ANDREW

ETHAN

YAROS

2014

ARCHITECTURE

2015

PORTFOLIO

2016

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Cycle (2010)

Weatherproof steel

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http://www.gagosian.com/exhibitions/richard-serra---september-04-2011/exhibition-images

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BY ANDREW ETHAN YAROS

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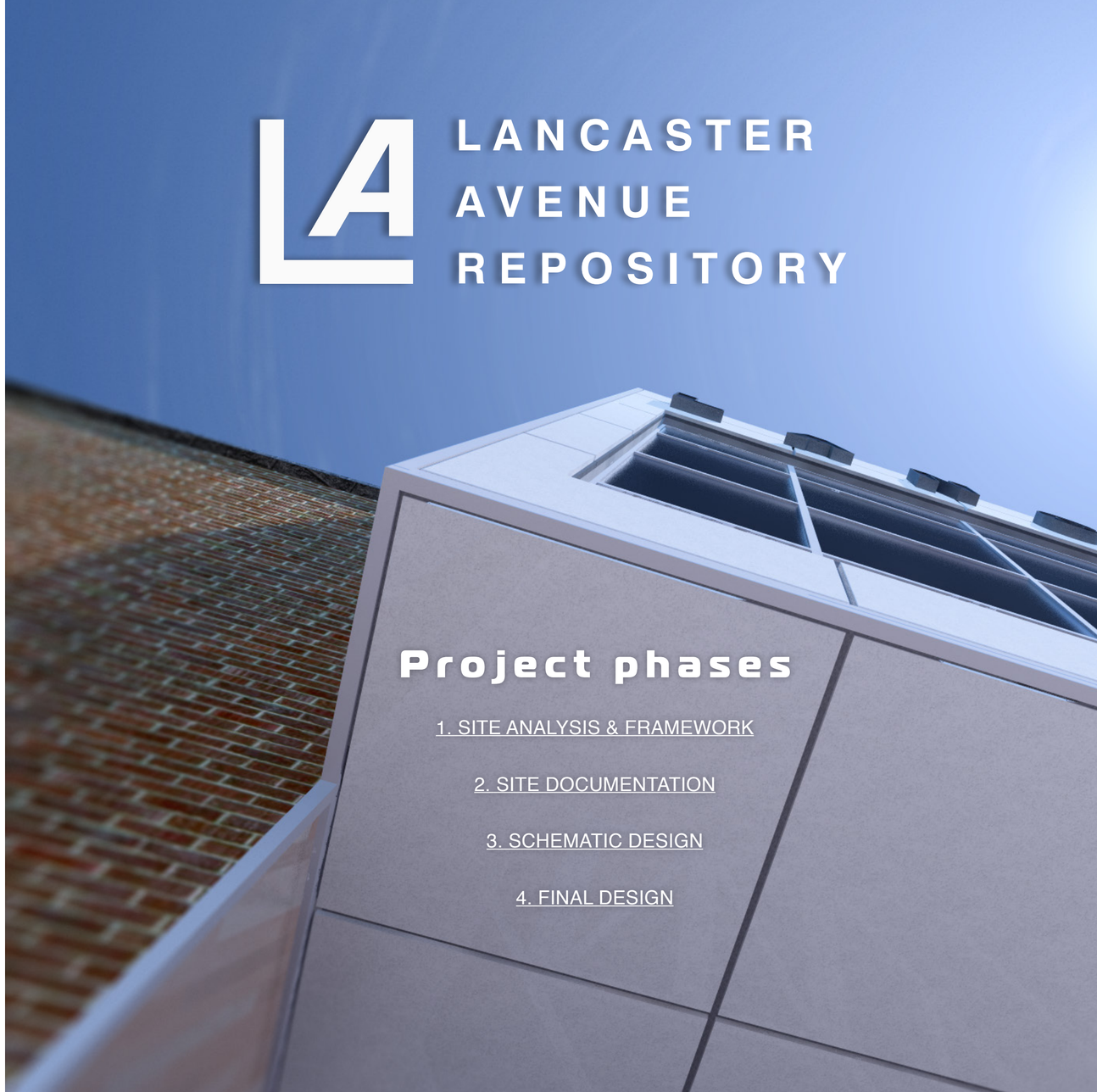
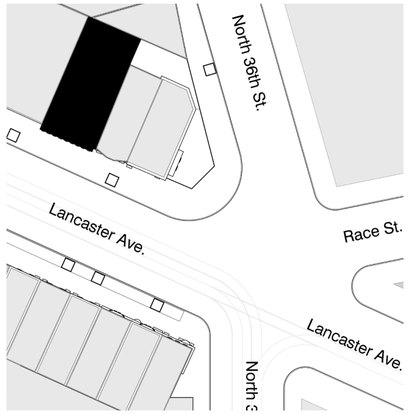

LANCASTER
AVENUE
REPOSITORY
Project phases
1. SITE ANALYSIS & FRAMEWORK
2. SITE DOCUMENTATION
3. SCHEMATIC DESIGN
4. FINAL DESIGN

In my second year spring studio class, I designed a small museum to house artifacts found along Lancaster Avenue (near Powelton Village in Philadelphia), preserving the heritage and history of the area as it undergoes extensive redevelopment.

This project took place over the course of eleven weeks and four main assignments: the initial site analysis, the development of a narrative and framework, site documentation, and schematic design. The class ended with a final presentation.



1A. SITE ANALYSIS

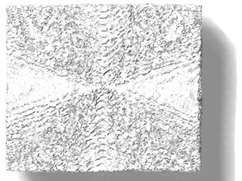
I started by visiting Lancaster Avenue in the areas between 34th St. and 40th St. Afterwards, I created a small study to show the various materials and textures of the area, organized by color. One of the themes of this project was urban decay: when a urban area falls into disrepair through poverty or neglect.

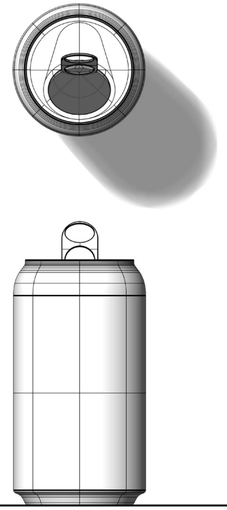
COLORS OF DECAY

BY ANDREW YAROS

1B. ARTIFACTS

We were required to find several “artifacts” along Lancaster avenue (which amounted to garbage or other discarded objects), document where we found them, and design a framework and narrative to relate them together. The artifacts I found were the following: an old handmade clay brick, an aluminum soda can, and a small poster (an advertisement for a weight-loss program). The framework I designed is a metaphor for the redevelopment of this area of the city.



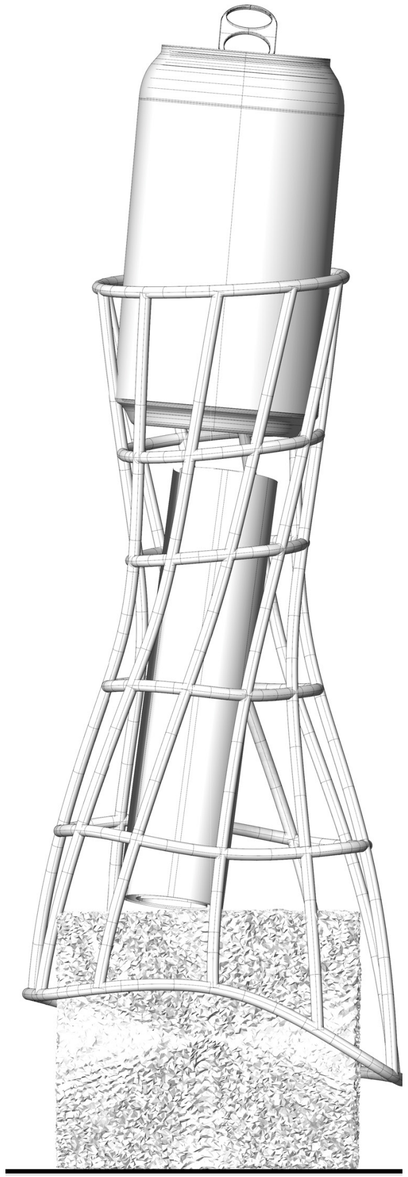


1C. FRAMEWORK

Placed at the bottom, the brick is quite literally a foundation representing the city’s rich history and present condition. Most of the older buildings were made of them. As a material, it is a product of it’s time, coarse, uneven, and full of imperfections. Yet it is a testament to the human labor which went into building Philadelphia.

The soda can at the top of the framework represents modernity. A mass-produced, machine-made object, it was created with a more advanced manufacturing process. The aluminum had to be extracted from bauxite ore and purified. Cans are disposable, recyclable objects, and it is easier than ever to make more of them, demonstrating the efficiency and automation which benefits us today.

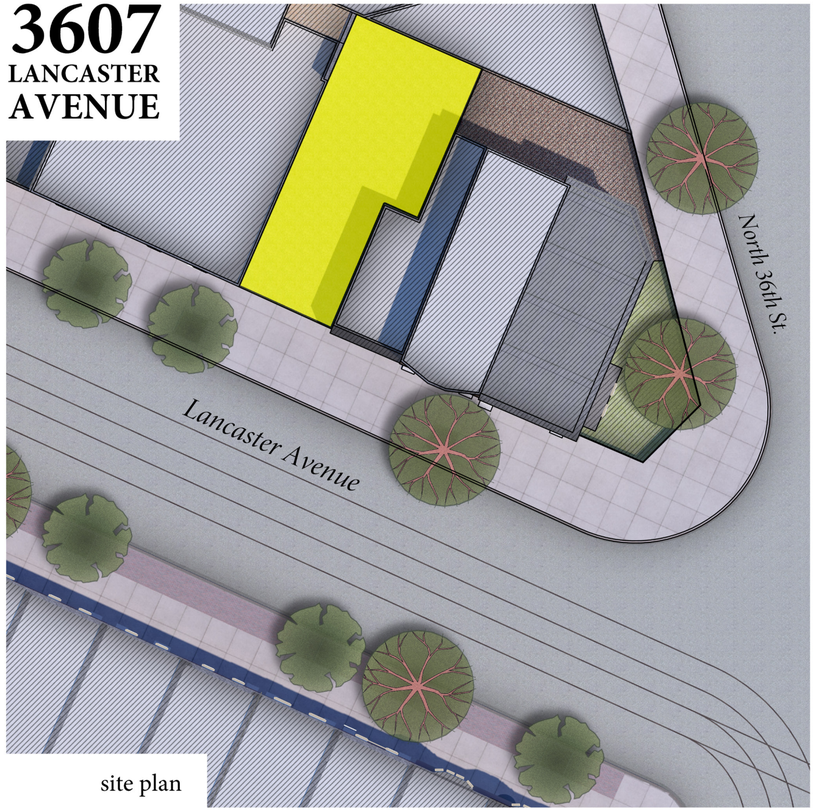
What is the solution to urban decay? Renovation and reform, as symbolized by the weight loss advertisement. It represents a path forward; an initiative to overcome the status quo both socially and financially. The ad, rolled up into a cylinder, is placed between the other two artifacts to bridge the gulf between the present and future. The framework, made of copper, is a twisted abstract shape which holds everything together.




Coca-Cola
2 FL OZ


Coca-Cola

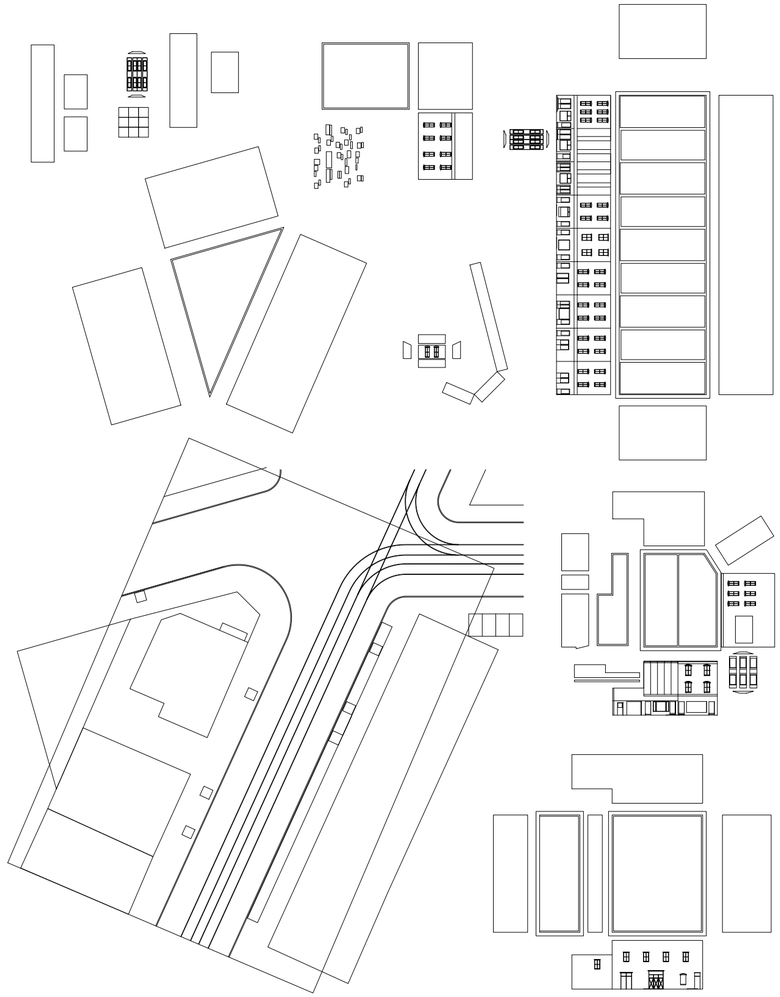
2. SITE DOCUMENTATION

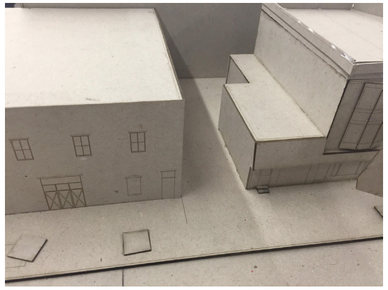


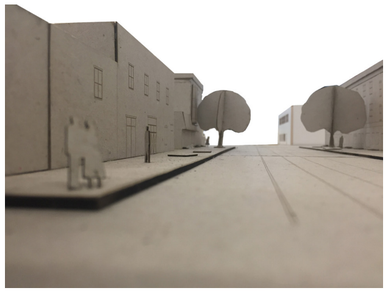
site plan

Our small class was split into two groups, each with a different site. My group was assigned an empty lot at 3607 Lancaster Avenue (highlighted in yellow). We were required to survey the site, create 2D documentation, and build a large 1/8th scale model. I ended up completing most of the documentation myself, and my 3D site model was the basis for our physical scale model. After we finished it, the group work ended and we each set out to create our own design to fit into the lot. Adjacent to 3607 is a single story building; on either side of both are three story buildings (see the longitudinal section above). Because of the constraints of this space, members of my group were given the option to build on top of the adjacent one story building. In reality, that would be a logistical nightmare, but thankfully this is only a studio project!

The model parts shown below were created directly from orthogonal views of my SketchUp model. The geometry was imported into AutoCAD and sent to a laser cutter. My group assembled the newly cut parts into a large 1/8th scale model.







3. SCHEMATIC DESIGN

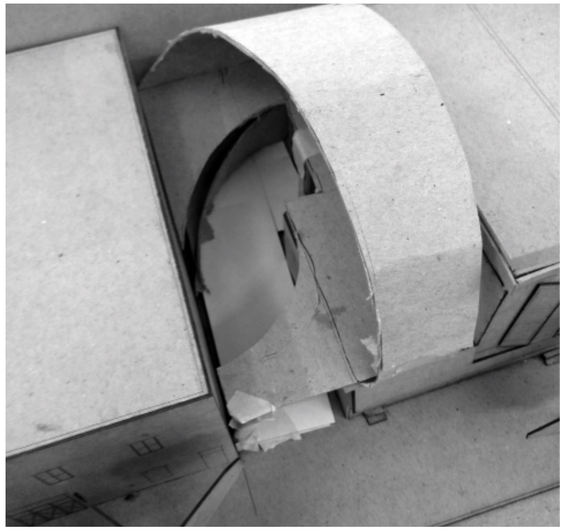
Our assigned program was deliberately vague. At the very least, we needed to include space to collect, research, prepare, and display artifacts recovered from Powelton village. We were given the option to incorporate or disregard the aesthetics of the site. I chose the latter, mostly because I'm not particularly fond of the older architecture in Philadelphia. I wanted to create a captivating design unlike anything in the area. Given the spatial constraints of the site, I aimed to design a "box" instead of an unconventional shape, like some of the other designs in my portfolio. This lets me make the most of the space I have - there's a reason most buildings are box-shaped... The messy model was a 15 minute in-class assignment meant to help us get started.

Later, to move forward with the design process, I considered the geometry of the area itself. Lancaster Avenue is a diagonal road which intersects Philadelphia's grid plan. In response to this, I decided to add diagonals into my designs. Study model A was fairly straightforward with increasingly recessed levels connected by a single staircase. In model B, each floor is cut in half diagonally, resulting in several alternating balconies. I preferred this; upper areas are harder to see and the pathway through the museum is less obvious, adding a feeling of discovery to each visit.

The exterior design was a bit tricky to figure out. I quickly realized a good approach was to split the front façade into two volumes. I accomplished this by recessing the entrance while extruding the upper area outwards, creating a small volume at ground level and a larger one at the upper floors, dominating the façade.

Schematic design photos (next page):

1. Messy model
2. Study model A
3. Study model B
4. Front façade and plan
5. Final design exterior
6. Placement in site model
7. Placement in site model
8. Final design interior



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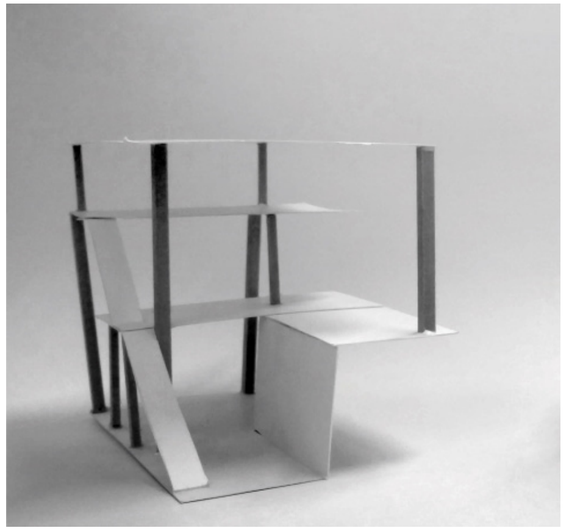

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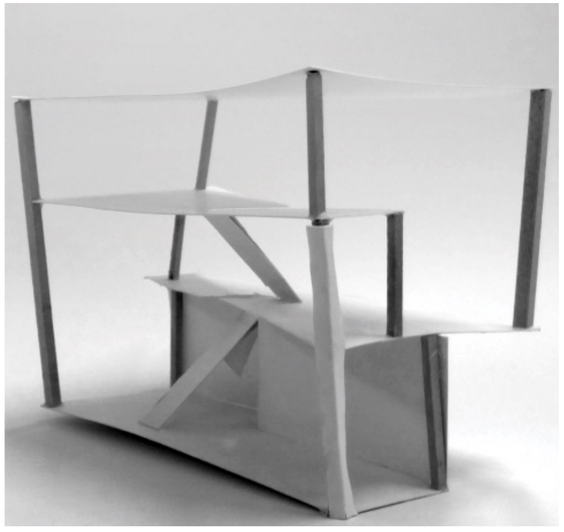

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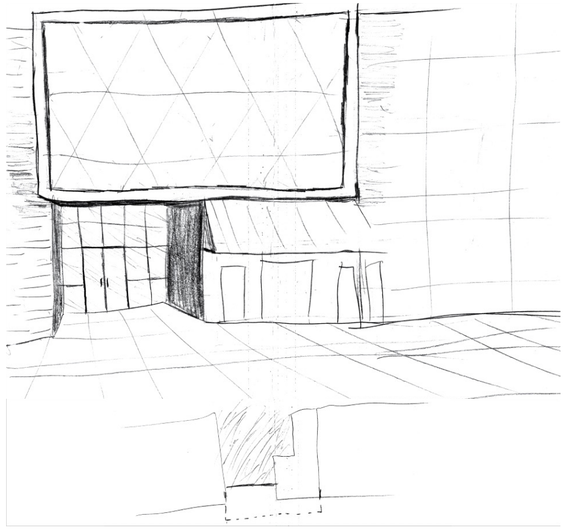

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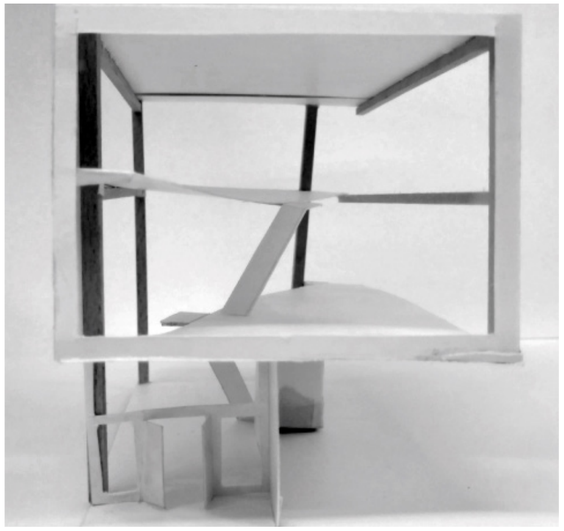

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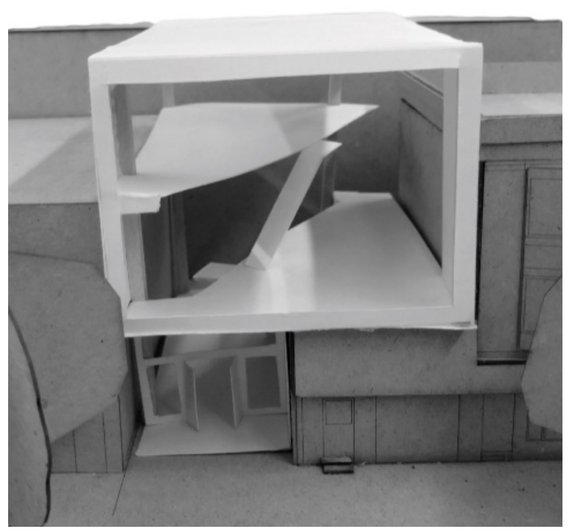

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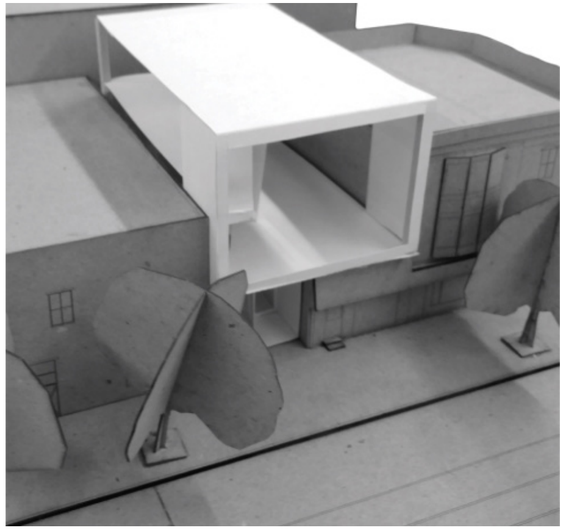

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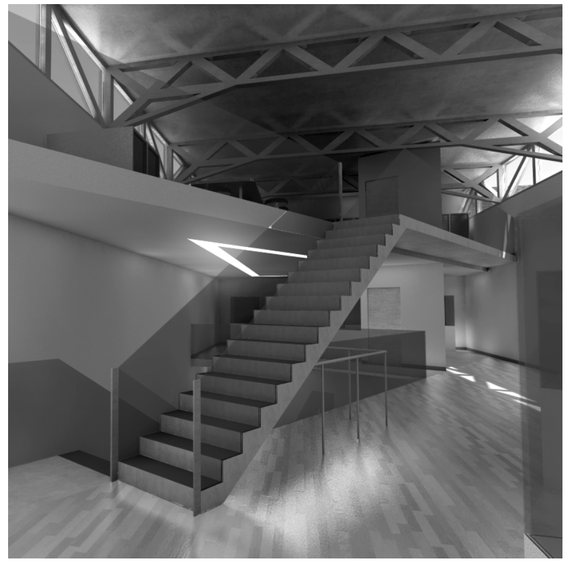
4. FINAL DESIGN

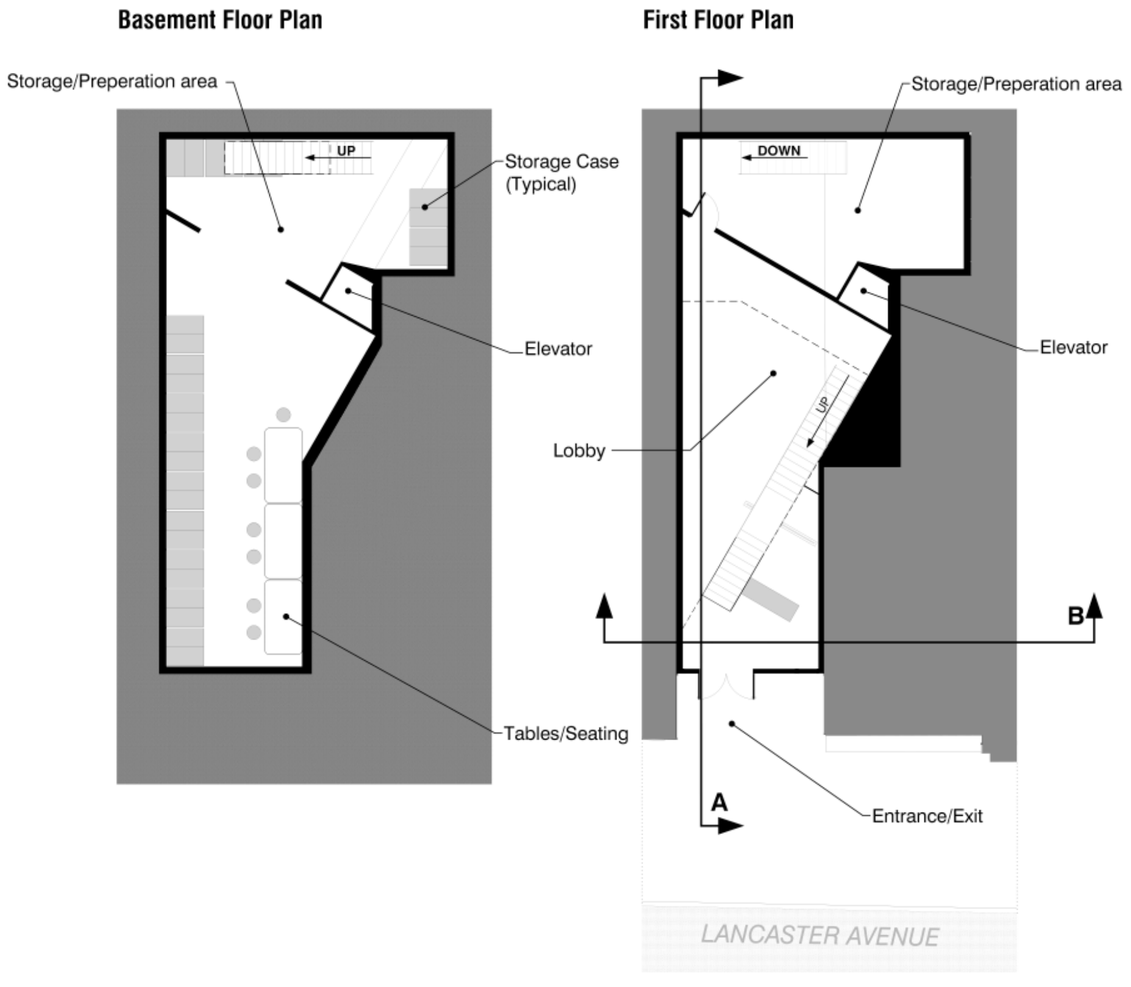


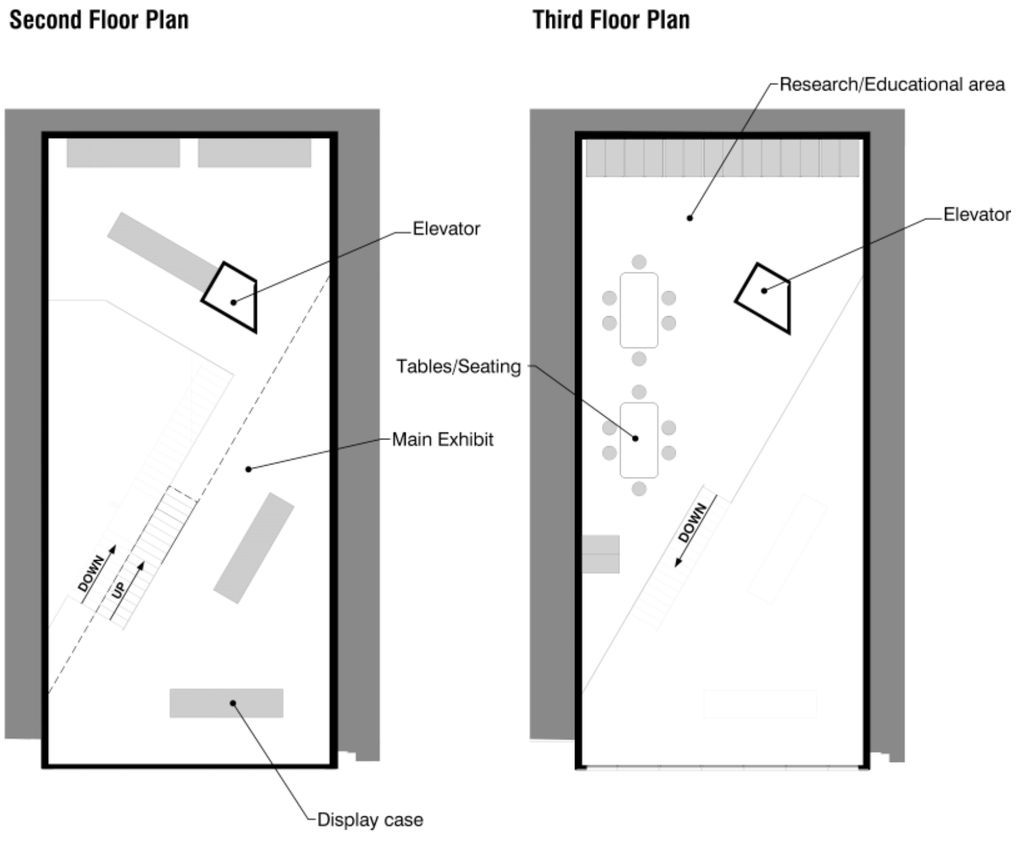
Basement: artifact storage and preparation

