The Arctic Experience

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Abstract

This thesis documents the academic year progress of researching building in the Arctic Circle, household material study in garments, building facade materials, and Arctic experiences with northern lights.

The final project is a design proposal ‘The Arctic Experience’ - a full service experience for visitors to have a place to learn about the Arctic Circle and a chance to view the northern lights. The project developed through light and shadow studies, hand drawings, massing models, and design iterations. Each iteration presented challenges to question in the subsequent iteration. Designing a project to be site specific in the Arctic proved to be the main challenge when moving forward with each iteration. Site specific meaning that the design project should take into account the local climate, previous design strategies, local building materials, and other site analyses.

Abstract - General

This document contains thesis iterations and research from the fall and spring academic semesters. The fall semester was research and material study heavy, while the spring semester's project development led to the final design iterations.

The fall was spent researching the Arctic Circle, building construction in that zone, and the Aurora Borealis. Then there was a brief shift in ideas - moving toward material study and garment architecture - taking household items and seeing how they can be re-formed. By the end of the thesis, material on building facades was studied and then later, a development for the Arctic was proposed.

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About The Arctic

About the Arctic Circle

The polar circles are located close to the poles of the Earth at 66.5 degrees north and south latitude. In this thesis, the north latitude, also known as the Arctic (Polar) Circle is being explored. There are eight Countries located in Arctic Circle: USA, Canada, Russia, Greenland, Iceland, Norway, Sweden, and Finland. The Arctic Circle is noted by the presence of a winter solstice where the sun does not break the horizon (24 hours of darkness) and a summer solstice where there is no sun set.

The best building construction materials for a cold climate are brick, stone, concrete, plastic, wood, and metal paneling. These materials are durable and good insulators in extreme climates. Below is a list of the specific details of why each material is desirable in cold climates.

Brick - thermal mass, good insulator
Stone - better quality than brick, more expensive, rough cut hold heat better
Concrete - withstand extreme conditions, not the most pretty material
Plastic - low thermal conductivity
Wood - framing with wood helps insulate, finishes help protect from harsh climate
Metal - steel is resistant to rust/corrosion, protects from elements

Building Conditions in the Arctic

Designing for this specific area it is important to keep in mind that the Arctic is known for harsh winds, snow, rain, freezing fog, and months of darkness. Material transportation is very limited in the winter due to freezing ice/roads and long dark winters. Easy design proposals with a short construction time is beneficial.

Building in the arctic is very limited and controversial. With climate change, animal and vegetation land, largely untouched by economical development, it is important to understand large disruption to the land will not be approved by local authority.

Rovaniemi, Finland

Latitude: 66°N, located on the Arctic Circle

Capital of Lapland

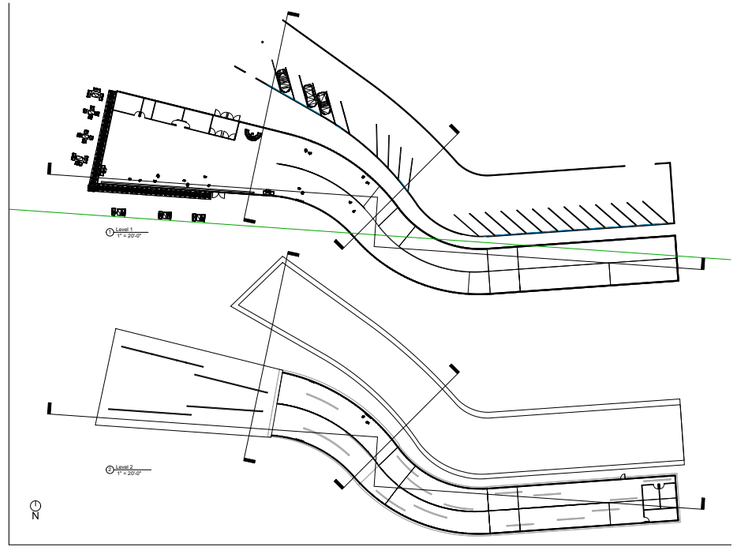
Polar Night - a phenomenon in which the sun does not rise above the horizon for at least 24 hours. In the northern most and southern most areas on earth, Polar Night can last for over 3 months. The reverse happens during the summer, where the sun does not pass below the horizon for 24 hours.

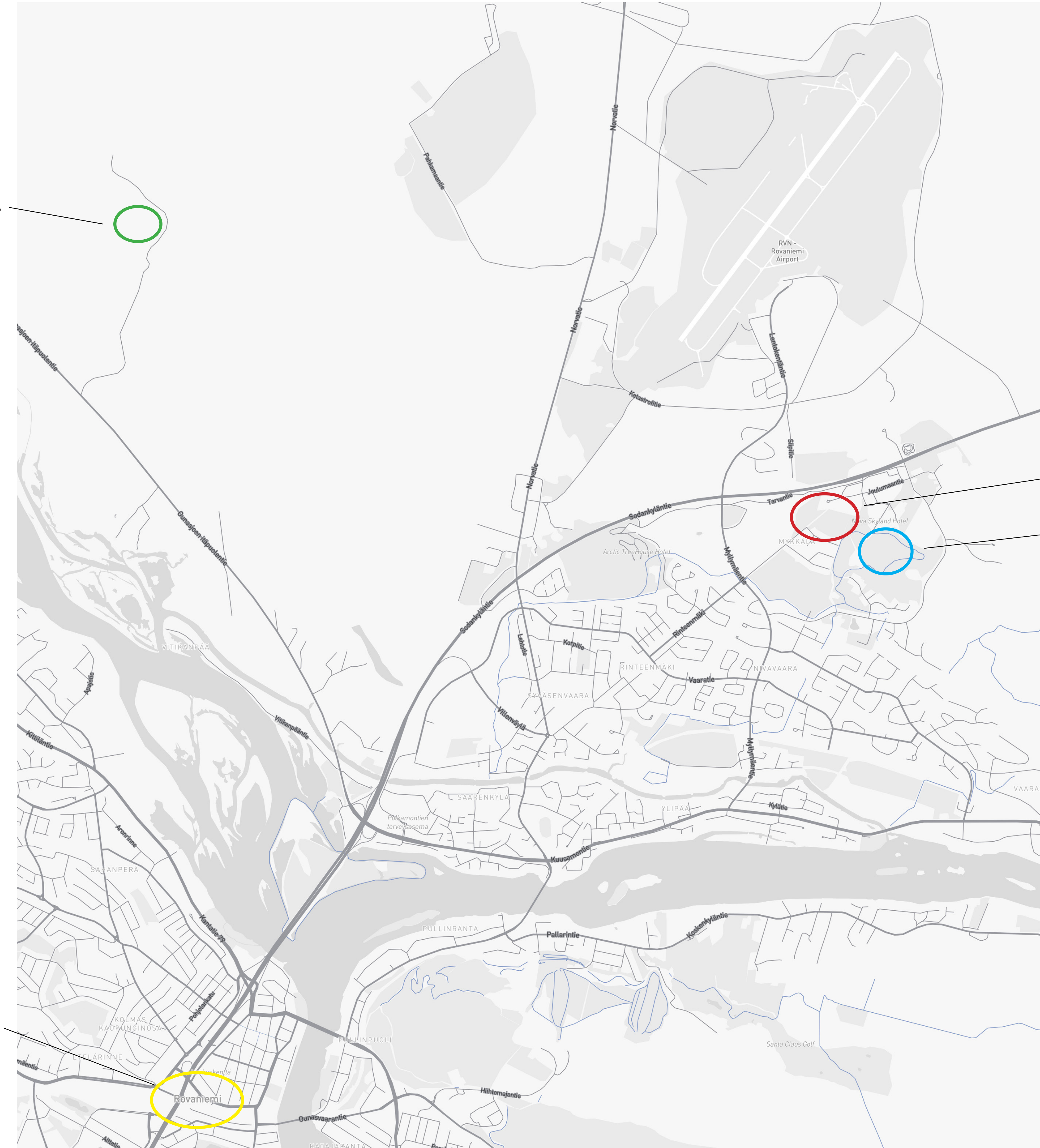
Polar Night is important to note because the final design is a building to view the northern lights - another phenomenon that can be seen in Rovaniemi roughly 200 nights a year. With there being little daylight, it is important to remember that the building will need to have minimal artificial lighting during the winter, but it's important that it does not interrupt the viewing of the northern lights outside of the building.

In Rovaniemi the average summer temperature is 59° while the average winter temperature is 10° F.

In Rovaniemi there is 20" to 30" of precipitation per year.

Important facts about Rovaniemi:
- Official home of Santa Claus
- 90% destroyed during WWII
- Already a national museum and science center for the Arctic history
- Great location to view northern lights

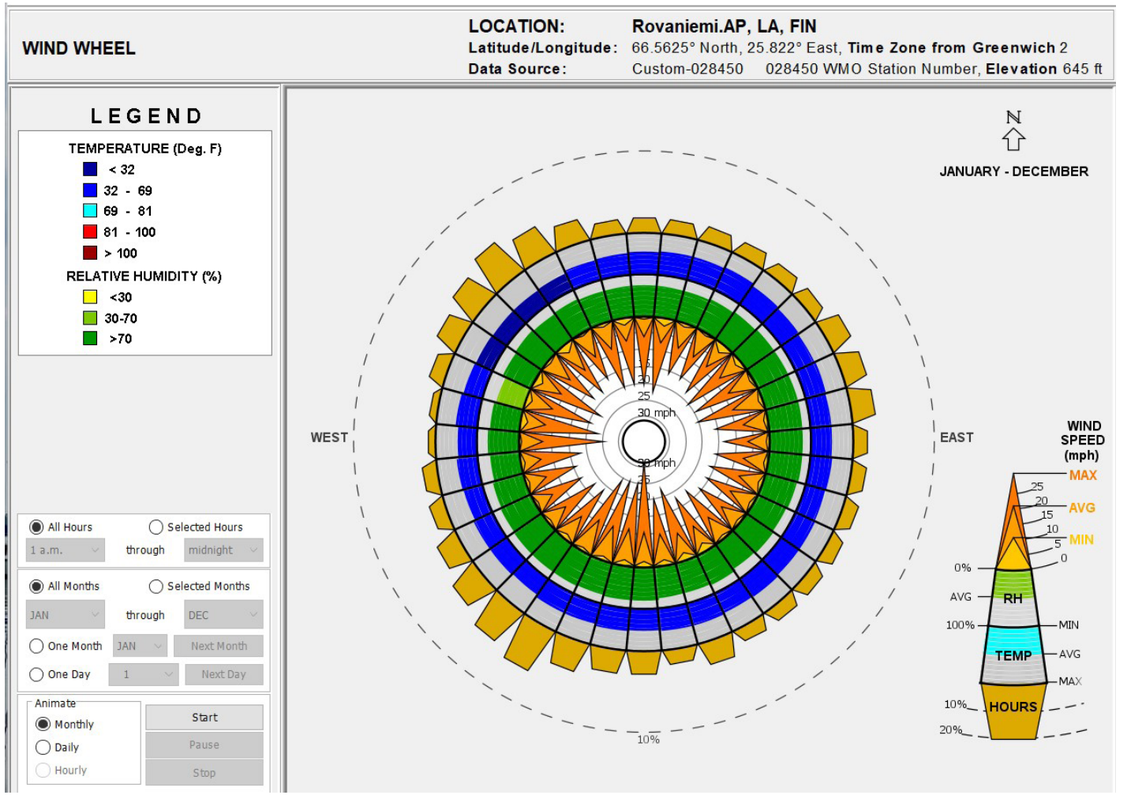



Site - Design Iteration 3
Santa Clause Village
Site - Design Iterations 1 and 2
Rovaniemi City Center
RVN - Rovaniemi Airport
Rovaniemi
Sodankyläntie
Kuusamontie
Pallarintie
Ounasvaarantie
Hiihtomajantie
Norvatie
Mylläjyväntie
Vaaratie
Rinteenmäki
Joulumaantie
Tarvantie
RINTEENMÄKI
SAARENKYLÄ
POLLINRANTA
YLIPAA
VAARALA
Santa Claus Golf

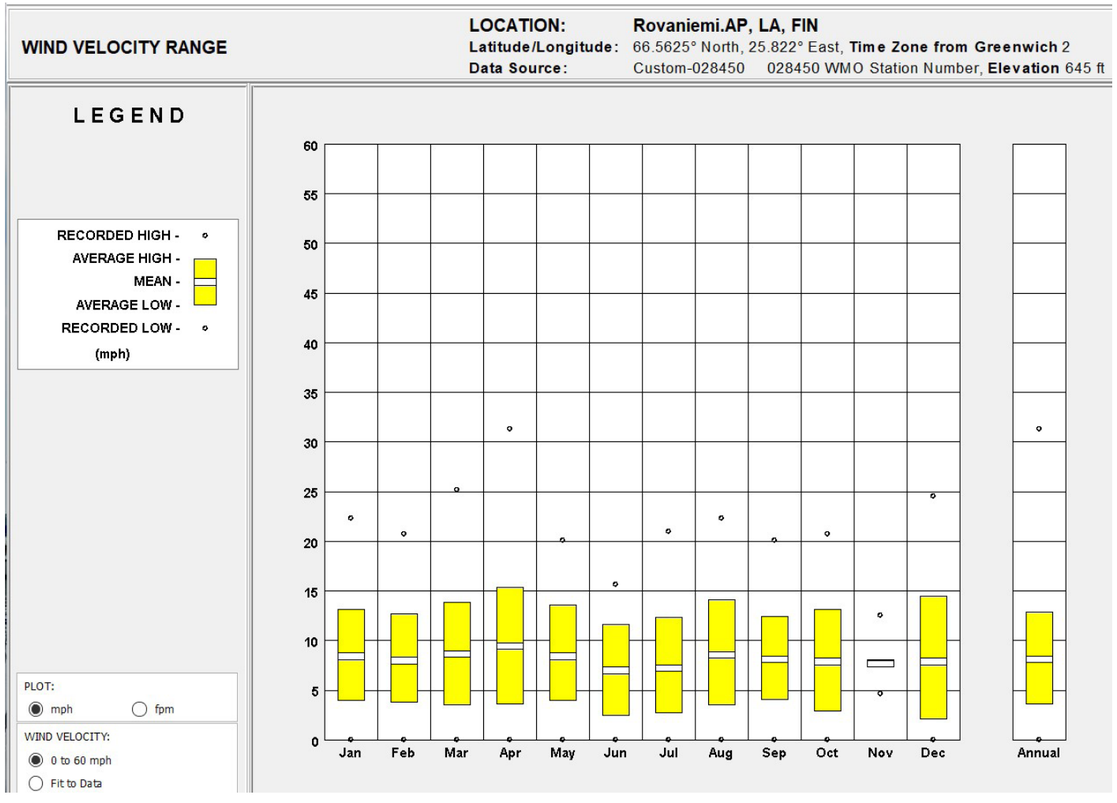
02. The official home of Santa and his village is located just minutes north of Rovaniemi. It is one of the main tourist attractions in Lapland year round.

