California Polytechnic State University
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# Intimate and Transparent Production of Space

by Thomas Fowler, IV

This paper illustrates the design work from an integrated third-year Architecture Design Studio and a Professional Practice (a.k.a., project constructability) Studio. There are two parts to this paper. The first part shows how students were involved in a collaborative interdisciplinary project with New Media Arts students in the Liberal Arts Department on campus. Students in collaborative teams designed and constructed a temporary pneumatic structure to house a virtually interactive technology called "Intimate Transactions". Lessons learned from this design build collaboration in working with the inventor of this technology system, along with the reading of a range of essays on new media design, and additional vocabulary generation exercises provided a launching off point for each of the architecture students' individual design projects. The second part of this paper shows the follow on building design process and design reflections for one of the student's studio projects (Jeff Hammerquist, who received the 2007 **form•Z** Honorable Mention Design Award for his Satellite Automobile Assembly Plant project).

Assigned activities in both the Design and Practice Studios 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 (1,2,3,4). In the case of this particular quarter, much of the lessons learned by students about experiential aspects of interactive digital space were acquired from the process of determining the spatial needs for housing a technology system called "Intimate Transactions". In meeting with this technology system developer, along with working in collaboration with New Media Arts students (the university's film students) and the short and very intense period of time for the actual design and construction of this space, many lessons were learned for translations for individual design studio projects.

## 1. Intimate Transactions Space (Figures 1-11)

The "Intimate Transactions" technology allows for two people, in separate locations, to interact with each other in an immersive digital environment. Spring Quarter 2007, students in this instructor's Third Year Spring Quarter Design Studio worked with a colleague in the New Media Arts and English departments, Professor David Gillette, along with a visiting digital installation artist, Keith Armstrong, from Queensland University of Technology in Brisbane, Australia. Keith developed an interactive technology system called Intimate Transactions. Students had only three weeks to figure out how this technology system worked along with designing and constructing a temporary theatre space to house it. Notions of Archigram's (1960s experimental architectural firm) [5,6] plug-in and Instant Cities, the Living Pod, and Airships very much did set the tone for the development of this structure.

Intimate Transactions [7] allows for each participant to climb aboard a device called the Body Shelf (similarly to a computer mouse that you stand on – Figures 1, 2), which tracks their movements as they travel through a virtual world and interact with one another through a live Internet connection. The body shelves can be in two different rooms in the same building, or on different sides of the planet. The participants are also each immersed in a

***Figure 1:*** The Body Shelf, with author's six-year old daughter, Hannah, using it.

***Figure 2:*** The Body Shelf in use.

***The Design Concept***

***Figure 3:*** Concept models for pneumatic structure.

***Figure 4:*** Montage of pneumatic structure in architecture building's stair court.

***Figure 5:*** Physical model of pneumatic structure.

***Figure 6:*** Detail of proposed pneumatic structure.

***The Construction Process***

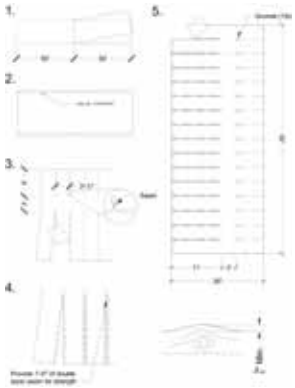


***Figure 7:*** Construction drawing for the polyethylene skin configuration.
Drawing by Jef Hammerquist.

***Figure 8:*** Polyethylene being rolled up to hoist into place.

***Figure 9:*** Students using the heat-sealer to connect polyethylene material.

complex sound environment comprised of an advanced surround sound system of eight large speakers combined with small, wearable speakers that send sound vibrations directly into the body of each participant. As participants move on the body shelf, their body motion is tracked and allows participants to mix the sound for the system on the fly, thereby creating a different sound experience with each new use of the system. One of the goals of Intimate Transactions is to provide participants a first-hand experience with cutting-edge interactive technology, while also teaching participants about the importance of sustainability and collaboration as they interact with each other to create a beautiful and sustainable virtual environment of light and sound.

## Background

Intimate Transactions is a multi-award winning new media work created by the Transmute Collective, a group of internationally recognized media artists, performers, sound artists, programmers, scientists and system designers with other designers and technologists at the Queensland University of Technology in Brisbane, Australia. Intimate Transactions has been presented in many shows across Europe and Asia, and was recently selected to represent Australia in the China International New Media Arts Exhibition accompanying the 2008 Olympics program in Beijing. Due to the work that the Cal Poly Architecture and English/New Media Arts students and faculty have contributed to Intimate Transactions, Cal Poly, San Luis Obispo has now been added as a "performance node" for the Intimate Transactions Olympics show in 2008. This connection between Cal Poly and Beijing installations of Intimate Transactions will be the only live and completely open interactive Internet link between the exhibit participants in Beijing and the United States.