First floor: lobby, additional storage space

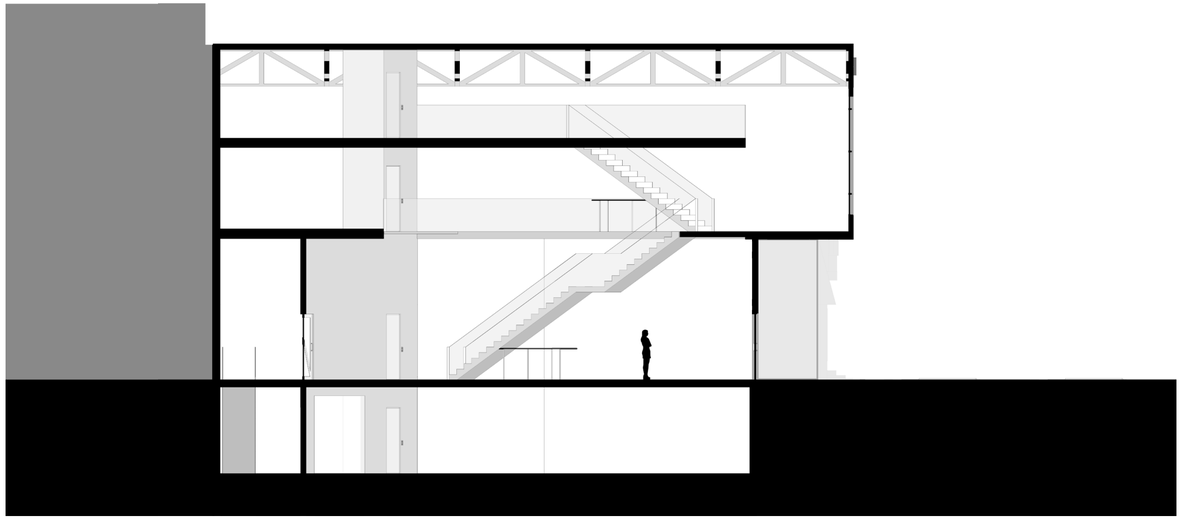
Second floor: main exhibit and display cases

Third floor: library and research area





Section A



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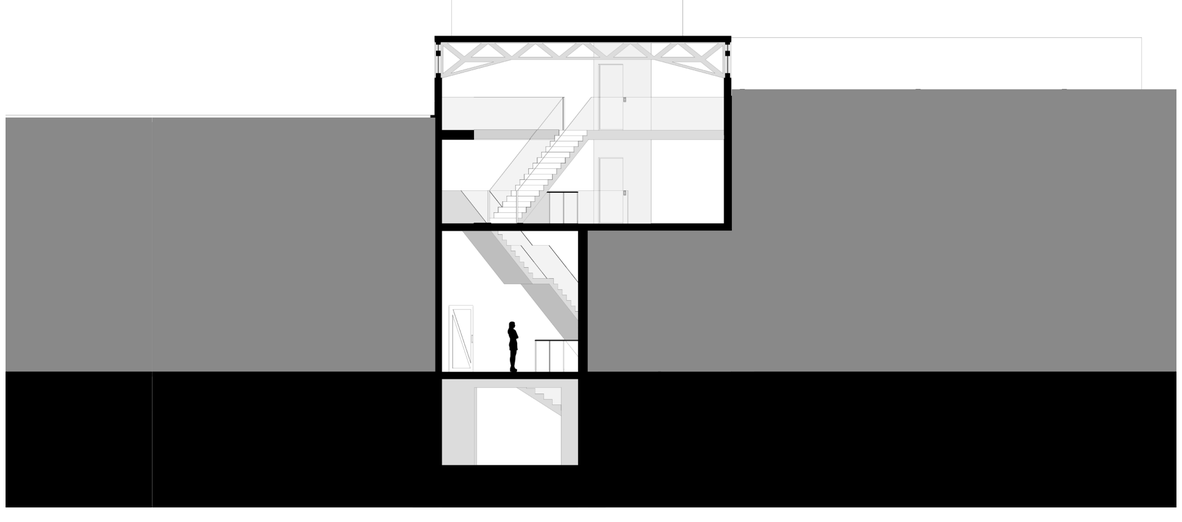
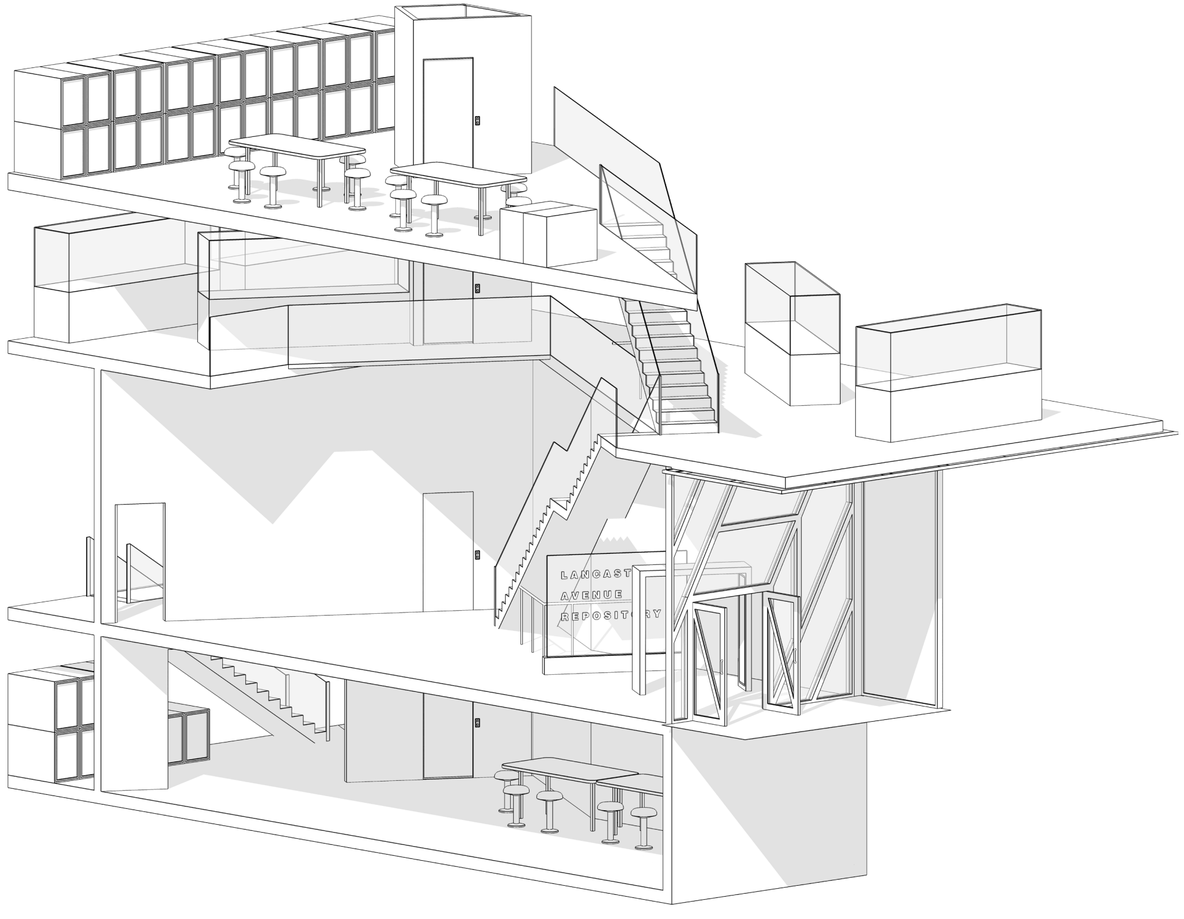
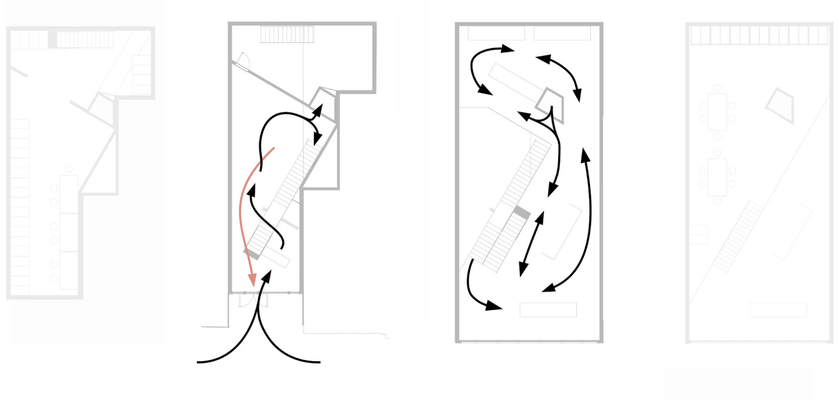


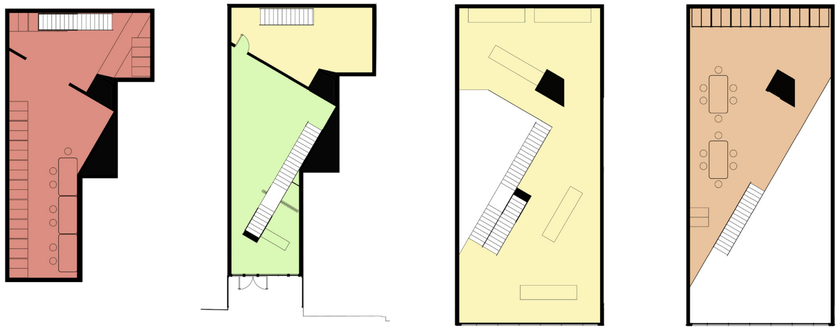


Circulation Diagram



Circulation on the first floor starts at the entrance. One walks through the lobby to the back right corner of the room. To reach the second floor, they may take either the stairs (which run along the diagonal cut of each floor) or the elevator. This choice determines where you enter on the second floor. With two different points of entry, and circulation which loops around the floor space, it is difficult to make a controlled linear exhibit that everyone will experience identically, which was my original intention. Instead, the exhibit design should embrace the opposite with an approachable non-linear design, providing each visitor a unique experience.

Public/Private Diagram



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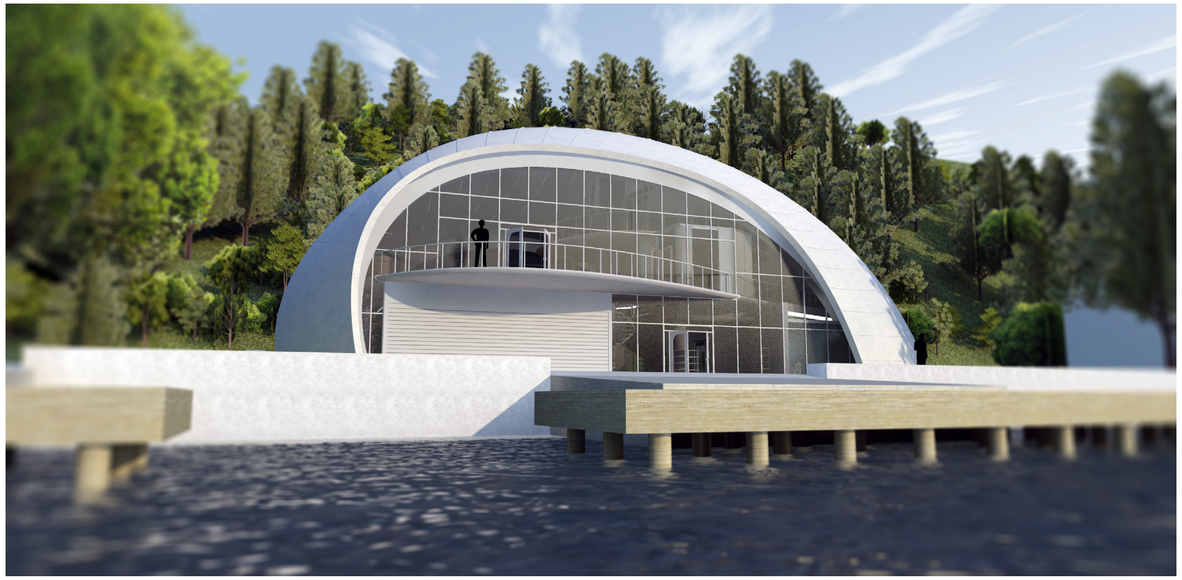
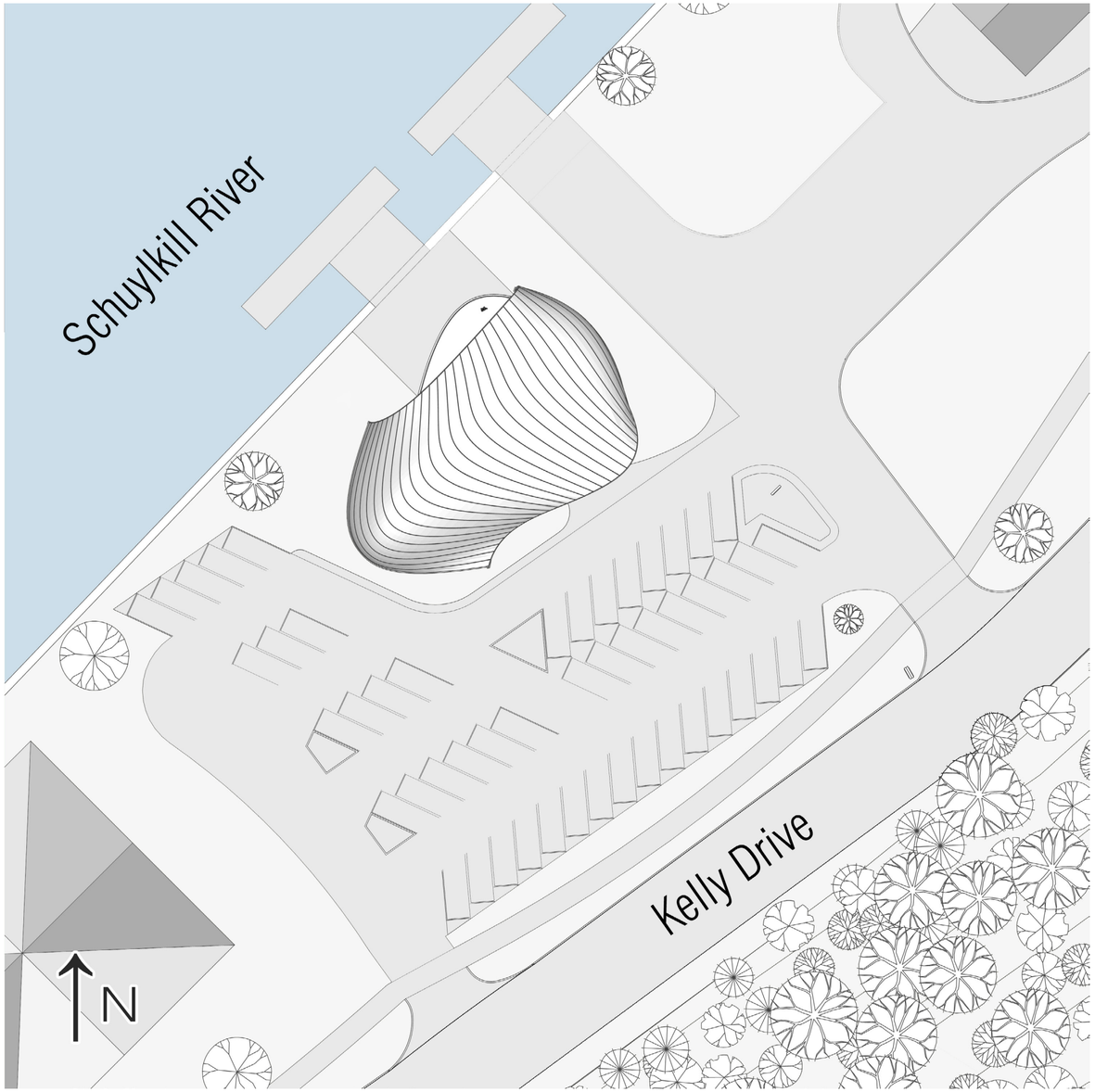
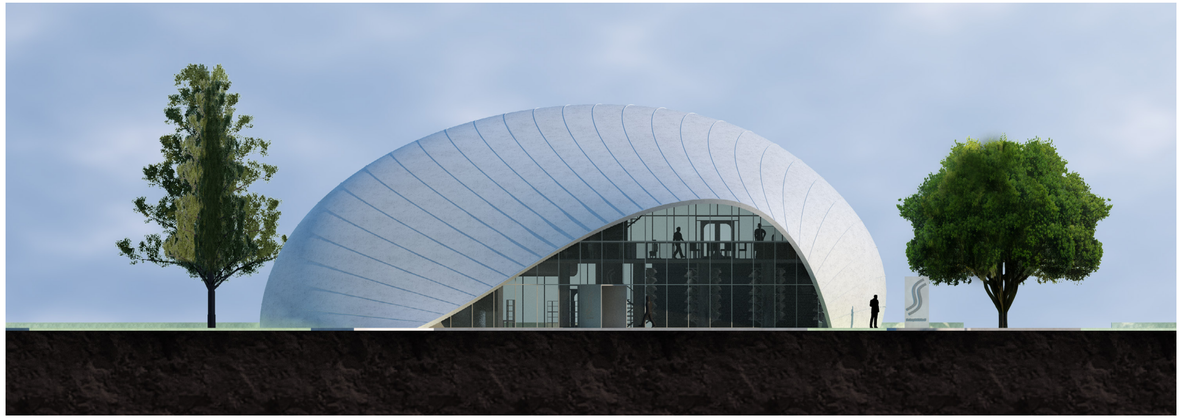


In this project for my second year winter studio class, I was tasked with creating a design for a boathouse along the Schuylkill River. It was designed for a new league of public and private schools to have their own space along the river, allowing them to compete in boat races and host social functions. The site is located at Kelly Drive between the St. Joseph's University and Temple University Boathouses. The program also calls for locker rooms, a weight training room, offices, a kitchen, and a trophy room to host events and showcase the league's awards and achievements.

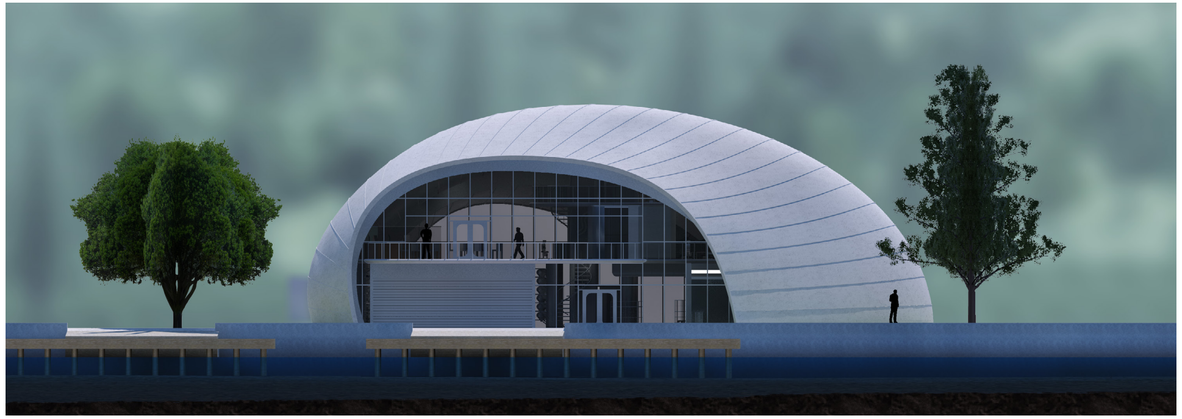
In the spirit of boat racing, I wanted the building to resemble a wave. This was best accomplished as an abstracted shape in the form of a ribbed concrete shell, which also happens to mimic the way most boats are constructed. Enveloping you as you enter through the front, its unique shape creates an unusual, memorable experience on the second and third levels.



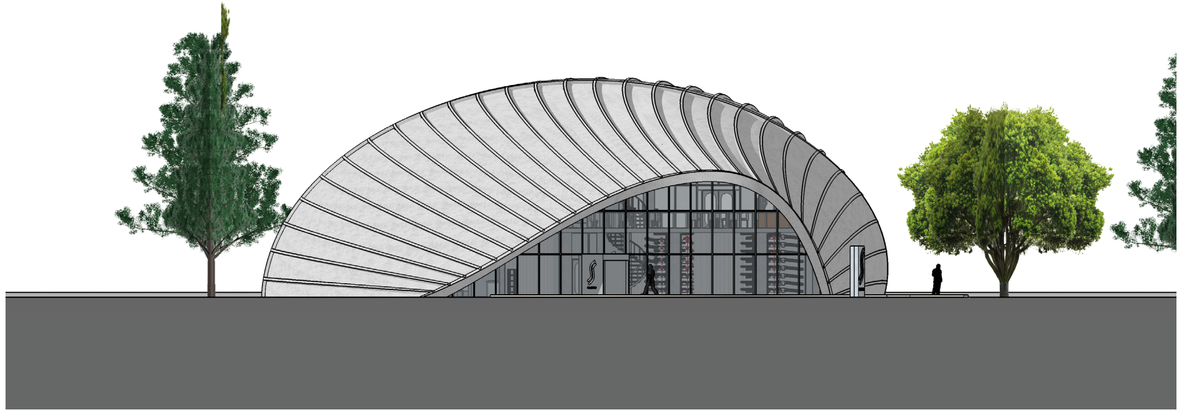
Kelly Drive elevation render:



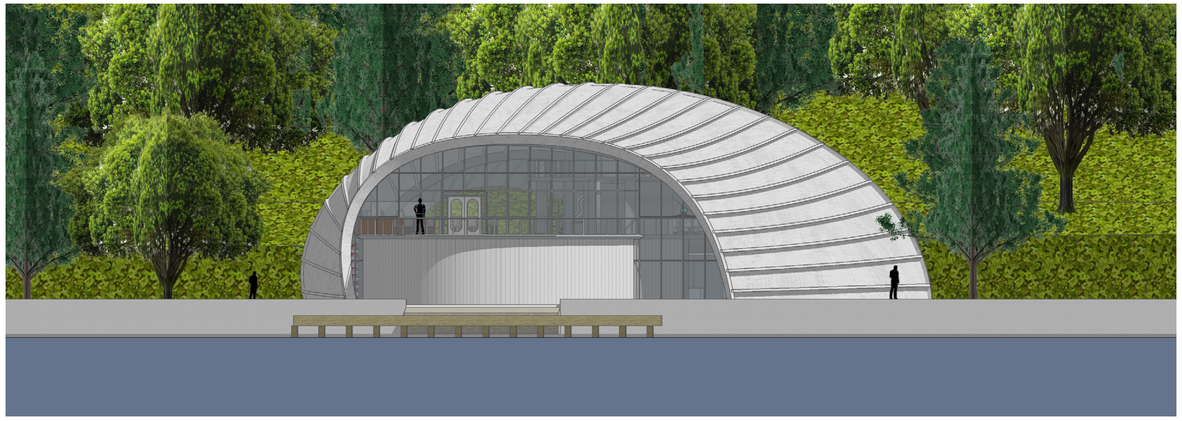
Schuylkill River elevation render:



Kelly Drive elevation:



Schuylkill River elevation:



Process information:

1. Program diagram

2. Initial layout

3. Midterm layout (it was way too big)

4. Post-midterm program diagram

5. Layout created from #4

6. Penultimate design

7-10. Near final model, created/rendered with Rhino3D

The model's large scale terrain was created in Rhino3D using contour lines from USGS survey data of the Philadelphia region. Most of the digital design work and layouts were created in SketchUp. The final design was created in Rhino3D. The model was imported into SketchUp, where textures, furniture, and scale figures were added. Final renders were ray-traced with Podium, a SketchUp rendering plug-in, and edited in Photoshop.

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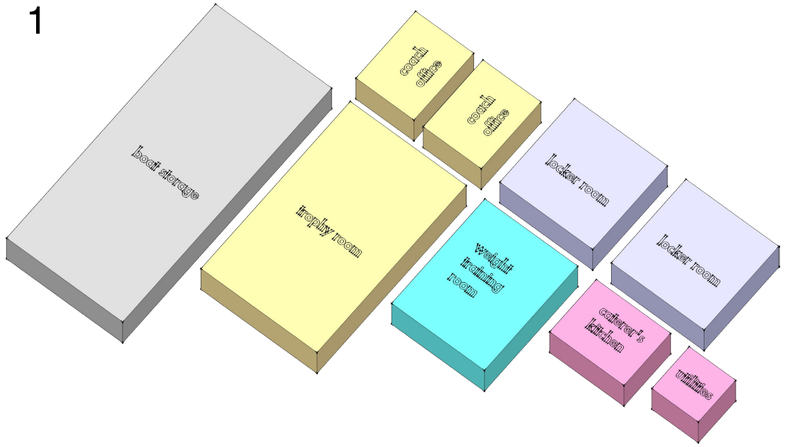

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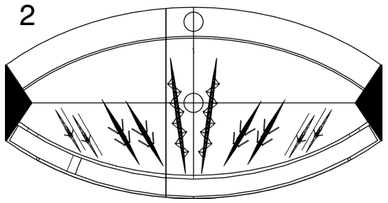

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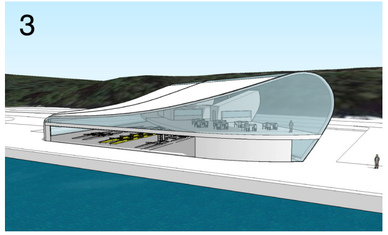

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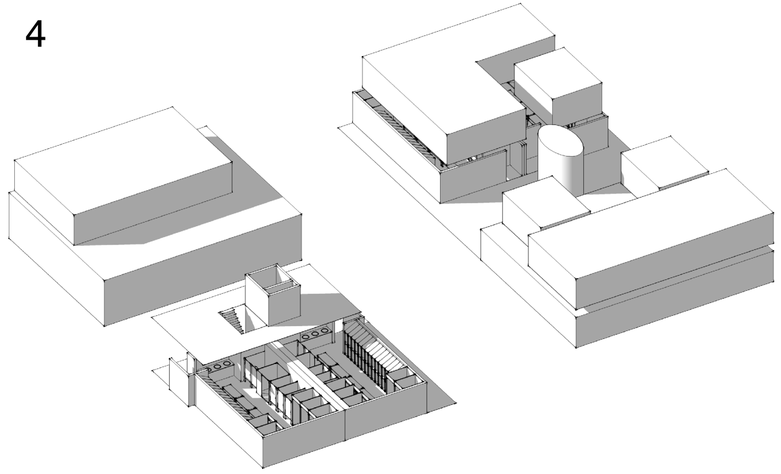

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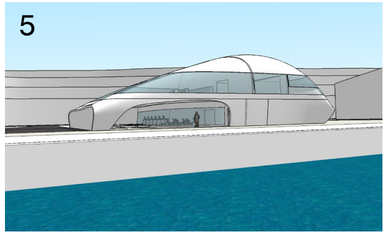

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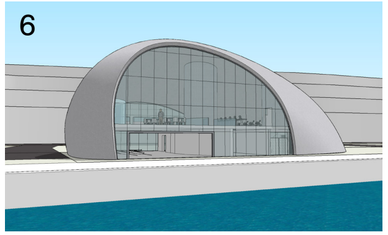

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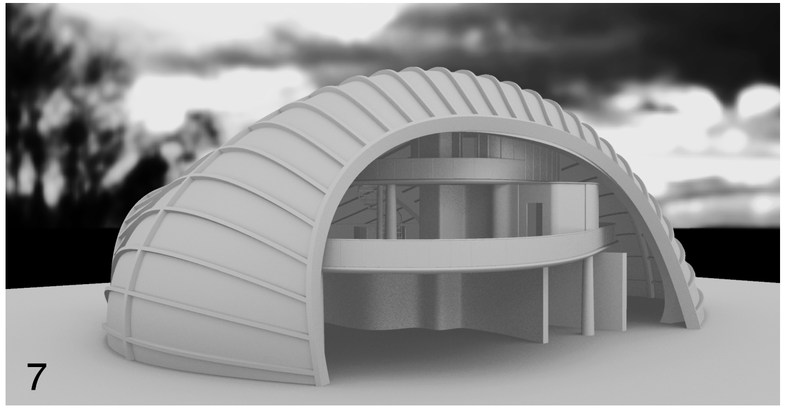

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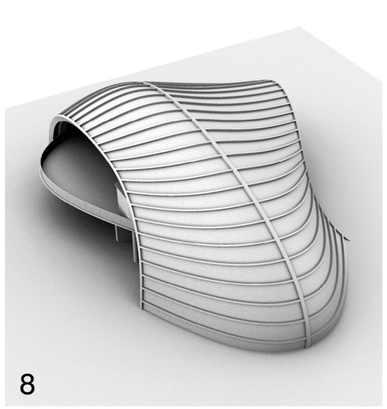

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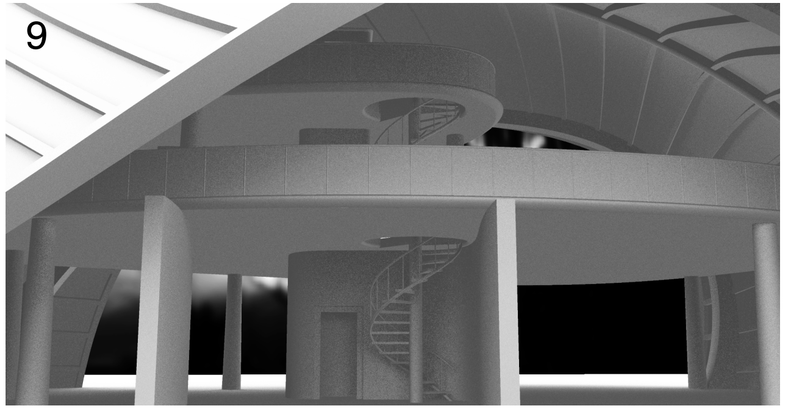

