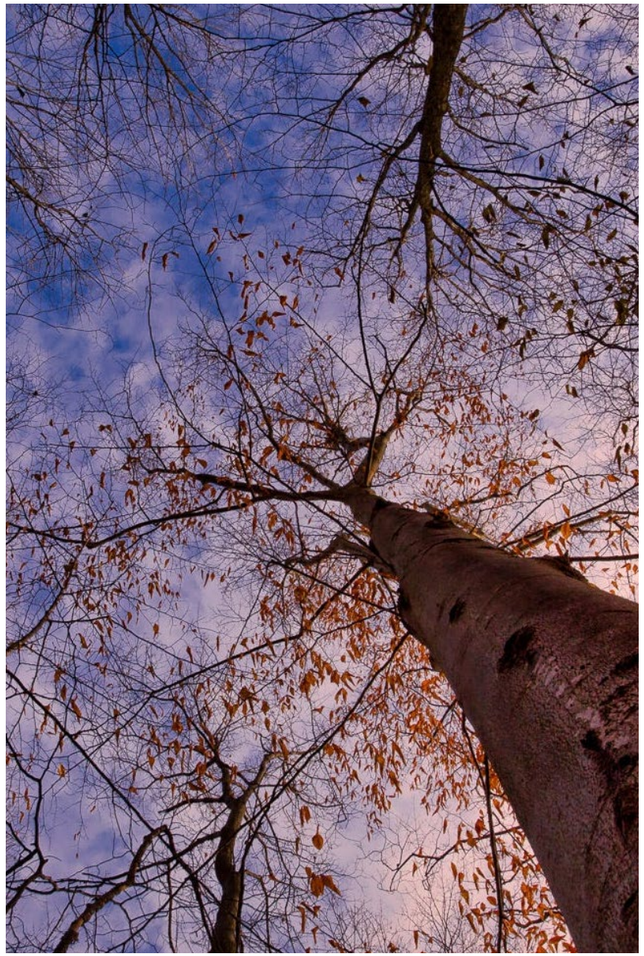
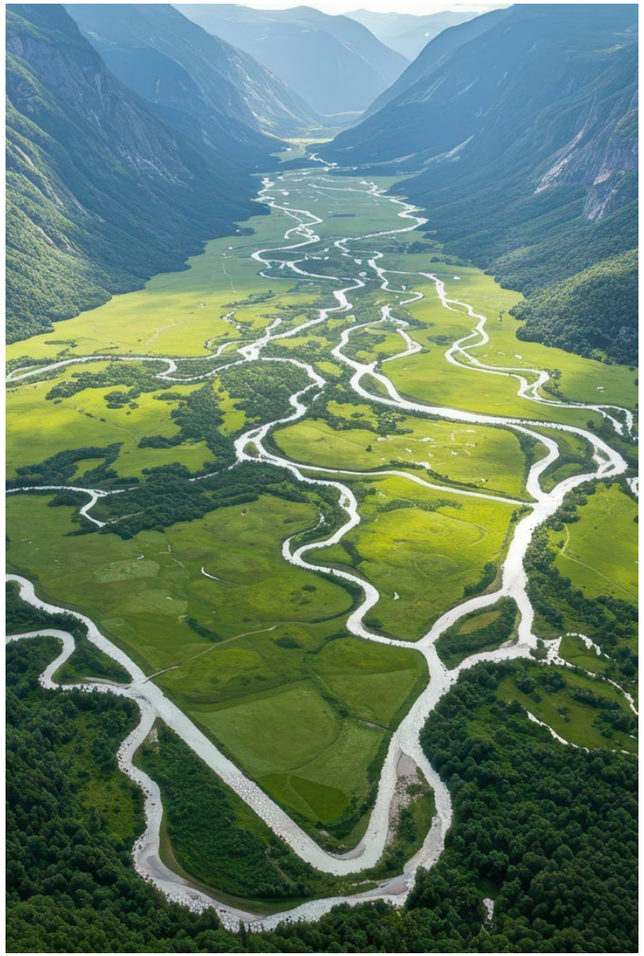
# Parametric Systems

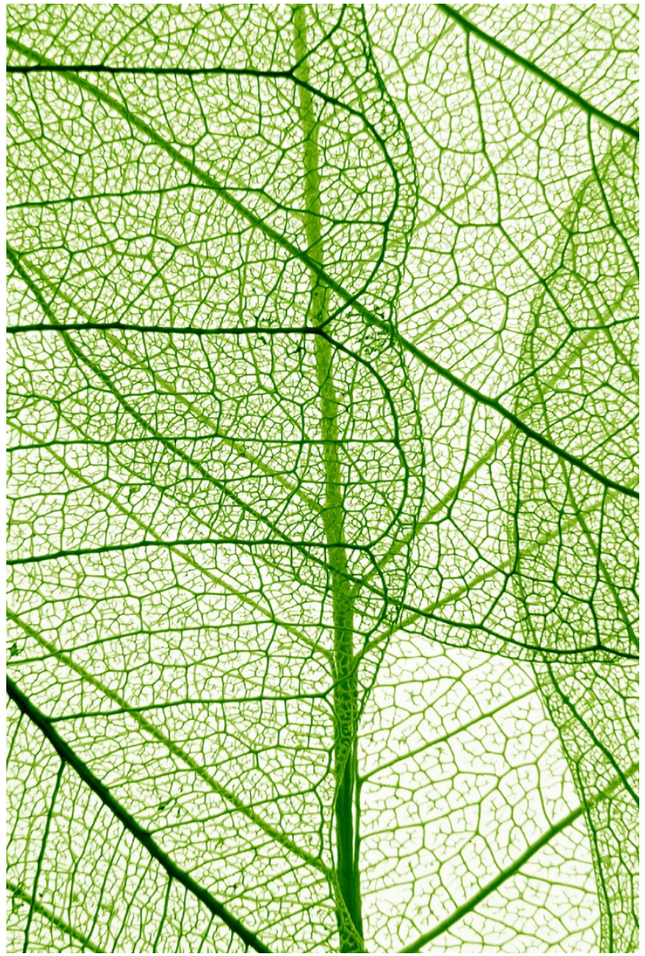
# Assignment 1



## Trees



## Rivers



## Leaves

**Process:**

What looks random in nature often has an underlying explanation. Trees branch out to reach areas with available light. Rivers meander because flowing water erodes the ground unevenly, changing their course over time. Leaves expand their surface area to collect sunlight and nutrients, and they form internal channels to transport those resources throughout the tree. Even when these systems appear chaotic, they are shaped by purposeful and predictable processes.

There. Your idea finally gets to put on real shoes.

# Parametric Sketches

# Assignment 1

10 min

1 min

10 sec

**Process:**

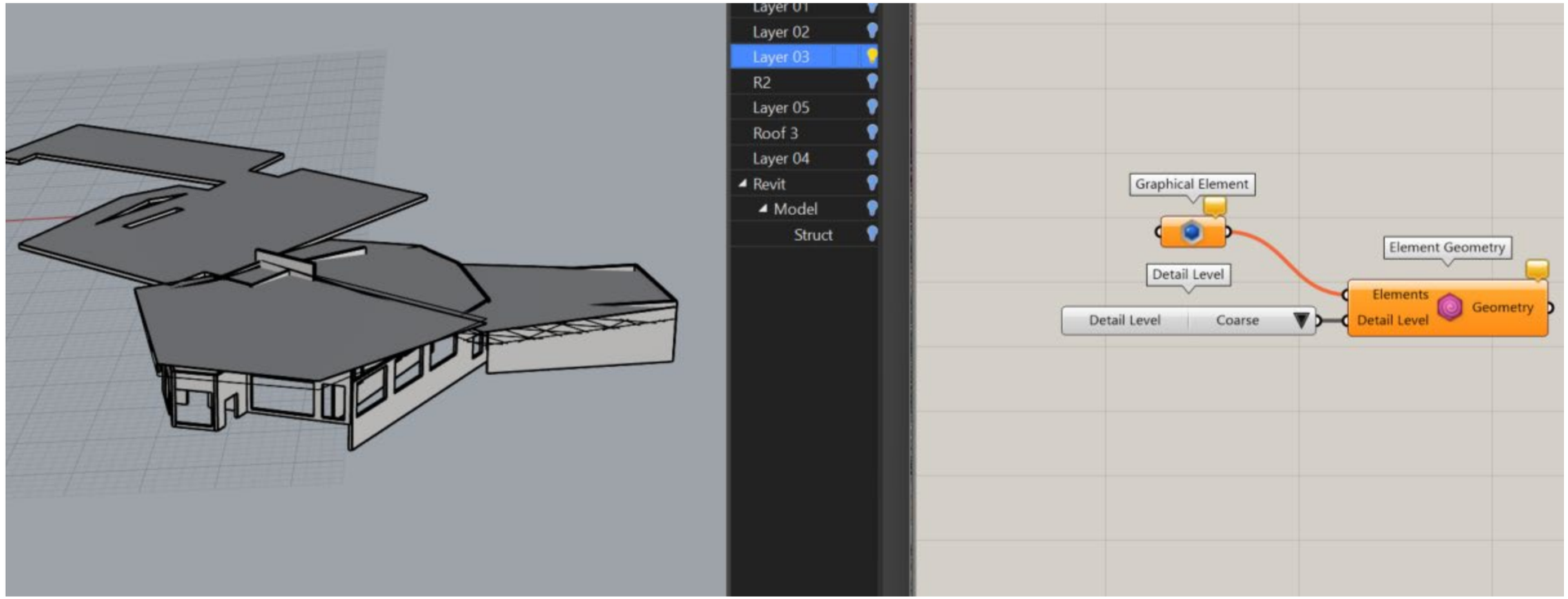
I went outside and looked for natural parametric systems. The one that immediately came to mind was the veins of a leaf. The 10 min sketch allowed me to look deep into the structure of the leaf. How there are main vacuoles that break down into smaller and smaller segments. It seemed like they broke down forever.
The 1 min sketch showed me the main arteries of the leaf; the central point of transportation within this small system.
The 10 sec sketch brought me to the form of the leaf. Why it is shaped how it is and how those shapes work together as a whole. This brekdown allowed me to better understand the parametrics behind the leaf.