03 Reindeer rides in Lapland

04. On average, Rovaniemi experiences 200 Aurora Borealis nights per year.



Software - Climate Consultant



Software - Climate Consultant

The wind rose chart shows that the strongest wind speeds come from the south and west in Rovaniemi, FI. Wind speeds can get up to 30 mph. During the design phase this information was taken into consideration. The building or site vegetation should block the wind from the south and west, or use this wind in a beneficial way on site. In April, the wind is the strongest on average at 10 mph according to the wind velocity chart. The winter months have lower wind speeds compared to other seasons, which is important because the final design is for guests who will experience the Arctic in the winter.

Precedent

Arctic Museum of Modern Art
Norilsk, Russia

“Covered city square”
Moving outdoor space inside due to arctic cold
Careful choosing of materials (to show structure)
Decorative plaster ‘fur coat’ that protects against weather
Brightly lit greenery inside of windows
Tinted metal lamellas

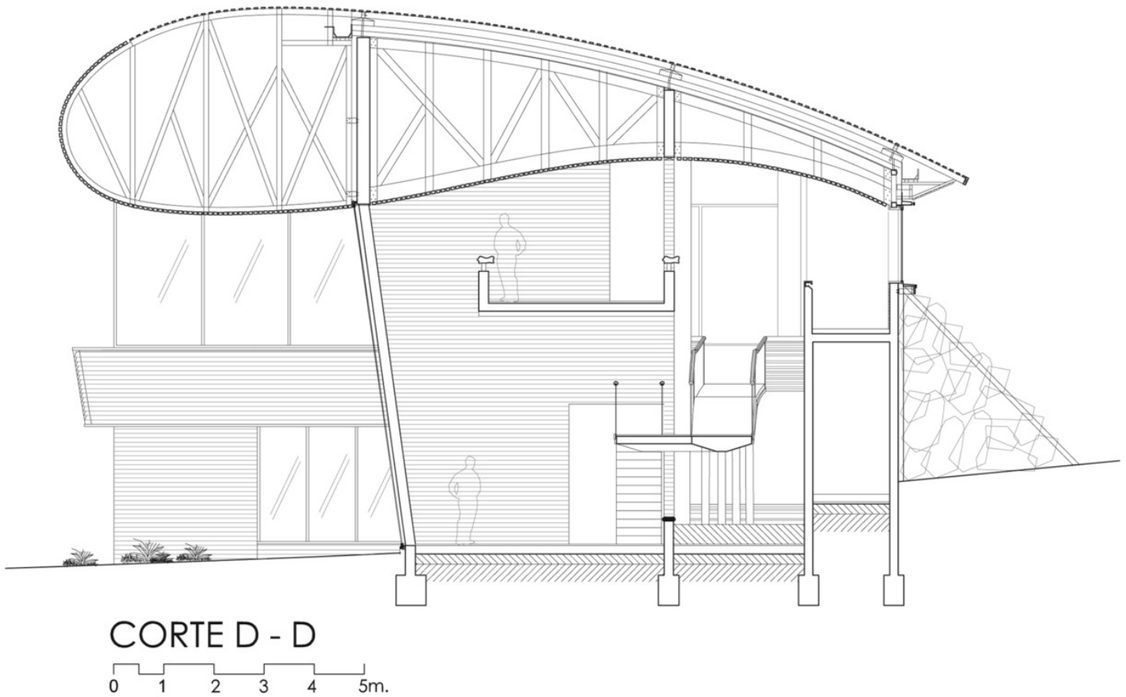
05

06

This precedent was used to study the benefits of artificial lighting when there is limited number of daylit days. This building is in the Arctic, and with snow cover most of the year it was important for the Architects to incorporate an interior green scape for people to experience. The Architects also used metal lamellas to light up the building during long nights, as a sense of direction for the community. This precedent shows that through simple, and only a few materials, creating a space internally as an escape from the harsh elements is possible, and a necessity in these locations.

Hotel Tierra Patagonia
Cazú Zegers
Chile

Building skin acts as an extension of the landscape surrounding.
Building form comes from the challenge of working with the wind.



07

08

This precedent was used to understand how the site informs the architecture. When designing a project for the specific Arctic location (and not anywhere in the world) became a challenge, this precedent was revisited often to study how the wind on the site informed the design of the form and specifically the roof structure.

The Wale
Norway

Roof covered with stone similar to coastline, that will patina with age.
Minimal and local materials - stone, wood, concrete.

09

10

This precedent was used to understand how the site and its inhabitants inform the architecture. When designing a project for the specific Arctic location (and not anywhere in the world) became a challenge, this precedent was revisited often to study how the Architects used the history of whales and the site location to inform the building design and specific materials chosen.

Kakslauttanen Arctic Resort
Lapland, Finland

Igloo hotel stay to view the northern lights
Full experience and traditional stay

11

12

These igloos are existing on the site, a few kilometers away from the proposed project site. These were used to show that glass is possible to build with in the Arctic, given the poor of insulation qualities glazing is known for. These are private accommodations for people to experience the Arctic, so more private spaces were not necessary in a new design proposal. A community, public space was the final design proposal for Rovaniemi.

Household materials study

This was a material study using 5 different household materials - vegetable mesh, painter's tarp, quilting fabric, denim, and Kroger shopping bag. The study was to experiment with how fabrics stretched and worked against its own grain when stitched together. A tee shirt design was chosen because it is a simple garment pattern and can be replicated easily. The study was less about the finished design, and more about how the material reacted, pushed, and pulled along with the thread and the sewing machine. The tarp (being thick and easy to manipulate) would be the easiest to cut, fold, and stitch together, however it was the hardest out of all of them to keep steady against the machine. The mesh was hard to manipulate as the holes make it difficult to piece together. This material is hard control in that when it is not stitched together with the right settings it will fall apart. The Kroger bag was easy to cut, stitch, and fold but the thin material made for easy tears. The quilt and denim were easy to cut, stitch, and fold. There wasn't any problem manipulating the material in order to form the design.

Shadow study - Morning

Shadow study - Mid day

Shadow study - Mid day (winter)

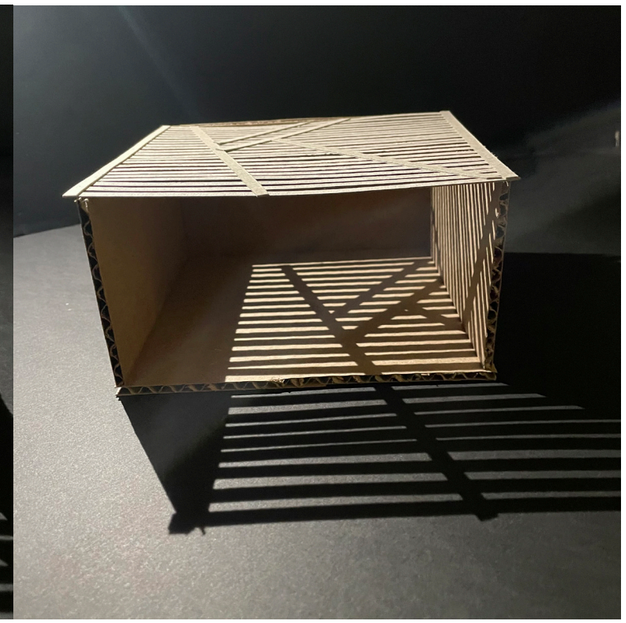
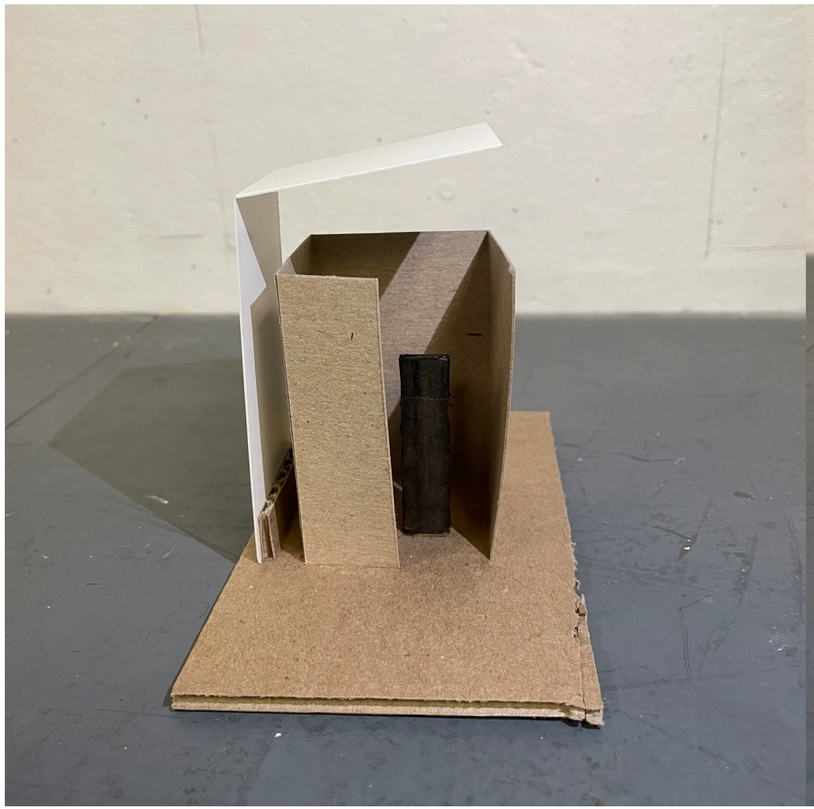


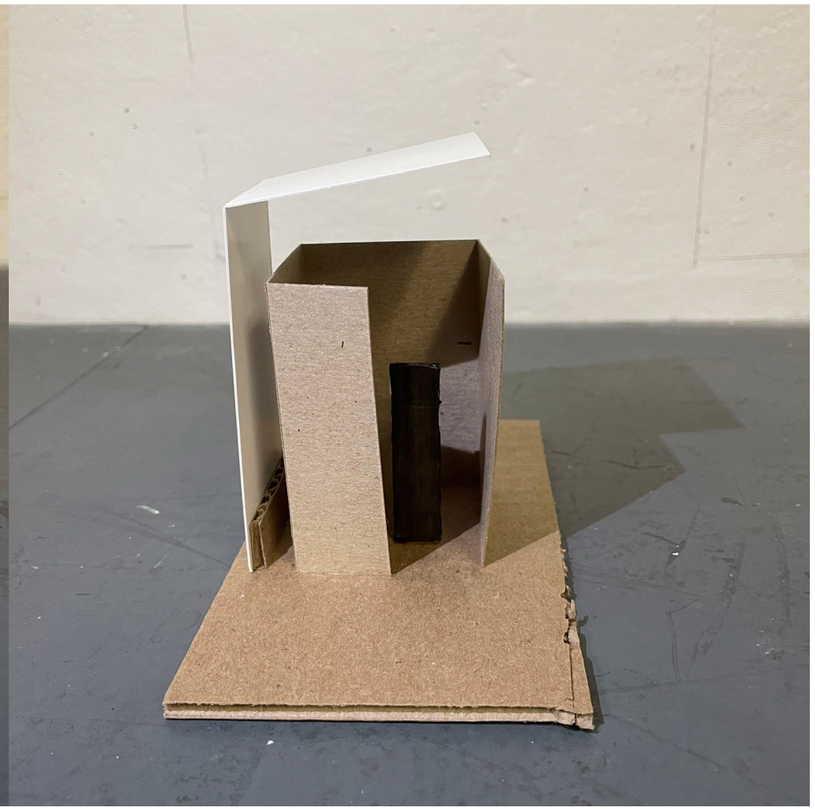
Figure 5: Shadow study - Afternoon

This was a study of the light and shadow patterns being cast throughout a daily sun cycle in the summer and the winter. The exploration looked at the degree of permeability of the surface with a perforated pattern. The evaluation of the resulting light and shadow patterns reveal the challenges to consider with regard to the size, the shape, and density of the perforated slots. Too many or too little perforations and they may impact clear visual queues and safe navigation of the space.