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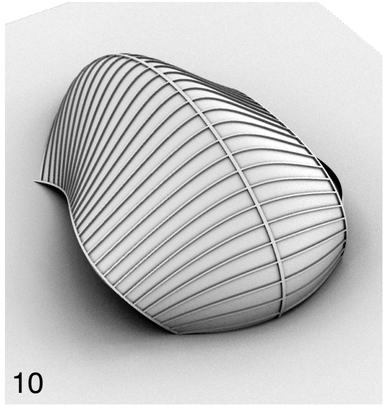
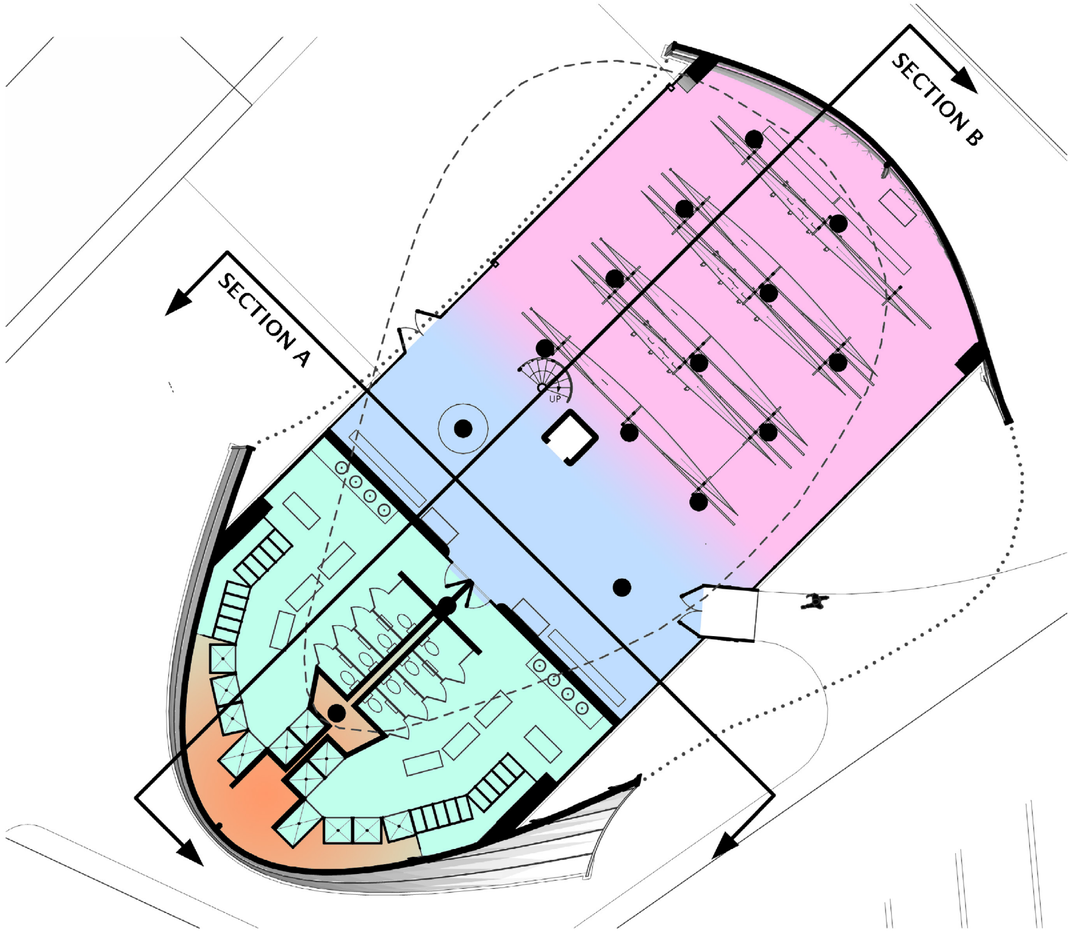
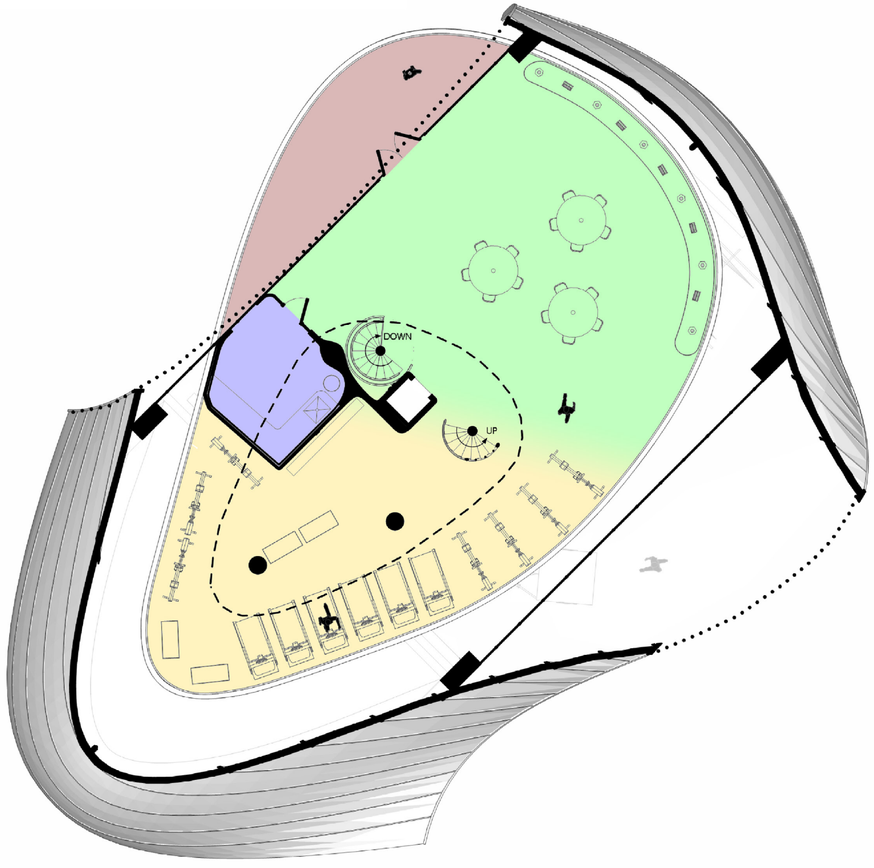


FLOOR 1



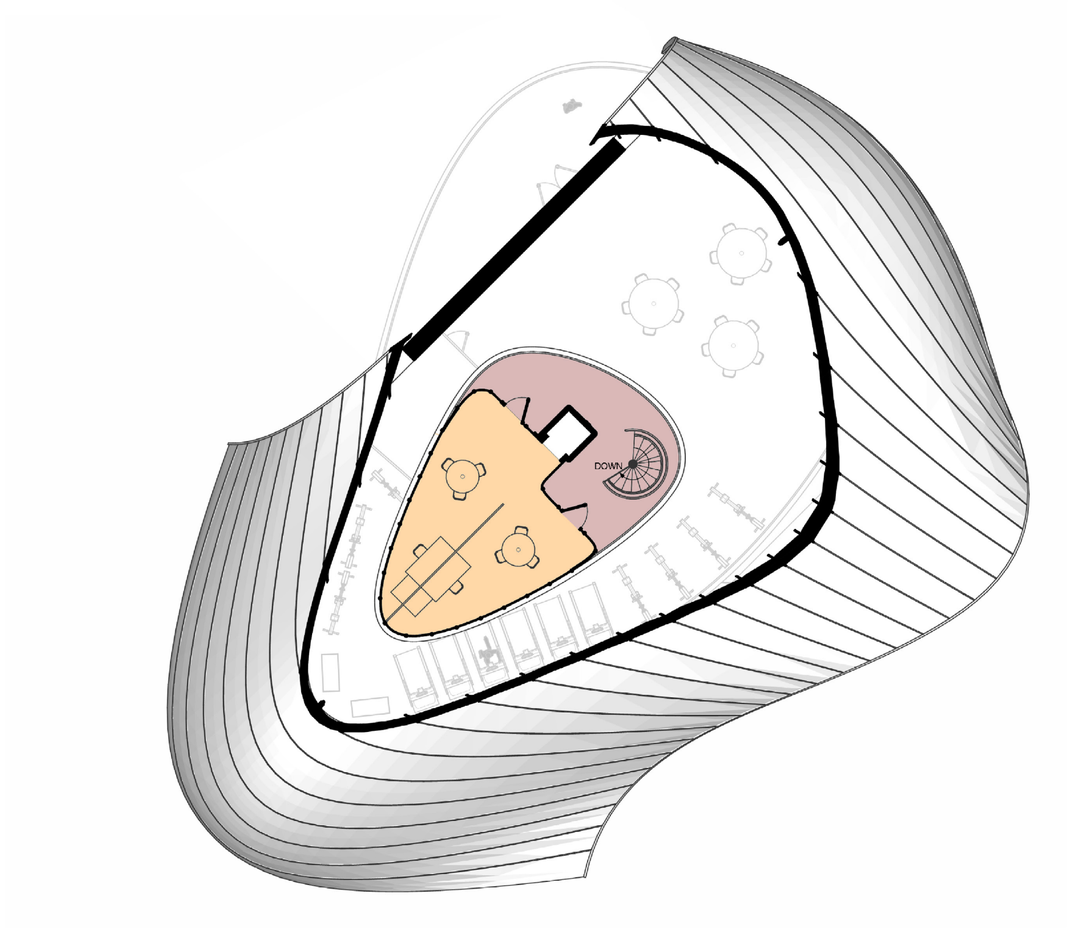
LEGEND: FLOOR ABOVE · ROOF LINE · UTILITY AREA · LOCKER ROOMS · LOBBY · BOAT STORAGE

FLOOR 2



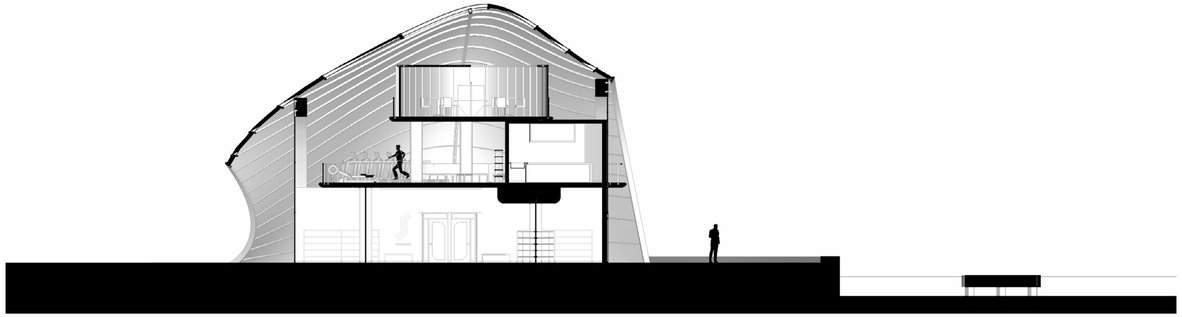
LEGEND: FLOOR ABOVE · ROOF LINE · BALCONIES · TROPHY ROOM · WEIGHT TRAINING · CATERER'S KITCHEN

FLOOR 3



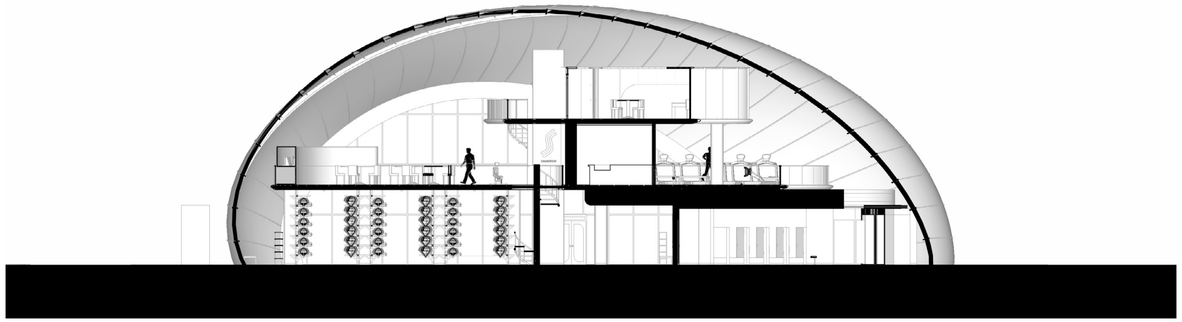
LEGEND: ---- FLOOR ABOVE ···· ROOF LINE BALCONIES COACH'S OFFICES

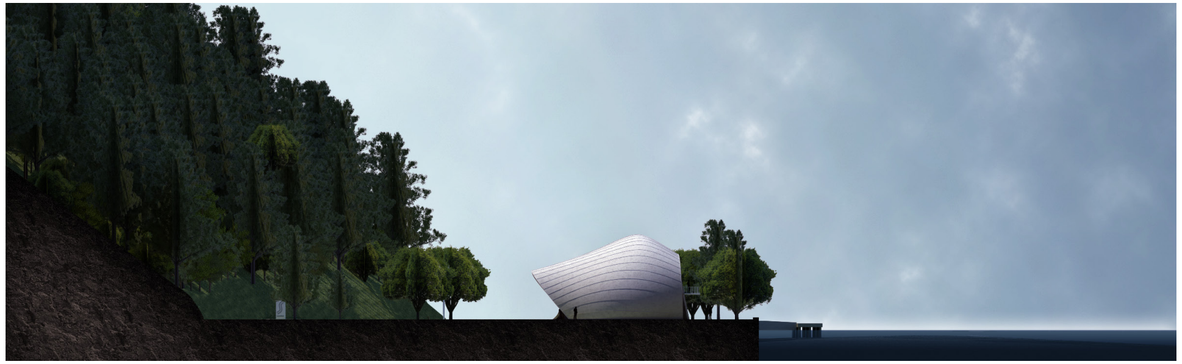
SECTION A

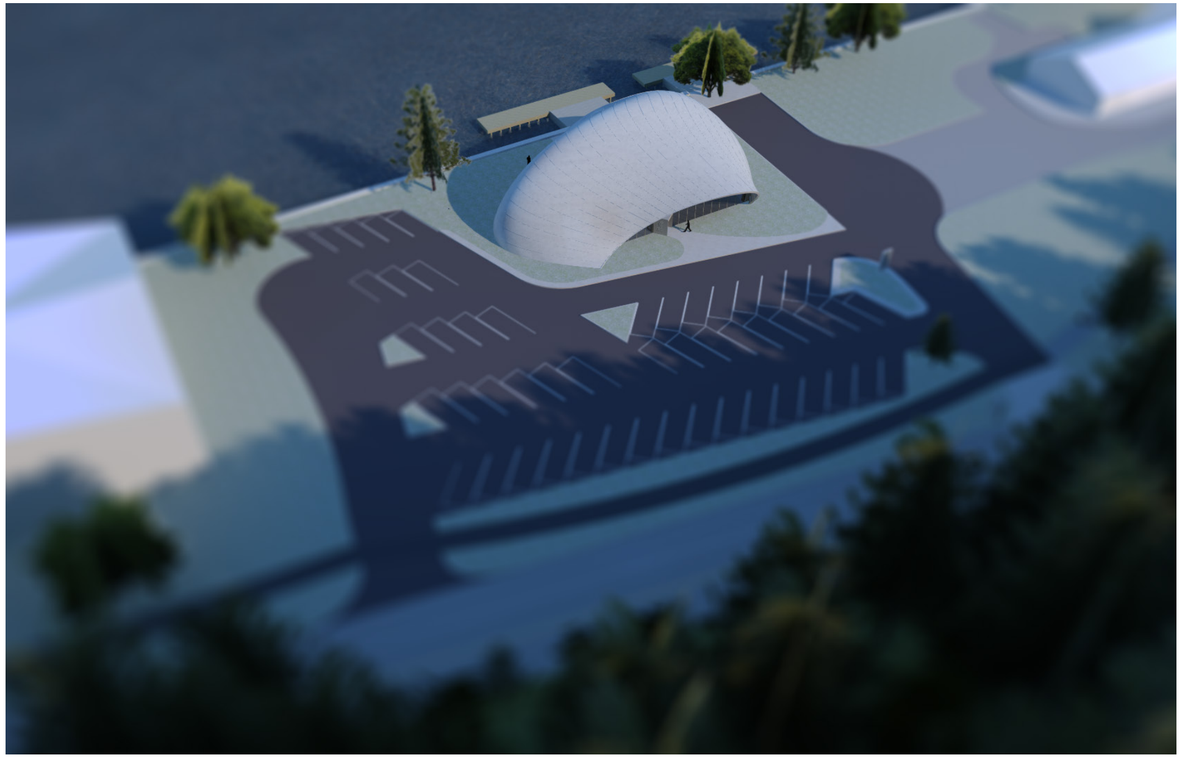


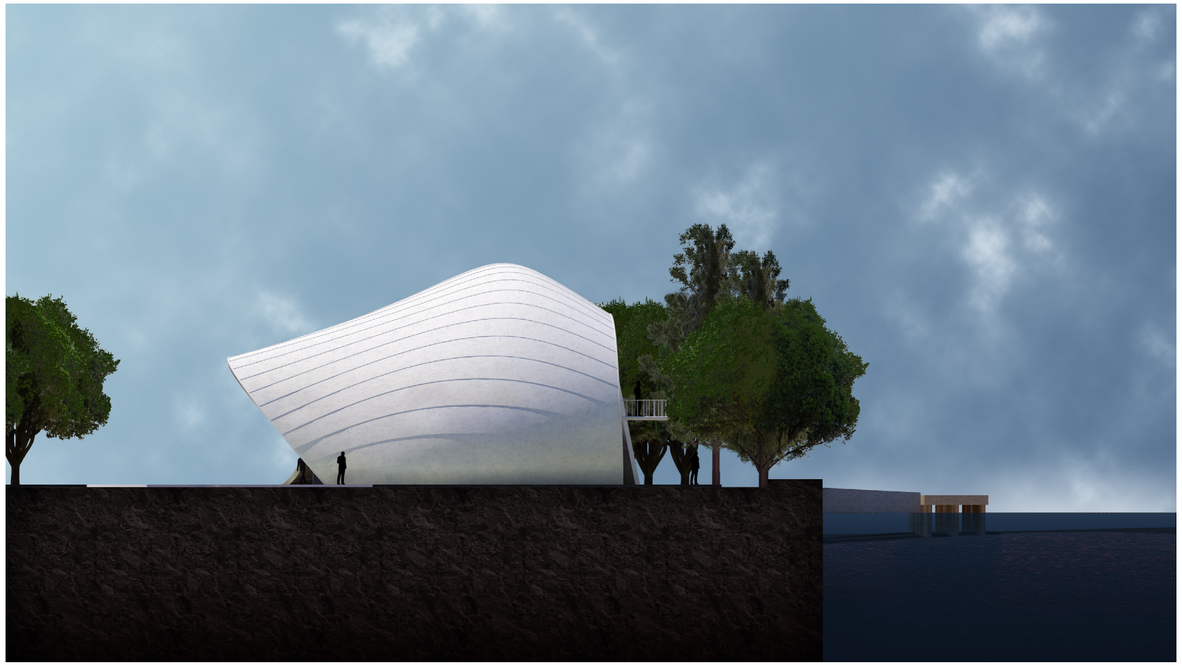
The interior of the building is a column and flat plate slab system separate from the exterior shell. The gap between the curtain walls and the second floor lets the trophy room appear larger and more expansive. As with most other boathouses, the sculls are stacked on top of one another via racks. A garage door underneath the balcony provides room for the boats to be moved out of the house and onto the river.

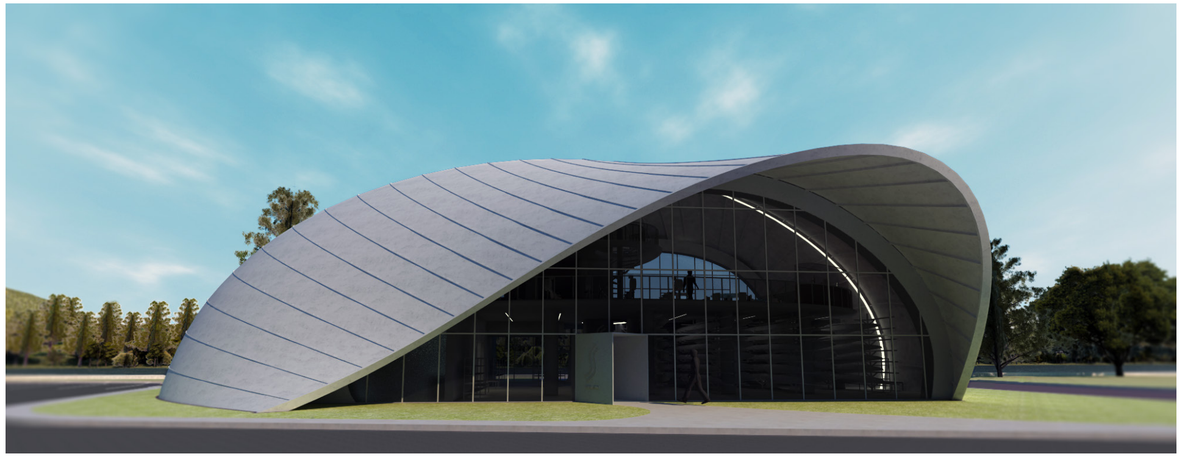
SECTION B





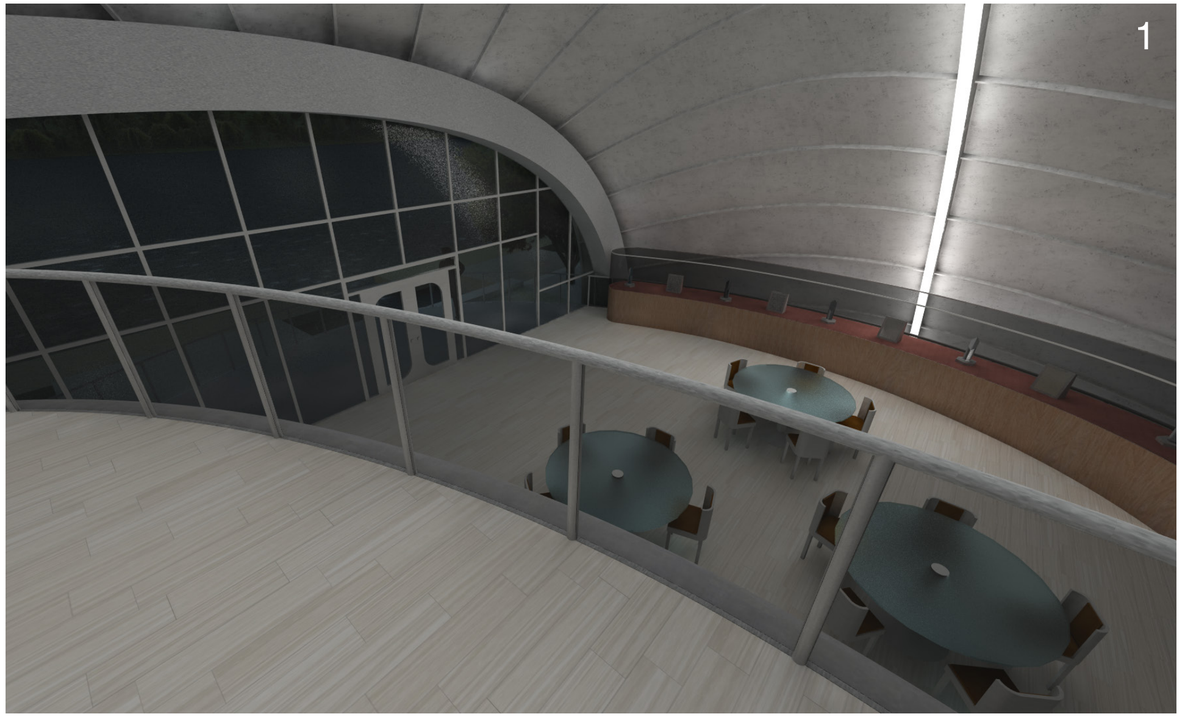


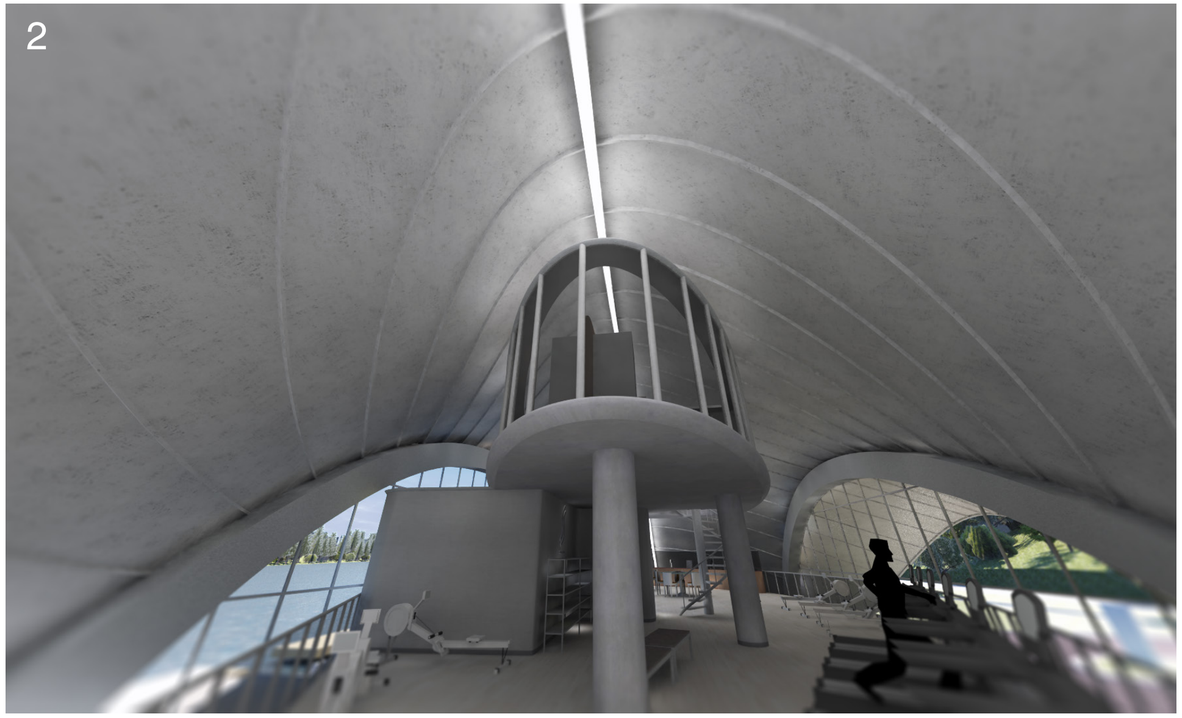




Interior renders, as seen on the next several pages:

1. Office balcony
2. Weight training area ceiling and office windows
3. Trophy room
4. Weight training area
5. Boat storage area
6. Coach’s offices



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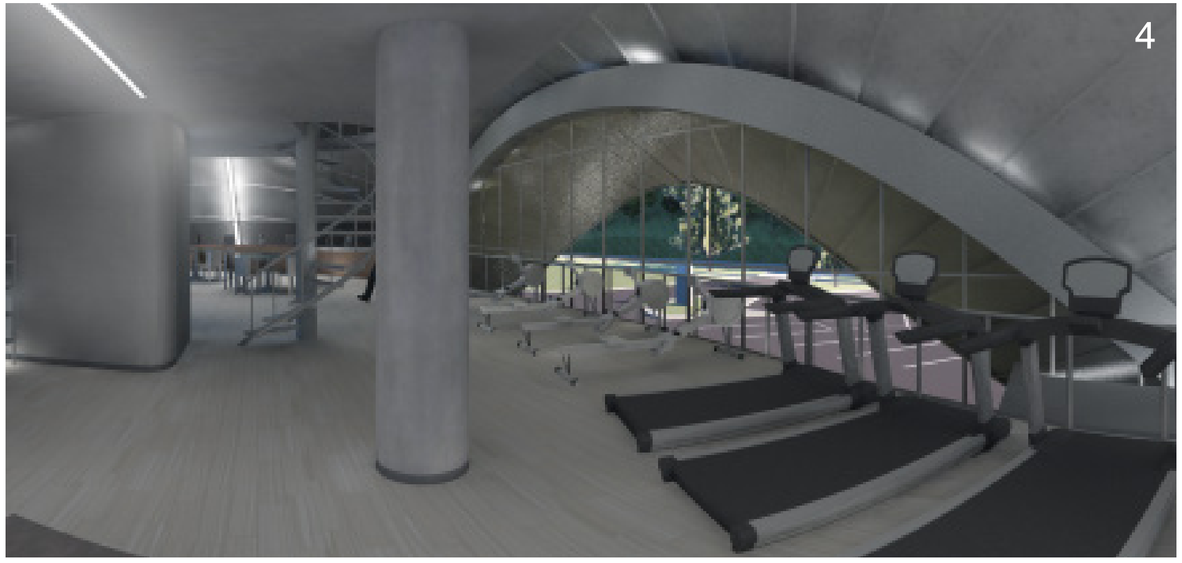
4


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6

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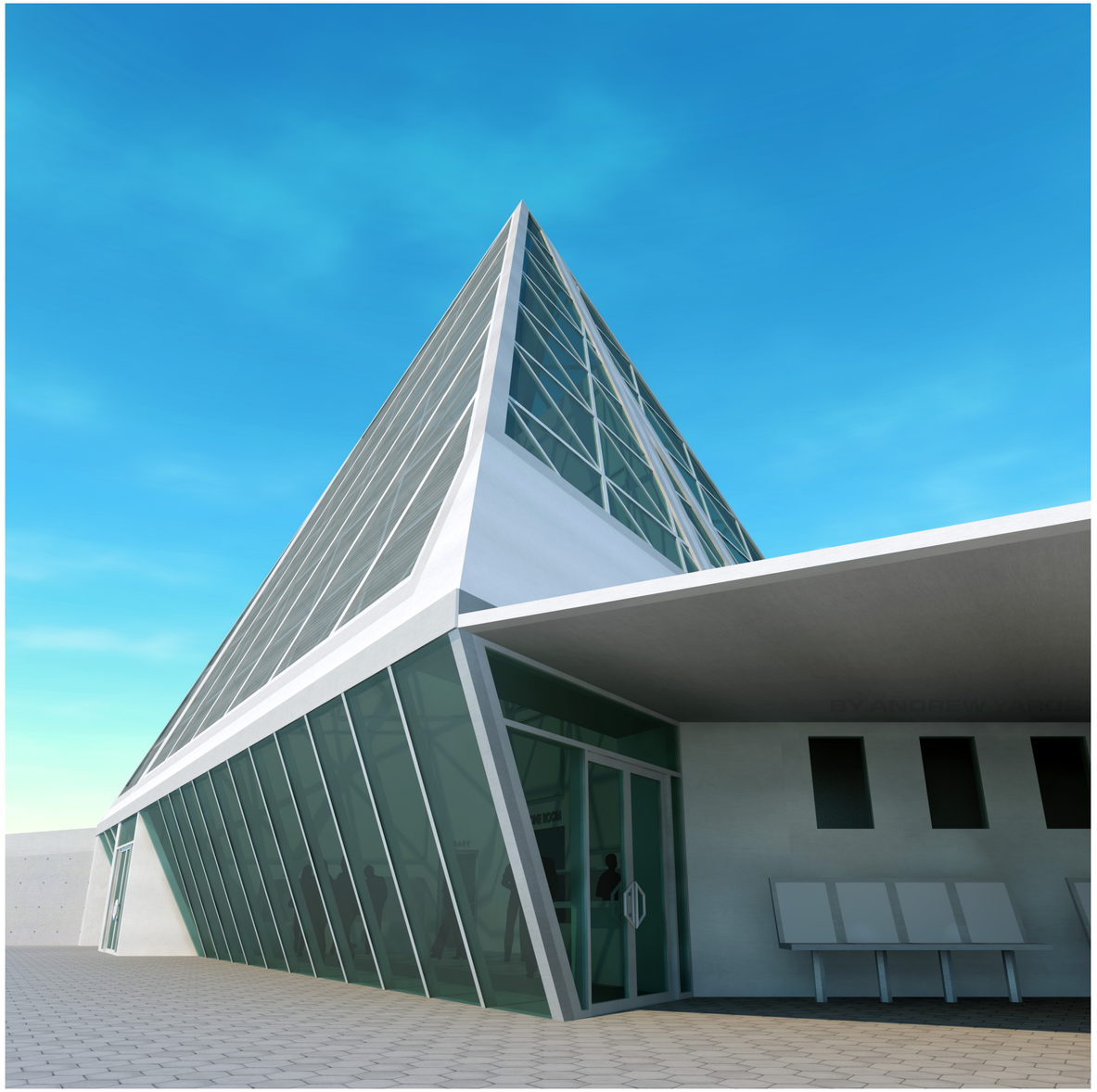
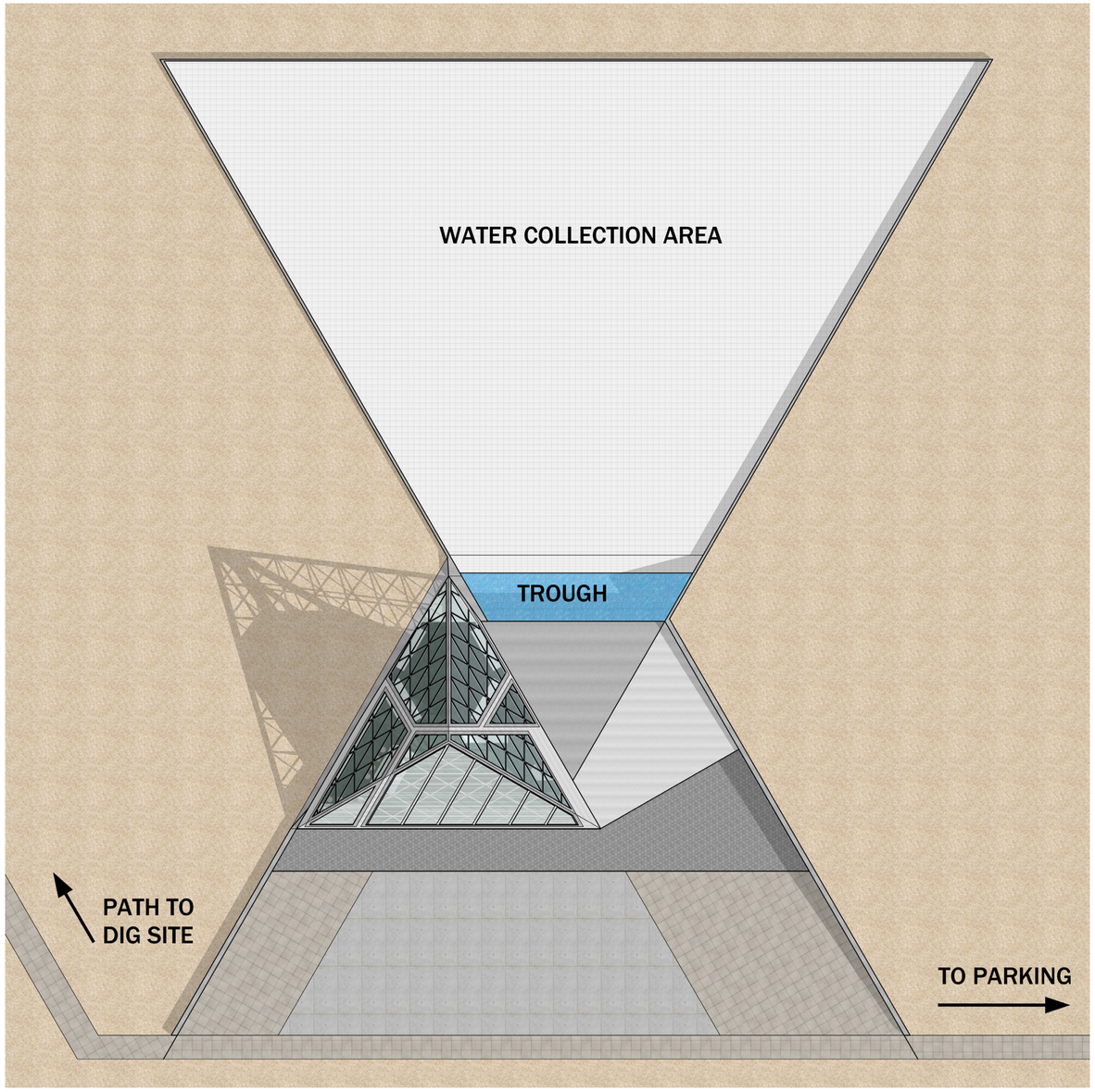


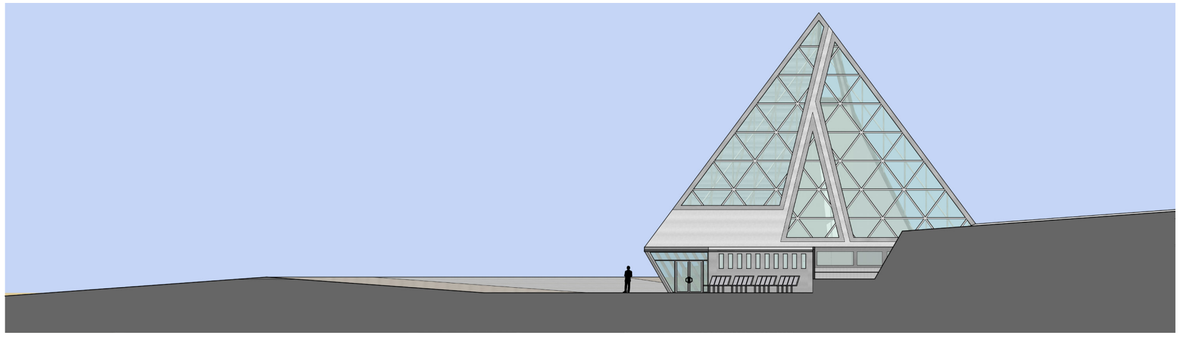
During my second-year fall studio class, I was tasked with designing an interpretative center for three ancient stones discovered in the arid region around Tucumcari, New Mexico. The stones originate from an ancient Native American tribe called the Wefa, where they were used in religious rituals.

