DIGITAL PEDAGOGIES

Partnerships in Learning 14

Guest Editor: Murali Paranandi

form•Z

Joint Study Program Report

2005-2006

Digital Pedagogies

Guest Editor: Murali Paranandi

Partnerships in Learning 14
2005-06 form•Z Joint Study Report

December 2006

Editor: **Chris I. Yessios**
Art Editor: **Wasuta Orser**
Copy Editor: **Jason Lichtenberger**

ISBN-13: 978-0-9792943-0-3
ISBN-10: 0-9792943-0-4

• This document was created electronically using Adobe InDesign® on an Apple Macintosh® computer.

Preface

Welcome to the 2005-06 **form•Z** Joint Study (JS) Program Report, the 14th issue since the JS Program started. For those of you that may not be too familiar with previous JS Reports, they initially consisted of displays of the student work member schools submitted as part of their annual reports. As the membership to the JS Program increased over the years and it became impossible to include all the work in a printed document, displays in the printed report were reduced to at most one page per school and an all inclusive CD accompanied it. The latter soon contained over 500 pages and, in addition to static displays, included multimedia projects, mostly animations that could be played directly from the pages of the respective projects.

After doing these reports for a good number of years, two years ago, AutoDesSys recognized that they tended to be repetitive and that the printed and CD versions were largely redundant. In mutual agreement with the PIs, the printed report switched to a "thematic" format, while the CD version continued the all inclusive format that became known as the "catalogue" format. The thematic format had actually been introduced in 1998-99 with quite a bit of success, but at the time it did not appear appropriate to repeat it every year. A couple of years ago, realizing the potential of the report to evolve into a scholarly publication, and with the vast majority of the PIs concurring, it became clear that the thematic report was worth repeating annually. After a highly applauded publication last year, AutoDesSys decided to take it even further this year.

To ensure that the thematic publication remained fresh and non-repetitive, AutoDesSys invited a Guest Editor to assemble the material. Proposals were solicited in June 2006 and, even though time was very tight, the expressed interest was higher than expected. Murali Paranandi, an Associate Professor at Miami University (Ohio) and a JS PI for many years was selected to assume the task. The fruits of his work are in your hands. Without question the result has almost surpassed our expectations and wish to sincerely thank him for his dedication and resolve. If there were a regret, it is that it took a few months longer to produce this year's printed report, an area to improve on next year.

C.I.Y.

Images used on the cover:

1. Aric Grauke, University of New Mexico
2. Amr Abdel Fattah, American University of Sharjah
3. Arturs Cepulis, Riga Technical University
4. Shraddha Aryal, Rhode Island School of Design
5. John Houser, Mathew Haynes, Justin Kyle, Texas Tech University

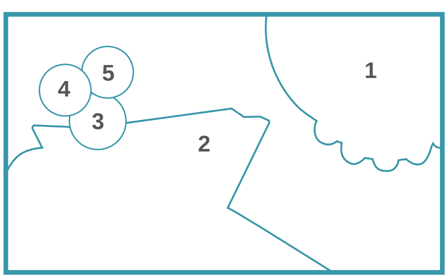


Table of Contents of the Printed Report

Reviewers

Michael A. Ambrose. ambrosem@umd.edu. B.Arch. Temple University. M.Arch. Syracuse University. Assistant Professor, University of Maryland School of Architecture, Planning.

Alfredo Andia. alfredoandia@yahoo.com. M.Arch. Harvard University. Ph.D. University of California, Berkeley. Associate Professor at Florida International University, Miami.

Peter Anders. ptr@andersassociates.net. B.S. University of Michigan. M.A. Columbia University. Ph.D. University of Plymouth Planetary Collegium. Architect, educator, and information design theorist based in Midland, Michigan.

Julio Bermudez. bermudez@arch.utah.edu. Diploma Architect-Universidad Catolica de Santa Fe, Argentina. M.Arch. University of Minnesota. Ph.D. in Education, University of Minnesota. Associate Professor of Architecture, Graduate School of Architecture, University of Utah.

Joachim Carels. me@joachimcarels.com. B.A. Miami University. A.A.S. in Fashion Design, Parsons School of Design. Production Manager at Parke & Ronen Men's Fashion.

Chris Carney, AIA. ccarney@microsoft.com. B.A. University of Notre Dame. M.Arch. Miami University. Environment Designer for Halo, Environment Lead for Halo 2 and Halo 3 Bungie Studios, Microsoft, Seattle.

Jeff Day. jeff@minday.com, www.minday.com. B.A. Harvard. M. Arch. University of California, Berkeley. Assistant Professor of Architecture at the University of Nebraska, Lincoln. Principal of Min|Day in Omaha, Nebraska.

Diane Fellows. ellowd@muohio.edu. B.F.A. Philadelphia College of Art. M.F.A. University of Wisconsin, Madison. M. Arch. University of Oregon. Assistant Professor in Theory and Design in the Department of Architecture and Interior Design at Miami University of Ohio.

Michael Fox. michaelfox@csupomona.edu. www.foxlin.com. SMARCH, MIT. Assistant Professor of Architecture, Cal Poly Pomona. Principal, Fox Lin Inc. Los Angeles.

Robert Flanagan, AIA. Robert.flanagan@cudenver.edu. B.S., Southeastern Massachusetts University. M.Arch. University of Colorado. Associate Chair and Associate Professor, Department of Architecture, University of Colorado, Denver.

Ganapathy Mahalingam. Ganapathy.Mahalingam@ndsu.edu. http://myprofile.cos.com/ganapathy. Ph.D. University of Florida. Associate Professor and Architecture Program Director in the Department of Architecture and Landscape Architecture, North Dakota State University.

John Humphries. john@phdv8.com. M.Arch. University of Texas. Assistant Professor, Department of Architecture University of Washington, Seattle.

Lukas Kalisperis. LNK@PSU.EDU. Ph.D. Penn State. Professor & Chair of the Graduate Studies at the Department of Architecture, Pennsylvania State University.

George Katodrytis. gkatodrytis@aus.edu, http://www.katodrytis.com. B.A.(Hons) University of Manchester. Diploma R.I.B.A. Architectural Association. Associate Professor of Architecture at the American University of Sharjah, UAE.

Greg Luhan. galuhan@pop.uky.edu, http://www.uky.edu/Design/luhan.html. B.Arch. Virginia Polytechnic Institute. M.Arch. Princeton University. Associate Professor, College of Design, School of Architecture, University of Kentucky.

Kenneth Masden. Kenneth.Masden@utsa.edu. B.Arch. University of Kentucky. M.Arch. Yale University. Assistant Professor of Architecture at the University of Texas at San Antonio.

Robert Mezquiti. graffitiempire@gmail.com, http://graffitiempire.com/. B.A. The University of Texas San Antonio. M.Arch. Columbia University, Visual Studies. Professor at Pratt Institute, School of Architecture. Assistant Professor of Design at Columbia University, School of Architecture.

Meg Nurre. mnurre@gmail.com. Bachelor of Arts in Architecture, Miami University. Designer at Pelli Clarke Pelli Architects, New York, NY, currently.

Mahesh Senagala. mahesh@mahesh.org, www.mahesh.org. B.Arch. Jawaharlal Nehru Technological University, India. M.Arch. Kansas State University. Associate Professor and Associate Dean for Research, College of Architecture, University of Texas at San Antonio.

Virginia San Fratello, RA. vfratel@clemson.edu. M.Arch. Columbia University. Director, Charles E. Daniel Center for Building Research and Urban Studies, Clemson University.

Tina Sarawgi. tina_sarawgi@uncg.edu. Assistant Professor Department of Interior Architecture, The University of North Carolina at Greensboro, NC.

Linn Song. linn.song@fh-rosenheim.de, http://song.maclab.eu. Registered Architect (Germany). M.Arch. University of Texas at Austin. Professor of Visual Communication, Faculty of Interior Architecture, University of Applied Sciences at Rosenheim, Rosenheim, Germany.

Alex Shapley, RA. Alex.Shapleigh@callison.com. B.S. Design Clemson University. Master of Architecture, Miami University. Director, Retail Studio at Callison Inc, in Seattle, Washington.

Aron Temkin, RA. atemkin@fau.edu. M.Arch. Cranbrook Academy of Art. B.Arch. Carnegie Mellon University. Director and Associate Professor, School of Architecture, Florida Atlantic University.

Stephen A. Temple. stemple@utsa.edu. M.S. University of Texas at Austin. B.Arch., Carnegie Mellon University. Associate Professor of Architecture, College of Architecture, University of Texas at San Antonio.

Lisa Tilder, RA, NCARB, member USGBC. tilder.1@osu.edu. M.Arch. The Ohio State University. B.Arch. Pennsylvania State University. Associate Professor of Architecture, Knowlton School of Architecture, The Ohio State University.

Tristan d'Estree Sterk. office@ofram.com, www.oframBFRA.com. Founder: The Office For Robotic Architectural Media & The Bureau For Responsive Architecture.

Kostas Terzidis. kostas@gsd.harvard.edu. Ph.D. University of Michigan. M.Arch. The Ohio State University. Diploma of Engineering, Aristotelion University, Greece. Associate Professor, Harvard Graduate School of Design.

Assembling *Digital Pedagogies*

In contemporary design practice, while there is no question about the validity of the digital tools for production work, very little consensus exists when it comes to their potential for design. While drawing with the computer has become a standard professional practice, it is the academic world that leads the way in exploring the possibilities of the computer as a design enhancing device. The essays collected in this publication are excellent examples of such explorations involving digital tools in general and **form•Z** in particular. Written by very talented designers and thinkers, both educators and students, they aim at uncovering design areas where the digital tools can prove highly effective and creative. Here is how these papers were assembled.

Late June 2006, when I received an e-mail seeking proposals for the Guest Editor of the **form•Z** Joint Study annual publication, I proposed to invite focused articles that emphasize strategic thinking geared toward the incorporation of digital media in creative endeavors. In the ensuing time, with the complete encouragement of AutoDesSys, Inc., I have strived to extend the transformation of the Joint Study Report into a scholarly work that might become a valuable source and reference for the education of novice designers. Upon careful screening of hundreds of projects submitted as part of the annual Joint Study reports, award winning student design work, forward looking design projects that were featured in broadcast and print media, and interesting peer-reviewed presentations at conferences during 2005-06, I assembled a review panel of twenty-eight accomplished experts with diverse design interests (see list on page 2) and invited thirty-four potential authors to submit proposals for articles.

The response was quite enthusiastic, to say the least, and thirty-one drafts of articles arrived by the deadline. At that time, I set up a double-blind review process to boost the quality by providing substantive feedback to the authors. Each essay was reviewed by at least two outside reviewers. I summarized the reviewers' comments and channeled them to the authors with suggestions for revisions and improvements. During this process a few of the authors dropped out, which resulted in the twenty-seven essays incorporated in this publication. They represent a well-balanced mix of pedagogical themes spanning a broad spectrum of creative possibilities.

Strategies to engage students for enhanced learning experiences in digital media courses are discussed in the context of high school by Clarkson and Meredith, in the context of undergraduate design students by Stauffer, Asojo & Lanman, and Steiner. Nieman and Heltzel favor the use of diagrammatic and non-photo-realistic rendering approaches to design, where as Pechlivanidou-Liakata appears to advocate more accurate and realistic renderings in the design process. Reynolds' work provides a great example of imaginatively incorporating texture mapping and camera animation features into film set design. Mahalingam shows how to exploit the Query and the Animation tools for quantitative and qualitative simulation, for creating responsive and sustainable architecture. Diewald and Frederick provide an excellent example for rapid visualization by supplementing **form•Z**'s modeling capabilities with 3DSMax in developing complex spatial geometries for their airport design. Viviano provides a provocative case study for clothing design. Zarzycki presents a phenomenological inquiry investigating the fluid aspects of architectural environments. Fowler demonstrates the advantages of going back and forth between digital and analog media during design development. Excellent examples of fabrication applications can be found at different levels and scales. San Fratello's work is at a product scale, Katodrytis's at a prototype scale, Thurnauer's, Economou's, and Tehrani's at a building scale, and Rael's at an urban installation scale.

The articles by Chui and Pechlivanidou-Liakata show how **form•Z** was successfully utilized in graduate design student inquiry investigating complex architectural forms and themes. Senagala examines the importance of **form•Z** in the discipline of architecture and, through a critical close reading of the software, compares **form•Z** and the institution of its production to such important works of architecture as the Villa Savoye. Sterk, a pioneer in developing smart structures and a winner of several awards, including the Schiff Fellowship in 2003 and a JS Award of Distinction in 1999, offers a vision for future computer aided design systems. Terzidis and Economou discuss critical means to conceptualize and concoct algorithmic architectures and present examples of using **form•Z** scripting to investigate them.

A number of articles feature projects that were recognized for design excellence in international juried competitions or exhibits during 2005-06: Roberts, Flynn & Barajas were winners of the second place and honorable mention, respectively, in the *ACSA/AISC Aquatic Center Competition*; Diewald and Frederick were the first place winners in the *ACSA/DHS Airport Competition*; Sterk was the first place winner in the *Emerging Visions Competition* for young architects in Chicago; Paranandi writes about Nye and Cerny who were the first place winners in the *Metal Construction Association Outdoor Pavilion Competition*; Boling writes about Hatter who was the first place winner of the *Lyceum Competition*; and San Fratello writes about the *Dishes,* a juried exhibit at the *ACADIA 2006 Conference*.

As a whole, the essays take positions, make points, and advocate directions, which I believe deserve further debate. To do this, I am setting up a forum on the Internet at <www.muohio.edu/digitalpedagogies> where the positions expressed in this publication may be further discussed and scrutinized. You are all welcome to come in and participate.

Concluding, I wish to wholeheartedly thank all the authors and the reviewers for their commitment and dedication to this project. I also wish to thank AutoDesSys for entrusting me the responsibility of assembling their 2005-06 **form•Z** Joint Study book. I hope that what I have been able to produce matches and may be even surpasses the qualitative standards they have maintained over the years. Last but not least, I wish to acknowledge and extend congratulations to the students whose projects fill these pages and frequently became the basis for the published articles. This book is about a partnership between instructors and willing students, all explorers of the new digital tools and their potential contributions to the evolution of fresh design cultures. I hope you enjoy reading this book as much as I did putting it together.

Murali Paranandi
Guest Editor

Joint Study Awards '05–06

One of the traditions the **form•Z** Joint Study Program and its report have established is the annual awards presented to deserving students for their exceptional work. This year eight awards of distinction and eight honorable mentions have been granted.

The nominations

To qualify for an award, a student should be nominated by the Principal Investigator (PI) of the JS school where he/she is enrolled. In addition to the images, the PI submits a summary description of the nominated project and states the reasons for which he/she thinks the nominated student deserves an award. This year, there were 105 nominees from 58 different schools.

The Categories

The nominated projects were divided in six categories: Architectural Design, Interior Design, Product and Industrial Design, Visualization and Illustration, Fabrication, and High Schools. One Award of Distinction and one Honorable Mention were granted in each category.

The Jury

The selection of the awards was made by five jurors outside of AutoDesSys, all experts or theorists of computer aided design. They are listed below, in alphabetical order.

• **Dennis Andes**, Designer and owner, Dennis Andes Inc., New Jersey
• **Peter van Colen**, Designer, Design East Corporation, Illinois
• **Wassim Jabi**, PhD, Assistant Professor of Architecture, New Jersey Institute of Technology
• **Victor Martinez**, Conceptual Designer, Film Industry, Los Angeles, California
• **Bart Overly**, Partner, Blostein/Overly Architects, Columbus, Ohio

The Process

The projects of all the nominees were sent to the jurors as Acrobat documents on CD-ROMs that also included animations that accompanied some of the submissions. Names and school affiliations were not included. The jurors returned their selections for the awards and grades (0 to 10) for each of the other projects. Selection of a project for an award was considered equivalent to a grade of 15. The grades were averaged and the one project from each category receiving the highest grade was selected for the award. Projects receiving the second highest grade were selected for the honorable mentions. The jury was also asked to comment on why they selected these particular projects. Their comments are included with the displays of the award of distinction and honorable mention winning projects.

Joint Study Award winners that attended the ACADIA 2006 conference

From left to right are:
Jae Oh - *Honorable Mention, Interior Design*
University of Bridgeport, Bridgeport, Connecticut, USA
Lorraine Ong - *Award of Distinction, Fabrication*
Georgia Institute of Technology, Atlanta, Georgia, USA
Luke Johnson - *Award of Distinction, Product and Industrial Design*, University of Bridgeport, Bridgeport, Connecticut, USA
Aric Grauke - *Honorable Mention, Visualization and Illustration*
University of New Mexico, Albuquerque, New Mexico, USA
Mike Frederick - *Award of Distinction, Interior Design*
Miami University, Oxford, Ohio, USA
Justin Kyle, Matt Haynes, John Houser - *Award of Distinction, Visualization and Illustration*, Texas Tech University, Lubbock, Texas, USA

The Prizes

All Awards of Distinction are receiving a **form•Z RadioZity** license with one year technical support and updates. They are also invited, expenses paid, to attend ACADIA 2006, where the awards are officially announced. In addition, AutoDesSys, Inc. will wave the processing costs of a 10-seat JS license for the school they attend, for next academic year. Honorable Mentions receive one year licenses and diplomas acknowledging the award.

DESIGN
ARCHITECTURAL

Advisor/Principle Investigator: **George Katodrytis**

Architecture, Fifth year **: Amr Abdel Fattah**

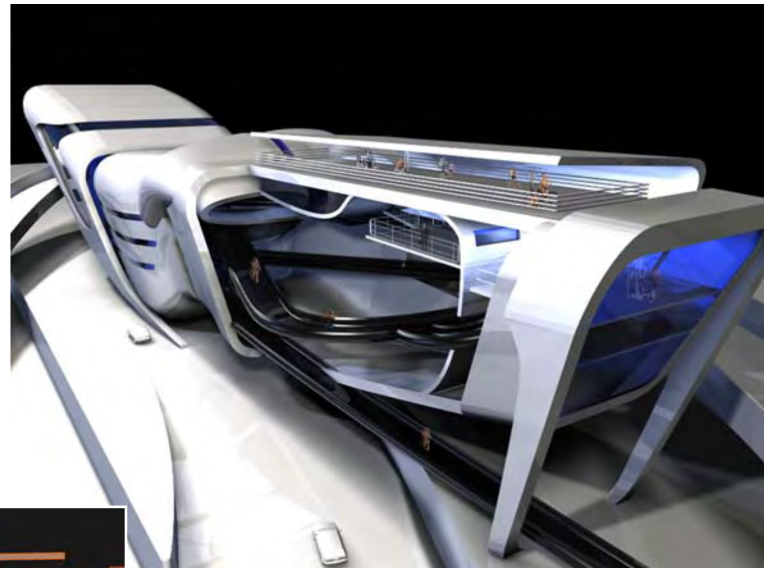
Urban Orthopedics Laboratory

Architecture Department
American University of Sharjah, Sharjah, United Arab Emirates

Summary Description of Project:

The project started by casting Plaster of Paris. The outcome resembled body joints and bones. These objects were also carved out. The project developed into an exploration of organically evolved forms and anatomical interior landscapes. The castings and their evolutionary forms were translated into 3D spaces, modeled and deformed using **form•Z**.

Digital modeling, only, was used to develop the final proposal. The project was developed as an Orthopedics Lab and running track with gymnasium. The representation included sectional perspectives and exterior as well as interior renderings, showing in detail materials, lighting, tectonic composition and human participation.



Reasons for the Nomination:

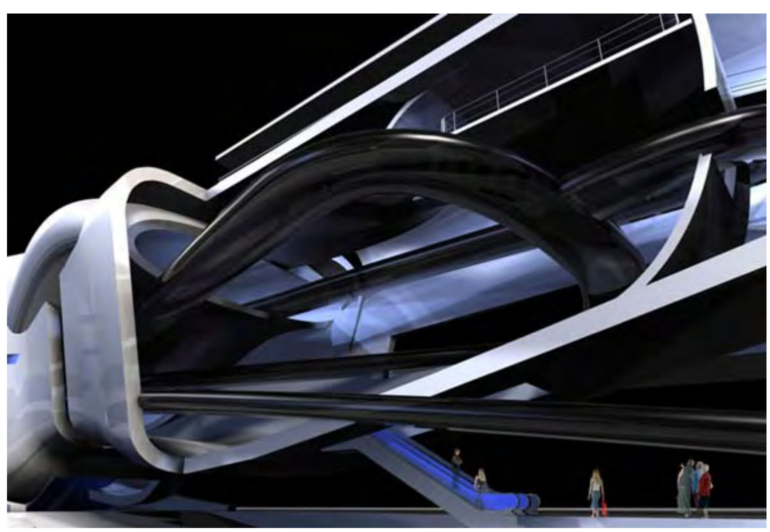
This student's studio project exemplified the processes and methods of abstraction as generators of form that were required in this studio. This project reflects a fluid transition from early concept to architectural development. The design elements interact with the historic Fort Adams site, which remains independent, but feels as if it is in a call and response dialogue with the new complex.

JURY COMMENTS:

I was delighted that the architect moved away from the box with an exterior curvilinear form that became a 3 dimensional icon for this unique Urban Orthopedics Lab. The interior spiraling running track and usage of clipped views, human figures/cars in motion, gym equipment for scale and the exploration of dynamic interior views nailed this presentation. Overall the student demonstrated a control of the **form•Z** and digital medium. Sign me up for a membership to the gym today... an excellent presentation. – **Dennis Andes**

The author of this project masterfully controlled his formal investigation. The project illustrates excellent understanding of fluidity, shell-like structures, and sectional interaction. The renderings are well considered and illustrate how digital tools can convey space and form like no other tools.
– **Wassim Jabi**

An impressive project showcasing both the visualization capabilities of 3D modeling and **form•Z** specifically. Missing are the tell tale clues of foam core model construction and a reliance on rectilinear planes. What is present is an exploration of organic space achievable with the use of computer modeling. The **form•Z** renderings do a wonderful job of allowing the viewer to become immersed in the concept of this architectural space. – **Peter van Colen**



Advisor/Principle Investigator: Howard Davis/ Lars Uwe Bleher

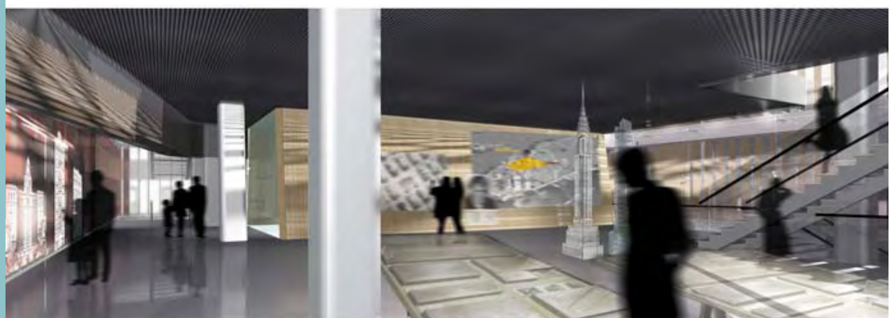
Bart Chui : Graduate, Studio Project

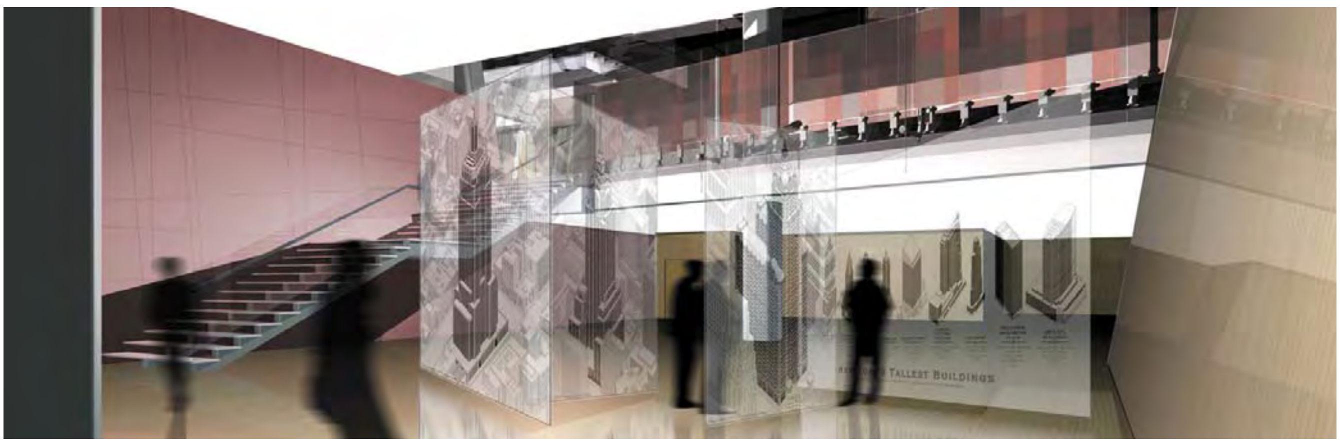
Museum of the Building, New York City

Department of Architecture and Allied Arts
University of Oregon, Eugene, Oregon

Summary Description of Project:

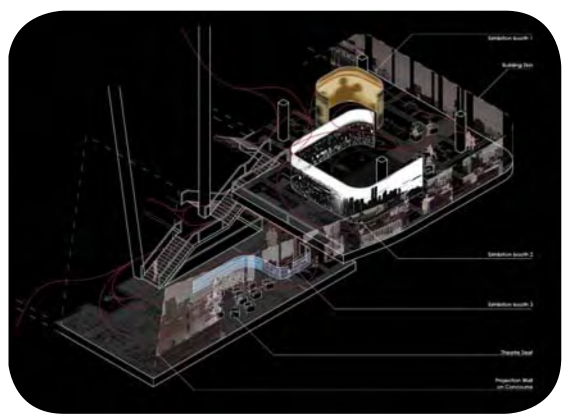
Program: The problem of Museum of the Building arises in the inherent contradiction of the program. Logically, the city itself is the Museum of the Building, a collection of buildings. A museum building containing buildings is inherently redundant. To rationalize the dilemma, a Museum of the Building therefore should imply a well-defined and confined volume that contains a dramatically different aura from the surrounding. Therefore the strategy of building consists of two parts: the skin, which wraps around and brings a smooth transition from everyday to the controlled: and the volume, which is further divided into a series of rooms.





Reasons for the Nomination:

Nominee was able to engage in a very creative project investigating space on multiple scale levels (urban, building, interior, exhibition). His design process was very rigorous and employed the full media spectrum in a seamless way: Physical models, sketching, digital modeling and drawing, physical and digital collaging. Nominee was a great team player, inspiration for his colleagues and a benchmark in the studio.



Jury Comments:

This student displayed a very cohesive and consistent presentation aesthetic that not only utilized a variety of rendering techniques from wire frames to cutaways to fully rendered perspectives, but did so in an elegant and meaningful manner. Thus, each mode of representation not only conveyed the information effectively, but also was essential to the development of the project. The project was not simply about creating a cool model, or a successful rendering, but really about exploring a design polemic and using digital media to not only represent those arguments but also defend them through a skillful exercise and well executed presentation imagery that transcends the media. - **Victor Martinez**

INTERIOR DESIGN

Advisor/Instructor: Murali Paranandi/ Raffi Tomassian
Principle Investigator: Murali Paranandi

Senior : **James Diewald | Michael Frederick**

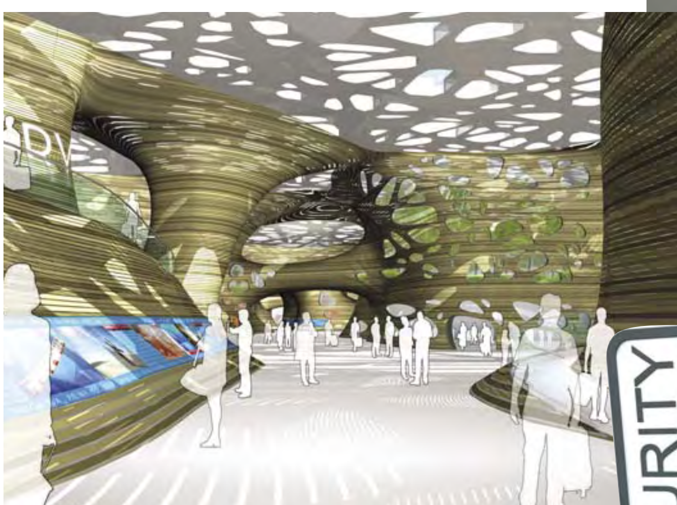
38 N 82 W Regional Airport

School of Architecture
Miami University, Oxford, Ohio

Summary Description of Project:

Post 9-11 security concerns, among other issues, have produced an atmosphere for air travel that is neither enjoyable, nor adequately secure. '38N 82W Regional Airport' identifies critical problems associated with conventional airports and attempts to resolve them through the introduction of a number of emergent technologies as well as innovative planning themes centered on the experience of travel.

Ecologically speaking, airports present major problems in terms of their impacts on surrounding areas. Out of a concern for local populations, runways and landscaping attempt to minimize the negative audio-visual presence of the new airport. Furthermore, interior gardens, green roofs, biotope waste processing, intelligent landscaping, and passive solar HVAC initiatives reduce the environmental loads of the complex.



Convenience and accessibility are addressed through several features. '38N 82W Regional Airport' utilizes a fully automated parking system in which parking spots literally become the front door of the airport, drastically reducing walking and transport times. By replacing paper tickets with RFID tags that interface with other systems, information can be custom tailored to each passenger. For example, a passenger with children could be directed to the children's play areas in the concourse and later notified of impending boarding times, eliminating the necessity of waiting in designated areas. Lastly, the layout of the airport allows for simple and efficient navigation through each of the program spaces and reduces the average walking distance from the curbside to the aircraft to less than 800 feet.

Reasons for the Nomination:

The digital tools here are used as a means of defining the morphology of his project. Tools are used as an abstract means of development and representation, working with flows and particles to define movement and stationary elements within the project. By working with contours, displacements, and folded sheets, new geometries are created, allowing a smoother interaction between landscape and programme.

Jury Comments:

Great use of the digital tools to both communicate through diagram and rendering as well as produce intricate form with a sensitivity to understanding form's material character. - **Bart Overly**

This project is impressive in its scale and the ability of the author(s) to convey design intention. The systematic investigation of security and flow through an airport is rigorous. The forest-like bamboo-clad interior effectively softens what would otherwise be a large sterile non-space. – **Wassim Jabi**

This project displayed a high degree of development and execution that culminated in a well-organized and cohesive presentation. This student used different modes of drawing, modeling and rendering to effectively convey the ideas of the project. Thus, the student displays a command of the media that allows them to formulate and defend their ideas both through execution and presentation. – **Victor Martinez** form•Z Joint Study Program 2006 HONORABLE MENTION

INTERIOR DESIGN

Advisor/Principle Investigator: John Kandalaft, Robert Brainard

Jae Ryong Oh : Senior, Interior Design Studio VI

Technopia Boutique

Design Department
University of Bridgeport, Bridgeport, Connecticut

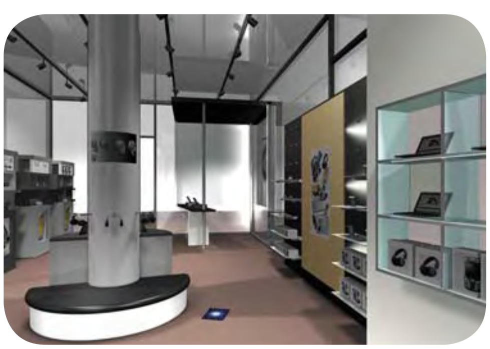
Reasons for the Nomination:

Technopia is a fictional electronics company retail store that was designed as part of the senior level interior design studio.

form•Z was used along with sketch development early in the design process to explore the possible design configurations. Floor plans and construction documentation were developed jointly with AutoCAD. It naturally followed to continue using **form•Z** for finalizing the concept and rendering images for the final presentation.

Reasons for the Nomination:

This student continues to show their understanding of 3D modeling, and their command of **form•Z**. In spite of a number of other software programs at her disposal at the University of Bridgeport, she continues to come back to **form•Z** for her conceptual and communication needs. Specifically she demonstrates an excellent level of development in **form•Z**, excellent presentation with **form•Z**, and an excellent all around integration of **form•Z** with the design process.



Jury Comments:

This interior project was convincing for this electronic retail store. The integration of seating cubicles into the walls, translucent exterior panels and good choice of views received my vote.

Some constructive criticism: Turn the track lights on and use a constant surface map on the laptop monitors, and rear illuminated dura-trans in the base pedestals would have perked up this presentation.

Sure beats the airbrush renditions when I was in design school.
– **Dennis Andes**

Advisor/Principle Investigator: John Houlihan, Robert Brainard

Industrial Design Studio V, Senior : **Luke Johnson**

Flare Storm

Design Department
University of Bridgeport, Bridgeport, Connecticut

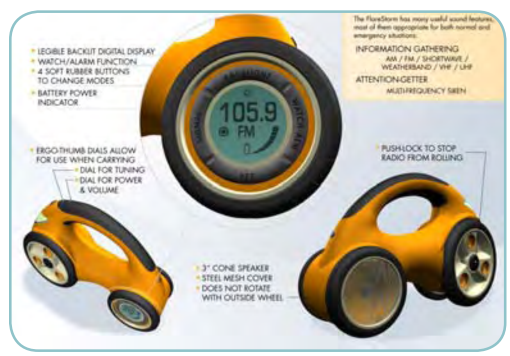
Summary Description of Project:

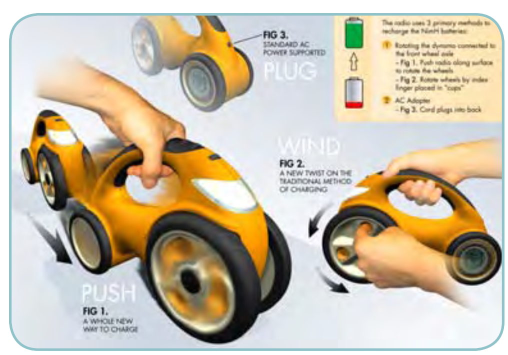
The Flare Storm is an emergency light and radio for disaster situations. Designed as part of the senior level industrial design studio, the intent is to combine three element s -- a flashlight, an emergency radio, and a hand powered generator. **form•Z** was used along with sketch development early in the design process to explore the possible product configurations.

It naturally followed to continue using **form•Z** for finalizing the concept and rendering images for the final presentation.

Reasons for the Nomination:

This student continues to show his understanding of 3D modeling, and his command of **form•Z**. In spite of a number of other software programs at their disposal at the University of Bridgeport, they continue to come back to **form•Z** for their conceptual and communication needs. Specifically he demonstrates an excellent level of development in **form•Z**, excellent presentation with **form•Z**, and an excellent all around integration of **form•Z** with the design process.





Jury Comments:

I felt this project was most adept at using the digital tools at hand to best communicate the design. The model was well detailed and the design thoroughly thought through. The student was able to use a combination of tools together seamlessly.
- Bart Overly

This student displayed a command of the digital media that allowed him to explore both formal concerns as well as effective functionality as expressed both in the model and presentation layout. Well done renderings and diagrams as well as written text all work in unison to effectively describe this project. I would have enjoyed seeing this project fabricated, or perhaps, use layered rendering techniques to create an x-ray/cutaway type rendering to reveal the insides or materiality of this product and add a bit of variety to the imagery.
- Victor Martinez

Upon viewing the first image I wondered where the driver sat... the hand image charging this product gave me the answer. This designer utilized the power of **form•Z** not only to beautifully model and virtually render Flare Storm to clearly communicate all its functionality features and show how the product works. The graphic plate layout was also nicely executed; I preferred the single plate with Flare STORM logo braking the top bar rule (be consistent). A well designed and strongly presented digital project.
– Dennis Andes

PRODUCT AND INDUSTRIAL DESIGN

Advisor/Principle Investigator: Gadi Freedman

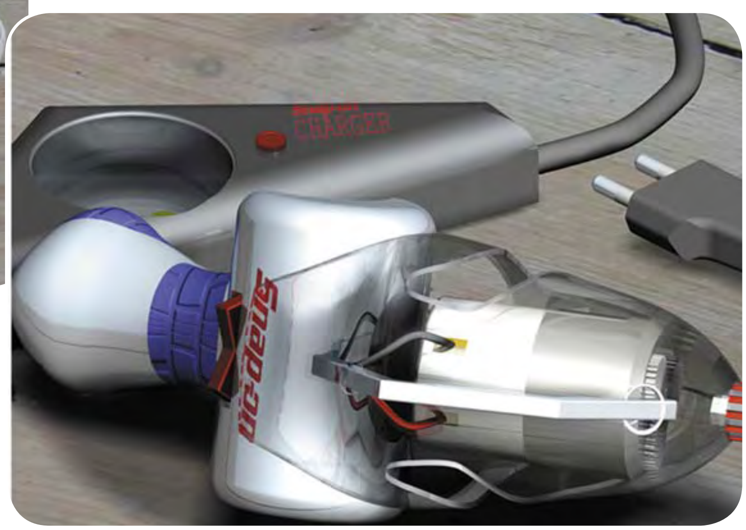
Lior Ori : Second year, Design School

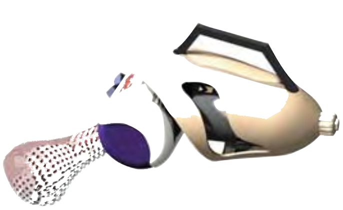
Hand Held Power Tool

Industrial Design Department
Holon Institute of Technology, Holon, Israel

Summary Description of Project:

An original design for a hand-held power tool. Design, rendering and presentation are all done with great care. The project is also presented in a realistic environment that compliments the product. Form and color tests help us to understand more about the product.





Jury Comments:

After reviewing all the entries a number of times, I felt this was one of the finest virtual renditions of all the submissions because of the surface styles, point of view and lighting. Very impressive especially for a student at this level!

The designer used many features **form•Z** has to offer to create this virtual photograph. A tip: To eliminate the halo for the "Snap on Charger" copy, use just a transparency map with a plain color red color rather than a color map with an alpha channel. Also, graphically offset Snap-on copy to miss the beveled edge. It all adds up to image perfection. Black & Decker sign the designer up today!
- Dennis Andes

This hand-held power tool project presentation shows how quickly both form and material can be explored and visualized using **form•Z** 3D modeling and rendering. The final design rendering does a great job of bringing the idea from concept to potential reality.
– Peter van Colen

The design process is clearly illustrated with multiple variations. The rendering is very realistic and well-lit with soft shadows. The rendered object is placed in a natural environment that helps the suspension of disbelief. I appreciated how this power tool sits on its charging base in a very natural position (on its side). **– Wassim Jabi**

Advisor/Principle Investigator: Bennett Neiman

John Houser | Mathew Haynes | Justin Kyle

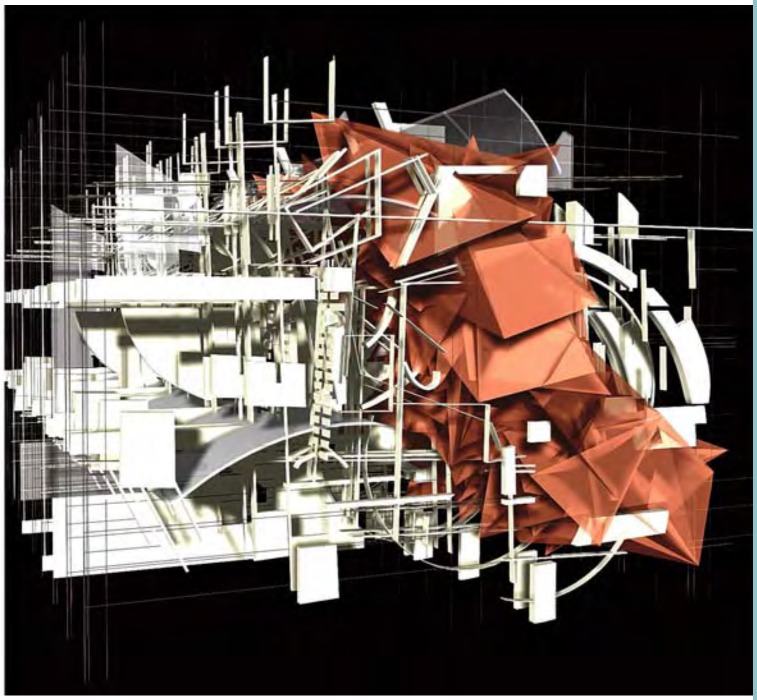
: Forth year, Architectural Studies Seminar

Analog-Digital Light Box: Blender Box

Architecture Department
Texas Tech University, Lubbock, Texas

Summary Description of Project:

Blender box -00h:01m:00s appliance, catalyst, unconventional, apparatus, vehicle, instrument, enclosed, sinister, disturbing, ominous, worrying, threatening, transparent, dormancy, peace -00h:00m:10s suspense, anticipation, tension, isolated, trepidation, concern, remote 00h:00m:01s explosion, ignition, blast, bang, discharge, transformation, alteration, illumination, kinetic, transitory, climax, disorganized, momentary, hectic, frenzied, erratic, enclosed, active, lively, energy, irregular, variable, liberated, ephemeral, organic, unrefined, crude, temporary, contained 00h:00m:05s abeyance, interruption, reflection, interpretation 00h:00m:08s continuation, resume, reckless, broken, busted, wrecked, shattered, disharmony, inconsistent, chaotic, disordered, 00h:00m:20s aftermath, repercussion, outcome, traumatized, crushed, fragmented, shattered, disarrangement, result, disarray, disorder, jumbled, consequences, scrambled, blight, disfigure, marred, devastated.



The concept of the blender box develops an environment that maximizes the amount of possible variables in a contained space. The concept is only the beginning of a greater experience and does not dictate the path of the exploration through the development of this project. Although some design methods follow a strict analytical path that fetishizes on an original concept, this group chose a liberated exploration of the endless possibilities of event.

Jury Comments:

This is an incredible experimental academic investigation. It was inspiring to see the use of many tools (**form•Z**, sketching, compositing, physical modeling and digital fabrication) working so well together in the production of a clear hypothesis of "production for the pure effect of production."
Bart Overly

This is a very ambitious and thoughtful exploration of analog and digital approaches to instigating a certain mood in the viewer. The digital work almost matches the intensity of the analog work. The animations are particularly unsettling and draw you in to attempt to understand them.
Wassim Jabi

I felt that this project was not only the strongest project in this category, but also perhaps, the most interesting project of all the categories. What an interesting project – so twisted, dark and raw, but at the same time, beautiful to look at. The renderings are perhaps some of the best, not because they are the best lit, the best shaded, etc., but rather because they display a level of abstraction that, when inserted into the whole of the project, they reinforce the mood and aesthetic of the work. Thus, the combination of different media (drawings, models, photos, video) all work in unison to create a cohesive expression that evokes both beautiful and uncomfortable moments that makes for a very interesting project. – **Victor Martinez**

Advisor/Principle Investigator: Tim Castillo

Aric Grauke : Undergraduate, Architecture 412

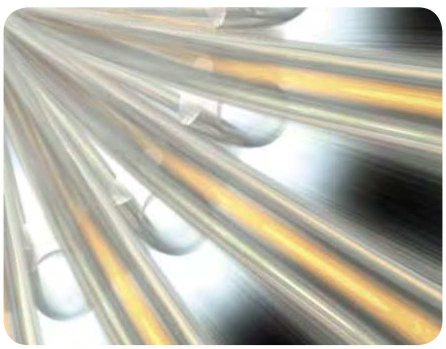
Love Letter

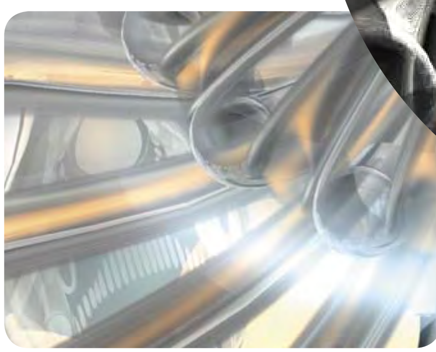
Architecture Department
University of New Mexico, Albuquerque, New Mexico

Summary Description of Project:

Love letter is an animation that investigates the spiritual properties of a conceived virtual space through interactions between the mechanical and natural forms. The animation/visualization explores the depth of networks and tells a story of mysterious and unknown worlds.

The exercise was created to investigate virtual environments using **form•Z** and other animation programs (Maya, 3-D Viz). The intent was to have students generate an environment that explored light, texture, time and velocity.

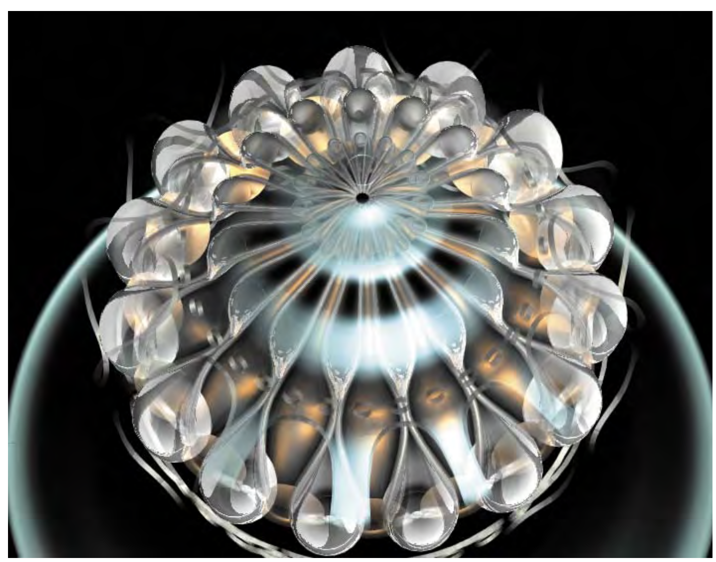


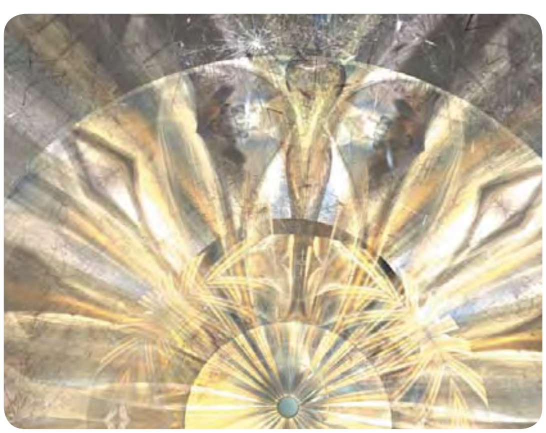


Reasons for the Nomination:

We believe that this student has created an animation that is unlike anything ever produced here at the University. His ability to convey a story through the use of form, light and texture creates a sophisticated environment that draws the viewer into his world.

Student has taken animation to a new level here at our institution. We are very excited to take this animation into a new dome immersive environment facility and to explore the potential of this technology to generate new poetic content.





Jury Comments:

This project clearly demonstrates an understanding of all the facets required for 3D visualization. The project communicates a well planned, story boarded, modeled, and rendered effort. This project also showcases **form•Z**'s ability to migrate 3D-modeled geometry to other modeling / rendering / animation platforms. – **Peter van Colen**

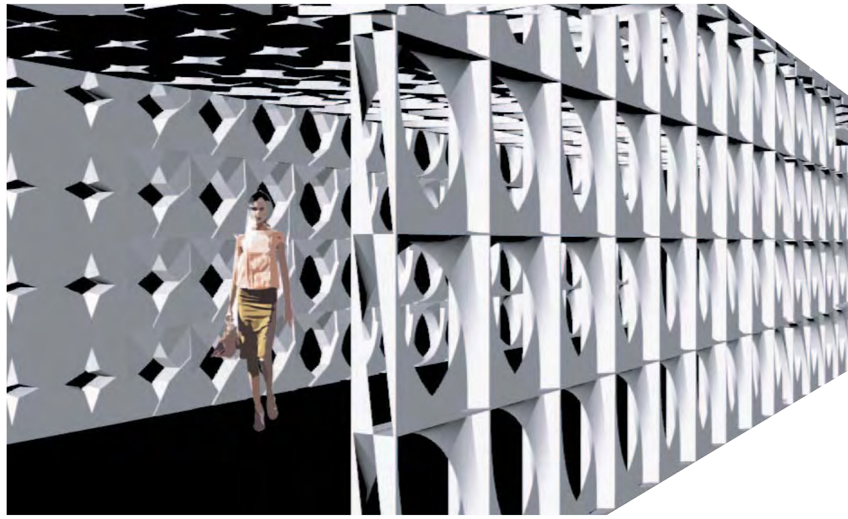
FABRICATION

Advisor/Principle Investigator: Athanassios Economou

Advanced Architectural Design, Second year, Graduate **: Lorraine Ong**

Scripting Concrete

Architecture Department
Georgia Institute of Technology, Atlanta, Georgia

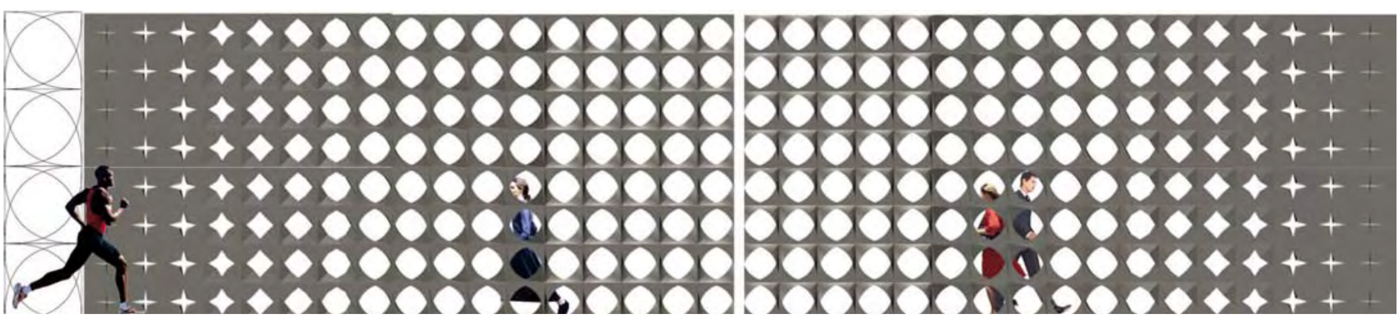


Summary Description of Project:

A study on the geometric evolution of a concrete wall into a panel with one opening. The study shows a particular strategy: an opening starting from the center of a rectangular module to gradually become a space between four curved corner pieces. The process starts out by creating a script in **form•Z** to map the gradual procession from void to solid and the other way around. The script is then reinterpreted in a 3D environment to generate variations on the z-axis. The end form is a gradual decomposition of the solid wall in all three axes. The set of instructions are finally used to generate a two-dimensional negative imprint-a modular formwork-that is used to cast the panels out of concrete.

Reasons for the Nomination:

The major reason is that the student masterfully and exemplary engaged computation at all levels in the creative design process; the design produced is entirely based on scripting conditions and is generated automatically by **form•Z**; the design could not have been visualized or represented in terms of traditional means of representation, digital or analog. It was the algorithmic encoding of form that permitted the gradual unfolding of the pattern and the precision of the representation. Two additional interesting aspects of the project were: a) the script was used to generate the formwork rather than the form and in doing so investigated one more condition in the loop between composition and construction, and b) the script was used at various scales to investigate aspects of the scalar properties of the design.



Jury Comments:

An algorithmic approach was the right choice in this project. It clearly indicates how a masterful manipulation of a few parameters can create a poetic cellular form. This project reminded me of the Arab Institute by Jean Nouvel. – **Wassim Jabi**

I simply just loved the visual created with this concrete wall form. This morphing of solid shapes through the use of a **form•Z** script or any other modeling means to establish the overall fabrication is very impressive. The architect used supplemental views to communicate and explore the created 3D patterns clearly. **– Dennis Andes**

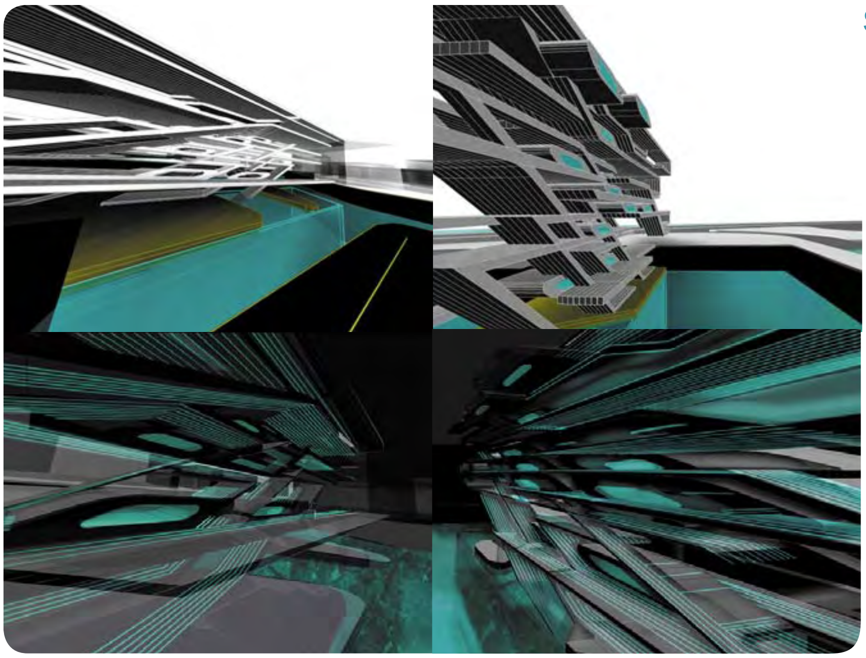
FABRICATION

Advisor/Principle investigator: George Katodrytis

Maisa Jarjous : Fifth year, Architecture

Nomadic Corporation: Hotel & Business Hub

Architecture Department
American University of Sharjah, Sharjah, United Arab Emirates



Summary Description of Project:

A series of sections was generated from a kinetic device tracing Bezier curves of moving particles. These slices were then stacked and interlocked to create a hovering billboard-type thin space of merging parts. Physical models were constructed and then digital models were derived. The unpredictable engagement with these interlocking solids and voids was developed into a business hub and hotel placed by the Creek waterfront, a very lively trading part of Dubai.

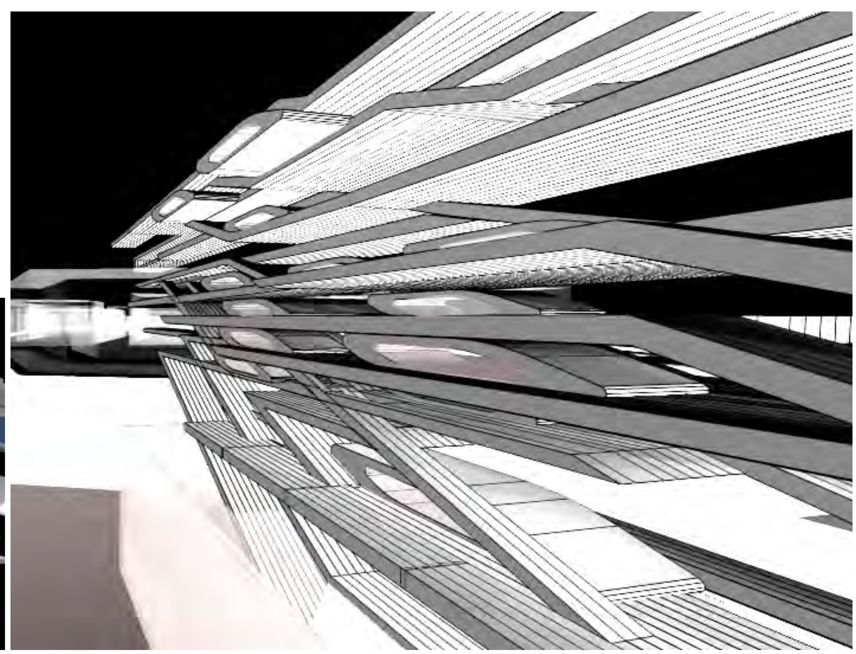
form•Z was used in the initial mapping of movement, sectioning the resulting form, modeling the early diagram of the space, rendering, as well as for the digital fabrication and laser cut of the final model.

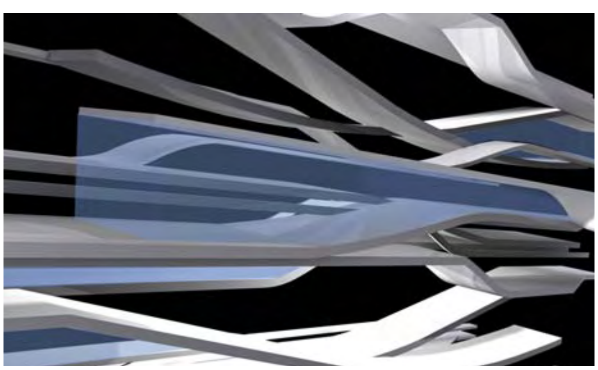
Reasons for the Nomination:

The use of modeling techniques, both physical and digital, to generate sections and eventually complex interlocking forms and fabrication.

Jury Comments:

One of the more visually strong entries of all the categories, this student explored an idea that was conveyed in a stunningly elegant form in which different modes of fabrication were not only aids in developing the form but absolutely crucial in exploring the integrity of the project as a whole. The use of modeling and fabrication techniques were done so with a discipline and rigor that was conveyed in both the execution of their ideas as well as formal aesthetic. The result is a visual poetry, whose form, through the incorporation of several fabrication techniques expresses not only their ideas, but also the process by which they arrived at their formal solutions. Really, a very beautiful project, and one that deserves recognition. **– Victor Martinez**





HIGH SCHOOLS

Advisor/Princi Advisor/Principle Investigator: Larry Maddams

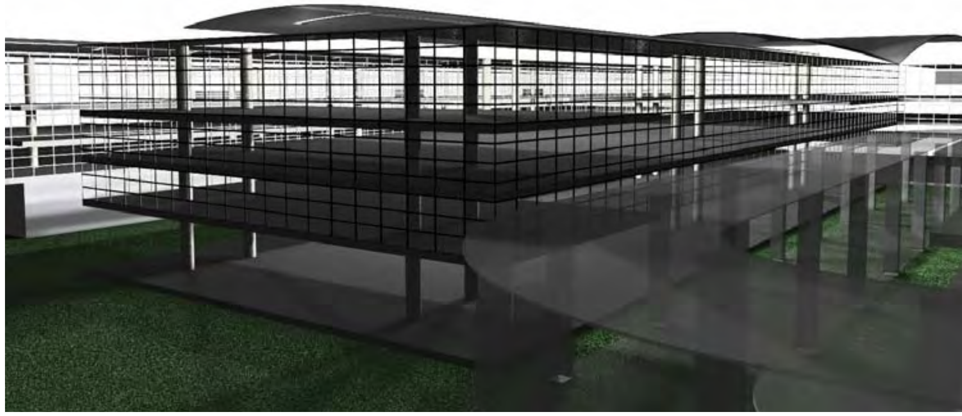
Interior Design, 9th-12th Grade **: Thitikorn Sopchokchai**

Airport Design

Information Technology Department
International School Bangkok, Nontaburi, Thailand

Summary Description of Project:

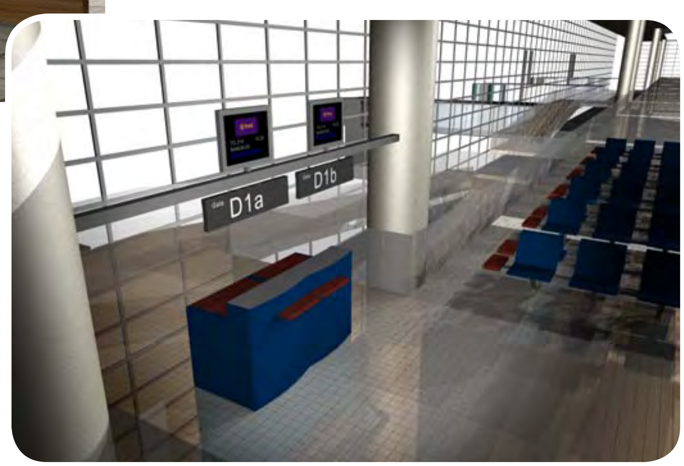
The project design began as an open ended suggestion to design a building where people can arrive, interact and depart. Most students chose a restaurant or shopping mall, however, this student chose to do an airport (perhaps because there is a new airport under construction in Bangkok).



Reasons for the Nomination:

As the project idea developed, nominee began his research by discussing his ideas with his family, purchasing books on airports, researching the current Suvarnabhumi International Airport and doing preliminary drawings.

As the project developed nominee defined the areas he/she wanted to model and possible views within the terminal. I have included a PowerPoint he did for his final presentation to the class which shows his dedication and skill to this project. I understand that PowerPoint file types are not accepted. I included it only to show evidence of his work and not to be included in the Joint Study Report.



Jury Comments:

A very competent project that communicates choice of materials, graphics, lighting and general atmosphere. I was particularly impressed by the texture maps that include signage, logos and imagery, in addition to simple materials. **– Wassim Jabi**

The student used various rendering techniques that explored lighting, shadows, materials and textures in order to convey ideas and, considering this is a high school project, I think it shows an excellent degree of execution. **– Victor Martinez**

It's a challenge for a high school student to tackle an airport and explore both exterior and interior views. The results are excellent for a student at this early level. Would love to see what you will create in 5 years... **– Dennis Andes**

This airport project is an impressive undertaking for a student at the high school level. It demonstrates an understanding of **form•Z** modeling usually seen by more senior users. The renderings allow the viewer to not only get an understanding of the mass proportions of the project, but also immerse the viewer into the model to appreciate the internal volume and light characteristics of the space. **– Peter van Colen**

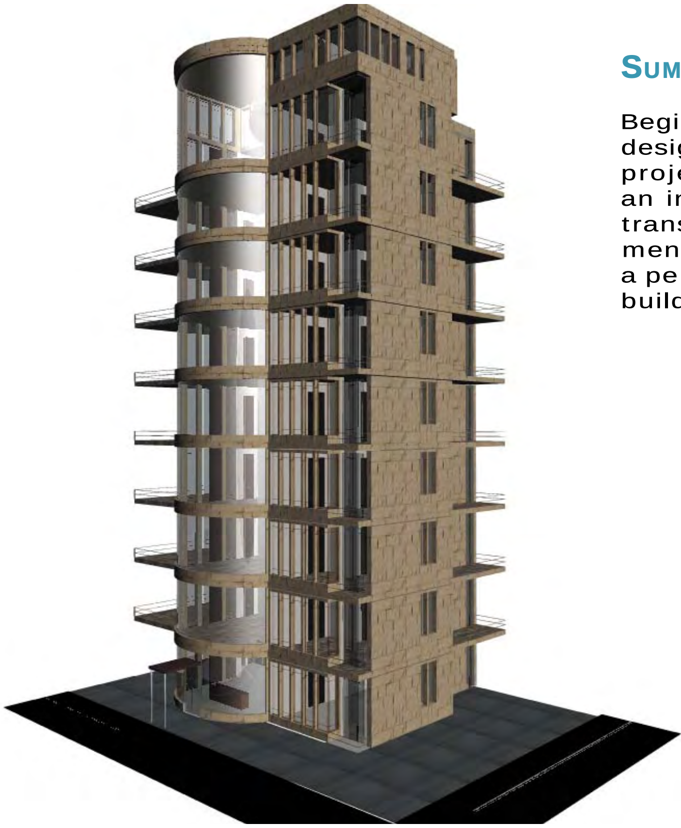
HIGH SCHOOLS

Advisor/Principle Investigator: Robert Meredith

Dana Sherman : 9th-12th Grade, Beginning Architecture

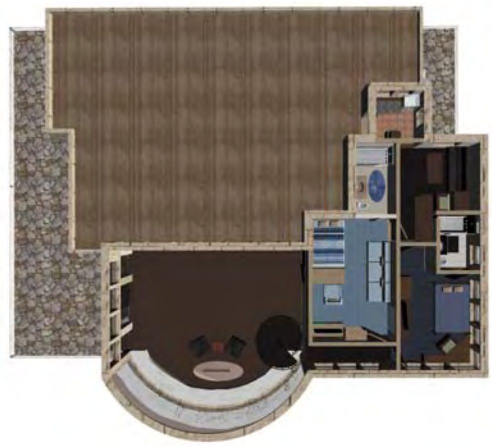
2500 Square Foot House Design

Art Department
Dalton School, New York, New York



Summary Description of Project:

Beginning Architecture students are asked to design a 2500 square foot house as a final project. In most cases students produce an individual home. This particular student transformed the house idea into an apartment building with his/her individual "house" a penthouse apartment atop the multi-story building.



Reasons for the Nomination:

Student successfully integrated vertical, horizontal, interior and exterior spaces of the apartments. A prominent feature of the building is sweeping curved glass facade creating a vertical spine along the front facade. In student's apartment, this glass curve defines a double height living room, while on the first floor the curve provides a dramatic entrance to the building's lobby. What is unusual in this beginning student's project is his/her attention to detail where he/she carefully refined window fenestration and furniture. Student's good design sense and dedication to the project produced one of the finest examples from my two beginning classes.

Jury Comments:

A very skilled modeling exercise for a student just becoming acclimated to digital modeling. The project shows the use of modeling tools as design evaluation tools rather than merely as rendering tools. Developing the skill to use modeling to understand many complexities of a project, both diagrammatically and visually, is an important step. **- Bart Overly**

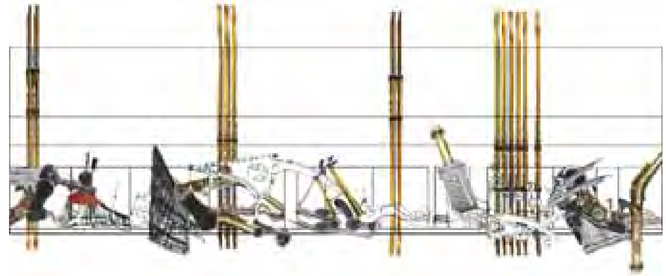
The Joint Study DVD complements the printed version of the form•Z Joint Study annual report for 2005-2006. It contains the following:

Electronic report: This is an all-inclusive PDF version of the Joint Study report. That is , with very few exceptions, all the material sent to us has been included. All schools are allocated as many pages as necessary to contain all their material. A table of contents of the JS DVD appears on page 18 to 19 on this printed JS report and also at the beginning of the DVD. The latter is also an active index. Clicking on the list item will branch you to that item. All the other Acrobat commands can also be used to zoom, pan, go to desired sections, etc.

Multimedia projects: These are mostly movies submitted by the schools as part of the JS reports. You can access them in two different ways: directly from the page of their school or through their own section at the end of the DVD report. That is, a movie logo has been placed on a button next to the display of those projects that also include an animation. Clicking on this button will play the animation. Also, a special section at the end of the DVD report displays images of the animation projects that are included. Clicking on those images will play the respective animation. In both cases the animation progress, speed, etc. can be controlled in the usual way.

The Joint Study DVD

Table of Contents of the DVD Report

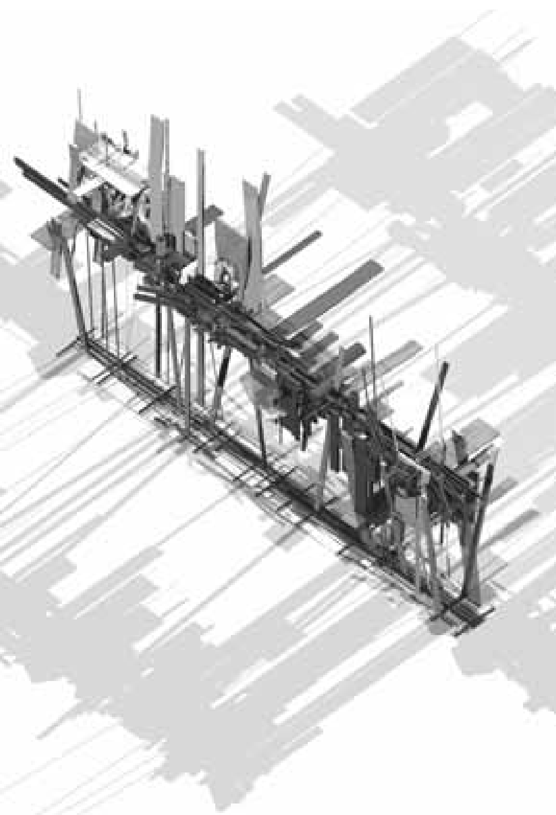


Interior Design

Product and Industrial Design

Visualization and Illustration

High Schools



Light, Materiality and Narrative; BEYOND FORM-MAKING in architecture

by **Andrzej Zarzycki**

This article builds upon a recent architectural digital design studio at the Rhode Island School of Design Interior Architecture department titled "*Im/possible spaces: envisioning a new experience in architecture, defining limits.*" The studio focused on the fluid aspects of architectural environments—environments that aspire to be exciting and meaningful, not necessarily rational or possible to implement with today's knowledge and materials. The question of 'what' space was, superseded 'why' it was, which allowed students to promote visual and experiential components in their designs over physical and factual qualities. The computer was a natural tool for these explorations because it allowed us to visually execute impossible aspects of space. With the introduction of digital tools and an intuitive way of negotiating space, the focus shifted to human experience facilitated through lighting techniques, materials and narration as form-making elements.

Overture

The most common expectation for an architectural space is for it to have a physical form. While it is necessary to focus on form, it is also critical to see and expect more from architectural space than just its physical structure. The goal should be to see architectural space not simply as a sculptural piece, but as a dynamic and evolving experience organized around human perception and emotions. Independent of its physicality, there are several components that affect, if not drastically change the way we engage with spaces, such as light, materiality and spatial narrative. These qualities have to be studied and understood to create visually engaging imagery.

The intention behind the approach of the studio was for it to act as a counterpoint to broader digital design practices, where form-making preoccupies the attention of architectural designers. Those designers often perceive the architectural frontier to be exclusively related to form searching, often ignoring other qualities that are integrally connected with the way people perceive reality and register space. The search for perfect form leads to script generated designs that may or may not have any relevance to us as clients and participants in an architectural space. The overemphasis on sculptural form-making comes at the price of pursuing light, material studies and developing symbiotic relationships between forms, texture and light. Realizing the

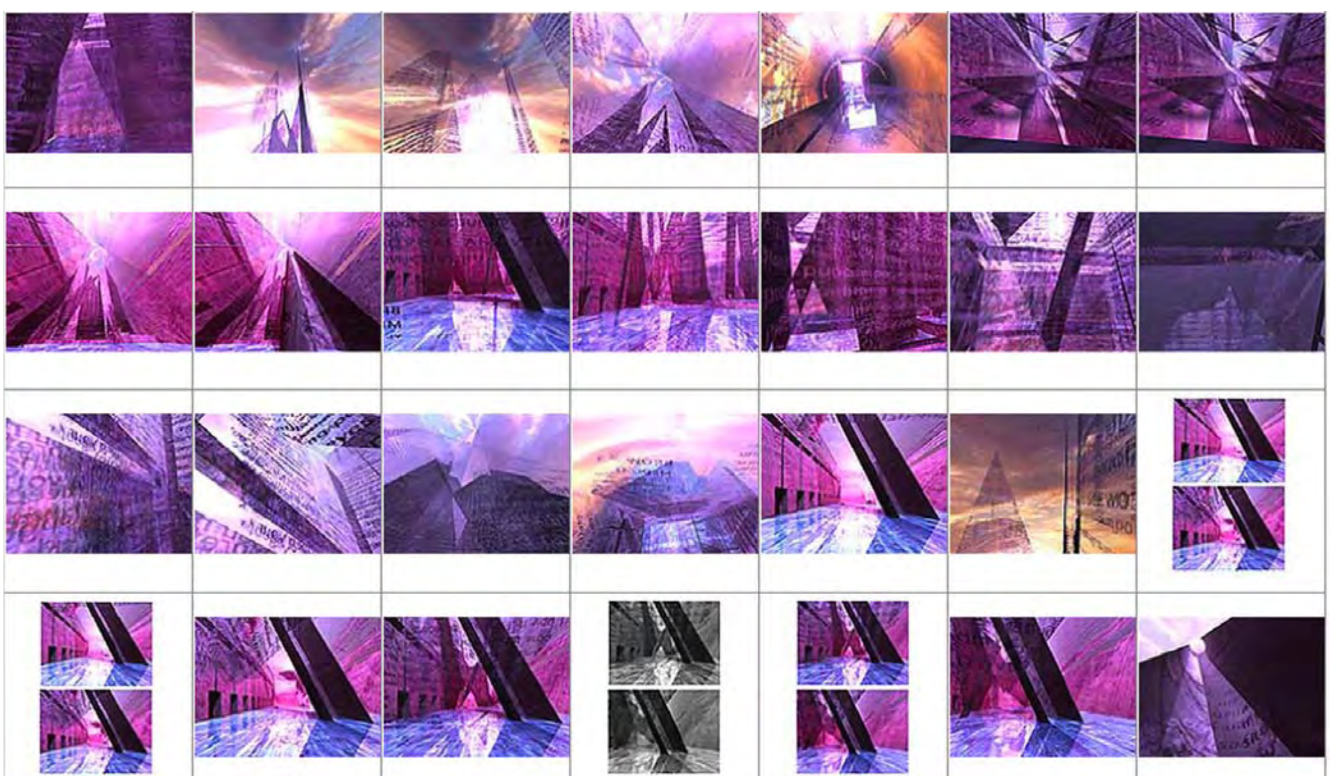


Figure 1: **Developing a visual sequence.**

shortcoming of formal studies alone, while stressing the experiential aspect of architectural spaces, such as being in a space subconsciously like in a dream or narrative, demands more depth from our spatial experience.

Studio Focus

While this design studio was concerned with digital explorations of spatial impossibilities, we quickly realized that these impossibilities had to be understood in a broader spectrum of design and applied to all aspects including experiential components, such as materials and lights. To further emphasize this concern, the main design project was preceded by two design sketch problems that focused exclusively on lighting and architectural narrative. This singular and directed focus helped

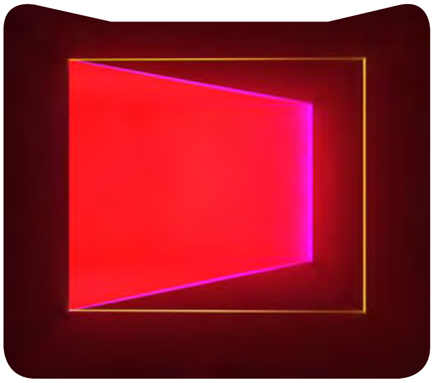


Figure 2: **Milk Run III installation digital "Re-creation".**

students to work exclusively on non-form related aspects of architectural spaces, while developing visual techniques to portray them (figure1). As a result of this centered approach, as well as bringing a broad range of references from other disciplines outside architecture, students started to gravitate toward unorthodox uses of various software packages. Through combining them, students were discovering new ways of creating digital spatial narrations. This resulted in projects that paralleled Jean Michel Jarre's comment regarding his 1986 Houston concert: "*… there is a real statement to be made by mixing music with architecture in a very modern way and using state-of-the-art technology…*" [1]

As a result of these sketch problems, students became aware of how light and materials can become a space independent of form. Furthermore, with digital technology we were able to imagine

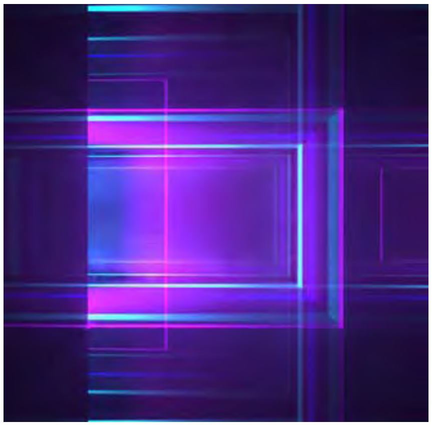


Figure 3 and 4 : **"Beyond Turrell" spatial solution.**

and explore material possibilities that may or may not be physically feasible just yet. Simultaneously, material explorations can inspire and set new directions for material research. Lighting is also an unexplored aspect of architectural space. With digital tools we can explore possibilities that are not limited to the physical properties of light. All of these individual aspects like light, materials and spatial narrative can together contribute to a new understanding of architectural spaces within digital environments. As interior architects, it is important to think about how mood contributes to the perception of form. It is equally important to develop a visual narrative that considers how we function in a space psychologically to reconnect architecture with human experience.

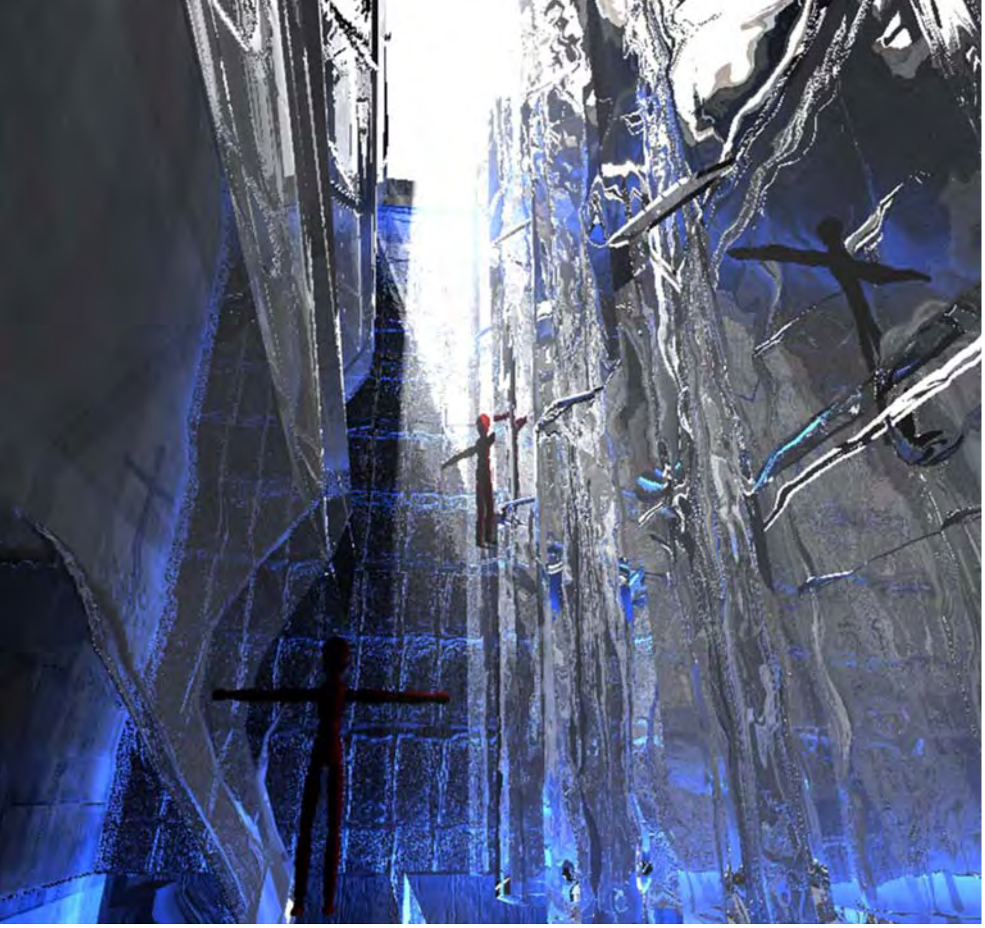
Students in this design studio approached spatial *im/possibilities* from a variety of different vantage points. Some students started with spatial narratives or light explorations, while others used materials as a vehicle to express spatial qualities. The following case studies illustrate these various approaches. Additionally, two personal student accounts, discussed below, share their experiences with digital design and elaborate in detail on their design process.

Light Studies

The sketch titled "Beyond Turrell," is an example of a light study as an unconventional space maker. Students were first asked to recreate within a virtual environment one of James Turrell's art installations. Turrell's work strongly related to the design studio's underlying concept to use light as a space maker. James Turrell's light installations, both on artistic and conceptual levels, are able to evoke strong spatial experiences within simple and neutral architectural enclosures. The artist said during an interview "*…if you want to get away from the particulars of the architecture, with its detail and attention to form, so as to make an architecture of space, then I have to rid the space of those details and features that call attention to form.*" [2] In this sense, he states that architectural form may often compete with light in rendition of space.

This first phase of the sketch problem helped students to relate digital tools and properties of digital lighting to those in the real world. By introducing real world limitations in lighting tools, this created necessary design and educational rigor to better understand the difficulties the installation artist works within real life situations. This "Turrell Re-creation" became a springboard for the second part of the sketch problem where students explored the spatial possibilities of one particular installation by introducing lighting properties that, while possible in the digital environment, are not physically possible at the moment. This broadening of light properties helped students to create spatial propositions that went beyond our usual expectation from space. It also gave students tools and a methodology for future design projects by demonstrating how to transform prosaic to innovative and poetic spatial possibilities. The final result were spatial delineations that were visually convincing and intuitive, although currently not physically possible.

On the educational and conceptual levels, seeing the diversity of spatial renditions of the same neutral architectural form reinforced this core idea of light being a critical form-maker. This can be seen by comparing the digital 're-creation' of James Turrell "Milk Run III" installation (figure 2) and several 'Beyond Turrell' images (figures 3, 4) that use the same virtual space, but with different lighting scenarios.



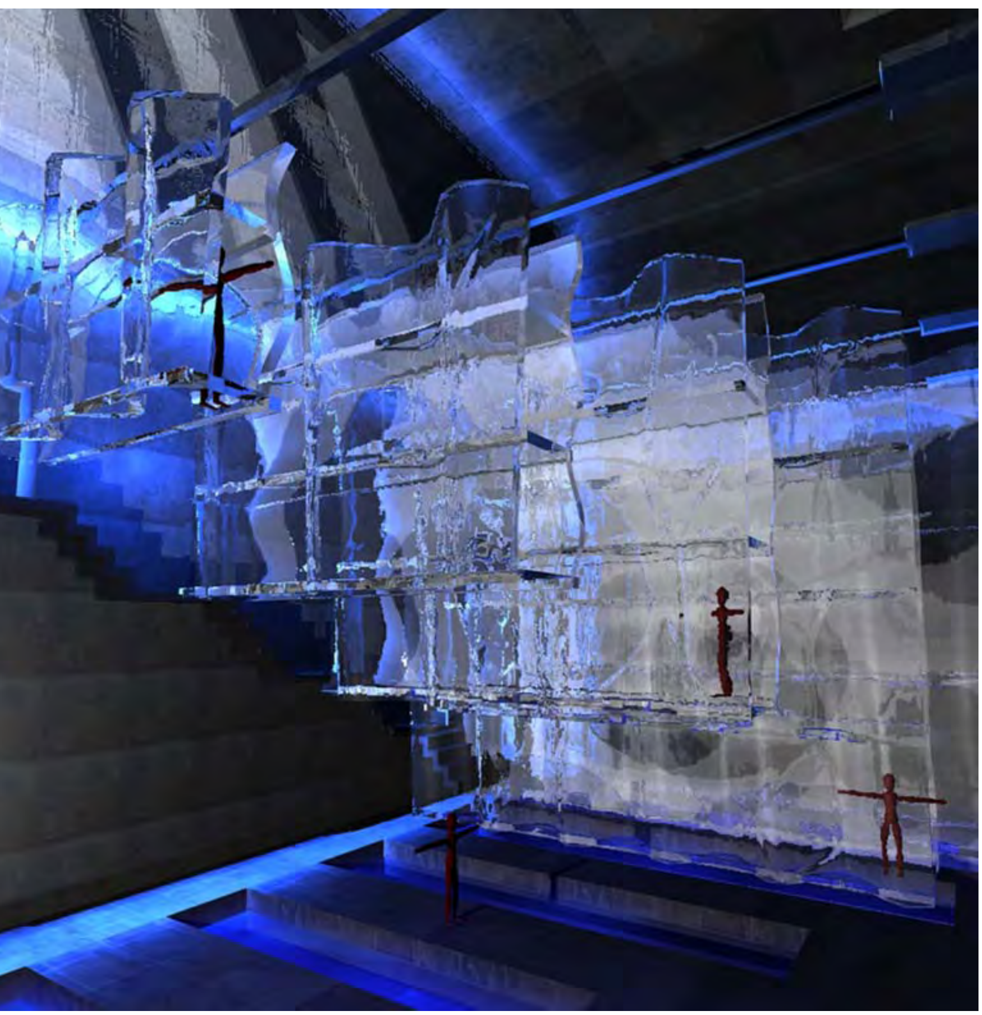


Figure 5 and 6: **Liquid glass or frozen waterfalls?.**

Material Studies

In a separate project, material studies were used to explore relationships between material and form, as well as light and form, resulting in spatial narratives with a strong experiential component (figures 5, 6). Students investigated unusual physical characteristics, morphing properties and animated textures often asking the question "what if…"

These explorations continuously crossed lines in what is physically possible with today's building technology and formed strong propositions toward future material research. In the *Im/possible Spaces* studio students questioned what is physically and technologically possible while they created visuals that connected easily with the viewer and were consistent with our expectation from reality. Furthermore, it proved a successful methodology in conveying to students how to use digital simulations as creative tools in the design practice.

