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".**

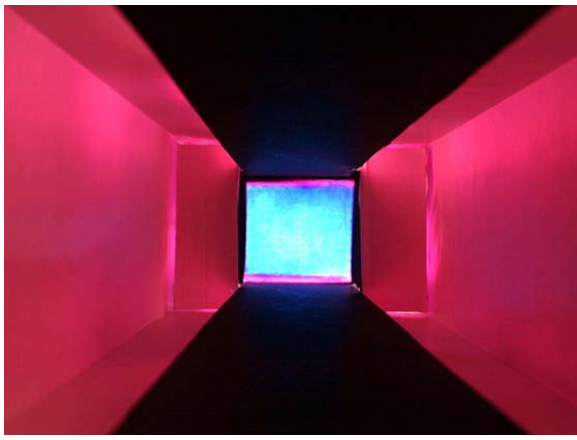

Figure 3: **Day Lighting Interpretation (Simulation at 12 noon) of Turrell's "The Light Inside".**

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

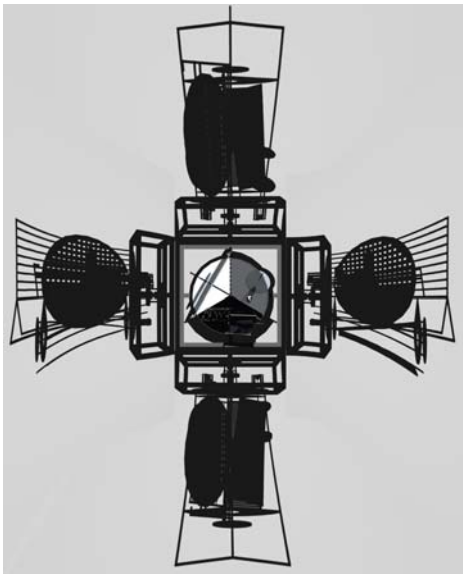

Figure 5: **Folded Out Digital Model Interpretation of Nagy's LSM.**

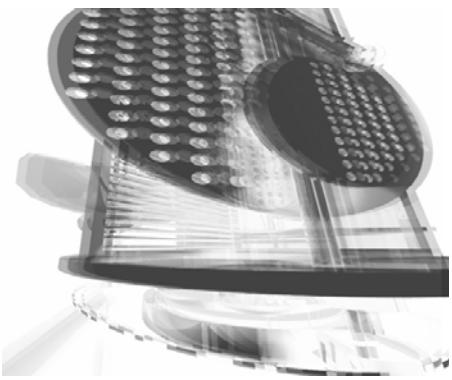

Figure 6: **Image from Moving Physical Model Interpretation of Nagy's LSM.**

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).