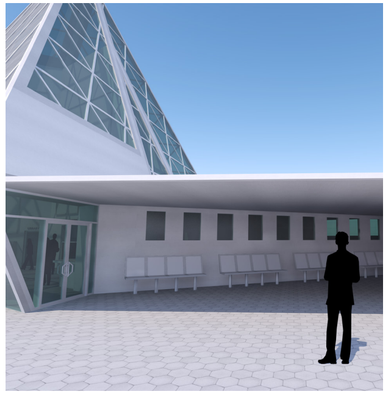
I was required to include an exhibit on the culture of the Wefa people (the interpretative area) and a display room for showcasing the stones.

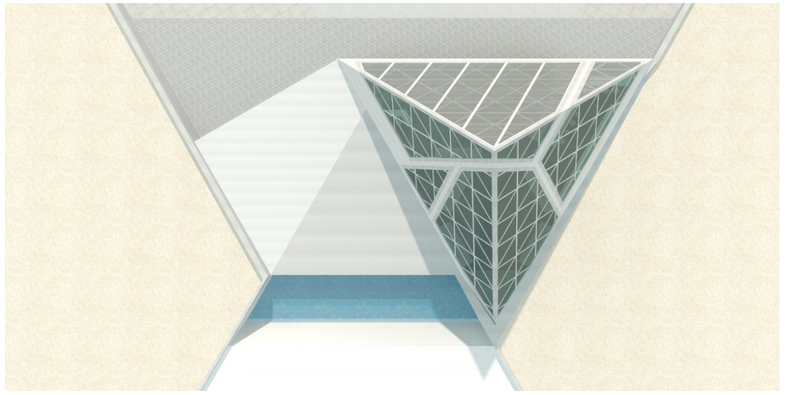
Each stone represents one of the four classical elements. The earth, fire, and water stones were discovered together arranged in an equilateral triangle. Unfortunately, the air stone was missing and has yet to be found. The question of how the air stone, if found, could be arranged among its companions is what led me to the design you see here.

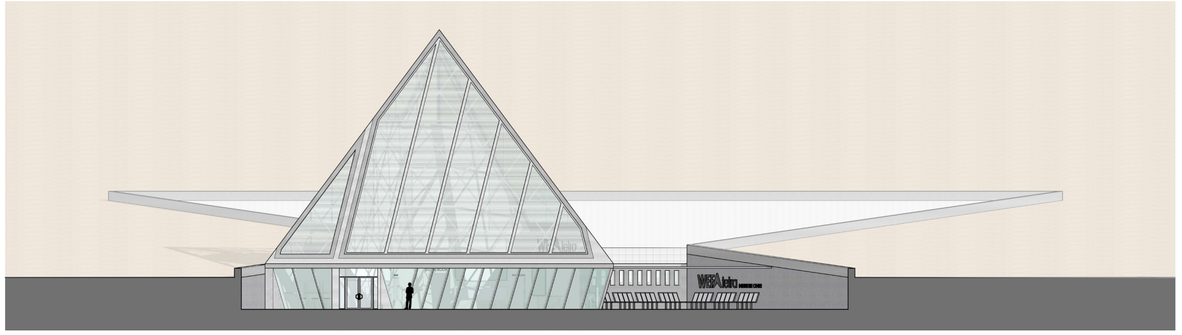
The triangular building plan was inspired by the arrangement of the stones. Air, the most voluminous of the elements, can be represented both literally and symbolically by placing the fourth stone above the other three, resulting in a tetrahedral shape (appropriately, it's a three-dimensional analogue of the triangle). Since the program only requires one floor, we are left with a huge, lofty space for visitors to enjoy.

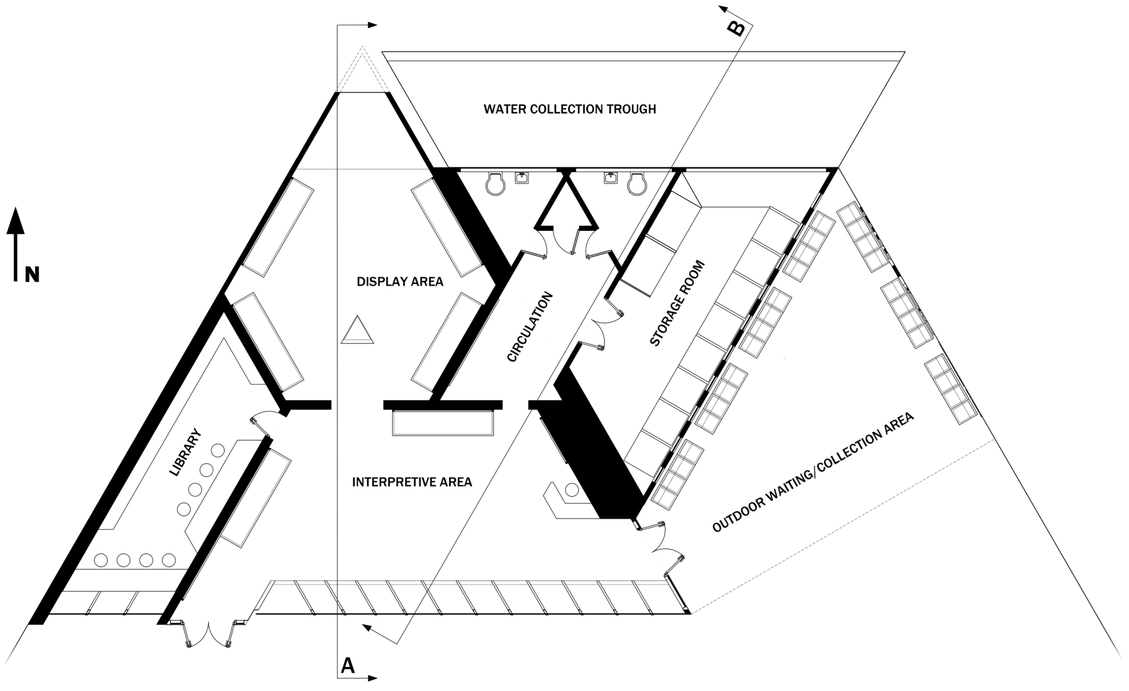

WATER COLLECTION AREA
TROUGH
PATH TO
DIG SITE
TO PARKING



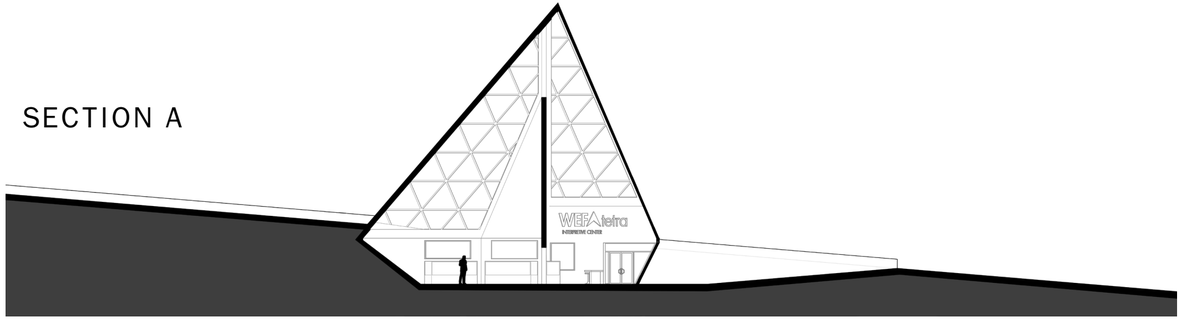


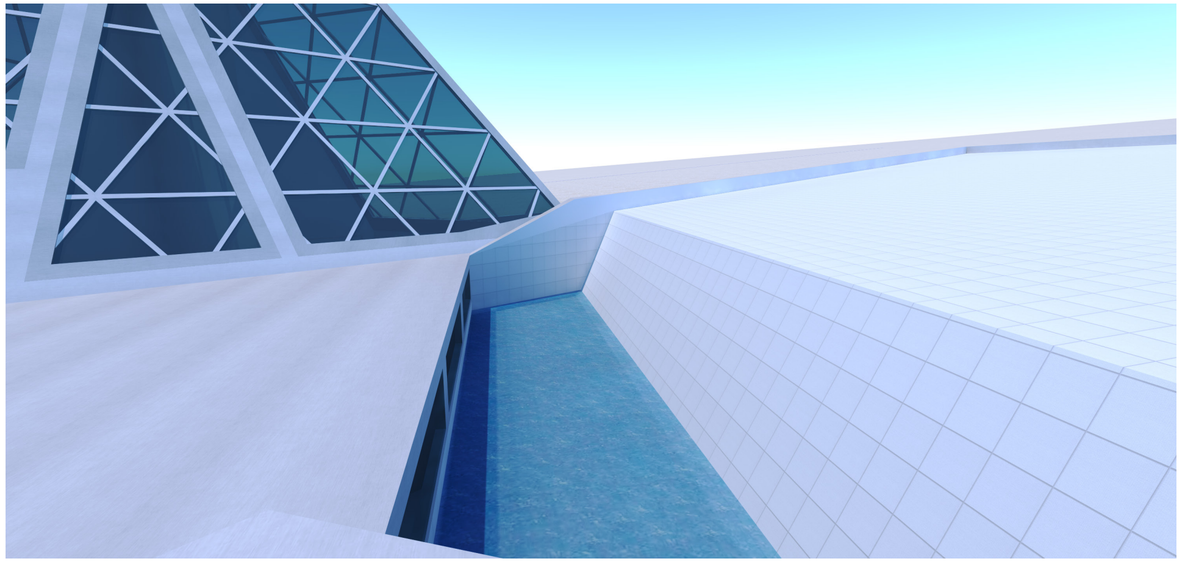




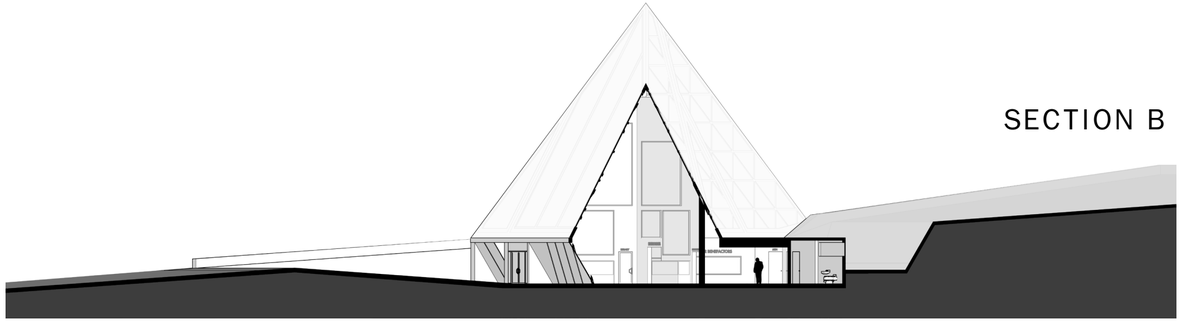


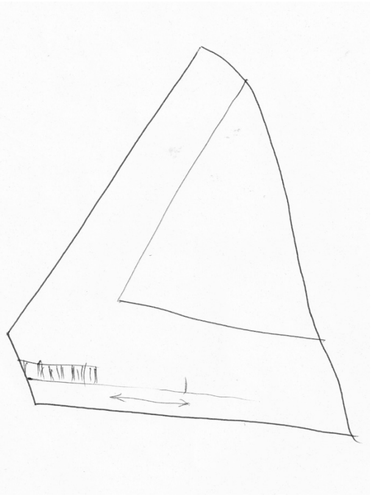
I placed the library, display and interpretive areas together into the main tetrahedral structure (left side of the plan below). Other program elements were placed to an ancillary area on the side (to the right). Special permission must be granted for researchers or guests to enter the library area.

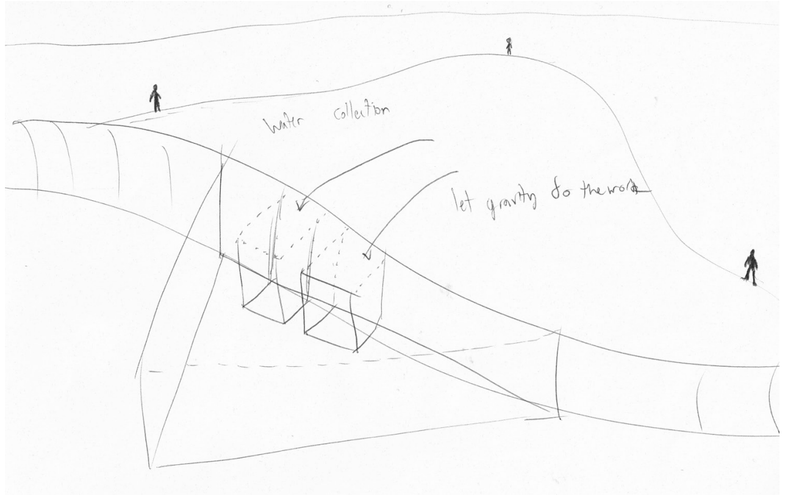


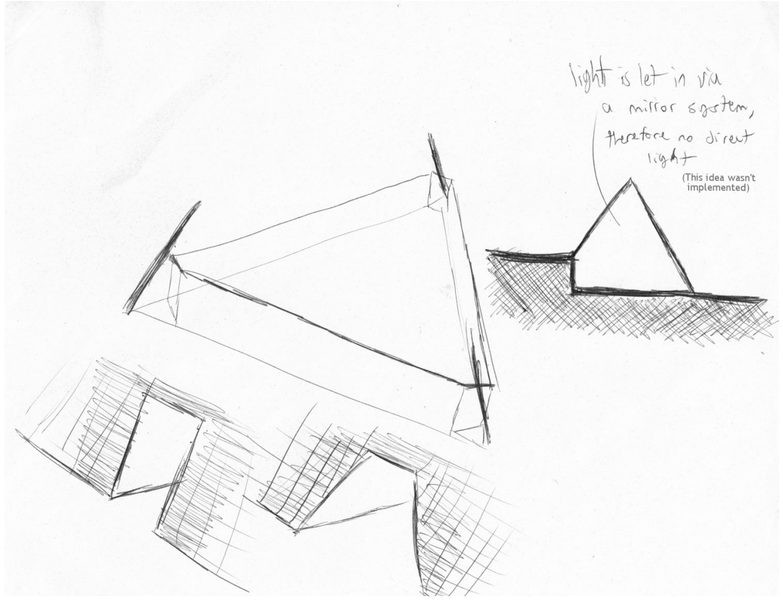


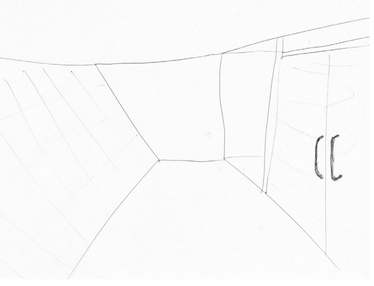
The storage room is off limits to the public, and houses artifacts from the dig site. The site has a water collection system for the few times it actually rains in this region. The ground condition has a 1:20 slope, so water which lands in the collection area is funneled directly into a trough. There it is stored and filtered; it can then be used for the restroom sinks or for drinking. (The restroom's self-composting toilets do not require water.)

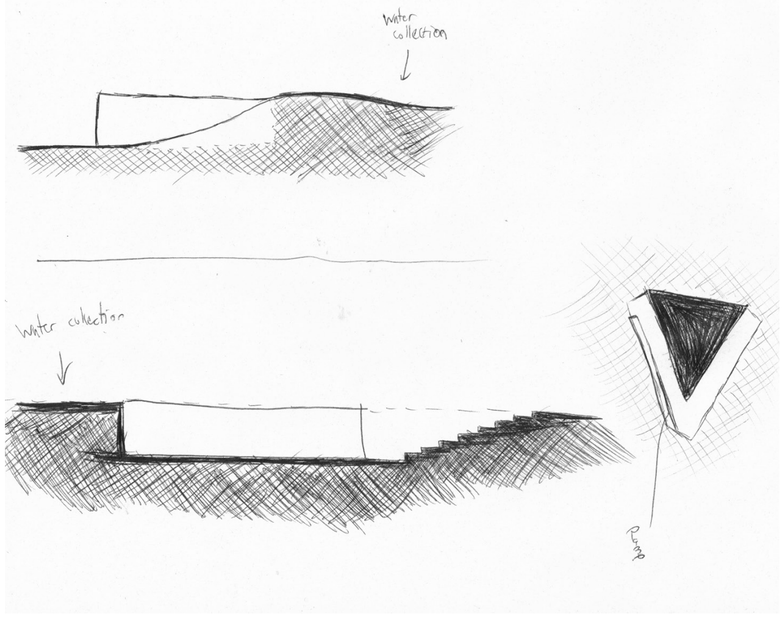


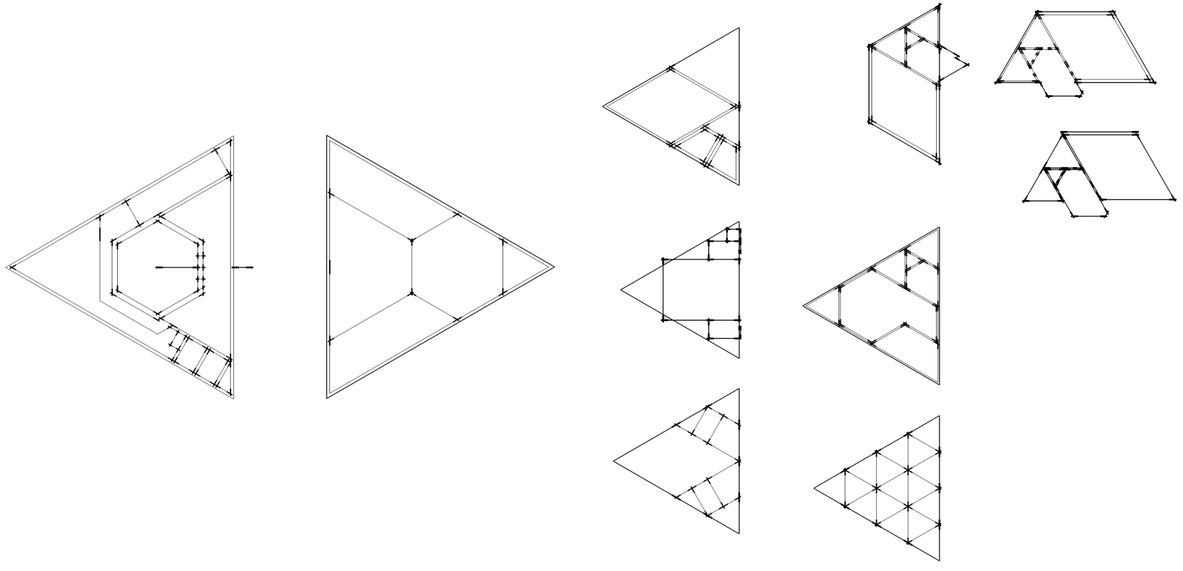


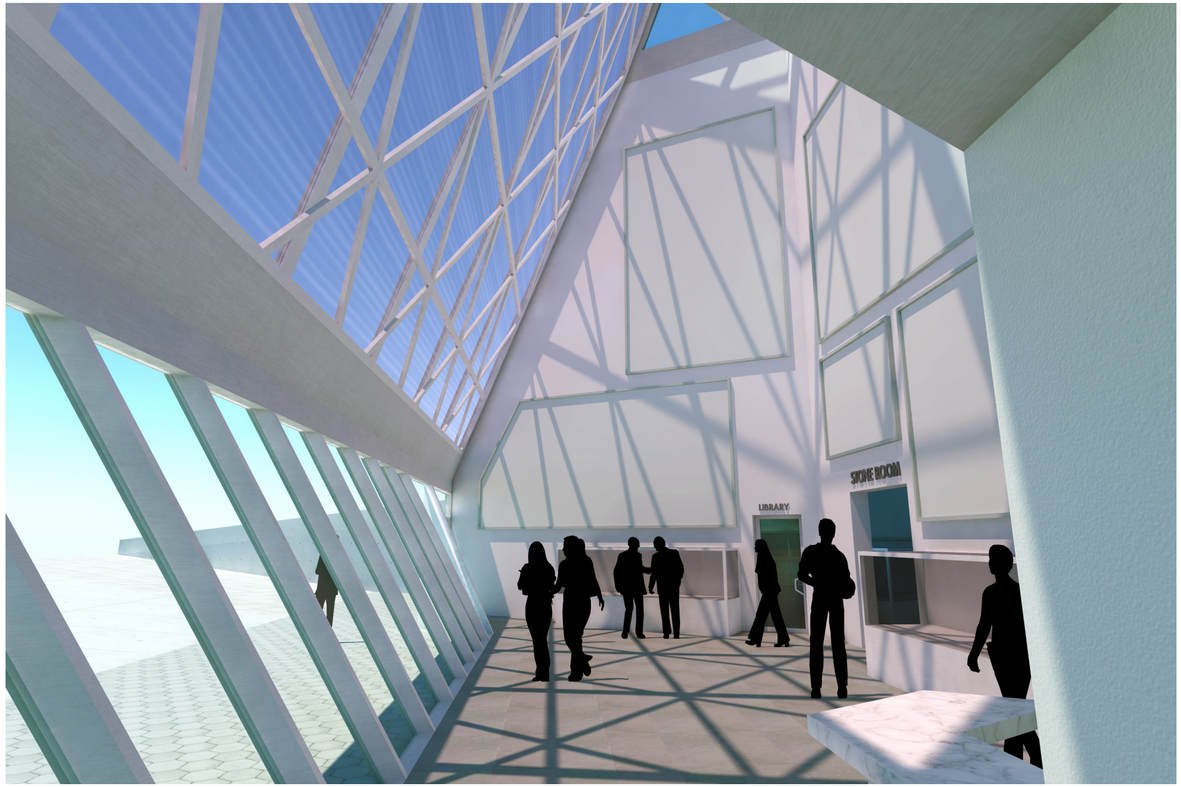

water collection
let gravity do the work


light is let in via a mirror system, therefore no direct light
(This idea wasn't implemented)




water collection
water collection



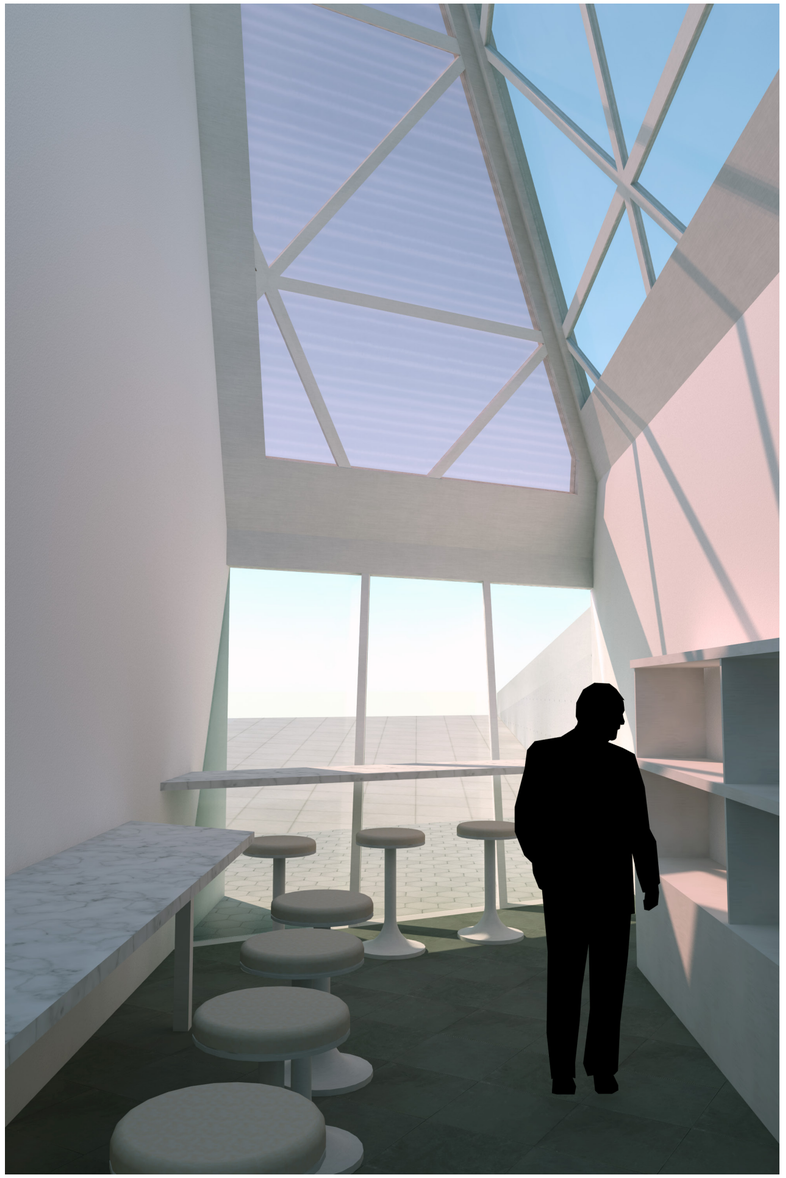


As you walk into the museum, the first thing you see is the large, lofty space of the interpretative area. This is consistent with the theme of spaciousness and air. The exhibit is all over the walls; areas higher up will show very large images and text, while display cases below will contain various smaller artifacts excavated from the region. On the left is the south facing side of the museum (which receives the most light); the wall is constructed from a metal frame and translucent corrugated plastic to block excess light and heat.

Several restrictions were given for this project; the goal was for my classmates and I to utilize the natural environment in our designs. Thus, the site is in a remote area in the desert and the building does not have electricity. The stones themselves have mythical properties; they supposedly emit bright patterns of light when hit by moonlight during full moons or the equinoxes. If the water stone is hit with direct light, it will lose the ability to do this. I wanted the stones to be displayed together, similar to how they were found, so I strategically positioned the display case in a shaded area.

Left page: the interpretive area, as described above | Bottom: stone display room

Right: The library, with shelving space and stools. This is a semi-restricted area where researchers or guests can learn more about the Wefa culture from the available books and research.



Above: Donor recognition wall (no museum is complete without one) and entrance to restrooms.

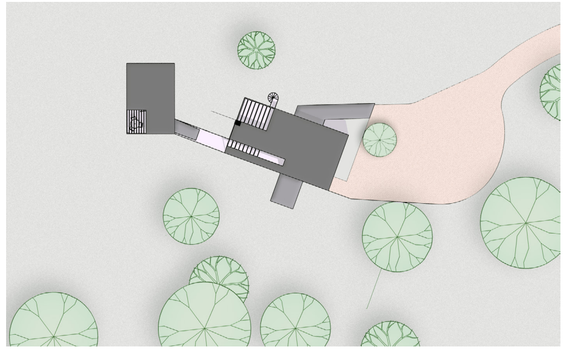
Lastly, if you haven't already guessed, the Wefa tribe never existed. "Wefa" stands for water, earth, fire, and air.

