

**Alex Porter** - Light and Shadow Final Report  
ARCH 410 | ARCH 423  
May 19th, 2011

## Intentions, Process, and Findings

At the outset of this project it was my intention to create a screen or panel system that would correctly mitigate light entering a research library space on the top floor of my terminal project student center. As a centerpiece for the larger campus this building needed to exhibit the sustainable qualities put forth in our campus mission statement, and make those attributes clear to the building's users. Early on I began to pursue a digital fabrication technique that could explore the inherent qualities of a material and generate a surface which would serve a dual purpose of creating dynamic and interesting light qualities while also serving as a compelling aesthetic piece. My logic was to create something that people wanted to touch, wanted to interact with, and that through this interaction a spatial emphasis would be created at the threshold of indoors and outdoors. By exploring the piece with their hands at the immediate edge, and moving parallel to its rhythm along the corridor students in the building would be drawn to notice the function of the screen.

This objective led me to two central investigations, one, an investigation of material, led me to explore several media and their ability to transmit/catch/reflect the slowly changing sunlight. The second exploration was an investigation of depth and a "shadow catching region". I was interested in investigating a digital fabrication process, spurred by the enormous body of work that is being completed with parametric software and the numerous conferences related to the topic occurring annually over the past few years. From my earliest explorations I married myself, for better or worse, to a CNC based process and explored the variability of light when incident upon or passing through a milled material. I first developed a screen of wood and evaluated the success of painting surfaces to catch and reflect light in different ways. Based on readings and a survey of contemporary projects utilizing digital process I became interested in a fractal-like aesthetic for the project, subdividing the wood panel's openings with translucent dividers. This exploration then manifested itself in a very ephemeral, and somewhat spooky, trace paper application that exploded the geometry of the wood screen into a series of 3 distinct layers. Each of these layers cast shadows on the next with the last serving as the canvas on which the picture was displayed to the user. It was during this time that I began to look at selectively admitting light by being deliberate about how and where I placed/designed the openings in the screen. These early explorations created compelling forms, but lacked the real application I had in mind for my building.

Moving up in scale in a computer generated format my process led me to conceive of these panels as full scale wall applications that could catch, reflect, and embellish the passing sunlight in a way that would create visual interest in the library's corridor. The first of these explorations were simply larger scale applications of my work in wood, and were not very successful in my own opinion. The screen needed to mitigate and diffuse the light without causing glare, but I did appreciate the way in which the light at specific times of day would be cast deeply over the sloped surfaces. This was intentional, and the thought of providing for specifically illuminated planes based on a known angle of sunlight owes its origins to Daniel Rozin's work. A problem that became apparent in the application of the form as a wood panel with an inset diffuser was glare. With a 50% WWR and an abundance of wood, a visually heavy and light absorbing material when unpainted, the panels stood out as glowing spots and provided less than ideal light to the space.

The final product is a wall system of self-similar shapes of translucent material nested within one another. Driven largely by an desire to create a mass-customizable wall system that could also be deconstructed and used elsewhere in the future these panels are separated from the building enclosure itself. My findings have led me to believe that this is a great solution in terms of the lighting effects, producing an entire wall of diffuse light with moments of point-light that recall the dappled effect of a shady park. However this solution is disappointing in terms of constructability and feasible material options.

This project continues to develop, reflexively informing my studio project and evolving to become an elegant and responsible solution to my design objectives. I am returning to the idea of the translucent panel nested within a similar shape of wood, and exploring options to paint and color specific surfaces to reduce glare and aid wayfinding in the project. Designing the planes and openings together to receive incident sunlight for specific times of year will be the next step in the project. This method upholds my previous explorations and objective to increase the users awareness of the outside environment and also provides design guidelines and direction that was lacking in the previous work.