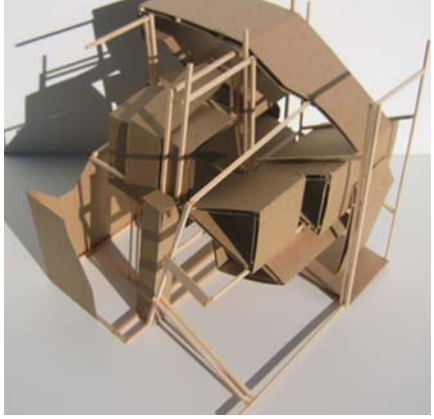

Figure 7: **Analog Model Interpretation of LSM, Ramirez.**

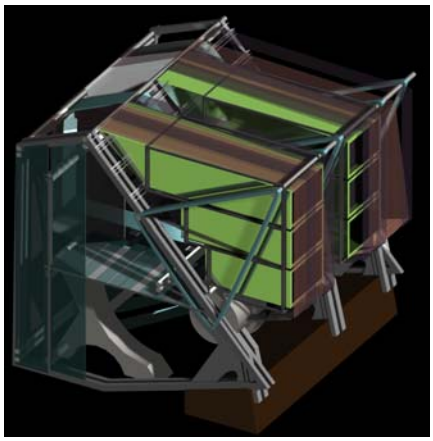

Figure 8: **Digital Model Interpretation of LSM, Ramirez.**

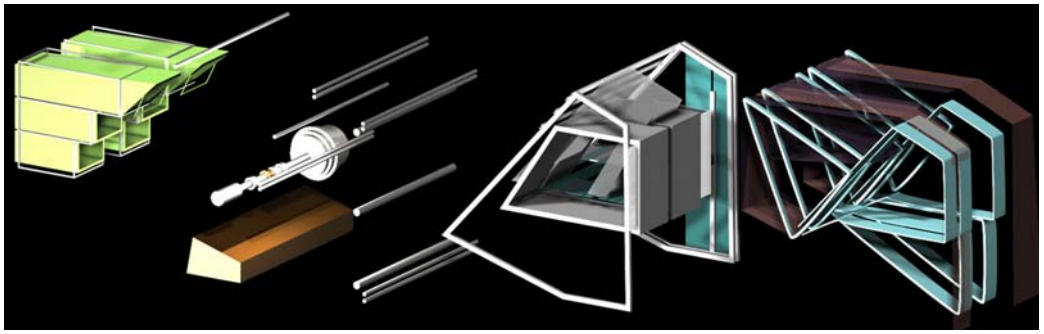

Figure 9: **Exploded Digital Model Interpretation of LSM, Ramirez.**

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).

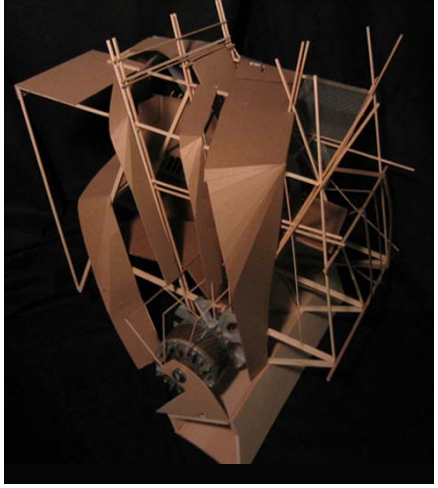

Figure 10: **Analog Model Main Space Vocabulary Study, View 1, by Sergio Ramirez.**

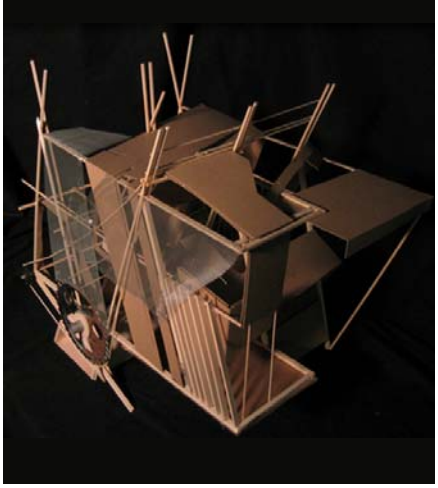

Figure 11: **Analog Model Main Space Vocabulary Study, View 2, by Sergio Ramirez.**

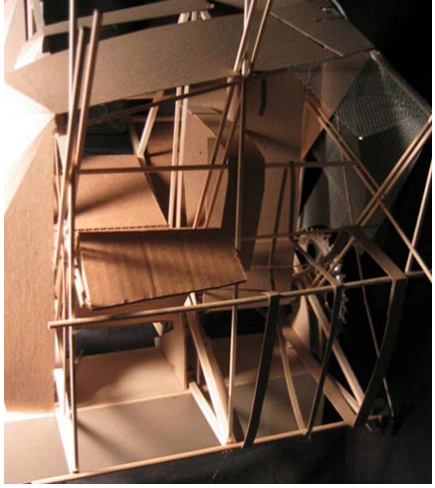

Figure 12: **Analog Model Main Space Vocabulary Study, View 3, by Sergio Ramirez.**

