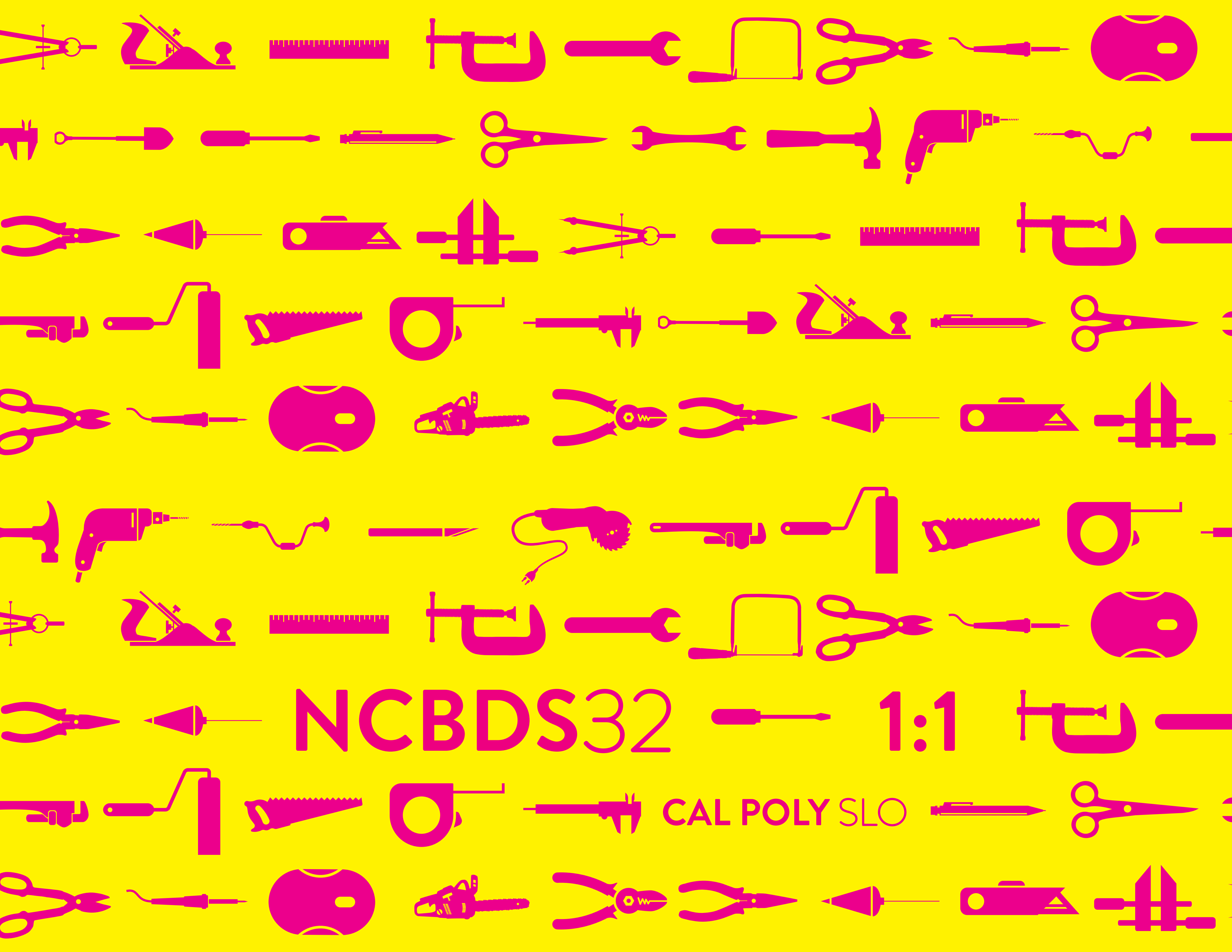

NCBDS32 1:1
CAL POLY SLO


1:1
NCBDS32
:
CAL POLY SAN LUIS OBISPO FEBRUARY 26-27, 2016

## ACKNOWLEDGEMENTS

The following people gave generously to NCBDS 32. We are grateful for your time and willingness to participate in this effort.

## CONFERENCE PLANNING TEAM

| | |
|---|---|
| Jeff Ponitz | Co-Chair |
| Clare Olsen | Co-Chair |
| Carmen Trudell | Co-Chair |
| Angela Bracco | Exhibitions Design & Coordination |
| Jennifer Shields | KTGY Exhibition |
| Garet Zook | Exhibitions Support |
| Lea Espinosa | Student Intern |

## STUDENT VOLUNTEERS

Leesa Choy
Edward Gibbons
Monica Mendoza
Nathanael Ramos
Adrian Tsou
Kailie Johnson
Jack Bower
Elaine Fisher
Mackenzie Bailey
Priya Bhat
Adndrew Shafer
Shiaohan Liu
Ishita Gupta
Nick Rademacher
Eli Mayerson
Clark Cyr
Natacha Schnider
Madison Agnew
Emma Degnan
Elizabeth Evangelista
Kelli Nightman
Lea Espinosa
Shaelin Morefield
Brynn Cummings
Katherine Garber
Carrie Carlson
Charles Lam

## SPONSORS

ZGF
ZIMMER GUNSUL FRASCA ARCHITECTS LLP

LPA
Architecture • Planning • Interior Design
Landscape Architecture • Engineering • Graphics

darden architects



This publication is available in alternative media on request.

## PEER REVIEWERS

| | |
|---|---|
| Ghazal Abasy-Asbagh | University of Virginia |
| Jim Agutter | The University of Utah |
| Phillip Anzalone | New York City College of Technology |
| Robert Arens | Cal Poly San Luis Obispo |
| Illya Azaroff | New York City College of Technology |
| Angela Bracco | Cal Poly San Luis Obispo |
| Caryn Brause | University of Massachusetts |
| Ryan Brockett | Cal Poly San Luis Obispo |
| Kelle Brooks | Cal Poly San Luis Obispo |
| James Brown | Leicester School of Architecture |
| Reese Campbell | Pratt Institute |
| Anselmo Canfora | University of Virginia |
| Ryan Carbone | University of Virginia |
| Erin Carraher | The University of Utah |
| Rocco Ceeo | Univesity of Miami, School of Architecture |
| Carla Cesare | Syracuse University |
| Olivier Chamel | Floirda A&M University School of Architecture |
| Severn Clay | New York City College of Technology |
| Dale Clifford | Cal Poly San Luis Obispo |
| Paul Coughlin | New York City College of Technology |
| Naomi Darling | Mount Holyoke |
| Mark Dekay | University of Tennessee |
| Keith Diaz Moore | University of Utah |
| James Doerfler | Philadelphia University |
| Paul Emmons | Virginia Tech |
| William Feuerman | University of Technology, Sydney |
| Ann Gerondelis | Georgia Tech, School of Industrial Design |
| Melissa Goldman | University of Virginia |
| Stephen Goldsmith | University of Utah |
| Craig Griffen | Philadelphia University |
| Sallie Hambright Belue | Clemson University |
| Harriet Harriss | Oxford Brookes University |
| Carol Hermann | Philadelphia University |
| Claudia Hernandez-Feiks | New York City College of Technology |
| Ben Jacks | Miami University |
| Doug Jackson | Cal Poly San Luis Obispo |
| Meg Jackson | University of Houston |
| Chandrika Jaggia | Cal Poly San Luis Obispo |
| Katherine Jenkins | Topo-logic |
| Leslie Johnson | Illinois Institute of Technology |
| Brian Kelly | University of Nebraska Lincoln |
| Lannis Kirkland | University of Houston |
| Zeke Leonard | Syracuse University |
| Anne Leonhardt | New York City College of Technology |
| Sandy Litchfield | University of Massachusetts Amherst |
| Mira Locher | University of Utah |
| Jason Logan | University of Houston |
| Michael Lucas | Cal Poly San Luis Obispo |
| Kent Macdonald | Cal Poly San Luis Obispo |
| Adam Marcus | California College of the Arts |
| Gregory Marinic | Syracuse University |
| Emily McGlohn | Texas Tech University |
| Phillip Mead | University of Idaho |
| Mari Michael Glassell | Texas Tech University |
| Jason Montgomery | New York City College of Technology |
| Whitney Moon | University of Wisconsin-Milwaukee |
| Joann Moore | Cal Poly San Luis Obispo |
| Holly Nelson | Rutgers University |
| Rashida Ng | Temple University |
| Clare Olsen | Cal Poly San Luis Obispo |
| Brian Osborn | University of Virginia |
| Eric Oskey | Temple University |
| Troy Peters | Wentworth |
| Jeff Ponitz | Cal Poly San Luis Obispo |
| Julieanna Preston | Toi Rauwharangi College of Creative Arts |
| Peter Raab | Texas Tech University |
| Joseph Ragsdale | Cal Poly San Luis Obispo |
| Jeana Ripple | University of Virginia |
| Erin Root | University of Virginia |
| Thomas Ryan | California College of the Arts |
| Meredith Sattler | Cal Poly San Luis Obispo |
| Nicholas Senske | Iowa State |
| Jennifer Shields | Cal Poly San Luis Obispo |
| Theodore Slowik | Temple University |
| Trent Smith | University of Utah |
| Barbara Smith Mishara | New York City College of Technology |
| Brett Snyder | UC Davis |
| Sandra Stannard | Cal Poly San Luis Obispo |
| Antje Steinmuller | California College of the Arts |
| Parker Sutton | Topo-Logic |
| Stephen Temple | University of Texas at San Antonio |
| Carmen Trudell | University of Virginia |
| Elpitha Tsoutsounakis | The University of Utah |
| Sanjive Vaidya | New York City College of Technology |
| Karen Van Lengen | University of Virginia |
| Alexander Wall | amw3ra@virginia.edu |
| Jermaine Washington | Cal Poly San Luis Obispo |
| David Watts | Cal Poly San Luis Obispo |
| Megan Werner | California College of the Arts |
| Catherine Wetzel | Illinois Institute of Technology |
| Emily White | Cal Poly San Luis Obispo |
| Greg Wynn | Cal Poly San Luis Obispo |
| Mo Zell | University of Wisconsin-Milwaukee |

## SESSION MODERATORS

| | |
|---|---|
| Robert Alexander | Cal Poly Pomona |
| Robert Arens | Cal Poly San Luis Obispo |
| Caryn Brause | University of Massachusetts, Amherst |
| Ryan Brockett | Cal Poly San Luis Obispo |
| James Brown | Leicester School of Architecture |
| Ellen Burke | Cal Poly San Luis Obispo |
| Erin Carraher | University of Utah |
| Dale Clifford | Cal Poly San Luis Obispo |
| Carey Clouse | University of Massachusetts, Amherst |
| Clifton Fordham | Temple University |
| Brent Freeby | Cal Poly San Luis Obispo |
| Meg Jackson | University of Houston |
| Doug Jackson | Cal Poly San Luis Obispo |
| Gabriel Kaprielian | Cal Poly San Luis Obispo |
| Brian Kelly | University of Nebraska-Lincoln |
| Michael Lucas | Cal Poly San Luis Obispo |
| Kent Macdonald | Cal Poly San Luis Obispo |
| Adam Marcus | California College of the Arts |
| Whitney Moon | University of Wisconsin Milwaukee |
| Kathleen Nagle | Illinois Institute of Technology |
| Brian Osborn | Cal Poly San Luis Obispo |
| Bob Pavlik | University of Oklahoma |
| Peter Raab | Texas Tech University |
| Edmond Saliklis | Cal Poly San Luis Obispo |
| Meredith Sattler | Cal Poly San Luis Obispo |
| Nicholas Senske | Iowa State University |
| Bryan Shields | Cal Poly San Luis Obispo |
| Stephen Temple | University of Texas at San Antonio |
| Umut Toker | Cal Poly San Luis Obispo |
| Elpitha Tsoutsounakis | University of Utah |
| Emily White | Cal Poly San Luis Obispo |
| Robert Whitehead | Iowa State University |
| Keith Wiley | Cal Poly San Luis Obispo |

## TABLE OF CONTENTS

### TOOLS:TACTICS

## PAST:PRESENT



## REPRESENTATION:SIMULATION

## OPEN

# CONFERENCE SCHEDULE

## FRIDAY 26 FEB — THE CLIFFS RESORT

**7:45** breakfast & registration | FOYER

### 8:45 to 10:00

**ACADEMY:COMMUNITY** — BEAUJOLAIS ROOM

International Service Work: The Academy's Complicated Relationship with Public-Interest Design
Carey Clouse
*University of Massachusetts, Amherst*

project (RE) Cycle
Robert Alexander
*California Polytechnic State University, Pomona*

Design Intelligence in a Box
Robert Arens
*California Polytechnic State University, San Luis Obispo*

Moderator: Dale Clifford
*California Polytechnic State University*

**TOOLS:TACTICS** — CABERNET ROOM

Supporting Students: Using Anthropomorphic Structures to Enhance Early Structures Education
Rob Whitehead
*Iowa State University*

The Prosthetics of Space: [re]Designing, [re]Structuring, [re]Forming
Brian Ambroziak
*University of Tennessee*

Emerging D-Forms: A Journey from 2D Shapes to 3D Forms
Negar Kalantar and Alireza Borhani
*Texas A& M University*

Moderator: Erin Carraher
*University of Utah*

**TOOLS:TACTICS** — PINOT NOIR ROOM

Light and Gravity: The Analytical Model as a Co-producer of Reality
Jennifer Shields
*California Polytechnic State University, San Luis Obispo*

Haptic Tactics: Increasing Engagement in and Application of Building Technology Through Hands-on Investigation and Integration with the Design Studio
James Leach, Kristin Nelson
*University of Florida*

Occupied Spatial Unit: Landscape Choreography
Rennie Tang
*California Polytechnic State University, Pomona*

Moderator: Emily White
*California Polytechnic State University*

**TOOLS:TACTICS** — SAUVIGNON ROOM

The Reconaedicule: Everyday Objects as Design-Build Agents
Frank Jacobus, Marc Manack, Jon Boelkins, Alison Turner
*University of Arkansas*

Shifts in Beginning Design Installations
Brian M. Kelly
*University of Nebraska-Lincoln*

"I can teach you nothing about design" or how I learned to stop worrying and love my tools
Kory A. Beighle, Vincent Sansalone
*University of Cincinnati*

Moderator: Brent Freeby
*California Polytechnic State University*

### 10:00 to 10:15

break | FOYER

### 10:15 to 11:30

**ACADEMY:COMMUNITY** — BEAUJOLAIS ROOM

Lessons from Shared Learning Across Two Disciplines in an Early Design Studio
Katie Kingery-Page, Lorn Clement, Katrina Lewis
*Kansas State University*

Multidisciplinary Hats and the 1:1 from Day One
Farzana Gandhi
*New York Institute of Technology*

Creating at the Intersection: Collaborative Integration in the Design Process
Brian Grieb
*Morgan State University*
Brittany Williams
*University of Maryland*

Moderator: Clifton Fordham
*Temple University*

**PAST:PRESENT** — CABERNET ROOM

Shelter: The Interior as a Site for Disaster Relief
Deborah Schneiderman, Renee Kim, and Nam Songsombat
*Pratt Institute*

Constructing the Gothic Vault in the Digital Age: Lessons in Accuracy and Precision
Jessica Garcia Fritz
*South Dakota State University*

Tea House Design/Build: Integrating history and cultural studies into the design studio
Naomi Darling
*Five Colleges*

Moderator: Carey Clouse
*University of Massachusetts, Amherst*

**STUDENT:TEACHER** — PINOT NOIR ROOM

1:1(00): Meeting Course Outcomes Effectively in Beginning Design Studios with High Student-to-Faculty Ratios
Patrick Rhodes
*American University of Sharjah*

Techniques in Titration: Active Learning in a Beginning Technology Course
Clare Olsen, Kent Macdonald
*California Polytechnic State University, San Luis Obispo*

Beyond the Studio: Alternative Models of Student/Teacher Engagement
Erin Carraher, Michael Hoehn, Scott Thorne, Alexis Suggs
*University of Utah*

Moderator: Caryn Brause
*University of Massachusetts, Amherst*

**TOOLS:TACTICS** — SAUVIGNON ROOM

The Ontology of the Aggregate
Sean Burns
*Ball State University*

Building Blocks
Bryan Shields
*California Polytechnic State University, San Luis Obispo*

Topological Tactics
David Lee
*Clemson University*

Moderator: Whitney Moon
*University of Wisconsin Milwaukee*

### 11:30 to 12:45

lunch | FOYER
*provided by a generous donation from ZGF*

### 12:45 to 2:00

**ACADEMY:COMMUNITY** — BEAUJOLAIS ROOM

Making it Theirs: Singular vs Inclusive Design Authorship in the Building Studio
Brad Deal, Miguel Lasala
*Louisiana Tech University*

Working Together: Refocusing a 1:1 community building partnership
Peter L. Russell
*SUNY, University of Buffalo*

33 Days: 14 Pavilions
Kathleen Nagle, Paul Pettigrew
*Illinois Institute of Technology*

Moderator: Rob Whitehead
*Iowa State University*

**TOOLS:TACTICS** — CABERNET ROOM

Design Geometry and Rationalization: Reciprocity between Digital and Physical
Bob Pavlik
*University of Oklahoma*

Scan Fab: The Application of Reality Computing Technology in Design
Gabriel Kaprielian
*California Polytechnic State University, San Luis Obispo*

Parametric Beginnings: Design Computation for the Beginning Design Student
Adam Marcus
*California College of the Arts*

Moderator: Nicholas Senske
*Iowa State University*

**STUDENT:TEACHER** — PINOT NOIR ROOM

Significant Social Aspects of Learning in Making 1:1 Constructions in Beginning Design
Stephen Temple
*University of Texas at San Antonio*

It's That Big: 1:1 Modeling in a First Year Curriculum
Michael Swisher, McKenzie Canaday
*University of North Carolina at Charlotte*

One to One at Year One
Michael Dickson
*University of Queensland*

Moderator: Umut Toker
*California Polytechnic State University*

**TOOLS:TACTICS** — SAUVIGNON ROOM

Educational Practices for the Introduction of Product Design
Martha Sullivan, Akshay Sharma
*Virginia Tech*

PUSH:PULL: a process for making products in beginning design
Elpitha Tsoutsounakis
*University of Utah*

Corporeal Complexities: Case Studies in Interactive Architecture
Meg Jackson, Michael Gonzales
*University of Houston*

Moderator: Brian Osborn
*California Polytechnic State University*

### 2:00 to 2:15

break | FOYER

### 2:15 to 3:30

**REP:SIM** — BEAUJOLAIS ROOM

Material Mapping: Tracing Construction Material Origins in Design-Build Courses
Peter Summerlin
*Mississippi State University*

Phenomenological Explorations, Mappings, Prosthetics and Thresholds
Sarah Young
*University of Louisiana at Lafayette*

Agency for Informed Design and Analysis: Time-based Media as 1:1 >> 1:many
Shai Yeshayahu, Joshua Vermillion
*University of Nevada Las Vegas*
Jonathon Anderson
*Ryerson University*

Moderator: Ryan Brockett
*California Polytechnic State University*

**PAST:PRESENT | OPEN** — CABERNET ROOM

Future Theories, Graphic Arguments: Activating History and Theory
Catherine Bonier
*Louisiana State University*

Starting with Transformation: First Introduction of Motion
Negar Kalantar, Alireza Borhani
*Texas A&M University*

Architectural Cartography
Amir Alrubaiy
*University of Colorado Denver*

Moderator: Michael Lucas
*California Polytechnic State University*

**STUDENT:TEACHER** — PINOT NOIR ROOM

Numbers Count When Truly Cultivating Creativity
Stella Robertson
*Massey University*

All Hands on Deck: Instructors as Collaborators and the Modified Dynamics of Design Build Instruction
Rob Whitehead, Carl Rogers
*Iowa State University*

From 1:1 to 31:31 or How to Leverage the Laws of Exponential Growth in Architectural Education
Heather Flood
*Woodbury University School of Architecture*

Moderator: Kent Macdonald
*California Polytechnic State University*

**TOOLS:TACTICS** — SAUVIGNON ROOM

Digital Tracings
Arief Setiawan, Christopher Welty
*Kennesaw State University*

Fabricating Space
Liane Hancock, Miguel Lasala
*Louisiana Tech University*

ANALOG : DIGITAL
Ting Chin, Claudia Hernandez
*New York City College of Technology*

Moderator: Meg Jackson
*University of Houston*

# CONFERENCE SCHEDULE (CONTINUED)

## SATURDAY 27 FEB — CAL POLY

**7:30** breakfast & registration | KTGY GALLERY

### 8:30 to 10:00 AM

**ACADEMY: COMMUNITY**
186-C200

Building to Learn: Learning to Build
Peter Raab, Terah Maher
*Texas Tech University*

BuildLab: the Urge to Humanize Architecture
Sandra Vivanco
*California College of the Arts*

Creative Dependence and Perpetual Performance: Lived Practice as Design Pedagogy
Andrew Santa Lucia
*School of the Art Institute of Chicago*

It Begins with a Diagram
Jeffrey Balmer, Michael Swisher
*University of North Carolina at Charlotte*

Moderator: Ellen Burke
*Cal Poly State University*

**TOOLS:TACTICS**
186-C201

GoodFastCheap: Democratizing Design-Build
Marc Manack, Frank Jacobus
*University of Arkansas*

Upcycled Furniture Prototypes in Public Space Design Studio
Carolina Aragón
*University of Massachusetts Amherst*

Furniture Design: Rethinking Normative Material Behavior
Stephen Belton
*University of Florida*

Orientation: Post-Formalism and the Beginning Architecture Student
Andrew Tripp
*Mississippi State University*

Moderator: Gabriel Kaprielian
*Cal Poly State University*

**STUDENT:TEACHER**
186-C202

History, Language, Drawing, and Synthesis (HoLDS): A Methodology for Implementing Concepts in the Design Process
Stephanie Travis, Catherine Anderson
*The George Washington University*

In the Beginning Were Buildings: the radical idea of learning architecture by designing it
Mark DeKay, Hansjörg Göritz
*University of Tennessee, Knoxville*

1:1 Beginning Design Entrepreneurship
Thomas Cline and Corey Saft
*University of Louisiana at Lafayette*

Make Your Method
Lance Walters
*University of Hawaii Manoa*

Moderator: Bob Pavlik
*University of Oklahoma*

**TOOLS:TACTICS**
186-C203

Surface Scratches: Material Investigations Between Drawing and Building
Keith Wiley
*Cal Poly State University, San Luis Obispo*

The Potential of Drawing: Emergent Techniques
Meg Jackson, Michael Gonzales
*University of Houston*

On (Experimental) Drawing: At Full Scale
William M Philemon
*University of North Carolina at Charlotte*

Constructed Ground: Reinhabiting the Drosscape Through Collage
Jennifer Shields
*Cal Poly State University, San Luis Obispo*

Moderator: Adam Marcus
*California College of the Arts*

**10:00 to 10:15** break | SST MEZZANINE

### 10:15 to 11:45

**ACADEMY: COMMUNITY**
186-C200

PUBLIC FAILURE: A Chronicle of @#%! Gone Wrong
Federico Garcia Lammers
*South Dakota State University*

Beginning at the End
Erik Sommerfeld
*University of Colorado Denver*

Raising the Roots: Community Engagement through Design/Build Education
Jennifer Akerman
*University of Tennessee, Knoxville*

The Container Space at Loy Farm: Practicing 1:1
Robert Michel Charest
*Elon University*

Moderator: Peter Raab
*Texas Tech University*

**PAST:PRESENT**
186-C201

Learning and Unlearning Precedent
Caryn Brause
*University of Massachusetts, Amherst*

Maison Recette: A Computational Pedagogy
Frank Jacobus, Marc Manack, Jon Boelkins, Alison Turner
*University of Arkansas*

Bruce Goff: A Visionary Engagement of History in the Design Studio
Francesca Hankins
*Washington Alexandria Architectural Center, Virginia Tech*

Affordable House: Sustainable Prefab and Community Based Design Build
Olivier Chamel
*Florida A&M University*

Moderator: Doug Jackson
*Cal Poly State University*

**STUDENT:TEACHER**
186-C202

Evaluating the Evaluation: Encouraging Risk Taking and Design Excellence via Studio Grading
Christopher Manzo, Dustin Headley, Katrina Lewis
*Kansas State University*

Soft Skills for Digital Designers
Shelby Doyle, Nick Senske
*Iowa State University*

Technology as Design Driver: professor and student perspectives on a breakthrough studio project
Meredith Sattler, Christopher Hague
*Cal Poly State University*

A Garment, Component, Joint: The Worth of Building What You Design
Tolya Stonorov
*Norwich University*

Moderator: James Brown
*Leicester School of Architecture*

**TOOLS:TACTICS**
186-C203

From Paper-Thin to Paper-Thick: On Handcrafting the Drawing Ground
Andreea Mihalache
*Mississippi State University*

From Excess to Surplus
Whitney Moon, Antonio Furgiuele
*University of Wisconsin - Milwaukee*

Word to Line: Drawing and Text
Matthew Shea
*University of Colorado Denver*

1:1 Matters
Catherine Wetzel
*Illinois Institute of Technology*

Moderator: Elpitha Tsoutsounakis
*University of Utah*

**11:45 to 12:45** lunch | KTGY GALLERY

### 12:45 to 2:00

**ACADEMY: COMMUNITY**
186-C200

Learning to Design for Users: Balancing Aesthetics & Performance
Clifton Fordham
*Temple University*

1:1 >>> Failure-Oriented Pedagogy in the Development of New Design(ers') Expertise
Dustin Headley
*Kansas State University*

Makin' Puddin': Performance and Risk in Beginning Design
Peter Olshavsky
*University of Nebraska-Lincoln*

Moderator: Edmond Saliklis
*Cal Poly State University*

**TOOLS:TACTICS**
186-C201

Projection in the Round
Emily White
*Cal Poly State University, San Luis Obispo*

Embracing Naïveté: Taxonomy, Joint and Surface
Matthew Hall
*Auburn University*

Make Re-Make: A Temporary 1:1 Workshop for Architectural Education
Simon Beeson
*Arts University Bournemouth*

Moderator: Meredith Sattler
*Cal Poly State University*

**STUDENT:TEACHER**
186-C202

Foundation: A Work in One Act
Vincent Sansalone, Kory Beighle
*University of Cincinnati*

Abstracting Scale: The One Week High School Prequel
Liane Hancock, Brad Deal
*Louisiana Tech University*

Presenting Incomplete(ness)
Jason Austin and Jacklynn Niemiec
*Drexel University*

Moderator: Bryan Shields
*Cal Poly State University*

**TOOLS:TACTICS**
186-C203

Frozen Form-Finding
Antonio Furgiuele, Whitney Moon
*University of Wisconsin - Milwaukee*

Kit of (odd) Parts: From Still Life to Conjectural City
Sandy Litchfield
*University of Massachusetts, Amherst*

1:1 Scale Transformation
Meg Jackson
*University of Houston*
Weiling He
*Texas A&M University*

Moderator: Robert Alexander
*Cal Poly State University, Pomona*

### 2:15 to 3:30

**ACADEMY: COMMUNITY**
186-C200

Designing Change: Teaching Social Responsibility Through Design
Lucinda Havenhand, Zeke Leonard
*Syracuse University*

From Waste to Wonder: Working with Residual
Nikole Bouchard
*University of Wisconsin Milwaukee*

Building Big With Habitat: A 'Tiny House' Prototype Using Universal Design
Christopher Manzo
*Kansas State University*

Moderator: Kathleen Nagle
*Illinois Institute of Technology*

**TOOLS:TACTICS**
186-C201

A Lesson in the Education of a "Craftist": Modularity
Seher Erdoğan Ford
*Temple University*

Striking a Balance: Integrating Tool Literacy and Critical Problem Solving in Digital Media Instruction
Daniel Eddie
*Iowa State University*

Graphic Language in the Classroom: Integrating Graphic Design with Interior Design Studio and Graphics Coursework
Susie Tibbitts
*Utah State University*
Roberto Ventura
*Virginia Commonwealth University*

Moderator: Robert Arens
*Cal Poly State University*

**STUDENT:TEACHER**
186-C202

The Success Team Program: A Model of Peer Mentorship
Suzanne Bilbeisi
*Oklahoma State University*

One to one to one: a triumvirate of interpersonal relationships in beginning architecture education
James Benedict Brown, Eileen McGonigal
*Leicester School of Architecture*

1:1 A Case for Collaboration in Foundation Pedagogy
Sallie Hambright-Belue, Martin Holland
*Clemson University*

Moderator: Stephen Temple
*University of Texas at San Antonio*

**TOOLS:TACTICS**
186-C203

Flat Paper to Form: Experimenting with Material
Jonathon Anderson
*Ryerson University*
Shai Yeshayahu
*University of Nevada Las Vegas*

Tactility at 1:1: Media and Context in learning about Building Materials
Aki Ishida
*Virginia Tech*

Dashed Hopes: Lessons in the Failure of Best Intentions
Greg Watson
*Louisiana State University*

Moderator: Brian Kelly
*University of Nebraska-Lincoln*

# SPECIAL SESSIONS

## FRIDAY 26 FEB THE CLIFFS RESORT

### 4:00 to 5:00 Tiny TEDs
BALLROOM

Rote
Samantha Krukowski
*University of Cincinnati*

A Fraction of Full Scale
Clifton Fordham
*Temple University*

Saying it HOT: A Graphic Design Primer for Architecture and Interior Design Presentations
Susie Tibbitts
*Utah State University*
Roberto Ventura
*Virginia Commonwealth University*

Translating Light from Site to Sight
Victoria McReynolds
*Texas Tech University*

Empowering Women Through Design-Build
Jade Polizzi
*University of Colorado-Boulder*

The Power of Collaboration in Design-Build
Stephen Eckert
*Eckalizzi Design*
Jane Polizzi
*University of Colorado-Boulder*

Small steps bring about big ideas
Kelle Brooks
*California Polytechnic State University, San Luis Obispo*

Cubes and Spheres
Catherine Wetzel
*Illinois Institute of Technology*

Speed-Dating for Beginning Environmental Designers
N. Claire Napawan
*University of California Davis*

Found in Translation
Nikole Bouchard
*University of Wisconsin Milwaukee*

spectrum of { judication }
Brian Dougan
*American University of Sharjah*

The Folded Can Construct
Roya Plauché
*University of Houston*

Pedagogical Constructions
Patrick Doan
*Virginia Tech*

## SATURDAY 27 FEB CAL POLY

### 3:30 to 5:00 EXHIBITIONS TOUR | SST MEZZANINE START

A. collaborative design : chairs | SST MEZZANINE
B. digital fabrication | KTGY GALLERY
C. beginning design | ARCHITECTURE BERG GALLERY
D. first-year curriculum | ARCHITECTURE LOBBY
E. collaborative design : parasites | ARCHITECTURE BLDG EXTERIOR
F. graphic communications | DEXTER LOBBY GALLERY

On special exhibition for NCBDS 32 is a showcase of beginning design work from Architecture, Architectural Engineering, Landscape Architecture, and Art & Design. Although the displays will be open from February 25th-27th, there's time allotted in the schedule for a tour, which will commence at the Simpson Strong Tie Mezzanine.

A. The work exhibited was co-designed in a collaborative studio between second year architecture and landscape architecture students as a 2-week, warm-up exercise.

B. An exhibition of objects from digital fabrication elective courses demonstrates the foundation of computation design thinking and skill building.

C. Berg Gallery holds first and second year architecture, architectural engineering and landscape architecture work. The selected projects, created this year, reveal a wide range of approaches to teaching beginning design studios.

D. The College of Architecture and Environmental Design lobby contains an exhibition of first year Architecture and Architectural Engineering students.

E. Throughout the exterior of the Architecture Building, you'll find 1:1 constructs, paraSITES, co-designed by first year architecture and architectural engineering teams of 3 or 4 students. In this month-long project, students were introduced to contextual, construction and code constraints while developing the experiential qualities of their designs.

F. An exhibition featuring beginning design work from the graphics and communications foundation courses.

### 5:00 to 6:30 EXPERIMENTS AND UTOPIAS
### NATALY GATTEGNO | FUTURE CITIES LAB
ROTUNDA

Nataly Gattegno is a founding design partner of Future Cities Lab, an interdisciplinary design and research collaborative that has developed a range of award-winning projects exploring the intersections of design with advanced fabrication technologies, responsive building systems and urban space. Future Cities Lab, led by Nataly and her partner Jason Kelly Johnson, is at the forefront of exploring how advanced technologies, social media and the internet of things will profoundly affect how we live, work, communicate and play in the future. Their approach to design and making, which has been described as "high performance craft", is also deeply experiential, interactive and materially rich.

Future Cities Lab employs an adventurous team of interaction designers, architects, technologists, digital craftspeople, urban ecologists, and more. While Nataly is deeply rooted in this community of vanguard innovators, makers and thinkers, she also practices architecture, teaches and exhibits work internationally.

Nataly is currently an Associate Professor of Architecture and Chair of the Graduate Program in Architecture at the CCA (California College of the Arts) in San Francisco. She has previously taught at University of California at Berkeley, the University of Michigan and the University of Virginia.

Nataly received a MA from Cambridge University, St. John's College, UK. and a M.Arch from Princeton University.

*Following page: Murmur Wall by Future Cities Lab. Currently on view at the Yerba Buena Center for the Arts, San Francisco, California.*

### 7:00 to 7:30 CLOSING REMARKS | MAC
CHRISTINE THEODOROPOULOS, Dean, Cal Poly College of Architecture & Environmental Design
MICHAEL LUCAS, Associate Dean of Academic Affairs, Cal Poly College of Architecture & Environmental Design

### BEGINNING DESIGN FACULTY AWARD
### DR. PATRICIA MORGADO | NORTH CAROLINA STATE UNIVERSITY

Eleven faculty at ten schools were nominated by colleagues and students for the first NCBDS Beginning Design Faculty Award. Each nominee demonstrated impressive ingenuity and enthusiasm as well as mastery of special knowledge and abilities that enhance the teaching of beginning design students.

The award selection committee is pleased to announce the selection of Dr. Patricia Morgado at North Carolina State University to receive the award.

Her inspiring teaching of beginning design is built upon a culture of sketching that empowers students to see and think through drawing, while enhancing the balance between analog and computer-aided methods in design education. She instills early habits of visualization that have lasting impact as students advance through the architecture program and begin their careers.

NCBDS Award Committee:
Gregory Marinic
*Program Coordinator of Environmental and Interior Design, Syracuse University*
*NCBDS Board Member*
Christine Theodoropoulos
*Dean of the College of Architecture & Environmental Design, California Polytechnic State University, San Luis Obispo*
Catherine Wetzel
*Associate Professor, Illinois Institute of Technology*
*NCBDS Board Member*

Award Nominees:
Suzanne Bilbeisi
Farzana Gandhi
Hans Hermann
Meg Jackson
Brian Kelly
Patience Lueth
Emily McGlohn
Brian Osborn
Carmen Trudell
Molly Wicks

## TOOLS:TACTICS

Design schools all over the world are increasingly emphasizing working at 1:1 scale. Physical material studies, spatial constructs, installation work, furniture, prototyping, and design-build are all common components of design curricula. Much of this renewed sense of engagement has been driven by digital technologies that blur the line between representation and fabrication; the differences between a drawing, a model, a prototype, and a product are increasingly difficult to discern. Submissions to Tools : Tactics describe innovative approaches to making in beginning design.

# The Prosthetics of Space: [re]Designing, [re]Structuring, [re]Forming

Brian Ambroziak | University of Tennessee

*Valéry becomes aware of the fact that a shell carved by a man would be obtained from the outside, through a series of enumerable acts that would bear the mark of touched-up beauty; whereas 'the mollusk exudes its shell,' it lets the building material 'seep through,' 'distill its marvelous covering as needed.' And when the seeping starts, the house is already completed.*[1]

- Gaston Bachelard. *The Poetics of Space*

## Introduction

Quoting the French philosopher Paul Valéry, Gaston Bachelard presents two extreme possibilities for constructing contained space: one an external process and the other internal. In so doing he, while not directly referring to it, introduces the possibility of a third in-between condition. This third condition positions itself between an internal structure – both physical and psychological – and an exterior reality and is defined by terms such as *skin, clothing,* or *shell* and is by its very nature a prosthetic form. Le Corbusier writes in *The Decorative Arts of Today,* 'We all need means of supplementing our natural capabilities, since nature is indifferent, inhuman (extra-human), and inclement; we are born naked and with insufficient armor. (Fig.1) Thus the cupped hands of Narcissus led us to invent the bottle; the barrel of Diogenes, already a notable improvement on our natural protective organs (our skin and scalp), gave us the primordial cell of the house.'[2] The idea that we need architecture to act as our artificial limbs, our support, our armor, is the driving force of all design. As such the prosthetic, which has long held a purely functional role based on physical and structural responsibility, is an area of research latent and ripe for early exploration in the design curriculum.

Working at a scale of one-to-one, the prosthetic is incorporated into the first year representation sequence as students are asked to design a device that enhances a chosen sense and acknowledges a distinct subject-object relationship. The project serves to introduce basic design ideas and techniques that include texture, transparency, veiling, *coat*ing, tectonics, scale and the body, and perceptual experience. Through this project, students explore and develop fundamental methods of presentation through successive iteration of several types of media and gain a sincere appreciation for material choice and fabrication.

*Fig. 1 A woman and child both wearing gas masks (1941). An indeterminate prosthetic layer that mimics and protects the human form.*

## Overview

An inquiry into architectural form and its association to the human body is by no means a new topic. To the contrary, it situates itself at the origin of architectural thought. Vitruvius's *De architectura* (Book III Chapter I), from around 15 BC, drew upon Greek precedent and articulated a direct connection between architectural form and human proportion. Some fifteen centuries later, Alberti's *On the Art of Building* drew heavily upon Vitruvius but took a more definitive stance with regard to defining *beauty*. Architecture's relation to the body became more subjective and inspired such works as Leonardo's iconic Vitruvian figure and the anthropomorphic drawings of Francesco di Giorgio Martini. Recalling Ovid's tale of Daphne escaping Apollo by going through a *metamorphoses*, from human to laurel tree, or the constructed wings of Icarus, so too did architectural thought embrace the idea of transformation. Only in this instance, it was the superimposition of man onto that of building and city and then cosmos. Ultimately, while the metaphor transitioned from nature to the machine, a focus on the human body remained a constant with the development of systems such as Le Corbusier's Modular. In *White Walls, Designer Dresses*, the architectural theorist Mark Wigley posits "modern architecture is not naked."[3] The white layer applied to its walls possesses an enigmatic quality, much as the prosthetic does, that situates itself between flesh and clothing.[4] In the 1960 and 70s, this layer became even more convoluted as words such as *membrane*, *film*, and *veil* came to the forefront. Design firms such as Archigram, Superstudio, and Haus-Rucker-Co. took the anthropomorphic abstractions that fueled the proportional systems of classical design and transformed them into high-tech machines that often morphed directly to the form of the human body. The advent of the computer and the emergence of the sci-fi genre fueled the imagination and began to envision a designed environment that could transform and have a more direct connection to its setting. In essence, architecture began to replace Alberti's emphasis on *aesthetics* with that of *prosthetics*, design that could be internalized to the point of not merely interpreting but enhancing perceptual stimuli.

## Starting Points: The Artificial Skins of Tim Burton's *Edward Scissorhands*

To begin the project, the class participates in a screening of a film. Films such as Jacques Tati's *Play Time* (1967), Ridley Scott's *Blade Runner* (1982), and this past year Tim Burton's *Edward Scissorhands* (1990) serve to convey the anxieties and ambitions of contemporary society in an often times more tangible way for the first year student. Looking closely at specific scenes from the film, students are asked to exploit the director's underlying agenda through a process of abstraction and synthesis. As such, they begin to understand how a theoretical argument can be constructed in time and space through staging and design.

In Tim Burton's romantic dark fantasy *Edward Scissorhands*, the story revolves around a character named Edward who exists as an unfinished cyborg creation and strangely has scissors for hands. In the film, the viewer learns early on that Edward was discovered by the film's narrator and brought from his isolated Gothic mansion down to the completely foreign realm of suburbia. At first glance, one might consider *Edward Scissorhands* a mere modern day retelling of Mary Shelly's Gothic masterpiece *Frankenstein*, a story of the constructed man who searches for his place in the world. However, after the opening scene where the camera pans in on a gridded suburban landscape filled with hermetically sealed cookie-cutter homes, it seems reasonable to assume that Burton has ulterior motives. In the original screenplay a setting is described that is *unimaginative* and *lifeless*:

*What looked so romantic from Edward's vantage point reveals itself in all its actual banality. The streets form a dull, undeviating grid. Rows of sagging trees have been planted at exact intervals. The houses are unimaginative variations on the same efficient tract house design. The people hardly add life to the scene. We pass house after house and see little activity.*[5]

*Fig. 2 Tim Burton's Edward Scissorhands (1990).*

Burton's answer to this reality, one that resides exclusively in the external realm, is a protagonist who takes the form of a constructed being and exists as a work in progress. The character of Edward embodies Valery's quote from Gaston Bachelard's *Poetics of Space.*[6] He is the *mollusk* and provides a counterpoint to the external wrapper of suburbia; a prosthetic that has lost its functionality. (Fig.2) Through the medium of film, Tim Burton masterfully navigates the external condition of suburbia. The character Edward Scissorhands allows us to understand new forms of engagement and begin to question standardized forms of contemporary culture. Burton evolves our understanding of a suburban landscape that we take for granted from simply an external container to forms of clothing in varying degrees, prosthetic devices. The prosthetic as presented through the film's protagonist Edward attempts to bridge the gap between the artificial and the hyper-real setting of suburbia. As such, the student is asked to consider the nature of the real. Through Edward, we internalize an external existence and consider new possibilities. The ultimate question posed is whether the clothing of suburbia suits us or does Edward, an outsider and seemingly strange form of creation, provide clues to a more suitable form of existence? Beginning design students start to understand the potential of the prosthetic to exist as an intermediary capable of negotiating between one's self and the space we construct around us.

## Conceptual Brainstorming: Subject-Object Relationships

Once conventional modes of thought about form have been expanded through the filmic precedent study and the prosthetic as an architectural idea has been established, students are provided with four subject-object relationships and asked to focus on a specific sense. The subject-object relationships are defined as:

[01] ARMATURE. The armature is a supplemental form that protects, holds, and defends the original form as both the experience and perception of space change through a dual development.

[02] GRAFT. Less extension and more transplant, the form of the graft inserts itself within the space of the host.

[03] FRAGMENT. Collections of parts and pieces that are otherwise unrelated are a natural occurrence. Places are collections of surrounding objects. Spaces are created with as many parts as bodies.

[04] ARTIFICE. The prosthesis can exist as a form of deceit. The artifice must consider artificial environments and the nature and the formal implications of *being honest*. The artifice must engage the philosophical and psychological implications of the prosthesis.

## Constructing the Object

Working in pairs of two, the process varies greatly among the teams of students. A valuable starting point for many is scouring antique and thrift stores in an attempt to assemble a kit of parts. These parts are then pondered on and certain possibilities come to the forefront. Drawing and collage often times begin to emerge as a proper way of advancing the argument through this phase of design and are typically followed by more trips to fabric stores and machine shops as more specific design intentions emerge. Two primary objectives materialize as part of the design process at this point: 01) obscure the inherent function of the original object such that it does not compromise the reading of a new prosthetic device and 02) design connections between the various pieces that possess a high degree of believability. As the prosthetics take form, writing is used to better understand the new contraption, a certain kind of nomenclature is developed that relies heavily on invention. Students are instructed to ere on the side of fiction. As such, they are encouraged to use phrases such as *trans-ocular magnification rods*, *J-150 amplification resin*, or *polysynthetic absorption veils*. The use of writing as a valuable tool in the design process relies on conventions, as Rudolf Arnheim states, that students are more comfortable with having been trained most of their lives in such a form of communication. The trick then is to generate visual equivalents that live up to the potential of these quickly transforming *synonym-search* phrases. The following three designs entitled *Captura Visio* (Fig.3), *Tactile Keratotomy* (Fig.4), and *Motus Colligere* (Fig.5) demonstrate the above-described processes and include examples of how writing complimented the student's creative process.

***Captura Visio. Sight (Akshata Dusa and Sidney Hatfield. Teaching Assistant: Nate Ryman)***

*Sight is the sense often thought of as being the most important. It controls and influences all others with its connections to people's values and beliefs through memories. Memories delivered in this matter are emotional, connecting one with their past and present simultaneously. Sight is also communication in which people pass judgment and the reality of life is fundamentally distorted... Sight's main limitation occurs when the optical organ is closed. Eyes can close for only a second to blink or for hours of slumber as the body rests. Even in a friendly one second closure the eye misses a magnitude of information that could aid in human comprehension. Our contraption is a remedy to this issue. When the eyelids fall, the Captura Visio powers on constantly recording the outside world. The product can later be plugged in and viewed so people never have to worry about* *missing a small detail ever again. In addition, the machine scans, records, and remembers movements as well as the peaceful scenes that dance through the mind while the wearer snoozes the day away.*

*Fig. 3 (top left and right) Captura Visio. (Akshata Dusa and Sidney Hatfield. TA. Nate Ryman) (bottom) Twelve glasses for another vision by Julio Le Parc (1966).*

***Tactile Keratotomy. Touch (Lauren Long and Mike Ludwin. Teaching Assistant: Christina Lulich)***

*Fig. 4 Tactile Keratotomy. (Lauren Long and Mike Ludwin. TA Christina Lulich)*

*Keratotomy (noun): a type of refractive surgical procedure. May refer to radial keratotomy, a procedure to the eye that relies on cuts on the surface of the cornea.*

*To be connected for so long, invested on its connection to the world, creates disconnect from others. Suddenly the world goes dark, engulfed in a sea of emptiness. No longer is vision viewed. Now, one is free from the connection and dependency of the visual sense. Protruding from the pupils and tapping into the dendrites, optical nerves are repurposed, their function distorted and twisted into touch. In place of sight, eyes hold a new purpose and are able to truly feel the surrounding features. Like television antennae to bring pictures into focus, this new function creates a new appreciation for sight. The sense of touch is heightened from the absence of its peer. Coiled extensions create new opportunity for feeling. Sight is converted into touch. Or rather, touch is an improved version of vision.*

***Motus Colligere. Touch (Hannah Allender and Clara Mefford. Teaching Assistant: Nate Ryman)***

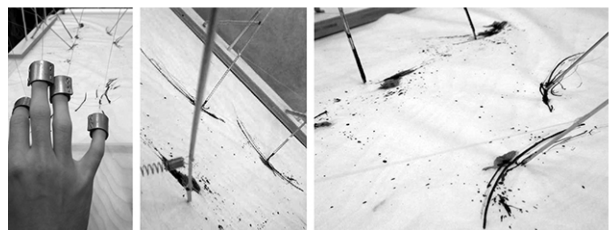


*Fig. 5 Motus Colligere. (Hannah Allender and Clara Mefford. TA Nate Ryman)*

*When the sense of touch is mentioned, automatically the mind goes to the hands and how they feel, grasp, and move objects and other things in the environment. Touch is the most direct way the human body interacts with the world; without it not only would an entire dimension of sensory intake be lost, but the individual would also be considerably more vulnerable to harm. The mind's motor memory is vital to how an individual recalls how to interact with specific objects and scenarios; imagine if that memorization process was stunted somehow. This device aims to aid in the motor memorization process by creating a visual representation of how a hand manipulates certain objects. To achieve this goal, five rings are placed onto the fingers of an individual and an object is placed under the hand. Then, as the hand manipulates the object, metal arms with ink are pulled via strings connected to the rings, creating lines on a length of paper that can be filed away for later reference.*

## [re]Forming: Reflecting and Cataloging

After the prosthetic devices are constructed, students are required to capture and compose their devises in a written and visual layout. This form of post-production is a critical part of the project that requires the student to not only compose their own invention, but to place them in the context of a larger body of work that draws upon literature, film, sculpture, music, and the sciences. Some common references provided by the students and the teaching assistants included the fashion of musicians such as David Bowie and Björk (Fig.6), film clips such as the fantastic path that Amelie takes as she guides a blind man down a block of Paris and the opening credits of Dexter, Aalto's Viipuri Library, the prosthetic sculptures of Rebecca Horn, and the writings of John Steinbeck and James Agee. At this point, a project that began in a dark auditorium under the hypnotic lens of Tim Burton and moved to pawn shops has finally arrived at its final destination; a point in which the student can longer separate their skin from that of their clothes, from that of the prosthetic, from that of the building, from that of the street, and from that of culture in all of its many forms.

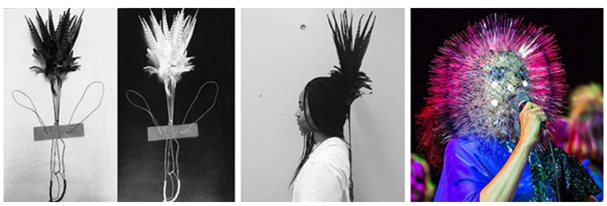


*Fig. 6 (left) Pulse Muffler. (Anaya Kabasu and Molly Tickle. TA Kelsey Julian) (right) Atmospheric Reentry collection by Maiko Takeda worn by Björk in concert (2013).*

*Fig. 7 IVTD (Leah Tatum and Sam Burford. TA Nate Ryman) A prosthetic designed for patients who are not able to eat solid foods but still desire the flavor of their favorite foods. By simply touching an object, the central memory system (CMS) is able to enhance the flavor of the object to match the patient's past experiences with flavor. The memory sensors mimic those used to map brain activity allowing them to send taste memories to the CMS for interpretation. The CMS then sends these flavors to a mouthpiece that activates the thousands of tiny taste buds on each papillae.*

## Conclusion

*But and empty shell, like an empty nest, invites day-dreams of refuge. No doubt we over-refine our daydreams when we follow such simple images as these. But it is my belief that a phenomenologist should go in the direction of maximum simplicity. And therefore I believe that it is worthwhile proposing a phenomenology of the inhabited shell.*[7]

- Gaston Bachelard. *The Poetics of Space*

With architecture, the concern is the conscious experience of space. With prosthetics, the attempt is to enhance this experience of space and also the experience of one's own body. It is acknowledged that the new assemblage may be better or worse but that it is never the same as the original. The introduction of this new element forces a new relationship with one's surroundings, both external, the perceived image, as well as internal, the psychological ramifications of a new set of sensory stimuli. These new objects are extensions of us in varying degrees. The palm of the hand relates to the door handle that connects to the cell that creates a degree of enclosure that speaks more closely to the body. The key element of these additions is that they enhance one's quality of life whether through basic protection from the elements, enhancing the senses, or rebuilding the human form to respond to structural necessity and visual norms. The ultimate outcome of the Prosthetics of Space project is that students gain valuable insight as to how form may be *redesigned*, *restructured*, and *reformed* such that their construction is a new answer to the same question.

*I would like to thank the various teaching assistants that provided valuable feedback throughout these assignments and often times directed students in the most unexpected of ways (Alexis Porten, Nate Ryman, Sierra Jensen, David Berry, Dillon Canfield, Kelsey Julian, Christina Lulich, and Kenna Cajka). As well, Jennifer Budde served as a personal research assistant and was invaluable in developing the framework for the various subject-object relationships.*

## Notes

[1] Gaston Bachelard, *The Poetics of Space* (Boston: Beacon Press, 1994), p. 106.

[2] Le Corbusier, *The Decorative Arts of Today*, trans. James Dunnett (Cambridge, Mass.: MIT Press, 1987), 72.

[3] Mark Wigley, *White Walls, Designer Dresses* (Cambridge, Mass.: MIT Press, 1995), 15.

[4] Ibid., 19.

[5] *Edward Scissorhands*. Screenplay by Caroline Thompson. Story by Tim Burton and Caroline Thompson. Dir. Tim Burton. Twentieth Century Fox, 1990.

[6] Gaston Bachelard, *The Poetics of Space* (Boston: Beacon Press, 1994), p. 106.

[7] Ibid., 106.

# Flat Paper to Form: Experimenting with Material

Jonathon Anderson | Ryerson University

Shai Yeshayahu | University of Nevada Las Vegas

## Introduction

This paper looks to facilitate a discussion on how beginning design students approach or think about a direct 1:1 connection between materials that inform the making of three-dimensional space, explorative processes, drawings, and models. Although, the integration of 1:1 design and making as an effective pedagogical tool has been widely disseminated, our approach looks to expand conversations by exploring ways in which experimentation and physical interaction with materials can increase our engagement with design making. These interactions facilitate a platform capable of driving innovation and discovery. Gail Peter Borden and Michael Meredith believe students and educators have developed "a more direct relationship with materiality. However, we continue to lack a way of understanding materials as protagonists rather than subservient to form."[1] Thus, we began to question how beginning design pedagogy could embrace an intimate relationship between materials and experimental processes that advance our current 1:1 making culture. In order for us to better understand or begin to answers our questions, we identified two significant movements in design education and studied various aspects that could influence or help us define a studio-based program that is experimental and open to change.

The first movement we studied was the art and culture of paper folding. According to Paul Jackson, author of *Folding Techniques for Designers: From Sheet to Form*, paper folding is "an essential topic in design education and design practice."[2] Folding exercises are quite common in beginning design pedagogy and often explore ways of finding form without considering the material properties. Our contention is that it is imperative for these types of form finding exercises to develop a strong sense of materiality and understand that paper's inherent properties which allow for easy and fast prototyping of a material that has a certain level of shape memory. This is only possible if students establish a direct 1:1 relationship between 2d drawings and 3d form while carefully understanding how the material will influence what is possible and what is not. Sophia Vyzoviti, a leading paper folding educator, believes that "folding is a challenge with great individual possibilities."[3] It is the uncertainty and laden possibilities that make paper folding an ideal platform for beginning design pedagogy where students have the ability to study how the material itself facilitates spatial exploration.

The second historical reference we identified was mid-century modern design. For us, this design movement looked beyond traditional forms and challenged the making process through experimentation and technology. At the forefront of this movement were Eero Saarinen and Charles Eames, whose concern with making and material processes was manifested in their award-winning molded plywood ideas for the 1940 Museum of Modern Art's Organic Design in Home Furnishings competition. More importantly, this competition marked a significant shift in regards to how we should educate future practitioners to challenge making processes through material investigations. During this time, Charles and Eero were teaching at Cranbrook Academy of Art, under the direction of Eliel Saarinen, and explored the importance of project-based learning through material studies and interdisciplinary ways of thinking. We feel their pedagogical approach to the classroom is still relevant today and should be further explored, with more specific direction, to better understand how to move from idea to model and eventually to full-scale prototypes.

We argue that adapting to any situation while challenging the fundamentals of design thinking and making is important. Thus, our studio-based classes are constantly looking at how we depart from our beliefs, and directly look to advance the spirit and mindset of a stagnant design culture. In this regard, we looked at paper folding and mid-century modern design, to push forward and challenge students on the basis of experimental processes that explore the limitations of materials and technology. These particular projects look at the paper folding culture for its use of material and mid-century modern design influences on our approach to experimentation as well as how technology is interlinked with the making process. For us, materials inform what we do with technology and how technology and experimental processes inform how the material itself responds and behaves. The interplay between these two movements begins to frame the context for what we do in design foundation studio. We are operating on the ideas that pedagogical experiments at the beginning design level are crucial and are important breeding grounds that can radically advance design education. Beatriz Colomina has carefully traced radical architectural pedagogy movements and strongly encourages faculty to challenge the times as "the discipline can best be changed by revolutionizing the way it is taught."[4] Specifically, of importance is that these ideas serve as the rational to allow us to move in a direction that challenges the medium and the use of technology in beginning design.

## From Drawing to Folding and Folding to Drawing

At the core of our methodology is a question surrounding the importance and relationship between drawings, models, and prototypes within the beginning design studio. We developed a framework that is defined by objectives and guidelines that can fit various studio scenarios (i.e. length and level of the studio, discipline specific, and desired outcome) and builds upon the ideas that drawings are instruments capable of communicating ideas at a 1:1 scale and model making. Within the studio, drawings are produced through a variety of means, including observational drawing and ideation drawings in both formative and non-formatives ways. Such techniques are demonstrated using analog and digital tools and may include; sketching, diagramming, tracing, projecting, video, and vector base drawing.

This fundamental two-dimensional act is the starting point to understanding form and is later revisited when the student understands the limitations or influencing characteristics of the material. It is then that the drawing is revised to account for such factors and begin the process of redrawing based on the new knowledge that is gained. We believe that the correlation between drawing (2d) and surface/form (3d) helps students better understand how drawings inform physical models and how physical models inform the drawing. This is a non-linear process that requires students to value material exploration and a commitment to the re-drawing process. We began the studios by introducing key elements such as point, line, surface, and volume, while tasking students with performing a preliminary investigation into the use of such vocabulary when exploring form making through material manipulation. These early explorations serve as a twofold; the first is to get them thinking about the non-linear process and the second is purely skill acquisition. In this process, the meaning is assigned to the drawn elements, and their translation or ability to inform the making works hand-in-hand with the material's response. More specifically, it is about the way in which point and line can be inscribed on the paper and then translated three-dimensionally. For example, a line can represent a fold or a cut where a point can be a vertex or a convergence of multiple lines into a single location, and or even an array composed of this vocabulary. Here one is able to assimilate a direct response that takes into account information that is two-dimensional in nature (points and lines) and understand the influence on the three-dimensional representation (i.e. is there sag in the surface, does another fold need to be introduced for structural purposes, or do edges connect within the intended design).

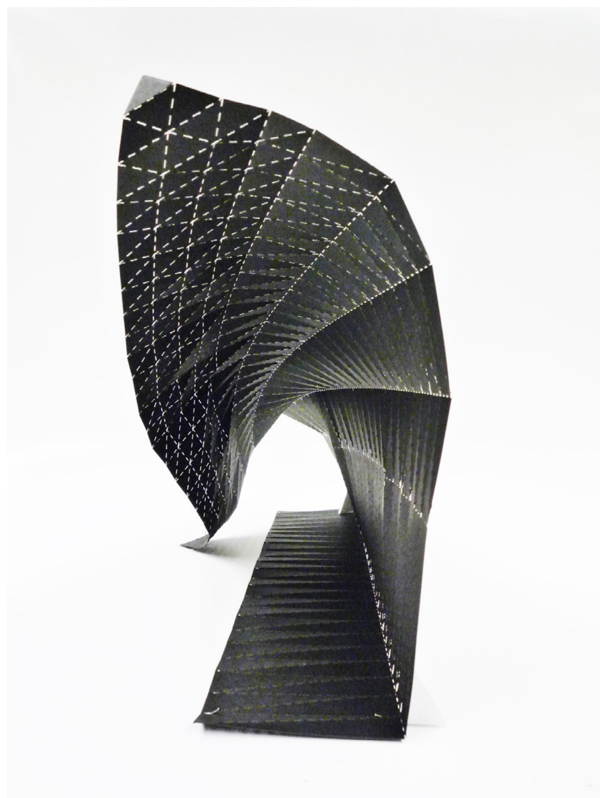


*Fig. 1 Foundation studio work that demonstrates the folding of a final scale model. The drawings inform the scale model and vise a versa. Student: Jacob Hughes*

The role of design ideation was similar within each studio; however, the end goals and objective were slightly different in each scenario. This speaks to the earlier mentioned idea that the framework was set up to allow for various scenarios. In one studio, the final objective or physical creation was a scaled model, as evidenced in figure 1, with drawings that also spoke to the diagramming and drawing of a scaled space. Whereas, the other studio's objective was to create a number of small components at a 1:1 scale. In this particular scenario, altering variables through a series of mathematic functions generated the 1:1 components. This processes represented the alternate variables a building block could achieve while considering a larger surface (figure 2 + 3) through modular units. The larger surface was drawn, to scale, and showed the surface in its totality. In each scenario, the design process was directly connected to the exploration and relationship between two and three-dimensional thinking and how such material can inform the making process. It is important to note that each studio departed from the manipulation of pre-existing grids with the objective of performing a sequence of operations using the traditional paper folding and cutting technique that Paul Jackson carefully describes and demonstrates in several of his books (figure 4).

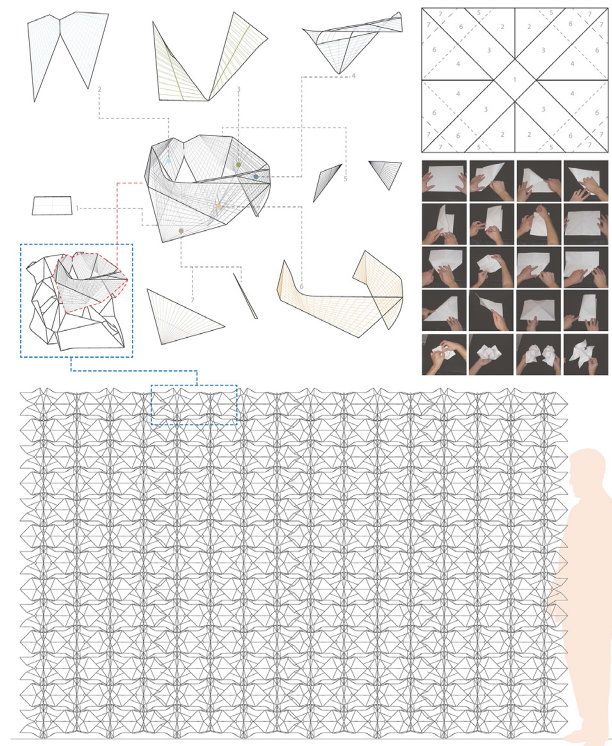


*Fig. 3 Foundation student work that shows the making and drawing process of a 1:1 scaled component. Student: Weston Willard*

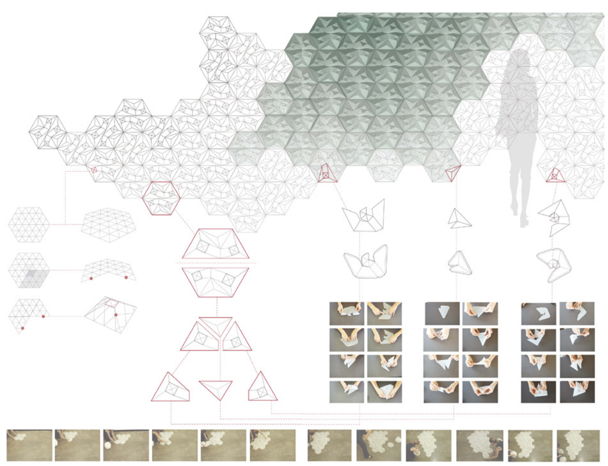


*Fig. 2 Foundation student work that demonstrates a collection of 1:1 components that are the direct result of the described process. Student: Laura Kimmel*

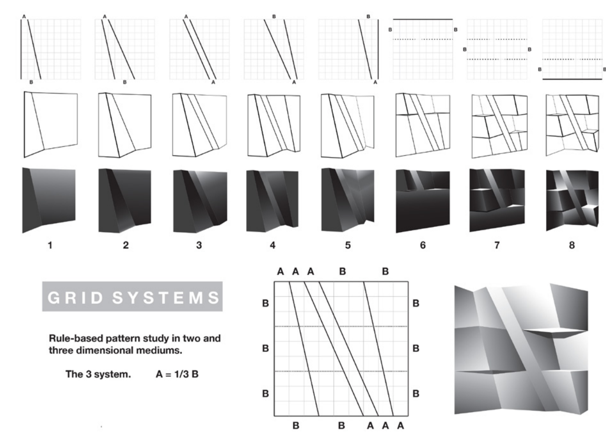



*Fig. 2 Example of student work that demonstrates the typical processes described by Paul Jackson. Student: Nitty Lee*

To promote this engagement, each studio had a series of hands-on workshops that explored how key elements can be applied to develop a design approach that uses this vocabulary and clearly communicates how the advancement of design ideas are iterative and experimental in nature. This process has also allowed students to grasp how to implement craft techniques and material influences through prototyping of paper mock-ups and two-dimensional drawings.  The introduction of craft techniques, such as origami and kirigami, served as a point of reference that allowed for learning to occur through mimicking and repetition. Ultimately, these references exemplified the fact that the more we exercise a process, the better we become at it. Hence, at the beginning of the studio, these activities were paramount in developing a workflow that is explorative rather than deterministic. In addition, this experience allowed for a quick transformation of ideas into something that can be discussed and shared with others. As students began to grasp the logic of patterns (grids) to what was being made, the paper experiments became informative and indicative of; feasibility of form, 1:1 relationship of drawings to tangible form, and further understanding about material limitations. Additionally, these relatively quick mock-ups forced students to engage with materials and making processes not only at an appropriate scale but also in relation to the physical world through drawings.

## Concluding Thoughts

For us, paper is an ideal medium for beginning design explorations. Paper has a physicality that allows for experimentation to occur and holds similar characteristics as other building materials, such as Modulus of elasticity, compression, and tension. Papers' uniqueness comes from its ability to be quickly manipulated through 1:1 iterative studies with little or no material expertise. This idea is not achievable with other materials as they have a steeper learning curve and a host of other issues that are not pertinent at that specific stage in the beginning design studio. It is not that we are asking beginning design students to manifest novel ways of using these materials, but instead, ask students to perceive how the transformation of a known material through experimental processes is directly linked to the translation of drawings and physical objects. This process develops the groundwork and logic that beginning design students must possess in order to develop a sensibility to a design process that deeply considers material in the production of drawings and tangible objects.

## Notes

[1] Borden, Gail Peter, and Michael Meredith. (2012) *Matter: Material Processes in Architectural Production*. New York: Routledge p 2.

[2] Jackson, Paul. (2011) *Folding Techniques for Designers: From Sheet to Form*. London: Laurence King. p 9.

[3] Vyzoviti, Sophia. (2003) *Folding Architecture: Spatial, Structural and Organizational Diagrams*. Amsterdam, BIS Publishing. p 6.

[4] Colomina, Beatriz. Choi, E. Gonzales, G and Meister, A-M. (2012). *Radical Pedagogies in Architectural Education*. The Architectural Review. Available online: http://www.architectural-review.com/academia/radical-pedagogies-in-architectural-education/8636066.article accessed 12.21.2015

# Upcycled Furniture Prototypes in Public Space Design Studio

Carolina Aragón | University of Massachusetts Amherst

## Introduction

As the world becomes increasingly urban, there is a greater need for improving the quality of our cities. The 2012/2013 UN-Habitat Report calls for urban prosperity through "transformative change towards people-centered, sustainable urban development" transcending economics to include "quality of life, infrastructures, equity, and environmental sustainability." The city of the 21st century optimizes resources, leaving behind unproductive and unsustainable models, to address the "tangible and more intangible aspects of prosperity."[1] Amanda Burden, former New York City Director of City Planning, speaks of the power of human-centered public space design to transform the experience of urban life.[2] Public space, with its power to strengthen the link between individuals and their everyday environment, provides beginner design students with opportunities to investigate the relationship between people-centered design and optimization of resources.

The exercise of building a 1:1 scale chair has traditionally offered students the challenge of merging material, aesthetic, structural and ergonomic considerations. As part of a public space landscape architecture design studio, the exercise also serves to highlight issues related to human comfort, behavior, and social use.  A chair offers a direct sensorial experience that mediates the user's relationship to a larger public environment. Its materials, dimensions, construction, and orientation, shape the public's experience of public space.

This paper describes the process and pedagogical value of constructing a 1:1 outdoor upcycled seating prototype in a public space design studio with third-year undergraduate landscape architecture students at the University of Massachusetts Amherst. In this introductory two-week exercise, students are challenged to create an original, beautiful, and comfortable seating prototype using waste materials from the University's Waste Transfer Station.  These prototypes, or the material transformation developed during their creation, are then used in the redesign of a student selected public space on campus later in the studio. The UMass campus, containing the highest population density within the surrounding area, is used to emulate urban conditions of public space design.

The goal of this exercise is to set the foundation for design strategies that support innovation, sustainability and social responsibility in the design of public spaces through design research and creative work. Upcycling creates an increased connection to the context of local waste and spurs creativity, as it demands imaginative and technical design solutions that transform the perception and performance of waste materials.[3] The creation of a 1:1 upcycled prototype also presents students the opportunity to use design research to explore issues of materiality, human factors and behavior. Different research methodologies are presented as opportunities to expand and support creative strategies for human-centered public space design. This paper presents upcycling as a promising model that introduces students to sustainable design and innovation, and describes methodologies, challenges and successes for incorporating design research with material innovation in public space design.

## Upcycling and the Creative Process

The process of upcycling embodies the transformation of waste materials into goods of higher quality or environmental value. An introduction to this concept was presented in William McDonough and Michael Braungart's *Cradle to Cradle* (2002) with their idea of creating abundance through continuous material reuse.[4] In *The Upcycle: Beyond Sustainability – Designing for Abundance* (2013), McDonough and Braungart refine their argument for upcycling, as an activity that "eliminates the concept of waste" through creative reuse of material resources, which can be seen as technical or biological nutrients.[5] Currently, materials that are recycled are downcycled, degrading them into materials or products of lesser value.[6] Upcycling thus creates a world of abundance through the creation of "goods [that are] literally 'goods,'" for their technical reuse, beauty, and pleasing quality.[7]

The upcycled seating prototype project asks students to only use materials retrieved from the University of Massachusetts Amherst Waste Transfer Station (UMAWTS). This facility handles a wide variety of waste and recyclable materials collected by the university, ranging from commonly recycled materials such as paper, corrugated cardboard, plastic and glass containers, to large items such as refrigerators and AC units, and assorted miscellaneous items such as video tapes, DVDs, mattresses, and broken furniture. The 2014 Waste Management Report for the University indicates that out of the 3,531 tons of waste produced that year, 2,037 tons (57.7%) were recyclable and compostable materials. [8]

*Fig. 1 Field trip to UMass Amherst Waste Transfer Station*

During a field trip to the UMAWTS, students collect materials for their seating prototypes while learning about the facility and the University's waste collection and recycling processes. (Fig 1) Because the University profits from the sale of recyclable materials, students are encouraged to collect materials with limited recycling value. Often, students select less commonly recycled materials that are being stored at the station until a viable quantity is obtained for their subsequent shipping and recycling. Examples of materials collected include: tires, microfilm tape, wooden reels, expanded polystyrene, high-density polyethylene tubing, and composite wood furniture. Due to the rapidly changing nature of the materials collected at the station, students' choice is limited to what is available during their visit.

Students are asked to design and build a full-scale original chair prototype using their selected waste materials as part of the redesign of an outdoor public space on campus. The prototypes must be beautiful, comfortable, and make trash not look like trash. They must function as outdoor seating that attracts and holds the public's attention while providing a comfortable interface for a social space. To achieve this, students experiment and develop methods of assembly that directly respond to their selected material. Their work must create new opportunities for the reutilization of waste materials while responding to issues of human comfort in landscape furnishings.[9]

The process of designing and constructing an upcycled furniture prototype fosters the high levels of creativity necessary to create innovative design solutions that support environmentally and socially responsible values. Throughout this process, the conventional nature of our material relation with the built environment is challenged through the realization that landscape and architecture can also be constructed with waste materials. As a foundation to sustainable design, upcycling introduces waste as an alternative primary source for material construction. The development of an upcycled seating prototype improves students' capacity for finding alternate sources of materials by expanding the notion of "local" to include materials in the local waste stream. It supports innovation in the development of material and tectonic strategies that expand the useful life of waste materials to respond to human needs and support the creation of active public spaces.

## Design Research: Materiality, Human Factors, and Digital & In-Situ Testing

The project incorporates multiple forms of research to inform the design process and situate the exercise within a larger context of issues related to waste and human factors in public space design. The goal of this research work is to expand the students' access for feedback beyond the traditional studio model. The multiple forms of research include: direct experimentation with materials; research on local waste streams; evaluation of their work through 1:1 human scale figures, digital visualization, and on-site user surveys. This research work fosters independence in the assessment of their creations, contextualizes the value of their designs, and introduces students to human factors and design research issues and methodologies that support the design of successful public spaces.

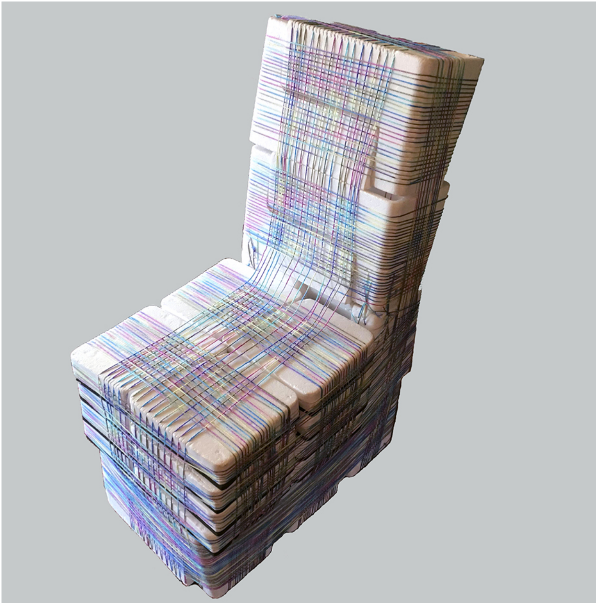


*Fig. 2 Expanded polystyrene & yarn chair. (Yifei Yan & Jasmine Su)*

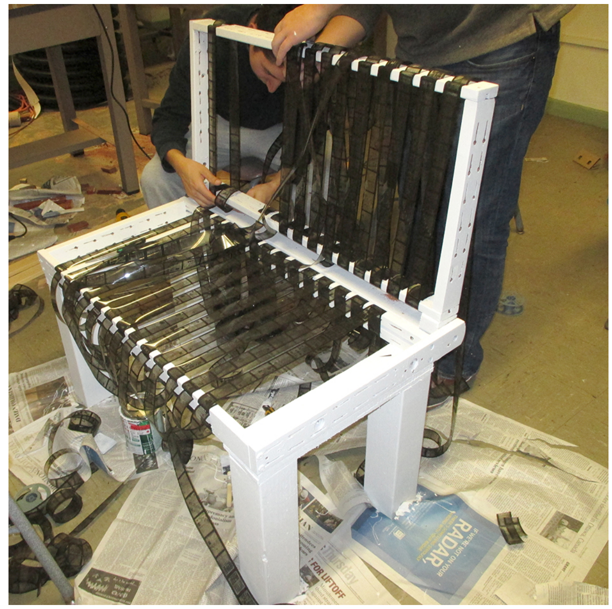



*Fig. 3 Woven film chair process. (Michael Abate, Nicholas McMenamin, Andrew Woodward)*

*Waste Material Research*

Research related to waste materials takes two primary forms in the studio: direct experimentation with materials collected from the Waste Transfer Station, and research to understand the origins of the materials and their relationship to local or regional waste streams. Experimentation with original tectonic assemblies offers direct feedback loops that allow students to become 'experts' of their own systems. Through this heuristic approach, students develop methods of assembly that maximize their current level of expertise and tool availability. Due to the limited time frame of the project and lack of access to the campus woodshop, students without power tools experience are encouraged to create solutions within their range of expertise. (Fig 2)

By limiting the material palette and restraining the use of external connectors, students develop methods of assembly that respond directly to the material properties of the waste material. Examples of these assemblies include the weaving of microfilm tape for chair seat and backing using the tensile strength of the film, or the weaving of inner bicycle tires tubes to create flexible surfaces for seating. (Figs. 3 & 4) Their creations can be evaluated through direct feedback offered by working with materials at a 1:1 scale and testing by peers and future users.

Additionally, students engage in research about their selected materials to answer questions about the manufacturing process, and their presence in the campus, local or regional waste stream. This process is guided by a University librarian who

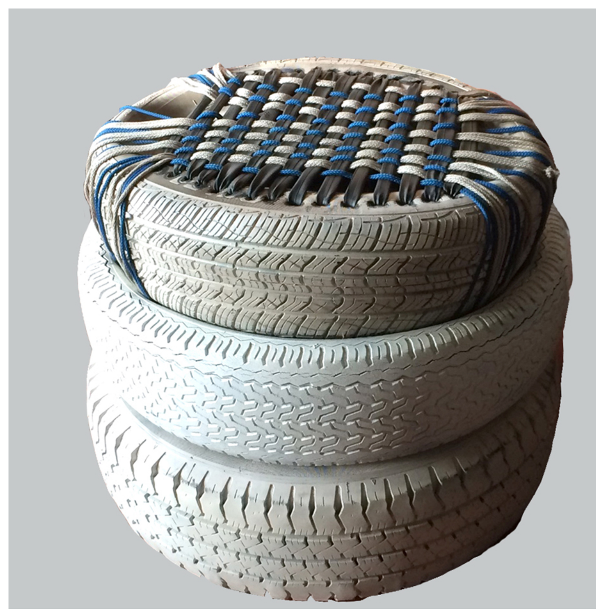


*Fig. 4 Woven seat with bicycle tire tubes and rope on tires. (Tyler Gaudreau & Dan Kossack)*

introduces students to the use of relevant material science, engineering and business databases, outside of traditional art and design resources. The information gathered by the students is visually represented through diagrams and infographics on presentation boards accompanying their chair constructions. (Fig. 5) This multi-disciplinary research enhances the creative value of upcycling by making direct connections between the seating prototype and its environmental and social context.

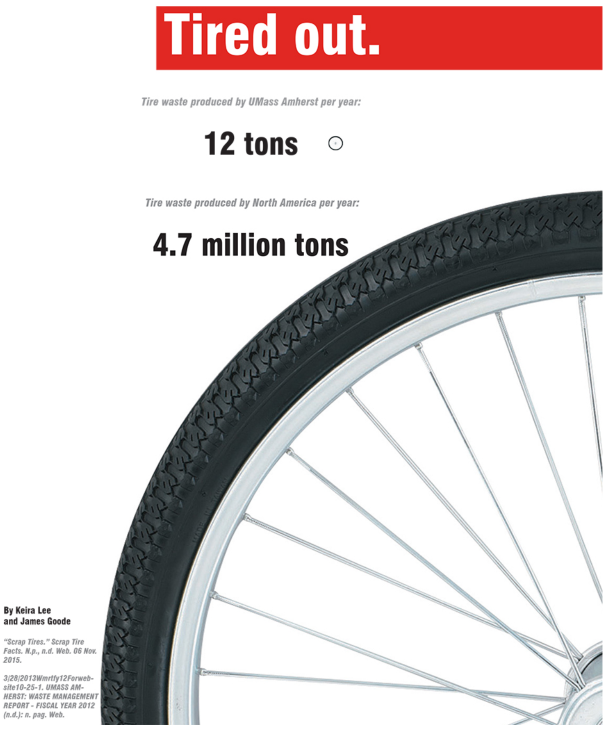



*Fig. 5 Infographic comparing tire waste at UMass v. North America. (James Goode & Keira Lee)*

*Human Factors*

Until recently, comfort was not a priority for public space seating. Lately, there been greater understanding of the role of comfortable seating in the design of successful public spaces to attract people and encourage them to stay. [10] Successful outdoor seating is thus related to ergonomics and its intended social use. Different dimensions and configurations of seating are necessary to adapt to the various activities incurred by users of different age groups. Challenging outdoor conditions and the need for maintenance may limit material selection. Through readings, students are introduced to common factors that serve as guidelines for a range of dimensions and configurations to support the comfortable use of seating for resting, watching, socializing and eating.[11]

These common factors are tested directly by the students during the development of their prototype using their own bodily dimensions. Inspired by Henry Dreyfuss' Joe and Josephine scale figures, students measure their bodies and create 1:1 scale corrugated cardboard figures with movable joints to test their prototypes.[12] (Fig.6) These scale figures allow students to compare their dimensions against the common factors, visualize their body in space, heighten their sense of the range of human dimensions by comparing their figures to their classmates', and

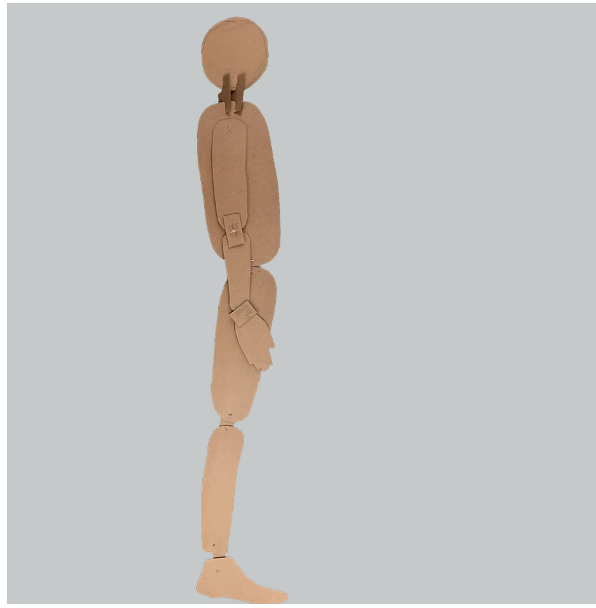


*Fig. 6 1:1 cardboard scale figure using student's dimensions. (Jasmine Su & Yifei Yan)*

visualize the final or optimal dimensions of their prototypes as they are being built. Although the scale figures cannot fully predict the level of comfort of the seating prototype, they provide students with quick feedback regarding the dimensional quality of their assemblies. This real-time testing is important as it supports the parallel development of new strategies for assembling unconventional materials to meet the requirement for human comfort.

Awareness of the dimensional quality of the human body is a first step toward understanding the role of human factors in the design process for public space. The seating prototype offers additional opportunities to test how its material qualities are perceived by human senses, primarily through touch, smell, and vision. This experience paves the way for a better understanding of the role of sensory experience and human factors in the successful design of public spaces.[13]

*Digital and In-situ Testing*

The seating prototype is limited in its ability to provide feedback regarding the redesign of a site. As a stand-alone object, it may not be capable of providing the necessary transformation to activate a public space.  Site analysis, behavioral observations, and post-occupancy-evaluation exercises will inform the site redesign later in the process. However, the studio uses the prototype for digital and in-situ testing to collect information ranging from counterfactual speculation to qualitative data about the public's response to the prototype. This allows students

*Fig. 7 Photomontage of wooden spool chairs on campus site. (Christopher Rucinski, Dylan Zingg)*

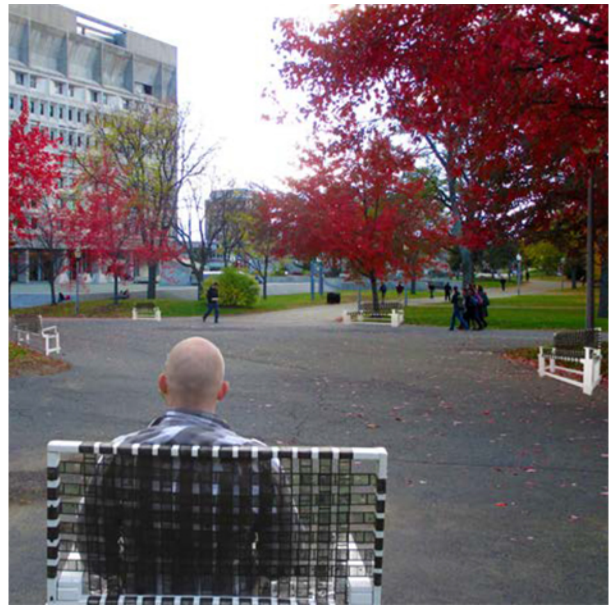


*Fig. 8 Photomontage of film chairs on campus site. (Michael Abate, Nicholas McMenamin, Andrew Woodward)*

opportunities for research activities that heighten their understanding of their site, human perception, and the use of waste to activate public space.

Using photomontage, students test the number and arrangement of the prototypes on their selected on-campus sites, intuitively experimenting with their density and configuration. (Figs. 7 & 8) As a preliminary speculative exercise preceding site analysis and behavioral observation, the digital visualization serves as a bridge between the experiential knowledge of the prototype and the limited understanding of the complexity of their selected site particularly as it relates to issues of scale. It also serves as an introduction to the challenge of creating a variety of seating arrangements to provide options so users can choose where to sit and feel socially comfortable.[14] The latter is often one of the limitations presented by digital visualization, where the single prototype is often insufficient to present a diversity of seating arrangements or environments.

During the final stage of research, students take their chair prototype to their selected on-campus site. Students site the prototypes and use them to conduct a simple survey and interview of passers-by (20 people minimum). The survey asks users their opinion regarding the beauty and comfort of the chair, the quality of the site as a public space, their knowledge regarding the waste materials used in the prototype, and their opinion regarding the use of these materials to improve the site as a public space. The data gathered by the students is presented through graphs, photographs, and video excerpts. (Fig. 9) Although the sample size is small, and students often engage friends in the surveys, the act of placing the chair in the site, and having people sit on it while answering questions about their perception, makes the user feedback more meaningful, increasing students' confidence in their creative and analytical abilities to design public space solutions utilizing waste materials. This 1:1 interaction with potential users and non-experts allow students to reflect on their achievements and limitations, broadening their perspective, and instilling an emboldened sense of purpose as designers.

## Results

The student response to upcycling as a model for design innovation is very positive. Students are enthusiastic about engaging in this material reuse project for its low to no-cost and its environmental value. Although the prototypes do not always achieve the requirement for beauty or comfort, all students have been able to create functional seating demonstrating their capacity for innovation and material transformation while improving their ability to conceptualize design solutions using waste materials at the site scale. In the process, they learn about materials, their presence in the waste stream, and grapple with the problem of what to do with their prototypes at the end of the studio.

The use of design research in the studio process expands students' sources of feedback beyond the studio instructor to include the public. However, students are confronted with the limitations of surveys to gain insight about the prototypes. Currently these offer information regarding the users' opinion rather than provide concrete suggestions for improving the performance of the chair prototype in public space, or address issues of beauty and comfort. Additional research and creative exercises may be required to bridge the gap between the 1:1 scale of the prototype and the site and human behavior considerations of public space design.

## Conclusion

Upcycling, as a process of creating something of higher value, can offer a model for design education, as it requires experimentation, research, understanding, evaluation, creativity and inventiveness. Not only does it signal a new relationship to the problem of waste in contemporary society, but it can also be the precursor to original design solutions that foster abundance and create healthier environments. From a design pedagogical perspective, an upcycled furniture prototype offers students the opportunity to create design solutions at an achievable scale that integrate social and environmental values. It promotes immediate awareness of the local waste issues, and provides students with an active opportunity to transform discarded materials into beautiful and comfortable furniture that improves public space.

The incorporation of design research in the studio supports human-centered design and innovation. As a means for understanding people's response to the prototype, this research process necessitates multiple voices beyond those of the studio instructor and expert critics. Innovation is supported through the incorporation of direct feedback as part of the material construction. By expanding the sources of feedback beyond the traditional studio model, students gain independence in their assessment of their material explorations and are better prepared to design with people in mind. These 1:1 creative and research processes may present the beginning of pedagogical models that support innovation in the design of urban public spaces.

Going forward, the studio will continue to explore strategies to strengthen the link between design research and innovation in public space design. In particular, the studio will expand the use of design research through behavioral observation of the public's response to the chair prototypes on the campus sites. This work will likely provide greater insight regarding user needs and behavior beyond the information provided from user surveys and interviews, supporting the exploration of new ways to design public spaces for the 21st century.

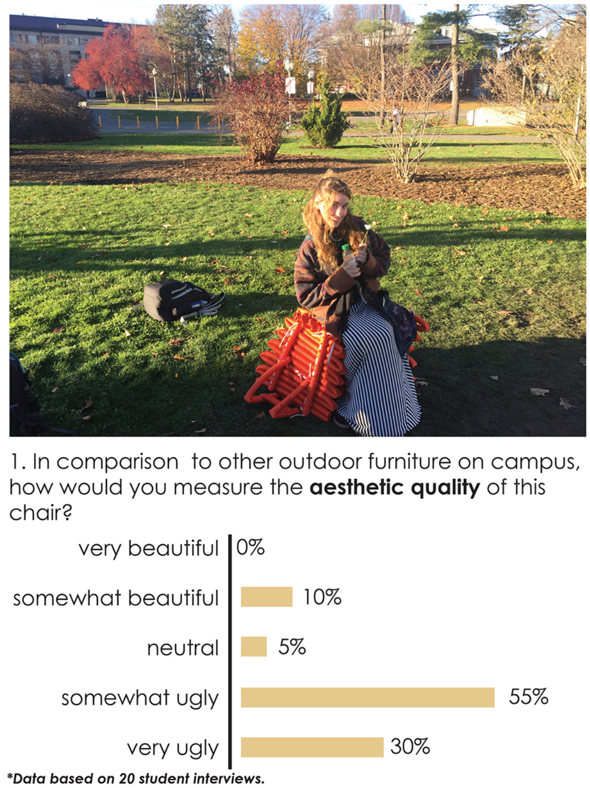



*Fig. 9 Survey questions and results for HDPE chair aesthetic quality (William Jurczyk-Villota, Matt Pilis)*

## Notes

[1] United Nations Human Settlements Programme, *State of the World's Cities, 2012/2013: Prosperity of Cities* (New York: Routledge for and on behalf of UN-Habitat) v.

[2] Amanda Burden, "How Public Spaces Make Cities Work," filmed March 2014, TED video, 16:55, posted January 2016, https://www.ted.com/talks/amanda_burden_how_public_spaces_make_cities_work?html

[3] Alejandro Bahamón and Maria Camila Sanjinés, *Rematerial: from Waste to Architecture* (New York: W.W. Norton & Co., 2010) 7.

[4] William McDonough and Michael Braungart*, Cradle to Cradle: Remaking the Way We Make Things* (New York: North Point Press, 2002).

[5] William McDonough and Michael Braungart, *The Upcycle: Beyond Sustainability - Designing for Abundance* (New York: North Point Press, 2013), 46.

[6] Ibid., 43.

[7] Ibid., 147.

[8] "UMass Amherst Office of Waste Management Solid Waste Report – Fiscal Year 2014," accessed January 6, 2016, https://www.umass.edu/sustainability/green-campus/umass-amherst-transfer-station-and-solid-waste-data

[9] Bill Main and Gail G. Hannah, *Site Furnishings: A Complete Guide to the Planning, Selection and Use of Landscape Furniture and Amenities* (Hoboken, N.J: John Wiley & Sons, 2010)

[10] Ibid., 83.

[11] Ibid., 92-108.

[12] Henry Dreyfuss, *Designing for People* (New York: Paragraphic Books,1967), 32-35.

[13] Jan Gehl, *Cities for People* (Washington, DC: Island Press, 2010), 31-59.

[14] William H. Whyte, *The Social Life of Small Urban Spaces* (Washington, D.C.: Conservation Foundation, 1980), 28.

# Make Re-Make: A Temporary 1:1 Workshop for Architectural Education

Simon Beeson | Arts University Bournemouth

## The Art of Building:

*"Architecture starts when you carefully put two bricks together. There it begins."* Ludwig Mies van de Rohe[1]

This paper considers one particular 1:1 workshop activity intended to introduce exploratory methodology of design grounded in materiality. It extends and expands on a pedagogical approach at Arts University Bournemouth that postulates architecture as an emergent property of building. For the beginning design student, this approach is primarily through models[2]. The workshop project presented here attempts to relate these issues to the human scale.

Speaking as an educator, in his 1938 inaugural address as Director of Architecture at Armour Institute of Technology, Mies begins:

"All education must begin with the practical side of life. Real education, however, must transcend this to mold the personality.....Thus true education is concerned not only with practical goals but also with values".[3]

These practical matters included the usual contingencies of building, from function to materials. His firm belief was that architecture was the *art of building*. His examples begin with the "primitive building methods" of stone and timber-beamed ceilings, but goes on to include brick:

"How sensible is this small handy shape, so useful for every purpose! What logic in its bonding, pattern and texture".[4]

Mies is expressing one of the recurring themes of architectural education. All programs of study must address how knowledge of the contingencies of building is introduced to inexperienced students. Often 1:1 making is considered as an appropriate method to acquaint the student with building, from practical issues of materials and technology to working with the requirements of a live brief. In some cases the starting point is as elemental as a brick, connecting speculative conceptual thinking with empirical experimentation.

*Fig. 1 Canteiro Experimental at FAU USP, Brazil.*

One excellent example is the *Canteiro Experimental*[5] (literally the "experimental site") at the Faculty of Architecture and Urbanism, University of São Paulo, which started in 1998 (fig. 1). A section of land between the school and the workshop has been put aside to experiment with various materials and construction techniques, from fabric structures to recycled bricks (fig. 2). The current facilities for the experimental site are themselves an outcome of student 1:1 projects. This sheltered site allows students to experiment with materials, such as the building of brick columns, arches, or wall sections (fig. 3). Among other recent projects the students have built a small brick vault and rammed earth building for the faculty team, headed by Prof. Reginaldo Ronconi, based on several years of experimentation (fig. 4). As with so many such programs, students attend the *Canteiro Experimental* class as part of their technical education, for a limited time of usually only one semester, and contribute to an ongoing process of research through exploratory building. This program reveals one interpretation of the relationship of *thinking and making*: thinking about the properties of materials through actual engagement in making with them. It also involves the students in collaboration with their peer group and with those that came before them and will take the class after them. As part of a five-year curriculum the program provides a hands-on opportunity to study building and understand the creative potential of materials and construction.


*Fig. 2 Brick made by students at FAU USP (9x5x19 cm).*

There are limitations of such projects. They are not usually available to every student, but taken as an elective or alternative to studio. As *Canteiro Experimental* demonstrates, they require space (specifically land), materials, technical support and academic staff, and a concentrated commitment from students. It is however one way to introduce at 1:1 the "logic" of materials and their expressive potential.

*Fig. 3 Students make and experiment with bricks at FAU USP.*

For a begining architecture student one of the greatest challenges is to understand how the technical limitations and contigencies of building inform a creative architectural design methodology. The process of design is exploratory and open ended, but *informed* by the many contigencies of building. This creative exploraton is characterised by redundancy, with many failed attempts required (and expected) to understand the possible route to a solution. The road to success is littered with failures. Rough card models and tracing paper drawings stress the ambiguity and provisional nature of design explorations. The process of design, described by Leatherbarrow as "showing what otherwise hides itself" reveales the hidden proposition[5]. But building is an unforgiving practice. A building has to be safe, affordable, and practical. By the time we set out to build, to create a work of architecture, the period of failure should be drawing to a close. By this stage, understanding of construction must already have been considered as part of the design process. Here in lies one of the inherent contradictions and complexities of architecture as a projective, design discipline: the more we understand the consequences of our designs, the better we can conceive a design. Yet, in the early years of architectural education a student has very limited knowledge on which to base design. Additionally the increasing use of virtual digital environments and the trend to Building Information Modeling (BIM) to integrate all aspects of design and construction require less ambiguous definition than the analogue tradition of drawing.

*Fig. 4 Canteiro Experimental new research office at FAU USP, Brazil.*

This knowledge of the craft of building for an architect is quite different from that of skilled craftsman or contractor. Technical knowledge in architectural education is not an end in itself, but introduces critical thinking about construction as it pertains to the conception of designs. As such we might consider building experience as valuable in architectural education not just as a process of manufacture that *informs* design thinking, but as an exploration of what architectural making *thinks with.* While it may well be true that a student who has building experience learns a great deal about the contingencies of materials and construction technology, it also acquaints the student with the thing that architecture as a discipline thinks about: inhabited spatial-material constructions.

It is in this sense, in understanding the creative impulse of architecture, that I believe Mies' statement on bricks must also be interpreted. He is not simply saying that being a bricklayer would make one a better architect. The "careful" placement of two bricks is a place of origin for building from which architecture emerges. He is suggesting that an understanding of architecture's means will elucidate its ends. Richard Sennett has termed this craftsman's awareness of the embodied potential in materials as "material consciousness"[7]. Indeed Sennett gives an example of the material consciousness of the brick maker as a transformer of clay[8]. But the architects understanding of a brick is not the same as a brick makers or a brick layers. Mies, the architect, is concerned with the placement of bricks to create the inhabited realm of architecture, as did Louise Kahn when he asked "what do you want, brick"[9], a statement described by Robert McCarter as a search for the *poetics of construction*[9]. Though the answer may technically be "an arch", the architecture that follows is one of light and shadow, structure and mass, space and eternity: "a thoughtful making of spaces"[11]. Commenting on Kahn's question to a brick, Hannah Higgins has observed:

"Alone, the brick is just a lump of mud or clay. As a brick, however, it embodies aspirations like social grouping, reaching, stretching, expanding, securing and breaking – an elemental portrait of a human being."[12]

## How to build:

"By limiting the creative act to one simple material, in ample supply, with clearly defined parameters (no fixing, no jointing, no additional materials, only balance and gravity allowed for the construction process) a door opens into a wholly unexplored creative territory." Aeneas Wilder[13]

Though an artist, Wilder's statement of intent is reminiscent of Mies's comments on brick. Since 1998 he has created a series of temporary installations of increasing complexity using just such limited means. In his case not a brick, but short sticks of wood[14]. As early as 1993, when completing his Degree at Duncan of Jordanstone College of Art (Dundee) Aeneas Wilder (b. 1967) had experimented with carefully balanced timber constructions, but it was on a residency at the Nordic Artists Centre (NKD, Dale, Norway) in 1998 that his stick-balancing works began to take on their characteristic form. Each work is usually made from a single repeated component, a stick of wood. These vary in dimension, but share the common quality of being easily handle by one person. Some of Wilder's works begin with some relatively straightforward balancing experiments that proceed as a series of temporary sculptural installations. For instance, his 2000 *Kinetic Installation* for an exhibition in Norway balanced 100no. 16' (4.8m) timber battens along a timber beam, which were then set in a rocking motion and documented by video. A series of works created for Aomori Contemporary Art Centre (Untitled #85, #86 and #87, Japan, 2002) explore the balance of 3' (900mm) sticks on their ends, two or three high. He also created a long wall of sticks (each 18", 450 mm long), following the curve of the main gallery (Untitled #88) and a series of towers supporting chairs (Untitled #89). One of the unusual notions explored in these works is that both the construction and demolition of the pieces also form part of the work. Delicate installations can take several hundreds of hours to construct. However the "kick down" demolition might last only a few seconds, revealing the venerability of the work and returning the component parts to a state of dis-order.

*Fig. 5 Aeneas Wilder* Untitled #155 *at YSP.*

The walls and columns that the works create are architectural in their scale and respond to the spatial context of the gallery. As such they offer a clear comparison with these same tectonic elements in the context of building. Some works create room like spaces, sometimes circular or domed installations. The scale and ambition of these projects has increasingly tested the practical and expressive potential of the sculptural premise. In 2011 Wilder created one of his larges circular spaces, 16' (4.8m) high and 60' (18m) in diameter, for the Yorkshire Sculpture Park (Untitled #155) with 9250 short strips of Iroko hardwood (fig. 5)[15]. As early as 2000 Wilder created an installation described as "a maquette for a much larger architectural work yet to be realised".[16] This piece consisted of a domed central form and a low enclosing wall, framing an entrance passageway. The assembly is reminiscent of the monastic corbelled stone structure at Skellig Michael (Ireland). These 6$^{th}$ Century "beehive huts" are of dry stone construction, and not much larger than the installation. Like Wilders installations, they are built from just one material, balanced against gravity.[17]

Wilders opportunity to build an architectural structure came in 2006 when he proposed a 50' (16.5m) high free-standing dome for the Follydock project in Rotterdam (Untitled #127). Competed in 2007, this semi-permanent structure used bolted timer dockyard beams. He has since completed several similar large works. Meanwhile he continues to experiment with other forms, such a spheres and beams, each responding to their specific exhibition spaces.

## Building/Learning:

*Fig. 6 Aeneas Wilder demonstrates circular layout in AUB studio, 2011.*

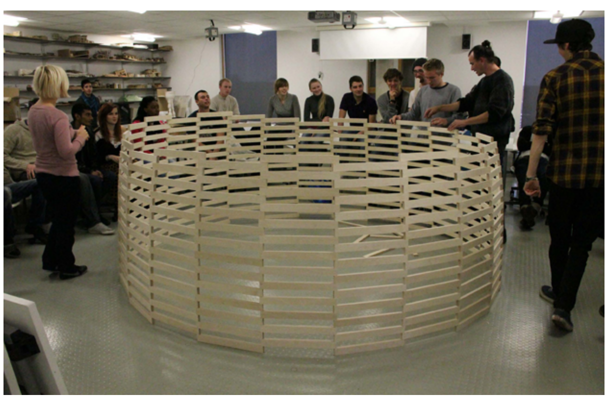


*Fig. 7 Aeneas Wilder and students dome building in AUB studio, 2011.*

Since 2011 the architecture course at Arts University Bournemouth has developed a workshop activity in collaboration with artist Aeneas Wilder. He has modified his art practice for use with architectural students (fig. 6 & 7). For ease of manufacture, storage and price, we chose a simple 16"x 1½x¾ (400x40x18mm) size, which can easily be cut from standard 8'x4' sheets of ¾"ply (2440x1220x18mm), yielding about 175 sticks (depending on saw cuts). Over the years we have accumulated over 3000 sticks, and add a few more each year. The workshops explore several themes related to beginning student studies.

*Fig. 8 First year students building in collaboration, 2015.*

These workshops are collaborative and encourage group working (fig. 8). We have used the exercise of building columns and domes on interview days to encourage small groups of students to interact and talk. Tentative building gives way to laughter as soon as the first structure collapses. Even after a short building session of an hour, students take pride in the form of these structures. The kick-down and the loud clatter of sticks is followed by whoops and applause. The lesson of trial and error, success and failure is celebrated. The workshop is also used to begin our three-week International Summer School, where students of different cultures, languages, and architectural experience enthusiastically engage in exterior projects with sticks, exploiting any summer weather Bournemouth can muster.

*Fig. 9 Contextual experiment, Summer School, 2013.*

Each work offers limited means, but with many solutions. Even the simple task of building a column of sticks offers up a rich variety of possibilities. Participants test the possibilities, first attempting to match the components to a preconceived form, as if one could draw with them, only to realize that the most successful visual and structural solutions exploit the properties of the sticks. The simplest structure can be the most revealing, especially when casting a surprisingly complex, constantly shifting shadow. While limited to a certain series of formal properties created by the alternating structure of timber and void, the structures take on new life when contrasted or combined with other elements, such as existing walls, doors or trees (fig. 9). The campus trees offer a particularly interesting geometry to respond to.

*Fig. 10 Trial and error building by first year students at AUB, 2012.*

Failure is embraced as a learning method (fig. 10). While columns and walls are relatively simple to construct, a lack of concentration, co-ordination, or a gust of wind, can topple a structure in seconds. The work requires concentration. Care is reflected in the quality of the final work. Pushing the potential of the method reveals creative thinking in response to challenges. To make an arch it is essential to grasp the role of counterbalance. Once completed counterweight sticks can be removed leaving simple elegant arches.

*Fig. 11 Repetition, recycling, re-making, AUB Summer School, 2015.*

Repetition, redundancy (such as failed experiments), recycling, and re-making are all encouraged to explore the possibility of exploratory research through making (fig. 11). And all of this happens at the human scale, working with real material, under gravity, revealed in light and shadow. As a method of 1:1 building it is quick, cheap, repeatable, and temporary. The works exploit and respond to found spaces on campus, requires no planning or building permits, and has defined, assessable risks (essential in the current climate of health and safety regulation). It is also a process open to many different abilities and well suited to introductory sessions for architectural design.

Unlike building with conventional building materials, such as brick, these works are not primarily exercises in architectural technology. They act as short focused opportunities to build at 1:1 in the real space of inhabitation. The placement of the structures explores the scale of spaces, heights of ceilings, location of doors, windows or other features of the space. Outdoor structures explore opportunities of orientation, existing elements, landscape or pathways, while framing views and casting shadows. The exercise prioritizes experimentation, learning by doing, risk and failure. However, they are not without an element of craft and introduce the students to the idea that materials might reveal an understanding of their potential through use. They are analogous building experiences. As such these structures have much in common with models and drawings, being inherently provisional. The exercise cultivates an attitude we would wish students to bring to their studio work; the exploratory making/thinking of an architectural design methodology, revealed these through tactile, material reality.

Comparison could be drawn with mocking up architectural proposals on site in string and bamboo, a common method in education and practice. There are also extreme cases of temporary structures to test proposals, such as Mies's own experience on the 1911 and 1912 full-scale wood and canvas mock-ups of the Kröller-Müller Villa[18]. However, while these mock-ups might test scale and visual impact, the stick stuctures explore the more tactile and phenomenal qualities of the material-at-hand. There are close similarities with other exercises in architectural eduaction, such as the work that of Regin Schwaen at NDSU, who uses handmade bricks, books or stick structures to develop a haptic pedagogy for understanding stuctures[19]. Like some of Wilder's structures, these are also amibiguous in scale, suggesting possible re-interpretaions at larger scale. Such projects extend our pedagogical method and the interogation of an architectural design methodology from models and drawings to the hands-on experinece of building. But perhaps the most distinguishing factor of the Aeneas Wilder Workshop is the kick-down, the invitation to make and re-make, to embed a methodology of risk taking and playful exploration at 1:1, in the sensory realm of inhabited space (fig. 12).

*Fig. 12 Redundancy and risk, AUB Summer School, 2015.*

## Notes

[1] Curtis, William J.R. Reputations: Mies van der Rohe (1886-1969). in *The Architectural Review* no.1378 Dec 2011 Vol. CCXXX p110.

[2] Beeson, Simon. "The Architects Table: a laboratory for making/thinking", in *NCBDS 29 Proceedings*. Temple University: Philadelphia. 2014. p65-72

[3] Mies van der Rohe, Ludwig. "Inaugural Address as Director of Architecture at Amour Institute of Technology", in Johnson, Philip. *Mies van der Rohe.* The Museum of Modern Art: New York. 1947. p191-3.

[4] ibid. p192

[5] Ronconi, Reginaldo. *Canteiro Experimental: 10 Anos na FAU USP*. Faculdade de Arquitetura e Urbanismo da USP, Sãu Paulo. 2008.

[6] Leatherbarrow, David. *Showing What Otherwise Hides Itself.* in Harvard Design Magazine. Fall 1998. p50-55

[7] Sennet, Richard. *The Craftsman*. Allen Lane: London. 2008. p119.

[8] ibid. p130.

[9] Kahn, Louis I. "1973: Brooklyn, New York" in Latour, Alessandra (ed). *Louis I. Kahn: Writings*. Rizzoli: New York. 1991. p323.

[10] McCarter, Robert. *Louis I. Kahn*. Phaidon: London. 2005. p302.

[11] Kahn, Louis I. "Spaces, Order, Architecture" 1957 in Latour, Alessandra (ed). *Louis I. Kahn: Writings*. Rizzoli: New York 1991. p75.

[12] Higgins, Hannah B. *The Grid Book*. MIT Press: Cambridge, MA. 2009. p31.

[13] http://www.ysp.co.uk/exhibitions/aeneas-wilder (accessed 1st October 2015)

[14] For Aeneas Wilder statements and works see: http://www.aeneaswilder.co.uk (accessed 1st October 2015)

[15] http://www.ysp.co.uk/exhibitions/aeneas-wilder (accessed 1st October 2015)

[16] http://www.aeneaswilder.co.uk/exhibitionsINAX02.html (accessed 1st October 2015)

[17] Löbbecke, Renate. *Corbelled Domes*. Walter König: Cologne. 2012. p334

[18] Mertins, Detlef. *Mies*. Phaidon: London. 2014. p48-49

[19] Schwaen, Reginald. "How I learned to stop worrying and love structures" in *NCBDS 29 Proceedings*. Temple University: Philadelphia. 2014. p455-459

(Note: All images by the author).

# "I can teach you nothing about design" or how I learned to stop worrying and love my tools

Kory A. Beighle and Vincent Sansalone | University of Cincinnati

*Fig. 1 Panorama of First Semester Design Studio Work*

It is the first day of class and a fall breeze rushes through large trees just outside of floor-to-ceiling, north-facing windows at the back of a large studio. The instructor enters the room and a subtle chatter falls silent as twenty wide-eyed first year design students sense the gravity of the moment; it is officially beginning, design school, but exactly what that means they still aren't quite sure of. The instructor looks up and down four rows of desks and states calmly and coolly, "*Hello, I am your new instructor and **I can teach you nothing about design**. Please take out your tool-kits and we will begin."* Looks of confusion cross any number of faces as desks rustle and large folios filled to the brim with Bristol paper and micron pens and trace paper and x-acto knifes and prisma markers and so on plop atop old wooden desks, each surface a few years past over-used. The instructor's voice cuts just above the clatter, *"These tools are your new best friends. Take close care of them and learn to love them so that they love you back."* Twenty pairs of eyes shot from their tool-kit, up to the instructor and back down to their tool-kit.

As the beginning design student sets out into the uncertain and ambiguous landscape of their new discipline, it is only natural that they might seek out some form of grounding or clarity. One of the most natural stabilizing factors for these beginning design students are often the tools and techniques that they are presented with. These tools and their use become the most tangible connection to their newly adopted discipline. The following study considers exactly why this connection with our tools is so vital and how the relationship may be changing in the context of our digital age. The study also considers how the student's relationship with his or her tools in the contemporary context can be operationalized as a pedagogy of agency within the uncertain trajectories of design disciplines in the 21$^{st}$ century.

In his book, Becoming Human by Design, philosopher and design theorist Tony Fry presents an argument that helps us understand why humans, and by extension, the beginning design student might form such a strong relationship with their tools. His narrative on the development of man suggests that human interaction with tools has and continues to be fundamental to how we have evolved.[1] Fry's work strongly makes the case that our tools are what define us, but more importantly, he suggests this defining is a perpetual process that, within our contemporary age, continues to fundamentally alter the way being is organized; it is our being and becoming. He writes,

> "Technology is becoming an ever-heightened means of the ontological designing of 'being now'. As such, it is a material instrument, 'a tool of knowledge' and a medium of communication. In its continued acquisition of power, there can no longer be any appeal to consciousness overcoming the power of technology any more than there can be an appeal to consciousness overcoming nature. Just as life can be lived or not with a critical and responsive/responsible relation to nature, so does this now extend to technology."[2]

In order to understand Fry's discussion, a few critical points should be highlighted. First, Fry's reference to technology here is assumed to be referring to the tools and techniques for life that humans have developed. In this sense, technology clearly can be linked to digital technologies such as the internet, but it can also be linked to something as banal as the glasses that rest upon my face. *"Technology"* as Fry uses it is both an object and a way of thinking about or using that object, as well as the interaction of/between these two phases of being.[3] Summarizing this concept, *"technology"* ceases to be about only the object of the tool or the technique of its use on the part of a user, but rather it begins to be a unified continuum referred to here as *tool-being*.[4]

Second, it is important that Fry advocates for a posture of criticality and responsiveness as opposed to that of overcoming. One could read this in a number of ways, but on one level it is a clear critique of modernist tendencies for certainty and control and an advocacy of a heightened sense of engagement, specifically reactionary in nature. This reading brings to mind the discussion of critical theorist Sanford Kwinter in his text Architectures of Time, who suggests that reaction is fundamental to a *"real"*[5] existence, as opposed to the abstractions, which he sees as the foundations of modern thinking.[6] Kwinter argues for reaction as a primary principle of being. To articulate this, he offers up the case of the surfer as exemplary of the concept. As opposed to almost every other sport, the surfer does not drive the action, but rather he or she is in a constant state of reacting, not against, but with the wave. It seems clear that Kwinter's concept of reacting is very much in line with Fry's point; one can see the surfer not so much overcoming the wave, but rather undergoing the wave. For Kwinter and for Fry, reaction becomes a method of being and of design.[7]

Unfortunately, while Fry's argument makes it clear that a reactionary position and a deeper engagement with technology, and by extension, tools[8] has the capacity to alter our processes of thinking, making, and being, exactly *how* this concept should be engaged and what it means to be reactionary remain somewhat open-ended. The most directly that he addresses these questions is when he implies that active and critical engagement with tools is connected to an embodied knowledge, built into the hand through direct interaction. "…it was the hand in its making, especially in the company of the tool that delivered the animal to its potential of humanness, for 'all the work of the hand is rooted in thinking'."[9] From this perspective, a direct, hands-on engagement with a wide range of tools, regardless of the contexts should begin to offer agency and the critical responsiveness Fry advocates.

Fry's discussion is clearly on a scale of human ontology, but it is not a stretch to apply the thinking at the smaller yet still structural level of disciplinarity. Applying Fry, we can say that our tools are what define the disciplines we identify within. What would architecture be without the plan, or the axon or the perspective drawing? What would we be without the mud brick, or the I-beam or the pane of glass? But these, the drawing or the building material, are only the physical implements; where would we be without our traditions of technology and history and theory? Tools, as has been explained, are potentially a vast category. Without our tools, we may still exist, but our ontology would be different. So, it stands to reason this notion of engagement with the tool, is at least one central act of learning and it is how individuals develop their sense of identity within fields of inquiry.

With these thoughts in mind, it seems reasonable that in the context of their new journey, the beginning design student might tend to latch onto their tools and it seems equally reasonable for their instructors to place a high value on these implements in the curation or implementation of any curriculum.

Unfortunately, past the illumination of the human-technology or human-tool relationship and the hinting of how one should engage in the processes of what has been summarized here as *tool-being*, there is a problematic turn in Fry's discussion. As Fry point's out, technology is changing the organization of our world. The digital age is affecting a great change on the fabric of humanity. The specific problem is perhaps rooted in the reason Fry is not more clear about how to proceed. Because we are entrenched in this becoming, it is difficult to observe the unfolding from the outside. While it is difficult to articulate the exact changes that we are undergoing, even at this very moment, it is not so difficult to observe a great number of expansions, contractions and collisions at play on the landscape of events. If one accepts the contention that the digital age is in fact altering the core of human structures of knowledge – both its production and dissemination – within the new paradigm, it stands to reason that disciplinarity, which has traditionally been the factory, storehouse and dissemination platform for this knowledge should also be on notice. [10]

Many of the traditional disciplines, be they rooted in the arts, the sciences or the humanities, have and continue to question both their own validity as singular mediums of expression as well as their relationships to the vast array of other language-mediums emerging within the postmodern condition of the digital age. Certainly, disciplinary processes of producing, assembling and disseminating knowledge are in flux. Some may choose to fight against this flux in an attempt to maintain the status quo, but change is ultimately the natural order. To fight against change is, in one sense, an attempt to overcome overcoming – a proposition that seems little more likely to succeed than Sisyphus with his boulder. Kwinter's image of the surfer undergoing the wave comes back to mind.

From an anecdotal level, this idea that disciplinarity is in flux feels as though it could not be more true of the design disciplines. The various intersections, collisions and collapses that design experiences on a routine basis are clearly pushing limits of and blurring the boundaries of each discipline. While it is not in the scope of this research to highlight and examine specific cases of this in practice, one might consider design practitioners such as Charles and Ray Eames, Diller Scofidio + Renfro or Olafur Eliasson who have and continue to question disciplinarity. One common element between each of these practices is that they tend to work in a cross- or trans-disciplinary way very similar to performing acts of translation. The reason that this is important is because such models of praxis embrace the intersections and collisions of our contemporary age to the point that they become methodologies of practice.

In this same spirit, the foundations program in the School of Architecture and Interior Design in the College of Design, Architecture, Art and Planning at the University of Cincinnati has attempted to develop a pedagogy of reaction over the course of the past several years through an iterative process of curricular experimentation. While the core of the whole curriculum revolves around this line of questioning, three specific project sequences have been isolated here to articulate how the pedagogical position is operationalized in a few different ways. Each occur over the course of the first semester, and while each individual series unfolds in sequence, the series themselves run alongside one another in tandem, coming and going over the course of the semester.

The first project series is something we call "*Line, Plane, Volume*." The sequence unfolds in a series of three primary projects called *"Line Block," "Plane Block" and "Balance Block*." For the first project, students are given a set amount of linear material and are asked to arrange it in a composition reminiscent of Sol Lewitt. A number of lines, composed effectively, delineate a cube. In the second project, "*Plane Block*," the same basic process is approached, but this time, instead of lines, the student is asked to use a pre-determined amount of planar material. In the final project, they are asked to examine volume and mass by exploring and developing a composition that delineates a 1-foot cube using 5 board-feet of basswood. The composition is required to rest on a single point no larger than four square inches.

Each project is intended to lead into the next, but instead of simply having the students translate line to plane and then to volume or mass, intermediary acts of translation are incorporated through two-dimensional analytique. These two-dimensional studies are somewhere between documentation and interpretation. The goal is to capture the compositional integrity of the preceding project, while taking advantage of the new medium to expand the student's understanding of and communication about the design. These intermediary steps are intentional layers of uncertainty, bordering on confusion, within the process and force students outside of straight-forward readings of their work.

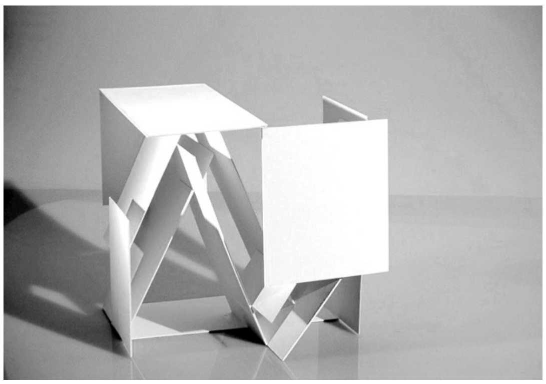


*Fig. 2 An example of the Plane Block project – the second phase of the Line, Plane, Volume Sequence described here. Construction by Emily C.*

The second project series, something we generally refer to as "100+1," has the core intention of exploring materiality and joint. The project is very much in the spirit of Louis Khan's listening to the brick explain "what it wants to be." This series revolves around two primary projects. The first introduces the concept and asks students collect "100" or more of a common, everyday item such as straws, playing cards, birthday candles, index cards or plastic grocery bags just to name a few. The goal of the project is to then use a "stitch" of some kind to help join the "100." The second project in the series is entitled *"Body Mantel"* and it asks the students to undergo the same basic process, collecting a mass of material and bringing it together with a "stitch" of some kind, but this time, they are given their body as the site of the composition. Many students choose to see the projects as a form of fashion design, but nothing about the prompt dictates that response. Both projects intentionally leaves the product out and only describes an open-ended process. Focus is repeatedly placed on the material itself and a series of iterations, working the material over and over, leads to the identification of a strategy and eventually a composition.

*Fig. 3 An example of the 100+1 project described here. Construction by Elizabeth W.*

The final project series does not have a name per se, but it is tied to weekly film screenings that we do with our students. Films such as *"Jiro Dreams of Sushi," "Rivers and Tides," "Man on Wire", "How to Draw a Bunny," "Pina", or "the Diving Bell and the Butterfly" (*just to name a few) introduce critical concepts that cannot be directly expressed in words, but can be experienced through the viewing of the film. The students are then asked to respond to each of these experiences through the production of a collage. Each collage becomes a personal translation of the films content into a new medium. These intentional moments of deep engagement extend the impact of the film and allow them to more directly embody their learning experience.

*Fig. 4 An example of a student film response collage. The piece was produced in response to the documentary film "Jiro Dreams of Sushi" by David Gelb. Collage by Emily C.*

Each of these series adopt the spirit of what was described earlier as *tool-being*, where their engagement with the tool at hand for each project takes on a sort of layered meaning in the spirit of Fry, but extended. In this last example for instance, the act of collage is not just about creating the object, or engaging in a process of re-mixing the film, but it offers the student the opportunity to translate and dimensionalize their experience in a form of communication. In each case, the instructor has a hand in the establishment of the parameters, but the students are the ones who play out the game. The students are the translators from one language to another or from one medium to another.

So, while one might imagine walking into class on the first day, and calmly stating, *"I am your instructor and I can teach you nothing about design,"* to be an uncomfortable statement for a beginning design student to hear at first, over time, the student can come to understand that *"I can teach you nothing about design"* is the mantra for good reasons.

First, teaching is not something that *"I"* as instructor do to *"you"* as student. At a minimum, it is something that we do together; knowledge is exchanged in a process – a feedback loop of evolution. If knowledge is not an object, but rather an event, the instructor must humbly be open to the students as co-participants in learning; both must react by setting up a continual string of evolving opportunities to engage. The concept of translation, touched on briefly, now returns; translation is a process of exchange and it requires multiple points of interaction to flourish and to be examined. Co-participation and co-exploration with a student population and with other faculty are the key to unlocking the potential of new trajectories. It is the multiple that might open the door.

Second, the word *nothing* is vital, but with a particular meaning; nothing is not the absence of knowledge, but it is a particular form of unwordable, embodied knowledge. In his manifesto entitled For the Blind Man In the Dark Room Looking for the Black Cat That Isn't There, art critic and gallery director Anthony Huberman develops a distinction between knowledge and what he calls "non-knowledge." Huberman's concept points to the personal experiences of engagement, where there is a clear moment of internalized knowing, and yet it is not the kind of thing that can be expressed. "Non-knowledge" is Huberman's way of labeling a hands-on embedding within the self that is the core of what design education is.[11]

Following *"I can teach you nothing about design"* with a heavy emphasis on the student's tools is important as a means of re-directing them toward where the learning really happens. The student's use, and even mis-use, of their tools will begin the feed-back loop of discovery and becoming. It is the student who must develop a personal agency and it is the student who must embrace the things that will bring them that agency. If this approach is adopted with rigor, the goals of design education open themselves up to a deep exploration of the potential of the discipline and beyond. We must stop trying so hard to overcome the technology that makes us who we are; we must learn to stop worrying and love our tools, even as they change and change us. If we do, who knows what is possible or what we might become.

## Notes

[1] Fry's point here about the relationship between man and his tools is perhaps not so uncommon and perhaps not so controversial, but it is vital to consider. Much of his case is made in his text Becoming Human by Design. The argument builds throughout the book through discussions of man and technology.

[2] Fry, Tony. Becoming Human by Design. Berg: London. 2012. p 31.

[3] This point is drawing specific attention to Fry's reference to technology being "material instrument, 'a tool of knowledge' and a medium of communication." From p 31 of Becoming Human by Design.

[4] This concept of *tool-being* is something that the author is still trying to formulate as a general theory of how humans relate to tools. The idea is rooted in Fry's work here, but there are many more connections to be considered that are not within the scope of this work.

[5] the word real is stressed here because it is potentially problematic. The discussion is not necessarily within the scope of this study, but Kwinter discusses the real as juxtaposed to the abstract. His whole discussion is focused specifically on the reality of time and he is questioning what it would take to make time real in our modern world.

[6] Kwinter's case is laid out in the opening chapter entitled "*The Complex and the Singular"* of his text Architectures of Time. Please refer to it for more detail on his argument.

[7] Interestingly, Kwinter points out that this idea of reaction as a primary principle is something that disciplines such as physics and mathematics have already adopted for a while. He points out newly proposed forms of geometry (phase space, fractals, attractor dynamics, scaling), algebra (nonlinear equations, recursion, genetic algorithms) and modeling tools (the desktop micro-computer, the interactive cathode ray tube). From Kwinter's reading of the trends this has not been a major trend in design and art disciplines, which he believes needs to change. One can imagine Fry feels similarly from the comments referenced in this essay.

[8] In chapter 6 of Becoming Human by Design, Fry specifically takes up the idea of the tool. The paper is not taking this up directly, but that part of the argument reinforces his discussion of technology.

[9] Fry, Tony. Becoming Human by Design. Berg: London. 2012. p 45.

[10] This argument is articulated well in Jean-Frncois Lyotard's text The Postmodern Condition: A Report on Knowledge. A detailed consideration of Lyotard's work is not taken up here because it is not necessary to this study, but it does offer a clear context that this paper is addressing.

[11] Huberman's work For the Blind Man In the Dark Room Looking for the Black Cat That Isn't There was published in conjunction with an exhibit that he curated. He argues that art practice is a form of knowledge production, but it's not what is traditionally defined as knowledge, and so he labels the fuzzy category "non-knowledge."

# Furniture Design: Rethinking Normative Material Behavior

Stephen Belton | University of Florida

This paper discusses the work of a furniture design and fabrication class and its use of investigations into material behavior at one-to-one as a principle driver of the design process. Material is perhaps the most basic constituent of architecture as the carrier of design ideas into physical form and space. For beginning design students, materials are both familiar and yet somehow still unknown as to their fundamental qualities. The scale of work at one-to-one allows for dedicated research into the nature of materials and the ability to question normative material readings and processes. At full scale materiality becomes, not simply a specification but a medium with which to inquire about the nature and manner by which something is made. Working at one-to-one, the student is forced to address the behavior of the material as fundamental to the understanding of design. Material cannot be ignored or put off for later, but rather must be confronted directly. As such, the lessons and implications for the student of architecture are much greater than the scale of the work would initially suggest.

## Material Testing: Tectonic Vs. Atectonic

Though furniture was the vehicle for the material investigations, the design of furniture was not discussed until several weeks into the class. Instead during the first phase of the course students were asked to test materials in two modes – a first mode that sought to understand and express an idea of a material's essential qualities and known techniques, and a second mode that specifically sought to challenge such presumed material readings. This process may be described as a *tectonic* material reading in a normative sense, and what may be termed an oppositional *atectonic* material reading. Eduard Sekler may be identified as coining the term when he stated "There may be a tectonic negation created with the aid of atectonic forms which tend to disturb the viewer, as in Mannerist architecture." [1] Despite Sekler's definition focusing on the visual, the term was appropriated for the purposes of the class to describe material behaviors that were unexpected or counter to their perceived nature, or to upend Louis Kahn's famous quote, what does a brick *not* want to be? The goal of this second series of tests was not to commit unspoken heresies upon materials, but rather to encourage students to challenge their own preconceptions, as well as those of the larger field of design and fabrication fields, as to what the acceptable or prescribed nature of a given material was or is. Many of these experiments could be considered failures in a strict sense, but led students to ask critical questions that led them along a line of inquiry that became the principle driver for their design concepts, before they ever arrived at the point of deciding what type of furniture they were going to produce or what form it should take (Fig. 1).

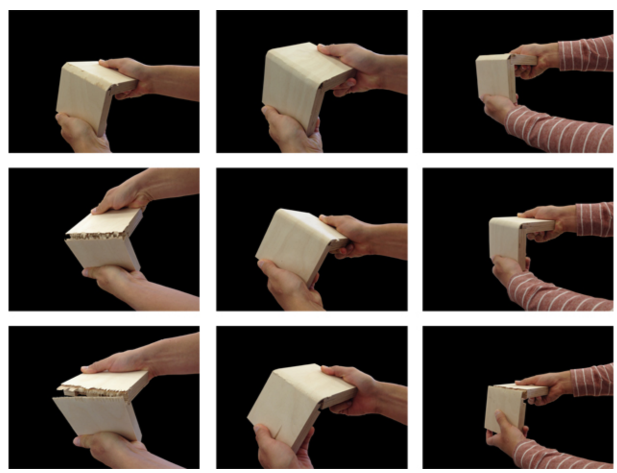


*Fig. 1 Testing material limits to failure to find critical design drivers (Felipe Lopera).*

These tectonic and atectonic tests also provided a framework for discussing with students how materials are employed in design more broadly and architecture specifically, and in turn how their nature has changed. The very distinction between tectonic and atectonic may in this light be seen as a moving boundary as material and building technologies have developed over time. For example, the whole field of engineered wood products has completely changed our conception of the nature of wood. Before industrial rotary veneer lathes and high-strength wood glues, the very concept of plywood would have seemed strange and unnatural, as would the concept of bending such a material until engineers looked to adapt the lightweight strength of plywood into three dimensional forms for the rapidly developing aviation industry. Such experiments fed by class discussions gave students the freedom and confidence to rethink material behavior and how such misreadings may become the drivers for design conception, before any ideas of use or function are considered. Sheila Kennedy elaborates upon this potential in what she describes as material misuse: "Sheet, roll and stick materials, once considered to be 'impure' because they were not naturally generated or configured, now possess an almost immutable, 'pure' status as idealized form types. The standardized dimensions and functional specifications of industrially manufactured building materials appear to be an unavoidable presence, a true constant, in architecture. However our culture's perception of these materials and the uses the architect can make of them shifts and changes. Today plywood is valued for its natural qualities as a form of wood."[2]

The term 'materials' has been used herein and indeed was employed throughout the course to discuss the open potential, implications, and broad conceptual aspirations for the student's work. Nevertheless, one particular material, wood, became the focus for much of the student's material tests and in turn the vehicle for the majority of their furniture design work. The focus was due not to any intended conceptual bias toward wood but rather as a result of practical considerations: wood is a readily available material in many formulations, and is easily worked by the hand, industrial, and digital tools available through our school's facilities. Because the wood industry has already evolved a vast array of products with varied properties, students were already working in a material realm without established boundaries that encouraged experimentation. The acquisition by our school of new tools – both digital and industrial – will allow for an expansion of the material palate for future investigations. Some students from the outset did begin research and testing with alternatives: fabric, resin, metal as primary choices.

In other cases the failure of wood to ultimately produce certain performative effects after numerous tests led the student to investigate and test other materials that would behave in the desired manner, leading to a new set of tests and drivers for their furniture design.

While students were encouraged to let their experiments take their work in any productive direction, there were several common directions the preliminary material studies took. Three major themes or categories emerged with some regularity: deformations, material stressing, and surface effects. Students investigating deformations examined how the material may change shape within the logic of the material itself through folding, bending, slicing, and reorienting. Inquiries into stressing looked at how a material may be placed under permanent duress to produce structural resiliency. Investigations into surface effects examined how material readings may be reimagined through various forms of mechanical or chemical processes on the surface or subsurface.

## Furniture Conception and Development

With the first phase of material testing completed, students were asked to begin conceiving of a piece of furniture of their choice, but to make sure their discoveries of material behavior and expression guided both the choice furniture and its formal development. Tables and chairs were often chosen as classic design problems with a rich history from which to draw and add to. Nevertheless, the chair was the most popular choice for development since its requirements of posture, engagement with the body, and resilience in response to structural issues often asked more of the material without having to invent new drivers to direct the material expression and behavior.

The first iterations in this design work returned students to the representational conventions more familiar to the studio design

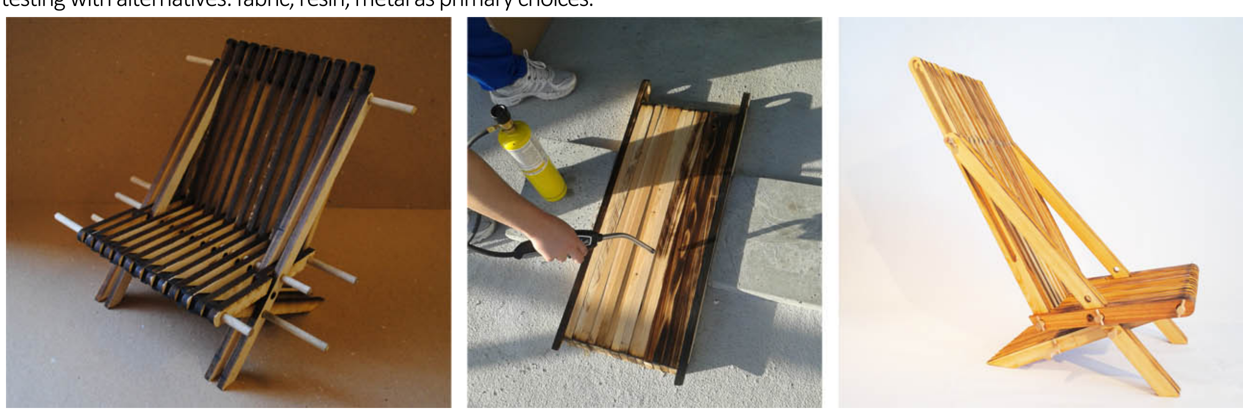


*Fig. 2 Finding opportunities through serendipitous means: charring developed from process artifact to surface finishing technique (Bahar Aktuna).*

process: sketches, scaled models and drawings. Since the students now had firsthand knowledge, original observations and conclusions from their material studies they were in a better position to use shorthand methods as carriers for their design ideas. As their designs developed they worked upwards back through one-quarter and half-scale models, toward full-scale mockups and testing of critical details. In returning to one-to-one, material investigations now became charged with intent and synthesized within a larger set of interrelated design drivers. Geometries, scales, proportions, formal adjacencies, and fabrication processes asked new questions of the preliminary material investigations. These new tests, rather than occurring in isolation were conducted to evolve their original material readings into a more complete and considered whole.

In returning to one-to-one students were also confronted with considering the tool employed in the material testing, and how this consideration affected the material behavior and reading. As many of the initial tests were done by hand or with power tools as the most immediate and rapid resource available, this second phase of testing often entailed migrating to digital fabrication techniques to compare with the first series. Distinguishing between hand (pre-industrial), power (industrial), and digital (post-industrial) tools allowed students to appreciate the dialectic between a given material and the tool used in creating a material affect, and how material affects are not immutable but change with time and the methods designers and fabricators employ to engage them. "The computer is not just another tool," Stan Allen writes, "but it is a tool nonetheless – a tool with very specific capabilities, constraints and possibilities."[3]

The move from analog to digital resulted not simply in a quantitative change of greater precision that digital tools offer, but in many cases resulted in a qualitative change. The change in tools gave rise to new material behaviors that provoked renewed investigations and material tests. At the same time new limits and design challenges presented themselves, evident only in working at full-scale with the actual material.

Mario Carpo has posited the eminent control through digital means of fabrication over the physical object in the design disciplines. "Soon BIM applications will be able to create and maintain a permanent, interactive digital doppelganger of each object of design."[4] Yet designers working with these tools have found continual enrichment in the interplay between these digital tools and the matter they engage with.[5] The students found these same opportunities and challenges. Rather than ultimate control over the material, they found the material still imposed limits and challenges. In some cases these were material qualities such as the direction of wood grain or the density of a material. In other cases they related to the practical limits of time and resources. In this students came to learn that though they might be able to achieve a certain effect, the solution could only be conceived as a one-off. Meanwhile, reconsidering their techniques allowed them to understand the potential of their work to be reproduced, and in this the implications for architecture and its means of production were much greater (Fig. 3).

*Fig. 3 Negotiating material effects with digital tools: early but time-consuming 3d milling process rethought to faster and more expressive 2d milling paths using 45-degree bit to explore plywood laminations (Sara Vecchione).*

In addition to the negotiation between the tool and the material, the final works produced were in many cases hybrid creations combining hand, industrial and digital (post-industrial) techniques. In working toward their final furniture piece, students developed solutions that combined and negotiated between these three types of tools, learning when to use the right tool for the task at hand. In some cases hand or digital techniques took the place of what would be industrial processes if produced in volume. These differences became further points of discussion in helping students understand the role of their own work and craft in the larger culture of architectural and design production at full scale.

## Developing Craft

The issue of craft is challenging for students working at one-to-one while simultaneously being asked to experiment and explore fundamental questions of material behavior. Their experience in much of their studio design process working at scale generally allows them to develop their craft in parallel with their design concepts and intentions rather than having the two directly tied to one another. Knowing that they would be responsible for producing by themselves a finished piece at full scale using tools and techniques with which they were unfamiliar had the potential to create a certain tension between experimenting and refinment. This was addressed by liberating the early experiments from any need to be precise. Rather, a certain informality to the preliminary material tests was encouraged to favor speed and immediacy over perfection. This favored iterative experiments and speeded up failures in order to bring about essential questions leading to more successful tests. Issues of craft at this stage were addressed only insofar as they inhibited arriving at the parameters needed for the material experiments to be legible in their intent. In this manner craft was improved incrementally rather than being a focus (Fig. 4).

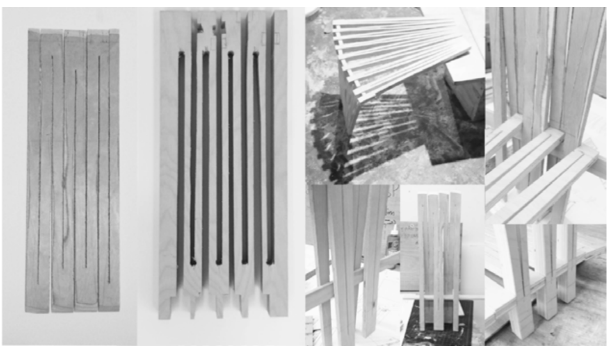


*Fig. 4 Material tests stressing plywood out of plane: obviating issues of craft from early material tests focused experimentation on material behavior (Omayra Diaz).*

*"An architect must be a craftsman. Of course any tools will do. These days, the tools might include a computer, an experimental model, and mathematics. However, it is still craftsmanship - the work of someone who does not separate the work of the mind from the work of the hand."*[6]

As their designs developed and students returned to full-scale tests and mockups, craft became of greater focus. Whether working by hand or digitally students were expected to refine their craft with each iteration. Interestingly, though the change to digital tools allowed much greater precision it did not obviate issues of craft, rather it simply changed their locus. As craft migrates from the immediacy of hand tools where feedback is direct and instantaneous, to the mediated digital tools that introduce layers of steps between input and output, the imperative to understand the connection between ones actions and their effects is all the greater. Errors, when they occur tend to have greater consequences, and at one-to-one tend to be more costly. Students learned this quickly, though sometimes at their own expense as seemingly small errors would lead to comprehensive fabrication errors, sending them back to begin their process over and with new material.

Whether analog or digital methods were employed, craft resided in what Branko Kolarevic calls "the craftsmanship of risk"[8] in referencing what David Pye describes as a process whereby "the result is continually at risk during the process of making."[9] While certain introductory techniques were taught to the class as a whole, each student came to develop their own craft linking various analog and digital processes together in a series of steps dictated by their design development. Each came to master the techniques in dialogue with their material experiments and design development.

## Conclusion

The process in the early stages of the class was more akin to a form of the scientific method where the preliminary testing presented observations and questions of behavior - the change in form, internal structure, surface characteristics, and effects – that in turn fed new hypotheses and tests in an iterative feedback loop. It was these preliminary phases of testing and speculation that became the foundation for the design and development of a particular furniture piece.

With the shift to material at one-to-one rather than a representational model or drawing, the dialectic of thinking through making takes on a new role. This dialectic is fed by the relationship of the tool with the material. Working at one-to-one allows for material experiments to drive the rethinking of normative material readings and evolve the conception of design thinking.

## Notes


1 Sekler, Eduard F. "Structure, Construction, Tectonics." In Kepes, Gyorgy, Ed. *Structure in Art and in Science*, 1965. p 89-95.

2 Kennedy, Sheila. "Material Presence" in Grunenberg, Christoph, and Sheila Kennedy in *Material Misuse: Kennedy & Violich Architecture*. London: Architectural Association, 2000. p 12.

3 Allen, S. (2009). *Practice: Architecture, Technique + Representation*. London: Routledge. p 74.

4 Carpo, Mario. *The Alphabet and the Algorithm*. Cambridge, MA: MIT Press, 2011. p 125.

5 Belton, Stephen, and Huang, Lee Su. "A Negotiated Materiality: Allographic Practices with Autographic Effects" in *What's the Matter? Materiality and Materialism at the Age of Computation*, 2014. p 149-161.

6 Renzo Piano, "In Search of a Balance" in Process Architecture #700, 1992.

7 Pye, David. *The Nature and Art of Workmanship*. Cambridge: University Press, 1968. p 20.

8 Kolarevic, B & Klinger, KR. *Manufacturing Material Effects: Rethinking Design and Making in Architecture*. Routledge, New York, 2008. p. 121.

# Emerging D-Forms: A Journey from 2D Shapes to 3D Forms

Negar Kalantar and Alireza Borhani | Texas A& M University

## Introduction:

Currently, the most readily available digital fabrication tool in the school of architecture is the laser cutter. Laser cutting is a technology typically used to process flat material stock. Despite the wide-spread development and adoption of three-dimensional (3D) modelling software, the construction of complex surfaces requires advanced machinery capable of milling custom 3D features not available when using laser cutters alone. For architecture students, moving from 2D to 3D methods of fabrication often leads to higher manufacturing costs and a need to access more fabrication facilities.

In general, this paper introduces a method called D-form1 that allows complex surfaces with positive or negative Gaussian curvatures2 to be constructed from planar surfaces. By using simple cutting technology3, the D-form method facilitates the construction of geometrically complex structures at significantly lower costs by allowing for such surfaces to be cut from flat panels. Specifically, this paper illustrates how freshman architecture students at Texas A&M University were able to generate intricate three-dimensional forms from two-dimensional sheets, simply by using this method.

## 3D Forms from Two 2D Surfaces:

Encompassing the relationships of material and formal explorations with non-Euclidean geometry, the focus of this paper is the integration of geometry and material processes into a single studio project. This paper describes the exploration of D-forms and their use in addressing developable surfaces within the bounds imposed by material properties. When operating from a foundation of D-form geometry, joining the edges of two flat surfaces that have identical perimeter lengths can prompt a host of designs for a variety of new three-dimensional forms[4]. Different volumes arise depending upon where one chooses to begin connecting the two surfaces (figure 1).

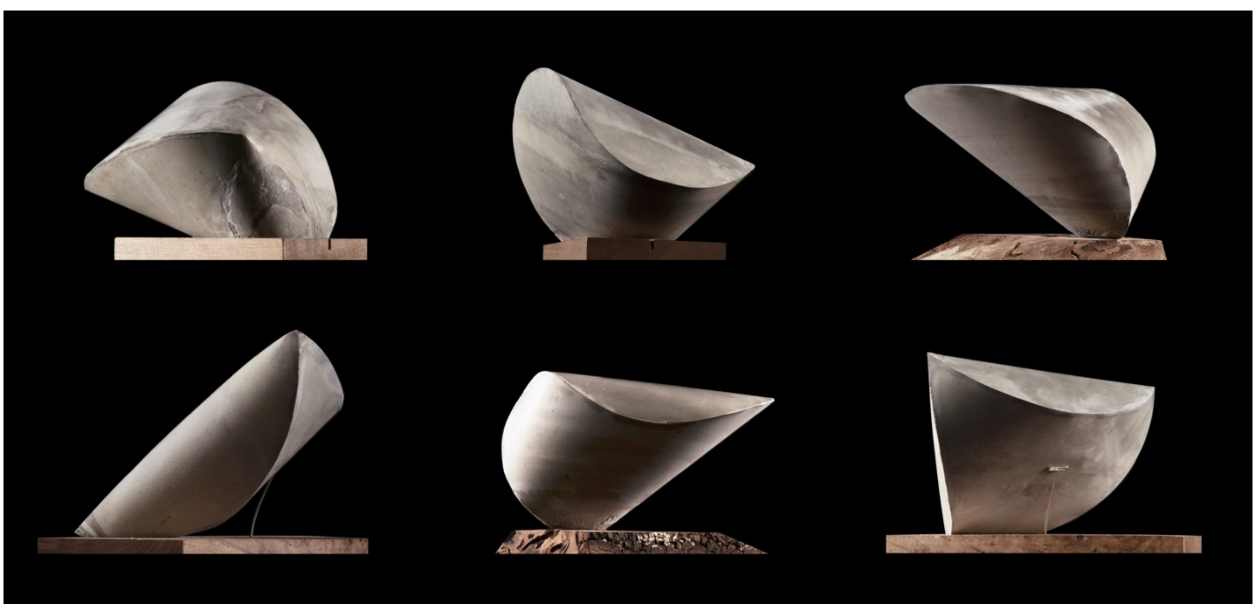


*Figure 1: D-form concrete sculpture: Making a range of form-works from two flat shapes with identical perimeter lengths (photograph by authors).*

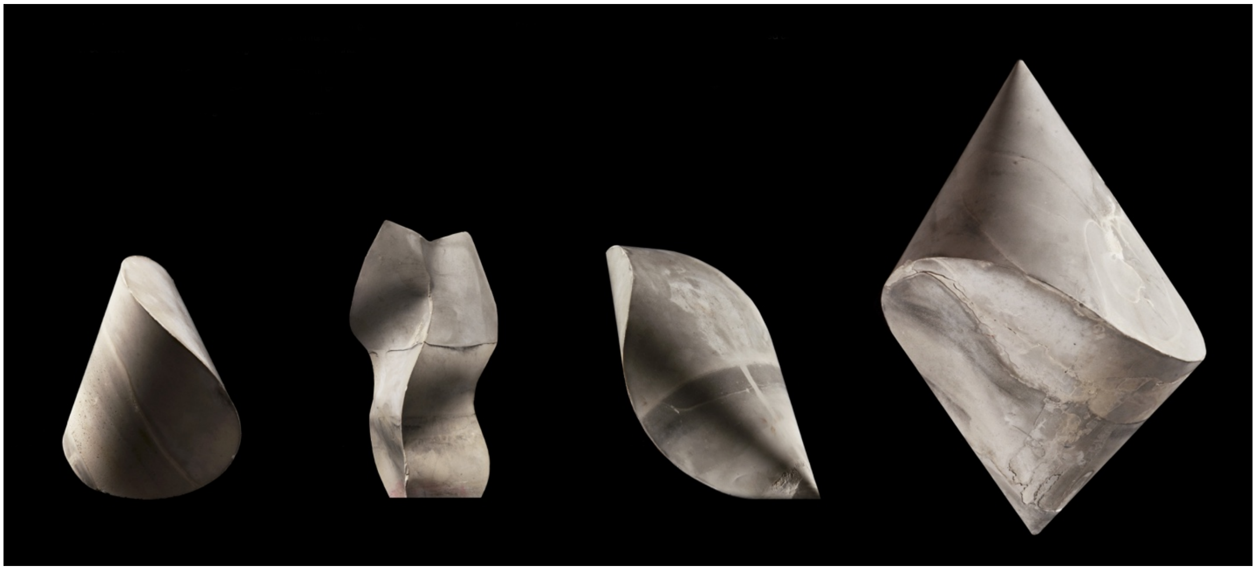


*Figure 2: By using D-forms as casts, freshman students built thought-provoking concrete sculptures (photograph by authors).*

As a means of creating a platform of competencies for beginning design students to draw upon when creatively portraying physical prototypes, the authors introduced D-form principles within the context of a foundational design studio in the Summer I semester of 2015. "D-form Explorations," the first assignment of this fast-paced semester, ran for only one week.

## Practical Possibilities of D-form Explorations:

By exploring the geometric complexities of the D-forms outside the bounds of Euclidean axioms and at the scale of the object, the assignment broadened the students' scale of focus to that of an architectural component; students were then able to move on to building subsequent design assignments.

Due to limitations in these beginning design students' fabrication knowledge, available tools, and materials, forms with planar faces were in demand. Generally, without using Computer-Aided Design[5] software, the real challenge for most of the students was determining how to convert a conceptual three-dimensional design into a series of flattened two-dimensional patterns so that they might then be used to build physical objects. This problem became more serious when the designs had compound curvatures that could not be easily flattened or unfolded.

Despite their simple construction procedure, the complex geometry of D-forms has not yet been fully mathematically[6] investigated. By forcing students to physically construct developable surfaces, the concept of the D-form helped them to design new forms, in a wide variety of materials, along many different scales, and within a multiplicity of contexts. By exploring the geometric complexities of D-forms outside the bounds of Euclidean axioms and on the scale of the particular object, the assignment broadened the students' scale of focus to the level of an architectural component; students were then able to move on to subsequent design assignments.

Here, students were given three design activities intended to expose them to the process of designing three-dimensional forms that could later be developed into planes. In the first two days, students engaged in an intense exploration of the possibilities

*Figure 3:D-form light fixtures: creating a constant dialogue between light, material, geometry and form (photograph by authors).*

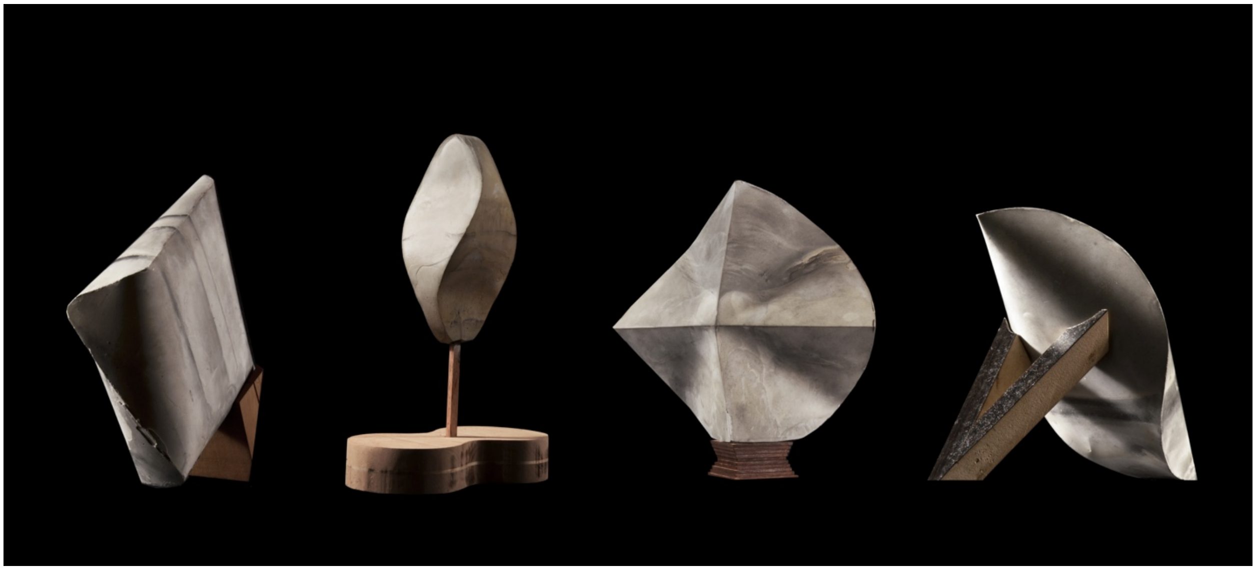


*Figure 4: D-form concrete sculptures with their bases: Building a concrete D-form that embodies the principles of developable surfaces begins with plane geometry and progresses to the three dimensional (photograph by author).*

offered by D-forms through multiple iterations of paper-based study models designed to cultivate a constant dialogue among materials, form, and geometry (Figure 5). Once they had completed their design charrette, students shifted their focus and worked for three days on designing a series of D-form light fixtures based on two 2D shapes cut from a non-elastic material (Figure 3). Finally, to best realize the students' D-form designs, concrete sculptures were cast. By speculating on the gravitational and hydrostatic forces of concrete objects in a liquid state, the last phase of this assignment honed students' ability to look closely at casting techniques (Figure 2). They were asked to design bases for their concrete pieces that retained a sense of the weight and mass inherent in the material (Figure 4).

Being bound by the geometry of the D-forms, the assignment sequence emphasized the mutual interactions among the formal characteristics and material processes, weaving together precision, jointure, detail, connection, and assembly. Armed with the empirical knowledge provided by the assignment, students were offered a wide playing field of possibilities for designing complex forms that would not have been possible without the use of D-forms. Under extreme time constraints and without a thorough knowledge of the digital modeling software, the students were challenged to transform their convex or concave surface outlines into thrilling objects that otherwise would have been difficult to build.

## A Developable Surface Fabrication Method with 2D Cutting:

For the first session of the studio, the authors gave the students a series of printed templates consisting of two shapes with the same perimeters. Students were then asked to generate a D-form by cutting the shapes out and joining their edges together using pieces of sticky tape. Students quickly discovered that it was essential to keep the width of tape small.

In a similar fashion, in order to make formworks for their D-form sculptures, some students traced the boundaries of their shapes

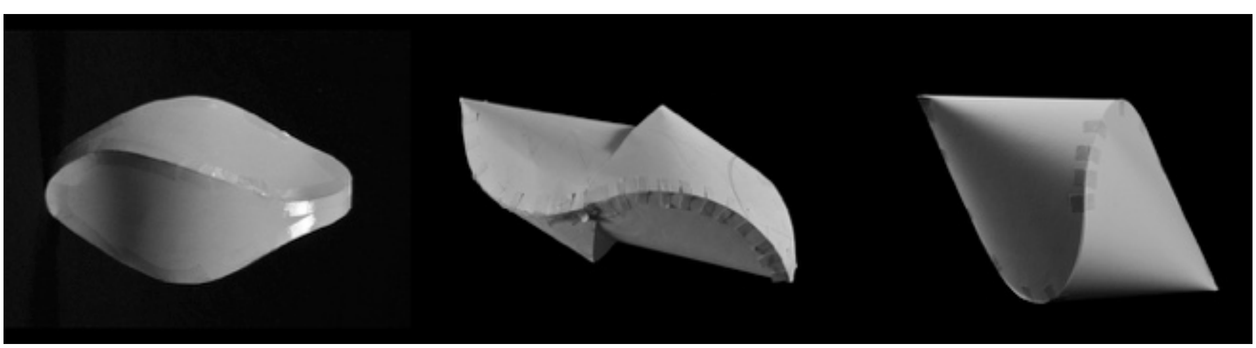


*Figure 5: D-forms exploration with paper: These D-forms are obtained by joining the boundaries of two flat shapes out of paper with the same perimeter (photograph by authors).*

*Figure 6: Combination of one circle and one square: to have the best result when a rounded shape (such as a circle) is joined to a polygonal shape with sharp corners (such as a square or triangle), the rounded shape should be creased (photograph by authors).*

onto thin, clear plastic sheets, or used laser cutters to directly cut their plastic sheets. Then, each student worked their way round the formwork until the edges of the two plastic pieces were joined together. A small part was left open for pouring in the Rockite[7] mix. It was necessary to connect the two pieces of the thin material so that they were edge-to-edge, so that the joints would be completely liquid-tight and properly sealed. Many aspects were considered in order to line up the perimeters of the two intricate boundaries and ensure the quality of the joints.

Students were invited to create the most aesthetically pleasing D-form sculptures possible; their designs were developed from a combination of concepts drawn from mathematics and various formal approaches. In these sculptures, the relationships among craftsmanship, originality, creativity, and spatial characteristics were also important considerations (figure 6).

For many, it was difficult to believe that all of the sculptures, with their various beautiful and pronounced curves and twists, were generated from only two pieces of planar material. By dealing with a heavy concrete mix that gradually changed from liquid to solid and utilizing formworks made from plastic sheets with very limited strength, elasticity, and stretchability, almost all of the sculptures evolved into rock-hard D-forms with no major wrinkles on their surfaces or other forms of defect (such as shrinkage cracks or blistering) (figure 8).

## Constructing a D-form:

Having shapes with identical perimeter lengths is essential to constructing a D-form. It was very challenging for students to determine if two shapes with different areas would have the same perimeter length. Nearly all of them were unable to calculate or even estimate the perimeter of an irregular shape made from curved lines. The simplest method was to lay a rope around the outline of the shape, and then measure the length

*Figure 7: A D-form light fixture was fabricated by two-dimensional sheets (photograph by authors).*

of that rope. Making larger or smaller D-forms required the measurement to be scaled.

Moreover, students could redraw the outlines of their shapes by manipulating the geometric parameters dominantly specifying the shapes' overall perimeter lengths, including the radius of a curve at any point along the shape's boundary, the distance between two points on that boundary, the number of corners, and the converging or diverging angles between two curves. Some students drew outline curves of their shapes in CAD software to determine perimeter length. To change the length of the existing boundary of their shape according to certain specified factors, points, or pre-set distances, students used different software-based strategies such as offsetting or scaling.

## Conclusion and Future Work:

Offered during the first week of a short summer semester, the D-form assignment included a diverse wealth of objects pertaining to different materials, fabrication methods, functions, and scales. In addition, working on D-forms provided beginner design students with the opportunity to dabble across various disciplines during their first year of undergraduate study, which helped them to become engaged with a new modality of research and practice that incorporated the fields of mathematics, engineering, computer science, art, and design (figure 9).

The principles of designing developable surfaces can be applied in many fields of work beyond those of architecture, such as ship-making, automobile design, and the clothing industry. For instance, for some of the large-scale curved shapes in airplanes and ships, the use developable surfaces can expedite both the manufacturing and assembly processes[8]. Since these surfaces can be manufactured inexpensively by using laser cutters on flat materials, the construction cost can be noticeably reduced.

D-form Explorations, as the first studio assignment, brought the power of geometry to the attention of these freshman students. Here, besides disseminating new knowledge about geometry, constructability, and materiality, this assignment helped students tap into and use their prior mathematical knowledge as they designed and made their D-forms. As expected, the geometrical knowledge and dexterity the students gained at the beginning of the semester were extended throughout the rest of the semester, positively informing their other assignments.

Perhaps what was most important was not so much the method that was offered, but rather the way that students internalized that method along their respective educational journeys; in turn, the process of becoming familiar with D-forms was less important than the understanding that the process generated. The D-form assignment drew students along on a journey, and did not simply point them to a destination. For instance, one of the lessons this assignment delivered was the possibility of making a range of volumes from a single pair of flat shapes. By moving from the simple to the more complex, more diverse volumes could be created (figure 7).

*Figure 8: A form-work was made from two identical flat shapes.*

As a step in framing the fascination, beauty, and power of geometry, the D-form assignment attempted to raise the question of how the principles of geometry in the beginning of a design studio could be properly practiced, and how those principles should be more effectively taught in order to further extend and solidify the freshman students' geometrical comprehension.

By embracing students' geometrical understanding and translating it into an opportunity for exploration, the authors hope in the future to construct one or two D-forms on a larger scale, with the help of the new software platform. Here, how students strive to transcend the boundaries of possibility will be the focus.

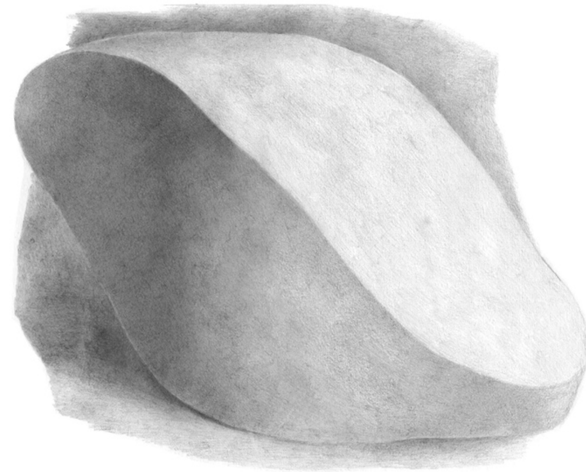


*Figure 9: As a relatively new form-making method applying geometric principles, D-forms engage the core notions of mathematics, engineering, design, and other allied fields (student work).*

## Acknowledgements:

The authors wish to present their special thanks to Dr. Ergun Akleman in the Department of Visualization at Texas A&M University. They would like to gratefully thank Dr. Dylan Shell in the Department of Computer Science and Engineering at Texas A&M University. The authors would also like to thank all the students who participated in the foundational design studio during the Summer I semester of 2015, especially the ones who put serious effort in producing high quality works.

[1] Helmut Pottmann and Johannes Wallner, Computational Line Geometry, Springer- Verlag, Berlin, 2001.

[2] "Gaussian curvature is an intrinsic property of a space independent of the coordinate system used to describe it." Retrieved from http://mathworld.wolfram.com/GaussianCurvature.html

[3] For instance, saws, laser-cutters, or 3-axis CNC routers.

[4] Tony Wills, D-Forms: 3D forms from two 2D sheets, Bridges: Mathematical Connections in Art, Music, and Science (2005), Reza Sarhangi and John Sharp, eds, London, pp. 503 –510.

[5] For example, both AutoCAD and Rhinoceros include commands for flattening 3D models. See the following: Flatten 3D model to 2D - Autodesk Knowledge Network: https://knowledge.autodesk.com/support/autocad/troubleshooting/caas/sfdcarticles/sfdcarticles/Flatten-3D-model-to-2D.html, and UnrollSrf | Rhino 3-D modeling - Robert McNeel & Associates: http://docs.mcneel.com/rhino/5/help/en-us/commands/unrollsrf.htm

[6] John Sharp, (2005). D-Forms and Developable Surfaces. In Bridges: Mathematical Connections between Art, Music and Science. (Reza Sarhangi & Robert V. Moody, Eds.).

[7] Rockite is a water-based structural anchoring compound.

[8] Gabriel Esquivel, Qing Xing, & Ergun Akleman, Twisted Developables, Proceedings of ISAMA 2011, Chicago, June 2011.

# The Ontology of the Aggregate

Sean Burns | Ball State University

“Sympathy, in my briefest definition, is what things feel when they shape each other.” - Lars Spuybroek [1]

## Introduction

Beginning design students often fall victim to an obsession with form and become enamored with the visual impacts the external form of an object may produce. Design exercises habitually demand a small-scaled model for study and presentation purposes; these models risk becoming objects of desire by which the success and appeal of the project is dominated by the appearance of an entity from a distant, unobtainable vantage point. Ultimately, this may result in the suppression of a focus on creating atmospheric conditions within the design, in turn, neglecting any reflection of how a person might respond to the created spaces offered by the design. Thus, too much responsibility and importance is frequently allocated to initial form creation prior to a student’s consideration of how a project’s design might be experienced.

This paper investigates how the student work of various 1:1 full-scale fabricated projects specifically utilize concepts of aggregation as a fundamental strategy to achieve the intended, embedded messages with a design. In each case study, the overall form or tectonic composition of the final design is emergent as students focus on an inward-out strategy as opposed to an outward-in design methodology. The external form is therefore informed, to varying degrees, by the configuration of the aggregated units and how the aggregates shape each other towards a discovery, interpretation, and translation of an experience by the end user.

## Discovering Form within the Design Process

Geoffrey Baker states, “Architectural form may be thought of as generic in its original state, and specific when the form assumes finality having been manipulated and organized to satisfy the functional demands of the program and the particular confines or opportunities presented by the site.”[2]

Often, educators of design studios ask students in the early stages of the design process to produce a series of parti diagrammatic sketches as a search for generic form that later is refined by forces and factors to become specific form. This approach invites students to quickly arrive at a determined form and explore its potentials through three-dimensional process models. While these small-scale study models are powerful tools to allow students the ability to visualize designed creations volumetrically, the benefits carry limitations that must be understood by the designer. Visualization of a designed project at a diminutive scale often is reduced to the overall appearance of the artifact’s form and does not translate to a comprehension of how a design might be experienced by its inhabitants. Further, perception is more than how a space or object is viewed from an intimate or distant vantage point and instead involves the infusion of multiple senses towards the creation of a memorable experience.[3]

Furthermore, if the purpose of creating forms, from a generic to specific state, is to designate and inform[4], as suggested by Bernhard Hoesli, could there be an effective preliminary process that influences the information before a designation is assigned?

### *Aggregation Techniques Towards Discovering Form*

Aggregation implies the repeated use of a singular or adapted unit as an assemblage of internal entities that inform the overall object. In this way, aggregation can be classified as an additive operation by which the component entities are configured to form a pattern-based system reliant on a set of imposed rules that often are predicted by the behavioral constraints of the aggregated units both individually and collectively. Patterns not only can provide order to chaos, they offer a degree of pliability and resiliency while remaining compositionally and systematically cohesive. The strengths and inherent flexibilities associated with patterns allow the system to differentiate, as it is capable of responding and adapting to introduced criteria, variables, demands, and desires. For Paul Anderson and David Salomon, a project beginning with patterns offers a process that takes advantage of pattern's potential multifunctional capabilities, "Instead of form following function, patterns produce performances."[5] These performances are played out through the interactions and discovered behavioral traits of the singular components towards the resultant pattern formation of the aggregated colonies.

Full-scale design exercises allow students to reconsider how a conceptual message might be translated through the holistic composition of elements and their tectonic relationships within the design. Emphasis on aggregation techniques in the initial design stages of a 1:1 full-scale project is useful as this approach allows students to pause and refocus their attention on a singular, repetitive, and adapted unit, disengaging their fixation on initial overall form generation. Using this strategy, the overall form is ultimately influenced by the use of the aggregate units and their proximity, interactions, and intrinsic behaviors relative to an overarching concept, allowing students to think systematically instead of primarily visually (Fig 1). For Gyorgy Kepes, "Patterns are the meeting points of actions." A perceptual shift in focus from isolated objects to an attention to systematic patterns offers a greater understanding of the active relationships and interactions between objects, as well as an insight into how the entity works within the composite whole.[6]

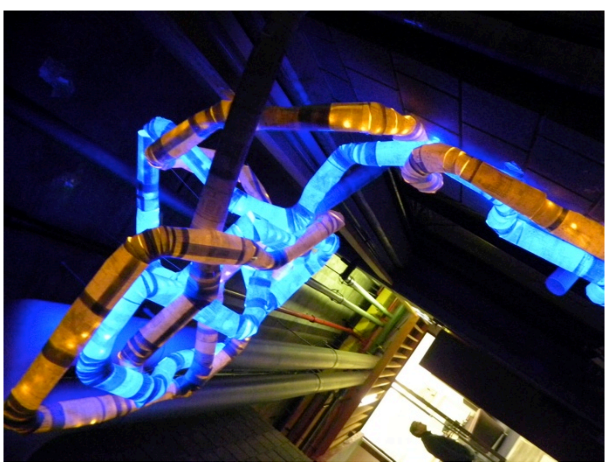


*Fig. 1. Student installation by Shannon Szabo and Aiden Dillingham using light-filled tubes clad in blueprints. These drawings' sizes and weight help to inform the movement and interaction of the main entangled light tubes.*

The following case studies are student projects that examine slightly different outcomes achieved by the introduction of an aggregation operation within the design process. It is the finding of the author that based upon the observed case studies, the use of aggregation operations as a design technique results in student projects that can be categorized as:

- **Form dependent** – The aggregation of elements become a focal point internally to achieve the desired effect and meet the project requirements, yet this system remains confined by the boundaries of a dictating form.

- **Form informed** – The project's overall form is emergent as it is significantly influenced by the information generated by the aggregated components.

- **Formless** – The aggregation of elements allows the project to be independent of any specific and determined overall form. Instead, the project's strength lies in the interaction and behavior of the individual aggregates and compositional whole to the degree that the choice of a form is insignificant.

The term formless is not to suggest a status of immateriality or absence of geometry. Instead, for this paper, the term formless closely aligns with Axel Kilian's perspectives of the formless as a procedural condition and as a design exploration beyond form. "The formless may be referred to as the replacement of direct manipulation of geometry with a procedural design process, in which the designer does not look for a single formal solution but instead reimagines the design as the current state of an evolving system of constraints, working through design discoveries made within this dynamic system." Kilian continues to state that, "Ultimately finding the formless means that form can no longer be the starting point of design."[7]

## Case Study 1: Form Dependent Project Using Aggregation Techniques

For a course entitled Narrative Furniture Design, students explored how concepts and methodologies of "narratology" might be integrated within the design and fabrication of an object. Students examined David Herman's four basic elements of narrative[8] as a means to understand what constitutes a narrative for discussion and analysis related to architecture. Each student expressed a chosen story, using narrative world-making strategies, to design a full-scale fabricated table. The tables encouraged the message of the narrative to be introduced for discovery and interpretation by the end user by how the table is comprehended and experienced as a functional object. This thematic criterion was intended to persuade students to consider various ways the design and fabrication of a 1:1 scaled object might tell a story based on strategies of form, structure, symbolism, functionality, and materiality. Most students began the design process exclusively sketching the form of the overall object.

Student Morganne Walker's design of a coffee table was inspired by the film *Cube* by Vincenzo Natali.[9] For Walker, the interpretation of the story centered on the individual and collective journey of the six characters attempting to escape a prison composed of cubic cells. The student's interpretation of the film had to acknowledge that little is revealed to the audience about the prison cube other than that it exists as a boundary element. Walker's early design sketches concentrated on exploring the paths of the six characters as they interacted with obstacles and ultimately were forced to reevaluate their positioning within the cube (Fig. 2).

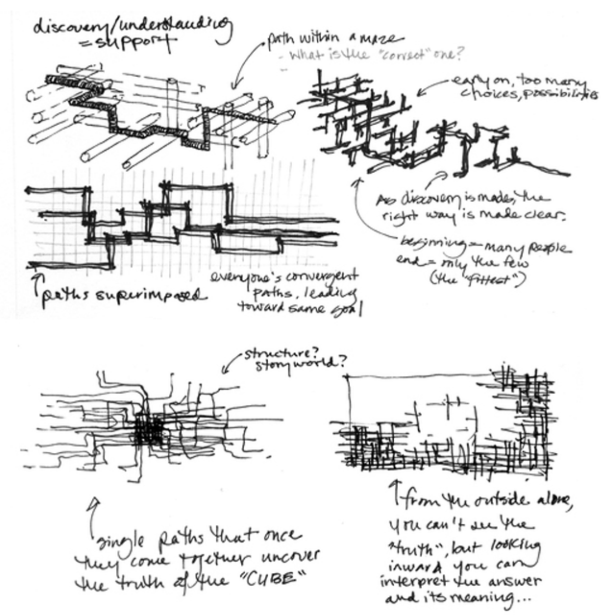



*Fig. 2. Initial conceptual sketches for table focused on journey of characters by Morganne Walker.*

An effort to aggregate an element throughout the composition of the table was made by the student in the very early stages of the design process. The experiential journey of the agents was valued as paramount in the narration of the story for the designed object. Small diameter iron pipes were chosen to express the characters' paths, and attempts were made to prescribe how the paths would weave as a sympathetic system throughout the composition of the table. The cube itself assumed a secondary role for the project and was later translated as a series of acrylic panels, spaced at even intervals, to serve as a backdrop for the iron pipes. The panes of acrylic established a demarcated volumetric boundary for the linear pathways of the entangled pipes, thus defining an overall form. When viewed from above, the stacked transparent acrylic panels created a visual cloudy atmosphere amidst the interpenetrating aggregate pipes, thus offering a level of ambiguity to the end user's interpretation for how the character paths progressed among the stages of the prison cube.

During the fabrication process of the 1:1 scaled object, the student discovered the predetermined multiple paths of the pipes could not be prescribed but instead were directed by the tolerance and behavior of the connections of the aggregate units to provide structure to the sequential acrylic planes (Fig 3). Consequently, each layered section informed the subsequent tiered level as the design was altered to accommodate the behavior of the system in the fabrication process. In summary, the final overall form of the table was accepted as a restricted rectangular volume that related to the human body as a functional object, while the tectonic composition, paths, and patterns of the aggregated units were emergent with the rules of the operation dependent on the constraints dictated by the limitations of the aggregate's material (Fig 4).

As commented by Walker, "As I discovered the scale, tolerances, and qualities of the materials, it allowed me to develop the table as a whole by understanding the process required to assemble it. In that way, the fabrication became an extension of the design process itself. The additive method in constructing the pipes' paths also allowed the final form to emerge with an appreciation and a knowledge of the tools used as a means for manipulating the object." [10]

*Fig. 3. Detail of aggregated pipe elements within interstitial spaces of acrylic planes.*

Fig. 4. Final design and fabrication of table by Morganne Walker

## Case Study 2: Form Informed Project Using Aggregation Techniques

First-year undergraduate students, in teams of two, were asked to design and fabricate a 1:1 installation with new spatial attributes for specific, existing, under-utilized spaces within the architecture building at Ball State University by exploring how human bodies might experience or occupy the revealed space. A stipulation existed that the installations must promote a multi-sensory experience while encouraging human interaction for users who traverse or occupy the realized space.

The student team of Ben Slightom and Catherine Hunley developed a conceptual strategy that examined how a portion of a large open space adjacent to an existing entryway to the building could be defined and specifically captured through the explicit and implied limits of an introduced boundary condition. The new boundary was designed to emanate from the existing control joints of the concrete flooring and lift vertically over the entranceway. The students determined the concept of a boundary and its proposed pathway in the initial stages of the design process.

For the boundary element, the students' intent was to celebrate the harsh qualities of material textures found within the existing space. To achieve this, an aggregated element was considered to represent the harsh textures along the boundary as well as to transform the boundary to an interactive surface that related to the user on a multi-sensory platform. The students selected coffee stirrers as aggregated elements that were paired in tandem with a steel mesh framework to represent the boundary element as a system. The coffee stirrers were embedded within the framework at the origin of the boundary and disengaged as a separate skin as the system proceeded to hover over the entrance to the building to represent how the harshness of the texture intensifies along the boundary's path (Fig 5, Fig 6). Here, the suspended aggregated elements fluttered in concert with the infiltrated air from the entranceway to emphasize the presence of air currents within the space and encourage this flow to be sensed tactually and visually.

For this case study project, the boundary path's trajectory was determined initially; yet, unlike in the previous case study, the confines and volume for the boundary remained flexible in their ability to be manipulated by the focal aggregated element. For this project the concept of the boundary, its point of origin, and its directional pathway were decisions that influenced the selection of an aggregate element through criteria that would allow for the specific behaviors along the boundary's trajectory to be achieved. In turn, the shape and material properties of the aggregated coffee stirrers suggested adjustments to the boundary's path and the manner that the aggregate engaged the accompanying framework to achieve a desired effect.

Fig. 5. Detailed area of final student installation by Ben Slightom and Catherine Hunley showing the use of aggregation strategies.

Fig. 6. Installation of aggregated coffee stirrer components as part of installation by Ben Slightom and Catherine Hunley.

## Case Study 3: Formless Project Using Aggregation Techniques

A student project entitled "The Inhabited Wall" by Kourtney Timmons questioned the lack of humanity in the current state of architecture with respect to place making and an emphasis on experience through human interaction. The project examined flocking intelligence as inspiration to explore the possibilities for architectural boundary conditions as a kinematic system that led to the design and fabrication of a 1:1 scale prototype (Fig 7).

For Timmons, the project was unconcerned with the overall form that was produced as the system was designed to offer flexibility in how it might be deployed to accommodate the needs of the user. An internal hierarchy was established within the design of an adaptable system based on the examined behaviors associated with flocking patterns. The units would slide to extend or retract along a primary axis and engage the adjacent secondary, and in turn tertiary, units to allow the barrier to be flexible in configuration, while assuming several functional responsibilities. This system was tested through several configurations in which each aggregated component was repeated and engaged the adjacent aggregated units. Ultimately, the student presented the project as several scenarios that suggested various functional capabilities of the system as opposed to a singular installed configuration (Fig 8).

This project represents an extreme condition in which the overall generic and specific form of a project is discounted, and the emphasis for the project is almost exclusively reliant on the process of aggregation used throughout the design and developmental process.

*Fig. 7. Fabricated prototype physical model by Kourtney Timmons.*

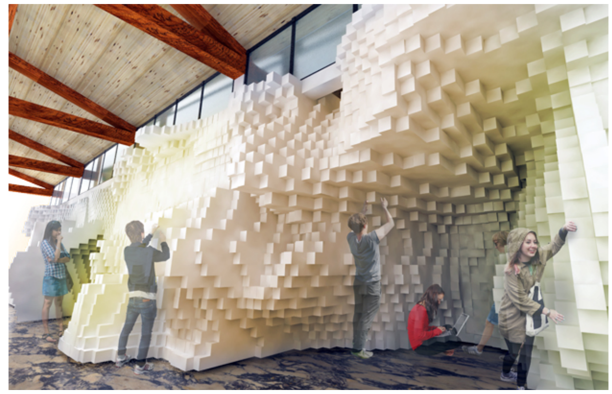


*Fig. 8. Rendering of scenario showing possible application of the aggregated system by Kourtney Timmons.*

## Conclusion and Findings:

Beginner design students such as Ben Slightom have found success with applying aggregation techniques in a variety of ways before, and at times towards, the establishment of specific form. Through observation by the author, it is noted that Slightom has continued to find these strategies helpful within the design process of subsequent projects (Fig 9).

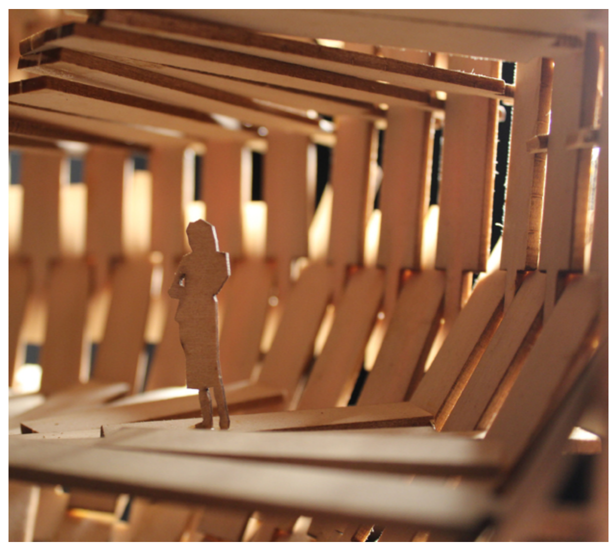


*Fig. 9. Subsequent project by Ben Slightom using aggregated components as an adaptable system.*

"The use of aggregation allows me to engage in holistic systems thinking that can be applied in a number of ways to create desired effects," Slightom says. "Doing so frees me from the concern of how a space should look and allows me to focus on how a space should feel. I find that aggregation allows me much more freedom to manipulate this sense of space than I could by using pre-dictated forms."[11]

The presented case studies examine variations of how systematic aggregation operations in the early stages of design might ultimately influence the form of a project as an alternative to the creation of preconceived, generic form at the outset. The introduction of this operational technique in the design process is not intended to disregard the impact that specific form might offer to the overall success of a project. Instead, the procedure is presented in this paper as an alternative to help beginner design students free themselves from the initial preoccupation of achieving a visually appealing form by reducing the scale of the project to the design of an aggregated object and allowing the student to discover the constraints and behaviors of the aggregate. It is the finding of this author that this procedure often leads to a realization and discovery of a generative form for the project in an emergent manner.

## Notes

[1] Spuybroek, Lars. “The Sympathy of Things, Ruskin and the Ecology of Design.” Rotterdam, The Netherlands: V2_ NAi Publishing. 2011. p 9.

[2] Baker, Geoffrey H. “Design Strategies in Architecture – An Approach to the Analysis of Form.” Abingdon, UK: Routledge. 1996. p 70

[3] Holl, Steven, Pallasmaa, Juhani, and Perez-Gomez, Alberto. “Questions of Perception.” - Phenomenology of Architecture.” Japan: A+U Publishing Co., LTD. 2008. p 30.

[4] Petit, Emmanuel, ed. “Transparent Form Organization.” *Reckoning with Colin Rowe: Ten Architects Take Position*” New York: Routledge. 2015. p 129.

[5] Anderson, Paul, and Salomon, David. “The Architecture of Patterns.” New York: W. W. Norton & Company, Inc. 2010. p 33.

[6] Kepes, Gyorgi. “The New Landscape in Art and Science.” Chicago: Paul Theobald and Co. Company. 1956. p 204-207, 226-231

[7] Ricciardi, Garrett and Rose, Julian. “Storefront for Art and Architecture Manifesto Series 01-Formless.” New York: Lars Müller Publishers. 2013. p 119-129.

[8] Herman, David. “Basic Elements of Narrative.” Chichester, UK: Wiley-Blackwell. 2009. p 9.

[9] Natali, V. (Director). (1997). Cube [Motion picture]. Canada: Trimark Pictures.

[10] Walker, Morganne. e-mail message to author. December 10, 2015

[11] Slightom, Ben. e-mail message to author. December 12, 2015

# ANALOG:DIGITAL

## The Digital Spine: A 1 x 1 strategy for integrating digital tools in foundation design studios

Ting Chin, Claudia Hernandez | New York City College of Technology

### Abstract

Architectural education today needs to foster the inherent conceptual and creative thought processes the profession demands but also knowledge of all of the tools that allow architects to create and produce their work. Over the last 25 years the number of digital tools used in the practice of architecture has increased exponentially. Incorporating these digital tools, together with analog ones still being taught in most undergraduate programs today, is overstretching already overloaded architectural curricula. This leaves us to consider how we maintain the quality of teaching as the quantity of content increases and the amount of time with students remains the same. Additionally the inclusion of these tools has not only impacted the content of curricula but has also propelled us to reexamine the classroom environment and transform the way we teach and communicate with students.

Undergraduate architecture curricula tend to engage both digital and analog tools in early exercises of visualization and representation. These tools are typically taught in separate skills based classes. Alternatively an innovative program called the Digital Spine, instituted in the Department of Architectural Technology, at the New York City College of Technology, incorporates the learning of digital tools, together with analog ones, into the design and technical studios.

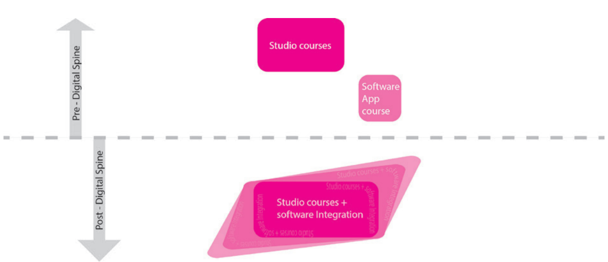



*Fig. 1 Diagram of the studio course curriculum before and after implementing Digital Spine*

The Digital Spine not only acts as a mechanism to teach software as needed during the design process but also encourages its use for rigorous iterative testing and developing a broader capacity to think critically and analytically when applied meaningfully. Additionally, strategies and models for teaching such as the inverted classroom and active learning methodologies have been introduced so that new content is not being forced into old models of teaching. Incorporating digital tools has brought further challenges such as preparing faculty to teach these new skills and developing mechanisms to support learning them while still allowing for a rigorous and well-rounded design education.

This paper will use the Digital Spine as a case study for how digital tools can be integrated with analog ones in foundation level design courses and debate the merits of each. During these formative years should there be a 1:1 relationship between digital and analog skills? Should they be reinforced equally? The representational media and technique one uses has a direct and lasting effect on architectural making and thinking.[1] How do these different tools each affect the teaching and learning of cognitive design thinking?

### Analog : Digital

Analogous to the world we live in architecture is becoming increasingly complex with higher expectations for building performance, construction, optimization and speed. This places a higher burden on students of architecture as they not only need to understand traditional notions of conceptualizing architecture through ideas about site, program and context but they must also be digitally fluent in computational design in order to develop rigorously tested design solutions based on performance, data and parameters. It is at the interface of both analog and digital mediums that architectural education lies today. In his essay "The Future that is Now," Stan Allen writes, "Clearly no single design direction dominates today, and while it is possible to map shifting intellectual agendas, the situation is not so much that one agenda supplants another as it is that one is layered over another, multiplying the possibilities and points of view." This multiplicity of outcomes and opportunities that students need to be exposed to shifts the relationship of analog and digital skills from 1 to1 (1:1) to 1 times 1 (1x1). The relationship between analog and digital skills is not exclusive but equal (1:1) but rather intertwined and symbiotic (1x1) leading to an ever increasing array of potentials and possibilities that need to be taught and learned.

*1x1 in Foundation Design Studios*

Although by the end of an architectural education most students are primarily working in digital media, if foundation level architecture students were to work solely on computers they would miss out on the tactile experience of creating architecture. Architecture is ultimately about the experience of a physical space that is reliant on the tangible forces of materiality, tactility, perception and tectonics. Without actually experiencing these qualities through physical model making, hand drawing and visiting architecture beginning design students are too far removed from the inherent nature of architecture. On the other hand students need to learn the digital tools used in the profession to be employable and to understand new ways of conceptualizing architecture based on digital processes. Many of these processes lead to outcomes that optimize buildings, construction and fabrication in innumerous ways but lack a concern for traditional notions of experience, site and context. The digital age continues to provide architecture with countless possibilities, and it is our challenge to explore and take advantage of these opportunities, but we must not sever our responsibility to the ultimate goal of thoughtfully crafting spaces that are physically realized and experienced. It is thus imperative that the beginning design student be exposed to the merits that both digital and analog tools and processes afford and offered the knowledge of how to evaluate, choose and apply the appropriate tools for apposite purposes. This leads to an untold combination of possibilities for how these skills can be taught and learned leading to a relationship of multiplicities, or a 1x1 relationship, between analog and digital skills.

## NYCCT

NYCCT has a history as part of the trade school movement that enveloped New York as a reaction to the industrial revolution. The development of trade schools in New York was seen as a way of integrating immigrants into the local workforce. This history is still relevant today as 42% of the enrolled students were born outside of the U.S., 58% come from households earning less than $30,000 per year and 80% of incoming freshmen receive need-based aid. Enrollment has seen a 48% growth in the last ten years demonstrating the need for an affordable education that is geared towards preparing students to enter the workforce. With reasonable tuition and a large enrollment capacity the Department of Architectural Technology at NYCCT is the most accessible architectural education in the New York City area. The program serves 700-800 students each year and offers both an Associate of Applied Science degree in Architectural Technology and a Bachelor of Technology.

The curriculum centers on a design education that is integrated with knowledge of the technology that is used in design and construction. Our design studios are coupled with building technology studios with each having the same number of credits and typically taken in tandem. In both studios students are expected to learn and understand the conceptual thinking behind the design and construction processes but also the tools used in them.

In 2011 the Department of Architectural Technology at NYCCT received a three-year NSF funded grant, entitled *Fuse Lab*, to rewrite, pilot and implement curriculum changes at the Associate Degree level to reflect, teach and support the technologies and software applications being used in the applied field. The objective was to equip students with the technical skills necessary to become viable candidates in the job market. One result of this grant was that in the period of a year the department went from having approximately 13 software applications available to the student body to over one hundred applications. It became instantly apparent that the department would not be able to provide courses to support all of these tools. In response to this a new strategy was developed called the *Digital Spine*. The Digital Spine was conceived of by the department as a way of integrating many of the newly available tools into the curriculum. This paper will discuss the process and outcomes of integrating the Digital Spine with the teaching and learning of analog skills in foundation level design studios.

## 1:1 OR 1 x 1

In order to devise a strategy for deploying the Digital Spine in foundation studio courses, we first had to establish an attitude and set of goals to help constrain its implementation. We began by asking the following two questions:

1. What is the role of the beginning design studio?

2. How can integrating software applications within the studios support this role without compromising the teaching and learning of analog tools?

To answer these questions we visited several institutions that offer degrees in architecture and related fields, studied their curricula and consulted with industry partners and our advisory board. Through this investigation we came to the conclusion that the role of a beginning design studio is to introduce foundational tools and processes that will support and inform a student's architectural education. Both analog and digital skills should be integrated into these early studios to expose students to a wide variety of methodologies and design strategies. Studios would be designed not to enforce a particular design methodology but rather to show students techniques for investigating design problems and communicating design solutions through a multiplicity approaches and media. The primary learning objective would be to prepare students with an array of tools and processes and the critical thinking skills necessary to discover their own individual approaches and explorations.

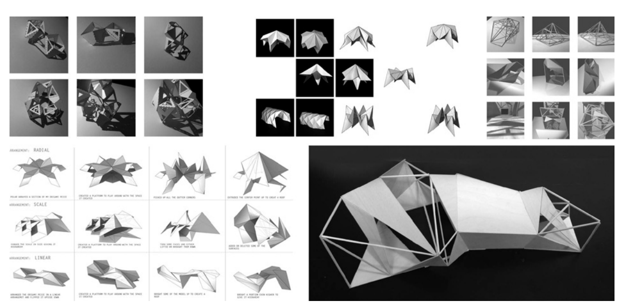
This attitude led to an exciting discovery in the development of the curriculum that as digital tools were woven into the assignments the relationship between analog and digital skills evolved from being 1:1 to 1x1. Initially there were two approaches towards adapting the digital tools in the design studios that each assumed a 1:1 relationship between analog and digital skills. Each set of skills was important and relevant but independent of the other. In the first approach digital tools were used strictly for documentation and generating output for final presentations. In the second approach digital tools were employed to investigate form-making. While the first approach does not take advantage of the iterative potentials of computational design, the second approach resulted in forms that were disconnected from ideas about spatiality, experience, tactility and context. This led us to believe that students had to be exposed to both approaches in order to develop rigorous design solutions that were based on the tangible qualities of program, user experience, scale and site while also optimizing the number of possibilities that could be explored. This resulted in a 1x1 approach that uses digital tools in tandem with analog ones to provide different lenses through which to generate and evaluate the potentials of a project's design strategy. It prepares students at the beginning of their design education to take into consideration and be opportunistic about the variety of approaches available to them. As Julio Bermudez states in his paper "Inquiring between Digital and Analog Media. Towards a Interfacial Praxis of Architecture,"

"Extremist approaches lack the necessary criticality, sensitivity and sophistication to tap into the opportunities that invariably exist in the space of betweenness. For it is in the gray areas where the dialectic processes unfold and new techniques, knowledge, and ideas first arise. It is also there where the true nature of the (seemingly) opposing ways of doing, thinking and communicating can be uncovered, grasped. The future thus is not ahead (in the digital) but between (the analog and the digital) . . ."

The dance between analog and digital skills is a means of testing and achieving complexity, possibility and project development, not complication.

## The Digital Spine: A 1x1 strategy

Most architectural curricula have a course, or courses, that focus solely on the learning of software applications. The Digital Spine instead incorporates the learning of software by teaching it within the design studio courses as it is applied to the design process. The students integrate the learning of digital tools, together with analog ones, by using them as needed during the design process. The intention of the Digital Spine is not to supplant analog tools but to generate a synergistic approach between learning analog and digital tools. As the new curriculum was launched at NYCCT we quickly recognized that in order to integrate both of these skill sets successfully it was essential for students to understand the underlining concepts behind the tools in order to establish baseline criteria for outlining the capabilities and inherent advantages of using one tool versus another. When highly digital approaches were tested the designs arrived at great formal complexity but students lacked an understanding of scale, tectonics, spatial relationships and proportion. Additionally, since the students did not possess the knowledge or dexterity necessary to manipulate the digital tools in order to achieve desired outcomes the approach became formulaic and the results, while seductive to the eye, were sculptural rather than architectural. For this reason as the courses continued to be refined, and in order to establish a symbiotic relationship between the analog and digital, a methodology or strategy for aiding the communication between the two languages had to be developed. We found that no matter whether we were asking students to design from a digital or an analog approach the commonality was that projects needed to establish rules, constraints and goals.



An example at NYCCT of how this 1x1 relationship is implemented in a foundations level studio project, where the oscillation between analog and digital tools is tested, is the Bridging Surfaces Project. In this assignment the primary elements for space and form making such as points, lines, surfaces and volumes, and basic design concepts such as balance, rhythm, repetition, proportion, order, symmetry/asymmetry and hierarchy are introduced as baseline criteria for establishing a common denominator between the digital and analog.

The students are asked to fold a series of basic origami shapes out of paper in order to transform a planar two-dimensional element into a three-dimensional form. After an array of shapes are tested and experimented with the students evaluate them and define systems of organization within them. They ask questions like: Can specific arrangements (i.e. linear, radial, cluster, etc.) be identified? Are there recognizable patterns? What are the operations that create spatial conditions and how are they controlled? Can the relationships between points, lines, surfaces and volumes be identified? Once a set of rules is outlined the students input the geometry into a 3D modeling program using a digitizing arm and begin creating iterations by establishing variables within the rules. The advantage of implementing this digital approach is it allows for a range of variations to be generated and tested very quickly. Once the variations have been produced the new geometries are laser cut and revisited through physical model-making where notions of structure, enclosure and assembly are tested. It is important to note that this exercise is not intended to be formal; its purpose is to help the student recognize the elements that create and imply space and form and how one makes decisions about manipulating them through both digital and analog tools. This process establishes controls and an understanding of how to oscillate between the tools. The exercise also introduces students to a rule based design process where geometries are understood and strategies for setting up controls and parameters are established. It requires an analytical rather than gestural approach to form generation while also providing tactics for editing, controlling and iterating the design to respond to an overarching idea. This framework is intended to aid the student in formulating a process where both analog and digital tools are implemented in order to develop design concepts that respond to project needs.

This process differs from the one described in the article, "*Selective Jamming: Digital Architectural Design in Foundations Courses,"* written by Stanislav Roudavki, in 2011, where a similar project is presented to a foundations studio at the University of Melbourne. Both projects begin by studying the transformation of a two-dimensional planar surface into a three-dimensional geometry through the act of folding. The pieces are then digitized, edited and fabricated. Where the two projects deviate is that in the University of Melbourne studies the entire geometry is a module that is deployed as a system, which has the ability to change in scale and proportion, generating beautiful sculptural objects. The assignment at NYCCT attempts to distil the geometry by establishing the variables that make up the module itself, while also studying notions of structure and enclosure with analog means. These differences endeavor to avoid the inherent seduction of complexity generated by the computational ability of the tool allowing the student to consider the why, and not only the what, and to move past a formal response and instead develop a design strategy with a conceptual premise.

## The challenges of adopting the 1x1 approach

The implementation of the Digital Spine has not occurred without its challenges. Increasing the amount of coursework has put pressure on professors to not only teach conceptual design thinking and representation but to also incorporate the new tools into the courses. For the professors whose design process does not incorporate digital tools this is a pedagogical problem and for those that do it is a problem of time. The Digital Spine was implemented without a change to the number of course credits and so has effectively increased the course content without increasing the number of contact hours. In order to realize this change a number of support mechanisms have had to emerge including the incorporation of inverted classrooms and the development of video tutorials, software primers, workshops, industry partnerships, software support inside and outside of the classroom and increased faculty training and coordination.

At NYCCT these support mechanisms have manifested themselves through the development of NYCCTfab, a computation and fabrication digital media assistance website that provides access to tutorials and primers created by students and faculty who have expertise with particular digital tools and the hiring and training of Digital Media Assistants who provide in-class support, one-on-one tutoring and weekly digital dexterity workshops. The intent of the Digital Spine was that the digital tools would be introduced in the studios as needed during the development of the design projects. To accomplish this digital tools are introduced in class, with support mechanisms in place outside of class, which are in alignment with the development of the projects.

The implementation of the Digital Spine has effectively increased the content being taught in the design studios. This affects both the time allotted to deliver content and puts a burden on the professor to know this additional, and sometimes new, material. In order to deliver the added content without compromising the quality of what is taught further measures have been put in place. Digital Media Assistants, who focus on the teaching of digital tools, are assigned to each design studio, teaching modules have been introduced by specialists in a particular software or design methodology and inverted classrooms are used where students are required to complete software tutorials outside of the classroom so that professors can focus on the teaching of conceptual design thinking rather than on technical tools.

### Conclusion

The relationship between analog and digital tools and processes is not separate but equal in a 1:1 relationship but rather intertwined and symbiotic in a 1x1 relationship leading to a multiplicity of opportunities and potentials that architecture students must contend with. With the implementation of the Digital Spine we have come to the realization that these tools should not be taught exclusively of each other but synergistically with each informing the student of different possibilities. In foundations studios it is our role as educators to expose students to the range of opportunities available to them and to teach the critical thinking skills necessary to investigate and evaluate these opportunities so that they may develop their own individual design agendas.

## Notes

[1] Bermudez, Julio. "Inquiring Between Digital & Analog Media: Towards an Interfacial Praxis of Architecture." *Proceedings of the 85th Annual Meeting of the ACSA: "Architecture, Material & Imagined*. 1997. p520-23. Print.

## Bibliography

Allen, Stan. "The Future That Is Now." *Places Journal*. Places Journal, Mar. 2012. Web. 30 Sept. 2015

Bermudez, Julio and Kevin Klinger, ed. Digital Technology & Architecture White Paper Submitted to the NAAB by ACADIA. 2003. Print.

Ching, Francis D. K. *Architecture: Form, Space, & Order*. Hoboken, NJ: John Wiley & Sons, 2007. Print.

Gross, M., and E. Do. "Integrating Digital Media in Design Studio: Six Paradigms. "*Proceedings of the ACSA*. 1999. p144-48. Print.

Oxman, Rivka. "Digital Architecture as a Challenge for Design Pedagogy: Theory, Knowledge, Models and Medium." *Design Studies 29.2*. 2008. p99-120. Print.

Paul, Annie Murphy. "Are College Lectures Unfair?" The New York Times. *The New York Times*, 12 Sept. 2015. Web. 05 Oct. 2015.

Roudavski, Stanislav. "Selective Jamming: Digital Architectural Design in Foundation Courses." *International Journal of Architectural Computing 9.4*. 2011. p437-62. Print.

# Striking a Balance: Integrating Tool Literacy and Critical Problem Solving in Digital Media Instruction

Daniel Eddie | Iowa State University

## Introduction

The topic of computational design instruction is an ever-evolving subject within academia. Integration of computational design with architectural education will continue to increase as applications are better understood through further academic studies. The existing models for the instructing computational thinking and digital comprehension involve computational cultures, full studio instruction, or lengthy curriculum scale integration. Most architectural institutions do not allocate adequate course hours to the instruction of digital media or computational tools. Often these courses are relegated as electives or secondary initiatives lacking critical design structure.

As architectural institutions look to the integration of computational design curricula, it is necessary to develop suggested paths of instruction and research. For those institutions where condensed or abbreviated courses are the only option, there are many pertinent factors related to instruction and curriculum integration. This includes criteria like: realistic expectations, prioritizing specific content, connection to fabrication and environmental performance, and how might design thinking be integrated into a "skills" course.

In Spring 2015, a digital media course structure was piloted at Iowa State University with the task of teaching the foundations of computational design and sensibility in a three credit elective. The primary objective of the course was striking a balance between teaching specific software literacy and moving beyond this to instructing a critical problem solving methodology then applied to student defined design problems. Through highly structured instruction labs, students with no previous experience with the tool *Grasshopper* were exposed to possibilities of computational design. *Grasshopper* is a graphic programming language that is integrated within Rhinoceros and is a platform to process or generate data through visual algorithms. This data can be visualized through the Rhinoceros interface in the form of 2D or 3D outputs.

Once essential levels of competency were achieved, the students were tasked with creating an individual project that could be assisted, automated, or optimized utilizing *Grasshopper*. The independent structure beyond basic competency allowed students to create their own design problems. Students had the opportunity to shape their learning experience through specific tool competency that related to the complexity of design decisions found in all design projects. The learned tools and methodologies were instructed for pragmatic means and not for creating a parametric vernacular devoid of functional and environmental considerations.

This paper describes the instruction methods, the impact of a condensed or abbreviated teaching approach, and the findings in student comprehension and perspective of the course. With the results of this study, schools will be aided in planning the instructional approach to teaching computational methodologies in beginning design education, specifically where condensed or abbreviated courses are needed.

## Course Organization

ARCH 436 is a digital media course offered annually in the Spring semester. It is preceded by ARCH 230; a Design Communications course that introduces design software to beginning design students. The ARCH 436 course description, "Special topics in design media applications,"[1] remains ambiguous as the course is intended to evolve in parallel with design disciplines and their expanding kit of digital tools. In previous iterations, under different instruction, the course had been utilized to briefly expose students to many tools. It eventually transitioned into a *Grasshopper*-only course with an emphasis on animation. Previous iterations had been structured as 60 minute labs, 3 days a week for the duration of

1 semester and utilized tutorial-only instruction disassociated with critical design thinking. In response to this pedagogy, a new course organization for computational design instruction was devised.

Prior to the start of the semester, a preliminary course schedule was put together dividing the 15 week semester into 3 phases of equal length. Each week was broken into (2) 90 minute computer lab sessions led by the instructor. The course content was designed to build upon itself starting with: Phase 1 - Beginning Competency, Phase 2 - Advanced Competency, and Phase 3 - Student Defined Project.

## Primary Objectives

*Tool Literacy and Critical Problem Solving*

As the course was previously taught, students attended tutorial-only instruction labs in which the learning experience was completely dependent on the instructor and the content limited to that prepared for each lecture.

In response to this learning experience the course structure was modified for the Spring 2015 session. Instruction still involved direct teaching involving tutorials, but in addition the labs utilized active learning where students engaged beyond solely following the instructor's directions.

This active learning involved open dialogue rather than lecturing so students could deeply understand and develop strategies on how to think instead of what to think. Ultimately the goal with this active environment was to teach students software literacy so they could script with relative independence. Due to the compressed nature of the course structure, students cannot gain complete mastery of their tool. However, similar to principles of language, students can develop from no proficiency (Phase 1) to working proficiency (Phase 3). By employing an active learning environment, students have the potential to achieve a level of comprehension beyond a tutorial-only instructional format.

Along with tool literacy, critical problem solving was a primary objective of the course. This was supported by instructor-led exercises of precedent analysis and reverse engineering. By leading students through the process of reconstructing existing precedents, they develop the ability to create and solve problems independently. This ability is tested as students apply their learned tools and critical problem solving methodologies in the student defined project.

*Design Thinking*

Parametricism, a term coined by Patrik Schumacher of Zaha Hadid Architects, refers to the contemporary architectural avant-garde style based upon the parametric paradigm.[2] It was the goal of the course to deviate from the purist foundations of Parametricism characterized by the often unnecessary displays of conspicuous complexity. Students that are taught parametric tools like *Grasshopper* need to learn more than a means to create style. Beginning design students are inexperienced and need to develop a strong understanding of why design decisions have been made or how they form with respect to design considerations. As it relates to architecture and building, Curtis B. Wayne explains the responsibility to address these considerations:

*If we do not make form that is beautiful because it performs a function of light, heat, cooling, and clean air; provides acoustic delight (isolation such that one does not hear one's neighbor's noise and scuffle) and of thermal, ergonomic and economic comfort - then we have shirked our responsibilities as the primary Integrators. And that is exactly what the 21st century architect's role must be.*[3]

By integrating design consideration into Grasshopper learning, students increase their understanding of the tool and its applicability beyond style generation. The significance of these parametric tools are their ability to compute, process, or optimize a collection of data which may or may not in turn be represented stylistically in geometric form. Student work produced in the class was inherently associated with Parametricism, but its foundation was rooted in critical problem solving of architectural design independent of stylistic boundaries.

*Resource Awareness, Availability & Sharing*

With available resources increasing with the maturity of *Grasshopper* pedagogy, supplementary materials are vast. Some are more useful than others, but a trusted cache of periodicals, videos, and scripts can be extremely helpful when developing all levels of comprehension. Even with a partially active learning environment, limiting the exposure and accessibility of resources to the window of class time does not benefit the students or instructor.

For the duration of the semester, course materials were documented on a class website curated by the instructor. The class website was created to assist student learning by providing means of accessing lab scripts/summaries, accessing course resources for development/referencing, and displaying student work through individual profiles that were updated throughout the semester.

As part of the course website documentation, content from each lab was uploaded at the end of the week. This content would include the *Grasshopper* script, a brief description of the script, and imagery of significant progress in the script geometry. The *Grasshopper* script itself was also organized into subgroups to break down the script in relation to dialog initiated prior to active scripting in labs.

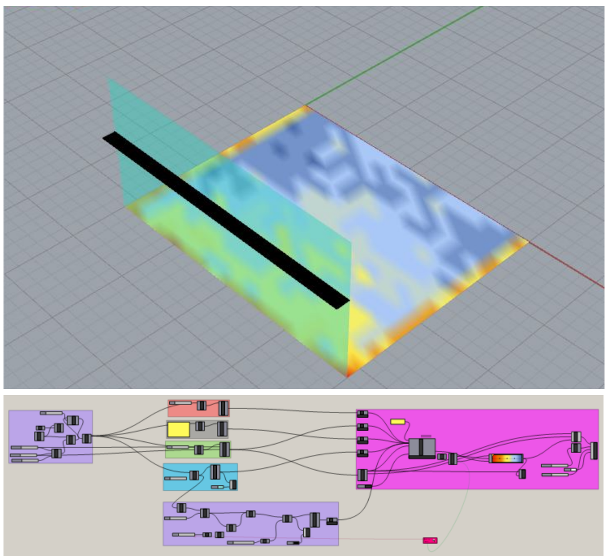


*Fig. 1: Example of lab image and subdivided script available on the course website for students to reference.*

*Measures of Success*

For the duration of the course, students did not receive progress grades. Initial communication with the students about grading stressed course success would be determined by their ability to exemplify professionalism by diligence in areas of the course that they could control. The course syllabus defines these areas in greater detail.[4] This was implemented so students would focus on the process and qualitative measures of their work rather than the instructor's quantitative evaluation.

During the course, students were actively engaged in an informal dialog between student and instructor on the breadth of their work. This dialogue culminated in a critical final grade assessment turned in by the students. Although the self-evaluations did not weigh in final grades, the ability to self-critique is considered a vital quality for students to develop and carry into their professional careers.

## Course Phasing

*Phase 1 (Weeks 1-5)*

For the first phase of the course students were briefly introduced to the concept of the course organization and *Grasshopper*. Students were then tasked with researching the *Grasshopper* tool and presenting their found interests and learning objectives for the course. With the addition of student input, a master lab schedule was formulated combining the goals of the course for all parties.

The purpose of this exercise was to balance ownership of the curriculum between students and instructor in Phase 1 and 2. Students should have a critical stake in their education. Partial ownership by the students engages them more fully in the class as the curriculum is specifically designed to include material of their interest.

After formulating an integrated schedule, instructional labs commenced with developing introductory level software competency through *Grasshopper* components and terminology. Once this foundation was laid, the labs grew in complexity through analysis and scripting of precedent projects.

These precedent projects embodied learning objectives outlined by students or the instructor and were analyzed during the first section of the lab. This analysis or reverse engineering process involved gaining a thorough understanding of the critical elements or tectonic makeup relative to digital modeling and physical construction. This activity assisted in development of critical query building by students prior to independent scripting.

After gaining adequate understanding of the precedents through an active learning process of overlay diagramming, written description, and verbal dialogue, the primary make-up was then scripted in *Grasshopper* and digitally modeled in Rhinoceros. The scripting and digital modeling was not intended to replicate the precedents, but the intent was to recreate the seminal gestures of the precedents related to the learning objectives of the lecture.

At the conclusion of Phase 1, students were able to complete basic scripts independently. Problem solving methodologies were developing well in analogue form, but students were limited in scripting by their understanding of *Grasshopper* terminology.

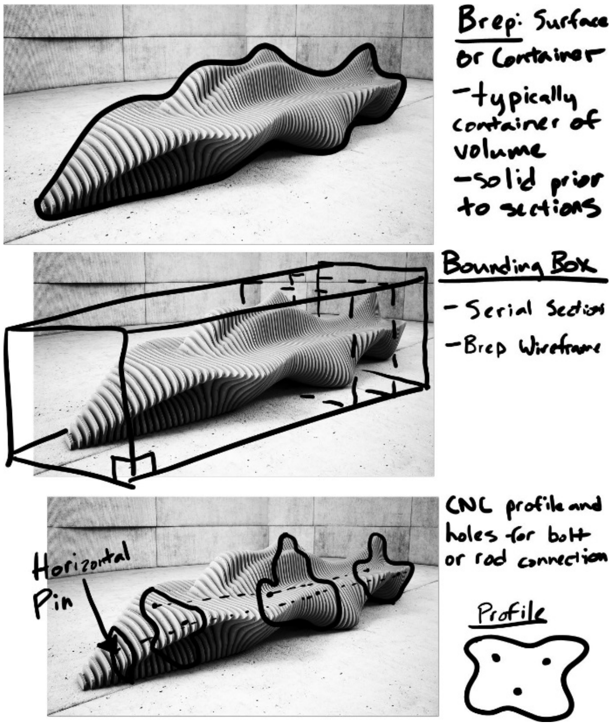



*Fig. 2: Example of overlay diagramming done prior to scripting*

***Phase 2 (Weeks 6-10)***

Before starting advanced competency lab instruction students completed research and developed proposals for their personal projects. These proposals were presented to their peers during class with relevant imagery and verbal description. Once proposals were established, students were instructed to continue developing their ideas and future deliverables outside of lab time. It was explicitly stated to students not to initiate personal project scripting or digital modeling until Phase 3. At this stage of the process student competency was premature, and it would have been counterproductive to begin complex independent scripting.

The periodic requirement of student presentations involving inspirations and proposals for the ultimate course deliverable was deemed important for the students integrated thought process. This increased the student awareness towards the short and long term goals of utilizing tools instructed within the labs.

Phase 2 built upon the instruction of Phase 1 through the addition of scripting complexity and exposure to the many plug-in tools that can be utilized in addition to the base functionality of *Grasshopper*. Plug-ins that were explored were *Rhinonest*, *Kangaroo*, *Karamba*, *Lunchbox*, *Weaverbird*, and *Diva* in conjunction with *Galapagos*. Each of these were explored briefly in context with the course's combined learning objectives. The exposure of these tools scratched the surface of their potential and allowed students to pursue further research and integration of the tools in Phase 3.

Along with the advancement of scripting skills, additional modes of representation were introduced in Phase 2. Students were exposed to the programs of *Sketchup*, *Adobe Photoshop*, *Autodesk Revit*, and *Cinema 4D* with the purpose of communicating possible extensions of the tool for different means of documentation.

The integration of these additional tools for representation was taught to ensure baseline presentation aesthetics for the work to be completed in Phase 3. With the varying experience levels of the students enrolled, it was important to attempt to level the playing field to reduce the variability in representation quality between students. A secondary goal of the course was to emphasize the representation of final projects for integration into their student portfolios.

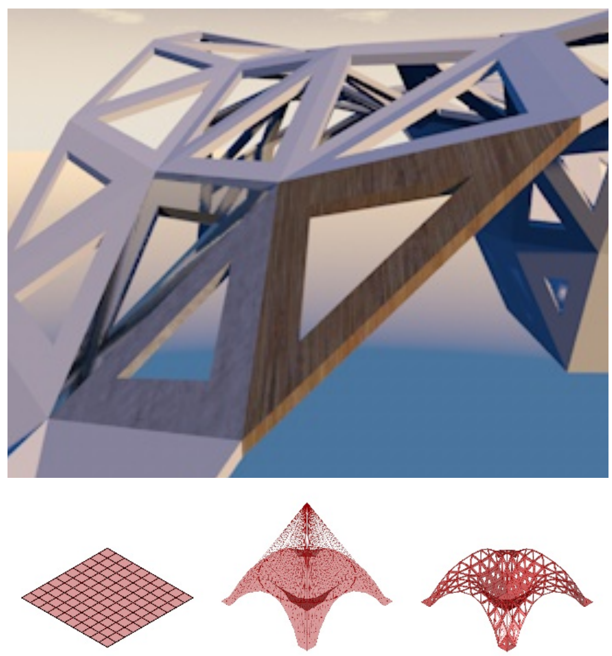


*Fig. 3: Cinema 4D rendering experimentation (Boyhun Chang), Grasshopper geometry of pavilion utilizing Kangaroo*

***Phase 3 (Weeks 11-15)***

The final phase began with student presentations detailing their final proposals for the personal projects. Final proposals communicated the project concept, tools to assist in execution, and potential deliverables for the end of semester presentation.

The course's independent nature gained strength in this final phase of the course. With no restrictions on the potential project output, students focused on their particular areas of interests. This individualized project extended the grasp of student ownership on the course learning objectives throughout the course.

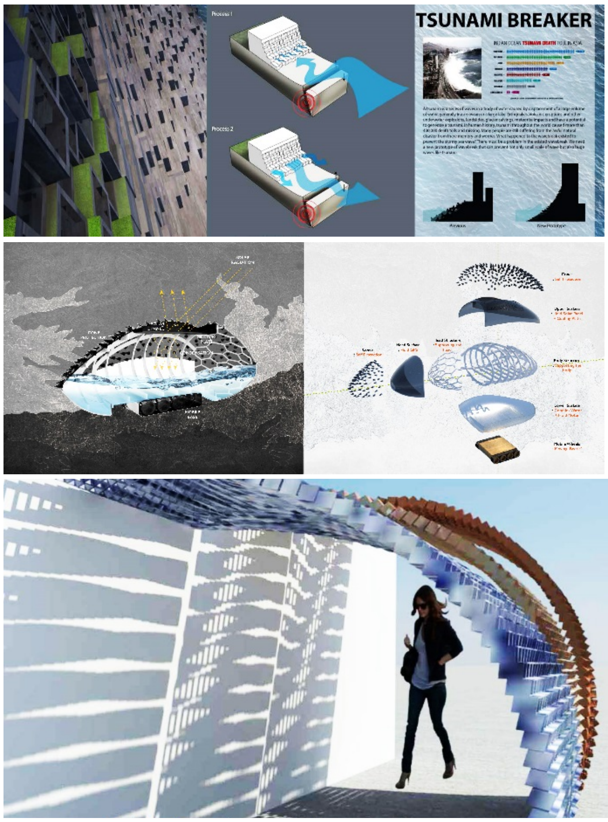



*Fig. 4: Tsunami Breaker: wave wall housing (Suk Lee), Desert Beetle: autonomous water collecting bot (Han Kwon), Multi-Rotational Partition: stone wall installation (Boyhun Chang)*

Taking skills learned during Phase 1 and Phase 2, students pushed themselves independently towards greater software literacy. To support this independent work, instruction transitioned to a desk critique format. Similar to a studio, each student met with the instructor once each course period having developed their scripts and projects to the point of being able to lead a focused conversation. Those students not meeting with the instructor continued their project research and development independently.

Many students thrived in this independent Phase 3 structure. They were able to work independently inside and outside of lab hours, but this independence was more difficult for some students. Some students required lengthy instructor desk meetings and additional critiques after lab hours.

## Integrated Assessment and Critique of the Course

### *Compression*

*Q: What are your thoughts on the organization of the course? Did the three phases of beginning tool instruction, advanced tool instruction, and independent research and design push you effectively in your course work?*

*A: I think it is essential to take the three phases. However, it is also kind of pushing it when three phases happens in one semester and is done. Either re-doing these phases every semester or extending the length of each phase and having multiple semester curriculum would be better. -Student Evaluation Response*

A computational design course of similar aspirations should be instructed through a series of integral curriculum courses. Even the slightly elongated structure of a studio has shown to make great impacts on computational literacy while instilling design principles. System Stalker Lab, taught by Maya Przybylski, has shown the ability to develop critical algorithmic or computational thinking through pseudocode and data parsing (quantitative) in a thoughtful design context (qualitative).[5] An elective course, if structured properly, has the potential to make positive impacts on students, but it is not the ideal format for students to reach high comprehension and content retention.

### *Content*

The introduction of additional plug-ins for *Grasshopper* in Phase 2 was beneficial for the sake of exposure, but reducing the scope of tools to only *Rhinonest*, *Diva*, and *Karamba* would allow for a more efficient use of lab time in the context of a compressed course format. It was evident these plug-ins were not fully understood or utilized by all students, only 5 out of 11 students utilized them on their final projects. Restricting the scope in this phase would help ensure comprehension of these plug-ins covering essential design principles of fabrication, environmental considerations, and structural analysis.

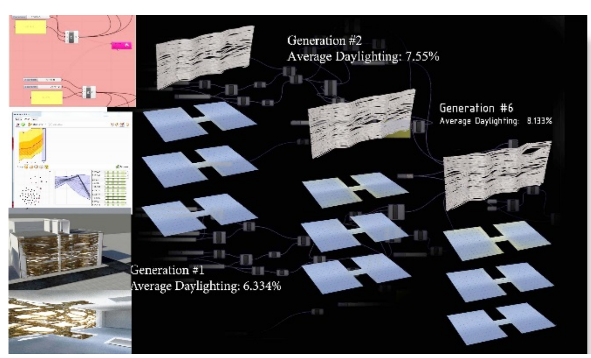



*Fig. 5: Bamboo façade, density based upon DIVA analysis (Shuaibu Kenchi)*

During the course, when some students were having difficulty keeping pace with the content and building retention, a small effort was put towards developing several "Brain Teasers" to help students relate native language to *Grasshopper* terminology. Relative to reverse engineering at a small scale and through a different lens, students were provided with a final product image, a series of terms describing the final product image, and a *Grasshopper* script with a disconnected grab-bag of components. Using deductive reasoning and a familiar but not yet concrete understanding of order of operations, students reconstructed the script to create the final product image.

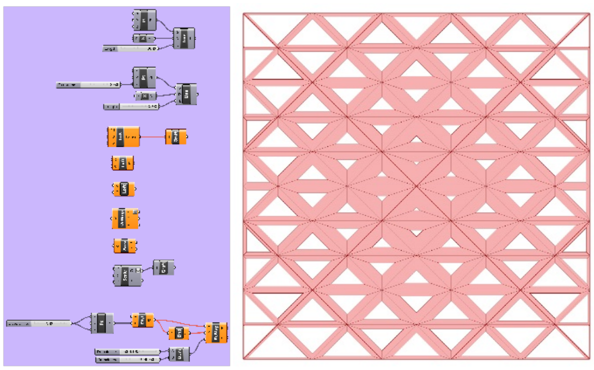


*Fig. 6: Triangle Panels: Attractor Point Script - Surface, Triangle Paneling 10 X 10, Remap Scale Based on Distance, Graft and Loft*

Several of these "Brain Teasers" were constructed for students to practice, and it was recommended by a number of students that there be more designated as homework and some for class session assignments.

### *Independent Structure*

For personal projects, many students completed their work without being hampered by their experience level. However, the vast spectrum of project types made it difficult to ensure universal comprehension of the analytic tools. While the tools were taught because of their applicability to design considerations, there was no guarantee of their utilization in each project. Each project should in theory address these considerations, but with a self-defined project in a compressed format, there is inherently a hierarchy or prioritization of tools. There is strength in allowing the projects to be a product beyond a partition, façade, or building. However, constraining the final project would be a productive means of ensuring and evaluating student literacy.

### *Resources*

*Q: How useful was the course website for you during the semester? Did you use it? If so how did you use it?*

*A: The course Website was useful since there were many resources that I could access for reference. I occasionally looked at other students work for understanding the pace and see just what others were interested in. Uploading the scripts and files on lecture basis was very useful; I could always go back opening the file, studying the scripts. I also used many other resources out on internet, so that I also used Youtube and Vimeo for plentiful of tutorials… In my opinion, I think it would be great if you keep the website and just keep add on next students works and script files so that it becomes a great library. -Student Course Evaluation*

In addition to lab material, links to *Youtube* pages and helpful websites were made available to students for reference material. Students were not required to study the website materials or other online student-centric learning tools. As a result these voluntary resources were underutilized and received a 76% usefulness mark in student evaluations. This mark suggests that there should be further enhancement of online resources and integration of the website in the lab structure should be required.

An integrated option may be supplementary materials paired with lab content and watched prior to the corresponding lab. During the lab, audio and video is recorded for follow up referencing in the first iteration, but it then becomes the pre-lecture content for future iterations of the course. This concept of self-sourcing video materials for future iterations allows repetition prior to the act of scripting, and it could replace part of the lab or provide more time for comprehensive dialog or active learning exercises.[6]

### *Course Performance and Evaluation*

Although 2$^{nd}$ year students completed less complex final project designs, their holistic effort and performance was high among their peers. As architecture students progress in their academic careers, their perceived value of elective courses diminishes in proportion to studio courses. Lower performance can be cause by many factors, but the elective bias appeared to be a factor in the relative performance of 3rd and 4th year architectural students enrolled in the course. The 5$^{th}$ year students were exemplary in their efforts and interest in the subject. For example, one of these students continued to work on their personal project beyond the spring session and created a full scale proof of concept.

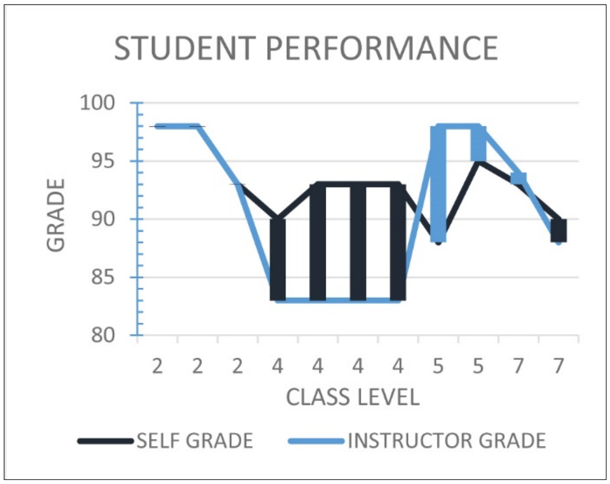



*Fig. 7: Graph detailing student grade level in relation to self and instructor class grades*

The sampling of 11 students for Spring 2015 is a small dataset for evaluating the course findings, and a larger dataset and supportive research is necessary to support the development of the ideas and findings stated.

*Conclusions*

The phasing of the course stages were successful in developing critical problem solving and literacy, but a compressed 3 credit elective is not an ideal condition for instruction of computational design. An ideal scenario would introduce students to the subject and have consistent reinforcement throughout their academic careers. To paraphrase Nick Senske, the objective of these types of introductory courses should not be to master a subject, but the goal should be to make students aware of a subject and to inspire them to want to learn more about the subject.[7]

Further iterations of this course structure to respond to these findings and implement new processes are needed, but at the time of writing the author/instructor is actively practicing architecture and is not conducting further iterations of the course.

Ultimately, these findings of a “skills” course aspire to provide insight for instructors and institutions as they look towards integrating this content into their curriculum. The course findings do not provide a solution to the problem of disassociation between tool literacy and design curriculum, but they are intended to be a link in the chain that connects digital comprehension and architectural education.

## Notes

1 IASTATE.edu. ISU ARCH Course Catalog. December 2015. <http://catalog.iastate.edu/azcourses/arch/>.

2 Schumacher, Patrik. “Parametricism as Style - Parametricist Manifesto.” PatrikSchumacher.com. 2008. Patrik Schumacher Writings - theorizing architecture. December 2015 <http://www.patrikschumacher.com/Texts/Parametricism%20as%20Style.htm>.

3 Wayne, Curtis B. The Shape of Things that Work. Lexington, KY: Curtis B. Wayne, 2013.

4 Eddie, Daniel. ARCH 436 Syllabus. January 2015. <http://danielthomaseddie.wix.com/arch-436>

5 See Przybylski, Maya. “Confronting Complexity: An Introduction By Way of Design Computation.” NCBDS 31 Proceedings. 2015

6 Senske, Nicholas. “Building a Better Computation Course: Achieving Student Success with Active Learning.” NCBDS31 Proceedings. 2015 (5)

7 Senske, Nicholas. “Rethinking the Computer Lab: an Inquiry-Based Methodology for Teaching Computational Skills.” NCBDS 29 Proceedings. 2013

## Figures

Fig. 2: Original Visualization by Soroko, Oleg. Murena Bench. “Parametric Furniture” Collection. <https://www.behance.net/gallery/18781883/MURENA-BENCH>

# A Lesson in the Education of a "Craftist": Modularity

Seher Erdoğan Ford | Temple University

*The author would like to thank and acknowledge Harris S. Ford, Miranda Mote and Teddy Slowik for their thoughtful contributions during the formulation and execution of the project discussed in this paper.*

## Introduction

Students lack an intentional grasp of materiality in early phases of design education.[1] Materiality, here, is defined as the set of specific and tangible properties that characterize the physicality of any substance. This struggle with substance turns into an anxiety regarding lack of control over the production process. One reason why students feel removed from materiality during the design process is the dominance of image and form in design pedagogy. This article is predicated on the proposition that a non-image based design process could, for students and makers in general, alleviate the lack of control and the sense of disconnect with the material results. It further argues that modularity as a design problem is one possible introduction to a methodical approach in design education not overly relying on preconceptions of image or form.

Guidelines for this alternative approach to making exist within a definition of craft often explored in literature originating not from within the design fields but from the social sciences. Disciplines such as sociology and anthropology have been able to engage productively in a discussion of craft unencumbered by the weight of style. What we can borrow from the theory on craft re-contextualized by non-makers is an aspect of workmanship—a positive notion of discipline, one that embodies a direct relationship to the object and exercises engagement, intelligence and resourcefulness: a "craftist" attitude.[2]

### *Background*

The course represented here is a skills-based introduction to Visual Literacy, required in the first semester of the Foundations program in Architecture at Temple's Tyler School of Art. In fact, the specific project originated at another institution where the group comprised architecture and industrial design students. At Temple, a comparable diversity among the Foundations group is present, before the students diverge into three separate tracks typically by the end of their second year: Design, Facilities Management and Historic Preservation. This mixed body of students, who will not necessarily all pursue design education at the undergraduate level, called for a reconsideration of how design thinking skills could support all students under a broader curriculum on the built environment. The course objective, then, is to deliver a practice-based methodology for solving and a desire to identify problems.

The specific project discussed in this paper is a modular screen wall built at full scale at designated "sites" in the students' studio space. Working in groups of three or four over the course of three weeks, the students design this assembly as their final project of the semester. In the past two iterations of the project, material palette was not limited, however in the most recent iteration the students were required to use corrugated cardboard and one other optional material. In terms of the functional program, the assignment calls for the screen wall to filter light during the day and act as a beacon of studio life at night. An overarching theme of the semester–that simple moves can yield complex results—culminates in and is visibly apparent in this project.

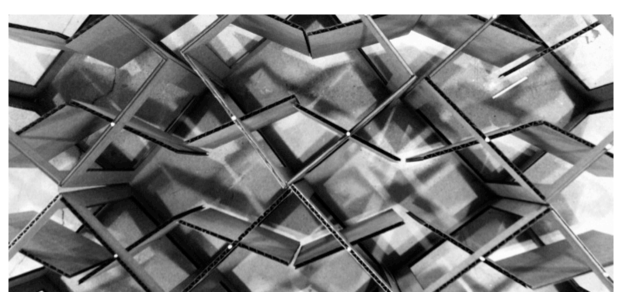


*Fig. 1 Detail view of model*

## Modular Thinking

Educators in the studio environment often observe that students may approach a problem with a pre-determined image or formal idea divorced from an informed understanding of the physical implications of their “vision.” This abstract and tenuous sense of knowing does not help the student in developing their design, and in fact may hinder, or at best, work against the formation of a good handle on the substances. This lack of concrete knowledge can yield anxiety over the production process. Students cannot answer the simple but powerful question of “What’s the next step?” because they cannot always clearly assess where they stand.

For practitioners, due to the nature of construction, opportunities to conduct 1:1 scale investigations come rarely or later in the architectural design process. For students, on the other hand, access to this scale of work earlier rather later in the design process would force an immediate confrontation with the physical realities of their intentions and may in fact provide them a better view of the whole picture. At this stage, empirical understanding of structural behavior in conjunction with haptic sensibility is invaluable – a lesson that can best be conveyed at full scale.

When developing strategies to address a given design problem -- in this case to build a modular screen wall that interacts with daylight -- a hands-on engagement with the physical material guides the development of the module. This sense of direction available to the student through working through the limits of the material – in this case cardboard--is constructive and helps him or her navigate a rigorous problem-solving process while allowing for moments of invention. [3] Much like the practitioner of a craft, as characterized by the sociologist Richard Sennett, students are able to follow the pragmatic sequence of operations to an extent where they attain a specific expertise of their own design, and once skilled, they may take small but agile leaps beyond this well-defined and self-guided route. In other words, the student starts by writing the code, consistently trouble-shoots, and ultimately “cracks” it. Given the scale of a module, the “code” may consist of decisions in terms of texture, color, orientation, porosity, geometry, or any other number of physical attributes. Upon investigating an additional material to introduce a play on texture, for example, one group of students discovered the opportunity to peel one layer of craft paper from the cardboard to showcase the folded planes of the corrugation.

Corrugated cardboard, as a material requirement, proves to be surprisingly productive because with time and careful examination students not only develop a better handle on the small but fundamental set of skills working with this particular sheet good, but they also discover the nuanced versatility of a cheap and arguably “bland” choice. The material constraint for a full-scale exploration eliminates the issue of discovering the “correct” material – in terms of finish or color, for example--and focuses students’ attention on the discipline of working with any substance in the *correct* way. This represents a way in which anthropologist Tim Ingold envisions making as a process of *growth*, during which the designer “joins forces” with the materials at hand “bringing them together, splitting them apart, synthesizing and distilling in anticipation of what might emerge.” Unlike the hylomorphic aspiration to impose an internal image in mind on to matter, the maker follows the flow of process working with the material. [4]

*Fig. 2 Final assembled model*

*Negotiation*

Modular thinking is just as much about a strategy for potentially infinite and complex growth patterns as it is about a deliberate focus on the simple unit. This strategy involves an approach to defining scales of growth and developing connection details that can ensure the object-scale resolution while facilitating variety. When designing their modules, students tend to move along two distinct directions as they begin to deploy their modular arrangements into structurally stable screens. In terms of vertical and horizontal aggregation, one tactic is to embrace the power of quantity and maximize the number of modules in an effort to take advantage of the unit’s versatility. While this arrangement may hide the regularity of the pattern, it achieves a complex spatial construction. Another tactic the students exploit is self-similarity. A modular design applied at multiple scales form fractal patterns, which yield a clear set of infinitely scalable operations and a robust visual pattern.

In both of these approaches, the module needs to address the task of establishing mechanical connections with its immediate neighbors as well as a cohesive integration with the larger pattern. For the purposes of this assignment, single module, independent of the assembly, is neither complete nor entirely resolved. Therefore, during this process, the relationship between the parts (module to module and module to pattern) takes priority over the execution of any individual thing. Refinement during the negotiation process becomes an essential aspect of the resultant state of the screen wall.

*Fig. 2 Detail view of final assembled model*

*Fig. 4 Detail view of model looking up*

*Invention*

During this discovery process, students establish this one fact immediately: a modular unit, alone, cannot address the design problem of controlling light.  While necessarily specific in terms of its construction and relationship to neighbors and/or to the next scale “up” of meta-module, the unit needs to remain a resilient component within a multiplying and thereby changing system. Most successful projects, in fact, leverage this aspect of dynamism as a transformative process within which the module may change function, appearance and, ultimately, its spatial affect. At the human scale, it performs as an *actor* in an ensemble, delivering multiple readings (or “showings”), almost to a point of self-negation.

As a lesson in material selection, students also discover the ironic notion that when implemented in a rigorous and methodical system, the “blandest” material can transform into another, and the simplest module can yield complexity.  As practitioners of their own methodology and experts of their design, the students are well equipped to take risks and employ creative “tweaks.”

## Assembly Logic

In the midst of the design process, students tend to hone in on one version of the module that is both adaptable and also able to meet certain critical requirements—evolutionarily speaking, this is the "origin" of an assembly. The two scales of thinking, object and architecture, overlap and exert conceptual pressure upon one another. While the logic of the assembly may be clear to the students, the "design" as a finished product is not. In this mode of thinking, the students have the buoyancy and the burden of not knowing what their screen wall is going to *look like*. It can indeed be an intellectual and even emotional burden for some, because the project is in flux and the production remains untethered--a frustrating state of ambiguity. However, this uncertainty also forces the students to trust their "intuition in action" and critically observe their work in the moment, against itself and not filtered through a pre-formulated idea of "the project." [5]

The design flow here suggests not a burst of inspiration or purely instinctual gesture but a practice of revising the work at multiple scales. The diagram for this sort of design would not be linear but a spiral of sorts, where students manage an "itinerant" process: a module deployed in an assembly, the assembly logic stipulating revisions on the module, the revised module in a revised assembly and so on... The trajectory of the spiral may at times drift further and further away from the point of origin of the "vision" for the project, and this is a healthy process of controlled development. [6]

Similar to modules, assembly of team members also shapes the process and thereby the final product. Much to the instinctual designer's dismay, the process is not about one person's vision, however clear or powerful it may seem, but a negotiation of ideas presented and "tested" at full scale through multiple iterations generated by group labor. One invaluable lesson students take from this type of collaborative and applied work, is that an idea is never "figured out" but merely carried to the next scale of resolution. This project allows the students to actually bring the design to full-scale fruition where there is no room for projection or quick assumptions—the confrontation is immediate.

Another, perhaps less urgent but critical aspect of group work, is the internalization by students that it is not the good idea but the good representation of a good idea that wins an argument where the goal is to get tangible and working results. As critics, we are biased as pedagogues and encourage students to show work that speaks their mind. What their peers can do is to actually exhibit the reality of a neutral environment where results do the talking. A parallel current pushing the design work along is assessment and editing. Students may collect a large set of design options, and have to devise ways to critically assess their group work. Of course, the editing is typically facilitated by or simply done by the studio critic. With group work, however, more formative critiques occur outside of actual studio time and amongst the team members. At first by mimicry of the line of questioning during "desk crits," later by independent thinking, students develop skills to probe each other's work. Another and perhaps a more complex round of negotiations happen between the requirements of the design brief, the group's collective aesthetic objectives for the project and the actual physical work they have at hand.

*Fig. 6 Detail view of connection detail*

## Presentation Mode

As students prepare for final presentations, having control over the project also feeds a nuanced kind of ownership--not only in a basic sense of possession but one that is founded on internalization. The screen is a result of a slowly practiced and calibrated process that involves critical design thinking at every phase. This is one understanding of craft, which embodies rigor and resilience, where rules and invention coexist.

This constructive sense of critical thinking comes through the verbal presentation at reviews as well. The anxiety of "what's next?" and the cumbersome preoccupation with " the correct answer" or "the critic's liking" is inherently replaced by confidence in methodology and excitement over discovery-through-process.

Remarkably, the students themselves are the shrewdest critics of this type of work; reflecting upon previous “turns” taken along the “spiral,” identifying the effective results, projecting on possible revisions that would improve the product at multiple scales. This clarity of vision stems from the fact that they are both integrally involved and safely distanced from the design—a result of the temporal space they gain away from the preconceived image of what the screen wall *should look like*. The students’ ability to view the process globally also gives them access to the understanding that, schedules permitting, a project may simply continue, hinting at the “fallacy of the finished artifact.” [7]

Operating in this mindset and with the background of a semester-long visual literacy course, the critics gently move aside to the role of facilitators. This is the immediate success of the project observed in the last three iterations applied at different institutions. The short-term measure is the nature of discussion during reviews to the extent that students “own” the conversation and expect an exchange of ideas rather than a “download” of comments.

While the design process for this project is heavily focused on physical models, the advancement of the beginner design student is visible in terms of drawing representation as well. Students communicate with each other through sketching, but the final drawings take on the function of “capturing” the state of screen wall at the time of the review. For example, exploded axonometric drawings describe connection methods at the modular scale, abstract collages convey registration of day lighting and orthographic projection drawings describes the geometries at the object and human scales. Students use these drawings as a vehicle to reflect on resultant affects and strengths through which they “see” their own projects for the first time.

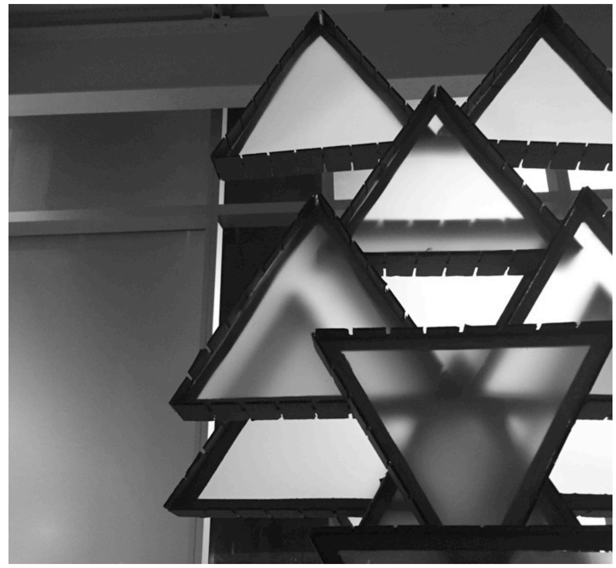


*Fig. 7 View of assembled screen at night*

## Conclusion

The modular screen wall project discussed here is representative of a pedagogical approach in the first semester of a Visual Literacy curriculum, before the students proceed with their introduction to digital studies. Within this framework, a project that emphasizes methodology and prioritizes establishing solid basis for any rigorous investigation through materiality is expected to serve the students well as they broaden their skillsets and tool-kits. A confident approach and practice-based problem solving would alleviate some anxiety when approaching and manipulating new and more complex technologies. Although not observed yet, the goal of the Foundations curriculum tested through this and other related projects is to build upon the craftist ethos and educate students who can conduct work and life with skill, striking a unique combination of rigor and resilience.

*Fig. 8 Photo of review day in studio*

## Notes

[1] Carlson-Reddig, Kelly. "Students Consider Architecture's Materiality." *Journal of Architectural Education (1984-)* 51.2 (1997): 96-104. *JSTOR [JSTOR]*. Web. 15 Sept.2015.

[2] Dormer, Peter, ed. *The Culture of Craft: status and future.* Manchester: Manchester University Press, 1997. Print.

[3] For discussions of craft from, respectively, sociological, historical and literary points of view, see Sennett, Richard. *The Craftsman.* New Haven: Yale University Press, 2008. Print; Heslop, T. A., "How strange the change from major to minor: hierarchies and medieval art." *The Culture of Craft:* Manchester University Press, 1997. Print; Betjemann, Peter, *Talking Shop: The Language of Craft in an Age of Consumption*. Charlottesville: University of Virginia, 2011. Print.

[4] Ingold, Tim. *Making: Anthropology, Archaeology, Art and Architecture.* Abingdon: Routledge, 2013. Print.

[5] Deleuze, Gilles and F. Guattari. *A Thousand Plateaus: Capitalism and Schizophrenia.* London: Continuum. 2004. Print

[6] Ingold, *Making,* 45.

[7] Deleuze, Gilles and F. Guattari. *A Thousand Plateaus,* 454.

# Frozen Form-Finding

Antonio Furgiuele, Whitney Moon | University of Wisconsin - Milwaukee

In recent years architectural education and practice have privileged form-finding methods as a means to propel both study and design.[1] Form-finding discourse within architecture allows for a different modality of exploration; to 'find' form through the study of physical and environmental force instead of using established disciplinary typologies or conventional cultural forms. The widespread accessibility and pervasive use of parametric software and fabrication technologies has ushered new interest in design literacy and experimentation in large-scaled 1:1 assemblies.[2]

Within the particular architectural discourse of form-finding, one model stands as a premiere form of study that directly engages both analog and virtual processes with environmental systems: Frozen Form-Finding.[3]

In the late 1950s, Heinz Isler a Swiss engineer and architect developed an experimental method to propel and challenge contemporary architectural pedagogy. During the winter of 1959, Isler created a series of form-finding experiments that utilized temperature shifts as a means to study, control, and advance the design of structural surfaces, yielding efficient forms, while using a minimum amount of material.[4] His 'ice shells' were first introduced to the academic community as a means to instantaneously and temporarily freeze and analyze thin-shell forms (fig. 1).[5] It allowed a fabric surface to be placed into tension, often 'upside down', modulated by the designer into a form, applied water, which was quickly absorbed into the fabric; allowed to freeze and once rigid, positioned 'right side up' converting forces into compression.

This method augmented knowledge from his previous studies of thin shell structures by instrumentalizing gravity to pull surfaces into efficient long span forms, making them rigid without the application of permanent materials (i.e., plaster or resin).

While Isler was able to advance this form-finding technique, his ice shells engage a deeper architectural history. The method of catenary study, well documented in other historical precedents from the 19th century, such as Antoni Gaudi's highly influential models of Sagrada Familia. Isler's contemporaries also engaged

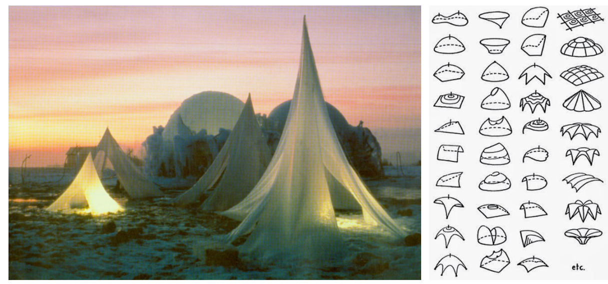


*Fig. 1 Heinz Isler, Ice Shells and iterations, 1959. Images: Heinz Isler, 'New Shapes for Shells', International Association for Shell and Spatial Structures (IASS), Madrid, 1959.*

this discourse, perhaps most importantly through the canonical work of Felix Candela and Frei Otto's form finding experiments of the 1960s. What was truly novel about the process introduced by Isler was that he tied this method of study of structural form and force, directly to a method to modulate surfaces through the control of temperature: the ability to 'freeze' form in place for a select amount of time. Whereas previous designers, including Gaudi and Otto, relied on drawing and photography to 'freeze' the structure into an image so it could be locked into place and further studied, Isler's method allowed the form to rigidly lock into place by tying its physical force (tension-compression) to environmental ones (thermodynamic). While this process allows forms to quickly become rigid, it also allows for a process of thawing, a control in temperature to enable other iterations of a single form; therefore allowing instantaneous and repeated control of temperature to be an active variable within the design process.

Since 1959, ice shell structures have been studied intermittently in architectural academia.[6] Often used as a form of didactic method of instruction, if offers a magical display of limp plastic surfaces becoming rigid structure: a design transformation from soft, absorptive, and pliable (surface in tension), to rigid and structural (surface in compression). Approximately 1/8" of ice absorbed into a surface, freezing in 30 seconds to 3 minutes (contingent of temperature and amount of material), the surface often translucent and glasslike in appearance, diffuses light and produces seductive luminous effects. The process of manipulating the form upside-down allows for a series of contingent variables to perform upon one anther: gravity, weight of the material (dead load), form (or shape), water, and environmental temperature. The final form is therefore an index of the process; a resultant of a series of material and environmental negotiations that are highly evident and controlled by the designer in relationship to the environment. Frozen Form Finding, as a didactic and exploratory method of structural forms has enormous potential for further exploration.

Within recent years the discourse of architectural form-finding has importantly been tied to the notion of parametricism, or the construction of form that is tied to a number of computational variables that directly influence the form and its subsequent iterations.[7] The increase in use of parametric software (i.e., rhino and grasshopper) has increased the value of physical-analogical models, as a method of study that can be manipulated in real-time.[8] Form-finding's increased value within architectural pedagogy can perhaps be best understood for its ability to allow for an intimate understanding of both the variables and instruments that establish form. Within paramtricism a series of tools of control and management are a direct reference to the physical world, most importantly the temperature commands of 'Freeze', 'Thaw', 'Bake'. These tools are also necessary technical concepts to make form stable during the process of design; a method to modulate individual moments (synchronic) with the process (diachronic).

The Frozen Form-Finding workshop, at the University of Wisconsin-Milwaukee School of Architecture and Urban Planning (SARUP), opens up the discourse of form-finding to more critically engage and explore this method of design. The annual workshop has three intertwined goals: to allow students an intimate understanding of how to open new potential within historical precedents and processes; second, to allow for a more critical understanding of this design method by framing the link between performance and environmental systems; lastly, to advance a workshop model to allow more speedy exchanges within the school between various architectural conversations.[9]

The workshop was structured to deliver a maximum impact on the discourse of the school. It allowed students and faculty a week of structural and methodological experimentation; made possible, as you might suspect, with some help from Wisconsin's beautifully sublime sub-zero temperatures.[10] The workshop was structured in two parts: the creation of an upper level team and what we conveniently called, "the Main Event", the workshop for the entire school. A group of upper level undergraduate and graduate students was first assembled. The faculty organizers provided them with a brief history of 19th-20th century form-finding experiments and thin shell structures; a brief discussion of the historical and material context, premiere precedents, and key challenges.[11] The team of 8 students formed into two groups; they experimented over the course of three days, created small prototypes, which culminated in two large scaled proposals (fig. 2, 6). The students developed a refined knowledge of the process and possibilities: techniques to manipulate the fabric so it would hold a minimum or maximum amount of water, by rolling or pleating surface edges; ways to hold the fabric into place by using strings and sewing; methods to apply water to expedite or slow down the freezing time by controlling the temperature of the water or selectively adding salt; techniques to stiffen the surface by making small concave and convex inflections, what was described as "functional ornament"; use of thermography to see how the ice was coagulating as a means to further control its thermodynamic exchanges with the environment (fig. 3). Central to the success for the main event, this group then became responsible for educating the rest of the school on their discoveries to facilitate and mature discourse.[12]

*Fig. 2 Process images, from tension to compression*

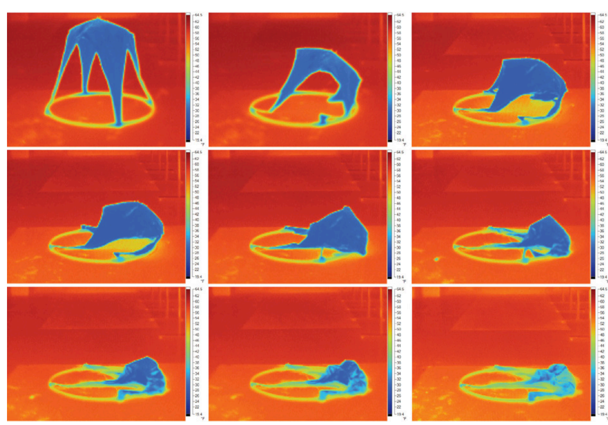


*Fig. 3 Thermographic time-lapse imagery. 45 minute analysis, test to failure.*

During our open session for the school, 25 first year undergraduate students participated in the Main Event. The upperclassman became mentors for these students, able to take advantage of the technical knowledge accumulated earlier in the week.[13] While the upperclassman constructed their large-scaled ice structures, they mentored other teams on their small-scaled forms. The main event lasted three hours and yielded six small-scaled ice structures and two supersized ones (figs. 4-6).

*Fig. 4 Process images, from tension to compression*

*Fig. 5 Small-scale ice structure details*

*Fig. 6 Large-scale ice structures*

**A Temporary Conclusion in the Form of a Future Agenda**

*On Process:* While most students are seduced by the possibility of creating highly provocative and sculpturally novel forms, the process of freezing, thawing, thinking, making, and remaking, should be foregrounded. The development of a single form should be explored through a series of iterations of repeated freezing - thawing - remaking: this would help students gain control over the contingent variables and heighten the instantaneous spontaneity integral to the process.

*On Formwork:* While most students used a single two-dimensional frame from which to suspend the fabric, modulate the form and develop the ice structure, other methods to secure the surface need be explored: use of inflatables, tent poles, and suspension members. The introduction of a specific formwork to individual teams would help the workshop gain exposure to the vital importance of this starting point.

*On Discourse:* As most students were unfamiliar with the precedents and key references. During the Main Event an image presentation of key form-finding precedents and thin shell structures were projected as a means to provide necessary references and heighten relationship to these discourses. The introduction of these architectural histories needs to be expanded upon to mature the level of experimentation.

*On Documentation:* Because Frozen-Form Finding heightens the awareness of the contingent variables of design, a method of documentation needs to more directly engage a form of temporality: time-lapse photography (image) and thermography (heat exchange) could be positioned to be central components of the project. This would allow students an analytical method from which to more critically understand the variables of Frozen Form-Finding.

Instead of drawing premature conclusions on a pedagogy very much in development, its best to offer up a ‘A Temporary Conclusion in the Form of a Future Agenda’; a series of necessary criticisms and conversations in which we hope to engage in the next iteration of this workshop.

## Notes

[1] Form-finding discourse within architectural study allows for a different modality of exploration and design; to 'find' form instead of the reliance of utilizing pre-established, disciplinary typologies, or conventional cultural forms. Form-finding as a discourse begins in the late 1950s-60s in tandem with other technical and disciplinary advancements in topology, cybernetics, and material sciences.

[2] This shift of production importantly allows the architect-designer to bypass the builder (woodworker, metal smith, contractor) and move from design to prototype to fabrication through the use of digital fabrication technologies.

[3] "Frozen-Form Finding" is the name given to this method. This name has been constructed by the authors to allow for a relationship to other historical methods championed in the 1950s-60s. Heinz Isler never used this term to refer to his 'ice shells' or 'ice structures'. Frei Otto popularized a series of methods and the term 'Form-Finding' in a series of publications. For more information refer to *Form Finding: Towards an Architecture of the Minimal,* Axel Menges, 1996.

[4] 'Thin shell structure' is the name of a structural typology that uses a minimal material surface, often classified as a form-rigid structure. While often described as a form with material and structural efficiency, the thin shell structures are rare since the labor required to construct the formwork make them cost prohibitive, and often obfuscate their political economies. Examples of these structures are often relegated to parts of the world where labor costs were low in 1950s-60s.