Due to the limited time and funds, it was decided to create a pneumatic structure to house one of the body shelves of the Intimate Transactions technology system for Spring Quarter 2007 design and construction installation (Figures 3-9). The second body shelf was housed in a space on the third floor of the architecture building. The idea was to simulate collaboration over at network over a long distance. Students worked in teams to generate design concepts and the design that was selected and ultimately constructed was the one that proposed to develop a double-skinned space that would fill the vertical void in the stair court of the building. An aluminum scaffolding structure was also built to help support and contain the pressurized pneumatic structure. The interior skin (the black polyethylene material) related to interaction of the person occupying the body shelf in this interior space. This space had to be free of outside light, so the video projection system would work well. There was also an initial idea that when the inhabitant entered or exited this inner space, the envelope of the pneumatic structure would collapse or inflate (depending on whether the person was leaving or entering) due to the opening or closure at the entry point. Several students thought it would be even more interesting to have the space pulsate in sync with the movements of the inhabitant on the body shelf – but not enough time to work out the details for how to get this to work. The outer skin (the white polyethylene material) was an attempt to reflect what was happening on the inside space by the projection of live data from the

***Figure 10:*** Final installation in the architecture building's stair court, views from the first and second levels.

body shelf via a range of video projectors. The finger-like details of the outer pneumatic skin allowed for an ability to walk between the two skins and to also see aspects of the inner black skin from the outside of the structure.

**The Construction Process and the Installation** (Figures 7-10)

There was an estimated quarter of a mile of polyethylene material used for the construction of the pneumatic structure skin along with an endless amount of time that the students devoted to heat-sealing (Figure 9) the seams together.

## 2. Production Space

*"Thinking, no matter how clear or correct, is not equal to actual doing. Exercising improvisation and intuition cuts through all of the pre-thinking and delivers us into ordinary processes readily accessible to designers, and therefore a more useful response to "real world" situations."*

Based on the lessons learned about interactive space from the design and construction of pneumatic structure, early diagramming of digital space and readings on the theory of interactive space students were provided as a beginning point for developing the Satellite Automobile Assembly Plant. The site was located at the south end of the parking lot for the South Campus of the Art Center in Los Angeles, California. This facility was designed to allow students to test car design ideas by constructing them in this facility.

**Group Exercises 1-3 Analog & Digital Vocabulary Building** (Figures 11-13)

In groups, students work together using a several-step analog & digital process based on Bauhaus principles of craftsmanship and visual perception [1,2,4] for analyzing a particular source image by Char Davis. The dissection of these images provided students a way of a having an integrated full body immersion, interactive 3D digital imagery and sound, and navigation via a breathing interface…Char Davis' works do provide a radically alternative approach to immersive virtual space…[8,9]. A strict set of guidelines applied the foundation principles of the Wassily Kandinsky