Spatial Narrative

It is important to use narrative in conveying architectural ideas. Traditional methods of depicting architecture through plan, elevation or section while suitable from a construction viewpoint, do not convey an experiential component within architectural space. In many instances a narrative can be a powerful tool for exploring space and imagining design possibilities. Not unlike filmmaking and media arts, it can often lead us into territories that are not easily reachable through other design approaches such as tectonics. This creative capacity is expressed by one student through his narrative:

" *...The idea behind my intervention is to create an awareness of progression by way of defining ephemeral boundaries that highlight the tectonics of space. The incorporation of weathering materials is a way to relate this intervention with the existing space and illumination that changes at intervals function as a metronome that marks time. (...) After being aware of the space, as a whole, one cannot inhabit the space anymore for it will be already transformed into another space.*" (Victor Serrano)

Still, there are other types of narratives, not necessarily verbal ones that could be best expressed visually (figure 7).

The introduction of a spatial narrative automatically refocuses the discussion in architecture from the depiction of a form into the realm of experiencing it. The

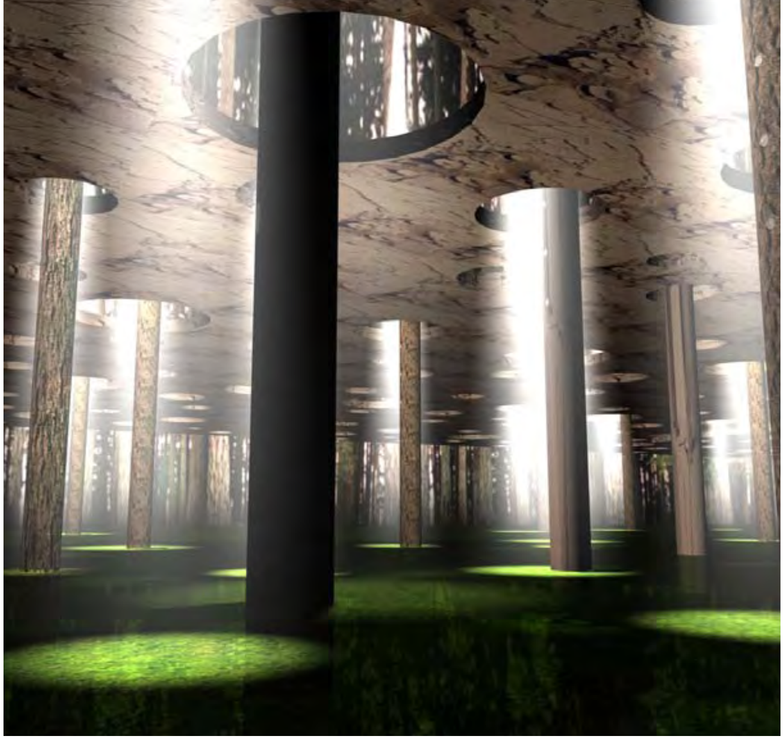


Figure 7: **Public Sanctuary.**

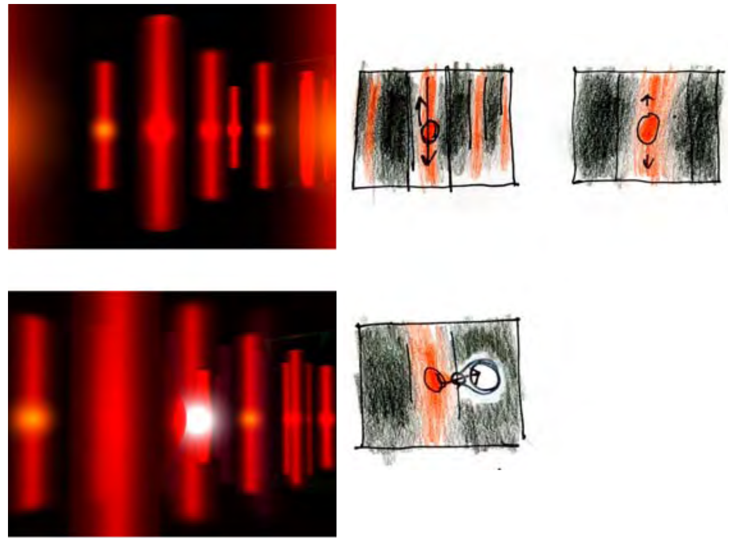


Figure 8: **Storyboard sketches and animation frames.**

purpose of spatial narrative is to tell the story of a space to an audience and perhaps, to suggest possible ways users could engage with a space (figures 8, 9). Interestingly, with the digital medium user engagement becomes much stronger and effortless in early design stages before the space is built, due to the narrative's strong visual character. The potential viewer is already familiar with other types of narratives through our ever-prevalent television and movie culture. This congruency of digital representation to cinematographic media shares similar successes by being more intuitive to an audience than two-dimensional, line projections found in architecture such as plans and sections.

Spatial narration re-introduces to architecture such elements as gateways, portals, thresholds, and dominants that are similar to those in public space planning and supplement formal categories such as ratios, proportions, orders, etc. Spatial narratives that are reinforced through animation is the closest a viewer can get to touching, sensing and perhaps even tasting space. This unique and intuitive form of expression is realized through more than just perspective projections, it is also through space immersions and an impression of spatial engagement through movement, scale and interactivity with space. More importantly, from the designer's standpoint, creating a storyboard for a prospective user's experience of an architectural space sets up a new set of expectations in design (figure10).

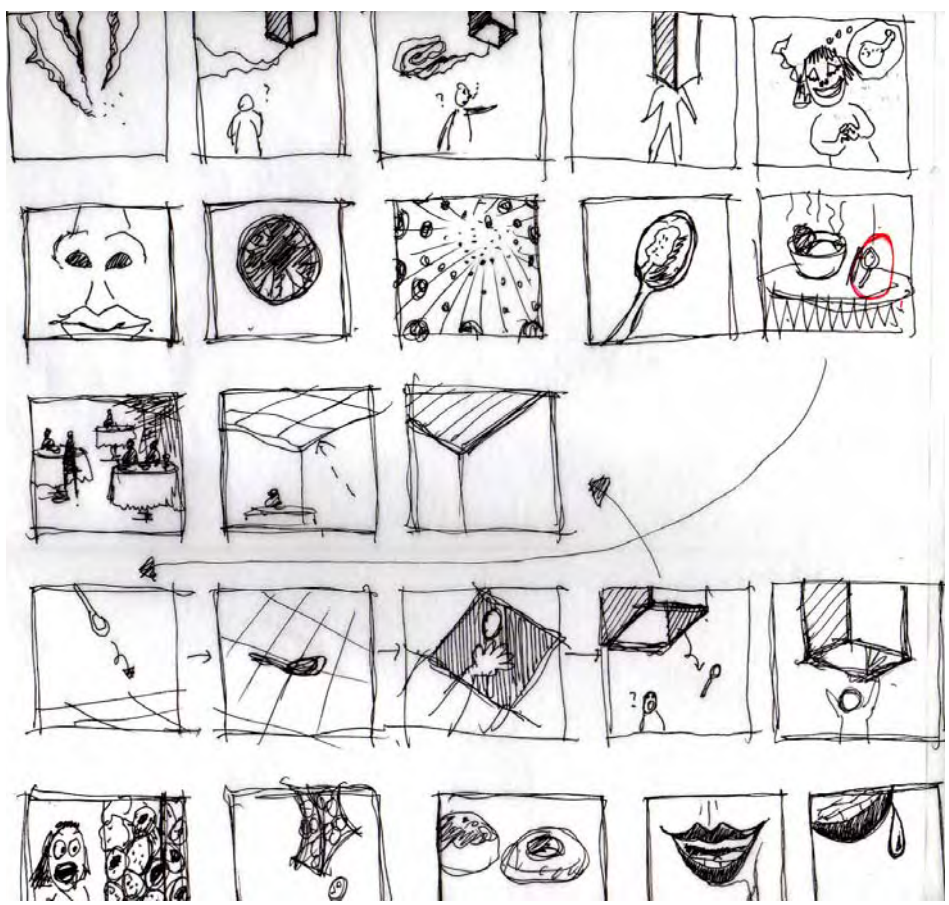


Figure 9: **Storyboard.**

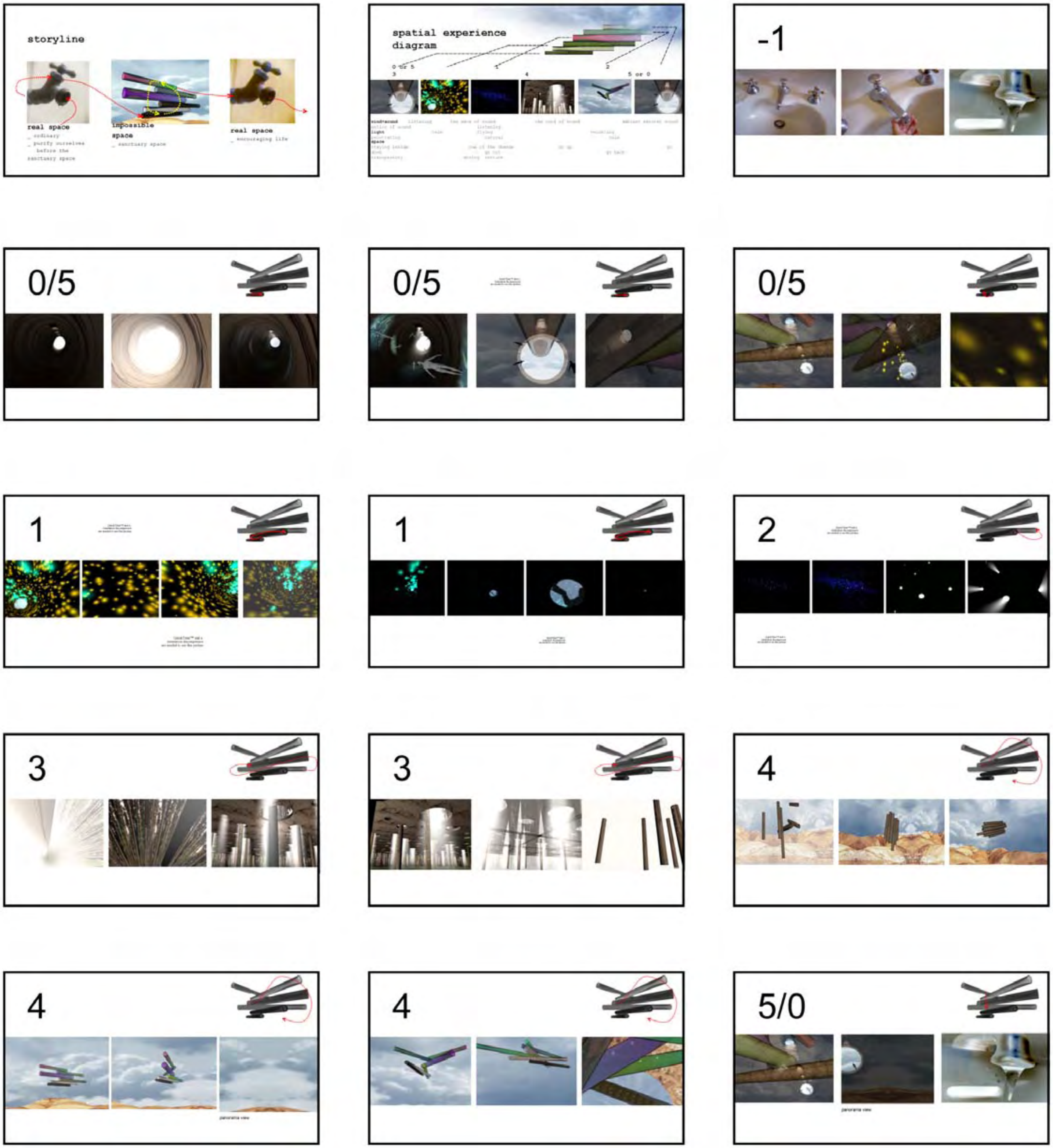


Figure 10: **Towards animatic.**

Accounts by students

Often times I find myself working back and forth between sketches and computers to implement a concept. The hardest part of the process is to generate tangible forms out of an abstract thinking. It was a continuous process of creating visual imageries through sketch and computer in order to make that leap from concept to form-making.

While working on the Public Sanctuary project, I was given the site pre-modeled in **form•Z***, but as I proceeded through the project, my design evolved and the need to re-model the site in* **form•Z** *emerged. I could have only modeled the parts that I was re-designing but in order to understand the spatial qualities of the architecture, I ended up modeling the whole thing. I would export a few perspective shots of the space from* **form•Z***, bring it to Cinema 4D, play with texture and animate it. If I felt that something was missing (which often was the case during the initial process) from the final outcome of the image or animation, I would go back to* **form•Z** *and re-define the spatial qualities of the space, keeping in mind my concept for the project. Once the main concept was outlined, it was a continuous process of editing and re-designing the space in* **form•Z***, animating sequences and adding texture and light in Cinema 4D and manipulating the imagery in Adobe Photoshop* (Shraddha Aryal '07) (figures 11, 12).

The increased use of computer graphics in today's design practice often causes a disconnect between the creative process and the product. In the Department of Interior Architecture at the Rhode Island School of Design (RISD) I had the opportunity to explore this kind of approach in a studio environment. The experience gained through the advanced digital design studio allowed me to bend some of the preconceived ideas about the computer as a way to approach a design problem. Applying a process that incorporates film production techniques such as through creation of storyboards, I was able to explore the idea of developing a spatial narrative through camera movement, light and materials in a way that architecture became less real and more evocative. In addition, hand sketching was incorporated into the renderings and back by way of printed images that allowed the exploration of textures, which were incorporated again into the material maps. Computer

Figure 11: **Narrative Space.**

Figure 12: **Public Sanctuary.**

images were also used to generate and iterate various ideas in a way that resembles a sketching process. This design method is useful to understand spatial relationships and variations on the ideas that can be achieved rather than portraying a realistic view of a final space. (Victor Serrano '07) (fig.13, 14)

Conclusion

Im/possible spaces was a fully digital studio. All communications and final presentations were delivered digitally using still images, panoramic images and animations. Design delivery was consistent with the cinematographic conventions that address human perception and evocative aspects of architectural space. The most satisfying realization in pursuing im/possible spaces was that even though some designed spaces are not physically possible according to laws of physics, such as the well known scene with the medicine cabinet from the 'Contact' film [3], they are easy to subscribe to and engage the viewer to the point that this impossible reality is no longer questioned.

While Turrell's work was the subject of the studio sketch problem, the studio discussed broader precedence in the use of light as a part of spatial choreography in a wide spectrum of examples from Albert Speer's "Cathedrals of Light," to Jean Michel Jarre concerts and visual effects. While many of the references originated from various visual and performing arts, they were constantly brought back into an architectural context to broaden their architectural language and set of design expressions. Students' work reflected a greater understanding in architecture and resulted in more meaningful projects.

The idea of conceptualizing space in a digital environment was perhaps the most significant part of this design studio. This conceptualization brought a new set of expectations and possibilities toward architectural environments especially those conceived by digital means. Light and materials as well as spatial narratives emerged as critical components in form-making. The physical form was no longer an independent category that dominated and grounded all architectural expressions in its singularity; on the contrary, it became symbiotically related to light and materials that enhanced the form. Through this process, we learned that all tectonic explorations should consider and understand the interdependence of all design components. Light and materials should be used to define, create and manipulate true perception of space not simply as decorative components in space. Finally, this enriched reading of architecture brought back to its center the most critical component and focus of design – human perception and human experience.

References

[1] Jean Michel Jarre: Oxygene Moscow, DVD; "Making the Steamroller Fly", Title 2/3, Chapter 5/10, 22m:50s.

[2] *Occluded Front James Turrell*, Interview with James Turrell, p.14, 1985 by Fellow of Contemporary Art, Los Angeles, The Lapis Press.

[3] *Contact*, Movie, Chapter 7/43, 22m:30s; director Robert Zemeckis, photography Don Burgess.

Image Credits

Figure1 by Marayia Lotts, 06;
Figures 2, 3, and 4 by Karin Wang, 06; Figures 5 and 6 by Jing Zhang, 06;
Figures 7, 8, and 10 Hae-Eun Choi, 06;
Figure 9 by Julie Ahn, 06;
Figures 11 and 12 by Shraddha Aryal, 07;
Figures 13 and 14 by Victor Serrano, 07.

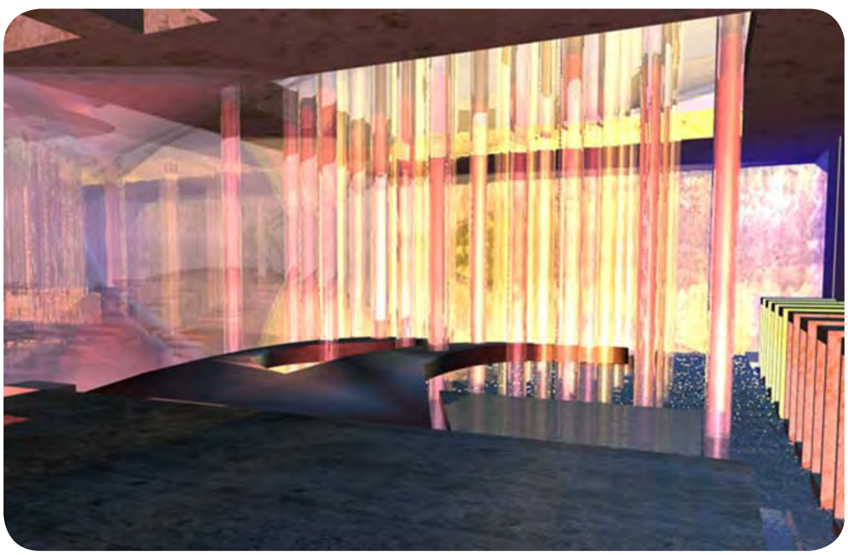


Figure 13: **Narrative Space.**

Figure 14: **Public Sanctuary.**

Andrzej Zarzycki is a Boston based architect and educator who employs digital tools to create experiential architectural spaces. He brings over 10 years of design practice combined with design teaching in the Interior Architecture Department at the Rhode Island School of Design. Research and experimentation is important component of Zarzycki's practice. His focus is primarily on design methodologies and architectural representation of space. Since 1996, he was part of the Architecture, Representation and Computation group at MIT. While there, he produced video presentations of Unbuilt Monuments for MOCA, Siggraph and other venues. At R.I.S.D., he teaches advanced digital design studios. Zarzycki has also published several design process and digital conceptualization essays. His speaking engagements include: Cinematic Approach to Spatial Narration; Build Boston 2006; Abstracting design, designing abstractions; Use of computer graphics in early stages of architectural design; Siggraph 2004; Digital Technology and Design Process, Build Boston 2001. Zarzycki is recipient of multiple professional awards in architectural representation and has also been recognized in various design competitions. Andrzej Zarzycki earned his Master of Architecture from the Technical University of Gdansk, Poland, and Master of Science in Architectural Studies from Massachusetts Institute of Technology, Cambridge, MA. Email: zarzycki@alum.mit.edu. Web Site: www.virtualimagining.com.

The Tectonics of Motion, Light, and Space

by Thomas Fowler, IV

*"**Without light there can be no space**" -- Louis Khan*

*"**…this quality to feel light exists, almost like we see it in a dream.**" -- James Turrell*

*"**The (light) space modulator provides the opportunity to relate design to direct work with materials as against previous architectural methods in which structural inventions were hampered by the shortcomings of visualization on paper alone. On the other hand, structural projects could be solved just as well by working with the model alone; but again this would not give the experience in visualization and development on paper which is essential to the exploitation of a 'space fantasy', one of the main requirements of contemporary architecture.**"*
— Laszlo Moholy-Nagy

This paper illustrates the design work from an integrated third year Architecture Design Studio and Environmental Controls Systems (ECS) Studio. As the final project, all students developed a 'Center for the Study of Light', based on the quarter long experiments with light. The quarter began with spatial experiments with both day and electric lighting. In the ECS course students started with several physical model interpretations of James Turrell's electric light installations and in the Design Studio several full-scaled working versions of Moholy Nagy's Light Space Modular were constructed to explore the connection of movement, light, space and materials. Another instructor taught the ECS course, but exercises were collaboratively formulated, so the student work developed would inform the architecture projects in the design studio. Assignment activities in both the Design and ECS courses are a continuation of a methodology of this author for using digital and physical media in a tightly structured framework for integrating building system principles into design studio projects. The main learning objective for the integration of these two courses was to create a range of improvisations early on in the quarter to create an intense focus on a kit-of-parts understanding of the technical aspects of environmental systems that can be shaped and molded into design project vocabularies later in the quarter [1,2,3].

This paper will briefly describe the sequence of ECS and design studio exercises that were assigned. The assignments along with student design work are a sampling of the type of exercises and analog digital process that students went through at a particular stage of the project. The paper will conclude with the instructor's reflections on this process.

1. Re-Presentation of a James Turrell light installation

From an image (Figure 1), and via building a scaled physical model and electrically lighting it, students had to figure out how to obtain the same effect that Turrell achieved in his actual installation. Even though many of the students had never been to a Turrell installation, through research and experimentation (Figures 2, 3), they were able to successfully build a scaled version that closely mimicked the original image. Also what they could not determine, they were required to hypothesize as to what they thought the intent or configuration of this installation should be. After their electric lighting version was completed, students were asked to translate this from an electric lighting interpretation to a day lighting interpretation where they needed to look at the impact of the lighting at different

Figure 1: **Turrell Installation, "The Light Inside".**

Figure 2: **Electric Lighting Interpretation of Turrell's "The Light Inside".**

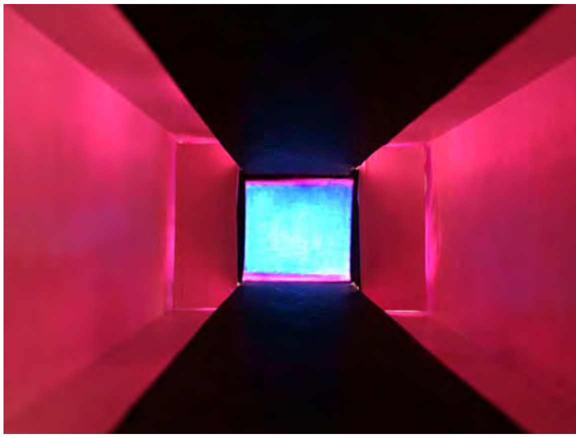


Figure 3: **Day Lighting Interpretation (Simulation at 12 noon) of Turrell's "The Light Inside".**

Figure 4: **Physical Model Interpretation of Nagy's LSM.**

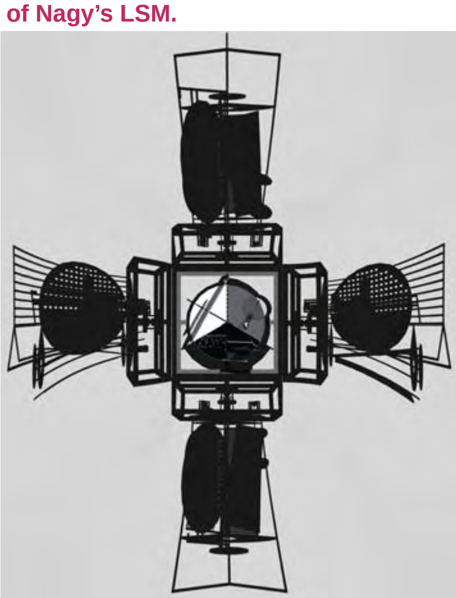


Figure 5: **Folded Out Digital Model Interpretation of Nagy's LSM.**

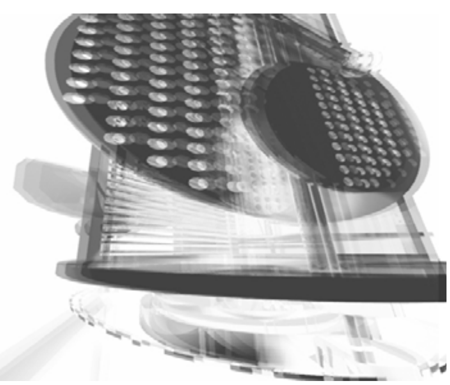


Figure 6: **Image from Moving Physical Model Interpretation of Nagy's LSM.**

times of the day. In the case of this project, the group hypothesized that Turrell's major intention was to create a division of space by use of light.

2. Analog & Digital Re-Presentation of Moholy Nagy's Space Light Modular

(Figures 4-6)

Students in teams of four were asked to build a working replica of Moholy Nagy's 1930's Light Space Modulator (LSM), which was a mechanically driven rotating kaleidoscope projecting ever-changing patterns of light, shadow, and color. There were three of these devices built by three separate student teams in the class, and all slightly different. These devices were built full-scale and were constructed mostly from images and narratives that could be found on the Web. The learning objective for building this device was to provide students with a connection of movement, light, space and materials. Students also experimented with still images and video footage to capture the qualities of light from this kinetic machine (Figure 6).

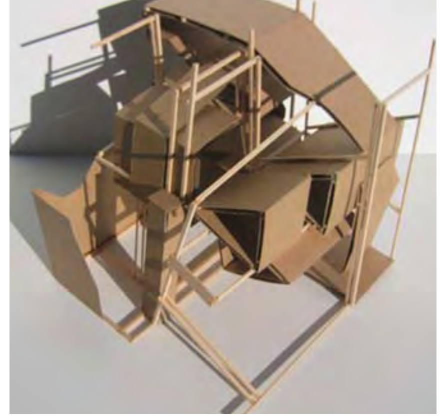


Figure 7: **Analog Model Interpretation of LSM, Ramirez.**

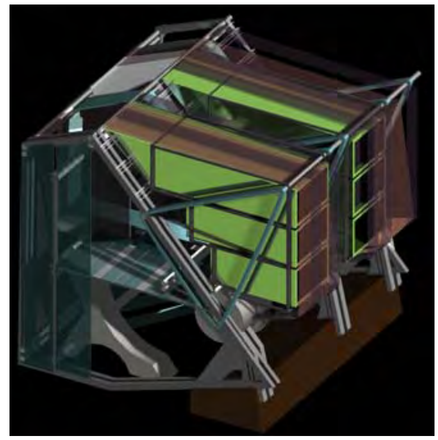


Figure 8: **Digital Model Interpretation of LSM, Ramirez.**

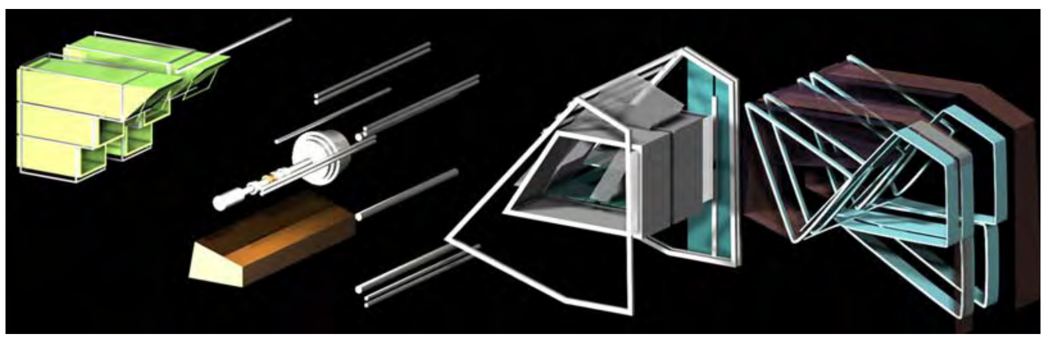


Figure 9: **Exploded Digital Model Interpretation of LSM, Ramirez.**

3. Analog & Digital Main Space Vocabulary Translations of Nagy's LSM and Turrell's Light Exhibition

Individually, students were asked to translate the tectonics of Nagy's Light Space Modular as a strategy for developing a grand main space (which would eventually be the grand main space for the Center for the Study of Light). Students were asked to explore the relationship of the kit-of-parts of the main space enclosure vocabulary (Figure 9) as a way to make a connection to the tectonics of the light space modular analysis. Sergio Ramirez 's studies (Figures 7-9) explored the idea of developing an inhabitable translation of the Light Space Modulator that becomes the main space of the building and the heart of the building is a machine where all movement is generated. A mechanical shaft extends throughout this main space [6].

4. Analog Main Space Vocabulary Development

This main space was further developed with physical modeling so students could explore the actual kinetics of the moving space and light. In this model study, Sergio explored the physical implications of a mechanical shaft extending throughout this main space [6] (Figures 10-12).

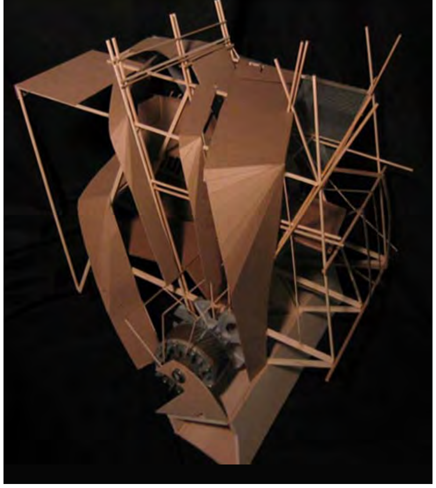


Figure 10: **Analog Model Main Space Vocabulary Study, View 1, by Sergio Ramirez.**

Figure 11: **Analog Model Main Space Vocabulary Study, View 2, by Sergio Ramirez.**

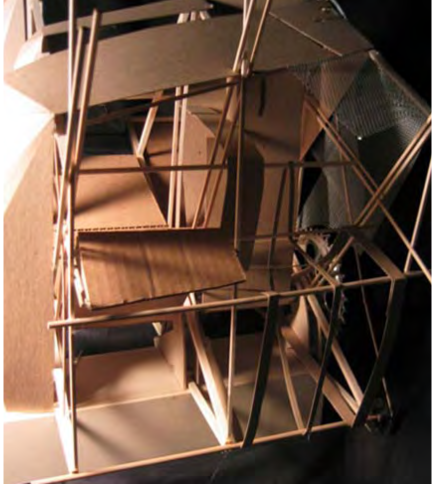


Figure 12: **Analog Model Main Space Vocabulary Study, View 3, by Sergio Ramirez.**

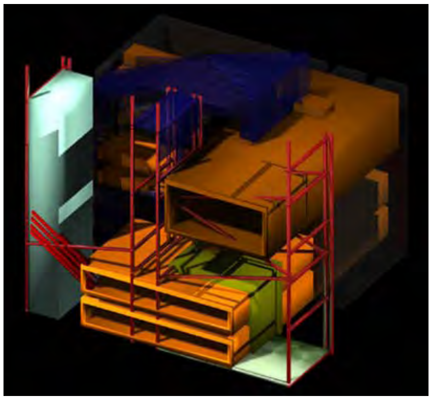


Figure 13: **Digital Model Main Space Program Study, by Sergio Ramirez.**

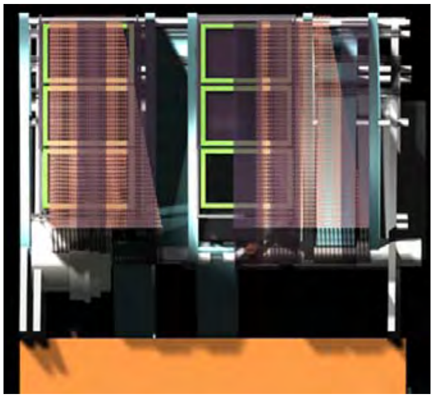


Figure 14: **Digital Model Main Space Skin Study, by Sergio Ramirez.**

Figure 15: **Analog Site Painting, by Sergio Ramirez.**

5. Digital Main Space Tectonic Studies

From the developed analog main space studies, students developed the relationship of the program to the space and also developed a range of skin studies digitally. Sergio's studies explored the relationship of the structure, space and enclosure and how best to articulate the mechanical shaft in the project [6].

6. Analog Studies for Building Site Placement

Students developed paintings to anchor projects to the site based on the same

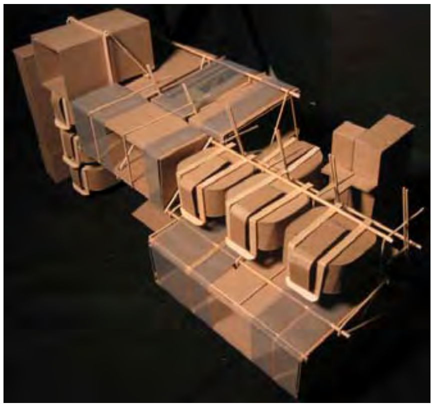


Figure 16: **Analog Model Study 1 of Entire Building, by Sergio Ramirez.**

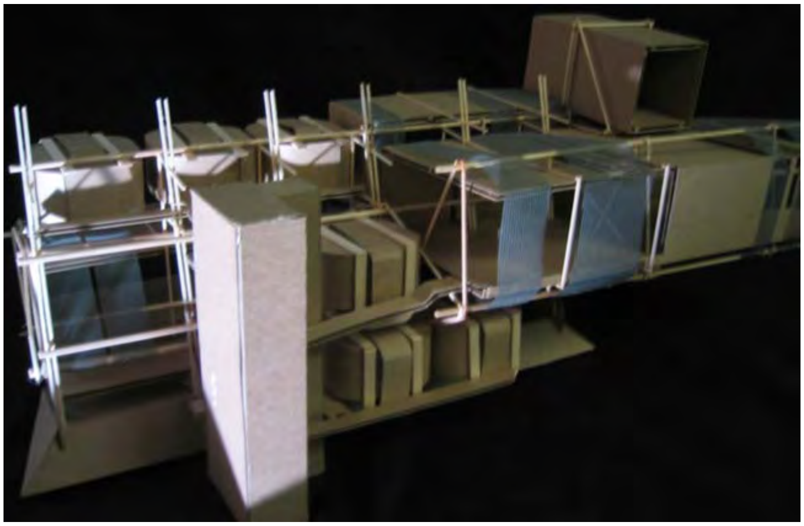


Figure 17: **Analog Model Study 2 of Entire Building, by Sergio Ramirez.**

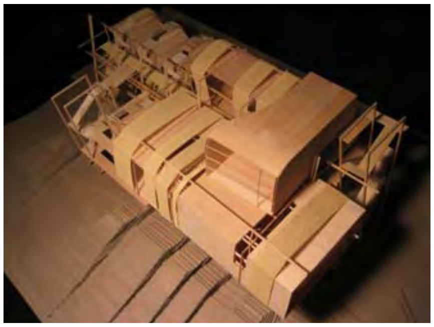


Figure 18: **Final Analog Model of Entire Building, by Sergio Ramirez.**

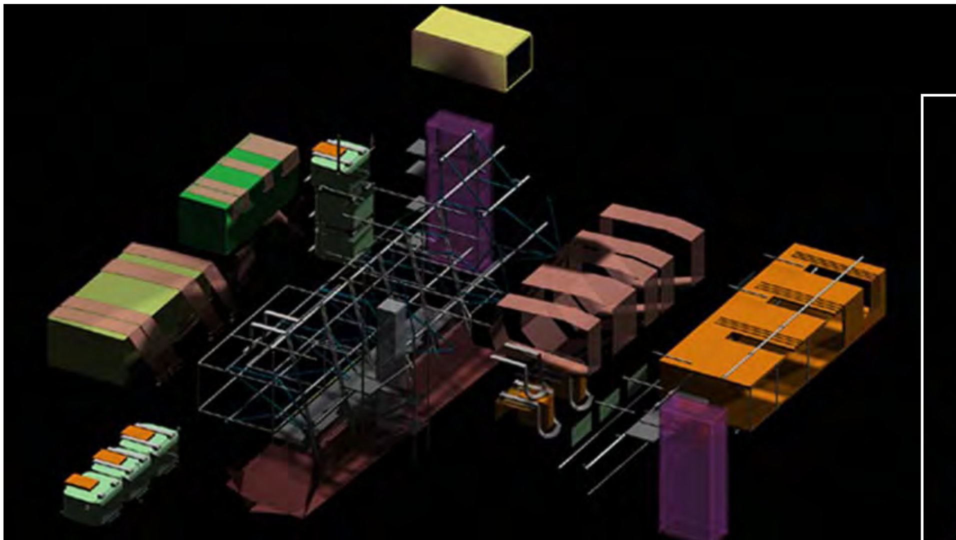


Figure 19: **Exploded Digital Model of Entire Building, by Sergio Ramirez.**

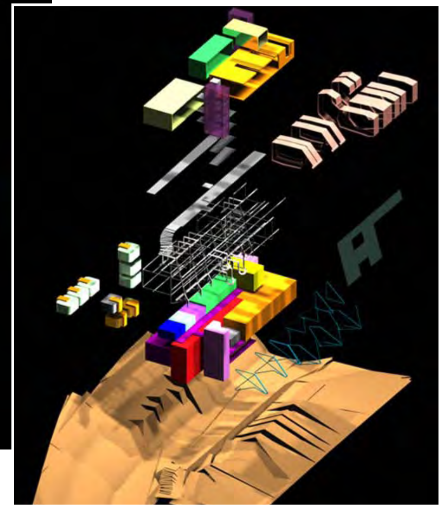


Figure 20: **Exploded Digital Model of Entire Building with Site, by Sergio Ramirez.**

strategies for developing their main space. Students were asked to explore the relationship of building to light in developing their site paintings. Sergio's painting study tried to create a feeling that the building and the site needed each other for meaning [6].

7. Analog Model Building Development

Students were asked to develop the remainder of the total building (The Center for the Study of Light) from the strategy that was used for developing the vocabulary of the main space. Sergio, extended from his main space this mechanical device to transfer movements to a series of minor shafts that rotate the perforated skins to create a play of light and shadow throughout the entire building [6].

8. Final Digital Models

Students were asked to continue project vocabulary development digitally of the entire project. For Sergio's project, the building's program is expressed as a color-coded kit of parts and is constructed into the machined steel structure, allowing the functions of the building to be visibly expressed in the architecture. As one walks through the spaces, the spirit of the Light Space Modulator is recalled in the motions and space articulations of light and shadow. The mechanical movement along the axis of the building establishes a carved into the landscape connection [6].

9. Instructor's Reflection on the Design Process

The integrated design and ECS studio framework allows students to engage in early improvisations in both studios that are strategically limited to predetermined issues, freeing students to explore and represent these issues in provocative ways, while not burdening them with all of the complexities of a building problem at the outset. It is not until the midpoint of the quarter that the design and ECS studios converge on an actual building project that is described in its entirety. The focus on lighting promotes a compelling dialogue between studios and offers a tactic for considering larger architectural questions. Day and electric light profoundly influences the identity, character and poetry of the architecture (design studio) at the same time it mediates relationships between interior and exterior space,

Figure 21: **Digital Longitudinal Section of Entire Building on Site, by Sergio Ramirez.**

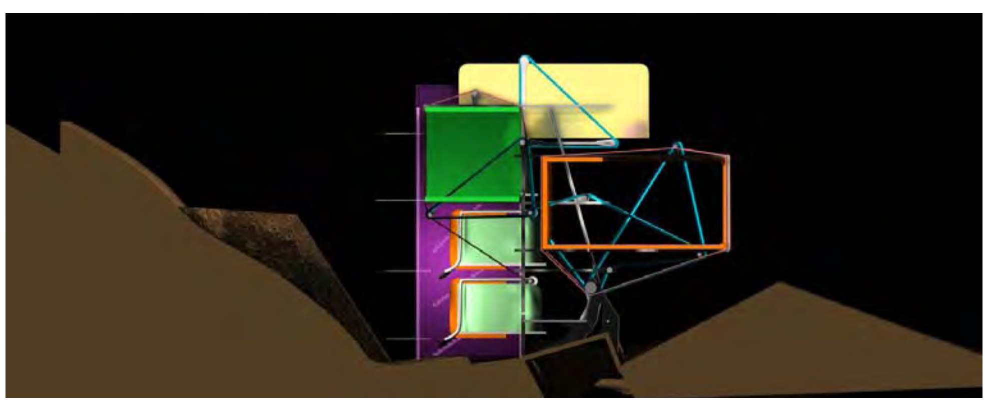


Figure 22: **Digital Cross-Section of Entire Building on Site, by Sergio Ramirez**

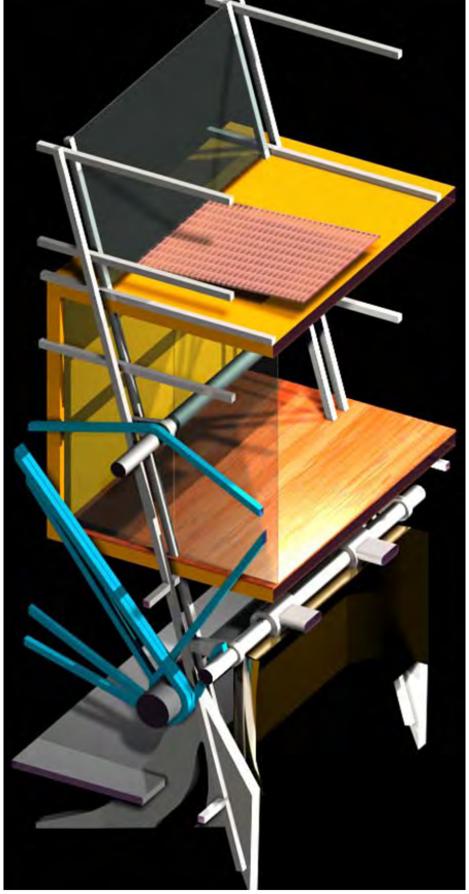


Figure 23: **Digital Wall Section, by Ramirez.**

facilitating desirable ways of developing the architectural vocabulary penetrations such as openings verses views, while blocking undesirable environmental phenomenon such as direct summer sun and moisture (ECS studio) [7].

Going back and forth between digital and analog media has the advantage of revealing more quickly and more clearly weaknesses in a project as well as inconsistencies between a student's original intentions and what is revealed in their work. The most successful students quickly identified shared qualities of images generated on the computer and on paper and a composite idea of the project seemed to emerge as they proceeded. These students committed to a consistent formal language that they could articulate and develop in both digital and analog realms [1,2].

References

[1] Fowler, Muller, "Physical and Digital Media Strategies For Exploring 'Imagined' Realities of Space, Skin and Light", in *ACADIA 2002*.

[2] Fowler, Muller, "Skin and Light", *ACSA West Conference 2003.*

[3] Shigemi, "Digital Physical Mashup", *Architecture Week* <http://www.architectureweek.com/2006/0419/tools_1-1.html>, accessed 12.30.05.

[4] Whittaker, "Greeting the Light", an Interview with James Turrell, <http://www.conversations.org/99-1-turrell.htm>, accessed 12.30.05.

[5] "The Light Inside", <www.pbs.org/art21/artists/turrell/clip2.html>, accessed 12.30.05.

[6] Ramirez, Sergio, *Reflective Essay of the Design Process*, Winter Quarter 2006.

[7] with Bermudez, Univ. of Utah, Bennett Neiman, Texas Tech Univ., "On Improvisation, Making, and Thinking", *October 2005 ACSA South West Regional Conference Proceedings* [the conference was cancelled, but the proceedings were published].

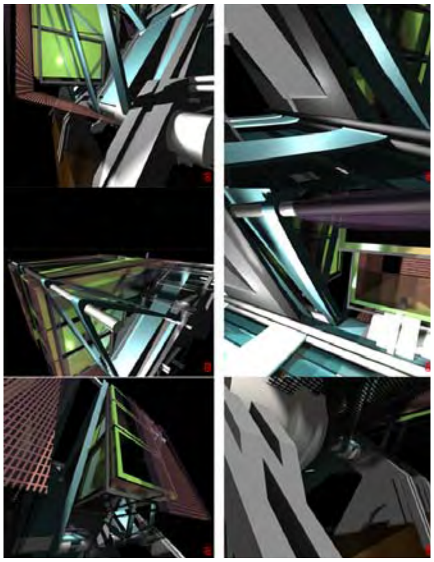


Figure 24: **Digital Wall Section Details, by Ramirez.**

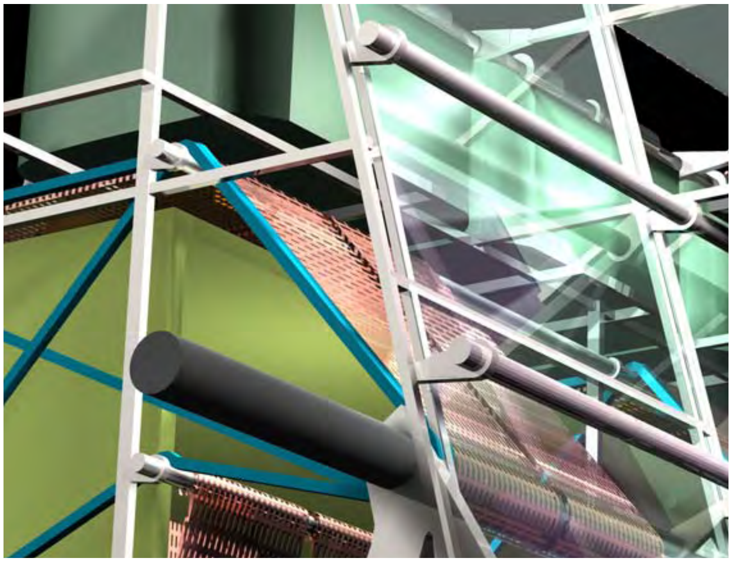


Figure 25: **Digital Wall Section Detail Close Up, by Sergio Ramirez.**

Thomas Fowler's, IV teaching responsibilities include third year design and building technology courses, and directing the computer laboratory at Cal Poly, San Luis Obispo. It started in 1997 and is called the Collaborative Interactive Digital-Design Studio (CIDS). This facility provides students with access to the latest digital technology for use in the design and constructability process in the studio. During his career he has received a number of awards in recognition of his teaching and research activities, which includes: Architecture Department's Faculty Teaching Award, 2005, "Young Faculty Teaching Award, ACSA/AIAS, 1996-'97", Nominated by Cal Poly's College of Architecture in both 2001 and 2000 for U.S. Professor of the Year Award, and "Young Architects Selection", Progressive Architecture Magazine, July 1994. Thomas has served as paper referee for numerous conferences, published a range of papers on his design studio teaching methods and interdisciplinary project activities and has had a successful track record for research grants. Recently he has had an essay published titled, "A Teacher's View", in Becoming an Architect, Lee Waldrep, editor, Wiley 2006. Thomas' practice experience includes working for Davis Brody Architects in New York City, and Hartman Cox in Washington, DC. He has also served as Associate Head of Cal Poly's Architecture Department from 2001 – 2007, served as the ACSA's Secretary to the Board, 2004 – 2006, has been appointed to serve on the National Architectural Accreditation Board (NAAB) as an ACSA representative from 2007 – 2009, and has had extensive experience in participating on NAAB visitation teams to 14 programs (4 of these he chaired) around the country.

scripting CONCRETE

by **Athanassios Economou and Nader Tehrani**

Exploration of problems of geometry and form vis-à-vis specific means and methods of assembly and construction has always been a central question in architectural pedagogy and practice. Not all types of geometries are possible within given construction domains and not all construction techniques are suitable to solve given formal problems. An iterative loop is clearly suggested at the outset of the problem and novelty is warranted by the designer's reflective understanding of the interplay between both domains of composition and construction. This paper discusses the design of an architectural pedagogy that is based on this reflection-in-action ethos and gives a brief account of its implementation in an advanced graduate architecture studio curriculum.

Among many and different kinds of ways that an architectural pedagogy can be designed to foreground specific relations between composition and construction, computation promises a most significant role: computer-controlled design algorithms visualize designs that would be difficult or even impossible to be thought and described otherwise; similarly, computer-controlled fabrication machinery produces designs that would be very difficult to or even impossible to be produced otherwise. The specific methodology described here has been particularly choreographed around issues pertaining to the design and fabrication of concrete structures. If generally, construction methods are rooted in problems of aggregation, of assembly, and of joinery using conventional 'units' of construction, the foundational difference in the construction of concrete is its indexical relationship to those very processes: concrete imprints the marks of formwork, it registers it, it mirrors it, and it tattoos it; its raw liquid state is defying any immediate additive assembly process. This dialectical relationship between the figuration of concrete form and the corollary configuration of elements that create formwork define the medium at its core. Alternatively, if concrete has seen a range of expressions throughout history, it is due to the varied techniques for formworks that have produced the mold for which these casts have become known. These techniques are examined here further as a way of understanding the nature of concrete construction-and moreover the nature of casting as a broader tectonic and computational medium.

The studio was structured around a series of four studies that were all meant to explore different aspects of the nature of casting; aspects of its representation, its parametric definition, its algorithmic definition, and its prototyping. For the first exercise, the students were asked to research categorically the various techniques that history has practiced, among others: cast-in-place, fabric-formed, pre-cast, and more recent digitally oriented practices. Specifically, the students were to examine how two-dimensional surfaces were formed to define frameworks for three-dimensional molds: that is, how two-dimensional surfaces of, say, wood, steel, fiberglass, etc., have to be manipulated in order to render orthogonal precision, curvature, folds, ruled surfaces, and complex geometries (Figure 1).

For the second exercise, students were asked to design a bounded surface unfolded in three dimensions featuring at least one or more holes – that is to say, a closed surface of topological genus n, for n>1. The feature of the opening was a significant part of the design problem to guarantee an encounter with the geometrical complexities of surface boundary, continuity, and closure, and

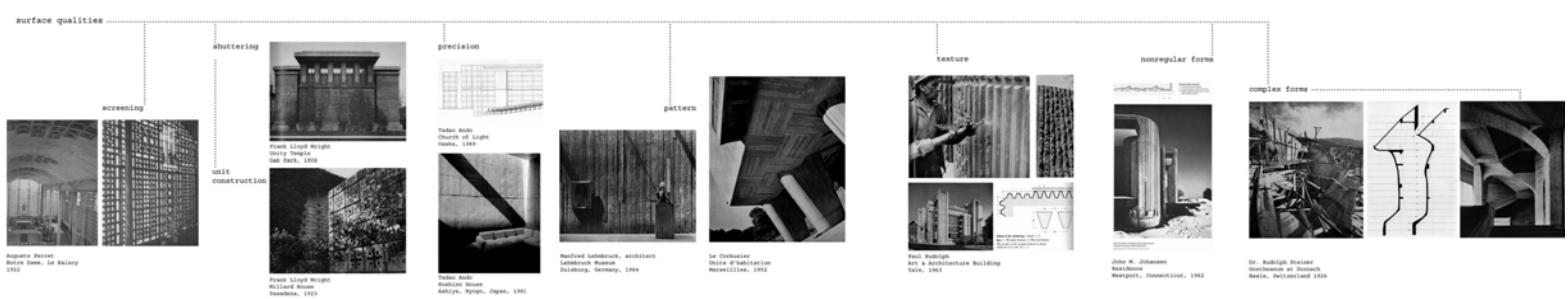


Figure 1: **Samples from the joint studio research on casting concrete (Richard Aeck, Erin Lindley, James Okelley, Lorraine Ong, Wendi Rahm).**

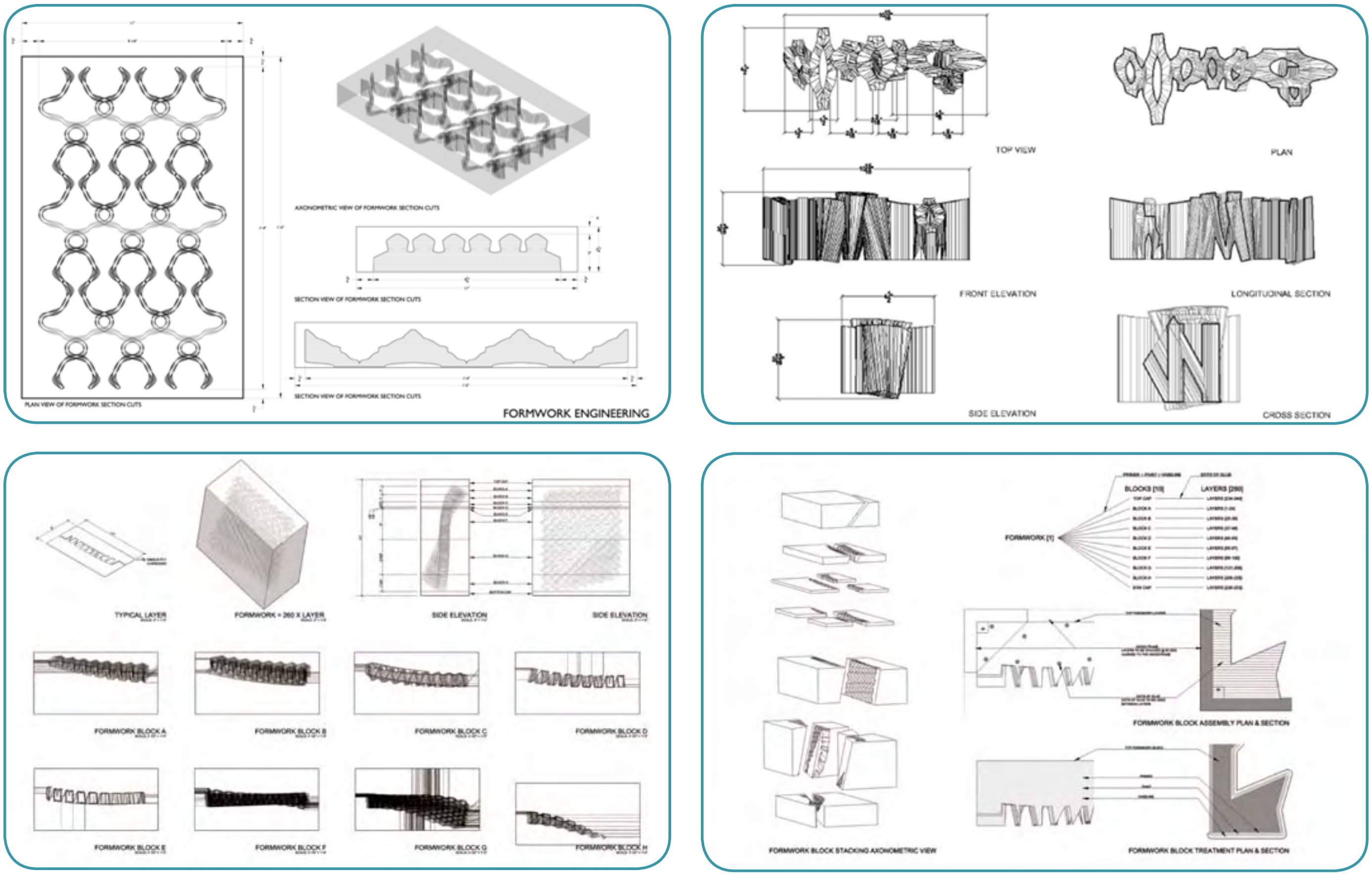
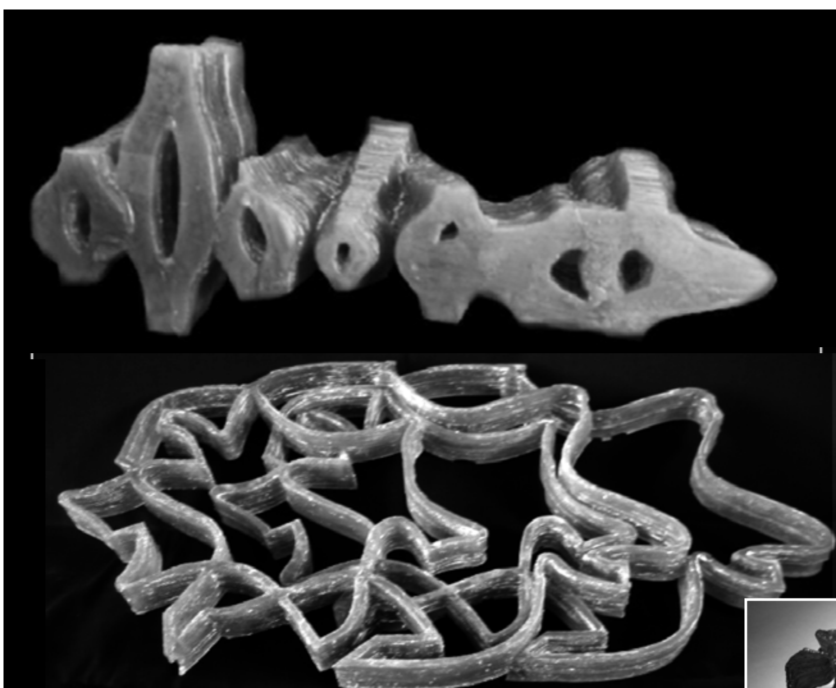


Figure 2: **Samples of the drawing specifications of the formwork of the surfaces (Richard Aeck, Erin Lindley, James Okelley, Lorraine Ong, Wendi Rahm).**



to evoke apt functional vocabularies such as windows, doors, staircases, chimneys, gutters and so forth. The outcome of the computation was the specification of the formwork -not the form (Figure 2).

For the third exercise, the students were asked to use the results of their first two exercises to create a cast module of 1x3x4 meters, within which multiple architectural contingencies could be embedded. The module was to be conceived as a programmable zone that could define the liner of a building. As such, its architectural duties were to establish some relationship between structure and skin, to calibrate the passage and quality of light, and most importantly for this exercise to establish a specific relationship to the body. Furthermore, this threshold between the inside and outside of the building was considered

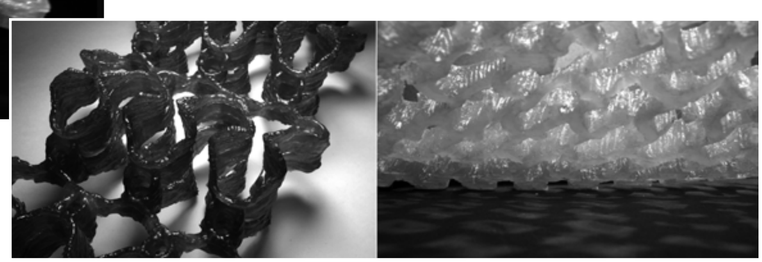


Figure 3: **Samples of the cast modules and the prototypes developed (Richard Aeck, Erin Lindley, James Okelley, Lorraine Ong, Wendi Rahm).**

as an opportunity for the students to investigate the relationship between architecture and furniture, using the body as the ergonomic measure of the cast. As a hand fits in a glove, the body was suggested to be molded into the building liner, not only for establishing a scale for the exercise, but as an alibi to negotiate the relationship between complex and simple geometries (Figure 3).

For the fourth exercise-iteration of the formwork-cast study, the students were asked to think of the formwork studies they had produced so far algorithmically; more specifically, they were asked to script these forms, -or other ones if so desired, and express them in terms of functions, variables, statements, expressions, complex data types and arrays. This encoding of form and formwork would challenge conventional ways of thinking about the designs they had produced so far and would bring to the foreground underlying assumptions and conventions used in their design and generation. In essence, the task was a parametric description of the designs dealt so far. It was expected that the attempts to describe their forms in this manner would not only describe a whole class of designs that share similar characteristics with the ones described or produced so far, but that they would also suggest possibilities that would have been entirely off the discourse unless this parametric definition had been attempted. Various methods were suggested to foreground this parametric definition; most of them coalesced around the notion of a simultaneous exhibition of all spatial variants on a single surface simulating a gradual growth. The granularity and scale of the module, the number of iterations to show the gradual morphing of one variant to another, and the number of discrete variants found in each complete design were left to each student team. All studies, scripts, implementation of matrices, execution and fabrication instruction were worked out within **form•Z** (Figures 4-6).

Epilogue

All series of design studies described here are presented as systematic studies exploring the nature of casting including aspects of its representation, its parametric definition, its algorithmic definition, and its prototyping. An underlying motivation for the whole project was based on our conviction that if conventional buildings thrive on mass production, recent possibilities of mass customization to adapt concrete to particular circumstances, may very well emerge from computational, technological, structural, programmatic, and geographic contingencies. All work discussed above emerged at the graduate advanced architectural design studio at the College of Architecture, Georgia Institute of Technology during Spring 2006.

Acknowledgements

This study was generously supported by an extended two-day workshop lead by AutoDesSys, Inc. personnel given at Georgia Tech during the Spring semester 2006.

Athanassios Economou is Associate Professor in the College of Architecture at the Georgia Institute of Technology. He teaches graduate and undergraduate architectural design studios and a series of core and elective courses in the field of Design and Computation. Design projects from his graduate studios at Georgia Tech have received prestigious awards and honorable mentions in international and national architectural competitions. He has served on the Technical committee for the Association for Computer-Aided Design in Architecture (ACADIA), the Scientific Committee of Mathematics and Design (M&D), the Scientific Committee of Computational Aesthetics, and others. He has been invited to lecture at several Universities including the University of Michigan, Ann Arbor, MI, the University of California at Los Angeles, (UCLA), the Ohio State University, Columbus, OH, the National Technical University of Athens, Greece, the University of the Aegean, Greece, and others. He holds a Diploma in Architecture (1990) from the National Technical University, Athens, Greece, a Masters of Architecture (1992) from the University of Southern California, and a PhD in Architecture (1998) from the University of California, Los Angeles. Email: thanos.economou@coa.gatech.edu. URL: www.coa.gatech.edu/~economou.

Nader Tehrani is the 2005-6 Ventulett Chair in Architectural Design at Georgia Institute of Technology and an Associate Professor of Architecture at the Graduate School of Design. Professor Tehrani has earned several prestigious honors, including the Architectural League of New York's Young Architects Award in 1997 followed by its Emerging Voices award for 2003. In 2002, he received the American Academy of Arts and Letters' Award in Architecture, one of its youngest recipients ever. Born in London of Iranian origin, Tehrani has resided in the United States since 1978. In partnership with Monica Ponce de Leon, Tehrani heads the firm Office dA and has been practicing architecture in Boston since 1987. He has also taught architecture at Northeastern University, Rhode Island School of Design. Tehrani received a BFA and BArch from the Rhode Island School of Design in 1986, and continued his studies in the History and Theory Program at the Architectural Association in 1987. He received a MAUD from the GSD in 1991. Email: da@officeda.com. URL: www.officeda.com.

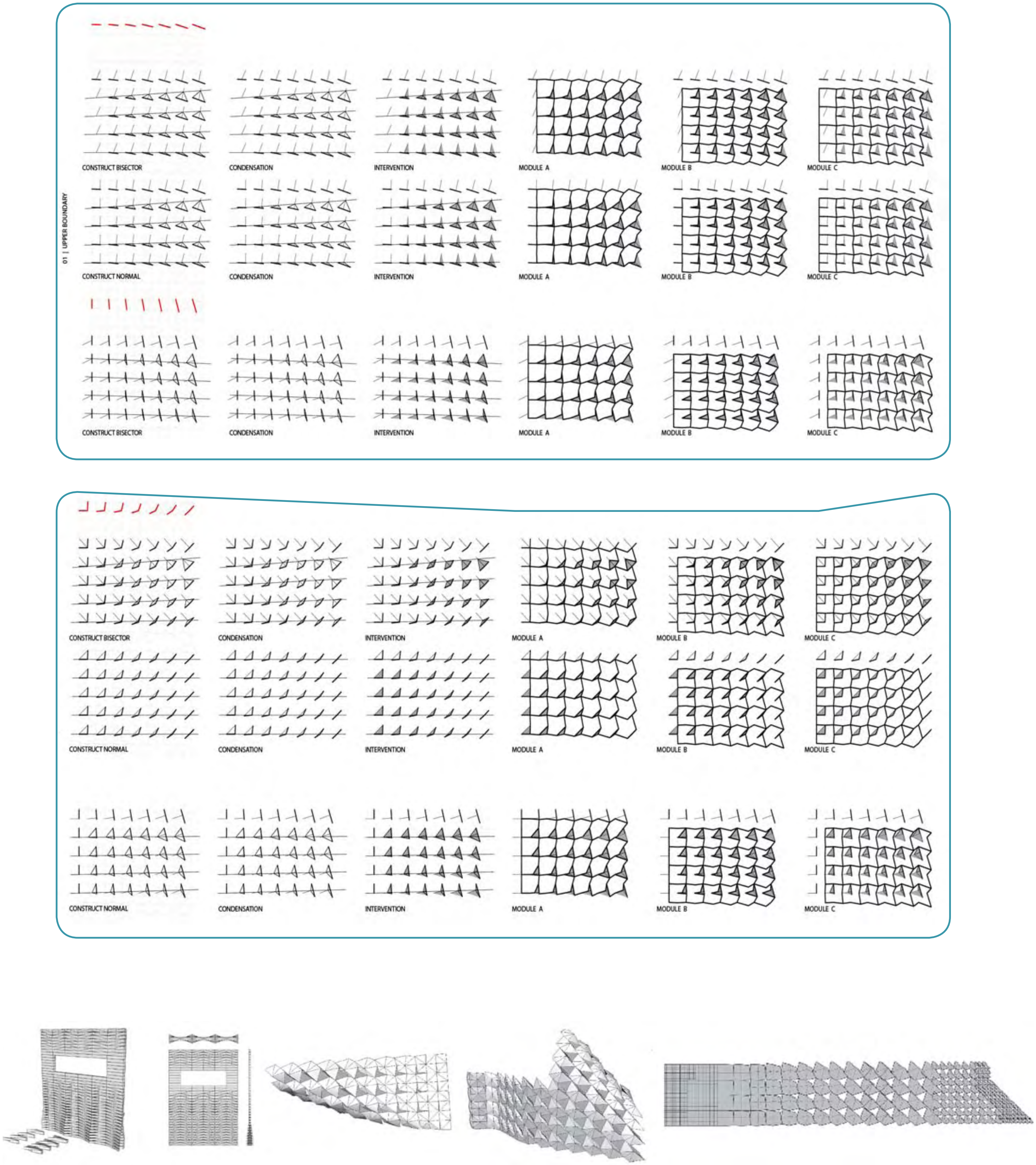
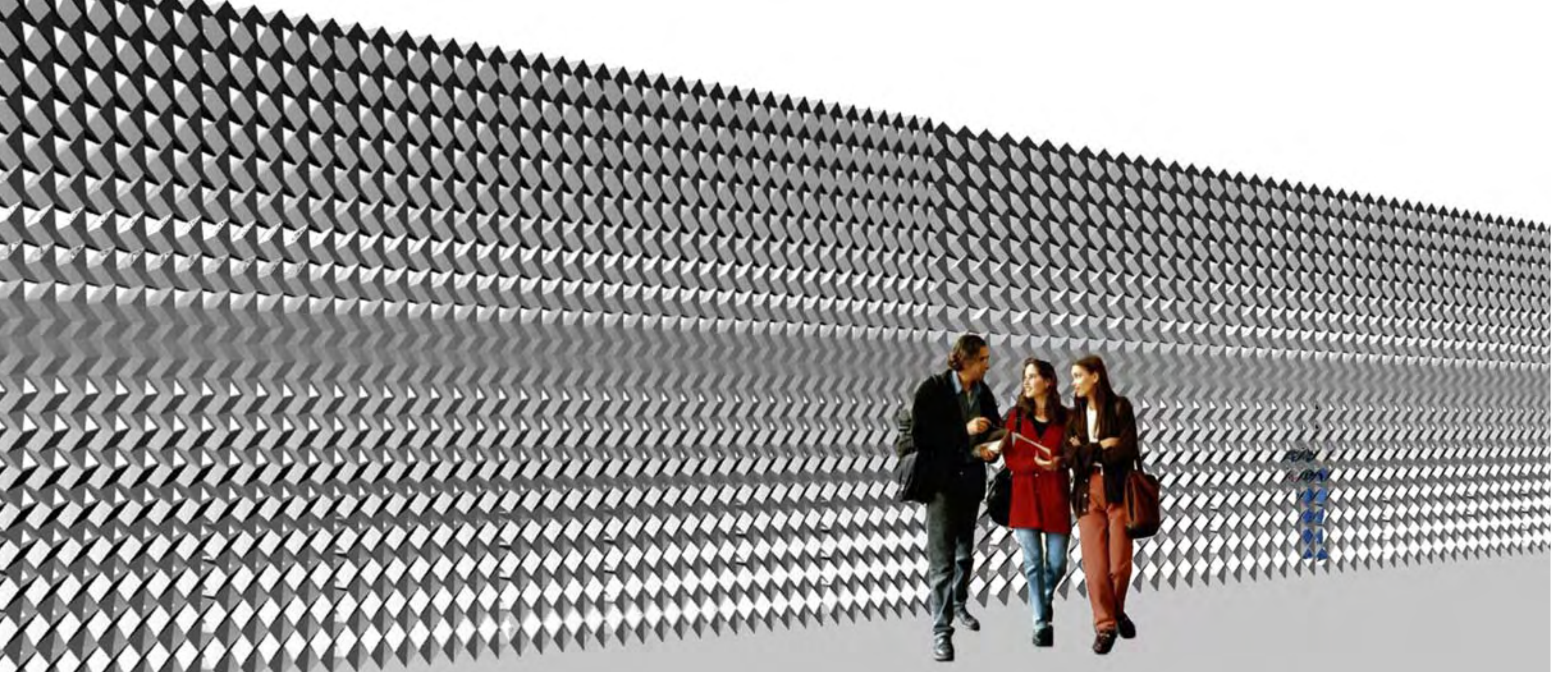
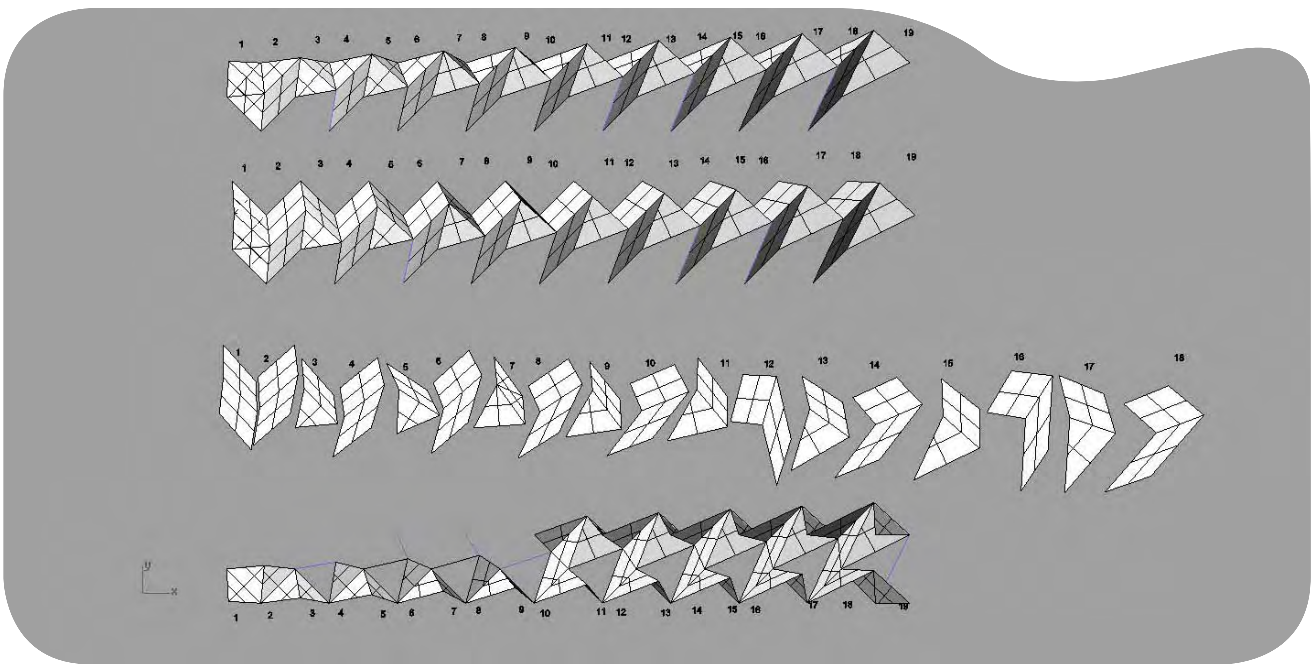


Figure 4: **Algorithmic description of forms and formworks by Richard Aeck and James Okelley.**





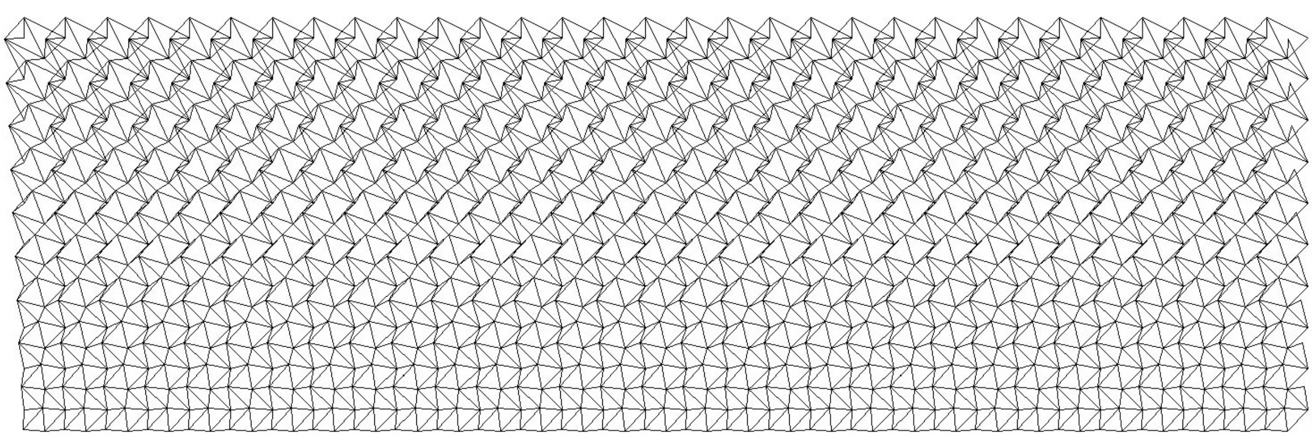


Figure 5: **Algorithmic description of forms and formworks by Erin Lindley and Wendi Rahm.**

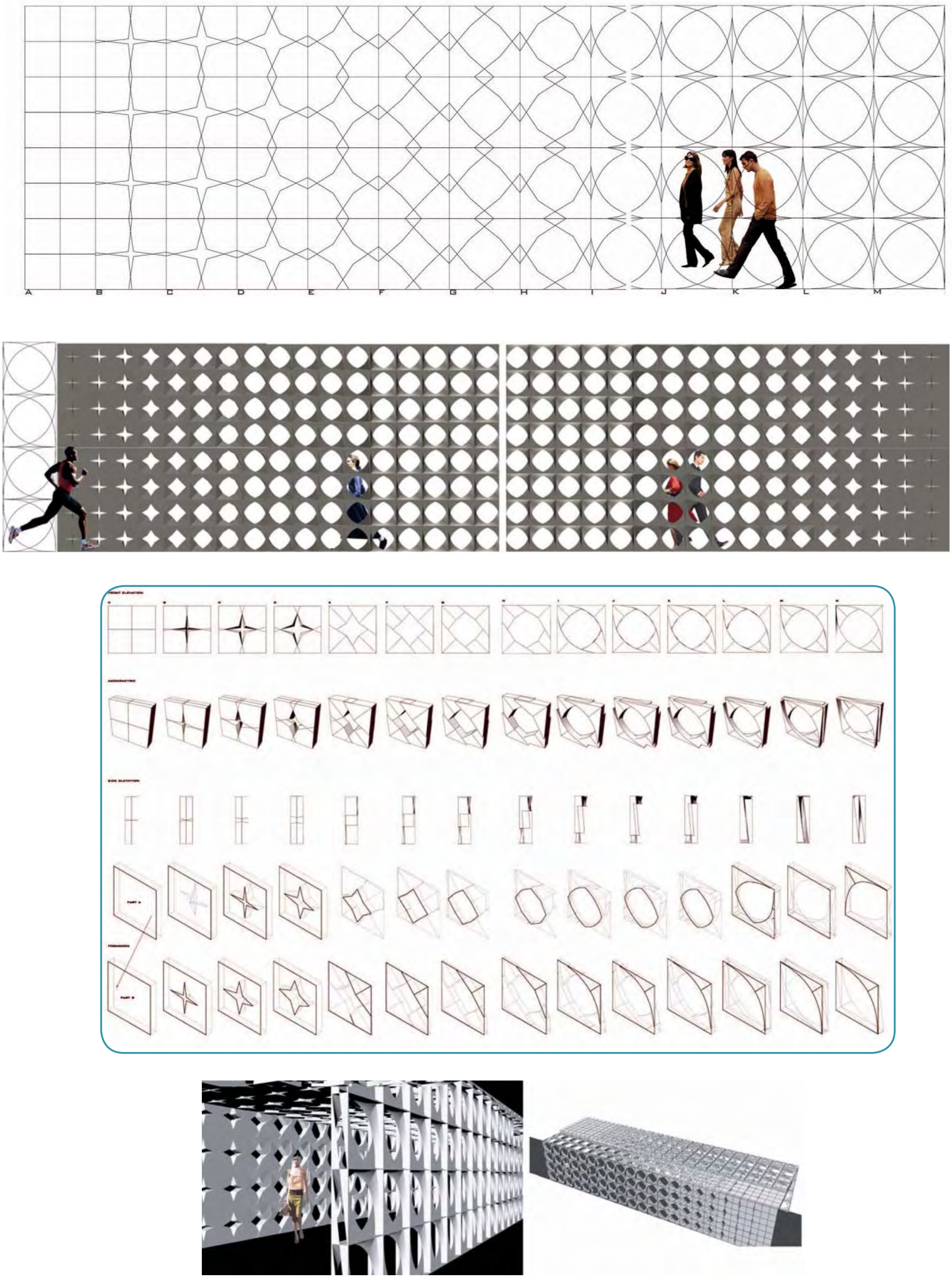


Figure 6: **Algorithmic description of forms and formworks by Lorraine Ong.**

THE bebop Studio

First you learn your instrument.
Then you learn music.
Then you forget both of those and just blow.
-Dizzy Gillespie

by Bennett Neiman

In an attempt to engage today's analog and digital media savvy architecture students, aspects of both methodologies were applied to a beginning architectural design studio, taught during spring semester 2006. This renewed pedagogy, satisfies the demands of incoming students who represent an evolving paradigm shift. A poetic tonality or attitude of this approach is discussed. Those interested in the specific processes and methodologies employed should consult earlier writings listed in the references at the end of this article.

The bebop STUDIO translates the jazz performance entitled Leap Frog, by Charlie Parker and Dizzy Gillespie into a series of improvisational layers, one portion interacting and superseding the other. Representations of form, space, light, line, volume, and texture are implied in the music. The student hears the three dimensional space of interpenetrating movements where primary, secondary and tertiary precincts are juxtaposed and projected against complex geometries.

NOTE: The bebop SPACES project, designed by Professor Neiman, received the 2005-2006 Association of Collegiate Schools of Architecture Faculty Design Award. A series of analog-digital workshops and seminars taught by Professor Neiman received the AIA Education Honors Award in 1994 and 1998.

The bebop STUDIO wakes up architectural dreams and places to experiment, discover, manipulate, interpret, and extract. The site of this ongoing investigation is the mind. The viewer, as the ultimate client, establishes the program. The material is space and light. The function is the psychological demand of spatial experience. The budget is time, passion, and commitment to the study of architecture.

The bebop STUDIO does not advocate photo-realistic rendering, instead empha-sizing design representation, translating fundamental concepts into architecture. Photo-realism implies an attitude of mimicking the real world. Here, new media is used as a tool for representation and form translation in conjunction with physical models. Students resist seeing the obvious or the literal in favor of imagination, exploration, experimentation and translation.

In jazz, the musicians record an improvised performance several times, critically deciding which "take" is the one that will appear on the final released album. The alternate takes are analogous to sketches. The students reflect a jazz attitude by treating each study as a "take".

The exercise is similar to a performance device or a game, exploring the boundaries of its limits. Each composition seduces and motivates the viewer into grasping its potential, thus requiring an ability to 'inhabit' and 'decipher' it. Doing so demands participation by both the performer and the viewer. Thus, each composition is always a two-sided event. Both the designer and the viewer can read multiple interpretations, extracting from the process at any time, allowing for the experiential interpretation of space from two-dimensional drawings into three dimensions at any scale, as a detail, as a building, or as a community of buildings.

The design process is a cause and effect relationship, beginning as a simple analytic structure that grows with compulsion. This mechanism rapidly unfolds as an open-ended experiential phenomenon. The structure develops into a metamorphic labyrinth, as a self-perpetuating continuum. Each composition is a complex work of resultant simplicity derived from an ordered language of constants and variables, constructing and articulating joints and connections. The complexity is discernible, traceable back to the original order of size, shape, treatment, location, and orientation. There is not one piece that is considered "the end product." The entire process is also the product.

Adobe Photoshop and Illustrator are used for image manipulation and early digital collage exercises. Collage structures are translated into physical three-dimensional models. Using **form•Z**, students start in the draft mode and swiftly move to digitally modeling the physical models. Professor Neiman argues that with **form•Z** there is no one way to make these forms. The students learn **form•Z** as they design. A willingness to experiment and play with the software is key.

Students enrolling as college freshmen in the fall 2006 were born after 1987. This means that during most of their lives they have been exposed to not just CD-ROMs, but realistic video games, Game Boy, dolls with embedded microchips, cell phones, the internet, the graphical user interface, digital cameras, digital video, Tivo, iPods, DVD's, flat screen HDTV, blogs, MySpace, and the emergence of Fox News Channel showing live satellite action directly from embedded war correspondents. High school students are making and editing their own videos and digitally composing their own music while they download, sample, rip and mix mp3's. Today's architecture student is willing and able to fluidly move data between many different digital applications including **form•Z**, transforming physical models into digital drawings and models.

The bebop STUDIO sets up a rigorous series of incremental and additive exercises, but at the same time introduces an attitude of open experimentation. This design studio presents a seamless exchange of information between various digital design applications, creating an inviting environment in the context of contemporary media. The studio provides students with the fundamental critical skills in formal manipulation, space and organization. The exercise stimulates action followed by reflection.

The bebop STUDIO is an evolving dynamic process. As each new group of students engages the exercise, new ideas are applied to the pedagogy for future groups. The quote by Dizzy Gillespie gives the underlying attitude for this process. In the beginning stages it is about learning a particular set of instruments. Then simultaneous to that it is about learning the architectural music or language. By the end of the bebop STUDIO, the student is in the beginning stages of just blowing, which in a certain sense is about forgetting about the rules and almost working intuitively with **form•Z** to create these works.