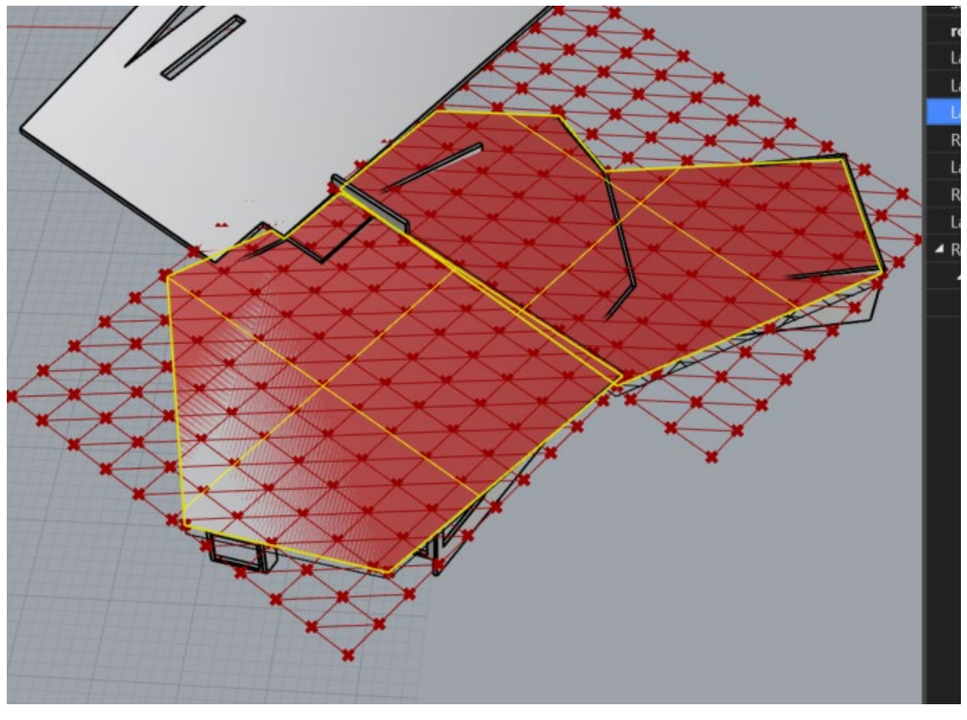
# Assignment 1 Reflection

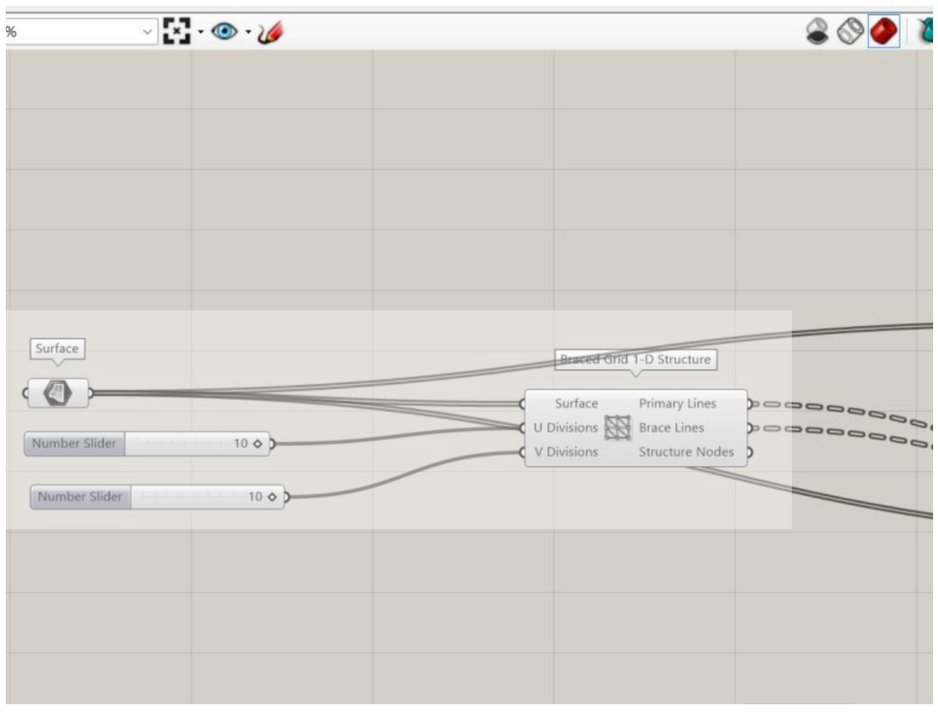
I learned how to take the naturalistic logic behind parametric systems and translate it into my design work. Being outside and observing real patterns taught me as much, if not more, than working solely on a computer. The landscape itself became a resource, and from it I identified a pattern that informed my design approach.

# Assignment 2

Bennett Walden





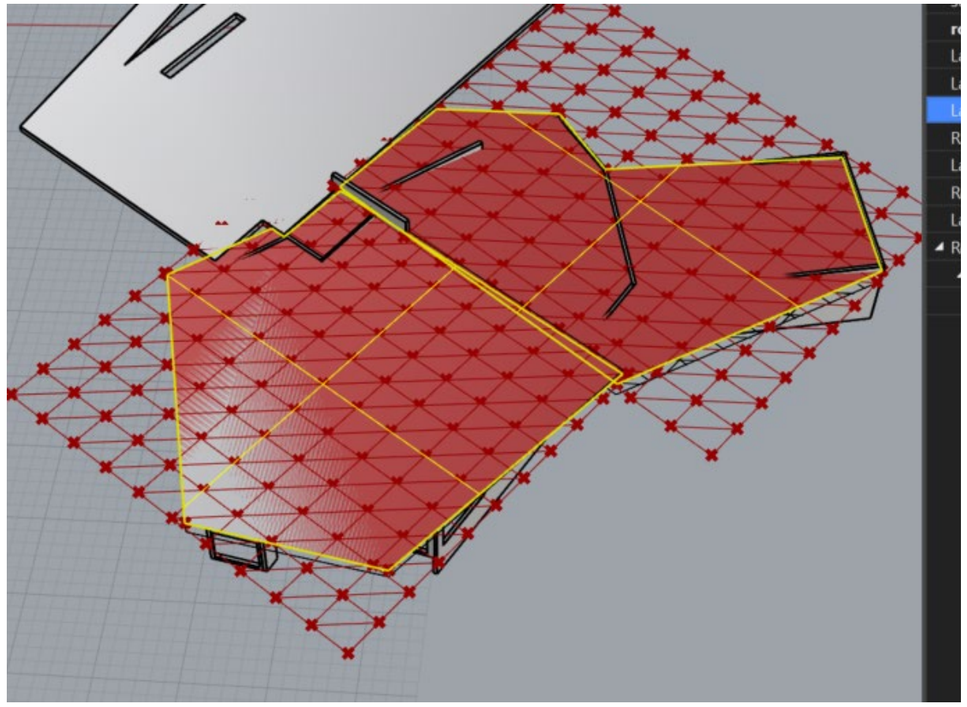

## Grasshopper Script:

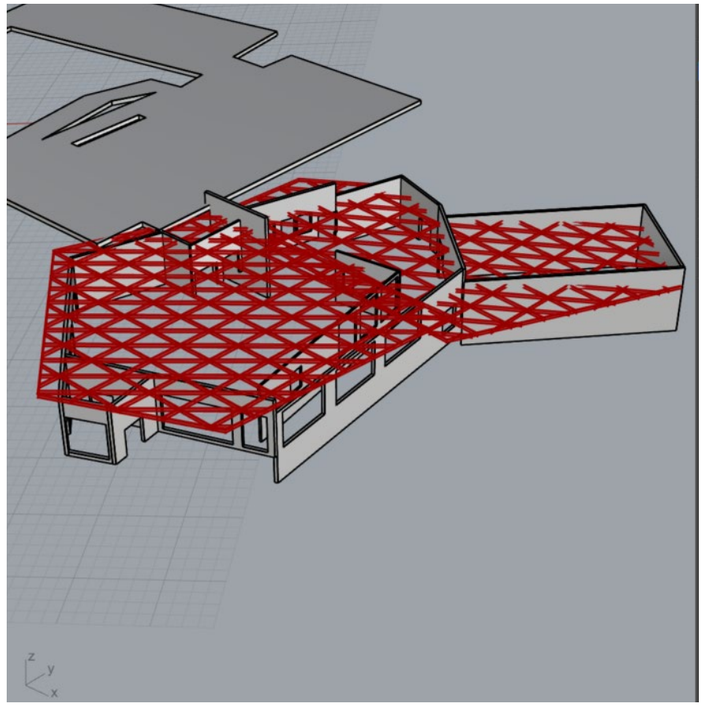
My goal for this project was to create a diagrid structural system for my studio project. This approach allows for larger spanning distances and greater head clearance.

My first step was importing my Revit geometry into Rhino to obtain the correct dimensions for the roof.

I then set my roof surfaces in Rhino to the Surface node in Grasshopper and connected them to the diagrid system I selected from the LunchBox plugin. Using number sliders, I customized the system to best suit the needs of my program.

This project had direct correlation to my studio project. I used resources like youtube, forums and other classmates to help me create a structural diagrid for my building.