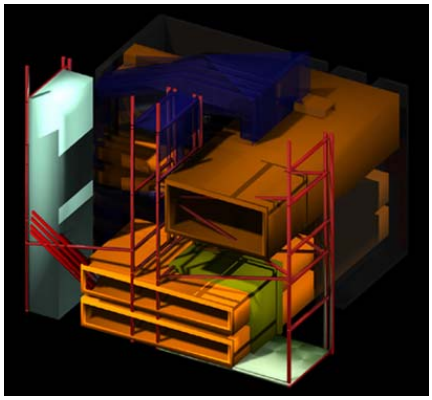

Figure 13: **Digital Model Main Space Program Study, by Sergio Ramirez.**

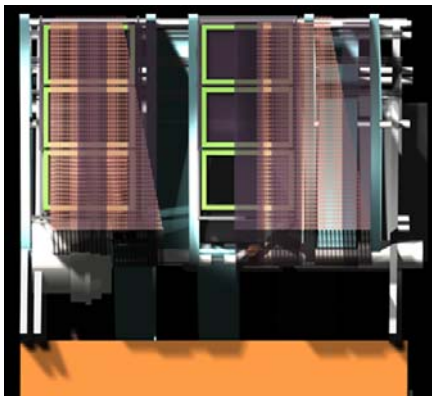

Figure 14: **Digital Model Main Space Skin Study, by Sergio Ramirez.**

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

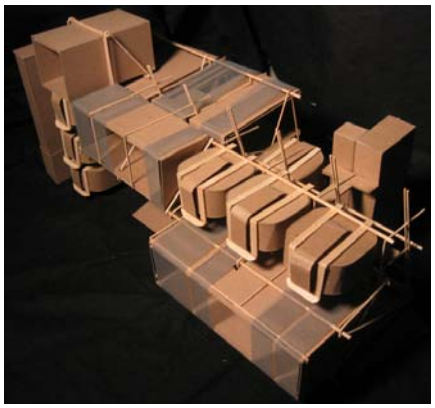

Figure 16: **Analog Model Study 1 of Entire Building, by Sergio Ramirez.**

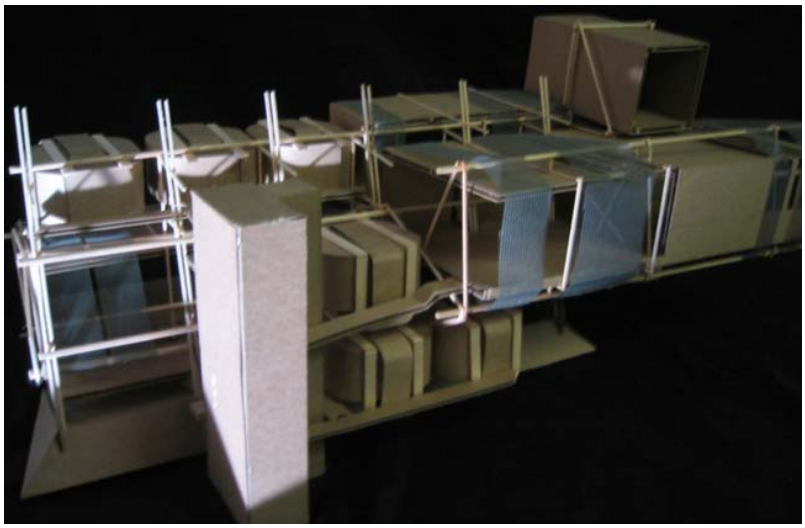

Figure 17: **Analog Model Study 2 of Entire Building, by Sergio Ramirez.**