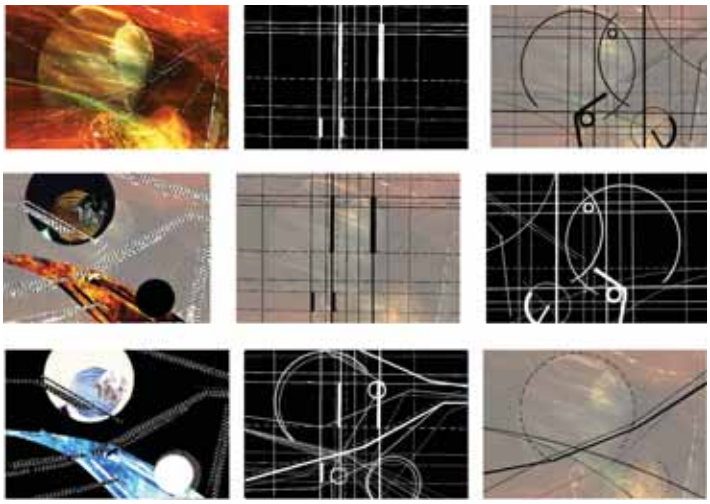


***Figure 11:*** Group warmup exercise 1: Analog diagrams of source image.

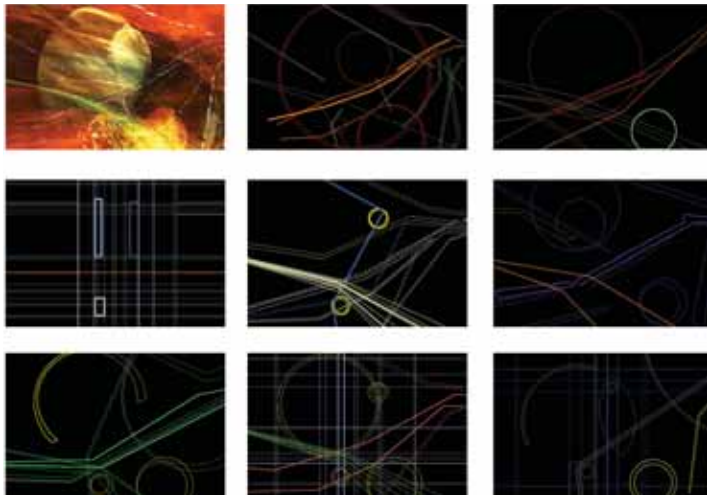


***Figure 12:*** Exercise 2: Digital diagrams.

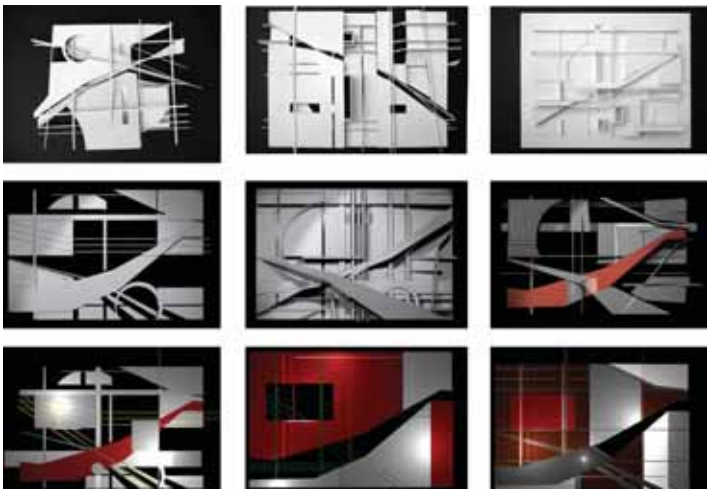


***Figure 13:*** Exercise 3: Digital relief models.

***Above images*** by Jeff Hammerquist, Zhong Ren Huang, Karen Kemp, and Bradley Chicone.

method of analytical drawing that breaks a still life composition into diagrammatic forces to express tension and geometry. Each step alternated between analog and digital media. This exercise started with still life images, then to acetate overlays, to analog/digital diagrams, analog/digital relief models and ended with a spatial manipulation device. The outcomes from these group projects provided a foundation vocabulary for individual student projects [1, 2].

**Individual - Foundation Vocabulary Study Mash Ups (Jeff Hammerquist)** (Figures 14-20)

Students were asked to translate the tectonics of the 40' cube of the Intimate Transactions space along with their interpretations of the group vocabulary studies as a strategy to develop a series of mash ups (e.g., a collision of both studies) for responding to the project site.

**3. Reflections on Design Process by Student, Jeff Hammerquist [10]**

## Project Concept

Transparent Production — The Satellite Automobile Assembly Plant was designed to showcase and expose the production process of a twenty-first century car. By focusing an audience on these transformations, it will help them quantify the volume of resources that go into the fabrication of a car.