Massing model - morning light

Massing model - noon light



Massing model - afternoon light

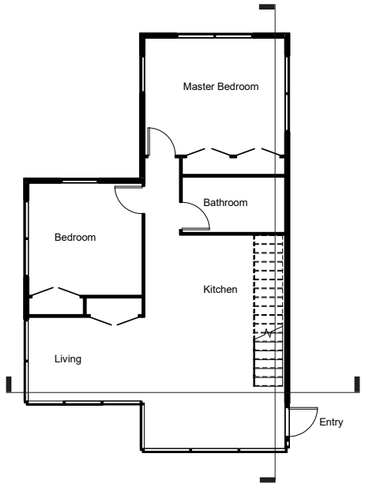
This study elaborated on light and shadow but, instead of perforated panels, it relied on a particular placement of folded planes. The planes define a vertical space, that perceptually changes with the gradual movement of the sun rays throughout the day.

Mini charette - The House massing model

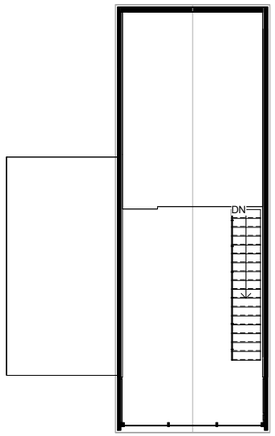
Mini charette - The House massing model

This is a study model for a 2 week charette. There was a strict program and short narrative behind the project to get an understanding of how different materials work with each other.

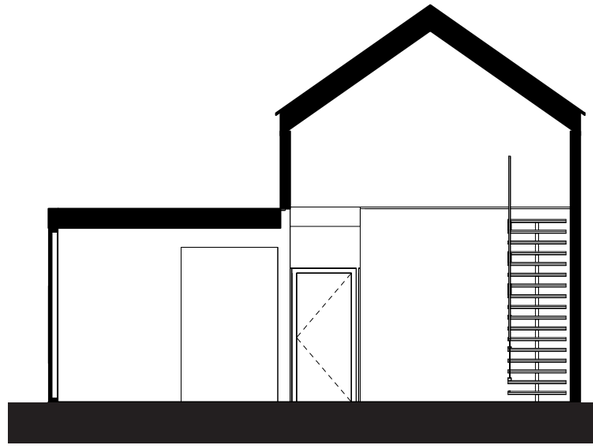
This design is for a man who choses to live in this experiment his whole life. He will come when he is young, and stay all his life. The materials chosen for the faced were intentionally chosen to further study the weathering patterns, recording the passing of time; the aging of both the architecture and its inhabitant.



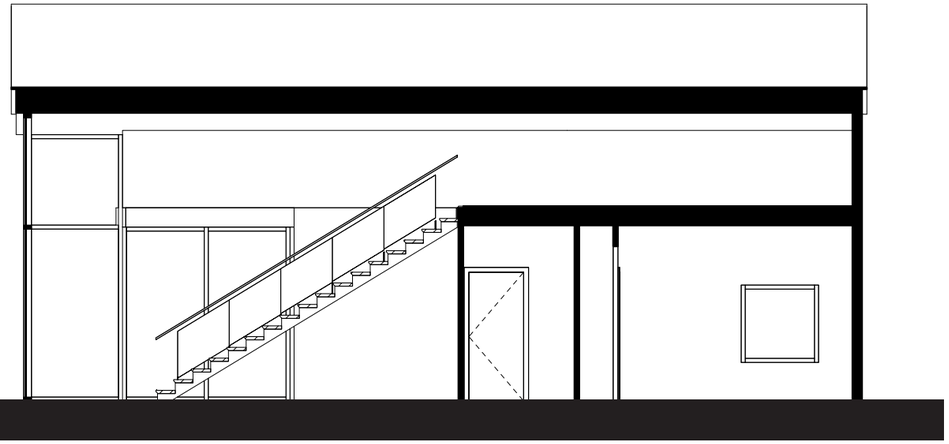
1 Level 1
1/8" = 1'-0"



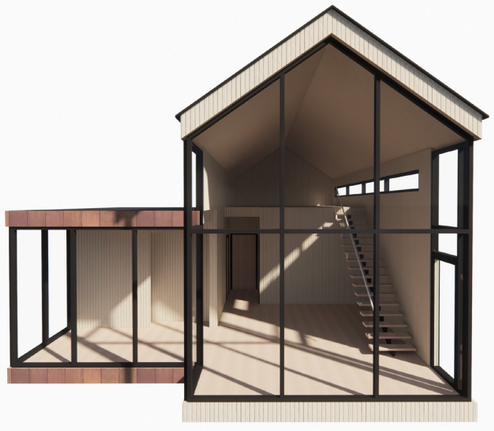
2 Level 2
1/8" = 1'-0"

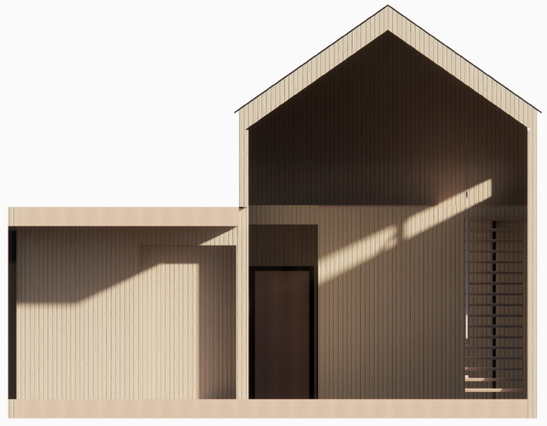


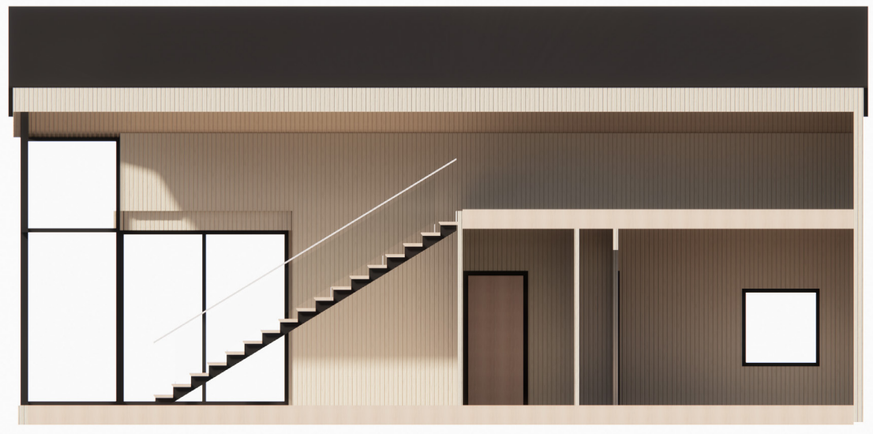
2 Section 1
1/4" = 1'-0"

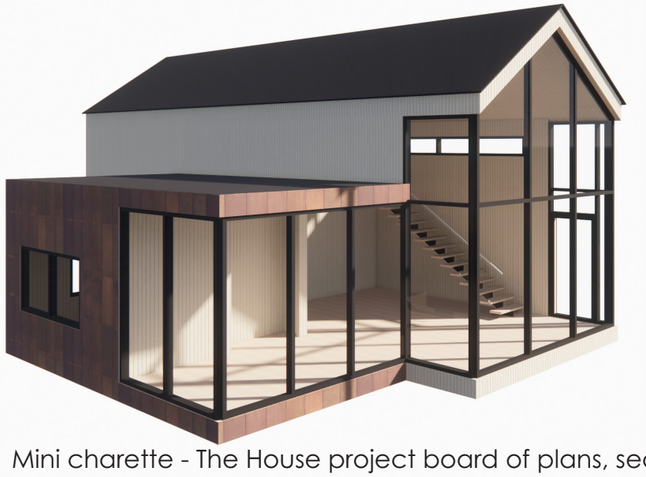


1 Section 2
1/4" = 1'-0"





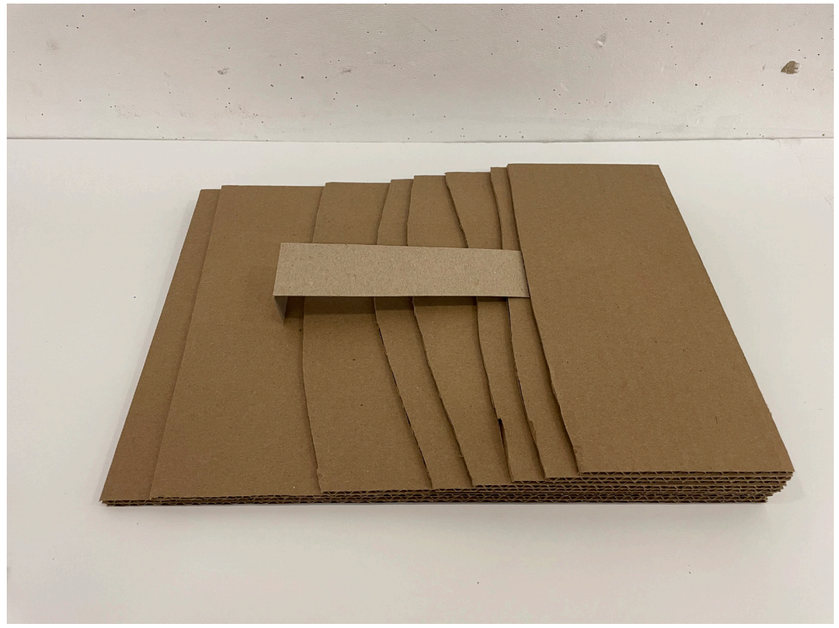




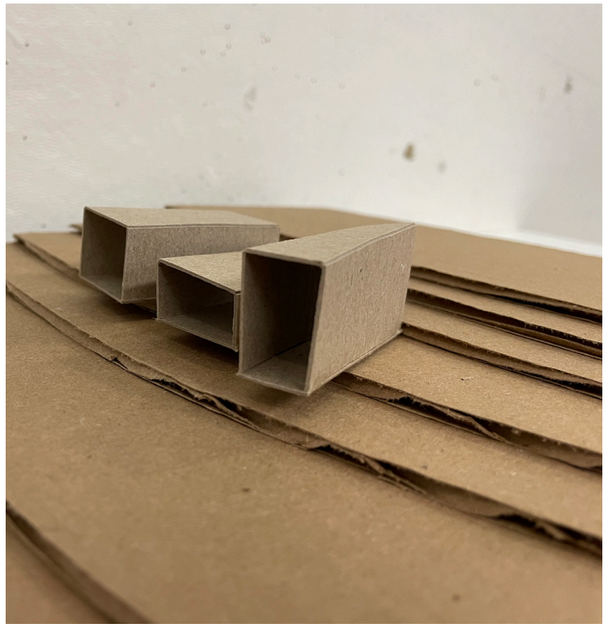
West Elevation
1/4" = 1'0"

East Elevation
1/4" = 1'0"

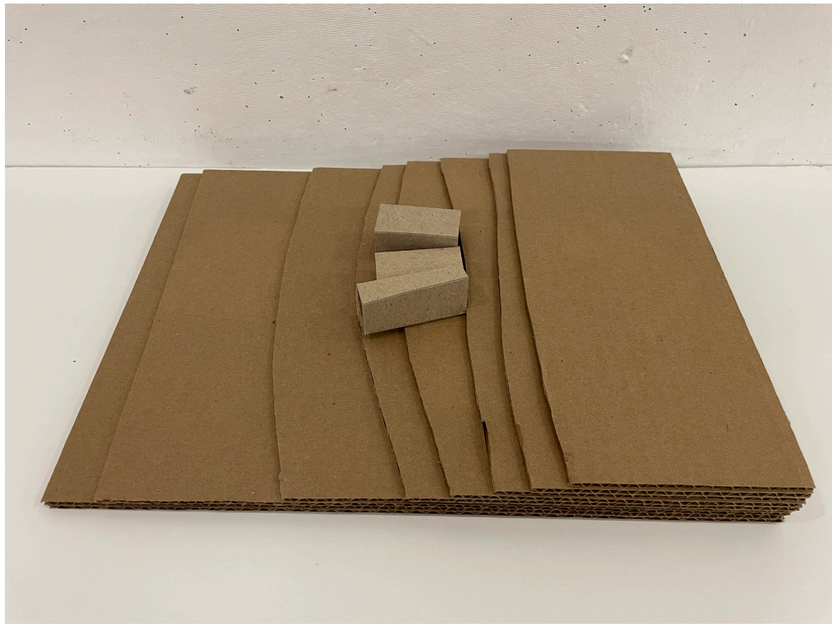
Mini charette - The House project board of plans, sections, perspectives



Massing model 1



Massing model 2 - three volumes - front



Massing model 2 - three volumes

These are preliminary models for iterations going into the final design. Playing with multiple forms to experience the best views, weather patterns on building facades, mold with the terrain, etc.