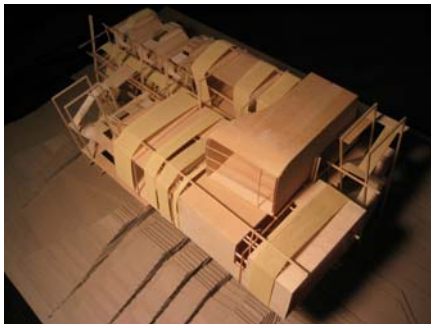

Figure 18: **Final Analog Model of Entire Building, by Sergio Ramirez.**

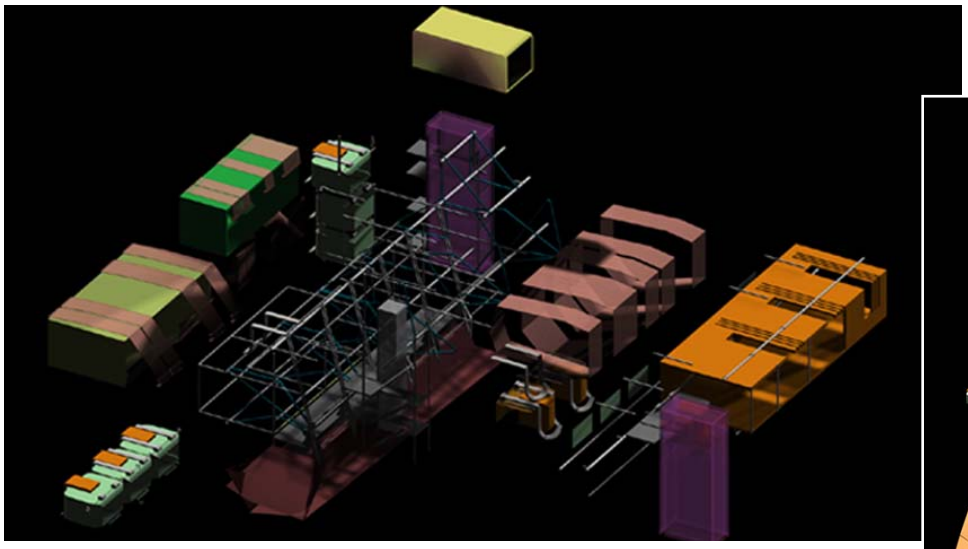

Figure 19: **Exploded Digital Model of Entire Building, by Sergio Ramirez.**

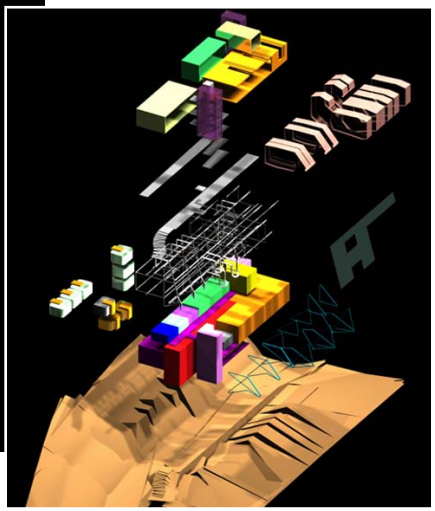

Figure 20: **Exploded Digital Model of Entire Building with Site, by Sergio Ramirez.**

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.**

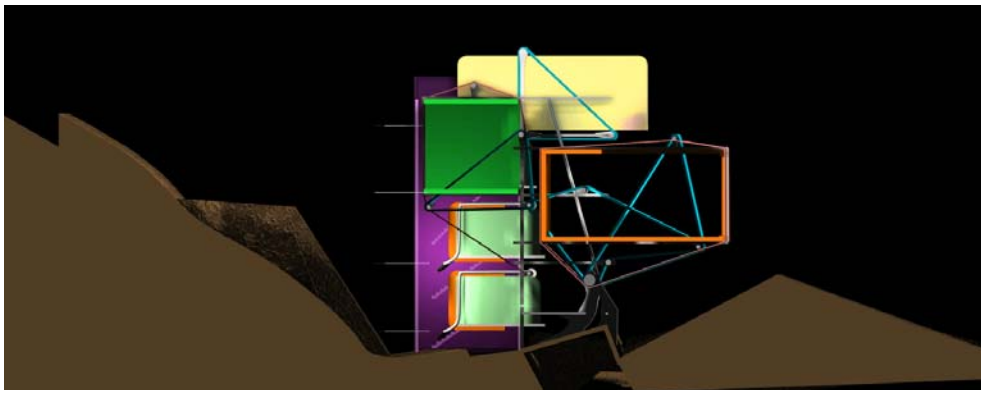

Figure 22: **Digital Cross-Section of Entire Building on Site, by Sergio Ramirez**

