

# FINAL

COMPILED

I can confidently say I learned consistently during this class and it was very inspiring during a very technical semester.



# CONTENT

## 01 ASSIGN

PARAMETRIC SKETCHES

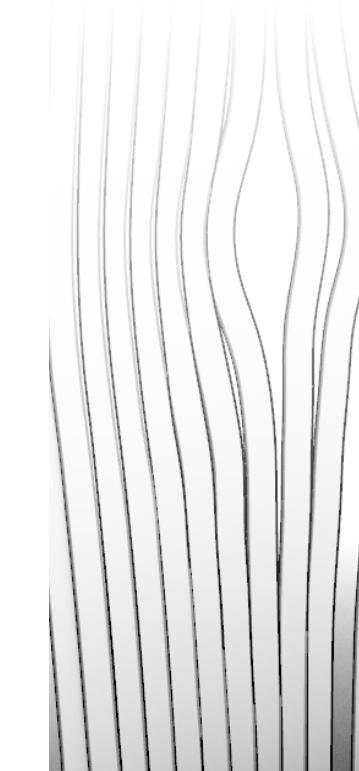
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## 02 ASSIGN

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### PARAMETRIC SKETCHES

We were asked to time ourselves while sketching in the natural environment. We started with a ten minute sketch and continued with a one minute sketch, and then finally a five second sketch. This led us to be able to identify the patterns found after the five second sketch.

### DIGITAL MODEL

After experimenting with Grasshopper and learning the tools further, we were able to create adaptive architecture models.

### LINKING PROGRAMS

From Rhino to Revit we learned how to transition smoothly and utilize Grasshopper in the process. It's important to make sure your Revit and Rhino softwares are up to date and compatible with one another.



### RENDERING

Twinmotion was a new rendering software that we were able to learn a good basis of. Thinking down to details like surfaces, layouts, furniture, lighting, etc. was tedious and very satisfying to see come together in a seemingly more real way.

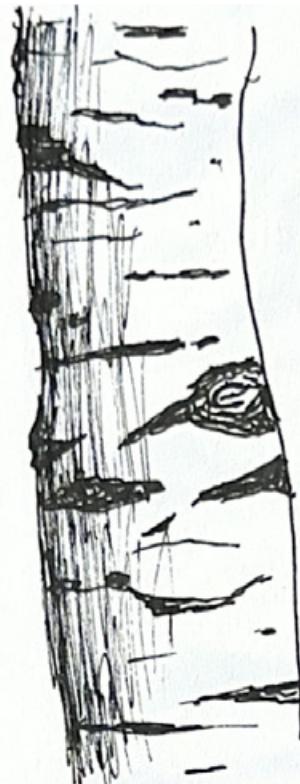


FINAL

## 01 ASPEN TREE

## TRUNK PATTERN

10 MINUTE SKETCH



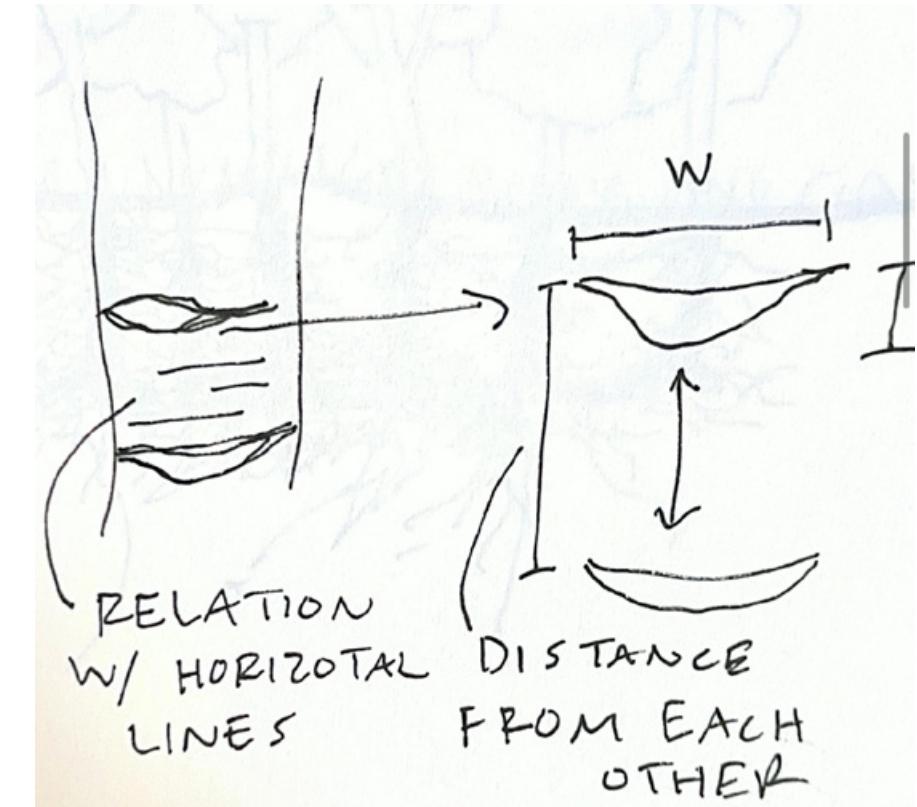
1 MINUTE SKETCH



5 SECOND SKETCH



PARAMETRIC SHAPES



## ASPEN TRUNK PARAMETRIC

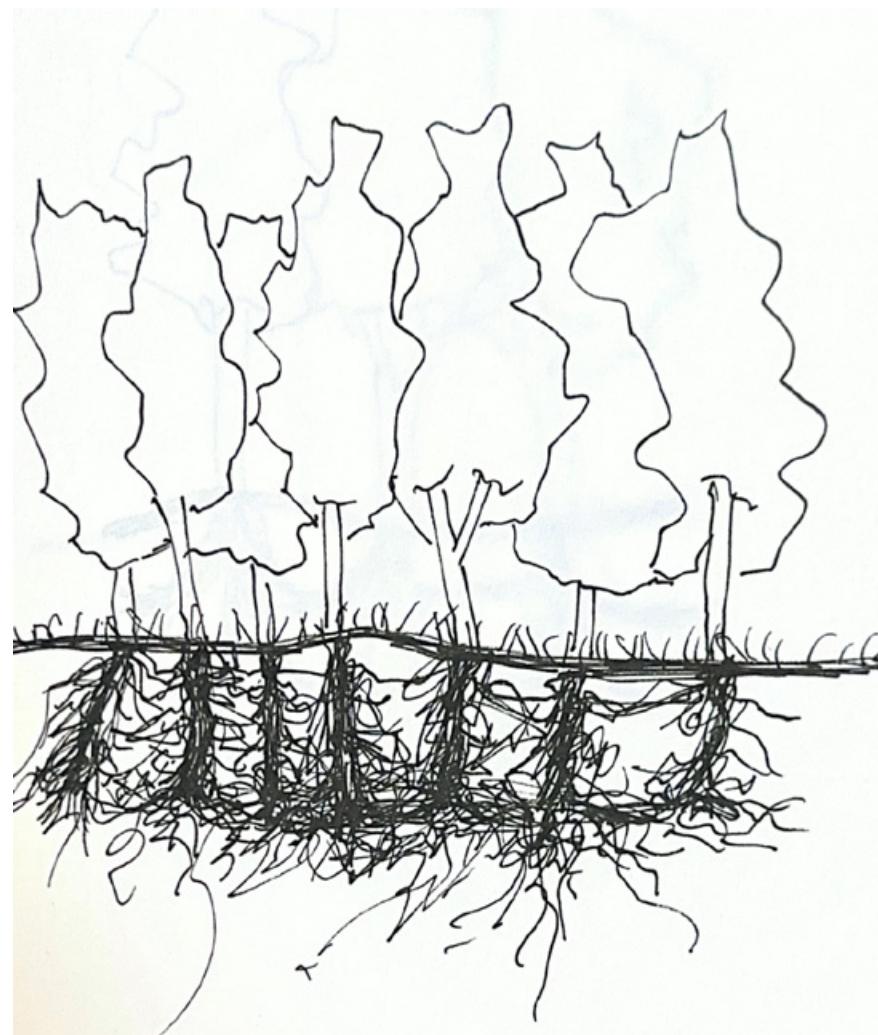
- The change in time between the sketches began to highlight the core patterns creating a clarity. Specifically showcasing the most common shapes that were seen in a repetitive nature.
- The most resilient aspects of the system were the horizontal lines and the scoop shape. Under the time restraints, darker shading and further detail got lost.
- These sketches start to inform parametric thinking in architectural practice by aiding to boil down the pieces that are necessary to maintain the pattern. They began to discuss relations between the pieces in the system.