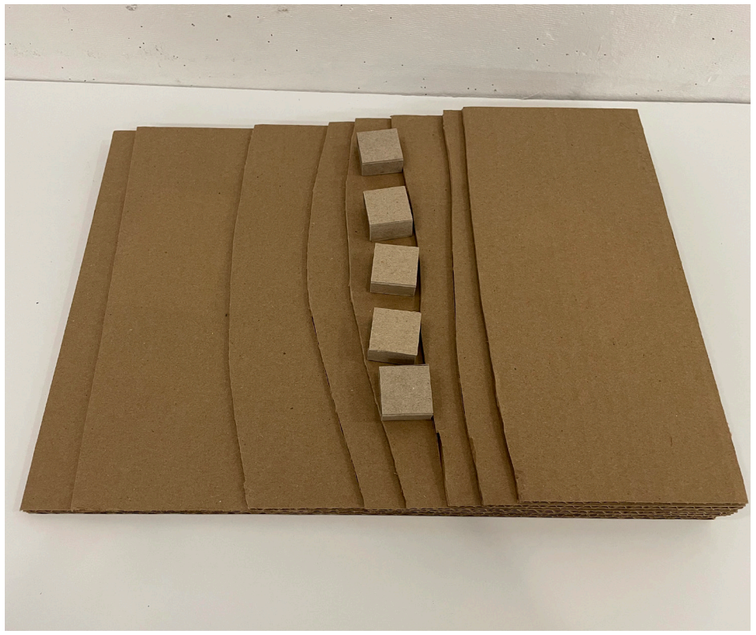


Figure 26: Massing model 3 - five boxes

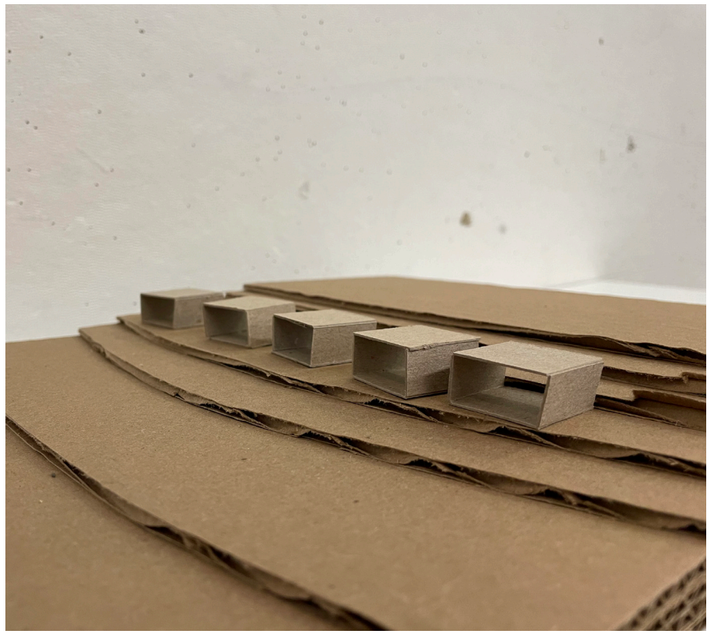


Figure 27: Massing model 3 - five boxes - front

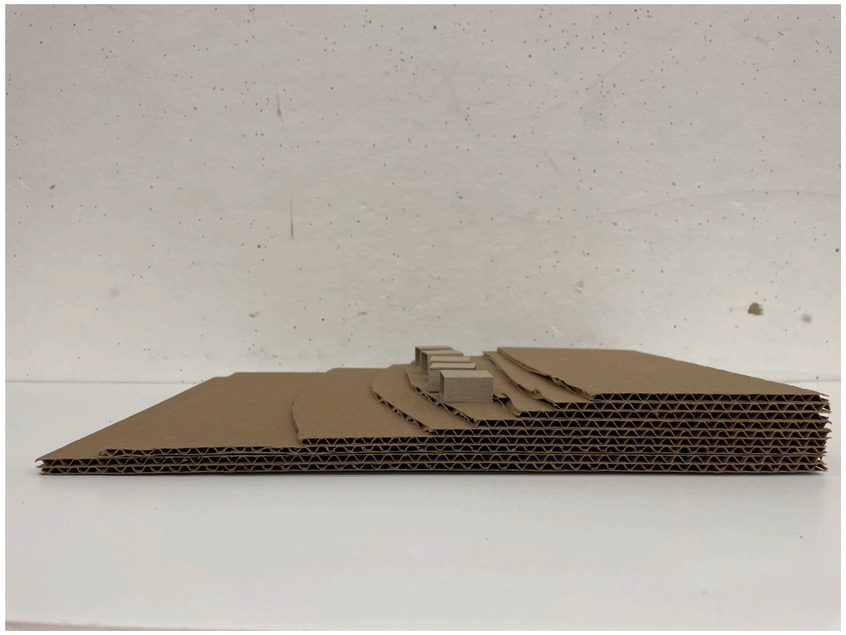
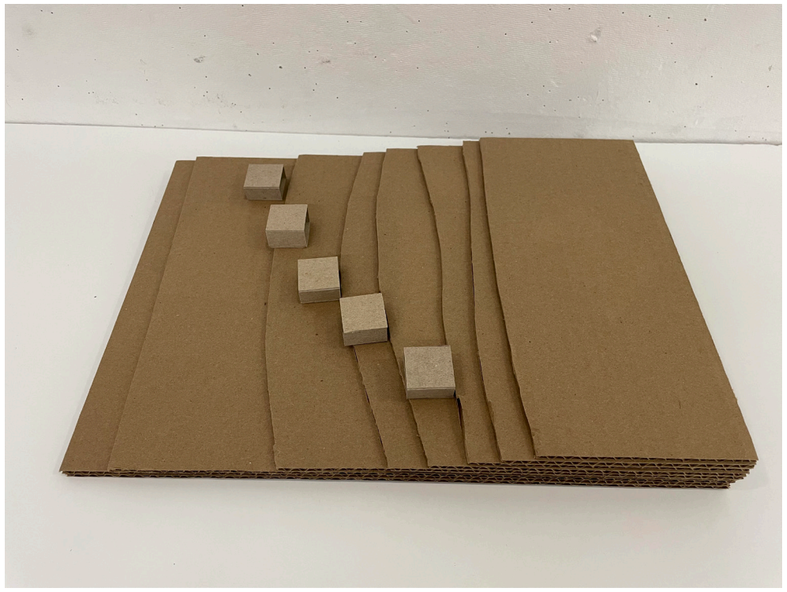
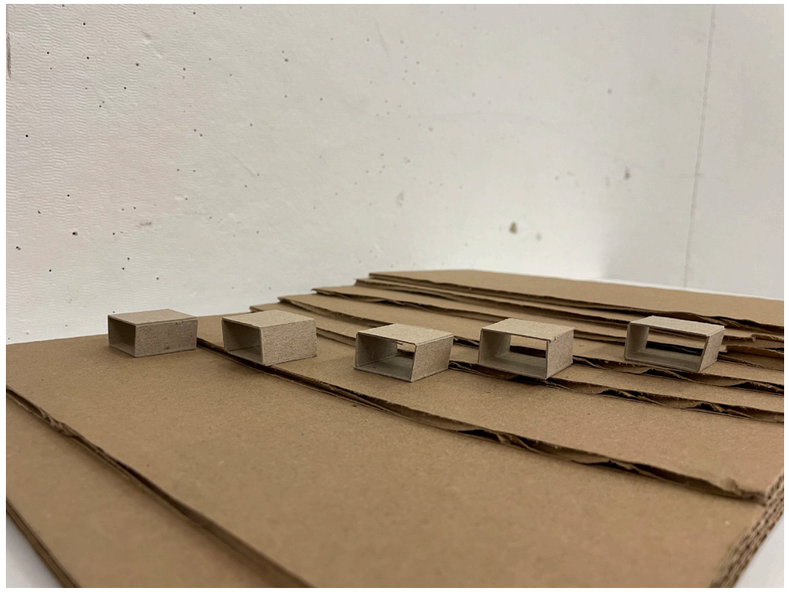


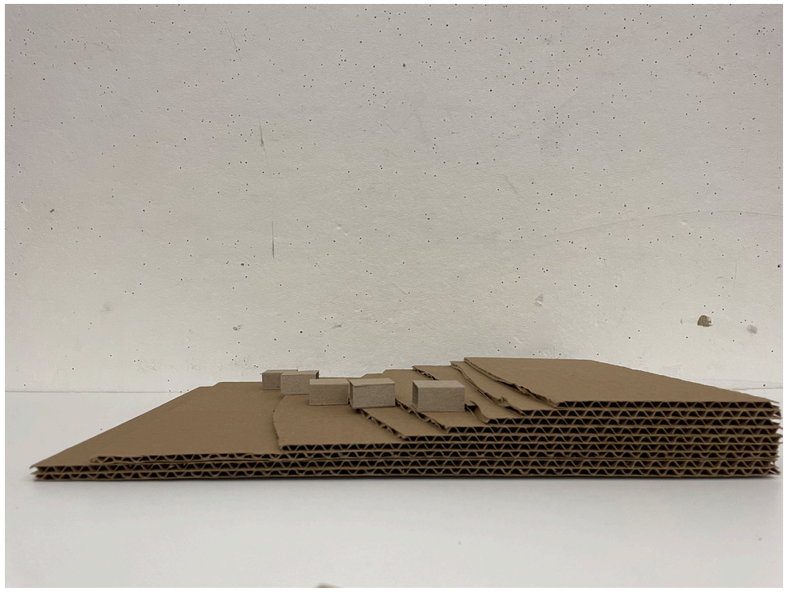
Figure 28: Massing model 3 - five boxes - side



Massing model 4 - five boxes staggered

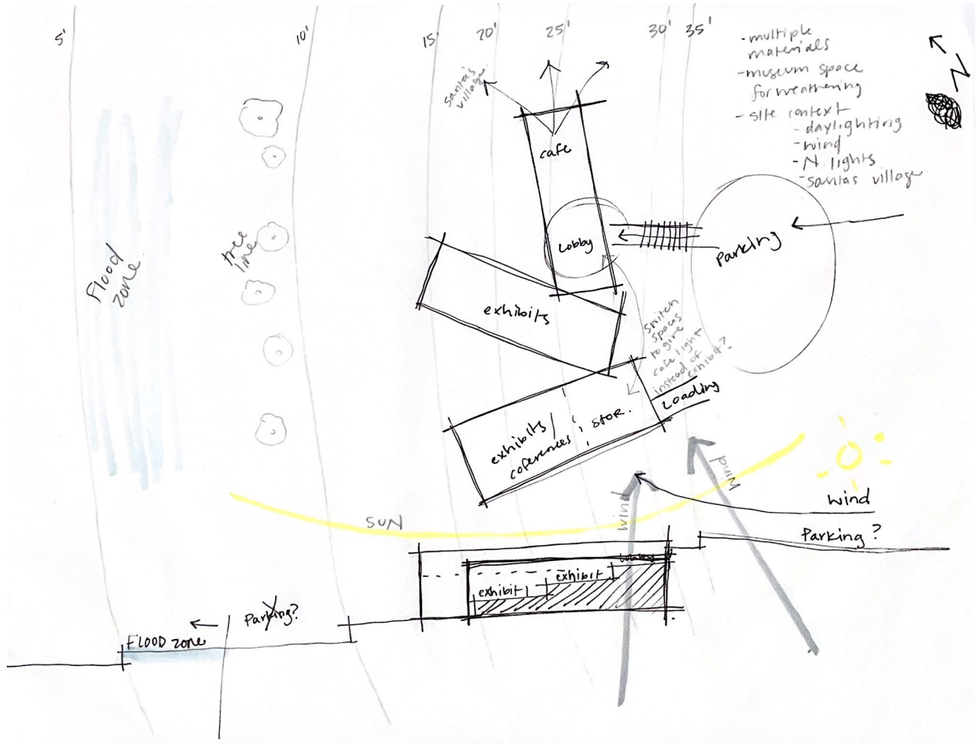


Massing model 4 - five boxes staggered - front

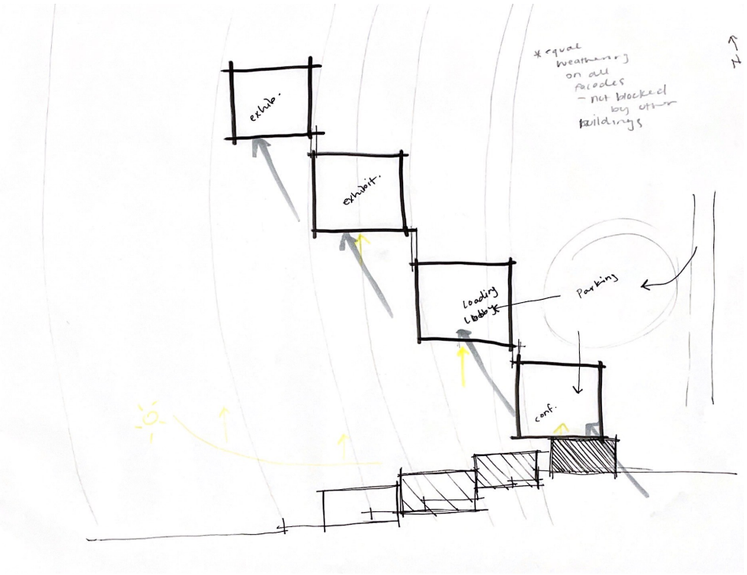


Massing model 4 - five boxes staggered - side

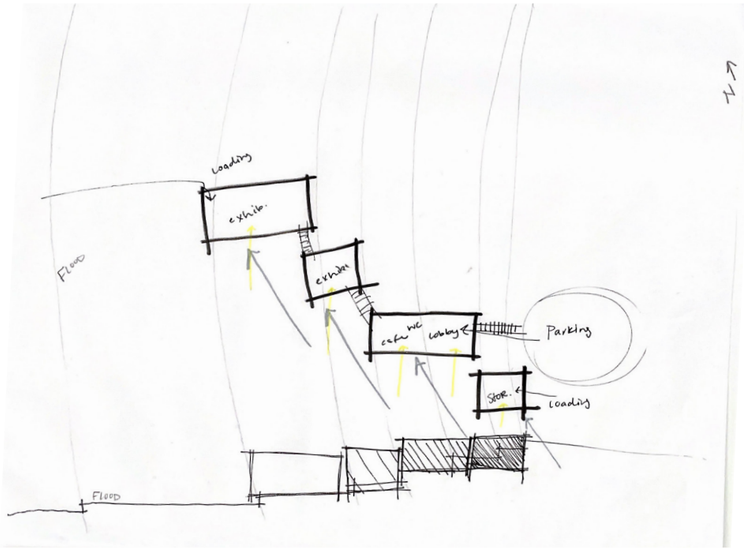
Models 3 and 4 are a similar idea, but in the end, model 4 was stronger in that the cubes are staggered to allow for maximum daylighting, and to ensure no facade is covered by another building to the south.