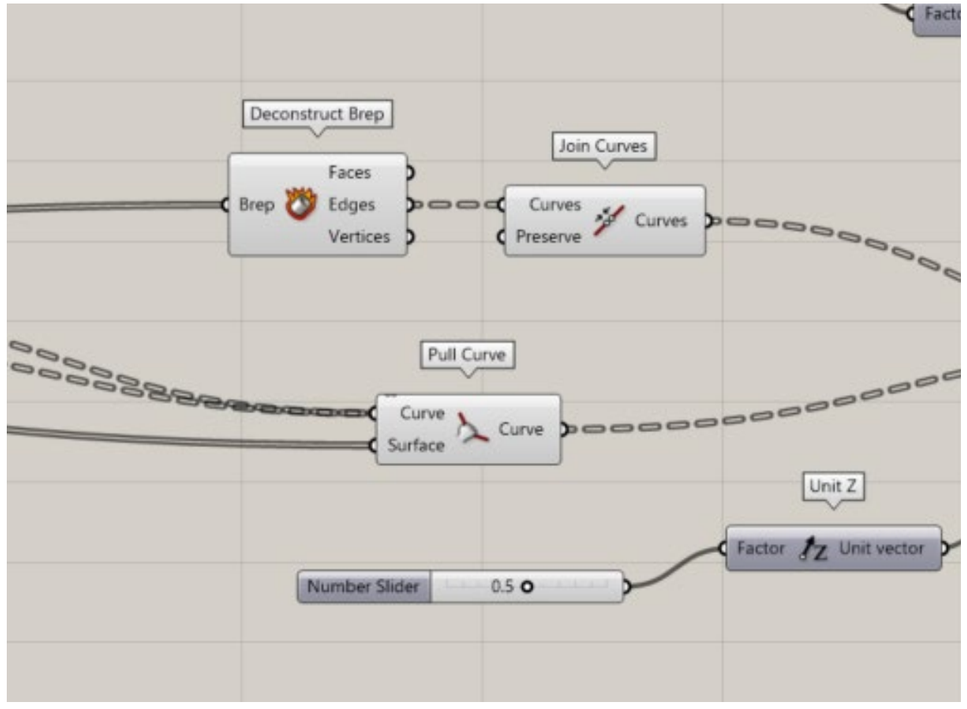


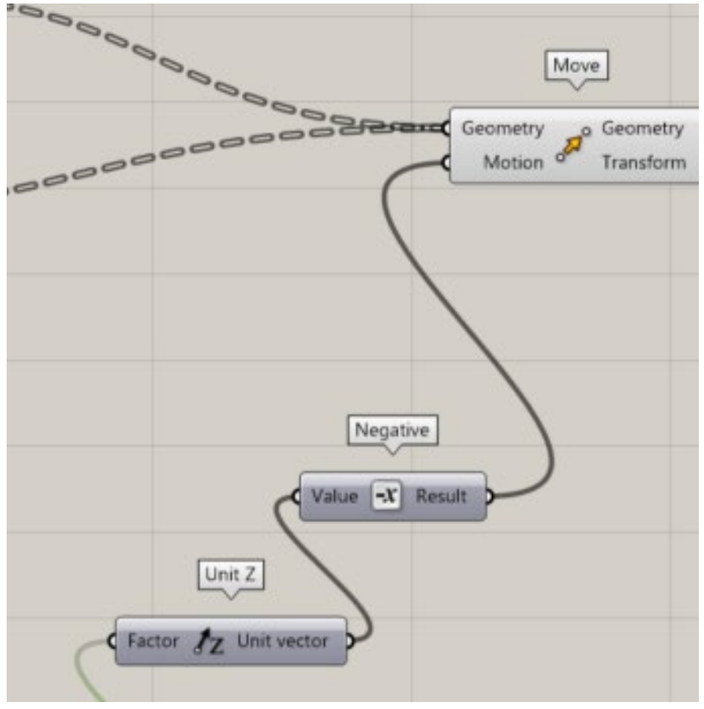
## Grasshopper Script:

After I had the desired grid layout, I used a Deconstruct Brep node to find the edges of my surface and joined those curves using the Join Curve node.

Next, I used the Pull Curve node to adjust the default grid so it aligned with the surface lines taken from my roof geometry.

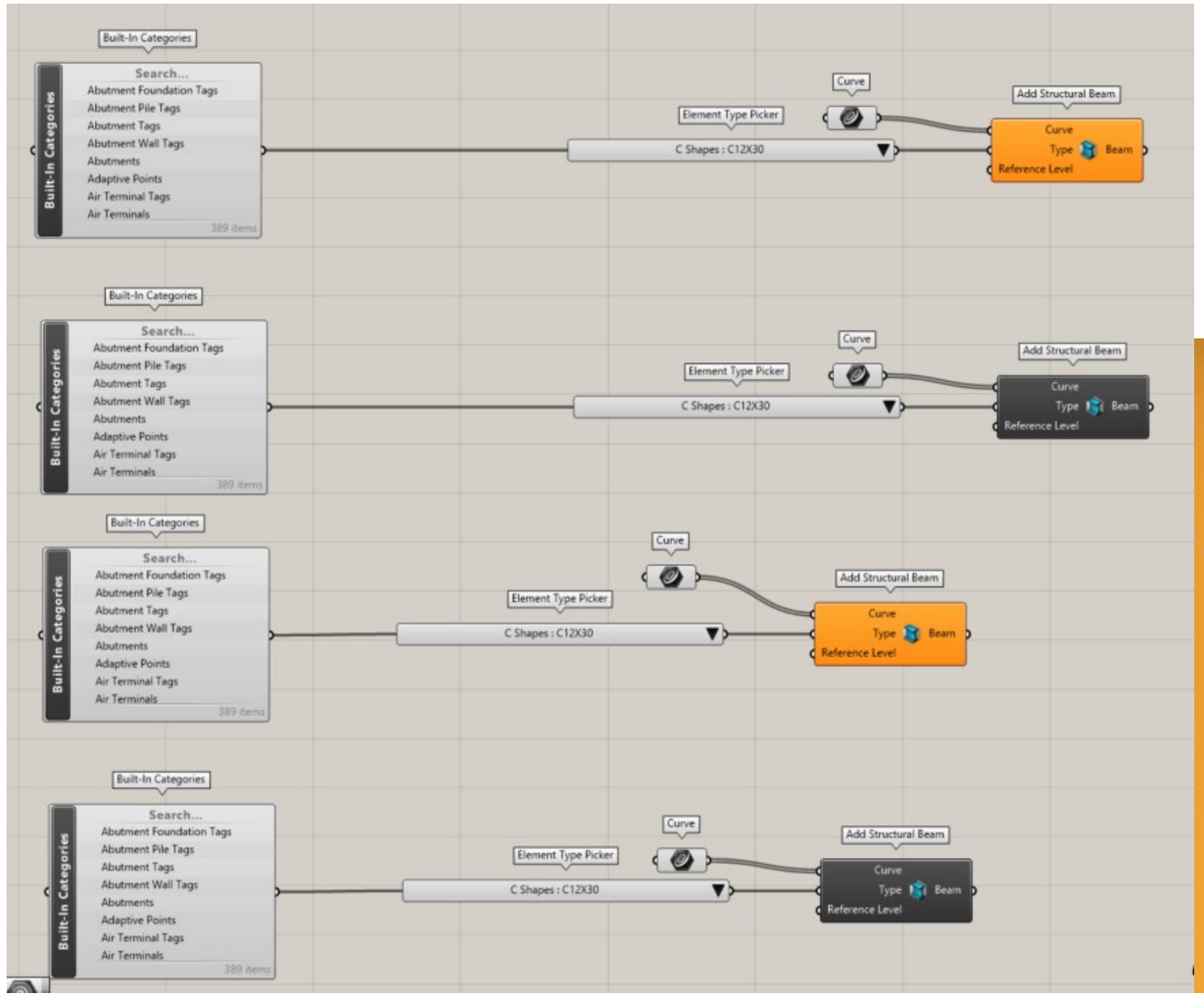
Finally, I offset the structure from the roof plane by using the Z vector tool and a Negative node to lower the structure relative to the roof surface.