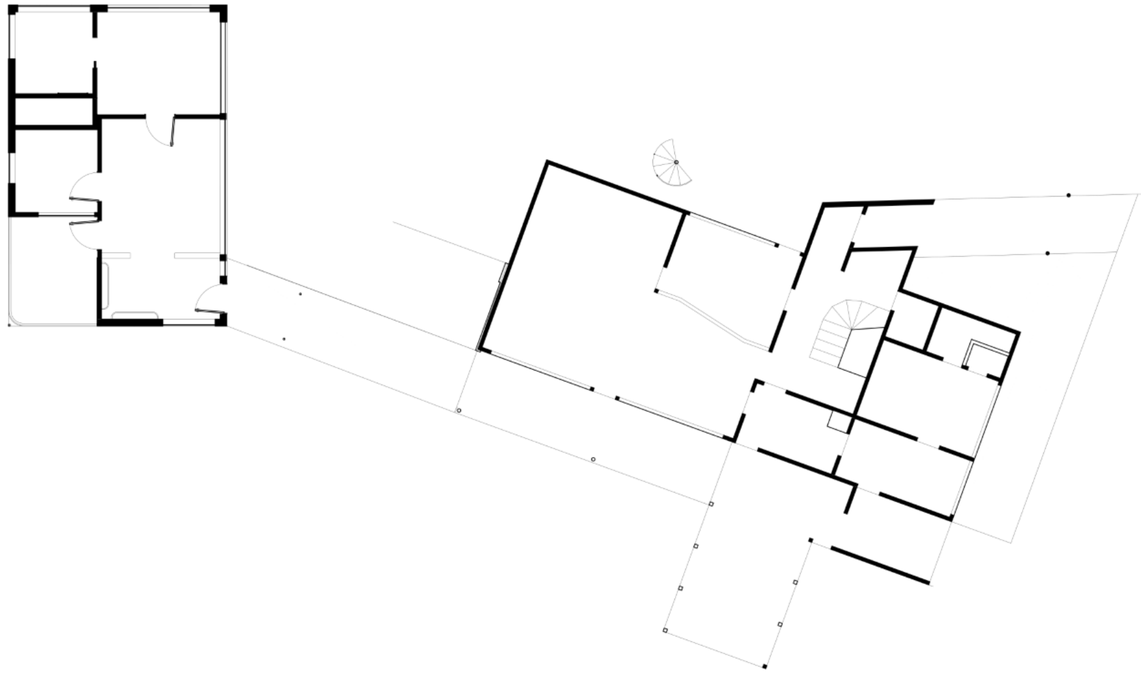
4

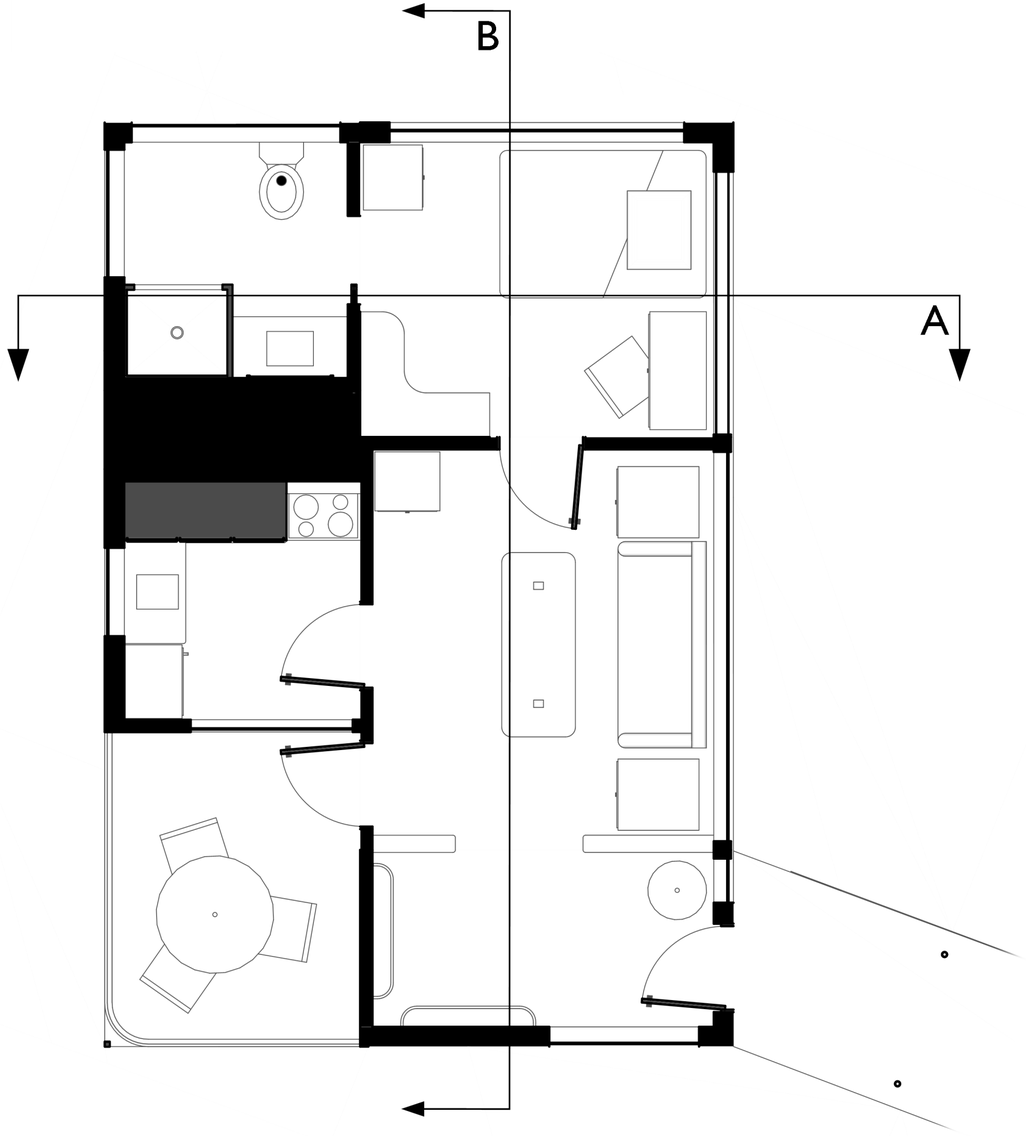
GUEST HOUSE FOR THE
GROPIUS RESIDENCE

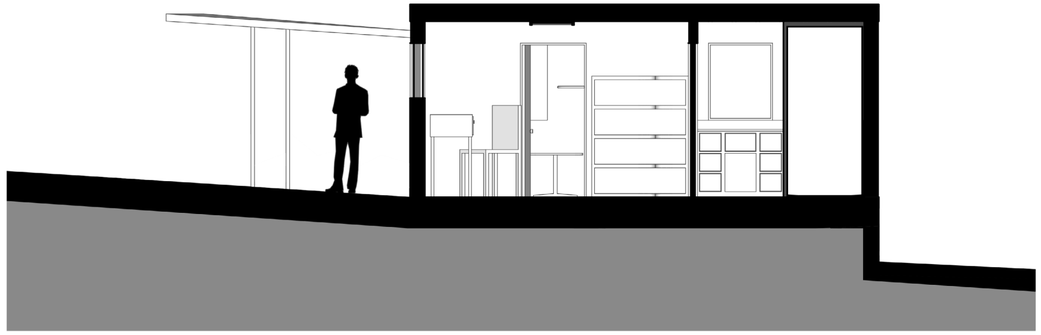
In this project for my second year fall studio class, I created a guest house for a residence designed by a 20th century architect. I chose the Gropius Residence in Lincoln, Massachusetts. Walter Gropius was the founder of the Bauhaus School in Germany, whose work led to the development of the international style.

At the time of its construction in 1937-38, this house was unlike anything else in the region. Interestingly, despite the stark contrast between house's modern architecture and its more traditional environment, Gropius still borrowed regional materials and building techniques (for instance, the painted wood façade).





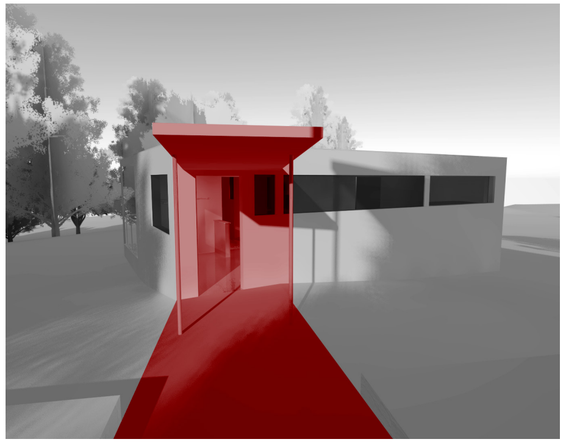


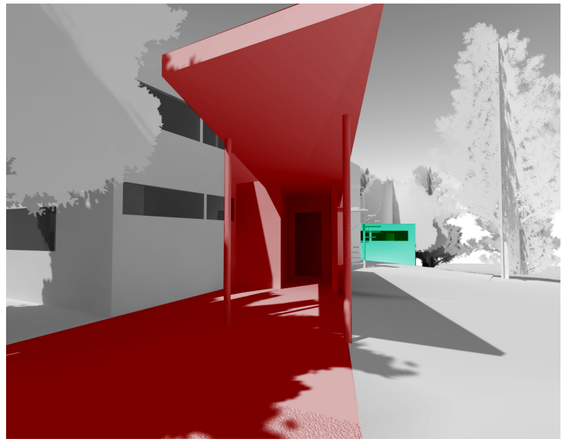


SECTION A

The guest house, like the original Gropius residence, is designed to be practical and efficient. It has a very open floor plan which lacks any dedicated space for circulation. Some of the features borrowed from the original design include a sloped canopy over the approach, long horizontal windows on the front façade, and a back porch, similar to the upper level sun porch in the residence.

SECTION B



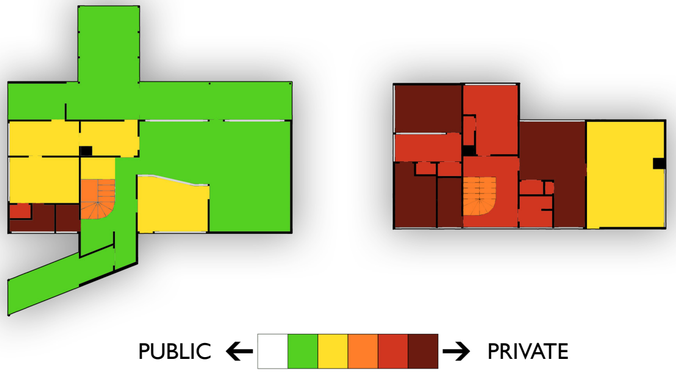


The guest house is meant to be a private space for visitors. Although it maintains a prominent presence in the landscape, it was strategically positioned to be inaccessible to outsiders. The façade of the guest house is perpendicular to the walkway leading from the driveway to the residence's front entrance. As one approaches the main residence's front door, the guest house can be seen peeking out from behind. To actually enter the guest house, one must exit the main residence through its back door and walk through a path in the backyard.

Next page: Public private diagram of original residence

Above left: Guest house approach (red highlight)

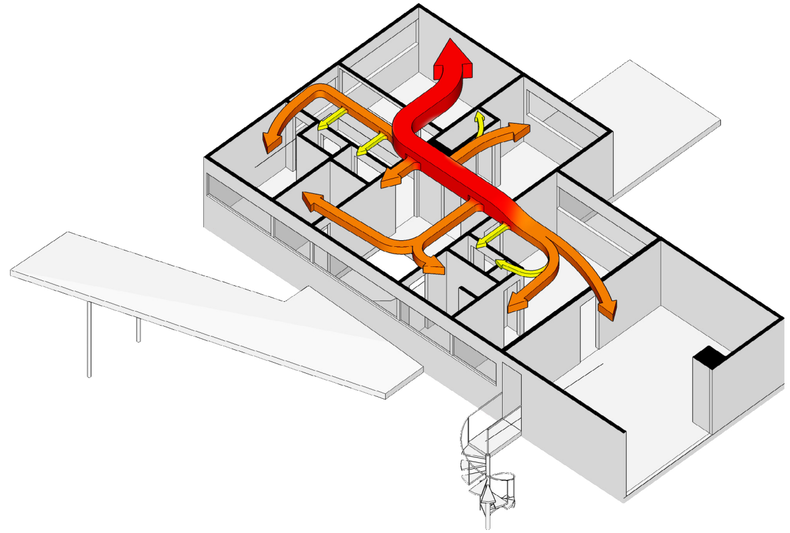
Above right: Main house approach (red) with guest house visible (teal)

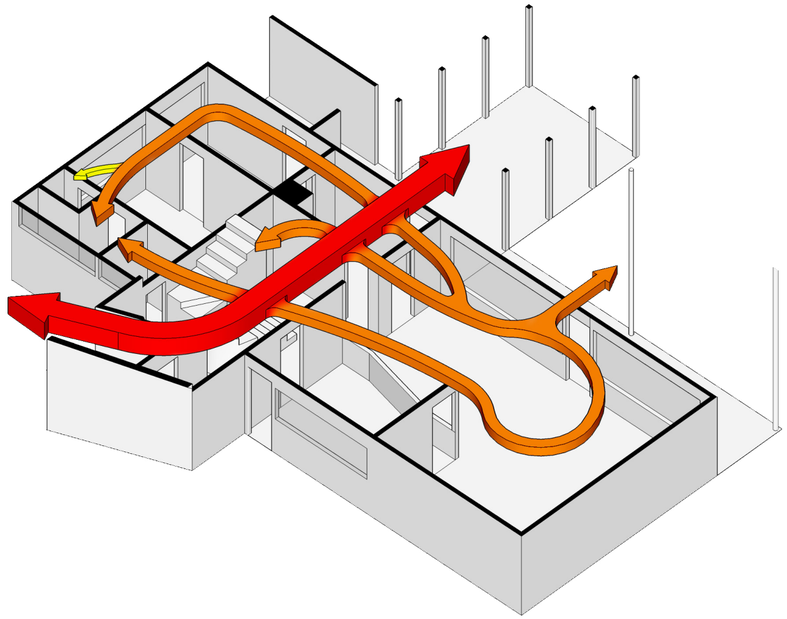


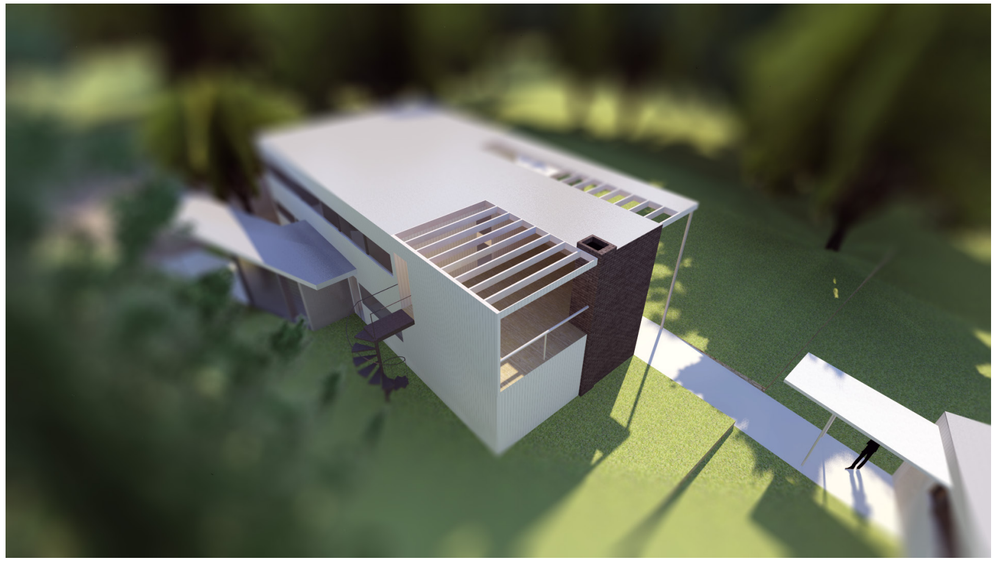
On this page: Circulation diagrams of original residence

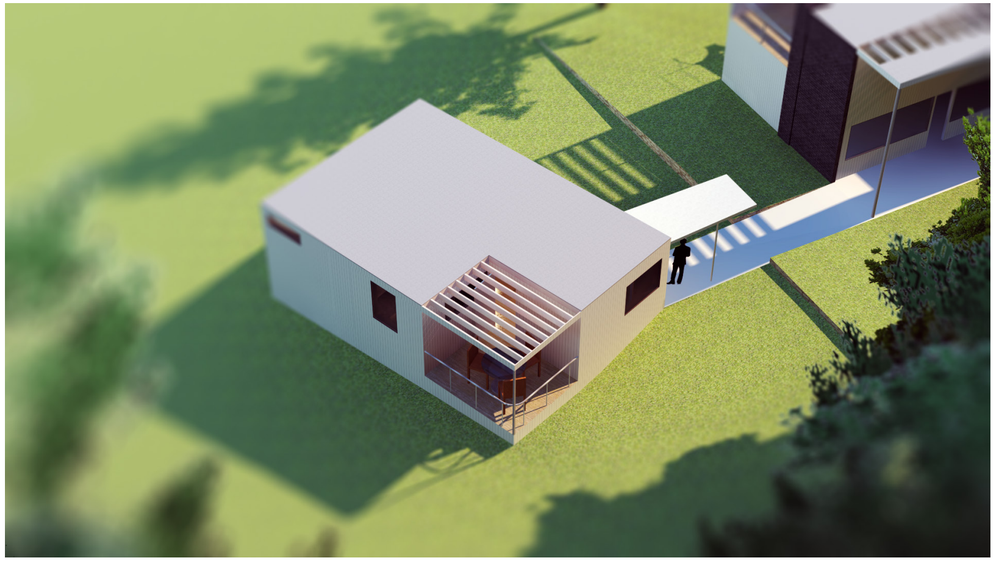
Upper right: floor 2

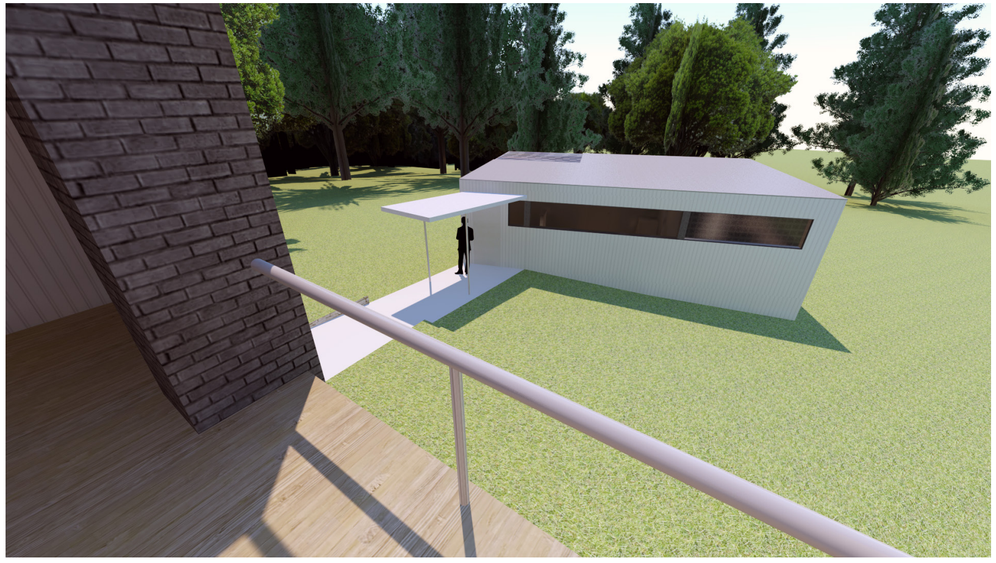
Lower left: floor 1





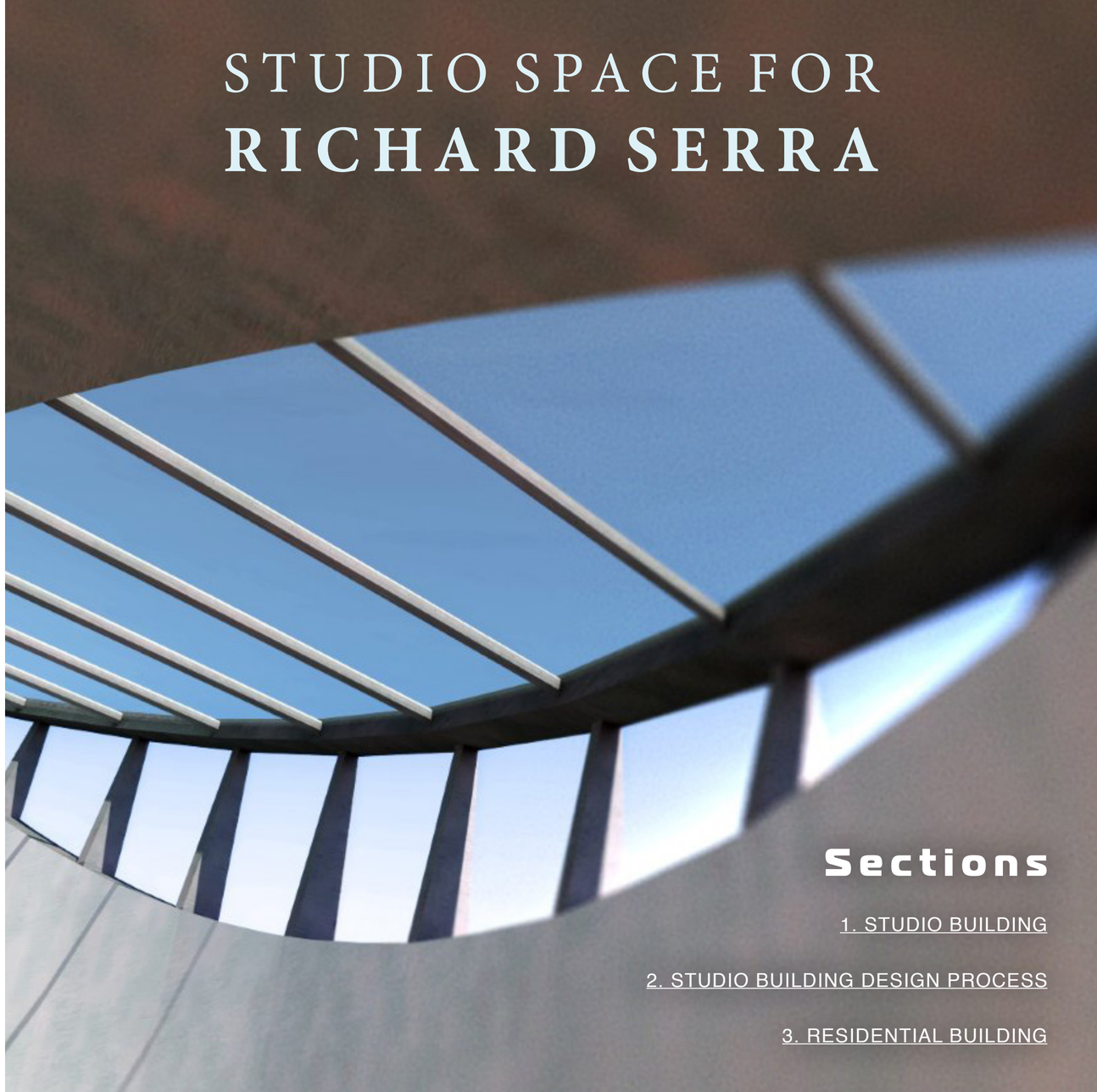




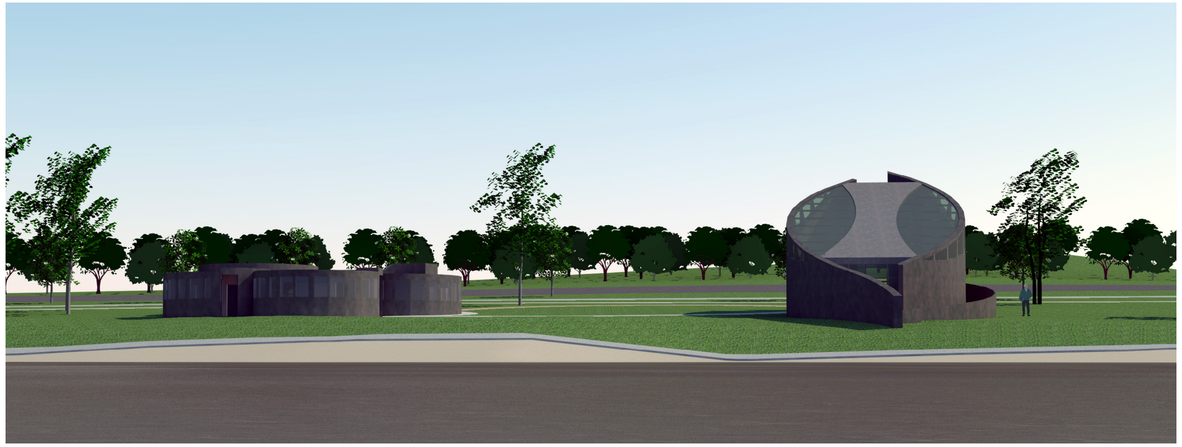


5

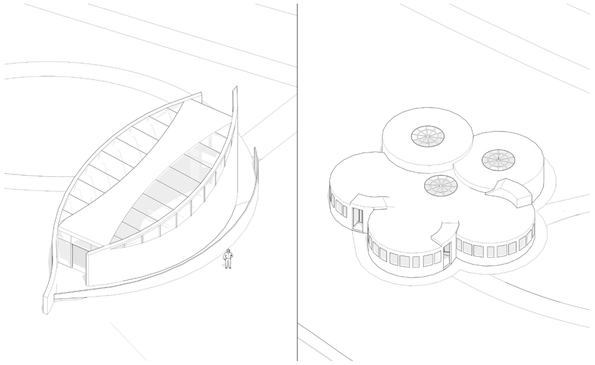
STUDIO SPACE FOR RICHARD SERRA

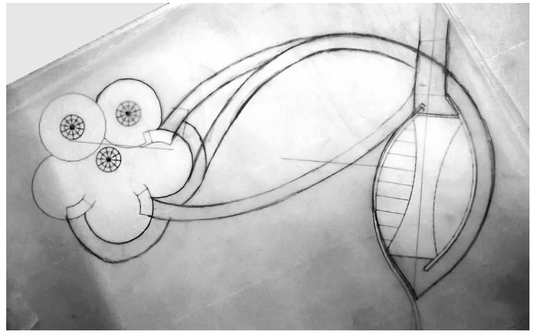


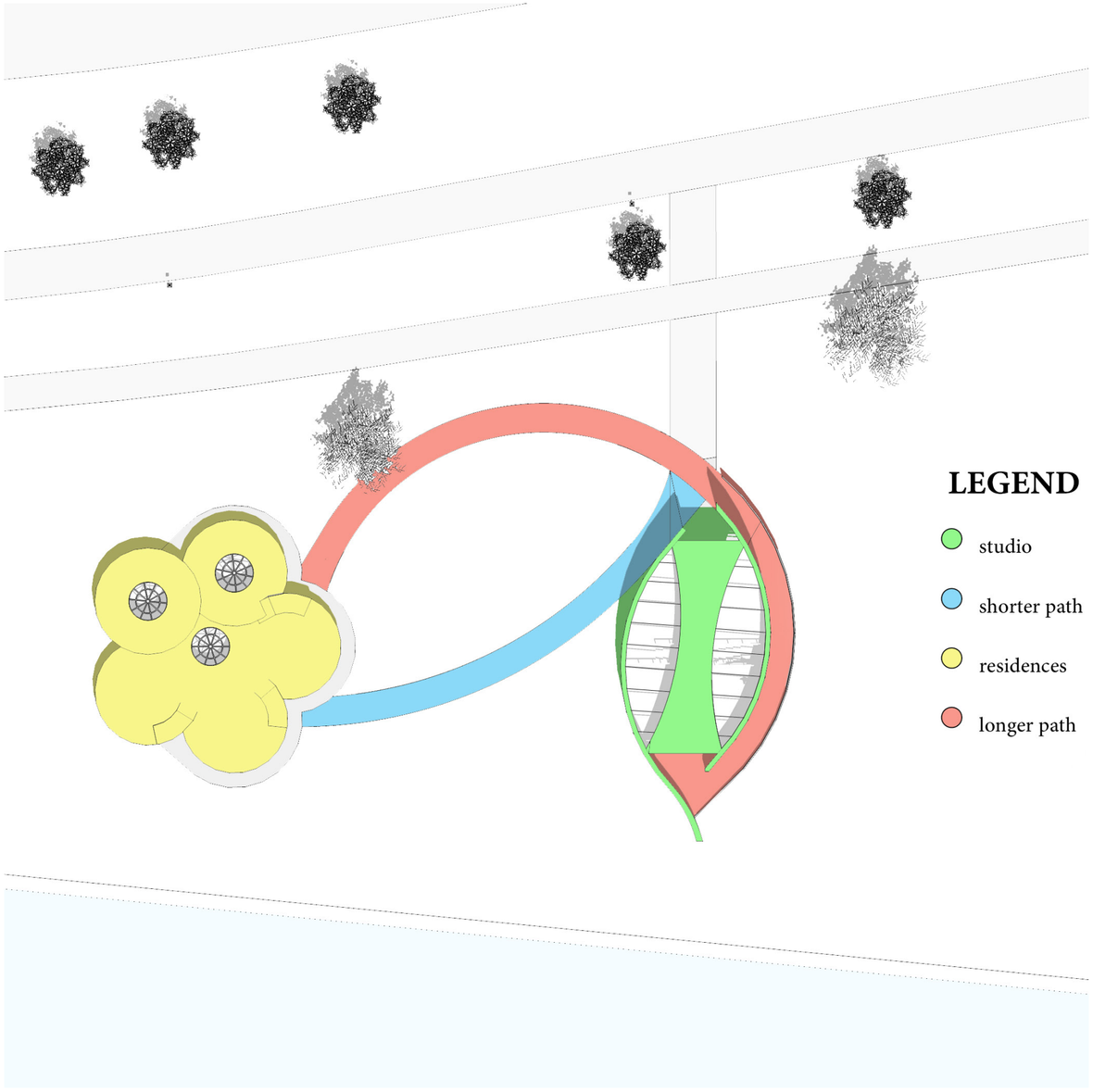
Sections



In my spring first-year studio class, I was given a two part assignment: to create a studio for an artist, and an adjacent residential building for five disciples. I chose Richard Serra, best known for his curved steel sculptures of immense scale. The location of the site is Fairmount Park in Philadelphia, PA, between the Schuylkill river and the biking trails alongside Kelly Drive. You may notice the site plan resembles a leaf (the studio) and a flower (the residences), connected by a stem (pathways). This was entirely unintentional; I only realized it after finishing the project!