Massing sketches, similar to model 2

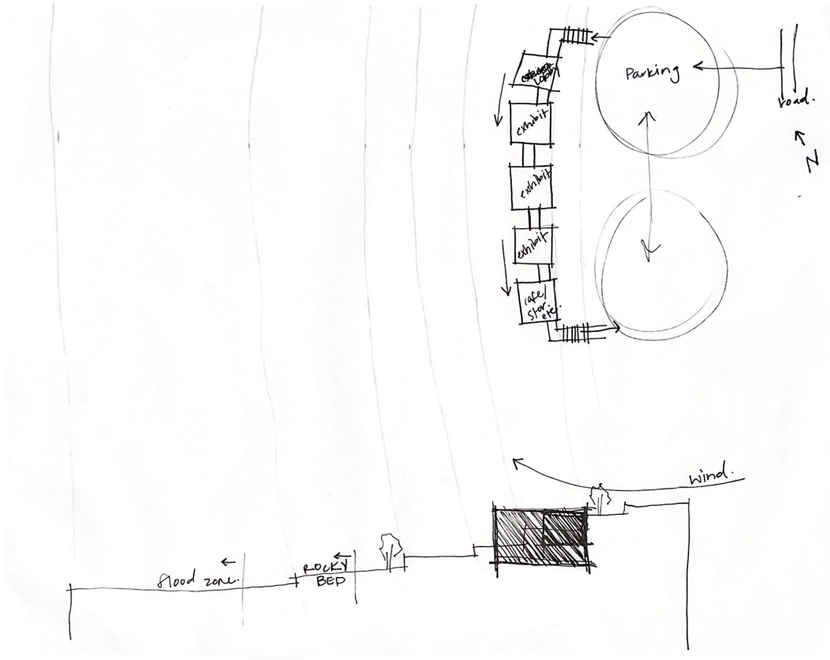


Massing sketches, similar to model 4

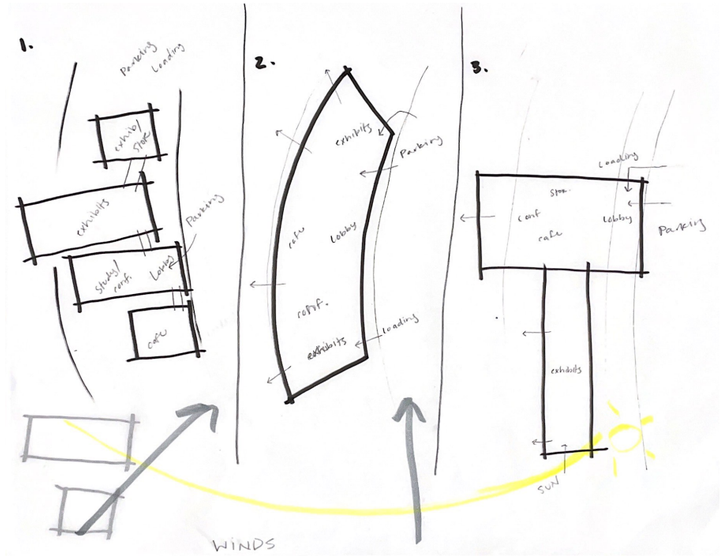


Massing sketches, similar to model 4

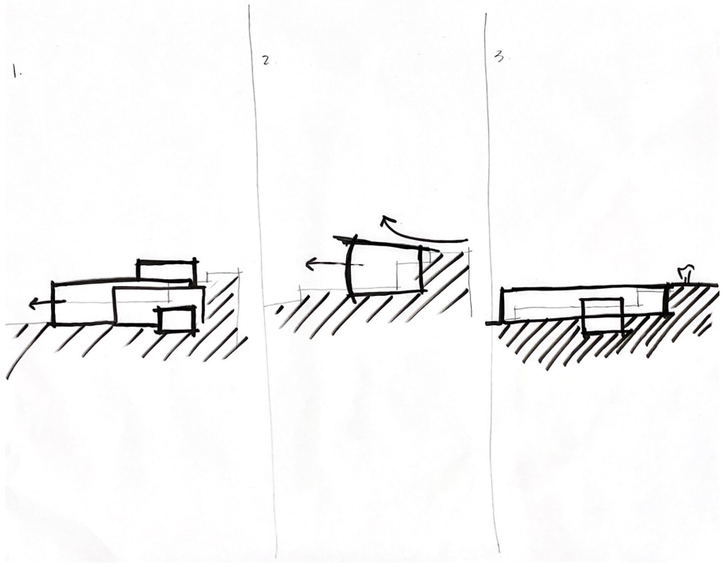
These sketches show the wind and sun direction on the site. These drawings help configure the building orientation and foot print on the site in relation to maximizing daylight penetration, while also blocking high winds on site.



Massing sketches, similar to model 3



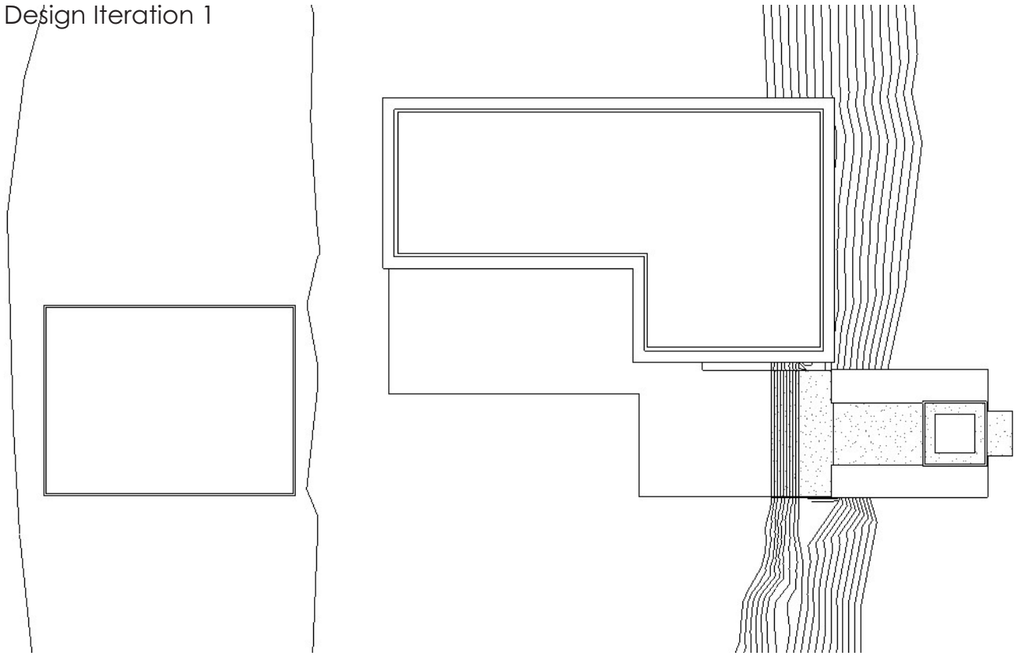
Preliminary massing sketches - plans



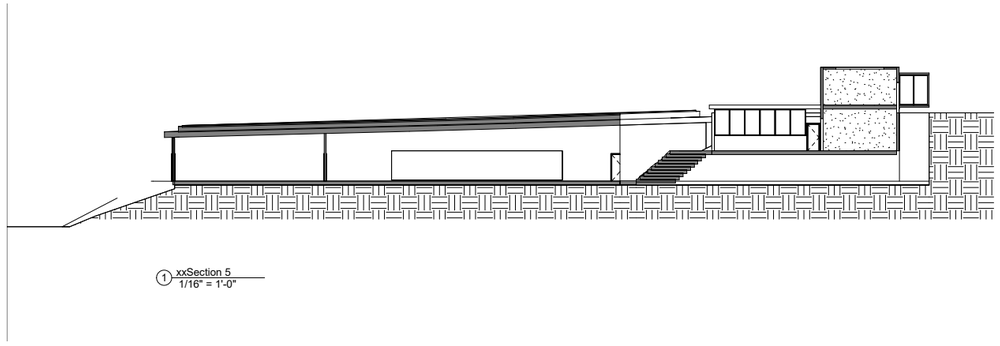
Preliminary massing sketches - sections

These sketches show the wind and sun direction on the site. These drawings help configure the building orientation and foot print on the site in relation to maximizing daylight penetration, while also blocking high winds on site.

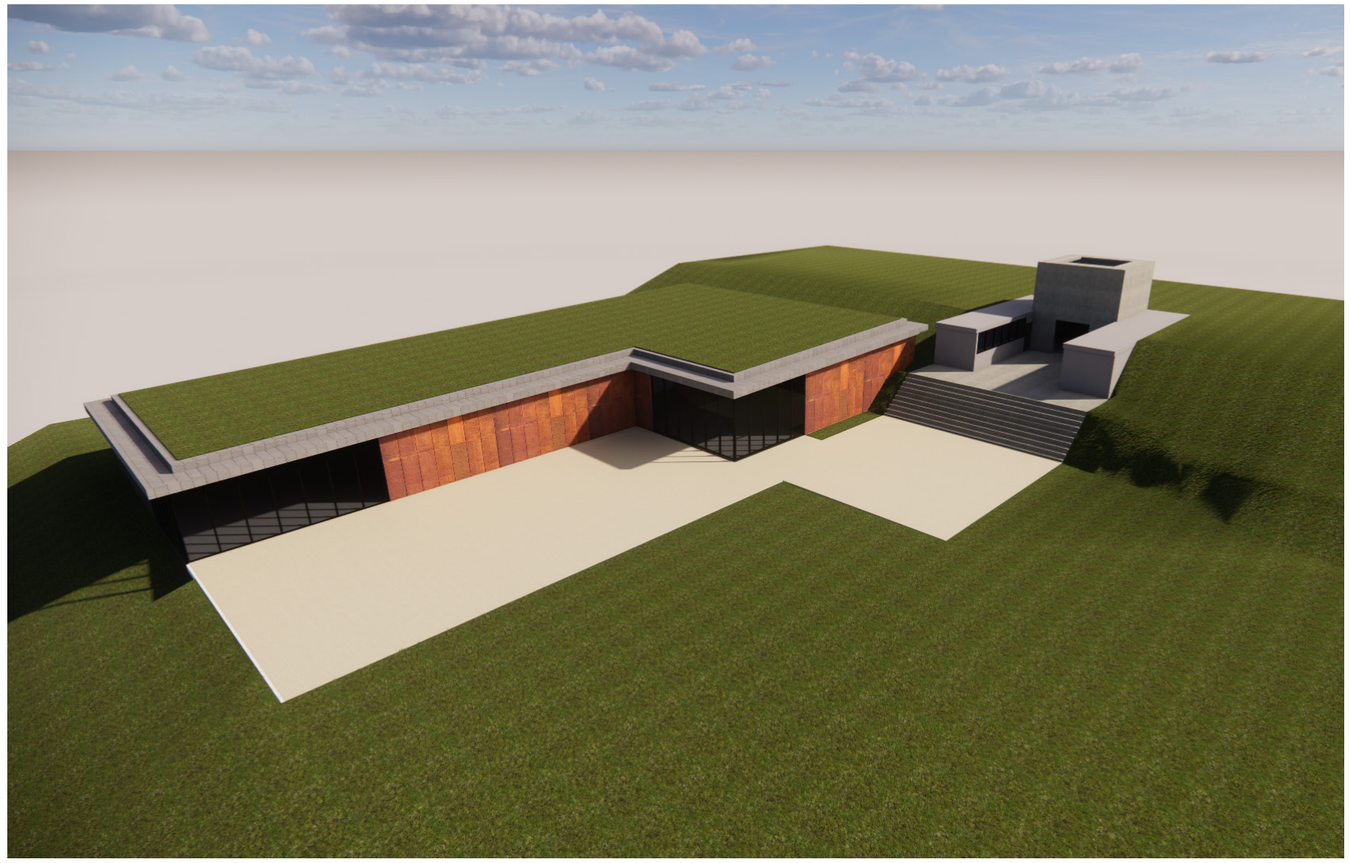
Design Iteration 1



Design iteration 1 - site plan (not to scale)



Design iteration 1 - section (not to scale)

