California Polytechnic State University
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Light Motion Machines

by Thomas Fowler, IV

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

Students worked in four teams of three to four each and were assigned the construction of a light motion machine. Teams developed devices, which were an interpretation of László Moholy-Nagy's 1930's *Space Light Modular Machine*. These machines had to have moving parts for the purpose of studying light and shadow projections in motion. László Moholy-Nagy's *Space Light Modular Machine* was a mechanically driven rotating kaleidoscope projecting ever-changing patterns of light, shadow, and color. Students were provided information on Moholy-Nagy's machine and also shown a range of interpretations students developed in a previous studio[1] (see Figure 1).

The light motion machines projects had the following requirements:

• Materials to construct the light motion machine had to allow the device to have a range of abilities to capture and project light and shadow. Materials were to have a range of reflectivity and transmissibility and be designed to work within a two foot plexiglas light/shadow cube;

• Light boxes were constructed so one side was left open, so the light motion machine along with lighting source(s) were able to placed in and taken out of the this box as needed;

• Groups were required to invent a two- or three- dimensional vocabulary from their light/shadow experiments to whatever level they thought was appropriate;

• Groups documented the light motion machines with visual and textural stories about the qualities of the lighting from the motion machine using digital stills, video footage, digital and analog diagrams, relief models and 3D physical and digital models. This range of representations showed how the developed vocabulary evolved from the light study.

The learning objectives for developing these light motion machines were the following:

1. Opportunity to bring all students to a similar working knowledge in working with digital modeling software (students used a range of modeling software that included **form•Z**);

2. Exposed students to the tools (digital and analog) and strategies in the first week of the studio that they would be using for the rest of the quarter;

3. Students explored the range of poetic possibilities for understanding light and motion;

4. Provided each student with a launching off point for a 'space fantasy' (Moholy-Nagy) exploration for the studio's building design project to develop an airport.

Prior Student Interpretations of László Moholy-Nagy's *Space Light Modular Machine*

Kinetic Energy: Energy can be stored or in motion, it is perceived in a variety of ways as heat, wind, motion, light, most tangibly in its kinetic state. Light energy is a form that we are all aware of because we have evolved to perceive part of the spectrum visually, this form, so familiar as it is, to this day still remains an intriguing mystery to us. With his Light Space Modulator it was this mystery that Laszlo Moholy-Nagy was seeking to explore. This almost crude yet beautiful apparatus, which we have recreated utilizing discarded objects, sets light in motion using the principles of reflectivity, opacity, transparency and shadow.