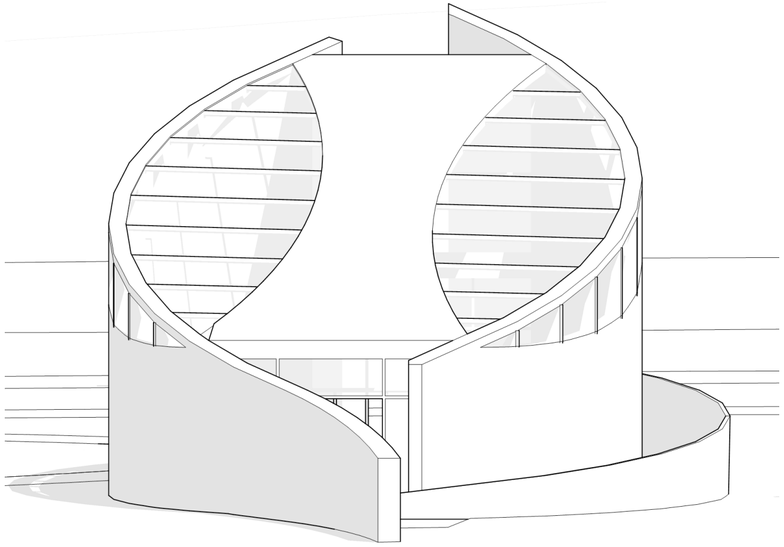


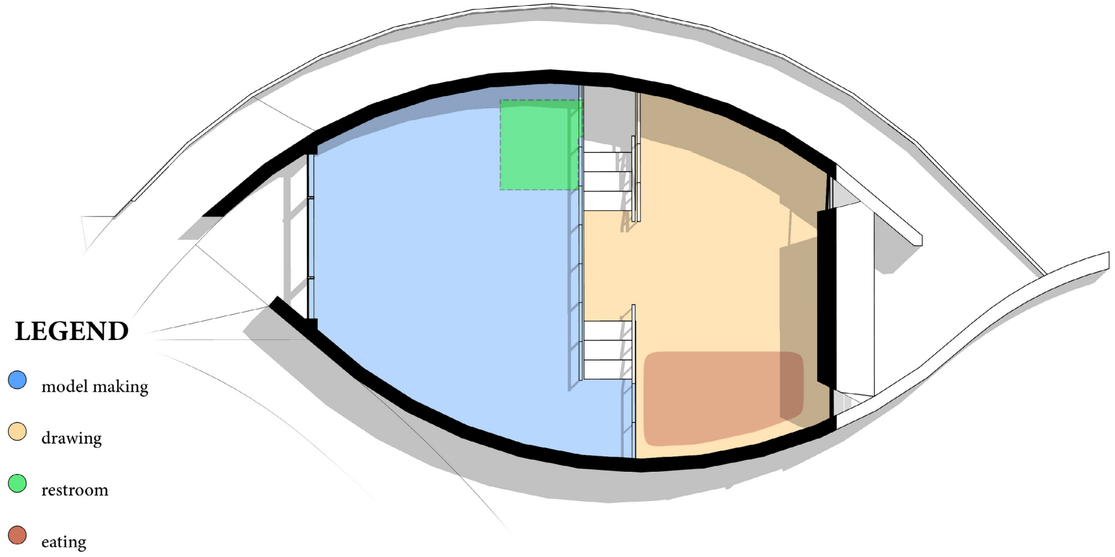


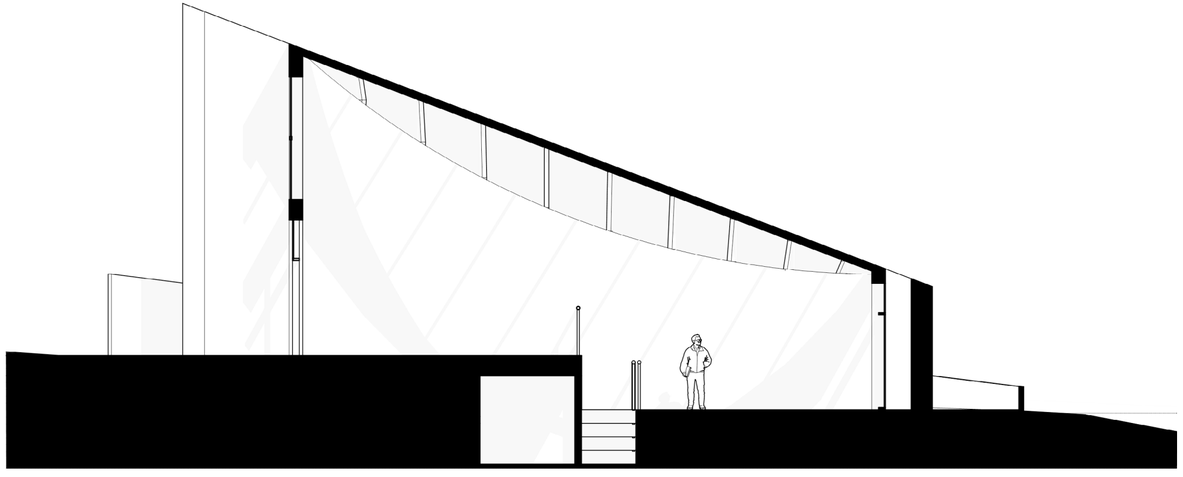
1. STUDIO BUILDING

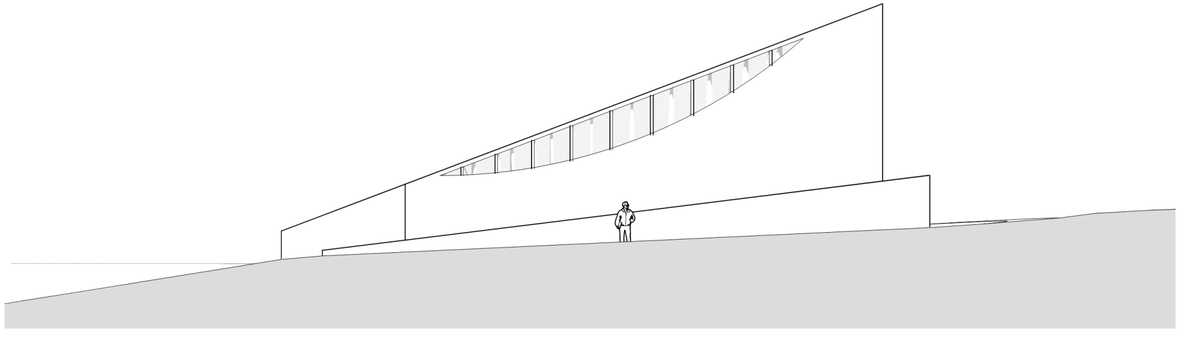
To actually construct his room-sized steel sculptures, Richard Serra requires a large warehouse or naval yard. However, Serra designs them using smaller scale lead models. He also does lots of unpublicized drawing and sketching; these works are usually unrelated to his sculptures. My goal was to create a studio to accommodate those smaller-scale activities. The site is in an isolated location, so I included a restroom and an eating area, with space for a refrigerator and a table or bar.

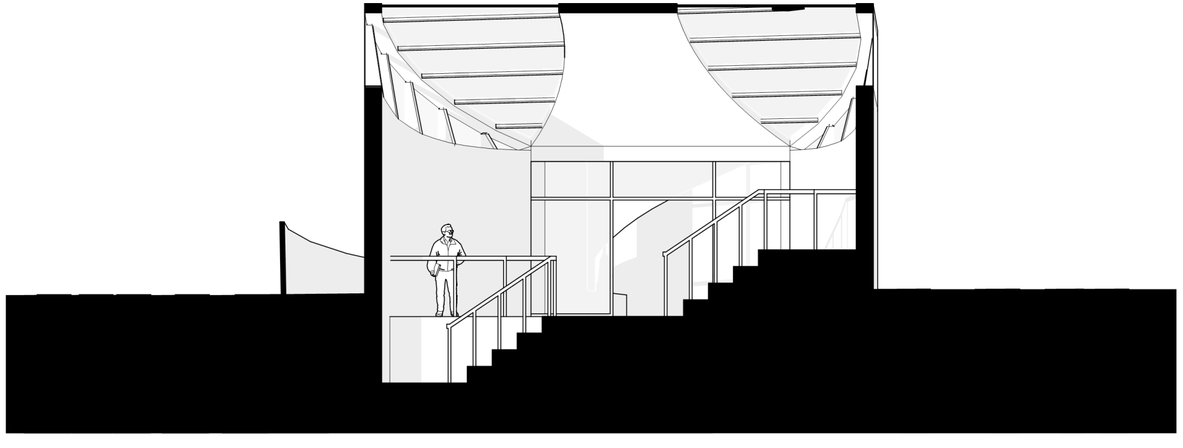
One can approach the building from the Schuylkill River trail and enter through the front, or walk around the building to the river-facing rear entrance. The building is split into two levels, connected (and divided) by a staircase. The upper and lower levels are for model-making and drawing, respectively. The restroom is at the bottom of the steps, directly under the upper level.

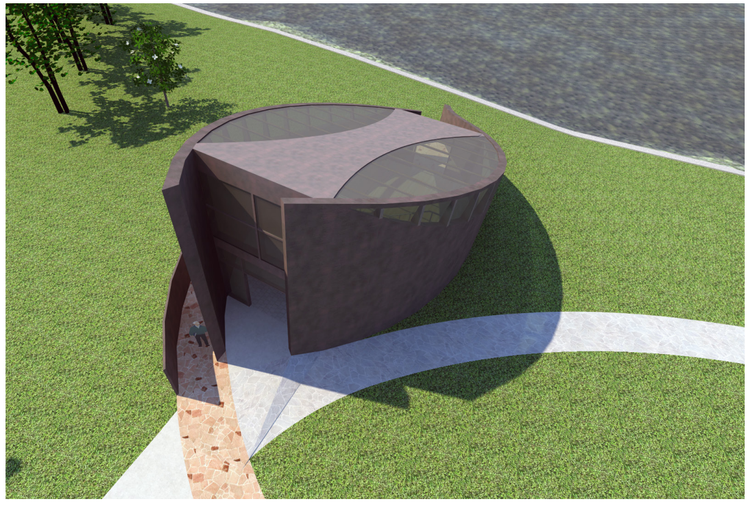


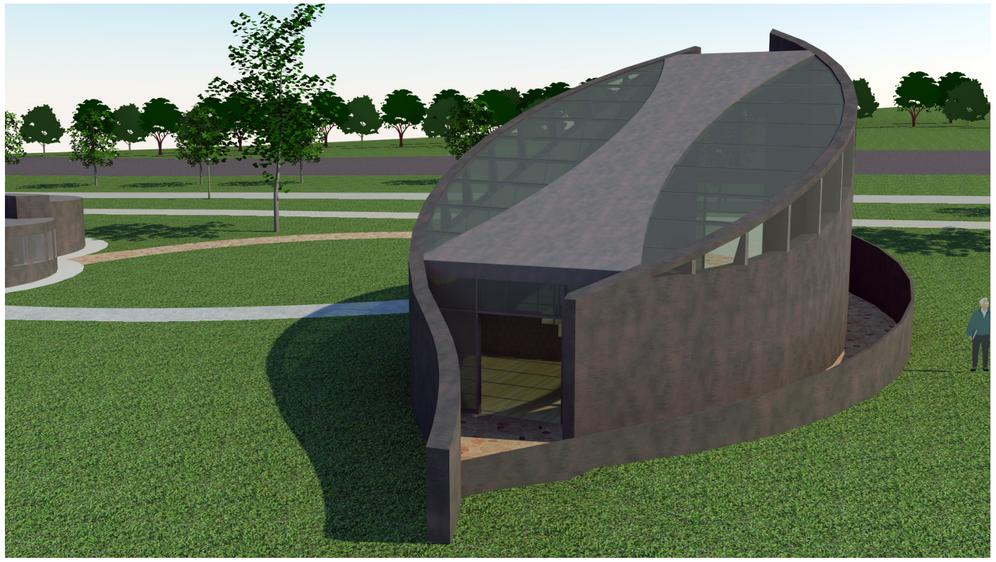


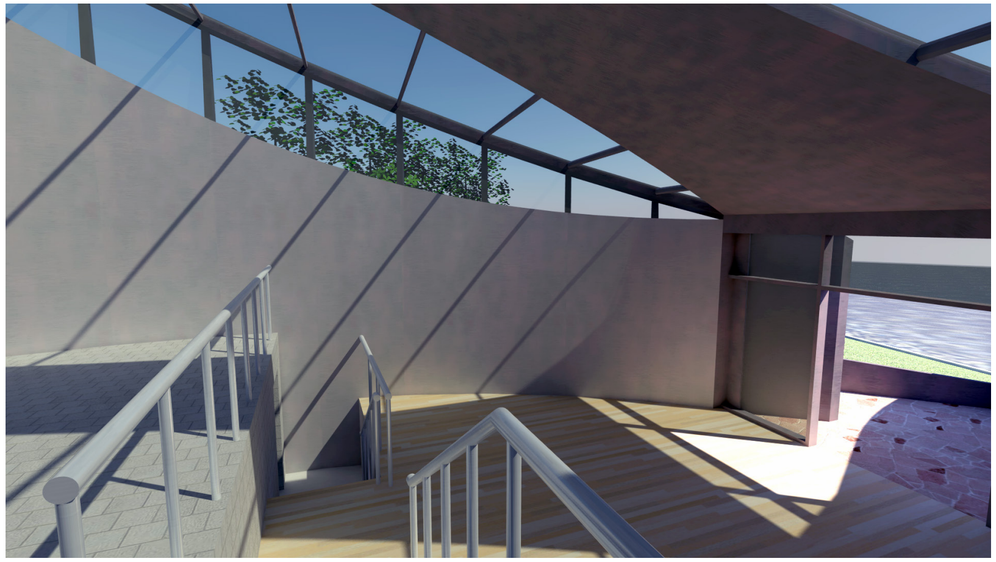


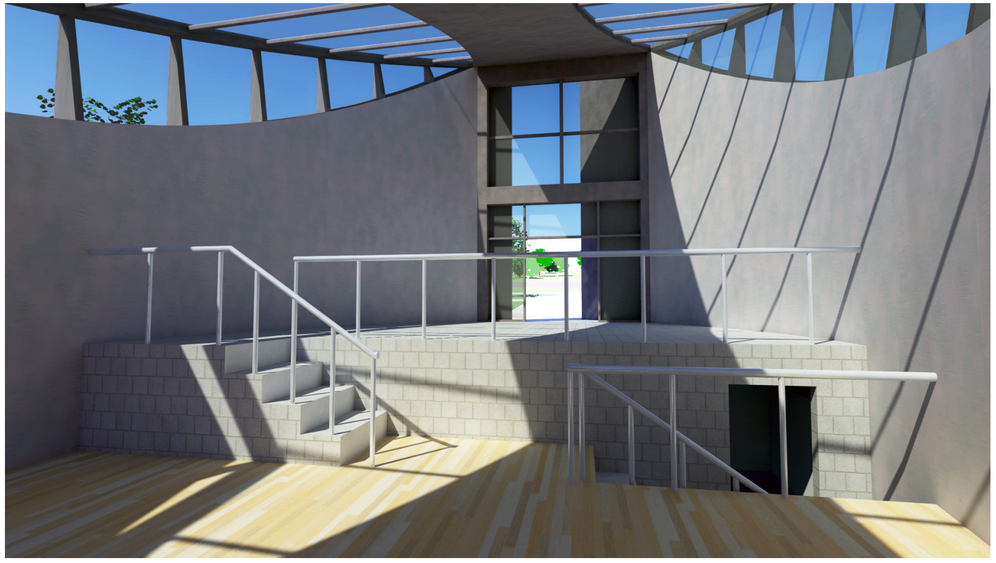


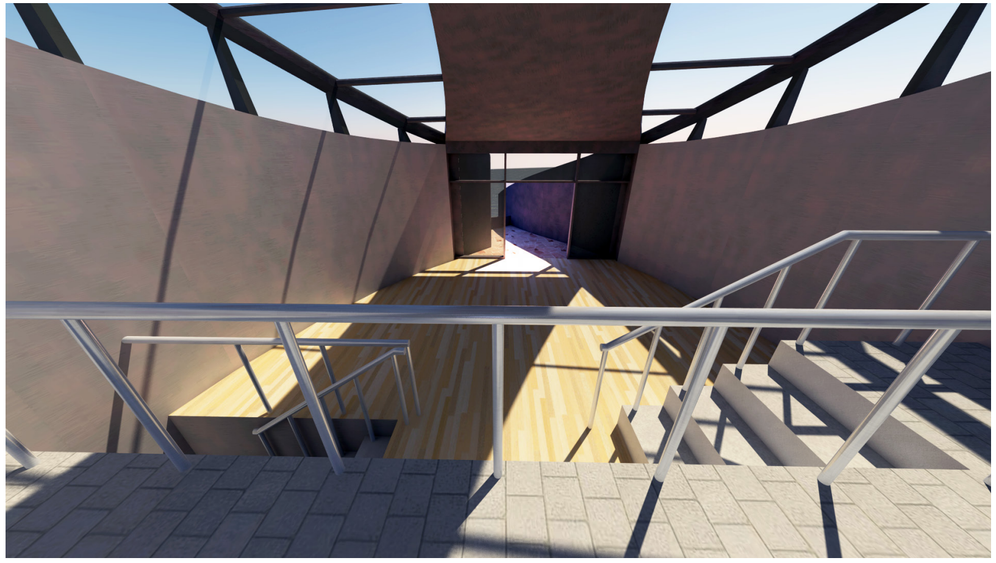












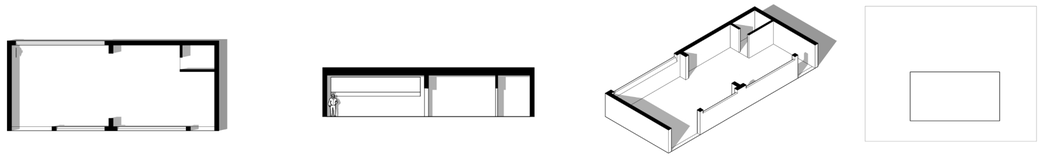
2. STUDIO BUILDING DESIGN PROCESS

Below is the design process I went through to make this over the course of 10 weeks:

1st ITERATION

I started with the most utilitarian design possible. On the left of the plan is an area for Serra to build models, and on the right is space for drawing. The small room at the top right is a restroom.

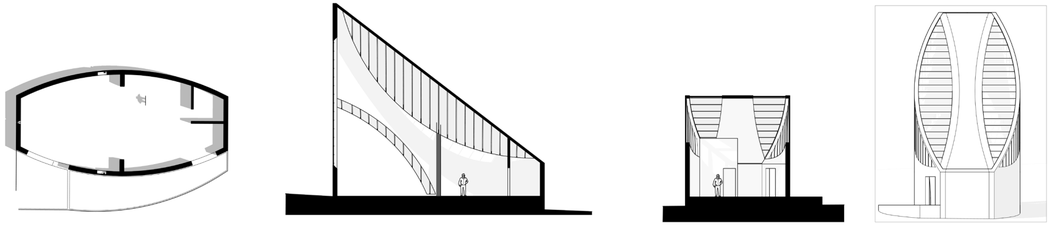
1



2nd ITERATION

Sculpting requires more room than drawing, so to differentiate the spaces I raised the ceiling upwards at that end of the building. I also began adding curves to the model to mimic some of the aesthetics of Serra's work. One motif here is a ")(" shape between the windows on the walls, as well as on the roof.

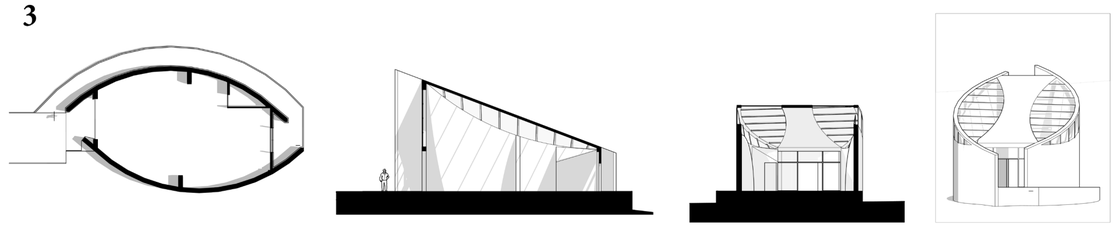
2



3rd ITERATION

As seen in the plan view, the positions of the walls were shifted, resulting in enclosed areas near the entrances. Thus, one is enveloped as they walk into the building, as is the case with many of Serra's sculptures.

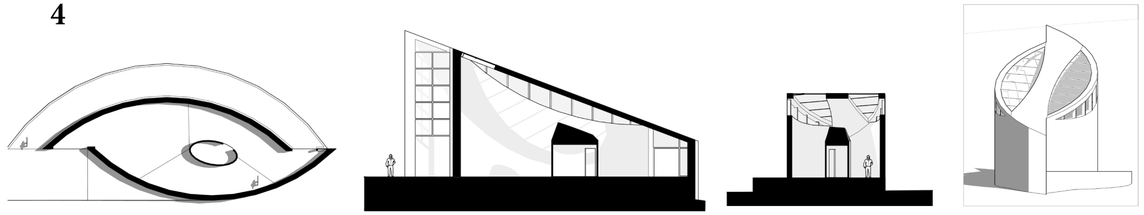
3



4th ITERATION

I decided to exaggerate the shift of the walls as far as possible. To divide the space further, I moved the restroom into the middle. Although this created an interesting interior space, it eliminated the exterior enclosures; this was one of the main reasons I abandoned this iteration of the design.

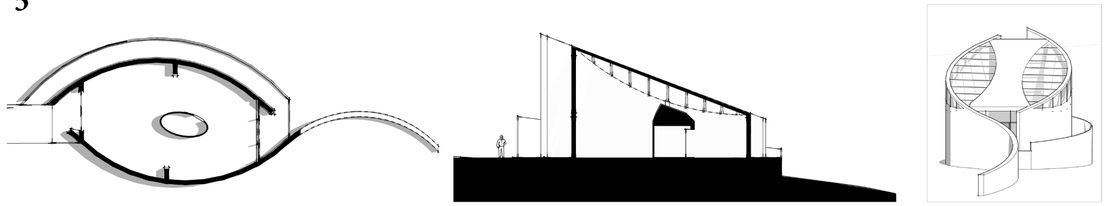
4



5th ITERATION

Based on feedback from my midterm critique, I made several additions to the third iteration. First, I added a wall alongside the curved pathway leading to the back entrance. I also extended one of the main walls out a bit into the landscape; this was meant to be a whimsical gesture. Notice, I did keep the restroom from the fourth iteration.

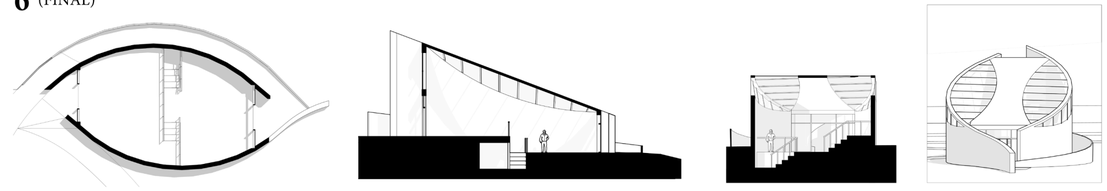
5



6th ITERATION

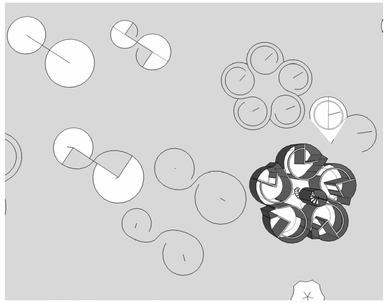
In the final design, the building has been split into two levels, taking advantage of the sloped ground condition. The two distinct spaces are connected (and divided) by a staircase at the center, which also allows access to the underground restroom.

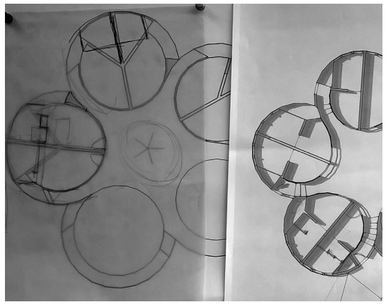
6 (FINAL)



3. RESIDENTIAL BUILDING

The second part of my assignment called for a residential building for five aspiring disciples to live near the studio of the artist I selected (Richard Serra). I was required to include bedrooms, restrooms, a kitchen, and common living space, and the building needed to be under 1600 square feet. Instead of starting with function and adding form, as I did with the studio, for this building I went in the opposite direction, basing the design on an actual Richard Serra sculpture (Cycle, 2010).



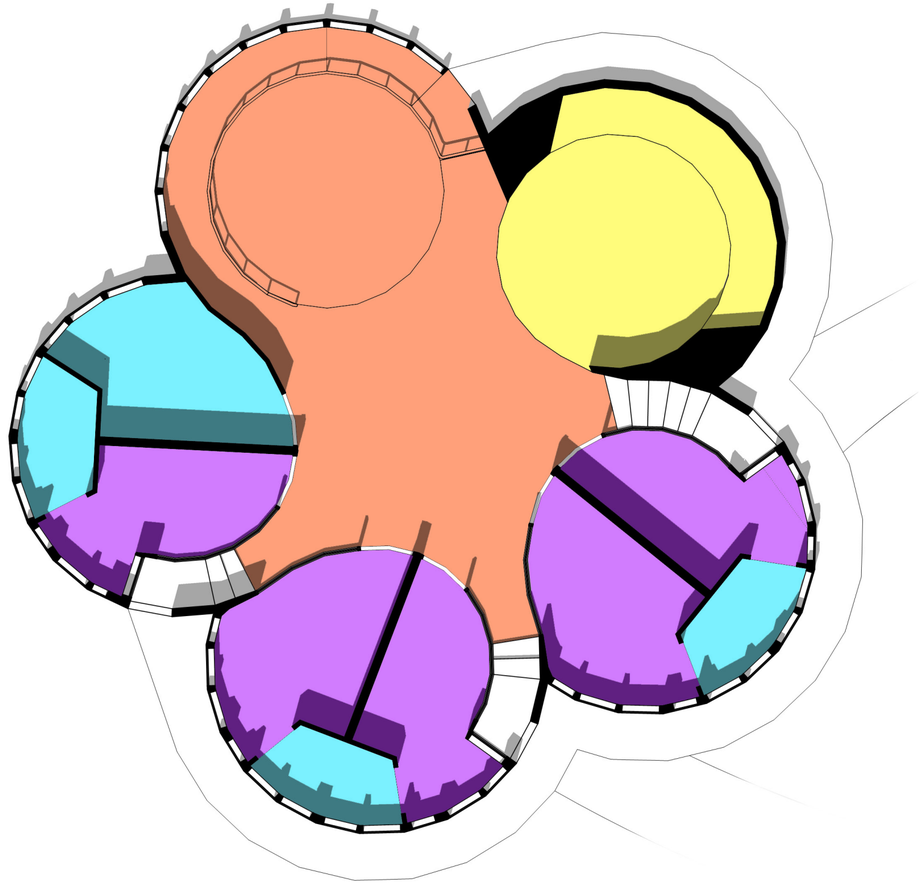


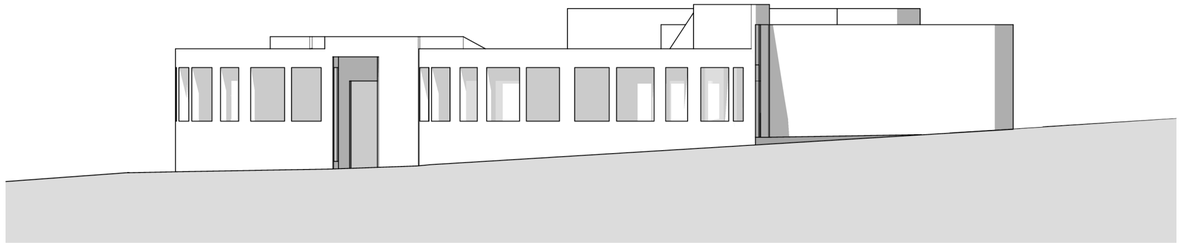
Cycle is made from three S curves; my original intention was to create a pentagonal version of the design with five bedrooms surrounding a central area. This left little room for anything else, so I divided three of the outer circular spaces in half.

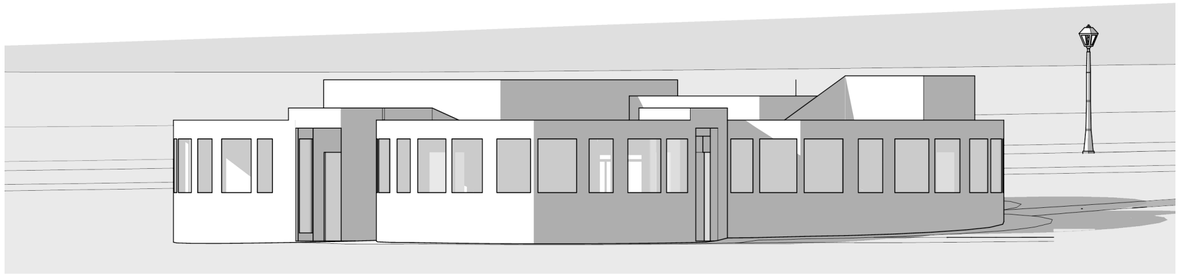
The bedrooms are smaller (and have “Jack-and-Jill” style bathrooms), but I managed to fit far more into the design than I originally thought possible. The smaller personal restrooms can fit a toilet and a sink, so I have a larger restroom area where a bathtub or shower could be placed. The design is half-submerged into the sloped ground; one of the exits has a longer staircase to accommodate this.

