# DESIGN FOR MENTAL HEALTH

## INTEGRATING DAYLIGHT AND NATURE INTO CAMPUS SPACES



by
TIANDRA RAY

Submitted to the Department of Architecture
in partial fulfillment of the requirements for the degree of:

BACHELOR OF SCIENCE IN ARCHITECTURE
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## ABSTRACT

The spectrum of mental and emotional health is broad, as are the causes and the variables within one's environment, relationships, and day to day activities. However, one's physical environment can significantly affect how they sleep, work, and interact with others- especially on college campuses where many do all of those things in the same spaces. In order to find applicable and specific effects of architecture on mental health, this thesis will focus on depression and anxiety. The goal is to find out if there are relatively low-cost, non-infrastructural changes that can be made to study and lounge spaces to minimize the environmental triggers for depression and anxiety and induce activities and habits that promote an emotionally healthy lifestyle. This raises a couple of questions both about architectural design and mental health:

1. Can the layout and design of a space affect how people act and feel within that space?
2. What types of spacial and personal interactions are emotionally and mentally healthy?
3. What are some environmental triggers for depression and anxiety?
4. How can a room's layout and overall atmosphere be altered to provide a mentally healthy space?
5. What are the purposes of various spaces on a campus, and are they designed for such?

The purpose of this thesis is to answer the questions above in order to understand the connections between architecture and mental health and use that understanding to design the "optimal space" for a university member to rest or work (while maintaining their mental health). This thesis will use precedent studies, interviews, observations, surveys and an installation to investigate ways in which mental health is currently being considered in the design process, as well as how we can bridge the gap between design and psychological needs. This thesis will then provide a series of findings about spatial aspects that most affect mental health, as well as measures that one can take to improve mental health and recommendations about how this can be incorporated into the design of public lounges and study spaces at MIT.

Advisor: Lawrence Sass
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# INTRODUCTION

As MIT students, or university students in general, we naturally gravitate towards specific spaces on campus. We are often in search of the perfect study spot, a pleasant place to eat lunch, or somewhere we can sit and check our email in between classes. For the most part, we are free to choose where we spend our time. However, this is limited by the lounge, study, and public spaces that are made available to us on this campus. MIT decides what gathering spaces look like, where they are located, and how much natural light or sound can penetrate them. However, does MIT put thought into providing spaces that are actually conducive to our physical and emotional wellbeing as students?

Over the past few months, MIT has been forced to face the fact that "many still see MIT as a place without a safety net."[1] The high number of student and faculty deaths in the past year has been alarming, so much so that the institute as a whole was called to take some time to pause and reflect on how we can do better as a community on September 29th, 2014- closely following two student deaths that occurred within the first month of classes.[2] Since then, the number of students utilizing MIT's Mental Health and Counseling services has increased significantly. In the last academic year (2012-2013), 72 undergraduate students have taken time off of MIT due to medical reasons, which are typically related to psychiatric conditions.[3] In the past two years, MIT has surpassed the national average for suicides, which were linked to a variety of causes including mental and physical illness.[4]

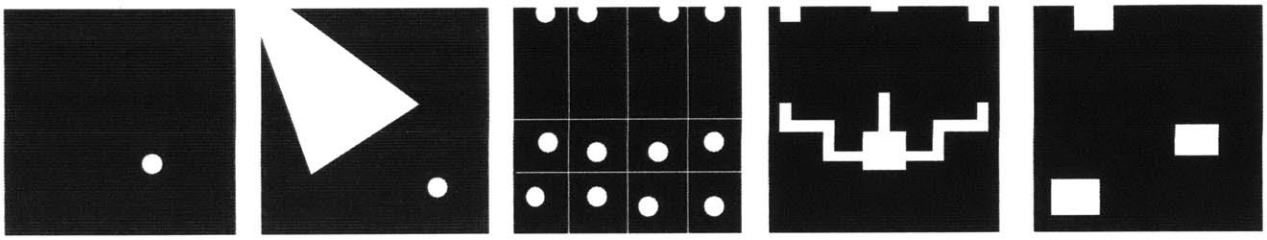
Although MIT is attempting to improve the emotional wellbeing of students through initiatives such as Save TFP, Active Minds, MIT Community Wellness, and access to mental health services, the institute has not yet launched an initiative to determine whether the physical environment of MIT has an effect on the mental health of students. It has become a running joke that the MIT Student Center (designed by Eduardo Catalano), where many spend their nights doing homework and working on group projects, slightly resembles a prison, with poor lighting and poor decor. Students often remark that their dorms can feel depressing if they stay inside for too long, and that the "institute white" walls that characterize most of the campus are quite boring. Walking around campus, one may notice the dominating theme of concrete structures and overall lack of public art (besides angular black steel sculptures and the ever popular "alchemist" depicting a man in the fetal position). It doesn't help that New England is

1 Doshi-Velez, "Supplementing 'All Doors Open.'"
2 Bent, "MIT Community Reflects on Recent Deaths, 'Opens Doors.'"
3 Banerjee, "More Mental Health Visits."
4 Jolicoeur, "After Suicides, MIT Works To Relieve Student Pressure."

already known for the grim weather that dominates from mid-October to mid-April every year, and with darkness setting in as early as 4PM in the wintertime, what little sunlight we receive is precious. We spend a good portion of our day in windowless corridors, even some classrooms and libraries do not have windows! How can these spaces be redesigned to facilitate learning and better our mental health and education experience?

# MENTAL HEALTH & ARCHITECTURE

## HISTORY: A BRIEF OVERVIEW




The sentiment towards mental health and how mental health institutions are designed and stigmatized has changed dramatically over history. In the 1600s, Europeans increasingly begin to isolate mentally ill people, often housing them with handicapped people, vagrants, and delinquents. Those considered insane were treated inhumanely, often chained to walls and kept in dungeons. In the late 1700s French physician Phillippe Pinel took over the Bicêtre insane asylum and forbade the use of chains and shackles. He removed patients from dungeons, provided them with sunny rooms, and allowed them to exercise on the grounds. In the late 1800s, mistreatment and overcrowding were still prevalent in U.S. hospitals for the mentally ill; but Thomas Kirkbride introduced a new standard for hospital design. His featured a liner plan and was based on the tenets of Moral Treatment. These Kirkbride institutions were located on vast farmlands and allowed for exposure to sunlight and fresh air. In the early 1900's, mental illness was discovered to be possibly caused by environment, leading to improved conditions and a mid-1960's shift from institutions to local mental health homes and facilities (as well as the introduction of campus plans such as McLean in MA). The current trend in mental health care is a shift towards community homes and more localized treatment.[1] [2]

1 Samels, "A Brilliant Madness."
2 Treece, Rangarajan, and Thompson, "Past, Present, and Future of the Asylum."

# PRECEDENT RESEARCH

## Mental Health Hospitals and College Campuses

Much of the research that has been done on the relationship between mental health and architectural design has been on the design of mental health hospitals both in the U.S. and internationally. The primary focus of my research is geared towards college campuses, but I do find these studies to be very helpful. With hospitals, architects must take great care not to aggravate or contribute to the high-stress and vulnerable state of patients. In the same way, a campus like MIT is full of students who are sleep deprived and stressed, and it would behoove us to spend time in spaces that don't increase that stress on top of all of our academic responsibilities. Many studies have noted the benefits of providing spaces that are "home-like," via the inclusion of colored walls, art, and plants. Many MIT students are living away from their homes for the first time, and efforts must be made by the institute to help students feel at home in their dorms and on campus.[3] Making lounge spaces more personable may help student feel more comfortable here. It is easy for large institutions to become impersonal in general, making people feel less in control of their environment.[4] Though there are many additional aspects of mental health hospitals, such as patient care and access, nursing stations, and prevention of assault between staff and patients, that are not entirely relevant to my research, there is much to be gained from the approach to designing a neutral space that can accommodate occupants of varying degrees of stability, needs, and past experiences.

## Perception of Space

When we talk about a room's "ambiance," we are categorizing the space by how we feel when we are there. This feeling, whether it is a sense of peace or stress, is a result of our own perception of the space, which is affected by both our own preconceptions and experiences as well as what the space objectively contains and looks like. The claim that "better health results from a state of mind which has a fortified sense of coherence" has significant implications for those who wish to design spaces that improve mental health.[5] When working with mental health patients, it is important to help them maintain a connection with the outside world. In a sense, one can do this by visually steering away from bending "reality." For example, preferring landscape paintings over abstract ones or avoiding perceptually confusing things such as wood

3 Connellan et al., "Stressed Spaces: Mental Health and Architecture."
4 Arya, "So, You Want to Design an Acute Mental Health Inpatient Unit."
5 Connellan et al., "Stressed Spaces: Mental Health and Architecture."

grain on a metal door. [6] Intentional design with a clear logic can make a space feel much more comfortable or familiar. At the very least, it will not subconsciously stress out its occupants. "The environment should ensure that perceptual cues are present to assist perceptual purposes; cleat textures, objects, and lines should prevent the possibility of perceptual distortion.[7] A room that is sloppily or haphazardly laid out, or even extremely loud in colors and patterns may not be a space conducive to getting work done or resting in between classes. At the same time, color schemes that are completely bland and institutional furniture that may appear clean and logical are also a source of discomfort, making one feel less welcome, more isolated and even trapped.[8] Although there aren't necessarily consistent or concrete evidence that there is an optimal color for a specific type of room, and the studies that have been done are primarily anecdotal, it is worth paying attention to the palette of a space, even if only to determine a color logic.[9] After all, "visual monotony can contribute to physiological and emotional stress."[10] Another aspect to consider is that the personal perception of each individual in a space may differ, and this can override the intentions of the built environment.[11] The focus of a person's perception of a space may also be external to a reaction to the space itself. For example, a worker who enters a workplace that is spacious and well-lit may not necessarily think "Oh, what a comfortable space that is very conducive to working collaboratively and efficiently!" Instead, the thought running through his mind may be "Wow, the management here really cares about us workers and considers us human beings rather than just labor!" A space can be very indicative of the value that an institution places on its occupants as individuals who have specific needs.[12] Spaces must be flexible and accommodating, for the connection or "relationship" between a room and its occupants is "transactional and not fixed."[13]

**Design Intent and Influencing Behavior**

Knowing that there is a logic to good design, one must determine what the purpose of a space is. This includes who is occupying the space, the types of activities that will occur in a space, and the level of privacy. In this, taking the "consumers" of the space into account is crucial.[14] When

6 Ibid.
7 Ibid.
8 Ibid.
9 Schweitzer, Gilpin, and Frampton, "Healing Spaces."
10 Connellan et al., "Stressed Spaces: Mental Health and Architecture."
11 Dennard, "More than Bricks and Mortar? Mental Health and the Built Environment - Halpern, D."
12 Connellan et al., "Stressed Spaces: Mental Health and Architecture."
13 Ibid.
14 Arya, "So, You Want to Design an Acute Mental Health Inpatient Unit."

designing spaces of healing or restoration, the occupant's well-being is the most important factor of the design. Therefore, extensive study should be done concerning the demographic of patients (or in our case, students) and their needs. Do they need a space where they can de-escalate and relax? Or do they need a place where they can be stimulated in such a way that they will be able to concentrate on schoolwork or want to engage in a conversation? The purpose of a space includes how you want people to act within that space, which can be heavily influenced by the layout and interior design. Again, it is important to note that if you are attempting to induce a behavioral change via an environment change, it is essential that you understand those that will be using the space- their workflows, values, and health needs- as well as be aware of how the needs of the occupants will evolve over time.[15] Design can be very powerful if the right components are taken into consideration. Lighting, for instance, has a huge effect on one's circadian rhythm- which consists of the "physical, mental, and behavioral changes that follow a roughly 24-hour cycle."[16] This includes regulating melatonin production, which influences biochemical and hormonal body rhythms. Maintaining a balanced and normal circadian rhythm can substantially increase one's quality of sleep, according to a study of patients with dementia and their rest-activity patterns.[17] We can use what we know about depression and anxiety and design spaces that specifically address those issues environmentally and encourage healthy and beneficial action. We can design spaces that encourage physical activity or increase productivity and job satisfaction.[18] For those who find that being forced into social interaction is a very negative experience, we can design a space that allows people to find comfort and pseudo-privacy in a public space.[19] There is a very wide range of possibilities here and potential for very successful spaces that both serve a specific purpose and subconsciously aid in the betterment of mental and emotional health.

### Lighting and Mental Health

One of the most blatant aspects of design that affects occupants is lighting. In the context of research on mental health hospitals, natural light has been linked to eating disorders, depression, circadian rhythm, Alzheimer's disease, sensory stimulation, therapeutic design, and therapeutic patient rooms. Light effects both mood and perception, and can determine how accurately one can perform a visual task. In fact, a study done in the 90's showed that patients

15 Ibid.
16 "Circadian Rhythms Fact Sheet."
17 Connellan et al., "Stressed Spaces: Mental Health and Architecture."
18 Schweitzer, Gilpin, and Frampton, "Healing Spaces."
19 Dennard, "More than Bricks and Mortar? Mental Health and the Built Environment - Halpern, D."

who were consistently in brightly lit rooms (as opposed to those in dimly lit rooms) had shorter hospital stays by almost 3 days on average. [20] The type of light does make a difference, as does the time of day. "Symptoms of Seasonal Affective Disorder and the depressive phase of bipolar disorder were diminished through exposures 'between 2500 and 10,000 lux'" (which is within the spectrum of sunlight) and the greatest benefits of this are in the morning. When exposed to an increased intensity of sunlight, one often experiences less perceived stress and marginally less pain. Looking at these studies, the best lighting design seems to be to increase the amount of natural sunlight in a space via increasing the number of windows that are oriented to "maximize early morning sun exposure. "However, we must also consider the negatives effects of glare and thermal discomfort." [21] This requires use of methods of diffusing and directing natural light such that one gets all of the benefits of sunlight without the glare and heat.