[5] The first public presentation of this work by Heinz Isler was the following: Heinz Isler, 'New Shapes for Shells', International Association for Shell and Spatial Structures (IASS), Madrid, 1959. A subsequent paper that describes 'ice-shell' structures, was presented by H. Isler at the IASS, Structural Morphology Group Colloquium, held at the University of Nottingham (1996).

[6] One example of a sustained investigation of ice shell structures within academia includes the 'Frozen Forces' course by Professor Caitlin Mueller at MIT, director of the Digital Structures Research Group. Her course during the MIT winter session, is a multi-week investigation of this structural type, which is open to any student or faculty member at MIT.

[7] For a recent discussion about parametricism and its relationship to form-find refer to the following:
"PARAMETRICISM". *www.parametricism.agency/*. ArchAgenda. 25 December 2015.

[8] Real-time, colloquially, refers to time that is mediated through an electronic, digital or virtual technology.

[9] Form-Finding Workshop, co-developed for the University of Wisconsin-Milwaukee, School of Architecture and Urban Planning (SARUP) by Antonio Furgiuele and Whitney Moon. Other faculty members who contributed to the discussion and added to the discourse: Michael Utzinger, Filip Tejchman, Karl Wallick, Sarah Keogh, and James Wasley.

[10] Average temperatures in Milwaukee for January range from 28-12 degrees and February from 33-19 degrees Fahrenheit.

[11] Important to note that while the Professors Antonio Furgiuele and Whitney Moon had studied form-finding and ice shell structures, they had only once constructed a small-scaled model using this methodology. The students' work was the first direct exposure to this process.

[12] Some important discoveries included: best techniques to adhere, fabric to a frame; techniques to manipulate the fabric so it would hold a minimal or maximum amount of water, by rolling the edges; ways to hold the fabric into place by using strings, sewing; best methods to apply water to expedite or slow down the freezing time, controlling of the temperature of the water; ways to stiffen the surface by making small concave and convex inflections; use of thermography imagery to see how the ice was coagulating and control its thermodynamic exchanges with the environment.

[13] The Frozen-Form Finding workshop occurred on February 27th (2015) from 6-8pm, at the University of Wisconsin-Milwaukee, School of Architecture and Urban Planning. The second workshop is scheduled for the week of February 4th, 2016.

# Embracing Naïveté: Taxonomy, Joint and Surface

Matthew Hall | Auburn University

## Premise

The ultimate goal for architecture is scale 1:1. The space of the site may be actual or theoretical, but ultimately our designs come into existence relative to the measurable: a hand, a body, a material, a representational medium, or a tool. The design student makes jumps in scale based on a desire for space or form, while the the professional balances the personal context desire against the constraints of reality in the form of external forces. This often results in a conflict between compositional, technical and contextual imperatives that is accepted as an inherent dilemma within our profession. Facing the issues of a complex constructed reality in the beginning design studio is rarely the aim of the academy; rather the education of a young architect often begins with play through composition and formal exploits. Later, the realities of material dimension, performance and contextual forces factor in which simultaneously enable and limit. This project's intent is to push these material realities and the discourse they facilitate to the forefront; a material basis for form versus a compositional one.

At The Auburn University School of Architecture, Materials and Methods courses span the entire second year. The benefit is that material issues are introduced early, but conversely, the students are naïve to the technical issues the courses must ultimately embody. Rather than treating this as a limitation, the beginners' status is harnessed to tackle directed design-build projects in 1:1. These projects take advantage of a lack of skill transplanting the prerequisite ideas of abstract representation and form making to the real artifact. The goal of the course sequence is to present a series of assignments that balance the development of a critical agenda with the "build first, ask technical questions later" mentality of the *bricoleur;* a precise mix of ad-hoc speed and theoretical consequence with clear and objectively measurable performance criteria. These 1:1 experiments can then be dissected and expanded upon in the context of real precedent and the technics of material performance and capacities covered in the second course of the sequence.

The agenda of the course sequence operates on the premise that material acts as the architect's media and methods are the complex and varied performance criteria that mediate. The projects presented for discussion tackle three related topics and build upon their respective results. The first; *Taxonomy,* involves a detailed compilation of material characteristics in the form of technical data, dimensions, proportions and capabilities. The second; *Tectonics*, borrows materials from the Taxonomy to fabricate joints based on provided performance criteria. The final assignment; *Surface*, builds from the previous projects to create a contextual skin and framework in-situ. All projects have precise goals dictated by the materials deployed and the methods chosen. Combined with a set of given rules and the judgment of the designers, this becomes an exercise in the communicated intent through precise design language.

How the architect decides and expresses intent is directly measured by a culture's ability to interpret and react; a feedback loop for design that inevitably determines success or failure for a work of architecture. The projects were run concurrently with the second year design studio project where structure and facade are points of focus. These two fundamental architectural systems are abstracted through the Tectonics and Surface projects, allowing for the leap to be made between the representational studio project at 1/8"=1' and the 1:1 exercises as informants for design choices and constant jumps in scale both tangibly and conceptually.

## Taxonomy

In an age where the master builder role gives way to the master selector, the architect is tasked with choosing from a seemingly endless array of potential materials. From the readymade materials of American construction to the high-tech prefabricated facade systems, decision making criteria are as numerous as potential materials. To the beginning student, the aim and result of their work is to produce a representation. They have a de facto list of materials from which to build from: chipboard, foam core, basswood, etc. Rarely do they stray from this pallet unless forced to "play" with something new or develop the mindset that materials have meaning and both quantifiable and experiential performance. Selection need not be immediately limited by what is at hand. It is a constant challenge to transform the expected and default choice to an intentional selection exploiting the fact that model building materials are abstractions with partners in the real world. Getting hands on a 2x4 rather than a bass wood stick is a good start.

For the purpose of this assignment, we began with the so-called "Pop-materials;" the Home Depot specials that make up the standardized kit of parts for most American construction. The students' study of material went beyond the tangible to initiate a discourse on the historical events and cultural values that necessitated standardization, resulting in a select group of materials to be crowned as our status-quo kit of parts. We hope that our students will have the opportunity to work with more, but accept that they will work with no less. The critical question is what can we accomplish with what we have?

## Tectonics

Project two investigates the myriad of operations and decisions that inform and dictate joints between materials. The term tectonics has multiple connotations. It often refers to lightweight, post and beam construction, contrasting with the stereotomic, which is heavy and of the earth. More importantly the theory behind the term suggests that the connections between materials have a capacity for language. The methods in which materials come together have the potential to speak about their context and the hands and tools that joined them. This project investigates combinations of materials from the Taxonomy driven by a set of assigned criteria set up to complicate decision making and hone judgment. The fabrications then serve as fodder for a discourse on language prompting such questions as: can the joint be clearly read, and how does the interpretation of the work differ from the designer's intent? The resulting work demonstrates how a different context and/or conceptual idea can vary the way materials interact while providing a venue for discussing architectural language (and of course the language for speaking about architecture.)

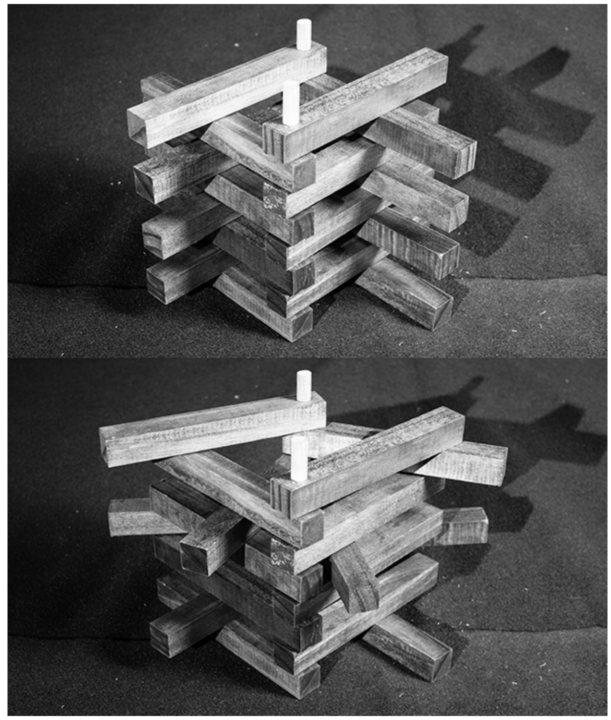


*Fig. 1 Aggregated and transformable joint*

Students were asked to design various material collisions based on strict performance criteria from economy and tradition to complexity, metaphor and mystery. There were five joint types assigned for exploration:

**1. efficient:** Create a combination of materials that is the most efficient in terms of time and thought. This is the ad-hoc approach, that of the *bricoleur* who's only aim is to get it done and get it done quick. Use at least two different materials with any fasteners of your choice.

**2. honest:** Create a combination of materials that speaks to their nature with a clear and honest method of joinery; no tricks but a pure expression of the material at hand. Use one material. There are no restrictions on fasteners.

**3. total/pure:** Create a combination that joins one of your material types in the most *total* way in an effort to make them read as one. Consider the premise: if one piece is removed, it all falls apart conceptually. This is the only fabrication type that should have no fasteners.

**4. aggregated:** Create a combination that is made of many smaller parts. Break your given materials down into a system of related parts to then reassemble them in a new way. Use at least two different materials.

**5. Joint emphasized:** Create a combination that celebrates and emphasizes the joint utilizing another material as a mediator, connector or buffer.

*Fig. 2 Total, honest or both?*

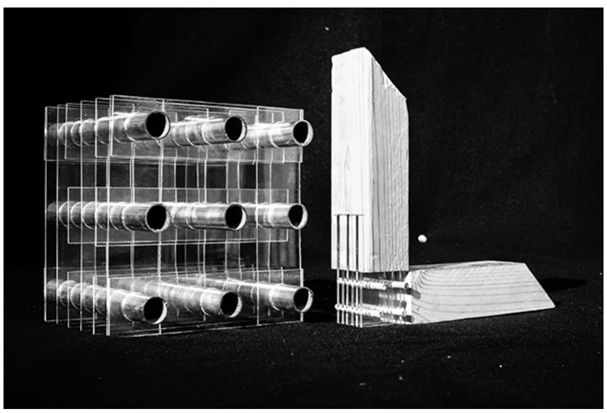


*Fig. 3 Emphasis on repetition, or repetitive concentrated parts to celebrate/mediate the connection between elements*

Joint 1 acted as the control. As we well know, the young designer procrastinates due to indecisiveness, operating in ad-hoc fashion by default. Including one quick and obvious joining method allowed for an intentional status-quo that forced contrast with the other assigned fabrications. The result was a catalog of moves with conceptual intent as the primary variable. Each joint type was based in a dialog with precedent: the honesty of the New Brutalists, the self-proclaimed conceptual and formal totality of Valerio Olgiati [1] or the fluid aggregation of Lewerentz's bricks at St. Peter's Church in Klippan to name a few. This contextualization was influential, but more often in critical fashion as students tested the legitimacy and potential of the moves and details they previously studied through readings and drawings.

The array of projects was then put before the class to categorize based on their reading of the joints. It was revealing to see which projects were clear and which were misinterpreted, as joints were mis-categorized and over-intellectualized. In the worst cases, the students learned how easy it was to be pedantic about nothing and completely dismiss thoughtful intent. In the best, interpretation matched intent and a discourse about clarity versus discovery ensued, framing the often utilitarian methods of joinery in new light.

## Surface

Building upon fabrications from the previous exercise, students then designed surfaces exploring material texture, proportion and scale with an emphasis on the construction sequence and the relationship between structure (the framework) and enclosure (the skin.) Until this point the decisions inherent to designing a facade in studio were strictly compositional. This stage aimed to advance the compositional act past typical formal systems. Composition was framed with a dependency on combination, meaning dimensional and proportional decisions were to be determined by material choice along with a critical attitude towards methods. Composition can also be explored less by instinct, and more by context and performance. To hammer this point, projects were contextualized as parasites, latching onto our building necessitating temporary connections and a relationship between the chosen surface material and the existing building acting as site.

Students were directed to adhere to the following rules to design a frame as armature, mediating between the context and the designed surface:

1. Choose an exterior site that allows for a temporary connection that suspends, props or buttress your design. This site will serve as your contextual driver and all decisions must have a clear and intentional relationship to it.

2. Choose a fabrication from the tectonics project that can be adapted to the site. From this, design a framework that will act as a mediator between the existing condition and the designed surface. It should have a clear vertical or horizontal orientation.

3. Using materials from the taxonomy, design a surface to attach to your framework. The skin must have a clear orientation and a proportional relationship to both the frame work and the site context.

4. Your skin should be an aggregation of multiple parts based on operative terms: panelized, stacked, layered, etc. It is not acceptable to simply attach a sheet to the frame. Consider the proportions of the materials to systematically break them down into smaller pieces to clad your framework.

5. Your skin should have a performative attitude towards theme and variation, reveal and depth, as well as penetrations, joints and gaps. Fastening method should have a clear and consistent agenda.

*Fig. 4 Foreground and background, a surface that mediates between scales.*

**This idea of composition being subject to combination frames aesthetics as a result rather than an aim.** Different motivations leverage the qualitative against measurable performance criteria. The idea of composition is clear: The nature of something's components in which a whole or mixture is made up. We typically understand this as either an intuitive exercise, or in more rigorous cases, a process governed by specific rules. Most often, the rules that govern a composition and our judgment as to whether it is good or not is subject to decisive interpretation. Combination implies a joining or merging of different parts in which the component elements are individually distinct. As an architect, it's impossible to combine without composing, so it is not a question of which, but rather which is first.

*Fig. 5 Parasite on the rails, layering and framing*

*Fig. 6 Aggregation of strips to mimic aggregation of bricks as a planar-coursing of material*

For many students this was their first project contextualized in 1:1 scale. Most of them failed structurally and a few worked out as planned. Students found that only so much can be predicted in a measured drawing without the experience to base it on. In the wake of conflicting criteria and non-hierarchal rules, prioritization and a clear statement of values was imperative.

## Discourse

In retrospect, tighter rules and more more prescriptive steps could have very well controlled the results with less risk of aesthetic failure. This approach, however conducive to decent 'looking' work, would be inappropriate. The project was primarily a venue for critical thought as students struggled to establish their own agenda within a set of constraints. The rules were presented without rhetoric, as such would occur by default as we attempted to "read" the intent of the work in-situ. Rules were purposely left open to allow space for interpretation, thereby necessitating judgment.

Our profession is one that is taught by example and learned through experience. Judgment within a defined system is perhaps impossible to teach as we can only at best facilitate scenarios for practice. Working within a set of rules is just as valuable a precedent as any compelling example of a building or text. These rules act as a primer for future rule-sets like code, technical specifications and budgets while working within diverse teams simulates the potential conflict of desire between architect teams, clients and context.

"Decorum therefore decouples to some extent the question of appearance from what we like personally. What is fitting can obviously take many different forms, provided that it serves the purpose demanded by the task." Johan Celsing

Every potential idea teeters on the edge of personal preference and contextual forces. While the students struggle with what is appropriate for a design concept, decorum is also a constant question for the educator. What is a truly fitting assignment in materials and methods for the beginning student? Are we asking too much for them to understand the consequences of making outside their own personal desires and concepts? No matter how much we justify or ntellectualize the work the students always seem to make do. This assignment could only succeed as a foundation for more in-depth study if a clear framework of culture and consequence was established upfront.

No materials are truly virgin, as they come pre-loaded with historical and cultural expectation, just as no methods are accidental, all stemming from precise intent. The discussion of context must go beyond the building site, allowing students to discover early that available material and the status quo must be understood as a cultural construct ripe for challenge, subversion or surrender. They always have a choice; it is simply a question of what factors influence or drive the decision making process.

As the students progress in the next course learning graphic language that conveys the logic of construction, they will do so with the understanding that materials are media, and methods are mediators. In essence, they learn the communicative nature of human production first through 1:1 construction with introduction to the myriad of performance criteria and value systems that determine decision making.

*Fig. 7 Alternating stacks in proportional dialog with frame*

## Operating Reasonably

"Reason is great and all, a decent way to begin solving problems, but rationalism often make people do sicko things. And somehow, truth gets a rubbery consistency in the hands of even the most rational thinker. I always thought a dash of common sense could be a corrective for this flaccid stretchability, but no one knows what common sense actually is. What then? Faith? Too divisive. Intuition? Too slippery. Emotion? Too volatile. Accumulation of experience? Too varied from person to person to person. A return to animal instinct? Too bloody. A customized approach? Too American. So what are we supposed to do? I guess we are forced to operate provisionally."[2]

Wampole asks a critical question (admittedly outside the context of design but clearly relevant here) about how one goes about operating within the world. As Norman Potter once said, "Every human being is a designer, some just choose to make a living at it."[3] How we balance our actions with consequences is the core struggle of any professional. All the designer's actions, be them formal, material or administrative, require decisions. If we have one goal as educators, it is to appropriately train students to navigate the myriad of obstacles that lie in the path of doing so with confidence. The considerations and contingencies are immeasurable, yet the designer must walk the tightrope balancing conflicting performance criteria, desires and contexts. We expect them to be rational while also being playful; to formalize intuitively but then make it work. It is seemingly impossible to be truly rational, so what then is the reasonable, "common sense" approach? To formalize is inherent in beginning design studios, but to materialize form with judgment and control is our existential struggle as architects. In short, most academic design problems can never be comprehensive enough to prepare students for the professional challenges that await them. Deep down, the students know that the only real consequences come in the form of evaluations. We can only hope that they are distilling a set of unique values from their experiences, which assist in building confidence and skills that can be repeated and refined.

The academy and profession produce documents or representations of intent. At every turn it seems that even the most meticulously crafted models and drawings are violently birthed into the world, immediately compromised as the ideal form is filled to the point of bursting with material consequence. A precise set of considerations must be introduced that provide a critical framework for evaluating and executing an architectural idea in the wake of countless conflicting criteria. If successful, at least disaster can be predicted and the bumpy road to realizing a design can be navigated with confidence. These projects are an attempt at more complexity, sooner rather than later, to balance the form making in studio with the 1:1 making we all know and expect students will eventually participate in (or administer) as they join the ranks of the profession.

be understood as a cultural construct to adequately challenge, subvert or surrender. Just as students learn a graphic language to convey the logic of construction, they must also practice material language at 1:1 exploring materials as media, and methods as mediators.

## Notes

[1] In interviews and various texts, Valerio Olgiati refers to a quality in architecture termed *totality*. He uses the term unconventionally, not merely referring to a unit to whole strategy that is inseparable, but more the idea that if one thing were removed, the architecture would fall apart conceptually. He elaborates by stating that this type of architecture requires a process of dividing rationally one idea rather than compositionally and additively solving design problems individually.

[2] Wampole, Christy. *The Other Serious: Essays for the New American Generation* "The Glare of the Enlightenment" Harper Collins: New York, NY. 2015. P 14

[3] Potter, Norman. *What is a Desinger: Things, Places, Messages* Hyphen Press, 4th Edition: London, UK. 2002.

# Fabricating Space

Liane Hancock, Miguel Lasala | Louisiana Tech University

This paper discusses teaching methods for the beginning design student that make tangible and real the abstract concept of visualizing and representing space. Throughout first year, every assignment is presented as a full scale 1:1 project. The 1:1 scale allows the students to get their eyes and hands into projects, and provides directed delivery of learning objectives freed from students' preconceived ideas of architecture. The foundation sequence begins in the fall with two dimensional interpretations of natural ordering systems, and ends at the third quarter with analog introduction of lofting and topological surfaces. The middle of this sequence, the second quarter, introduces the Cartesian coordinate system, solid geometry, and perspective. To accomplish this, students both make and draw at 1:1 scale in two co-requisite courses, Foundation Design II and Communication Skills II (Drafting). Curricular coordination between these courses results in the fabrication of objects that provide physical correlation to the teaching of specific drawing types (orthographic, axonometric, perspective projection).

## Solid and Void

The first exercise explores visualizing solid and void relationships by casting a mass in plaster to emphasize tension between volumetric void and poche. Students accomplish this investigation by eroding a 6"x6" cube through strategically placed voids in a cast plaster solid. Within a foamcore cube, students insert closed geometric foamcore shapes to create formwork that result in voids after the pour. The students attempt to visualize the resultant solid as they build the voids. After the plaster pour, the students evaluate whether the resulting articulated solid emerges as they expected.

We have taught this exercise three times. Twice the faculty emphasized erosion from the exterior faces of the cube; this past version, the faculty instructed the students to construct at least two voids that transected the cube. In all three iterations, we have found the students have difficulty establishing rules that provide continuous decision making across faces, and that it is difficult for students to project the rules into the poche to establish methods of carving. Too often the students begin with surface applique, resorting to an excess number of geometric shapes that have no relation to one another.

In the co-requisite drafting class, directly after this exercise, faculty present each student with a widget – a composite of foamcore planes, which the students use as drawing subject. A one inch grid establishes a Cartesian coordinate system across the cube of space, allowing students to keep track of where they are. The faculty constructs the widgets, with the end points of each plane generally falling on the grid. At 1:1, the widget is the subject the students draw in order to learn orthographic representation. (Figure 1)

Next year we intend to alter the schedule of the foundation studio slightly, employing the widgets as a generator for geometric rules across the plaster solid. The intention is that two students will receive a widget at 4"x4". They will redesign and enlarge the widget to 6"x6". Using the widget as a center element, the two students will each conceive of their solid as attaching to the widget, slipping onto it by at least 25%. As a result students will need to respond to existing "site" of the widget, projecting the rules and geometry of the widget onto the cube to achieve a more holistic strategy of erosion.

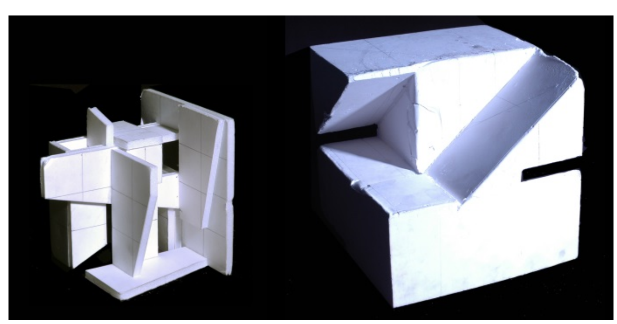


*Fig. 1 Widget and plaster pour.*

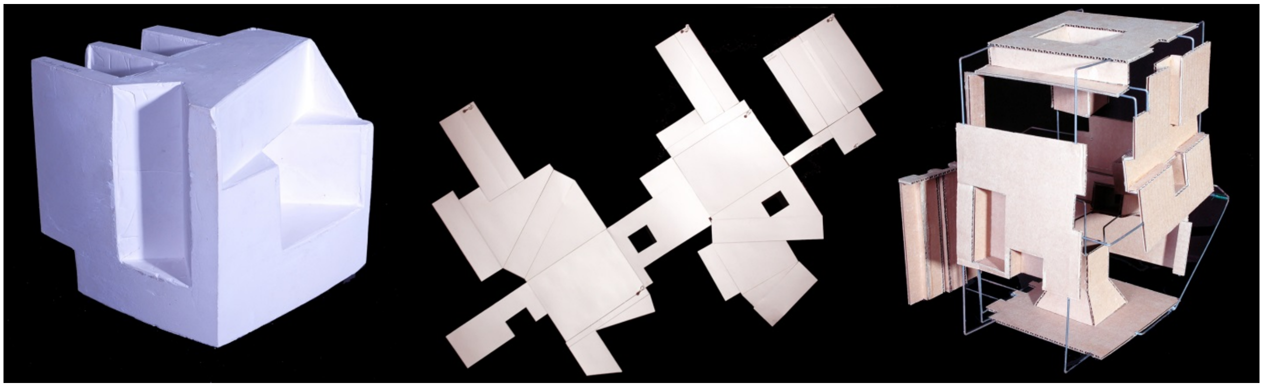


*Fig. 2 Plaster volume, pattern from unwrapping surfaces, and constructed exploded axon using cardboard and metal insulation rods.*

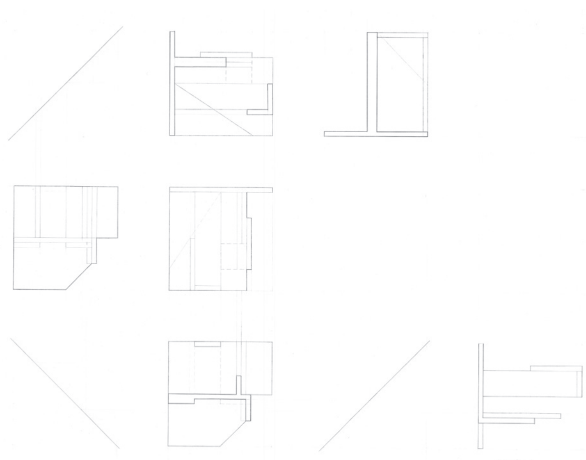


*Fig. 3 Orthographic drawings of a widget.*

## Unwrapping Surfaces

After the students complete the plaster pour, the faculty instructs them to carefully skin the solid in cardstock, which is unfolded to create a single pattern. The challenge here is to account for every face of the plaster artifact, and to avoid any overlap of the final pattern when it is completely unfolded. This is no easy feat, and at least one of our faculty members dreads this exercise every year.

Using tape and cardstock, the students painstakingly record every facet of their object in what will become a continuous surface, including representing the thickness of the foamcore as planes. They tape the surfaces together in place around the volume. To unfold, they cut several seams to flatten the main six sides. The complexity begins as they consider how to unfold the details of the project. In particular, reliefs that do not touch the edge of the face create particular challenges. In order to flatten them, incisions must be established to free the reliefs from the center of the plane. Initial expectations with regard to location of seams of the primary six faces must be rethought in order to prevent overlaps. Often we see students moving their fingers across the plaster volume to physically feel continuity as an aid in making decisions where to cut the seams. By having the solid available to touch, the students seem to better be able to visualize possible connections and continuity of surfaces. This year's greater emphasis on voids spanning the solid made unwrapping of the pattern more challenging as the surfaces of the voids spanned the entire dimension of the plaster volume resulting in prevalent overlaps. (Figure 2)

When students arrive to our architecture major, they rarely are able to correlate plan and section to three-dimensional space. We schedule the pattern exercise to occur just before the introduction of orthographic representation in the drafting course. This coordination was put in place two years ago, and has significantly aided in students ability to orthographically represent the widget. Previously, we found it was difficult to get students to slow down and account for every surface that makes up an orthographic drawing. The completion of the pattern exercise provides concrete physical representation of the entirety of the surfaces of the plaster volume, including the thickness of foamcore, from which both the formwork for the plaster volume and widgets are constructed. When students move from the pattern project to drawing the widget, they are far more careful and aware of the full number of surfaces that define the widget. (Figure 3)

## Translating Surfaces to Create Tension

The next exercise asks the students to imagine being in the center of the plaster solid, envisioning what it would be like to inhabit the volume. To help in imagining the surface as a delimiter of space, students employ what they constructed in the pattern exercise to create surfaces that enclose a space that describes the original volumetric mass. To both aid in visualizing the mass as a void, and to create dynamic relations between the surfaces, the faces are translated across space, creating gaps between surfaces. Students physically move the surfaces to create spatial tension. The surfaces of the volume are constructed with cardboard sheets and the surfaces are shifted out from the volume, along metal insulation rods. (Figure 2)

Concurrently in the drafting course, students construct exploded axonometric drawings of their widgets. By projecting the translation of the widget planes in the drafting course, students begin to understand how to physically model the translation of the surfaces in the studio exercise. At the same time, when the students move the surfaces across space in the physical construction, they learn to situate the exploded planes of the widget to maximize compositional impact in the exploded axonometric drawing.

This past year we recognized that this exercise resulted in losing the relationship between the poche and void. To make sure that relationship is still extant, this year the students projected the surfaces out from the solid, creating tension between the surface and the solid to develop an understanding of inhabitation between the faces. This change to the assignment updates the curriculum to more accurately represent contemporary design practice, and still underscores the importance of visualizing the spatial tension between surfaces. An additional twist to the assignment helps to break down the didactic compositional character of the project, making it more dynamic. Students begin by constructing the geometry of the faces of the plaster volume in cardboard. Students then situate their plaster mass so that it rests on one edge, orienting the geometry at an angle to the table surface. Using metal insulation rods inserted into the voids of the plaster volume, the volume is braced at this angle. Along rods, the cardboard surfaces are projected to create the exploded character of the axonometric, but now not only in relationship between the cardboard surfaces, but also in relation to the plaster mass. Resting the mass on an angle allows the heaviness of the plaster to be supported, and makes more dynamic the composition.

## Siting the Axonometric

Students complete an additional exercise rooted in axonometric projection, which increases the scale of drawing to that of the body to allow the students to envision inhabiting the space defined by the original plaster casts. Departing from lead on Bristol, the drawings are completed in painters' tape, with line weight defined by the width of the roll and hierarchy achieved through color. The faculty encourages the students to site their drawings in unexpected ways, to engage with changes in plane as walls meet the floor, and to cross thresholds between spaces. By not placing the drawings centered on walls, the siting of the drawings achieve dynamic positioning that activates the spaces of the building. In addition, projecting the drawings on both wall and floor makes the axonometrics appear more three-dimensional and inhabitable. (Figure 4)

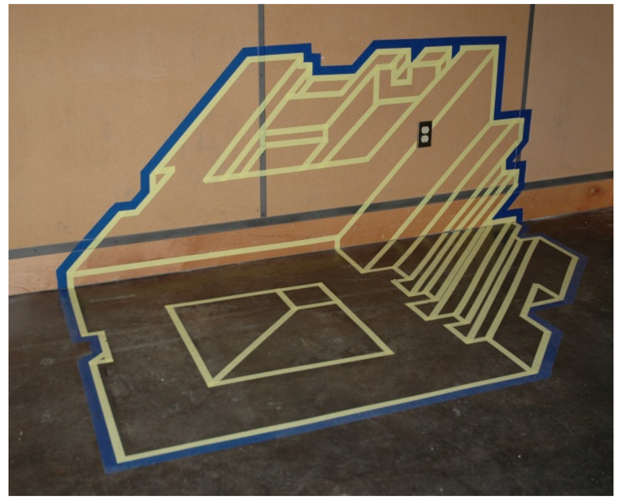


*Fig. 4 Axonometric sited in Hale Hall at Louisiana Tech University.*

## Material Investigation and Perspective

The final assignment asks students to use their interpretation of movie clips as a generator to redesign their constructions. Here the emphasis is on phenomenalism, and interrogating their assumptions about perspective. The movie clips present a range of cinematic techniques that feature material representation, and/or frame viewpoint.

*Depth of Field and Zoom:* Citizen Cane (Orson Welles), Limitless (Neil Burger), Vertigo (Alfred Hitchcock)
*Montage:* Lady from Shanghai (Orson Welles), 8 ½ (Federico Fellini)
*Continuous Scene:* Touch of Evil (Orson Welles), Soy Cuba (I am Cuba) (Mikhail Kalatozov), The Passenger (Michelangelo Antonioni)
*Sectional Investigation:* Life Aquatic (Wes Anderson),
*Apparent Suspension of Laws of Gravity:* 2001 A Space Odyssey (Stanley Kubrick), Inception (Christopher Nolan)
*Reflection and Shadow:* Lightplay (Maholy Nagy)

### *Materials*

Students consider the relationship of the body to their construction, assign materiality, and develop operability. Some

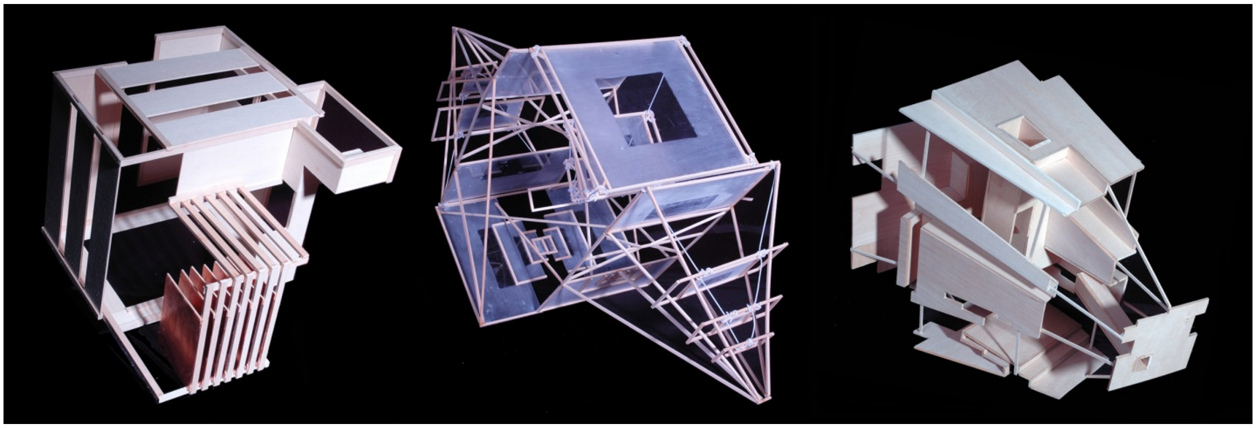


*Fig. 5 Examples of final exercise responding to film clips through material investigation and relationship to viewing.*

students emphasize reflection or the play of light; others become interested in casting shadows or projecting adjacent views and color onto the surfaces, while still others find it important to make portions of the construction move or unfold.

The first year, we threw the net open and encouraged students to select a wide range of materials. Some predictably investigated metal, glass, and wood; others worked with books, broken records, mirrors, and fabrics. While the range of solutions proved interesting, the short time frame available for development made developing sympathetic detailing problematic. Additionally, the more esoteric materials provided limited instruction on how to achieve more architectural tectonics, a learning outcome that the spring first year studio relied upon. Last year the faculty controlled the palette of materials to basswood, transparent/translucent plastic, and sheets of metal with far more manageable results. (Figure 5)

*Perspective*

Previously, this was the one place where the studio assignment did not present a direct corollary with the drafting assignment; instead the exercise directed students to investigate the relationship of the object to the body. In particular, we were interested in how the construction operated to draw the eye into it, and how views were framed within the object. The most successful projects were those that distorted along projective geometry. Most retained the didactic character of the cube, and it was difficult to get students to construct dynamic compositions.

In drafting, perspective construction is taught at the same time that the students are designing the final studio exercise. The students are presented with a simple geometric enclosure which they draw nine times, in four drawings. The first drawing

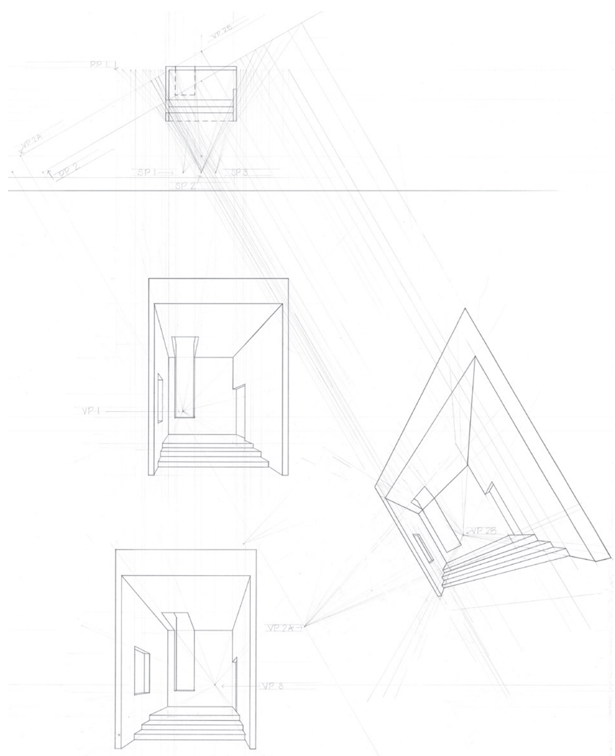


*Fig. 6 Perspective exercise: moving the station point.*

investigates location of horizon line: students assume one station point and construct a perspective first at eye level, and then again, moving the horizon line vertically up or down. The second drawing investigates the picture plane: students use a consistent station point and horizon line, but move the construction plane to show how it increases/decreases the size of the image. In the third drawing students move the station point forward and backward to show how it changes the foreshortening of the drawing. Finally, in the fourth drawing, students move the station point from side to side: by placing the station point first to the right, then to the left, students become aware of how parallel planes change in hierarchical emphasis within a one point perspective, and an additional drawing investigates how the representation of the space changes again by rotating into a two point perspective. By isolating horizon line, picture plane, and station point, the students gain an understanding of the underlying variables that manipulate perspective, and give them control over those variables. (Figure 6)

This year we have decided to relate the perspective exercises to the studio project by having the students build a space that distorts geometrically in relation to the variables introduced in the drafting course perspective assignment. Moving from 1:1 to a ¼"=1'-0" scale, students will design a space for one person to view the movie they chose. The siting is parasitic, perching upon one of our campus buildings. Students will distort the orthogonal geometry of their previous exercises to enhance specific perspectival views into the room and towards the screen. Exercises in the future may also include having the entire class building a temporary version of one or two of the viewing rooms at full scale.

## Conclusion

While our first year introduces design methods based in natural ordering systems and geometry rooted in lofting and topological surfaces to keep our program apace with contemporary design, we also believe it is important to reserve a portion of the foundation curriculum for investigation of the Cartesian coordinate system and solid geometry. This focus emphasizes our dedication to teaching orthographic, axonometric, and perspective projection. Coordination between our foundation studio and our drafting class allows us to make drawing exercises more tangible through physical analogs fabricated at 1:1 scale in the studio. The reciprocity between exercises fundamentally demonstrates to students that drawing informs design and design informs drawing. As an added benefit, these exercises also anticipate the introduction of rhino in sophomore year, presenting analog operations that are similar to Boolean and smash commands, and employment of the gumball.

After three years of teaching this curriculum, we have found that investing significant time in the coordination of these courses to cover these very specific methods for exploring space ultimately leads to richer composition of spatial relationships within final projects in the second quarter and in later studios.

.

# Tactility at 1:1: Media and Context in learning about Building Materials

Aki Ishida | Virginia Tech

## Introduction

> Modernist design at large has housed the intellect and the eye, but it has left the body and the other senses, as well as our memories, imagination and dreams, homeless.[1]
>
> - Juhani Pallasmaa

Vision was conceived as the dominant sense in modern architecture.[2] However, the precedence of vision over other senses of touch, hearing, and smell has a long history. During the Renaissance, representation of building in perspectives placed the viewer outside as a spectator. Alberti's fascination with harmony, proportions, and perspectival representation prioritized the ocular perception above all others. In the English language, 'to see' is 'to understand'. However, our comprehensive understanding of a place is made up of multi-sensory memories—the smell of the pine trees on the site, the sound from the fire station next door, or the texture of the honed stone floor felt by our feet. The full meaning of expressions such as 'as smooth as silk' is not entirely understood unless one touches, not merely look at, silk fabric. Eighteenth-century philosopher George Berkeley wrote that understanding through vision is very limited without the haptic sense. Attributes such as protrusion and solidity cannot be understood unless they are touched.[3]

How can architecture schools best equip students with both the intellectual and sensible knowledge of building materials so that the tools alone do not dictate how the materials are shaped? In an age in which vision dominates over other senses, could architecture education encourage haptic learning? As educational theorist Howard Gardner's multiple intelligence theory suggests, each person has multiple intelligences that are processed by relatively autonomous processors. Students' learning is deepened when educational materials are 'plurized' and presented through multiple means.[4] The course described in this essay combines the traditional cognitive learning modes of readings and lectures with hands-on exercises that activate the haptic sense and encourages learning through spatial, physical memory.

This paper presents how a semester-long two credit class for 60 students teaches the basic attributes of building materials at a one-to-one scale through tactile exercises and careful visual and haptic observations, both on campus and at shops and factories off-campus.

## Building Materials Course

Building Materials, a course that I developed over the past three years at Virginia Tech, is taught based on the notion that students learn best if they are introduced to major building materials through multiple media and contexts, both inside and outside of a lecture hall. Required for every Bachelor of Architecture student in their second year, Building Materials introduces the physical attributes of basic building materials before students learn about their assembly in subsequent years. It is the first in the building construction course sequence, followed by Art of Building in the spring of the second year, and Building Assemblies I and II in the fall and spring of the third year. The knowledge they gain through this Materials course is applied by students to their design studio projects. Major materials covered include concrete, stone, brick masonry, glass, steel, wood, fabric, plastic, and composite materials. For each one, they study the physical properties of the material, the ways in which it historically came to be used in building construction, and the current developments that enhance or modify its properties. The lectures are coupled with a hands-on experimental team project, a visit to a local production plant, and a presentation by a technical expert. Students read about the materials' facts and figures in excerpts from a building construction textbook.[5] Additional readings on specific materials are folded into the course to provide material application examples, historical contexts, and theoretical framing.

## Tactile Learning

Learning through experience was at the core of the German Modernist design school, the Bauhaus. Johannes Itten, one of its preliminary design course teachers, aimed to develop his students' design abilities through "subjective experience and objective rationale."[6] Lazlo Moholy-Nagy, who took over the preliminary course and established the 'New Bauhaus' in Chicago as the Institute of Design also advocated educating designers about materials by means of tactile exercises. Despite the dominance of vision over other senses, he saw a place for education to teach through tactility, and this remains a valuable mean for education today. In his 1928 book *The New Vision and Abstract of an Artist*, he claims: "Since the majority of people build up their world at second-hand, removed from their own experience, the Institute [of Design] must often fall back upon the most primitive sources in order to guarantee an individual approach."[7] Almost 90 years after Moholy-Nagy's writing, it has become increasingly true that students come to study architecture seeing materials through vast online resources, but not touching either building materials or works of architecture. Juhani Pallasmaa expresses his concerns about the state of vision-dominant architecture in which architects have become cool, outside spectators disengaged from touch: "With the loss of tactility, measures and details crafted for the human body—and particularly for the hand—architectural structures become repulsively flat, sharp-edged, immaterial and unreal."[8]

The projects for this class are written to provide opportunities to study materials through tactility, and to understand materials beyond the mere flattened representations that students see in computer rendering palettes. To understand concrete as a building material, for example, students are prompted to work in teams of three or four to construct a modular concrete wall that is roughly four square feet and allows the passage of light to pass through it. Some modular units have apertures cast within them while others have indentations and protrusions that make apertures between units (Fig. 1). Evaluation is based on five factors:

1. Design—Does the wall achieve stability while allowing the passage of light? How well do the modules stack or interlock with each other? A goal is to understand the properties of concrete so that it is used appropriately.

2. Execution—How well are the molds and the casts made? The modules should hold their shapes without falling or breaking apart.

3. Diligence—Did the team produce multiple iterations and improve upon the weakness of the previous effort? They must allow enough time to work out the design and the technical challenges.

4. Quality of photographs and drawings—How well do the photographs capture transmission of light? Did they use the

*Fig. 1 Left: Concrete blocks with apertures in each unit, by Jiaqi Dai, Brandon Drum, Zac Kothe, and Yunqian Li.*
*Right: Concrete blocks with apertures made between interlocking units, by Luke Dale, Hunter Stephenson, Charlotte Terry, and Sarah Walker*

*Fig. 2 Documentation of mold making and casting process by Habeeb Muhammad, Michelle Pannone, and Robert Riggs*

drawings not only as representation but also visualization tools to develop the design?

5. Site Management—How well did the team maintain the 'job site' both inside and outside of the building? The students are required to put their names on the molds to encourage them to be accountable for keeping a clean and orderly work site. When their names appear in the job site that their peers walk by every day, it is an incentive to keep a clean site.

In addition to the five factors, team work is an essential component of this exercise. The scope of work and the allowed time were planned so that the amount of labor would necessitate team work and would be neither feasible nor sensible for one person to complete alone.

Each team reviews the work with the instructor two weeks into the project, and they are expected to iterate and document their studies for the final presentation one week later (Fig. 2). The walls from 15 teams are presented on a plaza outside of the architecture school building and remain on public exhibit (Fig. 3). This gives fellow architecture and design students the opportunity to critique their peer's work and share in the learning.

At the completion of the project, the students are asked to respond to these inquiries on a reflective worksheet: how did their wall demonstrate understanding of concrete's physical attributes, and what aspects of concrete were revealed to them in executing this project? Some reflected on their discovery of how fragile unreinforced concrete is and the heat of concrete while curing. Many also described the manners in which concrete took on shape and textures of the mold, from the texture of the tape that lined the mold to the mold's wood grain. One student (Miles Navid-Oster) responded, "While I could model the blocks in *Sketchup*, stacking them in that configuration was impossible. I underestimated how dense and heavy such small blocks would be in a non-orthogonal fashion." Another student (Thanhthao Le) wrote, "I learned that concrete contracts from the mold as it cures and water evaporates. It is difficult to get the right consistency and when it is too wet, the concrete cures with a concrete lip that cracks on the edges. Using reinforcement such as chicken wire keeps fragile pieces from snapping." These physical qualities of building materials are merely abstractions when read in textbooks, but human bodies remember these qualities through their multi-modal sense experiences.

This casting exercise was paired with a reading of the essay 'A Building and its Double' by Mabel Wilson. In this essay, Wilson reflects upon the nature of concrete casts – that "one builds the building twice, its formwork followed by its pour."[9] The students, after having constructed multiple molds themselves and having seen how the concrete captures the textures of plywood sheets and the tape inside the mold, have a deeper

*Fig. 3 Student Robert Riggs demonstrates light and shadow qualities and physical strength of his team's concrete blocks*

understanding of Wilson's writing – the notion that with concrete, one builds the block module twice – once as a plywood formwork, then the cast in concrete. From this relatively quick project, the students now have a renewed appreciation for the exquisite surfaces of concrete walls by Tadao Ando or the exposed texture of rough wood formwork left on Le Corbusier's buildings. The best learning combination occurs when conceptual thoughts and haptic knowledge deepen understanding of each other.

## Learning to see with touch

Unlike concrete, glass fabrication is difficult to demonstrate or experiment with due to its unique power and equipment needs. The students view slides and videos from a Pilkington glass plant and learn that, due to the high cost of building and running glass kilns and the complex expertise required for glass making, there are very limited numbers of glass plants in the US compared to a high number of factories for other materials such as concrete or brick. From this story, they further learn that glass panels, especially those with unusually large sizes, shapes, or coating, must be transported across the country, sometimes from as far away China or Germany as Apple did with their Manhattan stores.[10]

The hands-on exercise for glass is not that of construction but learning to experience something that may not be immediately apparent. James Carpenter Design Associates, a studio specializing in artistic and technical uses of glass donated glass samples. The class prompt challenged the students to experiment with 15 different glass sheets under different light conditions to understand the physical attributes of the material. It asked students to: 1) Through photographs, study and document how the glass changes perception of space or objects beyond or around it and 2) Experiment under different light conditions (e.g., daylight and electric light) light sources positioned differently relative to the glass sheets. Working in the same teams as for their concrete projects, each team presents their studies through photographs (Fig. 4). The students often remark on different atmospheres that are generated by the effects of light transmitting or reflecting off of glass surfaces. Since light effects are scalable, the reflections they observe on a 12"x12" glass sample are a very close simulation of those on a 12' tall glass panel on a building. In addition to the empirical studies, the students read Carpenter's essay 'Capturing the Ephemeral'[11] to assist them in finding new ways to observe light phenomena.

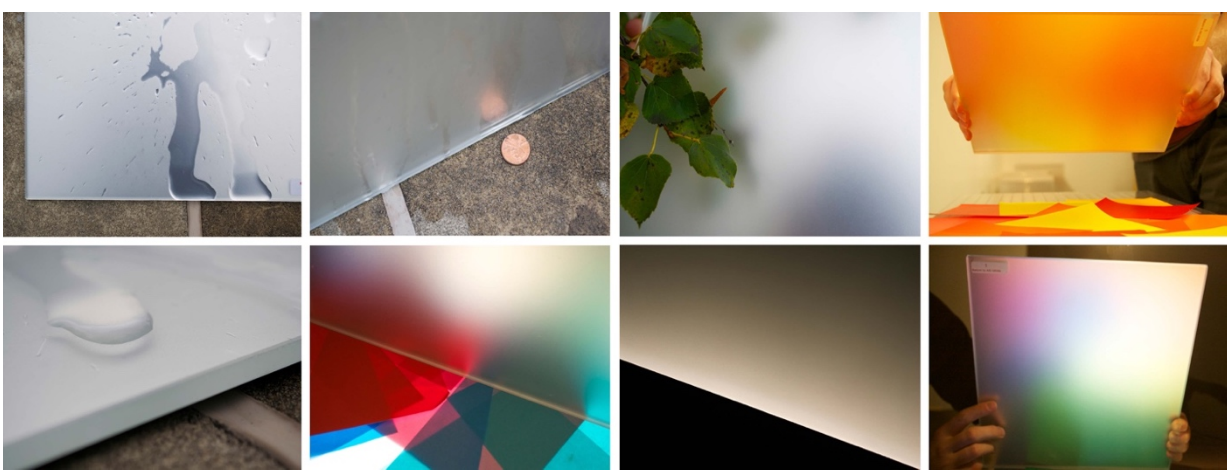


*Fig. 4 Study of translucent glass properties by Ibrahim Alwazir, John Murphy, Nevin Ounpuu-Adams, and Daniella Sohkhlet*

While this may appear to be an exercise that prioritizes vision over other senses, it is critical that the students manipulate glass sheets with their hands. A slight adjustment in the angle of the glass can result in a dramatic change in the color of light reflected off the glass. Careful visual observation is paired with haptic inspection. Because of its transparency and apparent lightness, a sheet of laminated glass often feels surprisingly heavy. What they gain from this exercise is entirely different if they merely search and collect images online without ever having to lift a glass panel or run their fingers over the roughness of acid-etched glass or the baked-on ceramic dots on fritted glass.

## Tactility with distance learning technologies

Technology used for distance learning makes it possible to tap into remote, highly valuable resources that are not otherwise available to students. When teaching about metal, students participated in a video conference with TriPyramid Structures in Westford, Massachusetts.

TriPyramid is a specialized metal fabrication shop with expertise in metallurgy, mechanical engineering, and digital fabrication. The two founding partners began applying their knowledge of fabricating metal fittings for racing sailboats to architecture decades ago. When the company was founded 1989, they fabricated glass fittings for I.M. Pei's glass pyramid at the Louvre, and since 2002, pristine metal fittings for the glass floor, stairs, and roofs at the Apple Stores worldwide. During the 50-minute video conference, the students also experienced handling metal component samples from TriPyramid's projects (Fig. 5), while Jeff Anderson, an architect and project manager from their office, discussed what metals they use for which applications and why they were selected.

*Fig. 5 CNC-milled stainless steel fittings fabricated by TriPyramid tructures*

The University's Video Broadcasting Services setup the interactive video conference in a classroom equipped for distance learning.

The equipment was arranged so that Anderson and the class could navigate TriPyramid's website on a large screen, while he could see the classroom, and the students could converse with him from their desks. Video conferencing technology paired with physical samples allowed us access to exceptional resources that in ways that would otherwise be not possible.

A student who took this course two years ago recently gave an account of her experience outside the classroom. At an Apple Store in San Francisco, she spotted the exact stainless steel and titanium fittings that she had seen and touched in class. Unable to contain her excitement to herself, she told the security guard at the store how she had a video conference with the engineers who designed and fabricated these fittings and that she had held a sample of it in her classroom before coming to San Francisco. This incident is significant for multiple reasons: a student is thrilled to see a material that she learned about in class, she is able to recognize the part because she had not only seen a picture of it but also touched it at 1:1 scale and interacted with people who made it, and she is able to deepen her knowledge of glass and metal by observing them carefully at 1:1 scale again, this time in the context of a building.

## Using local resources to learn about the global context of materials

Facts and figures of building materials are best understood, retained, and applied if they are presented in the larger context of their production. As MIT architecture professor Sheila Ken-

*Fig.6 Phil Meekins of Old Virginia Brick in Salem, VA discusses hand-mold brick making with students*

nedy writes in her book *KVA: Material Misuse*, "To be interested in materials is to ask questions about the nature of the real in contemporary culture, in all its complex and contradictory dimensions."[12] The contexts under which building materials develop and evolve can affect physical prosperities and, as a result, the spatial qualities of a building. For example, as the students saw by visiting a brickyard (Fig. 6), bricks fired with gas have different coloration than those fired with coal. As factories switch from using coal to gas in response to environmental concerns, the difference in energy source results in changes to the color, production time, and energy consumption of bricks.

An unusual resource at Virginia Tech is its own quarry of Hokie Stone located about 10-minute drive from campus. The campus buildings are almost entirely constructed with this stone. The students observed how Hokie Stone, a dolomite limestone, is extracted from the earth, sawn with a diamond-tipped blade, cut to smaller pieces with an hydraulic cutter, and finally packaged onto wood pallets ready to be trucked to construction sites on campus (Fig. 7). The students learned to connect the building material they see daily on campus to its natural source. When the students attempt lifting blocks of stone, their bodies remember the extreme weight of the stone. As a result of this physical memory, next time they have an opportunity to specify stones in an architecture office, they can evaluate the desirability of importing heavy, exotic stones from foreign countries.

Such contextual information is presented in this course to give students a deeper understanding of how building materials are extracted, developed, and changed over time. This tactile knowledge is transferable to other new materials that may be encountered in the future, such as Corning Willow Glass (an ultra thin flexible glass) or biomaterials. Leslie Hirst, Associate Professor of Foundation Studies at Rhode Island School of Design who teaches first year art and design students, writes:

> Knowing how to make something involves tactile interaction with materials and substances, and making something innovative requires eye-hand processing that trains the brain as well...Although going someplace unexpected is a goal, the ability to apply calculated predictions to the route will lessen the chance of an undesirable destination.[13]

Combining both the intellectual and haptic knowledge of various materials, the hope is that students gain a pluralistic understand of materials and that their thinking of how to apply material knowledge in their building designs might be triggered in multiple ways, ranging from cognitive to spatial understanding.

*Fig. 7. Employee of Virginia Tech's Hokie Stone Quarry explains quarrying and cutting process to students*

## Notes

[1] Juhani Pallasmaa, *The eyes of the skin: architecture and the senses*. Academy Editions: London. 1996. p. 19.

[2] Pallasmaa, p. 27.

[3] George Berkeley, *Essay Towards a New Theory of Vision*. p. 31, accessed January 6, 2016, http://www.earlymoderntexts.com/assets/pdfs/berkeley1709.pdf

[4] Valerie Strauss, "Howard Gardner: 'Multiple intelligences' are not 'learning styles'," Washington Post, October 16, 2013, accessed January 2, 2016, https://www.washingtonpost.com/news/answer-sheet/wp/2013/10/16/howard-gardner-multiple-intelligences-are-not-learning-styles/

[5] Edward Allen, Fundamentals of Building Construction: Materials and Methods. Wiley: Hoboken, NJ. 2013.

[6] Rainer K. Wick, Teaching at the Bauhaus. Hatje Cantz: Stuttgart. 2000. p. 124.

[7] Lazlo Moholy-Nagy, The New Vision and Abstract of an Artist. Wittenborn: New York, NY. 1946. p. 23.

[8] Pallasmaa, p. 31.

[9] Mabel Wilson, "The Building and its Double" in Solid States: Concrete in Transition. ed. Michael Bell, Craig Buckley. Princeton Architectural Press: New York, NY. 2010. p. 256.

[10] "NorthGlass' 'Love Story' with Apple," in North Glass website, accessed December 22, 2015, http://en.northglass.com/news_detail/newsId=ea37e648-59d1-466b-b209-9f75bf39d4d4.html

[11] James Carpenter, "Capturing the Ephemeral" in Material Design: Informing Architecture by Materiality. ed. Thomas Schropfer. Birkhauser: Berlin. 2010. pp. 106-117.

[12] Sheila Kennedy and Christoph Grunenberg, KVA: Material Misuse. Architectural Association: London. 2001. p. 12.

[13] Leslie Hirst, "Ground Work" in The Art of Critical Making: Rhode Island School of Design on Creative Practice, ed. Rosanne Somerson and Mara L. Hermand. Wiley: Hoboken, NJ. 2013. P. 41.

# Corporeal Complexities: Case Studies in Interactive Architecture

Meg Jackson, Michael Gonzales | University of Houston

## Introduction

In our introductory media course, prototypes are necessarily full-scale, 1:1. However, in the case studies presented in this paper, 1:1 is additionally defined as the relationship between the contemporary body and space. Our research in interactive environments explores the dynamic and evolving dialogue between human experience and spatial design. We are investigating the 'colon' in 1:1.

The rise of sensor technology gives designers a new medium to study, design, and communicate with the built environment and challenges the way in which the human relationship to space is traditionally understood. The widespread use of sensor-based technology and personal computing devices has redefined the way people engage with their environments and interact with each other. Computation and interaction have opened new territories for research and the production of physical space, ones that consider human interaction, perception, experience, time, and behavior.

*"The way we interact with the world has never before undergone such rapid change…the world we inhabit is no longer only a physical environment, but also a landscape that we occupy virtually. What was already false– the perception that the physical limits of our body define our personal space–has been clearly exposed as a fiction."*[1]

As our world becomes increasingly connected and interactive, communication with our spaces and objects becomes progressively mediated through intelligent devices and interfaces. Despite operating at varying scales, layers, and proximities to the physical body, architecture is rooted to the basic task of enclosing space around the human form. When considering the dynamic human factor, technology increasingly blurs the limits of the body's territory. Our introductory digital media course considers the design implications that result from our spatial territories expanding to include both our physical body and our personal data sets. The emerging field of sensorial spatial design explores how we can alternatively experience and potentially manipulate space.

## Methodology

Using a graphic programming interface (*Grasshopper and Firefly*), beginning design students are introduced to concepts of kinetic design, sensors, biofeedback, computer vision and various other input/output devices for understanding dynamic human interactions and developing interactive/responsive architectural prototypes. Traditionally it has been necessary for designers to become familiar with computer programming in order to communicate with interactive devices. However, in our course we build upon existing digital skill sets already familiar to beginning design students which allows us to focus more on the physical interaction between the participant and the spatial

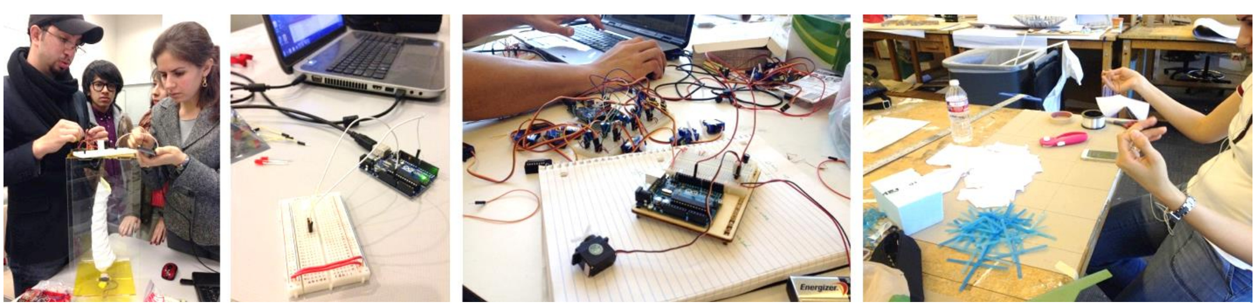


*Fig. 1 Interactive Prototypes – Student Work*

application.

Each week students are challenged to design and build responsive architectonic prototypes that integrate human interaction with weekly tutorials on various sensor-based strategies. These working prototypes vary in approach and scale, some of which include strategies that are physically responsive to their cellphones, their mind, their heart rate, physical movement, light, and sound. Class discussions are rich with excitement and curiosity about design, interaction, and the potential for application. (Fig. 1)

Initial 1:1 prototypes evolve throughout the semester as the students learn to integrate real time data, user interaction, and sensor feedback to create more complex and responsive spatial interventions. The teaching of digital skills and computational thinking is combined with actual efforts of making which encourages students to bridge between digital simulation and physical making, allowing them to connect with these concepts in a concrete way. Students are challenged with issues of material behaviors, scale, modularity, form, movement, assembly logics, and construction constraints while reinforcing the fundamentals of design relative to the human body, behavior, and experience.

The students work on a series of 1:1, explorative, model-making exercises that gradually incorporate engineering and computational components. (Fig. 2) This hands-on, incremental approach to problem solving is important because it allows the students to demonstrate, as opposed to simulate, their design ideas and intentions. A degree of demystification is essential for comprehending the complexity and interdisciplinary qualities of interactive architecture.

Perhaps ironically, the authors have observed over the course of three semesters, that the complexity of the concept of interaction and the advanced technology are often not as great a challenge as is the understanding of physical mechanics. The 1:1 scale tinkering is often the most difficult problem solving effort for the students.

As the seminar progresses these investigations are complemented with theoretical readings and advanced level tutorials researching cloud data, sound, computer vision, motion tracking, and bio-sensing. Building iteratively, each team develops a full-scale installation.

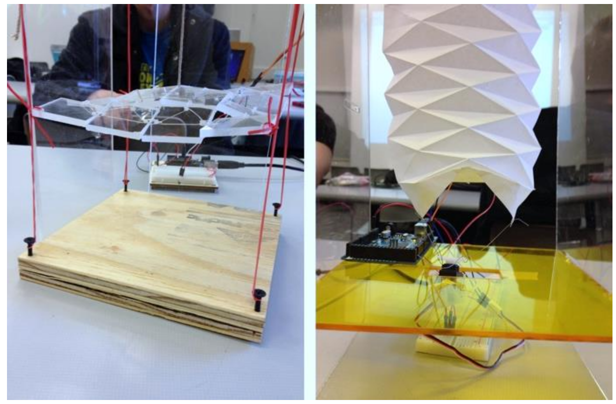


*Fig. 2 Analogue Prototypes – Student Work*

## The Dynamic Human Factor

*"The materials that surround the human body, including clothing and shelter, function as boundaries that mediate between the body and its environment... The spaces between the boundaries are architectures, ranging in scale from the most intimate – the space between the skin and clothing – to the most grand – the space between body and building. This indicates the potential for architecture that emphasizes the dynamic quality of materials – perhaps an architecture defined not by permanent partitions but by dynamic boundaries that choreograph movement by engaging and responding to human activity......By triggering or inhabiting these boundaries, the people who move through them also define them."*[2]

Interactive architecture, regardless of its physical size, is an extension of the body. This field of inquiry operates in the poché (the in-between space) between body and boundary. These seminar projects explore the potential of spatial relationships between a dynamic body and a dynamic boundary – 1:1. (Fig. 3)

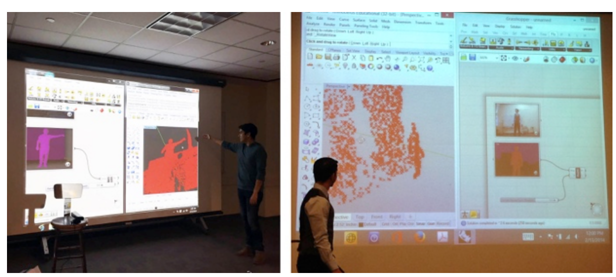


*Fig. 3 Personal Datasets – Student Work*

As in a conventional design-build studio, our seminar students are tasked with the challenge to build full-scale (also 1:1). They must address anthropometric relationships between their spatial construct and the human user. However, interactive architecture expands the discipline of architecture by acknowledging a departure from the traditional architectural notions of space and user. In this emerging context, architecture is "*to become sensate, intelligent, interactive, responsive, and adaptive*"[3] in which the user is an active participant. There has also been a gradual shift away from the notion of timelessness to the notion of time-based. "*There is a crystallization of a desire for architecture to be thought of as an active, evolutionary, and interactive being.*"[4]

The students have to investigate not just the physical occupation of space but also the physiological occupation of space. In Toshiko Mori's *Phenomena* essay she states, "*Sound and scent can perform, inform and transform: their impact is strongly felt even in the absence of material artifact in the traditional sense, making them some of the most efficient "immaterials."*"[5]

In addition to creating architecture that is responsive to human movement, our investigations broaden Mori's definition of 'immaterial' to include all five senses as well as the human's emotive, behavioral, and physiological states. Although not all of them are physically tangible, these human behaviors have physiological consequences which can be used as data which can then be calibrated, controlled, and manipulated with current technology. For example, brain waves emit electric signals that can be quantified with a numeric value which can then be used in an equation to control a mechanical movement. Therefore, architecture, when created in tandem with the logic of this technology, can have a spatial response to the behavior and activity of the body. (Fig. 4)

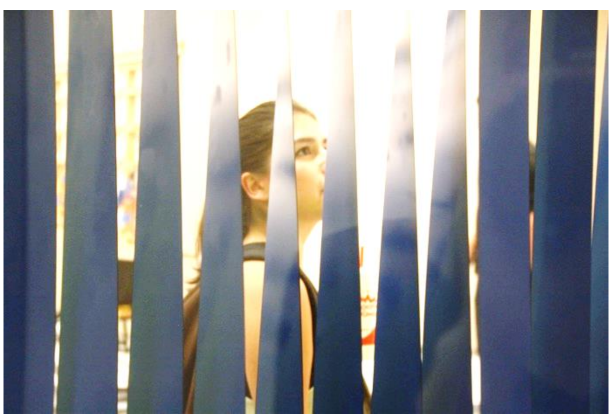


*Fig. 4 Kinetic Wall Installation – Student Work*

These conceptually complex, often abstract and intangible, dynamic human relationships are introduced to our students through very concrete methods of making at 1:1. The creative process involves experimentation, risk, constraints, testing, trial, error, intuition, failure, and curiosity. Our students must not only imagine the possibilities of interaction and response, but also design the physical mechanics and the procedural logic of the systems that quantify the behavioral data. In this way, interactive architecture represents a third pedagogical shift. In addition to evolving the traditional notions of space and of user, since design is understood as performance, the designer is not only a creator of objects but also is the designer of the operating systems. (Fig. 5)

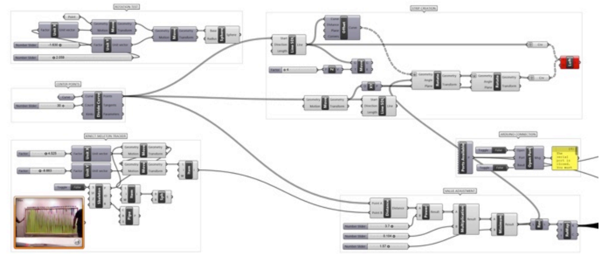


*Fig. 5 Grasshopper Visual Programming – Student Work*

By engaging not only the predominant visual sense, but also additional senses and activity, behavior, and experience, these explorations transform architecture into a real-time medium. Interactive architecture is not really about its technology, but about revealing new possibilities of relationships between architecture and people. Exploiting a participant's senses and behavior creates a multilayered experience that evokes time, space, memory and feeling.

## Motion-Based Kinetic Facades (Case Study 1)

*Playscape* and *Kinetic Wall* are motion–based kinetic façades. *Playscape* engages participants through 3 interactive modes: mimicry, avoidance, and attraction. *Playscape* is constructed using a Microsoft Kinect, 70 servomotors, a mountable MDF frame, acrylic panels, polyester fabric and plastic sheets. (Fig. 6) This case study began as a series of dynamically controlled pattern studies exploring variation within simple geometric systems.

*Fig. 6 Playscape Installation – Student Work*

*Kinetic Wall* engages participants by occluding or revealing views based on a user's proximity, speed, and direction of movement relative to the wall. *Kinetic Wall* is constructed using a Microsoft Kinect, 30 servomotors, a mountable aluminum frame, and a series of styrene panels. This case study initially began as a series of investigations exploring perspective, motion, and the mechanics of simple machines. Through a series of rigorous models and scaled working prototypes, the students developed a simple system that could achieve the dynamic effect they wanted with a minimal amount of material and mechanisms. (Fig. 7) In subsequent prototypes students were asked to analyze, adapt, and calibrate their initial studies to include a kinetic response to a stimulus - the body.

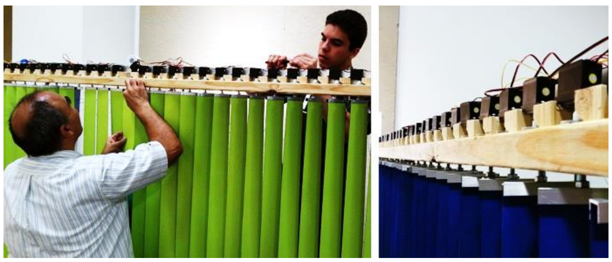


*Fig. 7 Kinetic Wall Installation – Student Work*

Throughout these later exercises students had to confront issues of human factors, ergonomics, and user interaction. These exercises are designed to build upon students' existing knowledge of parametric design and fabrication methods while introducing new concepts of interactive control and response. Students are challenged with calibrating the formal logics of their system with the physical constraints of material, construction and assembly. We have found that the communication between digital simulation and physical making early in the design process gives students the insight required to develop full-scale interactive prototypes. (Fig. 8)

*Fig. 8 Kinetic Wall Installation – Student Work*

For these particular case studies, the students explored the concept of Computer Vision. Computer Vision is a field of study that is interested in the processing, analysis, and understanding of images, similar to the abilities of human vision, by electronically gathering and understanding image data. The teams used Microsoft's Kinect for Xbox which tracks human movement and skeletal data through an infrared camera embedded in the device. Iterations on the working prototype require students to use a participant's skeletal data as the primary means of controlling movement. The added layer of human interaction challenges the students to analyze and calibrate their prototype to respond to the scale of the human body, complexity of interaction, and human behavior-issues applicable to contemporary practice in architecture and interactive design. It is exciting to see the students realize the scale of the body and recognize their own behaviors relative to the space and objects around them.

## EEG Kinetic Skin (Case Study 2)

The *Mind Manipulator* is an interactive wall using a participant's brainwaves to control a kinetic skin. The *Mind Manipulator* uses NeuroSky's Mindset, CNC foam insulation, LEDs, and an MDF base. (Fig. 9) Similar to *Playscape*, this case study began as an investigation in dynamically controlled geometric patterns. Once a catalog of patterns had been developed students were asked to analyze and translate their systems into physically responsive prototypes. Students explored various methods, some of which required multiple servos per module to stretched, fabric-based components. Through several material and kinetic studies, this team developed a system that was able to reduce the amount of parts used while maintaining the resolution of the pattern. The final prototype used stretched fabric, controlled through a series of hidden servos, to reveal a CNC patterned relief. This process challenged students to consider issues of material efficiency, fabrication, and assembly while maintaining design intent.

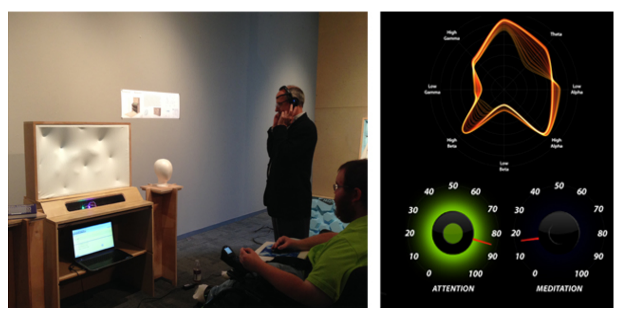



*Fig. 9 Mind Manipulator Installation – Student Work*

In subsequent research the team investigated the concept of brain-computer interfaces (BCI) as a method of interaction. BCI is a field of study investigating the communication between the brain and external devices. BCI gives designers the ability to analyze and rethink the relationship between the mind and its environment. For this case study the team used NeuroSky's Mindset. The Mindset is a commercially available EEG, electroencephalograph, headset that records and monitors users' brainwaves through a single dry electrode. Included with the Mindset is NeuroSky's proprietary algorithm which calculates user's attention and meditation levels. The team was challenged with understanding the relationship between one's mental state and the environment or objects around them. Through a series of interactive brain training games and physical models the team was able to calibrate their initial prototype to allow seamless communication between a participant's mental activity and the servos controlling the tension of the fabric. As a participant enters into an attentive state servos pull on the fabric revealing the patterned relief. The more attentive a participant is the greater the resolution of the pattern. Conversely, as participants enter into a meditative state the fabric is relaxed, returning to its unstressed state. This case study reinforced the concept of the body as an extension of space. Throughout the process students were able to acquire, visualize and monitor a participant's brain activity relative to their environment, requiring the team to rethink previous assumptions on human behavior and interaction. The dialog between data, experience and interaction proved effective as a strategy for introducing interactive environments as the communication between devices, spaces, cities and people.

## Bio-Feedback Installation (Case Study 3)

*Pulse Pavilion* is an interactive spatial installation inspired by the effects of anxiety and stress on the body. For this case study students were interested in understanding how to spatialize data and how to form a closed feedback loop between the body, emotion, data and space. This case study began a graphic exercise in visualizing multiple dynamic datasets. During these exercises students explored various parametric strategies for visualizing data in *Grasshopper* and *Rhino*. Throughout these exercises students focused on parsing multiple sample data sets to test multiple visualizations that could inform the final project. As the complexity of human interaction was introduced, students were challenged with gathering data based on a user's anxiety and stress levels in addition to developing an intuitive interface for interaction. After much research in sensor design and biofeedback strategies, the students developed a glove that could monitor a user's pulse with the use of an integrated optical heart rate sensor. The glove is attached directly to an Arduino microcontroller that feeds the data in real-time to *Grasshopper*. Once the data is parsed in *Grasshopper*, students can use this data to control their visualization studies. (Fig. 10)

*Fig. 10 Pulse Pavilion Installation – Student Work*

Furthermore, students were interested in presenting their data as a spatial construct to form a closed loop between the user, data, perception, and space. During this investigation the students tested multiple projection, sound, and material strategies for representing their data as a fully immersive experience. In the final iteration of this investigation the students developed an inhabitable space made out of wood framing elements, tulle fabric, speakers, and a projector. The final project allowed users to inhabit a 5'x10'x8' spatial projection of their real-time data, creating a closed loop between the body, data, and space.

It is the balance between technology, behavior, and human interaction that allows the project to communicate effectively with its participants.

## EEG Performance (Case Study 4)

*Brain on Dance* is an interdisciplinary research collaboration between the fields of Architecture, Neuroscience, and Dance. This interactive performance uses a dancer's brain activity to create a real-time emotionally responsive environment. Like the *Mind Manipulator*, *Brain on Dance* uses BCI. In this case, BCI gave us the ability to analyze and rethink the traditional relationship between the body and space. (Fig. 11)

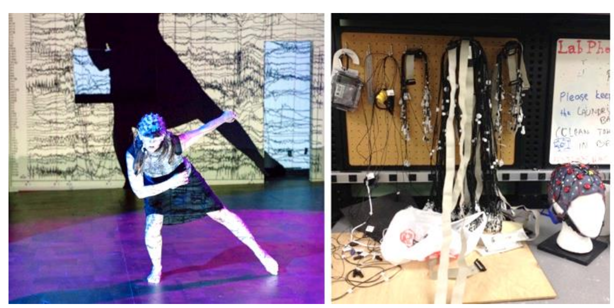


*Fig. 11 Brain on Dance Performance*

For this collaboration our team used a wireless 64 electrode EEG (electroencephalograph) skullcap that collects and transmits a user's brainwaves to a laptop. This investigation began by researching Laban's Movement Analysis, which is a method of visualizing, interpreting, and notating various types and degrees of human movement. In this method, movement is categorized by a combination of action efforts Laban labels as float, punch, glide, slash, press, etc. Our research team developed a series of algorithms and graphic representations that paired the brain's emotive state with physical movement based on Laban's action efforts. These algorithms and graphic representations were then translated and used as commands to control the hue, saturation, and intensity of the stage lighting providing a real-time interactive environment based on the dancer's emotive and physical states. Additionally, real-time brain activity was parsed and projected to the backdrop to give the audience a glimpse of what is occurring in the dancer's brain in real-time. The software developed for this research forms a closed –loop system that allows the audience, performer, and environment to all become participants in this collaboration. (Fig. 12)

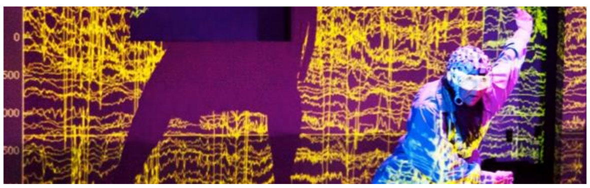


*Fig. 12 Brain on Dance – Image by Lynn Lane Photography*

## Outcomes

The final spatial, 1:1 prototypes promote cross-disciplinary exploration encouraging students to develop an architectural language based on aural, visual, physical, and anthropomorphic relationships while simultaneously communicating complex ideas of interaction relative to human behavior which can be both physiological and physical. All of the projects reinforce the concept of the body as an extension of space. Throughout the process, students have to rethink previous assumptions on space and human behavior.

*"The generalist designer must be able to meet the unforeseen demands of tomorrow and, thus, must be better prepared, and better educated and trained with a broader knowledge base including research, experiential experimentation, and an understanding of phenomenology. Just as earlier theories emphasized the need for building as a complete experience…life's activities are not to be seen as segregated or compartmentalized, but are to be understood as pervasive networks and systems. This requires an interdisciplinary and interdependent approach…Design education must embrace the interconnectedness of art and science, incorporate social and foundational knowledge and recognize the essential role of collaboration and teamwork."*[6]

These case studies illustrate a process of design research that integrates cross-disciplinary exploration in computation, user interaction, and engineering with methods of architectural thinking, making, communication, and fabrication. Combining interactive strategies with traditional design techniques as a method for introducing students to interactive environments has proven to be effective in several contexts.  In the hybrid design process, students understand these forces not as separate elements – abstracted from digital media - but rather as a layered system of complex interrelations.

The work in this seminar encourages students to think innovatively about the future of the built environment and the future role of the designer. The results are responsive, full-scale installations that reinforce design as the relationship between scale, form, materiality, perception, and experience.

## Conclusion

*"It is not enough to balance form and function, and it is also not enough to simply ascribe meaning. Design must now imagine all its previous tasks in a dynamic, animated context…"*[7]

*"The promise of our evolving supernatural facilities – thanks to a myriad imaginative prosthetic applications of digital technologies – demands that creative practitioners fully involve people in their development on both subjective and objective levels, enabling them to make their own connections between what are increasingly permeable cultural thresholds of perception and being."*[8]

Interactive architecture has the ability to transform the way people interact with those around them and the space around them. These projects rely on the performance of the participant and in doing so create new social relationships. We can imagine environments that are responsive to our actions, that communicate back to us, and that communicate with each other.

Looking ahead, those of us who teach beginning design students need to acknowledge the shift of the discipline to include expansive definitions of space, user, and designer. We need to prepare our students to think and to design architectural spaces as time-based, live, networked, dynamic organisms.

*"Increasingly, the personality of artefacts, whether objects or environments, is made up not only of appearance and materials, but also of behavior."*[9]

## Notes

[1] Shashi Caan. Rethinking Design and Interiors: Human Beings in the Built Environment. London: Laurence King Pub., 2011. P.170.

[2]Tala Klinck, "Body Performance, Boundary", Mori, Toshiko ed., Immaterial/Ultramaterial, Boston, Harvard Design School, 2002. P. 72.

[3]Mahesh B. Senagala, "A New Epoch had Begun", Fox, Michael, and Miles Kemp. Interactive Architecture. Princeton Architectural Press: New York. 2009. P. 250.

[4]Ibid. P.250

[5]Toshiko Mori, "Phenomena", Mori, Toshiko ed., Immaterial/Ultramaterial, Boston, Harvard Design School, 2002. P. 63.

[6]Shashi Caan. Rethinking Design and Interiors: Human Beings in the Built Environment. London: Laurence King Pub., 2011. P.176.

[7]Paola Antonelli, "Foreword", Talk to Me: Design and the Communication between People and Objects. Museum of Modern Art: New York, NY. 2011.

[8]Lucy Bullivant, "Alice in Technoland", Bullivant, Lucy ed., 4dsocial: Interactive Design Environments. John Wiley & Sons Ltd.: Chichester, UK. 2007.P.13.

[9]Masamichi Udagawa as quoted in "Alice in Technoland", Bullivant, Lucy ed., 4dsocial: Interactive Design Environments. John Wiley & Sons Ltd.: Chichester, UK. 2007. P. 13.

## Image Credits

Except where noted all images are student work done in collaboration with the authors.

## Selected Bibliography

Antonelli, Paola. Talk to Me: Design and the Communication between People and Objects. Museum of Modern Art: New York, NY. 2011.

Bachelard, Gaston, and M. Jolas. The Poetics of Space. Boston: Beacon Press, 1994.

Bloomer, Kent C., and Charles Willard Moore. Body, Memory, and Architecture. New Haven: Yale University Press, 1977.

Bullivant, Lucy. Responsive Environments: Architecture, Art and Design. V&A Publications: London. 2006.

Bullivant, Lucy. 4dsocial: Interactive Design Environments. John Wiley & Sons Ltd.: Chichester, UK. 2007.

Caan, Shashi. Rethinking Design and Interiors: Human Beings in the Built Environment. London: Laurence King Pub., 2011.

Dodds, George, Robert Tavernor, and Joseph Rykwert. Body and Building Essays on the Changing Relation of Body and Architecture. Cambridge,Mass.: MIT Press, 2002.

Fox, Michael, and Miles Kemp. Interactive Architecture. Princeton Architectural Press: New York. 2009.

Holl, Steven, Juhani Pallasmaa, and Alberto Perez-Gomez. Questions of Perception: Phenomenology of Architecture. San Francisco: William Stout, 2007.

Jones, Caroline A., and Bill Arning. Sensorium: Embodied Experience, Technology, and Contemporary Art. MIT Press: Cambridge, Mass. 2006.

Menges, Achim. "Integral Formation and Materialisation." In Computational Design Thinking. John Wiley & Sons, 2011.

Mori, Toshiko, Immaterial/Ultramaterial, Boston, Harvard Design School, 2002.

Oosterhuis, Kas. Hyperbody: First Decade of Interactive Architecture. Jap Sam Books: Heijningen. 2012.

Pallasmaa, Juhani. The Eyes of the Skin: Architecture and the Senses. Chichester: Wiley-Academy; 2005.

# The Potential of Drawing: Emergent Techniques

Meg Jackson, Michael Gonzales | University of Houston

## Introduction

Technology has blurred and expanded the definition, vocabulary and media of architectural drawing. While traditional drawing techniques continue to play a vital role in beginning design education; technological and cultural shifts require a reinvestigation of the role of the drawing in the design process. We must redefine the way in which we *teach* drawing as well as the way in which we *talk* about drawing to beginning design students.

This essay examines the greater potential of full-scale drawing by demonstrating three alternative methods of process and discovery. The projects help to develop unconscious drawing skills and mind/hand/eye coordination increasing the ability to think through one's hands.

Each of these drawing exercises purposefully anticipates digital thinking and digital processes of making. However, the projects are not designed as translations from analogue techniques to digital media. In fact, the drawing medium is somewhat irrelevant. Instead, these projects are designed as problem solving exercises which foster a conceptual understanding of computation as a medium.

All three case studies presented here are rooted in the traditions of 1:1, technical drafting. However, in each of these case studies drawing is celebrated as a physical act. The opportunity of these case studies is the focus on the performance and process of drawing as opposed to the drawing artifact. The methods presented in this essay are ongoing experiments in how to introduce the beginning design student to ways of seeing and ways of thinking by considering the spatial performance of drawing and a computational approach to design.

## Methodology

Architectural drawing is often seen simply as a medium for architecture. However, one can argue that architectural drawing and architecture share more than the connection that puts one in service of the other: each is dynamic, technological, and spatial.

The performance of drawing is itself a complex spatial investigation. However, conventional architectural drawings are static representations and the act of creating them is the process of flattening information. Introducing performance, time and event into the drawing process encourages the beginning design student to see drawings not as flattened representations but as complex, dynamic spatial ideas. In addition to gaining skills in graphic communication, students should develop ways of thinking in which choices of *how* to draw are as vital to design as *what* is being drawn.

The impact of the computer on architectural drawing and representation has changed the way architects design and think about space and has opened up many possibilities for the creation of complex geometries and advanced visualization techniques. However, more important to beginning design education is that computer drafting programs change *the way* drawings are created.

These case studies evolved out of the challenge to teach beginning design students how to understand the concepts of computer drafting – the systems used to create digital drawings. In order for a designer to have control over his medium, he must first understand the procedural logic behind the interface. Students must be taught to think, observe, analyze, and construct differently to anticipate the way in which the computer "draws". If students fully understand these concepts, they will be able to think critically about the process and regain control over the tool.[1] In these case studies, the actual drawing is handcrafted; however the way in which the drawing process is introduced is though the vocabulary and methodology of the digital medium.

The authors do not see this as a debate of the value of analogue versus digital means. Computational thinking must be introduced to beginning design students in critical ways independent of the medium.

However, while drawing methods should anticipate computational logic, drawing exercises should also be designed to increase the ability to think and to understand the visceral and iterative power of the craft of drawing.  The process of drawing, as the starting point of imagination, is the extension of a designer's thoughts.  Modernization of the medium--the pixel--has only increased the possibilities of drawing.

In all three case studies, the analytical potential of drawing is revealed through physical acts of making. These projects focus on the act of drawing not the drawing itself. In each case study, the complexities and abstractions of the drawing process are visualized physically. Drawing is understood as information -- a tangible system of relationships.

## The Measuring Machine (Case Study 1)

This project creatively and intensely engages students in the act of drawing in a tactile and visual way. This exercise focuses on the spatial translation from three-dimensions to two-dimensions. (Fig. 1) This exercise involves accurate measuring and the transcription of measured objects onto the 'site': the regulated drawing space.

This project originally started as a complex sectional dissection exercise first observed in graduate school at Columbia University and then adapted as a project for first year design students at several universities at which I have taught. In its current state, the project has evolved into a new drawing typology. What began as a way to visualize orthographic projection and how one would measure a three-dimensional object for two-dimensional drawings has become the motivation for the analysis. The apparatuses presented started as a way to secure the object into an active state and visualize section and have developed into complex, kinetic machines for measuring. (Fig. 2)

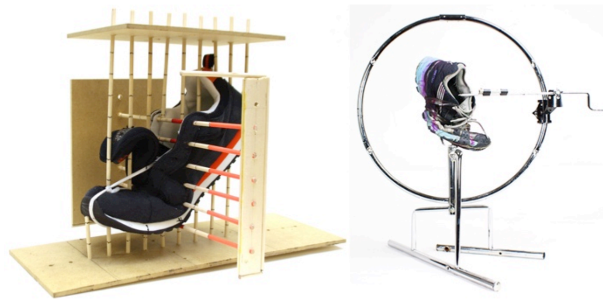


*Fig. 2 Measuring Machines – Student Work*

*Fig. 3 Measuring Machines – Student Work*

The first part of the assignment begins with securing the object in a "position of action" by positioning it in a way that allows for the exploration of a new idea about the object. The students must first consider the movement of, performance of, and forces on the object over time. The student's point of view is engaged from the beginning of the process. Students are then asked to discover and design a system of accurate measure-

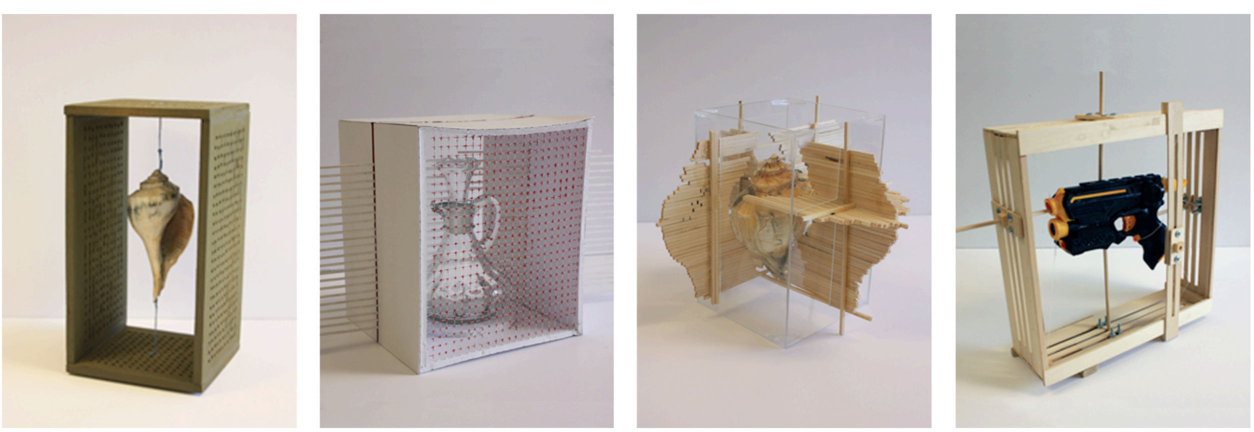


*Fig. 1 Measuring Machines – Student Work*

ment and build a machine/tool for measuring select profiles of their 'activated' object. (Fig. 3)

Privileging the process of measurement instead of the representation of the object challenges the limitations of two-dimensional drawings. This type of representation is dimensionally flattened as a matter of practice and efficiency, but it is also experientially flattened. Physically constructing the process of the dissection event allows for a complex understanding of three dimensional, spatial relationships beyond compositional layout.

In this case study, the act of drawing is understood as a network of data. Anticipating both manual and digital methods of articulating and generating space, the discussions focus on the concepts of systems, geometry, and order in spatial investigations.

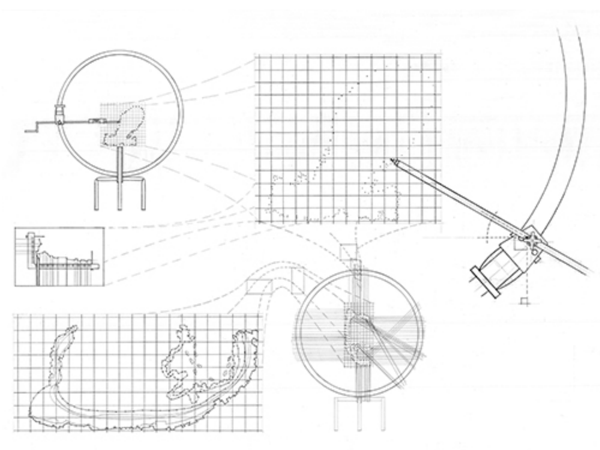


*Fig. 4 Measuring Machine Drawing – Student Work*

Throughout the investigation students are required to draw a series of sections and elevations whose composition and construction have a memory of the measuring device and the object. Each student has to develop a consistent system of measurement, mapping, drawing, and line weights to reveal the object. The sections are chosen in such that they investigate spatial relationships, construction, materiality, and topology. Success is measured by the individual's conceptual complexity, level of understanding and agility in exploration as well as the level of craft. (Fig. 4)

Additional variations of this exercise have been used to introduce complex geometries and projection theory to beginning design students. The machines are physical representations of the act of drawing. (Fig. 5)

The machine serves as a complex problem solving exercise with infinite unique solutions, yet a clear function and set of constraints. Its construction requires a 1:1 design build, material research and accuracy. The machine, which uniquely reveals both process and idea and is also purposeful, is an opportunity for the students to directly experience the process of making. The machine not only has to be a well-designed, well-crafted object but also has to be actually used by the student to accurately measure the profiles. The character of the student is evident in the personality of the final result of the machine.

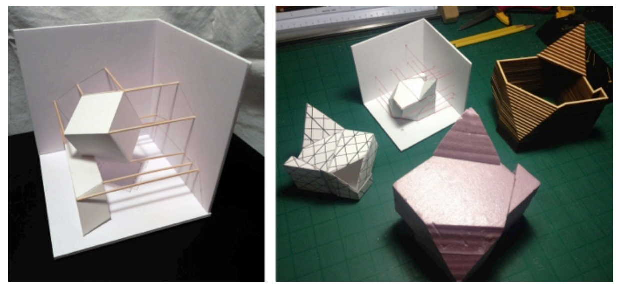


*Fig. 5 Projective Geometry – Student Work*

## Assembly and Dissection (Case Study 2)

Case study 2 is also a variation of a traditional 1:1, technical, analysis project. However, the challenge was to immerse our beginning students in digital modeling and drafting techniques in order to understand drawing, modeling, and assembly not as events disconnected from the design process, but rather as a layered system of active, spatial relationships. Although architecture convention is that the drawings precede the built work, current technologies offer a reversal of that process. Drawings are now constructed from digital three dimensional models. The concept of dissection – moving from three to two dimensions -- anticipates this digital process.

Students begin this exercise by translating their previously hand-drafted sections and plans into the computer. (Fig. 6)

These revised digital drawings serve as the basis for a newly constructed digital model. Through this process students are introduced to digital modeling and drawing techniques and the relationship between analog and digital workflows. From this newly reconstructed digital model, students dissect a series of section contours which inform the design of a hybrid three-dimensional drawing and model. Students must confront issues of material thickness, digital precision, dimensional tolerance, and assembly techniques throughout the development of their final project. By introducing digital workflows and fabrication as part of the design and drawing process, students are able to discover and understand the relationship between drawing, construction, material, and craft. (Fig. 7)

*Fig. 6 Assembly and Dissection Hybrid Drawing/Models – Student Work*

Teaching students to see three dimensional space as flattened representations can be tricky. In this project, instead of understanding planar line drawings as abstractions, students are forced to think critically about relationships in three dimensional space. Actively engaging in this discourse also advances the drawing process beyond representation.

Furthermore, contouring/dissection provides an essential graphic tool for understanding the manipulation of a surface and the concentration on the section cut allows the students to investigate the ways in which drawing can reveal topologies, spatial relationships, and construction information. Drawing the process of the dissection event allows for a complex understanding of three-dimensional spatial relationships and anticipates digital modeling.

Sequential sections are an important tool for students to understand the temporal conditions of space and more complex spatial relationships. Not only are the final constructs calibrated descriptions of the object, they also expose the productive, representational, and temporal possibilities of the section drawing.

## Drawing Machine (Case Study 3)

This exercise builds upon the two previous case studies understanding drawing as data and assembly with the added dimensions of time, motion, and interaction. As with the other case studies, the process of drawing is revealed through actual efforts of making.

The exercise begins with a brief introduction into simple machines and mechanics of motion. Developed in a workshop setting, students are asked to design a series of machines exploring the relationship between kinetic motion and drawing. The drawing machine, which uniquely reveals process, time, and motion, is an opportunity for the students to directly experience the mechanics of drafting as a spatial condition.

The project reveals the algorithmic choreography of drawing. The students must understand drawing as a data set. Through the design of simple mechanics the students must map the data to reveal the drawing. (Fig. 8)

In subsequent exercises students are introduced to advanced concepts of user interaction, sensor networks, and environmen-

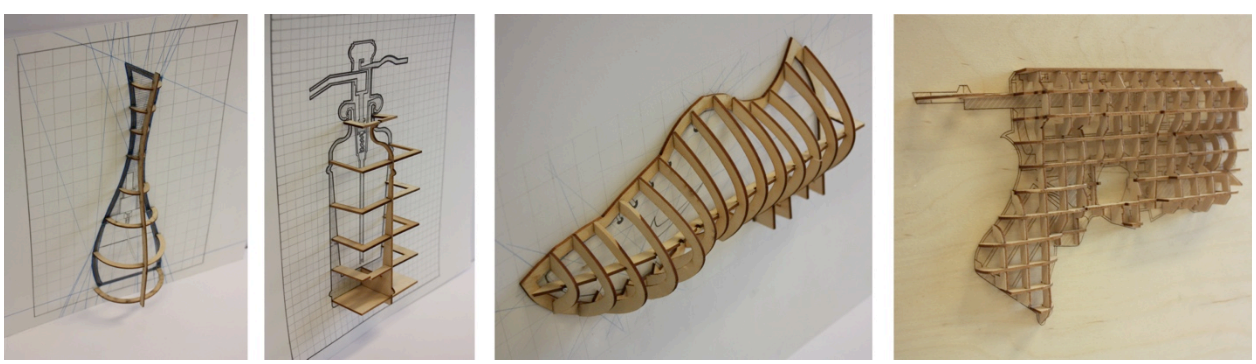


*Fig. 7 Assembly and Dissection Hybrid Drawing/Models – Student Work*

tal data through the use *Grasshopper and Firefly*, a parametric 3D modeling software and graphic programming interface. Full-scale, interactive prototypes allow students to create and manipulate digital information through a physical interface. Through this process students are challenged to rethink the mechanics through this added layer of interaction. These investigations introduce and explore drawing not only as a method of documentation and assembly but also as a complex interrelationship between participant, representation, interaction, time and motion.

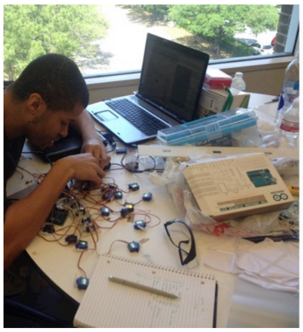


*Fig. 8 Interactive Drawing Machines – Student Work*

## Conclusion

In conclusion, the three case studies presented here are investigations into ways of introducing architectural drawing to beginning design students. The projects reveal the complexities of the process of drawing. The projects acknowledge the value of drawing and anticipate the influence of technology. While most of the projects are hand-drafted, each of the methods encourages a conceptual awareness of computing as a medium. Through these active, multi-layered, problem solving exercises and definitive abstractions, the students understand drawing as an analytical tool. Complex processes are rigorously engaged through thinking and making in a highly tactile and tangible way.

1:1 applies not only to the scale of the representations, but also to the scale of the process – defining, and perhaps evolving, the relationship between thinking and drawing.

## Notes

[1] Nicholas Senske's essay outlines an excellent argument for computational thinking in architectural education by linking computational thinking to digital craft. Refer to Senske, Nicholas. (2014) *Digital Minds, Materials, and Ethics: linking computational thinking and digital craft*, at CAADRIA 2014, Kyoto, Japan, 2014.

## Selected Bibliography


Belardi, Paolo. *Why Architects Still Draw*. MIT Press. 2014.

Cook, Peter. *Drawing: The Motive Force of Architecture.* Wiley: West Sussex, UK. 2008.

Diller, Elizabeth D. Lewis, and K. Shkapich. *Education of an Architect*. New York: Rizzoli International Publications, Inc., 1988.

Friedman, Jonathan. *Creation of Space: a Course in the Fundamentals of Architecture*. *Vol. 1* Dubuque, IA: Kendall Hunt, 1999.

McCullough, Malcolm. *Abstracting Craft: The Practiced Digital Hand*. The MIT Press: Cambridge, Massachusetts, 1996.

Menges, Achim. *Computational Design Thinking*. John Wiley & Sons, 2011.

Muckenheim, Mark, Demel, Juliane. *Inspiration.* BIS Publishers: Amsterdam. 2012.

Pallasmaa, Juhani. *The Eyes of the Skin: Architecture and the Senses*. Academy Editions: London. 1996.

Sheer, David. *The Death of Drawing: Architecture in the Age of Simulation*. New York: Routledge, 2014.

Senske, Nicholas. *Digital Minds, Materials, and Ethics: linking computational thinking and digital craft,* at CAADRIA 2014, Kyoto, Japan, 2014.

Spieler, Neil. *Architectural Design: Drawing Architecture*. Wiley, 2013.

Tschumi, Bernard. *The Discourse of Events.* London: AA Publications, 1983.

# 1:1 Scale Transformation

Meg Jackson | University of Houston

Weiling He | Texas A&M University

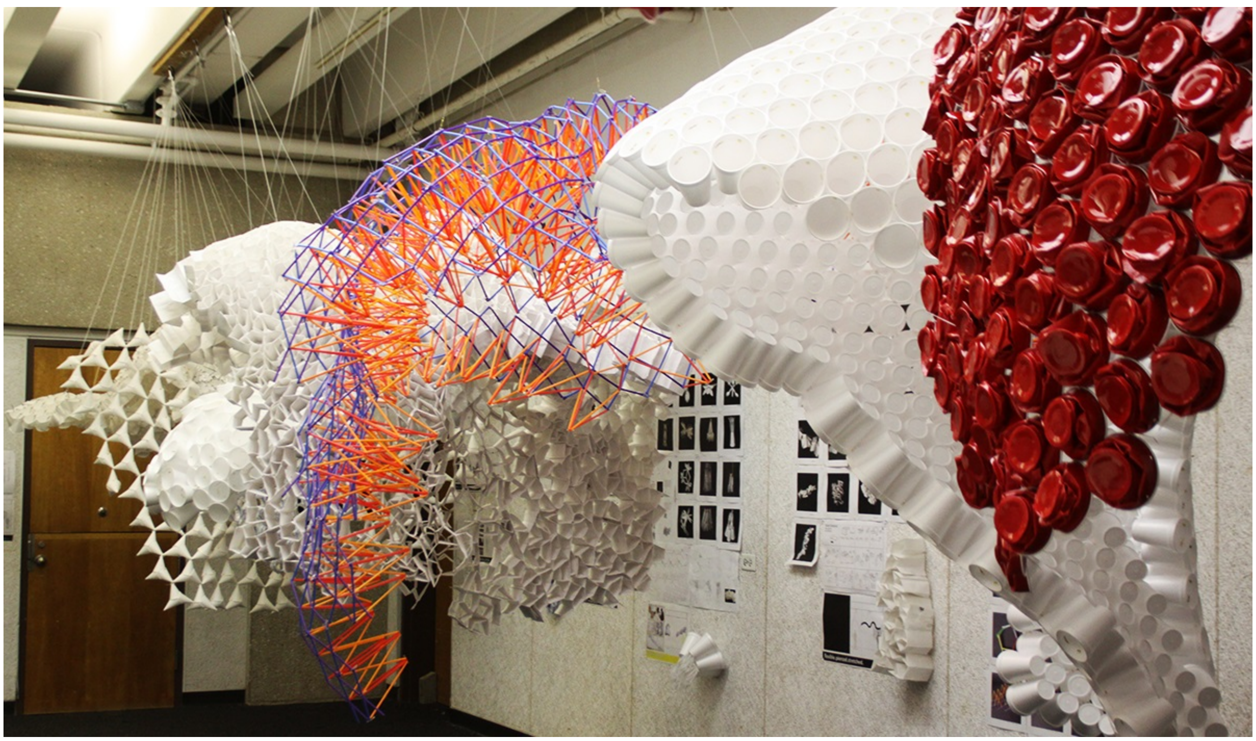


*Figure 1_ 1:1 Installations (Student Work)*

## Introduction

Through iterative acts of making, the 1:1 case studies (1) presented in this paper explore teaching strategies that embrace intuitive, yet rule-based, active approaches to learning. Students are asked to investigate, elaborate and implement complex attitudes towards materials and objects in space, especially as they relate to the human scale. The projects demand intense material investigations and iterative problem solving. The projects require the students to negotiate between the scale of the material and a scale relative to the human body.

*Introducing 1:1 Scale in Foundation Design*

It is through direct contact – physical, emotional, and of memory – and through direct problem solving that learning / understanding is created. In these 1:1 projects, students are not learning through inherited ideas but learning through individual problem creation and solution seeking. The students have to engage intuitively with an abstract concept as well as investigate an idea through a physical medium.

It is important to engage with traditional and emerging ways of making and material expression in a foundation curriculum. These 1:1 projects intimately connect students to materiality and gravity and the sensorial physical phenomena of the discipline. The projects challenge the students to transfer a complex, even abstract, idea into a full-scale design.

These projects operate on the premise that an architectural idea should not be an abstract thought but a material consequence – a material effect. The production of that material effect is the essence of architecture. Therefore, design is understood not as a representation of ideas but the physical consequence of them.[1]

The 1:1 approach to iterative, generative processes exposes beginning design students to methods of making, complex organizations, diverse materiality, alternative ordering systems, and construction tectonics.

The final installations, which uniquely reveal both process and idea, are an opportunity for the students to directly experience the process of making. The crafting of scalable materials reconnects the hands to the mind. By directly engaging with physical methods of making, students must confront issues of *"material behavior, fabrication constraints, and assembly logics which promote an understanding of form, material, structure and behavior not as separate elements, but rather as complex interrelations."*[2]

The case studies presented reveal teaching methods that increase a beginning design student's ability to think critically using rigorous generative processes. The work illustrated here emphasizes research, communication, evaluation, and problem-solving.

*Scale Inquires*

All projects begin with a 1:1 material and end with making a 1:1 space. The project brief is minimal. The students are to select an everyday, disposable object such as plastic ware, milk jugs, coffee sleeves, egg cartons, or boxes (2). They are to create a modular, aggregated surface at the scale of the human body that responds to the given site context.

Process is evaluated on the strength of the experimentation, intensity of the investigation, material manipulation, and innovation. Students document their process through sketching, diagramming, scale models, photography, and axonometric sequence drawings. Projects are evaluated relative to structural controls and formal assemblies, as well as the potential for spatial expression and creative problem-solving within the given constraints.

The final result is a 1:1 installation relative to the scale of the human body and the context of its site. The design investigations are 1:1 relative to the scale of the component object and the module. The design process operates within the dialogue between these scales.

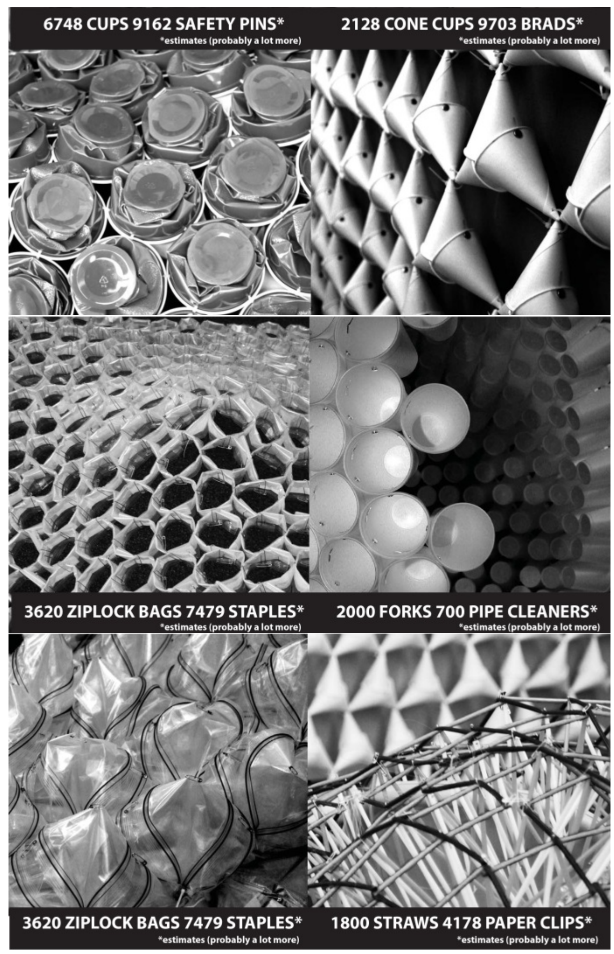


*Figure 2_Common Object Assemblies*

## At the Scale of the Component

The project begins with rigorous iterative experiments that are expressions of 1:1 material investigation and material performance. The final systematic assemblies explore 1:1 tectonic relationships and operate simultaneously at the scale of the object, at the scale of the module, and at the scale of the assembly.

These projects require that the students define a methodology and a systematic approach to the design process (3). Students are asked to develop rules, or strategies, which guide and organize their process of material transformation -- from the initial selected object to a structural module.

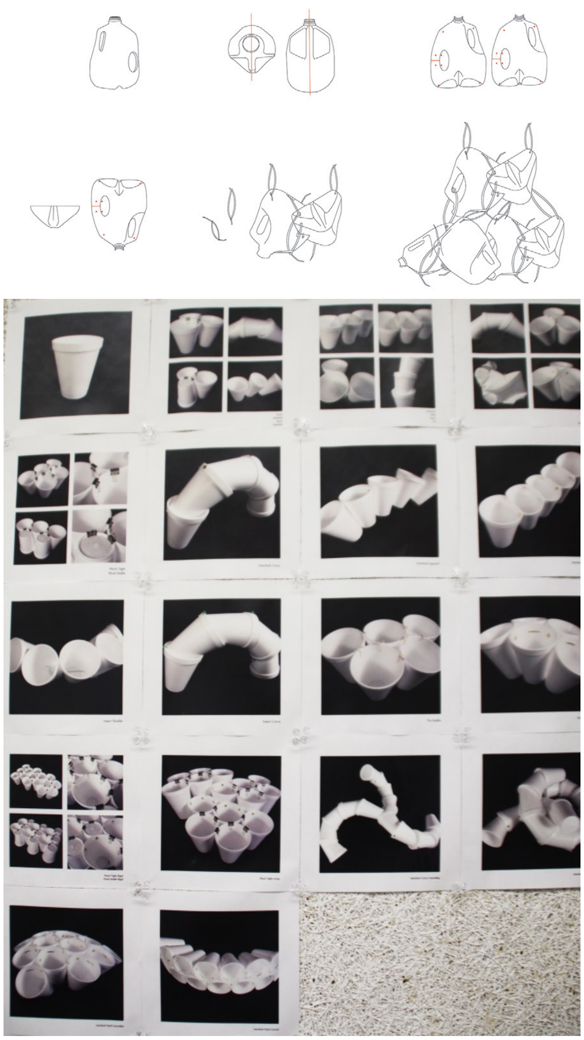


*Figure 3_Systematic Approach (Student Work)*

### *Material Scale*

Each common object has a clear original scale. Its function determines its construction, material properties, form, scale and identity. Students may transform the geometry of the component using measured, intentional, and precise operational techniques. The project challenges the logic, construction, materiality, identity, scale, and geometries of the found object, while revealing and extending its architectonic potentialities.

The component, a material with definitive limitations, offered an opportunity to unexpectedly manipulate an anthropomorphic, architectural research object at the scale of the human body to determine topological and functional potentialities.

During the investigation of a module's performance, many factors affect the resulting material scale including the material potential of the common object, the overall scale of the design, and production efficiency.

Each of the un-manipulated components have inherent structural integrity, however through the manipulation and accumulation of the component, its properties can be weakened or strengthened. Physical factors, such as strength and weight, are taken into account in the evaluation of the module. The structural potential of the module will determine the resolution of the final surface.

Besides physical factors and material potentials and effects, human factors, such as production efficiency, play a determining role in material scale. For example, in transforming water bottles, a student simply used the tying technique, utilizing the gradual shifting angles between bottles and the resulting overall curvature but avoiding the tedious cutting process. Material scale does not change in this case. However, the overall effect of the design is magnified (4).

### *Perception Scale*

Transformation happens both in reality and in perception. Between reality and perception, contrasting attributes exist in the same material, such as soft and hard, light and heavy, and flat and volumetric. In transforming common objects into modules and emphasizing their materiality, we discovered the important role that resolution of perception plays.

*Figure 4_Transforming material scale of paper cups (Student Work)*

The geometry of common objects is tied to their functional meaning. For example, a milk jug has a distinct cap, a neck, a handle, and a body. We understand what they are and what they are for. Increasing the amount, pattern, and repetition of common objects may change our perceptive resolution. Thousands of milk jugs together may resemble a pile of snow. The handles, from a distance, may create the appearance of softness in the eye. When a material is perceived in a new scale its resolution is re-defined and its appearance changes.

Through manipulating the component, one reinforces or weakens its original scale. For example, operations that expose the previously hidden interior space of an object reveal new qualities of that object. Repetitive systems that create equilateral, geometric modules, such as triangles and hexagons, cause the geometry of the module to dominate while the reading of the original unit of the object weakens (5).

*Figure 5_Perception of Modularity and its geometric aggregation (Student Work)*

### *Pre - Parametric Thinking*

These 1:1 modular investigations introduce beginning design students to not only traditional design processes, but also to parametric thinking, tectonics, and generative techniques. The investigations introduce concepts of tectonics, modularity, assembly, texture, and the manipulation of surface, pattern, and field. The design and performance of the surfaces are ultimately controlled and calibrated within the logic and geometry of the component's geometric parameters. Strategically layering and controlling primitives generate the installations; therefore, they have both rigorous order and parametric potential.

The simplicity of the common objects provides necessary constraints while at the same time their flexibility provides a potential for individual exploration. A system-based approach anticipates the need for beginning design students to connect with digital methods of making. These analogue projects are precedents for further exploration into complex computational geometries, parametric design, and digital fabrication methods.

In the 1:1 projects presented here, the material processes are time-consuming, yet their slowness offers considerable learning to the beginning designer. Students are able to thoughtfully consider the impact of time, choice, and the human dimension when manipulating materials with their own hands. Despite our own interest in digital tools, introducing the students to traditional techniques remains seminal, particularly since they will soon engage with the prevailing omnipresence of digital fabrication. Engaging materials with their hands, foundation-level design students form an emotional connection with their ideas, as well as a sense of authorship (6).

*Figure 6_Student assembling modules.*

*Module Systems*

Most of the material investigations focus on the connection details (7). These connections operate at two relative scales: at the scale of the designed module and at the scale of the surface assembly.

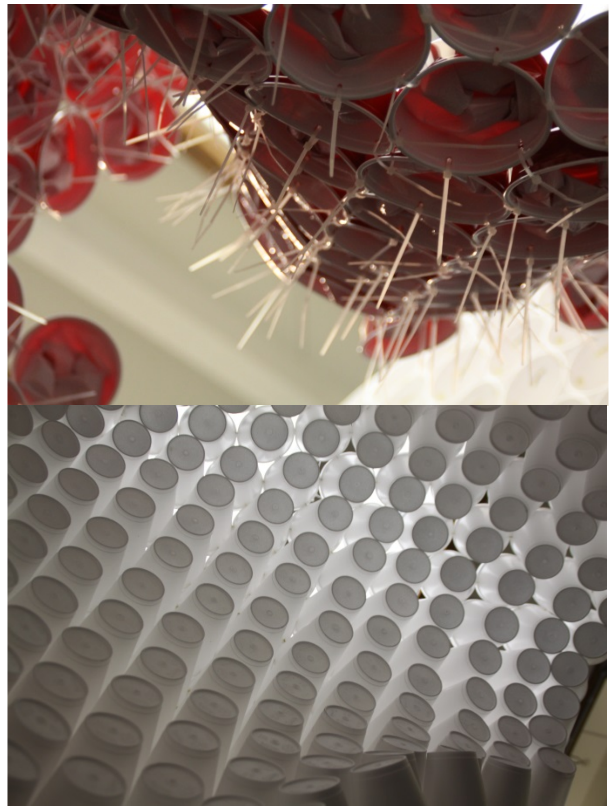


*Figure 7_ Tectonic Details | Figure 7_Surface (Student Work)*

These system-based explorations reveal the power of modulation as a space-making operation. Final installations, made by hand, even as a scale model, reveal the architectural implication of surface, as well as the ability of aggregated systems to define and make space. For students, this project serves as an introduction to the aggregation and tactile manipulation of two-dimensional materials as a full-scale approach to making space.

Once a module has been established, the focus turns to the performance of that module in an aggregated state and the system of joinery that creates the surface (7). The surface operates at the scale of the human body.

## At the Scale of the Body

Students are asked to investigate, elaborate and implement complex attitudes toward materials and objects in space, especially as they relate to the human scale. Learning through making allows for the investigation of the complexity of spatial human relationships beyond standard anthropometric tables and ergonomic requirements. Engaging directly with their own bodies moving through space and time and focusing on 'self', encourages a diversity of solutions. These 1:1 case studies provide alternative strategies to engage the students directly and actively with the complexities of spatial dynamics as related to human scale (8).

*Figure 8_ Surface enclosing the body (Student Work)*

A critical approach to making causes students to be aware of their bodies as a valuable reference point for understanding the complexity of spatial relationships. The process of creation leads to the discovery of the vital role that proportion, scale, and ergonomics play in design. The projects are in scale relative to the body that encourages the students to understand how the body is a measurement in relation to itself, other people, objects and surfaces affecting the environment: *"We behold, touch, listen and measure the world with our entire bodily existence, and the experiential world becomes organized and articulated around the center of the body."*[3]

*The Dynamic Human Factor*

In order to address issues of scale relative to the human body, students were required to do a series of diagrams during the design process (9). Diagrams have the unique capacity to dissect, layer, and process complexity that makes them a successful generative tool. The medium of drawing serves simultaneously an experimentation of graphic communication – media, hierarchy, technique, line weight and type, color, layering, notation—as well as an analytical, rigorously calibrated, precise drawing of the relationships between body, space, and time. The act and craft of making the drawing allowed for a deeper self-investigation resulting in a generative diagram and an ability to focus critical thinking. This type of analytic drawing offers a flexible, self-directed exploration based on solving a particular problem: *How to represent the complexity of the body in relationship to an object in space and in action over time?* Students develop a personal connectedness to the importance of human proportion, scale, *and* event.

The diagramming process promoted innovation—allowing each student to create an architectural

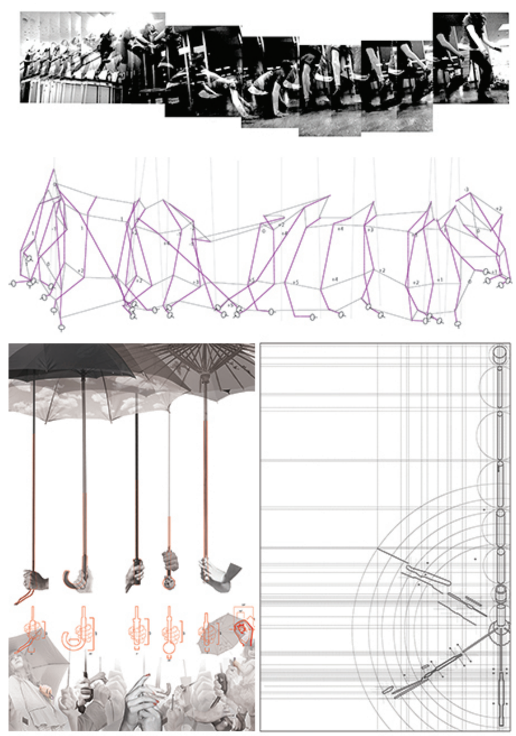


*Figure 9_ Diagrams investigating the body (Student Work)*

language to notate anthropomorphic measurements simultaneously communicating a complex spatial idea.

## At the Scale of the Site

All of the projects must respond to the context and scale of site. The original scale is relative to the scale of the common object. The assembled surface needs to adjust to the scale of the site. Both the scale and the identity of the common object are transformed with the context of the site.

Different spatial contexts demand different scales. In the physical world, one cannot escape from resolution and gravity in design and making. Resolution is a demand from the body's tactile and visual perceptions, and movement in space. Gravity constrains the structural existence.

In past iterations of these projects, we have experimented with varied scales of sites, such as the human body as site, interior spaces, spaces between buildings, and open spaces in nature. Each of these surfaces is relative to the scale of the human body. However, the object's scale changes relative to the scale of the context (10).

Perception scale also affects site scale. A site is composed of a hierarchy of space relative to depth, from the close up and immediate space to the farthest extension. Within this space, the viewer not only moves and senses, but also constantly makes references of the design in its site. Therefore, when one is at the periphery of the site or at a close distance to the design, he/she may perceive in difference scales. When being afar, the perception may be the overall formal logic of the surface, such as axis, datum, and direction. When moving closer, the perception may be an edge condition or a ground condition. Moving even closer, the perception may be the geometry of the modules, and eventually the tactile qualities of the material when sight is replaced by touch.

*Scale Models*

Iterative scale models were required in order to address these factors of scale early in the design process. As part of the problem solving process, the students are required to do multiple iterative scale models of their full-scale designs (11).

These intense, hand-crafted, working models allow us to address issues in studio beyond the component manipulation early in the process. They allow the students to set a goal for their projects and serve as physical evidence of the design development and process. Since the projects often require the students to engage with the site-specific context and have a relationship with the neighboring installation, the scale models are useful in group studio discussions. Unlike drawings, which were also required, working models are easy to refer to and access projects quickly.

*Figure 10_Project made from coffee sleeves in various contexts. (Student work)*

*Figure 11_Scale models with finished installs. (Student Work)*

Perhaps the biggest consequence of the scale models, however, is their value in teaching a design process – a systematic approach to the development of an architectural idea. Problem solving exercises with no formal methodology for the design process may miss opportunities for learning. While simultaneously addressing 1:1 material investigations, the scale models are necessary design tools to develop and evaluate concepts. The working model helps the student visualize his intent and helps to actively reflect on that idea (12).

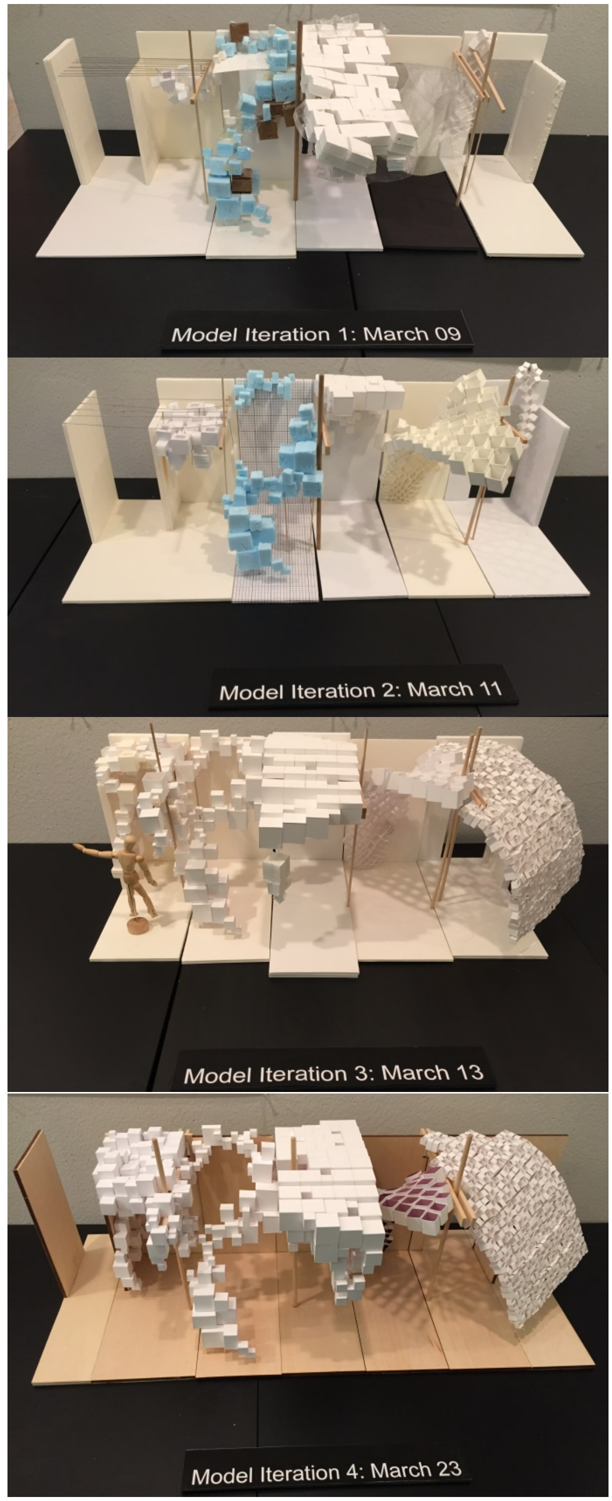



*Figure 12_Iterative Scale models (Student Work)*

Models force students to physically commit to the act of making. By organizing the design process and making it more transparent, the models helped the students visualize the potential of the abstracted architectural problem.

At the end of the project, the iterative scale models gave the students a clear look back at their design process. While the project outcomes were a source of pride, the rigorous process remained equally important in the evaluation and, more importantly, to the students.

The case studies presented are consciously full-scale at 1:1. During the design process the students were required to make scale reference models (1"= 1'). By working at both scales and having the unique opportunity to have their ideas "realized" at full-scale, the students perhaps understand the 1:1 scale more concretely and have a more intense appreciation for scale architectural models (13).

*Figure 13_Scale Translation | Scale Models with the full-scale install. (Student Work)*

## The importance of Iterative Process and Generative Design

The ability to think critically is the means by which designers observe, learn, investigate, and innovate. Accordingly, the responsibility of the educator is not simply to teach design as a *product*, but rather as a complex *process*. To that end, exercises must be designed not to encourage a finite conclusion, but, rather, to establish a limitless territory for exploration through iterative process, evolution of thought, and individual expression.

While the 1:1 case studies presented in this paper are somewhat abstracted from the realities of architectural construction, the projects define a systematic design process. Complex processes of translation are rigorously engaged through thinking and making. These acts are fluidly, freely, and independently advanced, moving between mediums in two- and three-dimensions. Likewise, thinking skills that prepare students for computational methodologies are embedded within the design process. Self-directed experimentation and innovation is encouraged to achieve a level of understanding beyond the familiar. Furthermore, the project begins and ends with the potentiality for discourse beyond both merely the original problem and the finite solution.

## Conclusion

In conclusion, we believe making is inextricably linked to architectural thinking. The process of each project produces analytic inquiry, and learning is made more effective because it is fueled by the promise of curiosity and discovery. Using a 1:1 material to make a 1:1 space demands scale transformation as well as transition from one kind of realness to another. In such transformation and transition, students establish a new materiality in an expanded context (14).

These case studies illustrate a process of design research that translates ideas into spatial, tectonic, and formal strategies while seamlessly integrating various methods of making, tools and techniques. Thus, beginning design students understand the act of design and the process of making as a dynamic shifting field, rather than as an autonomous act.

The body's relative size in space derives the literal scale. However, the body is more than a relative measurement. The human body does not solely influence scale and geometry, but also is a dynamic factor. Movement, time, experience, and memory influence the design.

Material iteration and re-iteration lead to a sequence of transformations: of itself, the space, and spatial effects. Processes of material transformation present a dynamic between resistance and expression. Starting from the initial state of materials, the design process involves rethinking and testing architectonic potentials. Form making obeys material limitations and opportunities, weight and gravity. The accumulated consequence of the final assembly may not resemble the initial material, but is itself a new material effect.

In addition, although representation, technique, and medium are necessary tools for fluency in the design process, as educators, we are responsible for the development of a design approach. Design, whether considered a noun or a verb, is a process – the act of making. The education of a designer must focus on applied and theoretical methods of making as well as aid in developing an emotional intelligence for design. We should actively and creatively engage students in ways of making while teaching ways of seeing.

Through iterative acts of making, the case studies presented here explore teaching strategies that embrace intuitive, yet rule-based, active approaches to learning.

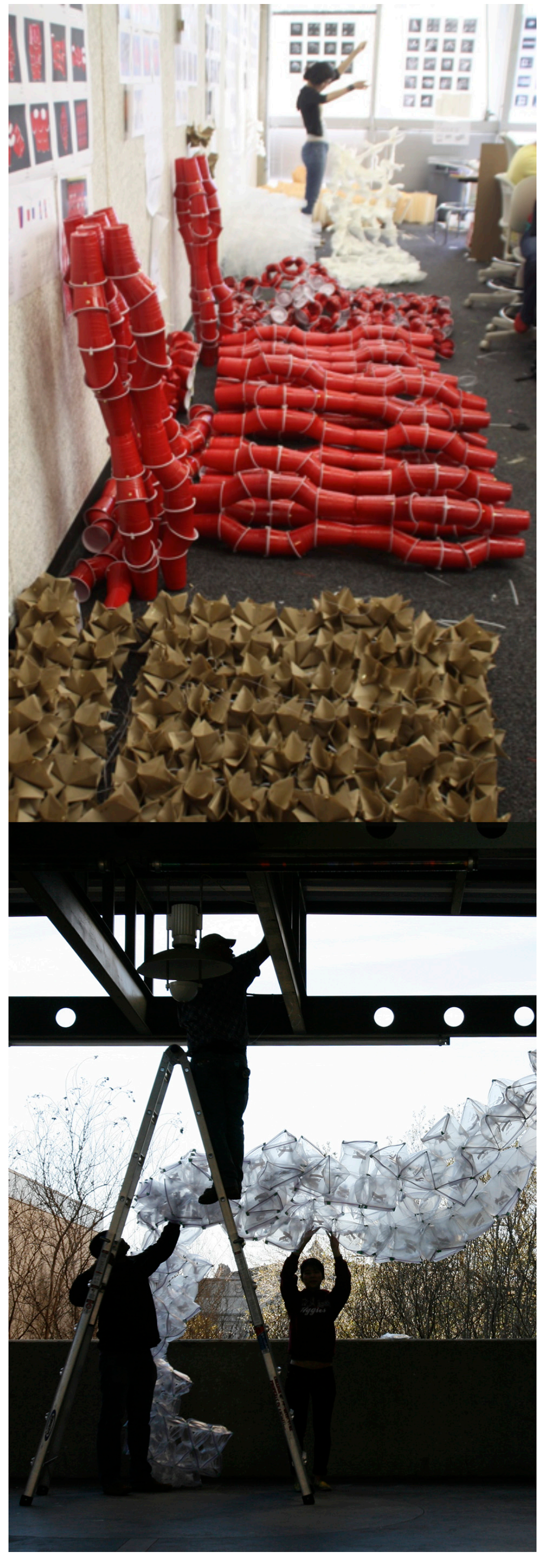


*Figure 14_Making*

## Notes

[1]Attributed to Jeffery Kipnis in Anthing Discussion 3, *Anything*, ed. Cynthia C. Davidson. The Anyone Corp.: New York, NY. 2001. p 129.

[2] Menges, Achim. "Integral Formation and Materialisation" In *Computational Design Thinking*. John Wiley & Sons. 2011

[3]Pallasmaa, Juhani. *The Eyes of the Skin,* Wiley-Academy: Great Britain. 2005. p 64.

## Selected Bibliography

Bachelard, Gaston, and M. Jolas. The Poetics of Space. Boston: Beacon Press, 1994.

Bloomer, Kent C., and Charles Willard Moore. Body, Memory, and Architecture. New Haven: Yale University Press, 1977.

Caan, Shashi. Rethinking Design and Interiors: Human Beings in the Built Environment. London: Laurence King Pub., 2011.

Clayton, Martin, and Ronald Philo. Leonardo da Vinci: The Mechanics of Man. London: Royal Collection Enterprises, 2010.

Diller, Elizabeth, Ricardo Scofidio, and Georges Teyssot. Flesh: architectural probes. New York: Princeton Architectural Press, 1994.

Dodds, George, Robert Tavernor, and Joseph Rykwert. Body and Building Essays on the Changing Relation of Body and Architecture. Cambridge, Mass.: MIT Press, 2002.

Gropius, Walter and Arthur S. Wensinger. The Theater of the Bauhaus, The Johns Hopkins University Press (Reprint), 1996.

Holl, Steven, Juhani Pallasmaa, and Alberto Perez-Gomez. Questions of Perception: Phenomenology of Architecture. San Francisco: William Stout, 2007.

Kieran, Stephen and James Timberlake, Refabricating Architecture. McGraw-Hill, 2003.

Lavin, Sylvia. Kissing Architecture (POINT: Essays on Architecture). Princeton University Press, 2011.

Mori, Toshiko Immaterial/Ultramaterial (Boston, Harvard Design School, 2002)

Pallasmaa, Juhani. The Eyes of the Skin: Architecture and the Senses. Chichester: Wiley-Academy; 2005.

Pye, David, The Nature and Art of Workmanship (Cambridge, Cambridge University Press, 1968)

Tilley, Alvin R.. The Measure of Man and Woman: Human Factors in Design. New York: Wiley, 2002

# The Reconaedicule: Everyday Objects as Design-Build Agents

Frank Jacobus, Marc Manack, Jon Boelkins, Alison Turner | University of Arkansas

The *Reconaedicule* (pronounced "re-con-et-ick-ule") was a design-build project given as a first assignment in our second-year design studio that emphasized design as the byproduct of resourcefulness, observation, intelligence, and collaboration; setting the tone for the year's work. The name of the project is a portmanteau of the words 'reconnect' and 'aedicule'. This was a team project (5 or 6 person teams) within which the individual students were responsible for bringing numerous design and fabrication ideas to the team, eventually refining those ideas into a single proposal in the course of the first two weeks.

The assignment required that the *Reconaedicule* was to be built using everyday materials, including potentially found materials. The student teams were given twelve sites throughout the School of Architecture and asked to carefully consider the site as having a direct impact on the resultant form. As a part of the process each student team was asked to develop a system of material aggregation alongside a vision for the form and effect of the entire assembly. A simple program was given which asked the students to consider the architecture they were constructing as a gravitational force that brings two strangers together to sit and talk; a loose rethinking of a Catholic confessional. In this spirit two spaces were to be provided, one in which someone could sit for a longer period, and another which an individual could move through more quickly.

This project required that the students engage in a deep curiosity about the world of objects that surrounds them. In other words, we asked the students to become the alchemists of contemporary culture and to remember that everyday objects - whether coat hangers, plastic bottles, or more normative construction materials - are themselves designed things. We often reify these common objects, accepting them as a natural (and somehow original) part of our environment. These everyday objects form the patterns and structure of our spatial world, yet we typically give little thought to the effect they have on our daily conceptions. A repositioning of these everyday objects has the power to create the unexpected from the familiar, displacing life's normative rhythms and offering new life to those objects whose aesthetic nuance is neglected by virtue of its everydayness. There is an exciting promise to this process that intimates other potential lives within everything that surrounds us; new forms waiting to emerge.

As a first project in Second Year studio the faculty believed that a pared down programmatic approach was best. As mentioned above, the students were given a simple program and clear constraints as to the material usage: they were allowed to use no more than two materials and the final object had to fit within an 8'x4'x8' dimension. These material and programmatic simplifications were essential so that the students could get right to the heart of the problem: learning how to maximize material effect in service of relatively direct programmatic desires. Without being bogged down in material choice or mired in programmatic complexity, the students were able to relax and iterate the simple material palette and corresponding form numerous times to achieve a high level of refinement.

Even though this was set up as a team project, the initial process involved individual students within the teams building small scale study models and proposing material assemblies that the entire team could discuss along with their professor. This allowed numerous options to be on the table in each team from the start. Knowing that this can often be a contentious process where individuals do not want to let go of ideas that become less popular in the group we made it clear as faculty that we cast the tie-breaking votes and have the final say on the approach. This cleared the way for open discussion and for the most part there weren't many hurt feelings from students whose initial ideas were passed over. Once we had met a few times and looked at ideas coming from the individuals within the team, we quickly determined the best approaches and began to work on only those as a team. This allowed an abundance of formal exploration on one or two primary material ideas which afforded deep discussions of space, form, and assembly details. This process offers multiple opportunities for buy in for those students who may initially not like the direction as they now have an opportunity to transform the team's selected idea into something better than the original premise. The entirety of this process was approximately 2-3 weeks.

One of the great advantages of design-build projects, especially for newly developing architecture students, is the demand that this type of project makes on their understanding of the relationship of drawing to building. In other words, by being forced to build at full scale and having used drawings as a means of arriving at that end, teaches the students a great deal about the potential deficiencies of drawings to explain how something will be constructed. Drawing wasn't the only means of exploring the final built object in our case but it was enough a part of the process that students learned about some of these deficiencies during the build. For instance, we had teams that used drawings to help establish material quantities. In a somewhat hand-off manner we spoke with the individual student teams about whether they had calculated their material needs and how they were using their drawings to do so. One of our teams, even after using a digital three-dimensional model to calculate material needs ordered only half the actual material they needed to complete the project. Many other teams were using the build process itself to determine how to fasten pieces of the Reconaedicule together. This is not to say that drawing has to solve every building program, but the project is a good introduction to beginning design students about how clear and descriptive one has to be with their drawings in order for there not to be a litany of unanswered questions during the build.

Related to the idea of drawing is the transition and projection of scale that takes place in this type of project. We were told by our First Year teaching colleagues that this particular group of students had difficulty understanding scale in previous projects they had done. This in part drove our desire to begin with a project that dealt with scale in a direct and physical way. The Reconaedicule project offered an opportunity for the students to draw and model something at various scales that they would soon thereafter build full scale and inhabit. This allowed a quick conceptual transition from inhabiting models and drawings to feeling the presence of the actual space. As individual studio sections we had discussions with our students about the expectations they had as they evolved their designs versus the realities of the built spaces. We had the students produce representations of their Reconaedicules after they were built so that that which they learned from the final space and form could attempt to be translated into drawings that were intended as clear communication of the thing itself. This forced the issues of scale and representation to be reflected upon once more as the students now stepped away from the full scale construct and had to scale down to determine how to best communicate their final results.

One of the larger pedagogical ambitions of the Reconaedicule project is that the students learn to see everyday materials in a new way. One could argue that their eventual charge and potential for success within the discipline of architecture is that they will be able to transform the everyday into something beautiful and meaningful. The vast majority of buildings that they will design in their careers will consist of *off the shelf* materials that they must creatively craft and configure to new ends. This project prompted that type of thinking. Students had a limited budget ($250-300) per team and so had to be resourceful when it came to determining which materials to use. Because of this, we had incredible invention taking place within the studio wherein materials that ordinarily wouldn't be considered for an architectural construct were now on the table. In one instance, the foam pool noodles used as floats in a swimming pool became the primary building material, while in another instance common household furnace filters were used to establish the overall working module for the final construct. It was this type of conceptual agility and ability to translate and project that motivated us to give the project in the first place. Below are descriptions of three selected projects out of the twelve in order to provide a deeper understanding of the processes and outcomes involved in the larger assignment.

## The Furnace Filter

In general, students took two approaches to the design of the Reconaedicule: exploring materials that suggest form or exploring forms that in turn suggest materials. The decision between the two strategies was more intuitive than rational, but proved to be an essential component of success as the project driven by material exploration rather than formal exploration was widely viewed as being the most successful, ultimately in both material and formal terms.

A team of five students focused their initial investigation on several found materials, but were unanimous in the interest in inexpensive furnace filters due to their availability, uniformity, as well as the quality of light they produced. The students quickly realized that the filters were available in dimensions that naturally coursed out to the maximum overall dimensions of 48" x

96” x 96” and set about producing a series of compositional studies that explored the variety of sizes available. The predictability and commercial availability of the material made estimating relatively easy.

*Fig. 1 Furnace Filter Pavilion*

Since inhabitation of the interior of the Reconaedicule was required by the project brief, the students also needed to determine how to incorporate openings, and while they explored a variety of possibilities that could be considered doors or portals, a short side was eventually left open, exposing a more sculptural interior made with quilting fabric draped and secured over chicken wire fencing, worked to define a pair of spaces for the occupants and an opening through the top. For each step in the design, the students prepared multiple models to study various filter sizes and configurations, at both full and reduced scale.

The full scale construction revealed the limitations of the material and their planning but the clear and inspiring nature of the design remained intact. The quality of the frame material for the filters was suspect and made for poor corners and joints. Since the overall dimensions were determined by the available sizes of the filters, the students had to work backwards to determine the dimensions for the simple wood-framed structure behind. Errors in these calculations produced gaps at the corners that were not intended.

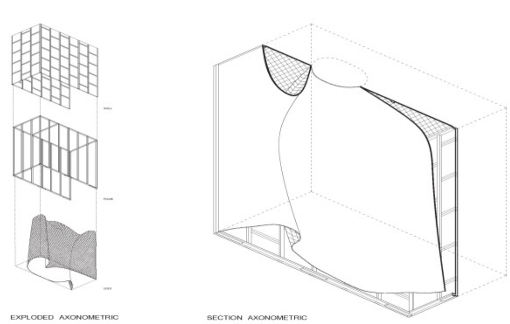



*Fig. 2 Analytical Drawing of Furnace Filter Pavilion*

Ultimately the students learned the evocative power of studying a material or product and both its capacity and limitation for inspiring and producing form. A simple furnace filter inspired a commitment to a quality of light and ephemerality that was a constant requirement of the evolving design. Students experimented with a variety of details and configurations to ensure that the form produced the right amount of light while using the limited material palette according to a quickly developed set of principles.

## The Fay Hay

In the first phase of the project, one of the students proposed using pillows as their modular building block. The team was intrigued by the idea of using an everyday item that, while modular and stackable, was also very pliable and somewhat unpredictable. After doing some initial research, the team concluded that the number of pillows needed to build a full scale structure would be cost prohibitive. The team then went about finding an alternate solution that would give them the same results of pliability and unpredictability. The most obvious next step was to take pillow cases and stuff them with something else, which quickly led them to hay; an inexpensive and readily available material that would allow them to also experiment with the size of the modules. The more challenging task for this team was finding a suitable “cover” to contain the hay. They started with pillow cases, but the contrast of the refined fabric of the pillowcases against the coarseness of the hay. Next they tried burlap bags, which was a better fit with the hay but still note quite right. Finally, they discovered that they could make their own “pillowcases” out of chicken wire, which allowed them to use two materials that are typically both found on farms. It also allowed them to expose the stuffing of the pillow, or the hay, which changed the students’ perceptions of the project and led them on a slightly different path.

The next step was to work with the hay “pillows” to find the best way to stack them to create the Reconaedicule. The students discovered that stacking them in the tradition sense created a thick wall and took a significant amount of material to construct. In an effort to use the material more efficiently, the team realized that the chicken wire pillows could be set on their side and bent to create a module which in itself was structural. After much iteration, they settled on bending each module in a zigzag pattern and offsetting each course to give the overall structure stability as well. To ensure that the structure would remain standing, they tied each module together with wire. During the construction of the Reconaedicule, the students noticed that the structure became less stable as more courses were added. To create more rigidity, and to create a more interesting form, they started tapering each course slightly towards the interior making the overall structure more solid and also creating a form that was reminiscent of a bale of hay.

*Fig. 3 The Fay Hay Pavilion (detail)*

The results of the project were an interesting play on a hay bale. Instead of a solid bale of hay, the Hay Fay Team made this material light with two interior void spaces, where the users could inhabit the hay bale. The pliability of the modules created an interesting dynamic in the way they had a tendency to lean giving the overall form a dynamic presence. This projects success was in the process; having the students find (or create) a module from inexpensive materials challenged the way they looked at the materials and forced them to come up with their own solution to a problem that they created. In the end, the success of the Hay Fay Team was in their willingness to experiment with the materials to find a solution that worked for the team.

## Chicken Pom-Pom

This project began with a material technique that found form and function. For their initial proposal, one of the students produced a concept model of *pomping* – a construction of chicken wire with cells filled of bunched tissue paper typically used in making parade floats. The material effect conceals the appearance of the chicken wire, creating a continuous, textured, and supple quality.

*Fig. 4 Chicken Pom-Pom Pavilion*

The students agreed that this technique proved the most promising and got to work producing a design that worked to capitalize on the integral relationship between form and structure offered by working with the chicken wire. Together they develop an unfolding series of surfaces that transformed seamlessly from vault to walled enclosure, articulating the active and passive spaces. To enhance the effect of movement while creating distinct ambiances for each space, students developed a rainbow colored gradient pattern that worked with the “pomping” method.

This group worked with intense effort and enthusiasm during the construction, which was part in parcel with the collaborative nature of their construction method. The chicken wire substrate erected quickly, with the majority of labor in stuffing the tissue paper, work performed simultaneously by the entire group at once. Team Chicken Pom-Pom group grew to enjoy the act of making and final product equally.

## Coat Hanger Bird’s Nest

Though there were a few alternate ideas within the Coat Hanger team early on they were quickly abandoned for a final material palette using coat hangers. Several students in the five person team were working initially with wire as a strand and wire in the form of the coat hanger and became interested in the idea of lightness that these materials invoked. Even having arrived at the initial idea early, there were still numerous questions for the team to answer. Should they use coat hangers which would provide them a given form but potentially a more difficult construct due to the shape they would be dealing with? Would using spools of wire allow them more freedom in selecting their form and potentially even gauge or dimensional size of material?

Ultimately, after sourcing and pricing materials as well as assembling several full scale details, the team determined that they had what they needed in the coat hangers and knew, through experimenting with physical assembly, how to construct a basically cubic module with the hangers themselves. They calculated the total number of hangers they needed at 3,200 and began to source them from local dry cleaners.

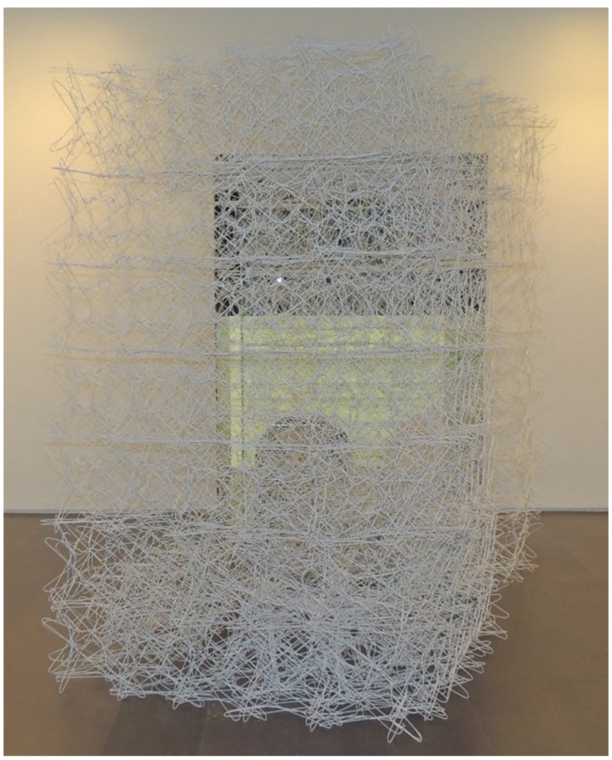


*Fig. 5 Coat Hanger Bird's Nest Pavilion*

It was clear early on that the cubic module formed by the hangers had a tremendous amount going for it in terms of constructability (a basic building block), formal aesthetic (a textile block of sorts), and spatial energy (a blurring but not disjointing of space). The team determined through much testing that the overall form needed to be more still and simple because the construct itself had a great deal of complexity so they opted to simply fill up the 8'x4'x8' space that they had been given.

The result of the project is a nested form that reads as white drawn lines in space – simultaneously solid an airy. A tighter nesting of coat hangers allowed for seating structure and obscuring of view from one module to the next. Most of all, the students learned that, as designers, they have the capacity to create an absolutely beautiful and mesmerizing assemblage from a material so common it hangs in everyone's closet.

## Conclusion

The Reconaedicule project allowed us to discuss issues of scale, tactility, tectonics, program, assembly, and the power of placing a new space within an existing one. Our beginning design students had to account for cost and material quantities while simultaneously thinking about how to transform common materials into something extraordinary. The project reinforced for the students that architects rethink the everyday, with each new conception, to ensure that life doesn't lose its mystery. In that spirit, the Reconaedicule project insisted that our students position themselves as contributors to the mutability of things, rather than passive observers of life's processes.

# Scan Fab: The Application of Reality Computing Technology in Design

Gabriel Kaprielian | California Polytechnic State University, San Luis Obispo

## Introduction

**1:1** scale evokes a sense of materiality and structure, rooted firmly in the physical world. Yet, the design process to realize full-scale work is increasingly completed in a digital workspace, apart from the laws of physics, constraints of scale, or materiality. In the architecture studio, students are spending a disproportionate amount of time developing their designs on the computer. Physical models are more often being fabricated as the end result of a digital design process. In this case, the hand is tasked with solely assembling pieces together, rather than developing a spatial awareness gained in the mind and body relationship of designing though physical modeling. Moreover, students are designing increasingly complicated forms through digital modeling, but are restricted within the form generative tools of the software rather than exploring structure, material, and spatial awareness.

There has been a fine dance in contemporary architectural education balancing curriculum between digital and analog approaches to design; often siding more heavily on the analog or traditional approach in beginning design education. Many programs have integrated a combination of digital and analog design methodologies into 1st and 2nd year studios. However, these two modes of design are often still seen as separate, representing a duality in the process of architectural design. This points to a chasm that divides digital and physical design workflows in the architecture studio. Digital fabrication, both additive and subtractive production processes, has been the common answer to this divide. Yet until recently, it has served as a one-way bridge, leading only from digital to physical production.

With recent advancements in Reality Computing technology, the boundaries between the physical and the digital have blurred, creating new potential workflow methodologies. Antoine Picon spoke of this hybridization between ordinary and digital space being made possible through the development of sophisticated interfaces.[1] The application of Reality Computing technology in design is just such an interface that serves to "capture information about the physical world, manipulate and analyze the information digitally, and actualize the result back into the physical world," creating a workflow that serves to bridge between the real and the virtual.[2]

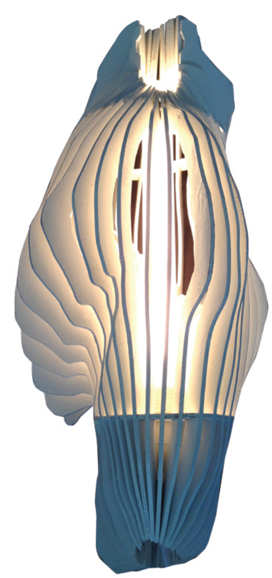


*Fig. 1 Scan Fab Lamp by Adrian Tsou*

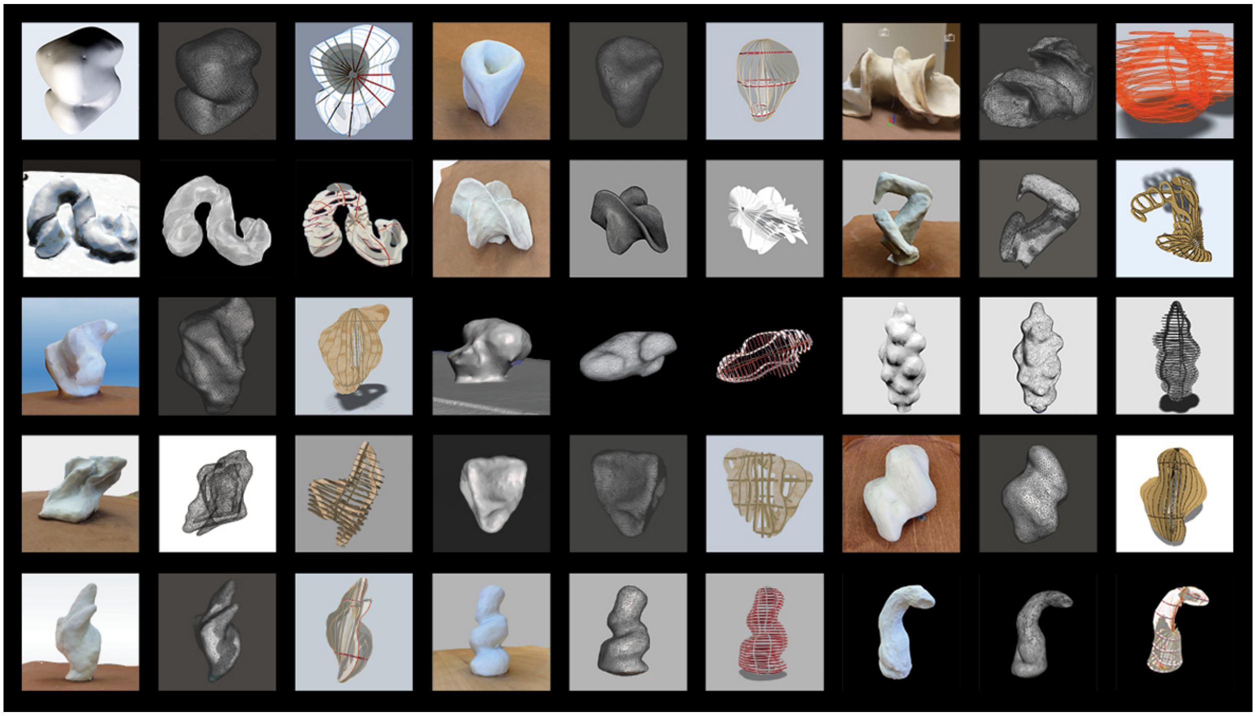


*Fig. 2 Scan Fab Lamp Process Boards: 3D scan of clay model with 123D Catch; digital mesh manipulation with Meshmixer; cut file preparation with 123D Make.*

In order to illustrate a demonstrated application of Reality Computing in design, I will use the *Scan Fab Lamp* project, completed by my 2nd year architecture students at the California Polytechnic State University in San Luis Obispo. In this project, each student hand modeled a unique form, which was digitized, modified, and fabricated to create a functional lamp. I will describe what we learned from the *Scan Fab* process, including the potential uses and current limitations, specifically in its application to beginning design.

To contextualize the implications of Reality Computing in beginning design education, I will attempt to elaborate on the discourse regarding computer-based design in the classroom and how the *Scan Fab* technique can assist in bridging the digital and physical divide. I will draw from the phenomenological arguments for a more haptic centered design process made by Juhani Pallasmaa, while posing a counterargument from Antoine Picon that advocates for an evolution of architectural design and production, as a result of the computer and digitization.

## The Thinking Hand

The prominent role given to the computer in the design process has found a number of critics, including architect and theorist Juhani Pallasmaa, who has written extensively on the bias towards vision and the suppression of other senses in contemporary architecture. This occularcentrism, as Pallasmaa describes it, is a result of computer-based design that "flattens" our "multi-sensory" perception by reducing the creative process to "a passive visual manipulation."[3] A digitally produced work leaves out the "thinking hand," which serves the role of connecting the mind and body in the process of design. This connection is essential in beginning design as students formulate a bodily awareness in spatial terms. Pallasmaa continues by stating:

> "The computer creates a distance between the maker and the object, whereas drawing by hand as well as model-making put the designer into a haptic contact with the object or space."[4]

With the *Scan Fab Lamp* project, students began the design process with sculpting form out of clay. By

*Fig. 3 Selection of Scan Fab Lamps; (top left and clockwise) Katherine Moore, Sophia Liu, Austin Kahn, Mark Luzi, Rachel Recksiedler, Juliet Luty, Jeffrey Baucom, Simone Miller, Tyler Kirkpatrick, Xian Chris Li.*

hand sculpting the form, students were able to use their intuitive design sense without the limitations of form generation through digital modeling software. This allowed students to create form complexity beyond their current skill levels. Rather than spending their time trying to master the software functions to create form, they were able to focus on the relationship between the mass of the clay object and the pressure applied with their hands and fingers to shape it.

Pallasmaa would describe this process of making as bodily identification, which incorporates multi-sensorial qualities in the design workflow relating directly to the way that we perceive the world around us. To touch and feel form with one's hands relays information to the brain in a different way than digital modeling on the computer. This haptic modeling process translates a sense of volume displaced by the shape of the object through the tendons, muscles, and nerves into the hand.

> "The hands are the sculptor's eyes; but they are also organs for thought…"[5]

Drawing heavily from Richard Sennet's writing on the importance of a hand and brain connection in both learning and making, Pallasmaa develops a thesis around the "thinking hand," which he describes as having its "own intentionality, knowledge and skills."[6] He places the hand as central to the role in the evolution of human skills, intelligence, and architectural production. Richard Sennett goes on to describe scientific studies that show how the use of the hand affects the way we think and learn.[7] The hand and mind connection, however, does not preclude the use of tools, which the computer can certainly be described as.

Tools are traditionally thought of as having a relationship as an intermediary between the body and the physical object that is being shaped. With the computer, we still have a hand and mind connection, but the object has been dematerialized in virtual space. It is precisely the goal of the *Scan Fab* process to make a physical connection with the object of design before it is digitized and disembodied. While the hand continues to modify the digitized facsimile of the object, it can still recall its shape and gravity through tactile memory in the senses.

## Between the Real and the Virtual

Architect and historian Antoine Picon presents a counterargument to the perceived "threat" of digital design to the field of architecture. Published over a decade ago, Picon's essay, "Architecture and the Virtual: Towards a New Materiality," has a certain prophetic tone. While describing the lack of concern for materiality found in many digital works of architecture at the time, he hints to the evolving nature of digital design in "reshaping, rather than an estrangement from, physical experience and materiality." [8] Picon alludes to the continuing development of digital interfaces, which may eventually bridge the gap between physical and digital modeling.

Picon concedes that the "computer breaks with the immediacy of the human gesture."[9] He describes a "thickness" inherent in digital design software that is not found in an analog and physical method of design. This thickness has to do, in part, with the biases of software towards certain operations. I would add that in beginning design this thickness could be associated with designs conceived primarily on the computer rather than in physical space. The hands, in this case, respond only to orders by the eyes and the mind and are not allowed to think on their own. Therefore, a deeper understanding of the spatial and tectonic qualities of the design is lost as this resides more intuitively within the purview of the hands.

For the *Scan Fab Lamp* project, I had students hand model forms out of clay for the quality of plasticity often attributed with advanced surface modeling in digital design. Picon also draws a parallel between clay modeling and the power of digital tools in the computer to model surface deformations and flows. He refers to early research conducted by MIT's Media Lab that sought to integrate clay modeling with digital modeling, likely an early precursor to the Reality Computing tools available today. He also talks about the Media Lab's investigations into digital gloves and tactile screens all aimed at combining physical and digital modeling.

Technology has progressed considerably since Picon's 2004 essay was written and now this hybridization of the virtual and real through Reality Computing is readily available in app form for your smart phone.[10] Utilizing these new technologies, the *Scan Fab Lamp* project seeks to explore the territory between analog and digital design workflow, combining haptic hand modeling with digital manipulation and fabrication, extending the realm of our senses through software interfaces.

## Scan Fab Lamp

The *Scan Fab Lamp* project was completed by 2nd year students in my Architectural Design studio course, during the spring quarter of 2015. This project was conceived of as a warm-up exercise that would both inspire the students and illustrate an alternative design workflow, which allowed them to digitize their conceptual handmade physical models. This is a similar process to that made famous by Frank Gehry's office, where the computer is seen not as a "medium of conception, but as a medium of translation" by digitizing physical models.[11]

Beginning first with sculpting clay form by hand, students used the concepts of Reality Computing to **Capture** (*3D scan clay models*), **Compute** (*manipulate digital models*), and **Create** (*digitally fabricate models as a lamp*). For the *Scan Fab Lamp* project we used Autodesk's 123D software for the Reality Computing workflow. While there is other software available, this choice was made based on its ease of use, consistent results, and availability as a free download.

*Fig. 4 Scan Fab Lamp by Emre Keskintepe*

The project steps are as follows:

*Sculpt*

The first step in the process began with the sculpting of a clay form by hand. This allowed for a tactile three-dimensional modeling experience that is unencumbered by digital modeling software. Beginning students were able to intuitively create form complexity with their hands that is beyond their current digital modeling skill level for any given software. The process of hand sculpting clay engages the "thinking hand," or as Juhani Pallasmaa might say, tapping into knowledge that "resides directly in the senses and muscles."[12]

*Capture*

Using Autodesk's 123D Catch software, which utilizes the Reality Capture technology of photogrammetry, students created 3D scans of their clay models. This process involved taking a series of photographs with a camera or on a smartphone application of the software, translating the physical form into a digital mesh facsimile. The capture technology is key to what Picon referred to as the "interface" to hybridize the real and the virtual. In this case, the 3D scan is the disembodied clay sculpture and represents the first transformation in the Reality Computing process. Results vary depending on

*Fig. 5 Shadows cast by a student lamp, Benny Lin.*

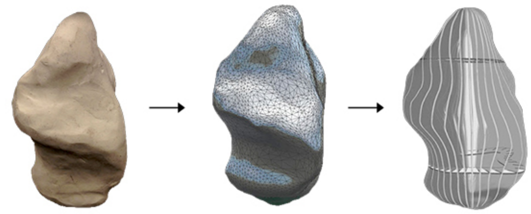


*Fig. 6 Clay model; digitized model (Meshmixer); digital fabrication model (123D Make)*

shape of the sculpted form and precision of the scanning process. Artifacts and imperfections are unavoidable, presenting either a challenge or an opportunity for further alterations.

*Compute*

The next step involved the manipulation of the digital mesh. Using Autodesk's Meshmixer software, students cleaned up the scanned mesh geometry and digitally edited the form with a variety of techniques to prepare it for fabrication. The mesh editing software allowed for a virtual sculpting process using a series of brushes to push and pull the mesh surface. Brush parameters can vary by size, strength, and type to refine the mesh to more accurately depict the hand-sculpted form or to further transform its shape.

*Create*

The ultimate goal of this project was to create a lamp; therefore, the relationship between the lamp structure, lighting fixture, and bulb was paramount. Using Autodesk's 123D Make software, students chose a variety of methods to "slice" their digitized clay model into interlocking pieces for digital fabrication. Students needed to consider lamp orientation and design pendant mounting before creating cut files.

Re-materialization through digital fabrication represents a metamorphosis from the virtual environment back into the physical. Different means of digital production offer the potential to edit the virtual object in order to create a radical change in re-embodied physical form. We chose to use interlocking surfaces with a laser cut plywood material for the lamps to keep costs down. Students adjusted the slice direction and count with consideration of desired lamp form and lighting quality.

## Reflections

While the *Scan Fab Lamp* project represents a modest exploration of Reality Computing, the application of this technique to architecture has the potential to bridge the gap between analog and digital design, creating a feedback loop between the two processes. The application to beginning design allows students to start with physical modeling by hand, which can then be digitized and used for a variety of applications in the design process. Students in my course continued to use the *Scan Fab* technique as an idea and form generator for the design of architecture in the quarter-long studio project. However, expectations of Reality Computing for beginning design should be tempered with an understanding of its current limitations.

It was our experience that many hand-modeled forms are not well suited to the Reality Capture process we used. Forms with holes or voids presented challenges in the digital capture process. These hollow spaces were often filled in by the pre-processing software, which interpolated the visual data to create a continuous surface. The darkness created by shadows is especially difficult for the photogrammetry process to translate into a digital mesh. It should be remembered that photogrammetry is made up of a series of photographs, therefore the quality of photos and uniform lighting are essential components to a good digital capture.

*Fig. 7 Students assembling Scan Fab Lamps.*

The use of photogrammetry as a Reality Capture in its current state is biased toward continuous surface conditions. For this reason, I choose clay for sculpting the form to be captured. It is also worth noting that process of Reality Capture involves moving the camera's position to take a series of photographs around all sides of the object to be digitized. This means that the object does not move and since it is likely placed on a surface, this part of the object will not be digitized accurately.

While I had my students use 123D Make to create digitally fabricated parts for their lamps, there are a number of alternative methods for preparing the virtual form for re-materialization. This is dependent on whether you choose a subtractive or additive fabrication method. The interlocking slices of 123D Make are ideally suited for ease of cut file output and assembly, but are limited in options, restricting the final form. For this reason, I had my students make two lamps, the second one adding a hand constructed "skin" or shell on top of the inside structure, which created a new quality of lighting. This allowed the students to come full-circle and finish the lamp design by hand, with a digitally fabricated hybrid form of their initial hand sculpted clay model.

Overall, the *Scan Fab Lamp* project was well received by the students who enjoyed learning new software that was relatively easy to use and which allowed them to integrate physical modeling with a digital fabrication workflow. We spent the first two weeks on this project, but I have done a workshop that produced similar results in one day. The quick learning curve and production turn around of the *Scan Fab* process are certainly beneficial to its success and usefulness. I believe that there is an opportunity for further investigation of its use in the Architectural Design studio.

## Conclusion

The field of architecture is continually evolving, as are the technology and software that it employs. While architecture has embraced digital technologies, it still remains deeply rooted in tectonics, materiality, and sensorial experience. These are aspects of design best explored physically through the act of making. For this reason, there will always be a place for physical modeling and hand drawing in both architectural practice and education. With the advances in Reality Computing technology there appears to be greater opportunity to integrate a physical and digital design workflow, beginning first with a haptic-based design approach that continues directly into digital modeling. The *Scan Fab Lamp* project illustrates one approach for the use of Reality Computing in beginning design. As this technology continues to advance, there will likely be many possibly applications in both architectural practice and design education.

## Notes

[1] Picon, Antoine. "Architecture and the Virtual: Towards A New Materiality" in *PRAXIS 6: New Technologies://New Architectures*, 2004. p 114-21.

[2] Autodesk, https://recap.autodesk.com/reality-computing/, Accessed December 20th, 2015.

[3] Pallasmaa, Juhani. "The Eyes of the Skin," Wiley-Academy, Great Britain, 2005. p 12.

[4] Ibid. p 12.

[5] Ibid. p 56.

[6] Pallasmaa, Juhani. "The Thinking Hand," John Wiley and Sons Ltd. Great Britain, 2009. p 12.

[7] Sennett, Richard. "The Craftsman," Yale University Press, New Haven, 2008, p 149.

[8] Picon, p 271-272.

[9] Ibid. p 274.

[10] (123D Catch software application of Reality Capture available for OS and Android Smartphone operating systems.)

[11] Kolarevic, Branko. "Digital Production" in *Architecture in the Digital Age: Design and Manufacturing,* Spon Press, New York, 2003. p 47.

[12] Pallasmaa, "The Thinking Hand," p 12.

# Shifts in Beginning Design Installations

Brian M. Kelly | University of Nebraska-Lincoln

## Introduction: Installation Art

Several definitions exist for the art genre term 'Installation Art.' The Irish Museum of Modern Art defines it as "[...]a broad term applied to a range of art practice which involves the installation or configuration of objects in a space, where the totality of objects and space comprise the work." IMMA expands this definition stating that:

"Installation Art requires the active engagement of the viewer with the artwork. This may involve the viewer entering into the space of the artwork and interacting with the artwork. By entering into the space, the viewer encounters the artwork from multiple points of view, rather than from a single perspective more typically associated with looking at a painting. Installation Art may engage many or all of the senses - touch, sound and smell - rather than just the visual or optical sense. Installation Art also foregrounds experience and communication over the production of a finished art object." [1]

Installations date back to the first half 20th century through the work of artists including Kurt Schwitters, Marcel Duchamp and El Lissitzky, but are most often associated from the 1960's on. At this point, works not only existed in the galleries and museums but also transitioned scales to environmental and land art through people including Dennis Oppenheim, Michael Heizer, Walter de Maria, James Turrell and Christo and Jeanne-Claude. Several used an architectural scale as well including Gordon Matta-Clark, Lebbeus Woods, and Donald Judd where both additive and subtractive strategies were deployed. Consistently, the work explores material, technique, and composition with heavy emphasis on conceptual development and communication of intentions.

## Installation Assessment Criteria

The use of installations in a beginning design program was seen as a strategic way of transitioning student mindsets connecting composition, materiality, and scale into cohesive directions. Student teams were challenged to develop conceptual positions with regards to site conditions, and do so with the purposeful use of material and tectonic. The three projects contained in this paper were developed and deployed by this author at California Polytechnic State University in San Luis Obispo, and subsequently at the University of Nebraska-Lincoln. The following three categories, perspective, technique and scale, will be unpacked as a way to qualify and gauge them.

*Perspective: Viewed vs. Immersive*

Historically, two-dimensional art, more specifically painting, was intended to be viewed from one perspective - frontal. Paintings are traditionally installed flat on a museum wall with ample space surrounding them to insure not diminishing their communicative quality. The viewer is able to process the visual content from a safe distance maintaining clarity of the art piece itself as the 'viewed' and the patron as the 'viewer.' As with any artistic medium, challenges to the conventions are expected. In painting, this challenge comes from techniques such as anamorphic projection where the two-dimensional work affords additional views that might contain supplemental and even controversial information for the viewer. A notable example of this can be seen through Hans Holbein the Younger's painting The Ambassadors where a frontal view shows two men surrounded by with their worldly possessions and scientific instruments of the day. A mark that appears as a stain or smear from the frontal view reveals itself as a skull from an oblique view and alludes to mortality. This is but one example of a work that embraces a technique infusing more information into a two-dimensional surface than is originally perceived.

Three-dimensional art is able to engage multiple perspectives, as the patron moves around the piece to comprehend its formal properties. Even so, these viewpoints are highly scripted to privilege certain views while others are diminished. One is able to process what is given, while other content is obscured and/or removed through, again, positioning the viewer and the viewed in a scripted condition of information exchange. Installation art challenges this by placing the viewer and the viewed in a much more intertwined relationship where the viewer is engulfed in the viewed, and in some cases even becomes the viewed through interactivity. The traditional relationship to the patron is broke opening up new potential for expression. Viewer immersion allows the author(s) to exert some level of control over the occupied space while the viewer is moved through curated space and material. For the pedagogical purposes of beginning design, the immersive condition of installation art was seen as a significant opportunity and encouraged discussions regarding occupation, anthropometrics, and affordances.

*Technique: making sequence and research*

According to Frank Barkow of Barkow Leibinger Architects, research into fabrication and materiality has seen a significant shift in mindset over the past 10 years as designers address the relationship between (1) materials, (2) the ways in which the material is tooled, and (3) the physical form of the design. He explains this transition as one from "Form to Material to Tool" reflected in the fabrication efforts of the early 00's to a mindset of "Material to Tool to Form" witnessed in more contemporary fabrication endeavors.[2] The "Form to Material to Tool" approach often foregrounded digital techniques and form generation while decisions on materials and ways the material would be tooled were made later in the process. Overarching compositional or organizational theories drove form decisions. The "Material to Tool to Form" approach sought to, in some regard, reflect the views of Louis Kahn suggesting that an architect should be empathetic to materials and their preferences. The latter approach allows form to be emergent out of an innate understanding of the material creating a more transparent connection between it and the form.

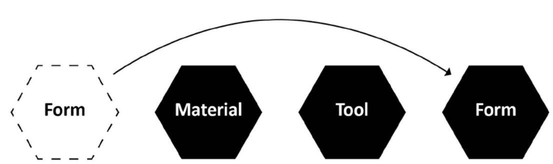



Fig. 1 Fabrication transition by Frank Barkow (image by author).

Initially, the lure of digital fabrication and its seemingly limitless options put materials into arrangements that were not always favorable. Investigations were diverse, and materials were seen doing several things that, at initial execution, worked but did not stand the test of time. More recent investigations have seen a shift in approach where materials are understood more intimately and the question of could vs. should becomes part of the linkage between form and material. An example of this shift is manifest in biomimicry investigations that have moved from *looking* like biological structures to *performing* like biological structures.

Contemporary practice has seen an incredible increase in the role of research within the design process to create what Michael Speaks refers to as "Design Intelligence." Research for design and research through design seek to position and validate work on verifiable and quantifiable information. In the words of Speaks "everything now depends on credible intelligence, on whether something might be true"[3] which is proven through research and testing. Material research for design determines compositional makeup, limits, properties and performance from a more scientific approach and serves as a base for innovation in prototyping.

*Scale: Model vs. Prototype*

Representational models use proportional scale translating intended forms and material compositions at a fraction of the eventual size. These translations make assumptions and afford the designer deference of decisions that either might not be ready to be addressed, or that scale, availability of materials, and/or tools might not allow. Within this translation as with any translation is the potential for information to be gained or lost. Projectional representation creates conditions where the designer can simultaneously be deceived or propelled forward. The seasoned designer can identify when this is happening, and make appropriate adjustments deferring decisions to be made when more necessary information is available. This is not typically the case with a beginning design student.

The use of installations with focus on full-scale fabrication sets forth an imperative of immediate feedback between the projections and the projected. As part of the installation design process, student teams can develop any form or composition they can justify, but the success of the project comes through its inevitable fabrication. Materiality plays a critical role in the decision making of the designer at some point in the process either sooner or later.

The prototype is most often used in design disciplines such as industrial design where full-scale mockups are a feasible option throughout the design process. The prototype is strategic in its ability to make design projections more immediate, allowing simultaneous decisions on composition, form, material, and assembly in a more synergistic manner. Again, Michael Speaks describes post-vanguard practice as being "more concerned with 'plausible truths' generated through prototyping than with received 'truths' of theory or philosophy. Plausible truths offer a way to quickly test ideas by realizing them, and therefore are the engines for innovation rather than its final product." [4] He continues stating "[p]rototypes create 'design intelligence' by generating plausible solutions that become part of an office's overall design intelligence." [5] This is important to a beginning designer as they are establishing foundations for their own personal design approach, and generating intelligence which can be deployed in future design investigations.

Installations at the beginning design level allow instructional teams to integrate the use of prototypes that work through specific moments in the design, and do so at full scale with actual materials and assembly techniques. In this scenario, students work with fragments of the proposal letting forms emerge out of a more intimate knowledge of those materials and how they can be composed to manifest design ideas. This transition has instructors asking for prototypes as opposed to scalar models, discussing the properties of the material by means of how they might be tooled, in turn resulting in forms which tend to agree, or at least dialog with the form. Prototypes worked to respond not only to a conceptual and formal strategy, but also to allow material and tectonic to be vital catalysts.

## Case Studies

The following section situates three case studies comparatively within the aforementioned categories of perspective, technique and scale.

*parasite (2005)*

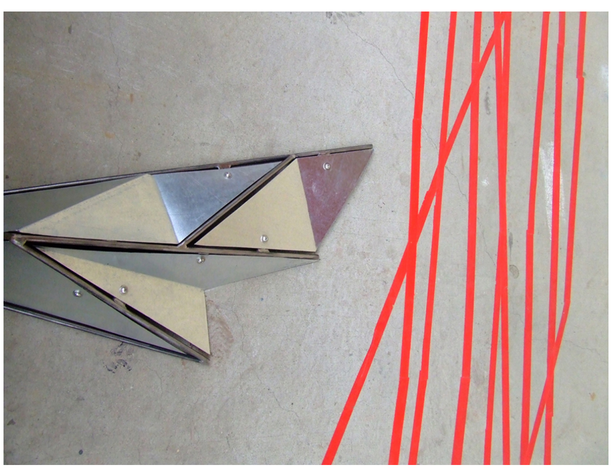


Fig. 2 paraSITE installation (photo by author)

paraSITE project began in 2005 at California Polytechnic State University in San Luis Obispo as a first year design problem seeking to give student teams of 4-5 people an experience in composition, siting, materiality, and assembly. The project's name was generated from the assemblage of two words: the prefix *para* meaning 'beside or adjacent to' and the word *site*. The project was also often referred to as architectural graffiti since design assemblies were installed at night under the cover of darkness left for users of the building to engage the next morning. That experience was most eloquently described through the words of Professor Michael Lucas as he entered the building the following morning after installation.

"I remember a crisp winter morning in 2006 walking across O'Neil Green, one of our signature lawns, toward the dreary but loveable systems concept/concrete frame, Brutalist building, our architecture home. Its massive open maw of a stair court swallowed those who passed through metaphorically and perceptually. But that day was different. Projects at human scale were lashed, suspended, cantilevered from columns, the walkway bridges, nested in spatial eddys... this was the birth of paraSITE." [6]

(Perspective: Viewed) While student projects were as diverse as the student teams composing them, the general character of the paraSITEs was one of being viewed where the viewer was able to move adjacent to them typically from a perceptual (not always physical) distance. Influenced by the given sites, they were positioned into gaps and tight residual spaces in the building where form and composition might serve to explain and complete the context with a missing episode.  As well, project placement in a circulation stair court was often within egress areas and could to not impede on code-required pathways. This precluded them from being highly immersive.

(Technique: Form to Material to Tool) Student teams were tasked with analyzing a given site in the building and documenting this analysis through representational graphics integrating intentional abstraction to encourage personal interpretation. The team's site analysis and interpretation was translated into a set of intentions and subsequent iterations where contextual form was privileged over material-driven investigations. Students worked through scale models and drawings, and eventually moved into the material selection based on desired conceptual and tectonic effect. Soon after, master/apprentice type training was deployed building skills in tooling the chosen materials. Material knowledge and fabrication techniques often came through knowledge of the instructional team as instructors conducted class in the shop alongside the student teams, often getting as dirty as the students in the process.

(Scale: Models) As architectural graffiti, the project was would eventually appear overnight. To maintain secrecy, teams worked through the design process at a distance from the actual site so as not to divulge the secret of when they would be installed, or what they would look like. Scalar drawings and models responded to form and space analysis of the site. Forms were assigned materials and translated into full-scale fabrications later in the design process as more clarity was achieved in regards to design intent. Often full-scale prints of unfolded surfaces and panel patterns filled the studio walls as the process moved closer to the install date.

***Linked In (2014)***

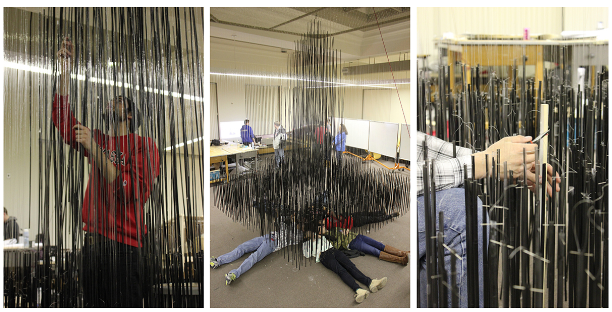


Fig. 3 Linked In installations with process (photos by author)

In the context of many schools, the beginning design student is not fully integrated into the studio culture. They are typically more transient using hot desks and taking several courses outside of the College as they work to fulfill general education requirements. Engaging young students often happens by means of social gatherings through student organizations. While these are helpful, they do not typically increase the design proficiency or rigor of the beginning designer. Linked In was completed at the University of Nebraska-Lincoln and sought impactful ways to engage the freshman student into the design school culture through full-scale installations coinciding with a citywide art opening. The desire was to increase exposure of the College's activities through engaging the public and upper level students in discussions with their design proposals serving as the content. LinkedIn brought in several outsiders and students were able to receive feedback from a variety of people, and more importantly, link them in as a part of the larger design community.

(Perspective: Immersive) Teams of 4-5 students were given a site in the building and asked to create an interactive design addressing a relation between anthropometric scale and material. Sites mostly existed within the studio proper or review spaces in the architecture building, keeping clear of required egress paths. Several of the designs created atmospheric conditions where senses were heightened outside of the visual, extending into a more experiential realm. The immersive experience also allowed the viewer to be the viewed as they interacted and often created a spectacle. As a learning device, the construction done in situ also became highly immersive where makers were absorbed into the construction process.

(Technique: Material to Tool to Form) Material selections were left open to student teams but were often one of the initial decisions made in addition to ways in which the design would address human scale. Materials ranged from found (ex. corrugated cardboard) to ubiquitous materials (drinking straws) and often did not use sophisticated tools in the process of making. Design directions came from researching the materials and working directly with them to see what they might be capable of through low-res prototyping. Material samples were present, and desk critiques were often centered on the iterative artifacts made from the actual materials.

(Scale: Prototype) With direct access to materials, student teams used full-scale prototypes from the beginning of the design process to explore and create 'little truths' [7] that could be aggregated into a larger position with regards to the user and site. A research through design approach found expressive opportunity within the materials, and since they were working full-scale with direct proximity, anthropometric scale and assembly was unavoidable. In the end, these conditions created forms that were born out of an intimate comprehension of the materials and their affinities. Scale models were not used, and scaled drawings were done initially as site analysis.

***Web Bridge (2014)***

Fig. 4 Final We Bridge installation (photo by author)

The summer of 2015 offered an opportunity to use installations at the high school level through a one-week immersive workshop. In the past, this workshop was conducted as a series of short-term, scalar design investigations that could be found in several beginning design studios. This strategy, done as individuals, used simple programs and abstraction as an approach to breach compositional principles and challenge preconceptions of architectural space and form. In 2014, the integration of installation art as a project brought students together as a team, created more opportunity for success in the process through shared knowledge/skill, and addressed the difficulty of creating proficiency within a short-term duration which could be used in a meaningful ways. Having taught the workshop in the previous years, the difference in energy, engagement, and expressive potential offered through the team-based installation took the students further and provided a strong base to build upon as they entered design school a year or two later. Primarily, this development was a direct result of the student's ability to directly engage, at full-scale, the essence of architectural design with issues of space, form, material, tectonic, and team-based research to yield a competent and compelling end product.

(Perspective: Immersive) The scale of the project and its ability to create occupied space was highly immersive. From the beginning of the design process, students considered how people might be able to interact with the installation bringing conversations of anthropometric scale and occupancy to the foreground. As well, through the making and shear scale of the piece, students were immersed in the project as it served to teach them about material, sequence, scale, structure, and team dynamic.

(Technique: Material to Tool to Form) Initial team formation was established based on research topics including materials, form, site measurements, anthropometric scale, and precedent. Research was integrated throughout the process as students used it to build upon when needed. The form of the final piece, while generally directed, could not be predetermined. Materials and technique had a large degree of command over the final form as adjustments were made to accommodate concerns regarding connection, and structural performance. Team decisions throughout altered the direction and responded in the moment to issues that needed to be addressed with research-fueled information.

(Scale: Prototype) With an extremely abbreviated timeline, students were not able to spend time developing sophisticated narratives or theoretical positions about the installation and its perceptual effect. Following an afternoon of team research, students jumped into the development of a structured working process and roles within the group. Low-res prototypes were done to test strength and material effect in key areas such as anchor points, surface edge and aperture. These fragment prototypes offered little truths that would be important throughout the process. While the overall formal direction was offered and the location chosen by the instructor, the final version could not be fully anticipated and the only way to get to that point of clarity was to immerse themselves in the making.

## Conclusion

As demonstrated by the case studies and resultant work completed, the use of installation art in a beginning design program can have significant impact through its ability to engage students with issues paramount to the disciplines for which they are preparing. Students composed into design teams are able to collaboratively engage composition, material, tectonic, and scale first-hand capitalizing on the diverse skillsets of a group. Giving students hands-on and immersive comprehension of spatial dimension and materiality can breach the difficult concept of scalar translation. As well, appreciation of that material and its properties are immediate demanding that the designer respond in an appropriate way. Installation art creates a 1:1 direct relationship fostering rigorous work and rapid development in the beginning design student.

## Notes

[1] Lisa Moran and Sophie Byrne. "What is Installation Art?" (Dublin: Irish Museum of Modern Art), 4-5.

[2] Barkow, Frank *"*Bricoleur Bricolage*"* Public Lecture, Hyde Lecture Series, Lincoln, NE, 30 Sep. 2015.

[3] Michael Speaks "Intelligence After Theory," in *Perspecta 38: Architecture After All,* ed. Marcus Carter et al. (Cambridge: MIT Press 2006) 104.

[4] Speaks, "Intelligence After Theory," 104.

[5] Speaks, "Intelligence After Theory," 105.

[6] Quote in a letter from Professor Michael Lucas

[7] Speaks, "Intelligence After Theory," 104.

# Haptic Tactics: Increasing Engagement in and Application of Building Technology Through Hands-on Investigation and Integration with the Design Studio

James Leach and Kristin Nelson | University of Florida

*"Tell me and I forget; teach me and I may remember; involve me and I will learn" - paraphrased from Xunzi* [1]

## Introduction

Contemporary architectural practice demands the integration of performance with design. This need for multivalence necessitates that instruction in design and technology are approached as compliments; students must comprehend *and* apprehend technical concerns, not only in the isolated context of the traditional building technology course, but more importantly, as one of many sets of concerns informing the holistic design decision-making process framed by the design studio.

There is an unfortunate tendency to suppress technical issues in the design studio, where building technology is often viewed as a barrier to design, rather than embracing engagement with technical issues as an opportunity to enrich, strengthen, and potentially guide the design project. Equally problematic is the traditional method of teaching building technologies, presenting topics as isolated and abstract, with the focus on memorization and calculation rather than synthetic incorporation of technical concerns into design thinking. Concepts are separated from a design decision-making context, and more importantly, they lack any connection to the physical world or the student's personal experience. In the terms of Blooms Taxonomy, building technology courses have traditionally resided in the realm of Knowledge, focusing on the recall of information, recognition of terms, and basic calculations. This approach not only fails to engage, but it presents little opportunity for students to apply their developing technical knowledge to ongoing studio design work. As the teaching of building technology has evolved, contemporary approaches strive to reach the levels of Application, Analysis and Synthesis in Blooms Taxonomy, asking students to apply concepts in laboratory settings, analyze precedents and to develop new concepts in the design studio informed by these experiences.

At the University of Florida, the members of the Technology Committee are currently in the process of reconsidering the technology curriculum to encourage greater integration between the technology courses, and between technology and studio. Embracing the concept of positive redundancy, the reinforcement of concepts throughout the student's academic career, presenting multiple exposures from different perspectives and of increasing complexity, is seen as a potential means to improvement under this reorganization. Currently, courses such as structures have only a single course in the undergraduate curriculum, and other courses such as materials and methods are placed far apart in the sequence. Offering opportunities for cross-over between the technology courses and studio, and the technology courses themselves can help alleviate these challenges. The pilot project covered in this paper was envisioned as an opportunity to test the potential of integrative teaching between technology courses and between technology and studio at the School. The pilot project involved two technology instructors, representing the areas of structures and environmental systems, teaming to provide an intensive overlapping exercise in a design studio also led by one of the instructors.

## The Design Studio

The Design 5 studio is the first design studio taken by students accepted into the architecture program at the University of Florida. As such, Design 5 is the first studio to focus on explicitly architectural issues such as: site specificity, environmental response tied to site and climate, tectonics and structural assemblage – all within the unique and complex context of the Florida landscape. The landscape of North Central Florida is the result of typically gradual, but occasionally dramatic, ongoing environmental and geological processes. On the surface, it presents as a generally flat, low-lying topography with a high water table, supporting a mixed forest of deciduous and coniferous trees with a dense understory. Plentiful rainfall, over 50" per year,[1] supports this foliage, which in turn generates a thick layer of organic material on the surface of the land. This landscape is delineated in section by water in the form of springs, streams and flooded sinkholes, linked by a huge subterranean network of fissures in karstified limestone. As rain filters into the earth, it passes through the layer of organic matter which acidifies the water. This acidic water reacts with the soft areas of the native karst limestone bedrock, creating a heavily fragmented subterranean condition.


*Fig. 1 Karst Limestone Geology*

Sinkholes, a famous feature of North Central Florida, are created when the corrosive action of acidic ground water percolation creates dome-like caverns near the surface. As water continues to permeate, the void expands, weakening the upper surface until it falls inwards, creating bowl-shaped depressions that can be hundreds of feet wide and deep. These collapses may occur more than once in the same location yielding different effects. Two or more collapses occurred vertically in the formation of the sinkhole at the Devil's Millhopper Geological State Park, one of the locations explored in the studio work. Seemingly a world away, but linked by the Floridan Aquifer, the Alachua Sink presents a different experience at the surface, as it is a group of smaller sinkholes, which joined together over time to form a flooded shallow wetland basin surrounded by forest.

***The Project Sites***

The two sites for the semester were chosen to highlight and explore different impacts of sinkholes on the landscape of North Central Florida and through this focus, to understand the larger ecological and geological links in this unique environment. The Devil's Millhopper was the initial location of the project, entitled DEEP. The second portion of the project, entitled WIDE, was situated at the Alachua Sink. The project sites were visited multiple times, and students were asked to propose a new spatial sequence for public access to the site. Through a series of project briefs and readings, students were asked to consider environmental forces as a primary design driver for their sequence, and to consider the layered nature of the interactions within the Florida landscape as a precedent. The term 'intentional touch' was used to ask students to focus on the transfer of the weight of the structure and its inhabitants to the earth, framing their project through the matrix of ecological relationships.

| Organism 1 | Organism 2 | Relationship |
|---|---|---|
| Positive | Positive | Mutualism |
| Positive | Neutral | Commensalism |
| Positive | Negative | Antagonism |
| Neutral | Neutral | Neutralism |
| Neutral | Negative | Amensalism |
| Negative | Negative | Competition |

*Fig. 2 Ecological Relationship Matrix*

The Devil's Millhopper is a monumental sinkhole located in northwestern Gainesville, Florida. The unique topography of the park was formed in two major collapses at least 500 years apart, with the upper, older portion of the sinkhole resembling a cone or funnel, and the lower, more recent portion resembling a vertical cylindrical form. The Millhopper measures over five hundred feet across at the surface and one hundred twenty feet deep.[3] The lower portion of the sinkhole is flooded to a greater or lesser degree depending upon the amount of rainfall and the infiltration rate of water through the sink at the bottom of the sinkhole. During the project, due to extreme rain events associated with El Nino, the water in the bottom of the Millhopper varied by approximately thirty feet, from the highest point to the lowest point. There are twelve springs which empty into the Millhopper, some as rushing waterfalls, others as trickles over the exposed limestone. The scale and depth of the

Millhopper create a true microclimate[3], a tropical forest of ferns and mosses within the sub-tropical surroundings, where the temperature at the bottom remains nearly constant year round. Due to its unique and engaging properties, the site has been used as a documented recreation area for over 150 years, and was known to and referenced by native inhabitants of the region. As use of the site intensified, concern for the preservation of the unique, delicate landform increased, and the site was eventually given to the State of Florida for use as a State Park. As part of this transfer, the Park Service limited access to the site to an elevated stair and deck system which allows visitors to move from the surface of the sinkhole to the flooded lower portion.

The Alachua Sink is a large, flooded sinkhole located in Paynes Prairie State Park. The park contains numerous Florida ecosystems, twenty five natural systems in all, and was described by William Bartram as the Great Alachua Savannah in his 1774 book Travels.[4] The site is accessible via the large and varied trail network in the park. This trail system encompasses earthen dikes raised above the typical water levels, areas of naturally higher land in deciduous forest, and raised wooden boardwalks that take visitors out into the Alachua Sink itself. The adherence to the trail system is enforced not by railings, but by the numerous, large alligators that call the Alachua Sink home. The Prairie frequently floods and again, as a result of El Nino, large areas of the trail system were underwater and inaccessible during the project.

## Technology Overlay

Concurrent with the Design 5 Studio, students are enrolled in the only structures course of the undergraduate sequence. The overall intent of the course is to provide a broad orientation to building structures. Within this framework, however this pilot project proposes that there is potential to highlight particular topics for additional development and application to the studio work. In course planning and coordination meetings attended by all faculty members teaching in the year, these potential overlaps were identified and agreed upon: soils and foundations, frame structures and load path, and passive environmental strategies. The primary structures faculty agreed to host the pilot integrative exercise over two regular course meetings. This exercise would cover the regularly-scheduled topics of soils and foundations, but with a particular focus on Florida's unique geology and its impact on foundation systems, and simple frame structures similar to those being developed in the Design 5 studio projects. The lecture introduced students to the basic concepts of soil physics. Soil types (sand, clay, gravel, bedrock) and the physical properties that affect load-bearing capacity, such as grain size and shape, density, and compressive capacity were presented. Deep and shallow foundations types were covered, as well as an introduction to foundation sizing and design, particularly the relationship of footing area to bearing capacity. Through this portion of the presentation, intuitive and illustrative photographic examples, taken from built work, rather than black and white diagrams, were used to illustrate concepts. An additional emphasis in the lecture was tailored to the unique aspects of Florida topography and geology that must be considered in the design of a foundation in the state. This focused on the unique soil types found throughout the state, including the red clays of the north, the ubiquitous quartz sand that creates Florida's famous white beaches, and the organic soils of the Everglades. Approaches to dealing with ground water at the building site were highlighted, as well as the unique characteristics of the Karst geology of the state and the concerns of sinkholes.

Immediately following the lecture, students engaged in a hands-on laboratory exercise on foundation systems and soil types. Working in groups, they were presented with several large bins filled with a variety of granular materials: sand, smooth and jagged gravel, organic soil, and various pre-made wooden pieces simulating different footing types and sizes. The students performed a systematic series of investigations, testing each footing type in each soil, applying loads (by pressing down with their hands) and observing the various performances. By completing the process, students gained an intuitive visceral understanding of the resistance in each case. Students documented each step of the process by measuring each footing's subsidence in each soil and photographing all steps of the process. Also, teaching assistants were able to vividly demonstrate *liquefaction*, the quicksand effect that occurs when certain soil types are saturated with water and lose stability by vibrating the bins of sand while they supported unloaded footings. Following the exercises, students were asked to answer a series of questions analyzing the physical performance of the various soils and footings and framing their findings in terms of the physical properties and soil types as presented in the lecture.

A further complication of the curriculum is presented by environmental systems in that, although this is the studio offering the most obvious link to the development of passive environmental response, students have yet to take any course work in this area. This issue was addressed by asking students to carefully observe and document their proposed project sites in a variety of ways within the design studio: still photographs, films, audio recordings, rubbings, sketches and measurements. Following this initial documentation, students were able to identify specific environmental factors influencing their proposed project, and return to the site with environmental measuring tools including decibel meters, anemometers, light meters and infrared thermometers, to create customized mini data sets for their proposals. On a case by case basis, students were directed to additional resources to research the path of the sun, the physics of wind and the built environment, the physics of sound, and temperature regulation strategies involving water, wind, mass and shade. A course reading selected from The Eyes of the Skin, by Juhani Pallasmaa encouraged students to consider the human response to an environmental factor as a primary design driver for the project form, materiality and engagement with the site.

## Design Studio Engagement

As already stated, the theme of the "intentional touch," the thoughtful consideration of the physical relationship of structure to site, was identified as a design focus by the pilot project team. It was also decided that continuing the development of building form, incorporating the consideration of gravity and lateral loads in the form and material diagram of the proposal would allow students to test their building geometry through the lens of the recent structures content.

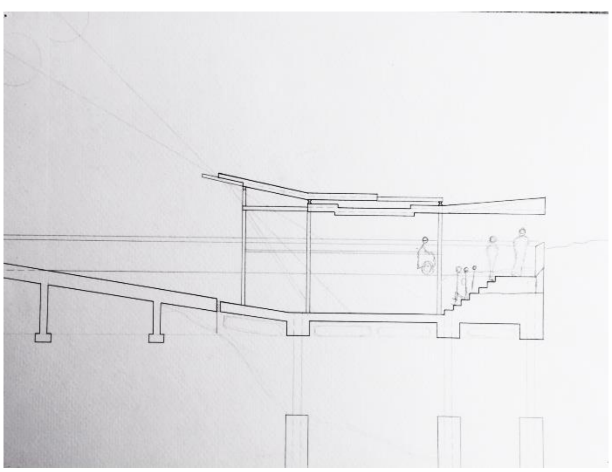


*Fig. 3 Sketch Diagram Integrating Structural Systems and Environmental Response*

As the studio progressed beyond the initial instructional prompts, students began to regularly ask for engagement with and explanations of additional technical content in both structures and environmental technology. Precedent projects where the form, relationship to the earth and materiality were generated from environmental and structural response were frequently used by students to help articulate their interest in natural phenomena and the human experience. Immediately following the structural lecture and lab assignment, studio work began showing (albeit conceptually) suggestions of the project below grade for the first time in the course without requirement from the design studio. Students asked, unprompted, if it was allowable to bring their structures content into the studio, and began to sketch their design as assemblages of simple frames, decking and lateral bracing. As instructors in both studio and technology, it was exciting to see the students actively and independently engage, pushing forward with the content after such a relatively brief exposure.

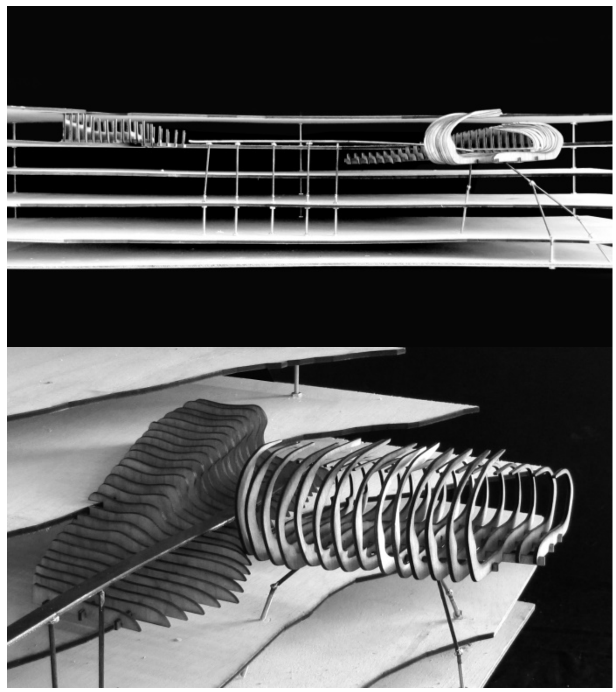


*Fig. 4 Physical Model Integrating Structural Systems*

The final project of the semester was entitled ZOOM. This brief portion of the project, at only three weeks, asked students to select one moment from DEEP or WIDE to explore more intensely. ZOOM asked for an integrated approach involving tectonics, environmental response tied to human activities proposed, and a structural load path diagram leading to a foundation that reinforced their design statement. An in-class lecture was presented by both faculty members, showing built precedent projects with documentation from the design phase of the projects focused on diagrams illustrating the responses requested in the assignment. As a result of the students self-motivated explorations, many were able to rapidly develop conceptual diagrams that functioned at a basic level. Examination of precedent projects suggested by faculty for each proposal aided the students in further development of each component of the assignment.

## Evaluation and Conclusions

Techniques used to increase overlap and engagement included faculty participation beyond the perceived area of expertise. The structures faculty member participated in design reviews, and the design and environmental systems faculty member attended the structural lab for soils and foundations. There was active coordination between the courses in the planning of the activities, and periodic updates concerning the progress in each course. Furthermore, each faculty member made an effort to include examples in lectures that would appeal to students and consciously linked the primary content to the other course content during lecture and discussion.

In considering the outcomes of the pilot project, areas of success and areas for improvement were identified. Our initial criterion for success was to observe the technical content from structures and environmental systems fully integrated into the studio projects. Noted successes include the aspects of one-to-one engagement, including site experience and documentation, site data set generation, and soils lab experiments, offering direct, unfiltered immersion in the uncompromising conditions of site, climate, and material properties. The processes of direct observation and documentation helped to develop feelings of competence and confidence in the students, encouraging them to push forward with more difficult design questions. For these beginning students, this experience marked a transition, moving from working in the abstract towards working with sensible phenomena that must be embraced to bring a successful project to fruition. As development was observed, including the student-directed crossover into the design studio project, it became clear that the potential for adding pertinent technical areas of emphasis to studio project work was abundant.

*Fig. 5 Hybrid Drawing Integrating Structural Systems and Environmental Response*

In order to reach the fullest potential, it must be acknowledged that intense participation, coordination and reinforcement between courses and faculty teaching these courses is required. In the pilot project, that level of integration only occurred between one D5 studio out of the five sections offered. The remaining studios were supportive of the idea, but the intensive final activity and special in-studio lectures were not offered in these studios. Correspondingly, the level of engagement with the material was less, not eliminated altogether, but not nearly as profound as in the pilot project studio. Furthermore, the soils and foundations exercise was run at the mid-point of the semester. This meant that the initial site observations for DEEP were completed before the students had an opportunity to consider the new perspectives offered by the structures exercise. Ideally, in a future iteration, the exercise could be improved by offering this exposure prior to the site visits.

Continuing the exploration of the ideas offered in this pilot project, the Technology Committee has begun to identify opportunities for additional crossover pilot projects, currently termed PROBES, for each semester in the undergraduate curriculum. These projects are envisioned as engaging with the existing design studio projects by offering an additional perspective and the opportunity to reinforce the idea that technology, history, theory and criticism are all important aspects of a fully-developed architectural design. Anchoring new concepts in real-world examples and hands-on laboratory experience, while linking the topical focus to fundamental issues relevant to the parallel design studio, allows building technology instruction to be made more relevant, more engaging and more understandable, ultimately improving outcomes in both the design studio and the technical course.

## Notes

[1] Dubs, Homer (trans.) The Works of Hsüntze. Probsthain's Oriental Series 16. London,1927. p 113.

[2] National Oceanic & Atmospheric Administration, National Environmental satellite, Data and Information Service: Annual Climatological Summary, Gainesville Regional Airport, FL, US http://www.ncdc.noaa.gov/cdo-web/datasets/ANNUAL/stations/COOP:083326/detail

[3] Florida Department of Environmental Protection Division of Recreation and Parks, *Devils Millhopper Geological State Park: A Geological Wonder.* 2015.

[4] Florida Department of Environmental Protection Division of Recreation and Parks, *Paynes Prairie Preserve State Park: The Great Alachua Savannah.* 2014.

## Figures

Figure 1: Ross Tolbert, Margaret. *Aquiferous.* Orlando: Fidelity Press, 2010. p 47.

Figure 2: Ecological Relationship Matrix. *Wikipedia*. https://en.wikipedia.org/wiki/Ecological_relationship.

Figure 3: Student project from Design 5 Studio, The Florida Landscape. Jasmine Simmons

Figure 4: Student project from Design 5 Studio, The Florida Landscape. Nicholas Acosta

Figure 5: Student project from Design 5 Studio, The Florida Landscape. Meagan Larsen

# Topological Tactics

David Lee | Clemson University


## Abstract

To teach ‘making’, particularly when considering a 1:1 scale product – the fully realized design – implies that there is a complete tectonic solution and constructability. The solution may be somewhat prescriptive, as in the specification of a building material or system, or it may be arrived at through technique as a consequence of the design morphology. With the latter, it is often the case that a particular geometrical/formal design is simplified – sometimes dramatically so – to arrive at a buildable solution. Designs of increasing geometric complexity are typically ill-fated to one of two directions: Either they are reduced to an oversimplification of their form to be realized, often with an inefficient and blasé technique such as contouring a form…or they are prototyped at a small scale to demonstrate a precise physical model of a design that has no concept of how it would be produced as a 1:1 construct without the budget of a small nation.

Topological tactics refers to strategies for the design and construction of architectural environments that utilize continuous surfaces, those whose connectivity is measured in spatial relationships rather than distances. The Möbius strip is commonly cited as an example of such surfaces, however it can be produced as a ruled surface. This research explores surfaces of double-curvature such as minimal surfaces, objects with complex shapes that cannot be constructed of flat sheet material as a ruled surface can. Using a mould, which requires complex formwork that cannot be reused, has until recently been the only way to produce such forms without relying on a tensile elastic membrane or exoskeletal structure. This has relegated much of the recent computational designs of stunning complexity to status as ‘installation’, ‘furniture’, or ‘fictitious’. 3D printing has been possible and prevalent in design schools for some time now, but it has most commonly been used to produce scaled physical models of a digital design rather than speculate on a method of construction

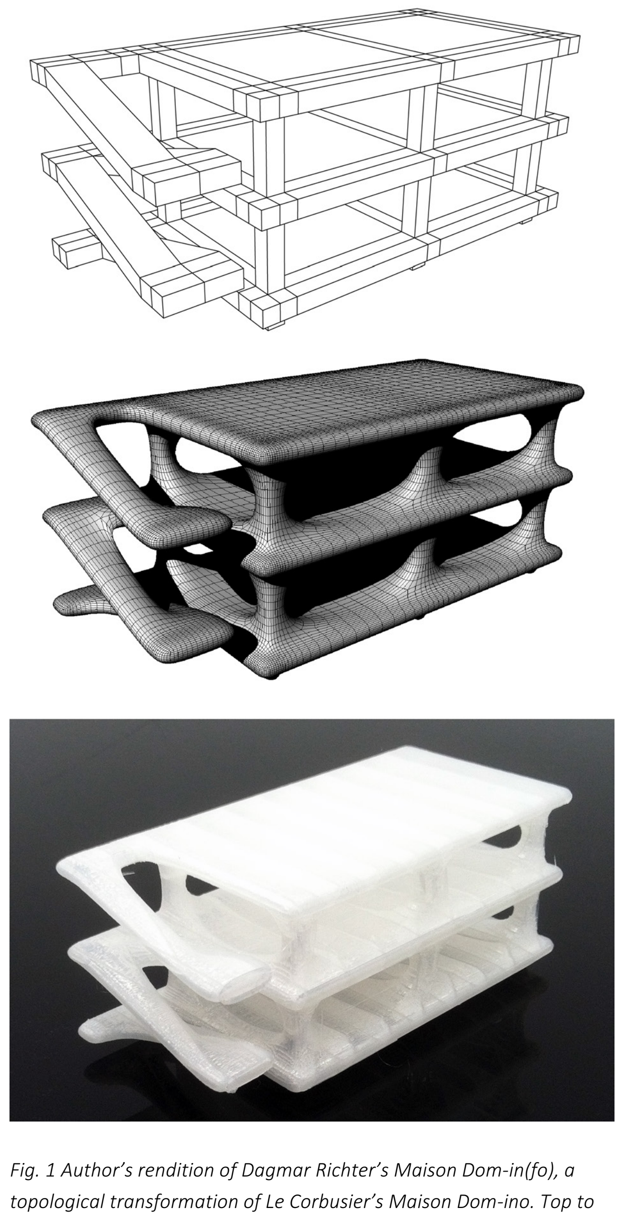



*Fig. 1 Author’s rendition of Dagmar Richter’s Maison Dom-in(fo), a topological transformation of Le Corbusier’s Maison Dom-ino. Top to bottom: Control mesh with minimized faces, Continuous surface model, 3D printed continuous surface model.*

at full scale. At the same time, additive manufacturing, essentially the industrial or trade name for 3D printing, has now advanced to the capability of printing at large scale and with a wide range of construction materials including concrete and wood. This presents an opportunity to realize these designs, 1:1, without sacrificing their form.

There are two primary inquiries of this research. The first is to question the possibility of 'making' complex and rigorously defined geometries at the scale of buildings using additive manufacturing technology. How are materials and assemblies considered in this context? The second inquiry concerns how design for additive manufacturing is taught with regard to 'making', particularly at the complexity and scale of buildings. With typical projects realized at full scale, even those that are completely digitally fabricated with flat sheet material, there is a requirement that the assembly of many parts be considered as inherent to the design process. Does a change in the construction/fabrication method that all but eliminates the aggregation of components eliminate the lessons associated with the construction process? Can those 'making' lessons be integrated with an additive manufacturing design and construction process?  In other words, can we teach the tool, the technique and the construction at the same time with the pairing of 3D printing and doubly-curved surfaces?

## Direct Digital Manufacturing

Additive manufacturing is increasingly becoming a viable and mainstream solution for producing readymade components. These can range widely from hobbyist parts and the Do-It-Yourself (DIY) community fostered by Makerbot[1] to aircraft engines and even complete automobiles that companies such as GE[2] and Local Motors[3] are currently producing. But can architecture benefit from this technology in realization of designs that are at the scale of buildings? Before this question is approached it is important to consider how designing with the end-product of a 3D printed architecture impacts the way we design.

In their recent book *Fabricated: The New World of 3D Printing* Hod Lipson and Melba Kurman outline what they call the 'Ten principles of 3D printing'[4], all of which highlight the positives: faster production time, no material waste, free complexity, pre-assembled components, infinite precision and quantity, etc. Of course, every list has its counterpart and the pragmatic elephant in the room is scalability. Machines are quickly growing in scale, however, as is the ability to print with a wide range of materials simultaneously. Perhaps less obvious to the optimist is the design impact of the collapsing of the design to fabrication process, particularly at the scale of buildings. As we know, one cannot simply scale an object without considering even such practical things as live and dead loads on the object. Scaling the machine is therefore only one part of the equation.

Direct Digital Manufacturing refers to the ability to move from digital design to 'part-in-hand' in a single step, by simply sending a file to a 3D printing machine. From a pedagogical perspective, this process changes the relationship of the designer to the process of making by removing the tactile sensibility almost entirely and places far more emphasis on the comprehension of materiality and craft in the digital 'making' process. It becomes critical that material performance and structural capabilities be applied parameters in the digital model. Even more so than with a digital model whose intent is to be sent to a CNC machine to be hand-assembled from numerous precisely cut components, a design that is intended to be realized by additive manufacturing processes must be perfect before it is sent to the machine for fabrication or the entire part will need to be reprinted. With this we see a shift toward a reliance on structural and environmental analysis, material simulation, and detailing in the computer. 3D printed surface models, especially minimal surface models, inherently have fewer parts than typical construction and can actually be a great advantage in terms of analysis and construction. While they can be incredibly complex surfaces, they have a simplicity in their reduction of joints and seams.

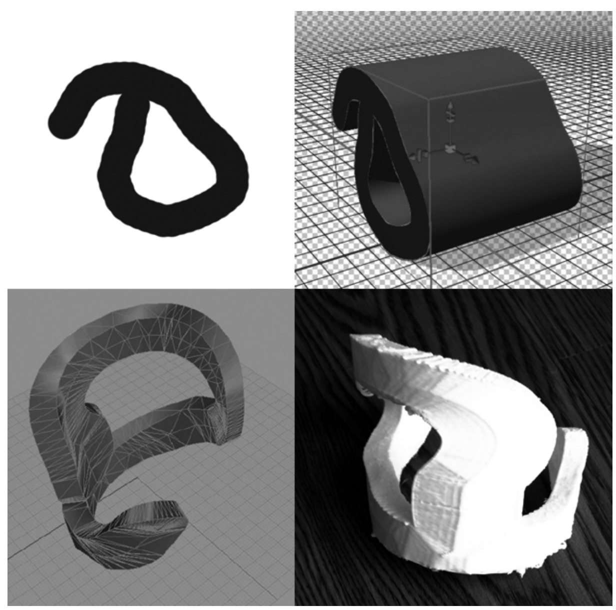


*Fig. 2 Example of single stroke gestural drawing, extruded, warped, and 3D printed into a wearable bracelet. Entire process including printing completed in less than one hour with no prior experience.*

*Prosthetics*

Actually realizing a design at full scale, whatever that scale may be, provides a sense of accomplishment as well as the challenge of contending with problems of scale and materiality that a representational model cannot approach. The first goal of this research was to provide students with the ability to confidently produce designs at full scale using additive manufacturing technology. The intent was to produce working parts rather than representational models and to highlight the strengths of the technology before we approached its apparent limitations.

To facilitate this it was imperative that the material be approached in a straightforward manner and that parts could be designed and fabricated as quickly as possible. With that in mind, the first exercise the students were given in this 1 credit hour seminar titled 'Direct Digital Manufaturing' was to design and fabricate a prosthetic device as a body enhancement in some capacity in the vein of Neri Oxman's *Imaginary Beings*[5]. Before developing the technical prowess to produce a complex and rigorous geometry, this exercise priveledged efficiency and the gratification of realizing part-in-hand in a single class session.

Students were asked to make a gestural and minimal single-stroke sketch and warp it into a bracelet shape using simple digital modeling tools and in less than ten minutes each had sent their bracelet 'design' to a 3D printer to be fabricated (Fig 2). In the second class session students used a 3D scanner to create accurate digital models of their bodies, isolate a body area or part to design around, and begin designing their prosthetic in the form of analog sketches. By the third class they were refining their designs as digital models and prototyping the components with 3D printing machines (Fig 3).

## Transformative operations

Moving from printing parts to conceptualizing a printed building is a huge step and required, above all, the ability to visualize buildings in a completely different way. This is because buildings, even simple ones, are constructed of thousands of components. A 3D printed building would have far fewer components and be principally designed as a single entity that may necessarily consist of several 'prints' or modules that would need to be assembled for larger constructs. This is a difficult problem because we want students to understand buildings as having numerous systems and components, yet 3D printing resists that notion. Further, a 3D printer wants all of the 'parts' of a design to be connected so it can produce the part with less

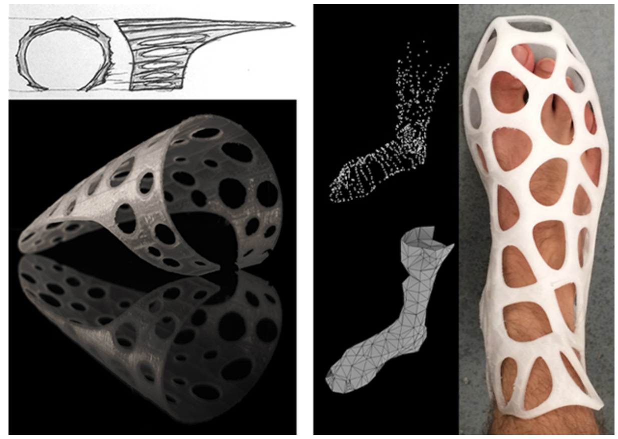


*Fig. 3 Left: Sketch of Prosthetic designed to form-fit to body part with final 3D print shown below. Right: Point cloud capture of body part, simplified mesh, and 3D printed prosthetic as worn on body.*

support material and, more importantly, so that its can be instantly useable with no assembly required once the print is completed.

*Continuous Surfaces*

To encourage students to examine in finer detail the relationship between the form, assemblage, and structure that a 3D printer requires they were each given an existing building to examine and asked to visualize it as a single surface (Fig 4). To facilitate this they reduced their buildings to an essential parti and considered how it might perform as a topologically consistent surface, more specifically a surface capable of homeomorphic transformation.[6] At the same time, they were also asked to visualize the surface topology as a monocoque structure by modeling using Catmull-Clark subdivision[7], essentially producing continuous flowing surfaces (Fig 6). This modeling had a double-motive in that it simultaneously developed in the students a greater sense of how buildings are organized and it provided them the tools to produce seamless models of great geometric complexity that would otherwise not be able to be realized as precise physical models.

Surfaces of this mathematical composition are not new to architecture, having received a resurgence of interest as digital modeling rapidly advanced in complexity in the late 1990's. In 2003, Dagmar Richter was among several architects that were asked to contribute to an important exhibition at the Centre Pompidou in Paris concerning what its curator, Frederic Migayrou considered 'Nonstandard Architecture'[8]. The exhibition represented the first collection of architectural work produced using what would today likely be referred to as computational methods. Richter's Maison Dom-In(fo) was a study of Corbusier's

Maison Dom-ino as a single surface topological transformation (Fig 1). It is not only an example of such transformation, but a compelling example of difference between the machine age dominated by industrial mass production and the emergence of an information age that privileges data and computational processes. The 3D printed models of her designs were presented as beautiful objects in the exhibition and it's not likely they were created to serve a further purpose, however they highlighted the ability of 3D printing to produce physical artifacts of intricate doubly-curved surfaces with astonishing speed and no waste of material.

*Scale + Material*

Before approaching the design of a complete building we set out to reconsider the design of individual components and modules found in buildings and investigate them as topological transformations. This research assumes certain archetypes found in architecture (such as floor, wall, and roof) must remain consistent. At the same time the modeling technique and tooling question their structural and formal relationships. When material is applied to the equation, even as a monocoque, a structural assessment must be made. Though outside the scope of this research, it would be possible to use Finite Element Analysis to 'program' the surface to have a variable thickness or number of connections to account for loads. How other building necessities such as mechanical, electrical, and plumbing systems are integrated must be addressed (Fig 5). Insulation, glazing, and waterproofing – wherever there are seams or punctures in a surface – are also concerns. Finally, how are building finishes to be applied and where are they desired or necessary?

For simplicity and purity, the approach of this research was to begin and end with a surface rather than consider a more traditional construction, therefore reducing the number of parts to a minimum. For geometric and structural reasons our first goal was to cut the surface as little as possible. Where additional materials were required or desired, multi-material printing was used. More advanced 3d printing machines are capable of printing in 15 or more materials at the same time. Because the printing process is an additive layering – essentially a very fine grain contour model – the multi-material construction can be embedded in surfaces and can include things such as printed LED. Materials can also be fine tuned to stop and start and exist in discreet moments within a surface as if they were floating in a mixture. For example, a floor surface can be textured as a continuation of that single-surface topology and can also be programmed to print simultaneously in a structural and secondary material. The floor surface material can be more forgiving and comfortable to walk on as well as of a material with a higher coefficient of friction to prevent slipping. At the same time, this floor surface can be 3D printed in one pass – and as one part – along with the remainder of the floor structure.

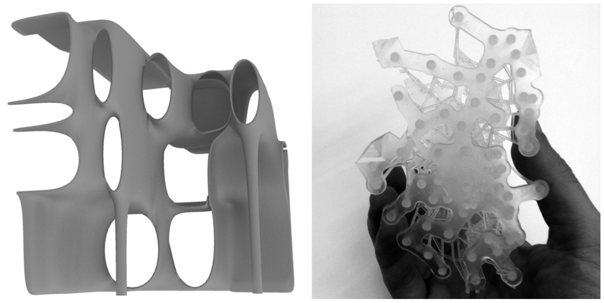


*Fig. 4 Minimal surface fragment model transforming Paul Rudolph's Orange County Government Center. 3D printed model shown at right with supporting structure.*

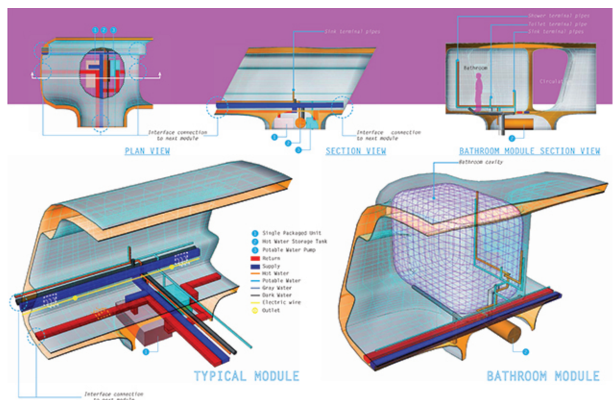



*Fig. 5 Protytype housing module illustrating MEP system integration. *3D printed 1:1 mockup currently in process.*

## Toward rigorously designed, 3D printed buildings

To revisit the question of whether architecture can benefit from 3D printing at the scale of buildings, we know the technology is already available, having been scaled and purposed to print such things as a building footprint in concrete including single family dwellings that are claimed to have been 'printed' in less than 24 hours[9]. At the other end of the spectrum are projects such as Rael+San Fratello's Bloom[10] which more carefully explores the potential of additive manufacturing with construction materials through component aggregation and ornamentation. Using platforms such as Autodesk's Project Dreamcatcher[11] it is also possible to simulate complex phenomena using generative algorithms to optimize the material to be printed which can transform the design and efficiently use material. Somewhere between these three might be a more sustainable future for a

3D printed architecture that can claim to be both well designed and function beyond its aesthetic value.

If it is useful to pursue the digital modeling method used in this research it is for its benefits in constructing a seamless, continuous surface and apply hard edges when necessary. This is mesh – or polygonal – modeling, used more commonly in the gaming and animation industry, as opposed to surfaced-based NURBS modeling which is more commonly used. The latter has the advantage of being more flexible to the majority of design applications. It is, of course, possible to 3D print using NURBS[12] models, and similar results can more practically be achieved. Mesh modeling was adopted for this research primarily as a teaching tool, however, to reinforce the idea that printed buildings can have both structural and formal continuity at the same time. While NURBS modeling can encourage the use of many parts that do not have clear relationships beyond, perhaps, their form, a mesh model (particularly one using smooth subdivision surfaces) must be constructed 'water tight' in order to function correctly. That all vertices and edges must be connected precisely underscores as a teaching tool a certain attitude toward craft and detailing in a digital design (Fig 6).

Something must also be said of creativity in the design process. The necessary refinements to a design that are made in order to produce 1:1 products are often their most salient attributes and provide important teachable moments along the process of a design that might otherwise stall for any number of reasons. This is not to suggest that refinement, iteration, and changes in design criteria cannot or do not exist in 3D printed designs. However, one question that arises from this research is how these things are taught in this environment.

The ability to produce large scale building elements of infinite form with minimal or no need for construction waste or skilled labor is both intriguing and a real possibility. Encouraging students to explore additive manufacturing technology as a 1:1 product for the construction of buildings can potentially shift 3D printing away from pure representation and into the arena of 'making'.

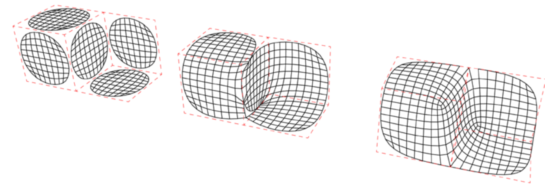


*Fig. 6 Digital craft. The same subdivided mesh model shown with three different topologies. The mesh at right is desirable for its automorphic and isomorphic consistency.*

## Notes

1 http://www.thingiverse.com

2 http://www.technologyreview.com/featuredstory/513716/additive-manufacturing/

3 http://www.popularmechanics.com/cars/a16726/local-motors-strati-roadster-test-drive/

4 Hod Lipson and Melba Kurman. *Fabricated: The New World of 3D Printing*. Wiley, 2013. p 20.

5 http://www.materialecology.com/projects/details/pneuma-1

6 http://mathworld.wolfram.com/Homeomorphic.html. Where two forms are topologically equivalent in that the topology (more simply the seams of the surface) are preserved throughout the transformation. A common example of a homeomorphic deformation is a donut and a coffee mug. The toroidal shape of the donut, given enough elasticity, could be reshaped into the form of the coffee mug without tearing the surface of the donut.

7 http://rosettacode.org/wiki/Catmull–Clark_subdivision_surface

8 Dagmar Richter, Surfaces Armees – Vers une Nouvelle Topologie. In 'Architectures NonStandard'. Centre Pompidou. Paris, 2003. P 78-89.

9 http://www.dailymail.co.uk/sciencetech/article-2615076/Giant-3D-printer-creates-10-sized-houses-DAY-Bungalows-built-layers-waste-materials-cost-3-000-each.html

10 http://www.emergingobjects.com/projects/bloom-2/

11 http://autodeskresearch.com/projects/dreamcatcher

12 NURBS: Non-Uniform Rational Basis Splines. This geometry is common in industry software and the mathematics and computer science of the geometry is taught in most major universities. For more discussion on the topic, see https://www.rhino3d.com/nurbs

# Kit of (odd) Parts: From Still Life to Conjectural City

Sandy Litchfield | University of Massachusetts, Amherst

## Introduction

A kit-of-parts can be loosely defined as a limited set of pieces which can be assembled, disassembled and reconfigured into various unlimited constructions. Kit-of-parts theory has been applied to many disciplines, including manufacturing, engineering, robotics and even information technology. As an architectural teaching tool however, the kit-of-parts is most renown as the nine square grid problem, which was first developed in the mid-20th century by John Hejduk and Bob Slutzky. [1] Since then it has been widely used by educators to teach design composition as a formal issue. Originally this problem was comprised of an exact and restricted set of wood parts with precisely defined measurements. The limited parameters focused on possibilities for arrangement that established order and spatial relationships. [2]

The reductive aspects of this assignment reflected the minimalist style that dominated that time. Many artists and architects who were part the modernist movement in the 60's were reacting against abstract expressionism by turning away from gesture and emotion, toward a more pure and essential geometry. This can be seen in the work of Mies van der Rohe, and artist, Donald Judd. The nine square grid, as it was originally outlined by Hedjuk, was in accord with the modernist ideals of its time.

Over the years, design educators have continued to debate and modify the use of kits, providing rich ground for pedagogic discussion. While most educators agree that the kit-of-parts can provide a strong beginning to a curriculum by helping students develop a vocabulary with which to analyze form, structure and composition, there has also been strong criticism for neglecting important principals and considerations of design education like context, site, program and materials.[3] Contributing to this debate in 2003, Professor Timothy Love published an article in Harvard Design Magazine.

"The nine-square grid and its progeny can be considered formative in the redirection of pedagogy in American architecture schools, although it was not pervasive until the late 1970s ... While the influence of these exercises can be considered positive for having energized and inspired avant-garde practice, the specific attributes of the exercises can also be criticized for what they left out. Most important, the term of the exercises severed the relationship between the sense of play afforded by sophisticated syntactical operations and the qualifying "content" of an architectural problem, whether the program or the rules of a constructural system."[4]

He goes on to argue that instead of rejecting the kit-of-parts, educators might consider injecting it with "an overlay of content to instigate the architectural process." This content could be a site, a program, specific materials, or a narrative– as long as it is relates to real life. But the content, he emphasizes, "must be introduced not as the Big Idea but rather as small-scale everyday intentions." The intersection of materials like wood and steel, for example, provides a means "to include the corporeal world."[5]

## The Kit of Odd Parts

This paper outlines an experimental project in which students were asked to create and then work through problems using a uniquely non-traditional kit-of-parts. This eclectic kit-of-parts was used throughout the duration of the course to teach the students about composition, representation, drawing systems and design thinking. Unlike the nine square grid problem, the kit used for this class was eclectic and variied.

*Introduction to Architecture Design and Graphics*, is a general education course, open to both majors and non-majors. As an introductory class it straddles art, urbanism, literature and basic design skill building. The lack of time, money and technical facilities devoted to this course made it impossible to fully develop a typical kit-of-parts sequence. These impediments led to questions about the necessity for a kit to be so rigid and strict. Could students, for instance, learn the same basic design skills from a more makeshift kit? Could they develop an understanding about architecture as it is described by Hejduk.

"The nine square grid problem is used as a pedagogical tool in the introduction of architecture to new students. Working within the problem the student begins to discover and understand the elements of architecture... to probe the meaning of the plan, elevation, section, and details. He learns to draw. He begins to comprehend the relationships between two dimensional drawings, axonometric projections, and three dimensional (model) form. The student studies and draws his scheme in plan and in axonometric, and searches out the three-dimensional implications in the model. An understanding of the elements is revealed, an idea of fabrication emerges."[6]

Furthermore, assuming that students could begin to grasp the elements of composition, construction and drawing systems, what else could an odd kit-of-parts teach them about improvisation and inventive techniques for architectonic design and creative practice? Inorder to answer these questions, an invesitgation began.

*Merz Principle*

The *Metz Principle* is a theory developed by the architect Yona Friedman in reference Kurt Schwitters and his famous Merzbau construction. In what could be considered a manifesto or philosophy, Friedman assumes that reality is a process or series of processes, as opposed to a sum of information. He describes the *Merz Principle* as a "random agglomeration of things that form a whole." [7]

The kit outlined in this paper advocates for a design approach that accommodates a range of disparate parts that don't fit neatly together. It argues against pure modernist ideals, proposing instead that *bricolage* be used as a methodology for aesthetic construction and creative planning. The French word, *bricolage*, means *do-it-yourself, improvisation or tinkering.* The word has been adopted internationally by artists to represent a process of creation using various materials that happen to be available. These materials could be mass-produced, hand crafted or cast off as trash or junk.

## Three Projects

At the beginning of the semester, students were asked to fill a shoebox with regular and irregular wooden blocks, panels, rods, and other found objects. The only rule was that some of the blocks share the same size (any single unit of measurement, such as 3 inches in length) and all the materials fit together neatly in the box. Students were encouraged to use wood scraps from a woodshop– cutting sets of them down so that they conformed to a single unit of measurement, which was not specified. Students were also encouraged to hunt for found objects with diversity of shapes and texture including, screens, round shapes, grids, curves, fragments, rubber bands putty, or fragmented objects. All objects that could fit neatly in the box, it were fair game.

*Fig. 1 Example used as a demonstration for contents that might be included in the kit.*

*1. Still Life Composition*

In the first project, students employed the kit as a tool to explore a 1:1 relationship with objects in the context of still-life drawing exercise. Like a typical still-life drawing exercise, the goals were to learn how to represent light, shadow and volume though an understanding of value, shading, and texture. In addition to this, students also learned about composition and translation of compositions from 3D to 2D.

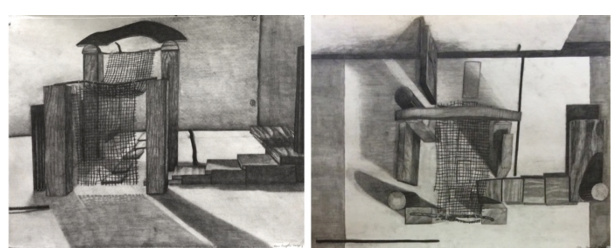


*Fig. 2 Still Life drawings by Alma Crawford-Mendoza*

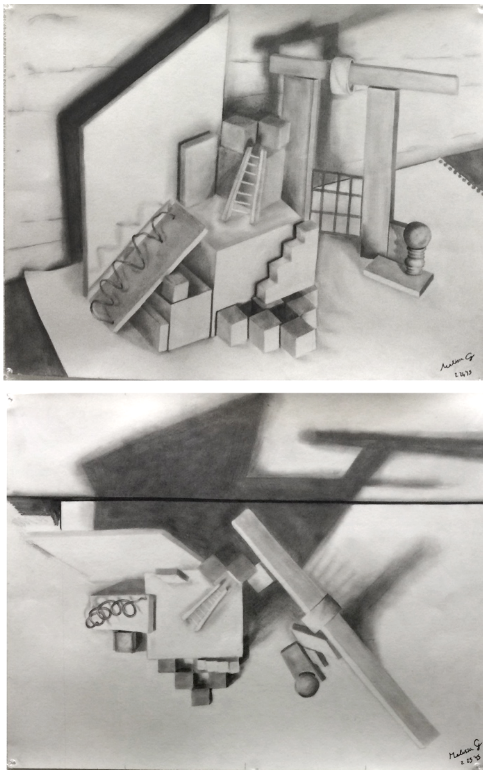


*Fig.3 Still Life drawings by Melissa Graham*

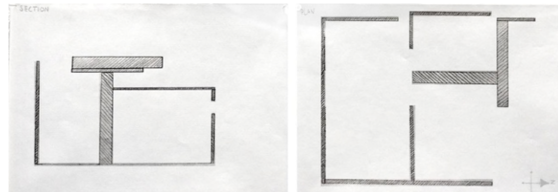
The assignment was to build a sculptural configuration that considers all the elements of composition– solid-void relationships, repetition, balance, flow, tension, and focal point. Once the composition was in place, they were to enhance the visual effects of light and shadow on their structure with a clamp light. Then, using a view-finding device, such as a camera, they were asked to make two still-life drawings: one from above, looking down on the arrangement, and one side or frontal view.

The use of found objects and recycled materials encouraged students to think about both the history of those materials– which contributed to the overall narrative of the composition– and the quality and intersection of those materials, which implied differing measures of interconnectivity and structural complexity.

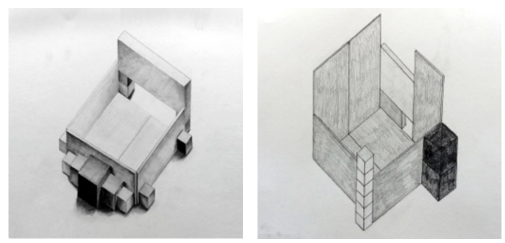
*2-Drawing Systems*

For the second section of the class, students employed their kit-of-parts to learn about drawing systems. This section was divided into three parts: flat projection (plans, elevations, and cross-sections), axonometric projection, and perspective. The abbreviated instructions are outlined below along with images of student examples.

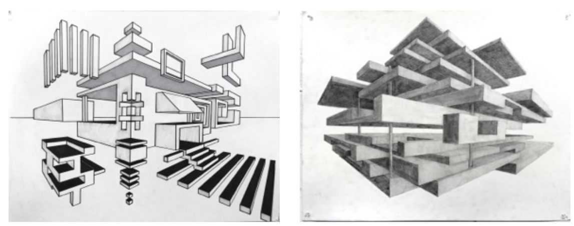
Flat Projection: Using the kit-of-parts, build a model construction that fits within an 8x10” rectangle drawn on 9x11” paper. Make at least four flat projection drawings of the model- 2 elevations, one plan, one cross section. Scale is 1:1.



Axonometric Projection: Build an orthographic model that fits within an 8x10” rectangle on paper. Make a 1:1 scaled plan of the bottom of your model on graph paper. Turn the plan to a 45-degree angle and lightly transfer it to an 18x22” sheet of Bristol paper. Then project it upwards according to the model.



Two-point Perspective: On Bristol paper, make a 2-point perspective drawing of an imaginary abstract construction. Use your kit-of-parts to help you conceptualize the features of structure.



In both the *Still Life* project and the *Drawing Systems* project, students were able to use their kits to learn freehand drawing techniques used in design. In this way, students gained an understanding of beginning design as it was described by Hejduk above.

The final project differs radically from the nine square grid problem. With a nod towards Collin Rowe and Fred Koetter’s book, *Collage City*, this project explores the notion of *bricolage* in relation to urban planning and design. For Rowe and Koetter, *bricolage* is seen as a way for city planners and designers to embrace our pluralistic past, which can include an array of architectural structures– from ancient ruins to newly constructed urban buildings.[8] Like Rowe and Koetter, Yona Friedman also views the city as an agglomeration of parts that, over time, is destined to ruin if its users and designers do not understand the capacity for these parts to have new life.[9]

This project developed in response to Yona Friedman's assertion that, "Intelligence starts with improvisation."[10] If a kit of odd parts could help students to conceptualize the spatial representation of objects on a 1:1 scale, what could it teach them about speculative design in relation to the wider scope of art, architecture and environmental planning?

*3-Conjectural Cities*

At the start of this project, students were presented examples of radical architectural designs such as Archigram's *Walking City*, Frank Lloyd Wright's, *Broadacre City*, Paolo Soleri's *Acrosanti,* along with other visionary thinkers like Buckminster Fuller and Hundertwasser. Included in the presentation was a short synopsis of utopian thought, beginning with Thomas Moore, and highlighting the influence that literature and philosophy has had on architectural design throughout history.

Our discourse was greatly enriched by guest speaker, Matt Bua, who come to our class to talk about his work. Bua, a visual artist, creates makeshift architectural structures out of mostly found material. He has shown his work internationally at public spaces including Mass MoCA, Art Omi, and PS1/MoMA in New York. He also co-authored a book called *Architectural Inventions,* which catalogs an array of vernacular, experimental, and visionary architectural drawings made by contemporary artists and architects. After his talk, Bua initiated a collaborative exercise in which tables were pushed together and students combined their kits to create a giant model of an imaginary city.

*Fig. 4 Collaborative building project with Matt Bua*

Needless to say, this was a lot of fun. But it also had educational value as it introduced students to new and inventive methods of appropriation, integration, and narrative in the context of an imaginary city.

*Fig. 5 Collaborative building project with Matt Bua*

The assignment began with a reading of *Invisible Cities*, by Italo Calvino. Afterward students had to write a fictional essay in which they introduced and described one particular building in one of the book's cities. This detailed description was to include, among other things, the building's purpose, site, shape, scale, materiality, light. This was their architectural invention in literary form.

For the final presentations, students had to create four drawings of their invention (and its site) using the representational skills they learned in the previous two projects. The drawings had to be done on 18x24" paper and could be constructed with any media including collage. One drawing had communicate the thematic concept they developed in their essay. This could be done with text, graphics and images combined.

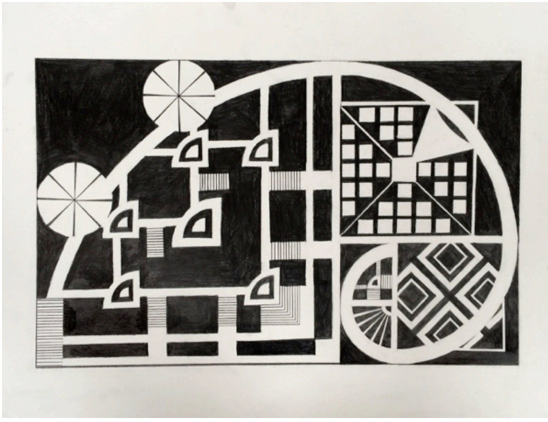


*Fig. 6 Student drawing of city plan, by Maya Gamble*

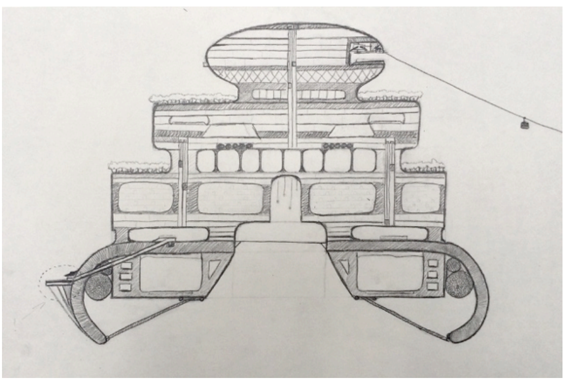


*Fig. 7 Student drawing of building cross-section, by James Diburro*


*Fig. 8 Student drawing of city concept, by Sadie Mazur*

This project exposed students to the notion of architectural design as a fictional medium– one whose primary purpose is not just to design buildings but to propose alternate realities that provoke discussion and debate. It introduced students to radical designers of the past, making them aware of their culteral contributions. Most importantly, however, this exercise taught students that architecture is not just about designing habitable spaces, its also a speculative practice, which could include social dreaming, and futurescaping.[11] And its scope extends deep into the cultural fabric that includes liturature, art, philisopy, and science.

## Conclusion

The paper suggests that a less standardized kit-of-parts can teach student about key architectural drawing techniques and creations in space. At the same time it works to foster a sense of resourcefulness and flexibility among students. It promotes inclusivity, while it presents the more difficult challenges related to the integration of form, idea, and material. As a beginning design tool, this kit of odd parts extends beyond $20^{th}$ century preoccupations with form, abstraction and concept towards $21^{st}$ century notions of heterogeneity, adaptation and resilience.[12]

Taken together these three projects cover a lot of ground, from the pragmatic drawing skills used in a still life, to theoretical propositions set forth in visionary urban planning. Some might argue that this is in fact too broad for first year students. But, on the other hand, architecture is a broad discipline, and first year students should get a glimps of the various ways it infiltrates our culture.

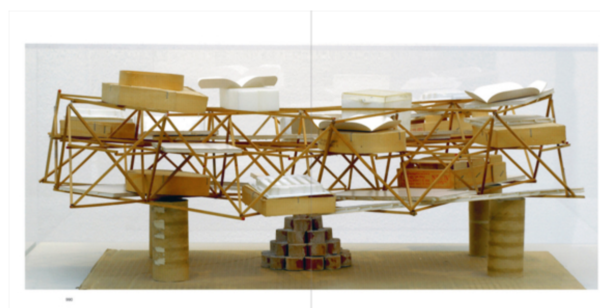


*Fig. 8 Yona Friedman's model for Ville Spatiale*

*"The architect provides ideas to be realized by others and 'Merz' is in effect a process that works through individuals, as the Ville Spatiale is a 'Merzstruktur' on an urban scale for a mass society consisting of individuals"*[13]

## Notes

[1] Among others who developed this concept were Lee Hersche and Colon Rowe according to Jonathan Friedman in Creations in Space: Fundamentals of Architecture. $2^{nd}$ Ed. P. 9.

[2] Mo Zell. Architectural Drawing Course: Tools and Techniques for 2D and 3D Representation. Quarto Publishing: London. 2008. P. 104.

[3] Timothy Love. *"Kit-of-Parts-in-the-World."* NCBDS. Stillwater, OK 2003. 2.

[3] Judith Bing. *"Beyond the Kit of Parts: An Integrated Approach to Beginning Design in Architecture."* NCBDS, New Orleans, LA 1993.

[4] Timothy Love. "Kit-of-Parts Conceptualism: Abstracting Architecture in the American Academy," *Architecture as Conceptual Art? Blurring Disciplinary Boundaries*, Harvard Design Magazine, No. 19, 2003.

[5] Ibid.

[6] John Hejduk. *Mask of Medusa.* Rizzoli: New York, NY. 1985. p. 37.

[7] "Yona Friedman" Accessed January 14, 2016. http://www.yonafriedman.nl/?page_id=676.

[8] Colon Rowe and Fred Koetter. *Collage City*. MIT Press: Cambridge, MA. 1984. P 102-105.

[9] "Yona Friedman"

[10] Hans-Ujrich Obrist and Yona Friedman, 2007. *Hans Ulrich Obrist & Yona Friedman: The Conversation Series.* Koln: Walther Konig. 2007. p. 62.

[11] Anthony Dunne and Fiona Raby. *Speculative Everything: Design, Fiction, and Social Dreaming.* MIT Press: Cambridge, MA. 2013. P. 11.

[12] *resourcefulness, flexibility* and *inclusivity* are named among the top indicators for resilient cities. "100 Resilient Cities" Accessed January 14, 2016. http://www.100resilientcities.org/resilience#/-_/

## References

Calvino, Italo. *Invisible Cities.* Translated by William Weaver. Orlando: Harcourt, 1974.

Bua, Matt*, "b-Home" Last updated, July 1, 2015 http://bhomepark.blogspot.com/*

Bua, Matt and Goldfarb, Max. *Architectural Inventions: Visionary Drawings.* Lawrence King Publishing: London. 2012

Friedman, Jonathan Block. *Creations in Space: Fundamentals of Architecture 2nd Ed.* Kendall Hunt Publishing: Dubuque, Iowa. 2000.

Eaton, Ruth- *Ideal Cities: Utopianism and the (Un)Built Environment*. Thames and Hudson, London. 2002.

# GoodFastCheap: Democratizing Design-Build

Marc Manack, Frank Jacobus | University of Arkansas

Every new form in the landscape alters the way we perceive the structure of our conceptual and built environs. We can't underestimate the power of this restructuring. Each new small project gives insight into an evolving world view and offers a suggestion as to how to reshape and rethink a possible future. As we actively construct the world in our own image and per our own desires, we create new forms of organization that physicalize our beliefs, our sense of order, and our sense of meaning in the world. Objects and pavilions contain the fresh energy of an architectural laboratory as they allow for rapid invention and an acceleration of action in architecture.

The object and pavilion emerges, marks and reframes; often an injection of that which is out of the ordinary, yet using that which epitomizes the ordinary as its medium. We must remember that everyday objects - whether coat hangers, plastic bottles, or construction materials -are themselves designed things. We often reify these common objects, accepting them as a natural part of our environment. These everyday objects form the patterns and structure of our spatial world, yet we typically give little thought to the effect they have on our daily conceptions. A repositioning of these everyday objects has the power to create the unexpected from the familiar, displacing life's normative rhythms and offering new life to those objects whose aesthetic nuance is neglected by virtue of its everydayness. There is an exciting promise to this process that intimates other potential lives within everything that surrounds us; new forms waiting to emerge.

The architect rethinks the everyday with each new conception to ensure that life doesn't lose its mystery. Architects position themselves as contributors to the mutability of things, rather than passive observers of life's processes. You are being asked to be deeply curious about that which surrounds you and to have the will and capacity to make it reemerge as something new and better. In other words, you are acting as the alchemists of contemporary culture.

*GoodFastCheap* is an alternative design-build model that privileges speed and efficacy in an effort to break down barriers that may otherwise prevent a majority of students from participating in design-build projects throughout their academic tenure.

*Good* in these projects refers to the ability of students to engage a social agenda while advancing their disciplinary knowledge; an effort toward both intellectual and social good. But the definition of good is also positioned in a way that accepts Fast and Cheap as having positive connotations in their ability to deliver agency to the students; empowering them to act. In other words, the *good* described in the projects below allows a greater number of students to partake in the process of design-build; more student participation equals more *good*.

Acting fast requires that we accept a variety of scales and let time become a more definitive design driver. For instance, we may begin with a constrained amount of time as the ultimate design driver and ask what is possible within this time. This develops a resourcefulness in our students that helps them conceptualize alternative practice models wherein every material encounter in the world becomes ripe for speculation as a project. If students and faculty embrace *GoodFastCheap* as a design-build model then the waiting game is over; no more waiting for a grant, a sponsorship, a donor – engagement in the process can begin immediately.

*Cheap* embraces materials that may typically be thought of as waste. This is not new to design-build but we embrace this part of its history unabashedly. Historically there are pleasures in the cheap being masked by our current educational model that overemphasizes the expensive. *Cheap* is all that some people can afford, so good designers need to learn how to make *cheap* appealing.

This paper will discuss projects that have been built within the academic setting that embrace the principles of *GoodFastCheap* described above. The first project, *Barn Again*, involves the reuse of falling barn materials which were harvested for a series of design-build efforts focused on hybrid assemblies that created multiple spatial installations and eventually a unique piece of furniture for a social organization. The second is the *Super Sukkah*, a competition that involved the design and construction of a temporary pavilion that merged conceptual opportunities with logistical challenges as an animating condition of the architecture. While the final projects discussed, the *2to3 Chairs* and the *Drift Lamp* are examples of small scale, rapidly produced furniture design and construction projects that have the pedagogical value of understanding the nuances and traps of the transition from design to build without having to wait too long for the results.

## Barn Again

Our interests and inspiration for the project were two-fold, contextual and disciplinary. Inspired by the photography of Falling Barns in the Ozark region by Phoebe Lickwar, we became interested in the possibility of reclaiming the wood of one of the barns to live on in a spatial installation that could travel and be adapted in a variety of contexts. The social agenda of project was a means to contemplate the extinction of an American rural archetype in the context of contemporary architectural form without being nostalgic.

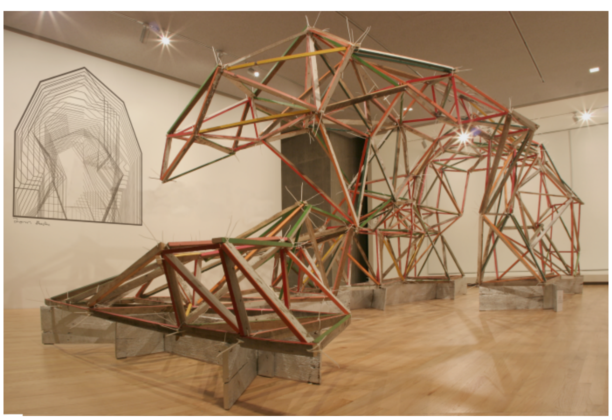


*Fig. 1 Barn Again Pavilion*

Lickwar's images revealed two consistently oppositional qualities. On one hand was the persistence and resilience of the iconic figure of the flat façade in many of the barns well into the process of decay, and the other, a dynamic filigreed space of immense depth as the wood members began to fracture and become suspended in animation. Our installation began as a speculation on how to synthesize these two competing conditions within a single architectural space or folly, to design a process that would create an otherwise unimaginable space with unique affects, offering visitors the possibility to walk through and experience a space that they could not otherwise engage.

As the design process unfolded, it became clear that we were engaging the recent history of discipline's interests in the architectural object, as the image of memory or motion. The image of memory, suggested by the transformation of vernacular or iconic form and style, best exemplified in the "Ghost Houses" of Johnson at New Canaan or Venturi at Franklin Court, use outlines or profiles of figures to suggest immediately recognizable images without facades transformed into a new kind of architectural space. The image of motion, suggested by deconstruction, and brought to fruition with the rise of the digital in architecture reached its apotheosis with Shop's PS1 Dunescape from 2000. Fields and patterns of flocking and swarming points, lines, and planes persist in the contemporary architects' design of pavilions since the Dunescape. We saw the design of our pavilion as the reconciling these two positions, speculating on the possibility of developing a logic of post-modern computation, having both the image of memory and of movement, at once both informal and classically formal and frontal.

As a point of departure, we lifted, and lofted, profiles traced from Lickwar's photos. The profiles were scaled with dimensions positioned to fit within an 8' wide x 8' high x 16' deep envelope. This was the largest dimension within the Smith gallery that would allow for visitors to move both around and through the installation, to experience it as both an object and a space. The series of spline profiles were then lofted in an expedient process that produced an unpredictable and strange geometry. In anticipation of constructing the installation out of nominal length wood members, the geometry was translated into a three dimensional faceted space frame of similar length line segments, creating a filigreed spatial affect.

To insure the complex shape could be built quickly we developed a computational process that would allow the installation to be fabricated and assembled by hand, as an act of construction. A script was developed that would not only rationalize the geometry, but would color code each segment by length, and ultimately produce a set of shop drawings for construction. The plans and sections of color coded line segments corresponded to a nominal grid, labeled as coordinates in space. This automation facilitated a quick turnaround for new shop drawings as the shape was tested and adjusted for structural stability, clearance, and accessibility requirements.

Century old yellow pine siding and red oak battens harvested from a local falling barn are the principle material used in the installation. As expected, the vintage material was weathered, warped and inconsistent. The wood could easily be cut to nominal length and widths, but precision geometry, fussy detailing, and exquisite craft were out of the question. Joinery would have to be elastic enough to allow for material movement and to accommodate the inconsistency of the processed wood members. The zip tie was ultimately chosen for its inconspicuous aesthetic, flexible, and quick assembly.

An experiment in expedient construction process within the design-build model, those that built the barn did not design it, and did not know what the final product was to ultimately look like. This released the constructors from attempting to create an idealized image, and allowed them to progress expeditiously. One piece at a time, line segment by line segment, and the shape emerged as the color coded pieces were accordingly zip tied together. Essentially a self-supporting largely tensile structure, the final form was "found" only after the last piece was installed.