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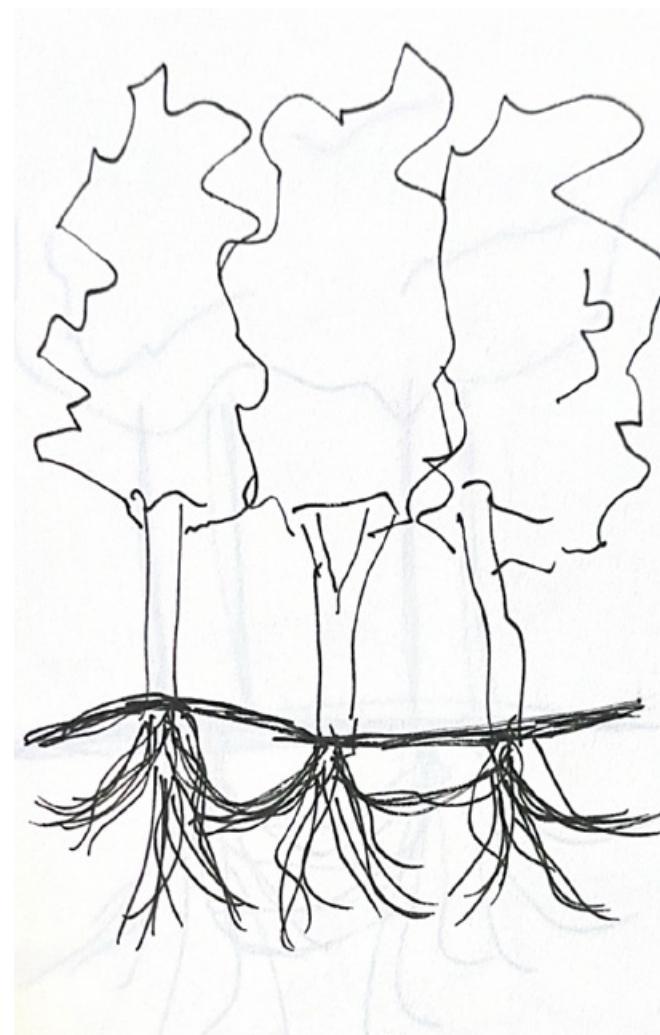
## 01 ASPEN TREE

## ROOT PATTERN

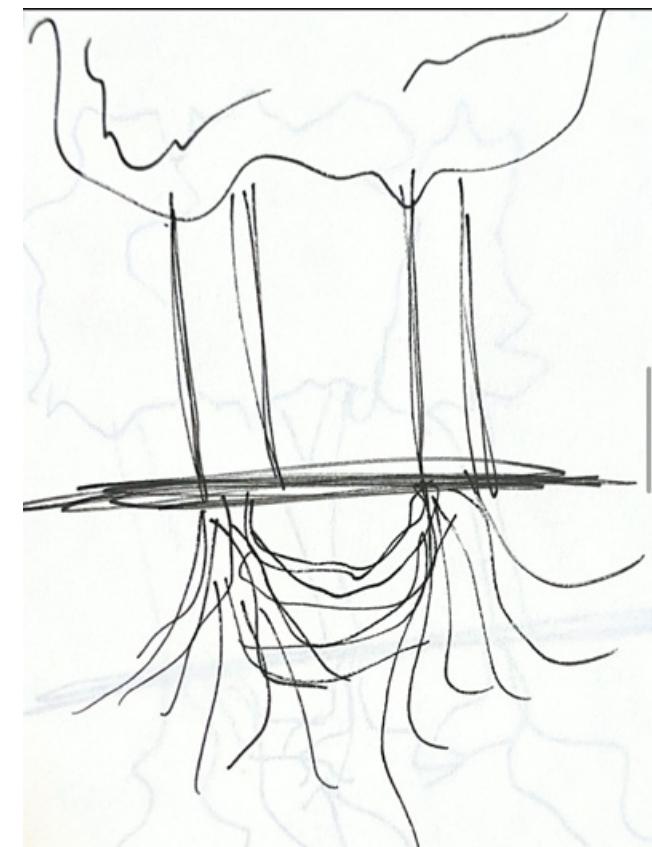
10 MINUTE SKETCH



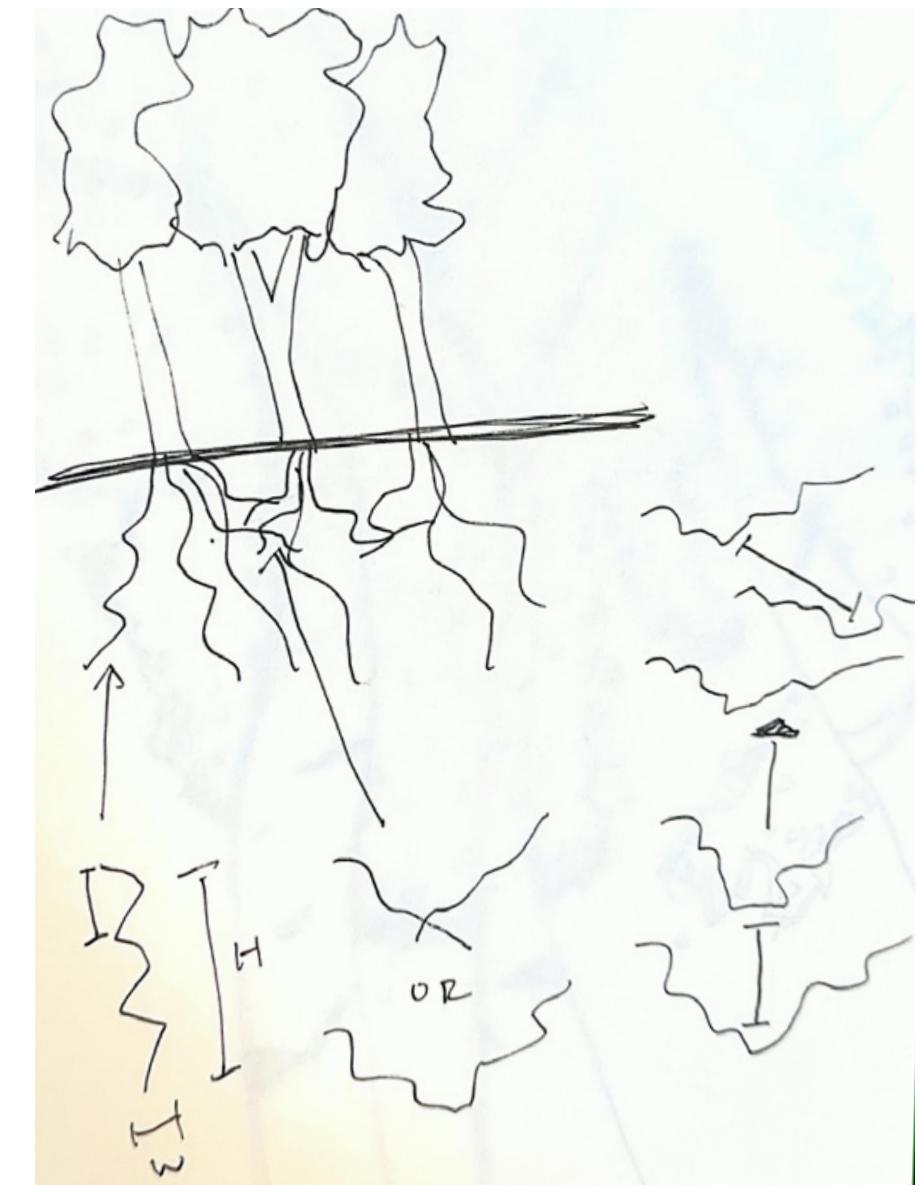
1 MINUTE SKETCH



5 SECOND SKETCH



PARAMETRIC SHAPES



## ASPEN ROOT PARAMETRIC

- The change in time between the sketches aided me when thinking about unseen connections. The 10 minute sketch started out very intense, but by the 5 second sketch I had realized just a few lines could tell the same story.
- The most resilient aspects of the system were the root lines that connect the root systems to one another. It starts to ask the question if these lines meet or cross when they touch.
- These sketches start to inform parametric thinking in architectural practice by taking a conceptual idea and starting to question and or create rules within the system.