References

Neiman, Bennett. (2005) "Analog-Digital Light Box Exercise." *form•Z Joint Study Program Report 2004-05*. pp. 86-89.

Neiman, Bennett and Jeff Olgin. (2005) "Institute for Jazz Studies at Fort Adams." *form•Z Joint Study Program Report 2004-05*. pp. 46-49.

Neiman, Bennett. (2006) "Bebop Spaces." *Proceedings of the 2006 ACSA Annual Meeting*, Salt Lake City, UT. pp. 169-172

Neiman, Bennett. (2002) "Bebop Space/ Leap Frog." *Proceedings of the Western Region ACSA Conference*, California Polytechnic State University, San Luis Obispo, pp. 129-132.

Neiman, B. and EllenYi-Luen Do. (1999) "An Analog Digital Language of Vision." *form•Z Joint Study Program Report 1998-99*. pp. 62-65.

Neiman, B. and EllenYi-Luen Do. (1999) "Digital Media and the Language of Vision." *ACADIA 99, Media and Design Process*, Snow Bird, UT, Association of Computer Aided Design in Architecture.

Neiman, B. and J. Bermudez (1997). "Between Digital and Analog Civilizations: The Spatial Manipulation Media Workshop." *ACADIA 97, Representation and Design*, Cincinnati, Association of Computer Aided Design in Architecture.

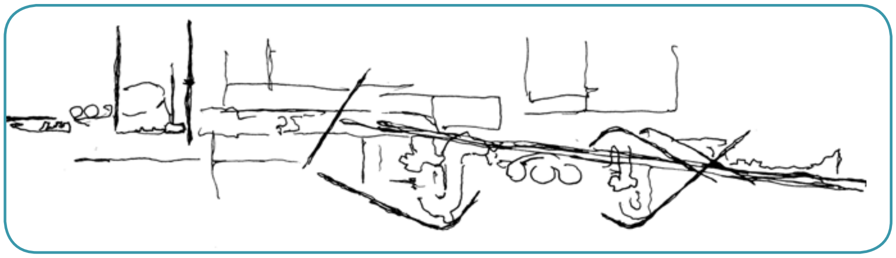
Neiman, B. (1996). "Improvisation and Articulation: The Jazz Studio." *ACSA European Conference*, Copenhagen, Denmark.

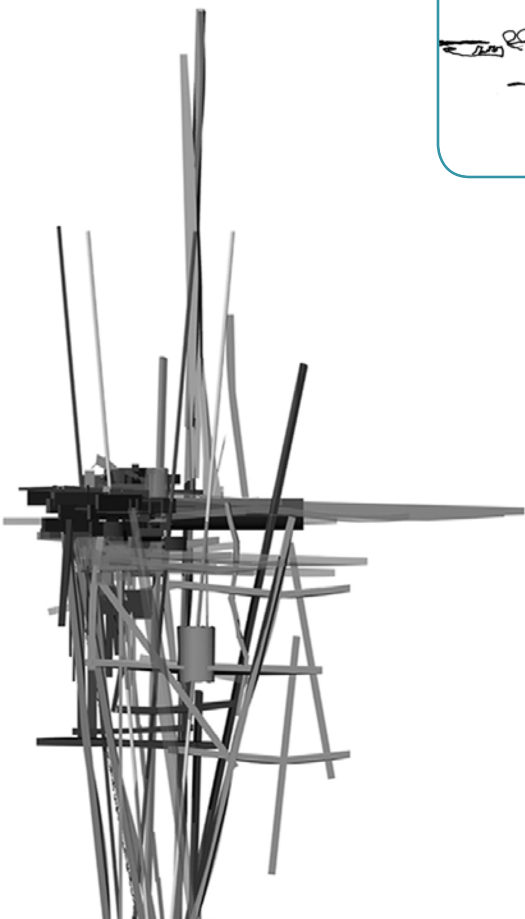
Bennett Neiman joined the Texas Tech University College of Architecture as an Associate Professor in 2004. He has also taught at North Dakota State University, Miami University, University of Texas at Arlington, University of Tennessee, Roger Williams University, and at the University of Colorado. Professor Neiman has received several honors for a series of self-generated design projects and competitions involving improvisation, order, and variation on a theme. His design seminars and studios exploit the strengths of both traditional media and digital technology. For this work, he received the American Institute of Architects Education Honors Award in 1994 and 1998, and the Association of Collegiate Schools of Architecture Faculty Design Award in 1990 and 2006. He was the recipient of the University of Colorado at Denver Outstanding Teacher of the Year, and the College of Architecture and Planning Excellence in Teaching Award in 1994. He received the Texas Tech University Alumni Association New Faculty Award representing the College of Architecture in 2006. Professor Neiman's students have won the **form•Z** Joint Studies Program Award of Distinction in 1994, 2005, and 2006, and an honorable mention in 2003. Email: bennett.neiman@ttu.edu Web site: http://bneiman.notlong.com/. Neiman's photograph by Jerod Foster (2006). *Photo by Jerod Foster (2006).*

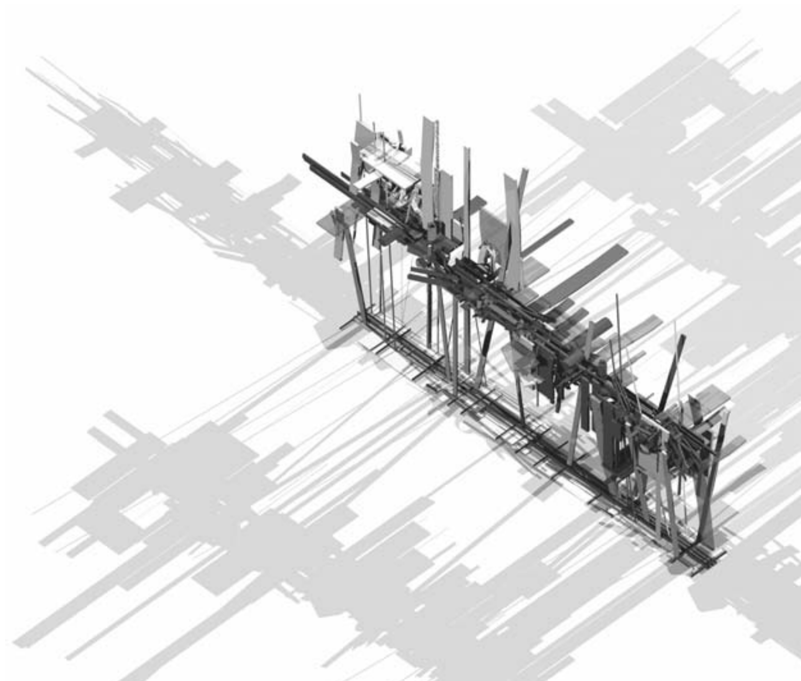
Selected student work from the bebop studio.

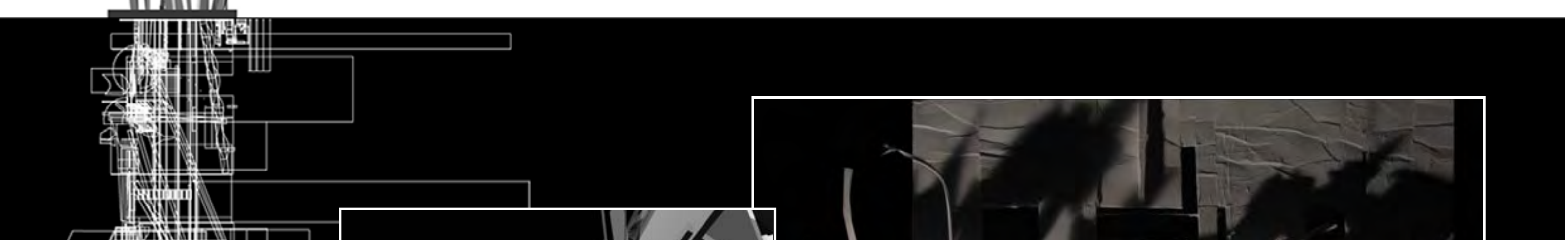
If I internalize the environment around me, who is going to control how the information eventually resurfaces? It's an uncanny situation; the creative act becomes a dispersion of self. Back in the day it was called alchemy, but in the hyperfluid environment of information culture, we simply call it the mix. I like to call it cybernetic jazz.
-DJ Spooky on rhythm science

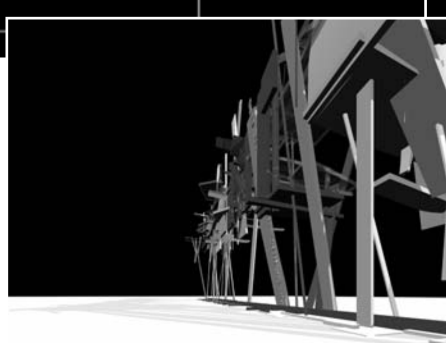
Craig Dixon. analysis, process, presentation, repeated structured, distillation, collage, representation, compress, transition, form, and expansion.

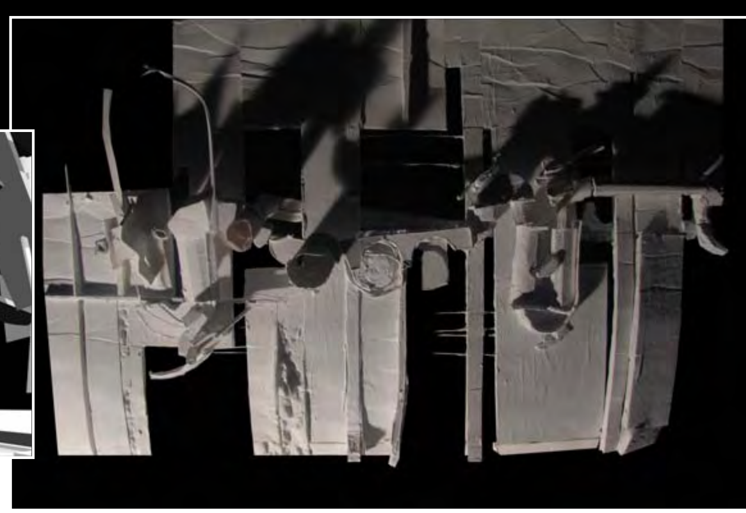




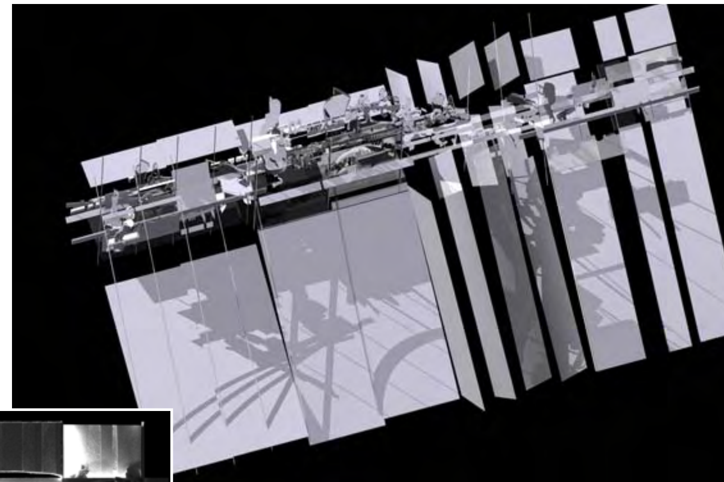


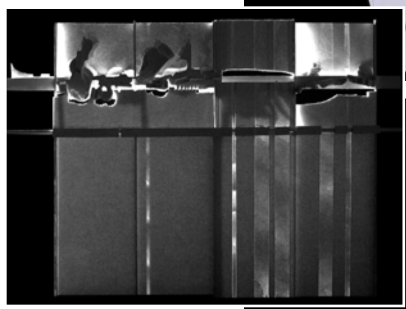


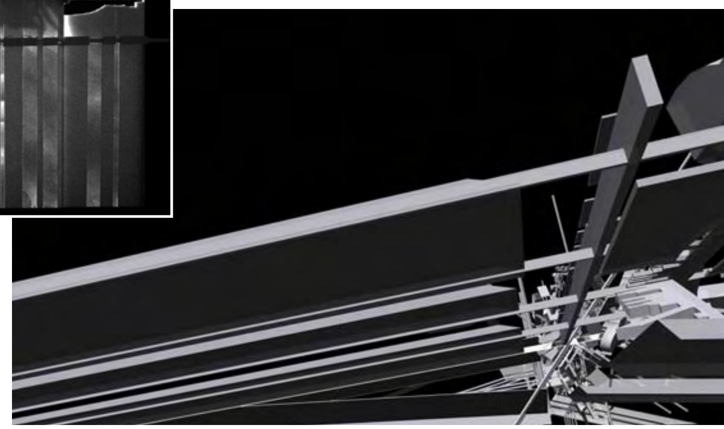


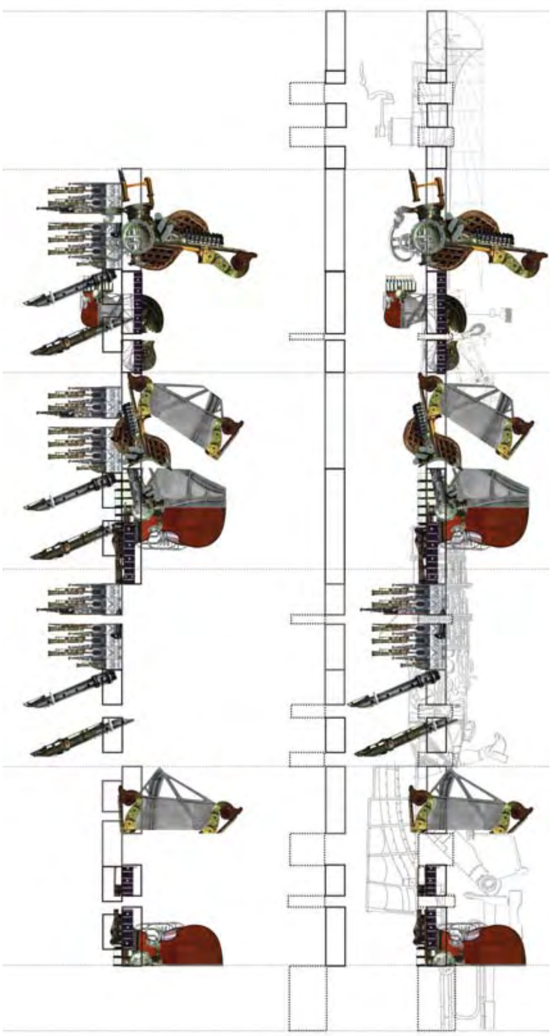


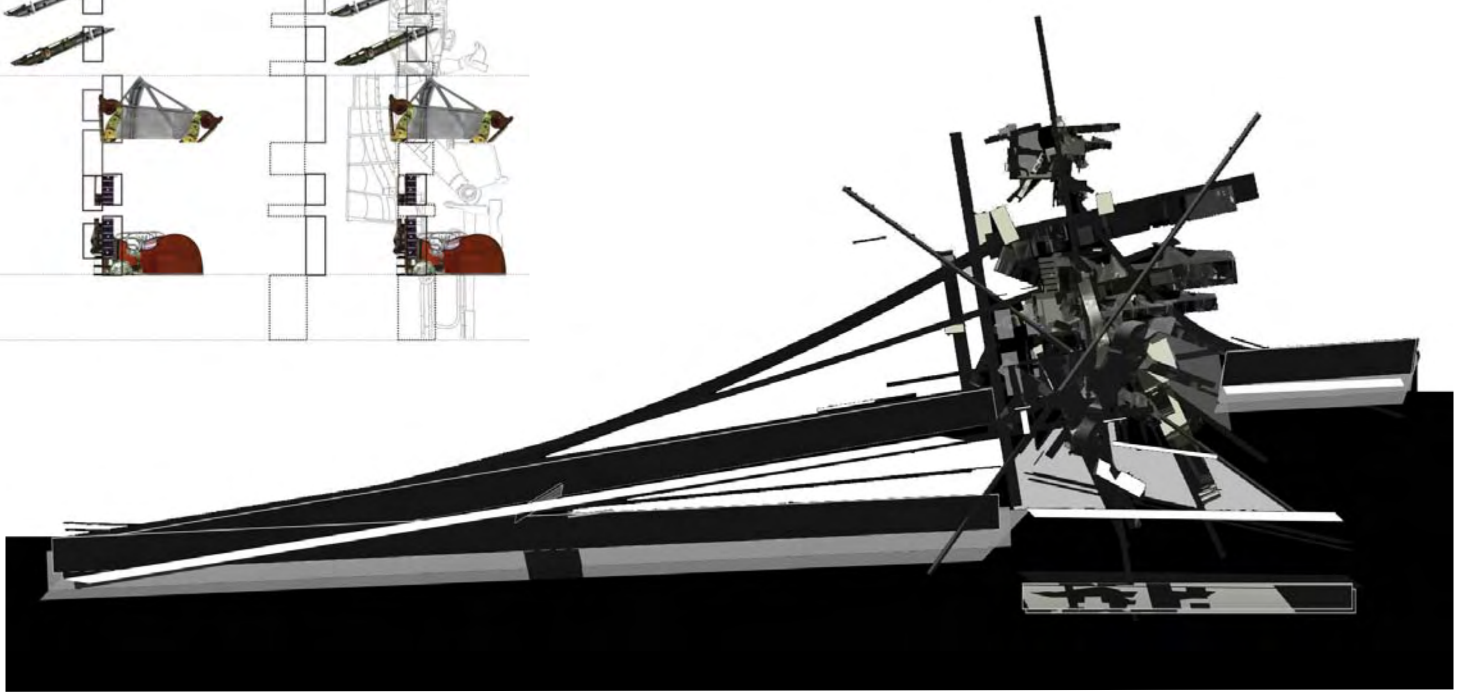
Jack Mussett. bebop spaces thrive on idiosyncratic forms derived from time, music, instruments, structure, and countless conscious and preconscious design decisions. It is intuition and iteration.



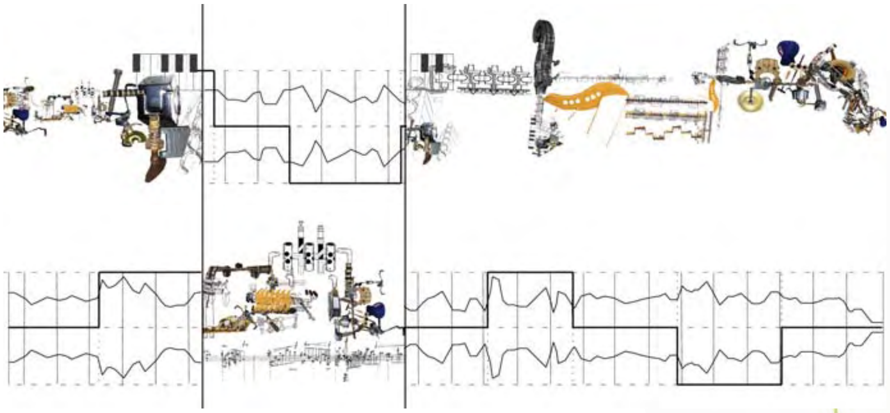


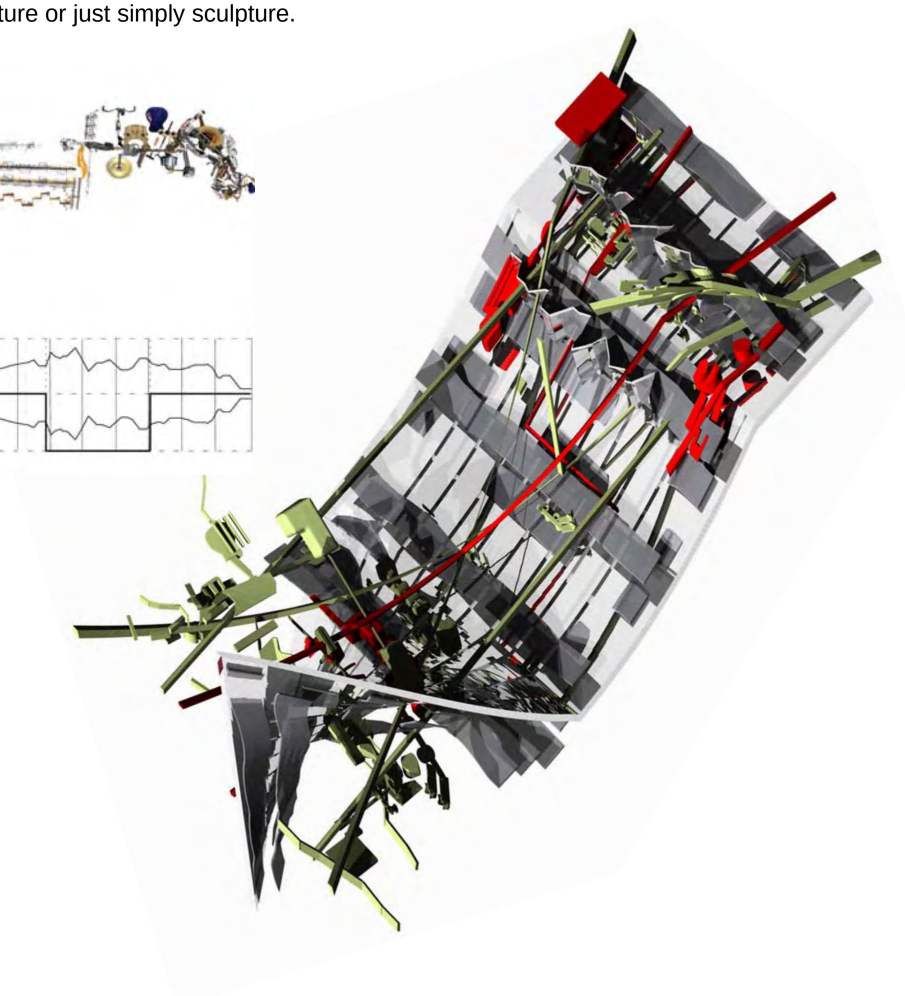


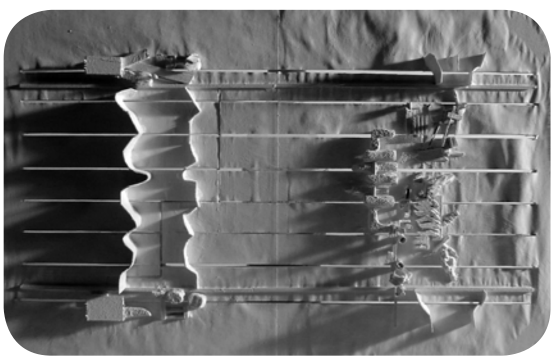


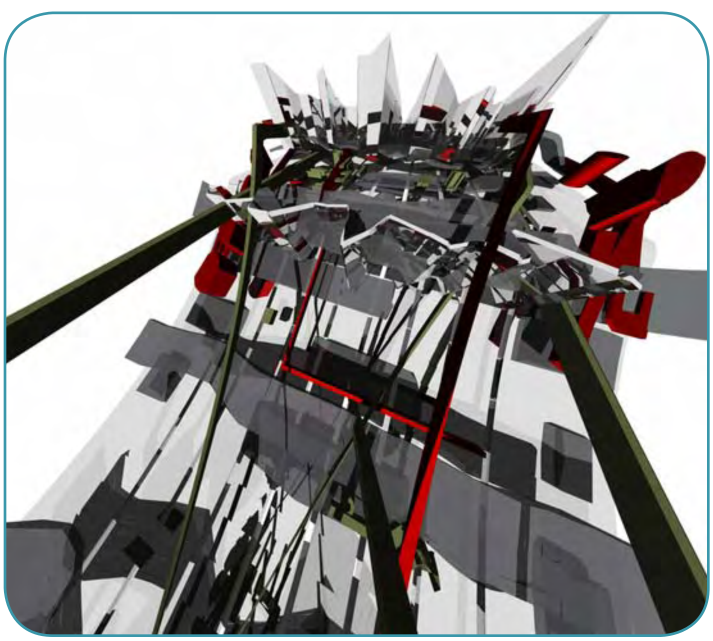


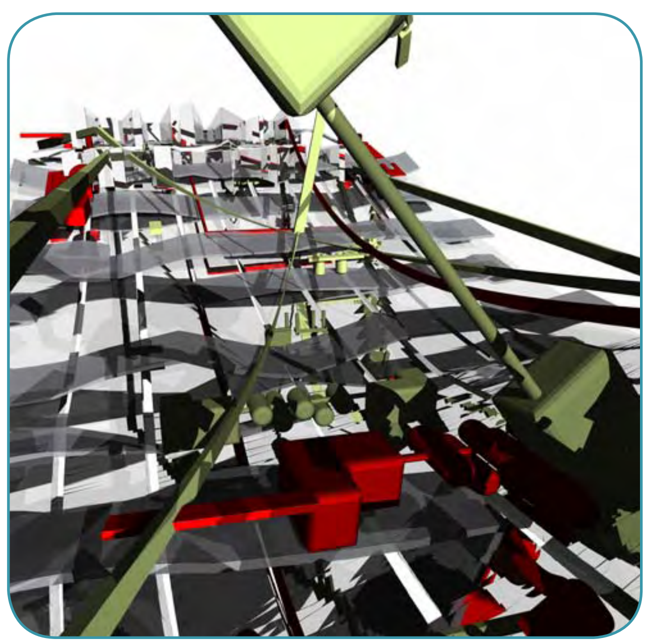
Jarod Fancher. Through expansion and reuse of pieces, a model is created. With the idea of structure and improvisation you exploit views of the model to gain more ideas and knowledge of the musical structure. The spaces and volumes in these views can be translated and transformed into an actual structure or just simply sculpture.



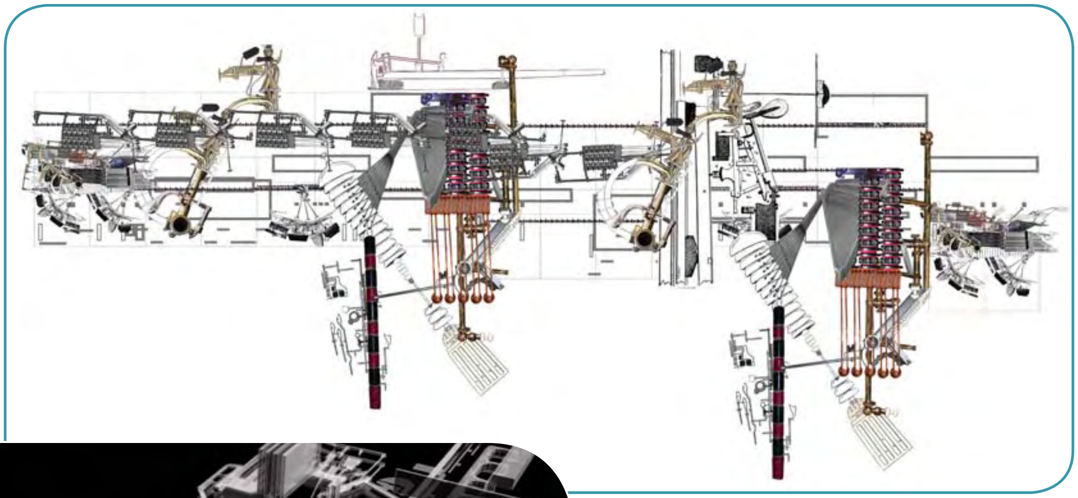


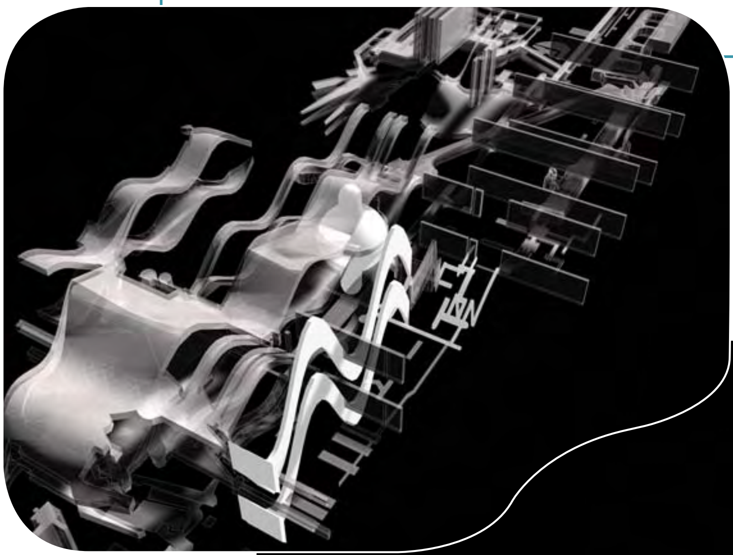


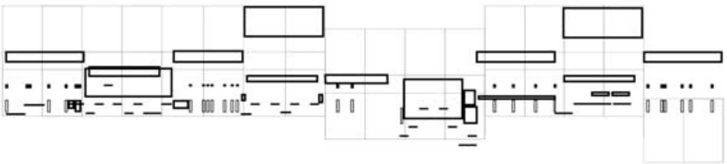


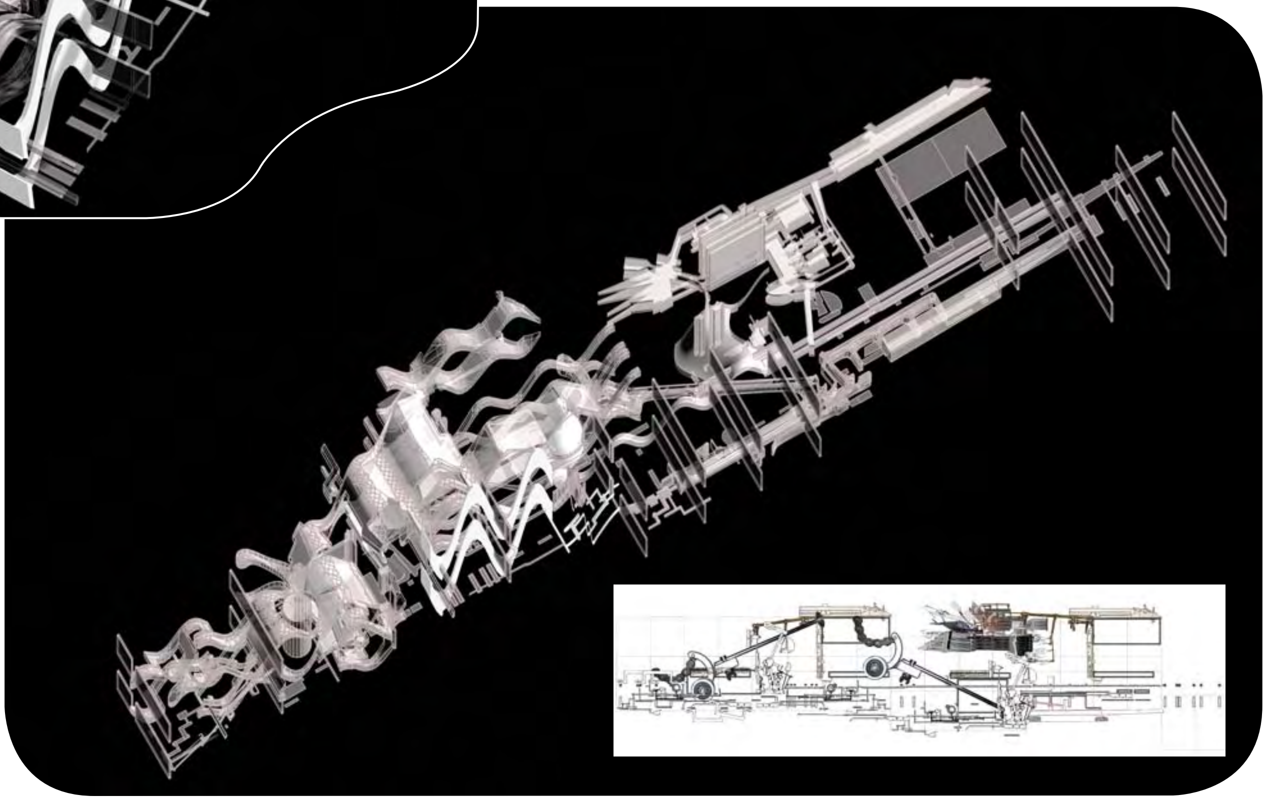


Jonathan Creel. **form•Z** was our main instrument. Certain elements of the underlying structure and theme of the song are diagrammed and described in detail. A catalyst for a broader idea could not be found by traditional drawing. The program changes. A new process of thought is involved. Images of musical instruments are fractured and turned into crystals. From a digital realm, an idea is converted to an analog expression of the original thematic sequence. It immediately conveys a mythical existence. There is no gravity; it's intangible space. There are infinite solutions and variations of themes that are invoked. This constant drives the possible variables. It begins with the analysis. This becomes a motor (immovable mover) which is, a moment captured. It's all in the perception. Once you hear music, it's gone, in the air. You can never capture it again

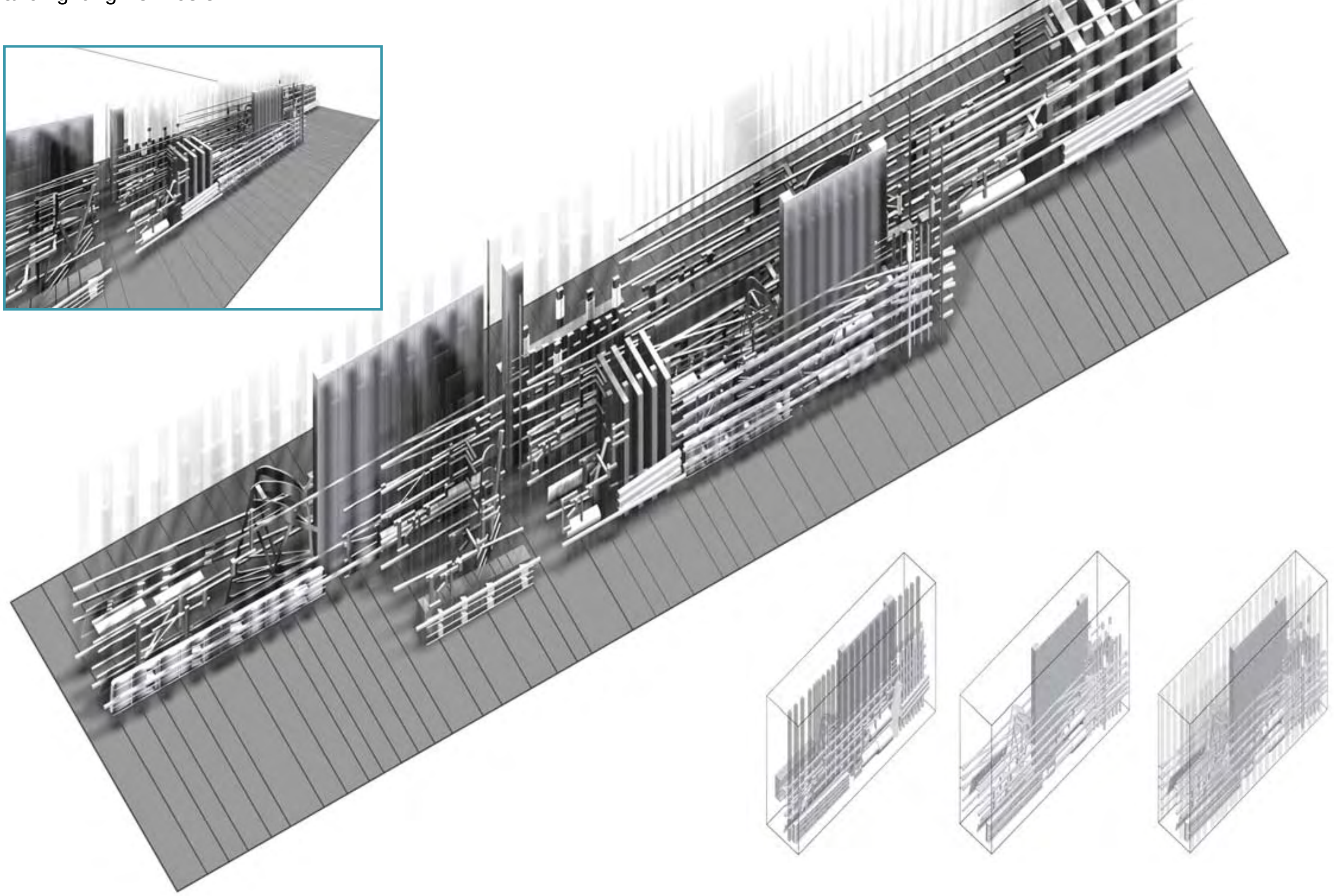


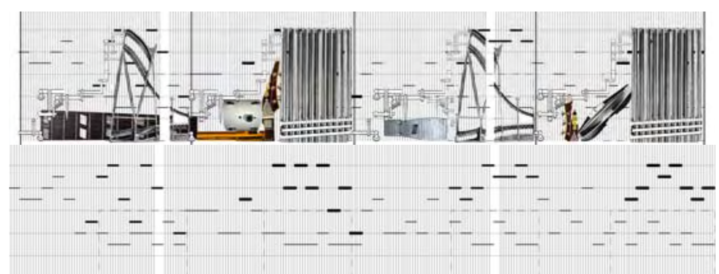


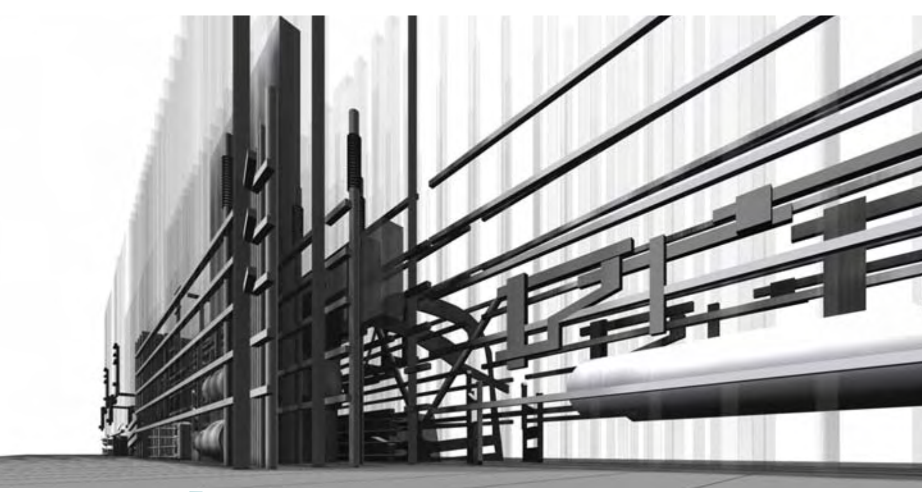


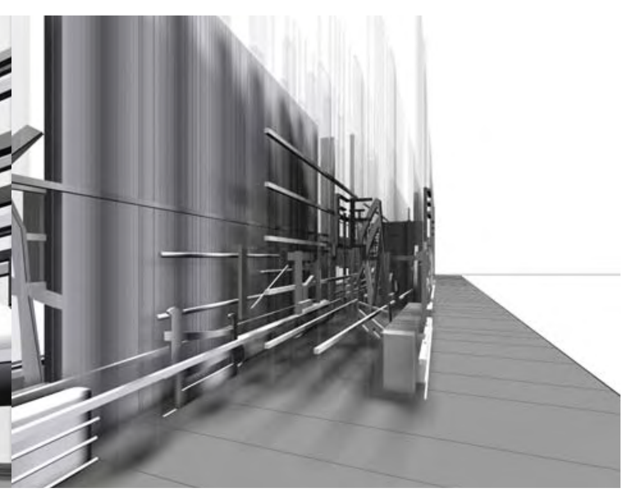


Kaitlin Underwood. Expanded models are combined and manipulated to create a final model. The lighting condition used on the digital model is reminiscent of the photographs of the physical relief. It uses high contrast similar to the back lighting and lighting from below.

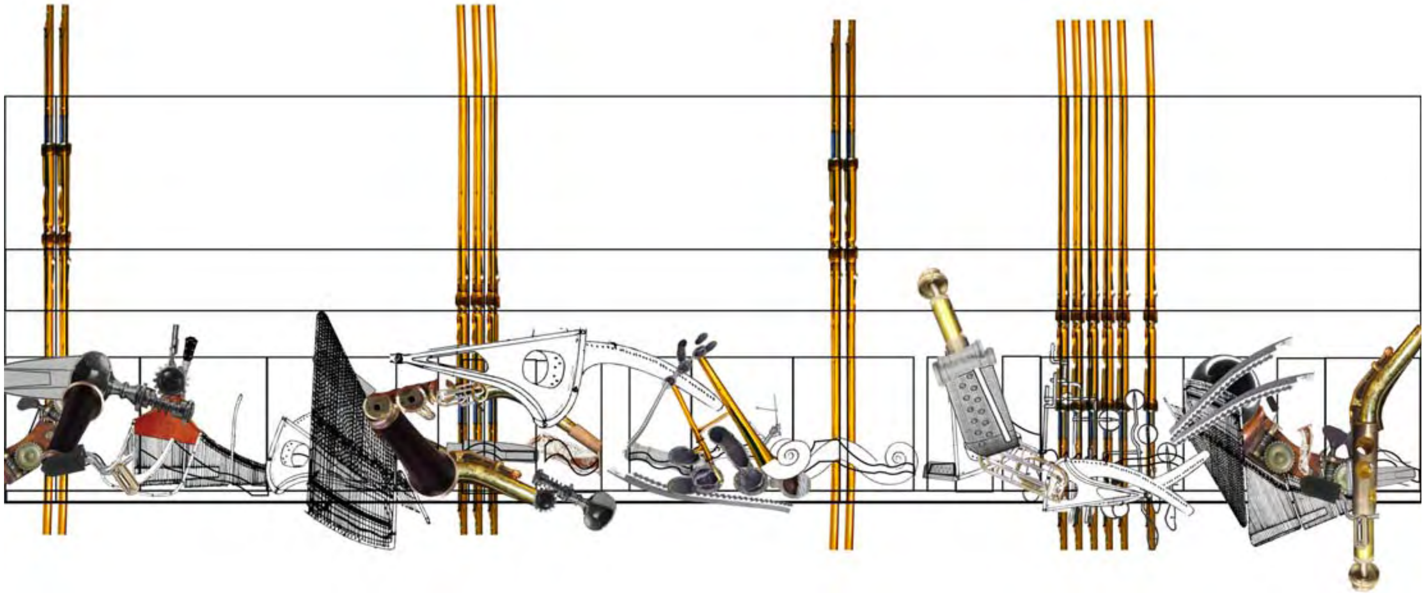


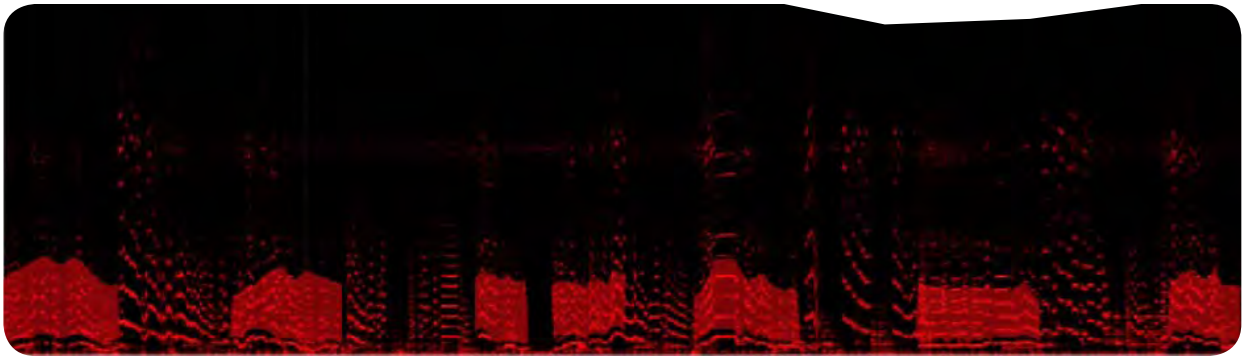


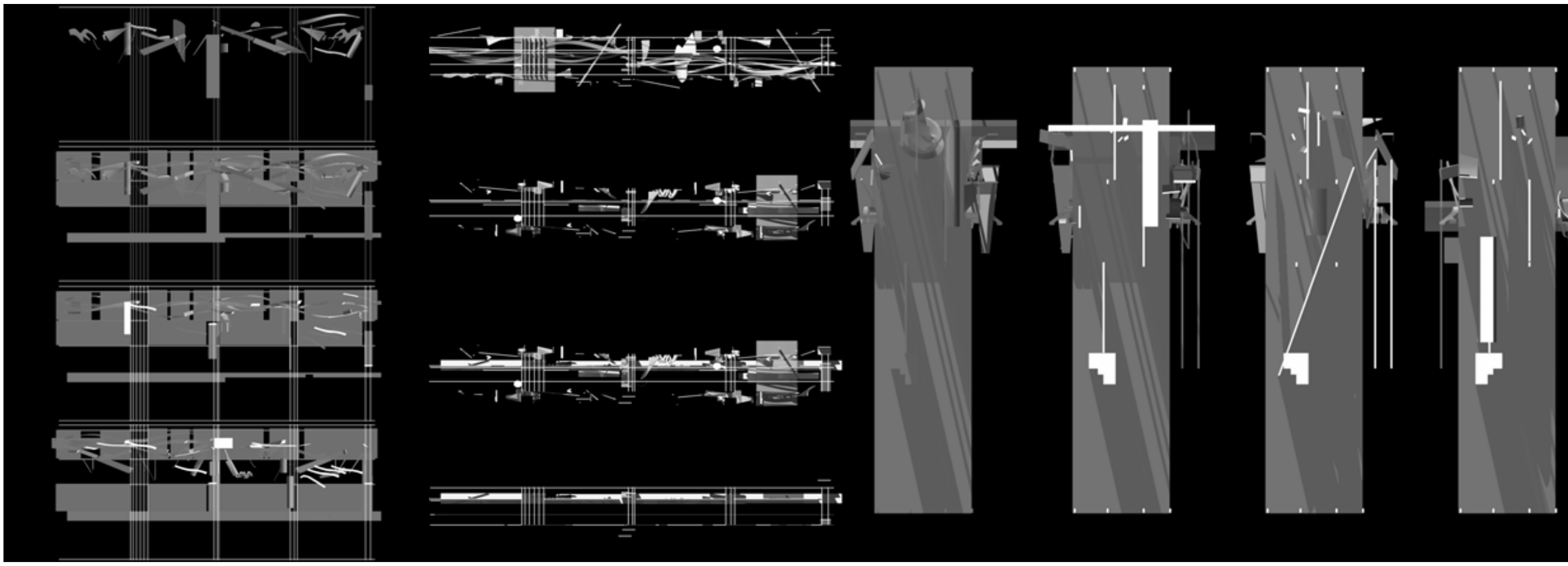




Ryan Gathmann. A spectral analysis is created using a clip from the song Leap Frog. Further simplification of the analysis defines the concepts of pitch vs. intensity which is used throughout the project. The sectional cuts become an expressive interpretation of both the fluidity of bebop music and architectural space.







University of Arts
Berlin, Germany

Construction and Atmosphere:

Modeling the tangible and intangible

by David Steiner

When dealing with the working methods and learning processes of 3D programs, one can approach the subject from various directions. The longer one works in this field, the more one begins to appreciate the structural logic of the digital programs, the interplay between program and designer, real world implications of working in the digital form, and challenges of conveying these themes to students. In this essay I present how I integrate these aspects into my teaching to instill in students a more generalized knowledge about methods and technologies beyond introducing them to software specific techniques. This enables them to have more freedom in the selection of their design medium. The first part of this essay explains my position on the digital design processes in general, while the second part describes the structure of courses I teach with specific examples.

The digital model: translation processes

The transformation from a design or a spatial idea into a three-dimensional computer model must always be seen as interplay between the individual's conceptions and expectations and how it could be represented and operated upon within the software. The computer forces a constant examination of the form, and its assembly of parts in detail. This demand for precision and specificity steers one towards a theoretical investigation resulting in a process of distillation and restructuring of the design concept. It is less important in which direction these interdependencies work, but that each decision in this process is made consciously and in a controlled manner. Being able to represent precisely (true to the idea) and then be able to control it (to study variations of theme) should be central to learning a 3D program for architectural design.

The logic that a three-dimensional program demands in every step of the way, forces one to think about the details and creates the largest obstacle for a free manner of working. So, to get around this, as a strategy, a spatial collage–developed as an image representing a specific design idea–in the form of a two dimensional representation, works the best to get the design process started. Once this collage sets the tone for design, the next and most difficult challenge is to develop appropriate strategies for three-dimensional digital representation to achieve this image. Successful strategies are the ones that support studying and evaluating the inherent design principles and the structural ideas. The next challenge is translating these into the command structure of the program.

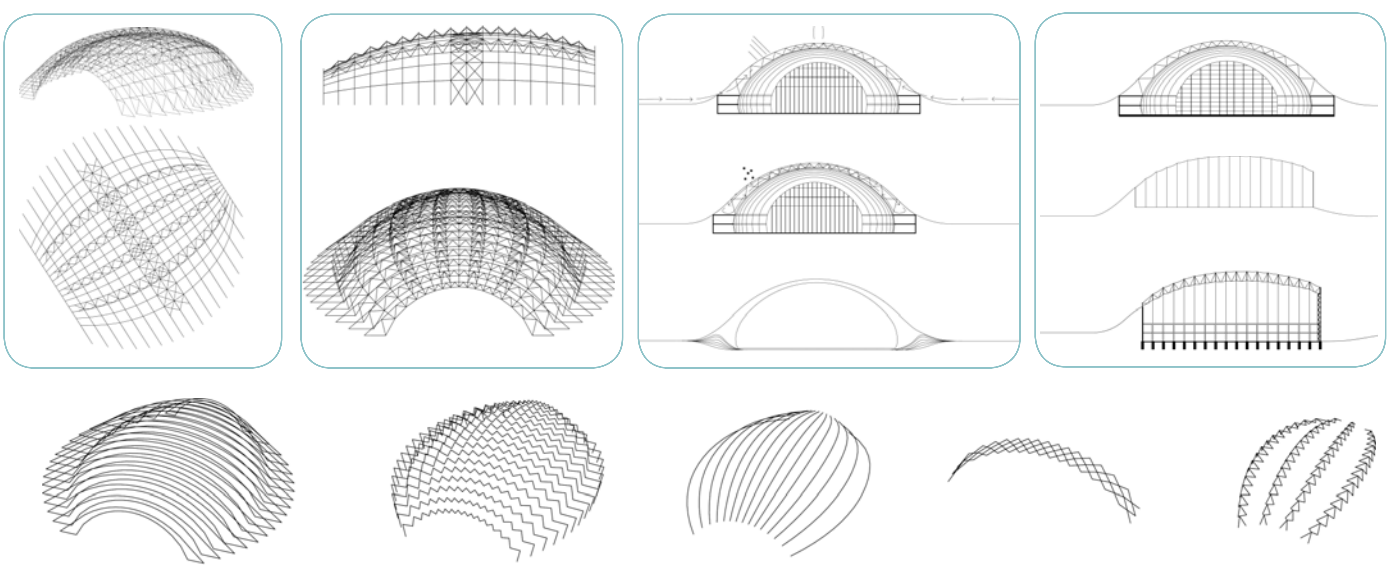


Figure 1: **Project showing structural development by Julian Schubert and Elena Schütz.**

In design studios we see a range of projects: some that excel in taking the initial concept to a deeper level of development replete with rich details which would not have been possible without the use of 3D programs. At the same time we also see others where design outcome appears to be hindered because of the 3D programs due to overly simplified details, conceptual contradictions, etc. A common preconception among the students that one cannot design with 3D programs needs to be alleviated. The issue can only be settled on a case-by-case basis, and is also largely dependent on a designer's proficiency of the program and the unique interaction formed between designer and program.

The input of a design into computer requires one to have a very good ability to abstract one's ideas within the logic of the program, without allowing oneself to become dominated by the logic. This involves the spatial disassembly of complex forms into basic elements, the geometrical definition of a free form, and the ability to define procedural steps to reach a specific end result. Figure 1 provides an example for such a process. Often there are many methods to get the same result. Students, who are successful in harnessing the specific powers of the computers in their design projects, possess this type of cognitive ability– something that cannot be provided by the computer or learned from software manuals. It should be recognized that despite the variations in interface, and number of features, every program has a certain predisposition to input, and predictable operational support. The interaction between the user and the computer always leads to special limitations with various programs. One aquires the abilities to work with the constraints, tricks, and deficiencies of the program with a lot of experimentation by "trial and error". It is important for the instructor to mediate this and pass on his/her experiences to the students.

In regard to the output of digital media, an ability to abstract is likewise required. For example, visual parameters of a printout such as sense of scale and size, line weights, patterns or colors cannot be effectively evaluated on the computer. One obtains experience with the corresponding program by making test prints and from systematic testing of variants. Proficient use of a 3D program as a tool means choosing the correct degree of exploration and appropriately limiting oneself to the relevant parameters for the input and output depending upon the task and objective, without losing sight of the complexity of the design.

Construction and Atmosphere

With an understanding of the issues of design input and output which are integral to any final presentation, the free spatial collage and the strict logical structural idea form the starting point for use of a digital program. In the last two years, **form•Z** has been preferred for use for these two distinct tasks, in a three-month long basic course I teach. This course has an enrolment of fifteen students and meets two hours per week. It deals with the basic functions of 3D digital programs involving several short projects culminating in a final project. The first project covers the coordinate system, dimensionally accurate input modes, and the logic of generative tools. In sequential order of complexity, other tools along with their functions are introduced. An effort is made to situate the functions relative to a spatial task. For instance, the derivative tools are introduced as expanders of the "degree of freedom" in modeling using existing objects – reducing the need to draw, and ensuring that forms fit with one another. The tools can be explained better in this manner and are internalized by the students more effectively. Concurrent to this, certain functions are discussed in generality, without relation to any specific programs. For example, Booleans are discussed as set operations, whose logic is applied to volumes. Much of the work is concentrated on the questions framed previously concerning the transformation process on the computer; specifically the possibilities of abstracting one's ideas based on the logic of the digital program.

Next, environment and rendering are addressed. Here as well, there are subjects that can be described in a generalized and program-unspecific way. For example, students are taught the distinction between pixel or vector-based renderings, or the ray tracing process. Simultaneously, we discuss certain specific issues as possible

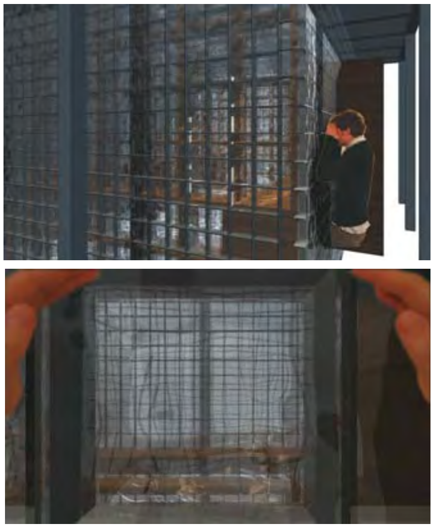


Figure 2:
Glass Brick Pavillon by Jan Lindschulte.

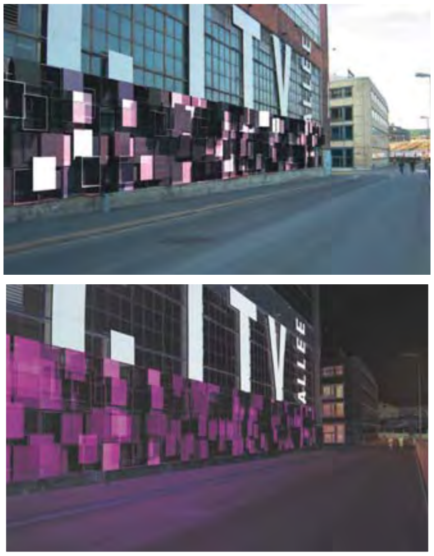


Figure 3:
Light Installation by Stefan Soom.

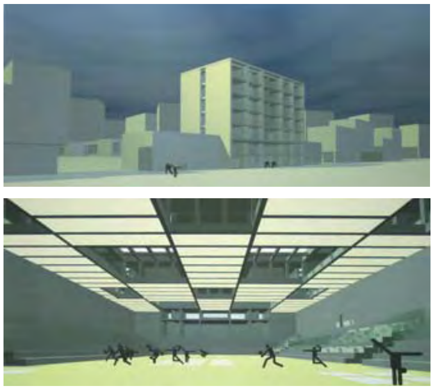


Figure 4:
Sports Center by Likas Schwind.

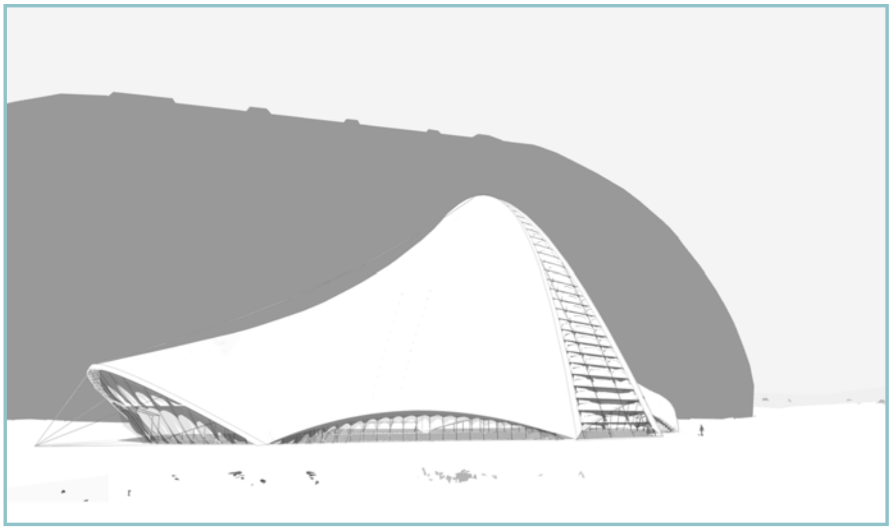


Figure 5: **Airship Hall by Veit Eickelt.**

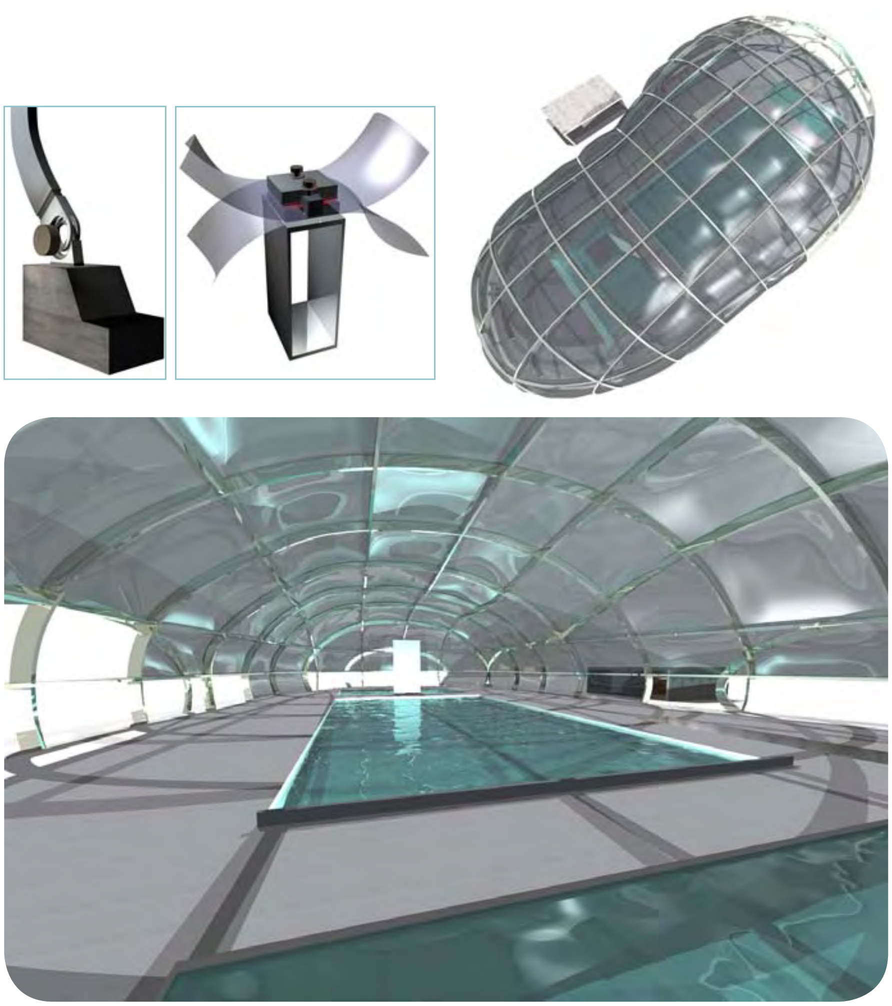


Figure 6: **Indoor pool by Ilja Bentscheff with Prof. Eddy Widijaja.**

The wing assembly of the hall is built of a light steel construction. Its surface is covered with air-filled cushions consisting of synthetic diaphragms. The main idea for this design was to develop an experimental wing assembly and to simulate its load-capacity by making use of computer calculations and models.

material settings for water or glass. Students complete several focused short projects, to gain a hands on understanding of these principles. The lessons from the program, in this regard, have more to do with matters of light, material, and environmental control; using all of the „tricks“ that these tools can offer. Essentially, my task is to identify the logic and interdependency of the parameters, which is often not evident. For example, the brightness of an object is dependent upon settings for materials, the various light sources and the environment. A central principle of my teachings in this field is that the quality of the work is dependent less upon the proximity to photorealism as it is from a precise elaboration of an atmospheric idea. If one observes design representations, the more abstract and unrealistic these atmospheric effects become, the more room they allow the viewer for interpretation.

For the final presentation, students select a project from their work from design studios. The projects are often done in groups of two or three students. With a distinct focus, they formulate “construction and atmosphere” guidelines for their projects. All projects start with a rigorous examination of logic of the form, scale, and tectonics. We formulate specific challenges for the rendering and consciously reduce the amount of modeling. My role is primarily to help develop the design approach, and help formalize steps to be taken with the digital program to translate the design into a computable form.

Perhaps the most interesting works to be mentioned, combining both aspects, are the projects from Veit Eickelt and Ilja Bentscheff. The image from Veit Eickelt, which appears so simple, yet was produced with great effort, draws its strength from the relationship between surface representation and complex geometries formed through its shadows. The work from Ilja Bentscheff is to a large degree an attempt to develop computer-generated forms that reach the limits of the program’s technical capabilities. These are examples of successful representations of “construction and atmosphere”. More examples of student outcomes of this project can be found on the DVD that accompanies this publication.

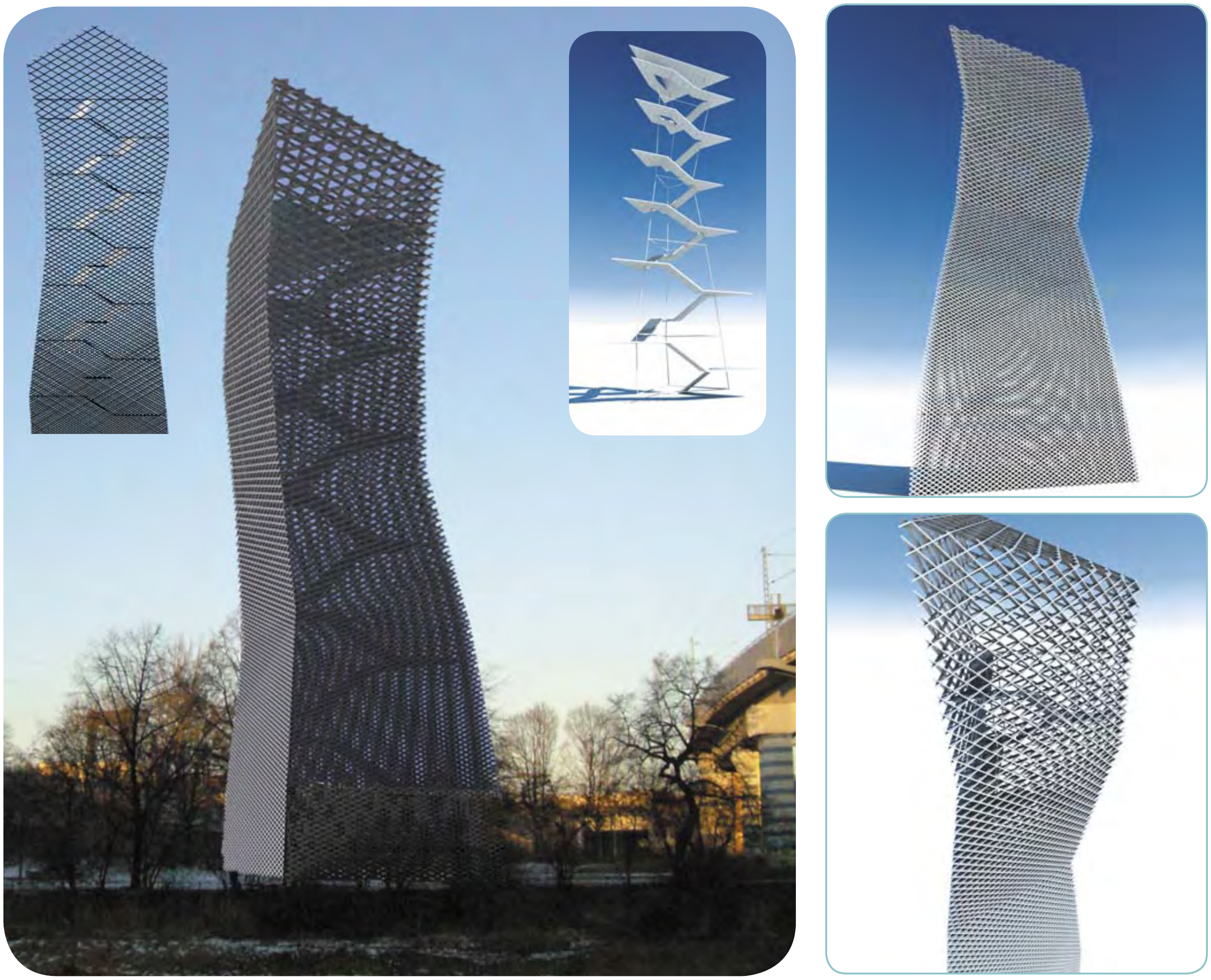


Figure 7: **Look out tower by Ilija Bentscheff**

"*The site is located at the canal, where there are two elevated train routes that separate a dense old working class quarter and a large scale industrial area of Berlin's Westhafen (West Harbour). The look out tower is a monolithic structure, 60 metres in height, competing with the huge industrial buildings in its midst. It loses its mass as it gets higher. This appearance comes out of the way the structure holds itself up. The power moments acting on the tower decrease the higher up you go. I used the legality of the structure to form the supporting frame and from this developed the diamond pattern, which widens from 30 to 90cm from bottom to top.*

The basic shape of the tower is generated by its 6 section lines and the boundary paths by the Skin tool. The top is stitched from triangles. The stairs are offset parallel to the surface with a distance of two meters. I generated their shape with the Parallel tool and diverse Boolean operations. The suspension structure that defines the surface is modelled from one line, which I scaled to distance (200x multicopy). The result was an increasing distance between the lines, which evolves from 30 to 90 centimetres. After extruding and joining them I used the Line of Intersection tool to generate the paths in the exact position of the basic shape of the tower for the surface forming panels. The panels are generated with the Sweep tool."

David Steiner was born in Hanover, Germany, and studied architecture at the University of Arts, Berlin, where he graduated with a diploma in civil engineering. Beginning in 1998 he worked as a student tutor at the university's CAD laboratory, and in 1999 he became its director. Also in 1999, David worked in the field of Architecture for Professor A. Krischanitz and Behles & Jochimsen in Berlin, specializing in competition work and 3D drawings. During this time, he also worked in collaboration with Erika Schaar for J. Mayer H, Berlin. In 2001, David collaborated on a book project with Mark Pzryrembel titled "Dortustrasse 61: Documentation of the restoration of a landmarked house in Potsdam" (editor Professor Pichler). He also worked on various architectural and cultural websites which include www.behlesjochimsen.de, www.nigihaven.de, www.mullerdechiara.com, www.huthbuch.de, and www.arch.udk-berlin.de. Since 2001, David has been working as a freelance architect in the office of Professor B. Tonon, Berlin. There he supervised the extension of Wetzlar primary school, a hotel and business building at the Zoo railway station, a shopping centre in Lichterfelde Ost and a Waldorfkindergarten. David is currently an assistant lecturer for Computer Aided Drafting and media courses at the University of Arts, Berlin. He teaches CAD and 3D programs, video layout, and image processing programs. David Steiner is a member in the Berlin Architectural Association. Email: office@d-steiner.de.

American University of Sharjah
Sharjah, United Arab Emirates

Parametric Intuition:
form_deform_reform_transform_superform_inform
(New studio methodologies and the production of digital form)

by George Katodrytis

Process vs. fabrication

"Parametric intuition" as a design process is an oxymoron. It assumes both subjective and automatic practices. On one hand, digital generative processes are opening up new territories for conceptual, formal and tectonic exploration, and articulating an architectural topology and morphology. On the other hand, the technologies of digital fabrication are radically reconfiguring the relationship between conception and production, creating a direct link between what can be conceived and what can be constructed. But there is a danger. Any digital process should be an outcome of a design-biased methodology.

One approach to the architectural design studio is the introduction of the basic methods and concepts of generative morphologies through the making of physical models. This design approach to the studio is somehow primitive. We start with intuitive notions of basic observations based on actions and forces. The process is such that unique moments of a process are identified and developed. These experiential approaches lead to ideas that are not yet concepts of spaces or buildings. Rough physical models, devises, machines and apparatuses are then constructed. These are rough and experimental. These are developed into more refined fabrications and spatial physical models. At this stage, there is no site to contextualize, nor a program to resolve. The process is intuitive and based on search than competition. The modeling process is then switched to digital.

Digital media are only a tool. As such the initial impact of the digital technology has been a complete shift in the design approach that takes human perception to a new level, notably that of repetition. The predecessor to the modern computer, Charles Babbage's Difference Engine, was derived from the Jacquard Loom, a machine for automating the repetitive task of weaving. As a device for repetition, the logic of repetitiveness has become highly refined in the field of computing.

Digital defamiliarization

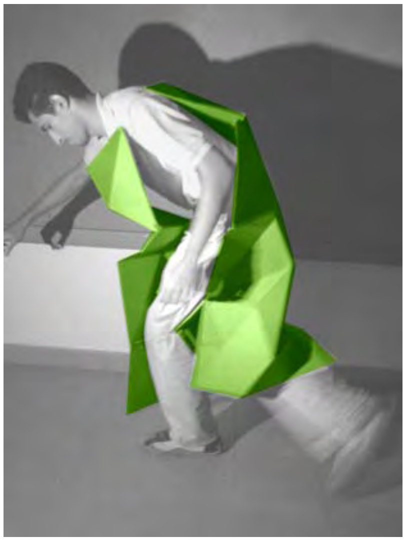
The primary role of computer-aided design in architecture and architectural education is one of invention followed by fabrication. One can unleash within a digital environment a population of virtual intuitive and formal explorations. This medium may prove to be the most valuable instrument in pedagogy. In a fabricated landscape where form follows simulation, the modeling machine becomes an instrument of intro-jection and reflection, placing itself both inside and outside in a world of speed and endless variations. The emphasis of the exploration is on morphological complexity. The new tools of topological procedures allow operations such as stretching without tearing, and folding without gluing, preserving only a set of very abstract properties invariant. According to Benjamin, the aesthetic experience consisted of keeping defamiliarization alive, as contrasted to its opposite - familiarization and security. This, taken into the studio design process, turns into a fascinating endeavor, as the outcome is not visible form the outset.

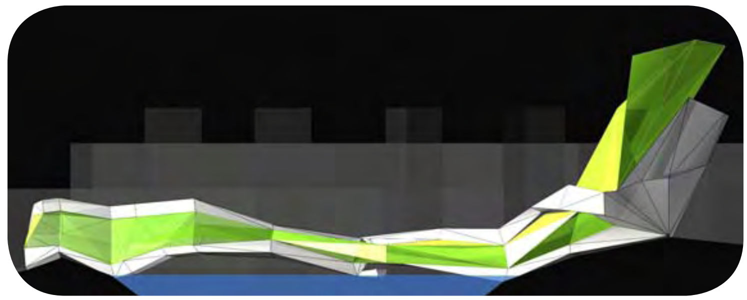
The Russian critic and writer Shklovsky describes "defamiliarization" as "*stumble[ing] onto a poetic something that was never meant, originally to serve as an object of aesthetic contemplation*". Shklovsky developed the concept of ostranenie or defamiliarization in literature. He explained this idea as follows: "*The purpose of art is to impart the sensation of things as they are perceived and not as they are known. The technique of art is to make objects 'unfamiliar', to make forms difficult, to increase the difficulty and length of perception because the process of perception is an aesthetic end in itself and must be prolonged. Art is a way of experiencing the artfulness of an object; the object is not important.*" (Shklovsky, "Art as Technique")

Architecture, like philosophy (and for that matter, biology and physics), is perpetually verging on and irresistibly drawn to its own virtualities, to ever-increasing loops of uncertainty and immanence that its own practices engage and produce. The future of each discipline requires that each open itself up to reconsideration of the virtual, and the promise for newness, otherness and divergence from what currently prevails.

Digital invention

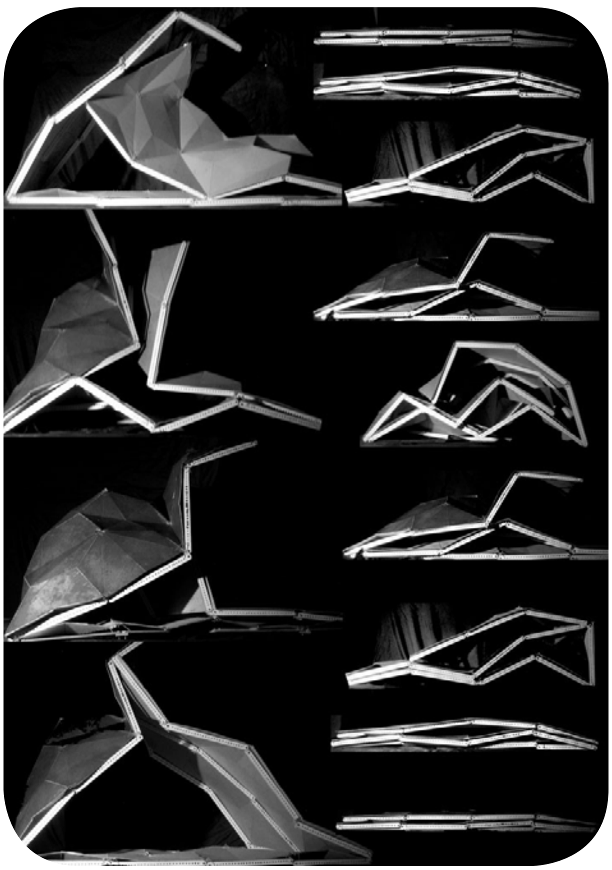
Instead of denying complexity, lack of control and contradiction, one may embrace these conditions and declare them as the starting point for projects. Utilizing the dynamics of transitional and evolutionary space, a studio program may develop new ideas and techniques for architectural proposals with design systems based on procedure and recursion, in order to index relationships between material systems, programmatic organizations and, ultimately, new formal languages. These design systems are tested through physical and digital models for their capacity to generate effective architectural responses. Students visualize architecture as an amalgam that sustains evolving transformations through multiple, diverse, and often conflicting and unpredictable forces. The

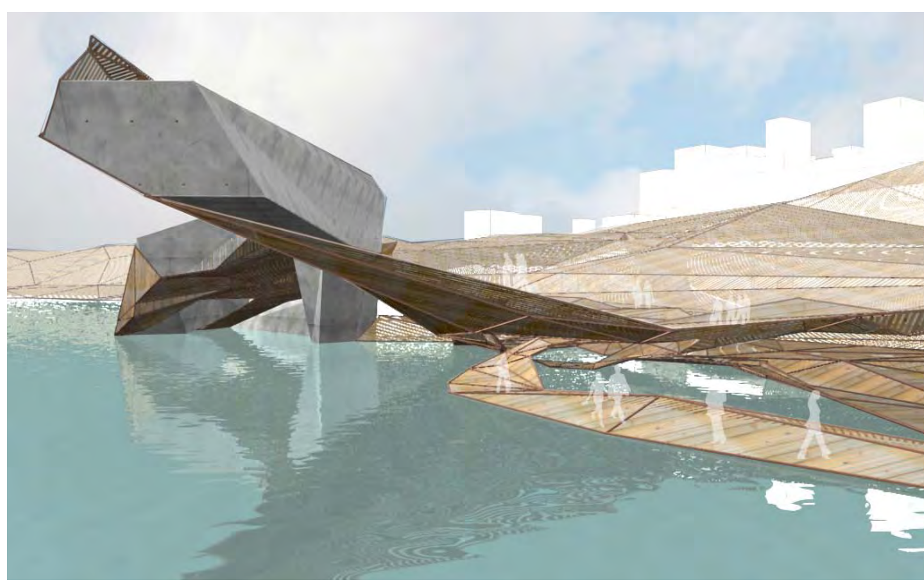




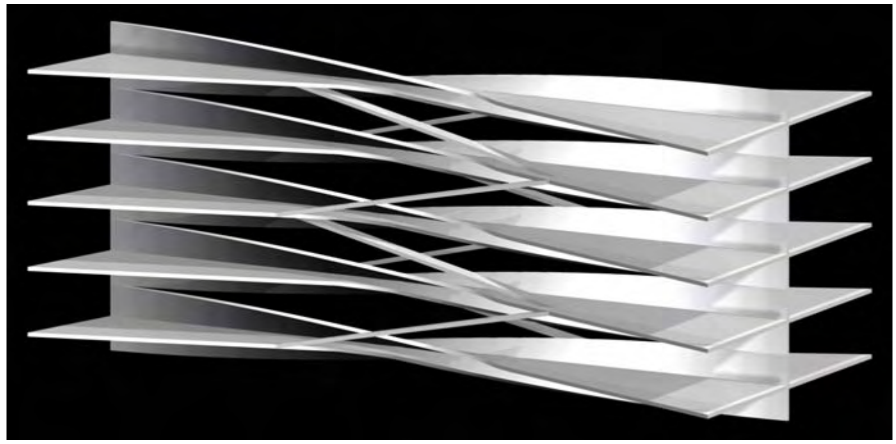
Barrak Al-Babtain:
Trans_form_ative urban_ism

Early experiments of body prosthetics as an abstract machine leading to the generation of form through digital mapping. Proposal for an artificial beach, with a hotel and customs at Dubai's creek/waterfront, UAE.





design process begins with the hypothesis that, in order to liberate architecture from functional preoccupations, one should relinquish the notion of function as a base-data from which design briefs and projects should originate. It develops performative morphologies that may alter the environment and, in doing so, suggest alternative forms of habitation. Liberated from the obligation to communicate meaning, architecture is free to give full expression to its creative potential. Fostered by an unapologetic fascination with formal language, the research aims to develop a cohesive and justifiable contemporary architectural language. The focus of this studio is twofold: the study of a particular notion of syntactic and morphological language (typology), and the investigation of geometric configurations (topology).

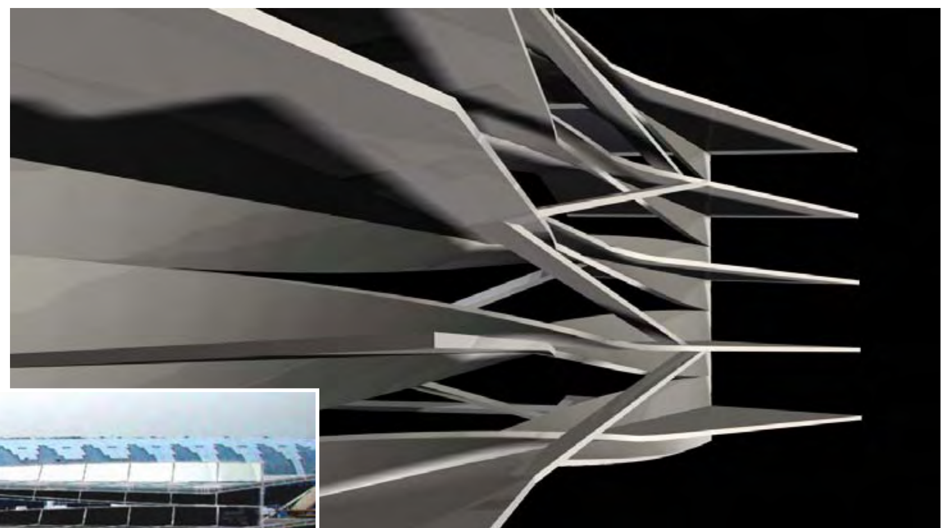


Hend Al-Matrouk:
Trans_form_ative urban_ism

Rotating planes creating continuous loops of corridors for facilitating movement for an airport terminal building: incoming, outgoing and in transit passengers. Dubai Airport, UAE

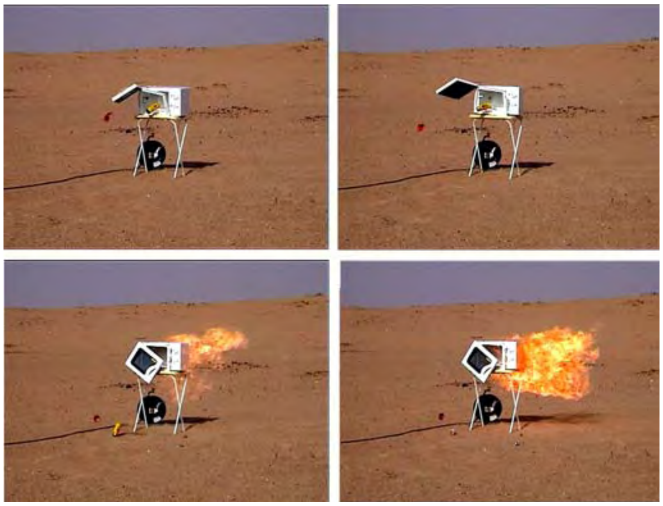
Digital Transformation

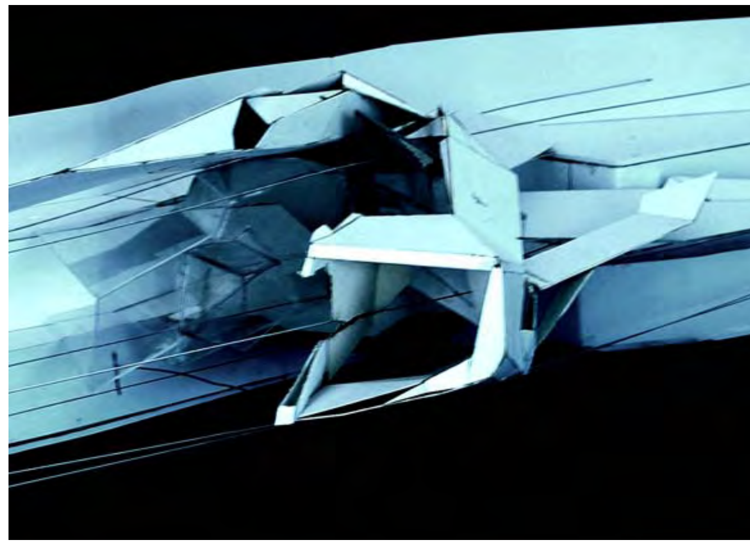
Transformation is central to the process of design. To start with, one approach to design in the digital architecture studio can be paradoxically primitive. This studio introduces the basic methods and concepts of generative morphologies though the making of physical models. The experiments in morphogenesis are based on an abstract formal system that is autonomous and deterministic once the rules are set and defined. It has the capacity and tendency to be transformed. To this extend, architecture is about transformation and exploration. Recent developments in digital methods have emphasized the exploration for morphological complexity. The construction and selection of rules that produce specific effects is motivated by aesthetic and plastic sensibilities. For the first time, architecture is genuinely searching for complexity of this formal type, in order to keep in touch with that of the city of the networks and systems, with the intricacy of culture and the vagueness of globalization. This abstract machine therefore calls into question traditional methods of architectural design and proposes a design process in which the architect becomes an inventor or constructor of formal systems. At the same time, it takes on the role of a navigator of the system's behavior over time.