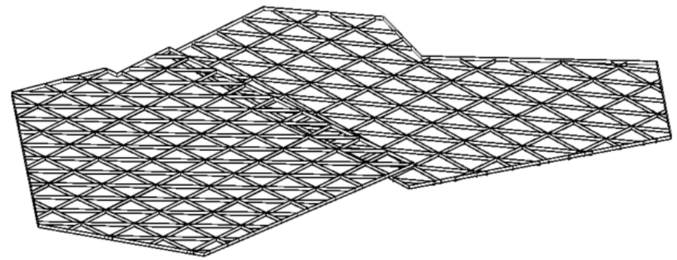


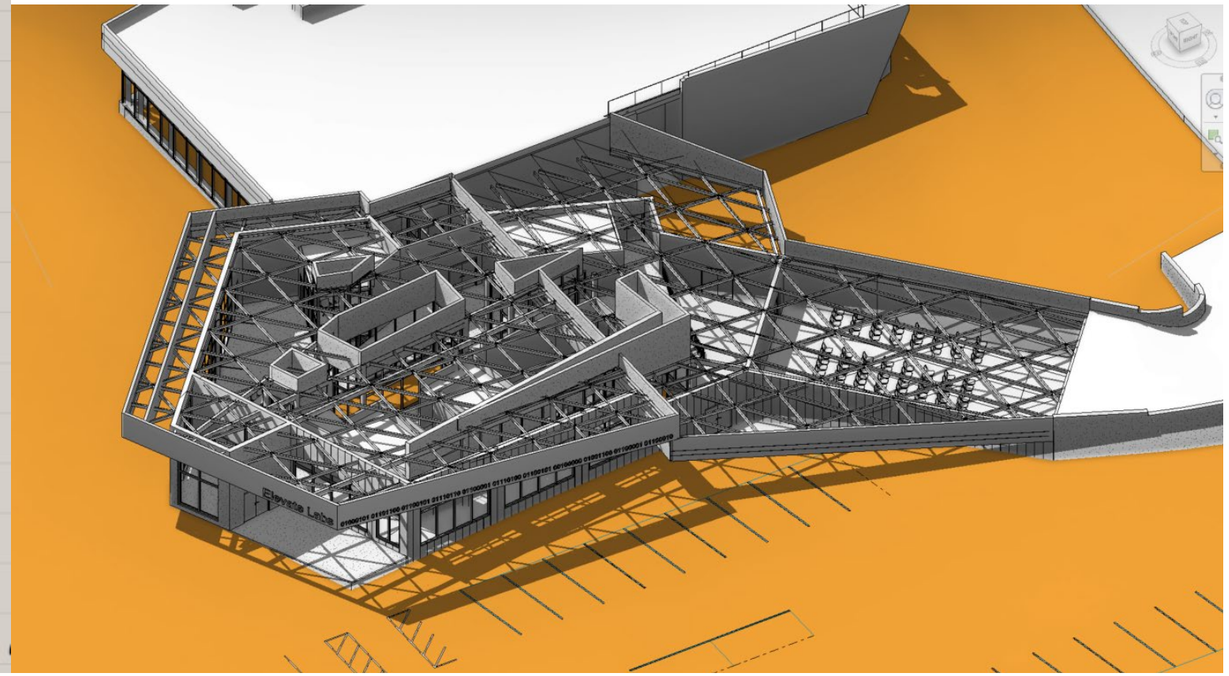




## Rhino Inside:

After I had my desired curves in Rhino, I baked them and assigned them to their corresponding curve nodes. I used the Built-In Categories node in Grasshopper to find the family I wanted the curves to represent in Revit. Then, using the Element Type Picker, I selected the type of steel I-beam I wanted for my diagrid structure. I connected this element to an Add Structural Beam node to bring those curves from Rhino into Revit as beams. Finally, I selected the boundary curve to add a girder system. The result is a complete structural system transferred from Rhino to Revit using Grasshopper.



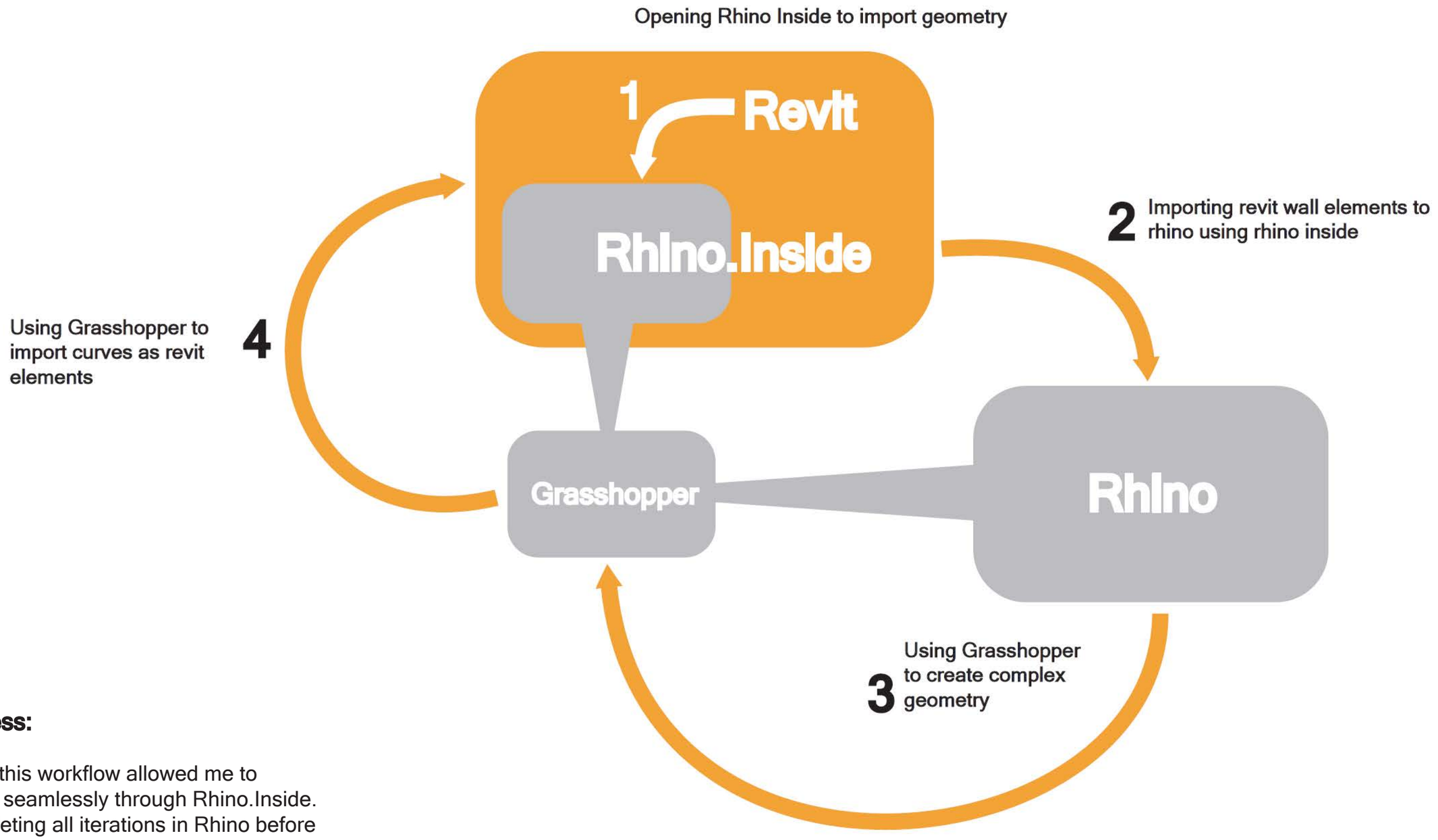





## Process:

During my semester abroad in Austria, I took a BIM course where I learned how to use Rhino.Inside.Revit to import vector geometry as beams and other building components. This skill allowed me to turn my parametric design into a functional architectural element within my project. The workflow makes it possible to bring complex parametric forms into a non-parametric environment like Revit by using nodes that translate data from Rhino into a format Revit can understand. I also reached out to my former BIM professor for guidance while developing this process.

# Workflow Diagram




**Process:**

Using this workflow allowed me to iterate seamlessly through Rhino.Inside. Completing all iterations in Rhino before committing to a final decision saved time and improved the overall quality of my project.

# Assignment 2 Reflection

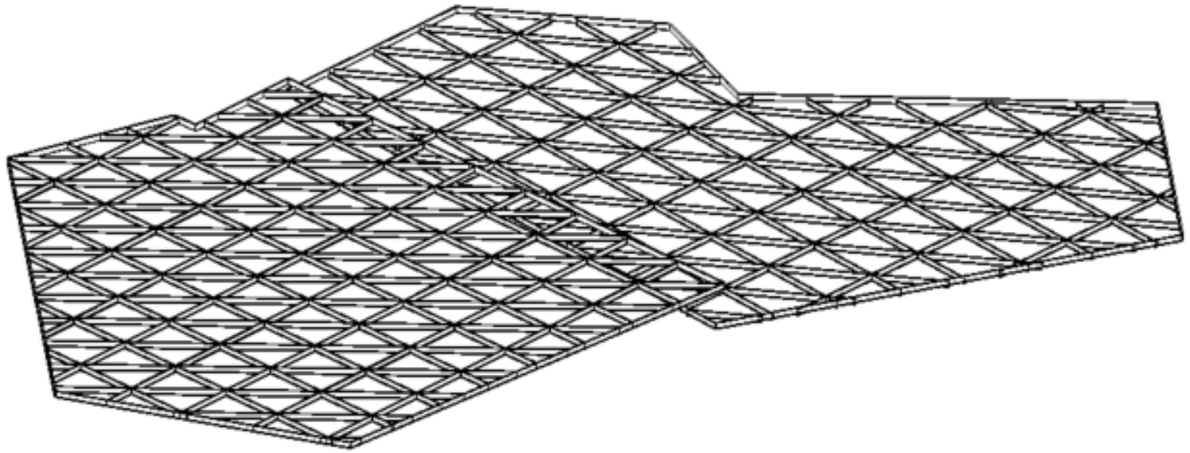
Assignment 2 expanded on the ideas from Assignment 1 and pushed me to think more critically about how parametric principles appear in nature and how they can be translated into architecture. Using Grasshopper, I explored the geometric logic of a leaf and reinterpreted it as a roof structure. This process helped me understand how natural forms can inform design intent when transformed through computational tools.