The use of found, inexpensive, and non-traditional materials and construction techniques allowed for the installation to be realized economically. As with any design build program, cheap labor doesn't hurt, but for around $350, and in about 2 weeks, this sizable installation was brought to fruition. A testament to the nimble design and construction methodology, the installation was reinstalled as part of a juried show, with a different size and form, but with a similar process to its realization. Additionally, months after the final exhibition, a service opportunity was presented to the Fay Jones School of Architecture to make a reception desk for the local food bank. Faculty and students again worked together to repurpose the wood into laminated planks and screens that would insure that the once falling barn would have an extended life, albeit, in a new form.

## Super Sukkah

The *Super Sukkah* project was prompted by an annual competition that involved the design and construction of a temporary pavilion that attempted to rethink the traditional Jewish Sukkah as a 21st century phenomenon. The project translates the Star of David into a three-dimensional shelter with a distinct day and night presence. Just as the traditional Sukkah was covered with materials that were once organic but have become disconnected from the Earth, the Super Sukkah's day time presence disconnects the slowly evolving characteristics of the organic materials in its immediate environment through the act of surface reflection. The day-time phenomenon signifies an environmental absence as the Super Sukkah becomes a Chameleon that reflects the nature of its surroundings. The night presence of the Super Sukkah is a geometric inversion that provides a new figural character defined by the illumination of the interior surfaces into Citron, Palm, Myrtle and Willow - four plant species important to Sukkot. These colored lights become a campus lantern whose figural presence glows from the energy gathered on one of the Super Sukkah's photovoltaic surfaces. The Super Sukkah employs reflection [absence] and transmission [presence] as both an embodiment of the Sukkah's rich cultural heritage and as a reinterpretation of its continued meaningfulness in the 21st century.

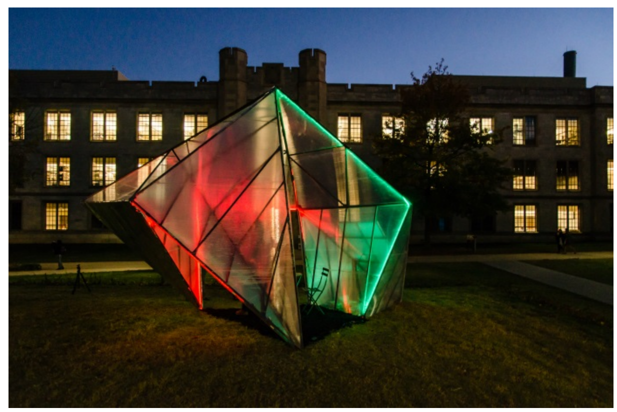


*Fig. 2 Super Sukkah at Vol Walker Hall*

We learned about this project approximately one week before the competition materials themselves were due and approximately 3 weeks before the finalists Sukkahs would have to be constructed on the Washington University site. This project also happened outside of any formalized class structure and so would not be able to consume much of our or the student's time. In other words, the *fast* in *GoodFastCheap* would act as a primary force in determining how to execute the project successfully. We quickly gathered a team of interested students and began working on strategies that could employ a minimal amount of material to create a maximal amount of space. Using the triangulated character of the Star of David we began to experiment with a series of triangles that could be extruded and rotated to create dynamic form and space. Through this process the triangles became pyramidal shapes that rest against each other to form the space of the Sukkah itself.

We asked the students to drive much of the build effort with limited guidance from the faculty (*good*). They gathered their team and as word spread about the project more students joined or volunteered to help when their schedules allowed. As mentioned earlier, *fast* became a given in this project due to the ambitious project schedule set by the Sukkah competition committee. We had a limited budget (*cheap*) and so the students had to economize and determine how things were to be done within a limited means.

The *GoodFastCheap* model of the Super Sukkah project taught the students that they had to be self-starters, had to learn to make decisions quickly, and had to work within a very specific set of constraints. We believe that this process teaches leadership, maturity and the ability to compromise a particular design intention to employ a deeper creativity by inventing another intention that may be necessary to get the job done.

## Quartered and 2to3 Chairs

Beyond the larger scale project discussed above, furniture Design studios are an opportunity for students to take architectural projects from concept through full-scale construction as well. In many cases this is their only opportunity to do so during their tenure within an architectural curriculum. Critical knowledge, such as the effects of material properties and the nature of material assemblies on design decisions is often lost on students whose designs have remained too affixed to the virtual world. This problem reveals itself most frequently in the furniture design studio when students, who haven't had the opportunity to test their drawings through hands-on, full-scale building, put together and test a descriptive drawing set. The process of construction of the full scale piece reveals many of the drawing's shortcomings, such as lack of details, misunderstanding about how certain elements will be supported, or an over appreciation (or sometimes under appreciation) of material strength. These problems are symptomatic of a lack of understanding regarding the physical nature of material and an over reliance on two-dimensional, "virtual" space. Through the process of construction the students discover the inadequacy of what they believed to be a comprehensive and descriptive drawing set and gain an understanding of the level of thought, detail, and embodied knowledge required when developing a set of drawings. We believe that the GoodFastCheap model is perfectly for these smaller scale design-build opportunities as well.

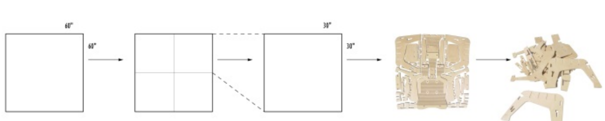


*Fig. 3 Quartered Chair CNC Cut and Parts*

An example of this mindset is embodied in the *Quartered Chair*, a piece of furniture built for 2-3 year olds out of a single 30"X30" sheet of Baltic Birch plywood that uses the CNC machine as the primary production tool. The *Quartered Chair* idea arose out of our fascination with the potential for using computer automated tools in the rapid production of low cost furniture products. Toward this end we set three primary goals for the project: minimization of waste (*cheap* and *good*), ability for rapid assembly (*fast*), and a playful masking of the two-dimensional nature of the stock material. For the *2to3 Chair* project we translated the first two of the *Quartered Chair* parameters into the project brief but left it up to the students as to whether they wanted to conceal or reveal the flatness of the material from which their chairs were built. Beyond the goals of minimizing waste and rapid assembly the *2to3 Chair* project focused on the transformation of a two-dimensional, 30"X30" sheet stock material into a three-dimensional functional object designed with mass-production in mind. By its nature this project forced the students to focus on issues of material waste and tightened design constraints; ideas that they'll encounter repeatedly during their lives as practitioners.


*Fig. 4 Quartered Chair Assembled*

The project brief for the *2to3 Chair* created a design problem that added definitive material constraints to what would have otherwise been an open ended search for a formal solution. In this respect, GoodFastCheap became an embedded value within the project that forced the students to acknowledge process, material and time as values within a design project that have the capacity to transform and bring a definitive social meaningfulness to the outcome.

## Drift Lamp

Our final example of how *GoodFastCheap* process can be employed in the academic setting is the Drift Lamp project. This project was done as a part of directed study with several students who signed up for the class due to their interest in the potential of small scale fabrication. The basic goal was to design a lamp whose form could be manipulated through a social network (*good*). In order to achieve this, a single parametric definition through Rhino / Grasshopper was created for each lamp that is transformed through a shared social network. The challenge was to design the definitions such that, no matter the allowable formal transformations, each new iteration would be able to be constructed as easily and quickly as any of the others. In other words, the parametric definition had to employ the constraints necessary to maintain a high level of order and organization in the lamp's manufacturability without being too limiting in terms of the potential formal variants (*fast* and *cheap*). This process emphasizes design as a social activity (*good*). The established parametric definition allows for virtually infinite variations with the same formal vocabulary - ensuring the uniqueness of each new lamp (*good* and *cheap*).

*Fig. 5 Drift Lamp, Two of Multiple Formal Options*

## Conclusion

Small scale design build projects, including furniture design and construction studios, offer a unique opportunity for our students to understand their relationships to society at large, to understand that time acts as a transformational value with a design and build process, and that the economics of a project has the potential to drive new form and material choices. The GoodFastCheap model empowers students and faculty, in a culture of tightening budgets, to become overly reliant on others to ensure projects get the momentum to become reality. This model ensures that the educational vitality that exists within design-build as an educational model is able to be experienced by all.

# Parametric Beginnings: Design Computation for the Beginning Design Student

Adam Marcus | California College of the Arts

## Introduction

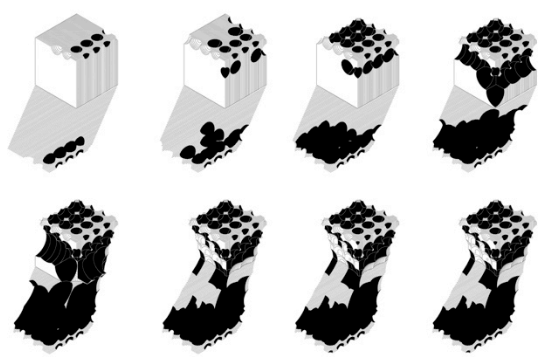


*Fig. 1: Iterative series of parametrically generated massings (A. Rouhi)*

Learning parametric design software can be very daunting for the beginning design student, particularly those with limited software experience. By the same token, the remarkable ease of contemporary visual programming languages such as Grasshopper can often yield a kind of banal uniformity to the work; we see this in the glut of twisty towers and endlessly panelized surfaces found in almost any architecture school. This paper presents one approach to addressing the challenge of how best to introduce these powerful tools at an early stage of a design curriculum. The approach, developed through a series of introductory courses and workshops, explores how parametric tools can be applied to two conventions of the architectural design process: iteration and representation.

## Walking Out Of Parametricism

The primary means of investigation for this pedagogical research is the parametric design platform Grasshopper, a program now prevalent in architecture schools and practices alike. Developed by David Rutten as a plugin for Robert McNeel & Associates' 3D-modeling platform Rhinoceros 3D (Rhino) and first introduced in 2007, Grasshopper is a free and highly customizable package that allows users to build parametric functionality into any geometric operation within the Rhino environment. Importantly, Grasshopper is a *visual* programming language, in which scripted behaviors are constructed not through lines of textual code, but rather through graphical nodes that the user can aggregate into relational networks of geometric procedures. This visual interface, while not unique to Grasshopper, has dramatically expanded the accessibility of design computation workflows to a new subset of designers previously unfamiliar or uneasy with textual programming.

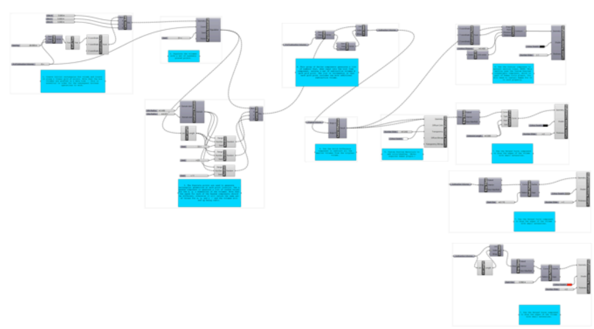


*Fig. 2: Screenshot of a typical Grasshopper definition, showing the visual programming interface of graphical nodes linked in a relational network.*

While the program remains in beta mode and has yet to be officially released, it has had an unquestionably transformative effect on both the practice and teaching of architecture. The ease and speed with which Grasshopper enables parametric[1] workflows largely explains its widespread adoption, so much so that the word "Grasshopper" has become shorthand for a go-to aesthetic of complex, curvilinear forms and richly patterned surfaces. Patrik Schumacher, perhaps the most vocal proponent of this contingency between technique and aesthetic, celebrates this aestheticization of the technology, claiming that the "shared concepts, computational techniques, formal repertoires, and tectonic logics that characterize this work are crystallizing into a solid new hegemonic paradigm for architecture"—what he calls "Parametricism."[2] While there is certainly value in the democratization of complex computational processes in architectural design (and the novel forms and geometries they yield), this mindset reflects an ultimately unproductive technological determinism, whereby the tool itself overly conditions the output. Grasshopper's radical facility—its great strength—becomes a liability as it perpetuates this kind of endgame.

This predicament is particularly acute in schools of architecture. Too often, parametric design techniques are introduced as a discrete skill set that can be used to perform specific tasks, such as the twisty tower or the panelized surface. This *a la carte* mindset precludes a more thorough understanding of how the technology can inform a design process in a less piecemeal manner. What lacks is a more holistic understanding of parametric design not as a *product*—a given set of techniques that produces a set of expected and predictable outcomes—but as a *process*, one of many techniques that are woven into making architecture.

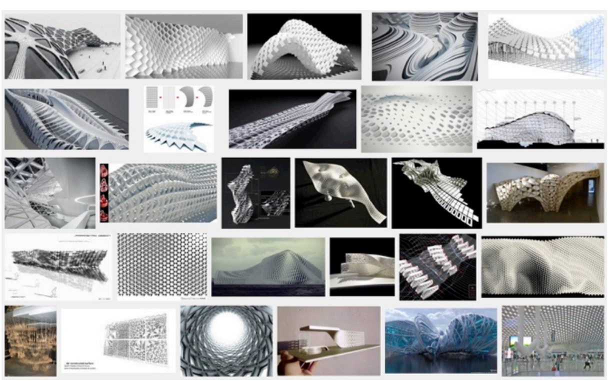


*Fig. 3: A search for "parametric design" on Google Images demonstrates the formal homogeneity that characterizes much of contemporary design computation.*

## Towards A Critical Pedagogy of Design Computation

The following student work is the product of a series of workshops and courses on computation for beginning design students taught at California College of the Arts in 2014 and 2015. Students in these courses are typically familiar with 3d modeling environments but are entirely new to techniques of parametric design and visual programming, and the Grasshopper visual program platform is the primary tool used to introduce these ideas. The pedagogy seeks to promote a more elemental and thorough understanding of the potentials of computational design software rather than succumb to the seductive tendencies outlined above. The curriculum is structured so as to deemphasize the software's association with formal qualities of curvature and differentiation, focusing instead on how parametric processes can interface with two essential aspects of architectural design: iteration and representation. The following three projects typically occur within a two-week timeframe.

*Project 1: 2D Fields*

The first project focuses on the concept of parametric variation in a two-dimensional field. Students begin by arraying a single type of geometry (such as a circle, or a square) in a grid. The software is used to deploy subtle variation across the field, such that each geometry varies from one to the next while maintaining an overall consistency at a global scale. Similar to "attractor-point" tutorials often found in introductory Grasshopper courses,[3] the project is an effective way to introduce students to parametric logic using the most elemental of two-dimensional geometries. Through this simple process, students develop an understanding of how to select a single quantitative parameter (such as radius, or rotation) and design a rule that governs how this parameter can change from one geometry to the next. After establishing this rule set, students then layer a second logic of geometric variation on top of the field as a way to explore how modulation of the two different parameters can produce compelling or unexpected visual effects.

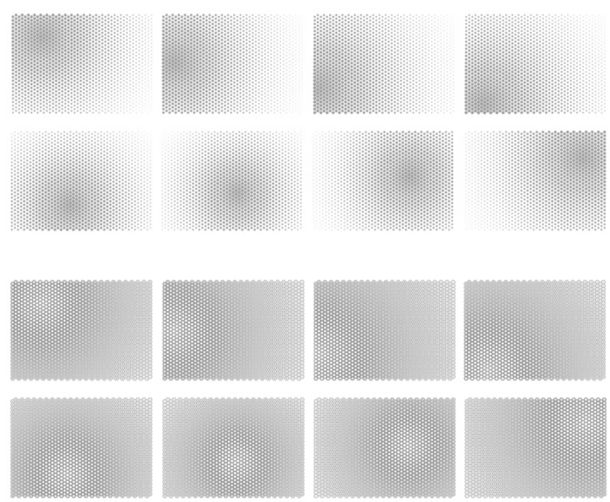


*Fig 4: Project 1 – Two-dimensional field drawings with one variable parameter (top) and two variable parameters (bottom). (S. Akolly)*

The project also introduces methods of using a "live" parametric model to cycle through design iterations. As the student modifies and tunes the logic of variation in the field, she outputs a snapshot of the field to record its change. This simple workflow (also known as "baking" the geometry, in Grasshopper lingo) and distinction between "live" and "dead" geometry provides important understanding of the value of the software's capacity for iteration.

*Project 2: 3D Fields*

The second assignment extends the logic of Project 1 to a three-dimensional system of geometries deployed along a surface. The process is similar: students identify two different parameters that are programmed with variable behaviors, and they output a series of iterations exploring the effects of that variation. Although the outcomes begin to evoke the language of continuous differentiation and panelization that is so often associated with Grasshopper, the intent here is otherwise: to foster a rigorous understanding of how to establish properties that are standard (or repetitive) and properties that are variable (or different). Importantly, the students are given a common surface to use as the basis for this project; this neutralizes the question of form and ensures consistency from one iteration to the next.

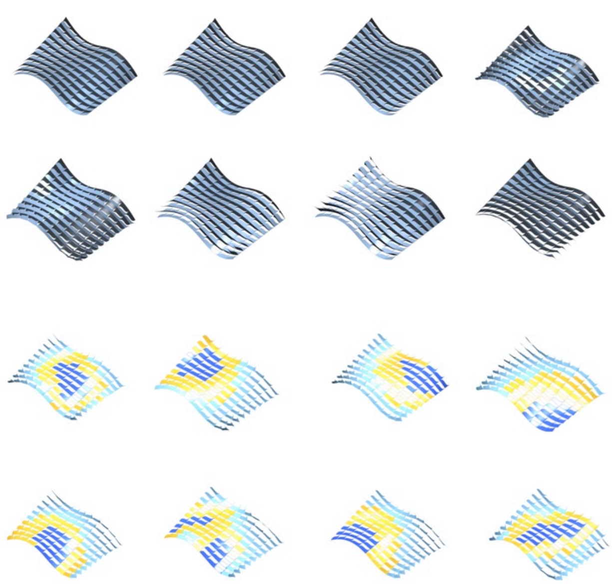
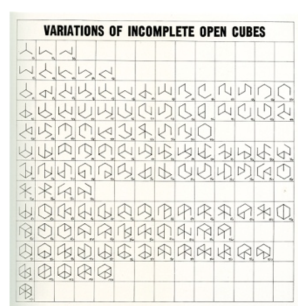


*Fig. 5: Project 2 – Iterations of a three-dimensional field system that demonstrates parametric change. The drawings at the bottom use color to index the changing rotation of the geometries. (A. Rouhi)*

As with Project 1, the focus of this assignment is to develop an understanding of parametric logic and a fluency with using the live model to generate numerous iterations. As an added dimension to this process, the project introduces basic techniques of parametric representation. Just as the software can be employed to modulate geometric properties in quantifiable and variable ways, it can similarly control the parameters of how those geometries are represented on the screen. These include line weights, line types, color, transparency, and virtually any other property relating to how geometry is rendered or previewed in the 3D environment. This assignment focuses on color—which can be quantified and computed using numeric red, green, and blue (RGB) parameters—as the basis for introducing a quantitative approach to representation. As a final step in generating the parametric system of three-dimensional geometries, students develop a logic for deploying variable coloration across the field. The changing color values typically are keyed to the variable behaviors of the geometries in the field, such as scale or rotation; while relatively simple and straightforward, this linkage of geometric parameters with representational parameters provides a basic understanding of how representational techniques can be controlled parametrically.

*Project 3: Iterative Massings*

The first two projects incorporate techniques and tutorial strategies that are fairly typical for introductory courses in parametric design. The third and final project takes on more advanced techniques, but it does so in a way that departs significantly from the mainstream of parametric design coursework in academia. Rather than focusing on formal acrobatics, complex facade systems, or logics of optimization or performance-driven design, the project instead takes a more disciplinary approach to understanding how parametric tools can be folded into an architectural design process.



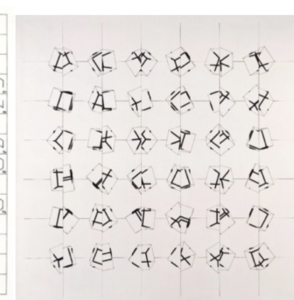



*Fig. 6 (left): Sol Lewitt, "Variations of Incomplete Open Cubes" (1974)*
*Fig. 7 (right): Manfred Mohr, "P-197 J" (1979)*

The premise draws inspiration from a number of process-driven precedents, such as the conceptual art of Sol Lewitt and the algorithmic drawings of computational art pioneer Manfred

Mohr. Both of these artists employ sequential, diagrammatic techniques of representation to communicate rule-based processes of geometric transformation. The early drawings of Peter Eisenman operate similarly, but in an even more critical way that foregrounds and problematizes the role of authorship in the architectural design process. Stan Allen describes how Eisenman's drawings typically "begin with a simple form and describe a linear narrative of increasing complexity," and how they "make explicit the usually hidden aspects of the design process, giving them a transparency and internal logic that serve to critique the arbitrary nature of such procedures as normally practiced."[4] Allen continues:

> [Eisenman] holds on to an idea of authorial intention, and sees the architect as the agent that endows the object with meaning – even if through a semiautomatic process. For Eisenman, design is the inscription of meaning into, or onto, the work by means of a series of more or less rigorous operations carried out by the designer. Eisenman as an architect imparts meaning to the building, which is in turn registered by its increasing complexity. This formal intricacy is intended to elicit a "decoding" operation as the viewer is invited to unpack the process of the making of the object.[5]

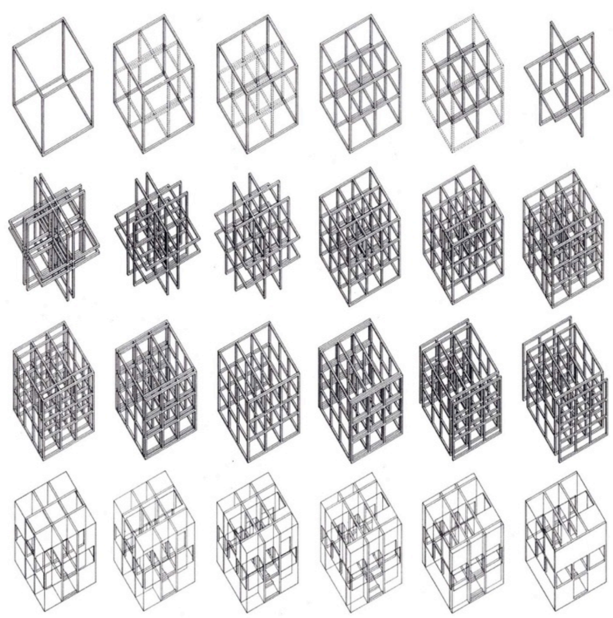


*Fig. 8: Peter Eisenman, "House IV" (1975)*

Allen's reading of Eisenman's early work touches on the complex nature of authorship within a rigorous process-based process. It is this dynamic between the designed and the automatic—between control and surprise—that the project to seeks to unpack, particularly within the context of contemporary design computation. The output is typically a series of iterative drawings that demonstrate the transformation of a simple primitive volume to a more complex form, following a precise set of rules or procedures. The project eschews formal techniques most typically associated with parametric design software and Parametricist dogma and instead emphasizes simple Boolean operations of volumetric addition and subtraction. Students start with a simple primitive (such as a cube or a sphere) and design a set of rules for sequential additive or subtractive processes to be performed on the primitive. The parameters of these Boolean operations (position, scale, and geometry) are controlled computationally through a combination of algorithmic and randomly generated logics; the balance between the two presents an opportunity for the student to define the limits of authorship in the design process.

The iterative structure of this exercise demands a high degree of representational rigor to ensure the legibility of the volumetric transformation. This aspect of the project taps into the software's ability to control not only formal or geometric operations, but also representational decisions. Students learn how to program parametric behaviors into conventions of representation such as line weights, line types, shading techniques, surface textures, and shadow casting. This fosters a representational awareness in the work and helps to reinforce the rigor of the iterative process. By leveraging the computational tool to iteratively construct both form and the representation of that form, this process promotes a synthetic understanding of computation—one that delivers a technical understanding of parametric software while also grounding the work within broader conventions of architectural design.

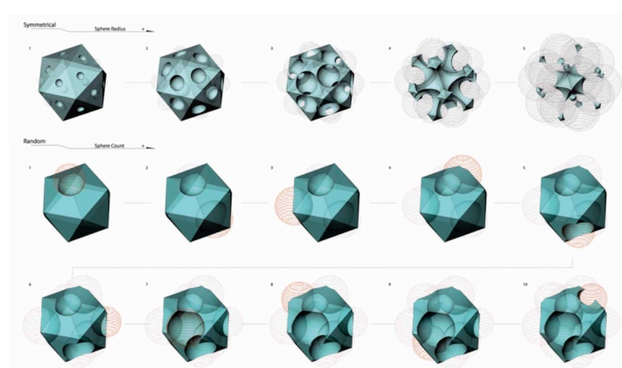



*Fig. 9: Project 3 – Boolean operations are systematically and iteratively performed on a simple primitive. (J. Joong)*

The final phase of the project asks students to perform a quantitative analysis on the geometry produced through the iterative massing studies. The intent is to introduce the software's analytic capabilities in a way that demonstrates the value of quantitative analysis without suggesting that the entire design process must be contingent on such techniques. Once the geometric transformation is complete, students identify a simple metric—such as surface area, or volume—and link this parameter to a color gradient that allows for a visual representation of the data. While the analysis in this case is largely self-referential (quantifying properties of scaleless geometry produced by an abstract formal process), it nonetheless reinforces the understanding of the software's ability to perform highly analytical operations. By doing so in a way that inverts the causal relationship between data and form that typically characterizes parametric design, it demonstrates how the technology can augment a design process rather than determine it.

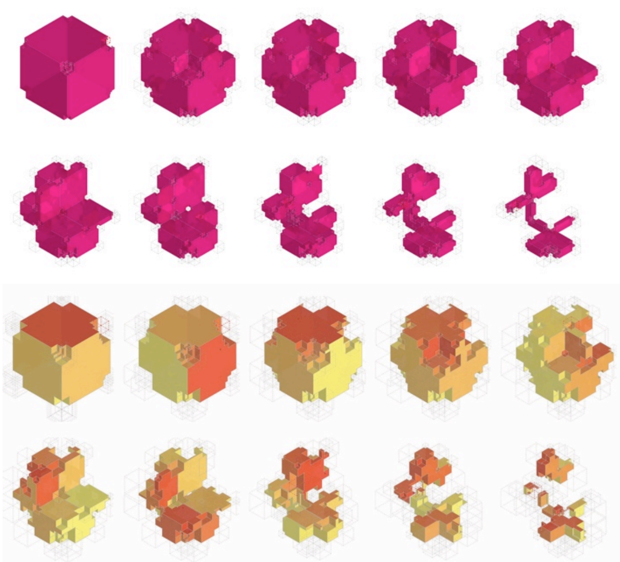


*Fig. 10: Massing studies (top) are subject to quantitative analysis (bottom) that uses color to represent the surface area of each face of the geometry. (H. Koo)*

## Conclusion

This set of exercises provides an alternative approach to introducing techniques of parametric design. The curriculum recognizes the importance of these skillsets and relevance to the architectural practice, but it also resists the conventional tropes associated with parametric tools. By understanding and resisting the software's bias for easy curvature and highly differentiated surfaces, and by redirecting its computational power to focus on disciplinary concerns of iterative design and representation, this approach promotes a more critical and systematic introduction to design computation. Eschewing the "hegemonic paradigm" heralded by Schumacher as the inevitable end game of parametric design processes, this more neutral approach ultimately provides more space for beginning design students to develop their own workflows and attitudes towards the technology and how to integrate it into the architectural design process.

## Notes

Acknowledgements: I am grateful to my CCA colleague Andrew Kudless for co-teaching an early workshop in parametric techniques of drawing and diagramming that informed the development of this pedagogy. Thanks also to Andrew Heumann, whose Grasshopper plugin "Human" has proven invaluable for facilitating many of the workflows of parametric representation described in this paper.

[1] The word "parametric" remains a contested and problematic term within contemporary architectural discourse. For the purposes of this discussion, it indicates a quantifiable system of variable parameters that the designer can control and modulate. For a broader discussion of the word and a working definition, see Adam Marcus, "Positioning Parametric Design: Interfacing Between Computation and Intuition" in *THERE: Journal of Design*, v.8: Interface, 2013, p. 44-53.

[2] Schumacher, Patrik. "Parametricism as Style – Parametricist Manifesto." 2008. http://www.patrikschumacher.com/Texts/Parametricism%20as%20Style.htm (accessed January 10, 2016). For an extended theoretical treatise on Parametricism, see: Patrik Schumacher*, The Autopoiesis of Architecture, Volume 1: A New Framework for Architecture*, London: John Wiley & Sons, 2010, and *The Autopoiesis of Architecture, Volume 2: A New Agenda for Architecture*, London: John Wiley & Sons, 2012.

[3] For a classic example of the "attractor point" project see: Akos, Gil and Ronnie Parsons, "Foundations: Grasshopper Primer V3.3," 2015, p. 63-67.

[4] Allen, Stan. "Trace Elements" in Cynthia Davidsion, ed., *Tracing Eisenman*, London: Thames & Hudson, p. 58-59.

[5] Ibid., p. 59.

# From Paper-*Thin* to Paper-*Thick*: On Handcrafting the Drawing Ground

Andreea Mihalache | Mississippi State University

At the beginning of a project students navigate through unchartered territory. There is fear of the unknown and uncertainty about the outcome. Erstwhile familiar instruments have lost their voice and are now mute. The drawing tools appear intimidating. But the most unsettling is the blank paper, which looks back at them with a flat stare. Nothing comes out of it and nothing goes on it either. But what if the drawing ground became the creative resource for the design project? Can paper itself as a material presence rather than an abstract emptiness generate ideas? Li Yang-ping, a Chinese poet and calligrapher from the eighth century, talked about "generative paper" as a living organism, "endowed with life, moist and fertile like soil, generating the structures of calligraphy as the ink runs like sap (or blood)."[1]

I will examine three basic conditions – *foreignness*, *slowness*, and *rigor* – that students encounter at the beginning of a project and how a way of engaging drawing media early in the design process has the potential to cultivate creativity and imagination. Specifically, I will discuss the importance of the very first assignment in a studio project from the particular lens of students making their own drawing medium from recycled paper and other specific ingredients. The paper becomes the vehicle that brings together the known and the unknown, the familiar and the foreign, the instrument and the idea. This assignment has been tested and implemented in several studio projects.

Historically, the paper has acted as the *site* of the drawing, while the *site* itself was the 1:1 drawing medium.[2] In the first book of his architectural treatise, Vitruvius identified the three forms of expression (or *ideas*) of an architectural work as *ichnographia* (plan), *orthographia* (elevation) and *skenographia*.[3] Scholars have proposed that the first term – *ichnographia* – described "the marking of the earth on the construction site."[4] The introduction of paper in the Western world in the fifteenth century changed the nature of the architectural practice and architects began to work at drawing boards rather than on site.[5] Around the same time, Filarete wrote in his architectural treatise that **"As it is necessary to have a site in order to build and to dig the foundations, so too we will first make the site in which we wish to make our drawing."**[6] Understood as an intricate entity, the site encompasses, not unlike a "primordial soup," a range of latent ingredients – cultural, historical, material, social – that the architect will identify and orchestrate. Mario Botta described this condition of the site not as a matter of a building's site, but rather of building the site itself.[7]

Starting from the premise that paper and site are analogous and comprised of elements with distinct materialities and flavors, I will look at the act of paper-making as a possible origin of the design process in relation to three necessary conditions associated with the beginning of a project.

## *Stone Soup* or the Necessity of Foreignness

Popular in many cultures, the story of the stone soup brings together a group of hungry strangers arriving late at night in a village, the local community – suspicious and fearful of the newcomers, a pot in which a stone is boiling, a curious child who dares to approach the foreigners, and, eventually, the participation of the entire village to the collective act of cooking and sharing the food.[8]

First, the story gives us the stone – the cause that generates the "plot in the pot" and the trick that distracts the villagers from the real meaning of the events unfolding under their eyes. Then the story tells us about wonder. The fascination with the unknown pushes a child to be braver than the others and approach the mysterious strangers to whom she asks the first question, thus creating the possibility of a conversation. Last but not least, the story is about the necessity of being a foreigner. Coming from the outside, intimidated, and fearing the locals as much as the locals fear them, the strangers find the obvious – a stone – and make it into something more that is less about the outcome and more about the process. It is the outsider who discovers the overlooked potential of the banal and the ordinary.

Students have to enter a project as foreigners to whom the most commonplace – the paper – provokes fear. The act of paper-making, of rendering the unfamiliar, familiar again and vice-versa, explores precisely this state of ambiguity and capitalizes on the condition of being a stranger to the project, rather than dismissing the obvious uncertainty. For the first studio assignment students research the process of making paper and begin to experiment with different ingredients. They establish criteria about what goes into the pulp and perform simple acts: select the recycling paper, cut it, mix it with water, and make the pulp. The first questions arise: what kind of paper is recycled and why. Is it glossy or porous? Which one works better? What is the best way to cut the paper? What is the difference between shredding it mechanically and tearing it manually? How does the quality of the edges – smooth or rough – influence the pulp and its capacity to absorb the water? (Fig.1)

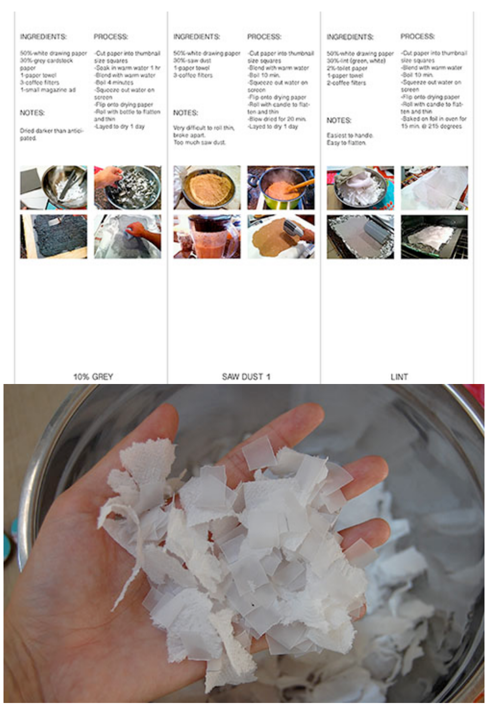



*Fig.1 Experiments in calibrating the ingredients (stud. James Catalano and Adrienne Trahan)*

One of the objectives of the assignment is to construct the paper as a *thick ground* which carries the memories and presences of everything that goes into it. Not unlike a magic trick, this 1:1 engagement with the paper "sidetracks" students from their own doubts, re-positions the question from the abstraction of a new project to the physical properties that can be grasped and transformed, and thus begins to build up a material, rather than a formal, understanding of the design process.

## *Pepperpot* or the Necessity of Slowness

A small country between Venezuela and Suriname with strong Caribbean influences, Guyana has a cultural heritage reflected in its cuisine: colonized by the Dutch and the British in the 17$^{th}$ and 18$^{th}$ centuries, the native Amerindian population was permeated by Africans, East Indians and Portuguese laborers. A culinary outcome of this melting pot is the local traditional Christmas dish – *pepperpot* – a stew whose preparation begins days and sometimes weeks in advance. Tough beef parts, such as shanks and tails, are slowly cooked with cinnamon, cloves and peppers.[9] But what can one do in a tropical climate, in the days before refrigeration, to preserve the food from spoiling? The answer is a secret ingredient: cassava. Filled with cyanide and therefore deadly poisonous, the root requires careful preparation and handling. Not boiled long enough it leaves lethal residues. Watched from too close, the deadly vapors might kill the cook. Boiled down to a dark and thick syrup, the juice – *cassareep* – has antiseptic properties, keeps the food from spoiling, and is supposed to have the complexity of caramel, with "notes of sweet, and notes of bitterness at the end."[10]

Making pepperpot describes the necessary condition of slowness: the beginning of a project requires time and maturation to soften rough ideas just as time is needed to soften the rough meats in the pepperpot. It also shows how something potentially poisonous– cassava root – is alchemically transformed into a key ingredient of the soup. Specific to a geographic location, this root allows the dish to exist only in this particular place. Engaging with the drawing medium, students experiment with materials and processes. Having to literally boil the pulp in order to make the paper, they discover how different ingredients – natural juices, spices, herbs or textile fibers – influence the alchemy of the process. This 1:1 interaction offers a way to enter the project through the microscale of materials.

As the paper-making experiments continue, invention begins to happen in small steps: students conceive of various devices to lay out the pulp, allow it to settle and spread it into sheet-like layers. (Fig.2) They test temperatures, times of cooking and thicknesses. Introducing spices such as cinnamon results in a fragrant paper. Each paper reveals itself as a topography, as the locus of ideas, but also the site of the project. Some students explore ways of incorporating elements of their actual site, such as dust, leaves, or grass, into the making of the paper. Others let the paper grow and inform the project. (Fig.3)


*Fig. 2 Discovering the process of paper-making (stud. James Catalano)*

In addition to building their paper, students also begin to make their own inks by mixing various ingredients. Before the discovery of artificially produced inks, architectural treatises have described various methods for obtaining colors. Vitruvius described the magic of deriving dyes and tints from nature as a culinary alchemy:

"Methods of making blue were first discovered in Alexandria … . The method of obtaining it from the substances of which it has been found to consist it, is strange enough. Sand and flowers of natron are brayed together so finely that the product is like meal, and copper is grated by means of coarse files over the mixture, like sawdust, to form a conglomerate. Then it is made into balls by rolling it in the hands and thus bound together for drying. The dry balls are put in an earthern jar, and the jars in an oven. As soon as the copper and the sand grow hot and unite under the intensity of the fire, they mutually receive each other's sweat, relinquishing their peculiar qualities, and having lost their properties through the intensity of the fire, they are reduced to a blue color."[11]

A necessary condition of these processes is patience. As work becomes ritual, paper turns into a place for reflection. This transmutation requires slowness and also openness toward a result which might not always be the one initially anticipated and therefore requires more than one iteration.

*Fig. 3 Paper-making and site-building (stud. Stephanie Parker and Sarah Gravois)*

## ***Wensi Soup*** **or the Necessity of Rigor**

Soups might appear undifferentiated concoctions where everything goes, however, it is most difficult to keep all flavors and textures present and in balance. No small task, this requires precision and rigor often acquired after years of experience. Soups can be challenging dishes. The Chinese imperial cuisine in the Qing dynasty developed some of the most elaborate and sumptuous courses. During the reign of the Qianlong Emperor a monk called Wensi became famous for making vegetarian dishes and particularly a soup that came to bear his name. The ingredients are few – bamboo shoots, green vegetables, shredded ham, and tofu – but this is one of the most difficult dishes to make as it requires a very precise and rigorous technique of slicing the tofu. To this day, it remains a knife skill test for experienced chefs. The cook has to cut the tofu into hair-thin strips that are added to the water into which the other ingredients are boiling. One has to wait until the shredded tofu rises to the surface and fans out into a delicate inflorescence. The tofu melts into the mouth giving the full measure of the chef's skills.

The mechanical action of slicing the tofu thus translates into the sensorial experience of the tofu dissolving into the mouth. Relationships between quantitative and qualitative properties of materials are common in architectural practice and have been noted in architectural treatises. Alberti observed that of the trees that bear fruit, "of those with a sharp and bitter taste, the sourer and more infrequent the fruit, the more solid the wood."[12] Regarding stones, on the other hand, he noted that those "dappled with polygonal markings are more solid than those with circular ones."[13]

The precision of cutting can be acquired only through practice, sometimes tediously repetitive, and requires patience, rigor, testing, and a long sequence of trials and errors. The process of paper-making begins as a vague and ambiguous endeavor whose goal remains unclear until the first results are achieved. With each iteration students fine-tune their findings, adjust the ingredients of the pulp, understand what it takes to reach a desired consistency, color, and texture. Rigor and accuracy begin to replace improvisation as the goals become clearer and more explicit.

Culinary metaphors have always been intertwined with design processes as they both "manifest themselves in the making; evolve and last in the form of memories, tastes, and time, ... and are based on thinking *with* things rather than thinking *about* things."[14] Filarete's fifteenth century architectural treatise was conceived as a dinner conversation that engaged what today would be trivially called the architect, the contractor, and the client.[15] Born during the French Revolution, Marie-Antoine Careme, arguably the first "celebrity chef," researched architectural treatises in the National Library in Paris to find inspiration for his elaborate confectionaries. In the first half of the twentieth century, Filippo Tomasso Marinetti published *The Futurist Cookbook*, a collection of exuberant imaginary recipes designed to regenerate the imagination of artists and architects.[16] Common to all these different instances is understanding the recipe not as a set of precise instructions, but rather as an act that requires a good balance between experimentation, improvisation and rigor.

Constructing the paper needs the same attention as making a dish, building the site or fabricating the floor. Often overlooked, these processes have similarities that students discover while working on their drawing media. As the ground of the future building, the paper/site/floor demands accuracy in making. Vitruvius observed that "great pains and the utmost precaution must be taken to ensure its [the floor's] durability."[17] Alberti recommended that "before you start any excavation, it is advisable to mark out all the corners and sides of the *area*, to the correct size and in the right place several times, with great care."[18] To leave the ground perfectly clear and level, in other words to erase the marks of previous presences, is a mistake that, Alberti remarked, only the inexperienced do.[19]

Inspired by the fragrant paper that she made using various spices, Sarah explored air circulation as the core concept of her design where the movement of air generated a system of cross ventilation and wind towers (Fig. 4) Hugh made paper out of cucumber and lemon slices. Understanding and taking into consideration the properties of fruits and vegetables, their life cycles and environments, he developed the design of his urban culinary school into a program whose main component explored the cultivation of the land in an urban location. (Fig. 5) Adrienne interpreted the paper-making as a performing act that was further echoed into a building whose components moved, slid and rotated in a carefully orchestrated scenario. (Fig. 6)

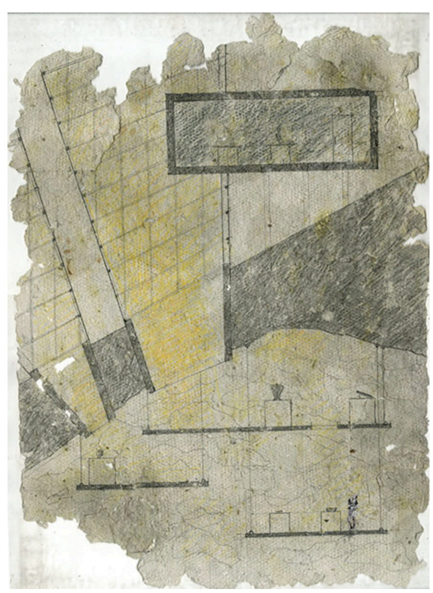


*Fig. 4 Stud. Sarah Gravois*

*Fig. 5 Stud. Hance Hughes*

*Fig. 6 Stud. Adrienne Trahan*

Starting from the process of making their own paper, students discover how unseen properties of their drawing ground could further inform their design. Sharing their experiences, they build studio conviviality in a process similar to food preparation that always brings people together. In addition, one of the main goals of the exercise is to test the handcrafted paper as *actual* drawing media rather than a glorified artistic experiment. Students sketch, draw and draft their project onto their paper. (Fig. 7) Working with the micro-scale of materials in multiple 1:1 iterations students overcome the intimidating blankness of the paper and formulate questions about site and topography. Just as the site is never simply a postal address, but always a conglomerate of cultural, historical, social and experiential properties, paper is no longer *thin*, but *thick* with materials and memories that find their way into the design.

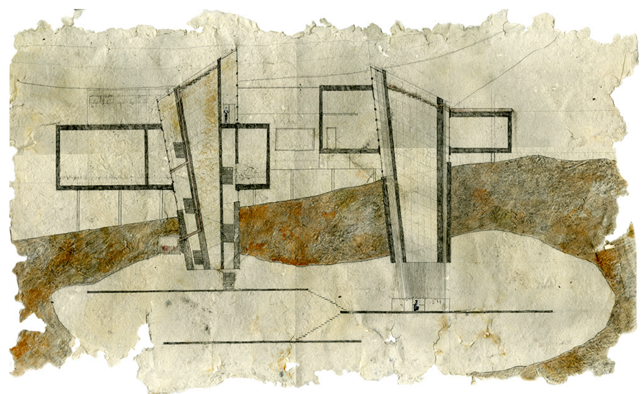


*Fig. 7 Stud. Sarah Gravois*

## Notes

[1] John Hay, "Surface and the Chinese Painter: The Discovery of Surface," in *Archives of Asian Art*, Vol. 38 (1985), 98.

[2] For an extensive discussion on the relationship of paper and site, see Paul Emmons, "Drawing Sites :: Site Drawings," in Suzanne Ewing, Jeremie Michael McGowan, Chris Speed and Victoria Clare Bernie (eds.), *Architecture and Field / Work* (London: Routledge, 2011), 119-128.

[3] Vitruvius, *The Ten Books on Architecture*, trans. By Morris Hicky Morgan, Dover edition, I.II.2. While there is a general consensus in translating *ichnographia* as plan and *orthographia* as elevation, *skenographia* is interpreted as section and/or perspective.

[4] Emmons, "Drawing Sites :: Site Drawings," 120.

[5] Marco Frascari quoted in Emmons, "Drawing Sites :: Site Drawings," 119.

[6] Antonio di Pietro Averlino (Filarete), *Treatise on Architecture*, trans. by John R. Spencer, (New Haven: Yale University Press, 1965) 177r.

[7] Mario Botta quoted in Martin Steinman, "Reality as History: Notes for a Discussion of Realism in Architecture," (first published in *A+U* 69, 1976) in Michael K. Hays (ed.), *Architecture Theory since 1968*, (Cambridge, Mass.: MIT Press, 1988), 253.

[8] Different cultures have different versions of the story, but the gist of it remains the same.

[9] Deena Prichep, "Guyanese Christmas Gives a Whole New Meaning to Slow Food," http://www.npr.org/sections/thesalt/2014/12/24/372514524/guyanese-christmas-gives-a-whole-new-meaning-to-slow-food, on-line resource accessed on September 28, 2015.

[10] Ibid.

[11] Vitruvius, *The Ten Books on Architecture*, VII.IX.1.

[12] Leon Battista Alberti, *On the Art of Building in Ten Books*, trans. Joseph Rykwert, Neil Leach, and Robert Tavernor (Cambridge, Mass.: The MIT Press, 1996, 6th edition), 45.

[13] Alberti, *On the Art of Building in Ten Books*, 48.

[14] Marco Frascari, "Canadian Cosmopoiesis: Meditations on Cuisine and Architecture," in *Cuisine: The Journal of Canadian Food Cultures*, Vol.!. No.2., 2009 – http://www.erudit.org/revue/cuizine/2009/v1/n2/037852ar.html on-line resource, accessed on October 1, 2015.

[15] Filarete, *Treatise on Architecture*.

[16] Filippo Tommaso Marinetti, *The Futurist Cookbook*, trans. by Suzanne Brill (San Francisco: Bedford Arts, 1989).

[17] Vitruvius, *The Ten Books on Architecture*, VII.I.1.

[18] Alberti, *On the Art of Building in Ten Books*, 62.

[19] Alberti, *On the Art of Building in Ten Books*, 62.

# From Excess to Surplus

Whitney Moon, Antonio Furgiuele | University of Wisconsin - Milwaukee

*An installation is a three-dimensional work of art that is site specific. In this sense it is very much art that aspires to be architecture. So what happens if an architect creates an installation? How is the work different from one made by an artist? The answer lies not in the work itself, perhaps, but in what it offers to the field of architecture.*

– Sarah Bonnemaison & Ronit Eisenbach[1]

## Installation Fever

What differentiates an architectural installation from a drawing or model is that the installation is a full-scale, site-specific, and (typically) temporary construction that actualizes, rather than represents space. Not unlike a building, the installation is a material assembly rendered through the movement of bodies, in space, over time. So why would architects, who typically design and construct buildings, participate in the creation of temporary installations? What opportunities does the installation afford, and how does it engage in disciplinary questions specific to architecture? And, in the context of beginning design education, what is the value of engaging in installation practices, and how can this be reconsidered, or re-evaluated to reflect contemporary concerns and preoccupations in architecture?

Because the installation affords architects the opportunity to test out their ideas at 1:1 scale, without the constraints often associated with a building (e.g., program, codes, budget, client, etc.), it could be said that the installation is the most hedonistic form of architecture. By dislodging architecture from its disciplinary status as a fixed or static object, the installation aims to challenge the norms of architectural representation (e.g., drawings and models), in turn generating new modes of constructing, perceiving, and experiencing spatial relationships. Rather than relying on standards and architectural convention, the installation is inclined to take risks (i.e., doing things that have never been done before). Material innovation is one means by which the installation allows architects to test out new ideas, technologies, and effects. But rather than simply looking cool, or foregrounding an aesthetic agenda, what are the social and environmental implications of these experiments? In other words, what is the capacity for an architectural installation to "perform"?

In recent years architecture has experienced "installation fever"—a prolific fascination with designing and building temporary constructions. This is due, in part, to our spectacle and media-based culture which facilitates the display and consumption of architecture as images. Because the installation operates as an instantaneous and seductively image-full assembly, it has ushered in an epidemic of ephemerality, where architecture is here one minute and gone the next. Simply put, we are addicted to the new and the now. So, what are the implications of this architectural impulse towards installation? What created this contemporary condition, and where is it headed?

Today, one of the most sought-after installation opportunities for emerging architects is the MoMA PS1 Young Architects Program (fig. 1).[2] Since 1998, the museum's courtyard in Queens,

*Fig. 1 Andrés Jaque / Office for Political Innovation, COSMO, Warm Up, MoMA PS1, Queens, NY, Summer 2015.*

NY has been transformed into a myriad of temporary architectural environments for the summer-long "Warm Up" music series.[3] Showcasing not only talent, but nascent disciplinary trends—water purification, bio-design, air purification, relational aesthetics, atmospheric effects, urban farming, digital fabrication, etc.—the five offices that are invited each year to submit a proposal must address, at a minimum, solar shading and seating for visitors. In addition, the entries are also required to "work within guidelines that address environmental issues, including sustainability and recycling."[4] According to their website, PS1 MoMA states that the winning installation proposals have each been allocated between $50-$70k for construction, but in recent years, the fiscal amount has not been indicated.[5] Despite a valiant attempt to exhibit the latest talent and trends in architectural design, with a penchant for being "green," the PS1 installation has evolved into an exclusive and luxurious display of hedonism.

For most young architects, installations are designed with a DIY sensibility. Often dictated by limited material and financial resources, these projects are carried out with available tools, expertise and labor. Regardless of the fact that working at 1:1 scale presents significant budgetary and technical challenges, how might these constraints be seen as opportunities for architectural invention? In other words, is it possible to achieve maximum effects with minimum means? Does an installation need to be expensive to have value? Perhaps the answer lies in reevaluating what materials and methods are used in installation practices.

According to Molly Hunker and Greg Corso (SPORTS), architectural installations can be produced from inexpensive and off the shelf materials. Their project, *Life Will Kill You* (2010), celebrated the excess of everyday materials (i.e., zip ties and electrical cord), exploiting their capacity to be transformed into a suspended "cloud-like volume" (fig. 2).[6] Utilizing over 100,000 colored and white zip ties, this "double-sided surface" installed at the Revolve Clothing Showroom in West Hollywood, CA contrasted the high-end nature of a fashion boutique. Despite its use of inexpensive and non-luxurious materials, the effects were anything but quotidian.

*Fig. 2 SPORTS, Life Will Kill You (2010), Revolve Clothing, West Hollywood, CA. Photo by Justin Harris. Courtesy of SPORTS.*

The problem with the installation is that nobody wants it once the "party" is over. Unlike a drawing or model that can be tucked away in a drawer or placed on a small shelf, the installation is an unwelcome pile of exhausted material excess.[7] (It is the proverbial elephant in the room—everyone notices the installation, but doesn't actually want to deal with its aftermath.) So, what exactly is the waste associated with installations? As architects, should we consider an after-life for these temporary constructions? Or, possibly reconsider what we are using to create installations all together? SPORTS offers one solution. With *Pop Thieves* (2015), a recent competition proposal for poolside cabanas in Miami, Hunker and Corso scripted into their installation a plan for disassembly of the modular steel structures, and their re-installation (underwater) as a strategy for reef regeneration.[8] This intention—to consider an after-life, after the party—suggests a contemporary turn towards addressing issues of excess and obsolescence, and the potential of surplus.

The installation now dominates contemporary architectural production, but a central question remains: how wasteful is it? In addition to exploring problems, has the installation generated a new one? As architects and educators, we take a pedagogical, disciplinary, and cultural position that directly challenges the myth that good architecture needs to be expensive and constructed out of precious materials. We argue that it our responsibility as educators to not only prepare students to create architecture, but to engage critically with its modes of production. How then, we ask, can the architectural installation engage in a practice that is better than "best practices"?

## The Event

Our project, *From Excess to Surplus*, explored the productive reuse of an everyday material through the lenses of waste and obsolescence.[9] Working exclusively with a donated stockpile of outdated phone books, first year architecture students at University of Wisconsin – Milwaukee (UWM) constructed a series of installations exploring materials, techniques, and effects at 1:1 scale.[10] Over the course of seven days, six different studios, a hundred and five students, using approximately five hundred phone books, formed a dozen groups to construct eleven super-sized site-specific installations throughout the architecture building at UWM.[11]

In the context of a beginning design studio, there were three major objectives for this project: 1) to introduce students to working at 1:1 scale (i.e., how what they draw or model translates into the real world); 2) to understand material and spatial effects (i.e., how the body experiences architecture, and how architecture can perform in certain ways); and 3) to expose students to the politics of architecture (i.e., how to address environmental, economic, and social issues through design.)

Employing a variety of techniques, the phone book underwent numerous performance-based operations, exploiting its potential to generate a site responsive and spatial system. By folding and forming paper in a variety of ways, the phone book was initially studied as both a volumetric and planar (sheet based) material. A module was devised, then repeated to generate a material system. These iterations were then tested and re-prototyped for their potential to manipulate and manage one of the following performance-based criteria: vision, light, or acoustics.

Throughout the project, the following questions were posed:

How can the material and formal properties of paper be expressed and challenged? How can differentiation be introduced into your module to generate an aggregate system? What is the part to whole relationship? How will the introduction of a secondary material transform this module/system to enhance its performance?

Introduced on the first day of the semester, and completed in just one week, *From Excess to Surplus* was broken down into five phases.

*DAY 1: Properties of Materials, Form & Tectonics*

Students worked in pairs to explore the various properties of paper. Using only the provided phone books they began by folding and forming a single sheet of paper in a variety of ways (fig. 3). Once an interesting module was developed, they were then asked to attach two modules together, without using another material or fasteners (i.e., no glue, no tape, no staples, etc.) A resultant tectonic strategy for interlocking paper emerged, and was refined to connect several modules together.

*DAY 2: Assembly Required*

Working in teams of six, students were asked to develop two large scaled assemblies measuring 18"L x 18"W x #"D that directly engaged one of the following performance criteria: light, sound, or vision (fig. 4). In other words, how might a paper assembly either dampen of amplify light, sound, or vision? For one of the two assemblies, it was asked that an additional material be introduced to aid in its overall performance, enhancing the material-form-tectonic strategies. These iterations were then tested, photo documented, and re-prototyped to maximize their performative potential.

*DAY 3: Site Assembly Required*

Teams of six were assigned various locations within the architecture building to develop a revised paper assembly. This phase necessitated that the location be precisely photo docu-

*Fig. 3 DAY 1: Properties of Materials, Form & Tectonics.*

*Fig. 4 DAY 2: Assembly Required.*

mented, including ½" scaled elevation and section drawings. Students were asked to take advantage of the particularities of the site, and to develop a new module to engage their selected performance criteria.

*DAY 4-5: Installation Proposal*

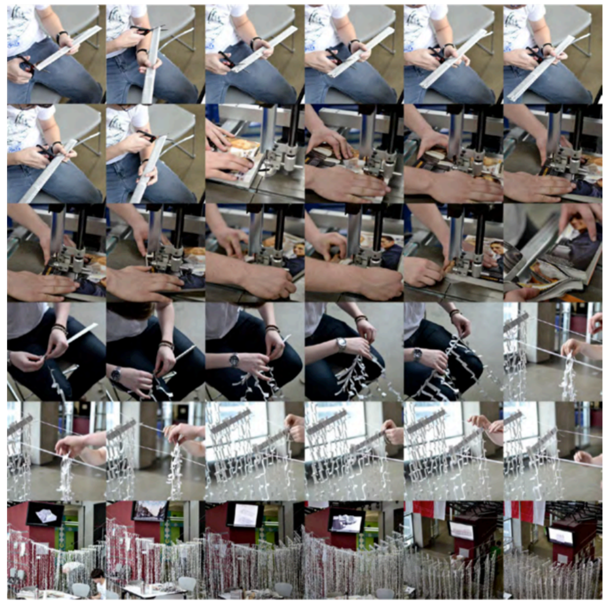
Taking this new site-specific module, teams of six developed a larger scale prototype (36"L x 36"W x #"D) that not only fit into their assigned site, but maximized their selected performance criteria (light, sound, or vision). Although this physical prototype only covered a portion of the select site, each group was asked to develop a ½" scale elevation drawing illustrating the entire proposed installation on a sheet of 36" x 36" vellum. In addition, photo documentation of the construction process and the assembly's performance was required. Guest critics were invited to a walk-through and presentation of the installation mockups (fig. 5).[12] After discussing and troubleshooting the proposals, two were selected from each of the six studio sections to be executed at full scale.[13]

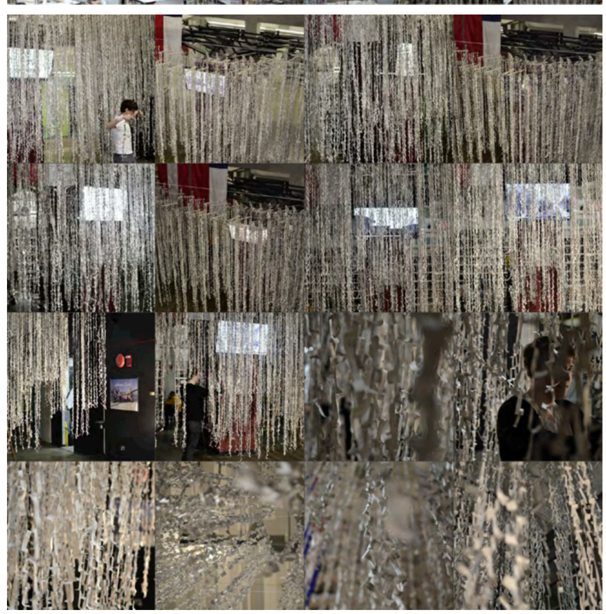
*DAY 6-7: Supersized Installation*

Over the weekend, eleven supersized phone book installations were constructed in various locations throughout the architecture building. Each group presented their installation in situ, demonstrating how their project addressed the performative criteria. Each group was asked to create a ½" scale elevation and section drawing of the final installation on a sheet of 36" x 36" vellum. In addition, photo documentation of the construction process and the assembly's performance was required as a means for students to analyze their own process and techniques (fig. 6, 7). A week later, the installations were disassembled and recycled.

## The Aftermath

Bonnemaison and Eisenbach acknowledge how "the installation is not the end product in itself or mere exercises in the absence of 'real' building, but a preliminary step in an ongoing process to develop the discipline of architecture and a way to engage issues critical to architecture."[14] Similar to the ways in which Installation Art historically challenged its own disciplinary boundaries, the installation offers to architecture a redefinition of the terms through which architecture is produced and experienced.[15] Freed from the constraints of a commissioning client, installations opt for critical content in lieu of the functional constraints of buildings. Releasing architecture from utility, the installation provides architecture with the necessary distance to reflect on itself as a cultural product, a necessary performance.





*(top) Fig. 5 DAY 5: Installation Proposal. Invited guest critics Molly Hunker and Greg Corso (SPORTS).*

*(middle) Fig. 6 DAY 6: Supersized Installation (Process).*

*(bottom) Fig. 7 DAY 7: Supersized Installation (Final).*

*Fig. 8 A student experiences one of the eleven Supersized Installations in the School of Architecture at University of Wisconsin – Milwaukee.*

*From Excess to Surplus* folded the problem of waste back onto the installation itself; by holding a mirror up to the project, we learned that it is not just about material, but more importantly, about "matter" (fig. 8). Whenever asking students to use materials for an architectural project, we need to think about where they came from and where they are going. That is, scripting the aftermath of a project is just as important as understanding its origins. If one is serious about systems thinking (i.e., energy, matter, labor, etc.), then there needs to be an asserted value at the end of the installation.

Although our students recycled their phone book installations, how do we move beyond this best practice of reclaim/reuse/recycle and take it to the next level? Meaning, how is this not only a creative exercise in upcycling, but also something that exposes students to the politics of architecture? Simply put, what is the take away? According to our colleague Nikole Bouchard, "As designers, it's our role to take on these issues; To question our preconceived notions of Waste; to conserve resources; to challenge our (design) imagination. If we don't do it, who will?"[16]

From our most prestigious institutions like MoMA, to the institutions where we teach, how do we not just "greenwash" environmental, economic, and social issues? As architects and educators, how do we craft and rethink both pedagogy and practice, and strive for inventive solutions to address excess in the Information Age? In the end, it's not just about "Waste to Wonder," or the transformation of trash into treasure, but also about designing ethical futures.[17]

What constitutes better than "best practices" when it comes to architectural installations? Is it being smarter about what the installation is made of? Or, is it the design of the entire process: from the selection of the material, to the techniques/methods and labor involved, to its effects, to its aftermath? In order to assert its role in the era of The Anthropocene, architecture needs to consider this full cycle of matter as the premiere matter of concern.

## Notes

[1] Sarah Bonnemaison and Ronit Eisenbach, *Installations by Architects: Experiments in Building and Design* (New York: Princeton Architectural Press, 2009) 14.

[2] According to *The Architect's Newspaper*, "The honor is considered one of the most prestigious platforms for emerging architects in the United States and internationally." Audrey Wachs, "MoMA PS1 Names Five Finalists for the 2016 Young Architects Program," http://blog.archpaper.com/2015/12/moma-ps1-names-five-finalists-2016-young-architects-program/#.VpFNjzZodX8 (accessed January 9, 2016).

[3] According to their website, 2016 will be the 19th summer that MoMA PS1 has featured architectural installations in its courtyard, and the 17th year of YAP. MoMA PS1, "Young Architects Program," http://momaps1.org/yap/view/19 (accessed January 9, 2016).

[4] "PS1 is committed to offering emerging architectural talent the opportunity to design and present innovative projects, challenging each year's winners to develop creative designs for a temporary, outdoor installation at MoMA PS1 that provides shade, seating, and water. The architects must also work within guidelines that address environmental issues, including sustainability and recycling." http://momaps1.org/yap/view/16 (accessed January 9, 2016).

[5] An undisclosed source has confirmed that it is now upwards of $100k.

[6] "*Life Will Kill You* is a temporary installation for the Revolve Clothing showroom in West Hollywood. To stand in contrast to the high-fashion clothing of the boutique, cheap everyday industrial materials - zip ties and electrical lamp cord - were aggregated to create a floating volume that nestles below an existing soffit. Though the soffit was designed to hide the store's inner workings, *Life Will Kill You* calls attention to the ducts and wiring of the store by employing an excessive amount of the electrical materials. The design explores the contrast between industry and elegance through material sensibility, form, and visual effect. The cloud-like volume is created by a double-sided surface composed of over 100,000 zip ties. The exterior surface of the volume is an aggregation of longer, wider white zip ties while the interior is comprised of shorter and finer colored zip ties. The resulting bulging form offers ever-changing glimpses of blurred yet vivid color combinations as the zip ties layer on top of one another in the predominantly black and white store interior." Molly Hunker and Greg Corso (SPORTS), "Life Will Kill You," http://www.sportscollaborative.com/#/life-will-kill-you/ (accessed January 11, 2016).

[7] As the dumpsters at most architecture schools at the end of the semester can attest, once a project is complete and photographed, it is typically thrown away.

[8] "The projects is fabricated with off-the-shelf 6" steel welded mesh sheets and selectively welded to create building blocks for easy site assembly. Each "cabana" is painted differently to provide distinct legibility as well as interesting visual overlays. The deinstallation is a simple disassembly of the building blocks. Upon de-installation, the project is intended to be donated to Miami coastal coral reef regeneration efforts." Molly Hunker and Greg Corso (SPORTS), "Pop Thieves," http://www.sportscollaborative.com/#/pop-thieves/ (accessed January 11, 2016).

[9] Although outdated repositories of data in the information age, phone books are continually reprinted and redelivered to our homes and businesses. Most end up unopened, unused, and relegated to the trash or recycling bin.

[10] *From Excess to Surplus* was carried out over the first week of Spring Semester 2015 in the School of Architecture & Urban Design at the University of Wisconsin – Milwaukee. The course – Arch 320: Fundamentals of Architecture Design Studio II – was coordinated by Associate Professor Karl Wallick, and taught by Antonio Furgiuele, Sarah Keogh, Matthew Messner, Whitney Moon, Joseph Stagg and Karl Wallick.

[11] In lieu of supporting the notion of the designer as individual genius, the project progression—working in groups of 2, then 6, then 9+—was more akin to that of an office environment, where students worked in teams to collaboratively design and realize their projects under very tight time parameters.

[12] Molly Hunker and Greg Corso (SPORTS) were invited from Syracuse University to critique the installation proposals, and also presented a public lecture entitled "Faster Horses" on January 30, 2015 at UWM-SARUP.

[13] Because of the time and labor involved with its papier-mâché construction, it should be noted that one studio decided to form a super-group and carry out only one installation.

[14] Bonnemaison and Eisenbach, *Installations by Architects,* 14.

[15] For further reading on the history of installation art see: Claire Bishop, *Installation Art: A Critical History* (London: Tate Publishing, 2008); Julie H. Reiss, *From Margin to Center: The Spaces of Installation Art* (Cambridge, Mass.: MIT Press, 2001); Mark Rosenthal, *Understanding Installation Art: From Duchamp to Holzer* (New York: Prestel, 2003); Nicolas de Oliveira, Nicola Oxley and Michael Petry, *Installation Art* (Washington D.C.: Smithsonian Institution Press, 1994).

[16] Bouchard adds, "Working with real-world contingencies requires designers to think critically and creatively while developing design ideas that are not self-referential, but instead engage a wide-range of audiences, including Architects, Artists, Industrial Designers, Landscape Architects, Ecologists, Environmentalists, Anthropologists and Garbologists." Nikole Bouchard, "Material Realities," lecture delivered at ACSA Fall Conference: Between the Autonomous and Contingent Object, Syracuse, NY, October 2015.

[17] It should be noted that Nikole Bouchard taught an upper-level design studio at UWM-SARUP in Spring 2015 entitled "Waste to Wonder."

# Design Geometry and Rationalization: Reciprocity between Digital and Physical

Bob Pavlik | University of Oklahoma

## Materials at Full Scale

The acquisition of 3D digital modeling skills is nearly universal among foundations-level architecture studio sequences. These skills typically focus on design geometry, where zero-thickness surfaces with an absence of material properties are sufficient to describe design intent. While these are adequate for design ideation and representation, they avoid the rationalization that is necessary for construction. The translation between conceptual geometry and the realities of material, structural, and assembly logics is often neglected as an opportunity for further design iteration and refinement.

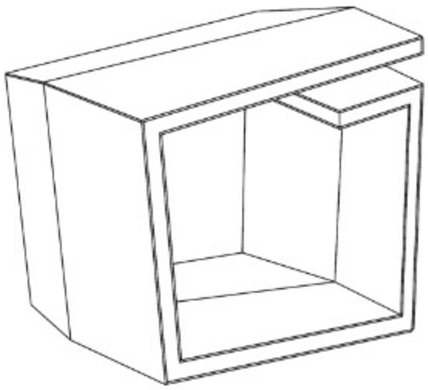
This paper describes a full-scale design-build project that was executed by a studio of ten first-year undergraduate students, over a two month duration. The design brief called for a playhouse, with a maximum 8' x 8' x 8' envelope (Fig. 1). The playhouse was required to be quickly assembled on-site from subassemblies which could individually fit through a standard double door.

*Fig. 1 Completed playhouse on exhibit at local mall*

This annual project within the University of Oklahoma, College of Architecture had traditionally been executed by upper-year students. It was transferred to first-year design studio to serve as a pedagogical tool to develop deep understandings of relationships between design geometry and the rationalization process. During the previous semester, students acquired basic digital skills working with Rhino3D, while accompanying design projects required the aggregation of large numbers of individual pieces. To realize these as physical models, accurate measurements of chipboard material were made, and this thickness was incorporated into the digital model to accommodate the process of laser cutting.

Along with a jump in scale and materials, the playhouse project introduced significantly more complex geometries. Students were encouraged along a design trajectory that included geometry that was relatively straightforward to resolve as single-thickness surfaces, but deceptively complex to rationalize and physically construct (Fig. 2). This necessitated invention of non-standard construction techniques through full-scale prototyping and testing (Fig. 3). Thorough understanding of these construction methods were in turn required for making geometrical decisions in the 3D model, such as whether material thicknesses should be added by offsetting normal surfaces, or translating along an axis. In the final design, each of the several hundred individual components was unique, with all requiring multiple complex compound miter cuts.

By immediately succeeding the acquisition of basic 3D digital modeling skills with this design-build project, a strong connection was made between the digital realm and the materials it can represent. Students recognized that the manipulation of digital geometries in space could mimic the mechanistic manner in which materials can be cut or assembled. Geometry is inherited from the process by which the physical material is manipulated. [1] This paper details the



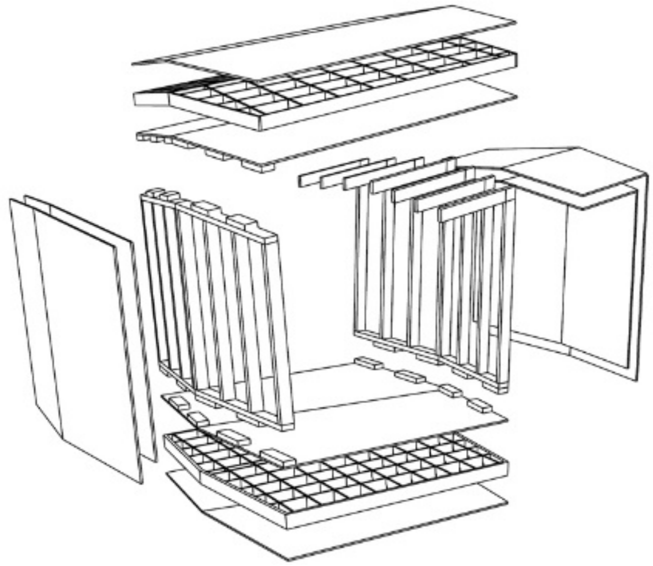


*Fig. 2 Initial rationalization of design geometry*

iterative design phases during this project. These were generated through feedback loops from intentionally reciprocal relationships between working digitally and with physical materials, and by toggling between a top-down design process and bottom-up methods of material experimentation.

*Fig. 3 Lightweight torsion box construction of floor and roof*

## Rationalization and Top-down vs. Bottom-up

Rationalization can be defined as a translation of an idealized design into a constructible object, one that can be realized with available materials and manipulation techniques. Rationalization often entails altering the initial design, whether subtly or substantially, so it can be constructed from standardized elements, or by conventional skills. Rationalization is a hallmark of top-down design methodologies, where the overall design comes first, and determining exactly how to make it follows later.

The concept of rationalization was brought to the forefront by digital architecture, where geometric complexity often requires an extensive rationalization phase to render it constructible. For example, the panelization of a NURBS surface, or breaking down into developable strips. Rationalization of digital architecture may require novel solutions such as non-standard uses of materials or inventiveness of construction technique.

Most normative architectural practice also follows a top-down process. Typically operating within a well understood set of stylistic design conventions, it will pose few problems during the rationalization process. It may not even warrant being called, or be consciously understood as rationalization, being simply called "detailing." Conventional design languages, which have been constructed in countless variations, have the basic rules and knowledge of construction systems already embedded. For a beginning design student with rudimentary knowledge of construction materials and systems, the simplest of designs may require a much more engaged process of rationalization. When incorporating more adventurous geometries, the student is forced into material exploration and inventiveness.

In contrast to top-down design process, a bottom-up approach may adopt a materials-first approach, in which material properties, behaviors, or methods of manipulation become the primary driver of a design. The global design is then the direct outcome of embedded knowledge of the process of making and assembling. A bottom-up design is inherently constructible, as that information provided its origin, but requires the designer to have a deeper understanding of materials and methods. Digital design also may incorporate this type of knowledge into the design process. Parametric tools may be used to embed the rules of material or aggregation logics into software, for a bottom-up software solution. This contrasts with top-down construction-aware software, which results in a computationally expensive translation of geometry. [2]

## Project Design Process

In addition to exposing students to the relationships between digital modeling and material properties, this project was used as a platform for introducing them to the tensions between top-down and bottom-up design processes. Design projects that introduce digital skills often follow a top-down process. Material realities are absent in the scaleless environment of the virtual model or image. Complex geometry can easily be generated, which has no straightforward method of construction.

This project was intentionally organized as a top-down design process, in which the realities of construction were suspended. The students had spent their first semester dealing extensively with physical models and combinations of bottom-up experimentations with materials and top-down translations of digital designs into spatial objects that could be constructed from sheet materials via the laser cutter. These projects served to introduce awareness of joint conditions and the concept of tectonic expression. However, these earlier projects were desktop-scaled investigations, and a bottom-up approach for this project was deemed impractical given its time constraints.

The initial design process was similar to many first-year exercises. The design brief outlined the parameters, and each individual student developed a design solution through an iterative process. Students presented their work through ¼" scale models, and orthographic and 3D images generated through digital models. The digital models were not intended as an exercise in rationalization, but were used strictly to generate imagery focusing on experiential aspects. After the presentation, the students voted on what they felt to be the strongest design within the studio.

Rather than construct this winning design, it was then distributed to the class for a second round of design development. The students were tasked with reinterpreting this project, radically if desired, based on their reading and analysis of the compositional language that had been developed. From this second round of development, another winner was chosen, this time for construction at full scale.

Through both phases of design, concern for constructability was given little significance. Few constructional constraints were imposed, other than it needed to be fabricated at ¼" scale for presentation. The students were, however, responsible for proposing and conveying a basic sense of materiality. Any sense of tectonic expression was merely speculative as they had little knowledge to guarantee that they could be realized at full scale, or withstand structural and environmental forces. This type of knowledge would be acquired through hands-on prototyping, materials experiments, and testing in the workshop.

## Acquiring Knowledge of Bottom-up Design

This cohort of students was concurrently enrolled in a companion course titled *Methods II- Material Awareness*, also taught by the author. The goal of this course was introduction to construction materials and systems, and concepts of architectonics. Basic material systems, such as wood, masonry (brick and stone), steel, and concrete (both site-cast and precast) were presented as primary determinants of architectural form and space. Through this lens, the history of each material was traced, witnessing how stages of development correlate to particular construction systems and methods, which in turn sanction certain spatial outcomes while preventing others. The course was transparent about its bias of presenting architecture as materially deterministic.

The study of each material began with investigating how natural resources are transformed into construction materials. Raw material properties were demonstrated to lead to particular methods of processing or manufacturing, and the outcome of those processes are construction materials which lead to particular systems of assembly or forming. In concert, the totality of these properties and processes were revealed to result in architectural conventions. Form-making and spatial characteristics are thus the outcomes of material logics.

Each historical period of a material's evolution was illustrated with architectural examples of how the development of the material and its construction systems led to shifts in architectural design. The examples shown were not necessarily ones that were the result of strictly bottom-up design processes, but ones that were the result of the architect having a deep understanding of the material which allowed new formal or spatial expression by embedding that knowledge into the creative design process. Through this lens, many canonical works of architecture also were understood as adventurous explorations in material manipulation or having developed new technological implementations. The latter demonstrating that conventions for material use are constantly in flux and subject to reinvention.

The course was accompanied by a series of theory readings focused on material processing, tectonics, and the concept of craft. Seminal writings such as David Pye's *The Nature and Art of Workmanship* provided additional insight into the importance of precision, quality, and craftsmanship, both with physical and digital execution.[3] A chapter from Fil Hearn's *Ideas that Shaped Buildings* framed the historically shifting attitudes and beliefs about how the role of materials could extend to moral imperatives or play a didactic role.[4]

## Bottom-up Prototyping

Students arrived to the OU College of Architecture workshop with a design to construct and a series of problems to solve before realization. Problem solving operated within two domains. The first was digital modeling to rationalize the design. With their limited knowledge of materials and construction systems, this was almost always informed by the second domain, which was a preliminary process of building full scale prototypes to solve isolated problems. These localized experiments and solutions would often have a global effect on the design.

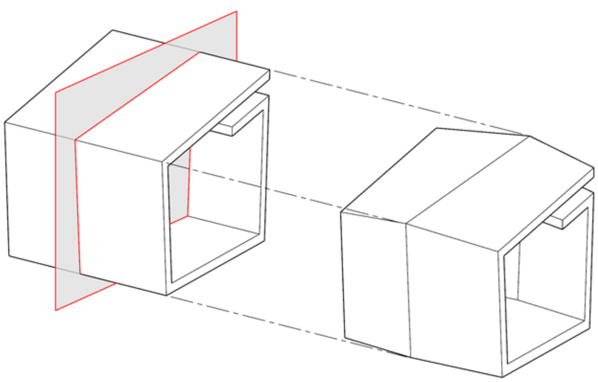


*Fig. 4 Surfaces folded along an intersecting plane*

The first alteration occurred after a quick full scale mockup was constructed of 2x2 lumber and plastic sheeting to test the scale of the design, and to verify it would have the desired spatial character. During mockup construction, the team decided to introduce a subtle kink into the wall and roof panels. A diagonal cutting plane was used to disrupt the formerly planar panels, to place a gentle fold line (Fig. 4). This was done for several reasons. The primary reason was to provide a stronger sense of spatial containment, while still being able to leave two end walls transparent. This change was also made in an attempt at reducing the scale of the space, to be more appropriate to inhabitation by a child. The other reason was to make the existing language of angled wall and roof planes more pronounced. Rather than exist as a simple cross-sectional extrusion, it was activated with similar angles along its length. This single geometrical operation at first seemed like a minor alteration to the existing design. In reality it was deceptively complicated, as all of the panels except the floor were now oriented at compound angles, which were difficult to resolve with the students' 3D modeling skills.

Several other design aspects required resolving through physical prototypes. The second two issues were related, and solved in tandem. The design proposal had floor, wall, and roof thicknesses that were equal, to read as a continuously folded plate. The resulting horizontal panels were excessively thin to withstand live load deflection. Each of the panels also required a demountable joint along its edge. At the author's suggestion, torsion box construction was investigated, consisting of a sandwich panel with an internal grid of ribs (Fig. 3). Partial assemblies were prototyped from scrap plywood, to test the resistance to deflection as well as construction methods (Fig. 5). After an afternoon of dado cuts, and discussions of internal grid spacing, they arrived at a successful strategy which also incorporated socketed joints for the walls to plug into (Figs. 2, 8).

*Fig. 5 Test cutting (foreground) and assembling (background) components for torsion box floor panel.*

The angled return at the top of the wall required prototyping to discover a method of creating strong moment connections from narrow cross-section lumber. A sequence of proposals were physically tested to destruction, before finding an adequately strong solution employing a glued and screwed lap joint, reinforced by gusset plates (Fig. 6.)

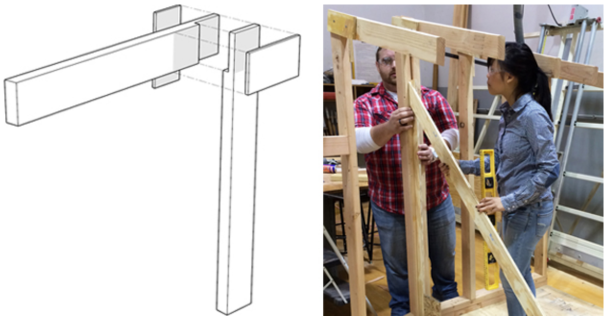


*Fig. 6 Prototyping moment connections*

Another feature requiring prototyping and testing was the exterior cladding material. During initial explorations, each student collected images of potential materials, along with generating a preliminary cost estimate. Several discovered the Japanese practice of flame-charring wood to create a weather resistant surface. Internet research uncovered vague instructional videos and descriptions of the process, so the studio purchased a propane "weed burner" torch to test the process (Fig. 7.) They cut a series of test coupons, recording the exact process that was used on each. The final method was a deep charring with the torch, wire brushing off the carbon, a second lighter char, another wire brushing, and treating with a clear preservative. The preservative was not needed for weather resistance, but was chosen because it brought out the grain of the wood and provided protection while on public display.

*Fig. 7 Flame-charring cedar cladding material*

## Digital Modeling for Rationalization

Each solution provided by physical prototyping was incorporated into an accurate digital model. This was a reciprocal process, rather than sequential. Often it was found that the computer could be used to help resolve geometries that couldn't be determined with the physical materials or through simple 2d drawings. The students often had difficulty dealing with material thicknesses and complex compound angles, discovering that geometric Rhino constructions often required a combination of modeling techniques, such as wireframes, offsetting and trimming planes, or Boolean operations on solids.

Attempting to accurately model every component made the students acutely aware of construction tolerances. They realized that it was impractical to be as accurate in reality as with the computer, but this could be used to advantage. For example, in the digital model every piece of sheathing had beveled edges. It was determined to be too complicated and time consuming to communicate cutting information. The 3D model was revised to allow for perpendicular edges, but this required decisions of where to place resulting gaps. In a couple of areas where panel edge bevels were important to maintain, it was determined that the panel could be cut slightly long, and dressed with a belt sander once installed, for perfect fit. This information was included in the 3D model.

## Discoveries and Conclusion

The students made many discoveries through their hands-on interaction with constructing a full scale architectural object. Among them were structural principles, relationships of strength to weight, and the difficulties of communicating information within a team. They recognized that in many aspects their design was overbuilt, and that the short spans could have been achieved with more lightweight and innovative construction.

The latter was caused by some students having previous framing experience and assuming this would provide the best solutions. For example, ignoring the success of the lightweight torsion box floor and roof, they could not be persuaded that the wall framing could be anything other than something resembling studs (Fig. 8.) Due to the non-vertical orientation of the walls, the studs had a parallelogram cross section and compound miter cuts at each end. Each stud was of unique length. They never fully resolved how to properly position the studs at the kinked joint in the middle of each wall. Insistence on 16" spacing where possible, although the overall panel width was not an even increment of that dimension, resulted in odd leftover spacing. By the end, they had concluded that when they needed to find inventive solution to their unique problem, it resulted in better solutions than when they tried to adapt conventional techniques.

*Fig. 8 Wall framing attempting to utilize conventional stud arrangement.*

By constructing at full scale, students witnessed physical behaviors that could not be understood through scale models or digital modeling. They witnessed relationships between materials, the methods of working with them, and how that informed the digitally constructed geometries. By intentionally framing the project as a top-down process that required rationalization through physical prototyping, the students gained awareness of the importance of being able to embed that knowledge into the design process. While they were able to successfully complete the construction, by the end they expressed that they wished they could go back and completely redesign the project based on the logic of the methods they had discovered.

## Notes

[1] Whitehead, Hugh. "Laws of Form" in *Architecture in the Digital Age: Design and Manufacturing*, edited by Branko Kolarevic. Taylor & Francis: New York, NY. 2005. p 83-84.

[2] Pottman, Helmut. *Architectural Geometry and Fabrication-Aware Design*, Nexus Network Journal: Vol.15, No. 2, 2013. p199

[3] Pye, David. *The Nature and Art of Workmanship.* Cambridge: University Press, 1968. p 1-12.

[4] Hearn, Fil. *Ideas that Shaped Buildings*. Cambridge: MIT Press, 2003. p 255-269.

# On (Experimental) Drawing: At Full Scale

William M Philemon | University of North Carolina at Charlotte

## Introduction to Full Scale Constructions

1:1 construction is critical for beginning design students because it allows them the opportunity to engage with something tangible rather than a representation of something that is imagined but never brought into reality. The other primary benefactor presented by true-to-scale drawings as constructs is an acknowledgement of form making in an age where form is seemingly denied by most designers.[i] Proponents of traditional full-scale constructions have developed unnecessary solutions that have inadvertently made this practice inaccessible to most students by being "expensive, resource intensive and time consuming."[ii] Full-scale drawings eliminate these inherent issues related to 1:1 construction while maximizing the potential benefits that are produced for students by such a practice. The recognition of drawing as an *object* rather than a *description* of another object allows students to freely explore virtually any idea related to design with a multitude of designed programmatic constraints.

### *What are Full-Scale Drawings?*

Educators often scoff at the notion that drawings, especially small drawings, are by nature full-scale constructs even if they were not intended to be viewed or studied as such. The reality is that one-inch is equal to one-inch whether it is measured along a piece of paper held in the hand or along a high rise that takes up an entire city block. A drawing therefore possesses all of the same characteristics and qualities as a large prototype or architectural intervention.

This realization means nothing if the ways in which drawings are viewed and produced are not reconsidered. A full-scale drawing must no longer be understood as a way to see or think about a *problem,* but as the *problem* itself. In other words, a 1:1 drawing is not representative of any other form or object because it does not serve a referential function. Eisenman described "*not classical"* architecture as being unresponsive to representing history, reason or reality in favor of purveying its own internal experience.[iii] The relationship of full-scale drawings and representation should be viewed in a similar manner. There must be an immediate separation from (any reference of) reality in order for this kind of drawing to be a fruitful design endeavor. However, that does not mean that factors beyond the bounds of the drawing surface cannot be taken in to consideration; in fact, they become key components in differentiating design drawings and fine art.

### *Why study Full-Scale Drawings?*

Design, more specifically architectural design, encapsulates an infinitely long list of variables, possibilities and circumstances that all play a major role in the decision making process. Every deliberate decision made to address one factor will consequently have either a positive or negative effect on several others both known or unknown. This creates a scenario that becomes nearly impossible for one to fully understand the ramifications of the design moves he/she is making. In his book *Analysing Architecture*; Simon Unwin distinguishes "ideal geometries" as being considered *perfect* so much so that they become abstract versions of geometry that are "set apart from the physical."[iv] The significance in this concept of *the ideal* or *the perfect* is that they cannot exist in actuality. Perfection or wholeness cannot commingle with the innumerous, potentially conflicting, variables that make up reality.

This matters to beginning design students because they need to see the decisions they are making and how they are reacting within a known set of parameters. It is impossible for them to gain facility over the fundamentals of design if they cannot accurately measure (the possible shortcomings of) their own work. To think about design through the use of scaled drawings or traditional mock-ups is like trying to hit a moving target while blindfolded.


*Fig. 1 photograph by the author illustrating a very small range of the variables that exist in reality and how any minor intervention in this site will result in a multitude of consequences.*

The student (or the instructor) can define the principles of the design and its environment(s) when a drawing is viewed as a drawing and not as a fictitious representation. This enables them to creates a more explicit "means of understanding the fundamental elements of architecture" and design in general.[v] This process empowers students to develop an understanding of the relationship between their decisions, the form that results and it's dialogue with context in a way that is unparalleled by traditional full-scale constructs.

## Constraints

In order for designers to narrow the focus of 1:1 drawings in the way described above, they must enable constraints. Tschumi describes Parc de la Villette as no longer being linked to the purely physical condition of reality so that his fragments can be recombined by through their own series of permutations.[vi] This implies that he defined a particular rule set that would govern his own design experiment. These rules, or constraints, can and should be directed towards developing an understanding of a particular objective or theme. These objectives become especially important in architectural design research because they define how the construction of form on a drawing surface addresses an issue in the built environment.

These parameters are ultimately what give a drawing (series) structure so that there is a clear motive for its construction. The constraints applied become the backbone of the full-scale drawing experiment in a way that creates an interesting organic relationship with the actual drawing that is produced.[vii]

*What qualifies as a Constraint?*

Constraints can take on many different forms and can vary in the amount of detail and instruction they provide. What follows are some examples of the range and type of parameters (used synonomously with constraints) that might be defined for a series of full-scale drawings.

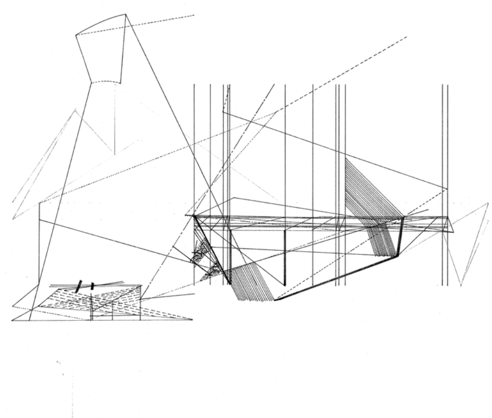


*Fig. 2 "L.1-01-1b" by the author represents a drawing that embodies many of the parameters described in this section.*

The most basic type of constraints are those that deal (almost) entirely with the physical production of the drawing itself. This might direct the author of the drawing in terms of a particular technique that is to be implemented or perhaps the mechanism with which to he/she is will use to create. An extremely basic example of this might be something as simple as, "the drawing is to be constructed using only horizontal lines to be drawn in black ink on a vertically oriented 9x12" paper." Others might prescribe a certain line type that is to be used in a specific way relative to a condition that emerges in the drawing. For example, the author could be required to draw orthogonal, dashed lines beginning at any intersection of two or more previously drawn lines. These examples may sound *random* or *unnecessary* but they can actually become a very well directed and efficient way for beginning students to understand the fundamental techniques of *drawing* and *seeing*.

The latter example in the previous paragraph begins to imply another very basic type of constraint; that is *behavior*. This involves an analysis of a given (or previously drawn) condition and a subsequent action that responds either directly or indirectly. This type of constraint can be approached in many ways and could have potentially any objective. The earlier example is representative of a behavioral constraint because there is an analytical component, finding and recognizing all intersections of two or more previously drawn lines, and a given response that will happen, an orthogonal dashed line will be drawn beginning at each of these points. The result is one where the behavior of the element to be drawn, the dashed line in this case, is guided by the direction of the initial analysis. However, this exercise is not completely scripted, as there is still much design work to be done on the part of the author. How long are the dashed lines? Do they become horizontal or vertical lines? If they are vertical, do they extend above or below the intersection? These are all valid questions that the author must answer while responding to this constraint.

As students advance beyond the fundamental components of design drawing they may start to address behavioral constraints that take on a seemingly more architectural or programmatic definition. This might include defining that specific type of space might be drawn relative to an existing one or perhaps a figure is drawn that predicts the placement of a figure that is to come later in the drawing.

Behavioral constraints lead to parameters that deal with conflict in the drawing.[viii] Conflict could take on a couple of different forms or meanings one of which, and perhaps the most interesting, is when the implementation of one behavioral response *breaks the code* of one or more constraints and causes what appears to be a *glitch* of some sort. This happens when a certain response by the author causes the *expectations* of the drawing to be changed, modified or forgotten. Is this a problem or is this a phenomenon that should be sought after in a well defined and tightly constrained drawing?

The following examples of possible constraints are perhaps the most "architectural" but are in no way any more or less abstract than the ones previously mentioned. Human scale, occupancy and relationship to ground can all become avenues for interrogating and constraining a particular element of a drawing. All of these (among many others) are key components in architecture and urban design that must be addressed in a myriad of ways with any given project. The same holds true when constructing full-scale drawings.

The viewer of a 1:1 drawing will by nature have a certain scalar relationship with the drawing and all of its components. This means that not only does the author of the drawing have to consider the form of the components to be read but also the way in which they will be read and perceived by the viewer. An example parameter that encapsulates this added dimension could be, "the drawing will be viewed from twenty feet away for one minute before being viewed from five feet away for four minutes." Another simple example might instruct "half of the drawing will be covered by white paper while the viewer sees the drawing from a seated position, when the viewer stands, the cover will be removed and the drawing viewed in full." Both of these examples incorporate the architectural space as defined by the drawing, the perception of the drawing that is reliant on the human scale/proportion of the viewer and the time/duration in which the drawing is viewed.[ix]

*Layers and Sets relation to Constraints?*

The previous descriptions of constraints imply that these drawings are often made up of multiple layers, each of which contains a different set of parameters. As mentioned, some of these might be in conflict with one another but typically they all work together in ways that progress the agenda of the drawing. The beautiful part about this type of development is that there exists a type of list that exists as a precursor to the production of the drawing. This list can then be used as a tool for evaluation in the hands of the author so that the relationship between layers and types of constraints can be better understood. An especially captivating practice is when the author documents the development of a drawing after completing each layer through photography or digital scanning.

*Fig. 3 "Blue One" by Landon Robinson is an example of a layered drawing/painting. In this particular case, the piece began with a drawing that was painted over in layers to a point where the initial drawing can longer be determined. This illustrates the value of documenting the work between each individual layer so that the various reactions/responses can be better evaluated.*

Another good practice is to complete these drawings in a defined series or set where multiple drawings are constructed with the same set of constraints or "rules." This way there can be multiple readings of how the constraints play out when applied and how each layer may react relative to different interpretations of the rule set. Grouping a body of work together in this way also presents an interesting reading of the constraints themselves; in what ways were they overtly explicit and likewise where were they more subjective?

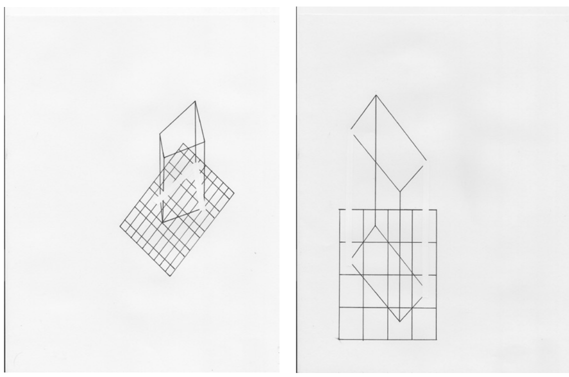


*Fig. 4 "2.1" and "2.2" by the author each represent the third layers in a ten layers made with the same list of constraints. One can gain a better understanding of the individual drawings (and their constraints) when grouped with multiple drawings produced in a single set.*

## Analog and Digital

The steps to creating full-scale drawings that include the described components can be carried out in both analog and digital formats.  It is outside the scope of this paper to go into detail about the positives and negatives of each of these methods, however there are is one process that is relevant to the discussion of 1:1 drawings. That is the method of transferring full-scale analog drawings to that of digital drawings with the possibility of then going back to analog drawings. This is an important topic because it is a characteristic of full-scale drawings that cannot likely be achieved by other forms of 1:1 construction. It is this trait that combats the notion that drawing is not too old-fashioned to be relevant in contemporary design education. An analog drawing can be scanned in a matter of seconds and subsequently augmented by any (combination of) digital software. One of the transformations that can occur during this process is to change the physical size of the drawing without ever changing its scale. For example, a drawing on a 4x6" note card can be doubled in size and reprinted. The size of the drawing has changed although it has remained true to scale throughout the entire process. One cannot change the size of a brick or a steel member in *traditional* full-scale mock-ups. This then allows the author to make a conscious decision of if, when and why to resize the drawing. Another interesting note about this particular method is that when digitized, there are virtually no limits to what the size of the drawing could become. A 2x2" drawing could turn into a 2x2 mile drawing. If not reprinted, the author/viewer can only experience a very small portion of the drawing at any given time. Could this apparent *problem* be used in a way that speaks to the purpose of the drawing? Absolutely.

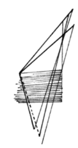


*Fig. 5 "11.3.1" by the author shows an analog drawing that was scanned and therefore converted to a digital image.*

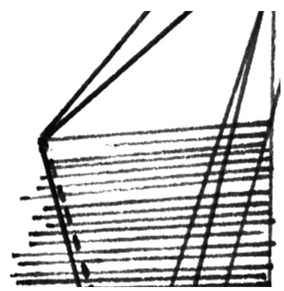


*Fig. 2 "11.3.2" by the author is the same drawing as shown in Fig. 5 after its physical size has been changed digitally.*

## Conclusions

The aim of this paper is to reintroduce educators and students to the idea of drawing as the object of design rather than a simple activity used as a tool with which to design. The difference in these two understandings of drawing is significant and should at the very least be recognized if not actively practiced. Traditional full-scale constructs can and should have a place in contemporary design education. In fact, they are essential elements in beginning design despite their apparent shortcomings exposed by 1:1 drawing. Drawing is the paradigm method for beginning design students to understand ways to explore an idea and how to amplify specific conditions at full-scale.

## Notes

[i] Form, or formalism, is being defined as an action rather than an object.

London, England. "Who's Afraid of Formalism." In *Phylogenesis: Foa's Ark*. Barcelona: Actar, 2003. Sanford Kwinter

[ii] "Call for Submissions." Accessed August 2, 2015. http://static1.squarespace.com/static/55831884e4b0c27daf078ce2/t/55c281c7e4b0b1f08da0a928/1438810567113/NCBDS 20 16 Call for Submissions.pdf.

[iii] Eisenman, Peter. "The End of the Classical." In Eisenman inside Out: Selected Writings, 1963-1988, 160. New Haven, CT: Yale University Press, 2004.

[iv] Unwin, Simon. "Ideal Geometry." In Analysing Architecture, 153. Third ed. London and New York: Routledge, 2009.

[v] This quote comes from a studio assignment by Lebbeus Woods. While not dealing with drawing at full-scale, this description of fabricating the "ideal" and how that allows for a better interrogation of design fundamentalsis very much in-line with the argument for 1:1 drawing.

MANIFESTO: The Reality of Ideals." LEBBEUS WOODS. June 6, 2011. Accessed November 10, 2014. https://lebbeuswoods.wordpress.com/2011/06/06/manifesto-the-reality-of-ideals/.

[vi] Tschumi, Bernard. "Madness and the Combinative." In Architecture and Disjunction, 180. Cambridge, Mass.: MIT Press, 1994.

[vii] Bryan Cantley coined the term "mechudzu" which becomes a good way to think about the relationship between the drawing and its underlying structure or constraints. Mechudzu describes the way that the growth pattern of kudzu is guided by whatever it's surroundings are. In many cases, the objects structuring this organic growth are actually man-made objects. This creates an interesting fusion of the natural and the mechanical in way that is predictable yet still unknown and uncontrollable to a degree.

Cantley, Bryan. "Opening Reception." Lecture, Dirty Geometries Mechanical Imperfections, Storrs Gallery, Charlotte, NC, February 19, 2015.

[viii] The acknowledgement of conflict in a drawing and its subsequent use to aid the development of the drawing is an idea brought to my attention by Bryan Cantley in a private thesis review with him at UNC-Charlotte. While the use of conflict as described is my own interpretation of this idea, it was nonetheless inspired and developed by this masterclass-like session with Bryan.

Cantley, Bryan. Interview by author. February 20, 2015.

[ix] Lebbeus Woods describes the physical size of the drawing as playing a role in how a person might physically inhabit a drawing. He subtly implies that this can only be done with large drawings. The author, influenced by conversations with Bryan Cantley, would argue that any drawing can and should be inhabited/occupied regardless of its physical size. This is works in tandem with the time in which one takes to read a drawing.

Woods, Lebbeus. "THE DREAMS THAT STUFF IS MADE OF." LEBBEUS WOODS. January 3, 2011. Accessed October 12, 2014. https://lebbeuswoods.wordpress.com/2011/01/04/the-dreams-that-stuff-is-made-of/.

# Digital Tracings

Arief Setiawan, Christopher Welty | Kennesaw State University

## Introduction

Drawings and models are a means of representation and a way to develop a design. The modern movement brought the notion of drawing as a diagrammatic tool, a way of extracting formal principles. In this trajectory, digital technology entered architectural education. Today Antoine Picon (2010) has noted this impact of the advance of the digital technology on design, both for representation and thinking.

At our institution, the dichotomy between design process and design craftsmanship is reflected in our curriculum. In it, the design foundation sequence includes design studios and design communications courses. In the past few years, the later has shifted its focus as a venue to introduce digital tools to the beginning students, including CAD, computer graphic, and fabrication software in the design communications course. We are interested in the issue of the dialogue between different tools, and how these interactions inform design decisions. In the context of design pedagogy, how do we instill the curiosities of students to explore relationship between the different tools? How do we stimulate students to explore representational tools and techniques to become a generative means in design?

## Literature Review

Reviewing and categorizing pedagogy of design studio, Ashraf Salama and Nicholas Wilkinson (2007) outlined a taxonomy of general approaches in studio pedagogy. The first is the academic approach, which considers architecture as fine art similar to paintings and sculptures. In this view, the formal aspect, and compositional theories, occupy the basic role. The second approach is the craftsmen-builder approach that puts emphasis on the tectonic of constructing an artifact. The third category is the engineer approach that emphasizes the integration of technology in construction and fabrication. In this way, design thinking would follow the logic of engineering. The fourth approach is the social-science approach in which the understanding of human behavior, personal and social, serves as a generative principles emphasizes program.

Historically, within the context of beginning design, design pedagogy emerged out of the system established by the Ecole-des-Beaux-arts, which was clearly a formal approach, hence the name academic architecture. The emergence of the Bauhaus as a reaction against the hegemony of the Beaux-Arts actually did not stray away from the formal principles, including the beliefs in proportion, rhythm balance, and scale. However, instead of developing the formal principles and compositional theory out of historical precedents, the Bauhaus developed theirs on the belief in the innate properties in formal cognition. Both the Beaux-arts and the Bauhaus systems no longer occupy their central role in directing the pedagogy in architecture schools. Colin Rowe's model, for example, was close and deep analysis of precedence based on their formal properties. Similarly, the Cooper-Union pedagogy by John Hejduk was a pedagogy that derived from a deep conviction in the formal principles.

One of the important aspects that appeared from Salama and Wilkinson's taxonomy is the impact of the development of knowledge in general on architectural education. The social-science approach that was prevalent in the mid-twentieth century related to the primacy of social science and the beliefs in progress of that period. The engineering approach values the primacy of technology, although it seems technology meant to be technology in constructions. This approach in evaluating design pedagogy is relevant to the shift relative to the rise of the digital age. In this vein, in its volume on the history of architectural education in the US, Stan Allen (2012) discussed the development of architectural education in the last couple of decades with regards to the impact of the development of digital technology. At the beginning of the development of digital tools for architects, software such various types of CAD were mostly used by practitioners for production. However, with the innovative works from architects such as Frank Gehry, Greg Lynn and Bernard Cache in the mid 1990s, the academic community started to notice the potentials of integrating digital tool as a design means. Indeed, software such as Form Z was born out of the challenge to accommodate Frank Gehry's designs. The next decade, the 2000's, digital infrastructure, both hardware and software, became more widely available. Crucially, they are also more available for students. As Molly Wright Steenson (2012) pointed out, the interest in computer in design started from an early stage of its development in the 1960s, primarily for its ability for mathematical calculation. Based on this capability, a distinction emerged between computer graphics, which referred to conversion of data to images, and computer aided-design, which referred to manipulation and abstraction of images.

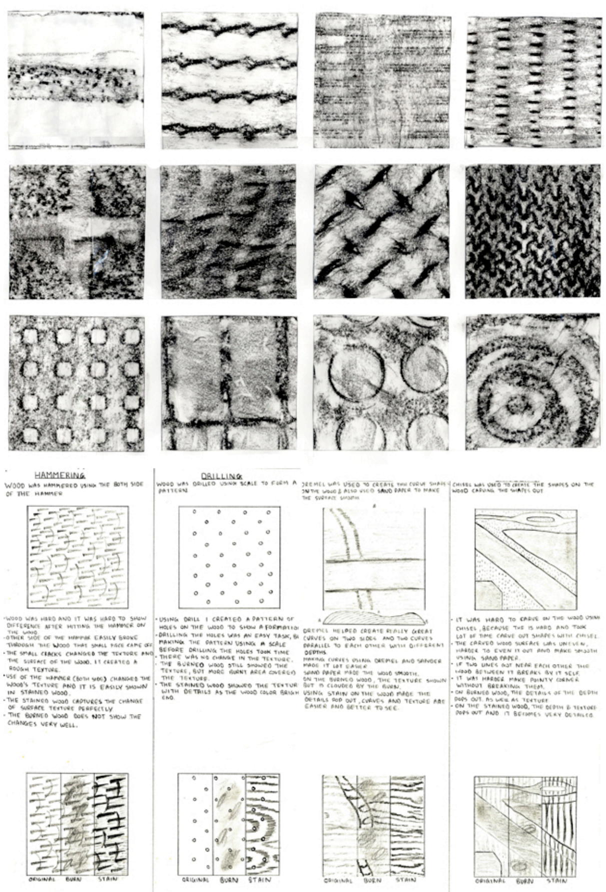



*Fig. 1 ARCH1002: Texture & Pattern, observations – Varshil PATEL*

Obviously, a clear shift in the educational realm was the diminishing role, or even training in the manual drawings and model making. Production wise, the use of digital tools provides many advantages in increasing the efficiency based on their capability to automate and calculate. However, as Picon (2010) underlined, digital tools has opened up a new horizon for designers and architects. If in the history of architecture the design is tied up to the Euclidian geometry, the digital tools opened up the whole range of different design vocabulary and geometry, such as fractal geometry. The ideas of basic elements and replications of these elements in generating design dated back from the Classical civilization. Digital tools, however, allows for much more complex replications of basic elements. Further, digital tools also allow for deformation of objects, such as compressing, elongating, or twisting, much easier. In short, digital tools have broadened the range of possibility.

Digital tools have become an ordinary thing. Every aspect of life cannot be separated from the use of digital equipment, from smart phones to CNC routers. The emergence of new tools has always impacted our cognition, the manner in which we perceive the environment and the way we operate in the world. However, although digital tools are a part and parcel of our everyday life, in architectural education we are standing at a crossroad.

## KSU Context

*Texture Project – Freshman Studio*

In the first year studio, we developed a module that problematizes the relationship between two-dimensional drawings and three-dimensional constructs. In it we focused on using a property of a plane as a starting point to stimulate the design thinking and the ability to visualize, between two and three-dimensional. As a start, students were asked to observe the environment, both natural and manmade to identify various textures. Including textures of walls, rocks, or tree bark. We intended to develop the awareness of characteristics and properties of the environment at various scales, from large and medium scales through observations and problematization of buildings and building elements to small scale through focusing on textures. After identifying varieties of environmental textures, they document their findings, using drawings and photographs. We aimed to develop their acumens in using digital tools that are simply ubiquitous today, such as cellphone cameras, by treating it as a prosthetic, an extension of their eyes continuing the development of their skills and ability to see. However, we also intended to keep nurturing their skills and ability in mastering more traditional and conventional tools and media by asking them to document textures through hand drawings. We intended them to develop their skills and ability in recording and documenting properties of the environment using pens and pencils as an extension of their eyes and hands.

It also served the purpose of giving students varieties of drawing techniques at their disposal. The drawings of the texture ranged in scales, from one-to-one scale to close-up drawings. We also asked students to assign keywords to textures, so they can develop the ability to document and describe properties of the environment visually and verbally.

*Fig. 2 ARCH1002: Texture & Patterns, artifact – Stephanie BALGA*

The next step intended to help students parse information out of their visual documentation by diagraming their texture drawings. Using trace paper on top of their drawings and photographs they extracted various formal elements, including points, lines, and planes from their textures. We intended to reinforce the sensitivity to comprehend the world in terms of basic geometric elements. In a way, we revisited and reinforce the ability of abstraction through diagraming. We shifted gears toward engagement of materiality asking students to develop their diagrams into a three-dimensional constructs using wood panels. We began by introducing and familiarizing students with tools in our woodshop. Designed as an introduction to making and constructing things, we limited our exercise on using small, handheld tools, both manual, such as chisels, and powertools, such as dremels. We asked students to bring small panels of wood and then test those with a variety of tools, being mindful of the contacts between tools and the material properties of woods, such as the grains and textures of their wood. As a part of developing sensibilities and awareness, we asked students to observe and document these interactions between tools and materials.

After students gained some appropriate level of mastery in handling hand-held tools, they transformed their wooden panels into three-dimensional textures using the diagrams of their environment textures as the starting point. For example, we urged them to investigate the possibilities of using different line weights from their diagrams as a guide to create different widths and depths of indentations on the surface of the wood. Another example was to think of a series of planes from the texture diagrams as a series of layers to create contours on the wood panels. Another way was by exploring the varieties of points of various sizes from the texture and then inquiring the transformation of such points into varieties of depth that can be carved or drilled into the wood. In the process, we asked them to be aware of the interaction between their actions and the natural textures and patterns of the wood and exploit those interactions for design purposes. These investigations would eventually lead them to produce a wall panel.

In this module, we observed the development of the ability in design thinking at the beginning level, in particular with regards to the cognition of phenomena in the environment and the engagements with tools and materials. Drawings and diagrams that students produced demonstrated their developing ability to distill the visual information as the basic geometric elements. More importantly for us, students started to develop the ability to identify and articulate the relationships between those elements and, further, speculate about possible rules and principles that might govern them. In a way, the drawing and diagramming processes were a set of exercises in which students traced phenomena in the environment through specific design filters. However, the biggest values for us from this module laid on the students' engagement with tools and materials. The module served to introduce students in our beginning design studio to the problem of constructing things, apart from using chipboard. In terms of the engagement with tools and materials, students demonstrated the willingness and enthusiasm to explore and experiment. The growing familiarity with tools and materials, both in two-dimensional, including the understanding of contour line drawings of various modes, and three-dimensional became the driving force of as the module progressed. In this line of thought, the design results were traces of the hands of students on the surface of the woods.

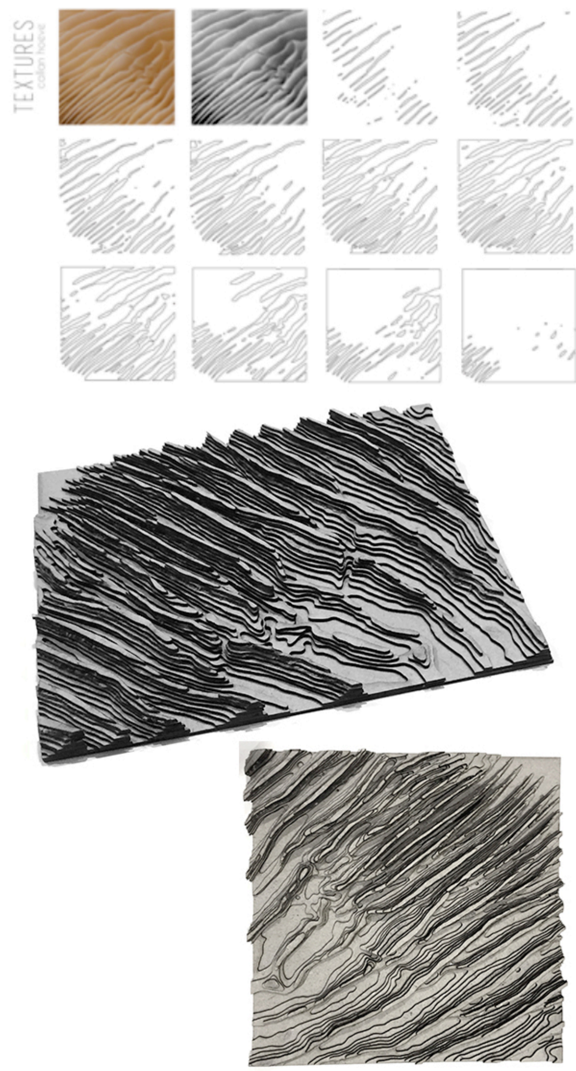



*Fig. 3 ARCH2242: Texture to Topography – Callan HOEVE*

Again students are required to observe and photograph a texture in the environment. After some discussion about the intent of extracting points and lines, students resized and cropped the image in Photoshop. Manipulation begins with desaturation of the image to remove color, utilizing the levels and brightness tools to distinguish more tonal variation. The student is free to play with a series of filters to further manipulate the image, and stimulate design thinking, with the goal to extract enough detail and contrast to provide verticality in the final fabrication.

The next step requires a series of procedural operations. Though the image is in black and white mode from the earlier desaturation, the image is converted to an indexed color. Doing this allows the students to exactly specify the number of colors in the file, which informs the level of detail in the final fabrication. For our exercise the number was limited to no more then 16. Students save the file in gif format using the exact colors option. On this new file students apply the median filter to isolate flat colors that represent layers in the final model. The stroke command follows to capture the perimeter shape of each solid color on a new layer, starting for either the darkest or lightest points. Though only as pixels, the multiple layers viewed simultaneously reveal the topographic map.

Moving the file to Illustrator allows a conversion of lines from pixels. Using the live trace feature the perimeter shapes can be converted to vector geometry. Each layer becomes a separate line drawing serving two purposes, the basis for a presentation drawing communicating the process as well as to refine geometry. Discussions of material selection and strategies of material optimization are addressed as the students develop cutting paths for the laser cutter. Final assembly is simply gluing together.

*Texture to Topography – Design Communication*

Similar to the first year exercise, the first Design Communication II exercise, entitled "*Texture to Topography*" challenges students to create a tactile topography by extracting three-dimensional constructs from two-dimensional drawings. In this instance the tools to create the artifact have changed from manual operations of pen on trace to digital tools of PhotoShop intended for abstraction and Illustrator for drawing rationalization and presentation. With a shorter time frame than the freshmen exercise process was emphasized over iterations. The exercise concludes with physical constructs created through contouring in which a series of slices are laser cut in our digital fabrication lab.

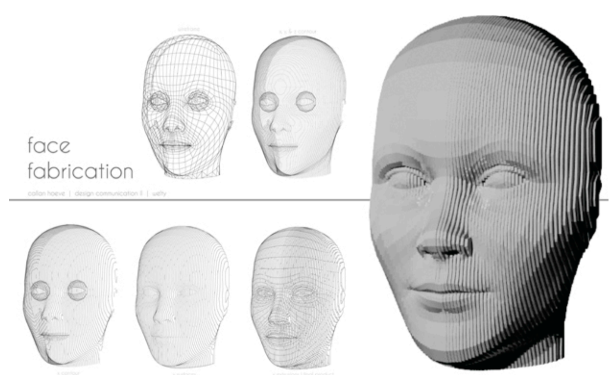



*Fig. 4 ARCH2242: Faces Presentation – Callan HOEVE*

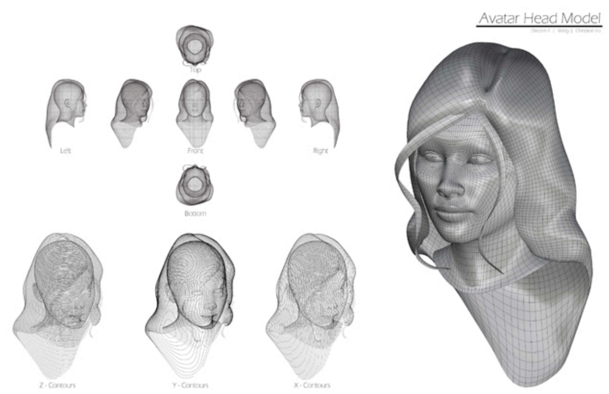



*Fig. 5 ARCH2242: Faces Presentation – Christine VU*

*Faces – Design Communication*

The *Faces* exercise is the final project of the semester continuing the dialogue between the digital world and physical artifacts. It follows a similar process of the *Texture to Topography* exercise though focuses on understanding complex geometries and how to rationalize the form for fabrication. Digital tools include Autodesk Avatar Creator, Rhinoceros, Illustrator and AutoCAD. Starting with observation, students are asked to create a digital avatar of them, paying close attention to replicate their facial details within the model. Once the avatar is complete, medium and high-resolution models of the geometry are exported.

In a class workshop students import their avatar model into Rhino and begin a series of operations. The head geometry is extracted from the body model, scaled and moved to the origin. Through a series of contour operations in Rhino, the head geometry is sliced to reveal the surface geometry. Students are asked to isolate the lines from the contour slices with the most legible detail and create a presentation drawing to communicate design thought and the fabrication process.

The final fabricated face was limited to roughly 9" tall. Students were asked to produce what they thought would make the best or most successful fabricated face knowing that the choice of material and technique would impact the contour process and thickness of the slices. The drawings and geometry were refined and labeled for cutting. Methods for quick assembly were discussed and suggested but not required. Final deliverables required a presentation and fabricated model.

## Discussions

In relating the studio and the design communication exercises, we based our thoughts on our realization that both explored similar ideas, mainly the back-and-forth movement between two and three-dimensional media. More importantly, we are intrigued by the role of media in the thought process. We are also curious about the role of drawings within the context of the emergence of digital tool. In comparing these two courses, we realized that the studio part put emphasis on the exploratory, while the design communication course was more of procedural. However, for us, by moving into introducing students to digital tools, we also noted that the boundaries between teaching representation and teaching design started to blur.

On reflecting the thought process that occurred throughout these two sets of exercises, we are interested in the relationship between design ideas, drawings, and designed objects. Ideally, we envisioned that they would be on equal measures, in which they worked on a one-to-one relationship. Design ideas would be explored through drawings, which in turn informed production and fabrication of the designed object. This does not suggest sequential and linear process, drawings may inform further development ideas. Similarly, three-dimensional object may also stimulate further iterations in drawings and ideas. However, in the face exercises, it seems that the role of drawings is diminishing.

In this context, we would like to refer to the distinction that Nelson Goodman (1976) made between the autographic and the allographic process. Goodman defined the autographic process as a process in which the artifacts were the result of the direct actions of the hand of an artist. Examples for the autographic work are paintings and sculptures. On the other hand, the allographic process referred to a process in which the artifact was produced indirectly through an intermediary medium.

*Fig. 6 ARCH2442 Final Face Fabrications – F15 Final Review*

*Fig. 7 ARCH2242: Faces Fabrication – Ashley EDWARDS*

A perfect example is architecture. An architect produces the design as drawings on paper following certain conventions, such as orthographic projections. These drawings were then handed over to builders who would use them as a reference in the construction process. Architecture, following the Renaissance tradition, was established on this very idea. Alberti famously made the distinction between lineage and matter. Rooted in this Renaissance thinking, architecture established itself as an intellectual activity that was separated from manual labors. Architects thought in abstract terms, facilitated by well-established conventions, such as conventions in drawings. In this sense, architects worked primarily with notation, instead of direct engagement with materials and tools. In turn, the education of an architect was also framed by and within these disciplinary boundaries. It seems to us that the integrations of digital tools started to challenge the distinctions.

## Notes

[1] Allen, Stan, "Architecture School: Three Centuries of Educating Architects in North America" Oackman, Joan (editor) The MIT Press, 2012.

[2] Goodman, Nelson, Languages of Art, Hackett Publishing Company, 1976.

[3] Picon, Antoine. "Digital Culture in Architecture: An Introduction for the Design Professions" Birkhäuser: Switzerland, 2010.

[4] Salama, Asharf and Wilkinson, Nicholas, et.al, "Design Studio Pedagogy: horizon for the future", The Urban International Press, Gateshead, the United Kingdom, 2007

[5] Steenson, Molly Wright, "Architecture School: Three Centuries of Educating Architects in North America" Oackman, Joan (editor) The MIT Press, 2012.

# Word to Line: Drawing and Text

Matthew Shea | University of Colorado Denver

The so-called emergence and evolution of form will no longer follow the classical, eidetic pathway determined by the possible and the real. Rather it will follow the dynamic and uncertain processes that characterize the schema that links a virtual component to an actual one. What is most important to understand he is that unlike the previous schema where the "possible" had no reality (before emerging), here the virtual, though it may yet have no actuality, is nonetheless already fully real...What this means is that the virtual does not have to be realized, but only actualized (activated and integrated); its adventure involves a developmental passage from one state to another. [1] --Sanford Kwinter

## Introduction

The most pressing question an instructor of beginning design students must answer is where to begin? For students starting a design curriculum that have never engaged in drawing this becomes particularly challenging and important to answer in a meaningful way. The curricular approach that is taken will largely shape how the student will think about drawing and visualization moving forward. If one teaches skills devoid of content then we disconnect the act of drawing from its projective power in the design field. We are at risk of relegating drawing to only a representational tool—drawing may no longer have the power of actualizing the virtual (as described by Sanford Kwinter) or for it to function as a speculative tool that may allow the student to move beyond analogical thinking in the digital realm. My intent is to academically answer how we can effectively introduce new students to drawing so that it is a process of actualizing, not realizing. In an attempt to accomplish this, I devised an intensive introduction to drawing workshop for incoming students with unrelated bachelors' degrees to our Master of Architecture program. The curriculum requires students to think of drawing as a passage from a textual state to a drawn or visual state.

## Present Introductory Drawing Pedagogy

There seem to be two predominant pedagogical approaches to teaching fundamental architectural graphics: facsimile or abstraction. The first is a process of taking existing drawings of architectural objects and reproducing the drawings. Often students are asked to change the scale of the drawings in an attempt to not have the student directly copy the original. The second is the process of abstracting a known architectural object into the orthographic projection using the views of plan, section and elevation. Through both of these exercises students are introduced to the conventions of drawing: projection (parallel), picture plane, line weight, line type, scale, and annotation. An understanding of these conventions is essential for a beginning architecture student.

On both accounts these approaches fall short of introducing drawing as a speculative and productive practice that can embody more than "correctly" drawing or redrawing the architectural object. It would be serendipitous if in these two approaches a student began to understand the hierarchy of information inherent to the architectural object or learn and appreciate the relationship of parts to the whole and the inherent organizational and spatial information embodied in the drawing of the architectural object. In both cases, the process of drawing is a shift or translation from one visual state to another visual state—drawing to drawing or object to drawing. However, the richness of the information lost in these two approaches can be regained and made explicit for the student in the process of drawing, if the student is required to render the architectural object virtual in one's mind prior to putting a line on the page. This process can be accomplished by having the student translate or shift the architectural object across disparate states.

## The Textual Architectural Object

The method I have developed to accoplish this is to have students translate the architectural object from a textual state to a visual state. The act of drawing becomes more than the creation of a set of lines. It is the actualization of a larger amount of information that constitutes the architectural object. To produce the architectural object in a textual state it was necessary to choose the format that the text would take. I identified three formats of texts: specifications, instructions, and description.

As specifications the textual architectural object would take the form of a list of architectural elements (floor, ceiling, roof, wall, etc.), their associated dimensions (height, width and depth) and characteristics. Likewise the specification would account for and specify alignments and separations dimensionally. This is the approach to drawing is the logic on which Building Information Modeling is founded. For example:

*Main Floor:*
Area: 20'-0" x 10'-0"
Depth: 1'-4"
Orientation: Long axis oriented east/west
*Entrance Door:*
Width: 3'-0"
Height: 6'-8"
Depth: 2"
Location: southern edge 4'-0" from southern corner of eastern wall

Such specifications can become more and more complex adding more information to each element.

Using specifications as the prompt for the sift from the textual to the visual state does not fully require the student to understand the full projective potential of drawing as the exercise for the student is limited to assembling these "parts" into a whole. Additionally, as a "kit of parts" the exercise skips an important step of relating and associating abstract formal information to architectural elements and geometrical and spatial information is relegated to numeric dimensions. If one where to use this method to teach drawing it would be possible to incorporate the ideas of hierarchy of information but it would be limited to the hierarchy of size, not placement, alignment or orientation. As such the drawing becomes the accumulation of these parts and the students exercise is merely to assemble them correctly. It minimally requires the students to translate and arrange the information prior to assembling the drawing.

As a set of instructions the textual state of the architectural object would consist of a set of step-by-step directives that would lead the student through the process of constructing the drawing. Such a textual state would look like:

1. Center the 40'-0" x 20'-6" extents of the building on your sheet of paper, marking these extents with construction lines. Orient the long axis horizontally on your paper.
2. From the bottom left corner, draw a 10'-0" x 25'-0" rectangle (representing a floor) with the long axis oriented horizontally across the paper.
3. Offset a second 10'-0" x 25'-0" rectangle above the first rectangle up by 6" and 15'-0" to the right.
4. Etc.

The exercise of following instructions is a rote execution of directives and it is the accumulation of these directives that the architectural object actualizes on the page. Though this process is not as directly representational as the facsimile of drawings or the abstracting of a physical object, it comes very close and may, in fact, be less educational than the process of abstracting the physical object. The reason for this is that the hierarchy of operations is invisibly embedded in the process. It is difficult to make them explicit outside of highlighting the order that the instructions followed. The exercise does not require students to internalize the operations and their hierarchy because the process is disconnected from the information. There is not explicit connection between where a line is drawn, when a line is drawn, and why a line is drawn.

As a description the textual state of the architectural object is constituted through a narrative describing the object. This description is not focused on or oriented to the confines of a sheet of paper. It refers to cardinal directions and uses un-scaled dimensions. Likewise the interrelationship of form and organization are described in relational terms—not absolute. Such a description looks like:

> ...The planes of the house and the terrace are placed side by side with the terrace on the south and the house on the north. The long axis of the house and terrace are oriented east and west. The two planes of the house are both 77'-2" long and 28'-8" wide. The plane of the terrace is 55'-3" long and 22'-8" wide. The plane of the terrace is separated from the planes of the house by 8". The western edge of the terrace is 22'-0" west of the western edge of the house planes. The overall dimensions

of the planes' layout is 99'-2" long and 52'-0" wide. The long axis runs east and west...

In this approach it is necessary for the students to parse information from background information and create associations between the information (organizing it spatially). They are associating certain information with particular views and developing the operational hierarchy and sequence. The interrelated nature of information needed to construct a drawing is made explicit through their need to continually cross-reference dimensions and alignments. By not making all dimensions explicit it is necessary for the students to derive dimensions based on for example the number of divisions in a tiled floor. It would require the students to work through and internalize the relationship between spatial hierarchy in an architectural object and the operational hierarchy when actualizing it in the visual state.

Out of the three approaches to creating the textual architectural object, the descriptive approach provided the strongest prompt for the students' exercise of translating the architectural object from the textual state to the visual state. Likewise, the descriptive approach allows for greater interaction and more robust conversations between the students and instructors as they heuristically shift the state of the architectural object.

## Moving from Textual to Visual State

To begin the drawing workshop the students received a lecture on the three views of the orthographic projection: plan, section, and elevation. Then I introduced the architectural object, the Farnsworth House, by Mies van der Rohe , which was given to the students in the form of a two and a half page written description (see above quotation). The students where then required to read the description of the house and begin a small group discussion about what they thought the house may look like—what is the primary massing of the house—and why they thought so. They had to use direct quotes out of the description to describe the extents of the house. The second phase was to have the students go through the text and highlight all of the information that they would associate with the different views. They quickly realized that some information was pertinent to more than one view and began coding the information. They were asked to scour the description and identify all of the information that would affect the construction of a plan. Through this process the students began to understand for themselves how to differentiate what information they would need to make the plan drawing. Once this was complete, the students were asked to do the same thing for the elevation view and the section view. The students began to identify parts of the information that where pertinent for multiple views which lead to discussions of the interrelationship between the views, the need for coordination between views, and the ideas of hierarchy and importance.

Once the students had completed this process and had thoroughly annotated their descriptions of the Farnsworth house, it was time for them to begin actualizing it in the visual state. The students were allowed to begin without instruction as to the order of operations. After a half hour of drawing and with mixed results that ranged from a correct layout to drawing off the edge of the paper, the students where again asked to group up and discuss their strategies for constructing the drawing. How they were laying the drawing out? What information where they using first? How did that information relate to the house? How important was that information? At what scale was the information working? Was it at the scale of the site, the house or the cabinet? Was it large organizational information or small detail information? Through these discussions the students quickly able to decipher what information they needed, the order in which they needed it and where they could find it. Some students even began to code the written descriptions in terms of primary, secondary, tertiary, etc. information.

Upon the completion of the plan the students where asked to locate and mark information that they had identified as having implications on other views. They were then asked (not instructed) to use the plan view to translate this information over to the other views. The students quickly began aligning the other views to the plan and drawing constructions lines from the plane to the new views. Once this information was translated they were able to incorporate the smaller and less hierarchically important information onto the drawings in an agile way. Upon the completion of the orthographic projection drawings student were able to utilize these drawing to create a paraline view (plan oblique) and a one and a two-point perspective of the house. Most importantly, the students are able to articulate the logic behind the process that they had derived from the exercise.

## Conclusion

This exercise has the ability to teach incoming students with no previous drawing experience the skills they will need to effectively draw in their educational and professional careers. This model will accomplish this in a way that instills drawing as a process of actualizing the architectural object in a visual state and is not merely representing it. My anecdotal observations after one course using this method are that students who have completed this exercise are significantly more facile moving between mediums (though all are visual states) in their studios than their classmates who did not participate in the workshop due to prior experience in architectural graphics. Students who completed the Word to Line exercise are able to move through the iterative cycle more quickly and develop and refine their studio projects to a notably higher level. I believe this approach to teaching introductory drawing has larger implication for students as they advance, whether it be actualizing a well-known architectural object (that may have even been actualized physically at full scale) or if it is actualizing something that has until now remained purely virtual in one's mind.

## Notes

[1] Kwinter, Sanford. "The Complex and the Singular" in Architecture of Time: Toward a Theory of the Event in Modernist Culture. Cambridge MA: The MIT Press, 2003. p. 8.

# Light and Gravity: The Analytical Model as a Co-producer of Reality

Jennifer Shields | California Polytechnic State University, San Luis Obispo

*"Every model shows a different degree of representation, but all are real...As agents in the ceaseless modeling and remodeling of our surroundings and the ways in which we interact, we may advocate the idea of a spatial multiplicity and co-production."*[1]

\- *Olafur Eliasson*

*Premise*

The artist Olafur Eliasson describes models as "co-producers of reality," advocating for models to guide us in understanding ourselves as agents in the built environment with a "spatial responsibility." For Eliasson, models are not just representations of a reality, but are real themselves, containing structure and time.[2] This paper proposes that physical architectural models can be both representational (models representing something else, containing a relative scale and spatial referents) and autonomous spatially-provocative objects, suggesting new architecture. The key lies in three criteria: *plasticity, abstraction,* and *ambiguity*. Models with these three qualities may achieve a dual meaning. As a movement reconceptualizing space in the Modern era, and a medium straddling two- and three-dimensions, Cubist collage will serve as a means of defining and clarifying these criteria. These criteria serve as tools for evaluating a precedent analysis project in a second year design studio.

*Plasticity* is integral to three-dimensional space. In its broadest sense, it is defined as "capable of adapting to varying conditions," implying a spatial responsiveness.[3] The Cubists challenged the plasticity of the two-dimensional canvas through the use of phenomenal transparency (according to Colin Rowe and Robert Slutzky) – an optical phenomena in which a figure can be perceived simultaneously as part of another figure(s) and an autonomous whole.[4] This perceptual flux can occur in three-dimensions as well, meeting the definition of plasticity. Architecture is considered a 'Plastic' art, meaning that it involves physical manipulation of material – however, spatial responsiveness is also requisite. The Finnish architect Juhani Pallasmaa describes plasticity as a tactile three-dimensionality, in which architecture "speak(s) of materiality, gravity, and the tectonic logic of its own making."[5] Pallasmaa argues that contemporary architecture does not always have this quality, but has become flattened and visually objectified. Physical architectural models, as three-dimensional constructs, must have plasticity in order to read as both scaled representations of inhabitable space and as scaleless spatial provocations.


*Fig. 1 Cubist collage: Juan Gris, The Bottle of Anis del Moro (1914)*

The second criterion for simultaneous meaning in architectural models is *abstraction*. Abstraction denotes a general idea or quality, as opposed to a specific reference.[6] The degree of abstraction is inversely proportional to the representational accuracy of the model. The more analysis and interpretation the original is subject to, the more distinct from the original the model will be – and thus more abstract. This deviation allows for a greater variety of readings and a looser connection to the original. Abstraction can be illustrated in Cubist collage. The Cubists' began with an analysis of scenes from everyday life, but through the process of abstraction, the elements of the original scene were transformed. In Juan Gris' *The Bottle of Anis del Moro* from 1914, the gestalt of a wine bottle oriented at an angle to the canvas can be discerned – but through geometric abstraction and fragmentation, the material figures on the canvas can also be read as a non-referential composition suggesting three-dimensional space. As Abstract Art evolved out of Cubism, any representational agenda was typically abandoned in favor of 'pure' abstraction. In order to maintain a dual meaning, an architectural model must carefully balance at this fulcrum.

The third criterion is *ambiguity*: "something that does not have a single clear meaning."[7] Ambiguity offers the potential for multiple interpretations. Cubist collage is intentionally ambiguous – the intention of the image being to simultaneously represent multiple perspectives of the same space or set of objects. An architectural model that demonstrates ambiguity can simultaneously represent an object of analysis and a unique spatial and material composition. The concept of ambiguity is closely tied to abstraction, in that abstraction permits ambiguity. As an analysis extracts more generalized information from the subject, and as this information is interpreted, the resulting graphic communication will be more open to interpretation itself – more ambiguous.

A secondary quality of ambiguity is the potential for the engagement of the imagination, resulting from the lack of semantic clarity. Philosopher Gaston Bachelard asks, while theorizing about the value of the miniature, "why should the actions of the imagination not be as real as those of perception?"[8] He surmises, "The cleverer I am at miniaturizing the world, the better I possess it. But in doing this, it must be understood that values become condensed and enriched in miniature. Platonic dialectics of large and small do not suffice for us to become cognizant of the dynamic virtues of miniature thinking. One must go beyond logic in order to experience what is large in what is small."[9] The capacity for models to promote imaginative musings is a quality that is valued in education at all levels, as we will see in the lineage of Kindergarten and the Bauhaus.

In a second year architectural design studio, I developed an assignment to conceptualize the physical model as simultaneously an architectural analysis and an autonomous artifact. The assignment was designed to promote analogue and digital skill development, framed as a precedent analysis. We had the unique opportunity to have the analytical models evaluated by the architect of the precedents himself: Mario Botta. Botta's own design process is reliant on the construction of physical models. An exhibition of Mario Botta's models and drawings at the Bechtler Museum of Modern Art in Charlotte, NC provided an opportunity for conversation with the architect and a complementary exhibit in which the 'Best in Show' projects of this assignment were displayed. These artifacts embodied the three criteria of plasticity, abstraction, and ambiguity as necessary elements for a dual reading of the models.

### *Architectural Modelmaking*

Architectural modelmaking in contemporary practice and pedagogy owes a debt to two previous moments in architectural history: the Renaissance and the Bauhaus, both advancing physical modelmaking as a testing ground for spatial and material design ideas (as opposed to using models as a means of illustrating a completed design).

While architectural models were constructed prior to the Renaissance, it was 15th century Italian architects who exploited this method of representing architectural ideas three-dimensionally. Alberti wrote extensively on the topic of the architectural model. In describing its purpose, he explains, "Better then that the models are not accurately finished, refined, and highly decorated, but plain and simple, so that they demonstrate the ingenuity of him who conceived the idea, and not the skill of the one who fabricated the model."[10] Michelangelo created small clay models to experiment with three-dimensional spatial compositions. He worked in model rather than perspectival sketch, because "he thought of the observer as in motion and hesitated to visualize buildings from a fixed point."[11] In addition to serving as a design tool, Renaissance architects used physical models as a communication tool: models illustrated the materials and methods of construction to the craftsmen. Ostensibly, "Creating a physical model was the only way Filippo Brunelleschi could easily guide his craftsmen in the construction of the dome for Florence Cathedral - a model he deliberately left incomplete to ensure his control over the dome as it was built."[12] Here we see evidence of the Renaissance architects' interest in plasticity, and to some degree, ambiguity in the architectural model. The model served as a testing ground for conceptualizing the design three-dimensionally, and its incomplete nature created ambiguity that could offer potential design alternatives.

Bauhaus pedagogy marked another critical turning point in the use of architectural models. According to Mark Morris in *Architecture and the Miniature*, "The Albertian model and its notion of a three-dimensional design process was not fully realized until the early twentieth century."[13] The Bauhaus, founded in 1919 by architect Walter Gropius, did not originally have an architecture department. Yet the school was based on the integration of the fine and applied arts as a pedagogical agenda. The Bauhaus was certainly indebted to Cubist spatial reconceptions initiated just a few years prior.

The Bauhaus Vorkurs ('fore-course') developed by Walter Gropius and Johannes Itten promoted three-dimensional material compositions. These models were not scaled representations, but rather compositional and material investigations as 1:1 objects. It is likely that Froebel, the founder of Kindergarten, and his Gifts (educational toys) influenced the Bauhaus pedagogy that emphasized the physical assembly of materials. Geographically, both Froebel and the Bauhaus have their roots in Weimar, Germany. Norman Brosterman in *Inventing Kindergarten* suggests that Gropius and Itten experienced Kindergarten, subsequently encouraged 'play' and experimentation with materials.[14] This agenda, and the resulting student work, shows evidence of plasticity, abstraction, and ambiguity, allowing the models to be suggestive of a multitude of spatial possibilities.

*Fig. 2 Bauhaus modelmaking: Contrast Study with Various Materials from Johannes Itten's preliminary course (ca. 1922)*

### *Mario Botta*

The renowned Swiss architect Mario Botta is a prolific modelmaker, investigating the composition of pure geometric figures into plastic architectural forms. While the Bauhaus precluded the study of history, Botta's education engaged it. He attended the Universitario di Architettura in Venice from 1964 to 1969, where he was educated under Carlo Scarpa. Botta's fascination with material, mass, and light is clearly an outcome of his time as Scarpa's thesis advisee. The rich cultural setting of Scarpa's and Botta's work and education necessitated the engagement of history. A project assigned to students at IUAV at this time was to create interpretive models of Renaissance precedents.

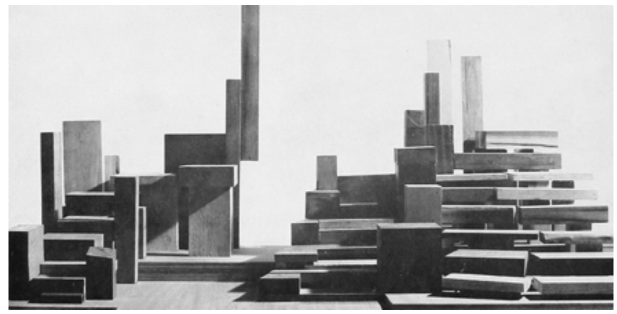


*Fig. 3 Interpretative model of the staircase in Biblioteca Medicea Laurenziana, Florence (IUAV, 1964, professor Bruno Zevii)*

Evident in Botta's subsequent design work is a desire to integrate architecture with context, through contrast. Botta described his method, saying: "Natural light brings plastic forms to life, shapes the surfaces of materials, controls and balances geometric lines. The space generated by light is the soul of the act of architecture...Gravity is the force that binds the architectural opus to the ground."[15] He favors pure geometries, strong Gestalt, stereotomic construction, and an immediate formal legibility. Botta's design strategy is driven by a method in which a pure geometric form (rectilinear, cubic or cylindrical) or combination of forms is carefully eroded. These design strategies were particularly suited for beginning design students initializing an analytical process.

Inspiration for the challenge to construct models that permit simultaneous readings came from Botta's San Carlino in Lugano, Switzerland (1999) in which Botta designed and constructed what is essentially a full-scale cross-sectional model of Borromini's San Carlo alle Quattro Fontane in Rome. What began as an analytical project in which a 3' x 2' x 2' model at 1/33 scale was constructed of laminated sheets of plywood evolved into a 1:1 manifestation of this analysis. This project, like the assignment given to our beginning design students, required the hybridization of analogue and digital methods. Computerized Axial Tomography and Laminated Object Manufacturing were used to prepare the cross-sectioned digital and physical models, while 35,000 wooden planks were manually assembled to construct the 1:1 object on Lugano's lakeshore.[16] Although constructed of wood, the subtractive nature of the final work and the dialogue between solid and void reinforced Botta's fascination with gravity and light.

Fig. 4 Mario Botta's San Carlino (Lugano, Switzerland, 1999)

Fig. 5 Mario Botta's Church of Papa Giovanni XXIII (Seriate, IT, 2000)

*Analytical Casts*

The beginning design students utilized the themes of *gravity* and *light* as lenses through which each precedent was analyzed. Alternating between analogue and digital methods, students experimented in three dimensions with the end goal being the fabrication of two small cast models. One model was intended to capture the theme of gravity, the other, light, in dialogue with each other.

Students were assigned one of five civic buildings (a church or a museum) by Botta, and first prepared a graphic analysis demonstrated through digital orthographic diagrams in 2D and 3D. The precedents were:

- Church of San Pietro Apostolo Sartirana
    - [Sartirana, IT, 1987-95]
- Chapel Santa Maria Degli Angeli Tamaro
    - [Monte Tamaro, Ticino, CH, 1990-96]
- Centre Durrenmatt
    - [Neuchâtel, CH, 2000]
- Church of Papa Giovanni XXIII
    - [Seriate, IT, 2004]
- Bechtler Museum of Modern Art
    - [Charlotte, NC, 2009]

The secondary design themes that the students were asked to investigate, as contributing factors to readings of gravity and light, included: relationship to physical/historical context, axis/entry/threshold, formal massing and spatial strategies, spatial overlap (phenomenal transparency), vertical organization/circulation and program, geometry, scale and proportion, and materiality.

First, students generated an extensive set of diagrams in plan, section, and axon to address these themes at a minimum of three scales: city/landscape, site, and building. They prepared a graphic analysis demonstrated through digital orthographic diagrams in 2D and 3D. Botta's drawings utilize a 33cm module, typically in a 2:3 format, so students created one 66 x 99cm (26 x 39") presentation layout that communicated their comprehensive diagrammatic analysis.

Shifting to analogue modeling, students sketch a minimum of three options for each of two thematic models, using their 2D and 3D diagrams as a starting point. Knowing they would be constructing two small cast models addressing Gravity and Light, they worked iteratively to design each model, considering these two models to be in dialogue with each other. These models were expected to emphasize plasticity and abstraction of the assigned case study (allowing for ambiguity), extracted from site. They were required to be contained within an 11 x 11cm cube.

Students then constructed study models to refine their final scheme for each cast model, using a quick, subtractive, method of carving foam blocks. They then created an exploded axonometric drawing using Rhino and Illustrator to show the intended massing and formwork for each of the cast models. The axons were formatted on a 66 x99cm layout and printed for review.

After refining their final strategy for each cast model, they created an exploded axonometric drawing using Rhino and Illustrator to show the intended massing and formwork for each of the cast models. Having virtually constructed each model and its formwork, students then fabricated the formwork for the final version of their Gravity and Light models using the laser-cutter and Masonite. Once assembled, each model was cast in Rockite.

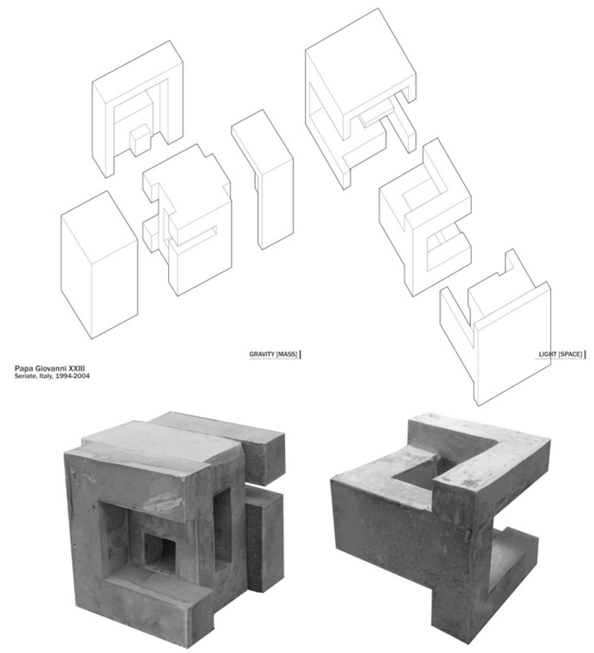



*Fig. 6 Student project: Formwork drawings and cast models analyzing Church of Papa Giovanni XXIII (Isabel Fee)*

These final cast models were constructed in anticipation of Botta's visit to the university. The models were exhibited collectively in the School of Architecture for Botta to walk through and critique. Students were motivated by his enthusiasm for their analyses, as he discussed the models in relation to his work. We also partnered with the Bechtler Museum of Modern Art to curate a small exhibit of the best analytical models produced in this studio, to complement a large exhibition of Mario Botta's work at the museum. Understanding the significance of their work as both an analytical process and a 'real' and meaningful spatial artifact was a valuable outcome of the project for the students.

### *Conclusions*

The famed psychologist Rudolf Arnheim, who wrote extensively on perception in art and architecture, describes the model as being "easily comprehended in the visual field," make the spatial relationships within the object it represents more easily understood.[17] Arnheim valued the legibility of space and form found in Botta's work – he wrote about Botta's chapel in Mogno in an essay about religious architecture, and even corresponded with Botta in 1992 to praise his work.[18] This clarity though, doesn not preclude multiple readings – it does not void the potential for plasticity, abstraction, and ambiguity. In an analysis of Botta's work, Irena Sakellaridou proposes: "Rules in interrelation create an intensive compositional structure, by virtue of which everything relates to the other and everything obeys the overall order. It is a structure that is stable and yet in a continuous state of oscillation between the creative search for the new and the transformation of what has already been explored..."[19]

The analysis undertaken by the beginning design students and the resulting physical artifacts, at their best, manifest these characteristics as well. The legibility of form and space that results from a casting process is plastic. Abstraction of the spatial conditions embodied by the precedent resulted in a new, plastic, spatial construct with the capacity for reading at a 1:1 scale or imagined as a scaled, occupiable, form.

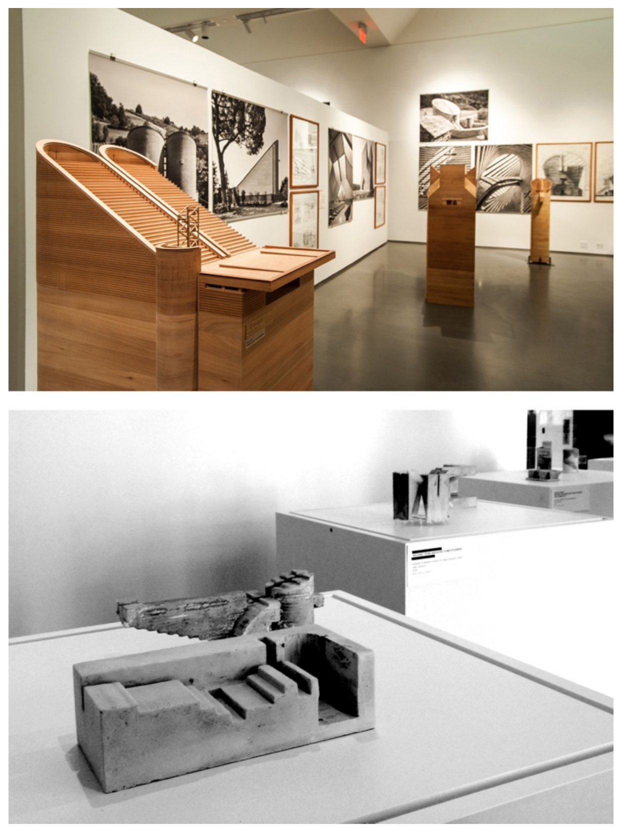


*Fig. 7 Botta Exhibition at the Bechtler Museum of Modern Art, Charlotte, NC (Botta's work above, student work below)*

## Notes

[1] Eliasson, Olafur. “Models are Real.” *Models*. Emily Abruzzo, Eric Ellingsen, and Jonathan D. Solomon, editors. Princeton Architectural Press: New York, 2007, p.19.

[2] Ibid, p.19.

[3] http://www.merriam-webster.com/dictionary/plasticity

[4] Rowe, Colin, Robert Slutzky, and Bernhard Hoesli. *Transparency*. Basel ; Boston: Birkhäuser Verlag, 1997, p.23.

[5] Pallasmaa, Juhani. "Six Themes for the Next Millenium." *The Architectural Review*, 196.1169 (1994): 74.

[6] http://www.merriam-webster.com/dictionary/abstraction

[7] http://www.merriam-webster.com/dictionary/ambiguity

[8] Bachelard, Gaston. *The Poetics of Space*. New York: Orion Press, 1964, p.158.

[9] Ibid, p.150.

[10] Smith, Albert C. *Architectural Model as Machine : A New View of Models from Antiquity to the Present Day*. Amsterdam ; Boston: Elsevier, Architectural Press, 2004, p.28.

[11] Ibid, p.25.

[12] http://www.architectural-review.com/rethink/architects-do-it-with-models-the-history-of-architecture-in-16-models/8658964.fullarticle.

[13] Morris, Mark. *Models : Architecture and the Miniature*. Chichester, West Sussex: Wiley-Academy, 2006, p.17.

[14] Ibid, p.43.

[15] Cappellato, Gabriele. *Mario Botta: Light and Gravity: Architecture 1993-2003*. Prestel Publishing: New York, 2004.

[16] Gubler, Jacques. “From the Village to the City.” *Botta : Mario Botta : Architecture and Memory*. Cinisello Balsamo, Milano: Silvana editoriale, 2014, p.117.

[17] Morris, p.68.

[18] *Botta : Mario Botta : Architecture and Memory*. Cinisello Balsamo, Milano: Silvana editoriale, 2014, p.60.

[19] Irena Sakellaridou, “Logic of Form, Richness of Meaning,” in *Mario Botta, Architectural Poetics*, Rizzoli, New York, 2000, pp.6-11.

# Building Blocks

Bryan Shields | California Polytechnic State University, San Luis Obispo

*Premise*

How can the foundational educational concepts defined by Friedrich Froebel in the development of the first Kindergarten pedagogy, including the value of multi-sensory experience, flexibility, and abstraction, spawn a methodology for design? This was the question posed to a topical architectural design studio.

Norman Brosterman argues a link between Modernism, specifically the geometries of Cubism and the International Style, and a Kindergarten curriculum widely in use when Georges Braque, Piet Mondrian, Frank Lloyd Wright and others were children, which taught children to see the world as simple, repeating, geometric forms.[1]

“In abstract art," wrote Piet Mondrian in 1941, "we see ... clearly there the elements of form are no longer veiled by the limited (the naturalistic) forms but appear as the expressive means."[8] Mondrian's reference to naturalistic, pictorial forms is always as "limited" or "limiting," and while that view of the pictorial vocabulary was not what Kindergarten teachers had in mind in their teaching, it may have been the emotional feeling conveyed to the creative children of many school generations.[2]

Friedrich Froebel, the father of the Kindergarten movement, created a series of 20 “Gifts” to foster a child’s creativity. Each successive gift represented an instance in the sequencing of a child’s development.

Froebel believed that a child must first learn concepts through abstraction before engaging the physical reality. Froebel’s “Gifts” and corresponding “Occupations” acted as a set of “graduated tasks that took the child on a quest for spiritual harmony with God, nature, and humanity.”[3]

The “Gifts” were not meant to be played with idly, but were expected to inspire the child, through direct manipulation and play, to form concepts of color, of texture, of size, of number, and of creative arrangements. The “Gifts” held a series of underlying objectives that privileged the sense of touch. The goals of each “Gift” were:

1. To aid the mind to abstract the essential qualities of objects by the representation of striking contrasts.

2. To lead to the classification of external objects by the presentation of typical forms.

3. To illustrate fundamental truths through simple applications.

4. To stimulate creative activity.

The corresponding "Occupations" further reinforced this approach. All of this Kindergarten work was deliberately arranged to correspond to a child’s inevitable and incessant activity.[4]

According to Jeanne S. Rubin, “All arrangements made with ‘Gifts’ and ‘Occupations’ were categorized into three types of forms: forms of life, geometric abstractions of familiar objects both natural and man-made; forms of knowledge, demonstrations of the principles of simple mathematics as well as plane and solid geometry, made possible by the graphed tabletop; and forms of beauty, a seemingly infinite variety of symmetrically and asymmetrically balanced forms.”[5]

Although Kindergarten in its original manifestation by Froebel was lost, the ideals found their way into the teaching of the Bauhaus. Architecture was the keystone of the Bauhaus curriculum. Because it straddles an intersection of the environment, mathematics, and aesthetics (or nature, knowledge, and beauty), and is the sum of all the plastic arts, architecture, particularly after 1900 (and half a century of Kindergarten) ought to have displayed evidence of the impact of Froebel's unified training in any number of ways.[6]

Early modernist architecture was scarcely the simple embodiment of "truth to materials" or "form follows function" that its some of its advocates claimed. With new technologies at the architects’ disposal, but no tradition for their employment, much of what advanced into modern architecture was provided by architects' involvement with the theories and practitioners of the allied discipline of abstract art. Cubism and geometric abstraction came just as architects were searching for new means of expression. Their concurrent adoption by architecture, which was recently unshackled from classical models, was assured. Kindergarten, which had become an important ingredient in art, was thus implanted into the architecture equation not only by the architects themselves (everyone of whom was born during the pedagogy's prime), but through contemporary art as well. Cubism, Futurism, and Neo-Plasticism found their way into architecture, bringing Kindergarten along for the ride.[7]

Even more direct connections can be made between Kindergarten and the distinct shift in architectural expression that occurred in the early twentieth century. Looking at the work and writings of Frank Lloyd Wright and Le Corbusier, there is substantial evidence that both were strongly influenced by the instruction of the original Kindergarten.

For Wright, the objective was unity, for Le Corbusier, harmony. A reliance on proportional systems and an almost religious devotion to the power of geometry linked the two, resulting in the creation of a substantial amount of what is definitive about modern architecture. "Wright transformed aspects of Froebel's system into the regulating grids upon which his plans were always organized and the interpenetrating rectangular solids that were their three-dimensional equivalent...Le Corbusier enlarged the Platonic solids to building size and ornamented them with nothing but their own shapes and shadows..."[8]

*Objective*

This paper describes an architecture studio project sequence in which the students were asked to reverse engineer a method of abstraction, using Froebel's "Gifts" as a foil for their analytical and interpretive process. This spatial interaction is inherent in Froebel's second gift, consisting of a sphere, a cube, and a cylinder. Learning is accomplished by way of comparison - the sphere with no flat planes, the cube with no curves and the cylinder being both flat and curved. This suggests a method for understanding the toy and its constraints before designing its classroom. How can the scale of the hand and the rules of play, affect the larger context it is located within? The position is that architecture is not static, but rather it evolves and learns over time.

The objective is to explore the interactive potential of architecture, design that is responsive to both its context and the user. One of the advantages of working in abstraction is that objects can remain simultaneously scale-less and scalable. As conceptual depth is gained, the site and/or program constraints can be applied to situate and ground the formal logic and rules uncovered.

El Lissitzky, a Russian Constructivists, spoke of his Proun as the seminal object of abstraction. He said, the "Proun begins as a flat plane, goes on to the construction of three-dimensional models, and beyond that to the construction of every object of our common life. Thus Proun supersedes painting and its artist on the one hand, the machine and its engineers on the other; proceeds to the construction of space, organizes its dimensions by means of its elements, and create a new, manifold yet unified, image of our nature."[9]

This passionate quest for harmony bears striking resemblance to Froebel's premise for Kindergarten pedagogy: "All is unity, all springs from unity, strives for and leads up to unity, and returns to unity at last." [10]

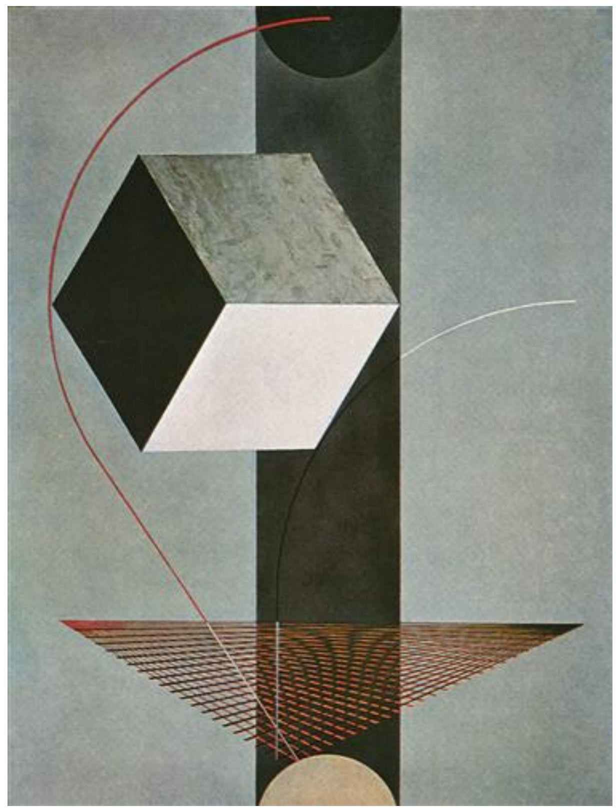


*Fig. 1: Proun 99 by El Lissitzky*

*Methodology*

The studio utilized a design methodology that has exploration at its foundation, able to evolve in order to build on the unknown rather than be limited by it. The studio approached the site and program requirements with the same inventiveness and exploration as Froebel's Kindergarten.

The semester was broken into four assignments. The first three assignments graduate and influence the fourth and final assignment. The sequencing of the course followed the intent Froebel laid out in his gifts - mastering the first step before moving onto the next.

- Assignment 1 focused on the analysis of the spatial complexities of abstract paintings.
- Assignment 2 used the spatial analysis from the first assignment as the basis for the design of a toy.
- Assignment 3 explored precedent; specifically, how the detail influences design as a whole.
- Assignment 4 culminated in the design of a Kindergarten in Brooklyn, New York.

ASSIGNMENT 1: Abstract Art Analysis

The students began by diagramming, in both plan and section, the influences of particular Froebel Gifts and Occupations in a work of Abstract Art. The diagrams demonstrated the concepts of color, shape, number, extent, symmetry, proportion, surface, lines, rings, and points. This exercise was based on Norman Brosterman's theory that the Abstract Art movement began in the "Child's Garden."[11]

The students selected two paintings: one from the Cubist and one from the De Stijl or Constructivist movements. For each of the paintings they created a bibliography and wrote a short abstract on the intentions behind the artist's work and a theoretical criticism of the painting.

Based on their group research and in-class discussions of the abstract movements they created a series of diagrams, in both plan and section, that demonstrated the influences of particular Froebel "Gifts" in the work of art. The diagrams illustrated the concepts of color, shape, number, extent, symmetry, proportion, surface, lines, rings, and points. The goal of the diagram set was to isolate each layer of the painting in order to develop a spatial hierarchy.

The diagrams prompted the construction of a series of maquettes that described their interpretation of the three-dimensional space represented by the artist. The maquettes were given specific material constraints for their construction in order to explore particular aspects of form and space.

ASSIGNMENT 2: The Toy

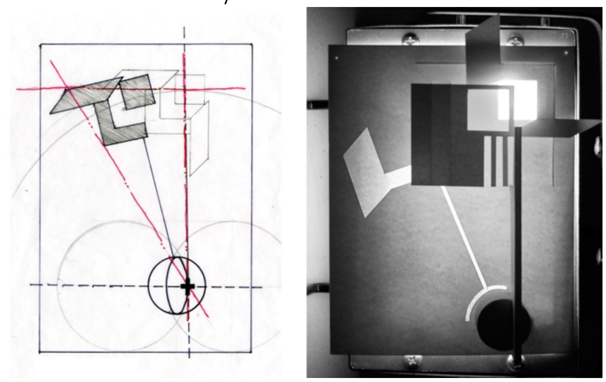


*Fig. 2: Student 2D to 3D Translation Diagram of Proun 99*

The students next constructed a toy to address one or more of the previous themes. The methods of abstraction discovered during Analysis were intended to provide a sense of order for the movement plays that the 1:1 object facilitates.

Friedrich Froebel developed teaching objects as part of a particular, integrated curriculum. "Froebel's program of graduated tasks of arranging spheres, blocks, paper, and other materials was developed from the Enlightenment legacy of understanding the forces of nature through experimentation but was joined to a Romantic quest for spiritual harmony with God, nature, and humanity."[12] Frank Lloyd Wright said that: "The smooth shapely maple block with which to build, the sense of which never afterwards leaves the fingers: so form became feeling."

From their analysis of Abstract Art in Assignment 1, students developed a vocabulary of "Gift" concepts. Assignment 2 asked them to elaborate on those concepts in the construction of a toy. Their toy was to address one or more of the following: color, shape, number, extent, symmetry, proportion, surface, lines, rings, and points.[13]

The students considered the following criteria in the design of their toy:

- The toy can be adapted to many uses in construction.
- As the child's ability increases, the toy responds to the growing needs and the variety of form grows.
- The construction that suited yesterday can be improved upon today.
- The toy is governed by a set of rules that determine their use in construction.

- The toy allows for subconscious growth in the grasp of number, combination and partition.[14]

The toy was required to fit within a 3”x3”x6” volume in its static or contained state. Students produced three diagrams of how they intended to manipulate this volume: one diagram that studied the concepts in a subtractive or solid form, one diagram that studied the concepts in planar form, and one diagram that studied a combination of solids and planes. The diagrams were axonometric drawings at 1:1 scale showing all components of the volume.

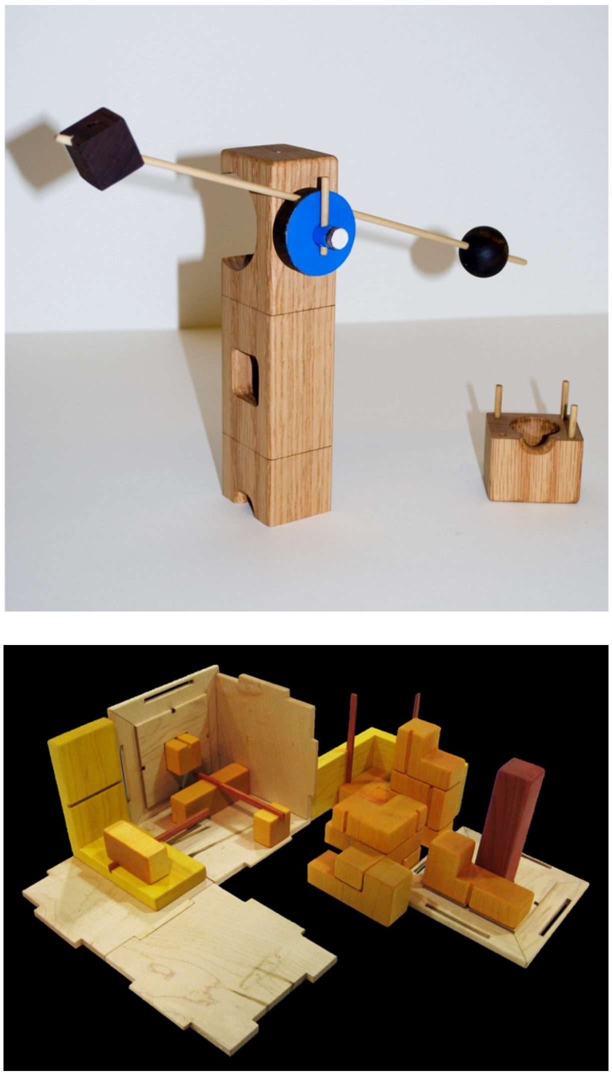


*Fig. 3&4: Student Toy Construction*

ASSIGNMENT 3: Precedent Analysis

Taking the lessons learned and questions amassed during Assignments 1 and 2, the students were asked to analyze a building and its context. The same themes and methods of analysis from their abstract art exercises apply to the works of architecture described below.

In Cubism, geometry, as something both new and perennial, is comparable to the status of abstraction in de Stijl theory, and the two terms are almost interchangeable, particularly since their associated ideas borrow from the same vocabulary. The vertical and the horizontal are-among the sensorial manifestations of natural phenomena - verifications of one of the most directly apparent laws. The horizontal and the vertical determine two right angles, out of the infinity of possible angles, the right angle is the angle-type; the right angle is one of the symbols of perfection.[15]

Research one of the following projects*:

- Maison de Verre by Pierre Cherault [Paris, France: 1932]
- Casa Curutchet by le Corbusier [La Plata, Argentina: 1953]

*Notable precedents omitted: Villa Müller [Adolf Loos] + Schröder House [Gerrit Rietveld]

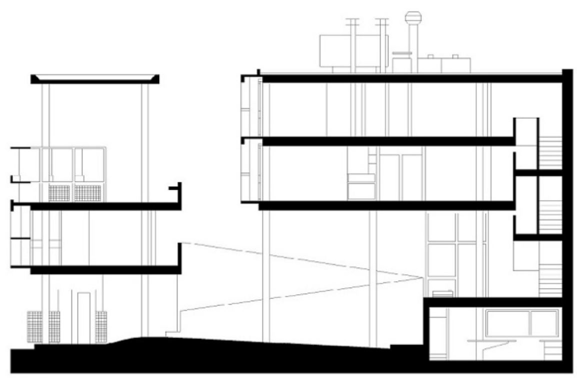


*Fig. 5: Longitudinal Section of* Casa Curutchet

The students each produced both analog and digital orthographic diagrams. They were required to explore both plan + section, as well as interrogate the project at the scales of the room, the building, and the urban block.

The diagrams created in the previous step were, as in Assignment 1, acting as drawings for the construction of a series of maquettes that describe their interpretation of the three-dimensional space created by the architecture. The maquettes were again constructed from a restrained material palette – studying the scale of the room, the building, and the urban block.

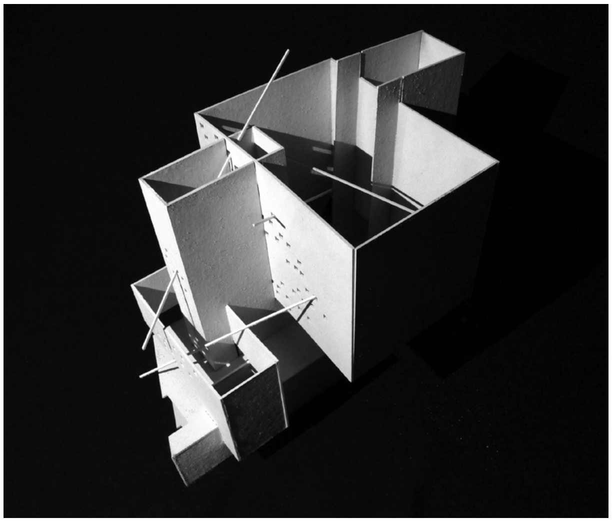


*Fig. 6: Student Precedent Analysis Maquette of* Casa Curutchet

ASSIGNMENT 4: The 21st Century Kindergarten

With the same concepts that guided the students through the Analysis and the Toy, students were asked to design a Montessori School within the ruins of the Tobacco Warehouse in Brooklyn, NY.  The change in scale from Interpretation to Intervention was a provocation to test the movement plays [abstraction + discovery] in translation from object to site scale.

The design of the Kindergarten was to accommodate the following programmatic requirements:

- Gathering Space
- Reception + Admin Office
- Classrooms*
- Teacher Offices
- Play Space** [Outdoors]
- Restrooms

*All classrooms were to have direct access to the exterior

**Play Space was to accommodate both group and individual play.

The Tobacco Warehouse shell could not be altered but students could attach to any of the existing walls. The footprint of their project could not extend outside the South, East and West sides of the warehouse. Although there was more than enough square footage within the walls of the warehouse to accommodate the program, they could extend into Brooklyn Bridge Park to the North of the site.

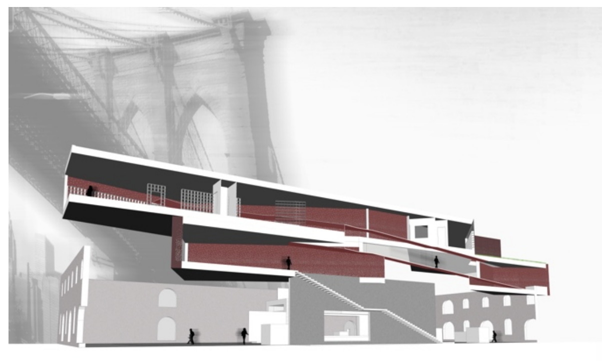


*Fig. 7&8: Student Building Designs*

***Conclusions***

The design of a piece of architecture with a more normative program as the concluding assignment provided for an interesting dialog within the studio. There was an impetus to jump right to the details of the project, assuming that the earlier precedent exercises served as the conceptual depth for the parti. The mid-review was a critical reminder that the relationship between the diagram and the detail had to be recursive. The reverse engineering assignment(s) were not meant to be formal drivers but to encourage an understanding of the vectors of site and program – and to celebrate the geometry of the context.

Reflecting on the question(s) posed at the beginning of the project, the strongest projects fully embraced the premise of abstraction to gain a deeper conceptual clarity. The site and its contextual vectors were viewed as a game board where a series of what Froebel called “movement plays” could unfold using the programmatic needs as a foil to the rules of site. The process was itself an abstraction of how Froebel set up the “Gifts” to correspond to their “Occupations.”

Subsequent iterations of this studio were given a much less normative program, challenging the students to more deeply analyze potential spatial relationships, rather than bringing deep-seated preconceptions to the project. In the words of Frank Lloyd Wright, *"Children should not be allowed to draw from casual appearances of Nature until they have first mastered the basic forms lying behind appearances."*

## Notes

[1] Gabriel, "Was Modernism Born In Toddler Toolboxes?" *The New York Times*: April 10, 1997.

[2] Logan, "Kindergarten and Bauhaus" College Art Association: *College Art Journal*, Vol. 10, No. 1 (Autumn, 1950), p 41.

[3] Brosterman, *Inventing Kindergarten* Harry N Abrams: New York, NY. 1987. pp 12-24.

[4] Logan, p 39.

[5] Rubin, "The Froebel-Wright Kindergarten Connection: A New Perspective" Society of Architectural Historians: *The Journal of the Society of Architectural Historians*, Vol. 48, No. 1 (Mar., 1989), p 28.

[6] Brosterman, pp 134-135.

[7] Brosterman, p 137.

[8] Brosterman, p 153.

[9] Banham, *Theory and Design in the First Machine Age*: Praeger: New York, NY. 1967. p 194.

[10] Hughes, *Froebel's Educational Laws for All Teachers*: Appleton: New York, NY. 1910. p 62.

[11] Brosterman, pp 36-56.

[12] Amy F. Ogata, "Creative Playthings: Educational Toys and Postwar American Culture" *Winterthur Portfolio*, Vol. 39, No. 2/3 (Summer/Autumn 2004), p 131.

[13] Brosterman, pp 36-56.

[14] Payne and Allen, "Kindergarten Theory" The University of Chicago Press: *The Elementary School Teacher and Course of Study*, Vol. 2, No. 3 (Nov., 1901), pp. 225-227.

[15] Banham, p 210.

# Educational Practices for the Introduction of Product Design

Martha Sullivan, Akshay Sharma | Virginia Tech

## Abstract

Is it possible to talk about form sans function? Is it possible to develop an understanding about the formal qualities of designed objects, and should design education reinstate the importance of "form enhances function"? Can introductory design education begin the necessary transformation in students to move them beyond just "doing design", but instead have them internalize how to become a designer? This paper attempts to answer these questions through a narrative about the realignment of studio and supporting courses that we offer as part of the design curriculum. We will outline the philosophical structure that inspired us to create strategic connections between courses and detail our sculptural approach to form, materials, and processes prior to the introduction of function through our Form Matrix Exercises. Some of the challenges we will discuss include: facilitating reflective practices necessary to becoming a lifelong learner in design, what resources are needed, time management, and the logistics of coordinating assignments in four different courses. Our aim is to produce thoughtful and intelligent designers, capable of not only working well in realms that they know, but also suited to define the problems of the future with the skills to implement exceptional solutions. We maintain that these qualities in future generations of designers begin with sound practices at the foundation level of product design education.

## id@VT in Context

The Industrial Design program at Virginia Tech, housed in the School of Architecture + Design and College of Architecture and Urban Studies, was conceived through the lens of the studio-based teaching model of the Bauhaus. The founder of the college, Charles Burchard, who was a student of Walter Gropius at Harvard, instilled a paradigm of "search" rather than 'solution" in a constructivist sense.[1]

The core of our curriculum is the studio, an active learning environment in which the professors lay out a framework for the students to discover a design methodology through themed programs. Skill building is critical to this process, but it is also constructivist in that the professors respond to the needs of individual students and encourage, as Schön suggests in the mid 1980's, "reflection-in-action" to develop creative instincts.[2] After one year in Foundation Design Laboratory, where ID students study alongside students from three other professional design disciplines, our students are enrolled in their first Industrial Design Laboratory. This studio style course currently enrolls 32-36 students led by two professors; the content and structure has been in developed and refined over the last five years. The two important components of this level of our curriculum that we are presenting here include our Form Matrix Exercises and how simultaneous supporting courses have the potential to foster creativity, innovation, and transformation of cognitive processes in students.

*Fig. 1 Studio Space in Burchard Hall, open studio plan with students' desks and meeting room for teaching and collaboration.*

## Form Matrix Exercises

Our Form Matrix Exercises are the core of familiarizing our beginning students with techniques to generate new and innovative forms through iteration and refinement. Our intention is to establish a methodology that the students can use so they are less likely to be stymied when they are not able to travel on a linear path to a solution and improve their capability to communicate and lead in a diverse work environment in conjunction with professionals in other fields of study.

We begin with a series of 2-dimensional compositions and diagrams as the first exercise to initiate a conversation about design elements and principles that are the foundation of the language of form, helping students build a vocabulary we can use to analyze and talk about form. It also gives us the opportunity to assess the differences in the students, each coming to us with a paradigm generated from their own life experiences, as well as from the different sections of the Design Foundation Laboratory. It is critical to build an environment where the students can discuss the knowledge they bring and also to have a forum where they can openly ask questions.[3]

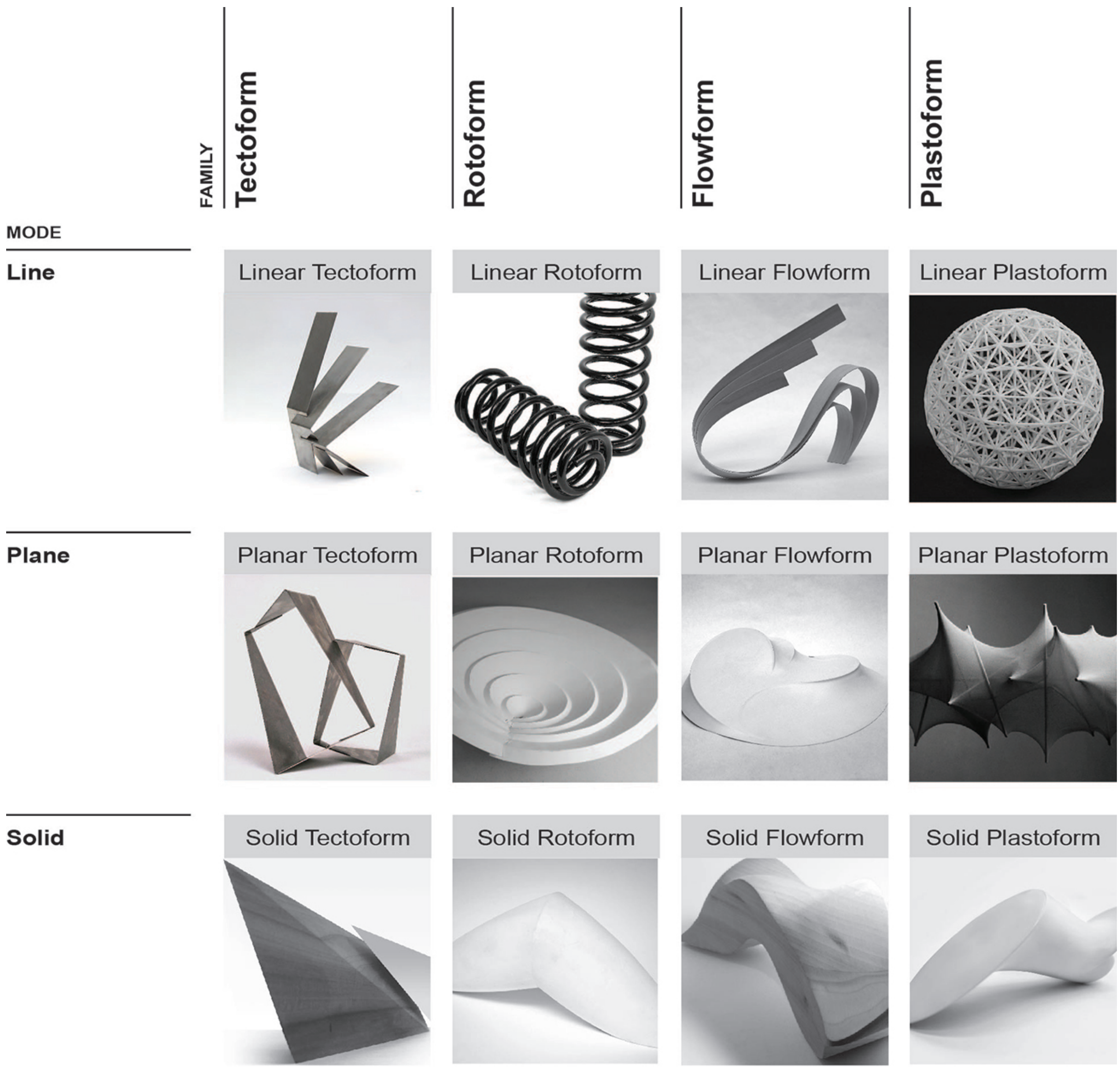



*Fig. 2 Form Matrix*

The initial 3-dimensional work that occurs in the studio was developed in collaboration with Joe Ballay and Mitzi Vernon. The Form Matrix, as we now call it, describes formal components of objects as they relate to industrial design. Looking at individual categories of the Form Matrix in separate exercises allows the students to deal with formal considerations unique to curvilinear, rectilinear, and rotational forms. We conclude with an exercise that requires the students to blend the different form categories into one construct to develop their command of transitions, called plastoforms. Along with form theory, each exercise introduces them to new materials and processes.

We put forward to the students that the form, shape, or the physical feel of an object can have a profound message hidden within its folds. To understand, interpret, and explore principles of design in physical forms is a challenging task in itself, so by detaching the functional requirements in our exercises, we are attempting to create a less intimidating introduction to the process. The exercises built around the Form Matrix are sculptural in nature. Students explore new formal compositions, perhaps starting with what they have seen, what they perceive, and what they know, but exploration with physical materials opens up a whole new world.[4] Each period of reflection and iteration exposes something different; they develop their own values about, and expression of, beauty itself.

Specifically, the materials and forms we currently focus on include: bent wood veneer for linear flow forms, sheet polystyrene for planar flow forms, 20 gauge sheet steel for linear and planar tectonic forms, a solid, laminated wood block for turning a rotational form, and finally, a combination of materials and forms, plus a filler such as bondo, for the solid plastoform. With each form, the students are given a design brief that is intended to expose the inherent traits in each of the forms. For example, the linear flow forms might suggest fair curves, directionality, movement, or accelerations; the planar flow forms might reveal fluid transition, lift, spines, or edges; the tectonic forms could express pattern, contrast, intersection, hierarchy, or containment; the rotational forms may reveal intensity, axes, beginnings and endings; and the solid plastoforms should incorporate intersection, transition, unity, and part to whole relationships.

At the conclusion of the exercises, when the students are able to manage materials and forming processes, they have built the confidence to command form. Later in the coursework, the addition of functional criteria becomes manageable in the design process in such a way that students are more apt to develop new or innovative approaches. The forms generated after this meticulous study convey a stronger relationship to the body and the intended use, they have an ease of manufacturing, as well as show more sensitivity to beauty and enjoyment.

## Companion Course Work

While the students are immersed in the Form Matrix Exercises in studio, they are simultaneously taking Design Visualization, Computer-Aided Industrial Design (CAD), and Design Proficiencies in Workshops. Design Visualization focuses on the ability to draw what we think, and it creates the foundation for new cognitive processes. CAD tools allow students to explore and examine formal arrangements that would be difficult to express with sketching. Both also facilitate communication of design intention.

During the implementation of the Form Matrix Exercises, the faculty unified the course content of studio and the concurrent classes to encourage domain transfer of the knowledge the students were building in studio. Further reflection on our program allowed us to identify the gaps in student comprehension and later fill them with custom designed short courses. For example, the importance of adding a compulsory module in Wood and Metal working, titled Design Proficiencies in Workshops, has had an impact on the quality of form explorations in studio. When united in a cohesive curriculum, where sketching of forms connects to a better understanding of CAD, which in turn is translated into a built construct, one can see the foundation for a designer+maker, witnessed through different iterations in a variety of mediums.

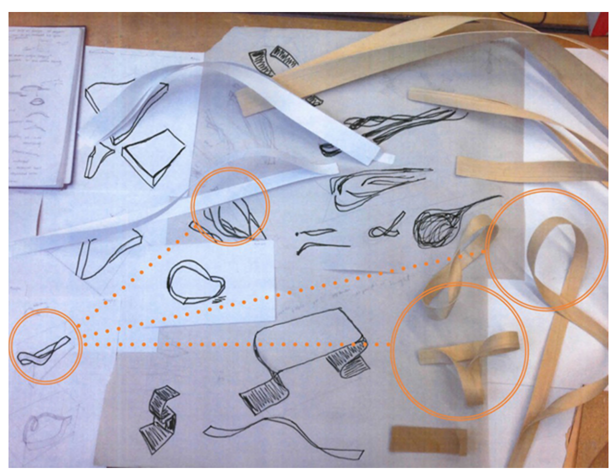


*Fig. 3. Overlap of sketching process and making process.*

The synchronized class concept is a logical extension of the holistic studio experience and we support that by aligning the exercises that are introduced in Design Visualization class and CAD class with explorations in design studio. For example, when students are exploring rotational form in studio they learn about revolve/rotate function in CAD and construct rotated forms in Design Visualization. The example below explains this idea visually.

### *Solid Rotational Form Design Prompt*

*Revolve:* move in a circle on a central axis; move in a circular orbit around.
*Exercise:* Sketch profiles revolved around a central axis in three dimensional space. Using the wood blanks you laminated in the Workshop Module reveal a rotational form that expresses rhythm. Draw the form and create a template as a guide for removing material on the lathe. Practice is possible in blue foam on the mini lathe in the plastics shop, please wear proper safety equipment. Using CAD, virtually model the rotational form, perform a cut operation to split the piece in two parts, and then reassemble in a new orientation.

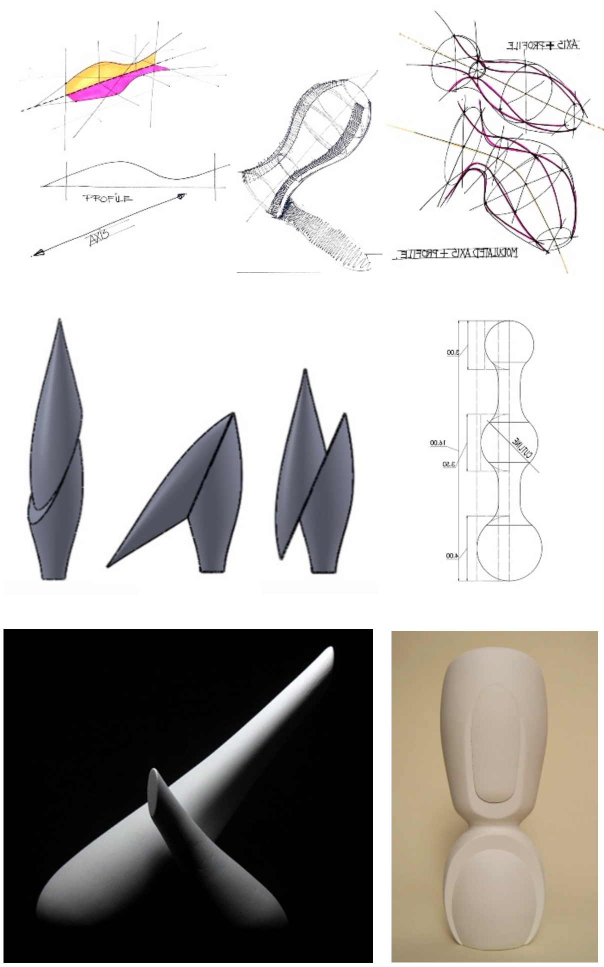



*Fig. 4. Rotational forms are explored through of sketching (top), CAD (middle), and turning wood on the lathe (bottom).*

At the conclusion of the courses, the participants were asked to take a brief anonymous survey asking if they felt the connection between the different classes, and if they thought the strategy of working on similar topics across classes helped them develop a deeper understanding of the design process. The premise for this survey was to help us prepare better a strategy for next semester. Following is the essence of the twenty one responses we received.

• Nineteen out of twenty one respondents said it was helpful and evident that the three classes were working in tandem
• All twenty one respondents said that it was helpful for them to understand the design process because they were able to focus on different aspects of the same project in different classes.

Here are some observations about the three courses working in tandem:
• "I believe CAD and studio were closely related, which was very helpful. I'm not really sure there was a direct connection between the other two classes and Design Visualization though, but this was ok because I think the purpose of fall was to teach us the basics of sketching and practice. "
• "Practicing sketching in Design Visualization really helped improve the quality of my work in studio, also being able to import sketches into CAD software was useful for rendering ideas."
• "Yes, the processes come together well when elements of creation are taught and paired - the relevance is clear and the work is projected in front of you in different forms."

These responses are about the effectiveness of the strategy:
• "Yes, but only because I was able to use skills from Design Visualization to better express what I wanted to convey in Studio. This made the design process more efficient, but I don't know if it made me understand it better."
• "It was a relief that many of the projects overlapped with each other since the classes covered similar topics. Design Visualization and CAD helped me understand where my strengths and weaknesses were, so I could understand where I had to improve to better my studio projects."

## Goals and Outcomes

At the conclusion of each of the Form Matrix Exercises, the students are given a topic for a product line to delve into through a rapid sketching and brainstorming session. The intention is for the students to make the leap from what feels familiar into unknown territory while they are at the pinnacle of their creative momentum. Moving into exercises that require the students to incorporate functional criteria adds a level of complexity that builds on their knowledge of form because they are cycling back to questions they have previously investigated, but with a new formulation of design thinking skills.

The physical nature of the studio requires students to have a comprehensive knowledge of materials and processes. As the students acquire robust skills in making, they are able to generate prototypes to develop possible products. Prototyping connects the viability of the form and material choices with the design intent and is considered a critical step in production process in our industry. Also, this concrete awareness of fabrication prepares students to better communicate with engineering professionals when working as a product designer.[5]

At the conclusion of the second semester, students build a fully developed functional product, such a mobile workstation or children's play furniture. They must define a context they want to investigate within the defined theme, research stakeholders and relevant human factors, iterate on potential solutions in sketches, CAD and rough prototypes, and then construct a detailed, working prototype. The culmination of the physical and cognitive skills they have gained are rigorously tested because they must link a series of complicated criteria to create a sophisticated and functional artifact.

Beyond the completion of the exercises and skill building, a major hardship we encourage the students reconcile is their role in their own education. Reflection is inherent in the design process, and qualities beyond creativity that are often critical in successful designers include motivation and resilience. Facilitating conversations in class, and with individual students, about their progress, and being transparent about the how and why we structure the class in a particular way can help the students mature into lifelong learners.[6] Furthermore, using individual blogs for each student provides an active forum for sharing research and initiating class discussions outside the bounds of traditional class hours. The students are also required to use this online platform to document their work at the conclusion of each project. This includes revealing their process and showcasing final work, and most importantly, thoughtful reflection on criteria they determined to be important, design intent, what they struggled with physically and conceptually, and how they were able to overcome those hurdles.

## Challenges

Maintaining this curriculum is expensive, resource intensive, time consuming, and logistically challenging. Fortunately our school is outfitted with three quality machine shops that the students would not otherwise have access to as an independent person. Student fees collected by the school cover the initial material costs of the form exercises, but the students are asked to have another $500 available for class work and design build projects. If the supplies purchased by the school were not sufficient, students have commented that they did not feel as if they were able to fully explore their ideas to the point of resolution and may suffer financial hardship to complete their work.

Beyond physical materials, human resources are also a concern. The availability of the machine shops and qualified staff to instruct the Workshop Module in metal and wood had to be negotiated, and was as complex as hiring new faculty. The shop staff has years of experience working with their respective materials and processes, a practical wisdom that is not easily replicated through any other means. The faculty also has expertise in design visualization, CAD, and studio practices that the students rely on as they develop their own design skills.

From a logistical standpoint, part of our school philosophy is that each student deserves an individual work space to maintain coherence between work sessions. The student desks are clustered together to foster open conversation and constructive criticism between classmates of the same year, and with those in years above and below. It takes commitment by students to maintain order in the work environment.

Timing is an issue for both planning and execution of the program. Coordinating the overlap of course work between Studio,

*Fig. 5. Student process for designing a "Lunch on the Go" system for a service dog. Using sketching model making and CAD.*

CAD, Design Visualization, and the Workshop Module requires preparation prior to the start of all courses, as well as revisions based on student performance during the semester. Our studio course has twelve contact hours per week in class between students and faculty, and it is nineteen to twenty two hours if the supporting courses are included. Above and beyond that, the students have considerable coursework to complete outside of instruction time. With iteration and innovation as a main objective, students spend considerable time generating, revising, and refining ideas, and executing them in physical form.

## Conclusion

Even though the curriculum is demanding, we think the current undertaking has proven to be sufficiently effective to warrant continued improvement.  As Larry Livingston states in Teaching Creativity in Higher Education, "Inventive people relish challenges, surprises, and even impediments."[7]

One key component of this experiment is the fact that the same two faculty are teaching Studio, CAD, and Design Visualization. This facilitated a very interesting phenomenon where a discussion about a 3D model in CAD class would effortlessly float into how that aspect would be useful in Studio. Similar instances also took place in Design Visualization where the studio project would become the prompt for a sketching exercise.

This experiment highlighted another very common phenomenon in higher education:  the stagnant nature of a course syllabus. The Design Visualization curriculum, schedule and deliverables had not changed since 2008, and the class has been training students in ideation quite effectively. The shuffling of content did not create new learning objectives for Design Visualization, but provided a relevance in other classes that became apparent on a weekly basis rather than later in the semester.

The overlap of techniques and fields of study, including Design Visualization, CAD, physical model building, research, conviction to iterate and refine, embolden the students' own decision making process.[8] Building the students' confidence in each area and then galvanizing the transition between them, so that the students need not depend on a linear and predictable path, establishes work habits and ethics that sustain the students as they begin, and throughout, their careers. We propose that the students start the path to becoming designers through a rigorous study of the universal language of form, grow in their understanding of dealing with complex situations by adding function and user needs, and are better prepared for the future as they internalize a broad range of converging techniques.

*Fig. 6. Linear Flow Forms*

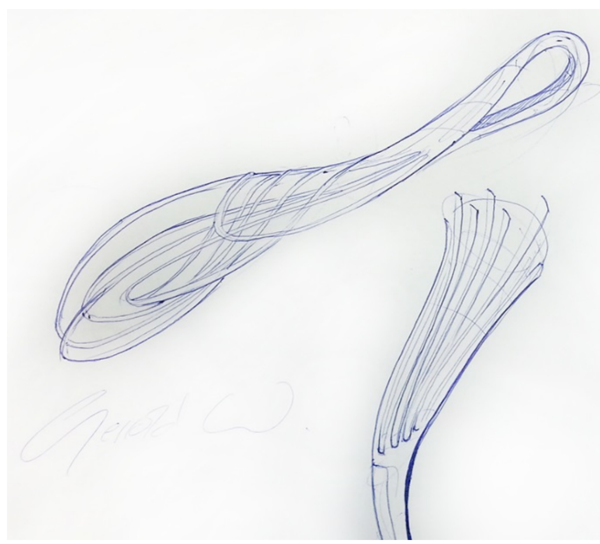


*Fig. 7. Student Design for Whisk*

## Notes

[1] Burchard, Charles. ”A Curriculum Geared to the Times,” AIA Journal (May 1967): 101-105.

[2] Schön, Donald A. “The Architectural Studio as an Exemplar of Education for Reflection-in-Action”. Journal of Architectural Education, Vol. 38, No. 1 (Autumn, 1984): 2-9

[3] Taboada, Manuela and Gretchen Coombs. Liminal Moments: Designing, thinking, and learning. Design and Technology Education: An International Journal 19.1 ( ): 30-39

[4] Wang, Joseph T. “To Make or to Create? What Should Students of Design be Taught?” Design Issues (2015) 31:3, 3-15.

[5] Yang, Ming-Ying, Manlai You, and Fei-Chuan Chen. “Competencies and qualifications for industrial design jobs: implications for design practice, education, and student career guidance.” Design Studies 26 (2015): 155-189.

[6] Winters, Tara. "Facilitating Meta-Learning In Art And Design Education." International Journal Of Art & Design Education 30.1 (2011): 90-101.

[7] Livingston, Larry. "Teaching Creativity In Higher Education." Arts Education Policy Review 111.2 (2010): 59-62.

[8] Shannon, Susan, and Antony Radford. "Iteration As A Strategy For Teaching Architectural Technologies In An Architecture Studio." Architectural Science Review 53.2 (2010): 238-250.

# Occupied Spatial Unit: Landscape Choreography

Rennie Tang | California Polytechnic State University, Pomona


## Abstract

Occupied Spatial Unit (OSU) is a project that I developed for the very first studio of the undergraduate landscape architecture program at Cal Poly Pomona. This project has enabled me to teach foundational principals through the live experience of them, rather than the application of principles through conventional techniques of drawing and model making. 1:1 scale is a method of teaching that allows design concepts to reveal themselves through the act of making. In the context of a landscape architecture design studio, it is critical that students move away from object-based thinking towards an understanding of 'space' as a substance that people move through and manipulate as they occupy it. This concept is well understood in the field of dance, from which the word 'choreography' is derived. The definition of dance choreography, "the art of ordering bodies and their movements in time and space"[1] could be reversed to create a definition of design: *the art of ordering space and time for bodies and their movements*. This definition speaks directly to the primary objectives of the OSU project.

The title 'Occupied Spatial Unit' emphasizes occupation of the body as well as the spatial capacity of both bodies and space. Working in teams of three, students are asked to design and build 1:1 installations on campus constructed out of 2x4 lumber. OSU's must respond to the immediate landscape of their selected site while enabling physical occupation of the human body. The project has been repeated over three consecutive years, each time with a slight variation but with the overall guiding principles remaining constant. Using this studio as a laboratory, this study compares three different approaches as design drivers: 1) Obstacle Course 2) Lexicon and 3) Performance.

By modifying the syllabus each year I have been able to test the effectiveness of the various strategies. Obstacle Course OSU's were the most accessible to passers-by and encouraged collaboration between teams. Lexicon OSU's used word prompts as form generators but led students astray from the site. Performance OSU's were valuable as a collaborative experiment between dance and landscape students. Culmination of the studio with an outdoor performance where dancers moved in response to the OSU's created a public spectacle that heightened the presence of the dance-landscape partnership on campus, taking the project to an entirely new level. OSU is an ongoing experiment that embraces 1:1 not only for the lessons it teaches but the collaborative values and sense of spatio-temporal engagement that it instills in the beginning design student.


*Fig. 1 OSU from LA102 2013 Obstacle Course*

## Learning Objectives

OSU is not a 'real' project in the sense of building something purposeful for a community or client nor is it a lesson on professional practice per say; instead it teaches students to tackle real-life issues that happen when a project is pulled out of the controlled environment of the studio and subject to the complex realities of public space. The learning objectives of this studio are outlined below:

*1) Understanding the realities of public space* –passerby reactions and engagement with project, campus safety concerns, responsibilities such as cleanup and precautions taken during construction, respect for campus maintenance regimens.

*2) Developing a sense of craft* – tectonics and attention to detail, the culture of 'making', the non-linear iterative process of design, basic woodworking skills and architectural drawing

*3) Understanding the agency of the site* – designing in-situ, in real space at 1:1 scale reinforces the site as driving force within the design process.

4*) Engaging in cross-disciplinary collaboration* – understanding design through the lens of multiple disciplines such as visual art, environmental or public art, architecture and dance opens up opportunity for creative thinking.

*5) Practicing non-representational design* – 1:1 moves students away from representational tendencies using drawings or models that *represent* something else but instead making work that 'is what it is'.

*6) Learning the lexicon* – instead of memorizing definitions or listening to lectures, learning happens through action; the meaning of words and concepts are drawn out, clarified and expressed through of the process of making. Design as a non-verbal form of communication is reinforced.

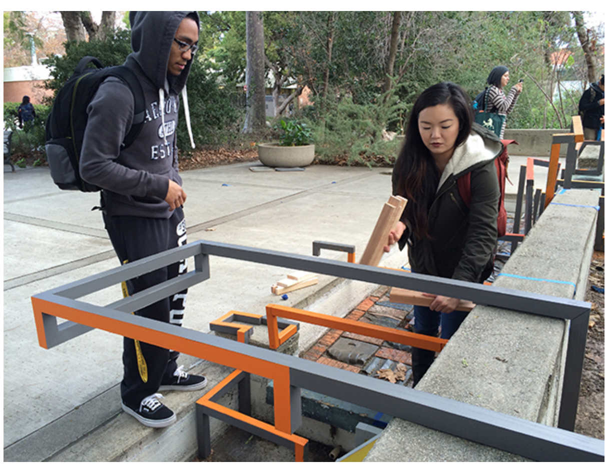


*Fig. 2 OSU from LA102 2016 Trace Concepts*

## Landscape Choreography

Linkages between landscape and choreography are rooted in landscape architectural history as found within theoretical discourse and investigations of design process. Landscape theorists have borrowed vocabulary from the field of dance. "Choreography appeared in landscape architecture discourse in the mid-twentieth century and is used today to signify the designer's script for how users will move through space. Performance...refers to the contingent and individualized reception of such scripts by bodies that may refuse to behave."[2] The notion of scripting space in order to control bodies is inherent to 'landscape choreography', which refers to the collaborative investigations of design process by landscape architect Lawrence Halprin and his wife/choreographer Anna Halprin. Lawrence Halprin's 1949 essay 'The Choreography of Gardens'[3] foreshadowed much of his subsequent work with Anna and informed his own landscape design projects.

In studying methods for teaching design foundations it is interesting to examine the early academic background of the Halprins. In 1941 Lawrence began studying design and architecture with influential Bauhaus modernists Marcel Breuer, Walter Gropius and Laszlo Moholy-Nagy, as well as landscape architect Christopher Tunnard. Inspired by sitting in on his design courses, Anna incorporated Bauhaus artistic principles into her own dance teaching. At Harvard she ran a series of dance classes aimed at architecture and design students, and delivered a lecture on 'Dance and Architecture'.[4] Both Anna and Lawrence focused as much on the *process* of creative exploration as on artistic *form*.[5] This philosophy was further developed through the couple's 1968 'Experiments in the Environment' interdisciplinary workshops that explored methods for stimulating collective creativity and community participation.

The evolution of the Halprins' work, their cross-disciplinary collaborations and Bauhaus influences, helps to position the OSU project as a fresh take on ideas and methods that have a long standing history in architecture and landscape architecture. Using different iterations of the OSU project to test the effectiveness of landscape choreography as a teaching method, has led me to question Veder's paralleling of choreography/design and performance/use; such an interpretation seems somewhat reductive considering the richness inherent in the merging of dance and landscape as embraced by the Halprins. Rather than seeking parallels between dance and landscape, the OSU project adopts a dance approach by removing the 'user' from the equation and dissuading students from designing 'useful' interventions (such as seating or pathways) in order to focus on spatial and temporal qualities of the construction. 'Body *as user* of landscape', is reframed within the OSU project as 'body *as* landscape,' a view that dissolves the binary condition of *landscape* and *user of landscape*. In this view, *landscape choreography* might be defined as an orchestration of body, space and time as an interactive process that sets the stage for landscape architecture. I believe that foundational design is well suited to this view because it defamiliarizes students from what they already know, or think they know, in order to understand space and time in completely new ways.

## Cross-disciplinary Influences

Beyond the non-representational lessons of the 1:1 scale project, the OSU studio is also a laboratory for exploring cross-disciplinary ideas. As such it reveals to students fluidity across the fields of performance and visual art, architecture and landscape architecture. For example choreographer Trisha Brown was one of the early pioneers of the 'site-specific' dance movement where the city becomes a stage for dance; she is also well known for her interest in the convergence of dancing and drawing. It is not surprising that Anna Halprin had a direct influence on Brown who in turn paved the way for the flourishing of more recent urban movement projects such as Willi Dorner's 'Bodies in Urban Spaces' (2007-14)[6] and Stephan Koplowitz's 'Grand Step Project' (2004-ongoing)[7] amongst many others. Set designs by sculptor and landscape architect Isamu Noguchi for choreographer Martha Graham create powerful dialogues between dance and design on the stage, which have clearly translated into Noguchi's narrative-based landscape projects such as 'California Scenario' in Costa Mesa, CA.

With a diverse range of reference points to draw from, the OSU studio was developed as an introductory landscape architecture design studio for the undergraduate landscape program at Cal Poly Pomona. An analysis of three different variations of the project represents the evolution of the course over the past three years. The fourth iteration is currently being taught at the time of this writing and will be touched upon briefly. The three approaches are: 1) Obstacle Course 2) Lexicon and 3) Performance.

### *Obstacle Course*

The Obstacle Course approach is based on the idea that people are often compelled to engage in physical movement for the purpose of challenge, whether through sports, exercise or simply the motivation to achieve a goal.

Designing for challenge forces the designer to consider the varying abilities of people and the temporal nature of human movement. In light of this many students saw the obstacle course as an opportunity to test out design strategies that force people to slow down or speed up, relating to JB Jackson's definition of landscape: "a space deliberately created to speed up or

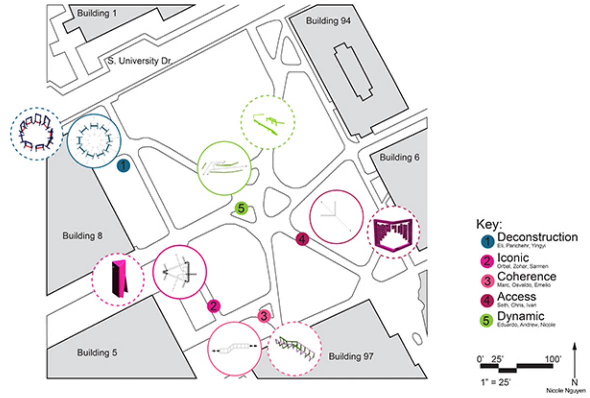



*Fig. 3 OSU Obstacle Course map from LA102 2013*

slow down the process of nature."[8] In this case it is the occupants of the space that are the 'process of nature'. Each temporary occupation of the site contributes to the OSU's temporality. In order to quantify time students were asked to collect data reflecting the length of time visitors spent occupying their OSU. Students learned that controlling time is dependent on multiple factors often beyond their control. For example one student team observed that the time visitors spent with their OSU depended on curiosity; time is stretched when level of interest goes up. For other projects that dictated specific movements such as zigzag paths or structures that must be climbed through, the visitor's desire for challenge became a defining factor. In general students also noted that random situations affected timing such as whether a visitor was a student rushing to get to class, carrying a backpack or participated with a group of friends.


*Fig. 4 OSU time study from LA102 2013 Obstacle Course*

The take home message for students was clear: that time is a measurable condition that reveals the dynamic nature of space but more significant was the phenomenological aspect of space, its temporality or *sense of time*.[9]

*Lexicon*

*Fig. 5 OSU from LA102 2014 Lexicon*

1) Build a minimum of 6 basswood study models at a scale of 1"=1'-0" (basswood size will be approximately to scale) generated from words below. Select 2 words per list.

| Pattern | Movement | Action |
|---|---|---|
| *grid* | *rhythmic* | *droop* |
| *curvilinear* | *lyrical* | *drop* |
| *rectilinear* | *heavy* | *rise* |
| *web* | *light* | *hover* |
| *spiral* | *tentative* | *roll* |
| *knotted* | *awkward* | *split* |
| *concentric* | *bold* | *flood* |
| *pixelated* | *random* | *smear* |
| *striated* | *punctuated* | *cluster* |
| *perforated* | *undulating* | *stretch* |
| *dotted* | *disoriented* | *scatter* |
| *clustered* | *jagged* | *bounce* |
| *radial* | *axial* | *weave* |
| *exponential* | abrupt | *spill* |

*Fig. 6 Word list assignment from LA102 2014 Lexicon*

The Lexicon approach is based on the power of words as spatial drivers. Verbs, adjectives and adverbs, rather than nouns, are useful for steering students away from the design of representational objects, toward the design of spaces that prompt action. For example, the verb 'to hover' asks students to deeply consider this word in order to translate it into a physical construction. There are many options for students in terms of how the word might be deployed – Does the structure appear to hover? Does the occupant feel like their body is hovering in space? Does the tectonic quality of the structure evoke hovering? The design could be any one or combination of these ideas. In addition to a word translation exercise, the project also introduces students to a lexicon of fundamental design terms such as figure-ground, perception and scale as the meaning of these concepts are drawn out through the making of the OSU.

*Performance*

The Performance approach ties landscape choreography back to its origins by incorporating actual dance performance into the project. Working in collaboration with dance students from Cal

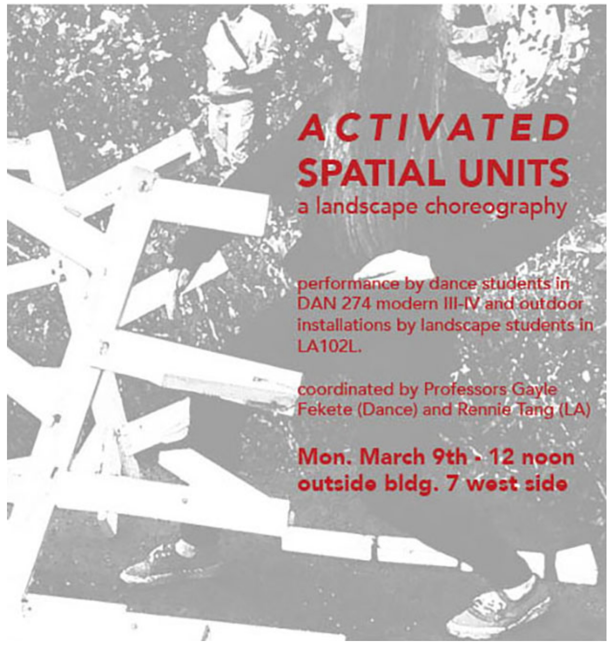



*Fig. 7 Activated Spatial Units flyer from LA102 2015 Performance*

Poly Pomona's Department of Theatre and New Dance, landscape students had the opportunity to witness their OSU's being 'activated'.

*Fig. 8 OSU with dancer from LA102 2015 Performance*

Dancers were invited to interact with the structures at mid-term and final stages of the project. At mid-term preliminary versions of the OSU were installed while dancers moved within and around them exploring their spatial and expressive qualities. The dialogue created between the dancers and the structures served as inspiration for landscape students in further developing their designs. The course culminated with a final performance titled 'Activated Spatial Units'. Combining prepared movement sequences with improvised responses to the OSU's the dancers' movements illuminated the notion of bodies *as*

*Fig. 9 OSU's from LA102 2015 Performance*

landscapes, rather than 'users' of space. Recalling the cross-disciplinary work of the Halprins this collaborative endeavor illustrates the value of reaching out beyond the confines of one department, taking advantage of the academic setting to enrich student learning. The exchange between landscape and dance students created windows into each other's discipline and opened up new modes of thinking and designing that otherwise may not have been realized. For landscape students, the act of occupying spaces was expanded beyond the ubiquitous acts of every day movement, by seeing the body as a spatial instrument with a wide range of locomotive ability.

*Fig. 10 OSU from LA102 2015 Performance*

## Analysis

Comparing the three approaches to the OSU studio in terms of their effectiveness for teaching foundational design principles enables me to evaluate of the studio in a more comprehensive manner. The Obstacle Course approach was the least abstract for students because there was a 'name' given to the final product. It offered students something familiar that they could grab on to, the challenge of seeing how long they could hold people in space and an opportunity for an all-studio collaboration through the final mapping exercise. However as the first time this project was taught, we encountered many issues related to construction on campus and intervening in public space. Since students were allowed to select any site on campus, projects were located far apart making them hard to control by instructors. Occasional safety concerns or conflicts with facilities were encountered. While these were valuable real-life lessons for the students, the issues were easily avoided in subsequent studios. For the Lexicon approach students had a hard time translating the words into physical objects, some of which ended up as familiar objects such as, a table, a bench, a seesaw etc. While the exercise of translating words into physical form is valuable, it is more successful when a level of abstraction is maintained. The Performance method initially suffered from similar issues as the Lexicon method because the students' first instinct was to design a stage or stage set for the dancers. They eventually realized that they were designing a spatial environment for dancers to interact with. During the final performance the dancers initially used the OSU's primarily as a backdrop for their own choreographed dance. Towards the end they began to engage the structures through improvised movement. This resulted in a dynamic dialogue between the two disciplines. My general critique of all the OSU projects is a lack of connection and sense of grounding to the site. Many projects ended up as stand-alone objects that could be placed anywhere, with a few more successful projects relying on site elements for structural support. Lessons learned from these three approaches have informed me in the further development of this studio.

*Fig. 11 OSU from LA102 2014 Lexicon*

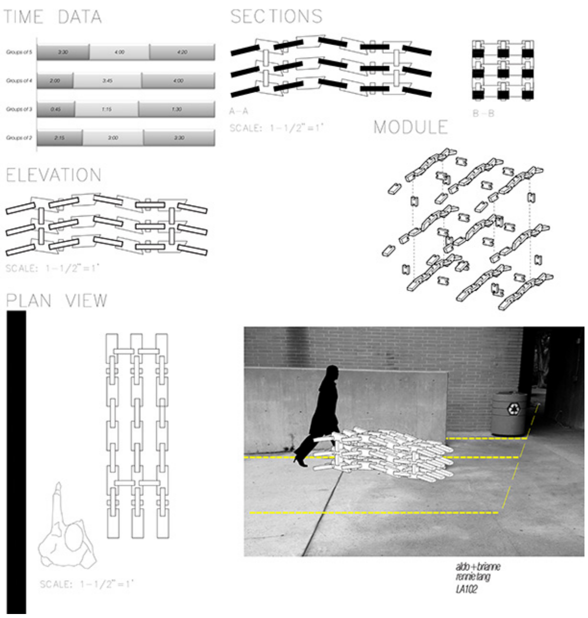



*Fig. 12 OSU poster from LA102 2014 Lexicon*

*Fig. 13 OSU from LA102 2016 Trace Concepts*

### *A Fourth Approach: Four Trace Concepts*

The next iteration of the OSU project is being taught at the time of this writing. The site is now confined to a small well-defined area that marks the location of an abandoned fountain. The varying ground plane conditions are composed of stepped concrete walls, pool-like enclosures, tile work and drains that speak to its former life. With this visible evidence one cannot help but imagine water in its absence. The entire class shares this single site and are led through a series of project phases based on Christophe Girot's essay 'Four Trace Concepts of Landscape Architecture', the concepts being *Landing, Grounding, Finding and Founding*[10]. Structuring the course around the reading and using its principles as a springboard for engaging with issues of site in landscape architecture enabled students to understand the studio as a whole at its onset.

OSU is an ongoing experiment that I believe will continue to evolve over time. With the intense range of skillsets learned, including computer drawing, conceptual thinking and craft, students quickly gain confidence and end up with a tangible project that is both abstract and real at the same time. Finding this balance is critical for the beginning design student as they navigate their way through processes that are more about asking questions than seeking answers.

## Notes

[1] Huschka, Sabine. "Media-Bodies: Choreography As Intermedial Thinking Through In The Work Of William Forsythe". *Dance Research Journal* 42.01. Cambridge University Press: MA. 2010. p62.

[2] Veder, Robin. "Walking Through Dumbarton Oaks". *Journal of the Society of Architectural Historians* 72.1. University of California Press: CA. 2013. p5-27.

[3] Halprin, Lawrence. "The Choreography Of Gardens". *Impulse Dance Magazine*. 1949.

[4] MPD AH Archives, 11(62), 'Dance and Architecture', by A.S. Halprin, n.d. c.1943–44. On her dance classes for architects, see Ross, *Anna Halprin*.

[5] Merriman, P. "Architecture/Dance: Choreographing And Inhabiting Spaces With Anna And Lawrence Halprin". *Cultural Geographies* 17.4. Sage Publications: CA. 2010. p427-449.

[6] Dorner, Willi. "Cie.W.Dorner - Studio 70". *Ciewdorner.at*. 2016. Web. 22 Jan. 2016.

[7] Koplowitz, Stephan. "Stephan Koplowitz Projects". *Koplowitzprojects.com*. 2016. Web. 22 Jan. 2016.

[8] Jackson, John Brinckerhoff. *Discovering The Vernacular Landscape*. Yale University Press: CT. 1984. p8.

[9] Heykoop, Lee. "Temporality In Designed Landscapes: The Theory And Its Practice In Works Of Some Major Landscape Designers 1945-2005". Doctor of Philosophy. University of Sheffield, 2015. p1.

[10] Girot, Christophe. "Four Trace Concepts In Landscape Architecture". *Recovering Landscape: Essays In Contemporary Landscape Architecture*. James Corner. 1st ed. New York: Princeton Architectural Press, 1999. 59-78.

Image credits: All photos by author

# Graphic Language in the Classroom: Integrating Graphic Design with Interior Design Studio and Graphics Coursework

Susie Tibbitts | Utah State University

Roberto Ventura | Virginia Commonwealth University

## Abstract

Design practices like those of Eva Maddox, Ghislaine Viñas, OMA and the Rockwell Group demonstrate how graphic design influences interior space conceptually, technically, and experientially. Equipping interior designers with basic graphic design fundamentals supports this demand for thinkers who can critically engage with these interdisciplinary collaborations.

Historic examples reinforce the traditional connections between interior design and graphic design. However, almost half of CIDA accredited undergraduate programs operate without a graphic design department or program in the same division or institution. Searching the *Journal of Interior Design* for scholarship on the integration of interior design and graphic design yields only one result, and it advocates studying graphic design only to strengthen renderings.[1] Scant evidence exists that interior design education values integrating graphic design into its body of knowledge.

Lacking access to faculty or scholarship emphasizing graphic design fundamentals, interior design students base two-dimensional design decisions on uninformed rationales. With an explicit foundation in graphic design, interior design students could more critically engage the growing intersection of these two disciplines common in contemporary interiors practice.

Educators at two schools addressed this schism by integrating graphic design content into existing interior design graphics and studio classes because of the synthetic nature of those courses.

Instructors identified significant overlaps between graphic and interior design fundamentals as articulated by Ballast[2] and Lupton,[3] and augmented their teaching with graphic design-specific exercises elaborating on typography, composition, communication and critique.

Typography studies introduced typeface anatomy, pairing strategies, and type's expressive potential. Compositional studies introduced analytical methods for understanding two-dimensional spatial zones,[4] which informed graphic design-intensive assignments focused on visual communication. Graphic design academics and practitioners provided feedback to the students on these projects.

After introducing graphic design learning activities into interior design studio and graphics courses, instructors noted changes in student work. Heightened awareness of and excitement about typography manifested itself in more sophisticated and ordered choices. Spatial zones and their coordination across compositions informed two-dimensional work and suggested parallel analyses of three-dimensional space. Requiring visual presentation cartoons early in the design process strengthened compositional decisions. Planning improved oral presentations, as graphic compositions informed speaking outlines. Graphic design practitioners and academics provided critique, reinforced instruction and provided additional learning opportunities for students and faculty.

Integrating graphic design principles into studio and graphics coursework was effective and efficient. Student confidence with graphic communication, especially with portfolio development, bolstered their post-graduation employment search. Students organically integrated graphic design into studio work.

Additionally, students explored professional paths that bridged both disciplines, like environmental graphics, web design, branding and exhibit design.

## Motivation

Through new fabrication processes and the rediscovery of interdisciplinary practice, graphic design exerts an exciting influence on the built environment. Branded Environments pioneer Eva Maddox brought the power of two-dimensional communication into interior space, synthesizing disciplines into an holistic conception.[5] Former AIGA president Sean Adams emphasizes this, saying "The physical environment is a primary contact point for the audience. As in branding...It is the gestalt of the entire experience."[6] Ghislaine Viñas blends basic interior design components with graphic elements, envisioning space as a three-dimensional canvas for color blocks and pattern. Two-dimensional graphics like wallcoverings, custom paint, rugs and artwork assume different expression and meaning through her unconventional applications and scaling. Rem Koolhaas/OMA integrated custom pictograms commemorating the life and history of the Illinois Institute of Technology with transparent panels at the McCormick Tribune Campus Center. The resultant material hybrid violated the modernist metaphysic of glass and suggested a truer material understanding of it as something that has mass, solidity, and surface. The Rockwell Group, in their work at the Las Vegas Cosmopolitan Hotel lobby, explores kinetic space by exploiting the potential of animated two-dimensional information and its influence on interior space. Liberated from the stasis of conventional space, kinetic spaces adapt to event, season, time, and user with great specificity.

Two significant characteristics can be observed in the precedents cited. First, each team integrates two-dimensional information in an holistic, integrated manner. The resultant hybrid exhibits graphic materiality,[7] the physical fusion of graphic design and building elements in service of artistic communication and spatial definition. Graphic materiality expresses itself through three characteristics: honesty; the presence of pattern and scale; and a phenomenological experience.

Second, each precedent was conceived by an interdisciplinary team of architects, interior designers and graphic designers. Maddox's work relied heavily on two-dimensional brand identity; Viñas often collaborates with her spouse, Jaime Viñas, a graphic designer; OMA worked with 2x4, a graphic design firm, to establish the IIT system; and the Rockwell Group collaborated with Digital Kitchen to produce the video at the Cosmopolitan lobby.

Given the power of these spaces, interior design and architecture students conversant in the graphic design dialect could engage these types of spaces and collaborations more effectively. This experience with graphic design could also naturally translate to stronger visual communication of design ideation and portfolio development.

## Problem

Despite innovative collaborations across design disciplines, the structure of academic departments is rooted in a twentieth century legacy of separation. Of the more than 160 CIDA (Council for Interior Design Accreditation) accredited undergraduate programs, three quarters operate in institutions that also support a graphic design department. Of those, just over half (54%) share similar academic divisions. Eliminating schools of art and design - for example, schools like RISD or SCAD - the numbers decline. For the over 120 undergraduate programs that fall into this category, about 66% operate in institutions that support a graphic design department; only about 30 of these interior design departments share the same academic division with their graphic design relatives.

While these separations do not prevent intramural collaboration, the bureaucratic and cultural obstacles are not insignificant. Scheduling conflicts, especially with studios, staffing and funding concerns, and institutional histories all represent impediments.

Additionally, interior design scholarship does not appear to address this separation. Searching the *Journal of Interior Design* for scholarship on the integration of interior design and graphic design yields only one result, Christopher Budd's "Valuing the Intuitive."[8] However, Budd only suggests that graphic design training may lead to better rendering results.

Lacking access to faculty, role models or scholarship emphasizing graphic design fundamentals, the majority of interior design students can only base two-dimensional design decisions on uninformed rationales. Interior design and architecture students are generally strong learners with the potential to successfully translate design fundamentals across varied platforms.[9] However, students are tasked with learning and speaking the language of visual and design thinking, and their priorities are required coursework. Any type of ancillary cross-pollination is up to the student who independently – and often without feedback and input – tackles the challenge.

However, with an explicit foundation in graphic design, students could more critically engage the growing intersection of these disciplines in contemporary interiors and architectural practice.

Therefore, the key is to make the instruction of graphic design principles explicit. However, curricula for accredited design programs is packed with required coursework. Adding graphic design classes to them will most likely receive very little support by students, administrators, or instructors.

## Method

An opportunity exists to integrate explicit instruction of graphic design fundamentals into existing interior design and architecture curricula in beginning studio and graphics sequences. Due to their synthetic nature, these provide the most logical locations for this introduction.

Interior design and graphic design share many fundamentals. Comparing principal texts from each discipline - Ballast's *Interior Design Reference Manual*,[10] and *Graphic Design: The New Basics*, by Lupton & Phillips[11] - one observes numerous overlaps at the design elements and principles levels.

| | **Interior Design** (Ballast) | **Graphic Design** (Lupton & Phillips) |
|---|---|---|
| **elements of design** | form (points, lines, planes & volumes)<br>scale<br>color<br>pattern | point, line and planes<br>scale<br>color<br>pattern |
| **principles of design** | rhythm, balance<br>emphasis & focus<br>proportion | rhythm, balance<br>hierarchy<br>figure/ ground |
| **related fundamentals** | light<br>contrast & variety<br>harmony & unity | space & volume<br>framing<br>layers<br>modularity<br>grid<br>diagram<br>information<br>time & motion<br>texture<br>transparency<br>rules & randomness |

*Figure 1. Shared Graphic Design and Interior Design fundamentals.*

With these similarities in mind, two instructors at different universities developed a series of lessons focused on introducing principles and practices of graphic design to beginning students.

These strategies divide loosely into four areas which specifically target graphic design in the context of interior design and architecture. A Typographic chapter focuses on understanding typefaces, their deployment and meaning. Compositional studies focus on the construction of two dimensional space. Communication emphasizes the emotive power graphic design holds for interiors and architecture. Finally, Critique specifically targets graphic design feedback.

### *Typography*

Many of the students have never fully explored the dozens of typefaces pre-loaded on their computers. A Typeface Inventory provides them the opportunity to survey their installed options as well as explore other sources. Students use Adobe InDesign to structure the typefaces similarly, enabling them to notice the nuance and quirks of type size, limitations of display fonts, and the flexibility of certain families.

Typeface Anatomies deconstruct the form and meaning of type. Using InDesign editing and compositional tools, students select a typeface from their inventory and dissect it, articulating x-heights, baselines, ascenders, and other components. Students also summarize an history of the typeface, providing insights into its origin and usage. Students begin to see these typefaces as powerful designed objects.

Typeface Flashcards explore overlapping connotations of language and typography. Drawing from a curated list, students manipulate twenty words through typeface selections, scale, color and composition to reinforce their associations. Each word is presented on one standard-sized postcard, providing insight on the ability of type to speak independently of content.

In service of their initial portfolio development, students develop a series of Typeface Drivers. Students critically review their design work and values, and express them in type. After this preliminary survey, students deploy these typefaces in a series of portfolio studies.

### *Composition*

Prior to developing their design presentations, students engage in Compositional Analyses. Drawing heavily on Rob Carter's discussion of typographic pathways,[12] students articulate the spatial zones – a content-driven organization of space more flexible and intuitive than an abstract, rigid grid - designers employ when composing information. Using InDesign drawing and editing tools, students develop a series of overlays revealing the structure inherent in well-designed compositions. Students also articulate and diagram hierarchy and movement, and note the categories of type and measure (line length). This exercise also lends itself to geometric *parti* diagramming of interior spaces, and provides an opportunity to see how different disciplines share analytical and communicative methods.

In advance of developing their design presentations, students develop Cartoons. Cartoons offer students the opportunity to inventory drawings, to establish content parameters, and to develop preliminary presentation drafts. With InDesign, students develop cartoons at full-scale where content drives organizational strategies. Often typed outlines of preliminary oral presentations, including refined concept statements, accompany the cartoons, as the two modes of communication mutually influence each other.

Cartoon critiques focus primarily on typographic, color, and compositional decisions in context of individual *partis*. Timed typically two weeks prior to deadlines, the cartoons are a chance to organize design thinking and refine the translation of the private conception to a public discussion.

*Communication*

The integration of basic graphic design as well as programs like Adobe Photoshop, Illustrator, and InDesign are critical for developing visual communication. Second-year students were asked to collect images and objects from nature to use as the basis of their designs. They began sketching abstractions focused on figure and ground to develop a two-dimensional graphic. They then extruded this into three-dimensional forms (Figure 2). The resultant three-dimensional graphic became a surface pattern implemented in the design of a hospital women's center.

*Figure 2. Two-dimensional communication translates to three dimensional space.*


*Figure 3. The two-dimensional composition reinforces experience.*

Beginning students typically take a straightforward approach to their visual communication, but there are opportunities to use graphic design in an expressive way to amplify the communication. The design and composition of the presentation board in Figure 3 attempts to immerse the viewer in an experience. The viewer is engaged and present in the space, casually sitting down for a drink at the hotel bar. This form of visual communication heightens the tangibility of the space and uses graphic elements in as an expression.

Resumes and portfolios, for example, require an understanding of hierarchy, composition, grids, and typography. This development process can be seen in the resume iterations in Figure 4. Although well versed and confident in her design abilities, the student's first attempt fell short. After much development, the student's final design achieved a professional, simplified and organized result.

Branding is useful for understanding how the nuances of a micro-culture influence the design of space. Branding plays a vital role in communicating what is unique about a particular micro-culture. Whether developing a brand or upholding an existing one, it is important for students to learn about the power and complexity of brand identity. Wally Olins notes that as society becomes increasingly globalized and homogenized, authenticity permits a connection to the specifics of culture and place. When globalization produces so many common or generic factors, articulating the identifiers - the elements that remain unique and authentic to the project - is branding's goal. [13]


*Figure 4. Focused revision keys development.*


*Figure 5. Branding provides conceptual* parti *inspiration.*

Projects that require students to explore brand identity and branded environments, either by working within an existing brand or developing their own, provide a beneficial learning experience. Neubrew was a brand developed by a student while designing a restaurant in a studio course (Figure 5). The established design parameters were dictated by the Neubrew brand and were reinforced in the design selections for the interior. As brands differentiate various entities, understanding how to design and use it as a guide for a design is invaluable.

### *Critique*

The feedback the instructors provide varies with their background. To offset this knowledge gap, instructors established relationships with local graphic design professionals and academics to serve as critics for graphic design-specific pin-ups and presentations. These sessions provided the students focused critique on two-dimensional communication and an additional opportunity to understand the lenses through which others might process their design thinking. Introductory lessons in typography and composition serve as inroads to deeper conversations in these critiques.

## Results

Because of the small size of the departments at each institution, both instructors have had the opportunity to observe specific students at the beginning and advanced levels. In each case, significant improvement was observed across the student body.

As might be expected, students arriving to each program with developed visual communication skills continued to exhibit improvement and increased sophistication in these explorations (Figure 7).

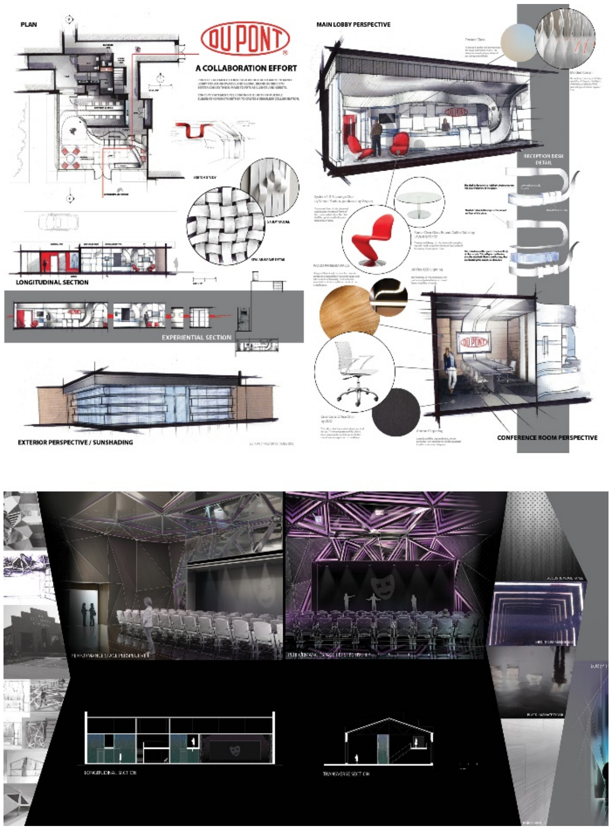



*Figure 6. 200 level layout (top) and 400 level presentation detail from students with graphic training illustrates continued refinement.*

Examining the work of students arriving without prior formal training in art or design also indicated radical improvement. The MFA at VCU, like many "three-plus" M. Arch degrees, welcomes graduates without backgrounds in design. Prior to their first fall semester, these students participate in a preliminary four-week workshop. Capping this session, students produce a portfolio of their work based on a rudimentary template. These portfolios represent the first attempt at organizing work graphically for many of the students. By the end of their second year, they complete a design thesis, complete with a comprehensive book exempt from many of the prescribed academic formatting common to theses in non-design disciplines (Figure 8).

Comparing early portfolio efforts from the workshop to the thesis books, one observes significant leaps in sophistication and conception. In addition to rigorous typeface and organizational structure, students also independently explored communicating information graphically through iconographic diagrams and details.

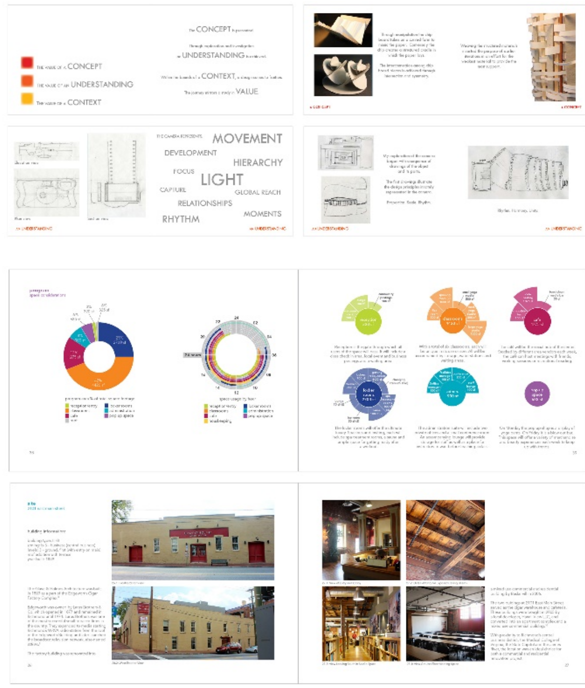



*Figure 7. Introductory MFA portfolio (top spreads) versus thesis book (bottom two spreads) provide a truer baseline for growth in graphic design.*

## Reflections

Instructors were able to introduce graphic design fundamentals into studio and graphics coursework without sacrificing other required content. This integration was facilitated primarily through a shift of instructional focus from an implicit hope for integration to the explicit instruction, critique and expectation of synthesis. Key texts and the regular invitation of professional and academic graphic designers to critiques provided the faculty an automatic series of seminars upon which they could build for the next round of instruction.

Student confidence with graphic communication increased across numerous classes, particularly those with journal-based project assignments. Portfolio development accelerated at upper-levels and jump-started post-graduation employment searches.

In studio, students began to organically integrate graphic design into project *partis*. Students armed with these graphic design fundamentals made more deliberate choices about type and composition throughout the design process. Frequent pin-ups and discussions became natural parts of the studio rhythm, and students engaged in peer-to-peer critiques of graphic design, facilitating instruction and conserving the hours for students and faculty alike in the run-up to the final presentation push.

Additionally, students explored professional paths that bridged both disciplines, like environmental graphics, web design, branding, and exhibit design.

## Notes

[1] Budd, Christopher. "Valuing the Intuitive: Reintroducing Design Into Interior Design Education" in *Journal of Interior Design*. 2011. p. 36(3), v–xi.

[2] Ballast, D.K. *Interior Design Reference Manual: Everything You Need to Know to Pass the NCIDQ Exam*. Professional Publications, Inc. 2010.

[3] Lupton, E. & J. C. Phillips. *Graphic Design: The New Basics*. Princeton Architectural Press. 2008.

[4] Carter, Rob "Creating Typographic Pathways," *Step-by- Step Graphics Designer's Guide*. 1990, pp. 172-176.

[5] Perkins + Will. "Eva Maddox and Eileen Jones on Creativity [Video file]". Retrieved from http://vimeo.com/37277189. 2012.

[6] Adams, S. "The Historical Survey of AIGA [Video file]." Retrieved from http://www.aiga.org/video-pivot-2011-adams/. 2011

[7] Tibbitts , Susie & Ventura, Roberto. "Graphic Materiality: Graphic Design as Building Element," in *Proceedings: 30th National Conference on the Beginning Design Student*. Chicago, Illinois. Ed. Kathleen Nagle. Chicago: Adams Press, 2014.

[8] Budd.

[9] Boyer, Ernest & Lee Mitgang. *Building Community: A New Future for Architecture Education and Practice*. Publisher: Jossey-Bass Inc Pub (June 1996)

[10] Ballast.

[11] Lupton, E. & J. C. Phillips.

[12] Carter, Rob.

[13] Olins, Wally. *Brand new: The shape of brands to come*. Thames & Hudson, London. 2014.

# PUSH:PULL: a process for making products in beginning design

Elpitha Tsoutsounakis | University of Utah

## Introduction

This paper will discuss a particular project for beginning product design students taught in DES 3600 in the Multi-disciplinary Design (MDD) program at the University of Utah. This project has been designed to introduce students to an iterative design process, while also teaching basic design principles and methods. Prior to the project discussed here, the students complete various abstract design problems to get them started in making and iterating their ideas. The studio quickly moves into designing a product from briefs created and developed by the students from their own design research. This approach has several advantages in learning outcomes including the opportunity to teach students the entire design process, from conception and project framing, to the end, including product evaluation and reflection on their work. The product itself is simple enough and handcrafted so that students have a direct 1:1 connection to the artifact they are designing both in terms of scale and manufacturing.

The MDD program awards students a Bachelor of Science in Design. About half of the degree requirements are University generals and design pre-requisites that students complete prior to entrance into the design program. Once they complete the prerequisites, including two design studios, students then apply to the program with a portfolio. Upon acceptance they complete two more years of school, completing the design sequence with 4 design studios in major. The two 'pre-major' studios are thought of as the beginning of the design sequence although students have technically not yet been admitted. These studios also comprise the core of the Design Minor, open to any undergraduate student at the University. The result is a beginning design course that includes both students who intend to major in design and students who are complimenting another degree – often unrelated to design – with a design minor.

### *Context in Design Pedagogy*

A critical value in regards to the design process is that students should be taught – and allowed to develop – the ability to create the design brief, rather than design solutions to pre-determined problems. It is often acknowledged that a properly framed problem is critical for good design outcomes. Albert Einstein has been referenced many times for his assertion "The formulation of a problem is often more essential than its solution." [1] This framing ability is an important learning outcome for students to take into the profession. The best way for students to develop and hone this ability is to give them as much opportunity as possible to do so, therefor each studio in the design studio sequence requires the student to develop their own creative brief. In this beginning studio the task is simple and the parameters are constrained to keep the project within the scope of the beginning design student. As the students progress through the curriculum the complexity increases, and the final studio prompts the students to complete a thesis project in which the entire brief, from topic to parameters, is at the student's discretion. In this approach, students have an explicit understanding of 1:1 relationship between problem and solution, they are not expected to just take the problem as directed.

Iteration is a widely promoted concept in design education, but it is often difficult to impress upon beginning design students just how much iteration we really mean by 'enough process'. Frank Chimero neatly summarizes the activity of iteration here: "Iteration is the key characteristic of any workflow or process that has a tight and open feedback loop. Ideas are tried, experiences are gained, things are learned, refinements are implemented. Iteration requires two distinct skills that work in collaboration with one another. First, the curating skill, which is able to realize and harness seeds of potential in ideas that are incomplete. This skill allows the feedback loop to push the work in completely new directions. The second is the proofing skill, which can earmark weak points that need improving. (Think red pens like heat-seeking missiles.) This is polish and refinement." [2]

Iteration is an essential tool for students to be able to systematically assess what they create and then correct or refine at each step of the process. It also allows them to develop responses to isolated parameters in a controlled way and then test how these solutions to each parameter can be combined. Early on the students are required to sketch and develop hundreds of solution concepts for their design brief. Once they start to narrow down to one solution, the cycle of prototyping and assessment makes the iterative process more explicit in that students have tangible objectives they are trying to meet with each prototype and real users are giving direct feedback about effectiveness. The parameters of user needs, materiality and making, and aesthetic form are all emphasized throughout the project.

It is critical to have an heuristic approach to design education so that students learn through making even if they go on to design less tangible, invisible products – i.e. interaction and experience design.  In order to truly understand design thinking, one must participate in a design process of some kind, even at a very basic level. This understanding can not be developed from reading about or being told a method or formula. It is further difficult for students to design a product that will be manufactured by industrial means because there is a disconnect between making in design process and the actual manufacture of the design. To reduce this additional difficulty, this project requires that students pursue craft methods and materials that allow them to make a final, complete product. In doing so, they can merge the functional prototype and the aesthetic prototype in a product that is ready for the end user. The students are not making artificial models of their designs, they are creating and finishing market ready products, which they briefed themselves – in their first design studio.

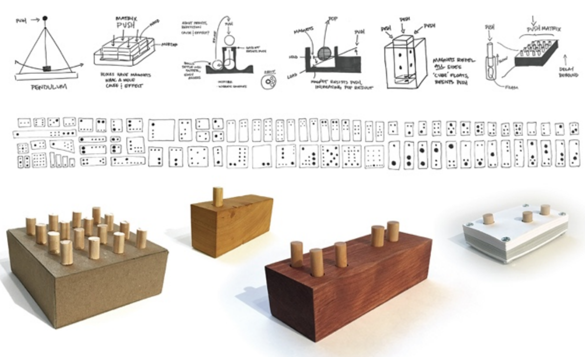
## Project Description

### *Intent & Objectives*

The intent of this project is to introduce the students to a particular process for designing products with the end user in mind – a human centered design process. The objective is to lay a foundation and set a disciplined work habit that can be developed throughout the following studios in the design sequence. The project is conducted in a studio that meets twice a week for 3 hours. The entire project is approximately 10 weeks. Students should begin to develop strategies for the following learning objectives:

1. Observe a particular topic or situation to develop insight and articulate what the problem is.
2. Create a design brief that identifies and describes the design challenge, including the user, parameters, values and context.
3. Sketch and ideate multiple solutions that can be iterated and filtered towards a final solution.
4. Use prototypes to test ideas and develop a final solution.
5. Practice making and craft.
6. Execute an elegant solution with regards to aesthetic consideration and formal design principles.
7. Consider ethical implications of their work in regards to social and environmental impact.

### *Process*



*Initial ideation and prototypes for a push toy by Ray Phillips.*

The students are led through a particular design process for accomplishing the task of designing an artifact that facilitates play – essentially a toy. The project is organized in 5 phases: Observation and Research, Ideation, Prototyping, Implementation, and Evaluation.

1. Observation and Research Phase: Students are randomly assigned one of four actions, Push, Pull, Stack or Nest. They are required to think about how this objective in motion relates to play of any context for a variety of users. They are prompted to observe and understand the action in terms of the human body, developmental milestones, properties of physics, etc. The intent is to cast a broad net to widen the opportunities for design. In combination with this observational research, they must

find precedents for products that combine play with the assigned action. For example, what are all the play products for either stacking, pushing, pulling, or nesting?

Their findings are discussed in studio and the students identify opportunities and insights that are most interesting to them. They are then assigned to write a design brief that addresses a particular problem statement developed from their individual insights for a particular user. Students are encouraged to focus on younger children, but some have chosen adults, seniors or even animals as their user. For example: a student assigned 'push', may choose to focus on a user from ages 1-3 years old to design an object that facilitates play. From their research they may have also observed that their particular user has an affinity for animals and hence the project will some how incorporate this. Or they may find that typical push toys for 1-3 year olds on the market have a particular limitation or are missing an opportunity and they will design to address this. The design brief must include a problem statement, a user, values, and particular parameters addressing materials, cost, and manufacturing. The entire observation phase and design brief are conducted quickly, allowing only 1 week.

*PUSHING* *PROBLEM PARAMETERS*

PROBLEM
IN GENERAL, ADULTS USE THE PUSH ACTION TO ACCOMPLISH WORK: PUSHING KEYS ON A KEYBOARD, BUTTONS IN AN ELEVATOR, LAWNMOWERS, SHOPPING CARTS, MOVING HEAVY OBJECTS, ETC. PUSHING IS RARELY PLAYFUL FOR ADULTS.

OBJECTIVE
BUILD A PUSH TOY THAT ADULTS CAN USE TO RE-EXPERIENCE PUSHING.

PURPOSE
CAUSE & EFFECT.
PUSHING RESULTS IN AN AMUSING CHANGE IN STATE, LOCATION, OR FUNCTION.

METHOD
THE PUSH SHOULD BE EASILY ACTIVATED AND ACHIEVED.

EFFECT
MULTI-SENSORY. NOTICEABLE PRESSURE AND NOISE.

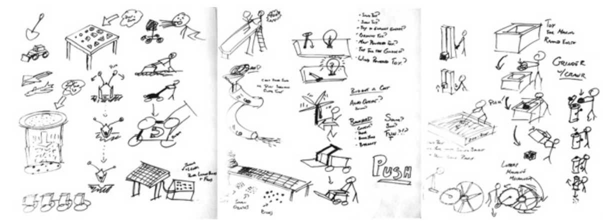
MOTIVATION
OBSERVE THE EFFECT OF PUSHING.
SECONDARY IS THE TACTILE FEEL OF THE PUSH:
FINE (SURFACE TEXTURE) AND GROSS (THE FORCE TO MAKE THE PUSH).

SCALE
SIT-ON-DESK SIZE. THE PUSH MECHANISM IS SMALL ENOUGH TO BE OPERATED BY FINGERS.
THE OBJECT ITSELF IS SUBSTANTIAL ENOUGH TO REQUIRE MORE FORCE THAN THE PUSH TO MOVE IT.

MATERIALS
CEMENT, PLASTER, WOOD, FABRIC, PLEXIGLASS, MAGNETS, SPRINGS.
THE MATERIALS SHOULD HAVE NOTICEABLE TEXTURE AND THEHEFT SHOULD BE SUBSTANTIAL AT THE GROSS LEVEL. IN THIS MANOR, THEY SUPPORT THE SECONDARY MOTIVATION.

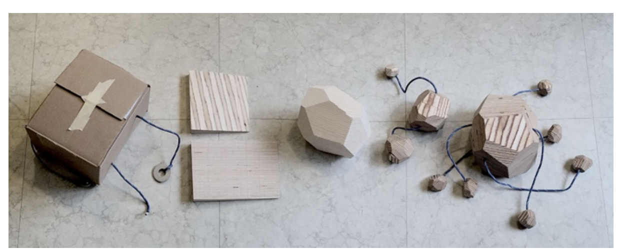
*Design brief for a push toy by Ray Phillips.*

2. Ideation: Once their brief is approved the students are required to sketch 100 possible solutions to the brief in just one studio period. They are encouraged to work quickly and suspend judgment of any one possible solution. "At IDEO, the goal isn't the perfect idea, it's lots of ideas, collaboration, and openness to the wild solutions." [3] The intent is quantity of ideas over practicality or feasibility. The students then use the parameters outlined in the brief to filter these solutions down to fewer ideas for development. The students may identify one particular trajectory or they may develop initial quick prototypes to test multiple opportunities. The work is constantly discussed in studio critiques and one advantage is that of the 20 students, no two projects are alike, so they have the opportunity to learn from a wide variety of projects.



*Initial ideation sketches for a push toy by Browne Sebright.*

3. Prototyping: This phase of the project is very simple in objective over several weeks: make and re-make the prototype to improve the product. The students are encouraged to test their prototypes with the end user and sometimes break down the parameters into discrete parts for iterative development. Students have access to the College fabrication shop and are encouraged to experiment with methods and materials. Prototypes are initially very rough, starting with cardboard or foam and systematically become more and more substantial in material and craft. Each studio period the students report their progress and next challenges to the class and the entire studio gives feedback and critique.



*Left to right: Prototypes and finished pull toy by Darin Winegar.*

*Users test initial cardboard prototypes. Project by Browne Sebright.*

4. Implementation: The final two weeks of the semester are for the final implementation of the design. At this point the students have tested the design, developed details, refined aesthetics and materials and just need to execute one final iteration of the product. The emphasis is on finish and craft of the final product. The students present the entire process at a final review, emphasizing that the process is just as critical as the final product. Guests, ranging from professional designers to other MDD faculty, are invited to discuss and critique the work.

*Prototypes and final for a pull toy by Cami Moody.*

5. Evaluation: After the review, students are required to test the final product with at least 5 users and create a report of what they learn from this experience. In the current iteration of the studio, the students are required to design and produce simple process books reflecting on their design process from the beginning through the final review and evaluation of the end product.

*End user testing the final product. Project by Browne Sebright.*

## Outcomes

Students often have the impulse to just decide what the final solution will be – they pre-suppose the final solution. This tendency is resisted in this project by first thinking about a particular action with a particular objective, i.e. stacking for the purpose of play.  It has not yet been determined that the student is "designing a set of blocks". This allows more creative freedom and potential for unknown solutions and innovation, if the students sincerely pursue enough exploration through iteration.

The process books at the end are an important step in reflection, it is only in the end that the students can truly look back and see how remarkable the transformation of their own idea really is. In the process books they can then understand and communicate the fact that the design solution is developed through iterative process.

It is important to demonstrate to students how to juggle multiple parameters in the design process. By requiring them to articulate their own parameters they are more invested in meeting these rules. They learn to assess and refine their prototypes by sometimes separating aesthetic issues from function or material and then bringing everything back together.

Testing and assessment by the end user is also critical. Students immediately recognize the value of the user perspective and it often illustrates how close beginning designers can get to their own work, taking their assumptions for fact. Students begin to rely on prototype testing as a powerful tool for refining their work.

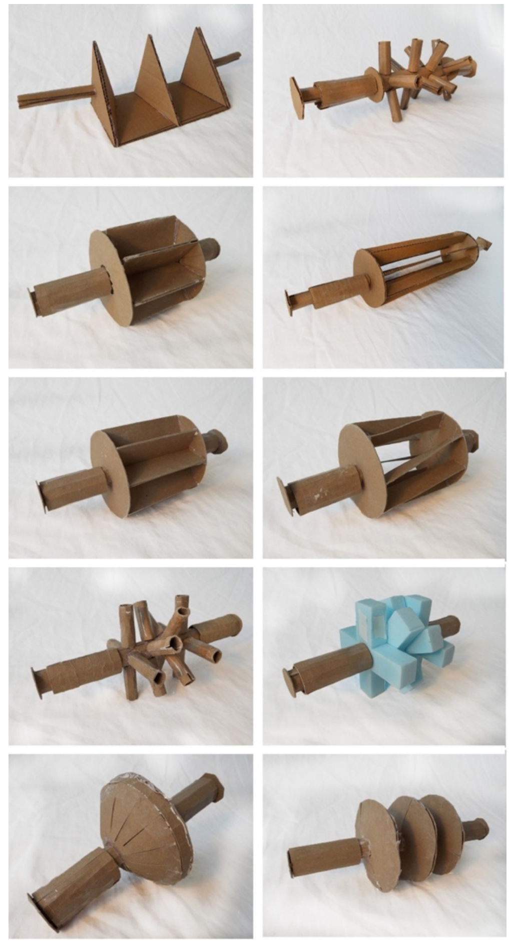
*Success / Failure*

By keeping the project simple and methodical, students have considerable success in what they create. Some students end up creating very innovative toys, others are able to refine and execute a classic toy with some new aspect to their approach. The students are often impressed with what they are able to accomplish and thus their confidence in the design process is bolstered. Others may fail miserably with the final product, but often these students learn the most from the process and are still successful in the class. Students are often promised that the studio is a safe place to take risk, but then there is no support when their risk might fail. The project grade is weighted heavily - 40% - on process and only 20% on the final solution to impress upon students that it is indeed the process that matters most.