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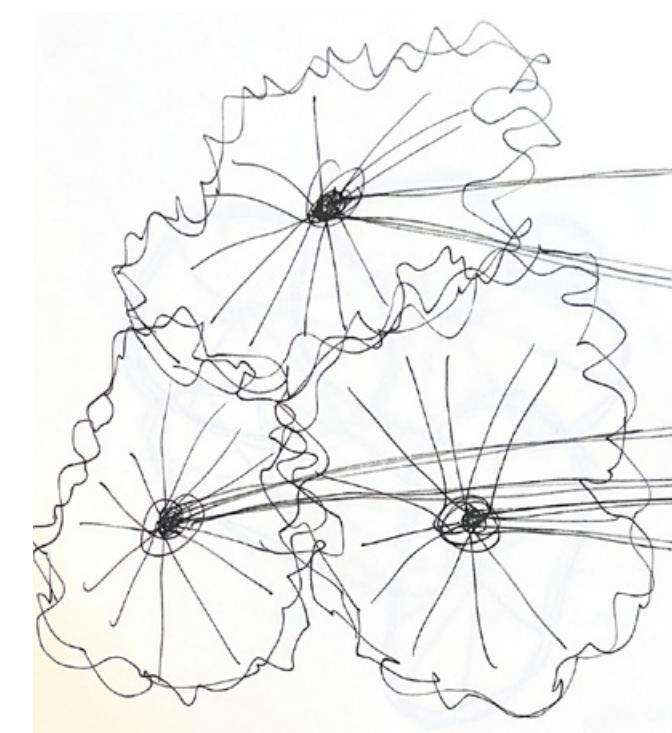
## 01 ASPEN TREE

## CANOPY PATTERN

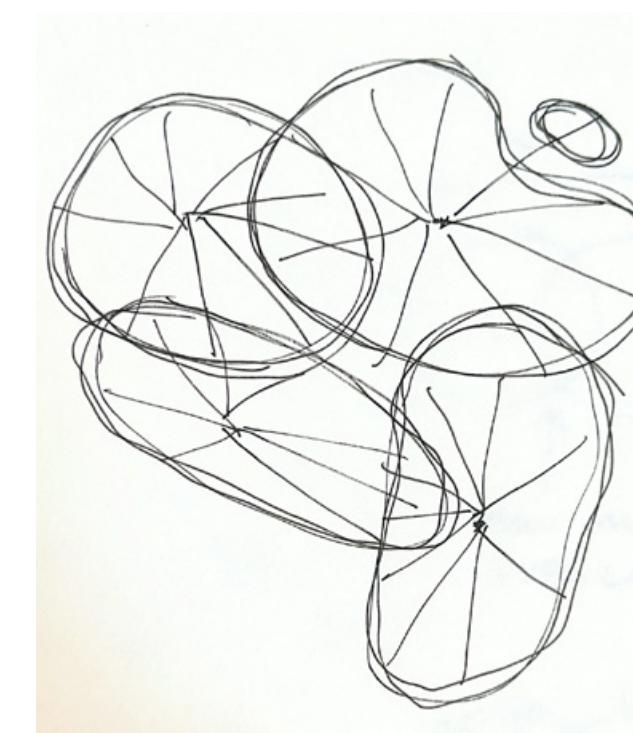
10 MINUTE SKETCH



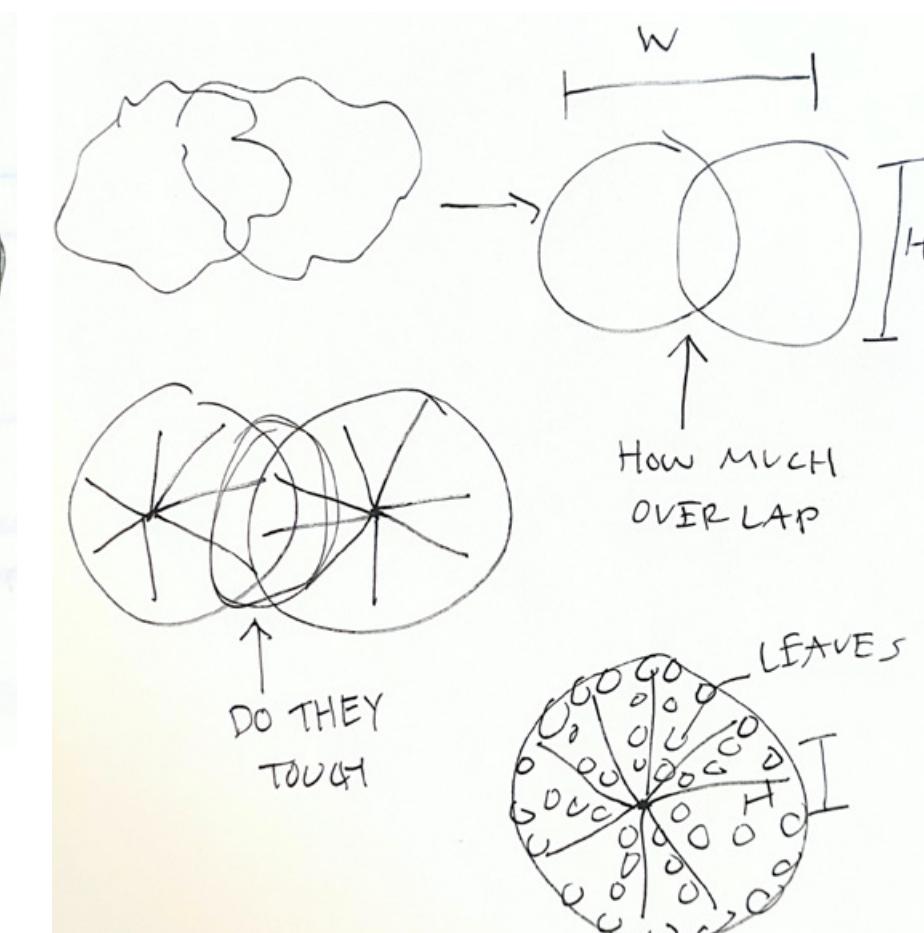
1 MINUTE SKETCH



5 SECOND SKETCH



PARAMETRIC SHAPES



## ASPEN CANOPY PARAMETRIC

- The change in time between the sketches allowed me to clarify what shapes I could derive from a complex system of leaves and branches.
- The most resilient aspects of the system were the circular shapes overlapping. Next lines stemming from a center point and smaller circles could be a secondary consideration.
- These sketches start to inform parametric thinking in architectural practice by reshaping graphical representation of the same system. This started with stripping back to simplicity before reintroducing complexity within a structured means.

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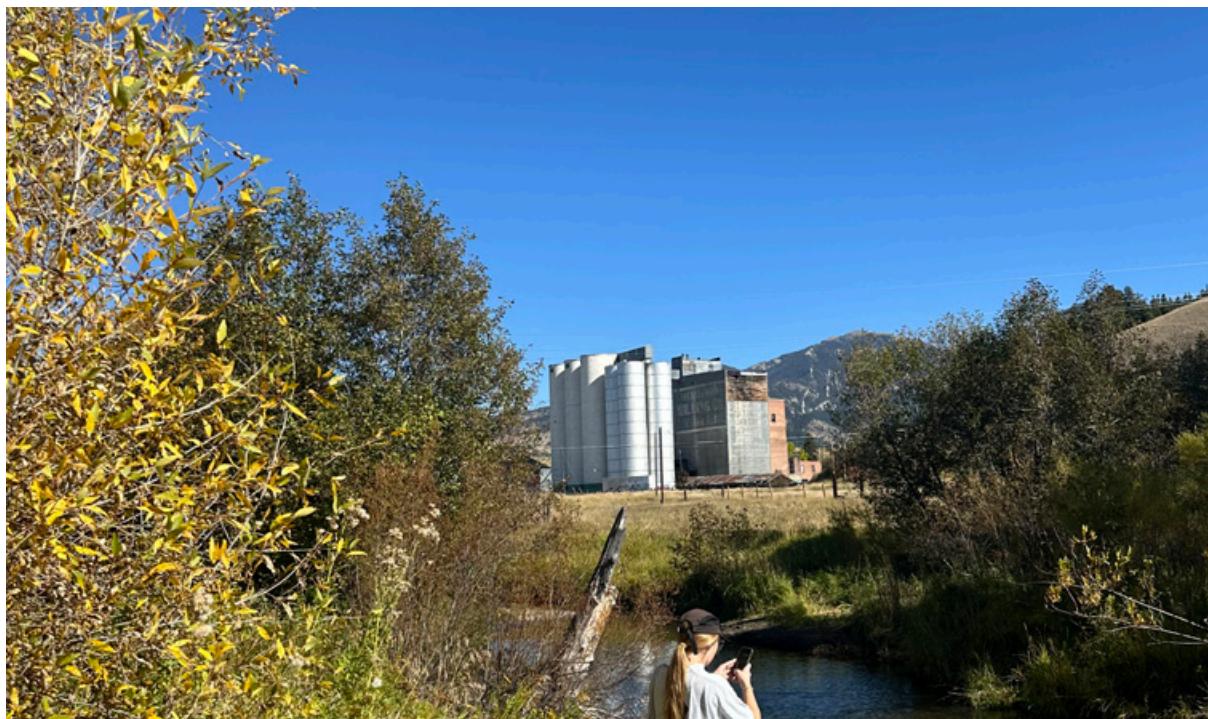
## 01 REFLECTION

## PARAMETRIC SKETCHES

## SUMMARY

This assignment was a great opportunity to spend a few hours outdoors and I became excited about patterns I found at the Story Mill park in Bozeman, Montana. Specifically the aspen tree patterns I was originally drawn to and continued to come back to frequently over the course of the semester. I think this sort of exercise would be excellent to attempt again and implement in my daily life. These simple drawings gave me plenty of inspiration to fall back on when I wasn't sure what to focus on next.