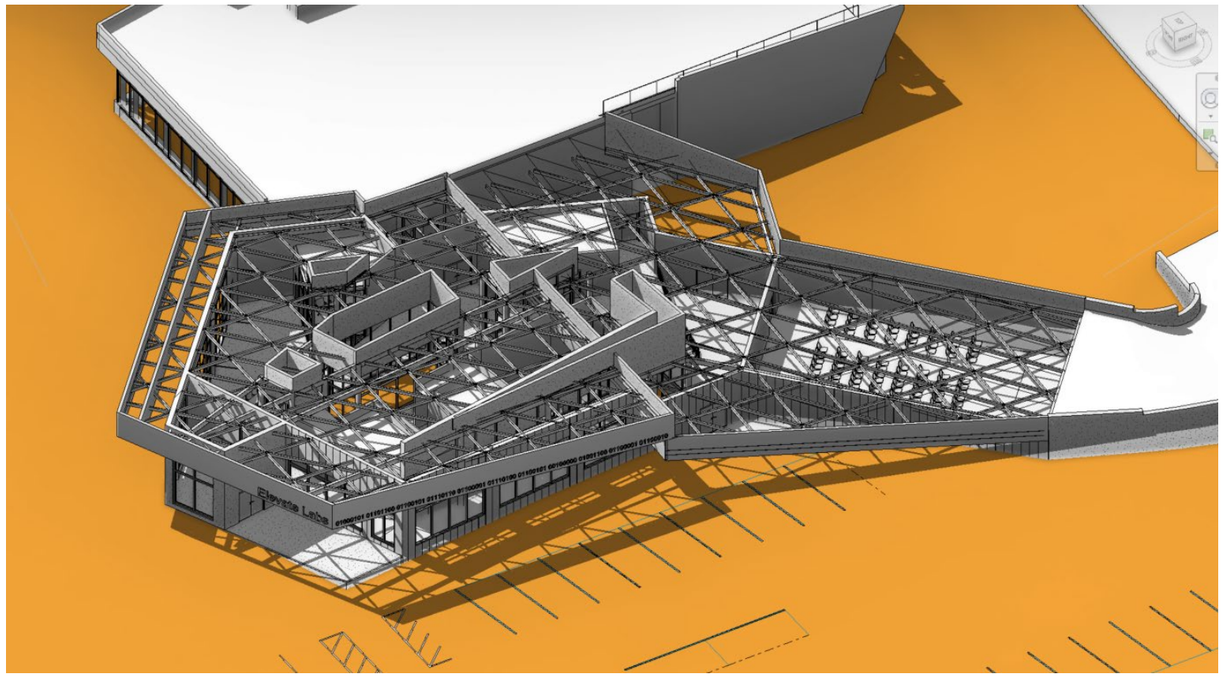
I relied on a range of resources to develop the concept and troubleshoot the workflow. Platforms such as Parametric House, 3D Beast, YouTube tutorials, and discussion threads on the Rhino Forum were invaluable for gathering ideas, solving problems, and making the design I imagined actually achievable.

Working across different software programs played a major role in my iterative process. Moving between applications allowed me to test variations quickly, refine the geometry, and evaluate how small adjustments influenced the overall system. This workflow made the development of the project much more fluid and intentional.

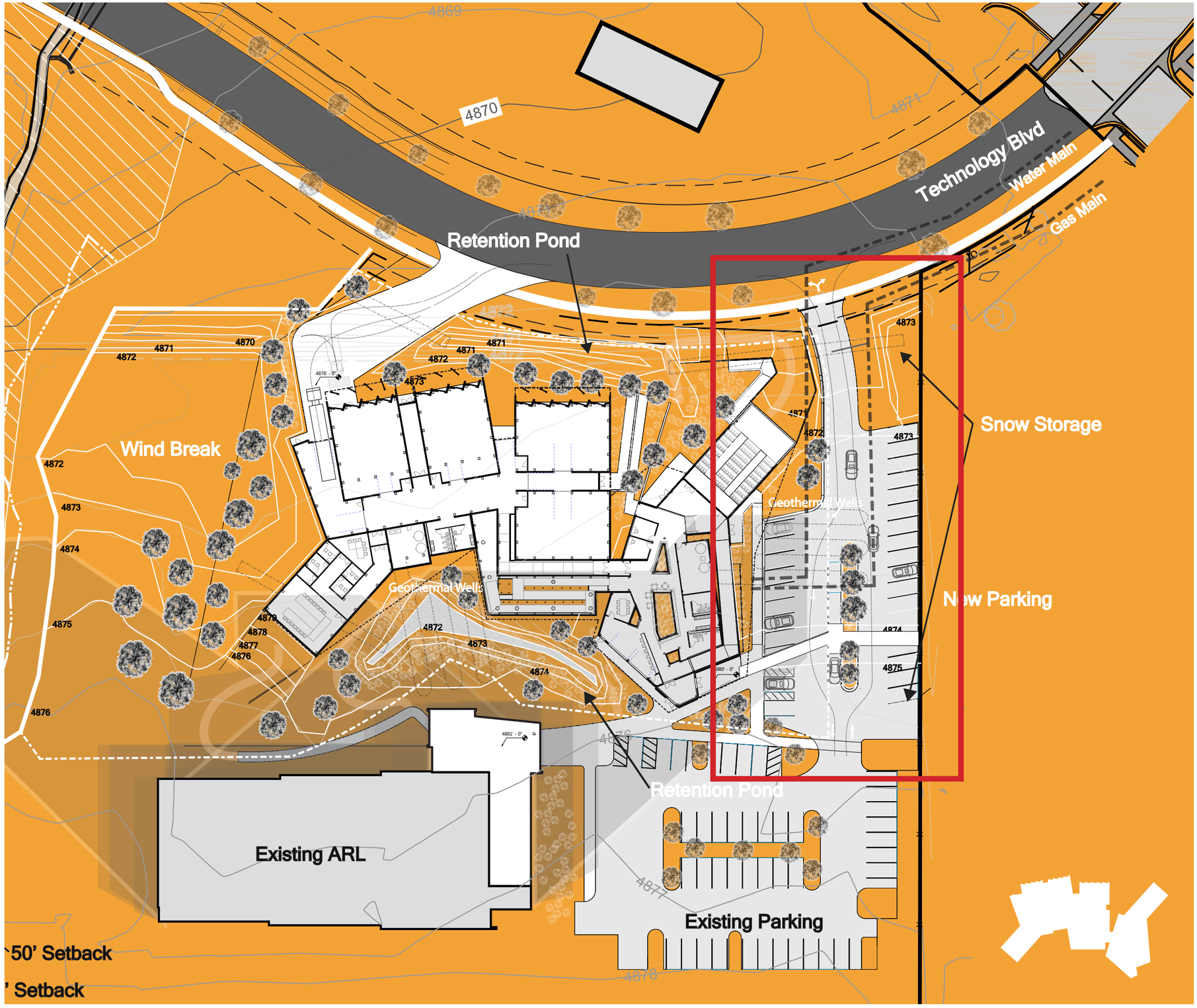
# Initial Ideas

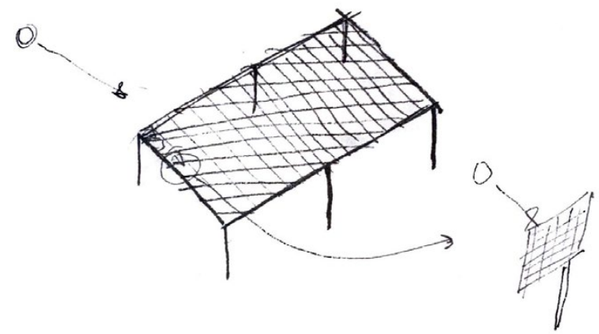






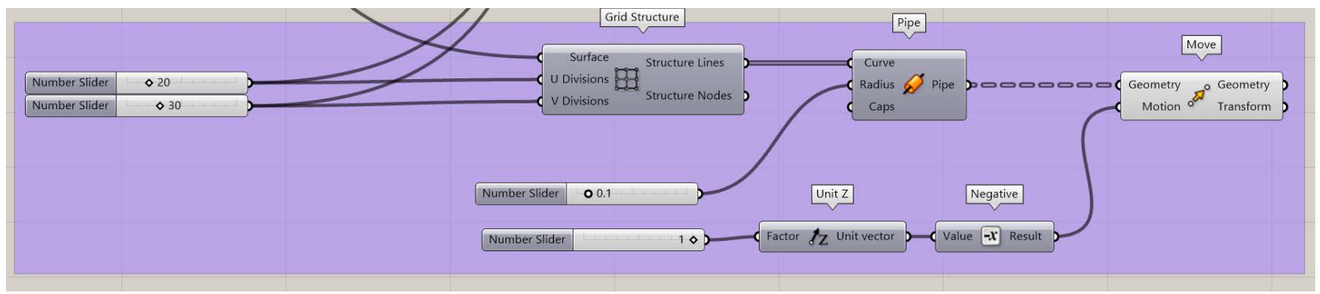
I wanted to emulate the existing structure of my project and extend its architectural language to another element on the site, creating continuity across the design. To achieve this, I decided to design a parking cover that not only provides a functional, sheltered space for visitors but also reflects the aesthetic and structural principles of the main building. By incorporating similar forms, materials, and patterns, the parking cover becomes an integrated part of the site rather than a separate, utilitarian addition. This approach allows the cover to serve multiple purposes: protecting cars and pedestrians from the elements, enhancing the overall visual cohesion of the project, and creating opportunities for sustainable features such as solar panel integration.