**Nature**

Along with the emphasis on natural light, across the board researchers recommend having a view of the natural landscape or having access to a garden or courtyard as a means of promoting mental and emotional health. This can either mean views from a window, or even paintings of nature. Various studies have been done to test the effect of exposure to nature on cognitive performance and health. A study done by Roger S. Ulrich for the Center for Health Systems and Designs at Texas A&M University showed that a patient's exposure to nature led to shorter hospital stays on average. In a study for the U.S. Forest Service by Rachel and Stephen Kaplan, it was found that nature is linked to recovery from mental fatigue, restoration of attention, psychological health, and the ability to process information. Similarly, studies at UC Irvine and the University of Michigan indicated that taking time for outdoor activities such as hiking or going on an hour-long walk improved attention spans up to 20% in addition to proofreading performance. Marc Berman found in a 2008 study that it doesn't even depend on how warm the weather is or whether the subject enjoys being outdoors; the results are the same in "80 degrees and 25 degrees". [22]

In terms of incorporating courtyards and gardens into one's routine and environment, depending on location weather can be a big issue. Also, depending on the layout, privacy can be a concern as well. Historically, gardens have been associated with healing, Nature in general

20 Connellan et al., "Stressed Spaces: Mental Health and Architecture."
21 Ibid.
22 Louv, The Nature Principle.

was (and often still is) associated with closeness to God, morality, rural work ethic, and the "romantic notion of man in and of the landscape". In the 18th and 19th century mental asylums, architectural features such as verandas, conservatories, aviaries, and the like were incorporated to provide views of the landscape from inside. For many, "the presence of the gardens can be one of the most positive aspects of psychiatric treatment." The benefits of these courtyard and garden spaces illustrates the importance of "being away," in both the physical and conceptual sense, in the restoration process. [23] These spaces give the mind a break, whether it be for a nurse who is in the middle of a 10 hour shift, a patient who has spent the day in group sessions, or a student who has been staring at a computer screen. But how can we make these spaces available in places where going outdoors is not an option due to cold weather? Perhaps there is a way of simulating this environment in a space that uses filtered light, or specific seating and wall patterns- a "garden room" of sorts- without delving into the complications and expense of maintaining a greenhouse.

**Analysis**

In my research, I encountered a few recurring themes and recommendations that are almost universally agreed upon in terms of making a space "mentally healthy": natural light, views of nature, logical design, and a non-institutional feel. One article illustrated this conclusion well in stating that "there was sufficient data to indicate a decrease in stereotypic behavior among patients and improved staff morale after elements such as wallpaper, live plants, increased light, colored walls, and upholstered furniture replaced the previous spaces that had green and gray walls and mismatched vinyl-covered chairs" However, "scarcity of research literature dealing with both mental health and architecture along with the specific lack of evidence-based research was noted" by many sources.[24] This was especially evident in trying to link color to mental state.

23 Connellan et al., "Stressed Spaces: Mental Health and Architecture."
24 Ibid.

# PRECEDENT SPACES

## Healing Architecture: Crown Sky Garden

The Crown Sky Garden is located in the Ann & Robert H. Lurie Children's Hospital in Chicago is a prime example of how the healing aspects of nature can be incorporated into technological and architectural design. Designed by Mikyoung Kim, this space was based upon research pointing to the benefit of natural light and contemplative spaces in patient recovery. The garden cleverly incorporates light, sound, water, and wood elements to create an interactive space that is enjoyed by children and adults alike. There are spaces for being active and for resting, and bamboo trees are playfully juxtaposed by light displays and meandering walls. This garden provides the unique opportunity to experience how natural and artificial elements can coexist in the context of a closed, covered space and urban environment.

Image Source: See Appendix A

# PRECEDENT SPACES

## Home Architecture: Frank Lloyd Wright

In the Fall of 2014, I received the Grossier Undergraduate Travel Fellowship for thesis-related travel over the following spring break. During my travel fellowship, I visited some of the Frank Lloyd Wright buildings in Chicago to explore the application of lines, geometric form, and ornamentation in architectural design and how these can contribute to and enhance a spatial experience.

### Home and Studio

Some key features of Wright's home and studio were his use of light, textures/materials, and open space. There were many vaulted ceilings featuring wood trim that drew one's eyes upwards, making the (very small) rooms of the house feel grand and spacious. Windows lined many walls, with patterns of the panes that filtered light into the rooms. The colors he chose were very warm and earthy, with some canvas-like textures on many wall panels and lots of wood (in both the furniture and the flooring. The studio space was similar to the Unity Temple in that it had a central atrium with two levels- one for artists and one for draftsmen- from which one could gather a view of the whole space.

# PRECEDENT SPACES

**Unity Temple**

I went to Wright's Unity Temple for their Sunday service, and was struck by the openness of the main sanctuary. It had a middle atrium with three level of seating around the perimeter of the room. Paired with the skylights, the nature of the space reminded me of the New Media Lab at MIT, where there is a central cavity surrounded by multiple floors with balconies that look out over the center space.

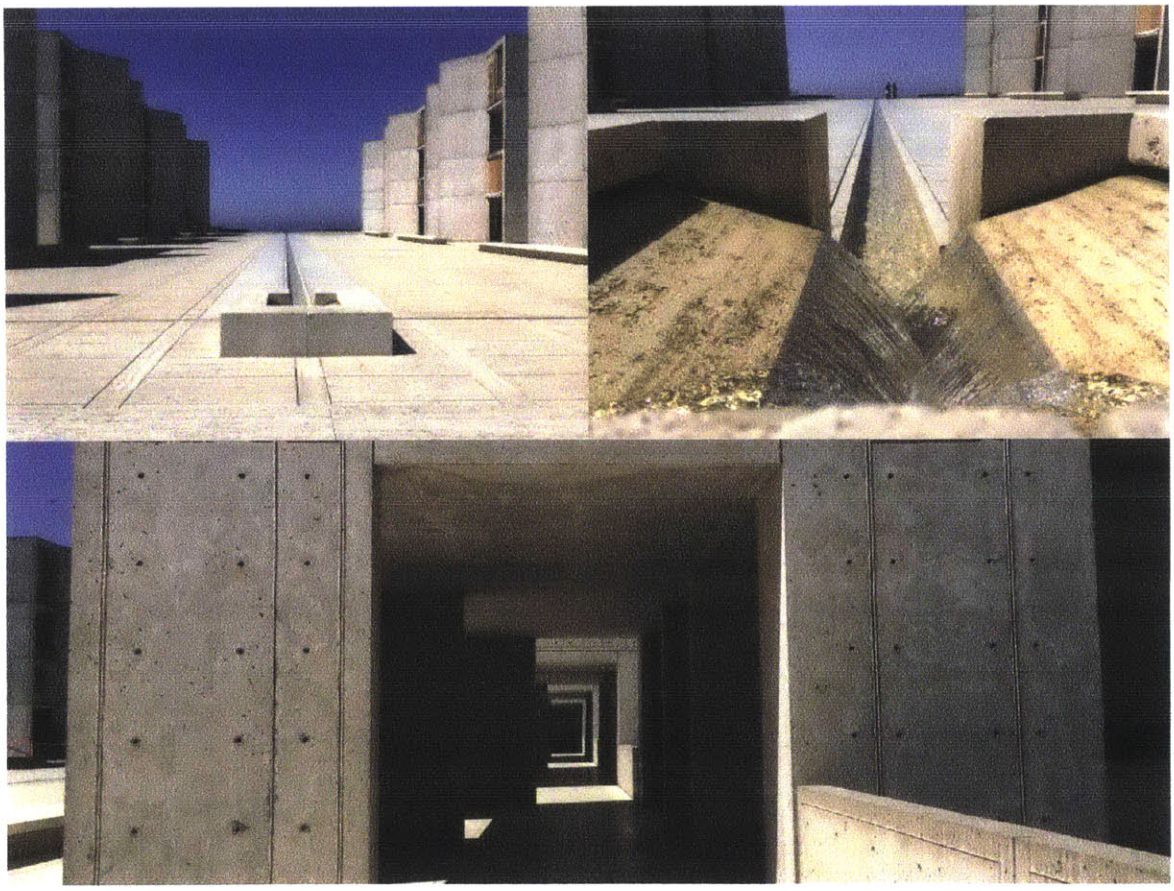
As a visitor, it was comforting to be able to see almost every part of the space, or at least have a sense of context even though I was on the third level. I felt very safe and secure as I knew where I was in relation to all the other people in the space. The oak trim that moved in straight lines and right angles along the walls, balconies, and ceiling gave the space a logic and continuity that guided my eyes around the rooms (as opposed to me just glancing at different parts of the room at random.

# PRECEDENT SPACES

## Academic Architecture: Salk Institute for Biological Research

While in San Diego for my travel fellowship, I toured the Salk Institute for Biological Research and met with an MIT Alumni who works there.

The clean lines of the Salk Institute's architecture, its cohesive nature and repetition with variation made for a very clean, satisfying environment. The central plaza with the runnel along the center was a very inviting, serene space with a gorgeous view of the beach that made one feel miles away from the city and college campuses next door. The two main buildings closed in the plaza in such a way that it was almost a secret oasis, with sun streaked corridors lining it and a direct channel to nature. The architecture was simple, but extremely refined and logical, allowing maximum natural light into the labs and stairwell through openings and light wells. It was a beautiful juxtaposition of privacy and escape within a bustling college campus and tourist area.



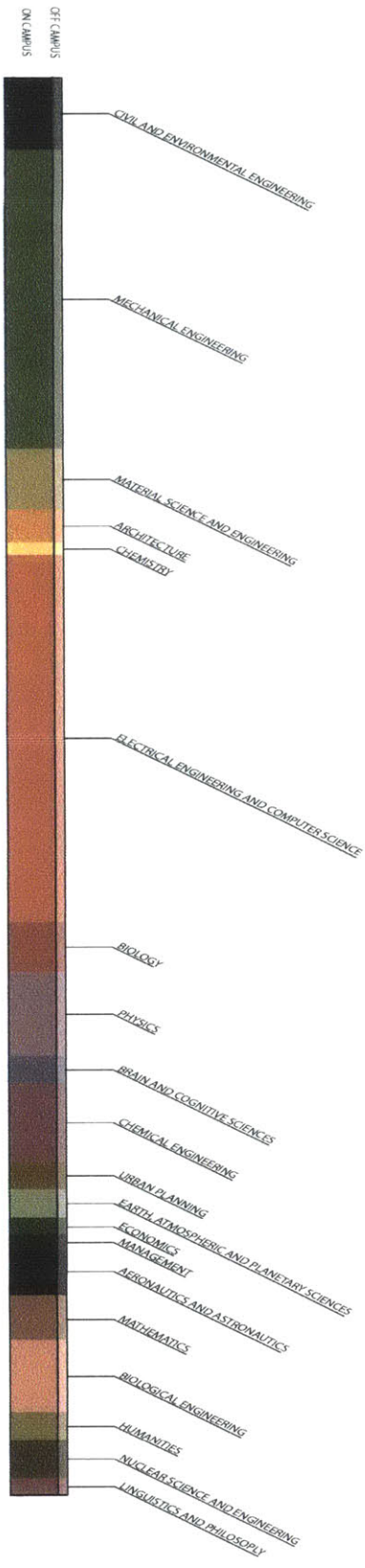
# PRECEDENT SPACES

Similarly, the psychiatric hospital at Helsingor uses light wells to incorporate natural light into lower building levels, and exists in a space that secludes it from the surrounding city just enough to provide an atmosphere of escape and the feeling of being surrounded by nature.

Image Source: See Appendix A

# COMMUNITY RESPONSE

## CAMPUS-WIDE SURVEY




It is crucial for me, as a researcher, to make sure that my research is relevant to students and not too skewed towards the realm of mental health hospitals since that is where most of the current sources on mental health reside. "Community mental health is impacted by architects and planners who impose designs on them which do not reflect community views or preferences," so it is important that the ultimate goal of benefiting university students be kept in mind. [1] Thus, in April I conducted a campus-wide survey and collected responses from over 250 undergraduates from almost every department and who lived both on and off campus.

1. Dennard, "More than Bricks and Mortar? Mental Health and the Built Environment - Halpern, D."

# CAMPUS-WIDE SURVEY

## Workspaces

Many students prefer to do schoolwork in their dorm or FSILG lounges due to the noise level and lack of privacy in public lounge spaces on campus, as well as a preferable layout in dorms. The most prominent factors that made study spaces desirable to students were convenient location, noise level, layout, and privacy. It seems like students gravitated towards spaces that could allow them to be focused in a semi-private space while still having others around.

Over 70% of students do their schoolwork during the evening and night time (before 2AM). This means that even though 68.8% of responses indicated a preference towards floor-to-ceiling windows (like those of Hayden Library), the majority of students are not sitting in sunlight while they are doing academic work. During the day, even when it is warm, the majority of students only work outside occasionally due to glare and wind.

## Finding Peace

When asked where they go on campus to find peace or calm their mind, students gravitated towards spaces that offered quiet, solitude and access to nature or a view of Boston/Cambridge. Some popular locations are Killian Court (with a view of the Dome), the esplanade and Mass Ave Bridge, and Sol Lewitt's "Bars of Color Within Squares" in building 6c. Interestingly, Hayden Library was a location that students both sought peace and a place to get work done. Many students looked to their own dorm rooms for comfort, using words like "home" and "comfortable," while 45 of the respondents either left this question blank or indicated that they did not know of a space to find peace on campus. One student responded "no peace until graduation."