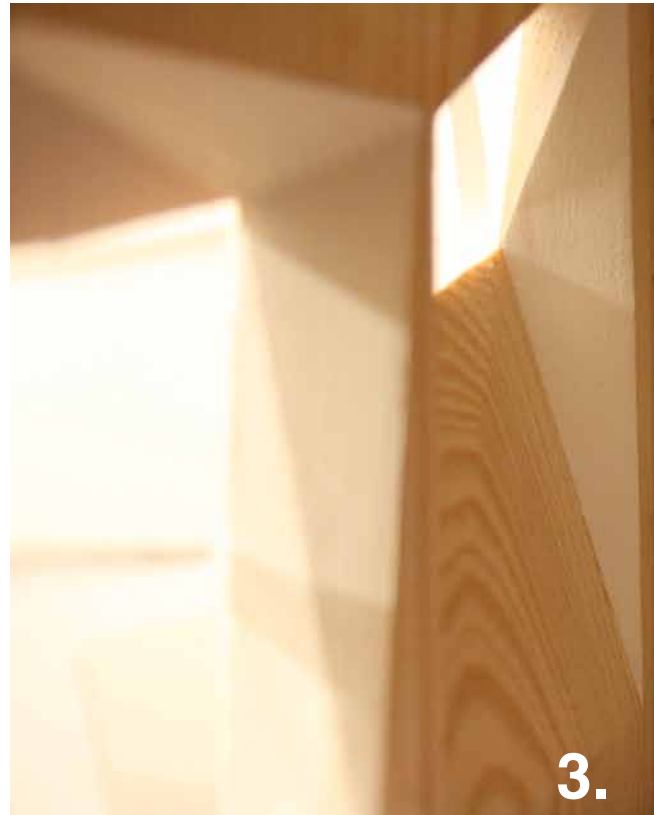
# Image Evolution of a Concept



Mill



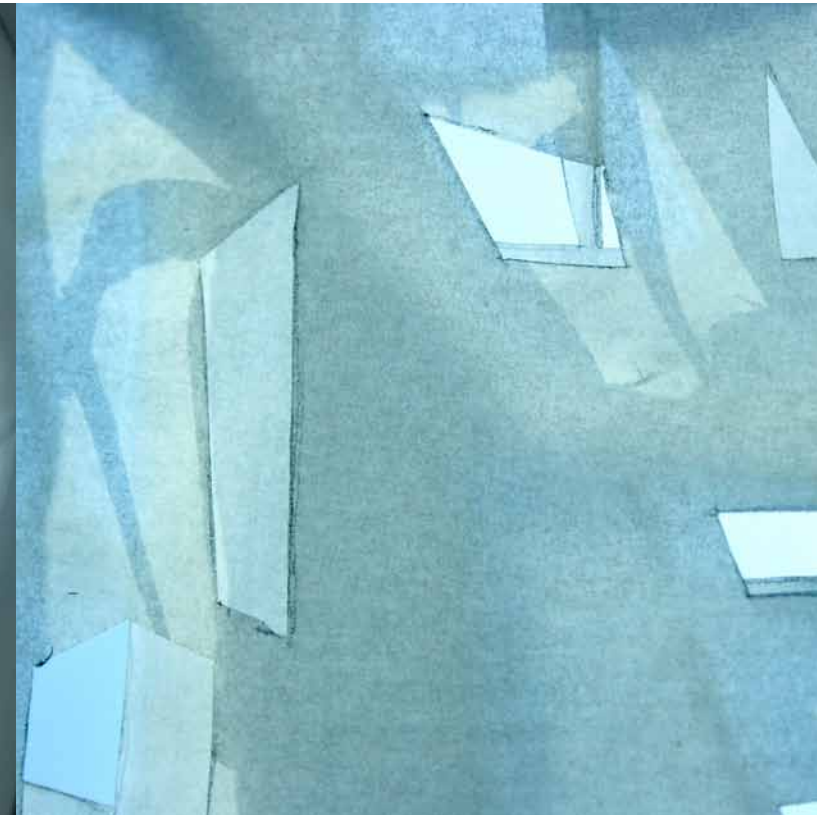
Wood edge light conditions



Paint and cast shadows



Explode geometry into layers

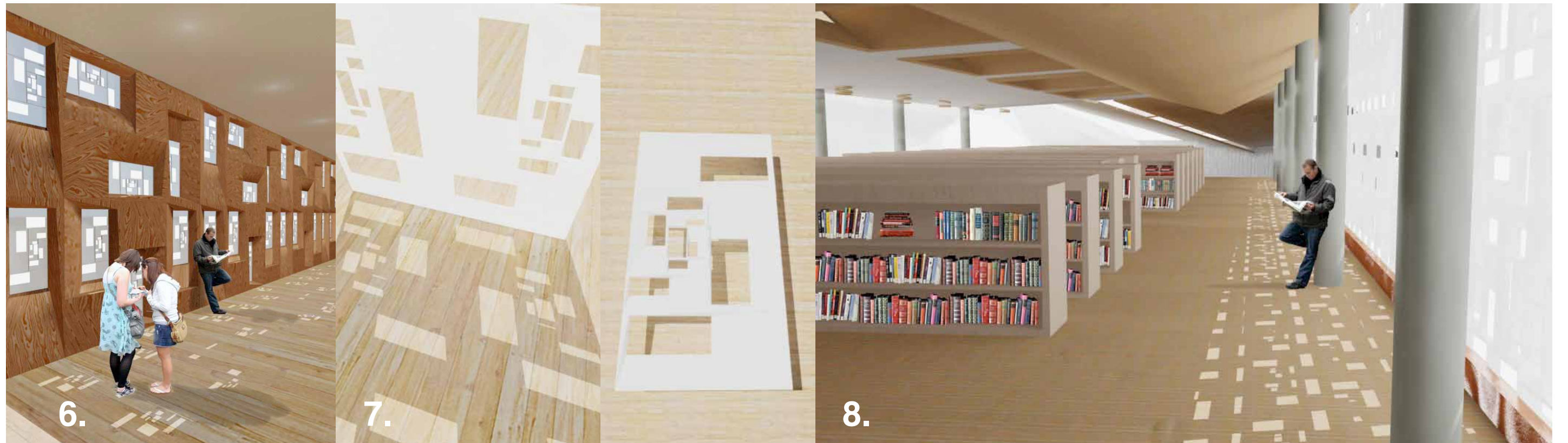






5.