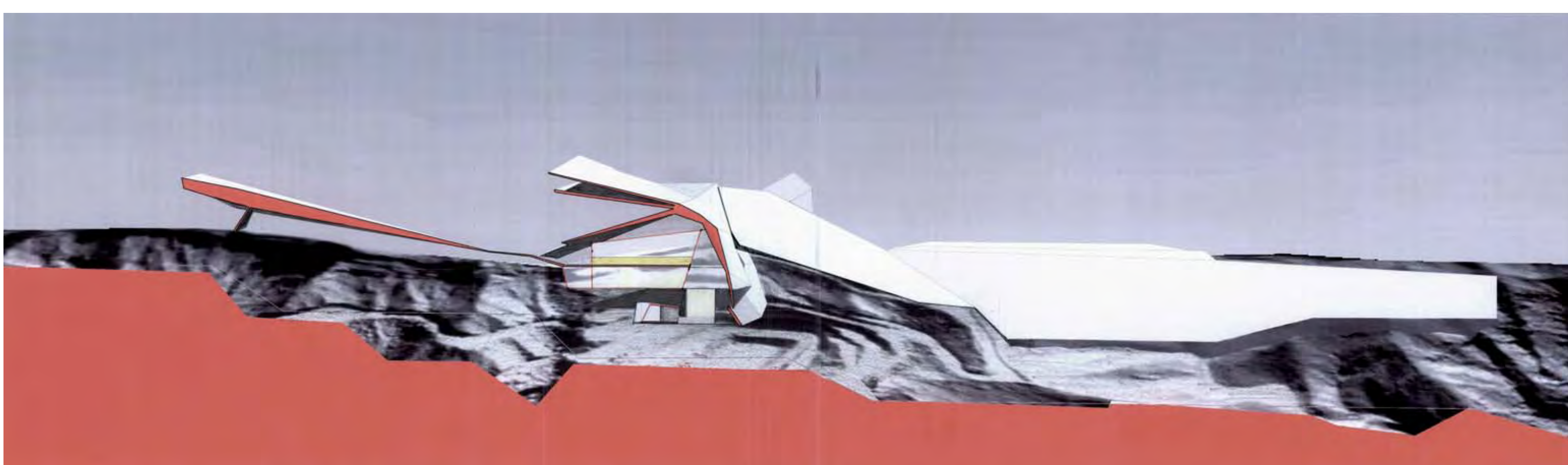


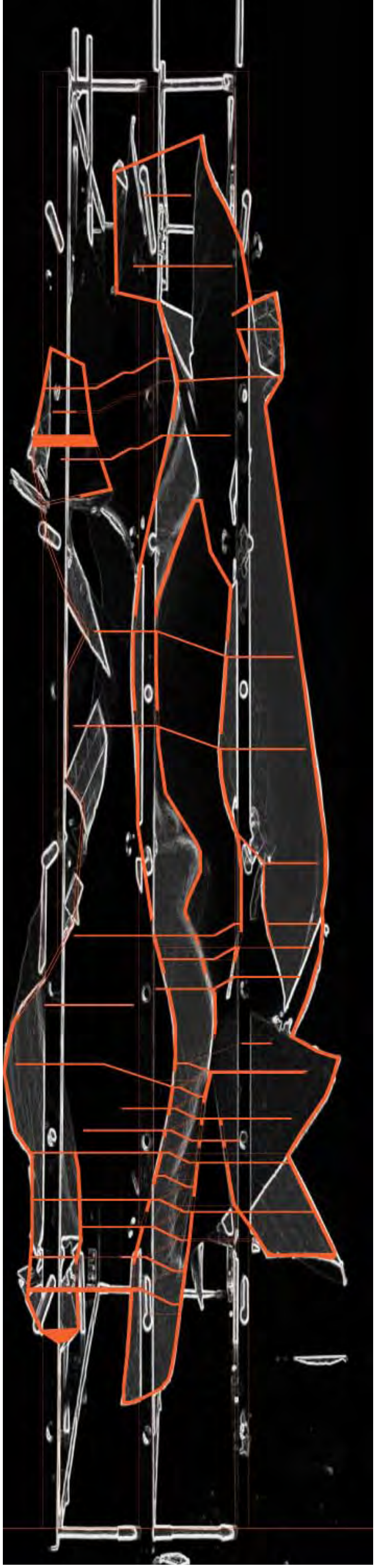
Basel Shuhaiber: Trans_form_ative urban_ism

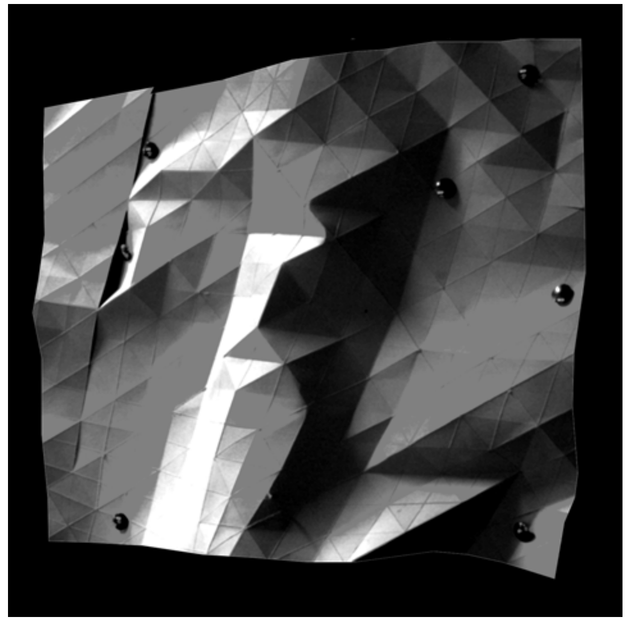
Abrupt transformations on the desert and the development of a kinetic enclosure to facilitate take off for a gliding school, Sharjah, UAE.

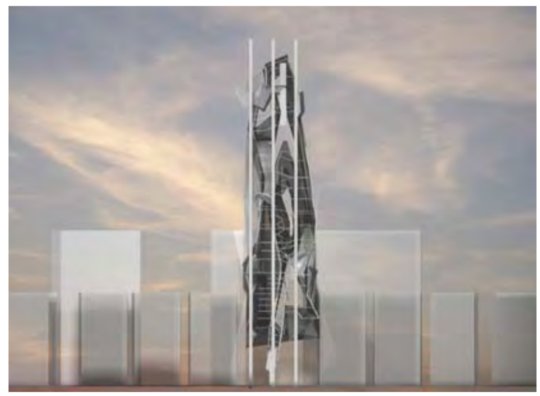






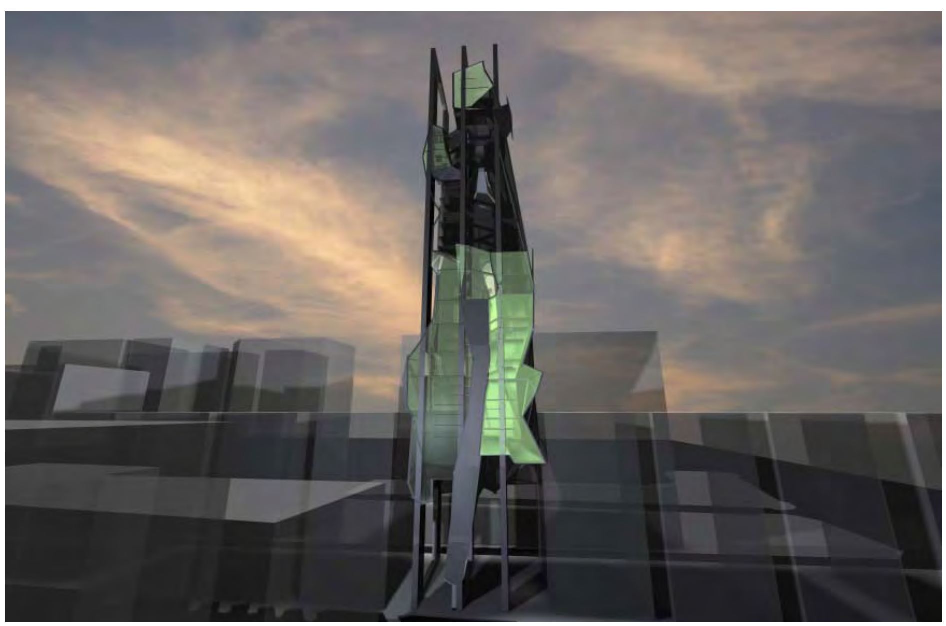






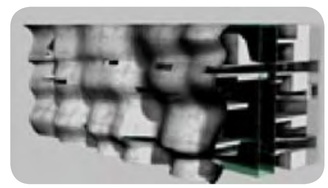
Tarik Nour:
Trans_form_ative urban_ism

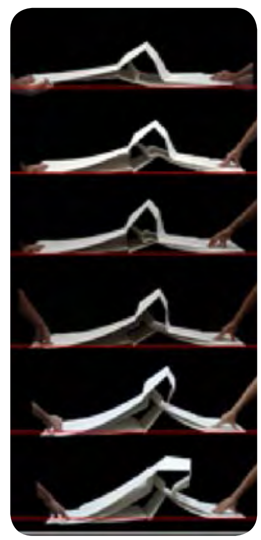
A devise for surface tessellation and adaptation develops into a vertical, flexible and rentable space thus commenting on Dubai's current inflexible office high-rise design, UAE.

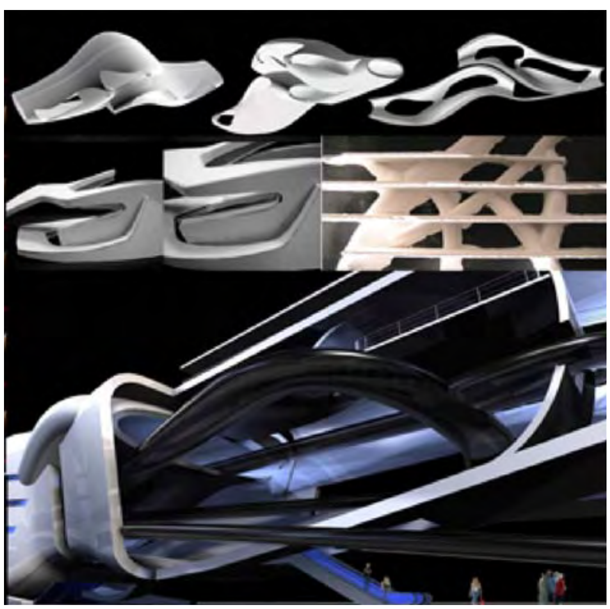


Collage

Collage of various studio projects demonstrating the transformation of physical to digital modeling.







George Katodrytis, B.A.(Hons), A.A. Dip., R.I.B.A. is an architect involved in practice, teaching and research. He is currently Associate Professor of Architecture at the American University of Sharjah, UAE. He studied architecture at the University of Manchester and the Architectural Association (AA). He worked with Bernard Tschumi in Paris, and with Michael Hopkins in London. He has taught at the AA and Bartlett. He has been a visiting professor at various schools in the UK and US, and at the Academy of Architecture in Moscow. In 1994, he established "George Katodrytis Architects" and built a large number of projects. He has lectured and exhibited widely. StudioNova Architects was established in 2003. The practice is involved in contemporary architecture, urbanism and cultural theory. Digital technology is adopted as a tool for establishing new formal languages. Experimentation and writings on contemporary design methods, processes and fabrication techniques, as well as advanced use of digital media are adopted for the design of small and large projects. The work addresses the contemporary "city," especially as it is evolving in the 21st century.
Email: gkatodrytis@aus.edu Web site: http://www.katodrytis.com.

University of Oklahoma
Norman, Oklahoma

Conceptualizing, Modeling, and Visualizing Space
Using form•Z in Design Curriculum

by Abimbola O. Asojo and Adam Lanman

Introduction

We present a pedagogical approach which utilizes **form•Z** in conceptualizing, modeling, and visualizing space in the architecture and interior design programs at the University of Oklahoma. Through several years of teaching **form•Z** in studio and lecture format, we found the program to facilitate student design exploration in three-dimension, visualization, and teaching of lighting design techniques.

Architecture Studio

form•Z utilization is entirely integrated into the studio sequence in architecture. The third year digital studio set out to introduce and explore a series of concepts within the physical and conceptual frame of digital architecture. In the studio taught during 2005-06 academic year, each of the three projects throughout the semester emphasized specific theoretical and practical issues while building towards an end product that realized the totality of the studio intent. Each project challenged the students to work far outside the box, so to speak, however practical concerns of building function and structure were continually being emphasized within the digital context of three-dimensionally sculpting a building.

With an introduction of specific modeling techniques, the students began to think and sketch using quick volumetric assemblies directly in **form•Z**. The challenge to the studio was to understand these new tools in a more sophisticated way than as simply new sets of forms and shapes.

The first project involved digitization of physical forms into computer models. This was achieved by first scanning cut segments from a fiberglass model and then transforming the polygon images into vector shapes. Finally the vector shapes were meshed together as a three-dimensional form using **form•Z** (Figure 1).

The second project emphasized issues of interface design and digital presentation through linking QTVR environments created in **form•Z** together and creating an experiential digital environment (no figures included).

The 'Lever House' project engaged all the ideas and methods from the previous two in the studio. The project takes on the challenge of ubiquitous computing in the context of responsive environments: spreading and integrating computation into the environment in order to enable people to move around and interact with computers more naturally than they currently do and achieve invisibility in use and embodied interaction. The studio took on the mantra of Weiser: "*The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.*" The project took an urban site currently home to the modern icon, the Lever house in New York City. The results show a series of buildings for living that derive from both building function and the idea of the building as a living interface working for its inhabitants. Figure 2. shows an exampleray project. More examples of student work from this project can be found on the accompanying DVD.

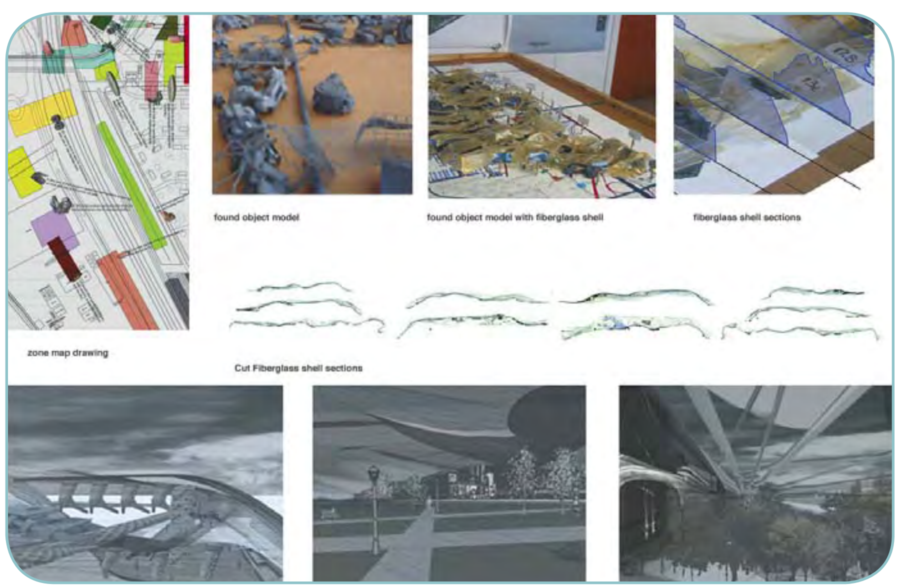
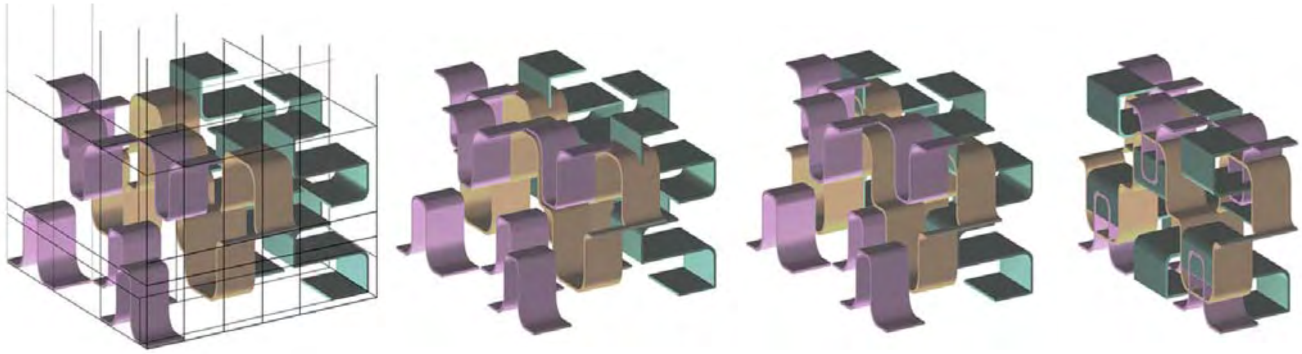
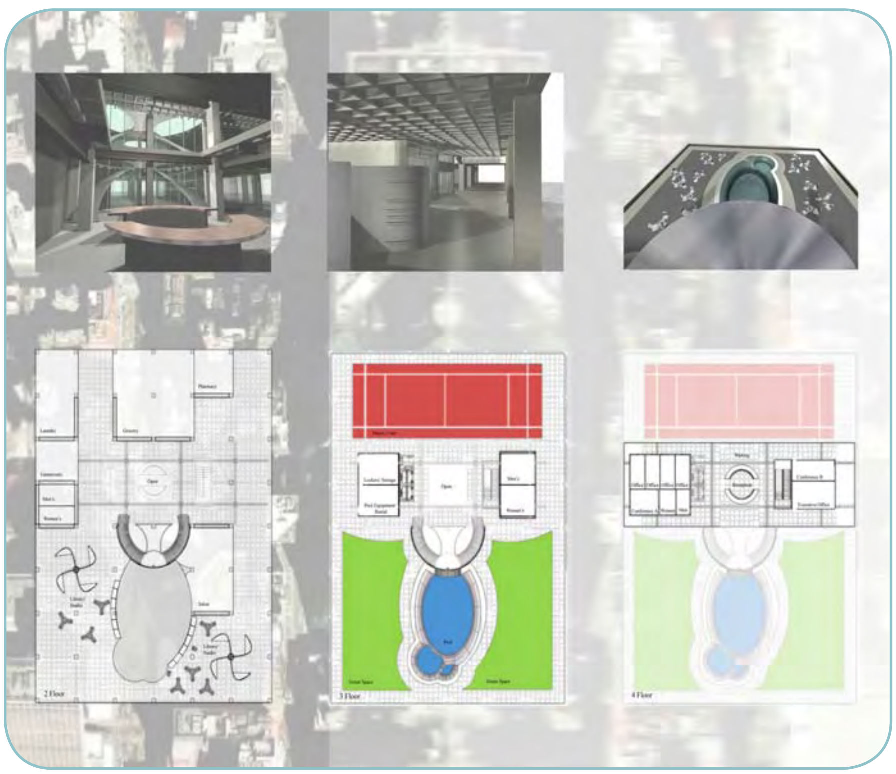


Figure 1: **Introductory project: digitization of physical forms into computer models.**





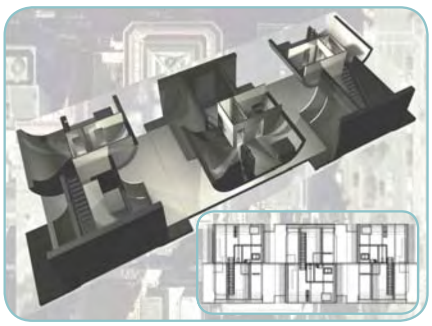


Figure 2:
Lever House by Stephen Chaffin.

Interior Design Studio

The process of utilizing **form•Z** takes two approaches in Interior design. First, in their second year graphics media course, students use it to learn about three-dimensional modeling along with other software including Autocad, Autodesk Viz, etc. Secondly, they used it in upper level courses such as lighting design and fourth year studio. The underlying principle in both approaches is that design entities and configurations are better created and visualized in 3D rather than in 2D. **form•Z** enhances the design process effectively and efficiently more than physical modeling because the interface allows student to quickly model and visualize space, as well as the opportunity to make quick modifications. **form•Z**'s support for dimensionally accurate input, versatile support for grids, facilitates student understanding of scale in three-dimensional space.

Lighting techniques in computing are usually challenging at the lower level studios because students do not yet understand the types of light and lighting concepts, particularly in relationship to interiors. One of the objectives of the third year lighting design studio is to teach aspects of lighting through computer visualization. The light palette is utilized to teach and facilitate student understanding of ambient and directional light sources in lighting. The point and distant light types are used to teach the concept of ambient lighting. The cone light is used to teach techniques of wallwashing, grazing, silhouetting, and directional lighting. The projector light is used to illustrate image projection techniques from an LCD in a conference room.

In the fourth year, their final year, students have the opportunity to present their capstone final year projects using computational techniques. In this project, students bring together the knowledge gained in their second and third years in modeling, lighting techniques, and material application through integrating these techniques in their final projects. Figures 3 and 4 illustrate rendering from fourth year interior design studio projects.

Conclusion

In both the Architecture and Interior Design programs **form•Z**'s unique interface continues to foster the ability to design volumetrically; explore form; model interior and exterior spaces; and simulate photorealistic renderings. In the Architecture program, computer modeling is integrated directly and taught in studio along with the other studio objectives. By contrast, in the Interior Design program separate courses are offered which focus on teaching computer modeling in a lecture lab format and students build on the concepts learned and implement the techniques in studio projects. Both programs are successful in encouraging students to engage **form•Z** for conceptual design.

References

Asojo, Abimbola. "Digital Trends: Visualizing, Designing, and Communicating in Architecture Representation." *Journal of Design Communication* (2000): p. 32-43.

Weiser, Mark. "The Computer for the 21st Century," *Scientific American 265*, No, 3, p. 94-104, September 1991.

Figure 3: **Adaptive reuse project in Oklahoma City by Monika Karriker**

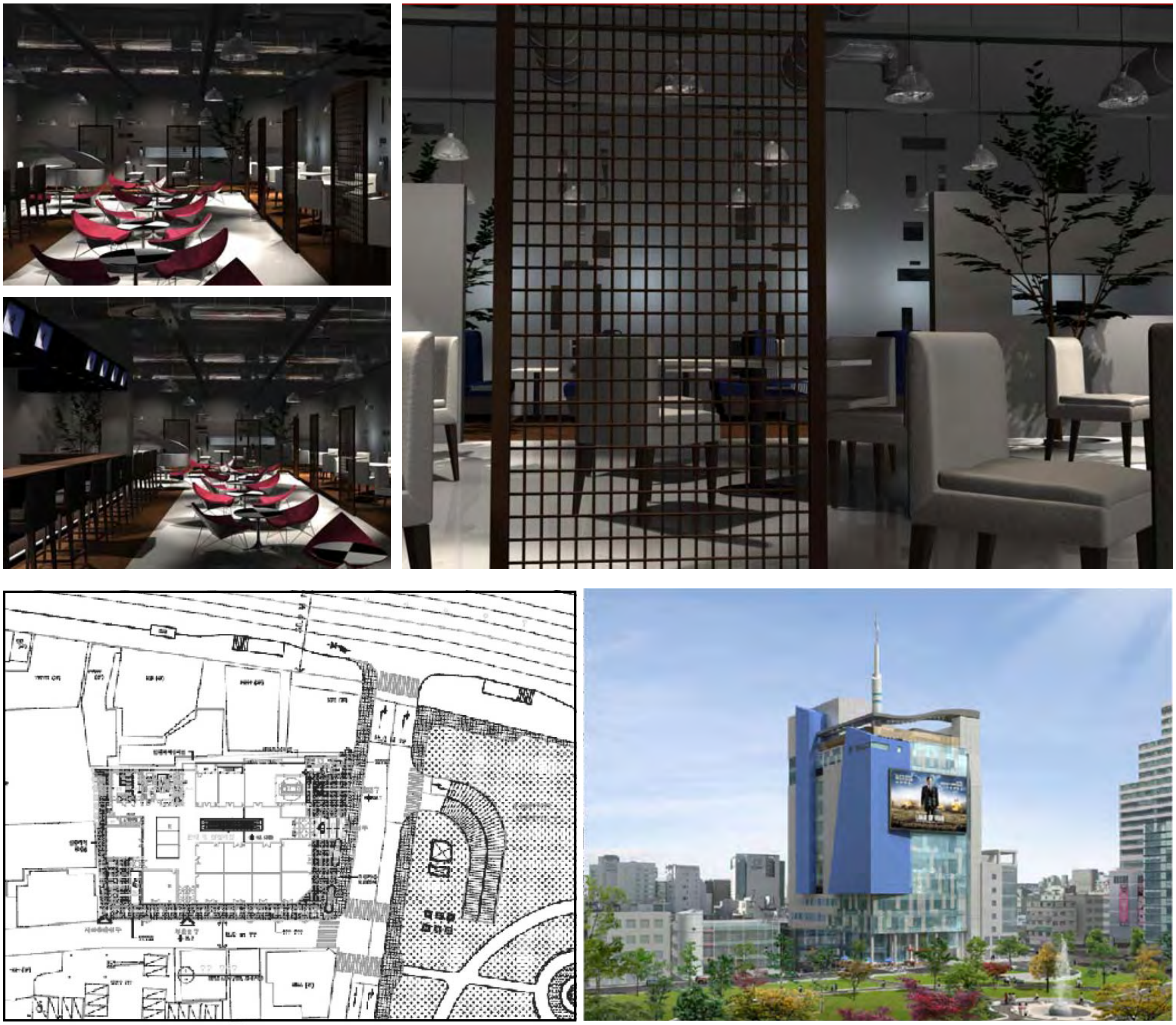


Figure 4: **Multiplex design project in Korea by Kyunju Kim.**

Abimbola Asojo is an Associate Professor and the Director of the Interior Design Division at the College of Architecture, University of Oklahoma. She holds a Masters in Architecture: Computing and Design from University of East London, and Masters and Bachelors in Architecture from Obafemi Awolowo University, Nigeria. Her teaching areas are lighting design; architecture design and human factors; computer modeling; corporate design; and commercial design. Her research areas are cross-cultural design issues; African architecture; computing and design; lighting design; and global design issues. She has published several articles in various refereed journals. She is a licensed architect in the state of Oklahoma and a member of the American Institute of Architects (AIA). Some of her design projects include Akinsola House, Ibadan, Nigeria; Al Manshar Commercial Complex, Kuwait City, Kuwait; Boley Museum of African-American Culture, Boley, Oklahoma; Light Club, Houston, Texas; and Safe Plaza Fitness Center, Houston, Texas.

Adam Lanman is an Instructor at the Architecture Division at the College of Architecture, University of Oklahoma. He holds a Masters of Architecture and Architectural Design Minor in Film & Media Studies from Cornell University and a Bachelor of Architecture from the University of Oklahoma. His teaching areas are architectural theory, design studio, and history of architecture.

University of Texas at San Antonio
San Antonio, Texas

form•Z in flatWorld: A Critical Close-Reading

by **Mahesh Senagala**

Introduction

The story of **form•Z**'s unique position among dozens of other geometric modelers is well-known. Most of the discussions about **form•Z** have been centered around a narrow focus on the features, technical capabilities, formal results, and comparisons to other software products in the market. In this paper, my intention is to shift the discussion away from a pejorative comparison of "what it can do" and steer it toward a more scholarly and systematic consideration of "what it is." It is indeed surprising, if not shocking, to learn that very little rigorous scholarship is available on understanding, analyzing, and framing the relationship between **form•Z** as a critical construct and the discipline of architecture. Continuing the line of thinking that the author proposed in his article on the critical close reading of AutoCAD (Senagala, 2004), he would like to propose that **form•Z** be viewed not merely as a software product that is a set of digital tools delivered on a CD-ROM. Rather, he proposes that **form•Z** be viewed as a comprehensive enterprise that is an equivalent to such significant buildings as Villa Savoye, or an equivalent to such theoretical frameworks as "Ornament and Crime" by Adolf Loos. Although this is an unusual proposition, the author will try to make a case for considering the critical significance of **form•Z** and the institution of its production to the discipline of architecture. The paper will begin with an examination of the initial argument that gave rise to **form•Z** fifteen years ago, and will conclude by examining the relevance of that argument today.

This paper will examine **form•Z** from two different yet related perspectives. The first perspective will examine how **form•Z** evolved as a "critical argument" as embodied and expressed in its interface design. The second perspective will examine the institution of **form•Z**'s production as an integral part of **form•Z**'s lifecycle and evolution. Further, the author will discuss possible future directions for not only **form•Z** but also CA(A)D in general.

It is not the intent or within the scope of this paper to evaluate **form•Z**'s manifest impact on the profession in terms of whether or not it transformed the design practices and processes as a tool. The author makes no claims either way. Rather, the focus here will be on examining if and how the "intent or argument" of **form•Z**'s designers is translated into the architecture of its interface, and into the modes of production and evolution of the software.

flatWorld: The Exponentially Changing Context

The world to which **form•Z** was introduced more than fifteen years ago, was very different from the world today. The growth and evolution of **form•Z** coincides with one of the most dramatic cultural shifts in the world. In 1991, AutoCAD® Release 11 was in vogue in the profession and in many schools of architecture. Manual drafting and techniques of drawing with traditional media were very much prevalent at that time. Many schools that emphasized design took pride in the mastery of traditional representational media. Also, deconstruction and the tail end of postmodernism were in vogue. The postmodernist obsession with semantics, double-coded communications, and valorization of all things historical eased into the deconstructivist taking-apart of texts and contexts. Computational tools available to architects were either glorifications of manual, two-dimensional media or fairly crude forays into three-dimensional modeling. Such advanced tools as IBM-Dassault CATIA were expensive, ran on expensive platforms and virtually unheard of among architectural circles until Frank Gehry adopted it in the early nineties. For all practical purposes, "fabrication" meant a lie. Except for academic circles, email was an exotic creature and "webs" were still populated by real spiders.

Of the last fifteen years, the last five years have been the most phenomenal in changing the world geography and economics. As outlined in the now well-known book *The World is Flat*, Thomas Friedman draws a world in which information, goods, and people flow with greater connectivity, speed, and entanglement than ever before in human history (Friedman, 2006). Friedman observed that the exponential connectivity and easy access to the Internet coupled with trade innovations have flattened the world into a level playing field. Irrespective of the actual merits of it, the flat world metaphor does capture at least some of the global transformations today. Perhaps our smart homes in, say, the USA, will be monitored or troubleshot or unlocked by customer service centers in India or elsewhere. Perhaps significant amount of architectural production, design, and coordination will be outsourced globally in the near future. Gone were the days when only a few privileged researchers at exclusive places like MIT and Carnegie Mellon University were toying with CA(A)D[a] on million-dollar computers. Today, the world of CA(A)D is a level playing field for anyone anywhere in the world. The context, role, reach, and relevance of CA(A)D has changed significantly since 1991.

The last five years have also seen the emergence of a shift in our view of how computing power could be applied in architecture. Our thinking is beginning to shift from the notion of computing affecting architectural design (as in CAAD and BIM) to computing in the making of architecture (digital fabrication) to the notion of computing integrated into architecture (smart and responsive architecture). Kevin Kelly's prophecy about a networked world are already becoming a reality: "the central act of coming era is to connect everything to everything. All matter, big and small, will be linked into vast webs of networks at many levels. Without grand meshes there is no life, intelligence, and evolution; with networks there are all of these and more" (Kelly, 1994). William Mitchell has put it lucidly when he said that "we become true inhabitants of electronically mediated environments rather than mere users of computational devices" (Mitchell, 1999). Mark Weiser's predictions about ubiquitous computing are becoming a pervasive reality (Weiser, 1991). Architecture that has some amount of global connectivity and real-time intelligent responsiveness is bound to be here and alter the way we approach how we dwell, and thus how we design and build.

Looking at longer term prospects and the continuing flattening of the world, Ray Kurzweil's compelling observations and arguments about what he calls Singularity are pointing toward radical possibilities, convergence and emergence in computational intelligence and biology (Kurzweil, 2005). Even if Kurzweil's observations are only fractionally accurate, we will see exponential (not linear) changes in terms of computing, integration of computational power and intelligence with all things natural and artificial (including architecture). We will see computational intelligence nearing human intelligence. It may be unsettling or even uncomfortable to consider such a longer term vision, but it would be unwise not to dwell upon such a perspective in discussing the future directions of CA(A)D.

As remarked earlier, questions of representation dominated the world of architecture in the seventies, eighties and early nineties. Coincidentally, emphasis on drafting and drawing were prevalent at that time. At present, questions of computability of complex form have come to dominate the architectural discourse. Not surprisingly, three-dimensional modeling and fabrication have been in vogue now. Whereas form is about containment, intelligence is about connectivity, integration, and responsiveness. If we are moving toward connected and intelligent architecture, we have to take into account the questions of computability of intelligent containment (smart form) and systemic performance (smart system) as well as systemic connectivity (smart networks), similar to biological organisms and processes. New times will need new arguments and new responses.

form•Z: Software as "Argument"

The roots of **form•Z** could be traced back to many of the academic and research projects that Chris Yessios undertook in seventies and eighties (Yessios, 1987). Chris Yessios has been quoted as saying that "**form•Z** is an argument against drafting" (Serraino, 2002). In his seminal paper written in 1986 "What has Yet to be CAD," Yessios identified the realities and challenges for computer-aided design tools and how they should differ from mere drafting or visualization tools often mistaken to be CAD. By drafting, Yessios did not mean mere technical drawing. He meant representational means that arrive after the completion of design (problem solving) process. For Yessios, CAD had to actively assist in the conceptualization, generation, and evaluation of design decisions. He wrote:

> *Design includes all activities which occur before a solution, final or preliminary, exists. It includes activities such as problem solving, decision making, value judging, conceptualization, information retrieval, and compositional creativity, where the list is not exhaustive. After a solution, preliminary or final, has been decided upon, it needs to be externalized and communicated either for visualization or construction purposes. The latter is done through drafting. Drafting is not involved with any problem solving oriented decision making, other then possibly deciding what line weights are to be used in what parts of a drawing.* (Yessios, 1986)

Yessios speaks of **form•Z** as a commercial package and downplays the larger academic and critical dimensions of the software (Serraino, 2002). Nevertheless, **form•Z** does stem from an academic argument against drafting when it began in early nineties. Upon close examination, the academic intent **form•Z** and its critical dimensions could be uncovered. The author would liken **form•Z** to Le Corbusier's Villa Savoye in the sense that both are critical constructs within the realm of architecture that challenged the prevailing norms. At first blush this might sound like an incongruent, exaggerated, or far-fetched comparison. But, it isn't.

Figure 1: **Villa Savoye (Photo courtesy Brian Pirie, Creative Commons (CC) Attribution 2.0).**

When Villa Savoye was built in 1930, it was an argument against a number of classicist dictums (Figure 1)[b]. Villa Savoye was a critical construct, an argument against the classicist canons of tripartite division, importance of the hearth, primacy of ground, non-inclusion of the automobile, etc. (Figures 2 and 3). Corbusier inverts almost all of the classicist conventions. Villa Savoye reads as an argument against many of the architectural conventions of its time. To use a Foucaldian term "valorization," Villa Savoye not only inverts but valorizes these inversions. It exaggerates, to the point of exclusion, in order to make a point. For instance, Villa Savoye stands on slender pilotis without a solid classicist base or massive columns (Figure 3). It embraces the automobile as an integral part of its program by accommodating its path and parking within the building's boundary. Villa Savoye rejects and inverts the traditional notion of "ground" by forming a garden/terrace on the second and third floors (Figure 4). The conventional notion of rectangular, punched openings as windows was questioned through the use of stretched ribbon openings. Servant quarters, which were usually relegated to the attic were situated on the ground floor in the villa (Figure 3). The fireplace was displaced from its usual central position on the ground floor to a relatively marginal position on the second floor (Figure 5)[c]. However, Villa Savoye is not just a reactive or subversive argument. It is also proactive in formulating a new agenda.

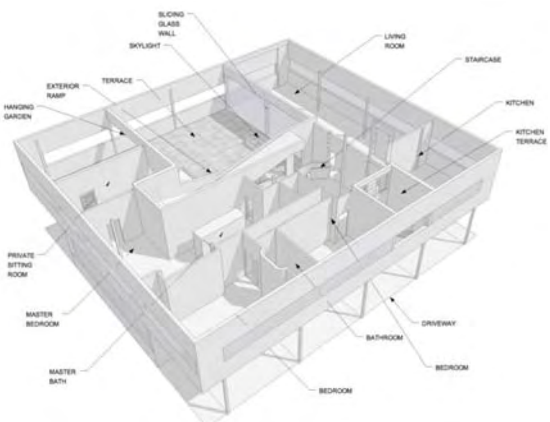


Figure 2: **Villa Savoye First Floor Model (Courtesy, architypes.com, CC Attribution 2.5).**

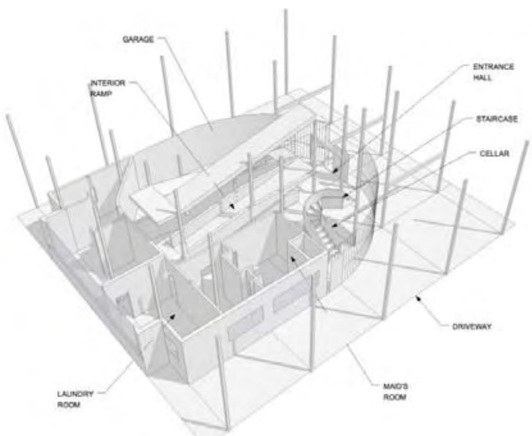


Figure 3: **Villa Savoye, Ground Floor Model (Courtesy, architypes.com, CC Attribution 2.5).**

Many avant-garde architects since Le Corbusier have exploited similar strategies. Peter Eisenman, Daniel Libeskind, Coop Himmelblau, and others have employed such critical strategies to varying degrees of success[d]. Architects have consistently used buildings to make a critical point or two. They have also used their drawings, models, and words to make their point[e]. However, it is not often that we hear programmers making a point through their software packages. Barring some open-source software and pestilent viruses, it is rare to see major software packages being designed as critical or subversive tools. Moreover, it is not common to see programmers making such a point in a systematic, rigorous, focused, and elaborate manner. In this respect, **form•Z** is perhaps one of the first CA(A)D software products to have a critical agenda. It is this agenda that probably endears **form•Z** to its users[f]. It is also this agenda and the consequent inflexibility in its interface design that likely repels others[g].

Architecture of form•Z's Graphical User Interface

Let us now look closely at **form•Z**'s interface to see if it reflects the software maker's initial intent, arguments, and convictions about design processes. Interface is not just that which is in-between. Face is the index of mind. Interface is the index of software's agenda. If we look into **form•Z**'s graphical user interface, we discover that **form•Z**'s critical agenda is not so hidden.

All through its evolution, **form•Z**'s interface design and configuration has not changed much in concept and layout (Figures 6 and 7). This gives us an opportunity to take a close look at the interface defaults in any version of **form•Z** to understand some of its essential critical agenda that has persisted until today.

a) **Visual versus Textual**: By default, command input in **form•Z** is only allowed mainly through menus and icons. This goes counter to the interface of a typical CA(A)D software where the user could type commands, macros, and scripts. The taking away of textual command input takes away some of the speed from the modeling process, but presumably forces the user to work primarily through visual means[h]. By taking away speed, the interface also demands and imposes more deliberation and thinking, which could frustrate users used to typing textual commands. This kind of valorization is akin to Le Corbusier's architectural strategies at Villa Savoye. Valorization (as opposed to moderation) is a mark of all critical work.

b) **Space of Interface**: There is only one place in **form•Z**, the Modeling Toolbar to the left, where object creation

Figure 4: **Villa Savoye Terrace Gardens (Photo Courtesy, Brian Pirie, CC Attribution 2.5).**

Figure 5: **Villa Savoye Living Room Showing Fireplace (Photo Courtesy, Brian Pirie, CC Attribution 2.5).**

and modification is commanded. Drop-down menus at the top offer options and ways of viewing and rendering the model. The palettes on the right side offer tool options and model data organization. The palettes at the bottom offer alphanumerical input. Various helper tools are placed at the bottom-left corner of the model window. There are no exceptions to these rules when the default settings are used. Such a clear-cut, zoned spatial configuration of the graphical user interface is a rarity in the CA(A)D world, and evokes some of Le Corbusier's modernist dictums of functional zoning.

c) **Artists' Interface versus Engineers' Interface**: Cyan, Magenta, Red, and Gray are the dominant colors in the interface. And these colors have specific meaning. Cyan icons are "tool-modifiers" that are used in object creation. Magenta icons are "void" operations used in space creation. Gray buttons interact with cyan or magenta icons to produce a desired modeling result. This notion of "mixing colors" is akin to an artist's way of working through a color mixing palette. Also, the cyan icons act as markers that vertically demarcate different sets of tools. The spatial conception and delineation of the interface does provide the user with a decidedly creative environment. Further, it is probably intended to make the user feel as though he or she is in front of an easel or a drawing board as opposed to being inside an aircraft flight deck. This aspect of the interface design can surely be read as being a big part of the "argument against drafting" and promoting spatial (void) modeling.

d) **Three-dimensional Interface**: By this the author does not mean visual three-dimensionality. Each icon in the modeling tool bar expands in X-Y axis. Double-clicking the icon reveals the "Z-axis" of the icon options that are "hidden beneath (or above)" (Figure 8). This three-dimensional organization allows for packing and folding more commands and command variations within a relatively small amount of interface real estate. Once again, the argument for three-dimensional thinking and processes is directly evident in the interface design itself.

e) **Cartesian Space versus Tabula Rasa**: In many-a-CA(A)D software, the modeling window is either a blank, black empty space, or occupied by a generic grid. **form•Z** shows its

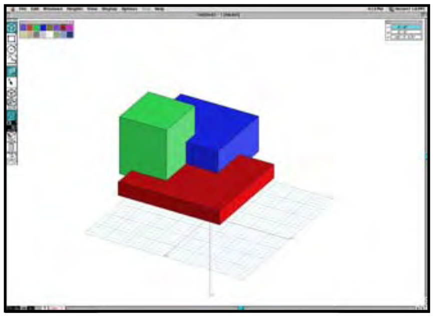


Figure 6: **form•Z 1.0 Interface (Courtesy AutoDesSys).**

architectural origins through the use of Cartesian grid with X, Y, and Z axes in axonometric view that greets the users upon entering the software by default. This view is reinforced by making the three-dimensional modeling and helper tools readily available to the users. These decisions are significant and go against many other comparable software products. Here, the interface designer is conveying a specific 3D spatial paradigm as opposed to a blank slate or a generic grid, both of which are fundamentally two-dimensional in concept.

All of the observations above clearly show the latent critical agenda and the way **form•Z** imposes certain rigors and software designers' preferences on the users. It is also clear that the "argument" has helped define the software's identity to a great extent. There are many well-known buildings, including those by Peter Eisenman, that critically impose specific ideas of habitation on its users, which have proven to be more than frustrating to some. The question of the merits of imposition of author's critical will of one kind or the other will continue to be debated ad infinitum. Are software packages allowed to enjoy similar prerogatives and privileges? The answer should be 'yes'! Do software packages (or buildings) with critical agenda have to be "popular" (as in large market share), easy to use, obedient, and have a sweeping impact on the discipline in order to be significant? Not necessarily.

The Architecture of Product Lifecycle and Production System

Criticism of software often stops at the review of a product. When examining a product, its performance, value, meaning, impact, and sustainability, it is important to consider the institution of its production, the production process, and indeed the whole life cycle of the product. As much as we would like to think that it is individuals who produce things, Gregory Bateson, Henri Lefebvre and Deleuze and Guattari would remind us that it is the institutions which strategically and systematically produce the space of possibilities through products. A product is but an expression of the systemic functioning of an institution and its subculture. It behooves of us to examine the institution of production when

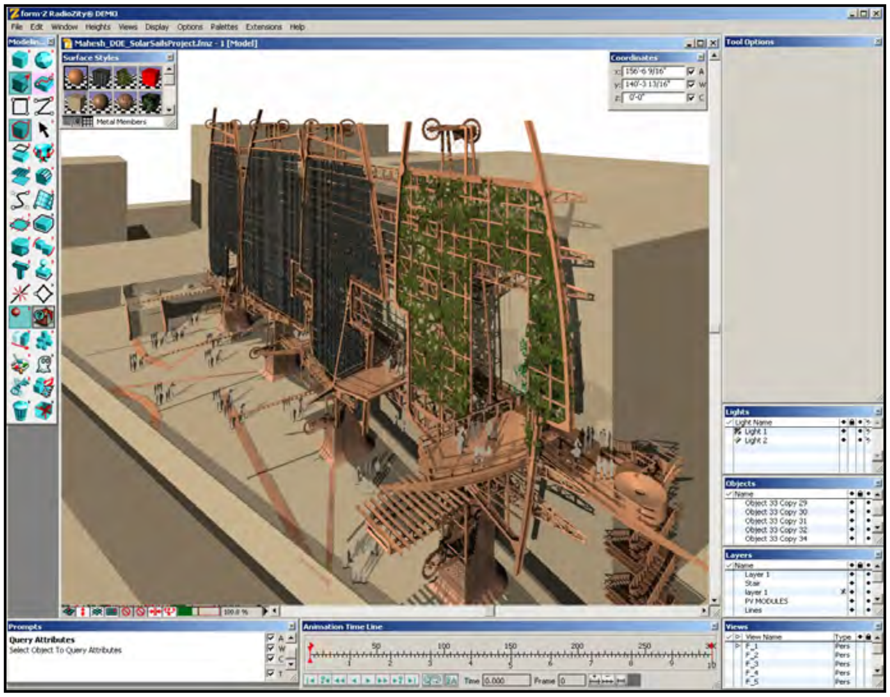


Figure 7: **form•Z 6.0 interface showing "Solar Sails," the 2nd Place Winning Entry by Mahesh Senagala, US D.O.E. and AIA National Competition, 2000).**

we wish to comprehensively examine a product. For instance, Honda as a company makes reliable automobiles. The reason for the excellence of the products made by Honda is the institution of its production, the company, its work culture, and its value system[i]. Another instance, this time a negative one, is the tobacco products and the institutions (corporations) that produce those products. It is by now common knowledge that the tobacco companies have a questionable record when it comes to ethical values in making and marketing their products. The overall significance, value, and sustainability of a product is directly dependent on the (corporate) culture of the institution of its production.

form•Z can be better understood if we carefully look into its entire lifecycle as orchestrated by AutoDesSys. The academic roots, the architectural roots, and the research roots of **form•Z** need no introduction. The software, although solely a product of AutoDesSys, began in principle in the spirited academic and professional environment of the Ohio State University. The product, although promoted as a commercial software, is undeniably academic in its bent. Moreover, **form•Z** is itself a record of Yessios' fruitful collaborations with Peter Eisenman in the late eighties (Yessios, 1987).

One of the shrewdest moves by AutoDesSys was to focus strongly on "grassroots" strategy of engaging the academic institutions through the Joint Study Program, which is one of the largest academic partnerships among software companies that features the following:

1. A rigorous feedback system that is contractually established
2. Recognition of quality results through its annual juried awards, and
3. The dissemination of the above two objectives through the production of an annual report

Although, for AutoDesSys, the bottom line is in the commercial sales of **form•Z**, undoubtedly their heart is in the Joint Study Program. A close reading of the terminology used in the program reveals this point. The representatives of the academic institutions who participate in the Joint Study Program are called "Principal Investigators," a term from the research world. The expectation from the PIs is to actually pedagogically and technically investigate the software so as to help evolve it. According to AutoDesSys, the goals of the Joint Study Programs are: "(1) to promote education in 3D modeling and computer enhanced design, and (2) to contribute to the evolution of computer driven design tools" (formz.com, January 2007). To the best of my knowledge, there is no other computer-aided design software maker who has an equally rigorous academic program with all the seriousness of joint academic and research investigation[j].

It is an aggregate of these instituted programs that endears **form•Z** to many of its academic users. It is this system of participation, feedback, and recognition that empowers and engages most of its budding professionals. The other software makers who make their academic licenses freely available to students probably do so mostly to improve their bottom line and to gain more market share, and not necessarily with the intent of joint academic investigation as a partnership. When examined in this larger context, **form•Z**'s critical agenda makes greater sense as an expression of the values and practices of the institution of its making.

Conclusions

In summary, the first conclusion the author would like to draw from this multi-pronged examination is that software products undoubtedly merit a more systematic and scholarly discussion about their role in the discipline of architecture with respect to what they are in addition to what they do. After all, a software is a body of knowledge, assumptions, habits, propositions, and arguments in a critical relationship to the issues of concern to the discipline. Just as buildings and texts play a critical role in challenging the norms of the discipline, so could software products. A close reading of **form•Z**'s graphical user interface reveals and reinforces the claims of the software maker that it is in part "an argument against drafting."

The second conclusion is that a software cannot be seen as a mere product in isolation from its lifecycle and production systems. A product should be seen as an expression of the deeper structures, values, practices, and beliefs of the institution of its production. Such a holistic consideration reveals the true value, meaning, and potential of a product.

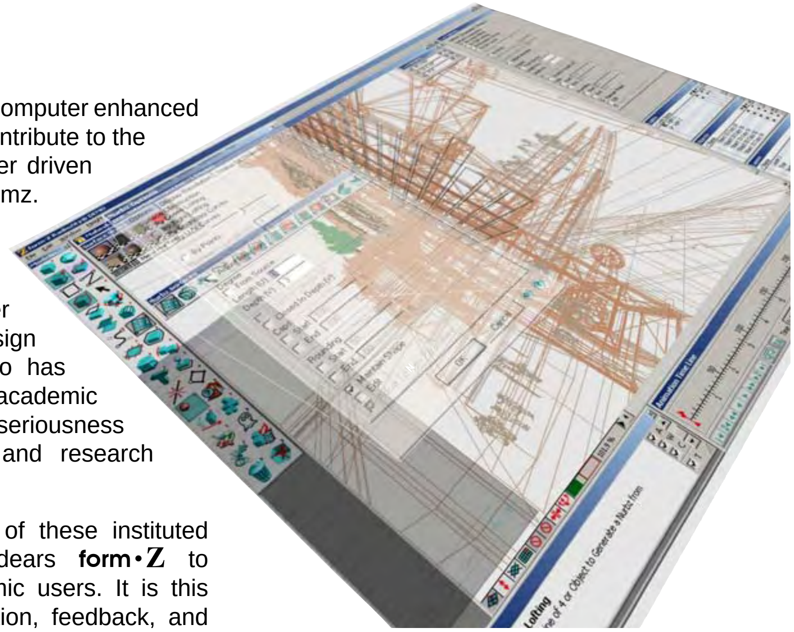


Figure 8: **X, Y, and Z Axes of Icon Organization in form•Z 6.0.**

form•Z is a significant contribution to the discipline of architecture, on par with Le Corbusier's Villa Savoye.

The final conclusion is that the nature, role, and relevance of CA(A)D software products are changing radically as we begin to experience more of the exponential evolutionary transformations that Ray Kurzweil, Mark Weiser, Kevin Kelly, and many others have observed. The challenges facing the discipline of architecture and the domain of CA(A)D fifteen years ago are not the same as the ones today. The concerns are going to be exponentially more different in the next fifteen years. It is ironic that the fifteen years of **form•Z** are parenthetical between one type of flatness (of drafting) and another type of flatness (of the world). As **form•Z** enters the flatWorld, it faces new challenges to which it could critically respond. If, fifteen years ago, **form•Z** began as an argument against drafting, what would be the argument against now and in the next fifteen years? That is a million-dollar question.

The author hopes that this critique has not only shed light on the critical aspects of **form•Z** but also opened the doors to new methodologies of scholarly examination of software products in response to the radically and rapidly changing context of the architecture of emerging flatWorld.

Disclaimer

The author would like to declare that this article was not commissioned by AutoDesSys.

References

1. Bayfield, Robert, and Paul Roberts (2004), "Insights from Beyond Construction: Collaboration- The Honda Experience," paper presented to the Society of Construction Law, Oxford, June 2004.

2. Friedman, Thomas (2006), *The World is Flat*, Ferrar Strauss and Giroux, New York, NY

3. Kelly, Kevin (1994), *Out of Control: The New Biology of Machines*, Perseus Books, New York, NY

4. Kurzweil, Ray (2005), *The Singularity is Near*, Viking Penguin Group, New York, N. Y.

5. Mitchell, William J (1999), *E-topia: Urban Life Jim, But Not As We Know It*, The MIT Press, Cambridge, MA

6. Negroponte, Nicholas (1976), *Soft Architecture Machines*, The MIT Press, Cambridge, MA

7. Senagala, Mahesh (2004), "Deconstructing the Software Interface: A Critical Close Reading of AutoCAD," in J. Bermudez and Jose Ripper Kos, eds., the *International Journal of Architectural Computing* (IJAC), Multiscience, V.7, December 2004, pp. 299-314.

8. Weiser, Mark (1991), "The Computer For The 21st Century," in *Scientific American*, September 1991

9. Yessios, Chris (2006), "The Singularity of Design Creativity," in **Communicating Space(s)**, 24th eCAADe Conference Proceedings, Volos (Greece) September 2006, pp. x-xvi

10. Yessios, Chris (1987), "The Computability of Void Architectural Modeling," in Yehuda Kalay, ed., *Principles of computer-aided design: computability of design*, John Wiley & Sons, New York, NY, 1987. pp. 141-172

11. Yessios, Chris (1987), "A Fractal Studio, Integrating Computers into the Architectural Curriculum," in *ACADIA Conference Proceedings*, Raleigh, North Carolina, 1987, pp. 169-182

12. Yessios, Chris (1986), "What has yet to be CAD," in *ACADIA Workshop 1986 Proceedings*, Houston, Texas, 24-26 October 1986, pp. 29-36

Notes

a The use of the abbreviation CA(A)D is intended to embrace the ambiguities that lie between the broader field of computer-aided design and its subset, computer-aided architectural design.

b. For Creative Commons License information, please see: http://creativecommons.org/licenses/by/2.5

c Le Corbusier's work is characterized by polemical inversions of classicist and prevailing architectural conventions of his times. These avant-garde strategies could be seen all through his oeuvre. See Jencks, Charles, Le Corbusier and the Tragic View of Architecture, Harvard University Press, Cambridge, Mass. 1974, for a detailed discussion of Corbusier's design strategies that challenged the norms of his day.

d Much has been written about the problems created by many avant-garde works of architecture to their users. Peter Eisenman and Daniel Libeskind seem to be the critics' favorites for scathing reviews of their built works and other creative work. See the following articles for a sampling of some of the critiques of critical buildings. Mark Lamster, "The Wexner Center: plagued by a bad layout and shoddy construction, Ohio State University seeks a retrofit of its Peter Eisenman building" in Metropolis 2001 July, v.20, n.11, p.54; Philip Nobel, "Peter's tantrum: after its multimillion-dollar rescue, the newly reopened Wexner Center remains as vexing as ever," in Metropolis 2006 Mar., v.25, n.7, pp.62-66; Robert Ivy, "Challenging Norms: Eisenman's obsession" in Architectural Record 191.10 (2003): 82-88; and Mark Kingwell, "Monumental / conceptual architecture: The art of being too clever by half," in Harvard design magazine 2003-2004 Fall-Winter, n.19.

e Interestingly enough, it is a commonly accepted notion that the discipline of architecture encompasses not only buildings but theoretical and critical texts, drawings, models, and a variety of other bodies of knowledge. It is not as common to see software constructs (in distinction to buildings designed using specific software constructs) being accorded that same status as buildings, drawings, and texts.

f Many of the leading architects today are known to use **form•Z** extensively in their design and visualization process. The list includes Peter Eisenman, Douglas Garofalo, Steven Holl, Morphosis, Antoine Predock, Michael Rotondi, and Bernard Tschumi. This maybe an indirect measure of **form•Z**'s critical impact on the discipline.

g A recurring criticism by many users of **form•Z** has been about what they term as its rational yet difficult to use interface compared to AutoDesk Maya® or Google's SketchUp®.

h **form•Z** does allow for many keyboard shortcuts by default that could be greatly customized.

i To quote Richard Bayfield, et al, "Honda's philosophy is summed up by 'Through [sic] challenge, fresh ideas, a young attitude, teamwork and a friendly working environment, we will achieve all we set out to accomplish'… The philosophy creates a culture in which it is appropriate to challenge the status quo; indeed the company encourages creative dissatisfaction. This means that every assumption or application within the automotive sector of the business is challenged regularly. It is the drivers (philosophy and culture) of the business which are the key" (Bayfield and Roberts, 2004). Further discussion of specific corporate culture examples could be found elsewhere. See Lightle, Susan, Kenneth Rosenweig, et al. (2003), "Why Toyota and Honda Topped the 2002 J.D. Power Quality Study," in Cost Engineering, Dec 2003, Vol. 45, No. 12.

j The Joint Study Program is perhaps the best example, in the commercial realm, of involving and integrating users' feedback into the evaluation and evolution of the software. In pubic domain or open source software, examples such as Linux abound where users collectively and directly author, alter, and evolve the software.

Mahesh Senagala is an Associate Professor and Associate Dean for Research at the College of Architecture, University of Texas at San Antonio. His interdisciplinary research interests include smart environments, design computing, tensile membrane structures, education leadership, and sustainability. He was a plenary and keynote speaker at a number of international conferences and workshops in North and South America. He is the author of over 62 publications including 45 refereed works. His writings have won Best Publication and Presentation awards at various international conferences. He has delivered over 25 invited lectures world-wide. He has been interviewed, quoted, and featured in the New York Times, Industrial Fabrics Review, Fabric Architecture, Texas Architect and other publications in Asia and the Americas. Professor Senagala has served on the steering committee of the Association for Computer Aided Design in Architecture (ACADIA) from 2002-05. Prior to joining UTSA, he was a designer with the Kansas City firm Gould Evans Goodman Associates, a Visiting Assistant Professor at Kansas State University, and a designer with the Chicago firm Griskelis+Smith Architects. He was the winner of the second prize in the U.S. Department of Energy Sun Wall competition, Washington, D.C. held in the year 2000. The Baron BMW Dealership project he designed at Gould Evans Goodman Associates won the 2001 AIA Kansas City Merit Award. An avid speaker, and an award-winning fiction writer, Professor Senagala draws inspiration from Latin American and Existentialist literature. Web Site: www.mahesh.org.

The Office of Robotic Architectural Media,
Bureau for Responsive Architecture
The School of Interactive Arts and Technology
at Simon Fraser University
Surrey, British Columbia, Canada

CAAD for Responsive Architecture

by Tristan d'Estree Sterk

Introduction

In the late 1960's through to the mid seventies a dramatic turn took place within architecture. Questions about the success of modernism and a looming energy crisis caused architects to search for new design methodologies to make buildings that better fit the needs of society. Amongst others, Gordon Pask, Cedric Price, Nicholas Negroponte, Yona Friedman and Charles Eastman explored the role that computers could play in satisfying this goal. Nicholas Negroponte proposed that three distinct roles would result: roles of improving design documentation systems, generative design systems, and finally a role in developing intelligent spaces into which computers are embedded. [1]

Many years later in 2005, while working at Skidmore Owings and Merrill, I recalled Negroponte's words at a talk by Robert Diamant, a former managing partner of the office. [2] Robert spoke of the changes that he witnessed throughout his career. He provided a vivid picture about how computers shaped the discipline by giving it a new series of design tools; tools similar to the documentation and generative ones mentioned by Negroponte. From these tools two significant developments changed our profession. Firstly computational tools enabled architects to design for a new type of client – the developer – a client whose needs could only be satisfied by mastering rapid design development, testing and documentation procedures. Secondly the rapid design processes that computers enabled opened the door to completely new methods of working. Skidmore, Owings & Merrill responded to this by building new types of design methodologies suited to quickening design processes and different studio arrangements. By dissolving traditional barriers, SOM did away with the traditional separation between conceptual and technical design processes. Interdisciplinary teams became the norm and new more technically sophisticated designs emerged. [3]

Architecture isn't static. New pressures are introduced into design when social and technological values change. Innovation and advancement occurs when these pressures are answered in new ways. [4] It is under this light that the positive and negative aspects of building processes become visible, especially as the needs of society outgrow and come into conflict with older buildings and design methodologies. As such one can say that even though today's buildings work well, they aren't perfect and they often needing adjusting and replacing.

A full-scale prototype of an actuated tensegrity structure for use within a responsive building envelope. This prototype was built from cast aluminum pieces that were first rapid prototyped from form•Z models. The structure is programmable and responsive to its surrounding environment. In the photograph above the structure is not yet clad.

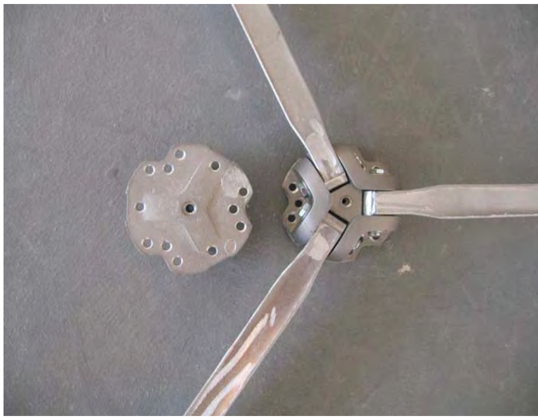
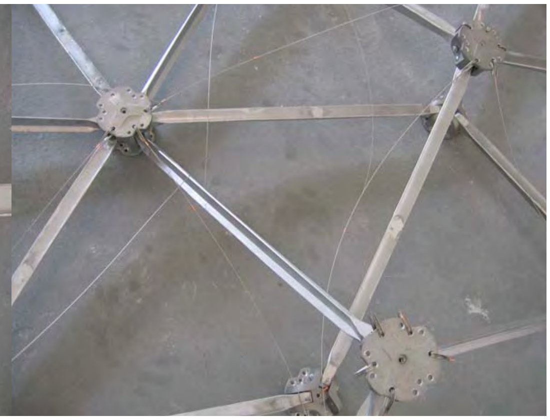
On top of this other significant problems have emerged. Very serious environmental issues now face our societies. Edward Mazria [5] provides a brief summary of the relationship between architecture, energy and the environment in a paper called “It’s the Architecture Stupid!” [6] Mazria says that energy use within America can be accounted for within three basic sectors, the architectural sector, the transportation sector and the industrial sector. The architectural sector consumes 48% of all energy used, while the transportation and industrial sectors consume 27% and 25%, respectively. Furthermore the architectural sector generates 46% of the America’s annual CO_2 emissions, a figure that is set to rise and that is already double that of any other sector. If these trends spread to encompass cities around the globe the architectural profession must come to address its impact. As such, the primary duty of today’s architects must be to reduce energy consumption within building practice. Architects must learn how to use fewer materials more intelligently to produce environments that help people live in more sustainable ways.

Reasons for Supporting Responsive Architecture

Responsive architectures are those that actively change in response to new environmental conditions and patterns of use. But more than being a series of smart systems attached to a dumb building frame, responsive architectures actually consist of intelligent frames, skins and systems. [7] These buildings change shape and color. They have intelligent systems within them and around them. They track the sun gradually and they adjust their shape to improve shading in the summer or day lighting in the winter. They shake snow from their roof. They even change shape to reduce wind loads or improve the way they ventilate. [8] But most importantly responsive architectures provide architects with ways to produce more sustainable buildings. Unlike the conventional boxes that we live in, these buildings adapt to the natural environment to improve the way that people live. They address suitability and socio-technical issues in three key ways. Firstly they provide a means to reducing the mass and embedded energy used within buildings without sacrificing robustness. Secondly they enable architects to produce a new class of building envelopes that actively adjust and shape themselves in relation to the natural environment, its seasons and weather. With this they offer great potential in reducing the energy used within buildings. The third, less quantifiable benefit that responsive technologies bring to architecture is that of a new aesthetic. Like modernism this aesthetic is the product of the way systems are assembled. The systems within responsive architectures operate very differently from conventional architectures. They bring a series of new design strategies, formal tendencies, and grammars to the discipline. The impacts that ultra-lightweight and responsive systems have upon building design are substantial. Yona Friedman reminds us about the impact that such changes have upon our tools when he said that as the tasks of architecture change so too must its methods. [9]

We are practicing at a time when static and unintelligent building technologies are being superseded by intelligent systems. As architects we must realize that, for the first time since the rise of modernism, shifts within the profession are being driven not by the mastery of industrial tools or machines, nor by the challenges of effective computer use, but by the very real need for us to stop harming the natural systems that support our existence. Importantly these new technologies enable architects to re-conceptualize building processes and also revisit the older tacit knowledge that architects draw from. The age-old knowledge that the shape of a building is intimately linked to its performance can now be understood, realized and advanced in very new ways. The impact that these changes will have upon architectural design will be profound. Going back to Friedman we must realize that this change will result in revisiting the tools and design methods we use to produce buildings. Computer aided architectural design (CAAD) systems must be a part of this process – a point emphasized within Ganapathy Mahalingam’s recent article entitled “Model behaviour” [10] Five Features for Supporting Responsive Architecture:



CAAD systems describe architectural form. Some describe the interchange between form and environment. Others describe the parametric relationships between members while others-still describe the forces that structural members carry. Responsive architectures are not adequately described within conventional CAAD systems because the assumptions that conventional systems make prevent sound responsive models from forming. Though beautiful and very evocative the models produced within conventional systems simply do not translate into working responsive buildings or systems. Five key features for the production of these systems are now discussed.

ONE) **Enabling Design with Variable and Controllable Rigidity**:

The fundamental requirement from which all responsive architectures are built is that of variable and controllable rigidity. Responsive structures, be they frames or skins, alter their shape and structural characteristics most effectively by changing rigidity. Within engineering fields rigidity is often termed stiffness, referring to the ability of an elastic body to resist deflection or deformation when forces are applied. Stiffness is a property of materials as well as structures. Structures with variable rigidity or stiffness incorporate controlled systems that either compress or induce tensile forces into a system. These forces can be localized or spread across an entire structure. Four processes must come together to support the design of systems that have variable rigidity, these are:

1) Structural modularity: Modular approaches help because they enable designers to limit the complexity of a system while also addressing constructability.

2) Structural connectivity: The ability to define connections between structural modules so that complete structural systems can be simply produced.

3) Structural loading: The ability to provide feedback about load transmission and the paths of load transmission with changes in rigidity.

4) Structural shape: The ability to accurately test the geometrical (shape) limits of a structural system must also be supported.

TWO) **Making Mathematical and Control Models Available to Designers**:

Models assist designers to analyze and test the systems that they are responsible for. In particular models help designers rapidly develop and refine processes that control the rigidity of responsive structures. Relevant mathematical models have been developed and they should be integrated within these CAAD systems. Such models include those that:

1) minimize mass
2) determine the equilibrium states of structures
3) locate actuators
4) determine the energy required to change the shape of a structure
5) calculate the frequency and location of dampening systems
6) minimize structural fatigue.
7) calculate load transmission, and
8) calculate thermal loads

Other models that predict the structures ability to harvest energy are also being produced. [11] Finding methods for integrating these models into the toolset of architects and multi- disciplinary teams is important. It is worth recalling a few of Robert Diamant's words at this point. Skidmore Owings and Merrill must be credited for being the architectural office that led the world when it came to the implementation of CAAD systems. SOM used computers to produce beautiful buildings that challenged the limits. They used these buildings to advance the technical abilities of the profession and advance knowledge. These advances were made possible by pioneering a generation of CAAD tools that incorporated engineering knowledge within design processes. It is within this spirit that our field must now produce a new generation of tools.

THREE) **Expanding the Quantity and Quality of Environmental Parameters**:

A major problem within current parametric processes is a lack of support for expanded environmental models. Expanded environmental models are those that include the necessary spectrum of environmental stimuli to model building responses, a set of four stimuli are required:

1) Light
2) Humidity
3) Temperature
4) Air pressure

These stimuli support connections between response mechanisms and the environmental factors that surround responsive buildings. They are the minimal needed to produce contextual information about sun location, wind direction, wind speed, precipitation, and temperature. CAAD systems must be able to simulate these processes before they will prove useful tools for the design of responsive buildings.

FOUR) **Enabling Designers to Construct and Test Responsive Behaviors**:

The three previous elements scaffold together to form a rich platform for producing responsive architectures however they do not, by themselves, help designers construct and test responsive behaviors. A two-part framework that supports the integration of software (control) onto hardware (the modular building structure) is required.

1) Control Packaging: a frame that ties structural models to mathematical control models to give designers a means to hook ideas about control to ideas about structure. This author suggests packaging behaviors via subsumptive methods similar to those developed by Rodney Brooks for producing robots.. [12]

2) Packet Distribution: Methods need to be developed for distributing control packages across complete buildings.

FIVE) **Tying Artifacts to Real World Outcomes**:

The final step in producing a CAAD

tool that can assist in the development of responsive architectures is to provide a means for collecting and embedding real world data into the system so that more accurate design decisions can be made. Only a small conceptual step exists between monitoring the performance of a responsive building that has been constructed and occupied and embedding relevant data collected from that product into a model but the ramifications of this final step are potentially very large. Architectural practices who follow this method of design will be responsible for collecting environmental and energy consumption data for buildings that they design and maintaining confidential databases of this information. While the data held will be rich and helpful in monitoring buildings it can also be used as a reflective design tool that improves practice. New architectural analysis and building industries may be born and extend the way in which architects practice and evaluate design outcomes.

Conclusion

Computer aided architectural design systems are successful when they tie design processes to real world outcomes in consistent ways. They must also provide convenient tools to help designers solve problems.The tools we use are fast becoming obsolete. New building technologies that are responsive are increasingly being applied within architecture and with this change new design challenges that require new sets of tools are emerging. If architects are to embrace responsive technologies and integrate them into the very core of architecture (rather than applying them superficially to cover dumb building frames and skins) a new generation of CAAD tools is required. These tools will support a different view and approach to design and they will make new assumptions that enable more appropriate ties to form with the real world. At the 2006 ACADIA conference held by The University Of Kentucky, a plenary session [13] about the future of architecture asked what next? What are the low hanging fruit of responsive architectures and what can we do today to progress toward this future? Without doubt much work needs to be carried out before the types of systems within this paper are built and in common use within the architectural community. Until they are, responsive architectures will remain within the domain of the special few who craft their own tools – this would be unfortunate.

A united effort between the specialists who produce responsive architectures and those who craft CAAD tools must soon occur. Without this, the discipline will suffer and significant opportunities to advance the profession will be lost. This paper represents a first attempt at forming this discussion. It also represents an open invitation to join forces and produce these tools.

Notes

[1] Negroponte, N. (1975) *Soft Architecture Machines*, Cambridge Massachusetts: MIT Press, pp1- 5.

[2] Robert Diamant spoke at Skidmore Owings and Merrill's Chicago office in an informal round table discussion (12.00 pm Thursday 4 August 2005). The blurb that advertised his talk was sent in office email and it read: "Robert Diamant, former SOM Managing Partner, worked on a number of classing SOM projects with Bruce Graham, Walter Netsch, Myron Goldsmith, Fazlur Khan and other notable partners. These projects include the John Hancock Center and 60 State Street in Boston."

[3] For information about one of the key players within Skidmore Owings and Merrill's technical achievements read about Fazlur Khan at http://www.fazlurrkhan.com or within the following book: Khan, Y., (2004) Engineering Architecture: The Vision of Fazlur R. Khan, New York: W.W. Norton & Company, Inc.

[4] Turner, G., (1986) *Construction Economics & Building Design*, New York: Van Reinhold Company Limited.

[5] Mazria is acknowledged by The American Institute of Architects as a leader in sustainable architecture within the United States.

[6] Mazria, E., (2003) "It's the Architecture, Stupid!" in *Solar Today*, May/June 2003, pp. 48-51.

[7] See works by this author: http://www.orambfra.com/earlyPrototypes/index.html.

[8] See recent articles: (1) http://www.wired.com/news/technology/0,71680-0.html (2) http://edition.cnn.com/2006/TECH/science/09/08/smart.buildings/ (3) http://www.economist.com/science/displaystory.cfm?story_id=E1_RPTNNDD (4) http://newcityskyline.com/ResponsiveArchitecture.html.

[9] Friedman, Y. (1975) *Towards A Scientific Architecture*, MIT Press, Cambridge Massachusetts, pp. 1 or: Friedman, Y. (1972) "Information Processes for Participatory Design", in *Design Participation*, Proceedings of the Design Research Society's Conference Manchester, September 1971. Academy Editions, London, pp. 45-50.

[10] Mahalingam, G., (2004) "Model behaviour" in *Intelligent Building And Design Innovations*, Issue 6, 2004: pp.36-38.

[11] This work is being done by Robert Skelton, partner at The Office For Robotic Architectural Media & Bureau For Responsive Architecture. See: http://www.oramBFRA.com.

[12] Brooks, R., (1986) "A Robust Layered Control System For Mobile Robots", in *IEEE Journal of Robotics and Automation*, pp. 14-23.

[13] The plenary session was entitled "Smart Futures" and was moderated by Mahesh Senagala and Anijo Mathew. Participants: Michael Fox, Murali Paranandi, John Nastasi, and Tristan d'Estree Sterk

Tristan d'Estree Sterk founded The Office For Robotic Architectural Media & The Bureau For Responsive Architecture in 2000. He has received international attention for designing buildings that change shape in response to user needs and the natural environment. Among other prizes he has been awarded first place in the prestigious Emerging Visions Prize given by the Chicago Architecture Club. E-mail: tsterk@orambra.com. Web: www.orambra.com.

LYCEUM COMPETITION

by Terry Boling

Project by Michael Hatter

Introduction

In January, 2006, I led a small group of students in a studio project for the Lyceum Fellowship, an annual international competition for selected schools of architecture, in which the University of Cincinnati School of Architecture and Interior Design has participated for more than 20 years. The competition, offered as an elective studio, is coveted as an opportunity to vie not only for prestige, but also for a $10,000 first prize to be used for travel by the winning student. The students were warned prior to studio selection that it would be an intense and rigorous quarter, replete with impossible expectations and exceedingly high standards, and with only a six-week time frame to work on the competition. Even after the scare tactics, I was rewarded with nine of the schools' finest students, ready for anything. A grueling 10 weeks followed, filled with the usual array of setbacks and individual triumphs, and after the dust settled, we were shocked to discover that we had placed in the top 5 positions out of six, collecting a total of $17,000 in travel grants and stipends.

Strategy

"Old meets new on a site recently opened up to a greenway as a result of the "Big Dig" atop a building in Boston's historic financial district. Construction on the roofs of existing commercial buildings presents a unique set of challenges. These include constructability, privacy, mixed-use design, and economies of scale. The focus of the project is dealing with these constraints creatively, while emphasizing advances in material science construction techniques and energy efficiency.

The program calls for a lightweight, energy-efficient, flexible, urban penthouse that meets the needs of a family of four that includes a professional musician, a venture capitalist and two teenage children."

Program brief from the 2006 Lyceum Fellowship competition

Traditionally, as in any competition, the lyceum studios have placed heavy emphasis on a high level of graphic innovation, which can often become the "raison d'etre" of the entire scheme. This attitude has become ever more pervasive in the design studio as students master digital tools with an unprecedented ease [1], yet fail to connect the images with the constructed world. While we felt that it would be necessary to attract the design jury with beautiful images, we would also need to demonstrate a deep and broad understanding of the complex issues of the program, and to synthesize that understanding into meaningful moments of architecture in order to sustain that critical jury attention. The competition brief presented a unique opportunity for us to approach the project not only as an exercise in graphic acuity, but more importantly, as a way to foreground architectural research as a pedagogy. This would require a conscious decision to resist the seduction of entirely internalized and software-driven investigations in favor of inquiries that embraced the realities of phenomena [2]. How could we create a project that was speculative and interrogative yet grounded in the facts of construction?

Research

"The new architecture will not be about style, but rather about substance - about the very methods and processes that underlie making."

Stephen Kieran and James Timberlake, Refabricating Architecture

The first four weeks of the studio were devoted to "communal research" (historical, theoretical, and technological), while the last six weeks were committed to the design and production of the individual competition entries. The research component of the studio centered on the interrogation of the materials, methods, and systems of construction, focusing specifically on component design, fabrication, and assembly. The primary texts for the studio were ***Surface Architecture***, by David Leatherbarrow and Moshen Mostafavi, and ***refabricating Architecture*** by Stephen Kieran and James Timberlake. Our task was to critically examine the theories and practices of prefabrication [3] ("mass universalization"), and to contrast them with ideas about specificity and place ("mass customization", "critical regionalism" [4]). We examined the history of pre-fabrication and tried to understand the reasons that it has never become fully integrated into mainstream construction. The students soon became strong advocates for repositioning the architect's role in the production of architecture, specifically regarding the integration of off-site fabrication into contemporary construction practices. Through our readings and discussions, the students also grappled with the relationship between representation and technology. Should architecture relinquish its image to visual reflections of systems of production, or should it simply become scenographic? [5] Would it be possible to posit a new understanding of this relationship by examining building performance as well as appearance?

Following the research period, I took the students to visit the site. We immersed ourselves for two days in the rich and complex fabric of Boston and the surrounding area, soaking up images in our quest for understanding more about the particulars of the place. We also visited the offices of ***Empyrean International***, one of the foremost pre-fabricators in the United States, located in Acton, Massachusetts, who were then working on the fabrication of components for the flat-pak house by Charlie Lazor [6]. By speaking directly with their designers and craftsmen, we discovered the practical benefits of pre-fabrication, such as leveraging more control over quality, time, and costs, in addition to minimizing waste.

Design

"How can design utilize the opportunities of current industrial production so that the practice of architectural representation is neither independent of nor subjugated to the domination of technology?"

David Leatherbarrow and Moshen Mostafavi, Surface Architecture

Now that the students were fully engaged with the research questions of the studio, we started to work on the competition. The strategy for the six-week design exercise was simple: Four weeks of development, with a studio pin-up each week, followed by two weeks of design development and final presentation. Since the pedagogic goals of the studio were connected to research, constructability, and craft, one of the primary hurdles to overcome was how to illustrate our response to these topics through the required competition format of six 11" x 17" images. I encouraged them to use physical models to explore tectonics and craft, and to supplement the physical work with drawings as necessary. The students were also asked to craft a clear and articulate written strategy to help the jury understand the goals of the project.

I will utilize the work of graduate student Michael Hatter to demonstrate the uses of various media, including **form•Z**, in the development of his first place project. I should note here that the University of Cincinnati School of Architecture and Interior Design program introduces **form•Z** into the curriculum in the freshman year, teaching basic modeling, animation, and rendering techniques. Sophomore year, the students use the program intensely in form, space, and site explorations in the immersion curriculum [7], followed by an introduction to component modeling and B.I.M. By the time they reach the elective studio offerings in their pre-thesis year, **form•Z** is one of the many tools they have in their arsenal.

Michael started immediately with some quick **form•Z** models that identified his preliminary design, a prefabricated truss structure with a segmented cladding suggesting varying degrees of enclosure (illustration a).

This image, while compelling, lacked a clear strategy. The diaphanous wrappers implied enclosure, yet floated ambiguously outside of the truss structure. This image is typical of the kind of digital work that often fails to advance due to the "sense of fulfillment" that occurs in the use of representational software [8]. I asked Michael at this point to quickly switch to a physical model, and to investigate the relationship between structure and skin. The new physical model (illustration b) generated significant discussion in regard to this relationship, as well as to the role of fabrication and assembly in the project, and how metaphor can be effectively utilized in the development of details. This iteration moved the thermal enclosure to the interior of the truss,

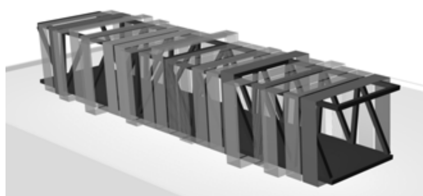


Illustration a

and suspended living spaces below the truss structure with a cable system that recalled the segmented wrapping of the earlier scheme. We were encouraged by the idea of cables wrapping the truss and defining the space below, however, the relationship between the space in the truss and the space below it was unclear. At this juncture, we recognized that the cable system was evocative on many levels, acting as both a privacy screen and as a sunscreen, defining exterior space, and providing a tension structure for the spaces below the truss. We felt that developing the tectonic articulation of the system in conjunction with its performative responsibilities could lend credibility and depth to the scheme. Michael researched a variety of cable assemblies, searching for a poetic tectonic strategy that drew from the program (house for a musician, illustrations c and d), the site (Boston harbor and clipper ships), as well from contemporary construction.

form•Z studies were the quickest and most effective means for exploring the tension cable connections and articulating them as a system (illustrations e and f). The ease of producing simple light effects and shading in **form•Z** contributed significantly to the legibility of the scheme, even at an early stage in the design. **form•Z** was also used to demonstrate the layering of systems and the fabrication sequence in one drawing. (illustration g) What began as quick 3D studies of joints and systems quickly became key elements in the graphic explanation of the project. Michael's final iteration illustrated the concept with a new clarity. The truss structure was wrapped in a tension cable system that supported a thin platform below, allowing for column-free living spaces below the truss, and providing a variable privacy/sun screen on the exterior of the glazed enclosure. (illustration h)

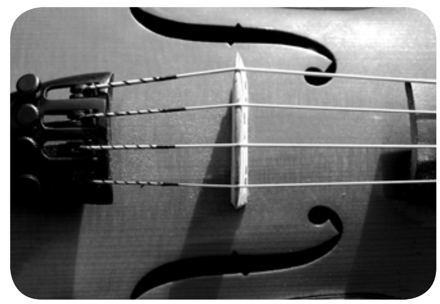


Illustration c

Illustration d

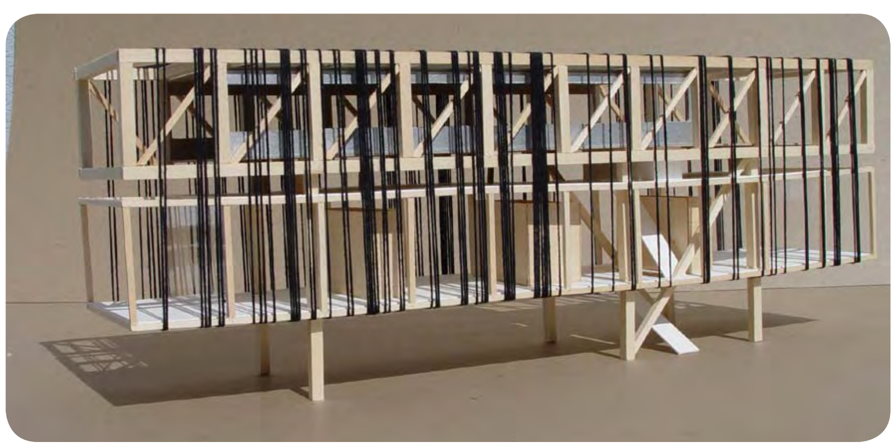


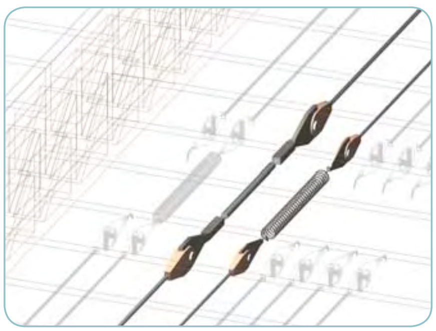
Illustration b

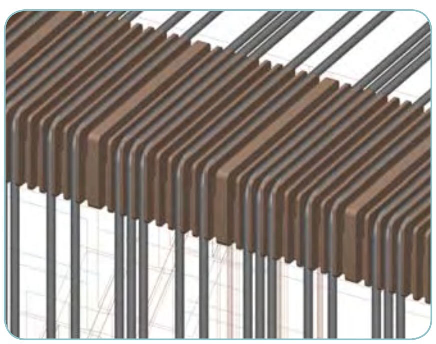
Conclusion

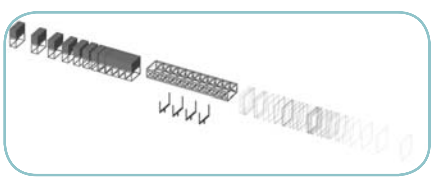
"Housing for Urban reTension seeks to reinforce the momentum of urban redevelopment and civic reconnection facilitated by Boston's Big Dig project. Through site strategy, production technology, and formal imagery the proposed design offers one solution to meeting the unique physical and social challenges presented by residential rooftop housing design.