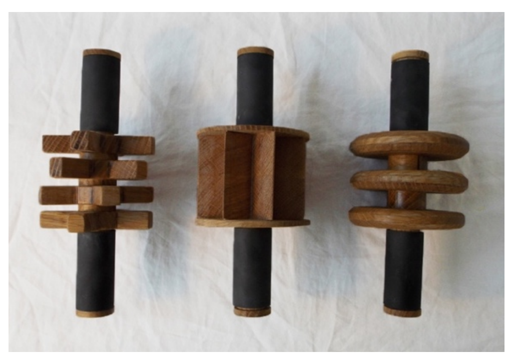
*Challenges*

Some challenges in this project are a result of the number of students and finding the right balance for how controlled or open their options are. There have been several obstacles in the 3 generations of this project. The first deals with simple enrollment statistics. The MDD program is growing in popularity and in order to get enough pre-major students eligible for application, the pre-major course enrollment is critical. The Fall 2015 semester offered two sections of the studio with 25 students each. This is simply too many students in a beginning design studio for one instructor, especially since each project is a unique problem statement. The ideal number is 15-18 students in each section.

Second, in the first two studios there were simply fewer students and hence, less deviation from original intent in how the students pursued the project. The first studios resulted in projects in which all students matched up users and parameters that were appropriate for their project and experience level. In the final version of the studio, some students focused on users in combination with problem objectives that were much more diverse, some resulting in projects that were simply too complex for a beginning studio or first design project. Some students heeded warnings that maybe they were getting into more than they could handle, but ultimately they must make the decision. While there is some hesitation to restrict the project too much, in the current version the user will be constrained to a particular age range.



*Cardboard prototypes by Browne Sebright.*



*Final push toys by Browne Sebright.*

## Conclusion

By allowing and encouraging students to begin earlier in the design process – with observation and research that leads to framing the problem – they are equipped with additional tools to inform the relationship between what they are making and why they are making it. There is a direct relationship in this process between the problem and the solution. This is complemented by a human centered approach that emphasizes iteration through prototyping, allowing students to test their solutions in an explicit way with the user. These objectives are illustrated though a project that is simple and broad enough to allow for a variety of responses and range of users, while still keeping with in the scope of curricular objectives for the beginning design studio.  While the tendency may be to look to new technology or tools to connect to the process of making, reframing where the process begins and ends can also provide new opportunities for design education.

## Notes

1. Einstein and L. Infeld, *The Evolution of Physics*, Simon and Schuster, New York, 1938, pp. 92.

2. Chimero, Frank (2010, January, 10) *On Iteration* (weblog post). Retrieved from FrankChimero.com

3. IDEO, *The Field Guild to Human Centered Design*, IDEO, Canada, 2015, pp. 95

# Make Your Method

Lance Walters | University of Hawaii Manoa

## Introduction

One of the greatest challenges of engaging design students with advanced tools is teaching them how to use the equipment while remaining flexible and creative with it. Knowing how to operate a tool is radically different than knowing how it works. In order to promote broad exploration and to remain in command of the design process understanding how something works is even more crucial than understanding how to operate it- whether the goal is design inquiry or design production, the importance of the underlying mechanics and associated mechanisms of our design tools should not be underestimated.

The vast majority of technology and fabrication courses focus on making (output), simultaneously de-emphasizing the mechanics (movements and electronics) of design instruments they employ. By stressing the user interface (UI) as a way to explore a given tool more attention is paid to the interface implications and less attention is paid to those imposed by its mechanical design. This often means that the interface itself, rather than the mechanical design, is what is used to explore and overcome the limitations.

The acknowledgement of these ideas led to the creation of an undergraduate architecture course in which students were asked to think about the design of their design tools. It provided an introduction to the mechanics and systems of the equipment that architects and designers engage with on a routine basis.

This paper tracks the pedagogical goals of this technology course. The two projects of which it is comprised are discussed as a means of instilling a deeper connection with the instruments of design. The final products represent a connection between the designer and design tool. The projects provide an exploration of the composition and construction of the tools themselves, rather than provide an explicit engagement of their output or use. In describing the sequence of projects and lessons the underlying mechanics will be addressed as a means of maintaining design creativity.

## Toys

Derived from the observations noted above, the thesis of this course and subject was reinforced by writings on digital design, fabrication, creativity and culture. A broad survey of recent writing and projects on design fabrication, much of which stands on the production end (with formal/geometric objects or other program-limited creations), was used to begin a dialog with students about the current state of technology related work and theory in architecture. At the same time, some less recent theoretical essays were used to interject ideas about nature of the equipment that makes up the technology itself. Of primary importance was reading and discussion of essays from Roland Barthes' *Mythologies*, which served as an introduction to the logic of the course.

The ability to think, imagine and design using mechanical tools is restricted by how we see them. The inadvertent acceptance of fixed tools over playful objects restricts the design environment and limits one's ability to be creative. In *Toys*[2] Barthes writes about a similar phenomenon, suggesting that representative, literal toys (such as dolls) repress and stifle creativity. He goes on to suggest that children playing with toys that do not describe culture so directly frees them- the toys become open objects and creativity takes over. Free toys (such as blocks) are objects which encourage individual exploration. Creating and making with these "free" objects may be literal *or* conceptual, stimulating invention and imagination in what is produced.

This course operated on the premise that Barthes' notion of children and toys is analogous to designers and fabrication tools. Toys and design equipment are tools for play and creation, especially in an educational. An understanding of our equipment as a collection of parts can turn it from a doll to an object (free toy). This idea, coupled with the need to incorporate modern technology into design education served as the guiding methodology for the lessons and projects.

## MYM

Make Your Method was first conducted as an undergrad elective for seniors. Because electives earlier in the curriculum are generally skill building or design investigations students entering MYM had a mixed but reasonably firm grasp of the operation of several digital fabrication tools. Nearly all were well versed in how to use the most common including laser cutters, CNC routers and to a lesser extent, 3D printers. -

At the same time they had very limited knowledge of the underlying mechanics of this equipment and the need to stress the intent of the course to the students was apparent from day one. Students needed to know that this course is not about making anything with digital equipment, nor would they be building highly functional fabrication machines. Also, because of their unfamiliarity with much of the material (mechanics, electronics) it was also important to reiterate that the course was introductory and that prior topical knowledge is not necessary.

The sequence for MYM was based around two projects. The first was heavily focused on process and invention with the goal of demonstrating a design idea through a machine, while the second was a more straight forward design project that built upon the technical lessons of the first . Project development in the form of desk crits and presentations were supplemented by independent and wide ranging lessons including programming, electronics, motors and mechanical operations.

## Project One: Manifest Form Machine

“The manifest form – that which appears – is the result of a computational interaction between internal rules and external (morphogenetic) pressures that, themselves, originate in other adjacent forms (ecology). The (pre-concrete) internal rules comprise, in their activity, an embedded form, what is today clearly understood and described by the term algorithm.”

-Sanford Kwinter (Who’s Afraid of Formalism?)

The first project, the “Manifest Form Machine”, began with the design of a static catenary curve system. The students were asked to create a rigid, 2 cubic foot box frame from wood. Pins were positioned evenly on the top perimeter. Chains of paperclips were hung from the pins, such that they hung down into the volume of the box frame, naturally forming catenary curve[3]. The idea of design control within the rules of this system were discussed as the students developed their structures. Multiple iterations are easily explored as the contact point of the paperclips (on the pins) can easily be adjusted. Using this construction method form and space can be created in a structurally sound way, but limitations on that form and space are also imbedded in the logic of it.

In this manner students learned about historical structures designed using similar methods, as well as explored designs of their own. These designs were derived from an assignment which required that the hanging chains had to avoid contact with predetermined points within the volume. As students became knowledgeable about the possibilities of this hanging system they were asked to lock the paper clips in place by soldering the connection points. Once all points were soldered the creations could be removed from the box frame and placed ‘upright’.

*Dynamics*

The next step was to showcase design iterations. Students were required to demonstrate multiple configurations in a sequence of adjustments that avoided the fixed, invisible points within the volume. The primary means to do this was to move the points of contact along opposite perimeters of the box frame from one point to the next. Basically, the ground contact points on each side of the box frame had to move while the catenary chains hanging within the volume had to avoid the predetermined fixed points. This simple restraint promoted control and intention within their designs.

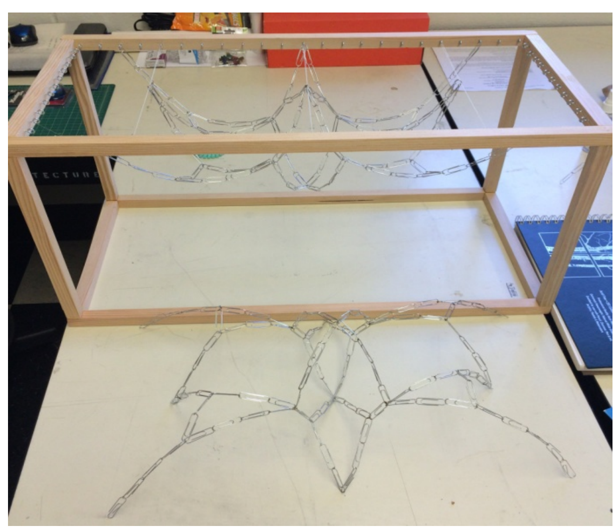


*Fig. 1 Catenary Curve exploration with paper clips.*

*Electronics*

The final phase of Project One was the automation and mechanization of the iterations, creating a dynamic system. In order to do so, students were introduced to Arduino microcontrollers and servos. These simple and cheap computers are easily programmable by a novice, and the power and motion of servos make incorporation into the projects very manageable. Students already knew how their ground points needed to move from the previous step so mechanical movements that could achieve that were studied, tested and constructed. Variations of oscillating rockers were used for side to side motion and simply geared reels used for moving points in the z-axis.

Throughout this project students were reminded that they were here to explore, create and then demonstrate. Developing a machine that automated their earlier studies of form and space kept their catenary work in the early stages of design. They were encouraged to make new catenary design changes using the mechanical movements only after they understood how the rules of both worked.

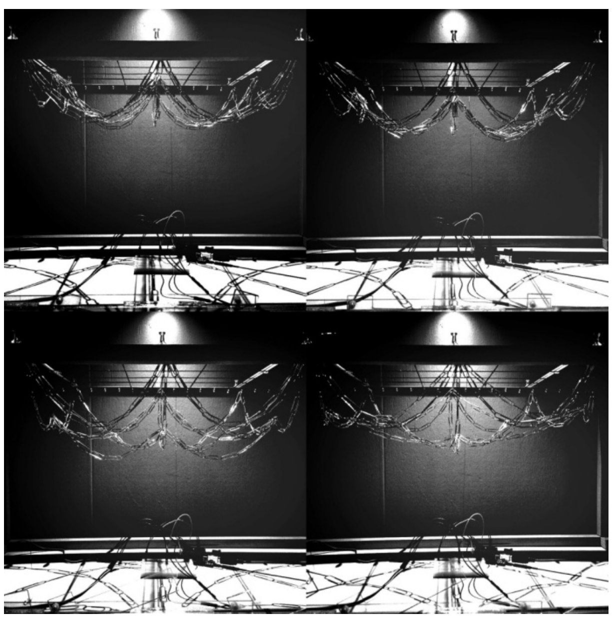


*Fig.2 The Manifest Form Machine positions and shadow study. Student: Diane Moore*

## Project Two: The Multi-Axis Machine

The principles of the most common fabrication tools are all the same; a perpendicular, multi-axis CNC machine is at the heart of nearly all digital tools from 3d printers to laser cutters. At a very diagrammatic level how one works is how they all work, only the implement changes. Because of this mechanical similarity an exploration of basic CNC operation provides a connection to a wide ranging set of tools.

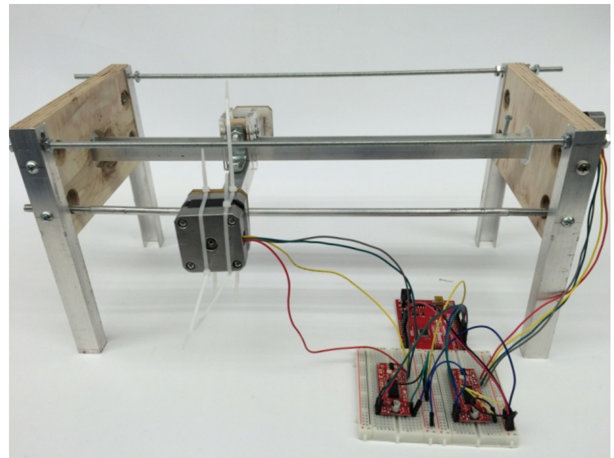


*Fig. 2 Two-axis CNC Machine. Students: Kristen Young, Lindy Hsieh*

In the second project students were required to design and construct an original, fully operable two-axis CNC machine. Discussion with the students again related to design control and intent, this time primarily directed at the physical implications of movement and computer control. The suitability of a CNC machine to maneuver a particular implement is determined by how it handles various forces- a laser cutter or router typically moves the relatively light laser mirror over a stationary bed on a wide gantry, while a 3d printer will often move the bed itself around the heavy printing head. In this way, students were asked to anticipate and manage forces and friction that arose from the way they designed their CNC machines.

This project was not developed in phases the way the first one was- the entire project was revealed from the start and students had to sketch out their own design process, testing various ways of controlling motion through motor, mechanics and structure. Movement was important, as was rigidity, component tolerance and power. Another important aspect of this project was that the machines themselves were not designed for a particular implement; although students were asked to envision possibilities for their machine later on they were restricted from building it in order to help them concentrate on the machine itself.

*Motors*

At this point the students were introduced additional two additional types of motors. Discussing the operation of three basic types of motors (servo, stepper and continuous) provided an opportunity to study a wider variety of mechanical movements and discuss the design considerations of each. Steppers work in increments, servos have knowledge of their position relative to their origin, and continuous motors allow smooth control over speed but not their revolutions or position. Any of them may be used to control movement along an axis, however each comes with unique implications on the utility and operation of the final machine- more than the interface, these are the mechanics that will determine what it can and cannot do.

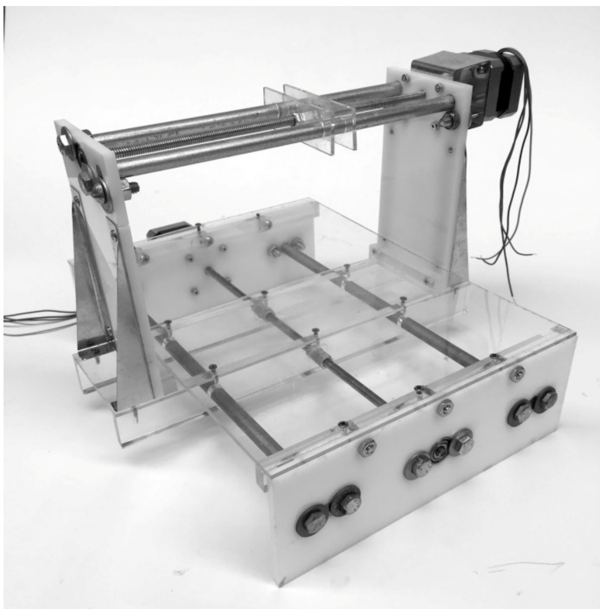


*Fig. 2 Two-axis cnc Machine Students: Danalli Ignacio, Carah Kadota*

*Parts*

While resourcefulness was encouraged, this project also opened students up to a huge range of parts and components of which they were previously unfamiliar. Understanding how things slide, move and roll- understanding the friction and forces that are introduced into a machine are fundamentally important to design logic and transferable to design at all scales. The students developed a deeper conceptual understanding of the implications of forces as well as the knowledge that the solutions to many of the challenge imposed by these forces already exist and are readily available.

## Conclusion

The machines designers are engaging with are not unique or even highly complex. Most of them (CNC routers, printers, etc) have been around since the computer was first invented, with non-electronic versions existing long before as NC machines. And while students and architects are increasingly encouraged to incorporate this equipment into the architectural design process it is more  important than ever that they have an opportunity to step back and consider how it works. The availability of cheap parts and open source systems make exploration of this equipment itself well within the grasp of any young design student, possibly opening their eyes to new creative ways of using it.

Students are typically taught how to operate or produce with a tool, but rarely are they encouraged to engage with the mechanics behind the instruments they will ultimately be expected to work with. Throughout this course students gained valuable mechanical skills and the machines they made changed how they view their own ability to more deeply engage with “advanced” design fabrication equipment. The methodology of the course was designed to help students understand how much the tools they work with can dictate the direction of their design investigations. The intent of this course was to stress the accessibility and possibility of determining what you work with, and how those things shape how you work. The impact of the design of our design tools should not be underestimated- creativity and control come from a deep understanding of all components in the design process.

Notes:

[1] (Barthes, *Mythologies,* 1986)

[2] The basis for this method for catenary structure development has a long history, perhaps most famously with Antoni Gaudi.

# Dashed Hopes: Lessons in the Failure of Best Intentions

Greg Watson | Louisiana State University

## Abstract

This paper presents work that explores important lessons found in the failure of intentions based on naïve expectations. These lessons develop in the spaces between conception, translation, and construction - between designing things and making things. The process presented involves first-year students who are generally unfamiliar with the specifics of structural and material behavior. They are given a familiar object to design: a small, tall, table, intended to act as a podium for a large, abstract, design project. They know just enough about the techniques of manual drafting to make a scaled drawing of their designs, based upon rigorous design sketches. They are given very specific dimensions and are asked to construct their designs, as drawn, using common materials. The results of these physical translations quickly reveal the gaps between their best intentions and the indifference of material reality to their expectations of perfection and integrity. At best, they are extraordinarily disappointing. Following this trial, time is given to graphically document, analyze, and reflect on the modes of failure and the difficulties associated with the un-predicted resistance of material to the designers' intentions. Next, collections of material shards and fragments are assembled that will be used to amend the construction and the design in ways that vividly reveal and correct the brightest points of failure within the work. The juxtapositions created between the prosthetics and the designers' hopes reveal new and larger opportunities within the work that exist far beyond what was originally conceived. Beauty and utility are found in the flawed and made vivid by failure.

## Introduction

"It is as certain as it is strange that truth and error come from one and the same source; for that reason one must often not do something to the detriment of error since one would do also something detrimental to truth." (1)

The title's sad description of the disappointments that attend much of the work of beginning design students, if left to their own devices, belies the essential lessons learned through failure. The lessons are, of course, well known but often left unexplored or, at worst, actively avoided. This paper examines the value, if not the necessity, of structuring beginning design projects to precipitate particular types of edifying failure. Of all the ways to learn these lessons, 1:1 work is perfectly suited for producing vivid, instructive, and transformative failure.

"The workmanship of risk has no exclusive prerogative of quality. What it has exclusively is an immensely various range of qualities, without which at its command the art of design becomes arid and impoverished." (2)

The work presented to support this position takes place in the context of a 30-week foundation studio curriculum. The structure and pace of the work is designed to take advantage of the vivid 'cognitive cliff' that confronts most first-year students. The cognitive and visual reflexes and habits that accrue over 12 years of primary and secondary education create the 'cliff.' These are habits of thinking and seeing that are reinforced by teaching and learning paradigms that place high value on producing reliable respondents, while discouraging petitioners. It is a way of knowing things that overvalues the power of description and transcription and undervalues, or heaps with scorn, ways of learning, understanding, and knowing based on instinct, intuition, conjecture, experience, and wonderment. The resulting cognitive and visual skills are maladaptive in the context of design education. This works seeks to exploit the tension between that skill-set and those needed to construct an inquiry through the design of probative questions, the development of experimental methodologies of representation, and iterative and recursive practice.

"In training...activity of thought, above all things we must beware of what I will call "inert ideas" - that is to say, ideas that are merely received into the mind without being utilized, or tested, or thrown into fresh combinations." [3]

These shifts in intent and process create a useful disorientation during which the habits of thought and the learning strategies used in their previous existence are revealed to be counterproductive. Like Lorenz's imprinting ducklings, the failure of expectations and habit, and the ensuing anxiety and uncertainty, create a brief moment of receptivity, a window of opportunity through which it becomes possible to introduce new ways of learning and constructing knowledge.

"What really exists is not things made but things in the making ... put yourself in the making by a stroke of intuitive sympathy with the thing and the whole range of possible decompositions coming at once into your possession, you are no longer troubled with the question which of them is the more absolutely true. " [4]

The most persistent, axiomatic, cognitive habit is one that assumes deliberate thought must precede action - a specific goal must be fully described before any investment in work. The reversal of this order does not only not exist as an option, but when suggested, is vigorously resisted. This militancy appears related to notions of learning efficiency and a common confusion between the meanings of error and failure. They are understood as synonymous, and so equally feared. To avoid this, all work is first conceptually problematized and 'solved,' much like a tricky word puzzle, before any time or material is inevitably wasted exploring multiple, useless failures. The effect of this habit is to treat all physical work as transcriptive, a picture or a construction of something that has been 'thought out' and where its success and value are determined by its concordance with carefully constructed expectations. It is a process that has a chilly efficiency suggesting that the work itself is an inert mechanical action that has nothing to teach.

"We may sometimes be persuaded to believe by reason, but within the welter of our experience reason is limited and weak. We believe always by coming, in some sense, to see." [5]

Bringing awareness to these habits and coming to see them as an important part of learning how to advance the work is a painful and halting process. The "Good Intentions," the students' desire to get the right answer, to produce beautiful 'correct' things that match their guesses about what is wanted, are critical to making these difficult lessons survivable. But they have to be maintained and protected from the frustrations that can overwhelm this process. The latency for these skills is long and it requires tremendous patience and a willingness to work in doubt.

## The Project

"The amateur is essentially a man with appreciation and with immense versatility in mastering a given routine. But he lacks the foresight that comes from special knowledge. The object...(is) to produce the expert without loss of the essential virtues of the amateur. The machinery of our secondary education is rigid where it should be yielding, and lax where it should be rigid." [6]

As with most of the projects in the foundation year, this one starts with the desire to reveal the static state of the students' understanding and knowledge of the subjects, the extent of their "special knowledge." The work also intends to provide opportunities to express the cognitive and visual habits common to novice design students, the 'essential virtues' of Whitehead's amateur. In general these habits and reflexes include strong stereotypic tendencies toward static visual balance, scalar and interval consistencies and a preference for thinking over looking.

The exercise is embedded in a larger project involving the translation of abstract, two-dimensional graphics into a series of large-scale, three-dimensional, topographic constructions. The students are asked to design and construct a 'podium' that will act as a base for these landscapes. They are given a simple material inventory including specifications for a plywood top and 2"x2" common pine furring lumber for legs and bracing, and standard height, width, and depth dimensions which they had to carefully match. They were also encouraged to experiment with joinery in ways that would make unnecessary, or at least drastically limit, the use of mechanical fasteners. Prior to getting the materials they were asked to use these specifications to produce a set of construction drawings that included a scaled plan, section and elevation drawings along with details of what they viewed as critical connections. Once the drawings were completed, they prepared the materials and began the process of construction. In a parallel assignment, the students were sent to a local salvage yard to collect fragments of machinery and other miscellaneous formed metal parts. They were told this material would be used in a subsequent assignment.

The relative flawlessness of the design drawings is immediately humiliated by the imperfections, dimensional distortions, and overall 'imperfect' quality of the materials and their low skill level in basic woodworking. The plans for connections, the desire for stability, for plumb and level surfaces, along with the designers' aesthetic ambitions, quickly fail or reveal both vivid and subtle weaknesses.

The results of this first trial are assembled and collectively reviewed. One striking, encouraging result of this exhibit is the amazing range of the responses to the challenge of designing a simple and familiar thing. While the hunt for novelty, a highly valued commodity in first-year studios, is restricted by the resistance of the materials, the dimensional constraints, and the relative skill levels of the students, there was strong evidence of a desire to challenge the conventions, material, form, and structure of the object within these limits. A very strong set of the very best of intentions.

*Fig. 1 , 2, & 3 Details of first trial podium constructions*

## Corpus Delicti

Following this review, the students were asked to photographically document and create an annotated inventory of the brightest points of failure within the work. The annotations included explanations of the modes of failure in the design and assembly, along with recommendations for possible corrective actions.

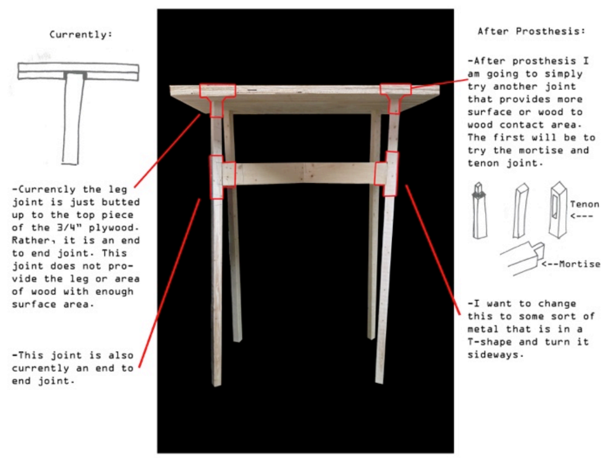
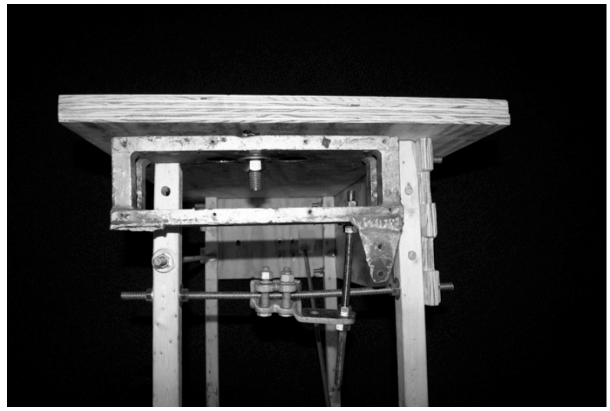



*Fig. 4 Example of failure studies and recommended corrections*

With the results of this analysis, the students were asked to design a prosthetic using the previously collected shards and fragments of machinery and formed metal, which would replace the most critically flawed sections of the work. The idea of prosthesis was introduced not just as something that replaces a malfunctioning or missing piece of anatomy in an analogically functional or cosmetic way, but as an amendment that could potentially enhance the performance of the piece it replaces and challenge the assumptions and intentions of the original design in its totality. It was suggested that the contrast of the prosthesis - materially, formerly, and spatially - to the remaining anatomy could act to visually intensify not only the area replaced but could alter the perception of the whole. In other words, the juxtapositions created by the prosthetics, against the designers' hopes and intentions, could reveal new and larger opportunities within the work. Beauty and utility could be found in the flawed and made vivid by failure.

This stage of the project begins with a series of scaled photo-collage studies testing options for the design and placement of various prosthetic strategies. Once completed, and the prosthetic's components have been identified, the next step involves disassembling, or excising, the afflicted areas. The podium itself cannot be remade from scratch and no new wood can be added to the revised construction.


*Fig. 5 Examples of material inventory and prosthetic studies*



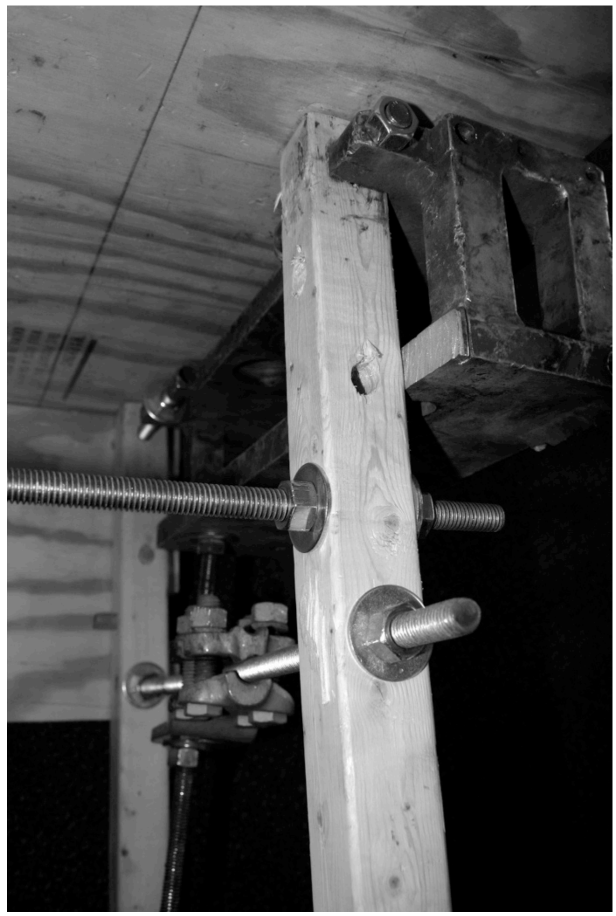


*Fig. 6 & 7 Details of prosthetics in place*

## Observations

With a new set of intentions for the design of the prosthetic and the revision of the podium, the deliberate reversing of the construction provides a second chance to reconsider the intent and assumptions present in the initial plan and construction. It was intended to stimulate moments of reflection and questioning that were now informed and disciplined by a direct, empirical understanding of the modes of failure of both the design process and the material assembly. This part of the project precipitated an increased clarity of intent. It also revealed an earned confidence evident in a more sustained patience with the challenges of dealing with highly contrasting, unworkable materials and forms. The use of scavenged objects as the components of the prosthetic served several important purposes. They confound the normative and naïve expectations for fit, connection, and physical and visual behavior. The 'stuff' needed to be looked at closely and explored for opportunities. It demanded attention. In the end, while serious flaws remained, and new, catastrophic ones appeared, there was also strong evidence across all projects of unexpected refinement, invention, and formal and material resolution. The results show a broad range of thoughtfully negotiated relationships between the new and the surviving construction. Much of this was at a level far beyond what would have been reasonable to expect given the results of the first podium trial.

The design of the podium, its construction, the analysis of its failure, the process of disassembly and dissection of the failed elements, the design of a functioning prosthetic and its incorporation into the remains of the podium are a challenging set of tasks given the baseline skills of first-year design students. Along with the naïve and unreasonable expectation for perfection, all of these efforts are destined to fail in large and small ways. But the experiences of these types of failures early in a design education are critically important and potentially deeply instructive.

Justin Kruger and David Dunning, in their seminal work on defining incompetence, provide important insights into the nature of being a beginner. Simply put, the defining characteristic of a novice is their incompetence.

"People tend to hold overly favorable views of their abilities in many social and intellectual domains. [...this overestimation occurs, in part, because people who are unskilled in these domains suffer a dual burden: Not only do these people reach erroneous conclusions and make unfortunate choices, but their incompetence robs them of the metacognitive ability to realize it." (7)

The 'best intentions' in the work of beginners, and the robust inability to predict or detect error or failure in the translations of their intentions, are analogous to the consistent overestimations of ability and performance revealed in Kruger and Dunning's study. But as also revealed, the way to gain competence is to gain an awareness of one's incompetence. Competence is paradoxically increased by an awareness of error. These results would suggest that work designed to avoid the ugliness, stress, and disappointment of failure by removing it as a possibility can only perpetuate the 'dual burden' of error and the inability to detect it.

Asking beginning design students to take on projects at 1:1 scale, using real things with mass and resistance is a powerful way of learning to understand and see the bright gap between what you know and what you think you know. Drawing and representation can, and should, be undertaken in ways that make conceptual, visual, and manual limits vivid. It can also, and often does, create illusions of control, misleading false positives, and a premature and untestable fit between intentions and outcomes. Trying to make material do stuff can instantaneously reflect the depth and breadth of your misunderstandings. Undebatable feedback, resistance to the unprepared, and awareness of the limits and consequences of design decisions and judgments, are lessons best experienced early.

*Fig. 8 Final exhibition*

## Notes

1. Johann Wolfgang Von Goethe, Art and Antiquity, III, (1821) as cited in *Maxims and Reflections* (CreateSpace Independent Publishing Platform, 2013) p 29.

2. David Pye, The Nature and Art of Workmanship (Cambridge University Press, 1968), p 1.

3. A.N. Whitehead, *The Aims of Education and Other Essays* (The Free Press, New York, 1929. P 1.

4. William James, "Bergson and His Critique of Intellectualism" in *A Pluralist Universe* (BiblioBazaar, Charleston, 2006), p 109.

5. Wendell Berry, "The Melancholy of Anatomy," *Harper's*, February 2015, p 11.

6. Whitehead, p 13

Greg Watson

[7.] Kruger, J., Dunning, D., “Unskilled and Unaware of It: How Difficulties in Recognizing One’s Own Incompetence Lead to Inflated Self-Assessments,” *Journal of Personality and Social Psychology* Vol. 77 (December 1999): P 1121.

Student Work (MSU): Lorianne Baker, Reed Bradford, Joseph Rose, Hannah Waycaster, Casey Walker

# 1:1 Matters

Catherine Wetzel | Illinois Institute of Technology

Pragmatism is the best teacher; learning is accelerated by purpose. We learn best when we need to know: technology is best understood by making; sequence is best understood when there is little time; teamwork is learned quickly when there is too much to do; topography is most apparent when we set the height of the platform. *Brian MacKay-Lyons, Ghost*[1]

In thinking about the relation of one thing to another, there are many scales of this ratio. The knowledge set of beginning design, skill, process and production, relates to a larger concept of professional discourse and higher education. Beginning design curricula proportionally amass a set of experiences that present representational skills and design processes as a theoretical entry into the production of architecture as a discursive activity. The immediate relationship between the theoretical and the practical is often elusive in the early design studio experience for students transitioning from a learning model of facts and information to methods of thinking that are sensitive to data but flexible, variable and evaluative. 1:1 as a full-scale design application provides a practice of applied theoretical concepts. 1:1 as a full-scale production method introduces the relationship of theoretical principles to architecture as a material practice.

In *Practice: architecture, technique and representation*, Stan Allen describes the material practice of the architect in which "Tactical improvisations accumulate over time to produce new models for operation."[2] For Allen, material practice is differentiated from hermeneutic or interpretive practice. Material practice "transforms reality by producing new objects or new organizations of matter."[3] The tactical improvisations translate, transpose and transcode multiple media.[4] Working through the intermediary of abstract codes an accumulation of rules and procedures frames a working model of the discipline. Donald Schön, philosopher and social scientist, describes learning systems as adaptive models in which societies recalibrate their working models.[5] Learning takes place as an adjustment or reformulation of previous knowledge within the context of the social environment. Learning cycles are the feedback and feed forward loops of individuals and groups.[6] Working from known processes, testing un-knowns, recalibrating and forming new habits informed by degrees of reflective action are innate methods of learning.[7]

At the scale of the studio, habits of flexible learning and productive thinking emerge from the sequence of projects, their ascribed principles and the associative behaviors. Using 1:1 as a recurring device promotes an engagement in the theoretical by means of the practical. 1:1 drawing and making exercises are introduced in the design process as recurring models linking observation to representation, and material properties to material assembly and performance. Within the realm of drawing, the rules of representation tease out the 1:1 relationship between the thing and the drawing such that the material

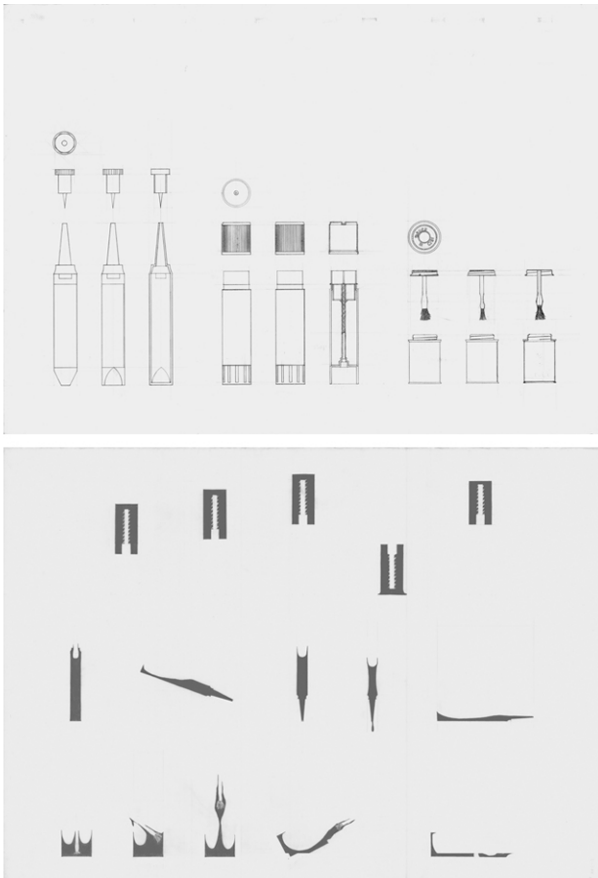


*Figure 1 Liquid container drawings, Mixed scales and 1:1*

and immaterial presence of the thing is known through the drawing as artifact and drawing as a process that reveals more than is initially apparent. The 1:1 making of full-size artifacts emphasizes material practice as a negotiated relationship between intention, performance and production.

At Illinois Institute of Technology, I have introduced 1:1 drawing and making projects as recurring devices in the first year of both the graduate (Master of Architecture) and undergraduate (Bachelor of Architecture) program for nearly 20 years. In their first year of study, a student is exposed to a minimum of three projects at full-scale. The projects structure thinking about architecture from the scale of the object and the body to the scale of site and public dissemination and ultimately, to the scale of material application, spatial configuration and structural behavior. In their totality, these drawing and making operations support an architecture based on a material practice. The lessons of technique and craft, logic and economy, spatial definition and transformation, and material properties and structural behavior are at the core of a material practice. To open beginning design processes to the full-size exploration of material assembly and site installations through a series of hands-on applications is to know the physical and tactile parameters of architecture. The use of operations promote full-scale thinking as an architectural endeavor, and drawing and making as habits of flexible learning. These projects divide into three categories of 1:1 tactical operations. Outlined below are a number of projects that illustrate the nature of tactical operations within each category.

**making DRAWING** : the delineation of common objects for the purpose of knowing through close observation and strategic representation including materiality, fabrication, commodity, life-cycle, and ergonomics. Using liquid containers (fig. 1), chairs (fig. 2), and kayaks (fig. 3), drawings at full scale explore techniques of measurement, material composition and fabrication, spatial void, and the object's relationship to the body and to other like objects. Limits of the page and techniques of projection determine a constructed hierarchy of intentions. The 1:1 relationship of the drawing to the object showcases larger narratives and opportunities for drawing implications and compositional structure to reveal observations gleaned through the active making of the drawing.

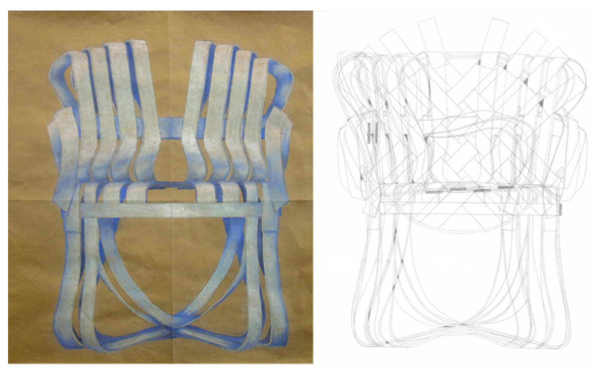


*Figure 2 Chair drawings, 1:1*

*Figure 3 Kayak drawing, 1:1*

The 1:1 relationship also exposes the shortcomings of one's ability to be accurate and the limits of orthographic projection to communicate qualitative characteristics.

The digital production of drawing has changed the nature of drawing methods. Drawings constructed through data entry as full-scale are in essence multi-scale in production and can be outputted to any scale. This radically changes the nature of 1:1 drawing as a tactile and dynamic act. The structure of the digital drawing is less dependent on the drawing conventions of projection and, as such, can be manifest in any number of ways. The freehand measurement sketch is instrumental in the production process as data is recorded and transferred in an improvised sequence. The digital drawing affords flexibility in compositional production. Views can be arranged at anytime in the drawing process, as compared to analog drawing where a views position on the page must be determined in the making of the drawing. Recognizing that orthographic drawing is a relic of an analog drafting system, 1:1 production overall provides a forum to strengthen the relationship between drawing as a process and drawing as a product.[8] What am I drawing? What is its purpose? What is its structure? How is it made? In asking these questions, the maker of the drawing interrogates the nature of the thing being drawn and the drawing process.

**making DRAWING / MAKING site** : the reconciliation of a conceptual framework of action in both drawing and making such that a transfer of an idea to a material presence is rendered at a larger scale and transforms a particular place.

Extending the making of drawings to a larger context, the operation of full-scale making transfers systems of measurement (geometry), optic sensation (color), and expanse (fields) from the desktop to the public domain. These projects project a construct of drawing on to larger sites in such a way that drawing is made physical through a change in scale, context and material. Temporality, weather, public access, visibility, and site constraints are all variables that require attention in this operation. Working in groups, students negotiated disparate ideas to shape a collective remaking of earlier individual drawings into full-scale material-based transformations of designated sites. The degree of investment in the material expression varies significantly based on the context of each project. The similarity between the project parameters is the physical making of a conceptually based idea that had been previously conceived in the form of drawing or collage.

The operations restructures the rules for making visible--the larger the drawing, the larger the scale of the material and drawing processes. In the case of geometry, the production paralleled the drawing system and reflected primitive marking systems using rope and stakes. Geometries were expressed as measures of campus sites using locally sourced seasonal materials (fig. 4). The color projects changed the focus from color studies in the form of collage on illustration board to constructed color tiles sited within the context of Crown Hall. The production process involved full-scale mock-ups and smaller tests of color mixing and color studies. The full-scale color installations required a sequence of production and a system of assembly and attachment. The field studies were more of a guerilla act in the city of Chicago and as such, relied on the speculative co-opting of found public spaces. These projects were by far the most public and, unlike Crown Hall and the IIT campus, did not have the safety of a seasoned audience. As a result the projects emphsized, either an economy of material and craft in favor of a large-scale 'bang-for-the-buck' operation, or an expenditure of labor and craft emphasizing a smaller localized expression (fig. 5, 6).

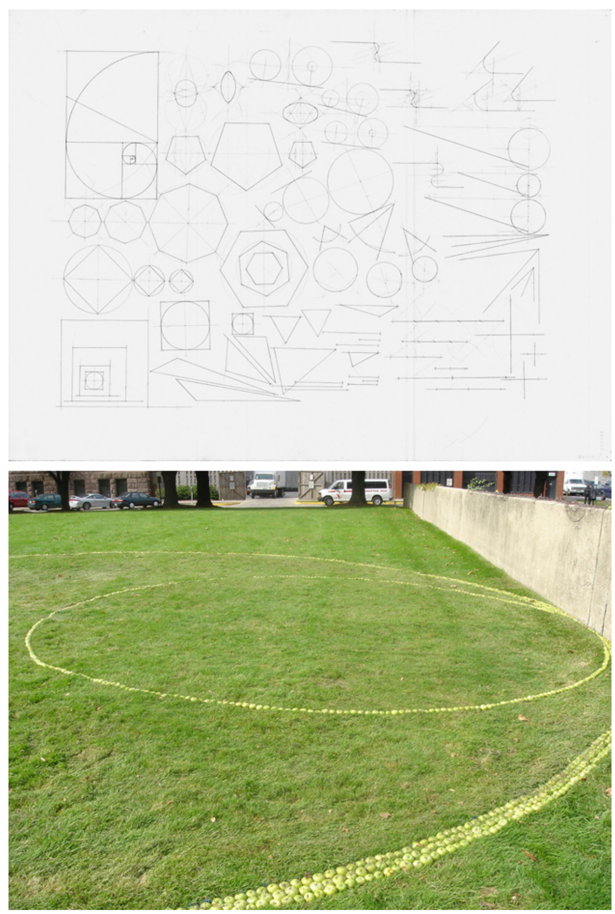


*Figure 4 Geometry drawing and installation*

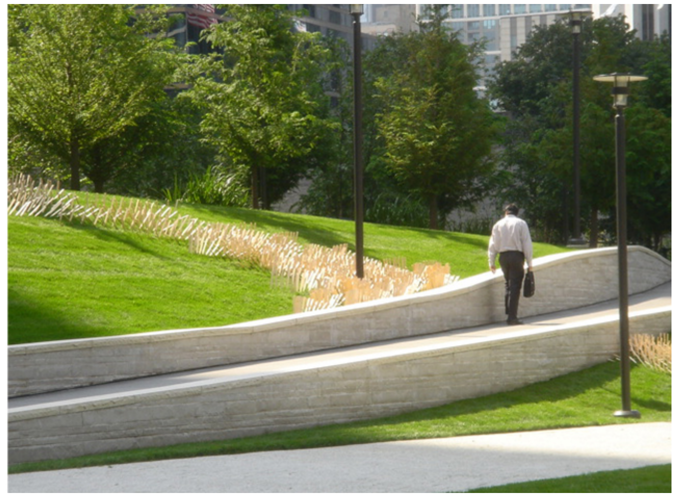


*Figure 5, 6 Field Installations*

**MAKING evident/evidence** : the production of a full-size artifact for the purpose of understanding the relationship of material performance, structural behavior and spatial configuration.

To make clearly understood and to have the artifact to prove it, the final projects of each year are full-scale investigations of architecture as a material practice. The accumulated skills of making and drawing test the integrated relationship of material, space, structure, craft, economy and transformation. The focus of the full-scale making varies from year to year in the undergraduate program but the repeated exposure to working with materials and found objects provides the groundwork. In the graduate program, there has been a direct link between the final full-scale project and the structures coursework. In both situations, these projects begin with initial material studies at partial scale and incrementally increase in scale through prototyping and material testing. Both student groups have received a fairly thorough exposure to material processes from wood to steel and from plaster to concrete in the architectural model shop. This is particularly important for these projects to be accessible and successful for all students.

In the undergraduate program the projects began in 1995 with the creation of portable soapboxes from which each student had to give a public oration. Other versions included an elevated passage that traversed the perimeter of Crown Hall, prototyping a live-work space for artists-in-residence in the Nevada salt flats with guest artist Steve Badgetts (fig. 7), and explorations of verticality and pure form (fig. 8). The largest of these projects was a 96-foot tall vertical mast (fig. 11). In the graduate program, the final projects ambitiously test structural principles beginning with dynamic models of existing buildings followed by proposed interventions and installations as part of the annual student exhibition. These projects utilize structurally determinant shapes; maximize material efficiency and rule of thumb proportioning[9]. The projects have included a stressed-skin bridge, a ring-cable cantilever, a Vierendeel truss space frame, tensegrity beams and a concrete shell. The largest of these structures was an 80' long horizontal parabolic arch, weighing over 1400 pounds and cantilevered 36' (fig. 9, 10).

*Figure 7 Clean Livin'*

As important is the success of the final projects, even greater is the value of recurring 1:1 operations relating architecture to the material practice of applied theoretical concepts. Structuring projects to optimize learning loops helps students in the transition from known processes to more variable and evaluative models, to re-calibrate and

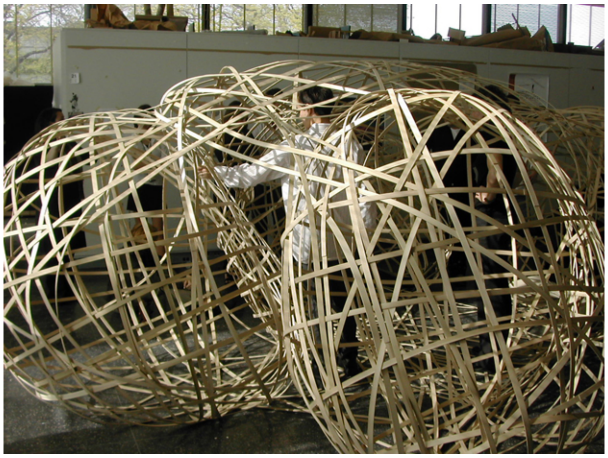


*Figure 8 Pure form wood amoeba*

develop new learning habits that are flexible and innate. The two things that matter most is that the students complete a year of study with a newfound confidence in the discovery process and the curiosity to engage further. "The practice of architecture tends to be messy and inconsistent precisely because it has to negotiate a reality that is itself messy and inconsistent."[10] The current shift from traditional industry to an economy based on rapid global communication, robotic industrial processes and intense data compilation, all impact the discourse of architecture. Architects, educators and students are engaged in fast nimble technologies with a strange warp of full-scale data driven derivations. That the relationship of size is both a fundamental principle of composition and a rational system for conceiving of material solutions in reduced proportions to the whole is a complex concept to master. Developing a fluid use of scale as a device of operation to determine appropriate proportion, size, format and medium for idea formation and project resolution, is a slow but formative process.

"Intelligent young people who choose a life in architecture intuitively know that architecture is concerned with issues such as the environment, making and community."[11] Bryan MacKay-Lyons' criticizes the predominance of the virtual and theoretical in the academy as disconnecting the head and the hand. A fundamental grounding of architecture in the 1:1 materiality of building connects the hand and the head from the beginning such that students have a strong foundation on which to develop the virtual and the theoretical. In quantitative terms, the ratio 1:1 of applied concepts to full sized operations implies that one value is of the same value as the other. The heuristic and haptic learning of full-scale making may be of greater value than the emphasis on scale itself. Higher

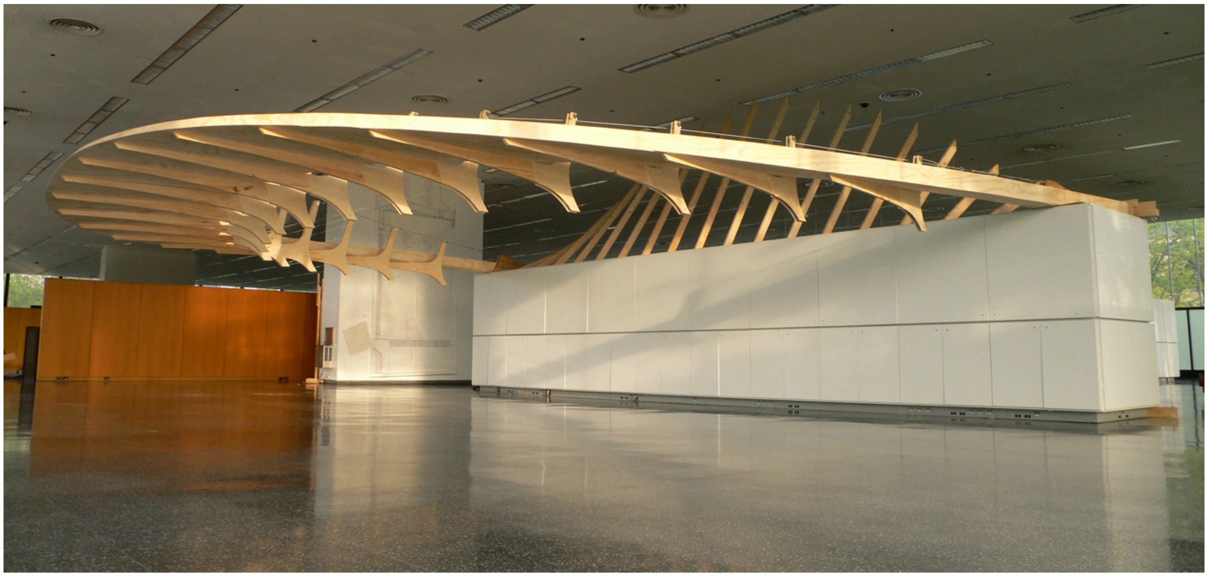


*Figure 8, 9 Parabolic, ring cable supported, arch*

education has two broad objectives in today's information age: build competence within the expertise of a discipline and develop competencies that can be transferred beyond a single discipline. In considering the material practice of architecture, the teaching of 1:1 operations matters in building competence within the discipline and learning models that transfer beyond the discipline.

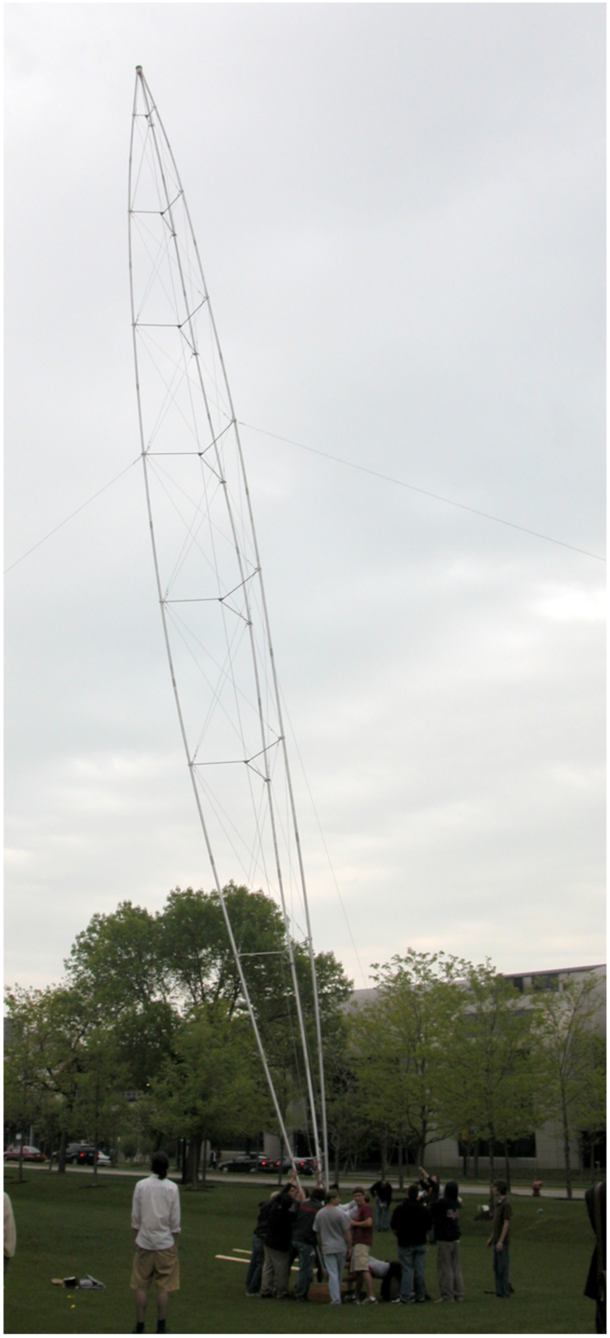


*Figure 10 96' Aluminum mast*

## Notes

[1] MacKay-Lyons, Brian. *Ghost: building an architectural vision*, Princeton Architectural Press: New York, NY, 1985. p. 138.

[2] Allen, Stan. *Practice: architecture, technique and representation*, G+B Arts International: Amsterdam, the Netherlands, 2000. p. XVII.

[3] Allen. p. XVIII.

[4] Donald A. *Beyond the Stable State*, Random House, New York, NY, 1971.

5 Hermansen Mads. *Relearning*, Danish University of Education Press and CBS Press, Copenhagen, Denmark, 2005.

[6] Hermansen.

[7] Schön.

[8] Note the inclusion of digital technology in *Architectural Graphics*, Ching, Francis D. K. 4th and 5th edition. "Digital technology continues to further augment and enhance traditional…"

[9] For a detailed description of this project see Wetzel, Catherine. Integrating Structures and Design in the First Year Studio, Journal of Architectural Education, vol. 66 no. 1, 2012. p. 107-114.

[10] Allen. p. XIV.

[11] MacKay-Lyons. p. 136.

# Projection in the Round

Emily White | California Polytechnic State University, San Luis Obispo

Projection is fundamental and, because it is an abstract way of thinking, can be a difficult concept for beginning designers. Even though our discipline has moved beyond conversations about digital versus non-digital, many first year representation courses still value traditional drafting because it makes projection tangible. When drafting by hand, a section is constructed by projecting from a plan, for example, with physical lines connecting the two in space. When this method of relating drawings enters digital space, it can seem retrograde because the allure of producing immediate, three dimensional objects is so great. Many students wonder: why construct something with lines when you can just begin with volume?

This paper describes work done in the first seminar of the undergraduate representation sequence at SCI-Arc. I taught it with Emmett Zeifman in Spring 2015. The seminar introduces students to the conventions of architectural projection for the description of form and space. My interest here is describing how our process made an abstract concept- orthographic projection- more tangible.

There is a richly documented history of the act of projection and the conceptual frameworks involved.[1] Each type of projection is beholden to a set of rules, variously controlling distortion, and these rules are much easier visualized for perspectival projection than for orthographic. This kind of actualized conceptual framework was our medium in the seminar, though we worked with orthographic projection. Students modeled and drew projective acts in the round. In the interest of maintaining the roundness of working in the round, we chose the cone as our subject and the substrate for projections.

For each of three projects, the students first constructed three dimensional cones (real and digital), then projected line onto them. We worked at full scale in all drawings and models, which contributed to the sense that our artifacts, whether representations or the things themselves, were equally real.

## Project 1: Constructed Cones

Students began by constructing cones, then identified and classified their various sections (circle, ellipse, hyperbola, parabola), and projected one section back onto a compound cone object made from two cone parts joined at a shared elliptical section. (Figure 1)

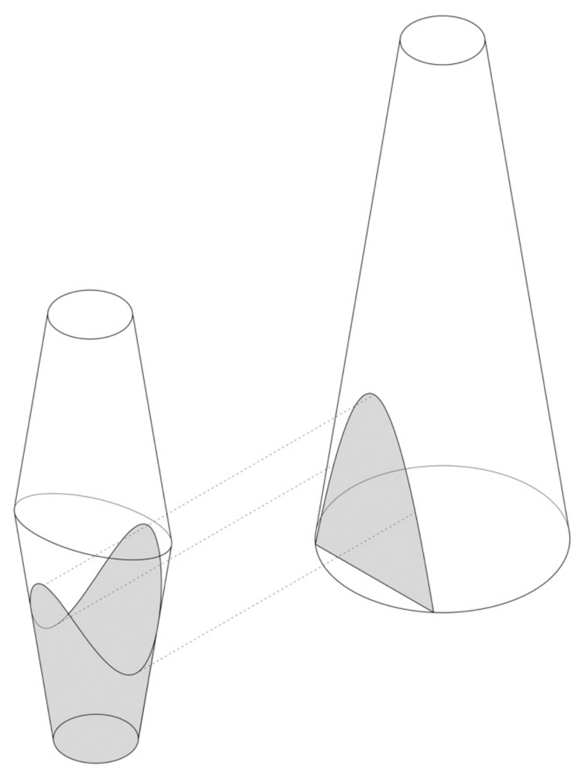


*Fig. 1 Ravyn Crabtree, Constructed Cone*

The result of this operation was a three dimensional figure in space. To make it tangible, students constructed an analogue compound cone object using one or two traffic cones joined at one or two shared elliptical seams. To describe the shape of the projection, they created a paper mask developed from the digital conic surface, and painted the projected figure in yellow. (Figure 2)

The resultant shape was identical (or nearly identical) to the digital projection, but the operation was not the same because the paint was applied to the surface in the round rather than being pushed across the object parallel to a single plane. The distinction is important because this operation produced a representation of a projection rather than being a projection. The representation, however, was tangible, and that was valuable to the students.

*Fig. 2 Installation view, Traffic Cones*

In this seminar students worked only with cones, conic sections, and conic surface fragments. We were interested in cones for a few reasons in addition to their roundness. Since our process of projection resulted in three dimensional figures, they could be modeled as tangible artifacts. Another benefit of working with cones was that there was an obvious difference between the surfaces projected onto- some conic, some planar, in the case of drawings on paper. This distinction would not have been so evident if we were projecting onto the faces of a rectangular prism, for example. And, since cones are developable, everything could be constructed with the skills these second semester undergraduates had already acquired.

## Project 2: Dumpling

Meanwhile, we had an interest in encouraging our students to work with their hands at the outset of design. Having laid the ground work that all cones can be developed from flat material, we assigned the students a second project: The Dumpling. Dumplings were to be cut and rolled from flat sheets as wontons, tortellini and fortunes cookies are from dough. The understanding was that there are cone fragments latent in these morphologies that could be unearthed through physical study.

Because the students were starting with paper instead of digital models, they had less control over whether they adhered to the rules of conic geometry. On the other hand, there was a greater diversity of shapes. The models needed to be reworked digitally in order to be useful for subsequent translations that relied on developable surfaces. The students then represented the dumplings and their construction geometry through drawing. (Figure 3)

There was a brief interlude in casting in which the dumplings' volumes were described as mass. Students used neoprene for formwork and faced a new set of challenges in calibrating the seams with their shapes, as the seams would be actual breaks in the material where the shape would begin to bulge, or out of which plaster might even squeeze. This registration of material behavior was more extreme than that of the materials used on the cone project.[2] After the casts were made, the dumpling shapes became the basis for further study in the seminar's final project.

## Project 3: Intersection

In the third project, we wanted to revisit an idea that came up frequently in conversations about the traffic cones and was at the heart of the dumplings: to what degree do seams influence our understanding of a thing's shape? In the traffic cones, there were physical seams where two cones met, and also seams implied by yellow paint at the edges of the projected conic section. There were a range of readings of the figures they defined. Sometimes they appeared as an orange figure with a yellow sub-figure, sometimes they appeared as a yellow figure on an orange ground, sometimes they appeared as equal orange and yellow figures co-existing. In some cases, the projections were more figural than the cones.

We wanted our students to continue using seams to produce figures. The compound object for project 3 was produced by intersecting a cone with a "cone-controlled dumpling." Students revisited the dumplings and modeled them digitally with all surfaces as cone fragments. Instead of a single elliptical seam as in the traffic cones, these objects' seams were constructed from the intersection of a compound object (the dumpling) and a cone. (Figure 4)

As objects, the legibiliity of cones and cone surface fragments was roughly proportional to their symmetry. We wondered how the legibility of seams is effected by concavity and convexity, and what influence other proportional and geometric characteristics have.

To complete project 3, students again projected a conic section onto their compound objects and used color to define it on a physical analogue. This time, instead of applying paint to a surface, the figure of the projection was developed as a separate surface from the digital model and constructed from another color of paper. The projected figure was inlaid to the compound object, resulting in a flush joint between the two surfaces. (Figure 5)

The rules and operations were similar to those of the traffic cones in project 1, but there were two important differences. First, the objects were just more complex and therefore less legible as figure (projected section) and ground (cone). Second, because the two parts were butt joined, neither was materially priveleged. The projected figures appeared really volumetric , and therefore seemed really "real."

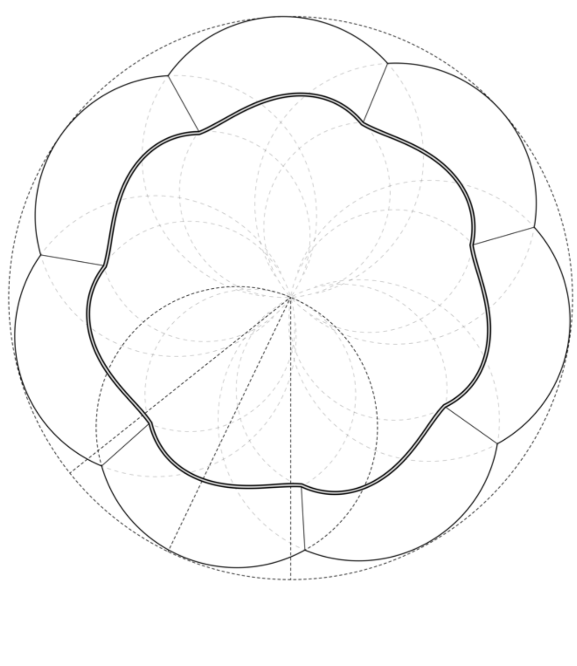


*Fig. 3 , Tian Hui (Vicky) Wen, Cone Controlled Dumpling*

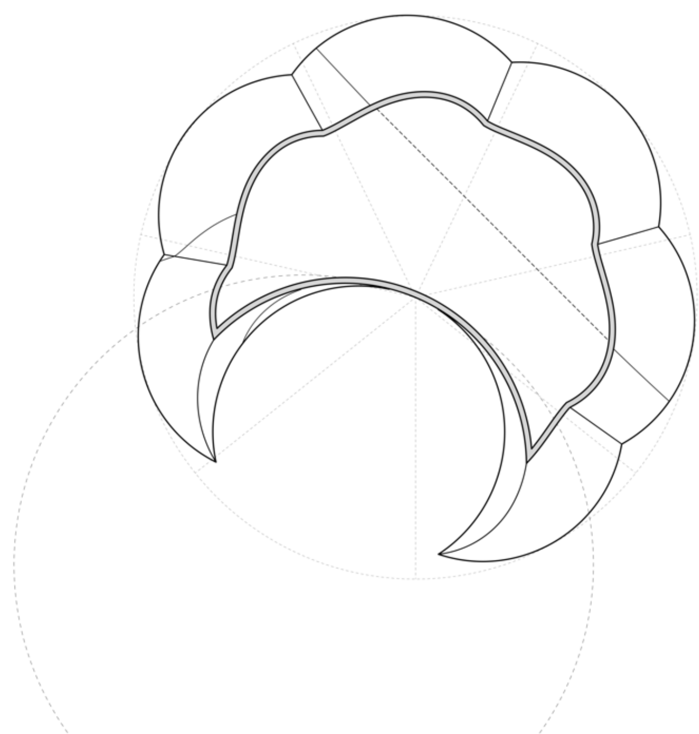


*Fig. 4, Tian Hui (Vicky) Wen, Compound Object 3*

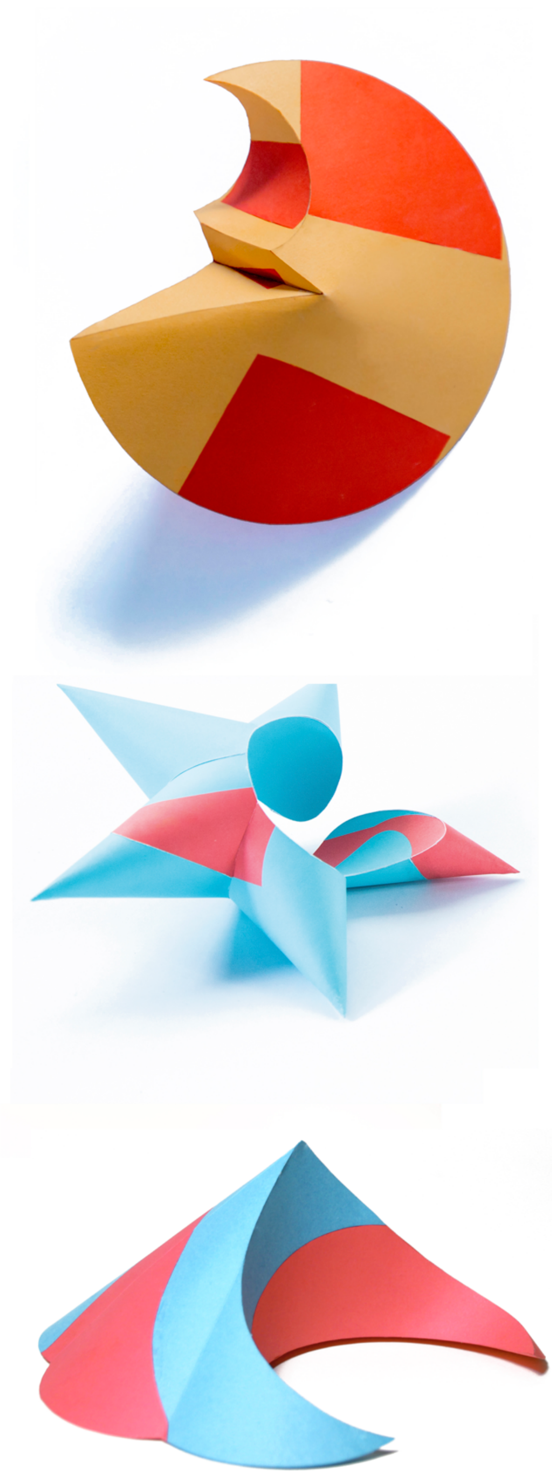


*Fig. 5 , (top to bottom) Chieh Sheng Huang, Tucker Van Leuwen-Hall, Tian Hui (Vicky) Wen, Intersected models*

## Post Processing

A conversation at the end of the semester between the instructors and colleagues Andrew Zago and Anna Neimark was fruitful in advancing some ideas about how students might consider the malleability of representational conventions with respect to future studio projects. We talked about how each mode of representation is also a description, and it is incumbent on students to describe their work with intention, which includes choosing the means of description. These projects could have been described as equations, for example, if a student wanted to communicate an idea about authorless shape. Or a project might have been described through narrative to convey its atmospheric and perceptual qualities.

On one hand, this was a seminar about building skills, including the skill of representing ideas. On the other hand, as instructors we brought our own agendas and interests relating to representation and making. Our objective of de-mystifying the abstract concept of projection was latent in each project brief and our methods were useful in doing so. As the semester progressed, we revisited questions of what is real, what is abstract and what constitutes a representation of a real thing? The students began to speculate on this by comparing objects in digital space with their physical analogues that confronted seams and seam placement. The students were able to speak with some authority about the differences among objects, models, representations and projections. At the same time, our students understood these distinctions are not fixed, and it became clear to many of them that part of our work as designers and architects involves grappling with conventions of representation.

Notes

[1] The most richly documented among these is The Painter's Manual, by Albrecht Dürer, translated by Walter L. Strauss. (New York: Abaris Books, Inc., 1977)

[2] We briefly disregarded our premise that cones are the building blocks of all other things during the casting project. Here students had to grapple with representing deviation, like stretching and sagging of plaster filled formwork. The objective of using developable formwork was to produce a semi-controlled, non-developable form. Seams in the formwork were the only means of constraining the forms. This was not really a success in terms of continuity, nor in terms of aesthetics, nor in terms of defining limits and constraints for the construction of objects. It was fun and messy, and students had ample opportunity to observe projects "deviating" from expectation.

# Supporting Students: Using Anthropomorphic Structures to Enhance Early Structures Education

Rob Whitehead | Iowa State University

## Reframing a Structural Sequence:

*“The process of visualizing or conceiving a structure is an art. Basically it is motivated by an inner experience, by an intuition.”—Eduardo Torroja, 1958*

After two classmates had lifted her off the ground by pulling her arms and legs apart, a smiling but somewhat weary student rolled over on the ground, looked up, and asked, “Are you sure this is architecture?” It was a fair question. An hour later, after her group had been shown the similarities between the structure they’d built with their bodies and the roof of Madison Square Garden, the connection became clearer (Figure 1).

*Fig. 1 In an attempt to create the largest spanning structures, beginning students intuitively enact the key components of a tensioned cable roof.*

***Learning to Visualize Behavior:***

This paper will argue that structural design courses for beginning architectural students should aspire to directly and immediately teach the important relationship between forces, structural behavior, and the array of potentially responsive architectural forms. Although critically integrating structures in a design requires an elevated technical acumen, students and instructors need not automatically feel apprehension about starting to learn these lessons. A pedagogical approach that focuses on enhancing visualization through hands-on experiences can be matched to address these challenges. These changes should begin with the way information is presented and the expectations for how it could be learned.

When architecture students are taught structures using the deductive teaching methods typically used by engineers, it limits their potential for learning simply by the way the information is presented. The deductive method incrementally reveals isolated lessons by focusing on the selection and assessment of discrete structural elements. This obscures the larger context for the learning and unnecessarily delays the opportunity for students to make conceptual connection between structures and architectural design for years (Felder, 1988). Students want to know what they are sizing, why they would size it, and how this learning fits in with a larger view of structures in architecture.

The opposite approach, induction, is better suited to promote the types of inquiries and discoveries needed in the problem-based design curricula of architecture. Inductive teaching begins by presenting examples of how a concept can be used in practice and asks students to make certain connections (some simple, some complex) as to how the concepts can be applied in practice (Michalski, 1983). But beginning design students have a difficult time imaging and visualizing structural behavior in complex systems so students need to be given specific activities that help them make these inductive connections more effectively.

If one can't "see" what's going to happen in a structural system, it's more difficult to imagine an apt design response. Unfortunately, the mathematical formulae and two-dimensional representations primarily employed in a conventional pedagogy are poor methods for promoting visualization skills of complex three-dimensional structural behavior. Therefore, an effective pedagogy must aspire to impart knowledge about these structural behaviors in a manner that enhances the student's capacity to visualize the potential behavior and understand these types of physical phenomena. The first step is to create an active learning environment that uses haptic learning methodologies, such as the testing of physical models (Williams & Franklin & Wang 2003). Testing scaled physical models is a great learning activity, but test results may be more effectively understood by experienced students (Severud, 1961).

As an effective alternative, students can use a structure they are already familiar with—their bodies—to help them better visualize and understand structural principles. Engaging students in simulations that use their bodies enhances their reasoning about the potential physical behaviors more effectively than the use of visual imagery alone (Barsalou 2008). Ultimately, integrating exercises that explore the relationship between the body and the physical world improves the ability to visualize abstract behaviors and helps to develop embodied cognition (Han, 2011). Students need to know that they already have an intuitive understanding of structural behaviors.

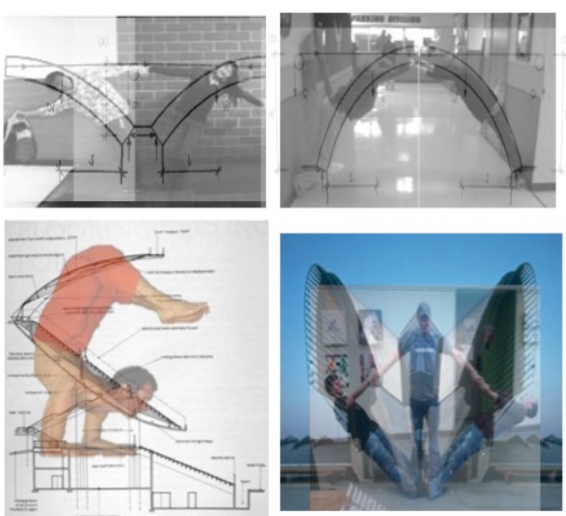


*Fig. 2 Examples shown to students of how body positions can help explain structural forms and static behavior.*

***How the Body Finds Responsive Structural Forms:***

*"There is nothing more noble and elegant from an intellectual viewpoint than this: to resist through form." –Eladio Dieste, 1992*

Initial exposure to complex topics can often make a significant difference in long-term learning efficacy and enthusiasm, so this Anthropomorphic Structures lab is the first structural lab project presented to Iowa State University architecture students. By asking students to construct lightweight structural conditions that mimic real world conditions, students are given a chance to experience, analyze, and describe the resulting structural behaviors. Although there are difficult concepts about structural performance underlying the activities, because they are able use their bodies, students are given a chance to make intuitive connections between what they felt and what they've "built."

In the lecture that occurs one hour before the lab begins, students are reminded that they've all cultivated an incredibly well refined application of structural principles throughout their lives (Zannos, 1987). Any time they balance themselves, lift an object, or walk across campus in the wind carrying their portfolio, their bodies make instantaneous adjustments to maintain equilibrium. They are shown examples of certain anthropomorphically inspired structures are asked to make inductive connections between the examples shown and their assigned exercises (e.g., "how can your intuitive experiences help you intentionally design a structure that works?") (Figure 2).

Students are taught that it's an imperfect testing system because unlike structures, our bodies are designed to be dynamic. We have numerous moveable joints with many degrees of potential rotation that make static positions difficult to maintain. They are reminded that under certain conditions, when their arms hurt, or their backs get sore, they may simply be experiencing an elevated level of stress that results from their body's structural form, and these conditions can be made a part of the potential lesson (Figure 3).

*Fig. 3 In an attempt to create a cantilever "shelf" the student group discovers that the hips/waist area are a weak point.*

## The Fun Times & Serious Business of Building Body Structures

As a means of simplifying the relatively complicated possible structural conditions, the lab intentionally presents two simple and easily understandable categories of structural challenges: *How far can you span?* and *How high can you reach*? The process of standing, reaching, and holding objects is so common that students often fail to recognize these seemingly innocuous activities solve the same structural challenges of "stacking and spanning" that all structural designers face. There are subsets and modifications of each pose that are designed to provoke the more specific lessons. To help students conceptualize, visualize, and communicate the structural behavior between team members, students were asked to take photographs during the lab and to keep a record of their lab activities and observations ("Show me where you feel it") .

Although students are encouraged to have fun, there are serious learning objectives tied to their activities that require a demonstrated level of understanding. The most important lesson is the relationship between the location and magnitude of forces within a structurally responsive form—specifically how modifications in the form can be made to more effectively resist the forces in a stable configuration (Dermody, 2010). But to have the inductive teaching method work effectively, students also need to make connections back to the foundational structural topics that make these configurations possible including:

-Forces & Loads: The sense, direction, and magnitude of forces caused by concentrated or distributed dead loads and live loads.

-Stress & Strain: The ability to identify and understand the different effects of compressive, tensile, bending, shear, and torsional stresses on a physical body.

-States of Equilibrium: Why static structures don't fall down (translational equilibrium) or tip over (rotational equilibrium).

After allowing students to experience the structural behaviors with their bodies, and discussing particular observations with them during their exercises, students were asked to develop representations of what they "built" and experienced (using pictures, diagrams, and descriptions) in a lab report.

### *Teaching Stability & Equilibrium:*

In conventional structures courses, many of the first deductive lessons about structural behavior focus on forces and equilibrium. Forces are shown as two-dimensional arrows and equilibrium is presented as a product of equalizing mathematical and geometric conditions. In this lab, they are able to visualize and "feel" equilibrium because they are using their bodies to simulate different loading conditions (especially with differently sized team members). They find translational and rotational equilibrium in the simplest way—by not falling down or tipping over. And although they've see the two-dimensional vector arrows that are meant to describe equilibrium, they frequently comment upon how unhelpful this representation is to describe the three-dimensional complexity they feel.

In one particularly helpful spanning exercise, two students hang off of each side of their middle teammate (Figure 4). All three people put their feet together in the side students slowly reach outward to create a relatively long spanning double cantilever diamond-shaped structure. This pose teaches several key lessons about stability: the weight of the hanging students should be relatively balanced or it doesn't work (rotational equilibrium side to side), all the feet need to be grouped tightly together at one point (concurrent forces and rotational equilibrium front and back), and it demonstrates the natural formal rigidity of a triangle in a system (between their arms, torso, and feet). Few students can hold this pose for a long time because of the internal stress felt in their arms. Students are required to discuss the type of stresses they felt and diagram their locations in the lab report.


*Fig. 4 The double cantilever spanning pose teaches critical lessons about rotational equilibrium, the difference between compression and tension, and the value of strong connectors (at the hands).*

Other students choose to forgo this long span option for the more radical solution where one student is held in suspension between two others, like the roof of Eero Saarinen's Dulles Terminal. The spanning student's body naturally hangs down in a funicular shape and is subjected to tension throughout the body. This basic configuration provides an opportunity to talk about axial stresses and direction of forces in a system—the two supporting students often lean back with their entire body, pulling as a means of creating resisting thrust (Figure 5).

*Fig. 5 The form-resistant hanging chain pose is a popular experiment. Several groups have tried to make a longer span but the amount of outward thrust and high levels of tension stress felt in their hands limits their options. These "failures" are the way of understanding how the structure really works.*

With poses like this, students first learn about "form-resistant" structures (such as cable and arches). Initially, without prompting, the middle student's body always hangs like a cable, but when they are challenged to stiffen their body into a flatten beam-like structure, they realize how much more difficult it is to try and maintain a static form when their body is subjected to bending stress. They feel the stress in their back and abs and instantly understand the internal force couple of compression and tension in opposite end fibers of a beam---even if they can't apply this knowledge to bending theory, they now know what it feels like and how to simulate this learning for later. They often find other exercises that also cause them to feel bending stress—they don't hold the poses for long (Figure 6).

Other types of stresses, such as moment forces, bending, and torsion are also easily demonstrated in the spanning/reaching exercise. The concept of moment force is perhaps most easily taught by simply asking students to hold a weight away from their body at various lengths—obviously the further away the weight is held, the more their shoulder has to generate an internal resisting "moment" to keep their arm from falling down. Simple mathematics are introduced here alongside other physical examples of shelf brackets and tree branches to show how certain shapes are designed to be form resistant against these particular types of stresses (Figure 9).

*Fig. 6 Experiments with forms that create bending stresses. Tension and compression are typically felt in the abs and back immediately.*

***Stress & Strain in Stacked Configurations:***

For the stacking exercise, students often build a pyramid-like structure with their bodies with two people on the bottom supporting a third in the middle. Intuitively they come to realize that the weight of their bodies (or props) are the loads in the system and these loads created different types of stresses (compression, tension, bending or shear) depending on the configuration. Because students are stacked on top of each-other, this exercise allows them to feel the impact that additive loads have on the base of a structure (Figure 7). When students are able to feel how much harder this is with one person on top of another, it is much easier to imagine the increased magnitude of forces and weight that act upon multi-story buildings. They learn that when these body parts begin to ache, or move, that this is the strain caused by the structural stresses.

Some body parts are better equipped to handle different stresses than others, so students intuitively adjust their poses accordingly. The two supporting students often use their knees, waist or shoulders to support the weight of the third teammate so the load transfer is more directly transferred downward. Interestingly, students at the base of the structure nearly always triangulate their feet by shifting them forward and backward and side-to-side. Typically this weight shifting is an uncoordinated effort between teammates that is often unspoken and intuitive—although this is always pointed out after they've completed the stance because it is such an important point.

These structures typically fail eventually not because the stance of the supporting students is out of equilibrium, but because the compressive stresses accumulate and fatigues the legs of the students nearly to the point of causing buckling. In later semesters when discussing the need to provide buckling resistance for compressive elements, such as columns, this lesson is brought up as an example.

*Fig. 7 Stacked Configurations. The location and configuration of the support points from the top student(s) to the supporting students is a critical item to focus on because it reveals many critical structural issues about force transfer, geometry, and pinned connections.*

These body structures look relatively stable once the students are in their final pose, but because the "construction staging" of these structures is often quite complicated, they are asked to describe how the states of equilibrium change during this process. Ideally this will help them see how structures aren't just a final static form but are a result of a dynamic process of construction.

***Reflective Learning in Lab Reports:***

To help achieve the learning objectives, student lab reports are required to address several questions put forth in the handout. The labs are modeled after other scientific lab reports so they are asked to include descriptions of their hypothesis (including early sketches), implementation process, testing (weights and measurements), test results (mode of failure), and a conclusion of critical lessons learned. The types of representations required in these early labs are intentionally left somewhat open-ended to give students the leeway to experiment with different ways of best representing what they learned. Most students reflect the inductive pedagogical process in their description. For example, they often show their final pose first and use photos, sketches, and other images and descriptions to describe how the concepts are integrated into their proposal (Figure 8).

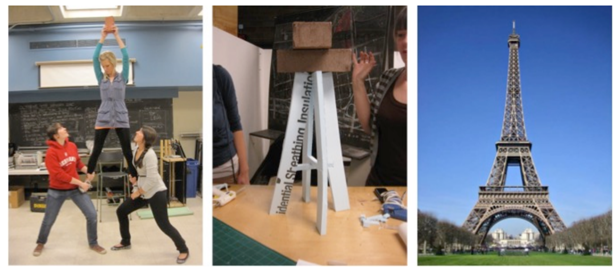


*Fig. 7 In their lab report, this student group explained how their body structure worked by comparing it to a constructed prototype and the Eiffel Tower.*

Although most student groups thrive in creating and explaining their body structures, their initial graphic representations and written descriptions are severely under-developed. This is to be expected as they haven't been taught these specific skills yet, but it is interesting to see the disconnection between what they experience (e.g., equilibrium as a three-dimensional problem) and the conventional over-simplified version of these events that they represent (e.g., large arrows pointing up and down overlaid on a photo of their pose).

Because it is important to translate structural behaviors into graphic representations, we spend the entire next lab reviewing their labs and teaching them ways to graphically represent forces, loads, and states of equilibrium. In a way, we have to reverse engineer their perceptual experiences to help them to visualize how to graphically represent the abstract behaviors they've experienced.

They also have to be taught how to write about their lab experiences with a critical and inquisitive voice. Most of the first drafts of their labs demonstrated an enthusiasm about the lab activities (e.g., "we had a great time with this pose") but a conspicuous lack of rigor in the descriptions and comparisons. We show them lab reports from advanced students and assign them readings about the scientific method in lab writings. Students are given a chance to redo the lab and resubmit it for final evaluation and nearly universally the results of the labs improve dramatically (Figure 9).

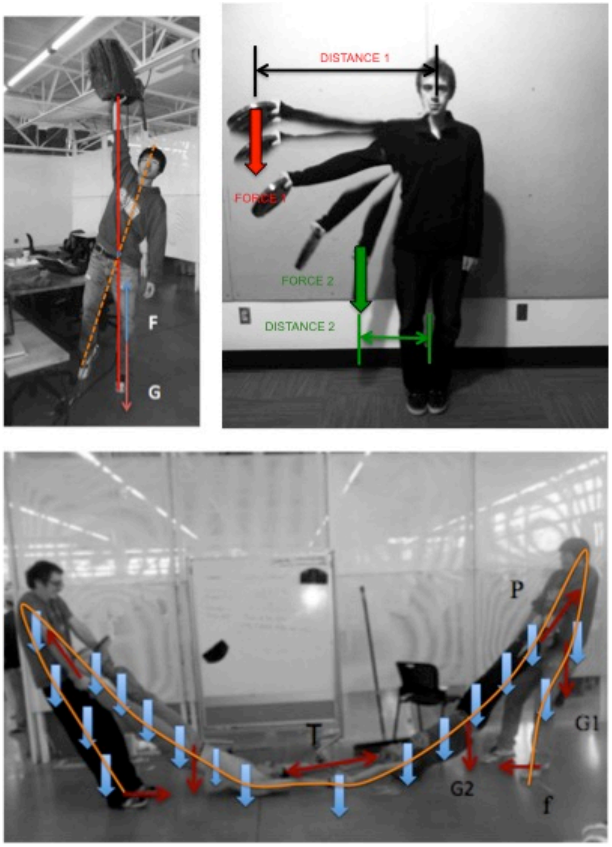



*Fig. 9 Images from first lab reports show the challenge of representing their experiences graphically.*

## Results, Revisions, and Assessments:

Although there is a clear advantage to haptic learning methods that tap into intuitive understanding of structural performance, learning structures only by using one's body has very specific limitations. Our bodies can only create a handful of loading arrangements, can only endure a limited amount of stress, and the possible range of our body forms and gestures can only be used to communicate a small range of structural behaviors. Therefore, as a subsequent follow-up to this lab, students were asked to "translate" their personal experiences of structural behavior into a three-dimensional model built with spaghetti and hot glue. These structures were tested with weights and students were asked to comment on the similarities and differences of the structures and their performance that resulted from the change in material and connections.

By encouraging students to safely push the physical limits of their bodies during these exercises, they were able to learn critical and insightful lessons about the limitations and internal stresses present in many structures, including the fundamental idea that there is an important relationship in efficient and effective structures between the applied forces and the resisting forms.

Because I teach the entire structural design sequence, I can attest to the ways in which this assignment has had a positive lasting impact on the remainder of their structural education. In many lab reports completed in later semesters, students often make references in their descriptions of behavior and modes of representations, to the "body structures." Typically these observations are found in form-active structural analysis labs (cables and arches), in the description of "buckling" in column and beam behavior, and in relation to structural connections (e.g., equating pin connections performing like ankles in a body).

At the conclusion of their structural sequence, students are asked to select a long span structure to analyze in great detail—perhaps not coincidentally, two popular choices are Madison Square Garden and Dulles Airport Terminal. Gratifyingly, these projects are usually quite well understood.

## Notes

[1] Barsalou, L.W., *Grounded Cognition*, Annual Review of Psychology, Volume 59, 2008, pp. 1-21.

[2] Dermody, R. J. *Get the form right! Teaching structural design to architects.* Structures & Architecture: 1st International Conference on Structures & Architecture, Ed. Cruz, (2010): p. 257.

[3] Dieste, E., *Some Reflections on Architecture and Construction*, Perspecta, Volume 27, 1992, pp. 186-203.

[4] Felder, R., Silverman, L., *Learning and Teaching Styles in Engineering Education*, Engineering Education, Volume 78, pp. 674-681,1988.

[5] Han, I., Black, J., *Incorporating haptic feedback in simulation for learning physics*, Computers & Education, Volume 57, Issue 4, December 2011, pp. 2281-2290.

[6] Michalski, R., *A theory and methodology of inductive learning*. Springer Berlin Heidelberg, 1983.

[7] Severud, F., *The Feel of Things*, Journal of Architectural Education, Volume 16, Number 2, pp. 18-22, 1961.

[8] Torroja, E. *Philosophy of structures*. Univ of California Press, 1958.

[9] Williams II, R.L., He, X., Franklin, T., Wang, S., Haptics-augmented engineering mechanics education tools, *Journal of Science Education and Technology*, Volume 12 Number 1, pp. 1-12, 2003.

Zannos, A., Form and Structure in Architecture, The Role of Statical Function, Van Nostrand Reinhold Company, New York, 1987.

# Surface Scratches: Material Investigations Between Drawing and Building

Keith Wiley | California Polytechnic State University, San Luis Obispo

*The order and connection of ideas is the same as the order and connection of things.*

*Baruch Spinoza*[1]

*In every instance of making, when concern for the formal integrity is at stake, we must recognize and operate within a relationship of total inseparability governing material, the tools employed in its transformation, and the labor spent in the process. This is demanded by the specificity of each act of making—the specificity of time and context that renders each instance unique.*

*Giuseppe Zambonini*[2]

In Fall Quarter of 2013, I was very fortunate to teach a Second Year design studio coupled with a practice class having the same students studying materials and methods. A few conditions came into existence that made this class a good opportunity for experimentation—namely, I was given an entire double studio for my students, and the other was that the term would be my fourth consecutive term with members of this cohort, having taught the entire First Year sequence with them the year before. This meant that I had a great familiarity with every project they had done previously, which gave me a rough idea of the student's skill set as well as a year's worth of operations, processes and techniques from which to reference.

Being in a large space, I decided to revisit a premise that was explored in a Second Year studio I taught in Winter of 2005, in which the students built a cruciform, wood-framed, 15 feet wide wall in the studio, where it served as the site of exploration for the quarter in a process-oriented sequence of projects that challenged traditional building materials and methods[3].

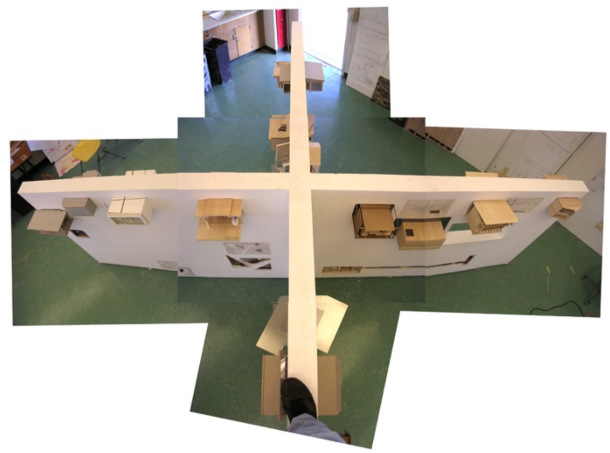


*Fig. 1 Wall Studio construction from 2005*

The assignments from that previous class were involved in exploring the poché of the wall by occupying the voids between studs with projects of various scales [fig. 1]. I wanted to use a similar sensibility of engagement with the wall, but I decided to shift the focus from the interior cavity of the wall to the progressively thinner layers of material that constitute its surface. This was accomplished by having the students engage in a sequence of drawings and relief techniques in order to engage drawing not as not only a haptic exercise, but a material one with an agenda of investigating the analog of drawing and construction.

While a wood-framed stud wall was being constructed by the students under the auspices of practice class [fig. 2], we simultaneously began a series of prescriptive yet abstract drafting exercises in studio. These exercises began with the preparation of drawing surface, specifically a 32x48 piece of gypsum wallboard. Through these operations, the piece of drywall became the site of drawing, modeling, and full-scale construction in both additive and subtractive modes. This was the driving concept of a process in which the language of construction materials is ultimately folded on top of the language of drawing materials, creating an analogous link between drawing and building. This board was referred to constantly as "the site" to further reinforce this link, and the use one of the more mundane construction materials as a drawing surface set to instill the idea that quotidian materials were going to be used in non-traditional ways. Here, the material of drywall is given agency by its introduction to the student outside of the context as a component of a construction system and potentially released from its traditional non-materiality of invisibility under an opaque matrix of mud and paint.

*Fig. 2 Framing in studio*

Text given to the class was minimal. Operations were written on the chalkboard, followed by a class discussion of potential and intent. Here are the opening steps:

*General Rules:*

• *Geometrically construct and project all forms when possible. Measuring leaves no trace and robs the drawing of visible process and future expansion.*

• *No erasing mistakes; layer with a "patch" of Bristol or gesso.*

• *Craft is of utmost importance.*

• *Always Always Always show your construction lines.*

*Process*

*1. In groups of three, take a sheet of drywall and divide it into three equal parts geometrically (without a tape measure).*

*2. Locate the precise center of your sheet with a small graphite cross for future reference.*

*3. Locate a rectangle approximately the size of your hand*

*4. Locate two six-sided orthogonal polygons (AKA L-shaped) on the sheet in relation to the previous rectangle and to each other. A non-orthogonal (AKA diagonal) line must cross both these spaces, and the nature of this line will change according to the material qualities of the space.*

*5. Fill one with graphite. Construct the line through this space subtractively and with precision using an erasing shield.*

*6. Excavate the other 1/2" into the gypsum. Construct the line through this space subtractively using a knife.*

*7. Locate yet another rectangle, inside of this, draw an axonometric of the enlarged are where the inscribed gypsum line meets the "wall" of the excavation and continues as a graphite line on the drywall surface.*

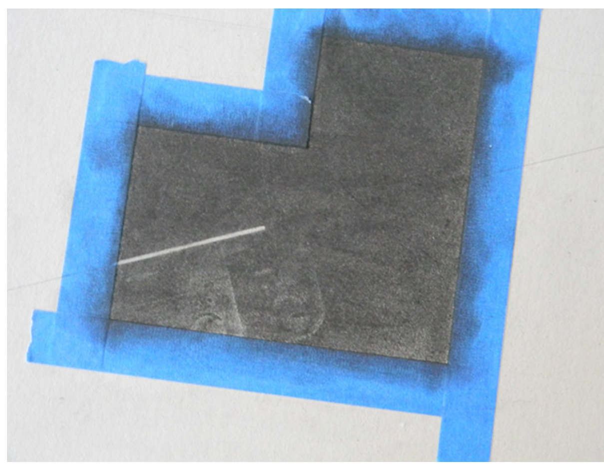


*Fig. 3 Masking and precise erasure of graphite fields*

In going through this series of operations, the students define two dimensional spaces through using drawing techniques in an almost painterly way. There is a tacit understanding that the material and method used to create something as simple as a line has an enormous impact on its form. If a line is used to define a space, what does a space look like when its lines are subtracted from a field of graphite [fig. 3]? What kind of space is represented by lines built up in layers of gesso? By engaging the materiality and technique of drawing in this way is to engage in the act of drawing as a material investigation, which makes the natural analog of drawing to building a natural progression.

*Fig. 4 Gesture studies with constructed pens*

*8. Create a unique drawing instrument with which to create a gestural line of ink. The nature of this line should change depending on how the instrument is held/angle/speed/etc. The line should be 12 inches long, although it may double back on itself. Practice this gesture many times on a separate sheet of paper. On the sheet, the line must be performed within a multi-sided orthogonal bounding box that has been primed with gesso. Consider the relationship between the box and the gesture. [fig. 4]*

*9. Create a mechanical drawing "bar" out of basswood that attaches to your sheet. This mechanism must have a minimum of 3 and a maximum of 6 points of contact with the sheet. All points of contact must be excavated 1/4" into the gypsum. With the mechanism, draw 2 arcs larger than 12" and with different center points, and at least 3 parallel lines on your sheet. The mechanism is not permanently attached.*

*10. Define a rectangular area containing at least 10 existing lines. Gesso this space so that the lines are still visible and add 20 more diagonal lines to this space.*

*11. Create three drawing curves/templates derived from the following sources: the action of the drawing mechanism, a detail of the morphology drawing from the beginning of the quarter, and a segment of your body. These will be used later.*

The second group of operations concentrates on development of instruments that directly attach to the board or are derived from forms in it [fig. 5]. In creating drawing instruments directly for the project, these tools take on the specific indexicality of the jig rather than the generic universality of an ordinary instrument. The creation of these tools, and their ultimate use in and on the wall, creates a situation where instruments are being derived from the project and in turn deployed on-site to create a layering and density of a site-derived construction syntax. Ideally, more operations would create even more tools, so the wall is regarded as simultaneously generating actions as well as receiving them. More graphic spaces are also delineated: The creation of a pen lead to development of a space based upon the geometric containment of a calligraphic gesture and another was a container for dense layering of lines.

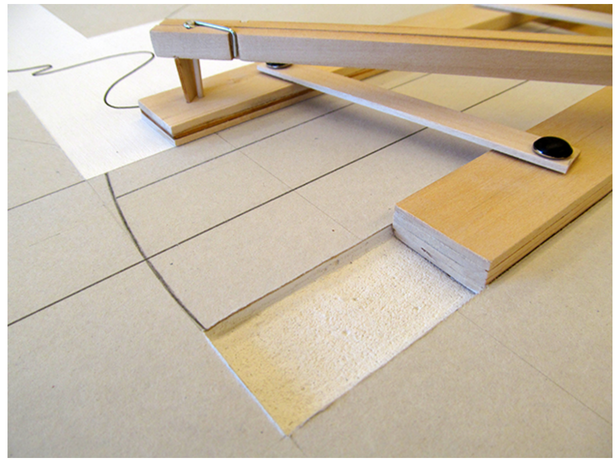


*Fig. 4 Framing in studio*

*12. Build a wall of 2x4 studs in collaboration with the rest of the class.*

*13. Mount your drywall drawing to the stud wall that was built in practice. Extend the geometry of your panel onto neighboring pieces of drywall as they are placed next to yours.*

*14. In collaboration with the studio, "finish" the wall using drywall mud & tape and ultimately paint. Maintain layers of previous construction by masking or sanding.*

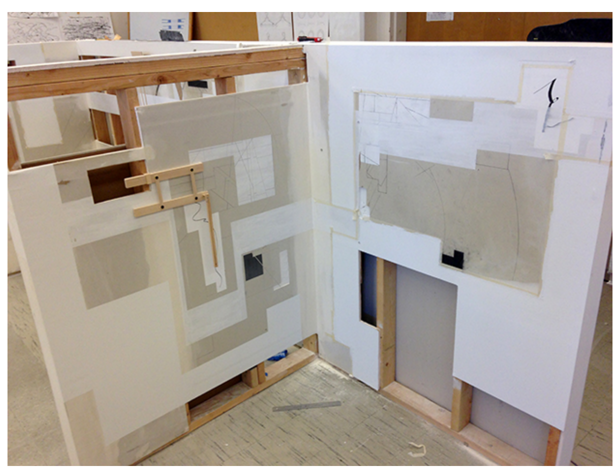


*Fig. 5 Simultaneous additive and subtractive making.*

At the point in which the operations began to utilize excavation into the drywall, the entire studio's boards were incorporated into a wood framed wall that the students were building simultaneously [fig.5]. A discussion of the tectonic potential of this building system lead the students to question the monolithic ideal of the wallboard systems, which in turn initiated a round of selective revealing, hiding, and layering operations on the wall itself. When the drawing/boards were finally affixed to the wall, the drywall assumed its more traditional role, but the studio was asked to consider detailing of the wall in a manner that would selectively reveal how it was made, and that maintained the same methodology of material investigation employed on earlier steps, except the expanded repertoire of drywall mud, tape to cover seams and the action of sanding and painting as erasing and obscuring elements is now added to their vocabulary.

*15. Develop a space from one of the forms on the drawing (see above). This space, at ½"=1', will translate the abstract drawing to built form. This space incorporates the texture-space developed in practice.*

*16. The model of this space occupies the poché of the studio wall. Interior spatial configuration for light wells should be negotiated with neighbors.*

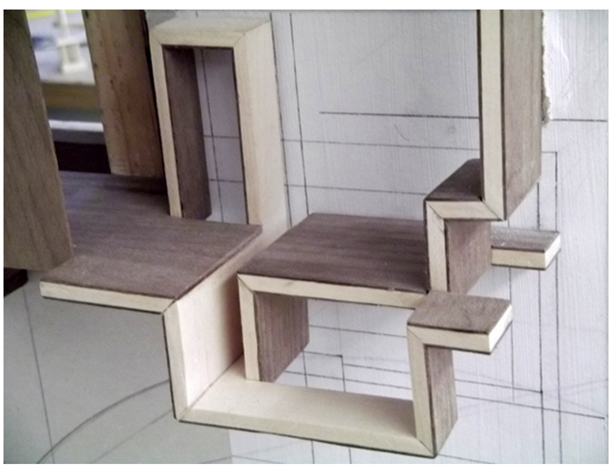


*Fig. 6 Spaces in and on the wall.*

The final project asked the students to excavate a site into their wall and insert an intimate space based on earlier graphic operations which is dominated by the presence of a high-material textured surface. Through a series of experiments with casting surface from found textures, the students worked with plaster, clay and wax to create a scaled architectural wall. The wall itself was the site for the model of this space, and the means of excavation and surface preparation had to follow the same methodology as the drawings and wall construction. Negotiations of site boundaries with neighboring students on either side of the wall took place to discuss the manner in which the poché was occupied and how apertures cut into the surface of the wall could provide interior light to multiple projects.

*Fig. 7 Completed wall.*

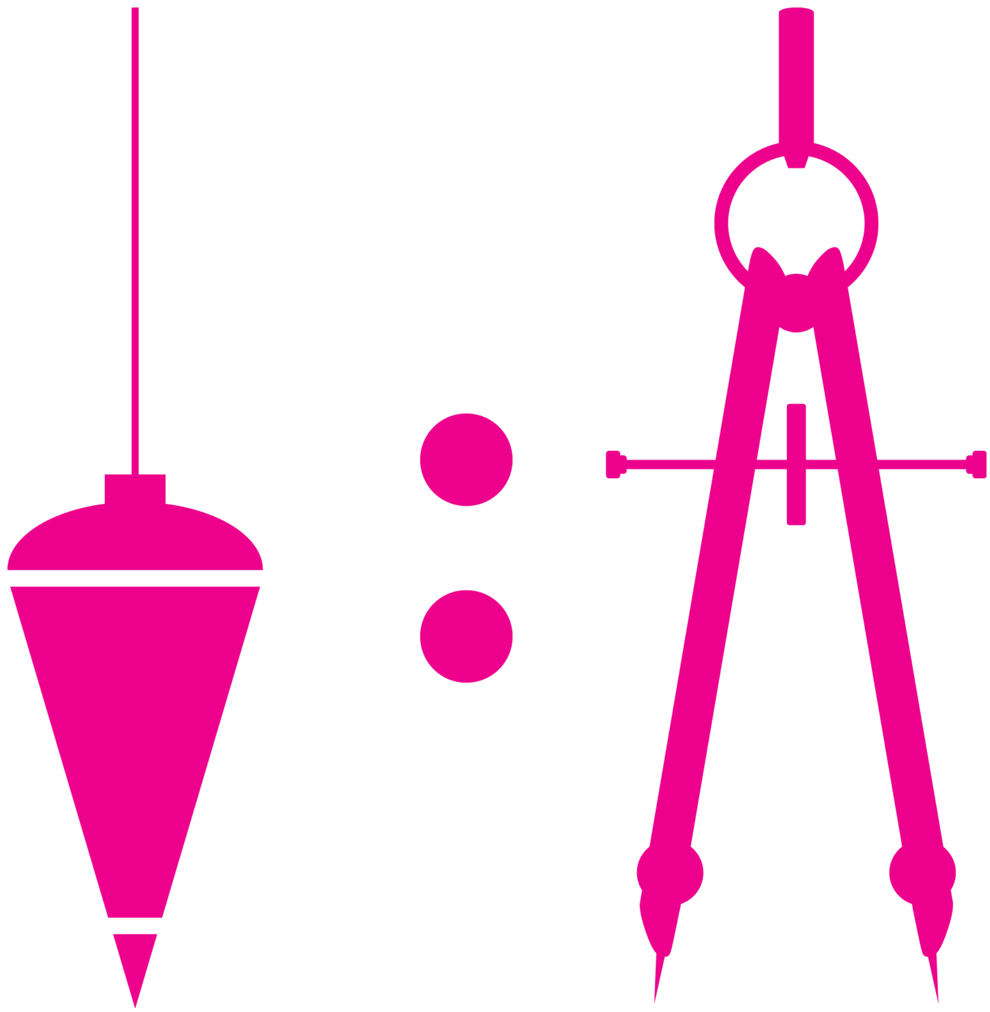
The processes in this studio are meant to engage, in a making-oriented way, the materiality of a common building system and the expressive potential of its detailing and materiality, starting with the premise that drawing is an act of tactility and materiality, as is the act of building. By emphasizing the link between the manner of creation of a drawing and the material influence of that drawing on the space it describes. In blurring the distinction between methods and tools used for drawing and those used for building, it is hoped that the students gained an understanding of the practicalities of such a common method of defining space while gaining an understanding of the potential for creative exploitation of just such a system.

## Notes

[1] Spinoza, Baruch. Ethics. 1677. Book 2, Proposition VII

[2] Zambonini, Giuseppe. "Notes for a Theory of Making in a Time of Necessity" in *Yale Perspecta 24* Yale University Press: New Haven, CT. 1985. p 8.

[3] Wiley, Keith. "Re-framed: Challenging assumptions of process and making in the design studio" in *Proceedings of the 22nd National Conference of the Beginning Design Student* Ames, IA. 2006. p 350.



## ACADEMY:COMMUNITY

Through 1:1 community and industry partnerships, beginning design students learn social responsibility and practical know-how while engaging in real-world problems. Submissions to Academy : Community highlight beginning design projects that connect students with the world outside of design studio—local and global communities, industry, and other disciplines.

# Raising the Roots: Community Engagement through Design/Build Education

Jennifer Akerman | University of Tennessee, Knoxville

"Architecture, more than any other art form, is a social art and must rest on the social and cultural base of its time and place. For those of us who design and build, we must do so with an awareness of a more socially-responsive architecture."

—Samuel Mockbee[1]

Full immersion in pedagogically-approached projects rooted in the public realm can advance a unique and lasting sense of agency and social-responsibility in beginning design students. This paper argues that, as architecture and design programs continue to explore the benefits of design/build education as a means of preparing students to be leaders in the profession, such agency and responsibility, in addition to the myriad well-established benefits of design/build teaching and learning, must be included among the critical learning objectives. This paper will present an ongoing design/build project being realized for a non-profit sustainable farm in an urban community in Knoxville, Tennessee (Fig. 1). Through this project, students and faculty are developing new methodologies for project delivery, for teaching and learning, and for evaluating the efficacy of community-oriented design. Students had no prior experience in design/build work, and for many this was their first encounter with issues of direct construction. Through this experience, students directly engaged local residents, farm workers, city officials, professional architects, engineers, and contractors, as well as industry partners. Ideas of meaningful engagement permeated the pedagogical approach, the design strategies, and the processes of construction.

*Fig. 1. Rendering of entry, Farm Center, Beardsley Community Farm (credit: students of the ARCH471|572 design studio, fall 2014)*

## Strategies of Engagement

*Thinking and Making*

There are many immediate benefits in student learning outcomes that can be attributed to hands-on, one-to-one design/build experiences. Though much has been written about this, William J. Carpenter's book *Learning by Building* (1997)[2] remains a significant resource on the importance of design/build education. He provides a fundamental insight, "The construction studio offers a process in which fabrication is inseparable from the conception of design. It allows for experimentation, learning, and collaboration. If architecture is a thoughtful making of place experienced through the senses, then construction itself is the *thoughtful making* in this phrase. The dual roles of thinking and making are symbiotically joined."[3] Students who have had design/build education benefit tremendously from the development of a deep, imbedded understanding of the connection between idea, implementation, and outcome. They become motivated to seek creative solutions, especially when fueled by very real budget, access, and time limitations. They become motivated to stay active in design/build endeavors beyond school.

*Fig. 2. Student mason laying the first course of brick, summer 2015 (credit: author).*

While those benefits continue to exist, the professional environment in which architecture is performed is becoming increasing more complex. Our graduates are entering a workforce where the architect is expected to provide design leadership, detailing and the development of construction documents at the highest level as to prevent unanticipated costs, comprehensive sustainable design services, and full building-integrated modelling. All of this is expected for limited and diminishing project fees, especially in public work. The increased risks of liability—for construction errors, for cost overruns, for damaged reputations—all contribute to a culture of conservative design in normative public work not commensurate with the needs and aspirations of our clients and of the public at large.

*Public, Socially-Responsive Design/Build*

Samuel "Sambo" Mockbee, the late founder of Auburn University's Rural Studio wrote, "All architects expect and hope their work will act in some sense as a servant for humanity—to make a better world."[4] Due to the interest of students, the energy of faculty, and the support of progressive schools, we see a powerful opportunity to take action in the public realm. Though design/build projects are never easy, the potential for students to directly benefit from such opportunities is enormous, and will shape their future contributions to architecture.

*Engagement as Process |Engagement as Design Objective*

The teaching and learning experience described in this paper stems from a fundamental understanding that engagement can be the motivation for such design/build work, and it can also constitute the design thesis and the pedagogic process at all levels.

## Participatory Design

*Project Overview*

Our client is a non-profit urban farm promoting food security and sustainable agriculture through practice, education, and community outreach. Beardsley Community Farm's mission is to educate people of all ages about the possibilities and methods of organic and sustainable urban gardening.[5] Founded 20 years ago in a public park in a neighborhood that was once a food desert, the farm excels in its mission to provide food to people in need through distribution agencies and non-profits, and its volunteers teach residents how to grow their own food. Yet questions remain. Though volunteerism is high, participation by the farm's key constituency—residents of the immediate communities, which include several public housing sites—remains low. Proximity is not enough to ensure effective engagement. *How could the design of a new facility help this farm more effectively engage and serve her communities?*

Students and faculty are working to design, build, and evaluate a farm shelter of approximately 1,200 square feet, consisting of a flexible classroom, administrative space for the farm staff, and restrooms. This project is understood to be more than a service building—it is expressly designed to create a real community place and to help the farm more effectively engage the residents of this community. The new Farm Center will help Beardsley Farm better educate the public about the benefits of sustainable farming. Designed as a teaching tool, the Farm Center will also educate visitors and volunteers about sustainable design principles in architecture. The design heightens sustainable strategies such that they become elegant and essential features of the place. More importantly, the architecture and landscape is designed to engage the public, especially at the intersections between park and farm. We believe key design qualities of the project will enable the farm to create a place truly for the community, to strengthen its outreach and engagement mission, and to promote a broader sustainability rooted in equity, health and wellness, and environmental stewardship.

*Fig. 3. Student masons on the job site, summer 2015 (credit: author)*

*Participatory Processes*

The city has taken the initiative to pursue student/faculty-driven DBE as a non-traditional project delivery path, recognizing the potential to achieve a building far surpassing the basic need. Additionally, the project includes contributions from an architect of record, a contractor of record, city workers, and a county project manager. The complexity of working with so many partners, within the limitations of an academic calendar, and in consideration of the novice labor force of our students has posed significant challenges and offered lessons in maximizing efforts.

## Forms of Instruction, Logistics of this Design/Build Teaching and Learning Approach

*Beginnings, Saying Yes*

The opportunity to offer this studio emerged quickly. Immediate action was necessary or the project likely would never have advanced. The City of Knoxville had worked with a local architect of record and a construction manager to develop a design intended to meet the modest project budget. Despite three rounds of design, documentation, and cost estimation, however, they remained over budget. Design faculty at UT were then approached to offer the opportunity for students to take this project on as a design/build effort. Faculty worked quickly, first identifying a potential cohort of students and courses that could possibly take this on. With only an approximate framework of the project life or the degree of engagement possible or needed, faculty and administration worked to secure tentative coursework permissions. A draft one-year plan was established, that was then re-considered each semester as new realities became evident. This summary should make it plain that extraordinary patience and flexibility based on mutual trust is the only way a project of this nature can move forward. Administration assisted to anticipate and clear hurdles. Faculty invested a significant amount of time and research funding to support the project beyond the city's available resources.

*Courses, Basic Pedagogic Structure*

To date, almost 50 students, including undergraduate and graduate students of architecture, landscape architecture, interior design, civil engineering, and environmental studies have participated in this project performing the bulk of the design and construction effort. Virtually none of these students started with experience in construction—certainly not specialized training in masonry or carpentry—though many have now developed extraordinary abilities in these crafts. Because our program does not have specific studios dedicated to design/build, faculty had to work the project into existing studios, including comprehensive design integration, and a series of options studios, supported by seminar courses in special topics of fabrication. All of these courses co-enrolled students of different levels—third-, fourth-, fifth-year undergraduate, and first-, second-, and third-year graduate students.

## Engagement

*Collaborative Design*

Primary design was conducted in the fall 2014 semester through a comprehensive design integration studio. It was essential that students move beyond the ego of the individual designer to embrace a fully collaborative design process in order to make progress. This held many challenges for students and faculty. The introductory design studio was run in some ways like an office charrette, students starting with twelve individual design approaches which were then collaboratively vetted for design merit, ability to meet the client's needs, and constructability. This involved a large amount of instructor-moderated group discussion to facilitate the discovery of common goals while maximizing design rigor. Students analyzed the initial approaches for strengths and commonalities, then synthesized three unique strategies for further study. Of these, one winning approach was selected by student and faculty vote with direct input from the farm, the city, and other project stakeholders. By the end of the fall semester this "Rock and Tree" scheme was developed into a final proposal.

*Working with Project Stakeholders*

At key times throughout the full project process, students presented their ideas to the farm managers, to the city, and to the architect of record. These conversations directly shaped the ethic and design decisions made collaboratively by the student team (Fig. 4). Representations of the design as well as project graphics overall were developed with a public and academic audience in mind. As construction began, students took place in weekly project coordination meetings and interacted daily with stakeholders at the job site.

*Fig. 4. First meeting with farm managers, fall 2014 (credit: author).*

*Understanding the Context of Engagement*

Students conducted a great deal of research into the site and history of Beardsley Community Farm and its surroundings. The farm is a non-profit that supports other non-profits: the food grown at Beardsley goes to other food agencies such as Mobile Meals, food banks, and shelters. Additionally, there are many entities in the nearby community who potentially could connect with Beardsley as potential volunteers, including public schools, churches, scouting groups, and a library. The Mechanicsville and Beaumont community also culturally significant as historically black neighborhoods adjacent to Knoxville College, a struggling historically black college. Design students worked with students of sociology and ethics to begin understanding the complex cultural context and history of this place. Students conducted mapping exercises, collages, and experiential representations to document their findings.

*Volunteering at the Farm*

Students also participated as volunteers at Beardsley Community Farm several times throughout the design phase. Through this direct experience, they gained insight to needs of the farm that the client had not been able to articulate. These included appreciation for site challenges such as topography, poor sight lines, and vandalism, that all informed the students' design approach.

*Interviewing Users of the Park*

Volunteering at the farm and spending extended amounts of time at the project site and the park, also allowed for direct engagement of non-farm users of the park. The project site is immediately adjacent to a basketball court used by many area youth. They often would ask questions about the project, opening dialogue to informally learn about these community members' needs and interests. This directly resulted in redesigning aspects of the amphitheater, water fountains, public restrooms, the outdoor classroom, and the site fence in interest of opening up a more productive dialogue and more effective engagement between Beardsley Farm and residents of the immediate Mechanicsville and Beaumont communities.

Designer, educator, and activist Liz Ogbu, formerly of Public Architecture, visited the College to deliver a lecture in fall 2015.[6] She met with students from our studio and offered advice from her experience of developing numerous projects intended to engage the public, including Public Architecture's design for a portable Day Laborer's Station and the NOW Hunter's Point project in San Francisco. Ogbu encouraged us to informally seek the advice of residents one-on-one, rather than organizing a larger public workshop. Though workshops and charrettes can be useful vehicles, they can also fail to be inclusive of the people most affected by a project, due to limitations of schedule, opportunity, and communication. In developing the design for a small amphitheater component, students mocked up the layout of retaining wall benches along a hillside that mitigates the center of the farm and the rest of the park. Leaving staked out string and spray-painted boundaries visible for several days, students asked passers-by for their input. This led to adjustments in the location and orientation of benches and gathering spaces, in the hope of creating a space that is more welcoming to users of the park at large.

*Fig. 5. Student volunteers installing amphitheater gabion walls, fall 2015 (credit: author).*

## Design Never Stops

### *Learning by Doing*

Throughout the "build" semesters, spring, summer, and fall of 2015, students engaged a cyclical and recursive process of thinking and making, designing and building that led to continual design evolution stemming from their enhanced understanding of the potential of various construction approaches.

Students worked directly with a master mason, J.C. Newman, to learn the craft of bricklaying. During the design phase of the project, students had selected load-bearing brick as the primary building material. They wished to take advantage of its passive heating and cooling benefits, to explore innovative detailing opportunities, and also to give the work both a real and perceived permanence for the community. With student masons as the workforce, a higher level of craft and performance became possible. The students were also instrumental in engaging a local brick manufacturer, General Shale Brick, in donating all brick and mortar.

Throughout spring and summer, students executed a significant amount of the structural work, laying the block foundation walls and structural brick walls (Figs. 2 and 3), while also designing and fabricating pre-cast concrete elements such as sills and lintels.

When rainy weather precluded progress at the construction site, students worked in studio developing large scale models and sketches of details yet to be finalized (Fig. 6). The design was continually under review and refinement well throughout the construction process.

Students in a seminar course in fall 2015 executed focused design development and fabrication of many discrete parts of the project fit-out, including custom doors, casework, the design approach for a bamboo screen wall, and the modest amphitheater within the park intended to directly benefit local residents. Concurrently, faculty and research assistants continued to provide project coordination, design, and fabrication assistance to aspects of ongoing construction.

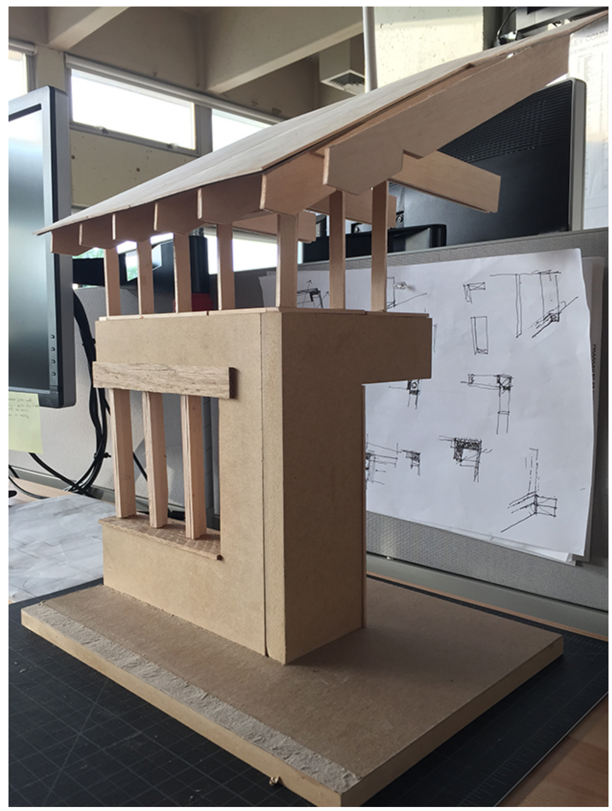


*Fig. 6. Large-scale study model, studio, summer 2015 (credit: author).*

### *Design and Fabrication Technology*

The continual design process was enhanced by access to the College's advanced design and fabrication resources. Students were able to achieve much more than would have been possible in a conventional design, bid, and construct approach because of the availability of tools and the students' and faculty's willingness to use inventive approaches. The ability to waterjet cut structural steel in the fabrication of column bases, and use of CNC milling to construct custom formwork for pre-cast concrete sills and lintels allowed project-specific details to be realized (Fig. 7).

The students used full building modelling as a means of detailing, through a mix of Revit, Rhino, and AutoCAD. After trying a range of approaches, the student design team found it most successful to develop detailing strategies through a very complete Rhino model that was then reverse-engineered into more conventional section and plan details. This allowed coordination and resolution at complex intersections, often overlooked until problems arise in the field.

*Fig. 7. Brick and concrete detail mid-construction (credit: author).*

## Consequences

### *Agency and Activism, Subversive Leadership*

Students participating in this design/build project gain imbedded knowledge through critical hands-on architectural research. Pedagogical approaches rooted in the act of making allow students to gain expertise and significant understanding of the possibilities and liabilities of the architectural craft. We see a passion for architecture and leadership emerge through this process. Samuel Mockbee said it is our obligation as educators "to remind the student of architecture that theory and practice are not only interwoven with one's culture but with the responsibility of shaping the environment, of breaking up social complacency, and of challenging the power of the status quo."[7] Through their experience designing and building the new Farm Center for Beardsley Community Farm, our students have gained an appreciation for the potential of architecture to serve a greater community, and for carefully considered design to actually facilitate the engagement mission of their client.

### *Engagement*

One of the metrics for evaluating the success of the design approach will be continued monitoring of how the public uses the farm, uses the park, and uses the intermediate spaces created through this project. *Do people linger in the amphitheater? Do non-farm-affiliated community members feel welcome to hang out in the outdoor classroom? Does any of that increase volunteerism of area residents at the farm? Do acts of vandalism decrease?* These are questions we will monitor and evaluate in the post-occupancy period as performative metrics of our ability to effectively engage the public via design/build architecture.

### *Professional Implications*

While we applaud the positive outcomes of this project, the fact that it exists indicates a failure in conventional delivery methods. John Cary, the former executive director of Public Architecture, writes in his introduction to *The Power of Pro Bono*, "Community, humanitarian, and pro bono design—indeed, the public interest design movement as a whole—evolved in response to the failure of the mainstream architecture profession to serve a much larger percentage of people than it has historically."[8] We see this project as the first of potentially many future collaborations between the University, regional governments, and nonprofit organizations to bring the expertise and experimentation afforded by educational design/build efforts to directly benefit members of the community who might not otherwise have the opportunity to participate in and benefit from carefully considered architecture. There are now 50 student veterans of this project. It is our hope that their future leadership in the profession will promote similar alternative design practices and evolution towards a more socially-responsive ethic.

*Fig. 8. Construction progress, fall 2015 (credit: author).*

## Notes

The author offers her sincere gratitude and appreciation for the contributions of many students, research assistants, faculty, administrators, and myriad additional team members who have made this project possible. The full project is a collaboration of the UT Design/ Build/ Evaluate Initiative (DBEI) of the College of Architecture and Design, the City of Knoxville, the Public Building Authority, Elizabeth Eason Architects, and Merit Construction. The construction budget is funded primarily by the City of Knoxville, with generous material donations from local industry partners and businesses.

Primary faculty: Jennifer Akerman with Robert French, Ted Shelton, and Tricia Stuth, and masonry instruction from J.C. Newman. Research assistants: Eric (Bud) Archer and Bailey Green, with Angela, Claeys. Students: Summer Abston, Kari Leann Anderson, Jennifer Aplin, Eric (Bud) Archer, John Battle, Edgar Bolivar, Caleb Brothers, Adam Buchanan, Lauren Buntemeyer, Hunter Byrnes, Kenna Cajka, Yu Chen, Angela Claeys, Lindsay Clark, Cayce Davis, Taylor Dotson, Catherine Dozier, Zane Espinosa, Catherine Felton, Rebecca Gillogly, Bailey Green, Ethan Griffin, Jake Heaton, Geneva Hill, Daniel Hodge, Kevin Jeffers, Sierra Jensen, Terry Lee Jones, Samyucktha Kadiresan, Will Logan Kimbro, Whitney Manahan, Hayley Mull, Mark Nickell, Changbum Park, Alexis Porten, Gina Raffanti, Justin Relyea, Andrew Russell, Chris Sayre, Michael Sena, Aaron Shugart-Brown, Demitrius Smith, Amy St. John, Jerry Sullivan, Hunter Todd, Jared Wilkins, and Nicholas Zath.

[1] Mockbee, Samuel. “The Rural Studio” in *Constructing a New Agenda: Architectural Theory 1003-2009*, edited by A. Krista Sykes. Princeton Architectural Press: New York. 2010; p 105-115.

[2] Carpenter, William J. *Leading by Building: Design and Construction in Architectural Education.* Van Nostrand Rothchild: New York. 1997.

[3] Carpenter, p 3.

[4] Mockbee, in Sykes, p 107.

[5] www.beardsleyfarm.org.

[6] www.lizogbu.com.

[7] Mockbee, in Sykes, p 108.

[8] Cary, John, Majora Carter, and John Peterson. *The Power of Pro Bono: 40 Stories about Design for the Public Good by Architects and Their Clients.* Metropolis Books: New York, 2010; p 28.

# project (RE) Cycle

Robert Alexander | California Polytechnic State University, Pomona

## An Introduction to Design (but bigger).

The education of first year architecture students and beginning designers poses special and unique challenges for studio instructors. Project briefs for introductory studios that are often seen by their authors as a tool to help expand student's visual acuity and aesthetic discernment can be beguiling and confusing to those who have no previous background in art or design. To the initiated this can frequently be the best part of teaching first year design studios, watching students discover, unpack and then utilize principles of design that are usually outside of their pre-college experiences.  It can however also sometimes lead to frustration on the part of students and instructors alike, as faculty ask students to at once to think critically and at the same time commit to work, that in the student's mind, may not have a clear outcome. The "leap of faith" and the commitment to a disciplined process that good design requires of students can sometimes be made more immediate by directly engaging in studio work that is built at full scale. It is in these projects that beginning students can quickly apprehend and experience the outcomes and consequences of their design decisions.

The full-scale project is also a useful way to postpone the kind of seduction that students are prone to, as Robert Somol puts it, "by new technologies that provide answers before the significance of the questions can be formulated"[i]. Gravity and its impact on architecture, it seems, still has a place in architectural investigation. The engagement in building at full scale can be a useful way to quickly initiate a conversation between all the design facilities that we seek to promote in students, both digital and analog.

As a teaching tool and as a design project, working on small projects that are executed at full scale in introductory design classes also has the potential to benefit faculty, students and the campus community alike in a collaborative and creative environment. This paper will discuss some observations and outcomes from "project (RE) Cycle", an exercise that was a part of Cal Poly Pomona's first year architecture studio curriculum, which ran from 2011 to 2014. Although the studio exercise began as an activity focused around the students of the architecture department specifically, over the course of several years, the first year studio was eventually invited to install projects on campus and they were the centerpiece of a festival highlighting cycling and sustainability hosted by the universities' student leadership.

*Fig. 1 - June 2013, First Year Project (RE) Cycle installed in the central campus at Cal Poly Pomona (Instructor: Robert Alexander).*

### *Project (RE) cycle.*

The design project (RE) cycle was initiated as part of Cal Poly Pomona's first year curriculum to give students experience in material exploration, design collaboration and an introduction to basic methods of construction and tectonics. After a series of case study exercises which saw the students building models and drawings at increasingly larger scales, Students were then asked to use their previous research of tectonic, material and organizational case studies to competitively submit designs for full scale constructions. These structures would accommodate student bicycle parking, seating and relaxation spaces. The size limitation of this exercise was held at one standard parking space (9 ½ feet by 18 feet) found in front of the architecture studios at Cal Poly Pomona. From these initial individual student projects, whose models and drawings were built and drawn at 1" = 1', a jury made up of faculty – who were not affiliated with the studio- selected the 12 projects that would continue to be designed and eventually built at 1:1 scale. The time allowed for this project from the initial design competition in the $5^{th}$ week of the 10-week quarter to the final completed installations was 4 weeks.

A secondary motive of the project's brief was to call attention to the lack of a sufficient bike infrastructure on the Cal Poly Pomona campus. Despite the increase in cycling traffic and the use of bicycles on campus over the last 5 years, the infrastructure has not met the demand and still remains completely inadequate. Confronted with a project for bike parking, students were put in the unique position of having to advocate not only for the novelty and appropriateness of design responses but also to make installations that would bring attention to the need for this type of project to be built on campus permanently.

*Fig. 2 Invited jurors, guests and students take part in the final selection process for the project RE cycle competition (Instructor: Orhan Ayyuce)*

*The Project Site.*

The specificity of the parking lot site provided some useful constraints that students found particularly challenging. Because the chosen parking lot for the project was in use most of the day, construction had to be choreographed around the parking patterns of the studio building's users. This led many of the successful student teams to adopt design strategies that could be moved, constructed and then staged with a minimum of on-site assembly. A second challenge that the site provided was for the students to imagine how their projects would interact with the cars and the spaces created between both filled and vacant parking stalls in the lot. This aspect of the exercise ultimately proved to be problematic in the pilot year of the exercise for students and faculty using the parking in the lot. It also became dangerous at times for students at work in an unprotected area and in subsequent years a "safe zone" for construction was demarcated in the parking lot as well as a time limit for project assembly. Despite early setbacks with the exercise, the use of the parking lot as a site proved not only to be beneficial for student's to access their construction sites frequently, but it also proved to be an excellent way to create a connection between faculty and students of other years and of other programs on campus that used the parking lot. In this way the disruption of the student's projects worked to attract attention and helped to facilitate the start of some dialogue within the school and also potentially with those who oversee parking on the campus as they were forced to acknowledge that bicycles take up much less space to park than cars do and that it was very hard to give parking tickets to architecture projects.

*Fig. 3 One of the student projects (Instructor: Behn Samereh) being used to host lunch.*

*Fig. 4 Projects under construction before final installation (Instructor: Ana Escalante).*

***Exploring Materiality.***

In the project (RE) cycle assignment the role of recycled materials was of prime importance. Students were limited using materials that were already on their second or third lives with the necessary new mechanical fasteners and attachments being the only exception to this rule. The purpose of mandating the use of recycled building materials was two fold; to aid the students in understanding a materials potential to be discovered or rediscovered and also to force the students to confront a useful constraint on the design that would limit the units or modules of construction to a size that was manageable to build in the short time frame of the studio.

The challenge of the project became not only one of making a legible form of a project made up of reused materials or of exploring clever methods of attachment and construction. The central problem of the assignment became a logistic one of how first year students could procure materials, get them to the site, and prepare them for installation within the scope and the original intentions of the designs that they had initiated. As the project has developed over the years, students and faculty have begun to build a network of potential donors and locations where recycled building materials can be found and purchased inexpensively in the area. In engaging in the recovery of potential materials, students were encouraged to look outside of traditional locations that they may typically think of to buy materials, such as large retail hardware stores or plastics distributors. This has helped students to potentially discover more layers in their designs than they might have previously by using a more deterministic approach in execution and material choice. Instead they have had to curate and select from an assortment of choices with an eye towards a material's development and incorporation into their projects. As part of the assignment, it became necessary for students to weigh a material's potential not only aesthetically and economically, but also logistically in a setting where the impact of failure had very few consequences and could easily be remediated at a very low cost.

*Fig. 5. Final projects being reviewed in their assigned parking lot sites. (Instructor: Robert Alexander)*

***Project Management.***

Experience has taught that 1:1 constructions require an enormous amount of attention by studio instructors, who in foundational design studios, take on a great deal of responsibility for their student's project management, scheduling and coaching to ensure successful project delivery.  The failure to deliver successful projects that are built at full scale can and have had a larger affect on student's morale and confidence than perhaps with smaller scale traditional studio projects. The scale of the projects themselves demand an attention and scrutiny that can be more easily avoided "inside the building- in the studio" and can sometimes result in failures, structurally or aesthetically, that are much more obvious to peers of both faculty and students. While the stakes of a project like this are still much smaller than building permanent buildings, these installations and their potential failure can have a lasting impact on the psyche of young students. Teaching good project management habits and skills in 1:1 scale constructions becomes a vital part of not only ensuring a successful project but also helping to instill a much needed sense of confidence and sense of accomplishment in the beginning design student.

In this exercise students formed teams in which they assigned specific roles to each other. A student project manager was chosen out of the team of 6 to 7 that was usually not the designer of the selected project. Creating this role in the student led teams had two positive outcomes. The first was that studio instructors had one point of contact to discuss and assess how the project was being executed and what problems may have appeared on the horizon during its development. The second was to acknowledge certain students who may have possessed skills that were not necessarily befitting the more traditionally praised "star" student designers of the class. This was a rare opportunity in an academic architecture environment, that at times, evaluates a design student's success almost solely by their conceptual accomplishments or by their representational capacity and to give some attention to other students with unique skills and characteristics. In this exercise, design and formal novelty were balanced with other equally important skills that are vital to a student's development as a future professional like their ability to organize, communicate with each other, and to be an effective team member.

*Evaluating Group Work.*

The scale of 1:1 construction projects as a studio exercise meant that some collaboration and /or group work was inevitable. In the pilot year of this exercise, individual studio instructors were responsible for selecting and organizing groups within their classes. With 20 to 22 students per studio section, this meant that each studio group was responsible for completing 3 designs for a total of 12 projects that year. With a group of 6 to 7 students working as a team, inevitably conflicts can and did arise. After previously difficult experiences with group projects in other first year exercises, the faculty implemented a mandatory peer grading system to help students understand that they would be held accountable to each other for their performance during the project's design and construction. At the conclusion of the quarter, Students were asked to score their team members based on the following criteria: communication, leadership, care, detail, and organization. Initially some student's reacted negatively to the idea of "telling on" or "ratting out" their classmates, but as faculty began to use these scores as a portion of the student's overall studio grades and students had an expectation that they would be evaluated using these criteria, it became a useful document for instructors to understand the dynamics of the team and problems during the quarter that may have gone unseen out of the view of the faculty.

*Fig. 6 Project (RE) cycle constructions installed in the central campus of Cal Poly Pomona (Instructor: Behn Samereh)*

### The Power of Architectural Spectacle – Reaching Out to the Larger Campus

After 2 years of hosting project (RE) cycle in the parking lot of the architecture building, a site that is somewhat removed from the rest of the campus, the first year faculty was approached by the Cal Poly Pomona ASI (Associated Students Inc.) -the University's student leadership, to bring the studio's finished bike shelter projects into the central of campus to be a part of a cycling and sustainability themed festival. The spectacle of students from around the university watching as architecture students prepared, assembled and presented their full scale projects in heavily travelled and used spaces on the campus spoke to the power that student projects built at full scale have to engage a university's non-architecture community in a dialogue with designers. With a majority of Cal Poly Pomona's architecture department's studios located outside of the center of campus, a large portion of the campus community, including faculty and administrators rarely come into direct contact with the architecture department's student's projects. Because of the nature of these constructions; their obvious function, their scale, and their novel use of recycled materials, people found the projects accessible and spent time talking to the students responsible for the projects. The projects acted as a conversation starter on the campus for the day that they were installed and had people from the university, who were not involved in architecture or the department asking questions that students may not have expected from a more typical review of their work by faculty and invited guests.

### Notes:

---

[i] R.E. Somol, "Operation Architecture" in *Inchoate: An Experiment in Architectural Education, Marc Angelil* (Zurich: ETH/ACTAR, 2003), 11-17

# Design Intelligence in a Box

Robert Arens | California Polytechnic State University, San Luis Obispo

*Fig. 1 Version 4 of the shelter in its final stages of completion*

The author of this paper, along with colleagues and three teams of students of architecture and engineering, set out to develop an emergency shelter that could be mass-produced and rapidly deployed to disaster relief sites. At the outset we found that this project challenged us on multiple levels: 1) the scale of the shelter was closer to product design than architectural design thus requiring a different way of thinking than typical design and delivery methods; 2) due to the shelter's emphasis on prefabrication, lightness and simple erection, conventional materials and methods of construction common to architecture were largely irrelevant; 3) given the project's emphasis on large-scale production and rapid-deployment, aesthetics and form were secondary to the shelter's agency, function and performance; and 4) the lack of a specific site and cultural context challenged our notion of architecture's relationship to placemaking. These challenges collapsed into one overriding question: How do we understand and work through this unique architectural problem?

Although this project occupied the fringes of architecture, we nevertheless sought a theoretical framework for our work. We drew heavily from the notion of design intelligence, specifically versioning, a methodology that leverages technology to expand the possibilities of design through iterative prototyping and experimentation. The two related ideas of design intelligence and versioning which emerged in the early 2000s have proven to have limitations when addressing architecture's social, cultural and urbanistic programs, but given our project's emphasis on agency, function and performance, as well as our desire to develop the shelter at full-scale with actual materials, they provided the disciplinary-specific grounding we needed to approach this unique problem.

Our approach to the shelter's design was tested with successive prototypes, and each generation not only informed new prototypes but also clarified our research position. Many of the materials used for prototyping were outside the normal palette used in architecture and shaped using digital tools which required a skill set we didn't possess. A considerable amount of our time was spent consulting with material engineers, product engineers, packaging designers and farmers. Looking back at this project we realize that we were pushed well beyond our limits as architects and engineers, and this resulted in immeasurable growth as designers. This raised a second question for us: if versioning was a catalyst for design growth in our research pursuits on the emergency shelter, could a similar methodology be a pedagogical platform for interdisciplinary design education?

## Design Intelligence: The Context of Versioning

Amid discussions taking place in the early 2000s regarding shifts taking place in architecture, Michael Speaks wrote, "If philosophy was the intellectual dominant of early 20th century vanguards and theory the intellectual dominant of the late 20th century vanguards, then intelligence has become the intellectual dominant of 21st century post-vanguards." To Speaks design was privileged over all other activities, particularly when it employed digital design and fabrication, as well as the knowledge that accrues from research and engagement with "the Real". "While vanguard practices are reliant on ideas, theories and concepts given in advance, intelligence-based practices are instead entrepreneurial in seeking opportunities for innovation that cannot be predicted by any idea, theory or concept."[1]

The term that Speaks coined to characterize the emerging attitude was design intelligence. He wrote, "Design practices with high design intelligence quotients are able to manipulate the problem given to search for opportunities that can be exploited, thus allowing for a greater degree of innovation. Such practices also view design as dynamic and non-linear, and not as a process with a beginning, middle and end. Accordingly, the relationship between thinking and doing becomes more and more blurred so that thinking becomes doing and doing becomes thinking, engendering highly collaborative, interactive forms of practice that are already changing the face of architecture".[2]

*An Attitude Rather than an Ideology*

The argument of Speaks for "the relevance of the design act and how it carries its own embedded knowledge" was a convincing one, but also vague in terms of actual strategies for generating design intelligence. Coren Sharples and her colleagues at SHoP Architects stepped in to suggest that designers become active collaborators in the entire process of architectural realization by engaging technology, specifically parametric modelling and digital fabrication, and using it to integrate design with construction. They edited an edition of *Architectural Design* in 2002 entitled *Versioning: Evolutionary Techniques in Architecture* and invited contributions from their peers who were interpreting versioning in various ways. In the introduction Sharples writes, "Versioning can be seen as an attitude rather than an ideology. It implies the shifting of design from a system of horizontal integration (designers as simply the generators of representational form) towards a system of vertical integration (designers driving how space is conceived and constructed and what its effects are culturally)."[3] She echoes Speaks' suggestion to collapse thinking and doing in an interactive form of practice: "Can the forces that make the object, both in the generation of the broad strokes and the specific resolutions, combine with an intelligence of fabrication to become a 'process product'?"[4]

As it turns out, versioning wasn't entirely new, but rather was a concept borrowed from other disciplines such product or packaging design. It was the cornerstone of disciplines that develop prototypes prior to high-yield production. Designers in these fields create an initial prototype or primary source, then evolve successive prototypes in a linear process, with each new generation measured against the archetype. Sharples sought to expand this strategy for an architectural context, in part due to architecture's scale and complexity. She wrote, "By not relying on a formal apparatus or protoform, the practice of versioning is capable of responding in a nonlinear manner to multiple influences. By developing an elemental vocabulary of conditions in the planning stages for each project or project type, the practice of architecture becomes less about a search for a specific overriding form and more about a specific formal means of production to address variable conditions."[5]

The project team saw the emergency shelter prototypes, with their complex program but manageable scale, as an opportunity to test the concept of design intelligence. By employing a combination of traditional (linear) and architectural (non-linear) versioning strategies we sought to accelerate the development of multiple full-scale iterations of the shelter. And by toggling back and forth between vector-based information and actual materials, we hoped to discover affordances and contingencies in our work. Approaching the emergency shelter as a 'process-product' seemed to us a viable direction for the project.

Sharples and her colleagues sought to make the design/fabrication process more opportunistic, strategic and optimistic; all of these were objectives we established for the shelter. She wrote, "Versioning can be characterized by a set of conditions organized into a menu or nomenclature capable of being configured to address particular design criteria. The primary source is constructed from a set of detail types comprising a menu, and organized around a collection of specific detailed actions capable of evolving parametrically to produce specific effects or behaviors."[6] Our set of conditions, criteria and actions that evolved in of the shelter project are discussed in the next section.

## Emergency Shelters: A Prelude

National and international headlines regularly point to the alarming frequency and severity of natural disasters. Even a cursory glance at statistics compiled by international agencies reveals the extreme costs in human life and the enormous social of natural disasters spiked dramatically in the 21st century, a trend that is likely to continue. In total, an average of 335 weather-related disasters were recorded per year between 2005 and 2014. This represents an increase of 14% from the recorded during 1985-1995.[7]

*Fig. 2 Before (left) and after realities of tent cities*

When considering how designers may address this grim situation, a number of areas present themselves: housing, food and water supply, infrastructure, etc. The combined expertise on our team led us to focus our effort on what is commonly referred to as sheltering, that is providing basic shelter for persons displaced due to the loss of their permanent housing. As context, disaster officials, such as the Federal Emergency Management Agency in the United States, view post-disaster housing in three ways: sheltering, interim housing and permanent housing. Sheltering (see Fig 2) refers to basic protection employed for short periods of time until the disaster subsides and the displaced population can return to their permanent dwellings. Interim housing refers to situations where permanent dwellings have been destroyed or rendered uninhabitable by serious disasters thereby necessitating temporary structures for displaced populations to occupy for extended periods (generally up to 18 months). Permanent housing refers to long-term structures used as permanent residences following natural disasters; these may be habitable or repairable structures that displaced populations return to, or may be housing intended to replace structures rendered permanently uninhabitable.

*Taking the Long View on Shelter Materials and Methods*

Due to complex and overlapping factors, the line between these three types of housing is often indistinct. Major factors such as the severity of disasters and the shortage of resources (funding, labor, materials, etc.) contribute to secondary factors such as extended clean-up periods and the inability to repair or replace existing housing stock. Consequently, shelters constructed of temporary materials are soon pressed into service as interim housing inhabited for years not months, a period well beyond its intended lifespan. Worse yet, most sheltering, if forced to function as interim housing, reaches the end of its useful life before permanent housing can be provided (see Fig. 3). Although a greater challenge, we felt it was necessary to design a shelter that would address rather than ignore this troubling reality.

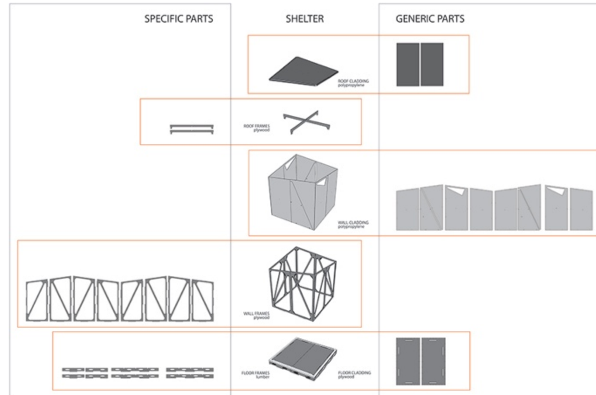



*Fig. 3 Our strategy calls for a combination of specialized elements using short-life materials and generic elements using durable materials*

The design team crafted the following set of six goals for the shelter design: efficiency, lightness, pack-ability, constructability, adaptability and re-usability. The first five address the short-term considerations of producing and providing a viable emergency shelter. The last goal, re-usability, was a response to the harsh reality of sheltering, namely that short-term shelters often become interim housing in settings where the resources to replace it with permanent housing are limited. In other words, unless temporary shelters can contribute to the future rebuilding effort in some measure, they are a solution of limited value. Our approach called for a combination of short-life components that are easily recycled and more durable components that are easily repurposed as building materials for bona fide interim or replacement housing (see Fig 3).

## Versions of the Shelter: Prototyping at Full-Scale

Due to the material and constructional feedback prototyping affords, we planned to give it a central role in the design process That said, the design team initially focused on research and simulation when we began the project. In terms of form, we looked at precedents that achieved strength with the minimal means possible, e.g. thin shell structures from the 1950s and 60s by Candela, Dieste and Isler which had favorable strength-to-weight ratios. Their understanding of structural form, particularly the nature of the hyperbolic paraboloid, allowed them to reduce the material thickness without sacrificing stiffness. As designers we wondered if the hypar's strength-to-weight ratio, as well as its characteristic of being formed from a series of straight segments, could indirectly inform the durability, lightness, and stiffness of an emergency shelter. Of course, we also looked closely at the scores of shelter approaches offered by designers addressing the vexing problem of disaster relief.

*Fig. 2 Versions 1 (left) and 1X of the shelter*

We also conducted research on a broad range of materials. Although our focus was on sheet materials in wood, cardboard, plastic, etc. we also looked at composites made from combinations of recycled materials. One which showed promise consisted of a matrix of polypropylene reclaimed from irrigation tubing used in agriculture and destined for the landfill. The fibers that lent the material its tensile strength were harvested from kenaf, an inexpensive and fast growing plant from the hemp family. Ultimately this material was determined to be too dense and heavy for this project, but hopefully this promising material may eventually find its way into the architectural lexicon.

*Version 1: Refining and Testing Our Approach*

We began prototyping with several key decisions derived from our research: 1) the shelter components should stack flat and fit into a crate built of stock lumber sizes; the crate should also double as the floor; 2) in order to pack flat in the crate, the walls and roof would be made of two layers of sheet materials, one acting as structure and the other as cladding; 3) the base and cladding materials should be of durable materials and generic in form to allow for reuse in building projects beyond the life of the shelter; the structure may be of non-durable materials and specific in form as long as it is recyclable; 4) connections should be as simple as possible (friction joints, zip ties, bungee cords, etc.) and allow for replacement or hacking; and 5) the shelter design should avoid cultural references as much as possible so as to avoid inappropriate architectural associations. Versions 1 and 1x of the shelter (see Fig 4) were developed by a team of four students and the author (Team 1). We used 4'x8' panels of plywood as the base, wall and roof structure; our objective was to shape the two base panels as little as possible (to allow future use) and to shape the eight wall panels as much as possible (to save weight). Version 1 was constructed as a single 64 square foot module of space as defined by two sheets of plywood (two halves of the overturned crate), whereas Version 1x was a double module or 128 square feet. To shape the wall and roof structure, we cut each panel using a CNC router which not only allowed our work to be more precise, but also allowed the study

*Fig. 5 Versions 2 (left) and 2X of the shelter*

of possible high production methods for fabricating the shelter components. For cladding we explored the use of recycled corrugated polypropylene, a material that is light, strong, inexpensive and available in a range of translucencies. Through prototyping we found that clear 4mm thick panels with scored openings for doors and windows worked well as wall cladding, while thicker panels of 6mm gray PP effectively braced the roof and reduced solar gain. The clear panels used for the walls transmitted ample, filtered daylight and their cavity construction provided a small amount of acoustic and thermal insulation.

*Version 2: Material Modifications*

A new team of three students and the author (Team 2) analyzed the strengths and weaknesses of Versions 1/1x with a fresh critical perspective so we could formulate the next generation of shelters. Version 1's plywood base performed well both as a crate and a floor and it was generic enough to lend itself to future rebuilding efforts. The corrugated polypropylene functioned well as cladding since it was light, weather-resistant, inexpensive, durable and re-usable. The plywood structure used in Versions 1/1x, however, was strong and durable to a fault; its lifespan would far exceed its use in a temporary structure. Since it's specialized shape would likely preclude their use in future rebuilding efforts, we decided that the structure should be built of lighter, less durable materials. The goal of the Versions 2/2x then, was to optimize the walls and roof (see Fig 5).

As an alternative to plywood we explored the use of paper-faced honeycomb panels commonly used as dunnage by the packing and shipping industry to protect and secure freight. These panels have some of the characteristics that attracted us to plywood: they are panelized, modular, they can be easily cut on CNC tables, and their cross-sectional properties give the panels a surprising strength-to-weight ratio. Most importantly, the panels have a shorter lifespan, lower cost and lighter weight than plywood making them an appropriate choice for the shelter's structure. Additionally, they are easily recycled at the end of their useful life.

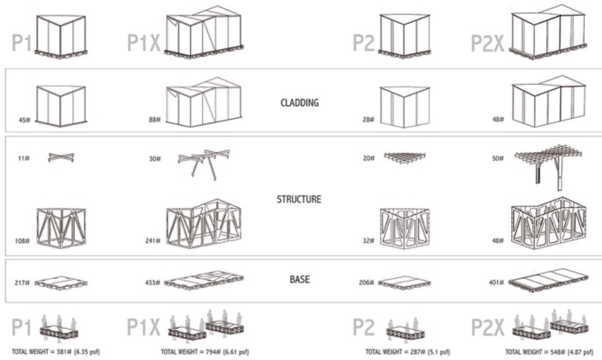



*Fig. 3 Version 1-2 with associated weights for each component*

Wall panels were developed using 1" thick corrugated cardboard panels. These were found to be light and stiff enough as individual panels, but unstable when combined as a one or two module shelter. The roof therefore became a critical stiffening element for the entire structure; to make it stiff we designed and built it as a grid shell with notched and zip-tied connections.

*Version 3: Formal Modifications*

Yet a new team of students and the author (Team 3) generated a new version of the shelter based on the advances and drawbacks of Version 2. Our material choices seemed sound, but our approach to the grid shell roof required excessive fabrication (cutting) and increased field labor (assembly; hoisting). In response, we abandoned the grid shell and opted for a simple shed configuration that allowed the structure to consist of four 4' x 8' paperboard panels notched to create simple connections to wall panels (see Fig 1). Light and strong, the panels were easily lifted into place. Since the friction connections in cardboard invariably slacken over time, however, the roof provided less bracing for the walls and instability resulted. Our solution was to subtly angle each panel to create pleats. The team found that a deviation of 6" sacrificed only a small area of interior space but resulted in a significantly stiffer structure. To stabilize the structure further and improve weatherproofing, the roof cladding was changed from corrugated PP sheets to a polyethylene tarp secured to the base with bungee cords. The tension in the tarp increase the friction in all joints and "belted" the entire structure. Additionally, the tarp provided variability: it could be adjusted to provide additional additional shade on one side of the other or adapted as a cover for an outdoor space.

## Conclusion: Research into Pedagogy

A methodology that embraces prototyping at full-scale provides a level of engagement with materials and construction that few other experiences can offer. More importantly, this engagement may accrue as design intelligence, a form of lifelong learning, which may be especially valuable for students. Although most curricula/course objectives cannot accommodate a prototyping project like the emergency shelter, versioning has potential as a pedagogical approach in programs that espouse a "learn by doing" ethic.

Certainly there are challenges. For one, projects approached using this strategy foreground materials and construction and run the risk of sidelining architecture's social, cultural and urbanistic programs. Instructors should remember to establish conditions and criteria that extend beyond the internal objectives of the project. In the case of this project, extensive research was conducted into disasters and their architectural responses; this research shaped the criteria used to evaluate each version of the design. Another challenge is the amount of time required to successfully generate and analyze a full-scale prototype, let along a series. On the shelter project we approached each successive prototype with a different team of students; this may provide a roadmap for academic settings. In other words, could one studio pass its prototype to a successor studio for critical analysis and refinement/reconsideration? Although this could potentially blunt the feedback loop intended by versioning the instructor could serve as a bridge to facilitate discussions and information sharing between studios.

Although the author has not tested this approach in a design studio he looks forward to shifting the focus from product to process, or as Sharples suggests, to a hybrid domain of process-product.

## Notes

[1] Speaks, Michael. "Intelligence After Theory" in *Perspecta 38*. MIT Press: Cambridge, MA. 2006. p 104.

[2] Speaks, Michael. "Design Intelligence: Or Thinking After the End of Metaphysics" in *Architectural Design*. Vol. 72, No. 5. 2002

[3] Sharples, Coren et al. Introduction to *Versioning: Evolutionary Techniques in Architecture. (Architectural Design).* Vol. 72, No. 5. p 7. 2002.

[4] Sharples. p 9.

[5] Sharples. p 8.

[6] Sharples. p 8.

[7]" The Human Cost of Weather Related Disasters" published by the The United Nations Office for Disaster Risk Reduction (UNISDR).

# From Waste to Wonder: Working with Residual

Nikole Bouchard | University of Wisconsin Milwaukee

*Fig. 1 The ARTery, an 8-acre linear park, is a ⅔-mile long extension of Milwaukee's historic Beerline Trail that bridges the Riverwest and Harambee neighborhoods.*

## ARTERIAL Inspiration

In the Fall of 2014 I was invited to attend the Riverworks Design Development Charrette that was hosted by Community Design Solutions (CDS) at the University of Wisconsin Milwaukee (UWM). This cross-disciplinary event brought together a wide range of professionals, faculty and students from the area to discuss potential design ideas for the post-industrial Riverwest neighborhood of Milwaukee, Wisconsin.

During the Charette I had the pleasure of meeting Keith Hayes, a local Guerilla Artist and Sp/ace-Maker. In 2010 Keith founded Beintween, a social and spatial network that works on "improve(is)ing spaces to build community".[01] In 2012 Beintween, in collaboration with The Greater Milwaukee Committee and Newaukee, received a $350,000 ArtPlace America Grant for a creative placemaking initiative known as *The Creational Trails*. This generous grant enabled Keith and his Beintween colleagues to begin to realize their vision for *The ARTery,* an 8-acre linear park that extends Milwaukee's historic Beerline Trail ⅔ of a mile as it bridges between the Riverwest and Harambee neighborhoods.

*The ARTery* reclaims a former industrial rail corridor as a space for community-based activity. The project works with local stakeholders, including the Riverworks Development Corporation, the Harambee Great Neighborhood Initiative, community organizers, neighbors, local government leaders and property owners to reimagine the corridor in ways that strengthen the community. Through its programmed events, *The ARTery* "embraces cultural

*Fig. 2 University of Wisconsin Milwaukee School of Architecture & Urban Planning (UWM SARUP) students participate in a site visit discussion at the ICAN 2 Lab with Keith Hayes of Beintween. The ICAN 2 Lab is a real world example of working with Waste (A Shipping Container, Railroad Ties, and Recycled OSB) to create Wonder (An Educational Space for Local Youth). The ICAN 2 Lab was a collaboration between ArtPlace America, The Greater Milwaukee Committee, Riverworks Development Corporation, School Factory and MKE-LAX. Students were exposed to the process of building at 1:1 and to the collaborative relationships between multiple stakeholders. (Photo by Nikole Bouchard)*

differences, enhances connectivity and rejuvenates community. The project empowers local residents and businesses to work or, ‘pull’ together, to address the repercussions of segregation and create opportunity for equitable and sustainable development.” [02]

### *The ARTery and its ICAN 2 Lab*

This initial introduction to *The ARTery* intrigued me. I wanted to know more, so I scheduled a follow-up meeting on site with Keith Hayes to better understand the project, its elements and the programming that took place during *The ARTery Season 01* in the summer of 2014.

Upon learning more, of particular interest to me was the *ICAN 2 Lab*. This primary element along *The ARTery* consisted of a repurposed shipping container that was clad in recycled railroad ties and OSB. The space was equipped with Wi-Fi, computer tablets, creative tools and work benches to foster a flexible environment that provided creative and educational opportunities for the local, underserved youth. In the summer of 2014, thanks to the generous support of School Factory, Beintween was able to host a number of activities at the *I CAN 2 Lab* that engaged neighborhood adolescents.

Further down *The ARTery* trail was *The EATery,* a space centered on a 100’ long dining table and lined by a pathway constructed of recycled tire treads and two raised garden beds. Throughout *The ARTery Season 01*, *The EATery* hosted a series of events that brought people of all ages, races and backgrounds together around food, art and culture.

### *Introducing The ARTery to UWM SARUP Students*

In the Spring of 2015, I taught an upper-level design studio titled *From Waste to Wonder* in the University of Wisconsin Milwaukee School of Architecture & Urban Planning (UWM SARUP). It only seemed natural to use this studio as a pedagogical opportunity to introduce students to *The ARTery* – A 1:1 real world example of working with Waste to create Wonder.

Throughout the semester Students conducted several site visits, gathered existing data and participated in discussions with municipal organizations, local community groups, stakeholders and neighbors to gain a comprehensive understanding of the complex, site-specific circumstances that surround *The ARTery.* Students worked closely with Beintween to develop Sp/ace Making design interventions. As defined by Beintween, Sp/ace Making “in contrast to master planning, explores the spatial and social contexts of an urban condition for staging temporal processes rather than

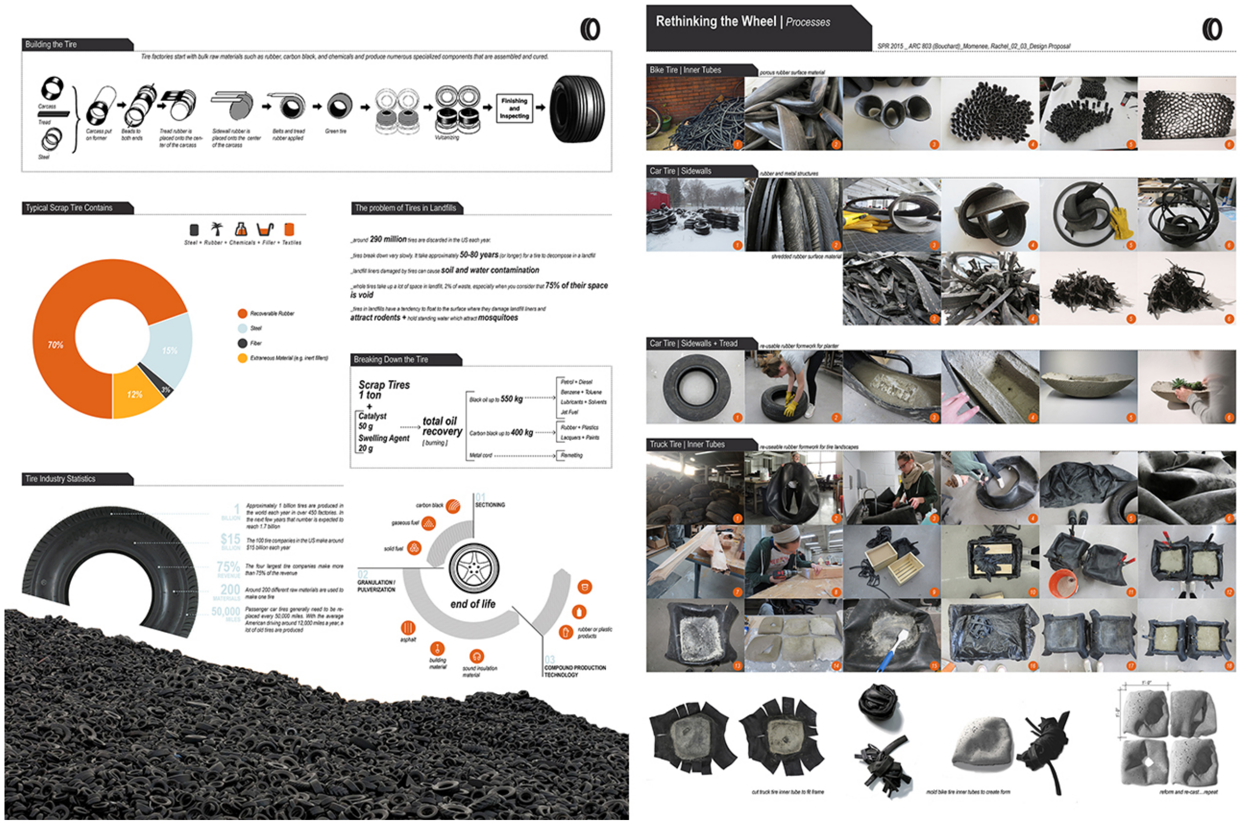



*Fig. 3 Re-Thinking the Wheel research and design by Graduate Student, Rachel Momenee at the University of Wisconsin Milwaukee School of Architecture & Urban Planning (UWM SARUP).*

premeditating a permanent development. Sp/ace Making examines latent potential, establishes dialogue, and experiments onsite; thus an authentic foundation is laid for local exchange to inform and drive placemaking projects that result in engagement, education, and empowerment. This practice breeds further economic opportunities that allow neighborhoods to thrive in place." [02]

Throughout the entire semester, the *From Waste to Wonder* Students explored the rust-belt city of Milwaukee, its Waste flows and its overlooked sites where layers of history and existing infrastructure offer opportunities to reimagine the contemporary city. The results were rewarding and wonder-filled.

## FROM WASTE TO WONDER Design Studio

For thousands of years humans have experimented with various methods of waste disposal - From burning, to burying, to simply packing up and moving in search of an unscathed environment. The present global population expansion and the related increase in resource consumption poses a major threat to the future of our environment. According to the Environmental Protection Agency (EPA) "the average American generates 4.38 pounds of waste each day." [03] The majority of it ends up in the "nearly 3,100 active U.S landfills" [04] where the waste continuously pollutes our environment. Challenges with trash disposal have grown critical in today's crowded world. Re-thinking the ways in which we produce, collect and dispose of our Waste, including innovative methods of design, are essential to ensure a more sustainable future.

The *From Waste to Wonder* Research & Design Studio encouraged Students to challenge their preconceived notions of Waste. Students conducted in-depth research of various waste flows and simultaneously analyzed the work of a range of designers that are known for physically transforming bountiful by-products into full-scale works of wonder. These explorations served as inspiration for Students to conserve resources, recycle, reuse and challenge their (design) imagination. 1:1 design projects were thoughtful, inventive and oftentimes unlikely approaches to waste management. By the end of the semester, Students developed numerous design interventions that physically turned our trash into treasure, while making a significant statement about the ubiquitous wastefulness that is often times overlooked in contemporary culture. During the course of the semester Students researched and worked at a variety of scales (Small, Medium and Large), and produced 1:1 prototypes. Design explorations ranged from local to global and from material studies to master-plan proposals.

*SMALL-SCALE: Re-Thinking the Wheel by Rachel Momenee*

Project 01 of the semester was a two-week long, three-part exercise that challenged Students to research and reconsider the life-cyle of a selected obsolete material. The goal of this Small-Scale Project was to create a critical and comprehensive Index of Precedents, an Inventory and Analysis of Available Local Waste Materials and a Catalog of Innovative Design Ideas.

For this project, UWM Graduate Student Rachel Momenee chose to work with tire waste. To begin, Rachel analyzed various recycled rubber design precedents, including *Safe Zone* by Stoss and *Matireal* by Beintween. From there, Rachel moved on to research tire waste, where she discovered that there are nearly 455 tire factories in the world that manufacture over 1 billion tires annually. Within the United States alone, approximately 290 million tires are discarded each year. Tire waste poses a major threat to our environment as they fill a significant amount of space in our landfills and can take anywhere from 50-80 years (or longer) to decompose.

With this in mind, Rachel worked to discover imaginative ways to re-use the abundance of local tire waste material. She reached out to Tire Express of Milwaukee and arranged for a site visit to their tire collection facility. She also scoured *The ARTery* and the vacant sites that surround it to collect the tire waste that littered the landscape. For her 1:1 explorations, Rachel brought this raw material back to the design studio, where she began to shred, crumple, aggregate, crush, fold, layer, stack and stuff the rubber. The results were exciting and eclectic. Her 1:1 material explorations included a number of porous rubber surface typologies and re-usable rubber formworks that produced tiles, planters and potential playscapes.

*MEDIUM-SCALE: Franken Houses by Brad Pokrzewinski*

Project 02 of the semester was again a two-week long, three-part exercise that challenged Students to identify, locate and quantify a local Waste material. This time, Students were asked to work with either Demolition Debris or Manufacturing By-Products. Inspired by their Precedent Analyses and informed by their Waste Research, Students were asked to develop a Medium-Scale, Pavilion design proposal on *The ARTery.*

Bradley Pokrzewinski, a Graduate Student at UWM SARUP, chose to take on Milwaukee's foreclosure crisis. His proposal,

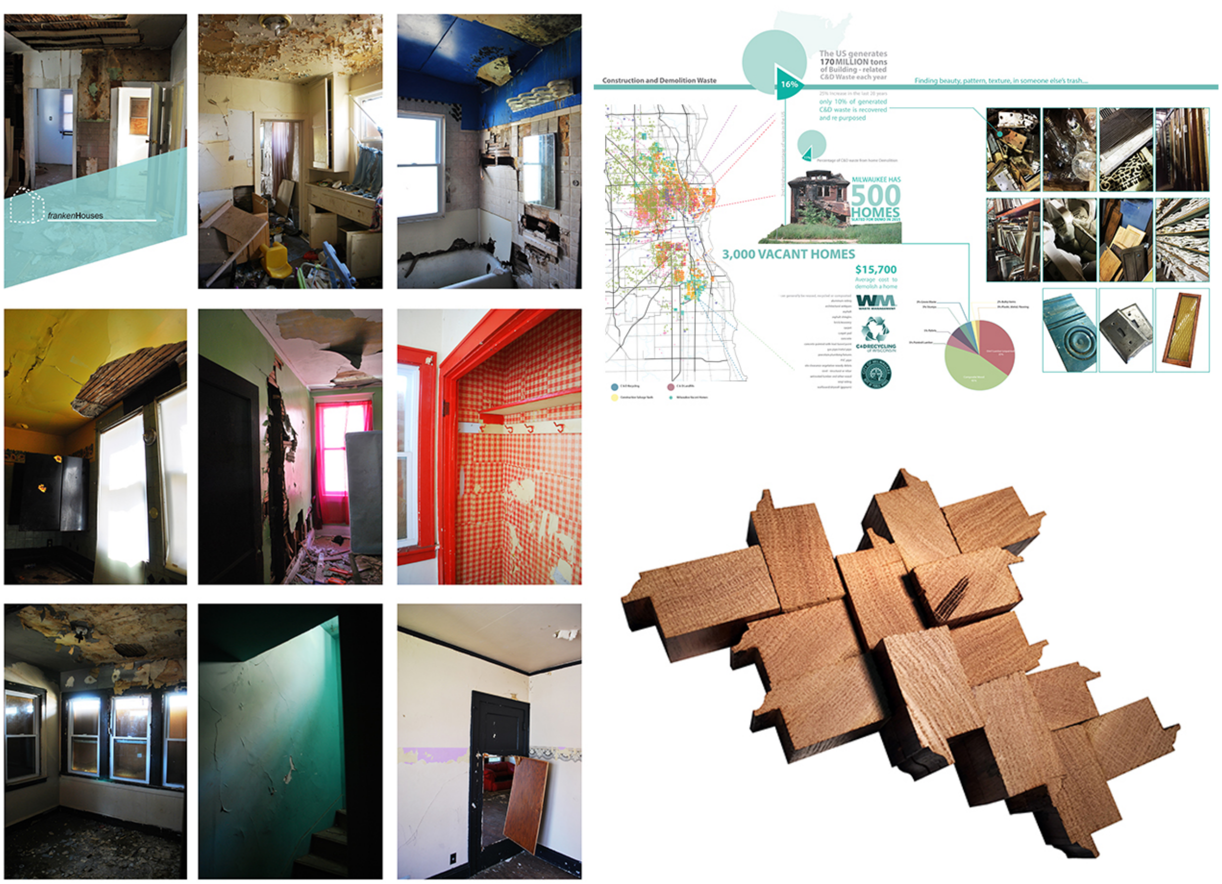



*Fig. 4 Franken Houses research and design by Graduate Student, Bradley Pokrzewinski at the University of Wisconsin Milwaukee School of Architecture & Urban Planning (UWM SARUP).*

*Franken Houses*, was an insightful analysis and innovative approach to addressing the devastating realities that resulted from the burst of the housing bubble. *Franken Houses* proposed to record and recompose the materials, artifacts and events found in the vacant homes that surrounded *The ARTery*. *Franken Houses* aimed to rejuvenate this region of the city and to weave together the broken pieces of the Harambee and Riverwest neighborhoods.

Through several site visits, research routes and community outreach efforts, Bradley quantified and documented the foreclosures, vacant homes and demolished properties in the area. He established a relationship with WasteCap, a local non-profit organization that provides construction and demolition waste reduction and recycling assistance to regional businesses and The City of Milwaukee. This type of work is incredibly important in a city like Milwaukee where today, problems tied to the Foreclosure Crisis run rampant. "Before the housing bubble burst, The City owned fewer than 100 foreclosed residential properties at any given time." [05] By the end of 2014, Milwaukee held title to nearly 1,600 tax-foreclosed properties. In addition, there were 1,400 bank-foreclosed properties blanketing the city. To date, "WasteCap Resource Solutions and its clients have diverted over 618,000 tons, or 1.236 billion pounds, of construction and demolition waste from landfills. That equals 215.2 pounds per person in Wisconsin." [06] Bradley was proud to participate in these efforts as a volunteer for WasteCap. As part of his *From Waste to Wonder* research and design explorations, he visited a number of foreclosed homes with WasteCap to salvage as much material as possible prior to demolition.

With this found material, Bradley produced contingent design proposals at the scale of The Human, The House and The Neighborhood. *Franken Houses* honored Milwaukee's historical housing typologies by recomposing these forms, figures and materials to create welcoming micro-communities that worked together to revive the larger neighborhood.

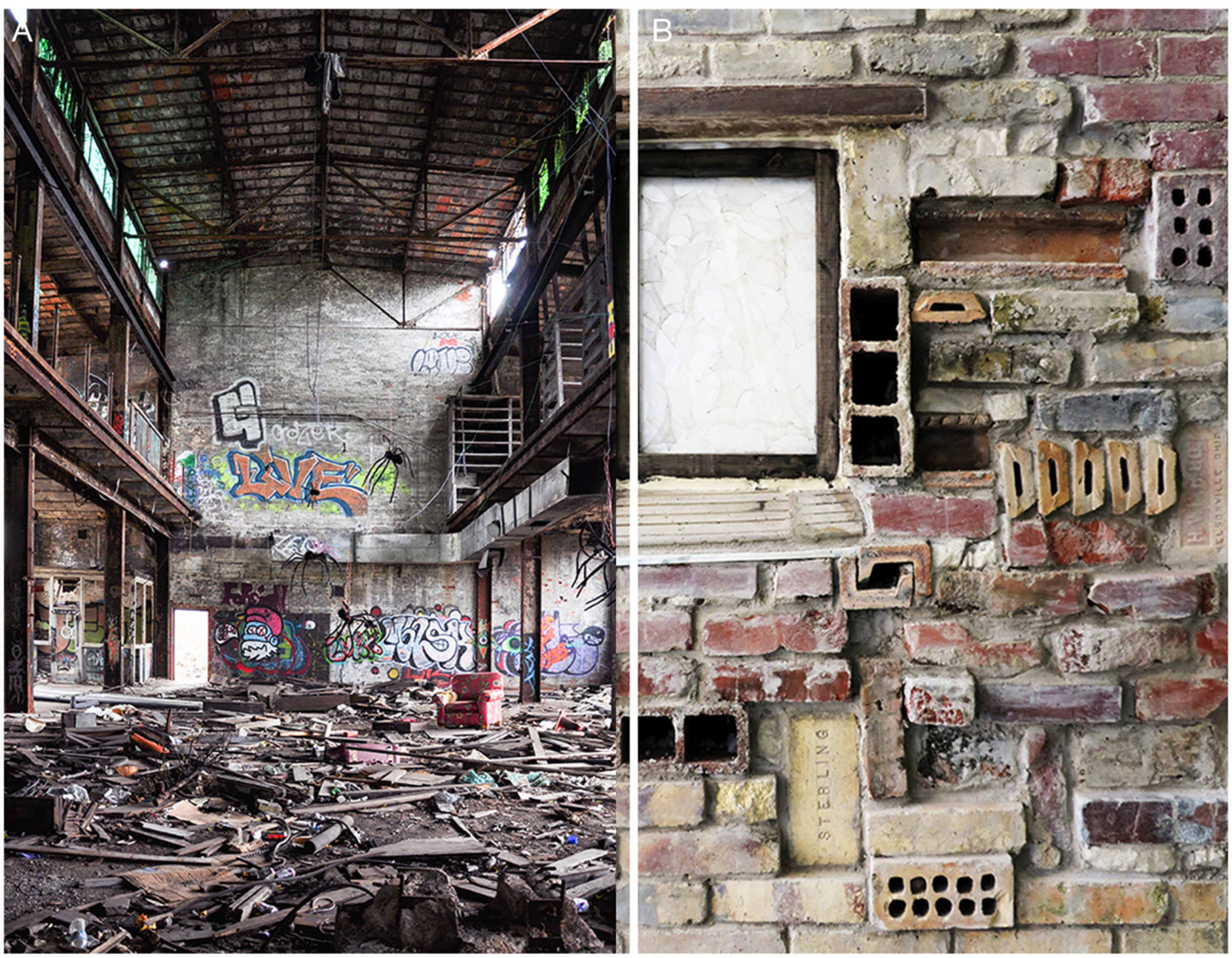



*Fig. 5 Waste to Wonder Wall by Undergraduate Student, Brandon Sather at the University of Wisconsin Milwaukee School of Architecture & Urban Planning (UWM SARUP).*

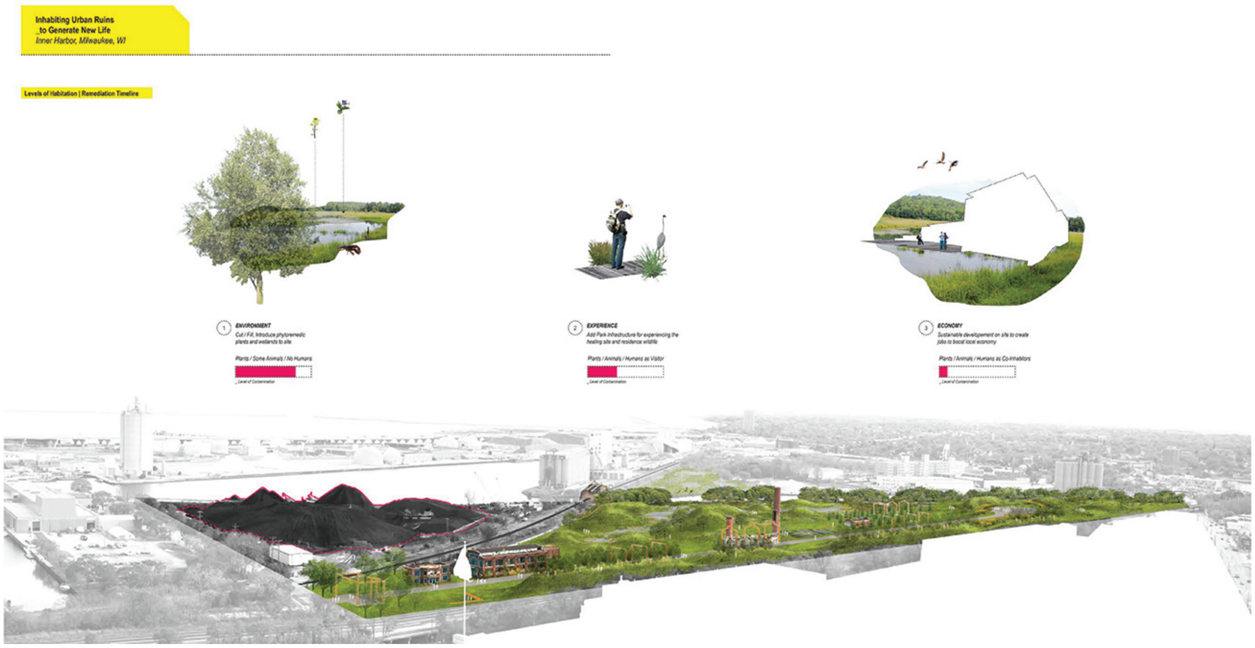



*Fig. 6 No Vacancy by Graduate Student Rachel Momenee at the University of Wisconsin Milwaukee School of Architecture & Urban Planning (UWM SARUP).*

### *MEDIUM-SCALE: Waste to Wonder Wall by Brandon Sather*

For Medium-Scale Project 02 UWM Undergraduate Student Brandon Sather found himself wandering amongst the industrial ruins of Milwaukee's Inner Harbor. Just west of the Port of Milwaukee, the 100+ acres of brownfield waterfront was once home to an array of bustling industries. Today, this toxic landscape is the focus of various economic redevelopment and ecological restoration plans that are spearheaded by the City of Milwaukee and the newly formed Milwaukee Harbor District.

While wandering through the Wastescape, Brandon became fixated on the industrial ruins of the 46-acre Solvay Coke & Gas Plant. This former factory was in operation from 1866 to 1983, at which point Wisconsin Wrecking began a scrap and salvage operation on the site. In 2003 the majority of the Coke & Gas manufacturing buildings were demolished as part of an EPA hazardous waste removal project. For this two-week long material exploration project, Brandon literally picked up the pieces of the industrial ruin to fabricate his *Waste to Wonder Wall*. Inspired by Artists like El Anatsui and Architects like Wang Shu, he scavenged the site over the course of several visits, scouring the landscape for any rubble he could find; From Cream City Bricks, to concrete blocks to 16-foot tall walls of wood waste. With this found material Brandon constructed a 3-foot by 6-foot *Waste to Wonder Wall* in one weekend. His *1:1 material exploration* honored the past, confronted the present and contemplated the future of Milwaukee's industrial economies and inner harbor.

### *LARGE-SCALE: No Vacancy by Rachel Momenee*

By Project 03 Students were very familiar with the research and design methodology that the *From Waste to Wonder* Studio fostered. For the Large-Scale Design Project Students were asked to identify, locate, quantify and transform Waste at the Landscape Urbanism Scale. Large-Scale Wastes to consider included Natural Elements (like Earth, Wind, Water and Fire), Post-Industrial Landscapes, Abandoned Urban Infrastructures, Vacant Lots, Toxic Terrains and Organic Wastes.

This time around Graduate Student Rachel Momenee elected to take on the task of working with multiple Wastes. Her Large-Scale Project, *No Vacancy*, was a Sp/ace Making Proposal for the Post-Industrial Landscape of *The ARTery*. Her project proposed a series of site-specific strategies for the Abandoned Urban Infrastructure of the former Beerline Railroad and transformed Municipal Organic Waste into fruitful Food Forests.

During the Research Phase, Rachel met with Urban Agriculture Specialists at Milwaukee's Growing Power. Growing Power is a "national nonprofit organization and land trust supporting people from diverse backgrounds, and the environments in which they live, by helping to provide equal access to healthy, high-quality, safe and affordable food for people in all communities. Growing Power implements this mission by providing hands-on training, on-the-ground demonstration, outreach and technical assistance through the development of Community Food Systems that help people grow, process, market and distribute food

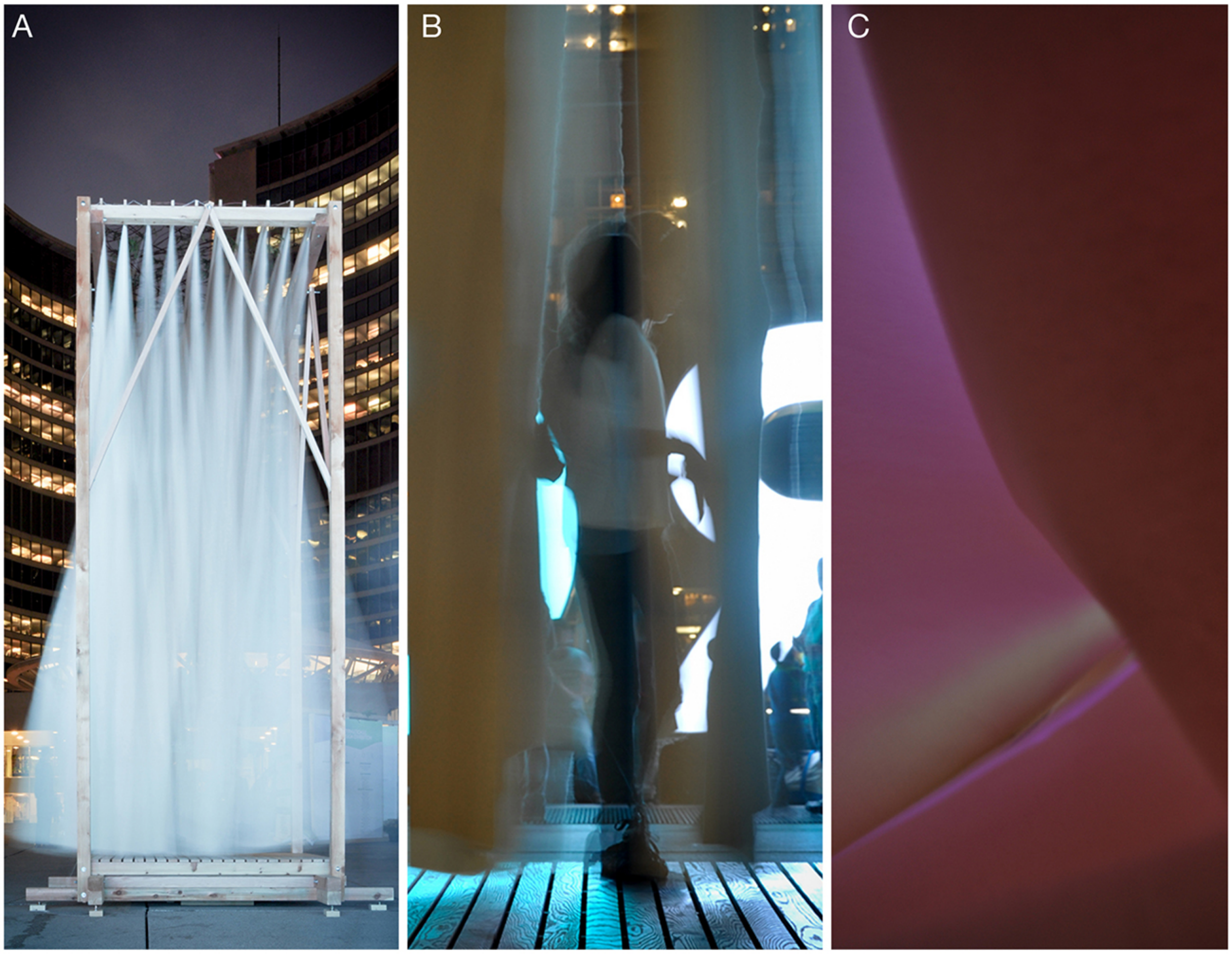



*Fig. 7a Canvas Cocoon, a 1:1 temporary public pavilion by Nikole Bouchard, Milo Bonacci and Julien Leyssene, is a No/Low Waste design proposal that encourages the public to play. The space (made of Cedar Timbers and Canvas Sheets) transforms over time as a result of human interaction, the changing winds and varying light conditions. Fig. 7b The tactile experience of the Canvas Cocoon invites the Public to explore, engage and entertain. The Pavilion brings activity and energy to forgotten urban environments. Fig. 7c The interior experience of the Canvas Cocoon hints at the project's afterlife. Upon disassembly, the Canvas Sheets will be donated to local schools and organizations. These groups will use the Canvas to create works of Art, which will then be distributed back into the Community to reinvigorate the City. (Photos by Nikole Bouchard)*

in a sustainable manner."[07] Rachel used this newfound knowledge to design a series of systems that would provide high-quality, healthy and affordable food for the residents of Riverwest and Harambee.

*No Vacancy* addressed the fact that *The ARTery* and its surrounding neighborhoods face issues of access, water management, food security and socioeconomic despair. At the same time, the project recognized that the area has an abundance of untapped potential. *No Vacancy* transformed Waste into Wonder by converting *The ARTery's* wasted spaces into accessible and productive landscapes. This project took an investigatory approach to gather in-depth research on neighborhood demographics, community health and wellness, climate, water and ecology in order to thoroughly understand the systems that were in play. *No Vacancy* programs were broken down into categories of: Neighborhood Amenities + Greenspace, Urban Agriculture + Community Gardens, Active Multi-Use Zones, Storm Water Management Spaces.

A serialization of design components and approaches were developed and deployed along the 8-acre linear park - Creating a diverse catalog of ways to occupy and ameliorate the wasted spaces of *The ARTery*. These landscape interventions would have the capacity to create accessible greenspace for the community within a 5-10 minute walking radius, capture and reuse storm water in order to better manage and prevent flooding and provide opportunities for the community to produce their own food and even generate income. *No Vacancy* aimed to become a catalyst for sustainable neighborhood development - A testing ground for the transformation of underutilized urban spaces and underserved urban populations.

## LOOKING FORWARD Reflecting and Revisiting

Inevitably the Spring 2015 *From Waste to Wonder* Research and Design Studio has had a tremendous and positive impact on the way I approach my pedagogical and professional work. This influence is evident in a recent project that I completed in collaboration with Milo Bonacci and Julien Leyssene. In September we were invited to Toronto, Canada to participate in Sukkahville 2015. Our Sukkah, *Canvas Cocoon*, was one of eight finalist selected to be built in Toronto's Nathan Phillips Square.

The *Canvas Cocoon* was a temporary, reusable structure that enabled users to relax, rest and recreate during and after the festival of Sukkot. The space was constructed of three primary materials: wood, cotton canvas and jute. Large sheets of canvas were suspended from the wooden structure. These canvas sheets were fastened to the wood struts at the top of the structure to create a series of flexible walls. The arrangement of the canvas sheets created a cloak that provided a sense of security and comfort for the user(s), as if being wrapped in a warm blanket. An oculus provided stunning views of the sky above.

Following Sukkot, the *Canvas Cocoon* was disassembled and returned to Milwaukee. The canvas sheets will be given to various local artists and community organizations that are connected to *The ARTery*. These groups will produce unique artwork to disseminate back into the Riverwest and Harambee communities. The *Canvas Cocoon* which once provided a special space for users during the festival of Sukkot, will now spawn opportunities for city-wide engagement and artistic expression in Milwaukee.

*From Waste to Wonder: Version 2.0*

The *Canvas Cocoon* was an exciting 1:1 design challenge that stimulated many ideas of how I may approach *From Waste to Wonder 2.0* in the future. Despite the Sukkah's relatively small size (6'W x 6'D x 16'H), the project proved to be a rather large and complex undertaking. In addition to the material, size and structural constraints that are tied to Sukkah design criteria, we had to develop a Sukkah that was designed-for-disassembly, no/low waste and easy to transport 1,240 miles round trip. We were also asked to work within a rather modest budget of $2,500 USD and to erect the structure on-site within a 12-hour timeframe.

The *Canvas Cocoon* has proven to inspire new 1:1 ways of approaching the *From Waste to Wonder* Research and Design Studio. This design exercise is invaluable for students as it requires the consideration of budget, construction techniques and timeline, waste, logistics, afterlife, social responsibility and cultural sensitivity.

The ongoing *From Waste to Wonder* Research and Design sees the City as a living laboratory, where opportunities for architectural exploration and social engagement are rich and plentiful. Design explorations exist in the neglected neighborhoods of forgotten urban environments throughout the City. Students are encouraged to consider these spaces as opportunities for realized, 1:1 community based art and architectural interventions. Students engage local stakeholders to co-define public space, provide resources and establish relationships that promote creative cultural and economic development. Through these physical installations and event programming, Students embrace cultural differences, enhance connectivity and rejuvenate communities by empowering local residents and businesses. *From Waste to Wonder* encourages Students to understand and engage in the central role that arts and cultural activities can have in the revitalization of American cities.

## Notes

[01] Jannene, Jeramy. "$350,000 Grant Funds Art Corridors." *Urban Milwaukee*. 20 May 2013. Web. 10 Jan. 2016.

[02] Hayes, Keith. "Sp/ace Making." Cleveland Urban Design Collective: Emerging Practitioners Lecture. Cleveland Urban Design Collective, Cleveland. 24 Apr. 2015. Lecture.

[03] "Advancing Sustainable Materials Management: Facts and Figures." *EPA: United States Environmental Protection Agency*. Web. 10 Oct. 2015.

[04] Landes, Lynns. "LANDFILLS: Hazardous to The Environment." *ZERO WASTE America*. Web. 12 Oct. 2015.

[05] Wisla, Matt. *Battling Foreclosure in Milwaukee: Foreclosures Block by Block*. 2015. Print.

[06] "WasteCap: About." *WasteCap*. 2015. Web. 10 Jan. 2016.

[07] "Growing Power: About." *Growing Power*. 2014. Web. 10 Jan. 2016.

# The Container Space at Loy Farm: Practicing 1:1

Robert Michel Charest | Elon University

"We see the sun rise and set but, we think of the earth as moving around the sun." – Henri Frankfort

## The Scaffolding of Civilization

Four Years after accepting an appointment to teach architecture and design in a department of environmental studies, a chance encounter with Dr. Wes Jackson has served to validate this leap of faith. Dr. Jackson is a force of nature in every sense of the expression. Never tongue-tied and with a mysterious scroll in hand he speaks of land use and agriculture in a poignantly contextual manner and with incredible depth. Dr. Jackson is the president and co-founder of the Land Institute, a cutting edge and science-based organization that promotes an alternate path to destructive agricultural practices. [1] The flagship product of the institute involves the development of perennial grains that offer the potential of restoring food production to a state that is in symbiosis with natural ecological systems.

In the fall of 2015 Dr. Jackson was invited to speak at our University's *Voices of Discovery* series and to spend the day interacting with faculty and students. He was also scheduled to visit my morning studio where I had instructed students to research Dr. Jackson and the Land Institute, as well as to prepare prompt questions. The latter was absolutely unnecessary.

Upon entering the studio, Dr. Jackson reorganized the space so that students would be seated in a circle. He immediately jumped in with "simple" questions pertaining to land use, energy consumption and food production. Later he introduced the concept of the *scaffolding of civilization,* which represents the complex web of interdependent structures that enable our modern way of life. The *Sunshine Farm Study*, a sobering research project led by Dr. Marty Bender from the Land Institute fleshes out the scaffolding. The study was a ten-year experiment focused on assessing the output of a 210-acre farm that uses only the available sunshine as energy. Unfolding at the Land Institute's headquarters in Kansas, data was fastidiously tabulated in order to tease out a true account of the farm's "inputs" and "outputs." In order to audit precisely the value of the bio-diesel [produced at the farm] tractor, mining of the iron ore used in its fabrication was taken into account. Even a portion of the construction and maintenance of roads was factored in. However, incorporating intangibles such as idling vehicles, travelling company board members and industry lobbyists is nearly impossible, as Dr. Jackson points out:

"What we failed to appreciate is how quickly the scaffolding of civilization became so elaborate and so energy intensive and so unknowable." [2]

When we follow Dr. Jackson's critique of agricultural practices it is certainly not difficult to draw a myriad of parallels with the design, construction and maintenance of our built-environment. When selecting materials for a project, one might begin to question how thoroughly—if at all—the scaffolding is integrated into LEED's rating system.

Incidentally, the scroll—literally a scroll—that the good Dr. clutches and loves to dramatically deploy is that of a 1:1 photograph of the root system of Kernza, perennial wheat. The stunning image depicts, side by side, the Kernza's stout ten feet long root system and the shallow frail roots of annual wheat.

## The Vitruvian Wall

If the Brundtland Report philosophically captures the essence of sustainable development, our *scaffolding* renders it extremely difficult to implement in fleshed design projects. Meaningfully addressing the four interdependent sectors of ecology, economics, politics and culture—each integral to sustainable development—can prove extremely challenging in an academic setting.

In recent memory, a concerted response to global environmental preoccupations has emerged from the allied design fields. Sustainability related courses are usually present across the curricula in most design programs. Although the range and depth of penetration of each course varies greatly, it would seem that the concept of sustainability has graduated from specialty to core academic pillar. We might be tempted to proclaim that the challenge of providing sustainable design solutions has been transcended. We would argue here that this statement is a stretch by any metric.

Only in rare occurrences is the study of ecological systems woven into design curricula via joint faculty appointments [e.g.: between architecture and biology]. In most instances, the ecological context is reduced to a literature review of environmental publications and/or online climatic data. On the other hand, few if any environmental science/study programs offer meaningful design courses.

For many decades—from architecture to industrial design schools—the modus operandi for reconciling the act of designing with a significant context has been through the vehicle of linguistic concepts. Emerging from the theoretical works of Ferdinand De Saussure, Alain Colquhoun and Charles Jencks [to name only a few] language games have been part of design's academic *eidos* since the latter part of the twentieth century. Although systems constructed for the exegeses of signs and symbols might be relevant for the appreciation of works—they operate on a one-way street. In other words it is doubtful that a work can ever be infused with a recoverable and literal message. Nonetheless, in many instances the design review process consists of evaluating a designer's ability to maintain a "connection" between a project and its self-referencing concept, which incidentally was conjured by the author.

In an ironic twist, we believe that de-constructivist architect Peter Eisenman best exposes the frail limits of linguistic theory as a vehicle to meaningfully ground architecture:

"A wall is a wall, it is not a word, it is, it is never about. It is the thing that the word "wall" refers to, it is the opposite condition of a word: words are transparent whereas walls are opaque." [3]

In contradistinction to Eisenman's theory we do not believe that this condition precludes a work from being significant or to hold meaning.[4] In book two of Vitruvius' Ten Books, architecture, language and other primal pursuits—including food production—are described as the founding elements of the archetypal community. A dramatic and frightening storm is described as the event that flushes "men-animals" out of their caves and into the "public" realm. Discovering fire and one another, "they kept coming together in greater numbers into one place" and "they began in that first assembly to construct shelters." [5]

At this point, we propose revisiting another seminal passage—The Education of the Architect—from Book I of Vitruvius' opus: [6]

"Let the designer be contextually educated, skillful with tools, instructed in ecology, know much about the environment, have followed the philosophers with much attention, understand art, have some knowledge of agriculture, know the opinions of the politicians and be acquainted with science."

## The Environmental Center at Loy Farm

Our small Liberal Arts University is situated in central North Carolina and flanked, within driving distance, by two research-one institutions. Both campuses include an established architecture program and both are part of our state's public University system. By contrast, the efforts made towards establishing a design program at our college are rooted in the department of Environmental Studies and being concurrently developed with the planning of a living-learning community: the Elon Environmental Center at Loy Farm.

Elon University has an enrollment of approximately 5,300 undergraduate and 700 graduate students. The diverse student population spans 48 states and 48 countries and is served by a faculty of 400. Our department of Environmental Studies is a transdisciplinary unit representing biology, agro-ecology, philosophy, engineering, wildlife management, political science, art, geography and design. Students can choose from three main tracks of study, a B.A. in Sustainability, a B.S. in Environmental Studies and a B.S. in Environmental and Ecological Sciences. A minor is also offered, as is a dual degree in Environmental Studies and Environmental Engineering in collaboration with the Physics Department. The University's Pre-Peace Corp program is also housed in our department. While both Bachelor's of Science degrees are steeped in the ecological sciences, the Bachelor of Arts in Sustainability offers three concentrations – Responsible Design and the Building Arts, Sustainable Agriculture and Human Ecology.

Covering the basic skills required by our métier, the Responsible Design concentration unfolds in a contextualized and engaged curriculum. The success of our teaching, learning and research experiences is due to a collaborative community that has long been cultivated between the primary and secondary faculty in the department of Environmental Studies. The Responsible Design and Building Arts concentration is intended as an introduction to the built environment and as a pathway to graduate studies in the design fields [product, interior, architectural, landscape and urban design]. The curriculum for the Responsible Design Concentration is structured as follows:

*Core Courses*

ENS 110 Humans and Nature

ENS 111 Introduction to Environmental Sciences

ENS 200 Strategies for Environmental Inquiry

ENS 381 Internship

ENS 461 Senior Seminar

*Humanities Pillar [one course]*

ENS 350 Environmental Visions

ART 339 Ecological Art

ENG 318 Writing Science

ENG 339 American Environmental Writers

PHL 348 Environmental Ethics

*Social Sciences Pillar [one course]*

ENS 340 Water Resources Management

POL 224 Environmental Policy and Law (most recommended)

ECO 335 Environmental Economics

PST 320 Food Policy

*Natural Sciences Pillar [one course]*

ENS 215 Diversity of Life

ENS 314 Agro-ecology

ENS 320 Restoration Ecology

ENS 321 Urban Ecology

*Responsible Design and Building Arts Courses*

ART 112 Fundamentals of Design

ENS 160 The Art of Sustainable Architecture

ENS175 Designing Sustainable Buildings

ENS 360 Green Design and Sustainable Futures

ENS 366 Sustainable Design Technologies

ENS 372 Sustainable Design Studio

ENS 499 Apprenticeship

The Environmental Center at Loy Farm is a faculty led and University supported initiative located on a 30-acre on-campus farm that consists of a 10,000-panel solar farm, high tunnel greenhouses, organic plots, a five-acre managed forest, several groves, bee hives and the Container Space. Loy Farm is intended as a living laboratory centered primarily on the transdisciplinary teaching and research of responsible design and sustainable agriculture [juxtaposing the built environment and food production]. In a broader sense, the farm is a place where disciplines interested in studying the environment [ecological sciences, art, engineering, philosophy, geography, physics, political sciences, etc.] can deepen their academic connections.

## From Tool Parts to Dwellings

Completed in the spring of 2015, the *Container Space* is a flexible studio and prototyping lab design-built by repurposing four intermodal shipping containers [Figures 1 through 4]. Courses and research at the *Container Space* are focused on responsible product design and micro housing. The *Container Space's* "engine" is the NEW Studio, a community-oriented design-build effort steered by the core values of responsibility, innovation & affordability. We operate out of Alamance County, a challenged rural area located in North Carolina's Piedmont region. Our studio collaborates frequently with students and faculty from biology, agro-ecology, engineering, art, philosophy, physics, policy and law, as well as geography. The New Studio is sponsored by SGY, a company that develops and manufactures Kobalt Tools for Lowes Home Improvement.

*Fig. 1 Students in ENS 360 working on the Container Space formwork.*


*Fig. 2 Placing of intermodal shipping containers.*

*Fig. 3 Students in ENS 372 working on the Container Space ramp.*

*Fig. 4 Container Space West Elevation.*

The New Studio Is the natural extension of Urban Studio, founded by the author in 2005 at The University of North Carolina Greensboro. Urban Studio, in partnership with the City of Greensboro's Department of Housing and Community Development, The North Carolina Housing Finance Agency, The YWCA and United Way successfully completed several projects on time and on budget while passing all building inspections on the first call. 909 Dillard, our maiden effort, was the first home replacement home project in the City of Greensboro. With a budget of $49,500 and during the course of one academic semester our studio design-built an innovative two-bedroom/one-bath, 1000 square-foot insulating concrete form home for Lillie and James Marshall. Urban Studio also undertook the design-build of a Health and Human Services licensed, 5000 square-foot LEED home for teenage moms. My Sister Susan's House was heralded as community transforming and was inaugurated by U.S. Senator Kay Hagan in early 2010. From forming footings to fabricating cabinetry, our design-build studios—in a short time—have served to define engaged service-learning in North Carolina.

The open source nature of the NEW Studio has spawned research projects in the community [Figure 5] and at the Container Space. One student majoring in Environmental and Ecological Sciences conducted research on the impact of the construction process on a site's ecological systems. Data on soil compaction, temperatures and chemistry were collected and are currently being compiled and analyzed. This research will allow for a better understanding of the effects of construction activities on a rural or natural site. In turn, strategies could be developed to better protect the periphery of construction environments. In another instance, an engineering faculty has developed a research and methods course centered on evaluating special coatings that increase the Solar Reflectance Index [SRI] and thus reduce heat gain when building with intermodal shipping containers. In the spring of 2015 a biology student worked in the studio to design-build custom brood chambers to undertake research on the impact of environmental conditions [the variation of humidity and temperature] on honey bees.

As part of our partnership with Kobalt Tools [SGY] we are currently assisting in the design of patented components for pneumatic tools. The new tools are expected to operate more efficiently, be more powerful and last longer. Our studio participates in the design process, in modeling and fabricating prototype parts, in establishing a blind study protocol and in performing tests. In return our sponsor provides tools and consumables for the studio, as well as financial compensation for students. In addition, SGY is funding our current design-build project, an affordable 50 square-foot home that functions on and off the grid or as a hybrid [Figure 6] called MOBii. MOBii serves as a pretext to operate and generate wear on the tools. It is also a great promotional device to demonstrate the entrepreneurial potential of academic, industry and community partnerships.

*Fig. 5. Students in ENS 175 working on an Eco Art Studio and Gallery project in partnership with the Art Department.*

*Fig. 6 The NEW Studio working on the fabrication of MOBii's structure.*

We believe that design-build studios are ideal for challenging apprentices with the tangible rigors of our métier. We must emphasize that our approach does not aim to nostalgically teach students how to master the block plane. Instead we provide an environment that promotes the deep thinking of Juhani Pallasmaa juxtaposed to the craftsmanship of Norm Abram. The envisioned model is intended to integrate representation tools with those made for prototyping. We are simply proposing a teaching, learning and research environment for the exploration of responsible design.

We unequivocally concede that ours is not an orthodox model. We provide relevant and quality instruction to our students and we accept that our transdisciplinary and perhaps exceedingly contextualized approach transgresses the norms set by organizations governing the design professions. We purposefully did not set out to satisfy the requirements necessary for the pursuit of professional accreditation. Currently, the Council for Interior Design Accreditation [CIDA], the National Architectural Accrediting Board [NAAB] and the National Association of Schools of Art & Design [NASAD] are simply not on our radar. The thoughtfully planned curricula offered in the department of Environmental Studies interfaces well with our University's strategic plan and the Environmental Center at Loy Farm's mission. As we continue to refine our program we are not excluding the possibility of implementing an "as the crow flies" professional track.

## Notes

[1] http://landinstitute.org

[2] Jackson, Wes. "Consulting the Genius of Place: An Ecological Approach to a New Agriculture" Counterpoint Press: Berkley, CA. 2011. p 11-12.

[3] Eisenman, Peter. "Architecture and the Problem of the Rhetorical Figure" in *Architecture and Urbanism,* Volume 202, 1987. p 17-20.

[4] See Handa, Rumiko. "Against Arbitrariness: Architectural Signification in the Age of Globalization" in Design Studies, 20:4 Elsevier Science: Waltham, MA. 1999.

[5] Morgan, Morris H. Trans. "Vitruvius The ten Books on Architecture" Dover Publications: " New York NY. 1960. Book 2:1:1.

[6] Morgan, Morris H. Trans. "Vitruvius The ten Books on Architecture" Dover Publications: " New York NY. 1960. Book 1:1:3.

# International Service Work: The Academy's Complicated Relationship with Public-Interest Design

Carey Clouse | University of Massachusetts, Amherst

## Abstract

The rapidly-evolving field of public-interest architecture has been transformed over the past several decades, now boasting an extraordinary range of dedicated practitioners and disciplinary aims. Students, faculty and design professionals have benefitted in many ways from their exposure to new types of people, environments, and design problems. Moreover, the skills and perspectives of the design disciplines have been shown to provide real value for communities in need, offering a collaborative approach to problem solving. This work isn't easy in the best of circumstances, and design aid can become even more challenging in international contexts with inexperienced students. This paper addresses the opportunities and challenges of public-interest design abroad, with a focus on the beginning design student.

## Introduction

Over the course of the past three decades, public-interest design has emerged as a vital and well-respected genre of design practice.[1] As social justice has moved to the forefront of disciplinary interests and priorities, architects, designers and planners have responded by participating in a growing number of community-engaged, humanitarian, or pro-bono efforts.[2] This work sets the tone for a more ethical form of practice, one in which the concept of service can act as both a moral compass and force of inspiration.[3]

Not surprisingly, universities, colleges and design schools have played a central role in this relatively recent effort to highlight, validate and practice "do-good design."[4] This involvement is apparent at almost every level of the academy, from the growing number of public-interest design centers and certificate programs to the multitude of classes, field trips, design|build studios and student initiatives focusing on this new brand of architectural engagement. Even beginning design students, who might possess limited technical skills, seek out opportunities to participate in these programs.[5]

To write public-interest design into educational programming serves a number of goals, not the least of which is to affect positive change. Other benefits include exposing students to different skillsets, such as community-engagement or cross-cultural communication; attracting new donors to school programs through a visible and seductive cause; highlighting student work in a real-world context; and expanding student perceptions of the aims and objectives of this disciplinary sub-field. Moreover, in embedding architectural altruism within the design academy, educators have an opportunity to introduce the practice of public-interest design to new generations of students, and in the process, help to normalize this work.[6]

## The Changing Role of the Architect

Indeed, both the role of the architect and the scope of appropriate practice appear to be ever-evolving disciplinary constructs. According to the editors of *Volume 1*, "The discipline will become splendidly irrelevant, if not extinct, unless new modes of engagement are cultivated. Cherishing the ancient conviction that the architect is first and foremost a public intellectual, an activist synthesizer of diverse forms of knowledge, an eloquent commentator on the world, our schools must go beyond themselves."[7] Architectural practice, of course, has deep roots in public-interest service.[8] And while the discipline's enthusiasm for this topic ebbs and flows over time, schools can help to set the tone and framework for public-interest efforts.

As many critics are quick to point out, the architectural profession has also historically largely represented the needs and desires of the global elite. As Gautam Bhatia notes in his study of social architect Laurie Baker, "If an architect's contribution to society be looked upon as the public's perception of him as a socially responsible professional, and his work as a socially responsible act, then most of Baker's contemporaries have deliberately forsaken this responsibility in favour of wealthier clients and larger commissions."[9] Baker was, indeed, an unusually-altruistic product of his generation. However, the development of socially-responsible architectural outlets in design schools chart a more optimistic trend, one in which ever-growing numbers of graduates are positioned to change the scope of practice over time.

This bottom-up approach to service work effectively nudges architecture's disciplinary needle into new and productive terrain. In so doing, it could have an extraordinary impact on the profession's scope and range, opening doors to new types of clients, places, and projects. According to educator Tom Fisher, "Design as a form of public health would enable us to meet the needs of literally billions of people through affordable, prototypical, and locally appropriate solutions to people's most important physical problems."[10] While Fisher's vision for this transformation has the power to transform the entire discipline, he also recognizes that it is a movement that could begin on campuses across the world.

Indeed, the re-branding of the architectural profession through the lens of social justice and community-engaged practice is already well underway, and many schools are leading this effort.[11] Trailblazing University programs also help to expose some of the trends, considerations, and challenges facing the broader realm of public-interest design. Beyond justifying this work, educational programs have a responsibility to set the tone and standards for public-interest design engagement. As this aid work becomes increasingly recognized as a novel and useful form of practice, emerging designers have an unprecedented opportunity to structure and shape this domain.

## Global Practice

The development of a more uniform set of best practices for public-interest design engagement is a necessary next step for the discipline, and perhaps even more needed in international endeavors.[12] Designers working abroad are notorious for misunderstanding cultural and social cues, and tend to overlook critical contextual factors.[13] Worse, as educator Jay Wickersham notes, is the tendency for designers to impress their ingrained formal, functional and aesthetic language on foreign projects. In drawing attention to this practice, he asks, "Are we creating vital and new architectures, or are we homogenizing cities and landscapes and obliterating regional differences?"[14] Indeed, international design engagement comes with it's own peculiar set of problems and limitations, not often well understood by the beginning designer.

*Fig. 1 A client looks over a set of drawings made by a foreign designer for a solar school in Zanskar.*

Central among these drawbacks is the difficulty of assimilation; foreign designers need to be well informed about a multitude of factors in order to effectively manage foreign projects.[15] International practice brings the additional complications of language barriers; new environmental, social and political contexts; and the difficulties associated with cross-cultural collaboration. According to Wickersham, "Architects working abroad face a further challenge, perhaps even more complicated and confusing: making sense of the social and political projects in which they are involved."[16] Without this grounding, many international pro-bono projects lack the requisite investment and awareness from the design team.

In both the classroom and the field, the training required by public-interest projects abroad is something that could be taught to beginning design students. This is made even more necessary by the growing number of informal outlets, such as volunteer opportunities abroad, self-funded travel or internships, that students can now access to do this work independently. As beginning designers seek these opportunities to engage in international work, they would benefit from first gaining a theoretical grounding of the issues, and the ability to practice this work under the guidance of a more seasoned instructor.

*Fig. 3 A French designer team meets with villagers to plan a new school for nuns in Pipiting.*

*Fig. 2 The exterior of the pro-bono, foreign-funded Solar School in Zangla.*

## Opportunities

Foreign-sponsored architecture projects can offer many benefits to host communities, such as design insight and vision, expertise with building technologies and innovative materials, and links to both donors and public relations.[17] Often pro-bono efforts are self-funded, with built-in sources of support, such as capital, donated labor and materials. Visiting design teams tend to have entirely new social networks and public relations outlets, which can increase the global visibility of the project as well as the host community. In this way, foreign design assistance garners support for issues beyond the specific project at hand, catalyzing change outside of the limited ambit of the project itself.[18]

Foreign practitioners can also bring unconventional design and construction techniques, new tools and innovative ways of working. These design teams offer up-to-date information on energy efficiency and new standards for building code compliance. Beyond suggesting new aesthetic solutions, visiting architects can also improve building safety measures, such as seismic and egress provisions.

These new modes of working can also influence existing industries in the region, potentially establishing contemporary standards for best practices. For instance, foreign-trained designers tend to be skilled in digital modeling and representation, as well as considering and managing multiple groups of stakeholders. They have access to new technologies, building techniques, and imported building products that could begin to inform other projects in the area. By sharing these ways of working, as well as new norms for professionalism and education, both hosts and visitors stand to gain.

To be sure, foreign designers bring a unique skillset to the public-interest project abroad, one that merits resourcing. Likewise, students can benefit greatly from exposure to another design context and the unique constraints and opportunities of that location. Their work may be forced to chart new creative territory, as a result of challenges and obstacles. Work abroad often provides architects with an opportunity to do more with less, just as "Baker's work has often been referred to as the architecture of marginality as his designs make optimum use of available funds and materials."[19] Perhaps most importantly, students who are exposed to social issues early on in their education recognize new outlets for meaning and purpose in design practice, and often alter their career paths accordingly.[20]

## Critique

Of course, the problem is that with even the most well-intentioned design engagement, there can be communication or contextual divides that unwittingly exacerbate existing problems, create power imbalances, or prop up prevailing hegemonic forces in a foreign landscape. Design work that lacks a connection to the relevant cultural, social and environmental context in which it is made may become, in the words of James C. Scott, "a spectacular failure."[21]

Scholar Lewis Hyde suggests that "Given their bonding power, 'poisonous' gifts... must be refused."[22] But buildings are difficult gifts to return: they tend to be strong physical structures meant to persist over time. Lack of management and upkeep may be the equivalent of a returned building gift, witnessed as an abandoned or underused site. According to the Tulane City Center's Emilie Taylor and Dan Etheridge, "We have learned through experience that lack of buy-in, or lack of the ability and understanding to care for a project (even if it is just a shade structure in a garden) could create a liability and could add to the neglect and blight of a city struggling to rid itself of those things."[23] Public-interest practice abroad runs the additional risk of a lack of follow-through or capacity from foreign design firms, communication challenges through language and cultural disconnects, and a lack of site-specific knowledge that might move a project from success to failure.

In considering the unwanted gift of architectural assistance, as well as the unintentionally tone-deaf project, the difference between *transactional* and *transformative* public-interest projects becomes more clear. Organized under the banner of altruistic aid, the entrenched assumptions, values and beliefs of designers can lead to unintentional consequences. While it is perhaps convenient for visiting architects and planners to view themselves as forward-thinking change agents, in many instances their work instead causes far-reaching and unintended ripple effects.

According to Thomas Fisher, architects must guard against the tendency to explore in new arenas. Unlike science experiments conducted in labs, design experiments "often happen at full scale and in real time, with the potential for great harm and tremendous cost should they fail---as they sometimes do."[24] In the context of post-disaster rebuilding, Adrian Parr cautions designers to address the invisible social, cultural, and political context where they will work. This attention is critical to the success of the project, Parr suggests, where "design must involve itself with the social conditions disaster creates and how this distorts pregiven power relations."[25]

The power structures of architectural aid work become even more fraught in international contexts and with student designers. Lisa Findley questions this practice in University-community design|build work, wondering "Whose aesthetics and cultural values are embodied in the project? Should the community just be happy with whatever they are given? Who actually benefits, and in what ways?"[26] In structuring foreign pro-bono work, educators and students might first consider operating form a position of humility and service.[27] The belief that "we must send our most brilliant teachers to share their skills with countries in need,"[28] exposes the persistence of neocolonial attitudes underpinning architectural service work today.

## Conclusion

Despite these drawbacks, public-interest architectural engagement offers a multitude of benefits for both client and designer. Architectural critic Adrian Parr considers the positive implications of architectural advocacy work, particularly in cases where "The combination of technical knowledge, practical focus, and creative experimentation of the design field means it is able to directly alleviate some of the debilitating effects natural disasters wreak on the lives of individuals, families, and entire communities."[29] However, she goes on to caution that "For designers the question now becomes one of not only how to stitch back together social networks that help communities thrive, but also to design in a manner that fosters a sense of agency once more; only then can design interventions be truly sustainable."[30]

This desire to positively affect change in a foreign country must be reinforced by an even stronger effort to overcome the numerous barriers to successful practice abroad. As Palleroni notes, one goal for university-led public service projects could be to reaffirm "architecture's role as a cultural product that facilitates dynamic exchange, while acting as a constant reminder of the power of communities to provide for themselves."[31]

While it may be "appalling that architects remain uninterested in and *out of touch with* building for the most vulnerable and impoverished people,"[32] students must navigate the process of public-interest design engagement scrupulously and intentionally. Cultural disconnects, as well as the inexperience of beginning designers, can compound errors. In asking, "Are architects helping to strengthen and develop the economies of host communities, or are they acting as unwitting tools of inequality and repression?"[33] Jay Wickersham cautions designers to parse their own motivations and outcomes. He also suggests, in an effort to move forward, that practitioners work "to develop a shared set of principles and behaviors, which can help guide global practice in the future."[34]

Design students and experts alike face additional challenges and opportunities when working outside of their home environment. As designers and educators continue to develop best practices for public-interest design work, one of the critical questions remains: How can outside designers--- with their so-called expertise, energy and resources--- effectively integrate with the client designers---- who have a much deeper awareness of the core issues and will ultimately need to live with the results? This interrogation of the practice can involve beginning design students, stimulating a broader discussion of the role of the design community in service projects, and the soliciting ideas for appropriate modes of engagement.

## Notes

1 Charlesworth, Esther, ed. Humanitarian Architecture: 15 Stories of Architects Working After Disaster (New York, Routledge, 2014) pp. 1-15.

2 Aquilino, M. ed. Beyond Shelter: Architecture and Human Dignity. Edited by Marie J. Aquilino. New York: Metropolis Books, 2011; Bell Bryan & Katie Wakefield eds. Expanding Architecture: Design As Activism. New York: Metropolis Books, 2008; Charlesworth, 2014.

3 Deamer, Peggy. "Invitation to a Dialogue: Less Ego in Architects," The New York Times, August 4, 2014, p. A 20. Accessed 12.23.2015 at: http://www.nytimes.com/2014/08/04/opinion/invitation-to-a-dialogue-less-ego-in-architects.html?_r=0

4 Clouse, Carey & Zachary Lamb. "Post-Crisis: Embracing Public-Interest Architecture with Humility." Journal of Architectural Education, 67:2, July 2013, pp. 186-194.

5 Clouse, Carey & Zachary Lamb. "Design|Build and Community Advocacy: Teaching to Broaden the Design Profession" ii: the International Journal of Interior Architecture and Spatial Design. Spring 2013, vol.1. pp. 96-101.

6 Charlesworth, 2014.

7 Ole Bouman, editor. Volume 1 (January 2005).

8 M. Sorkin, in Humanitarian Architecture: 15 Stories of Architects Working After Disaster ed. Esther Charlesworth (New York, Routledge, 2014) pp. viii-xiii.

9 Bhatia, Gautam. Laurie Baker: Life, Works, & Writings. Delhi: Penguin Books India, 2000. p.66.

10 Fisher, Thomas. Designing to Avoid Disaster: The Nature of Fracture-critical Design. New York: Routledge, 2013. p.160

11 Bell, & Wakeford, 2008.

12 Feldman, Roberta; Sergio Palleroni, David Perkes and Bryan Bell. "Public-Interest Architecture in Practice: A Guide to Public Interest Practices in Architecture," pp. 1-151.

13 Scott, James C. Seeing Like A State: How Certain Schemes to Improve the Human Condition Have Failed. Yale University Press: New Haven, CT, 1998.

14 Wickersham, Jay. "Code of Context: The Uneasy Excitement of Global Practice," Architecture Boston, Winter 2014, vol 17 no.4, pp. 32-35. p. 33.

15 Scott, 1998.

16 Wickersham, 2014, p. 35.

17 Hawthorne, Christopher. "Altruism, Architecture & Disaster,' Architect Magazine, September, 2011. pp. 155-169.

18 Pearson, Jason. University Community Design Partnerships: Innovation in Practice. Princeton Architectural Press, New York, NY, 2002.

19 Bhatia, 2000, p. 48.

20 Charlesworth, 2014.

21 Scott, 1998.

22 Hyde, Lewis. "Some Food We Could Not Eat: Gift Exchange and the Imagination," The Kenyon Review, New Series, Vol. 1, No. 4 (Autumn, 1979), 32-60. p. 34

[23] Taylor, Emilie & Etheridge, Dan. “Radical Incrementalism: An Open Letter in Defense of the Small,” Oz Journal. Vol. 35, (2013) pp. 10-15.

[24] Fisher, 2013, p. 170. Fisher also notes that because designers don’t tend to talk about their work as experimental, they also don’t process the results in the way that scientists would (Fisher, 2013, p.172).

[25] Parr, Adrian. Hijacking Sustainability. Cambridge: MIT Press, 2009. p. 120

[26] Findley, Lisa. “International Design/Build: Community Service or Architectural Imperialism,” accessed 01.08.2016 at: http://www.acsa-arch.org/programs-events/conferences/annual-meeting/104th-annual-meeting/call-for-papers#12

[27] Perkes, David. “A Useful Practice,” Journal of Architectural Education. 62:4 (2009). pp. 64-71.

[28] Coulombel, Paul. “Open Letter to Architects, Engineers, and Urbanists” in Beyond Shelter: Architecture and Human Dignity. Ed. Marie J. Aquilino. New York: Metropolis Books, 2011. p. 289.

[29] Parr, 2009, p. 8.

[30] ibid.

[31] Palleroni, Sergio. “Cultivating Resilience: the BaSiC Initiative.” in Marie J. Aquilino (ed.) Beyond Shelter: Architecture and Human Dignity. New York: Metropolis Books, 2011. p. 231

[32] Coulombel, 2011, p. 286.

[33] Wickersham, 2014, p. 33.

[34] ibid, p. 35.

# Making it Theirs: Singular vs Inclusive Design Authorship in the Building Studio

Brad Deal, Miguel Lasala | Louisiana Tech University

## Introducing Freshmen to 1:1

The creation of architecture at full scale requires significant material, time, and capitol investment, and as a result, only the best design work often emerges from a select few students. However, when student design work slated for collaborative construction is selected via competition format, the majority of students who's designs are rejected experience diminished motivations and reduced engagement in the process once they are asked to invest significant effort into a project that is no longer their own. This paper explores the role of maintaining individual authorship within the collaborative design/ build project in order to improve students' ability to experience the epistemological and motivational value of full-scale construction in the beginning design studio.

The architecture program at Louisiana Tech University has a robust portfolio of successful design build projects executed in 3rd, 4th and 5th year studios. In 2014 and 2015, 1:1 construction of student's studio design work was introduced for the first time at the freshman level. In the first iteration, the studio used the competition format to select a single student's design for the entire class to build. Responding to solicited feedback, in the second iteration of this process in 2015, before dividing the construction responsibilities, an additional week was invested in merging all students' designs into an eclectic yet cohesive form. Through the empirical comparison of these two processes and interviews with both groups of students regarding the value of their experience, this paper makes clear the pedagogical value of merging design work to create inclusive design authorship prior to commencing construction of built student projects.

## Curriculum Context

Design build projects at Louisiana Tech have consistently been executed at various points within the curriculum over the past two decades. Beginning with student construction projects from the 1990's through 2012, the design-build studios have served as the capstone experience for the undergraduate program.

During the in the 2012/2013 academic year, ongoing debates over the critical application of the lessons gained through the design/build studio in subsequent design processes spurred the creation of two distinct 1:1 building experiences at two transition points within the curriculum. First, the traditional "capstone" design build studio was compressed to a single quarter (11-week) community-based design build studio that would occur during the spring quarter of a student's third year in the program. Additionally, a two-week campus-based design/build project would also be integrated into the final project of the freshman spring studio at the end of their 1$^{st}$ year and creating an introductory design build exercise that could serve as a reference through the remainder of the curriculum.

## 1$^{st}$ Year Building Goals

The first year studio curriculum at Louisiana Tech utilizes abstract design problems to teach design thinking and conceptual project development without the inhibitions, preconceptions, and assumptions that students naturally bring to traditional architectural programs. The full scale construction experience in the final two weeks of the 1$^{st}$ year curriculum marks the complete transition from design abstraction to full, physical realization of design solutions that in turn prepares students for the structural, tectonic, programmatic, and code requirement challenges ahead in second year studio.

In earlier iterations of 1st year design studios, an array of full scale design experiences have been executed using bamboo stalks, cardboard, lumber, string and other materials at 1:1. However, these projects were always designed through highly intuitive processes that resulted in ephemeral installations that were only left in place for a few days. In response to these critiques of earlier 1:1 design experiences, in 2014 the Spring quarter freshman studio adopted much of what had previously been the content of the Fall sophomore design studio - the introduction of students to lofted surfaces, structure and conceptual composition - and added to the end of it a new 1st year building experience. Rather than arbitrary and ephemeral installations the students would carry out the semi-permanent, full scale construction of a project that had been developed through an iterative sequence over the entire course via scaled drawings and models in order to provide consistency and clarity of concept and spatial intent from initial sketches through built form.

The resulting construction would be required to exist outdoors, exposed to the weather for a full year, striking a reasonable balance between durability and cost while also allowing each project to serve as an example to the next year's class. The experience of the building process at this early stage in their design education is also meant to challenge them to maintain and even amplifying the poetics and meaning in their design work while navigating the practical considerations of fabrication methods, material limitations, structure and connection.

## The 135 Design Sequence

In ARCH 135, the final freshman design studio offered each Spring, the 1:1 construction experience is the final step in a fast-paced sequence of assignments covering conceptual development, abstract design thinking, design via simultaneous drawing and modeling, structural design, tectonic exploration, design development and simplified construction documents. The students begin this sequence by developing three closed shapes that they derive from Richard Serra's verb action list. Through both axonometric drawing, and model, the shapes are employed as sections, and are connected to create a solid through an analog process that approximates the lofting and surface manipulation in Rhino. Students divide the solids into 12 section cuts, which the students translate into a series of structural ribs.

These ribs are further developed by using extension lines to help accomplish structural triangulation. Sizing and the duplication of members, along with the combination of various materials employed, further develop the tectonic language and member connections. The application of planar materials and lateral bracing, along with all other design adjustments, are meant to reinforce the qualities of the original Sera verb in the final composition.

Following this rigorous sequence of design development, the resultant designs which had been developed as 1:1 armatures are then considered at a 1/8" = 1'-0" scale, allowing the designs to then be thought of as a pavilion structures. The final two weeks of the course are spent on the construction of a single full scale structure by the entire class in a coordinated group effort.

## 2014 Build: The Competition

During the first iteration of this studio, approximately one week before the structural "rib" models were due, the students were informed of the competition style review that would take place on the due date. That day, a panel of visiting architecture faculty selected six of the 29 projects presented for further development.

With the finalists selected, the second phase of the competition was explained and the students were informed for the first time that the entire class would be constructing the final winning design at full scale in the courtyard of the school's shop. With this knowledge, the students divided themselves into equal teams across the 6 projects and were told to consider their models as 1/8"=1'-0" representations of a pavilion structure and that they needed to develop them as small gathering spaces with bench style seating elements at 18"above the ground.

The student teams were given one week to refine their designs, add the seating and generate hand drawn plans, sections, details, material takeoffs, and a budget. These materials were then presented for each project and the students cast their vote for the design they preferred to build (Fig 1 &2).

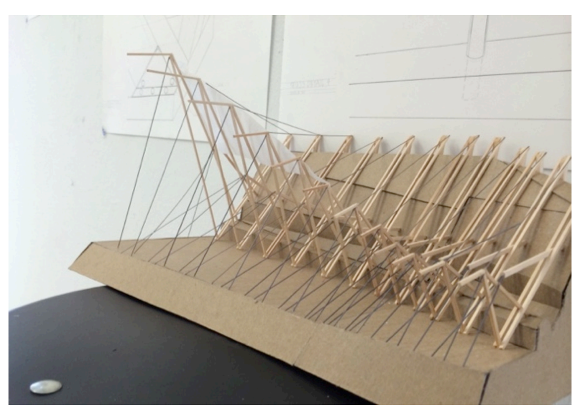


*Fig. 1. Winning project model in the 2014 Design Competition*

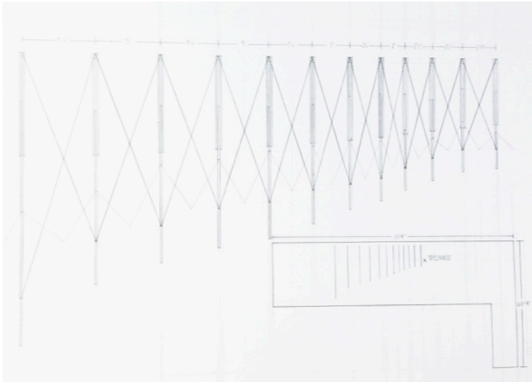


Fig. 2. 2014 project site plan

The instructors tallied the student's votes and considered them when selecting the final design for construction.

Through this process of practical design  and detail development many of the students revealed a general lack of familiarity with much of the practical knowledge of hardware, tools and materials necessary to construct a basic wood framed pavilion with standard, screws, bolts and steel fasteners.  Many of the proposed details had to be redesigned several times over the course of the week.

With the final design selected, the faculty and students worked together to divide the work assignments considering construction familiarity, personal interest and ability. This resulted in a pair of students constructing each "rib" element and a few students completing overall tasks such as pouring footings or lateral bracing installations. Unfortunately these general tasks, which effect all parts of the project and require more labor, were delegated to the students who were not excited or interested enough to volunteer for one of the initial responsibilities offered.

As the construction process ran its course, the work assignments became much more fluid. Natural leaders, followers, and bystanders, emerged mainly because design authorship rested primarily with a single student and the team that developed the drawings for the project. The members of that team became de facto project managers fielding questions and making decisions that governed their peers efforts through the course of construction.

Fig. 3. The completed 2014 rib pavilion

The construction process lasted approximately two weeks with official class meetings 3 days per week for 3 hours, with many informal work sessions taking place outside of class time.  The end result (Fig. 3)was a unified project that reflected many of the qualities of the original design however clear personal motivation and investment in the process seemed to only be had by about one third of the class – a topic addressed further in the conclusion of this paper.

The following year, during the planning stages of the course, the instructors solicited informal verbal feedback from the students that had completed the initial 2014 project. The feedback reinforced some of the pitfalls suspected of the project format and helped prompt the instructors to abandon the competition phase in favor of a collaborative design process leading into the construction portion of the studio.

## 2015 Build: Collaboration

In the 2015 iteration of the studio, the initial design assignments ran just  as they had previously, including the verbs, sections, lofting and rib models, but rather than holding a competition style review on the day the rib models were due,  each student was asked to select the single rib from their project  that they liked the best and provide a duplicate of that rib that was not attached to the rest of the model.

Following some group discussion  evaluating the strengths and weaknesses of the individual rib model designs on the day they were due the announcement was made that the studio would be using the provided individual loose ribs to begin to collectively design a hybrid rib pavilion that would incorporate seating, shading, and become the final design to be constructed at full scale.

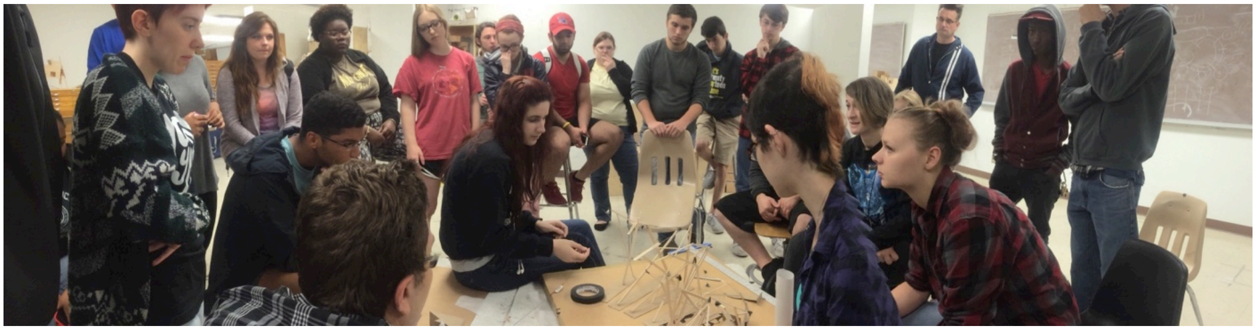


*Fig. 4. A class wide design meeting combining ribs elements from everyone's projects.*

In spite of some initial confusion about how to approach the merger, the following week was spent modifying the unrelated rib designs into a somewhat cohesive form (Fig 4). Some students expressed frustration at the idea of starting over when there were perfectly successful complete designs to choose from. Others did not prefer the inherent eclecticism of combining so many rib varieties, but on the first day of this process the initial step was to arrange all 29 individual ribs into a single form in order to generally sort them out by size, search for common geometries and begin to think about what sort of space this collection of ribs could be used to create. It was this initial exercise that led the 2015 design to incorporate more of a round table gathering space within the pavilion opposed to a linear bench seating arrangement.

At the end of the first large group design session the 29 rib arrangement was starting to show some promise of becoming something more interesting than the singular 2014 pavilion, the ribs were paired with the most similar neighboring rib and the two students that had created those ribs were required to work together to combine them in to a unified hybrid design. Some groups consisted of 3 students in order to compensate for the total of 13 ribs in the final design. The teams went through 2-3 iterations of refining their ribs to try to relate to the geometry of their neighbors without loosing the primary elements of their original form.

This approach found the majority of students contributing significant effort outside of class time, as several natural leaders emerged within the studio. Class time also offered a chance for the instructors and those less involved outside of class to contribute to the design direction. After a week of effort by all, and approximately 3 full iterations, a final design that struck a balance between the original unrelated ribs and a new unified form was approved for construction.

With a model of the new design completed, the design of the connection details between each member were explored through an iterative 1:1 mockup assignment. To begin gathering ideas for these connections and to prepare the worksite for construction, this assignment began with the careful deconstruction of the 2014 project. By disassembling the previous years work, students were able to get a sense of when to use bolts vs screws and how concrete, lumber, and steel can be fastened to one another.

For homework students were asked to sketch a variety of ideas for tectonic connections between the members of their ribs. During the next class meeting they were then tasked with assembling a mock up of their most successful sketch from full scale wood scraps (Fig 5), sometimes allowing cardboard to represent steel mending and flitch plates. Most ribs had 4-8 intersections to be resolved through this process, which doubled as a way of introducing students to some of the shop tools necessary for working at full scale. Deconstructing the previous year's project gave the 2015 group an advantage in terms of tectonic development, and the breadth and sophistication of mock ups proved invaluable.

Following the mock ups assignment, each group was responsi-

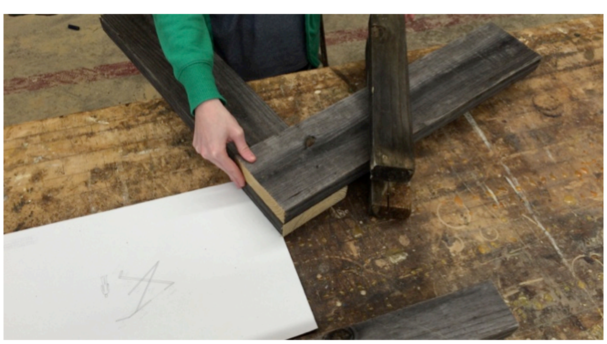


*Fig. 5. 1:1 connection mock up during 2015 studio*

*Fig. 6. The completed 2015 rib pavilion*

ble for creating construction documents, material takeoffs, and budgets for their individual rib design. Each group was also responsible for pouring footings, help in creating shading panels and developing cross bracing. In this iteration (Fig 6) there was a more equitable distribution of responsibility in which students felt more comfortable making their own design decisions, leading to a clearer sense of collective ownership of the project.

## Comparing the Modes

By adjusting the method of selecting and developing the final designs for construction, the 2014 and 2015 freshman design build projects resulted in two unique student experiences. During the Fall of 2015, both sets of students were interviewed and asked to reflect on the experience, their motivations for completing the project and its value to their education.

Overwhelmingly both studios reported that they were most clearly motivated by the novelty and excitement of the construction process and that in hindsight, the most valuable aspect of their experience was to be found in their new knowledge of construction processes and a better understanding of the realities of teamwork.

"Learning to work as a group was definitely valuable, because it led to better communication skills…there's something really valuable about moving from pencil and paper to a three-dimensional space where you really understand the weight of materials and the strength of the things that hold them together" - 2015 student

The two studios differed however in their overall satisfaction with the process and in the suggestions they offered for improvement. The 2014 studio expressed a general frustration with the design competition format with a full 50% of those surveyed suggesting that the larger group be allowed to provide design input rather than pushing forward with the work of a single individual.

"Having a single person's project built was not ideal because then they were in charge of everyone and it created conflict among classmates" - 2014 student

Conversely, the 2015 studio, which merged all designs into a single project, generally expressed a more positive experience, with about 25% of the group expressing dissatisfaction with the collective design effort and suggesting that a single person's design be selected to improve the consistency and homogeneity of the design.

In the end, each studio had a few students who claim they would have preferred to an experience more like the other. Both groups experienced some dissatisfaction surrounding design authorship. The 2014 group had many members of the team less engaged in the project because they were not allowed to contribute to the design, while the 2015 group saw relatively few people dissatisfied with the design because the process was much more democratic in nature.

## Guidelines for Future Builds

These findings support the general principle that all students involved in a design build project are far more likely to take an active role in the project and benefit personally from the experience if they feel they have contributed significantly (or at least had the opportunity to contribute) to a design that they are excited about constructing. Similarly, it would seem from these experiences that if students are not allowed by their peers to make decisions for themselves, alienation and dissatisfaction can occur further reducing student's learning opportunities.

For future projects of this type, the collective design merger seems far more likely to be effective at engaging more of the class in the design process, however, an improvement on this format would be to allow more time for the refinement of the collective design. This would, in theory, allow the design to develop into something that everyone is excited to build while including design influence from all that are interested in contributing.

Overall the process of 1:1 creation through the design build process is a powerful and immersive educational experience to which most students respond positively. As with most group projects, when many are asked to work together, the concept of individual design ownership can be more of a liability than an asset due to its potential to alienate those who feel they've been excluded from the decision making process. To ensure an engaging, valuable experience for all involved a thorough merger of the best design ideas from the group would be carefully leveraged to unify the team and allow each participant to be motivated by quality teamwork and collective ownership of the design and construction processes.

# Learning to Design for Users: Balancing Aesthetics & Performance

Clifton Fordham | Temple University

## Background

Learning expectations for Materials & Methods courses are passed on through tradition and are shaped by NAAB (National Architectural Accreditation Board) requirements with which professional and pre-professional architecture programs are expected to comply. An examination of a classic text book such as Edward Allen's *Materials & Methods of Building Construction,* the primary text used for this course and a mainstay in architectural education for the last thirty years, reveals the breadth and depth of information a student is expected to engage within the course. The sheer volume of information in the text, which is over a thousand pages, and contains twenty-four chapters, can be overwhelming.

The majority of chapters in Allen's text correlate with common material systems utilized in North America. Examples include wood light frame construction and pre-cast concrete. Other chapters are dedicated to entire construction categories such as interior wall systems and ceiling systems. Topics addressed within the chapters include an abbreviated history of specific materials related to building construction, the physical properties of the materials, explanations of how the materials are classified, descriptions of how the material systems relate to regulations, and elaborations on how materials are assembled to achieve building objectives. The later activity which takes up the majority of space in the book is supported with technical drawings, photographs of buildings under construction, and occasionally images of completed buildings.

Allen's book is comprehensive and detailed enough to provide a basis for instruction for beginning engineers and construction mangers as well as designers. The level of detail approaches that of a reference book, runs counter to the established culture of design education which is to guide students from processes based in abstraction, toward practice environments where specific information is applied. This linear path which places large demands on firms to provide instruction in specifics is a source of the ongoing debate of the respective responsibilities of the academy and practice to educate design professionals.

In addition to concentrating on abstraction, reasons for deferring engagement with specific information include demands on time, and the fact that technical information can seem dry. It is difficult to advocate for building technology in design education culture where the tendency is to present the design process as a form of personal expression as opposed to a broader act of problem solving. Presented in this context, technical information and knowledge can be particularly unappealing. Challenges in finding interest are compounded when knowledge appears disengaged from action and problem solving.

There is little contemporary consensus on why technical courses exist in architecture school except to provide some framework for anticipating situations to be encountered in practice. Studio course which take up the majority of curriculum bandwidth make few demands on technical knowledge with the exception of some structural and vertical transportation considerations. Questions of the relevancy of other subjects in beginning design education such as history have been debated, with the instruction of history remaining intact; largely bolstered by the notion that critical theory which has been incorporated into history courses, supports design thinking.[1]

The location of building construction instruction in support courses which are eclipsed by studio, and the diminishing context in which subjects rich in information, or linked to objective knowledge, are embraced by students does come with liabilities. Chief among them is the increasing performance expectations of buildings which places demands on the historical role of architects as synthesizers and coordinators. Most building performance advances have been tied to systems performance that are scientifically grounded and removed from decisions made by intuition not grounded in empirical knowledge. Beginning designers who have not been introduced to design processes that consider building performance face an almost an insurmountable climb toward practice efficacy unless privileged with mentorship in the most sophisticated work environments.

Critical engagement with buildings also is limited if approached without an understanding of the technical demands of buildings. Under this scenario, large formal design moves draw disproportionate attention with environmental responsiveness, human accommodation, material choices, and detailing overlooked or suppressed in assessments. Students are particularly susceptible to formal gimmicks and greenwashing, although mature professionals are also drawn toward spectacle which is compounded by the difficulties of engaging buildings in person over time.[2]

Existing structures, when available can serve as examples, or inspiration, making them more amenable to information oriented courses where the accumulation of knowledge is the primary objective. Even with this avenue, challenges exist with the private nature of building ownership, and the layered reality of construction which limits perspective and hiders a reading of existing structures that go beyond surface; although systems and materials are less concealed in some structures. Access to buildings under construction is even more limited than completed works, with the slow progress of construction, and limited time for site visits making it difficult to take advantage of job sites in lecture courses.

*Establishing Connections in School*

An alternate strategy to approaching building construction as a disconnected dry subject is to introduce links to contemporary design. This is fundamental to the approach that I have taken with my Materials & Methods classes at Temple where I have grounded discussions with connections to notable and less notable, but well-designed buildings, into narratives on building construction. It is also the approached codified in *Skins, Envelopes, and Enclosures* written by Mayine Lu, which is based on lecture notes for a course she co-taught at Columbia University. Her book differs from most text intended for building construction courses in that it draws lessons from celebrated buildings found in architectural history books and lectures.

Forging a link between aesthetic issues and building technology helps make dry material relevant by linking them to objectives that students are more likely to find interesting than goals tied to building underperformance such as wear, or failure. This strategy places building technology on a closer ground to history and theory which typically has a higher status in design education. Both traditional building technology text and formal analysis of buildings tend to overlook the functional demands of buildings and why specific systems better support human needs. Rather they acknowledge structural functions, fire protection, and fundamental weatherproofing, goals that are assumed to be met in all buildings notable, or normative.

Engagement in the human factors of design has also too often been omitted from design studio education, occasionally finding a home in support courses. Postponement of consideration of human factors as a fundamental part of design thinking shares similar advantages to postponing technical factors in that is allows for greater isolation of formal issues as a basis for developing design approaches. Once again the ability to integrate these factors is projected into the future realm of professional practice. Many design instructors resist incorporation of even the most fundamental practical requirements on the grounds that they can inhibit a student's ability to be innovative or make creative leaps.[3]

Lack of acknowledgement of multiple performance issues in design studio sparked an opportunity to address a middle ground between studio design, performance criteria, and building construction knowledge. It also opened up opportunities to address how beginning designers experience building design. At the heart of design problem solving is the notion of simulation and representation. Studio design typically involves generating scale representations of abstract designs that are disengaged from building materials, fabrication logistics, user needs, and cost; all factors that buildings are shaped by.

Full scale construction entails challenges that are difficult to surmount within the limits of the current model of design education. As a result they occur, but are difficult to locate within the time frame permitted by design studio sessions; and non-studio courses which have even fewer contact hours allotted. Time allotted for building crowds out other activity such as reading and discussion. Construction also entails material costs which can exceed limits established by institutional policies, and raises risks inherent in building that must be insured against. Fabrication skills for larger installations have to be instilled, or farmed out, creating logistical hurdles. Additionally, land availability is also a significant barrier in dense urban settings such as Philadelphia where Temple University is located.

*Chair Project*

Despite these challenges, the prime motive for engaging full-scale fabrication in Materials & Methods class was the opportunity to engage actual materials so that they resulted in a functional artifact as opposed to a non-functional fabrication. A build project would augment observational assignments where students are sent into the city to record and assess given conditions of older buildings. It would also offer a dynamic experience on design and purpose that visiting a construction site does not afford. Since studios problems are typically devoted to building abstractions, a project at the human scale was identified which could be evaluated and tested in a way simulations cannot.[4]

A chair project presented an opportunity to engage issues that are seldom addressed in studio including comfort, ease of use, efficiency and safety. These issues were introduced with the intentions of innovation and expressiveness being tempered by function and performance. The potential downside was that student frustration might arise from clear design criteria which might stunt creative leaps or conceptualizations. This risk of having students engage in design thinking that did not privilege aesthetic novelty was considered minimal weighted against the upside of direct feedback available at full scale. The chosen project would also allow user feedback from non-designers which are rarely incorporated into design school evaluation.

Within a non-studio course, a chair project was feasible because its primary functions can be clearly identified and fabrication could occur in school shop facilities with skills the students already possessed, or could quickly obtain. Chairs designed and constructed by each student would allow each student a range of creativity and personal experience with fabricating something that would be tested under real world conditions, a perspective that is missing in design studio. The project also allowed for incorporation of technical drawings that was part of prior versions of the course. Additionally, some students enrolled in the class were facilities management and preservation majors; programs that don't carry the expressive objectives of design.

This project contained an unusual twist on the typology of the chair in that it would be for a two-year old rendering the outside dimensions a fraction of a chair built for an average sized adult. The students were told that the chair would be tested with dead weights, and if deemed safe, an actual toddler. By reducing the extents of a chair, students would consistently economize material, an important consideration when student resources are thin due to text requirements in lecture courses and supply requirements in studio. There is not as much precedent for child scale chairs vs. adult chairs which was seen as an opportunity for students to look beyond precedent, or at least not be fixated on conventional solutions.

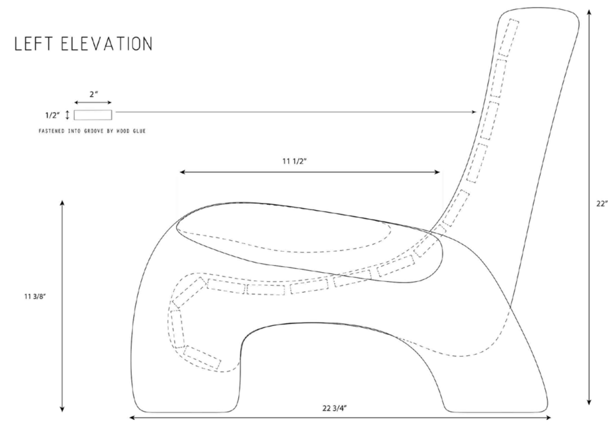



*Fig. 1 Elevation of Chair indicating Dimensions drawn by student*

## Brief and Design Criteria

When the first step of the project was issued, major design criteria were made clear at the beginning of the project including structural soundness, comfort (ergonomics) and safety, economy of materials, adaptability, and visual delight. The latter was to be seen as a bonus on top of satisfactory performance of the other criteria. Students were told that they would be designing for an actual two-year old, but they were not introduced to the child or privy to any data or images of him at the time. This obligated a research effort on the part of the students to determine what the dimensions and weight of an average two-year old which would influence the robustness of a small chair.

The chair was to be fabricated from materials available at Lowes's, Home Depot, Target and Walmart which would allow for an extended range of inexpensive materials. Students were encouraged to approach material choices with intentionality, but also with open-mindedness to finding items that they were not originally seaking, but could be incorporated into a chair. Between the stores there are items not intended for furiture and buildings, for instance textiles and synthetic membranes used to handle materials. Another intention of specifiying stores was to limit trips expended to specifiy materials, and to allow for associating materials with specific costs which were required to accompany design proposals.

*Project Steps*

In addition to research, the students were each first tasked with creating a set of schematic scale drawings (half scale) for the final chair to be fabricated later in the semester. The plan, sections, and elevation drawings were to include dimensions and notes calling out specific materials and means of joining the materials together. For instance fasteners and or adhesives were to be identified. Accompanying the drawings [Fig. 1] was a set of specifications that included an accounting of intended materials, their costs, and a brief narrative of the overall design rational.

After a group review of the drawings and specifications, the students were next asked to build a mock-up of their chair that reflected insight gained from the review. They were told that the mock-up was to be constructed of inexpensive or found materials, such as cardboard and string, and that the model should not be seen as precious, but rather as a development tool. A mock-up allowed for assessment of form and performance at full scale, including application of physical pressure, making ergonomics issues and structure factors readily accessible. The students were asked to consider how tweaks to their designs would improve the performance of the chair. Universal changes or creative leaps after this point were discouraged to concentrate on development.

The final stage of the project was the fabrication of the chair using the actual specified materials, and the submission of final drawings and specifications reflecting changes made since the intial design and mock-up. The students were reminded that the final review would include actual testing. for structural and safety considerations. First a weight would be placed on the chair and if it survived the child might be placed in it. If they were concerned that their chiar had structural faults they could forgo the test by the child by conceeding that they did not think their chair would survive a weight test.

*Fig. 2 Critics making initial observations*

## Evaluation

In addition to participation of the toddler, four critics were invited to the review. The chairs were arranged at the perimeter of the review space and each assigned at number. Each of the reviewers were issued an evaluation sheet with six vertical columns, each associated with six evaluation criteria. Numbers assigned to the students were listed vertically and each review was asked to rate each chair in each category from 0 to 5. After completing the form, a general discussion ensued in which chairs were identified by the critics and critiqued in a fashion typically associated with design studio reviews. As a result, all the students were able to gain insight without having to defend their work, or supplement the product with commentary.