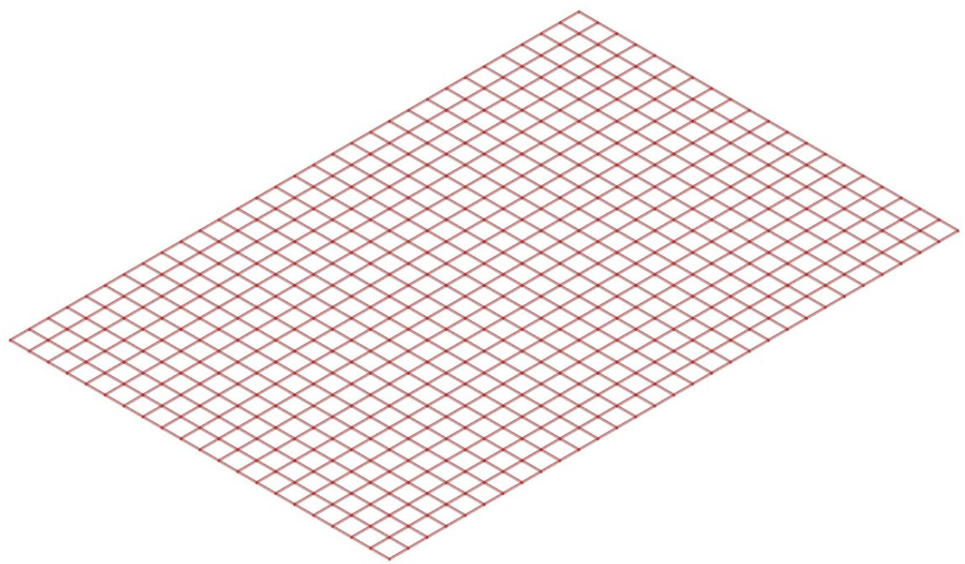



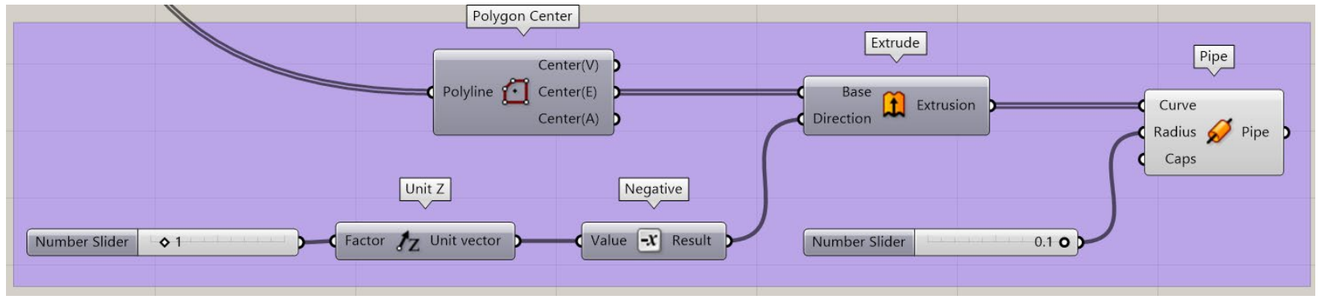
I'm adding a cover over the parking lot to make the space more practical, sustainable, and visually connected to the rest of the project. It provides shade and protection from weather for both cars and people, while also serving as a solar panel collector that generates renewable energy and supports the project's environmental goals.

# Rhino Parametric Design

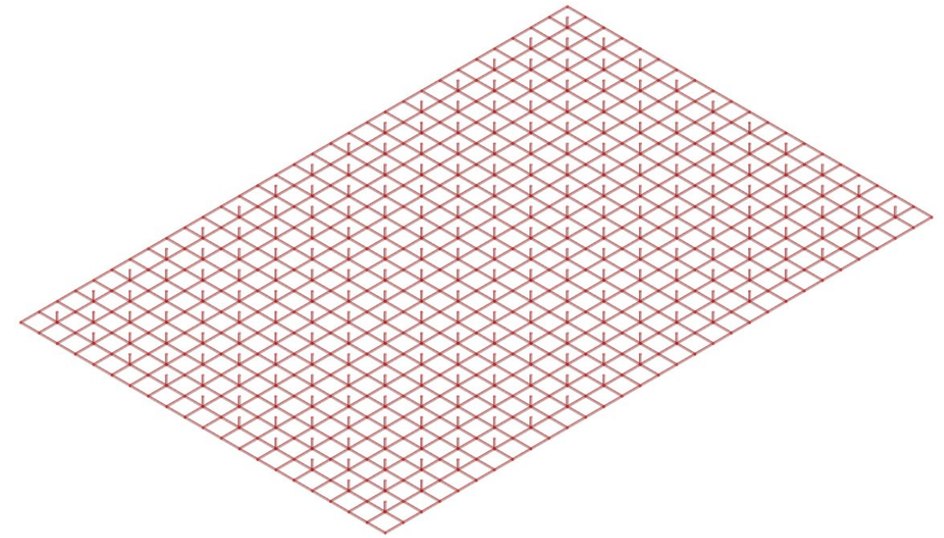



I began by developing the base structure of the system to better understand the overall space requirements and proportions for this addition to my project. To achieve this, I used a simple grid system as a foundation for organizing and defining the layout.



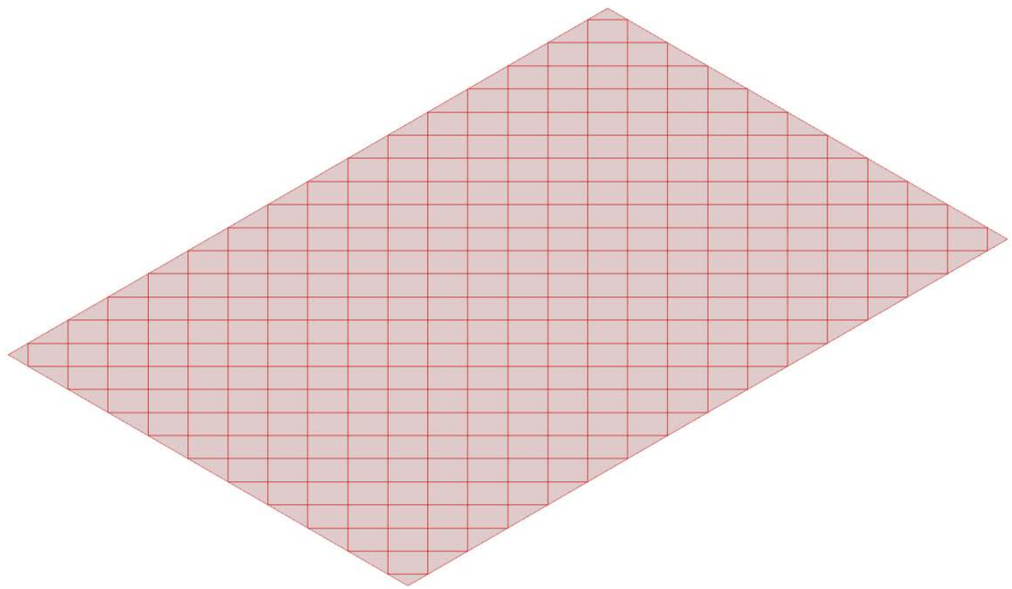


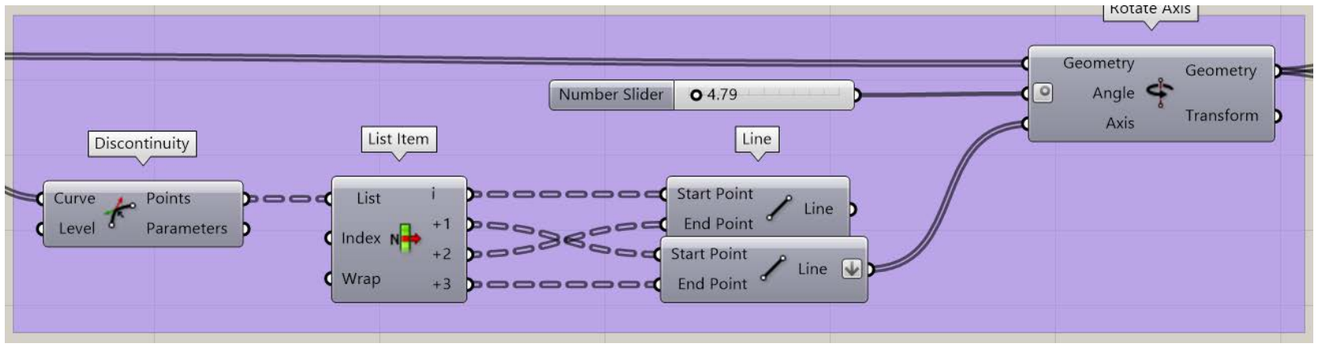

In addition to the base structural grid, I added posts to support the panel system. These posts are designed to be tall enough to allow the panels to move freely without any restrictions.



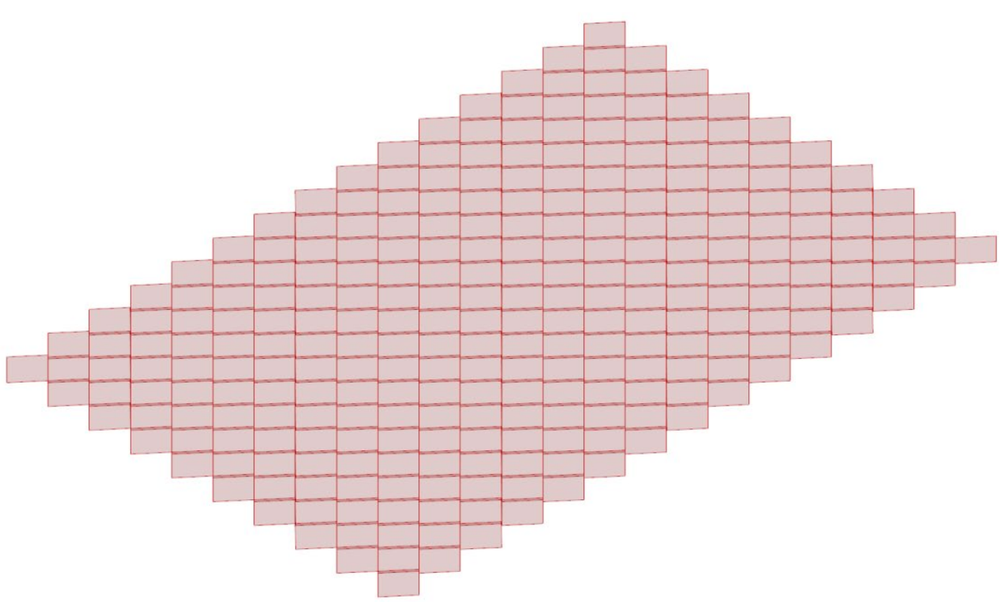
# Rhino Parametric Design


I then focused on developing the diagrid system to mimic the structural design of my building. Using the LunchBox plugin, I applied the Diagrid Panel System to generate and organize these panels.