This assignment also reminded me of something I don't want to forget. The computer is a tool, and sketching is just as valuable if not more impactful and helpful at times. Sketching is unique in the way that it's quick and allows you to visualize the ideas in your head and around you!

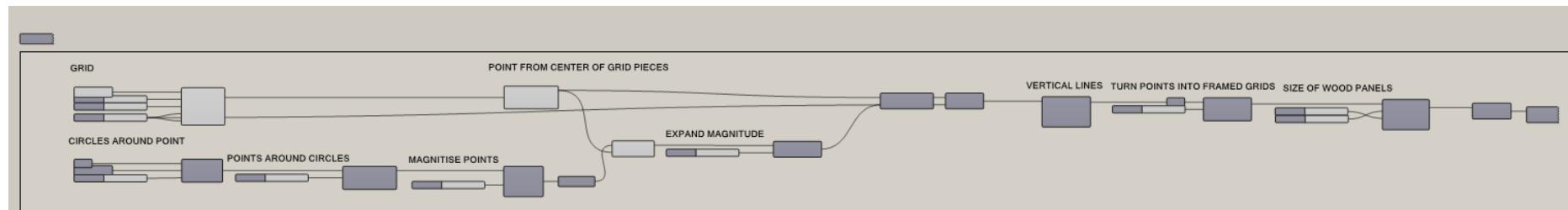


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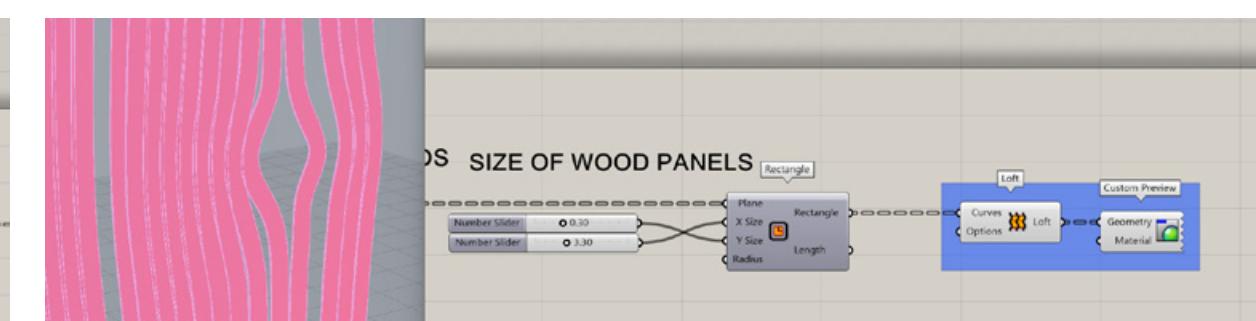
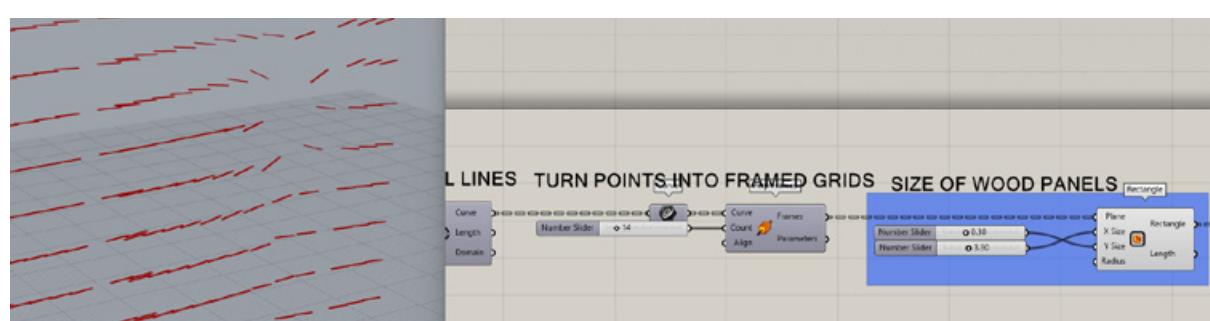
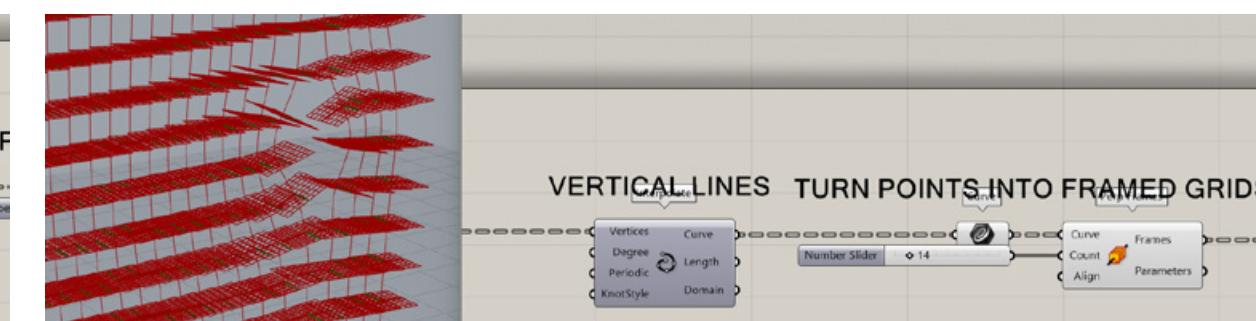
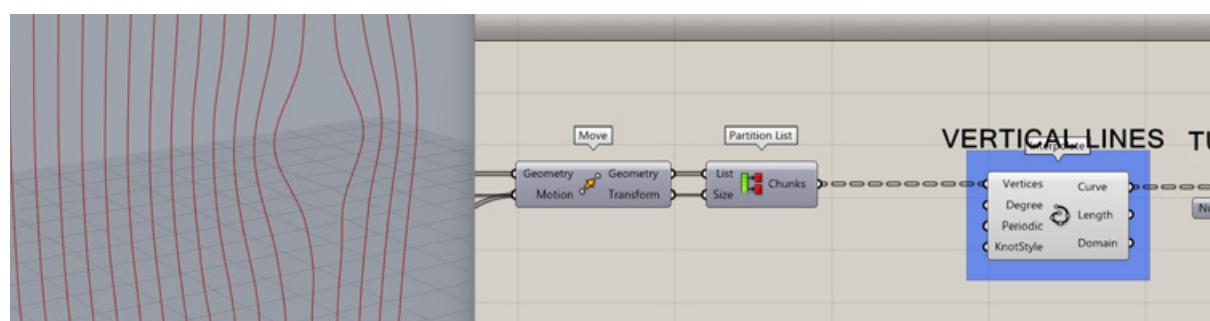
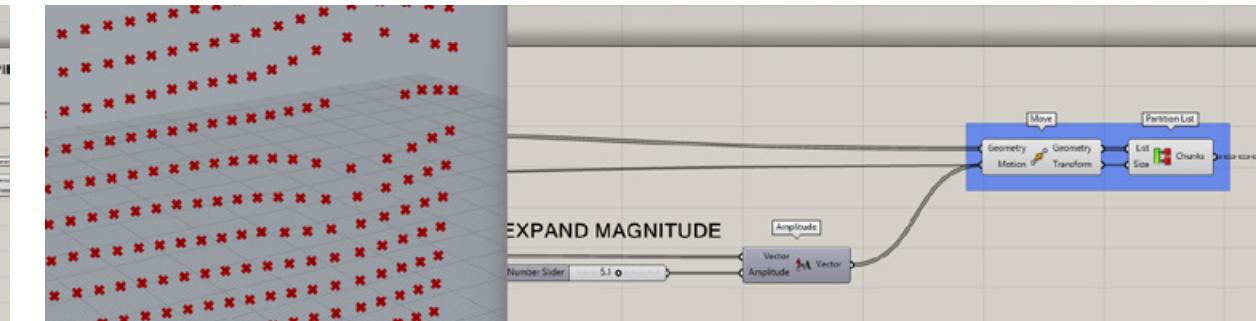
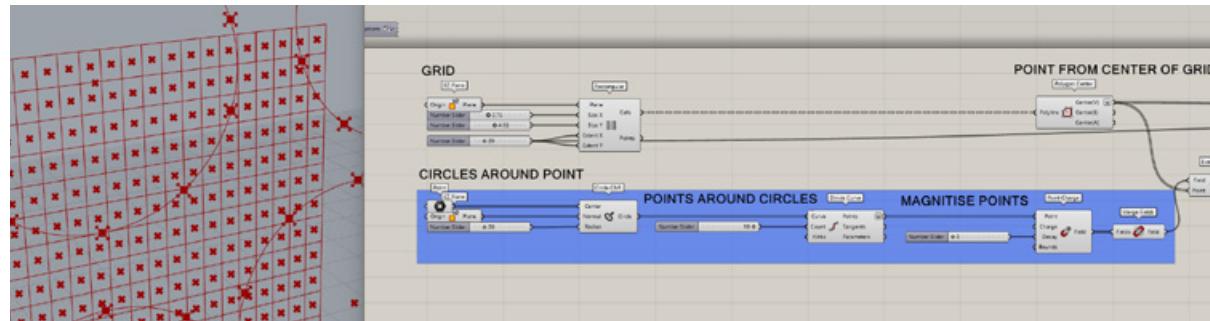
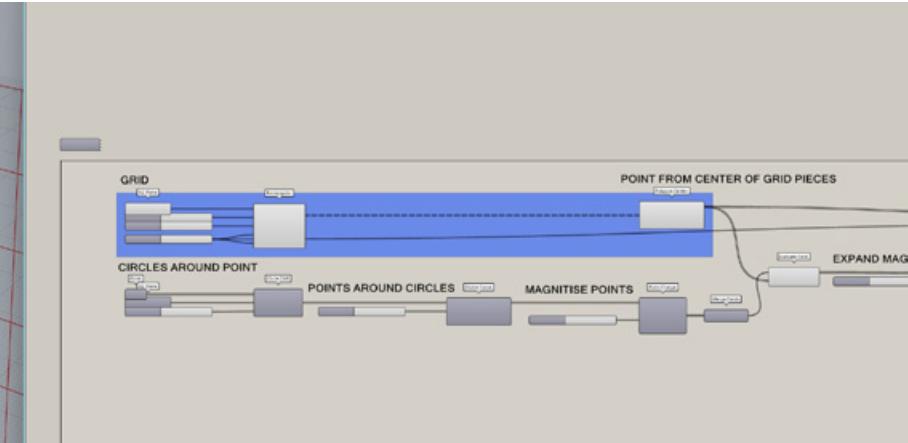
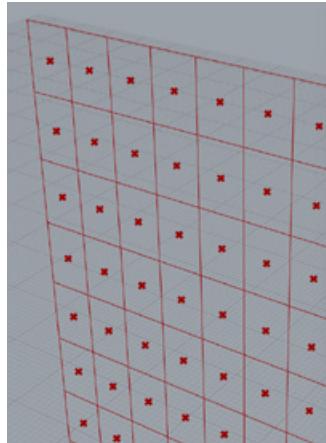
# 02 GRASSHOPPER