*Fig. 3 Adult critic and toddler at work during review*

Concurrent with the form based evaluation, and early part of the group discussion, the toddler was free to roam the review space and engage the chairs. During this period he zeroed in on a few chairs that were different from the ones the guest reviews were drawn to later in the event. For example a low slung cushioned chair and a wood chair with a drawer in it [Fig. 3]. Differences in the young user's preferences and inclination for adult critics to point out other chairs for positive qualities highlighted a historic difference between user and expert opinions.[5]

Later on in the review the toddler (my son) was placed in some of the chairs to see how structurally sound they were and to gauge his reaction. In one case he took joy in bouncing up and down on a chair for a few minutes, until it was determined that the brackets used to fasten the legs to the sled started to loosen. In another case he was placed in a foam chair that was deemed to have too little supprt at the back. Rather than let user testing remain a point of levity, the adult critics seized the oportinity to make constructive comments, drawing greater attention from the students than when comments were made when the toddler was away from the chairs.

*Conclusion*

This project was initiated as a way to engage issues of materials, fabrication, scale, human comfort, and safety; design factors that are often overlooked in design studio. The presence of a client and the prospect of testing the design artifact allowed for a form of feedback seldom available in school. Designing for a small person allowed the feedback to be unfiltered and direct. It also allowed for economy of materials relative to design for an adult. Because the toddler could not perceive some functional criteria, this feedback along with comments from the adult critics allowed for different perspectives and experience.

*Fig. 4 Toddler and student interaction*

The students understood from the beginning of the project that the chairs had to meet fundamental criteria including structural soundness, and had to be free of sharp edges or other characteristics that could injure a user. These expectations could have been perceived as objectives that are contrary to the student's freedom of expression, or other design agenda that the students might believe trumps soundness. Despite the stated criteria, the project was not without creative leaps and unconventional responses to the program. One student used a rubber ball as the departure point for her chair. Other students used atypical materials such as PVC pipe to fashion structural components of the chair.

## Notes

[1] Gutman, Robert. "Redesigning Architectural Education" in *Designing for Designers* Fairchild Publications: New York, NY. 2007. p 14-17.

[2] Investigations of how buildings perform over time are almost non-existent in architectural criticism. Perhaps the most influential book addressing this issue is *How Buildings Learn* written by Stuart Brand who is not an architect. A more recent attempt to address the void can be found with Rumiko Handa's essays in her book *Allure of the Incomplete, Imperfect and Impermanent.*

[3] Lawson, Brian & Dorst, Kees. *Design Expertise* Taylor and Francis: Burlington, MA. 2009. p 34-38.

[4] In her book *Simulation and its Discontents*, Sherry Lawson provides case studies illustrating many of pit-falls inherent in simulations.

[5] Preiser, Wolfgang. "Introduction" in *Architecture beyond Criticism* Routledge: New York, NY. 2015. p 3-5. In the introduction to this collection of essays Preiser highlights tensions when attempting to integrate judgment based criticism with experience performance based evaluations.

# Multidisciplinary Hats and the 1:1 from Day One

Farzana Gandhi | New York Institute of Technology

The foundation years of any contemporary design curriculum are critical in not only teaching students how to see, how to draw, how to talk, and how to think, but also in exposing students to real-world design problems and processes. It is here that full-scale exercises have traditionally found a place in academia. These projects have always practiced a sense of social responsibility - responding to the needs of communities and working hand-in-hand for the greater good. Given the changing nature, however, of how these projects are found, defined, supported, organized and delivered, it is imperative that we also redefine what it is we mean when we speak of full-scale in architecture schools. Put simply, working full-scale means confronting *all* of the issues that would allow the project to be realized. Today, this encompasses far more than simply ending a semester with full-scale construction.

Architects are taking on increasingly complex, multi-faceted work. This includes everything from disaster relief shelters to projects that can act as economic stimuli in distressed communities. With these messier design problems come messier scopes of work. The delivery of a full-scale physical solution is not enough to ensure a project's success and broader social impact. Students must put on multidisciplinary hats and dive deep into a supporting socio-economic and cultural infrastructure. These 1:1 realities must begin from the start and continue throughout. Similar to a process of product design, "virtually every step along the ideation path can be prototyped – not just at the development stage, but also marketing, distribution, and even sales. We've also learned not to be precious about prototyping... we cycle through prototypes, and our first prototypes can be pretty darn crude."[1]

This paper offers a pedagogical model that challenges students with the 1:1 constructional logics of architectural design simultaneously with the 1:1 equivalents defined by other disciplines typically outside the scope of design education. Furthermore, it argues the importance of embracing these full-scale considerations from day one.

## Day One vs. Day Fifteen (or Thirty)

An academic semester system splits the nine-month school year into two halves of roughly 15 weeks each. Normally, architecture seminar or studio courses meet either once or twice a week, respectively, for a total of 15 or 30 sessions. One of the biggest challenges of involving students in any design-build endeavor is that of time. Real project schedules don't align with academic semester timelines. Both Auburn University's Rural Studio and the Yale Building Project offer one solution – they structure these experiences so that spring semesters devoted to design via scaled drawings and models are followed by intense periods of full-scale fabrication in the summer. Although these programs successfully root theoretical constructs in the realities of practice and built form, they follow a traditional model of design-build – for the most part, construction begins when design ends at class day 15 or 30 (in other words at the end of the semester).

Such courses at the New York Institute of Technology (NYIT) have overcome semester time constraints first, by defining more finite problems and second, by overlapping design and construction as one process. Projects are sometimes small enough (pavilions, installations, furniture, prototypes) to complete construction within the constraints of a semester. When they are more complex (multi-year, multi-phased, international), the research is parceled into manageable scopes per semester. Regardless, consideration of the 1:1 begins at day one. This devotes more time to research, experimentation and failure (fig. 1). Students wade into unchartered territories – pushing the boundaries of material properties, form, and fabrication on one hand and participating in work outside of the architecture discipline on the other.

*Fig. 1 NYIT students working 1:1 in the shop*

## The 1:1 in Architecture

By working with material, dimensional, and environmental specificities from the very start, students can not only make more informed design decisions, but also find more opportunities to innovate and experiment. The separation between design and construction is erased and one continually informs the other. While students might think that having investigated 1:1 details early ensures a smooth and efficient construction process at the end, it is important to learn that this is often not the case. Especially apparent when designing for remote locations, students find that working 1:1 in a studio is quite different than what one finds in the field. The process of trial and error must continue through to the very end.

In a recent semester-long course at NYIT, the author's undergraduate architecture students collaborated with Prof. Andrea Bauza and her graduate students at the University of Puerto Rico Rio Piedras (UPR) to design a small beach pavilion for a community in Culebra, Puerto Rico. Although modest in scale, the students proposed that the prototypical project be replicated across the length of the beach to instigate improvement of this economically distressed area, ripe for tourism.

The realities of budget, time, and materials were considered from day one. NYIT and UPR students exchanged design ideas throughout the semester. Standard lumber dimensions and available shop equipment forced one set of constraints, while material economies and cost set another. To accommodate an ease of construction and assembly, the project was conceived of as a 7'-6" cube sliced into five 1'-6" wide modules (fig. 2),

*Fig. 2 Community Beach Pavilion designed as modules for ease of construction and assembly*

each programmed for picnic seating and shade. Two of the five modules extend out of the cube to offer changing room space, viewing frame to the landscape beyond, and an information kiosk.

*Fig. 3 Students building the project in Puerto Rico*

During their Thanksgiving break, the NYIT students traveled to San Juan, Puerto Rico to participate in building the pavilion. A "critical-path" schedule took into consideration material delivery dates, shop equipment hours, and numbers of students per task to ensure that the project could be built within the allotted timeframe. What students did not foresee were the weather conditions that week. Building 1:1 details in New York City is far different than building in the heavy rains and high humidity of Puerto Rico. Students quickly found that warping wood and material moisture content caused rigid moment connections to fail (fig. 3). Thinking on their feet, they designed jigs that operated much like car jacks to hold failing corners at 90 degrees while details were rethought. Learning from the inevitable moments of failure that exist in the space between assumptions and realities is what actually marks the success of this course.

## The 1:1 Multidisciplinary Equivalents

Within any collaborative project, it is important to structure student work with assigned roles and tasks. Traditional design-build studios will allocate roles such as project manager and construction manager and sometimes even those of design-related consultants (structural, MEP, lighting). In the case of the project in Puerto Rico, the NYIT and UPR students took these on and many more. The nature of the design problem at hand demanded that they act also as sociologist, economist, fundraiser, marketing manager, and social media expert.

If 1:1 can be broadly defined as directly working with the real, what are the multidisciplinary equivalents to working with architectural materials and construction specificities? It is clear that each of these roles requires its own full-scale considerations per discipline.

### *Sociologists, Economists and Urban Designers*

A community typically does not know how we can help it. In the absence of a traditional architect, client, contractor triangle, we often design *and* build, and also identify project, problem, site, and scope. As Brian Bell puts it, "Traditionally, architects and clients start their working relationship when the clients, who understand what architecture is and what they need from it, contact the architect. But when architecture is a community service, it is the architect who seeks out the clients."[2]

Although the municipal client in Puerto Rico was on board from the beginning, the "what" and "where" was undefined. UPR student "sociologists" spent quite some time in the community, conducting interviews, workshops and feedback sessions to learn about locally specific needs and social behaviors. Student "economists" researched factors that had led to the area's economic decline, finding that tourism had decreased substantially due to aging beach facilities in need of an update. Interviews with primary sources (local residents) offered important insight to the project – ultimately proposed as a series of beach pavilions within a larger masterplan that could revitalize the area.

Through surveys and observations, working full-scale in urban design points to a deep understanding of existing social systems and how people live. Like in architecture, the 1:1 of urban design moves beyond a theoretical construct and engages the realities of being on the ground. "In *The Practice of Everyday Life*, Michel de Certeau contrasts the objective aerial view of the city with the view of ordinary practitioners at street level who move from space to space, creating links and paths without knowing their relationship to the abstract whole."[3] Acting in this way, the architect is privileged to have both views at once.


*Fig. 4 Fundraising with homemade empanadas!*

*Fundraisers, Cost estimators, and Business Planners*

Quite often, non-profit clients do not have sufficient funds to carry out construction. NYIT student fundraisers raised over $1200 of our total $2000 budget within just a few weeks, holding bake sales and individually approaching donors for sponsorship (fig. 4). Developing a sponsorship package or writing a grant is "very effective at grounding a project in reality. Funders look for how the proposed project will meet the needs of the community, the effectiveness of the proposed solution, the ability of the applicant to deliver that has been proposed, and a realistic budget. Working these questions out while refining the design is the type of experience that is lacking in architecture schools..."[4] Students followed their fundraising activities with careful cost estimates and material takeoffs to deliver the project within budget.

In a previous instance of this design course, the author co-taught with NYIT Prof. Jason Van Nest to work with students in the design of a new (now patented) roofing system made of plastic waste for disaster relief scenarios. A shipping pallet that delaminates and breaks apart into linear roofing purlins was developed. The geometry of the pallet allows crushed water bottles to interlock and overlap like Spanish tile, resulting in a waterproof, naturally ventilating shelter. In this case, students went beyond the typical 1:1 considerations of design-build (material joinery, fabrication) to participate in both short-term and long-term economic viability. A Kickstarter campaign successfully raised over $4600 to supplement funds for immediate semester-end, full-scale shelter prototyping. Although outside of their comfort zone, these architecture students also embraced basic business terminology to identify the product's value proposition, market competitors, target audiences, and benefits to various stakeholders. They placed as finalists in the NYS Business Plan Competition two years in a row, winning the Judges' Choice Award and People's Choice Award, respectively.

*Marketing Managers and Social Media Experts*

The communications discipline plays an important role in design, both in how we work with each other, but also in how we reach our end users. Designing and building a project for the community overcomes only half the battle in a path of success. Architects must find ways to "sell" the project and establish trust with local residents. "Today's audience is changing. No longer content to simply digest messages, these users increasingly approach design with the expectation of having to fill in the blanks and actively insert content. The daily use of websites such as Vimeo, Flickr, Facebook, and YouTube has conditioned the public to contribute."[5]

After much debate, students named the Puerto Rico beach pavilion project, *Contorno*. This had a graphic and identifiable "brand" that was suggestive of its sites along the contoured beachfront, but also of its modular pieces, designed to fit the contours and proportions of the human body (fig. 5). As marketing managers, they also reached out to a number of architecture blogs and publications with a press release once the project was complete. Additional public awareness and momentum can be credited to the student social media experts. These students maintained a Facebook page, Instagram feed, and twitter account by posting regular updates not only during construction, but also during the early phases of research, material experimentation, and design development.

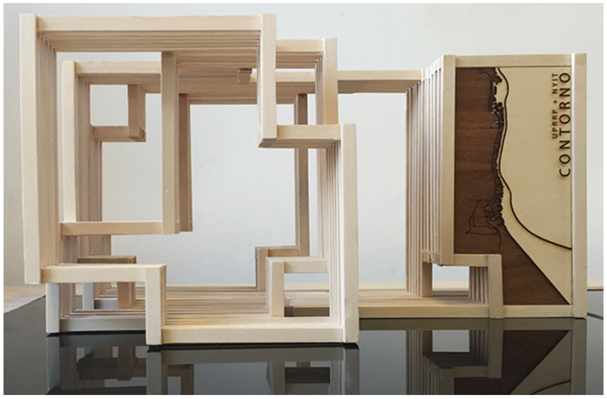



*Fig. 5 Contorno (or contours): branding the project*

## Does the 1:1 make architects relevant?

While Adolf Loos is most known for his discussions of ornament, embedded in his rants is really a concern for the architect's diminishing relevance in the design for the everyday individual. At the time, technology had made mass produced items more affordable than the hand-crafted. This underscored a misalignment between the mass clientele and the designer. Today, architects continue to close this gap by taking on community-based projects and humanitarian, non-profit work. Leading to such exhibitions as the *Design for the Other 90%* at Cooper Hewitt and the United Nations, this work frequently inspires design-build projects taken on in schools.

The son of a stonemason and sculptor, Loos advocated for a 1:1 in education that in contemporary terms might be defined simply as working with the practicalities of materials, construction processes, and fabrication equipment. In his 1897 essay, Loos claims, "Painters, sculptors, architects are leaving their comfortable studios behind them, saying farewell to high art, and turning to the anvil, the loom, the potter's wheel, the furnace, and the carpenter's bench. Away with all this sterile drawing, away with academic art! What we should be doing now is examining life, our habits, our need for comfort and practicality to discover new forms, new lines... In our country people still believe that before a man can be entrusted with the design of a chair he must know the five orders of Greek columns inside out. I think that first and foremost he ought to know something about sitting!"[6]

Erasing the boundaries between artist and craftsman (or today's designer and builder) found a place in many schools of that time, including within Loos' own architecture school in 1913 and also within Gropius' *Vorkurs* or basic course at the Bauhaus in Weimar between 1919 – 1928. When the Bauhaus reopened in Berlin, one of its students wrote, "a new type of builder and craftsman will emerge from the school. Through the teachings of the rudiments of all the crafts, a wonderful command over the methods of technical procedures is acquired."[7]

Interestingly, our profession is reinventing itself still today in a continued struggle to maintain relevance. For Loos and others at the start of the 20th century, a direct participation in the 1:1 of design and fabrication logics was thought to be a sufficient remedy. While this is certainly still a critical component of public interest design today, our profession must not only keep up with changes in mass production (or today's project delivery processes), but also with changes in the way such projects are initiated (often in the absence of client, program and site), accepted (by the end user), and made certain of impact (long after the project is built). Our relevance is, therefore, necessarily also dependent on a deeper investment in supporting social, economic, and cultural systems.

## The Pros and Cons of Wearing More Hats

Diluting the basic essence of what we do, the growing tasks of the architect beyond that of design and construction may be considered quite negative. "The expanded field demands that the professional engage with a new set of tools, some of which may be outside the traditional comfort zone... interviews, scenario testing, collaboration, business development, policy writing, prototyping... by which time we are in danger of having a cacophony of methods that threatens the very viability of professional stability."[8] On the other hand, and as Jeremy Till and his colleagues go on to argue in *Spatial Agency: Other Ways of Doing Architecture*, this broader role allows architects to engage supporting issues and end constituents more directly.

Having a stake in multiple areas by wearing more hats allows the architect to see a larger picture, make more informed decisions, and orchestrate greater control in what results at the end. He is able to set up strong, local and global partnerships with industries and other disciplines to ensure a project's longer term viability in the community. Ironically, it is this greater relevance that also permits an architect to let go of some control and make certain that the end user is made part of the project. Offering the public a voice in what is built is often vital for a project's success. The architect must plant the seeds and then move on, letting the community actively transform and embrace the project in a way that works for its residents. Anderson argues, "...its final form is not always a finite construction... the action of public interest design praxis requires implementation as it often relies on improvisation and change for its realization instead of a priori determination."[9] This reciprocal relationship between architect and end users is only possible through extensive outreach, both in person and through digital (marketing and social media) means.

In academia, this expanded role of the architect offers additional advantages. In the past, design-build opportunities have typically only been open to upper level students. After all, working through construction documents, code compliance, and structural and environmental issues demands a level of design skill and technical competency that cannot be expected of a beginning design student. At NYIT, the author has enjoyed a vertical setup in such courses, with a mix of student levels involved. This along with a greater set of available roles allows students to emerge as leaders in areas they feel comfortable. Upper level students can guide design development and detailing while lower level students take on marketing, fundraising, and social media tasks. This results in a unique and team-spirited dynamic in which each student feels equally invested.

While dozens of community design toolkits and how-to-manuals can now be readily found online, it is clear that the processes associated with this kind of work are hard to generalize and define. Each project comes with its own unique challenges and multidisciplinary requirements. This is both challenging and exciting. Experimenting with this scholarship of community engagement in academia continues to offer insight in the way we can tackle such projects in practice.

## Notes

[1] Kelley, Tom. *Ten Faces of Innovation* Currency/Doubleday: New York, NY. 2005. p 43.

[2] Bell, Bryan. "Finding Clients" in *Good Deeds, Good Design: Community Service Through Architecture* Princeton Architectural Press: New York, NY. 2004. p 23.

[3] Anderson, Nadia M. "Public Interest Design as Praxia" in *Journal of Architectural Education* 2014, 68:1. p 17.

[4] Bell, Ballard. "Tools for Change – Making a Studio Project Real" in *Good Deeds, Good Design: Community Service Through Architecture* Princeton Architectural Press: New York, NY. 2004. p 57.

[5] Armstrong, Helen & Stojmirovic, Zvezdana. *Participate: Designing with user-generated content* Princeton Architectural Press: New York, NY. 2011. p 11.

[6] Loos, Adolf. "Our School of Applied Art" in *Adolf Loos Ornament and Crime: Selected Essays* Ariadne Press: Riverside, CA. 1998. p 15 - 16.

[7] Kentgens-Craig, Margaret. *The Bauhaus and America* Massachusetts Institute of Technology: Boston, MA. 1999. p 222.

[8] Awan, Schneider, &Till. *Spatial Agency: Other ways of doing architecture* Routeledge Press: New York, NY. 2011. p 44 - 45.

[9] Anderson, Nadia M. p 20.

# Creating at the Intersection: Collaborative Integration in the Design Process

Brian Grieb | Morgan State University

Brittany Williams | University of Maryland

## Introduction: Exploring A New Interdisciplinary Pedagogy

Each day, the buildings that shape our world are becoming increasingly complex, as the technology, materials, and methods evolve to meet one of the global challenges of our time: the environmental stewardship of our planet. To create these buildings, architects are challenged to design solutions that demand expertise far greater than any one professional discipline can realistically prepare and practice. Despite the environmental, physical, and social complexities that our profession is asked to solve, many architects begin their professional paths in design studios that are rooted in independent, insular problem-solving environments. While this studio pedagogy may be reflective of a deeper cultural norm that salutes and celebrates the individual creator, our research objectives focused on exploring a design process where this unsustainable method is replaced with one where the architect is a catalyst for an interdisciplinary, collaborative design process.

Frans Johansson, in his book The Medici Effect, states that “when we bring together different perspectives we have a far better chance at breaking new ground.”[i] His thesis contends that innovation is far more achievable when we blend a people of diverse backgrounds and expertise. It is at this “intersection of ideas” that the greatest solutions are generated. One place we believed capable of testing this methodology was the architectural design studio. Moving from a traditional design studio that focuses on an individually designed fictitious project, we sought to rethink how we could create a studio focused on building an interdisciplinary team for the creation of a real-world project.

This paper seeks to disseminate the summary results of a pedagogy that explores an ever more relevant approach to education that challenges our academic “silos” historically found on campuses as a way to prepare students for the challenges posed by environmental stewardship. Working at a 1:1 scale and using the design and construction of a sustainably focused, high performance house as the avenue for pedagogical exploration, this new, highly interdisciplinary model is built around consensus-developed project goals and an increase in intellectual exchange, helping to subvert the prejudice and competitiveness indicative of segregated disciplines. No longer is success rooted to a hero but to the collective efforts of the multi-disciplinary team. The research methods used in this process integrated not only varying disciplines within the university, but professionals and trades-people alike, allowing for reciprocal relationships between academia, the architecture profession, and building industry professionals. While exploring real world solutions, the interdisciplinary process served as a test bed for full scale innovative exploration, with project results that provided students the means and methods to approach issues of environmental stewardship beyond the project.

## Dismantling Silos

Building consensus among a complex interdisciplinary team comprised of wide-ranging expertise and experience is a key to success. While seemingly simple in theory, to create this in the academic realm of the university is no small feat. The academic village, originally conceived by Thomas Jefferson for the University of Virginia, created an environment that strategically placed learning and living in an intimate relation around a great lawn. With this arrangement, Jefferson's design promoted interaction between the minds of scholars and students to enliven the pursuit of knowledge.[ii] In contrast today, many universities' academic departments are isolated, bogged down by vicious academic infighting and cumbersome institutional structures. According to an article in the Chronicle of Higher Education the silo mentality has become legendary.[iii] Like many professional environments, it is filled with intense pressure to impress and garner peer recognition.[iv] Academia rewards time spent alone on research and writing. The academic silo creates a culture that rewards individual scholarship. This individual nature is pervasive both among faculty and infiltrates the student culture as well. In a world faced with a growing complexity of problems to solve, solutions are not bound by the minds one discipline alone.

In order to test this interdisciplinary model through design and construction of a fully integrated house, the existing norm of the academy simply did not work. A paradigm shift had to be made.

## A New Paradigm

The testbed for this shift to a more interdisciplinary architecture educational experience was the University of Maryland's entry to the US Department of Energy Solar Decathlon 2011. The international competition, first held in 2002, challenges 20 collegiate teams to design, build and operate solar-powered homes that blend innovation, affordability and energy efficiency with design excellence. Because of the complex nature of designing a high performance house that pushes new & refined sustainable technologies while meeting the stringent requirements of the competition, the team was structured to blend students, faculty and mentors from a wide range of majors and specialties, representing not just architecture and engineering, but other disciplines such as environmental science, landscape architecture, business, finance, and communications.

For team members, competing in the Solar Decathlon affords the prospect to explore, engage and learn by moving beyond the traditional classrooms of their declared majors. Through the formation of these interdisciplinary teams, ideas and experiences blended and offered new solutions to the challenges imposed by the competition. Maryland's team mixed experience and disciplines to engage not just students, but faculty and mentors to share ideas and research. The endeavor focused on creating a team culture from the outset by developing problem based and project oriented goals. A pyramid-like structure would have risked stressing communication flows, stifling ideas and limiting the team's decision-making capability. So the team entirely re-imagined the basic organizational structure of traditional top-down team leadership hierarchy.

Applying the use of precedents to the deliberate design of the team structure, the team looked to other organizations for insight and precedent in the structure of the team. Knowing they wanted a structure that would spark creativity and promote the "intersection of innovation", the team adopted organizational ideas similar to the product design company IDEO. Organized in a "flat hierarchy", IDEO blends individual autonomy into a shared culture of teams organized by discipline to create a system guided by a democratic process.[v] To achieve this, the team employed a circular-based diagram, in which each discipline was a planet, orbiting and equally spaced around a set of team-developed guiding ideas and core principles located at the center, sun position. This "flat hierarchy" placed students, faculty and mentors in equal position to one another. No one group or person was above another. Each individual shared an equal and collective footing and the core principles and goals became the leader of the design. Interspersed in the "Planet Diagram" was a diverse, multi-generational group of faculty, industry partners and mentors, lending professional experience and providing "gravitational assistance" to guide the "planets" in their orbit (Fig. 1). This diagram became the operational roadmap that helped guide the team's success. The team structure was reflected in the team's design principles, to create a house that operated as part of an interconnected network of systems.

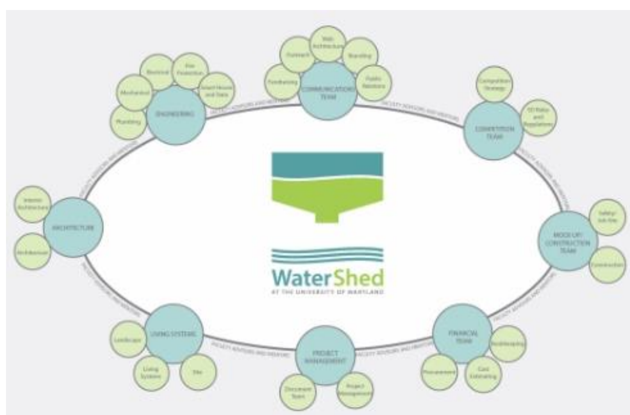



*Figure 1 "Planet Diagram" used to visually organize the structure of the team.*

The typical semester long design studio was extended into an effort that spanned two years; formally divided into three design studios, five architecture seminars and multiple engineering and environmental science electives. The project was led by the architecture program, but in order to foster a true interdisciplinary approach, a large faculty team was formed from schools and colleges across the University. To combat the inherent competitiveness and growing isolation found in the academic community, the Maryland team looked to test a new model. As such, a deliberate approach was taken in the formation of the team members to ensure that an interdisciplinary design process could occur with faculty representation from architecture, engineering, environmental science and the University library system. Over 200 students touched the project at some point with about 40 core students being involved for the duration. The faculty advisory team was supported and supplemented by a diverse team of mentors, including a master electrician, structural engineer, general contractors, carpenters and many others. The mentors for the project worked alongside the students helping expand their educational experience in order to learn from industry professional and tradespeople. For example, during the design process, the team worked with experts, ranging from general contractors who helped them understand the implications of their design decisions on building craft and materiality to a master electrician who assisted in the design refinement and installation of the photovoltaic array. On any single day, both in the classroom or on the construction site, the beginning design student may have had meetings with engineering and environmental science students accompanied by multiple faculty members and several mentors.

An effective team structure and support system for students was critical in the formation of a framework for the implementation of this interdisciplinary model. The institutional support from the University fostered the synergy and collaboration between departments, colleges and disciplines.

## Implementing the Paradigm Shift

From the outset, the team understood that collaboration required a physical place in which ideas could be tested and nurtured. The status quo of the compartmentalized university structure and the transient nature of classroom space on campus would not suffice. Students and faculty needed the ability to come together. They needed a physical environment to promote the exchange of ideas, a "Jeffersonian lawn" to foster the team's collaboration. With steadfast commitment and careful planning, the multi-disciplined faculty team created a course schedule in which all related Solar Decathlon classes would meet in the same building at the same time each week. For three semesters, the related classes were held either in the Architecture School or on the construction site, allowing the team of wide-ranging majors to work under one roof.

Coinciding with the course schedule, regular all-team meetings convened after the formal class times to allow students, faculty and mentors alike further opportunity to design, plan and strategize for the competition.

Within the Architecture School, the team used a dedicated multi-functional space to allow for a continuity of ideas and permanent colocation of study and full scale models. With a generous amount of room, the space provided individual, group and conference size meeting areas for the team to gather and develop the project. The space could accommodate a variety of needs, accessible 24-hours a day for team members to collectively explore material assemblies, create full-scale building mock-ups and strategize design solutions. Most importantly, it seamlessly stitched divergent methods of design communication into a collective location where drawing, computer modeling, scale and full-size physical modeling and team discussion occurred concurrently and in real-time.

This new classroom provided an atmosphere that was simultaneously chaotic and organized. Far from the traditional classroom most students were accustomed, this new classroom model contributed to the team's success. With the variety of personalities and their diverging backgrounds, the team was never short on opinions. Design ideas were constantly tested and challenged. Students from different disciplines had to learn each other's design "languages." Whether in the studio or on the construction site, debates frequently occurred. However, decisions were always made complimentary to the goals of the project. The organization and process favored consensus. Seldom, if ever, did it entail wrangling and suave persuasiveness from a few charismatic team leaders. It was the shared vision that created and shaped the project. Once construction began, the team continued this same model on-site and in the construction trailer (Fig. 2).

Like the vision that guided the team, this new classroom model broke down barriers of academic and individual competitiveness and refocused the energy into the team's shared goals: a house guided by the ideals of nature, a home that not only conserves, but produces resources through a blending of time-tested materials and methods with cutting edge technological design solutions.

Whether strategizing the best energy reduction measures with the home's systems or selecting paint colors, prospective solutions were always joined with sober debate. Other than the usual "straw poll" method to gauge team opinion for an impending project decision, options were never placed to a formal vote. Consensus was not driven by a majority rule or a dictatorial leader, but by a process grounded in determining what best met the principles and goals established by the team. The vision was "the constitution, the criterion for decision making in the group."[vi] Most important to this process was that it avoided pitting team member against team member, idea against idea, faculty against student. Instead, it bonded the students. The principles created a litmus test, a way in which the team could collectively weigh each idea equally, unify and move forward based on what best promoted the teams shared vision and principles.


*Figure 2 Students work on the exterior building envelope at the construction site.*

The process was not devoid of disagreement. However, even in the most contentious moments inclusion was always paramount. Because of the flat team structure, isolation in the design process was minimized. It encouraged student commitment over the duration of the project. They were all contributors; all its creators often leading and learning in two opposite directions. At times, the students themselves could be seen "teaching" mentors and faculty. This idea was never more apparent when a student simply surmised that the project required them to "sometimes lead and sometimes follow." The ideas were not penned by a few individuals, but the result of many, many talented individuals working in concert to achieve a shared goal.

This inclusive decision making process fostered an open arena for exploration and conversation, creating a framework for students to think, talk and make decisions through making.

## Example in the Making

Of all the challenges faced by the team over the course of the project, one of the greatest obstacles was transforming beginning design students from green and untested individuals to seasoned experts and accomplished builders within a matter of months. Because of the nature of the project, not only were the students tasked to design and construct a "real" building for the first time, they were challenged to deliver a highly sophisticated, technologically advanced house capable of competing in an international competition. Aware of this challenge from the outset, the faculty team knew it was imperative for the team of students to be complemented by mentors and industry experts in order to realize the project.

The interdisciplinary process in the context of a design-build project provided a positive and profound effect on the design manifestation, the student learning experiences and ultimately the success of the completed project. The research and technological and material testing that accompanied overall design and each individual element of the project required an advanced learning curve and an interdisciplinary approach from schematic design through construction.

One particularly successful example of the impact of the collaborative intersection of design-build and interdisciplinary design was visible in the building envelope of the house. Within the first few weeks of design, beginning graduate design and engineering students visited a building material and assembly research facility run by a prominent builder in the Washington, DC area. During this visit, students toured the testing facility, where the owner introduced the team to the importance of assembly testing by showing them a variety of mock-ups with testing underway. From there, the students then built a variety of wall and floor structures using both conventional and experiential framing techniques (Fig. 3). From this first hands-on exploration, a discussion was instigated between the faculty, general contractor, structural engineer and the students that identified potential flaws with the standard wall construction related to thermal bridging, construction waste, and lack of tectonic expression. More importantly, the process of collaborative thinking and making began to take root.

This development of the wall and roof assembly happened in conjunction with many disciplines on campus as well as with the consultation and advice of professionals and tradespeople. The ultimate design of the building envelope, which used a method of advanced framing techniques to maximize thermal insulation, minimize thermal bridging and visibly express the house structure was the result of countless hours of research, design, debate and deliberation. More so than any other system or assembly on the project, the building envelope impacted virtually all involved design disciplines - architecture, structure, electrical, mechanical and environmental science. Because of this anticipated complexity of the design, the complex nature of the competition and the relative novice level of design experience within the student team, the faculty paired students with a variety of industry experts to allow the students to synthesize information through the design of the building envelope assembly.

*Figure 3 Student team member assembling wall mock-up framing.*

From the early explorations of framing options, the team's research, learning and confidence continued to mature as they collaborated with the team's structural engineer and builder mentors to understand issues of constructability and maximize resource efficiency. But where the structure on many projects would develop in relative isolation, engineering students worked with the architecture students to understand the structural system as it related to the energy loads of the house. From information garnered through energy modeling, the team's engineering specialists had as much impact on the development of the wall assembly's insulation, wall thickness, window sizes and locations, and structural components. What was best for the project, and not the will of a particular person or group, pushed the project to excel towards the design vision. The development of this one example building component was indicative of the overall process by which students learned not only how to design through building and build through designing, but also how to make reasoned, researched and innovative decisions within a group. The experience ultimately provided all students involved with the tools to collaborate and the ability to understand what questions to ask and of whom to ask.

## Conclusion

We live in a divided world; divided by generations, values, customs, cultures, technologies, professions, and environments. Our challenges are vast, ever-changing and exceedingly complex. Through project-based learning opportunities like the Solar Decathlon though, the tools to dismantle those barriers are being taught and disseminated. Students, faculty and industry alike are learning how to work beyond their individual disciplines, share ideas and pioneer new solutions. The successes were not merely the completion of the project, but in the change in mindset. The dissolution of disciplinary boundaries and redirecting the competitive forces from each other to that of the project's challenges offers enormous hope for the future.

Although projects like the Solar Decathlon create enormous financial and bureaucratic burden for universities and are difficult to sustain semester after semester, the lessons learned from the pedagogy tested can be applied at a variety of scales for the early design student. Design-build projects that focus on the intersection of sustainable technologies and interdisciplinary design can be replicated on smaller scales and shorter time frames. The kinds of lessons disseminated from this type of pedagogy are far reaching within the university and the lives of the students.

As universities continue to educate the next generation of leaders, our academic culture must strive to increase opportunities for disciplines to intersect, for that is where the greatest potential of innovation rests. We must breakdown the silos embedded in our academic culture, for only those with a diversity of minds will we discover solutions to the challenges of our world.

## Notes

[i] Johansson, Frans. The Medici Effect: Breakthrough Insights at the Intersection of Ideas, Concepts, and Cultures. Boston, Mass.: Harvard Business School, 2004. Print.

[ii] Boudreau, Tom. Universitas: The Social Restructuring of American Undergraduate Education. Westport, Conn.: Praeger, 1998. Print.

[iii] Thorp, Holden, and Buck Goldstein. "How to Create a Problem-Solving Institution." The Chronicle of Higher Education. 29 Aug. 2010. Web. 3 Jan. 2016.

[iv] Brooks, Leslie. "Are Academics the Loneliest Professionals?" BlogHer. SheKnows Media, 25 June 2008. Web. 2015.

[v] Kelley, Tom, and Jonathan Littman. The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm. New York: Currency/Doubleday, 2001. Print.

[vi] Covey, Stephen R., and A. Roger Merrill. First Things First: To Live, to Love, to Learn, to Leave a Legacy. New York: Simon & Schuster, 1994. Print.

# Designing Change: Teaching Social Responsibility Through Design

Lucinda Havenhand, Zeke Leonard | Syracuse University

## The Role of the Designer/Educator

Embedded within the idea of design in the modern era is the notion that we design "for the greater good." From its origins in the reform movement of the mid 19th century to the institution of design education at the Bauhaus, that subtext has been clear. As historian Paul Greenhalgh posits in his Introduction to Modernism in Design:

> Design was to be forged into a weapon with which to combat the alienation apparent in modern urban society. It was therefore construed to be fundamentally a political activity, concerned with the achievement of a proper level of social morality. It was meant to improve the conditions of the population that consumed it.[i]

As design educators we adhere intuitively to the notion that every design project strives to make society better. However, the answers to the questions of "whose better" or "what actually constitutes better" become less clear as issues of budget, time, function, aesthetics, style and trends take priority.

The definition of "social responsibility" or "good" often shifts depending on a variety of contexts. This is especially true when design briefs that respond to commercial needs take precedence in the market. Can a high-end office building or luxury apartment complex possibly serve a social good? With that in mind we must ask the question: regardless of our continued idealized linkage of design and good in our understanding of ourselves and our professions, has design in reality separated itself from its roots in social justice? Have our original ideals and our current realities separated?

It is interesting to look at our discourses about ourselves in that regard. The Interior Design Educators Council web site states: "We believe the foundation of interior design education is grounded in ethics and encompasses environmental, cultural, social, global issues." The American Institute of Architects' website states that "for more than 150 years, the members of the American Institute of Architects have worked to advance our quality of life through design." Such claims by the American Institute of Graphic Designers and the Industrial Design Society of America on their web sites are less visible with no specific language of greater good or social justice finding a place on theirs.

In the larger discourses of the design disciplines, we find the continued discussion of social justice and its links with design: In his book *Design for the Real World* (now considered a classic in design literature), Victor Papanek claimed that

> Design had become the most powerful tool with which man shapes his tools and environments. . . This demands high social and moral responsibility from the designer. . .As socially and morally involved designers we must address ourselves to the needs of a world with its back to the wall.[ii]

Papanek's treatise is still referred to as the watchword of design and social good. Current efforts such as David Berman's "Do Good Design" and Noah Scalin and Michelle Taute's call to design activism continue Papanek's charge. Bhatt and Dubb remind us that "…the practice of community development *is* a form of applied education."[iii] Nonetheless all these efforts are often considered by both professionals and educators to be "in addition to" rather than the core of design teaching and practice, which still for most part centers on aesthetics, formalism and market forces.

The authors of this paper believe that it is (or that it should be) our responsibility as design educators to imbue our students with a concern and respect for issues of social justice. Although separated by a generation in age and diverse in our experiences we both share the same strong belief in the moral imperative of design and our charge to transfer that belief to our students.

For this paper, we ask "How do we teach the imperative of social good through design?" Particularly, how do we teach this in an age and environment where students are often both economically and socially privileged and have little or no direct experience with social injustice? In an attempt to work our way through these questions we present here both description and analysis of our efforts in attempting to bridge this privilege gap as a case study or roadmap. This work is qualitative, specifically ethnographic based in everyday experience, observation and anecdotal findings.

The main vehicle for this work has been in undergraduate senior-level thesis prep and thesis courses in a BFA interior design curriculum. Using these courses as testing grounds and a case studies over the course of four years, we have developed strategies that can be applied to students at all levels and design disciplines. It is important to note that students even in the upper levels of a course of study are always beginners in some ways.

Our methods for introducing and imbedding the concerns of social justice within our curricular goals have been multivalent and in some case experimental. Over the course of four years these methods have included: story-telling and collecting; mandatory volunteer experience; mentorship; situational analysis; library research; reflective exercises; and peer sharing and collaboration. Much of this methodology has involved thoughtful and intentional personal engagement at a 1:1, designer:user scale.

## Discovery

As design educators most of us work in programs that attract a variety of students. Since design education does not reach back through the K-12 system, most students find design only through research or unique educational experiences (summer camps, workshops) or by means of someone who knows what design is. Generally this means that we attract only students who are able to know and appreciate design through their parents, mentors, media or public culture. Therefore, not all potential students find design, and aspiring to be a designer is not generally an accepted role (such as a doctor, lawyer, or architect) except to those who have the opportunity to know design. Furthermore the historical trend and insistent reality of most interior design and fashion programs is that they attract young women and usually young women from middle to upper---class backgrounds.

The first step that must be taken when addressing social responsibility with this demographic is "taking the temperature" of how socially conscious the students already are. To this end, we back out to a larger discussion of empathy and aspiration. Our first exercise is an assignment that asks, "What is your passion?" Within this exercise students consider this question and answer it as succinctly as they can. We tell them that everything is fair game and there is no right or wrong answer, to take their time and be thoughtful and honest. They are then required to write a paragraph using "analytical, professional language to explain what your passion is and why you feel drawn to it." Our goal in this exercise is to open up an emotional door, to allow the student to understand what it means to feel strongly about something and to commit to it. We then ask the students to see what possibilities are presented by looking at their passion critically and to explore ways and contexts within which their passion expresses itself in a concern, an effort, or a project that is happening in the real world. They are then required to expand on this by writing three additional paragraphs, each explaining ways that their passion is related to issues or situations at a local, community and national/international level. Passions as obscure as "makeup" led to a discussion of artistry and precision, to a consideration of teaching art to local children, then to the position of art as a positive tool to promote self esteem. The centering of this project around a student's passion creates a strong link between the student and the project. This personal positioning is essential to teaching an affinity to social justice, as well as fostering an internal 1:1 conversation: Thought the student may not be analogous to the proposed end user, s/he begins and executes the design project with an empathetic eye.

Another tool we use during this introductory phase is The Empathy Quotient test, an assessment tool developed by psychologists which has been used primarily to screen for autism spectrum disorders in adults. In our case, we are not concerned about how the students score but how the sixty questions on the test open the student's mind to the idea of empathy and how it is demonstrated in their own actions. The end result is that the students move forward in their projects with a heightened awareness of empathy as a concept and as part of the design process. We believe that awakening a student's understanding of passion and empathy are essential if we want them to adopt a socially conscious stance through their design work.

## Immersion

The next step is to send the students out from the classroom to experience human needs first hand. This happens in two ways, the first is that we use local sites and agencies to provide design problems that need to be solved and allow students to directly engage with them. A project might concern itself with developing strategies for the city to deal with littering and recycling, allowing students access to different groups of constituencies from politicians, to work crews, to citizens on the street. These specific community based projects are always designed for the students to meet real people in real situations. In many cases students are introduced to scenarios and populations as a part of this phase that they have had no experience or contact with. The required 1:1 experience of interviewing and dialogue provides a place where empathy can be developed.

Students are then required to collect "the stories" of the interviewees and clients and to also write about their experience. The stories as told and written become the basis of (and provide the logic for) the design as it moves forward.

The second out-of-classroom teaching method we use in this phase is volunteering. All seniors working on their thesis projects are required to volunteer for twenty-five hours over the course of the semester for an agency or organization that has some relation to their thesis project. This experience allows the student to not only *observe* an experience or population but to actively *engage* with it. In the role of volunteer, the students are often exposed to their first experiences as agents of change, which positions them as participants, rather than observers of the design problem.

## Aspirations

Building on the experiences of awakening self---awareness and empathy as well as first hand experience of social conditions--- the students are then ask to look outward for inspirations, precedents and role models. They are asked to consider who in the greater world is also concerned with their chosen issue; who as designers are working in a socially conscious framework; who is writing about issues of social justice; what do they say; how can lessons that they have learned be applied to design? Students are asked to cast a wide net to gather the answers to these questions and find those who can be considered "heroes" in design for social justice. Here we are purposely asking students to find those they can emulate or projects that reflect best practices. We are strategically taking advantage of our society's interest in creating cults of stardom and heroes by asking our students to find a hero related to design. In this effort, students sometimes become "obsessed" with their new design heroes, following their work and achievements closely and often applying for mentorship and internships with their offices. In this end we have manipulated a cultural tendency to a more productive and substantial end.

## Insistence

Even with this project structure we cannot underestimate the role that our own insistence about social justice plays in this process. As educators we are always role models for our students. Students learn early what we like or dislike and often play to those preferences. Our insistence on the relationship between design and social justice labels us to the students as well. We are trying to imprint students with this importance, in the same way that we might imprint on them the proper way to draft, set up a proposal, or present their work. Making our own concern for social justice visible is as important a tool in trying to teach design for social justice as any of the methods that we have listed above.

## Results:

Over the past four years over one hundred students have passed through our program of study that employs these techniques to teach social justice. The impact of this training has exhibited itself in various ways.

Most directly, students who turned their attention to social issues began producing more thoughtful, interesting, and well-considered work. A student that had directly worked with disabled children demonstrated a larger understanding of a body moving (or not moving) through space and other scenarios. Spatially the project was more challenging to status quo, more innovative and more successful. Everyday items such as bathrooms, kitchens, stairs, halls were considered through a different lens, which once applied became normative.

More importantly the students came out of their projects committed to understanding ways that design can facilitate larger changes in society. In the documentation of a project about creating an accessible sports facility for differently abled children the student Cassie P. concluded:

> Overall, this project presents many opportunities for engagement via interactions between the users, the site and the Near West Side community. The goal is to expand the dialogue about disability and sport on a local level so that the issue is better recognized. For this reason, I plan on showcasing the talents of the children, adolescents and adults who will be the stars of the space as a symbol of positive reinforcement.

Another student, Chelsea S. said in reference to designing an Art Center for low resource students:

> Finding a solution for creating a positive and welcoming reputation with the community is extremely important. My method of presenting the ideas and values behind what the center represents to the community will help me get my audience to join me in my efforts to make a change. Helping to make the community more inclusive and progressive for the generation now and the next to come is the focus that will drive this solution.

For many the volunteering experience was the turning point in their understanding of a design problems and social responsibility. Students often described their experience as having personal and long---range impact on themselves as designers. Cassie P. stated:

> I have completed 25 hours of volunteering at various adapted sports clinics and conferences sponsored by the Fitness---Inclusion Network, a subsidiary project of the Burton Blatt Institute. They are a collaborative, cross---institution initiative that...develops innovative ways to promote and support inclusive recreation for children, adolescents and adults with disabilities in Central New York… I spoke with community leaders in this field, participated in adapted sports and experimented with the equipment. This volunteer work challenged me to take a "roll" in someone else's shoes in order to really understand the difficulties and limitations associated with physical and mobility impairments. I was thrilled to get the opportunity to play outside of my comfort zone and meet paralympic athletes because it changed my point of view as a designer.

Katie, a student designing a retail operation for low resource women reported about her volunteering experience:

> I grew to learn certain people by name and they got to know me so it was a very meaningful experience that I'm happy to have been a part of.

For the most part student evaluations revealed that students appreciated what were trying to do even in the most pragmatic sense. One student said:

"This process of coming to my thesis topic was very helpful. Beginning discussing our passion and then issues with that passion made it easier for me to decide on my topic."

Some students did ultimately feel frustrated by being pushed to design something that was not really of interest to them. "Can't I JUST design a restaurant?" one student asked. In this interaction we had to admit to ourselves that our approach to teaching social justice could actually be seen as oppressive and limiting. Another student, Emily W. came to the thesis process knowing that she wanted to design a high ropes interactive exercise course for college students. For the first several weeks she struggled with ways to make this accessible to other demographics, finally asking if we had to "change the world with our designs," her implication being that she did not mind serving only the single demographic. While acknowledging the privilege inherent in her demographic, she asked "what's wrong with helping to empower them? A lot of them don't know what their potential might be."

This kind of questioning helped us see two things: First, assumptions about demographic are dangerous in both directions. If the privileged college students that Emily wanted to engage could learn lessons about mutual support, leadership, and teamwork in her facility, should they not have access to that? Second, that even when the students push back against our ideas about socially active design their work ends up being infused with it. Though this lesson provided great insight for us, we were also happy to understand that this opinion was not held by the majority of students, who embraced sincerely what we were offering.

We do have to acknowledge the shortcomings to this type of design education. One limitation is the temporal one: a fifteen week semester does not give a student very much time to find a volunteering opportunity, do the twenty-five hours of work, and then incorporate the lessons learned into their design. One student wrote in an anonymous evaluation: "I felt like the volunteer requirement was a little tedious for this project. We didn't begin the volunteering until the second half of the semester which made it harder to find the time to complete it. I felt like I just chose a place to volunteer at because we had to, not because it was valuable for my topic. It was very hard to find a place that had enough hours for me to work, or even wanted a volunteer in general."

Grading necessities in our institution made it imperative to impose the limitation that the students finish their volunteering by the end of the semester, which in some (but not all) cases also limited the depth of their experiences. Another possible shortcoming comes from the point of view of the community: at the end of their twenty five hours of work the students stop volunteering, which impacts the organization they have been working for. There is not currently a method in place to fill the hole that the student leaves behind.

Success for any teacher is indicated by the success of their students. Watching and tracking our students' entrance into professional life and seeing what kinds of firms and projects that choose to work with reveals that we have impacted their perspectives. One student , Clairanne P., graduated and chose to pursue a job at the U.S. Green Building Council rather than work for a design firm so that she could deal more directly with issues of sustainability. When she left USGBC a few years later to join a design firm she was hired partially for her sustainability expertise and her grounding in social consciousness. Another student, Maureen B., worked on a project for a school in Central America for low-resource children and invited current students in the program to participate in the project. By doing so students could see how her commitment to social justice carried beyond her thesis project into her professional life while affirming its importance and relevance from outside the classroom. Two recent graduates, Katie M. and Michelle P., were so impacted by what they had learned in their thesis process that after graduation they stayed local to the university and worked to maximize their contact network to provide design services on a sliding scale to local not-for-profit organizations.

Surveys taken of our students both during their time in school and into their early careers reveal that they are aware of and carry with them their linking of design and social justice. "As a designer I realize I see the world differently," one former student reported, "and see how I can use design to improve it. I feel very empowered by the skills I have as a designer to try to 'change the world.'"

As educators we realize that we are in a crucial position for framing social justice and bringing our students to an understanding of how they as designers can contribute. With that knowledge we feel we have had great success. We also feel strongly that our methods and objectives are translatable to design pedagogy at any level. We are working now to make it a standard part of our program's practice beginning at the freshman level and continuing through the student's four-year academic arc.

## Notes

[i] Paul Greenhalgh, ed. "Introduction," Modernism in Design, London: Reaktion Books, 1990, pg. 8.

[ii] Victor Papanek, "Preface to First Edition," Design for the Real World, Chicago: Academy Chicago Publishers, 1984, pg. xiii---xiv.

[iii] Keane Bhatt and Steve Dubb, "Educate and Empower: Tools for Building Community Wealth" The Democracy Collective, Takoma Park Maryland2015, pg. 102

# 1:1 >>> Failure-Oriented Pedagogy in the Development of New De-sign(ers') Expertise

Dustin Headley | Kansas State University


## Abstract

This paper reports on a pedagogical methodology for enhanced engagement and understanding of 3D scanning and digital manufacturing/fabrication techniques for 1:1 fabrication with beginning design students in their second and third year. This research was developed through an Action Research framework[6] that embraced ambiguity and failure-oriented discovery as core values in the design process. Ham [6] noted that students fail to engage cutting edge technologies due to the embodied effort involved in learning new tools when challenged with limited time to master them, that is, *they are afraid to fail*. The need for failure as a part of the design process has been embraced widely throughout design discourses, particularly in industrial/product design as exemplified by the popular motto "fail fast, fail early, and fail often" [2]. Iliescu et al [9] note that (rapid) failure leads to an increased understanding of issues and subsequently enhances the quality of design work.

Despite the benefits of failure-oriented discovery, current academic models distort the value of failing through the evaluation of results over process. The research presented follows a group of students from Kansas State Interior Architecture & Product Design Program through a failure-oriented studio design project specifically oriented at body augmentation and explored 3D scanning, 3D printing and laser cutting. Students articulated all project parameters and process prototypes were considered final review materials. The research concluded with a design project in which students engaged in fashion design utilizing the same technology limitations later in the curriculum and were only given assistance with digital modeling.


## Introduction

Design forecasts an event on the basis of past experience[4]. From its inception, architecture has been chiefly concerned with failure so that the profession might develop increasingly effective construction technologies [9]. As noted by Tschumi [18], over the past several hundred years there has been an increasing distanciation of architect from the construction site. The implications have reduced the scope of the architectural practice and can readily be observed in the application of construction technology in building. The architect no longer designs, tests, fails, discovers, repeat, with regard to construction. These responsibilities, in large part, have been delegated to industry to prescribe solutions[18]. This is punctuated by the development of Revit families produced for architects to plug into their work instead of the architect divining such constructions from thoughtful observation of the conditions and collaboration with industry.

Simultaneously in education, methods have sought to compress and simulate the experience gained through practice in several ways: the trial-error studio teaching method, study abroad programs, and internships. These methods are intended to immerse the student in an environment where they must reflect on their own understandings and develop more critical perspectives. However, these educational structures rely heavily on the students' ability to perceive, comprehend, process and then assimilate experiences, a skill set that arguably develops with age[7]. These methods do not orient the students to actively fail and experiment but instead passively locate students in positions where such experimentation is merely possible.

Failure has been devalued. In the case of professional practice, fear of litigation constrains the profession from actively developing experimental work [11]. While in education, having exceptional final representational skills will enable the masking of underdeveloped design thinking.

This paper describes a methodology that celebrates failure as the mechanism for measuring the rigor and quality of beginning design student work. As a strategy for orienting students towards a failure-oriented design process, rapid prototyping was coupled with recursive design processes. Results were reviewed alongside their sister experiments so that the rigor of each exploration might be exposed, framed and celebrated; there is no final design only final prototype since at some point we must move to full scale building. These methods were engaged at a second year undergraduate level, so that a conceptual understanding of the importance of failure-oriented processes could be extended to future activities in a subsequent full scale, one to one, fashion design project in the students' third year. The outlined process engages students in failure-oriented design development while also integrating one to one construction from digital to physical into the pedagogical model.

## Research Framework: Action Research Method

The Action Research falls under applied research and acknowledges the participation of the researcher for the identification, evaluation and potential solution for issues and problems that arise during the study [6]. Action research [13] actively and intentionally endeavors to effect change within a system. In this instance the research encourages the students to develop a clearer understanding of one to one construction as process which has an embodied effort and knowledge. Further, the research seeks to shift perceptions of the value of failure as it is perceived by beginning design students, which in turn addresses the students' apprehension with uncertainty. Action research was put into operation to address these problems/issues which have been under domination, as asserted by the authors, by traditional modes of education.

## Trial-Error Method vs Failure-Oriented Method

The trial-error studio teaching model frames both the professional and educational perspectives on the role of failure, where failure is an entirely internalized process. Under such a model, the students produce design work along with design drawings that ultimately arrive in front of critics. The final iteration is reviewed and it is understood that the final refinement reflects rigor. Through this fallacy, students' ability to represent and apply standards and conform to rules is paramount. While outwardly, the benefits of iterative design might be acknowledged, the critics are often not directly evaluating nor rewarding the processes that brought the work into being [17]. This characteristic removal of iterative processes in the representation of work describes a desire to portray the Architect as the master who gestures with perfection. As Timothy Brittain-Catlin [5] notes, the narrative remains incomplete and the unfulfilled missteps beget an insight that drives the design engine.

Within failure-oriented methods, it is clear what Philip Ball[1] observed in the writings of D'Arcy Thompson: "…pattern formation is not a static thing, but arises from growth: everything is what is because it got that way". By tracking the missteps, how something came to be cannot only be exposed but also be rewired to guide students to new Elysian Fields. By celebrating these prototypes, the perception of the work can be transformed by proximity, leading the students to see their work from new vantage points. We begin to see the criteria by which the student drove the work. From this, the critique frames not only of the multiplicity of designs but also the understanding of the subject matter from the lens of the student, lending insight into the values overlaid onto the project by the student as versions are assessed as failures or successes.

The failure-oriented process implies a similar evolution of the engine in a car. Where once it operated independently of the vehicle, it now contributes to the role of the rigidity of the frame, it is no longer separate from the body of the vehicle or even the wind shield [3]. The melding of independent elements and features is then integral in perceiving the design process, and thus enabling a questioning of their origin and discovery of the interpenetrating relationships the student formed through experimentation to resolve complexities (Fig 1).

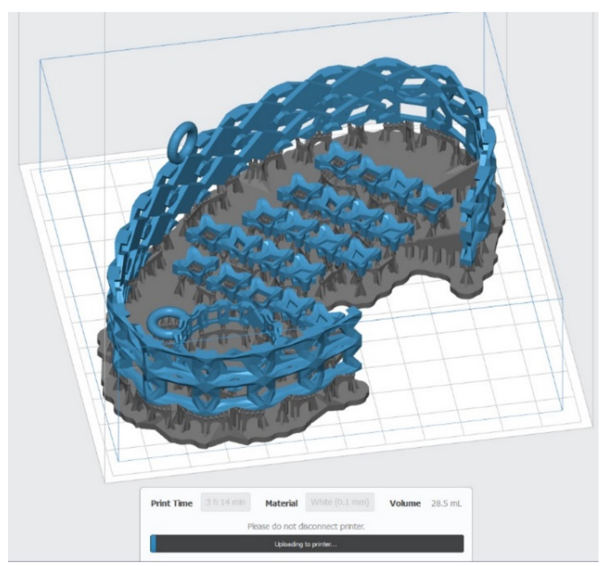



*Fig 1: Initial prototype for bracelet assembly, student improperly negotiated scale when taking measurements resulting in parts that didn't connect with body or each other proper but did prove the assembly method was possible for further development.*

## Millennial Students / Design Studio Structure

### *Student Profiles*

Students in this second year design studio were Millennials as categorized by Howe and Strauss, and were observed exhibiting (but not limited to) the following personality traits: confident, sheltered, team-oriented, achieving and conventional [7]. These specific characteristics influenced the formation of the failure-oriented strategy and ultimately informed the future fashion design project. Confident and sheltered characteristics inform an attitude within the students causing them to jump to conclusions rather quickly, which had substantial impacts as the students began to interrogate 1:1 scale from the digital to physical realm and as they understood material assembly which was generally treated as something that "would work itself out" on the fly. The teaching strategy negotiated these attitudes through constant production of representation. Each operation represents a "conclusion" while simultaneously representing an iteration that exposes faults. As each iteration is documented, the limitations of representational skill also emerges, not through critique but through required self-reflection in the context of this team-oriented group. The traits of achieving and conventional become pitted against each other as the perceptions of the conventions become redefined through the achievement of successful work, again in the context of the team. (Fig. 2)

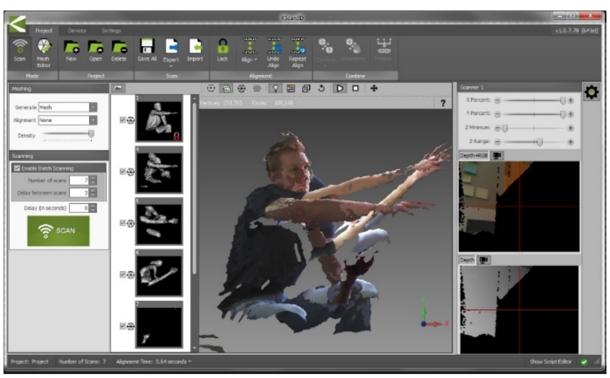


*Fig. 2: As the body augmentation project developed, students were exposed to 3D scanning as a mechanism to gain accurate digital information about the 'site' for with they were designing. Once a student engaged the process, the methodology was shared and more students subsequently engaged in the process.*

### *Studio Design Problem and Structure*

The design problem was intentionally set up as an ambiguous question that directly engaged the technologies and their permeation into contemporary culture. During the three week project, students were tasked with generating a body augmentation that was framed through digital observation and 3D printing. The work began through analog measurements and clay constructions before shifting into digital realms, which informed an attitude about the gravity free, infinity lucid space within the machine; students began to understand true dimensions before articulating solutions in a scale free environment. Upon generating the design solutions the work was rapidly prototyped and the design (process) halted and presented. What was reviewed was the understandings of the body, materials for construction, tolerance, and most importantly scale.

The framework for the design studio was arranged so that the students were continuously encouraged to embrace construction and deconstruction as equally important activities. The acts of making and exploring were recognized as internalized actions necessitating translation through representation (which in itself, also becomes an exploration of means for understanding the common visual languages of design). From these representations, the distinct fragments and thoughts describing design features that might otherwise be grandfathered into later iterations were exposed, and could then be evaluated. Discussion circled around how the thinking informs the form, and evaluation could then instruct the student into new perceptions in form development as well as programmatic understanding. (Fig. 3)

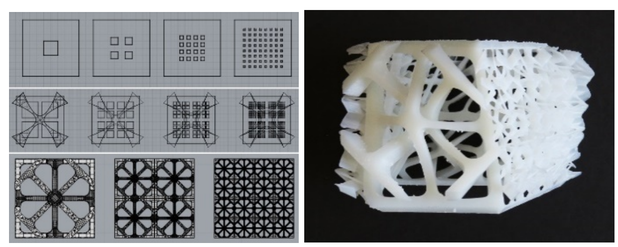


*Fig. 3: Left: Development of perforation pattern for a bracelet assembly. As the design developed the tiling system engaged a method for building a two independent woven tiles to enable greater flexibility in the operation of the piece. Right: Developed iteration at time of review.*

Structurally, four strategies were enumerated for students to operate within for exploration of the work:

- Doing is Thinking. Discussion reacts to that which exists and is tangible.
- Representation is Exploration. Conventions are not "applied," they are "interrogated".

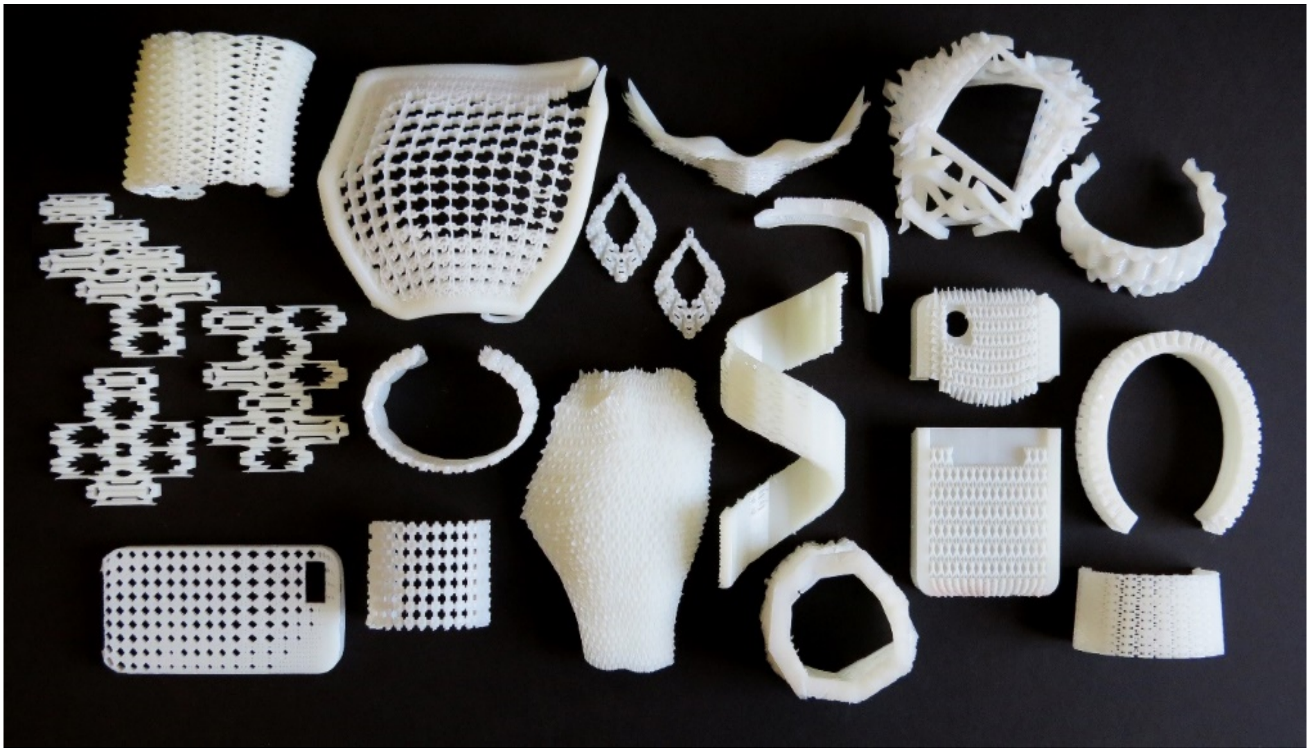


Fig. 4: Above are the final rapid prototyped iterations of the studio design, resulting from the iterative development of form and ergonomic understandings of comfort. Each project engaged a body condition, dealing proportion, weight, function, space (on and around the body), as well as the process for use.

- Evaluation informs Perception. Missteps and fragmented prototypes are documented for both what worked and didn't.

- Transparency. All work aims to make representation and design process transparent for evaluation at all stages.

Success in this context was not evaluated from the vantage point to aesthetics, ergonomics, or representational qualities; the final iteration was itself a prototype and experiment. What was evaluated was the formation of process and the rigor of exploration. The uncertainty embodied in the failure, which might otherwise generate tension and apprehension, became the center piece of the review. From these iterative sequences, which were only halted when pressed under the condition of time, the design process itself became exposed (a powerful agency for the beginning design student to perceive and comprehend). From that vantage point, the mechanism for processing experiences (failures) was also exposed, and this (Figure 4) was where the method became advantageous. With the exposure of the design process and perspective on failure, the students could then engage in refining their own design processes, informed by the consistent representational challenges forcing them to articulate and make tangible their decisions.

## Phase 2: Fashion Design

*"...it appears that interactions between handmade and computer media are a complex mixture of the artifacts and the effects introduced by each of them. If, indeed, such artifacts and effects force the reinterpretations that generate design information, then media interactions amplify the designer's opportunities". - Daniel Herbert.*

### *Design Problem and Structure*

Students, now in their third year of undergraduate study and enrolled in a required Digital Design course, were divided into teams of two, noting the above conditions of the Millennial generation, and tasked to develop one garment and one piece of jewelry for a fashion show to be held within the college. Using 3D scanning technology, students selected the teams' model (strongly encouraged to use themselves as the subject) and scanned them with an X-Box Kinect scanner. During the first week students developed the scope of their designs (keeping reasonable levels of complexity in mind) and develop a tectonic

Fig 5: Student's grandmother assisted in the final assembly with her expertise in the sewing. This process acknowledged not only creative inquire but also acknowledgement of mastery of someone outside the design professions. In performing this activity the student also had to consult on the fabrication tolerances needed for the equipment available to be used; flanges needed to be added to the original flattened laser cut pattern to enabled seams to be created in the final construction.

*Fig. 6: Students engaged in resin casting, laser cutting and water soaked ply wood bending combined with pop-riveting to generate the final assembly.*

model by hand which informed both the garment and the jewelry. From there students used the scan and develop the garment geometry in the software and prototype it. Materials were left open to those that can be safely cut on a laser cutter (remembering the intention is to also develop technical skills in

*Fig. 7: Students explored posable constructions for an archery arm guard an integrated the method into the final construction.*

addition to the failure-oriented pedagogy). Students were simultaneously encouraged to be creative and ask questions of the technology through their material explorations which looked at paper, leather, plastics, felt, etc. There was a volumetric limitation on the 3D printed jewelry which was based on available materials.

*The Work*

Once again the failure-oriented model was engaged. Notably, the students were prepared for it and creativity within the project structure expanded geometrically. Instead of the instructor guiding the questions for 1:1 construction, the students themselves self-organized strategies for analysis, fabrication, and ultimately assembly. In this action, the expertise engaged extended beyond the professor and college and into other fabrication sites where sewing machines were available. Students acknowledged that they had limited expertise and sought out the expertise from colleagues and family members (Fig. 5). The inquires expanded the students abilities to interrogate process and to creatively problem solve while also learning respect for the trades required for construction and assembly (in this instance sewing, but these logics are easily extended into relationships with clients, contractors, engineers and other specialists required for 1:1 construction/production of any type).

Final results in the fashion show demonstrated both a clear understanding of the role of failure and experimentation in devising design solutions. Students experimented with all fabrication methods available and expanded the list where the tools were inadequate to meet *their* parameters for success (Fig. 6 & 7).

## Conclusion

Through this failure-oriented pedagogical strategy, students negotiated with their own notions of what failure embodies. While the initial studio project represented a brief cross-section within the entire studio, the project enabled thoughtful discussion of failure in the role of design processes. The subsequent Fashion Design project proved that these beginning design students were able to not only develop a process for experimentation and understanding of building 1:1, they were also able to creatively seek out gaps in the knowledge required for construction. Students began to reformulate perspectives on their own design processes and explore representation as a question rather than a singular solution. The failure-oriented studio environment enabled them to explore ideas rather than being seduced by the minute of detailing and the representations afforded by the machine.

Additionally, the group began to look more broadly at the design process and started exploring the parameters that drive design, rather than engaging singular observations. The purpose of these exercises being to expand critical thinking, which, if developed, would lead to a greater willingness to explore and challenge in other arenas, including internship, study abroad and ultimately practice.

This revives the notion that schools were set up to challenge wisdom of the world and its corruption rather than reinforce it [8] and challenges the current academic models of production which demand finality within a semester structure. The design process fundamentally informs the strategies for enabling students to engage in broader ideas and organized open-mindedness. Once the students stop merely following instruction and begin to interrogate the problem in tangible ways, new models for operating professionally and dealing with risk might also be engaged. Thus the students might engage in a more global understanding of the design profession and self-teach as well as explore new models for what the profession might eventually transform into.

The research, while obviously not at the scale of a building, suggests that the students gained an appreciation for construction assembly and detailing while also dealing with the technologies for fabrication (3D printing, laser cutting, sewing, etc). It is not unlikely that these skills will subsequently be extended into larger full scale projects that will require the same line of questioning: What do we know? What do we not know? What do we need to know? How do we locate the knowledge to bridge the observed gap to get things built at 1:1?

## Notes


[1] Ball, P.: 2012, Pattern Formation in Nature, *in* Menges, A. (ed.), Material Computation Architectural Design, John Wiley and Sons, London, UK., Profile No. 216, 22-27.

[2] Basulto, D.: 2012, The new #Fail: Fail fast, fail early and fail often, < http://www.washingtonpost.com/blogs/innovations/post/the-new-fail-fail-fast-fail-early-and-fail-often/2012/05/30/gJQAKA891U_blog.html>, Accessed on April 14, 2014.

[3] Blassel, J.F.: 2005, Engineering in a Performative Environment, *in* Kolarevic, B and Malkawi, A. M. (eds.), *Performative Architecture: Beyond Instrumentality* Spon Press, New York, NY.

[4] Brawne, M.: 1995, Can we Describe How we Design?, *in* Pearce, M. and Toy, M. (eds.), *Educating Architects* Academy Editions, 72

[5] Brittain-Catlin, T.: 2014, Bleak Houses, MIT Press, Cambridge MA.

[6] Fellows, R. and Liu, A.: 1997, Research Methods for Construction, Blackwell Science. Oxford UK.

[7] Ham, J.: 2013, The Evolution of Media Use in the Design Studio *in* Schnabel, M. (ed.) *47th International Conference of the Architectural Science Association*, pp 33-42.

[8] Howe, N. and Strauss, W.: 2000, Millenials Rising: The Next Great Generation, ed., Vintage Books, New York.

[9] Iliescu, S.: 2009, The Hand and the Soul: Aesthetics and Ethics in Architecture and Art, University of Virginia Press.

[10] Kolarevic, B and Malkawi, A. M. (eds.): 2005, *Performative Architecture: Beyond Instrumentality* Spon Press, New York, NY.

[11] Libeskind, D.: 1995 Observation on Education of Architects, *in* Pearce, M. and Toy, M. (eds.), *Educating Architects* Academy Editions, 88

[12] Levy, M. And Salvadori, M.: 2002, Why Buildings Fall Down, WW Norton & Co., New York, NY.

[13] Lewin, K.: 1946, Action Research and minority problems *in Journal of Social Issues*, 2, 34-36.

[14] Mau, B.: 2004, Massive Change, Phaidon Press Limited, London, UK.

[15] Post, N.: 2011, ”BIM Lawsuit Offers Cautionary Tale” <archrecord.construction.com/news/2011/05/110519-BIM-Lawsuit-1.asp>, Accessed July 14, 2014.

[16] Pearce, M. and Toy, M. (eds.): 1995, *Educating Architects* Academy Editions, Great Brittain.

[17] Salvestrini, G.: 1995 The Teaching Method: More Questions Than Answers, *in* Pearce, M. and Toy, M. (eds.), *Educating Architects* Academy Editions, 42

[18] Tschumi, B.: 1995 One, Two Three: Jump, *in* Pearce, M. and Toy, M. (eds.), *Educating Architects* Academy Editions, 24

# Lessons from Shared Learning Across Two Disciplines in an Early Design Studio

Katie Kingery-Page, Lorn Clement, Katrina Lewis | Kansas State University

## Inform: Introduction

In early 2012, the authors wrote a paper entitled "Collaborative Case Studies of Low-Energy Homes and Sites with Early Design Students" for the Twenty-eighth National Conference on the Beginning Design Student. Within the paper, written after a six-week collaborative experience, the authors discussed the case study pedagogy employed for experiential learning during a field trip and teamwork between the two disciplines. The case studies' goals included learning about the interplay between interior (building) concerns and exterior (site) concerns in the creation of low-energy environments that are functional and beautiful; and to stimulate the students' imagination with meaningful precedents. The faculty designed the case study exercise as a prelude to a collaborative design project involving the same students. Students were to design an off-the-grid complex of buildings and open spaces for a coffee collective in rural Nicaragua (known as La Reyna).

The outcomes of the exercise were evaluated on two levels: first as an independent exercise intended to build collaborative thinking and fundamental knowledge, and second, as a preparatory step to a longer, more complex design process. In 2011, student products and feedback in the form of class discussions and surveys were used to gauge outcomes and were written in-depth in the 2012 published paper. Results of the six weeks of cross-disciplinary study indicated strong growth in collaborative thinking with mixed results in applications of fundamental knowledge for low-energy design. In 2015, the faculty brought the interior architecture and landscape architecture students together again in a focus group to reflect upon the six weeks of cross-disciplinary learning in 2011 and successive learning over the next three years.

## Choreograph: The Pedagogical Approach

In 2011, interior architecture and landscape architecture faculty brought together 44 students who were entering their respective degree programs to complete case studies of low-energy homes and a collaborative design project. The students were enrolled, respectively, in second-year interior studio, second-year landscape studio or a first semester landscape graduate studio. The faculty expanded the mission of the semester to include cross-discipline collaboration (Fig. 1). The pedagogical goals included strengthening student understanding of spatial form, addressing connections between inside and outside realms, and introducing concepts of low-energy design, along with collaboration and communication goals. The vehicle for accomplishing these goals was a collaborative case study (1-1/2 weeks) of low-energy homes and sites followed by a comprehensive design effort for an off-the-grid complex of buildings and open spaces (4-1/2 weeks) (Fig. 2) (Clement, Kingery-Page, and Lewis 2012).

*Fig. 1 Initial Collaboration Meeting: Discussion of Low-Energy Design (William Yankey)*

Fig. 2 La Reyna Coffee Cross-Disciplinary Collaborative Project Example (Clement)

*Student and Faculty Demographics*

In 2011, the interior architecture students (25) were all non-baccalaureate undergraduates. Of the landscape architecture students (19), three were first semester post-baccalaureate graduate students. The 44 students enrolled in the studios were split into three teams of 15 with approximately eight undergraduates from each discipline and one post-baccalaureate landscape architecture student on each team. The team composition for case studies was not by student choice, but by faculty discussion centered on skills, maturity, personality factors and other considerations. For the comprehensive design effort, students selected their own partners based upon similarity of initial concepts, and worked in interdisciplinary teams of two and three (Clement, Kingery-Page, and Lewis 2012).

Faculty drew upon their respective backgrounds and research interests in landscape history, landscape design, art, culture, social justice, and sustainability to adapt a common case study methodology (Francis 1999) to the specific needs of the subjects and beginning design students. The interior and landscape undergraduate students shared a prior first-year experience of design and drawing concerned with spatial perception, organization, definition and relationship, and communication through two and three dimensional models—which significantly, excludes computer-aided work. The three post-baccalaureate graduate students in landscape architecture had backgrounds in planning, landscape design and landscape management, respectively, so they, too, shared some fundamental knowledge of spatial design (Clement, Kingery-Page, and Lewis 2012).

In 2015, the authors invited the former second-year students to a focus group (Fig. 3) to discuss how the case study exercise and collaborative design project impacted their design education since 2011. There were 19 interior architecture and nine landscape architecture fifth-year students in attendance. Since the six-week collaboration in 2011, four interior architecture and three landscape architecture students decided not to continue with their degree-granting program. The three post-baccalaureate graduate students in landscape architecture had previously graduated and were not able to attend the focus group session. This means 90% of interior architecture students attended the session, while 70% of landscape architecture students attended.

*Fig. 3 2015 Focus Group (Lewis)*

*2011 Student Learning Objectives*

The 2011 educational objectives included: gaining knowledge of sustainable technological systems employed in local residential scale projects through direct experience; understanding the interplay between interior and exterior spaces; experiencing a collaborative interdisciplinary process with instructor-led activities for project management, some leadership and management of project tasks; using a simple but comprehensive case study methodology; and effectively communicating observations and analysis through imagery, associated text, and verbally as a team (Fig. 4) (Clement, Kingery-Page, and Lewis 2012).

*Fig. 4 Final Crit of the La Renya Design Project (Clement)*

## Reflect: Rationale for Interdisciplinary Teaching

As practitioners in architectural fields will attest, "Collaboration between geographically distributed, multidisciplinary teams is becoming standard practice in the [architecture, engineering, and construction] industry. However, educational models in architecture, engineering and construction have been slow to adjust to this rapid shift in project organization. Most students in these fields spend the majority of their college years working on individual projects that do not build teamwork or communication skills" (O'Brien, Soibelman, and Elven 2003, 78). In recent surveys, both design college administrators and professional firm leaders have listed "integrated and interdisciplinary practice" within the top two issues they address (Design Intelligence 2013). Contemporary professional practice, "demands early team formation and constant communication throughout the project life cycle" (O'Brien, Soibelman, and Elven 2003, 79).

In a 2016 issue of *Landscape Architecture Magazine,* Jennifer Reut, in her article "Got the Job: Three Firms Talk about Who They'll Hire Next and Why" interviews practitioners in three very different-sized firms, but all speak to the need for communication and collaboration skills in new hires. The principal of a small firm notes, "We'd like to have strong design skills, but maybe more important is whether or not they have strong organizational, management, and communication skills…" and "I'm looking for emotional intelligence" (Reut 2016, 56). A principal at Stantec, a very large multidisciplinary firm, states that key skills in the next two or three years of hiring will involve "understanding the interdisciplinary approach. Even the firms that are just pure landscape architecture, all of their practice is collaboration…they are all relying on multiple disciplines to achieve their project" and "you really need to understand how all of the professions contribute to the success of the project" (Reut 2016, 58).

In recent years the studio culture in the Department of Landscape Architecture and Regional & Community Planning, within the mission of the College of Architecture, Planning and Design, has embraced collaboration among students from the third year to the fifth year, and faculty require a significant number of collaborative projects. In 2011, this was not the case, but the landscape architecture culture has shifted. In the Department of Interior Architecture and Product Design, the studio culture is largely focused on individual efforts, but there is a very strong ethic of sharing and collaboration in the department. The culture of the design disciplines and individuals, as noted by O'Brien et al., varies considerably, and it contributes to or stems from the manner in which faculty conduct themselves and the personalities of students (2003). The culture of the discipline is a relevant background issue and contributor to collaborative success or failure, encouraging individual "silo" behavior or collective efforts, sharing, risk-taking and other activities of design. By starting collaborative projects early in the curriculum, the authors believe that the proclivity of students to "enter the silo" may be delayed or reduced. This seems to be the case with a majority of the students who were interviewed in the focus group of 2015.

## Evaluation: Methods

Initial evaluation of the six week, interdisciplinary learning process occurred through an online survey of student perceptions combined with faculty reflection upon learning outcomes (Clement, Kingery-Page, and Lewis 2012). Since 2011, the authors were interested in whether there might be long-term impacts on the students' education from this six-week collaboration in second year. In spring of 2015, the graduating fifth-year students were asked to discuss in a focus group whether the collaborative case study exercise and collaborative design project affected their design education. Twenty-eight of the original forty-four students attended the focus group.

All three faculty attended and co-facilitated the focus group. Discussion was prompted by simple questions addressing three foci: first, understanding of concepts for low-energy, sustainability design; second, working process and collaboration during the 2011 studio; and third, building collaborative thinking and fundamental knowledge between disciplines and understanding boundaries of their disciplines. Faculty allowed open-ended conversation among student participants, only contributing to the discussion themselves in order to clarify comments, answer questions, or move to the next focus.

Faculty audio-recorded the focus group for its duration of one hour and ten minutes. This audio recording was the primary data record analyzed and reported upon in this paper. Analysis occurred through a repetitive noting process while listening to the recording—a common method of qualitative content analysis (LeCompte and Schensul 1999). The noting process allows themes to arise organically from the data, rather than a process of searching for pre-conceived ideas. Each faculty member contributed to the noting process, listening to the record in full and noting observations and reflections upon the focus group recording. Finally, the recurrence of thematic statements was analyzed by color-coding related statements in the digital word processing file used as a noting document.

Analysis of focus group comments yields several themes, including: in spite of frustrations stemming from working in mixed discipline teams, the case study field trips were memorable and valuable as "real world" examples of sustainable design; students' initiation to interdisciplinary collaboration had some frustrations, but inspired greater and long-lasting awareness of collaboration; and the collaborative design project (La Reyna) initiated students to the process of designing for cultures and sub-cultures other than their own.

## Transform: Pedagogical Findings form the Focus Group

*Designing for Defined Users Within Another Culture*

The design phase of the 2011 studio was a hypothetical campus design for an actual, existing, fair trade coffee growing collective located in Nicaragua, named La Reyna. During the focus group, several participants noted that the 2011, interdisciplinary project was their first experience designing for a "defined user" from a culture different than their own. Multiple students noted that the inter-cultural aspect of the design project was a valuable learning experience and introduced a process applicable to design for other cultures and subcultures.

During the focus group, many students brought up examples of designing for different cultures and sub-cultures later in their design education, ranging from a city in China to downtown bicyclists' sub-culture in a midwestern city. They cited the La Reyna Coffee Collective project as opening their eyes to the process of designing for "defined users." Specifically, one student noted that the La Reyna project challenged the students' perception of design norms and made research necessary.

*Learning about Low-Energy Design*

The 2011 field trips to low-energy sites and homes were intended as an experiential introduction to practices of low-energy design: use of reclaimed and recycled materials, design for passive heating and cooling, daylighting, and integrated stormwater management. The field trips included an owner-built earthship home, a contractor-built LEED certified home, a design-build passive solar home created by architecture students, and a large scale property that is part of a public green infrastructure demonstration. Each student team completed a multi-factor case study of one of the three homes. The green infrastructure demonstration site served as context for student critique of the lackluster sites of the residential properties.

Student reflections during the focus group reiterated the value of the field trips (Fig. 5), many times. Students credited the field trips with "making them more aware of using resources at hand," "reusing materials in an artistic way," "relating ecology to the human world," and making them aware of passive technologies. Concurrent enrollment in classes that focused upon ecology and sustainable building systems coincided with the cross-disciplinary project; students felt this helped foster understanding of sustainability. Applying what they were learning from the case study field trips and in the other classes to a design project was remembered as a positive experience. Students noted that the "La Reyna [project] influenced our constant use of sustainability" later in their studies.

Fig. 5 Field Trip Case: David and Susan Millstein's Home (Clement)

*Interdisciplinary Design Process*

Students in the focus group reported overall positive experiences, but not without difficulty, during the case study and project phases. One student described the experience as a "beautifully frustrating." He and another student expanded that line of thought to specifically address design vocabulary and different understandings of similar concepts. Students discussed having to manage (perceived) differences in professional vocabulary, and having to manage time better in order to "get on same page." Many noted the motivation generated by being responsible for contributions to the team and to individual teammates. Students realized that environmental designers have much in common, including working across many scales.

One student clearly articulated that in a later professional practice class, she perceived the interior architecture and landscape architecture students much more able to collaborate than architecture students. As another interior architecture student put it, "its much easier for us to work with the landscape architecture students than with other students." Students expressed interest in future collaborations, having "skipped" the discipline of architecture: "I am curious as to how much opportunity each discipline will have to collaborate in practice. I envision each discipline having closer dialog with architecture."

The interior architecture and landscape architecture students reported that they understood one another's disciplines well and were able to work well together, that they could talk and "figure out what each person needs to get out of the project and how to get the project done cohesively together." One reflective comment from a student was, "Collaboration can be scary and fast. The one-table thing kind of scares me. But I can respect talent in singular work. The woven-in aspect of movement back and forth from 'openness at one table' to individual focused work seems to be what works for me."

One student commented, along these lines, that "early-on" collaboration is key to success in "taking a more hands on approach to the other profession's work" and "taking an active interest in the dilemma's of the other discipline's process." And another, "not being afraid to push those boundaries of inside/outside realms of design...push your thinking into the realms that may belong to the other discipline...in between spaces...what do we do. Now I'm not afraid to push boundaries as then. It was a 'weird dance' with who's space is this if its in-between...now we can navigate the interaction better."

With regard to cross-disciplinary critique, one student commented that he recently had an excellent critique on his furniture design project by an landscape architecture student and "realized that they were studying the same theory;" that he appreciated informal critiques as being valuable; and appreciated the "cross-over between disciplines." A related comment, by a landscape architecture student was, "all environments become about the human scale as you experience them...design across scales is a common experience."

Similarly, comments on splitting work and the "pitfalls of sitting at the table together trying to do all design together" included, "Balancing work all together with personal time alone was valuable." Advice during the focus group included, "Develop the concept and create buy-in; then define roles. Interiors and landscape dividing up the design responsibilities: this was part of what made [the] La Renya [project in 2011] successful." "In a later project, in a different class, it was crazy when four people were all trying to do the same thing...splitting tasks up helped us make real progress [during the La Reyna project]." Another thought on good collaboration was to seek a focused critic or mentor for certain aspects of a project, as opposed to collaboration on broad feedback.

The faculty authors of this paper required the flow of work in the case studies and La Reyna design project to be in parallel, in the blended teams, and not the passing of design work "over the wall" (in sequential order with passing from one student to another after completion of a step) as described by O'Brien et al. (2003, 85). This pattern did not take immediately, but in the very compressed time frame, the students did not have much choice, but to dive in and generate products from class period to class period.

## Synthesis: Discussion

The challenges faced by students in the 2011 studio effort can be described as anticipated and unanticipated. Perhaps the most significant challenge in the case study phase was a mismatch of digital skills; a second issue involved misunderstandings of interdisciplinary design process. Second-year landscape architecture students were using computers during this semester, but interior architecture students were not. The skills possessed by landscape architecture students included using SketchUp for orthographic drawings, paraline and three-dimensional modeling, and Adobe Illustrator and InDesign for two dimensional diagrams and page layouts. In the focus group one landscape architecture student noted that it was "super frustrating" to be the computer savvy side of the team. An interior architecture student, acknowledging the landscape architecture software knowledge, said she felt lost and "useless at times, just watching while the landscape architecture students did some of the work," and that she "could be helpful with design perspective but could not finish things for the project."

There was a student perception voiced in the focus group that the two disciplines involved in the 2011 blended teams were more able to collaborate in later classes, as compared to their peers in the discipline of architecture. It is difficult to say whether this perception resulted from success of the interdisciplinary interior architecture/landscape architecture collaboration, or whether the student perception is a result of a culture of architecture that has been described by others. O'Brien et al. noted that during interdisciplinary learning, some students exhibited attitudes or beliefs that hindered true collaboration: one architecture student in that collaborative project—among architects, structural engineers and project managers—referred to his teammates as "my engineer" and "my contractor" (2003, 87-88).

## Activate and Transfer: Conclusions

During the 2015 focus group, the fifth-year graduating students reflected positively how sustainability principles became part of every design exercise after La Reyna, learning about cross-cultural design for defined users, and the awareness of a collaborative design process. Students fondly remembered the field trip and the impact on their understanding of low-energy design. Minor frustration was expressed about the differences in skills and disciplinary knowledge and learning to work together in a team. As noted earlier the landscape architecture students were using software while the interior architecture students utilized hand drawing skills for visualizing architectural form and space.

The authors met their goal of teaching within the sub-disciplines within a unified studio exercise sequence, consistent with our College's mission at Kansas State University. Several students, however, concluded that faculty must have felt the interdisciplinary design studio was a failure, because it was not repeated again. The authors (in the debriefing focus group) explained that they had hoped to re-establish the collaborative interdisciplinary studio exercise, but were unable to repeat the studio experience due to changes in faculty assignments and semester studio scheduling. The occurrence or faculty ability to do collaborative interdisciplinary studios effectively depends upon curricular alignment, personalities of faculty, and many other factors. Repetition during the course of study for all students in the college would be desirable, as noted by O'Brien et al. (2003). Repetition is important in building options for future design collaboration later in the students' curricula—both directed and impromptu.

The disciplinary differences in the use of formal vocabulary and a sense of scale presented opportunities to learn through comparisons of observations made during the field trip and during discussions afterwards; however, the relatively large number of young, inexperienced designers presented some challenges in communication among group members. The authors would recommend for future interdisciplinary collaborations more guidance on interdisciplinary design skills, on personality assessment and understanding, and group process dynamics. Focusing on interdisciplinary design skills would have assisted our young students with the collaborative thinking and transferring fundamental knowledge across the disciplines. Beginning design students struggle to work within group settings, but taking time to identify and understand students' individual strengthens and weaknesses and leadership styles is essential to create productive interdisciplinary learning. Collaborative student learning could have been even reinforced further, if several hours had been spent focused on individual and team dynamics.

The authors would recommend allowing a longer (extended) period of time for this project. Six weeks required a very fast pace; a full semester would have been ideal. Students and faculty agreed more time was necessary, especially with beginning design students.

When asked about current collaborative work 45% of the focus group students indicated that their current master's project involved interdisciplinary efforts. Some students cited the La Reyna experience as the reason they thought it possible. In the words of O'Brien et al., "...there is a need to gradually reshape the curricula of architecture, engineering, and construction programs to encourage collaboration and exchange of ideas among students. If universities and schools can create an overall academic setting where collaborative, multidisciplinary work is considered commonplace, students could focus on refining skills in collaboration in capstone courses rather than learning these skills almost from scratch as they tackle the complexities of a design project (2003, 92)." Our 2011 effort was one step in the right direction.

A point of discussion before, during, and after the semester's efforts involved the perceived trade-off between technical skill-building and gaining substantive disciplinary knowledge versus learning, by direct experience, process skills such as collaboration and communication. The authors did ask themselves, "Was the tradeoff worthwhile?" The authors believe that, yes, the trade off was worthwhile, especially as students matured and progressed further in their respective curricula and continued to collaborate of their own initiative.

## Notes

Clement, L., K. Kingery-Page, and K. Lewis. 2012. Collaborative Case Studies of Low-Energy Homes and Sites with Early Design Students. Twenty-eighth National Conference on the Beginning Design Student. pages 59-66.

Design Intelligence. 2013. Students, Deans & Firms Weigh in: Top Architecture Programs. Retrieved from http://www.di.net/articles/students-deans-weigh-in-top-architecture-programs/

Francis, Mark. 1999. *Case study methodology for landscape architecture*. Washington D.C.: Landscape Architecture Foundation.

LeCompte, M. D., and J. J. Schensul. 1999. *Analyzing and Interpreting Ethnographic Data*. Book Five in the *Ethnographer's Toolkit*. J.J. Schensul and M.D. LeCompte (Eds.). Walnut Creek, California: AltaMira Press.

O'Brien, W., L.S. Soibelman, and G. Elvin. 2003. Collaborative Design Processes: An Active-and Reflective-Learning Course in Multidisciplinary Collaboration. *Journal of Construction Education*. Summer 2003 Vol. 8, No. 2, pp. 78-93.

Reut, J. 2016. "Got the Job: Three Firms Talk about Who They'll Hire Next and Why." *Landscape Architecture Magazine*. January 2016 Vol. 106, No. 1, pp. 54-58.

# PUBLIC FAILURE: A Chronicle of @#%! Gone Wrong

Federico Garcia Lammers | South Dakota State University

## SIMULATING PUBLIC WORK

### (Academy : Community)

*Speaking of public space can be a rhetorical convention that covers up the confusion that stands out over and above the values pertaining to the city as a political place, place of subjective intervention, place of the "polis".* [1]
*-Manuel de Sola-Morales.*

One of the most compelling aspects of 1:1 design pedagogy is the opportunity for students to engage the complexity of the *polis*. This complexity is most evident in the potential to define and speculate about the role of *public space* and to simulate what it means to work in the *public sphere* (Fig. 1).

*Fig 1.* Public student presentation to City Commission in Huron, SD.

The aim of this paper is to suggest the potential for a 1:1 pedagogy rooted in the failure of public projects evident in the simulation of working in public. Section two of the paper will discuss a specific undergraduate studio project and define its public failure.

In academic discourse, simulation operates at the intersection among complex geometries, performance analysis, and fabrication technology. This academic context should not be concerned with establishing whether the role of simulation in digital technology is good or bad. Instead it is more important to consider the direction, and better yet the missed directions through which the role of simulation can include a different set of circumstances relevant to the teaching of architecture. The important role played by digital technology and simulation should not lead to the narrow avenue of technological determinism. Instead, simulation can become relevant when thinking about 1:1 pedagogy and the economic, social and political factors that shape architecture and the city. [2] The implications of digital technology in architecture are the topic of speculative discourse that pervades the academy and avant-garde architecture practices throughout the world. The role of simulation as a means to analyze, synthesize and visualize is conditioned by the ability to speculate about the implications of unbuilt or soon to be built projects. Contemporary discourse about simulation is focused on the technological relationships formed through the use of fabrication and representation tools. How can the role of simulation include the political implications of working in *public* and the effects of this work on beginning design students?

Simulation can further establish the relationship among design ideation, construction, and the political framework present in academic projects that engage local communities and industry partners (Fig. 1 & 2).

## COLLABORATION STUDIO

Since the fall of 2013 the Department of Architecture (DoArch) at South Dakota State University has conducted a yearly Precast Concrete Studio. This third year undergraduate studio is largely funded and sponsored by a grant from the national Precast Concrete Institute. The pedagogical sequence associated with the Collaboration Studio starts during the first semester of undergraduate study when students visit and analyze a small community in South Dakota. This first year analysis consist of making a large city model that is presented to the community in a public forum. This presentation and analysis are the foundation for coming back and working with the community as part of the Collaboration Studio during the fall of third year.

*Fig 2. Students Visiting Gage Brothers Pre-Cast Concrete Facility.*

In addition to exploring the materiality of precast concrete, DoArch has framed this studio as collaborative experience in which students focus on the design and installation of a public space in a small South Dakota community. The Collaboration Studio is focused on positioning students in the uncertain terrain of the working in the public sphere, while studying specific material construction methods. The pedagogical implications of this studio operate at the intersection between service learning and speculative architectural research. Each Collaboration Studio project is framed by a 1:1 design build approach, but is primarily defined by partnerships formed between DoArch and communities across South Dakota. The primary focus of the Design Build studio is to propose physical means through which to measure, engage, and structure the public landscape. The projects proposed for each version of this studio respond to the unique set of site conditions and constraints corresponding to each community. With each studio DoArch faculty and students carefully craft a set of spatial provocations intended to occupy and engage public space across South Dakota. In order to engage the role of public space in the state, the scope of the Collaboration Studio is organized around three factors: in-studio collaboration, interface with the precast concrete industry, and community involvement. The last of these factors, community involvement, is the most fragile of all three relationships. This fragility is what leads to the potential of a project to fail. For the purposes of this studio failure is defined as not being able to construct the project as a consequence of interference from governing bodies in the community. The collaboration studio leverages design-build pedagogy against the complexity of the political process of the city and the circumstances that surround a public project not being constructed. What if engagement with communities was not seen primarily as a way for students and faculty to provide a service or to pretend to be architects, but rather to experience the possibility of public failure outside of the design studio.

## A CASE OF FAILURE

In the fall of 2014 the Collaboration Studio worked with the city of Huron, South Dakota to design and build a public space. The project was not built.

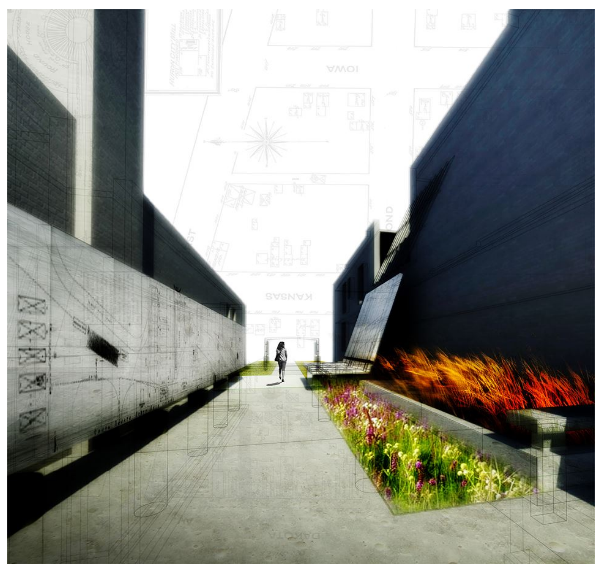


*Fig 3.* Student rendering of Kansas Mall project.

The Kansas Mall project was designed and planned to be located in downtown Huron, South Dakota. The Mall is a vacant urban infill site linking Dakota Avenue and a public parking lot heavily used by movie theater patrons and downtown workers, visitors and shoppers. The site is roughly 4000 square feet, stretching 165 feet from Dakota Avenue to the parking lot located on Kansas Avenue. The focus of the design project was to create a series of public spaces that connected the ends of the site and provided ways of engaging with the existing elements of the historic buildings surrounding the site. The materiality of the project combined the lowness of the prairie landscape with two precast concrete walls, a long wall and a tall wall. These precast walls were designed to be inscribed with a 1916 Sanborn Map of the city of Huron and operate as a spatial and historical reference physically unfolded on the site (Fig.3).

Huron is located in east central South Dakota positioned at the intersection of the historic Chicago Northwestern Railway and the James River. With a population of 12,500 Huron is the county seat of Beadle County and is the ninth largest city in South Dakota. The history of Huron is deeply tied to the development of the railroad and after its survey and platting in 1880 the city expected to grow in significant ways and play an important role in the politics of the state. Poised to be a larger city than it became, Huron has a built scale and stock of buildings that highlight a sense of verticality rarely seen in South Dakota. *3*

Fifthteen out of the Seventeen students in the studio participated in the first year undergraduate experienced mentioned in the previous section of the paper. Many of the students were familiar with Huron's core urbanism and history. However, the political structure and governance of the city was not familiar to students. It is this structure that largely frames the work of the studio. Throughout the semester students interacted with one governing body, the City Commission and three individuals representing specific departments within the city of Huron. The Parks and Recreation Director, Public Works/City Engineer, and the Planning Director participated in multiple discussions with students and faculty. The interactions were framed through commission meetings, site visits, and public presentations (Fig. 4).

*Fig 4.* Student and Huron community members discussing ideas at a public design meeting organized by the Department of Architecture.

At the onset of the project the City Planning representative made it clear that the design and construction of the Kansas Mall project would be the most comprehensive public space to be designed along the main downtown corridor of Huron. This was the first hint of potential failure because it marked the rarity and lack of precedent for these types of spaces in the city. This sentiment was also accompanied by doubts about the future of the city being primarily shaped by the making of public space and not through the beautification of street facades along downtown.

The failure of the project was influenced by three factors. The community's definition of the role of public space, the City Commission's expectation that the students and faculty operate as service providers, and the budgetary structure of the project. The students were responsible for outlining and defining the potential of the project during several public presentations (Fig. 3 & 4). The intent of the Kansas Mall project was framed and setup by faculty, communicated to the community and reinforced by students at these public events. The overall costs were outlined in relation to the grant budget allocated for the design, fabrication, and installation of the project. This detailed budget was not provided to the community until the scope of the student work was refined and measured against the community's expectations and resources. Throughout the semester students were exposed to the budgetary implications of the projects. The exposure happened through discussions in studio as well as the media releases done by the community. Below is an excerpt from the Huron Plainsman written by Roger Larsen explaining the project's financial implications.

*HURON – As the funding picture becomes clearer, construction of a downtown improvement project designed by South Dakota State University architecture students is set to get under way soon.*

*A combination of grant funds, city dollars, a corporate donation, outside cash and in-kind resources, and a local fund raising effort will pay for the $82,500 project at the Kansas Mall, the public area at 244 Dakota Ave. S. between PB Sports and Sherwin Williams Paint.*

*Improvements will include tall, decorative pre-stressed concrete walls, new concrete sidewalks, concrete seating, lighting and landscaping with irrigation.*

*The existing picnic shelter will be refurbished and moved to the east end of the park.*

*Students from SDSU were in Huron last fall to present project proposals at two public hearings.*

*With discussion on the appropriate level of city funding, the commission on Monday voted to set aside $18,500. In voting no, Commissioner Doug Kludt said he thought that amount was too much, and suggested a maximum of $10,000, including $5,000 already budgeted* *from the Community Improvement Commission.*

*Leadership Huron has proposed to raise $10,000 and the Pre-Stressed Concrete Institute will donate $28,200. SDSU will provide $15,800 in cash and in-kind resources.*

*The city is also hoping to be eligible for a grant from the National Association of Realtors, but that amount is unknown at this time. The city is also applying for $5,000 from the Huron Community Foundation.*

*Mayor Paul Aylward, in supporting the additional funding, said the city has a long way to go in improving the downtown area for residents and visitors. He said the city contribution is a good bargain when considering how many dollars from other sources will be leveraged for the work.*

As the city found more objections with the scope of work, objections that were primarily focused on costs and doubts about the public role of the Kansas Mall, the project became more fragile. This led to several member of the City Commission to a halt the project. The project never regained enough momentum to complete the necessary work for its execution.

While this process was unfolding continued to document and produce a series of drawings preparing for the execution of the project as thought it would be built. In three separate teams, students worked on a shop drawing package for the precast concrete formwork, a drawing package that described the scope of the project and its parts, as well as a series of diagrams and images describing the intent of the project (Fig. 1). This documentation was done while the students and faculty were evaluating the dismantling of the project. In addition to drawing packages much of the essential communication and evidence of failure came in the form of short written communications between community, faculty, and students. As the project began to unravel each step of this process was shared the students (Fig. 5).

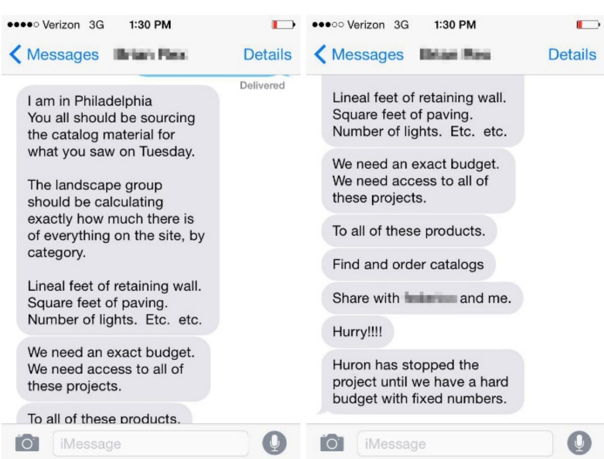



*Fig 5.* Text message between students and faculty after phone call with Huron Planning official.

## #@%& SHOULD GO WRONG

The final decision to stop the project came from the faculty after the semester was complete and there was not enough city support behind the project. One of the most difficult positions to put students in is to ask them not to pretend to be architects while immersing themselves in the political implications of working on a public project. This position is also difficult for faculty, especially as the growing pressure of executing the project can lead to favor "professional responsibility" to the community over research and teaching. One could argue that engaging the community through providing professional services is a substantial part of teaching this type of collaborative design-build, but the 1:1 relationship among, faculty, students, and community in the Collaboration Studio is better served if it is framed through research and not the pseudo professionalism of letting students pretend to be architects. The role of simulation is relevant in making this distinction because the act of simulation is not about pretending or faking, but rather about adopting symptoms that yield a faithful effect. [4]

This is one of the biggest challenges when working with a small community who expect that students are being directly trained to be architects at all times. The opportunity to simulate working in public and navigate the political territory of architecture does not mean that students are working as architects, nor does it mean that the studio operates as an architecture office. In Baudrillard's terms, trying to position the community as a client would be fake. When working with the Collaboration Studio communities like Huron are not primarily receiving a service or being provided outreach, instead they are participating in a dialogue that facilitates the complexity of academic teaching and research that happens at the intersection of public space and politics...the polis. By strictly separating the implications of service from research the role of failure can play a significant part in the 1:1 pedagogy of the studio.

The willingness to fail and learn from failure is praised in architectural education. However, failure and the documentation of such failure has been excluded from the narrative of academic work in communities. If the role of 1:1 design pedagogy is to find productive methods of simulation, then the effects of public failure as a way to shape student knowledge can be critical. What if community and industry partnerships that are tied to 1:1 scaled constructions were pursued when they were most unlikely to happen, most fragile, and almost certain to fail. The possibility of forming knowledge around these circumstances can distance students from the object-subject relationship typically formed in the architectural design studio. This distance should put faculty in a position to ask students to document and mitigate failure at the intersection among making, community and interdisciplinary practices. These circumstances are what frames the complexity of making *public space*, and the opportunity for 1:1 design pedagogy to address the rhetorical convention of thinking of *public space* as the left over parts of small scale communities.

Implementing academic projects focused on methods of 1:1 simulation should be about working in public. The implications of this work can be framed as a political public act fundamental to the education of design students. The ideation and construction of *public space* can prepare students to learn from failure and speculate about possibilities when #@%& goes wrong.

## Notes

[1] Sola-Morales, Manuel. "The Impossible Project of Public Space" in In Favor of Public Space: Ten Years of the European Prize for Urban Public Space. Actar: Barcelona, Spain. 2010. p 24.

[2] Picon, Antoine. "Digital Culture in Architecture" Birkhauser: Basel, Switzerland. 2010. p 9.

[3] City of Huron website and Beatle County history section.

[4] Baudrillard, Jean. "The Divine Irreference of Images" in *Simulacra and Simulation.* Michigan Press: Ann Arbor, MI. 1981. p 3.

## Figures

All images are property of the author.

# Building Big With Habitat: A ‘Tiny House’ Prototype Using Universal Design

Christopher Manzo | Kansas State University

## Introduction and Issues

“A world where everyone has a decent place to live.”
- Habitat for Humanity’s Mission Vision[1]

This paper is a process case study and documents the inception, formation, and launching of a 1:1 building project within a typical design educational setting at the scale of an occupiable near space environment. At the time of this writing, the Spring 2016 term has begun, student teams have been meeting bi-weekly, a trailer has been purchased, and undergraduate research has commenced. We are preparing for a design charrette at the start of week three. Our case study project (Tiny House 1.0, or tH1) utilizes a Research/ Design/ Simulate/ Build pedagogy (Hinson and Miller, 2013). We are focusing this effort through the Service Learning and Community Engagement of ten second year IAPD students, three fourth year AR students, and one fourth year student from Agriculture, via the fabrication of a Tiny House (161 s.f.). We have partnered with Habitat for Humanity (HfH) serving an aging population by embodying Universal Design principals.

In the fall semester of 2015, the author, in conjunction with Professors Dustin Headly and Katrina Lewis, taught a second year design studio at Kansas State University (KSU) College of Architecture, Planning, and Design’s Department of Interior Architecture and Product Design (IAPD). Assistant Professor Dustin Headley introduced students to the six week ‘Tiny House’ design exercise. The design project emphasized residential design issues, designing around basic users’ needs, wood frame construction, and designing at all scales. To test their ideation, students drew 1:1 in chalk on asphalt to better understand movement through plan and section within the tight confines of their Tiny House schemes (See Fig. 1 and 2). Each student built ½” scale frame models to reinforce an understanding of wood frame construction (See Fig. 3). The author’s case study project (tH1) began out of the students’ desire to take their model making, drawing, and design work a step further.

*Fig. 1 Drawing 1:1 Testing Movement Within Their Tiny Houses: Students of Professor Katrina Lewis’ Studio, Second Year IAPD (Manzo).*

As our studio ideas around designing Tiny Houses coalesced in mid-October 2015, the author had a conversation with Manhattan , Kansas community members interested in Tiny Houses.

*Fig. 2 Students Drawing 1:1 Testing Their Ideation At Full Scale: Claire Reid and Mekena Rhodes, Second Year IAPD (Manzo).*

Out of the students' desires and this conversation, coupled with the pivotal backing of a visionary Department Chair and a HfH chapter seeking to try new housing solutions for the rural poor, tH1 was formed. The students' desires to positively impact their community fueled our larger partnerships into action.

Being near Fort Riley Military Base with established research connections to KSU, it was initially considered that our student teams would partner with a local veterans group, focusing our Tiny House efforts on accommodating and addressing the needs of veterans that were convalescing. This initial intent proved impractical given our condensed time frame and we pivoted our focus to that of creating a Universally Designed Tiny House prototype that would be the basis for serving potential future client groups: the elderly, the handicapped, and veterans.

Building 1:1 at any scale is not for the faint of heart; the complexities and players involved in a 'regular' studio environment are multiplied five-fold[2]. Issues that are largely theoretical take on legal, fiscal, and schedule dimensions with corresponding repercussions as to outcome. What is a fairly direct relationship between professor and students with clear course goals and objectives (typically spelled out in a syllabus on day one) becomes a negotiated journey between multiple external parties, the students, and one's self, protracted over six months. Schedules and Reviews that could typically shift within studio now have negatively impactful effects upon building trades relying upon the student executed work. Changes on paper – a staple of typical studio work – begin to have significant dollars attached to them, in addition to critical schedule considerations.

## Partnerships and Roles

Atypical to studio, in a 1:1 build project there are a multiplicity of partners involved in daily decisions, and each has a critical role throughout the duration of the project. Without any one of these partnership relationships, tH1 would not have gotten off the ground. The roles, at least initially, are often unclear and conflicting; communication and patience are key to team formation. For tH1, the author forged partnerships between:

- the Client – Manhattan Area Habitat for Humanity;
- the End Users – the elderly of Riley County, Kansas;
- the Institution and Department – KSU College of Architecture, Planning, and Design Department of Interior Architecture and Product Design school (IAPD);
- numerous Community Members –Tiny House Co-Ops, Businesses and Business Leaders, Vendors, Consultants, Code and Zoning officials, Interested Citizens;
- the Faculty – the author and additional faculty support contributors; and
- the Students.

*Fig. 3 Framing Model At ½" Scale. Zach Simpson, Second Year IAPD (Manzo).*

Out of these partnerships the following questions have arisen:

- who is the contractor;
- is Habitat the client or the client's (end user) agent;
- is the principal faculty member the construction manager, chief designer, or simply a facilitator;
- how do you choose which student design to build;
- who is 'responsible' for budget and schedule decisions;
- what is the role of the end user in the building of the Tiny House given our compressed schedule;
- and the anticipated question – what happens when the students want to do something reasonable, but aestheticlaly different, that the client does not?

tH1 Schedule - Spring 2016

Students Introduced to Tiny House, Fall Term

| | Activity | Topics |
|---|---|---|
| Week 1 | Intro | ADL, UD, Shop, and Site |
| Week 2 | Research | Habitat, Client, Tiny Houses |
| Week 3 | Charrette<br>Research | Design Intent and Ideation<br>Drawing/ Making 1:1 |
| Week 4 | Research | ADL Prototyping, Code |
| Week 5 | Research | ADL Prototyping, Structure |
| Week 6 | Research | ADL Prototyping, Make Parts |
| Week 7 | Design | Integrate ADL Research |
| Week 8 | Build<br>Design | Floor/ Prep<br>Drawings to Make From |
| Week 9 | Spring Break | |
| Week 10 | Build | Walls/ Skin |
| Week 11 | Build | Roof/ Skin |
| Week 12 | Build | Button Up and Mech. Fit Out |
| Week 13 | Build | MEP Fit Out |
| Week 14 | Build | Components and Finishes |
| Week 15 | Build | Components and Finishes |
| Week 16 | Build | Components and Finishes |
| Week 17 | Celebrate | Punch List |

*Fig. 4 Spring 2016 Term Schedule (Manzo).*

## Resources:

In addition to the people needed to initiate tH1, there is the very real need of aligned resources. As tH1 took shape within the partnerships, the follow became apparent:

- Funding – there has to be sufficient funding to facilitate both the educational exploratory aspects of the work (undergraduate research and 1:1 prototyping), the actual construction itself, plus a 15% construction contingency, to address the unexpected – tH1 is anticipated to cost, approximately $20K, our construction budget is $15K;
- Students – they are the lifeblood of a project – not only do they bring talent, energy, enthusiasm, and curiosity to the work; but they each have networks within their own communities of individuals and businesses often willing to partner in projects such as tH1;
- Volunteers and Community – provide the expertise, logistical support, donations, and skill sets often absent in students. MHfH has a solid and experienced team of local volunteers (many are professionals within the building industry) willing and able to provide instruction on site and backup to our students';
- Shop – it is imperative to have access to a shop, and more importantly, shop faculty to assist in a 1:1 build effort. There are simply too many other resources to marshal to not have dedicated shop faculty involved. KSU APDesign's Richard Thompson will head up our safety, material, and shop efforts, often working on his own time with our students throughout the semester and on build Saturdays;
- Space – Sufficient dedicated floor space for 1:1 prototyping is required. The trailer for the Tiny House is eight feet wide by twenty-four feet long;
- Faculty and Leadership – Visionary leadership and a steady hand on the helm are needed to successfully initiate a project of this scope and scale. There will be obstacles to overcome and without dedicated leadership the effort will flounder from within;
- Time – this is a two-fold requirement; one, a realistic project schedule has to accommodate the scope of the project (See Fig. 4), and two, you have to have

dedicated student class time structured to execute the work effectively. The course has been meeting on W/F for 1 hour to address content issues and have dedicated Saturdays from 8am-4pm for twelve of the sixteen weeks of the term. This is a heavy time commitment on the part of the students for a three-credit elective and it is a very tight schedule given our scope.

Again, without any one of the resources, the chanes of success for a project such as tH1 diminishes.

## Design Process Paradigm

The tH1 case study uses a Research/ Design/ Simulate/ Build (R/D/S/B) pedagogy, acknowleding that these discrete actions often occur iteratively, and out of sequential order throughout the process of design. Contrasted to a typical studio process, R/D/S/B leverages the process of making to scale to inform each of the other activities: ie, Research is not theoretical – literature reviews regarding ADL issues are mocked up and tested directly by the students to gain a first hand knowledge of the issues at play, leading to improvements in design based upon research results. Our Culture of Building – everything from land acquisition, insurance issues, codes, construction methodologies, and material procurment, was discussed. We identified key Culture of Building issues within current housing production and contrasted those to the Culture of Building we were creating locally through the fabrication of the Tiny House (Davis, 2006). These issues will be reflected upon by the students throughout the semester.

*Research*

Students were exposed to the seven Universal Design (UD) priciples (NDA, 2015), Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL) behaviours (Levine, 2003 and Leibrock 1999), Tiny House issues, and construction considerations through guest lectures, field visits, readings, culminating in direct experimentation and testing. Questions were asked such as: how are typical UD solutions impacted by the constrainst of a Tiny House and how do we design a prototype that is adaptable to the particular ADL needs of a future user (See Fig. 5)? Research teams of four were establish to investigate a variety of design drivers at smaller scales:

Universal Design Principles (ASPE 1990) –

- Equitable Use;
- Flexibility in Use;

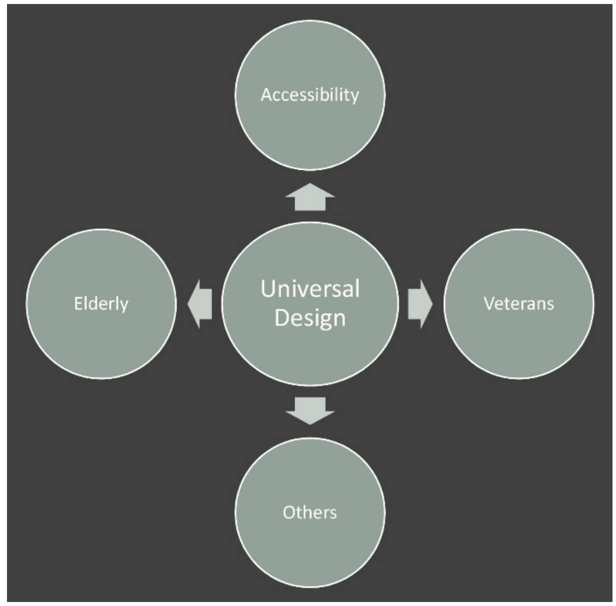


*Fig. 5 Universal Design As The Basis For Future Prototypes (Manzo).*

- Simple and Intuitive Use;
- Perceptible Information;
- Tolerance for Error;
- Low Physical Effort; and
- Size and Space for Approach and Use.

ADL Activities –

- Functional mobility – often referred to as transferring (moving from one place to another while performing activities) For most people, functional mobility is measured as the ability to walk, get in and out of bed, and get into and out of a chair;
- Bathing and showering (washing the body);
- Toilet hygiene (getting to the toilet, cleaning oneself, and getting back up);
- Dressing and Personal Hygiene with Grooming (including brushing/combing/styling hair); and
- Self-feeding (not including cooking or chewing and swallowing).

IADL Activities –

- Cooking/ Preparing Meals;
- Housework/ Storage;
- Sleeping/ Resting; and
- Getting Out into the Community.

Other Activities or Internal Design Considerations –

- Relaxing/ Hospitality;
- Engagement with the Exterior/ Near Environment;
- Gardening/ Growing (Which way is South on a Tiny House?);
- Daylight and Views from the inside out; and
- Sense of Arrival and Home.

*Design*

The design of tH1 will proceed in three stages. On day one, the author introduced Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL) as the principal design drivers for tH1. The students will be looking at the design of tH1 from the inside out, and the implementation and findings of their research will be integrated in the weeks ahead.

After a series of introductory lectures and a literature review, a design Charrette will be held allowing the four student teams to ideate schemes and present their initial findings to their client, MHfH. After receiving feedback for these four proposals, a single course will be taken, with the intent of incorporating stronger components of the three schemes not chosen. Using the Housing and Urban Development Fair Housing Act design guidelines as a basis of design, each student team will further refine an interior component based upon their ADL research and simulations. Lastly, upon conclusion of their research, the students will regather for a final design Charrette, integrating their component solutions into a single whole. It is intended that the internal design considerations 'push' upon the exterior envelope, subsequently altering the final design form of tH1.

*Simulate*

The undergraduate research into Universal Design issues will be undertaken in the context of 1:1 simulation and testing of numerous interior components, such as: cooking space, sleeping 'furniture,' bathing accomodations, and toileting facilties. Sketching, drawing 1:1, model making, full-scale prototyping, and 3-D printing will be utilized to test and modify typical UD solutions (Levine, 2003). Solutions will be iterated and then mocked up in context to scale to assure an integrated and holistic design solution.

*Build*

Within IAPD there is a strong culture of Design/ Make, Make/ Design; or design via making. This haptic approach to design is a hallmark of craft traditions, allowing for issues of materiality, gestural expression, detailing, and craftsmanship to impact final design choices and configurations.

The students will undertake the building of the Tiny House in conjunction with MHfH leadership and training. It is expected that some pre-made components will be shop fabricated and brought to the build site for installation to expedite schedule. A total of ten site build days have been established to frame, sheath, and finish out tH1. Professional building trades such as Plumbing, Electrical, and HVAC are being coordinated with the students' efforts via MHfH.

Building materials will be purchased, recycled via the Habitat Re-Store, or donated directly. It is the author's intent to have the students design and build around unique 'found objects.'

## Community Engagement and Service Learning

Given the compressed nature of our schedule, community engagement and service learning have been the most difficult components of this case study to set in motion. MHfH is engaging the students via talks, Re-Store visits, and workday leadership. It is our intention of having Habitat clients participate with the students on build days.

Already the students are taking this issue up independently. Their enthusiasm has spilled over within their own communities and networks, resulting in several businesses – previously with no connection to KSU – donating materials such as specialty plumbing fixtures to tH1. Additionally, students will present their work to the larger Manhattan, Kansas community through gallery style reviews on three occasions throughout the term. It is the authors intention of identifying and implementing additional opportunities for student community engagement and service learning as this process unfolds.

## Lessons To Date

The 1:1 build of tH1 has unfolded quickly. Aligning materials and forging partnerships have been the principal activities to date. Currently we are transitionging into the ‘active’ stage of the project with the students picking up the bulk of the design/ build effort. As there are numerous people involved in a work such as tH1, you can never communicate too much. Clarity around the control of budget and schedule are key issues to resolve with partners, as well as each partners’ role within the overall build effort.

The trailer arrives Monday. It is time to build.

## Notes

[1] (Habitat for Humanity International, 2015)

[2] The author is a Visiting Assistant Professor executing this work in the context of a three-credit elective course, Spring 2016.

## Cited Works

Davis, Howard (2006) *The Culture of Building.*

Hinson, David and Miller, Justin. (2013) *Designed For Habitat: Collaborations with Habitat for Humanity.*

Leibrock, Cynthia and Terry, James (1999) *Beautiful Universal Design.*

Levine, Danise (2003) *Universal Design New York.*

Web Page: www.habitat.org/how, Habitat for Humanity International, 2015.

Web Page: aspe.hhs.gov/basic-report/measuring-activities-daily-living-comparisons-across-national-surveys, U.S. Department of Health and Human Services, 1990.

Web Page: universaldesign.ie/What-is-Universal-Design/The-7-Principles/, National Disability Authority, 2015.

# 33 Days: 14 Pavilions

Kathleen Nagle, Paul Pettigrew | Illinois Institute of Technology

*Fig. 1 Pavilion details*

## Context

A commitment to making and its importance in design pedagogy has been embedded in our College curriculum for decades. In 1938 Mies van der Rohe described the trajectory of a new curriculum that would "guide our students over the road of discipline from materials, through function, to creative work."[1] Emphasis on craft and understanding of building materials provided the foundation for further study of architecture as both a practical endeavor and "pure art." "This is accomplished in the curriculum by so interrelating the different fields of instruction that the student is always conscious of, and is always working in the whole sphere of architecture in its fullest sense of designing a structure for a purpose, ordering it so that it attains significance as art, and working out the conception so that it may be realized in the executed building."[2]

Mies' vision grew out of the Bauhaus emphasis on craft and the necessity of understanding and experiencing the entire industrial process. While the curriculum has changed, the foundations of craft and material, and the art of building remain embedded in the teaching, particularly in the foundation years. For the past seventeen years our first-year curriculum has included, at the end of the second semester, a full-scale construction, using real materials. This final 1:1 project is a first full exposure to the relationship between material, structure, function and design.

The first-year 1:1 project is positioned at the end of a year that begins with the craft of drawing and physical modeling, and moves from abstract composition toward the understanding of buildings. Through hands-on experience with real materials and a complete design process, the final project synthesizes first-year skills; it also prepares students to understand detailing and materials in the context of larger construction systems investigated in the second and third years where materials and construction systems are taught in the studios. While  first-year students may not yet have technical knowledge, by working through these 1:1 projects they gain intuitive or "tacit" knowledge that will later be augmented by learned knowledge. "Tacit knowledge has been described as 'the know-how' as opposed to 'the know-what' (facts). It involves learning and skill building but not in a way that can be drawn or spoken. It is acquired through formative experiences."[3]

This is not the students' first full-scale project of the year, nor is it their first experience with real materials. In the fall semester we assign at least one full-scale project at the scale of the human body. In the fall of 2014 each student designed and constructed, in cardboard, an extension of the body inspired by Oskar Schlemmer's Triadic Ballet. While cardboard is a stand-in of sorts for real materials, students still need to detail appropropriate connections and understand the structural possibilities of the material. First-year students also receive a full-year of instruction in the materials lab, with the focus on wood in the fall and other materials in the spring.

## 1:1 and Sustainability

Material investigation, structure, function and design are all embedded in a 1:1 project. Some of our past projects were pure material investigations, open-ended and non-predictive – where the exploration of the material determined the direction of the design within the project parameters, and function was not an issue. Other projects have been more sculptural pieces –

a more predictive design process, but also less emphasis on function or structural support. The functional-object project incorporates material, structure, function and design in more equal proportion and follows a more traditional design process. The appropriate project type depends upon many factors including the specific pedagogic objectives of the studio, the difference in logistics of working with small vs. large class sizes, and the materials and resources available to the studio.

Concerned about the amount of material waste that was being generated by large classes of students building at full-scale, the faculty have sought more sustainable soutions: either find a home for the abstract material studies or find a long-term purpose for the 1:1 projects. After two years of working with an on-campus organization, in the spring of 2015 we found a local community partner and structured the design problem to achieve our pedagogic goals while satisfying a real need.

## Project Description

(4) 8' cedar 4x4s
(4) 8' cedar 2x6s
(10) 8' 5/4 cedar decking
(2) 4'x 8' sheets corrugated poypropylene
Stainless steel or galvanized bolts & screws (no glue or nails)

Using a finite selection of materials and working within size constraints developed for ease of transport by forklift, student teams designed and constructed fourteen pavilions for sitting, standing, resting or interacting. The pavilions were designed for the Schulze and Burch Biscuit Company, a 100+ year-old commercial bakery in the nearby Bridgeport neighborhood. Pavilions now populate an employee garden developed on a vacant lot adjacent to the Schulze and Burch baking facility. Designed for use before work, after work and during breaks, the garden is part of the bakery's healthy lifestyle initiative encouraging line workers and managers alike to get outside and walk. The goal of our project was to provide pavilions as destinations in the garden.

Each pavilion was simultaneously an abstract formal/spatial study, an exploration of material relationships, and a functional object, designed for a specific site and set of users.

## Structuring the 1:1 Design Project

Partnering with an off-campus business introduced logistical issues that the first-year faculty had not encountered in previous iterations of design/build projects, and it required more advance planning on our part to ensure the success of the project. Dicussion began five months in advance for the project start date of March 2015. A first meeting with our future client took place in December, and conversations continued via email up to the start of our project the final day of March.

*Time-Frame*

Our typical spring semester full-scale project, without a client, takes four to five weeks, and we did not have room in our schedule to increase the project duration. Introducing a client, client feedback, client approvals and the coordination between the hectic business life of a corporate executive and the inflexible time and day schedule of a design studio resulted in schedules that rarely aligned.

*Compatibility of Goals*

Client goals and interests tended towards safety, practicality, maintenance, repair and cost. Student and faculty pedagogic goals needed to be implemented within the confines of a client-driven program that placed less emphasis on grace than pragmatism, serviceability and utility.

*Compatibility of Scale*

From the client's point of view, large-scale projects were preferred, i.e. pergolas, picnic benches and architectural structures that could be occupied by large groups of employees. From the faculty's point of view, small-scale projects were preferred to keep the student team sizes manageable. We were fortunate that the client (company manager) was flexible in her vision for structures in the garden. Her goal was to get employees outside and walking. Thus Schulze Burch didn't necessarily need a single large structure; the goals could be met by our proposal of multiple small structures . The garden was large and well-suited for siting an indeterminate number of smaller pavilions. The company would decide which and how many of the finished projects they could use after our final review.

*Liability*

This was our first experience with a project that was both off-campus and meant to be used (vs. just viewed), thus liability became a potential issue. Fortunately IIT's legal department had recently developed a simple document for advanced studio design/build projects that was appicable for our project as well. The document allows IIT Architecture to transfer "equipment" to the client, and the clent releases IIT from any and all claims related to the physical condition, usability and/or functioning of the structures.

*Budget*

Material costs were paid from student lab fees only. Students pay a $40 studio lab fee in the fall and a $100 fee in the spring. The first-year faculty reserved as much of these funds as possible for the final project. The approximate budget for each of the fourteen pavilion projects was $400, or $100 per student. In a few cases, students purchased additional material and fasteners, although the faculty discouraged this practice as being less efficient in regards to planning and execution.

Budget constraints meant that lumber, sheet goods and fasteners would need to be calculated with much precision both in the process of ordering by faculty and in the process of estimating and incorporating into the projects on the part of each student group.

*Portability*

The possibility of constructing the projects on site was determined to be a logistical nightmare. Thus portability became a key concept in the planning stages. Weight would be an issue, i.e. structures would need to be light enough to be carried by a group of four students. Determining the proper size was critical in the planning stages. The pavilions would need to be small enough to be loaded onto a truck, and large enough to provide numerous options for use by one to three or more employees at a time.

The final size of 48” x 40” x 96” tall was arrived at as a combination of : efficient use of available lumber, polypropylene dimensions, compatibiltiy with forklifts, hand-jacks, IIT shop door heights and truck door heights, and reasonable spans for the dimension of materials that became the most economically advantageous. The client agreed to provide a truck and laborers to transport the structures to thea site.

*Pre-planning*

Prior to the start of the project, faculty generated a combination of preliminary dimensioned design drawings and calculations to test the proposed dimensions of the project, material dimensions, material quantities and estimated budget against possible design options that would be both structurally stable and large enough to be used by at least two people at any given time. These drawings were used as part of an early lecture on tectonics to simultaneously give students a visual of what the project brief was describing and what would be necessary to create pavilions that were functional and structural.

Knowing that the projects would be kept and used outdoors at all times and in all weather conditions became both an important factor initially for faculty in the selection of materials and fasteners and later for students in the design of their structures.

*Concerns*

While setting up the project parameters our primary concern was that such strict constraints on size and material would lead to projects that were too formulaic or prescribed. What we found, however, was that students pushed the envelope; in many cases their ambitions surpassed their understanding of structure and material, but once reined in, the end results were remarkably varied given the constraints. The open studio and the visibility of models and mock-ups created an atmosphere in which student groups actively worked toward more diverse designs.

## Structuring the Process

From experience we have found that teams of four are an ideal size for a first-year project of this scope. The team is small enough that all team members can participate, experience all aspects of the project and be held accountable for their work. Four is a large enough team to handle the diverse requirements of the project. Students chose their own teammates, with faculty encouraging teams of diverse skill sets, i.e. conceptualizing, physical modeling, digital modeling, graphic design, construction and the ability to present the group’s work well both orally and graphically.

The project duration was 33 days. Student work moved quickly between phases.

*Days 1-5* were spent presenting the project, organizing groups and researching landscape structures, cedar as a material used for structures exposed to the elements, and the variety of metal fasteners that might be used to join cedar to cedar, cedar to polypropylene, or polypropylene to polypropylene.

*Fig. 2 Concept models for one project (1”=1’-0”)*

*Days 5-9* required each member of the group to produce at least one 1”=1’-0” conceptual model, preferably more. Since each project essentially began with a kit of parts it was easy for students to begin modeling their ideas in wood, cardboard or foam core. Concept models were included in the discussion following a lecture on post and beam construction by IIT’s Director of Technologies. Our students don’t begin their structures course sequence until second-year, so this lecture was designed to discuss general principles as well as these principles in relation to student design proposals – the challenge of the twisting tower, the challenge of the un-braced corner, the necessity for shear panels, etc.

*Fig. 3 Concept review with the client*

*Days 9-11* The company manager reviewed students’ proposals during schematic design and added detailed insights on the workings of her company and her vision for how the garden and pavilions would be used. She touched upon employee habits and demographics, factory schedules, shift-work, and management objectives. Student teams were able to further develop their projects using her specific input, in the process learning that attention to real client concerns can improve and even inspire design concepts.

*Fig. 4 Concept models and sketches for review*

Assumptions were sometimes upended; the group that proposed a place for a smoker to stand in a shaded spot was told that smokers were relegated to the rear of the property and were not encouraged to smoke in the garden. Many students designed semi-concealed seating areas only to be told that there needed to be a balance between privacy and visibility. Overall, the client encouraged the diversity of the proposals; her vision was to scatter pavilions throughout the garden as a stimulus for exploration and movement. The diveristy of possible interactions around the pavilions was consistent with the many ways and times of day in which employees might be using the garden, from fifteen-minute breaks for fresh air, to working breaks and small meetings for management, to resting before or after a shift.

The client interaction enabled students to modify their concepts based on specific programmatic situations, goals or behaviours that they would otherwise be inventing.

*Days 11-16* Student received written client feedback and began the process of responding and consolidating their individual concepts into a collective or group concept.

*Fig. 5 Suggested joint types (mock-ups)*

*Days 16-20* Members of the first-year faculty delivered a lecture and demonstration on tectonics and construction methods that specifically addressed the scale and material components of this project. Faculty created mock-ups of recommended joint types left on display in the studio for reference. Students began the process of digitally modeling their projects in Rhino and converting Rhino models into two-dimensional views that could be used for material and fastener calculations. Student groups were required to present drawings describing design intent and ability to be constructed with the given quantity and types of materials and fasteners.

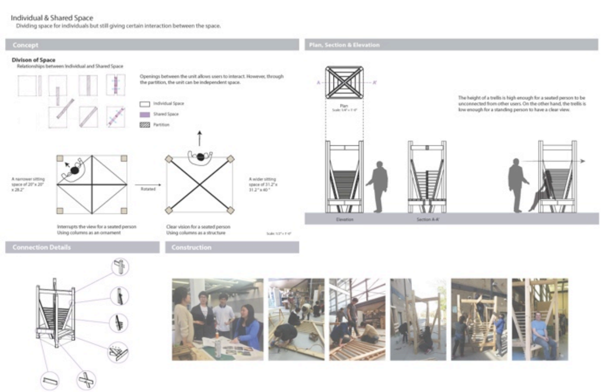



*Fig. 5 Project documentation booklet*

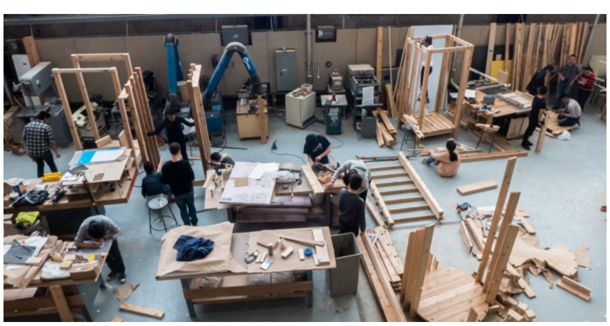


*Fig. 7 a&b Construction in the shop*

*Days 20-32* Materials were distributed and fabrication began in the IIT shop. Faculty met with students in the IIT shop to monitor progress, design changes and troubleshoot unanticipated problems. Simultaneously, student groups were assembling written texts, diagrams, sketches, dimensioned drawings and photographs into a booklet that could be handed out and passed around during final reviews.

*Day 33* Projects were moved from the shop and arranged on temporary sites across from Crown Hall. The final review on campus with faculty, client, structures professor and shop instructors provided specific feedback on consistency of detailing and construction in relation to initial concepts. Students were aware throughout the project that our client could refuse any or all of their projects. The client accepted all fourteen projects, a 100% success rate.

*Fig. 6 Pavilions on campus before final review*

The pavilions remained on campus for the end of year student show, then transported to the site 1.6 miles away. Schulze and Burch employees unloaded the projects by forklift and drove them to locations in the garden selected by the client. The client was able to rearrange the pavilions based on observations about sun, shade and use in the short term, and store them indoors during the winter months.


*Fig. 9 Delivery to the site*

*Fig. 7 Select projects in place on site*

## Conclusions

Students benefit from the experiential learning involved in a full-scale project in the first year; they develop their intuitive understanding of structure as well as apply learned knowledge. Through making, we reinforce the importance of craft, "the refinement which is made through physical and repetitive engagement with the specific material itself....true craft in construction can only be achieved through physical labour that leads to a deeper and more sophisticated understanding of what it means to build, as opposed to what it means to draw or to speculate."[4]

The challenges of a short-term project are logistical, but logistics can be solved with advance planning and tighter project constraints. Tighter constraints may be seen as a negative, in that they limit students' range of exploration, but in this project constraints contributed to a high success rate, and students were able to produce more varied and expressive solutions, within the constraints, than we had anticipated.

The short time frame does not allow as much room to learn from experimentation and failure, so instructors need to anticipate problems, tailor instruction specifically to the project, and help students work toward best solutions. Working with an outside client also leaves less room for exploration. The trade-off, however, is the sense of purpose that students gain knowing that their projects will last beyond the end of the semester.

## Notes

[1] Mies van der Rohe, *Inaugural Address* (1938), printed in Pao-Chi Chang and Alfred Swenson, *Architectural Education at IIT* (Chicago: Illinois Institute of Technology, 1980), p. 26-27

[2] Mies van der Rohe, *The Architecture Curriculum at IIT* (1941), printed in Pao-Chi Chang and Alfred Swenson, *Architectural Education at IIT* (Chicago: Illinois Institute of Technology, 1980), p. 29

[3] Martin Self and Charles Walker ed., *Making Pavilions: AA Agendas No. 9* (London: AA Publications, 2011), p. 24

[4] Martin Self and Charles Walker ed., *Making Pavilions: AA Agendas No. 9* (London: AA Publications, 2011), p. 26

# Makin' Puddin': Performance and Risk in Beginning Design

Peter Olshavsky | University of Nebraska-Lincoln

## Teaching Agenda

Architecture as a performing art was the focus of a second-year architecture studio project that enabled students to design, construct and test 1:1 prototypes, and fabricate working inflatable elements for a new play: Puddin' and the Grumble. The project was an interdisciplinary collaboration that situated beginning design students at the University of Nebraska-Lincoln in a creatively risky setting at the conjunction of introductory architectural knowledge, knowledge creation (research), and multiple communities outside the traditional beginning design studio environment.

Along with describing the delivery of a full-scale project, the following paper will discuss the background of the play, the structure of the interdisciplinary collaboration and articulate the roles performance and risk played in beginning design education. Not only did the students have to consider all of the structural, material and logistical issues of their work but also they had to responsibly engage with larger communities (audience, etc.). This demanded considerations that were enriched and validated through performance.

This interest began ten years ago at an East Coast university I began teaching second-year studio. After focusing on this level of education for a few years, it became clear that something was missing. This can be summed up by the term "risk." Beginning design students (including first and second year education) were not being put in situations that were creatively risky. I do not mean risk in the sense of physical danger. Rather students lacked exposure to settings that required them to deliver designs at a high-level under a deadline and face potentially unwelcome results or criticism beyond the usual project/critique model. In short, the stakes in the studio environment of the university were lowered; meaning the students typically strove to that level.

More recently at the University of Nebraska-Lincoln, I sought opportunities for projects that placed the architecture students in creatively risky settings. Risk, as the potential for unwelcome results, was cultivated through a focus on performance. By moving past the concern for the formal or technical manipulation of objects, more responsibility had to be accounted for within the students' designs. Setting up creatively risky settings was also developed through collaboration with other disciplines (specifically theater). Collaboration fostered self-identity (i.e., conventions, protocols, and practices) coupled with productive transactions at the edges of architecture's boarders (i.e., where is the line between architecture and theater designer?). Lastly, getting students involved in projects that interfaced with the public increased the project's stakes encouraging students to be more engaged.

## Background & Project Structure

Premiering locally before traveling to the Fringe Festival in Edinburgh, Scotland, Puddin' and the Grumble is a play that examines issues surrounding childhood hunger and food insecurity. The play tells the story of a 10-year-old girl, Puddin', whose mother is forced to take a second job at night to supplement their income. Needing to live with her grandma, Puddin' misses her mother, struggles with 5th grade, and feels as empty as her stomach. Added to this she's being followed by, the Grumble, an grotesque creature that stands-in for her hunger.

The issue of food insecurity initiated the development of the play, and ultimately shaped the architectural design response, is national in scope. "According to the United States Department of Agriculture, 15.8 million children under 18 in the United States live in the households where they are unable to consistently access enough nutritious food necessary for a healthy life." In the University's county (Lancaster), nearly 19% of children experience food insecurity. Measures have been taken to combat this issue. Programs such as the BackPack Program provide food to schoolchildren at times when other resources are not available. In Lincoln, Nebraska this program began at Clinton Elementary School in 2004. Over the last two years, playwright Becky Boesen and producer Petra Wahlquist began working with the Clinton Elementry's 5th graders (91% of whom are backpack recipients) in a weekly after-school club to explore story content and lyrics that would come to create the core of the new play. Commissioned and produced by the Lied Center for Performing Arts in Lincoln, Puddin' and the Grumble was created by Boesen and Wahlquist as part of the GROW A SHOW program in collaboration with members of ASCAP in Los Angeles who began to compose the music with this input. They also sought out the local Food Bank and received support from UNL's College of Fine and Performing Arts. Following the success of a previous performance project the year prior, my second-year architecture studio in the College of Architecture was invited to collaborate and see what the architecture students might offer.

At the start of the interdisciplinary project, there were a series of meetings with the producer and playwright regarding content, expectations, and schedule. These meetings set the overall agenda and collaborative protocols for the students. From the outset, it was clear that this project would need to be divided into two parts run during different academic terms. Meaning two different groups of students worked on the project. Though more common at the graduate level, this set-up intentionally went against the delivery of discrete studios in each term at this level. The break down the two parts was generally straightforward. Of course, the full nature of this project was too complex and at times too tacit to recount in full. However, unpacking the pedagogical orientation through performance and risk will be useful to show how it differed from a typical studio environment of this level. Of course, the descriptions and images can only partially express the value these experiences had for the students involved. Hopefully they are able to convey some of the ways the project achieved unique experiences, insights, and opened the students to questions early in their education.

*The project's first part took place during a six-weeks period in the spring semester of 2015 with twelve students. This part had three phases. The first two phases were short design exercises individually and in small groups in which the students researched, generated ideas, framed the project's parameters, and got a sense of the possibilities and limits of the architect's role on the stage. At this point, they were not fully concerned*

*Fig. 1 Inflatable 1:1 polyethylene prototype with stage lighting (photo by author). Students with 1:1 backpack prototype & 1:1 polyethylene prototype (photo by author). Playwright with inflatable stage element (photo by author). Critique with nylon inflatable stage element and process (photo by author)*

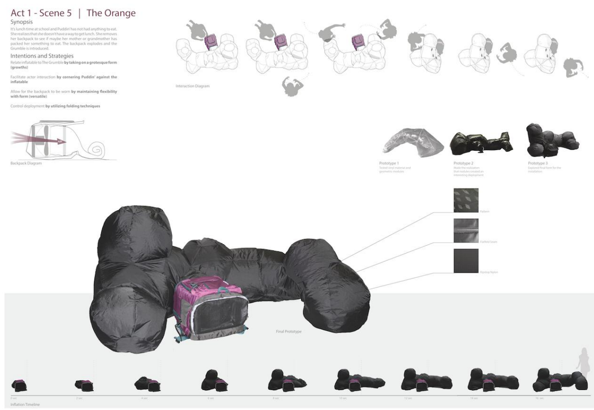



Fig. 2: Black Nylon Inflatable & Backpack #1


Fig. 3: Black Nylon Inflatable & Backpack #2

with the material outcomes of a typical beginning design studio. Rather the students were asked to interpret the fragments of the script as they were being written (i.e., spatial activities, intentions and materiality) and grasp the myriad of factors to making places and architectural possibilities within the limited frame of the stage (including thrust, in-the-round and proscenium). This ambiguity, of course, is not easy for this level of student. The last phase of part one was approached as a full studio. During this phase, the students prepared to hand off the project the next group. They generated clear design intentions, design strategies for inflatables, mechanics for the inflatables, material tests, and a research book that documented their knowledge (including logistics of travelling stages, types of theater configurations, material studies, mechanical studies, etc.). Finally, they fabricated working prototypes (Fig. 1). The first was a nylon inflatable that was fan powered and deployed from a backpack. The second was a large-scale (21'x9'x7') polyethylene inflatable that was blower powered. These offered the theater team "proof" of the student's ideas and strategies.

The project's second part was run as a single phase over seven weeks at the end of the fall semester with twenty-one students and supported by a teaching assistant. In the second part, the full studio was divided into three teams to design and test three architectural elements for specific scenes of the play. The script was basically finalized and after meeting with the playwright, it was decided that the inflatables would work best for three imaginary sequences within the play. The first two scenes are the only time two times the Grumble appears on stage and the thirds scene is when the Grandmother is looking for Puddin' who has run away after a confrontation with the Grumble.

As these three elements were developed, the students has various design reviews in consultation with the playwright, director and educational coordinator at the Lied Center for Performing Arts and received input from one of the primary actors. In this sense, the project was truly collaborative. The script, music, and actions informed the conception, development, and realization of the architectural elements and vice-versa. For instance, when the architecture students came to the notion of inflatables this logic began to inform the language and other non-designed elements in the play (e.g., swelling from an allergy, etc.).

For studio deliverables, the students produced a research pamphlet (summarizing their knowledge), drawings (including process to scalar documents), models, material tests, and 1:1 prototypes. The prototypes proved the designs would be durable for the various rehearsals and performances in which they would be used. To conclude the term, they fabricated three final architectural elements at 1:1 scale that will be used on stage in three separate scenes this coming spring and summer. The students generated two black nylon inflatables (Fig. 2 & 3), as suggestive manifestations of hunger, that were remote controlled powered by battery-powered fans and deployed from backpacks during the two Grumble scenes. The third inflatable, evoking the trope of the dark forest, was constructed of clear and black vinyl and would be inflated off-stage (Fig. 4). To be sure each of these elements were appropriate and performed as claimed, the students were required to act out the scenes as a means to validate their intentions and strategies.

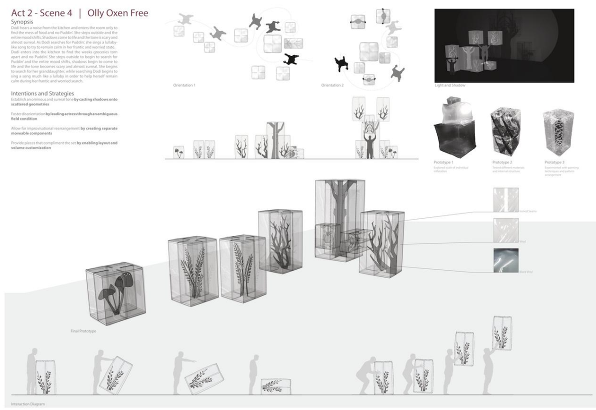



*Fig. 4: Clear & Black Vinyl Inflatable Field Condition #3*

## Performance & Risk

Part of the rationale for choosing to collaborate on a theater project is the belief that architecture students too frequently rely on formal or instrumental means to orient their work. These start in beginning design. To redress the limits of these approaches, this project focused on architecture as performance. Why performance? “To treat any object, work or product ‘as’ performance,” the scholar Richard Schechner explains, “means to investigate what the object does, how it interacts with other objects or beings, and how it relates to other objects or beings.” This offers a rich “tradition of thought,” Gray Read explains, “that casts architecture as both set and player in the ongoing theater of social life.” To say this differently, this promotes design that is critically considered in time and for people in a setting.

From an educational standpoint, “most learning,” Ivan Illich famously said in his classic text, Deschooling Society, “is not the result of instruction. It is rather the result of ... participation in a meaningful setting.” While this quote is somewhat overstated, it points to a core notion that placing students in meaningful social settings can be immensely rich. The richness stems from the fact that these settings, or what the philosopher Charles Taylor calls “reality,” are not value-free spaces. As he says, people experience the world in terms of values because we live in a “moral space” and not a Cartesian void. In these value-laden spaces, students arrive with a background, identity and ways of evaluating worth. To say this differently, they are not empty vessels ready to be filled with so-called design; rather they have “inescapable horizons” that can be expanded and reframed through education.

What Taylor means by “horizons” can be exposed by meta-questions like: What are my goals? What do I value or conceive as good? What is a higher or lower mode of life? In what ways ought my design work frame and shape those modes of life? These horizons, which people use to determine worth, are developed from their backgrounds (prior, during and beyond university), surroundings, other people, and a host of factors.

Horizons play a part in identity. “Discovering my own identity,” Taylor argues, “doesn’t mean that I work it out in isolation, but that I negotiate it through dialogue, partly overt, partly internal, with others.” This is one of Taylor's key points: identity is primarily dialogical. With “significant others” students further develop their identities and value sets. Taylor goes on clarify this when he says, “my identity is defined by the commitments and identification which provide the frame or horizon within which I can try to determine from case to case what is good, or valuable, or what ought to be done, or what I endorse or oppose. In other words, it is the horizon which I am capable of taking a stand.” The same, I argue, holds true of the identity of architecture for beginning design students. Taylor famously explains, “To know who I am is a species of knowing where I stand.”

Taking a stand brings up the issue of risk in education. A large part of risk, as I see it, is about promoting certain types of disciplinary “edges.” Richard Sennett observes: “Edges come in two sorts: boundaries and borders. A boundary is a relatively inert edge; population thins out at this sort of edge and there’s little exchange among creatures. A border is more of an active edge ... this is a zone of intense biological activity.... In human ecology, the eight-lane highway isolating part of the city from each other is a boundary, whereas a mixed-use street at the edge between two communities can be more of a border.” Extending Sennet’s metropolitan examples to the pedagogy of architecture, it was my belief, that edge-as-borders would problematize the student’s comfortable assumptions about architecture, what architects do, and enable the students to see beyond their often limited view. Creating disciplinary boarders, more than any other experience, opened the architecture students to unexpected observations, insightful questions and showed them a tangible example where their growing knowledge and skills can be put to good use.

## Appraisal & Moving Forward...

Precisely what mattered most in this two-term project was worked out as the students articulated their position within the collaborative space provided by framing architecture as a performing art. This promoted beginning design students to gain disciplinary knowledge (e.g., skills, conventions, etc), challenge their pre-conceptions (e.g., theater has no relation to architecture) and help them speculate about architectural possibilities while facing the real risk of failure.

Setting up a creatively risky setting no doubt had a significant impact on this group of students. There were three items that can easily be noted in this short paper. The risk clearly altered the students' commitment to their work because they saw value and impact the work might have beyond their own personal skills and knowledge. Risk also prompted a reconsideration of who the students saw as their "client." Having to act and face a large public made students cognizant of the fact that performances like architecture are for others. Thus, the role of the client became more complex for the architecture students' education because this was the first time any of them had experiences designing for someone else. Risk also encouraged the students to proactively ask questions because not asking the right question might mean failures or mistakes. These questions ranged from pragmatic concerns like safety in a dark scene to speculative ideas about the ways a narrative arc might be suggested by spatial, formal and material conditions in time.

The collaborative project with the Lied Center has fundamentally started to change second year education in the architecture program at UNL for the foreseeable future. And hopefully, the future success of Puddin' and the Grumble project will create new opportunities for collaboration outside of our College. When seen in this light, the nature of this collaboration was not an end, but a means to an end, which was actually a beginning.

# Building to Learn: Learning to Build

Peter Raab, Terah Maher | Texas Tech University

*“Pragmatism is the best teacher. Learning is accelerated by purpose. We learn best when we need to know: technology is best understood by making; sequence is best understood when there is little time; teamwork is learned quickly when there is too much to do; topography is most apparent when we set the height of the platform.”* [1]

Brian MacKay-Lyons, Ghost

*“The sensations of a specific density and presence, distance and intimacy, materiality and hapticity, echo and light, can be grasped only as full, bodily encounters. Besides, the experience of a building is always the sum and culmination of numerous other factors, such as the journey to the site, the wider cultural and environmental context, the weather, and the nature of the light of the region. Profound buildings are not merely visual compositions; they are epic and existential narratives of our encounters with them.“* [2]

Juhani Pallasmaa

## Abstract

We believe that the lessons of architectural education are most memorable when tied to physical experience. For the last several years at Texas Tech College of Architecture we have consciously incorporated into our coursework prompts that instigate active participation through the design and construction of 1:1 projects. The assignments engage the students' haptic senses through an active building process requiring their hands, eyes, and bodies. These projects are linked by a brief and intense design phase and subsequent quick-build, which emphasizes cooperation, intuitive response, and situational feedback over ponderous and often isolated design deliberations. All the projects are collaborative, which require the students to participate in the most fundamental level of public engagement - one another. Students experience personal and collective agency as they rapidly test ideas at full-scale in a public setting. The social responsibility incurred with working in shared public spaces, coupled with the experienced know-how of physically executing small-scale structures, is a two-pronged tool for teaching students how their efforts can affect change on their world.

This paper will describe four different projects asked of students ranging from freshman to graduates. *Tape Drawing* and *Tectonic Quilt* bookend the coursework in Design Studio I. *Nest* occurs within a mandatory construction course for third-year designers. *Reception* is a design-build competition open to all student levels. While the products of the assignments are short-lived and embedded internally within the school's community, the parameters of all the exercises touch upon professional concerns such as economies of budget, scale, build-ability, material, siting, structural integrity, safety considerations, and public occupancy, gesture, and presence.

## Occupiable Installations

Utilizing the temporary 1:1 installation as an assignment format achieves multiple pedagogical benefits. When allotted production time is limited, swift action must override hesitation. When the life of the installation is pre-known to be short-lived, the psychological seriousness of permanence is removed, opening up avenues of intuition and creativity. Students with little experience in building materialize physical constructs with greater ease than they believe possible. This rapid materialization of student production also quickly provides large quantities of work to test, critique, and discuss. As Sarah Bonnemaison and Ronit Eisenbach, in *Installations by Architects,* state, describing the relative difference between Installation and Architecture: “an installation...is temporary, that is, its demise is planned from the outset; its function turns away from utility in favor of criticism and reflection; and foregrounds the content. [Installations] also offer precious freedom to experiment."[3]

*Beginning Exercises: Tape Drawing and the Tectonic Quilt*

The charette *Tape Drawing* is introduced on the very first day of Design Studio I. It serves as an energetic and collaborative ice-breaker for students new to one another. Students are asked to reconsider the perspective projection they studied in their previous semester's drawing class. This time, instead of working at a constructed scale on a flat projection plane (the paper), they are asked to draw 1:1 on the 3-dimensional surfaces and volumes in the architecture building stairwells and hallways. Pencil is substituted with colorful painters' tape.

Students start with a simple drawing of a rectangle. They work in small teams, and one person is designated the spotter, whose eye serves as the center of projection. The teammates apply the tape to the walls, as directed by the spotter. Very quickly, the team must develop a specific communicative vocabulary to translate nuanced spatial directions in order to build the spotter's vision. As the drawing stretches across multiple surfaces, the spotter must maintain a singular point of view to build a shape that reads as a flat graphic rather than a series of kinked or fractured lines. Students then switch roles and draw as many figures as they can within the allotted time.

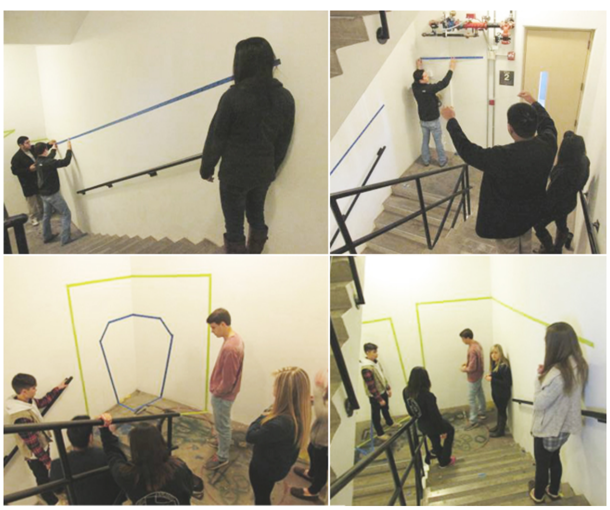


*Fig. 1 Example of tape drawing exercise affecting shared, public spaces throughout the Architecture building*

Tape Drawing is a lesson in communication, teamwork, and self-reliance. Students are given little direction in how to complete the task, and must figure out the best methods of construction through trial and error. It is also an important training in seeing: developing the visual flexibility to oscillate one's gaze between a flat projection plane and the 3-dimensional space that contains it. This simultaneity of the 2D image and 3D space is further investigated by a subsequent assignment where the students must create a playful sequence of photos of their bodies interacting with the drawings, which activates the space of the drawing in an unforeseen way.

Finally, the tape drawings serve as an announcement of the presence of the new design class; the drawings remain on the walls for the next several weeks for the rest of the school to enjoy. To aid wanderers in finding the correct center of projection, the station point and point of view are marked by an X and a designated viewing height on the floor, in front of each perspective.

*Tape Drawing* begins Design Studio I, while *Tectonic Quilt* completes it. Students have executed a series of individual assignments throughout the semester and are now brought back together for a final collective assignment: a giant canopy over the entire school's courtyard. In teams of two, they are assigned a 10'x10' square of the sunken courtyard, and a simple material combination, from an list of visqueen, duct tape, twine, zipties, polyester string, elastic string, fabric strips, fabric sheet, bubble wrap, duct tape, and cardboard. Each team conceives a woven patch of the two materials, which can then be knitted to neighboring patches. They are given three days to build the patch and connect it to neighbors, and on the third day a public lifting party occurs during which the entire tensile weave is raised into the air. Each square is individually conceived yet collectively assembled, requiring a great deal of negotiation across not only immediate neighbors but the entire canopy as tension lines must connect from far edge to far edge. The canopy covers the school's blustery courtyard for a week, after which it is removed collectively.

*Fig. 2 Tectonic quilt installation during the final stages.*

*Occupiable Installation: Nest*

During *Nest,* teams of four are each asked to create an occupiable intervention within the multi-level Art and

Architecture courtyard that invites the interaction of the human body with an architectural construct. This assignment is given during the third-year, within a required foundation construction course offered to both interior and architectural design students. This construction course builds on previous knowledge of materials and methods of assembly while introducing students to the design and interaction of structural systems through forces, loads, joinery, and statics to create site-specific, full-scale installations. These third-year design students are well versed in building both scale and full scale models, having previously been introduced to a variety of materials - wood, masonry, concrete, steel, glass, metals, plastics, etc. - during Construction I, and within the design curriculum. (A longer description of the entire construction sequence at Texas Tech, minus *Nest*, was described thoroughly in NCBDS30:IIT. [4])

During the early design process, rudimentary calculations, conceptual models, full-scale mock-ups, diagrams, and shop drawings are used to test design ideas and assess material costs prior to constructing the final project. This process mimics the iterative process used within design studios, and in architectural practice. Students are prompted to consider the given and permanent conditions of the nests' final locations. This relationship is explained as a tectonic installation that relies on the inherent structural qualities of existing confines of the courtyard.

With 100 students, or 25 teams, it is important to ensure that every team has a designated site. Teams determine where they will place their installations, followed by an in-depth analysis of existing site conditions as students measure columns, walls, corners, parapets, railings, and stairs to determine how to best integrate their ideations. This site analysis coincides with quick design decisions, emphasizing both the team's notion of occupation and how the newly designed structures will augment and incorporate the existing structure in situ. With such a large class, the oversight of instructors, student assistants, and shop personnel is essential for safety and success.

*Constructing Identity*

The *Nest* project, first issued in the fall of 2013, became the precursor to executing future full scale, 1:1 installations within the Art and Architecture courtyard. The presence of these constructions has been unmistakable, even as temporary installations. Students and several of the faculty have embraced these physical constructs as an identifier of the college of architecture. This transformation, only in its fourth-year, is already helping to create an identity for the college at the university and beyond. Since beginning this transformation, other temporary, parasitic, and occupiable constructs that have been issued at other institutions have been brought to our attention. The use of term parasite here is intentional, as the "paraSITE" project has been utilized as a first-year design/build exercise for several years at Cal Poly, San Luis Obispo, and is an excellent example of how to instigate material and construction knowledge as early as first-year studios.[5]

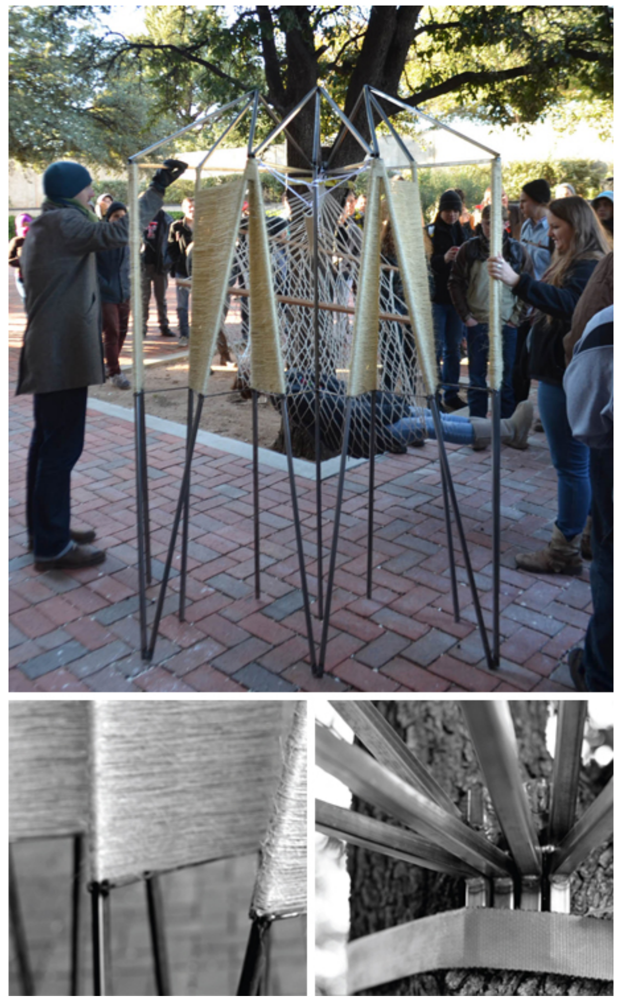


*Fig 3: Full-scale materiality / connection joints and final Nest installation during our 'show-and-tell' outdoor classroom event.*

Our impetus for fabrication originates in the student's first semester studios, and can be seen rippling throughout their architectural education – from construction lecture courses, design and digital fabrication courses, furniture studios, land arts and other 3D studio art classes – as the connective sinew binding our curriculum and unifying our identity.

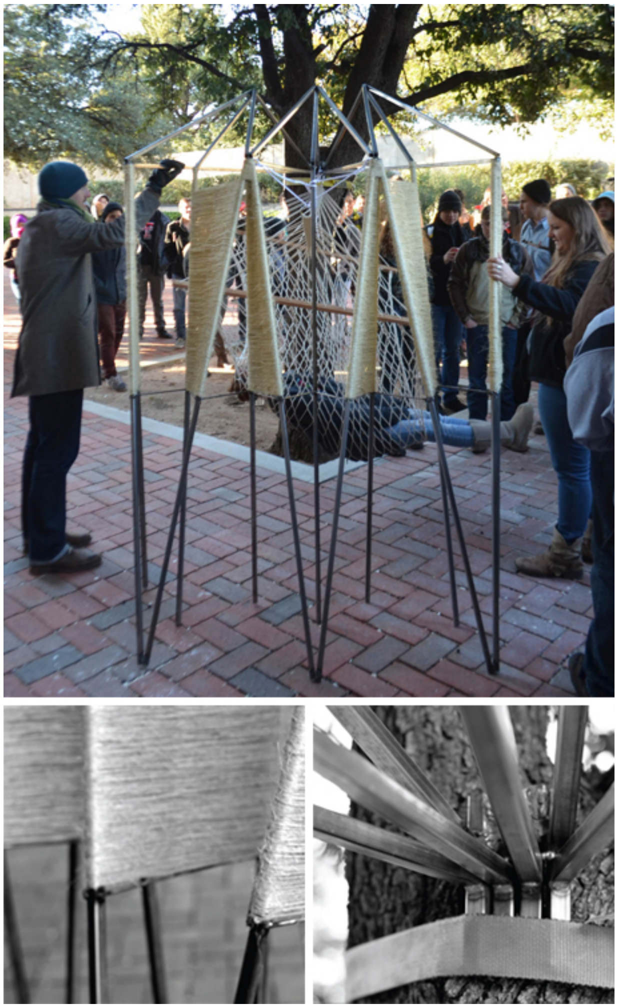


Fig 4: Full-scale materiality / connection mock-ups and final Nest installation.

*Design-Build Competition: Reception*

Building on this desire to convey this newfound methodology, we initiated an internal design-build competition to re-design the ground level entry desk. Literally the first thing that is seen when visiting the school, the 1980's beige cubical has been an eye-sore that neither conveys the extremely industrious nature of the students within the building or the rich culture that we are trying to foster.

The logistics of the competition, which was advertised within the college, and encouraged multi-disciplinarity and collaboration by being open to every field and level at the greater university. The design prompt gave specific site constraints and programmatic requirements, but allowed teams to design the future reception desk of the architecture building as long as they stayed within the assigned budget of $1200. Each proposal provided measured drawings, assembly diagrams, and material budget in addition to the typical rendered visualizations. Six of the thirty-two entries were short-listed and given the opportunity to present their concept to a four-person jury. The winning team, consisting of two third-year design students, succeeded by presenting an elegant design concept, revealing an industriousness by sourcing local materials and suppliers, and confirming an understanding of how to employ the extensive metal shop, wood shop, and school's CNC tools to complete the project. The following semester, these students worked closely with a faculty member to refine and finalize their designs. This process included several iterations of connection details, troublesome joints, and material finishes that were mocked-up at full-scale.

While both students and faculty were excited about the advent of this school-wide design/build competition, there were some criticisms levied. Firstly, although the initial design process was relatively quick, the intermediate steps of jurying and the creation of an independent study to facilitate the fabrication of a quality piece of permanent structure was lengthy, muting some of the initial energy. Secondly, the competition prompt asked for digital [and printed] 24" x 36" boards only, and did not require a 3D physical model component, allowing the design ideas to remain overly conceptual. This was seen as a flaw, especially since the winner would eventually be required to physically construct their final project. Thirdly, the relative permanence of the entry desk installation required a greater deal of oversight, precision and long-term safety assurances.

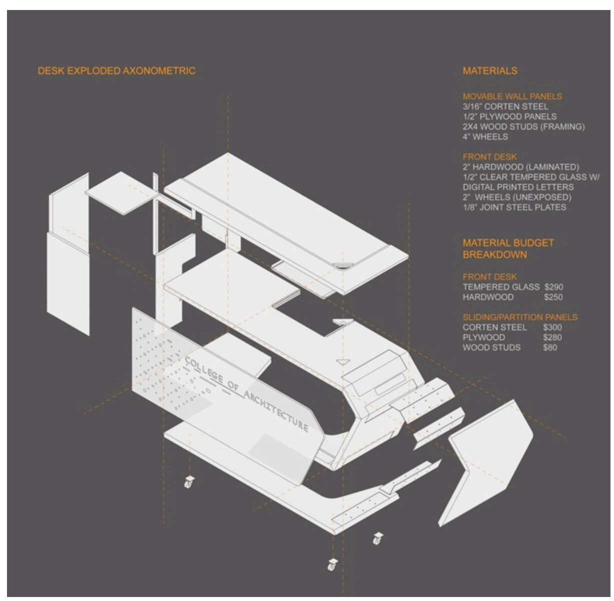



Fig. 5 Exploded axon, material list, and budget to demonstrate an understanding of the fabrication process and general build-ability.

But overall, the project has been a success, garnering publicity and attention from across the college and university, while offering the students the ability to impact their environment through their design skills and construction chops. This incredibly visible and long-term addition capitalizes on our extensive shop facilities through the hard work of talented and energetic beginning design students. Publicly placed and a constant statement of the college's identity within the larger university context. We are designers, and we should not shy away from our role in society.

*Fig. 6 Rendering of winning entry for 'Reception'.*

## Failures + Other Outcomes

While these small, but impactful projects are not representative of the entire beginning design curriculum for the architectural design student at Texas Tech University, they demonstrate an attempt to introduce ALL students to the physical and material aspects of design through full-scale intervention. Importance is placed on the iterative process as a learning tool to better understand both established practices of material fabrication as well as innovative methods to manipulate and design alternative spatial realities. Successes occur when designs adapt to accommodate budget, material, or technological limitations. This is evidenced in examples such as iterative joint detailing studies, during which students learn first-hand the unacceptable flexure, tolerances, or how to weld materials for the first time. More generalized successes include spontaneously alteration of a design to fit within given constraints [site, time, adjacent design], which occurred frequently during the jointing of the individual squares into the final aggregated canopy. In each of these cases, failures, often repeated, prompted the students to find alternative solutions quickly without sacrificing content.

*Learning to Build*

The design projects presented in this paper act as tests – they require high-energy, have high visibility, and yet are ultimately of low consequence due to their relatively temporary nature. This combination emphasizes personal agency for the student, and a public celebration of design product. Students, working together, must not only consider the essence of the object, but as importantly the practical implementation of the object, and its physical and visible reality.

To physically affect their environment through their own designs is an exciting opportunity for most of the students, as it fully engages the senses and tests their ideations through 1:1 constructs. This immediacy is echoed within Erdman and Leslie's *Introduction*, in volume 60 of the JAE, which describes positive interactions with the surrounding world as some of the deepest and most intimate "both as an act, and, once built, as a set of spatial and sensible experiences."[6]

Once built, the student work is confronted with the temporal realities of atmospheric conditions, the practicalities of responding to human weight and use, and the eye-opening revelations of natural light and real-world tolerances transforming pristine digital ideations into physical reality. While the authors realize that the presence and the public impact of the projects located on campus - the excitement (or ambivalence) of the community's reception is limited - we believe that these small, haptic experiences give all participants a nascent understanding of public critique and consequence. Learning through building, and building in order to learn.

## Notes

[1] Brian MacKay-Lyons, *Ghost, Building and Architectural Vision*, Princeton Architectural Press, New York, 2008, p 138.

[2] Juhani Pallasmaa, "Geometry of Feeling: The Phenomenology of Architecture" Encounters, Architectural Essays, ed. Peter MacKeith, [Helsinki: Rakennustieto Oy, 2005]. Originally published in Arkkitehti, The Finnish Review 3 [March 1985]. p 88.

[3] Sarah Bonnemaison and Ronit Eisenbach, Installations by Architects: Experiments in Building and Design [New York: Princeton Architectural Press, 2009], p 14.

[4] Mari Michael Glassell and Peter Raab, Materiality, Essence + Substance: 2014 National Conference of Building Design Student Conference [NCBDS30:IIT] Proceedings, IIT, Chicago, IL. April, 2014, p 237-243.

[4] Brian Kelly, Brent Freeby and Michael Lucas, "Power[tools]: paraSITE's Progress" Beginning of, In the End: 2011 National Conference of Building Design Student Conference [NCBDS 27] Proceedings, University of Nebraska, Lincoln. April, 2011, p 40 – 45.

[5] Jori Erdman and Thomas Leslie, "Introduction," Journal of Architectural Education 60:2 [2006]: p 3.

# Working Together: Refocusing a 1:1 community building partnership

Peter L. Russell | State University of New York, University of Buffalo

## 1.1 Educational Context

In 2005 Lee Schulman has described professional education in the context of signature pedagogies. In his description, he highlights studio teaching as the signature pedagogy of design education. A pedagogical approach that is so ubiquitous to a discipline, Schulman describes, becomes a signature pedagogy when, it "demonstrates the types of teaching that organize the fundamental ways in which future practitioners are educated for their new professions" (Shulman 52).

This context is important to understanding and evolution of professional architecture education as it embraces a "big re-think": for a number of years. (The RIBA and The Ferrell Review in London, the effort of the NAAB and AIA to clarify paths to licensure in the USA). While the "studio" is and should remain the signature pedagogy of architecture education, the characteristics of this signature have shifted rather dramatically in the face of these efforts. Further pressures from a more technologically and socially minded faculty and student population, have pushed new approaches into the mainstream of design education, among them Design/build and 1:1 work are very prevalent, but are often complemented with Virtual Learning environments, rapid prototyping, an other emerging teaching methods and pedagogical tools.

In particular the influx of design/build, and 1:1 projects into design studio, has become so prolific that it is beginning to define a new or significantly altered signature pedagogy, or at the very least a pedagogical tool that has some characteristics of the signature pedagogy. This is having an influence on certain paths through professional design education; student experience, and the relationship between university and community has shifted as design build projects become more commonplace in the design curriculum offerings of community based design education.

Many of the widely publicized and aspirational projects

*Fig. 1 project based partnerships, often yield impressive built objects, but can be quite repetitive for students.*

have another layer of service learning built into the curricular delivery. Design/build projects of this nature rely on a partnership with an organization acting as a pseudo client. Commonly these projects are being termed (specifically in the UK architecture literature) "live projects."

*"A live project comprises the negotiation of a brief, timescale, budget and product between an educational organization and an external collaborator for their mutual benefit. The project must be structured to ensure that students gain learning that is relevant to their educational development."* (LPN 2015).

The very nature of a live project is project based, growing out of the transactional nature of the architectural object, and while Live Projects are very good at simulating architectural practice, they can potentially compound the issues of project management and project delivery, potentially prioritizing delivery of service over academic learning outcomes or student experience.

Live Projects with a 1:1 component have an incredible potential to produce very interesting built work, much of which can be of great benefit to partners working with the design studio. Brown details in an *Output of Value* the precarious nature of the relationship between the "client" and the studio in these situations. (Brown 2013) The Rural studio has been criticized for operating at the opposite end of the spectrum, whereas much of the work of the Rural Studio becomes an architectural gift, which creates a different set of critiques and power relationships (Del Real 2009).

*1.2 Habitat for Humanity*

In the United States, several architecture programs have worked with Habitat for Humanity or other low-income housing suppliers as a way to develop and deliver design build programs. These can be ideal starting places for design build programs, as the Housing provider more often than not is a more agreeable as a "client" than any traditional architect client relationship. Further to this, the structure of the organization streamlines the process of design and construction at the potential expense of the end users. Slightly contrary to this point, a study of projects done with Habitat for Humanity and schools of architecture in partnership; projects that involved the homeowner, in the process (rather than a two way dialogue between Habitat for Humanity and the architecture school) were regarded to be noticeably more successful process (Hinson & Miller 2013). It is important to note that very often the partnership with Habitat for Humanity and other housing providers continues to develop the 1:1 model of design education as a series project based learning opportunities. That is, the project is designed and built, and then another project is designed and built, and so on.

*1.3 Habitat for Humanity Buffalo*

The City of Buffalo, though enjoying a renaissance of late, has been through major economic stress, as well as demographic shifts in the last 30 plus years. In the face of this the local chapter of Habitat for Humanity has year on year been the largest single private-builder of new construction homes in the city for several years. The model of Habitat Buffalo, in the spirit of Habitat international's mission for "*simple decent affordable housing for all*" has been to build new houses of a singular type in the city, as well as developing a specialization in renovating old homes in Buffalo.

For the last twenty years the University at Buffalo School of Architecture and Planning has worked in partnership with Habitat for Humanity Buffalo in the delivery of new build homes. This has been managed through the delivery of a construction understanding and service-learning seminar. This class is an elective, tutorial module targeted at third and fourth year students, with an emphasis on the substantial completion of a new build ranch house. (Design is not part of this process). From the perspective of Habitat for Humanity, the class is a reliable source of well-trained volunteers; from the students' perspective the class is a welcome break from the corridors of the architecture department.

## 2.1 Shifting the Partnership

The evolving nature of design education, as outlined earlier, coupled with the resurgence of Buffalo and the resulting alterations in the approach of Habitat Buffalo has necessitated a restructuring of this long standing partnership. The goal has been to move away from the project based, or even service based partnership that has existed for years in this case, and is normative in university / community design build pairings. Understanding exactly what this was to be required the development of new working relationships, as well as new curriculum at the School of Architecture.

Fig. 2 UB Students and Instructor during a structures lesson

The resulting partnership is a potential model for working with design build partners within the framework of a professional architecture curriculum, and an academic calendar. Rather than a project based partnership, the engrained partnership model allows students from the School of Architecture to work on Habitat for Humanity projects without the heavy burden of project completion within the academic calendar (or even removed from completion entirely). Students may be exposed to, and work on, the portions of a project that are the most relevant to their design education. This approach while still new has the potential to be a much more impactful as a method for educating young designers, through removing several tedious and remedial tasks, while retaining the value of working at 1:1 and service learning.

## 3.1 Results

The model of *working together* to mutual benefit, beyond the scope of project based partnership, has allowed us to better focus curricular goals on learning activities. The goal becomes, to integrate learning architecture through making at 1:1 scale, rather than learning architecture through the process of project completion. This has implications throughout the curricular matrix.

There remains an opportunity for project-based partnerships, even ones that fit nicely into the academic calendar. *(Habitat Buffalo ensures that every home it delivers includes a "shed." Postgraduate students have the opportunity to undertake this scale as a design-build research project in their final thesis work.)* Students are invited to undertake research into construction materials and methods in the exploration of a manageable and affordable scale. Habitat Buffalo benefits from this as a boost to capacity (one less project they undertake).

In addition to this, studio curriculums have been developed upon the Habitat for Humanity Buffalo, base house manual, in which students not only gain experience working within very real design parameters, they begin to push the boundaries of the base house, and become a platform to explore new conceptual ways of approaching the construction of a *habitat house.* This has obvious benefits for both the pedagogy of the design studio, but for the development of ideas and best practices at Habitat for Humanity Buffalo as well.

Additional opportunities are beginning to emerge in the paring of short building or design projects that allow our students to work with Habitat on specific short-term design problems, as part of a lager seminar or studio work (that is not the entire semester project). This area of the curricular development of the partnership has some of the most potential. As it develops, it begins to harness the power of 1:1 service-learning projects, without the length of commitment required or mundane details of a start to finish building project.

Further to this there is potential for a developing research base, which can benefit from this partnership. Beyond the obvious and previously mentioned work into construction materials and methods, there is research potential for the university in the application of low-income housing. As the partnership continues to mature, opportunities for existing areas of university excellence to impact Habitat Buffalo emerge; the Inclusive Design Research Center (IDEA center) has become involved in working to design a re-built turn of the century property to a universal design standard with Habitat for Humanity. As the partnership continues to develop there is an incredible potential for post-occupancy evaluation, and continual performance evaluations as the School of Architecture begins to influence performance standards of the homes.

*3.2 Beginning Design Students*

Specifically as it pertains to beginning design students this partnership has opened an opportunity for our first year students (and incoming international students) to work at 1:1 on a construction project. The benefits of this work are magnified throughout their educational journey as they have the potential to design the next project that a new set of beginning design students work to construct. Tangible experience with the 1:1 scale project is, in this case, primarily a skill building exercise. As the demographics of the program (and higher education in general) change and the curtailing of technical education in secondary education becomes commonplace, beginning design students often have little to no experience with building technology. This partnership provides a teaching tool to bring every student to a basic level of understanding. Coupled with safe working habits, and knowledge of fabrication, the students are then prepared to progress in design education with a focus on making and experimentation that is rooted in basic skills.

The partnership that we refer to as the *working together* model, has tangible benefits for both Habitat for Humanity Buffalo, and the University at Buffalo School of Architecture and Planning. Though both are clearly capable of delivering on their missions in isolation from the other, the partnerships enriches the outputs of both, while simultaneously offering educational opportunity to students from beginning design student to post graduate researcher.

## Notes

[1] Brown, J. (2013). “An output of value” - exploring the role of the live project as a pedagogical, social and cultural bureau de change. Association of Architecture Educators Conference Proceedings 2013.

[2] Hinson, D., & Miller, J. (2013). Designed for Habitat: Collaborations with Habitat for Humanity. New York: Routledge

[3] Live Projects Network. (n.d.). Retrieved January 18, 2016, from http://liveprojectsnetwork.org/about/

[4]Shulman, L. (n.d.). Signature pedagogies in the professions. Daedalus, 52-59.

[5]Real, P. (n.d.). “Ye Shall Receive”. Journal of Architectural Education, 122-126.

# Creative Dependence and Perpetual Performance: Lived Practice as Design Pedagogy

Andrew Santa Lucia | School of the Art Institute of Chicago

*"As with labor, generally in our on-demand, just-in-time world, post-studio practices are much better at applying skills to tasks that are myriad and changing from moment to moment, context to context. In other words, painters will still exist, but more and more they'll produce not just paintings but parties, magazines, clothing, dinners, performances, graphic design, apartment galleries, blogs, music, etc..."*[1]

Theorist Lane Reylea suggests that American art practice post-Reagan has been dominated by person-to-person networks that have profoundly changed the way art professionals interact, how the 'art object' is produced and even what constitutes art's objecthood anymore. The GFRY design-build studio at SAIC has always been situated within these networks of change, outside design, architecture and art practice in a hope to interject disciplinary thinking into outer realms. In 2014-2015, SAIC partnered with Chicago based artist/developer Theaster Gates to partake in a design-build remediation of a derelict building, as well as create a breeding ground for non-conventional approaches to being and making in South Side communities. The question of planning a studio that inhabits all the essential components of a contemporary developer-artist's 'lived' practice, as well as his position within the Grand Crossing community, becomes the most difficult to answer because pedagogy must reflect these things whilst imposing its own methods. This retroactive account of the GFRY studio is meant to think through the two most important traits of Gates's Lived Practice: *Creative Dependence and Perpetual Performance.*

*Creative Dependence* is the transparent acceptance of different producers necessary to complete complex city work that is at once relevant, crafted and beautiful. *Perpetual Performance* is the acknowledgement of life's stage always being a place for potential expression, such as parties, live events, meetings, walkthroughs and public presentations. These two traits fit into notions of *Lived* Practice or the very act of living a certain way as an example of one's design and art. These terms will act as a framework to define a pedagogy of empathy and action in this essay.

By focusing on these traits, this essay will create an argument about how designers might interface through community based design and development projects in three ways: (1) present a language and attitude towards community projects that challenges neo-liberal approaches to social engagement; (2) define the theoretical and practical implications of creative dependence and perpetual performance; and (3) look at the architectural simulation *Back of House* as a possibly critical moment in the direction of community based academic design-build projects in Chicago

### *"Social Practice" is a Neo-Liberal Brand*

One of the most substantial obstacles in the way of a *Scholarship of Engagement* is the prevalence of the brand name *Social Practice Art*. That is to say, engagement begins with language and ends with action. "Social Practice Art" foci at universities in the United States have grown exponentially in the last ten years. The central issues behind this language and subsequent implementation is that it attempts to quantify something fundamentally qualitative.[2] That being said, it is also a relevant opening into the realm of art and design practice that is full of a myriad of ways to engage communities. Conversely, philosopher Slavoj Zizek states that, "Today's left effectively offers global (neo-liberal) capitalism with a human face, more tolerance, more rights and so on. So the question is, is this enough or not."[3] Ultimately, there is no argument as to whether design as a discipline should engage communities through the academy, but the way in which they choose to could mean the difference between an patronizing or opportunistic project and a truly horizontal and productive one.

The GFRY studio started with identifying the audiences and languages they might employ whilst engaging new communities. This linguistic model challenges the general teaching of esoteric trope heavy disciplinary jargon that is happenstance in design education. Secondly, this model helps students and teachers alike to develop an outward and inward attitude towards our partners and the community. Media theorist Paul Duncum illustrates the importance of language in the visual arts by stating that, "to be relevant to contemporary social practice, art education must embrace interaction between communicative modes."[4] Following that logic, the GFRY studio spent a great deal of time during its infancy establishing language guidelines that Gates was already using in his predominantly black, low-income and underserved neighborhood of Grand Crossing on the South Side of Chicago. Another important language for the GFRY studio was the terminology Gates used with his personal design practice. Students of the GFRY studio learned languages of practice and local communities by listening and engaging, not attempting to envelope said engagements by any particular social, disciplinary or philosophical theory. This was referred to as a *language of empathy.*

The remediation called for a very particular program: a monastery. However, this was not an ecclesiastical building and instead was a performance space for non-amplified music; a tea house in the Japanese tradition; an interior courtyard for outdoor intimate events; situated within a larger 10,000 sq.ft. garden. The GFRY studio began with a language exercise that used words to sketch out rituals that might create movements - programmatically and corporeally - through the monastery. (fig. 1) These words would be incorporated throughout the class and into the final public presentation, creating a continuity of language for our patrons and the community who would use the space.

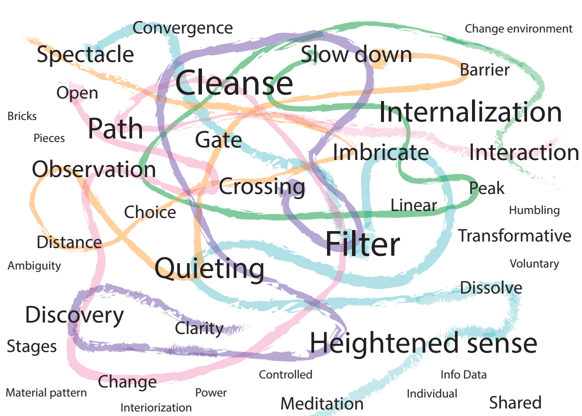



*fig. 1. Word and Ritual Programming Map*

*fig. 2. Theaster using hearth to explain tea ceremony*

Another example of the *language of empathy* was in the way students presented their projects throughout the semester. A popular format of presentation was the performance, or the intuitive acting by presenters to simulate different parts of the project. Using full scale models and performances, students were able to convince community members of the different uses within the space, instead of simply pointing to a representation of the project. Although representation as a tool was a central aspect of development, the ultimate goal was to find a new way to engage the community. Performance was used to augment the community's senses so as to facilitate the image of themselves within the space. That is perhaps the most central tenet of community work in urban settings. One example of this was when students and Gates lit the hearth/fireplace and discussed the process of drinking tea in more eastern traditions. Instead of simply explaining customs, the visual language action of pouring tea around a fire enhanced the empathetic ability of the community to engage with the idea at the same time they were able to critique it. Eventually, the performances acted as new format for architectural simulation that challenged the ubiquity of social practice curriculums, through non-linear action and ad-hoc advocacy.

### *Practice Living, Create Dependently & Perform Perpetually*

The disciplines of architecture and design do a fantastic job at learning techniques, tools and strategies from outside influence. There are disciplined ways to learn and immersion is one of them. "I actually no longer use 'art' as the framing device. I think I'm just kind of practicing things, practicing life, practicing creation," states Gates.[5] This sentiment defines the focus of our critical engagement with Gates's practice. Uncovering that he gives up an incredible amount of creative space to his design and construction team, helped the GFRY studio quantify the aspects of projects that were open for change. This was our entrance into lived practice.

Conditions for creative dependence established a bedrock of intellectual exchange and material production for the GFRY studio. These exchanged productions were populated by momentary lapses of judgement, failed experiments, negativity veiled optimism and spurts of development. They became the registers of a complicated process of production that championed two or more people working on tasks related to the same thing; osmosis induced learning via proximity to others producing in the same spaces; as well as ridiculous and/or logical suggestions. Essentially, creative dependence is a landscape of uncertainty precisely because of the many players involved in its scenario of design development. Ultimately, the moment when the hands of one listens to fleeting comments of the other, an almost bluesy soloing begins.

Creative dependence is feedback, not only in its back-and-forth, but in its sustained resonance within the moment of design. The result of creative dependence is not certain, but certainly different than singular notions of the genius designer. In this way, a lived practice for design students calls to not only have creative dependence, but to depend creatively on the other, to wholeheartedly want the jarring suggestions of some other body to profoundly complete the ideation or and direction of your own.

*fig. 3. Gates's spontaneous concert to discuss acoustics and atmosphere*

Perpetual performance is a condition of art practice that accepts the stage of life as one where an act is necessary to exfoliate interaction with others. Artist Daniel Tucker states that, *"artists occupy an exceptional space where their livelihood permeates all aspects of life, eroding boundaries between the personal, the professional, and the political. This raises a little-analyzed question: Beyond making a living, how are artists making life?"*[6] It is certain that Gates's practice depends on perpetual performance as another layer of his objects, spaces and/or an extension of his work. One without the other works, but not nearly as well. Perpetual performance is the evidence of creative practice's pervasiveness. Ultimately, the moment when others experience the performance of a living act *vis-a-vis* banal, normative and/or exceptional situations, practice ceases to be divided by where and when 'art' or 'architecture' happen.

Perpetual Performance is also part of a feedback loop in which the content, style and format fundamentally affect the reception of the product of creative dependence. In this way, the call to perform perpetually is exhaustive, yet supercharges ones work to move past the boundaries that professions and disciplines have set as standard. Instead, by performing perpetually the artist or designer automatically ensures their work to be understood through the producers own physical, emotional and social state, as well as space. It is the insurance that ones' work will not be devoid from themselves. (fig. 3)

The GFRY studio learned constantly and was reminded of its own shortcomings, but that was humbling. Hardwiring a space for being humbled, designing for an uncertain future and empathizing with the community audience were the three guiding factors in creating an approach for the class. Observing, mimicking and ultimately simulating Gates's aesthetic and productive tendencies became a central exercise in the context of the class. Through the investigation of nuance and idiosyncrasy, the GFRY studio was able to produce its own work *through* the practice of Gates, without ultimately copying.

*Simulating Design as Community Buy-In*

The final built work was presented as *Back of House* and attempted both a representation of architectural design endeavors in the form of an exhibition, as well as a simulation of their real effects in the shape of a full-scale fabricated installation, to bring audiences into Gates's Monastery where they could empathize with the student's design. The resultant project was a simulacra and pushed against/with the practice the students were learning from. The objects, canopies, walkways, walls, seats, lights and sounds constituted an architecture, however minute, that expressed a year of learning to creatively depend on one another and to perform a perpetual ritual of self-expression meant to illuminate their work together.

*fig. 4. Full scale fabric tensioned architecture walls*

The crux of the built work dealt with making the space accessible – physically and intellectually - to the public community. Students spent roughly two months finalizing their design and fabricating the installation. The different elements came together in a series of territories divided by simulated full scale components and representative visual media. (fig. 4 + 5) Connecting the the early moments in the studio, such as simulated tea ceremonies, improvised musical performances, ad-hoc built models, spontaneous material exploration, with *Back of* House created a continuous atmosphere that had nothing to do with 'process' and everything to do with practice, albeit lived.

*fig. 5. Entrance to representation territory*

In conclusion, it is difficult to design a pedagogy through a philosophy of complex art practice such as Gates's whose work exists in communities that face systemic racism, poverty, violence and lack of access to social services. Pedagogy is not philosophy. If at all else, it is philosophy put to practice *via* academic and social exchange. Learning from Gates's creatively dependent perpetually performing machine meant embracing the complexity of the audiences for ones' work without being patronizing. The GFRY studio achieved a practice that called for producing design and architecture that included the community in the image and process of the work. Without this, the machine ceases to productively produce. In general, that is a warning sign while creating a pedagogy of action that engages difficult contexts through the academy for the production of design and architecture. Perhaps more importantly, trying to granulize and package such a practice for consumption of pedagogy might not only be impossible, but also irresponsible. A S*cholarship of Engagement* begins and ends with empathy, a lesson that is such a transgressive part of maturing as a designer and should be taught early on.

## Notes

[1] Reylea, Lane. *Your Everyday Art World.* MIT PRESS: Cambridge, MA. 2011.

[2] Journalist Carolina Miranda states in her ARTNEWS article that, "It is in academia, perhaps, that the art of social practice has gained the most traction. In 2005, the California College of the Arts (CCA) began offering social practice as a concentration within its M.F.A. program and soon put it in the curriculum. Since then, similar programs have launched at Queens College in New York, Portland State University in Oregon, the Maryland Institute College of Art in Baltimore, and Otis College of Art and Design in Los Angeles. Ted Purves, who founded the program at CCA, explains that these courses emerged out of pedagogical necessity. "If you're interested in doing work out in the world, you need another box of tools," he says—tools that go beyond studio practice and art history. "You need classes on social theory, theories of politics, and theories of public space." While this is an important distinction and I make no objection to classes in politics and social theory, the branding of an otherwise un-brandable and non-genrefiable process has created a culture of dissatisfaction and failure in the creation of 'social practice' projects. In ARTNEWS, Dec. 11, 2014

[3] Slavoj Zizek interview, Democracy Now (March, 11 2008)

[4] Duncum, Paul. "Visual Culture Isn't Just Visual: Multiliteracy, Multimodality and Meaning". Studies in Art Education 45.3 (2004): 252–264.

[5] Gates, Theaster. "Perry Chen and Theaster Gates on Community-Driven Creativity." Interview by Perry Chen. *New York Times* [New York] 30 May 2013: n. pag. Print.

[6] Tucker, Daniel. "Immersive Life Practices". Chicago Social Practice History Series. (School of the Art Institute of Chicago: 2014): 17

[1] Reylea, Lane. *Your Everyday Art World.* MIT PRESS: Cambridge, MA. 2011.

[2] Journalist Carolina Miranda states in her ARTNEWS article that, "It is in academia, perhaps, that the art of social practice has gained the most traction. In 2005, the California College of the Arts (CCA) began offering social practice as a concentration within its M.F.A. program and soon put it in the curriculum. Since then, similar programs have launched at Queens College in New York, Portland State University in Oregon, the Maryland Institute College of Art in Baltimore, and Otis College of Art and Design in Los Angeles. Ted Purves, who founded the program at CCA, explains that these courses emerged out of pedagogical necessity. "If you're interested in doing work out in the world, you need another box of tools," he says—tools that go beyond studio practice and art history. "You need classes on social theory, theories of politics, and theories of public space." While this is an important distinction and I make no objection to classes in politics and social theory, the branding of an otherwise un-brandable and non-genrefiable

process has created a culture of dissatisfaction and failure in the creation of ‘social practice’ projects. In ARTNEWS, Dec. 11, 2014

[3] Slavoj Zizek interview, Democracy Now (March, 11 2008)

[4] Duncum, Paul. “Visual Culture Isn't Just Visual: Multiliteracy, Multimodality and Meaning”. Studies in Art Education 45.3 (2004): 252–264.

[5] Gates, Theaster. "Perry Chen and Theaster Gates on Community-Driven Creativity." Interview by Perry Chen. *New York Times* [New York] 30 May 2013: n. pag. Print.

[6] Tucker, Daniel. “Immersive Life Practices”. Chicago Social Practice History Series. (School of the Art Institute of Chicago: 2014): 17

# Beginning at the End

Erik Sommerfeld | University of Colorado Denver

## Introduction

Traditionally 1:1 projects happen towards the end of a student's career. While the learning opportunities from design ideation to project completion are undeniable, there is often little room to research the success or failure of the project. When reflective learning is used as a tool to understand the project's success, it often happens as an individual exercise void of the client that the 1:1 project was meant to serve.

For beginning design students trying to understand what worked, or didn't work, with past 1:1 projects, the reflective analysis that might have been gleaned is lost with the graduating students. Faculty who retain the institutional memory of these successes and failures can talk students through old projects, but their narrative is merely a single perspective.

In the fall of 2015 Colorado Building Workshop, the Design-build program at the University of Colorado Denver, redesigned the *Introduction to Design-Build* course to capitalize on this missed opportunity. The objective was to introduce incoming students to client interaction through Post Occupancy Evaluation, POE. The POE process serves two outcomes. First, students learn to work with community and industry partners gaining valuable real-world insight into the partner's values and process. Second, the students better understand the complexities and constraints of 1:1 projects preparing them for critical inquiry into future projects that they will engage.

## Post Occupancy Evaluation

This fall beginning design students enrolled in the *Introduction to Design Build* seminar course researched, designed, administered, and evaluated the previous semester's project; the Colorado Outward Bound Micro Cabins. The 14 micro cabins were designed and built in 19 weeks (January –May 2015) to serve the Colorado Outward Bound School as housing for their summer staff. The cabins are located in Leadville, CO at an elevation of 10,200 ft. deep in a lodgepole pine forest.

*Fig. 1 Cabin number 2. One of 14 micro-cabins designed and built for the Colorado Outward bound School in the spring of 2015*

The Colorado Outward Bound School represented a large number of constituents including the executive director, facilities manager, resource director, senior staff, field staff, and cabin users. The program also engaged industry partners in CNC fabrication and structural engineering.

The complexity of the project and its constituents allowed for an in-depth POE by the incoming students. The students were given an opportunity to interview and run focus groups with the community partners and industry experts. They were also able to engage the students and faculty who designed and built the project the previous year.

### *Research and design of a POE*

The first assignment was an investigation into other POEs. While a number of articles and research topics were used, the main guiding document was the *Guide to Post Occupancy Evaluation* [1]. The students followed the *structure for building a brief* and the recommended *evaluation techniques* sections closely.

The first objective was to identify the constituents involved and categorize them by how they informed the project. This provided the students with a better understanding of the complexity of the design and construction of the cabins. The second objective was to identify an evaluation method that would allow for the collection of the most unbiased data. The students concluded that five main groups existed, in addition to their own perspective, and three types of analysis would be used.

Constituents and POE Methods of Evaluation

- Senior Administration and Campus Facilities
  - Focus Group
- Faculty and Community Partners
  - One on one interview and Survey
- Students (who designed and built the cabins)
  - Surveys
- COBS Non-Users (those residents who willingly choose not to live in the cabins)
  - Focus Groups and Surveys
- COBS Cabin Users
  - Focus Groups and Surveys
- Students (who were conducting the POE)
  - Survey and Data Collection

*Administration*

The administration of the POE took place on the Leadville campus over the course of two days. This allowed the students to collect their information in one condensed timeframe. It also allowed the students to stay in the micro-cabins for one evening and develop their own opinions of the design.

Prior to their arrival on campus the beginning design students were given a project brief. The brief was a summary of the previous semester's pre-design interview with the goals of the project clearly outlined. The intent was to have them evaluate each cabin's success as it related to the brief when they arrived at the Colorado Outward Bound School's campus.

We began the field trip by requiring the students to come directly to the cabins. The objective was to shelter them from other opinions of the projects before experiencing and evaluating it for themselves. They were immediately given a section of the POE, developed by one of the student groups, and asked to rate the cabins in a number of areas. Since each of the 14 cabins are unique we intended the students to formulate opinions on the cabins they felt were most successful prior to hearing from the various groups involved in the project. This data collection also allowed them to compare notes.

After the personal evaluations were complete the students

*Fig. 2 Beginning design students visit last year's Colorado Outward Bound micro-cabins to conduct a post occupancy evaluation. Students were asked to do a personal analysis of each cabin prior to administering the POE to the various constituents.*

were organized into teams to conduct the interviews and surveys. This divided the workload and allowed these groups to act as *experts* in their area of research. Over the course of the next two days students gained valuable skills interacting with clients, conducting focus groups, and administering surveys.

*Fig. 3 Students conduct focus groups as part of the interview process for the Colorado Outward Bound School POE.*

One unavoidable outcome with this condensed timeframe was that the students already had feedback from the client and users prior to staying the night in the cabin. Ideally the personal data collection, overnight stay, and summary of their experience in the cabins would have been completed prior to meeting the various groups, instead of splitting the data collections and overnight stay between the interviews. This would have yielded the most honest feedback and allowed for a more interesting final summary of the POE results from each student.

## POE Outcomes

At the conclusion of the field trip students were asked to compile the data they had collected for their section of the POE and summarize their findings. In addition to the quantitative and qualitative data they collected they were required to submit a series of diagrams that helped explain what they considered the most important conclusions of their section of the POE. Some students chose to create infographics summarizing survey results while others highlighted important relationships or organizational aspects of the Colorado Outward Bound School.

Following is a brief summary of the data collected from each section of the post occupancy evaluation.

*Student Perspectives*

Overall last year's students were satisfied with the client, the design process, the faculty, and their fellow students. They felt the timeline and construction logistics were difficult to manage, but their biggest concerns were with site logistics, and tools. This information became informative to the beginning design students in their POE summaries.

Most of the students concluded that their biggest obstacles could be overcome by better planning . In and of itself this one conclusion validated doing the POE from a teaching objective. The power of hearing how they could do better from an existing student is more powerful than any lesson we could construct on *setting up a worksite*, or *implementing the design work on a project site*.


*Fig. 4 A summary of the beginning design students conclusions from their personal analysis of each cabin. The survey was broken into sections that asked each student to rate the cabins from 1-5 based on their analysis of architectural design, site response, function and craft (only cabins 1-7 are shown)*

*Faculty and Community Partners*

This section of the POE was the most difficult to draw conclusions from and highlights the challenges of conducting a POE through surveys and independent interviews. Each individual faculty member talked critically about the areas they could improve on and generally complimented areas that they weren't involved in. The POE should have been conducted as a survey first and then as a focus group. This would have allowed the students conducting the focus group to mention the discrepancies and allow the focus group time for critical dialogue, drawing more clear conclusions through an extended conversation.

*Senior Administration and Campus Facilities*

The general conclusion from these constituents was that the vision had been achieved but their was room for imporvement. They complimented the group for its ability to communicate throughout the design process and were grateful that the final cabins improved the marketability of the Colorado Outward Bound School. They were critical of the ventilation of the cabins, the craftmanship on some of the cabins, and the lack of privacy that the larger windows provided.

The students reconginzed that the senior administation and facilities department were involved from the beginning of the project to the end, and will continue into the next year. The students felt that this group provided the POE with its most valuable data, evidenced by their continued references to the senior staff's comments in their personal conclusion. This also became an opportunity to better understand the roles and personalities that they would be interviewing the following semester.

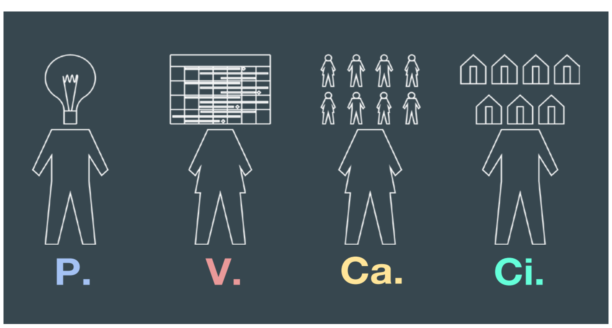



*Fig. 4 A student diagram of the roles of the Senior Administration for the Colorado Outward Bound School. This became a key to better understand how the response of each administrator shaped his or her answer to the question.*

*Cabin Users*

The students obtained a good deal of relevant information from the cabins users. Given that most of the students are the same age as the Colorado Outward Bound School Field Staff the students found them easy to relate to and honest in their opinions of the project. They communicated their desire for more privacy, more durable finishes, and better ventilation. They also provided valuable insight into the mindset of someone returning from their assignment in the field. This interview process created empathy for the user which will serve the students well as they move into the design portion of the design-build curriculum.

*Cabin Non-Users*

This group was underrepresented in the survey and focus groups. The majority of the individuals choose not to stay in the cabins because they did not provide enough privacy or they simply didn't have the seniority within the Colorado Outward Bound School to be assigned a cabin.

However, underrepresented as they might have been, the idea of privacy did not go unnoticed by the students conducting the POE. The requirements outlined in the brief and the data collected by the cabins users and even a number of the non-users became obvious that privacy was of the staff's main concerns. The senior administration was hoping to create a community, a place that the Colorado Outward Bound School staff could call home. Exterior spaces and covered porches were designed to increase the social nature of the site. Windows and doors were oriented to facilitate the idea of small neighborhoods, but through the POE process it became clear that wasn't necessarily what the field staff wanted in their housing.

The students learned a valuable lesson that the reality of what the users want can be very different from what other people, mainly the senior administration and architectural designers, *think* they want. In the focus groups with the users, and non-users, they heard stories about the field staff being with their students for weeks or even months in the field. They learned that the staff sleeps side by side every night they are on assignment. When they return from the field they want privacy; read a good book and be left alone. They want to be able to sleep in and not share a space with anyone else. The students learned the valuable lesson that the client isn't always your user and reconciling that schism can be one of the most difficult challenges in architecture.

## Conclusions

The overall success of Post Occupancy Evaluation of 1:1 projects as a beginning point for new design-build students, will only be know as new projects are completed. While early indications are positive, there are a number of lessons that can be learned when the process is repeated this coming fall.

For more consistent data a professional POE will be used in the future. Having graduate students develop their own POE in such a short period of time proved problematic. The questions were often confusing and written from the perspective of what the students were interested in hearing about. They were biased towards design and often overlooked building performance. The research portion of the course could still be maintained as a way to understand the history and theory of the POE, but the questions in the POE need to be modified to reflect data sets that are less driven by student interests.

The beginning design student's personal evaluation of each cabin proved powerful but was written after a tremendous amount of data was collected. This created a bias towards certain outcomes based on the other interviews they conducted. In future POEs it will be important to sequence the analysis so that data collection follows the student's personal analysis. Instead of a single field trip to visit the project, and the related constituents, it would be more appropriate to break it into two visits. The first visit would be done prior to any data collection, within the first week of starting the project. This would give the beginning design students the freedom to individually critique the project free from any outside information. A summary document would be completed and then a second field trip would be undertaken to conduct the evaluation techniques on the constituents. This new sequencing will lead to a more interesting dialogue between students as they defend their positions against the data they collect.

In the end the POE proved invaluable in a number of ways. First, the students learned how to engage clients and community partners prior to starting their own design-build project. This gives them a skill set that will directly translate to early meetings in the design-build studio and a life skill they can carry into the profession. The POE created empathy for the clients needs in the project and helped students understand the gravity of design-build. Second, the incoming design-build students learned from past students and community partners about the complexities of scheduling, construction, and site logistics. This will allow them the foresight to tackle these issues earlier in the semester. Finally, the POE helps reinforce concerns that faculty raise throughout the semester about the constraints of a 1:1 project. This evidence will be invaluable as a project develops and we pull from lesson of past projects.

## Notes

[1] University of Westminster and AUDE. "Guide to Post Occupancy Evaluation" Higher Education Funding Council for England (HEPCE), 2006

# BuildLab: the Urge to Humanize Architecture

Sandra Vivanco | California College of the Arts

## Introduction

We live in a time where people have a renewed interest in making. The reasons may be political – an ecologically conscious reaction against unnecessary transportation of goods that favors locally sourced and fabricated products; economic – a response to loosing jobs to automation and the global economy; or sociological - the result of a primal human need to make in the midst of a world that becomes ever so digital. Independent of why, making is changing our streets, our zoning, our spending patterns, our leisure time and in an interesting way, bridging traditional realms of suburbia and the city.

It's not a coincidence that so many architecture students and faculty have become interested in making things again, an activity that seems to go in and out of fashion at schools of architecture on a regular basis as the winds of pedagogical fancy dance between the poles of thought and action. In the current wave, digital fabrication is all the rage, buoyed by the promise that architects will increasingly be able to bring their designs to built fruition through clicks of the mouse, bypassing the messy reality of the traditional construction process.

As exciting as this prospect is, the reality is that even with powerful new tools of design and fabrication, there are elements of the process of making that will always require choreographing interactions with people, tools, budgets, and rules. If architects truly want to extend their reach further into the depths of project realization, they need to acquire additional skills, and more fully engage in the broader issues of how and why we build, where and for whom. This paper showcases four 1:1 projects by the CCA BuildLab that seek to engage all of the complexities of global and local design-build projects, including the provocative questions and themes of this conference.

## BuildLab History

Initiated by two seasoned San Francisco practitioners - Anderson and Vivanco - who have a rich and long liaison with the California College of the Arts, the CCA BuildLab enables applied research to become an integral part of architectural pedagogy. Since its official inception last year, we have completed a public interest design project every semester.

Shared with his brother Mark, Peter Anderson's studio *Anderson Anderson Architects*, is well known for experimental building proposals that explore components and modularity in architecture. They equally engage pre-fabricated architecture as well as emerging fabrication technologies.

Sandra Vivanco's practice *A+D, Architecture + Design* has built a robust reputation based on the premise that inclusiveness and design excellence do not have to be mutually exclusive. As one of a handful of Latina-owned architecture firms in California, A+D explores cultural identity representation as design inspiration for public spaces.

What both practices share is a concern with the increasing unaffordability and preciousness of experimental architecture. Even after one accounts for new fabrication technologies that theoretically should make building more accessible to the general public, our critique is that rarely parametric design engages social equity in meaningful ways.

The BuildLab's academic home, the California College of the Arts also known as CCA, has a 109-year history based on the legacy of the Arts and Crafts movement. Originated in England as a reaction to the industrial revolution at the dawn of the 20th century, William Morris' main concept was that beauty should be part of daily life for every person, not simply those who could afford it. In doing so, society could be greatly improved. The primary vehicles for Morris's ideal of art and life harmoniously joined were crafts –such as furniture, glass, textiles, ceramics- and architecture. Morris' success in making the production of fine crafts valuable again created a new way of thinking about, and a new respect for, the role of artisans in relation to the fine arts.

The ethos of CCA is interdisciplinary and our motto is "Make Art that Matters". This stated institutional commitment highlights the process of making as well as the intention to do so in a meaningful and altruistic way. Therefore it is somewhat ironic that until recently there was no specific arm within the architecture school to accomplish this important design agenda.

The CCA Build Lab changes all of that. We have gathered under one theoretical umbrella previously isolated projects from past years that meet three criteria:

- Faculty initiated and student run - from funding to management to installation.

- 1:1 design-build - crafted at CCA fabrication shops.

- Social impact design - working with non-profit organizations and/or under-represented communities.

## Our Mission

The BuildLab uses, the concept and the history of, making as a tool to probe complex situations of social inequity and ecological imbalance. At the same time we provide the students with the crucial hands-on experience of designing, fabricating and testing an architectural response to a real life situation. How the students choose to define the problem and what do they prioritize in their design response is all an important part of the architectural learning experience.

CCA BuildLab aspires to ingrain in students the value of interdisciplinary research, collaboration and civic agency. By forming student teams from different disciplines we enable a collaborative process that learns from different modes of working. The BuildLab focuses on human-scaled interventions in the public realm designed in collaboration with community-based non-profit clients towards a common goal: to energize public space and to architecturally represent 'invisible' communities in our midst.

Additionally, working with the CCA BuildLab might be the first time a female student has been exposed to the challenges of fabricating and installing a physical urban intervention. In many cases students of color are similarly given the opportunity to advocate for their own communities and act as cultural translators to our team. In both situations we empower and encourage students to be civically engaged, as they better understand their power and privilege in society. Finally, working in the public realm better prepares a young architect to enter the profession.

Let's reflect for a moment on the origins of the term Architect as Master Builder. Our traditional architectural education favors large-scale abstract thinking but typically does not require the student to bring those design decisions to bear at the scale of 1:1. How often do we question what are the immediate consequences or ramifications of the big moves we encourage our students to make? How do the students test the BIG ideas we expect, one may even say demand, from them? Architecture is highly dependent on the scale of the body. Even the most compelling architectural proposal can be truly relevant to the general public only at the 1:1 scale.

## A Question of Scale

Whether the user is an individual or a group, the projects we undertake are specifically related to the intimacy and fidelity of the 1:1 scale. The two key pedagogical objectives are on one hand the technical knowledge required to understand basic structural principles, material possibilities and building methodologies and on the other hand the strategic thinking necessary to produce maximum effect in the public realm with minimum effort.

Almost immediately after starting one of our projects, the beginning designer is forced to go beyond form. Contrary to most architecture school studio briefs, the design process starts with the constraints and only later indexes a range of spatial and tectonic possibilities. The process of completing a thorough analysis of client expectations, site constraints, transportation requirements, fabrication opportunities and material possibilities at the start of the project, nurtures creativity that emerges from a informed desire to define the questions and invent appropriate responses to them.

No matter how one unpacks it, 1:1 refers to immediacy and directness. The process of designing 1:1 is more related to prototyping, iteration and construction mock-ups than to traditional architectural design. As designers, we no longer have to build our design twice: once in drawing and once in physical form. We arrive to the ultimate proposal by a series of design iterations that are explored in full scale and built upon each other. This enables a more considered and conscious, if perhaps less lyrical or subjective, architectural design proposal.

It is important to note that human scale does not exclusively refer to size, but encompasses the corollary issues of inhabitation: thermal comfort, protection, affordability, context, environmental impact, resource utilization, building program and site, firmness, comfort, adventure and delight.

## Process and Logistics

It is incredibly empowering for a student to probe the limits of architecture while being ushered through a design collaboration with real-world parameters such as the limitations and opportunities inherent in fabrication and installation; and the necessary adherence to schedule, budget and a decision-making process that goes beyond project authorship or personal preferences to favor the public good and the best possible result within a set of tangible guidelines.

Our projects usually originate in one of two ways. In the past the project ideas have mostly been proposed by faculty, based on an existing working relationship they have with a non-profit organization or a particular area of research they are pursuing at that time. As of late different governmental agencies and community groups have been coming directly to us. Once we accept a project request with a feasible timeline and budget, we evaluate it and route it to the appropriate BuildLab faculty member. Additionally we are actively participating in national forums such as SEED - Social Economic Environmental Design, Public Interest Design and Design Futures. This allows us to reflect on our methodologies and design objectives and to contextualize the work we do with the critical help of our colleagues. In this way we share experiences and resources and are able to hold each other accountable and to develop new pedagogies together.

## Physical Legacy

In the last few years, the BuildLab has responded to many different design-build challenges. Today I will briefly discuss four selected projects arranged from most permanent to most mobile. They are: a series of interior installations in a Latino Immigrant Community Art and Service Center; an intervention in the city's pilot Homeless Navigation Center; a culturally resonant canopy structure that is both mobile and static; and finally a portable lightweight classroom for West Africa that must breathe and shelter at the same time.

*Mission Resource Center Plaza Adelante*

The interior urbanism project at MRC Plaza Adelante (Figure 1) completes a one-stop financial, health and legal services agency for Latino immigrants. Plaza Adelante is also an important cultural arts institution situated in the heart of the vibrant Mission district of San Francisco. A former furniture factory, this building was rehabilitated and is administered by Mission Economic Development Association. Also known as MEDA, this community-based organization promotes economic empowerment for recently arrived Latino population and provides a host of bilingual services to ease their transition ranging from home ownership, to small business incubators, and from digital literacy to economic empowerment.

The goal of our BuildLab studio was to explore various architectural interventions within this community-oriented services assemblage. The students researched and analyzed the history of the different institutions occupying the complex as well as that of the neighborhood. In small groups, they designed, fabricated and installed a family of relevant and appropriate habitable installations that address the boundaries between the diverse services offered at Plaza Adelante and at the same time actively bring the vibrancy of the street into the heart of the center.

*Fig. 1 Mission Resource Center Plaza Adelante, San Francisco*

The installations included a reception desk, a cafe complete with seating, display doors for a commercial business incubator space, mobile vendor carts, a donor ceiling canopy, a display system and lighting for an art gallery and finally a historical photographic timeline for the neighborhood non-profits as well as way-finding system for the building.

*MOH Mission Navigation Center for the Homeless*

When the San Francisco Mayor's office of Housing received a $3Million grant from the San Francisco Interfaith Council to address core issues of homelessness in the city, the main focus was on establishing a short-stay facility in the heart of the Mission District. Here clients could have short stays (not to exceed two weeks) to stabilize, rest, and engage with intensive care and placement services. The main innovation is to welcome individuals with their loved ones, including pets and a few essential personal possessions, to ease their transition from the streets and build a supportive community around them.

An obsolete complex of portable school structures was available to serve as a physical base, but the program reached out to the CCA BuildLab to help plan, design and install a number of improvements and additions to humanize and harmonize their facilities exterior space. We were presented with two main challenges: schedule and budget. The center needed to open before the semester was over and there was zero money for materials.

How does one make something significant from nothing? We requested access to the City's materials depot and made a thorough graphic inventory while we identified these as potential building components. The project was built entirely with re-purposed and up-cycled materials with minimal paint and hardware donations and completed in a series of weekend building marathons with volunteers.

Primary interventions by the student/faculty teams included space planning and landscaping for the exterior living spaces. We transformed a former parking lot into a series of activity-focused courtyards for gardening, eating, socializing, and sports. The main design-build effort was to create a new front façade and welcome courtyard (Figure 2) for the complex, a window onto the street and into the neighborhood to dignify the facility and those who use it.

*Fig. 2 MOH Mission Navigation Center for the Homeless, San Francisco*

***Fluidez at SF Carnaval and Mission Cultural Center***

FLUIDEZ was originally created as a float for the 2012 San Francisco Carnaval Parade and later installed at the Mission Cultural center gallery. The annual theme, "Crossing Borders, Bridging Cultures" combined with local celebrations such as the Year of the Water Dragon provided the departure point for the initial design. Throughout the design development, the CCA BuildLab design team worked closely with Youth Art Exchange, a nonprofit organization devoted to teaching art in San Francisco public high schools. Supplementing their own learning, the college students taught the high-school students and learned how to collaborate with them in the joint design project.

Conceived through a series of physical and three-dimensional prototypes, the formal project articulation was carefully refined in response to structural considerations as well as programmatic and dimensional constraints. The resulting exoskeleton emerges a free form with a geometric grid, creating a sense of tension and playful drama, embodying the culture of Carnaval.

The desire for mono materiality surfaced early in the design process as a way of evoking a sense of continuity and movement that would support the structure's dual purpose: a kinetic sculpture moving through Mission Street as part of the parade and later as a static installation piece designed to organize a gallery exhibition (Figure 3), creating both interior and exterior environments. After a series of experimental material explorations, birch plywood was selected as the primary material. The final design is a culmination of intuitive design informed by structural considerations and refined by qualities inherent to the chosen material and the process of fabrication and assembly

*Guinea-Bissau classroom prototype*

This studio challenged students to work as a team to devise strategies for bringing simple structures to remote areas of the world for humanitarian purposes, to design and prototype them, and plan for the full range of complex issues in delivering and deploying the structures.

Fig. 3 Fluidez at the Mission Cultural Center gallery, San Francisco

We focused the studio on creating school classrooms, but the concept of lightweight easily deployable structures is equally applicable to other building types, such as clinics, community centers, and disaster relief efforts. The specific design criteria came from a request from a real-life client, a non-profit foundation based in Portugal and Guinea-Bissau, whose primary purpose is to help bring educational opportunities to a remote region of islands off the west coast of Africa—the Bijagos Archipelago.

The islands have a unique culture and environment, and many areas are protected as a UNESCO biosphere reserve because of the largely undisturbed and fragile ecosystem. One of the reasons the islands remain undeveloped is because it is very difficult to access them, as there is no regular transportation system connecting the islands to the mainland or to each other. There is only one small airstrip and an occasional ferry on the most populous island in the chain, and most of the other islands are accessible only by shallow draft canoes.

The prototype developed by the project team addresses all of these challenges, and considers the appropriateness of the result to the needs and culture of its intended users, as well as the practical realities of actual implementation. In the first iterations of the class, we focused on understanding these requirements and the logistics involved in accessing these locations, planning the routes and hand-off locations for fabricating the components in industrialized countries, then shipping them by container to the nearest port, where the pre-prepared bundles would be unloaded and brought by a sequence of truck, motor boat, canoe, and human hands, to their final locations.

Along the way, we realized that the situations of limited access would be similar to many other locations in the world—not always because of land separated by water, but also because of lack of roads or other necessary transportation infrastructure. This led to our understanding of the issue as a need for lightweight, easily assembled structures as a specification for a much wider application than just for islands. In the most recent iteration of the process we concentrated on developing the fabrication and assembly strategies for the primary structures, which was tested by making and erecting the frame of the structure (Figure 4), then disassembling and storing the pieces for redeployment in other locations.

*CNC Cutting Lay-outs and Sequence Diagrams*

The design is composed of 50 unique pieces; each replicated a different number of times. The challenge was to nest these pieces on 4X8 plywood sheets in the most efficient way possible. The structural components in Prototype 3.0 were designed to accommodate this 4X8 dimension required for CNC tooling.

The overall construction consists of two major parts: structure and floor. The structure is assembled in four parts while the floor is assembled in two parts. These diagrams show the pieces that make up the structure and floor and how the overall model comes together.

## Conclusion

For many reasons, we at the CCA BuildLab continue to be passionate about our mission:

- In an academic environment where there are limited opportunities for hands-on involvement in the ensuing process necessary to bring design projects to physical realization, we are enabling architecture students to test their design proposals in real time-place situations.

- The BuildLab ethos requires effective collaboration and team communication and elevates inter-disciplinary work

- In our studios, our students learn time management, resourcefulness, approval and entitlement processes, budgeting, public relations, and fundraising. This important experience is required for many design projects in the professional world but in architecture school is seldom delivered in parallel with design.

- Our students are exposed to cross-cultural communication when communicating with diverse clients and constituencies, while starting to bridge the gender gap as we give female students equal responsibility for physically demanding fabrication, installation and transportation work.

- We make our students keenly aware of the power dynamics and the privilege we designers automatically bring with us to many under represented community situations.

- We hopefully instill in them a desire to master the fine art of listening and to ask the right questions while we teach them empathy and resourcefulness.

Transforming the public realm, these four projects have been widely exhibited and repeatedly peer-reviewed. The CCA BuildLab will continue to disseminate the idea that thoughtful inclusive design contributes to the architectural discourse while improving our streets and our quality of life.

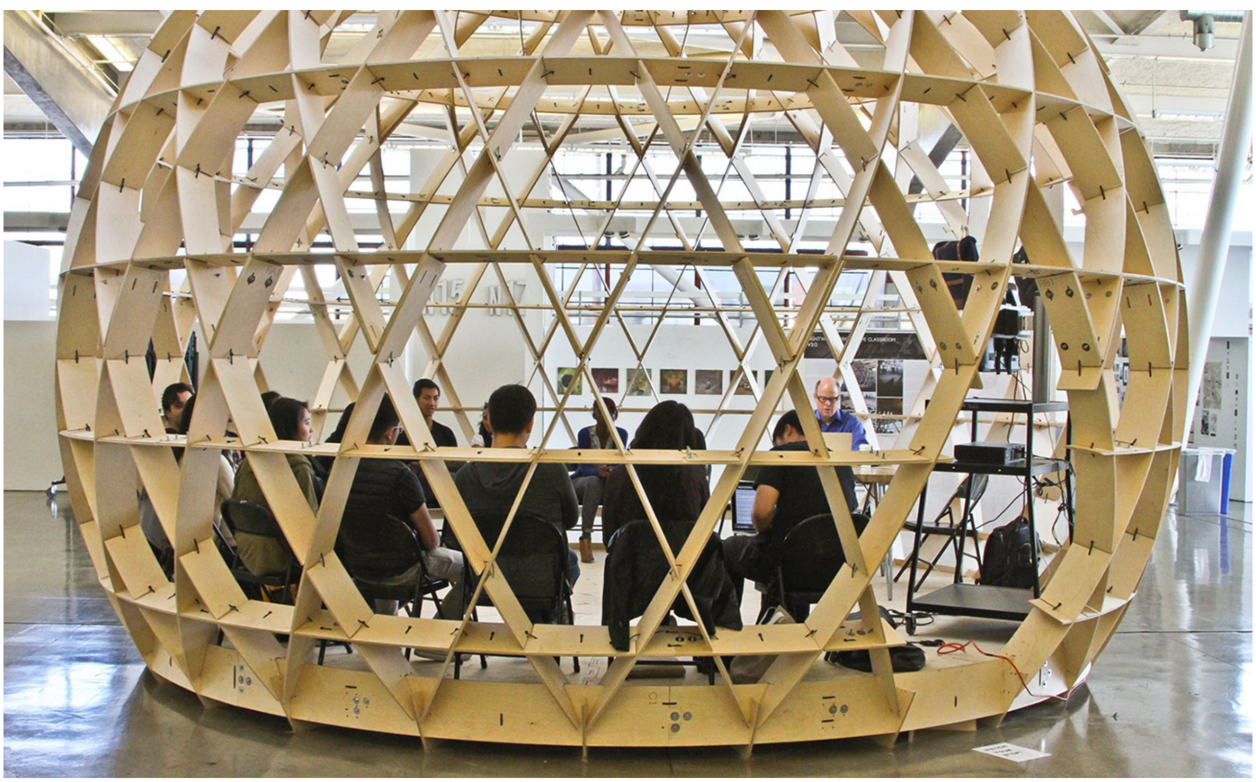
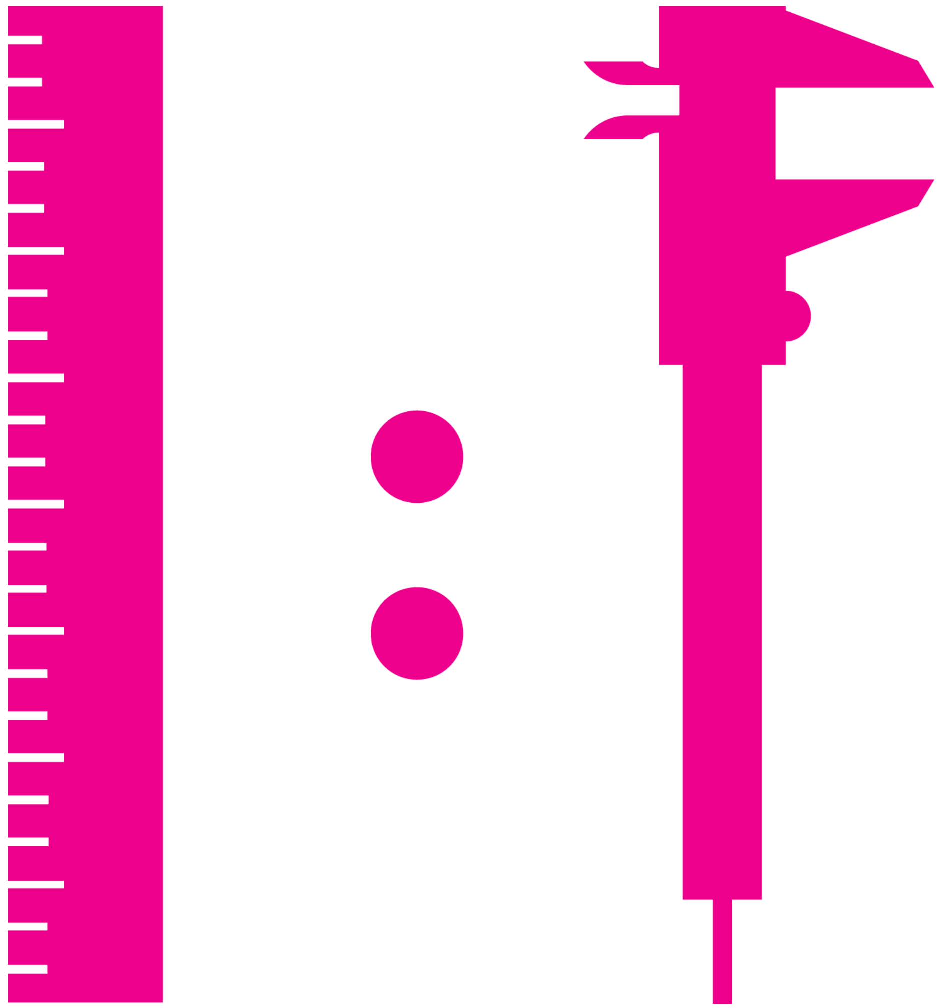


*Fig. 4 Guinea-Bissau classroom prototype at the CCA Nave*



## STUDENT:TEACHER

As many schools face pushback about studio-based teaching in the name of “efficiency”, similar strategies are viewed as revelatory in the science disciplines where the studio format is enabling greater interactivity amongst students and faculty and active engagement with the course material. Does the 1:1 studio teaching mode work for beginning design education? How is the mode celebrated or scrutinized? What are alternative teaching practices? Submissions to Student : Teacher discuss approaches to design pedagogy that give insight into the relation between teacher(s) and student(s).

# Presenting Incomplete(ness)

Jason Austin and Jacklynn Niemiec | Drexel University

## Abstract

We have been wondering how incompleteness could be reconsidered in design education. This paper explores the incomplete and its place amongst a generation of students whose modes of daily communication function within an incomplete framework. Through two different modes of conversation with our foundation studio students, we will describe how an incomplete dialogue could be structured and implemented in the beginning design studio.

First, during an informal live blogging session, students were asked to reflect on their studio experience midway through the year through a series of moderated questions. The results of this step back provided the conceptual framework of the "incomplete final review." This reconsideration of the final review reversed the format of a traditional end of term review. Rather than jurors moving around to each single student's body of work, the students and juror move together. They engage in conversation to discuss the project through a series of isolated snapshots of their process.

## Introduction

The process of design is messy and the associated design thinking that comes with it is non-linear. Moving backwards is, in fact, necessary to move forward within the development of a project and an education. By embracing this incompleteness in our curriculum we are attempting to communicate with the beginning design student in a new way. As architects, we must be agile – and uncommitted to just one possible resolution – and embrace the act of moving forwards and backwards within the process in lieu of remaining static and attached to a single moment in time. So, as educators, we must embrace the notion of the unfinished idea as a productive means to foster dialogue between students and faculty.

The perceived millennial effect in higher education has focused on the medium – the integration of technology and new means communication. Nevertheless, as long as we're using the same digital platform or interface as the current generation of students, we will get through to them. However, assuming the medium is the message is somewhat dangerous in a world where the medium of choice changes every year. For millennials, it was texting and Facebook; for post-millennials, it is Snapchat and likely more to come. The interface will always change, but the structure of conversation holds true as an informal exchange of thoughts.

We didn't embark on a crit revolution or a mission to systematically dismantle the established tradition of the design review. This accidental revolution has come by way of reflecting on a process-driven studio curriculum. Our interest in design process is not unique, but the shifting of this pedagogy from the students back onto ourselves shed light on new possibilities for the structure of beginning design education. The nature of the traditional design review seems somewhat uncomfortable in a world where communication has evolved into an instantaneous amalgamation of abbreviations, images and icons. So many thoughts in a conversation have been censored to 140 characters and are typed rather than spoken, but is this really the end of conversation? We don't think so. We will argue that the art of conversation is actually embedded in this efficiency and that we, as educators, may learn from its incomplete structure.

## ChitChat

In our first year of teaching at Drexel University, we had both committed to *process* – "the journey not the destination" would be our rallying cry. In ARCH 101, the act of making and mistaking (or the iterative practice of making) was central to the inquiry-based learning exercises within the studio. The success of a student's project resulted from the questions that were asked throughout the design process (as opposed to being answered) between student and material, student and student, and student and instructor – thus creating a learning culture comprised of inquiry in lieu of resolution.

Through our rigorous (or perhaps maniacal) process-driven studio, students became skeptical. This skepticism is not uncommon as architecture school is never what it seems, but "Why are we doing this again?" became a common muttering. A process-driven studio is by nature ambiguous: to know where you're going would hinder that journey.

As a response to our students' hesitation, but moreover as a gut check for ourselves, we arranged for the last class of the term to reflect on the past 10 weeks. Knowing that the format was critical to the type of feedback we would receive, we set up an anonymous blog. This morning chat amongst students was moderated by us, the professors, through a series of questions and interjections when follow-up was needed. The ability and need for our students to reflect on their work and process of learning was an enlightening exercise. The medium was digital, but the conversation was true. The blog was a circuitous network of thoughts; students referenced responses from earlier exchanges, nimbly replying to one or many students at a time. The instinctual and incomplete responses reflect this communication culture shift. The students' networks of thoughts are concise, fluid and often unfiltered.

*Eavesdropping: Student:Student; Blackboard Blog*

Jacklynn Niemiec said... What is the value of ambiguity (or not knowing everything) in the design process? Posted: Wednesday, April 09, 2014 09:41:15 AM EDT

Anonymous said... Ambiguity definitely made us uncomfortable because for our whole lives we have been told what to do and exactly how to do it. With ambiguity, creativity and free flow of ideas are nurtured. Looking back, ambiguity is what we all needed to break away from doing exactly what every teacher has told us to do our whole lives and create something that was uniquely our own design and ideas. Posted: Wednesday, April 09, 2014 10:37:53 AM EDT

Anonymous said... It is very important. if we know everything in the design process, then we begin to question the necessity for certain steps and will often take shortcuts to get to the finished product. Many times we ask ' why are we doing this?' without really getting an answer...that is, until the end of the project when we reflect on what we did. Wednesday, April 09, 2014 10:38:57 AM EDT

Anonymous said... RE: "Ambiguity definitely made us uncomfortable..." Yes it made you uncomfortable, but is that because you aren't use to having to create your own steps to a project? Most of us go through school being guided with a solid set of rules of what is supposed to be done (if not done correctly then it effects our grade) but here we are encouraged to stretch the boundaries of what is acceptable [which] allows more creative thoughts to occur. Posted: Wednesday, April 09, 2014 10:41:12 AM EDT

The blog took on a life of its own. We, as faculty, would only interject when we felt the students were nearing great insight in their collective reflection or if the conversation had gone completely off track. We found that students were refueled by our brief interjections and questions. The instantaneous nature of the blogging session provided an informal and incomplete platform for an open conversation about what our students had learned beyond the surface. We were interested in learning about how each step in the process shaped the way they now thought about architecture.

*Eavesdropping: Student:Faculty; Blackboard Blog*

Jason Austin said...How does the design process inform/construct/choreograph experience? Posted: Wednesday, April 09, 2014 10:27:17 AM EDT

Anonymous said...RE:"how does the design process inform/construct/choreograph experience?
This was the first project when people began to think about users. It was a test for everyone to understand how people using a space will need to inform construction/spaces that need to actually be occupied with somewhat of a scale. The pier was the final result of understanding relationship between spaces and now applying that to how people interact with a surface, a space, a pier. Posted: Wednesday, April 09, 2014 10:28:35 AM EDT

Jason Austin said...How does this design process breed spatial diversity while providing spatial constraints/limits? Posted: Wednesday, April 09, 2014 10:30:14 AM EDT

Anonymous said...RE:"how does this design process breed spatial diversity while providing spatial constraints/limits?" We were given the constraints/limits of scale and the boundaries of our pier length and width, but with so many different discoveries throughout the design process, like a different spatial operation or maybe a new way of creating depth, all of the piers were vastly different. Posted: Wednesday, April 09, 2014 10:34:05 AM EDT

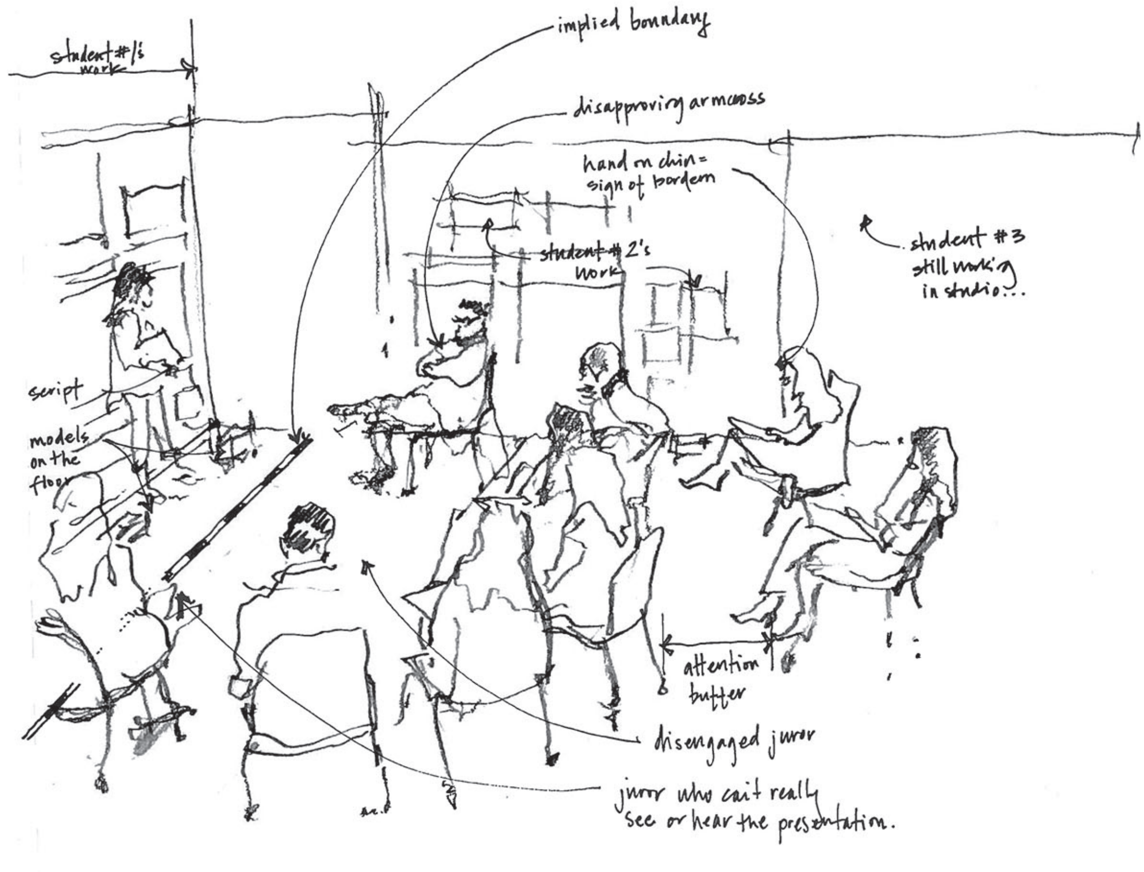



*Fig. 1 The classic or "complete" review structure*

Anonymous said...RE:"how does this design process breed spatial diversity while providing spatial constraints/limits?" Every step of [the] process was a step in filtering out and choosing what was successful and what we wanted to keep or just get rid of. Posted: Wednesday, April 09, 2014 10:43:57 AM EDT

## Common Ground

Traditionally, the design review supposes a clear format: actor and audience. [Fig. 1] We call this organization the "complete" or "formal" final review. Even the spatial diagram reflects opposition – an us-and-them distinction. The traditional final review is structured with students individually presenting their entire chain of work for the term. Invited jurors critically absorb the student's verbal presentation, while ruminating on their visual presentation that is staged on a vertical pin-up surface. Upon the completion of the student's presentation, a few clarification questions are asked by the jury and then, from this point forward, the student remains quiet (especially beginning design students), waiting for the first comments, desperately hoping for some positive reinforcement after relentless hours of investment into the work. At this time, the jury – typically being pressed for time with the number of students in the first year architecture class – barrages the students with their personal interpretation and criticism of the work that hangs in front of them. Dialogue is minimal and retention of information likely follows suit. Regardless of the conduit, dialogue is essential for understanding.[1]

Countering this structure, the format of our "final" review didn't celebrate "final" work in unequal proportion – but, instead, provided a platform for all parts of the design process to be given equal time for conversation and discussion between student and juror. [Fig. 2] The recipe for the incomplete review was as follows:

### *Organization of Work*

Stations of work (a total of six) collectively exhibiting similar individual project deliverables (i.e. each individual student had equal representation within each station – models with models, final drawings with final drawings, partí sketches with partí sketches, study models with study models, etc.).

*Organization of Students*

Groups of three students (with similar typological project attitudes) paired with one juror; each student group escorted their assigned juror to each of the six stations, spending a total of 10 minutes per station before rotating to the next station. Each student had an opportunity to briefly describe a few words to their juror about their work within the station to initiate the conversation. Each jury member spent a combined 60 minutes with the group of three students.

*Organization of Review*

Depending on which station number each group of students and juror started from (i.e. #1-6, where station #1 showcased initial concept studies and #6 showcased final-quality polished perspectives), the students had to present their work moving both forwards and backwards, focusing only on the exhibited media at their particular station.

When given an opportunity to talk candidly to a juror about their work within a less than formal review platform, the students performed without hesitation or reservation – they were able to intelligently articulate their big ideas as well as the detailed grain within their work. And it was at this moment, that we, as their instructors, realized just how much they learned from not only us but more importantly from one another. They were invested not just in their own work but the collective work of their peers, utilizing the work on the wall that wasn't theirs as a means for situating their own work and personal position on the project. The conversations flowed, history lessons were told, architecture precedents were suggested, comparisons were made, notes were taken, and the dialogue between students and the juror didn't stop until the timekeeper shouted, "Time!"

## TBD

The feedback was unanimous from both jurors and students – our "incomplete" presentation format constructed the desired, comprehensive and open-ended (thus "incomplete") conversation that we found absent from the classical final review model.  But perhaps the most important revelation from our experiment (for it was an experiment!) was the role that the conversation and critical dialogue played within a discontinuous exhibition of their work. The collective conversation within each

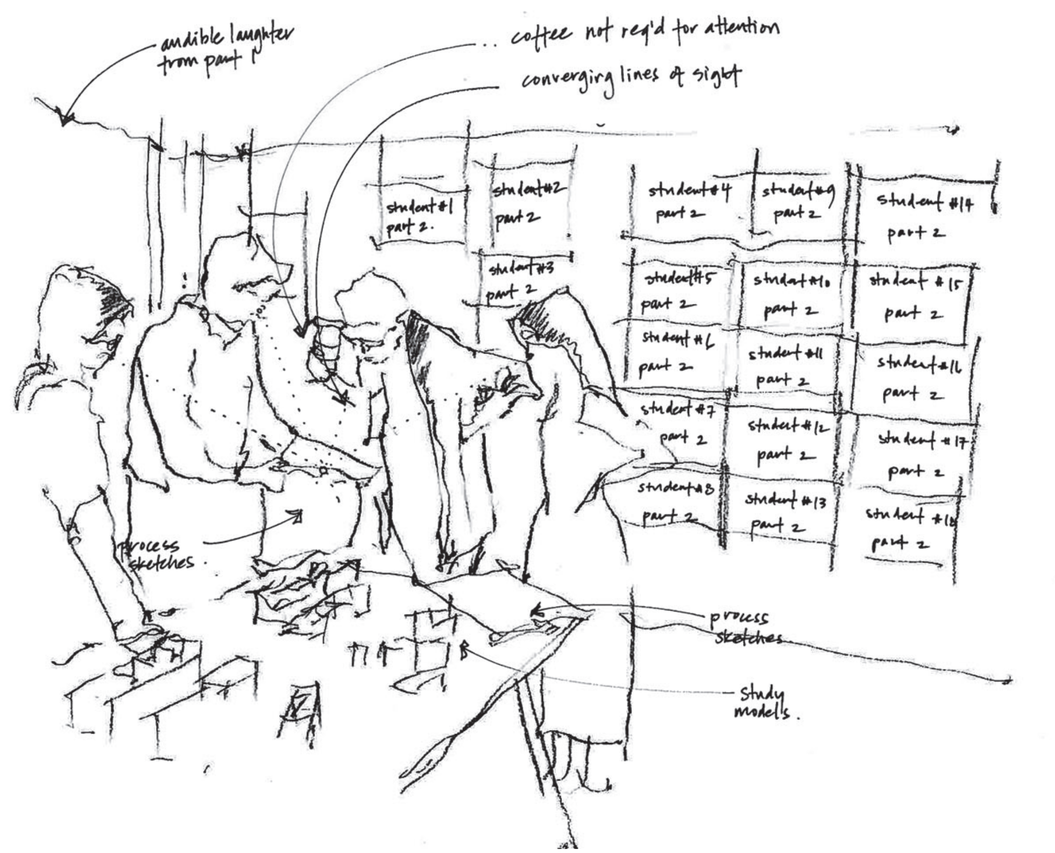



*Fig.2 The informal or "incomplete" review structure*

group of students acted as the agent for new design discoveries – prompting inquiry and renewed potential within their work and reflecting on their editing and thinking processes while tactically trying to uncover the strongest threads of commonality from all phases of the project. Additionally, the fragmented format revealed to the jury the importance of evaluating the design process as an equal player within the delivery of the final review.

*Eavesdropping: Faculty:Faculty; Google Chat*

Jacklynn Niemiec: Does this idea of the incomplete support the idea in the curriculum development of every studio not trying to do everything? I.e., can deliverables be left out or not given as much weight? Something about the sum of the parts…

Jason Austin: Sum of all parts makes sense – especially if you think about the foundation years as a "kit of parts"– leading up to the "comprehensive" studio towards their final years of study.

Jacklynn Niemiec: Kit of parts, better.

Jason Austin: I think there's also something to the genius of the assemblage of parts.

Jacklynn Niemiec: Yes! Our education is a catalog of knowledge. Small bits that are assembled through a curriculum.

Jason Austin: The juggling of all these seemingly fragments parts/pieces to the design problem should be preparing students for the factors/forces of the procession that shape a project unevenly over time – similar to how a curriculum should develop over time.

Jacklynn Niemiec: I just reread the sentence about "uncovering the strongest threads of commonality" (in TBD). I think this idea of the thread is really interesting. While there are always parts and pieces, finding and having the ability to see the thread is critical for controlling the "incomplete."

Jason Austin: Yes! Seeing the thread and understanding how it behaves between the parts and pieces.

## Incomplete Conclusions

The informal and the incomplete shape the world surrounding the beginning design student. By embracing the incomplete review in a foundation studio curriculum, we can help to shape our millennial students' design vocabulary, confidence in their work and interaction with faculty or mentors and ultimately magnify the value of their making and mistaking in the messy process of design.

## Notes

[1] Disclaimer: The picture we just painted for a typical final review in the preceding paragraphs may not always be the case, but, having been on numerous design juries at multiple universities over the course of the last decade, we find that the description above is disturbingly accurate of the conventional final review format.

# The Success Team Program: A Model of Peer Mentorship

Suzanne Bilbeisi | Oklahoma State University

The first year at the university can be particularly trying for students entering the difficult major of Architecture. The unusual time commitment, as well as the high standards for performance, can confound entering students. To seek excellence, and to be able to absorb citicism and revise work with that input, is a difficult working mode for freshmen to adopt. Added to this new and demanding level of expectations is the unfortunate lack of a sense of belonging. The influence of upperclassmen can be a useful tool in resetting the academic expectations level, and can help build a sense of community for these beginning design students.

The common studio teaching model of fifteen students per faculty member is an accepted and effective model for achieving adequate interaction and personal attention in the studio learning environment. An underutilized yet also effective method involves employing undergraduate upperclassmen to mentor and assist freshmen students in the initial foundations course, thereby building in essence, a community. In their important thoretical treatise on learning, Lave and Wenger state that "A community of practice is an intrinsic condition for the existence of knowledge, not least because it provides the interpretive support necessary for making sense of its heritage."[1] In the all encompassing and overwhelming world of architecture school, this kind of apprenticeship into the community allows newcomers to participate at the edge while learning the lingo and developing an intiuitive sense of the shared identity of the community.[2] For beginning design students, this transition into the school is a critical moment.

*The Success Team Program*

In 2004, our College instituted a formal mentoring program for all freshmen students, called the Success Team program, to be held in collaboration with the "Introduction to Architecture" first semester core course. This course is not a studio course, it is a large classroom, lecture based, introduction to the myriad of issues involved with beginning the study of architecture: addressing drawing skills, introducing architectural concepts and vocabulary, and providing a review of the profession itself through precedent study, tours, interviews, and assigned research. (Figure 1) It is a two credit hour course intended to introduce the discipline of study, and prepare students for entering the spring semester Architecture Studio I.

*Figure 1. Introduction to Architecture lecture, Fall 2015*


*Figure 2. A Success Team orientation meeting, Fall 2015*

As part of this introduction course, groups of ten to twelve freshmen are assigned an upperclassman to help them navigate the difficulties of adjustment during the first seven weeks of their first Fall semester. Weekly meetings with this small group of freshmen peers, guided by the upperclassman mentor (or coach), immediately establishes a sense of community within the school of architecture for this newest group of design students. (Figure 2)

With a typical student enrollment in the class of 120+ freshmen (2/3 architecture and 1/3 architectural engineering majors), approximately ten to twelve coaches are employed each Fall. Coaches are selected via the process of an application; the questions on the application are related to why the upperclassmen desires to be a leader, and what they feel they can contribute to a freshman's initial experience at the school of architecture. One applicant reflected that "I had upperclassmen invest in me when I entered the School of Architecture and that impacted me tremendously; I realize how beneficial that was for my education in architecture as well as for my personal growth entering college. I wanted to be a success coach to have a specific avenue to give back to the school that has given me so much."

Coach candidates must be accomplished students within the school of architecture, and be willing to develop their leadership skills. Annually, more students apply than can be selected, which is evidence of the positive perception of the program throughout the school. One coach commented "I absolutely love what I do here, and I am proud to advocate our major to younger students." A second-time coach stated "Getting to mentor younger people is one of the coolest things you get to do as an upperclassman and I look forward to sharing what I've learned about architecture every year."