Supporting the goal of limited site disturbance, the design employs twenty-two 8' x 19' prefabricated, largely pre-finished modules that can be trucked to the site and efficiently craned into place. The modules fit into or are suspended by cables below a glue-lam wood truss. The structural cables that support the living spaces not only carry gravity loads, allowing for an extremely light-weight module assembly, but, as they vary in density across the face of the building, also act as light shading and privacy screening. Borrowing from local imagery and materials, the design strives for a sensitivity to both the old and the new, to the historic and the modern, as it lends itself to Boston's ongoing effort to reconnect the commercial core with its waterfront roots." (illustration i)

Michael Hatter, final project statement







Top to bottom: Illustrations e, f, g

The studio experience was both invigorating as well as exhausting, and was successful on many levels. Not only did we get the jury to notice the projects, but we did so by resolving the complexities of the program with a rigor and grace that stemmed directly from our research. And while the six-week time frame initially seemed like an obstacle, it became clear that the abbreviated schedule forced each student to commit to a strategy early on, to stay loyal to it, and to develop it as thoroughly as possible through multiple iterations. Finally, the students achieved a confidence that can only come from "being in the trenches". There was an amazing collaborative vibe and camaraderie that was felt throughout the quarter that belied the notion of a competition.

In conclusion, I would like to acknowledge all of the students who participated in this studio: Their commitment and unbridled enthusiasm created the rich working environment that made this project so satisfying. They are: Michael Hatter (First Place), Ryan Newman (Second Place), Dawid Pol (Third Place), Tony Schonhardt (Citation), Magda Wala (Merit Award), Chris Davis, Sarah Krivanka, Priya Arora, and Kunal Dhavale.

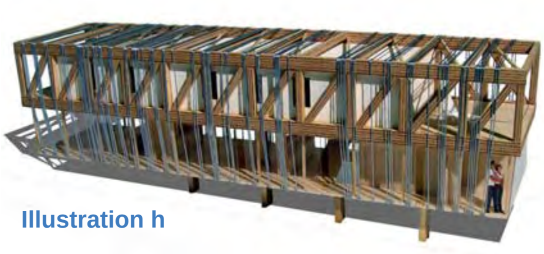


Illustration h

References

[1] Cuff, Dana. "Digital Pedagogy: An Essay", in *Architectural Record*, September, 2001, Pp. 200-06.

[2] Balfour, Alan. "Architecture and Electronic Media", in *Journal of Architectural Education*, Volume 54, No. 4, May 2000, ACSA Inc., Washington D.C., Pp.268-271.

[3] Kieran, Steven and Timberlake, James. *refabricating Architecture: How Manufacturing Technologies are Poised to Transform Building Technologies*. Mcgraw Hill, New York, NY. 2004.

[4] Frampton, Kenneth. "Towards a Critical Regionalism: Six Points for an Architecture of Resistance". *Labour, Work, and Architecture: Collected Essays on Architecture and Design*. Phaidon, New York, 2002. Pp.76-89.

[5] Leatherbarrow, David and Mostafavi, Moshen. *Surface Architecture*. M.I.T. Press, Cambridge, Massachusetts, 2002.

[6] Lazor, Charlie. http://www.flatpackhouse.com/.

[7] Harfmann, Anton. *Immersion Studio: An integrated, immersive sophomore quarter of study*. School of Architecture and Interior Design, College of Design, Architecture, Art and Planning, University of Cincinnati http://edcommunity.apple.com/ali/story.php?itemID=1073.

[8] Balfour, Alan. "Architecture and Electronic Media", in *Journal of Architectural Education*, Volume 54, No. 4, May 2000, ACSA Inc., Washington D.C., Pp.268.

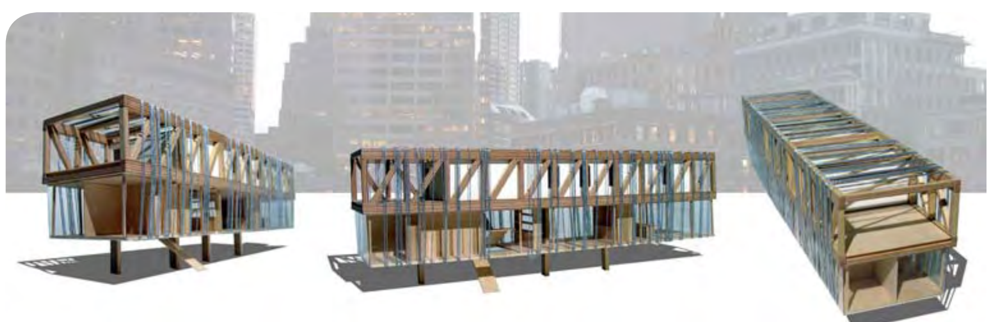


Illustration i

Terry Boling is a Field Service Assistant Professor at the University of Cincinnati and a practicing Architect in Cincinnati, Ohio. After graduating from the University of Cincinnati in 1989, Terry lived in Europe for a number of years, working for Philippe Samyn in Brussels, Belgium, and for Hans Hollein in Vienna, Austria. His award winning design/build practice revolves around the questions of material research, technique, and fabrication. Mr. Boling's work has been published in I.D. Magazine, Architecture Magazine, and was recently featured in Architecture Record Magazine's "Archrecord2" section, for and about the emerging architect. His work will also be featured in an upcoming book entitled "Young Americans - New Architecture in the U.S.A." Email: www.terryboling.com

From Design to Fabrication: Precast Concrete with form•Z

by Mark Thurnauer

Recent advancements in computer software and technology have had a profound effect on the design and construction of architecture. The architect at forefront of the integration of computer technology throughout design and production is Frank Ghery, whose architecture firm has utilized software from the aeronautical profession. With the capability to translate 3D computer models into production drawings and data for fabrication, it would seem that there are no limitations in the development of architectural forms. But, buildings are still governed by good detailing practices such as: material limitations, weather resistance, construction tolerances, and feasible construction sequencing. The Varsity Village Athletic Center at the University of Cincinnati is a tremendous example of sharing 3D computer model data between designers, fabricators, and contractors.

The form of the Athletic Center generated as a response to where architect Bernard Tschumi chose to situate the building on the site. Wedged between the existing basketball arena to the east, the football stadium to the west, and bound by the new Rec Center at the north, the selected site is both dynamic and confining. Pedestrian circulation crosses the site in both the north/south and east/west directions. The footprint of the new structure overlaps two existing sub-grade floors containing a mechanical room and a football locker room that remained operable throughout construction (Figure 1). The building also spans over an existing loading dock for the basketball arena that accommodates video broadcasting trucks which require barrier-free maneuverability. To resolve these site challenges, a structural system was devised that allowed for large column free spans.

Figure 1: **Figure ground sketch by Bernard Tschumi Architects**

Arup Engineers developed a structural system referred to as the diagrid exo-skeleton which allows the building to span above the existing sub-grade levels with only one column penetration through the existing building. This structural system is comprised of an exterior frame that acts as a large triangulated truss following the curvature of the plan. The rigidity of the truss minimizes the number of required support points at grade (Figure 2). The Diagrid was initially envisioned to be fabricated out of structural precast concrete. This posed many detailing complications such as: differential thermal expansion of the external to internal structure, waterproofing, and

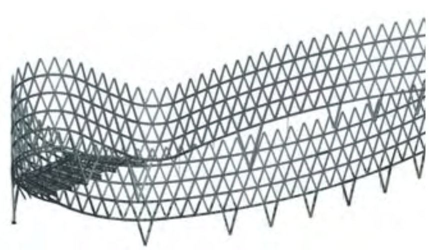


Figure 2: **Axonometric of Steel Diagrid Exo-skeleton.**

connection between the precast panels. To resolve these problems, the structure was switched to a steel frame enclosed within the building envelope. Numerous exterior cladding options were considered but architectural precast concrete was selected for cost and aesthetics.

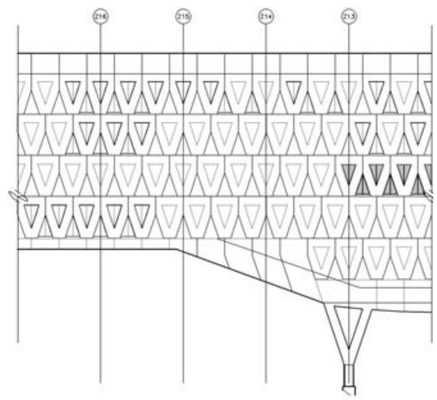


Figure 3: **Unwrapped elevation of precast concrete cladding.**

The diagrid was conceptualized as an unwrapped skin (Figure 3). As such, the diagonal members of the envelope were straight segments. After wrapping the linear elevation around the curvilinear plan form, the diagonal members were actually helical geometry. Yet, the steel members behind the skin remained straight members. During schematic design, 2D sections were drawn through the building envelope to determine the relationship between the steel structure and the precast cladding. The thickness of the precast cladding, quantity of insulation, fireproofing coverage on the steel, and the steel construction tolerances all needed to be accounted for in the design (Figure 4). The position of the steel in relationship to the precast was variable and therefore 2D drawings inadequately conveyed the relationship between all of the building components. The geometric complexity of wrapping the diagrid elevation around the curvilinear plan form could not be understood without 3D modeling. Working with the precast concrete fabricator during design helped to resolve constructability issues. Helical or warped surfaces would be expensive to form and difficult to strip from the formwork. The windows in the exterior envelope needed to be flat to meet the project budget.

To resolve the casting problems of the helical geometry, a modeling method was developed that generated flat surfaces at the window openings while creating the perception that the diagonal members are helical (Figure 5). The method was envisioned as if projecting the image of a triangle on a cylindrical surface; the image of the triangle warps around the surface, creating the appearance of helical edges. When the projected image passes through the cylinder, the cut out would have planar sides. The first attempt at this method resulted in a shape that did not have positive draft. The cutting shape was revised from an extrusion of the triangle to a shape that went from the triangle and extended to a point on axis with the radius of the face of the building skin.

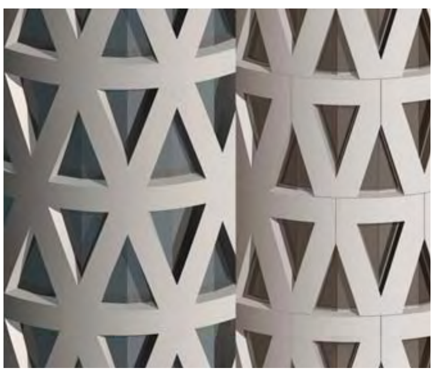


Figure 5: **Image of true helical geometry on left and actual modeled solution on right.**

During Design Development, High Concrete was hired to fabricate a full-scale mockup of one panel. This offered an opportunity to test the fabrication method. The initial intent was to make the formwork directly from the computer model by implementing the use of a five-axis milling machine. The method successfully reproduced the geometry, but the formwork lacked durability and was destroyed when stripping the piece from the form (Figure 6). Before being awarded with the project, High Concrete had anticipated finding a coating that would allow multiple castings from one form. The milled formwork was also too labor intensive to set up. High Concrete decided that the final formwork would be all steel construction for durability and speed of assembly. Helser Industries was hired to design and fabricate the formwork (Figure 7). The 3D model was exported from **form•Z** and imported into Autodesk Inventor to generate the geometry for fabricating the formwork.

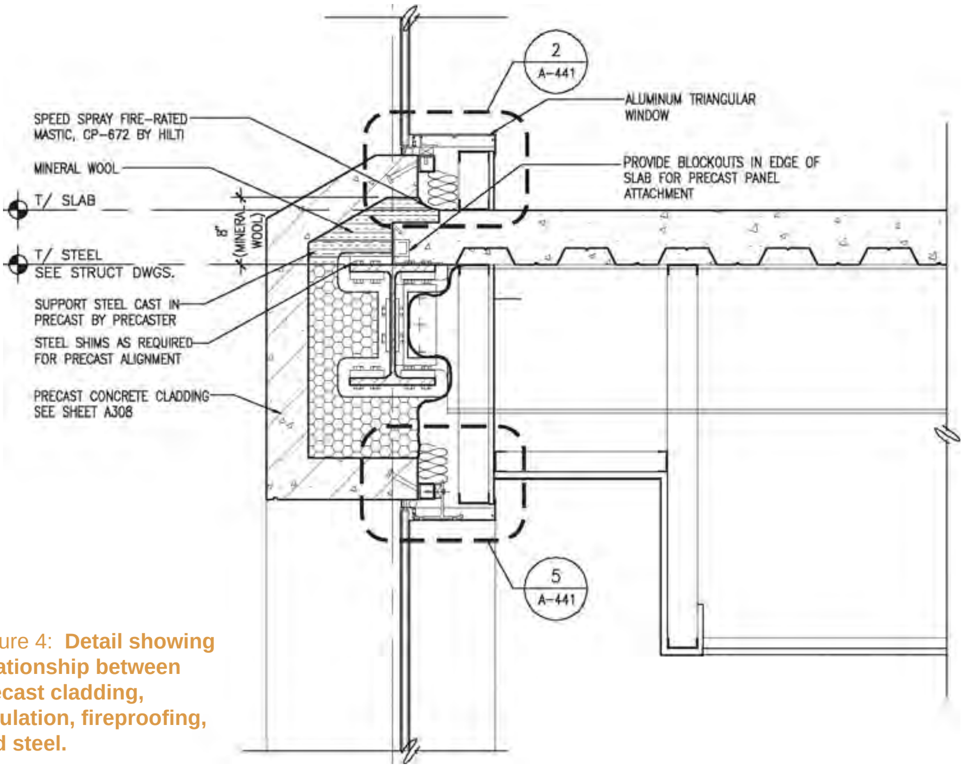


Figure 4: **Detail showing relationship between precast cladding, insulation, fireproofing, and steel.**

Often, precast concrete is utilized for its economy of repetition. The elevation of the Athletic Center appears as if it is comprised of a few repeating shapes. The geometry however is much more complex (Figure 8 and 9). The plan has seven different radii, each requiring a separate shape. The transition between each radii requires two unique shapes to stitch the transition. Within each radius, there are numerous panel variations such as: parapet panels, infill panels, bottom panels, and panels covering the base V-shaped columns. In total, the envelope is made of over 450 pieces of precast concrete, consisting of over 140 unique shapes, every piece 3D modeled. The steel formwork achieved efficiency by being fabricated as a large kit of interchangeable parts creating all the possible variations.

Even though the geometry of the formwork was generated directly from the model, traditional 2D shop drawings

Figure 6: **Photo of form made from five-axis milling machine.**

Photo provided courtesy of High Concrete.

Figure 7: **Photo of steel form fabricated** by **Helser Industries.**

Photo provided courtesy of High Concrete.

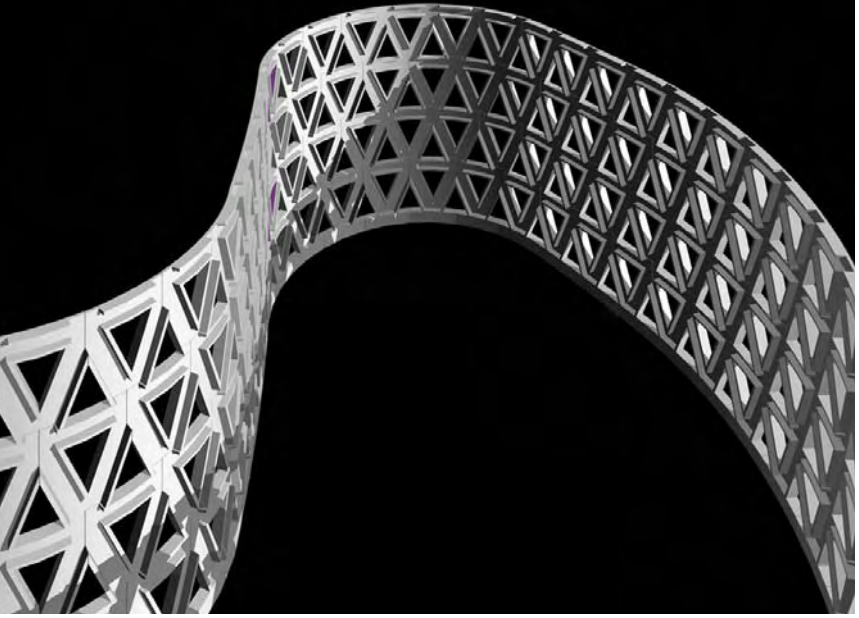


Figure 8: **Perspective of precast concrete computer model.**

Figure 9: **Perspective of the precast computer model illustrating the compound helical geometry.**

were still a contractual requirement of the project. High Concrete hired Glaserworks to produce the 2D shop drawings from the **form•Z** model. 2D elevations and sections were created in **form•Z** for all the pieces and exported to AutoCAD. The model geometry was also queried to provide 3D coordinates of the panels in preparation of erection drawings. Since the formwork was generated directly from the 3D model, the 2D shop drawings primarily served to check that the formwork was properly assembled and to indicate the spacing of steel reinforcement and connections.

The 3D model of the precast cladding was also utilized to check for proper tolerances between the steel structure and the precast cladding. The steel fabricator was required to submit a 3D model as part of the shop drawing review. Detecting interferences between the steel and precast within **form•Z** was not an automated process. Given the size and complexity of both models, performing a Boolean operation between the two models would not have been possible. Numerous sections were cut through the model and closer attention was given to areas where steel and precast were observed to be closer than construction tolerance. This exercise paid off as two areas of interference were detected and the steel and precast were adjusted prior to delivery, saving both time and money.

The utilization of 3D computer modeling resulted in minimal fabrication errors and almost flawless erection (Figure 10 and 11). Out of all of the prime contracts on the project, the precast concrete contractor had the fewest number of conflicts, resulting in minimal change orders. Though the production of shop drawings and error checking was a tedious manual process of exporting information from the model, future software development promises to automate the process. The Precast Concrete Software Consortium, a group of precast concrete producers from North America, is currently working to develop 3D parametric modeling software similar to that used in the steel industry. It is reasonable to presume that design professionals and fabricators will work with different software, so the 3D computer model needs to be capable of transfer without loss of quality. There is still a reluctance to share digital information between designer and contractor due to liability concerns, but sharing of information may actually reduce potential problems. The complex forms of leading architecture today often cannot be conveyed through traditional methods and the free flow of 3D data throughout the life of a project is essential for the project's success.

Figure 10: **Construction photo of north side of building.**

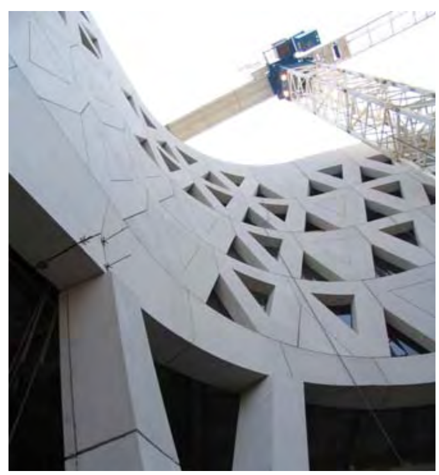


Figure 11: **Construction photo of east side of building.**

Mark Thurnauer is a Project Manager with Glaserworks Architects in Cincinnati, Ohio. He also maintains a 3D modeling consulting business, 3D Vision. Mr. Thurnauer has taught numerous courses in digital media. His presentation, *Computer Modeling in Precast Concrete* was accepted for the 2004 ACADIA conference. He received a Bachelor of Environmental Design in 1996 and Masters of Architecture in 2001 from Miami University and was the recipient of the AIA Award of Excellence and AIA of Honor in 2001.

Tool-Makers vs Tool-Users (or both)?

by Kostas Terzidis

There is a fundamental difference between algorithmic and CAD-related (or inspired) design. The difference is not only technical, representational, or graphical but also scientific, rational, methodological, and as such, intellectual. Algorithmic design employs an abstract symbolic language for representing ideas, concepts, and processes to be manipulated by a computer. It is a way of thinking, whose power is derived not only by the articulation of thoughts within the human mind but also, most importantly, by the extension of those thoughts using computational devices. In contrast, CAD related design is a graphical manipulation of predetermined elements or processes given to the designer as tools but whose potential capabilities have already been set in advanced. Every time a CAD programmer creates a new tool to be added to the palette, the programmer predetermines what the designer may need. This process involves at least two paradoxes: first, the intellectual effort to conceive, picture, and determine the use of a tool, involves by definition decisions, opinions, and predispositions that set limits to its use by others. The imagination of a particular person has its unique limitations confined however only for that person, not necessarily for others. Second, while the programmer is able to provide those tools that are believed to be needed, at the same time the programmer is unable to provide the means to create the tools that are not believed by the programmers to be needed (but may be) by the designer.

Algorithmic design involves symbolic languages and as such provides the means to create anything whether needed now, or not yet. CAD is about the pre-established needs of a designer who should act in a certain conventional way of thinking. William Mitchell argued that "architects tend to draw what they can build, and build what they can draw." Using CAD tools involves by necessity a Whorfian effect in which the designer is bounded to the potentiality of the new tools, who, in turn, bound the mind of the designer to think in a certain way in order to take full advantage of those tools. This unfortunate circular situation can only be eliminated when the designer and the CAD programmer are one and the same person. Then, the mind that designs is also the one that invents the tools that allows the mind to exceed its own thoughts. A tool is not only an instrument that is used in the performance of an operation whose purpose is known, but also a vehicle

Figure 1. **A housing arrangement for 200 units is constructed using a scripted algorithm based on cellular automata theory. While the final form of the arrangement was unpredictable, the programmatic requirements were predicted to be satisfied**

to help conceive operations or ideas that are not known in advance. The difference between a conventional and a computational tool is in the intellectual nature of the latter. Computation as a process is similar to the way the human mind works, and while it may not have intention or purpose it does perform in a similar manner.

The dominant mode for using computers in design today is a combination of manually driven design decisions and formally responsive computer applications. The problem with this combination is that neither the designer is aware of the possibilities that computational schemes can produce nor the software packages are able to predict the moves, idiosyncrasies, or personality of every designer. Therefore, the result is a distancing between the potential design explorations and the capacity built into computational tools. Designers often miss the opportunity opened up to them through digital tools, merely because of lack of understanding that computation can be part of the design process as well. While some digital designers are claiming to be great fans, users, or explorers of digital design, a lack of knowledge on what really constitutes digital design contributes toward a general misunderstanding; the use of computer applications is not per se an act of digital design.

Digital, in the true sense of the meaning, is about the reduction of a process into discrete patterns and the articulation of these patterns into new entities to be used by a computer. Digital is an achievement of the collective organizational properties of computers not the intrinsic nature of the appearance of their products. In other words, digital is a process not a product. If it is seen as a process, then the emphasis is placed on understanding, distinguishing, and discerning the means by which design can enter the world of computation, and not the other way around. The world of computational design is quite different from the manual world of design. Terms, concepts, and processes that are seen as inconceivable, unpredictable, or simply impossible by a human designer can be explored, implemented, and developed into entirely new design strategies within the digital world. Instead, what is happening is the use of computers as marketing tools of strange forms whose origin, process, or rationale of generation is entirely unknown and so they are judged on the basis of their appearance often utilizing mystic, cryptic, or obfuscating texts for explanation.

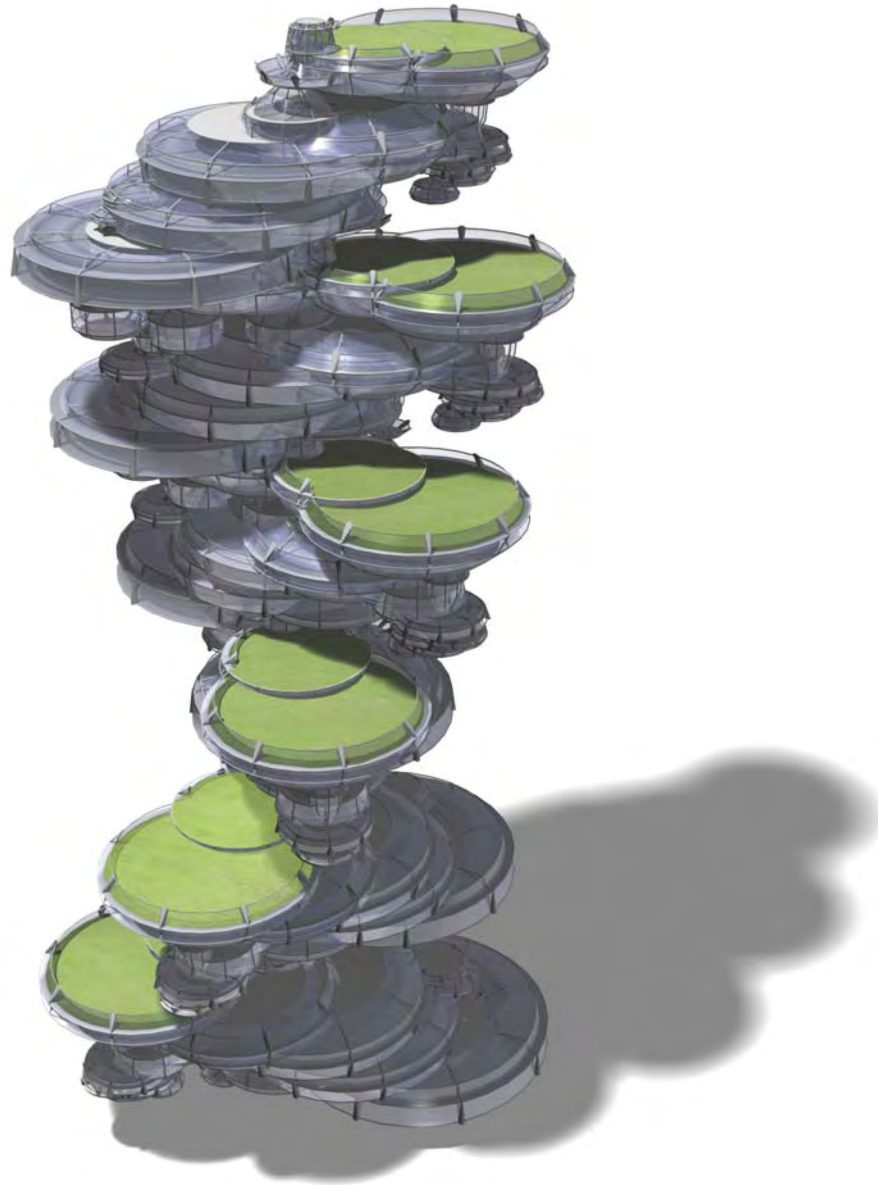


Figure 2. **A building configuration constructed gradually using a scripted algorithm.**

The problem with algorithmic logic in design is that fixed interrelationships between numbers and concepts appear to some designers as too deterministic. In fact, many designers are not interested in the mathematics of a design composition but rather in the composition itself. While this position may be interpreted as a defense mechanism against the possible rationalization of design, yet it becomes also an obstacle in exploring the limits of a possible rationalization of design. Computer systems that are referred to as CAD systems are in essence collections of algorithms each of which addresses a specific graphical design issue. A user of a CAD system, i.e. a designer, makes use of these algorithms without knowledge of how they work and consequently is unable to determine the full value of their potential. While CAD systems helped designers significantly to organize, speed up, or communicate ideas using high-level commands, only a few CAD systems offer the means to combine those commands algorithmically (i.e. scripting, API, or open-source) in ways that would allow one to explore "out of the box" possibilities or to break

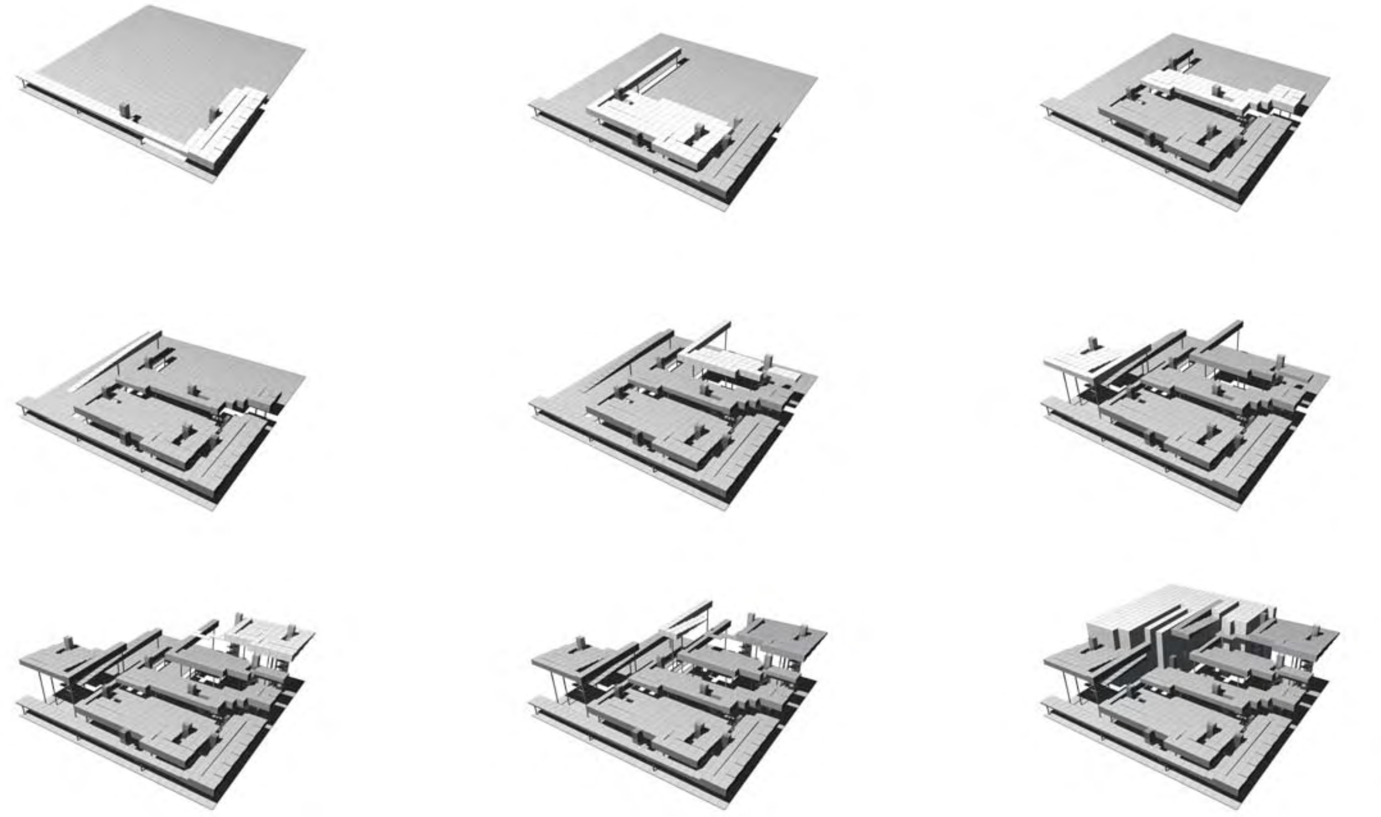


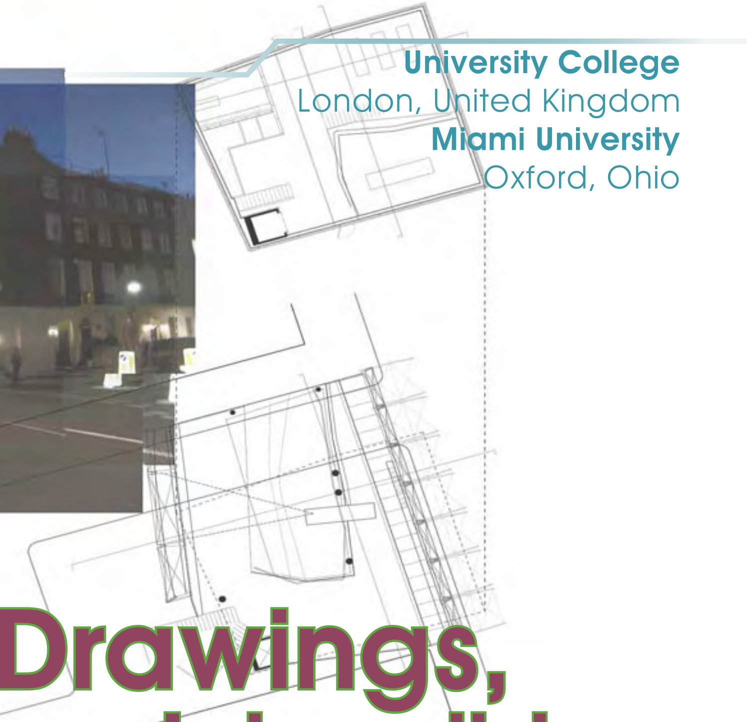
Figure 3. **A library constructed using a scripted algorithm based on stochastic search. The phases of construction reveal a progressive evolution of form based on iteratively satisfying the program's spatial and relational constraints.**

down the commands in ways that would allow one to explore what is "under the hood". Further, very few designers have the knowledge to understand the computational mechanisms involved in a CAD system, or, reversely, very few CAD developers are also equally accomplished designers.

Both non-users and users agree that the effect computers will have on design whether desirable or not will be significant, profound, and far-reaching. This agreement is based on an important yet peculiar relationship between design and its tools. It is apparent that design is strongly depended on the tools utilized and, reversely, tools have a profound effect in design. Traditionally, this dependency is controlled by the human designer who decides which tool is to be used when and where as well as the range of possibilities a tool has for addressing, resolving, or accomplishing a design task. Further, it is possible that the use of tools may also have further implications in the process of addressing a task: just because a tool is available, a task is now possible, or, further, a tool implies a task. However, a problem arises when the tool is not entirely under control of its user. In the case of a computer as a tool, the results may be unexpected, surprising, or unpredictable even by the users themselves. While such moments of surprise may be advantageous, enlightening, or perhaps even undesirable, they do exhibit a theoretical interest because they challenge the basic premise of what a tool is or how a tool should behave. Further, such behavior may lead to alternative ways of executing the task that were not intended and may lead to results often superior than intended.

Traditionally, the dominant paradigm for discussing and producing design has been that of human intuition and ingenuity. For the first time perhaps, a paradigm shift is being formulated that outweighs previous ones. Algorithmic design employs methods and devices that have practically no precedent. If design is to embark into the alien world of algorithmic form, its design methods should also incorporate computational processes. If there is a form beyond comprehension it will lie within the algorithmic domain. While human intuition and ingenuity may be the starting point, the computational and combinatorial capabilities of computers must also be integrated.

Kostas Terzidis is an Associate Professor at the Harvard Graduate School of Design. His current GSD courses are Kinetic Architecture, Algorithmic Architecture, Digital Media, Advanced Studies in Architectural Computing, and Design Research Methods. He holds a PhD in Architecture from the University of Michigan (1994), a Masters of Architecture from The Ohio State University (1989) and a Diploma of Engineering from the Aristotelion University in Greece (1986). He is a registered architect in Europe where he has designed and built several commercial and residential buildings. His most recent work is in the development of theories and techniques for algorithmic architecture. His book Expressive Form: A Conceptual Approach to Computational Design published by London-based Spon Press (2003) offers a unique perspective on the use of computation as it relates to aesthetics, specifically in architecture and design. His latest book Algorithmic Architecture, (Architectural Press/ Elsevier, 2006), provides an ontological investigation into the terms, concepts, and processes of algorithmic architecture and provides a theoretical framework for design implementations.



University College
London, United Kingdom
Miami University
Oxford, Ohio

Computer Drawings, Tangible and Intangible

by **Thomas Heltzel**

This project explores a film festival in a sleepy, (hypothetical) English village, Slowtown. The annual Slowtown Horror Film Festival descends on Slowtown's High Street in the last week of October. The citizens of Slowtown anticipate the arrival of the ceremony; a weeklong viewing of the town's most venerated horror films revealing themselves within the center of their homes. This project investigates the entwinement of the festival's architecture with the visual and audio sensations of the ceremony.

The appearance of counterweights signals the beginning of the event's weeklong procession and allude to what will emerge later that evening. Rough, pale concrete blocks with a complicated system of pulleys and levers are positioned along High Street's cracked sidewalks, announcing the festival's arrival. These grounded masses seemingly become the only existing connection that the architecture has to the street, tying the structure to the people below and representing the tension between the existing environment and the festival's architecture. Movie projectors are placed in the windows of host buildings and project the classic horror films onto the opposite buildings' facades.

As night falls, vertical theatres lurch out from above the buildings to over the street. Large, flexible lattice trusses extend and cantilever over the counter-weights below. Plush red theatre seats and speakers are suspended on a pulley system running between the rooftop trusses and the street level counter-weights. For each film, the speakers are set to varying, unique heights. The projectors then project the movies onto the opposite building's facades. As the film progresses, viewers reposition their chairs vertically to find the best combination of sound and sight. During a showing of Hitchcock's, The Birds, speakers are placed high, skimming the rooftops. The viewers move their chairs up the building to gain the best sound, while also enhancing the fear of height and isolation. Expandable trusses and theatres allow for an expansion of the ceremony by night and reclamation of the street by day. The structures rise from the shadows and the festival is re-born every evening as the ceremonial qualities of the event emerge. When morning approaches, the architecture retracts to its' hiding position, leaving behind the counter weights as the only trace of activity during the night. The architecture is not merely a setting for the ceremony; rather it is the facilitator of the festival's ceremonial qualities.

The second part of the project entails the Slowtown Horror Film Club Headquarters. This building acts as an archive for the club's film collection, as well as a meeting place and bar. Most importantly, it establishes a visual focal point for the film festival. It occupies a major intersection above Slowtown High Street. Perched on slender columns it produces a new public plaza. The first floor contains the public and social program of the club. An undulating concrete honeycomb tops the structure, while the walls are constructed of semi-translucent folding movie screens, further evolving the public space as the movie projects through the screens and the interior's activities are witnessed on the street.

On another level, the project explores various ideas for representation of the design. Specifically, it attempts to challenge the idea of the generic computer rendering. The decision to use the computer is not always appropriate. Likewise, the computer should not be trusted to provide a final image. With the diverse opportunities provided by computer modeling and rendering, a good drawing should represent something more than just visual information of the tangible aspects of the project. It could do more. A good drawing could describe the tangible and the intangible, the rational and the unconscious, the collective and individual dimensions of architecture.

In the process of constructing a computer model, hundreds of bits of information are compiled. Decisions about design are constantly being made such as the height or the position of individual objects. The encoding process within the computer can be much more complex and a tremendous amount of information can be computed rather quickly compared to traditional media. Likewise, the computer is capable of rapidly changing and updating the design. Therefore, all quantifiable aspects of the design (height, radius, position of the sun) can be constructed or changed within the computer quickly and easily. This process opens infinite new possibilities in the design process. Interaction with the media becomes magnified and changes in design can be clearly recognized. These new types of interaction transform the design process and should be communicated in new ways. According to Gerhard Schmitt, founder of the Chair of Architecture and CAAD at the ETH Zurich, "*the means by which the machine can help us externalize previously hidden mechanisms, making the invisible visible and in the process expand human design capabilities, beyond that what was and will be possible by hand, are. To be very clear, these instruments will not replace conventional design interactions between humans and external media but will enrich them tremendously in qualitative ways*." (p. 6, Engeli, 2001). However, problems arise from being trapped within the dimensions supported by the individual computer programs. The ease with which we could compile the quantifiable and tangible aspects of the design overrides the unique qualities of each project. Ideas such as the change in light from one moment to the next or an exploration of scale as one moves through a space are lost when we fail to realize the scope of an individual program. Likewise, many processes of each computer program are taken for granted, and often overlooked. For example, the naiveté of just hitting the render button without critical engagement blurs the expressive potential of each drawing. The challenge of the "Slowtown Horror Film Festival" project was how to use **form•Z** to demonstrate the special, qualitative aspects of the architecture along with the quantitative.

Architects draw to communicate ideas. To manage the complexity of computer modeling, we must again examine why we draw. Simon Herron of the Bartlett School of Architecture explains that, "*Once they decide the 'why'- what the drawing has to do- the 'how' becomes clearer… You draw not to illustrate but to discover, to uncover the project. It is a device for speculation, a tool rather than an end product. It can be with a rapidograph, with an Epson printer, with light on photosensitive paper, with gunpowder. All media are valid so as long as there's an intention*" (Pg 119, The Bartlett Book of Ideas). A new relationship between the 'why' and the 'how' must be developed. Is the drawing communicating the light at 12:43 on the 15 of May, or should the drawing express grander ideas about the changing light through the course of the day? The course of the year? Any of these could be relevant, however, this intention could be hidden by interaction through a modeling program.

To understand the importance of a drawing's intentions, we can look to traditional media. With the washes of light on small notebook pages, infinite qualities of intangible aspects are observed in Steven Holl's watercolors.

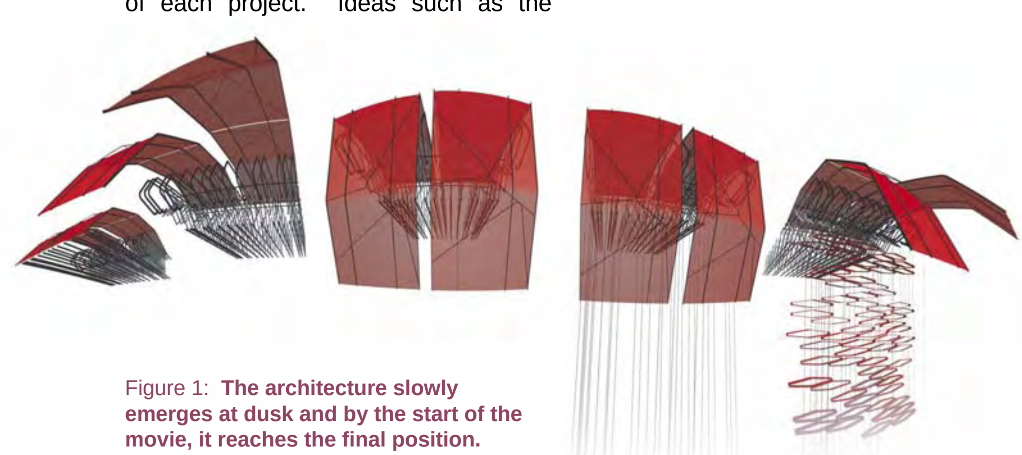


Figure 1: **The architecture slowly emerges at dusk and by the start of the movie, it reaches the final position.**

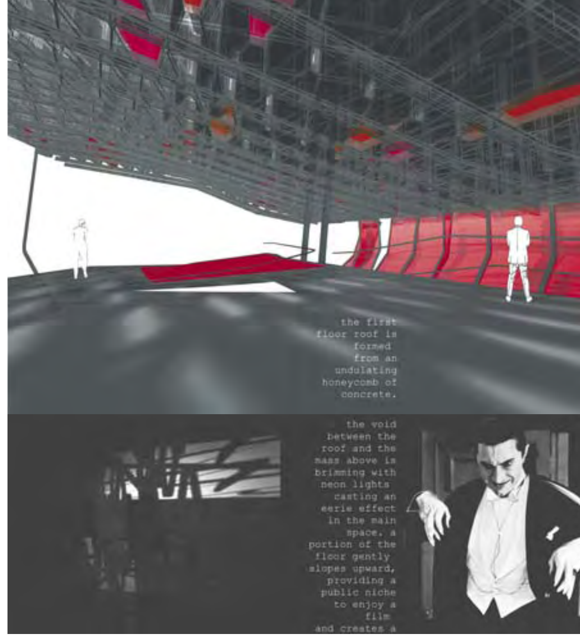


Figure 2: **Interior perspective.**

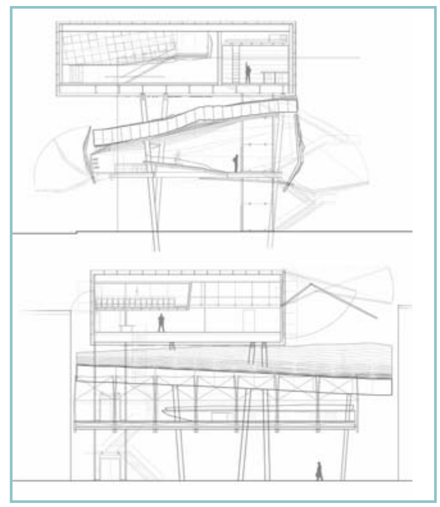


Figure 3: **Sections of film club headquarters.**

"*The diversity of techniques – the infinitely varied rendering of appearances – introduces the permanence of the links which are reenacted in the ceaselessly renewed experiences we can have with architecture*." (Garofalo, 2003, pg. 14) The depth of information contained in Holl's renderings clearly communicates the architect's intentions and consequently reassures us, "about its 'authenticity' and its correspondence to the concept, and thus his ability to predict in abstract the perceptual and phenomenological effects of his works of architecture" (Garofalo, 2003, pg. 13). Holl's work shows the importance of the connection between representation and a final architecture. However, the crude use of a computer's ability usually masks this primary connection in a common computer rendering. Consequently we don't learn much about the artist's intentions from them. They

Figure 4: **These various images attempt to freeze intimate moments of the festival, such as the beam of light from the projector illuminating the base pulleys, and a viewer slowly moving his chair vertically through the night.**

are representations, not investigations. To manage the complexity of interaction brought through computer modeling and to communicate the architect's intentions, a new process of representation must be utilized. Thus, the task becomes to force the modeling program to become a means to an end, not the end itself. Once we decide each drawing's intention we can go about modeling in an appropriate way. In this way we can state a goal for the final outcome, and then through the process to reach that goal we can learn much more than simply attempting to build the complete model and export an image for presentation. Accordingly, the interaction process becomes amplified; not only do we lean from the actual process of modeling, but also rendering, interacting with the design from start to finish.

In the Slowtown Horror Film Festival, I used this method to produce two drawings with contrasting time scales. They each attempt to show a specific quality of the project over a varying length of time. The drawings are used to connect the mood of the ceremony - at varying durations - with the specific qualities of architecture associated with that moment of the festival. The first drawing (see Figure 4) is of the base pulleys at night. The drawing shows the bottom counter weights of the theatres during a show. A beam of light cuts through the darkness, revealing the architecture, yet only for a split second. Time is frozen and we understand the spontaneity of the light cutting through the street, the elusiveness of the architecture. To produce this drawing, the **form•Z** model was only one of several constituent parts for the final image. The extensive detail of the model was used to contrast the vagueness of the photograph. The image investigates the project by compiling the model with the photograph and understanding the specific qualities of light. Similarly, the other drawing (Figure 5) uses a sense of collage to demonstrate a series of events. Here, an entire street block of rooftop theatres is shown in various positions throughout the night. The collage reinforces the idea that we are not capturing just one moment but a collection of complex events. A single model was manipulated many times, indicating the temporality of the architecture. Instead of relying on the computer to produce a final image, the model and various other media investigates the festival throughout the course of the night.

In these cases, the computer does not increase to breadth of information contained within the drawing; it increases the depth of the drawing. The drawing is part of the creative and design process, not a representation of it. In this way we are constantly learning and interacting with the design.

Notes

Cook, Peter (Ed.). (2000) *Bartlett Book of Ideas*. London: Bartlett Books of Architecture.

Engeli, Maia (Ed.). (2001) *Bits and Spaces*. Basel: Birkhauser.

Garofalo, Francesco. (2003) *Steven Holl*. New York:Universe Publishing.

Holl, Steven. (1996) *Interwinning*. New York: Princeton Architectural Press.

Pallasmaa, Juhani. (2002) *Thought, Matter, and Experience*. El Croquis,108, p. 6-27.

Figure 5: **Slowtown High Street throughout the first night of the horror film festival.**

Thomas Heltzel is currently a senior architecture student at Miami University. He pursues an architecture grounded in materiality and technology and is interested in the political dimension of architecture. He was an affiliate student at the Bartlett College of Architecture and Planning at University College London in 2005-2006 and participated in an Italian traveling studio with Studio Urquiola in 2005. He has worked at VOA Associates in Chicago, and is currently working with Mile^2 Lab in Oxford, Ohio. Email: heltzetg@muohio.edu.

Classical Principles for 3D Film Production Design

by Richard Reynolds

The American Film Institute Conservatory uses a multi-skill approach based on the screenplays' characters to develop set design for film. The emphasis is on design solutions that complement the narrative, that is, the storytelling of the screenplay and the characters within.

These skills are taught in a two year MFA program in separate classes of film analysis, storyboarding and illustration, drafting for construction documents, 2D computer graphics and 3D modeling and rendering using **form•Z**.

The American Film Institute Conservatory is an accredited two year MFA program, granting a degree in Film Production Design, as well as the areas of producing, directing, writing, editing and cinematography. AFI fellows are actively involved in making student films throughout their time at AFI.

2D computer skills are taught in the first year and **form•Z** is used for 3D computer modeling and rendering in the second year. This course is a 3D computer design practicum for film production design purposes, using classical architecture to illustrate the principles of design and 3D computer modeling. Additional emphasis is placed on specific film production design conventions and techniques.

We utilize **form•Z** for 3D modeling of our film sets, rendering for conceptual presentation and keyframe illustration, 2D drafting for set construction documents, and animation both to explore a set spacially, and to present the set as a specific film camera will see it to the director and producer.

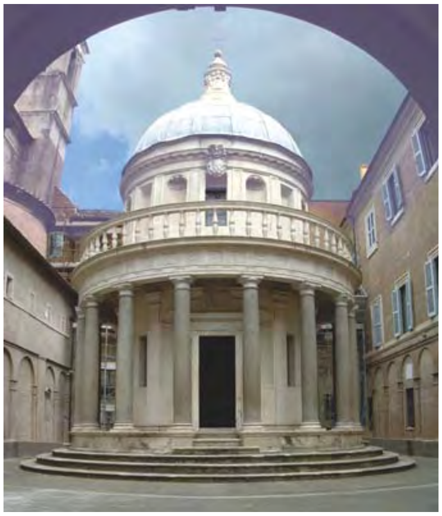
We begin with simple modeling exercises, then study classical proportions in 2D and then in 3D while modeling columns and entablature. Signage is an important component in art direction for film and **form•Z** is a great place to create signs of all sorts. We proceed to model, texture map, light, and render Bramante's "Tempietto", Rome (1502), in order to refine our design and modeling skills.

We also use Borromini's work on St. Ivo della Sapienza, Rome, (1643), for advanced nurbs modeling and sophisticated geometric planning.

The last part of the second semester is devoted to the students' Final Project, which is a film of their choosing, redesigning one or two key sets in coordination with similar work in their other academic courses.

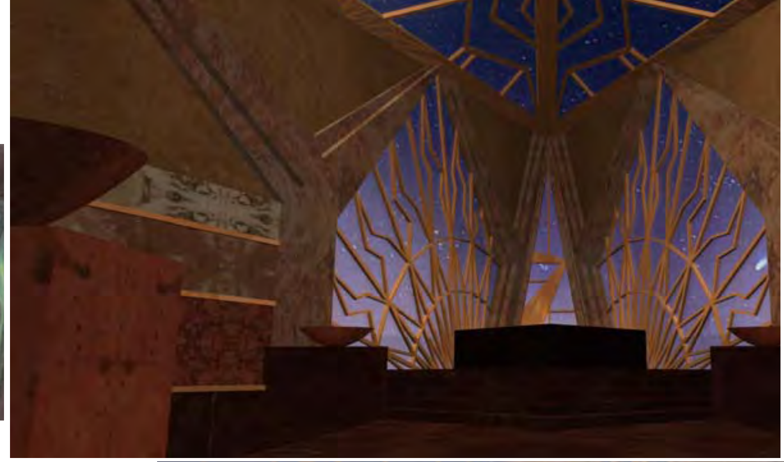
Included with this article are write ups of two Final Projects by Javiera Varas and Lei Jin. They both describe the guiding design elements and other considerations of their projects.

In the design work of these two students the principles of classical architecture are imaginatively expressed through the sophisticated use of proportion, symmetry, balance and hierarchy. They have each created unique spaces that exemplify character and support the story, leading us, as the movie viewer, to a fuller understanding of the narrative and a deeper, more emotionally-based experience of the film.



Bramante's Tempietto, Rome, 1502

Richard Reynolds works as a 3D computer Set Designer for feature films in Hollywood, Ca. He has 28 years experience as a film Production Designer, Art Director, Set Decorator and Theatrical Stage and Lighting Designer. Architectural illustration and animated pre-visualization is a current area of work as well. He has taught at the American Film Institute for the past 9 years as a **form•Z** Principle Investigator, specializing in the use of 3D computer design for film Production Designers. Recent credits include "Pirates of the Caribbean 2 & 3", where he designed 'Davy Jones' pirate ship, "Sky High", "Superman-Flyby", "The Terminal" and "Minority Report" directed by S. Spielberg, "Cat in the Hat","Envy","T3", "Solaris", "Planet of the Apes", "Pearl Harbor", "Mission to Mars", "Carnivale"-pilot, and the soon to be released "Disturbia". He was the Visual Effects Art Director in charge of designing all the miniature special effects shots for "Batman & Robin", and has designed for all formats of television. Reynolds' work as a 3D designer has been published in Computer Graphics World, on display at the Art Directors Guild in Hollywood, used as advertising graphics nationwide for **form•Z**, and he is a frequent contributor to **in•form•Z** and the **form•Z** Calendar. Reynolds holds a B.A. degree from Pomona College, Ca. and an M.A. from San Francisco State University, both in Stage and Lighting Design.

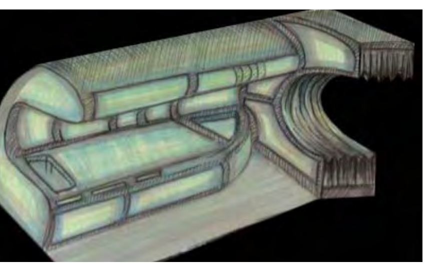


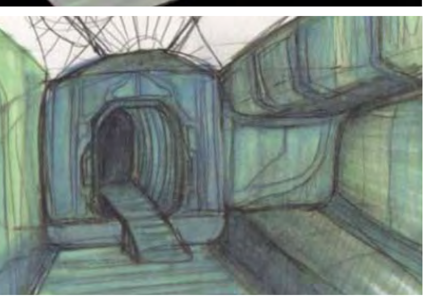
THE FIFTH ELEMENT

Re-design by Javiera Varas

The Fifth Element is a movie famous for its high visual concept, great cast and involving story line, so the exercise of re-designing it was not an easy task. As the title enunciates, the core of the movie is about the 5 elements (water, fire, air, earth and ether) and how their harmonious integration will ultimately save the world. This statement gave me the foundation from which to work: the elements.

First, I tried to understand what each character's personality was and with which element they could best relate. Secondly, I translated this language into space, into an environment in which they can not only be the element, but also provide the necessary tension and atmosphere for the scenes to unfold. This way actors move through a space that is supporting the action and providing a visual context of significance.

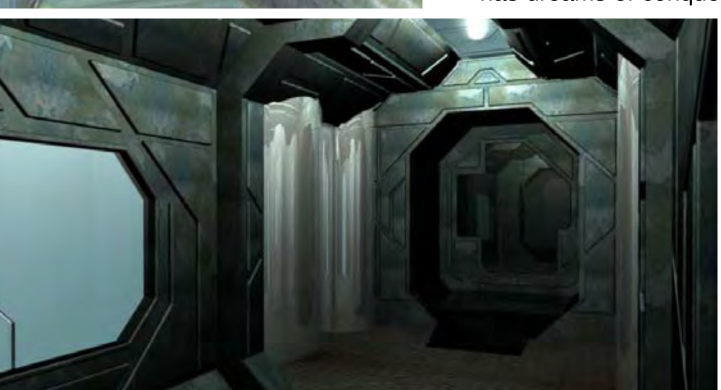


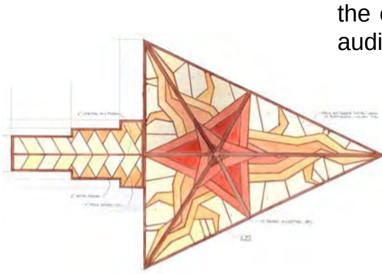


The first set I designed is Korben's apartment (Bruce Willis' character). I assigned him the water constitution because his personality in the beginning of the movie is melancholic, stagnant, apathetic, stuck. This water affiliation led me to design with curved patterns and reflective materials, also a paint treatment to simulate stagnant water. The center part of the set is small and cave-like, to accentuate the claustrophobic feel and show how the character is trapped in his reduced space/life. The different compartments of the room open and close in regard to the action, allowing the space to be more flexible and adaptable to a moving camera.

The second set I designed is Zorg's office (Gary Oldman's character). I assigned him the fire constitution, as he is a very aggressive character, ambitious and cruel, the perfect antagonist. Since he has dreams of conquering the world, I was inspired to incorporate elements of fascist architecture, where high thick columns and tall ceilings give the impression of a very imposing space. The color palette I selected is red rusty tones, while the marble surfaces provide the necessary coldness appropriate to the character. A glass ceiling as well as huge glass windows with fire patterns allowed for interesting lighting possibilities. The different levels were crucial for the action, as the attending monk had to be constantly rising in order to reach Zorg.

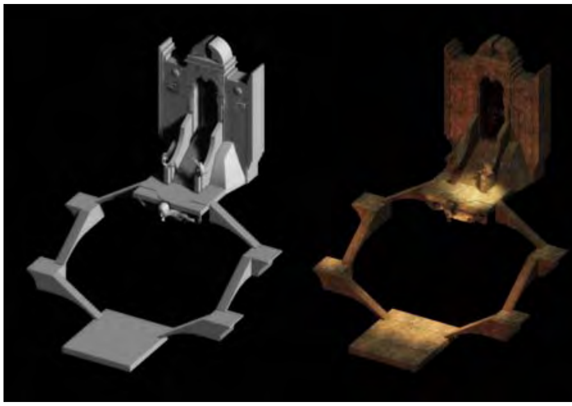
form•Z was an essential tool in the pre-visualization of this project. It allowed me to render these sets in a reasonable time frame and to have an accurate sense of materials, lighting and camera angles. It even allowed me to create a camera move I thought would be appropriate for a specific scene within the set, the final confrontation. Since this is a re-design exercise for a motion picture, the way the camera sees the set is the way the audience will.





JOURNEY TO THE CENTER OF EARTH

by Lei Jin



A grand entry to the lost city of Atlantis, was one of the scenes I selected for an experimental project Journey to the Center of the Earth at the American Film Institute. This movie was first made in 1959 and is an excellent film for its day.

For my assignment, I wanted to enhance the look of the final sequence "Atlantis City" taking it to a more extreme and mythical level. The entry to Atlantis, as the first impression of the underground ancient empire, deserves a marvelous look according to the script. I started with the idea of putting a giant gate high up on a cliff above an abyss. By raising the camera up from the dark abyss to our world, the entry's unique architecture could be revealed dramatically, enhancing the excitement in the upcoming intense drop scene.

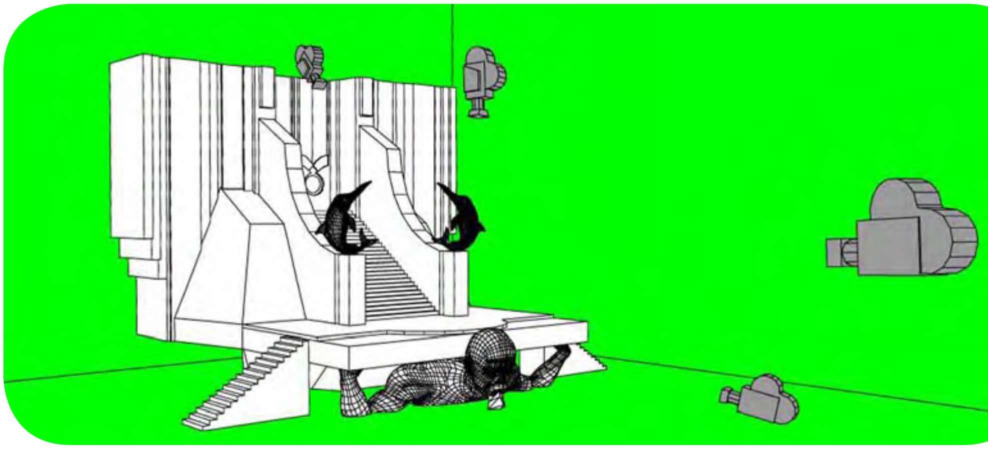
With this concept in mind, I sketched a number of options, also blocked in some simple 3D geometry and viewed them in a virtual camera in **form•Z** to help instruct my vanishing points, space and composition for line drawings. Once the basic shapes were finalized on paper I began to lay it out in the more traditional manner of drafting. Different from concept sketching, a lot of decorative details need to be defined in this process, and most importantly, it makes a set understandable to a construction crew and also reasonable to financing producers.

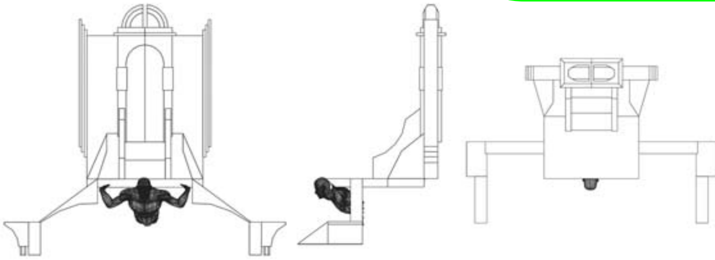
Remarkably, **form•Z** was involved in this process and became a great tool again. By developing the simple 3D model I used before, my drafting had gained additional detail from its top, front and side renderings. And this continually developing drafting became a vital reference for my 3D model and rendering later on. So within one process, I was actually able to finish two tasks, and both would be integrated in my final product.

Out of the need to achieve this ambitious scene cost-effectively, the use of a "green-screen" to allow for the later compositing of digital visual effects, had become necessary at this stage. The biggest challenge was how to partition the green-screen area off from our physical, construction set. Within a digital 3D environment, I could layout all possible camera positions, angles, lenses, and actors' moves, and I could also animate the scene in various ways, to help figure out how much space would be required to build a real set, and what parts could be digitally added in post-production.

To present my final design to directors and producers, I still needed one more step, the final rendering. But before I started this step, I first needed to determine the atmosphere and lighting sources for the images. I decided that my light source should come from the bottom (emanating from the earth's core lava), and I wanted to create a horrific scene.

I worked first with the lighting, because in this scene, I wanted to use only two texture maps and allow my lighting to shade and highlight the surfaces in unique ways.





Any complicated movie shot can now be completely designed and visualized in a digital program, like **form•Z**. In this project, digital media offered me a great opportunity to explore and investigate my design choices. **form•Z** is not only a final presention tool, but also an idea generator.

North Dakota State University
Fargo, North Dakota

Dynamic Architectural Constructs

by Ganapathy Mahalingam

The advent of **form•Z** 6.0 has brought with it a new range of tools for the animation of objects. Hitherto, tools for the animation of cameras for walkthroughs and flybys have been available that have made the dynamic visual exploration of architectural forms possible. Early adoption of such animation techniques had designers assuming the role of film makers and directors (Temkin, 2003). However with these initial animation tools, the modeling of dynamic architectural constructs based on performance has not been possible in **form•Z**, until now. This new set of animation tools provides an exciting opportunity to explore architectural designs using radically new approaches.

In his book *Animate Form*, Greg Lynn provides many provocative insights into the use of animation tools for architectural design. According to him, "the challenge for contemporary architectural theory and design is try to understand the appearance of these tools in a more sophisticated way than as simply a new set of shapes. Issues of force, motion and time, which have perennially eluded architectural description due to their "vague essence", can now be experimented with by supplanting the traditional tools of exactitude and stasis with tools of gradients, flexible envelopes, temporal flows and forces. It is not necessary for architects to perform the differential equations that generate topological forms, as the equation for even the simplest spline is too complex for most architects to calculate. Instead, designers must understand the patterns of topology as they unfold dynamically with varying performance, rather than understanding them merely as shapes." (Lynn, 1999) In doing so, Greg Lynn distinguishes digital media as being different from paper and pencil by highlighting the three fundamental properties, which are different in digital media than inert media, such as the paper and pencil, typology, time, and parameters. He goes on to define this approach as an "organic tradition" that often involves non-dialectical relationships between matter and information, form and time, and organization and force. This resistance to treat form, time, and motion discretely is what he says is equivalent to an organic tradition. He believes that the development of "animate forms" is the creation of new symbolic forms in architecture. He says, "The use of parameters and statistics for the design of form requires a more abstract, and often less representational origin for design. The shape of statistics, or parameters, may yield a culturally symbolic form, yet at the beginning, their role is more inchoate. This marks a shift from a modernist notion of abstraction based on form and vision to an abstraction based on process and movement." (Lynn, 1999)

In the fall semester of 2006, in the Department of Architecture and Landscape Architecture at North Dakota State University, an advanced digital design studio was offered to students. The main focus of the design studio was the generation of architectural forms based on specific performance criteria. The intent of the studio was captured in the title, "Forms of Performance." **form•Z** was chosen as the vehicle to conduct these design explorations. Students were not required to have prior experience in using **form•Z**. This allowed us to test whether it was possible to quickly learn the various tools in **form•Z** and become productive within the scope of a semester. **form•Z** is often chided for its steep learning curve. Our experience has pointed out that though it takes time to understand the intricacies of how **form•Z** works, it is indeed possible to start afresh and become productive in the use of **form•Z** in a matter of weeks.

One of the problems that the students worked on was a design exploration called "Volumes of Heat." Students were asked to start with a quantity of heat in British Thermal Units (BTUs) and asked to derive a volume of air that would contain that quantity of heat at optimum conditions of human comfort (75 degrees Fahrenheit and 55% Relative Humidity). This they did using the specific heat of air and the density of air at the appropriate conditions of temperature and humidity. They were then asked to derive an architectural form that contained that volume of air and locate it on a site. Using the climate data for that site and the site orientation of the architectural form, they then calculated the heat gain and losses of the architectural form over a period of one year. Instead of pumping air or water in and out of the architectural form to regulate the temperature inside the form through heat exchanges, the students were challenged to make their architectural form a dynamic construct that changed and adapted in order to preserve the interior optimum conditions of comfort. The architectural form became a breathing "lung" that was homoeothermic. The architectural form was treated as a dynamic construct that changed to preserve the optimum interior conditions of comfort. As the form changed dynamically, it was important to keep track of the heat gains or losses created by the changing form. These tasks turned out to be non-trivial. Strategies that the students used to create the dynamic architectural constructs included changing the volume of the form, changing the size and position of glazed windows, retractable louvers, retractable wall panels, retractable volumes, etc.

Rather than just animate by changing affine transformations, the students actually changed the architectural forms in time by changing the quantities involved in the various parameters of the architectural forms. In order to create these dynamic constructs they had to engage most of the tools in the animation toolset of **form•Z**. To achieve a fine level of control of the dynamic architectural form, they had to get into the intricacies of the Animation Editor and pay close attention to how animations were set up in **form•Z**. This design exploration was an excellent way to get introduced to, and become proficient in the use of the set of animation tools in **form•Z**. The design exploration also served to integrate two areas of the architecture curriculum that are seldom integrated, digital design media and environmental control systems. Functional animation that results in environmental control is the product. In this process, animation is transformed from an aesthetic process to become a functional process as well through dynamic architectural constructs. In addition, an often overlooked set of tools in **form•Z**, the Query tools were used extensively to find out the volumes of forms, the areas of surfaces and the areas of openings. The Query tools are invaluable in making informed decisions about architectural forms, especially when they have to be manipulated to achieve specific performance criteria, which are not limited to environmental performance criteria. Structural design comes to mind with the availability of mass properties of forms. Tools such as the Scaling tools also became critical for making marginal changes in volumes and surfaces of objects that drove the setting of animation keyframes.

The students used Microsoft Excel spreadsheets for all of their calculations. They manually transferred the results of the calculations to the operations in **form•Z**. This was a process that was prone to error and required constant care. It would have been a more seamless exercise if they had been able to use the **form•Z** scripting language to perform the calculations and then directly drive the animations of the dynamic architectural forms within **form•Z**. The ability to perform basic, trigonometric and logarithmic calculations using the scripting language would be an invaluable asset in **form•Z**. This is something we look forward to being available. Given that many of the students were using **form•Z** for the first time, learning to use the scripting language was not within the scope of the studio. In the future, with additional knowledge of the scripting tools, it may be possible for students to develop and execute dynamic architectural constructs from within **form•Z**. This is something we are looking forward to implementing next year.

In conclusion, our design explorations using the new set of animation tools in **form•Z** has enabled us to successfully consider the "dynamic architectural construct," an alternative to static buildings in the achievement of environmental performance. This is also conceptually connected to interactive and responsive architecture, where architectural forms respond to information gathered from spatially distributed sensors that measure various environmental performance criteria. An early project that epitomized this concept was the Aegis Hyposurface project (Goulthorpe, Burry and Dunlop, 2001). Such projects did not emerge initially from the **form•Z** user community simply because the animation tools required to model such projects were not part of the toolset of **form•Z**. However, Tristan d'Estree Sterk won a **form•Z** Joint Study Award in 1999 for a responsive architecture project that was presented without animations, and could have benefited from such animation tools that are available today to reveal the full complexity of his project.

The animation tools currently available in **form•Z** lend themselves easily to the modeling of the effects of sensor+actuator based systems. Conceptual models for sensor+actuator based systems have been developed in recent years by the author, which are the initial steps to modeling such systems (Mahalingam, 2005; Mahalingam, 2001). One can now show through animations how dynamic architectural constructs can respond to human inhabitants. The Hyperbody Research Group at TU Delft in the Netherlands, under the direction of Kas Oosterhuis, has demonstrated the viability of responsive and interactive architecture projects by building full-scale prototypes whose development was most likely the result of using robust animation tools. Difficult implementations such as the 'tunable' auditorium have now become possible with the availability of such tools and are being investigated by the author.

References

Biloria, N. and K. Oosterhuis, “Envisioning the Responsive Milieu: An Investigation into Aspects of Ambient Intelligence, Human Machine Symbiosis, and Ubiquitous Computing for Developing a Generic Real-Time Interactive Spatial Prototype,” *CAADRIA ’05 Proceedings*, New Delhi, India, 2005, pp. 421-432.

Goulthorpe, M., M. Burry and G. Dunlop, “Aegis Hyposurface: The Bordering of University and Practice,” *ACADIA 2001 Proceedings: Work-In-Progress* Part I, Buffalo, New York, 2001, pp. 344-349.

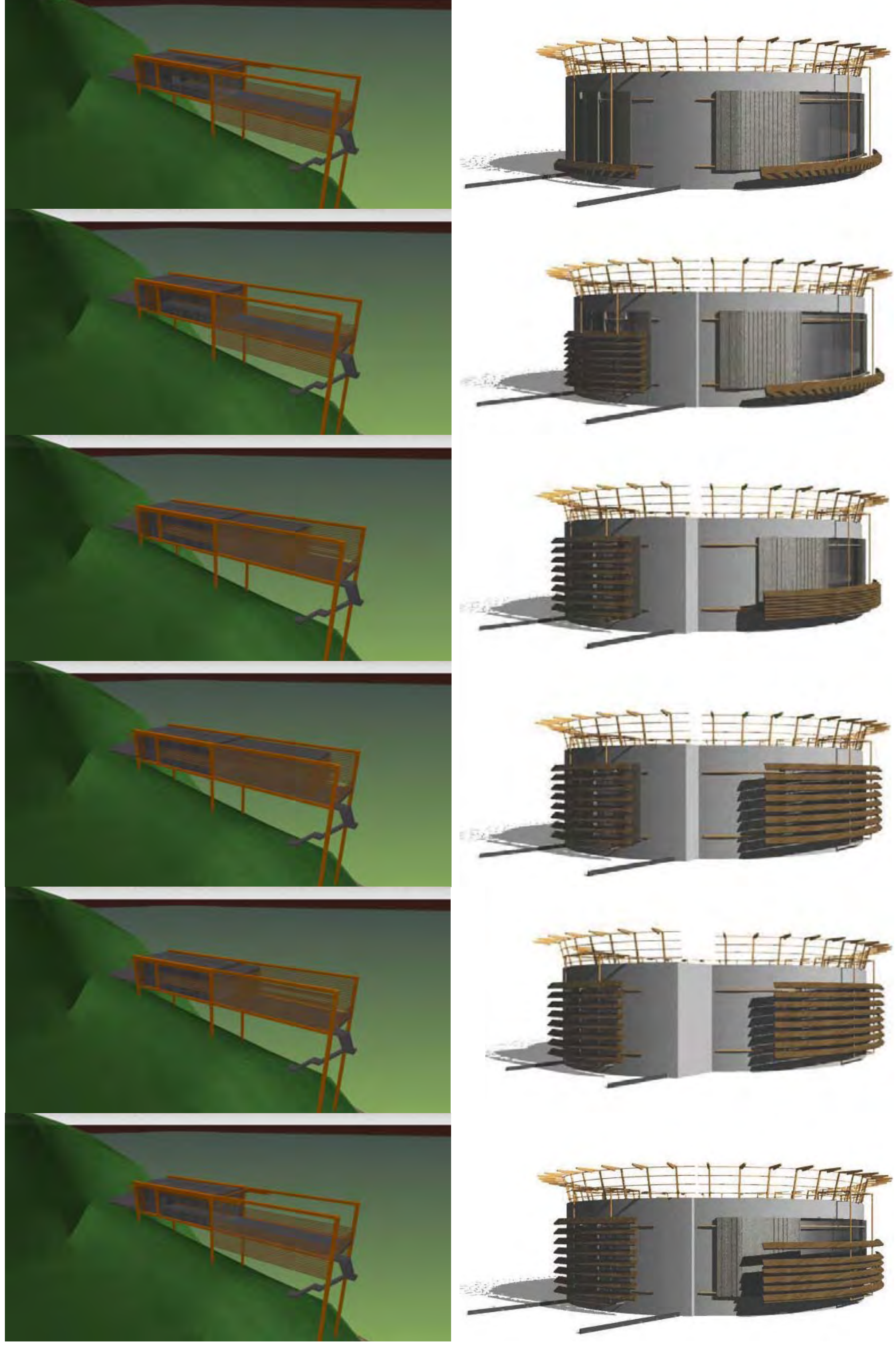
Lynn, G., *Animate Form*, Princeton Architectural Press, January, 1999.

Mahalingam, G., “A Computational Model of a Sensor Network for the Optimization and Control of Acoustical Performance Criteria in Spatial Enclosures,” *CAADRIA ’05 Proceedings*, New Delhi, India, 2005, pp. 475-483.

Mahalingam, G., “POCHE: Polyhedral Objects Controlled by Heteromorphic Effectors,” *Computer-Aided Architectural Design Futures 2001*, edited by Bauke de Vries, Jos van Leeuwen and Henri Achten, Kluwer Academic Publishers, 2001, pp. 603-614.

Sterk, T. d’Estree, “Using Actuated Tensegrity Structures to Produce a Responsive Architecture,” *ACADIA 2003 Proceedings*, Indianapolis, Indiana, 2003, pp. 85-93.

Temkin, A., “Seeing Architecture with a Filmmaker’s Eyes,” *ACADIA 2003 Proceedings*, Indianapolis, Indiana, 2003, pp. 227-233.



Animation sequences by **Andrew Eitreim** (left) and **Matthew Moore** (right).

Ganapathy Mahalingam is an Associate Professor and Architecture Program Director in the Department of Architecture and Landscape Architecture at North Dakota State University in the U.S.A, where he has taught since 1993. He was awarded a Ph.D. in Architecture by the University of Florida in 1995 for a doctoral dissertation on the application of object-oriented computing in the development of design systems for auditoriums using a process called acoustical sculpting. He recently served as the President of the Association for Computer-Aided Design in Architecture (ACADIA) from 2001 to 2003. He has presented papers in numerous national and international conferences and has developed software for the design of auditoriums using Smalltalk and the VisualWorks programming environment. His current research interests are focused mainly on the computational modeling of architectural entities and processes using object-oriented computing, graph theory and virtual finite state machines. He has taught numerous courses in computer-aided architectural design at three U.S. universities, Iowa State University, the University of Florida and North Dakota State University. He continues to strive to resolve the computability of architectural design.

An Intermediate/ Advanced Sculpture Class,
Grand Valley State University
Allendale, Michigan

Almost Useless Invention

by **Norwood Viviano**

Student Project by **Meghan Hindenach**

In the fall semester at Grand Valley State University, I teach Introductory Digital 3D Computer Modeling to junior-level fine art majors from sculpture, graphic design, illustration, and metalsmithing. The Digital 3D Curriculum at Grand Valley State University provides an introduction to computer 3D modeling, drafting, and rapid prototyping within an Art and Design Department. The studio projects range from simple wire frame renderings, schematics for larger fabrication projects, rapid prototyped objects, and animations. Students learn basic skills with **form•Z** that are applied to their studio projects in various areas of study: sculpture, metalsmithing, ceramics, graphic design, illustration, printmaking, painting, art education, and art history. The classroom environment is part computer lab, part lecture hall, and part sculpture workshop. This means that students have the ability to work within an instructional and experimental environment, to attain the desired results.

The Almost Useless Invention is the second major project in a 15-week semester. Students are instructed to create a virtual almost useless invention using **form•Z** as a design tool. As part of this project students are expected to support the design work by creating a poster in Adobe Illustrator or Adobe Photoshop. To help set the context for multipurpose objects, we talk about the relationship between function and design, and about the absurd. Much of the discussion and source concepts are based on the book ***101 Unuseless Japanese Inventions: The Art of Chindogu*** by Kenji Kawakami. To further frame the conversation, we discuss artists like Andrea Zittel and Joseph Beuys and architects and designers like Buckminster Fuller and Kosuke Tsumura. We explore the process a product goes through before it lands on a store shelf: design, prototyping, manufacturing, marketing, and distribution. During our discussions, I emphasize that we are framing this investigation within a fine art context.

Some familiar products advertised on late night television are used to introduce the assignment. For example, the Ginsu Knife and the Clapper are products with a level of absurdity in their design and marketing that are discussed during the course of the assignment. Rather than technology, it is the simplicity, the price and the novelty that sell the Ginsu Knife and the Clapper. On the other end of the invention spectrum, we discuss Dean Kamen's Segway human transporter, which is an incredible piece of technology. Kamen's first remarkable invention, the iBot, reinvented the wheelchair and individual mobility; however, the Segway is still searching for its market. All of these inventions have longevity primarily because of strong and memorable marketing strategies.

Meghan Hindenach, currently a Grand Valley State University metalsmithing major, incorporates the absurd by embracing the multipurpose or convertible object. Hindenach's almost useless invention is the Ponchtent, a dark green poncho that converts to a tent. Made from waterproof canvas, it incorporates short copper poles that can be adapted for a decorative collar. The Ponchtent functions both as an article of clothing and a dwelling. Since it is designed to fit the body, we can visualize the scale of the shelter it creates when set up as a tent. It is a shelter for one, made for the occasional emergency. To allow for change in fashion tastes, the Ponchtent fabric can be updated and the tent hardware readily reused. If one moves to a drier climate or no longer needs the poncho, it can function solely as a tent.

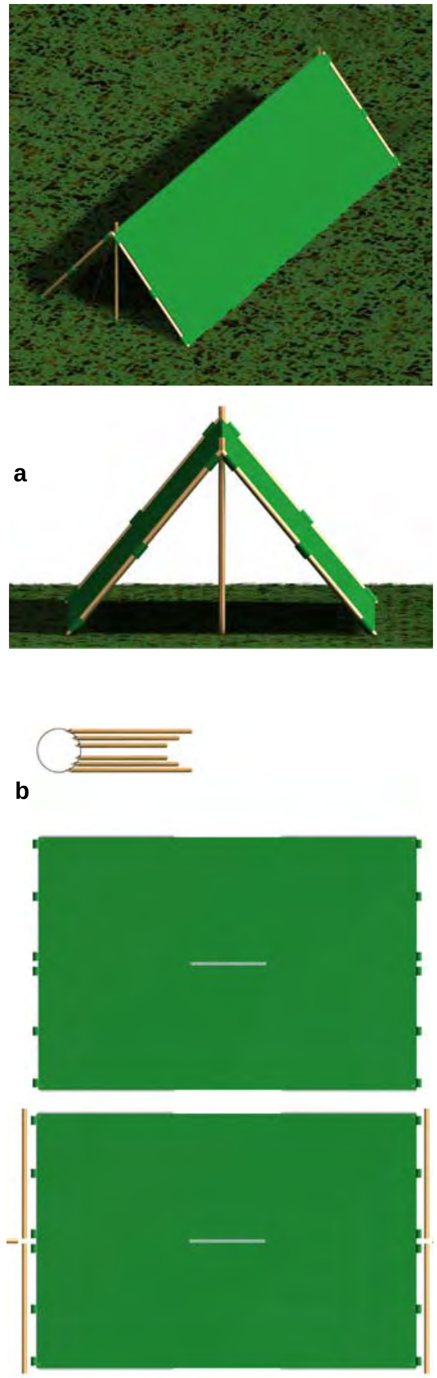


Figure 1: **Ponchtent computer model (a) set-up as a tent and (b) with decorative tent pole collar (unfolded).**

Figure 2: **(a) Ponchtent hidden line rendering. (b) Ponchtent wireframe rendering. (c) Ponchtent renderzone rendering.**

At this point, it is worth noting, that Hindenach is working on a sculpture assignment. Efficient and cutting edge design is not her goal. The Ponchtent references nomadic culture in direct contrast to the technology used to create it. Hindenach's work comments not only on fashion using an obvious historical reference, but also she discreetly incorporates every necessary part of both functions into the Ponchtent. In doing so, she plays with the boundaries of the functional object crossing into that of narrative object and visual art. Since we discuss this project as a piece of art rather than a formal design assignment, it is the narrative that occurs between the Ponchtent and the viewer that pushes this object to transcend function and allows the imagination to soar. The viewer wants it to work and, in the process, he thinks of alternatives and additional functions for the piece.