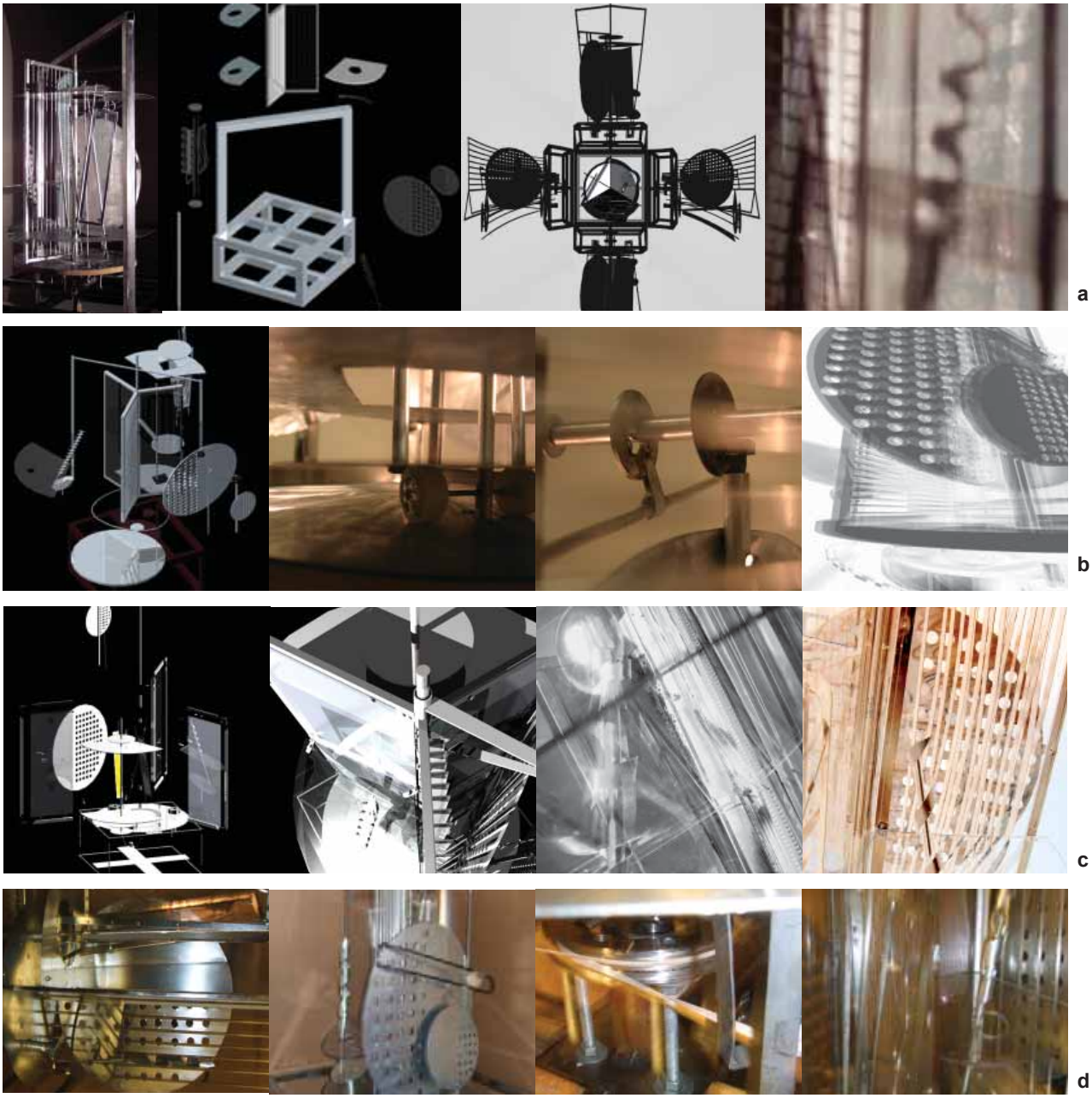

Figure 1: Prior student interpretations of László Moholy-Nagy's Space Light Modular: (a) Kinetic energy: (left to right:) physical model, exploded digital model, digital folded out shadow projection model, and same; by Rob Caras, Sergio Ramirez, Nate Kipperman, Sylas McFarland, and Katie Duncan. (b) Wholly Mo Holly: (left to right:) digital model, physical model detail, physical model connection detail in motion, and physical model photograph of device in motion; by Yiling Deng, Brandon Vielguth, Joe Lyman, and Francisco J. Maravilla. (c) Play of Light = Play of Movement: (left to right:) digital model, perspective view, view in motion, and detail view; by Frank Lara, Joe Moore, David Pak, Florencio Rodriguez, and Yimon Aye. (d) Mysterious Machine: physical model; by Nick Holbein, Carlos Villegas, Cuc Ngyen, and Mike Hernandez.

Figure 2: The Orbitals Light Machine, by Austin Duncklee, Denisse Martinez, and Nathan Mendelsohn.

Figure 3: Light Collisions Light Machine, by Celeste Madrigal, Corinne Mclaughlin, Jared Diganci, and Emily Pappalardo.