Realize idea in acrylic



6.

Apply in fractal formation

7.

Evaluate as a single piece

8.

Product: panelized wall system creating dappled light and diffuse illumination



## Further Development and Constructability - Repeated Aluminum Panel v1

My initial approach to this project was through a CAD / CAM process, which has been extremely helpful and informative up to a point. This process, combined with design intentions from the building itself, have led me to the unique form of this final product. Through the project I have developed an interest in utilizing light, shadow and color to highlight the complex geometries made possible by a digital design process. However, producing 1-to-1 scale components for a building utilizing only a CAD / CAM process is both inefficient and underachieving of the potential of digital process. Furthermore the aspect of color in the project was very shallow and really only intended as a visually interesting surface treatment.

The proposed final wall system utilizes an inset of the original panel, which is still to be made of milled HDPE. However the panel surround, shown in wood or not at all in the previous explorations, is now made from aluminum sheet stock. Each side is cut and folded from flat stock and then insulated and bolted to a sister panel to form a contiguous wall system that integrates the screen and shadow functions into one element. As can be seen in these iterations the use of color is now keyed to wayfinding within the project and defines the various collections within the research library.

Making the enclosure and light diffuser as one element created from a well understood material is a great stride towards creating an integrated design that is feasible for the project. In addition the resulting design is stronger both inside and out and creates a more dynamic and compelling corridor space than was previously proposed.



1pm

2pm



4pm

6pm

7pm

# Further Development and Constructability - Panel Options Axon

Each interior panel is composed of 5 components with 4 parts to the enclosure itself and a single milled HDPE screen in the center. At the time of fabrication the panels can be painted on any number of facets to create a surface for bounced color, for this project I have chosen two colors, a light green and blue, for the composition and restricted their use to the right triangle and bottom panel only. By shifting the orientation of these panels or mirroring their geometry it is not necessary to seek more complexity in how the panels are created.

Exterior Panels have glass in place of HDPE and are shop welded, assembled, and shipped to site.