# WORKSPACES

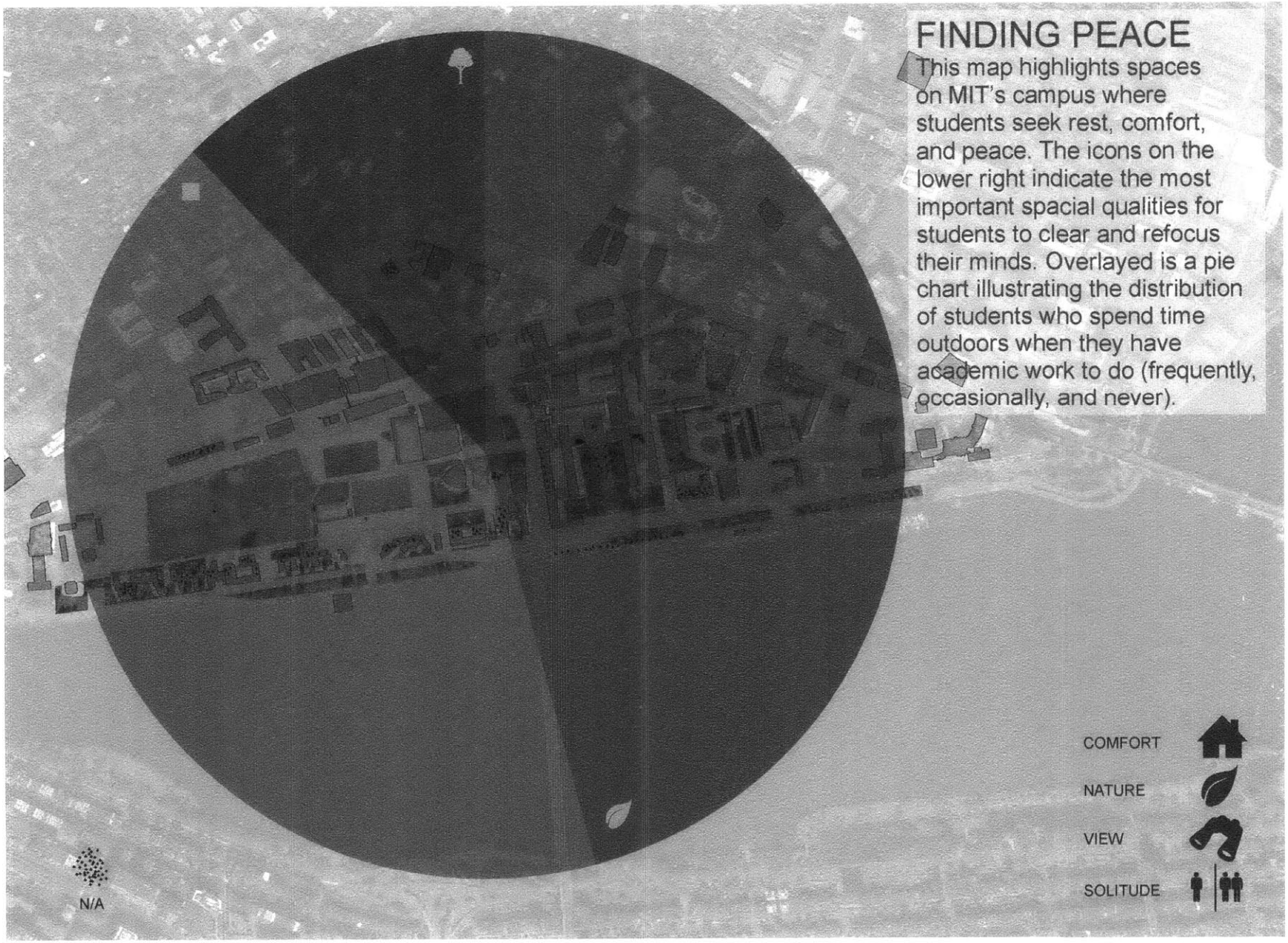
This map highlights spaces on MIT's campus where students prefer to do academic work. The icons on the lower right indicate the most important spacial qualities for a good study space according to students. Overlayed is a pie chart illustrating the distribution of students who typically work at night as opposed to during the day.

LOCATION

NOISE LEVEL

LAYOUT

PRIVACY


FINDING PEACE
This map highlights spaces on MIT's campus where students seek rest, comfort, and peace. The icons on the lower right indicate the most important spacial qualities for students to clear and refocus their minds. Overlayed is a pie chart illustrating the distribution of students who spend time outdoors when they have academic work to do (frequently, occasionally, and never).
COMFORT
NATURE
VIEW
SOLITUDE
N/A

# CAMPUS-WIDE SURVEY

Although a wide variety of opinions were expressed, there were many trends within the survey results, such as a general dislike for the design of the student center, and an association of nature with the idea of growth, new life, and being refreshed. Students also are drawn towards the complexity of colors within nature, particularly the color green (going back to the idea of growth and budding). The sun and warm temperatures were also frequently mentioned as desirable aspects of being outdoors.

There is significant dissatisfaction among students with the overall design of MIT's study and lounge spaces, and after a few picture surveys I've found that the campus is very inconsistent when it comes to the incorporation of windows and natural light throughout campus. Some of the most well lit spaces are in corridors and lobbies that are only meant for passing through, while there are study carrels and classrooms with no natural light at all. In the next three sections, I will explore how to account for these inconsistencies to make all campus spaces "mentally healthy".

## QUOTES FROM STUDENTS: WHAT WOULD THEY CHANGE?

WITH CORRESPONDING COURSE NUMBERS

"Control ambient noise much better (reduce HVAC noise and add absorption)." [4]

"The amount of sun and warmth. Use more organic colors and materials. More natural light." [11]

"Lighting and color choices--I wish they were closer to daylight and felt less like pulling an all-nighter in a room with no windows." [18]

"Oh god, the student center. Make it brighter or shinier or something. It's just so ugly" [6]

"Happier colors." [20]

"More plants/nature based design" [2]

"It would be awesome to have a room or area dedicated to quiet and reflections, with lots of light and warmth. It doesn't even have to be aesthetically complicated." [7]

"Add lots of small study spaces/ conference rooms along the various hallways." [2]

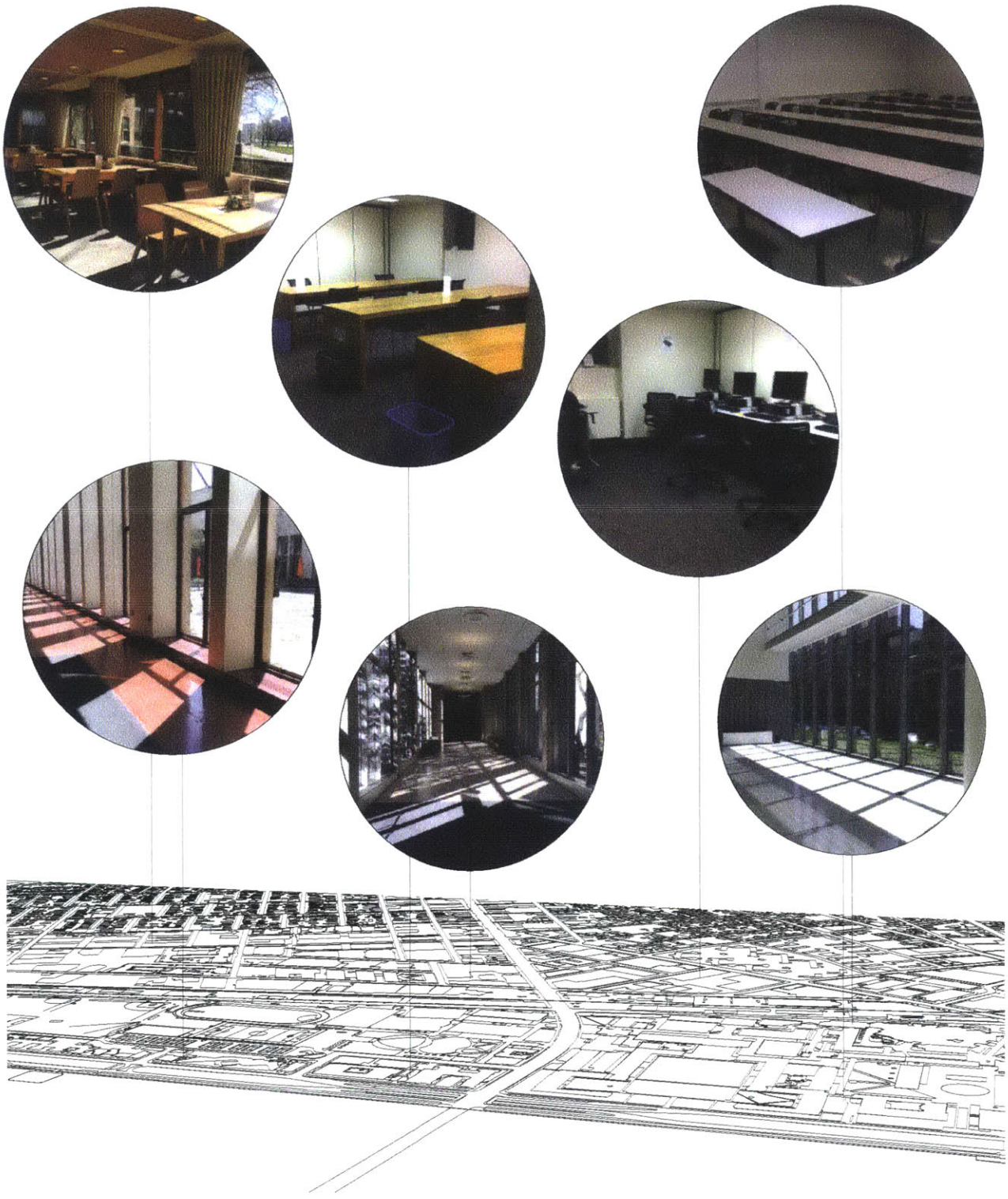
"We need more wood, wood is the new concrete dontcha know" [7]

"Better lighting --it's really hard to work in dimly lit spaces" [4]

"Maybe create a more homey feeling so people feel less like a working machine. :)" [15]

# EXISTING CAMPUS SPACES

Many of the brightly lit spaces are either corridors not accessible to all students.



# EXTRACTION & EXPERIMENTATION

## PATTERNS

According to my research, a well-designed space is one were "perceptual cues are present to assist perceptual purposes; clean textures, objects, and lines should prevent the possibility of perceptual distortion."[1] Nature is already believed to accomplish this, thus during my travel fellowship I decided to conduct a thorough exploration of recurring patterns and forms in nature. I spent two days in Torrey Pines State Reserve in San Diego meticulously collecting photographs of natural textures and color palettes. I then brought these photos back to MIT and began extracting different elements of these patterns to facilitate their use in informing architectural and interior design, while making note of trends in lines and form.

**A Few Observations**

I took many photos of the colors, shapes and patterns that I found in the trees, shrubs and flowers at Torrey Pines. I noticed a prevalence of vertical lines (in grasses and stems) that gave the patterns I saw a specific orientation and repetitive nature. There were also many leaves and petals that curved into "pod" shapes that can be used as inspiration for architectural form. In terms of colors, there was a large variety. I found some schemes (in earth tones) that paired with concentrated, bright patches of color could serve to be a beautiful representation of what I repeatedly saw in flowers peeking out from bushes and grass.

1 Connellan et al., "Stressed Spaces: Mental Health and Architecture."

# PATTERNS

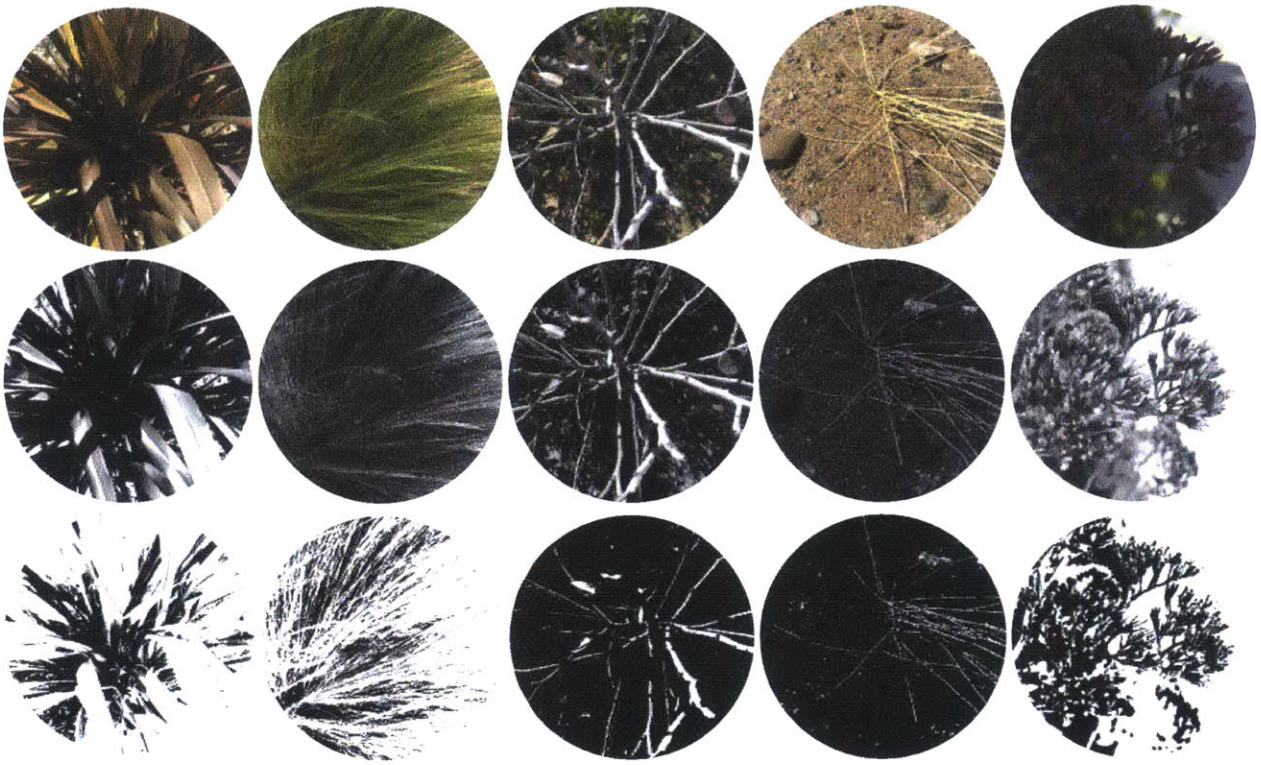
In my search for a way to mediate the disconnect between outdoor and indoor space, I decided to focus in on the patterns found in nature. While color palette is an important part of experiencing nature, the tolls and interventions that I am designing cannot be constrained to a single color scheme. Rather than attempting to duplicate the complex color palette of the outdoors, I can use patterns to mediate not only light but a view of the outdoors, and it can be applied to any palette or environment, providing a lens to look through rather than an obstruction of nature simulations.