## LINKING PROGRAMS

MODEL CREATION IN RHINO | Paneled Screen for Shading

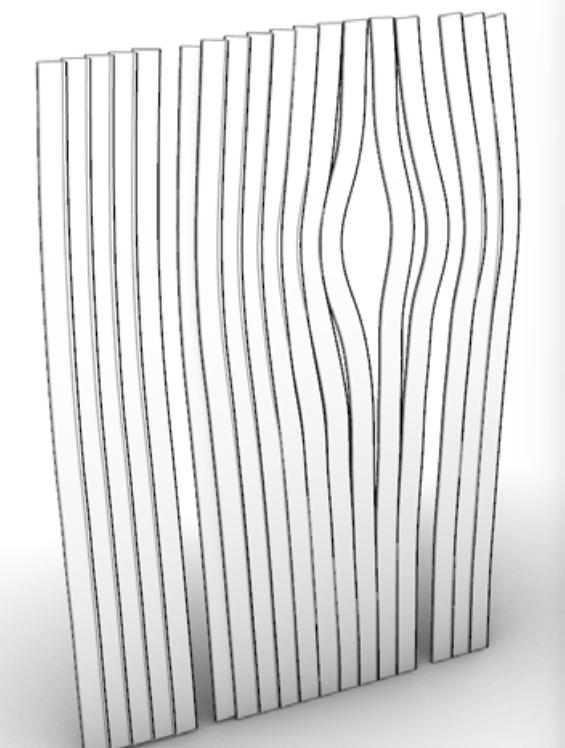


Parametric Geometry



**STEP 01:**  
Develop a parametric idea: Create a paneled screen to use for shaded area or bird watching sanctuary & use a wood pattern.

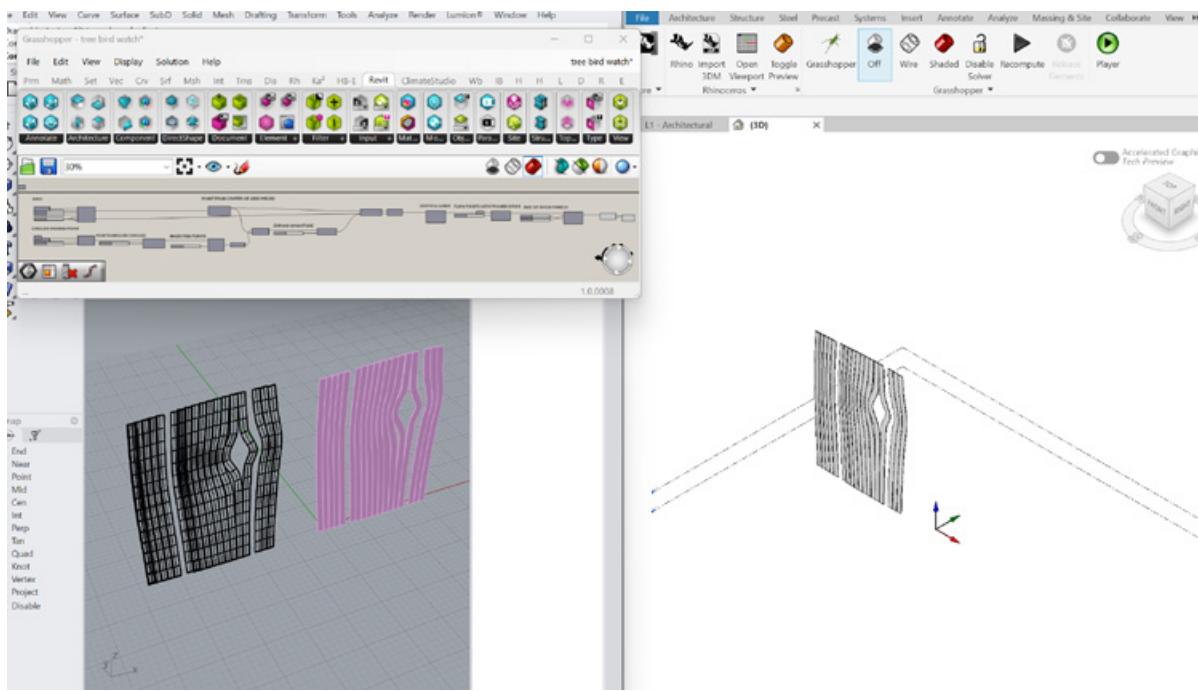
**STEP 02:**  
Open Grasshopper inside Rhino and create a file ready to bring into Revit.