Folded aluminum enclosure derived from sheet stock

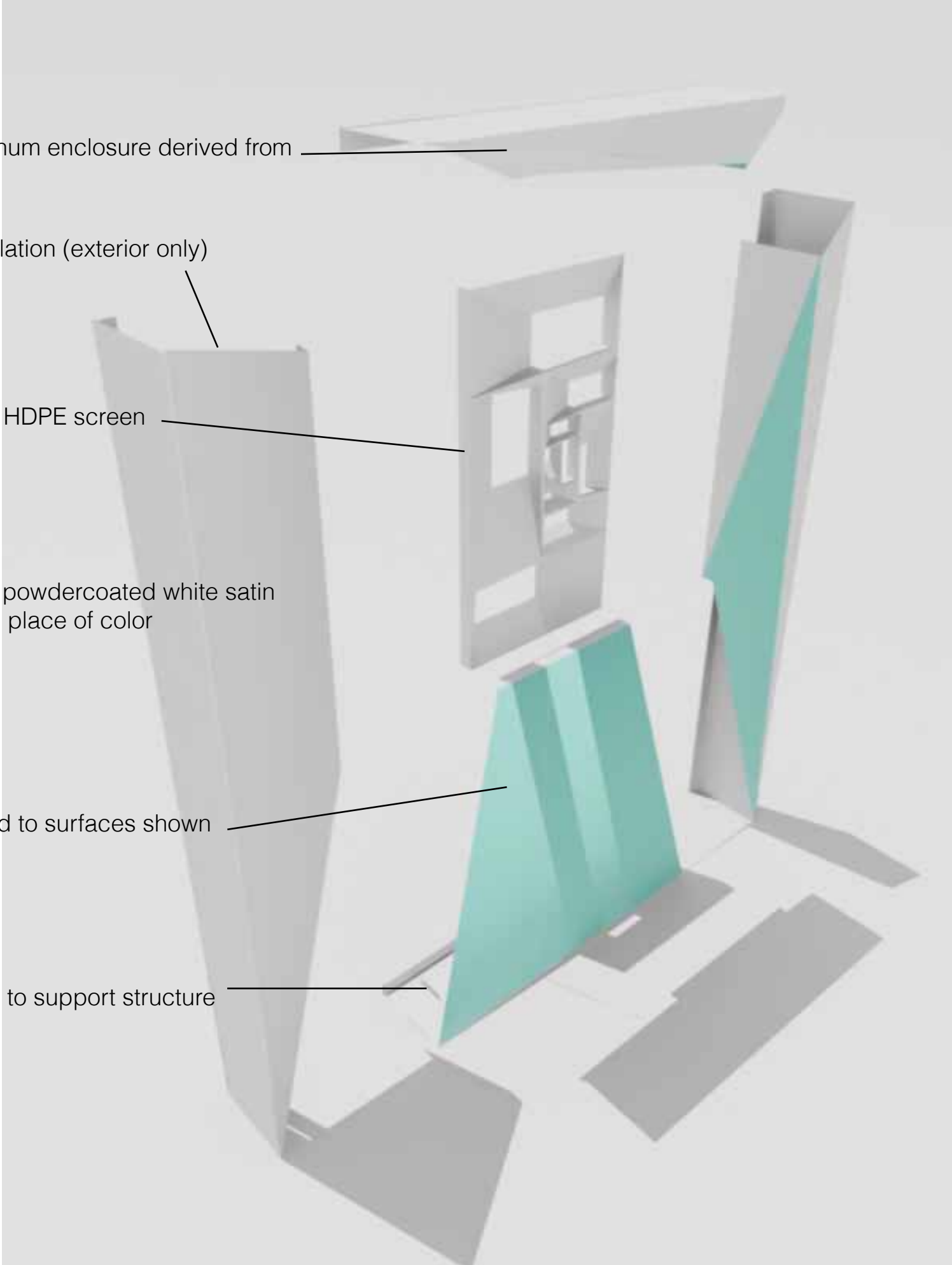
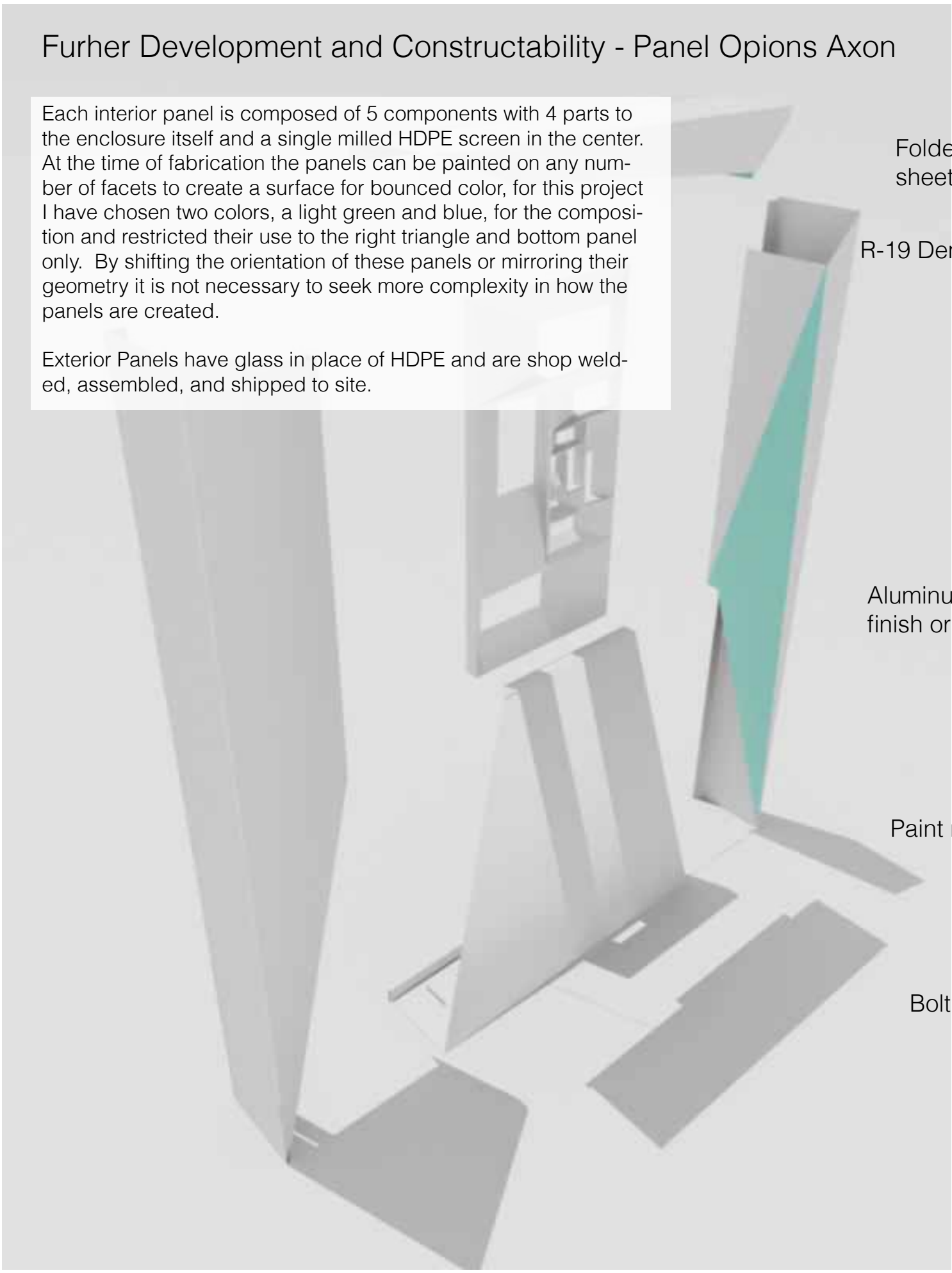
R-19 Denim Insulation (exterior only)