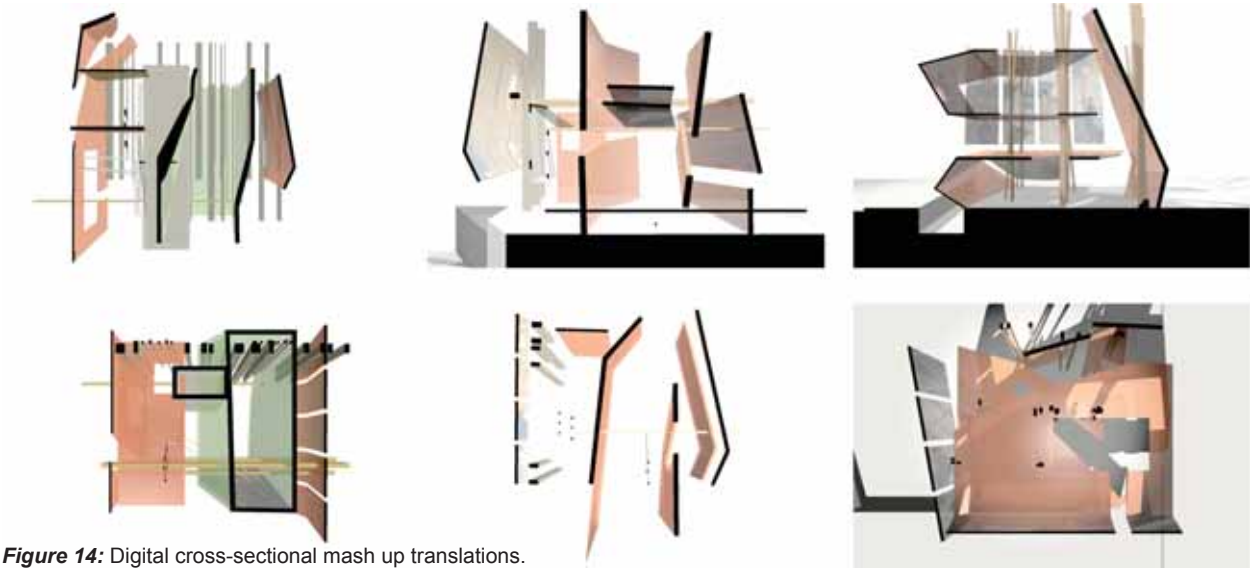
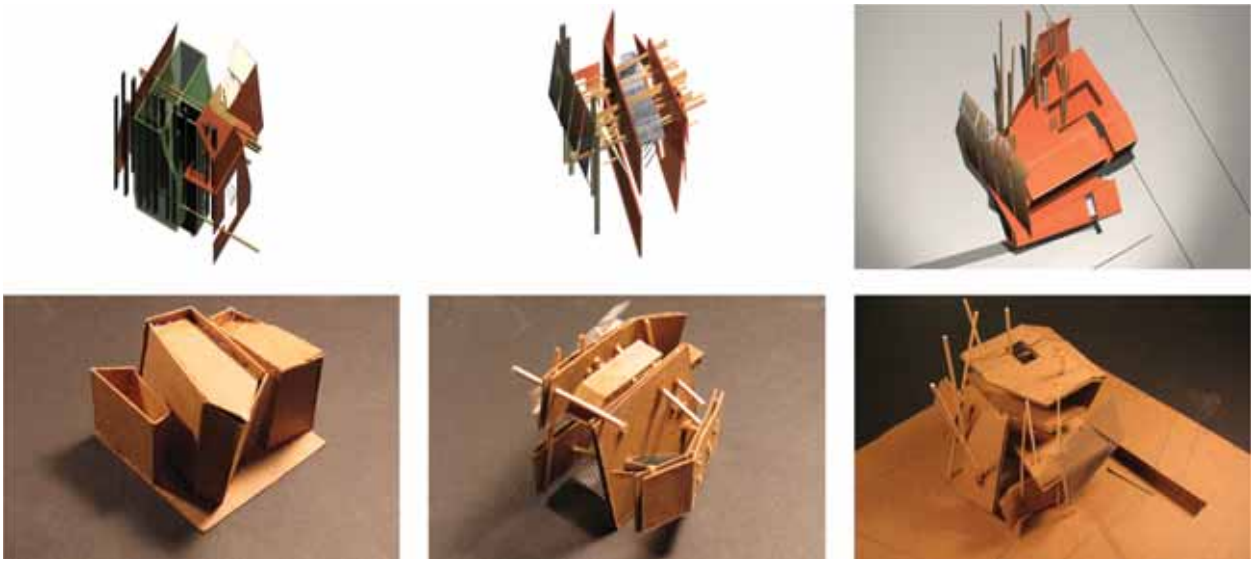


***Figure 14:*** Digital cross-sectional mash up translations.

***Figure 15:*** 3D physical and digital model mash up translations, both by Jeff Hammerquist.



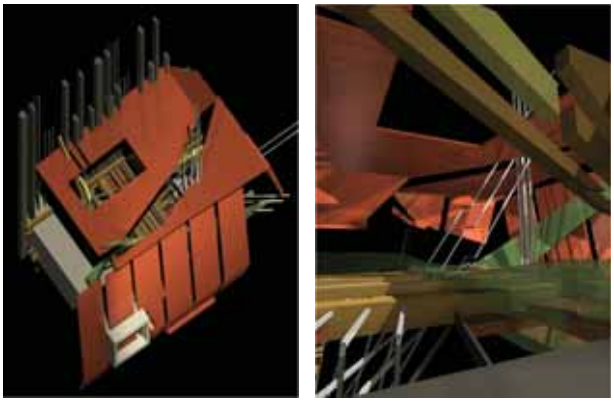


***Figure 16:*** Initial digital axonometric and immersive view of axonometric vocabulary model mash up (between intimate transactions cube and group vocabulary study), by Jeff Hammerquist.