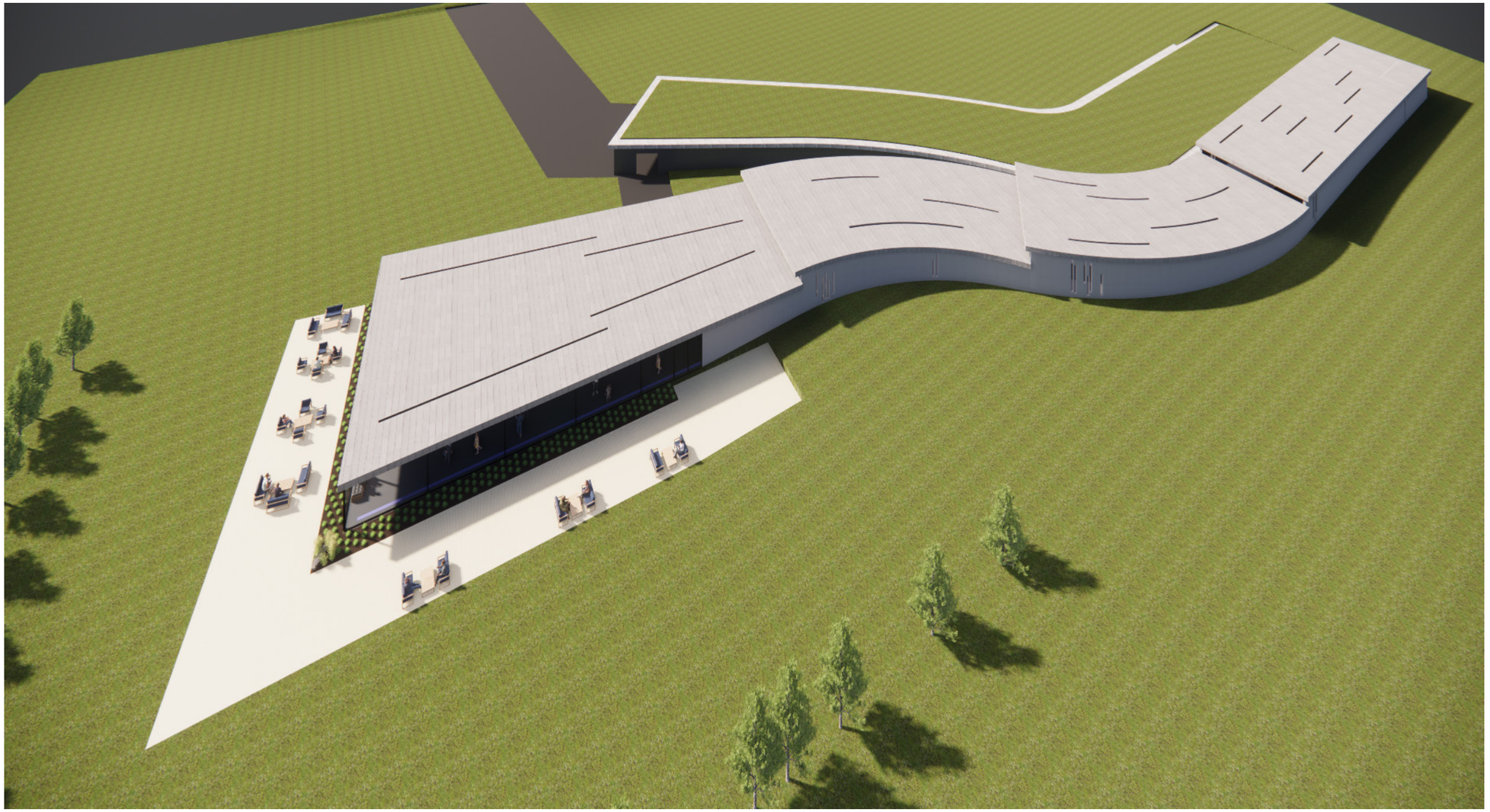


Design iteration 1 - exterior perspective render

Iteration 1 was a museum to explore the arctic as well as show weathering on the facades.

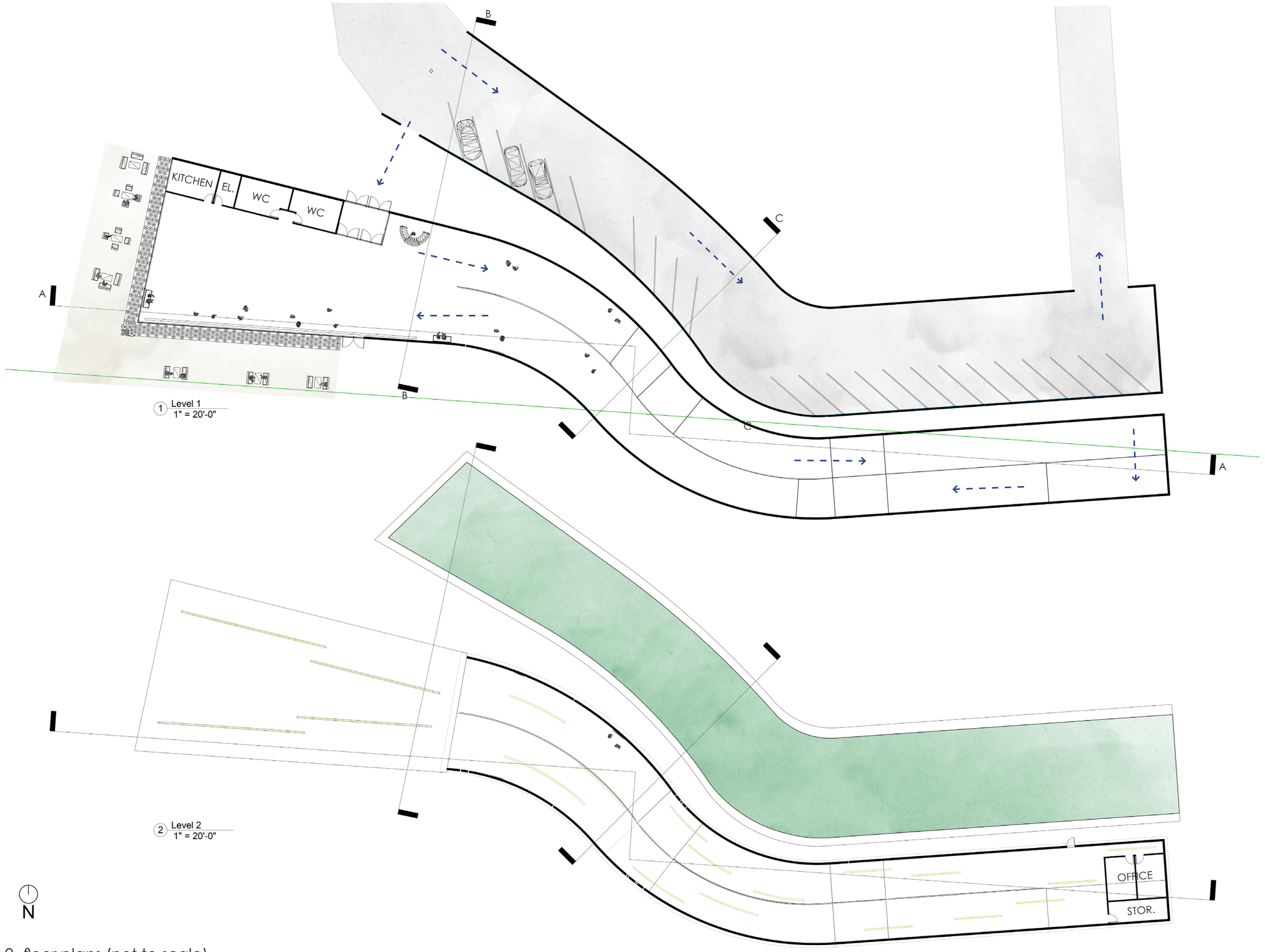
The challenges of this iteration were that there were too many ideas being brought together for one design. The decision moving forward was to focus on the Arctic as the main topic and move away from including weathering of materials. It is difficult to include weathering of materials without doing experiments on the materials - and the required experiments would take more time than given to complete. Other comments about the building were that there is not a specific design element that proves this building is designed for a site in the Arctic. This building could be placed anywhere. The main focus points for starting iteration 2 are to make a building fit within the site context and focus on the Arctic and northern lights.

Design Iteration 2

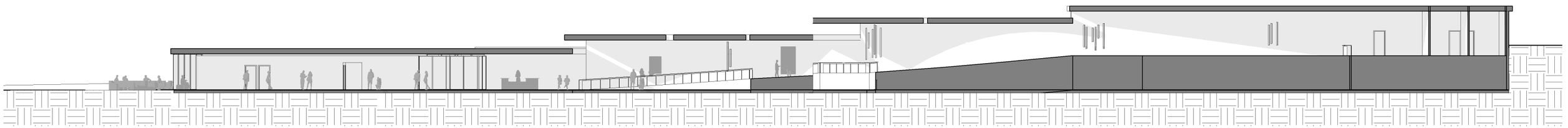


Design Iteration 2 is a Community Center and Arctic Museum that will display local art and host events. There is a main floor that can be blocked off from the rest of the ramping museum hall. The form of the building resembles the a sliver of the Aurora Borealis with panels of colored glass along the facades and roof of the structure.

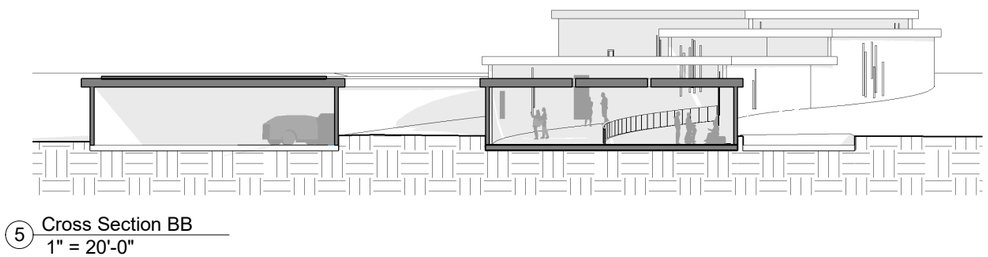
Reflection: This building is meant to be a welcome center to both tourists and the local community while providing a history of the arctic and a view of the northern lights. This design proposal did not offer a quality view of the sky through the roof in order to view the northern lights. This building was not site specific as there was limited detail in the design to show that this would be a building located on the arctic circle.



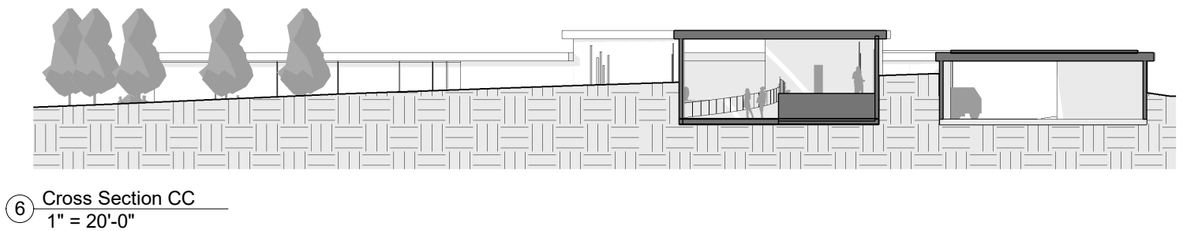
Design iteration 2 -floor plans (not to scale)



7 Long Section AA
1" = 20'-0"

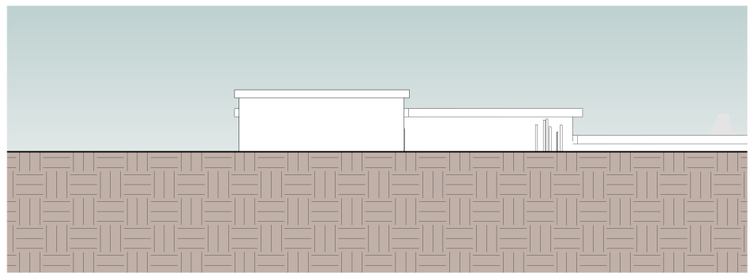


5 Cross Section BB
1" = 20'-0"

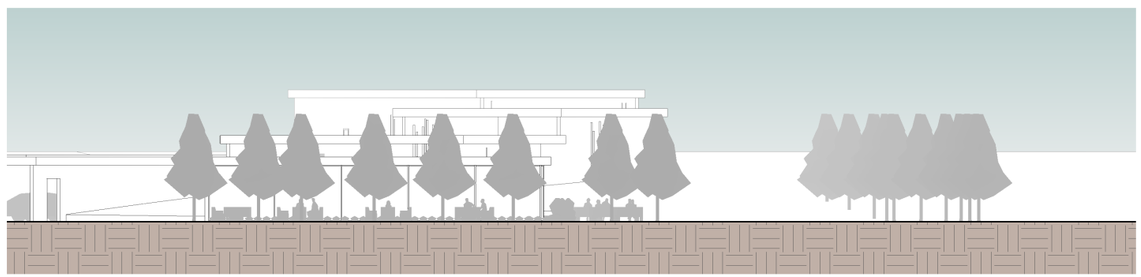


6 Cross Section CC
1" = 20'-0"

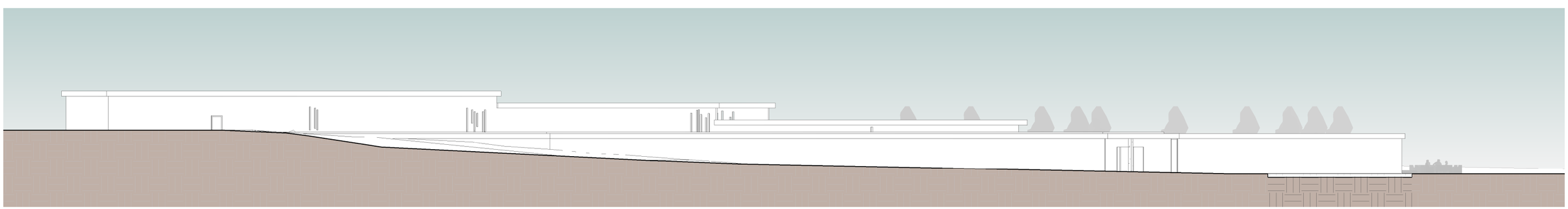
Design iteration 2 - Sections (not to scale)