Weekly coach coordination meetings, led by the faculty and a designated coach coordinator (also a student), ensure that the upperclassmen have sufficient monitoring such that they know the expectations and can ask any questions of each other, or of the instructor. It is common at these meetings for stategies related to increasing positive group dynamics to be shared and discussed. A sort of 'coach community' thus results; one coach related that "the communication between everyone was fantastic, and I felt like I got to know the other coaches and the professor much better as well." The coach coordinator is also responsible for collecting time sheets, coordinating individual team meeting locations, and distributing other information to the coaches as warranted, thereby building the coordinator's leadership capabilities in human resource management.

The academic content of the team meetings is controlled, and is complementary to the lecture material presented in the Introduction to Architecture class – the coaches assist students with aspects related to the weekly assignment. Freshmen are offered advice and can ask questions of the mentors that aids in their success in the course. One freshmen surveyed said "I really enjoyed having a student's viewpoint and helpful advice for each assignment. These tips made each assignment much less nerve-racking." (Figure 3) Topics for the assignments range from developing drawing skills – orthographic documentation and perspective sketching, to assignments focused upon understanding fundamental ordering systems and design principles such as axis, hierarchy, repetition, datum, etc.

The coaches lead their student team on a 'mock' assignment each week, which parallels their assignment without solving the actual homework. If we accept that knowledge is defined as the process by which a person or a group of people acquire a situated understanding within a social context[3], here we find many 'Aha' moments, where interactions with peers and the coach lead to a more thorough understanding of each issue, as the areas of study build upon one another.

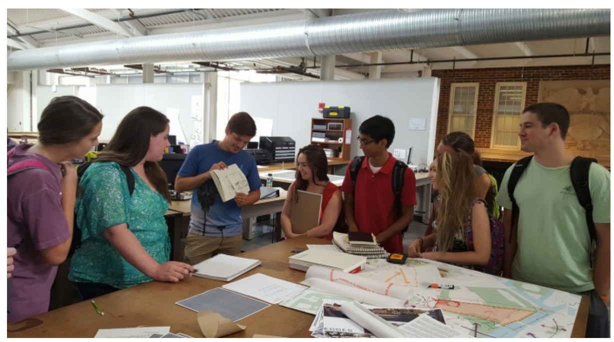


*Figure 3. Sketching review as part of a team meeting, Fall 2015*

Most importantly, however, is the social aspect of the peer mentoring which breaks down the fear level and makes achieving the degree seem possible. "The Success Team program has introduced me to alternative avenues of thought, new friendships, and a glimpse into the future of my architectural studies!", wrote one student. Another stated "This program allowed me to meet other like-minded students who are taking the same classes I am. This allowed me to find partners to work on asisignments with, and to study within a group for our other classes too." Coaches are eager to share their own experiences, especially the difficulties they overcame. A freshman observed "It helped to know that she was once in the same position but improved , and now is in her fourth year of architecture school – it gives me hope!" These impressionable beginning design students see that they are not alone, and that it is alright to be less than perfect in this transition; instead they can perceive the bigger picture of where they could be in just a few short years.

*Program Benefits*

The program benefits are many; for the freshmen the advantage of the assistance of a personal coach is invaluable. Time management is an important topic the coaches are required to discuss with their team – it is the key to success in architecture school, as well as knowledge of how to access university resources. (Figure 4) Coaches also provide the academic and technical assistance of 'this is how you can achieve that' in terms of content and execution quality – not only what to observe and how to document it, but also how to cut, glue, draw, compose, etc. As a result of coach input, the overall homework scores have improved for the course, and the assignments have in fact been allowed to become more complex in their scope.

*Figure 4. Students gather with their coach to discuss time management strategies, Fall 2012*

Of equal importance, however, the coaches provide an introduction to the culture of architecture school, and encourage engagement while offering opportunities for interactions with peers and the student organizations. "My coach kept us updated on school-wide events", one student reported. Freshmen are invited to attend AIAS evening meetings, for example, and when they arrive they actually know someone there. This freshman program has in fact increased participation in the school's student organizations, leading to a more vibrant community from top to bottom.

One critical asset to the course is a section of studio real estate, designated as the 'Intro to Architecture' open studio space which is available for the freshmen to use as if it were an actual studio. (Figure 5) And many do use the space, at all times of the day and week, further increasing their integration into the studio culture. They have a 'home base' in the Architecture Building, should they choose to make use of it.

Not surprisingly, the program has proven to aid with first semester retention rates (August to December), which hovers at 85 - 90% annually. While for most freshmen the program is an affirmation along their intial path in architecture school, for others it helps them realize their passions may lie elsewhere. One student found that "Although the Success Team helped me a ton, I have decided to switch to a different engineering discipline. I enjoyed the assignments but I don't think this is what I want to do." This kind of realization is equally valid.

*Figure 5. A coach discusses design principles with his team in the Intro studio, Fall 2010*

At the end of semester survey, the freshmen responded at a rating of 8.45/10 that the program assisted with their transition into the school of architecture 'community'. With a rating of 9.07/10, they reported that they now understood the expectations (workload, attitude, rewards, etc) of an architecture or architectural engineering student better. These results are consistent with previous annual program survey ratings, indicating that the Success Team concept continues to be making a difference in the feshman experience for students in the school of architecture.

The benefits for the coaches is obviously found in the opportunity to hone leadership skills, involving improved communication techniques, managing group dynamics, and leading activities. The coaches reported at a 9/10 rating that they found their leadership skills were improved as a result of participating in the program. At an overwhelming 9.9/10 rating, the upperclassmen felt that coaching in the Success Team program was a valuable enhancement to their own experience in the school of architecture. One coach earnestly stated that "In my studio it is easy to lose sight of why architecture spoke to me in the first place, and interacting with these new students is refreshing. It lets me escape from ADA, egress, fire suppression, etc for a while." Every teacher in a school of architecture can relate to this sentiment!

*Program Challenges*

With all of these known benefits, there are the inevitable challenges for the program – the major of which is financial. There is a departmental cost to this program as the mentors are indeed compensated a small payment of $300 each for their work in the seven week program. Each year, special funds have to be petitioned from the Dean of the college to ensure the continuation of the program. This is especially problemmatic in difficult budget years.

Another challenge lies in the intial pairing of team members to coach; for many years a random draw method was utilized, with mixed results. More recently, teams have been formed according to the specific major within the discipline (Arch or AE), and that has seemed to improve satisfaction levels with the program. Students typically want a coach who is pursuing the same discipline - someone on the same career path as they now are. Diversity within teams is maintained based upon the random draw of in-state/ out-of-state/ international mixture of students in the course, as well as the racial and cultural diversity found in such a large class.

The most pressing challenge, however, comes from the potential sense of dependency on the coach. In some instances after the conclusion of the seven week program, the coach becomes a lifeline for the freshman student, and the borderline of appropriate involvement can be breached. It is important that the coach doesn't get unneccessarily involved with a student's issues beyond their capability to assist. According to university legal counsel, for student employees participating in the mentorship program, and acting within the scope of his/her employment, Oklahoma's Governmental Tort Claims Act provides some protection against potential liability.[4] In the eleven year history of the program, there has never been a need to utilize university resources to address any such issue, but it requires an awareness of coach and student activities by the faculty.

Despite these challenges, over the years the program has proven itself useful and popular, with freshmen student evaluations ranking it as 'very valuable' – at a 9.2/10 rating. Beginning design students clearly see and appreciate the benefits of the program. A real sense of community is established, even without an actual design studio to facilitate that occurrence. Annually, upperclassmen rush to apply to become coaches in the hopes of making a difference for the freshmen students. The challenges involved with program operations, though they exist, pale in comparison to the many program benefits afforded to the freshman student experience.

***Moving forward:***
***Mentorship through Academia and into the Profession***

The Success Team program is a mirror of mentorship suggested by the AIA Code of Ethics wherein members are encouraged to "nurture their fellow professionals as they progress through stages of their career, beginning with professional education in the academy, progressing through internship, and continuing throughout their career."[5] Indeed, this process of fostering personal and professional growth must begin during the formative years of academia.

This program is the beginnings of professional mentorship for students at our School of Architecture. One coach remembered that "Thinking back to when I first started, I had no idea why I chose this major. I felt lost, a little afraid, and anxious. My success coach helped alleviate these worries while also giving me access to a group of other students who were probably going through the same worries that I was. I want to be just like that person who helped me so long ago, my coach, who ultimately pushed me to become the designer I am today." This is classic 'pull mentoring', where the coaches, just a few years older than the mentees, reach back to assist the next generation of potential architects in line. When asked if they felt that their own understanding of fundamental design issues had been 'refreshed' because of their role in the program, the coaches agreed at a rating of 9.4/10 that their current design thinking had indeed been influenced. Mentors ultimately find that by helping others develop knowledge and skills that enhance the overall organization, they themselves become more successful.[6]

In addition to the Success Team program, within our school of architecture there are two other mentoring programs: the 'Big/Little' program that is organized as a volunteer activity by AIAS for 2$^{nd}$-5$^{th}$ year students and is a continuation of the student to student peer mentoring process, and the newly created Centennial Mentorship Program designed to connect students in professional school with alumni. The Big/Little program was initially conceived by the OSU AIAS chapter over 30 years ago, and has remained a part of the school culture for all these years. Annually, 40 to 50 upperclassmen volunteer to mentor second year students in a one-on-one relationship. (figure 6) Approximately 100 students participate in the program, reflecting a participation rate of nearly half of the eligible student population of the School of Achitecture. The new Centennial Mentorship program is in the test phase, but the intial response from both students and alumni has been very positive. In this program, one alumnus will be matched with two to four professional school students, with weekly contact (Facebook, Skype, Email, etc) required. The purpose of this program is to ease the transition from academia to the profession, by having a mentor available to assist with issues related to job search, development of career goals, and many other issues a soon-to-be graduate will face.

The inherent struggles involved with architecture school, and all that this new culture entails, is the glue that binds these mentoring relationships. Structured mentorship programs can be remarkably successful because they take the pressure off of the junior member from having to ask the more senior member to be their mentor.[7] Social anxiety is lessened, and at the university level student performance can be enhanced.

*Figure 6. AIAS Big/Little program helps to form bonds between upperclassmen and second year students, 2013.*

The importance of mentorship is undeniable in the development of a future professional – whether in the position of mentor or mentee. As a person's needs change throughout their career, so will the qualities they value in a mentor.[8] While structured mentorship programs can be perceived as 'forced' in that those initially paired in a mentor/mentee relationship don't know one another at all, in this situation the shared milieu of architecture school creates an often reciprocal relationship where not only does the mentee gain from the mentor, but the students benefit from knowing one another. The junior members remind the senior members of themselves, therefore it is a natural relationship to sustain.[9]

And so each Fall we welcome our next group of freshmen into architecture school to be mentored by newly promoted upperclassmen, followed in the spring by fifth year students/graduates entering the workforce to find their own mentors as they begin their careers. The chain of mentorship must seamlessly continue through academia and into the profession. In the words of Sheryl Sandberg, "Being unsure about how to proceed is the most natural feeling in the world. Asking for input is not a sign of weakness, but most often the first step to finding a path forward."[10] Occurring in those first two critical months of the student's university career, the Success Team program is a proven means of effectively assisting the beginning design students forge their path en route to becoming professionals.

Notes

[1] Lave, Jean and Etienne Wenger. *Situated Learning: Legitimate Peripheral Participation*. Cambridge University Press, MA, 1991, p 98.

[2] Hara, Noriko. *Communities of Practice: Fostering Peer to Peer Learning and Informal Knowledge Sharing in the Workplace.* Springer Press, 2009, p 11.

[5] ibid, p 17.

[4] Governmental Tort Claims Act, OKLA. STAT. tit. 51, §§ 151-171.

[5] 2012 AIA Code of Ethics, Cannon V "Obligations to Colleagues", section E.S. 5.2.

[6] Goetsch, David. *Building a Winning Career in Architecture*. Pearson Prentice Hall, NJ, 2007, p 183.

[7] Sandberg, Sheryl. *Lean In For Graduates.* Knopf Doubleday Publishing Group, 2014, p 86.

[8] Kim, Grace. *The Survival Guide to Architectural Internship and Career Development*. John Wiley & Sons, NJ, 2006, p 167.

[9] Sandberg, Sheryl. *Lean In For Graduates.* Knopf Doubleday Publishing Group, 2014, p 90.

[10] ibid, p 90.

References for student quotes and program evaluations:

Blind survey of 12 Success Coaches for the ARCH 1112 course, administered Fall 2015.

Blind survey of 89 student participants in the Success Team Program within the ARCH 1112 course, administered Fall 2015.

# One to one to one: a triumvirate of interpersonal relationships in beginning architecture education

James Benedict Brown, Eileen McGonigal | Leicester School of Architecture, De Monfort University

## Abstract

This paper presents a critique of the implicit and explicit conceptions of one-to-one relationships in beginning architecture design education. Over the last two decades, higher education in the UK has undergone a period of profound structural change and marketization, manifested in the introduction of £9,000 fees and the lifting of the government cap on student recruitment. As new architecture courses are established and existing ones grow, the shift in focus from one-to-one design tutorials to group teaching has often been driven not by pedagogical imperatives but by economical and political efficiency.[1] In light of this, our premise is that a successful contemporary studio needs to have three overlapping one-to-one relationships: the tutor-student relationship; the tutor-studio-group relationship; and the student-student relationship. We argue that a group project in and of itself is an insufficient means of prompting a studio group to act collectively and collaboratively. We argue that the historical one-to-one master-student relationship, while an important touchstone for architectural educators, is now secondary in importance to a triumvirate of more dynamic one-to-one relationships.

## Context

For the benefit of those unfamiliar with the recent changes in British higher education, it is worth briefly restating some of the significant milestones that have been passed.

Up until the late nineteen-nineties, university education in the United Kingdom was free of charge. With the passing into law of the Teaching & Higher Education Act (1998), annual tuition fees of up to £1,000 (US$1,700)[2] per annum were introduced. With the passing of the 2004 Higher Education Act, annual tuition fees were raised again to £3,000 (US$5,450). Following the Independent Review of Higher Education Funding and Student Finance (also known as the Browne Report) in December 2010, the Secretary of State for Business, Innovation and Skills Vince Cable announced a fee cap of £6,000 ($9,500) that would rise to £9,000 ($14,200) only “in exceptional circumstances.”[3] Being a free market in name only, within six months of Cable’s announcement all 123 universities and university colleges in the United Kingdom had declared their intention to charge at least £6,000, and more than half (64) would charge the full £9,000.[4] With few universities wishing to be perceived as cheaper than the competition, the “exception” became the norm. Fees for international students outside the EU are substantially higher, significantly incentivizing the recruitment of overseas applicants.

While the upward spiral of tuition fees represents the most visible evidence of the marketization of higher education, the process has been significantly altered by the lifting of government caps on student recruitment. From autumn 2015, British universities are no longer penalised by central government for recruiting beyond their nominal targets. In September 2015, the Universities Minister Jo Johnson argued that if the British higher education sector is to function as a market, then it must be structured in such a way that permits commercial failure. In Johnson’s words, "a properly-run market has to have scope for market entry and market exit. If you don't have scope for market exit, you don't really have a market because there is no incentive on institutions to ensure they are competitive."[5] While, at the time of writing, no university has yet to enter administration, there is a growing sense of unease in the sector that a failure to recruit sufficient numbers of students to attractive facilities across a portfolio of commercially appealing courses will have a profound financial implication, or as our neo-liberal government prefers to call it, "market exit."

Many British universities, notably the former polytechnics that gained university status in 1992, do not enjoy the long-term stability brought by large endowments. Our own institution made headlines in 2012 with the securing of a £110m public bond, the first such private investment in a British university. That investment has been used to invest in campus facilities, including a major redevelopment and expansion of the building in which our school is located.[5]

In addition to this sector wide growth of higher education, the subject of architecture has also grown. Over the last five years a number of institutions have established wholly new undergraduate courses in architecture. There are now some fifty higher education institutions in the UK that offer undergraduate degrees in architecture that are either professionally validated by the Royal Institute for British Architects or that have candidate status for validation. Over the last decade, this represents an increase of approximately one school per annum.

## The shift from 1:1 to group teaching

The changes described above, both to the higher education sector in general and to architectural education in particular, have contributed to a climate in which the inherited École des Beaux Arts model of one to one design tuition is being diminished.[6] The diminishing influence of one-to-one design teaching in architectural education is complex and multilayered, and is supported by three distinct but interrelated arguments: economic, pedagogical and political.

- Given the contextual changes to higher education and architectural education described above, *the economic argument* for group teaching in architectural design – in the UK at least - is obvious: it is simply cheaper to teach in groups, and decisions of appropriate staffing levels are now made by management who are conscious of the financial implications of strong recruitment.

- Over the last three decades *the pedagogical argument* for group teaching has been significantly advanced. Didactic learning permits students to help students, making connections between different projects, identifying similarities of problems and sharing solutions.[7] [8] [9]

- The widening participation agenda of higher education – both at a national level and a subject level - has contributed to a compelling *political argument* for group teaching. We believe that group teaching to be more inclusive for students of international, minority ethnic and social groups.

Given these familiar arguments, how can the beginning architectural design educator reconsider the role of the one to one relationship in architectural education?

## Thesis: a triumvirate of interpersonal relationships

There is an apocryphal quote attributed to the Brutalism husband and wife duo of Alison and Peter Smithon that, instead of the normative progression in scale from micro to macro, students of architecture should begin their first year studies by designing an airport and gradually progress downward in scale until they design a door handle for their thesis project. Inspired by this provocation, in this paper we adopt a position that argues against the tendency for students to begin with group work in their formative early semesters before progressing to the height of individualism in their thesis project. Our premise is that an inclusive design studio needs to engage with three overlapping one-to-one relationships throughout the course of an undergraduate degree, and not merely that of the traditional studio-master and student.

*1. The tutor-student relationship*

The foundation of our triumvirate remains the traditional tutor-student relationship. The origins of formal architectural education in the atelier system of the Parisian École des Beaux Arts have been widely discussed[10] and critiqued.[11] [12] What we find compelling is that the contextual changes affecting higher education and architectural discussed at the start of this paper have contributed to an academic climate which has lead to a questioning of the sacred cows of design studio education. While preparing this paper in January 2016, a snapshot survey of first year undergraduate design studio educators at about a half dozen British schools of architecture revealed that design studio staff-student ratios range from as 1:12 to 1:24, typically with one or two contact days per week. Anything beyond the median ratio is not likely to support a satisfactory pedagogical encounter if tutors persist with one to one tutorials, thereby obliging even the most reluctant of educators (tenured or not) to engage with the possibilities of group teaching. In the beginning architecture design studio of the Leicester School of Architecture, we expressly forbid our design tutors from conducting individual tutorials unless a specific personal pastoral matter demands it. Switching from individual to small group tutorials does cannot completely alleviate Webster's critique of the design tutorial between Professor Quist and student Petra in Schön's *Reflective Practitioner,*[13] but the introduction of a third or even fourth voice encourages students to become critical and constructive participants in others' tutorials. The development of beginning architecture students as critical thinkers who participate constructively in all tutorials makes new demands of our tutors. As the student assumes responsibility for these contributions, so the tutor must respond proactively to the new directions brought about by students – even in the first year of the undergraduate course.

This model supports what we regard as the on-going evolution of the architectural design teacher from *studio master* to *studio facilitator*. It is, in turn, reflected institutionally by beginning design projects that place a significant if not equal value on academic process as architectural product. It also facilitates student work that reflects more deeply the interests of the student herself, instead of the personal values and interests of the studio master, at least until the moment at which a student can select their preferred (or second-preferred) studio or unit option.

*2. The tutor-studio-group relationship*

During his tenure as Chairman of London's exclusive Architectural Association School from 1971 to 1990, Alvin Boyarsky laid the foundations for a capitalist interpretation of the École des Beaux Arts model of the atelier. Sitting around what Boyarsky famously called "a well laid table," students express their preference for a studio master based on their their interests, experience and pedagogical or architectural proposal.[14] Whereas the student of the École des Beaux Arts sought out their studio master in the city, Boyarsky's model formalised the school itself as the market place (or dining room buffet) of the atelier. This model has, in turn, influenced countless other schools around the world, including our own. Studio masters were expected to sink or swim based on the popularity of their studio proposals. With tuition fees rising and traditional academic institutions struggling to articulate the relevance of their teaching, the UK is amongst a number of European nations to witness the emergence of a new model of postgraduate architectural education. The London School of Architecture, established in 2015 and currently persuing professional validation, partners with architectural offices throughout the capital to deliver evening classes alongside practical experience. Having no physical home, lectures and seminars take place in the spare practice meeting rooms. Meanwhile, in Lyon, the French architect Odile Decq has established Confluence, a boutique postgraduate school of architecture that capitlises on the professional reputation and branding of its starchitect patron. We imagine it is only a matter of time before international starchitects with large London offices realise the economic opportunities of charging their interns for an education.

In all of these examples, the physical learning environment of the studio is retained. However that environment is no longer exclusively within the school itself. And so the notable development of the relationship between tutor and studio group can be seen in the realm of mobile technology. Whereas the computer entered architectural practice and education as a standalone device for the completion of discrete tasks, digital technology now has the greatest role to play in terms of dispersed and user-centric communciation.

Beginning in 2015, students in the first year of our BA(Hons) Architecture and BSc(Hons) Architectural Technology courses have been been offered a reinterpretation of the traditional introduction to CAD and BIM through a Blended Learning model. This was driven by the recognition that a wider and more appropriate means of communication was needed between tutor and studio group. As the first school of architecture in the UK to subscribe to the American video library Black Spectacles, students at the Leicester School of Architecture have access to hundreds of hours of on-demand video that explain and demonstrate everything from first principles to precise tasks of numerous major software platforms. These can be watched, paused and re-watched at the student's own pace, and thanks to mobile technology, in any location supported by wifi or mobile data. Crucially, this new technology has not been used in isolation. Lectures and drop-in workshops blend traditional teaching modes with independent learning. The final component of the module is a simple online forum, curated by module leaders and tutors who categorise and respond to student queries. In many instances, these queries have been answered by other students before tutors, but as in other public internet forums, the tutor maintains a softly-softly input as forum moderator.

In many ways, embracing this peer-to-peer model of learning has been driven in part by a search for pedagogical innovation, but also by a recognition that students will use social networks which tutors cannot be expected to participate in. We may not be able to inform or police every Facebook, Snapchat or WhatsApp conversation, but by providing learning resources through our own institutional systems or proprietary platforms such as Pinterest, we can provide for both multiple modes of learning and for the cross fertilisation of architectural precedents between studio groups.

*3. The student-student relationship*

The third leg of our triumvirate of one to one relationships in beginning architecture design education is that between individual students. We have seen above how students can be supported through formal and informal virtual environments, both with and without input from faculty staff. At the Leicester School of Architecture, in the current academic year we have adopted a number of modest adaptations to the delivery of the first year design studio modules. These changes to the macro-structure of architectural education seek to support the development of informal networks at the micro-level

While much has been written on the positive and negative effects of the traditional crit or design jury, especially on beginning design students,[15] we have built on the work of our peers to develop an approach to design reviews that sets them as a venue not only for expert feedback but also for student to study feedback. This builds on a now established tradition in British architectural education that regards critical thinking as a necessary component in the development of creative capacities.[16] [17] Studio lectures - weekly events within the 60 credit[18] design module - are used repeatedly to discuss not only the project being undertaken but also where it sits in the frameworks of the individual module and overall curriculum. The difference between summative and formative feedback is distinguished, and design reviews are programmed not as end of term events, but as part of a continuum of weekly formative feedback. We do not believe that is reasonable to expect a beginning architecture student to enter their studies with an appreciation of the difference between formative and summative feedback, not between formative and summative assessment.

Beginning in 2015, pairs of students in the first year of the BA(Hons) Architecture degree at the Leicester School of Architecture have been responsible for the weekly completion of mutual tutorial record forms which must be submitted as part of the academic portfolio for assessment. At the end of a project, the project review (or crit) does not contribute to the formal assessment, which is made by the tutor against the portfolio of work.

Project reviews, like those in most institutions, are open events in the neutral territory of a review space, i.e. one that is not normally assigned to a particular cohort. In addition to separating out the delivery of feedback from the academic assessment of the portfolio, our students submit anonymously using student number instead of name. Not only is informal peer to peer feedback and discussion of work encouraged by this veil of anonymity, but also by setting pin-up deadlines at 4PM the evening before an all-day review, students have time before every project review to tour and discuss the whole cohort's work, not to mention sleep soundly for twelve hours.

## Conclusion

We have made the argument elsewhere[19] that the pedagogical discourse surrounding architectural education in the United Kingdom is akin to an inverted duck. Above the surface, there is much flapping and paddling, while below the surface everything continues in exactly the same manner. Every few years, our community has a tendency to try and "reset the agenda" via the platforms of conferences such as *Changing Architectural Education: Society's Call for a New Professionalism* (De Montfort University, 1999) *The Oxford Conference* (University of Oxford, 2008) or more recently the annual conferences of the new Association of Architectural Educators (Nottingham Trent University, 2013; University of Sheffield, 2014; & University College London, 2016). While we resist the bombastic desire to announce a complete revolution, we are eager to report to our North American cousins that we find the situation faced by architectural educators in the UK today presents a rare opportunity for innovation. That innovation is both driven both by circumstance and aspiration. The changes to university tuition fees may not appear unreasonable in comparison with American universities, but the pace of change in the UK has been remarkable. We must emphasize that the shift from one-to-one design tutorials to group teaching is not driven only by economical and political efficiency, but also by recognition of the profound benefits it brings to beginning architecture education. We seek to reclaim this narrative, by emphasising not a linear (and therefore, by implication, regressive) change from that which is perceived to be better to that which is worse, but instead learning and teaching environment in which there are multiple layers of one to one relationships. The beginning architecture design studio, perhaps more than that at any other level, needs to explicitly engage with and support the three overlapping one-to-one relationships.

## Notes

[1] McGonigal, E. *The Largest First Year in the UK – Size Matters*. Paper delivered to the CEBE Conference, London, November 22, 2005.

[2] Where tuition fees have been converted into US Dollars, historic exchange rates have been used. Source: http://www.xe.com/currencytables/

[3] House of Commons Debate 9 December 2010, vol 520, col 542 [Online]. Available: http://www.publications.parliament.uk/pa/cm201011/cmhansrd/cm101209/debtext/101209-0002.htm#10120946000003 Accessed 6 December 2015.

[4] Sedghi, A. & Shepherd, J. "Tuition fees 2012: what are the universities charging?" in *The Guardian* [Online], 23 June 2011. Available: http://www.theguardian.com/news/datablog/2011/mar/25/higher-education-universityfunding Accessed 6 December 2015.

[5] Espinoza, J. "'Let failing universities go to the wall,' says minister" in *The Telegraph* [Online], 9 September 2015. Available: http://www.telegraph.co.uk/education/universityeducation/11854659/Let-failing-universities-go-to-the-wall-says-minister.html Accessed 26 December 2015.

[6] Crinson, Mark & Lubbock, Jules. *Architecture – Art or Profession*. Manchester: Manchester University Press, 1994.

[7] Dutton, T.A. (ed). *Voices in architectural education: cultural politics and pedagogy*. London: Bergin & Garvey, 1991.

[8] Nicol, D. and Pilling, S., (eds). *Changing Architectural Education: Towards a New Professionalism*. London: E & FN Spon, 2000.

9 Salama, Ashraf. *Spatial Design Education: New Directions for Pedagogy in Architecture and Beyond*. Farnham: Ashgate, 2015.

[10] *Ibid*.

[11] Stevens, Garry. *The favored circle: the social foundations of architectural distinction*. Cambridge, MA: MIT Press, 1998.

[12] Webster, Helena. "Architectural Education after Schön: Cracks, Blurs, Boundaries and Beyond" in *Journal for Education in the Built Environment*, 3(2), December 2008, 63-74

[13] *Ibid*.

[14] Cook, Peter. "Alvin Boyarsky (1928-1990)" *Architectural Review* [Online] Available at: http://www.architectural-review.com/rethink/reputations/alvin-boyarsky-1928-1990/8636161.fullarticle September 28, 2012.

[15] Koch, Aaron et al. *The Redesign of Studio Culture: A Report of the AIAS Studio Culture Task Force*. Washington, DC: AIAS, 2002.

[16] Morrow, et al. *Building Clouds Drifting Walls. Year One Design Studio: A Critical Appraisal.* Sheffield: University of Sheffield, 2003.

[17] Harris, Harriet & Froud, Daisy, (eds) *Radical Pedagogies: Architectural Education and the British Tradition*. London: RIBA Publishing, 2015.

[18] Out of 120 credits per annum.

[19] Brown, James Benedict. "Conversations with Paulo Freire" in Harriet Harris & Daisy Froud (eds) *Radical Pedagogies: Architectural Education and the British Tradition*. London: RIBA Publishing, 2015.

# It's That Big: 1:1 Modeling in a First Year Curriculum

Michael Swisher, McKenzie Canaday | University of North Carolina at Charlotte

## Note:

*What follows below is a hybrid submission, part abstract, part writing sample and part outline. Because our presentation incorporates three distinct perspectives, we thought it necessary to present a fragment of each voice. Therefore, the first paragraph –* General Framework *– Is a brief abstract of 107 words. The remaining abstract is now a part of the paper.*

## The Structure of the Presentation:

*General Framework – The Abstract:*

This presentation facilitates three views into our First Year program. It presents part of what we do, why we do it, and the experience of teaching it. It proceeds from three voices. The two authors of the paper present two distinct voices regarding the material. The first voice is that of the original author of the assignments and assignment sequence. The second voice represents the experience of a former student, now a current teaching fellow. The third voice is a hybrid of both authors. Thus, we present both the intention and the experience of our program. Following that, we present a reflection on results of that structure.

*The Working Premise:*

A little context by way of history should set the stage. Our first year program consists of four studios that share not only projects but also common daily lectures and assignments. The teaching staff includes two tenured faculty members and two teaching fellows.

Our structure is a little over ten years old. It has been going on long enough that our two current fellows (McKenzie Canaday and Will Philemon) both are products of the system (albeit an earlier version).

The working premise of first year is that we assume nothing of the student. We choose our students after a fairly rigorous admissions process that includes personal interviews. This means that we are able to ascertain both the fit of the program to the student and the student to the program.

We know a bit about our students. We know that our newest students do not hold the skill set that we as teachers and designers possess that allows us to see scale accurately and that becomes our first objective.

These first observations support that the ability to look at an orthographic drawing and see its spatial implications is a skill set that we learn through practice and not through theory. As with reading – where we no longer see letters but only the words, our memory of learning that skill set resides in the distant past, a vague memory.

Our first semester projects lead students to discover a relationship between orthographic drawings and physical modeling – between two-dimensional and three-dimensional design. In focusing on that relationship, the issue of scale complicates learning unnecessarily. Therefore, in practice, we lead the students to perceive order and assembly in drawings first and in models second. Here the role of three-dimensional modeling has a distinct purpose. It underscores both material knowledge and the problem of assembly.

Later in the second semester, we introduce the transformations of those 1:1 skills and apply them to scaled artifacts.

The first image group presents the entire sequence in our first figure-ground assignments. These typically occur during the first week of the semester. Aside from the discussion of figure ground, defined and implied spaces, and the construction of grids, these exercises allow students to craft small drawings that are exactly the size they are.

These are not buildings, but they are architecture – compositional arrangement within a hierarchy. The central purpose of making the drawings is practice, a craft issue.

Equally important, however, the students study the drawings to familiarize themselves with the critical visual impact of different kinds of marks. These include weighted pencil lines, cut black paper and cut yellow trace. While not an explicit part of the assignment objectives, these materials begin the slow process of leaning to see into a drawing, to initiate its richer representational capacity.

As the semester progresses, the subtlety and complexity of imagined visualization – seeing in – becomes more central to the task.

(Images of diagram cards and diagram models from project group 3 possibly and axon card from project group 2) – Student examples

(See outline)

## Voice One – Underlying Assumptions:

Three project groups in ascending complexity and length comprise the first semester project groups. As mentioned, the first project group lasts one week and has four distinct steps.

The second project group builds on those figure-ground observations. It adds multiple elements within the ground and vertical and horizontal planes as part of the figures.

(Images of figure-ground black + yellow cards – photographs of final projects, models/drawings, and express the particulars of the students design logic and execution)

These added elements require a more deliberate observation from the students, including constructed models of the resulting composition. Throughout the project, the assignments play back and forth between two to three-dimensions, building hopefully clear relationships in the minds of the students.

The third and final project group proceeds from a three-dimensional construct utilizing all three axes – X, Y and Z.

The purpose of that construct is to challenge the dominant reading of ground as a literal base. The elements – thee volumes – have specific spatial orientation, one for each axis. We mentioned that for the first time the student's model at half the size of their initial drawings. This allows for a casual early discussion of scale. Overall, the project serves to introduce a broader range of formal elements. These include linear columns and beams, planes of three materials and a series of presentational strategies.

(See outline)

## Voice Two, Part One – A Former Student's Reflection:

In recalling my own experience as a student, there were four integrated components to what I learned in the first semester. Both learning to describe (learning what) and learning to make (learning how) played equal reciprocating roles. I first began to learn the language of description and with it acquired a vocabulary that was quite specific to the tasks at hand. These in turn helped to name the fundamental design principles of pattern, beginning with figure/ground and extending to axes, boundaries, fields and figures (the formal language of figure/ground).

Building on those two was the acquiring of skills, using tools to make adequate two dimensional and three dimensional models.

At last I learned to see, to visualize two dimensional thought and their embodiment in three dimensional form. This included recognizing and manipulating pattern and doing so to define comprehensive order.

(See outline)

## Voice Two, Part Two – A New Teacher Observes:

So what is composition?

Composition is:

- Anyhting that's structured by a set of rules. Any grid is composed
- Pattern making exists as a result of composition.
- Any arrangement of form in either two, three or four-dimensions (music is a four-dimentional event – time and energy).

Compostiion is that set of rules that dictate the arrangement of of the formal analysis of any two-dimentional or three-dimentional work. The rules governed are description of the relationshio between figures in any given composition.

I now find myself teaching the same assignments, shifting my role from novice to authority. As much as that makes me uncomfortable, I have discovered the role of my voice, my point of view. I present to the students an educated aspect calling on my own experience to help them accept the difficulty of new learning. In addition, the language that I struggled so hard to learn helps me clarify for the students the precise role of language in shaping the assignments.

Part of our teaching method involves maintaining a journal. It is witihin the journal that the studetns add language to images and attempt to summarize their learning.

When I was a student, the journals represent a way of putting my thought into pattern. For this reason the journal has been a major focus in my contribution to the assignment structure.

This past semester I introduced the students to a continuous drawing in the form of an unfolding single journal page. The students struggled mildly from this. There were two things that I learned from this. The project forced me to confront just how much I learned in six years that I've studied architecture. Sharing knowledge is not as easy as people want to think.

The project was an unqualified passable experience. Despite that I spent most of my time demonstrating my skills techniques new to the students, in the process learning something about teaching

(See outline)

## Voice Three – Our Conclusions:

From the materials we present it should now be obvious that designing 1:1 is more subtle than wacking together 2X4's. In our experience it is literally connecting your eyes your hand and your mind. Aristotle wrote early on that there are two kinds of knowing: *knowing that,* and *knowing how.* The first is a set of facts or truths. The second is practical, describing technique and actions that allow us to understand the world beyond facts. Scale can be thought of as theoretical, but it is only understood when we experience it as a physical sensation.

As we've said, the overall goal of the first semester studio instruction is to promote the cognitive skills necessary to perceive and manipulate order in the world and in those things we design. Central to our approach are drawing (in its broadest sense) and making artifacts – models. Connecting those two actions – orthographic representation and three dimensional form – underwrites and edits all the projects in our first semester.

We make the assumption that most errors come not from poor thought but from weak observation, not from bad facts but from bad practice. Students literally cannot see what they do in any critical way. Our teaching therefore, focuses on formal order and the perception of that order. Keeping scale issues to the side – working 1:1 – keeps things simpler and more direct.

As you have seen in the materials we present, designing 1:1, has a richer aspect than just making real things. We feel that by holding back illusions of scale, our first semester studio sequence builds a foundation of close observation and aids in learning that most difficult of meta skills - seeing in a two dimensional artifact implications for three dimensional constructions. It is our experience that the original premise (that learning to see accurately is paramount) holds as valid. We hope that in our demonstration we have made that clear and also suggested an underlying method that could be integrated in any number of early assignment sequences.

## Outline

*I. Premise*

- The general framework
- The working premise

(See above)

Materials presented will include:

- Relevant orthographic drawings
- Images of volumetric models – physical and digital

*II. Voice One*

- The underlying assumptions

Materials presented will include:

- Examples of all three projects from teaching materials

(see following **Images**)

*III. Voice Two – Part One*

- A former student's reflection

Materials presented will include:

- Journals
- Examples of own work

*Iv. Voice Two – Part Two*

- A new teacher observes

Materials presented will include:

- Student journals
- Examples of student work

*IV. Third Point of View*

- Our conclusions

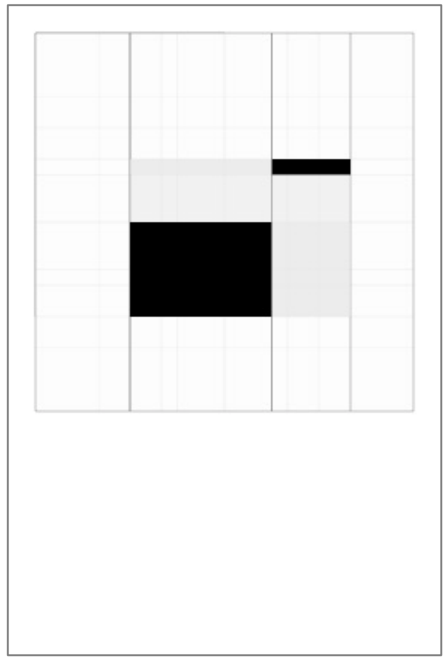
Michael Swisher & McKenzie Canaday

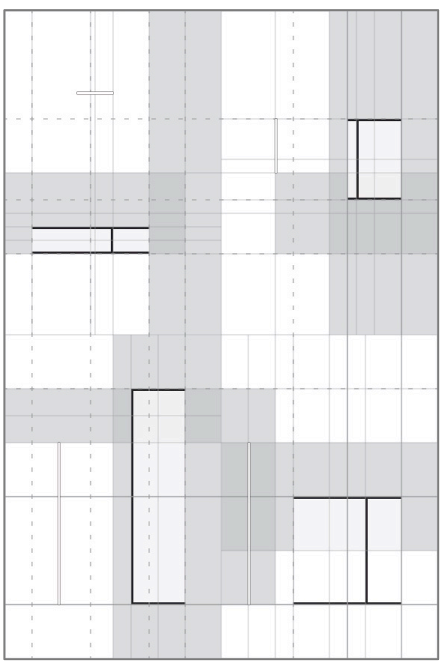
**Images:**

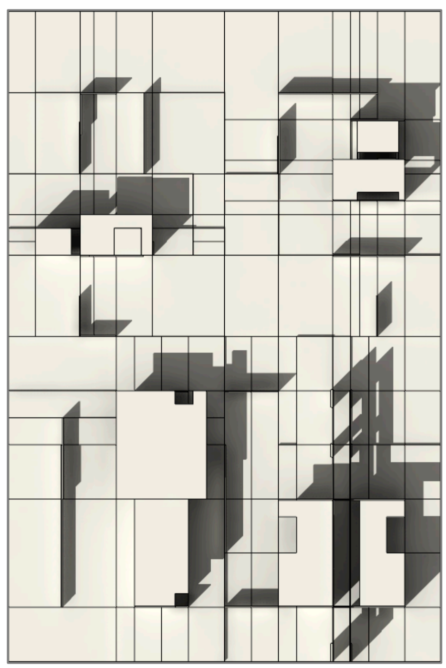
**Left:**
Project 1: *Example, Figure-ground field study.*

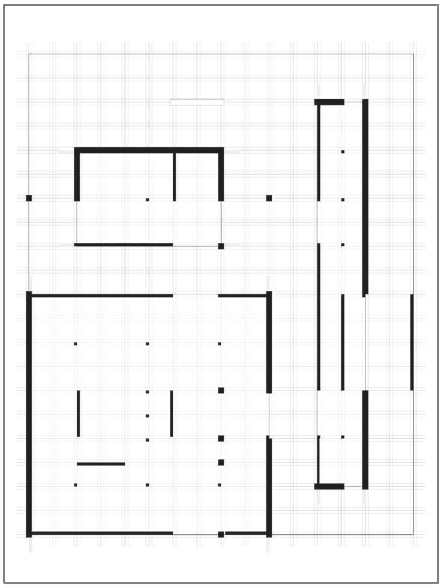
**Below left:**
Project 2: *Example, Figures & Fields, drawing.*

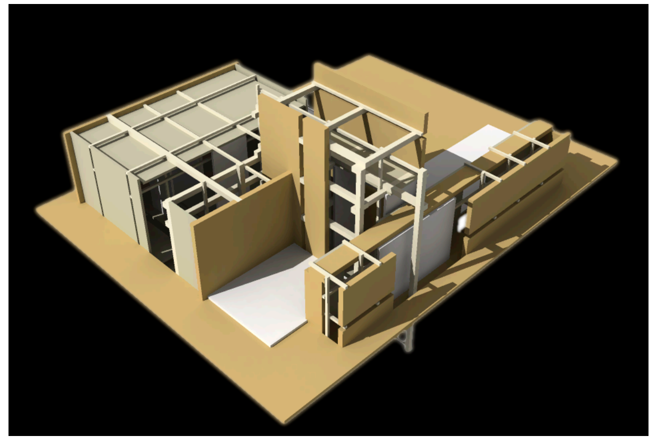
**Below right:**
Project 2: *Example Figures & Fields, virtual model.*





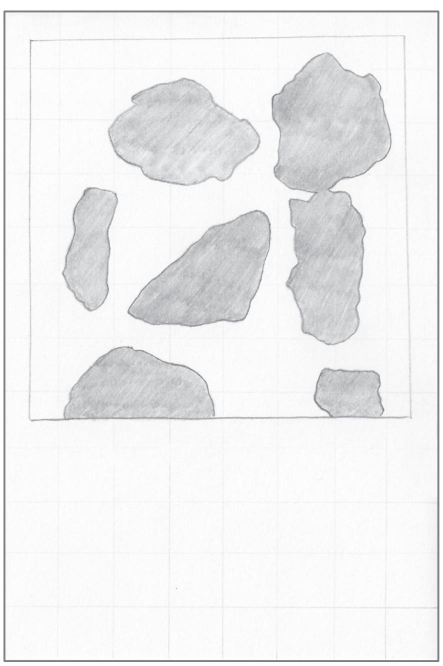


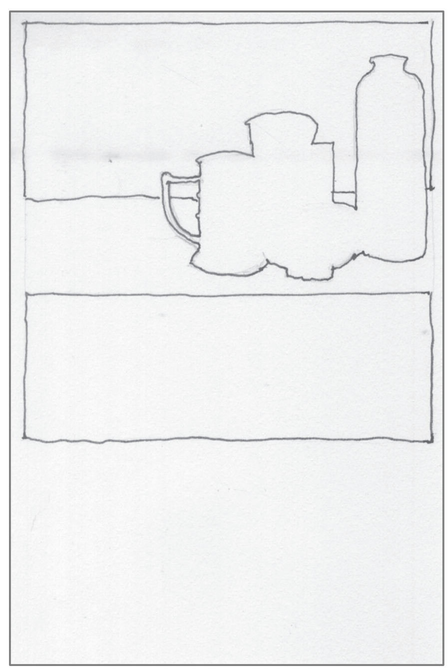




**Above:**
Project 3: *Examples, plan and virtual model.*

**Below:**
Skills class: *Student examples, figure-ground studies.*





# Beyond the Studio: Alternative Models of Student/Teacher Engagement

Erin Carraher with Genie Bey, Michael Hoehn, Marin Smith, Michael Soderberg, Otto Stefan, Andrew Steiner, Connor Stephens, Alexis Suggs, Scott Thorne, Alan Taylor, Jody Zimmer | University of Utah

## Introduction

*"Education is the acquisition of the art of the utilization of knowledge."*
*Alfred North Whitehead* [1]

The roles of teacher and student in contemporary architecture education began with the master and apprentice model prior to the establishment of formal education programs. When education formally distinguished itself from practice, architecture educators evolved in their roles depending on the cultural context – they served as masters to ateliers of students in the Beaux-Arts model, shepherded students through rigorous technical training in the German polytechnic, and later transitioned to a more collaborative role at the multi-disciplinary Bauhaus. Contemporary architecture education, which began in the middle of the 19th century, has roots in all of these models.

The development of curriculum and pedagogy at this time was also strongly influenced by John Dewey's progressive education model that emerged at a timely confluence with the immigration of Bauhaus leaders like Walter Gropius, Josef Albers, Ludwig Mies van der Rohe, and Laszlo Moholy-Nagy to the United States in 1933. The two pedagogical models shared a 'learning by doing' approach that valued group work, exploration and risk-taking, and civic engagement.[2] However, architecture programs like all forms of education are currently grappling with an increasingly global, digital, and market-driven world in which both the means and methods of teaching the next generation of students are in flux.[3]

The types of people who will thrive in this new context are those who are able to not just problem solve but to challenge the very nature of the problem. "The new economies demand a deeper conception of talent and the organic nature of our lives demands it too. What we become in future is deeply influenced by our experiences here and now," says education reformer Ken Robinson, who champions creativity as a critical skill for all students. "Education is not a linear process of preparation for the future: it is about cultivating the talents and sensibilities through which we can live our best lives in the present and create the best futures for us all.[4]"

If today's more and more diverse student population faces a future where the only certainty is change, if they will be tasked with challenging norms to define their own careers and finding new ways of critically addressing the complex issues of our time, if they are motivated to work across disciplines and value the collective mind over the individual genius, then today's educators are tasked with nurturing their abilities in integrative, synthetic thinking, empathetic entrepreneurship, and in fostering collaboration through open-ended, real-world projects.[5] Students need to find problems interesting to be motivated to spend the time exploring them. They need to feel like the work they are doing – at however early a stage in their education – is relevant and of benefit to others.[6]

*Student Perspective: "This [ChicagoLAB service learning] experience prepared me more than any course or studio for the professional field. It was experience you could not teach in a classroom, and the knowledge gained through the experience continues to help me practice architecture professionally. You can talk about [the experience of practice] all you want in the classroom, but until you participate in a program like ChicagoLAB you'll never really understand what architectural practice really is." Jody Zimmer (BS Architectural Studies '13, M Arch [University of Michigan] '15)*

A model already exists in architecture education that supports the development of each student's abilities and interests through a deep interpersonal relationship with their studio professor. During the exploration of increasingly complex projects, architecture students work to holistically address program requirements, develop an artistic vision, and resolve technical issues within a broader social, environmental, and cultural context. "What most distinguishes architecture education from other types of professional and graduate training is its syncretic nature. Geared to producing skilled practitioners and founded on concepts and discursive formations that have evolved since the time of Vitruvius, it combines technics and aesthetics, sciences and humanities. Schools are called on to impart highly disparate types of knowledge, negotiating the architect's multiple identities as craftsman, technician, and creative artist; professional and intellectual; public servant and businessman."[7]

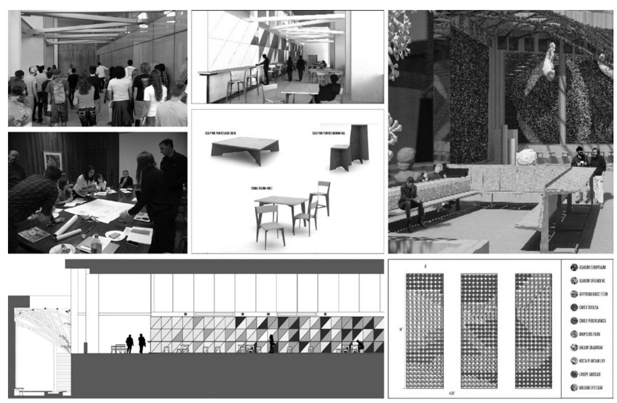
This paper presents a number of projects that build off of the best aspects of architectural education but move beyond the traditional studio to utilize faculty design and research projects as learning opportunities for students to deploy their growing skill sets within a supervised, professional context. The pedagogical, conceptual, and contextual framework for this approach to service learning, research-based projects will be presented from both the faculty and student perspective.

## Authentic Learning Experiences

According to Barbra Davis in her book *Tools for Teaching*, "Authentic learning focuses on complex real-world problems and their solutions. The instructor selects a problem that is ill-defined and that requires sustained investigation and collaboration. Students are not given a list of resources but must conduct their own searches and distinguish relevant from irrelevant information. Authentic activities engage students in making choices, evaluating competing solutions, and creating a finished product.[8]"

Architecture studios utilize problem- and project-based learning strategies to create such authentic learning experiences, which have been shown to produce students who are "more motivated, demonstrate better communication and teamwork skills, and have a better understanding of issues and how to apply their learning to realistic problems" than those educated using traditional models[9]. "Professional education is also by its very nature *formative*; its impact on the young architect is intense and enduring."[10] Education is not about myopically preparing students for the challenges of today but setting them up as future critical practitioners. Meaningful experiences with research and exposure to practitioners while still in school activate students' quest for information and desire to develop new ideas.[11,12]

In this context, teachers are not conveyors of facts but cultivators of experiences who recognize opportunities to develop worthwhile experiences.[13] As Dewey states, all knowledge is abstract until it is applied through experience: "Growth depends upon the presence of difficulty to be overcome by the exercise of intelligence. Once more, it is part of the educator's responsibility to see equally to two things: First, that the problem grows out of the conditions of the experience being had in the present, and that it is within the range of the capacity of students; and, secondly, that it is such that it arouses in the learner an active quest for information and for production of new ideas."[14]



*Library Sculpture Garden Project Process - Student Interns: Elizabeth Poulsen, Genie Bey, Katja Lund, Michael Hoehn, Otto Stefan, Sara Xu, Scott Thorne, Brooke Keene; Library Collaborators: Luke Leither, Greg Hatch, Ian Godfrey*

## Applied and Transferred

Such experiences cannot be isolated, but must be developed with an understanding of the students' background and future trajectory in the curriculum. According to the seminal 'Boyer Report' (formally titled *Building Community: A New Future for Architecture Education and Practice*), "A connected curriculum would encourage the integration, application, and discovery of knowledge within and outside the architecture discipline, while effectively making the connections between architectural knowledge and the changing needs of the profession, clients, communities, and society as a whole."[15] This statement echoes Walter Gropius sixty years after the fact: "I want a young architect to be able to find his way in whatever circumstances; I want him independently to create true, genuine forms out of the technical, economic and social conditions in which he finds himself instead of imposing a learned formula onto surroundings which may call for an entirely different solution. It is not so much a ready-made dogma that I want to teach, but an attitude toward the problems of our generation which is unbiased, original and elastic."[16]

To teach critical thinking skills requires not only addressing the theory of creativity but also its application in practice, says Robinson. Students need to be able to imagine new things, develop their ideas through multiple iterations, and be able to bring them to fruition[17] through self-discovered learning rather than through imposed facts.[18] Davis describes an approach called 'guided design':

> In guided design...students work in groups of four or five, and they are led through a complex sequence of steps to solve real-world problems, with the instructor providing feedback at each step. These steps might include defining the situation, stating the problem and goal to be achieved, generating ideas and selecting the best one, defining the new situation that would result when the selected idea is implemented, preparing a detailed plan to implement the idea, implementing the plan, and evaluating and learning from the success or failure of the process and the plan. Guided design serves as a bride from single-solution textbook problems to applied open-ended problems.[19]

Open-ended problems support the development of the ultimate learning outcome – transfer – that occurs when students are able to independently apply what they have learned in one situation through the translation to another context[20]. This "adaptive expertise" enables navigation of rapidly changing environments though it is may not equate to traditional academic success in the ability to retain facts and figures.[21] The benefits of applied learning experiences need not be restricted to quantitative; Dewey's concept of "collateral learning" is used to qualify adjacent and indirect learning. "Collateral learning in the way of formation of enduring attitudes, of likes and dislikes, may be and often is much more important than the spelling lesson or lesson in geography or history that is learned. For these attitudes are fundamentally what count in the future. The most important attitude that can be formed is that of desire to go on learning."[22]

## Learning Context

Designing environments for optimal learning requires a learner-centered approach; clarity in what is taught, why it is taught, and what competency of the subject matter entails; understanding where students are coming from; and fostering a supportive and collaborative context.[23] At the University of Utah, this type of environment is supported at each scale – university, college, and department. The case study project structures described below not only provide alternative models to the traditional studio structure of engaged education, but they also meet a mandate defined by the current university president to "offer every entering high school student the opportunity to participate in at least one signature experience — a genuine and deep engagement outside the classroom."[24] These experiences are not meant as extra-curricular or optional but as ones that transcend the traditional lecture course (or studio) framework to provide students with a transformative learning experience.

The College of Architecture + Planning has a value- and place-based approach to structuring the educational experience: "We believe that innovative processes predicated on human-centered, evidence-inspired, integrated, collaborative inquiry and harnessing emergent technologies to enhance these processes are essential to preparing the design mind of the future. These processes must be tested in real-world applications—such as problem-based community engaged learning, applied research and reflective practice—so as to both respond to the needs of our local, regional and global communities and to provide immersive educational experiences that create a strong foundation for life-long learning."[25]

Grounded in this context, the School of Architecture supports students connecting "their values with making and the production of space." We believe an architect should be "a dedicated team player that seeks to elevate everyone in the community through collaboration. They should be constantly curious, learning and expanding their understanding of culture and the impact of architecture on communities."[26]

## Service Learning

Each of the case studies – all of which incorporate first- and second-year undergraduate architecture students – has as its intent not only the development of a design concept but the understanding of how the design can have an impact, how students can develop empathy through engagement with diverse populations, how community engagement can be a mutually beneficial experience bringing significance to students' work, and how these experiences can lead to the transfer of knowledge to new contexts as students continue to grow.

*Student Perspective: "I enjoyed being involve and seeing how I could make a difference through service and in turn learn about architecture. I am still learning how to do this, but the Girl Scout cabin project was the springboard for my continued community involvement. Because of this one project, I later participated in the ChicagoLAB, DesignBuild-BLUFF program, served as the Student Advisory Committee representative, served on the Curriculum Committee, was elected AIAS president, worked as a graduate research assistant, and helped coordinate the college's professional mentoring program. Through each of these projects I was able to network with other people across many disciplines, connections that helped me to easily find employment immediately following graduation." Marin Smith (BS Architectural Studies '13, M Arch '15).*

*ChicagoLAB student team reviewing progress with program director Andrew Balster.*

The case studies include: a program developed by the University that offers students funded research positions working with faculty mentors; a summer applied research program embedded in leading architecture offices where students pursue academic projects tied to ongoing themes in the local community; and a series of one-off opportunities to engage students in research or outreach with a tangible design outcome. Though diverse, each project involves a service learning component.

Defined as a pedagogical approach that combines teaching and civic engagement, service learning "emphasizes reciprocity between students and an outside agency and its clients – the insights, experiences, and benefits each can offer the other – and includes a series of formal reflective activities. Service learning courses can (1) broaden and deepen the intellectual content of undergraduate instruction by integrating theory and practice; (2) increase students' motivation to engage in academic work through the experience of applying knowledge; (3) encourage students to develop their skills as independent scholars and researchers; and (4) contribute to students' sense of civic and social responsibility."[27]

## Case Studies

*Undergraduate Research Opportunity Program (UROP)*

Context: UROP is an ongoing university program to support faculty interested in involving undergraduate students in ongoing research by providing funding for research pay for students up to 120 hours a semester

Educational Objectives (faculty): to provide undergraduate students exposure to applied research methods and developing professional case studies

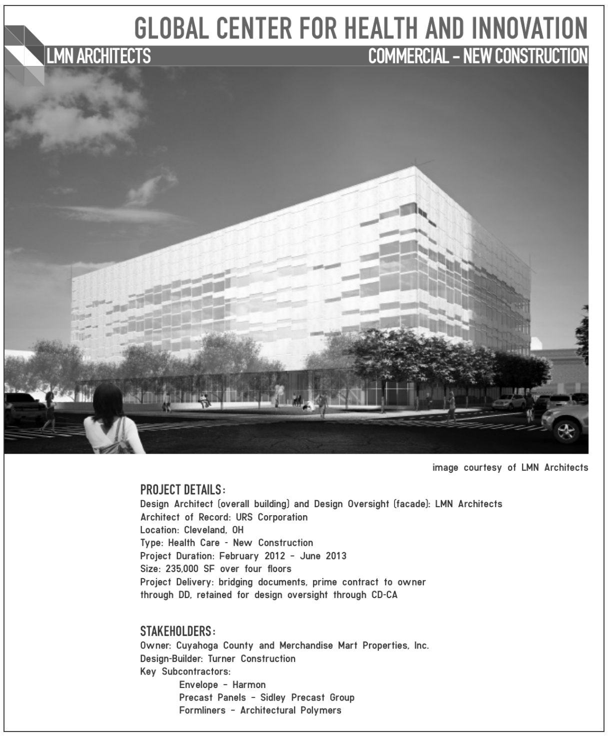
Timeframe: 1-2 semesters (ongoing)

Faculty Mentors: Ryan E. Smith, co-author and co-advisor to Michael Hoehn and Diego Garrido; Anne Mooney, advisor to Alan Taylor

*Student Perspective: "I was really interested in learning about research practice in architecture as an undergraduate student so that I could gain experience before attending graduate school and determining my potential career path. My hopes were to find out if this would be an area that I would like to focus on in my continuing education. I was also interested in the topic of the research itself [leadership and collaboration] because I felt it was an area in which I needed improvement. I felt that both of my mentors were great examples of leadership and people I could truly learn from." Michael Hoehn (BS Architectural Studies '16)*

*Student Perspective: "I worked offsite in a professional firm for a semester-long research experience that developed into an internship with the firm in the summer. The biggest draw for me was to experi-*

*ence the difference between academia and the profession. It allowed me to work on a professional project and really affect it in a way that was tangible. I was doing work that was no longer for myself or my institution but for a client. I had never worked on a project like this and was lef to to my own devices to creatively problem solve and figure out what to do and how to do it. Half of the time, I felt like I had no idea what I was doing, but then meeting with my professional mentor always brought me down to earth. It was an incredible experience." Alan Taylor (BS Architectural Studies '15, M Arch [University of Oregon] '17)*




*Cover of sample UROP case study for leadership and collaboration research project*

### *ChicagoLAB*

Context: The ChicagoLAB is an intensive summer studio housed in top firms in Chicago, IL for architecture, planning, design, and urban design undergraduate, graduate, and PhD students. Students take a preparatory course in SLC prior to leaving for the Chicago experience where they work on academic projects with topics related to ongoing efforts in the city such as sustainability, community development, master planning, and design.

Educational Objectives: to provide vertical multi-disciplinary student teams to work in a fully immersed professional setting to work on academic projects

Timeframe: 6-8 week summer program (ongoing)

Key Collaborators: Andrew Balster, Director of ChicagoLAB

*Student Perspective: "I hoped to gain a different perspective on the architecture field overall. I recognized a disconnect from the professional field of architecture compared to my education because of my time spent as an intern with an architecture office. After being immersed in the educational realm of architecture, it was enlightening to see the real world application. I was also hoping to work on a project that made an impact on a community, or even more importantly a lasting impact. The work we did on researching and developing a master plan for Chicago's Chinatown is still referred to by CMAP, and elements of our plan have been incorporated into the neighborhood. I felt completely invested in the work." Jody Zimmer (BS Architectural Studies '13, M Arch [University of Michigan] '15)*

*Student Perspective: "I feel that the overall experience was priceless. ChicagoLAB will forever remain a cornerstone for my architectural education. I was able to work on several skills that have ultimately helped me to become a more confident designer and leader." Michael Hoehn (BS Architectural Studies '16)*

### *Fine Arts & Architecture Library Sculpture Garden*

Context: This project entailed two phases of student engagement opportunities that emerged through a proposal by the Fine Arts and Architecture Library under the leadership of Luke Leither to remodel a large unused outdoor space adjacent to the library into a sustainable study area and sculpture garden. The first phase (which began while the larger project was still theoretical) involved all first-year architecture students working in collaborative teams to develop a holistic proposal for sculpture, seating, study, and gathering functions in the space with an emphasis on sustainability and the incorporation of living elements like green walls. Near the completion of phase one, the larger project was fully funded, which offered the opportunity to leverage eight competitive paid internships available to undergraduates in any discipline in the college to sustain student involvement in the project and further develop the designs relative to the expanded scope.

Educational Objectives: (Phase 1) The Design-Model-Build educational structure, which was developed collaboratively with Leither and successfully funded by the University Teaching Committee grant, provided a unique learning opportunity for students to develop design proposals with feedback from an actual client and to have them professionally fabricated. (Phase 2) The internships were intended to allow students to work with library clients, professional architects, fabricators, and landscape designers in a multi-disciplinary collaborative team to be exposed to every aspect of the planning, designing, and building process through the development of flexible, sustainable seating, study areas, art display systems, and living walls.

Timeframe: Phase 1 – Fall 2014, Phase 2 – Spring/Summer 2015

Key Collaborators: Luke Leither, Greg Hatch, Ian Godfrey/Marriott Library, Fine Arts & Architecture Library

*Student Perspective: "As my background is in Urban Ecology and Environmental and Sustainable Studies, I was interested in the opportunity to collaborate with students from different programs in the College of Architecture & Planning. The other students I worked with inspired, supported, and challenged my work throughout the project. Each of the students was able to recognize personal strengths as we collaborated and picked up responsibility where it best suited our individual tool-kids. It was really interesting to notice this recognition and to begin to develop myself as a working professional." Genie Bey (B.S.Environmental & Sustainability Studies/B.S. Urban Ecology '15)*

*Student Perspective: "It's a very unique experience to have a studio where your design could actually be built. Opportunities for continuing studio projects into internships should definitely continue to be pursued. Including professionals early on in the process would enhance the experience." Otto Stefan (B.S. Architectural Studies '16)*

***Sorenson Unity Center Our Town: Claim It!***

Context: This is a funded contract through the primary grant recipient to engage the AIA Utah Young Architects Forum (YAF) and American Institute of Architecture Students in a multi-tiered mentoring structure to engage with service learning opportunities and funded internships. The project combines arts-based civic engagement strategies to enhance livability in the west-side neighborhoods of Salt Lake City by engaging youth through arts-based education and harnessing the catalytic potential of creative place-making events to engage residents, stakeholders, and artists in the implementation of the West Salt Lake Master Plan.

Educational Objectives: Students are working with the YAF project leaders on all aspects of the curriculum planning, design consulting, code review and logistics, community event development, and construction management for the design and implementation of three civic arts projects on predetermined 'catalytic' sites in the neighborhood.

Timeframe: 1-2 years (in progress)

Key Collaborators: Chris Peterson, Kim Thomas, Ken Perko/Sorenson Unity Center; Megan Hallett/Civic Arts Curator

*Student Perspective: "My experience working with the other students has been amazing. Everyone who is working on this project is really invested and wants this to succeed. This makes for great collaboration and communication between everyone. The project at times has been vague and it has been a little unclear as to what we needed to do, but we kept on working at it until things cleared up. Now, things are going really well. The experience for me has been very rewarding. I am getting to see a very different side of architecture and I am learning a lot about how to help others (in this case middle school kids) develop their ideas. I am being pushed to think about things that I haven't ever had to think about before like lesson plans and master plans that I don't think I would be exposed to in a normal studio." Alexis Suggs (BS Architectural Studies '16)*

## Future Development

At a time when the boundaries of education and practice are becoming more and more fluid, architects and educators should embrace this opportunity to explore opportunities for engagement across the false silos of practice and the academy. These projects create new platforms for the introduction of themes such as empathy, service, diversity, and privilege to be discussed in applied contexts and not as abstract concepts.

The further refinement of service learning models that provide students opportunities for richer, more realistic, meaningful, and impactful engagement will help prepare students for the changing nature of practice to come. The introduction of service learning programs, design-build projects, and collaborative practice as early as beginning design studios has been demonstrated to support the development of self-motivated students who work well with others and are better able to transfer the skills they learn in school into real-world scenarios.

In the words of past student Marin Smith, "I have learned that the most rewarding experiences are those we seek out and put all of our effort into. This has certainly been the case for me with these types of activities and programs. When I reflect on my undergraduate and graduate education, these experiences will always be the first things I remember."

## Notes

[1] Whitehead, Alfred North. *The Aims of Education and Other Essays*. Macmillan Company, 1929.

[2] Simon, Madlen. "Design Pedagogy: Changing Approaches to Teaching Design" in *Architecture School: Three Centuries of Educating Architects in North America,* Joan Ockman, ed. MIT Press, Cambridge, Massachusetts, 2012.

[3] Ockman, Joan. "The Turn of Education" in *Architecture School: Three Centuries of Educating Architects in North America*. MIT Press, Cambridge, Massachusetts, 2012.

[4] Robinson, Ken. *Out of Our Minds: Learning to be Creative (2nd Edition).* Hoboken, NJ, USA: Capstone, 2011.

[5] Darling-Hammond, Linda. "School Reform at the Crossroads: Confronting the Central Issues of Teaching" in *Educational Policy*, Vol. 11 No. 2, June 1997.

[6] Bransford, J., Brown, A., and Cocking, R., eds. *How People Learn: Brain, Mind, Experience, and School*. National Academy Press: Washington, DC, 2000, p. 77.

[7] Ockman, Joan. "The Turn of Education" in *Architecture School: Three Centuries of Educating Architects in North America*. MIT Press, Cambridge, Massachusetts, 2012.

[8] Davis, Barbara, *Tools for Teaching, 2nd Edition*, John Wiley & Sons, San Francisco, CA, 2009, p. 217-219.

[9] Davis, Barbara, *Tools for Teaching, 2nd Edition*, John Wiley & Sons, San Francisco, CA, 2009, p. 217-219.

[10] Ockman, Joan. "The Turn of Education" in *Architecture School: Three Centuries of Educating Architects in North America*. MIT Press, Cambridge, Massachusetts, 2012.

[11] Dewey, John. *Experience and Education* (1938). New York: Simon & Schuster, 1997.

[12] Bransford, J., Brown, A., and Cocking, R., eds. *How People Learn: Brain, Mind, Experience, and School*. National Academy Press: Washington, DC, 2000, p. 212.

[13] Dewey, John. *Experience and Education* (1938). New York: Simon & Schuster, 1997.

[14] Dewey, John. *Experience and Education* (1938). New York: Simon & Schuster, 1997.

[15] Boyer, Ernest L. and Mitgang, Lee D. *Building Community: A New Future for Architecture Education and Practice.* Princeton: Carnegie Foundation for the Advancement of Teaching, 1996.

[16] Gropius, Walter. *Scope of Total Architecture*. New York, New York: Collier Books, 1962.

[17] Robinson, Ken. *Out of Our Minds: Learning to be Creative* (2nd Edition). Hoboken, NJ, USA: Capstone, 2011.

[18] Dewey, John. *Experience and Education* (1938). New York: Simon & Schuster, 1997.

[19] Davis, Barbara, *Tools for Teaching* (2nd Edition), John Wiley & Sons, San Francisco, CA, 2009, p. 217-219.

[20] Bransford, J., Brown, A., and Cocking, R., eds. *How People Learn: Brain, Mind, Experience, and School*. National Academy Press: Washington, DC, 2000, p. 51.

[21] Bransford, J., Brown, A., and Cocking, R., eds. *How People Learn: Brain, Mind, Experience, and School*. National Academy Press: Washington, DC, 2000, p. 73.

[22] Dewey, John. *Experience and Education* (1938). New York: Simon & Schuster, 1997.

[23] Bransford, J., Brown, A., and Cocking, R., eds. *How People Learn: Brain, Mind, Experience, and School*. National Academy Press: Washington, DC, 2000, p. 25.

[24] "Pershing's Proposals," *Daily Utah Chronicle*, October 26, 2012. http://dailyutahchronicle.com/pershings-proposals/, accessed October 5th, 2016.

[25] Diaz Moore, Keith. "College of Architecture + Planning Vision: Designing to Make a Difference" http://www.cap.utah.edu/visiongoals/

[26] "Vision and Mission of the School of Architecture." http://soa.cap.utah.edu/vision-and-mission/

[27] Davis, Barbara, *Tools for Teaching* (2nd Edition), John Wiley & Sons, San Francisco, CA, 2009, p. 234.

# In the Beginning Were Buildings: the radical idea of learning architecture by designing it

Mark DeKay, Hansjörg Göritz | University of Tennessee, Knoxville

Curricular answers to the questions, "What is fundamental to design?" and 'What must be taught first now?" frame what students perceive as the core of their discipline and generate different student products and learning outcomes. The methods students learn in the beginning set in motion ways of working that can be more—or less—easily built on by future courses and instructors.

What follows is the story of experiments in beginning design education for 3.5-year Master of Architecture (March-3) students. We examined the aforementioned questions for these students without prior architectural education. In the fragmented post-modern theoretical landscape of architecture schools, having faculty members align on these questions allows progressional logics. In the absence of a shared framework, students attempt to construct their own knowledge systems to integrate the multiple instructors' points of view. The essence of our work was to frame six essential lines of knowledge development in building the consciousness of an architect and to identify the fundamental level (1:) of knowledge and skills for each. By this we arrive at a low complexity, level 1 to level 1 correspondence among all six related and co-defining but irreducible knowledge lines—yielding beginnings that are in no way proto-architecture, but rather, buildings.

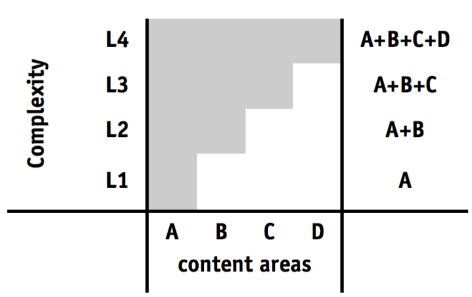



*Fig. 1 Conventional Curriculum of Additive Content, in its Ideal Form: Complexity built by addition, no L1:L1 possible. Contrast to Fig 2.*

Developing complexity stands in stark contrast to a common pedagogy found in our school and (with variations) in many others, focused on: 1) A single spatial-formal line of development; 2) Pre-architectural abstract composition; and 3) An additive process of sequentially increasing form-driving issues over long time periods (Fig 1). Instead, in starting our compressed graduate program, we found success in an integrated beginning studio curriculum, teaching students to design *buildings,* addressing at a beginning level: 1) site and context, 2) program and use, 3) form and space, 4) human experience and feeling, 5) architectural ideas and meaning, and 6) building technology. Beginning design becomes a curriculum of multiple relationships at 1:1, that is, among the first level of each line.

## Contextual Issues

For several years our MArch program had suffered from low enrollment and student work quality. The summer program is an intensive 9-week introduction to architectural design studio, graphics and ideas in three concurrent courses. The faculty had a dim view of the graduate program, agreeing that student work quality and capabilities were far behind that accomplished in the comparable beginning level of the 5-year BArch program. Students beginning the MArch-3 program came with 4-year non-architecture bachelor's degrees in fields such as psychology, history, theology, art and opera. These students started in the summer “boot camp,” which was also a place for other types of students: transfers to the BArch and Bachelor of Interior Design (BID) program, etc.

Some colleagues claimed the “old guard” was our problem. Their solution was simply to put the right players in place and all would be well. When different faculty did not get the desired results, the students were then to blame. “These are the worst students I have ever had. I’m not teaching graduate students anymore!” Most agreed we were in crisis.

### *Right Sizing*

A new Graduate Program Committee began to look more deeply and we noticed that, because of low enrollment, students in multiple programs were combined in a one-size-fits-all summer introduction. There were simply not enough graduate students to run stand-alone courses. We then sought to recruit a full cohort of quality students, so the graduate introduction could develop in its own direction, one better suited to older students. We set goals to improve enrollment quantity and quality. A full class of MArch-3 students implied having to grow the MArch-2 (+2 program) enrollment to a full studio cohort. In one year we increased from admitting 6 or 8 students to admitting 24 qualified students in two programs.

The second issue was that the 9-week summer curriculum was essentially the same as the 28-week academic year freshman design program, except studios met four days per week instead of three. This was our curricular recipe for academic disaster. We hypothesized that the beginning of design education for graduates, in their shorter academic career, needed to be different from undergraduates in some fundamental ways.

*Levels or Laziness?*

Another critique of the MArch-3 students was that they were lazy. As one professor put it, "The graduate students are interested in 'talkitecture,' not architecture. They would rather talk endlessly than do the work to learn the skills needed." So we inquired into this perception. Was there something essential that differentiated a 26-year old college graduate with a couple of years' work experience and independence from an 18-year old freshman?

We could easily observe that the typical graduate student, had travelled more broadly, was more articulate, had more resources outside of architecture to draw on, and was more willing to question and even debate with the instructors. They were also interested in the service and ideas that design could provide. In general, undergraduates had fewer life obligations and thought nothing of "doing an all-nighter." The freshman would take direction better without question and stick with the work methods of skill building and mistake-correction-retrying longer.

We thought that, while the skills and knowledge of beginning architecture should be the same for both groups, the age gap between them made more difference than anyone had previously imagined. Was there a developmental or educational theory that could explain this difference? We speculated that graduate students needed an approach that addressed their level of adult development.

## The Curriculum as Culprit

Was a new approach at learning fundamentals really needed for older students, perhaps a way to use and build on their experiences? By contrast, a stated goal by many instructors in the BArch program was to "clean the slate" of the students' minds of all their previous mundane and low-culture library of experiences and ideas about architecture. This was evident in the a-contextual abstraction of the school's beginning design program. What if, we wondered, our summer program issue was not with the faculty or with the quality or intelligence of the graduate student? What if the issue really was our curriculum?

In principle, the three courses—design studio, representation, and introduction to architecture—were coordinated and related. Looking deeper we found that "coordination" was defined mostly as avoiding conflicting due dates. There was a single meeting in the beginning of the summer and little, if any, coordination or integration after that. Each course ran its own sequence of content, lectures, readings and projects, independently. The drawing course, for example, started with hand sketching and arrived at drafting by mid-summer. Meanwhile, in studio, plans, sections, and elevations were taught and required for numerous projects that were already completed by mid-summer. Students who had been through the program concurred that, from their perspective, the instructors were more in competition for student attention than interested in coordinated learning.

Would it not be possible to construct an integrated and thematic introduction experience for students? Should beginning students not be given a leg up by having the framework make sense to them? What if, radical idea though it seemed to some, the drawing class focused on the studio projects? Could we do collaborative field trips and have one logical master reading list? Were simple themes possible that could connect three ways of studying architecture and remove the feeling of fragmentation students felt?

*Less [architecture] is more?*

Next we asked some uncomfortable questions: "What is fundamental to architecture and therefore fundamental to learning to design buildings?" The *existing* curriculum was comprised of a series of exercises beginning with 2-D abstract composition, leading to low relief, then 3-D abstractions and eventually to quasi-architectural 'constructions.' As a colleague recently wrote in describing this existing curriculum: "...[The] 'normative' fall courses taken by the majority of students in this college, present early design as rooted in abstraction, composition theory, and Modern ideals of universal space, abstracted ornamentation, and functionalism," (1) In reality, attention to function was absent. Buildings were saved for the second year, while technology appeared in year three.

In looking at our normative curriculum, from the viewpoint of what is fundamental to architecture, the list of what was NOT traditionally taught in our summer program or in our BArch first year was shocking. There, the curriculum began with points, lines, and planes. There were no real-world materials and no means of construction, or their symbolic representations in drawings or models. The opportunity to oscillate between concrete and abstract modes, as described eloquently in Temple's *Making Thinking* (2) was not possible. Projects were absent a site, city, neighborhood, culture or climate or any physical or social context at all. No people inhabited these compositions, at least until the end; inhabitation was not generative. There was nothing alive—no human, animal or plant. This, for all its principles and historical merits, was a curriculum that conveyed to students that what is essential is that which is visual and that the order of space and form is independent of knowledge or external inputs. In this world, nothing that cannot be seen is valued as essential. There is no sun, wind, heat, or time, no human experience or feeling. There is no story, myth, or meaning—other than that given by its author. Many of these missing issues seemed essential not just to high architecture but *to all buildings.*

## Designing Buildings from the Beginning

We imagined it was possible to learn to design buildings *and* include all the things that, if left out, would make the design *not a building*. We wanted to have beginning architecture students begin learning to design by designing buildings. This we imagined would consist of simple projects of simple composition, located on a simple accessible site, and so having an observable physical and social context, with a simple program, inhabited by people with human experiences, and conceived of in real materials but a simple construction system—all engaging a few fundamental architectural ideas. "But you can't do that!" some colleagues cried. "All that complexity will stifle their creativity."

Instead of beginning with pure abstraction, we chose to begin with the real. Instead of a curriculum beginning only with a singular focus on form, we envisioned multiple simultaneous content themes (Figure 2) unfolding in complexity over time. Space and Form (line A) is informed by context, use, technology, experience and ideas (lines B–F)—not additively at "advanced" future levels, but rather, throughout an education that begins in the beginning. This aligns with assessments from think-tank events such as *The Penn Resolution* (4), which concluded that education for urban designers of the future will require both learning formal complexity and its interactions with ecological complexity and learning to see formal patterns in relation to their performance impacts.

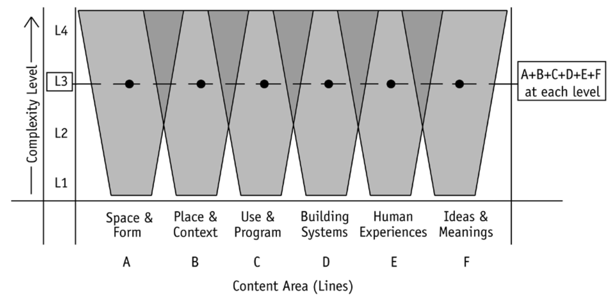



*Fig. 2 Complexity built by unfolding multiple lines of design awareness (3), integrated at each level (1:1).*

### *The Very Beginning: Choto Farm/Cades Cove Community*

We chose the most basic of occupancies, a habitat, representing the most familiar use and also the most prevalent building type the world over. As the first summer studio began, the faculty complaints rained down. "Have you seen what is happening in the graduate summer program? They are designing a house! A HOUSE! That is the worst thing possible for a beginning student design...... This is going to be a disaster!" We did not expect that trying out some different ideas to attempt solving a longstanding problem would be considered so radical. But it would prove more contentious than anyone working on the graduate program ever imagined.

We introduced design as the process of generating form, space and order for a specific site in the pristine setting of Choto Farm, in Cades Cove, within the Great Smokey Mountains National Park. Students were exposed to reading landscape, experiencing climate, and reading and making a place. We had students examine the prosaic pragmatics of past solutions derived from the necessity of working the land and making things to purpose. The lesson was not rural style but rather our opportunity to design for our time, absent intellectualized willfulness.

Students were asked to take the quiet poetry of simple "background" buildings as models for composing an elementary dwelling and garden. Such simple yet refined, timeless prototypes for a specific place and material, were also universal modules and examples as described in *Vast Vicinity* (5):

*Fig. 3 First design project: Houses as Settlement at Choto Farm / Habitat + Hortus at Cades Cove*

*Habitat* An interior "room" of seven elements:
Places for Fire, Oven, Eating, Sleeping, Washing, Storage, Stairway

*Hortus* An exterior "room" of seven elements:
Threshold, Screen, Window, Plinth, Water/Well, Resting, Tree

These elementary prototypes were explored for their essential impact on human well-being. Rather than imitating, we wanted beginners to re-investigate and therefore profoundly inform their designs. MArch and Master of Landscape Architecture (MLA) beginners teamed up for skill-building and early professional co-operation, exploring the following themes:

- *Cultural context and meaning* by comparing examples from film, photography, painting, and literature to real but idealized places [Cades Cove, Pleasant Hill Shaker Village]
- *Places, structures, materials and methods* via excursions to Cades Cove, Appalachian cantilever barns, Kentucky Shaker Village
- *Climate, weather and purpose* to understand placement, orientation, materialization, and detailing solutions
- *Documentation* of a prototypical building and landscape setting with sketches, drawings, photographs, and structural model
- *Criteria and work ethics* for enduring design
- *Collaboration* by architect + landscape architect to design site and cluster scale + individual design of single units
- *Scalar reciprocity* of private and community Habitat + Hortus patterns
- *Structural logics* of timber structures
- *Site responses* to vistas, rural nature, wind forces, natural ventilation, solar orientation, and outdoor microclimates
- *Physical 'sketch models'* as design tools
- *Hand sketching and drawing*

Hardly anything is as challenging and rewarding as a simple well-designed dwelling and garden. Through exercises in 'omitting,' students were challenged to concentrate on the essential. They internalized good practice by oscillating between research, design, and implementation, in accordance with the precept "to design is to construct is to design." In contrast to the tradition of complicating abstraction into ornament, we sought to teach the fundamentals of beginning design by focusing students on doing ordinary things extraordinarily well, which sounds simple. However, to be simple can also be hard, and simplicity became a challenge, a means to establish principles universal yet personal.

***Second Lap:***
***Urban Writing Place, Market Garden, Visitors Space***

In the first project, precedent analysis provided a palimpsest for solidly designing domestic artifacts in the landscape. The second iteration was an exploration of a landscaped experience within an urban fabric. This project builds on the skills and concepts of the first while introducing additional depth and increasing complexity. It began to develop additional representation skills using measured perspective, shade and shadow, and computer based text and graphics applications. As students became more familiar with the conventions and aims of the architect, additional depth in concepts of context, experience, and metaphor were introduced. The canvas shifted from rural to an urban site and pedestrian scale.

The notion of *meaning and experience in architecture* was introduced by an imaginative *character study*. The final outcome was a window into a better understanding of what is authentic and specific about *city* while remaining open to multiple readings. Each composition was to reveal something about the character's poetic qualities and their unique interaction with space. Each student photographically explored three of these characters: athlete, clergy, veteran, child, astronomer, shadow, philosopher, detective, etc. Students were asked to take on the persona of one of their characters and develop a *mapping of the city* based on the unique spatial understanding embodied by the character.

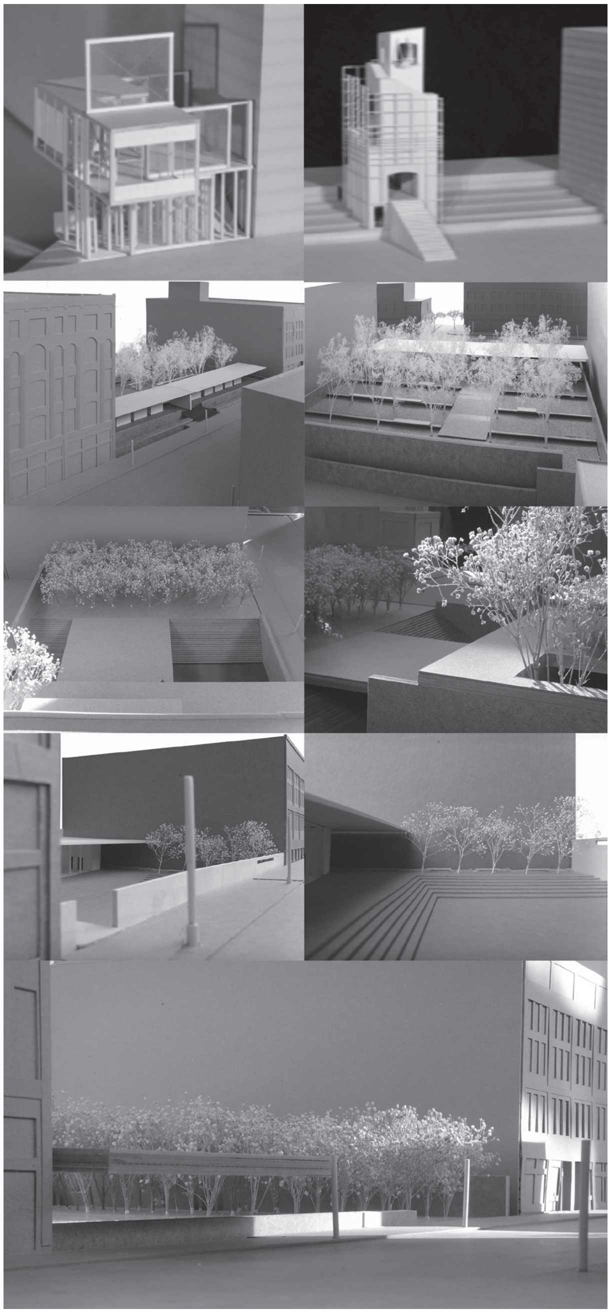


*Fig. 4 Second design projects: Urban Writing Place, Market Garden, Visitor Orientation Space*

In the third and final project, students proposed the design of an urban *Writing Place, Market Garden*, or *Visitor Orientation Space*, containing individual pavilions dedicated to the experience of the city derived from the characters. The vacant site in the center city was ringed by its institutions. Again, MLA and MArch students collaborated to determine an arrangement of landforms and architecture meaningful for each pavilion while contributing to a cohesive whole. Individual pavilions included: 1) *a gallery,* image display space for artifacts and texts portraying the character's understanding of the city; 2) *a cell,* crafted as an architectural experience embodying the spatial understanding of the character, and; 3) *the core,* an area containing functions in support of the visitor. The MLAs helped determine the best location for the Pavilions and designed the site around them as extensions of the characters' concepts. *Principles of composition, then, were taught in the context of multiple architectural issues.* 'Contrast,' for example, was studied in the composition of forms, spaces, construction materials, plantings, and paving to clearly convey concepts, rather than merely non-objective abstraction. Drawings and perspectives were hand drawn with *poche´*.

## Second Game: Same Themes, More Complexity

Following the 9-week summer was a regular 14-week semester. We again emphasized the same six overarching themes in the students' second studio course. To recapitulate, the logic of our approach was *to teach design by having students design buildings early on with all of the major classes of themes present in all buildings—and, over time, to increase their capacity in each of the six aptitudes by increasing the complexity of their design challenges.*

### *Game Two, Lap One: Addition to Sea Ranch*

The first project was to design an addition to Sea Ranch Condo One by MLTW. Since the required CAD class had been eliminated from the curriculum based on student input, digital representation was introduced in the studio with the assistance of a graduate assistant.

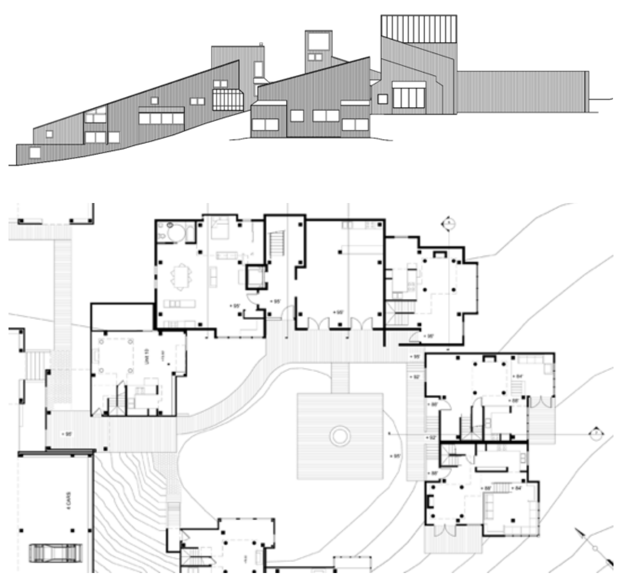


*Fig. 5 2nd semester project 1: addition to Sea Ranch condos*

This project reiterated summer themes with new situations:
- Working in teams to design site and cluster scale + individual design of units
- Private housing and community use patterns
- Design for continuity across scales
- Response to rural nature and strong wind forces
- Daylight provision to each room
- Creating outdoor microclimates

It also deepened and expanded some of the summer themes:
- Developing spatial ordering logics from modern precedent and landscape context
- Moving from light frame to the logics of heavy timber construction
- Expanding designing for natural ventilation to include stack effect

*Additional* issues:
- Handicapped accessibility
- Designing experiences of prospect and refuge
- Conceptual design for lateral forces
- Designing for passive solar heating
- Hand drawing in ink
- 2-D CAD for plans, coordinating among collaborators

*Race Two, Lap Two: Downtown masonry mixed use*

The second project of this term was to design a commercial ground floor space of the student's choice plus upper living space set on a narrow urban site using primarily masonry construction and a facade for three repeated units. This project continued to develop the six themes. *In addition* to the issues from project one, the second students engaged in:
- Discovering relationships between spatial order and masonry in precedents

*Fig. 6 2nd semester project 2: Masonry live/work building*

- Designing within the logics of masonry construction and vertical structural loads by masonry
- Facade composition
- Programing for residential and non-residential uses
- Public and private relationships
- Response to actual urban architectural context
- 3-D visualization

## Curriculum Evolution

That first summer and fall, three experiments were done within existing course descriptions: 1) Segregating the older beginning graduate students, 2) Relating the content among three courses, and 3) Designing buildings from the beginning. The curricular "boxes" all stayed the same while graduate and undergraduate sections took different paths. This depended on a fragile alliance among instructors and was possible inside generic course descriptions that allowed wide latitude.

The curricular change process that followed resulted in faculty approval for these and other changes. A summer curricular task force developed a short preamble to course description changes: *"The summer curriculum is designed as an integrated experience introducing design as a discipline of significant ideas expressed in formal order and implemented in materials. Design is introduced as the process of generating form, space and order, along with interpreting its meaning, through interaction with contexts, human inhabitation, construction, human experience, and theories."*

The new curriculum of "beginning with designing buildings" was a radical shift from the former 2-D abstractions of paintings transformed into a sequence of self-referential, increasingly 3-D compositions. Learning to draw buildings was radically different than beginning by drawing vegetables, old shoes, and tools. This way of beginning generated categorically different results, the quality of which took even the critics by surprise.

## But would it work with beginning undergrads?

We experimented with an evolution and adaptation of the same principles in a new situation in collaboration with a colleague at Auburn University, which admitted undergraduates without portfolios, their potentials unknown. This was an intense all-day-all-week studio structured as two sessions of four weeks each to develop:
1) A craft of drafting / painting / modeling of key architectural components
2) A studio as an introduction to architectural design

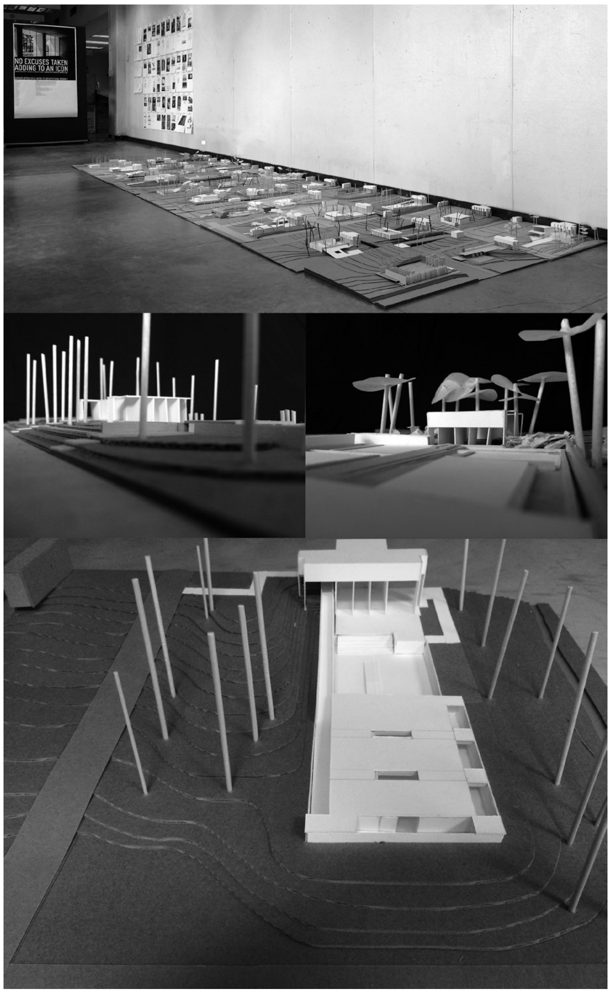


*Fig. 7 Beginner undergraduates at Auburn University: Building + garden additions*

Thirty students, who learned the basic craft and theory during the first phase, progressed to a real design experience. Again, working in a real context, with a real site, a real building (a modernist icon), beginners were asked to design an exhibition space addition and a garden room. The solution could be *on*, *off*, or *in* the site. A substantial context with majestic trees and a water feature provided inspiring experiential grounds. The integrative work spanned across all scales:

0) Precedent studies
1) Drawing site and topography in plan and section, with features and vegetation, including adjacent structures
2) Parti sketching at business card size, then 3" x 5" index card concepts
3) 3" x 5" physical sketch models, then 1" = 64' physical *sketch models*
4) 1" = 32' study models
5) Physical presentation models and plans at the same scale, complemented by diagrams and a model photo, montaged into a key photograph of the site at eye-level.

A simple rigorous and developmental learning methodology provided orientation, guidance, and experience of the meaningful application of isolated skills learned previously. This methodology, originally developed to address more mature novices at graduate level, became the palimpsest for freshmen, sophomores, transfer, and foreign students, all of whom were undergraduate architecture novices. Strong results and high praise from faculty peers offered evidence that the pedagogy is effective at this level as well, and more importantly, appears suitable as a method for accelerating student accomplishment in education for *architecture as an applied art* in general.

## Conclusions

Rooted in these fundamental experiences, we observe that many contemporary approaches to beginning architectural design suffer from dilemmas of competing, ungrounded, fragmented theoretical positions. It is as if each instructor or school stakes a personal territory for design's beginnings—one of many integral design components, privileging formal composition or phenomenology, concrete making or 1:1 scale, context, or whatever, while ignoring or marginalizing the rest.

The models instigated in the studio or classroom become the frameworks to later build in the world. Abstraction without referent, fragmentation, and isolation appear to yield just such progeny. The same authors of this paper also teach in upper level vertical studios, where we can keenly observe the result of this phenomenon in the designs of students educated without the challenge to grasp the fundamentals of formal composition informed by the simultaneous range of design issues. Therefore, sadly, we begin again to "teach first year in fifth year."

The reciprocal of this causality is that contextual, integral, developmental and holistic experiences at the beginning hold the promise for a built environment that is also integral and comprehensive. In our school, and in others we observe, it typically takes several more semesters before students are designing simple buildings with the range of form-making considerations that our students engaged in the first two semesters. Indeed, some may never do so in an entire professional degree program. It is not *only* in the beginning levels that design education has come to a culminating irony where "learning architecture by designing it" is now a most radical revolution.

## Notes

[1] Teton, Liz, Valerie Friedman, and Jennifer Akerman. "*Context to Conecpt: place phenomena and experience made tangible*," Proceedings, NCBDS30:IIT, College of Architecture, IIT: Chicago 2014, p177–183

[2] Temple, Stephen. *Making Thinking: beginning architectural design education*. Kendall Hunt: Dubuque, IA. 2011

[3] DeKay, Mark. *Integral Sustainable Design: transformative perspec-tives.* Island Press: London, 2011

[4] Penn Instuture for Urban Research. *The Penn Resolution: educating urban designers for post-carbon cities.* PennDesign: Philadelphia, 2011

[5] Göritz, Hansjörg. "*Vast Vicinity: learning from essential settling and dwelling*," Proceedings, Sustainable Development and Planning IV, WIT Transactions on Ecology and the Environment, Vol 120, WIT Press: Wessex 2009, Volume 1, p339–35

# One to One at Year One

Michael Dickson | University of Queensland

## Abstract

Learning at one to one implies two aspects of a design studio; firstly scales of operation involving large scale prototyping and secondly peer to peer learning where challenges are addressed collaboratively. Managing a large scale design build project usually a group learning environment but rather than viewing this as a consequence of logistics alone it presents a pedagogical opportunity intrinsic to design and build studios. Peer learning needs to be explicitly recognised and leveraged as part of the process to maximise the learning outcomes beyond simply a means to making stuff.

Design build typically occurs later in a design curriculum when students have an advanced design repertoire and technical skill set. They are mostly selective based studios and involve smaller groups to manage the logistics of instruction and making. These selective studios sit at the margins of the curriculum and generally, but not always, don't figure in the experience of every architecture student's education. However if we truly believe in the benefits of collaboration and deep engagement with a design problem, shouldn't we be advocating the pedagogy to larger cohorts at the foundation years of their education? Simplifying the aspects of the build with less emphasis on the built object whilst maximising the benefits of the process could help first year design students address some foundation architectural design principles and studio culture.

This paper will expand upon a first year design studio that explores an *inquiry through making* process and discusses how foundation design principles can be explored in a student centred decision making process. Efforts to reinforce studio culture were factored into the playfulness of the project deliverables and process of decision making in an effort to create enduring support networks for the novice designers.

## One to One at Year One

Teaching architectural design at a scale of one to one is once again making an impact in architecture schools globally. Design build projects are pursued enthusiastically by a small, growing and dedicated cohort of academics who passionately advocate the method but must at the same time recognize that the pedagogy still resides at the margins of a typical architectural curriculum. Often published projects are published with an emphasis on the built work rather than the pedagogical aims and benefits to student learning. Judging the value of the work with same the frame of reference as we judge mainstream buildings shifts the focus away from the teaching and learning aims and outcomes and places a very high double standard on the studio project where one aspect; either the teaching and learning, or the building, may be compromised to improve the outcomes of the other. A great built outcome does not necessarily equate to a great learning experience any more than a poor built outcome translates to a poor learning experience. We need a better description of the build studio and its value to learning to justify the cost, risk and displacement of some of the traditional design studio to the benefit of student learning and ultimately the wider discipline.

Most student design build studio projects fall into one of two camps. By far the majority are what we could call *inquiry through making* which typically result in small pavilions, art installations or other non-habitable buildings that sit somewhere between sculpture and very large architectural models. Projects typically adopt a limited palette of materials with specific design and construction processes. Aside from the intrinsic learning opportunities of the design and build process, *inquiry through making* studios often explore innovative applications of technology and materials, digital design and fabrication or architectural place making. The experimental and ephemeral nature of built structures coming out of these studios can afford a significant license for provocation and speculation unachievable in normal professional practice.

The other studio type focuses on the *live project*; a studio that engages with real communities and stakeholders and can perhaps be described as *community action and making* studios. The demands and risks associated with *community action and making* are significantly higher than *inquiry through making.* Buildings from a *community action and making* studio must stand up, not leak, be fit for purpose, be durable, not become a burden to the new owners and be delivered within defined time frames and cost. It is closer to what we would describe as professional practice but at the same time they are unlike professional practice in that projects are built by the people who design them. Flourishing improvisation throughout the design and making process can be a formative learning experience that is unlike professional practice but at the same time cannot be the default modus operandi so as to put the project at risk and diminish the understanding of the value of clear decision making during design.

Therefore we could describe *inquiry through making* as being about models whereas *community action and making* as being about buildings, but both about architecture. Both studio types have deliverables that are beyond the capacity of any one student that consequently demands collaboration at some point in the process. Some specific aspects of learning and engagement differ between the two studio types that relate to client management, regulations and permission from authorities however both studio types need to deal with translating ambitions into ideas and designs, managing complex logistics, project planning, technical performance and fabrication strategies. One could argue that working at one to one describes both to the project scale and the intrinsic aspect of design build studios that involves working broadly with peers and experts and resolving issues one to one; one person to another and one to many.

Most practicing architects and design school academics would agree that professional practice is by and large a collaborative process. This sits in contrast with the majority of traditional architecture school studio projects that focus on and evaluate individual effort. In such an environment, design projects at one to one are a welcome antidote to this dominant way of working and though the projects may not be legitimate parallels to practice, the process of negotiation and working within explicit constraints provides valuable experience in a future career negotiating diverse perspectives and expectations.

***Design Build in the Foundation Years of an Architectural Design Curriculum***

So why aren't there more design build in broadly based foundation year studios? Searching through recently published projects it is almost impossible to find a project that is broadly based and involves first year students. The "Design Build Exchange" database, dedicated mainly to *community action and making,* lists no foundation year projects.[i] The proceedings of the 2014 ACSA fall conference, "Working Out, Thinking while Building", yields no broadly based foundation level studios[ii]. The larger "Live Projects Network" database lists 5 out of a possible 128 projects that have 50 participants or more in a foundation studio[iii].

Planning and delivering a design build studio is more than starting with a traditional design studio and ending by managing logistics of the build. Intrinsic to the collaborative process of design build is the philosophy and process of decision making. The traditional studio design process is formed around the cycle of proposal and critique. In a scenario where multiple propositions are culled to produce a smaller number of built outcomes, the process evolves into a survival of the fittest, an extreme version of "the crit" with winner take all and potentially demotivating other participants in the process. Two long running design build studios focused around *community action and making* illustrate differing approaches to collaborative design and decision making processes effecting the scope and outcomes of the studio.

The Jim Vlock first year building program at Yale has been running for over 40 years and remains one of the only broadly based postgraduate Architecture programs in the world. The program is embedded in the curriculum as a foundation experience for every student in the postgraduate program with a cohort that varies around 50 students. Being a postgraduate program, some students will be novices where as others will already have at least three years of undergraduate design education. Since 1989 the program has focused on the design and provision of affordable housing in poorer inner city neighborhoods of New Haven.[iv]

Managing the logistics of the program with large numbers requires a systematic approach to the learning sequence to ensure equal participation. Essentially the design process adopts the pattern of the traditional studio where small groups become large groups and designs are selected by an esteemed jury. Around 8 different groups comprising 6-7 students develop and document proposals with one selected by jury at the end of the design process for construction. All students are involved in the build, working on site in shifts in order to experience varying aspects of the build. There is no doubt that the Jim Vlock program is an impressive design build achievement and unique in the world, it works in large part due to the resources for support staff and a very systematic and hierarchical approach to the teaching and learning sequence.[v]

In contrast, the Howard S Wright Neighborhood Design Build at Washington State University led by Steve Badanes is a much smaller open ended program. Since 1998 the studio produces one small built project a year for a local community organization. The program is elective with smaller student numbers however the program distinguishes itself on the basis of the design build pedagogy which places the student at the center of the process which can only be achieved by scaling back the build. Central to the philosophy of the program is a consensus based decision making process and full involvement of each member of the student cohort from the start of design to the end of the build. The continuity of involvement from the design to build helps learning and motivation whilst the focus on a specific process of design that is unlike the traditional studio model transcends the design build studio to help influence the decision making process in future collaborative design projects.[vi]

Developing a broad based, foundation level, single building studio sets up a certain paradox. On the one hand the project needs to be large enough to accommodate large numbers of students but in doing so it must systematize the process to manage the numbers. One can argue that a consensus based approach by contrast is more student-centered and inclusive but requires smaller projects that in turn limits the total number of participants and consequently cannot be broadly based.

A number of studios in the foundation year based in the UK work around this paradox with large numbers on multiple small projects based on an *inquiry through making* mode. The Chelsea College of Arts "Details and Spaces" and "Re-Constructing Garden" projects and The University of Strathclyde "To Shelter" projects produce large scale temporal sculptural installations in an outdoor context.[vii] The common aspect of these projects is that the material palette is restrained and the design process and context are very clearly defined. By restraining the palette, the complexity of the build logistics is reduced and provides a common reference for parallel teams to compare and contrast without needing to cull design propositions. Although these studios do not have the same provenance as the Howard S Wright or Jim Vlock program, and they avoid the complexities of a *community action and making* mode of working, they help define a process that is broadly based and student centered whilst delivering teaching and learning outcomes that are common to *community action and making* and *inquiry through making* design build modalities.

### *Developing a First Year Inquiry Through Making Project*

In 2008 the University of Queensland undergraduate architecture program developed a studio project that used an *inquiry through making* project to explore physical and social place making within the first year foundation design studio comprising 110 – 130 students. The "Pods" project was repeated over three consecutive years which allowed time to refine and evaluate the learning sequence. The studio project did not stem from the desire to make something with students, rather it was conceived as a vehicle to encourage collaborative ways of working in studio. The project sought to strengthen the foundation of studio culture as a space that facilitates student-directed learning in a supportive and social environment.

The strategy was to develop a series of group interactions that would grow into a large network of relationships for each student. Project logistics were kept simple to keep costs down and to increase the capacity for innovation within limited design and materials knowledge of novice designers. Paper and cardboard were used as the primary materials for experimentation with model making the primary mode of communication which facilitated the fast understanding of material properties couple with a less ambiguous mode of representation.

Inspiration for the “Pods” project came from earlier works in cardboard by Peter Hübner in the 1970’s from his own practice and work at the School of Architecture at the Stuttgart Technical.[viii] Peter’s work with lightweight cardboard structures illustrated the degree of sophistication that could be achieved by deploying clever geometry and folding working with simple materials. Peter’s “Polyfalt”[ix] cardboard structures demonstrated the structural capacity of material and inspired us to challenge students to develop temporary habitable structures using a defined quantity of standardized cardboard sheets.

Whilst the project was pursued with serious intentions we could not help to observe that the process of making pods with cardboard parallels childlike pursuits of making cubby houses and other play structures more familiar to children. Rather than perceiving this as a negative we sought ways to theorize the aspect of play and games to structure the development of creative thinking in novice designers.

The thinking followed that creativity has often been linked but playfulness in the spirit of open ended and perhaps pointless exploration rather than childish behavior. Playfulness can be seen as opening up an almost unconscious pipeline to imagination but to be useful needs to be disciplined with critical rigor and hard work.[x] [xi] Vygotsky’s theory of creative imagination cascades through four tenets; firstly that imagination is the internalization of child’s play, imagination is directed consciously, creative thinking involves the collaboration of imagination and thinking in concepts and artistic creativity requires such collaboration between imagination and thinking in concepts.[xii] There is a view that play may act as a catalyst for creativity through regression and in our case building a “cubby house” could facilitate what Ernst Kris described a childlike state of mind which can weaken the barriers between the conscious and unconscious mind allowing problems to be viewed in a new way.[xiii] Though perhaps unscientific, the thought was that the weakened childlike state of mind would encourage engagement whilst at the same time if strict rules of the “game” we applied the process would encourage a purposeful development of novel and creative ideas.

The rules of the game provided a framework to judge the development of proposals and provide a foil against which groups can reflect on their work compared to other groups. We developed a simple but strict set of rules that were:

- pods will accommodate four people for three days
- each group will be provided the same 10 sheets of cardboard, 2200mm x 1100mm x 7mm,
- plastic tarpaulins could only be used as ground cover,
- plastic cables ties could be used to join panels,
- no materials could be used to strengthen the structure,
- pods could be painted,
- each structure had to be flat packed to 2100 x 1300 x 250mm
- assembly would be by a different group and finally,
- assembly instructions could not use text.

For the first project iteration each group worked independently which translated to a chaotic arrangement of shelters on site and narrowed the degree of reflection and interaction between groups. In subsequent iterations the arrangement of the pods on site became a primary design consideration and helped to shape the preceding cycle of reviews and evaluations. The process worked by allowing groups to form to create their first ideas for the shelter and develop models at a scale of 1:20. In the following week all the models were laid out and reviewed by the whole group. We asked groups to rearrange the models that used similar design strategies and geometries. This resulted in clusters of pods and groups which we used to begin defining shared experiences and challenges. The clusters were then asked to refine their choices so that there was a limit of three or four pods to a cluster. Once this was achieved we asked each cluster to create a common space between pods and that would host a coordinated banquet. (fig 1)

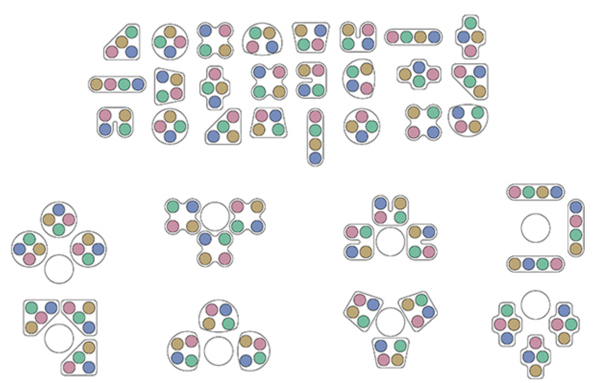


*Fig. 1 Sorting and Clustering*

The clustering approach introduced another layer of communication and student reflection. The similarity of approaches between pods broke down the notion of originality and focused attention of group sharing of strategies around solving problems specific to each group’s pod. Planning the logistics of the banquet established roles for each member of the group who would in turn liaise with group members with the same role within the cluster. From the instructors perspective the efficiency of the clusters meant that we could reduce the number of repetitive smaller conversations and spend more time discussing the project in depth. On site this also translated to an orderly encampment which opening up of conversations about the hierarchies of space from the city to the room and concepts of type, originality, repetition and scaling.

Taking the project out of the studio and allowing students to experience the product of their own design led to some predicted and some unexpected outcomes. Focusing on the pods, students reflected how different solutions provided better or worse living conditions over the three days relating to the scale of spaces, shared space vs personal space and how the use of inside and outside space was scheduled. The efficiency of structures were tested against the amount of material used comparing the space provided, the structural stability over time and the ease if erection on site and the clarity of assembly instructions. This was implicit in the project and figured in entries into some of the students' reflective journals.

Leaving the campus provided the opportunity to compress and intensify the studio and we deliberately chose a site that was rural and remote to focus the studio on the site and each other. The combination of groups and clusters alongside a set piece social event primed widespread and productive relationships in the project that created a buzz that was brought back into the studio. The complexity of interactions and reflection of the lived experience fed back into conversations about design process which became richer and less abstract as one could always refer back to anecdotes of the studio experience. (fig 2)

*Fig. 2 Student Banquets*

*Consolidating Foundation Year Studio at One to One*

One to one studios should not be seen solely as simply making things with the focus on built product. The process of collaboration necessary in a build studio can teach valuable lessons in the value of our own ideas in the context of a wider pool of other people's ideas. The decision making process in filtering ideas can be staged in a way to value traditional survival of the fittest or find ways of achieving consensus with both approaches having potentially significant consequences to the way future designers conduct themselves. Design as a social process and the validation of ideas into products are the basic tool kit of a collegiate approach to studio that belongs at the very start of a novice designer's career.

The inquiry through making studio run in the first year at UQ was cost effective, sustainable and instrumental in creating a vibrant studio culture. First run in 2008 it ran for three years by two different academics and then assigned to history. So many novel teaching and learning opportunities developed by individual academics using one of the modes of design build have short lived success but most find it difficult to break through a become entrenched in the culture of their host school. In most instances and with a majority of academics I have spoken with who use design build to teach are doing it from a personal passion and using a bottom up approach to hopefully gain institutional recognition.

The risks and costs involved in running a design build studio are hurdles blocking widespread adoption in lieu of traditional studio project models. In the first instance we need to better articulate the different modalities of design and build studios and balance the demands of the project and the focus on student learning. Broad based studios entrenched in the design curriculum are rare in architecture schools and tend to be the products of top down decision making. Scaling a large cohort across a large single built object has consequences in the way decisions and logistics are handled that may compromise a student centred approach which may be better served by smaller projects. Smaller, simpler, cost effective inquiry *through making studios* may not deliver real buildings to real people but they have the teaching and learning benefits of collaborative design processes where ideas are tested at full scale and belong in the early years of a design curriculum.

## Notes

i http://www.dbxchange.eu/ accessed 03.10.15

ii Ted Cavanagh, Ursula Hartig and Sergio Palleroni, eds. Working Out, Thinking while building, Paper proceedings from the 2014 Fall Conference of the Association of Collegiate Schools of Architecture. (ACSA Press, Washington DC 2014)

iii http://liveprojectsnetwork.org/ accessed 03.10.15

iv Richard W Hayes. The Yale Building Project: The First 40 Years. (Yale School of Architecture, New Haven, 2007) v Hopfner, Adam. 2015 Personal discussion, New Haven, 04.05.15

vi Steve Badanes. "Building Consensus in Design Build Studios" in Expanding Architecture, Design as Activism edited by Bryan Bell and Katie Wakeford. (Metropolis Books, New York, 2008).

vii http://liveprojectsnetwork.org/ accessed 03.10.15

viii Peter Hubner – Reprint 1968-1993 Facsimilie-Nackdruck von Veroffentlichungen aus 25 Jahren mit Werkverzeichnis, Institute fur Baukonstruktion, (Universitat Stuttgart, Prof. Peter Hubner, Prof Peter Sulzer.)

ix Peter Blundell Jones. Peter Hubner, Building as a Social Process. (Edition Axel Menges, Stuttgart 2007)

x Csikszentmihalyi, M. Creativity: Flow and the Psychology of Discovery and Invention. (New York: Harper-Perennial 1996) p61

xi Dacey, J S and Lennon, K H. Understanding Creativity: The interplay of Biological, Psychological and Social Factors. (San Francisco: Josey-Bass Publishers,1998) p115

xii Smolucha, L and Smolucha, F. "L. S Vygotsky's theory of Creative Imagination". Paper presented at the Annual Convention of the American Psychological Association, Washington DC August 22-26.1986. p2.

xiii Dacey, J S and Lennon, K H. Understanding Creativity: The interplay of Biological, Psychological and Social Factors. (San Francisco: Josey-Bass Publishers,1998) p38

# Soft Skills for Digital Designers

Shelby Doyle, Nick Senske | Iowa State University

## Introduction

Computer-Aided Drafting and Design (CADD) technologies have become commonplace in architectural practice as tools of efficiency and production. For these very reasons the introduction of CADD in early architectural curricula has been fraught with anxieties along a continuum: from the undoing of creativity through positivist and reductionist logic [1] to a firm belief that these technologies will revolutionize the way architects practice and think about design. [2] At the same time, there is a presumption that students who have grown up with digital technologies are "digital natives" who possess special aptitudes or insights which are disruptive to learning computing. The presence of these anxieties and biases often leads to gaps in digital design instruction, as tools are misunderstood and misappropriated by students and teachers alike.

The aim of this paper is to take control of the pedagogical agenda for digital design in architectural education by debunking the myth of the digital native and by defining a new set of soft skills for computational design and digital representation. This paper is a discussion of architecture, design, and education; not an argument for software and computer use in design. Soft skills provide a framework for learning and understanding digital skills which in turn support the development of technical skills. These base proficiencies in turn facilitate the development of sophisticated digital architectural designs.

## Soft Skills and Fostering Learning Habits

Computer use in digital design is often discussed and taught as a series of technical or "hard (as in absolute)" skills. In contrast, "soft" skills are related to emotional intelligence, attitudes, habits, and interpersonal relationships. An example of a soft skill is resourcefulness: being inclined and able to find alternate solutions to a problem, rather than giving up or deferring responsibility. In this manner, soft skills influence the ways that an individual applies technical skills to achieve goals. Professions such as business and information services have cited employees' lack of soft skills as one of the biggest reasons why projects fail. [3] For students, developing soft skills is equally as important, if not more important, than learning technical skills.

This paper proposes that a set of complementary "soft" skills is missing from most discussions of digital pedagogy and that teaching these skills can improve student outcomes and the integration of digital technologies into architectural pedagogy.

*Fig. 1 Knowing how to operate a smartphone does not necessarily make one an effective computer user.*

While soft skills have a role to play in professional education and practice, they are not to be confused with professionalism. [4] Professionalism is a social construct about social behavior in a professional setting. At their core, soft skills support and activate learning. The influential Boyer report on architectural education concluded that:

> *[A]rchitectural education is really about fostering the learning habits needed for the discovery, integration, application, and sharing of knowledge over a lifetime.* [5]

Soft skills are the learning habits Boyer references and as such must be taught rather assumed to be pre-existing skills. This also extends to those soft skills which relate to digital design and digital tools. [6] Architectural education must recognize that university students are not comprehensively or consistently trained in digital technologies when they arrive on campus. This is exacerbated when less privileged students are potentially less digitally skilled than students from economically privileged backgrounds. By not addressing these inequalities institutions, such as architecture schools, are perpetuating disparities through education.

## The Myth of the Digital Native

The common belief that students are self-regulating when it comes to learning and using technology may come from the notion of digital natives. The label "digital native" derives from a series of articles written by the technologist Marc Prensky during the early 2000s. Prensky describes the generation of young people born since 1980 as "digital natives" due to what he perceives as an innate confidence in using new technologies such as the internet, videogames, mobile telephones and "all the other toys and tools of the digital age." [7] Enrique Dans counters Prensky's claims: "Simply being born into the internet age does not endow one with special powers. Learning how to use technology properly requires learning and training, regardless of one's age." Dans goes on to expand upon the issues of assuming students do not need to be taught to use technology thereby becoming "digital orphans", lacking in any model to copy or experiences that might have generated criteria for understanding. [8]

For this reason, beyond basic fluency, architectural instructors are uniquely positioned to model substantive content creation and healthy critical thinking about these technologies. By perpetuating the myth of the digital native architectural education is missing the opportunity to establish strong digital foundations from which future digital advancements will emerge.

## Traditional vs. Digital Soft Skills

The kind of soft skills described in this paper are not entirely the same as soft skills introduced earlier. While traditional soft skills such as conscientiousness and empathy are helpful for architects, *digital* soft skills have a different purpose and apply specifically to the tools and processes used in digital design. Digital soft skills, such as asking clear questions, estimation, and planning skills, enable effective collaboration with other people while using digital tools and promote effective workflows for collections of digital tools. Digital soft skills support students as they are learning digital design and, later, help students apply technical skills successfully and with sophistication.

Digital soft skills also differ from traditional soft skills because they take into account the particular challenges of computing and digital machinery. The special attributes of digital tools that make them powerful, such as symbolic logic, abstraction, and automation, can invite cognitive biases when designers operate those tools simplistically, at face-value (i.e. using a computer like a cell phone, a pencil, or a typewriter). Humans must adapt their thinking, expectations, and habits, as their natural inclinations can interfere with working effectively with digital tools. [9] Even those who work with digital tools frequently need to learn digital soft skills, as they may have developed bad habits and misconceptions over time. Merely using digital tools is not enough to cultivate mindfulness of the medium and one's responses to it.

To cite an example: digital tools are often "black boxes" with complex layers of interrelated procedures that make it difficult for users to be aware of what they are doing and how their software operates. Users expect simple cause-and-effect relationships between their operations and the results on a screen, when the reality is that many "hidden" processes are at work and can affect the outcome of an interaction. [10] This is also one reason why computers are not always dependable and why they tend to break down in obscure and obtuse ways. Working responsibly with digital tools requires a certain level of comfort and responsiveness with an opaque tool. Students who lack the digital soft skills to understand and respond to this condition often have a poor attitude when faced with computer problems and may spend their time in unproductive ways trying to "hack" solutions to technical problems. [11] This affects not only their final designs, but their outlook on technology in general.

Digital soft skills are similar to traditional soft skills in the way they affect how students apply technical skills. Unfortunately, very little time, if any, is given in digital design curricula to the explicit cultivation of soft skills.

## Samples of Digital Soft Skills

The following list is a representative sample of digital soft skills which could be taught in an architectural curriculum, organized according to four primary headings.

***1. Communications Skills***

Communicating clearly with others is a critical set of soft skills for digital designers. For instance, many students have never been explicitly taught how to ask a question via email: to provide necessary information and files upfront, anticipate follow-up questions, and to communicate their expectations for resolution. This is important not only professionally, but especially when trying to learn or fix something like a new piece of software.

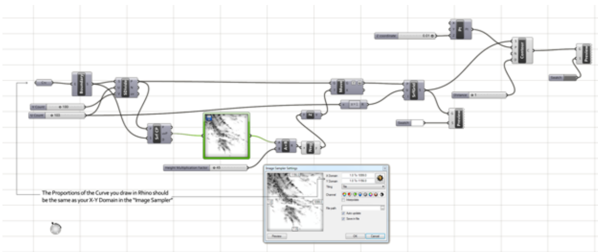


*Fig. 2 Example of a downloaded Grasshopper definition. Working digitally demands questions of authorship and intellectual property be discussed with students.*

- Collaboration - The ability to work with others digitally, particularly at a distance. One aspect of this is organizing files and sharing them across a digital platform.

- Authorship - This is the ability to understand digital intellectual property and to distinguish between resourcefulness and plagiarism. This notion of authorship becomes increasingly important when the line between programmer and designer is blurred by the use of digital tools. Of particular note is the downloading of code or Grasshopper definitions which are then deployed as design generators.

- Support - Designers should be able to seek, locate, and pursue support for software and technical issues, many of which might exceed the abilities of the instructor of the support offered by an academic institution. These skills include asking fellow students, contacting the software maker directly, and using the Internet as a resource.

*2. Adaptability*

Adaptability is resiliency in response to imperfect tools and a field constantly in change. Digital designers should work with the understanding that failures are to be expected, while being empowered to seek alternatives. They must also update their skills and abilities often while remaining critical users of technology.

- Autodidacticism – The ability and inclination to teach oneself (quickly) is a valuable skill for designers. This includes planning and scheduling regular time to learn and a recognition of common concepts and methods shared between tools, which can make learning more efficient.

- Conversion – An effective strategy for error recovery is knowing how to share data several between types of files and programs. It is important to also note that many computer programs are able to convert various file formats and often have similar procedures.

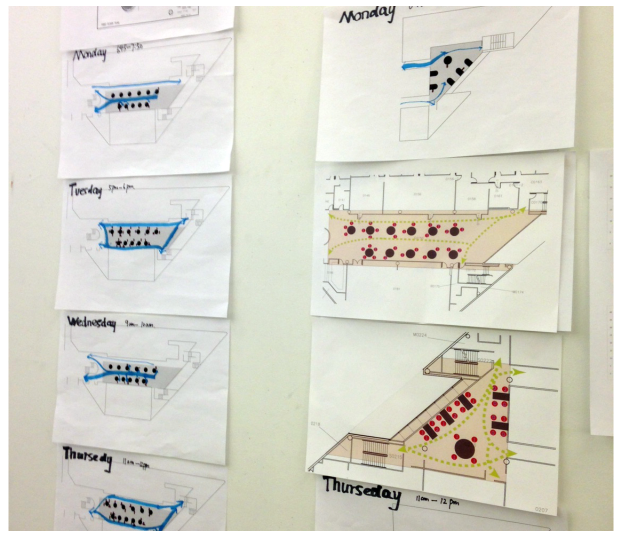



*Fig. 3 Example of a response to a large print which failed. Soft skills encourage students to anticipate such failures and to develop alternatives, such as printing on 8.5x11 paper, creating analog versions, and using a projector.*

*3. Time Management*

Digital design projects are often complex, involving many different programs and machines, as well as human team members. Some of these elements can be hands-off (such as rendering) or very hands-on (supervising CNC fabrication). Part of completing them successfully is knowing the workflows involved and having a sense of their coordination and time requirements.

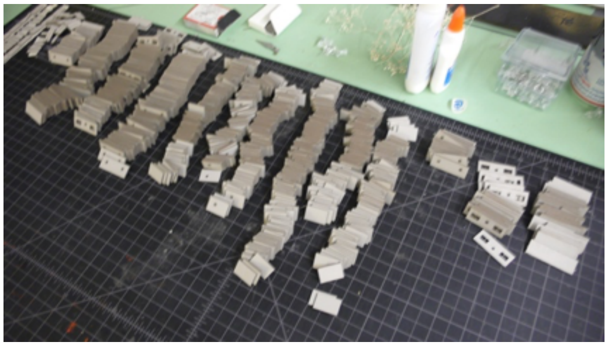


*Fig. 4 Example of a time management and workflow issue common in digital production. It must be reiterated that the computer is not automatic nor is digital production in and of itself 'fast.' A tedious laser file will become a tedious model to assemble.*

- **Estimation** - Determine the full amount of time needed to complete a task or processes (e.g. milling, printing, rendering).
- **Sourcing** - Identify the most effective tool and process for the development of the idea and in relation to the time available for production.
- **Preparation** - Plan for contingencies and alternatives. Assume some things will inevitably not go as expected and know the options available.
- **Scheduling** - Develop internal deadlines, realistic calendars, and skills for planning and implementing a multi-step process. For instance: development of a digital file for fabrication, then fabrication, then post-production.

*4. Digital hygiene*

Digital hygiene refers to the good habits of caring for equipment, computer hardware and software as well as preventing and recovering from errors.

*Fig. 5 Example of a back up protocol. Soft skills enable students to feel confident that computers will fail and that they are empowered to seek alternatives.*

- **Organization** - Maintain files in a structure which is both navigable and searchable by users.
- **Backups** - Create a backup routine that is an embedded part of the digital process (cloud, physical media, & storage). This also includes knowledge and use of software auto-backup and recovery. Keep at least one physical backup off-site.
- **Clean-up** – Regularly sort, store, and purge project files to manage storage and make important files easier to locate.

## Teaching Soft Skills

Many of the examples listed under soft skills can be classified as character or personality traits. Successful students may already practice soft skills and therefore it is often assumed that these are character traits rather than teachable attributes. One might wonder, given the age of many college students, if such habits can be changed. However, the very notion of "soft skills" implies that these behaviors and habits can be taught to students. There is evidence to support the idea that, with training, young adult students can learn new traits and learning strategies. [12]

Another common argument is that soft skills are best learned in the workplace. While the workplace presents an authentic context, it does not offer the same opportunities for focused learning as design school. Moreover, one of the reasons for learning soft skills is to make one more competitive in finding employment. Students should have a sense of them before they enter the market.

How can schools teach digital soft skills? Merely lecturing to students about them is not an effective strategy. While lectures can be helpful for delivering information or persuading an audience, changing and developing habits requires more engagement. The method of training varies depending upon the attribute and the audience, however, generally-speaking, habits of learning can be developed through a process of investment and practice.

Supporting a new habit which a student does not create themselves requires helping them understand its meaningfulness. It can be easy to dismiss soft skills out of hand because they might seem to be obvious or less interesting than learning technical skills. For this reason, it is important for the instructor to communicate why new strategies and habits are helpful. [13] Investment begins by identifying the soft skills in question and explaining to students the value of the skills within design and production workflows. To be most effective, those values should be immediate and goal-oriented. Although it is true that developing soft skills can help a student get a job in the future, explaining to a student (for example) how organizing their files saves them time and reduces errors on their current project is less abstract and applies to their current situation. Helping students understand the gaps in their present abilities and how learning soft skills can help close those gaps is the first step toward effective habituation.

To be most effective, teaching soft skills should be integrated with hard skills teaching and preferably in the context of a project.[14] It is not necessary to revamp an entire course around soft skills. An instructor can introduce them where they naturally occur within design and production processes. For example, using an error that students commonly encounter to introduce search, problem-solving, and communications skills. Relevant material like this helps focus student attention while a legitimate context helps them retain and access what they have learned later.

Demonstrations can be more effective when they are supported by teaching materials that help organize knowledge for students.[15] A simple check-list, for example, can help students remember how to organize a digital group project. Once students have mastered the soft skills involved, the student will not need the scaffolding provided by the list. However, if the student makes a mistake or needs to refresh their learning later, the list provides a useful reference and a prompt for activating digital soft skills. Externalizing implicit practices and helping students focus on relevant information and methods improves the effectiveness of soft skills teaching.

Delivering soft skills in class benefits from a coaching approach. Because the goal is to change student attitudes over time, rather than delivering information or procedures, a "one and done" demonstration is not an appropriate teaching style. [16, 17] With coaching, the instructor discusses the advantages of a skill (creating investment), then models the behavior while explaining to the student what they are doing and why. This last step is important because students need to understand when to apply a skill as much as they need to know the technical operations involved. [18, 19] Next, students demonstrate the skill and receive feedback from the instructor on their performance. This is followed by more practice and feedback over time and in concert with other skills to approximate holistic design activities. The goal of coaching is to cultivate not just practice but deliberate practice over time – making the student aware of their own actions and motivating retention and refinement. [20] This creates deep and lasting learning.

Adopting a coaching style of instruction requires a change in how students are graded and given other feedback. Most assessment in studios and seminars is summative, meaning it measures the final outcome of a students' work. This is suboptimal for shaping behaviors, as it does not measure the process sufficiently and is often too late to influence a student's soft skills. Formative assessment techniques, which encourage personal reflection, timely feedback, and student response are useful support for the "coaching". [21] To supplement these techniques, instructors should not only observe student behaviors but review digital files, as well. Many courses emphasize the final artifact and never look at the files involved. Reviewing files is critical so the instructor can observe attributes such as organization, efficiency, and other procedural nuances.

Lastly, in order to properly cultivate habits, soft skills should be reinforced in the studio and lab even when they are not being formally taught. Instructors should be mindful and consistent in their own habits, demonstrating modeled behaviors in their personal actions. For example, an instructor's demonstration files should be well-organized to set a good example for the students. Student interactions should also emphasize consistent behavior. If a student asks for help with a tool, for instance, the instructor should evaluate how the student asks questions and replay the scenario with them while making explicit the strategies involved. Learning should be embedded in the classroom experience. It must be a continuous practice, not merely an exercise.

## Conclusion

While digital design skills are critical for 21st century designers, architectural education must also recognize and deliver more than technical proficiency. Working creatively and effectively with computers, digital fabrication machines, and other devices requires a new set of workflows and adaptations to professional behaviors. Soft skills support the goal of not only working well with technology, but together with other people in technologically-supported ways. Attitudes, habits, and workflows not only shape one's process, but one's goals and outcomes, as well. Soft skills impact design and so they should be of interest to anyone who values good design.

Incorporating soft skills into existing digital instruction may require more work from both the instructor and the students, but the benefits are lasting. Becoming more aware of one's process and developing good digital habits pays off, no matter what software or tools one encounters. Ultimately, teaching soft skills is about making students more independent and self-directed learners. With the rapid pace of technological change, students need to be comfortable with and capable of learning, relearning, and integrating new programs and tools throughout their career. For these reasons, soft skills can and should be taught in foundation design.

## Notes

[1] Pullasmaa, Juhani. The Eyes of the Skin: Architecture and the Senses. John Wiley & Sons, Inc., 1996.

[2] Kieran, Stephen and James Timberlake. Refabricating Architecture: How Manufacturing Methodologies Are Poised to Transform Building Construction. McGraw-Hill Education, 2003.

[3] Bancino, Randy, and Claire Zevalkink. "Soft Skills: The New Curriculum for Hard-Core Technical Professionals." *Techniques: Connecting Education and Careers (J1)* 82.5 (2007): 20-22.

[4] Professionalism accounts for the skills, good judgment, and polished behavior crucial to professional success. These traits include: consistent academic preparation, actively engaging in discussions, meeting deadlines, collaborating courteously with classmates, giving and receiving respectful academic criticism, incorporating design feedback, managing time effectively, respecting the course space and building, and communicating in a polite and considered manner.

[5] Boyer, Ernest L. and Lee D. Mitgang. Building Community: A New Future for Architecture Education and Practice: A Special Report. Jossey-Bass Inc., 1996. (Preface xvi)

[6] Hereafter, digital tools refers to software programs, computing devices such as laptops, tablets, etc., fabrication systems (laser cutters, 3d printers, CNC machines, etc.), robots, embedded systems, and anything else that involves computers.

[7] Prensky, Marc. “Digital Natives, Digital Immigrants.” On the Horizon. MCB University Press, Vol. 9 No. 5, October 2001.

[8] Enrique Dans, “The Absurd And Unfounded Myth Of The Digital Native.” Jun 4, 2014 https://medium.com/enrique-dans/the-absurd-and-unfounded-myth-of-the-digital-native-45d1ff397785#.t959mvxza Accessed January 9, 2016

[9] Sheil, Beau A. "Coping with complexity." *Office Technology and People* 1.4 (1983): 295-320.

[10] Blackwell, A. "What is programming?" *14th workshop of the Psychology of Programming Interest Group*. 2002.

[11] Pea, Roy D. "Logo programming and problem solving." (1987).

[12] Perkins, David N., and Gavriel Salomon. "Are cognitive skills context-bound?." *Educational Researcher* 18.1 (1989): 16-25.

[13] McCombs, Barbara L. "Alternative perspectives for motivation." *Developing engaged readers in school and home communities* (1996): 67-87.

[14] White, B. Y., and J. Frederickson. “Inquiry, modeling, and metacognition: Making science accessible to all students." *Cognition and Instruction* 6: l. 1998.

[15] Bransford, John D., Ann L. Brown, and Rodney R. Cocking. How people learn: Brain, mind, experience, and school. National Academy Press, 1999.

[16] Mistrell, J. Teaching Science for Understanding. pp129-149 in Resnick, Lauren B., and Leopold E. Klopfer. Toward the Thinking Curriculum: Current Cognitive Research. 1989 ASCD Yearbook. Association for Supervision and Curriculum Development, 1989.

[17] Bransford, John D., and Barry S. Stein. "The IDEAL problem solver."1984.

[18] Scardamalia, Marlene, C. Bereiter, and R. Steinbach. "Teachability of reflective processes in written composition." *Cognitive Science* 8.2 (1984): 173-190.

[19] Simon, Herbert Alexander. Problem solving and education. Carnegie-Mellon University, Department of Psychology, 1978.

[20] Ericsson, K. Anders, Ralf T. Krampe, and Clemens Tesch-Römer. "The role of deliberate practice in the acquisition of expert performance." *Psychological review* 100.3 (1993): 363.

[21] Vye, Nacy J., et al. Cognition and Technology Group at Vanderbilt. “SMART environments that support monitoring, reflection, and revision." *Metacognition in educational theory and practice*: 305-346. 1998.

# From 1:1 to 31:31 or How to Leverage the Laws of Exponential Growth in Architectural Education

Heather Flood | Woodbury University School of Architecture

## Background

In the essay The Turn of Education, Joan Ockman describes the syncretic nature of architecture and the particular challenges of educating students who must engage a wide-range of knowledge types from technology to humanities to science. [1] The Beaux-Arts versus Polytechnic divide that emerged in American education in the late 1800's underscores the history of emphasizing one knowledge type over another in distinguishing one university from another. In the essay, The Battle between Polytechnic and Beaux-Arts in the American University, Michael J. Lewis describes the rapid expansion in architectural courses and programs offered at universities across the country at the turn of the twentieth century. He attributes much of the expansion to the growing complexity of the profession which suddenly had to develop expertise with HVAC and electricity systems. [2] As technology advances, the tools that architects use and the responsibilities that they absorb increase. In recent decades, the binary divide in architectural education between the technical and the artistic has splintered. Today, particularities of software and emphasis of values shift dramatically from office to office and from university to university. While BIM and sustainability may be emphasized in one setting, parametrics and history may be emphasized in another. The ever-expanding terrain of architectural production has expanded the possibilities for foundation studies. As universities continue to differentiate from one another so do their foundation courses. If this assertion is correct, then there may be more value in comparing systems for delivering foundation content then there is in comparing the content itself. This paper will describe a method of teaching a first semester studio in Architecture. The method is designed to grow intellectual and technical skill at an exponential rate.

Exponential growth is the phenomenon wherein something develops at an increasingly rapid rate in proportion to a growing number in size. For example, when a piece of paper is folded once it produces two rectangles, when it's folded twice it produces four rectangles, when it's folded three times it produces eight rectangles, when it's folded four times it produces sixteen rectangles, etc.... While the input (fold) is increasing in small increments, the output (rectangles) is increasing in large increments. Another example is population growth. If an individual has two offspring and those two offspring each have two offspring, etc... by the fourth generation you will have 16 offspring. While the first example highlights the value of repetition of action (folded paper) the second example highlights the value of collective action (population).

In both examples above, an investment that began with a 1:2 yield quickly transformed into a 4:16 yield. In design studio terms, this ratio is re-conceived as the energy expended by a single student : the knowledge gained by a single student. Unlike advanced studios, foundation studios measure success in terms of growth and not in terms of sophistication. Students enter the first year with little to no disciplinary experience or expertise. It is the responsibility of the foundation instructor to determine the basic skills necessary to study architecture at their university and then to build that base under each student. By applying logics of repetition and collective action in studio content delivery, the depth of knowledge will increase at an exponential rate. In other words, foundation studies is a numbers game.

## Overview

The course that will be used as the case-study in this paper was developed and taught at Woodbury University School of Architecture during the fall semester of 2015 by Heather

Flood, Anali Gharakhani, and Jason King. It is the first design studio in the architecture sequence. There were thirty-one students enrolled in the studio. While the students were divided into sections and assigned a specific instructor the studio behaved as a collective.

The aim of the studio was to provide an intellectual, technical, and ethical foundation for engaging in the study of architecture on contemporary terms. It is the belief of the instructors that, at its core, the practice of architecture is the practice of creating, specifying, and resolving three dimensional form in relation to specific contexts (e.g. sites, programs, budgets, materials, and client values). It is also the belief of the instructors that to engage the study of architecture in a meaningful way, students must be equipped with basic form-making and form-thinking skills. Front-loading technique, as this studio did, empowers students to processes and act upon the conceptual frameworks of architecture that will be introduced in subsequent semesters on design terms.

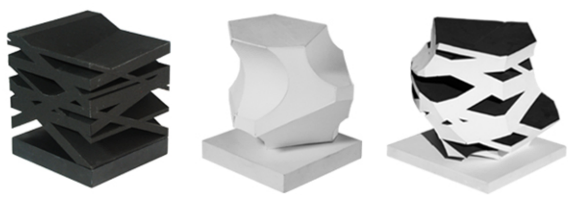


*Fig. 1 Results from the black, white and grey exercises. Student: Kevin Solarz.*

The work in the studio is highly abstract, overtly formal, and self-referential. *(see Fig. 1)* The pedagogical bias leans on the example set by Rowena Reed Kostellow who pioneered and taught the foundation program at Pratt for half a century beginning in 1934.[3] Kostellow's work with students was similar to this course in that it centered on the production of abstract three-dimensional forms. Unlike this course, the foundation exercises that Kostellow developed were designed to impart rules of composition that underscore beauty. In this studio there was no preconceived quality such as beauty being pursued. Instead, students developed skills for generating and representing complex three dimensional forms. They were then asked to identify the qualities of what they've produced, identify the techniques that produced those qualities and then to systematize those techniques in the production of a coherent whole.

The subject matter for the semester was limited to form generation and representation. The narrow scope of interest facilitated an exponential growth in skills over the course of the semester. The limited range of concerns allowed the same processes and issues to be worked on repeatedly. The constrained format ensured that results were easily comparable in a collective setting. When the curriculum emphasizes repetition and collectivity, the mode of faculty engagement shifts away from one on one as the primary means of passing down knowledge and towards many on many as a primary means of sharing knowledge. To successfully manage this shift, faculty must do two things well: 1. develop a methodology for experimentation, and, 2. create a forum for sharing results.

## Methodology: The Value of Repetition

In the essay, *An Agenda for Education: on the Relationship between Architectural Design Education, Technology of Architecture, and Information Technology*, Luca Caneparo argues for the value of method-oriented education.[4] His text suggests that methods, which provide an ordered and systematic process for experimentation, can be a platform for nurturing individual modes of expression. The outcomes of method-oriented education are not evaluated against the taste, proclivities, or style of the instructor, but rather, against the techniques each student establishes for navigating the method. In other words, there is no a prior ideal guiding the development of student work. Instead, the method allows students to hone techniques towards the production of an emerging aesthetic.

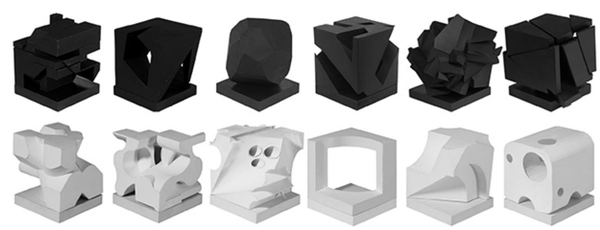


*Fig. 2 Results from the black and white exercise. Students (from top left to bottom right): Kevin Solarz, Christian Boling, Joseph Cupido, Armen Janazyan, Hanshi Li, Armen Janazyan, Kevin Solarz, Kevin Solarz, Joseph Cupido, Amir Fakharian, Amir Fakharian, and Amir Fakharian.*

The methodology in this course was comprised of three exercise (black, white, and grey) that built upon one another to culminate in a 1,000 square foot building proposal. Students began in Rhino with a 6" cube. They transformed the cube using a single technique, such as slicing, and then repeated that technique multiple times. The resulting transformed cube was then unrolled, laser-cut, and re-assembled into a physical model. The physical models were painted either black or white and then located on a 1" x 6" x 6" painted MDF base.(*see Fig. 2)* The only difference between the black exercise and the white exercise was that the black exercise was restricted to straight lines and flat surfaces and the white exercise was restricted to radial lines and curved surfaces. Each student repeated the black exercise four times and the white exercise four times. Thirty-one students produced eight models each for a total of two hundred and forty-eight 6"x6"x6" models.

*Fig. 3 Results from the grey exercise. Students (from right): Christian Boling, Weidong Zhou, Armin Janazyan*

Following the black and white exercises, student embarked on the grey exercise which began in Rhino with the scaling-up of the 6" cubes to 12" cubes. Each black cube was intersected with each white cube to produce sixteen 'grey' digital models. Each digital model explored multiple boolean possibilities for combining the two disparate masses into one. One of the sixteen digital models was unrolled, laser-cut, re-assembled, painted, and located on a 1" x 12" x 12" painted MDF base. *(see Fig. 3)* In addition to modeling, each exercise included a drawing component. Each student produced a plan and a section of their four black models, their four white models and their one grey model for a total of nine plans and nine sections per student or two hundred and seventy-nine plans and two hundred and seventy-nine sections for the class. *(see Fig. 4)*

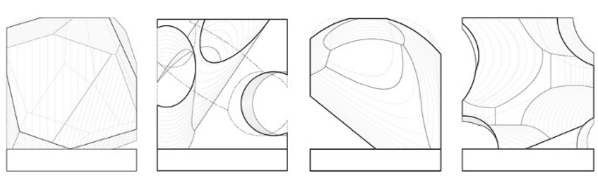


*Fig. 4 Results from the black and white exercise. Students: Amir Fakharian, Christian Boling, Kenia Roman Cortez, Kevin Solarz*

The strict methodology imposed on these black, white, and grey exercises yielded three things: 1. results that are easily comparable, 2. rapidly increasing skill sets, and, 3. emergent outcomes. The differences between projects were pronounced as a result of the relentlessly uniform formatting. Minor increases in degree of angle or diameter of tube from one result to another are immediately identifiable.  In most cases, the fourth iteration of the exercise was the most sophisticated and the least time-consuming to produce. On average, it took students four hours to complete their first plan and section drawings and thirty minutes to produce their last plan and section drawings. The increase in speed and advancement of skill is a direct result of repetition of action. Finally, the outcomes resulted from a rigorous process and not from a compositional logic. Students were taught to systematize an intuitive action into a set of techniques. This allowed authorship to emerge out of the unique way individuals navigated the method and controlled the tools. [4]

## Forum: The Value of Collectives

In the essay, *The Battle between Polytechnic and Beaux-Arts in the American University*, Michael J. Lewis discusses the effect of institutionalizing the education of the Architect. [5] He states: "The rise of formalized architecture programs did not substantially change the content of the architect's education. Whether in an office or a classroom, students still learned about drafting and rendering, materials and construction, planning and composition…What did change may be called the culture of education. This was previously a vertical affair, in which knowledge passed from master to apprentice. Now it became much more horizontal, with the critical exchange of ideas especially occurring among the students themselves." In this course the instructors developed conversation and review formats that were designed to intensify the horizontal exchange of knowledge.

Firstly, a common language was established for describing and evaluating what one sees and what one is working on. This studio framed 'MVG', or mass, void, ground, as the primary lens for discussion. Specifically, students were provided with adjectives such as symmetrical, asymmetrical, figural, coherent, distributed, dissonant, etc… as ways of identifying and talking about the particular qualities of the mass and the void in each project. Additionally, students were provided with adjectives such as stable, unstable, co-planar, hovering, levitating, imposing, etc… as ways of identifying and discussing the relationship between the figure and the ground.

Four forum types were established for discussing and sharing work. Two of those, round-ups and show & tells were internal to the studio. On average, the students produced one model per week. Each week would begin with a round-up of the new models which would be displayed in a grid with space around the grid for circulation. *(see Fig. 5)* Students were asked to identify a project other than their own and describe something interesting about it. The round-up conversations were free-style in nature. No order was imposed and it lasted until no one had anything further to say, usually an hour and a half. These weekly conversation were designed with peer to peer learning in mind. Students were encouraged to 'steal' from each other by appropriating the lessons embodied in another other students work.

*Fig. 5 A weekly round-up (top), the white show & tell (bottom left), and the black show & tell (bottom right).*

There were three show & tell reviews over the course of the semester. *(see Fig. 5)* One occurred at the end of each exercise. These reviews organized work into a rectangular grid. Each student displayed their four models in single row with one foot between the models. The distance between rows was also one foot. The equal spacing in both directions foregrounded the intellectually collective nature of the work. At these reviews, students would present their models and drawings to the instructors. Emphasis was placed on helping students identify and articulate the formal qualities that emerged from the exercise. There was no good, bad, right, or wrong. There was simply can you see it, can you name it, can you talk about it, how would you do it again differently.

Two forum types were established for presenting and discussing the work with students and faculty who were not enrolled in or teaching the class. The first, an installation, marked the culmination of the black, white, and grey exercises. *(see Fig. 6)* All of the models and drawings were installed in the School of Architecture's central gallery. There were two hundred and forty-eight 6"x6"x6" black and white models arrayed in a grid in the center of the floor. There were thirty-one 12"x12"x12" grey models displayed against the walls with drawings above. The entire school was invited to view and comment on the 'Encyclopedia of Form' that the first semester students generated. The installation demonstrated for students that their work has life beyond them and that it is part of a culture within the school and within the discipline of architecture. It also taught them that the perception of their work to people outside the conversation of the studio may differ from the perspective of their instructors.

The second forum type designed to engage an outside audience was digital. *#WU1A* (Woodbury University 1A) was a hashtag dedicated to circulating the work of the studio through social media outlets. Facebook, instagram, twitter, blogs, and websites were all used as platforms for disseminating the work to a wide audience that included students, educators, friends, and families. *(see Fig. 6)* Through these outlets students were able to discuss their work with peers at other universities and with each other in a casual and on-going way. While the instructors also participated in the hashtag forums, it was specifically meant to enhance peer to peer conversations.


*Fig. 6 The installation 'Encyclopedia of Form' (top), an instagram post from student Vanessa Shealy (bottom).*

Weekly round-up's, show & tell's, the installation, and the hashtag were all conceived as venues for knowledge exchange. The idea for these forums emerged from the simple observation that there is a direct correlation between the collective effort of the studio and an individual student's capacity for learning. The consistency in the models and drawings combined with the organizational logic of the forum types made a comparative analysis of the work easy. Because students were able to compare the results of the exercises they developed a depth of understanding that would not have been possible by simply evaluating their own work. Because the methodology that produced the work was embedded with repetition, they were able to do this two hundred and seventy nine times over.

## Notes

[1] Ockman, Joan. "The Turn of Education" in *Architecture School: Three Centuries of Educating Architects in North America.* Ed. Joan Ockman with Rebecca Williamson. MIT Press: Cambridge, MA. 2012. p 10.

[2] Lewis, Michael J. "The Battle between Polytechnic and Beaux-Arts in the American University" in *Architecture School: Three Centuries of Educating Architects in North America.* Ed. Joan Ockman with Rebecca Williamson. MIT Press: Cambridge, MA. 2012. p 76.

[3] Hannah, Gail Greet. *Elements of Design: Rowena Reed Kostellow and the Structure of Visual Relationships.* Princeton Architectural Press: New York, NY. 2002.

[4] Caneparo, Luca. "An Agenda for Education: on the Relationship between Architectural Design Education, Technology of Architecture, and Information Technology" *Design Studio Pedagogy: Horizons for the Future.* Ed. Ashraf M. Salama and Nicholas Wilkinson. The Urban International Press: Gateshead, The United Kingdom. 2007. p 345-346 and 355-357.

[5] Lewis, Michael J. "The Battle between Polytechnic and Beaux-Arts in the American University" in *Architecture School: Three Centuries of Educating Architects in North America.* Ed. Joan Ockman with Rebecca Williamson. MIT Press: Cambridge, MA. 2012. p 89.

# 1:1 A Case for Collaboration in Foundation Pedagogy

Sallie Hambright-Belue, Martin Holland | Clemson University

## Abstract

We recognize that the 1:1 scale is an incredibly useful pedagogical tool for assisting beginning design students to understand issues of design/build at a familiar scale while providing a unique chance for them to explore material qualities, engage with construction processes, and experiment with fabrication. However, we would also like to offer an alternative reading to the concept of 1:1; one that transcends scale but is still very focused upon the notion of relationships. For the authors, 1:1 is an equitable relationship that regards collaboration among the design disciplines as a fundamental component of design pedagogy.

"Learning is not a spectator sport...[Students] must talk about what they are learning, write about it, relate it to past experiences, apply it to their lives. They must make what they learn part of themselves."

~ Arthur W. Chickering and Stephen C. Ehrmann.[1]

## Introduction

As the pace of technological advancements within the design disciplines of architecture and landscape architecture seem to constantly increase, there is an underlying tendency to try to incorporate latest trends in digital visualization, Building Information Modeling, and 3D Printing within an already stretched to the limit curriculum. This ceaseless desire for new technology, coupled with the enrollment of students of the "millennial generation" (those who were born from 1982 - 2003) within post secondary educational institutions, has placed an emphasis upon unfettered access and implementation of the latest forms of technology within the classroom, lecture hall, or design studio.[2,3] However, the authors of this paper argue that the primary core skillset that requires development for first year design students lies not in expanding their digital literacy, nor a repackaging of traditional design exercises, but rather in a refinement of their non-hierarchical perspective to problem solving. This epistemological approach includes traditional design exercises concerning form, scale, composition and balance, but also focuses on productive working relationships, full student engagement, and the incorporation of a sense of mutual ownership of projects across the disciplines. This equitable, "1:1" collaborative approach is also based upon the latest requirements identified by our accreditation agencies who insist upon greater levels of collaboration among professionals.

### *A Brief History of Collaboration at the University*

Emphasis on collaboration may not strike some as a major trend within the design disciplines, but the adoption of new organizational structures in both architectural pedagogy and professional practice reinforce the necessity of actually *teaching* skills necessary for effective student collaboration. Approximately a decade ago, our University like many other public institutions with architecture programs and related disciplines, adopted the idea of a "common core" as the starting point of the undergraduate curriculum. The supposition was that a class, specifically taken in common by students across the disciplines, would both introduce and encourage a cross-fertilization of approaches and ideas among architecture, landscape architecture, and construction science and management students. While there were successes produced by this method, it became clear that such a course often resulted in student frustration as incoming students often lacked a firm disciplinary perspective, let alone a skillset capable of adding value to a collaborative project. The school abandoned this "common core" approach in 2001, however by 2013 a renewed, albeit, highly modified effort was introduced with increased faculty interest and changing accreditation standards.

### *Current Collaborative Efforts*

The renewed effort was undertaken by the School of Architecture, Department of Landscape Architecture and Construction

Science and Management to reintroduce the idea of collaboration. Discipline specific concepts and skills would be taught to the students by their faculty, however three times during the semester, *all* the students would meet to experience a common lecture, engage with a panel of collaborating practitioners, and to cooperate across the disciplines in a common project. While the lecture and the presentations were well received by the students, the results of the shared project left much to be desired. The interdisciplinary project required teams to design and construct a toy for an eight-year-old child. A list of deliverables were required including a budget, schedule detailing the time frame required for construction, design drawings, and a prototype of the toy itself. Faculty provided no instruction on how teams should work, but instead expected the students to negotiate that issue on their own. The deliverables were successfully submitted, but it was apparent that the process used was flawed. Many groups failed to present their final product, and the level of true collaboration was minimal. The landscape students refused to participate, as they believed that the process and the product was outside their expertise, the architecture students not only designed but also constructed the toy, and construction management students merely decorated the item after it was completed. One group of construction management students rebelled, undermining the efforts of the architects by painting the toy train hot pink and purple, then covering the toy in a faux leopard felt print. It was clear that what was supposed to be a collaborative effort in generating understanding of the other disciplines instead reinforced negative stereotypes, and ultimately, created a hostile work environment for all of the groups. We learned from this failure, and it became clear that we could not expect first year students to engage in topics outside the scope of their majors. We kept the idea of collaboration alive the following year, by still having the students meet three times during the semester, but ultimately they had nothing invested in these meetings, as the only collaboration that year was the physical sharing of a lecture hall for the joint meetings.

The recent redevelopment of the course by faculty refined a collaborative, "1:1" disciplinary component to accompany our respective introductory courses. This component is novel as it does not focus on a specific product to be delivered, but instructs the students that they will establish, develop and refine the *process* of how they as representing different disciplines, will work together to produce a Collaboration Plan. Using one of the University's Capital Project Request for Proposals, student teams will develop a plan for collaborating among the disciplines and deliver the plan to the project owner. The Collaboration Plan asks students to work as interdisciplinary teams to develop common goals, establish an open communication plan, develop a conflict resolution strategy, practice trust building techniques, and promote a leadership plan. The group will then submit a package outlining their methodology for working collaboratively and the project will be 'awarded' to the team with the most comprehensive Collaboration Plan. Students will be evaluated on their shared plans encouraging collaboration and on a reflective written statement describing what they learned from the exercise. In addition, a self- and peer- assessment will be issued to address topics such as mutual respect, development of listening skills, establishment of trust and the emphasizing of group success over personal achievement.

What is novel regarding this pedagogy is the delivery of knowledge that is typically not found within a design curriculum. Many times students are expected to develop these interpersonal skills on their own, but it has become increasingly common that they lack these aptitudes at the start of their university education. There is a palpable need to teach skills like, conflict resolution, mutual goal development and effective communication. In addition, these skillsets are beginning to appear in the various disciplines accreditation requirements further solidifying their necessity to appear within our curriculums.

*The Value of the Accreditation Process*

This significant modification with regards to teaching interpersonal skillsets was not just borne out of the students and faculty's past frustrating experiences, but from the guiding requirements of accrediting agencies. The attainment of professional accreditation for our programs is an essential step to guarantee not only the highest level of professional standards, but is also necessary to stay relevant to the professional practice of the fields. One of the chief benefits of undertaking re-accreditation is the reflective process encourages faculty to reflect on established programmatic strengths, and identify areas in need of improvement. It was through this cycle that increased collaboration was identified as a necessary condition for recertification of one of our academic programs.

The primary "Defining Perspective" required for accreditation by the National Architectural Accrediting Board (NAAB) is identified as *collaboration* and *leadership*. NAAB states that an architecture program; "...must describe its culture for successful individual and team dynamics, collaborative experiences and opportunities for leadership roles."[4] The importance of collaboration and leadership are such foundational goals to the NAAB that these priorities are articulated prior to any reference of traditional architectural design work. We believe that this attention to collaboration and effective communication are the foundational skills needed to reflect current professional practice in a globalized and interconnected marketplace.

The standards of the American Council for Construction Education (ACCE), the accreditation agency for Construction Science and Management programs, also specifies the urgent need to formalize the collaborative process. They state:

It is essential that the student have a firm understanding of the role of and relationship with design professionals. As such, development of abilities to communicate, participate, and contribute as a team member in the planning and design phases of such project delivery methods as design-build and construction management, and continued participation through such approaches as integrated project delivery are crucial.[5]

This statement is the first articulation of *any* guiding principle needed for those undertaking a professional career in construction management.

The Landscape Architectural Accreditation Board (LAAB), does not articulate any specific requirements for collaboration for the education of landscape architects, rather they instead place the emphasis on three basic categories for achievement; advance academic quality, demonstrate accountability, and the encouragement of purposeful change and needed improvement.[6] It is this last category that allows for the development of collaboration with academic programs noting that programs must "anticipate and address needed change" as well as "stress student achievement."[7] Given the wide range of professional practice of landscape architects, and the long standing collaborative role of the profession, it is not surprising that the accreditation board's guiding principles do not specifically articulate collaboration as a necessity. However, it is clear that continued collaboration among all the stakeholders is necessary to attain highest levels of design and construction quality of our built environment.

## Pedagogical Strategies for Teaching Teamwork

Identifying collaboration as an essential skill and teaching collaboration effectively are two different matters. According to the comprehensive study *"Is there a "Big Five" in Teamwork?"* successful collaboration, is in fact, a learned skill.[8] While faculty recognize and understand that collaboration must be taught to meet the demands of a changing industry, design schools and their curricula often fall short of the intended mark. Faculty often only divide students into equal numbered groups in order to complete a project, and while we focus on teaching the disciplinary skills associated with the project, we rarely address the process of effective teamwork. Almost any educator will attest to having student teams produce work beyond their individual capacities, and regrettably, also confide that they have had numerous dysfunctional teams, or lackluster results. Definitions of what constituted a successful or failed team, and their work were left up to the students themselves to identify.

The teamwork article states that team effectiveness goes far beyond the project itself, "team effectiveness takes a more holistic perspective in considering not only whether the team performed (e.g., completed the team task) but also how the team interacted (i.e., team processes, teamwork) to achieve the team outcome."[9] They identify five essential elements to team effectiveness, including effective team leadership, supportive mutual performance monitoring, backup behavior, adaptability, and team orientation.[10] In addition, there are "three supporting mechanisms" that help ensure team success; shared mental models, mutual trust, and closed-loop communications.[11] A "shared mental model" is a common outcome that the team understands as their primary goals, while "closed-loop communications" is simply the manner in which a communication is sent by one team member to another who acknowledges that the communication was received and understood. Mutual trust is a shared agreement that team members will perform their tasks to the benefit of the group, not to further individual interests.[12] When these mechanisms and elements are compared with the principles of Integrated Project Delivery, mutual respect; mutual benefit; early goal definition; enhanced communications; clearly defined open standards; appropriate technology; high performance; and leadership, it is clear that IPD fundamentally relies upon effective teamwork for success.

### *Collaboration is the Practice of Tomorrow*

The necessity of collaboration is reinforced not only by the accrediting boards, but also by marketplace demands for increased use of collaborative project delivery methods.[13] Integrated Project Delivery (IPD) is a relatively new delivery methodology starting in approximately 2004 and it has demonstrated consistent growth regardless of the most recent economic downturn.[14] What is fundamental to the IPD delivery method is collaboration and teamwork, with collaboration being an important aspect of professional practice within design firms for years, however collaboration with outside disciplines is a new development.

Collaborative practice offers designers numerous benefits and an advantageous position within the profession by granting more leverage for the design fields. A collaborative project delivery method like IPD provides designers a meaningful way to reestablish control over the design process, including the final implementation of a project. Under IPD, disciplinary responsibilities and professional liabilities are shared equally by the group, not placed on individual team members or their professional firms.

This methodology guarantees that the designer is invested throughout all stages of the project. Professional responsibilities are never "handed off," as the expected deliverable is not an initial design or a set of construction drawings, but is rather the completed project. While this may strike many as placing an excessive burden on a designer's time, it may prove to be beneficial to the architect's financial bottom line. IPD projects are based on financial incentives that encourage effective communication and teamwork; while architects must take on more financial risks and time investment, they do offer the architectural profession a way to demand compensation for design innovation, quality design and added value. If design schools are going to adequately prepare students for the future workplace, we must emphasize "one to one" collaborations early as a fundamental skill. Yet, as we have detailed, it is our experience that teaching collaboration is one of the most challenging problems encountered when educating first year students. The AIA's 2007 publication, "Integrated Project Delivery: A Guide" asserts:

Innovation is stimulated when ideas are freely exchanged among all participants. In an integrated project, ideas are judged on their merits, not on the author's role or status. Key decisions are evaluated by the project team and, to the greatest practical extent, made unanimously.[15]

This non-hierarchical approach is one of the major defining characteristics of the millennial generation, where they shun artificial titles, prefer working as a unified team rather than as disparate individuals, and embrace a diversity of opinions and perspectives.[16] It is clear that the rapidly evolving professional practice, added to the next generation's affinity for non-hierarchy and technology; the architectural workplace will alter such that collaboration and leadership will be essential skillsets.

## Conclusion

Interpersonal skills that lead to effective collaboration has become an essential quality necessary for the effective practice of design disciplines. In order for our students to be proficient collaborators, capable of meeting the challenges and demands of the future workplace, educators must provide them with opportunities to assess, develop and ultimately master, these fundamental teamwork skills. Industry is taking the lead in demanding collaborative project delivery methods and faculty must ensure that our curriculum for design studios are structured such that the skills of collaboration and teamwork are not just identified, but are specifically taught and developed by our students. It is vital to begin first year design education with an introduction to collaborative and teamwork techniques including leadership, mutual goal development, mutual respect, effective communication, etc. At our University, the foundation faculty from the School of Architecture, Department of Landscape Architecture and Construction Science and Management have been working together for the past three years to implement a competent strategy for delivering such skillsets. This innovation is finding traction by highlighting the processes necessary for teamwork rather than the traditional approach of teamwork as a means for completing a project. If we fail to instruct our students for the future architectural workplace by omitting communication techniques, skill development exercises, and opportunities to augment teamwork and collaboration, we are denying them the experience of working 1:1 across disciplines which is a crucial component of their architectural education, and limiting their potential to be committed and engaged professionals.

## Notes

[1] Chickering, Arthur and Stephen C. Ehrmann, "Implementing the Seven Principles: Technology as Lever," *American Academics and Higher Education Bulletin*, October 1996, pp. 3.

[2] Berk, Ronald. A, "No Teacher Left Behind: Teaching Strategies for the Net Generation." *Transformative Dialogues: Teaching & Learning Journal*, 3(2), p 78.

[3] Strauss, William and Neil Howe, *Millennials Rising: The Next Great Generation.* New York, NY: Vintage Original, 2000.

[4] National Architecture Accrediting Board, *2014 Conditions for Accreditation*. July 18, 2014. p. 11. Available at http://www.naab.org/accreditation/2014_Conditions (Accessed September 11, 2015.)

[5] American Council for Construction Education, *Standards and Criteria for Accreditation of Postsecondary Construction Education Degree Programs*, April 29, 2015. p. 11. Available at http://www.acce-hq.org/images/uploads/Document_103_050314.pdf (Accessed September 11, 2015.)

[6] Landscape Architectural Accreditation Board, *Accreditation Standards and Procedures*, February 6, 2010, revised Spring 2013. pp.1-2. Available at http://www.asla.org/uploadedFiles/CMS/Education/Accreditation/STA

NDARDS%20PROCEDURErevised2013.pdf (Accessed September 20, 2015)

[7] Ibid, p. 2.

[8] Salas, Eduardo, Dana E. Sims, C. Shawn Burke, "Is There A 'Big Five' in Teamwork?" in *Small Group Research*, vol. 36 No. 5, October 2005, p. 559.

[9] Ibid, p. 557.

[10] Ibid, pp. 560-561.

[11] Ibid, p. 564.

[12] Ibid, p. 568.

[13] Welker, Matthew, "Survey Shows Growing Awareness of IPD, But Barriers to Wide Adoption Remain." 2015 Available at www.aia.org/practicing/AIAB094213. (Accessed September 10, 2015.)

[14] AIA, AIA Minnesota, and School of Architecture - University of Minnesota, *IPD Case Studies,* March 2012. p 1, Available at http://www.aia.org/aiaucmp/groups/aia/documents/pdf/aiab093703.pdf. (Accessed September 10, 2015)

[15] American Institute of Architects, *Integrated Project Delivery: A Guide*, 2007. Version 1, Section 3.3, p. 5

[16] Berk, Ronald. A, "No Teacher Left Behind: Teaching Strategies for the Net Generation." in *Transformative Dialogues: Teaching & Learning Journal*, 3(2), p 81.

# Abstracting Scale: The One Week High School Prequel

Liane Hancock, Brad Deal | Louisiana Tech University

## Where to Begin?

What if we consider the beginning before the beginning? This paper investigates a teaching model that delivers a weeklong summer camp both as a singular one-off experience for high school students and as an analog to the architectural curriculum offered at Louisiana Tech University.

In recent years, high school summer programs for architecture have proliferated. The American Institute of Architects currently catalogues over 75 high school architecture programs hosted by colleges and universities.[1] Too often these programs are seen as other. With little or no reference to their parent institution, these programs typically are not considered part of the foundation curriculum. Yet, the yield rates from these programs into first year can be high. If the summer program parallels the teaching pedagogy of the school, the "alumni" of that program quickly accept foundation level studio pedagogy when they enter first year. Based on observation, it is clear that just a few such students can influence an entire class, turning the character of the first year studio from fear and resistance, to an atmosphere of experimentation.

## What Can You Teach in a Week?

The structure of this camp is organized to introduce students to the major learning objectives that our professional 4+1 program instills: defining space through enclosure and the study of surface; perception of space and the scale of the body; defining the building envelope through the design of cladding over structure; investigating tectonic resolution; and incorporating digital fabrication into workflow.

Over the week, students design a pavilion through a series of exercises, each presented at 1:1. The pavilion project is not presented at the outset, rather it is revealed through the series of exercises, with each presented as an experiment with specific performative requirements. As each exercise concludes, the faculty reframes the resultant design at a specific scale, allowing the project to advance in depth of design exploration. By didactically beginning each step at a 1:1 scale, the students leave behind their traditional vision of architecture, and can achieve complex designs quickly. The pace of the project results in one fully completed exercise per 24 hour period, with each exercise broken into 1 to 2 hour projects in class with homework that typically emphasizes production.

The studio course occurs each afternoon for four hours. Complementing the studio experience, the camp also presents lectures, workshops and field trips in the mornings. The camp has been taught twice, with each of the co-authors teaching it slightly differently – and the variations in method are presented in this paper.

## The Exercises

*Exercise 1.1: Enclosing Space*

Students begin with an investigation of the topological character of surface and its ability to enclose space. The faculty provides students with index cards, instructing them to slice and connect the cards, using tabs, to create a continuous surface that encloses space. Students develop a series of iterations, and at the end of this hour-long exercise, students present the result of their effort in an informal round-table review, discussing the goals, merits and shortcomings of each iteration. From this discussion, each student selects a final design based upon formal character and enclosure of space.

*Exercise 1.2: The Module and Surface*

Next, the faculty instructs the students to shift from conceiving of units as individual containers of space to aggregating them as modular components to form a surface. Students can choose to use their existing module, conceiving how to tile it across a surface, or they can develop a new unit.

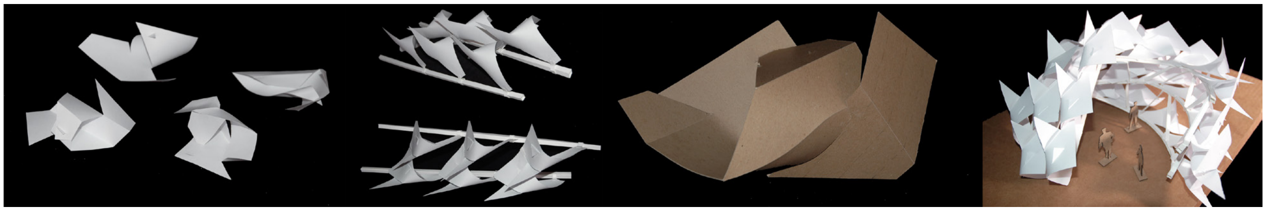


*Fig. 1 Summer 2014 process: unit, structure and modules, mockup of pavilion in chipboard, and final project.*

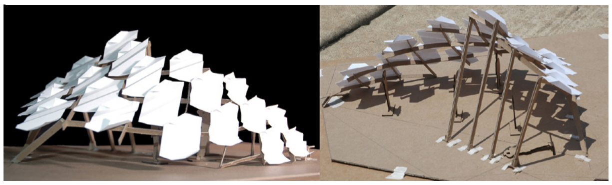


*Fig. 2 Summer 2014 project using secondary cladding unit.*

To design a new unit, students engage the same fabrication methods of cutting, scoring and folding index cards. The faculty introduces this assignment without providing a scale so that the exercise occurs in the abstract scale-less environment of an experiment.

In summer of 2014, to form the surface, the faculty instructed the students to first develop a tiling pattern for the units. The students considered whether the tiles touched, whether they oriented in the same direction, or whether some flipped front to back, or rotated. Students also considered the spacing between the units. Once they developed a pattern, the students designed a structural support system. Using cardstock or chipboard, students designed primary members which measured roughly eight to nine inches long, and approximately ¼ inch in depth. They then added secondary members to brace between the primary members. The students resolved how to connect the cladding units to the support system, inventing additional plates and braces. If the units touched, the students designed how the tiles connected to each other. The students conceived of the surface at 1:1, with this sequence providing an introduction to a simplified conception of building envelope.

In summer of 2015, the students began by designing a surface composed of tiles, using the index cards to create modules that could be linked to similar or complimentary units on four sides to form a continuous expandable surface. In this case, the modular surface was meant to be a semi structural, self-supporting skin rather than reliant upon the structural frame to support the panels individually. As a result, the structural frame was designed in a later exercise. As was true the previous summer, the students considered the surface as 1:1, again rendering it as an experiment evaluated solely on its own terms.

*Exercise 2: Introducing the Pavilion and Siting*

For the next exercise, students increase the size of the original space-enclosing unit by four times. At this point, the faculty informs the students that their goal for the remainder of the week is to design a pavilion for a single person: a contemplative, private space for reading, reflection and meditation. This conversation provides the opportunity to discuss how the user enters the space, and inhabits it. The faculty also discusses positioning towards the sun and away from winds, and how the cladding strategy can be altered through orientation and density to enhance the pavilions' capability for providing shelter.

The students now convert their original index card space into a structural frame clad with their modular surface system. The space and the modular cladding system evolve through further iterations to better coordinate with one another and to fit the desired programmatic and environmental responses.

In summer of 2014, initially the shift to four times larger occurred in chipboard, allowing students to gain an understanding of the size of the enclosure. An hour into class, students were told to define the surface of the enclosure through the structural support and cladding system from the previous day. Students then rethought the geometry of the system, and its connections – so that it wrapped around the enclosed space – rather than existing solely in planar form. In order to accomplish this, students developed a structural frame that approximated the form of the original space-enclosing unit, visualizing it as a scaffold instead of surface. Simultaneously, students were introduced to the scale ruler, and told that their projects were 1/2"=1'-0". (Figure 1 and 2)

The students were told that their site was on a slope facing south. They reacted to this information by developing both their structure and their cladding system to respond to sun and wind orientation. After completing the structure, students then set to making numerous units by hand, which they affixed to the scaffolding.

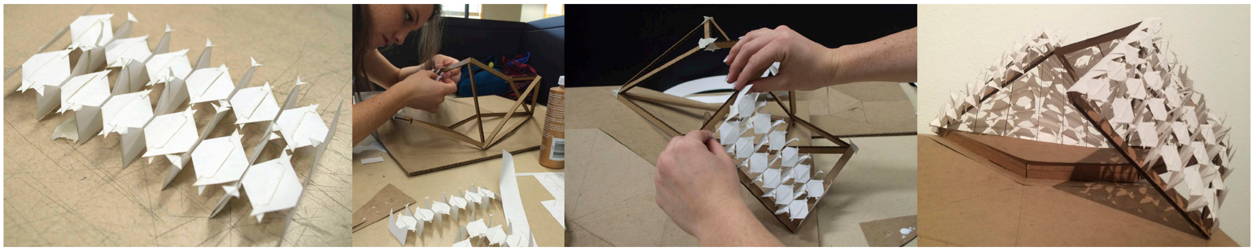


*Fig. 3 Summer 2015 process: units making a surface, constructing the structure, cladding the structure, and final project.*

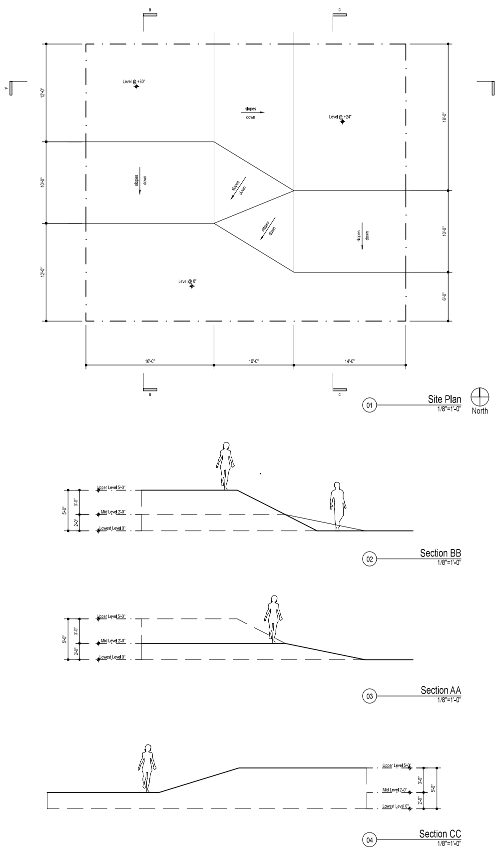



*Fig. 4 Site drawings.*

The project was completed in the next 48 hours, allowing for a Friday morning critique and open house for parents.

In summer of 2015, the final processes were different both in definition of site and production of the model. In lieu of a simple sloped site, the students were presented with a simplified kinked berm that created 3 distinct level surfaces and 3 sloped surfaces. The description of the site was used as an opportunity to introduce orthographic drawing. The students were asked to build a model base from a single page of drawings that included a site plan, section cuts through the site, indication of elevation height at level areas, and a perspective – allowing students to synthesize the plan and section information. Introducing the site allowed the students to engage with drawings in a critical, investigatory fashion in order to understand how they can convey objective information. Additionally, students learned how to translate information between multiple scales by working from a ¼"=1'-0" site plan to construct a ½"=1'-0" site model. (Figure 3 and 4)

As the students began to translate their modular tiled surface to the correct scale for the final model, one additional limitation was placed on them: the modules were to be designed as though they were constructed from 2'x3' materials meaning 1"x1.5" rectangles at ½" = 1'-0" scale. To assist with this translation approximately twenty 1"x1.5" paper rectangles were laser cut and provided to each student. Once they had modified their tile design to fit this module, the students had their design approved for production by the instructor and then took a single un-folded module to the teaching assistant. With oversight and assistance from the student, the teaching assistant drafted the unit in AutoCAD and laser cut a few examples to confirm that it had been accurately replicated. Once approved, the teaching assistant cut between 50 and 100 modules for each student, effectively incorporating digital workflow into the production process. By producing the tiles for each student, a significant efficacy was accomplished. The students could spend more time on the patterning of the tiles, in lieu of simply producing them through analog means. Students completed production and assembly of the final project between Wednesday evening and Friday morning, in a schedule that paralleled the previous year's production. (Figure 5)

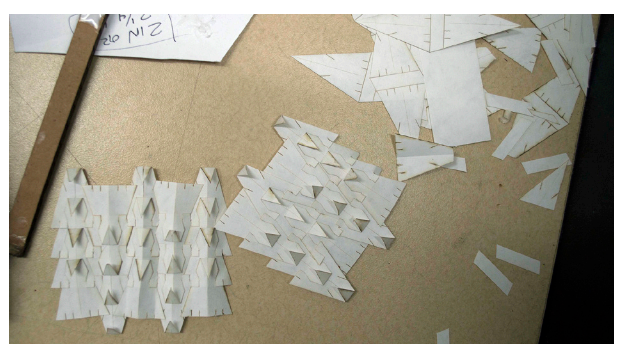


*Fig. 5 Digitally cut tiling modules.*

*Fig. 6 Final exhibit showing with the students, final models and the full scale units.*

*Exercise 3: The Cladding Unit at 1:1 and Digital Work Flow*

In summer of 2015, the efficacy of producing the scaled cladding panels through digital fabrication methods allowed an additional learning objective. Having incorporated the laser into the design process, it was easy to present an additional step of digitally cutting cardboard “full scale” mockups of the cladding units at 1:1. (Figure 6)

The previous exercises had made the students comfortable with the idea of modeling architectural space at a scale. This final assignment allowed the faculty to employ a final abstraction, shifting scale once again. In this last scale shift, the teaching assistants utilized the laser to cut 6 to 8 full scale cladding units out of chipboard. Because the module was limited to 1”x1.5” at ½”=1’-0” scale, at full scale the units were 24”x36”, the size of the bed of the laser. Working at 1:1 allowed the students to fully understand the scale and tectonic implications of their design. The notching and interlocking cladding techniques taught in earlier steps were easily executed at full scale without additional adhesives or assistance, meaning that the units were not models, but full scale mockups.

## Conclusion

Much can be taught in one week. This camp presents a microcosm of the architectural design process, with each separate exercise conceived at 1:1, and then reframed at a scale to magnify design intention. Breaking the week down into distinct steps allows the faculty to sidestep students’ assumptions about architecture, and their youthful temptation to avoid process in a self-possessed rush to complete the project. Simultaneously, starting each step at a scale of 1:1, as a teaching tactic, allows the faculty to hopscotch through stages of the curriculum, boiling down learning outcomes to their fundamental objectives: surface and the enclosure of space; structure and surface to define building envelope; tectonic and structure investigated at scale of inhabitation; and finally, the individual cladding component and its tectonic expression at full scale. This final step provides the opportunity to discuss design-build – an important aspect of our curriculum – and offers the supplementary benefit of underscoring digital fabrication as part of workflow. Finally, this pedagogical approach shows students how the rules that they initiate can be employed iteratively to design an increasingly complex project, providing them with a holistic introduction to the broader architectural curriculum, while at the same time offering a complete experience in a single week.

## Notes

[1] American Institute of Architects, “Summer Architecture Education Programs for High School Students,” http://www.aia.org/education/AIAS075245.

# Evaluating the Evaluation: Encouraging Risk Taking and Design Excellence via Studio Grading

Christopher Manzo, Dustin Headley, Katrina Lewis, Edward Nowlin | Kansas State University

## Introduction, Objectives, and Grading Issues

*Grading Is Not 1:1*

Grading design creativity is the fixed temporal assignment of a single determinate variable (%) codifying a multi-variable, highly creative, and principally subjective, series of student choices[1] that are made over time in a cumulative and interdependent fashion (See Fig. 1). Additionally, grading occurs in the much broader context of: students' concerns, cognitive styles, and growth (Roberts, 2006); external interests wrought with false equivalencies; imbalances of power and representation within the overall process (Webster, 2007); and pressure from various stakeholders in having higher student GPA's. As such, the mediation mechanism of grading is not a one to one equivalency focused solely upon student learning and outcomes (though it often appears or is represented to be so): it is the communicated assessment of an open-ended project via an evaluation and feedback within a much broader cultural construct of multiple and often conflicting agenda. An evaluation method and its accompanying feedback, provide two distinct values for students: input as to how to improve their design process, product, and presentation; and a reasoning or justification for their grade.

*Objectives Of The Case Study*

Using the framework of Bloom and Anderson's *Theory of Knowledge* (Bloom, 1956; Anderson, 2001), and Guildford's analysis (Guildford, 1950, Stein, 1953) of the categories of metacognition[2], how can the educational requirement of grading become an opportunity to promote increased design understanding, greater risk taking, and increased designer confidence in the beginning design student? In short, how can educators best design the act of giving grades to promote design excellence? The authors began this study by exploring the effectiveness of three studio grading evaluation methodologies (EV) in giving grades (G) and feedback (F) to early design students engaged in Creative Problem Solving and open-ended Project Based Learning: *Written Evaluation* (EV1), a hybrid *Rubric/ Red-line Evaluation* (EV2), and a hybrid *Rubric Self-Evaluation / One-on-One Evaluation* (EV3) (Seymour, 2008 and 2010, and below).

Our objective was to articulate and clarify the issues around grading and the grading event; designing the act of grading to reinforce studio culture, design excellence, and student learning. The authors seek to better understand how the act of giving a grade can become a focused learning opportunity leading to better pedagogical outcomes.

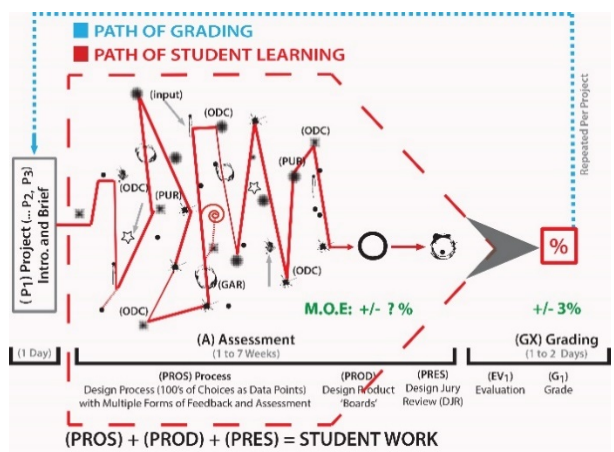



*Fig. 1 The Mediation Mechanism Of Grading*

Through the authors' observations of the students, the research began to look at feedback and grades within a larger set of grading issues From this, the authors became interested in looking at how the act of grading (GX) is contextualized within academia, the institution, student concerns, and the profession. Firstly, the authors articulated that Assessment and Grading are two different acts, often employing the same or similar tool sets. Secondly, the authors noticed that regardless of Assessment (A)

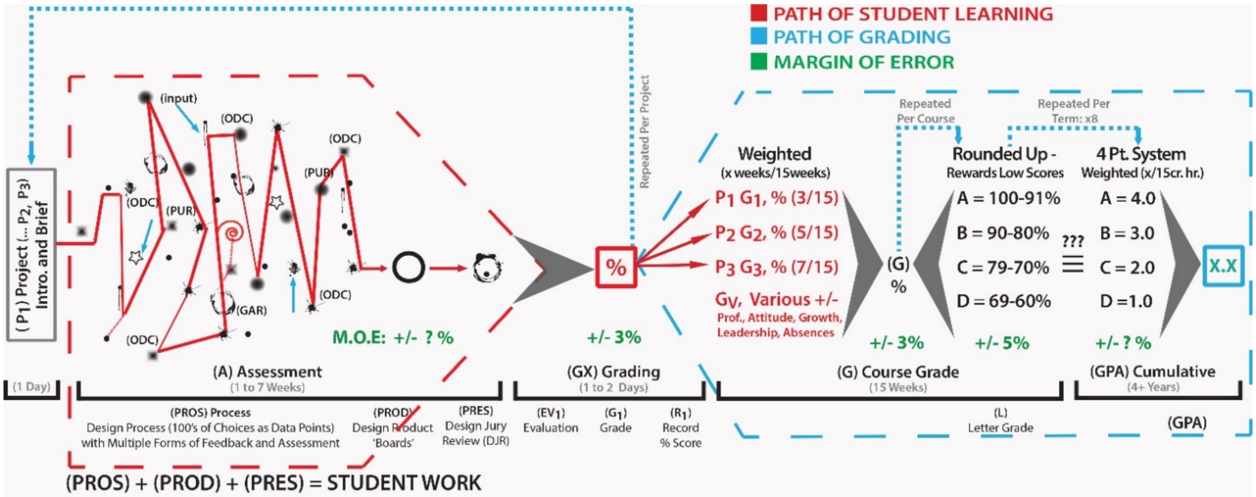



*Fig. 2 Assessment Versus Grading In Its Broader Context.*

and Evaluation (EV) methods, there are numerous false equivalencies within the overall grading system that contribute to student frustration or mis-understanding (See Fig. 2).

*Grading Issues*

Student perceptions of assessment and grading are varied and well documented with an overall preference for one-on-one interaction with professors (Seymour, 2008 and 2010). Students perceive grades to be necessary for scholarships, maintaining a standing within a program, as a mark of likeability, as milestones for a personal sense of accomplishment, meeting a set of Rubric Criteria to get an 'A' (assignment mentality); or even as a representation of the quality of their work and design process. Very few of these grading concerns have much to do with the process of design education, design excellence, or steps toward professional mastery. Grading Evaluation always takes place within the larger context of Assessment. Our goal as educators is to best align the giving of grades with the encouragement and promotion of design excellence, increased risk taking, and deepened student understanding.

Grades are not a 1:1 representation of students' work and serve many purposes involving multiple stakeholders – the student, the student's guardians, faculty, the department, the institution,

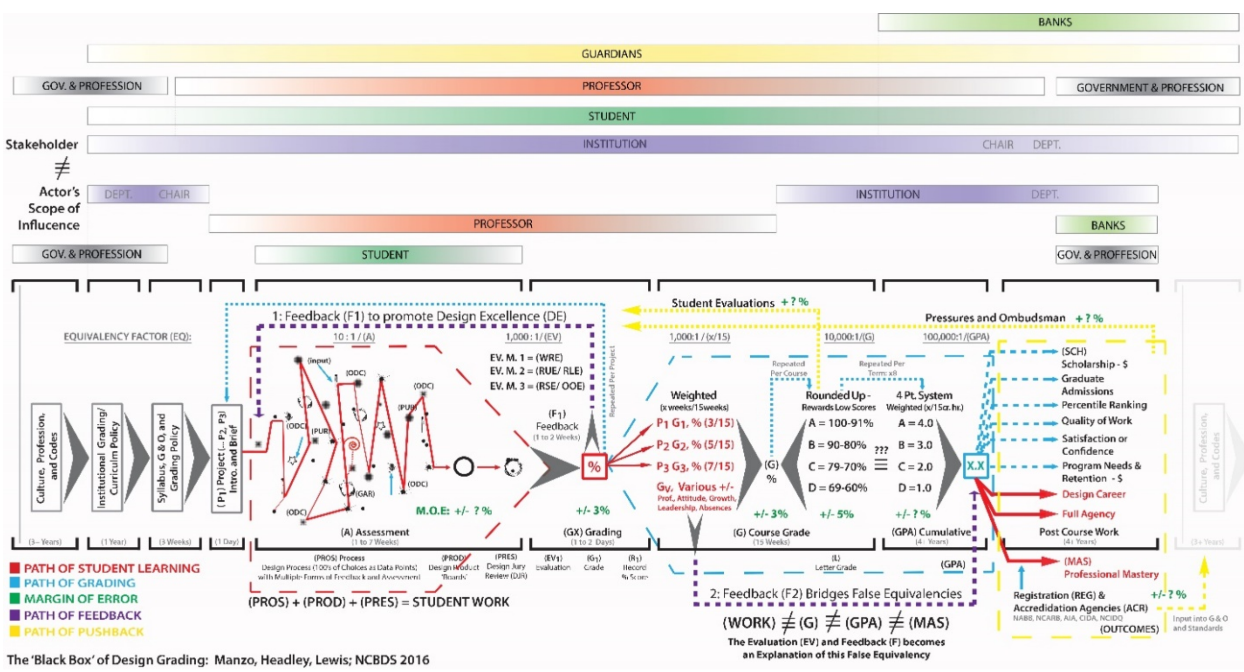



*Fig. 3 Contextual Grading Diagram With Multiple Mediation Mechanisms, Actors, And Stakeholders Shown.*

banks, the government, and the profession (See Fig. 3). Grading can easily distract students from the real work of subject mastery by substituting a goal of marking a checklist to receive a simplistic grade for the complex activity of subject mastery and design excellence. Perceived fairness, grade inflation, general accuracy, long-term usefulness to the student, the role of grades in tuition, scholarship, and retention, the role of grading within the educational institution itself, and the value of a fixed Rubric in assessing fluid creativity are just a few of the additional grading issues consistently at play.

## Assessment, Evaluation, and Grading Methods

Evaluation within studio culture is normative with the Assessment of student work occurring on a near daily basis. Likewise, Grading is a normative—if often unpleasant—aspect of studio culture. Grading (GX) is defined as: the assignment and communication of a percentage number (such as an 87%) to a student for a given project's completion. The authors differentiate the typical means of assessment and feedback (Evaluation) from grade giving (GX). Assessment and feedback are best described by Seymour in his outline of nine (9) typical assessment methods (Seymour, 2008 and 2010). The authors modified and amended this list by: standardizing nomenclature to clarify the method ('Review'), the level of formality ('in-depth'), the means ('verbal'), the location ('at desk'), and the participants ('Jury'); articulated five (5) additional means of assessment; and articulated four (4) Grading Evaluation (GX) methods in light of these fourteen (14) typical design assessment methods.[3]

1) *One-on-One Desk Crits* (ODC): A conversational critique (verbal and graphic[4]) typically at the student's desk between the professor and student during the design process. Of the feedback techniques presented, the One-on-One Desk Critique is the only evaluation method that occurs simultaneously during the entire design process.

2) (GX)[5] *One-on-One Evaluation* (OOE): An in-depth, formal critique (verbal and graphic) of a completed project involving the student and the professor at a place other than the students' desk; in this case study, to review the student's *Rubric Self-Evaluation.*

3) *Peer Evaluation* (PRE): An informal critique (verbal and graphic) of a project by one or more of the student's classmates, often taking place at a student's desk or a nearby shared space.

4) *Design Jury Review* (DJR): A formal presentation and defense (verbal and graphic) of a completed project to a jury of qualified professionals, which could include professors, additional faculty, invited professionals or other guests as well as an audience consisting of the student's classmates. In our study, students were encouraged to both take notes for one another during Review, and to engage in this critical conversation directly.

5) *Gallery Review* (GAR): An informal review of a completed project (verbal and graphic) in which the student's work is displayed and both professionals and faculty speak about the work individually or in small groups.

6) *Studio Pin-Up Review* (PUR): An informal studio critique (verbal and graphic) episodic in the design process typically involving the entire class or smaller groups within the class. This critique could involve the professor(s), the student(s), additional faculty, or invited guests, and takes place in a shared group setting.

7) (GX) *Written Evaluation* (WRE): An in-depth, critique (written) of a completed project by the professor(s).

8) *Written Peer-Evaluation* (WPE): An in-depth, critique (written) of a project by one or more of the student's classmates.

9) *Written Self-Evaluation* (WSE): An in-depth, critique (written) of the student's own project.

The five (5) additional methods of studio assessment, including two (2) additional methods of Grading (GX), which the authors are articulating in this case study as:

10) (GX) *Rubric Evaluation* (RUE): A scaled assessment of a completed project using fixed charted criteria given by the professor.

11) *Rubric Peer-Evaluation* (RPE): A scaled assessment using fixed charted criteria given by one or more of the student's classmates.

12) *Rubric Self-Evaluation* (RSE): A scaled assessment using fixed charted criteria given by the student regarding their own work.

13) *Red-line Evaluation* (RLE): An in-depth, mark up (graphic) of student documents addressing a broad range of topics (from concept and research to lineweights and format) by the professor.

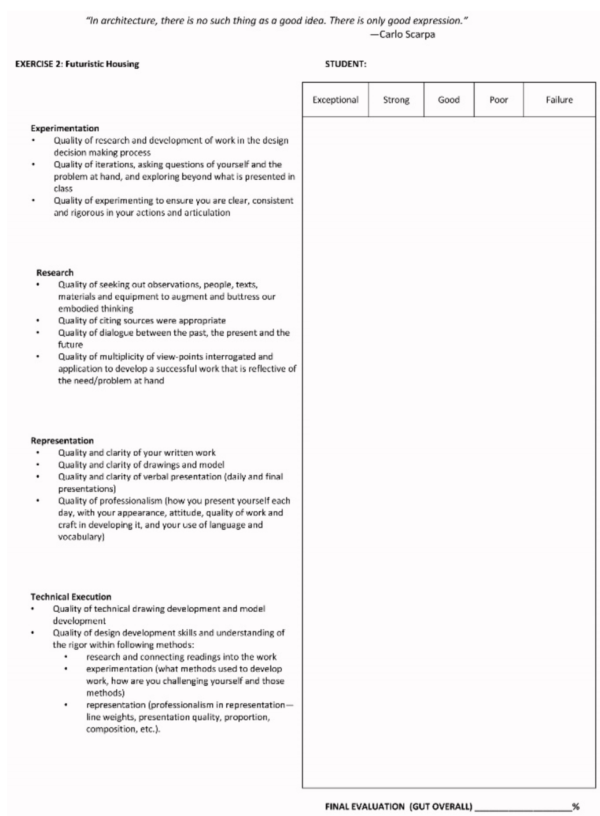
14) **(GX)** *Cultural Expectation Evaluation* (CEE): A percentage or letter grade is posted (typically via an on-line system) by the professor to the student upon completion of a project. In the traditional analog this was called: 'receiving your report card.' This method relies heavily upon a common understanding, language, and set of cultural expectations strongly communicated via ongoing channels throughout the term, such as One-on-One Desk Crits, Studio Pin-Up Reviews, Design Jury Review or existing graduate level peer work defining excellence within an institution.[6]

All methods of Assessment were used during the case study term except *Written Peer-Evaluations, Rubric Peer-Evaluations,* and *Cultural Expectation Evaluation.* To sharpen student critical thinking, peers were strongly encouraged to lead *Studio Pin-Up Reviews*, *Gallery Reviews,* and critically contribute to *Design Jury Reviews* alongside guest jurors. The three studio professors believe strongly in each of the above methods of feedback, including the traditional *Design Jury Review,* as this method of presentation assists in the preparation of students for the design profession (Webster, 2007). Additionally, criticism, iterative exploration, and a rigorous honesty of assessment were consistently encouraged, with these qualities forming a common part of Kansas State Interior Architecture and Product Design studio culture. And while not a direct part of our evaluation methodology, Kansas State's College of Architecture, Planning, and Design is a multi-disciplinary school with a strong culture of excellence at the graduate level. This peer work provides younger students a clear target with increasingly rigorous expectations.

## Designing Grading

The case study was undertaken in a second-year undergraduate Interior Architecture design studio (N=32) at Kansas State University and was co-taught by three professors ($n_1$= 10, $n_2$= 11, and $n_3$= 11). Three design projects of two and a half, five and a half, and seven weeks duration were undertaken for the semester and a *Rubric* was created using typical criteria (See Methods above, Fig. 4, and Clary, 2011) For each of the three project grades posted, grading assessment ($GX_{1, 2, \text{and } 3}$) was consistently given by one of three Evaluation (EV 1, 2, and 3) and feedback methods ($F_{1, 2, \text{and } 3}$): Written Evaluation by the professor using the *Rubric* guideline as a basis; hybrid *Rubric/ Red-Line Evaluation*; and hybrid *Rubric Self-Evaluation/ One-on-One Evaluation.*

Overall grading criteria was spelled out in the course syllabus at the start of the term. The three professors shared all design exercises, instructional presentations, calendar deadlines, and course content through a common online forum and taught from a coordinated set of course objectives, student learning outcomes, lectures, guest lecturers, and exercise statements, meeting one time per week to co-ordinate in-class activities. The beginning design students were evaluated on the rigor of their works and efforts, that is, the depth and intensity of their explorations around the following four *Rubric* criteria (each with several sub-categories): Research, Experimentation, Representation, and Technical Execution. The three professors defined the exercise Rubric for the students as fundamentally ambiguous and riddled with interdependencies (one cannot test research without experimentation and experimentation is invalid unless grounded in some research; and in turn, all ideas are represented in form making). Taking our que from Carlo Scarpa, "In architecture, there is no such thing as a good idea. There is only good expression," the professors stressed that Design is an act of taking indeterminate conditions and translating them into determinate ones (Scarpa, 1981). With all this in mind, students



*"In architecture, there is no such thing as a good idea. There is only good expression."*
—Carlo Scarpa

**EXERCISE 2: Futuristic Housing** **STUDENT:**

| | Exceptional | Strong | Good | Poor | Failure |
|---|---|---|---|---|---|
| **Experimentation**<br>• Quality of research and development of work in the design decision making process<br>• Quality of iterations, asking questions of yourself and the problem at hand, and exploring beyond what is presented in class<br>• Quality of experimenting to ensure you are clear, consistent and rigorous in your actions and articulation | | | | | |
| **Research**<br>• Quality of seeking out observations, people, texts, materials and equipment to augment and buttress our embodied thinking<br>• Quality of citing sources were appropriate<br>• Quality of dialogue between the past, the present and the future<br>• Quality of multiplicity of view-points interrogated and application to develop a successful work that is reflective of the need/problem at hand | | | | | |
| **Representation**<br>• Quality and clarity of your written work<br>• Quality and clarity of drawings and model<br>• Quality and clarity of verbal presentation (daily and final presentations)<br>• Quality of professionalism (how you present yourself each day, with your appearance, attitude, quality of work and craft in developing it, and your use of language and vocabulary) | | | | | |
| **Technical Execution**<br>• Quality of technical drawing development and model development<br>• Quality of design development skills and understanding of the rigor within following methods:<br>  • research and connecting readings into the work<br>  • experimentation (what methods used to develop work, how are you challenging yourself and those methods)<br>  • representation (professionalism in representation—line weights, presentation quality, proportion, composition, etc.). | | | | | |

**FINAL EVALUATION (GUT OVERALL)** ________________%

*Fig. 4 Grading Rubric*

were evaluated against the Rubric criteria, again noting the interdependencies between the criteria and that excellent design is embodied by their cohesion.

The evaluation and assessment of the students' work was ongoing and project feedback was continuous through the semester via bi-weekly *One-on-One Desk Crits*, periodic small group *Studio Pin-Up Reviews*, *Gallery mid-Reviews* for longer projects, and upon conclusion of a project, a *Design Jury Review.* After which, each professor used one of the articulated Evaluation methods for Grading each of the three major project exercises during the semester, leading to three percentage project grades (%) conveyed to students via the evaluation Feedback, recorded on-line in *Canvas,* and then translated into a Letter Grade (L) via institution based on-line software (See Fig. 5).

### *Written Evaluation*

The *Written Evaluation* method of grading utilizes the direct feedback for growth and development of the students' design process. Each student is evaluated based on the four criteria listed above and given feedback that is specific to the various tasks within the project that were functionally productive for their thinking (study models, drawing experiments/explorations, etc.). Additionally, students are given expectations for future development based on shortfalls within the evaluated project (See Fig. 6). This method enables the professor to not only push students in areas where they perceive needed growth, but then also monitor those touch points through the overall review of all the projects.

### *Hybrid Rubric/ Red-Line Evaluation*

The hybrid *Rubric/Red-Line Evaluation* is a method of grading which utilizes the combination of the Rubric and Red-lining and

*Overall Design Work*

Mariah you started off very strong with the client research but seemed to lose steam when it came to the design of the tiny house. It will be interesting to see how you do with the Product Design Studios (I think you'll find yourself more at home there).

Craft and construction were substantially improved.

You need to work on your comfort level making decisions. I think this will develop as you start to develop a process for understanding the design problem from your own perspective. You rely on me to make confirm decisions for you (or to advise you on next steps). While I will guide you some of the way, you have to start making leaps on your own. This will be your challenge in the final project. I'll be looking to see you grow with this. In doing research about the design problem you'll develop a perspective to defend your decisions.

*Research*

This portion of the project was VERY strong in the client analysis portion and got weaker once we moved into the design. You did the analysis and understood who your client was, but then didn't translate that into decisions for that person well. It seems like the infographic was of utility in terms of consolidating what you know into digestible terms. I recommend doing that for other portions of the project. Not only are they good diagrams for final presentation, they'll enable you to galvanize your perspective more quickly while developing useful (portfolio worthy) graphics.

*Experimentation*

I'll be looking to see this also get pushed as we move into the final project. You've got the skills, be brave.

*Technical Execution & Representation*

Craft in your model and boards were improved in this project compared to the last. Noting the growth I still think that there is room for improvement here.

*Fig. 6 Typical Written Evaluation*

follows a traditional *Design Jury Review.* The professor uses a traditional rubric articulating accomplishments and improvements, calculates a grade (a letter grade is used versus percentage), and sticky notes (See Fig. 7) with particular comments are placed on students' drawings and models. In returning grades to the class, the professor verbally summarizes the overall strengths and weaknesses of the class on the project, breaks down the number of grades earned (two As, six Bs, two Cs, etc.), then hands out the Rubric with individual grades, along with the noted drawings and models. During the next design project, the professor discusses what needs to be improved on the new exercise individually with students in *One-on-One Desk Crits*.

### *Hybrid Rubric Self-Evaluation/ One-on-One Evaluation*

The hybrid *Rubric Self-Evaluation/ One-on-One Evaluation* uses the same base *Rubric Evaluation*, but is self-graded by the student upon completion of their project after a traditional *Design*

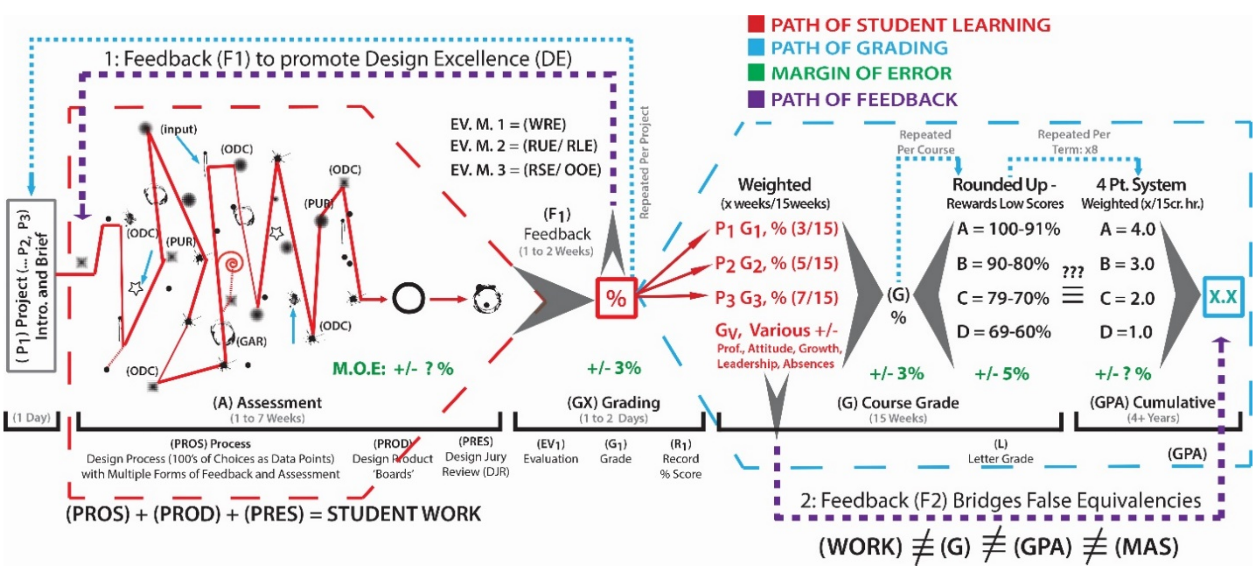



*Fig. 5 The Evaluation (EV) and Feedback (F) in Context*

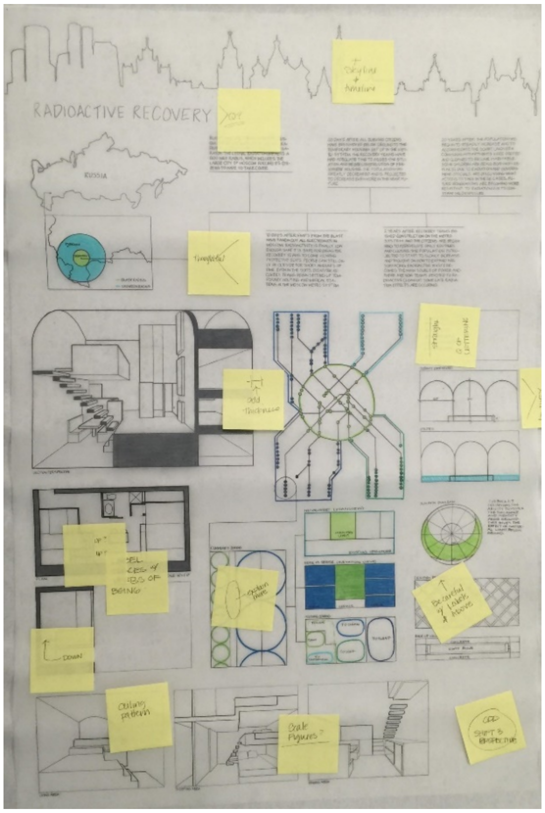



Fig. 7 Typical Red-Lined Evaluation

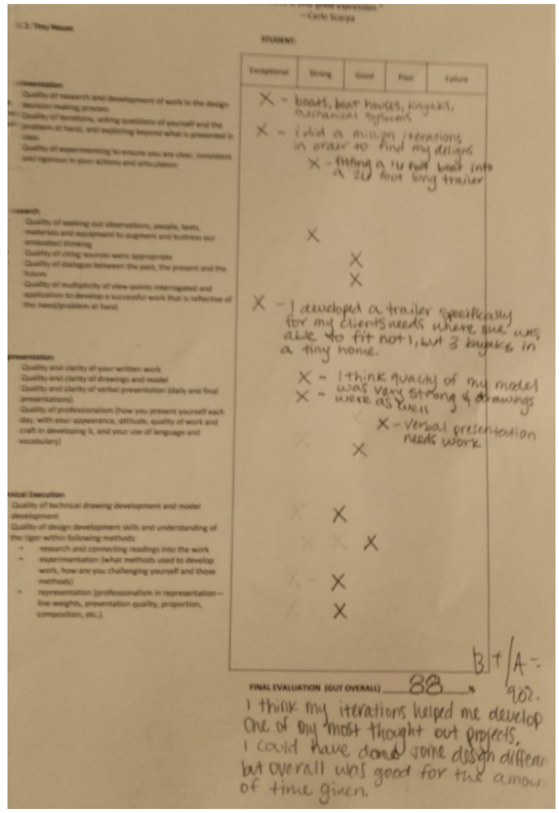
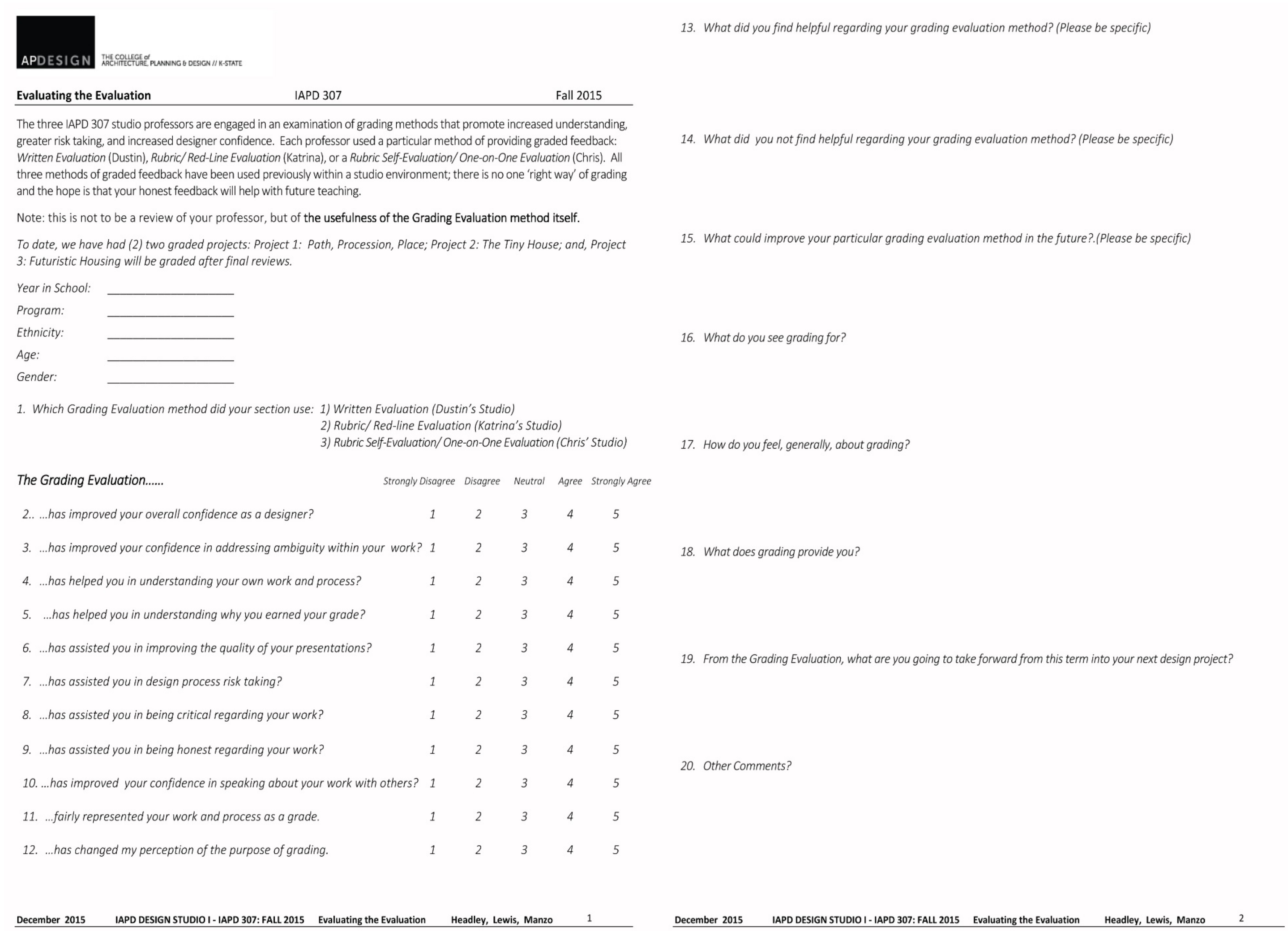



Fig. 8 Typical Self Evaluation Rubric With Professor Grade

*Jury Review.* The self-graded rubric is then discussed by the professor with the student and a conversation regarding process, product, final review, strengths, weakness, missed opportunities, and next steps ensues. The student's self-given percentage grade (% typically expressed as a 3 point range) is then discussed as to its accuracy of events and outcomes. Sometimes the student argues for a higher assessment but more often, a student assess themselves low to accurate regarding of their work and process. The professor marks the *Rubric* in any of the categories in which there is a difference between the student's assessment and theirs and a final percentage grade (%) is articulated by the professor comparing/ contrasting the rubric criteria with what went on in studio the previous weeks. Process, epiphanies, work flow, failures, and craft are discussed. Afterward, this percentage is then recorded into the weighted project assignment on-line (See Fig. 8).

## Method

Data were collected from the Interior Architecture and Product Design program at Kansas State University with thirty-two students completing the paper survey. At the conclusion of the course, the second-year students completed a survey of the class which contained one categorical question, 11 Likert items on a 1 to 5 scale (1 = strongly disagree, 5 = strongly agree), and 8 open ended questions (See Fig. 9). The categorical question addresses that three different professors provided feedback to the students different ways during the semester. These feedback methods include: a) written evaluation, b) rubric/red-line evaluation, and c) self-evaluation/hybrid evaluation. The study examines student perceptions about the effectiveness of the three different styles of professor feedback across different dimensions for developing design students including confidence as a designer, design process risk taking, design presentations, accepting and being honest about criticism, and finally the grading process (see Table 1). The survey resulted in 36 different means – 1 mean for each question and for each different feedback style (3 x 12). To determine if the different teaching styles had a statistically significant impact on student perceptions of their design skills, we ran a series of Independent Sample T-Test using IBM SPSS. The analysis compares the means and determines if the means are statistically significantly different from each other and not simply numerically different.



APDESIGN THE COLLEGE of ARCHITECTURE, PLANNING & DESIGN // K-STATE

**Evaluating the Evaluation** IAPD 307 Fall 2015

The three IAPD 307 studio professors are engaged in an examination of grading methods that promote increased understanding, greater risk taking, and increased designer confidence. Each professor used a particular method of providing graded feedback: *Written Evaluation* (Dustin), *Rubric/ Red-Line Evaluation* (Katrina), or a *Rubric Self-Evaluation/ One-on-One Evaluation* (Chris). All three methods of graded feedback have been used previously within a studio environment; there is no one 'right way' of grading and the hope is that your honest feedback will help with future teaching.

Note: this is not to be a review of your professor, but of **the usefulness of the Grading Evaluation method itself.**

*To date, we have had (2) two graded projects: Project 1: Path, Procession, Place; Project 2: The Tiny House; and, Project 3: Futuristic Housing will be graded after final reviews.*

*Year in School:* ____________________

*Program:* ____________________

*Ethnicity:* ____________________

*Age:* ____________________

*Gender:* ____________________

*1. Which Grading Evaluation method did your section use: 1) Written Evaluation (Dustin's Studio)*
*2) Rubric/ Red-line Evaluation (Katrina's Studio)*
*3) Rubric Self-Evaluation/ One-on-One Evaluation (Chris' Studio)*

| *The Grading Evaluation……* | *Strongly Disagree* | *Disagree* | *Neutral* | *Agree* | *Strongly Agree* |
|---|---|---|---|---|---|
| *2.. …has improved your overall confidence as a designer?* | 1 | 2 | 3 | 4 | 5 |
| *3. …has improved your confidence in addressing ambiguity within your work?* | 1 | 2 | 3 | 4 | 5 |
| *4. …has helped you in understanding your own work and process?* | 1 | 2 | 3 | 4 | 5 |
| *5. …has helped you in understanding why you earned your grade?* | 1 | 2 | 3 | 4 | 5 |
| *6. …has assisted you in improving the quality of your presentations?* | 1 | 2 | 3 | 4 | 5 |
| *7. …has assisted you in design process risk taking?* | 1 | 2 | 3 | 4 | 5 |
| *8. …has assisted you in being critical regarding your work?* | 1 | 2 | 3 | 4 | 5 |
| *9. …has assisted you in being honest regarding your work?* | 1 | 2 | 3 | 4 | 5 |
| *10. …has improved your confidence in speaking about your work with others?* | 1 | 2 | 3 | 4 | 5 |
| *11. …fairly represented your work and process as a grade.* | 1 | 2 | 3 | 4 | 5 |
| *12. …has changed my perception of the purpose of grading.* | 1 | 2 | 3 | 4 | 5 |

**December 2015 IAPD DESIGN STUDIO I - IAPD 307: FALL 2015 Evaluating the Evaluation Headley, Lewis, Manzo 1**

*13. What did you find helpful regarding your grading evaluation method? (Please be specific)*

*14. What did you not find helpful regarding your grading evaluation method? (Please be specific)*

*15. What could improve your particular grading evaluation method in the future?.(Please be specific)*

*16. What do you see grading for?*

*17. How do you feel, generally, about grading?*

*18. What does grading provide you?*

*19. From the Grading Evaluation, what are you going to take forward from this term into your next design project?*

*20. Other Comments?*

**December 2015 IAPD DESIGN STUDIO I - IAPD 307: FALL 2015 Evaluating the Evaluation Headley, Lewis, Manzo 2**

*Fig. 9 The Survey Instrument*

## Results and Discussion

Table 1 presents summary information about the results of the analysis. The results suggests that there is not a statistically significant difference between professor feedback style and student responses on questions 2-11 (See Fig. 10). Meaning, students do not (statistically speaking) perceive a difference between the feedback styles and their responses to questions 2-11. However, evaluation/ feedback method and perception of the purpose of the grading (question 12) is significantly different between written and self-evaluation ($t$ = -2.03) and rubric and self-evaluation ($t$ = -2.06). However, the results are not significant between written and rubric evaluation ($t$ = 0.38).

Based on the findings, our results indicate that generally speaking professor evaluation/ feedback method has no statistically significant effect on student outcomes with the exception of purpose of grading. The hybrid *Rubric Self-Evaluation/ One-on-One Evaluation* method clearly forces students to acknowledge the purpose of grading in a manner that is better than written and rubric feedback. It is also interesting to note that all three feedback methods have the lowest numerical results on student risk taking in the design process (Q 7, mean is 3.694) while having the highest numerical impact on purpose of grading (Q 5, mean is 4.373). This result suggests that students are focused on grades even to the detriment of design process and capabilities. This results provides evidence of a disconnect between course intention of growing design capabilities and student intention of achieving a desired grade.

*Written Evaluation*

From the qualitative data, it appears that the *Written Evaluation* method (EV 1) of grading provides students with a clear and articulate understanding of: their own work and process; where they should take further risks, and as a basis in assessing their work honestly (Q 4,7, and 9). From the qualitative survey results, this appears to be a useful Feedback method. One weakness expressed by students was the apparent disconnect between the written feedback and the grade given.

"It brought areas that I needed to work on to my attention but also celebrated the things I executed well."

"Comments are more specific while grading, say than during presentations."

"Understanding that there are different parts of the design process that all play a part in designing holistically."

"Professor would grade according to our own individual project, process, and work…the length was helpful addressing both negatives and positives."

"I gained confidence in my work and flexibility with people's opinions of the work."

*Hybrid Rubric/ Red-Line Evaluation*

From the qualitative survey results, the hybrid method of *Rubric/ Red-Line Evaluation* bolstered students' confidence as designers and assisted them in improving the quality of their presentations with concrete input on required changes for future projects (Q 2,and 6). This method of feedback seems best for students struggling with concrete issues needing concrete and specific feedback. One area of improvement students mentioned often was the need for personalized verbal feedback.

"I really understood what I needed to work on. The comments were directed…"

"It gave physical feedback I could look back at whenever."

"The sticky notes provided easily identifiable spots where things were good or needed to be improved."

| Total Values per EV Method | | | T-Stat | Significant | T-Stat | Significant | T-Stat | Significant | ? # | *The Grading Evaluation….* |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 (WRE) | 2 (RUE/RLE) | 3 (RSE/OOE) | 1 & 2 | Y/N | 1 & 3 | Y/N | 2 & 3 | Y/N | 1 | (Section/ Evaluation Method) |
| 3.800 | 4.091 | 4.091 | -1.130 | N | -1.138 | N | 0.000 | N | 2 | *…has improved your overall confidence as a designer?* |
| 4.100 | 4.000 | 4.182 | 0.278 | N | -0.279 | N | -0.559 | N | 3 | *…has improved your confidence in addressing ambiguity within your work?* |
| 4.500 | 4.364 | 4.364 | 0.409 | N | 0.452 | N | 0.000 | N | 4 | *…has helped you in understanding your own work and process?* |
| 4.300 | 4.182 | 4.636 | 0.318 | N | -1.141 | N | -1.266 | N | 5 | *…has helped you in understanding why you earned your grade?* |
| 3.900 | 4.091 | 3.909 | -0.608 | N | -0.032 | N | 0.413 | N | 6 | *…has assisted you in improving the quality of your presentations?* |
| 3.900 | 3.545 | 3.636 | 0.895 | N | 0.777 | N | -0.262 | N | 7 | *…has assisted you in design process risk taking?* |
| 4.300 | 4.273 | 4.273 | 0.131 | N | -0.109 | N | 0.000 | N | 8 | *…has assisted you in being critical regarding your work?* |
| 4.300 | 4.182 | 4.182 | 0.078 | N | 0.344 | N | 0.341 | N | 9 | *…has assisted you in being honest regarding your work?* |
| 3.900 | 4.091 | 4.273 | -0.408 | N | -0.900 | N | -0.461 | N | 10 | *…has improved your confidence in speaking about your work with others?* |
| 4.200 | 4.182 | 4.364 | 0.060 | N | -0.513 | N | -0.546 | N | 11 | *…fairly represented your work and process as a grade.* |
| 3.800 | 3.636 | 4.455 | 0.383 | N | -2.032 | Y | -2.065 | Y | 12 | *…has changed my perception of the purpose of grading.* |
| | | | | | | | | | | |
| 45.000 | 44.636 | 46.364 | | | | | | | Total Values | |
| 4.091 | 4.058 | 4.215 | | | | | | | Section Averages | |

*Fig. 10 Table 1*

"All details from feedback from design process to final presentation."

"Grading Rubric was clear and detailed."

***Hybrid Rubric Self-Evaluation/ One-on-One Evaluation***

The hybrid method of *Rubric Self-Evaluation/ One-on-One Evaluation* provided statistically significant data indicating students' increased their understanding of the purpose of grading, and that their grade was fairly represented (Q 5,11, and 12). Ironically, this was not the intent of the authors efforts or study. One weakness of this method expressed by students was the lack of a detailed left behind; a document they could refer to in the future as they began new projects.

"I found it helpful to reflect and be honest with one's work...and then discuss it with your professor."

"Giving myself a grade first helped in my self-assessment and self-discovery."

"I liked that we got the opportunity to defend our projects and talk through our successes and failures."

"I was better able to analyze my work after detaching from it. I participated in figuring out how to design better, rather than being told what was wrong."

"Being able to talk it out, so I better understood what was said... being able to state my point of view.... It made me more critical of my project."

## Conclusions

It is very difficult to directly correlate grading evaluation and feedback to bettered student outcomes. Overall, the authors found student perceptions mid-to high on all questions asked with statistically significant data collating around two issues: Evaluation Method 3 helped students understand grading better, likely due to its being discussed directly and often; and that from the questions asked, it is clear that students overall are more concerned with grading issues than bettered learning outcomes.

It would appear from students' qualitative answers, that the three Evaluation methods used are complimentary to one another in providing feedback, and that one evaluation method's pros often counter-balanced another method's cons, creating a more holistic and clarified picture for students. As an example, the limitations of personal design feedback via a *Rubric* were offset by copious red-lines that were particular to a student's work. The *Rubric* provided a broad contextual understanding – the red-lines specificity. The *Written Evaluation* and *One-on-One Evaluation's* personalized responses and questions off set the very public nature of the *Design Jury Review,* helping students better understand both their work and their grade in context. The optimal Assessment/ Evaluation/ Feedback method looks to be a liberal use of a variety of methods of assessment throughout the design process and term culminating in a one-on-one grading assessment with a clearly written and noted leave behind.

Lastly, the authors observed that Feedback (F) while Grading (GX) served two distinct purposes: one, it provided students with concrete steps to better themselves as young designers on their next project; and two, it provided a logical narrative as to why the student received their particular grade. This second function bridges some confusion perceived by students within grading due to the many false equivalencies made between their actual work and the fixed single digit numeric summation of their GPA.

## Notes

[1] Typical student Work includes the many thousands of 'events' within the design Process, the creation of a final Product, and the giving of a Presentation for a given Project – see Fig. 1.

[2] From Guilford, 1950 via Clary, 2011: Factual Knowledge – Conceptual and Procedural Knowledge – Meta-Cognitive Knowledge.

[3] The following list is derived from Seymour, with the modifications and additions as noted.

[4] 'Graphic' is listed where participants often draw or make with the student, illustrating their verbal comments.

[5] (GX) denotes an act of grading when a grade (G) is assigned and communicated to the student.

[6] The Harvard GSD uses this system with its 'Pass, Distinction, and High Pass' system of graded feedback. It is simply assumed that students will perform up to level (Pass): 'the grade of "Pass" is the standard mark for recognizing satisfactory work." In light of this, the grading system simply focuses upon acknowledging and distinguishing excellence. It is the author's understanding that this method was normative within architectural design education up to the mid-1990's.

## Works Cited

Anderson, L. W., and Krathwohl, D. R. (Eds.). (2001). A taxonomy for learning, teaching and assessing: A revision of Bloom's Taxonomy of educational objectives: Complete edition, New York: Longman.

Bloom, Benjamin S. and David R. Krathwohl. (1956). Taxonomy of educational objectives: The classification of educational goals, by a committee of college and university examiners. Handbook 1: Cognitive domain. New York , Longmans.

Clary, Renee; Brzuszek, Robert; Fulford, C. Taze: *Measuring Creativity: A Case Study Probing Rubric Effectiveness for Evaluation of Project-Based Learning Solutions.* Creative Education 2011. Vol.2, No.4, 333-340 Copyright © 2011 SciRes.

Graduate School of Design at Harvard University, USA, Webpage.

Guilford, J. P. (1950). Creativity. American Psychologist. 5, 444-454.

OECD (2012), "Good Practices in Survey Design Step-by-Step", in Measuring Regulatory Performance: A Practitioner's Guide to Perception Surveys, OECD Publishing.

Oregon State University. (2004). OSU extended campus: Course development: Instructional design -The Taxonomy Table. Retrieved April 3, 2005 from http://oregonstate.edu/instruct/coursedev/models/id/taxonomy/.

Roberts, Andrew. (2006) Cognitive Styles and Student Progression in Architectural Design Education. Design Studies, 27 (2), 167-181.

Scarpa, Carlo (1981). Frammenti, 1926-78, Rassegna 7, pp 82.

Seymour, M. (2008). Beginning Design Students' Perception of Design Evaluation Techniques. *24th National Conference on the Beginning Design Student.* Atlanta: Georgia Institute of Technology.

Seymour, M. Wand Chance, S. M. (2010). Assessment Formats: Student Preferences and Perceptions,*The International Journal of Learning,* 17(10), 137-154.

Stein, M. I. (1953). Creativity and culture. Journal of Psychology, 36, 31–322.

Webster, Helena.  The Analytics of Power:  Re-presenting the Design Jury.  Journal of Architectural Education, 2007, 21-27.

# Techniques in Titration: Active Learning in a Beginning Technology Course

Clare Olsen, Kent Macdonald | California Polytechnic State University, San Luis Obispo

## Big Scale Active Learning

In an effort to address the great divide that often exists in the one:many relationship between lecturer and class, the authors embarked on an active-learning approach to teaching a required materials and methods course, called Architectural Practice, which is the first course in the technology sequence for all second-year architecture students at Cal Poly San Luis Obispo.[1] Although pass rates of the course taught through the traditional lecture method were high, the technology faculty (eight colleagues including the two of us) met in June of last year to discuss ways of clarifying learning outcomes, fostering "titration of learning" over time through the curriculum, and improving retention of technological principles. Through that meeting, three ideas for transforming the course emerged: (1) despite a large number of students (170), initiate active learning to encourage students to engage the material; (2) augment the course content in order to lay a wider foundation for technological skill building; and (3) coordinate course content more closely with student's learning in their concurrent design studios. We subsequently implemented all three of these strategies in the course offered last fall. Through active learning, we found that the students engaged the material and faculty more closely, providing a more solid foundation for their technological and design thinking for beginning architecture students. Through one:one engagement with the course topics and students in a large technical "lecture" course, active learning generated higher levels of enthusiasm for the learning material and taught habits of mind that enhanced technical know-how in students' design thinking.

In a typical "traditional" materials and methods course, a professor lectures about the material, while students read a textbook, often Edward Allen's Materials and Methods, and then take exams on that material. Educators throughout the country, however, recognize the need for new delivery methods, especially in the context of the learning styles of the millennial generation of students. New research provides even greater impetus. "Research comparing the two methods has consistently found that students over all perform better in active-learning courses than in traditional lecture courses. However, women, minorities, and low-income and first-generation students benefit more, on average, than white males from more affluent, educated families."[2] Educators seeking to address the need for new approaches to teaching reference Benjamin Bloom's famous taxonomy of learning, which was created by a team of educators in the 1950s to establish guidelines for curriculum development and delivery methods. In the handbook, higher levels of understanding and demonstrated knowledge are encouraged with "creating" at the highest level of the taxonomy.

Cal Poly is an institution that embraces the "learn by doing" approach. Sometimes referred to as "the studio model" or "flipping the course," active engagement with learning material was advocated in the early 1900s by John Dewey, a hugely influential educational philosopher and activist. He wrote about the need for reform and experimentation in teaching to shake up the habitual aspects of education and encourage creative thinking with the goal of improving the human experience.[3] Creative thinking, of course, is an integral part of design studios, but teaching this in other subject areas (despite that Dewey advocated for it a century ago) is still rather novel. Chemistry and physical professors, for example, have embraced the studio model as a means to create a more comfortable, less formal learning environment, so that faculty can discuss ideas in small groups and students are encouraged to talk and help one another understand ideas. By making the material more tangible through peer-to-peer teaching, experiments and research, learning can happen in multiple ways and learning material becomes more accessible.

Recognizing that technological topics are learned differently by different types of learners, active learning permits multiple methods for "reaching" and engaging students. With this in mind, the authors asked how the studio model could inform technical course work in architecture. Given the large student numbers, making material assemblies was unfortunately not possible given our university's facilities. As an alternative, following "mini-lectures" that framed the course's readings at the beginning of each class, the students were asked to undertake a series of individual and group research projects and assignments. Our primary goal was to develop and reinforce concepts so that they became "habits of mind," rather than material to memorize for an exam. This was especially important since the course is only the first in a seven-course series, so since titration is crucial--creating a ladder of knowledge that builds gradually and is continually reinforced throughout the curriculum--providing greater impetus to rethink the delivery methods and content of the foundational course.

Since there were 170 students and it was our first foray into active delivery for a large "lecture" course, we experimented with multiple methods throughout the quarter. Testing methods created different learning opportunities for students, and also helped us to understand which approaches worked better. These methods included peer-to-peer teaching, in-class activities based on readings done prior to class, mini-lectures (20-35 minutes) followed by in-class activities, jeopardy games that encouraged involvement of large numbers of students, and research projects that asked groups of students to create didactic reports on material by creating posters or videos. Asking the students to engage the material through the design of a poster or video provided an opportunity for creative thinking, and since the projects were developed in groups, it also helped students to find their "sense of purpose" and "their ability to lead or be part of a team," ideas stressed by IDEO's education leader, Sandy Speicher, in the Future of Learning.[4] We emphasized the importance of these assignments by making them 50% of the grade (5 points each). The rest of the grade was based on two quizzes (really midterms), valued at 20%, and a final exam, valued at 30%.

Throughout the course, we attempted to integrate the learning material with the content of the design studios that ran in parallel. The faculty teaching alongside us in the studio labs were offered their choice of assignments depending on whether or not studio integration fit with their teaching approach and course sequence. For example, for one exercise, student groups were asked to research and analyze a site—faculty who had already picked a studio site asked their students to research that, whereas those who didn't have a studio site researched a random one. Integration was also attempted with the drawing assignments where faculty were again offered a choice. Some students worked on drawings to further their studio project and others worked on drawings of precedents. Finally, one of the last projects of the quarter was a detail model or drawing. For that project, all students developed a detail of their studio project, and studio faculty helped us to grade the assignment.

Through encouragement of our colleagues, in addition to the delivery methods and assignments, we also revamped the course's content to include less physics and more discussions about aesthetic choices in architectural practice. In addition, the technology faculty as a whole encouraged us to introduce sustainable design more broadly and earlier in the curriculum. This portion of the course was titled Design Drivers, and the topics included human comfort, climate, solar geometry, site analysis, and programming. We endeavored to teach that understanding those topics—both as opportunities and constraints—has an impact on material decisions, building massing and orientation. As first principles, they were discussed first in the course sequence.  The next few weeks of the course focused on Drawings for Practice. We introduced the basic principles and conventions of the most commonly used technical drawings, and how these change as a project progresses through the various design phases, ultimately becoming the bases for construction. The remaining weeks were devoted to the Materials of Construction, and we spent two "lectures" each on wood, concrete, masonry and steel, discussing how they're made, how they're used, and how they perform.

## Outcomes of the Active Learning Experiments

Although we didn't anticipate this benefit prior to the course, we were pleased with the opportunities that the in-class activities provided to address the student:teacher relationship. Although in large courses, it can sometimes be quite tedious to ask questions and stare at a sea of blank faces, the active mode from the start of the course meant that (1) we could walk around the lecture hall and talk with students in a more conversational way, (2) all students were encouraged to talk amongst each other about the course material, creating a more casual and supportive learning atmosphere. As a result, students were surprisingly willing to ask questions, shout out answers and react to material presented in the mini-lectures. As this momentum increased, we were able to encourage dialogue with students throughout the mini-lectures, prompting them with questions about the reading during lectures, which were sometimes verbally answered by many of the students in the room.

*Attendance*

Another benefit of the active approach was that the class was well-attended. This was especially true on days when students were told in advance that the in-class activities would be turned in at the end of class or when the in-class activity involved group work to create a poster or study guide for an exam. Doing the "homework" problems together allowed students to ask questions as they arose, teach one another, and build confidence in their knowledge of the material.

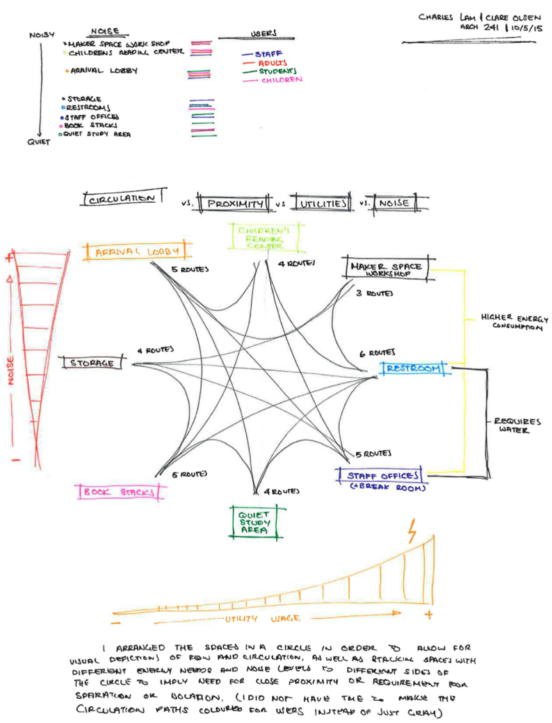



*Figure 1. Charles Lam, In Class Programming Assignment, Fall 2015*

*Most Effective Activities*

One of the most successful in-class activities was an exercise that followed a mini-lecture on programming as a driver for design. After describing the programming concepts and examples from practice, we asked the students to draw a program diagram addressing noise and adjacency concerns for a list of library spaces. Students were permitted to discuss ideas with one another, but with 20 minutes to complete the exercise, most of them hunkered down and sketched. At the end of the class, they were asked to turn in a colored diagram with a key and a short narrative that explained their approach. Figures 1 and 2 show examples of two students' work; the diagrams were quite strong overall. We also found that after this exercise, students' approaches to programming and diagramming in their design studios were more sophisticated and thoughtful than program diagrams completed by students previously.

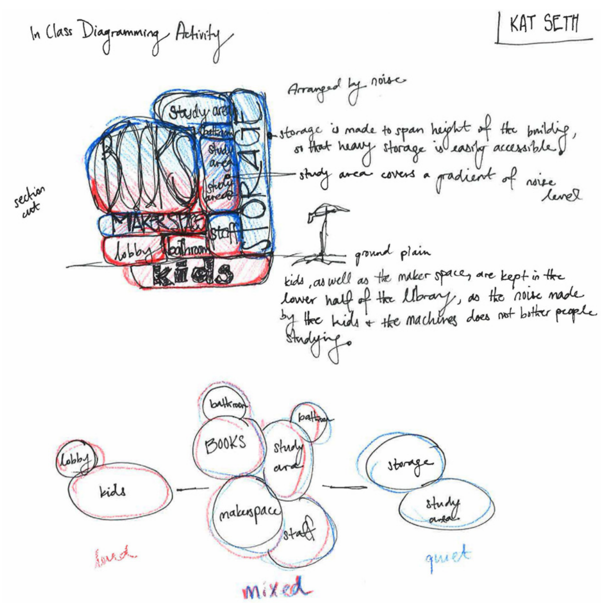



*Figure 2. Kat Seth, In Class Programming Assignment, Fall 2015*

We were also really pleased by the group research projects in which the teams created a five-minute video to teach their colleagues about a particular topic. For the climate research project, for example, one team developed a narrative comparing hot-humid and hot-arid climates through a story about someone moving from Hawaii to Iran. The students drew vernacular housing types from each region on the chalk board and explained the passive cooling strategies used by each. See still from the video in figure 3. In another example, students filmed their experience trying a concrete slump test for the first time. Although naïve, the video provides evidence of knowledge building and taught fellow classmates about the balance required in concrete mixtures. Although not many students took advantage of the video format, choosing to create a poster instead, the we were generally impressed with the videos produced. The format provided a much clearer, more entertaining avenue for teaching fellow peers about course concepts.

*Biggest Challenge: Grading*

The challenges of the active learning experiment with 170 students and a team of faculty were multifold. Although the activities were a powerful way to engage material, the resultant pile of projects equated to a huge burden on us as well as on our teaching assistants (we had three). With weekly assignments piled on top of course development, a backlog was created from the third week of the course. We learned through that process that shorter assignments and more teaching assistants are required if active learning is to be a priority.

*Other Challenges: Confidence in Course Material*

Two other major challenges were the problems of lectures and exams. In "A Delicate Balance: Integrating Active Learning into a Large Lecture Course," the authors teaching two 250-student biology sections at the University of Minnesota compared active and traditional lecture style delivery methods and found that "end-of-term survey results showed significantly higher confidence levels for students in the traditional section on five out of nine items (other items showed no significant difference)."5 It was interesting to learn that our students anecdotally reacted similarly to active learning. In the 25-question knowledge survey conducted at the beginning and end of the course, at the start, 56% of students responded that they didn't know much and 10% said they knew a lot about the course topics. At the end of the course, confidence in the course material went up: 72% of students who responded indicated that they knew something or a lot, and 10% said they didn't know much. We found, however, through the course evaluations and a questionnaire in the end-of-quarter portfolio that students lamented we didn't tell them exactly what to study on the exams in our lectures, and many said the lectures could have been longer. Other researchers have found that "students have come to expect efficient content delivery (Hake, 1998; Walker and Jorn, 2007)."[6] Furthermore, Wilson and Korn evaluated a number of studies on students' attention spans and found the results to run counter to common beliefs. "It is clear that students' attention does vary during lectures, but the literature does not support the perpetuation of the 10- to I5-min attention estimate."[7]

This research and our own experiences provide varying conclusions, making the transition to active learning a confusing one. But recognizing that the true power of active learning is to abandon passive modes so that students are engaged with the material, it is worth continued exploration. Recalling Dewey, it is not surprising that active engagement creates more work and some discomfort. It is helpful to be aware of this and communicate the growing pains of the learning process to students so that they can adjust their expectations.

Since the group research, readings and other activities were meant to inculcate knowledge, it was difficult to ascertain if that was working—how much knowledge was being retained—without testing it. The fastest way to do that for 170 students was to give exams. In fact, "frequent quizzes [sic] oblige students to retrieve knowledge from memory rather than passively read it over in a textbook. Such quizzes have been shown to improve retention of factual material among all kinds of students."[8] However, the format of the exams we wrote didn't match up with the delivery methods and in the first exam, the students claimed they were confused about how to study. They assumed that we were only interested in retention of broad concepts, so the first quiz was a whopping failure and had to be graded on a curve.

Although the second quiz had better results, we are grappling with ways to test (and enforce) a broad range of concepts within large courses. Ultimately, student learning outcomes will be best assessed through the titration of knowledge seen over the span of the entire technology sequence and the demonstration of technical expertise in their design work.

## Implications for Beginning Design and Tips for Future Courses

With the goal of engaging students in course material to teach habits of mind and technical knowledge as a driver for design, the ultimate hope is that students will become better, more responsible designers. By reinforcing topics like climate early and often, asking students to demonstrate their knowledge of climate through research projects, in-class discussions, and on exams, we hope that climate concerns will be at the forefront of their design thinking as students move through and beyond beginning design studios.

The following are a few suggestions for those wishing to implement active-learning techniques in large-lecture classes:

1. Use different types of delivery methods to insure understanding amongst different types of learners. Embrace a mix of mini-lectures and activity types to reach a larger array of students.

2. Follow a clear and concise format for mini lectures that reinforce key concepts from the readings.

3. Test on the lecture and reading material via midterms and finals, but as much as is practicable, create exams that test for problem-solving and application rather than rote memorization.

4. Frequent but short on-line quizzes reinforce the necessity of coming to class—period—and better yet, coming to class prepared.

5. Communicate with students about the learning process. Discuss the discomfort that may come from engaging material in new ways through active learning. Since spoon-feeding and hand-holding are off the table, students must gain confidence in themselves through peer-to-peer interaction and positive reinforcement from faculty.

6. Use a combination of in-class homework problems and out-of-class research where the final projects are presented using a didactic format, preferably a short video. Keep assignments short and manageable.

7. If possible, seek support from your administration, especially through teaching assistants. Active learning requires a lot of grading. Use of automatically graded on-line quizzes and can also alleviate grading pressures.

8. Find or created venues that support teach-student engagement and peer instruction. At our university, the course was held in a 230-seat lecture hall with tiered seating. The configuration hindered the student's ability to collaborate as well as our ability to have physical access to all of the students, many of whom "hid" in the middle of the rows!

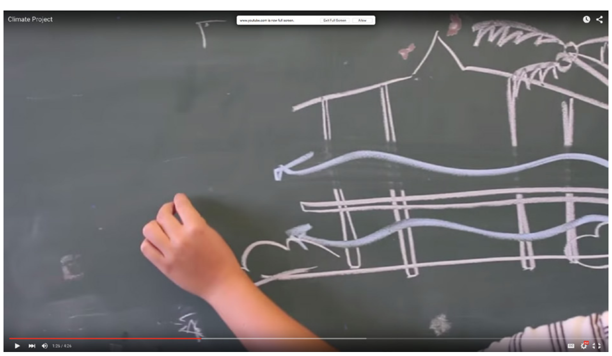



*Figure 3. Katherine Seth, Emma Gracyk, Samuel Witt. Climate Assignment, Fall 2015.*

## Conclusion

At a fall-quarter faculty retreat where we had introduced our plans for flipping the course and altering its content, one of our colleagues asked if we weren't afraid of "failing," given all the obstacles we faced: nearly 200 students, a tiered lecture hall, an unusual start time, and the esoteric nature of the technical material itself. Indeed, we wondered ourselves if our plans would work. But another colleague responded: "We ask our students to take risks all the time. We shouldn't be afraid of taking risks ourselves."

At the end of the quarter, we asked the students to give us feedback on the class and its method. The responses ran the gamut, pro and con. For example, asked to comment on group work, one student said that it was a problem: "I only understood my part really well." But another said that "group projects and activities allowed me to see other perspectives and different ways of learning and thinking." On the in-lecture activities, one student complained that there was not enough time to do them well while another wanted more activities: "Ultimately, the class was not hands-on enough." But whether pro or con, the students made many thoughtful comments that showed both a metacognitive investment in their own learning and their good will for our efforts; they seemed to appreciate what we were after and wanted to help us get there: "The activities were a good way of switching up our learning but having someone explain it is still beneficial;" and, "Ask 'why?' not 'what?'" We couldn't have said it better.

## Notes

1 The course met at the unfortunate time of 8-9 pm on Monday and Wednesday evenings in a tiered lecture hall.

2 Paul, Annie Murphy. "Are College Lectures Unfair?" Editorial. New York Times [New York City]: 12 Sept. 2015.

3 Biography.com Editors. "John Dewey Biography: Academic, Philosopher, Educator." Bio.com. A&E Networks Television, n.d.

4 Speicher, Sandy. "The Future of Learning." Metropolis Magazine September (2015): 94-95

5 +6 Walker, J. D., S. H. Cotner, P. M. Baepler, and M. D. Decker. "A Delicate Balance: Integrating Active Learning into a Large Lecture Course." Cell Biology Education 7.4 (2008): 361-67

7 Wilson, K, and JH Korn. "Attention During Lectures: Beyond Ten Minutes." Teaching of Psychology, 34.2 (2007): 85-89.

8 Paul, "Are College Lectures Unfair?" ibid.

# 1:1(00): Meeting Course Outcomes Effectively in Beginning Design Studios with High Student-to-Faculty Ratios

Patrick Rhodes | American University of Sharjah

## Introduction

During the spring semester of 2015, we made the difficult decision to teach all 160 first-year students in our Foundations Program's beginning design studios with only two primary instructors. This meant that each instructor would teach 70 to 90 students across four sections, with some sections as large as 40 students. Making conditions more challenging, the primary instructors were paired with one junior faculty each, whose sole assignment was to observe and learn, as part of a mentorship initiative to build capacity among college faculty to teach at the beginning design level.

This decision came after years of internal debate over appropriate approaches to teaching beginning design in a first-year program shared by both Architecture and Design departments. In the past, Foundations studios were typically capped at 18 students, maximum. Any given semester, nine to ten sections, generally, would be taught by five to seven facutly, with no overloads. But, following a 2014 Ministry of Higher Education and Graduate Research accreditation report on the Foundations Program citing unmet conditions due to curricular inconsistencies among design studios, and a subsequent self-assessment of the program that identified personnel constraints as a primary cause, we were compelled to implement radical pedagogical and structural changes with the intention of providing a common educational experience and developing curricular consistency.

In considering the challenges that high student-to-faculty ratios pose, we developed a new instructional model, the Principal Team Model and implemented a daily studio protocol, consisting of sharing, discussing, and making. While open-ended questions leading to discussion were highly encouraged, we deterred convergent, yes-and-no questions from students, which can lead to student co-dependency on the instructor to make decisions and a play-it-safe attitude. Finally, we asked students, in addition to their regular course evaluations, to write personal reflection essays at three points during the semester, allowing us to periodically gauge their overall learning. The assessment presented here evidences both the drawbacks and the advantages of the strategies implemented, reveals the quality and effectiveness of meeting course outcomes.

*Seeing: Plaza Tile Photograph, 60cm x 60cm*

## Does Class Size Matter?

There is a common perception, or misperception perhaps, throughout education that smaller class sizes are better. Political support for smaller class sizes is backed by its "enormous" popularity with teachers and the public and evidence shows that the majority of Americans prefer smaller classes over higher teacher salaries.[1] Although beginning design studios are not typically held to the same criteria as upper-level studios by the National Architectural Accrediting Board (NAAB), they tend to be structured similarly and not deviate too greatly in terms of class size. While NAAB has no specific student-faculty ratio for design studios stated in its conditions for accreditation, they shape their position for ideal studio sizes of 1:16 through practice, as Visiting Team Reports will cite unmet conditions when design studios grow above a ratio of 1:18.[2]

*Seeing: Tile Rubbing, 60cm x 60cm*

There are alternative models that utilize high student-faculty ratios to structure design studios, however, even in Western systems that evolved out of the same traditions, such as the Italian architectural education system, where drawing studios can be as large as 200 students taught by a single faculty member and several assistants.[3] In one experiment at the University of Illinois at Urbana-Champaign, implemented a vertical graphic design studio model in which section size ranged between the mid-twenties to low thirties. Although the pedagogical goal of the high-ratio structure was to achieve a wider range of results in student work, results showed "less imaginative" work and some of the lowest course evaluations ever received. Based on this, the model was adjusted in the next academic year to reduce class size to the mid-twenties mark.[4] Yet, there are studies, especially in STEM education, that demonstrate the benefits of high-ratio structures in laboratory-based environments, including higher academic achievement and continued higher course evaluations.[5]

Since the economic downturn of 2005, research institutions, faculties, and the mainstream press in a vast number of articles have expressed grave concerns over the potential "harm"[6] done to students due to deep budget cuts leading to increased class sizes, one article going as far as to claim that "students are doomed."[7] While budget cuts will surely have a negative impact on education in other ways, the body of research on class size, peaking in the 1920s and sustained over the last hundred years, reveals that results of these studies are mixed, with most research showing at least "some evidence of positive effects" from reduced class sizes. But, these benefits are minimal and inconsistent across the body of research, despite popular sentiment to the contrary.[8] These results imply that our education system has "overinvested in class-size reduction" and that high-ratio models "may represent a budget-cutting strategy that minimizes harm to students."[9]

## The Principal Team Model

The Principal Team instructional model was developed primarily in reaction to the systemic and persistent challenges identified in a 2014 self-assessment of the Foundations Program, citing personnel issues as the most significant issue impacting the overall quality of the program, including inconsistency of faculty assignments, faculty expertise, and faculty desire as major causes. It assumes that teaching in the foundation year requires disciplinary expertise and was designed to satisfy the prerequisites of both the Department of Architecture and the Department of Art and Design while building capacity within the college to teach at the Foundations level. The trade-offs, in the short term, would mean fewer experienced faculty members teaching design studios, less exposure of students to a variety of teaching perspectives, and higher faculty-student ratios.