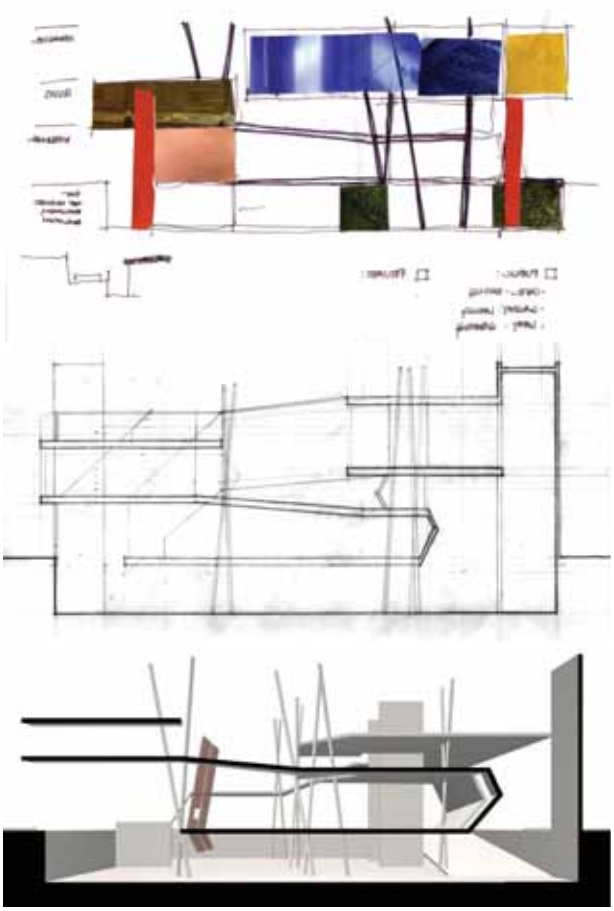


***Figure 17:*** Studies of Satellite Automobile Assembly Plant, by Jeff Hammerquist. (a) Analog vertical cross-sectional collage. (b) Refined analog vertical cross-section drawing. (c) Refined digital cross-section drawing.

## Process Overview (Figures 16-23)

My process was characterized by taking my project through a series of translations (mash ups) between representational types and media. These translations allowed the project to evolve and adapt to a formal vocabulary, programmatic requirements, site considerations, and an approach to structure and skin. While these elements were at first unrelated (i.e., the design and construction of the pneumatic structure for Intimate Transactions interactive technology, the analysis and dissection of the Char Davis Immersive image) they all began to inform each other, eventually coalescing into helping to evolve and formulate one cohesive concept. This was particularly true for how the vocabulary and program for my project developed and how this had a key role in how the project evolved.

I came into this class with significant previous experience using **form•Z**, mostly from when I was a first year student. Although my modeling ability has improved dramatically during this quarter, being familiar with the program helped immensely. Early in my process, digital modeling provided a quick way to generate formal vocabulary. I constructed initial diagrams with AutoCAD, which I found to be most useful for two-dimensional drafting. Once I began to work in three dimensions, I moved the diagrams to **form•Z**, where I used them to generate three-dimensional shapes. Both by duplication and by Boolean operations, I was able to quickly generate positive, negative and hybrid vocabulary alternatives that retained the initial shapes and vocabularies derived from the diagrams, but differed significantly from each other.

Later in my process, I used the **form•Z** digital model as a tool to complement physical modeling and hand drawing. Digital immersive views gave me a new view of the project, helping me see opportunities not apparent in other modes of representation. The digital model also facilitated analog methods by providing a consistent reference to the project's geometry. I used this by printing out templates for drawing or cutting, eliminating the need to measure.

While I have always considered the computer to be an essential tool in my design process, I have learned to be wary of the digital models lack of scale. Since a digital model can be zoomed in on… the way a physical model

***Figure 18:*** Analog vertical cross-section collage drawing study of Satellite Automobile Assembly Plant, by Jeff Hammerquist.

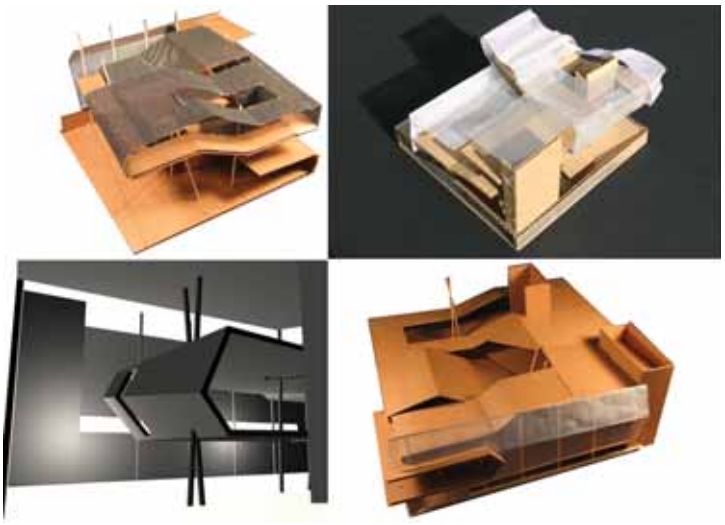


***Figure 19:*** 3D physical model translations and immersive view of digital model of Satellite Automobile Assembly Plant, by Jeff Hammerquist.

cannot, one can easily waste time by focusing on details too early on in the project (whether it's analog or digital media) that are irrelevant to the larger scope of design approach. I have improved my ability to recognize this tendency, and to change to a different media before I begin wasting time.