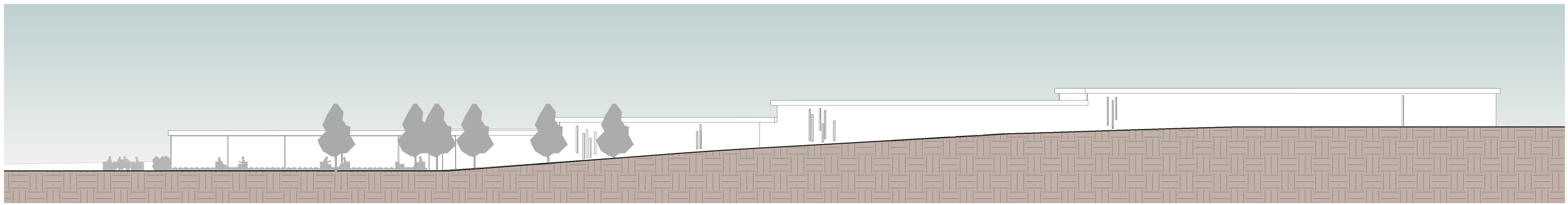
1 East
1" = 20'-0"



4 West
1" = 20'-0"

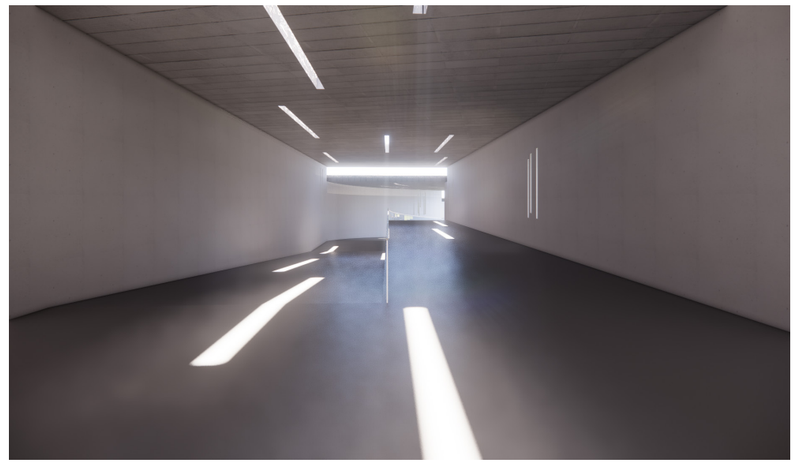


2 North
1" = 20'-0"



3 South
1" = 20'-0"

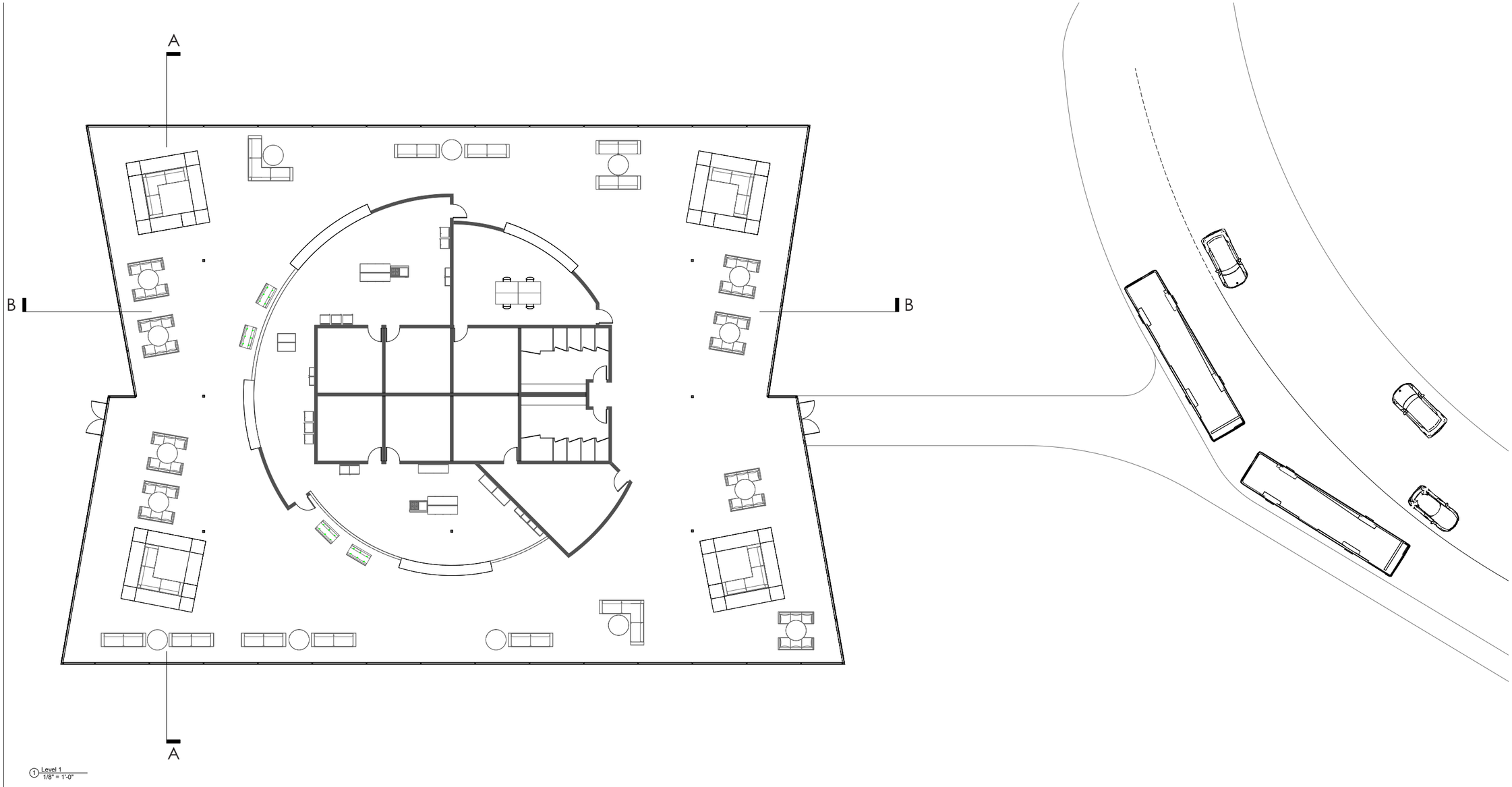
Design iteration 2 - elevations (not to scale)



Design iteration 2 - perspective renders

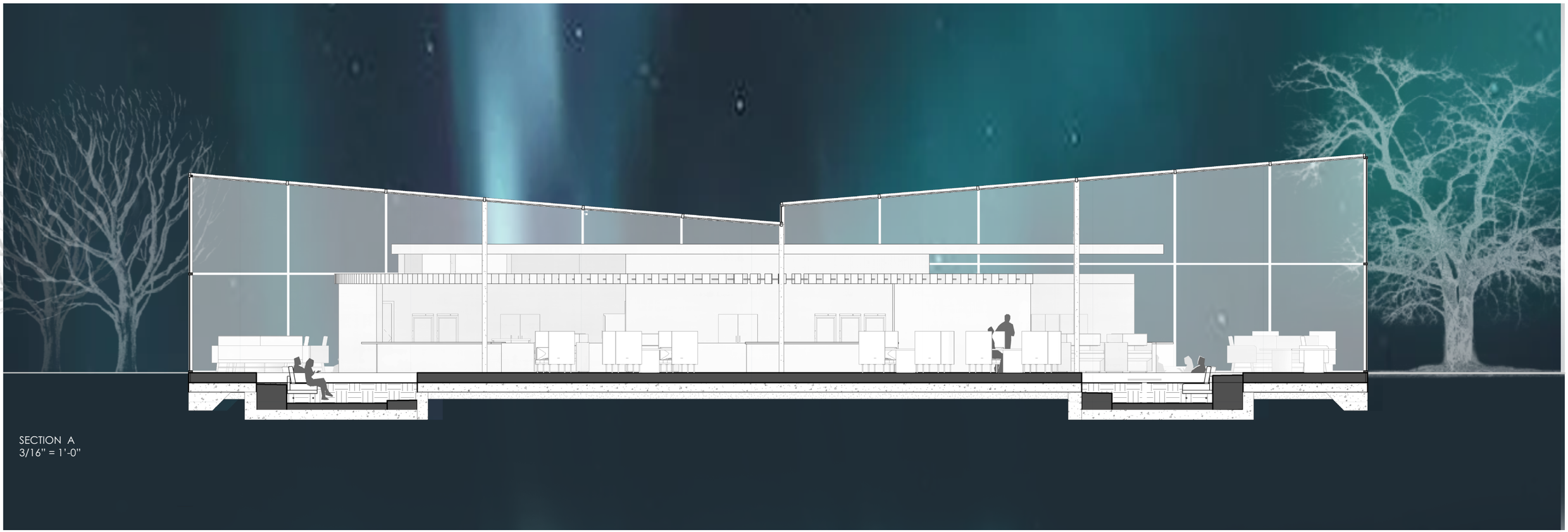
Design iteration 3 - exterior perspective render

The Arctic Experience is the final design proposed for an all inclusive - one stop shop to view the northern lights and have an Arctic getaway. On the east side of the building - directly off the county road - is a public service shuttle that will take visitors from the airport and Rovaniemi City Center to the pavilion. Guests can also arrive by nordic skiing or snowmobile.



Design iteration 3 - floor plan (not to scale)

The entrance is located on the east side, a direct walk from the shuttle stop. There are four main sunken lounges; one at each corner of the building. There are couches, lounge chairs, and booths for a variety of seating arrangements. The center of the building services a food and drink , blanket, sled, ice skating rental, offices, WC, and storage spaces. On the south lawn there are bonfire pits and benches for families to overlook the ice skating on the pond.

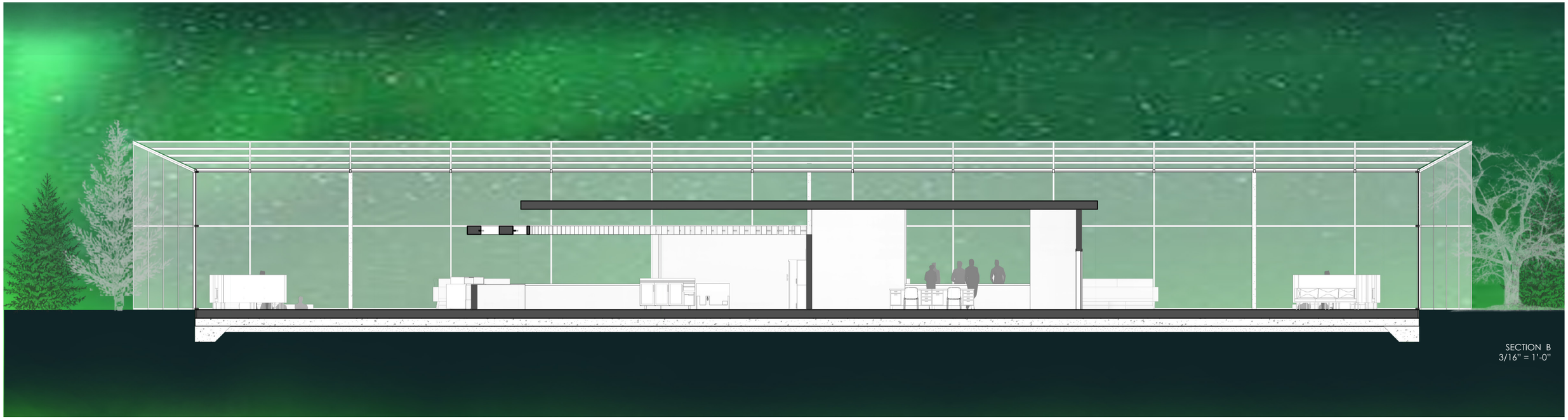


Design iteration 3 - Section A (not to scale)

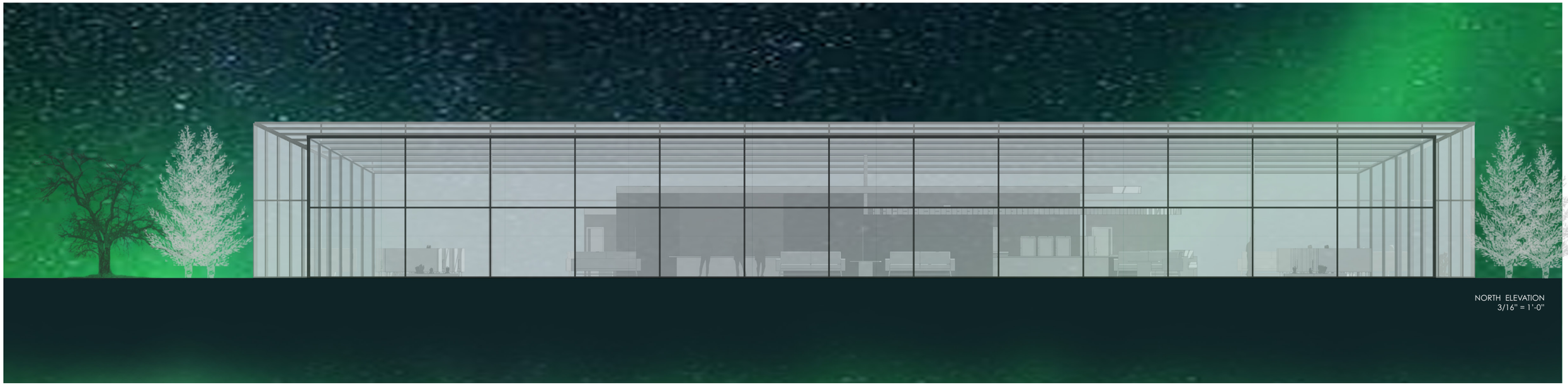
There is a structural grid layout for concrete columns that will help with the large glass span. Minimal artificial lighting during the evenings will help the building blend into the landscape, and allow for the best views of the northern lights without glare.