I went through the process of stripping my nature images down to their most basic, primitive forms by removing color and gradient, resulting in a distilled, polygonal representation of the patterns we see every day. Thus, the patterns were made able to be combined, dissected, and replicated.

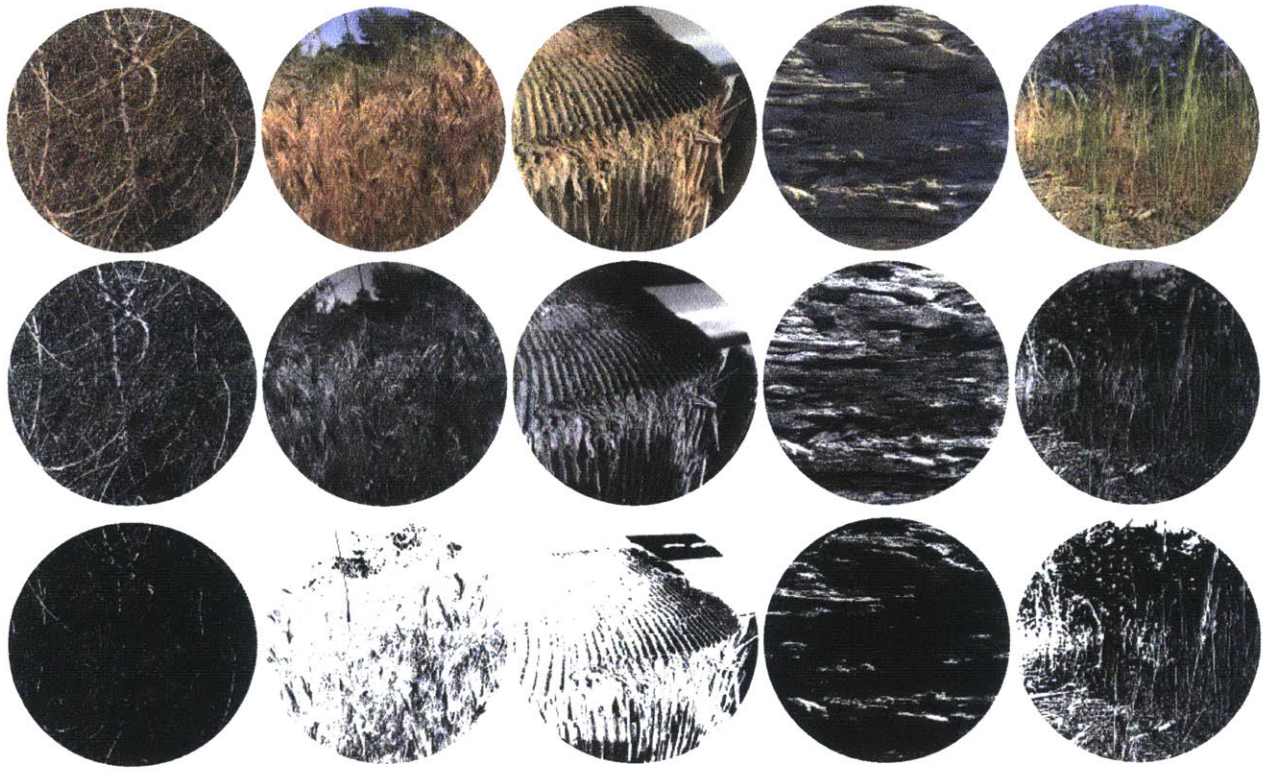
Image Source: See Appendix A

The following pages illustrate the process of taking images from nature, grouping them, and extracting primitive, simplified patterns.

## CONVERGENCE AND BRANCHING

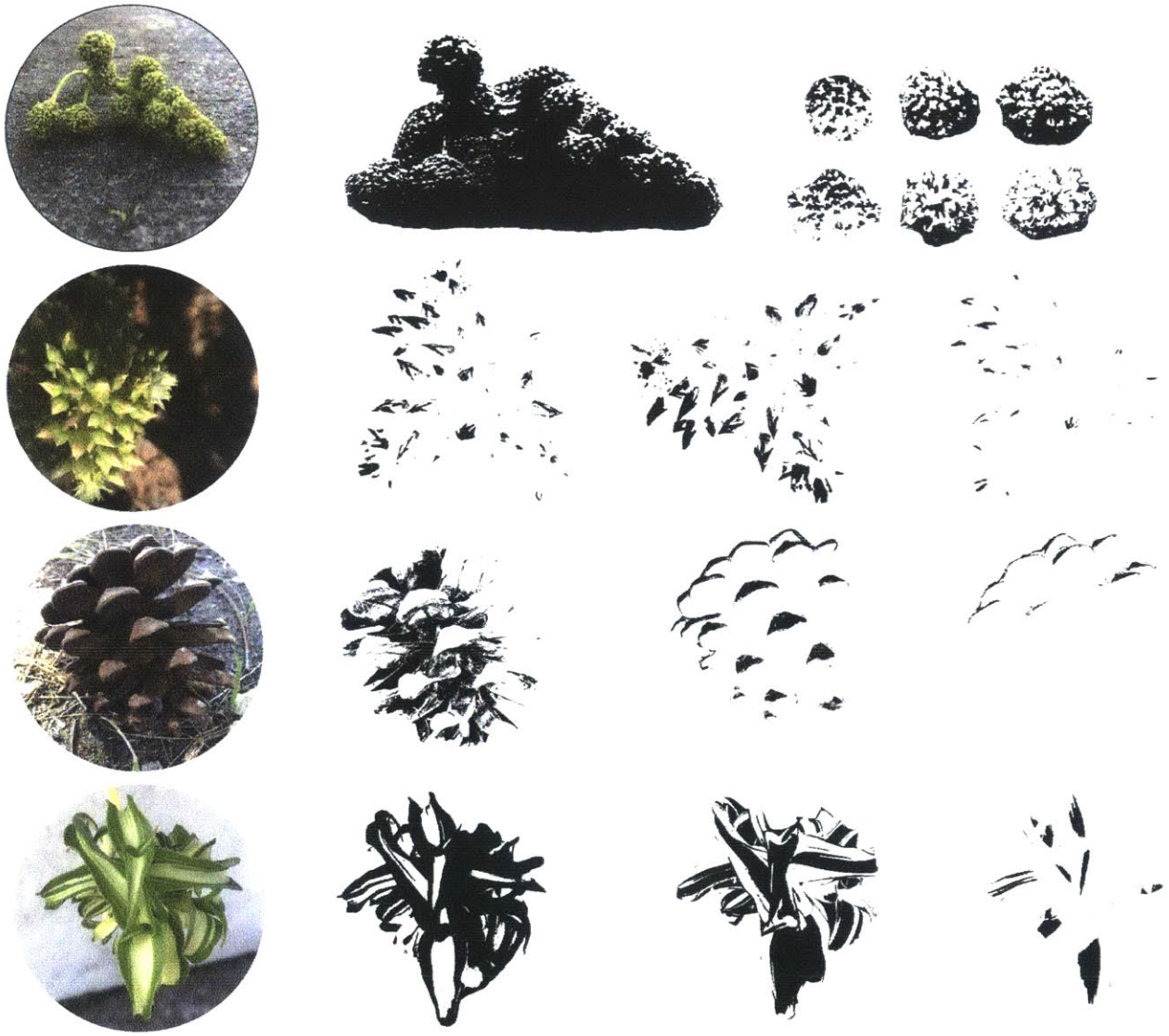


## DENSITY AND LINEAR DIRECTION



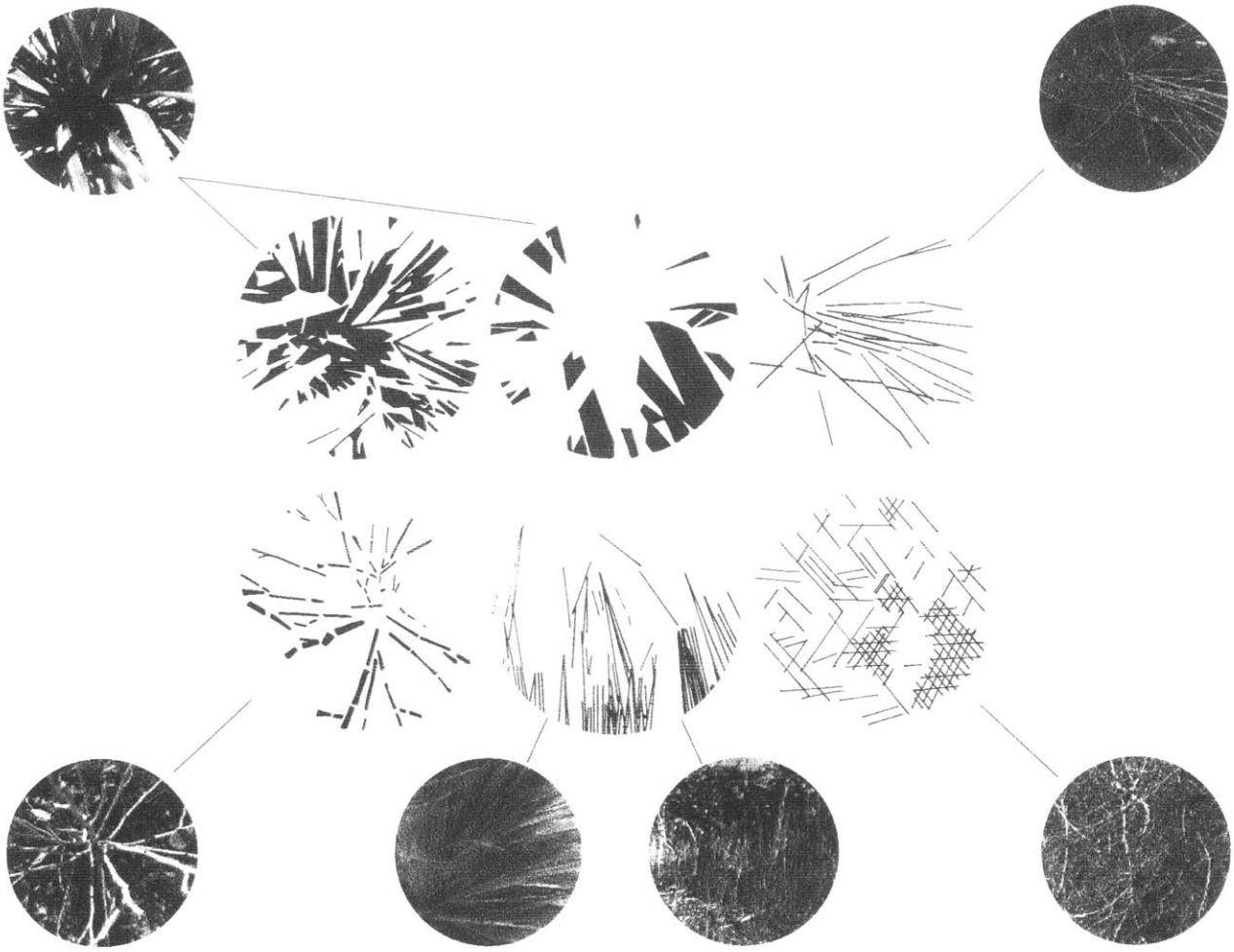
# NATURAL FORMS

These images illustrate the process of discovering the spacial attributes of small-scale nature objects.



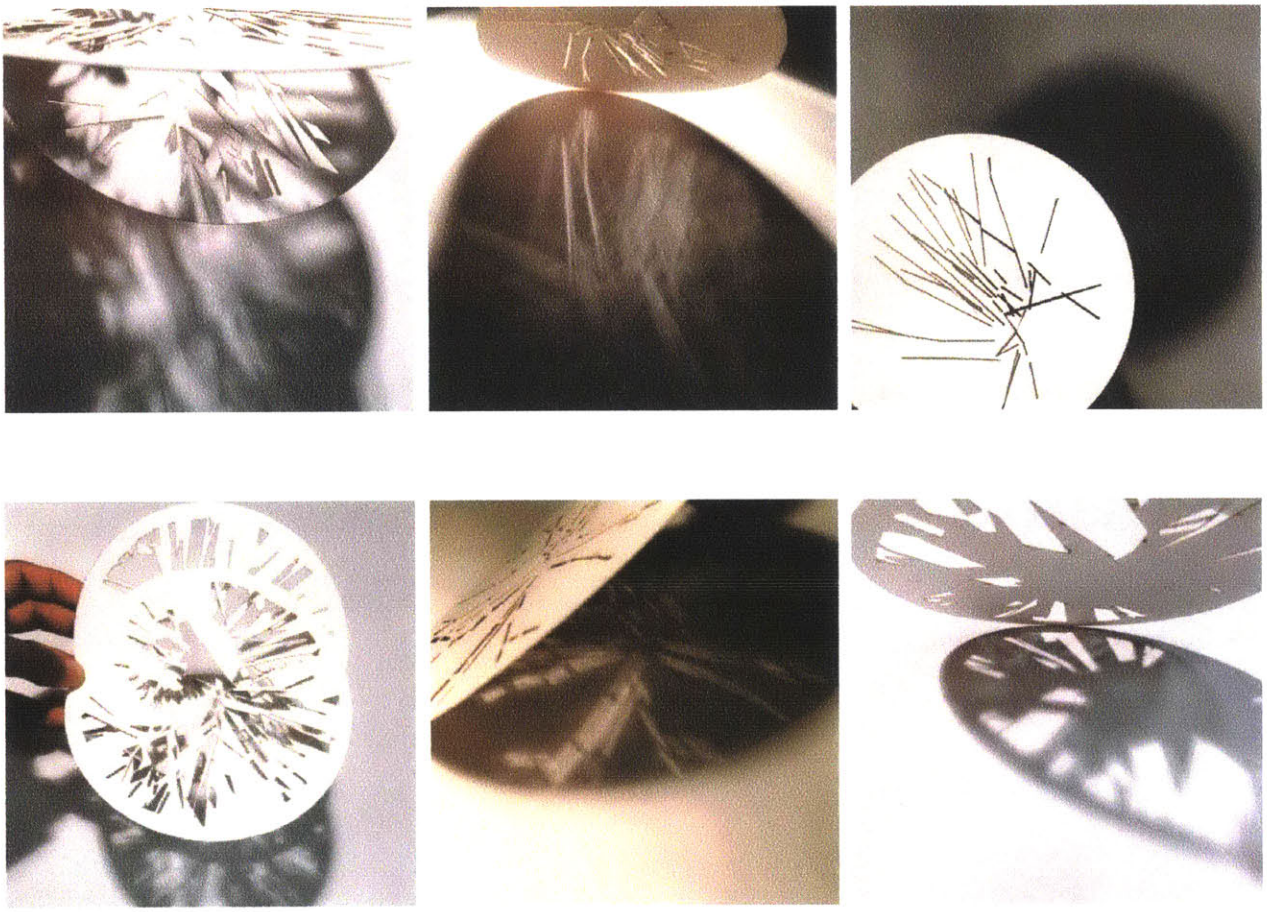
# SELECTION, COMBINATION AND ABSTRACTION

This is an illustration of the final patterns derived from groups of textures and photos.