I actually began my design process in assisting with the collaborative design and construction of the pneumatic structure and continued my discovery of space through the analog and digital vocabulary building exercise. These two experiences gave a different sense of how to develop my ideas for developing a production space for the design and manufacturing of cars. Going back and forth between using the digital and analog media and generating numerous iterations during various stages of the design process was very helpful in getting me to commit to a project vocabulary early on in my development process which was an essential step in providing an opportunity to develop and refine it.

To explore program, I built several analog program models exploring different ways the programmed spaces could be arranged to work with the site and with my concept of 'transparent production.' This helped me gain a physical understanding of the proportional relationships between different parts of the program, and how much room they occupied in relation to the site. These models were important because they showed my approach to program in a simple diagrammatic way, providing a reference for later stages of my project.

The feedback I received from the midterm review primarily focused on the introspective nature of my project, and how the interior courtyard space worked not only as an observation platform, but also as a stage. I addressed this criticism by placing the café in the center of the space, providing a spectacle for those in the surrounding spaces to enjoy.

This class led me to realize the importance of thinking through doing, providing a physical record of the design process. Design is really the art of making decisions. Since the quality of a design is defined by how well it addresses the conditions present during its physical existence, the quality of a designer is defined by how many of these conditions he or she can discover and address. Since the enormous amount of information we as designers need to process is far too complicated for us to store in our own memory, it is essential that we develop a way of storing it in artifacts that we can reference as we face the myriad of decisions inherent in design. During the class, I found that by physically recording the trail of my process, diagramming, physical models, and constant written reflections were best at keeping my previous discoveries and decisions in my design conscience when I made new decisions. Working between drawings, the computer, and physical models also kept me aware of these different aspects of the project by continually changing my point of view.

I expected to learn how to generate form in this class before I entered it. After completing the quarter, I would say that more than learning how to generate form, I learned how form influences and is informed by program, site considerations, and other forces to create a complete project. This cross-pollination is much more important to a project than any pre conceptions of a vocabulary we may harbor. This intensive approach to handling vocabulary and form is the best thing I will take from this class.

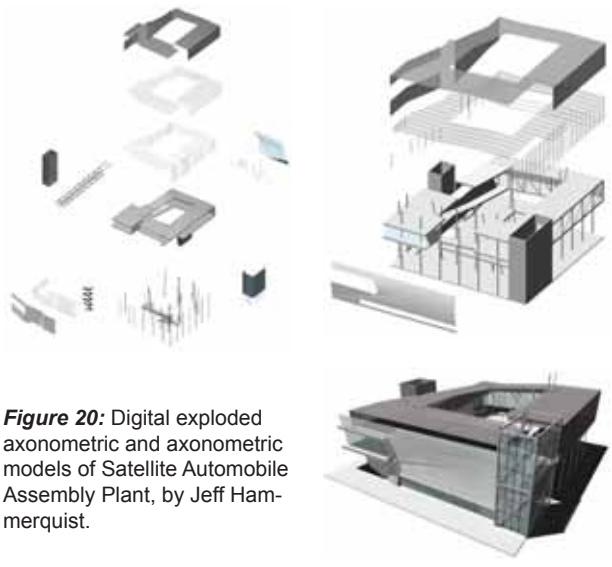


***Figure 20:*** Digital exploded axonometric and axonometric models of Satellite Automobile Assembly Plant, by Jeff Hammerquist.