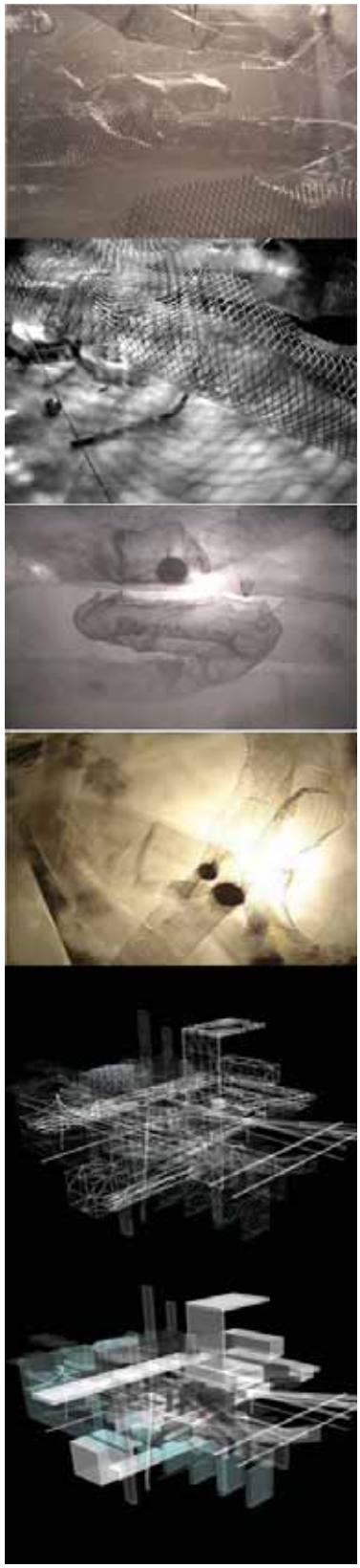

Figure 4: Transience Light Machine, by Rachel Glabe, Cesar Olivas, Laura Ng, and Lauren Lee.

Figure 5: The Superior Machine Light Machine, by Melissa Ramos, Judy Quan, Mauro Cardenas, and Jose Castillo.

Wholly Mo Holly: The objective was to re-create to the best of our ability a replica of the Light-Space- Modulator designed by Laszlo Moholy-Nagy. Our efforts were directed at approaching the experiment with the same spirit of Laszlo – to explore the different manifestations of how certain shapes and materials manipulate light and shadows through movement.

Play of Light = Play of Movement: Understanding every movement and what was created by this movement was a focus that was accomplished by understanding the light modulator digitally and through many different analog models. This allowed us to build a device that was equal to the Moholy-Nagy machine.

Mysterious Device: The device generates different lighting patterns that are simple by the use of different materials. It is a profound device; people see the light modular only to wonder, how it was constructed. The development of an interpretive Light Modular was unique and a good learning experience since it allowed us to better understand how different materials are manipulated or how light can create something out of the ordinary. We saw many aspects of light and shade and shadow in projected appearance, figure and volume.

This Year's Light Motion Machines

Figures 2 through 5 illustrate a few light motion machines produced by this year's class. Summary descriptions of these projects are as follows:

The Orbital Light Machine: Use of orbital objects provided an exploration into the qualities of light (textural patterns of light to dark) and space. There was an intentional emphasis for using a basic shape such as the orbital for the study of light.

Light Collisions: Light is captured through this mechanical device and twirls it around to provide for multiple shadow collisions into projected space.

Transience Light Machine (a.k.a "Bowel Movements"): The elusive temporal nature of shadows and light are captured through the morphing images projected from the inner structure of the light box. When illuminated, the exterior shows mysterious glimpses of the organism inside.

The Superior Machine: A compilation of diverse materials (a series of glass tubes with red-dyed water inside) provided a sculptural response that offers a projection of geometric patterns that become more interesting than the object itself. The exploited machine tries to escape —it runs —it screams —it shakes —it tries and once it finds itself trapped in its limited existence where it can only express beauty through light, it becomes docile and abides.

Application of Light Motion Machine Study

All students in the class were asked to use the vocabulary artifact (detail) that was developed from the group's motion and light study as the launching off point for the airport terminal building design project. Students first developed their grand main space for their airport terminal using the lessons learned about motion and light machine study. After students developed the main space of their building, the remainder of the project was developed.

One student's project and the respective thought and design process follow:

Rachel Glabe's Reflections on The Design Process[5]

Early Light Motion Studies

The early light box studies of light and movement inspired my precept of the activation of space and how an environment can best showcase a particular use. This translated into the airport project, driving the design process and influencing the configuration of spaces/program, as well as influencing the vocabulary. Throughout the design process, I used both digital and analog media. This proved very beneficial as each helped me to develop certain areas of my project. It was easier to digitally explore multiple variations and take multiple immersive views to get a better feel for the special qualities. Building analog models at various scales helped me to see the project in different ways and work out real connections.

Project Concept

The airport integrates plane and building to create an interactive space (continuation of the initial "light machine" study). Rather than connecting to the building externally, the planes are brought into the building underneath the grand space. The airport celebrates the plane by adapting it through the configuration of spaces, and the constant transformation that takes place throughout the day as the building's kinetic steel components extend to meet the plane.