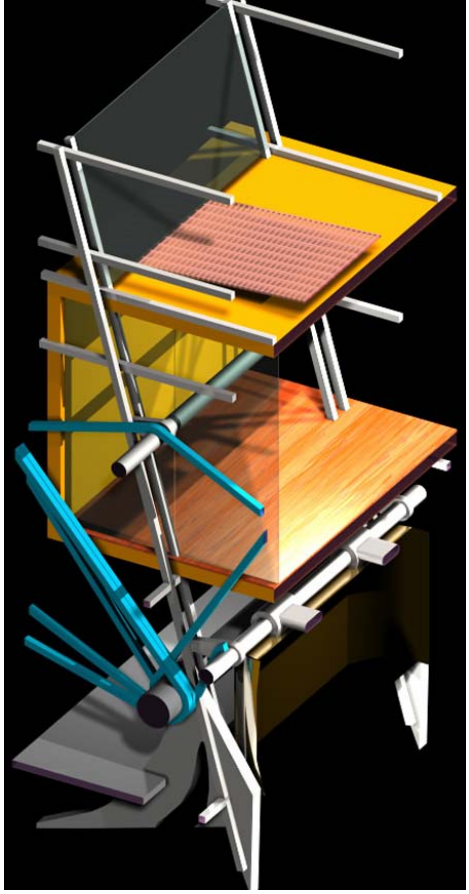

Figure 23: **Digital Wall Section, by Ramirez.**

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].

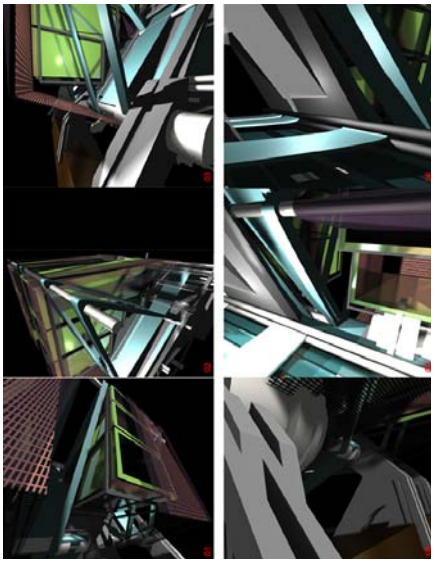

Figure 24: **Digital Wall Section Details, by Ramirez.**

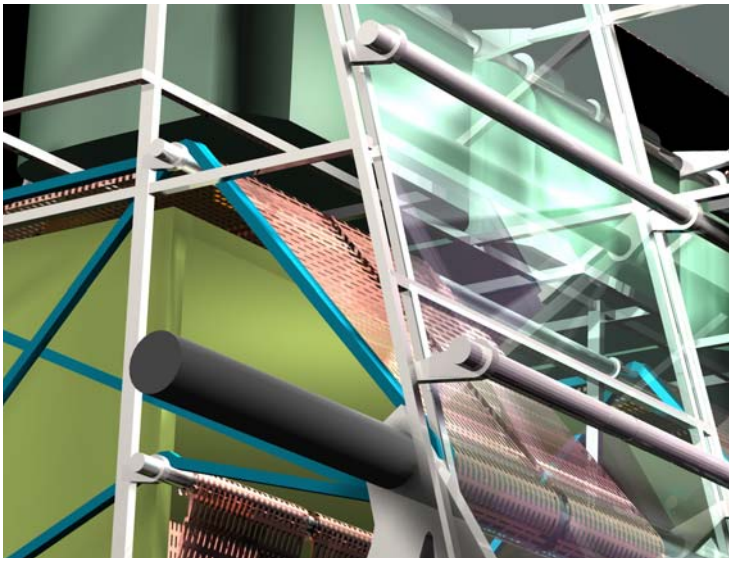

Figure 25: **Digital Wall Section Detail Close Up, by Sergio Ramirez.**

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.