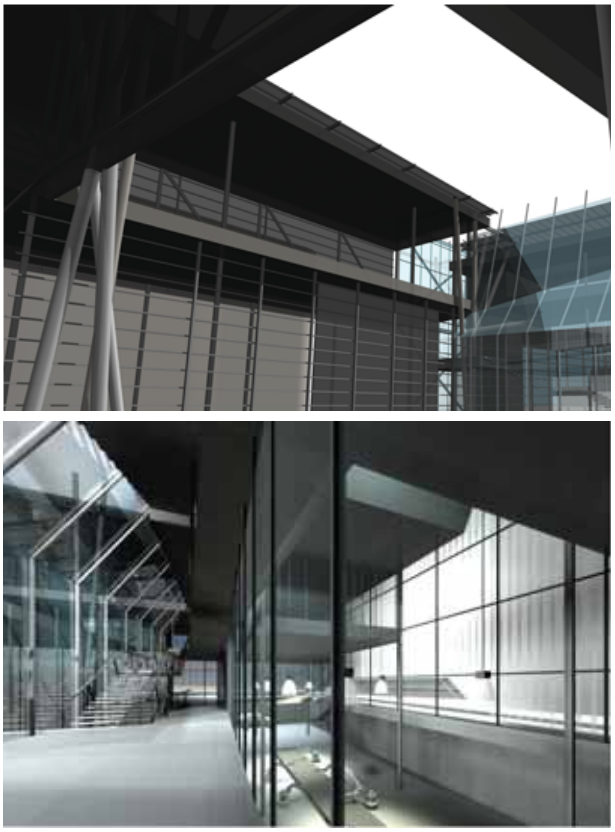


***Figure 21:*** Immersive digital view of Satellite Automobile Assembly Plant, by Jeff Hammerquist.

## Interdisciplinary Collaborations Background

Professors David Gillette and Thomas Fowler have been building these temporary theaters with the assistance of Architecture and English/New Media arts students over the last three years. The first theater was built for the University's Open House in 2005 and housed a developed virtual reality movie that allowed visitors to also interact with the movie by creating 3D virtual immersive drawings. These temporary theaters are proof of concept projects for the evolving Lumiere Ghosting Device <http://ghosting.calpoly.edu/> project. The Lumiere Ghosting Device is an ongoing project for developing a low-cost portable theatre that will allow for individuals to have fully immersive virtual reality interactive 3D cinema theater connection to other Lumiere Ghosting devices through a high-speed Internet connection.

The concept is for the participant in each Lumiere Ghosting device to see, talk to, and freely interact with other participants from distant locations who are represented as full-scale 3D interactive puppets modeled on the actual images of the live participants. All participants share the use of the same virtual environment in each device (theater), which can be used for open collaboration, artistic expression, gaming, training, and various forms of cinematic storytelling. Participants in the device also interact in this shared virtual environment with a number of artistic

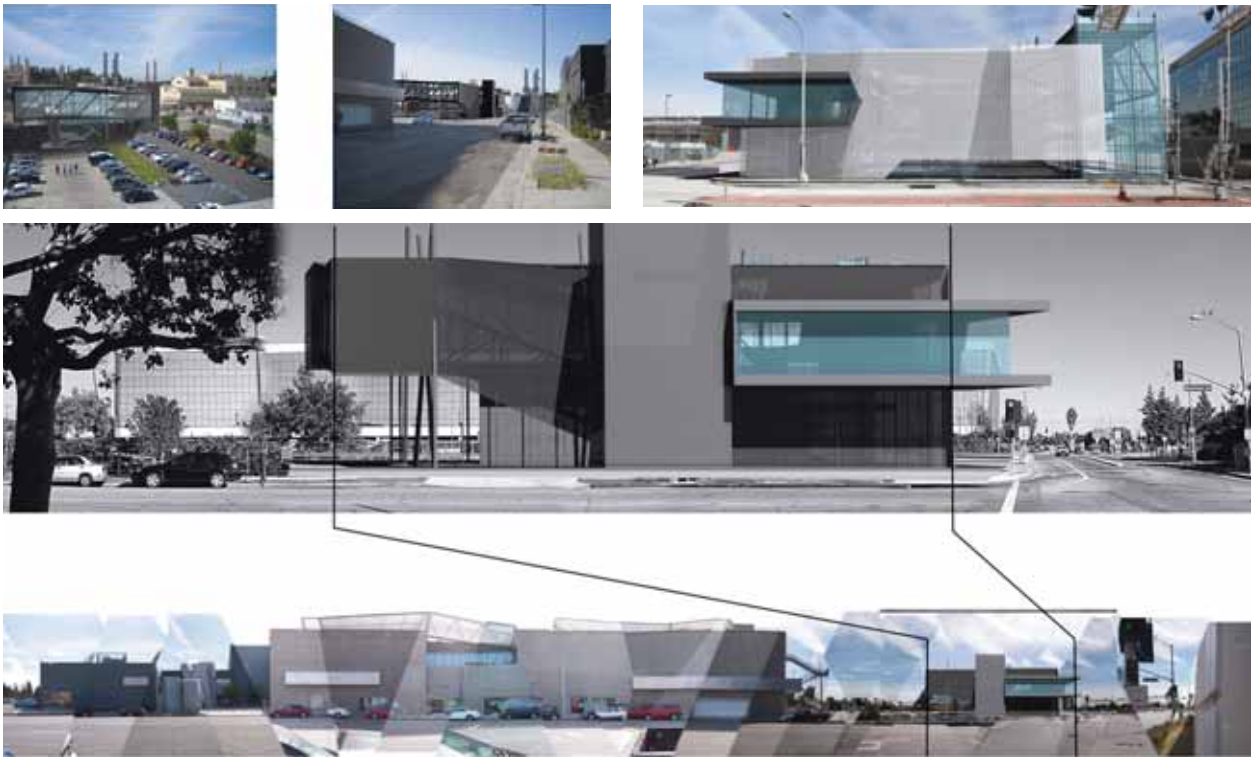
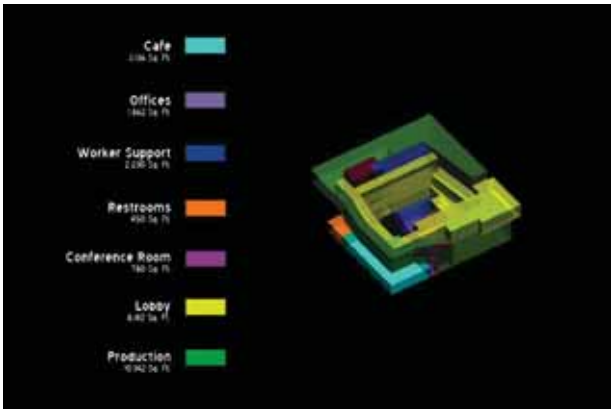