# LIGHTING AND SURFACE STUDIES

Once the patterns were simplified, I experimented with the ways they could interact with light as either a device for filtering and mediation or to create structural surfaces. Referring to Frederick Law Olmsted's philosophy on natural design, I focused on the idea of "complexity of light and shadow near the eye and obscurity of detail further away."[2] This is achieved by experimenting with mixing different patterns laser-cut into bristol paper and playing with their proximity to light and surfaces.

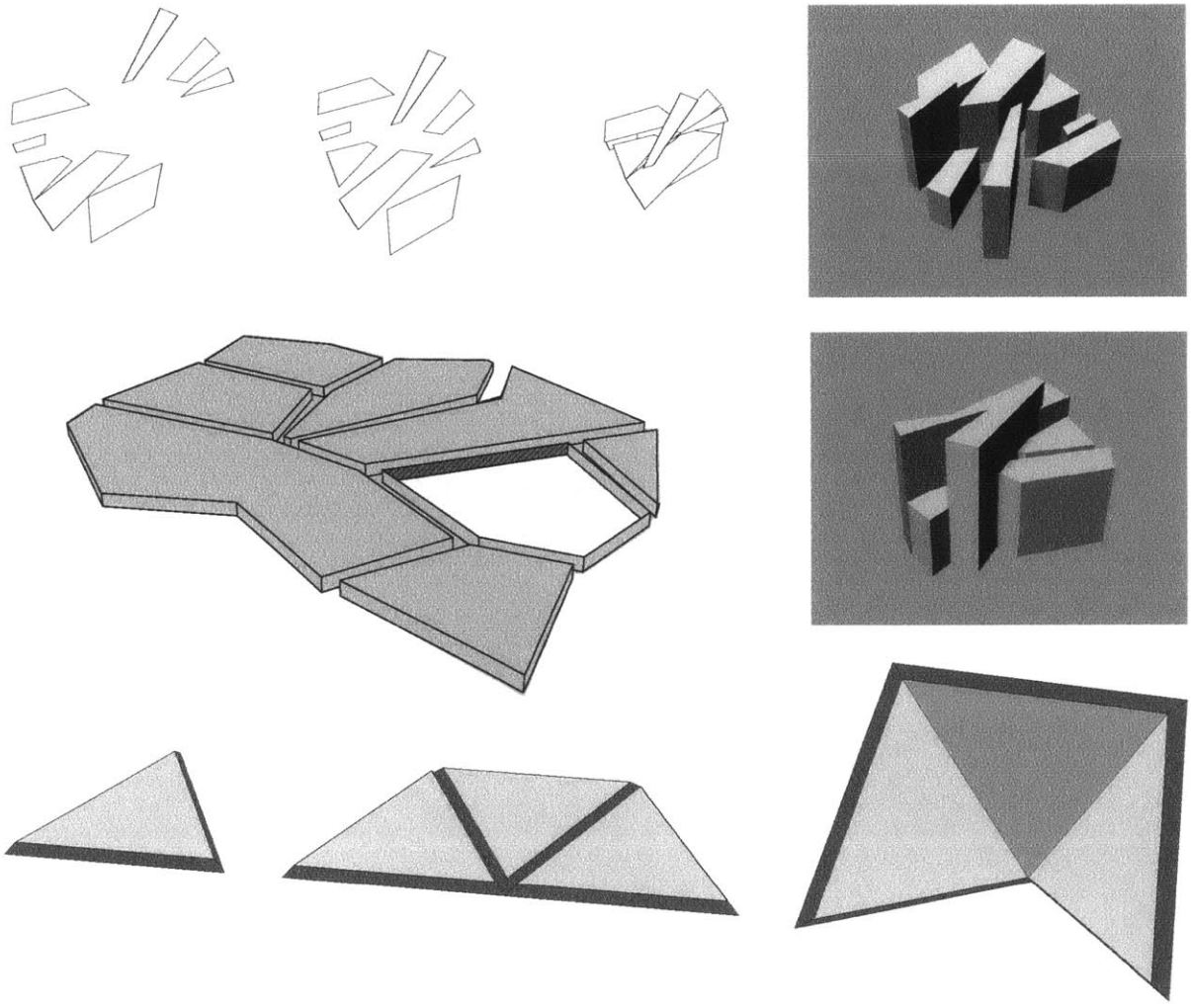


2 Beveridge, "Olmsted - His Essential Theory."

# TRANSLATION

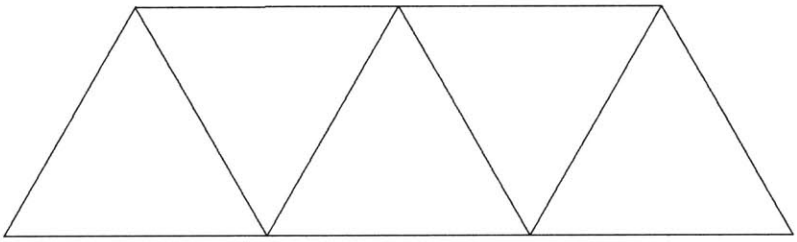
## FROM PATTERNS TO PHYSICAL SPACE

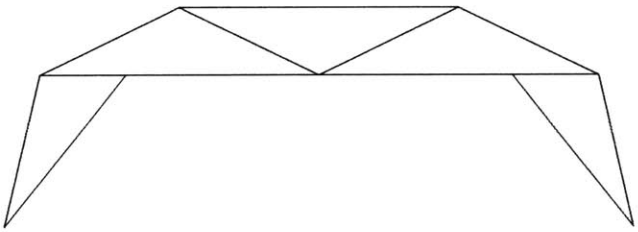
Based on survey results, students prefer personalized space and often seek pseudo-privacy within public spaces. Thus, I chose to explore the creation of customizable physical forms that could be inhabited either by a student seeking to do academic work or retreat and rest. Using the pattern extractions, I began to design physical geometries and consider the possibility of filling a space with modules that could be assembled into structures and carrels per the preferences of the user. This would not only give the user control over his/her surroundings, but would provide the means for creating a mini-oasis, where one is surrounded by shadows of nature and light. If fabricated, these modules should be able to be illuminated at in a similar way to daylighting lamps (though less intense). This would allow for the simulation of sunlight passing through the semi-opaque modules on rainy days and in windowless rooms.

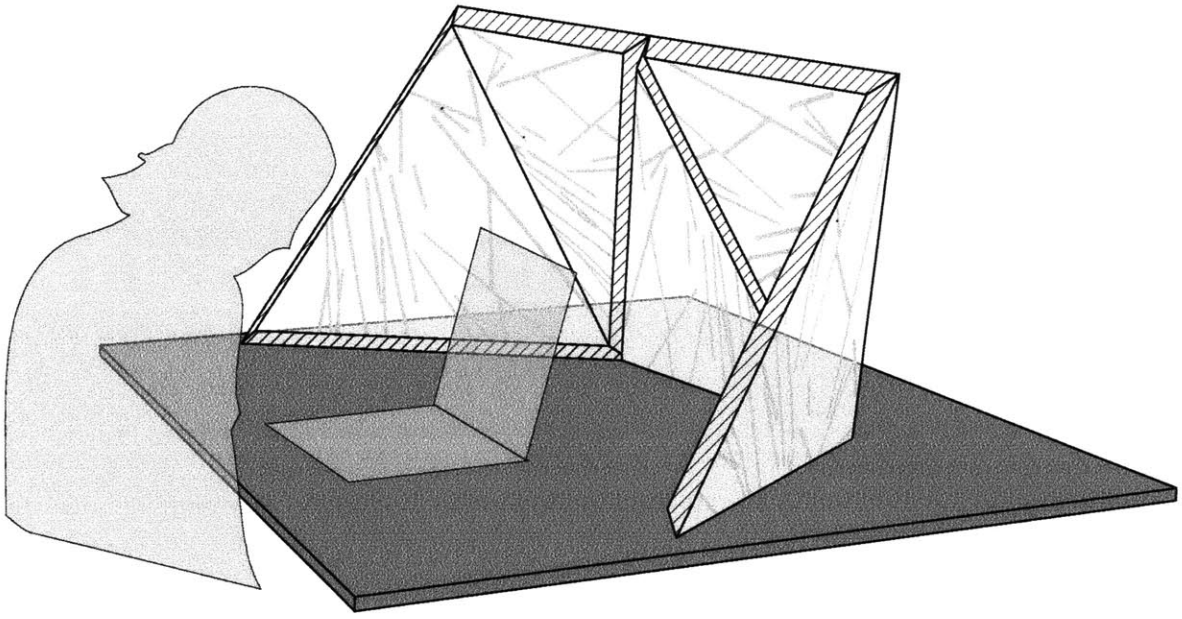


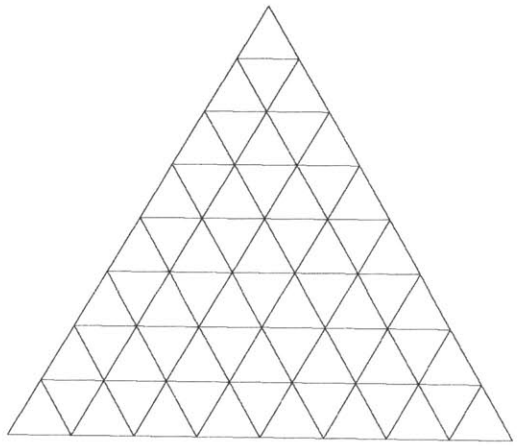
# FOLDABLE FORMS

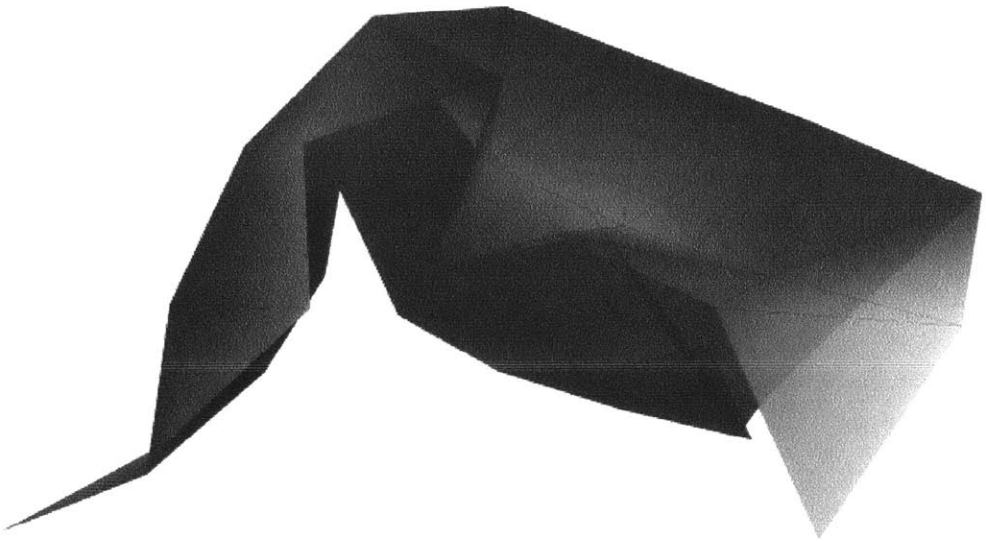
I decided to use simple geometric forms-such as triangles, to house the complex nature-derived patterns. To experiment with the form possibilities of folding triangular modules, I used an origami simulation software developed by Tomohiro Tachi from the Graduate School of Arts and Sciences at the University of Tokyo. This software allowed me to specify various fold patterns and manipulate planar facets in 3D space (while placing constraints on which facet edges were connected to the "ground" and how acute a fold could be). The result was a series of forms that could be created using folded triangular modules, which I placed into the context of campus spaces. Below is a simple carrel made of one of the folded modules, followed by the structured derived from various folded formations.