We find this dialogue throughout Contemporary Art. Well-known artists like Joseph Beuys and Kosuke Tsumura reference the potential of multipurpose objects through the creation of art pieces and clothing exploring survival strategies. In his edition of the piece Sled, Beuys outfits each sled with a survival kit. The survival kit contains a flashlight, felt blanket, and a hunk of animal fat (much of Beuys's art work references the time he was shot down over Crimea and almost died in World War II, but was saved by nomadic Tartars after being wrapped in felt and animal fat). [1] In Final Home, Kosuke Tsumura creates clothing and accessories that become the "ultimate shelter." Tsumura's, Final Home uses industrial and recycled materials to create a range of objects that aid in the survival of urban life, for example, the formal black wool buttoned blazer that easily reverses into a waterproof nylon jacket with zippers and snaps. [2] In our critique of Hindenach's Ponchtent, we discuss artists like these and question whether the art object that references multipurpose objects is compromised by its duality.

The Ponchtent poster harkens back to advertisements for products found in early Sears Roebuck catalogs or to plans that were found in the back of a post-World War II era Popular Mechanics. It is the black and white image, the typeface, and descriptive information that remind us of the history Hindenach is referencing. Multipurpose products have long

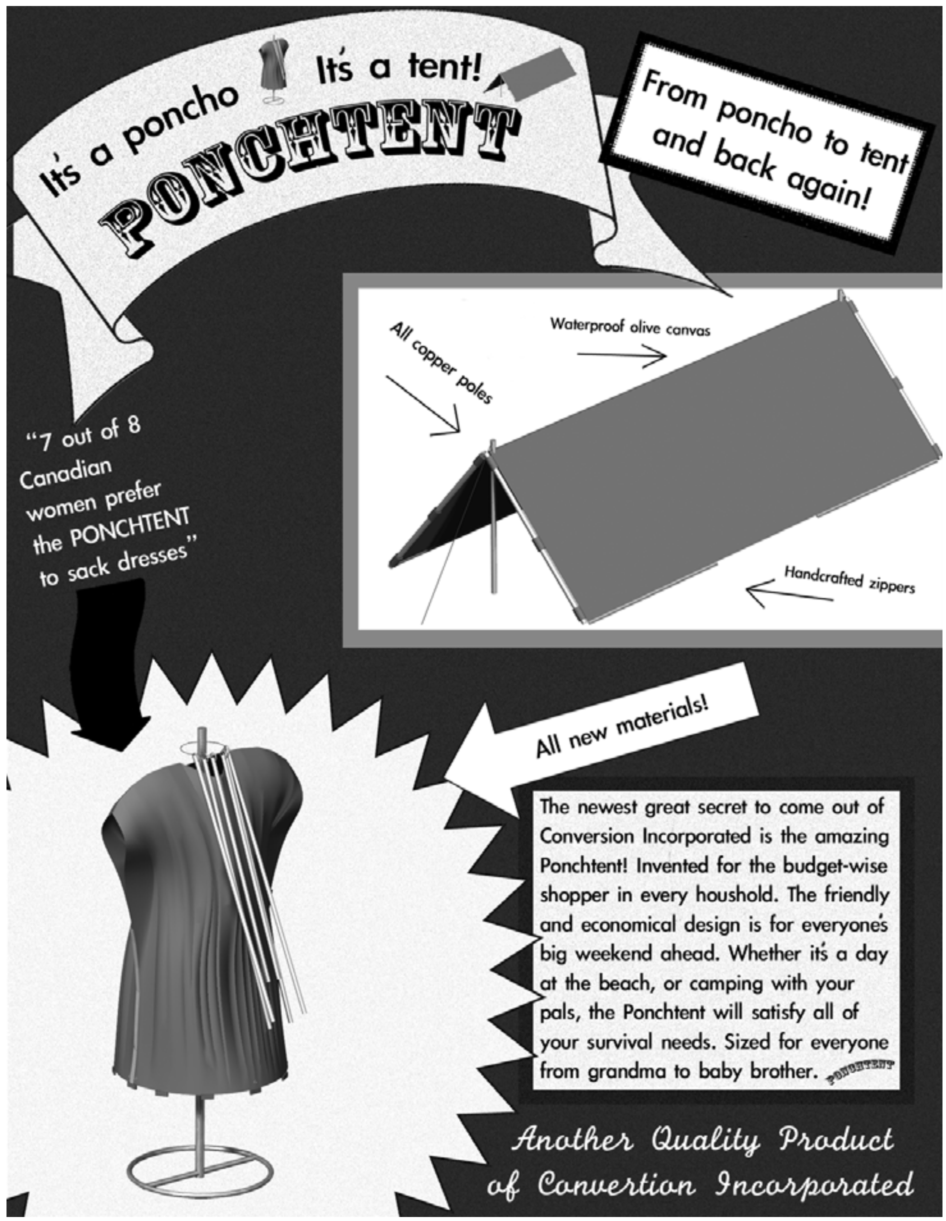


Figure 3: **Ponchtent poster created in Adobe Photoshop using form•Z models.**

been popular because they conserve space, emphasize utility over form, are cheaper than purchasing numerous individual products, and are often very clever. During the evolution of Ponchtent we discussed how this project embraces an era that precludes 3D computer modeling, and at the same time emphasizes the many strengths of **form•Z**.

My primary goal in teaching **form•Z** to fine art majors is to accelerate the visualization process for a 3D concept in sculpture. In the case of Meghan Hindenach's Ponchtent, it was designed and rendered in the computer 3D modeling course before she considered fabricating the project in the Advanced Sculpture course. Computer 3D modeling allows one to conceptualize an idea that is not yet bound by the physical world. Unlike traditional drawing, computer models have the ability to exist in virtual space, allowing for exploration of concepts and formal elements as well as quick editing before the final design and concept are acceptable.

During my three years of teaching **form•Z** and using it as part of my own creative process, I have found each edition to be more and more user friendly. The newer Nurbz tools made Hindenach's Ponchtent project possible for a beginning student. The poncho portion of Ponchtent was created by using the contours of the body to derive control lines for the creation of the Nurbz surface. The Merge Nurbz tool allowed the front and back sections of the poncho to be assembled seamlessly. Even though the Ponchtent fabric is a simple rectangle, it was useful to explore it in a complex way with Nurbz in **form•Z** to better understand how it fit on the body. Other tools that played a significant role in Hindenach's project are the Sweep tool, and various surface styles to make the product feel more real in the poster. **form•Z** is a powerful software package on its own; however, it works seamlessly with other image-based programs like Adobe Photoshop and Adobe Illustrator. It is this relationship to other programs that allows **form•Z** to work well within a fine art context.

As the Principal Investigator and Assistant Professor of Sculpture, I find **form•Z** to be extremely versatile. The program allows my sculpture students to find new approaches to drawing, idea generation, and problem solving. It also is a powerful rapid prototyping tool. My students' projects vary considerably based on the goals of my fine art majors. Meghan Hindenach's project Almost Useless Invention, Ponchtent, demonstrates how students can explore the potential of **form•Z** as a sculpture and fabrication tool.

Notes

[1] Hannah Andrassay, "Just do it," *things magazine*, Winter 1999-2000. http://www.thingsmagazine.net/text/t11/justdoit.htm. Accessed: January 2, 2007.

[2] Julia Szabo, "Wear House," *Yeohlee*, May 1999. http://www.yeohlee.com/article4.html. Accessed: January 2, 2007.

Figure 4: **Fabricated Ponchtent**
(a) set-up as a tent, (b) on stand, and (c) on Meghan Hindenach.

Norwood Viviano is an Assistant Professor of Art and Design at Grand Valley State University in Allendale, MI. He joined the faculty at Grand Valley State University in August of 2002 as a Visiting Assistant Professor. Viviano has a Bachelor of Fine Arts degree from the N.Y.S.C.C. at Alfred University (NY) and a Master of Fine Arts degree from Cranbrook Academy of Art (MI). He has also taught sculpture at The School of the Art Institute of Chicago (IL) and Alfred University (NY). Viviano received the Emerging Artist Award from the Glass Arts Society, Kiki Smith Endowed Scholarship and Alfred University Partnership Scholarship from the Pilchuck Glass School and has participated in residencies at the Royal College of Art, London (UK), Sculpture Space (NY), and a PONCHO Artist in Residence at the Pratt Fine Arts Center (WA). Solo exhibitions of his artwork include the Garibaldi-Meucci Museum (NY), Lemberg Gallery (MI), McMaster Gallery (SC), Esther Claypool Gallery (WA), and Spaces Gallery-SPACELab (OH). Group exhibitions include: Revolution Gallery (MI), Soil Gallery (WA), Spaces Gallery (OH), Fort Wayne Museum of Art (IN), and Review Magazine (MO). Viviano's current research focuses on projects that explore mapping, metaphor of materials, computer 3D modeling, and rapid prototyping technology.

Dishes of New Orleans

by Virginia San Fratello

The premise of this architecture studio was to find new forms through the use of traditional materials and means of making as they align with the technologically advanced methods of production today. Product designers and architects increasingly use 3 dimensional modeling applications to design, for mass production, building components, and products. They also sometimes fabricate prototypes for testing but very rarely does the CAD/CAM rapid prototype become the finely and digitally crafted final product in itself as it is intended to in this studio. Additionally, through the combination of traditions with digital media, the final digital and CAD/CAM products become cultural and contextual. They become intimate, site specific vessels of memory, tactility, and life.

For years architects have been designing tea and coffee piazzas, memory containers and vessels that not only mimic architectural forms but have also used the design of objects to explore new techniques and materials that might make for a more modern or efficient method of production. Architects and designers in the German werkbund, for example, saw the potential of mass-production, and wanted to work with the new industries to establish a reputation for high quality manufactured goods and believed that this lay in fundamental product design rather than decoration. Because ornament did not fit in with industrial productions, designers needed to produce smooth forms reduced to their essential function. The werkbund advocated the hands-on approach to design teaching and instituted training workshops that would teach the students to actually make things as well as design them. This new teaching method encompassed two main innovations. For the first time, handcraft was introduced into a Fine Arts institution and secondly, the Bauhaus introduced their ‘preliminary’ course which was all encompassing in terms of design. Its primary aim was to remove incoming students’ preconceptions about art and design, directing them instead to start from scratch.

First year architecture graduate students at Clemson University have also been asked to remove all of their assumptions about what it means to prepare a meal, the ritual of dining, and the process of dish design? What do we create when we set the table? Additionally, students were asked to explore digital craft, new materials and fabrication techniques that are new to the late 20th and early 21st century. Students were asked to use 3D modeling software, 3D printers; CNC routers, and laser cutters to not only design their dishes but to actually make them.

There is a long history of dishes being designed to suit very specific foods, cultures, cooking techniques and even specific buildings. For example, the tagines, jabenas, fondue pots, oil and vinegar cruets, tea balls are all only suitable for one particular use or dish but many people find them indispensable as they are a part of their daily ritual. The specificity of their task also makes the design of them very specific and unique, not generic like a platter or a bowl. These dishes often reflect the traditions of a culture or region. Unlike the Bauhaus, which was searching for a kind of universal product that everyone could afford and have in their own modern home, we were searching for a design that was specific to a region and culture but we wanted to use the new digital craft to make it. The tools of digital craft, the CNC router, the 3DS printer, and the laser cutter allow us not to be concerned with mass production but to use technology to produce incredibly precise and inexpensive custom pieces out of precious materials that we otherwise would not have been able to do ourselves.

Students were asked to choose a food (entrée, dessert, aperitif, appetizer, etc.) that is a part of the New Orleans regional cuisine (old or new) and design a new dish for consuming the chosen food item. The new dish should subvert traditional ways of presenting and consuming the food item(s) and should instead hyper assert or amplify the functions associated with the cooking, storing, serving, eating and disposing of the food. The new dish should elaborate the preparation and consumption and simultaneously be a desirable mechanism of architecture. Students were asked to consider how smelling, seeing, and tasting become intertwined with the device to aid in the ingestion of the food and how the device is oriented towards the body, to consider the dish a performative space for food. Additionally, cultural practices associated with eating or drinking were considered. What is the site in which that food is regionally consumed. For example: Is it mobile? Is it shared?

Case Studies

GUMBO DISHES:

The folding of cultures and traditions that created gumbo inspired the bowls' form, fabrication process, and materials. French bouillabaisse, African okra ("gumbo"), Spanish peppers, German sausage, and Native American filè powder are some of the elements that combined in Louisiana to become what is now gumbo. As a result of many influences there are hundreds of variations, which require versatility in serving and consuming. The rice and gumbo bowls have been separated to allow each individual to create their own combination, as well as sit in different positions depending on how they are being used (filling, passing, or pouring). The serving dishes can also be used in different orientations depending on the consistency of the recipe. Two layers of veneer fold around each other to create the bowls. The birch interior is wrapped in a mahogany veneer, reflecting how African traditions folded into New Orleans culture.

The dishes were modeled in **form•Z**, then unfolded using the Unfold tool to create templates. The templates were used to cut and score the materials on a laser cutter, allowing the layers to align and the bowls to interlock (Figures 1 and 2).

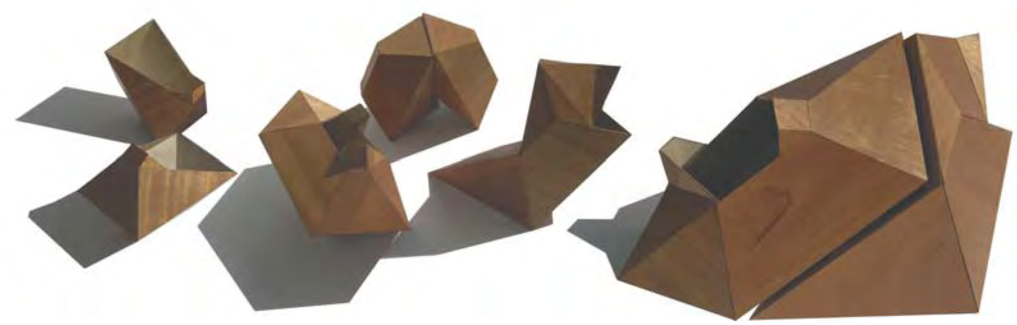


Figure 1: **Gumbo set**

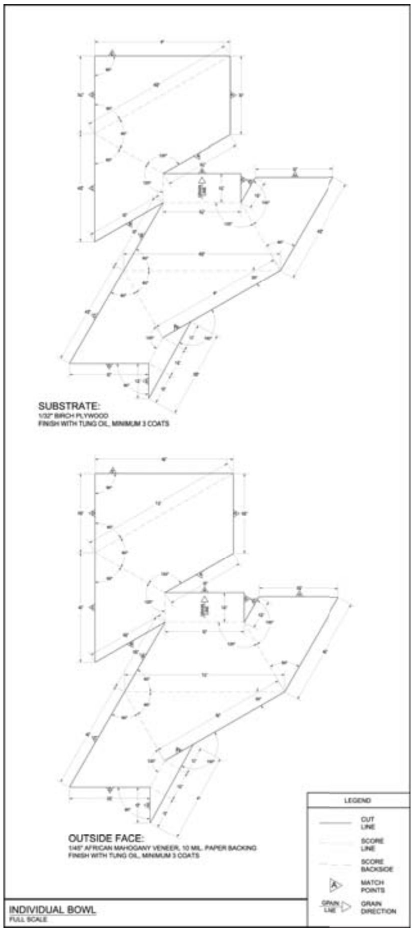


Figure 2: **Unfolding**

BRONZE BREAD PUDDING DISH:

The creation of these dishes was built around measurement, specifically time, temperature, volume of ingredients and product usage. The final design included a central mixing and cooking well, with four outer measurement chambers for the ingredients of bread pudding. A water well was also included as a measurement of cooking time through evaporation. A second nesting dish was designed in a similar fashion for use as a pan for cooking a bourbon sauce. The sauce would then be poured over the bread pudding before serving (Figure 3).

form•Z was used as a modeling program throughout the design process. Casting molds were created using a Z-Corp Z310 rapid prototype printer with Z-Cast as a medium. Once molds were created, the final product was cast in bronze. Bronze was chosen as the casting material secondary to its properties of heat conduction. Another primary element of bronze includes its alteration over time with usage, reflecting again the primary concept of measurement over time.

Figure 3: **Bronze Bread Pudding Bowl by Tim Takacs.**

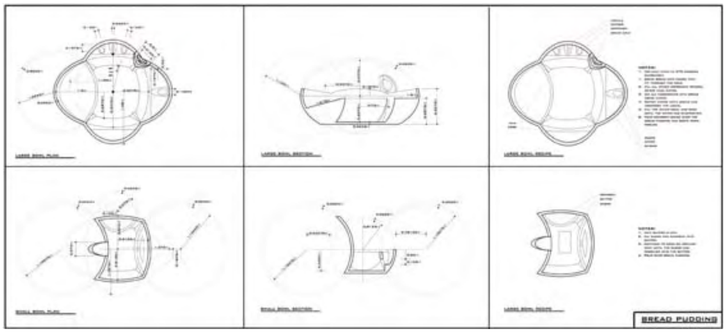


Figure 4: **Drawings of the Bowl.**

Figure 5: **Jambalaya Dish by Jeremy Hughes.**

Through the execution of this project students learned to model with **form•Z**, to use the laser cutter, 3D printer, and CNC router to make finished products not just representations in the form of renderings or models. For the mahogany gumbo dishes, the student actually went to the wood supplier and selected the veneer flitch for her dishes, she researched and tested different not toxic adhesives and developed a system of easy assembly that was executed in studio. The design studio as workshop model has been with us off and on for over 100 years and it is irreplaceable as a method of learning. The tools are changing, hence the nature of the designed object is changing. The Bauhaus had a dream that we would all have access to industrially produced well designed goods and we do. The teapot designed by Michael Graves, commissioned by Alessi, sells at Target for around $30.00 dollars. Designers of the 21st century see the potential for every design studio, and perhaps every home, to have access to a 3D printer where we will be able to print the utensil that fits our hand perfectly or the dish that holds our favorite combination of jambalaya.

Figure 8: **Making the Dishes.**

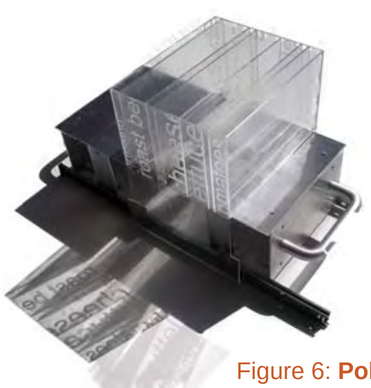


Figure 6: **Poboy Machine by Jason Mobraten.**

Figure 7: **Sugar Cane Dish by Jane Ann Bolin.**

Figure 9: **Crepe Plate by Lee Henderson.**

Figure 10: **Cookie Formwork by Kathleen Lily.**

Virginia San Fratello, RA, is the Co-Director of the Charles E. Daniel Center for Building Research and Urban Studies in Genova, Italy and an Assistant Professor at the Clemson School of Architecture. San Fratello is a partner in Rural Office Architecture: Rael + San Fratello. She recently won the 2006 Metropolis Magazine Next Generation competition for her Hydro Wall design. San Fratello has a masters degree in Architecture from Columbia University.

Tools and Technique

by Jay David Stauffer

Tools: anything used as a means of accomplishing a task or purpose.
Technique: technical skill; ability to apply procedures or methods so as to affect a desired result.

Although the emphasis in the language of architecture school was never on the tool, but on the technique, architecture school proved to be an introduction to all sorts of fascinating tools (parallel rule, tech pen, compass, mechanical pencil, computer). As we set out to learn to analyze/document architecture through material construction (model) it was mentioned that "sometimes you need to make your own tools". For example, we learned to make a woodcut to punch windows into a clay model. In another experience, I found that I could use the band saw to cut a jig to help guide the lathe to make a sphere. It sounds convoluted, but this is using a tool (band saw) to make another tool (jig) to reach the intended outcome (the sphere, see Figure 1). The band saw by itself can not mill a sphere because it does not easily create forms that are radially organized. It is two and a half dimensional. The lathe makes every input into something radially organized, but the sphere is a very specific shape requiring input to be thoughtfully guided and measured. The solution layers multiple tools to overcome the lack of specificity of a single tool, constraining the latter tool while empowering the user. And that is where we want all students to be with whatever design tools they use.

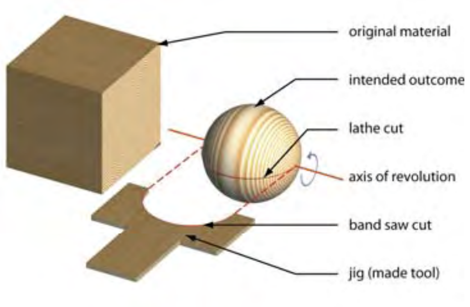


Figure 1: **Sphere illustration.**

Teaching Digital Design Tools

Most people struggle with their initial encounter with digital design tools. The question is where and how to start. It seems that too many students abandon perfectly good analog techniques when faced with the seemingly new digital tools. The computer lends itself to the perception that there is a right input and a right tool to select to get directly to your intended outcome. This is neither the nature of tools or design. Like the problem of making a sphere with physical tools, no single digital design tool fits the vision precisely. It lacks that kind of individual specificity. This perception is also intimidating because "close doesn't count". Getting close to the intended outcome with a sketch and then refining later is precluded. Furthermore, mastery of the software tools is reduced to memorization. What is left when the tools are considered to be new and the techniques have been abandoned, is the paralyzing fear of the blank page.

This fear of the blank page can be mitigated by teaching every tool as a concept or analogy. In my first year of teaching at the Boston Architectural College, I set out to teach the **form•Z** tools along with the concepts behind them. I teach the tools in the tool palette as analogous [sic] to analog tools. For example; the Revolve tool is like a lathe and makes radial objects, and the Section tool is like a band saw that can be used on the whole model. Other tools have similar techniques instead of being analogous to physical tools. The concept and story behind Primitives is the lesson from figure drawing that complex shapes can be closely approximated from simple geometry: the palm of a hand is a square, the fingers are divided at the knuckles into rectangles, a head and eyes are ovals, and a nose is a triangle. If the digital tools and methods are analogous to something already known, the student should already have a method for working and thinking. A student who knows how to sketch already has a way of processing complex objects and a student who knows how to draft does not need to abandon the use of construction lines as a way to regulate, position or otherwise facilitate working in 3D space.

Second Order Technique

With an understanding of the tools and techniques restored, the student can begin to go beyond the limits of any single tool and begin to both use tools and to make other tools. Sanford Kwinter in the Afterword to Tooling [Pamphlet Architecture] explains that "*one needs cranes not only to create edifices, but also to build larger cranes without which one cannot create the greater and more demanding edifices*." This "second-order" thinking can be applied to our software tools to become a technique where multiple tools are combined.

It is a characteristic of the **form•Z** tools that they are general purpose. They require thoughtful input from another tool. Therefore the infinite variety and power of **form•Z** is in combining or layering of multiple tools. Like the example of making a jig to make a sphere, or using a crane to make a bigger crane, a source form must be made with another tool before the Derivative tools can be used and more complex shapes generated. The mutability and facility to duplicate and modify digital form makes every object on screen a potential tool. Every object in **form•Z** can be thought of as having two un-exclusive paths. We determined that it should be thought of as an object for further refinement but it can also be thought of as a tool to refine another object.

In a simple example, the roof object is both the roof object and the jig for differencing the walls. Or as is the case with the work featured and explained below, a primitive is sectioned to derive a source shape which is modified and used for a C-mesh to create any variety of more complex forms. The complex form can be deconstructed into more source shapes and the process continued. By working this way, we leverage the mutability that is characteristic of digital design tools in a manner free from the constraints of any single tool. What this means for teaching is that it is not simply enough to demonstrate the functions of the digital tools, but to teach the students the concepts and analogies and make them aware of the power of the second-order thinking of combining **form•Z** tools.

Introduction to the Work

The **form•Z** project featured is the work of **Leslie Evans** and was completed during the summer session at the Boston Architectural College. The class is eight weeks long and consists of two projects. The first project, due at mid-term on the fifth week, is intended to allow students to get comfortable with the software by creating an interior scene from their imagination. The remaining three weeks are spent on the final project to present a known object. The subject is suggested to be a local building for the Architecture students, but students with other backgrounds are encouraged to work with subjects pertinent to their field of study. I believe this project exemplifies a combination of instruction in the tools and concepts along with second-order thinking. It is also an example of a lot of hard work and a mind that needed to create the way that **form•Z** works. Here is how the project progressed in Leslie Evans' own words.

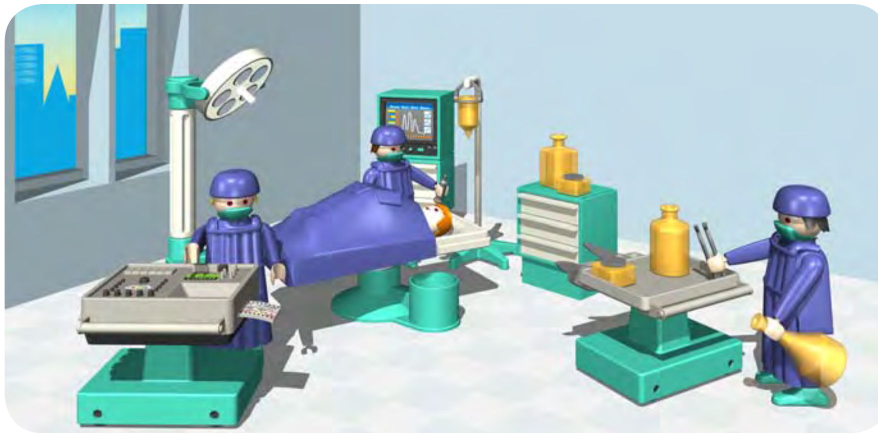


Figure 2: **Scene.**

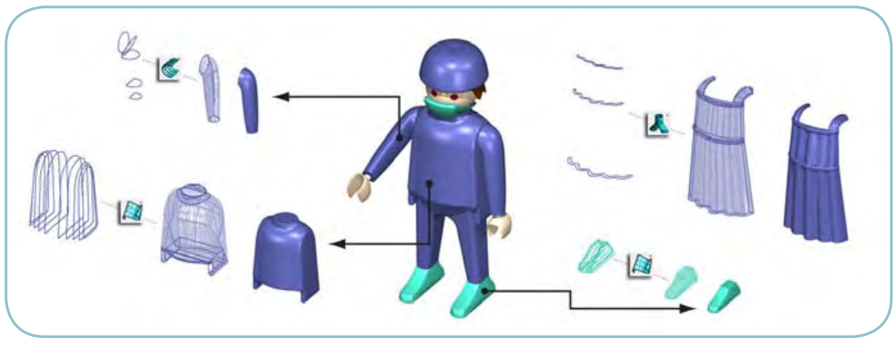


Figure 3: **Figure.**

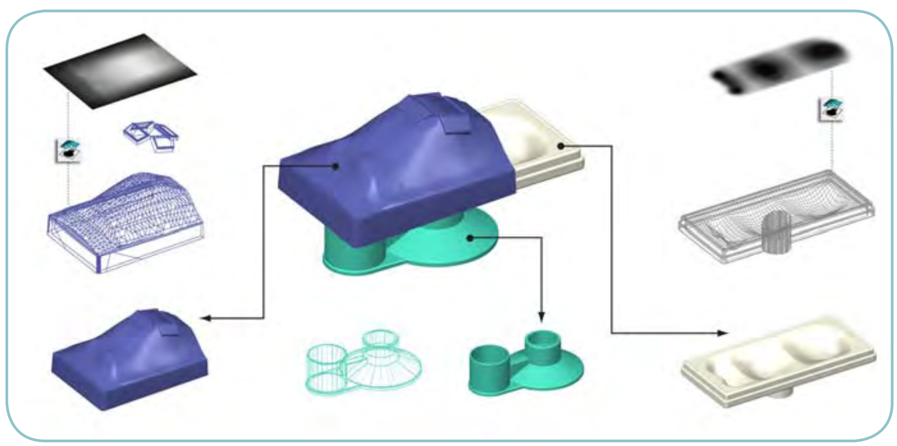


Figure 4: **Bed.**

The Work

When the class was given our second (and final) major assignment of the semester, to translate an actual building or object into **form•Z**, my mind immediately jumped to toys. The Playmobil® Hospital (see Figure 2) was a perfect choice for my first major **form•Z** modeling effort because the set contained objects of varying complexity. If I was in need of instant gratification, translucent jars could be made simply and quickly using the Revolve tool. More complicated objects like the hospital television and computer required significant time and patience, but still could be constructed using tools I was already comfortable using. The figures and bed proved to be the most challenging aspects of the project, forcing me to expand my **form•Z** skill set and blindly experiment with tools that I had little or no previous experience with.

I initially tried to make the more complicated body parts of the figures by merging together less complicated shapes and rounding the edges. Early attempts at the arms (see Figure 3) entailed using the Union tool to combine a cylinder for the long part of the arm with a sphere for the shoulder. Although these techniques did not produce shapes that accurately represented the real figures, examining the cross sections of these crude body parts, made with the Section tool, provided valuable patterns from which to create source shapes. The body and shoe were constructed from these source shapes using the Nurbz tool, while the arm was created with the C-mesh tool, and the two panels of the apron were created using the Loft tool.

It often tends to happen that once I have some familiarity with a new tool in **form•Z**, I try to use it to make any new object I am trying to construct, even if it is clearly not the best tool for the job. Once I had a basic understanding of using the C-mesh and Nurbz tools, I immediately tried to use them to make the hospital bed. Visualizing cross sections of the bed sheet and operating table proved to be very difficult and I had a hard time making the sheet look like there might actually be a person lying under it.

Luckily, my next **form•Z** class covered the mesh displacement tool, which provided a much easier solution for modeling the bed (see Figure 4). To create the 2-D images for the Mesh Displacement tool I imported an image of my figure into Photoshop as a template and, using a paintbrush with a soft edge, shaded in the indentations the figure would make when lying in a bed. The image for the sheet was made with a similar technique.

There is no doubt that the many hours that I put into the project were a major factor in successfully modeling the hospital set. I'd also like to think, however, that a good mindset for learning a new piece of software can be just as powerful as stubborn determination. I tried to attack learning **form•Z** with the mentality that if I think the software should have a certain functionality, it probably does and I just haven't found it yet. I was amazed at the amount and quality of work that I could produce in **form•Z** after just eight weeks of using the software.

Leslie Evans

Figure 5: **Operation.**

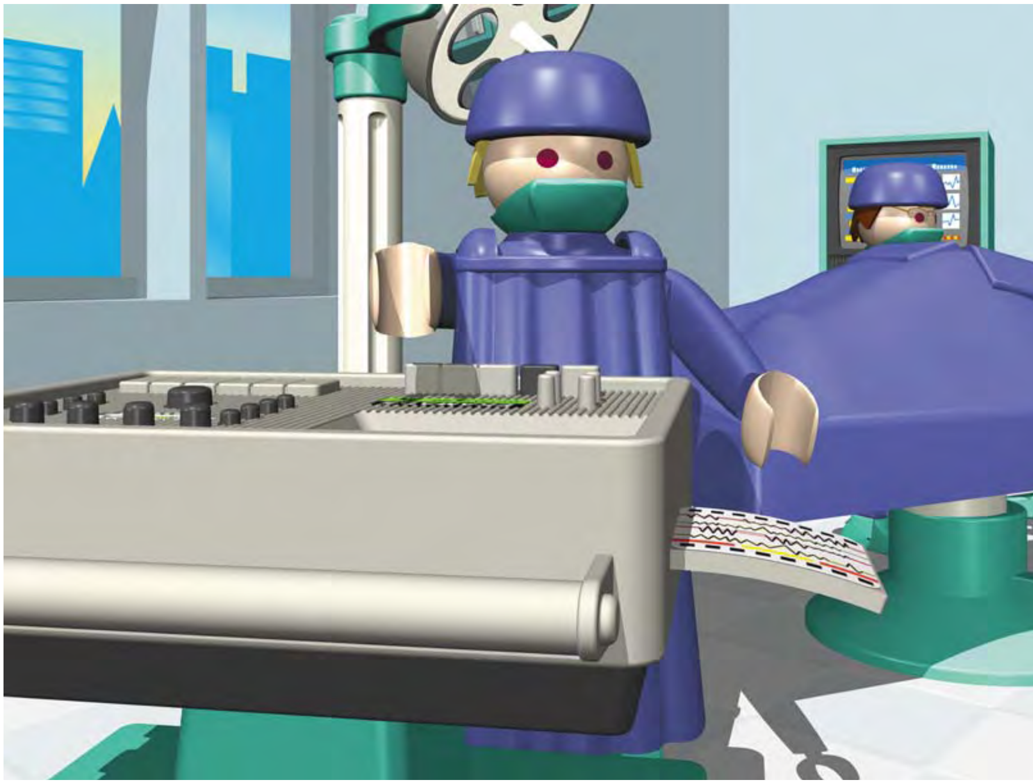


Figure 6: **Computer.**

Jay David Stauffer is the Instructor of **form•Z** at the Boston Architectural College and a Designer at Payette in Boston, MA. His professional work is concentrated on high-tech environments like research laboratories and health care facilities. His current projects include a 260,000 GSF chemistry building for Princeton University. He joined Payette in 2004 as a 3D Visualization Specialist, helping to advance technology's role within the firm while discovering professional techniques to augment teaching at the BAC. In this role he modeled and rendered marketing and schematic design images for many of the firm's projects, and developed an interest in images that show how architecture thinks rather than how it appears. Jay David earned a Bachelor of Architecture from Penn State University in 2004 and also interned with the Master Planning and Urban Design Studio of Walt Disney Imagineering in Orlando, and Office for Planning and Architecture in Harrisburg, PA. Email: jstauffer@payette.com.

Instructor - St. George's School
Vancouver, Canada

Snap to the Familiar: Using Virtual Lego to Teach form•Z

by **Graham Clarkson**

I am a teacher of Drafting and Design at St.George's School in Vancouver, Canada. I teach **form•Z** as our design platform for grades 10-12 with a focus on product design. Since **form•Z** has so many options and so many features with only one term to get the students to the point where they can create their own virtual products, they need a certain degree of fluency in operating the interface. **form•Z** has a very intuitive interface, but to be able to tap into this, students need to develop a solid comprehension of basic possibilities of the program within a condensed frame of time.

In order to teach something that for most students starts out as completely foreign, one must find a bridge of familiarity to cross from something known into something new and unknown. I began to think about what students could identify with outside of 3D modeling. I thought that Lego would be the perfect tool for this for many reasons. Firstly, Lego in the western world is synonymous with an early understanding of construction and manipulation of interlocking objects. Lego teaches dexterity to children who are just learning to hold and move objects in their hands. Since it teaches this sort of physical learning why couldn't this translate into what one may think of as a type of virtual-visual dexterity? Also, building with Lego lends itself to basic comprehension of building with prefabricated and modular components. This is not only a characteristic of Lego, but also a convention of modern construction and architecture. The most important part of choosing Lego as the basis for a **form•Z** project is that Lego is seen as being "really cool" by most young people or anyone who has a passion for designing and constructing models.

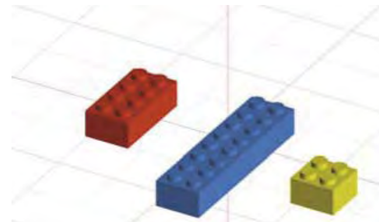
It is Lego's affiliation with all things cool that gets a positive response from the students when they first hear about the project. It is the students' immediate identification with "playing Lego" that gets them foaming at the brain with the possibilities of what they are going to create. Immediately, they are tapping into their creativity and interests.

The contextual padding of the assignment begins with a lecture on modular design which is essentially what Lego is. The lesson features examples of architectural marvels like "Habitat 67" by Moshe Safdie along with some lesser known examples of domestic, modular construction. Modular and interlocking design is also found in every day products from tea cups to ipod docks. In this case Lego is a pedagogical launch pad helping students move to a deeper understanding from a familiar context to a new one. The same applies to using the interlocking toy for learning to design with **form•Z**.

The Lego Project

The assignment itself is quite simple: build anything you can think of using virtual Lego. I begin the project by

Moshe Safdie's Habitat '67, Montreal, Canada



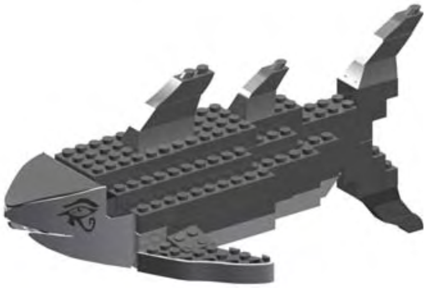
Virtual Basic Lego Pieces

prefabricating some virtual blocks including very basic Lego pieces. The pieces are the visual verbatim of real Lego and come in a package of three. I distribute the pieces in the form of fmz files on a CD. The students bring the file into the program and immediately the game is on. I give those students who don't already know what they'll make class time to research and surf the net for ideas.

This assignment connects the students with something they already understand and also removes complex modeling from the equation of the assignment which can be quite intimidating for first time modelers. This allows the students to focus on tools in the palette that are centered with movement such as the "geometric transformation tools". It is also a really good starting point for teaching object movement along active plains incorporating the "perpendicular lock". Accuracy is important and is emphasized as a key part of the assignment. The blocks must be as seamless as possible and appear as though they are "snapped" together (It is of course that satisfying 'snap' that working with virtual Lego lacks).

Since the students are only given three prefabricated blocks, they are forced to create more by using the "copying tools". With so many pieces to move around and snap together it then becomes important that the students learn to use the "Boolean union" function to unite pieces into solid walls or rely on the "group" function to name certain completed walls or components.

As the students become rapidly virtual-Lego-savvy, they get more interested and more complex ideas begin to evolve. The three pieces become not enough to sustain the volume of their ideas. This forces them to learn to cut, combine and alter the blocks to become customized pieces. For instance, this student needed to make many customized pieces to complete his Lego shark. Another student needed to make a specialty piece for the tires and hood of his car. Of course the building of cars leads to the building of Lego drivers. Modeling Lego people leads into full blown modeling using "sweeps" and "revolves" or other tools. Teaching the students to use the "decal" tool also becomes necessary for them to put specific images onto their pieces. They use the decal tool to add characteristics like facial features, numbers or other details that help to define the students' projects.



Lego Shark by Simon Tseng, Grade 10

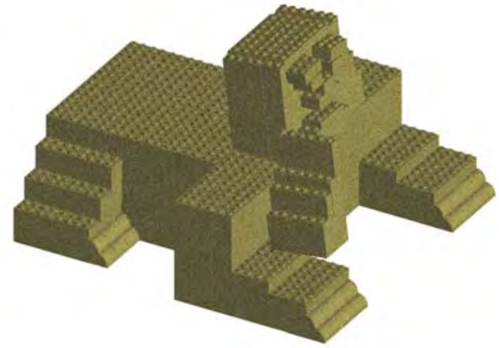
Lego Car by Albert Chan, Grade 10

I found with this project, one thing leads to another and their learning snowballs. It is the freedom of the assignment without harsh structural parameters such as what the students should build that lends itself to the quality of learning through being engaged with the assignment as a form of play.

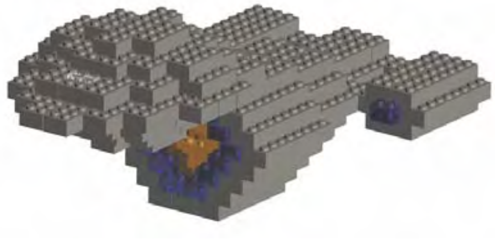
Placing restrictions on the project such as dictating what the student should create inhibits their creativity and the natural flow of learning. This also goes against the nature of Lego itself as a toy of seemingly infinite potential. I believe it is also import for this assignment to have a certain amount of autonomy from objects of design such as furniture or product design. If a student is inspired to make a Lego MP3 player or a Lego couch that's fine, but later in my course the students are expected to design hand held products and furniture. I see this assignment as a mere springboard or introductory assignment for the students to gain confidence and understanding of the interface its tools and processes.

Giving the students creative carte blanche over what they make is equivalent to letting a child sit in blissful solitude with a new box of Lego and watching their ideas realized a brick at a time. With each brick and the interplay of objects (pre-built and newly created), the interest in the project deepens. I believe that this reflects the nature of discovery of actual Lego. Kids get lost in the magic of those simple little blocks and are moving from houses to castles, and from cars to rockets. The toy itself evolves as its creator becomes more skilled and in effect more creative.

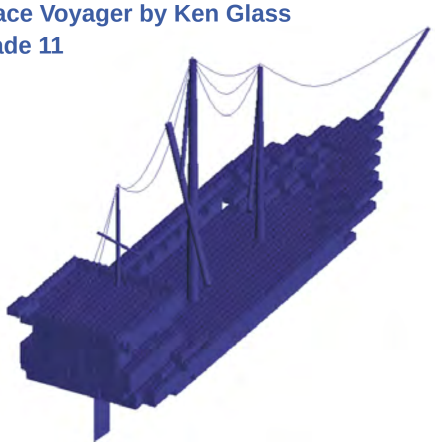
I found that the Lego project was successful for learning technical aspects of **form•Z** and sparked the imagination of those who may not otherwise be inclined. I have no doubt that the rate of learning is directly proportionate to the depth of one's personal interest in any project. Many of us are reluctant to learn and create in a medium that we don't understand. The familiarity of Lego as a tool makes for a comfortable context in which one can learn the essential tools that make **form•Z** an equally comfortable interface for 3D modeling. Once **form•Z** becomes as familiar as Lego it can be a platform for the deeper understanding of design. The Lego assignment is a steppingstone to other forms of design, further learning and the discovery of new possibilities.



Lego Sphinx by Stephen Mah Grade 10



Space Voyager by Ken Glass Grade 11



Lego Ship by Jun Taek Oh Grade 10

Graham Clarkson lives in Vancouver, Canada, and is an instructor of ceramics, sculpture, drafting, and design at St. George's School. He is also a freelance graphic designer. Graham received his BFA from University of Regina Canada and holds a Masters of Visual Arts from The Australian National University in Canberra, Australia. Before becoming a school teacher, Mr. Clarkson worked as a product designer in Sydney, Australia, for a porcelain manufacturer. His work was selected by the Australian Trade Commission along with nine other designers to be featured in a UK international trade expo in 2003. During this time he was also featured in Graphic Design publication's "Education Resource Guide 2003" in Australia as a new designer. Previous to this he worked as an instructor of Digital Media at the Tuggeranong Art Centre in Australia where he was awarded a certificate of excellence for teaching visual arts. Email: gclarkson@stgeorges.bc.ca

College of Architecture and Urban Planning,
University of Washington
Seattle, Washington

An Adaptable Community Aquatic Center

2nd Place Entry in the 2005-2006 ACSA/AISC Student Design Competition

by **Rebecca L. Roberts**

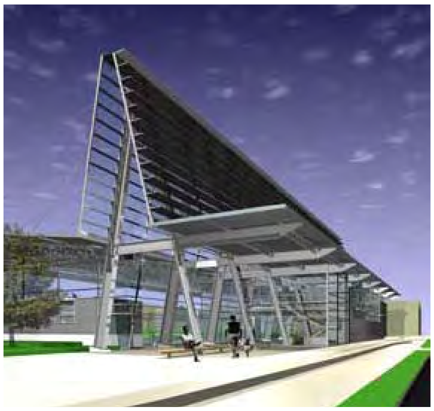


Figure 1: **The main public entry from the street.**

The 2005-2006 ACSA/AISC Student Design Competition challenged students to explore the use of steel as the primary structural material in the development of a design for a Community Aquatic Center. The program requirements included a natatorium with three pools, spectator seating and concessions, wet classroom, administration and lifeguard space, as well as other support spaces. Given a hypothetical site, **form•Z** proved valuable early in the design process as a means through which to synthesize fragmented site information into a comprehensible whole.

Observing water as an adaptable element that changes its form and state in response to its environment, a concept of adaptability was applied to this project. The design is that of an element which may transform in response to internal or external demands. The linear, rigid forms of the primary steel structure juxtapose the transformative nature of the enclosed water. This design explores the potential adaptability of a community

A Student Design Competition in a Tectonic Studio by Richard E. Mohler, AIA

This project was completed in the context of a required, ten-week, second year design studio at the University of Washington. The course, generally referred to as the tectonic studio, is taught in conjunction with a design development course, the principal requirement of which is the construction of a large-scale section model of the studio project in week seven of the term. The pedagogical intent of both courses is to reveal to students the tectonic implications of their design decisions while introducing them to the potential of tectonics as a conceptual impetus for design. The ACSA/AISC student design competition provided an ideal framework with which to pursue these goals. In addition, the competition, with its limited presentation format, compelled students to rigorously define their conceptual positions and the means by which they were represented.

The illustrated project exemplifies the pedagogical intent of the studio in both process and result. Conventional and digital drawing and modeling techniques, including **form•Z**, were employed throughout its inception, development and presentation. **form•Z** was used to model the hypothetical site and explore potential building strategies within it. Once a site/building strategy was established, conventional and digital drawing techniques were employed to quickly assess variations on the 'mast and roof' diagram. A critique with an invited structural engineer mid-quarter led to the 'A-frame' mast, which provided greater strength and stability than other variations. A ¼" = 1'-0" physical model of this condition served to confirm the structural integrity of the design and clarify joints between structural members and between structure and enclosure.

Beyond this stage, digital modeling with **form•Z** provided the most comprehensive understanding of the design's spatial and tectonic potential and prompted several design revisions. For example, the triangular form of the masts, which had previously extended through the roof to be exposed on the exterior, were instead clad in continuous glazing and exposed within the building. The resulting vertical section at the upper level reinforced the conceptual and spatial importance of the community space on this floor and allowed the structural diagram to be legible from within as well as outside the building. The physical model was, in turn, dismantled and reassembled in response to the revisions explored in **form•Z**. **form•Z** modeling also enabled the development of a vocabulary of clear and consistent details accommodating a wide variety of conditions throughout the project to a degree that would not be feasible using hand drawings or other means of two dimensional representation.

The use of the **form•Z** model in presenting this project was particularly successful. The quality of light and transparency one would experience in the space was portrayed to a degree not attainable with less sophisticated modeling programs. **form•Z**'s ability to clearly render details and connections afforded an essentially seamless integration of the digital model images with photographs of the physical model within the presentation.

In sum, the selected project embodies an exceptionally successful use of **form•Z**. This was largely due to its integration with physical drawing and modeling in a fluid and cyclical design process. From an instructor's perspective, the only shortcoming of the program was its tendency to task the student owned hardware it employed. **form•Z** simply took significant time to regenerate a rendered image when views were changed. This tended to limit the extent to which the project could be reviewed within the timeframe of a desk critique.

aquatic center in the following ways:

- Response to programmatic demands, providing enclosure or extension of activity space related to functional nature and season.
- Response to environmental conditions, adjusting the quality of ventilation and daylighting of interior spaces.
- Response to structural demands and gravity through the development of a suspended roof system, producing an open spatial condition.

The use of both digital and analog media provided valuable exploration of these goals for adaptability, addressing functional, environmental, structural, and tectonic, issues. These components of design were investigated both through a physical sectional model (Figures 6) and a digital model which showed the urban context (Figure 2). Working with a digital 3D model allowed simultaneous exploration of site response and tectonic development, providing a visual representation of how these elements worked within the overall design.

Adapting to programmatic demands, the building acts as a dynamic organism which provides full enclosure during cool seasons, and opens outward for warm-weather activity (Figures 3b, 3c). With the north wall withdrawn, the site becomes a single large space for activity, defined by main building masses to the south and west, and dense landscaping to the north and east. The interrelation between interior and exterior space is blurred, providing accessibility to and visibility from the natatorium. This activity "room" extends in layers through the covered space of the building to the open-air exterior, with seating elements integral to the structure of these spaces. Spectator seating cantilevers from the masts which support the roof structure, while benches at the entry porch are attached to the same steel masts. Exterior seating steps upward from the cast-in-place concrete foundation, adapting to a different structural condition. While a physical model provides an abstracted representation of the structural system and its plausibility for resisting forces, a digital model

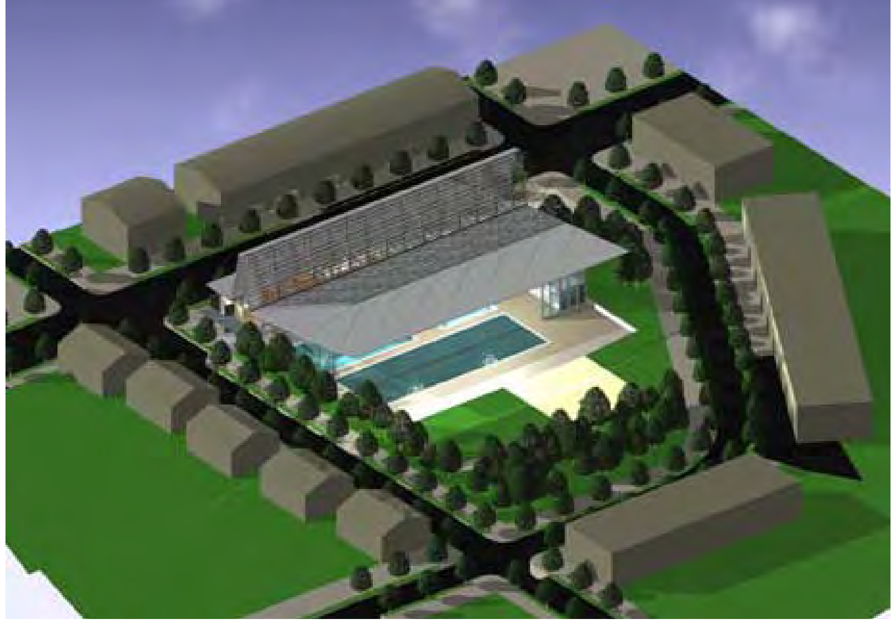


Figure 2: **The project blurs the boundary between interior and exterior.**

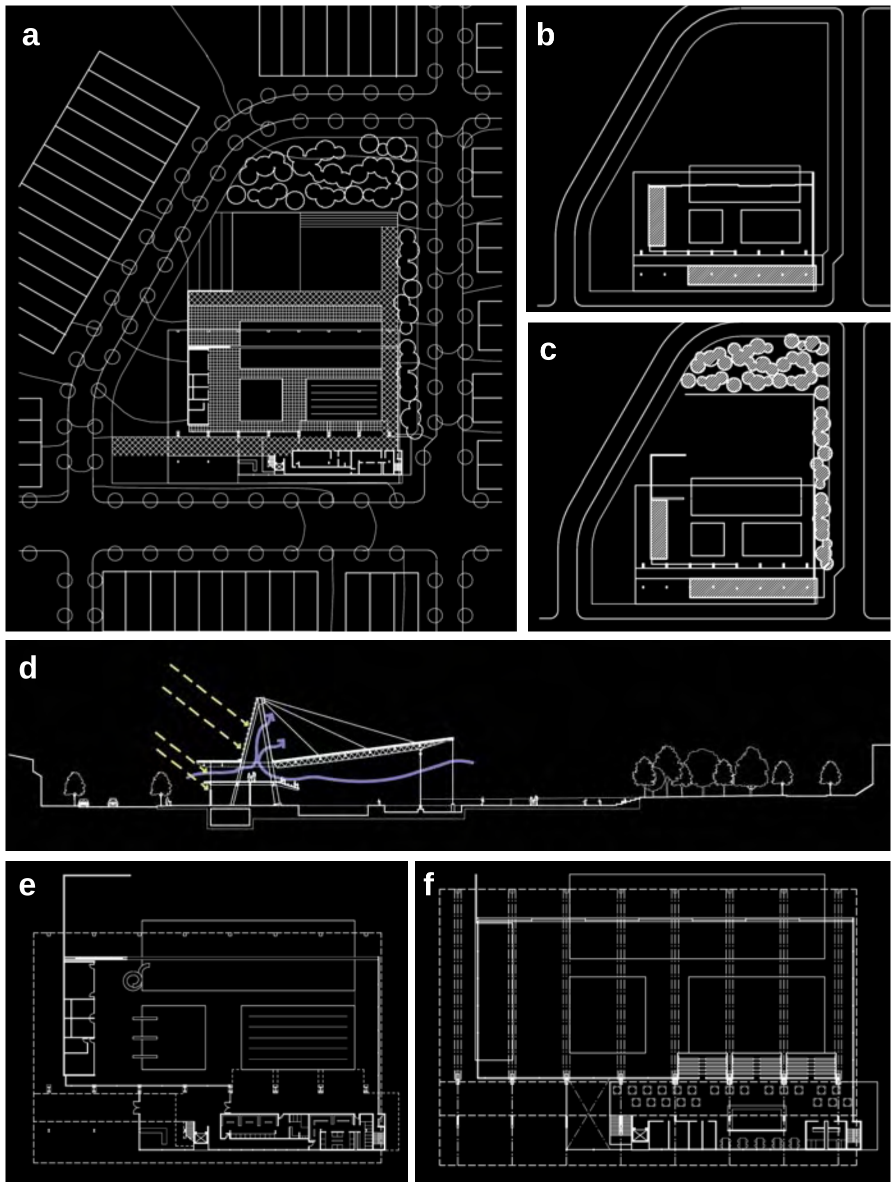


Figure 3: **(a) Site plan; (b) spatial enclosure; (c) spatial extension; (d) site section; (e) ground floot plan; and (f) second floor plan.**

completed with form•Z best provides a realistic graphic representation of materials and the structural integration of the whole.

In addition to the retractable north wall partitions, several elements allow for adaptability to environmental conditions. Combined with operable windows in the skylight and clerestory of the south elevation, this transformative enclosure creates a breezeway of continuous natural ventilation during appropriate seasons (Figure 3d). Likewise, interior partitions provide thermal separation between the natatorium space and enclosed program elements along the south side of the building. Operable louvers on the south elevation and skylight allow solar control within work spaces and the second-floor public space, while vegetation provides daylighting control on the eastern and western ends of the building. Digital capabilities allowed for the exploration of lighting and shading effects, providing a preliminary assessment of the requirements for controlling natural light.

The design of the suspended roof structure strives to create a primary interior space that is column-free on its north side, giving this space the ability to literally extend, uninhibited, to the exterior. The a-frame configuration of wide-flange steel masts and tiebacks support the suspension of long-span tube-steel triangulated trusses over the natatorium (Figure 4). An adaptation of the larger scale pin connections which attach the steel trusses to the masts, a series of clevis connections join suspension rods and cross-bracing to plates set within the all-weld connections of the mast structure. Second-floor program elements are supported on cantilevered beams extending through the depth of the a-frame. The cafe space provides a sense of verticality and visibility of the roof structure through a skylight, while also serving as a vantage point from which to see the extension of uninterrupted space stretching horizontally to the exterior (Figure 6). The robust structure serves as an indication of the building's significant role in community events and activity.

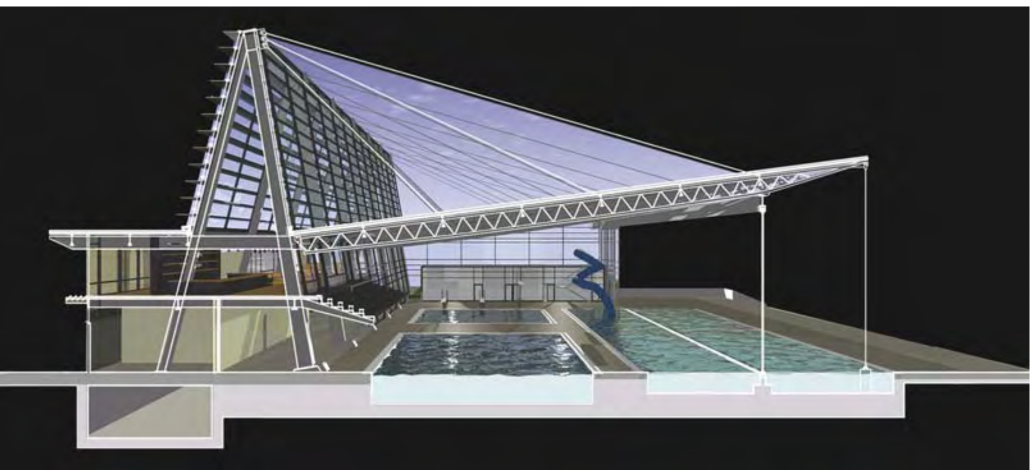


Figure 4: **Section perspective view showing structure and spatial relations.**

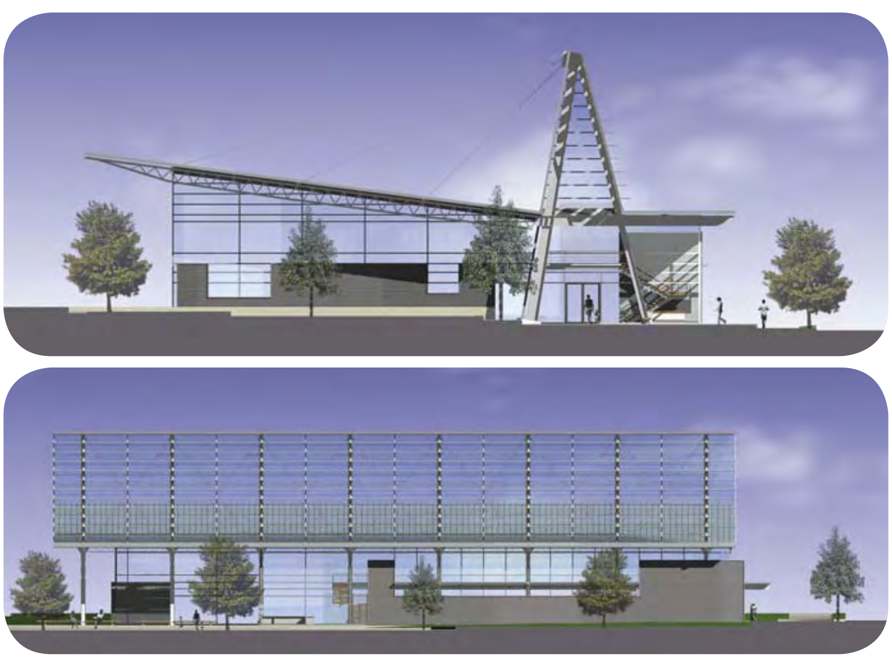


Figure 5: **West (top) and south (bottom) elevations.**

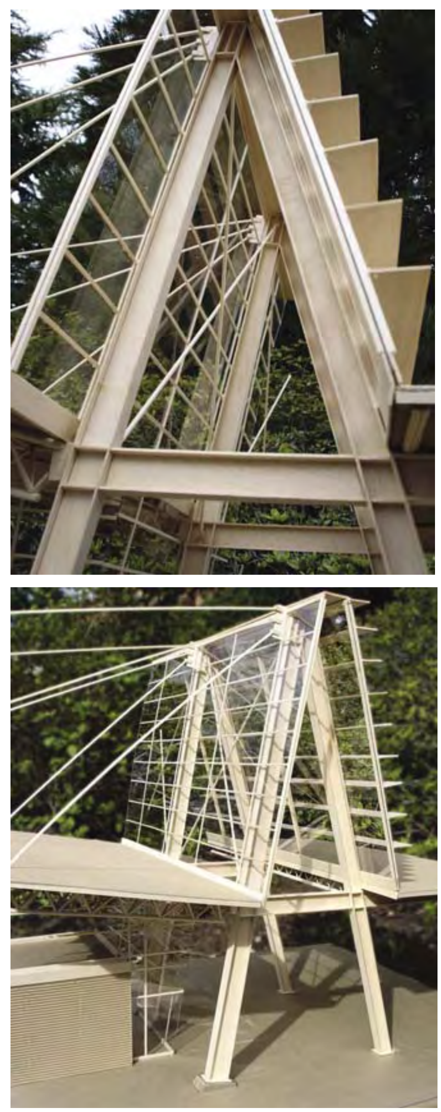


Figure 6: **A physical tectonic model for exploring structure and details.**

For this project, **form•Z** was most useful as a tool for generating the final representation. As a submission for the ACSA/AISC Student Design Competition, it was critical that the final product be both clear and interesting, as the presentation would not have the benefit of an oral explanation. The explanatory renderings provide an effective illustration of the ideas and development of design, enhancing the understanding of the intended experience of the building through texture, materiality, and light. Such a comprehensive description is not easily obtained through other means, and provided a crucial advantage where entries were restricted to still images with a limited amount of display space. The digital images presented a convincing representation of structural integrity, demonstrating steel's ability to gracefully span a significant distance and provide programmatic flexibility. The use of light and shadow brings viewers to the human scale, illustrating how the concept of adaptability led to a response to human needs relative to their environment. Enhancing renderings with Adobe Photoshop and composing presentation boards with Adobe Illustrator led to a compelling, succinct display that successfully conveyed the important ideas and goals of the project.

Figure 6: **The Cafe space provides a view of the glazed A-frame structure.**

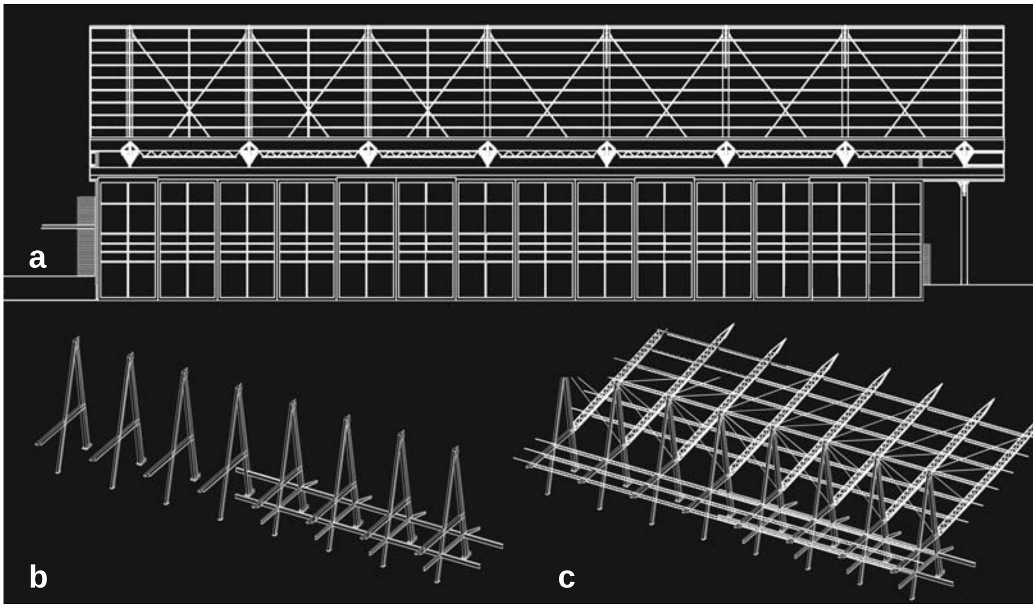


Figure 7: **Structure: (a) north elevation, (b) primary frame, and (c) roof.**

Rebecca Roberts is a student in the Master of Architecture program at the University of Washington in Seattle. She received her Bachelor of Science in Architecture from the University of Maryland, College Park. Prior to pursuing her Masters Degree, Rebecca worked at Design Collective, Inc. in Baltimore, MD. There she contributed to various architecture and urban design projects, including several public charrettes for urban revitalization. She received a 2nd Place prize for her entry in the 2005-2006 ACSA/AISC Student Design Competition. The project has been published in the ACSA/AISC Student Design Competition book, as well as the University of Washington's Skin 3.0 publication of student work. Email: beckylr@u.washington.edu.

Richard E. Mohler, AIA, is an Associate Professor of Architecture at the University of Washington and a principal of Adams Mohler Ghillino Architects in Seattle. He received both Bachelor of Arts and Master of Architecture degrees from the University of Pennsylvania. Mr. Mohler's academic responsibilities include teaching graduate level design studios and advising master's thesis students. His architectural practice, which specializes in residential and small-scale commercial projects, has been recognized through local and regional AIA awards, national design competitions and publications.

Chairs: A Study in High School Architectural Design

by Robert Meredith

Le Corbusier's lounge, Mies van der Rohe's Barcelona, Rietveld's Zig Zag, Charles and Ray Eames' LCW, and Gehry's Hat Trick –- these are all classic chairs made by architects that have become clarified expressions of architectural design. They seem to be a concentrated link between the architect's building and the human. Chairs comfort, support, enthrone, and excite. So many architects have been compelled to make chairs for their buildings as a functional extension of the architecture itself. One only has to look at Frank Lloyd Wright's Johnson Wax chair to understand that the same conceptual ideas are present in the chair itself as those found in the building.

Chairs have evolved over millennia, exploring a variety of permutations, materials and forms. Who has not been "invited" to sit down when confronted by an extraordinary chair? Designers, architects and craftsmen through history have reworked the seating formula in an attempt to engage the mind and comfort the body in the hope of creating a new classic.

This common appreciation of chairs is precisely why I decided to offer a design assignment to my high school Advanced Architecture students as a most compelling way to engage them in translating the concepts of building to the personal level. My advanced architecture students have all previously had a year's experience with **form•Z**. Their knowledge of the software's fundamental tools as it pertains to making architecture is at an intermediate level. During the chair assignment they have an opportunity to expand their range by experimenting with more organic modeling, texture mapping and lighting. This vocabulary is accessible in new ways with the software.

There is always immediate attachment to this assignment. Everyone in the class believes that they know exactly what makes up a successful chair and wish to express their opinions on the subject. I begin the project by trying to reshape preconceived ideas and introduce students to the variety of chairs formed throughout history. I then ask students to research one particular chair they find engaging. Students offer a brief class presentation accompanied by images of their selection. With each presentation, elements of good design, form and function, proportion, and material are discussed and evaluated for their strengths and faults in order to determine the salient elements that make up a fine chair. Once students have this knowledge base, they begin to design their own.

For the chair assignment, I prefer to have students work between drawings, sketch models of corrugated cardboard and wood, and 3D computer models. Students begin by generating ideas in the sketch model, developing a sense of form, function (comfort) and proportion by using an articulated artist's mannequin for scale. From here students move to the computer to refine their concepts and further articulate their designs. Most find this method of working from paper, to model, to computer a natural evolution for the development of their ideas. **form•Z** makes it possible at each junction for students to manipulate their components much more easily within the framework of technical and practical constraints. This goes beyond the obvious facility to visualize changes and has an impact on the way students can imagine changes in three dimensions.

What remains most impressive to me about this assignment is the variety of personal expression that can come from the class. This particular year brought out chaise lounge chairs, bar stools, futuristic task chairs with computer components sandwiched between glass sheets (figure 1 & 2) and organic "twig" chairs reminiscent of Adirondack stick chairs generated a century ago (figure 3).

Figure 1: **Brian Lehrer, Computer chair**

Figure 2: **Brian Lehrer, Computer chair (detail)**

Figure 3: **Matt Evanusa, Vine Chair**

There were also the conceptually unique examples such as Jeffrey Weinstein's circulating water chair (figure 4) which enclosed cascading water surrounded by a glass enclosure, or Johnathan Pryor's spider chair (figure 5), made up of a throne-like web of welded concave filaments meant to enclose the arachnid-friendly user in a spherical cocoon. Spiderman would approve.

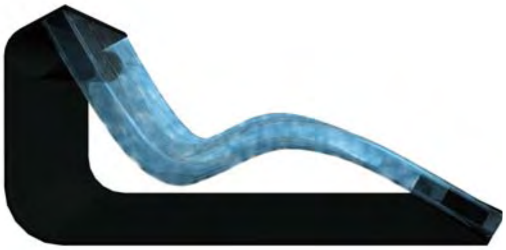


Figure 4: **Jeffrey Weinstein, Water Chair**

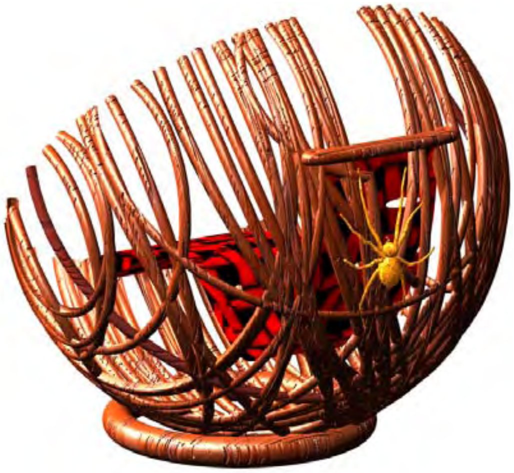


Figure 5: **Johnathan Pryor, Web Chair**

For the second phase of the chair assignment I ask students to think about their chair in the context of architecture. Just as Gerritt Rietveld used his Red Blue chair of 1918 in his Schroder - Schrader house in Utrecht to help create a homogeneous expression of architectural design, where expanding and dividing spaces were articulated by expanding plains in primary colors, I encourage my students to construct a complex relationship between their chairs and a work of architecture. This proves to be a bit more challenging, but there are some experiments worth mentioning, for example, Brent Palmer's pergola with double lounge chairs and a table (figure 6 & 7) or Zain Talyarkhen's marble bench and table inspired by an antique version from India, simply protected in a contrasting fabric canopy supported by poles. (figure 8)

Figure 6: **Brent Palmer, Pergola and Lounge Chairs**

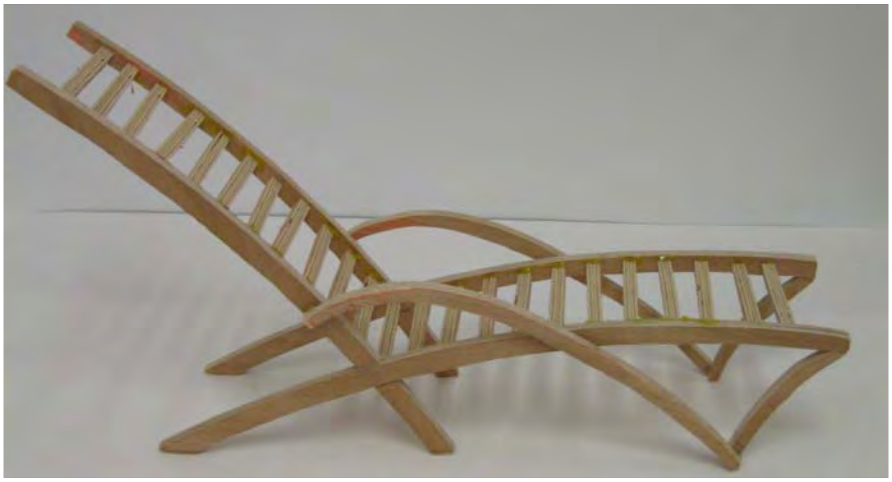


Figure 7: **Brent Palmer, Lounge Chair**

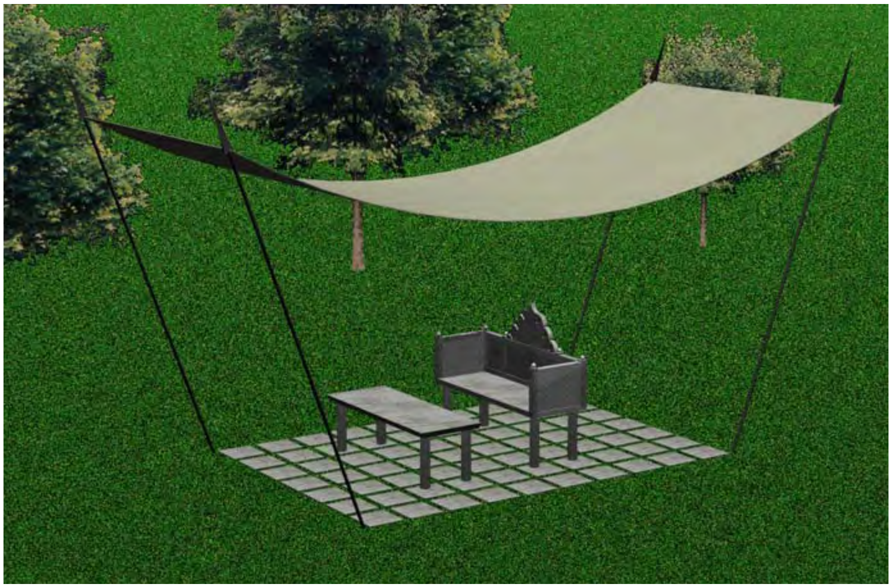


Figure 8: **Zain Talyarkhan, Marble Bench and Table**

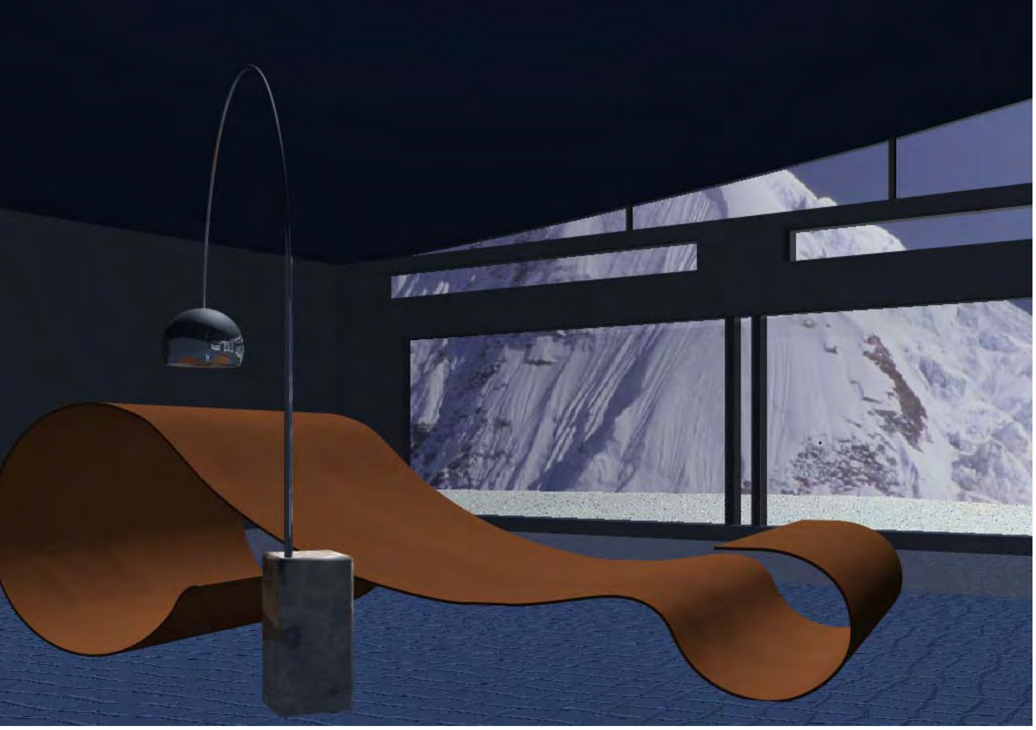


Figure 9 : **Michael Rosen, Chair**

A final chair successfully integrated into a pavilion is Michael Rosen's solution to the assignment (figure 9). Michael took a single sheet of steel and bent it into caressing and playful curves that culminated in cylindrical ends. This oversized noodle of a lounge is at once recliner and sculpture. When he places this chair in a faceted glass-walled pavilion in the mountains, it creates a meditative retreat where one can contemplate the majesty of the landscape. This is an example of how the computer can improve the level of visualization for the student. The ability to "see" a chair design within an architectural environment allows the student to conceptualize their work more fully, therefore assisting with the evolution and refinement of the design at every step of the creative process. Students are more able to think about relationships in a comprehensive way that seems to expand their understanding of architectural form and space.

Chairs are fascinating objects that we all come to appreciate. They suspend us above the ground, relax and cradle our bodies and define our personalities. Henri Matisse, who collected chairs and featured them in many of his paintings, once said:

> *"What I dream of is an art of balance, of purity and serenity, devoid of troubling or depressing subject matter, an art that could be for every mental worker, for the businessman as well as the man of letters, for example, a soothing, calming influence on the mind, something like a good armchair that provides relaxation from fatigue."*

I believe the reverse is also true; a well-designed chair is refreshing as a work of art. My students' exploration of this assignment demonstrates the range of possibilities available and expresses their unique young personalities.

Figure 10: **Corey Benson, Bar Stool**

Rob Meredith has been teaching art at The Dalton School for 28 years. He developed the architecture program at the school in 1979, later adding his popular course Art History in the City. More than 30 of his students have continued studies in architecture at college and graduate levels. As chair of the High School Art Department for 13 years, he oversaw the introduction of digital art (including media, video and architecture) and the construction of a new art facility. His recent focus has been on initiating projects that reach across disciplines and grade levels: The Original Mind Program brings extraordinary scholars to the school for inspiring collaborations with faculty and students; the Day of Service sends the entire high school volunteering in area neighborhoods. Currently Rob is spearheading the development of a cross-cultural curriculum with two-week student exchange with Dalton's Dutch counterpart, Dalton den Haag. Academic year 2007-2008 will see the first link of these students and their projects on line and in each other's homes, studying international politics, art, architecture and the connection between Holland and New Amsterdam. Originally from Massachusetts, Rob Meredith is a sculptor, BFA from SUNY Art & Design Alfred, MFA from Yale University.

University of Oregon
Eugene, Oregon

THE MUSEUM OF THE BUILDINGS in New York City

by **Bart Chui**

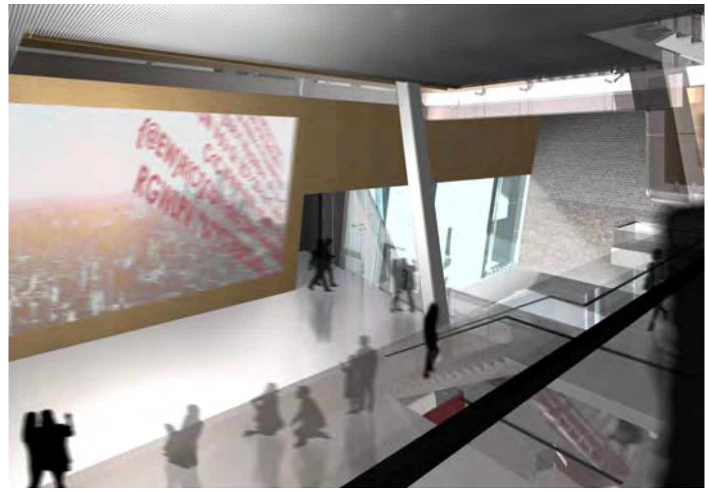
The broad and ambitious title of this project offers the opportunity to investigate into the relationship between the city (urban design), the building (architecture), and exhibition design (interior architecture). The three fields all deal with spatial problems in very different scales. The ultimate goal of this project is to break the barrier between the city and exhibition design through architecture.

In this project I attempt to utilize digital media in the design process for the first time. **form•Z** has been used as the tool to visualize the design ideas in very early phases and helps design-decision-making throughout the entire process. The first design study through **form•Z** is to figure out the building's relationship to its immediate context. I first built the model of the maximum building size according to the zoning code. After compromising with the program and with a goal of looking for a massing scheme coherent with the context in mind, it is placed in a digital site model, and manipulated through both subtractive and additive operation. The relationship of the building and its adjacency is the best illustrated by the day and night view and the elevations. It can be interpreted as an appropriated agglomeration of adjunct buildings.

View 1

After forming the preliminary massing scheme, a hole connecting the two ends of the site is carved out. It forms the public corridor on ground floor, recreates a cross block transparency and provides the medium for intense urban activities within the building. The media skin on one side invites people to go behind and step up the stair to enter the museum (view 1). Another triangular space is carved out perpendicular to the corridor and forms the entry to the museum. As a welcoming gesture, the slanted wall of the triangular space creates an illusion of a heightened room, which provokes the feeling of walking in the canyon of skyscrapers in New York City. It is also used as a projection wall for moving images, bringing information of the city to the visitors. The space frames the existing brick wall of the neighboring building as a part of the exhibit. The juxtaposition of an old wall next to a new structure provokes visitors' imagination and contemplation on the history of the city (view 2). As the visitors proceed from the public corridor to the triangular space, and eventually into the museum space, the series of events are linked up by a monumental staircase soaring from the ground floor to the top floor. This strategy ensures clarity of circulation. It also gives a constant reference back

View 2



View 3

to the major spaces while visitors are roaming in the museum (view 3).

As the design develops, **form•Z** also helps to determine the construction details. It turns out to be the most important feature in connecting the content of exhibition to the city.

As a museum, there is certainly a need to present delicate artifacts or projection images in a contained box, very much like in an art museum. But more often the exhibits need to be presented in a certain context as a reflection of actuality, just as a building should sit in the city for a full reading. Sometimes both strategies need to be employed to achieve a new reading of the exhibits from the visitors. Thus I come up with the idea of an ultimately flexible exhibition space – not the Miesian enclosed, empty white space, but the space with the freedom of either closing out or opening up the interior to the outside world (diagram 1).

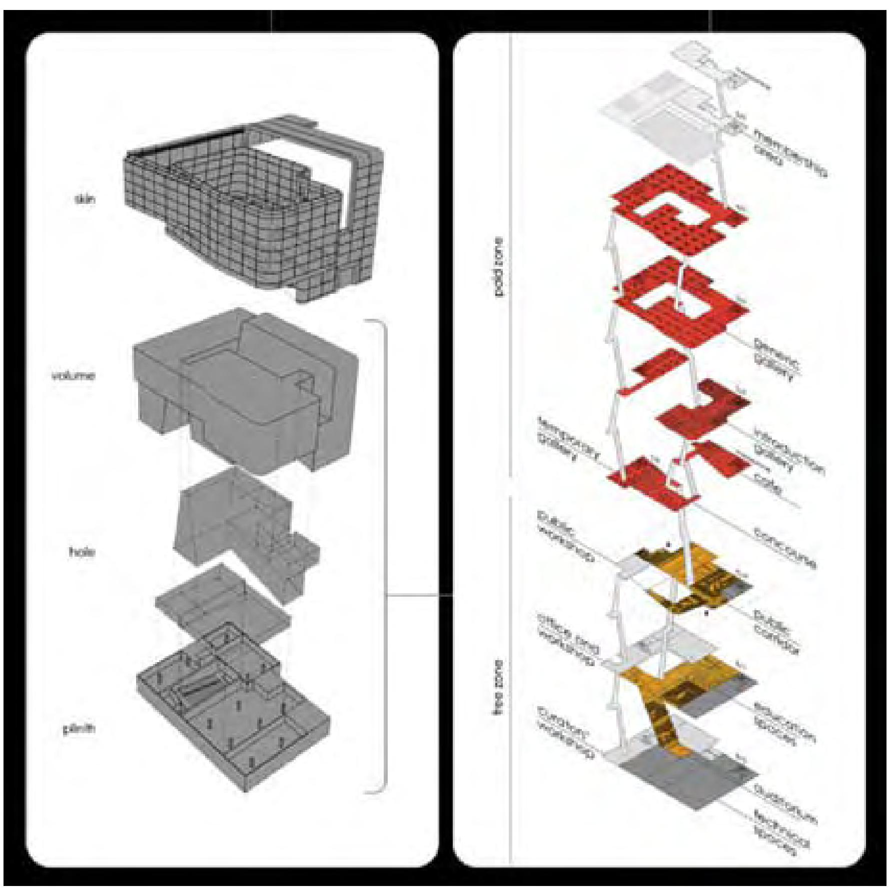


Diagram 1

It is made possible by the building skin. Its goal is to ensure the control of such connection between the exterior and the interior by actively changing its transparency. A more transparent skin provides more connection to the actual context, while a more solid one makes the interior more detached from its environment. An appropriate transparency can be adopted depending on the nature of exhibition. Sometime the exhibition material is presented together next to a view opening to the exterior at the end of the room (view 4, wall on the left), or sometimes the materials are simply presented in a totally confined room (view 5). The skin also wraps around the building and folds to form the interior lining, defines galleries of different sizes and gives subtle changes to the continuous space. It is not only introduced as the external envelope, but also as an active interior spatial divider, such as the media skin wrapping over the public corridor on ground floor mentioned before.

The skin is a triple layer construction controlling penetration of natural light and view (view 6). The vertical fins, slotted in between the double glazing, are operable by turning and sliding. It controls the relationship between the exhibition and the city as discussed above. It also regulates the interior lighting quality the atmosphere of the gallery space. I am pursuing a gentle, natural light that penetrates into the building when the operable fins are opened. The design and actual construction of the skin is investigated through modeling in **form•Z**.