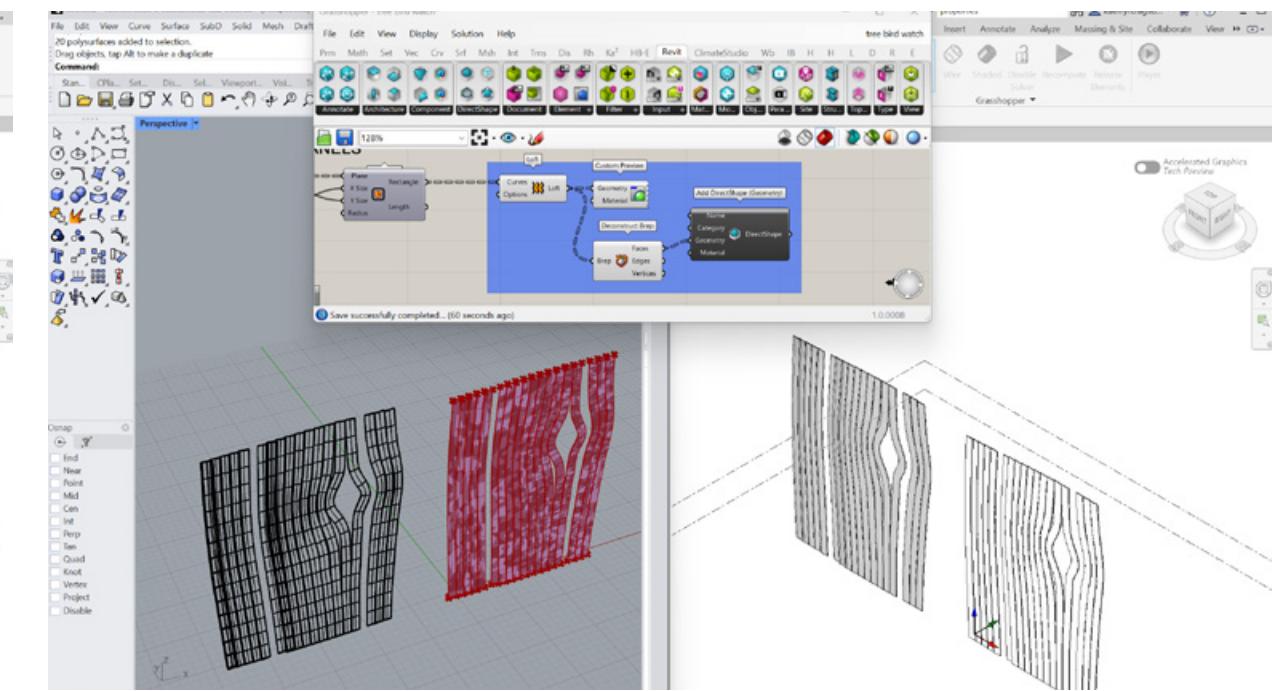
FINAL

# 02 RHINO IN REVIT

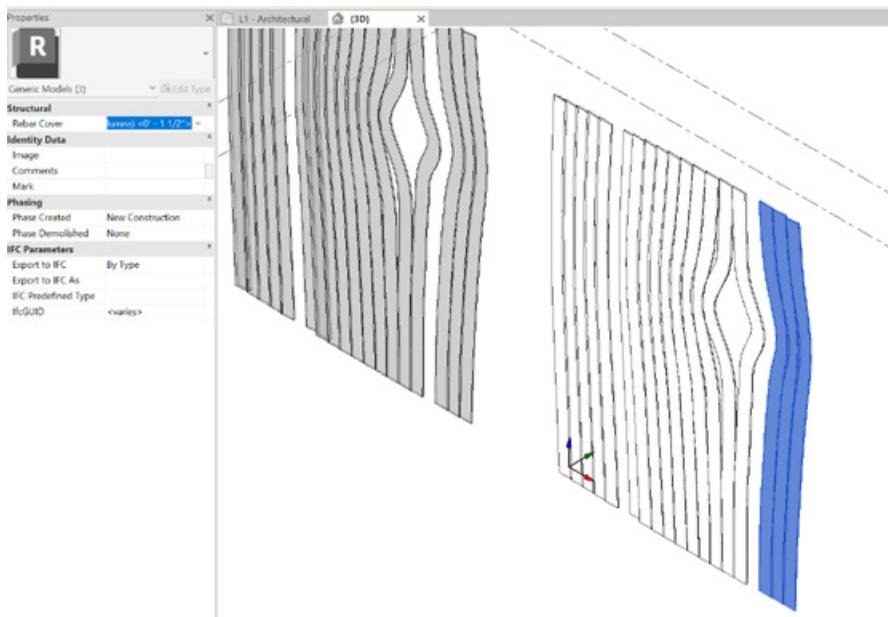
## DATA EXCHANGE WITH REVIT



Import Geometry using Revit Inside Revit



Translate Geometry into Revit Element



Translate Geometry into Revit Element

## STEP 03:

Once in Revit, open Rhino.Inside.Revit. Go to a 3D view and edit VG. Turn on Internal origin point under site.

## STEP 04:

Open a Rhino file and open the same Grasshopper file created in step 02.

## STEP 05:

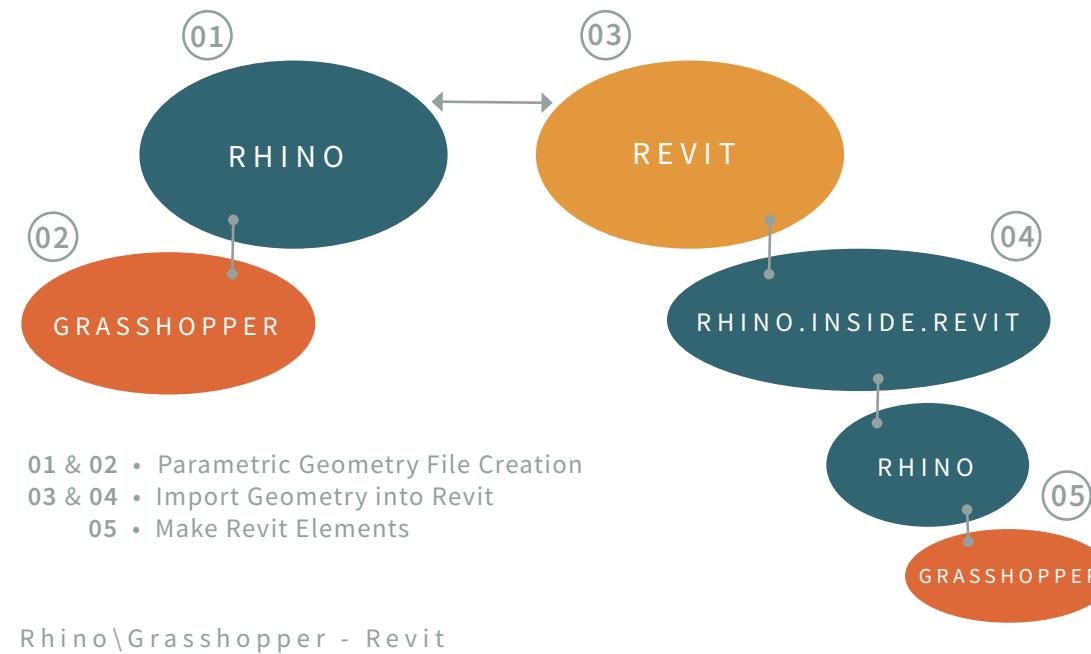
Use Revit tools inside Grasshopper (opened with Rhino.Inside.Revit) to develop Revit elements:  
Transformed Rhino Geometry Slats into framing elements that can individually be selected in Revit.

FINAL

## 02 REFLECTION

## LINKING PROGRAMS

## WORK FLOW DIAGRAM



## SUMMARY

- STEP 01:  
Develop a parametric idea: Create a paneled screen to use for shaded area or bird watching sanctuary & use a wood pattern.
- STEP 02:  
Open Grasshopper inside Rhino and create a file ready to bring into Revit.
- STEP 03:  
Once in Revit, open Rhino.Inside.Revit. Go to a 3D view and edit VG. Turn on Internal origin point under site.
- STEP 04:  
Open a Rhino file and open the same Grasshopper file created in step 02.
- STEP 05:  
Use Revit tools inside Grasshopper (opened with Rhino.Inside.Revit) to develop Revit elements: Transformed Rhino Geometry Slats into framing elements that can individually be selected in Revit.

This workflow highlights the process of linking Rhino and Grasshopper with Revit through Rhino.Inside.Revit. I first modeled a parametric geometry in Grasshopper, providing more control over flexible parameters to replicate tree bark. With Rhino.Inside.Revit this geometry was imported and translated into Revit elements. The integration showed how early parametric experimentation can go directly into Revit without loss of efficiency.