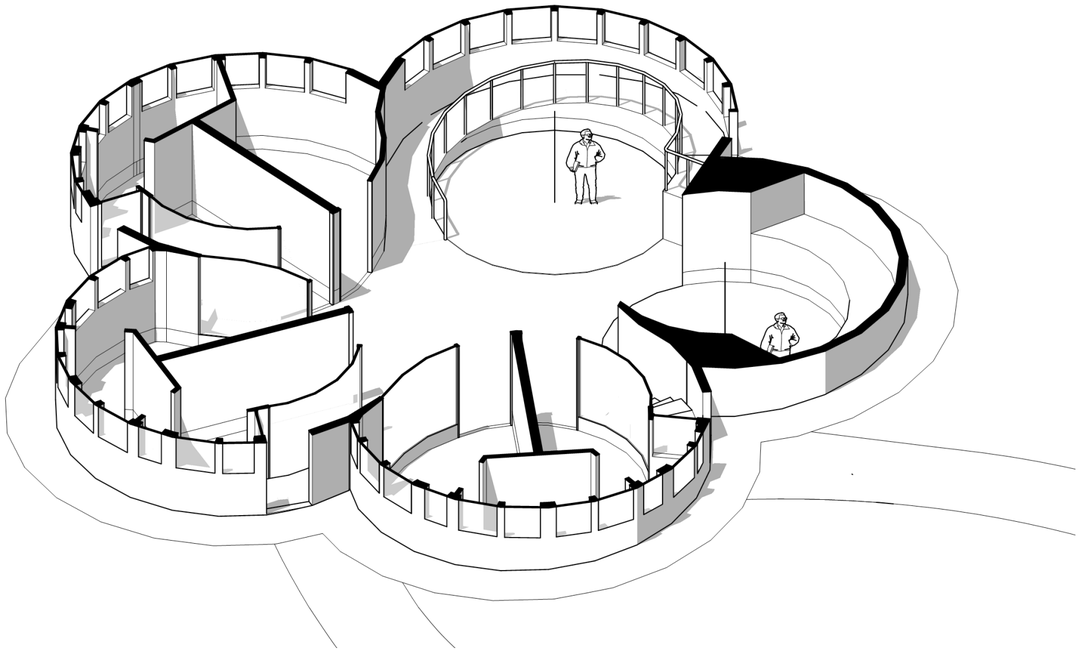
LEGEND

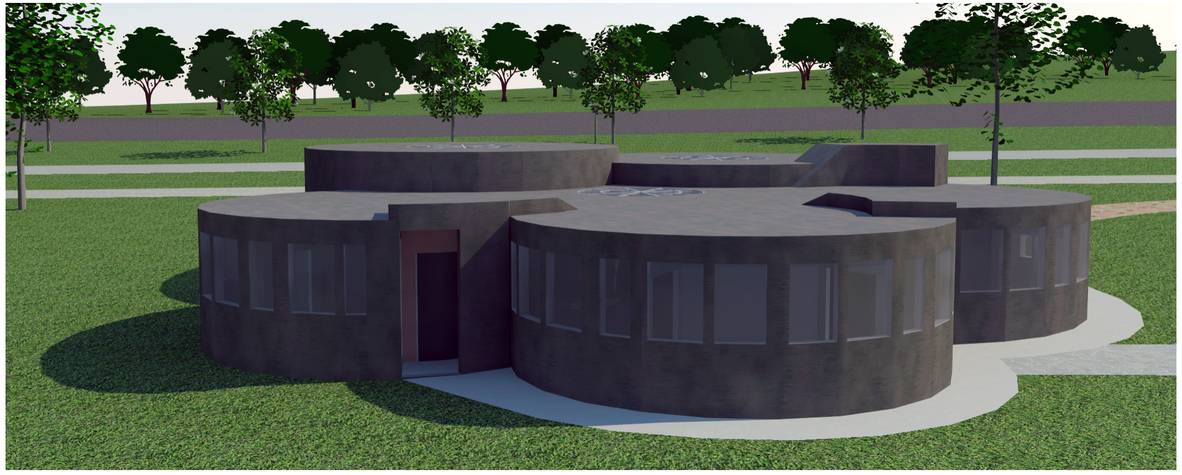
- bedrooms
- restrooms
- kitchen
- living areas

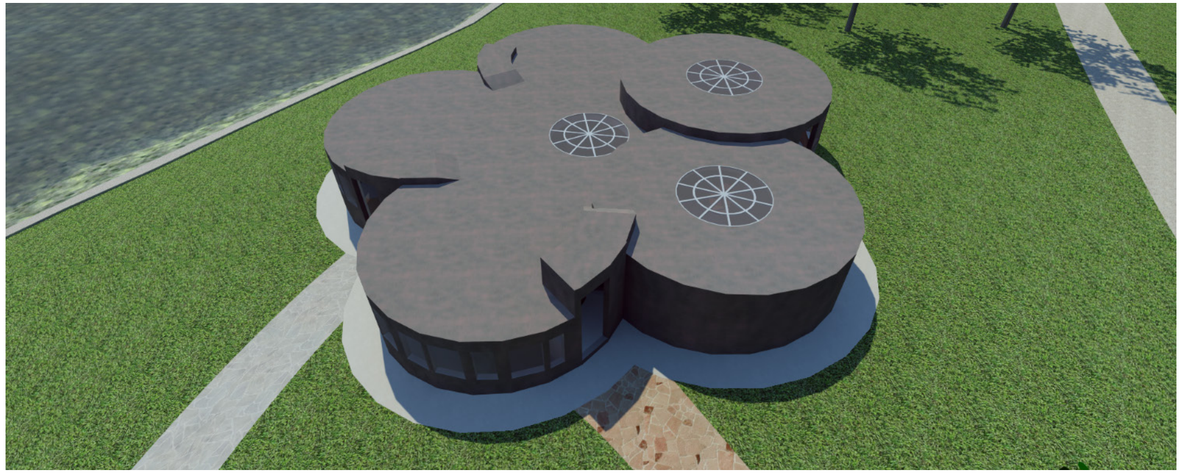


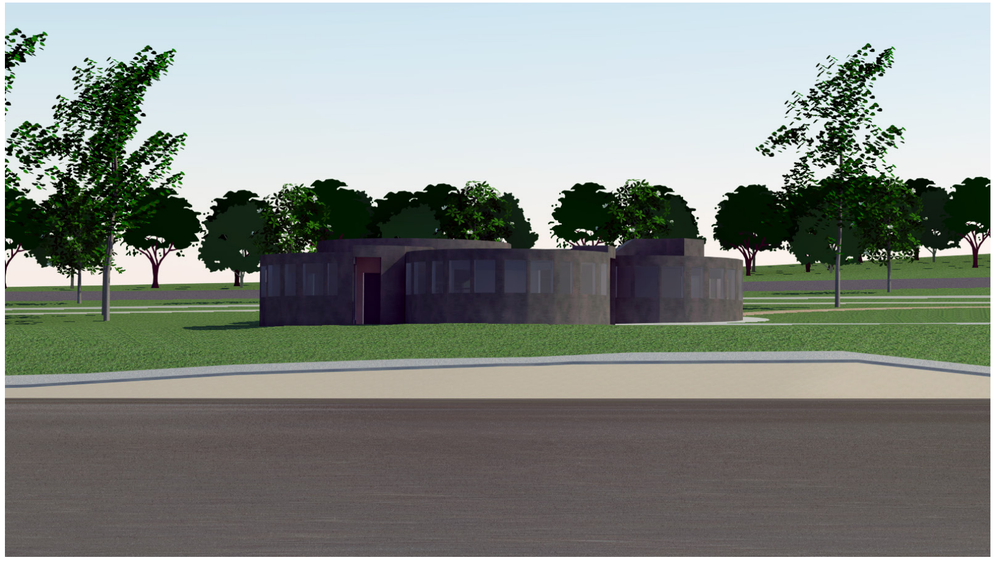


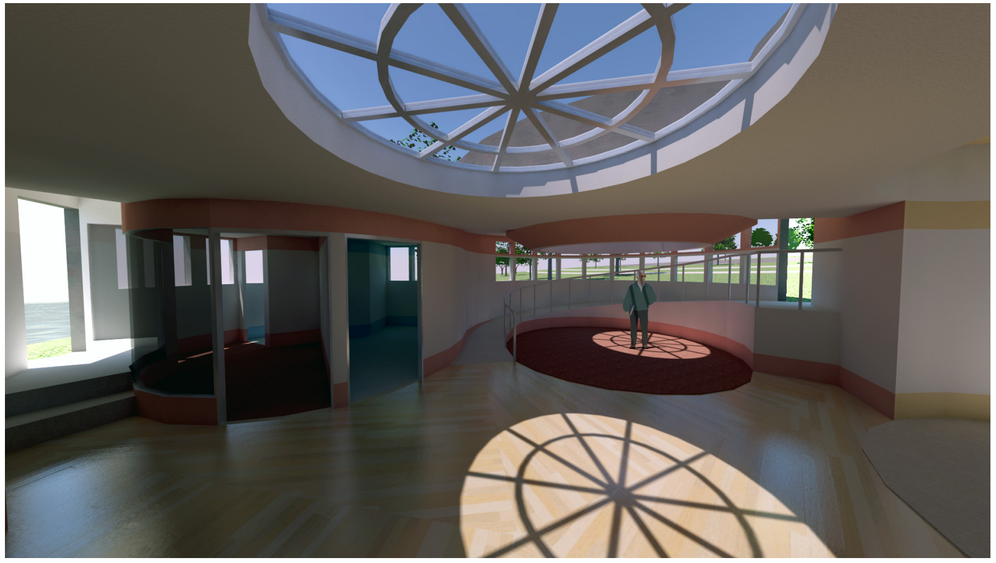












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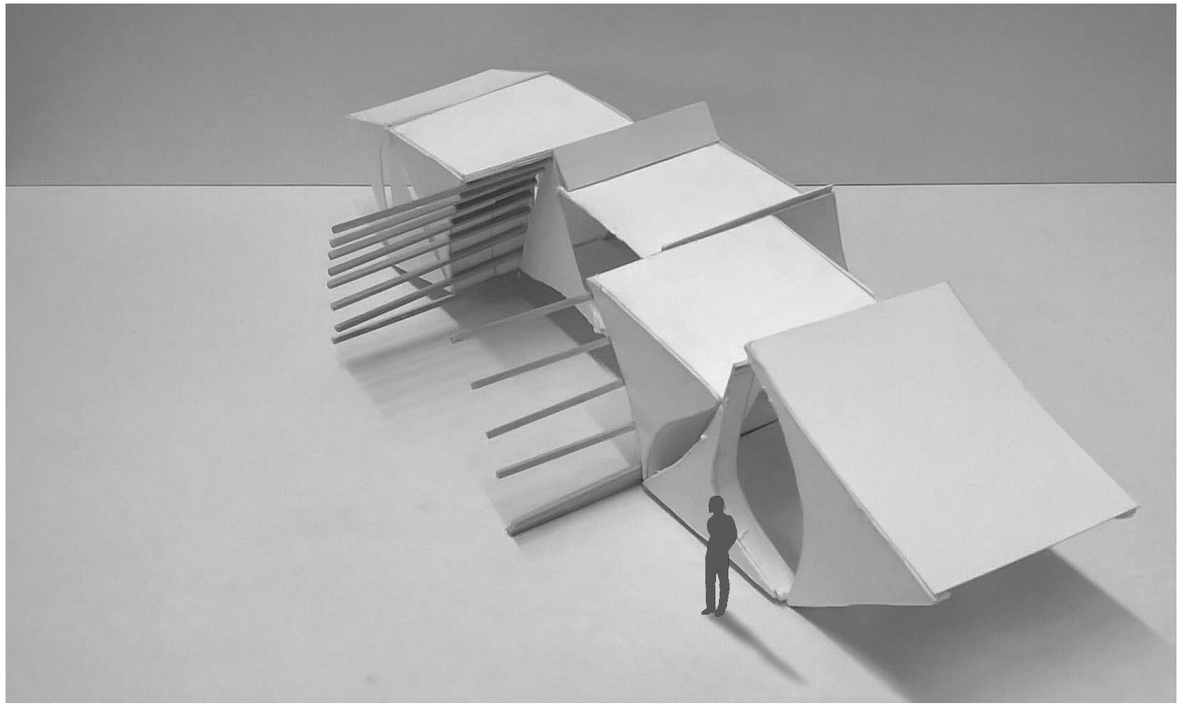
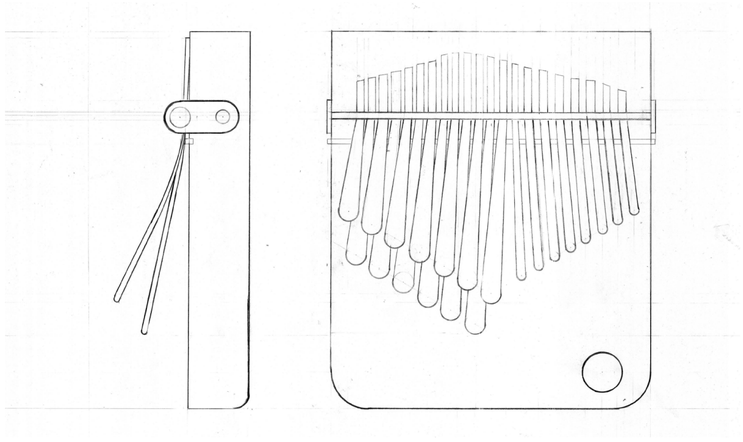
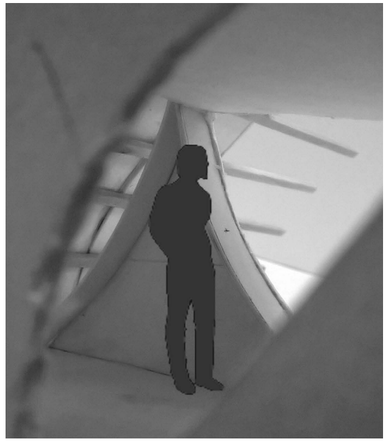


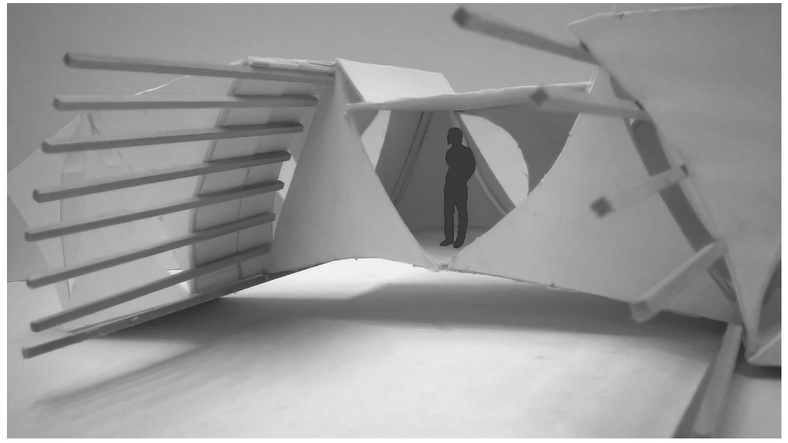
For my first-year winter studio class, I researched an obscure instrument and used its sound as a starting point to design a pavilion with space for a soloist to play it. I was assigned the Kalimba, an African thumb piano.

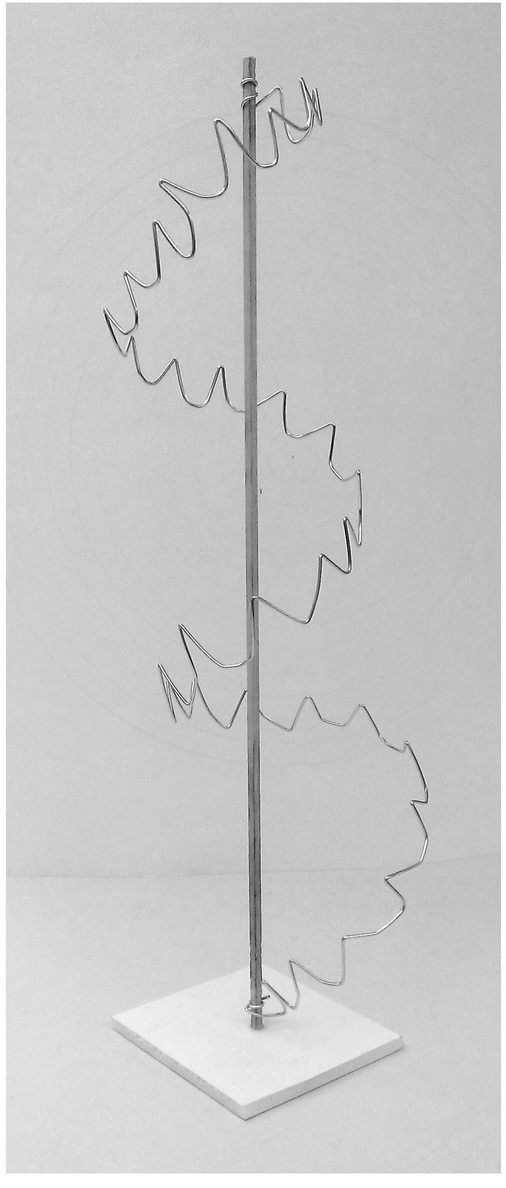


Right: My drawing of a kalimba

Above right & next page: final model



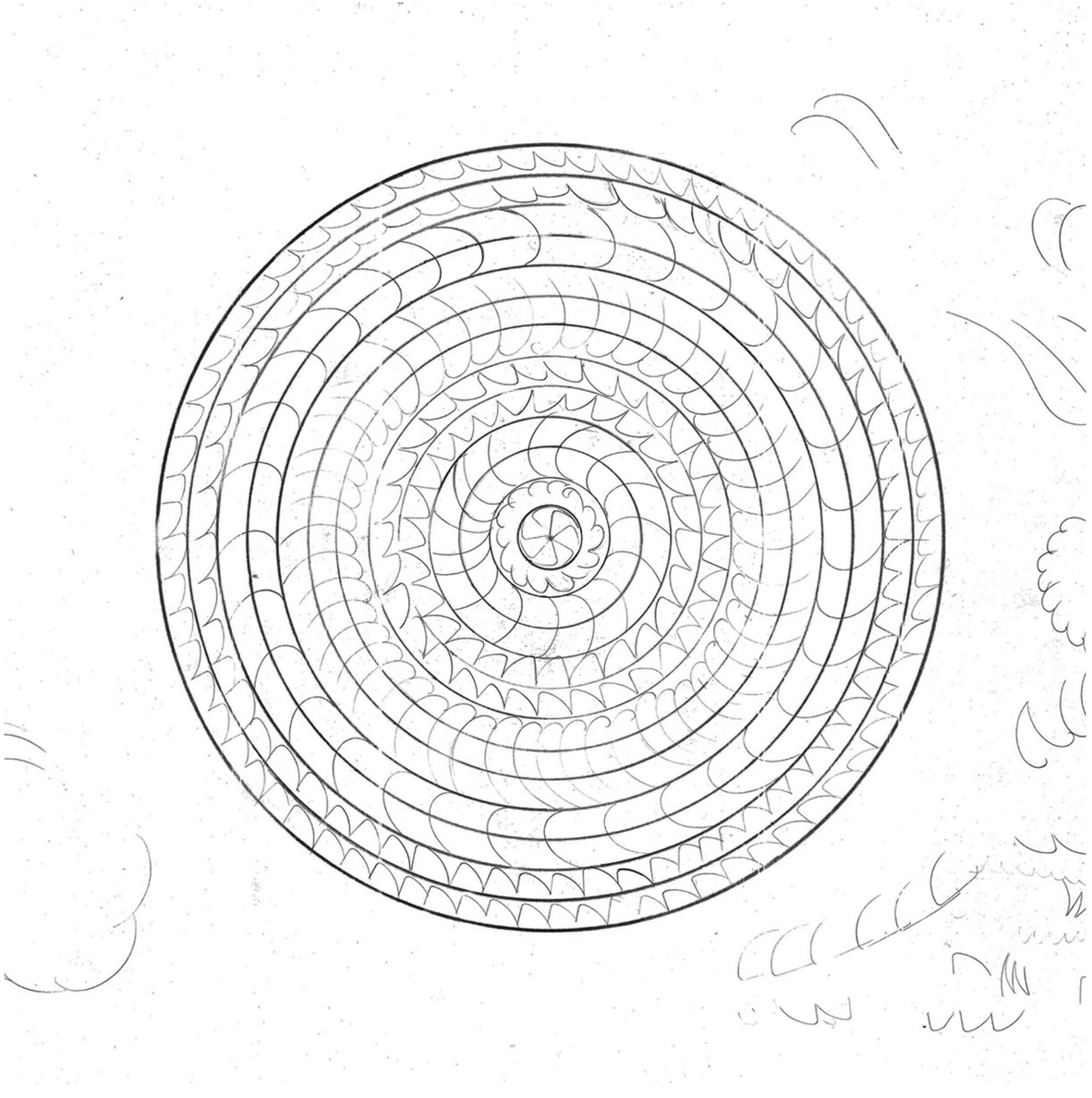




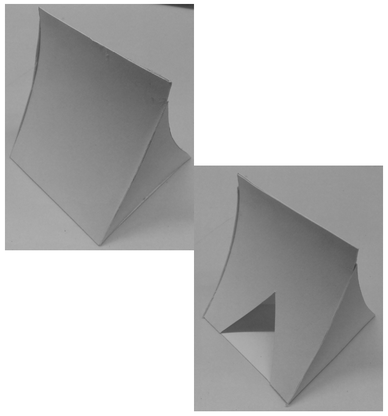
To describe the sound the Kalimba makes, I created a concept model and a drawing. The many distinct bends on the wire in the model are like notes in a melody plucked on the instrument. The helix shape symbolizes the repetitiveness of the rhythms in the song.

This page: Helix sound model

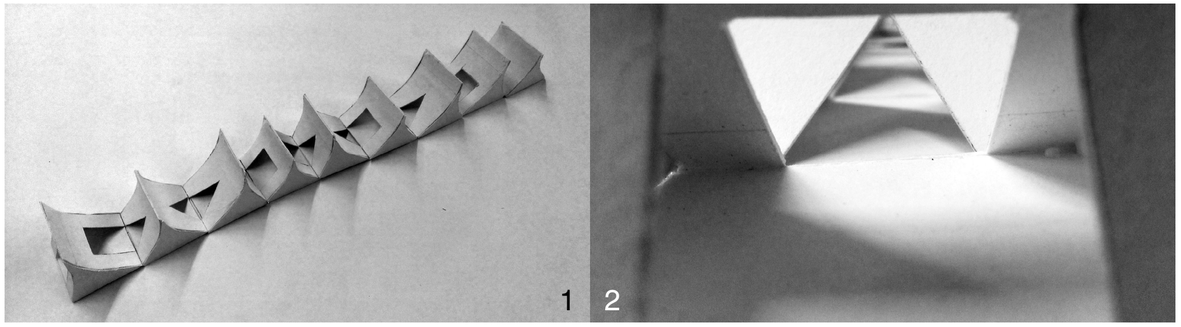
Next page: Sound drawing

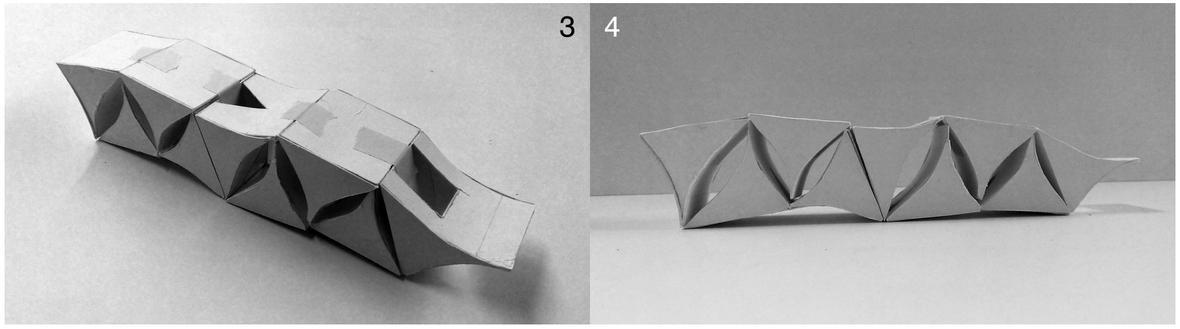


The next step was to translate this idea into 6”x6”x6” modules (right) which “contain” the sound. I decided to take the shape of the bends and extrude them into a prism shape. The way the sides bend upwards is reminiscent of the “plucking” sound of the Kalimba.

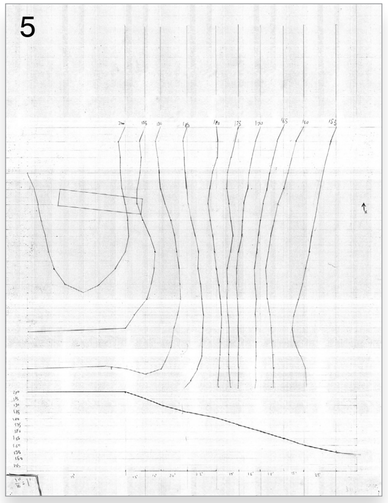


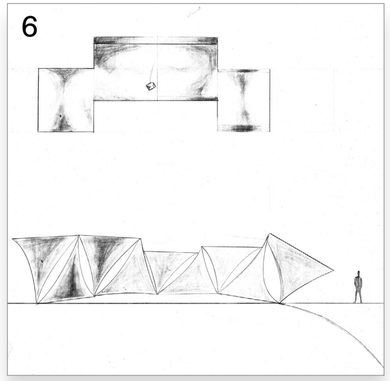
I shrunk the modules down to 2”x2”x2” size, created nine of them, and experimented with different combinations. At first, I laid them all out in a row. Since each module is a note, I imagined one might walk straight through them as if walking through a song. However, I decided on a more compact aggregation.

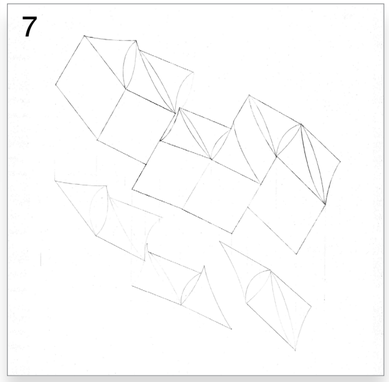


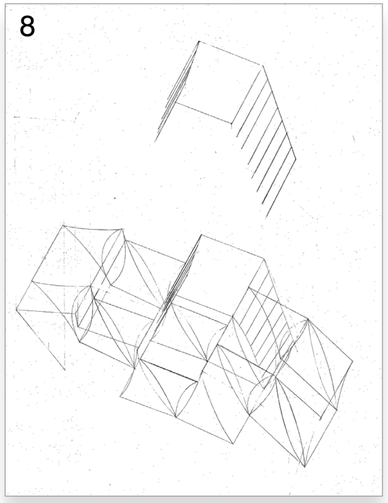


The design continued to evolve over the next several weeks. I shifted certain modules over to create three distinct spaces inside the pavilion: an entryway, a space to play the instrument, and an observation area, since the site is located at the top of a hill at Fairmount Park (in Philadelphia, PA). Basswood was used to frame an exterior space where an audience can sit down and listen to the soloist play.









(Previous page)

1,2: Initial aggregation

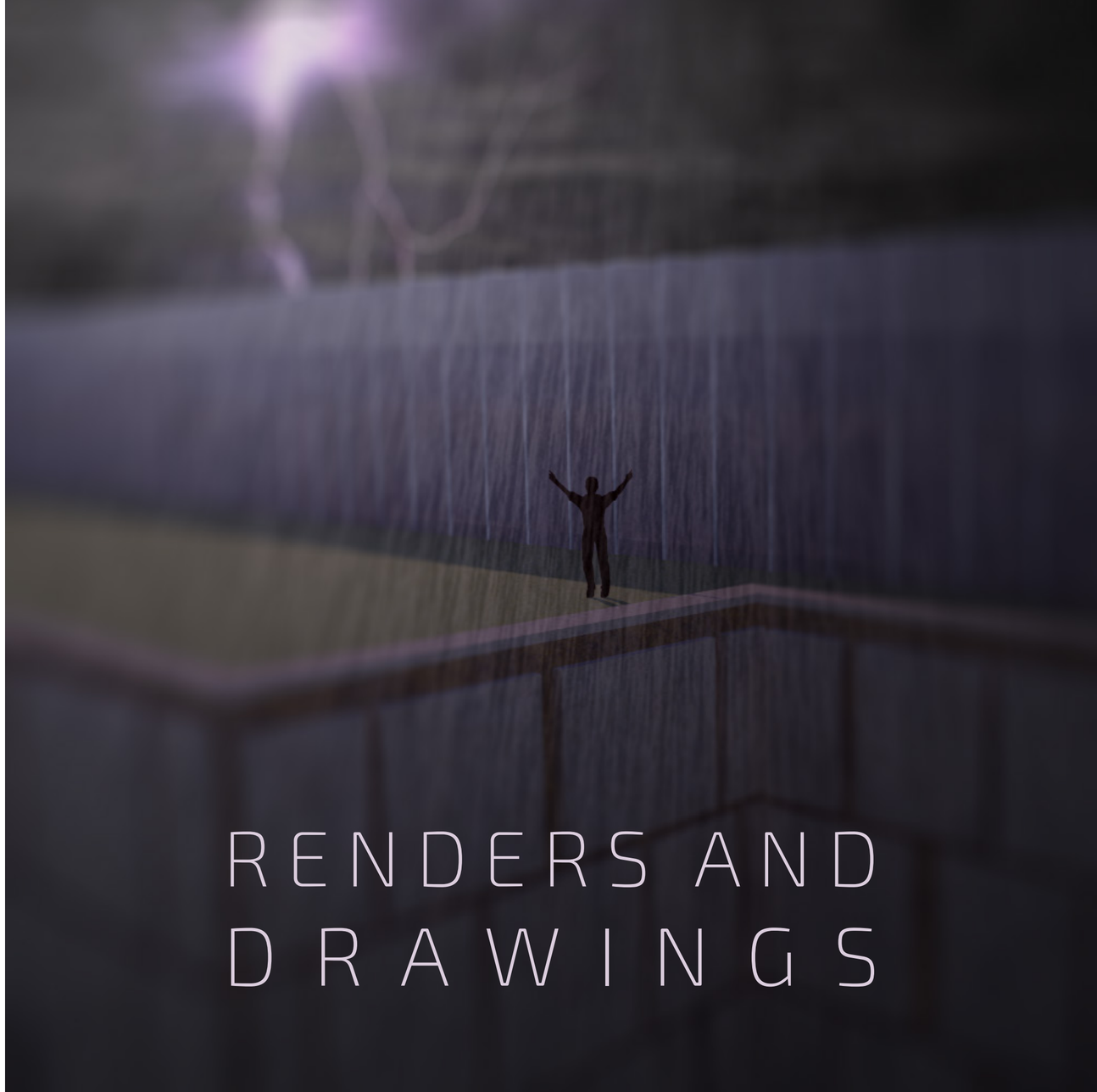
3,4: Compact aggregation

5: Site plan drawing with contour lines

6: Pavilion plan and elevation drawings

7,8: Exploded axonometric drawings

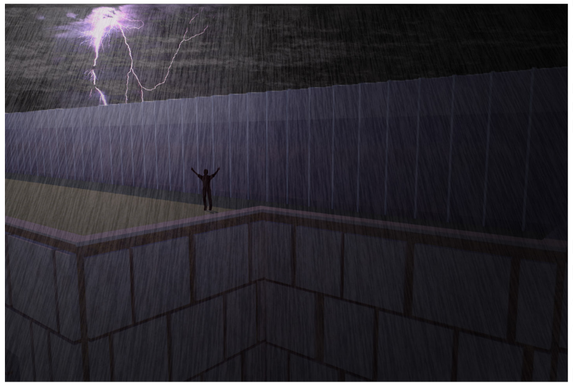
7



RENDERS AND DRAWINGS

The Barnes Museum

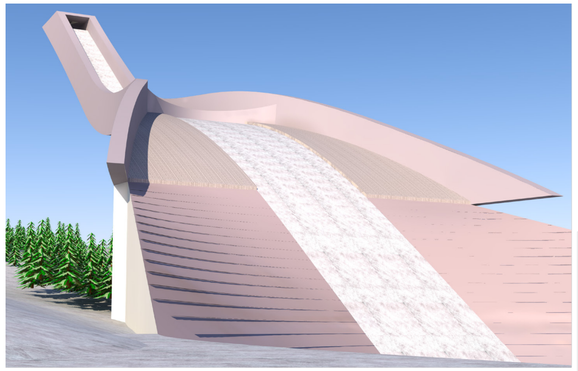
This was the final project for my third architectural representation class. The entire model was created in SketchUp. I used Podium to produce the renders and added clouds, rain, and more using Photoshop.