Views 4 and 5

Top to Bottom: **East, West, and South Elevations**

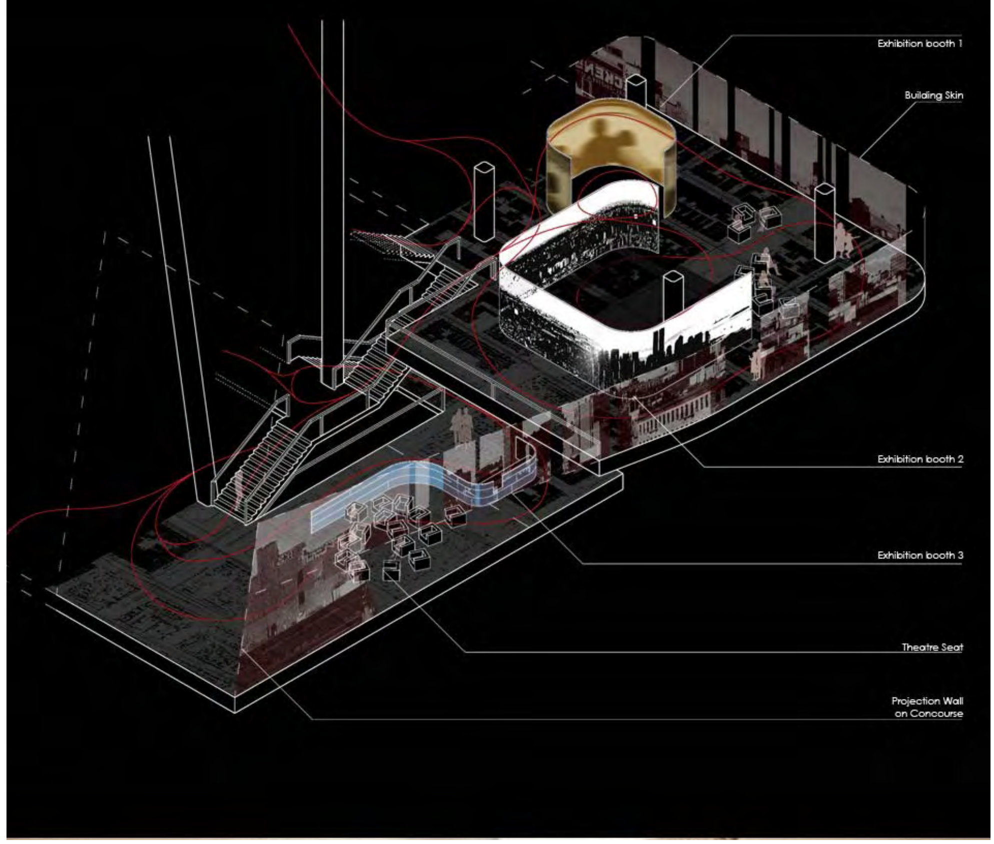


Diagram 2

To achieve the desired lighting quality and figure out the appropriate member size of the operable parts, I first finish the basic design in sketches, which is translated into preliminary vector drawings. **form•Z**'s modeler enables a freedom in altering the members' dimension easily. As an experiment, a series of models with different member sizes are generated. Then the operating mechanism for the system – rotating, sliding, and retractable members, are tested and animated.

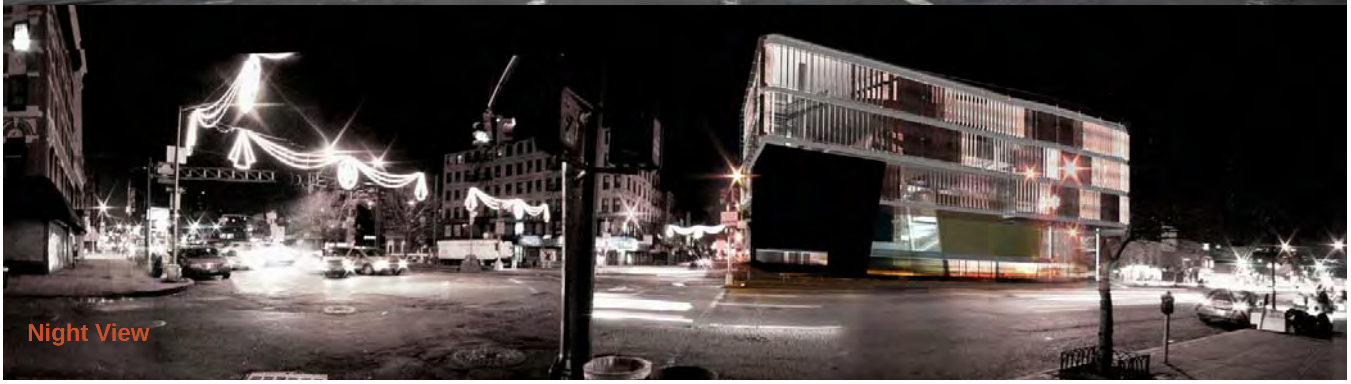
form•Z's rendering engine, **RadioZity**, is capable in predicting lighting quality to a high degree of accuracy and thus is used as an investigative tool to emulate the interior lighting. After entering the fixed parameters to the program, including the opacity of glass, the time and the site's longitude and latitude, a series of animations are generated. Rendered images that were produced (but were lost in a computer crash and are not shown here) depict the intensity of the light, how far the shadow penetrates into the space, and the most interestingly, how the interior shadow pattern changes as the light source moves etc. Through trial-and-error, constant discussion, and convincing renderings, an appropriate dimension and operation mechanism for the skin can then be determined. It actually also suggests a certain floor height to floor slab ratio for such lighting condition to occur, which in turn refines the basic massing scheme and influences other design decisions, including placement of building service core and circulation pattern.

With the help of **form•Z**, the goal of the design – to bring exhibition design and urbanism together through architecture – is achieved through the massing strategy and the transparency of skin. Apart from design-decision-making, the program also helps in illustration and analysis of design ideas. The sectional perspectives and organizational diagrams are the digital model in 2D vector drawings exported to other vector-based programs. They are extremely effective in conveying design ideas.

To conclude this exercise on digital design in this short paper is difficult, but I am very glad to incorporate **form•Z** into my design media tool box.

Sectional Perspectives


Day View


Night View


Interior View from a Physical Model


Exterior View from a Physical Model

Bart Chui received his BA Degree in Hong Kong University and Master of Architecture Degree from University of Oregon. He has been a teaching fellow at the University of Hong Kong (2004-05) and University of Oregon (2006), where he taught a digital media course and was visiting studio critic. Mr. Chui has received numerous design awards, including the Student Design Achievement Awards from Society of American Registered Architects, and an honorable mention in the international design competition jointly held by NTT DoCoMo, Inc. and Shinkenchiku in 2007. He currently works at John Friedman Alice Kimm Architects, Los Angeles. Mr Chui is interested in architectural conservation and sustainable urbanism. He was on the team on application process of Macao to world heritage listing in 2005, and has participated in several international conferences, including the International Association for the Study of Traditional Environments (IASTE) in 2002, and Modern Architecture of Asia Network (mAAN) in 2001.

MCA Student Design Competition: How Computing Helped Competing and Vice Versa

by Murali Parannadi

Project by Mark Cerney and Taryn Nye

The Department of Architecture and Interior Design at Miami University, offers an elective design studio that focuses on engaging computers into the design process at the upper level undergraduate program, which I have taught for over ten years. Here, I present a recent project by Mark Cerney and Taryn Nye (referred to as the student team here on), to illustrate the pedagogy and process involved in teaching such a studio.

During fall 2005, for a period of 6 weeks, my studio took part in the Metal Construction Association student design competition[1]. The competition challenged the students to use metal as the primary structural material to design an outdoor band/performance pavilion located in Washington Park, in a historic Chicago neighborhood. Stated criteria for judging included successful and creative use of metal in addressing structural, functional, environmental, and cultural needs.

The first two weeks involved literature research, site/program analysis, and sketch design culminating in a field trip to Chicago for a site visit and case studies in the use of metal. Inspired by Anish Kapoor's Cloud Gate at the Millennium Park, the student team wanted to pursue a concept that provides a kinetic experience of the park's landscape to the people. To achieve this, they came up with an idea to construct a light trap[2] to provide a show of color, light and shadow even when there is no event scheduled at the venue. They also wanted to submerge the pavilion into the land to shield the noise from the street level, and to make minimal visual intervention on the existing landscape of the park.

Taryn started in a very rational manner with the computer. Since the site plan provided by the competition organizers was out of date, she developed an image of site plan in Photoshop from their own research from site visit, and from google map search. She then used this as an underlay in form•Z, to trace the existing pathways and locate the existing trees using symbol libraries. To get a sense of scale, she started by drawing the individual programmatic spaces as boxes to represent appropriate square footage. To get a better volumetric sense, she extruded these boxes. She placed 3D scale figures on a separate layer from "people for people[3]" symbol library. She also setup a sequence of perspective views at the eye level, defining the keys for walkthrough animation. From this point on, these proved crucial throughout the design process, in evaluating the processional experiences of arrival, being at the event, and departure (figures 2(a), 4, and 5).

Mark, by contrast, started with an idiosyncratic study of canopy forms by nesting metal meshes and wires and placing them on a light table to observe the light and shadow patterns (figure 1). When they brought their individual explorations together, two important decisions were made to focus on their concept of creating a lighting phenomenon. First, they wanted the structure of canopies to be more like the tree forms and become lighter and transparent. Second, they decided to use the aforementioned boxy program spaces Taryn extruded in form•Z as they are, because their minimalist form enables them to act as blank canvases to capture the images of light filtered by the canopies.

The subsequent two weeks of the study involved building another physical model where they represented these metal trees by folding thin wire mesh into funnel like forms (figure 2(b)). This proved useful to

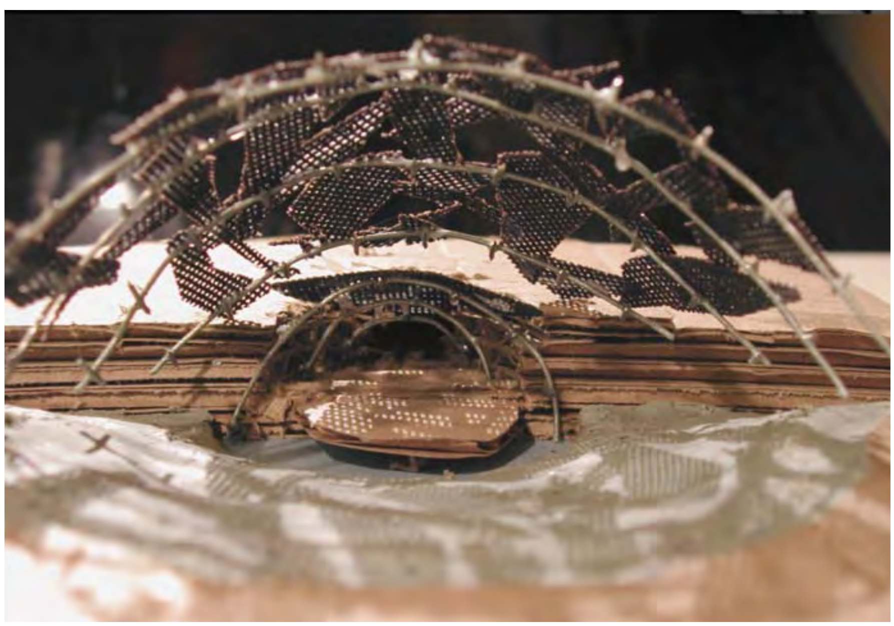


Figure 1: **Early study model built with cardboard and metal wires/meshes.**

see how light and transparent the metal trees can be, and the phenomenological beauty of patterns created by light filtering through. But it was not easy to control the forms of these funnels, keep them erect, and connect to one another. Also, based on their experiences with the earlier study model, they did not pursue manipulating the landform, as they considered doing so with cardboard medium to be ineffective.

So, concurrent to this, they built a digital model (figure 2(a)). They considered the Landform tool,[4] nurbz, and patches[5], and were advised not to use any of them. Since the site was practically flat, they represented the land as a plain mesh and used the deformation tool (move mesh with profiles and path) to sculpt the landform. They constructed the seating, stage, and other program elements as simple extruded solids on separate layers and overlapped it with the landform. The metal trees were constructed using the Skin tool by sweeping a circular cross section along multiple paths. They were able to scale and move these tree forms around the site freely.

At the end of the fourth week pinup, when they presented **form•Z** rendered images along with a physical model, the critics acknowledged the strength of the concept but were not entirely convinced with the tectonics of these monolithic metal tree structures depicted in the presentation, and encouraged a more rigorous study.

With two weeks remaining for the competition deadline, the students decided to take this advice seriously and focused solely on developing the metal trees using **form•Z**.

The important aspects for modeling the tree were not only to make them to have organic forms that are unique, but to study their structural support, articulation, and fenestration/shadow formation. Upon experimentation with various ways to model the tree (figure 2(c)), they decided to represent it as a ruled surface (figure 3), as it corresponded best with their understanding of the process of fabricating it with metal.

This time, they drew the profile in section representing the structural rib. The location of the points on this profile

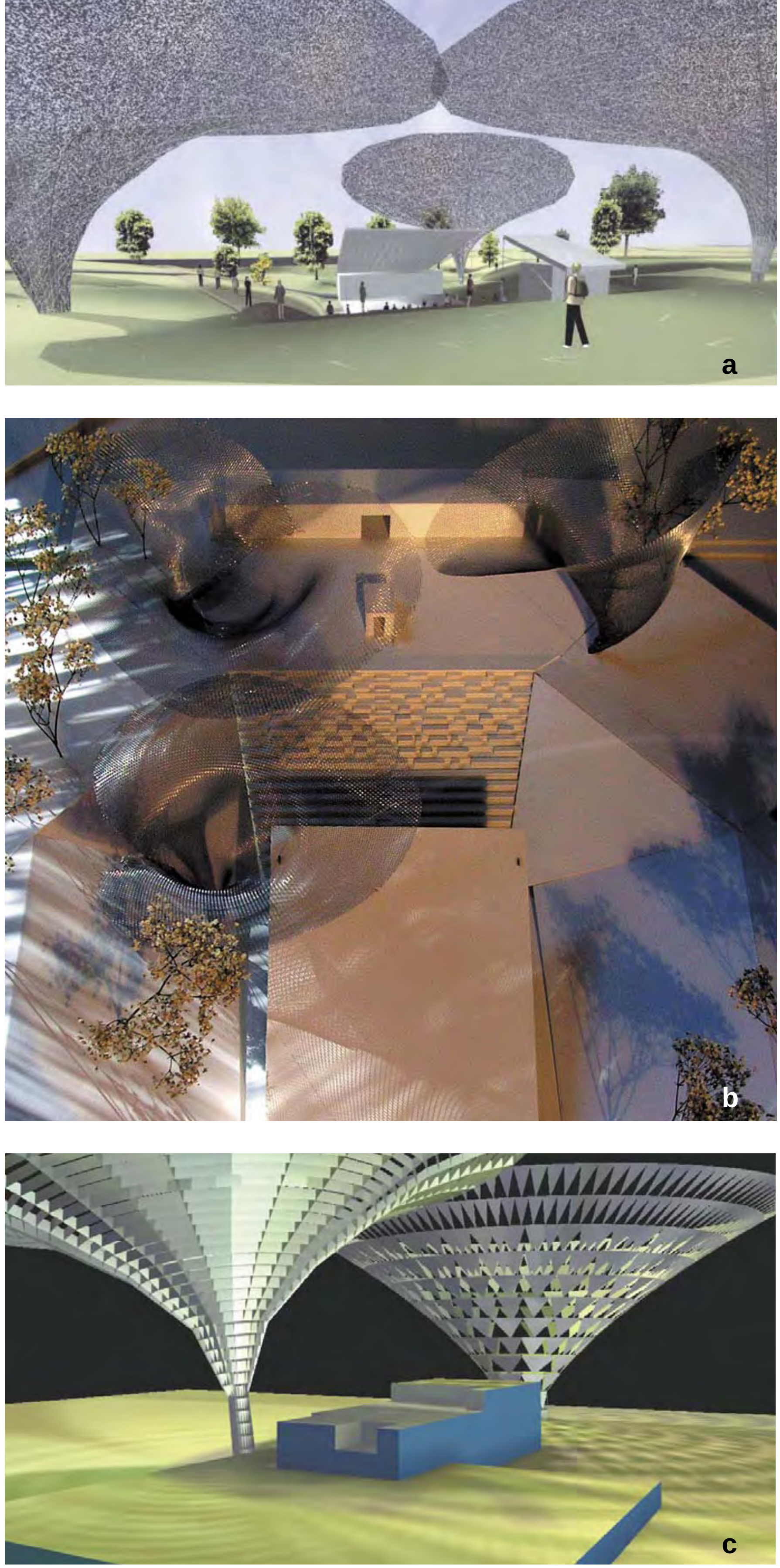


Figure 2: **(a) First attempt to model the metal canopies in form•Z. (b) Early physical model. (c) form•Z model studies to identify the appropriate technique for modeling metal canopies.**

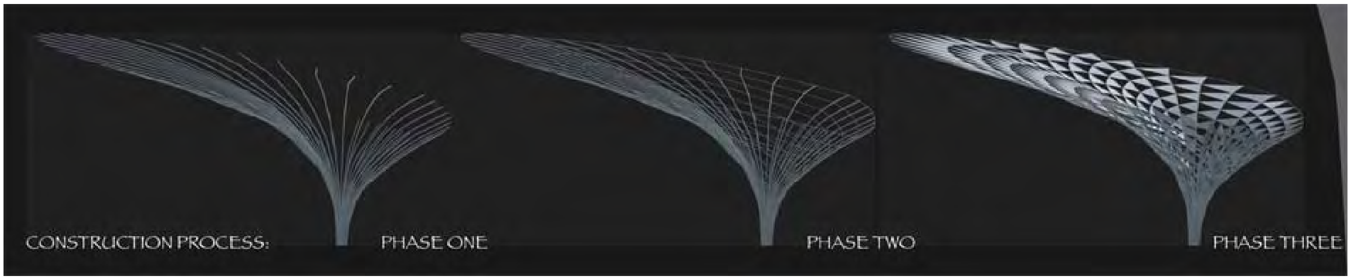


Figure 3: **Construction of the metal canopies as a ruled sufrace.**

represent where the welds would go for the lateral ties, and the metal panels. A copy of this profile was rotated in plan. Subsequently, its points were carefully moved in plan and section, guided by Fibonacci sequence[6], to adjust the shape and configuration. A mesh was constructed through these profiles as a triangulated ruled surface using the C-mesh tool. Alternative faces were deleted topologically to make holes to let the light through. At this point, the Derive 2D Surface tool was used two ways on this mesh surface. The "2D Surface From Stitch" option generated paths (for axial sweep with a circle) to make the structural lateral ties, by clicking on lateral segments sequentially. "2D Surface From Selected Entities" generated independent triangular objects from all the faces, to make the aluminum panels that are to be welded to the ribs. The control lines used to construct the mesh were un-ghosted, a circle was swept along to make the major structural ribs.

They used eye-level walk through animations to fine-tune the configuration of program elements, placement and the scale of metal trees, and the contour of the landform. But unfortunately, the competition format did not allow for submitting these animations. Interested reader is directed to view these animations on the accompanying DVD.

They used Photoshop to compose their three presentation boards (also available on the accompanying DVD) using images from their form•Z model and the physical model and shipped it off at the beginning of seventh week of the project. They were thrilled to hear the results. They garnered the top honor - the First Prize!

More on the competition jury process can be found in Marge O'Connor's "A Walk in the Park", in the January 2006 issue of MetalMag, also available online at http://www.metalmag.com/docs/06 link pages/06 JANUARY STORIES/ JANUARY ARCHANGLE.pdf.

Epilog

Despite being introduced to an array of 2D and 3D computer graphics programs in skills based graphics media courses prior to entering this studio, the students' depth of usage of computers for design is limited. Studies show that despite experience, many computer users possess minimal command knowledge[7], and do not progress to an efficient use of complex computer applications[8].

Most daunting thing for a design student is to represent the idea into a computable form. Computer interface is primarily command based. Getting the idea into a computable form requires translating the design intentions into specific commands. It is very helpful to have a well-articulated and succinct high concept to guide the process of negotiating the command universe. Competitions generally have clearly defined program, project/site constraints, and most important – criteria with which to evaluate the design outcome. As

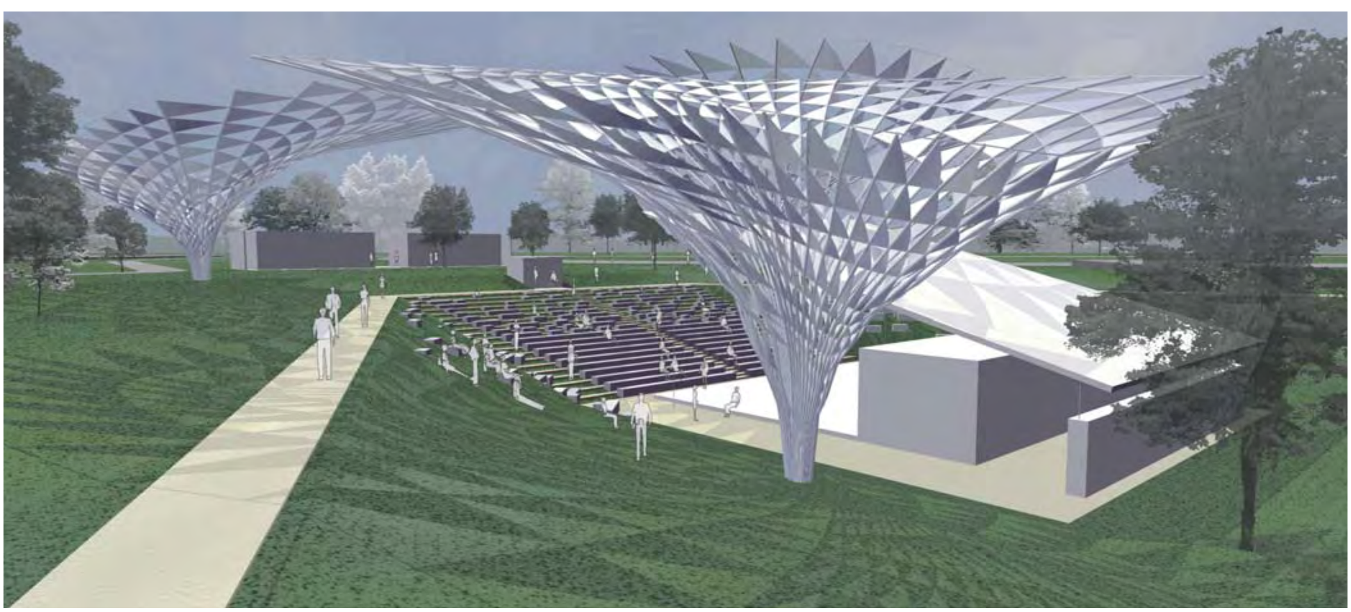


Figure 4: **An eye level view from one of the pathways of the park.**

suggested by Alvin Toffler, thinking about "big things" while doing "small things", can make the "small things" go in the right direction.

One of the first readings[9] in the studio studies the role competitions played on the success of SHoP architects. This motivates students to develop a focus by carefully distilling their conceptual intent into a few important things that really matter. Once these ingredients have been identified, it is generally possible to have an open discussion in the studio about how computers may or may not help investigate these. At these discussions, as well as during desk critics, students need direction in matching their design semantics to specific features that exist in the specific software programs we have at hand. More importantly, in a parametric manner that allows further study and iterative exploration and experimentation of the ideas in 3D. After all, the competitions encourage experimentation and taking risks.

Requiring the students in studio courses to present their mode of inquiry as part of their reviews, along with the design content, the process of engaging the computer becomes the subject of discussion during the critiques. These discussions become very important in helping the students find the functionality in the computer to execute a strategy. As it turns out, each student's investigation ends up being focused on one or two specific features of the program. It is extremely important to create an open environment where these processes are exposed, discussed, and critiqued so that everyone involved learns.

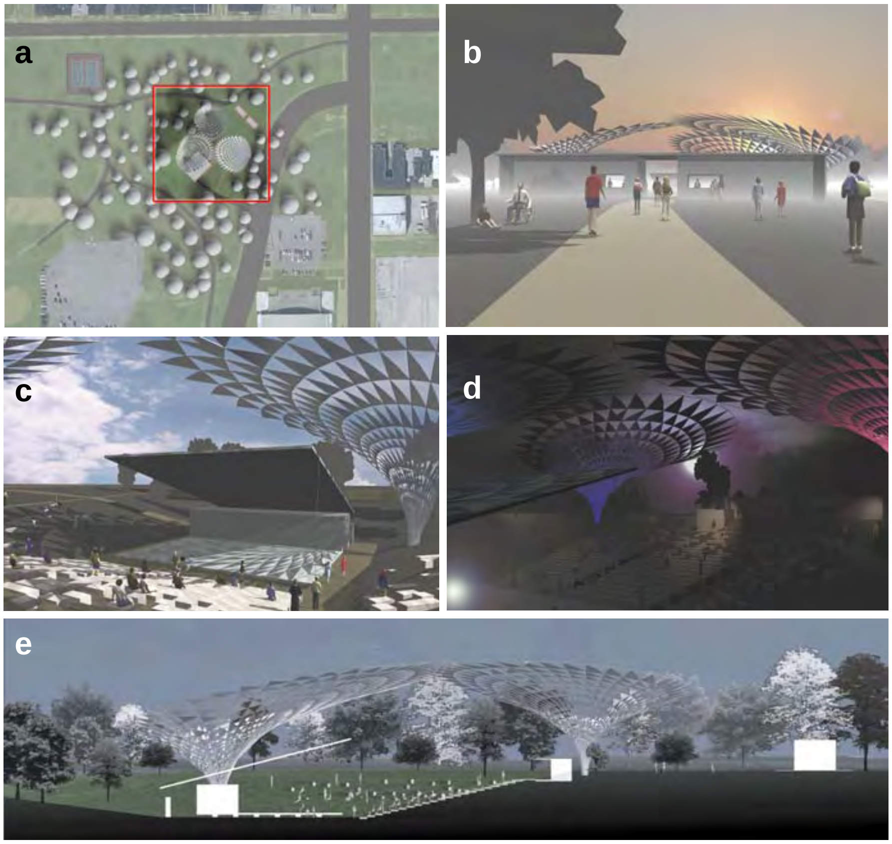


Figure 5: **(a) Site plan showing path ways and context. (b) Entry point with ticketing/concessions. (c and d) Lightng effects during day and night. (e) Longitudinal section showing landform manipulation.**

Notes

[1] Competition brief and the winning entries can be viewed at http://www.metalconstruction.org/. Accessed: February 19, 2007.

[2] Inspired by Ball and Nogues' Maximilian's Schell installation. http://www.emanate.org/schell.htm/. Accessed: February 19, 2007.

[3] Purchased for academic use from http://www.peopleforpeople.com/. Accessed: February 19, 2007.

[4] These tools are designed to extrude 3D landforms as stepped, or triangulated, or mesh forms from a set of valid contour lines and site outline. This method requires one to think about 3D landforms in terms of contours. While this tool can be extremely helpful when dealing with very specific information to build very precise land forms, it becomes inefficient when the form is still ambiguous.

[5] NURBS require thinking about 3D form as surface interpolated by defining cross sections. Patches work by defining boundaries of an area and are manipulated by pulling and pushing points on the surface. While these result in fluid looking form with relatively little effort, precision and control is not easily accommodated.

[6] Although possible, staying pure to the Fibonacci was not their main concern at this stage. Overall, they were more rigorous about it in section, by spacing the lateral ties at z, z, 2z, 3z, 5z, 8z, 13z heights. In plan, articulating the canopies and the distribution of spaces took precedence over Fibonacci.

[7] For example, Microsoft office user "experience team" research found that out of roughly 1400 built-in commands, five commands (Paste, Save, Copy, Undo, and Bold) account for 32% of usage of Word 2003 and that use of other than the top 10 commands was strikingly rare. http://blogs.msdn.com/jensenh/archive/2005/11/07/489864.aspx Accessed: February 19, 2007.

[8] Bhavnani, S.K., and John, B.E. "The Strategic Use of Complex Computer Systems". *Human-Computer Interaction* 15 (2000), 107-137

[9] Kellogg, Craig. SHoP [interview]. Competitions 2000 Fall, v.10, n.3, p.44-[55], ISSN 1058-6539.

Murali Paranandi is an associate professor and coordinator for computer studies at the Department of Architecture and Interior Design at Miami University in Oxford, Ohio. He earned a B. Arch. from Jawaharlal Technological University, M. Arch. from Kent State University, and M. Arch and postgraduate certificate in CAAD from the Ohio State University. His research and teaching intersect with the engaging digital media in concert with traditional media for architectural design. His research work in digital pedagogy received funding support from National Science Foundation, Miami University, and others. Professor Paranandi's students from Miami University have won a total of five **form•Z** Joint Study Program Awards of distinction in the categories of architecture (2000), interior design (2004, 2006), and animation (2005); and honorable mention in architecture (2002). During 2005-06 year, his students won four prizes representing a total of $34,500 cash awarded, including two first prizes, in Metal Construction Association, and Association of Collegiate Schools of Architecture (ACSA) design competitions. *Photo by Vishnu Paranandi.*

BILLBOARD:
MISSION CREEK AQUATIC CENTER

by Patrick Flynn and Joseph Barajas

Billboard: Mission Creek Aquatic Center draws inspiration from its surroundings and context, both formal and cultural. Its structure and form seeks to expand upon the vernacular precedent of a once industrial neighborhood in rapid transition, while its most public facade renews the political and decorative tradition of mural art in the predominantly Latino Mission district of San Francisco. The experience of the building is largely focused on the visitor's movement throughout the interior, dictating views and experiences of each visitor type, as well as the community's movement on the surrounding streets as we attempt to break down the monotonous façade of the industrial landscape. Submitted to the 2005-06 6th Annual ACSA/AISC Steel Design Student Competition, the Billboard project was designed over the course of a semester and was awarded an Honorable Mention in a field of more than 400 other projects.

Throughout the design process, not only did **form•Z** simplify technical details by speeding up calculations and measurements, it invaluably put language to form, helping us as designers communicate our vision. From the outset, **form•Z** permitted us to defy conventional physical model building and instead rapidly create multiple iterations of our proposed form. The animation potential allowed us to focus on the pedestrian and vehicular experience of the building grounding the project in its urban context; utilizing walk-through animations created a discourse between the desired experiential affect such as the cascading nature of spectator seating toward the pools and the formal moves that could heighten it. Additionally, while our physical sketch models allowed for rough massing and expression, the "digital" sketch model allowed for clarification and the refinement of acute angles and materiality of earlier proposals, often informing future iterations. We found such a dialogue between the physical and digital environments to be rich and productive.

Figure 1: **The billboard facade along Folsom Street.**

The emerging form of the building took the local industrial vernacular as its formal vocabulary, celebrating the historic industrial language of the Mission and Potrero Hill Districts of San Francisco (Figure 6). The initial gesture of the project was a 5° planar shift that aligns the building plan and roof profile due north from the city grid's alignment which was further articulated with saw-tooth incisions along the roof plane aligned with the superstructure, an elegant open web long span truss system supporting the modified saw-tooth roof (Figure 7). Sun exposure was a critical consideration in our design process. The modified saw-tooth roof is not only a formal nod to the surrounding neighborhood, but also a practical solution for reducing glare to swimmers through its northern orientation. **form•Z**'s sun-positioning tool digitally rendered solar azimuth and altitude allowing us to avoid direct sun exposure to the pools, and created renderings for any day of the year confirming that we had achieved the desired sun shading.

Figure 2: **Main entrance.**

Figure 3: **Cafe entrance.**

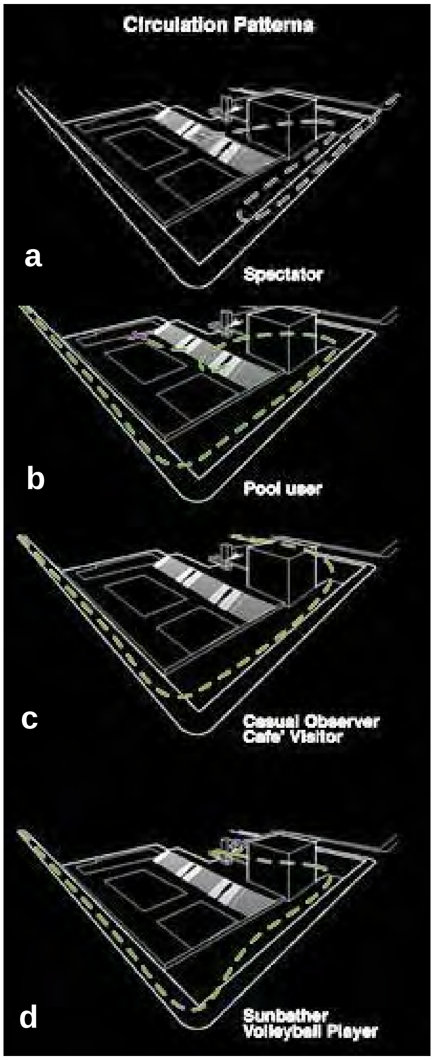


Figure 4: **Visitor circulation patterns.**

Upon completion of the schematic design phase, the design development revolved around two primary organizing principals: repetition and complex angles. The project site, along the busy Folsom Street commuter corridor called for a dramatic large-scale gesture. The goal was to design a façade that had impact at both vehicular and pedestrian scales. We quickly came to the idea that this façade should act as an oversized mural or billboard reflecting the colorful history of the neighborhood's mural arts culture (Figure 1). This move would also enable collaboration with the community and local artists in the design and creation of the mural. The primary billboard structure served as a repetitive structure, echoing the vertical fins found along California highway medians. These fins, while preventing direct sight of oncoming headlights, allow for glimpses with a more acute view angle. The fin-like "super-mullions" reflect the billboards 5° shift in building plan and section-elevation. Here again sun exposure was a big consideration, and the 250' long Folsom Street façade diagonal slope was used to allow light to penetrate the 125' depth of the pool shed while defusing direct glare caused by early morning eastern light. To achieve this new set of design goals, **form•Z** was used to cut through some of the tedium, equally dividing the 250' façade and dictating the placement of the billboard super-mullions and long span truss system. Using **form•Z**'s Boolean operations, we took the larger massing models and began to break them down in order to articulate individual building systems horizontally and vertically represented in the 5° planar shift, its dimensions, relationships to the mullion structure and glazing. The Folsom Street façade's etched graphic imagery is at a scale large enough to be read by commuter traffic, while offering pedestrians views into the aquatic center along the sidewalk through the billboards upward sloping design (Figure 2).

The aquatic center entry draws the visitor up a ramp at the slope of the sidewalk. The lobby floor emerges as a spectator plinth providing sweeping views of the pool and its steel shed. This is the heart of the Billboard project (Figure 11). Our intent was to introduce spectators, at first glace, to the building structure above with its elegant simplicity then dramatically displaying the most exciting event, diving, at the spectator's feet below while offering unobstructed views to all activities from every seat in the aquatic center. The spectator seating then cascades below toward the pools where visitors can access the locker rooms, classrooms and therapy pool. The therapy pool is a glass-encased, autonomous space surrounded by the lobby yet only accessible from the pool level. When unused, the most public space of the building, the lobby, is provided a bird's eye view of the most private space, the therapy pool. As the therapy pool is activated and the room filled with steam, condensation provides privacy from the other building inhabitants; this change in transparency renders the therapy pool private. The therapy pool again takes visitor perception and experience into great consideration. With a ceiling height of 50 feet, visitors could easily get lost in such a space. The therapy pool design intent, as with the pool shed, was to enhance the senses of each visitor through transparency, light, and simple materiality. Our design does not focus on superfluous formal expressiveness, but on experiential intensities. Throughout the project's development we placed an emphasis on the processional sequence of both the approach and progression through the Aquatic Center. The animation capabilities of form•Z allowed us to illustrate study and develop our understanding of this movement and based on the multiple animation iterations we were able to fine-tune the building's programmatic arrangement in order to choreograph its inhabitants' experience.

Again, we exploited form•Z's Boolean operations for rendering perspective-building sections for use on our competition boards (Figure 5). These perspective views better express sectional qualities of the project, creating a more experiential drawing and enhancing the typical two-dimensional building section drawing. Furthermore, material and texture renderings helped bring the building's interior qualities to life in our drawings. form•Z's rendering ability enabled us to clearly communicate our design intent.

As we submitted this project to a national architecture student competition, it was important to us that we used the most sophisticated tools at our disposal. As a design team, we must find a way to take our amazing synergy and vocalize it in our work. While normally we create lucid physical models for in-studio presentations, form•Z allowed us to clearly articulate our design goals digitally when our competition entry boards must speak for us.

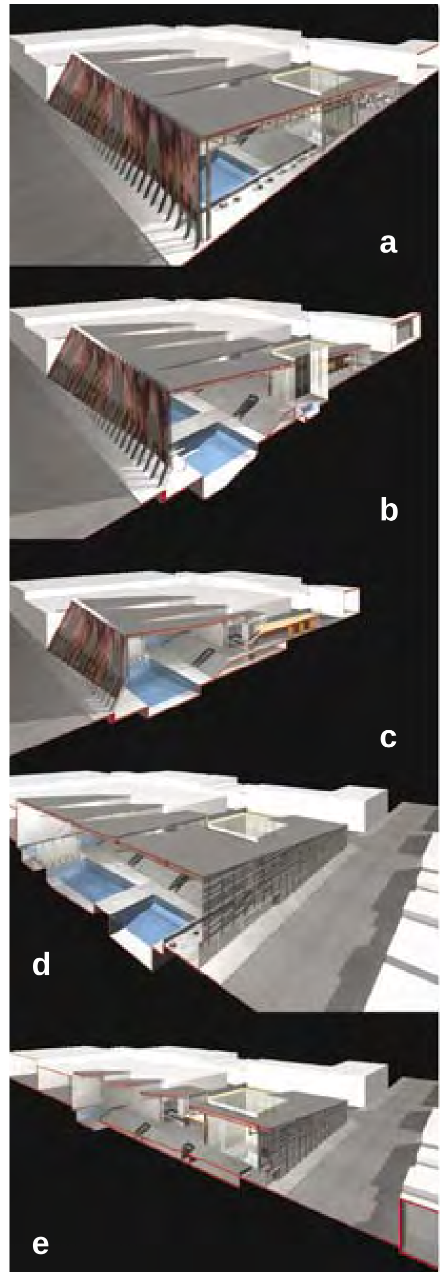


Figure 5: **Sectional perspectives showing spatial connections.**

Figure 6: **The Aquatic Center is located in the Mission District of San Francisco.**

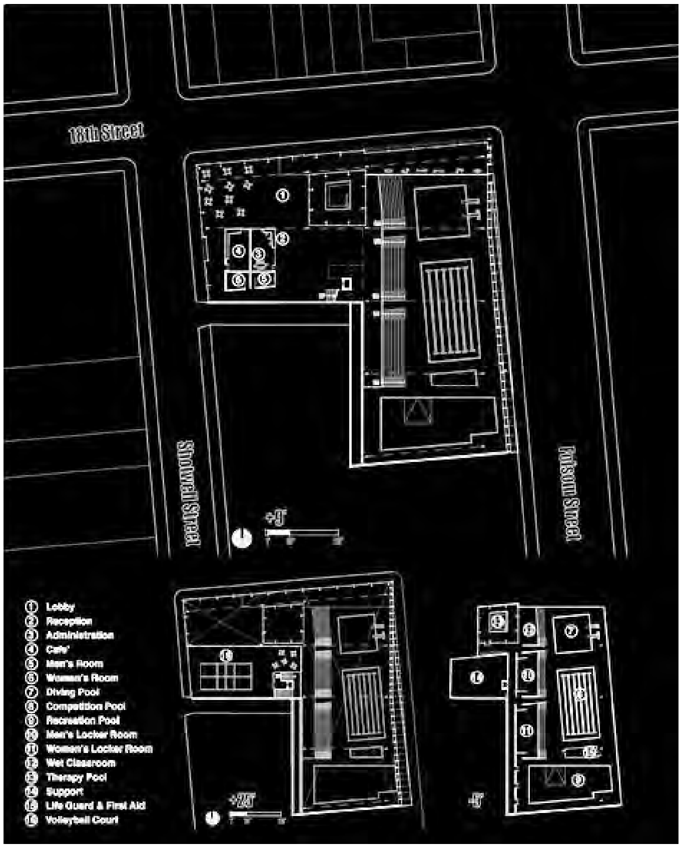


Figure 7: **Site, roof, and lower floor plans.**

Figure 8: **Structure components.**

Figure 9: **Photos from the physical model.**

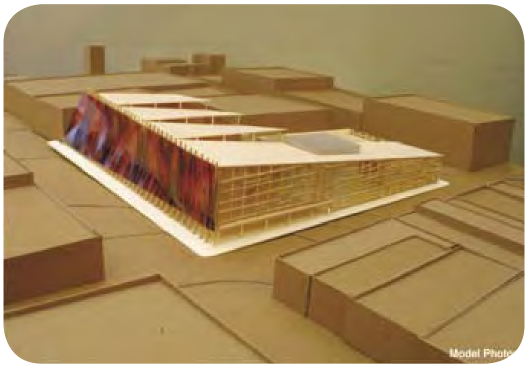
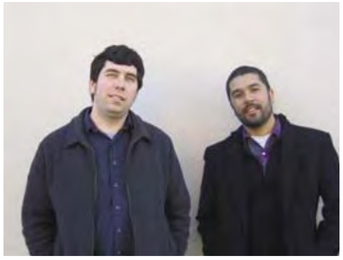


Figure 10: **The physical model.**

Figure 11: **Entrance procession.**



Patrick Flynn and **Joseph Barajas** met while classmates at the California College of the Arts (CCA). In 2005 Patrick and Joseph were part of a four-student design team whose entry to the National AIDS Memorial Competition was awarded an Honorable Mention and published in a book entitled *Emergent Memories: The National AIDS Memorial Competition*. Patrick graduated with a Bachelor's of Architecture with high distinction from CCA in 2006 and is now a Project Designer at envelope Architecture+Design. In 2005 & 2006 Patrick received awards for Excellence in Digital Media and Representation from CCA. In 2005, his entry to the AIA Boston's *In Pursuit of Housing* competition was awarded an Honorable Mention. Before attending CCA, Patrick studied Computer Science at Northeastern University in Boston. Joseph is currently completing his Bachelor's of Architecture and is graduating in Spring 2007. Joseph received the Third Year Book Award for Building Innovation and Design Excellence in May 2005. He is currently an intern at Tom Eliot Fisch in San Francisco. Prior to attending CCA, Joseph studied Interior Architecture at the School of the Art Institute of Chicago.

Miami University
Oxford, Ohio

38N 82W Regional Airport: Processes and Methodology

by James Diewald and Michael Frederick

1. The Project

38N 82W Regional Airport is a one million square feet, 24-gate facility designed as a submission for the ACSA and the Department of Homeland Security sponsored 'Airport Security Circulation' competition[1]. The project was a research-intensive investigation aiming to develop a new paradigm for air travel in the future. The spirit of the project centered upon improving the experience of contemporary air travel.

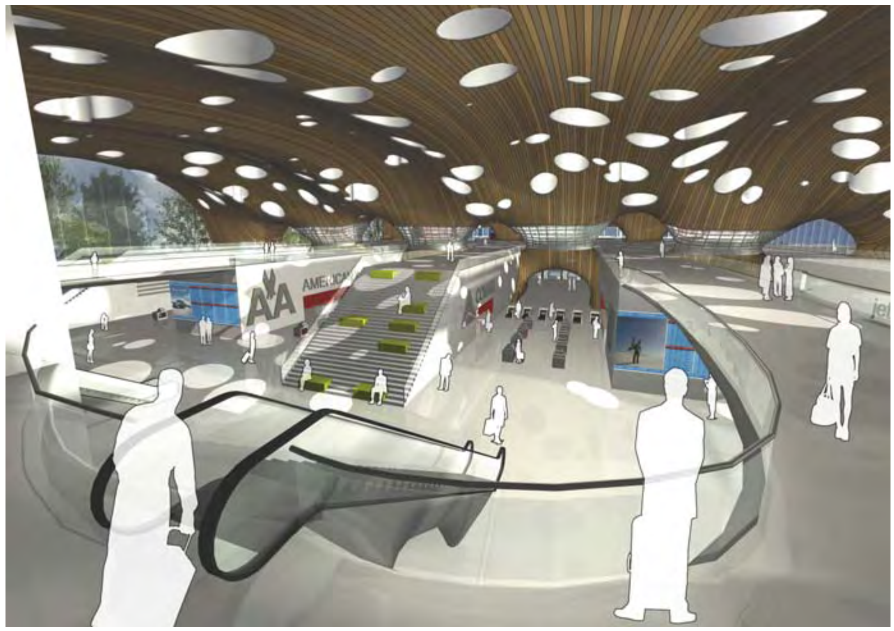


Figure 1.1: **Entry to Ticketing Hall**

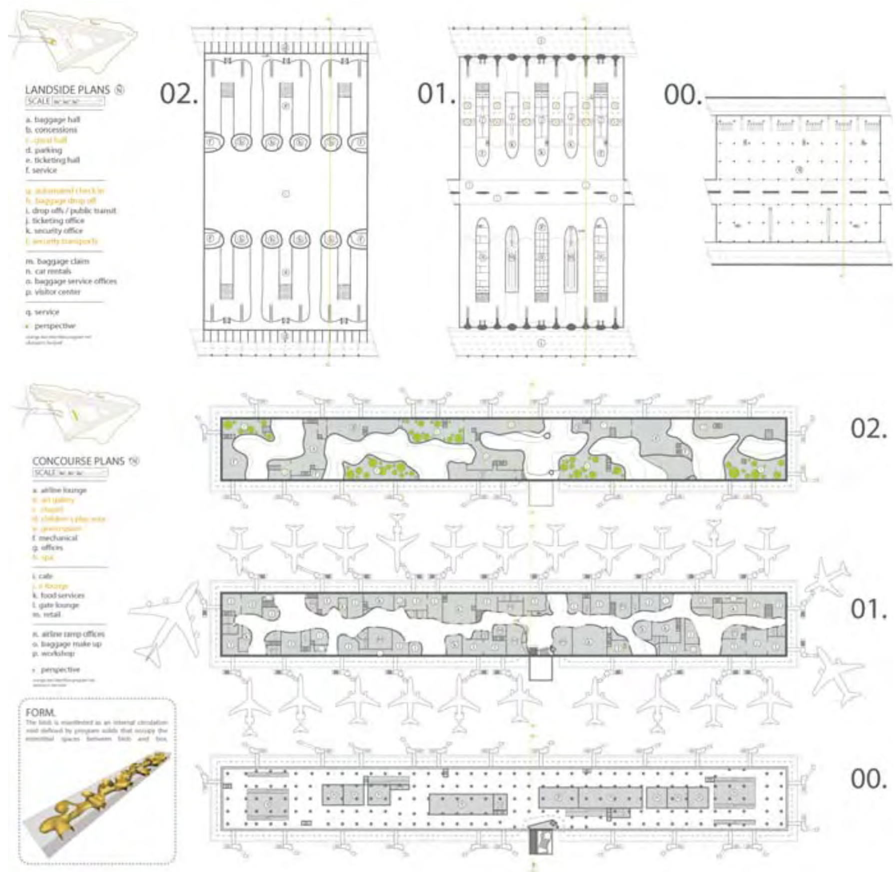
Many of the problems associated with today's airports stem from a boom in airport construction during the sixties and seventies, at a time when planners and architects anticipated neither the passenger volumes, nor the security concerns that are associated with air travel today. The spatial layout of those airports relied heavily upon relatively low security and a reasonable number of passengers to provide a smooth and enjoyable transition from the curbside to the aircraft. The changes imposed by increased volumes and 911 security concerns have forced these outdated structures to the brink. Still, particularly in the United States, these airports do not bear the stamp of innovation. The scars of retrofit after retrofit in an unending struggle to keep up with the times are abundantly visible.

38N 82W Regional Airport attempts to rectify many of the pitfalls associated with contemporary air travel through a number of emergent technologies as well as innovative planning themes. Key initiatives include ecologically sound, or sustainable design principles, a distinctive, legible spatial structure, and a minimally invasive security solution that increases safety and eliminates many of the hassles commonly associated with conventional systems. Beyond the processes and ideas behind the design of this project, we hope to elaborate upon the some of the techniques involved in realizing this design competition submission and more specifically, the benefits of working between a variety of media and software.

Through our research, interviews with airport officials, and personal reflections we identified several core problems with existing airports. One article in USA Today even noted a wish list of features and amenities that would make travel more enjoyable, including fitness facilities, fireplaces, free Internet, and places to nap among others[2]. The problems we discovered were actually quite simple. First, nobody likes to wait in a line, particularly right before an impending departure. Second, the duty free shops and spartan waiting lounges that have come to characterize most US airports have failed to satisfy people's needs and interests. Finally, security solutions, as they stand today, are lacking an adequate level of security and fail to accommodate the massive flows of passengers that currently bombard today's

Figure 1.2: **Baggage Claim**

Figure 1.3: **Ticketing Checkin**



airports. What we need is an airport that does not compromise the experience of travel with security concerns. We wanted to minimize the times spent waiting in lines and make waiting periods more engaging and pleasant all while providing the highest possible level of security.

Taking cues from existing airports, we began to develop a new strategy to address the aforementioned challenges. Linear satellite concourses, like those at the Atlanta or Denver international airports, are highly flexible and efficient and offer a physical separation of program, promoting security. However, the transition from the landside services (baggage and ticketing) to the concourse is interrupted and complicated by long lines, security checkpoints, and an overcrowded underground tram system. To counteract these problems, we merged security screening procedures with transit to the concourse. Multiple smaller, pod-like transporters were introduced to replace the larger underground trams, offering flexible capacities and the ability to function on demand. This unifying idea led us to the production of a number of spatial massing strategies that would ultimately inform the architecture. In short, the landside services adopt a hybrid typology resembling both a railway station and an airport. This space is direct, easy to navigate, and produces a perceptible entry and exit to the airport. The concourse would be reprogrammed to accommodate a variety of amenities including gardens, children's play areas, and a spa among other things that would be arranged along a meandering path we came to envision as a sort of Main Street within the airport.

Figure 1.4: **Security Transporter Unit**

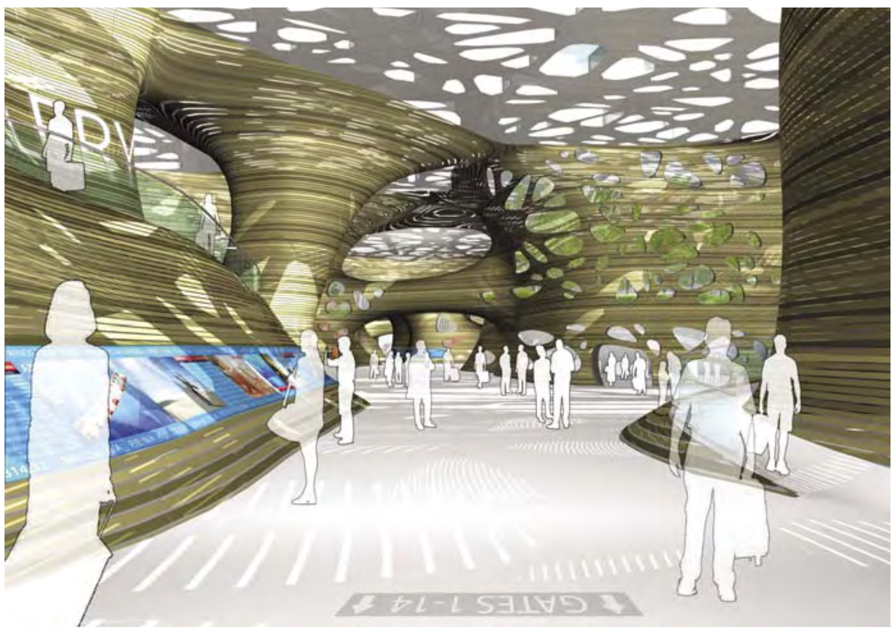


Figure 1.6: **Main Concourse**

Figure 1.5: **Entry to Concourse from Transporters**

2. Notes on Functional Organic Geometries

A functional, easily legible organization of program was necessary to address the needs of the airport, yet the repetitive, mundane geometry of most airports was not something we hoped to recreate. We began our process with simple massing models in form•Z to study and evaluate programming strategies. Using the software allowed us to quickly and accurately 'sketch' ideas in three dimensions. It accommodated the complex programmatic relationships inherent to airport design and planning while allowing for the generation of visuals for presentation and feedback. Figures 2.1 and 2.2 depict the functional diagrams of the landside services that were used to confirm quantitative data, such as square footages, walking distances, and vertical relationships that formulated the groundwork for the development of an architectural language.

As we continued to develop our formal ideas through sketches and additional models, we found that the smooth modeling capabilities of **form•Z** were not best suited for our requirements. We turned to 3DS Max and utilized low poly modeling techniques, commonly associated with character modeling, to produce highly editable surfaces that could be easily and dynamically subdivided for smoothing. 3DS Max, however, failed to provide us with the necessary tools to accurately construct these surfaces and we began a dialogue between 3DS Max and **form•Z** to produce the final result.

The roof structure of the landside services benefited greatly from this synergy. Beginning with a series of sketches (Fig. 2.3), we brought this information into **form•Z** to dimension and scale using the previously developed program massing model (Fig. 2.1). These sketches became the basis for contour lines that established the form of the surface. A triangulated reference cage was constructed in **form•Z** and confirmed necessary clearances, spans, and other information that required accuracy (Fig. 2.4). This reference cage was imported to 3DS Max and reconstructed in quadrangular polygons (Fig. 2.5) and smoothed with the turbo smooth function (Fig. 2.6). Similar techniques were also applied to the interior surface of the concourse (Fig. 2.7).

3. Pixels vs. Geometry

The geometry and appearance of each of the surfaces within the airport was intended to reinforce the directional flow of the system. To further this notion, we utilized a parametric map to simulate bamboo slats, giving the surface a 'grain' (Fig. 3.2). To allow for greater levels of natural light in the ticketing and baggage halls, we decided to pierce the surface

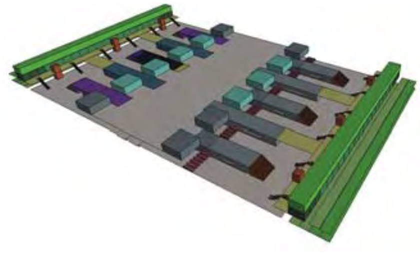


Figure 2.1: **Landside Organizational Massing**

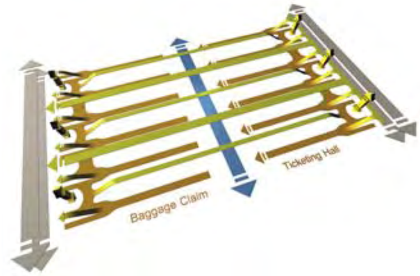


Figure 2.2: **Landside Circulation**

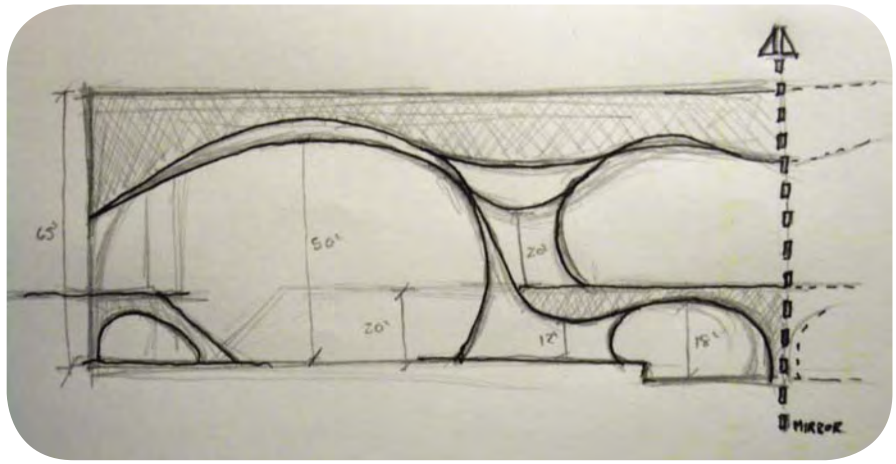


Figure 2.3: **Section Contours Sketch**

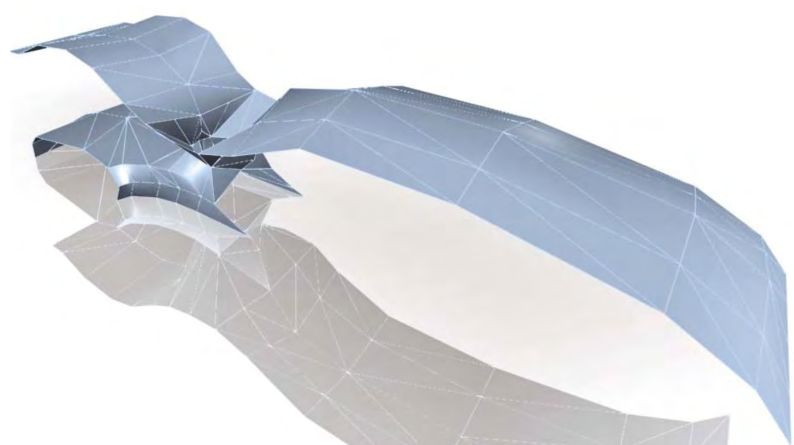


Figure 2.4: **Triangulated Reference Cage**

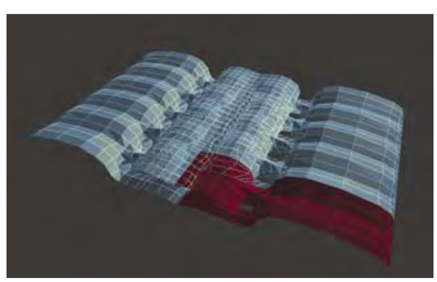


Figure 2.5: **Quadrangular Surface Construction**

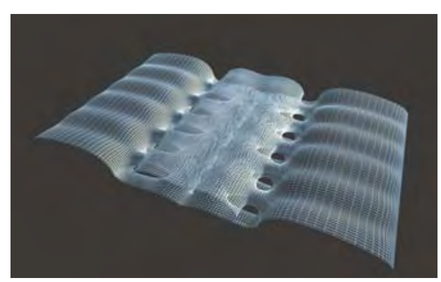


Figure 2.6: **Completed Smooth Surface**

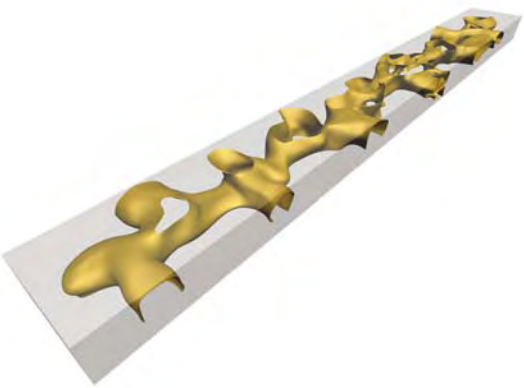


Figure 2.7: **Concourse Surface**

with random circular tubes. Rather than physically modeling this geometry, we opted to produce a transparency map (Fig. 3.1), drastically reducing our rendered polycount and preserving the editable surface. However, when it came to rendering, the surface appeared to be too flat. To maintain the aforementioned benefits, we kept the simple transparency map and constructed 3D solids from extrusions traced onto the surface (Fig. 3.3). These and other elements were rendered separately and later combined in Adobe Photoshop for the final image (Fig. 3.4).

4. Physical Geometry from a Bit Map

The roof and facades of the concourse (Fig. 1.6) presented another modeling problem. We wanted to produce a surface defined by linear structural elements in which the openings became a random organic mesh. For purposes of lighting and physical depth we decided that a transparency map would not suffice and this surface would need to be modeled. Given that we already had a transparency map that we liked (Fig. 4.1), we were presented with a new problem; how do you produce physical geometry from a bitmap? The end product would be planar, so all that

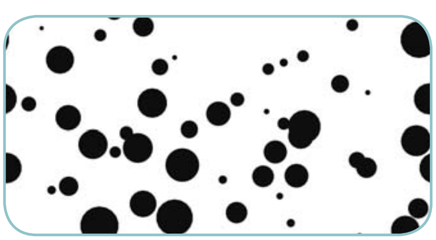


Figure 3.1: **Roof Transparency Map**

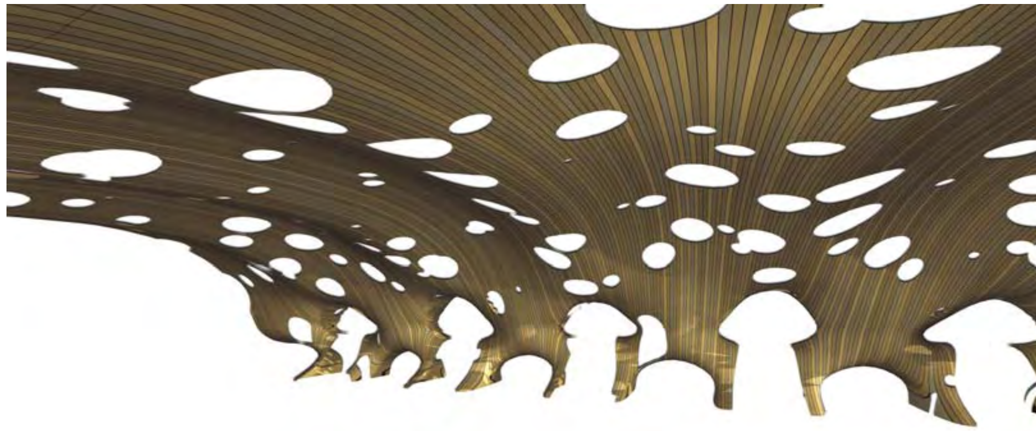


Figure 3.2: **Isolated Roof Surface**

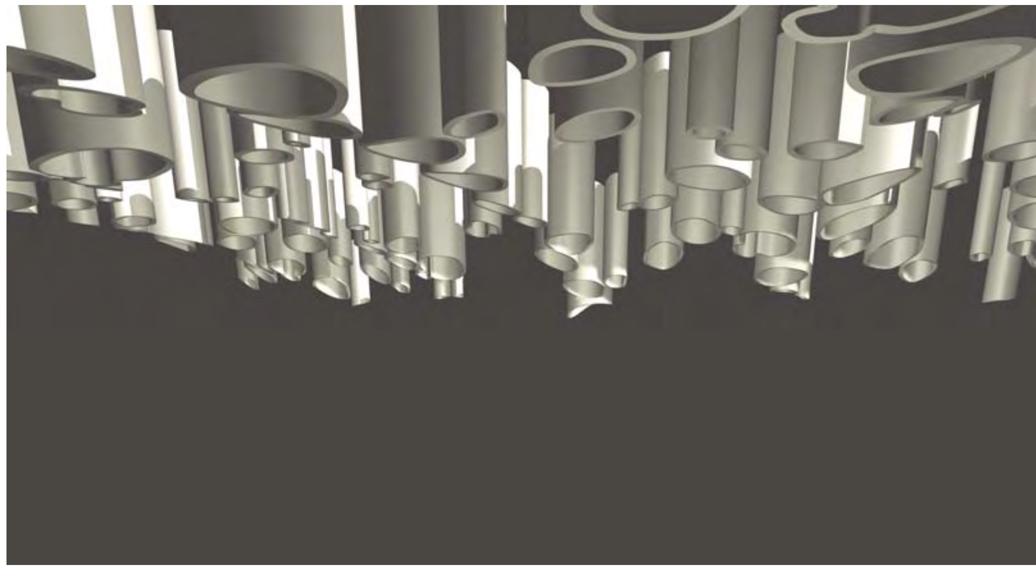


Figure 3.3: **Constructed Roof 'Tubes'**

Figure 3.4: **Completed Rendering**

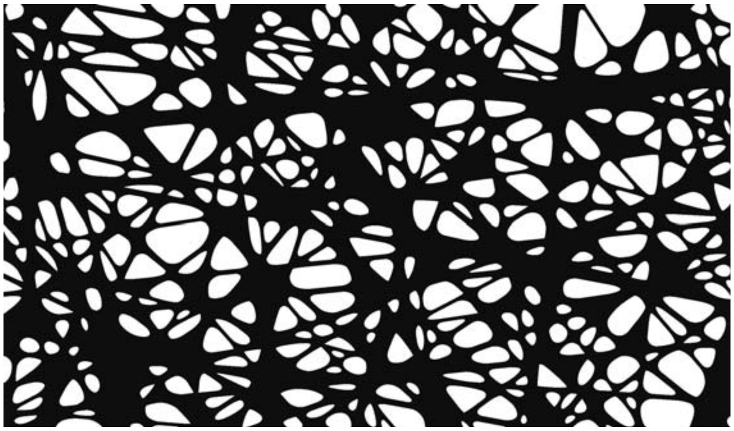


Figure 4.1: **Concourse Transparency Map**

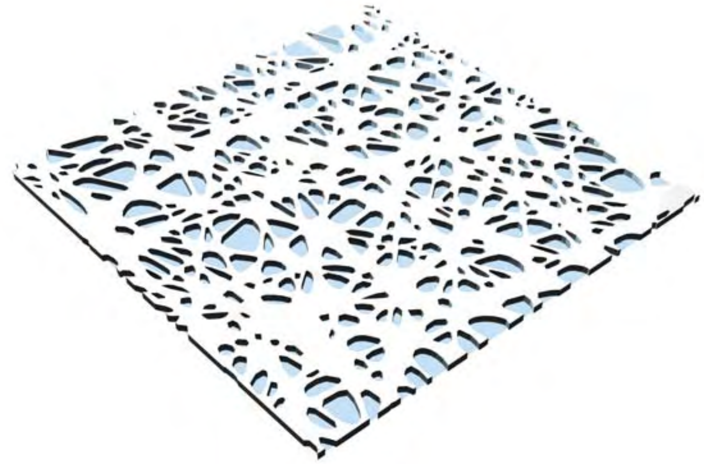


Figure 4.2: **Completed Physical Geometry**

was necessary was a simple extrusion of the bitmap. Instead of tediously tracing each line, the document was brought into Adobe Illustrator and the 'Live Trace' function was used to derive vector data from the raster image. This information was exported as a .dwg and we used controls within form•Z to reduce the number of vertices and control the poly-count of the extrusion. The final geometry was visually pleasing and time effective (Fig. 4.2).

A hierarchy of importance emerged in these approaches. For the landside roof, elements were separated both to enable workable rendering times and to allow for future edits to the surface geometry. For the concourse roof and facades, the dynamic between 2D and 3D, vector and pixel, was employed to allow us to manipulate different ideas within the most adapt interface, in this case Photoshop. Both solutions offered significant time savings and workflow advantages over traditional Boolean modeling approaches.

5. Rendered in Layers

When working on this competition, it was critical to rapidly produce images that quickly and easily conveyed our ideas. There were many circumstances where the time required to complete a modeling operation or rendering forced us to alternate methods. We often found it more helpful to obtain the look or structure of an image by isolating its elements and tackling them separately rather than trying to get the perfect image from a single rendering pass. Similar to Jeremy Birn's process of rendering in layers where one separates highlights, shadows and color[3], we separated distinct elements of the rendering to later be compiled in or produced in Photoshop.

The best example of this process can be seen in the main rendering of our concourse. Here, several elements were combined to give an overall feeling of lightness and resolution that would have been impossible to resolve in modeled geometry under the given time constraints. The base image (Fig. 5.1) provided the lighting, shadows, and colors for the scene on top of which other elements could be added. Rather than using complex mapping procedures to achieve the several openings in the interior surface, they were simply masked in Photoshop to expose the wintergardens and shops behind (Fig. 5.2). The illusion of depth was painted in using Wacom graphics tablets and glass was rendered out separately and layered in Photoshop (Fig. 5.3). The info screen which can be seen in the lower left corner of the rendering was flat mapped to the entire interior surface and masked in Photoshop so it would appear as an integrated element and avoid the procedures associated with placing a decal (Fig. 5.4). These and other processes were combined to gain the qualities we desired in the least amount of time. The separation of distinct elements also offered reduced rendering times and flexibility for each element within the final image (Fig. 5.5).

In our experience, architectural competitions are an exercise in graphic communication as much as in design. The processes of producing work for such an end require the creative manipulation of a variety of resources to accomplish architectural tasks within time constraints. Rather than relying upon a singular solution, it seems prudent to judiciously allocate tasks based on the strengths and compatibility between media. Throughout the production of 38N 82W Regional Airport, the design team utilized a variety of available tools to accomplish the end goal, projecting a positive and optimistic image of the future of air travel.

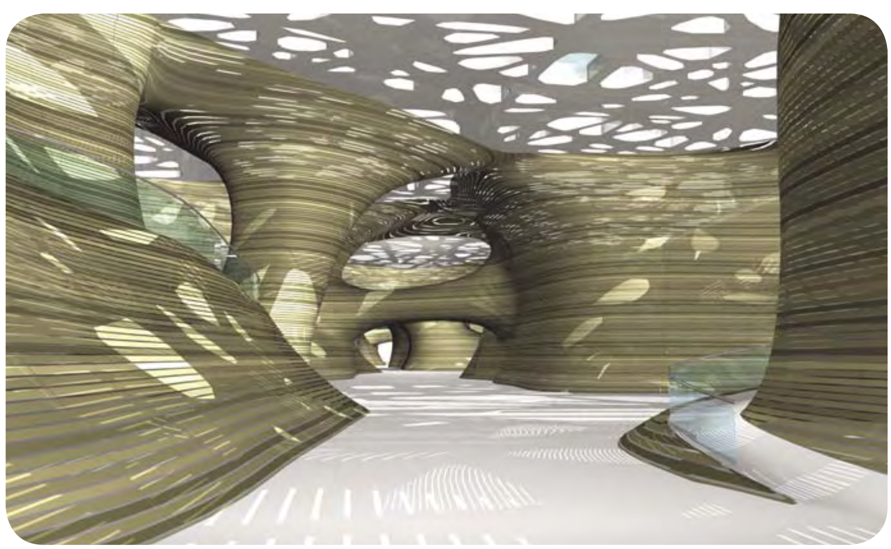


Figure 5.1: **Concourse Base Render**

Figure 5.2: **Photoshop Masked Openings**

References

[1] https://acsa-arch.org/competitions/airport.aspx.

[2] Sloan, Gene. “Piecing together the perfect airport.” *USA Today*. 24 March 2006, LIFE D 1.

[3] Jeremy Brin. [digital] *Lighting and Rendering*. New Riders Publishing. 2000. Berkeley California.

Acknowledgements

We would like to thank: professors Murali Paranandi and Raffi Tomassian for their continued help and support on this project and others; Mark Molen of Yang Molen Design for his insightful critique; Chad Everett of the Cincinnati International Airport for his gracious interview; and all of the friends and family whose support made this project possible.

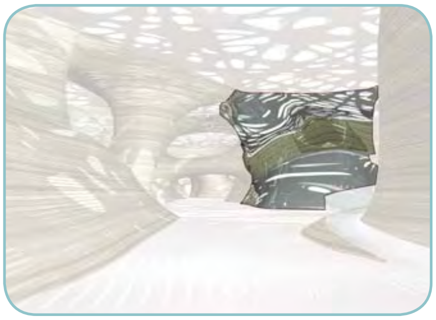


Figure 5.3: **Glass for Reflections**

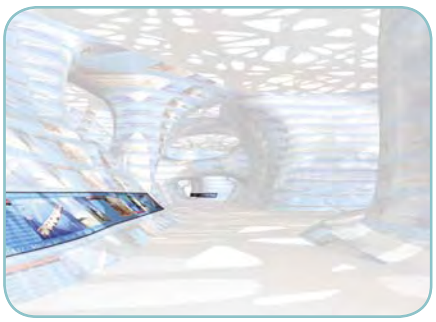


Figure 5.4: **Info Screen Image Map**

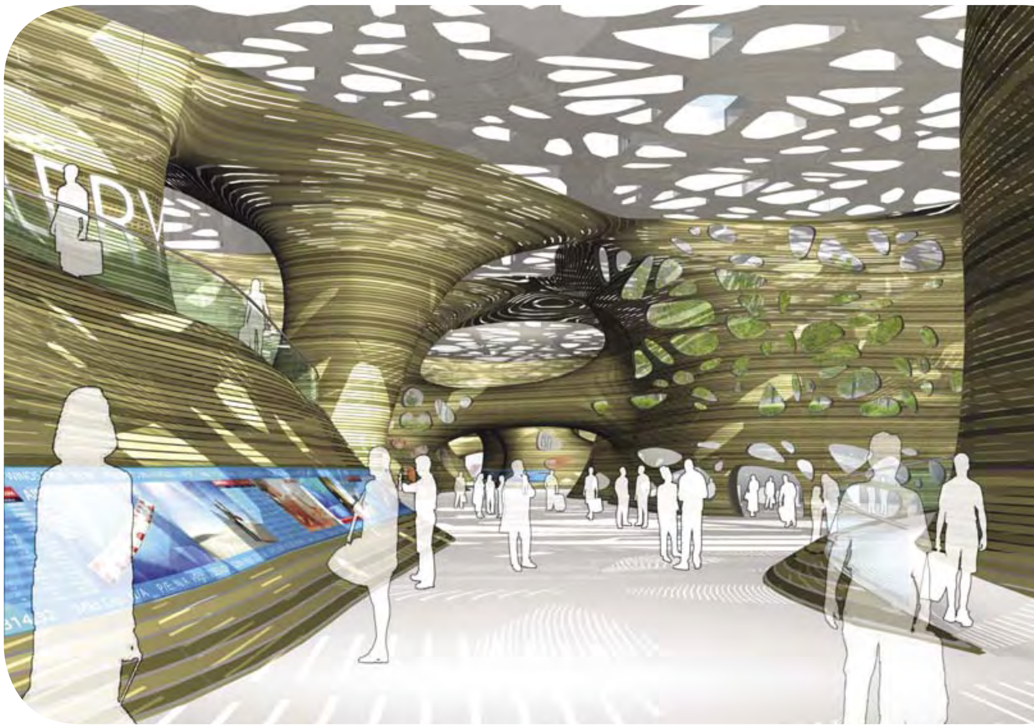


Figure 5.5: **Completed Concourse Rendering**

James Diewald is an intern architect at Behnisch Architekten of Stuttgart, Germany. He is currently working on Harverd’s Allston Science Project, a one million square feet laboratory facility with strong sustainable initiatives. James holds a Bachelor of Arts in Architecture from Miami University, graduating Magna cum Laude in 2006. He has received numerous awards for design excellence and service including the Alpha Rho Chi Bronze Medal in 2006. Most recently, James and colleague Michael Frederick won first prize in the ACSA sponsored, Airport Security Circulation design competition. James’ work has received national and international attention and has been published and exhibited at several venues, including the Script, Beyond Media exhibition in Florence, Italy and the 2006 ACADIA Synthetic Landscapes symposium.

Michael Frederick is an architectural intern and a LEED AP for LMN Architects in Seattle, Washington. Originally from Cincinnati, Ohio, he attended Miami University as an undergraduate and completed his BA in Architecture in 2006. While at Miami, Michael received the Alpha Rho Chi Medal and the Potter Maxwell Excellence in Architectural Design Scholarship. Michael spent his time in academe collaborating on a wide range of design competitions and exhibitions. “38N 82W Regional Airport,” was the winner of the 2006 ACSA Airport Design Competition as well as the winner of the 2006 Form Z Joint Study Award in the interiors category. Michael also was a contributor to Miami University’s 2005 entry that received honorable mention for the EPA’s P3 Sustainable Design Competition. Michael has jointly exhibited work at the ACADIA 2006 conference as well as collaborated on the design and production of an exhibition that was part of the Image – Beyond Media Exhibition in Florence, Italy in 2005. Both exhibits showcased important design methodologies, exploration of sustainable principles, and integration of emergent technologies such as Building Information Modeling.

School of Architecture,
National Technical University
Athens, Greece

From representation to (abstract) form generation

by Anastasia Pechlivanidou-Liakata
with Teaching Assistants Stelios Zerefos and Tina Mikrou

Student work by Dimitris Sotiropoulos (8th semester 2005)

The work presented in this article is an example of the dynamic relationship that can develop between a software tool and its user, which disproves the notion that modeling software is merely for representation and shows instead that the exploration of modeling software as a generator of form can become a powerful factor that leads to creative design.

The student carried out his investigation within the context of an introductory to 3D digital modeling class for students of the 8th semester of the Master of Architecture program. The class was structured in such a way that the digital modeling tool and techniques were taught and used not only as a descriptive medium of architectural forms, but most importantly as a means for investigating spatial, formal, structural, and perceptual questions. Within this framework, students were asked to build a digital model of their major project in the design studio of the previous semester (studio tutors: N. Marda and K. Moraites), which had continued into the current semester, with an emphasis on structural, interior design, and detailing aspects. The two classes were not required to be sequential, but the majority of students took the opportunity of adding a new powerful tool to their design arsenal and elected to take this course.

This year's major studio dealt with the study of a multifunctional cultural building within the dense urban fabric of the harbour city of Piraeus, which is close to Athens. The main target of the student's proposal was to design a building that can attract people not only during the morning hours, which are characterized mainly by the intense trafic of the sea transport companies' employees, but also at night, when there is less activity and the coastal zone is desolate. To achieve this goal, the program of the building included a variety of functions such as a cinema, a video club, a library, a café, a restaurant, a bar, a gym, a gallery, and an exhibition area. The desire to organize a diverse multitude of users and uses, not always compatible with each other, within a common shell led the student to experiment with the idea of "folding surfaces". These aim at achieving morphological and functional unity, while creating an impression of continuity, as the building deploys at several different levels. The movement toward and inside the building complex is guided by the undulating surfaces that not only define closed spaces but also support the continuous ascending movement within the building. This was an interesting project within the framework of a studio that employed rather conventional media, namely sketches, drawings by hand or computer, and cardboard models (see figures 1-3).

Figure 1

Figure 2

From this point on, the student's thinking transformed from an actual representation to an abstract conceptualization. This process went through three stages. The first was the construction of the digital 3D representation with the use of **form•Z**. As the student had already reached his basic design decisions, he concentrated on developing his digital "interpretations," which included renderings, detailing, as well as additional experimentations with alternative schemes for lighting, color, and materials (figure 4).

Figure 3

During the second phase of interior detail design, the student places his emphasis on the dividing panels (of an undulating form) that define the closed units within each floor (such as the sanitary spaces). The student enjoys accentuating reflections and shapes that can intensify them. He discovers that the shape of a dividing cell made of a continuous metallic surface in the plan, offers intensely deformed reflections (figures 5-6). After the completion of these stages, which satisfied the course requirements, the student decided to further his research, and I quote his own words: "*The 3D model of this project was my first model using* **form•Z RadioZity***. The potential of continuous surfaces occupied my mind after this project was finished. … I wanted to discover more about the aspect of the form and how this idea could go further using 3D modeling. So these models attending the main project are my experimental work, on a form based level, and they are in a way a continuation of the first project*."

Figure 4

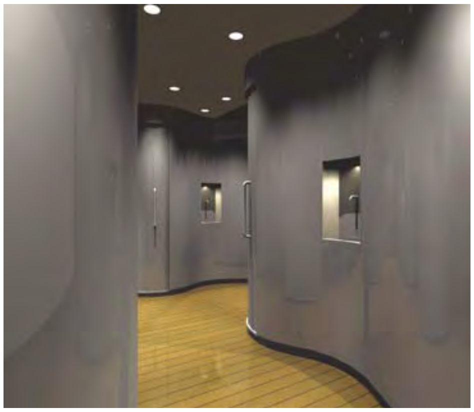
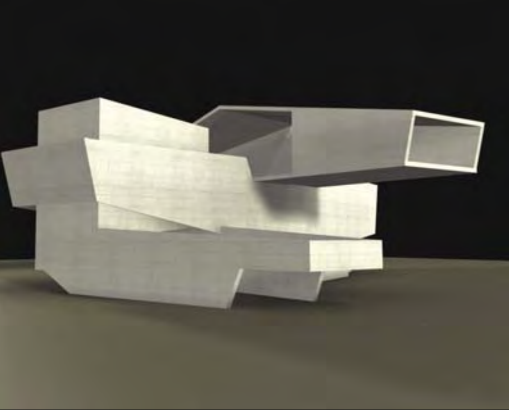
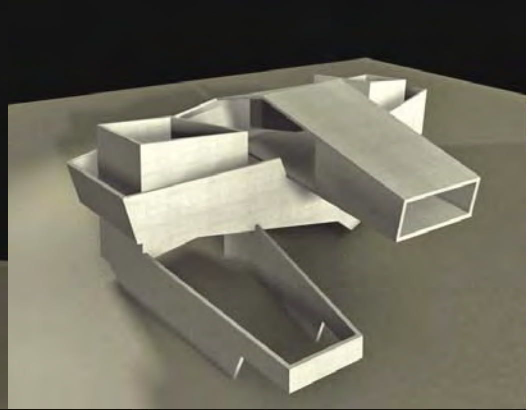
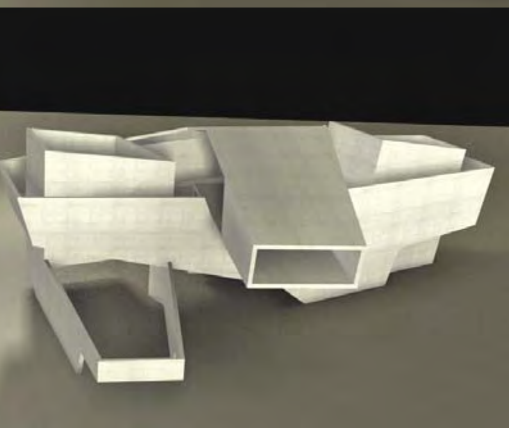
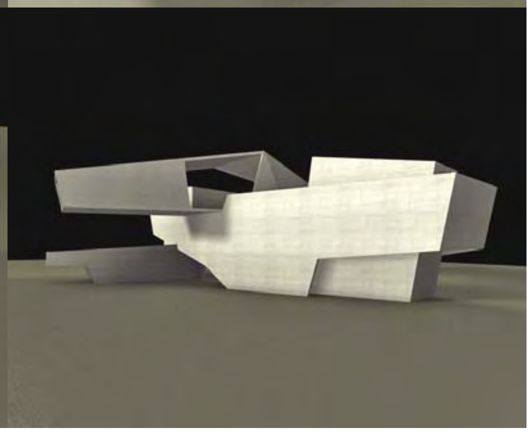


Figure 5

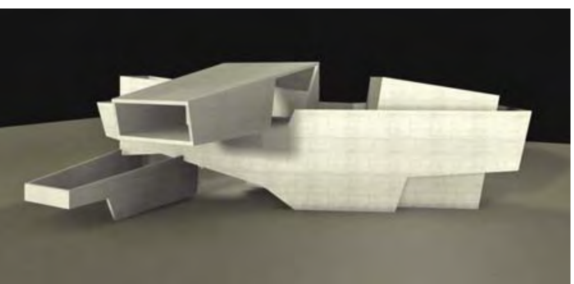
Figure 6

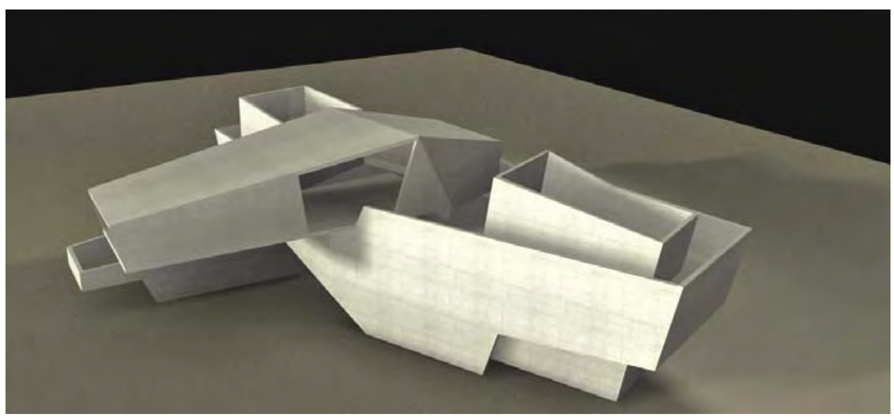
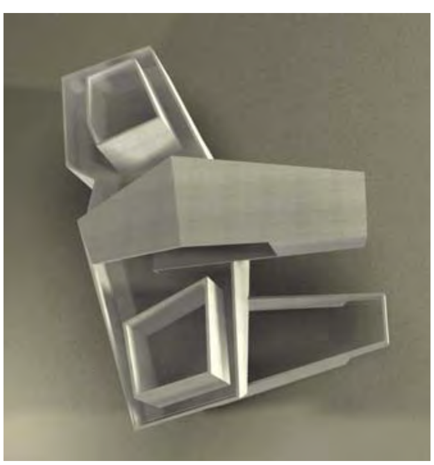
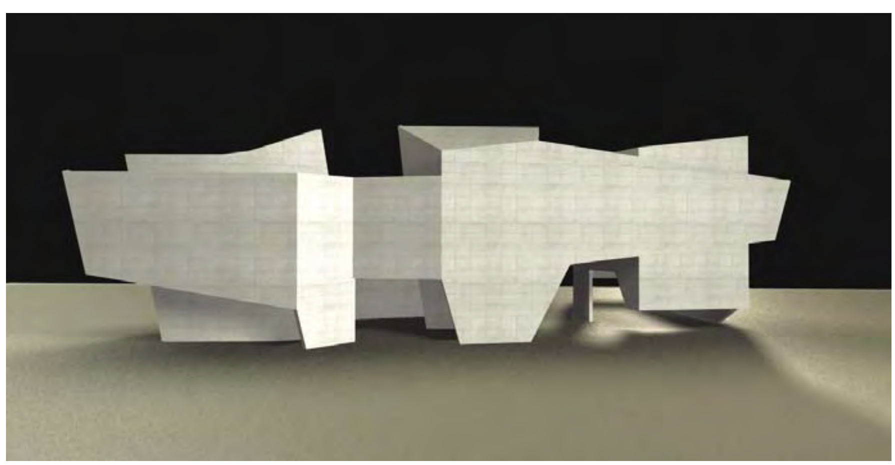





This is most interesting because it is a direction the student chose on his own and was not suggested by the class. It stemmed naturally from his own thinking and it represents an endeavor intended to test his ideas. The result was the following three small research projects on form generation, which are illustrated by a series of sketches and renderings, step-by–step.