The process ultimately improved the way I view modification of building elements. The main challenges were ensuring that parameter updates in Grasshopper were correctly synchronized within Revit and the coordination between plug-ins. However, once established, the link allowed for what was in Rhino to show in Revit and change as the Grasshopper script was further developed. This workflow would be very useful in professional practice for many building systems looking to bridge conceptual modeling and technical documentation in an iterative loop.

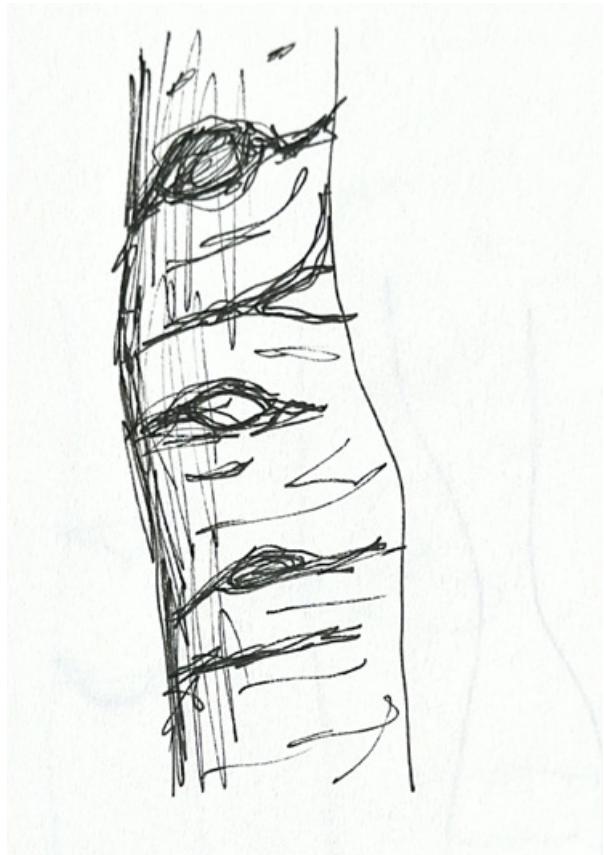
FINAL

# 03 INITIAL SKETCH

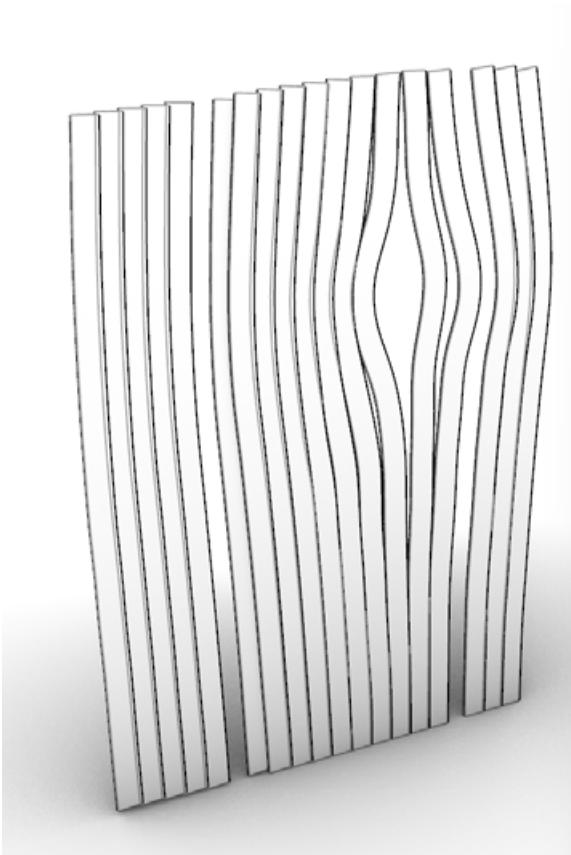
## PAVILLION STRUCTURE

INITIAL IDEAS DERIVED FROM ASPEN TREE