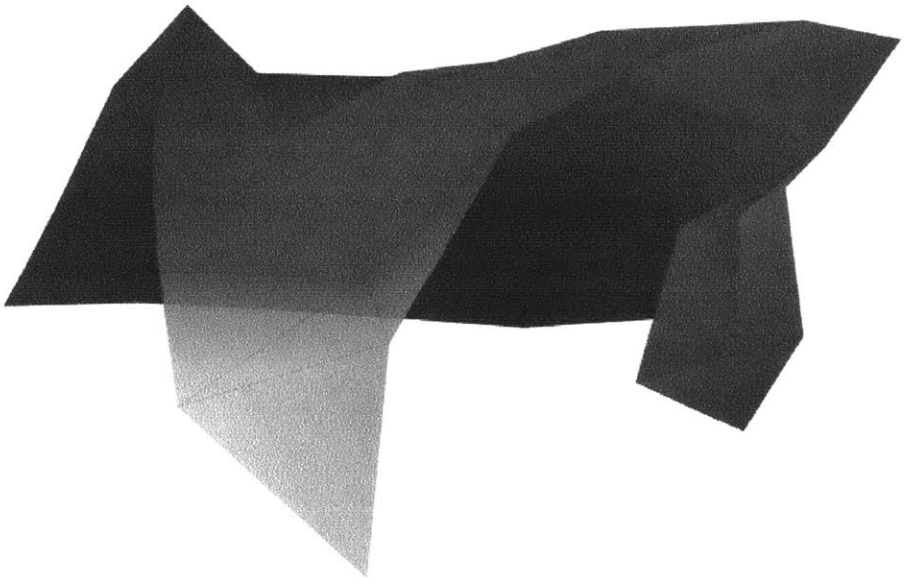


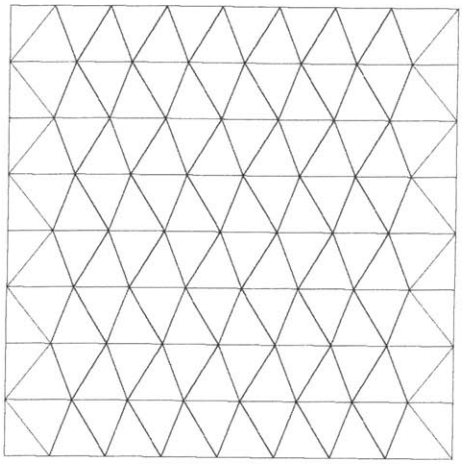


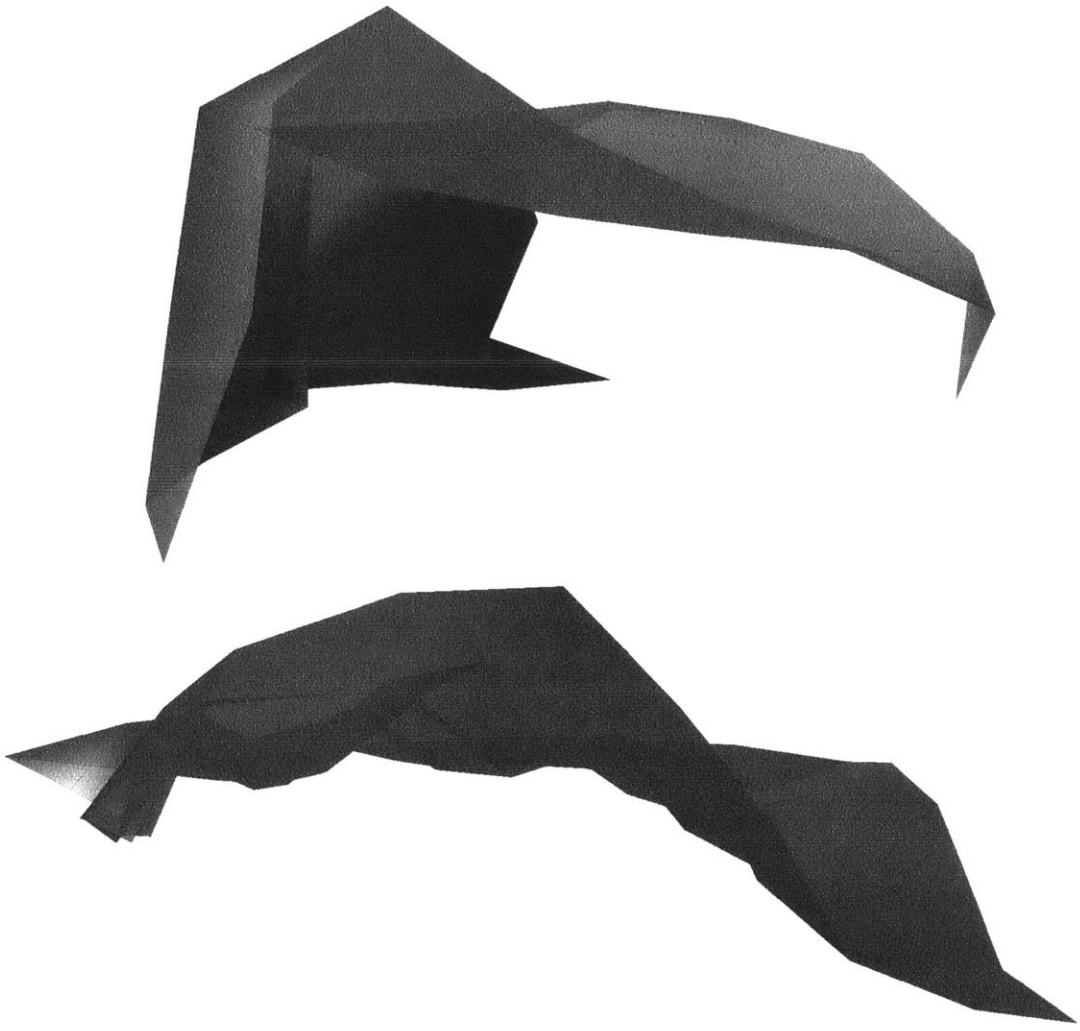


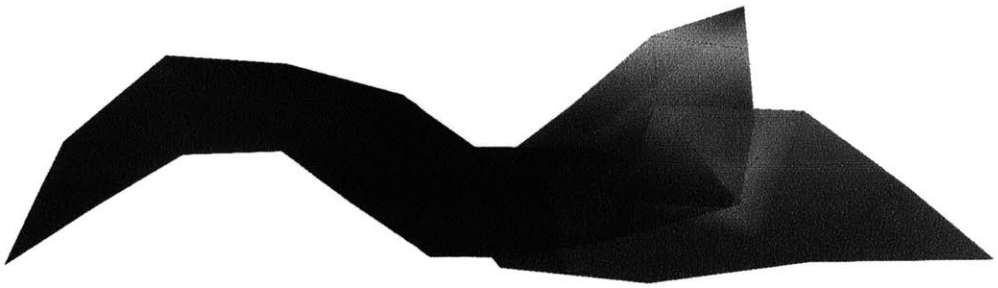


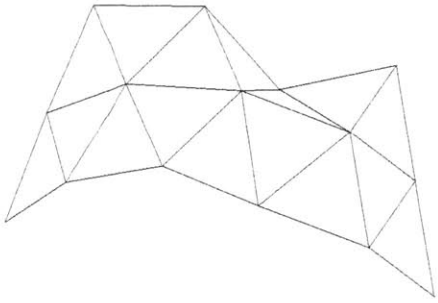


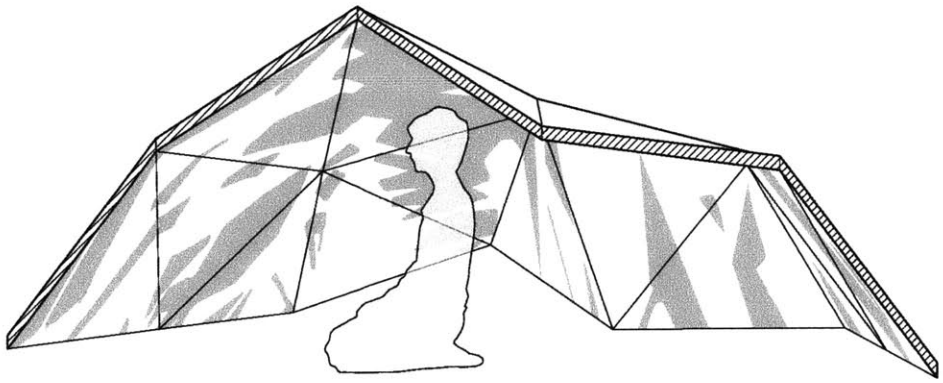


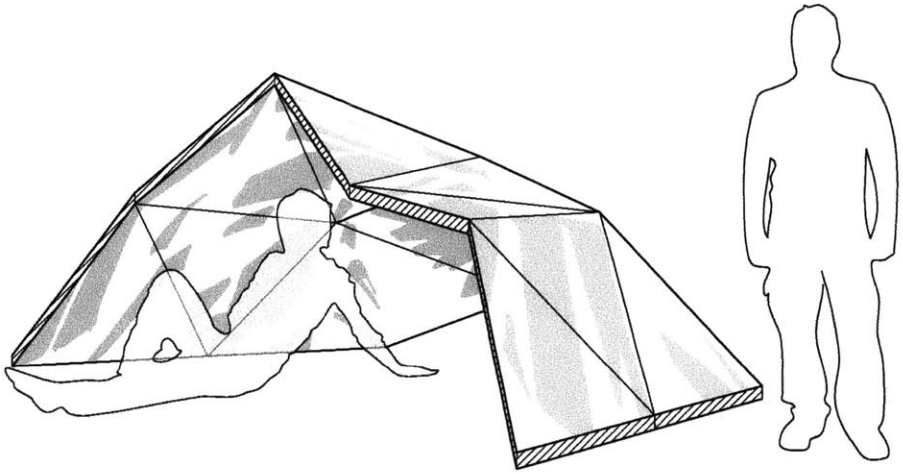


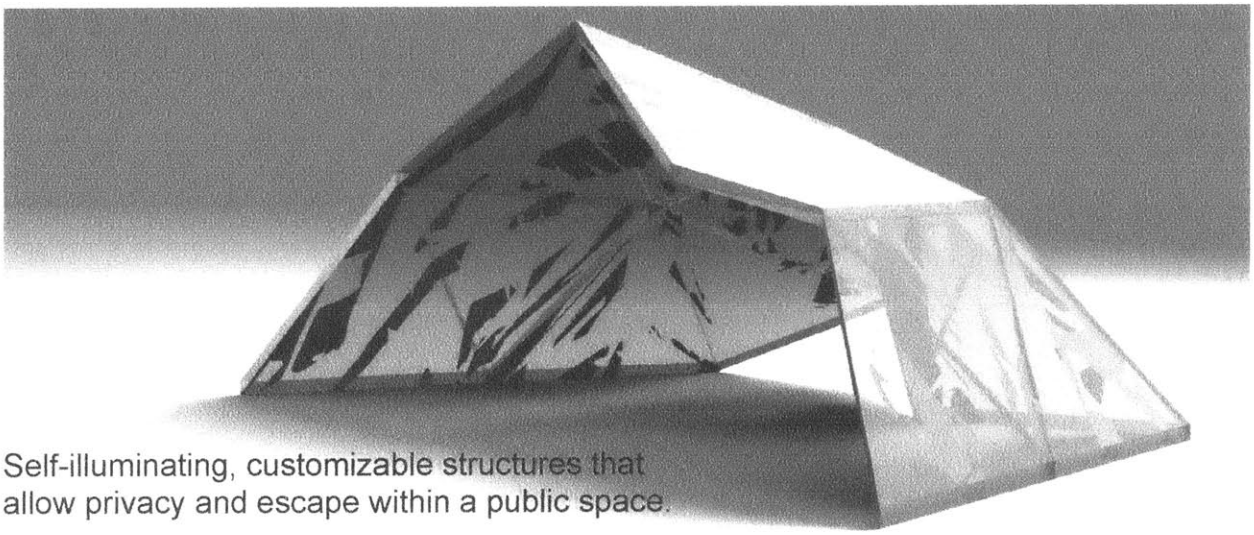




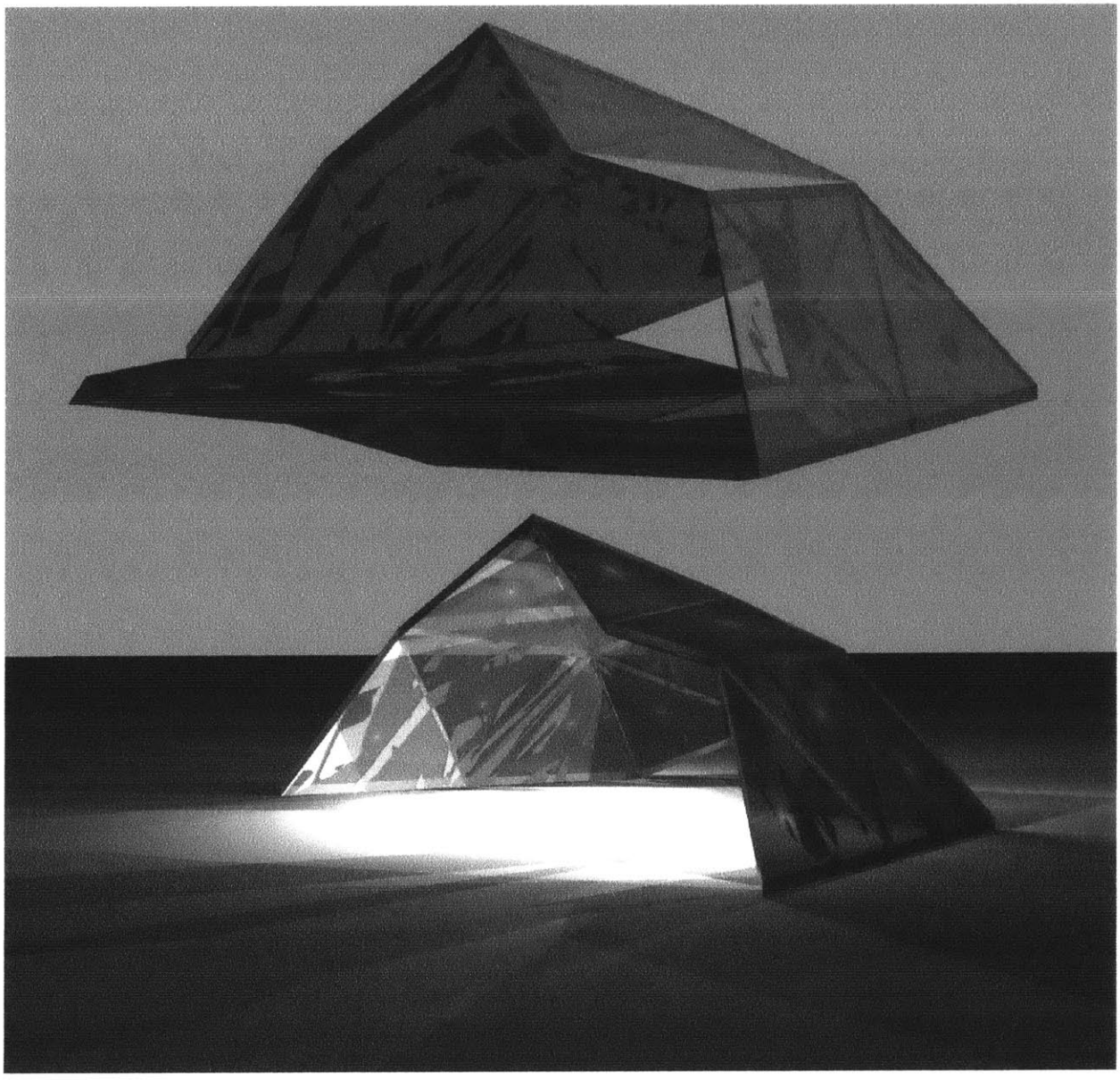








Self-illuminating, customizable structures that allow privacy and escape within a public space.