A Principal Studio is either solo-taught by an experienced faculty member, team-taught by an experienced faculty mentor and a faculty member (X) new to or inexperienced in teaching Foundations in order to to build capacity. The student enrollment of a Principal Studio will be twenty in a single professor format and forty in a team-taught environment. The number of faculty assigned to teach in a Principal Studio format, at present, during any given semester will be between four and six.

As teaching in the Foundations Program requires a defined capacity or set of assets, the initial step in following an asset-based approach is to determine and document the existing types and degree of resources, abilities, and expertise of the program and individual program faculty. These assets are ultimately correlated with program goals and outcomes, and the defined capacity of Foundations instructors to determine the specific nature of the Principal and Team units. By exploiting the capacity of inexperienced Foundations faculty while instilling the defined Foundations capacity through mentorship and training, the model ensures that program outcomes are also met at maximum capacity. Developing and maintaining a current and accurate capacity inventory is paramount to the success of the model.

## The Protocol

It may seem obvious to most experienced design studio instructors that the primary challenge of teaching in a high student-faculty environment is classroom management. Crowd control was certainly an issue and was the catalyst for developing a structured studio environment, our main concern was to compose a procedure, or protocol, for critical learning and engagement of each student, not just the outgoing few, regardless of how civilized the atmosphere might be. In order to be successful, the protocol would have to depend less on us being able to instruct and more on students developing the capacity to learn independently and with intention. This "intentional learning" requires students to be motivated, self-directed, and autonomous with the ability to see connections between and interpret disparate fragments of information.[10]

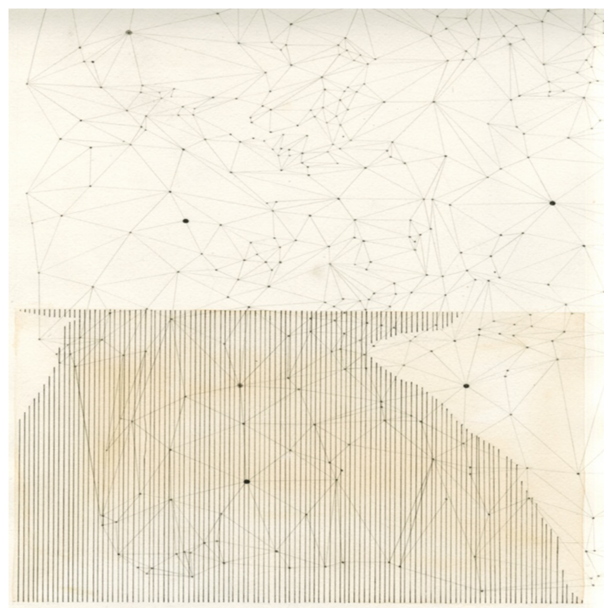
The daily protocol was divided between sharing, discussing, and making, or thinking and doing, aimed to give students the tools to become lifelong learners, one of the core missions of AUS[11] and considered to be a "critical competency" necessary for college graduates to negotiate the modern world.[12] Unexpectedly, the high student-faculty ratio was less a hindrance than a facilitator, as the large numbers necessitated independence and self-direction.

### *Sharing*

To begin each studio session, students placed their work on a long row of tables. Instructors then selected and arranged particular examples on an adjacent row of tables, based on an overriding theme or set of issues evident in the work, such as intention, control, and rigor. Students were next asked to write quietly about each example in an A5, unlined book, being critical about success and failure, addressing a series of questions relative to the theme or issues. They were required to write in complete sentences and increasingly use vocabulary developed throughout the course of the semester. They were asked not to write about their own work, unless they could be objective. They were encouraged to not only make comments, but also to ask questions. Over time, students demonstrated an understanding that the more comprehensive and critical they were in their writing, the richer the following discussions would be.

### *Discussing*

In general, discussions were led and sustained by students. Respect and courtesy were fostered and prioritized. The process was anonymous, as students were prohibited from talking about or defending their own work. This anonymity was intended to buffer them from personal emotions, such as embarrassment, and give them the space to freely observe and interpret remarks.  The role of the instructor was to help guide or direct the conversation through a series of well placed questions, and to identify and call on less engaged students to join the discussion.



*Seeing: Tile Field Point Space Drawing, 60cm x 60cm*

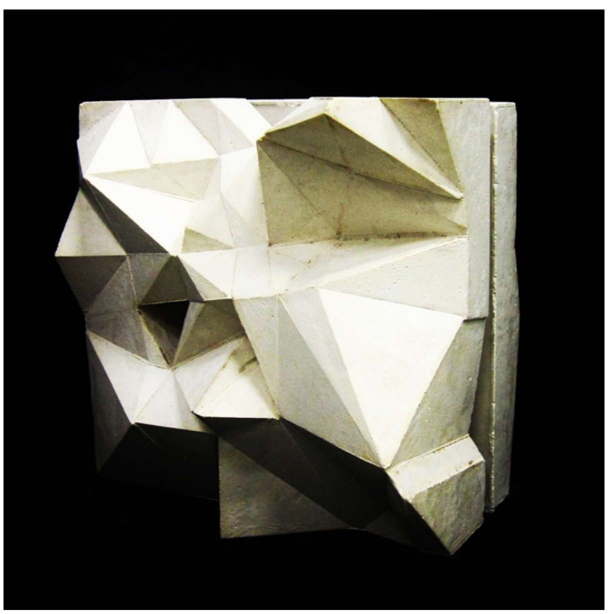
### *Making*

We promoted that physical work should always coincide with intellectual work, and that the best time to initiate practicing something was as soon after the learning of it, as possible. Beginning to iterate, as the third stage of the protocol, in studio immediately following the discussion was intended to insure that acquired knowledge could be more significantly retained and developed as projects evolved. This activity allowed faculty to immediately gauge student learning and redirect students, through further questioning, back to the day's discussion, if necessary.

*Course Objectives*

Below are the learning outcomes that were stated in the syllabus for the course and were developed specifically for the course for the spring 2015 semester:

- Demonstrate the application of critical thinking to critiques, the design process, and self-assessment
- Demonstrate the ability to communicate complex ideas through verbal, graphic and three-dimensional representation
- Demonstrate the ability to establish and maintain a rigorous, independent design process based on an understanding of design principles, underlying ordering systems, and iteration
- Demonstrate a critical attitude toward craft, combining making with critical thinking
- Demonstrate the ability to critically and effectively utilize a complex range of materials, techniques, and ideas within the design process



*Materializing: Tile Plaster Topological Study, 60cm x 60cm*

*Reflection Essays*

Students were asked to write a 500 to 750-word personal reflection essay at the beginning, mid-point, and end of the semester. The constraints were open, simple, and few, requesting only that students be introspective and describe how they feel, if and how they have changed, and how they have dealt with these changes based on a timeframe of the recent past. Any relationships they made to learning outcomes or intentions we had for the course were unsolicited.

*On Questioning*

Using the Socratic Method, we posed divergent, open-ended questions to students which favor possibilities and have been shown to promote active participation, deeper cognition, and a higher quality of learning.[13] We deterred students from asking yes/no questions, such as, "is this right?", which keep students dependent, safe, and assuming that design is somehow formulaic, with "right" and "wrong" answers to be arrived at. We focused, therefore, on problem-posing, rather than problem-solving, to develop curiosity. The importance of curiosity in design and education cannot be understated, as "there is no human competence which can be achieved in the absence of a sustaining interest."[14]

## Outcomes

*Reflections*

The vast majority of reflections cited the importance of iteration. Many of these recognized iteration as the key component of a design "process". Some described having an adverse attitude toward iteration and then gaining an appreciation for it over the course of the semester:

*"At first, I felt like I was repeating myself over and over but when I took a look at the overall body of work it was clear to me that each iteration corrected the previous one and included a newer idea, which eventually were all combined to create the final composition."*

A large number of reflections described a lack of motivation stemming both from the amount of work assigned and the lack of personal feedback, which allowed us to adjust the workload:

*"I'm tired, running low on self-motivation and again, tired. The work has become more complex. Ironically, the feeling of having more space to think, is unloading a weight of unwritten rules on my back. I am tired but I think that's inevitable, more importantly, I don't think it's a bad thing. If I'm tired, it means I'm working, if I'm working it means I'm learning, and if I'm learning it means I'm growing, and that's what this semester and life in general is about. Growing."*

More than half of the reflections referred to the development of critical thinking, in some cases describing its application in the design process:

*"I have always been a thinker, but throughout my coursework, I have greatly sharpened my critical analysis skills. Instead of focusing on proposed meanings or biographical background, I have learned to continuously ask myself "why" on many different levels. I challenge myself to dig as deeply as possible and unpack every detail to develop a satisfying project with process and good craft."*

Some of the essays described a new or developed sense of independence:

*"I remember craving high school days where everything was simply spoon fed to us. It was a very difficult change that I felt that I can never endure. However, as the studio proceeded I found out that this change was the best thing that ever happened to me. I learnt how to explore to find the answers by myself. I felt that I changed to a responsible individual. The feeling of self dependency and working by my own agenda was a beautiful experience."*

A few of the reflections revealed the development of a critical attitude toward craft:

*"I have learnt this semester that craft is love. It is the passion and care one puts in his work. Craft is the understanding of nature, tools, and us. It is the engagement of process using tools to transform a raw material using sensitivity and care. Therefore, if you love your work and make it your child, by nature, it will be beautiful."*

*Course Evaluations*

Student course evaluations were consistently high across all sections and, further, were consistent with instructors past evaluations for the same course. On a reversed five-point Likert scale, the average evaluation out of nine sections was a 4.2, with a high of 4.6. The two lowest evaluations, 3.8 and 3.9, were in sections listed under mentored faculty.

Feedback from one of the lowest scoring sections, consisting primarily of Art and Design majors, cited content rather than the high student-faculty ratio as the primary negative, complaining it was overly architectural. Only six students complained specifically about the large class sizes, although two of those conceded its ultimate success. One student praised the course for helping her to become more independent.

In general, we found that the evaluation results were typical and were affected very slightly by large class sizes, if at all.

*Course Learning Outcomes*

While students demonstrated achieving course outcomes for critical thinking and communication primarily through class discussions, critiques, and personal reflections essays, their design work, overall, revealed a high level of craft and rigor through iteration, intention, and execution of technique. In addition, the quality of work was more consistent across all sections than in previous semesters.

*Articulating: Plaster Topology Site Intervention*

*Mentorship*

There were two primary instructors and two supporting instructors in a mentorship structure. Of the two supporting instructors, one was a junior tenure-track faculty member with a few years of teaching experience in upper level studios, and one adjunct instructor with no prior teaching experience, hired to be developed as a Foundations instructor, based on her perceived potential.

The feedback received from supporting was mixed. The junior faculty member did not have a positive experience, stating that she was underutilized and that the structure undermined her position and her relationship with students. The adjunct instructor described an overall positive, constructive, and educational experience. Both responses could be expected, but because neither of them has returned to teaching in the program, results of the team teaching structure and capacity building are inconclusive.

*Conclusions*

In line with the high-ratio, vertical studio study out of the University of Illinois reference earlier, we found the main drawback to teaching design studio with large class sizes to be exhaustion of the primary instructors. Our fatigue was intensified early on by having to motivate students who were discouraged by a lack of individual attention. However, over time this condition diminished and energy levels increased in students and faculty.

The sophistication of the work and the quality and depth of the reflection essays demonstrated a high level of success in meeting course outcomes across all sections. From our perspective, we met course outcomes not only despite high-ratio, but in some regard because of it, as evidenced by the independent attitudes developed in many students. Ultimately, we will have to track student achievement in future semesters to gauge the actual success of the high student-faculty ratio model. That research is forthcoming.

## Notes

[1] Glass, Gene V., and Mary Lee Smith. "Meta-analysis of research on class size and achievement." *Educational evaluation and policy analysis* 1.1 (1979): 2-16.

[2] Visiting Team Report, North Dakota State University. National Architectural Accrediting Board (March 29, 2006): 3.

[3] Interview with Cristiano Luchetti, Assistant Professor of Architecture, American University of Sharjah.

[4] Peterson, Matthew, and Brad Tober. "Institutionalizing the Vertical Studio: Curriculum, Pedagogy, and the Logistics of Core Classes with Mixed-Level Students." *Proceedings of AIGA Connecting Dots Conference*. 2014.

[5] Macías-Guarasa, Javier, et al. "Tools and strategies for improving PBL laboratory courses with a high student-to-Faculty ratio." *Frontiers in Education, 2005. FIE'05. Proceedings 35th Annual Conference*. IEEE, 2005.

[6] Palacios, Vincent, Ingrid Johnson, and Michael Leachman. *Recent deep state higher education cuts may harm students and the economy for years to come*. Washington, DC: Center on Budget and Policy Priorities, 2013.

[7] Nathanson, Rebecca. “City College Faces Deep Budget Cuts: ‘Students are Doomed’.” The Gothamist. Web. 12 Nov. 2015.

[8] Chingos, Matthew M. "Class size and student outcomes: Research and policy implications." *Journal of Policy Analysis and Management* 32.2 (2013): 411-438.

[9] Ibid.

[10] Wirth, Karl R., and Dexter Perkins. "Learning to learn." *Retrieved May* 12 (2008): 2010.

[11] Mission Statement, American University of Sharjah, 2015.

[12] Gardiner, Lion F. *Redesigning Higher Education: Producing Dramatic Gains in Student Learning. ASHE-ERIC Higher Education Report No. 7*. ERIC Clearinghouse on Higher Education, One Dupont Circle, NW, Suite 630, Washington, DC 20036-1183, 1994.

[13] Arslan, Mehmet. "The Role of Questioning in the Classroom." *Hasan Âli Yücel Eğitim Fakültesi Dergisi* 3.2 (2006).

[14] Kashdan, Todd. *Curious?*. HarperCollins e-books (2014): 6.

# Numbers Count When Truly Cultivating Creativity

Stella Robertson | Massey University

## Introduction

This paper describes efforts made to retain key learning on a first year design course called *Material Matters* at Massey University's College of Arts (CoCA) after significant changes to the course delivery. In 2012 pressure on space on campus meant two classes of twenty students merged into one class of forty and a major round of academic development in 2013 reduced class contact by one quarter. Prior to these changes the primary teaching mode for this course was 1:1 meetings (Fig. 1). This more intimate delivery was considered particularly important for beginning designers and the 'coaching of creative behaviour'. This term has been used to describe deliberate efforts to (a) develop creative thinking in design students and (b) explicitly encourage what Cropley describes as "facilitatory aspects of personality"(p.9)[1] that support creativity. Craft summarises these in a key study of creativity in education as risk taking, perseverance, self-belief and "tolerance for ambiguity" and "willingness to grow"(p.21)[2]. These attributes have been described as central to *Future Thinking* or *21st Century Learning*[3]. Bellanca et al. [3] cite risk taking, autonomy and reflective practises as aspects that encourage this form of learning. Schon[4] states that the skill of reflection is an effective way to improve practitioners' creativity and in *Materials Matter* this practise is most often encouraged during the 'coaching of creative behaviour'.

Design is most easily understood by novice designers as a noun, an output or product. For any output to be considered creative it has to be deemed to be not only novel or unique but also appropriate or useful[5] . Design as a verb refers to the creative process, which is most often referred to in terms of cognition[5]. Helping beginning designers to see design as a thinking process is an important part of their introduction to the domain. An overarching cognitive strategy used in design is divergent thinking, described as a key creative strategy that relates to open, associative and imaginative thinking[6]. However many researchers believe that divergence alone cannot account for creativity and that this should be followed by a period of convergent thinking [5] [7] in order to determine the best solution to the problem. *Materials Matter* places cognitive flexibility at the centre of teaching creativity in design and directly teaches strategies to cope with the undetermined and complex nature of design problems, often referred to as *wicked problems* [8]. Stolterman says that dealing with *wicked problems* means that designers have had to develop particular ways of working to help them cope with "unknown or partially known situations"(p.55)[9]. This relates directly to Craft's "tolerance for ambiguity"[2]. In the assignment *Materials Matter* students are explicitly asked to take risks and move away from what they know in order to discover something new. To help them cope with this challenge we specifically coach perseverance and encourage self-belief. This kind of deep learning often relies on more personalised tuition, something that the recent changes to CoCA courses could not support to the same degree[10].

## Materials Matter & Delivery Modes

Materials is delivered twice a year by the Textile Design Major to a cohort of eighty first-year students from any part of the design degree. The course has been co-ordinated and led by the author of this paper for five years, is usually staffed with two other lecturers and supported by up to six technical demonstrators. The additional lecturers for this course regularly change. Only one visiting tutor, K. Johnstone, regularly taught on Materials before and after the changes occurred. L. Munnelly, a lecturer in Textile Design, taught primarily on the original version of the course and experienced one round of delivery of the current version of Materials (Materials II).

The original course was considered a sound introduction to both Textile Design and to first years in general. Therefore we were advised to retain the previous learning outcomes as we developed the course. In a statement about the course, CoCA first year co-ordinator, Dr C. Campbell says,

*"The transformation of commonplace materials into elegant and inventive solutions is evidence of their high quality of thinking and commitment to problem solving through design. The prototypes and material tests accompanying the final outcomes are excellent. Not only do they show students competency with materials, they are evidence of students ability to successfully apply design processes, such as idea generation and ideation, to the final solution. It is wonderful to see such thinking and skill from this group of first year students".*

As the content of the course needed to stay largely intact despite the larger classes and reduced contact hours, we focused on modifying the content delivery methods.

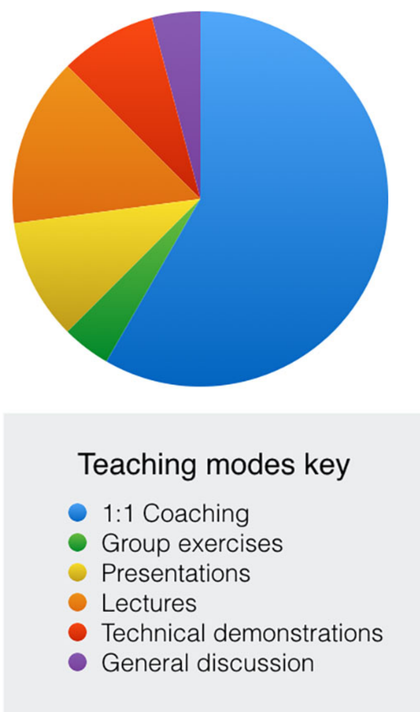



*Figure. 1 Allocation of hours of teaching modes in the original version of Materials Matter*

An analysis of the delivery modes used in the course (Fig. 1)[11] identified six different types of student engagement as: 1:1 coaching, lectures, technical demonstrations, group exercises, general discussions and presentations. Looking at the number of contact hours for each delivered mode in the original version of Materials shows that over half of the teaching was delivered via 1:1 coaching. Therefore, the main strategy for addressing CoCA's changes while maintaining the learning was to find a way of delivering the 1:1 coaching content more efficiently.

## Materials Matter Aims

The aim of the course is to introduce new students to key creative thinking and action strategies used in design and to improve their knowledge of material properties and how this affects making.

*Figure. 2 MDF and thread sample*

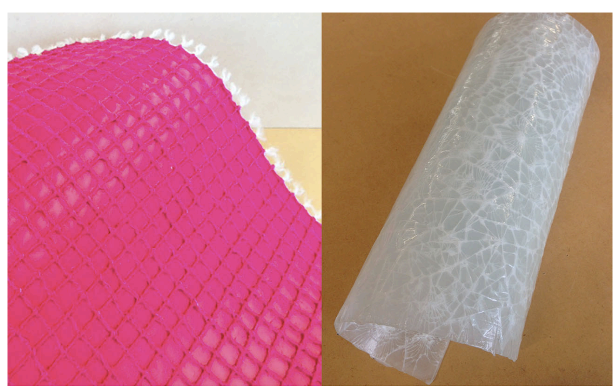


*Figure. 3 Flexible paint and wool sample & Rolled glass*

We engage the students in this learning by asking them to create their own 'new' material. A 'new' material is defined in two ways:

1. The properties of one or more of the original sourced materials is changed and now behaves in an unlikely way. For example a rigid material draping (Fig. 2), flexible paint or glass (Fig. 3)

2. A traditional making process rendered in a non-traditional material (Fig. 4)

*Figure. 4 Traditional processes with non-traditional materials - Needle punched latex gloves(left), Woven glad wrap (centre), Knitted plastic baling wrap(right), knitted felt coated in silicone (2 x bottom)*

By clearly defining what we mean by 'new' we give the students specific strategies for achieving creative outputs. This relates to Sternberg and Lubart's [5] definition of creativity as something 'unique'. They select their best samples in relation to this 'newness' and two other criteria in Fig. 5. We relate measuring success in this way to the second part of to Sternberg and Lubart's creativity definition of something that is useful or appropriate .

| | **Assessment Criteria** |
|---|---|
| 1 | Change of material properties |
| 2 | Uniqueness of sample |
| 3 | Resolution of crafting |
| 4 | Potential for the material to be made into a useful product |

*Figure. 5 Assessment criteria for selecting the best 'new' materials*

Once they choose the best material they visualise it as an appropriate product that showcases their 'new' materials properties (Fig. 6).


*Figure. 6 End use moodboard showing collapsible, rollable, paint and wool sample*

*Materials Matter* emphasises the process of creation over the final design outcome. This is reflected in the assessment structure and weightings. By making the assessment at the halfway point formative only we remove the pressure of grades at this interim stage. The weightings of the final assessment focus 75% of the mark on the process of creation while only 25% is allocated to the final work. Both these measures support risk taking and encourage a playful, experimental approach towards making.

## 1:1 Coaching Of Creative Behaviour

This section describes three key areas of focus of the 1:1 coaching meetings in the original version of *Materials Matter*. The coaching sometimes occurs in small groups as it was often considered beneficial for other students to hear advice given to their peers.

### *Divergent Thinking For Flexibility & Fluidity For Sourcing & Making*

Student's natural tendency in this assignment was to choose three or four materials that they felt comfortable using, these were often materials commonly used for the process they were trying. For example, Fig. 7 illustrates a student weaving traditional yarns. By helping the student realise this was limiting her ability to make something unique and helping her brainstorm, "What materials could be woven?" she became more open and imaginative with her material choice.

*Figure. 7 Woven iterations - from yarn (left), to straws, to elastic, to balloons (right)*

By encouraging both Torrance's measures of divergent thinking, fluidity and flexibility [12], the class began to recognise that the students who made the most samples and who sourced widely for different materials were typically the ones with the best ideas. Discussing these strategies modelled this behaviour to students who were still struggling to diverge their thinking and helped to counteract the belief that some people were better at coming up with good ideas than others.

*Navigating Not-knowing*

In the initial stages of the brief most students were embarrassed about rough samples, experiments "going wrong" and anxious that they did not have 'an answer'. By coaching the students to re-frame their critique towards learning from their "mistakes" we encouraged a more open mode of thinking that helped identify the directions for the next iterations.

Dividing elements of a student's sample into *process* and *material* helped us to define the most successful aspect of the material that could inspire this next stage. For example in Fig. 8, by identifying the process used to make the early, 'embarrassing' sample (top left) as, *sandwiching one material* (wire mesh) *with another* (blue foam), we defined a *process* that was working. Applying this process to the broken glass of previously samples led to a series of samples where glass rectangles were sealed between sheets of adhesive film making it more flexible.

*Figure. 8 Iterations from blue plastic to flexible glass*

The breakthrough (literally) came when the student wished to recreate the pattern of an earlier sample (on the left) by carefully smashing the trapped glass with a hammer. Flexible glass was an excellent change in properties. By coaching the students to identify a next step we helped them to know what to do in the short term without having them plan the whole project to the end and so encouraging an experimental mindset. We also promoted ideas such as, 'mistakes are part of the creative process' and 'good ideas will not necessarily look good in early stages'.

*Evaluation, Selection (Convergent Thinking) & Reflection*

All the way through the project the students were asked to evaluate their samples and document their reflections in a workbook (Fig. 9 & 10). Boud[13] says,

> *In developing expertise of any kind, it is often helpful to become more deliberate and conscious of the process and more aware of the decisions being made by others and ourselves. It is through exposing these decisions to scrutiny that the assumptions behind them can be identified and a conscious decision to act from a new perspective can be taken. (p.13).*

During selection stages of the project the coaching shifts to helping the students with evaluation, where the lecturer models decision making and articulating the reasons for these. The lecturers all agree that selection and evaluation is particularly challenging for beginner students.

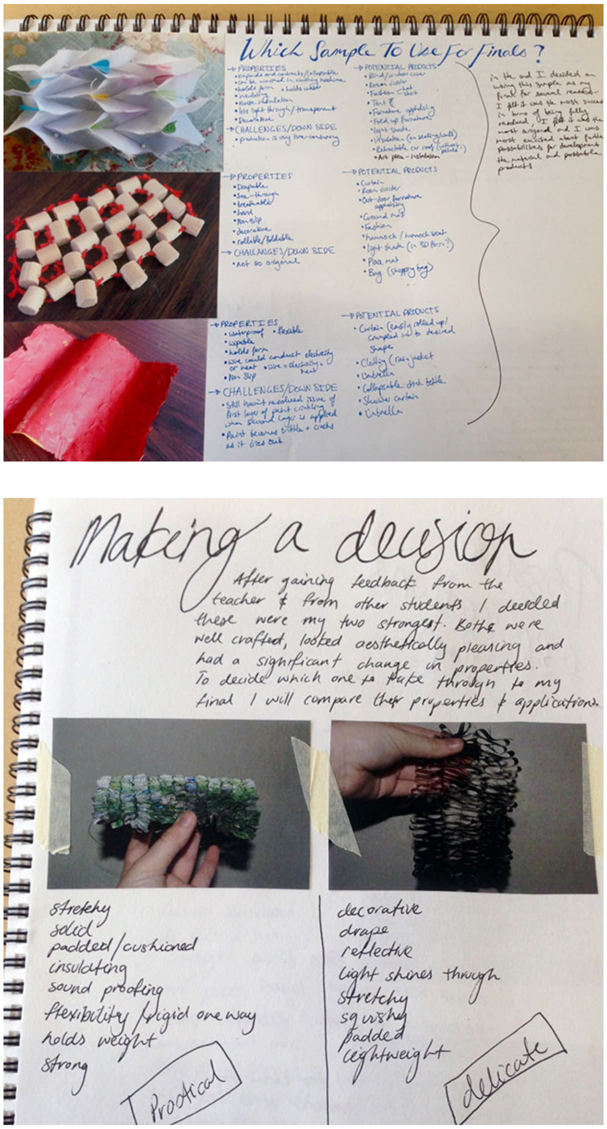



*Figure. 9 & 10 Student workbooks: Documentation of analysis and selection processes*

In summary, coaching novice designers through some of the fears and doubts they have about not being creative is a very personal process. This relies on the student trusting the lecturer. Developing trust and transcending self-doubt requires time and repeated encouragement. However it should be noted that not all students attended 1:1 meetings regularly enough to receive repeated coaching.

## Materials Matter II

Disseminating the same learning outcomes to a group of forty students rather than small groups of four or five, or in many cases an individual, meant changing the delivery modes of *Materials Matter* significantly. A summary of how the change in contact hours and group size affected the teaching modes is conveyed in Fig. 11. Hours for technical demonstrations and group discussions did not alter, lectures were shortened and made more interactive and one presentation was replaced by a group critique. The fundamental changes to delivery were reducing 1:1 coaching time by half and covering some of this content in group exercises. This increased time for group teaching by four times. Three of the exercises the staff believe to be most effective are described here.

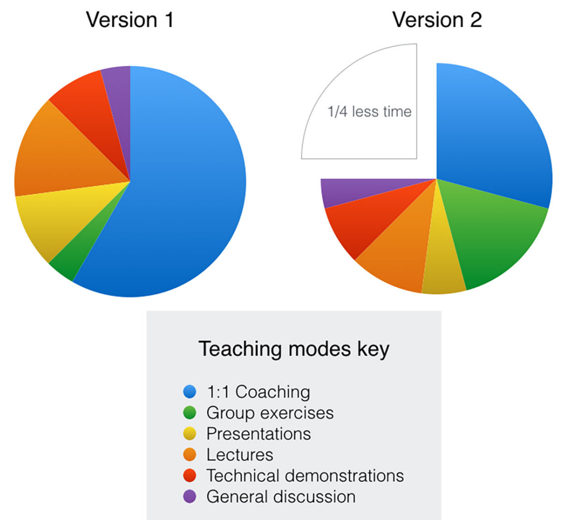



*Figure. 11 A comparison of time spent using different teaching modes between the two versions Materials Matter*

### *The Materials Library*

One of the key aims of the course is to give students strategies for producing more unique samples. One way for them to do this is to start with an unexpected material. However, this often relied on the staff's knowledge. To deliver this learning more efficiently we devised the following group exercise.

Small groups are asked to source a range of materials from a diverse list of retailers, bring these back to the next class and co-create a categorised library of materials displaying pricing information and the supplier's name (Fig.12). In the original course the students were asked to source eight materials individually and without guidance. By doing this exercise together the students are exposed to far more materials and they become aware of which materials are more commonly sourced and which are more unusual. Johnstone says that by directing the groups to more unusual outlets such as plumbing stores and sailmakers, we expand their thinking beyond the arts-and-craft suppliers where novice designers tend to source their materials. She adds that organising the findings under categories such as soft, hard or joining materials encourages the student to think more deeply about their materials. Munnelly believes that this exercise helped the students find different materials far earlier in the project, however she felt the students did not use this excellent resource enough as the project progressed.


*Figure. 12 Creation of the Materials Library*

In summary, this exercise helped students diverge their thinking around sourcing earlier and created a vast amount of shared knowledge for the class to draw from, encouraging more autonomous choices of materials and boosting confidence in their own knowledge. Additionally, by having a library of 'known' materials we aimed to minimise the seeminly infinite starting points for this project, easing some of the students discomfort with not-knowing.

*Peer to peer critique*

At the interim assessment students select three or four samples that will inspire the next round of experimentation using the criteria in Fig. 5. This group exercise guides the selection of the best samples. The students lay out all their materials and make an intuitive selection of their work (Fig.13). In groups of four they move to critique four other students work in relation to each criteria and may change the materials selected. Each student summarises their critique in their workbook (Fig 14). The students return to their own work and see if their selection has changed. If it has and the owner of the work disagrees with the new selection, the group aims to justify their choices. At this point the lecturer helps with the selection, especially if they disagree with an individual or group's choice.

This interactive critique replaced a formal presentation centred around the lecturer's opinion. Johnstone stated that putting the critique in the hands of the students was more empowering for them.

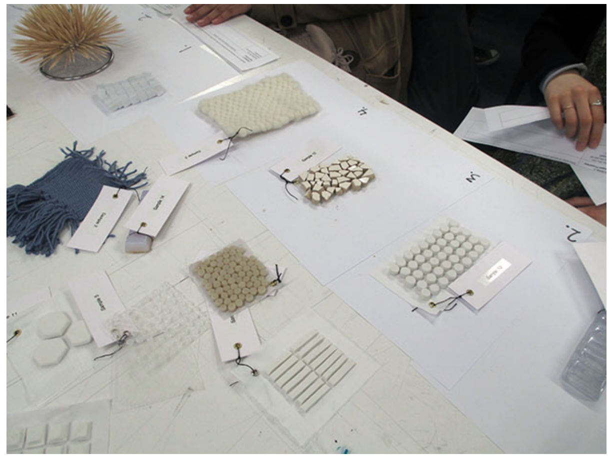


*Figure. 13 Student selection of work in Peer-Peer Critique*

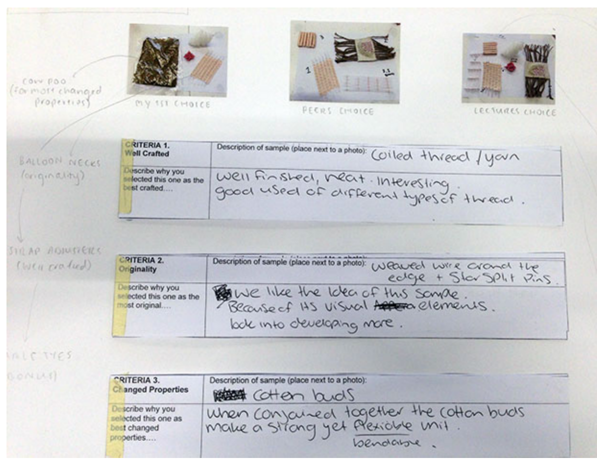



*Figure. 14 Documentation of Peer-Peer Critique*

*Reflecting on the creative process*

This group exercise and discussion happens in the session after the peer critique. We show Fig. 15 up to stage three and explain how this maps the thinking stages of the design process already undertaken. Divergent thinking and iteration are named as deliberate strategies for creativity. Then the final three stages are revealed, mapping the whole process of navigating not-knowing through to a place of knowing and the linear refinement of one sample. The diagram's diamond shape, caused by the expansion of ideas before selection is discussed

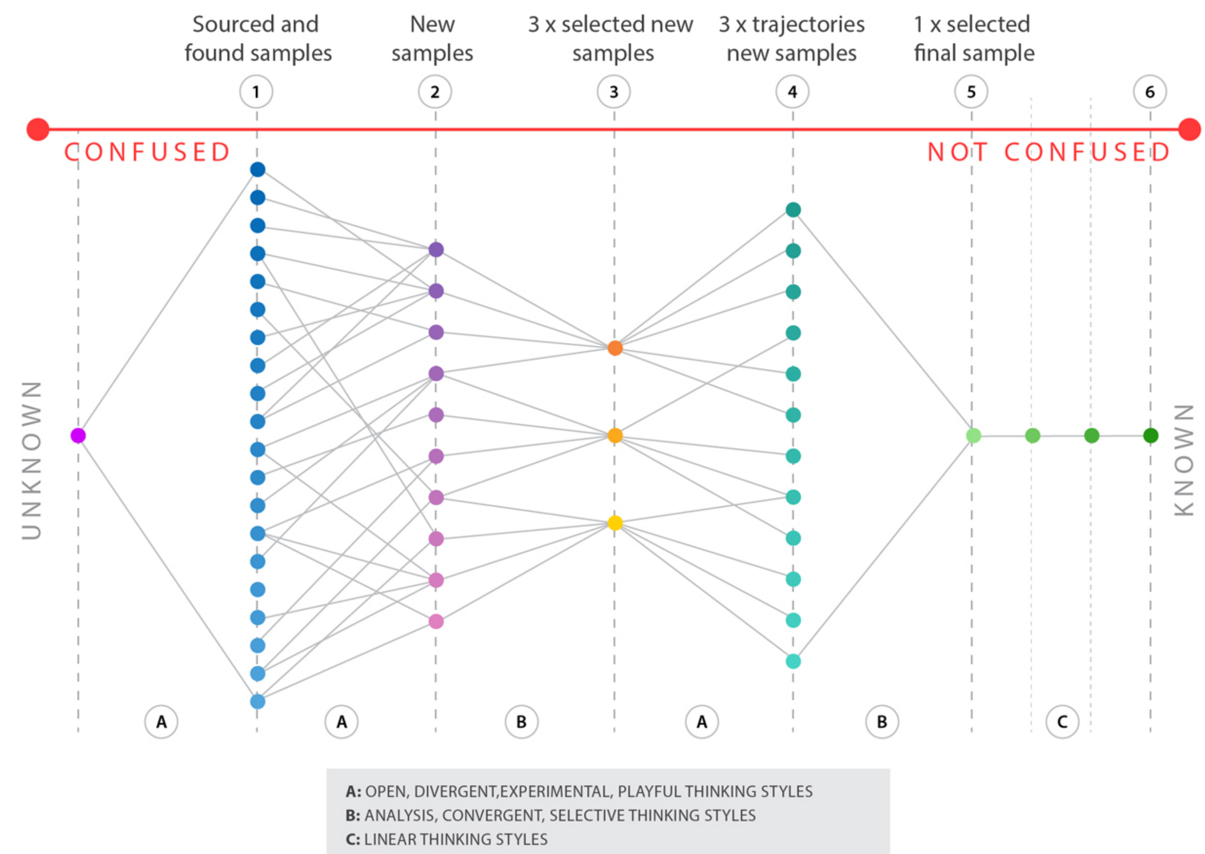



*Figure. 15 Diagram mapping thinking styles and the creative process from not-knowing to knowing in design*

as a strategy for creating the 'new'. The shift from divergent to convergent thinking is emphasised as a significant moment of creativity. It's explained that the focus of thinking styles in design is likely to differ from thinking styles that dominate most school classrooms, i.e. convergent thinking, where knowing is all important. We stress that feeling anxious about not-knowing is a normal part of creativity, and practising design thinking improves this struggle.

It's explained that this is a theoretical diagram that cannot possibly represent the chaos and complexity of the creative process, but that is does helps us more easily identify the thinking styles that support each stage of the design process. By doing this we aim to become more conscious of our own particular challenges during creativity. This relates to Boud's quote about the positive impact of awareness on developing expertise already cited[13]. We now ask the students questions to identify whether they found choosing samples (convergent thinking) more challenging than idea generation (divergent thinking) or vice-versa. This kind of deeper reflection used to happen in 1:1 meetings only, but by doing this in a large group we reach everyone. Also by helping the students identify the times when they feel most challenged we aim to help them become more aware of when they need to seek staff support.

Johnston believes this diagram helps clarifies the main learnings of the course and assists the students to see how this applies to other design subjects. There has been significant verbal feedback from students around this exercise. Many conveying feelings of relief and question why other design subjects do not discuss this information.

## Conclusion

As the changes to *Materials Matter* happened incrementally the new strategies were also introduced in stages. Subsequently there is no definitive before and after comparison that would provide a clear picture of how the new course compares to the original version. This makes the opinions of the courses lecturers an important source of information.

Munnelly says,

***"it's hard to say if the quality of student work has changed. The students are still creating great work, however I'm concerned about retaining the depth of learning with less to 1:1 time. 1:1 coaching especially helps with evaluation and selection. With less of this I've seen students miss selecting the best work."***

When the changes were announced the author shared Munnelly's concerns, particularly around losing the depth of content around creativity. There is no doubt that there is now less focus on an individual's creative process but by converting much of this learning into group work we have potentially supported more students in their creative practice. In addition, The Materials Library seem to encourage more divergent thinking earlier in the project. Teaching both the knowledge and the regulation of thinking (Metacognition)[14] around creativity in a systemised way has meant the how's and why's of design, which tend to become very intuitive to seasoned lecturers, are clarified. Demystifying design for beginner designers is becoming increasingly necessary as while this domain continues to expand to include broader problems it is becoming more crucial for novice designers to understand design as a cross-disciplinary approach and a way of thinking, working and acting that is reliant on a broader idea of creativity.

In Materials we always aimed to encourage deep learning about creativity but perhaps now it could be said that we are now addressing student creativity in a broader sense by introducing more co-creative practices and setting up group learning where leadership skills can develop. Both which are crucial for this expanded view of the design domain.

Johnstone says that communicating learning around creativity is now easier for staff and so therefore clearer for the students. She believes students are empowered by having deep knowledge of the creative process and by doing more self-directed learning. However, she senses that though we may be helping the lower grade students improve their work, we may have less 'A' level grades than previously.

Comparing the grades between the versions of the course has limited value as the new course has not run long enough to draw any sound conclusions. However the author's gut feeling mirrors Johnstone's. This may suggest that for beginner designers, group work contributes to averaging out class grades. Perhaps because students who were less self-directed are being motivated and assisted by more group work, while students who would normally score higher grades are less motivated or distracted by group lessons. On the other hand (or in addition) less personalised coaching, particularly with selection, may be contributing to less 'A' grades as Munnelly suggests.

We could spend time testing these hunches but first we would need to ask the question, "Is improving grades really an indication of depth of learning?" Surely this depends on what you are marking. Swaying the emphasis of the criteria towards the creative process rather than the final product has always been part of this course. However this is not the norm in CoCA where great emphasis is placed on winning awards for most creative product.

This is not a problem in itself but in an ideal world deeper measures of creativity, like risk-taking, perseverance and personal growth would have equal weighting in design assessment criterias, especially for novice learners. This would be in keeping with Baynes, Norman & Stables[15] concepts of "nurturing the designerly" and Stables[15] idea of "little 'd' designing"[16] that shifts design education's emphasis towards developing more "balanced and fulfilled humans" (p.6).

In an ideal world time would not be an issue when developing this most desired trait in our future thinkers and *Materials Matter* could retain the same amount of personalised coaching of creativity *and* reach more students with group exercises. Back in reality numbers count and we have to make choices. However cultivating creativity in larger groups does not automatically reduce the value of that learning and it may even broaden the focus by including co-creative practices. Using limitations as an inspiration is after all a creative strategy in itself.

The 'next stages' in the design of *Materials Matter* are:

- Focus many of remaining ten hours of 1:1 meetings on coaching selection processes
- Retain the use of the Material Library more throughout the course
- Extend the reflection in the workbook to record more personalised aspects such as thoughts and feelings during the creative process and find ways to share this easily with lecturers
- Focus some reflection on how students worked in a group during co-create and evaluation

These next stages are evidence of co-creativity enhancing divergent thinking. Thank you Munnelly and Johnstone.

## Notes

[1] Cropley, A. J. (2001). Creativity in education & learning: A guide for teachers and educators. Psychology Press

[2] Craft, A. (2001). An analysis of research and literature on creativity in education. Qualifications and Curriculum Authority, 1-37.

[3] Bellanca, J. (2015). *Deeper learning: Beyond 21st century skills*. Indiana: Solution Tree Press.

[4] Schön, D.A. (1987). Educating the reflective practitioner: toward a new design for teaching and learning in the professions. Jossey-Bass, San Francisco

[5] Sternberg, R. J. & Lubart, T. I. (1999). The concept of creativity: Prospects and paradigms.In R. J. Sternberg (Ed.). *Handbook of creativity.* Cambridge: Cambridge University Press.

[6] Russ, S. W., & Schafer, E. D. (2006). Affect in fantasy play, emotion in memories, and divergent thinking. *Creativity Research Journal*, *18*(3), 347-354.

[7] Torrance, E. P. (1963). *Education and the creative potential*. University of Minnesota Press.

Guilford, J. P. (1973). Characteristics of Creativity.

Noppe, L. D. (1996). Progression in the service of the ego, cognitive styles, and creative thinking. *Creativity Research Journal*, *9*(4), 369-383.

Csikszentmihalyi, M. (1997). Flow and the Psychology of Discovery and Invention. *HarperPerennial, New York*, *39*.

Cropley, A. (2006). In praise of convergent thinking. *Creativity research journal*, *18*(3), 391-404

[8] Alexander, C. (1964). *Notes on the Synthesis of Form* (Vol. 5). Harvard University Press.

Rittel, H. W. J., & Webber, M. M. (1974). Wicked problems. *Man-made Futures*,*26*(1), 272-280.

Schön, D. A. (1983). *The reflective practitioner: How professionals think in action* (Vol. 5126). Basic books.

Cross, N. (2001). Designerly ways of knowing: Design discipline versus design science. *Design issues*, *17*(3), 49-55.

[9] Stolterman, E. (2008). The nature of design practice and implications for interaction design research. *International Journal of Design*, *2*(1), 55-65.

[10] Officially the ratio of staff to students stayed the same, however with double the students in the space it became far harder to keep the group focused while 1:1 meetings occurred

[11] Technical demonstrations - weaving and hand tufting on a frame loom, hand stitching and paper folding. NB. these are introductory processes only, the students are then expected to push these further or choose new processes.

[12] Torrance, E. P. (1974). Torrance Tests of creative thinking. Directions manual and scoring guide, verbal test booklet B. Scholastic Testing Service.

[13] Boud, D. (2001). Using journal writing to enhance reflective practice. *New directions for adult and continuing education*, *2001*(90), 9-18.

[14] Hargrove, R. (2012). Fostering creativity in the design studio: A framework towards effective pedagogical practices. *Art, Design & Communication in Higher Education*, *10*(1), 7-31.

[15] Norman, E., Stables, K., & Baynes, K. (2010). Design education: nurturing the designerly but at what cost. *Technological Learning & Thinking*.

[16] This relates to Craft[2] and Csikszentmihalyi's[7] discussions about little 'c' creativity.

# Foundation: A Work in One Act

Vincent Sansalone, Kory Beighle | University of Cincinnati

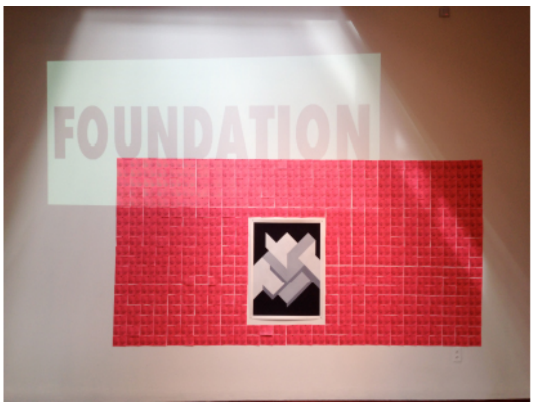



*Fig.1 Studio Work Exhibit*

## Introduction Manifesto

This paper is premised on the unified foundational experience of students entering the DAAP disciplines freshman year. The intended outcome of such curriculum and curricular change will not only give breath to a body but give depth to a life to improve the interdisciplinary education needed for successful artists, architects, designers, and planners of today and tomorrow. We believe the community formed at DAAP must cultivate inquiry. Inquiry is the notion that people re-envision the world around them and possess the ability to critically change it. Our aim is to have this philosophy be the core component of their foundational experience. We premise that the pursuit of inquiry will inculcate students with a desire to become active participants in visual

cultural production, leaders in global innovation, entrepreneurs within the culture industry, and theorists who confront and solve the most pressing problems of the world. But, to be clear, this not only a first year strategy but part of a vertical strategy where the tactics learned in first year play throughout students tenure at the University.

As first year faculty, coming with diverse voices with unique pedagogical and curricular focuses, but all with a clear desire to foster young minds, we lead approximately 450 students in the processes of educating themselves in both making and applied visual thinking, all sited within the historically essential elements of the visual and plastic arts. The protagonist in this play is the humanist mind and the critic or foe is the job. Here the Poetics of the script dates back and stands on Aristotle and his writing on observation.

Following in the rigorous tradition of the Bauhaus and Black Mountain with a nod to MIT Media Lab, this foundations program aspires to trans-disciplinary thinking to the sound of 'Take Five'. Accordingly, students go beyond representation, both in theory and practice to an outline for thinking that investigates the ideas of the past, critiques and deepens current best practices, but dares to suggests a future that propels DAAP into the forefront of preparing students to become the cultural leaders.

In this paper I hope to show how this constructivist pedagogy weaves a new fabric of thinking and working through the students and beyond. The opening line of the story may start with "line' plane, volume" propped with materiality; but it is staged in the theatre of ethics on the scale beyond the ivory tower.

## Staging

The ways in which foundational disciplines are historically taught and thought (praxis as theory-practice) have an influence on the curriculum and philosophical dispositions faculty relay to their students. By using the vast body of pedagogical research on teaching arts and humanities, the proposed program can avoid teaching practices that hinder foundational understandings and research, and connect with the goals of the integrated foundational set of capabilities we seek to instill into our students, ie.

students out of the seats. In this practice, we seek the stage of Third-Space, a place of exploration of object, context and the interstitial space of possibility.

In this plan, all courses that students take in their first year will be housed within DAAP, including University requirements. The model of an integrated foundations allows us to engage more deeply with content and connecting the practices of thinking and making in their first year. Additionally, it allows for students to utilize their non-DAAP course offerings to explore more advanced material that informs their studio practices. Ideally, we would replace several required courses in the University curriculum with courses that deeply integrate the philosophy of making and critical inquiry.

This demanding pedagogy is rooted in active spatial construction, a comparative practice that crosses the boundaries of two- and three-dimensional design disciplines. First-year students learn core principles, but more importantly, they learn to question and transgress the traditional. The curriculum places a heavy emphasis on self-awareness. In other words, it requires students' constant consideration and incorporation of physical scale—the set of physical qualities, and quantities of information that characterize motor, sensory, social, and mental capabilities. Over the course of the semester, the program(s) unfolds in a series of projects developed to teach the principles of composition, form, and materiality through an acute understanding of the hand and making via iteration, craft, scale, and questioning.

Foundational experiences thus must be integrated vertically and horizontally in various ways throughout a student's time at DAAP. Finally, the need for comprehensive foundational integration and practice in DAAP disciplines requires acknowledgement of best practices, pedagogical innovations and initiatives for cross-disciplinary studies already in progress. With this in mind, this paper focuses on strategies and actions for implementing and creating a culture of collaborative research and pedagogical practices that will led the College (DAAP) and University (UC) into a new era of integrated visual cultural studies, especially with the humanities and science.

The second sentence is film, collage, re-presentation. This is the step to transition between 2-Dimentions, the 3rd and time.

## Off Stage


*Fig. 2 Poster of Gallery Show DPMT7*

DPMT7 is research studio of architects, artists and designers that practice in the way they teach. It becomes the laboratory for investigations of practice both academically and professionally. This feeds directly into the work in the classroom and at times becomes the classroom for the students. This curriculum accentuates process and likens it to the scientific method: The question is akin to the hypothesis and like scientists, we/students research, conduct experiments, analyze results, and create and share their results and new knowledge. That said, like 'artists', the process honors the creative process as a whole: intuition, conversation, ideation and exploration, crafting and making mistakes, stepping back, self-critique, celebration, and reflection. This done from constructing a 'flying' Pelican, salt blocks in a game of exquisite corpse to the extension of a brand in a special environment.

## Characters

***The Math of Making*** looks at the structure of work from the geometry of the page to the systems of civilization to facilitate quantitative reasoning and enable students to connect quantifiable research practices to a more fluid and dynamic integration into the studio. Ideally, this course would be taught by faculty in Architecture, Planning and/or University faculty

***The Logics of Making*** is an intensive writing course focusing on analytical-critical and descriptive writing. Analytical-critical writing involves critically analysing text and writing positions based on arguments and reason; as well as visual type. This course would be taught one of faculty in Art Education, Art History, or faculty in the PhD Program in Architecture.

***The Articulation of Making*** is an intensive writing course focusing on subjective and generative writing techniques involving the application of judgments and poetic responses to visual culture; as well as visual type. This course would be taught by faculty in Art Education, Philosophy, Graphics and Architecture.

*The Context of Making* is a novel course that focuses on ideas of visual literacy from multidisciplinary perspectives. This would be a lecture course taught in collaboration by faculty from a variety of disciplines including but not limited to; Art, Design, Architecture, Planning, History, Cultural Anthropology, Sociology, and Philosophy.

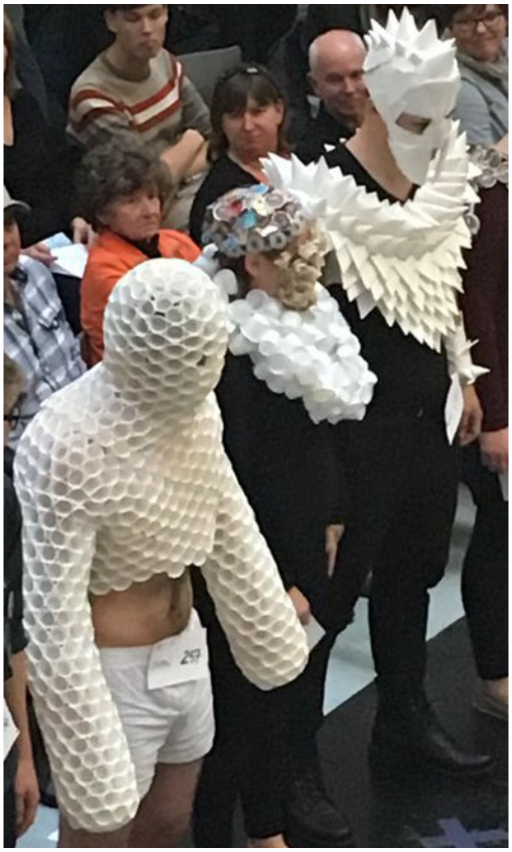


*Fig. 3 DAAP Body Mantle Show*

*Fig.4 Student exhibit*

## Stage Direction

8:00 until 12:00 Monday, Wednesday and Friday; come rain, snow or shine or what you may be, the students can count on that. The hand, the gesture of the arm, the elements of drawing and making; with the eye of looking and seeing within the presents of the self; the art of the presentation. The body in space and the constructed environment of life; a symphony of players who rehearse with time and the cultural of the studio within society as a whole.

Instructed and guided in their journey, the students develop a deep understanding of the presentation of the actual. Focus is placed on teaching critical thinking rather than just researching, regurgitating, and imitating the work of the masters. This question requires that we investigate the text through Beckets voice with a twist of Josef Albers and Donald Judd, a taste of Sol Lewitt, through the lens of Anish Kapoor staged of Robert Wilson (with Martha Graham). The stage is not the vivid scene of the flat screen but the movement of hitting ones light for the mark. Defining foundations historically as the core set of skills required for advanced work within any discipline. It is not just delivering the lines of the text but the passion of the scene and the ability to contextualizing the moment. We argue that any 'foundation' not only includes the skills of making, but critical thinking, seeing, and articulation (writing and other 'text') and that this not only occurs during the freshman year, but needs to be reinforced and experienced throughout their education. Furthermore, this paper takes as a major premise the notion that a foundation in thinking is necessarily symbiotic with a foundation of making.

## Principles

The first-year program(s) also revolves around design constraints which reduce spatial language to its simple vocabulary, iterated for unabridged understanding of the complex, formal language of design. This repetition of making and the subsequent juxtaposition of a number of resultant works, stress design questioning instead of design answers. Within this context, the work takes on multiple forms: the object, the documentation of the object, and the quintessence of process.

*Below are three points of interest revolving around curricular principles for thinking about and teaching the above proposed foundations at DAAP.*

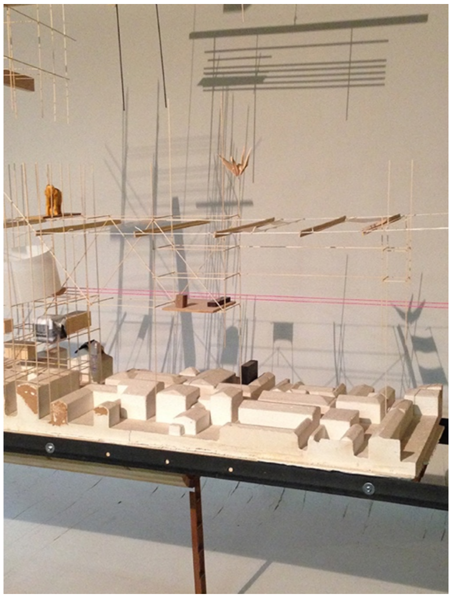


*Fig. 5 Competition Model DPMT7*

*Inquiry Based Teaching - Inquirers vs Disciples*

A disciple simply parrots knowledge and relies on dogmatic thinking to continue to solve the same problem with the same solutions. While this might work in some fields, the DAAP disciplines require inquiry. Inquiry is a description of the dispositions required to explore the world non-dogmatically and foster specific skill sets needed to generate knowledge free from dogmatic constraints. In addition, critical thinking, knowledge of history, and an experimental mindset are the hallmarks of inquirers, making them sought after in the fields found at DAAP.

*Project Based Learning - Posing Questions & Problems*

Project based learning at its heart involves an inquiry-based mindset geared towards solving specific problems with novel solutions. The idea of project-based learning is that students use previous knowledge to generate, collaborate, and combine previous knowledge to form novel solutions to posed problems. In addition, this learning paradigm includes possibilities for students of different learning types to articulate questions and responses to a variety of projects. Given the tasks asked of future DAAP students, and the growing importance of these fields, generating a culture of inquiry via project based learning is essential to creating successful students and sustainable practitioners.

*Research Practices - Knowledge & Dissemination*

A foundations curriculum requires an understanding of what research is and which current research methodologies play key roles in knowledge production, articulation, and dissemination. Typically the production of knowledge occurs in process of undertaking research. However, it is important to push the story of knowledge, which must include its production, its articulation, and its dissemination. Further, we are charged to realize how the articulation of said research and its dissemination complete the knowledge practice. Therefore research methodologies must be explored in foundational education to understand the roots of ideas, how they are described, and how they come to be widely known. A focus on the practice of knowledge, its articulation, and modes of dissemination (including processes of legitimation of research), must be present in the curriculum in order to reveal the system on knowledge that underscores the ways of knowing in the DAAP disciplines.

## Conclusion

The first-year faculty, a merry band of full-time professors, adjuncts, and grad assistants, reject passive, “talk at you,” lecture-style teaching. Rather, on all levels we embrace dynamic practices and kinesthetic engagement. Knowledge is disseminated in a process similar to the solo in free jazz: an improvised style characterized by the absence of set timing or chord patterns. The “lecture,” as improvisational solo, is expressed in the vein of John Coltrane’s performance in *Ascension*, with the sound of Eddie Floyd; while the band, or in our case, the first-year faculty, carries the form of the work.

It is with this that we believe the students are aware of what is good today can be better tomorrow. Simply what we do is inspire, we do not teach design we give the tools to make the world of the mind. This is not a TV sound bite, it is a way of living today and tomorrow.

# Technology as Design Driver: professor and student perspectives on a breakthrough studio project

Meredith Sattler, Christopher Hague | California Polytechnic State University, San Luis Obispo

In the spring quarter of 2015, 2nd year students at Cal Poly SLO participated in a tripartite design/ technology curricular construction intended to facilitate the integration of technical subjects with design process. While each studio took on a different site, program, and method, they were all linked by common technological themes concurrently addressed in the ECS course: 207: Environmental Control Systems for Externally Load Dominated Buildings. To further this integration, their ECS lecture course was linked to studio through a "practice" lab which met in their studio space two times a week for 2 hours, the same days as their ECS lecture. The intent of this practice lab was to facilitate the application of ECS lecture delivered content into the studio members' individual design projects. This paper explicates the development of a breakthrough studio project that occurred within the context of this relationship between the ECS lecture and one studio: IN≅EX: Body_Envelope_Environment which was taught by one of the 207 professors.

IN≅EX was designed to embrace the students' initial exposure to the process of site driven design and the integration of envelope dominated ECS as design drivers through the exploration and articulation of performative boundary conditions. As a means to deepen beginning architectural understandings of relationships between the body's health and comfort, building envelope, and environmental conditions, the studio utilized the construct of matter-energy exchanges to engender multi-scalar systems thinking. The goal was to introduce a design process that engaged relationships and feedbacks between interior forces [such as program, function, thermal comfort, and delight] and exterior forces [such as culture, climate, context, and constructability] through the mediating device of the building skin. Utilizing the notion of a thickened or layered boundary condition [the building envelope reconsidered as a set or series of layers which may expand significantly beyond the typical enclosure, into the adjoining interior and exterior spaces] the intent was to encourage the studio to explore the potentials of program and agency within this zone of micro-climate creation. The Thickened Boundary was conceived as not only a performative trope, but simultaneously a formal one. Careful attention was paid to coordination between ECS content delivery and studio design sequence in order to take full advantage of the studio's study of the applications of thermal comfort, bioclimatic design, thermal transfer, and psychrometrics within the studio members' emerging architectural design process.

This paper is the product of a post-term dialogue between the studio/ ECS professor and one of the members of the studio. It traces and reflects upon the how the tripartite studio/ practice/ ECS lecture construction contributed to the generation of a breakthrough design innovation. In order to preserve this conversation, the paper is intentionally formatted to read as a chronological conversation between the professor and studio member. Factual context generally spans the page, the professor's commentary generally originates from the left, while the studio member's commentary generally originates from the right…

## Entering the Thickened Boundary Condition: IN≅EX: Body_Envelope_Environment

Studio members initiated the quarter with a one hour Boundary Condition exercise that prompted them to define environments on either side of a thickened boundary condition which they designed to mediate/ filter/ exchange those environments. Their prompt read:

_ Create hypothetical interior and exterior conditions:  program/ circulation / phenomenological quality?   [imagination or words only]
_ Identify an exchange of energy and/or matter that occurs between them.  Keep it simple. Possibilities might include things like wind, water, scent, sound, etc.
_ Then charrette a detailed thickened envelope condition that facilitates/ filters the exchange of the energy and/ or matter [identified above] between the inhabitant on the interior side and the external environment.
_ Utilize heavy papers to accomplish this task, paying careful attention to engaging the material's inherent properties to generate and define structure, aperture, and translucency.

*I knew this very open-ended and non-formally driven approach could be a risky way to start a beginning design studio.  It is one of my goals as a studio critic to nurture the individual voice of each designer.  Because of this, I tend to structure the initial conceptual phase of a project exceedingly loosely, while relying on subtle cues to guide the studio members in the direction of the prompt's challenge.  In retrospect I could have more aggressively limited their palette of energy/ matter exchanges to ensure they were choosing exchanges that would have technological design implications.  With a few exceptions, their choices were interesting, and not only provided raw material for ECS exploration, but also began to suggest spatial and programmatic implications.*

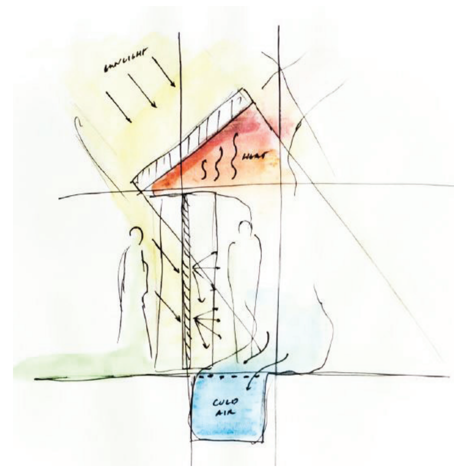



*Fig. 1 Chris's 1st boundary condition focused on comfort.*

Prior to their next iteration, the studio examined precedents focused on coordination between spatial organization and solar shading.  We examined Le Corbusier's brisé soleil and its influence on the organization of the Unité d'Habitation.  We also analyzed Studio MK27's Cobogo House which utilized Erwin Hauer's façade elements to define light and shadow, to create interstitial spaces, and to organize programmatic elements to create microclimates.

Next, studio members iterated their boundary conditions and presented Pecha Kucha style precedent studies on global typologies of performative envelopes, screens, and spaces from ancient to contemporary.  These included:  *brisé soleil, light shelf, lattice, sudare, misu, jali, shīsh, portico, cryptoporticus, arcade, bahama shutters, loggia, veranda, qamarīyah, mushrabīyah, and shoji.*  Multiple and linked aspects of performance were emphasized.  For example, in the case of the *mushrabīyah* the means by which bioclimatic performance influences program and relates to the definition and use public and private space, or the way that the *shoji's* operability facilitates a fine-tuning of thermal comfort and the modulation of framed views over the course of the day.

*My intent here was to further link what may have seemed to many an inordinately abstract or anti-formal design exercise to the performative and formal histories of architecture.  Chris demonstrated that he had already picked up on this relationship in the way that he examined his precedent, The Veranda:  as a device that protects bodies from sun and rain, as circulation and extension of living spaces, and as a critical façade element.  Through Chris's and others production, It was clear that these precedents began to influence the next iteration of their thickened boundary conditions, and increasingly they were looking into incorporating light.*

*As part of the evolution of the idea in the first day of class, a slight shift happened when I started to steer more towards shading and passive heating and cooling through solar gain, and stack/ cross ventilation, and how these envelope the human condition to gain comfort.*

## The Influence of Southern Climates on Strategies for Bioclimatic Design

The first weekend of classes, the studio embarked on field research in Los Angeles and Palm Springs to examine relationships between siting, spatial organization, building performance, and microclimate creation. The bulk of the visits were to mid-century modern structures designed by "The Desert Dozen" which included: Neutra's VDL Studio and Residences, Eames's Case Study House Number 8, the Frey House II, Palm Springs Art Museum and A+D Center, and Palm Spring's City Hall.

*Though it was barely April, Palm Springs was starting to heat up. We got excellent exposure to innovative and passive architectural interventions designed to tame harsh desert conditions. Many were low-tech and focused on mitigating solar gain. Though we hadn't covered solar shading yet in ECS, on site we were able to engage somewhat sophisticated conversations about solar geometry, microclimate creation, and building form. This experienced helped prepare them for their project site's climate of extremes [well, relative to California]: the Carrizo Plain.*

*Frey's shading element at the Palm Springs City Hall was so simple yet worked so well. With modern technology, I could see how it could be developed further to do amazing things.*

Back in studio, site research and whole-building precedent analyses began. Physical light study models of the studio members' boundary conditions were constructed. Simultaneously, group examinations of a variety of approaches to linking spatial organization with the filtration of light included: Kahn's Kimbell Museum, Bruder's Phoenix Central Library, Foster's London City Hall, Prové's Maison Tropicale, and Miralles's Olympic Archery Range. Pairs were then assigned precedents to analyze for relationships between bioclimatic design and spatial organization. Chris's team examined Renzo Piano's Menil Collection.

*By now, in ECS and practice the studio was gaining familiarity with climate responsive architectures, thermal comfort, and psychrometrics, so our conversations about the performative aspects of their boundary conditions were becoming more sophisticated.*

*Chris's boundary began to take shape as one clearly influenced by his precedent, Renzo Piano's Menil Collection. Quickly our conversations turned to the question of the utility of a glass box in a desert environment.*

*Different from my previous studios, Professor Sattler stressed using precedents through the divergence from specific fruitions but rather emphasized utilizing the knowledge of their technologies and solutions.*

*We revisited the question several times. Each time Chris was convinced he could design to mitigate the intense greenhouse effect he understood he was generating. Given his determination, demonstrated work ethic, intelligence, and seeming lack of concern about the possibility of failure, I was curious to see how this would play out.*

*I became fascinated by the idea the frailty of a glass box full of program, and now the question became: How can I ecologically protect it with an exoskeleton or thickened boundary condition in a harsh real world environment. The first answer came in the form of a thick dual layer glazing system [using an air plenum as insulation] topped with large louvers angled toward the north to let as much soft light in as possible, but in section they were aligned to omit every angle of the suns path year round.*

*As Chris is critiquing the Menil Collection ceiling package based on his understanding of thermal performance, I suggested that he examine Piano's subsequent solution next door, the Cy Twombly Gallery. This appears to provide a means to move forward for Chris. I am surprised by how earnestly the students are responding to the precedent studies given that typically there is not significant use of them at Cal Poly.*

*This became a multi-week endeavor as a critique on the layering of the Menil Collection ceiling assembly where the shading is on the interior, causing exces solar gain and unintended greenhouse effect. The Menil created inspirational daylighting but had problems with the order of the ceiling glass and shading fins. When Professor Sattler steered me toward the Cy Twombly Gallery, I thought "Renzo Piano critiqued himself and improved the design." It was very eye-opening to see an established architect "correcting" his own work, and it gave me permission to do the same. This further reinforced my strive towards the utility of my glass box and shades.*

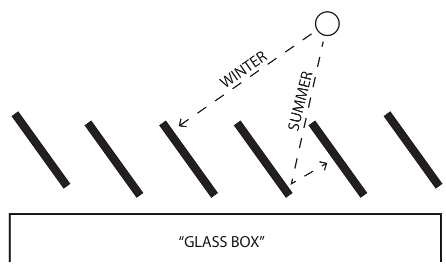



*Fig. 2 Macro-louvers shading the aforementioned "glass box", yet creating maximum northern exposure.*

## The Site at Carrizo Plain: Environment of Extremes

The second weekend of classes, the studio embarked on field research to their site in the Carrizo Plain of Central California. It is one of the last areas in the state that still contains native grassland (albeit only about 20 percent of the natives have endured the onslaught of invasives) and is one of the harsher climates in California. It has relentless winds, an average diurnal temperature swing of over 40 degrees in the summer, and some of the most intense solar radiation in the nation. Recently it has become ground zero for solar harvesting as PV Ranches have resurfaced a significant portion of the plain. The area has been desiccating since the dust bowl when water intense agricultural practices modified the fragile ecosystem, and today is sparsely habitated. A bright white dry salt lakebed is visible south of the site and the San Andreas Fault lies to the east.

The prompt called for the design of a 14,000 sq. ft. Native California Grasslands Research Institute with labs, greenhouses, residences for researchers, and a public education center. Utilizing bioclimatic design principles, the institute was to maximize views to the salt lakebed and surrounding hills and maximize indoor/ outdoor microclimate creation while accomplishing appropriate solar control for each of its program types.

*The studio members were somewhat shocked by the scale and desolation of the plain and clearly felt the site was a let down. We transported the light study models out there to test them under the specific quality of light. It was so windy we couldn't manage taking photographs. It was a bit of a reality check for everyone despite the fact that the extreme climate of the place made for very interesting analysis utilizing their newly minted bioclimatic comfort charts.*

*My model performed as expected, it kept the "glass box full of program" completely in shade, thus never allowing an intentional build-up of radiant heat within the envelope. In addition, the space had an incredible amount of exposure to the northern sky dome, creating a space filled with soft cool light throughout the annual and diurnal shifts.*

*At the time I was content, although I did not understand yet that I would need to utilize solar gain in the winter.*

At this point, as the studio members began developing their building proposals in earnest the studio began operating less as a unit and more as a crit space to work through each members' individual design. In ECS, solar geometry and shading masks were introduced; they had a significant effect on quantitative aspects of the developing relationships between programmatic organization and thickened boundary conditions. The first major review which focused on conceptual design, occurred at the end of week 4.

*While many of the studio members are struggling with space planning, Chris is iterating spatial organizations in relationship to program, circulation, and daylighting without issue. That said, he is clearly underperforming in terms of integrating his solar shading fin strategy and appears to be struggling, but his confidence doesn't seem shaken, nor does he seem paralyzed. I give him space and time to work things through, and he arrives at the review with a solid, and well represented, but somewhat uninspired proposal. He has experimented with representational strategies which integrate ECS ideas in section which is encouraging.*

*At this point I understood the solar geometry, but solar masks for climate and comfort (introduced in ECS) were a brand new topic that made me re-evaluate the way I was thinking about shading and comfort. I realized that my building should capture solar gain in the winter because Carrizo Plain temperatures fell much below the comfort level of 68 degrees Fahrenheit. I realized that my design didn't yet perform around thermal comfort and thus, could not succeed in the comprehensive way that was intended.*

## The Study of Daylighting: Quantitative and Qualitative Methods Merge

At this point, the studio members are iterating and refining their conceptual building proposals and translating them into measured and line weighted technical drawings that simultaneously communicate materiality and organization. The studio takes a time-out from quantitative boundary condition exploration to dedicate a significant portion of time to redlining drawings. The second major review, focused on their iterated concept as expressed through measured drawings, occurred at the end of week 6.

*Working through the language of line weight and nomenclature, the studio is struggling to develop proposals that communicate strong positions about the relationships between thickened boundary condition, skin, tectonic, spatial organization, and building performance. As a group we revisit examples of formal ordering systems successfully deployed in master works of architecture and discuss strategies for communicating them graphically. It is sophisticated material for 2nd year undergraduate architecture students, but essential. For the majority of them light bulbs are illuminating, albeit dimly.*

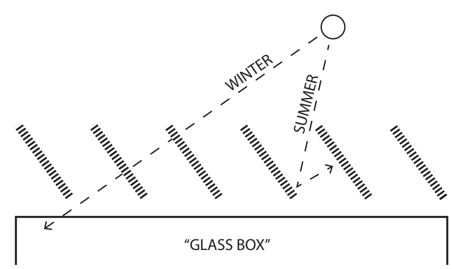



*Fig. 3 Aggregated louvers shade the "glass box" in summer, but allow intentional solar gain in winter.*

*Chris is continuing to struggle with his shading strategy. He has broken his large louver/ fins into smaller units which is helping his strategy formally, but it is accomplishing little in terms of shifting performance. He is caught between the scalelessness of solar shading and the scale dependent nature of cladding systems.*

*I redesigned the macro-louvers to be comprised of small louvers placed closely together to block summer sun angles, yet allow the low winter sun in. This adherence to conventional methods was creating frustration; everything*

*Once again, he arrives at the review with a solid, and well represented, but somewhat uninspired proposal. I sense increasing frustration, but am uncertain as to how to assist.*

*outside of the plane of the sectional cut cannot be qualified. The resulting design suffered at angles of azimuth that were not represent in the section cut plane, blocking necessary light ingress in the morning and evening year-round.*

With 4 weeks left before the final review the studio is dropping in scale to return to iteration of the thickened boundary condition at detail scale. In ECS daylighting is covered, which provides additional information about the more qualitative aspects of natural lighting while simultaneously providing quantitative tools for its analysis. The studio endeavored to, once again, study the thickened boundary conditions through models, but this time the modeling was digitally driven. Studio members had choices between utilizing grasshopper's plug-in Heliotrope, Sefaira, or Diva for Rhino.

*In order to transition the studio from site/ building scale back into detail scale, I gave a presentation that examined the development of Renzo Piano's solar shading device for the Nasher Sculpture Center. We examined his patent drawings in detail in order to unpack his strategy for leveraging the 3-D geometry of the skydome to shape his miniature, and very elegant, cupped shading hoods.*

*After seeing that Renzo Piano took the solar geometry into its native construct of the third dimension, but realizing the design was solely focused on light ingress, and void of climatic response and thermal comfort, I posed the question: How can I design three dimensionally in response to specific climate and thermal comfort?*

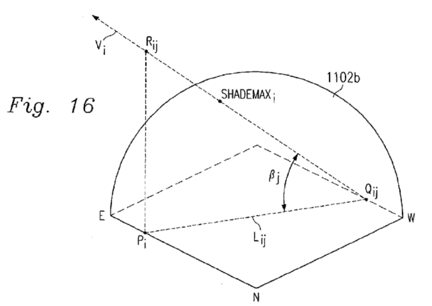



*Fig. 4 Renzo Piano Nasher Patent Drawing of solar geometry in relationship to skydome "hood", Fig. 16.*[1]

*I looked at two-dimensional sun-path diagrams for my site, and created a solar mask that highlighted not when shade was needed, but rather when solar gain was necessary. To construct this three dimensionally, I first had to reverse engineer the sun path diagram back into the third dimension. After an embarrassingly long afternoon, I created three-point arcs from sunrise to solar noon to sunset for each month. The result was seven circles that fell on the same axis that had a tilt equal to the latitude. Then dividing those seven circles into 24 even increments resulted in: the elevation, azimuth, time of day, and time of year of the entire sun path in one three dimensional construction of a graduated sky-dome. Hybridizing the solar ingress mask with the 3-dimensional plot resulted in a surface that related the sun to climate to thermal comfort at the site.*

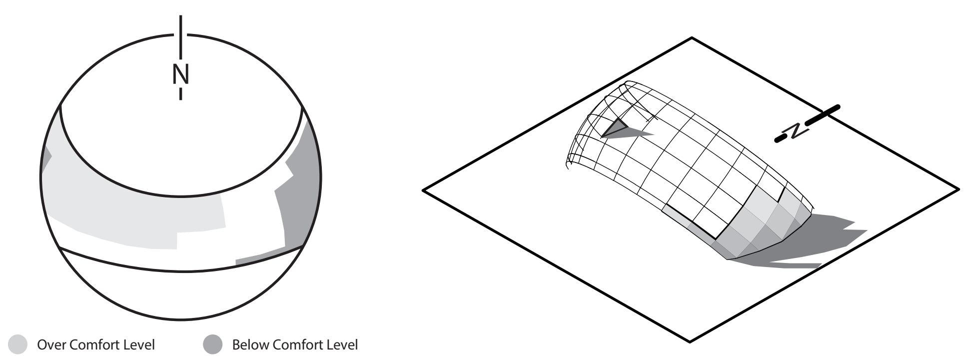



*Fig. 5 2D shading mask versus the 3D shading mask.*

*While I am not at all convinced that Piano's innovation lead directly to Chris's solar shading breakthrough, from a timing perspective, the events did occur in proximity to one another.*

*What was truly astonishing to witness was the speed and sophistication with which Chris's solar shading device emerged. When Chris showed me his design during desk crits, I was floored. I also knew that he had to create a visual that communicated how he came up with the design. We spoke a little bit about possible diagramming approaches and two days later he produced the following, which furthered his thinking about how to scale the device through efficient use of standardized sheet material in mass production.*

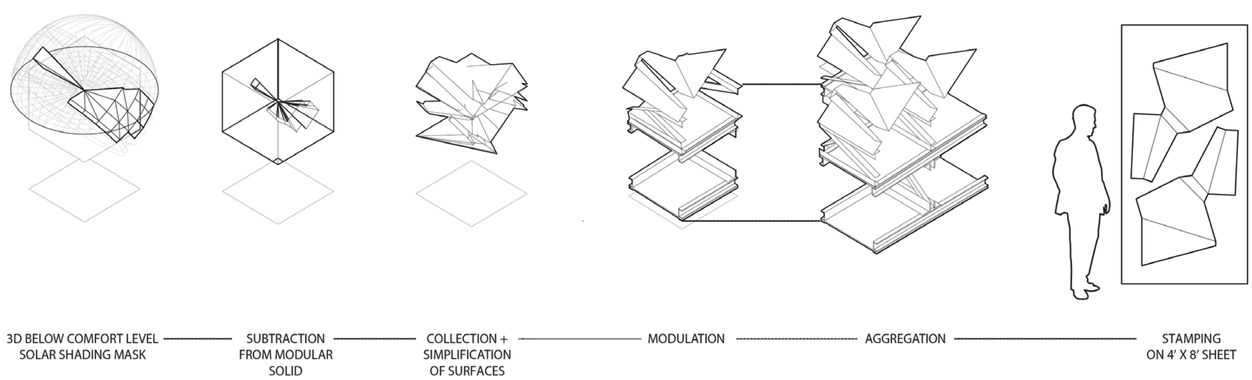



*Fig. 6 Design flow from three dimensional mask to final unfolded shading module.*

## The Top of the Stretch

Three weeks before the final review the studio is working to bring all scales of the project together into a final proposal that demonstrates its performance through impeccably line weighted technical drawings, visualizations of physical and digital daylight modeling, and sections/ perspectives that demonstrate relationships between body, envelope, and environment.

*It is a tall order, and there's a frantic energy in the studio. All members are working hard on the challenge, and most are gaining significant headway.*

*Formal design is an area in which I struggle. I chose to undertake a significant redesign because of frustration and dissatisfaction with form/ organization.*

*Two and a half weeks before the final review date, Chris announces that he is going to start over on the design of his project. Of course, I sternly cautioned him against it. That said, I knew I had little ability to influence his decision.*

*2.5 weeks before the final. I had my shading elements and building technologies, but I didn't have an organization that I was satisfied with. In response, I hunkered down at my desktop and cranked out my final design with an eye focused on the final review, and representing the complexity of what I'd come up with.*

*I also felt his confidence and keen awareness of the risk he was about to undertake.*

*He did have a point: his current building design did not leverage the power inherent in his shading device to drive its spatial and programmatic organization. He had demonstrated that his way of working required additional time and space, so I gave my blessing, and he took it. Nonetheless, he was running out of time…*

And then Chris disappeared.

*As many of us have experienced, there are often significant surprises awaiting us on the wall at final reviews. Chris's project was no exception.*

*We were lucky that the jury that afternoon was comprised of versatile professors capable of critting both beginning design projects in constructive manners, bioclimatic design, and sophisticated theoretical projects.*

*Chris's project not only resolved a stunningly elegant and sophisticated solar shading device, but also formulated a sectionally driven building around it that had theoretical implications that he perhaps couldn't yet see. We had a refreshingly advanced conversation at a second year review that day.*

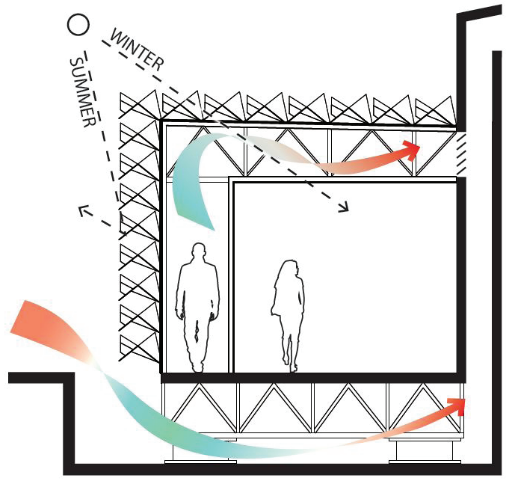



*Fig. 7 Shading and energy exchange through seismic pan, occupied space, plenum, vertical stack and shading elements.*

*Throughout the quarter I had been influenced by how Renzo Piano integrated systems together, a sum of pieces. Exposure to precedents got the wheels turning, showing trains of thought used to solve problems.*

*In conclusion, the project came together as a whole that became greater than the sum of its parts; a comprehensive condition that became a nexus of energies. Although the energies/ spaces were connected, and mutually influential, yet separated. Going forward, architecture is a convergence of a multitude of systems, thus more study is needed into their integration.*

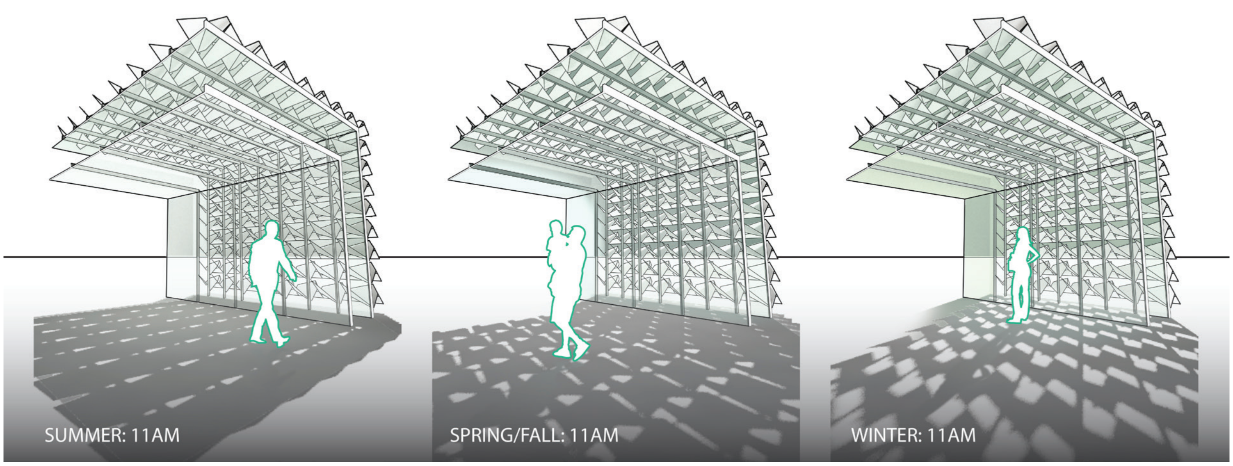



*Fig. 8 Shading assembly study at 11AM from left to rigth: summer, spring/fall, winter*

## The Boundary Condition as Anti-Boundary

*As beginning design instructors, we have all had this rare, and dare I say mystical experience, of watching a student breakthrough to the other side of a challenging concept or problem. For me, it is endlessly fascinating and mysterious when it occurs. This paper is an intimate attempt to study the phenomenon in more detail.*

Chris's "breakthrough" behavior resembles a pattern currently being discussed in higher education circles related to *Threshold Concepts.* "Threshold concepts are pivotal but challenging concepts in disciplinary understanding. They act like gateways. Once through the gate, learners come to a new level of understanding central to the discipline."[2] It appears that somewhere in the linkages between the technical knowledges of solar geometry, thermal transfer, human comfort, and daylighting, exposure to Renzo Piano's design thinking regarding solar control, and Chris's own fearlessness and drive to solve an inherently 3-dimensional problem from within a 3-dimensional construct, Chris blew through a disciplinary gateway in a radical way. It is difficult (perhaps impossible) to predict where or when a student will take this on, but in Chris's case it appears that deep curiosity, willingness to take risks, and a significant amount of loosely pressured time and space were critical ingredients. As a professor it is, of course, the goal to assist as many students as possible achieve such radical breakthroughs, but as this case suggests, it won't always happen through more standard, and even improved, "teaching" practices. In Chris's case, trusting that the best way to "teach" was to set up the problem space, walk away, then provided critical support, but only when needed. It's a delicate and nuanced mode of working which can be problematic within the context of a larger group of students, but critically important nonetheless.

These moments force us, as educators, to question how we actualize our roles and assume responsibilities. It is a tricky and delicate task to develop a course that acts as a container for a multitude of intelligences, skills, and design capabilities. And trickier still to establish mechanisms such as grading rubrics, attendance policies, and expectations that are not only appropriate, but facilitate the highest level of actualization possible, across the gamut that is the board. But ultimately, it is perhaps the trickiest thing of all to teach respect for the rules, and simultaneous respect for when it is the most appropriate response to break them. Perhaps this is the ultimate beginning design lesson.

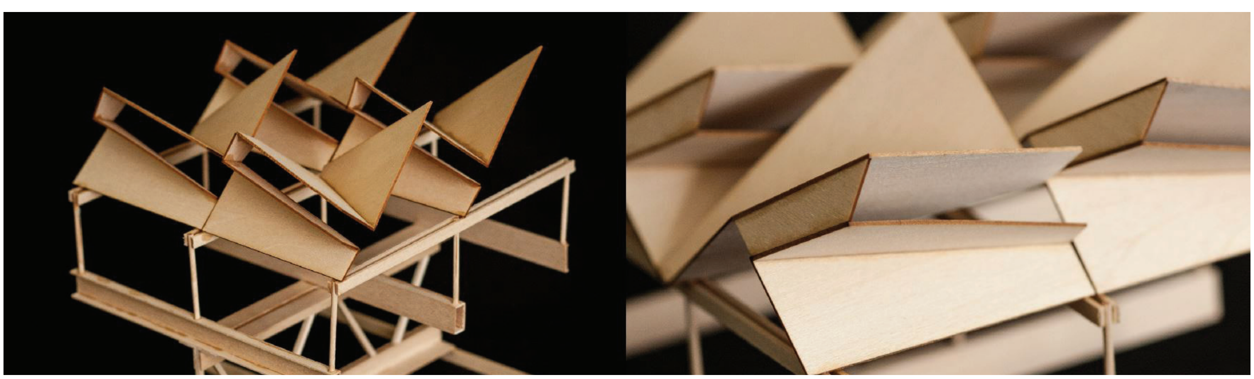


*Fig. 9 Shading assembly final model, scale: 1-1/2 in. = 1 ft.*

## Acknowledgements

The authors gratefully acknowledge the support of the Cal Poly San Luis Obispo College of Architecture and Environmental Design, and the Department of Architecture. The authors wish to thank Professor Margaret Pedone and Anne-Elise Chung. This paper was presented at the 2016 NCBDS 32 Conference. The contribution of the current and previous NCBDS conference organizers and committees is hereby gratefully acknowledged.

## Notes

[1] *Piano, Renzo, Duncan Campbell, and Alistair Guthrie. "Light transmission system and method for buildings." U.S. Patent 7,222,461, issued May 29, 2007.*

[2] *David Perkins, "Constructivism and Troublesome Knowledge," in Overcoming Barriers to Student Understanding: Threshold Concepts and Troublesome Knowledge, ed. Jan H. F. Meyer and Ray Land. (London and New York: Routledge, 2006), 43.*

# Significant Social Aspects of Learning in Making 1:1 Constructions in Beginning Design

Stephen Temple | University of Texas at San Antonio

## Introduction

This paper describes a first semester beginning design experience that utilizes collaborative design and construction of full-scale 1:1 environments as the culmination of a succession of full-scale projects made of actual (non-representational) materials. This follows a pedagogical principle that making decisions in a social context about materials, tools, and construction in direct relation between abstract design conceptualizations and the progressive tasks and decisions of making that concretely transform these ideas can best construct ground for design thinking at the beginning of design education. In making this claim, *Constructionist* learning theory will be compounded by *Constructivist* learning tenants for social interaction as a root factor in learning and the personal transformations that underlie fundamental 1:1 design learning experiences. Also explained are best methods of team formation and the instructor's role in fostering projects for 1:1 constructions for design education that is exploratory and increasingly self-directed.

## Concrete to Abstract in Beginning Design Learning

Design can be characterized as thinking about what is being made prior to engagement in making it, analogous to the way a recipe differs from using it cooking. Relations between thinking and making are fundamental to relations between the abstract and the concrete. However, the correlation between abstract ideas and concreteness of experience is not a 1:1 relationship. Given that designers of the built environment conceptualize and develop what is in the end made concretely tangible, it is reasonable that first year pedagogy should introduce and cultivate interactions between the abstract and the concrete as a first step toward identifying and actualizing their essential, enduring aspects within learning architectural design processes. I contend that modeling beginning design pedagogy to better enable development of relationships between abstract and concrete processes can more holistically define transformative actions between these factors. 1:1 design learning experiences that correlate the abstraction of thought with the concreteness of making will recognize their transformational interdependence as a sound foundation for development of design processes.

Initial design learning experiences are especially paradigmatic for beginning designers. Many design educators consider thinking the first step in design learning experiences and in so doing appeal to conceptual thought as the primary means of designing. Conceptual thought is a form of abstracting that is distanced from our actual embodied experience[1]. Many beginning design programs emphasize projects that are framed as abstract learning experiences that limit or obscure direct experience in the world. Conceptual thinking, visual thinking, analysis, precedent research, diagramming, and even representational drawing are fragmented from the world we experience as we live it. This abstract lack of groundedness in experience causes students to become uncomfortable with their own learning. Because it is their first design experience, working by way of abstraction can too easily become misconstrued as a methodologically template for design. Learning abstraction may be necessary to design but only as part of the larger, more encompassing structure of learning design.

Educator, Robert Leamnson defines learning as "stabilizing, though repeated use, certain and desirable synapses in the brain," that, to become established, require "experience and sensory interaction with the environment that promotes and stabilizes neural connections."[2] According to Leamnson, neural formation that accompanies learning takes time to form and will degenerate if not established through repeated testing of mental representations against the reality of direct experiences until one's thinking, or brain pathways, have been altered due to experience. Learning in this way forms fundamental queries that are personally transforming and can form a fundamental basis for inquiry over an education and career. Effective foundational design studio learning experiences are those that stimulate and challenge beyond current behavior patterns while also connecting to mental life (thoughts, ideas, dreams, and consciousness) and at the same time realizing external consequences within a larger, tangible world. This involves testing design ideas and actions against the mental life and consciousness of others, that is, within a shared social context.

## Making as Beginning to Design

If the process of abstraction is defined as moving away from the world in transformative stages, reversing this process reveals a pedagogical structure that can more concretely retain connectedness of abstractions to the concrete. Making things is an educational design activity that enables a re-orientation of abstract thinking to the world. Making is an activity that engages the whole individual learner by directly engaging them in manipulating materials while continually and simultaneously engaging the mind. In making things, the concrete experience of physical qualities of materials becomes a primary contact upon which processes of abstraction can be grounded. A maker's generalized concept of the object being made emerges from an understanding of what is done with materials, especially in consideration of a project's physical, social, and moral context as it is materialized in physical form. Forms of thought involved in the act of making things emerge as a relationship between thinking and acting. Making actualizes "thought in action and thought about action" within a "process of discovery of what it is that one is making in the process of making it."[3]

*Constructionism* is a developmental learning theory that supports the building of abstract "knowledge structures through progressive internalization of actions."[4] Constructionist learners making objects come into engaged relationship with them and the knowledge needed for their construction, causing an increased likelihood that abstracted knowledge will become affixed to the concrete. By constructing concrete objects in the world external to them, students become compelled to make explicit decisions about how to connect different fragments of their knowledge. Basic questions are raised about the relationship of knowledge to action, as manifest in transformations and iterations of the material project being constructed. Makers must investigate how one piece of knowledge connects with another and which are most basic. Makers must also determine which pieces of knowledge are significant enough to incorporate into the construction and which can be reliably omitted. This cycle of self-directed learning is an iterative process by which learners invent and develop for themselves the tools and representations that best afford the explorations of greatest concern to them. Making things as a process always engages opportunities to self-correct from experience by making approximations through continual adjustment of mental representations within a process of trial and reflection that feeds on the concrete adjustments of material. Making depends on complex interactivity with abstract mental directives as direct knowledge in experience develops with no mediating interface with representations outside the mind. Tasks involved in operations of making situate the contingencies of the qualities and resistances inherent in material substances with respect to constant judgment of what is being done in terms of intentions, what the outcome will be, and what will work and not work as possible design outcomes. Conceptualized purposefulness is formed in the actualization of the work within its immediate, situated context in the actual world. Constructionism, or learning through making, encourages externalization of knowledge by viewing an object being made as a distinct *other* with which we come into meaningful relationship, rather than an artistic expression.[5] This is especially important for beginning designers to learn, due in part to the tendency toward the naive view that design ideas are sudden and brilliant inspirations. Actualizing ideas by constructing them in the world makes them tangible and shareable which, consequently, shapes and refines these ideas in communication with others.

Engagement in making always causes students to engage in and reflect on relationships of process as basic to design activities - to formulate for themselves basic structures of process. Fundamental to early development of design processes is the direct experience of the transformational nature of direct engagement. Beginning design experiences engaged directly with materials enable design work to be performed as ground for curiosity, inquiries, and abstract thinking. Importantly, making as a pedagogy is always a full summation of design activities, as making exercises engage design work from conception to full-scale construction of an actual object that can be judged for what it is, rather than what it merely represents. Making necessarily engages students in developmental processes in the planning and production of iterations. This alleviates student propensities to delay progressive developmental efforts in favor of last minute production that lacks adequate consideration.

## Constructivist Learning

Constructionist learning theory addresses well the 1:1 relationship of a maker to the thing being made but only obliquely addresses the educational context of design studio with multiple learners. When multiple learners are simultaneously engaged in making there is a dynamic of learning magnified by social interaction. *Constructivist* learning theory begins with the educational theories of Lev Vygotsky, who stated that social interaction has a key role in the development of knowledge. Simply stated, individuals attain knowledge beyond their own efforts when they realize what they can achieve with help from others partially because interaction with others causes a realization of what they are unable to do on their own.[6]

*Constructivist* learning theory extends Vygotsky's social perspective when learners construct new knowledge or concepts built upon previous knowledge. This is an active process where learners build their own cognitive structures that allow for selection and transformation of information, conceptualization, and decision making. The meaning of on-going trials and experiences is weighed against ever-developing cognitive structures and emerging measures and criteria related to that structure.[7] In a social context, the interacting cognitive structures of multiple learners (or team members) working toward an emerging common direction can attain conceptual directions and meaning beyond that of an individual alone, given the same starting point. In a Constructivist context, a group of multiple learners develop a focused agenda in the tangible, material world of the object of their design. Large 1:1 scale projects are of the size and complexity that causes them to be collaborative and even public. 1:1 scale projects allow for critical dialog between learners to be focused on physical trials that result in decision making with concrete results that can then become the subject of clear, non-hypothetical debate. Collaborative contact with others while engaged in 1:1 making invariably leads to encounters with those with greater abilities on tasks and differing or better understandings. In the give-and-take of directly engaged, iterative design decision making, learners through dialog and experimentation, will invent, innovate, and develop for themselves the tools and thoughts that best afford the explorations and connections of greatest concern.

1:1 projects produce circumstances in which the many conditions of the learning situation will become of self-determined in a reconstitution of student consciousness. This creates a pedagogy that becomes self-directed and measured in a *collaborative conversation* with objects, materials, processes, and finally, experience. In this context, an instructors role becomes reduced to the social construction of teams and setting design problem parameters in a manner containing variables that can be clearly grasped by the learner groups but not so complex as to seem unresolvable. The variability of actual materials and relations between sets of materials must be investigated through trials so that constrains can be discovered. An instructors role will structure these trials and interact with groups through the entire process in an active (Socratic) dialog to effect guidance through questions about direction of group decision making and raising of issues for further development. This takes form in mediating group decision making most often by answering questions with more questions but in a way that focuses rather than dissipates directions the group is already pursuing.

### 1:1 Full-Scale Project

This paper will elaborate a case study project in first semester beginning design courses in the Architecture program at the author's University. The project culminates a semester of 1:1 projects that move from the scale of the hand to body to room. The full scale project is designed and built full-scale of teams formed of students from different course sections to build community through finding common ground as they strategize, conceptualize, experiment, and build an 1:1 scale architectural construct, making design decisions about actual materials, selection, joinery, sizes, and actual experience.

#### *Constructing Teams*

Since student teams consist of one student from each of four course sections, students in each team rarely know one another at the beginning of the project and each has experienced the curriculum from a slightly different perspective. Course sections are taught by a different faculty member, each of whom varies the course content according to a differing focus while addressing all issues of each project. Some focus on the construction of inquiry while other focus on materiality and still others focus on workmanship. Placing them into teams facilitates dialog about differences in learning experiences and gives each team a more critical perspective from the start.

Mechanisms of group selection ensure compatible grouping without resorting to profiling due to personality or prior accomplishment. The first criteria for group selection is gender mixing. Groups are balanced according to gender to the extent possible. Groups of a single gender are not permitted because they readily develop a culture of decision making responsive only to a male or female culture. Gender balancing keeps design ideas from becoming gender based, avoids differentiation of any one group solely due to gender, and fosters intermixing of ideas that may originate within gender biases. Mixed gender groups also tend to reduce internal competitiveness among the members.

*Fig. 1 Passage project – Occupancy in action during final review*

A second criterion for group selection is ensuring that each group has at least one member with prior experience with tool use of making in some form. This is due to poor experiences with previous projects performed by groups without such a member. A group solely comprised of members with no making experience has difficulties performing actions on materials. Many factors are involved in this problem, none the least of which is reluctance to engage against the seemingly daunting notion that full-scale construction has to be accomplished correctly or painstaking efforts and materials are lost. Working in full scale, in actual materials risks failure, and this feeling can paralyze an entire group faced with limited materials. Just one member with prior experience can address the risk of failing workmanship on materials because this member tends to lead the others within this phase. This member knows that failure is a matter of degree because it has been previously encountered, and this bit of experience can set the others at ease just enough to proceed.

The third, and most important, criterion for forming student groups is to construct a balance on each team of students who are extroverted versus those that are introverted. Students are asked, after a brief description, to self-identify these traits. Extroverted students are those whose personalities are outgoing and socially confident, who will readily approach another person socially, and freely and ambitiously communicate their thoughts and feelings. A student with the traits of an introvert can be defined in terms of a personality that is withdrawn, inward looking, and comfortable being alone. Extroverted personalities seek social engagement while introverts seem cautious about social engagement. It has been my experience that students grouped for the purposes of working together on a design project operate best when there is a balance extroverts and introverts. Groups with an imbalance toward extroverts seem to have an overabundance of those wishing to lead the group, have difficulty agreeing on a common conceptual direction, and cannot quiet the desire to rush to action. Groups with an imbalance toward introverts seem to have difficulty finding leadership in the group, have difficulty raising issues of a conceptual direction, and are slow to action. In a group that has balance, these traits become complementary.

*Project Description*

The project statement directs students "*to design/build a passage" with* materials limited to wood lattice strips, with binding material and sheer fabric of their choice. Glue and external mechanical connections were forbidden. Each group of four students was assigned a six foot square site arranged into one complete space. Basic human activities are identified from experience, and defined, resulting in a list of occupancy names such as "a place of meeting; a place of prospect; a place of contemplation; a place for waiting; a place for the sky"; etc. Each team was assigned to 28 different teams of four students. An exploratory exercise to design/construct a panel containing fabric raised the potential of the given materials. This gave rise to detail. Each group was then challenged to find common ground as they conceptualized, experimented, strategize, and built architectural support for the given form of occupancy. (Figure 1)

Passage is both a place of human transformation and a threshold between places. It is a place for the human body that sustains and defines space in the abstractness of *being inside* and alters perception of both space and the perception of oneself in relation to it. Theorist

Yoshinobu Ashihara believes a “key explanation for the great diversity in basic perceptions of space lies in the nature of the boundary that distinguishes internal from external space.”[8] This design project’s premise is that if this boundary condition can be experienced first hand, as a test of design intentions, a fundamental lesson linking architectural design and human experience will be had.

## Beginning Encounters

The full-scale 1:1 project is founded in a pedagogy in which students become engaged through the direct experience of their own collective design efforts in an actual construct, enabling discovery of an interactive and operational agency between concrete making and abstract thinking, between direct experience at both the level of individual and within the social engagement of everyday experience. In full-scale making, design processes are transformed by production and experimentation and social discourse that is reflective, critical, observational. Direct contact with materials requires heuristic investigations that foster discovery of a material’s workable properties in relation to design intentions. Modes of conceptualization and experimentation are implicit in the efforts of working with materials to complete the projects.[9] Workmanship is a constant measure of intentions as a fundamental category of design.[10] The category of workmanship, so directly experienced in the making of a project, often facilitates the opening of critical discussion because it is readily distinguishable in project comparison.

It is an enlightening moment when projects are assembled and experienced. Walking in and out of the actual projects makes evident not only design processes, but enables discovery of the fundamental nature of their own bodies in space as measures of design intentions and concepts, and as a relation to the connecting boundary between individual architecture experience and shared experience of place. Design issues proposed abstractly through the conjecture of drawing and model forms, when measured against the full engagement of the experience of the body in space, results in new measures of both architectural experience and of the quasi-predictive nature of representations used in design thinking. As an analogy to actual buildings, common relationships between people and architecture become evident at the level of individual experience. Also evi dent is that individual experience is shared, and the mechanism of that communication is architecture. Architecture is dialog that happens at the level of the body that in turn informs the collective.

*Fig. 2 Use single column images when possible*

*Fig. 3  Full scale Passage project installed*

## Conclusion

Large 1:1 scale exercises enable a pedagogy of direct inquiries and decision-making that result in students building their own understandings, knowledge structures, and meaningful connections in the context of social experience as a root factor in learning and cognitive development and the consciousness that underlies personal transformation. 1:1 projects ground architectural design education in actual human experience and establish fundamental relationships on which a rigorous architectural educational can be constructed. A pedagogy of experiential learning modeled on transformational interdependence between making and thinking realizes relations between concrete and abstract processes as a primary relationship. Structuring design activities through engagement in concrete experience establishes ground for both the complex abstractions of design learning and the holistic human experience of buildings. Initial design education learning experiences, when they are framed as deep fundamental queries of the experiencing embodied, socially interactive beings, are especially paradigmatic for beginning design students because they are personally transforming. 1:1 projects challenge established individual student behavior patterns by realizing individual intentions in the real world, first at the level of the individual's own hand, and then by testing design within a larger, tangible world of the intentions and experiences of others.

## Notes

1. Lakoff, George, and Johnson, Mark, *Philosophy in the Flesh: The Embodied Mind and Its Challenge to Western Thought,* Basic Books, New York, 1999., xi.

2. Leamnson, Robert. *Thinking about Teaching and Learning: Developing Habits of Learning with First Year College and University Students.* Stylus Publishing, LLC 1999, 5.

3. Harrison, Andrew. *Making and Thinking: A Study of Intelligent Activities.* Indianapolis: Hackett Publishing Co. 1978, 33.

4. Harel, Idit. and Papert, Seymour (Editors). *Constructionism.* Norwood: Ablex Publishing Corp., 1993, 1

5. Harel and Papert, 1993.

6. Vygotsky, Lev Semyonovich. *Thought and Language.* Cambridge, MA: MIT Press. 1962. Vygotsky, Lev Semyonovich. *Mind in Society.* Cambridge, MA: Harvard University Press. 1978.

7. Bruner, Jerome. *Toward a Theory of Instruction.* Cambridge, MA: Harvard University Press. 1966. Bruner, Jerome. *Acts of Meaning.* Cambridge, MA: Harvard University Press. 1990.

8. Ashihara, Yoshinobu. *The Aesthetic Townscape,* MIT Press, Cambridge, Mass, 1983.

9. William carpenter builds a strong argument for the activity of making as having a transformative purposiveness that is clearly situated between society and the individual. Carpenter, William J., *Learning By Building,* Van Nostrand, New York, 1997.

10. Pye, David, *The Nature and Art of Workmanship,* Cambium Press, Great Britain, 1995. Also, McCullogh, Malcolm., *Abstracting Craft: The Practiced Digital Hand,* MIT Press, Cambridge, Massachusetts, 1996. Workmanship is evaluated formally as fifty percent of each project.

# History, Language, Drawing, and Synthesis (HoLDS): A Methodology for Implementing Concepts in the Design Process

Stephanie Travis,Catherine Anderson | The George Washington University

## Introduction

Beginning architecture and interior design students frequently misunderstand the identification and application of concepts, which are elusive due to the fact that they can only be "seen" under the scrutiny of analysis. In an introductory history of architecture course, students typically struggle to effectively employ a concept to advance the design of a studio project. Even when a concept is applied in the latter scenario, it is somewhat difficult for students to understand not only why concepts are used, but also how to recognize them in an existing context.

Engaging the student in a visual, creative way that provides cognizance about the ideas and concepts of architecture is a three-pronged approach that, when integrated, helps them to develop a strong foundation in history, a basic design vocabulary (as seen in Francis Ching's *Architecture Form, Space, & Order*), and drawing. Studio courses act as a sort of laboratory to implement and explore concepts and their development in design projects. This paper describes and illustrates a methodology—the HoLDS Method (**H**istory, **L**anguage, **D**rawing, and **S**ynthesis)—for professors to adapt in their curricula to introduce these concepts to students.

### *History*

History of architecture courses typically use slides, videos, short films, and readings to educate students. Required texts that accompany class sessions enforce and expand on information from the lectures. While this paper focuses on a History of *Modern* Architecture course (typically the second course in a two-semester sequence), the importance of pre-modern history of architecture is not to be understated. There are a number of excellent books on the history of modern architecture, such as *Modern Architecture since 1900* by William J.R. Curtis, *Modern Architecture* by Alan Colquhoun, and *Modern Architecture: A Critical History* by Kenneth Frampton, to name a few. These books focus on the context of modern architecture within society, politics, and technology. Author Curtis states, "Modern architecture has emerged against a setting of major social and technological transformations; it has registered a gradual shift from rural to urban existence in the industrializing world."[1] While this aspect is necessary for the architectural historian and academic, the beginning architecture student is lost within this advanced context. The vast historical references are not yet known, and the student cannot often connect or make sense of the text.

Thus, the beginning design student would benefit from a deeper investigation into the architectural *concepts* and *language* of the buildings. Books relevant to a beginning design student include *Understanding Architecture* by Robert McCarter and Julian Pallasmaa, which take the student through a building using a floor plan, clearly marked views, and color photographs, with "the premise that architecture cannot be evaluated or understood without our experience of it"[2]. *The Elements of Modern Architecture: Understanding Contemporary Buildings* uses sketches and diagrams to tell a visual story of each building. While these books provide a highly visual narrative and conceptual analysis—unlike traditional history texts—basic lectures and readings alone do not allow the students to create their *own* analysis. "Making an analysis of this kind is like designing, indeed, it involves designing an analysis. It is a creative act in itself. Like designing, it is a reflective process in which processes of investigations, proposing, and testing take place in a cycle that leads to increasing understanding and confidence."[3] At its core, the history of architecture course(s) for the beginning design student should be about understanding architectural *concepts* as they apply to buildings of all scales and type.

It is this imperative knowledge that can inform a designer of solutions that were previously explored and that could be used today—in a different manner. But the lessons in history become much richer, meaningful, and memorable when the analysis of a building's concept is not only presented verbally and visually through photos, but also through creative analysis such as diagramming. Students at the George Washington University (GWU) investigate significant and iconic buildings through this process, first by examining the site plan, floor plans, elevations, sections, and photographs to apply architectural concepts, and then by using visual images to explain the main ideas used in the buildings (Figs. 1-2). Analysis through exercises that use diagramming to study concepts allow students to derive and visually explain their own conclusions with a more active-learning, hands-on approach. With guidance provided by the instructor and a well-curated list of buildings to study, the beginning designers are given an opportunity to extract their analysis while developing skills to graphically communicate their findings. Multiple iterations and transference of various ideas while viewing a structure in plan, as well as section and elevation, can provide a more comprehensive understanding of “seeing” architecture (rather than just “looking”).

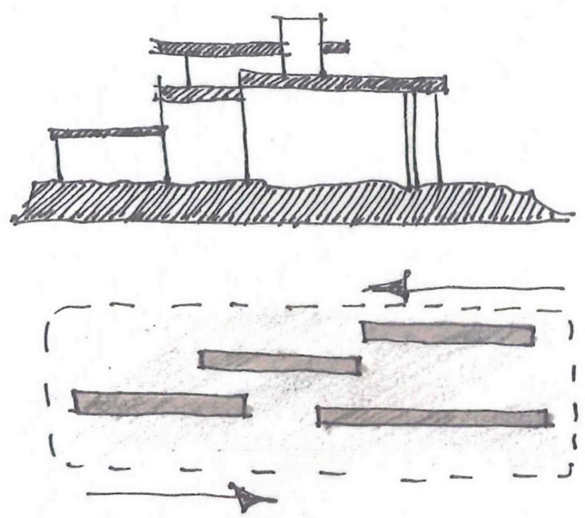


*Fig. 1 A student's analysis of Richard Neutra's Kaufmann House indicates the use of horizontality as an underlying concept, which is then graphically represented.*

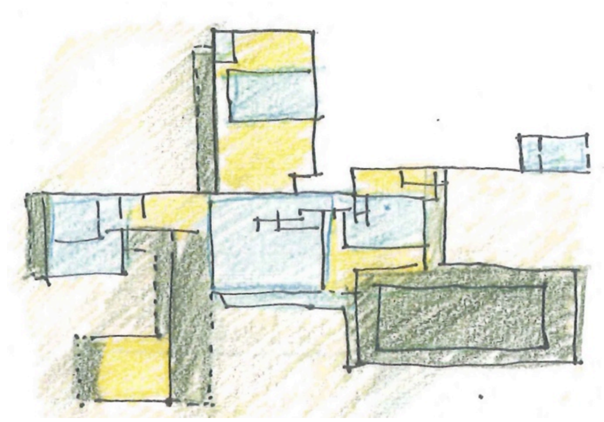


*Fig. 2 The student uses color blocking to emphasize overlapping forms in Kaufman House, further investigating the forms through boundaries and connections.*

In summary, History of Architecture courses for the beginning design student that focus on visual, hands-on learning that incorporate architectural concepts through visual explanation and communication are beneficial to students in their design studies, specifically within their studio work. This is evident when viewing student work, particularly the capstone or thesis project in their final semester.

*Language*

When studying any language, many fundamentals must be learned prior to forming sentences that convey meaning. Similarly, the jargon of architecture and design needs to be taught before students can explain and describe not only their own projects, but also their own analysis and observations when speaking about others' works as well. “The analogy between architecture and language can be helpful in understanding what it is to do architecture. In using language we take words (vocabulary), compose them according to particular arrangements (syntax) into ‘sentences’, and hopefully convey messages (meaning) to others. Something similar happens in doing architecture: the basic architectural elements (wall, roof, doorway, etc.)…constitute the equivalent of vocabulary…”.[4] In order to convey design intent, one must first understand the vocabulary so that the language of design is spoken and applied correctly.

At the start of the first-semester studio, students diagram words (such as hierarchy, transformation, disruption, balance) as a single visual (Fig. 3). The initial step requires them to use books such as Ching's *Architecture: Form, Space & Order* or Unwin's *Analysing Architecture* to define the words. Through desk crits, students draw diagrams to communicate the intent of the word; abstraction is a must, since literal pictures, the use of words, and symbols are not permitted. The purpose of this exercise is threefold: First, students begin to comprehend the vocabulary words that are commonly used in any discourse related to architecture. Some words are familiar but they have rarely been analyzed in the framework of design or to the extent that they are scrutinized. Second, as students present their projects throughout the semester, they begin to speak critically and thoughtfully about their design intentions (as well as others) by utilizing these vocabulary words. Lastly, the task of creating a drawing or diagram from an idea, word, or concept on paper is an extremely difficult and elusive function for the beginning design student. Conveying the intent of one word into a single image challenges students to think graphically (vs. letting an oral explanation suffice); to draw with purpose (vs. doodling); and to connect deeply with the word in a design sense (vs. having a colloquial understanding).

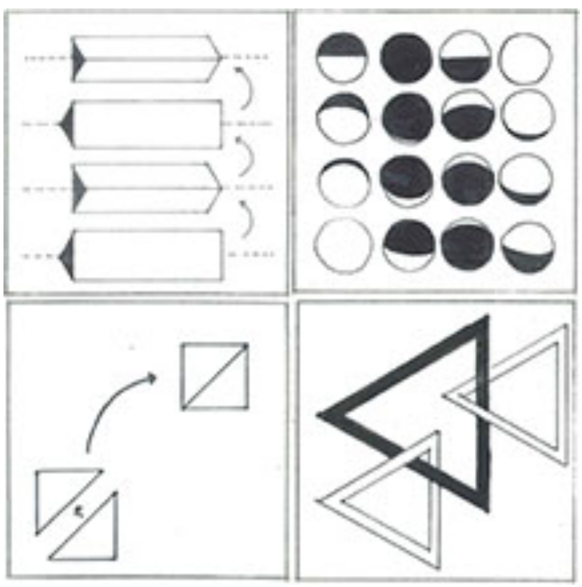


*Fig. 3 Diagrams by students representing "vocabulary"; clockwise from top left: rotation, sequence, interlocked, addition.*

Another assignment asks students to identify examples in the built environment of the vocabulary words that were introduced in the project as described above. It is important to determine and analyze design strategies that surround the students and to start understanding how designers and architects use these concepts to convey meaning. GWU students are encouraged to use buildings within the city of Washington DC (specifically, structures along the National Mall), since ascertaining the vocabulary words or designs are meant to be experienced rather than merely observed. Selecting three words from a list (such as axis, scale, symmetry), the project requires a sketch and a diagram of these words as seen in architecture, interior design, landscape architecture, or even some large-scale sculpture. Seeing three-dimensional forms that express the vocabulary helps to reinforce the notion that design is driven by intent or, more specifically, concepts. This exercise encourages students to become aware and to begin to analyze what they see rather than merely looking.

### *Drawing*

Courses such as sketching and architectural drawing are imperative in continuing to enforce architectural concepts and ideas. This paper focuses on the use of hand drawing to understand design concepts, although it could be argued that computer technology is also a valid drawing tool. Students at GWU experience a *mostly* analog first semester (the exception is a graphics course that introduces and emphasizes the principles of composition and design presentation, more than the computer programs themselves). Digital Drafting and Modeling is taught in the second semester, and uses tools such as AutoCAD, Revit, and Rhino to build upon the students' sketching/drawing foundation.

The beginning drawing course typically has the student investigating and then representing furniture, interiors, and architecture in two- and three-dimensions, by hand. "To draw an object, interior, or building, you have to look at the subject in a new way. You are forced to pause and scrutinize, as drawing requires another way of thinking, shifting into a deeper realm that encompasses elements such as shape, form, texture, rhythm, composition, and light." [5] The understanding of these elements is crucial to becoming a strong designer. Drawing courses that emphasize the process of *seeing*, rather than the end result, instill a valuable attribute in the designer's education. Drawing courses push the student to look deeper, to represent what they see in many forms (both two-dimensionally and three-dimensionally) and to use many materials (pencils of varied thicknesses, pens of different widths, charcoal sticks, watercolors, etc.). Students at GWU use sketching to draw and understand iconic buildings as well as the spaces they inhabit on a daily basis (Figs. 4-5).

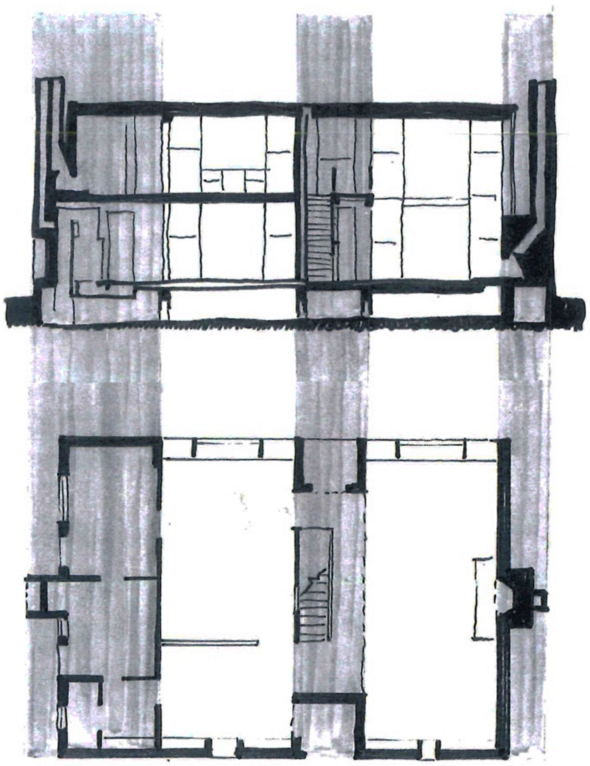


*Fig. 4 A student represents Louis Kahn's concept of served/servant spaces with a sketch that expresses the organization of Esherick House through drawing techniques such as shading, poche, and line-work.*

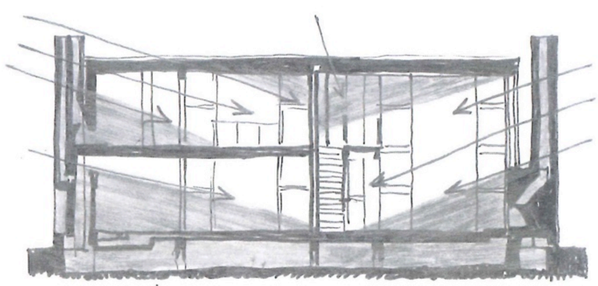


*Fig. 5 Further investigation of Esherick House indicates light sources as the dominant element in creating a powerful interior; the student represents this through a section using pencil shading to provide contrast.*

As students become successful at drawing what they see, not what they *think* they see, sketching exercises should move beyond representation—such as peeling back the layers of a building and representing them individually, or showing a building at hourly increments so that the shadows change as the sun rises and sets. Examining and recording negative/positive space, multiple viewpoints, and the expressive qualities of a building—as well as how concepts such as movement, geometry, repetition, and hierarchy can be represented through drawing—are all exercises that will not only give students a deeper understanding about what a concept actually is, but also teach them how to apply these concepts to their own projects.

Working in conjunction with the history course(s), these drawing skills allow students to analyze historic buildings through the creative process. Furthermore, these skills will translate into the design studio (to be further discussed in depth in Synthesis). Drawing is not just about communication—it is about learning to see as a designer. Emphasizing drawing within the beginning curriculum will encourage in-depth study of the built environment and the expression of concept analysis, ultimately resulting in innovative, creative designers who can define and illustrate design concepts in objects, interiors, and architecture that they see, study, *and* design.

### *Synthesis*

When students apply learned strategies and lessons (as mentioned above) to their own designs in studio courses, synthesis evolves and leads to the development of a concept results. Nowhere is this more critical than during the students' capstone projects, completed during their last semester. By this time, they have been through this design process many times. While the duration, breadth, and depth of this project is longer, wider, and deeper than anything they have encountered previously, the unique aspect of this studio is that they are formulating their *own* project, schedule, and deliverables. With this complete autonomy and few parameters, it can be a bit disconcerting for the design student. "If you have total freedom, then you are in trouble. It's much better when you have some obligation, some discipline, some rules. When you have no rules, then you start to build your own rules." [6] How are these rules and guidelines formed or invented? The concept enables the designer to make decisions regarding any and all aspects of a design by questioning each "move" to see if it supports the overarching idea. Establishing this operative system or a framework to develop, critique, and set priorities is the driving force of a concept.

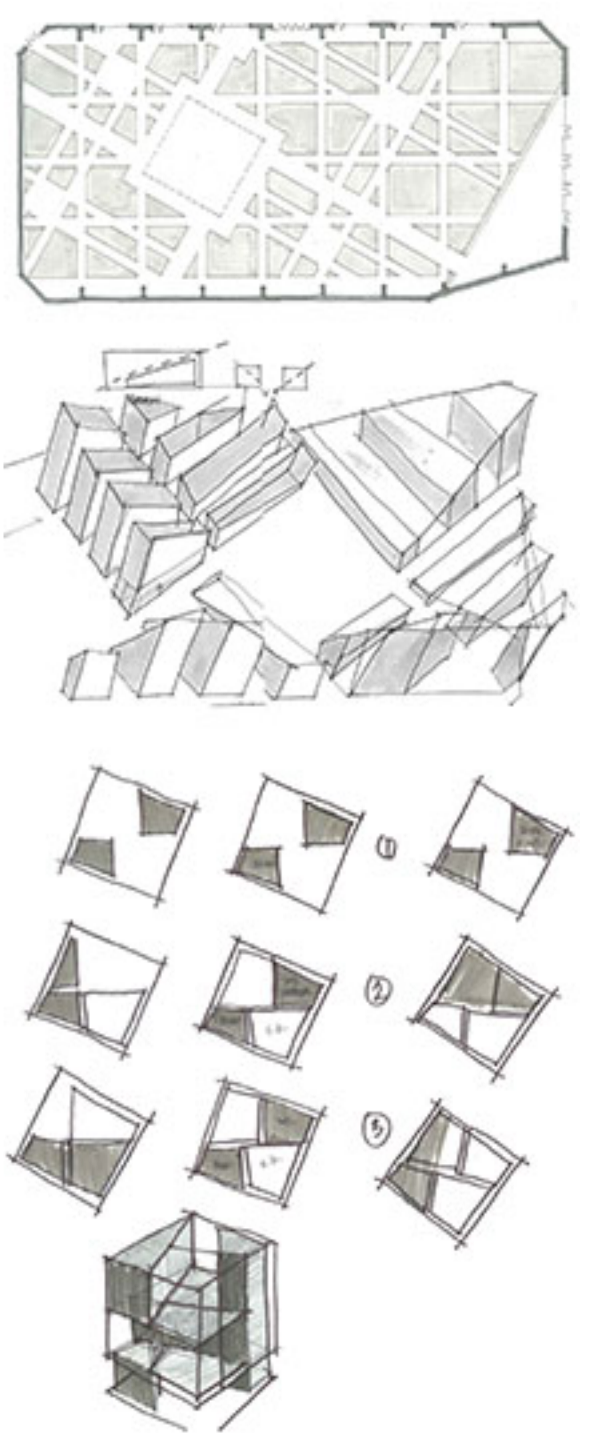


*Fig. 6 Concept development generated from studying the layout of Washington DC (top diagram) as well as analysis of a "hub" that forms connections.*

Inspiration to derive a position or stance towards the design can be found by studying *history* (precedent studies); investigating *language* by transforming vocabulary words (such as overlap, shift, carve) into simple volumes and forms; and translating objects or metaphors into *drawings* that capture spaces or evoke a mood. By synthesizing these various approaches, students have more alternatives at their disposal to explore and foster the evolution of an innovative concept that inspires and shapes their own studio work.

## Notes

[1] Curtis, William J.R. *Modern Architecture Since 1900*. Phaidon Press Limited: London. 2012. p 13.

[2] McCarter, Robert and Juhani Pallasmaa. *Understanding Architecture.* Phaidon Press Limited: London. 2010. p 5.

[3] Radford, Antony, Selen Morkoc and Amit Srivastava. *The Elements of Modern Architecture: Understanding Contemporary Buildings*. Thames & Hudson Limited: London. 2014. p 12-14.

[4] Unwin, Simon. *Analysing Architecture*. Routledge: New York, NY. 1997. p 34.

[5] Travis, Stephanie. *Sketching for Architecture + Interior Design*. Laurence King Inc.: London. 2015. p 6.

[6] Piano, Renzo. Quote from http://www.ilikearchitecture.net/tag/renzo-piano/

## References:

Ching, Francis D. K. *Architecture: Form, Space & Order*. John Wiley & Sons Inc.: Hoboken, NJ. 2015.

Colquhoun, Alan. *Modern Architecture*. Oxford University Press: London. 2002.

Unwin, Simon. *Twenty Buildings Every Architect Should Understand*. Routledge: New York, NY. 2010.

## Figures:

Fig. 1-2. Mackie, Anna. The George Washington University, 2012.

Fig. 3. Fall, Natou. The George Washington University, 2014.

Fig. 4-5. Carlson, Iryna. The George Washington University, 2013.

Fig. 6. Hicks, Jenn. The George Washington University, 2014.

# All Hands on Deck: Instructors as Collaborators and the Modified Dynamics of Design Build Instruction

Rob Whitehead, Carl Rogers | Iowa State University

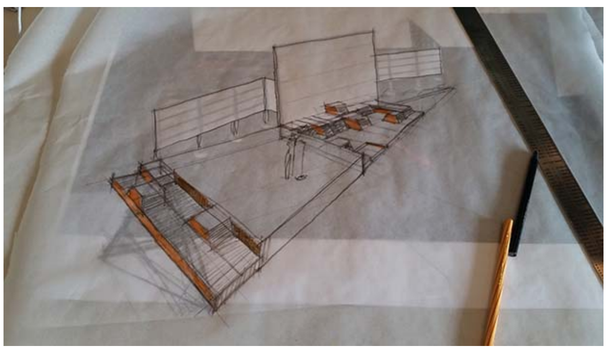


*Figure 1: Perspective Drawing of Stage Platform-concept design*

## Building Parameters:

In beginning architectural education, design-build studios offer uniquely challenging, but beneficial, learning opportunities. Because of the elevated expectation that the studio activities will conclude with an occupied environment designed and built primarily by students, students and instructors have to bear new responsibilities and apply a broader range of skills towards the project. These new responsibilities require responsive pedagogical adjustments.

This paper will discuss several intentional shifts in the teacher/student relationship that were implemented by the authors (an architect/professor and a landscape architect/professor) during a recently completed design-build project for graduate-level beginning architecture students at Iowa State University. The project, an outdoor performance platform and seating deck created for a local non-profit community arts social club, was programmatically simple but had restrictive project conditions (e.g., a tight budget, a compressed schedule, and challenging site conditions) that made it a complicated endeavor (Fig. 1).

As might be expected, very few students had any professional design or construction experience before the course began. Their inexperience, coupled with the project conditions and elevated expectations for their impending responsibilities were a source of initial apprehension and timidity in some. Certain students erroneously assumed that their relative inexperience, compared to the instructors, would (or should) limit their participation in the project to that of an implementer or laborer. These sorts of concerns are common before a design-build course begins, but if they are left unchallenged, it can have an adverse effect on student engagement and learning.

To counteract those concerns, we made certain changes to the traditional studio environment and activities to better reflect the collaborative, productive, and effective learning environment that we desired. Specifically in our interactions with students we shifted certain traditional teacher/student roles towards a more collaborative learning environment based on shared goals and cooperative activities. The paper will show examples of these moments throughout the scope of the project and how these changes positively impacted student learning and project delivery.

## Design Build & Curricular Motivations:

A review of contemporary design-build surveys in architecture and engineering programs suggests that design-build is a relatively common pedagogical practice that is adopted for many reasons by different academic programs (Gaber, 2014). Although most design-build courses generally attempt to demystify the construction process and to link student design activities to a physical outcome, there is no universal pedagogical motivation. Each program, or course, typically develops a pedagogical emphasis that is extracted from the inherent limits of the different project circumstances. Or alternatively, these motivations influence the internal processes by which the different projects are set-up and the courses are taught (Canizaro, 2012).

At Iowa State, the primary motivation for including a required design build project at the end of the first year of a graduate-level architectural education was based on the simple idea that beginning students could learn more effective ways of designing and documenting projects if they spent time building one. For the last 11 years, the modest budgets ($2,000-$5,000), compressed schedule (8 weeks of a part-time summer studio), and small class size (8-16 students typically) have limited our projects to highly refined, small, and simple projects with a relatively conventional range of materials and assembly strategies—primarily for supportive public institutions. time has passed, a pedagogical purpose has emerged from these constraints that now resonates throughout their curriculum. “Building” isn’t taught as a means to an end, but as a central skill that could be applied to other design problems. Simply put, design-build doesn’t just produce a project, it teaches a process.

## Design/Build/Test & Repeat

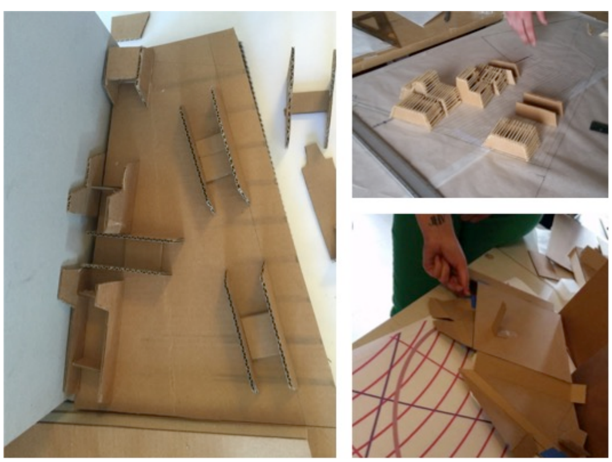


*Fig. 2 Different study models were developed to explore the shape of the stage and the layout of the benches.*

At this stage in their education, many of these beginning design students are simply not prepared for the elevated challenges of design-build coursework, and they require a modified pedagogy that acknowledges this. In addition, the skill level of each student varies from students who have worked construction to students who have not lifted a hammer or cut a piece of wood. They all share a common value that the design process can empower them to learn the value of building to realize ideas. If design-build instructors don’t teach specific skills that incorporate “building” as a central part of the design process, research shows that students are more likely to become disengaged with the design process, limit their participation in course activities for fear of failure, quickly defer to other perceived figures of authority for decision-making, and ultimately compartmentalize themselves in a limited role as simply an implementer (Sheppard, Jenison, 2012).

To improve student learning, increase engagement, and develop critical skills during the studio, the authors/instructors felt that it was important to establish several pedagogical policies before the class started that would be implemented and applied to instructors and students alike. We knew that the haptic-learning activities that teach design-build skills have also been shown to motivate student learning and improve retention and understanding of physical behaviors of structures (Inshook, 2011). Not surprisingly, we would encourage them to learn by building. We decided to create a framework of required classroom activities that taught the design / build / test (DBT) method; a tested method that utilizes student’s ability to ideate, fabricate, and evaluate their work (Elger, 2000). From the first exercises onwards, we would encourage our students to use multimodal tools to continually build, test, and assess their work at increasing scales of refinement to improve their ideas (Fig. 2). By the time the final construction process occurred, it could be presented as a simple extension and refinement of the skills and processes they’d been practicing already. Instructors would be able to participate in this design process as needed but as collaborators and not primary authors of the design.

Because students would ideally have several built iterations of their work available for review, we hypothesized that we would be able to have a more complete means of assessing their work in ways that are different than a traditional studio. We wanted to make sure that everyone involved with the project would have a voice—not just the instructors, so we would establish a “show me, don’t tell me” policy, born out of the collaborative practice model experience of both professors.

If an idea was proposed collectively by anyone, it could be evaluated openly and honestly without fear of retribution or penalty. However, anyone criticizing the idea (a teacher or a student) must be willing to propose an alternative. We felt that incorporating critical evaluation skills into the DBT process allows for honest and productive exchange of ideas, and as a result, assessment would become a central part of the studio culture. We knew that in practice that we'd be criticizing the work of students, the work of each other as instructors, and that we'd have to be open to student criticism of any work we propose to the group. This would shift the perception of our traditional roles as instructors, but we felt that it was an important concession to the collaborative design environment we desired. Unfortunately, it wasn't the most time-productive decision as we soon learned once the project began.

## Open-Ended Beginnings:

Our first main challenge was finding, and defining, a project scope that fit with the course constraints and matched our curricular goals. As part of his work with the Community Design Lab at ISU, Professor Rogers had worked with a local non-profit, the Des Moines Social Club (DMSC), on the re-design of an exterior parking lot that was to be converted into an outdoor performance venue and gathering space. In anticipation of outdoor performance events, the client had already built three large skewed concrete walls in the corner of the courtyard and wanted to add a permanent stage in front of the walls to complete the project. The client was open to the idea that the final project could include additional projects proposed by the Community Design Lab project such as seating, shelters, outdoor display areas, and/or community garden spaces.

Because we wanted to create a collaborative design environment, we felt it was important to include students in the initial design stages of problem definition. We presented the stage as the primary project goal but invited students to speculate about how other additional project components could be integrated into the work. To help define this scope, on the first day, students were asked to find provocative examples of similar outdoor environments or elements. Although this decision was a catalyst for some helpful initial research, we soon found that the scope's open-ended nature was a problem because we simply couldn't make any immediate progress. Instead of building consensus around a refined proposal, this exercise actually expanded our options.

After a week of work, the student proposals were mostly sprawling collages of precedent-inspired elements. We realized that students simply didn't have the professional experience or perspective necessary to see how these design decisions also had ramifications on their classroom activities. For the good of the class, we exercised our authority and decided, even among some dissention, that the final project scope would simply be an uncovered stage and seating platform. Interestingly, exercising this authority didn't seem to harm our role as collaborators but instead provided the necessary voice of authority and professional guidance that was needed in the studio. Some students already felt a sense of uncertainty about their activities before the class began and so they all seemed to appreciate the certainty that came along with this decision because they could move past the traditional studio exercises they had been doing towards more design-build specific explorations. It was a reminder that we could be collaborators without being peers.

### *Finding Resources for Larger Scale Explorations:*

The three existing concrete walls that were to serve as the background to the stage and seating had a peculiar orientation in the courtyard and to each-other and there wasn't a clear solution as to where the elements would be placed within this context. Students realized that defining the final size, materials, placement and use of the project left many open-ended questions that they could explore. As the scale of project shifted towards these more refined design questions, the students again returned to their precedent studies as a source for additional information about materials and assemblies. They were now looking at these projects not for inspiration but information that could be used to translate their design ideas into more tangible proposals.

Student-directed research may seem like an unremarkable process, but it is a very critical component to cultivate in a design-build studio because it puts the student, not the instructor, in charge of finding and incorporating critical information into the project. It is natural to have students look towards instructors as their central resource for information because of their relative expertise, experience, and role in the classroom. If the instructors become the primary source for answering questions, the students will be less likely to explore for answers themselves.

Certainly instructors should provide mentoring and reactive feedback when issues are brought to them. However, the instructor also needs to know not to become the primary source for information or answer, when not to interfere, and how to resist the urge to over-teach (Malmqvist, 2004). The danger in having instructors provide too much information is that students will stop searching, stop learning, become disengaged and become implementers not collaborators. The most productive way for design build instructors to suggest ways of working together is to join the design effort as a team member to develop drawings, models, full-scale prototyping, etc., direct students towards primary sources of information (resource books, consultation with engineers), and at certain points simply join in the construction process.

*Fig. 3 Instructor and students testing out seating arrangements on the full-scale mock-up taped on the floor outside studio.*

## Instructors as Active Collaborators & Provocateurs:

As the project developed we frequently provided "just in time learning" instruction about how certain tasks could be completed if their initial efforts were unsuccessful (e.g., "frame it this way, try this material," etc.). Promoting self-discovery and collaborating doesn't mean abdicating the responsibility to also provide instruction. Design is collaborative effort involving participants with various skill levels and finding different resources to test and improve your project (peer to peer feedback, feedback from engineers, or even from instructors) is an important part of the process. But it's still their project design. We regularly drew with them, built with them, critiqued each-other, and became active participants in the process—particularly when the project was at a critical stage of development. However, we didn't want to be the authors of the design. They needed coaches and editors and we happily filled that role. Our "show me, don't tell me" process allowed for our contributions to be placed alongside student-produced work and received public criticism. Sometimes, our combined expertise as instructors was just what the project needed.

At one critical moment half-way through the course, student progress was somewhat stalled—the DBT process seemed stagnated with conventional plans and sections that seemed more concern with technical acumen than occupation or experience. The students didn't seem to understand the scale and arrangements of the elements that they'd proposed or the potential consequences for how it would be used. We reminded ourselves that we were there to teach them a process of design. From experience we knew that confronting the design at 1:1 scale is an experiment best performed during design and not after construction, so we took a tape measure and several rolls of tape to an open floor area outside of their studio and created a full scale mock-up in plan. We grabbed remnants of old boxes and nearby chairs to use as stand-ins for our proposed seating.

We used the design dimensions and layouts proposed by the students (warts and all), and upon completion, called the students out for our most important "show me" moment (Fig. 3) Students assessed the project not as an abstract image, but as an occupied space—walking on and sitting "in" the parameters. This activity ignited the studio activities and conversation. Within moments we had made major adjustments in the scale and geometry of the project (it was too big, they felt), reduced the number of proposed benches, and they developed a new idea for the geometry and use of the benches designs that was previously un-explored. Within 12 hours, two bench prototypes were built, a 3D framing plan was drawn, and the first realistic budget was produced. The concerns about starting construction quickly faded to enthusiasm for the process and the proposed design. This was so effective, that for the remaining week before moving on-site, we frequently returned to the space and populated it with actual prototypes. Seeing the stage footprint in a space at full scale encouraged students to occupy it and assess it for its size, height, edge detail, seating height and other physical design attributes. This skill of 1:1 proved valuable as overall design questions materialized about when the stage was not being used as a performance platform. They realized that with the right bench design and configuration, users could sit in multiple seating configurations and interact with each-other (and the stage) in ways that dramatically improved the project and created a unique project aesthetic.

## On-Site Experts & Confident Conclusions:

By the time the crew arrived on site, different students had gravitated towards "ownership" of certain parts of the project: final dimensions and layout, structural framing, perimeter benches, decking, and seating. Because they had collaborated together throughout the process in an open way, there was a good deal of trust established between everyone. As instructors, we continued to reinforce this trust by modeling the desired behavior. For example, on the first days on site, Prof. Whitehead, who has years of experience in construction, asked the small group of students in charge of layout and framing to lead the initial efforts—the site was strangely sloped in two-directions and the student's guidance helped us level the platform relatively easily (Fig. 4). We grabbed our tools and worked alongside the students, consistently asked them "what's next?"

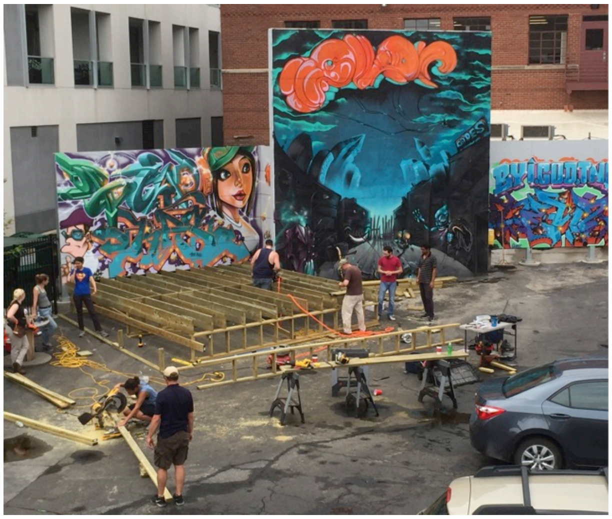


*Fig. 4 Student led construction effort for deck framing.*

*Fig. 5: Because of the skewed geometry of the deck and back walls, the detail for the deck edging was worked out in the field.*

This process repeated itself over-and-over in the next two weeks of construction as several components of the design needed to be adjusted in the field due to unforeseen site circumstances (Fig. 5). At each time, the students would immediately suggest alternative solutions—the "show me" method frequently meant immediate alterations to the final project. Although we maintained quality and safety standards, the construction process demonstrated to students that they had a real agency in critical decision making about design, project management, and construction. The students managed the tools, the material deliveries, the distribution of labor, and kept a close enough eye on the construction management that we finished under budget and on time (Fig. 6).

We continued to work alongside the students every day on the site, modeling a work ethic and enthusiasm, and providing guidance for how things should be built smartly and safely (Fig. 7). Few students needed nudging to participate fully—the greater challenge was asking the students with the highest level of construction competency to allow less experienced peers to take over.

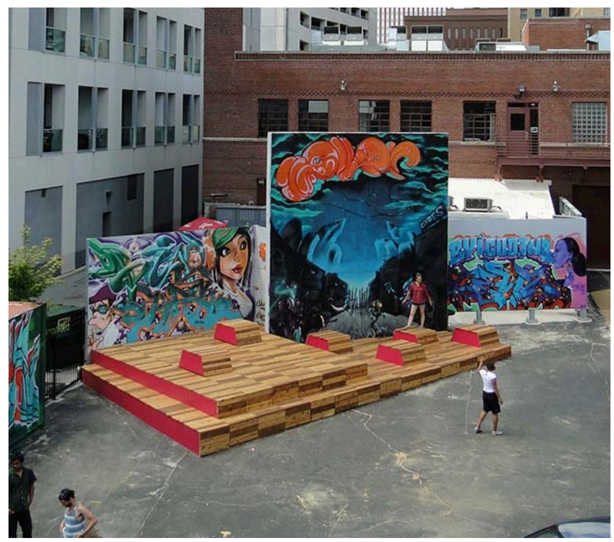


*Fig. 6 Final Performance Stage from rooftop terrace.*

***Building Culture:***

Ultimately, we found that the experiences and interactions we went through on-site were accurate reflections of the process we had taught off-site; specifically the collaborative and iterative efforts to design, build, test, and improve our work. By continually participating in collaborative design processes and consensus building along-side their instructors throughout the process, students developed more confidence in their ability to generate ideas and make decisions when they received the support of their teachers and peers. Ultimately when the work shifted onto the site, students had developed a collective expertise about the project that enabled them to continue to make design decisions in the field and to assign construction tasks to everyone—including the instructors.

But along the way, this required specific adjustments in the pedagogical process and the student/teacher relationship. Instructors needed to maintain dual complimentary roles as experienced critics ultimately in charge of protecting the project interests, and as a senior-level project collaborator that offers drawings, ideas, encouragement, and sweat equity of labor in support of the project. Because the instructors intentionally pulled away from providing all the answers and resources they needed to develop the project, the students learned more—despite their inexperience and the elevated expectations.

Now that the project is complete, several students have visited the project and seen it in use (during a community yoga event, concerts, or simply just a lunch crowd)—they've reported positive feedback, as have the clients (Fig. 8). But the legacy of the project hopefully also exists within their memory as a formative educational experience that they will return to during many of their subsequent projects. We hope that through this experience they not only emerge as stronger designers, but they learn how to be good collaborators, leaders, and instructors within their practice—willing to shift their roles and responsibilities as needed.

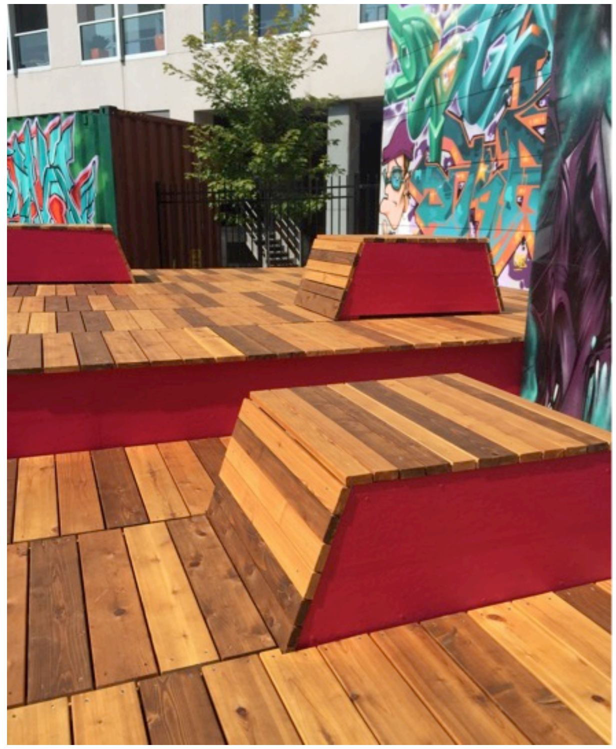


*Fig. 7 View of bench seating from the platform. Benches on the stage are moveable. The staggered deck boards were a consequence of the deck edge detail and provided a welcome variation in the deck pattern.*

*Fig. 8 Students testing out the versatility of potential functions of the final benches.*

## Notes

[1] Malmqvist, J., Young, P., Hallstrom, S., Kuttenkeuler, T., and Svensson, T. "Lessons Learned From Design Build Test Based Project Courses." International Design Conference, Design 2004.

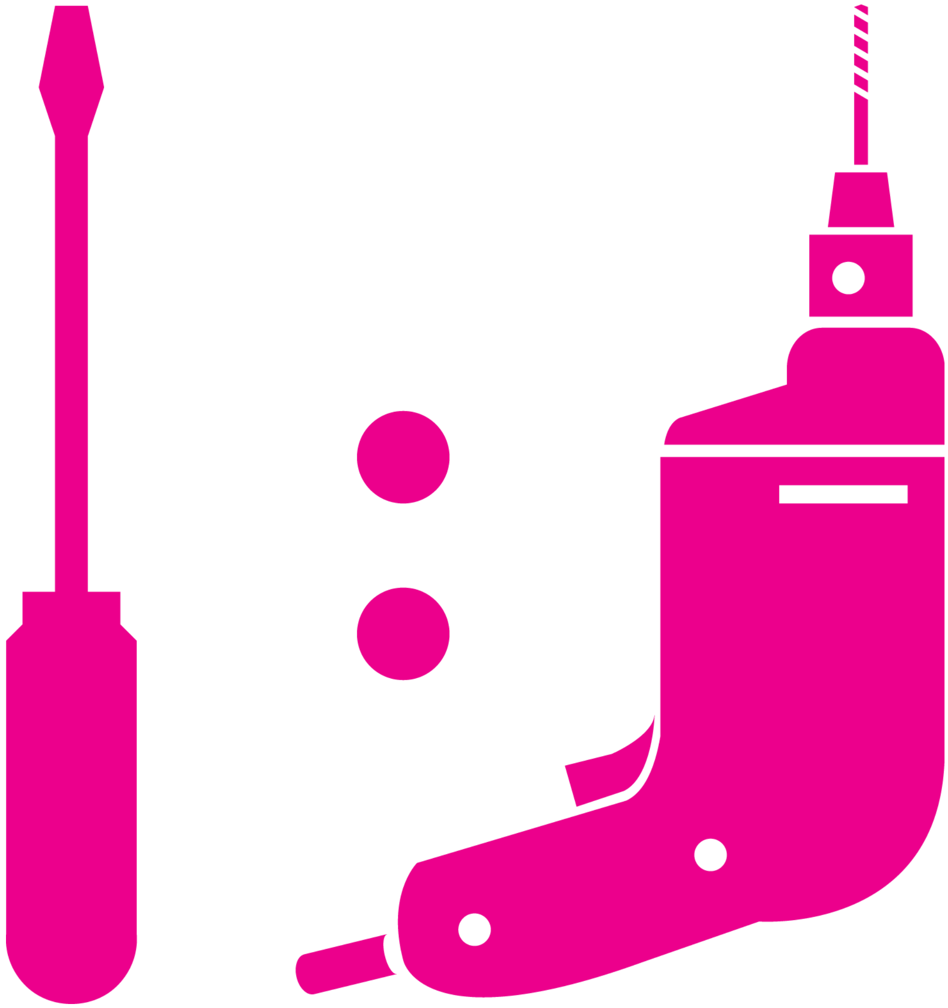
[2] Canizaro, V., "Design Build in Architectural Education: Motivations, Practices, Challenges, Successes and Failures." Archnet-IJAR, International Journal of Architectural Research, Vol. 6, Issue 3, November 2012.

[3] Elger, D, Beyerlein, S., Budwig, R., "Using Design, Build, and Test Projects to Teach Engineering," ASEE/IEEE Frontiers in Education Conference Proceedings, Session F3C, October, 2000.

[4] Gaber, T., "The Agency of Making and Architecture Education: Design Build-Curriculum in a New School of Architecture," Archnet-IJAR, International Journal of Architectural Research, Vol. 8, Issue 3, November 2014.

[5] Sheppard, S., Jenison, R., "Examples of Freshman Design Education," International Journal of Engineering Education, Vol. 13, No. 4, p. 248-261, 1997.

[6] Insook Han, John B. Black. *Incorporating haptic feedback in simulation for learning physics*, Computers & Education, Volume 57, Issue 4, December 2011, pp. 2281-2290.



## PAST:PRESENT

While the act of design is inherently forward-looking, history often plays a central role in the design process, whether through the use of precedent, application of theory, or the mining of personal or collective histories. How is the beginning design studio used to engage history--or conversely, how can design history classes use studio-based techniques to teach students? Submissions to Past : Present describe the tactics through which the course framework or deliverables have had a 1:1 engagement with history.

# Future Theories, Graphic Arguments: Activating History and Theory

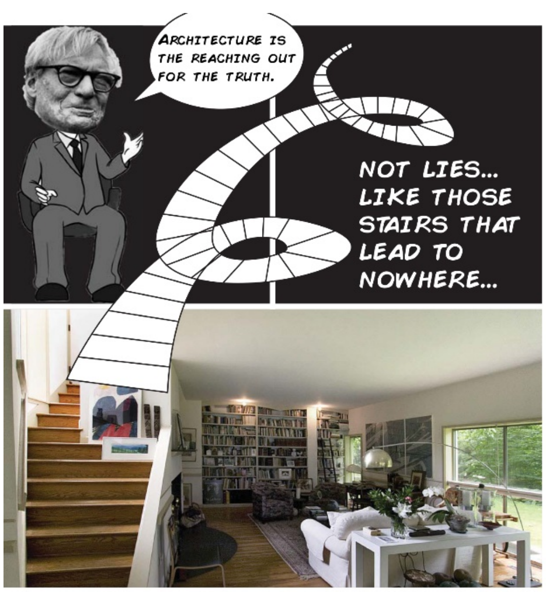
Catherine Bonier | Louisiana State University

## Design and History, a 1:1 Connection?

A profound disjunction exists, both within curricular structures and in the minds of students and faculty, between history and practice. History is a graveyard to be picked through for inspiration, fuel for slideshows and exams based on memorization. History classes become a necessary chore to be dispensed with before moving on to the real work of design. It seems important, especially in the digital age, when the chasm between past and present expands, to introduce students to the struggles and visions of past designers in order to promote active learning and a more synthetic and grounded contemporary architecture. An active investigation of the motives and methods of past architects helps connect students to the underlying issues of design that remain constant.

How can the integration of manifestos, design proposals, and visionary theories into history curricula activate student creativity, and revive the depth and continued relevance of historical design debates concerning nature, form, material, technology, politics, and production? This paper describes a 1:1 relationship between historical analysis and design provocations, with graphic novels and illustrated narratives as the final products of history and theory seminars.

In history seminars offered at Louisiana State University, students conduct research and construct weekly presentations assessing different works of modern and contemporary architecture (post-1750) through the lenses of theoretical manifestoes and designed interventions. Students particularly examine positions architects have taken in regard to natural, formal, material, and technological inspirations, and also ask how visualization and production techniques have influenced thought and design.



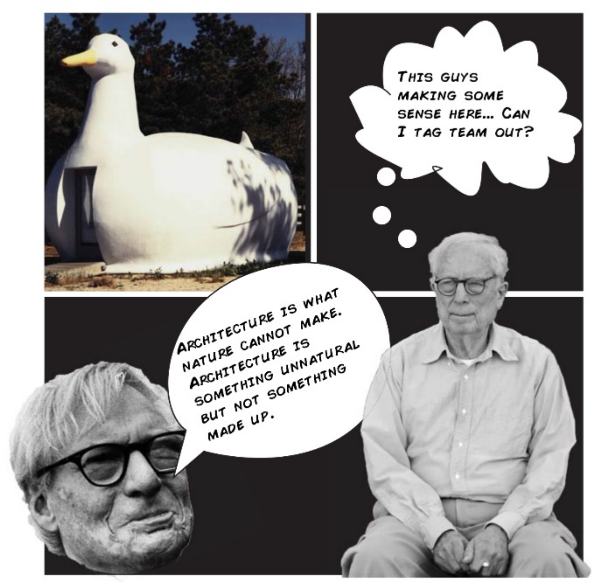




*Fig. 1 – K. Bosarge, the Clarity Movement*

In tandem with historical research, students develop their own manifestoes, inspired by a chosen technology or natural model, and design a graphic novel, invoking different figures from history to argue for and against their design rules. Students use direct quotations from these designers' writings to make their own points and counterpoints. These graphic novels, like the canonical visual arguments of Le Corbusier, Sant'Elia, Archigram, and others, utilize borrowed images and collage, as well as original images that demonstrate the design implications of each student's theory at the scale of the unit and the city.

*Fig. 2 – K. Bosarge, The Clarity Movement, MRI urban render*

Losing a 1:1 connection to history means a loss of architectural integrity, and leaves architectural designers adrift, blindly revisiting timeless problems. There is a danger in understanding the range and fluctuations of architectural history as a series of formal "styles" or "tastes," without recognizing that each moment has been based on ethical and political positions. Furthermore, technologies and techniques of analysis, representation, and production have changed radically in the past 40 years, but even more radical shifts have occurred in earlier times. Formal maneuvers come easily in digital design work, and flow quickly into a realm that students perceive as radically different from all that has happened before. In order to reinforce the issues and needs that remain constant, and to understand which challenges are profoundly new, students need to learn as activists, rather than as passive receptacles for a litany of form. As political, environmental, and technological situations change, students need to develop a facility in connecting intellectually, ethically, and intuitively with the world. By producing a graphic novel, a short argument that demands and develops visual presentation skills, students knit together connections between their own ethical and aesthetic stances and a wider dialog of design visions.

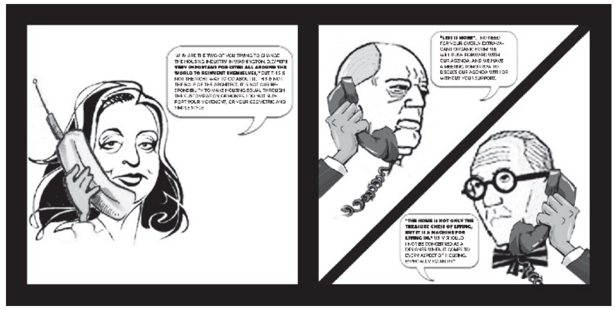


*Fig. 3 – A. Malone, Transformative Architecture*

Students have commented that revisiting theories and designs studied during the semester to defend their own ideas and visions gave them a deeper understanding of the past. By positioning themselves as designers at the moving endpoint of contemporary history, students become active agents. In generating visionary novels, history is neither left inert nor blindly mined for formal inspiration, but instead invited to enter contemporary discourse and production. Once they understand the influence of past design ideas on the built environment within social context, students can prepare themselves to imagine the range of implications of their own built works. This 1:1 activation places students on a level field, playing directly with the past, taking ownership of the future.

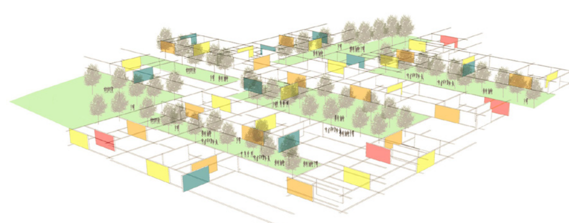


*Fig. 4 – A. Malone, Transformative Architecture, collage*

## Design Interrogations: splitting the difference

The syllabus calls on students to "to interrogate contemporary architectural practice as a social, cultural, political and philosophical act." The courses are sequenced to follow buildings and drawings paired with primary writings, not just by architects and theorists, but also by the philosophers and scientists by whom designers have claimed to have been influenced. For instance, the study of Greg Lynn's Embryological House is paired with a reading of Deleuze and Strauss' "The Fold" of 1991, not to demonstrate cause and effect, but instead to allow students to assess the links and the gaps between philosophy and practice. In another week, Heidegger's "Building, Dwelling, Thinking" is unpacked alongside Tsien William's Folk Art Museum, in order to wonder as a group about the phenomenological buffer and bridge the museum once provided. With the swooshy ubiquity of Zaha Hadid's work, students consider Patrik Schumacher's writings, and compare them to nineteenth-century Darwinian design theories that posited a teleological evolution of architecture towards fitter forms. With each study, students weigh the relative role of social, technological, ethical, and egotistical concerns, and see that the products of making always, or almost always, surpass in their richness the initial ideas (or post-facto justifications) which have been put forward to explain them. In this way, students define the areas of knowledge and practice that are unique to built work, which cannot simply be extrapolated from theory.

*Foundations: 1:1, plus 1*

The device of the graphic novel is the end product of a seminar that seeks to draw out the connections and the disjunctions between theory, design, and practice. The point of the class, based on my own position, is that these three elements are profoundly and integrally related, but cannot be linked through direct translation. In other words, by reading the theories of Le Corbusier, one may better understand his ego, interests, ambitions and self-justifications, within the context of his time and place. Words alone, however, by no means adequately explain the drawing or the building. The understanding of each element of the triad provides a depth of knowledge, and always reveals the striking and fruitful disjunctions between theory, design, and practice.

The seminar or discussion section format, oriented around a semester-long theme, allows students to investigate and to understand design as a complex narrative of the built environment. Students gradually understand that the interplay between theory, design, and practice unfolds entirely under the influence of events and individuals outside the realm of design. I have used the device of "technology" as the thread for students to follow in contemporary studies, which gives them a window into larger, extra-architectural historical shifts. In courses covering 1750 to 1950, I have chosen instead to use the idea of natural model or scientific theory as inspiration for new design arguments. In this case, I ask students to research emerging science to provide the basis for their own "primitive hut." These two themes of nature and technology---especially when "technology" is understood to include not just the materials that make artefacts and buildings, but also the tools and languages of analysis, representation, and fabrication--both connect and divide the 1:1:1 relationship of theory: design: practice. It is this tension that interests me. While it can be hard for students to grasp this idea, by testing their own theories and designs, they do get a sense of the design potential within this friction.

Technology and technique, or nature and science, are relevant to contemporary practice, but equally provide a framework for understanding the built environment from its earliest foundations. Once students begin to see the perspective drawing system as one of many technical means of graphing and creating "space" it is an easy leap to wonder at the systems arising from 3D digital modeling and the geometries and scales of visualization it supports. By viewing retroactively, they are able to obtain some critical distance to see that their own choice of "tools" from pencil to Rhino to CNC mill or router, will have profound results not just on the shape of their design, but on the range of what they can imagine.

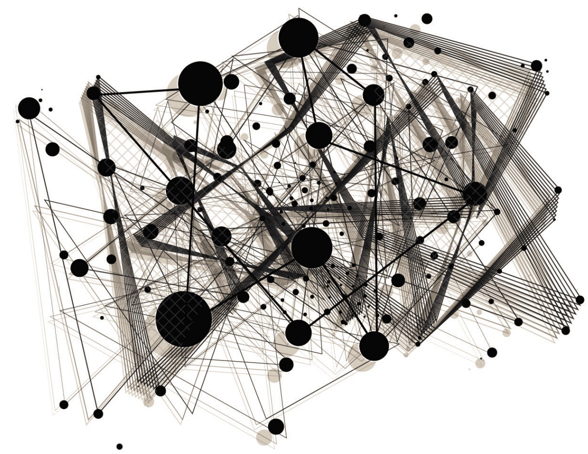


*Fig. 5 – J. Canales, Network Architecture, collage*

*Assignment 1: constructing an argument*

The midterm assignment for contemporary history students asks students to develop their own position which is grounded on a specific technology:

*We have been studying architectural theories in relationship to ideas of technology - and have seen the ways both have changed together over time. We've also seen the way architects have taken the technologies of their own time and tried to extrapolate from those to imagine futuristic cities and buildings. Inspiration takes many forms. Sometimes technology and* *scientific inventions are taken as a formal inspiration, or the processes of those devices are mimicked, or a much exaggerated version of that technology is imagined. For this assignment you will pick a contemporary technology, and devise your own theory that is extrapolated from the inspirational technology, and expressed in a list of rules, a group manifesto, and a carefully constructed image.*

*Fig. 6 – Y. Wang, Film Architecture, collage*

This is a heavy-handed brief, which asks students to follow a strict procedure to generate an initial manifesto :

*1. Pick an inspirational technology invented after 1960 - NOT A CELLPHONE or COMPUTER - though you can pick an app or program that runs on a cellphone or computer.*
*2. Consult Conrads, ed., Programs and Manifestoes on 20th-Century Architecture (Cambridge: MIT Press, 1997) especially focusing on assigned examples of 20th century manifestoes, to understand the form.*[1]
*3. Make a list of rules or future guidelines for an architecture based on your chosen technology.*
*4. Compose a 1600 word manifesto that describes the architecture and cities of the future, based on this technology.*
*5. Construct a collage, CAREFULLY composing 1 image that demonstrates your theory - find an expression and style.*
*6. Give your architectural movement a name!*

The students present their draft manifestos and collages to each other. They are allowed to provide no additional explanation or information. They critique each other's work, asking whether, seeing the collage alone, they might have guessed the rules behind the design. Reading each other's manifestos, students ask whether each line is powerful, logical, and necessary. Of course, this is in part a graphic exercise, but it also demands solid logic and the ability to write clearly and concisely. Non-architecture students could certainly work with manifestos and collages with worthwhile results, both in terms of skills obtained and in terms of end products.

The base themes of technology and nature required considerable preparation and presentation in advance, so that students could understand the array of possibilities. It helped to revisit manifestos of the past and present which call on construction technologies and attempt mimesis of biological form, but which also invoke race cars and grain silos and theories of time and motion during the early twentieth century; and a shift towards space travel, television, consumer products, and DNA during the post-war period.

*Fig. 7 – K. Autilio, Degrading by Design, collage*

Students chose surprising technologies as the basis for their architectural theories—MRI, biodegradable polymers, network theory, string theory, mycological colonies, adjustable runner's starting blocks, sewing machine, electric toothbrush, computer mouse, google glass, helicopter. (I was lenient, allowing devices invented prior to 1960.) The chief revision necessary after the first presentation was that students needed to take more seriously the procedures and systems connected to their technology, both directly and analogically. By working together in group critique, students were able to expand their technological device from an interesting icon or formal inspiration, to something which might imply particular patterns and systems that could apply directly to design and to building.

In an elective seminar with a similar manifesto and graphic novel assignment, students invented new infrastructures based on current scientific investigations, with an even wider array of results. Reverse osmosis desalination, magnetic levitation, biosolar, bioluminescence, hydrokinetics, geothermal, and other evolving infrastructural technologies fueled narratives and imaginations of future living conditions. In this case the technology to theory to architecture to urbanism link was much more direct than was required or desired in the architectural history seminar.

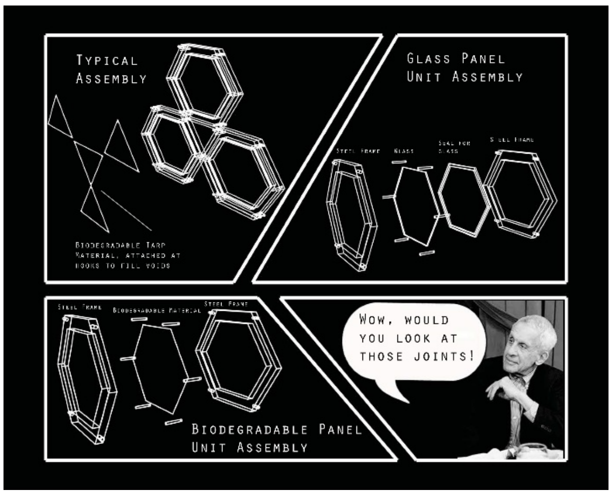



*Fig. 8 – K. Autilio, Degrading by Design, detail*

***Assignment 2: constructing a story***

Why a graphic novel?

The graphic novel is a revived art form that students can easily understand and cleverly deploy. Its brevity forces them to edit and to focus, both worthwhile skills. Graphic design is now an even more unavoidable underpinning of architecture in the world of portfolios, powerpoints, and competition boards. Graphic novels force the experimentation within regimentation that is required to express design ideas clearly and quickly. This is also an age of experimentation with the book form and graphic layout, perhaps best known in the work of Rem Koolhaas and the Office for Metropolitan Architecture.[2] The graphic novel is a short form that forces students to consider hierarchy, pace, tone, mood, and focus, all of which are important elements, not just of graphic design, but of architecture and other art and design disciplines. By generating their own book, printed online, the students enter an ongoing dialog on their own terms.

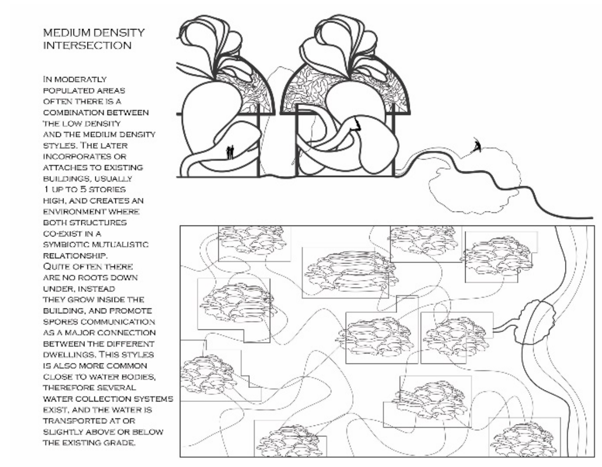



*Fig. 9 – A. Orosco, Beeja Architecture, plan and section*

The graphic novel, despite its venerable history, is an inherently and eternally youthful art form, and appeals easily to students of many backgrounds. Most design students are familiar with the popular graphic novel *Yes Is More: An Archicomic on Architectural Evolution* (2009) by Bjarke Ingels of BIG.[3] This book provides a specimin for students to study, to evaluate one way of rationalizing what is in fact a deeply personal idiosyncratic design process. Students also see the ways in which form-finding may require retroactive diagram work. Ingels represents a successful if unnerving mix of intuitive talent, pragmatism, salesmanship, and egotism. This semi-disingenuous but usually unconscious melange of attributes is emblematic of many great designers past and present. Since this combination of qualities should be both a model and a cautionary example for students, the device of the graphic novel is a suitable fit for our times. (An animated short is more appropriate to the twenty-tens, but requires greater technological savvy and time commitment. The design studio or design elective class format more easily supports experimentation with video animation.)

The graphic novel speaks to contemporary trends and techniques, and also connects to a long history of design arguments and narratives. *Yes is More*, beyond its obvious reference to Mies' famous aphorism, demonstrates the influence of the cut and paste work of Archigram, Archizoom and other 60s and 70s design provocateurs, filtered through the ubiquitous Adobe software products used by design students. Ingels plucks terms from the history of architectural theory, such as Venturi, Scott-Brown, and Izenour's *Duck* and *Decorated Shed*, giving students a sense that architectural history evolves as a conversation, using a learned language.[4] Posing Ingels' techniques of argument against Le Corbusier's *Vers un Architecture* of 1923 (published in 1927 in English as *Towards a*

*New Architecture*), students also recognize strange similarities, particularly in each architect's insistence that their approach to design is the most rational solution to pressing contemporary problems.[5] Students are also left wondering why the inspiration of industrial technology and of historical precedent are both less present in contemporary theory and design.

In an attempt to set a fixed framework within which students can stretch their imagination, the final graphic novel follows its own strict set of rules:

*1. Revise the midterm manifesto assignment according to the feedback received from your professor and from peers. This will form a brief abstract and introduction to your graphic novel.*
*2. Continue to RESEARCH graphic novels following the in-class presentation. Devise your own palette, style, tone, and layout.*
*3. Write a narrative outline which allows you to demonstrate your theory and its architectural results.*
*4. Create a storyboard. You will need to create a template to establish the layout and how many images you will need. Use a consistent set of page-spread templates for a clean design.*
*5. Include a plan, section, and elevation of the basic unit, as well as an urban plan and assembly.*
*6. Bibliography. Cite any direct borrowing or quotations of text or images with endnotes. (Chicago citation style)*

*+ n.b.1. Every good comic book needs a conflict with a bad guy or challenge, think of how you will show the current state of cities and buildings, and how your theory will change the world!*

*++ n.b.2. You must reference and argue against at least two of the architectural theorists we have read this semester, and quote them directly in your argument. You should also have 1 positive example, or agreement, and quote them directly as a support for your theory. Revisit the primary readings!*

It was important to provide clear lessons on both storyboarding and graphic novels, and to review storyboards. All aspects of this assignment could easily be achieved without a computer, and some students created books that layered together hand-media such as charcoal or pastel with digital techniques including Photoshop, Illustrator, and InDesign.

*Fig. 10 – V. Cutrer, Submerged, collage*

## Conclusion: the power and the problem of translation

The graphic novel assignment provided powerful results, allowing students to think simultaneously about ethics, ideas, designs, and images, using technology as the thread to bind them together. The strength of the work was that each student improved their written and visual skills of visualization and argumentation, and better understood the positions and the problems of past architectural theorists and designers. The work was engaging and difficult, but also enjoyable and elucidated and problematized the 1:1:1 relationship between theory: design: and practice. The emphasis of critique and dialog was to understand that the colon ( : ) between these three elements does not signify an unchanging lock, but rather a flexible joint with room for decisions based on personal, aesthetic, social, and political values—all of which shift in time.

The formulation of design rules that result in an illustrated narrative is a worthwhile exercise, not just for what it provides, but for the ways in which it fails. Students recognize that their designs, based on theory and graphic technique, but without sufficient development based on other criteria, are thumbnail sketches. These preliminary and often cartoonish designs, however, reveal to students their own curiosities, inclinations, and ethical positions. By recognizing and refining their own ideas, and connecting them within a long dialog of design history and theory, students move forward in a stronger position to generate and to evaluate their own designs, and to find power in the gaps between ways of thinking and making.

This active study of history provides traction, using past examples not as a simple "case studies" or rote references, but as interpretive lessons in the complex interplay between theory, design, and practice.  Digital technologies can offer the illusion that thought can be directly and perfectly translated to model and product. Students need not just technical skills, but critical intellectual abilities in order to understand that these translations offer opportunities precisely in the difficult in-betweens, in the spaces and translations between 1 and 1.

## Notes

1 Ulrich Conrads, Programs and Manifestoes on 20th-Century Architecture (Cambridge: MIT Press, 1997 [1970])

2 Rem Koolhaas and his Office for Metropolitan Architecture have influenced the field with books drawn from their own and student research, which rely heavily on graphic design and experimentation with new forms of representation and visualization. S, M, L, XL by Koolhaas and Bruce Mau (New York: Monacelli, 1995) set a standard for doorstop tomes pairing vibrant design with provocative imagery and text. In recent years large monographs and conference compilations appear more frequently and with reduced impact.

3 Bjarke Ingels, Yes is More: An Archicomic on Architectural Evolution (Köln: Evergreen, c2010 [2009]).

4 Robert Venturi, Denise Scott Brown, Steven Izenour, Learning from Las Vegas : the forgotten symbolism of architectural form (Cambridge: MIT Press, c1977)

5 Le Corbusier, Towards a New Architecture (New York: Dover Publications, 1986 [1927]).

# Learning and Unlearning Precedent

Caryn Brause | University of Massachusetts, Amherst

## Introduction

Representation and visual communication are integral to all facets of architecture, from conception to realization - as generator, as mediator, as symbol, and as an end unto itself. Visualization is a central method for selling architectural services, as well as a key product of those services. But in the media-saturated world that beginning students encounter, visualization skills pose inherent certain risks. First, there is the risk that the visualization takes on a life of its own, driving and defining the design process. Then, there is the seductive, and self-contained universe of the visualization, one that seeks to erase the risks that accompany real world variables, including human occupation and the destructive reality of construction.

To counterbalance the seduction of visualization, analysis provides a stabilizing force. In beginning design courses, precedent studies of canonical buildings are frequently advanced as a primary vehicle for studying analysis, idea generation, visualization, and communication.[1] The National Architectural Accrediting Board (NAAB) situates precedent study in Realm A: Critical Thinking and Representation and defines the use of precedent as the "Ability to examine and comprehend the fundamental principles present in relevant precedents and to make informed choices about the incorporation of such principles into architecture and urban design projects."[2] Precedent studies often align with studio projects in which the analysis of buildings is tied to those with similar programs that the students will design. This form of analysis typically focuses on formal, organizational, material, and structural qualities. However, NAAB Realm A also asks that graduates from accredited programs "understand the impact of ideas based on the study and analysis of multiple theoretical, social, political, economic, cultural, and environmental contexts."[3]

This paper examines a visualization assignment situated in a digital skills lab in which a traditional precedent study is a device for teaching graphic communication, software techniques, and analytical methods. The author's hypothesis is that introducing an exercise in image compositing provides an opportunity to consider multiple readings of the precedent being analyzed—it opens up the analysis to the position that architectural artifacts are dynamic rather than static, subject to interpretation and appropriation as well as decay, weather, aging, and abuse. In this manner, students are encouraged to both learn and "unlearn" precedents simultaneously over the course of the semester. Additionally, as the assignment occurs in parallel with the instruction of architectural rendering techniques, it provides a provocation to consider critically the propriety of glamorous and sanitized representations of architecture at the same time that students are gaining the very skills necessary to produce these representations.

## Rendering & Responsibility

Responsibility accompanies image creation skills. As technology has advanced and become more affordable, design visualizations have become highly realistic. For the designer, these advancements enable testing of concepts with great visual accuracy. For clients and stakeholders, they are persuasive tools to convey architectural ideas, in part because laypeople can appreciate and understand perspective images even without a sophisticated knowledge of architectural conventions. However, "the rendered image evokes a notion of building in a complete state. But unlike the construction of perspectives or classical elevations drawn by teams of architectural disciples in the past, these high resolution renderings are generated off of trace amounts of real information."[4] In place of accuracy, visualizations often amplify desirable features while omitting or distorting undesirable ones; when realized, the built work then greatly differs from the one promised in the images.[5]

This gap in the relationship between conception and construction is centuries old. For example, Renaissance architects used drawing as a tool in the conception of architecture to distinguished themselves from building craftsmen, and thus enhance their roles as professional designers to acquire higher status and wider respect. Facilitated by the new methods of drawing, this shift from builder to conceiver enabled them to operate at greater distances from construction sites while still communicating their ideas and instructions to the workmen, the patrons, the project administrators, and the building officials involved in the construction process.[6]

These drawings were primarily produced to convey instructions for material realization in built form. However, architects developed a parallel tradition of producing images for public consumption, in which the accuracy of the images and their relationship to the final building were not always intended to have a 1:1 relationship. Palladio, for example, produced images of his buildings, stripped out of their context, in order to offer them to the public as idealized architectural models.[7] Similarly, Le Corbusier modified images of his buildings to preserve the transmission of their ideas in perpetuity through publication, rather than privilege their realization.[8] The Museum of Art and Design (MAD) by Allied Works provides a contemporary example of a project that is portrayed closer to its conceived state on the firm's website—without the large horizontal picture window that the client required for the ninth floor restaurant.[9]

Several practices have emerged to provide a check against these distortions. For example, to protect project stakeholders, some jurisdictions require visual impact studies as part of the permitting and planning process. The London View Management Framework requires that developers submit an "Accurate Visual Representation" (AVR), also known as a "Visually Verified Montage" (VVM), to assess the possible effects that new development may have on views to and from Strategically Important Landmarks and World Heritage Sites.[10] To protect their design process, some architects have responded to the demand for photorealism by building abstraction into their visual communication strategies. They point to the risk of closing down the design process at a time when imagination is still critical to maintain the potential of the avenues of inquiry. Mansilla y Tuñón Arquitectos notes that renderings must "be open enough to leave room for the development of the project, but specific enough to communicate whatever it is that makes the project special. They should be more about the attitude with which the project is faced rather than about how exactly it is going to look."[11]

## Course | Context

This image-compositing assignment is situated within a digital skills laboratory, which is a companion course to the first semester graduate studio. Over the course of the semester, students conduct a typical precedent study on a well-known twentieth or twenty-first century house. The houses have been selected for diversity of conceptual, spatial, organizational, structural, and material qualities in order to contribute to this studio's design dialogue. After conducting background research on their selected precedent study, students complete a formal, spatial, and tectonic analysis of the house while they concurrently digitally reconstruct the building.

In the assigned project, students deconstruct the canonical architectural imagery of these houses and then re-compose it to create an alternate narrative - one that challenges the building's historical and geographical context. To create their narrative, students select a passage from one of the course's assigned readings, their case study research, a quote by the designer or client, a dictionary definition, or any other piece of text that, when combined with their re-composed image, supports, extends, or transforms their conceptual approach.

Beyond the precedent study content, this assignment has several overlapping objectives for. First, students encounter essential graphic design concepts such as typography, composition, collage, and layout. Second, students gain beginning knowledge of image manipulation and graphic design software—in this case, Adobe Photoshop and Illustrator. Finally, students critically evaluate graphic architectural materials for content and message. While analyzing the ways in which architectural imagery is deployed in practice, students must consider the role of visualization in architectural ambition and deception.

### *Method*

This assignment immediately follows a lesson on fundamentals of typography. Students analyze a range of historical and contemporary materials to examine the structure and optics of text including size, spacing, case, weight, stroke contrast, body width, posture, and visual style as well as variables as well as paragraph alignment, rag, spatial interval, and texture. In an attendant exercise, students iteratively reconfigure a single chunk of textural information, adjusting one variable at a time to explore hierarchy, alignment, clarity, and layout. (Fig. 1)

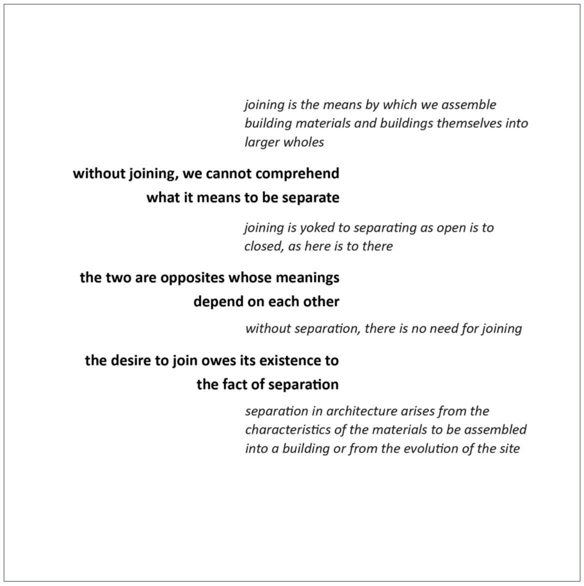



*Fig. 1 Typography Assignment Example*

In the subsequent assignment, students combine their selected text with their composited image to test and refine their interaction and integration. They must create a conceptual basis for their investigations and explore potential visual relationships between text and image. These interactions pose serious challenges, but also create the possibility of examining both elements more critically. Both text and image are composed of lights and darks, open and closed spaces, points, lines, and volumes. They may share proportional attributes or stand in contrast to each other. By testing juxtapositions, students may find resonances in the shape or size of elements in each.


*Fig. 2 Mobius House Collage Study, Peng Zhang*

Regarding the design process, these collisions of text and image create a search for meaning. Facing these associations, students pursue different directions—some choose to compose images to illustrate the text, some choose text that describes their image, while some iteratively play with letting text and image construct each other.

Some students selected quotes by the architects or the clients, or other passages written about the projects. They then sought to create text and image collages that shared compositional qualities highlighted by the passage. For example, one student juxtaposed text about the Mobius House and then deconstructed the text, experimenting with reversing and adjusting the color, size, and spacing. The image is experienced as a series of layers—first a layer of insistently horizontal text, then a vertical layer of trees trunks and, in the background, the horizontal mass of the building. (Fig. 2) Another student, working with Tadao Ando's Horiuchi House, chose a text that highlights distortion, and explored the occupant's experience of looking in and out from behind the glass block wall. (Fig. 3)


*Fig. 3 Horiuchi House Collage Study, Y. D. Kim*

Other students select passages from a variety of sources that challenged them to re-site their buildings in new locales, and create narratives in which the structures are re-occupied by humans, animals, or others; As a result of these juxtapositions, the houses may host previously unconsidered activities, or respond to unexpected weather events, violence, and deterioration. For example, one student felt called, by his reading of David Gissen's "The Architectural Reconstruction of Nature," to imagine passing by the Villa Shodan in a ruinous state while kayaking along a nearby waterway. Employing a centered alignment for the text passage, which readers may associate with formal certificates, and tombstones, completes the poetic effect. (Fig. 4)

A student who selected a passage from Carol J. Burn's essay "On Site: Architectural Preoccupations" then considered the detachment of building from site. Through a series of juxtapositions, the student then grappled with a fluctuating relationship between text and image—Tadao Ando's 4x4 House—aligned, superimposed, overlapping, dominating or responsive to each other which provided an analog to the issues raised by the passage regarding the relationship between building and site. (Fig. 5) Another student, studying OMA's Villa dall'Ava, selected a George Orwell quote. The text, regarding perceived income and social inequities, then drove the selection of entourage, creating a narrative in which the Villa is situated behind a wall in a low-income neighborhood, its clad volumes resonating with the piled residences stacked on the slope in the background, and a series of tense relationships set up between figures inside and outside the structure. (Fig. 6)

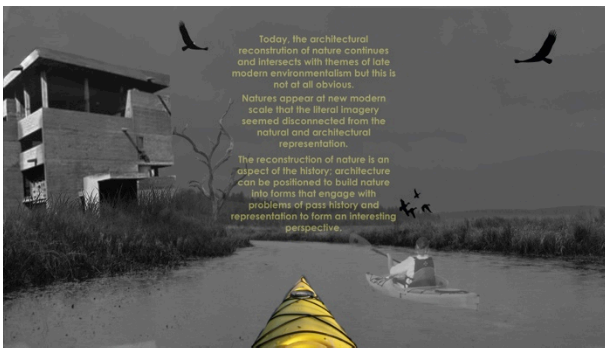



*Fig. 4 Villa Shodan Collage Study, Andrew Stadnicki*


*Fig. 5 4x4 House Collage Studies, Nikki Perry*

### *Discussion*

This assignment has been implemented in the curriculum in various formats for the last four years. In some years, the exercise took place at the beginning of the semester, prior to the building analysis, to provide time for students to digest the information and imagery that they are gathering for their precedent study while building Photoshop skills. At other times, the exercise occurred toward the end of the semester, after students have analyzed and reconstructed the house and gained greater intimacy with the subject matter.

Thus far, there has been more variation in outcome with respect to individual students and their text selection than there has been with respect to scheduling of the assignment. The text selection had the greatest impact on the outcomes: some students were more experimental at the beginning of the semester when they viewed the assignment as pure composition and image manipulation while other students had increased confidence after taking apart and putting back together the building digitally, which fostered more adventurous text selection and collage juxtapositions. The assignment was twice given without the text component—as an exercise solely about image composition. Each time the students seemed to have more difficulty constructing a compelling visual narrative through compositing alone. The collision of text and image produced discomfort, as wells as a struggle for meaning that then drove more sophisticated overall compositions, and with it, greater skill development in both image manipulation and typography.


*Fig. 6 Villa dall'Ava House Collage Study, Rob Kane*

## Further

Is it subversive to portray these known icons in this manner? The approach to acquiring building knowledge exhibited in this assignment posits that the architectural canon is open to contradictory attitudes and criteria. The exercise suggests that through the reconsideration and recreation of architectural imagery, we can transcend the traditional view of these precedents by replacing images of perfection with the realistic imperfection of human experience and, by doing so, engage the complex endeavor of human inhabitation. In this way, we can engender, from our student' first semester, a multilayered approach to understanding, digesting, appropriating, and ultimately transforming our inherited environment.

## Notes

[1] See, for example, Balmer, J. and Swisher, M, *Diagramming the Big Idea*. Routledge, Taylor & Francis: London, 2012.

[2] "2014 Conditions for Accreditation" (Washington, DC: The National Architectural Accrediting Board, Inc., July 18, 2014), 16.

[3] Ibid., 15.

[4] Elizabeth McDonald, "From China, Without Love," *Clog: Rendering*, 2012, 33..

[5] Curbed NY's Rendering vs Reality column provides regular examples. www.curbed.com

[6] Catherine Wilkinson, "The New Professionalism in the Renaissance," in *The Architect : Chapters in the History of the Profession* (New York: Oxford University Press, 1977), 125.

[7] Hélene Lipstadt, "Architectural Publications, Competitions, and Exhibitions," in *Architecture and Its Image: Four Centuries of Architectural Representation: Works from the Collection of the Canadian Centre for Architecture*, ed. Eve Blau et al. (Montreal : Cambridge, Mass: Centre Canadien d'Architecture/Canadian Centre for Architecture ; Distributed by the MIT Press, 1989), 115.

[8] Beatrice Colomina, "Le Corbusier and Photography," *Assemblage* No. 4 (October 1987): 12-14.

[9] "Museum of Arts and Design," Allied Works Architecture, accessed January 14, 2016, http://www.alliedworks.com/projects/museum-of-arts-and-design/. This discrepancy is discussed in John Hill, "Photoshop Therapy," *Clog: Rendering, 2012*, 46–47.

[10] "London View Management Framework—Supplementary Planning Guidance" (London: Greater London Authority, March 2012).

[11] Mansilla Y Tuñón Arquitectos, "Managing Freedom (House in Losvia)," *Clog: Rendering*, 2012, 85.

# Tea House Design/Build: Integrating history and cultural studies into the design studio

Naomi Darling | Five Colleges
*Hampshire College, Mt. Holyoke College & University of Massachusetts, Amherst*

## Introduction: Tea House typology

*Architecture, objects, fire, bodies, words –*
*these five elements form a perfect whole in a small space, and an intensely personal time is passed.*
- Fujimori Terunobu, Fujimori Terunobu Architecture, 50.

This paper describes a studio, TEA HOUSE Design/Build, offered at Hampshire College in the fall of 2014. It was an elective intermediate studio offering within the Five College Architectural Studies undergraduate major shared by Amherst College, Hampshire College, and Mt. Holyoke College. The studio had several objectives: 1. To integrate history and cultural studies within a design studio, 2. To introduce formal analysis in studying precedents, and 3. To give students the opportunity to design and build a project at full scale – with all the associated considerations of program, material choice, joint details, schedule and budget.

The traditional Japanese Tea House seemed the perfect vehicle to meet all of these objectives. As architecture becomes more and more a global under-taking and architects are frequently asked to work in cultures not their own, it becomes important to introduce design students to approaches and research methods when beginning a project with a foreign cultural component. That foreign culture can be as geographically close as a minority ethic population that is not one's own but who are one's neighbors, and as far-flung as the culture of a people in a far-away country. As a bi-racial architect and educator whose experience and practice has always bridged the cultures of Japan and the US, a studio integrating a Japanese cultural component was one in which I could speak as both a cultural insider and outsider. At Hampshire College, specifically, architecture is housed within the School of Humanities, Arts and Cultural Studies, and students must fulfill a multi-cultural perspectives requirement which this studio satisfied.

Teaching within the liberal arts context, students have much fewer required architecture courses than within a pre-professional program. Each course, therefore, has to be strategic in the course content that is offered, and in some cases combine components of several courses into one class. Introducing and integrating formal analysis through both drawing and model-making, forced the students to look deeply at a project to extract formal relationships while improving drawing and model-making skills. For all of the students in the studio, this was the first time they had been asked to closely examine a precedent building in this way.

In terms of a design/build project, the traditional Japanese Tea House is renown for its simplicity of program and space, and has often been used by (Japanese) architects as a typology with which to test ideas and experiment with materials, technology and construction techniques. As such, the program and cultural significance of the tea house to Japan made the tea house the ideal typology to investigate in a semester-long design/build studio.

## Integration of History/Culture into Studio

The challenge in designing this studio was to give students enough background and depth into an understanding of the importance of tea culture and its impact on Japanese culture more broadly while still allowing enough time in a semester for the students to then apply this knowledge in the design and construction of a full-scale tea house that could accommodate two people. I had to be careful in specifying that while we were studying traditional and contemporary precedents of the

Japanese Tea House, the students were to re-interpret this typology and program to create a space to fit their own lives and needs as college students in Western Massachusetts. There was not a requirement that the designed structures meet the requirements of a formal Japanese Tea Ceremony and the students were their own clients.

To introduce students to a Japanese tea room, we are fortunate to have at Mt. Holyoke College, one of the campuses that shares in the major, a full scale traditional Japanese tea room, Wa-Shin-an. As the students began the studio with no prior experience of what a Japanese tea ceremony is, it felt important that the students have the opportunity to experience a tea ceremony in Wa-shin-an. A tea master trained in ura-senke in Kyoto joined us in the second week and this experience set the tone for the semester.[1] As one student, Nick Jeffway, wrote in his reflection essay at the end of the semester,

*" Before the tea ceremony, I had no idea what to expect. I did not know how to carry myself. I did not know what to say. I did not know how long it would be or what the tea would taste like. I was a bit nervous. However, I remember something very distinct that Johnny (the tea master) said when we met before hand in the Mt. Holyoke (College) library. He said that when inside the tea house and during the tea ceremony, only think and only speak about what is happening at the present moment.*
*This comment stuck with me and it stuck with me because by accepting this idea, I was able to fully immerse myself in the ceremony and embrace all the work done by both the tea master and the builder of the environment. ...*
*I remember leaving and walking to my car and feeling renewed. I felt like I had a bit more spring in my step. From that moment on, I went into each assignment and each class with the same mentality: to enter with a clear mind, and let the present moment dictate the next step in either my models, my designs or my drawings."*

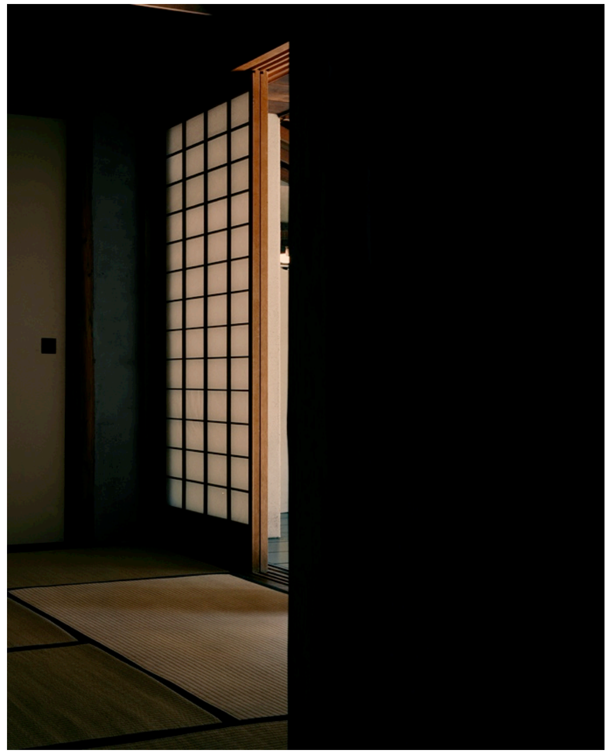


*Fig. 1 Wa-shin-an Tea Room, Mt. Holyoke College, by Billie Mandle*

Another student, Oliver Martinez, wrote about the impact of spending time in Wa-shin-an on his approach to materiality. He wrote:

*"One example of this is Wa-shin-an, which had columns of natural wood, with the bark removed, and in places these columns peeked out from concrete walls that were molded right around them. Being present in this tea house and observing details of the harmony between vastly different materials such as this was a valuable experience that gave me new understanding about material choice in structure."*

In addition to experiencing a tea ceremony, students read classics[2] about Japanese aesthetics and tea and were also introduced to the history and evolution of the tea room by an art historian[3] for whom this is a specialty.

## Precedent Research and Analysis

Concurrent to the tea ceremony, reading and guest lecture, the first six weeks of the semester were occupied with precedent research and analysis. The semester unfolded with students each selecting a precedent from a list of historical and contemporary tea houses.

Working with their selected precedent, students researched and presented the architect of their project and then engaged in formal analysis using both drawings and models to discover and communicate geometric proportions and relationships, assembly methods, and materials.

Researching the precedent tea houses including historic projects allowed the students to become familiar with traditional japanese building techniques and the tatami mat module as being a standard in designing and building space. More contemporary tea house precedents such as Ando's Veneer Tea House or projects by Kengo Kuma, Shigeru Ban and Terunobu Fujimori, allowed the students to see how contemporary Japanese architects have re-interpreted this traditional form. For all students, this initial six week period spent learning about specific tea houses as well as Japanese culture and aesthetics more generally proved foundational in how they ultimately chose to design their own tea houses.

The first phase of the precedent research was for students to draw basic plans, sections and elevations of their tea houses – for some where the information was readily available, this was not a difficult task, but for others, it involved finding photos in various texts and making their best guesses as to how it all fit together. The next stage was for the students to use the axonometric drawing as a tool to analyze, disassemble, and interrogate the formal relationships at play within their projects. Through the process of drawing, students discovered the layers of planning and design that are present within seemingly simple spaces.

Nick Jeffway: "*once I gained an understanding of the axon, I was able to perform intense analysis on the relationship between opposing sides of the structure, the relationship between the plan and the elevations, circulation, structure and volumetric concerns. … This process was quite exciting for me because my idea of Tôkyû-dō completely transformed as I uncovered more and more in regards to the rich level of thought which was put into the building.*"

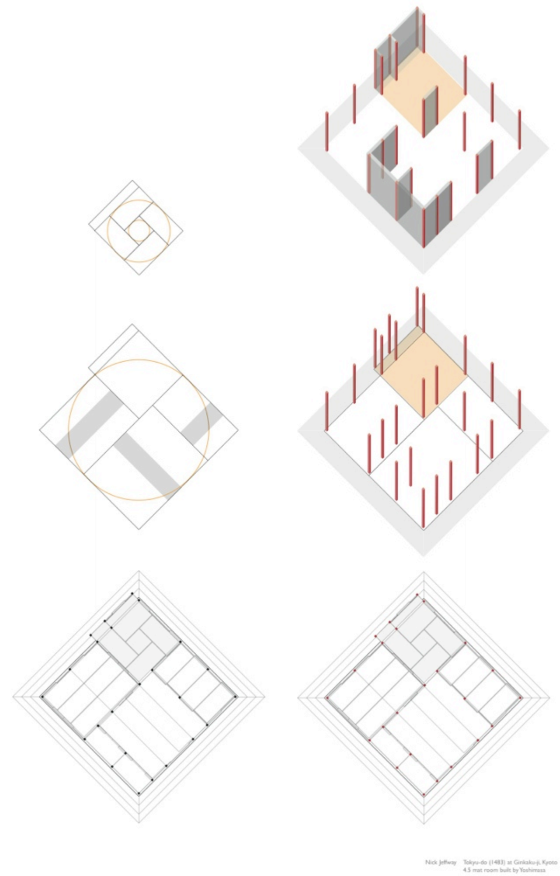


*Fig. 2 Nicholas Jeffway, Tôkyû-dō (1483) at Ginkaku-ji, Kyoto, analysis drawings.*

In the case of Tai-an by Sen-no-Rikyu, two students with very different backgrounds – a UMass student from the United States and a Mt. Holyoke College student from Vietnam, shared complementary discoveries about their projects that gave further insight into this critically important tea room. In the design/build portion of the studio, these two students decided to work together.

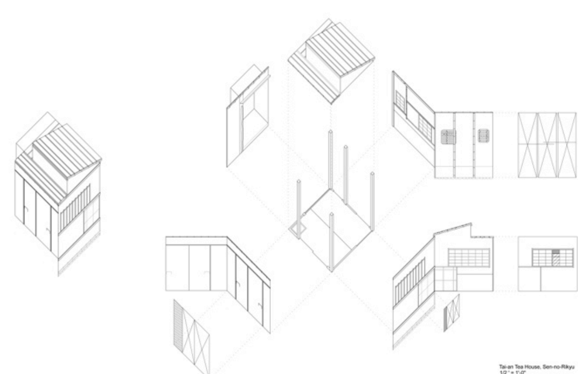


*Fig. 3 Georgi Goldstein, Tai-an (1582) at Myoki-an, Yamazaki, by Sen-no-Rikyu*

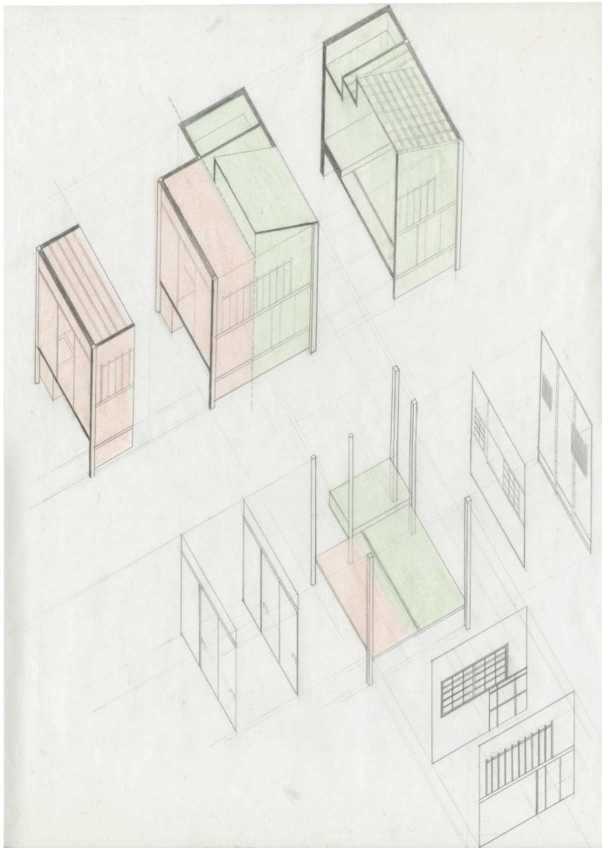


Fig. 4 Ngoc Anh Luu, Tai-an (1582) at Myoki-an, Yamazaki, by Sen-no-Rikyu

*Georgi Goldstein: Our drawings naturally complimented one another and without trying, it was as if our projects were two halves of one complete, comprehensive study of Tai-an. Almost literally, the precedent study showed me that Anh and I both had different things to bring to the table and that we would only benefit from one another in the process.*

As can be seen in these analysis drawings, the students came to the studio with not only different perspectives but also different skills – the pre-professional students were, in general, more facile with the computer programs while the liberal arts students showed the nuance that is possible with pencils and layering of drawings. I believe the combination exposed all students to a greater range of representation.

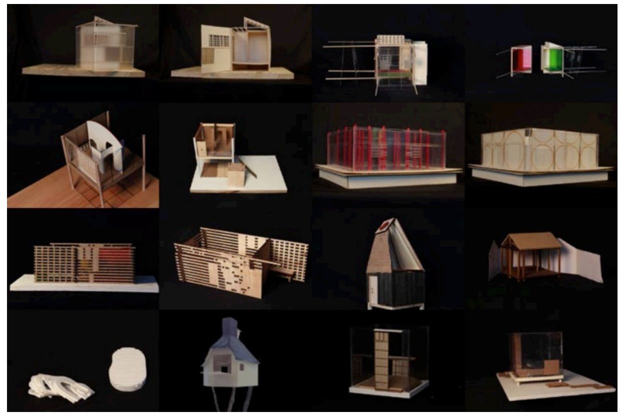


Fig. 5 Photos of student precedent models

The final phase of the analysis was to build three-dimensional analytical models further developing their analytical drawings but also materiality, structure and constructability. Building the models served as an important transition from analysis to design/build as students engaged in a creative, abstract interpretation of precedent through a small-scale planning and making exercise.

## Design/Build

*"Man built most nobly when limitations were at their greatest."*
-Frank Lloyd Wright

Having spent the first half of the semester engaged deeply in a precedent and a broader study of the history, culture and aesthetics of tea, the students eagerly jumped into the design and build of a full scale tea house for the remainder of the semester. Each student was given a budget of sixty dollars[4] and the space had to be large enough to accommodate two people – a host and a guest. The tea house also needed to be portable so that the students could transport their structures to the college gallery for an exhibition, and then ultimately to their dorms or homes. Finally, the tea houses also needed to be designed and built in the remaining eight weeks of the semester. Students were given the option of working alone or with a partner if working together was mutually desired (this also increased the budget of the tea house to $120). Four students chose to work together while eight students worked independently – at the end of the semester, there were ten full scale tea houses.

### *Influence of Precedent Analysis*

As we entered the design/build portion of the studio, the hard work undertaken in the first part of the semester paid off and all of the projects were influenced by the precedents studied. Ines

Aguilar and Sarah-Jane Young chose to work together creating a wood-framed crystalline enclosure created by webs of string.

Sarah-Jane Young*: "For my precedent research, I focused on Terunobo Fujimori's teahouse, Takasugi-an. It did not take me long to realize the many idiosyncratic elements of this structure in relationship to what is expected of a more traditional teahouse. Having loved learning about Fujimori's work and other teahouses that push the boundaries of the expected, it came as no surprise to me that my own designs mimicked his whimsical sentiment."*

Ines Aguilar*: "The combination of the Oribe pavilion (by Kengo Kuma) and Takasugi-an (by Fujimori) inspired us towards a concept focused on imperfection, contrast, and geometry."*

In their exhibition statement they wrote:
*Although our teahouse is neither precariously balanced on two trees or shapeless and luminous, we certainly feel as though we pushed the boundaries of what is expected of a traditional teahouse.*

Another student, Ander Garcia O'Dell, wrote of the influence of Ando on his own design:

*Tadao Ando's Veneer tea house is reflected in my design through the decision to use fabric for the majority of the enclosure. Playing with different ways light can hit a structure was one of Ando's main focuses. By using light fabric, I hope to recreate the interesting patterns I saw while building a model of the Veneer tea house.*

*Fig. 6 Untitled by Ander Garcia O'Dell, photo: Eugene Huff*

***Budget Constraints and Material Inspirations***

For many students, this studio was the first time to realize a project of a scale that they could enter into. The students were excited by the challenge and managed to work around limited shop hours and severly limted work space.[5] If this studio were to be offered again, these circumstances would need to be addressed. The design/build process started with drawings and models, and quickly (for most) moved into full scale mock-ups of critical components of their design. As to be expected, every project evolved as the students were faced with budget, schedule, and constructibility issues – this was based in part on the skill level of the students involved.

Bethany Aban: *I entered HACU 282 (Tea House Design/Build) with little-to-no experience with power tools and knowledge of materials. The task of building my creation was daunting to say the least, but was ultimately one of the most rewarding experiences of my college career. I began with so much hesitancy and uncertainty in my abilities that I designed a structure to be as minimalistic as possible. I assessed my abilities and came to the conclusion that a simple structure would challenge me just as much as complex structure would challenge a skilled carpenter.*

*Fig. 7 Nahabing Bahay ("Woven House" in Tagalog) by Bethany Aban photo: Bill Li*

The budget constraint also proved to be a significant editor as students refined their initial designs to adapt to materials that they could afford, or went in search of free materials. Students knocked on the door of a person who had bamboo growing on their property, asked a farmer about taking boards from a derelict barn, and upcycled pallets and plywood that had been discarded.

Chris Hurlow: *I also learned a certain resourcefulness throughout this semester. Not having enough funds to spend on new lumber and other items, I was pushed to look for new sources of materials. It was this restraint that lead me to find what became my driving material for my design--aged barn wood. Upon finding this material, the rest of my design seemed to revolve around its aesthetic and structural qualities. This discovery gave me a critical insight into my overall design process moving forward. I found that the materials really became the main obstacle, but sometimes the arbiter of my work.*


Fig. 8 Untitled by Chris Hurlow photo: Kat Dimitruk

As architects, one of the most satisfying aspects of our work is to be able to inhabit the spaces which we have designed. For many, this experience does not come while a student, but only after working in the profession for many years. The value of having this experience as a student was something that many wrote about in their final reflection essays.

Ngoc Anh Luu: *The satisfaction feeling [sic] when seeing your design standing up in life-size scale after being through a lot a trials and errors is unforgettable. And I am thankful I have [sic] the chance to experience that feeling.*

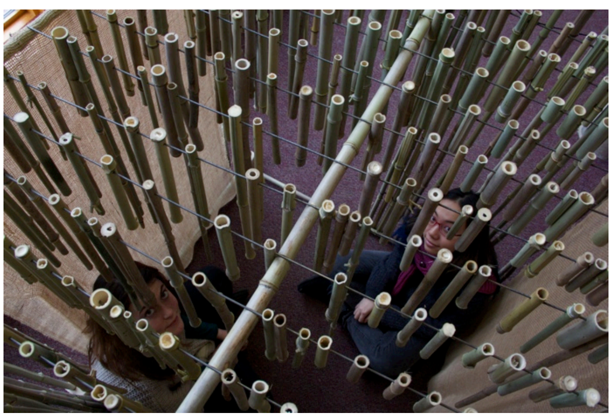


Fig. 9 Take-An by Georgi Goldstein and Ngoc Anh Luu, photo: Ryan Kulas

## Conclusion

Integrating a study of the history, culture and aesthetics of tea into the design studio context was very successful and added a depth of understanding and nuance to the student's work leading to stronger projects that connected to a broader dialog of architecture and the tea ceremony. The Design/Build component of the studio was very challenging and rewarding for the students, and to ground their design projects in a typology with a rich history of architectural experimentation from a culture that values wabi-sabi allowed the students to take risks with precedents they could reference. Finally, the constraints imposed by time, budget and constructibility proved to be productive editors and generators of creative design solutions throughout the design/build process.


Fig. 10 Soyo-Kaze ("Soft Breeze" in Japanese) by Nicholas Jeffway, photo: Nicholas Jeffway

*Ines Aguilar: Overall, it has been a very good experience and I have learned a lot, personally, about theory and about practice. I realized the importance of building your own designs, therefore having very clear drawings and models. It's been a growing process to work with my hands as well as having concepts such as appropriation, culture, the self and the other, dimension and space in my head throughout the whole semester and beyond.*

*Georgi Goldstein: Every step of this semester was a learning experience for me. I didn't know anything about bamboo as a building element or even as a plant before this course. I didn't know how to use power tools and had hardly any experience working in a shop. I had no idea that I could work with a partner as successfully as I did. And most of all, I didn't know about*

*Japanese tea ceremony. I'm walking away from this course with a new outlook on Japanese architecture.*

## Notes

[1] Although Johnny Fogg is trained in traditional urasenke tea ceremony, his presentation was a relaxed and adapted version of a tea ceremony in which he met with the students before hand in the library to give them a little of his background and philosophical approach to tea. The students were divided into two groups of 6 students each for the tea ceremony itself – the upper limit for an intimate tea experience.

[2] (1) Leonard Koren. *Wabi-Sabi: for Artists, Designer, Poets and Philosophers*. Imperfect Publishing, 2008. (2) Jun'ichirō Tanizaki . *In Praise of Shadows*, Leete'S Island Books, 1977. (3) Kakuzo Okakura. *The Book of Tea*. (various editions have been published over the years – any is fine) (4) Norman Waddell. *The Old Tea Seller – Life and Zen Poetry in 18th Century Kyoto*. Counterpoint Press, 2008.

[3] special thanks to Prof. Samuel C. Morse, Departments of Art and the History of Art & Asian Languages and Civilizations, Amherst College.

[4] The $60 budget was set to establish an equal playing field and ensure that all students could comfortably afford to build their projects. This number is comparable to a lab fee, course materials fee or book budget for other courses.

[5] We were fortunate to have access to the theater wood shop that is in the same building as the architecture studio – but as the wood shop is adjacent to the black box theater, the students had to work around practice and performance schedules. In terms of Design/Build, we were fortunate to be the only studio being taught that semester, so the students could take over the architecture studio but some students spilled out into the hallway as the studio was too small to accommodate everyone.

# Constructing the Gothic Vault in the Digital Age: Lessons in Accuracy and Precision

Jessica Garcia Fritz | South Dakota State University

## Introduction

In Fame as the Avatar of History, Peter Eisenman recounts a conversation with Colin Rowe in which Rowe states, “Once you have seen one Gothic cathedral, you have seen them all.” From this conversation, Eisenman concludes “there were no ideas in cathedrals that could not be gleaned from a quick look at any single cathedral.”[i] This sentiment clashes with the introduction of Gothic Architecture delivered via lecture in Architectural History courses. Some of the great lessons of Gothic Architecture lie not only in the style or the spaces formed in a cathedral. Instead, lessons also lie in the fabrication and assembly of the components that form the structural system. Historically, fabricating these components required great precision in the tools and methods that made them; a precision founded in methods of trial and error. In the twentieth century, the emergence of digital tools and methods implemented a standard of both precision and accuracy in the representation of systems through digital models and their eventual fabrication. By implementing digital tools and methods to construct a gothic vault, beginning design students not only understand and demonstrate how the structure of a gothic cathedral works through the Gothic Vault, but are also exposed to lessons in precision and accuracy as they represent and construct the vault 1:1 (Fig. 1).

These lessons come as part of the coursework for ARCH 332: Building Shop in the Department of Architecture (DoARCH) at South Dakota State University. Since the initiation of the pre-professional, professional, and graduate program in the Department of Architecture five years ago, the foundations of the department have been rooted in ‘learning through making”. ARCH 332 is a required, iterative elective that is taken three times during the course of a student’s undergraduate professional study. This paper describes a set of exercises based in the Vaulting Space section of ARCH 332: Building Shop

*Fig. 1 The assembled Gothic Vault (Emily Hezeen).*

## Vaulting Space

The string of sections that comprise each Building Shop supplement the Building Arts in the DoARCH curriculum. Building Arts stem from pedagogical practices rooted in the Bauhaus by combining arts and crafts into a focused study. Each Building Shop section is lead by a different faculty member and has included topics based in tensile structures, laser scanning, cinematic architecture, etc. Each Building Shop teaches fundamentals in a tool(s), a method(s), and/or a material(s) by digging deep into a given subject in order to allow students to better understand design.

Design studio models generally (but not always) are based in the combination of tools, methods, materials, and representational practices brought into a study that emphasizes the exploration and implementation of concepts and principles through a hypothetical project. Architectural History courses typically serve as a platform for understanding and extracting these concepts and principles established by previously constructed buildings, drawings, models, and writings. Building Shops within the DoARCH curriculum work to combine these approaches into a focused study by isolating a specific tool, a method, and/or a material based in historic or contemporary practices. This approach works within tightly defined constraints and evokes training similar to apprenticeships in the crafts and trades as students learn by making.

Not all Building Shops in the DoARCH curriculum are based in architectural history nor are they based in 1:1 construction. Vaulting Space, however, engages both by using the Gothic Vault as a fundamental tool to test various methods of representation and construction upon. Throughout the coursework, tools, defined as devices for making or exploring, and methods, defined as procedures, are selected and studied through a rigorous approach. The Gothic Vault as an object and tool has remained largely consistent throughout history as a component of a larger structural system. The methods for making the vault, however, have evolved. By representing and constructing Gothic Vaults at a 1:1 scale amplifies both a historical lesson as well as contemporary digital lessons.

*Understanding the Gothic Vault*

Throughout history, the representation and construction of the Gothic Vault has shifted with the evolution of tools and methods. The first Gothic Vaults matured between the 11th and 14th centuries when master masons, geometers, carpenters, and stonecutters practiced Stereotomy, the art and science of carving solids in order to construct Gothic Vaults. In the 1760's, Descriptive Geometry gave graphic representation to Stereotomy. Representation further advanced with funicular form finding, a process made famous by Antoni Gaudí in the 19th and 20th centuries with his hanging structural models for the Sagrada Familia. While all of these types of tools and methods allowed for precision, they did not allow for accuracy. With the onset of the digital age in the late 20th century, new technologies emerged leading to greater precision and accuracy in the digital environment.

When students enter the Vaulting Space Building Shop, they enter with knowledge of how Gothic Vaults make space, but with little to no knowledge of the tools and methods that make them. Students explore the Typologies of Gothic Vaults, the Construction of the Gothic System, and Critiques of the Gothic System through readings, lecture, and discussion. John Fitchen's *The Construction of Gothic Cathedrals: A Study of Medieval Vault Erection*[2] serves to establish a foundation in medieval vaulting practices. These methods, typical of an Architectural History course, offer a background for students to refer to throughout their course of study.

*Representing the Gothic Vault*

The evolution of vaulting practices from those based in stereotomy to those based in descriptive geometry, funicular form finding, and digital modeling indicates a change in the methods used to represent the Gothic Vault. How and why did these representational methods change? During the fifteenth century a shift occurred between Gothic and Renaissance thought. A distinction between building and design was established as a result of Leon Battista Alberti's *De Re Aedificatoria*. Alberti played a significant role in establishing Renaissance concepts and principles as his approach to representation through drawings and the way space was projected reflected his new geometrical definition of architectural projection drawings (and models). He also provided a consistent set of notational tools suited to his new way of building based on representation. As Mario Carpo describes in *The Alphabet and the Algorithm*, "according to Nelson Goodman, all arts were born autographic-handmade by their authors. Then, some arts became allographic: scripted by their authors in order to be materially executed by others."[3] The notion that Architecture as an allographic art begins with Alberti, further supports the belief that architecture as a practice lies in representation.

The Gothic Vault, however, was not conceived under these conditions. Instead, the Gothic Vault was the product of centuries of trial and error in construction as well as the dispersing of knowledge among master masons, geometers, craftsmen, and stonecutters. The emergence of Descriptive Geometry in the eighteenth century offered new methods for representing the Gothic Vault and was closely followed by new treatises on stonecutting and stereotomy, such as Edward Dobson's *Rudimentary Treatise on Masonry and Stonecutting.*[4] These helped to codify the representation of the Gothic Vault as well as its main component, the voussoir. Through new arithmetic and geometric methods, the optimal dimension of a voussoir could be found and implemented in order to ensure its efficient replication within the arches of a vault.

These methods for "voussoir finding" form the basis for the *Gothic Digital Vaulting Project* in Vaulting Space. Historically, these methods were drawn two-dimensionally in order to lift measurements from the drawing sheet for application in fabricating voussoirs. In *the Gothic Digital Vaulting Project*, students are required to draft two cross sections, one for the voussoir of a diagonal, transverse, and longitudinal rib as well as the voussoir for a tierceron rib in Rhino 3d. As a software, Rhino 3d offers the ability to install plug-ins for various design parameters, renderings, as well as digital fabrication procedures. A two-foot dimension was established as the bay unit for the vault. Through a series of prescribed steps laid out in a project brief, students are asked to draft arches for two (2) diagonal ribs, two (2) transverse ribs, two (2) longitudinal ribs, and four (4) tierceron ribs. From the midpoint of the diagonal rib, sixteen lines are radiated from the center in order to determine the optimal dimensions for a voussoir in a 2'-0" x 2'-0" bay (Fig. 2).

Following the "voussoir finding", students continue to explore the Gothic Vault by making a digital model of the voussoirs that form the primary components of the vault. These components are digitally assembled into a system, labeled, and color-coded according to their position in the vault (Fig. 3). Ultimately, each student's Gothic Vault is digitally modeled the same; each consists of four Tas de Charges (gray), twenty Diagonal/Transverse/Longitudinal Voussoirs (blue, yellow, and orange), four Diagonal/Transverse/Longitudinal Keystones (red), one Central Boss (red), sixteen Tierceron Voussoirs (magenta), and four Tierceron Keystones (red).

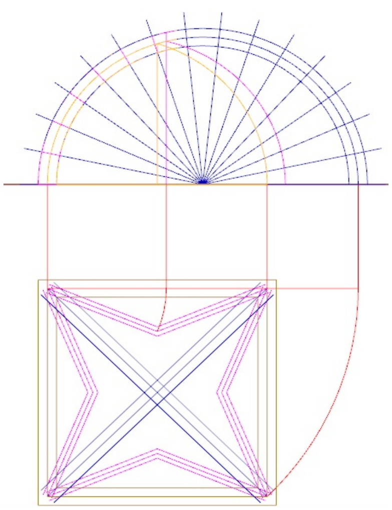


*Fig. 2 Geometric voussoir finding in Rhino 3d.*

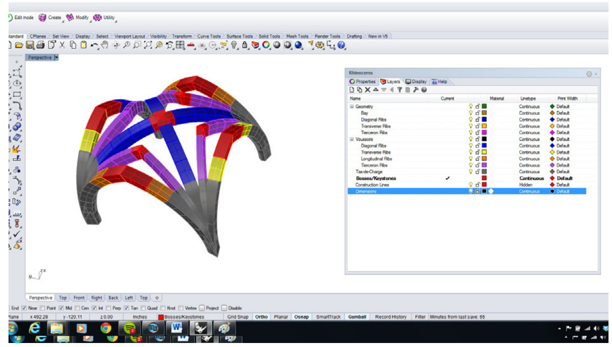


*Fig. 3 The completed Digital Gothic Vault.*

*Constructing the Gothic Vault*

To draw or model with accuracy is to represent a system as close to the true measurements as possible. By digitally modeling the gothic vault, students bring components together into a system in which all units are precisely and accurately modeled. However, it is not the digital environment that translates the construction of the gothic vault at 1:1, but rather the implementation of digital fabrication tools. In the *Physical Gothic Vaulting Project* students are paired and assigned a component to fabricate. Using digital fabrication tools such as a laser cutter and/or a CNC milling machine, students make molds from their digital models (Fig. 4). Accurate & precise molds can be modeled digitally, milled using digital fabrication tools, and components cast repeatedly using cement, hydrocal, or other forms of liquid casting materials.

Finally, students bring each component into an assembled Gothic Vault. With centering used to stabilize the vault, components are dry-stacked in order to construct arches and ultimately the vault. While mortar is not used, construction sealant ensures the voussoirs remain in place over time. Students not only learn about the components of a Gothic Vault, but also how to model, fabricate, and assemble these components into a system.

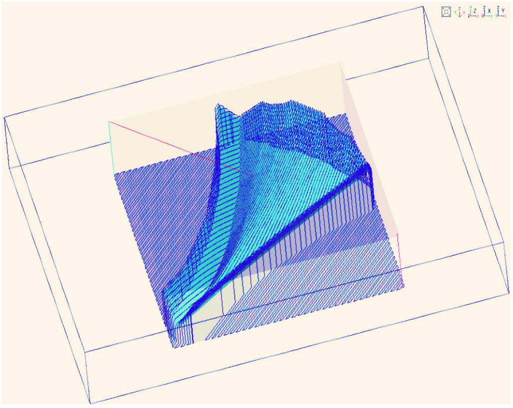


*Fig. 4 Tool paths for digital fabricating the Tas de Charge are made visible in RhinoCAM (Emily Hezeen).*

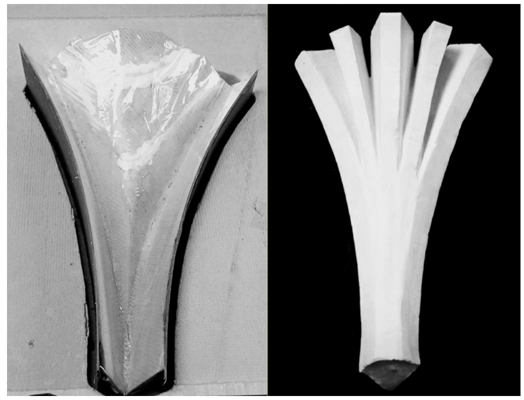


*Fig. 5 The mold and casted component for a Tas de Charge (Emily Hezeen).*

## Conclusions - Precision and Accuracy

After teaching this course over the period of three semesters, the questions and discussions that stem from these exercises suggest the beginning design student who enrolls in this course not only understands how the Gothic Vault works, but demonstrates this understanding through the use of digital modeling and fabrication tools.

Ultimately, these digital and phyiscal methods become empirical tests in the role of accuracy and precision. Students continually discuss their frustration with making a digital model accurate to multiple decimal places only to discover the materials used in the physical construction do not allow for that degree of accuracy. The tolerances within the digital model and the physical model are different. As Francesca Hughes states in *Matter, Measure, and the Misadventures of Precision*, "One of the more peculiar effects of the digitization of architectural production has been the now stable use of a degree of precision that is always redundant to the process of materialization."[5] Questions of "how accurate and precise should the digital model be" and "what is the tolerance of the material being used" are questions that are raised and should accommodate any architectural project.

Most importantly, by implementing digital tools and methods, this process initiates a pedagogical approach in translating historic methods through contemporary tools and methods (Fig 5). The implementation of tools that are both precise and accurate allow students to learn how a structural system based in a component can be modeled, fabricated, and assembled, leading to impacts on the practice and construction of architecture.

## Notes

[1] Eisenman, Peter. "Fame as the Avatar of History" in *Perspecta.* MIT Press: Cambridge, MA. 2005. v. 37. p 164-171.

[2] Fitchen, John. *The Construction of Gothic Cathedrals: A Study of Medieval Vault Erection.* The University of Chicago Press: Chicago, IL. 1961.

[3] Carpo, Mario. *The Alphabet and the Algorithm.* MIT Press: Cambridge, MA. 2011. p 16.

[4] Dobson, Edward. *Rudimentary Treatise on Masonry and Stonecutting.* Bradbury and Evans Printing: London. 1859.

[5] Hughes, Francesca. *The Architecture of Error: Matter, Measure, and the Misadventures of Precision.* MIT Press: Cambridge, MA. 2014. p 4.

* All figures are property of the author unless otherwise noted.

# Bruce Goff: A Visionary Engagement of History in the Design Studio

Francesca Hankins | Washington Alexandria Architectural Center, Virginia Tech

Bruce Alonso Goff (1904–1982) (Fig. 1), mid–western twentieth–century architect famous for his visionary architecture having been posthumously awarded the American Institute of Architects Twenty–Five Year Award for the Bavinger House (1945–50) (Fig. 2), was also significantly dedicated to architectural education. Goff taught at the University of Oklahoma's School of Architecture from 1947 to 1956, becoming Chairman of the program just one semester after his initial arrival on campus. Eric Mendelsohn wrote after his visit to campus,

> Bruce's school is excellent and far superior to Berkeley. Very deeply involved in 'elastic structures' and full of remarkable people. Although it is far from the main currents of this country, one has the feeling of being at the heart of the pulsating field of force in a new epoch.[1]

During Goff's tenure at UO, the school developed an international reputation identified with his philosophical outlook based on freedom of individual self-expression with a pedagogical premise that each student had the potential for creativity.[2]

Philip B. Welch, architect and former student wrote:

> Bruce Goff had all the qualities of a great teacher. He was an excellent communicator, he demonstrated by his own creative work what could be achieved in architecture and painting, he was always available to students, and he left students alone to develop architectural forms and ideas.[3]

There was no distinction between Goff's teaching methodology and his design work. The underlying principle of his work was in his own words, "not a matter of creating a beginning, a development, and an ending. These are things we learn from history, and as Gertrude Stein says, 'Let me recite what history teaches, history teaches.' You see. It does."[4]

*Fig. 1 Bruce Goff, Norman, OK, 1947*

*Fig. 2 Bavinger House, Norman, OK, 1955*

Goff believed that there was nothing new in design for all of it has been known for thousands of years, but what is new is that each time we discover something, in his words, "we become part of the *continuous present* as everything continues to change according to life's purpose."[5] In other words, Goff believed that by looking deeply into a work there will always be some fresh relationship you can sense in its parts and by looking into a composition—giving it depth, one finds another dimension of meaning. Therefore, you look into the work just as you would nature.[6]

Goff taught his students that the process of designing a building was one of self-discovery, and that personal growth was vastly more important than an adherence to a particular architect or architectural movement."[7] However, this vastly understates Goff's theoretical ideas he learned from many sources, such as Louis Sullivan, Claude Bragdon, Frank Lloyd Wright, Antonio Gaudi, Erich Mendelsohn, the Prairie School, and countless others in which he assimilated into his own design work.

In an interview from March 11, 1953 Goff talks about how he arrived at his design solutions and how they developed.[8] He recites that while working at the Rush office, he noticed that whenever "Mr. Rush designed anything he went over and opened a cabinet that he always kept locked. He would pull out a dog-eared magazine and would peek in at it and look carefully [to see] if anyone was watching. Then he would go over and draw like mad. He would put the magazine back in the cabinet and lock it. This secrecy intrigued me, so I watched [for] my chance. One day he went out for lunch and left the cabinet unlocked, I stayed on and got into the jam. I looked into this magazine. It was the March 1908 issue of *Architectural Record*. It was the first comprehensive showing of Mr. Wright's work anywhere. It was the first I saw. Of course, it knocked me for a loop."[9] Goff continued to describe his experience in reading the article "In the Cause of Architecture," which he felt was Wright's best exposition. "That was my bible and I could have recited every word of it then. I never copied any of his work, but I couldn't help feeling the impact of it. Every line I drew looked as if I had copied it straight out of the book, while I really hadn't."[10] What Goff did throughout his career was to synthesize the many influential sources and combine into his own original statements.[11]

*Architectural History in the Design Studio*

In 1990 Stanford Anderson hypothesized of an increasing separation between the discipline of the history of architecture and the discipline of architecture. By *discipline*, he clarified by suggesting what he believed "should rightly be inclusive enterprises: the potential concern of every person—not just professionals—with all aspects of our physical environment. Indeed, the professionalism of the fields of history and of architecture contributes to the divorce of one from the other, and of both from the broader domain of concerns about our physical and social environment."[12]

And, in a later article, Anderson asked: "Is history germane to architectural production, or education? Or not?" He suggested that if it is then its value may be as a "source of critical insights into the position of architecture in society."[13] The debate on the relationship between history and design goes back to the 1960s.

Prior to World War II, aside from a few exceptions such as the Bauhaus, architectural history was at the core of the design studio.[14] But, the post-war Modern Movement completely broke with the architectural past in favor of rule-based design methodologies derived from a techno-rational positivist view.[15] Design became a mechanistic response to instrumental needs and history was viewed as irrelevant[16] If history was included, its role was to follow the historiographical notion that the study of the past logically unfolded into the present which would offer designers an appropriate language.[17] Therefore, references to history would generally be presented as precedents to emulate, often superficial and unrelated to context.[18]

Goff rebuked most architecture schools as not permitting students to have ideas of their own in favor of emulating the expressions of the International Style which was emerging in the late 1940s and 1950s. Goff felt this emphasis on visual style alone was devoid of any emotional content or diversity of expression with which a particular environment aspired to.[19] Critical to architecture was the process of discovey in order to arrive at the honest expression of an idea.

Why is the integration of history important in architectural design education? According to Alberto Pérez-Gómez, the importance of history is one of hermenuetics in which stories of the past can used and translated into our own questions, which assist us in designing our environment from an ethical point of view."[20] In an interview with the *Journal of Architectural Education*, he says:

> Architecture does offer something specific. It has something to do with us finding a place that is ordered, that speaks back to us, that allows us to dream, that orients us, ... like a metaphysics that is

> made into material, that allows the inhabitant / participant to find his or her own place in the world in relation to an institutional framework, wherever we may be in time and space. There is something very basic that architecture does offer and has offered throughout history because the questions that architecture addresses are resonant with the big questions of mankind.[21]

In sum, what matters is how we go back and engage with the past work or text — "text" to indicate anything that conveys *meaning* and bring its relevance into the present.[22] This interpretive framing of historical material helps us to find and wrestle with important social and cultural questions today.

### *Goff's Design Philosophy*

The University of Oklahoma's architectural school's developing pedagogy reflected Goff's philosophy of architecture.[23] He believed that most schools of architecture were engaged in a "'new eclecticism'" that allowed for indiscriminate appropriation of ideas from the masters, which led to "lifeless imitation."[24] Rather, students should have a critical understanding in order to "distinguish between inspiration, influence, and imitation. Great works of the past, as well as nature, might inspire or influence a design, but the principles must be understood and assimiliated to produce an authentic work."[25] For example, Goff recounted how Frank Lloyd Wright would criticize those who would imitate his work. For both Wright and Goff it was important to be influenced and inspired, to study the underlying principles, but ultimately find one's own way.

In 1953, Goff gave a lecture at the university entitled, "The New and Different in Architecture." He was addressing the schools' reputation as being "something strange and New and Different."[26] What he was referring to was unlike many schools in the 1940s and 1950s who, in his view, followed limiting and rigid design principles—derivative expressions of the International Style,[27] designers should "approach each problem with an open mind ... so that new ideas can come into it—an then some of these ideas retained for our creative work where a position can be established in regards to something we are doing, some principle at stake ... can come through the work."[28] For Goff, an open mind generating ideas was all part of growing which entailed change, as "it is only through change that we can keep growing ourselves, and we can keep our art alive."[29]

### *Continuous Present*

Influenced by Frank Lloyd Wright, Goff would speak about how buildings should have a sense of order—an *idea*, also recalling Louis Sullivan. Wright, and now Goff use the Japanese word *ed-aburi* to mean the "formative arrangement of the branches of a tree."[30] In other words, "the sense of order in the design of a particular kind of tree that you would find in the arrangement of its branches ... this sense of order isn't just in the differences of the kinds of leaves; it carries through the textures, all the way through ... In nature you find that almost everything has its own kind of order."[31] And further, "what comes out will have a sense of order and unity with freedom and discipline."[32] For both Wright and Goff, this sense of order was "organic."[33]

Similar to Wright's "organic architecture," Goff would develop what he called the "continuous present." His first recorded use of the term was in 1933 with the goal of designing "architecture not of the past or future, but for the continuous present."[34] Goff credited Gertrude Stein (1874—1946), with the term "con-tinuous present" for his belief that "architecture should express change as much as permanence and he sought for architectural metaphors for the fluidity of time." Similar to Stein's "continu-ous present," Goff's was a composition lacking a conventional structure – or more "more particularly lacked an ordinary se-quence of beginning, development, and end."[35] Goff wrote in regards to his design for the Bavinger House: "I wanted to do something that had no beginning and no ending. Gertrude Stein says we begin again and again; this house begins again and again. She talks about the sense of not being in the past, pre-sent, or future tense, but in the 'continuous present.' I was thinking in those terms."[36]

As early as 1933, Goff prepared the initial manuscript he hoped to publish describing his initial theory, "*Thoughts on Housing as Architecture*", which slowly developed into "*Forty-four Architec-tural Realizations*."[37] Goff wrote of "change" as a necessary component of architecture, and similarly "transformation" as the "natural process of evolution." Goff explored the relation-ship between humanity and the universe, as the necessary re-flection on the condition and relationship of habitation, and ultimately the relationship to civilization. He was interested in the search for the "Individual" spirit of architecture, not in the polemical debates regarding the "new" modern architecture. The *Continuous Present* began as "free architecture:"

> Now since architecture has not yet emanci-pated itself from the forms of the Stone Age, it has been limited to horizontal, vertical, and

> circular expression. It is not my wish that we abandon these forms, but let us explore the others! Another drawback to freedom is found in the tools with which the architect works. On a flat surface of pale paper or linen, he uses a t–square for horizontal lines, triangles for verticals, and a compass for arcs and circles, and finely pointed pencils and pens for drawing lines. He is not, and consciously becomes theirs. And the result is lineal.[38]

In the above quote Goff claims a break with traditional architectural rules which recalls Wright's equally deliberate break in order to be more true to tradition than current conventions and ideals of architecture would permit.[39] Goff's position reflected that of William James' pragmatism rejecting the universal solution to be more appropriate than the real.[40] However, even though Goff's idiosyncratic designs suggest otherwise, many projected a clear geometric organization. Goff's use of geometry would come from many sources and influences. His father was a jeweler and so he may have had access to crystalline rocks and semi-precious stones which were easily found all over the American south-west.[41]

The 1974 version of the manuscript summarized his principles, now a more "complete system" for architecture following "organic law and order called 'the continuous present.'" Organic defined as "that which grows within outward through the natural use of materials so that form is one with function."[42] Contrasting the modernistic bleakness of the early twentieth-century, Goff found hope in Organic architecture as "rich in the divine spirit of a new consciousness."

*Bavinger House (1945–50)*

The physical epitome of Goff's continuous present is found in the Bavinger House (Figs 3 & 4). It exemplified the early Organic architecture within the Modern Movement. The house "spirals joyously into the Oklahoma sky, cut loose from the earth by a mind as free as the prairie landscape, a celebration of the spirit of man and nature united in architecture," and "superbly integrates" the inspirational principles of the organic spirit of a playfulness amongst the natural elements water, earth, sky, and fire.[43] It profoundly exhibits Goff's sensitivity to its unique cultural and environmental conditions using local building materials and the inherent landscape of the Midwest.

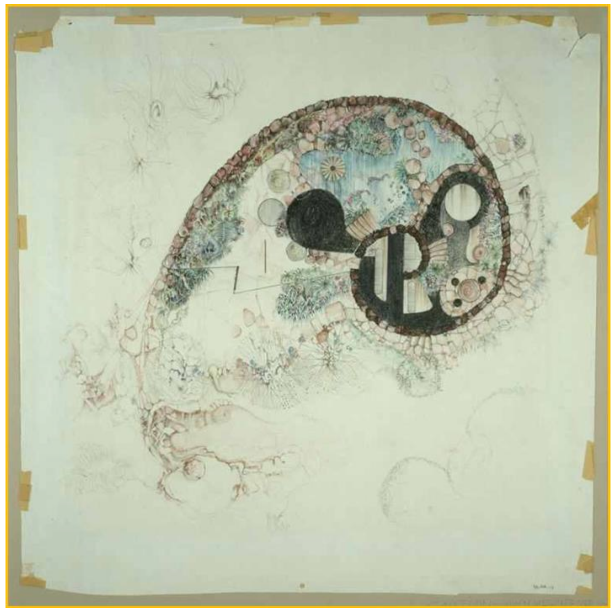


*Fig. 3 Bruce Goff, Bavinger House, Norman, OK, 1947; first floor plan.*

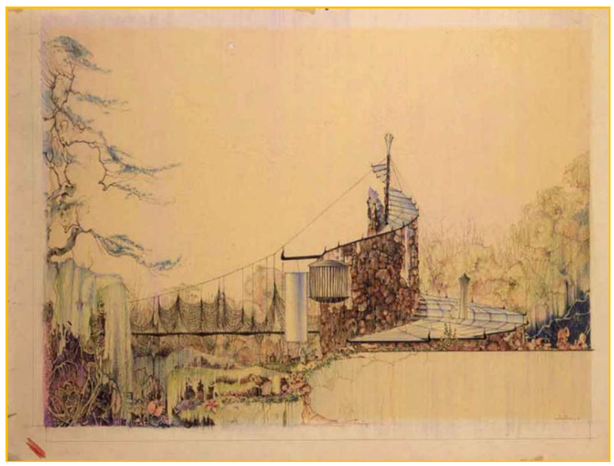


*Fig. 4 Bruce Goff, Bavinger House, Norman, OK, 1947; perspective drawing.*

Goff's principle method in lecturing was in anecdotes—usually humourous stories.[44] During an invited talk at the University of Santa Clara, Goff recounts the story of when Alfonso Iannelli gave a talk at the University of Oklahoma. The Bavinger House had just been completed and someone who hated the house stood up and asked "if he thought an architect was justified in making a client live in a spiral ... Mr. Iannelli responded, "'Well, I suppose you are referring to the Bavinger House, and I see Bruce out there in the audience, so how would you answer that Bruce?" Bruce Goff, architect of the Bavinger House deferred the question to the house's owner also in the audience, Gene Bavinger, who said, "'You know, I resent the question, because it implies that my wife and I are a couple of stupes that had no idea of what we were getting into, and that we were forced into this design by someone. It is true we never dreamed we would live in a spiral, never thought of it. We told him what we wanted, what we liked, what we didn't like, and it ended up with a spiral, and we are damned glad it did.'"[45]

In telling this story, Goff's aim was to demonstrate that each of his projects were designed for specific conditions of client, site, materials, and so forth, and not according to the architect's own justifications. Similar to Wright's conception of organic architecture in which each home designed would be as different as the people who lived in them, but dissimilar in that Wright created a "style" with countless combinations.[46]

As both a teacher and an architect, Bruce Goff believed that architecture concerned principles beyond mere habitation. He designed by integrating characteristics that honored both site and client, that expressed structure, plan, as well as historical archetypes in order to express a new aesthetic sensibility.[47]

## Notes

[1] Eric Mendelsohn, *Letters of an Architect*, ed. Oskar Beyer, trans. Geoffrey Strachan (London: Abelard-Schuman, 1967), p. 179; as quoted in David G. De Long, *Toward Absolute Architecture* (Cambridge, MA: MIT Press, 1988), p. 88.

[2] Arn Henderson, "Teaching the Organic," This Land (November 28, 2011): 1–3, accessed February 4, 2015, http://thislandpress.com/11/28/2011/teaching-the-organic/

[3] Pauline Saliga and Mary Woolever, eds. *The Architecture of Bruce Goff, 1904-1982: Design for the Continuous Present.* Exhibition catalogue (Chicago, 1995): 57.

[4] Bruce Goff, "The Continuous Present in Architecture," in *Goff on Goff: Conversations and Lectures*, ed. Philip B. Welch (Norman & London, 1996): 191–225.

[5] Ibid., 206.

[6] Ibid., 198.

[7] Ibid., 7.

[8] Bruce Goff, "Goff's Creative Growth and Design Philosophy," in *Goff on Goff: Conversations and Lectures*, ed. Philip B. Welch (Norman & London, 1996): 17–38.

[9] Ibid., 19–20.

[10] Ibid., 20.

[11] David G. De Long, *Toward Absolute Architecture* (Cambridge, 1988): 3.

[12] Stanford Anderson, "Historiography and Architecture I," *Journal of Architectural Education* 44, 3 (May, 1991): 130, accessed December 12, 2015, http://www.jstor.org/stable/1425260.

[13] Stanford Anderson, "Architectural History in Schools of Architecture," *Journal of the Society of Architectural Historians* 58, 3 (Sep., 1999): 282–290, accessed December 12, 2015, http://www.jstor.org/stable/991520.

[14] Adrian Snodgrass, "Designing Amnesia and Remembering History in the Design Studio," *Architectural Theory Review* 8, 2 (2003): 1–16, accessed October 4, 2015, http://dx.doi.org/10.1080/13264820309478481.

[15] Ibid., 2.

[16] Ibid., 3.

[17] Carla Eyvanian, "Teaching History to Architects," *Journal of Architectural Education* 64, 2 (March 2011): 25–36.

[18] Adrian Snodgrass, "Designing Amnesia and Remembering History in the Design Studio," *Architectural Theory Review* 8, 2 (2003): 1–16, accessed October 4, 2015, http://dx.doi.org/10.1080/13264820309478481.

[19] Arn Henderson, "Teaching the Organic," This Land (November 28, 2011): 1, accessed February 4, 2015, http://thislandpress.com/11/28/2011/teaching-the-organic/.

[20] Saundra Weddle and Marc J. Neveu, "Interview with Alberto Pérez-Gómez," *Journal of Architectural Education* 64, 2 (March 2011): 76–81.

[21] Ibid., 77.

[22] Adrian Snodgrass, "Designing Amnesia and Remembering History in the Design Studio," *Architectural Theory Review* 8, 2 (2003): 1–16, accessed October 4, 2015, http://dx.doi.org/10.1080/13264820309478481; Adrian Snodgrass and Richard A. Coyne, *Interpretation in Architecture: Design as a Way of Thinking* (New York: Taylor & Francis, Inc., 2006).

[23] Arn Henderson, "Teaching the Organic," This Land (November 28, 2011): 1–3, accessed February 4, 2015, http://thislandpress.com/11/28/2011/teaching-the-organic/.

[24] Ibid., 1.

[25] Ibid., 1.

[26] Philip B. Welch, ed. *Goff on Goff: Conversations and Lectures* (Norman & London: University of Oklahoma Press, 1996): 109.

[27] Arn Henderson, "Teaching the Organic," This Land (November 28, 2011): 1, accessed February 4, 2015, http://thislandpress.com/11/28/2011/teaching-the-organic/.

[28] Philip B. Welch, ed. *Goff on Goff: Conversations and Lectures* (Norman & London: University of Oklahoma Press, 1996): 109.

[29] Ibid., 82.

[30] Frank Lloyd Wright, *In the Cause of Architecture*, ed. Frederick Gutheim (New York, 1987): 53; Philip B. Welch, ed. *Goff on Goff: Conversations and Lectures* (Norman & London: University of Oklahoma Press, 1996): 40.

[31] Philip B. Welch, ed. *Goff on Goff: Conversations and Lectures* (Norman & London: University of Oklahoma Press, 1996): 40.

[32] Ibid., 42.

[33] Frank Lloyd Wright, *In the Cause of Architecture*, ed. Frederick Gutheim (New York, 1987): 53.

[34] David G. De Long, *Toward Absolute Architecture* (Cambridge, 1988): 303; Bruce Goff, "Thoughts on Housing as Architecture, Prepared for Alfonso Iannelli and his Associates" (unpublished manuscript, October 28, 1933), 11 pages, not paginated.

[35] David G. De Long, *Toward Absolute Architecture* (Cambridge, 1988): 303.

[36] Paul Heyer, *Architects on Architecture: New Directions in America* (New York, 1966): 517; as cited in De Long, 303.

[37] Bruce Goff, "Thoughts on Housing as Architecture, Prepared for Alfonso Iannelli and his Associates" (unpublished manuscript, October 28, 1933), 11 pages, not paginated.

[38] Ibid., n.p.

[39] Frank Lloyd Wright, *In the Cause of Architecture*, ed. Frederick Gutheim (New York, 1987): 123.

[40] Herb Greene, "Recollections of Bruce Goff as Teacher," in *AD Profiles 16* 48, 10 (1978): 55–62.

[41] John Sergeant, "Bruce Goff, the Strict Geometrist," in *AD Profiles 16* 48, 10 (1978): 55–62.

[42] Bruce Goff, "Forty-four Architectural Realizations," Unpublished manuscript (Art Institute of Chicago, 1974): n.p.

[43] David Pearson, New Organic Architecture: The Breaking Wave (Berkeley, 2001): 1.

[44] John [44] John Sergeant and Stephen Mooring, eds., "Bruce Goff," *AD Profiles 16* 48, 10 (1978).

[45] Philip B. Welch, ed. *Goff on Goff: Conversations and Lectures* (Norman & London, 1996): 192.

[46] Stephen Mooring, "A Starting Point: Bruce Goff and his Clients," in *AD Profiles 16* 48, 10 (1978): 15.

[47] Herb Greene, "Recollections of Bruce Goff as Teacher," in *AD Profiles 16* 48, 10 (1978): 55–62.

# Maison Recette: A Computational Pedagogy

Frank Jacobus, Marc Manack, Jon Boelkins, Alison Turner | University of Arkansas

As Charles Moore so eloquently stated in *The Place of Houses*, "establishing a territory for habitation, physical and metaphorical, is the prime basis of architecture."[i] The single family house has been, and continues to be, a key instrument through which architects consider and test meanings in human habitation. Through a project delivered in our second-year design studio, we explored the single-family house as an early pedagogical tool for students to understand how the qualities of architecture result from a computational logic of fundamental relationships of cause and effect emerging from the transformation of internal and external conditions.

As a beginning design studio we believed it vital to introduce the students to effective precedent search techniques, drawing as both an instrumental exploratory and representation method, and finally a simplified design process that allowed them to get their feet wet without overwhelming them choice to early on.

## A Hard Look at Precedent

So often in our studios we employ deeply flawed precedent search processes. In the best case scenarios students ask questions about the underlying causality of form in relation to program, site, and other considerations but then do not explicitly and directly use that knowledge to inform strategies for their own eventual work. We hope instead for eventual intuitive regurgitation of the vast array of precedents researched. In the worst case scenarios students simply analyze form with no honest questioning of causality and therefore can only hope to gain what appears to be a mystical understanding of form without the benefits of questions and answers about underlying intentions. This is an unacceptable way to teach beginning design as it does not empower the students to act in accord with other potentially great past actions that exist in abundance in their discipline. Lastly, most precedent methods that we've employed or experienced do not allow an effective cross-comparison and categorization of ideas. This may be implicitly done in normative precedent approaches but we were determined to make the process more explicit.

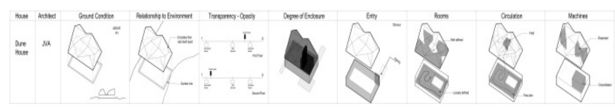


*Fig. 1 Single Student Row from Precedent Matrix*

Keeping the past precedent analysis failures noted above in mind while constructing this project we determined that we needed to employ a more rational and scientific process to the analysis of existing form. We began the project with a precedent search wherein the students were asked to categorize sixty seminal houses with respect to a given series of predefined characteristics (positioned in relation to ground, gradients of interiority, etc.). This act of analysis, accomplished through plan, section, and axonometric diagrams, were populated into a matrix that allowed a cross-comparison of these houses from the four studio sections and also acted as a living document to frame discussions of student design work. This diagramming process was a way for students without much experience to understand complete works of architecture before they took on their own projects, and it gave them diagrammatic tools to use once their design process began.

## Project and Program

Given a simplified house program of approximately 1,200-1,400SF, the students were assigned specific constraints related directly to the precedent matrix regarding the house's relationship to the ground, to its immediate environment, its interior/exterior nature, etc. Concurrently they worked from a list of operative methods (aggregate, overlap, interlock, carve, etc.) as a means of designing and constructing within their given constraints. This process enabled them to transform the internal functions of the house and its relationships to the external environment to create form and space with specific effects that took lessons from architectural precedent, showing how new architecture extends concepts and effects (knowledge) from the great work of the past.

We chose house as a program type for several reasons. First, houses are a typological space with which each of our students is intimately familiar. This is an asset because the types of spaces and how they function within houses are simple and clear. The risk of this program type stems from this familiarity. Depending on the particular type of experience of house that each student has had, there potentially could be preconceived notions that disrupt inventiveness brought to the program. We combated this through our rigorous precedent search and the assignment of operations and ground conditions. These givens often radicalized our student's approaches in a way that didn't afford them the opportunity to rely on their preconceived notions of house. In this way, we benefitted by the programmatic familiarity without being overwhelmed by house as a culturally iconic suburban form.

Scale was also a factor in choosing house for our program. This in many ways is the first normative architectural design problem that these students would encounter during their academic careers. We wanted this project to be small and manageable enough so that program and scale didn't become a burden to the design process. The recognizable nature of the program as mentioned above and the relative small scale allowed for a focus on precedent, form, and space that may otherwise not have been possible. Time was also a serious consideration in the project as we had determined as a faculty that we wanted the students to work on three projects during the semester.

Finally, house is where many architects make their initial reputation in the discipline and there are countless inspiring precedents to learn from. This made the project more romantic for our students which we believe inspires them to action in positive ways.

## Process

The students were assigned one of four potential ground conditions to work with; under, in, on, over: the four conditions of architecture described by Steven Holl. We then visited our relatively large building site and showed the students three potentially areas that they could select from to construct their house. The ground conditions were a nice limitation for the students which forced in some cases exaggerated conditions that then had to be dealt with through design. For instance, students who were given 'under' as a ground condition had to situate their dwelling underground and therefore necessarily had to use the operations mentioned above to bring light, air, view etc. to the house. Initially, most of the faculty believed that the 'under' and 'in' conditions would be difficult for the students; a disadvantage in their conceptualization of the project. In retrospect, the more seemingly difficult the given ground condition the more interesting and therefore successful the project. Ultimately, working with the ground itself and understanding the ground as part of the construct, enriched those projects more than others who did not have the same constraints. Some of the more advanced students who were given 'on' or 'over' as a site condition seemed to understand this and so actively engaged the ground in ways that created interesting partnerships between the house and the land.

Working individually primarily through model the students selected a portion of the larger site on which to construct their house. Typically we would meet in our individual studio sections in groups of 4 or 5 students that shared the same ground condition. This allowed us to have discussions about shared issues within the projects and offered the opportunity to see how each student was dealing with a similar ground condition. Eventually each section began to mix the pairings in the studio, sometimes by operation and sometimes random, so that the students got to hear a diverse range of issues being discussed.

## Student 1 – Above

An initial rectilinear volume large enough to accommodate the basic program of Maison Recette was assigned as point of departure along with a ground condition and a series of formal operations. Students were asked to consider using the spatial operations they were assigned, or additional ones that they selected, to modify the relationship to the ground. In effect, the original volume began completely above the ground, with no part of it touching. The process of fracturing allowed the volume to begin to negotiate the varying topography of the site; in this case the presence of an existing barn foundation and adjacent ravine.