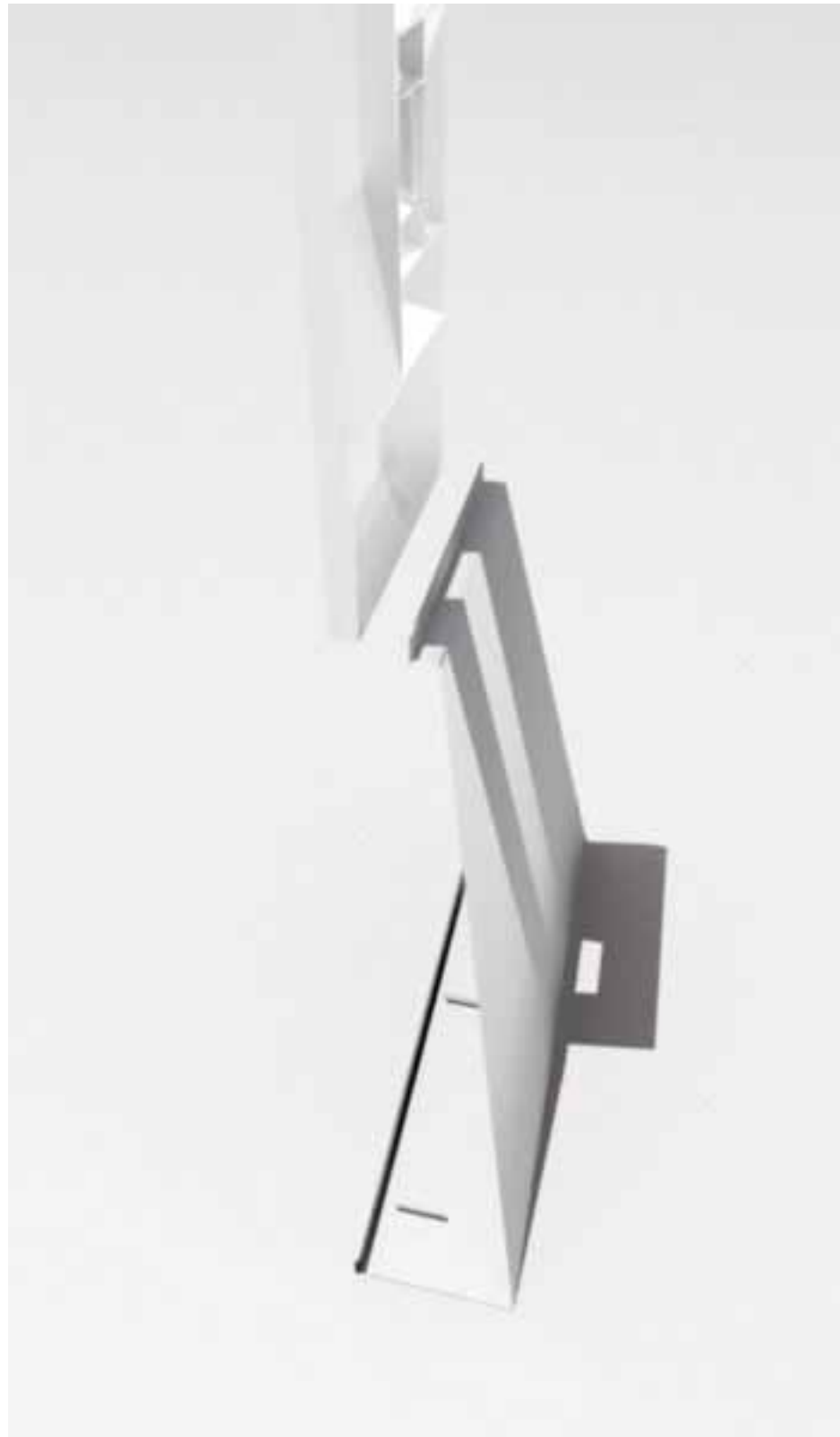
Milled HDPE screen

Aluminum to be powdercoated white satin finish or gloss in place of color

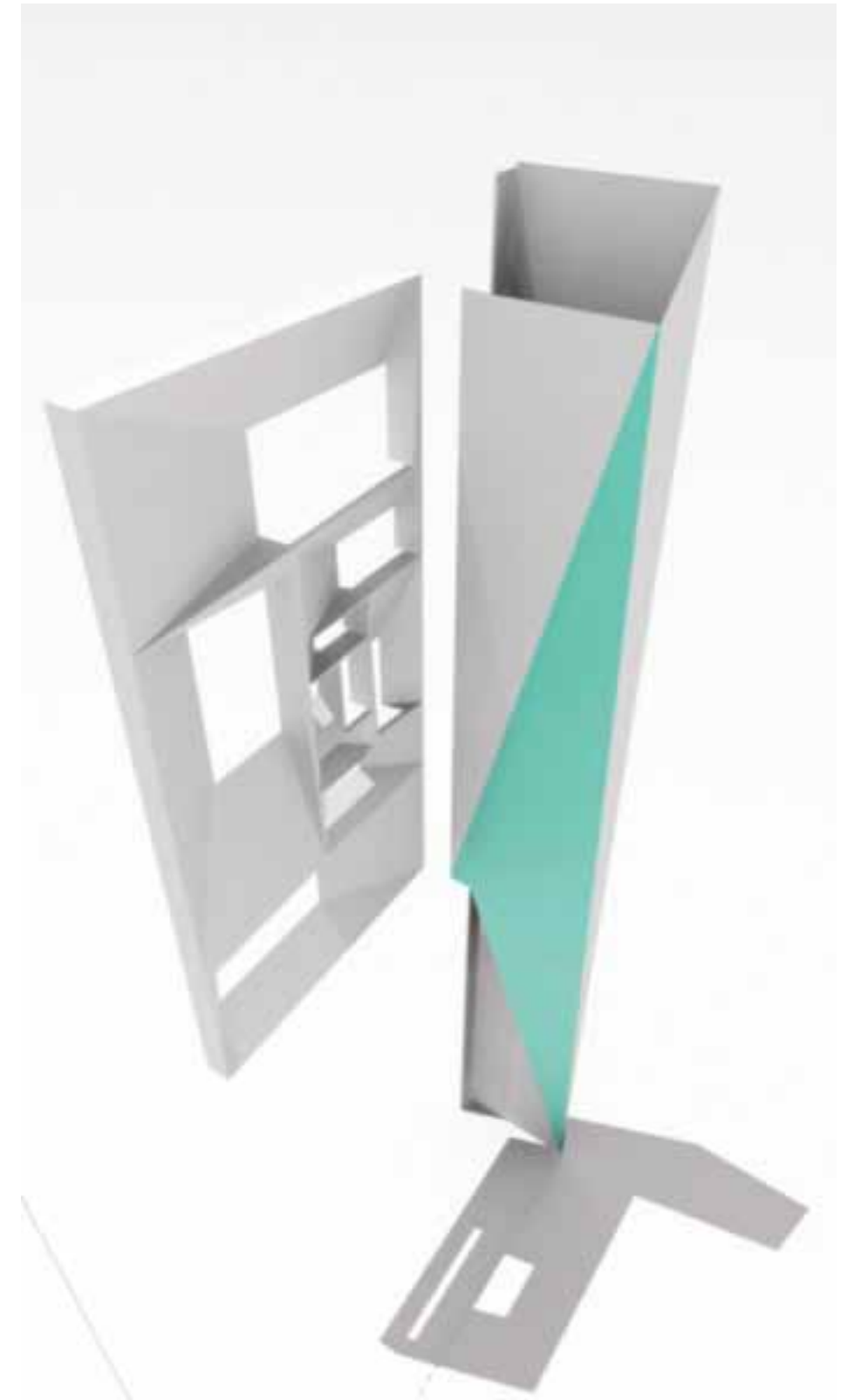
Paint restricted to surfaces shown

Bolt through to support structure





Panel Details



Each Panel has been created from aluminum sheet material which can be produced quickly with an automated manufacturing process. While the exterior panels are shop welded and assembled before shipped to site the interior panels do not need to be as thoroughly sealed. With the HDPE being inset there are opportunities to customize each screen, remove them, or replace them alltogether in the future.





## Exterior Application

This project, as was the intention, was part of a reflexive process with my terminal studio with each piece informing the other throughout design development. In looking at the things this panel can do for depth of surface and visual interest, combined with my recent efforts to create an enclosure system that integrated the screening function, my enclosure and facade became devoted to showcasing these functions. Shown here is the exterior side of the daylighting studies that follow on the next page.