Prior Digital Modeling Experience

Prior to taking this instructor's course I had some experience with computer modeling programs, but my skills were limited. Throughout the quarter, I built up my digital skills through each stage of the process. The first couple weeks forced me to use more digital and I became more comfortable with computer modeling as the quarter progressed. I focused on how to set up the lighting and apply materials in the modeling program. As my project progressed, I found it necessary to render my digital models to achieve

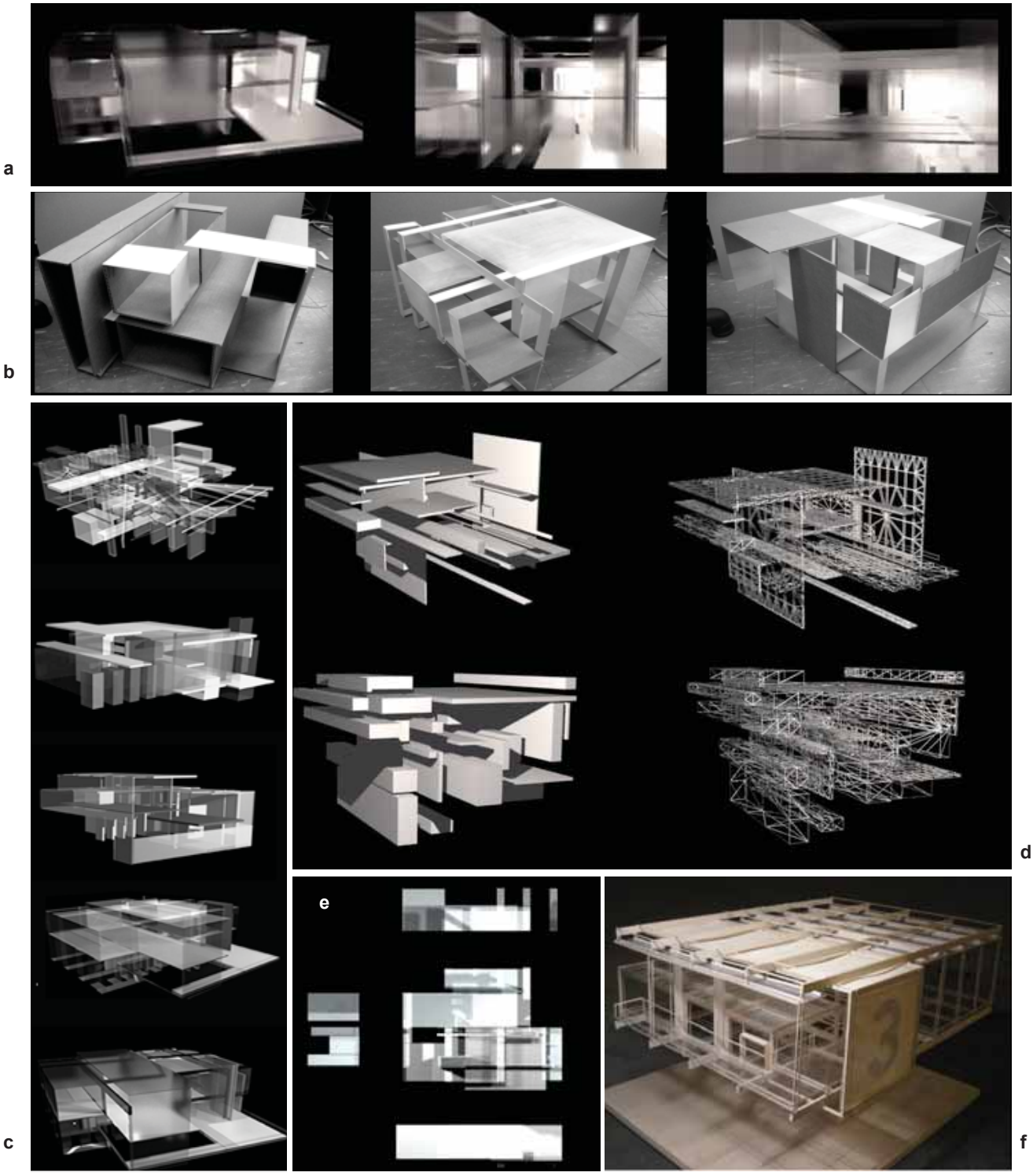

Figure 6: Rachel Glabe's building design process that evolved from Transience Light Machine group's vocabulary. (a) Stills of digital animation for the study of light. (b) Analog vocabulary models for the study of light. (c) Project vocabulary evolution. (d) More digital vocabulary study iterations. (e) Digital vocabulary developmental skin studies. (f) Physical model detail views of airport terminal.

the desired material properties and appropriate lighting. Before taking this class, I felt overwhelmed by digital media, but after a lot with both programs and figuring out a system, I feel much more comfortable.