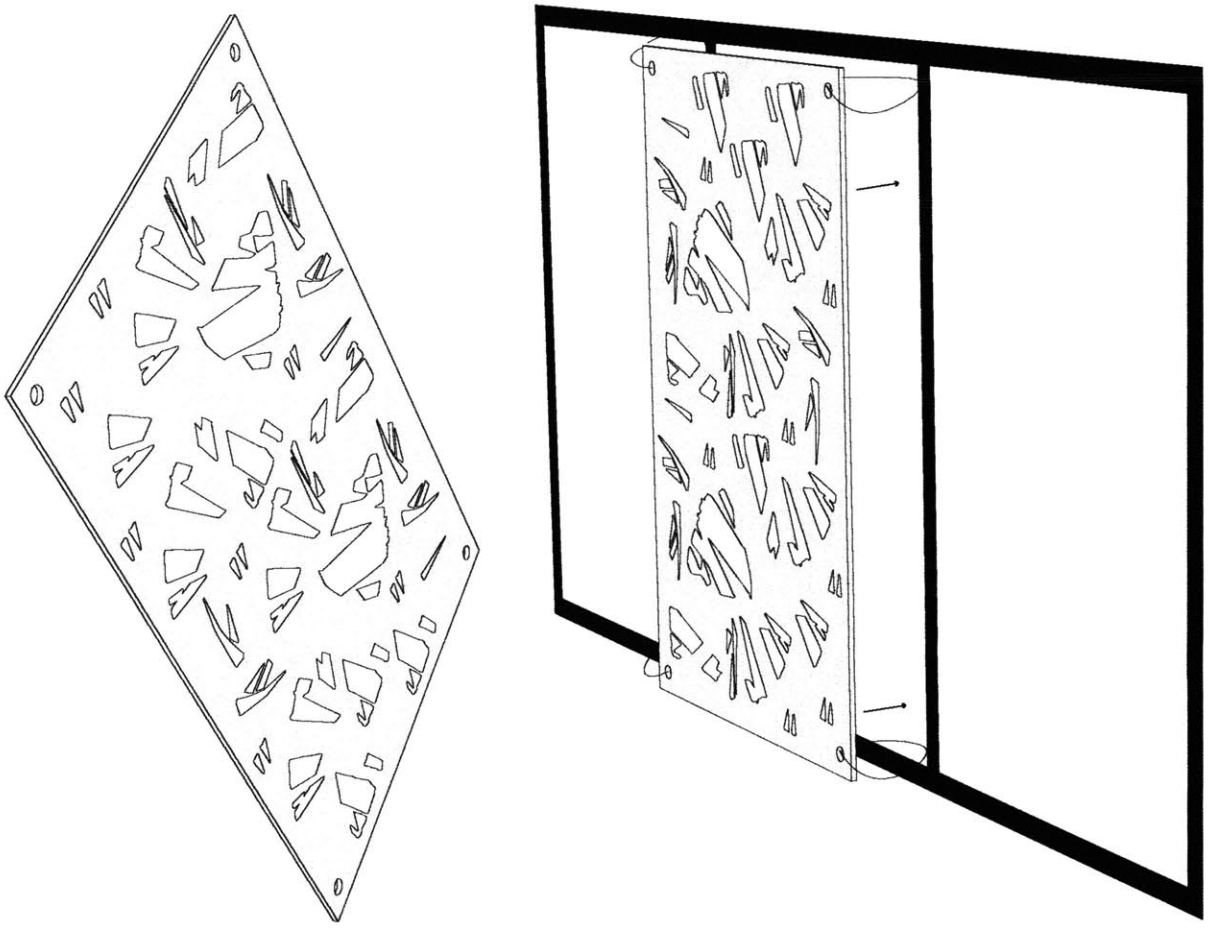


# INTERVENTION

## LIBRARY INSTALLATION

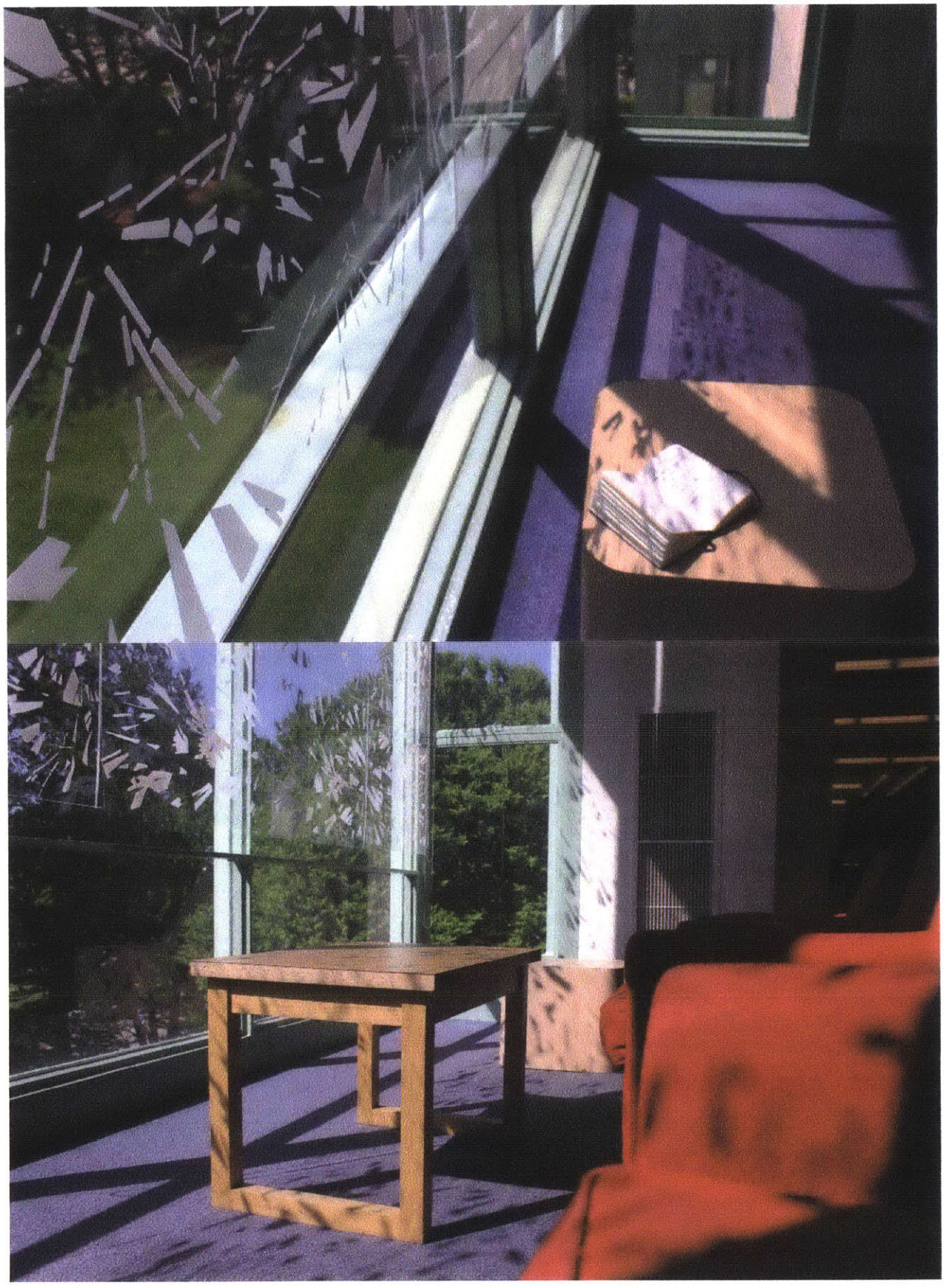
In order to observe the full-scale effect of light-mediating patterns derived from nature, I designed an installation as a campus intervention. Patterned panels of varying opacities were installed in Hayden Library (a space frequented by students both for quiet solace and focused productivity) for several days. The result was an intricate interaction between light and shadow during the day, with a dynamic figure-ground relationship in relation to the location (or presence) of the sun.

During the day, the patterns blend in against a background of foliage, they're existence manifested in the shadows they cast across the nearby couches and tables. This subtle complexity and depth (in the ability to look beyond the patterned panes), hits back at Olmsted's interests in the interplay between distinct forms in the foreground against less distinct forms farther away.[1] The installation was quite successful and can be further expanded to explore other light patterns around campus, including artificial light, in future iterations.



1 Ibid.

External view of Hayden Library-
daytime and evening



# CONCLUSION

Overall, my exploration of form and pattern derived from nature and the intervention of such extractions in campus spaces points to a larger potential within the field of architecture and interior design. The undertaking of promoting mental health through spatial design is an interdisciplinary one at heart- involving daylighting, psychology/cognitive science, and biology. The approach of intervening in existing spaces is especially important and relevant in old North Eastern cities likes Boston, where bringing a building up to code, let alone renovating one of the old brownstones, can cost a fortune. The solution of intervention can be customizable, low-cost and flexible. To an extent, with what was observed at the Hayden installation, it can also be non-invasive. Are we as designers willing to embrace the patterns and forms we see all around us, forsaking the sterile, modular "white box" and revisiting the aesthetically controversial realm of ornamentation? Perhaps the next step is to delve into a more quantitative analysis of the effects of installing these abstracted simulations of nature indoors. Or one could first expand the variety of samples of nature used and derive new patterns and trends based on that larger sample. Regardless, it is a direction worth pursuing.

**Additional Note:**

This project earned a feature on the MIT Homepage within a spotlight of the author on May 18, 2015

https://newsoffice.mit.edu/2015/student-profile-tiandra-ray-0518

Image Source: See Appendix A

# APPENDIX A

### Image References

Page 16: Crown Sky Garden http://worldlandscapearchitect.com/crown-sky-garden-chicago-usa-mikyoung-kim-design/#.VVydePlVhBc
Page 20: Helsingor http://architizer.com/projects/psychiatric-hospital-helsingor/
Page 28 & 43: MIT News https://newsoffice.mit.edu/2015/student-profile-tiandra-ray-0518
Page 45: McLean https://gonzotopia.wordpress.com/2012/07/21/a-bit-of-asylum/, Kirkbride http://www.pitt.edu/~super1/lecture/lec39001/028.htm, Nike http://www.mcfc.co.uk/citytv/features/2010/july/us-tour-nike-behind-scenes, Google http://bits.blogs.nytimes.com/2015/02/27/google-unveils-plan-for-new-corporate-campus/

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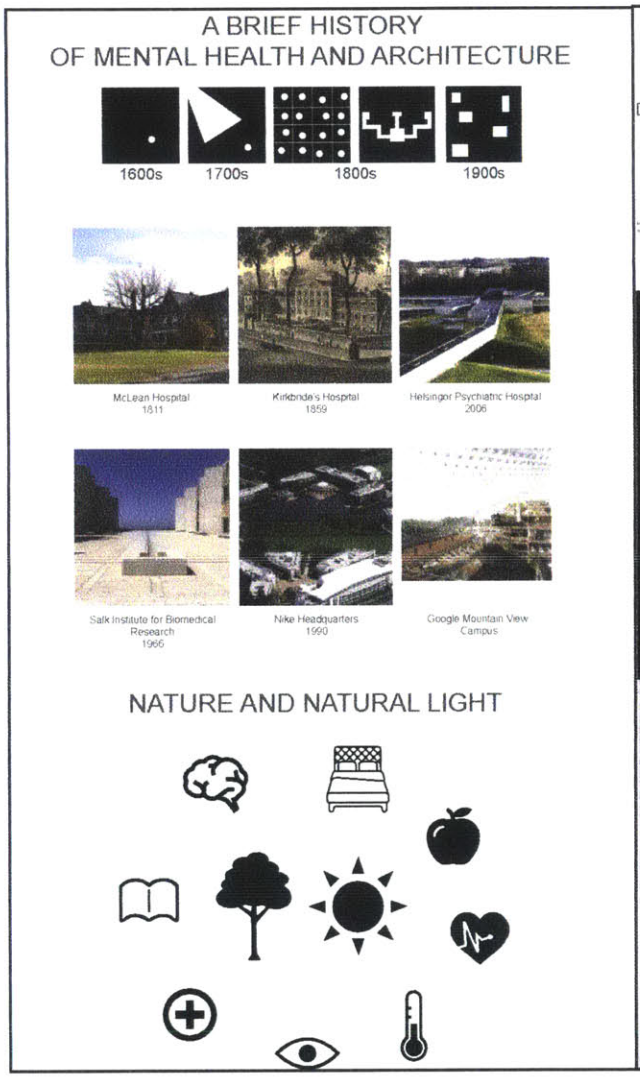
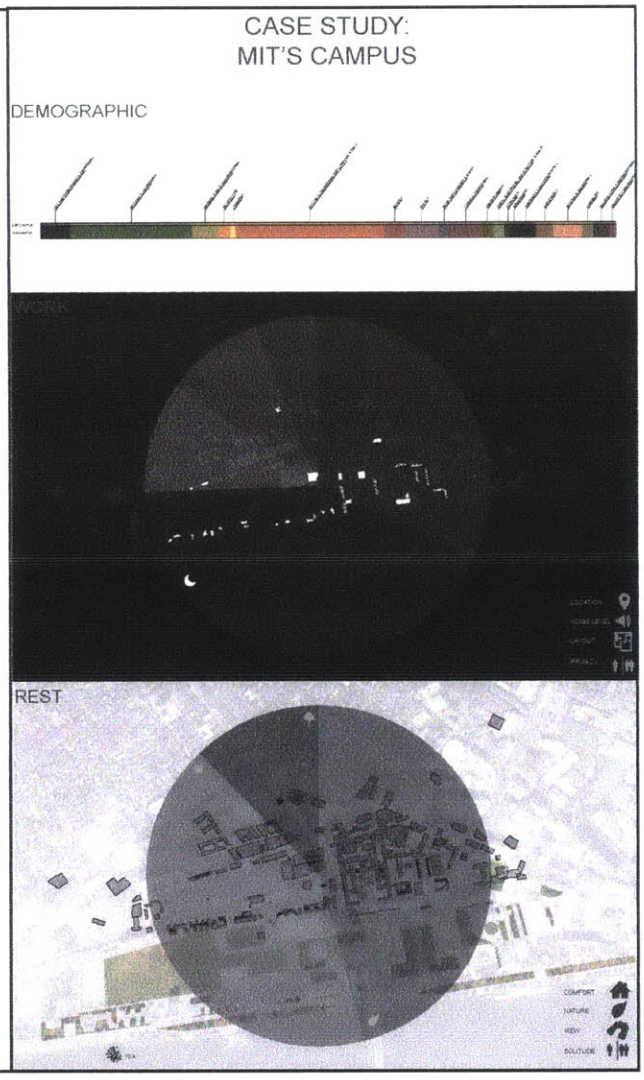
# APPENDIX B