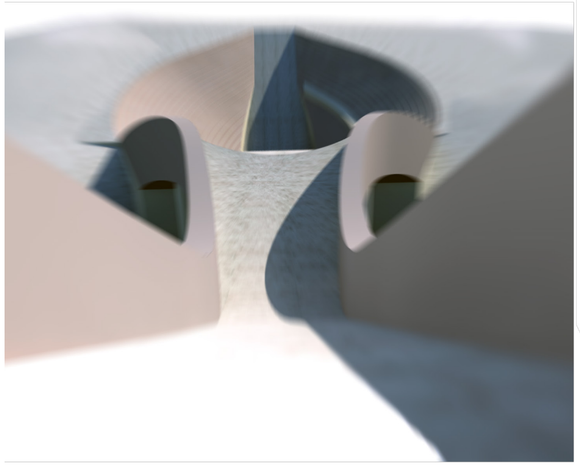


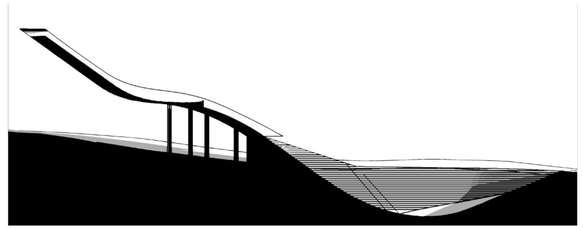
THE BARNES MUSEUM

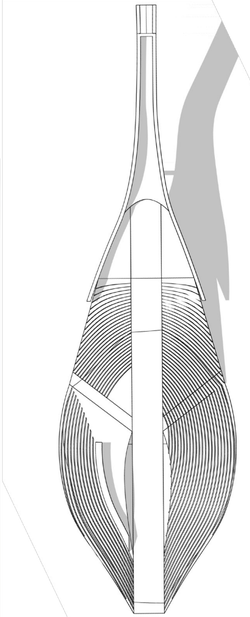
BEFORE, AT THE MOMENT OF, AND AFTER THE APOCALYPSE

BY ANDREW YAROS





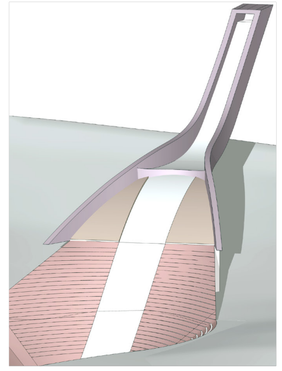




HOLMENKOLLEN

SKI JUMP

MODELED BY ANDREW YAROS

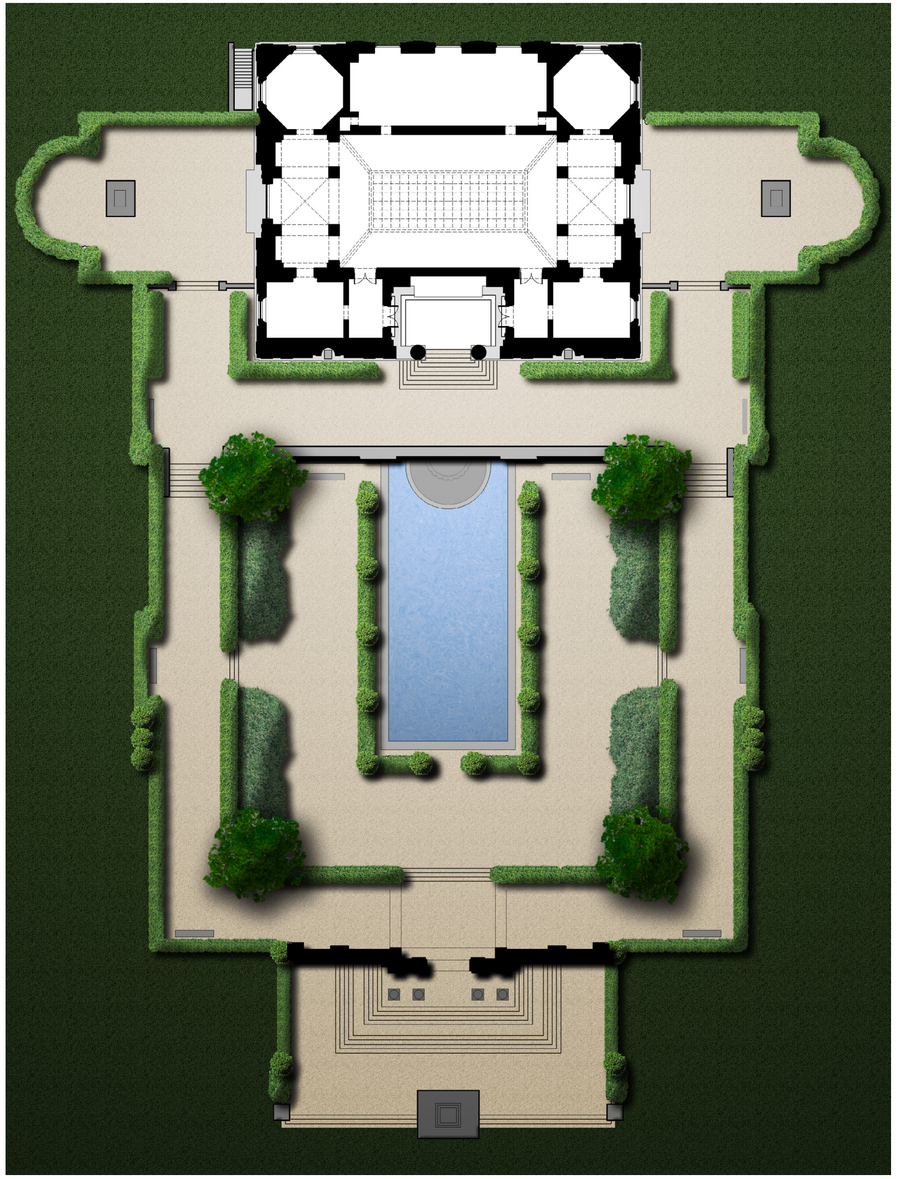


Holmenkollen Ski Jump

Final presentation for my fourth architectural representation class. After creating the main model using Rhino, I imported it into SketchUp to add a few trees and get some Podium renders.

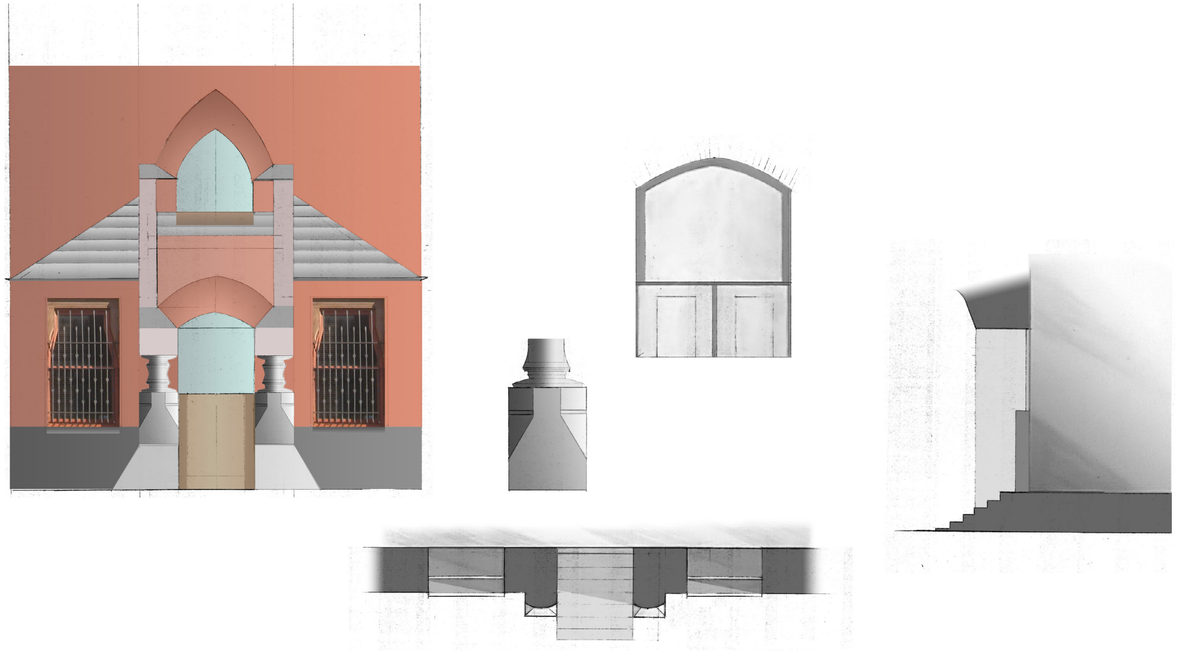
Rodin Museum
Site Plan

I redrafted an existing site plan into AutoCAD. After exporting linework to Photoshop I added textures and scenery.



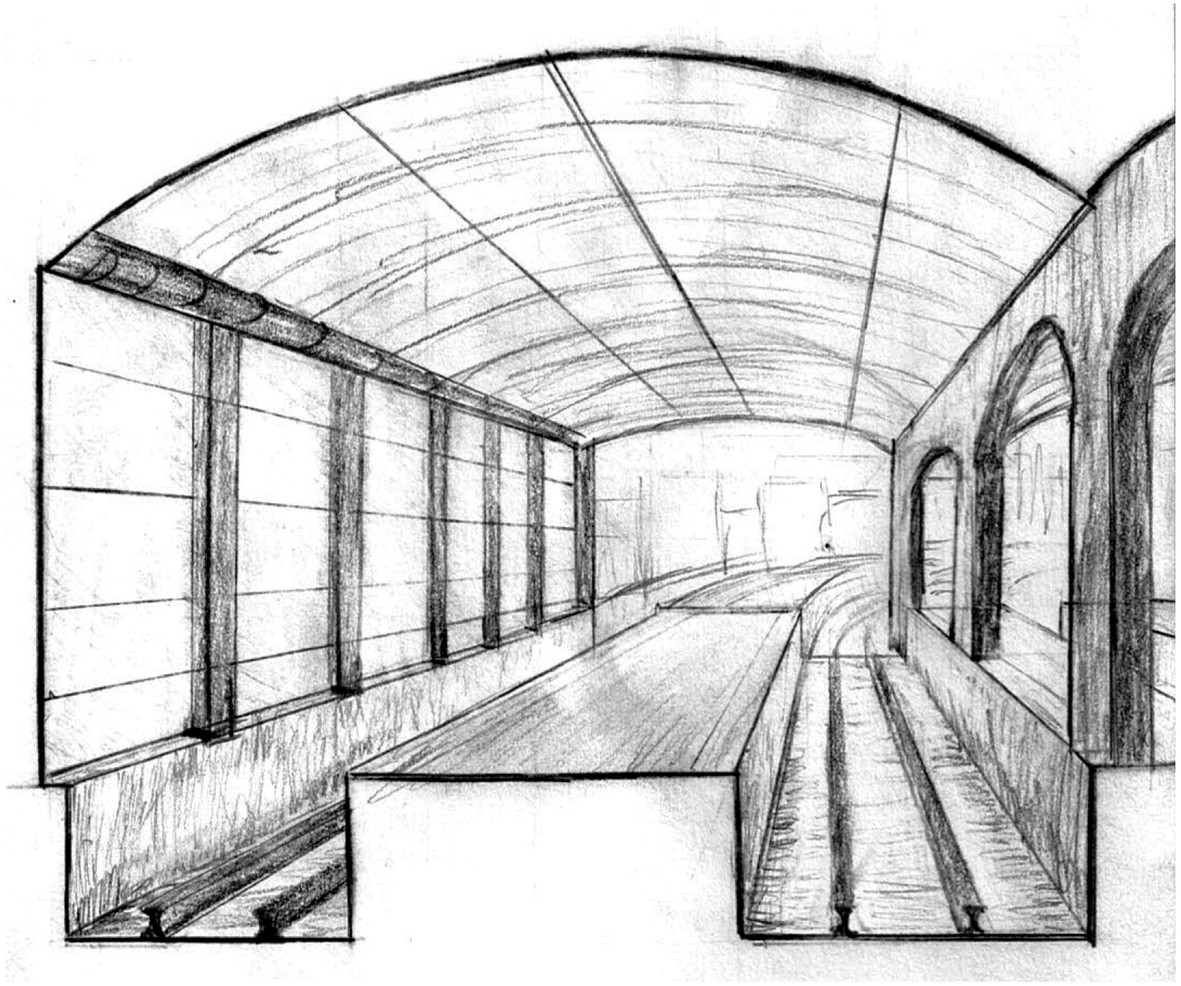
Rodin Museum Elevation

I redrafted an existing elevation into AutoCAD. After exporting the linework to Photoshop I added textures, scale figures, scenery, and a sky.



Paul Peck Alumni Building

In this assignment, we studied the transition between the exterior and interior of the Paul Peck Alumni Building at Drexel. Photoshop was used to shade the scanned drawing.

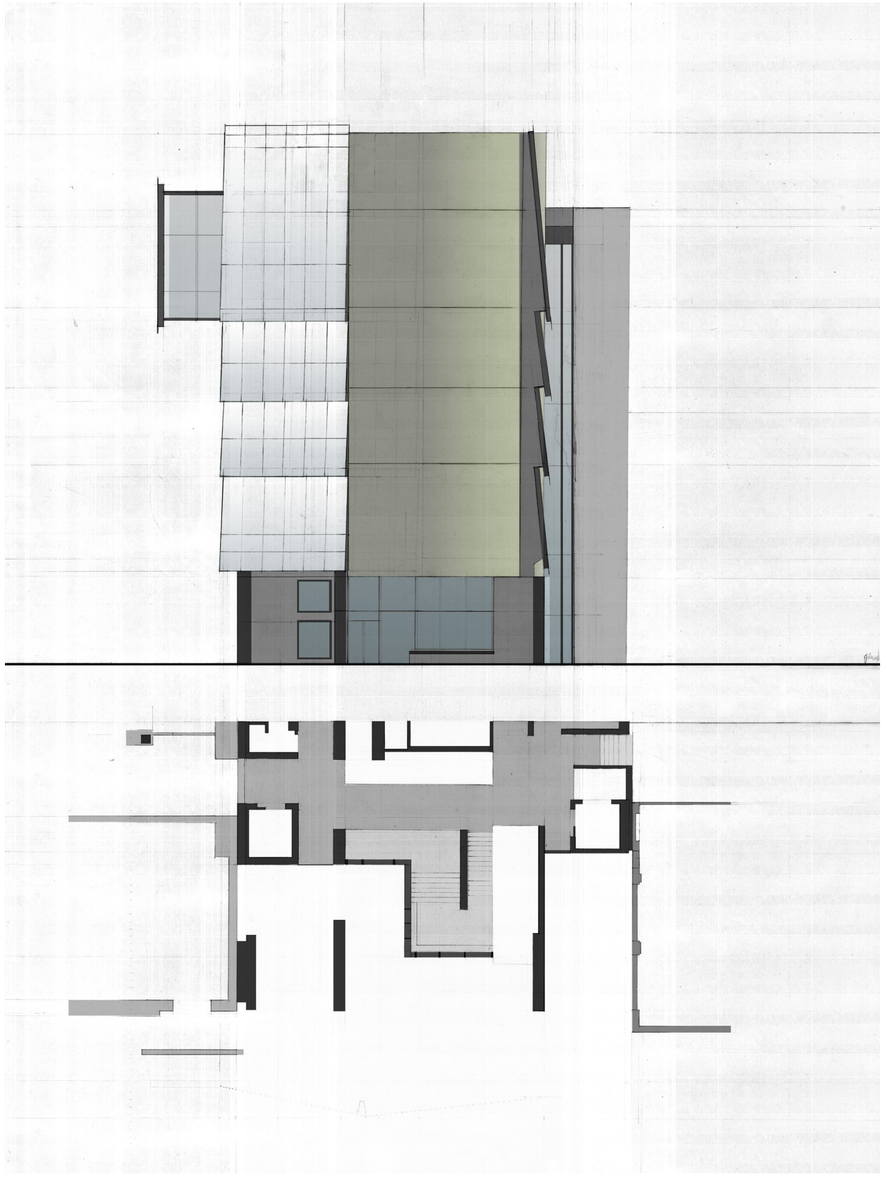


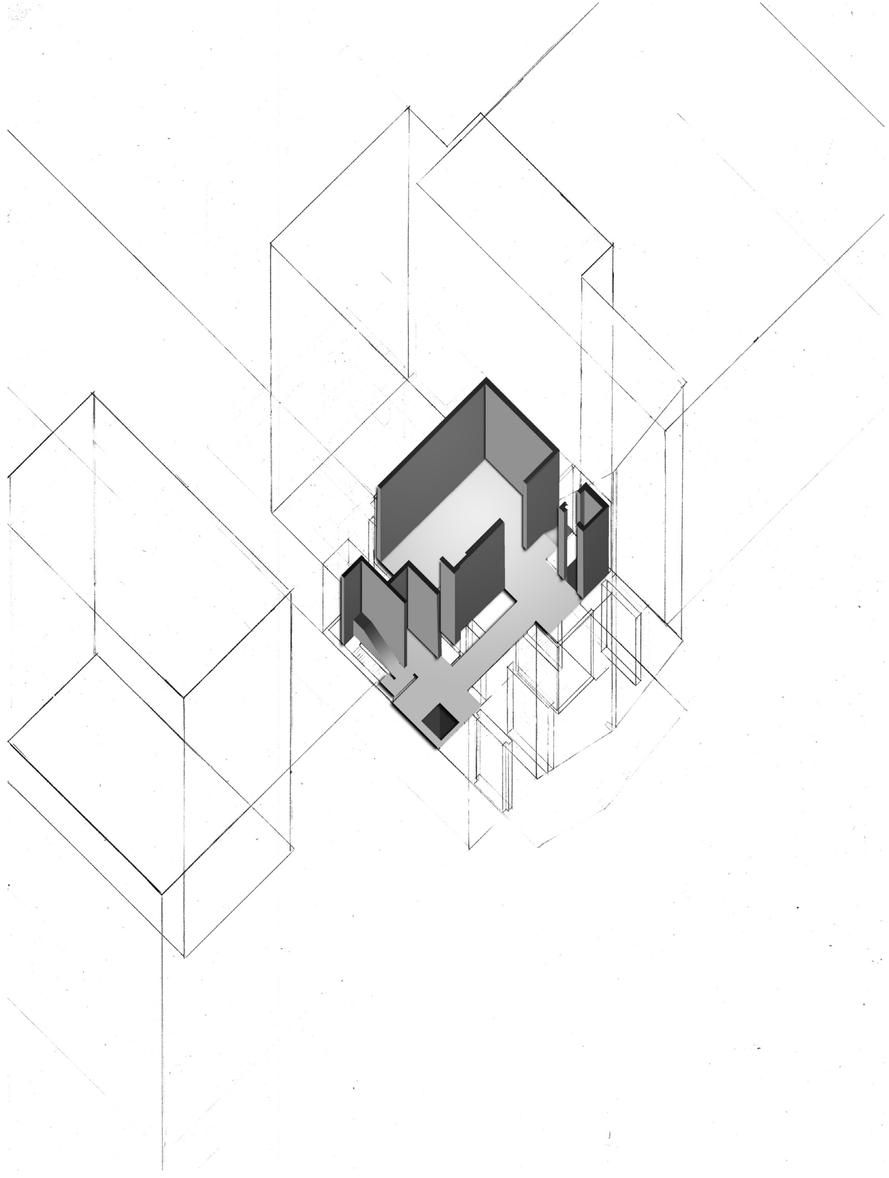
30th St. Sketch

I drew this sketch for an assignment; it is loosely based on platforms at Amtrak's 30th St. Station in Philadelphia.

Skirkanich Hall
Plan and Elevation

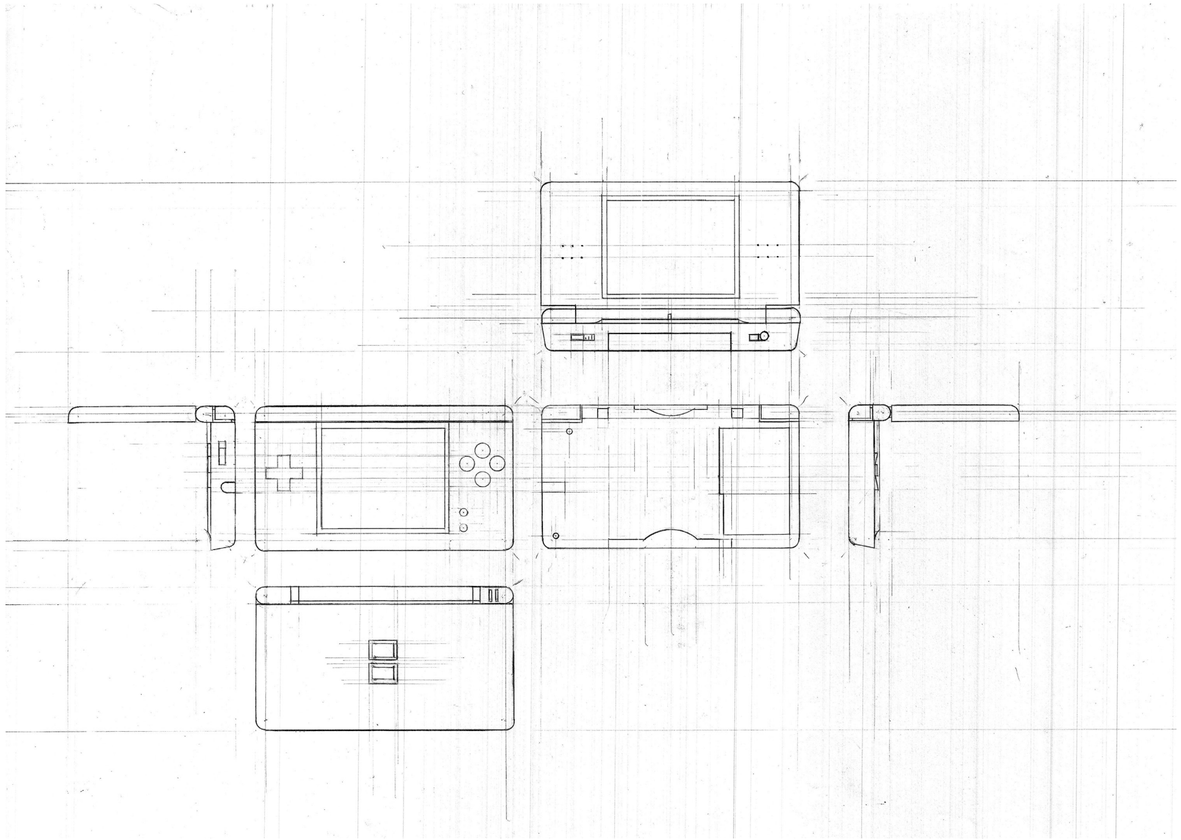
For this assignment, I re-drafted an elevation and floor plan of Skirkanich Hall, located on The University of Pennsylvania's campus. Photoshop was used to shade the scanned drawing.





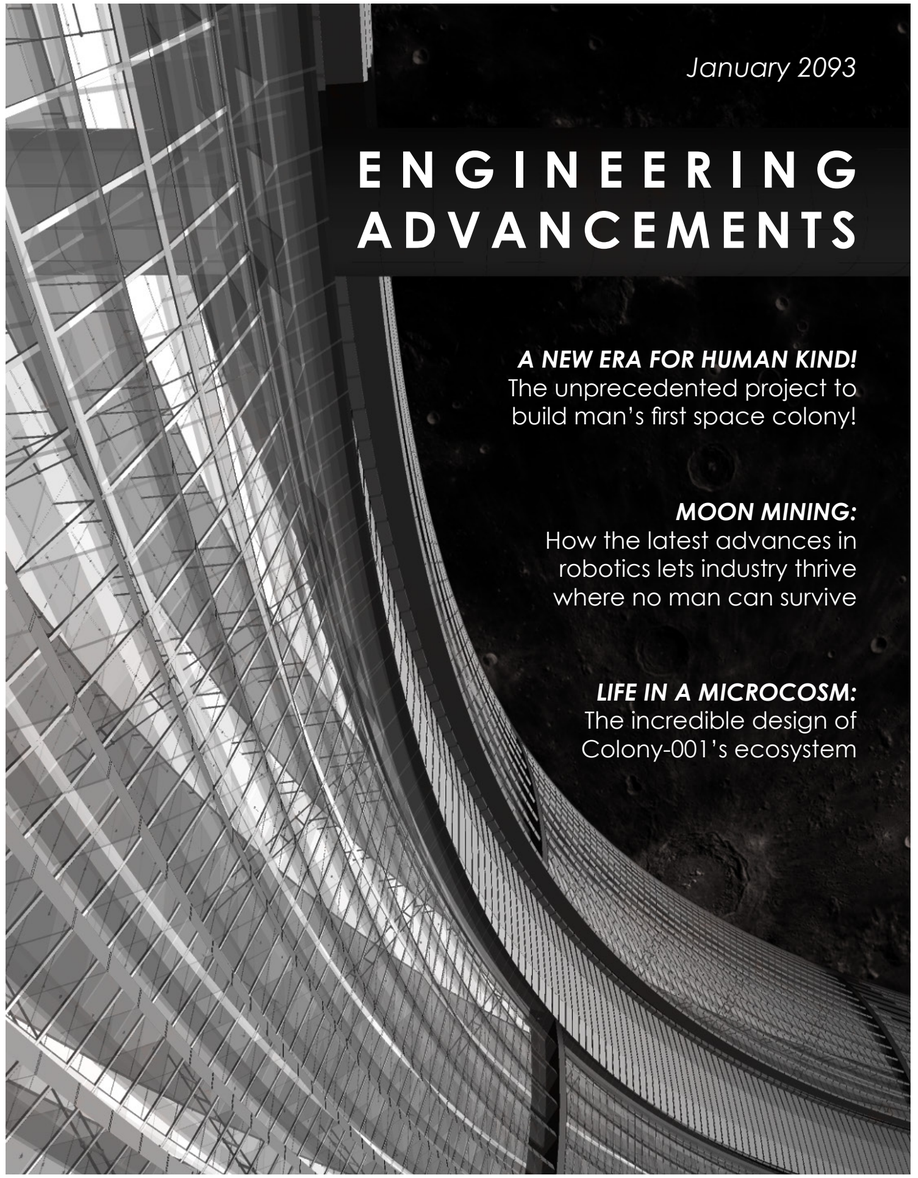
Skirkanich Hall
Axonometric Drawing

The second part of the assignment on the previous page. I used my floor plan and elevation of Skirkanich Hall to create an axonometric drawing. After scanning it in, Photoshop was used to add shading.



Nintendo DS Lite

Originally drafted at 1:1 scale.

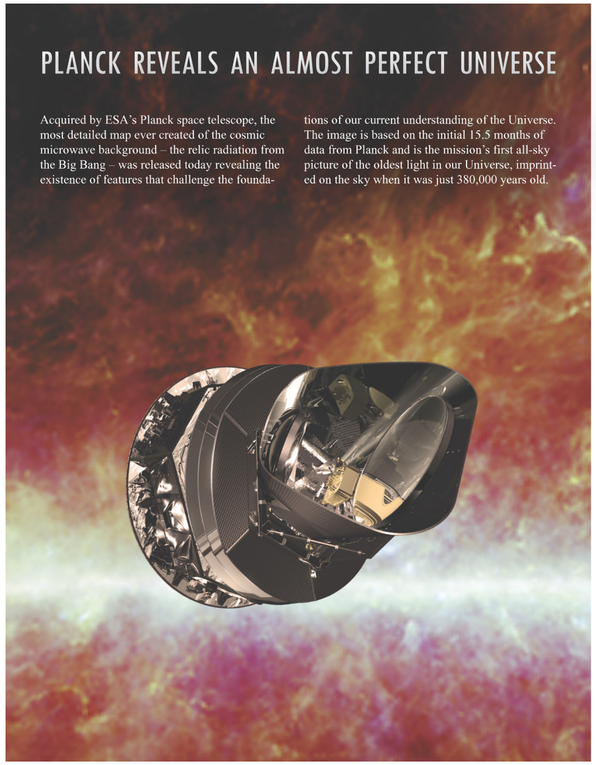


Engineering Advancements 2093 cover

Future issue of a fictitious science magazine I created for a class. The Stanford Torus seen here is a project I created in SketchUp.

Engineering Advancements 2013 cover

Cover of a fictitious science magazine I created for a class.



PLANCK REVEALS AN ALMOST PERFECT UNIVERSE

Acquired by ESA's Planck space telescope, the most detailed map ever created of the cosmic microwave background – the relic radiation from the Big Bang – was released today revealing the existence of features that challenge the foundations of our current understanding of the Universe. The image is based on the initial 15.5 months of data from Planck and is the mission's first all-sky picture of the oldest light in our Universe, imprinted on the sky when it was just 380,000 years old.

Left page: Artist's impression of the Planck space observatory. (Credit: ESA)

At that time, the young Universe was filled with a hot dense soup of interacting protons, electrons and photons at about 2700ºC. When the protons and electrons joined to form hydrogen atoms, the light was set free.

As the Universe has expanded, this light today has been stretched out to microwave wavelengths, equivalent to a temperature of just 2.7 degrees above absolute zero.

This 'cosmic microwave background' – CMB – shows tiny temperature fluctuations that correspond to regions of slightly different densities at very early times, representing the seeds of all future structure: the stars and galaxies of today.

According to the standard model of cosmology, the fluctuations arose immediately after the Big Bang and were stretched to cosmologically large scales during a brief period of accelerated expansion known as inflation.
Planck was designed to map these fluctuations across the whole sky with greater resolution and sensitivity than ever before. By analysing the nature and distribution of the seeds in Planck's CMB image, we can determine the composition and evolution of the Universe from its birth to the present day.

PLANCK'S ANOMALOUS SKY

Overall, the information extracted from Planck's new map provides an excellent confirmation of the standard model of cosmology at an unprecedented accuracy, setting a new benchmark in our manifest of the contents of the Universe.
But because precision of Planck's map is so high, it also made it possible to reveal some peculiar unexplained features that may well require new physics to be understood.

"The extraordinary quality of Planck's portrait of the infant Universe allows us to peel back its layers to the very foundations, revealing that our blueprint of the cosmos is far from complete. Such discoveries were made possible by the unique technologies developed for that purpose by European industry," says Jean-Jacques Dordain, ESA's Director General.

"Since the release of Planck's first all-sky image in 2010, we have been carefully extracting and analysing all of the foreground emissions that lie between us and the Universe's first light, revealing the cosmic microwave background in the greatest detail yet," adds George Efstathiou of the University of Cambridge, UK.

... THIS LIGHT TODAY HAS BEEN STRETCHED OUT TO MICROWAVE WAVELENGTHS, EQUIVALENT TO A TEMPERATURE OF JUST 2.7 DEGREES ABOVE ABSOLUTE ZERO.

One of the most surprising findings is that the fluctuations in the CMB temperatures at large angular scales do not match those predicted by the standard model – their signals are not as strong as expected from the smaller scale structure revealed by Planck.

ASYMMETRY AND COLD SPOT

Another is an asymmetry in the average temperatures on opposite hemispheres of the sky. This runs counter to the prediction made by the standard model that the Universe should be broadly similar in any direction we look.

Furthermore, a cold spot extends over a patch of sky that is much larger than expected.

The asymmetry and the cold spot had already been hinted at with Planck's predecessor, NASA's WMAP mission, but were largely ignored because of lingering doubts about their cosmic origin.

"The fact that Planck has made such a significant detection of these anomalies erases any doubts about their reality; it can no longer be said that they are artefacts of the measurements. They are real and we have to look for a credible explanation," says Paolo Natoli of the University of Ferrara, Italy.

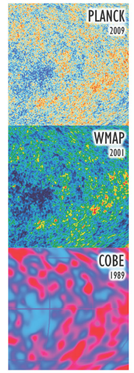
"Imagine investigating the foundations of a house and finding that parts of them are weak. You might not know whether the weaknesses will eventually topple the house, but you'd probably start looking for ways to reinforce it pretty quickly all the same," adds François Bouchet of the Institut d'Astrophysique de Paris.

One way to explain the anomalies is to propose that the Universe is in fact not the same in all directions on a larger scale than we can observe. In this scenario, the light rays from the CMB may have taken a more complicated route through the Universe than previously understood, resulting in some of the unusual patterns observed today.

"Our ultimate goal would be to construct a new model that predicts the anomalies and links them together. But these are early days; so far, we don't know whether this is possible and what type of new physics might be needed. And that's exciting," says Professor Efstathiou.

NEW COSMIC RECIPE

Beyond the anomalies, however, the Planck data conform spectacularly well to the expectations of a rather simple model of the Universe, allowing scien-



Above: Planck's map of the cosmic microwave background compared to maps from previous missions- note the increase in detail. The temperatures shown are a few degrees above absolute zero within a range of several hundred microKelvin.

(Credit: NASA/ESA)

Engineering Advancements 2013 two-page spread

Two-page spread of a fictitious science magazine I created for a class. I picked the article because of my interest in cosmology. If you want to read the whole thing you can visit the source:

http://www.esa.int/Our_Activities/Space_Science/Planck/Planck_reveals_an_almost_perfect_Universe

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