The triple pane glazing will help keep the wind out of the structure, however it won't be completely heat loss resistant. There are blankets and parkas available inside, but visitors coming will understand and expect a cool interior atmosphere. The building will be heated.

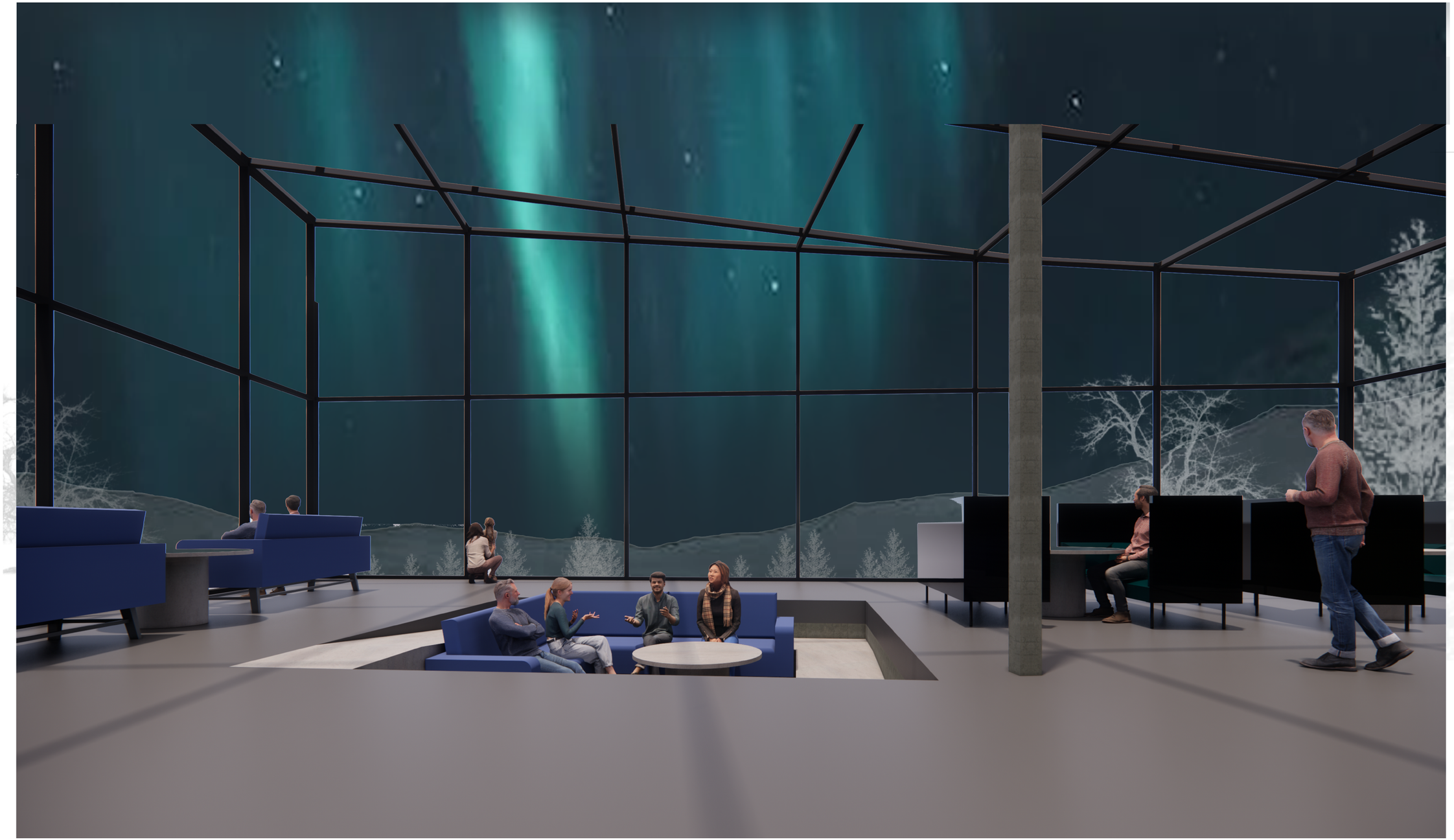
Floor to ceiling glass envelope encloses the whole structure to stay protected from the elements, while allowing for optimal views of the northern lights. There is a lake nearby that can be used for ice skating in the winter and swimming in the summer months.



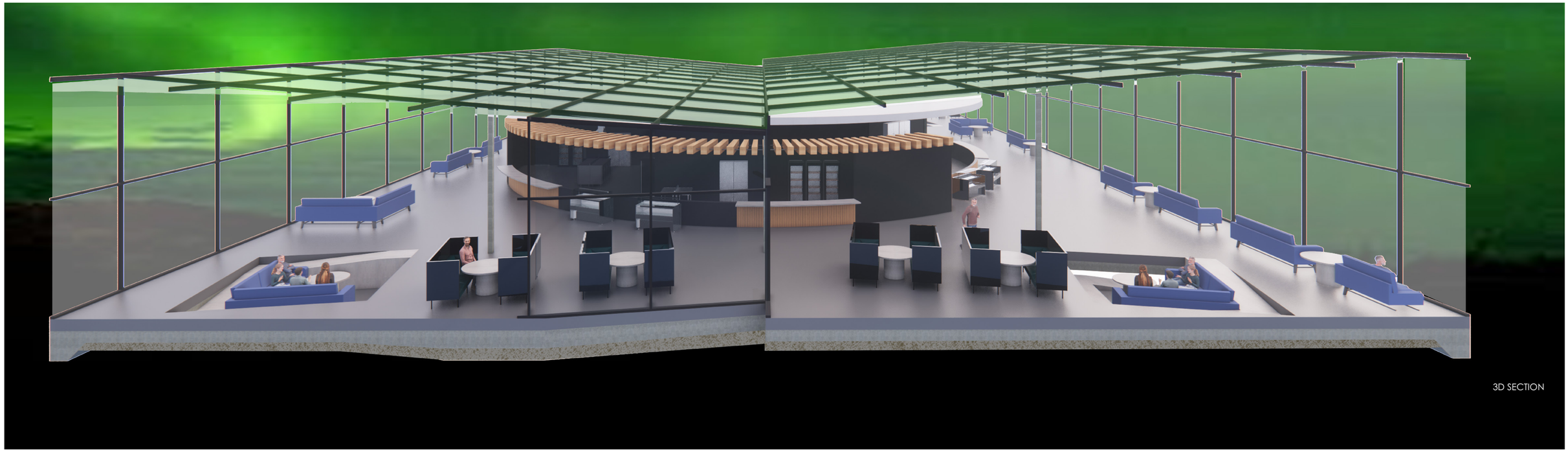
Design iteration 3 - Section B (not to scale)



Design iteration 3 - North Elevation (Not to Scale)



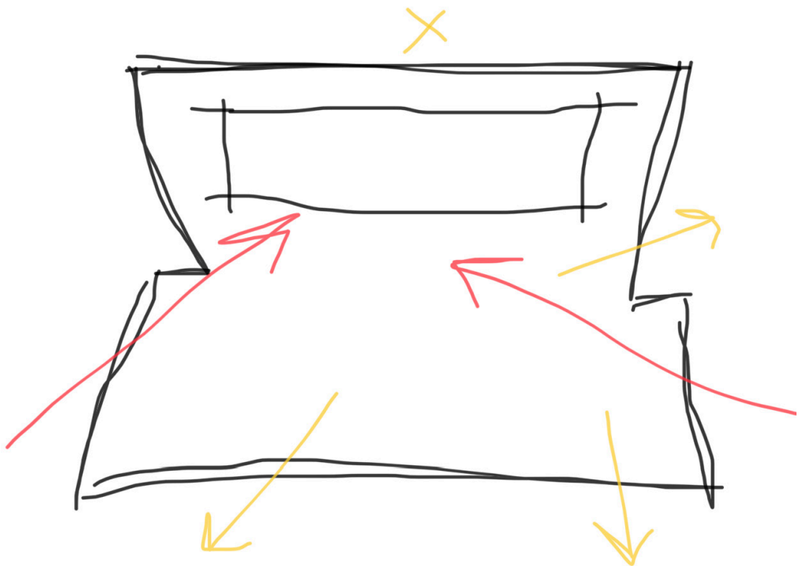
Design iteration 3 - interior perspective



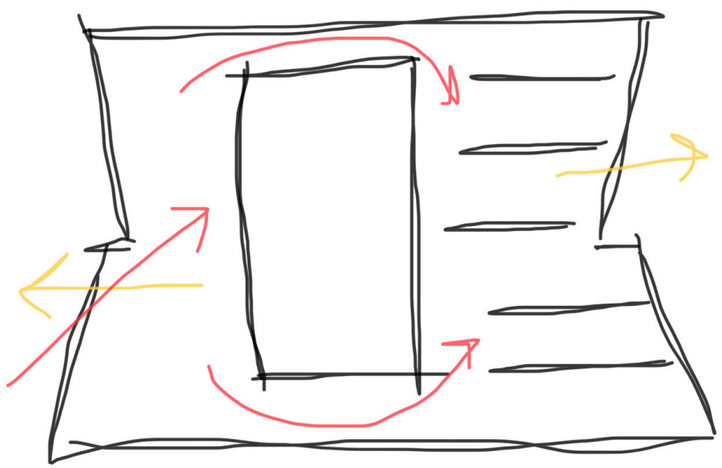
Design iteration 3 - 3D Section

Reflection Diagrams

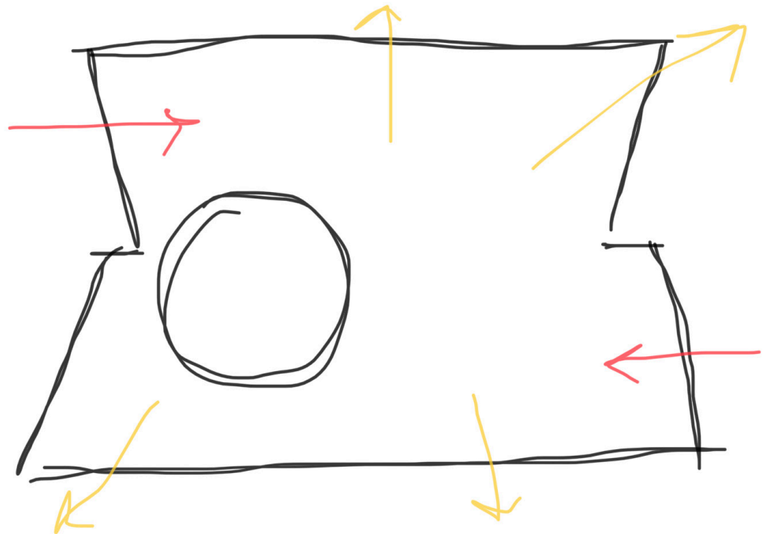
After the thesis defense, there was time to review the work and reflect on the design decisions. The main areas were the layout of the interior spaces, the reasoning for the glass envelope, and the structure of the building.



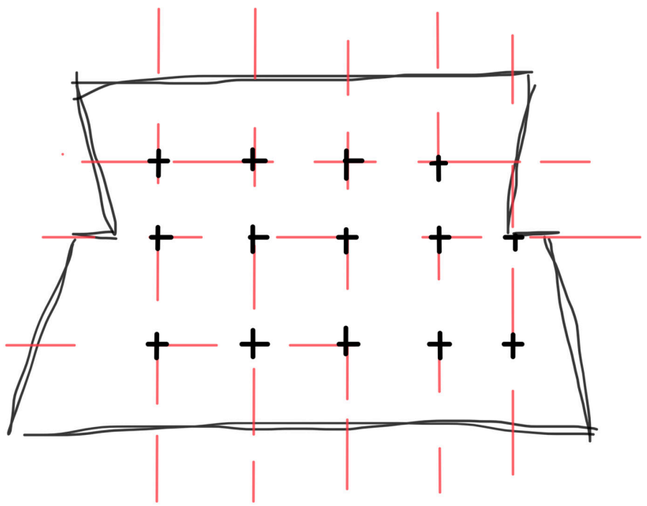
This is a diagram of the back of house spaces moved to the north wall - however now it blocks any view from the north, or vice versa if the space were moved south.



This diagram splits the seating spaces to have a more public open side (left) and private seating (right). There is less space for people sit with this option and circulation is disrupted.



Moving the BOH oval off to one side provides the best alternative option for public and private seating. There is good circulation around the interior amenities, and different locations for people's seating preferences.



This is a basic structural grid diagram showing where the concrete columns will be placed.

Appendix

Images

01. “Finland Map.” Google Maps, www.google.com/maps/place/Rovaniemi,+Finland/@65.6385277,18.7084474,5z/data=!4m6!3m5!1s0x442b4bbd76772553:0x158088adb48841c4!8m2!3d66.5039478!4d25.7293906!16zL20vMDE1bmlw. Accessed 21 May 2023.

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