## THESIS DEFENSE



## WHAT WOULD STUDENTS CHANGE?

"Control ambient noise much better (reduce HVAC noise and add absorption)." [4]

"The amount of sun and warmth. Use more organic colors and materials. More natural light." [11]

"Lighting and color choices--I wish they were closer to daylight and felt less like pulling an all-nighter in a room with no windows." [18]

"Oh god, the student center. Make it brighter or shinier or something. It's just so ugly" [6]

"Happier colors." [20]

"More plants/nature based design" [2]

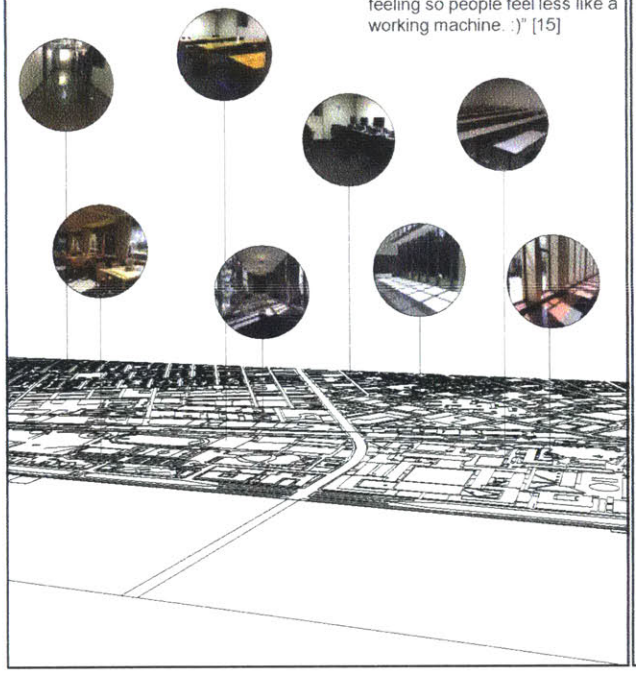
"It would be awesome to have a room or area dedicated to quiet and reflections, with lots of light and warmth. It doesn't even have to be aesthetically complicated." [7]

"Add lots of small study spaces/conference rooms along the various hallways." [2]

"We need more wood, wood is the new concrete dontcha know" [7]

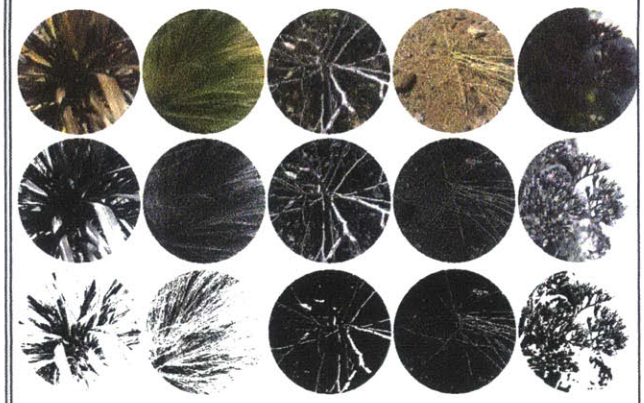
"Better lighting --it's really hard to work in dimly lit spaces" [4]

"Maybe create a more homey feeling so people feel less like a working machine. :)" [15]

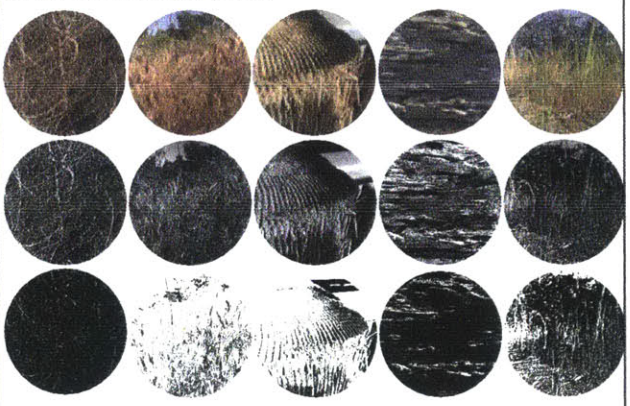


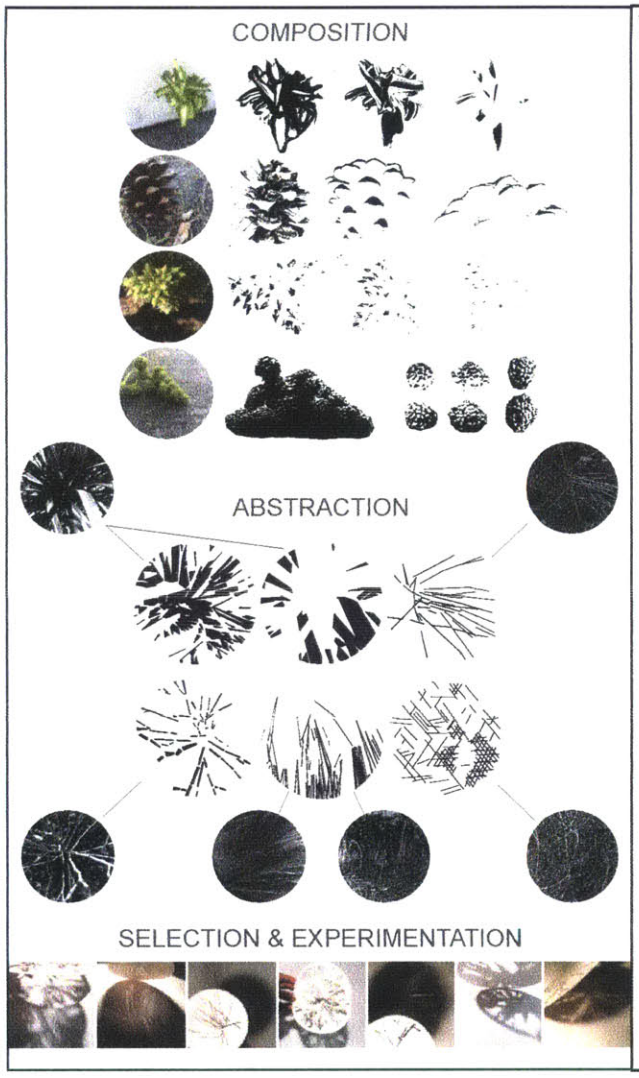
## EXTRACTION

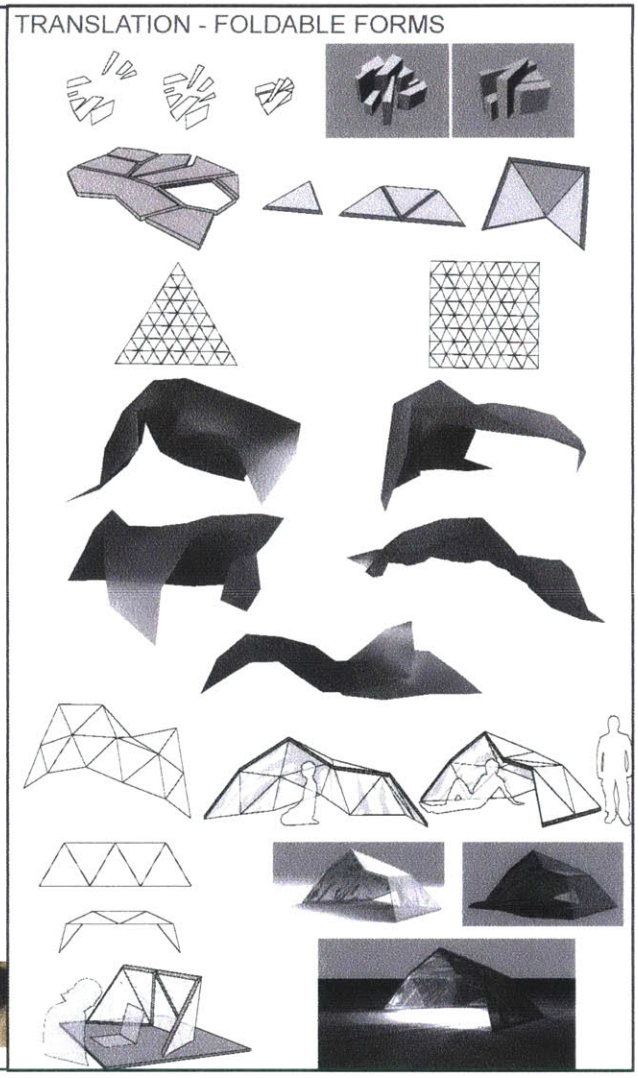
CONVERGENCE & BRANCHING

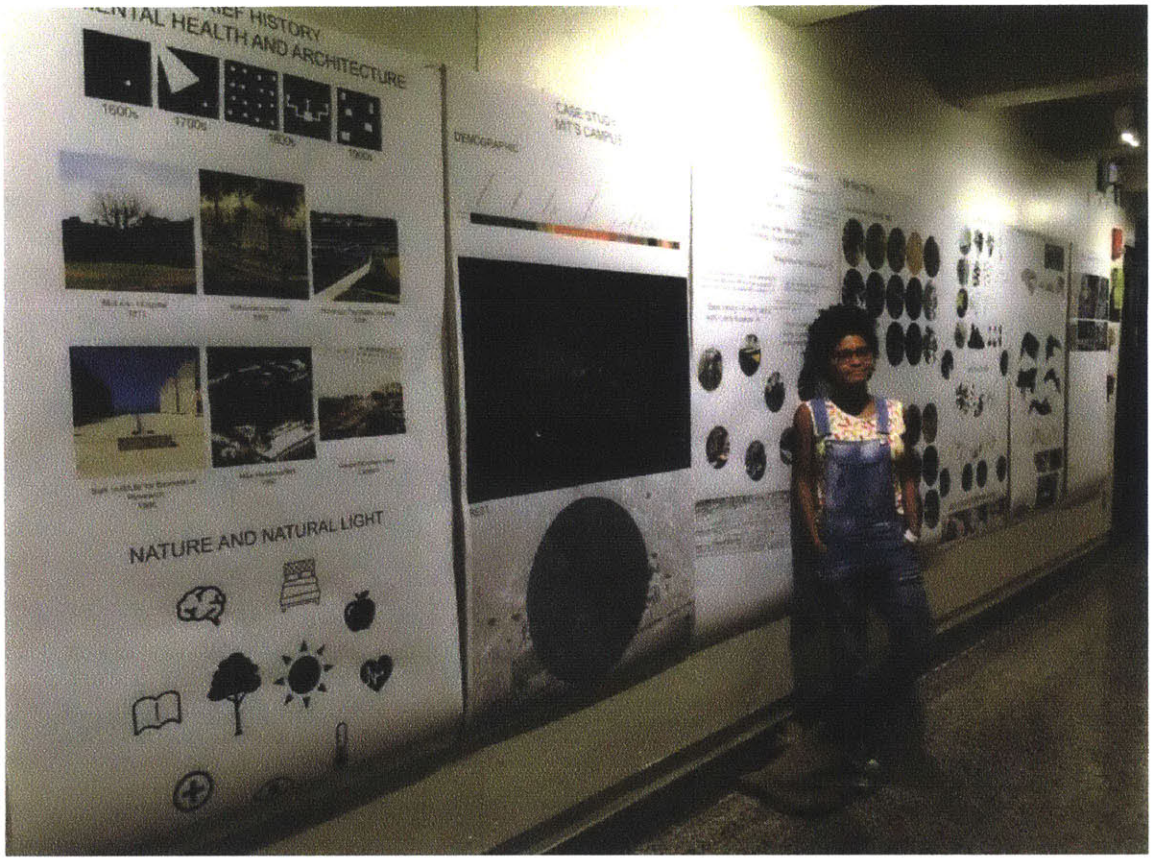


DENSITY & LINEAR DIRECTION




COMPOSITION
ABSTRACTION
SELECTION & EXPERIMENTATION


TRANSLATION - FOLDABLE FORMS


BRIEF HISTORY
MENTAL HEALTH AND ARCHITECTURE
1600s
1700s
1800s
1900s
DEMOGRAPHIC
CASE STUDY:
MIT'S CAMPUS
NATURE AND NATURAL LIGHT


ABSTRACTION

# APPENDIX C

## STUDY MODELS

The models shown below were created for the exploration of different materials and how light interacts with pattern and form.