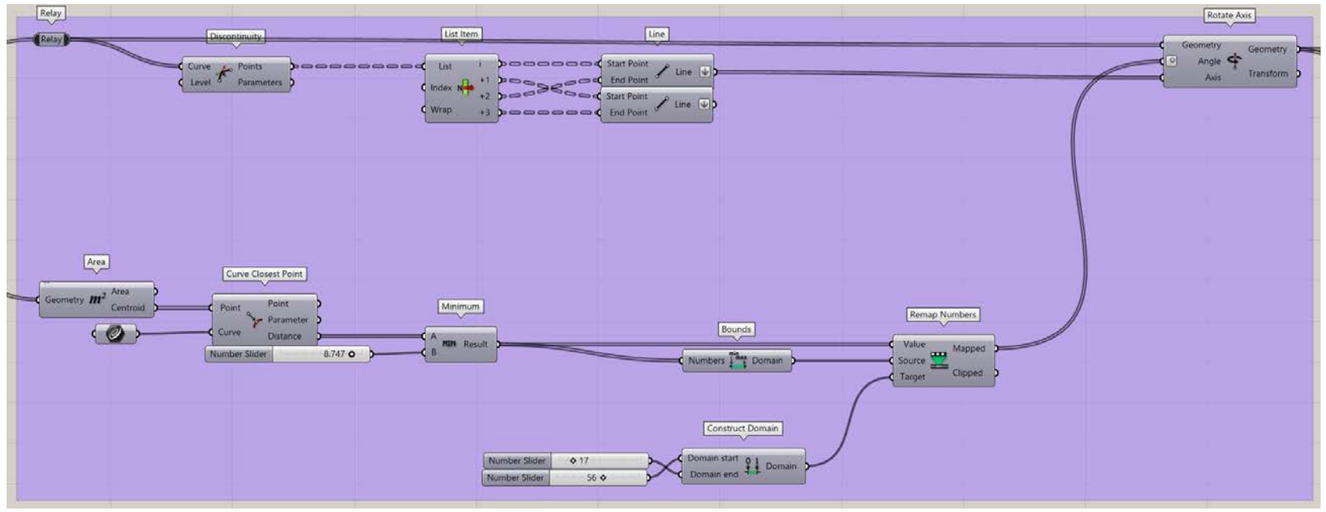




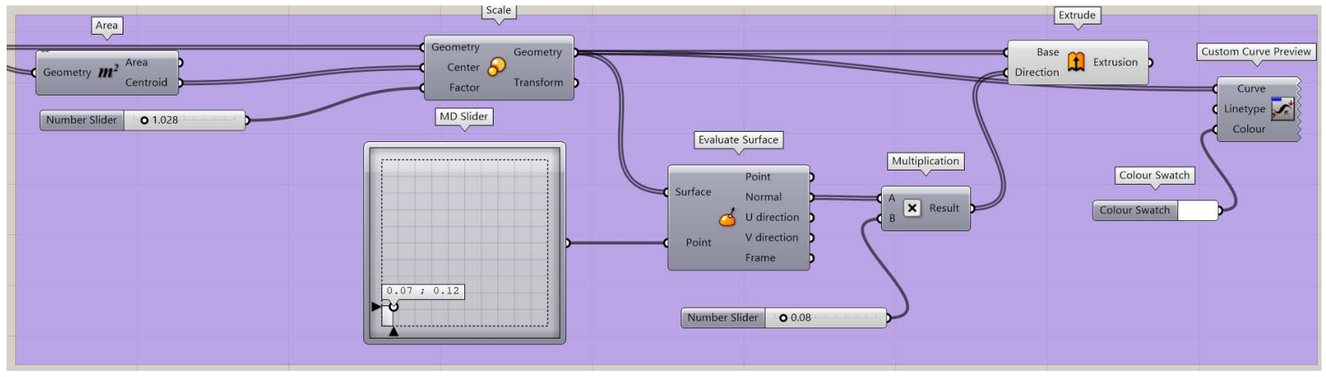

I isolated the diagrid structure from the rectangular base to allow for easier adjustments later in the process.



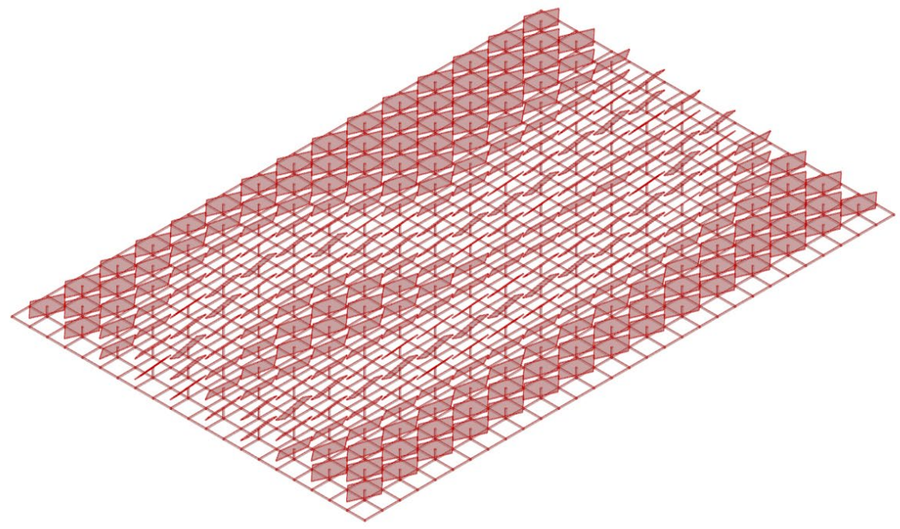
# Rhino Parametric Design



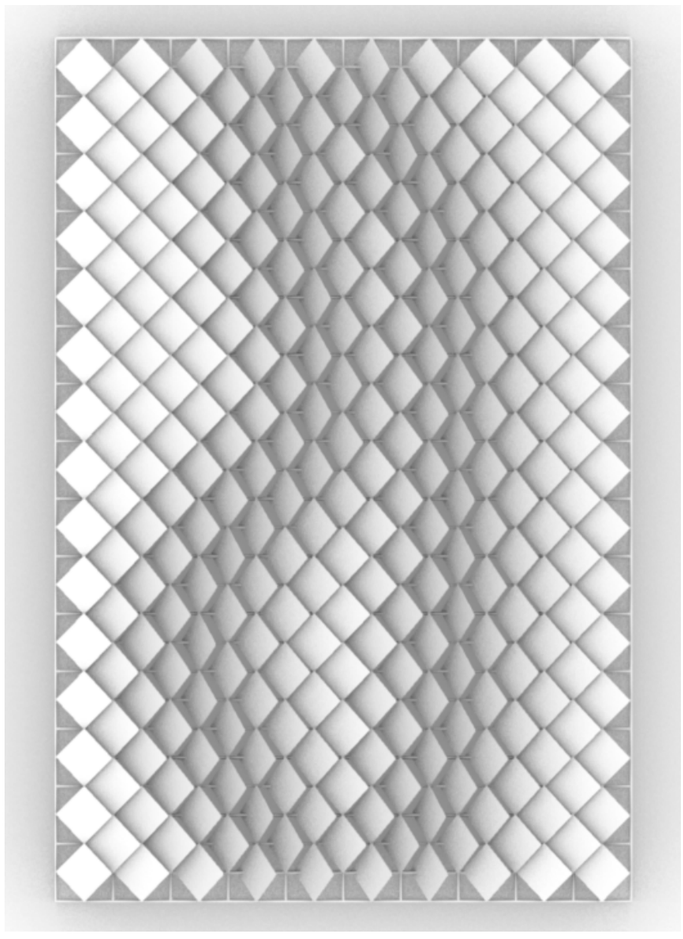

I then focused on rotating these objects to reflect the paths of movement through the parking lot. Areas with stationary cars or pedestrians are covered, while zones of movement are left open. This approach allows natural light to guide users through the space toward the building.

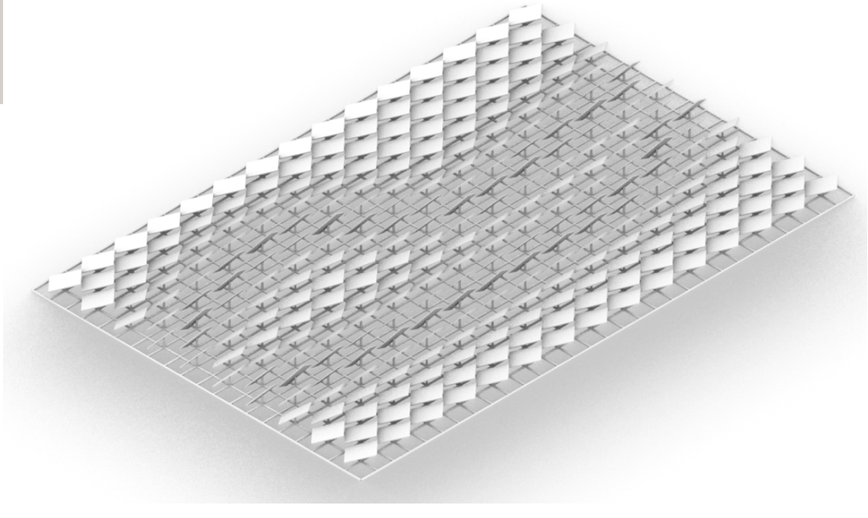



I then added depth to the panels, matching the actual dimensions of PV panels. This ensures accuracy when importing the model into Revit and maintains precision throughout the design process.



# Output





The parking lot cover successfully combines functionality, sustainability, and design. Starting with a base grid to establish space and proportions, posts were added to support the panel system, allowing full movement of the panels. A diagrid system, developed with the LunchBox plugin, reflects the structural language of the building, while rotation and positioning of the panels respond to movement patterns–covering areas of stationary activity and leaving openings where circulation occurs. Depth was added to match real PV panels, ensuring accuracy for Revit modeling. The final design creates a space where people are both protected from the elements and guided intuitively by light, while also offering the potential for renewable energy generation through solar integration.

# Assignment 3 Reflection

Assignment 3 focused on parametric movement systems, which proved more challenging due to my ongoing learning curve with Grasshopper. To build a foundation, I used resources such as 3D Beast and various YouTube tutorials to develop a baseline model in Rhino, then iterated from there. These iterations helped me understand just how versatile Grasshopper can be when exploring dynamic behavior.