***Figure 22:*** Digital model of Satellite Automobile Assembly Plant shown in context, by Jeff Hammerquist.



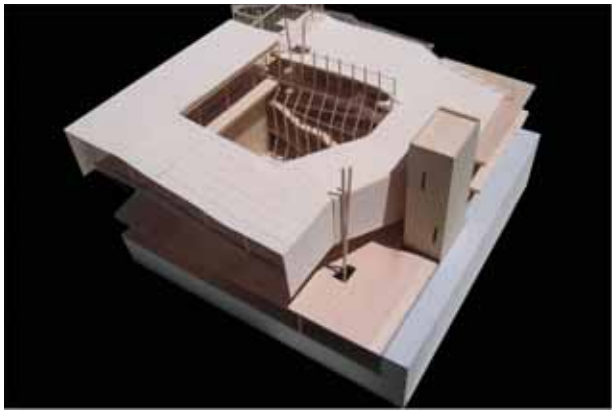



***Figure 23:*** Digital diagram and program model of Satellite Automobile Assembly Plant, by Jeff Hammerquist.

data visualizations (Blog ghosts, video storm clouds, global beach balls, data mosh pits, virtual architecture spaces) created out of samples selected from a continual stream of live data gathered from every part of the Internet.

The Lumiere Ghosting device essentially creates a cinema-like environment in which individuals can easily interact with live participants and with video, audio and textual data gathered from all over the globe. This system is an innovative integration of live 3D digital display and artistic data visualization techniques combined with non-invasive motion tracking technology, connected through a high speed Internet connection that allows for a seamless exchange of interactive data from one Lumiere Ghosting device to the next. Making use of recent developments in higher processing speeds and smaller computing and projection systems, the Lumiere Ghosting device is designed to be portable so the entire device (theater) can be built, calibrated, connected to the Internet and fully operational in an afternoon, using a small technical crew of three or four people.

## Credits for Construction of Pneumatic Structure

There are many people to thank for helping with the construction of the pneumatic structure for the Intimate Transactions technology system installation during spring 2007. Thanks to the College of Liberal Arts for inviting Keith Armstrong to Cal Poly. Thanks to David Gillette and Keith Armstrong for their interest in working with my architecture students in the development of the temporary pneumatic theatre structure. Thanks to Elbert Speidel from the Construction Management Department who provided students with an overview of how pneumatic structures work along with loaning us his heat sealer device which allowed students to piece together the polyethylene material. Also much appreciation to all of the instructor's design studio students (Bradley Chicoine, April Fame, Walter Garcia, Paul Goss, Matthew Granelli, Jeff Hammerquist, Ben Handy, Ren Huang, Tucker Huey, Jason Immaraju, Ahmadreza Kashani, Karen Kemp, Jai Kumaran, Ryan Lamb, Arthur Loh, Guillermo Perez, Jason Pignolet, Alexander Polzin, and Lulu Saleh) for spending the long hours in the design and construction of this pneumatic structure (along with trying to get other things accomplished for class) in such a short period of time. Thanks also to all of the Media Arts students that were involved with this project.

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For a biographical summary of Thomas Fowler, IV, see page 41.