## Final Interior

No longer confined to the notion of a single floorplate the panels were able to create space that connects to and extends beyond the immediate space. In places the floorplate does not meet with the panel, as it slopes either towards or away from the floor, offering glimpses into the spaces below. This concept, creating numerous individual connections that provide opportunities for placemaking and discovery within the building, is a central part of my efforts in studio. Happily, choosing to rotate and mirror the geometry of the panels not only created visual interest along the corridor but also mitigated the encroachment of late afternoon sun into the bookstacks by placing some of the openings closer to the floor and increasing the depth of the overall system. What can be seen in these photos then is that as the day passes there are certain bays that receive direct light at different times. This makes space that allows users to choose their lighting condition *and* their proximity to the exterior, a condition that did not exist when the panels were all similar.





# Bibliography and Influences

---

The following sources have contributed to this work:

The Digital Crafting Network  
ORAMBRA  
MAPT  
Daniel Rozin  
Scott Sona Snibble  
Daylighting For Sustainable Design  
In Praise of Shadows  
Digital Fabrications  
Folding Architecture  
Light Zone City

**The Digital Crafting Network** – <http://www.digitalcrafting.dk>

I examined the work of the Digital Crafting Network, a research collective whose work focuses on the interface of technology, architecture/design, and media to explore new possibilities in the built environment. They are supported by the Danish Council of Independent Research and are closely tied to the work of another Danish organization, CITA (Center for Information Technology in Architecture). I found their work in last year's "Workshop 4: Generative Logics: How to Grow" to be inspiring in terms of their process and the quality of the resulting light forms. Teams utilized processing and self-arranging structures to produce final projects. Without a focus on producing dynamic light qualities it is interesting to see that these "natural" structures are highly successful in that regard.

In particular it is easy to see how I was highly influenced by the following quote from the network's research question: "CNC tooling makes crafting part of all the involved practices. Rather than externalising the crafting of an object or a building as something that takes place after its design, planning and optimisation, crafting shifts to a much more central role of how design interfaces with material."

<http://www.digitalcrafting.dk/?cat=4>

<http://www.digitalcrafting.dk/?cat=26>

<http://www.digitalcrafting.dk/wp-content/uploads/2011/01/workshop4-3.jpg>

<http://www.digitalcrafting.dk/wp-content/uploads/2011/01/workshop4-4.jpg>

**ORAMBRA** – [www.orambra.com](http://www.orambra.com)

My approach to this project, and in part my outlook on design and the future of the profession, has been influenced by the work of Tristan D'Estree Sterk and his firm ORAMBRA, the Office for Robotic Architectural Media and Bureau for Responsive Architecture. Their work is worth mentioning for its inclusion of fabrication and material as a fundamental part of the design process. Their hypothetical project, Idea Cloud, is a good example of how the use of natural structures, processing, and actuated tensegrity can have an outlet in the future of architectural design. I found Sterk's introduction for the 2009 ACADIA conference, titled "Thoughts for Gen-X – Speculating about the Rise of Continuous Measurement in Architecture" to be particularly helpful in putting the discussion of parametrics and architecture in its place within architectural theory and movement:

ACADIA 09: RE-FORM, Building a Better Tomorrow. Tristian D'Estee Sterk, Russell Loveridge, Douglas Pancoast. 29th Annual Conference of the Association for Computer Aided Design in Architecture (ACADIA) Introduction – Tristan D'Estee Sterk "Thoughts for Gen-X".

Several artists and installations have been a part of my explorations in this class. For the most part I sought out artists working with the interaction between light and people. In particular I was looking for examples of how our environments can become more interactive and dynamic to create a stronger connection to, and a greater appreciation of, our built environment. Several artists and companies are working on this frontier, of them a few briefly described below.

**MAPT**, Mediating Architecture Process and Technology, is a small Danish design firm trained at Sci-Arch in Southern California. They have created an interactive bench in Copenhagen that encourages people to pause, touch, and actually play with the installation. The piece relies on a projection camera precisely aimed at the bench, and an infrared sensor to perceive the presence and movements of people in the scene. The program then changes the projection to interface with these movements.

[http://www.framemag.com/video/1727/The-Playful-Bench-by-MAPT.html?utm\\_source=newsletter-15-february-2011&utm\\_medium=email&utm\\_campaign=newsletter&utm\\_content=image&utm\\_nooverride=1](http://www.framemag.com/video/1727/The-Playful-Bench-by-MAPT.html?utm_source=newsletter-15-february-2011&utm_medium=email&utm_campaign=newsletter&utm_content=image&utm_nooverride=1)

**Daniel Rozin** - Rozin, in his series of mirrors, is an excellent example of utilizing a known lighting condition, such as an incident angle, to manipulate the surface quality of an otherwise regular surface. Individually actuated panels move to create a specific tone, which can then be tied into the overall system to create a pixelated image. The actuators are instructed by a small camera in the piece to reflect a highly reduced image of the piece's environment. The pieces are surprisingly accurate and unassuming with the choice of material.