I started the design process experimenting with light and movement and the effects they had on the larger environment, studying how the light box itself could best showcase what was inside. I carried this through into my precept in the development of the inhabitable tectonic detail. At this stage I focused on the configuration of shapes and spaces, as well as materiality. When I began the process of designing the airport, I thought about how an airport could best showcase and celebrate the airplane, and decided that the planes should be brought into the space.

Program development

As I began to develop the program spaces, I arranged the volumes around the planes to explore various configurations. I first started by building analog volumetric models and manipulated them digitally, which allowed me to explore different options more quickly. During this stage of development, I was also focusing on circulation and progression through the space. My next step was taking the program configuration and beginning to explore the building's vocabulary through a series of analog and digital study models. Creating positive, negative, and hybrid studies was helpful in generating interesting alternatives. Working out the program configuration and vocabulary made things easier when I began modeling the airport. Looking back on the process, I shouldn't have spent so much time agonizing over earlier study models, because it seemed like the stronger studies were the ones that I did faster and more intuitively. This process really helped me to focus on each aspect of the project as it related to the whole and my concept, making for a much more refined final product.

Project refinements

The midterm review was very helpful in that it helped me to pinpoint what needed tweaking and what I could do to take the project further. The feedback that I received focused mainly on how I could best convey my concept and how to most effectively bring the planes into the building. After the review, I concentrated on refining each part of my project. I refined the structure, skin, details and connections to make the design stronger. I pulled the steel structure outside the building to better express the horizontal extension out toward the runway, and developed connections for the glazing to hang from. One of the most important modifications I made was making the floor of the grand pace completely transparent rather than translucent. This slight change really transformed the grand space, providing an unobstructed view of the planes below.

Reflections

Going through this specific design process this quarter was very beneficial. The earlier light machine studies provided a good foundation for the process and the airport project. The use of both digital and analog tools helped me to really understand my project better and develop stronger skills in both areas. I really enjoyed each stage of the process, especially after realizing the importance of and opportunity in each step. This quarter I learned how to most efficiently and effectively approach a design project, as well as how important it is to stay focused in order to really move forward. I am anxious to apply this process to future projects.

References

[1]. Fowler, "The Tectonics Motion, Light, and Space", 2006 **form•Z** Annual Publication, AutoDesSys, Inc.

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

[3]. Fowler, Muller, Skin and Light, ACSA West Conference 2003.

[4]. Fowler with Bermudez, University Of Utah, Bennett Neiman, Texas Tech University, "On Improvisation, Making, and Thinking", October 2005 ACSA South West Regional Conference Proceedings [Conference Cancelled, but proceedings published].

[5]. Glabe, Rachel, Final Journal Reflections on Design Process, Fowler's Third Year Design Studio, Winter Quarter 2007, March 2007.

Thomas Fowler, IV is teaching third year design and building technology courses, and is directing his digital media facility founded in 1997, called the Collaborative Integrative-Interdisciplinary Digital-Design Studio (CIDS). This facility provides students with access to the latest digital technology for use in the design and constructability process. He has received a number of awards for his teaching and research activities, including Architecture Department's Faculty Teaching Award, 2005, nominations (2000, 2001) for U.S. Professor of the Year Award, Young Faculty Teaching Award, ACSA/AIAS, 1996-'97, 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 grants for his research. Recently his essay "A Teacher's View",was published in Becoming an Architect, edited by Lee Waldrep, Wiley 2006. He has also served as Associate Head of Cal Poly's Architecture Department (2001 2007), as ACSA's Secretary to the Board (2004-2006), on the National Architectural Accreditation Board (NAAB) as an ACSA representative (2007-2009), and has participated on NAAB visitation teams to 15 programs (5 of these he chaired) around the country.