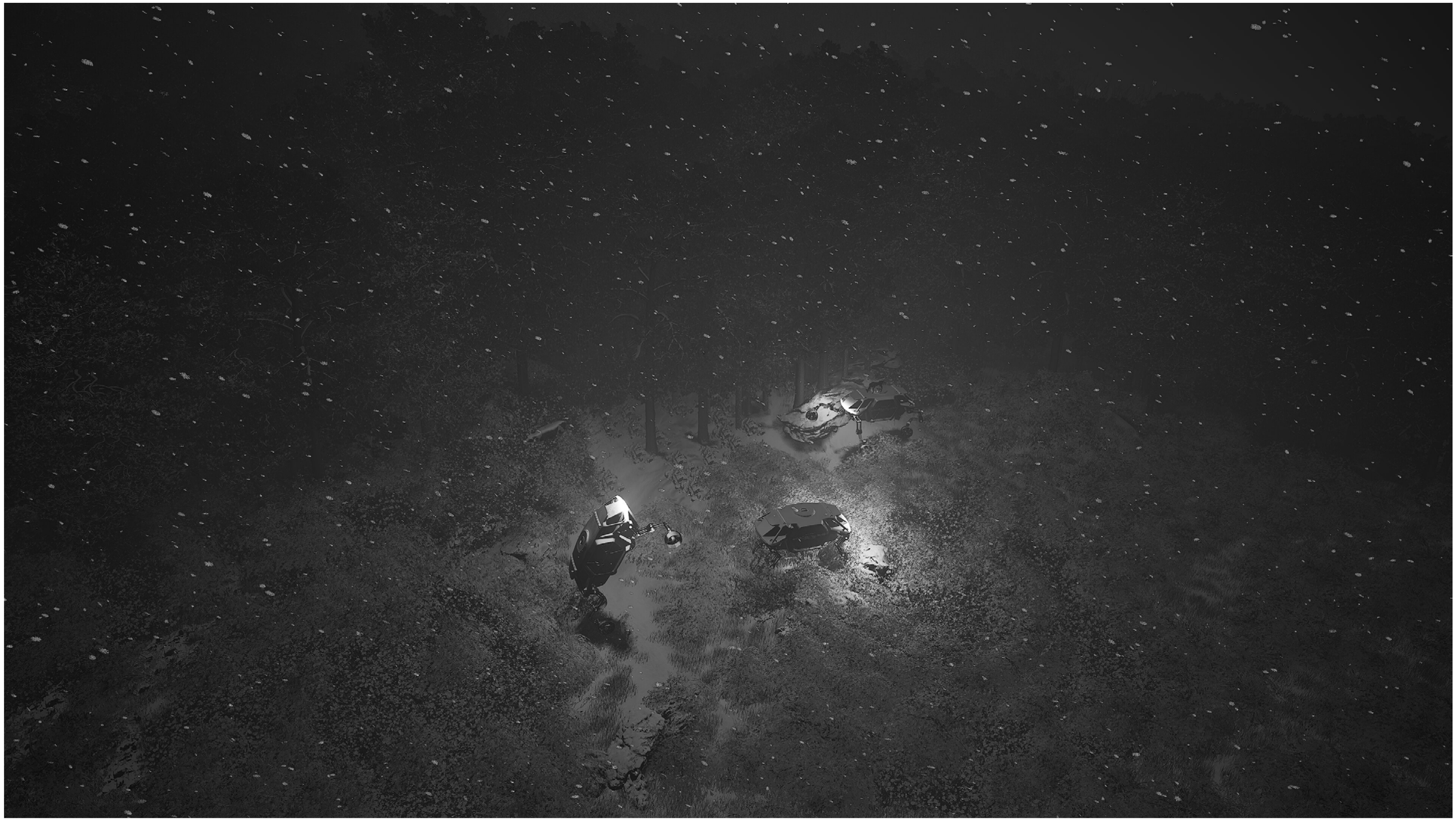
Through this process, I developed a system that responds to the sun as well as the underlying program, allowing the structure to adapt based on environmental conditions. Although I ultimately did not incorporate this design into my studio project, the assignment gave me meaningful experience with parametric movement and expanded my understanding of computational design workflows.

# Assignment 4
Rendering

## Programs

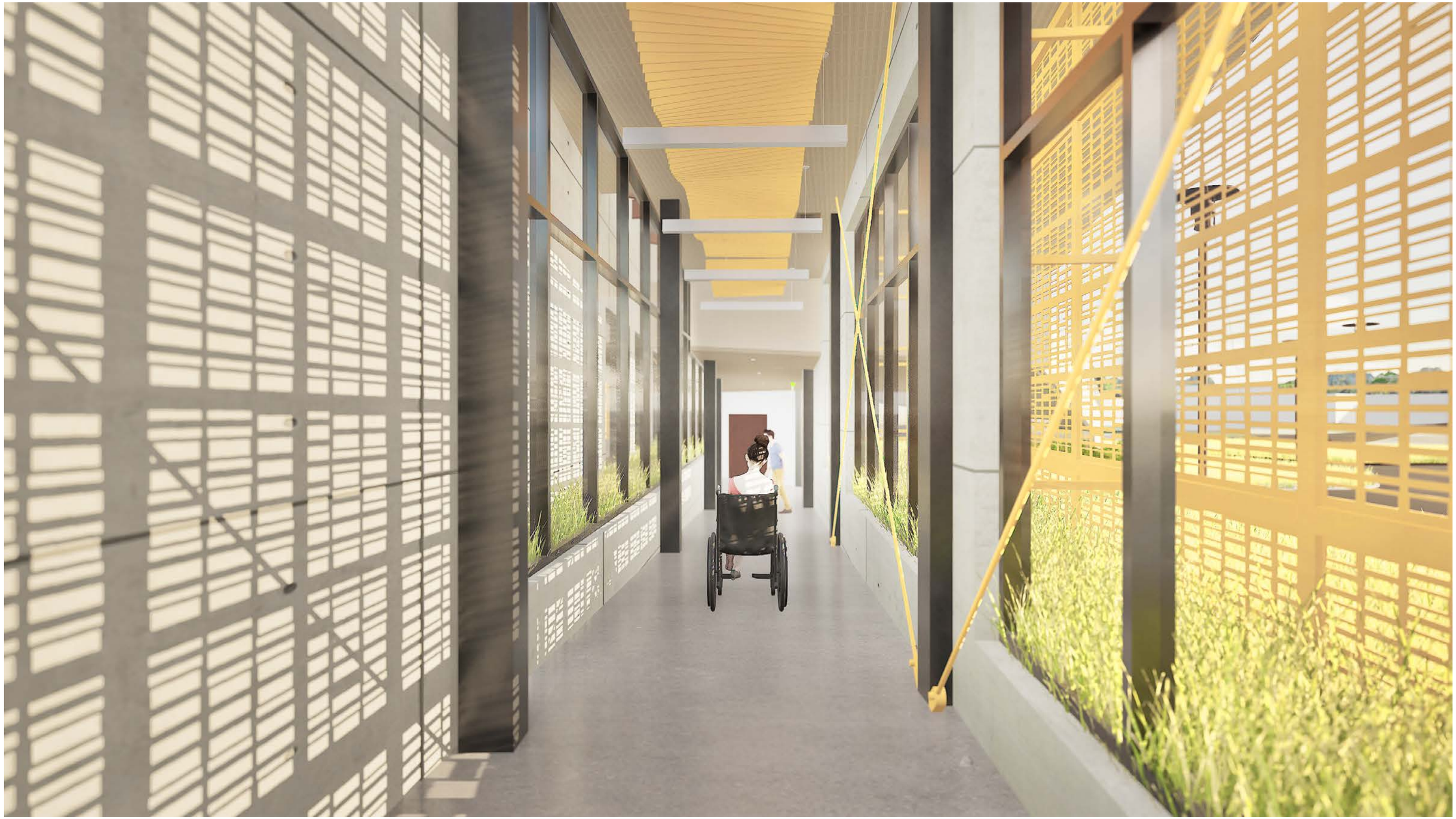
### Twinmotion

### Photoshop



This render features a vehicle designed to traverse all types of terrain. I aimed to depict these machines venturing out into the dead of night during a snowstorm to rescue lost people. I began with a generic landscape and added rocks, grass, and trees to build the scene. Adjustments in media mode really brought the render to life.

This render highlights the exterior courtyard of my project. The most challenging part was arranging the trees and other vegetation accurately and realistically. I'm still learning techniques for creating convincing landscaping, but this turned out quite well. One key takeaway from this process was to turn off layers containing high-poly components, which significantly sped up adjustments.



This is an interior render of a key area in my studio building. I like how the interplay of light and shadow creates a warm, inviting atmosphere.


This is an exterior render of my building’s entrance. While I like the style, it doesn’t fully capture the vision I had in mind. The contrast feels a bit too strong, and there’s something slightly off about the overall feel. Still, it turned out pretty well.

This render showcases my studio project, including the courtyards integrated into the design. The base image felt a bit flat, so I enhanced it in Photoshop by improving the lighting and sharpening the overall quality. I also added an alien.

# Assignment 4 Reflection

I have always enjoyed rendering, and before this class I primarily used Lumion for most of my work. Being introduced to Twinmotion opened my eyes to how much more is possible in terms of visual quality and atmosphere. I began by watching a few tutorial videos, but quickly moved into experimenting with different filters, lighting presets, and rendering styles. There was a learning curve, but once I found a workflow that matched my personal style, the transition became seamless.

After generating the base images in Twinmotion, I brought them into Photoshop to refine the visuals further. I adjusted certain elements, enhanced lighting, and emphasized the focal points to bring more clarity and intention to the final renderings. This combination of software greatly expanded my rendering process and helped me produce images that felt more expressive and polished.