<http://www.smoothware.com/danny/>

[http://www.youtube.com/watch?v=1ZPJ0U\\_kpNg](http://www.youtube.com/watch?v=1ZPJ0U_kpNg)

**Scott Snibble** - The work of Snibble in Boundary Conditions is an older source, but an excellent example of a compelling environment that relies on the interaction with users. The piece doesn't exist until at least two people present in the space, making the work part of a social environment or conversation. It explores the notion of dynamic public space, showing each user's "personal bubble" represented by a line between the figures. Although the use of light as a medium is not fundamental to the exploration it stands as a precursor to the work of organizations such as ORAMBRA, CITA and the Smart Geometry Conference, and the numerous firms exploring actuated tensegrity as a new kind of built space.

<http://www.snibble.com/>

<http://www.snibble.com/projects/interactive/boundaryfunctions>

**Daylighting for Sustainable Design** – Mary Guzowski - McGraw Hill NY, 2000

This project has evolved in part around a specific need in my terminal studio project to create a link with the natural environment while providing adequate and even natural light to a research library space. Daylighting for Sustainable design was influential in my decision to pursue a system that simultaneously allows users to interface with the buildings façade, and provide a condition that minimizes or reduces glare at that location. Chapter 2 deals with the reduction of glare by use of top-lighting and diffusing panels, among other subjects, and helped direct my decision to utilize a translucent medium for my wall panel. This panel, easily reproduced or un-installed from its application in the building, pays homage to the ideas set forth in chapter 3 in allowing future users to replace, customize, or rearrange the composition and physical nature of the diffusing wall. And in chapter 7 the discussion of the quality of light, and its incredible impact on the psychological feeling of the space, weighed heavily on my aesthetic decisions and attempt to create an engaging dappled light that recalls the rhythm of tree-cast shadows.



# Bibliography and Influences

**In Praise of Shadows** - Junichiro Tanizaki – Vintage Classics, Random House, 2001

Tanizaki's "In Praise of Shadows" is a classic work explaining the subtle nuance and joy that can come from light and the surfaces and places it illuminates. My work on this project casting shadows, particularly my trace-paper explorations of catching shadows, owe their ephemeral nature to Tanizaki's beautifully written book. His description of the luster of material, and how its qualities are contingent upon the incident angle and tone of light, helped direct the material progression of work, exploring paper materials, wood, and plastics for their inherent qualities.

**Digital Fabrications**, Architectural and Material Techniques - Lisa Iwamoto - Princeton Architectural Press. NY, 2009

My explorations in form and layering owe a good deal to Andrew Kudless' work and specifically the C-Wall project found in Lisa Iwamoto's book Digital Fabrications. The entire book is filled with great eye candy and interesting takes on the parametric/digital fabrication process, but he Kudless' work stood out to me. I was intrigued by the way in which the system could be both a light diffusing screen and a structurally stable form, and enjoyed the way in which the piece reads with much more depth than it actually has. This encouraged me to explore the separation of my panel into several layered screens of various porosities. These explorations were interesting but ultimately were abandoned as superfluous for a real building application, which I was working towards for a final product.

**Folding Architecture: Spatial, Structural and Organizational Diagrams** - Sophia Vyzoviti - BIS Publishers. Amsterdam, 2003

The aesthetic quality of the work in Folding Architecture has had a great impact on my work within Light and Shadow, and has transferred to a refinement of my terminal project itself. My building employs many of the qualities of a folded architecture, and I wanted that to communicate down to the level of the panels I was working towards in the class. By examining the visual phenomena and spatial composition of the examples in this book I moved my once cluttered design towards a reduced and simple panel of self-similar shapes.

**Light Zone City: Light Planning in the Urban Context** - Christa van Santen - Birkhauser Publishers. Basel Switzerland, 2006

The book Light Zone City has an ongoing impact on this project, and on the finish quality of my studio building. Having come to this source a littler later in my process the influence is not immediately apparent in the renderings I have produced so far. What I found particularly engaging in the text was the use of glancing light to enhance and embellish a depth of surface, something that is an integral part of my panels and my concept. The book shows examples of opaque surfaces, but in my project I'm beginning to explore how my translucent wall when illuminated at night can be combined with a top-down, or bottom-up light to create a second layer of depth. It occurs to me that with a translucent material its evening glow will wash out a great deal of the depth I have painstakingly constructed, and that considering the building from the ground and city level, it is advantageous to include night-time lighting to bring out the qualities of this surface.