Research Form 1

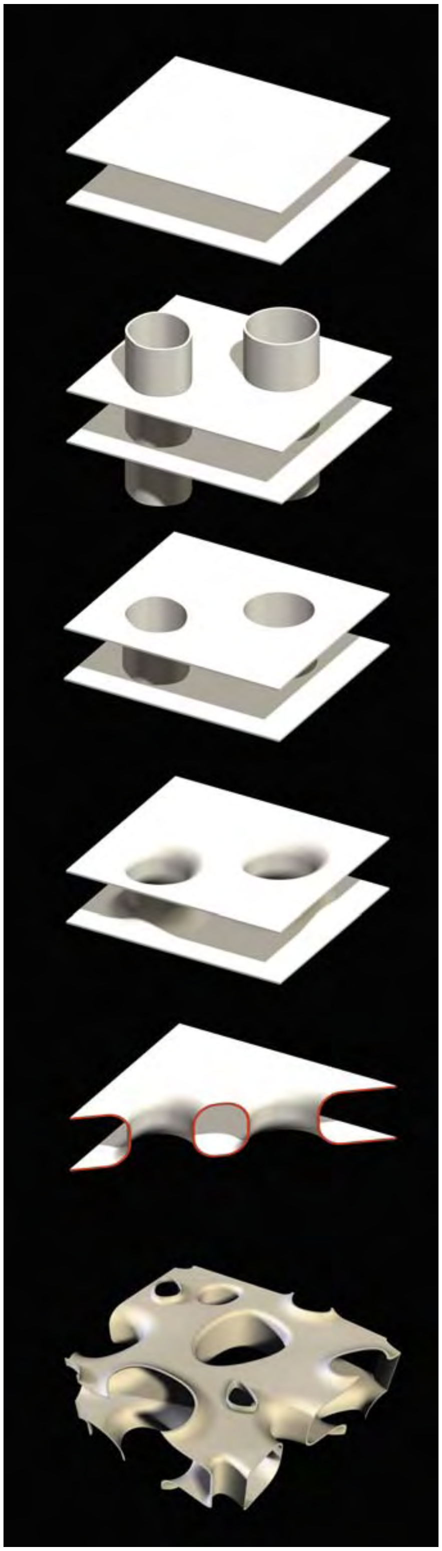
To create this form, a folding surface is used, which is divided into more surfaces that are again folded so as to define different spaces. This project relates directly to the initial studio project, but the surfaces are treated more freely (see images on this page).

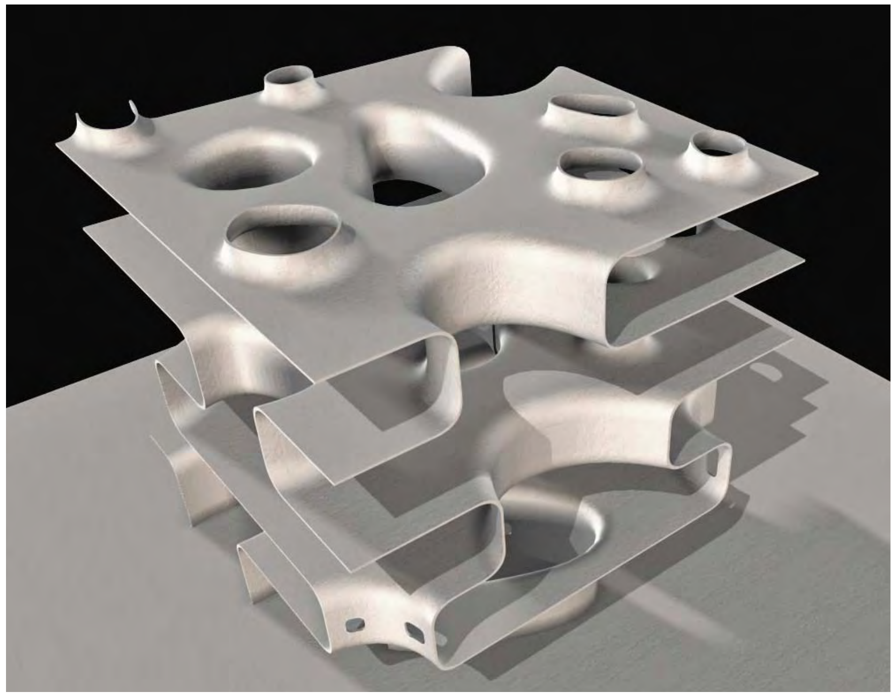


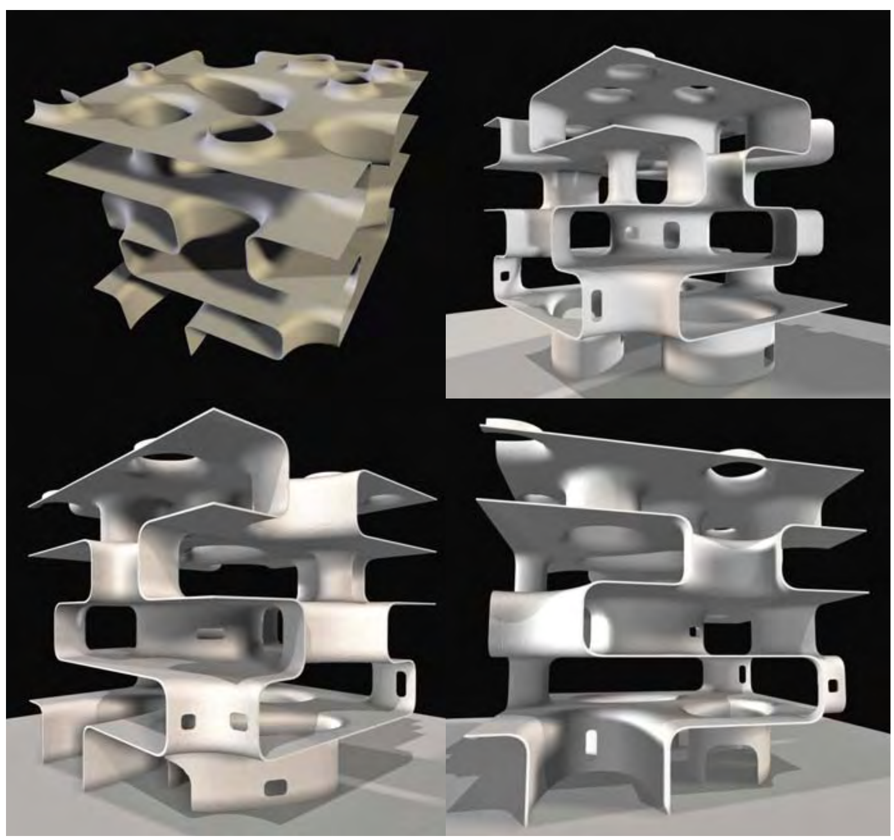




Research Form 2

This research project is about a four-story structure characterized by an organic relationship between its horizontal surfaces and vertical tubular elements that "grow out" of the surfaces. This happens in such a way that one seems to evolve from the other through some kind of a transformation. In a real building, the vertical elements could be nodes of vertical communication or lighting (see images on this page).

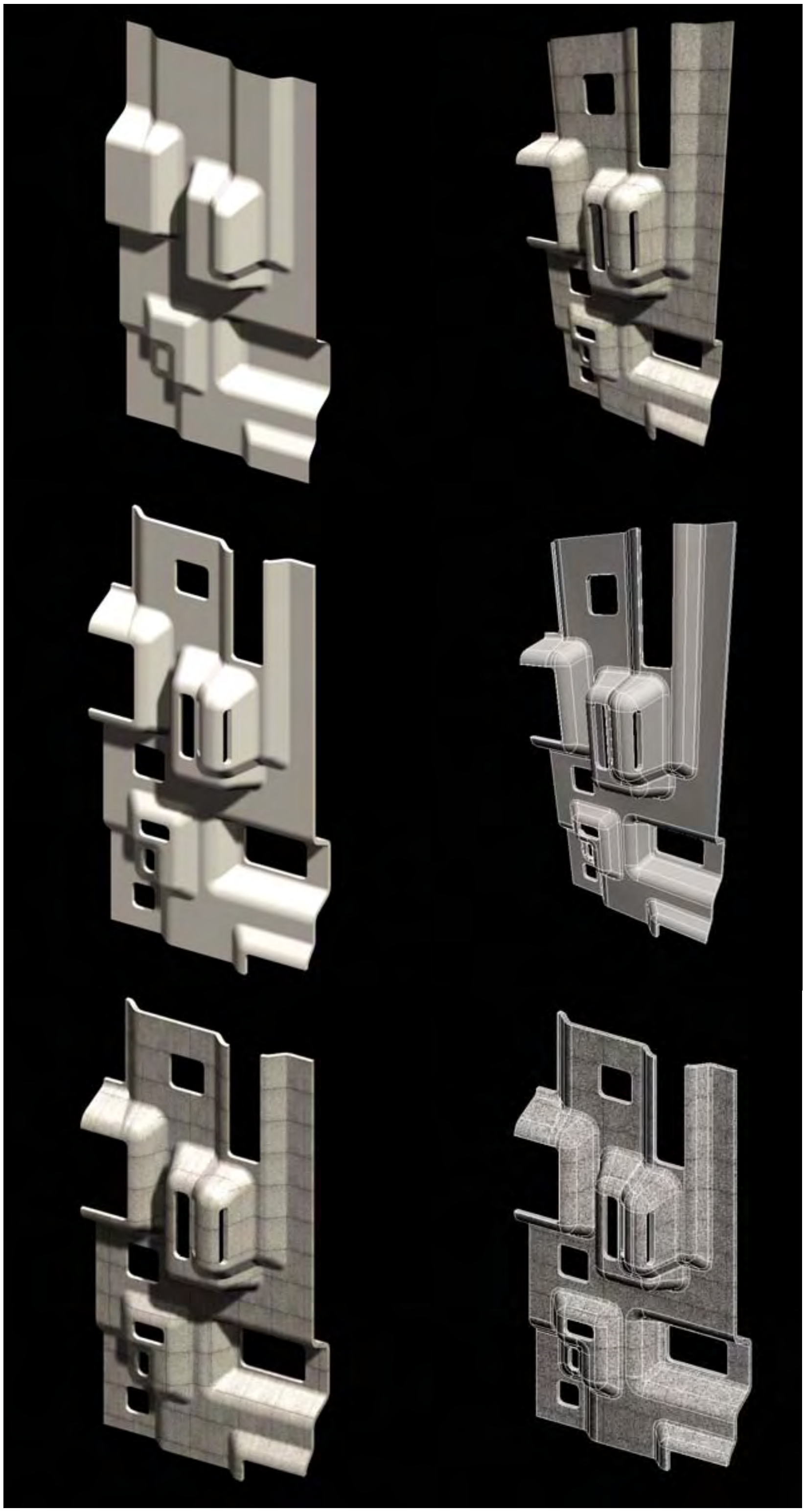


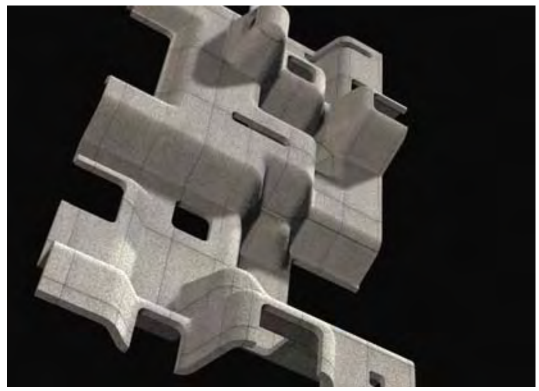


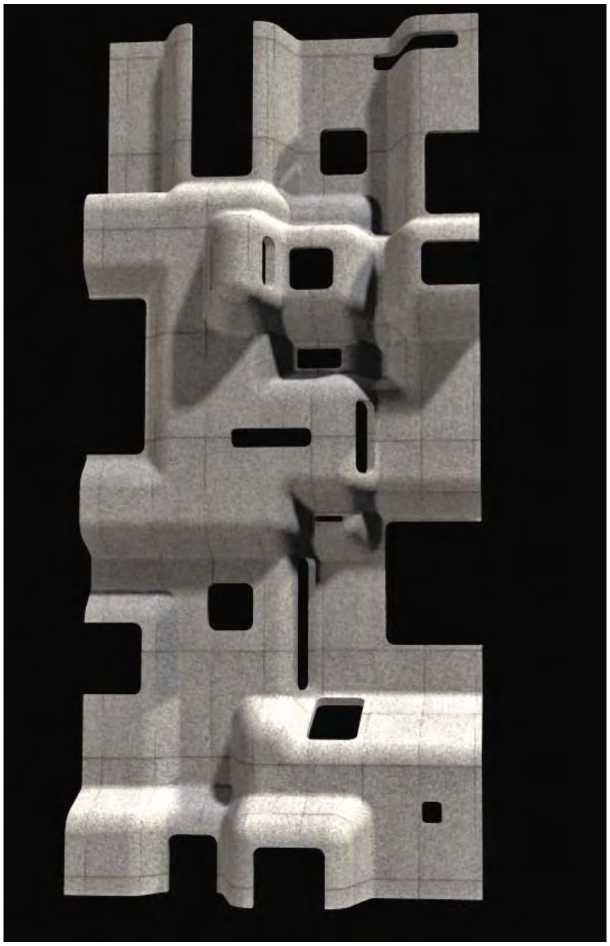


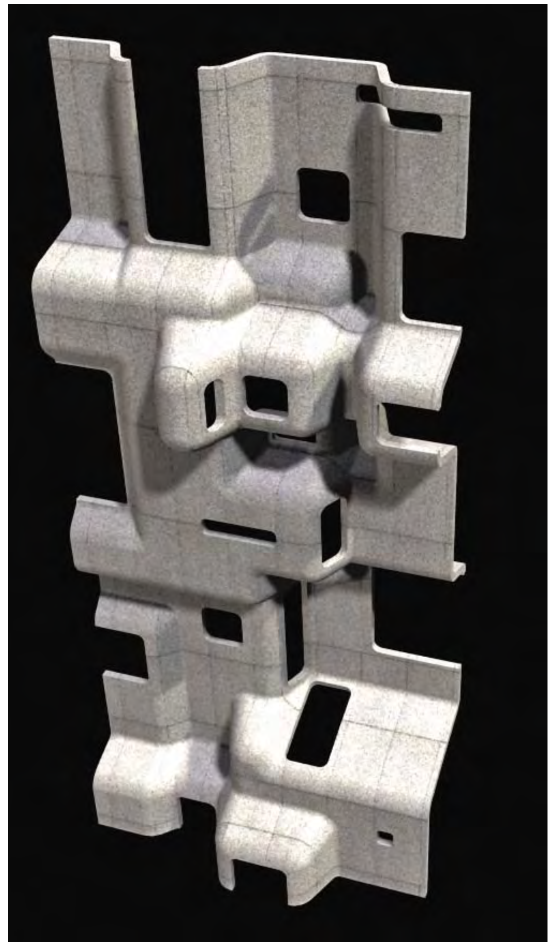
Research Form 3

In this project the surface of the skin of a building is exposed to forces. These forces are perpendicular to the surface of the façade and push or pull points of the surface with different force intensities. This results in deformations, which are subsequently smoothed out, producing a visual effect that is organic rather than with rough edges. At the end openings are added to the planar portions of the deformed surface (see images on this and the next page).









It is worth mentioning that Research Form 1 was not too abstract as it was still related to the initial idea of the student's design project. The intention of the student was to use the new software to learn more about folding surfaces, to discover more about their properties, and to re-evaluate the initial process using his new knowledge.

It is also worth observing that, within the limited time at his disposal, the student prefers to depart towards a research task that is more abstract and also more intriguing. By doing so he uncovered the great power of the digital tools and their unique ability to give visible form and physicality to a virtual entity. With the spirit of a craftsman [1] he follows the intelligent and playful character of a project that lends itself to improvisation and produces a useful result [2].

"*Ultimately the computer is a means for combining the skillful hand with the reasoning mind. We never had such a tool… At the same time computers let us turn the tables - to apply something of what we know about using tools to achieve richer symbolic processing. Metaphorically they let us get a hold of our ideas. Concepts become things we can't touch yet, but already we can look at them, and work on them as though with hand-held tools…*"
(M. McCullough, *Abstracting Craft*, p.81)

For the educator the above case can offer a motive for reconsidering the power of the software, which may cause him/her to revise his/her teaching method and approach. We know that new thinking and new tools may go together, but only rarely are an altogether new tool and an altogether new task invented simultaneously. Usually a new tool is employed to do things in the old well practiced fashion, whereas a new task is usually performed by means of existing tools. Thus, once again is confirmed that invention and innovation are most often gradual.

References

[1] MacCullogh Malcolm, *Abstracting Craft*, The MIT Press, London, 1998.

[2] Stickley Gustav, "The Truth About Work", in Sanders, ed., *The Craftsman - An Analogy,* Santa Barbara, Peregrine Smith, 1978.

Anastasia Pechlivanidou-Liakata is professor at The School of Architecture of the National Technical University in Athens. She is teaching Architectural Design. Founder and director of the Simulation Lab of the School of Architecture since 1998, she introduces digital design studio in her elective courses. Her research and post graduate classes focus on issues of perception and behaviour within digital environments. Co-author with Ioannis Liakatas of the book under print "The landscape of inhabited space." During 1985,1994, and 2004 she has been visiting scholar and professor at diverse universities in the States. Private Practice as Ioannis Liakatas & Anastasia Pechlivanidou Architects & Planners with more than 40 distinctions in architectural Pan-Hellenic and International Competitions (first prizes for the second Pan-Hellenic Competition for the Acropolis Museum, the Kalamata Municipal Cultural Centre, Convention Centre at the International Olympic Academy in Olympia) the two latter are built. She studied Architecture at the National Technical University in Athens, 1969 and took her MA degree at The School of Architecture and Urban Planning, UCLA, 1980.

SITES OF MEMORY MUSEUM OF MEMORY:

Digital Foundations at Clemson University

by **Ronald Rael**

The Foundation Level studios at The School of Architecture at Clemson University have employed the concept of **digital foundations**, a means by which students are taught the fundamentals of architecture by drawing, modeling, fabricating and representing using the computer as a primary vehicle in those explorations. With careful attention to elucidate the physicality of the material, spatiality, context and a connection to the body through the use of digital processes - processes that can often displace one from those actualities, students work back and forth between the digital and the analog. Models and drawings built in the computer leave the digital world to find a home in the physical world allowing students to explore making through casting, assembling and analysis. Material explorations in the physical world are invested in the digital world for further examination. Bolstering this pedagogy is the Digital Design Shop, which includes a laser cutter, 3D printer and CNC router. By the sophomore year students have been exposed to a broad cross-section of digital modes and methods of design thinking and are extremely capable of modeling, fabricating and representing in both the digital and the analog using their digital toolkit. The inclusion of **form•Z** into the students' palette as the chosen modeling tool for foundation learning was because of its ability to model, render and easily integrate with CAD/CAM equipment.

Within this pedagogy, a sophomore studio investigated three projects: Sites of Memory, A Museum of Memory, and a publication, The Ninth Ward, that examine the post-Katrina landscape of New Orleans, specifically the Ninth Ward. By proposing a series of site-specific installations that raise critical questions of how one builds in this ravaged landscape, especially as it pertains to the memory of the city whose physical presence is absent or radically altered. Because the City of New Orleans and its neighborhoods are built, in large part, upon their relationship with the water and this gives the spaces of the city distinctive meaning. Food, culture, the port, the historic arrival of the distinct cultures, the cemeteries, and the architecture can all be seen as shaped by the forces of water. Decay, growth, destruction, and construction prompted by hydrological forces are all components of both the aesthetic and material meaning of the fabric of the city.

Sites of Memory

Sites of Memory is a project that explores the relationship between water and the making of architecture through the examination of transformative and temporal material responses to water relative to the dynamics of "fluid" materials through casting and form making. The outcome of this investigation is the design, construction, and installation of a Hydrocache – a location specific architectonic artifact, a gift to the Ninth Ward, that marks and contains essences of memory relative to material responses to water and location. Each Hydrocache is constructed in large part of materials whose properties are shaped by a transference from liquid to solid states through form-making and casting with materials such as concrete, acrylic resin, latex, rubber, aluminum, and bronze.

The design for each Hydrocache was created using **form•Z**. Unfolding, contouring, milling, 3D printing, and laser cutting were the primary vehicles for extracting the information from the computer and into a precise, site-specific model at 1:1 scale. The examination of material and time allowed for students to question and re-investigate how their digital models could be fabricated in the physical world. The forces of water over time, such as flooding, rain, humidity, and fog transform the Hydrocache, after being inserted into a specific location in the Ninth Ward. Imbedded into and stored by each Hydrocache, exists a prescribed or/and indeterminate material memory that responds to forces of water, such as swelling due to absorption, rusting, cracking, drying, and molding. The Hydrocache marks specific Sites of Memory that reflect stories shared by residents who were displaced by Hurricane Katrina. The locations of the Hydrocaches are mapped with using a GPS device and presented via Google Earth and Frappr.com, encouraging visitors to the neighborhoods to raise awareness of the tragedy inflicted by Katrina.

Museum of Memory

Museums are important institutions that record the memory of cultural transformation. Occasionally, this transformation is a result of human tragedy and many museums house a collection of artifacts, images, text, and art produced in response to a particular period. Also, museums are often sited in the contexts of the event, making a visit to these locations even more powerful. The Auschwitz-Birkenau Memorial and Museum, housed in a concentration camp is one example of this. In addition to visiting the actual camp, one can see the examples of property collected from Jews brought to the camp assembled en masse as a curatorial vehicle to explain the scale of the tragedy. A room filled entirely with eyeglasses, another filled with human hair, and another with prosthetics, all different sizes and for different sexes, recall the memory of the occupants of the camp. The Vietnam Veterans Memorial by Maya Linn, which contains the names of every serviceman who died during the war in chronological order, offers a history of the event through occupation of the memorial itself. Offerings left at the memorial, of which National Park Service and the Smithsonian Institution have collected an estimated 30,000, are now on display in an exhibit separate from the memorial itself, reinforcing the preservation of the memory of those who lost their lives.

The purpose of the Museum of Memory is two-fold. First, the museum is to serve as a place where the history and culture of the Ninth Ward is celebrated. In addition, the grounds of the Museum of Memory will serve as a memorial to the residents of New Orleans who lost their lives as a result of Hurricane Katrina. The Hydrocache and its latent potential are the catalyst for the architectural proposal. Students drew from the material, procedural, memorial, and formal responses to the site and reconsidered them in their museum proposals. Programs such as a Memorial Water Garden, Fats Domino Collection Gallery, and photography gallery were included in the Museum to question relationships between the ephemeral and permanent as they pertain to this historic community along the Mississippi River. In this case water, communities, structures, and culture can be seen as both permanent and temporary. The questions that emerged from siting the installations in the Ninth Ward continue in the discussion of siting the Museum. Material, circulation, and form also have direct connections back to the Hydrocache. Like the Hydrocache installation, the Museum itself must mark previous floods and respond to impending floods that are certain to impact the area.

Digital processes continued to be important in the development of the Museum of Memory. The refinement of casting, the physical production of complex geometries that presented assembly sequences or formal and spatial solutions and digital modes of physical output from the 3D models and their pertinence to the program were explored. Material was also again heavily considered, extending their reaction to water to include reactions to light, time and occupation.

The Ninth Ward

The final culmination of the design studio was the production of a book that presented the projects Sites of Memory, Museum of Memory as well as a series of photo essays that document the present condition of the Ninth Ward at the time the studio took place. Using **form•Z**, the studio spanned the processes of design, fabrication and finally representation through the digital renderings of the projects that are found within the book.

Students in the Class

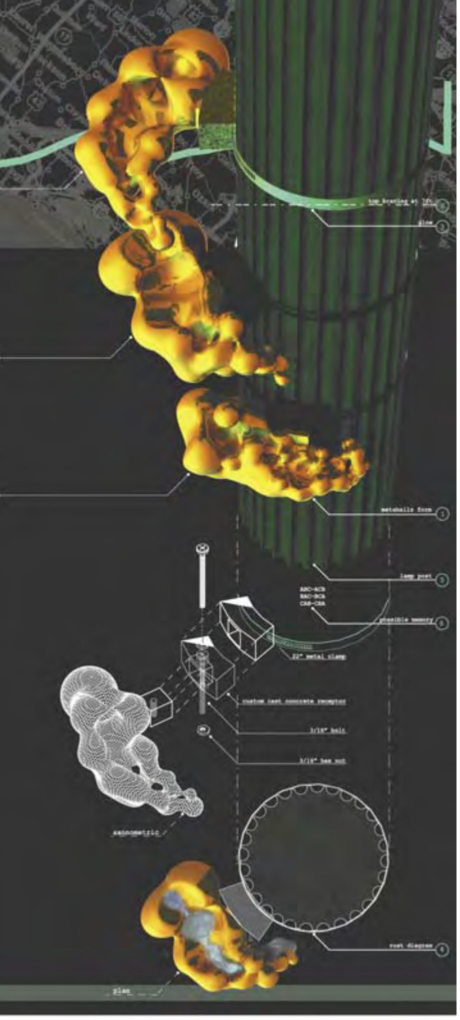
The students who participated in the project were:

Rosalind Ashburn,
Brad Baxley,
Sara Ashley Brown,
Amanda Carter,
Tony Cates,
Beth Copelan,
Robert Eleazer,
Benjamin Felton,
Janis Fowler,
Mark Gettys,
Blane Hammerlund,
Clifford Hammonds,
Shana Hyman,
Joseph Lane,
Jeffery Lowder,
Matthew Rhodes,
Eulanda Rogers,
Nicholas Svilar, and
Broderick Whitlock.

The studio was directed by the author.

More information can be found at: http://www.clemson.edu/caah/architecture/9thward/

Ronald Rael is the Co-Director of the The Charles E. Daniel Center for Building Research and Urban Studies in Genova, Italy and for four years the coordinator of the Core Architecture Studios. Prior to joining the faculty at Clemson he was a member of the Design Faculty at the Southern California Institute of Architecture in Los Angeles and a Senior Instructor at the University of Colorado at Boulder. He earned his Masters of Architecture degree at Columbia University in the City of New York where he was the recipient of the William Kinne Memorial Fellowship.



LAYERS OF MEMORY

North Dorgenois Street & Alvar Street

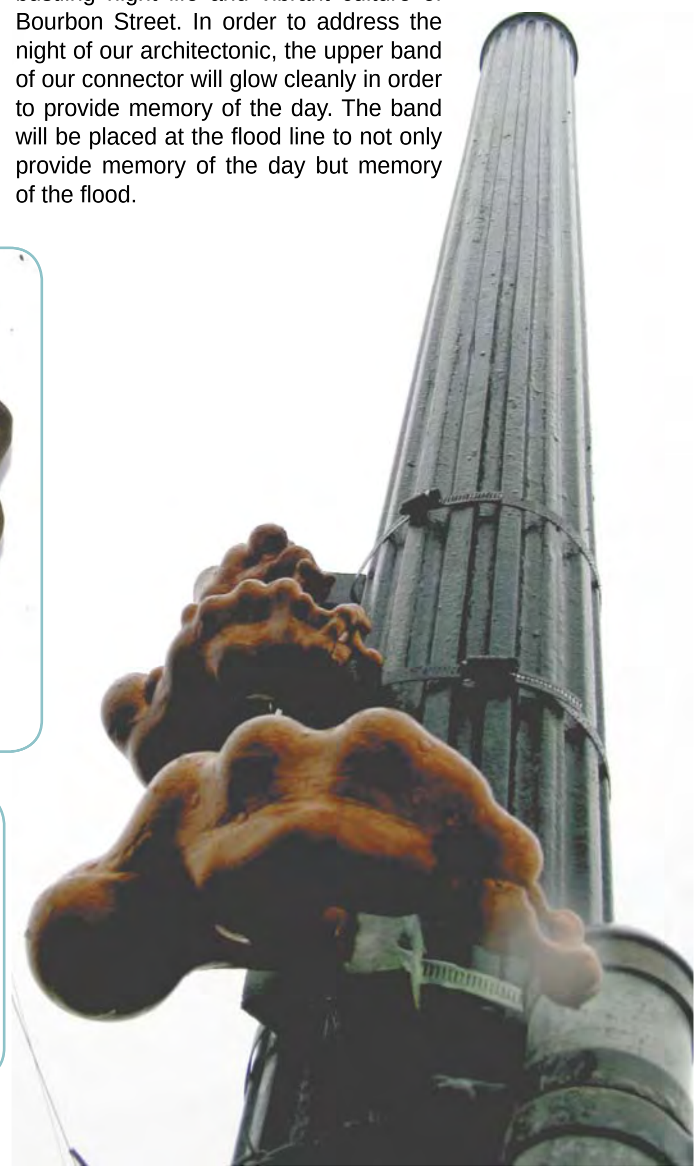
N 29°58.818' W 90°01.928'

by **Tony Cates, Mark Gettys, and Robbie Eleazer**

Water has a propensity for both construction and destruction. Architecture too, has both the desire to transform space, a constructive and destructive act simultaneously.

Our architectonic will seek to graph and exploit the architectural nature of water in order to display memory. New Orleans, specifically the Ninth Ward, was devastated by Hurricane Katrina in August 2005. This area housed 20,000 people that were at or below the poverty level. The density of this area created layers of memory - families, traditions, religions, all clashed to create a layered culture. Our architectonic will respond to the idea of layered memory by creating a vertical and horizontal system to control water.

Once an established rusting pattern has appeared upon the fluted lamp post, the general public will be able to challenge this pattern by changing the arrangement of the metaball forms and horizontal receptors. Once changed, a new rusting pattern is created. Depending on the amount of tie a rust system is in effect, and the amount of rain that passes through the system, and the arrangement of the system, layers of memory will form on the lamp post. The metaball forms are constructed of bronze, an alloy of copper, to ensure a certain beauty to the rusted forms. Night and day should be considered equal, especially in a city that truly never sleeps - with its bustling night life and vibrant culture of Bourbon Street. In order to address the night of our architectonic, the upper band of our connector will glow cleanly in order to provide memory of the day. The band will be placed at the flood line to not only provide memory of the day but memory of the flood.

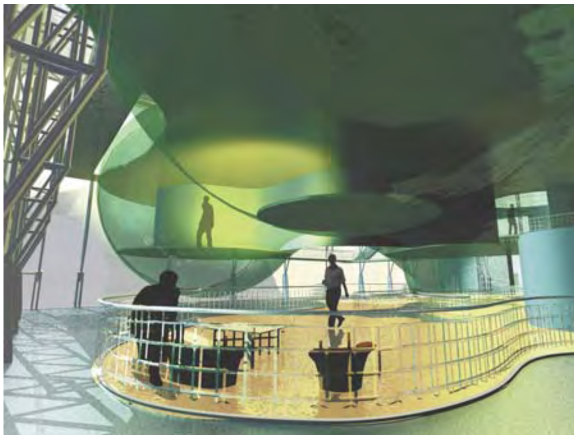


FLUID MEMORY

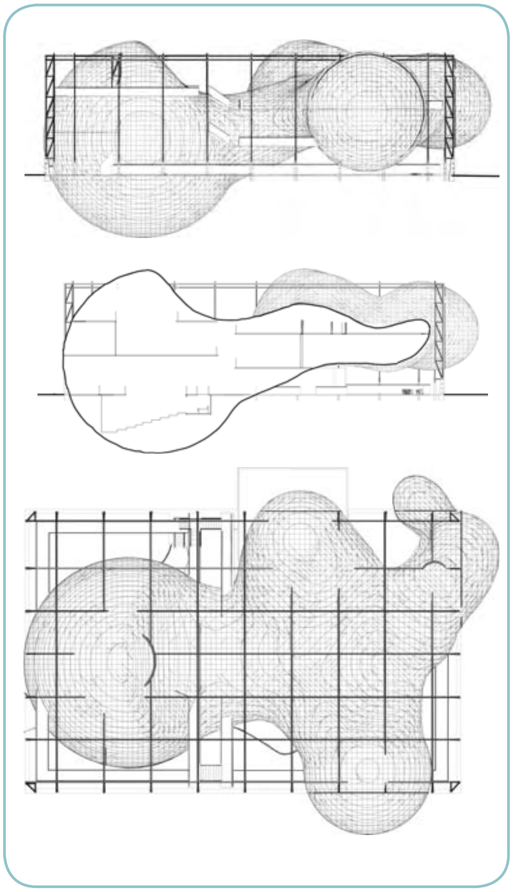
by **Mark Gettys**

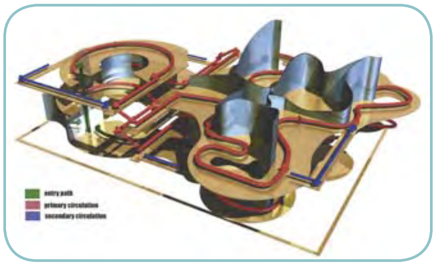
Water definitely has a profound impact on the inhabitants of the Ninth Ward of New Orleans and has for decades. Originally a cypress swamp, the Ninth Ward is bounded by a river and two lakes, and has suffered repeatedly from deadly hurricanes. The Museum of Memory serves as an important institution that records the memory of cultural transformation caused by, in its simplest form, water. The design of the Museum of Memory focuses first on fluidity, the essential makeup of water and celebrating the history and culture of the 9th Ward; and secondly on memory, as a memorial to the residents of New Orleans who lost their lives as a result of Katrina.

Visual fluidity serves as the primary focus of the museum and controls everything in the building from first view to exit. The flow of water on a molecular level surges through the grounds of the 9th Ward and pours through a traditional rectilinear form, defining the walls of the museum. The very symbolic and visually empowering structure provides a viewer with a profound respect for this fluid form and how it has dampened the lives of this community. The fluid structure is incased by a transparent rectilinear form that contrasts its organic nature without obstructing view of it. This notion of fluidity is carried through the building as the circulation from entry way toward exit resembles the flowing path of water in nature, an organic path from high ground to low, driven by gravity. Also the gallery walls parallel this notion of fluidity and are organic as well, conforming to the boundaries of the original fluid structure. The walls are designed to move and collect people through the museum relevant to flows and collection of water in nature. This is achieved through gradual larger gallery spaces connected with smaller "funneling" transition spaces.

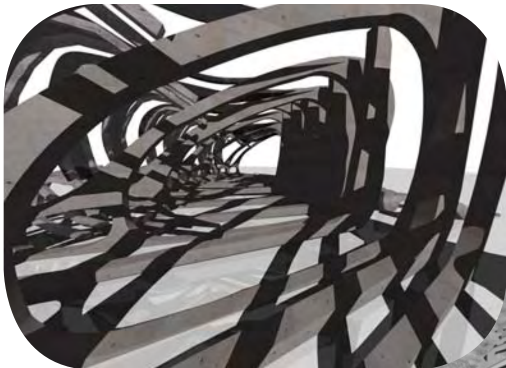


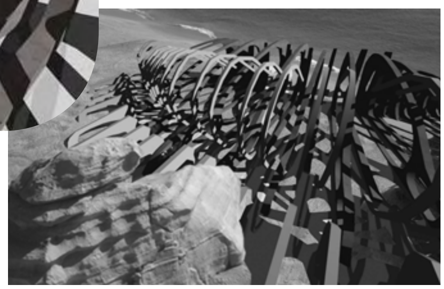
Memory is the core for the museum's ambitions. The Museum of Memory first marks this ceremonial seven foot line in the lobby as this fluid structure soars over the viewer in an organic fashion. There is a notion of water flowing over one's head about seven feet high; this serves as an exceedingly profound way to remember how drastic Katrina forces were. The design of the museum encompasses the conception of phenomenal transparency, in which intersecting vertical, horizontal, and fluid forms give glimpses through the museum without actually being transparent. The viewer can see where they are about to go, while they are going to the point, while also remembering where they have just come from. A network of recollection is thus created as one flows through the museum. This idea is furthered with the cladding of bronze tiles to the floors of the museum. The memory of the circulation through the museum is preserved as these tiles begin to patina over time with the humidity of the environment. Specifically based galleries also celebrate memory of heroes, with the Fats Domino gallery; of the destruction, in the photograph gallery and gallery of memory; of culture, with the Ninth Ward Rotation exhibitions gallery; and of the future, with the virtual stories gallery.





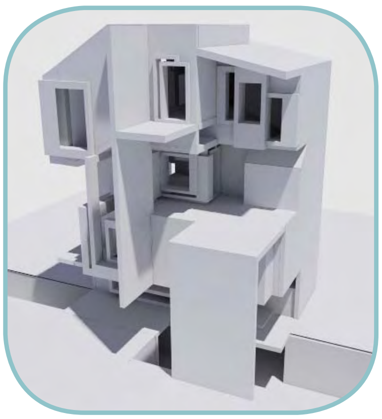
Potpourri





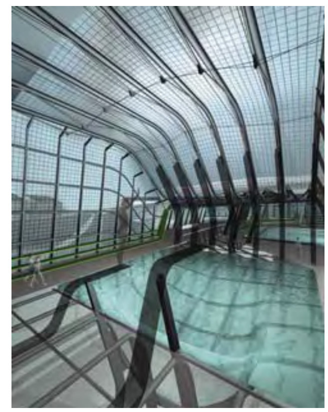
Kristina Iverson ▲ ►
"Design Explorations"
Hampton University

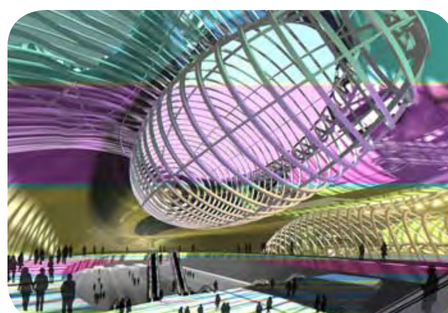
Kevin Hayley ►
"Urban Living"
Royal College of Art



◄ Marcel Baumann,
Esther Steube
"Building the Normal"
Swiss Federal Institute
of Technology

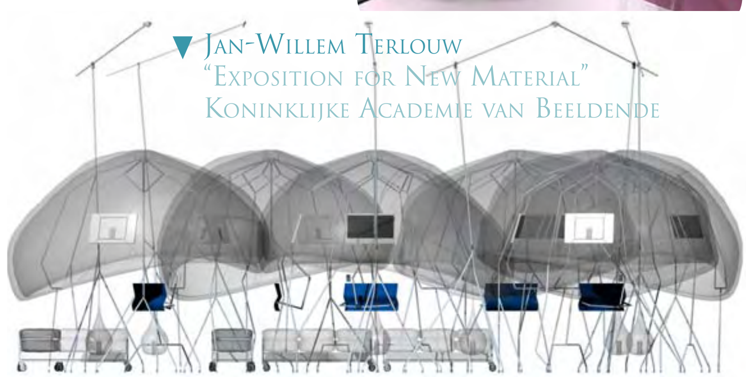
Ann Kiekheffer, Cassidy Keim, ►
Hart Marlow,
Michael McCune
"Aquatic Center"
Louisiana Tech University





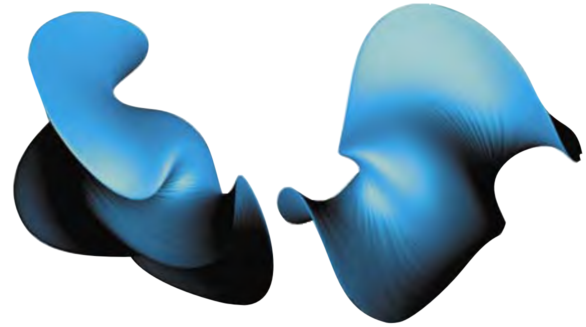
◄ ▼ Ryan Lorey
"Architectural Impetus
(Thesis)", Pennsylvania
State University

Urs Mueller ▲
"Information system for a Staircase"
Zurcher Hochschule Winterthur



▼ Jan-Willem Terlouw
"Exposition for New Material"
Koninklijke Academie van Beeldende

▼ Danielle Sernoskie
"Digital Designs", Ryerson University

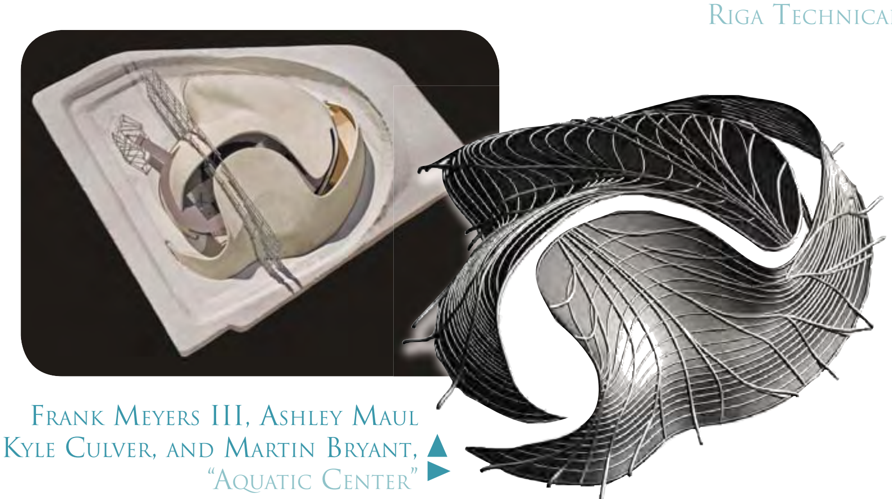


Kahkasan Akhi ▶
"Exploring Structures"
University of Texas
at Arlington

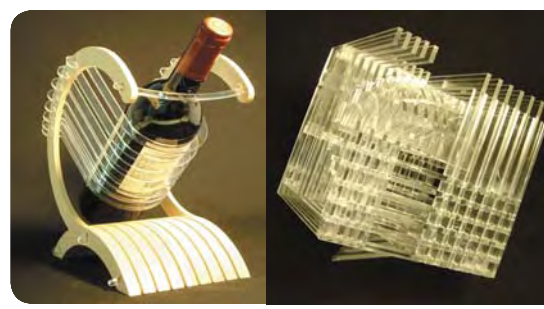
Sandra Zollinger ▲
"Sculpture for a Staircase"
Zurcher Hochschule Winterthur

Oskars Elksnis ▲
"Human Sculpture"
Riga Technical University

Arturs Cepulis ▲
"Form Study"
Riga Technical University



Frank Meyers III, Ashley Maul
Kyle Culver, and Martin Bryant, ▲
"Aquatic Center" ▶
Louisiana Tech University



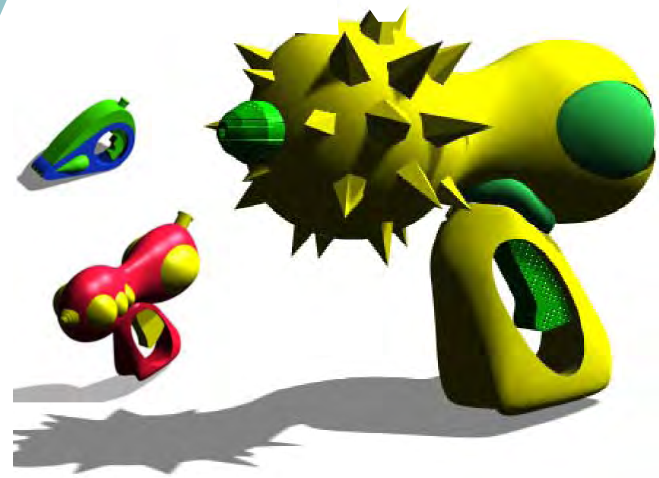
▲ Yu-Huan LIN
"Fabrication Exercises"
Tamkang University

▲ Stacey Roecker
"Studies for Interiors", Ohio University

Jim Wiese ▲
"Architectonic Assemblies", University of Texas at Arlington

Potpourri

▲ Justen Kanthack
"Winged Workstation"
Minneapolis College of Art and Design



▲ Oshrat Kalmanoviz
"Water Guns", Holon Academy Institute of Technology

▲ Mark Majewski
"Concept Car"
Art Institute of Pittsburgh

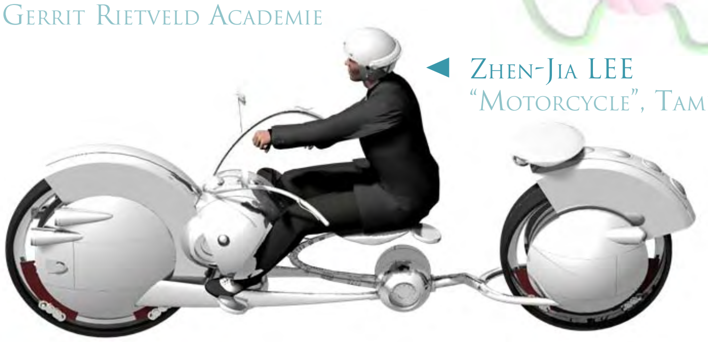
▲ Losang Champa and Samr El Chemali
"3D Printed Lamp", Concordia University

◄ Chris Anderson
"All Terrain Ambulance"
Art Institute of Pittsburgh

▲ Dawn Hourigan
"Pillbox for HIV Patient"
Gerrit Rietveld Academie

▲ Moti Barzilay
"Cam"
Holon Academy Institute of Technology

▲ Joep Jansen
"Chairs", Gerrit Rietveld Academie



◄ Zhen-Jia LEE
"Motorcycle", Tamkang University

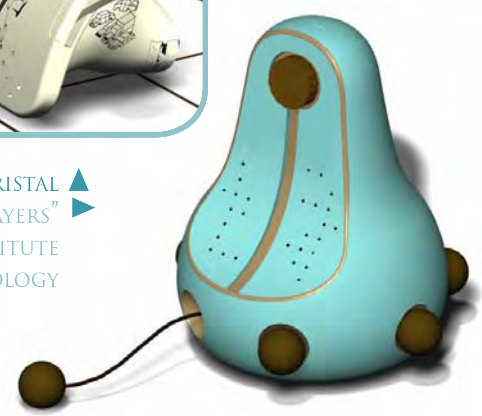
▲ Adam Tolsma
"Coffee Table"
Minneapolis College of Art and Design

Elinor Dafni
"Ghost"
Holon Academy Institute of Technology

Ellia Nattel
"Mice", Holon Academy Institute of Technology

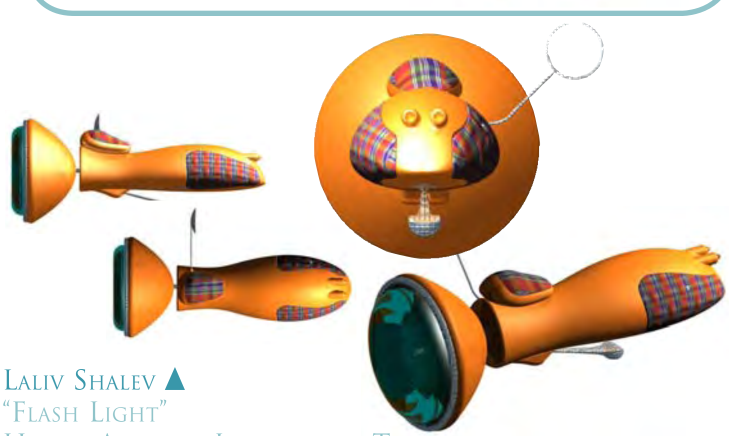
Tehilla Saar
"Tooth Brushes"
Holon Academy Institute of Technology

Ellia Nattel
"Dog Leash"
Holon Academy Institute of Technology



Yael Kristal
"MP3 Players"
Holon Academy Institute of Technology

Tal Margalit
"Electronic Medicine Extractor for Kids"
Holon Academy Institute of Technology



Laliv Shalev
"Flash Light"
Holon Academy Institute of Technology

Nitzan Debbi
"Dogi Style Drill"
Holon Academy Institute of Technology

What we learned from the 2005-2006 Joint Study Reports

This article summarizes the responses we received to the questionnaire we sent to the Principal Investigators (PIs) of the Joint Study (JS) Program for the 2005-2006 academic year. This article purposely follows the same format with corresponding articles of previous years in order to facilitate comparisons.

Participation

This past year, the JS Program had 248 active members; 152 were in the USA and 96 were international schools. From these member schools we received 74 fairly complete reports, which are featured in the DVD portion of this year's Joint Study Report. We also received 126 responses to our questionnaire upon which the findings reported in this article are based.

The total numbers of lab seats at schools across the globe and extension licenses for the past five years, including last year, are summarized below:

	01-02	*02-03*	*03-04*	*04-05*	*05-06*
Lab Seats	10,086	9,495	9,160	8,940	8,464
Exten. Lic.	3,306	3,363	3,517	4,520	4,761
Total	13,392	12,858	12,677	13,460	13,225

Over the past 5 years, the total has deviated only slightly from year to year. However, the trend we observed in recent years, which is that schools are reducing their support of lab seats and require instead, or simply encourage, individual licenses on individual portable computers, continues. More schools every year hand their students computers complete with the required software at the time they start their studies.

Among the schools that had lab seats, there were 45 with 50 or more seats and 11 schools with 100 or more seats. The University of Southern California had 603 seats, the most in a single school. The Ohio State University was second with 405 seats and Swiss Federal Institute of Technology in Zurich was third with 220.

The ratio between key and network based installations has remained at last year's levels, which is 23% of the schools prefer hardware keys while 77% prefer networks.

Used across the board

Schools are reporting that **form•Z** is involved in courses that range from a single one to over 20, with the average being about 6 or 7 per school. Thus over 1,000 individual courses are mentioned by the 148 schools that responded to our questionnaire. In addition, a number of schools are again reporting that "**form•Z** is used across the board", "is available to all the studios", or "is used in all the labs." The specific courses mentioned include design studios, CAD/modeling courses, thesis projects, fabrication courses, energy analysis courses, lighting, construction/structures courses, seminars, graphic communications, and color.

In terms of trends that may be manifesting themselves, we have encountered schools indicating that they have stopped offering courses that teach software and expect their students to learn it by themselves by the time they need to use it in design studios or other classes. Quite often **form•Z** is used together with other software, while a number of PIs are eager to declare that, by student choice, **form•Z** remains the core 3D modeler. Lastly, the popularity of fabrication using all the available methods appears to continue to grow and schools continue to acquire rapid prototyping, 3D printing, and CNC machines for student usage. At the same time, many PIs report that **form•Z** does a very good job supporting these processes and features that facilitate fabrication, such as the Unfold and Section tools, the STL and Z Corp export formats, are becoming quite popular.

Best features of form•Z

The table below summarizes the features of **form•Z** that were identified by at least 10% of the PIs as being its main strengths. Once again, the list is very similar to last year's and contains only one new item, lighting, which last year had less than 10% of the votes. The order has slightly changed and how it compares to last year's is shown in the second column (the numbers in parenthesis). The items that were in last year's list but not in this year's (effective teaching tool, fabrication support, parametrics, and technical support/forum) were still mentioned this year but by less respondents. In addition, there were another 31 features mentioned but by smaller numbers.

feature		#	%
1. 3D modeling range/power	(2)	93	74
2. easy to learn/use, intuitive interface	(1)	89	71
3. rendering	(3)	54	43
4. interoperability (import/export)	(5)	29	23
5. flexibility/versatility	(10)	19	15
6. accuracy	(11)	16	13
7. lighting	(--)	15	12
8. effective design/conceptualization tool	(6)	15	12
9. 3D character/visualization	(4)	14	11
10. topological levels	(12)	13	10
11. cross platform	(9)	12	10

In terms of individual tools/operations, the new animation was mentioned by 12 respondents, Boolean operations by 11, and object editing by 9. Other tools that received between 3 and 7 votes were unfold, terrain modeling, skin, section, derivatives, nubz, and querying.

Beyond the statistics, some of the comments that PIs offered also speak quite eloquently: One PI repeated that "**form•Z** definitely has the ability to excite the students..." Another that "Using **form•Z** is an aesthetic experience." A third had this to say: "I have looked at many 3D modeling software packages and always come back to **form•Z** because of its clarity and interface simplicity."

Improvements and new features desired

Animation was the item mentioned most frequently: 9 respondents suggested that it should be improved while another 10 acknowledged the recent release of object animation and a number of them expressed satisfaction. This apparent discrepancy reflects the fact that many of the PIs sent their responses before they had a chance to run version 6.0, which drastically extended the animation capabilities of **form•Z**. Other features mentioned by at least 5 of the respondents as requiring improvements are summarized below.

improvements	#	%
rendering	15	12
drafting	10	8
interface	9	7
stability	9	7
navigation	8	6
nurbz/smooth object editing	7	6
lighting	6	5
error reporting/Help	6	5
make using scripts easier	5	4
fabrication support	5	4

Another 22 items were mentioned by between 1 or 3 respondents.

One interesting finding of these statistics is that, with the single exception of drafting, all the features that are mentioned here as requiring improvements were also mentioned as being among the main strengths of **form•Z** by other PIs. Regarding drafting, the exception, we have to recognize that upgrading it is long overdue and AutoDesSys has already announced that it is working on it.

When it comes to desirable new features, the following table summarizes those requested by at least 3 respondents.

desirable additions	**#**	**%**
terrain model editing	6	5
global illumination	6	5
video tutorials	5	4
architectural parametrics	5	4
2D/3D integration/linkage	5	4
BIM (building information modeling)	4	3
modeling history	3	2

There were also another 19 requests made by one or two respondents.

Interestingly, 4 of the 7 requests, including the top 3 and BIM, appear for the first time this year. Global illumination and BIM are both techniques that have gained in popularity in very recent years and it is only normal that they now appear on our wish list. As **form•Z** offers more and more editable parametrics in recent versions but not for terrain modeling, asking for it has to be considered natural. The request for video tutorials could also be expected after the introduction of the new on-line electronic manuals.

Administration of the JS Program

75% of the respondents answered the question of how well we administered the JS Program. All but one were positive: 22% said excellent, 39% said very well, 28% said well, and the rest said fantastic, no complaint, or OK. One graded us poor due to too much paper work, a complain expressed by two more.

The vast majority of the comments are most appreciative of the way we handle the JS Program: "I have a lot of thanks for your patience and collaboration." "I still believe that the JS Program is a fabulous opportunity for the students and the faculty..." "Still probably the single best program I have seen for our department and for our students." "I do not know of any other program that has such a wonderful support at the educational level." "I have only praise for the Joint Study Program." "**form•Z** is an outstanding pedagogical and design tool." Once again, specific praise and thanks were also expressed for our JS Administrator and our technical support group.

A couple of the requests we had this year are repeats from previous years: "Make PDF files with editable fields for easier form filling." "Offer a way to apply and pay for a student extension license online." "Easier transition to professional life, by allowing students to continue usage of extension licenses for some time after graduation." We expect to be in a position to address all of these requests soon.

The form•Z JS extension licenses

From the 248 participants to the JS Program this past year, 141 or 57% of the schools had extension licenses. 20 schools had more than 50 and 11 schools had more than 100. The Wentworth Institute of Technology had 1068, which is the most on a single campus, with the University of Cincinnati second at 656, and the University of Tennessee third at 199.

This past year, there were 4,761 extension licenses. Statistics for the most recent 5 years are summarized in the following table:

	01-02	***02-03***	***03-04***	***04-05***	***05-06***
USA	2719	2632	2804	3782	4023
International	587	731	713	738	738
Total	3306	3363	3517	4520	4761

From the 126 schools that responded to our questionnaire 68% had extension licenses. Without exception, they were all positive about the value of the extension licenses. "Students who use an extension license have a better grasp of the program." "The best part about the extension licenses is that students can work independently of lab hours... and they love it." "The extension license program is an extremely effective solution for students to have 24/7 access to the software."

Evaluating last year's JS Report

About half of the PIs responded to the last question in our questionnaire, asking for an evaluation of the previous year's Joint Study Report. We were interested in evaluations of both the format and the overall appearance and layout of the material.

The vast majority was in favor of the thematic format while two expressed preference for the previous "catalogue" format. Here are some of the comments: "I enjoyed the more extensive reports that seemed to showcase the student work more completely. The variety of pedagogical approaches was enlightening." "The report has become an excellent source on the current thinking in 3D design." "As an instructor, the JS Report has been very helpful to see how other schools are exploring the software." "It looks better every year. It is a very good example for my students." "Excellent publication with lots of articles describing how others have used **form•Z** and modeling problems and solutions." "Excellent report! I use it in class to demonstrate the range of **form•Z** capabilities." "It is very helpful to see what other schools are doing." "The thematic approach gives the **form•Z** academic community a wide series of pedagogic directions. We think this is a much better way of 'reporting' ... and a more useful way of sharing information, which is the point of the report in the first place. Keep on doing it." "The Report, utilizing the topical articles, is a real showcase, which is a pleasure to read,"

Regarding the appearance and layout of the material, again most expressed satisfaction: "It is always very well done and I think last year's was one of the best yet." "The report last year looked great." "The report looked good as always." "Last year's report was again a very impressive product." "The report was beautiful as always." "The JS Report, as usual, was very well produced. I would not change any of the essentials in the report." In addition to this praise there was also some criticism. Three of the respondents suggested that the graphic design of the report can be improved by allowing more empty space and making the pages less crowded.

There was also appreciation expressed for the support AutoDesSys extends for the education of novice designers, the publication of the JS Report being one part of it: "I must complement your company on taking the time and effort to prepare such a well designed and enticing report." "The JS Report sets a standard in the industry that has no parallel."

The printed JS Report this year again follows the thematic format, in accordance with the recommendation of a strong majority. For the first time the material was handled by a Guest Editor, Murali Paranandi. He tells us how the material was solicited, reviewed, and assembled in his Introduction to this printed report.

Concluding

AutoDesSys would like to take this opportunity to thank the Principal Investigators, the Lab Managers, the students, and last but not least the authors of the articles that fill the pages of this publication. Also, a special "thank you" to Murali Paranandi for putting this material toghether. Earlier issues of the JS Report have been valuable resources for both students and instructors and we hope that this year's Report will prove even more valuable and informative.

C.I.Y

United States Schools

Alabama
Auburn University
• Department of Architecture
PIs: Alan Cook, Charles Thomas

Arkansas
University of Arkansas
• School of Architecture
PI: Russell Rudzinski

Arizona
Arizona State University
• School of Architecture
PIs: Scott Murff, Yoshihiro Kobayashi

California
Academy of Art University
• School of Architecture, PI: Mimi Sullivan
American Film Institute
• Production Design Department
PIs: Richard Reynolds, Joe Bolden
California College of the Arts
• School of Architecture
PI: Kathrina Simonen
California Polytechnic State University, San Luis Obispo
• College of Architecture, PI: Tom Fowler
California State Polytechnic University, Pomona
• College of Environmental Design Architecture, PI: George Proctor
Chabot College
• Architecture Program, PI: George Tolosa
East Los Angeles College
• Architecture Department
PI: Patricia Combes-Brighton
New School of Architecture and Design
PIs: Cameron Crockett, Sara Taylor
Otis College of Art and Design
• Department of Environmental Arts
PI: Felipe Gutierrez
Pasadena City College
• Engineering and Technology Department Architecture Program, PI: Peter DeMaria
University of California at Los Angeles
• Academic Technology Services
PI: Diane Farvo
University of California, Berkeley
• College of Architecture
PIs: Yehuda Kalay, Guy Vinson
University of Southern California
• School of Architecture
PIs: Karen Kensek, Douglas Noble
Woodbury University
• Interior Architecture Department
PI: Randall Stauffer

Colorado
University of Colorado at Boulder
• College of Architecture
PIs: Shane Rymer, William Henry
University of Colorado at Denver
• College of Architecture and Planning
PIs: Shane Rymer, John Semple

Connecticut
Joel Barlow High School
• Department of Technology, PI: John Lewis
Salisbury School
• Art Department, PI: Roger McKee
University of Bridgeport
• Department of Industrial/ Interior Design
PI: Robert Brainard
Wesleyan University
• Department of Art and Art History
PI: Martha Anez
Yale University
• School of Architecture, PI: John Eberhart

Florida
Florida Atlantic University
• School of Architecture, PI: Aron Temkin
University of Florida
• School of Architecture, PI: John Maze

Georgia
Georgia Institute of Technology
• College of Architecture
PI: Thanos Economou
Southern Polytechnic State University
• School of Architecture, PI: Ameen Farooq

Hawaii
University of Hawaii at Manoa
• School of Architecture, PI: Tony Cao

Illinois
Illinois Central College
• Department of Architecture, PI: Al Rusch
Judson College
• Department Of Architecture
PI: Keelan Kaiser
Loyola Academy
• Department of Fine Arts
PI: James E. Cleland
School of the Art Institute of Chicago
• Interior Architecture Department
PI: Anders Nereim
University of Illinois at Urbana-Champaign
• Department of Landscape Architecture
PI: Douglas Johnston

Indiana
Ball State University
• College of Architecture and Planning, Department of Architecture
PIs: Roger Whitted, Joseph Blalock

Kentucky
University of Kentucky
• College of Architecture, PI: Greg Luhan

Louisiana
Louisiana State University
• School of Architecture, PI: Tom Sofranko
Louisiana Tech University
• School of Architecture
PIs: Robert Fakelmann, Michael Williams
Southern University
• School of Architecture, PI: Cooper Barnes
Tulane University
• School of Architecture
PIs: Ila Berman, Karen Bullis

Maryland
University of Maryland
• School of Architecture, Planning and Preservation, PI: Michael A. Ambrose

Massachusetts
Boston Architectural College
• Department of Design Media, Arts and Computing, PI: Diego Matho
Harvard University
• Graduate School of Design, Department of Computer Resources, PI: Stephen Ervin
Massachusetts College of Art
• Department of Environmental Design
PIs: Robert S. Coppola, Meg Young
Northeastern University
• Department of Architecture
PI: George Thrush
School of the Museum of Fine Arts, Boston
• Sculpture Department, PI: Ken Hruby

Michigan
Grand Valley State University
• Art and Design Department
PI: Norwood Viviano
University of Michigan
• College of Architecture and Urban Planning
PI: Malcolm McCullough

Minnesota
Bemidji State University
• Industrial Technology Department
PI: Barbara Hanus
Carleton College
• Art Department, PI: Stephen Mohring
Minneapolis College of Art and Design
• Department of Fine Arts, PI: Brad Jirka

Mississippi
Mississippi State University
• School of Architecture, PI: Michael A. Berk

Missouri
Drury University
• Hammons School of Architecture
PIs: Marshall Arne, Paul John Boulifauld
University of Missouri-Columbia
• Department of Environmental Design
PI: Mohammed Uddin

Nebraska
University of Nebraska, Lincoln
• Department of Architecture, PI: Jeffrey Day

New Hampshire
Dartmouth College
• Studio Art Department
PI: Karolina Kawiaka

New Jersey
Princeton University
• School of Architecture
PIs: Miles Ritter, Linda Greiner

New Mexico
University of New Mexico
• School of Architecture
PIs: Geoffrey Adams, Tim Castillo

New York
Buffalo State College
• Design Department, PI: Tara Stephenson
Cooper Union for the Advancement of Science and Art
• School of Architecture, PI: Kevin Lippert
Cornell University
• Department of Architecture
PI: Arthur Ovaska
• Departments of Landscape Architecture, City and Regional Planning
PI: Roger T. Trancik
Dalton School
• Art Department, PI: Robert Meredith
Hofstra University
• Department of Fine Arts, PI: Alex Roskin
New School University
• Academic Technology Department
PI: Daniel Herskowitz
Pratt Manhattan
• Center for Continuing and Professional Studies, PIs: Karen Miletsky, Lara Guerra
Rochester Institute of Technology
• Interior Design, PI: Alex Bitterman
School of Visual Arts
• Interior Design, PI: Lovejoy Duryea
Syracuse University
• School of Architecture, PI: Scott Ruff

North Carolina
East Carolina University
• School of Art, PI: Wayne Godwin
North Carolina A & T University
• Architectural Engineering Program
PI: Ron Bailey

North Carolina State University
• College of Design, PI: Arthur Rice
University of North Carolina at Charlotte
• College of Architecture, PI: Eric Sauda
University of North Carolina at Greensboro
• Department of Interior Architecture
PI: Tina Sarawgi

North Dakota
North Dakota State University
•Department of Architecture and Landscape Architecture, PI: Ganapathy Mahalingam
•Department of Apparel, Design, Facillity and Hospitality Management, PI: Aditi Hirani

Ohio
Cleveland Institute of Art
• Technology Integrated Media Environment
PI: Ioannis Yessios
Columbus College of Art and Design
• Departments of Interior Design and Industrial Design, PI: Aniket Vardhan
Columbus State Community College
• Construction Sciences, PI: Doug Ritchie
Delaware Area Career Center
PI: Kelly T. Kohl
Dublin Coffman High School
PI: James Roscoe
Miami University
• Department of Architecture and Interior Architecture, PI: Murali Paranandi
Ohio State University
• Knowlton School of Architecture
PI: Beth Blostein
• Advanced Computing Center for the Arts and Design, PI: Maria Palazzi
Ohio University
• Department of Interior Design
PI: David Matthews
Pickerington High School North
• Technology Education Department
PI: David Lindquist
University of Cincinnati
• School of Architecture and Interior Design
PI: Anton Harfmann

Oklahoma
University of Oklahoma
• College of Architecture, PI: Abimbola Asojo

Oregon
Clatsop Community College
• Industrial and Manufacturing Technology
PI: Lucien Swerdloff
Marylhurst University
• Art Department, Interior Design
PI: Paul Pavlock
Portland State University
• Department of Architecture
PI: L. Rudolph Barton
University of Oregon
• Department of Architecture
PI: Lars Uwe Bleher

Pennsylvania
Art Institute of Pittsburgh
• Industrial Design Department
PI: Scott Rittiger
Carnegie Mellon University
• Department of Architecture
PI: David Burns
Drexel University
• College of Interior Design, PI: Amy Walter
Pennsylvania State University
• Department of Architecture and Landscape Architecture, PI: Katsuhiko Muramoto
• Center for Information Technology
PI: George Otto

Temple University
• College of Engineering and Architecture
PI: Bill Fox
University of the Arts
• Industrial Design Department
PI: Rod McCormick
University of Pennsylvania
• Department of Architecture
PI: Branko Kolarevic

Puerto Rico
Escuela de Artes Plasticas
• Disenó Industrial
PI: Charles Juhasz-Alvarado

Rhode Island
Rhode Island School of Design
• Department of Interior Architecture
PI: Peter van Colen
Roger Williams University
• School of Architecture, PI: Roseann Evans

South Carolina
Clemson University
• School of Architecture
PIs: Ronald Rael, Richard Norman
Clemson Architecture Center
• Department of Architecture, Arts and Humanities, PI: Joshua C. Allison

Tennessee
University of Tennessee
• College of Architecture and Design
PI: Jeffrey Wilkinson

Texas
Booker T. Washington High School for the Performing and Visual Arts
• Technical Education Department
PI: Nancy Mack
Rice University
• School of Architecture, PI: John Casbarian
San Antonio College
• Department Physics, Engineering, Architecture, PI: Dwayne Bohuslav
Texas Tech University
• College of Architecture
PI: Bennett Neiman
University of Houston
• College of Architecture
PI: Elizabeth Bollinger
University of Texas at Arlington
• School of Architecture, PI: Thomas Rusher
University of Texas at Austin
• School of Architecture, PI: Dean Almy III
University Of Texas at San Antonio
• School of Architecture
PI: Mahesh Senagala

Utah
University of Utah
• Graduate School of Architecture
PI: Julio Bermudez

Virginia
Hampton University
• Department of Architecture
PI: Carmina Sanchez-del-Valle
James Madison University
• School of Art and Art History
PI: Ronn Daniel
University of Virginia
• School of Architecture, PI: Eric Field
• Institute for Advanced Technology in Humanities, PI: Bernard Frischer

Vermont
Norwich University
• Department of Information Technology/ Architecture PI: Eleanor D'Aponte

Washington
Cornish College of the Arts
• Design Department, PI: Hal Tangen
University of Washington
• Department of Architecture
PI: Brian R. Johnson

Wisconsin
Milwaukee Institute of Art & Design
• Interior Architectural Design Program
PI: Rebecca Balistreri
University of Wisconsin at Milwaukee
• School of Architecture and Urban Planning
PI: Kevin Forseth
University of Wisconsin, Marathon County
• Art Department, PI: Thomas Fleming
University of Wisconsin-Stout
• Department of Art and Design
PI: Susan Hunt

International Schools

Australia
Australian National University
• Canberra School of Art
PI: Gilbert Riedelbauch
University of Adelaide
• School of Architecture, Landscape Architecture and Urban Design, PI: Susan Pietsch
University of Melbourne
• Faculty of Architecture, Building, and Planning, PI: Andrew Hutson
University of Newcastle
• School of Architecture and the Built Environment, PI: Rod Halligan
University of Sydney
• Sydney College of the Arts
PI: Andrew Speirs

Austria
Technische Universität Wien
• Computer Laboratory of Architecture
PI: Gunther Wehrberger
Universität für Angewandte Kunste
• Institut für Design
PIs: Thomas Lorenz, Helga Roessler

Brazil
Sociedade De Educação Ritter Dos Reis
• Faculdade De Arquitetura e Urbanismo
PI: Júlio Celso Vargas
Universidade De Brasilia
• Faculdade De Arquitetura e Urbanismo
PI: Neander F. Silva

Canada
Carleton University
• Department of Architecture
PI: Michael Jemtrud
CEGEP Marie-Victorin
• Design D'Intérieur, PI: Pascal Marthet
CEGEP de Saint-Laurent
• Department of Architecture
PI: Pierlucio Pellissier

Concordia University
• Department of Design Art
PI: Martin Racine
Dalhousie University
• School of Architecture, PI: Patrick Kelly
McGill University
• School of Architecture, PI: Sam Yip
Simon Fraser University, Surrey Campus
• School of Interactive Arts and Technology
PI: Robert Woodbury
St. George's School
• Visual Arts Department
PI: Graham Clarkson
Université de Montréal
• Department of Industrial Design
PI: Tomás Dorta
Université Laval
• École d'architecture, PI: Pierre E. Côté
University of British Columbia
• School of Architecture, PI: Jerzy Wojtowicz
University of Calgary
• Faculty of Environmental Design
PI: James Love
University of Manitoba
• Faculty of Architecture
PI: Terence J. Walker
University of Waterloo
• School of Architecture
PI: Thomas Seebohm

Chile
Pontificia Universidad Catolica de Chile
• Faculty of Architecture, Design and Urban Studies, PI: Claudio Labarca
Universidad de Chile
• Facultad de Arquitectura y Urbanismo
PI: Andrés Cavieres

China
University of Hong Kong
• Department of Architecture
PI: Marc Aurel Schnabel

Dominican Republic
Universidad Iberoamericana
• Department of Architecture, PI: Irma Soler

Denmark
Aarhus School of Architecture
• The Datacentre, PIs: Ole Schelde, Jørgen Hedegaard
Denmark's International Study Program
• Department of Architecture and Design
PIs: Anna Yust, Jonah Chiarenza
Royal Danish Academy of Fine Arts
• Kunstakademicts Arkitektskole
PI: Henning Ørbæk

Ecuador
Universidad San Francisco de Quito
• Colegio de Arquitectura, PI: Marco Villegas

Germany
Brandenburgische Technische Universität Cottbus
• Lehrstuhl für Architekturdarstellung & CAD
PI: Sebastian Finckh
Staatliche Hochschule für Gestaltung Karlsruhe
• Product Design, PI: Sandra Groll
Universität der Künste Berlin
• Department of Architecture
PI: David Steiner
University of Applied Sciences, Potsdam
• Department of Architecture and City Planning, PIs: Ludger Brands, Bettina Dittemer

Greece
National Technical University of Athens
• School of Architecture
PI: Anastasia Pechlivanides-Liakata

Guatemala
Universidad Francisco Marroquin
• Facultad de Arquitectura
PI: Hector A. Santamarina

Israel
Holon Academic Institute of Technology
• Design Department, PI: Gadi Freedman

Italy
ENAIP Novara
PI: Massimo Giribaldi
Istituto Statale D'Arte
PI: Mauro Gierubini
Tessile di Como
PI: Vincenzo Cotticelli

Japan
Kanto-Gakuin University
• Department of Human Environmental Design
PI: Takashi Nakajima
Kanazawa International Design Institute
• Digital Foundation, PI: Shunpei Taniguchi
Kokushikan University
• Department of Civil Engineering
PI: Yoshihiro Kitagawa
Nishinippon University
• Department of Architecture
PI: Kentaro Yagi
Tokyo Kogakuin College of Technology
• Architecture Department
PI: John F. Leaver III

Latvia
Riga Technical University
• Division of Descriptive Geometry and Engineering Computer Graphics
PI: Modris Dobelis

Mexico
Universidad Iberoamericana
• Departmento de Arquitectura
PI: Irma Soler

Netherlands
Gerrit Rietveld Academie
• Department of Architectural Design
PI: Christiaan Thiel
Hogeschool voor de Kunsten, Utrecht
• Department of 3-D Design
PI: Jan Harm ter Brugge
Koninklijke Akademie van Beeldende Kunsten
• Interieur Architectuur
PI: Jan Harm ter Brugge

Norway
Norwegian University of Science and Technology
• Department of Architectural Design, Form and Colour Studies, PI: Knut Rø

Saudi Arabia
King Fahd University of Petroleum & Minerals
• Department of Architecture
PI: Yahya Al-Najjar

South Korea
Dankook University
• Department of Architecture
PI: Yong-Gib Yun
Hongik University
• Department of Architecture, PI: Uk Kim
Namseoul University
• Department of Architecture
PI: Kunsoo Oh

Switzerland
Haute Ecole d'Arts Appliqués
• Department of Interior Architecture
PI: Rémy Bochet
Hochschule Technik & Architektur Luzern
• Department of Architecture, PI: Toni Kotnik
Swiss Federal Institute of Technology, ETH Zürich
• Department of Architecture
PI: Serge Bilgeri
Universitá della Svizzera Italiana
• Accademia de Architectura, PI: Enrico Sassi
University of Art & Design Zürich
• Departments of Interior Design and Product Design, PI: Barbara Berger
Zürich Hochschule Winterthur
• Department of Architecture, Design, and Civil Engineering, PI: Amadeo Sarbach

Taiwan
Tamkang University (Tansui)
• Department of Architecture
PI: Chen-Cheng Chen

Thailand
International School Bangkok
• I.T. Department, PI: Larry Maddams
Sripatum University
• Faculty of Architecture
PI: Kamon Jirapong

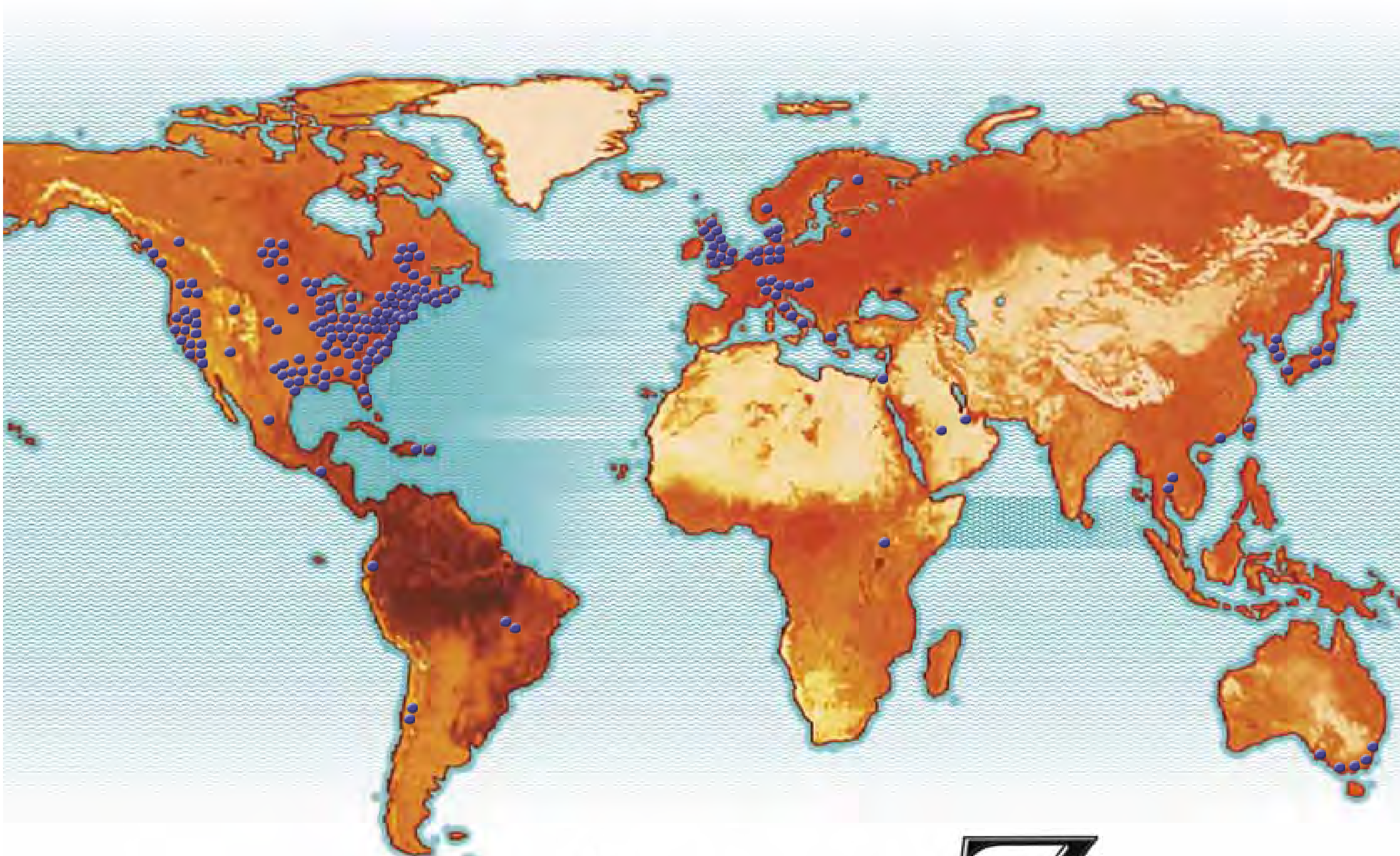
Uganda
Uganda Martyrs University
• Faculty of Building Technology and Architecture, PI: Mark Olweny

United Arab Emirates
American University of Sharjah
• Department of Architecture and Design
PI: George Katodrytis

United Kingdom
Architectural Association School of Architecture
• Department of Technical Studies
PIs: Michael Weinstock, Julia Frazer
Bath Spa University College
• Fine Arts Department, PI: Roger Clarke
Blackpool and The Fylde College
• School of Art and Design
PI: Michael J. Tully
Glasgow Caldonian University
• Department of Engineering, Science and Design, PI: Fred Birse
Leeds Metropolitan University
• School of Architecture, Landscape Design
PIs: Rupert Bozeat, Andrew de Feu
Ravensbourne College of Design and Communication
• Interior Design Environmental Architectures Program, PIs:Layton Reid, Adam Burt
Royal College of Art
• Department of Architecture and Design
PI: Hilary French
University College London
• The Bartlett School Of Architecture
PI: Jean Garrett
University of Cambridge
• School of Architecture, PI: François Penz
University of Edinburgh
• Department of Architecture
PI: Richard Coyne
University of Strathclyde
• Department of Architecture and Building Science, PI: Scott Chase
University of Wales Institute, Cardiff
• School of Art and Design
PIs: John Drummond, Elys John

Locations of the form•Z Joint Study Schools

2005-2006



form•Z

Partnerships in Learning

The **form•Z** Joint Study is a program by which AutoDesSys Inc. supports and subsidizes the learning of the new digital tools, primarily 3D modeling, by students at Universities and High Schools worldwide. When schools agree to incorporate 3D modeling in their curriculum, AutoDesSys provides them with **form•Z** licenses, one year at a time, at the cost of material and processing. In return the schools agree to report about their experiences, offer recommendations, and share the projects produced by their students or researchers.

AutoDesSys assembles this material into an annual full color publication and DVD, which, in addition to the still images and textual reports, includes multimedia projects. Currently in its fifteenth year, the **form•Z** Joint Study Program involves over 250 Universities worldwide, which translates to over 13,000 student seats a year. The Annual **form•Z** Joint Study Report has evolved into an event that documents the excitement and progress of computer aided design and 3D modeling education in the institutions of higher learning.

autodessys INC

2011 Riverside Drive • Columbus, Ohio 43221

phone: (614) 488-8838 • fax: (614) 488-0848

e-mail: formz@autodessys.com • www.formz.com

ISBN-13: 978-0-9792943-0-3

ISBN-10: 0-9792943-0-4