The simple break that the fracture produced was challenging to maintain. As the program was systematically resolved inside the fractured volume, the conceptual clarity of the form was regularly compromised. The overall proportions and scale were of the exterior volume were then adjusted to properly contain the program. This back and forth worked the program against the form and vice versa through a series of iterative drawings and study models of increasing scale and complexity. Throughout the process, the conceptual clarity of the original formal studies was used as a reference and check against the increasing complexity of the evolving design. Perhaps the most challenging aspect for the student was the resolution of circulation within a relatively complex form. Since the drawings and initial models didn't allow students to 'get inside' their projects (and none built three dimensional computer models) larger section models were built to enhance visualization of the interior and resolution of the circulation.

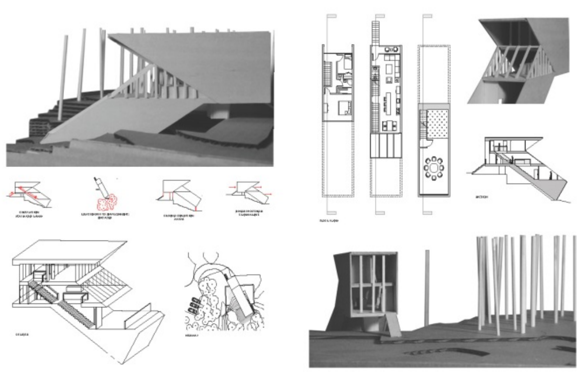


*Fig. 2 Student 1, Example of 'Above' Condition Project*

A significant outcome for the student was the illustration of how dedication to a concept in the process of incorporating programmatic relationships and complex site conditions can produce clarity. The initial operation remained evident in the final drawings and models. A significant surprise in the process was that the final model was capable of being rotated into a number of positions, with seemingly equal success. In effect, the power of the initial operation was independent of orientation.

## Student 2 – On

This project began with the *on* condition, and sought to create an exterior appearance of disengagement from the site while inverting that relationship on the interior. The student arrived at the cylindrical figure in plan for the possibility of its distinction from the environment as well as its indifference to view shed on approach. She then sited the house at the bank edge between upland to lowland, giving it the appearance of sliding off the slope in suspended animation, asserting independence from the ground it rests on.

Once inside the house is organized fairly conventionally as corridors and rooms, with each space attempting to offer dramatically different experiences. The corridors are encased in opaque interior walls that are contrasted by a field of small windows on the roof and exterior wall. Once in the main living spaces, the wrapping envelope frames unique views of the surrounding forest and fields. Using the operation *bend*, the student enhanced the unique spatial quality of each space while unifying the atmosphere of the circulation spine.

For this student, the operative logic in the work became a heuristic. As the process unfolded and the project developed, she allowed for flexibility and interpretation in the use of the term without being dogmatic--when it works, use it, when it doubt, try something else. The important lesson for her was the discovery that architecture necessarily involves an ensemble of techniques, and cannot be reduced to a big idea or single operation.

## Student 3 – In

One of the three available building sites within the larger property was an old barn foundation. The barn had recently burned but a generous, 8 foot deep foundation remained. The open side of the foundation looked upon an ideal hilly landscape with trees and a creek in the background. The closed side of the foundation was along the high side of the earth and happened to be adjacent to where one would enter the larger site.

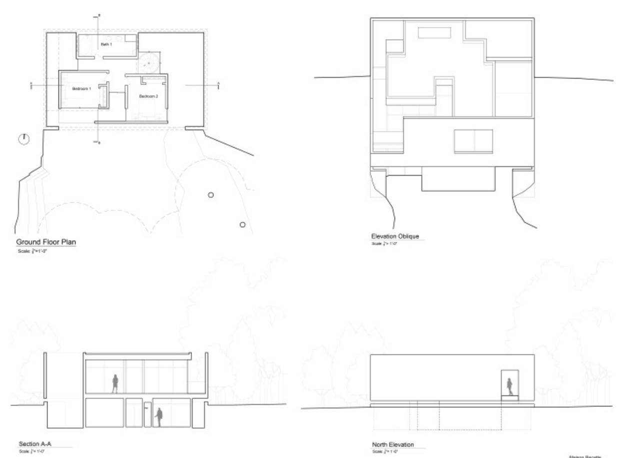



*Fig. 3 Student 3, Example of 'In' Condition Project*

This particular siting choice along with the student's operational choice of 'aggregate' allowed a visible public presentation of what appeared to be a one-story dwelling along with a private two-story revelation at the opposite end. The operational condition of 'aggregate' was used to situate distinct programmatic volumes, offset from one another, while a simple wall that wrapped the entire perimeter at the level above the foundation wall was used to conceal the offset conditions beyond. This particular arrangement created a privatization of dwelling, especially as regards the visual perception by the public and created interstitial spaces between the wrapping wall and the offset volumes within. Offsetting allowed for new smaller voids to establish light filled spaces that looked onto unique and private courts within a larger walled enclosure.

This is an example of where the site condition, paired with a particular operational requirement, manifested creative opportunities for the student that otherwise would not have existed. It is an example of how a few appropriately structured project constraints can actually enhance a creative approach. Instead of personalizing the conditions as would normally happen in this type of project, the student begins to look more objectively at the work as a series of given constraints that they have to affectively operate within.

## Student 4 – Under

This student started with two given conditions: the ground condition was to be *under*, meaning that the majority of the structure should be below grade, and environmental response will be to have moments of *connection* and moments of *disconnection*. With those two givens, he explored several different formal operations to create the spaces for the house. He looked at *branch*ing and *lift*ing the spaces, both of which proved somewhat challenging with the underground condition. Other more successful iterations included *skew, shear, split* and *notch*. In the end he chose to work with notch, as it created the most interesting result of the three ideas.

For him, the operation of *notch*ing was to make three indentions (or notches) in the landscape which became the three main spaces of the project: the bedrooms, the kitchen and dining room and the living room. The spaces were then connected by a series of hallways that remained entirely submerged. The three notched spaces reveal themselves on the surface in various ways. Connecting and disconnecting to the environment helped him organize the spaces on the site and allowed him to create a dynamic sequence of events. One enters the project from a parking area at ground level and descends down a staircase underground. A series of skylights lead you further into the space towards the kitchen and dining area with an adjacent sunken exterior court providing the only natural light in the space and a view towards the sky. As you progress further into the house, you reach the living room, which the student located where the site dramatically slopes towards a creek and allows the only full view of the wooded site from the interior of the house.

This project was very successful in using the given conditions and the formal operation to control how he sited the project, how he organized the spaces, and how he introduced natural light and controlled views. In past projects this student has a difficult time making decisions, but this process streamlined that part of the project and gave him an overall sense of clarity. One of the negatives of this particular project, was that because the idea was discovered quickly, he had a difficult time progressing past the initial diagram.

## Drawing

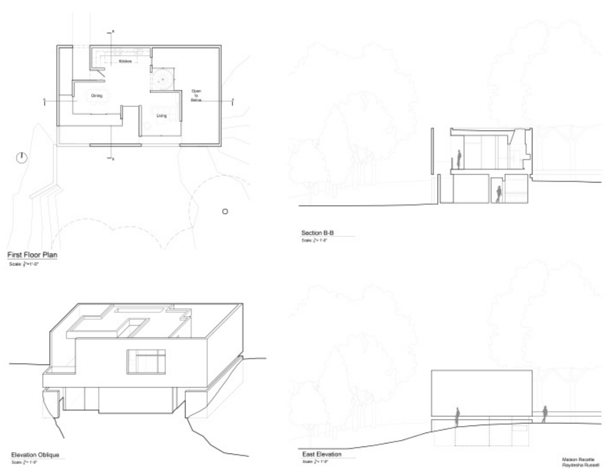



*Fig. 4 Representational Drawing Example*

It is important to state that our second year students are actively learning how to draw and represent work. They are still relatively new to drawing as a means of exploration and drawing as a means of representation. The precedent part of the project discussed above was a way for our students to use similar drawing techniques, that they were learning for the first time, to enable a cross-comparison of various precedents. This allowed a clearer comparison but also forced the students to determine what the most effective drawings were for the information and ideas they were trying to communicate. Learning this palette of drawing types also allowed the students to have more tools to work with while moving through their design process. Knowing that they communicated precedent findings in an axonometric drawing for instance meant that they could use the same or similar technique for representing new ideas in their own project. Drawing also became a representational tool and we worked hard on a basic framework for how to clearly articulate space. Learning line weight and line types as vital communicative mechanisms means that our students can speak our disciplinary language clearly and therefore have heightened discussions with faculty about their intentions. In this way drawing becomes an active and deliberate mechanism of communication in the studio; where ideas may have been verbalized before, we demand that architecture be communicated and understood through drawing and model.

## Conclusion

This project purely explored form and effect. While specific material speculation was not a concern, dimension and scale were emphasized. As opposed to considering named materials, we were instead interested in quality as it pertains to the phenomenal characteristics of built form; porosity, transparency, translucency, opacity, visual weight, rhythm, texture, etc. Out of this project we developed a new matrix, similar to that of the precedent research, of our own Maison Recette forms. Student projects were grouped at the final review in relation to where they fit within the matrix, allowing a discussion of not only the students houses in relation to one another, but more importantly, of their houses in relation to the seminal precedents with which they had grown intimately familiar. We consider this a new computational model within our pedagogy which engages history, primarily through the lens of form and effect, in order to educate young architects to speculate within the rich preexisting languages that the built environment has to offer.

---

[i] "The Place of Houses"

# Sketching Insights into the Past: Visual Notes

P. Jeanne Myers | University of Memphis


## Abstract

In an effort to reinforce sketching skills and drawings techniques emphasized in design studios, as well as emphasize projects studied in the two semester History of Architecture series, a project of visual notetaking was designed. Within this project, hand drawings are presented as an integral part of note taking in History of Architecture classes; the project is designed to help students practice sketching on a daily basis as well as process the multitude of project images explored within architecture history classes. While it is important for students to discuss and contemplate the projects considered in the class, they are also challenged to create quick sketches and diagrams to help them better understand the essence of the built environment being studied in class as well as viewed around them. It is through these weekly explorations in which concepts and patterns begin to emerge, thus bolstering lectures and readings.

Each week, students turn in an assignment capturing and documenting the past week's readings, lectures, and other observations. These weekly projects are also scanned for future use; at the end of the semester a digital file with a complete course worth of work is available for student and faculty scrutiny. As with most things, the weekly, if not daily practice of drawing over the course of a semester works to bolster the confidence and skill of students. The ability to see the entire semester's work in one sitting at the end of the course, demonstrates to the student the growth of their sketching ability as well as serves as a master study guide for the final exam.

The project is in its third class of students and has produced some interesting outcomes, as well as highlighted areas for improvement. Successive years have built upon the more successful parts of previous projects while additional requirements have been altered to fit class and student needs. These changes have allowed the project to be ever-evolving across the two semester courses, as well as incorporate the summer break. A study of the work produced shows an increase in hand drawings abilities in those students who consistently completed the project, as well as a better retention of the material evidenced through higher test scores. The overall intent of the project was to assist beginning students in applying and improving their drawing skills as well as develop critical note taking skills. Based on these goals, the project has proven successful and is being utilized independently by students in other classes in an effort to aid in studying and in overall material retention.


## Visual Notes – Context and Background

The Department of Architecture at the University of Memphis is a 4 + 2 program; the undergraduate degree is a Bachelor of Fine Arts in Architecture. As with most architecture programs, this program is an intense course of study for most students. To assist them in their transition into the program, the first semester of First Year is focused on introduction to design. The second semester of First Year is where students enter the History of Architecture classes, covering buildings, sites and trends from prehistoric times through roughly 1900 in History of Architecture 1 & 2.

After teaching History of Architecture classes for several semesters, with a wide range of outcomes, there was a desire to find an assignment which would incorporate sketching. Searching for a project which would assist students in note taking, encourage additional exploration beyond class time and be more than an essay or research paper, several architecture history syllabi were found which required sketchbooks as a part of class work. In addition, the books *Visual Notes* and *Back of the Napkin* came up in web searches. The ideas presented in both books made sense for the very visual nature of architecture history class. "Visual Notes: the ability to record visual information which enhances and expands our knowledge, understanding, and effectiveness in a rich and complicated world.”[1] This quote from Crowe and Laseau became the essence of the Visual Notes Assignment; synergizing sketchbook assignment with graphic note-taking for lectures.

*The Assignment*

The Visual Notes assignment is introduced and begun on the first day of class. The overall assignment is viewed as weekly summaries of readings, lectures, discussions, personal observations, and research. This information is scanned to PDF for future reference by the student and the original is submitted for grading weekly on an 11” x 17” format. A project statement is provided to all students with guidelines for the assignment; all work is to be hand-drawn on one side of the paper. Student’s name and the due date are written on the reverse so work can be displayed at a later time. Since the assignment is called Visual Notes, it is expected that the majority of the information be in a graphic format and should include diagrams, plans, sketches, elevations and sections. Text is permissible as a supplemental tool to better understand the graphics. Inclusion of vocabulary words as well as buildings site and building forms are encouraged to gain a better understanding of the terminology used.

*Goals and Objectives*

Three goals for the Visual Notes assignment include; bolster information from readings and lectures, reinforce sketching skills and drawing techniques used for this and other classes, and increase note-taking ability by including graphics in addition to text information. Expanding the understanding of Architectural History and vocabulary is the primary focus of the Visual Notes assignment. As noted in *Visual Notes*, getting image on paper can create new and “better associations” while” promoting “deeper understanding,” more so than a casual observation;[2] as students draw more of what they are seeing in class, they begin to see patterns and similarities between projects and building forms. Through the sketching of vocabulary words with studied buildings, students better understand jargon specific to design. The exercise provides students with another way of recording information; rather than using words to describe and explain ideas, Visual Notes requires graphic representations to adequately represent the topic at hand.

A second focus of the Visual Notes assignment is to reinforce sketching skills and drawing techniques used throughout the program. Although the level of drawing skill does not factor into the grading of the Visual Notes assignment, students are

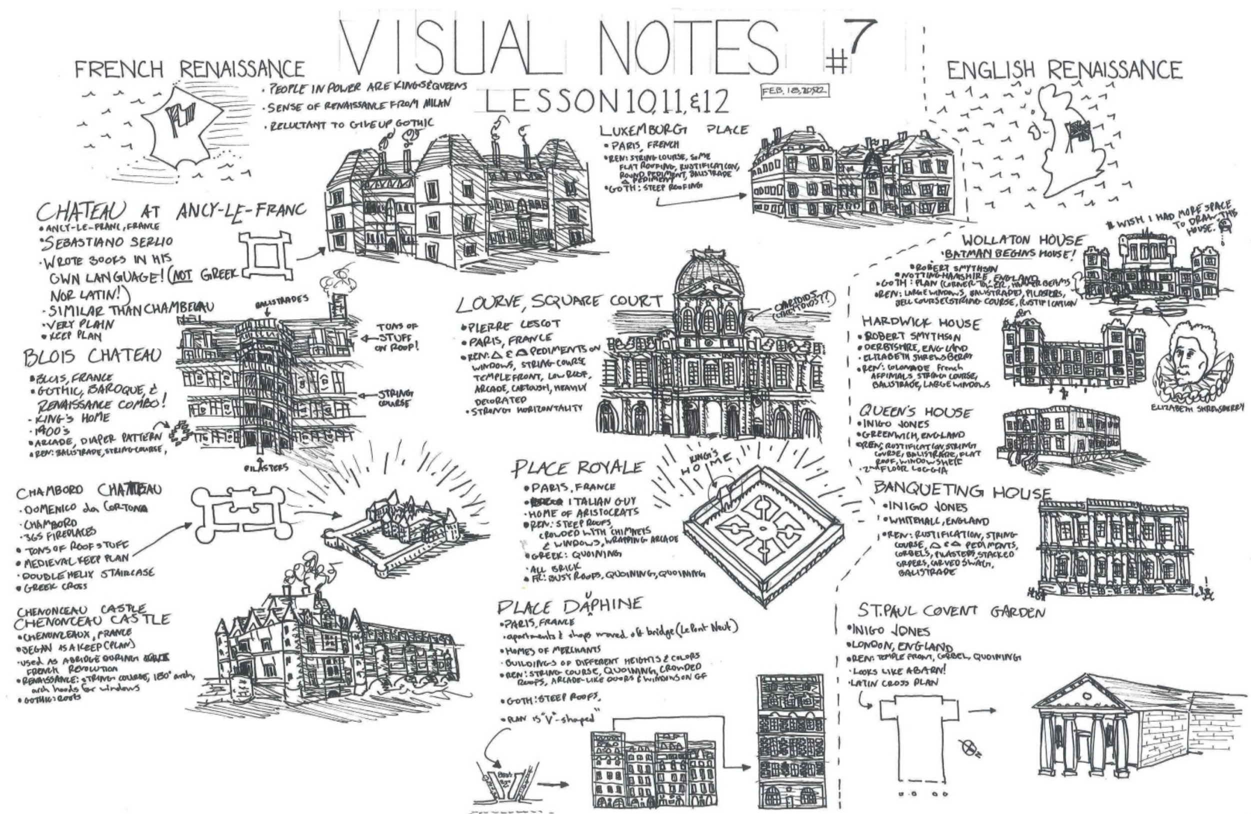



*Figure 1. Sketching as a part of notetaking, incorporating information to study for quizzes and examinations. A. Winstead.*

encouraged to take the time and care necessary in order to produce neat, well-crafted drawings. This care of craft, evidenced by neatness and handwriting/lettering, is taught in first semester classes and is part of the Visual Notes weekly grades.

Taken concurrently with History of Architecture 1 are two studio-set classes focusing on drawing skills such as shade, shadow, color, and texture along with design thinking and making. The Visual Notes project is a good opportunity for drawing skills to leave the studio setting and seamlessly work within a technical lecture setting, thus bolstering the importance of practicing the skill.

As the semester progresses, Visual Notes get better; partially because students better understand the nature of the project, and more so because their note-taking skills are improving. Students learn what types of drawings they need to record to better prepare them for quizzes and examinations. In this way, Visual Notes is the recording of “lessons learned”[3] as well as reflection of lectures and readings. Sketching as a part of note-taking is a way for students to better understand concepts and helps to improve their comprehension of the topic at hand[4] (Figure 1).

While numerous studies show that the act of writing or drawing information helps users to retain information, Crowe and Laseau explain it this way, “... authors held intense, immediate associations with their sketches; they could easily recall the circumstances in which the sketches were made....Most saw their notes not as products but as experiences.”[5] Over the years, students have expressed their surprise at their knowledge of the information while studying for exams. Similar to the authors Crowe and Laseau interviewed, students are better able to recall buildings and other information during examination and when discussing precedents in studio because they are taking notes and sketching as a part of the Visual Notes project.

*Deliverables*

On the first day of class, students are provided with a project statement and shown examples of past work. An assignment is submitted weekly in an 11” x 17” format; by the end of the semester the full content of the class is covered by the assignment. While each student has the same assignment, to record works studied for the week in a hand-drawn format, the execution is student determined. Most use bond paper, although a few students have used vellum, cardstock, or watercolor paper; writing utensils are also student-determined and varies from week to week. To date, students have turned in work done in pencil, colored ink, colored pencil, a mixture of pencil and ink, and even watercolor; the variety in media is often aligned with what students are working with in other classes at the time, allowing for exploration in media as well as sketching techniques.

Along with an assortment of media, drawing type also varies and often corresponds with work in studio classes. As students add to their sketching skills learning to add depth with color, as well as shade and shadow; these techniques are often experimented with outside of studio on Visual Notes assignments. Initial Visual Notes drawings are often elevations or simple perspectives of the projects studied. However, as the class progresses and students become more comfortable with the assignment and sketching in general, drawings become more complex. Students are learning to “look better”[6]; seeing beyond recreating an image and beginning to find insights through their sketches. By the second semester in the series, work is varied and one-point perspective drawings have been added to the mix of drawings used to recorded works studied in class.

At the beginning of the assignment, many students do not have a compositional technique for their work. As the class progresses, many students learn how the project works best for them and will fall into a compositional pattern. Personalities of students often come out in the composition and organization of the work on each sheet throughout the semester. For the most part, students take notes during class in a sketchbook or other notebook and transfer the notes to the final weekly deliverable. This has the added benefit of student drawing multiple versions of the same sketch, helping students to process and retain the information through repeated tactile contact association with the images.

A few students devote one sheet per class for the assignment; their work is often done during class with touch-up and clean-up work done after class, and regularly covers most projects studied in each session. Other students will work on the assignment daily, adding to the work with each lecture, creating a more haphazard composition. A few of the more organized students will divide their paper in to thirds vertically, devoting a section to each lecture period. Often these more structured works are transferred to the final sheet(s) at the end of the week from notes taken during class (Figure 2). One student went so far as to fold their paper into a grid and filled each rectangle created from the folding with a different image.

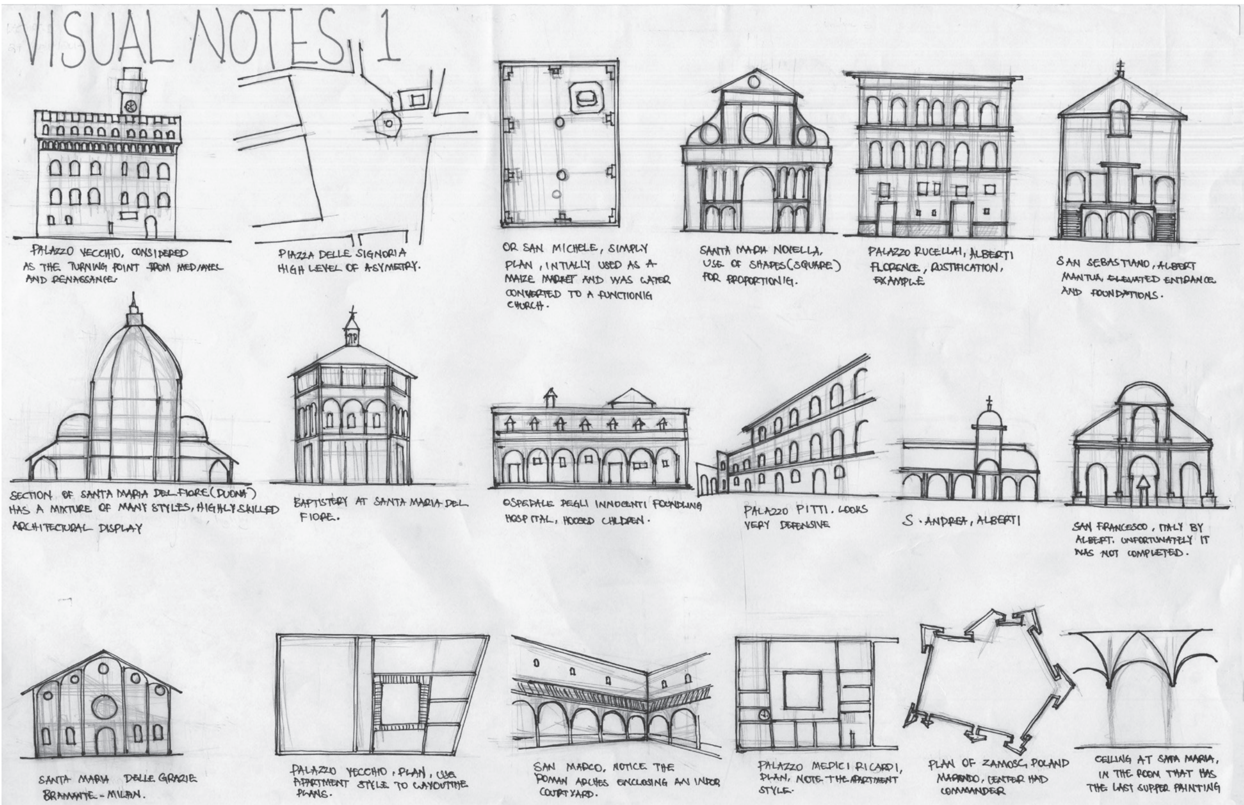



*Figure 2. Organizing Visual Notes horizontally by lecture. J. Jassu.*

## Lessons Learned

Over the past three years of assignments, slight alterations have been made based on observations and student feedback. Most of the alterations have been minor, such as moving the due date to the first class period of each week. Another small change has been to create a grading matrix based on the class lecture schedule. This form allows faculty to quickly see what information should be included in the Visual Notes. Alteration in the semester sequence of classes has led to the biggest alteration to date, the summer postcards project.

### *Summer Postcard Project*

Two years ago, History of Architecture series changed from a Fall/Spring to a Spring/Fall, with summer break separating the classes. This move precipitated a desire for a summer project to reinforce History of Architecture 1 curricula. Using postcards, rather than 11x17 sheets, students draw vocabulary and projects from History of Architecture 1 and weekly mail in their work. This summer assignment is part of students' grade for History of Architecture 2 and serves to lessen the "brain drain" associated with long periods between courses. Often the postcards arrive with notes regarding students' summer activities (Figure 3).

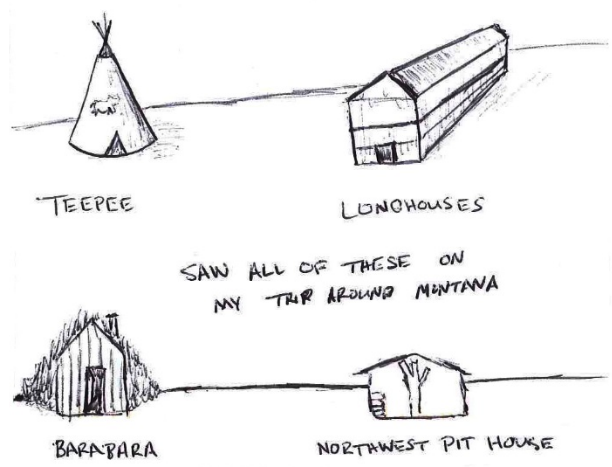



*Figure 3. Summer post card assignment. N. Bond.*

Throughout the summer, the best assignments are collected and displayed on homasote panels along Department of Architecture corridors. In the fall, students across the program can be found studying posted work and commenting on sketches. In addition to helping current students retain information, this exhibit serves as sketching examples for new First Year students; encouraging them to sketch while introducing them to a future project.

*Outcomes in History of Architecture and Beyond*

The initial hypothesis that Visual Notes would help students perform in class is evident when examining cumulative visual notes grades for each semester, comparing them to examinations and final class grades. Over six semesters, 132 students were assigned Visual Notes; 78% of these students passed the Visual Notes assignment along with the class. Students who earned a failing average on their Visual Notes assignment, usually for lack of effort, were more likely to fail examinations and the class. Those students who earned an “A” on the Visual Notes assignment passed the class, with the exception of one studnet; 41% also earned an “A” in the class.


*Figure 4. First Visual Notes in the History of Architecture series. B. Winslet.*

Although final class grades show a strong link to cumulative Visual Notes grades, Mid-term and Final examinations do not have as large a margin between passing and non-passing grades. A lower percentage of students passing the exams versus those passing the class could be due to test anxiety; 58% of students passed the Visual Notes assignment as well as the Mid-term exam, while 63% passed the final exam and the Visual Notes assignment. Test anxiety could also explain the difference between the percentage of students passing the Mid-term and Final exams.

While there is a correlation between a passing Visual Notes cumulative grade and passing the class, causation needs to be studied. A higher class grade could be due to student effort; a student who completes all assignments earns a higher average grade when compared to students who did not complete all of the required work. Additional study of Mid-term and Final exam grades, along with the final class grades of classes before the Visual Notes assignment was implemented, is needed to determine if causation exists.

The Visual Notes project serves to not only expand the knowledge and understanding of architectural history and the vocabulary of design, it also increases the confidence and drawing skills of students over the course of two semesters, while improving their visual literacy and note-taking skills (Figures 4 and 5). Because students have a scanned copy of their work, they can look at their progress over the year. This reflection on past work serves to bolster confidence in sketching abilities and encourages them to continue sketching on their own. Several students have shared that they have used skills learned from the Visual Notes assignment to take notes in other classes, such as Determinates of Modern Design and Contemporary Architecture. Their toolkit for note-taking has expanded with the addition of visual notes. The hope is that these tools are utilized in future classes and professional endeavors.

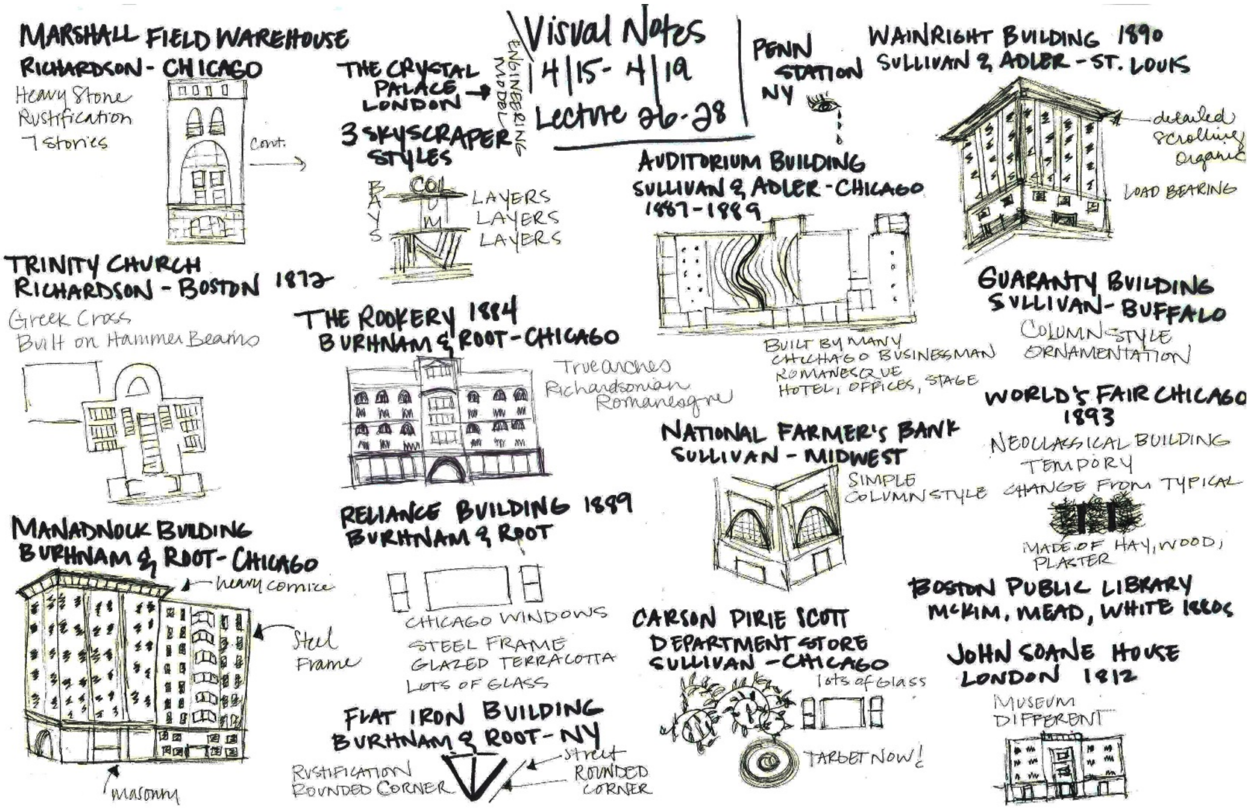



*Figure 5. Final Visual Notes in the History of Architecture series. B. Winslet.*

## Notes

[1] Crowe, Norman, and Paul Laseau. *Visual Notes for Architects and Designers.* Van Nostrand Reinhold: New York. 1986. Page vi.

[2] Ibid, 4.

[3] Spector, Tom and Rebecca Damron. *How Architects Write*. Routledge: New York. 2013. 15-30.

[4] Hadjiyanni, Tasoulla, and Stephanie Watson Zollinger. "Stimulating Student Interest in Design History Classes." *Archnet-IJAR: International Journal of Architectural Research* 4, no. 2-3 (2010): 296-309.

[5] *Visual Notes*, 102

[6] Roam, Dan. *The Back of the Napkin: Solving Problems and Selling Ideas with Pictures – Expanded Edition*. Portfolio/Penguin: New York. 2008. Pages 45-88.

# Shelter: The Interior as a Site for Disaster Relief

Deborah Schneiderman, Renee Kim, and Nam Songsombat | Pratt Institute

## Problem

With radically shifting weather patterns at the forefront of our student consciousness, particularly following Hurricane Sandy and the devastation it laid at our doorstep, students have learned that the interiors of urban mega structures are often utilized as shelter sites, making disaster relief a critical interior issue. To address this issue, Interior Design students, fall 2014 and 2015, were assigned the design of interior disaster relief shelters. Supporting and sustaining human well-being is critical to survival and is an ethos central to the discipline of interior design, extreme or otherwise.[1]

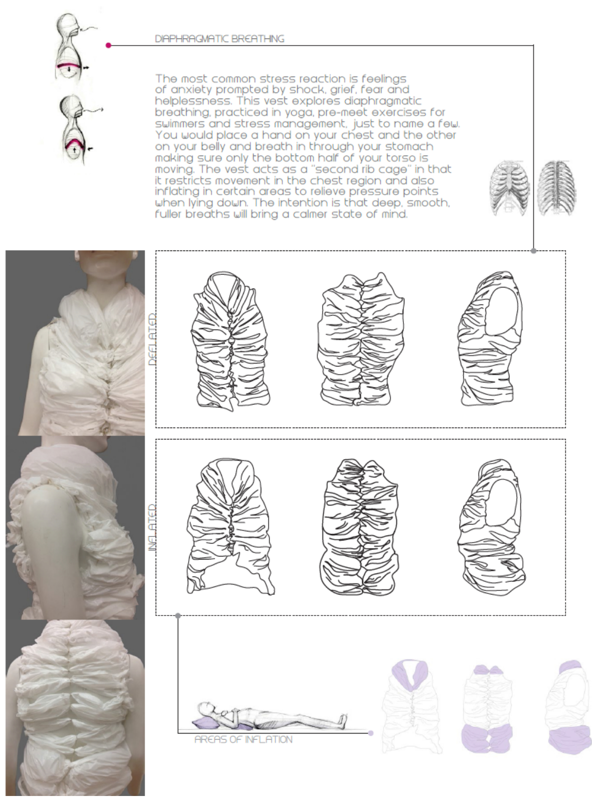



fig. 1. Wearable, Ashley Kuo

## Teaching Methodology

The brief for this studio was written with a binary intention. Firstly, to broaden program typologies available to Interior Designers. Secondly, to integrate critical theoretical readings into the design studio in direct alignment with the design and making of projects. The coursework was developed to introduce the critical program typology of interior disaster relief shelter. The studio embraced the pedagogical stance that critical interior design theory and the act of making and testing design solutions simultaneously is essential to interior design practice. The coursework was constructed as a series of three primary design investigations that increased in scale, each investigation focused around the close reading of a series of critical essays from Lois Weinthal's theory anthology *Toward a New Interior* (2011).[2]

The project was assigned in three major parts, A, B and C, each with their own set of aligned readings. Students were to build and test their designs at full scale. For project part A students were to design a wearable element that satisfies a basic need in a disaster relief shelter. They were asked to consider how Interior Design is largely about creating and modifying enclosure for the body and how they think about enclosure at an intimate scale (Readings: Evans "No Man's Land"; Lupton, "Skin: New Design Organics"; Kraft, "Cutting Patterns"). For part B students were assigned to design a place to sit. They were asked to consider how a seat can become place-making, how people sit, and can a seat contribute to survival? (Readings: Blauvelt, "Strangely Familiar: Design and Everyday Life"; Smith, "The Rules of Her Game: A-Z at Work and Play"). For part C students were to design an Interior Shelter and Site Plan. They were asked to consider, how can you accommodate individuals and families? Are there security issues? In space planning the shelter how will you consider human behavior? (Readings: Colomina, "Interior"; Betsky "Furnishing the Primitive Hut").

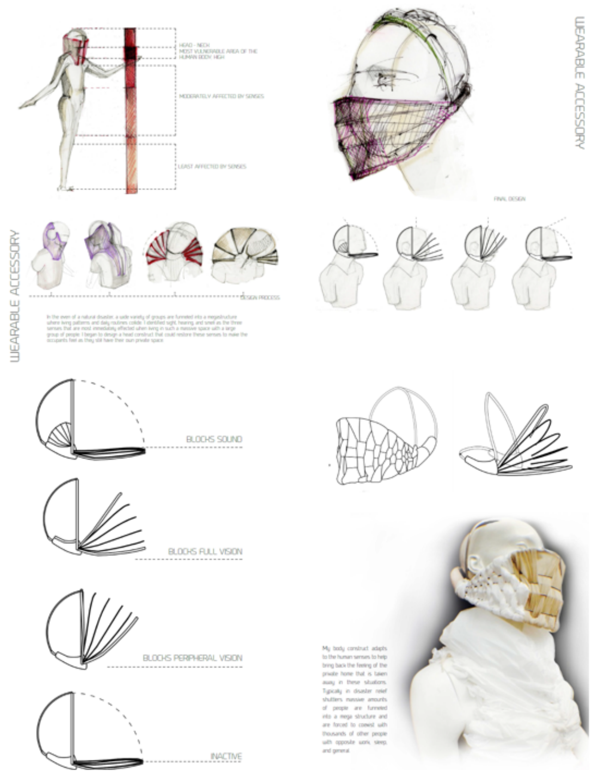


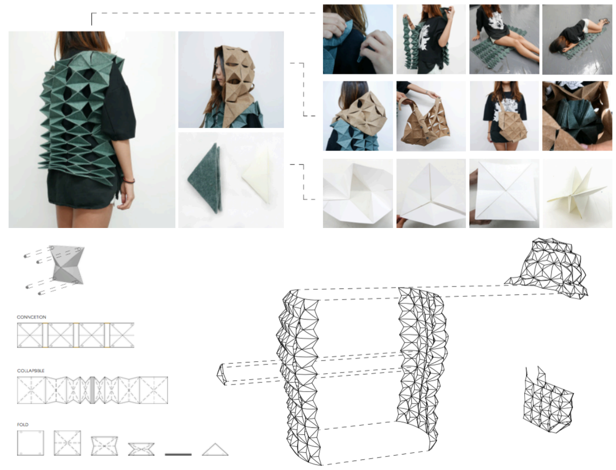
*fig. 2. Wearable, Jennifer Paloma*

## Case Study

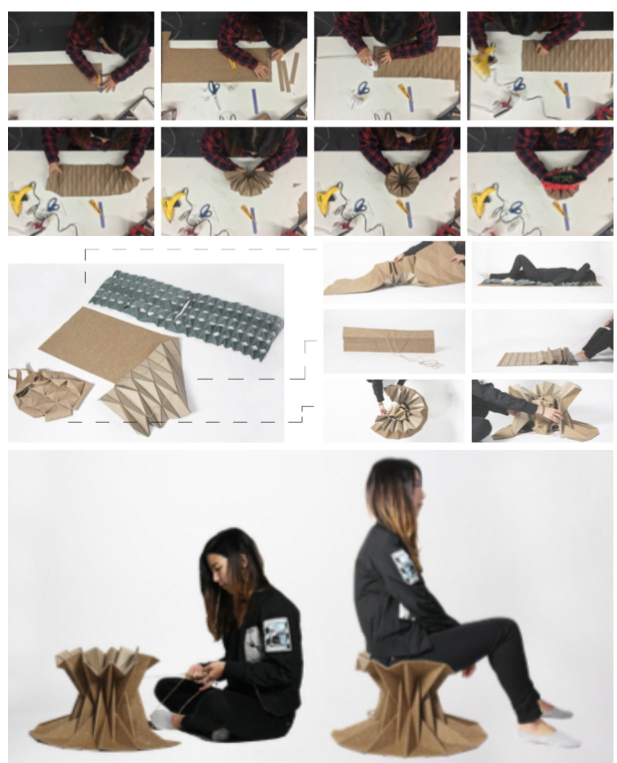
The following case study projects are taken from the Fall 2015 studio. The students worked individually on parts one and two of the project, most elected to work in teams of two for the third part of the assignment – the design and construction of the full scale shelter. Forming a team required that the students assess their design concepts to date and work to integrate ideas and elements from both into the final design investigation.

### *D-Cape/D-Stool*

For the design of D-Cape, the student's primary concern in disaster situations was for basic human needs to survive, such as food, sleeping, belongings, and storage. To solve this problem, she approached the design for the body construct with an intention that it be multi-functional. She worked toward a design that could be manipulated to address and support some basic needs for survival. D-cape is a set of wearable elements consisting of a cape, hood, and pocket. The cape is wearable during the journey to the shelter. When not in use, users are able to take it off and lay it down as a blanket. The hood functions to protect the user's head and doubles as a bag for storage. The pocket on the cape contains various objects, such as a foldable water filter, and utensils that satisfy the user's needs.

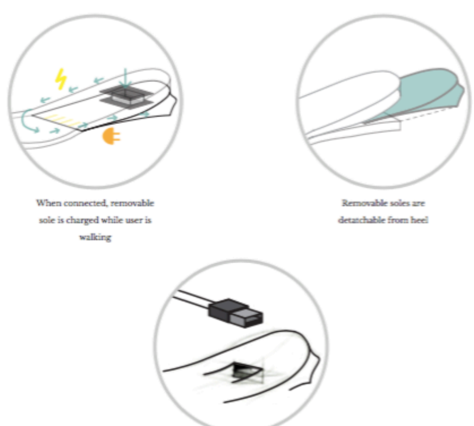

*D-Cape, by Renee Kim*

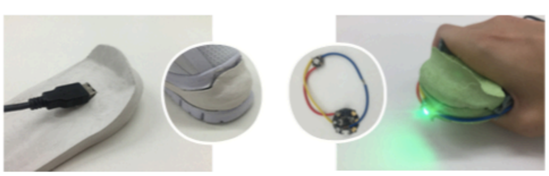
The student then further developed the collapsible and multi-functional system into her chair design such that it would be easily compressible, transportable and foldable. The foldable stool, when constructed, could be used for seating and to store belongings within its form. Once laid out flat it functions as floor seating or a sleeping mat in conjunction with D-Cape. In her design the student drew primarily from the Lupton and Blauvelt readings.


*D-Stool, Renee Kim*

*Piezo Grip/Blob Chair*

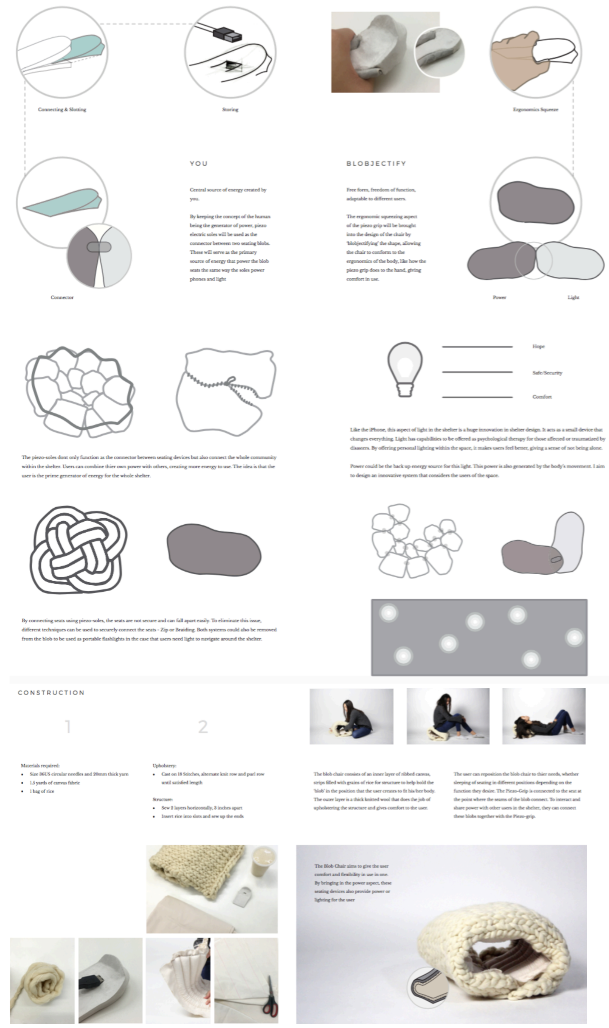
In contemporary society, humans are increasingly dependent upon their phones and other electronic devices. The intent for this disaster-relief-product was to provide the wearer the ability to self-generate electricity through typical daily activity, so that energy could be captured and stored within the object for use in an emergency situation. The student designed a prototype for removable shoe soles that use a piezo-electric system to generate electricity. To develop the concept product, she studied Pavegen floor tiles, which utilize a piezo-electric system for a marathon floor that captures the energy from the runners to power street lights and vending machines. For the disaster relief product, she wanted the user to be able to generate their own energy by walking. The design for a removable element in the sole of the shoe had a dual function, it would allow the wearer to charge their phone and be used as flashlight (with and ergonomic grip) during an emergency situation.



*Peizo Grip, Nam Songsombat*

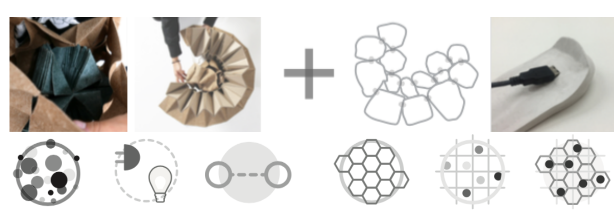
The ergonomic design of the flashlight element was adapted into a blob seat form for the second part of the assignment. The seat was designed to form around the body. By keeping the concept of the human being as the generator of power, piezo-electric soles could be utilized as the connector between two seating blobs. The removable elements would serve as the primary source of energy that power the blob seats similarly to the how the soles power phones and light. The student drew from ideas about technology found in Evans' article as well as the discussion of the familiar in Blauvelt's article.




*Blob Chair, Nam Songsombat*

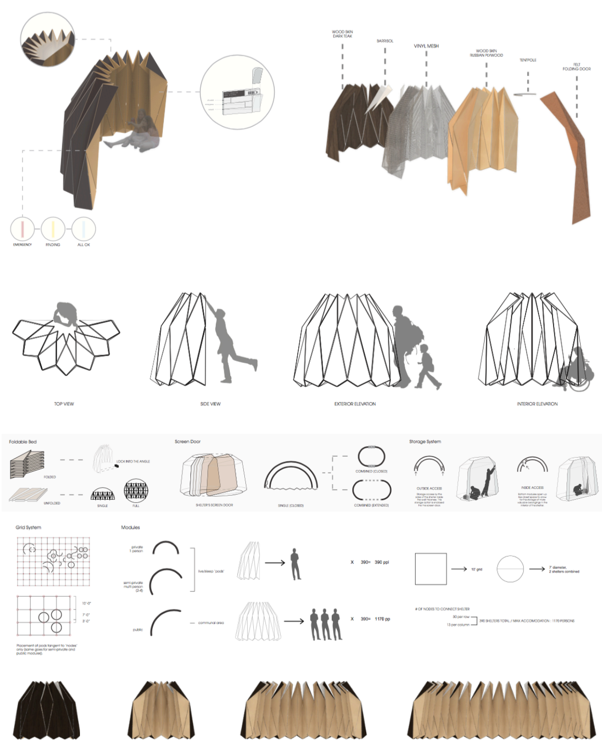
***Shelter***

Although the projects described above were seemingly substantially different systems, the students were able to combine their ideas and in the overlap, address issues that they found were missing from each project. They began by highlighting the most important aspects of their concepts and concluded that the formal system for foldable space saving elements combined with energy and lighting innovation could generate a strong proposal.



*Shelter Combination, Renee Kim and Nam Songsombat*

The students drew primarily form the Betsky article to begin their shared shelter proposal. They then determined their three most important design issues, space and crowding, basic human needs, and interaction. Space and crowding – since there is expected to be a great number of people entering an urban interior disaster relief site, crowding is a major issue and the shelter would require intelligent programming to fit the population. Basic human needs – because in a disaster situation those displaced would likely not have time to pack essential belongings, they would require basic necessities available for use. Interaction – to create bonding within the community, interaction in community building has been shown to increase human resilience.



*Shelter design, Renee Kim and Nam Songsombat*

The concept for the shelter was to create an interactive design through modular structures and lighting to solve the problem of overcrowding. The students designed the shelters such that the inhabitants could manipulate levels of privacy within as well as the sizes of the modular structures. Lighting was utilized as signage and to facilitate communication.

The piezo supported light in the shelter is a critical innovation in the design for the shelter. This power generated by the body's movement, encourages inhabitants to be mobile in order to generate more electricity – crucial to keep them healthy and help to keep mind stress-free. When charged, the piezo grip is designed to be inserted into the shelter to provide power as well as ambient lighting that indicates if the users are in need of help.

The indicator lighting is connected to the exterior of the modules. It is operated by the piezo grip that is inserted into a control pad, designed to function like a hotel keycard. On the exterior of the shelter are three lighting options, each signifying the type of help needed. The first button is for first aid users, indicated with a red light, middle for those missing family members in yellow light, and all is well in white light.

The shelter is fabricated from seven primary materials. The exterior layer is made from dark stained teak wood and the interior is light-weight plywood. The students selected teak because it is suitable for interior and exterior use as it is resistant to rain and sun. On the top of the shelter, some modules would be made from Barrisol, a translucent material, to allow light to enter the shelter. Wire mesh is laminated to the backside of the wood, Tent poles that curve toward the top of the shelter help keep the arc-shape in place. The material for the door is felt that is starched to add rigidity and provide a formal language similar to the teak portion of the shelter.

The design form of the shelter was derived from the origami exploration found in D-Cape/D-Stool and was collaboratively iterated to reach the final shelter form. The circular overall shape of the shelter takes into account ADA codes for wheelchair accessibility. The circular full shelter module could be used in 4 different positions, each accommodating a different number of people. The first and smallest is a semi-circle which can accommodate 1 person, when two semi circles connect it forms a circle that could accommodate 2-3 people. When two modules are connected at 1 side, a larger semicircle is formed to accommodate 4 or more people. More modules could also be joined to create spaces for larger groups. The largest accommodation is the most open arc, utilized to support public spaces such as dining.

The students were assigned to "test" their shelter designs in Park Slope Armory in Brooklyn, NY because it was operated as a disaster shelter during Hurricane Sandy. The overall shelter is programmed such that those who need aid can be readily accessed from the entrance, and all is well inhabitants are initially located toward the center of the space. This student team divided the armory floor plan into a10' by 10' grid system. Each shelter would be placed tangent to the nodes of the grid.

The envelope of the shelter modules functions as a storage system as well as an enclosure form. The polygon shapes that form enclosure are able to open like cabinet doors enabling belongings to be stored within the thickness shelter enclosure.

*Shelter fabrication, Renee Kim and Nam Songsombat*

The door/screen is constructed from material similar in appearance to the rigid portion of the shelter enclosure but is only a single soft single layer of felt which could be utilized to control privacy. The soft elements also function as the connecting mechanism between two or more shelter modules.

The bed was designed with a similar folding language. When folded out, it is the size of a standard FEMA cot, when folded in it functions as a chair, with a designed angle that locks it into the shelter interior wall.

*Shelter, Renee Kim and Nam Songsombat*

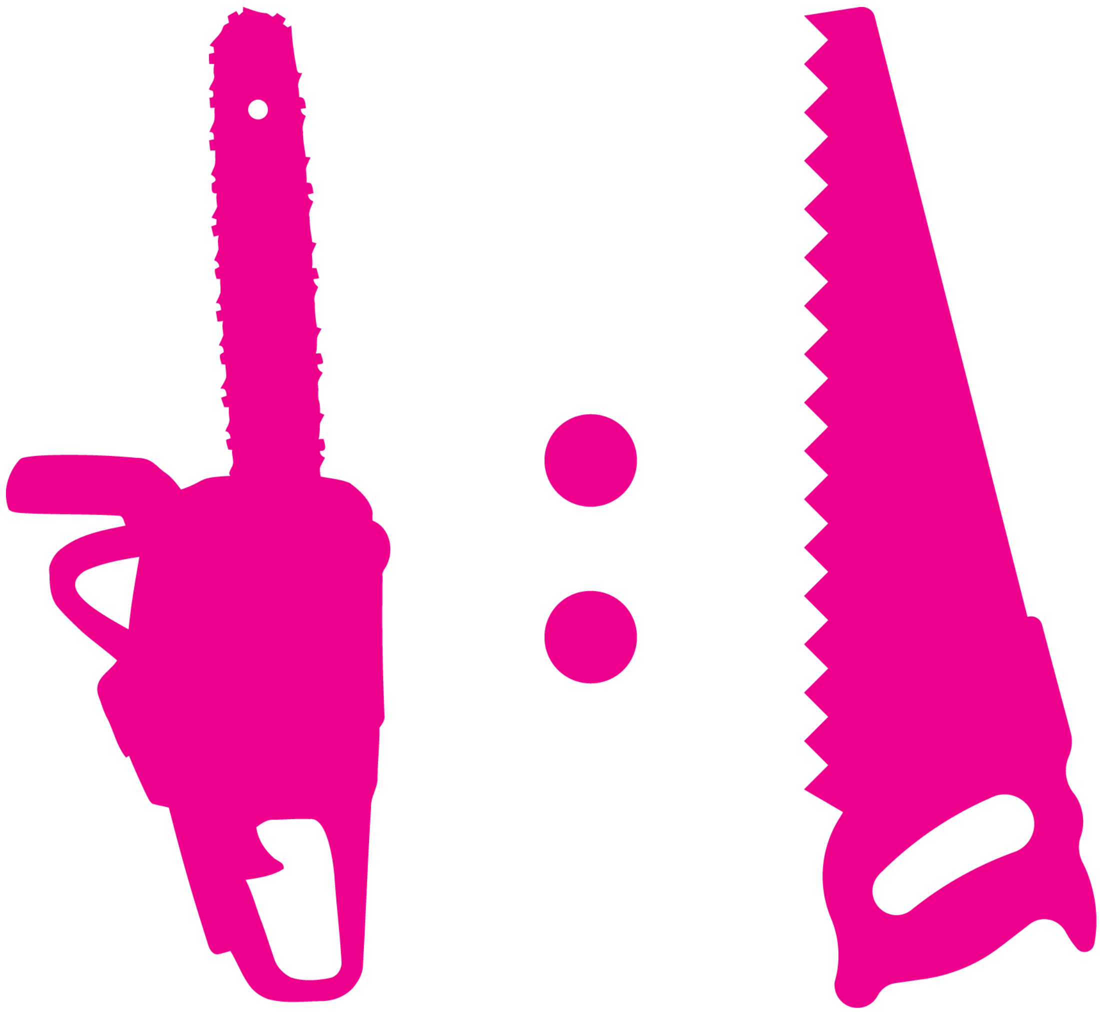
## Conclusion

Students produced a series of full scale testable prototypes that were initiated by a series of theoretical readings while investigating a necessary and extreme program typology. Student work evidenced the material learned from assigned readings, which offered insight into the understanding of related disciplines broadening the students understanding of potential overlaps within the design disciplines. In addition, students were introduced to theoretical thinking about place-making that furthered their design investigations.

## Notes

[1] Lois Weinthal, ed., *Toward a New Interior: An Anthology of Interior Design Theory (*New York,Princeton Architectural Press, 2011).

[2] Brian F. Davies, "Design for Extreme Environments Project [DEEP]: A Case Study of Innovations in Mediating Adverse Conditions on the Human Body," in *Textile Technology and Design: From Interior Space to Outer Space*, eds. Deborah Schneiderman and Alexa Griffith Winton , London: Bloomsbury, 2016), 145.



## REPRESENTATION:SIMULATION

Energy modeling, computational fluid dynamics, and building information modeling are samples of tools that are collapsing the difference between representation and simulation of built systems. Crowd-based digital applications such as GasBuddy, Instagram, and Twitter also provide real-time data feeds about human behavior that is easily harvested. What role should these tools play in beginning design education? Submissions to Representation: Simulation address pedagogical approaches related to dynamic information gathering, processing, and communication.

# Material Mapping: Tracing Construction Material Origins in Design-Build Courses

Peter Summerlin | Mississippi State University

## Introduction:

The sourcing of landscape construction material has shifted dramatically since the early twentieth century, from localized material acquisition to more centralized production and global distribution. Material specification that previously involved simple materials now involves highly processed materials and engineered composites. Projects that historically would have extracted stone from onsite, might today integrate exotic materials from overseas. At the same time, construction trends have shifted from skilled craftsmen to cheap laborers. The result, as described by Meg Calkins, is "a consumptive and sometimes wasteful materials industry with use of a limited palette of nationally standardized site construction materials."[1]

What can be lost in this complex materials industry is an understanding of the 'actual' costs of material specification beyond the sticker price. This can be especially true for the beginning design student. For one, material sourcing is seldom required in design studios that might concentrate more heavily on spatial organization. More obvious is that students only engagement with the materials with which they are designing is either in a catalog, at a distribution center, or once the materials are delivered to the project site. This isn't to say that these issues aren't discussed in the contemporary design curriculum. They likely are. This paper suggests that a method of mapping the geographic footprint and manufacturing processes of materials used in design-build courses would enhance student understanding of the global materials industry, its impacts and opportunities.

### *Material Mapping*

According to the Landscape Architecture Body of Knowledge (LABOK) Study, material specification and sourcing is a key component of the Site Design and Engineering domain.[2] This domain is often discussed and applied in studio courses, however the foundational knowledge is generally introduced in courses specific to landscape construction technology. As design schools increasingly emphasize design-build construction, these design-build courses will become another opportunity to discuss material sourcing and specification. The materials utilized in the construction of a 1:1 project have potential to serve as the subject of an investigation described as "material mapping." Material mapping requires one to trace a specific construction material back to the acquisition of the raw materials, and then document its process through manufacturing, distribution, and ultimately to the construction site. This material mapping documentation is both geographic in its mapping of the transportation routes from extraction to the site and conceptual in its discussion of manufacturing, energy, and waste.

For the beginning design student the process of material mapping provides insight into a single material and, by default, a glimpse into the larger materials industry. Partnering material mapping with Landscape Design-Build courses provides the specific construction materials to investigate through the mapping exercise. It also offers a platform for material specification discussion and debate. The intertwining of the constructed project with a more comprehensive understanding of the materials used is beneficial for both the beginning design student.

## Precedent for Material Mapping:

### *Travels of a T-Shirt*

Material mapping projects have a creative history. The National Public Radio (NPR) podcast *Planet Money* executed a similar process in following the production of a T-shirt. The NPR team designed and purchased custom T-shirts with the intent to trace their T-shirt back through manufacturing to the very field where the cotton was grown. This process led them to a cotton field in

Clarksdale, Mississippi. The cotton bails were followed to Indonesia for processing, to Bangladesh for assembly and printing, and finally shipped back to the United States for sale. The documentary shows the physical movement at all stages of production, including the cotton plant genetic engineer at Monsanto. Naturally, the NPR *Planet Money* team is examining the economics of the transaction at each stop in the material mapping exercise. Ancillary discussions arose in this process that examined social and cultural narratives alongside the economic ramifications. While the process wasn't physically mapped, it is documented through their blog, podcasts and videos, describing the specifics of their investigation.[3]

### *Tacoshed*

Landscape Architect and California College of the Arts Professor David Fletcher led a team in mapping the ingredients of a taco (Fig. 1). The project, titled "TacoShed", dissected all components of a taco purchased at a local food truck and traced them from harvest, to manufacturing, distribution, and ultimately to the food truck and taco itself. This mapping of a familiar food would provide "visceral insight into the connections between the systems [they] were exploring." Maps of various scales (regional, national, and international) produced by the team document the geographic locations of each transaction of ingredients and trace the routes and modes of transportation. Ingredients ranged from the nearby communities (iceberg lettuce) to distant countries (avocado), revealing a network of systems that form, as they describe, the global "Tacoshed."[4]

### *A Trail of Stumps*

After controversy over the use of ipe in the construction of New York City's High Line, Landscape Architect and Harvard University Professor Jane Hutton began to investigate the origins of ipe and what its production entails from an ecological and social perspective. Hutton confesses, "it is often hard to find good information on this subject [material origins and production]" and in an effort to understand more about the material, she "followed some back to its Brazilian habitat." Hutton's article, "A trail of stumps", describes the complex process of ipe wood transportation as well as the conservation efforts of Brazilian environmental agencies to regulate and protect the slow-growing and rare resource. Hutton documents similar material mapping histories of two other materials used in New York City projects. Granite from Maine was tracked from the stone quarries in the Fox Islands to the gatehouses adjacent to the Central Park reservoir. Steel from Ambridge, Pennsylvania was brought

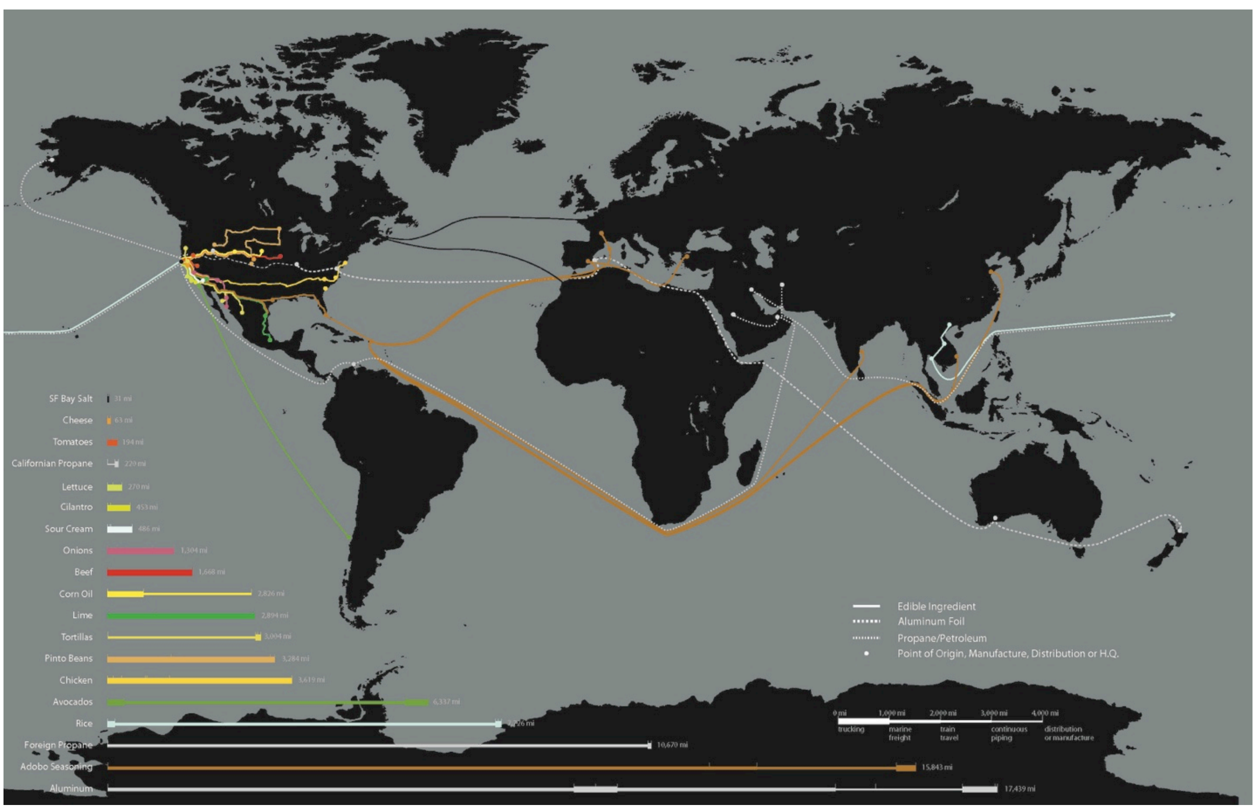



*Fig. 1. A map produced by David Fletcher and Rebar Studio traces the components of a taco in San Francisco back to their origins. The results are a self-described "Tacoshed" that explores the systems flows and ecologies of a taco in global food industry (David Fletcher, 2010)*

to Riverside Park in New York City in the form of rail tracks as part of New Deal redevelopment of the 1930s.[5]

The spirit of Hutton's work is a deeper understanding of the collateral effects of material sourcing. The use of locally sourced material in landscape architecture often minimizes negative environmental impacts by lessening the total transportation distance. Manufacturing and extraction has similar and sometimes greater significance. Such is the case with ipe and the loss of vital habitat through harvesting.

## Material Mapping Methods:

The importance of material mapping is an emerging topic for designers, developers, and even consumers who want to know the story of the built projects around them. Those same conversations can be embedded into teaching methods for the beginning design student through the integration of material mapping in design-build courses. This paper describes a specific material mapping method utilized in conjunction with design-build courses in the Department of Landscape Architecture at Mississippi State University.

*Methods*

The design-build project material lists were divided into single materials or simple composites. Both materials that comprise the built work and materials used for construction (i.e. wood for concrete forms) were documented as a part of this process. In one particular project, the concrete used was mixed onsite and the sand, aggregate, cement, fly ash, and fibers were mapped individually (Fig. 2). In certain instances, students were active participants in the purchases. The contacts made with the distributors initiated the process of material mapping, starting with the distribution center and tracing through manufacturing and back to the extraction site. In other instances, where materials were ordered in advance, receipts and contact information were provided to the students to initiate the investigation.

The most successful avenue for gathering information and documenting the process were field trips and in-person interviews with individuals involved in the process. This wasn't always a viable option and in many cases, phone calls and emails were utilized. In some cases, the process was lengthy, requiring multiple phone calls and referrals. In the end, data and notes were compiled in a spreadsheet that charted the company, contact, location, notes and images for each stop in the material route from extraction to site. For a typical landscape material, this included one distributer (or retailer), one manufacturer, and one acquisition site. Often the manufacturer also managed the acquisition site. More complex elements including plastics might have several stops in the manufacturing process alone.

*Fig. 2. Materials used in the construction of a design-build project at Mississippi State University serve as the subject for a material mapping exercise. (Peter Summerlin, Michael Keating, 2015)*

Once information was compiled, the process moved towards a geographic mapping of the acquisition, manufacturing, distribution and installation locations with connecting routes and transportation modes (Fig. 3). Materials mapped tended to have a wide range of distances traveled to the site. This meant that the maps were often divided into three scales: regional, national, and international. The mapping was also conceptual, describing the processes, energy, waste, and by-products of each stage in the process. In every case, the conceptual mapping was loosely defined and directly related to resources and data compiled through the process.

The final component of this process required student speculation into alternatives for either the material manufacturing process or the material use in the design build project altogether. The intent was less about solving a complex issue of material manufacturing or logistics. Instead, simply questioning the material process and specification yielded valuable discussions and theories among students.

*Inherent Difficulties*

The process is not without complications that might obstruct the investigation. The most obvious hurdle is the amount of time required to conduct a material mapping exercise. Much of the data is dependent on interviews with company representatives and students are subject to the representative's schedules. For this reason, the material mapping exercise is spread out over a lengthy period of time and runs concurrent with other classroom activities.

In many instances, the complexities of the manufacturing processes are difficult for the beginning design student to manage. Intricacies of the manufacturing and shear number of players involved with composite metals and plastics create challenges in both the physical and conceptual mapping. In the case of pressure treated lumber, the lumber is sourced from a large region (typically tied to distribution range), making the actual location of the raw extraction a broad region as opposed to a specific site. Seldom is the problem of direct obstruction from the companies themselves. While the students always disclosed the work as student research, there was hesitation from companies to reveal raw material sources.

## Learning Outcomes Observed:

Despite the inherent difficulties of the material mapping process, the learning outcomes observed are affective in advancing the way students perceive design and material specification. This paper presents four learning outcomes observed during the material mapping process in conjunction with design-build projects.

*Reveals the Broader Material Costs*

Both the geographic and conceptual mapping have potential to reveal hidden costs associated with materials used in the design-build process. Comparative analysis of the geographic footprint of materials visibly distinguishes the transportation cost of materials used in the project. While the shipping costs are embedded in the actual price of the product, the understanding of the mileage of these routes gives context for students who might alter their material use for more local yet equally viable material for the project. Additionally, the conceptual mapping might reveal waste and byproducts of manufacturing. This revelation has several layers. The impacts of various manufacturing and disposal processes are often invisible, but play a large role in environmental and human health impacts.[6] Students observe that these ecological and social costs are embedded in the manufactured products and impact the sustainability of a project.

*Revelations from the Extraction Site*

A subset of the physical mapping is the determination of the raw material extraction location. While this is valuable for determining the transportation routes and byproducts of material harvesting, it was observed that this discovery instilled a unique appreciation for the material and its use in landscape construction. As Rob Sovinski states, " to capture the soul of a stone requires a deep respect for the millions of years it took nature to give it form."[7] It was observed that the discovery and investigation of the material extraction site instilled a deeper apprecia-

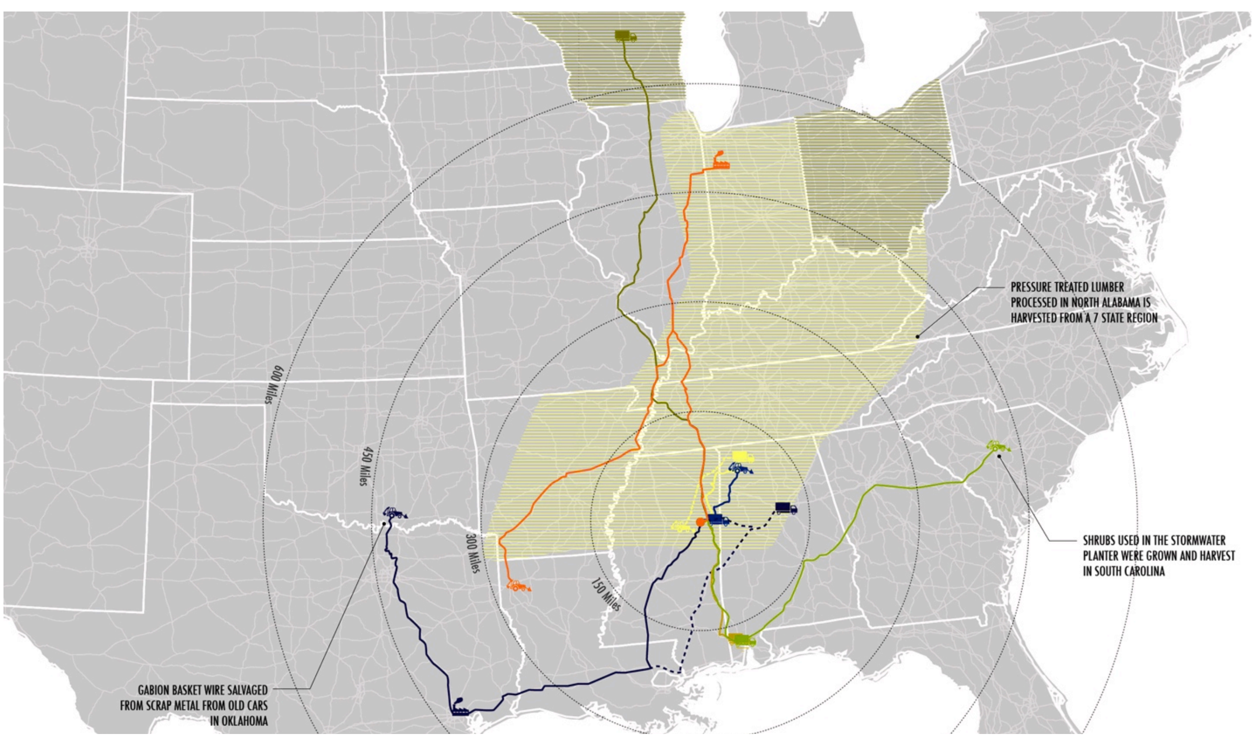



*Fig. 3 Student maps locate points of raw material harvesting, manufacturing, distribution centers, and the connecting transportation routes for materials used in design-build projects. (Stephanie Sigman, 2015)*

tion of the material itself. Furthermore, the evaluation of the actual void left from the raw material extraction also yielded interesting speculation on the post life of many of these borrow sites.

*Realizing Significance in Local Economy and Culture*

The material mapping process also leads to insight into the cultural and economic implications of material sourcing for the local community. Increasingly, consumers are more aware of the source of their products and landscape construction has potential for those same trends. The benefits are two-fold, supporting both the local economy and retaining the intrinsic identity of a space by using native materials. From an economic standpoint, research indicates that supporting locally based companies retains twice the money in the local community compared with making purchases from companies that sell imported goods.[8] The close proximity also lends itself to more precise specification by virtue of seeing the material prior to delivery to the site.

For all the efficiencies of the globalized materials industry, the byproduct is a homogenized material palette. That homogenized palette has potential to upset the genius loci of a site. In many cases, material mapping exposes this fault and provides an opportunity for discussing the preservation of identity through the use and reuse of local materials. This sentiment is common across several industries through the creation of local coalitions and businesses alliances that aim to shift cultural perception towards an appreciation of local culture and spending.

*Encouragement of Alternate Material Speculation*

While some maps provided validation of materials used in the design-build project, other maps called into question the necessity of certain material use. This type of post construction evaluation is essential to elevate design-build projects beyond strictly lessons construction strategies and logistics. The required material substitutions as a part of the material mapping process challenges students to develop their own perspectives on material sourcing. The basis for the substitutions might range from solely aesthetics to solely energy costs. Regardless of the decision, students are challenged to assert their personal views on material use.

## Conclusion:

The visual product of material mapping can be compelling. The maps alone provide a new and often unseen perspective of where construction materials originate. Additionally, the conceptual material mapping generated in this exercise can synthesize complex systems to better explain material processes to fellow students and the broader audience of the design-build project. For the beginning design student, however, it's the process itself that is more important than the visual outcomes. Examining a single material from extraction to site provides a deeper understanding and value for the materials used in construction. Moreover, this process for a single material can serve as a microcosm for the larger materials industry.

The linking of material mapping with 1:1 investigations provides a richer platform for beginning design education. As Jane Hutton notes, "we are increasingly interested in where materials come from and what their production entails from an ecological and social perspective."[9] For the beginning design student, material mapping reinforces the sentiment that "materials are not a free ride—they are taken from somewhere, and we forget that at our own peril."[10]

## Notes:

[1] Calkins, Meg. Materials for Sustainable Sites: A Complete Guide to the Evaluation, Selection, and Use of Sustainable Construction Materials. Hoboken, NJ: John Wiley & Sons, Inc., 2009. p 1.

[2] "LANDSCAPE ARCHITECTURAL ACCREDITATION BOARD Accreditation Standards And Procedures." American Society of Landscape Architects. February 6, 2010. Accessed January 25, 2015.

[3] National Public Radio. Planet Money's T-Shirt Project. http://www.npr.org/series/248799434/planet-moneys-t-shirt-project.

[4] Flecther, David. Biography of a Taco. http://rebargroup.org/tacoshed.

[5] Hutton, Jane. "A Trail of Stumps." Landscape Architecture Magazine, May 2013, p 116-126

[6] Calkins, Meg. Materials for Sustainable Sites: A Complete Guide to the Evaluation, Selection, and Use of Sustainable Construction Materials. Hoboken, NJ: John Wiley & Sons, Inc., 2009. p 2.

[7] Sovinski, Rob W. Materials and Their Applications in Landscape Design. Hoboken, NJ: John Wiley & Sons, Inc., 2009. p xiii.

[8] Schwartz, J. D. "Buying Local: How It Boosts the Economy." Time. June 11, 2009. http://content.time.com/time/business/article/0,8599,1903632,00.html.

[9] Hutton, Jane. "A Trail of Stumps." Landscape Architecture Magazine, March 2013, p 118.

[10] Hutton, Jane. "A Trail of Stumps." Landscape Architecture Magazine, March 2013, p 126.

# Agency for Informed Design and Analysis: Time-based Media as 1:1 >> 1:many

Shai Yeshayahu, Joshua Vermillion |University of Nevada Las Vegas

Jonathon Anderson | Ryerson University

## Introduction

In an era of constant surveillance, where security, body, and dashboard cameras are an integral part of a documentation process that is rarely analyzed, lies an excellent opportunity to identify the role of time-based media in the beginning design studio. In our day-to-day activities when the need to analyze content arises it typically has an efficient workflow to track movement of humans and objects in relation to time and space. In some cases, this interface is capable of associating specific information over many instances of time, and this is where a new narrative emerges, one that is specific, where frames from different time and space are strung together. Stitching them together compresses time and space in a nonlinear fashion; it becomes relevant because it generates a new narrative that is tailored to be nonspecific to one author and measured against well-defined performance criteria. Ideally, this culminates in the production of a graphical presentation that communicates the essence of the project to a broad range of viewers.

Currently such production means are not accessible in a capacity that we can make use of it. Hence, the thinking behind the technology is of interest to us because it has a strong precedent in the work of different disciplines dating back to the developments of photography and film themselves. In the mid and later 19th century, photography was explored as a medium for capturing action and movement. Eadweard Muybridge conducted numerous photography studies of subjects in motion, the most famous of which is of the galloping horse, showing a momentary instance within the gate of a horse at full gallop in which all four legs of the horse were off the ground (figure 1).[1] Étienne-Jules Marey, a physiologist and a contemporary of Muybridge, likewise, used photography (mainly the stacking of multiple exposures on the same plate, called chronophotography) to study time and movement related to the locomotion of anatomy in humans and other organisms.[2] The ultimate aim of Marey's studies (the content or narrative) was related to anatomical mechanics, for instance, the way a human body moves when walking versus running. However, in the course of all of his experiments, Marey helped to rethink how cameras and film might be deployed, making many modifications and innovations to his equipment, to achieve his 'moving' images.

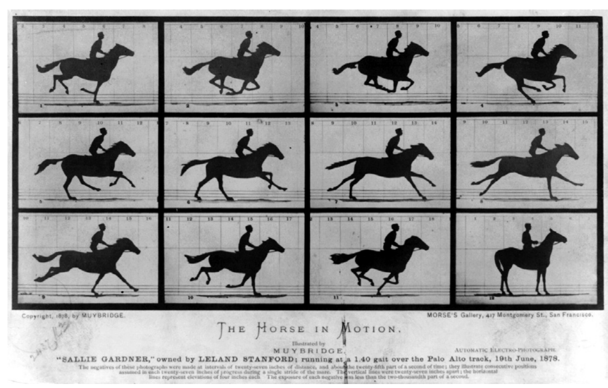



*Fig. 1. The Horse in Motion, 1878. Eadward Muybridge.*

Beyond innovating with his equipment, Marey also significantly abstracted the appearance of his moving subjects to be photographed. In figure 2, one can see the movement of a human walking, represented as a series of lines and points. The subject simply wore a dark suit with light strips of wood or fabric and buttons over key body limbs and joints, thus rendering the motion skeleton of the subject rather than the full human figure. These tricks with highlighting only select portions of the subject against a dark background gave his photography a unique (for the time) aesthetic—reducing the photographic information down to the most useful information to analyze anatomical movement, but also an abstraction of movement and forces.

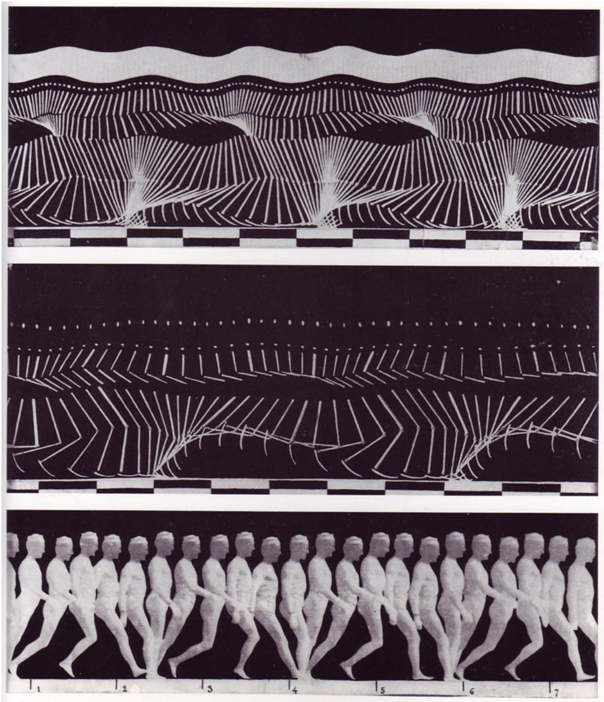


*Fig. 2. Human Locomotion Chronophotography Composite, c. 1886. Étienne-Jules Marey.*

Similarly, Frank and Lillian Gilbreth shot video and long exposure light painting photography to analyze the work of laborers to break down and optimize specific tasks. Backgrounds had clocks and grids to understand spatial distance and elapsed time. The subjects of the photographs wore blinking lights on their wrists. These analyses, rendered in bright paths and curves were used to find the most optimal, or in Gilbreth's words, the "one best way" to perform any activity.[3] These chronocyclegraphs were sometimes translated into three-dimensional wire models to demonstrate better the actions and movements to lay people for the sake of more efficient or less difficult labor (figure 3).

While coming from different backgrounds and disciplines, each of these early innovators had to invent or modify their equipment, and they also gave a lot of thought to the subject and the information contained therein—often abstracting the information for deeper understanding, superimposing more data, or reconciling two-dimensional images into three-dimensional representations.

*Fig. 3. Scene in laboratory making wire models of motions from stereocyclegraphs, c. 1915. Frank and Lillian Gilbreth.*

A more contemporary example is how Paul Eckman operates on the micro scale by identifying microexpressions—very brief facial expressions, lasting only a fraction of a second.[4] These occur when a person either deliberately or unconsciously conceals a feeling. Although trained people can detect microexpressions with the naked eye, most people don't, and here the use of video feed allows for the identification of micro facial expressions in a discernable manner, which is learned and then exercised in direct observation (figure 4). For future designers, examples such as these are opportunities to explore how one can develop sensitivities to storytelling and graphic composition using words, drawings, and models as the protagonist in this process. As such, physical size and time-duration open a window to explore how time-based medium can become an agency for informed design.

## Creation, Observation, and Evaluation of Time-based Content

The creation of time-based media in one scenario asked students to document their action as raw footage with the objective of gaining insight into what takes place as they elaborate on their design. Additional requirements were length, setup and clarity about the specific action filmed. Initially, students begin by documenting their actions in a very intuitively manner and this process forced them to carefully orchestrate their scenery, how it is framed, as well as the point of view and the way in which they choose to tell a story about their actions. In the first round of videos, mostly everyone was overly eager to produce a stylish video without paying attention to the essential requirement of non-edited footage. The observation part, in this case, was done in stages. Initially, comments were given to each student as to the basic flows that existed, for example, background noise or distraction that didn't allow for the subject itself to be clear or the point of view about light source or what existed within the frame as a composition.

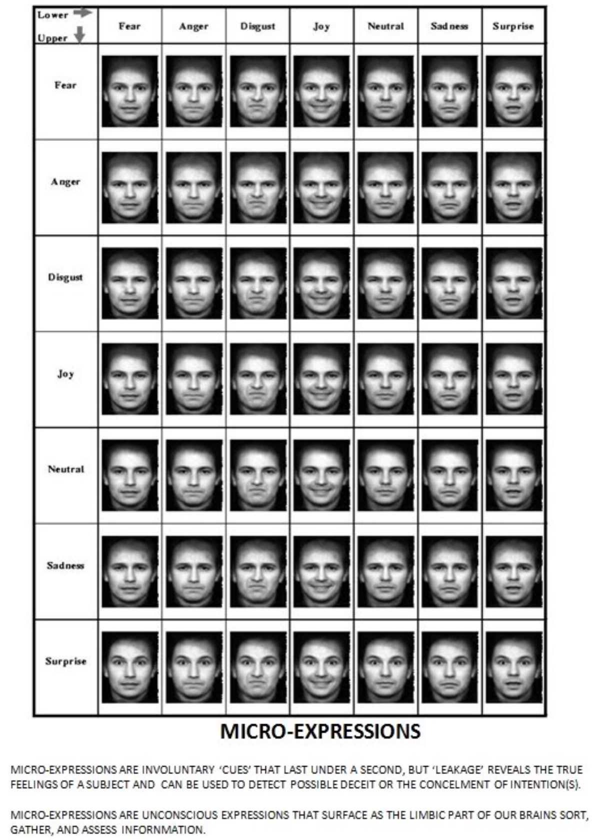



*Fig. 4. A catalog of facial clues for microexpressions, from http://microexpression.weebly.com/.*

In the second round, the outcome reveled higher sensitivity to the task at hand and the content demonstrated a clear grasp about what was being asked and as such the observation stage for this round was more effective. The videos were then screened in class to facilitate a dialogue regarding the advantage of points of view and the differences between top, bottom and side views and what they reveal to the viewer. Also, we discussed what is being included in the frame and how that gave the viewer insight into how and what was being made.

Ultimately these observations helped with evaluating the content to the extent that it allowed everyone in the studio to gain insight to the different methods and techniques that were developed in response to the same problem. Most important in this stage were the observations and then the evaluation of unexpected moments where the author went beyond the required task to document the action of making and provided insight about what was being made and the performativity of the object (see figure 5). These unexpected discoveries gave us insight into the direction in which the process can inform the design itself and this discovery became the proof of concept. Although not easy to replicate, we have noted that such actions go beyond the documentation and bleed into what we call experimentation with what was being made. It was important to us that activity documented using time-based media became visible, readable and interpretable in more ways than just the intentions of the author. Therefore, we choose to follow the saying that content does hold a message, and now that message can be viewed and interpreted.

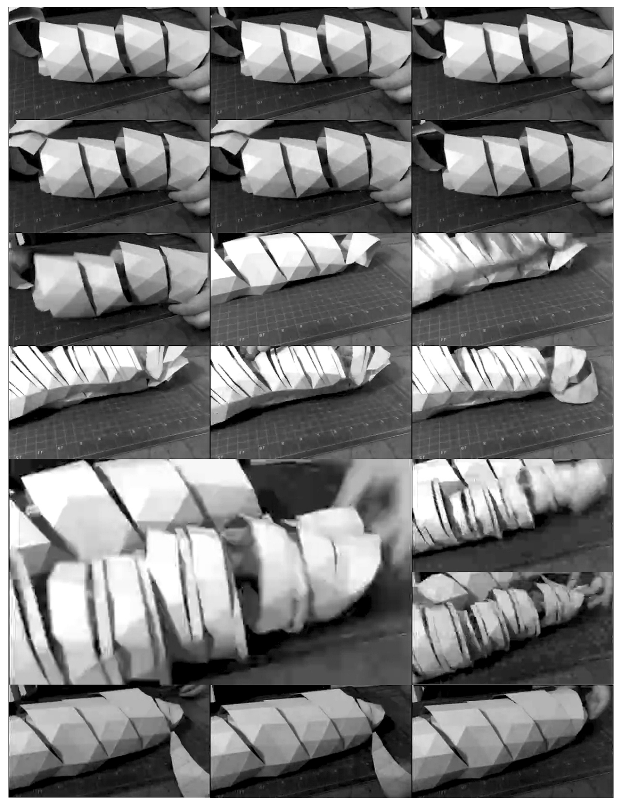


*Fig. 5. The superimposition of two models creates unexpected moments that lead to new discoveries. Video study by Laura Rivera.*

In another studio context, video was deployed as a tool for understanding "place"—at first, to document, but also to analyze and interpret the tangible and intangible phenomena that occur in a complex urban environment. This exercise focused on visual experimentation with video collected in and around a design studio project site. The instructor was interested in creating a feedback loop related to the subjects being filmed, post-processing techniques and effects, and the edited narrative/message iteratively informing each other. Among the 'tricks' the students were asked to experiment with were speed, contrast, and super-imposition. The students used GoPro and DSLR cameras along with tripods to set up photography and filming to observe in time lengths that varied between 5 and 60 minutes. Things the students considered about the 'place' they were investigating while collecting video were: The various systems that take part in making place (natural and human-made), how these systems interact—some are co-dependent, others are disruptive or in conflict, as well as the scale of these systems relative to the site and to each other.

*Fig. 6. Sample stills from Place video studies showing blurring, echo, and color effects used.*

Despite the efforts to guide the students toward a method that will aid them in the design process, this didn't materialize. The students had very hard time abstracting and experimenting with their video studies for deeper or newer understandings of their content, and this led to difficulties with composing their studies according to any narrative. Beyond this problem, there ultimately was little or no connection in the students' minds between the videos and their further notes, notations, drawings, and initial design ideas and decisions. This disconnect between 'seeing' and 'designing' was evident to the instructor and external reviewers during studio presentations.

Some of this suggests that the students faced a steep learning curve in working with video. This would include, both, inexperience with the technical side of capturing and post-producing video, but also lack of familiarity with thinking about the after-effect of time base media, information, meaning, and communication beyond merely consuming television programs or popular films. At the end of the semester, the questions of how our students can use time-based studies to inform design decisions and lead rather directly to drawing and modeling were left unfulfilled.

## Conclusion

With the introduction of content sharing on social media, including the self-documentation (selfie) format, time-based content is now accessible through various forums and platforms. More importantly is that this wealth of content provides an example to self-expression using time-based media to document a real-time activity. Despite the abundance of such content, we wish to discuss what pertains to the pedagogical arena—the ability to understand what it takes to make such content appealable to an audience who is addictively viewing and posting similarly documented activity to Instagram and other social networking apps. This practice of social media connectivity allowed for the video to be seen as a "1:1" documentation of an event. Much like in the words of Paul Ekman, video capturing of actions (in his case, facial expression) can provide black-and-white interpretations and evidence of the truth. However, that can only be done through keen observation and close attention to details and by developing cognitive abilities to see beyond the obvious. In that regard, our contention is that the use of time base media begins to establish the awareness to such traits and as such begin to spark the thinking that designers require to become more attuned to when solving various scales of design problems. For example, a design is a time-based process in which content requires time to observe and evaluate and then used effectively to inform models for design decision-making. To reinforce the aspect of time and its critical role, according to Shane Frederick, most intuitive thinkers make uninformed decisions only because they fail to see the logic of what they are being asked; over-reliance on intuition should not be a common practice.[5] Rather logical thinking, which leads to informed decisions require time to arrive at. Hence, the other question that became of interest to us was what can be done in these contemplative moments to help induce the growth and capacity of creative thinking.

The experiences recounted in this paper led us to the understanding that introducing time-based media earlier as a tool in the seeing, thinking and design process could potentially prove to be more successful in upcoming studios. In our context, students' analytical inquiries suggest that video and other time-based media, regarding substance and meaning, have a "1: many" capacity, in providing new ways of creating and observing evidence, and finding logical means for interpreting it. These exercises aren't about finding truth or creating efficiency like the historical examples mentioned above; rather they are about exploring opportunities to denote the differences between reasoning out answers versus intuitively knowing them.

## Notes

[1] Sheldon, James L. and Jock Reynolds. *Motion and Document, Sequence and Time: Eadweard Muybridge and Contemporary American Photography,* Andover, MA: Addison Gallery of American Art, Phillips Academy. 1991.

[2] Braun, Marta. *Picturing Time: The Work of Etienne-Jules Marey (1830-1904),* Chicago: University of Chicago Press. 1992.

[3] Mandel, Mike. *Making Good Time: Scientific Management, the Gilbreths Photography and Motion Futurism,* Santa Cruz, CA: M. Mandel. 1989.

[4] "Micro Expressions - Paul Ekman Group, LLC." Paul Ekman Group LLC. Accessed January 2, 2016. http://www.paulekman.com/micro-expressions/.

[5] Frederick, Shane. "Cognitive Reflection and Decision Making," *Journal of Economic Perspectives,* 19(4), 2005, p 25-42.

# Phenomenological Explorations, Mappings, Prosthetics and Thresholds

Sarah Young | University of Louisiana at Lafayette

## Introduction

It is our responsibility as designers of the built environment to create architecture that is sensitive both to the human condition and the world in which we dwell. To develop this capacity requires an immersion in what Husserl called the *lifeworld*, which can be effectuated by a phenomenological approach. The benefits of this perspective in design education are outlined by David Seamon in his essay on interior design research which states that phenomenology "provides one conceptual and methodological means for examining the spatial, environmental, and architectural dimensions of human life."[1]

An immersion in the spatial, environmental, and architectural dimensions of human life is particularly important for architecture and interior design students today. As millennials, they are thoroughly engaged in the digital world,[2] yet they strive to become the future designers of the physical world. Architecture acts as a steward of experience, and it is perceived by the body through our senses. As such, part of our job as educators of fledgling architectural designers is to ground them in the real. To address this concern, our second year studios introduce a semester-long project which uses phenomenological studies as a basis for architecture. In this project, which unfolds in four interdependent phases, students must sensorily engage a given site and ultimately use their findings to design a small-scale architectural intervention on that site.

In order to better understand the reasons and methods behind this project, the author would like to briefly examine its context in the pedagogy at the University of Louisiana at Lafayette School of Architecture and Design. In their first year, beginning students in architecture, interior design, and industrial design take the same beginning design studios. These studios teach design as a process translatable to any discipline. Projects are set up in a series of steps that build to create poetic, tectonic projects that do not fit comfortably into any of these three disciplines, i.e. masks, fashion garments, relief sculptures, etc. Concurrently, first year students take a separate course for hand drawing and drafting.

Second year, as a time of transition for our architecture and interior design students from general to more architectural design strategies, attempts to initiate an awareness of the sensory potential of architecture by focusing attention on the means through which our bodies perceive the world. The first second year project requires a series of translations in order to both ensure the continuance of the process-driven design practice learned in previous studios and to learn the unique advantages of each of the design tools at their disposal, synthesizing modelling and drawing skills into a cohesive design and communication practice. Finally, the second year studios introduce site as a generator of architecture, and architecture as a mediator of site conditions.

To achieve these learning outcomes, we introduced a project which proposed architecture as an intensifier or focusing lens for an observed phenomena which students found particularly fascinating in their site studies. This paper intends to describe the project methodology and conclusions, as well as to analyze its successes and shortcomings in order to continuously improve learning outcomes.

The fall 2015 class of 44 students was team-taught by two architecture professors, the author and Thomas Cline, and interior design professor Brian Powell. The four-hour studio class was taught with a combination of large group pin-ups and discussions, and individual work time in which students received one-on-one feedback from each of the three professors. This class structure allowed the opportunity for students to learn from

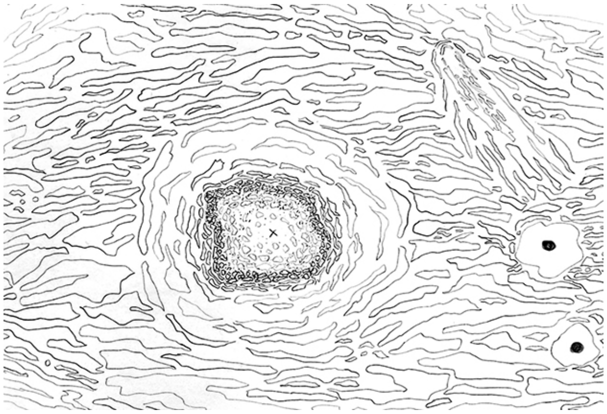


Fig. 1 Ripple Mapping from Outcome #1. Student: Shauna Martin, 2015.

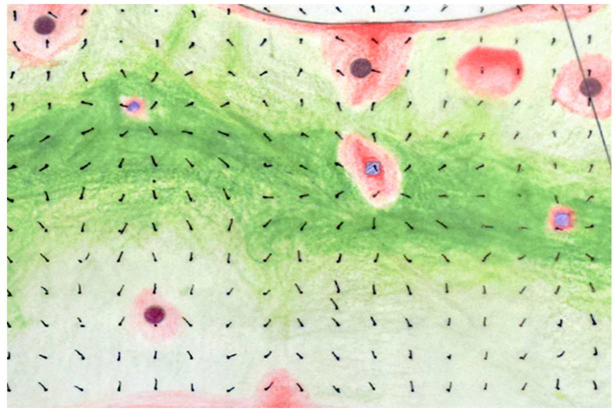


Fig. 2 Water runoff and erosion mapping from Outcome #2. Student: Sean Sivaro, 2015.

each other's projects, and also to receive three (at times, conflicting) critiques on their own work. In this environment, students must begin to drive their own projects instead of relying on the opinions of one professor. The semester long project is introduced one phase at a time; the final outcome is not revealed to ensure that each phase is given due consideration and to prevent a circumvention the design and discovery process.

## Methodology: The Four-Phase project

*Phenomenological Explorations*

This phase was introduced with a short reading from Michael Benedikt's *For an Architecture of Reality*:

> "There are valued times in almost everyone's experience when the world is perceived afresh: perhaps after a rain as the sun glistens on the streets and windows catch a departing cloud, or, alone, when one sees again the roundness of an apple. At these times our perceptions are not at all sentimental. They are, rather, matter or fact, neutral and undesiring- yet suffused with an unreasoned joy at the simple correspondence of appearance and reality, at the evident rightness of things as they are. It is as though the sound and feel of a new car door closing with a *ker-chunk!* We're magnified and extended to dwell in the look, sound, smell, and feel of all things."[3]

In this phase, students' attention was directed towards what Seamon describes as "the day-to-day world of taken-for-grantedness to which, typically, people give no attention because they are caught up in their ordinary, daily pursuits."[1] Students began by taking daily visits to the site (a park adjacent to campus) to observe and record natural phenomena using their five senses. In this phase, they conducted qualitative analysis of site through informal journal entries, sketches, and photographs in order to activate a heightened sense of awareness. Diane Watt explored the benefits of this kind of reflexive research, noting that it heightens the understanding of the both the phenomenon under study and the means of observing it.[4] These observations were recorded on the spot, directly engaging the body in space in real-time, creating a direct and immediate relationship between the person and the perceived phenomenon.

This research was conducted daily over a period of three weeks. The duration of this study was significant, as it created the repetition necessary for reaching beyond face-value observations; each day they delved deeper into the phenomena they found interesting. Over the course of a couple of weeks, the were asked to narrowed their focus to a particular phenomenon of their choosing, one which genuinely fascinated them, i.e. wind rustling tree leaves, ripples in the pond, dappled sunlight, paths worn into grass, etc.

*Phenomenological Mappings*

After the discovery phase, students became more analytical in order to develop a method of communicating their chosen phenomenon through drawing. Data collection and visualization techniques were explored and discussed as site explorations shifted from the qualitative to a more quantitative approach. Students begin to translate their informal observations into data collections, and then into measured drawings. This challenge was broken down by asking a series of questions: How can natural phenomena, especially those that you can't see, be translated to a two-dimensional drawing? How do you draw change or the passage of time? How best can you illustrate the forces which cause phenomena?

These measured drawings were analog and low-tech; students were not encouraged to use (though not discouraged from using) tools or devices used measure aspects of the phenomena they studied. Instead, emphasis was placed on their visceral experience and observations on the site. Through group discussion, a distinction was made between diagramming and mapping forces on the site. Diagrams tend toward systematic depictions of abstract concepts, while mappings depict specific relationships.[5] In order to understand their particular phenomenon as specifically as possible, mapping was encouraged over diagramming.

In order to accurately communicate their phenomenon on paper, students were encouraged to experiment with a variety of drawing techniques and media. Students used at times unconventional drawing techniques in a set of measured orthographic drawings to create a vivid, three-dimensional depiction of their observations. They were also encouraged to explore the evocative and/or metaphorical potential of different media to aid in the **process of translation and communication: charcoal can appear delicate or strong depending on the way it is used, watercolor could be an appropriate medium with which to communicate about water, etc.** These site investigations were to be regarded both as projects in themselves and as generative tools for their future design process.

*Phenomenological Prosthetics*

Referring back to the role of this project within our pedagogy, the first year is focused on the development of tectonic systems, often through wearable projects. To tap into these previously learned skills and begin to apply them to external factors, students were asked to create wearable prosthetic instruments which intensified the effect of their mapped phenomenon on the body; operable devices that focused the wearer's attention on specific sensory stimuli. Translations in this phase were made from passive mappings of phenomenological events, to active enhancers of them. Students developed their three-dimensional tectonic systems through a series of iterative models.

The purpose of this phase was to engage the body at the scale of the body. This scale offers copious familiar examples of ways the senses can be mediated, i.e. glasses for sharpening sight, hearing aids for magnifying sound, etc. Outcomes of this phase often involved the translation of information gathered by one sense into another sense, i.e. sight to touch, touch to sight, etc. The final translation required strategies from the prosthetic instrument to be translated from a wearable scale to the scale of architecture.

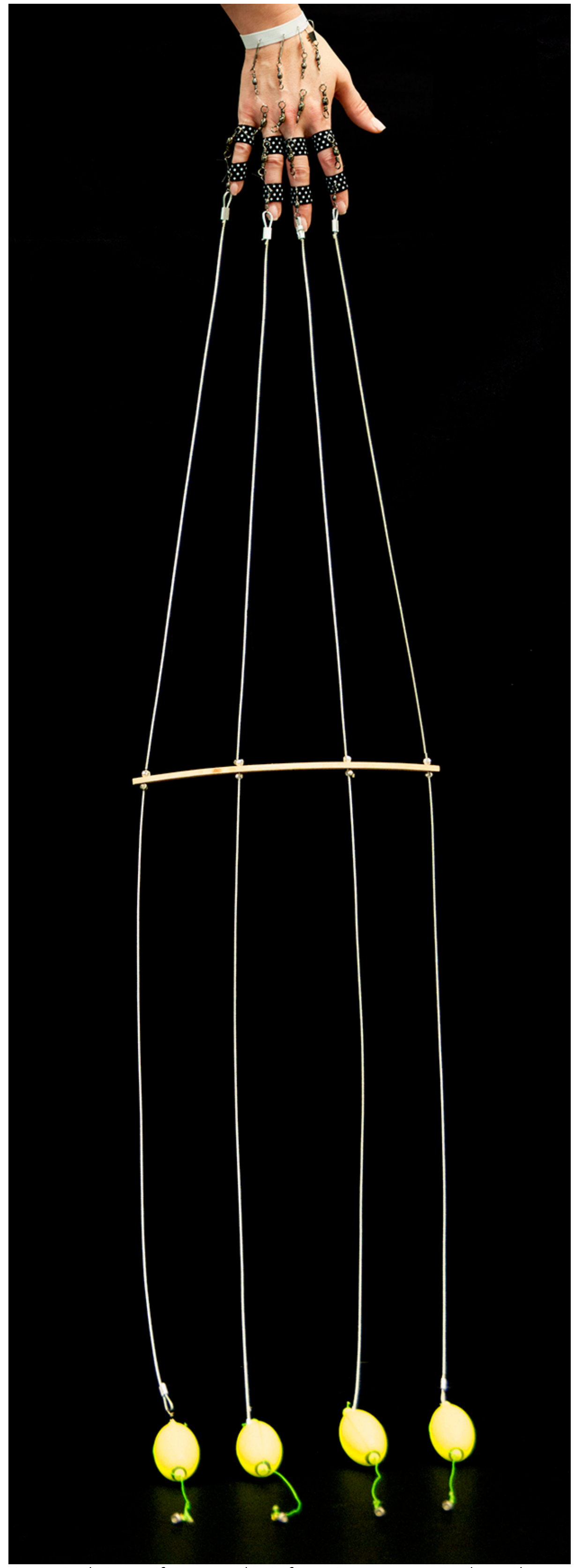


*Fig. 3 Ripple intensifying prosthetic from Outcome #1. Student: Shauna Martin, 2015.*

*Phenomenological Thresholds*

At the onset of this phase, we discussed the idea of a "threshold," an intentionally vague term with many interpretations. Thresholds can be boundaries between two conditions, or a bridge between them; they can be subtle or overt; they can be gradual or abrupt. The threshold (or series of thresholds) they designed had to bridge between on/off or high-intensity/low-intensity conditions of their phenomena on the site in order to create a heightened sensory experience for visitors to it.

These interventions forced a jump in scale from the 1:1 handheld objects which function as prototypes, to an architectural scale which requires the design to be rendered in miniature. Students were instructed to explore the variety of ways their intervention could immerse a visitor in the experience of their phenomenon. Ground planes, vertical planes and overhead planes (floor, wall, and roof, the basic building blocks of architecture) were discussed as unique opportunities to affect the space within and around their projects. Students were instructed to use these tools to design a varying experiential sequence through the site. As part of this phase, students were asked to create fragment models at 1"=1" scale of a detail found in their threshold. This prompted a discussion about how the conceptual ideas driving their projects could be expressed in and reinforced through architectural detail.

When this step is concluded, the semester-long project was presented in its entirety to the faculty of the school in a formal review. For this review, the final requirements were a 1-1/2"=1' scale model, a site section and site plan at any scale they deemed appropriate to showcase their particular project, and a detail model at a 1"=1" scale. They were also encouraged to display any other models or drawings which would help tell the story of their threshold's experiential sequence and their design process.

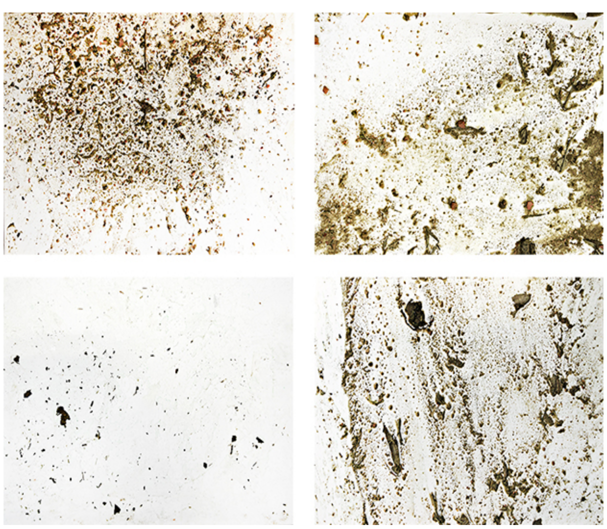


*Fig. 4 Earth canvases created from Erosion Art Generator from Outcome #2. Student: Sean Sivaro, 2015.*

## Outcomes

Two projects in particular are indicative of two common processes through which students designed these projects.

*Example Outcome #1: Ripples*

In the first outcome, we find a student who became fascinated with the ripples in the pond. While at first she found particular interest in the reflections caused by the ripples on the surface of the water, she quickly shifted focus to the motion, shape, and amplitude of the ripples as caused by different forces within the pond. She mapped varying kinds of ripples created by different sources, i.e. the fountain, ducks, the wind, etc. Her prosthetic was a device which translated sight to touch. Using this device, a user could feel the ripples on the pond while standing beside it. Her device used fishing bobbers to float on the surface of the water, steel cable to "extend the fingers," and elastic bands to attach the cables to each fingertip. Each cable was carefully isolated through a sliding bridge so that each finger would have a greater range of motion with which to feel the ripples. She directly utilized the sliding tectonic she developed in the prosthetic to design her threshold project. She designed a bridge across the pond with a series of floating platforms which, while connected, bobbed independently of each other with the ripples of the water. She extended her tectonic vertically and over the platforms to create a more immersive experience for the visitor. This also had the effect of creating an undulating ribcage visible to visitors from a distance, enticing them to approach and enter the installation. This outcome illustrates an example of a student who took the path we had initially intended for our students; to develop a series of clearly translatable steps in order to produce an architectural product. Some other students took a more oblique approach.

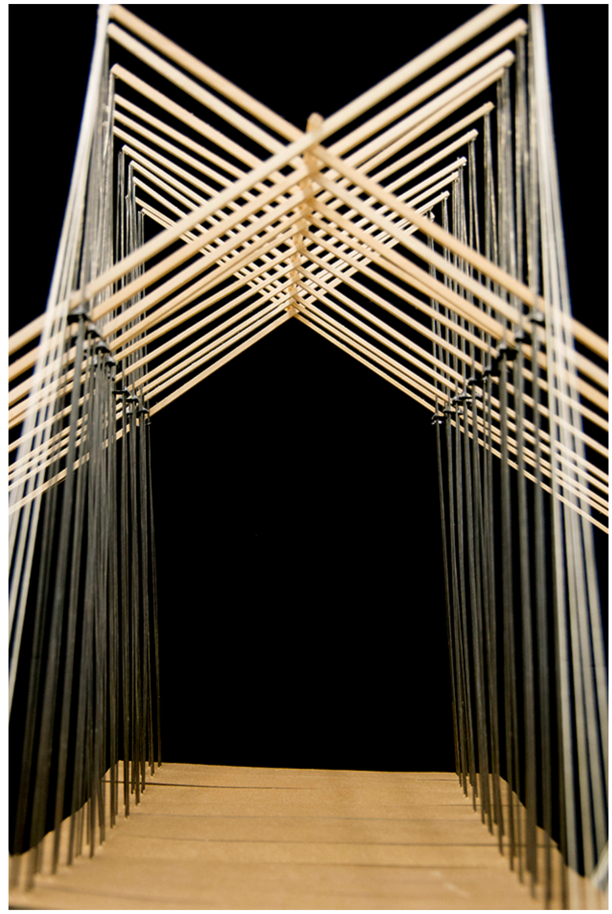
*Example Outcome #2: Erosion*

In the second outcome, a student became interested in eroded earth as an indication and record of water runoff on the site. He developed mappings of the topographic changes and direction of water runoff over a large portion of the park. His prosthetic was an erosion-art generator. A tank for paint-tinted water with a valved hose and a rack holding canvases was strapped on to the user's back. The user would take a canvas from the rack, place it on a patch of bare, sloped earth, and run water over the soil and onto the canvas. Varying patterns of residue would stick to the canvas, which would then be placed horizontally back on the rack to dry. This prosthetic took a humble phenomenon that usually goes unobserved, erosion caused by water runoff, and elevated it into art. The threshold project was a small staircase which ran down the slope of a modest hill, touching the ground lightly with delicate, trussed supports. The stair steps were tilted downward in the direction of the slope in order to draw the visitor down them like water is drawn down the hill. The handrail was offset a few inches outside of the stair in order to invite the visitor to lean over and hold on, which having the effect of drawing their attention to the eroded earth below. This student and others gained an understanding and appreciation of their phenomena from their mappings and prosthetics, but did not derive their threshold tectonics directly from them.

## Findings and Conclusions

This project achieved several of the intended objectives. There are, however, improvements could be made to the course in the future. It was difficult to address the diversity of phenomena presented in group critiques. Students began to stop paying attention when they felt that the discussion was not directly related to their phenomenon, which meant there were less opportunities to learn from each other. In the future, we could limit the choices of what they could focus on, perhaps to phenomena involving light and space, some of the building blocks of architecture. There was a tendency for students to simulate the phenomenon instead of vivifying it; mimicking it without bringing something new to the table. It would be useful to discuss more frequently the role of architecture; how is it different from nature, and what can it do that nature cannot? Also, the relationship between the initial mapping and the final threshold was not strong in all of the outcomes. Many students abandoned the tectonics they developed in the prosthetic, not realizing the potential they had to inform their thresholds. In the future, more methods of accountability could be introduced.

Breaking the project down into distinct phases and introducing each of them one-by-one allowed students to focus on the learning opportunities at hand rather than trying to control the outcome. One of the biggest successes was the heightening of awareness of their environment overwhelmingly reported by the students at the conclusion of the semester. Students came to the understanding that architecture is not inert. It affects the way a person sees, hears, and feels, whether the designer intended it or not. Awareness and control over this potential is necessary for the creation of architecture which dwells. This



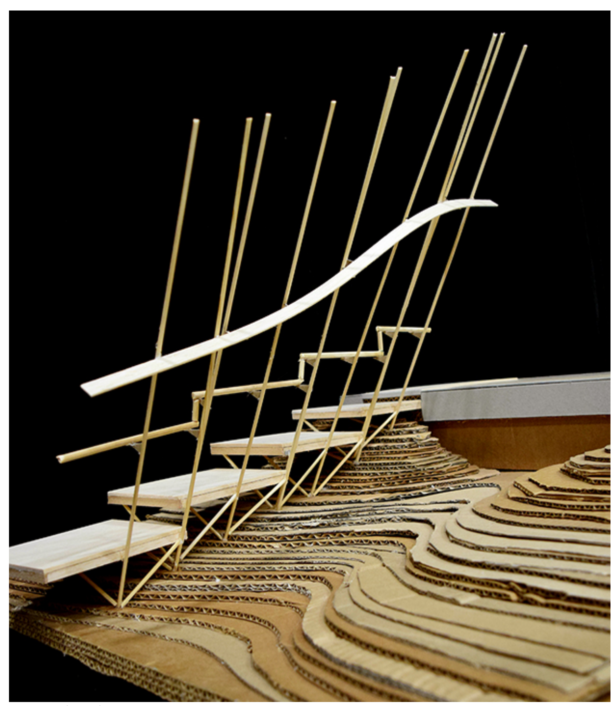


*Fig. 5 (top) Ripple intensifying bridge threshold from Outcome #1. Student: Shauna Martin, 2015. Fig. 6 (bottom) Erosion intensifying stair threshold from Outcome #2. Student: Sean Sivaro, 2015.*

project plays a significant role in initiating beginning architecture and interior design students into the nature, responsibility, and existential potential of their chosen fields before they continue on to more pragmatic "professional studios" in third and fourth year.

## Notes

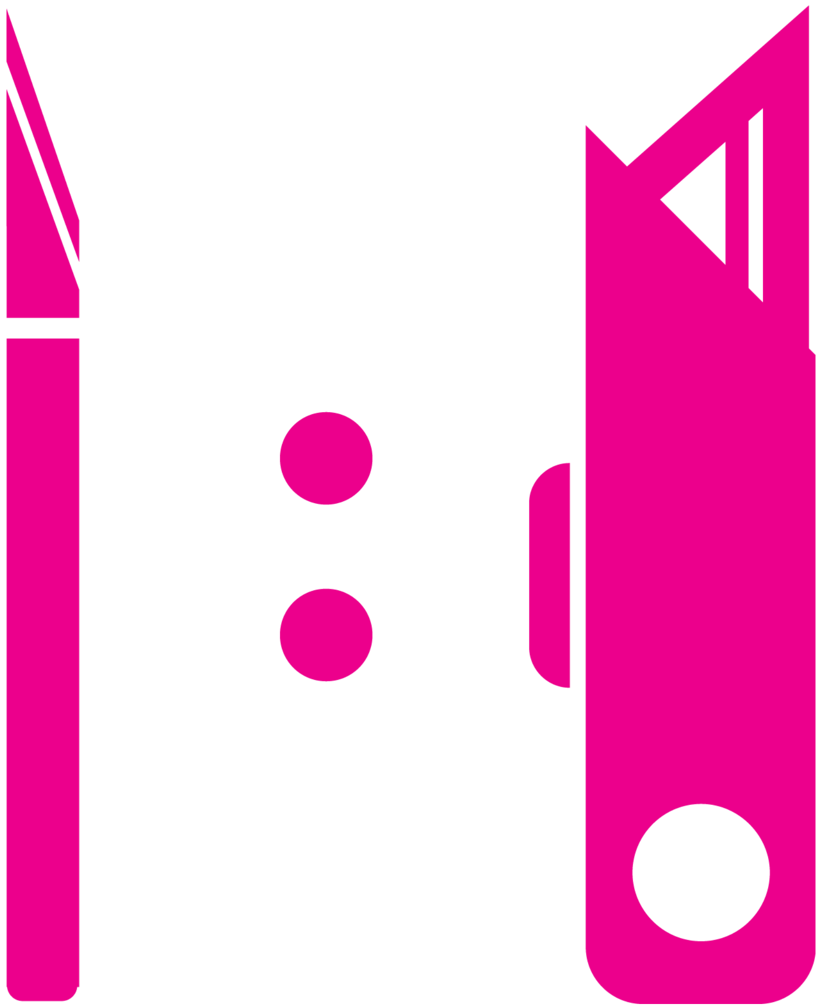
[1] Seamon, David. "The Phenomenological Contribution to Interior Design Education and Research: Place, Environmental Embodiment, and Architectural Sustenance" in *The Handbook of Interior Design*, ed. Jo Ann Asher Thompson and Nancy H. Blossom. John Wiley & Sons: Singapore. 2015. p 417-431.

[2] Prensky, Marc. "Digital Natives, Digital Immigrants Part 1." *On the Horizon* 9.5 (2001): 1-6. *EBSCOhost.* Web. 15 Jan. 2015.

[3] Benedikt, Michael. *For an Architecture of Reality.* Lumen Books: New York. 1987. p 2.

[4] Watt, Diane. "On becoming a qualitative researcher: The value of reflexivity." *The Qualitative Report* 12.1 (2007): 82-101. *EBSCOhost.* Web. 15 Jan. 2015.

[5] Eppler, Martin J. "A comparison between concept maps, mind maps, conceptual diagrams, and visual metaphors as complementary tools for knowledge construction and sharing." *Information Visualization* 5 (2006): 203. *EBSCOhost.* Web. 15 Jan. 2015.



## OPEN

Not all beginning design topics are covered in the categories outlined by the conference chairs. The following papers are clearly outside the boundaries defined in the prior chapters, and yet are still integral to the conversation about beginning design now.

Open

# Architectural Cartography

Amir Alrubaiy | University of Colorado Denver

## Introduction

As both the discipline and profession of architecture continue to grapple with how to prepare new generations of Architects, we necessarily adopt tools and technology to help position ourselves to meaningfully influence projects. Certainly BIM and digital fabrication practices have contributed to architects learning to shift their influence relative to material and management aspects of architecture. However, these tools come into play late in the building process. By contrast, information collected, analyzed and visualized in Geospatial software is increasingly the information that sets the terms for architectural projects. Municipalities, developers and corporations use the data visualization capacities of GIS to make decisions about the future built environment before architects are hired. To this point the potential for architects to leverage GIS technology remains relatively unexplored.

This paper describes how geospatial technology and techniques are used in both an undergraduate studio and seminar setting. Students use GIS to assume the role of architect as developer in order to be exposed to the range of contextual decisions traditionally made prior to their engagement. We use GIS to visualize and analyze the complex social, economic and regulatory networks within which the project will be situated. Later, students use visualizations to expose opportunities and generate proposals. Finally, maps provide project foundations and evidence. Students also explore maps as designed objects and narrative devices. Initial experiments begin with basic cartographic techniques using color, image, symbol and text. Intermediate projects focus on the expression of layered descriptions of urban conditions. A culminating project is the design, fabrication, and installation of a large scale layered, mixed media map of Denver. Material constraints and opportunities drive cartographic decisions.

The following work is significant in multiple ways. Geospatial tools allow students to quickly and effectively visualize and engage complex urban conditions. Experience with GIS provides students with a skill that can open unforeseen professional opportunities outside of traditional architectural practice. Finally, because architecture is unique in its ability to translate and narrate complex conditional networks, turning our attention to the map as design material opens our students to the methods used to locate and identify Architectural potential.

## Learning Oportunities

Systems of representation or expression naturally filter what types of information they express. Visual art privileges the formal and compositional. Prose lends itself to a linear and sequential presentation of information. Graphs and charts excell at presenting comparative and/or functional information. Often the implicit filtering by given media or tools is taken for granted or forgotten. However, by conscious examination to what particular tools “prefer” to express, we can craft learning opportunities that exploit these preferences.

Most architecture students race to learn design software. Rhino, Maya, Revit, and even Sketchup dominate their attention. The Adobe suite is nearly as essential as basic drawing and modeling skills. The importance of these platforms is not to be diminished. They are essential to rapid and inventive exploration of Architectural space and material. These platforms, however, naturally privledge formal and spatial information. These environments are aimed at designing and developing material artifacts. As such, their interfaces and commands mimic 2D and 3D material operations. The digital objects or layers manipulated in these softwares are analogous to materials in the physical world. The screens approximate objects and compositions that have their precedents in paper, film, clay, etc. Because of this, thinking is necessarily directed towards modes that lend themselves to physical analogies.

Shearing, layering, shifting, etc. are the mental schemas operating in these investigations.

GIS, however, is not concerned with generating material objects directly. It is an analysis tool with a cartographic output. Its power and usefulness derives from its ability to catalog and filter vast quantities of "attributable" data and associate those data with geographic locations. While this power is useful, it tends to be more revelatory than inventive. This shifts the emphasis of the GIS environment away from the visualization and toward the data behind it. Because of this, the tools and methods students are used to using to manipulate material, become useless as they move into a world of spreadsheets and SQL statements. Spatial and material analogies are not natural to the manipulation. Instead, grammar, equation, and "if/then" become the operative cognitive schema used in dealing with data. GIS is not an environment in which concepts are naturally developed so much as it is one in which concepts are informed.

There are several teaching opportunities that may exist when this difference is foregrounded. In the following examples, we are concerned with two. The first is that the GIS environment allows for a renewed discussion of context for the Architectural project in terms of regulation, opportunity and investment. Context is defined as a matrix of data that either preclude or allow certain Architectural interventions. It is an environment that holds architecture as a means to an end, but cares very little about architecture, per se.

The second opportunity occurs when a course turns a design agenda towards a subject that isn't naturally concerned with design. In other words, what happens when you take what is perceived as an output and attempt to turn it into an artifact. However in this context, we're not concerned with high-level data analysis. Instead we explore how different visual techniques, namely collage and layering, affect the communicative power of maps.

## Orienting Precedents

The work within these courses uses two precedents relative to architectural mapping. These precedents serve as poles around which the work orients. The first is characterized by a sequential and distilled presentation of information akin to Thom Mayne's LA Now[1] project. The second is the type of "eidetic"[2] mapping characterized by James Corner's work, particularly in his book Taking Measures Across the American Landscape[3].

Cartography typified by the LA Now project aims at revealing the operation of a complex subject through clarity and distillation. These maps strive for a singular reading that derive from their graphic cleanliness and simplicity. Their power comes from repetitively reproducing the same scope and scale map, with different sets of information. Each map is singularly clear. Complexity emerges cumulatively, as the viewer encounters each map sequentially. As a result, the tools we use to develop maps in this mode tend toward the precise and delineated. Adobe Illustrator, minimally filtered GIS, and CAD platforms are the norm.

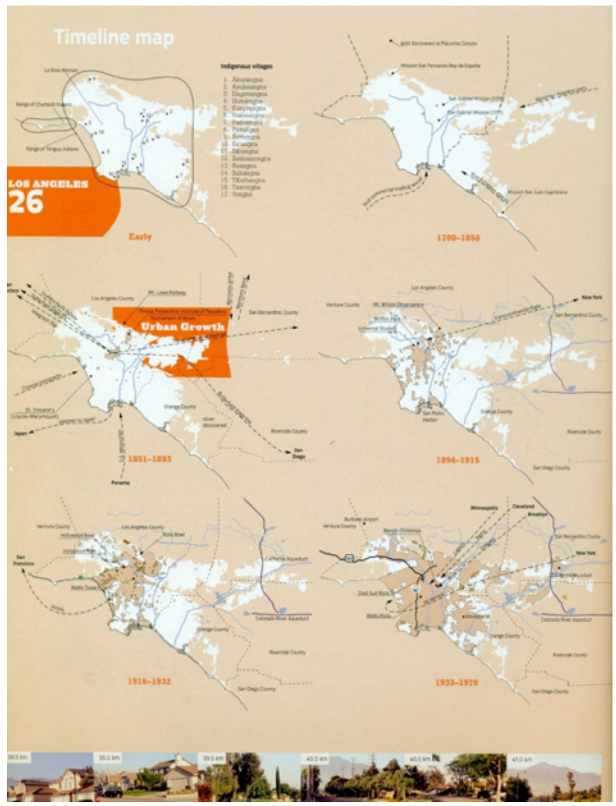



*Fig. 1 Timeline Mapping of Los Angeles[4] as an example of distillation mapping.*

By contrast, the visual territory occupied by James Corner's work, strives for the rich and layered readings afforded by collage and mixed media drawing. While precision and accuracy remain essential for the seriousness and usefulness of these works, these qualities are not utilized in the same way as the more traditionally cartographic work described earlier. Instead, Corner aims for an open reading in his drawings, which strive to be as suggestive as they are revelatory.

*Fig. 2 Pedological Drift[5] Example of eidetic mapping.*

These precedents share some similarities. Both elevate the mapping project to artistic levels that go well beyond the expedience of legibility and clarity. They also both make heavy use of supplemental images to flavor the reading of each map. However the use of image illustrates a significant difference between these projects. In LA Now, images are adjacent to maps or used as backgrounds for associated data. Images are complete and legible. This technique directs the viewer to interpret the content of the map without interfering with the cartography. The maps are complete without the image, and the image does not occupy the cartographic space.

By contrast, Corner's mappings use images in multiple ways. They are superimposed, spliced, and layered into the space of the map. Sometimes they elaborate or contextualize the subject, other times they are manipulated to become texture or background for the composition.

These differences belie different agendas for each project, and the courses make students aligning their work with one or the other, conscious of this. The LA Now mapping, with its repetitive presentation, lends itself to analysis and comparison. The clarity afforded by each map's distillation helps build a case and justify projects. The eidetic mapping, on the other hand, lends itself toward suggestion and provocation, presenting information as simultaneous, layered, and incomplete. Students operating toward this pole are in the realm of suggestion rather than justification.

By consciously aligning the work in the following courses toward either the eidetic or distilled precedents, students encounter specific lessons derived from the mapping process. In the case of the studio, which is more tied to the distillation and analysis of information, we couch the architectural project within a data environment. In the seminar, we take an aesthetic stance toward the map object in an attempt to move the work beyond simple analysis and into the realm of suggestion.

## ARCH 4120: Design Studio V

Within the BS Arch curriculum at University of Colorado Denver, this is a culminating studio. In the context of how architecture operates relative to other disciplines, this is an introductory studio. It is the first opportunity students have to experience architecture in an expanded context (as opposed to the strategically narrowed explorations of form, scale, program, tectonics, etc.). While students are familiar with how architecture operates as a discipline, they are complete beginners in engaging architecture as a practice.

To generate this experience, the course is organized in collaboration with a senior level Project Management course in the College of Business. While our students take on the role of "Architect as Developer," the business students function in the role of "investor" or "financial institution." Architecture students perform market research around a given project theme (in this case food access and distribution), develop program proposals around the research, identify affordable sites for the project, and finally, develop an Architectural proposal. In the first three of these phases students make heavy use of geospatial tools and techniques. Many of the methods we use are basic and fundamental to GIS, but to students coming from a world of 3D visualization and rendering, these techniques represent a vastly different digital experience.

The primary learning opportunity resulting from engaging GIS in this studio is that the data-centric nature of the software enables conversations about the non-architectural pressures exerted on architectural projects. As students generate cartographic output with "attributable" data, locating trends in demographics, regulations, services, and land cost (to name a few), they engage the factors that will determine the success or failure of their projects, independent of the sophistication of the architecture.

This is relevant to the students when they perceive and manipulate the numeric and quantitative information used to make framing decisions about Architectural projects. Even the most basic functions of buffering, querying and locating expose students to the network of architecturally implicated decisions made independent of Architectural involvement. They directly perceive how regulation, cost, return on investment, etc. inform whether a project happens at all.


*Fig. 3 Student work from ARCH 4120 showing walkability analysis of small food stores*

Students, who engage and manipulate geospatial data, bring informed and pre-filtered arguments to the negotiating table with the business students. When conversations turn to the expedient or purely profitable, the architecture students counter with arguments rooted in data rather than aesthetics or desire. Further, by leveraging the clarity of the distilled map, students are able to impart a layer of credibility to their aesthetic positions.

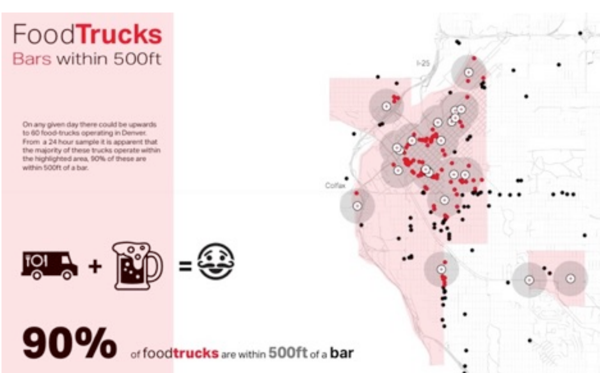



*Fig. 4 Student work from ARCH4120 showing spatial analysis of bars and food trucks*

Finally, because these are still design students who are manipulating content in the realm of business (regulation, cost, competition, available income, etc.), they impart an unexpected level of beauty and wonder to the data. This has two effects. First, it makes the data desirable in a way that encourages buy in. People want to pay attention to it. Second, they make an implicit case for the value design adds to conversations not typically associated with the discipline.

## ARCH 3800: Architectural Cartography

While the type and context of the project in ARCH 4120 lends itself to mapping strategies that tend toward the analytic and quantitative, the format of "Architectural Cartography" allows the work in this course to go down other paths. While there is an emphasis on fluency and fluidity with GIS, reaching a sophisticated level of analytic ability is not the primary agenda. Instead, as designers, we're interested in exploring how the strategic integration of image and text, as well as the conscious use of color and symbol can tell different stories with the same data. This course positions students to engage the more suggestive and layered potentials of eidetic mapping techniques

In pursuit of this, we make heavy use of traditional techniques associated with collage and hybrid drawing. This course presents collage as a technique that, through its repositioning of fragmented and often contradictory images, can engender unforeseen readings. These compositions allow the viewer to simultaneously perceive different information, often occupying the same graphic space. Students operate within a framework where splicing, superimposition, vignetting, and phenomenal transparency are used to achieve specific communicative goals.

We define "splicing" as bringing images together in a rough and often jarring way. Images that use this technique tend to suggest two sets of information in conflict with one another, or at least competing for the same meaning. Superimposition, by contrast, is defined by smooth transitions between graphic elements. When compared to splicing techniques, these images connote a more reciprocal relationship between components. This technique is also useful in presenting different temporal events occupying the same physical space. We use vignetting to highlight and expose particular content in the image relevant to the narrative. This typically occurs within one set of data, but with emphasis on certain bits. This is usually accomplished through differentiation in color, saturation, or texture within a data set. Finally, phenomenal transparency is a concept borrowed from visual art. We take it to mean the concurrence of two visual elements. Or, more simply, it is two visual elements sharing a single formal element.

The course begins simply. In the first two weeks, Students learn a basic GIS interface, methods for finding and importing geospatial data and simple spatial analysis. These initial projects show existing conditions, perhaps revealing some rudimentary insights. The next two weeks are spent generating iterations exploring different ways to use color, symbol and text. All of this work gets students comfortable with generating maps and manipulating their emphasis. The work to this point is singularly focused and does not attempt to combine multiple interpretations or sets of information.

To get the maps reading in multiple ways, the course introduces concepts common to collage technique discussed previously. Students generate a series of hybrid drawings that combine multiple cartographic media. The goal of this project is to generate images that communicate multiple points in time, or multiple interests simultaneously.

*Fig. 5 Student work from hybrid drawing project showing layered historic maps*

The hybrid-drawing project is really a preparation for the final project. In Fall 2015, this project was a multi-layered, multimedia installation map of downtown Denver and the Auraria campus. The installation is approximately 6ft tall x 10ft wide and hangs in the exhibition space outside of our Dean's office.

As students studied their focus areas within the city, we all became fascinated with the amount of erasure and reconstruction that had occurred. This was generated by the discovery of a high-resolution aerial photograph of Denver from 1933. As a class we began to wonder if we could visualize this hidden history in a single composition.

A competition ensued and the winning design emerged. This design used four historic structures, present in 1933 and enduring today, as the centroids of focus areas that would layer up different points in history represented by different media. Current building footprints are expressed with vector data, a 1952 Sanborn Fire insurance map shows up as "rasterized vectors," and the original 1933 photo is pure image.

The main question here was how to translate visual effects that had worked in digital and print format into a large-scale material installation. The class decided that returning to our collage principles and making material and tectonic decisions around them would be our guide. Since we were dealing with multiple points in time and multiple types of cartographic media, students linked each media set with a particular technique. We used splicing to underlay the 1933 aerial map, locating its "bubbles" at the base layer. Superimposition allowed the 1952 Sanborn to occupy the space immediately above the image and reveal significant changes in the urban fabric. Finally, building footprints are layered above and are vignetted using color and material to indicate historic status and hierarchy.


*Fig. 6 Acrylic layering in final installation for ARCH 3800*

Throughout the process, the class performed countless mockups and material studies. What was easy to achieve in the computer proved mysterious in wood, acrylic, and mylar. The construction itself went smoothly until the final installation. The class learned first hand, the difficulties in interfacing sets of materials that had been digitally fabricated with elements that had been hand cut. In the end, however, the final installation was very close to how students had conceived it.

*Fig. 7 Final acrylic and wood installation for ARCH 3800 in Dean's Gallery*

Since the installation, the map has become the conversation piece we intended. The scale and materiality have illuminated a previously hidden narrative, and it allowed us to publicly bring to life the discoveries students made in their preliminary research.

## Conclusions

The work described here emphasizes the conviction that different design software encourages different ways of engaging information. By critically engaging the way GIS accesses, processes, and visualizes information, we can expose students to new ways of approaching architecture. This is particularly true in the case of the studio where using GIS immerses students in the data that shapes the context of their projects. This work also attempts to explore the effects of imposing an aesthetic agenda onto a data-centric product. This exploration is based on the belief that aesthetics may say things that data visualizations alone cannot. In both of these explorations we are working to open a door for design to add value in areas where it is not considered a primary player.

## Notes

[1] Mayne, Thom, Richard Koshalek, and Dana Hutt. *LA Now: Volume One*. Los Angeles: Art Center College of Design, 2002.

[2] Corner, James. *"Eidetic Operations and New Landscapes."* In *Recovering Landscape: Essays in Contemporary Landscape Architecture*. New York: Princeton Architectural Press, 1999.

[3] James, Corner. *Taking Measures Across the American Landscape. Vol. 1*. New Haven and London: Yale University Press, 1996.

[4] Mayne, Koshalek, Hutt, *LA Now: Volume One*

[4] Corner, *Taking Measures Across the American Landscape*

# It Begins with a Diagram

Jeffrey Balmer, Michael Swisher | University of North Carolina at Charlotte

*Today we are familiar with numerous natural examples of originating processes that can develop only by sawing off the branch from which they were able to grow. They only develop by erasing the conditions of their development; they only have successors by destroying their predecessors. The more originating they are, the more they are turned toward what follows them and the more they turn their back on the ensemble that presupposes them, the sequences that condition them.* — Michel Serres, *Rome: the Book of Foundations*

*A beginning immediately establishes relationship with works already existing, relationships of either continuity or antagonism or some mixture of both.* — Edward Said, *Beginnings: Intention and Method*

## Introduction

Musing on the origins of history, Michel Serres explores the Janus-like nature of *beginnings*, with their necessity for antecedents, and the simultaneous erasure or palimpsest of those selfsame events. Beginnings embody the coexistence of what he distinguishes as the vacuum-like void of the *black* – '*misunderstanding, the zero of information'* – and the infinite potential of the inaugural *white* – *'all possible worlds*.'

In his own examination of beginnings, Edward Said approaches the subject from the perspective of literary theory rather than history. Yet many of his findings overlap those of Serres': that the apparent singularity of beginnings also embodies a multiplicity of both precedents, and subsequent intentions.

When we consider the study of architecture, the observations by Serres and Said are particularly cogent: they pose general questions that have far-reaching implications for contemplating the role of beginnings in the teaching of a complex and disparate discipline. Where shall we begin? Is there one, best, point of departure, or can we choose from multiplicities? In evaluating such options, to what ends do we seek to definitively arrive at? Moreover, in setting forth, what (if any) *a priori* knowledge does the beginning negate, whether deliberate or not?

Beginning the study of architecture is a daunting prospect. Though we spend the majority of our lives inside and among buildings, the processes that underlie their design remain impenetrable to most, even to those who profess a keen interest in the built environment.

We might ask why these processes remain obscure, even while the products of architectural design appear all around us. Three common answers to that question suggest themselves. First, the criteria for realizing buildings are intrinsically complex, comprising the aspirations of client and designer, the utility and comfort of intended occupants, and compliance with myriad legal and life-safety regulations. Second, the process of designing and building engages the technical expertise of a wide range of specialists, including designers, engineers, builders, financiers and public officials, and this network of expertise lies beyond the direct experience of the rest of us. Third, architects indulge in bewildering jargon that renders their discourse largely unintelligible to others.

All of the suggestions above have merit. However, the primary reason that *design thinking* remains inscrutable to the uninitiated is the same reason that it provides such a perplexing challenge to students beginning the study of architecture: *the fundamental alpha-numeric bias of our education system.* Reading, writing and arithmetic alone do not and cannot provide the means for evaluating form and space, and for distinguishing order and pattern in the visual world.

Despite living in a culture commonly described as 'visually oriented', few learn to analyze what, and how, we see. We generally presume, at our peril, that making sense of visual phenomena is universal, and comes equally easily to us all: it does not. However, at the same time, each of us shares in an innate understanding of order in the perception and comprehension of the world around us. This native sensibility can, and should, form the basis for beginning an understanding of fundamental principles of architecture as a discipline.

*Disciplinary Beginnings: The Beginnings of Discipline*

*The origin refers to another origin, the beginning demands a beginning, the founding needs auguries, the foundation required preliminaries; as with a ray of light caught between two nearly parallel mirrors, reproducing image after image, everything recedes in an infinite sequence.* – Serres,

*Is the beginning of a given work its real beginning, or is there some other, secret point that more authentically starts the work off?* – Edward Said,

Learning to think like a designer is no small task. It calls upon faculties and patterns of thought seldom exercised by the modalities of alphanumeric education. It obliges us to perceive and to interact with our environment in unaccustomed ways, even as it requires us to recover an innate sense of order and orientation. It compels us to question all our assumptions and expectations, yet also asks that we draw deeply from hard-won experience. Perhaps most paradoxically, design thinking directs us to assess dispassionately all that surrounds us, all the while admonishing us to experience the world in a state of wonderment.

As design instructors, we confront these same challenges. In determining what – and how – to teach novice students, we feel compelled to question the way that we ourselves discovered architecture. In doing so, we have cause to interrogate any and all assumptions about best practices in beginning design pedagogy. A simple question guides our research: What is design thinking, and how do we teach it best? The degree to which our students acquire these concepts and skills leads us to another simple question: Have they acquired the ability to decide and to describe what is important in their work? Underpinning these questions is another that we ask ourselves and bring to our students – a question so fundamental that it usually remains hidden in plain sight: What is architecture?

Defining what architecture is proves to be more difficult to do than one might first imagine. Despite centuries of debate concerning architecture, its definition remains unsettled. Moreover, because other disciplines borrow the term 'architecture', its parameters inevitably vary by context. When asked on their first day, our students offer a range of definitions, usually including the design of buildings. The definition that we share with them on that first day is as follows: architecture is organization toward a purpose.

'What about buildings?' they ask. This is an excellent question. Our response goes something like this: While it is possible and desirable to build toward a purpose, it is not a foregone conclusion. Sadly, examples of buildings without clear organization or clear purpose surround us.

The alternative to these ill-conceived constructions enriches our definition. First and necessarily, architecture is a conceptual organization, an intellectual structuring. We give order to what is knowable by the means. It is in this larger sense that other disciplines borrow the term architecture. Invariably, architecture denotes a system of organization, of order.

When it engages with the physical world, we say that architecture organizes environment toward a purpose. By environment, we mean the tangible, four-dimensional world that surrounds us and through which our bodies play their part. In this more tangible definition, architecture is how we make sense of the world by establishing our place within it. When we rest beneath a solitary tree in a large field, our relative spatial proximity – what Simon Unwin calls 'circles of presence' – help us make sense of our environment, whether we are conscious of doing so or not.

In this same sense, architecture can also involve the physical arrangement of environment. It is this re-ordering of the physical world that we may define further, in terms of measure and matter. Measure comprises the dimensional attributes of form and space. Matter is the 'stuff' of the world, its materials and their intrinsic properties. Form is subject to the presence of visible matter, while space is contingent upon its absence.

The diagram, as an agent of analysis, serves to make sense of the physical environment by revealing or proposing its underlying conceptual organization. As such, a diagram may not only act to represent architecture, it constitutes architecture in the sense that it demonstrates or embodies an intellectual structuring. The proof of architecture resides in its diagram.

*Beginning with the Diagram: Precedent and Process*

Explication is the invention of a diagram, a hypothesis, and an intelligible principle that can be applied without exception to the ensemble of occurrences of the thing to be understood. – Serres

The designation of a beginning generally involves also the designation of a consequent intention. – Said

Diagrams are both explicative and generative: they reveal and propose the essential. They both summarize and speculate upon the significance and potential of any given work. They distill. As such, they are fundamental to an understanding of architecture, and toward an initiation into the design process.

In their explicative or analytical role, diagrams provide the novitiate with elemental insights into the synthetic nature of design – simultaneously revealing a project's conceptual and representational underpinnings. Learning to read diagrams trains the beginning designer to distinguish principles of order and to decipher codes of representation. Analytical diagrams also provide the means by which we may evaluate and compare significant precedents – formal, material, typological –, employing strategies and tactics that initially transcend the notice of the untutored.

In their generative capacity, diagrams empower beginning designers to practice design process, permitting them to enact the fundamental iterative methodology central to the capacity for thinking and acting as a designer. Tasked with generating a diagram, students gain insights into the defining and articulating systems of order within their own, evolving designs. In grappling with 'best practices' for clarity, students reckon with the self-effacing tendencies of effective diagrams: the more self-evident and inevitable a diagram appears, the more ingenious and economic its underlying mechanism.

For experienced designers, the integrated methods of design thinking have become second nature. As such, the primary challenge for those tasked with instructing beginners is to unlearn – to attempt to re-inhabit the way we engaged the world around us before learning to think like a designer. It is a tall order – akin to re-inhabiting the initial panic of learning to drive, where each individual task urgently fights for the conscious attention of the novice. Diagrams offer the beginning student the same learning curve, without the risk of road rage. In the spirit of Serres and Said, diagrams provide a road map of intentionality. They constitute beginnings, yet they inextricably link to desired destinations. Learning to read and thereby to generate them, diagrams pave the way to the practice of architecture, toward ends both general and specific.

Open

# Affordable House: Sustainable Prefab and Community Based Design Build

Olivier Chamel | Florida A&M University

This project started in the context of the deepest recession this country had seen in decades and from the somewhat idealist notion that low income families should have access to well-designed and well-constructed homes at a price they can afford. Although we were approaching this issue from the viewpoint of the designer our intention was not to create an award-winning architectural project but rather to design an efficient and functional home which would respond to the needs of its inhabitants, be comfortable and display an identify compatible with their values.

Aside from doing “the right thing” another reason for attempting to propose low-cost housing solutions had to do with the current overwhelmingly poor quality of mainstream affordable housing. In a context where typical affordable housing projects lack the adequate design attention they deserve it seemed appropriate to investigate innovative design solutions and therefore involve the school of architecture as a design consultant and as a key participant in a low cost housing project. We initiated this project based on the assumption that despite very tight construction cost, a design approach based on frugality, efficiency and the relentless questioning of our preconceive notions of design and construction processes could bring significant improvements to this project type. The overall design strategy consisted in creating a design that would allow significant cost savings at a number of different levels such as material quantities, finishes and ratio between interior and exterior volumes in order to redirect these savings towards a better quality and energy-efficient building envelope. The need for energy efficiency appeared crucial as it would significantly affect the long-term affordability of the house.

We also assumed that in order for such a process to be successful the project designers could not operate in isolation within the world of academia but needed to be integrated in an interdisciplinary team where all project participants would be represented. This would give students an opportunity to interact with a client (the City of Tallahassee Department of Economic and Community Development and a non-profit, the Big Bend Community Development Corporation), a general contractor (LLT Construction) and a building manufacturer (SIPS Team USA).

## Chronology

The project was initiated in the fall of 2012 in the context of a special study course titled “Efficient House”. The goal of the course was to engage in a reflection on wasteful design and construction practices in the US and provide an opportunity to develop more efficient strategies in terms of space planning, energy conservation and material sourcing. A series of lectures were presented to students touching on issues such as residential space planning, building system layout, site design on small lots, foundation systems and building envelope design in order to initiate some thoughts about how to design a house in a more efficient manner.

Because the ultimate goal of this course was to develop realistic design solutions we contacted the City of Tallahassee Department of Economic and Community Development to understand what they considered to be affordable and efficient housing and possibly involve them in the project. They expressed a strong interest and suggested we also get in touch with a local non-profit organization which actually manages the construction of affordable homes in partnership with the city and finds tenants for such homes. Since adhering to a strict and very low construction budget was crucial to the success of the overall project we brought a local construction company on board as well as a SIP manufacturer to help with cost control and advise us on panelized construction. Students were therefore brought into a scenario where they could engage with a realistic project team.

*Phase 1: Schematic Design (fall 2012)*

At the start of the project in the fall of 2012 students were given a simple program and an existing unbuilt lot on which they were to design a 1400 square-foot house using a target budget of $65 per square foot as defined by the City of Tallahassee. The program included living, dining, kitchen, three bedrooms, an enclosed garage (for security reasons) and potential exterior spaces such as patios and covered porches.

In addition to having a quantifiable program students met with the Big Bend Community Development Corporation (the non-profit) and inquired about more qualitative issues such as space organization, natural lighting, security issues and views to and from the site as well as defining an architectural language appropriate for the future tenants and the neighborhood. Prior to starting design the class visited the manufacturing facility of SIPS Team USA to better understand panelized construction as it relates to this specific design process. Students worked in teams of three or four.

This preliminary design phase brought mixed results and despite having been exposed to a specific construction system students had difficulties proposing solutions that would combine a working floor plan with a simple building envelope and therefore provide a clear path for cost savings. They did better when it came to laying out spaces to meet the needs of their client and present esthetically interesting solutions though not driven primarily by cost. At this stage they created a set of drawings which included floor plans and exterior elevations.

*Phase 2: Design Development (fall 2012)*

Following the shortcomings of the first design iteration we asked a general contractor to make a presentation to the class and discuss cost saving strategies along with a methodology to create a construction cost spreadsheet based on a combination of material take-offs and cost per square foot assumptions. In the meantime the original schematic design was reviewed and marked up by faculty so students would have actual visual notes as to how they could improve their design. The expected outcome of the design development phase included a graphic presentation composed of a rendered site plan, floor plan, exterior elevations, exterior and interior 3-D views, building sections and a typical wall section with sun shading strategies for the east, south and west facades. Students were also tasked to create a detailed spread sheet outlining all construction components and providing an overall construction cost with a projected cost per square foot for the entire house. The drawings and cost information were presented at the end of the semester to the project team including the City of Tallahassee, the Big Bend Community Development Corporation, the construction company and the SIPs manufacturer.

Overall the quality of the presentations was good and students were more successful this time around in proposing solutions based on concepts of space and construction efficiency rather than solely on solving the client's program and attempting to make an architectural statement. Most projected budgets were higher than the $65 per square foot initially proposed but some came close around $70-$75 per square foot. Despite the inherent difficulty to generate a construction cost spreadsheet as this is something architecture students are unfamiliar with, this exercise was well received and provided an opportunity for students to see how design decisions carry consequences in terms of cost. There was a sense of discovery and a bit of empowerment among students as they gained new knowledge and control.

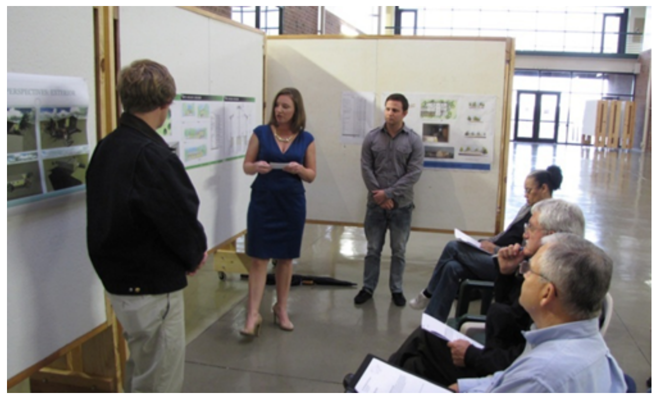


*Fig. 1 Design Development Presentation by Students*

*Phase 3: Design Tweaking (summer 2013)*

*Following the presentation made by students at the end of the* fall semester we gathered the comments from the various team members and developed a revised design proposal that incorporated desirable features identified by our client and consultants among all the different student projects presented. I personally worked with a student during the summer to refine the design and produce a set of construction documents with enough detail to obtain preliminary pricing from a contractor. Looking back, this phase of the project could have been pedagogically more beneficial for students had it been incorporated into an assignment within a Materials and Methods or a technology course. Certainly there would still have been a need for a registered architect to review the final set of construction drawings.

*Phase 4: Waiting, Waiting and Waiting Some More (fall 2013 to fall 2015)*

A preliminary set of construction documents was presented to the Big Bend Community Development Corporation in the fall of 2013 and pricing was obtained from a local contractor to verify feasibility of the project and its affordability per the city's guidelines. At this time the cost of construction not including land came out to $133,185 including a 15% contractor fee. Based on an enclosed building area (including the garage) of 1760 square feet this brought the construction cost to $75.6 per square foot. Using these figures the project was presented to the city for funding as an opportunity to build one energy-efficient affordable house.

Subsequently the City of Tallahassee approved a proposal for the construction of two houses as it provided a frame of reference and an opportunity for the city to measure the energy performance of the SIP house against its conventional counterpart. In the spring of 2015 the project was bid by two contractors with affordable housing experience. In the meantime leadership at the Big Bend Community Development Corporation changed providing a continued interest for the project and closer ties to the decision makers, which proved instrumental.

As we were moving through the design process and the project seemed to have a chance to materialize we started exploring ways in which students could realistically take part in the construction of the house. Our school had experience with smaller design/build projects but not with the scope and associated legal issues of our current endeavor. Therefore we felt the need to contact other schools with successful program at a similar scale. We contacted the Golf Coast Community Design Studio which operates in Biloxi Mississippi as an outreach program of the College of Architecture Art and Design at Mississippi State University. We also reached out to URBAN build, Tulane University design/build program. From these conversations we gathered that in order to address professional liability issues and produce quality construction documents such drawings needed to be supervised by a registered architect. We also decided to sign and seal the set of construction documents as this would provide a better tool to control design intentions through construction. Regarding the construction we establish the need to bring in a contractor who would be willing to cover students physically involved in the construction under his liability insurance policy.

*Phase 5: Construction (spring 2016)*

As of December 2015 final budgets for both houses have been allocated and construction is scheduled to start in January 2016. Currently the city of Tallahassee has committed $300,000 to build two identical prototypes, one house build using a SIP system and the other using conventional stick frame construction.

## Design Strategies

From the start our overall design strategy was driven by cost since the challenge of this project was to improve design and construction quality while dealing with the limitations of a very low construction budget of $65 per square foot. The goal was to approach the project in a way that would be realistic in a typical private market situation and where the construction of the house would not benefit from any substantial material donations and the contractor would be able to make a profit. The only pro-bono services were architectural design services provided by students and faculty of the School of Architecture Engineering Technology at Florida A&M University. With this approach we would be able to establish the actual affordability of the project in the context of a realistic market. Should we succeed in designing and building the house within budget this would prove the feasibility of such project beyond a pilot experiment.

*Fig. 2 View of the House from the West and Street*

Because we were committed to realistically design a low-cost house we structured the design process as a collaborative effort between the school and local community partners who had valuable knowledge and experience in that area. We also included pricing during design development and emphasized to students how every design decision they made was to be weighed by its impact in terms of cost whether it concerned massing, spatial layout or material selection. Students were invited to challenge any preconceived ideas they had regarding low cost housing in order to save money wherever possible and create an efficient design. The strategy consisted in saving as much money as possible through innovative design solutions and meaningful value engineering in order to alleviate the cost of the SIPs panels.

*Fig. 3 South Elevation*

Some of the cost saving strategies involved grouping the kitchen, living and dining room as one open space and therefore reducing the amount of circulations. Where corridors were unavoidable they would provide access to functions such as laundry or storage spaces. Plumbing was grouped as much as possible considering programmatic requirements. Regarding finishes we limited interior trim to simple base boards, door casing and window sills. The floor throughout the house except in bathrooms (ceramic tiles) was to be sealed concrete.

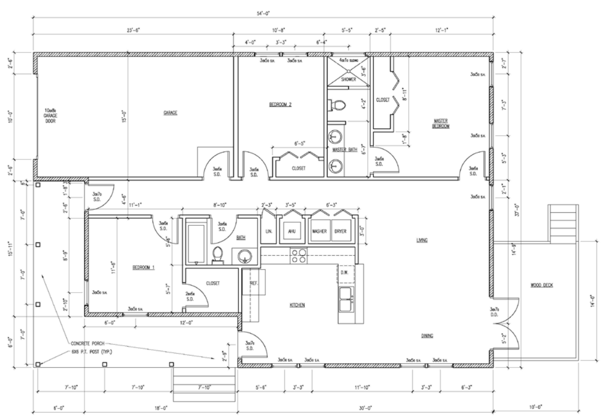


*Fig. 2 Final Floor Plan*

## Pedagogical Strategies

We envisioned this design/build project as an opportunity to bring into light the inadequacies and shortcomings of what is considered mainstream affordable housing in the US but more importantly to demonstrate how young designers could come up with innovative design solutions in order to solve a difficult design problem and develop a project with social significance. The ability for students to improve a low-cost housing typology would be a testament to the power of ideas and good design in general.

More pragmatically this project gave students a chance to operate outside the school and interact with a client and other professionals and assume the role of facilitator and coordinator which is key to the role of the architect in the professional world. Another important lesson we hoped would emerge from the whole process was the idea that architects do not design in a vacuum but are accountable towards other professionals and take into account strict parameters such as a challenging budget. The idea of designing a project based primarily on cost considerations was certainly a departure from the typical student experience in academia but all project team members outside the school recognized the professionalism of the students and their ability to operate in a real world context. One of the positive outcomes of this overall experience was an awareness that even young designers can exert control through design on a series of concrete factors such as construction quality and cost.

## Cost Considerations and Concluding Thoughts

As we indicated earlier the target construction cost provided by the City of Tallahassee for standard affordable housing not including land was $65 per square foot. The nonprofit organization actually managing the project was able to purchase the 2 lots at a price of $5,000 per lot. This price was on the low-end of what non-profit involved in affordable housing can expect to pay for such small lots (5,000 sf) in a low income neighborhood. These types of properties can typically be purchased between $5,000 and $15,000.

The final cost per square foot for both houses is as follows:

SIPS: $82 /sf (heated & cooled + garage)
Stick build: $76/sf (heated & cooled + garage)

The final budget presented by the selected contractor shows the implications of using SIP versus conventional framing. The construction items directly affected by SIP included the framing package, framing labor, electrical and HVAC. The SIP package was $13,000 higher compared to stick construction though labor was slightly less by $1,000. Electrical came $1,000 higher for the SIP while the HVAC system was significantly lower by $4,000. The higher cost of the SIP package can be explained by the fact that it physically contains more material when compared to stick construction. SIP also came in higher because the R-value reached in the stick built model was considerably lower than the R-value of panelized construction. The additional cost of the electrical work came from additional labor associated with cutting the SIP panels in order to run electrical wires. On the other hand lower HVAC cost can be explained by the sizing of the system. SIP is based on a ratio of 1 ton per 1100 square feet while conventional construction requires 1 ton per 600 sf. The cost comparison of the two identical but not quite equivalent houses using SIP and conventional framing was skewed due to a difference in R-value. Therefore a strict cost comparison based on identical product was somewhat flawed.

Nevertheless the opportunity to build these two houses side-by-side will definitely bring useful data in terms of cost and energy performance over time. Another reason to be optimistic when it comes to the cost of SIP construction has to do with its relative rarity in the overall construction market. For instance the contractor selected had no previous experience with this type of construction. As imperfect as this experiment is it provides an opportunity to compare two systems more objectively in terms of ease of construction, scheduling and overall long-term performance.

Open

# 1:1 Beginning Design Entrepreneurship

Thomas Cline and Corey Saft | University of Louisiana at Lafayette

## Value and Design Education

In the view of the general public, more specifically beginning college students and their parents, the value of an education in design has, seemingly, lost its luster. Until recently, the idea of pursuing an education in architecture, interior design, or industrial design—the disciplines represented in our School of Architecture and Design—has not been met with questions of prudence. Such questions ask whether an education in design is a prudent move as an intellectual pursuit or, more commonly, as a means of employment, and thus, financial security. Students, and their parents, are faced with a five-plus year educational/financial commitment that positions them to enter a workforce with relatively low starting salaries, as compared to other technical fields, and a dependence upon frequent economic fluctuations. These challenges, coupled with a shift in an understanding of what education is and how it should perform, have left design education in a position that requires it to justify its practices or to modify those practices to meet expectations.

In 2009, Monica Ponce de Leon suggested that contemporary design practice had "shown its limits, its weaknesses, and its flaws."[1] Additionally, she suggested that technological changes coupled with economic forces have significantly altered the practices of design and that conventional techniques and practices can no longer suffice if design is to remain a viable field, if design is to remain relevant in, and have an impact upon, the creation of culture. Relatedly, Ponce de Leon goes on to suggest that educational practices—practices that have not significantly changed in over 100 years—must also evolve beyond the conventional if they are to support design as a cultural discipline. Educational philosopher Jane Roland Martin echoes these ideas when she suggests that education is "an interaction between an individual and a culture in which both parties change."[2] For Martin, this conception of education allows both individual learning and the transmission of cultural ideals which act to insure cultural continuity. It appears that each of these ways of understanding education suggests that educational practices are responsible for both disciplinary and cultural practices. Both of these educators have linked education, discipline, and culture; however, their views are still askew of the recent common perception of education as a means of career training.

While it can be argued that design education, and perhaps higher education in general, has failed to maintain a critical position in the creation and transmission of culture, it has also seemingly been transformed from a process of intellectual curiosity to a form of career training. Such a move has precipitated further changes to our understanding of education; it has transformed from a field of inquiry to one of certainty, from broad understandings to particular knowledge, from interpretive explorations to rational positionality. These culturally driven shifts in the public conception of education have caused design fields to loose students, to change teaching methodologies, and to redefine themselves. As individual design educators, we have not been immune to these issues and, in an effort to redefine and revalidate what relevance design education might have, we have begun to explore educational practices to reposition design education as an irreducible field of intellectual inquiry with viable career paths encompassing an even more varied set of career choices.

This investigation has become increasingly relevant in order to broaden the skillsets of designers so that we can participate in cultural development while simultaneously providing a greater opportunity to generate personal wealth. In an attempt to reposition design education as a viable means to civic engagement (participation in the creation of culture) and to financial well-being, we created a pop-up course within our existing and long-established curriculum. This pop-up was envisioned as a means of exploring the integration of design education with a spirit of entrepreneurship; what we are calling design entrepreneurship. Ultimately, this pop-up was envisioned as a means to introduce a culture of design entrepreneurship that has the potential to effect a change in the pedagogical practices that currently define our curriculum. While this entrepreneurial mindset is not intended to replace our curriculum, it is hoped that it has the potential to provide additional knowledge, skills, and resources as our students move forward in shaping the future of our cultural, physical, and economic environments.

## Pop-up Innovation

At the beginning of the 2015-2016 academic year, my colleague and I began to discuss ways that our shared design interests might begin to focus a methodology of addressing what we perceived to be limitations to a typical NAAB based design curriculum. The idea for instigating a pop-up focusing on design and entrepreneurship came about through discussions we had been having at the intersection of our interests as educators and a perceived reluctance of most design curricula to address the changing needs of students. Simultaneously, we were receiving clear signs from students that they too were ready for some guidance in how they might enhance their current educations and their future prospects.

In a university environment where students pay by the credit hour, have very limited elective courses, and are encouraged to take only classes that lead to "on time" graduations—what we might call the commodification of education into career training—it is difficult to find a place for a paradigm changing course. We found ourselves in a situation where it appeared that change was necessary, where our University, our College, and our School of Architecture and Design encouraged such change, but where the structure of higher education and prevalent public attitudes toward education could not provide the space for this sort of investigation. Consequently, we chose to offer this pop-up outside our existing structure of university education. Rather than offering a credit granting course that required tuition-paying students, we opted to treat our course as a pop-up; an ad-hoc course that would have no official impact on students, but might offer a significant educational impact. Our intention was that this pop-up would act like a club—without the bureaucracy of being an official student organization—that met outside normal class times but fully utilized the resources of the university. In this way we could attract highly motivated students who were passionate about pursuing design ideas and interested in how those ideas might have entrepreneurial impact without burdening those students with additional fees and/or delayed graduation dates.

## Creating a Culture of Design Entrepreneurship

Our recruitment and enrollment methods for the pop-up were well matched to our interest in integrating entrepreneurship into our program. We began our recruitment with a flyer—posted in studios and common areas of the school—that attempted to convey the nature of design entrepreneurship that had attracted us and would hopefully attract our students (See Figure 1). This flyer was followed up with personal invitations to students that we had worked with in the past who we thought might have some interest in exploring the idea of design entrepreneurship. Finally, we encouraged interested students to invite their friends—this gave students a level of comfort and accountability that made the course easier to engage. Primarily, we relied upon genuine curiosity as the sole motivator for attendance; we were interested in students who were already interested in making changes. Passionate self-starters were our target demographic and this self-selection introduced the fundamental entrepreneurial aspects of the class that we had hoped would form.


*Fig. 1 Pop-up Flyer*

Our first pop-up began as a conversation on this topic. This conversation revolved around questions like: *Why were you curious enough to show up?* and *What does it mean to be a designer and an entrepreneur; can there be value in having these two identities combined?* We discussed whether there might be some conflict in defining these two concepts in the singular; of conceptualizing a design entrepreneur. Traditionally, it seems, that there has been a purposeful separation between those who design and those who benefit from entrepreneurial enterprises. The skills of the designer are "hired out," leaving us to play supporting roles rather than leading efforts to produce cultural change and to attain financial well-being. These discussions led to conversations about innovation; particularly whether innovation could, or should, be defined as the output of some combination of designer and entrepreneur.

Further, we described the fact that they, as students, were being trained to be innovation workers—with the skillsets to prototype their visions and to passionately direct their efforts toward the public realm and the greater good—but not to be leaders in innovation. While performing in service rolls—acting as designers for particular clients—is an important and essential role in society, we suggested that there might be better ways for our students to capitalize on both their educations and the skills that they have acquired.
The first pop-up concluded with a discussion about responsibilities being placed upon our students. Their generation is being asked to take responsibility for a century of largely short-term thinking and being asked to do so with limited resources. They have seemingly insurmountable challenges that new ways of thinking might help alleviate. We discussed the implications of design entrepreneurship in relation to the suggestion, attributed to Albert Einstein, that we can't solve problems by using the same kind of thinking we used when we created them. This led to additional questions from a wholly different perspective, questions like: *What was it that we can hope for from our current programs and our college degrees?* and *What do we need to do now to make our educations count; to be prepared to take on the challenges that we will face?* With this discussion winding down, we had developed questions of process and purpose that could conceptually drive the course forward into design explorations and fabrication pragmatics; this discussion gave us an understanding of the *wh*y, our next challenge would move us on to the *how*.

Our second pop-up gave us the opportunity to begin to introduce digital fabrication resources that have not been a significant component of our established pedagogy. Our School of Architecture and Design prides itself on our ability to teach students a design tectonic through the process of making. We suggest that this emphasis on making—a repetitive process of fabrication and prototyping—is one of the essential skillsets that our current design curriculum brings to a marriage with entrepreneurship. Our current process of making, however, has been predominantly limited to manual skills. Intentionally, students do not significantly employ the computer until their third year in our program and then, use of the computer is generally limited to technical and presentation drawings. Models, of all scales, are still primarily created by hand. With such a delayed start in acquiring and developing computer skills, the use of digital fabrication equipment has not played a major role in the development or prototyping of design ideas—only one course currently devotes time to learning to fabricate using our digital resources. Resultantly, students do not readily see the relation between the computer as a design tool and digital fabrication as a means of entrepreneurial development, nor the advantages of such a relationship. This second pop-up was, therefore, structured to allow for students, at multiple year levels and in multiple disciplines, to begin exploring the possibilities of rapid prototyping and digital fabrication as means of entrepreneurial design development. In a significant way, this was our "in" to the world of entrepreneurship; it was here that designers could also become manufacturers.

## Case Studies

All of the students who joined our pop-up came with a sense of wanting to do more with their time in school. These students generally fell into two categories in relation to our course objectives: those looking for a way to test the waters and those that were already jumping in. Consequently, all of our meetings seemed to flow naturally without significant guidance on our parts. The meeting would start where we, as faculty, would establish a general theme by beginning an off-the-cuff conversation about what was important for us in regard to design as an entrepreneurial process and why. We would then draw students into the conversation by asking their opinions of these topics and how those opinions might affect their design processes. A more general conversation generally followed and we found that the group itself was quickly able to support on-going discussion without our having to lead it. There were even a few moments where it seemed that we were sitting in on private discussions where students were working out their own ideas. The primary characteristic that facilitated this format, that gave us such rich engagement, was the mix of students. Those who had already come to the conclusion that innovation was a skill that could be widely and inventively applied were driving the conversation, and encouragingly, were bringing the others along.

One such student was TM who came with an idea for a modular structural system for a tiny house project. TM is a little older than the average student, has a good sense of craft as a he grew up around a cabinet shop, and generally has a self-directed personality. He had been carrying this idea with him for some time and already had a few simple models that formally demonstrated how he was conceiving this structural system. While TM put forward some interesting ideas, once he stopped talking the other students engaged these ideas and we watched his ideas be quickly, and thoroughly, tested and transformed in a number of interesting ways. While his initial idea emphasized triangulation and modularity, another series of potential strengths quickly emerged. Conversations and critiques suggested that his form could be adaptable enough to be pressed from a single sheet material and had a form that might readily be adapted to bank/soil stabilization and planting. Thoroughly engaging this idea led to discussions about a modular family of landscape elements including lighting, planters and seating. The idea of bank stabilization re-emerged with an emphasis on the potential elegance of how this form could be easily used by one person, having both a built in mechanism to engage the soil and creating a horizontal surface that could be used to establish plantings. This elegance allowed for a single unit that could be cleanly pressed from a single sheet and would allow for easy and efficient manufacture, storage, and application. While students discussed the merits of this system, a few paper models were made to further test the ideas. TM continued to evolve the idea over several meetings. His idea is currently at the point where further research, with firms doing this kind of work, and a more complete survey of the existing state of the market needs to be undertaken.

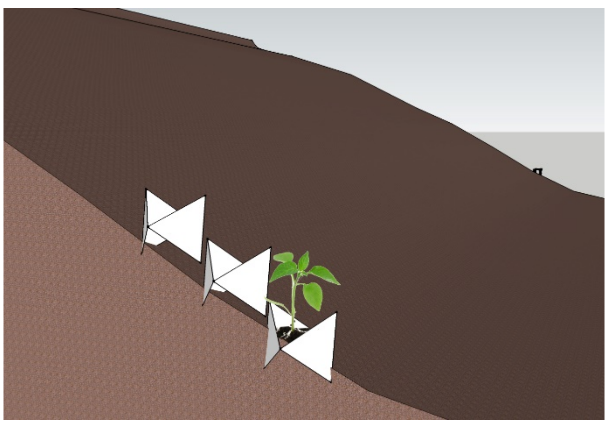


*Fig. 2 Soil Stabilization Iteration*

A second student, QD, entered our program with some background in computer science and came to the pop-up with an interest in using this experience to develop a sensor-triggered interactive wall. During the timeframe that the pop-up was meeting, a college level Call for Installations was initiated that asked for proposals fusing art and technology. QD's involvement in the pop-up was utilized to successfully develop his idea for submission and, subsequently, he was awarded a grant to develop these ideas. QD, and our pop-up group, are now working with a $1000 budget to develop a twenty foot long responsive wall that will be installed in a prominent downtown gallery. The sensors, Arduino boards, and other resources that the grant has provided will give functionality to the wall and will eventually become the property of the department and be available for use by our growing design entrepreneurship group.

## Assessment

Beyond the strategic reasons for offering this pop-up in design entrepreneurship as a no cost, no credit event, there are several factors that, seemingly, lent themselves to our chosen pop-up environment. Primarily, the pop-up was seen as a means of harnessing and applying the potentials of highly motivated and highly talented students who are interested in design as a broader subject beyond the mandates of existent curricular offerings. In essence, we approached this pop-up as adding value to—not actively replacing—the current curricula of our students. We hope to enable our students to identify design opportunities, to conceive of practical and elegant solutions, to assess market viability, and, then, to bring those products, ideas, and processes to market in a way that provides both cultural and financial value. Methodologically, we hope to instill in our students an awareness of the opportunities that they can engage in to add value to their communities and provide them the skills necessary to negotiate these opportunities in order to be financially compensated in relation to the impacts that they make.

Having progressed through only one iteration of our pop-up, we cannot yet make any significant declarations; however, we can offer some observations that will direct our next attempt. Most significantly, this pop-up was successful as an initial investigation into curricular opportunities intended to expand how we conceive of and teach within the domain of design. While we believe that the design fields are an essential educational cornerstone in developing the creative economy, we also recognize that our graduates need a new kind of design education that is hybridized with entrepreneurship. While it can be argued that the Liberal Arts remains the intellectual underpinning of an exceptional education, design and entrepreneurship have become increasingly complementary skills that will assist our graduates in transforming themselves into the foundation of a 21st century workforce within a creative economy. In response to these recognitions we believe that it might be most beneficial to both update our current curricular offerings and build a new degree offering that can deliver a creative, open-ended experience that expressly prepares students to enter the workforce as creative thinkers, to innovate through the design of their own businesses, and to make significant impacts on their communities all while creating better lives for themselves.

## Notes

[1] Ponce de Leon, Monica. "Dean's Message" Taubman College of Architecture and Urban Planning: https://taubmancollege.umich.edu/about/deans-message ; accessed 05 January 2016.

[2] Martin, Jane Roland. *Education Reconfigured: Culture, Encounter, and Change.* Routledge: New York. 2011. p. 2-3.

Open

# Starting with Transformation: First Introduction of Motion

Negar Kalantar, Alireza Borhani | Texas A&M University

## Overview

Within contemporary architecture, there is a growing need for students, academics, and practices to create adaptive designs, building components, and architecture that changes the quality of space and the connection humans have with their environment. Motion has long been part of the architectural repertoire, but little thought has been given to motion studies in architectural education and the existing tradition of static forms is almost the sole type taught in schools of architecture[1]. Although the primary role of motion – to improve environmental performance – has been acknowledged by scholars for decades, it has not been made an overarching priority by typical curricula addressing sustainable studies. As a result, sustainable design courses focus only sparely on the role of motion in creating a better environment.

## Motion in Education

Since the knowledge concerning motion design principles exists but is spread across many disciplines, the question is how to fuse the necessary knowledge that has been collected by various fields in order to generate motion design guidelines for architects. The lack of clear guidelines[2] makes it difficult for beginning design students to imagine, design, and fabricate their motion-based concepts.

*Figure 1: Review session. The motion pedagogy was integrated into the studio environment at Texas A&M, Spring 2015.*

The concept of motion pedagogy[3] has been established and employed to structure this paper. Motion pedagogy is founded on the premise that the built environment is a dynamic, rather than static, system. Therefore, the development of pedagogy of transformable design as an alternative method of architectural thinking could recast the architectural design process and transmutes the landscape of how we do architecture.

Motion pedagogy demonstrates essential subjects for early designers eager to understand transformable architecture[4]. This Pedagogy endeavors to create a better understanding how an exploratory concept of motion can be codified to suit different

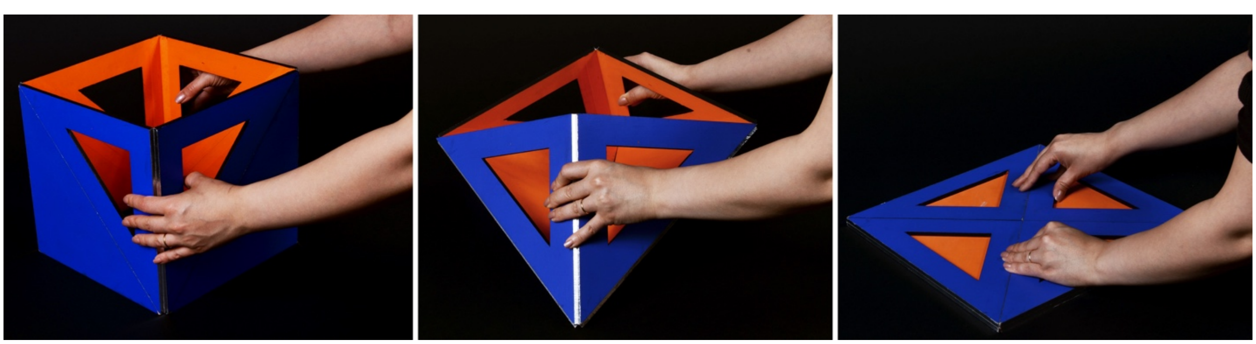


*Figure 2:"Opening a Cube", students' projects (photograph by authors).*

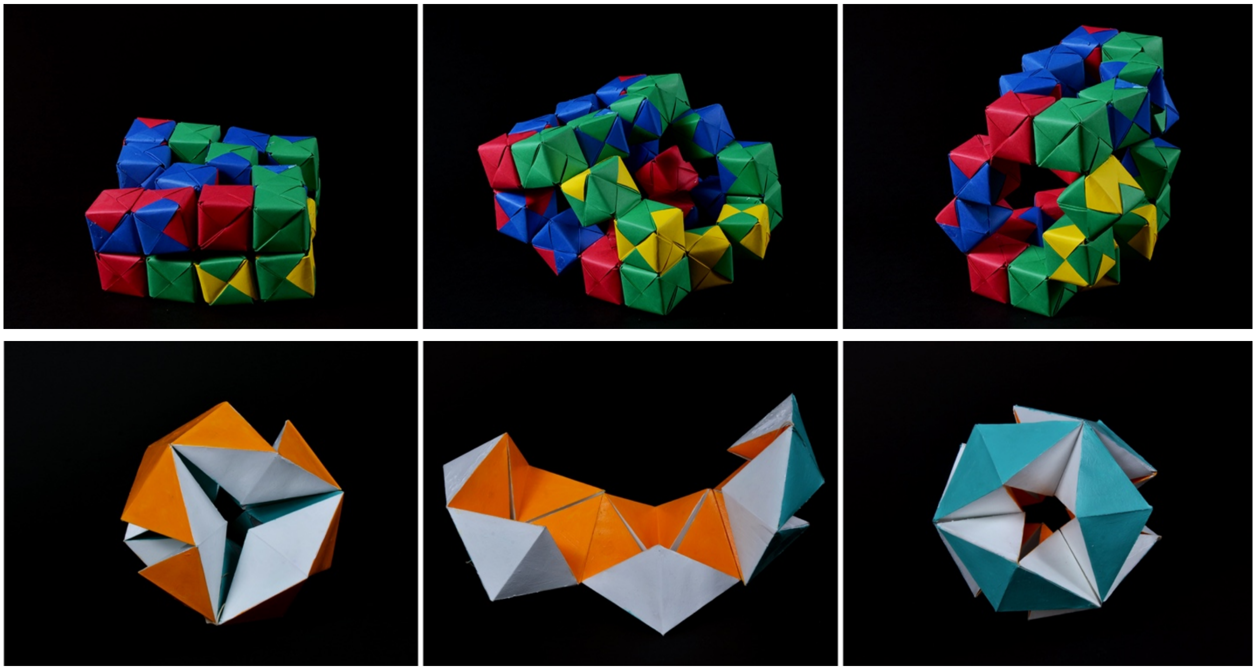


*Figure 3: "Opening a Cube", students' projects (photograph by authors).*

technical, economic, and cultural considerations. By engaging the vocabulary and syntax[5] of motion language and manipulating their bounds and constraints, the Pedagogy of Motion views this language as expansive and containing insightful and practical guides to the motion design knowledge.

## On Pedagogical Model

In 2014 and 2015, the authors attempted to contextualize the motion pedagogy in two different universities experienced within transformable design activities. The goal was to examine how best the motion pedagogy can be integrated into the curricula and evaluate the content and delivery. By engaging the vocabulary and syntax of motion language and manipulating their bounds and constraints, students examined the potential of motion language by designing and making different mechanisms in a variety of shape-shifting forms that offered the possibility of change.

To assimilate the principles of motion design into the existing knowledge structures of a foundation design studio at Texas A&M University, two motion-related assignments were offered by the authors in the first four weeks of the spring semester of 2015 (Figure 1). These two assignments called "Opening a Cube" and "Portable Research Laboratory". Besides freshman students, the "Opening a Cube" assignment was offered to fourth year students at Virginia Tech University in the spring of 2014. To keep the consistency of the text, this paper concentrates more on the first assignment than the second. The outcome of comparing these two studios can be a vehicle for eliciting evidence of the challenges and opportunities architecture programs face in addressing motion-related courses.

At Texas A&M University, by letting freshman students become familiar with the fundamental geometric thinking supporting the concepts of motion, the "Opening a Cube" and "Portable Research Laboratory" assignments built on the idea of how a novice designer could explore time as a geometric parameter that is not stagnant (Figure 2, 3& 4).

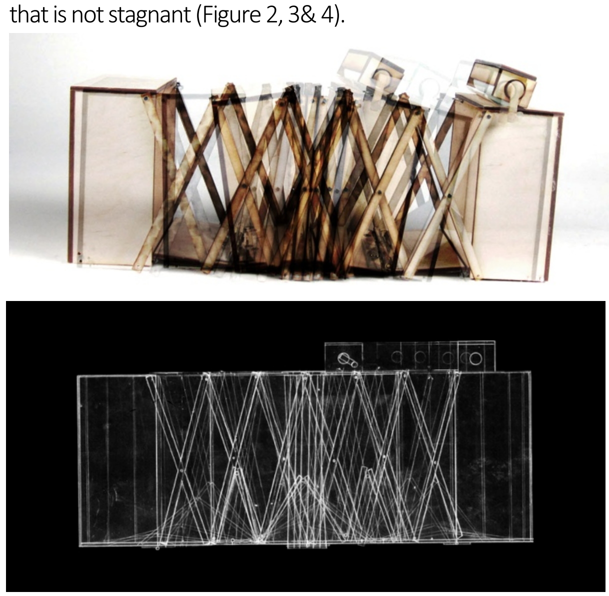


*Figure 4: "Portable Research Laboratory", (photograph by Jordan Taylor).*

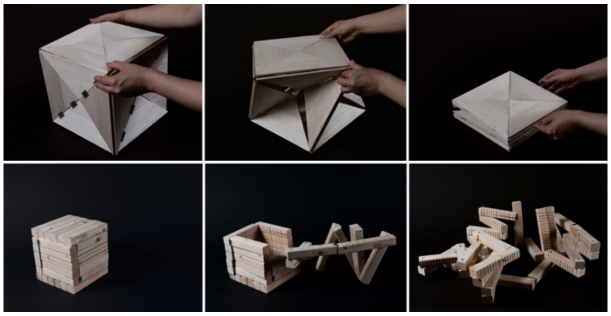


*Figure 5: Examples of students projects, (photograph by authors).*

## Opening a Cube

The Opening a Cube assignment was explored first. The intent of this first assignment was to explore ideas of openness and closed-ness, according to two basic movements: rotation and translation. To do so, students attempted to transform a 10"X10" cube by building physical prototypes that could gradually be opened and closed. By transforming a cube, students were encouraged to foresee, form, and interact with motion. Here, motion was abstractly considered; it served as an introduction to motion design principles.

In their second assignment, Portable Research Laboratory, freshman students were asked to relate their motion experiences to a specific design context: designing portable and versatile field-ready research laboratories in deserts across the globe. By maintaining a capacity for rapid deployment and removal, the lab's structure was intended to be easily erected by researchers at locations where less nimble facilities would be impossible. The lab was intended to be moved frequently, as the research required.

*Figure 7: Freshman students' projects at Texas A&M, 2015, (photograph by authors)*

In the first assignment, students were asked to consider how the movement of their proposed designs and/or sequence of its components' positions could be introduced through drawing, making, recording, and photography (Figure 12). Specifically, students were asked to reflect their inspiration, foundational concepts, challenges, and learning experiences through written documentation such as design statements and self-evaluation forms. By facilitating the construction of students' knowledge, these written documents offered students the opportunity to analyze what they had done, and predict what might be accomplished going forward. The documents also provided the authors, as the studio instructors, with a useful window into what the students did and did not know. As a means of providing evidence for the arguments it posits, this paper incorporates examples of those students' written feedback.

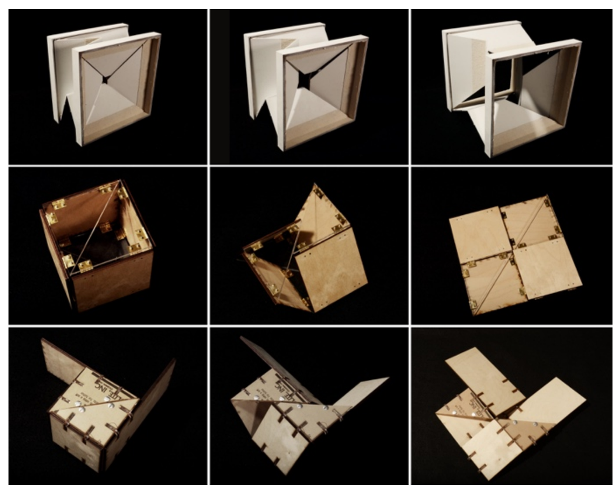


*Figure 6: Forth year students' projects at Virginia Tech, 2014, (photograph by authors)*

Before engaging with the first assignment, students were given several verbs such as expand, collapse, pivot, swing, spin, revolve, glide, and slide. The intention was to inspire these students to consider the different types of movement that could transform a given object.  To encourage brainstorming and promote creativity and critical thinking, students were encouraged to select and familiarize themselves with one or two of the suggested verbs. For example, one student wrote: "I used [several] verbs and began to draw ways a cube could embody [them]. It resulted in my cube swinging in an accordion-like manner[6]." The main goal of this activity was not only to spark students' interest and increase their involvement with the diversity of motion in their daily lives, but also to encourage them to become fully engaged with the potential of motion.

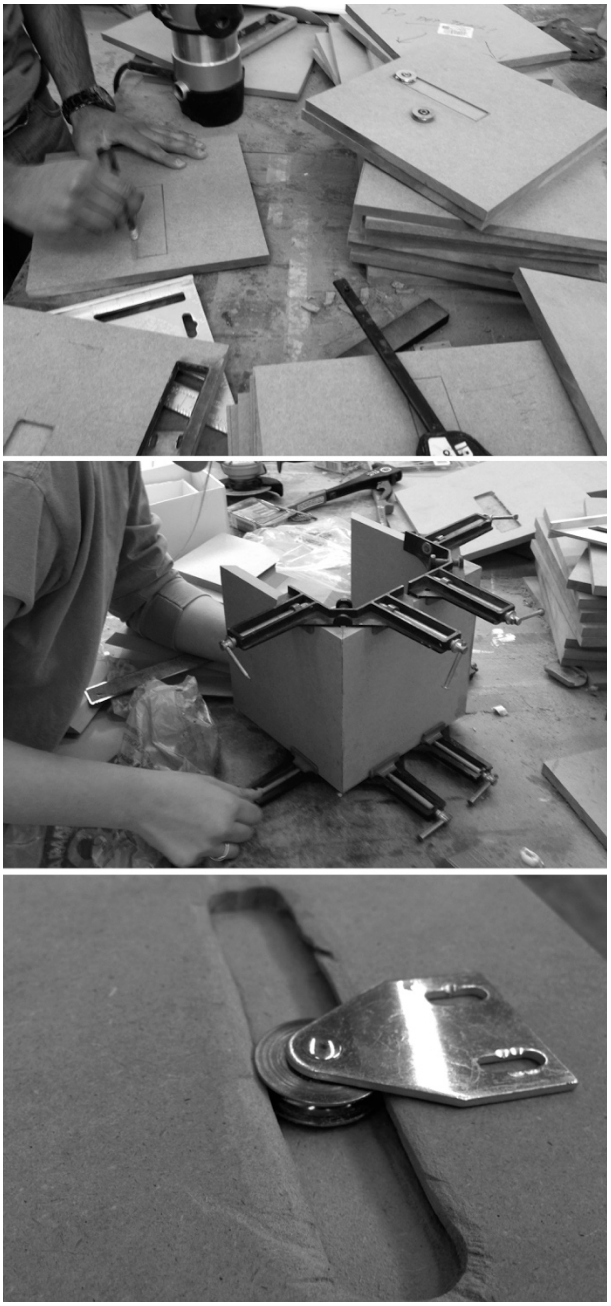


Figure 8: New design challenges caused by changing materials and scale of the cubes.

Complex combinations of very simple transformational actions – for example, rotation and translation – can deliver a gradual transition from a closed to an open state. A variety of different ideas emerged; different students developed different ideas to infuse their cubes with movement and excitement. After the desired transformation of form had been accomplished, almost all of the cubes were able to return to their original state.

In the first assignment for this studio, students began with simplified study models in order to facilitate a clear understating of the principles of motion design. In the first step, student attempted to predict what motions could be achieved, and their connection to simple pull, push, and rotation mechanisms. Then, they were encouraged to describe how their applied mechanisms led them to orchestrate their design processes.

Although several students tried to transform their cubes from being completely open to almost entirely closed, one of the student's designs moved the cube from a controlled, six-sided state, to a chaotic collection of jumbled, chain-like wooden pieces connected together by hinges.  Another folded a ten-inch cube into a two-inch prism (Figure 5). Yet another design transformed and multiplied one cube into three, as it was unfolded. Another cube was broken into nine smaller cubes, with magnets holding the various pieces together; this allowed the pieces to slide horizontally and be organized into various shapes (Figure 6).

Some students found this assignment challenging, and concepts of motion troublesome to design. Before using drawing to study the geometry of pure motion, they endeavored to perfect their understanding through trial and error. Even after addressing the geometry of parts in motion and drawing it on a set of points, line segments, or surfaces representing their trajectory through space, it was difficult for students to analyze certain forces that they could not predict, such as friction, surface tension, inertia, and gravity. While making their prototypes, some students discovered that there were too many unpredictable forces to allow for proper movement. As one wrote: "my largest challenge was trying to get the pieces to move once I discovered that there was too much friction between the rail and track[7]."

Due to unpredictable technical flaws, most students faced random errors that impeded the clear expression of their concepts. The authors attempted to promote the students' ability to think ahead and plan over time, and cultivated an awareness of what should be taken into account to ensure the operation of the desired mechanism. As the fabrication outcomes highlighted, whatever was planned at the beginning of the design process was not always possible, at least not by adhering to the original plan. For instance, once students moved from their primary study models (made mainly of Bristol board) to more progressive prototypes (constructed from stronger materials such as chipboard, plywood, or Plexiglas), the added thickness occupied the space previously dedicated to motion, which caused performance problems (Figure 8). Moreover, the transition from a thin planar sheet material to another medium did not allow the cubes to be closed or opened as completely as desired.

The lack of proper accessories (such as hinges or rails) that would allow parts to move only in desired directions or create a hierarchy of movement was one challenge preventing certain students from realizing their designs. Other challenges involved the size, availability, and cost of such accessories. One student wrote: “some challenges were finding the right type of hinge to use because my project required a lot and too small of a size, so searching for an easier and more frugal option was difficult[8].” Fortunately, some students overcame this challenge by creating their own hinge mechanisms (Figure 9& 10). For example, in fabric hinge design, students used strips of fabric that were laminated between the flat panels. These hinges allowed the joints to lay completely flat when opened. In some cases, these fabric hinges permitted the pieces to pivot smoothly and the cube to collapse to be completely flat (Figure 11).

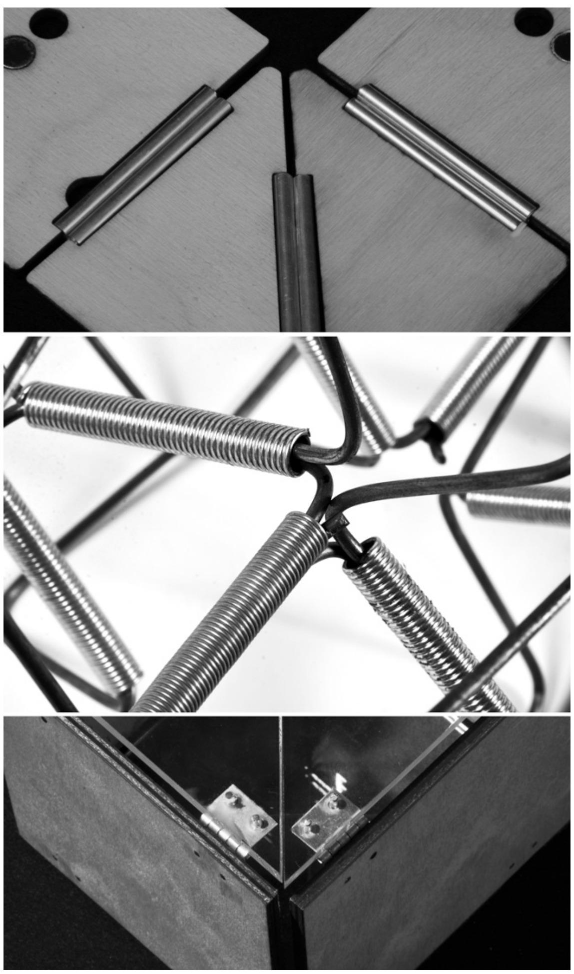


*Figure 9: To achieve the desired motion, students designed and fabricated their joints, (photograph by authors)..*

*Figure 10: Custom made hinges, (photograph by authors).*

## Closing Thoughts

As mentioned above, to help catalyze the development of transformable design principles for the education of future architects, the “Opening a Cube” assignment was offered to both freshman and fourth year students (Figure 7). This assignment served as an attempt to draw comparisons and contrasts between novice students and their experienced counterparts; it exemplified how students' awareness of the principles of motion design in a foundation design studio was comparable to a fourth year student dealing with motion. For both group of students, the assignment was intended to serve as an introduction to motion design. Interestingly, the freshmen and senior students' levels of knowledge about motion were remarkably similar, irrespective of their ability to represent their thoughts or skill in developing a design process. In spite of their intuitive notions about Opening/Transforming a Cube, both groups of students had the minimum knowledge and experience necessary to apply their concepts to their designs and develop their motion compositions.

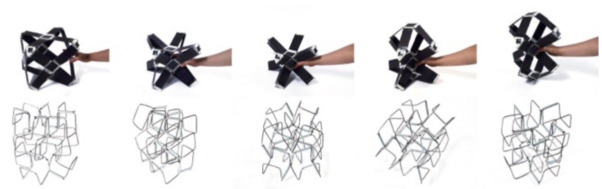


*Figure 11: Fabric and spring hinges in transformable cube design*

Rarely was a model built exactly per the first intuitive concept[9], but most of the students at both the freshman and senior levels showed that they had instinctive but unclear and unspecific ideas about concepts related to motion. For both groups, there was a trial and error process wherein they clarified their intuitive ideas about motion. In this assignment, the unfortunate truth was that the senior architecture students still lacked the experience and confidence to quickly turn their motion-based concepts into transformable cubes. As was expected, however, the seniors were still able to develop their designs in less time than the freshmen. Within the first of the semester, opening a Cube was, on the whole, exciting and abstruse for both groups of students, leaving them wanting to learn more about the principles of motion design. It is worth mentioning that at the end of this assignment, nearly all of the students from both groups had a sense of the path to being a better designer. By employing the concept of transformability as an exquisite design tool, the value of this assignment was to introduce new ways of thinking about design itself.

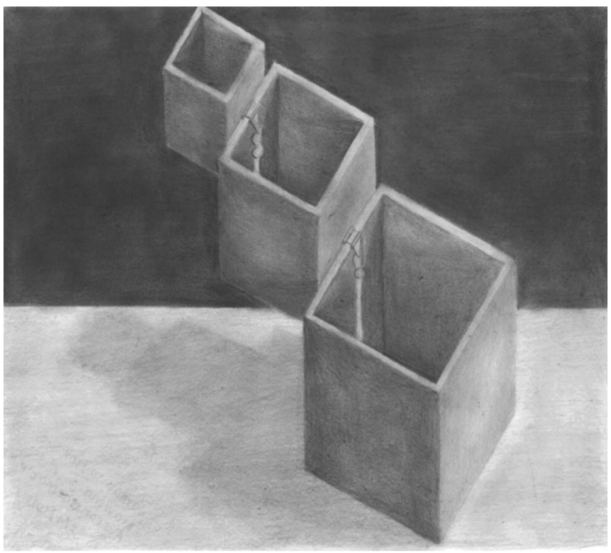


*Figure 12: Students demonstrated their motion design through different mediums.*

[1] Kalantar, N. & Borhani, A. Studio in Transformation:: Transformation in Studio. Journal of Architectural Education (JAE) 70:1, Spring 2016.

[2] De Marco Werner. C, Transformable and transportable architecture: analysis of buildings components and strategies for project design. Master Thesis, Escuela Técnica Superior de Arquitectura de Barcelona, 2013.

[3] Kalantar, N. & Borhani, A. Establishingthe Language of Motion Formation for the AURA Kinetic Shading System. International Conference on Adaptation and Movement in Architecture (ICAMA), Toronto, Canada, 2013.

[4] Kalantar, N. & Borhani, A. Beginnings in Transformable Design Pedagogy. The National Conference on the Beginning Design Student (NCBDS), Houston, TX, 2015.

[5] Kalantar, N. & Borhani, A. Developing the Design Model for Implementing Dynamic Kinetic Mechanism in Kinetic Shading Systems. First International Transformable Conference, Seville, Spain, 2013.

[6] Reflected in a design statement of work, a freshman student at Texas A&M.

[7] Reflected in a self-evaluation form of work, a freshman student at Texas A&M.

[8] Ibid

[9] Material properties, means and methods of fabrication, availability of the required fastener and accessories, proficiency in software, and changes in opinion all played a part in shaping the final designs for this assignment.

# Constructed Ground: Reinhabiting the Drosscape Through Collage

Jennifer Shields | *California Polytechnic State University, San Luis Obispo*

*"As Walter Benjamin observed, fragments and ruins are archetypal emblems of allegory, because in them the loss of decay of prior meanings is rendered visible as both a natural and historical process. This process of depletion allows fragments and other borrowed materials to sustain the superimposition of new second-order meanings within a new context."*[1]

- *Christine Poggi, In Defiance of Painting*

### *Premise*

In an effort to interrogate the possibilities for the reinhabitation of the urban Drosscape, collage has been tested as a design methodology in an architectural design studio. Drosscape, a term coined by Alan Berger, refers to waste landscapes in urban areas that have the potential for reuse.[2] Collage offers a means of investigating the complex relationship between figure and ground, between architecture and landscape. The fragmentation and layers of meaning inherent in collage serve as an analogue to the fragmented nature of the Drosscape. As a means of image-making in which to investigate the potentialities of three-dimensional space in a two-dimensional medium, collage has facilitated a new conception of space. One hundred years ago, the Cubists, for the first time in 450 years, had rejected the Renaissance approach to representation in which visual experience was privileged and instead represented aspects of daily life through abstraction, material juxtapositions, and fragmentation and synthesis of form, capturing spatial and material qualities. The Cubists valued collage as a hybridization of painting and sculpture existing at the threshold of two and three dimensions.

Collage, as an art form unique to the modern era, emphasizes process over product. A collage as a work of art consists of the assembly of various fragments of materials, combined in such a way that the composition has a new meaning, not inherent in any of the individual fragments. According to Diane Waldman in *Collage, Assemblage, and the Found Object*, a collage has several levels of meaning: "the original identity of the fragment or object and all of the history it brings with it; the new meaning it gains in association with other objects or elements; and the meaning it acquires as the result of its metamorphosis into a new entity."[3] Simultaneity of spatial, material, and intellectual content is inherent in collage through a synthesis of unrelated fragments. Instigated by Cubism, the interconnectivity and overlap of subsequent collage methodologies in art movements of the twentieth and twenty-first centuries provide a diversity of ideologies, techniques, and materials from which architects have drawn, and will continue to draw, inspiration for analysis and design. Collage is thus practiced not only to capture spatial and material characteristics of the built environment, as an analytical and interpretive mechanism. Through this understanding, the potential exists to respond to the multivalence extant in sites of atrophy.

### *Objective*

Using collage as the design methodology, we considered how a parti might evolve from a considered interaction between three elements. Students investigated collage as a tool with which to synthesize the project concept (providing a framework), the site (as the context within which to test the concept), and the program (as the vehicle through which we can test the concept). At a conceptual level, this studio interrogated concepts of ground, considering fragmentation, aggregation, and synthesis through the collage-making process.

Ground, as the foundation for both architectural constructs and Cubist collages, is subtle and non-hierarchical: design potential exists at these moments of disconnect and overlap, where the relationship between figure and field is ambiguous and in flux. The complex interweaving between building and ground is most apparent in layered sites built up over time such as those of the Drosscape, creating a rich palimpsest of physical and cultural memory. By considering a building's physical engagement with the ground, we can understand an inscription of the progression of time, juxtaposing the scale of geologic time with the scale of human life. These juxtapositions occur in the fragmentation and aggregation of ground and human-made artifact. In our experience of site, Dalibor Vesely's observation of the fragment is apt: "[The fragment] cannot be grasped in a single intuition; it relies on a sequence of stages bringing together individual phenomena and the universal ground in a process that may be described as the restorative mapping and articulation of the world."[4] The accumulation of experiences, recorded through perceptual or subjective spatial and temporal measurements, constructs an embodied memory in the site - a sense of place. The recursive fragmentation and aggregation over time as a physical manifestation of place has been captured through the collage-making process - experiential qualities of place illuminated and explored through collage. Breaking down form to accommodate new relationships between architecture and site/ground, fundamental to Cubist collage, can be understood through this dialogue as embodied in post-industrial sites. According to Robin Dripps, the irregular datum of ground common to sites such as this "reveals its multiple ground planes intersecting, reinforcing, or else contradicting one another to produce a new set of volumes, linking these fragments of the past to condition the present."[5] This studio asked students to explore collage as a methodology for design in a post-industrial context, investigating collage as an instrument for analysis, an instrument for design and representation, and finally architecture itself as collage.

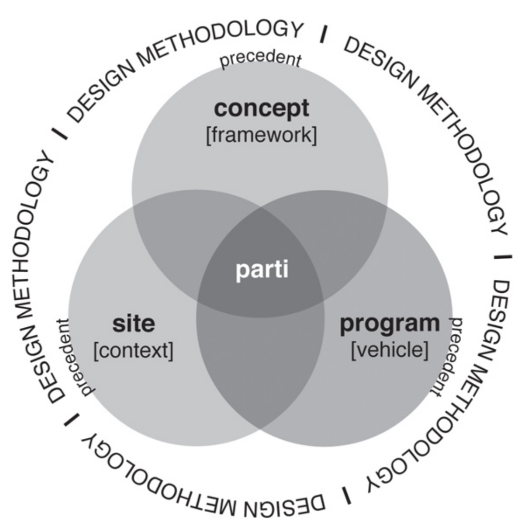



*Fig. 1 Design Methodology Diagram*

*Content*

This studio asked that students apply the same resolution they strive for in the design process to 'receive' the post-industrial site analytically, laying the groundwork for design. In order to implement this methodology of collage and initiate the analytical process, we engaged an abandoned industrial artifact in Charlottesville, Virginia's Woolen Mills neighborhood, beginning with research and observations of the existing conditions of ground including physical, perceptual, historical, and cultural phenomena as a means of comprehensively interpreting the site.

*Fig. 2 Site Analysis Collage*

The abandoned 1913 power plant on the banks of the Rivanna River mediates the complex geography of Blue Ridge waterways and a neighborhood founded on the textile industry, drawing on the energy and transportation infrastructure at the confluence of river, creek, railroad, and Market Street. The current dereliction of this industrial area belies its dynamic past. In the early 19th century this confluence was the port of Charlottesville, called 'Piraeus' after the port of Athens, Greece: the newly navigable Rivanna River offered connectivity to Richmond and on to the Atlantic Ocean.

The abandonment of the shipping and textile industries in Charlotte left a void in this neighborhood, a Drosscape, which is slowly being rebuilt. For this studio, the inserted program proposed to reinhabit the shell of the power plant, creating a workshop and gallery space for a contemporary textile artist while reflecting the industrial heritage of the area. The proposed intervention was intended to serve a didactic purpose, communicating the cultural and industrial history of the site. Juhani Pallasmaa describes the need for slowness in architecture in order to convey this complex history, saying, "There is a tacit wisdom of architecture that has accumulated in history and tradition...architecture needs slowness to re-connect itself with this source of silent knowledge. Architecture requires slowness in order to develop again a cumulative knowledge, to accumulate a sense of continuity and to become enrooted in culture."[6] A thoughtful and deliberate collage-making process acknowledges the importance of slowness, serving as a venue for analysis of the industrial landscape through the lenses of multiple scales. The resultant analysis and interpretation offers a greater understanding of the experiential phenomena extant in this site that could be heightened / subverted / manipulated to reveal the rich layers of physical and cultural memory imbedded in the industrial landscape.

*Method*

Like a collage, revealing evidence of time and its process of construction, a work of architecture contains accumulated history as it is lived and engaged rather than observed. Just as a work of architecture is only fully created and comprehended through bodily, sensory engagement, collage offers a counterpart, providing the medium to interrogate spatial and material possibilities. Students were asked to consider the perception of the built environment as an amalgam of sensory phenomena understood through personal experience and memory, rather than completely and objectively through a formal evaluation. According to Sanda Iliescu, "As a design method, collage has much to offer. The poetics of collage are potent both because they make room for ordinary, crude, or fragmentary materials and because they represent a challenge to rigid or normative boundaries between art and life. Overly literal interpretations miss the most significant contribution of collage: its ability to both surprise us and change our way of looking at art and at the world."[7] The students employed this collage methodology throughout the semester, in their site analysis, interpretation, and design. Beginning with site analysis, students documented conditions of order, the sensory environment, temporal transformation, and qualities of place that they observed during their visit, returning to the studio environment for the construction of analytical collages. The synthesis of analogue and digital methods was highly valued, as it provided the opportunity to integrate digitally obtained graphic data (such as photos and maps) with the tactile realm of construction. The haptic interface became the threshold where students could capture the phenomenological experience of the site in its spatial and material expression.

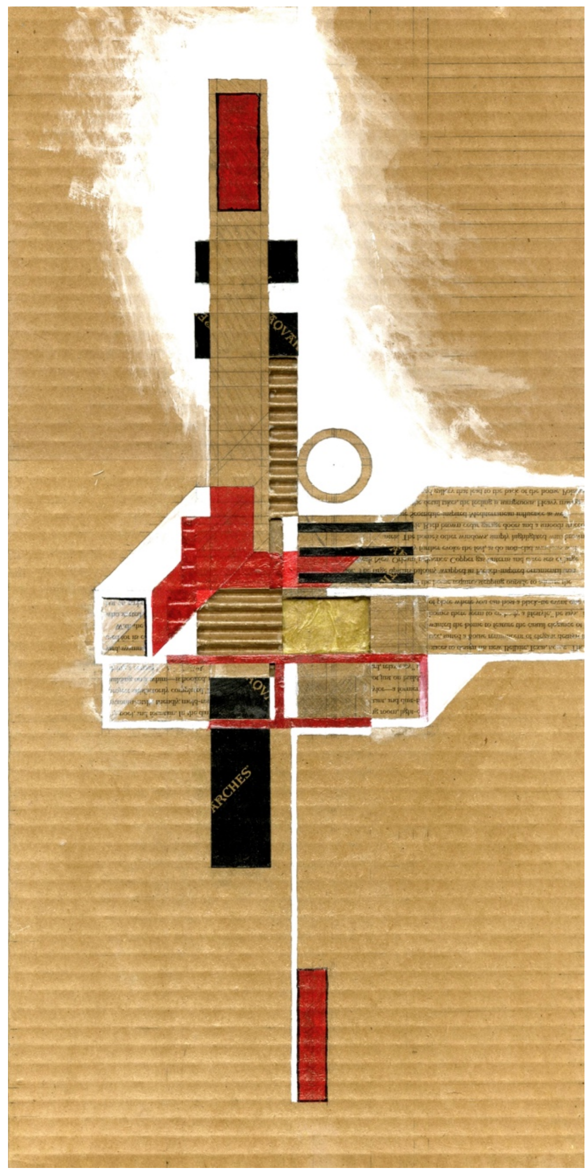


*Fig. 3 Generative Collage using cut paper and image transfer*

Shifting from the analytical to the generative, collage has been implicated in the architectural design process in a range of scales and conceptual and technical collage methodologies in the field of architecture over the past century. Though collage as a theoretical concept in architecture only became widely discussed after the publication of *Collage City*[8] by Colin Rowe and Fred Koetter in 1987, Le Corbusier, Mies van der Rohe, and other early 20th century architects made use of collage in their design process to experiment with spatial and material juxtapositions. Architects including Morphosis and Rem Koolhaas have since exploited collage for both its conceptual possibilities and its material, formal, and representational potential. As we consider the role of collage in design, we must consider the legacy of the Cubists and proximate movements in modern art, and their adoption of collage as a means of synthesizing unrelated fragments. Themes of figure/ground reversal, phenomenal transparency, and simultaneity are significant in architectural works in the Modernist canon. As these themes are translated into the realm of architecture, it becomes evident that the recognition of spatial as well as temporal conditions and the value of process play a crucial role. The students were asked to consider the role of time as they proceeded from analysis into interpretation, understanding that time finds expression through architecture both spatially and materially, while collage, as a two-dimensional medium, must express time materially, implying spatial conditions. These generative collages, interpreting their observations of the site, initiated an iterative process in which collage-making, diagramming, modelling, and writing worked in dialogue. Students were first asked to examine their techniques, identifying at least one tool or technique of collage-making that they determined to be the most suitable for use in the representation of their concept, establishing a correlation between concept and method. This technique was then employed in the construction of generative collages, considering how the technique worked with assembly of materials, utilizing color, texture, and layer to identify conditions of order and hierarchy as they proposed new architectural interventions.

Extrapolating the three-dimensional implications of the generative collages, the students then constructed a series of study models. These models made three-dimensional the concepts they began to represent in collage, adapting them to the specific configuration of the site. These study models investigated various ways in which one might intervene in the existing site and structure, using collage concepts such as layering, transparency, overlap, ambiguity, multivalency, juxtaposition, fragmentation, aggregation, and synthesis as means of operating on the site. The conceptual language developed through the site analysis thus became a means by which to construct architectural interventions.

*Fig. 4 Study model iterations derived from concept collages*

Continuing the dialogue between collage and diagrammatic model, students were asked to consider both the poetics and tectonics of their project in seven days of construction. They began by writing a narrative describing the existing conditions of the site and the process by which they would build. Questions to be contemplated included: Is the first act on the site subtractive or additive? Given your conceptual 'operators' (displacement, excision, etc), how would you begin to intervene? Is the first act to inscribe a path, insert a spine, construct a series of frames? How/when will you engage the existing structure? Development of this narrative helped to establish a hierarchy of figures and fields on the site while organizing the spatial sequence and program. To graphically convey this narrative, students created a series of collages documenting the actions occurring on the site for each day of construction. Similar to the collage diagrams that illustrated the layering and hierarchy of the proposal, this iteration considered the order of intervention in the site and ruin, while furthering the development of structure and material expression.

Collage, as a means of experiencing three-dimensional space from multiple perspectives, served as an invaluable partner to iterative drawing and model-making in the design process. In the final iteration, structural, spatial, and material articulations began to find resolution. In addition to employing a number of representational methods, studying the intervention at multiple scales was paramount. A rigorous assessment of the physical and perceptual characteristics of the site, from the scale of the human to the scale of the neighborhood, offered a rich context with which to synthesize the proposed intervention. Design decisions were vetted based on their ability to reinforce the concept at each scale of inhabitation.

*Conclusions*

In this investigation into the reinhabitation of the Drosscape, the fragmentation and ambiguity of meaning essential to the collage-making process offered an analogue to these conditions in the site. According to J.B. Jackson, "...there has to be that interval of neglect, there has to be discontinuity; it is religiously and artistically essential. That is what I mean when I refer to the necessity for ruins: ruins provide the incentive for restoration, and for a return to origins. There has to be (in our new concept of history) an interim of death or rejection before there can be renewal and reform. The old order has to die before there can be a born-again landscape."[9] Collage offers the potential for synthesis, a reconnection and interweaving of spatial and temporal conditions in richly layered sites. The dynamic nature of spatial and material conditions inherent in collage-making reveals the potential for a multiplicity of interpretations and experiences in the design process and the resultant work of architecture. These methods help to establish a dialogue between the physical intervention and the physical and cultural context in which it has been embedded.

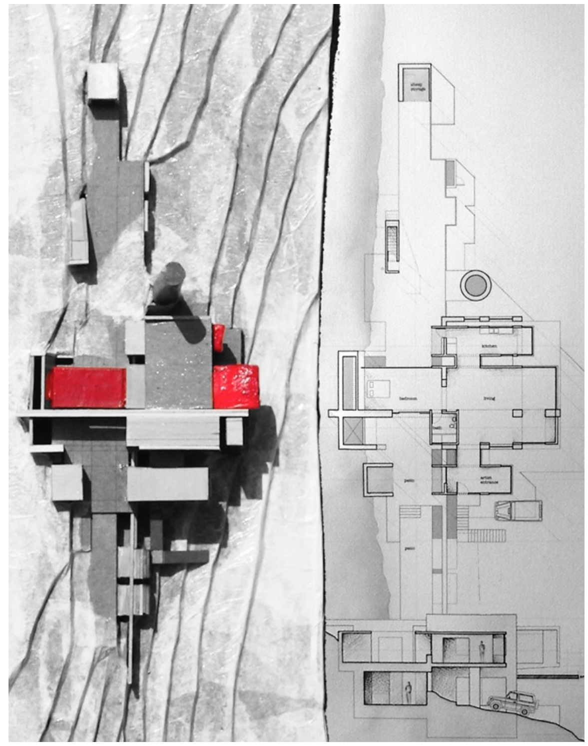


*Fig. 5 Montage of model/plan/section*

## Notes

[1] Poggi, Christine. *In Defiance of Painting: Cubism, Futurism, and the Invention of Collage.* New Haven: Yale University, 1992, p. 32.

[2] Berger, Alan. *Drosscape : Wasting Land in Urban America*. New York: Princeton Architectural Press, 2006.

[3] Waldman, Diane. *Collage, Assemblage, and the Found Object*. New York: Harry N. Abrams, 1992, p. 11.

[4] Vesely, Dalibor. *Architecture in the Age of Divided Representation: The Question of Creativity in the Shadow of Production*. Cambridge: The MIT Press, 2004, p.334.

[5] Dripps, Robin. 'Groundwork.' Burns, Carol J. and Andrea Kahn, eds. *Site Matters*. New York: Routledge, 2005. 59-91.

[6] Pallasmaa, Juhani. "Six themes for the next millennium," *The Architectural Review*, July 1994: 74-79.

[7] Iliescu, Sanda. "Beyond cut-and-paste: the promise of collage in contemporary design." *Places 1* (2008): 60-69.

[8] In Collage City, the authors were interested in collage for its metaphorical value, a means of understanding the potentialities in the rich layering and complexity of the built environment.

[9] Jackson, J.B. *The Necessity for Ruins: and other topics*. Amherst: The University of Massachusetts Press, 1980.

Open

# A Garment, Component, Joint: The Worth of Building What You Design

Tolya Stonorov | Norwich University School of Architecture and Art

## Introduction

Hands on learning through the act of building what you design at full-scale translates theories and ideas into real world experience. This type of applied knowledge forces the designer to be accountable for her work and provides a deeper understanding of material reality. Building work at a 1:1 scale supports the idea that building, making and designing are intrinsic to each other: knowledge of one strengthens and informs the expression of the other. "Verum Ipsum Factum, We know what we make."[1] Through full-scale building, students track design concepts through to built detail expression, *Fig. 1.* Too often architecture students become immersed in the theoretical space of the buildings they design. The level of abstraction that frequently exists in drawings dissolves when students are tasked to physically make a connection - to build the joint they design. Full-scale construction instills in students a strong commitment to understanding the implications of design decisions and provides deeper knowledge into what it means to be an architect. The importance of the design-build experience, of understanding material relationships at a 1:1 scale, is invaluable. Every architect should have to engage in the process of building her own work. This exercise gives a more complete understanding of the consequences of design choices and results in an experience-based respect for the builders who make architecture into a physical reality.

The nature of building full-scale work in studio moves beyond traditional intellectual exploration, bridging academic (theory) and professional realities (practice). Issues of structure, cost, material procurement and constructability take on concrete importance, forcing students to deal with the real world constraints of fixed budgets and complex material connections. These constraints further enforce the students' responsibility for their design decisions.

*Figure 1, Concrete to Glass Joint, Kristen Houghton*

Building at full-scale necessitates an in depth focus on material choices and building methods. It is critical that these choices and approaches be understood in relation to the larger context of local and global sustainability. When students research the life cycle of their material choices, they come to terms with the fact that their selections can aid in sustaining or destroying our world. It is crucial to explore and understand the wider implications of decisions and processes put in motion in the pursuit of design goals. Because process shares the same social and environmental concerns too often singly associated with the products of design, process too must be designed. I.e. equal importance must be given to the decisions of how we make things, as the things we make. Design and research that simultaneously enmesh the immediate and perceptible qualities of projects with the broader implications of design decisions and methods push for new and innovative solutions in thought, process and form.

Having students construct at a 1:1 scale supports the belief of 'making through thinking and thinking through making'. In a world where digital screens dominate much of our mundane work environment, many academic settings are driving the process of physical making toward extinction. Full-scale design-build exercises ground us in the physicality of the world we live in. Unable to press Ctl-Z when a drill slips or when a joint has excess movement, physical making instills a responsibility and respect for craft. Students gain unique and tangible knowledge from this experience. There is feedback specific to working with materials, tools and methodologies that directly informs concept, design, assembly and built work. Through the manipulation of a material, one learns what it wants to be and how it most successfully performs. Specifically, when working with materials by hand, one can literally feel material resistance. Conceptually, building at 1:1, with actual materials, helps to instill a greater respect for external restraints that architects experience daily in the profession.

In this paper, I examine two case study studio settings that incorporate full-scale fabrication: Second Year Studio Building Component/Joint Project and the Urban Water Body Studio Garment Construction. In Second Year Studio, beginning design students first encounter complex architectural realities. In the Urban Water Body Studio, 3rd and 4th year students prepare for dynamic and layered practices, also a beginning of sorts, towards their transition into the professional world.

## Background/Foundation

The insertion of full-scale building projects into the pedagogy of my architecture studio curriculum has its beginnings in my own graduate studies at the University of California, Berkeley. After years of designing large buildings and representing them with small, scaled models, I became disenchanted with that method of project representation. I yearned to build the actual thing that I was designing - at full-scale. As my work focused on the relationship of the built environment to the body, I began to explore the garment as the smallest form of architectural housing. Working with clothing provided a much-needed outlet to fabricate designed work.

This early study became the foundation for my later thesis work, which examined the layered relationship between public and private space. I studied this interface by looking at the relationship between the traditional female garment and architecture. I proposed that garment and building share a similar language, both providing shelter to the body. The focus of each is simultaneously outward and inward and what is revealed is designated by choices of spatial proximity, permeability and layering. The play between what is shown and what is hidden provides a tenuous balance between the public and private realm. The passage towards private space in built form is analogous to the

*Figure 2 , Garment to Built Screen, Tolya Stonorov* movement towards the body through the layers of a garment. My research looked at this analogy through the relationship of the kimono and the veil to the traditional Japanese and Islamic house. The study examined how lessons could be extracted from this relationship, abstracted and applied to built form, *Fig. 2*.

As part of this thesis, I fabricated a piece of the building: a kinetic screen that allowed the user to define her own level of privacy. This allowed me to test my concept through actual use *and* to experience the trials of construction with steel and fiberglass. The worth of this exercise brought life to a design process that felt stagnant and disconnected from the built world.

I have seen the value of this approach repeated in my own students' work. Depending on the studio setting, I incorporate full-scale work either in the beginning of semester, as a conceptual jumping off point for later work, or as the final project, a way to attain a deeper understanding of the complexities of the building the students have designed. In both cases, the design-build project encourages students to consider the intricacies involved in very simple moments of architecture. It further helps the students to understand material relationships and joinery.

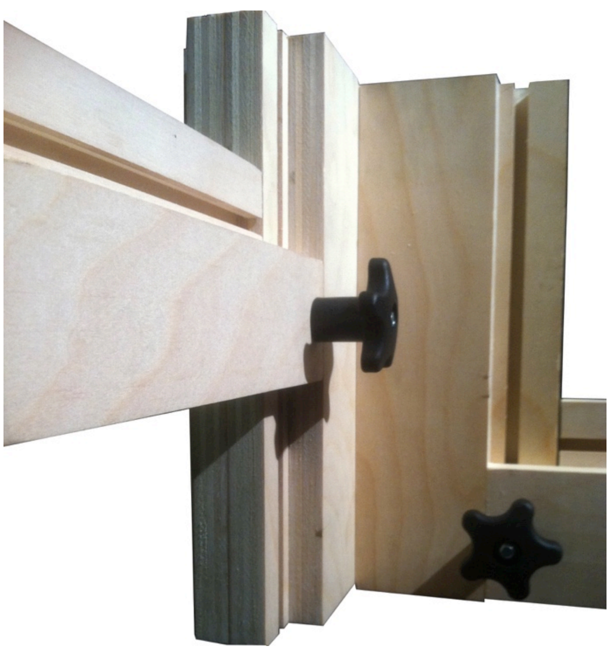


*Figure 3, Modular Construction, David Burke*

## Examples/Results

In the fall semester of Second Year Studio[2], students spend six weeks designing their first building that has a complex program and site. At the culmination of this project, students are asked, in a building component project, to select an element from their building and develop its design thoroughly. This element can be a door handle, a light fixture, a material joint, a stair tread, an exterior screen or other. The students are asked to shift scales, to approach the design from a different angle. Until this point, students primarily focused on the macro of the project: site, program and overall building design. The building component project requires the students to explore the micro, to try to understand the details of their building at full scale. The intensive 3 week exercise tasks students to explore their idea through a single, small part of the whole project. This idea, of a part representing the whole, is widely represented in nature as can be seen in proportional relationships of the golden section in Nautilus shells.[3] The building component exercise attempts to highlight this compelling and complex relationship between detail and whole. It further points to the importance of working with actual materials at full scale: concrete, wood, glass, lights, etc.

In 2013, for this building component project, architecture student, David Burke, chose to fabricate a series of moveable joints, *Fig. 3.* As his building explored the module and its possible transformations, this physical study allowed him to test the

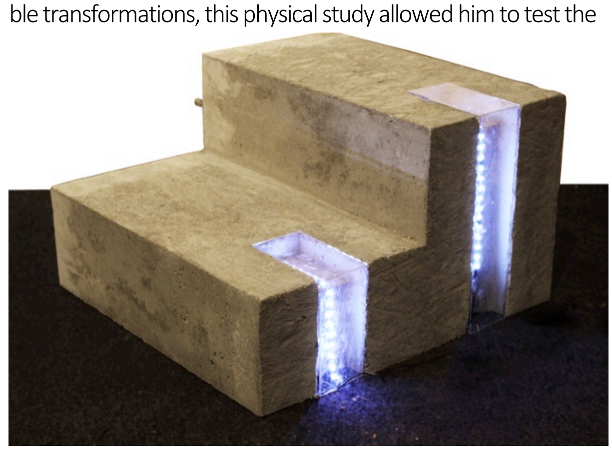


*Figure 4, Concrete Stair and Light, Ainsley Vail*

theory of how these pieces could plug into one another. The study highlighted the importance of hardware and joints. With a short window in which to make decisions, hardware choices became limited to what was readily available. Burke learned the importance of repurposing easily accessible and cheep materials in an innovative way. Sarah Bedard focused her building component on a floor system threshold where wood meets concrete. This exploration highlighted the joint between two disparate materials. She began with a butt joint, but through iteration realized that a separation of materials - a space, a reveal - allowed the materials to exist on their own. This move created a tension between the two materials, a vibration. In 2014, Kristen Houghton chose to build the connection of a concrete and glass wall, *Fig. 1.* Through this process, she was able to understand and test the inverse relationship between formwork and concrete admixtures. By choosing packing tape as her finish formwork material, the concrete took on a glassy texture. Houghton was able to see how the process of making directly affected the outcome of the product. Alex Menard fabricated a moment of aperture in a concrete and wood window frame. The importance of formwork construction and material joinery was brought to light as he struggled with how the concrete would meet the wood. His study exposed the difficulty in fabricating minimalist architectural details and taught him a strong respect for the builder. Ainsley Vail worked to construct a concrete stair to show how the assembly could incorporate lighting to accentuate space and path, *Fig 4.* The simple reality of mass and weight, of cavity and void, was emphasized as she labored to construct and pour the piece.

In 2015, the same building component exercise produced two particularly interesting projects: a portion of a stair by Nathan Russell, *Fig 5,* and a sound panel by GianCarlo Greco, *Fig 6.* The stair was especially successful as Russell was able to gain knowledge about the material nuances of wood and concrete and issues of structural integrity related to single stringer stair construction. Similar to other concrete projects, Russell explored concrete's relationship to formwork and internal steel tensile strength.

*Figure 5, Concrete + Wood Stair, Nathan Russell*

Because Greco's project included a recording studio, he chose to fabricate a sound panel. To generate the digitally designed and fabricated panel, Greco started with a 2 dimensional soundwave diagram. He then multiplied and shifted it in section and draped a surface over the form. From this Rhinoceros model, Greco used the CNC router to cut the foam surface. The resulting panel undulates with robust shadows, creating a desired acoustic quality and a dynamic surface.

The learning outcome of this project, of applied knowledge, changed the way these students approach detailing. The physical memory of making was absorbed into their conceptual design foundation. From the ideas inspired by strong precedents, teaching a 1:1 exercise is "conceived as a means of binding together thinking and making, engaged and embodied in the action of building." [4]

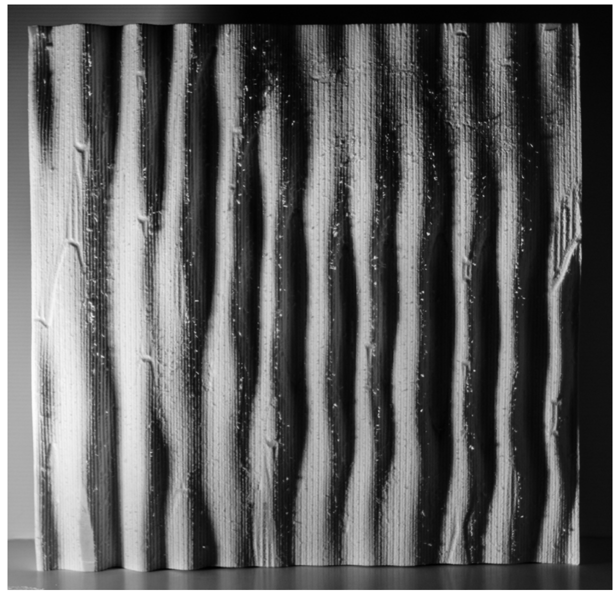


*Figure 6, Sound Panel, GianCarlo Greco, Photo by Greco*

In 2015, I returned to my research on clothing and incorporated garment construction as part of the Urban Water Body Studio. The garment project began with students studying their own bodies through the construction of duct tape mannequins.[5] After a week long exploration into organic skins, which included bark, snake, jellyfish, shark and grapefruit, I asked the students to delve deep into the exploration of how their research on skin could be translated into garment. Students explored possibilities through form, pattern, 2-Dimensional, 3-Dimensional, layering, use, etc. Many students chose skins that dealt with multiples and repetition. As organic forms, no two are exactly the same. In architecture, this 'natural mass customization' has become more attainable today with the introduction of digital fabrication. (Mass customization is defined here as the ease that digital design and fabrication afford in the production of varying forms.)[6] The method of the garment fabrication was discussed in relation to digital and traditional means. Students read from Ellen Lupton's *Skin: Surface, Substance and Design*[7] and discussed the complexities of housing the body, of texture and of creating a dual use for the garment. Each piece was designed to be worn and to provide a service to the user. They ranged from a sweater made entirely from wool socks from a local factory with a cowl neck that secretly housed a gas mask for emergencies in a dystopian world; a hooded vest that could be zipped from the inside to hide the face and allow for privacy and rest; a mesh shirt that could be unwrapped to become a screened space during hiking; a plastic jacket that catches rain-water in its collar, collects it within the jacket and provides a spigot and straw for personal use and a shirt that is covered in varying levels of transparent polycarbonate shards that serve as weapons in battle, *Fig. 7.*

*Figure 7, Battle Garment, Taylor Davidson*

David Burke focused his skin research on the snake. The snake's molting process became a fascination - the skin's construction allows it to shed layers. His garment research focused on folding techniques, creating multiple iterations of sewn patterns and pleats. Using the snake's biological construction as his rule system, Burke fashioned the overall fabric length to be greater than the actual garment length. The snake's method of pealing back the molting skin also informed the garment in the way it is employed. Fabricated as a space for pause, the vest's extended hood can be pulled over the head and zipped from the inside to create an interior space for the user, *Fig. 8.*

Fabricating this one to one scale garment allowed students to understand the materials and the user experience in a different way than modeling to a smaller scale. In essence, they gained intimate knowledge of the piece they designed. The abstraction of a wall thickness is removed when making decisions of how a garment will relate to the skin of the body. Details like thread thickness and how to treat a seam cannot be eliminated when constructing the actual object. Furthermore, the user, in this case the body, had to be understood in great detail to effectively create a housing that *fit*. Each student garnered a robust understanding of the complex forms that make up their own figure.

*Figure 8, Snake Garment, David Burke*

The exercise of building at full scale exposes the multitude of unknowns in the design process. It removes the ability to fake comprehension of how architecture transitions from thought to built form. Furthermore, shifting scales enlivens a studio and illuminates the importance of craft. Pouring concrete and witnessing the failings of too little rebar or too week formwork, insures a real understanding of the material and this, in turn, translates into better informed design work. The worth of building what you design brings new meaning to architecture projects, removing students from the abstraction of academic studios and grounding them in a more authentic reality. Fundamentally, fabricating full-scale work, whether in the conceptual phase or as a detail of a fully designed project, deepens students' understanding of architecture, it instills a greater appreciation of materials and garners an experience-based respect for craft and building.

## Notes

[1] Giambattista Vico; "Carlo Scarpa had this …phrase…carved over the entry of the Venice School of Architecture and Urban Design." Paraphrased from Ghost, Building an Architectural Vision; Brian MacKay-Lyons, Robert McCarter; New York, Princeton Architectural Press, 2008, p.193

[2] Co-taught with Cara Armstrong, 2012, 2014; with Steve Kredell, 2013 and Wendy Cox, 2015

[3] Jonathan Hale, The Old Ways of Seeing, The Principals of Pattern, Mariner Books, 1995, p. 61-61

[4] Brian MacKay-Lyons, Robert McCarter; Ghost, Building an Architectural Vision; New York, Princeton Architectural Press, 2008, p.193

[5] http://www.handimania.com/diy/your-own-shape-sewing-mannequin.html

[6] Lisa Iwamoto, Digital Fabrications: Architectural and Material Techniques, Princeton Architectural Press; 144 p. edition, 2009

[7] Ellen Lupton, with essays from Jennifer Tobias, Alicia Imperiale, Grace Jeffers, Skin: Surface, Substance, and Design, New York, Princeton Architectural Press, 2002

# Orientation: Post-Formalism and the Beginning Architecture Student

Andrew Tripp | Mississippi State University

*What is most personal is most universal.*
- Carl R. Rogers

*This is the problem from which I would start. Orientation.*
- Berthold Lubetkin

## Introduction

One of the most persistent and pernicious tendencies in the education of the architect is the acceptance of the idea that architecture is a ***visual art***; one that can be defined in essence as-- and therefore evaluated by-- visual elements (such as lines, planes, volumes, textures, colors, etc.), which altogether play a game of simultaneous contrast and continuity with the eye. Architecture has long been reducible to problems in the psychology of visual perception because of the assumption that it is somehow *about* visual perception. This is, of course, the aesthetic tradition of formalism, at least as it has been known ever since the publication of Lessing's *Laocoön* (1766). In apparent contrast to this tradition, there is the well worn idea that architecture is a ***performance art***; one that is concerned with successive movement and duration, much like literature, poetry, or theater. But when we contrast these positions we tend to forget that they are simply the two sides of Lessing's spatial-temporal analysis, and that both reflect the same compulsion to define universal formalist criteria for architecture; criteria that aim at transcending cultural change and difference, but in fact intend so from within the history of one specific tradition.

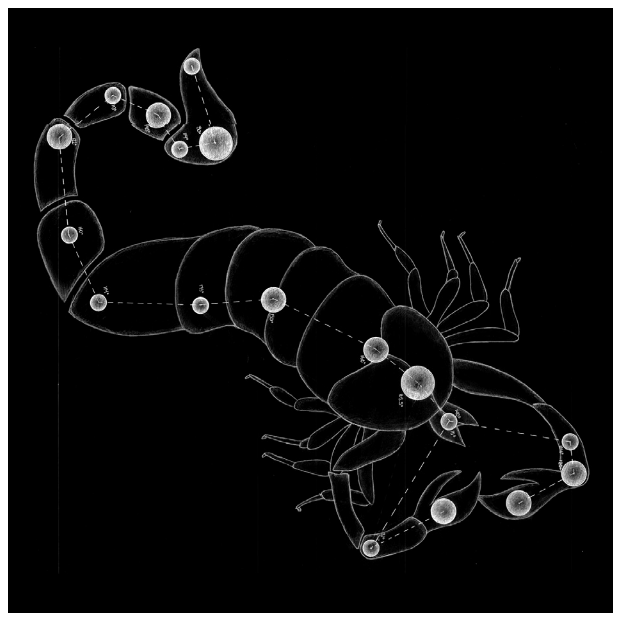


*Fig. 1 "Scorpio: Constellation with brightness, distance, and figure" by Brooke Russo, Spring 2015.*

Nowhere in the education of the architect is the pressure to give into this compulsion to define formalist criteria greater than in the beginning studio; when young students from various backgrounds are exposed for the first time to their capacity to create things and to the capacity for these things to represent meaning. But in studios defined by formalism, to what degree do these criteria come first to substitute-- and then ultimately replace-- the content of meaning? Take for example, the idea that young students might be 'learning to see' in the course of a beginning drawing assignment; are we not simply ushering them into a 'visual culture' in which what they create is simply about what is seen. On the other hand, should we be so willing to throw out such a powerful and attractive tradition?

In an elliptical pursuit of such questions, I have come to rely on the writing of David Summers and his notion of a post-formalist theory of interpretation.[i] This paper represents one possible development of a such a theory into a beginning architecture studio project based on the theme of orientation.

## Orientation

Rather than a ***formal*** understanding of a work of art or architecture, Summers proposes a ***conditional*** understanding. The term 'condition', originally from the legal discipline, carries the sense of a contract or an agreement: *I will do this on the condition that you will do that*. The core metaphor of its Latin root 'dicere' means 'to show' or 'to indicate' and therefore 'to point to' by means of language. A condition is a stipulation that makes an agreement possible. Conditions hold together things that are otherwise apart. One particularly potent condition, as he describes it, is orientation. Orientation is also a familiar term in architecture. In language, as we all know, the term is derived from the Latin word for 'east', 'oriens', from the verb 'orior', meaning 'to rise' or 'to appear', but which in another sense also means 'to flow', 'to move', or 'to run', as in a course, or a river (i.e., the Rhine in Germany). The term is associated with a deep sense of beginning and rebirth, and therefore also with knowing one's place and finding one's way. It is perhaps because of these associations that we use the term 'orientation' as a substitute for any "proper spatial relation to things and other people in the world."[ii] We call ourselves properly 'oriented' when we know where to go, what to do, or how to behave among others; and we are 'disoriented' when such things are unknown. Insofar as we choose to face or align with one direction or another, orientation can "entail values and polarities of values."[iii] In the most general way, we might ask: 'With what should we align ourselves? What should we face?'; or as architects we might ask: 'With what should this building align? What should it face?'.

For Summers, orientation, or more generally, alignment and facing, is a condition of social space. Consider a horizontal platform, what Alberti calls an area: "a certain, particular plot of land to be enclosed."[iv] Such an area might be said to present any number of potential alignments with its larger surroundings. Phenomenological thinkers teach us that when we stand within such an area, the cardinal alignments of our own body - its uprightness, facing, symmetry, handedness - register or 'dovetail' with those potential alignments. Summers writes that:

*"Our actual facing presupposes some relation to a more or less limited area, and that area has the potential to be a definite place, in some relation to the implicitly indefinite world at large. Insideness, outsideness and some right, 'facing' relation between the two are conditions of social space before it has been specified as one social space or another. When such specification takes place, then our facing may also become a culturally specific 'course of action'. If a clearing has an upright stone opposite the side on which we enter, then the floor not only has an internal alignment, it also directs our attention, movement and actions. The alignment or external orientation of a place, which may further shape our facing, may be further determined by something of importance outside of the place itself, a mountain, for example, or the rising sun. In this way, literally by means of a social space, our alignment is made part of a larger embracing order, part of a cosmos."*[v]

Cultures that bury their dead often align the body in right or proper relations to a larger embracing order. In ancient Egyptian burials, the dead were laid on their sides facing west. Early Christians were aligned to the east. Some cultures sought topographical rather than cardinal alignments, others saw a need for further distinctions. In northern Canada some Inuit men were laid facing the sea, with women facing the land. A whole anthropology of ritual alignments is available to the patient scholar.

In an aboveground setting, a fine example of orientation interpreted as a condition can be found in the Sacred Rock at Machu Picchu, where an elevated rectangular area flanked by two structures is concluded on one end with an upright stone that has been honed flat and cut to the precise profile of Mt. Yanantin in the distant background. The alignment of the mountain, the stone, and the opposite and open edge of the area defines a positioning around which the meaning of the space is structured. Entering the area, we can image how our body might 'dovetail' with the mountain by facing the stone. But the stone only appears as a profile or outline of the mountain *on the condition that* the alignment is achieved. Often, the mountain in the distance is obscured by weather, but the stone remains in its position as a substitute, a re-presentation of what is known but otherwise unseen.

In the European tradition, the Roman writer Vitruvius considered orientation or alignment to be a fundamental dimension of architectural ordering.[vi] In making the plan of the city or the house, he advised the architect to position certain parts relative to the east in order to promote health and convenience;[vii] but in the plan of sacred sites his statements were guided by a different intention. In a well known passage in book four, he writes:

*"This is how to determine which regions of the sky the sacred houses (aedes sacrae) of the immortal gods should observe (spectare). If no*

*reason stands in the way, and given the unrestricted power to do so, both the house (aedis) and the statue placed in the cella are to look toward the evening region of the sky, so that a person approaching the altar to make offerings or sacrifices looks to the part of the sky where the sun rises and also at the statue in the temple. In this way, when people undertake vows they will gaze at once upon the temple, on the sun rising in the eastern sky (oriens), and on the statues (simulacra)*[viii] *themselves that seem to come-forth (exorientia)*[ix] *along with the sun and gaze back upon those praying and making sacrifices - which obviously demands that all the altars of the gods face east."*[x]

Again, the interpretation of orientation is conditional; statues "seem to come-forth... and gaze back upon those praying" *on the condition that* the supplicant and shrine are aligned with the statue and sun. In this sense, and in reference to the image, all conditions are pre-existing. Vitruvius's proposal for a theory of orientation in sacred settings was concerned with structuring an agreement between an unseen other - the benevolent gaze of the gods (*deorum inmortalium*) - and the pious gaze of man.[xi]

The potential power of this format for agreement is put into relief by the sympathy between a change in alignment and a change in culture. Consider the case of the Acropolis, razed by the Persians, then later rebuilt after the Athenian victory with a second Classical Propylaia constructed along a new alignment framing the site of the Battle of Salamis in the distance. Consider Michelangelo's renovation of the Capitoline Hill and the realignment of the elevated platform away from the ancient and mediaeval city and toward the Vatican and the new Renaissance city. In such cases the change of alignment becomes the bearer of new meaning, a promise, but this promise is not always benign. For example, consider the case of the Aztec Temple Mayor, originally aligned with temples that faced west, directly at the causeway leading from the mainland onto the island precinct; but when the Cathedral of Mexico City was overlaid the alignment of the area was transformed such that the major direction was now north-south. So powerful was the meaning carried by the pre-existing alignment that the Spanish denied a conventional westwerk on the cathedral in order to avoid equivocation.

But for as significant as alignment is to architecture, it suffers from a divided interpretation. Today, in the discipline of architecture, 'orientation' typically refers to the science of positioning architecture in relationship to the sun and its energy with the intention to make the best use of this as a resource. We might call this scientific understanding of orientation its 'instrumental interpretation'. The mechanisms of this interpretation have been firmly in place ever since the birth of rational town planning; for example, in the Raymond Unwin's *Town Planning in Practice* (1909), and later in the *Zeilenbau* of the Frankfurt CIAM (1929), and then such technical documents as the R.I.B.A.'s *The Orientation of Buildings* (1933). We cannot ignore that our contemporary world is fashioned by-- and for-- an instrumental interpretation of architecture and the natural world. On the other hand, there always exists the potential for a 'conditional interpretation' that connects us in agreement with one another and with larger unknowns.

## Projection

While this all may seem rather divorced from the immediate concerns of architectural education, it leads me to a question: Can we imagine a project that 'observes' both an instrumental and conditional interpretation of architecture and the natural world? And can we do so without doing violence to the idea of one or the other?

This question was the motivation for a beginning architectural project about orientation, given to students in their second semester at the School of Architecture at Mississippi State University in the Spring of 2015. The title of the project was 'An architecture of several orientations'.

In part one, 'Alignment with the macrocosm', students researched a set of astral bodies - the earth, the moon, the moon-constellation, and the sun-constellation - as they 'appeared' at the place and time of their birth. In projective drawings, they described the spatial relationships between the three distances implied in the alignment of these bodies: first, the position of their body; then the position of the sun and moon; then beyond these, at the distance of the zodiac, the associated constellations and their figures. Students developed techniques associated with polar coordination, but also techniques for rendering distance, direction and duration. Indeed, just as there were three scales of depth, there were three scales of duration. However, for the sake of brevity, students were only asked to draw these bodies in their precise spatial and temporal relationships over the course of twenty-four hours.

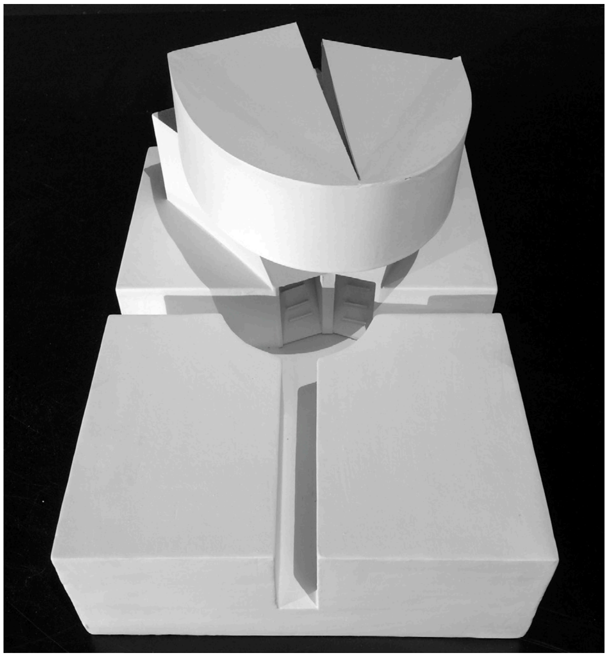


*Fig. 2 "Final proposal" by Garland Willcutt, Spring 2015*

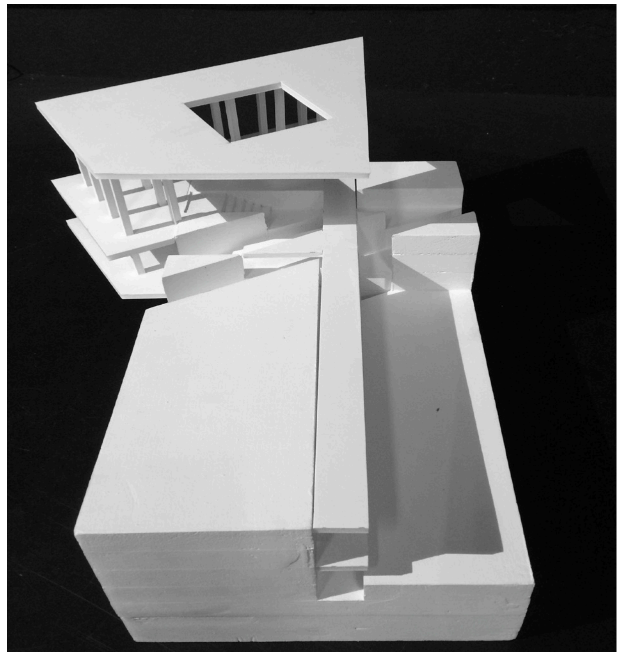


*Fig. 3 "Final proposal" by Asher Paxton, Spring 2015*

In part two, 'Alignment with the microcosm', students researched the measurements and profiles of their own body - as it existed in the flesh. In drawings, they described the numbers and ratios between the members of their bodies, but also how these relationships accorded with the anatomical orientation of the body - its sagittal (right-left), coronal (front-back), and transversal (top-bottom). From these ratios and directions, students developed a rhythmic orthogonal grid that was to be applied onto an invented site, which was developed separately from a series of abstract but scalar parameters.

In part three, 'Spaces and stories', students synthesized the two previous parts; putting together their polar coordination of directions and distances with their orthogonal grid onto their scaled site. In doing this students were asked to create lines, planes, and volumes conditioned by three kinds of alignment; one according to the zodiacal horizon, one according to the topography of the site, and one according to the cardinality of the body. Students imagined that their spaces were inhabited by 'observers', but here the metaphor of the observer was meant to extend beyond visual perception and mean something more like the way one might be said 'to observe' a holiday, with-- and for-- others.

Finally, students were asked to use their final proposal to tell a story about the events that could be included in their proposal. To our surprise, at the final review, nearly all of these stories began in the same manner: Hello my name is ___ and I was born on ___ in ___ . The students then proceeded to describe how their proposal observed alignments with particular events of real significance to them, which they then relied on to compartition their spaces into a variety of possible uses at particular times. At the final review, rather than a history of their compositional processes and procedures, students presented, without prompt, the relevance of their own biography to their proposal. Despite an otherwise 'impractical' project, the students found very 'practical' content in describing their own origins as a basis for creating architecture.

## Conclusion

Here is a question that perhaps I could have started with: Who is the beginning architecture student? Should the beginning architecture student be a student of the visual arts or the performing arts? The philosopher Paul Ricoeur teaches us that the answer to the question 'Who?' is always a narrative, and that the way we judge such a narrative is in the way in which we depict ourselves in relation to others. In relating a narrative, and furthermore one founded on a respect for their individual origins, the students hinted at alternative criteria for comparing and judging their work, and ultimately confirmed, at least to me, that what is most personal is likely also what is most universal.

## Notes

[i] On the idea of post-formalism, see: Summers, David: "Conditions and conventions: On the disanalogy of art and language." in Kemal, Salim and Gaskell, Ivan. *The Language of Art History*. Cambridge: Cambridge University Press, 1991.; "Form and Gender." *New Literary History* 24.2 (1993): 243-271.; "'Form.' Nineteenth-century metaphysics, and the problem of art historical description." *Critical Inquiry* 15.2 (1989): 372-406.; *Real Spaces: World Art History and the Rise of Western modernism*. New York: Phaidon Press, 2003.; and "The 'Visual Arts' and the problem of art historical description." Art Journal 42.4 (1982): 301-310.

[ii] Summers, *Real Spaces* 181.

[iii] Ibid.

[iv] Alberti, Leon Battista. *On the Art of Building in Ten Books*. Trans. Joseph Rykwert, Neil Leach and Robert Tavernor. Cambridge: The MIT Press, 1989, 8.

[v] Summers, *Real Spaces* 182-3.

[vi] In my interpretation of Vitruvius's text, I have adjusted existing translations of the Latin using the transcription of the British Museum's Harleian 2767 manuscript published in Frank Granger's translation of *Vitruvius On Architecture* (Cambridge: Harvard University Press, 1931/1998). For guidance, I have turned to Ingrid D. Rowland's recent translation of *Vitruvius: Ten Books on Architecture* (Cambridge: Cambridge University Press, 1999), as well as those passages most expertly translated in Indra Kagis McEwen's *Vitruvius: Writing the Body of Architecture* (Cambridge: The MIT Press, 2003).

[vii] According to Vitruvius, in the plan of the city, the architect should avoid the alignment of marshes and winds arising from the east, see: Vitruvius 1.4.1, 1.4.11, and 8.2.3. Then, in the plan of the house, the east is the most appropriate position for private bedrooms, libraries, dining rooms, and mangers, see: Vitruvius 1.2.7, 6.4.1-2, 6.6.1, 6.6.5, and 6.7.3.

[viii] It is important to note that the term *simulacrum*, translated above as 'statue', can- and perhaps should- be understood in relation to its wider significance as 'image' or even more generally as 'representation'. In *De architectura*, the context of the term *simulacrum* suggests several different meanings. On several occasions, Vitruvius uses the term to refer to sacred statues of specific deities, see: Vitruvius 1.1.6, 2.9.13, 7.5.2, and 9.P.16. Elsewhere he uses the term to refer to sacred statues in general and the architectural adjustments required to accommodate the approach toward them, see: Vitruvius 4.3.4, 4.3.8, and 4.9.1.

[ix] The notion that heavenly representations arise rather than rise (*exoriri* rather than *oriri*) is repeated by Vitruvius only in his discussion in book nine of the sun's course through the zodiac, in which the term *simulacrum* takes on the meaning of 'constellation'. See: Vitruvius 9.3.1, 9.4.2-3, 9.4.6, and 9.5.1. In this celestial context, he is referring to the astronomical poem *Phaenomena* by Aratus of Soli, who he cites and likely knew through Cicero's translation, Vitruvius 9.6.3, as well as to the related tradition of "synchronic risings and settings" in which heavenly bodies drag each other along their course. On astronomy, see: Vitruvius 1.1.10, and 9.7.3.

[x] Vitruvius 4.5.1. "Regiones autem quas debent spectare aedes sacrae deorum inmortalium sic erunt constituendae uti, si nulla ratio inpedierit liberaque fuerit potestas, aedis signumque quod erit in cella conlocatum spectet ad vespertinam caeli regionem uti qui adierint ad aram immolantes aut sacrificia facientes spectent ad partem caeli orientis et simulacrum quod erit in aede, et ita vota suscipientes contueantur aedem et orientem caelum ipsaque simulacra videantur exorientia contueri supplicantes et sacrificantes, quod aras omnes deorum necesse esse videatur ad orientem spectare." English translation adjusted from McEwen (2003), 173.

[xi] McEwen has made a compelling case that, while this passage does not accurately report on Greek or Hellenistic temple layouts, it does reflect the tradition of Imperial Roman temples that follow from the Temple of Divus Julius built on the eastern end of the Forum Romanum and dedicated to Julius Caesar in 29 BCE, see: McEwen (2003), 174.

CAL POLY