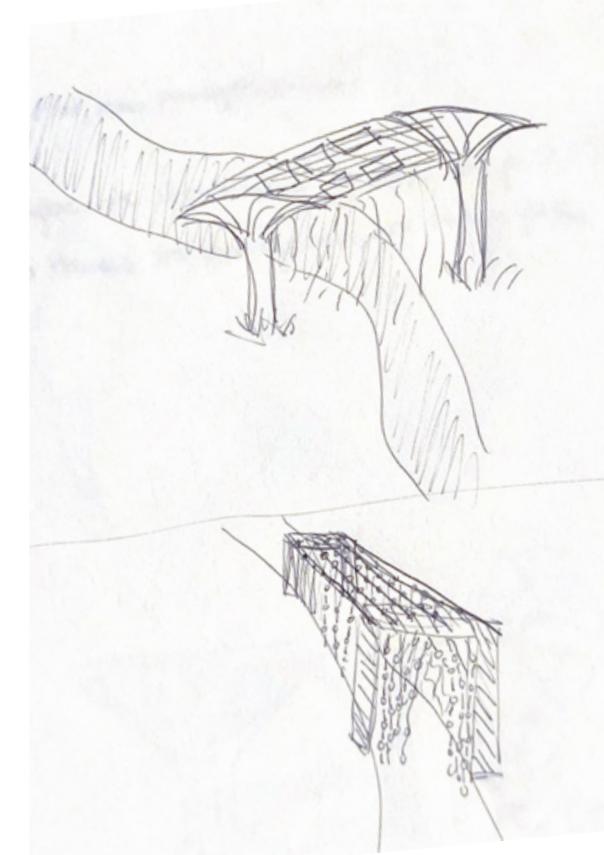
1 MINUTE SKETCH



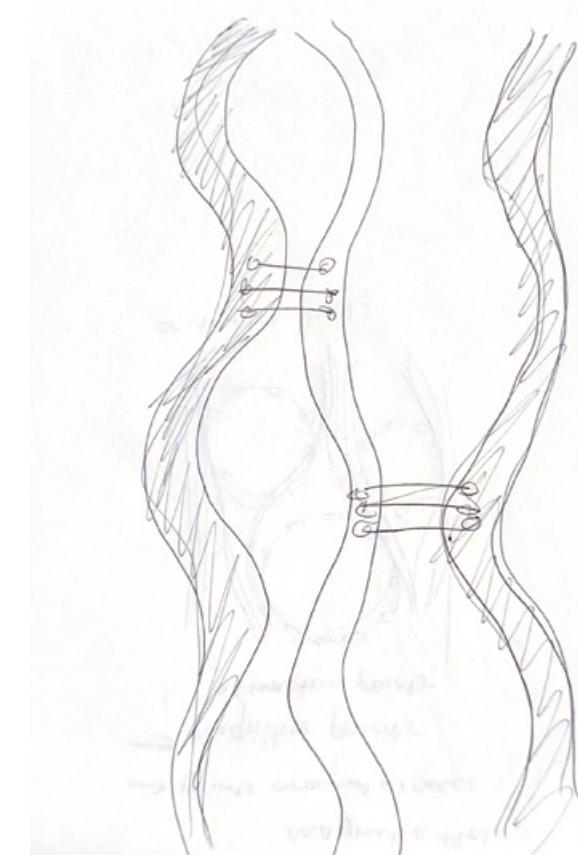
PARAMETRIC GEOMETRY



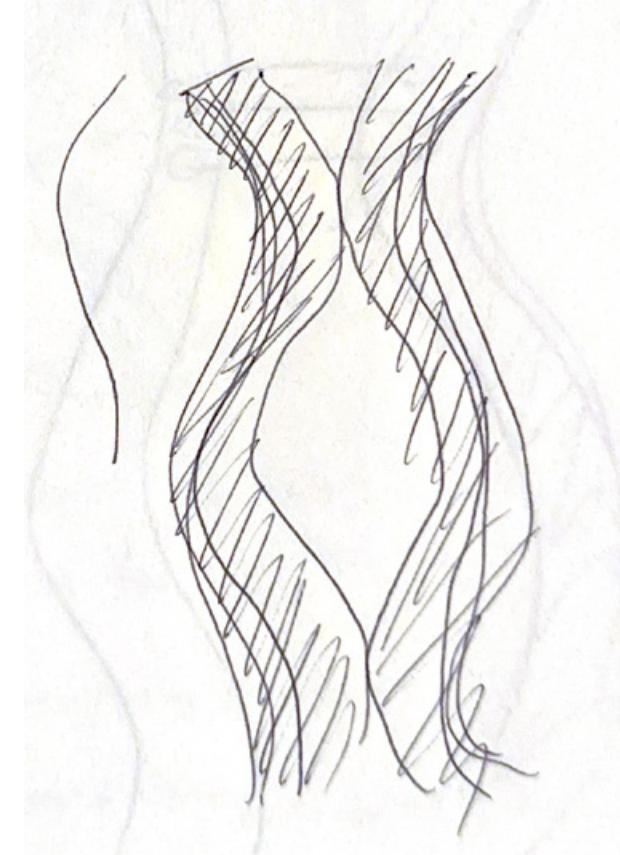
ITERATIVE SKETCHES



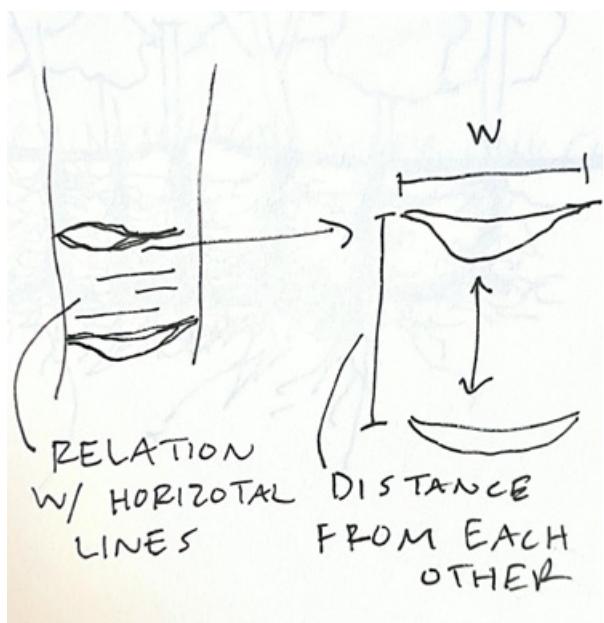
1. WIDTH OF MEMBERS ON ARCH



2. DEPTH OF MEMBERS ON ARCH



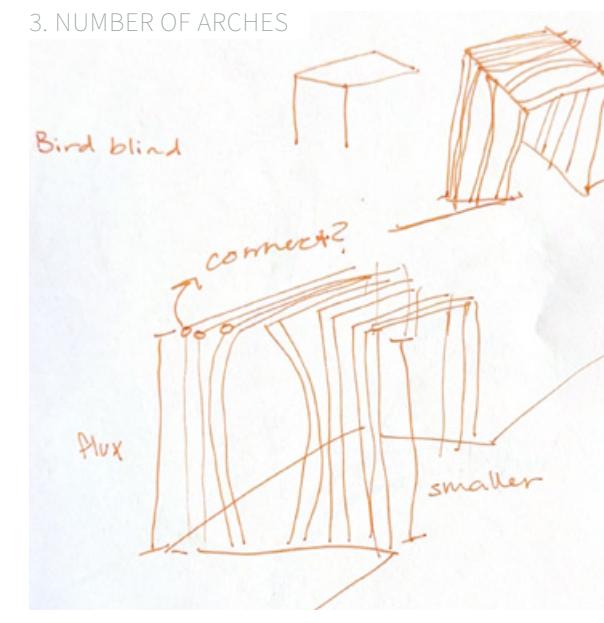
PARAMETRIC SHAPES



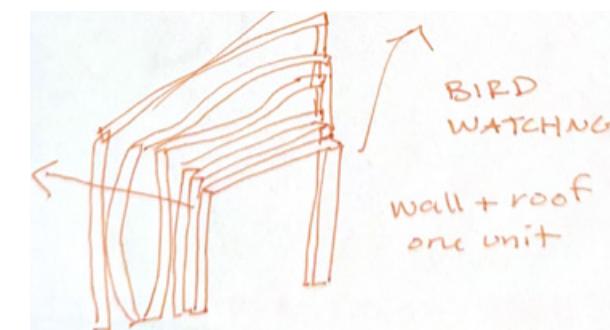
### PARAMETERS FOR PAVILLION

1. WIDTH OF MEMBERS ON ARCH
2. DEPTH OF MEMBERS ON ARCH
3. NUMBER OF ARCHES
4. HOW SPREAD APART ARCHES ARE
5. HEIGHT OF ARCH

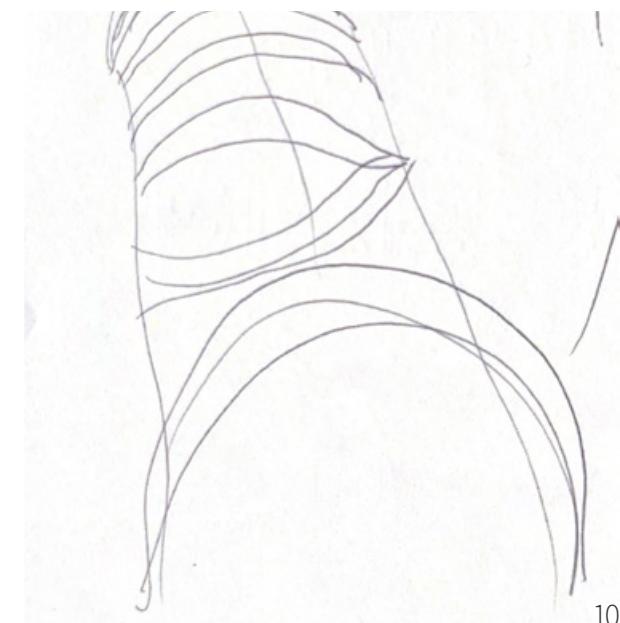
ITERATIVE SKETCHES



4. HOW SPREAD APART ARCHES ARE



5. HEIGHT OF ARCH

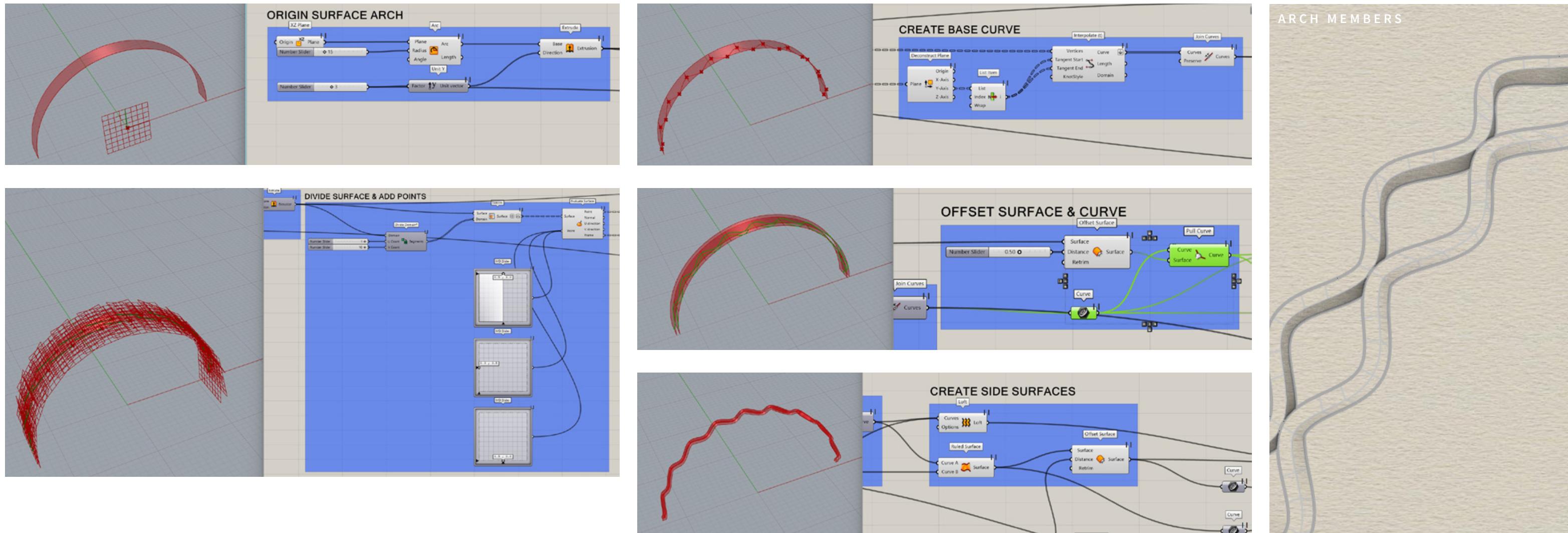
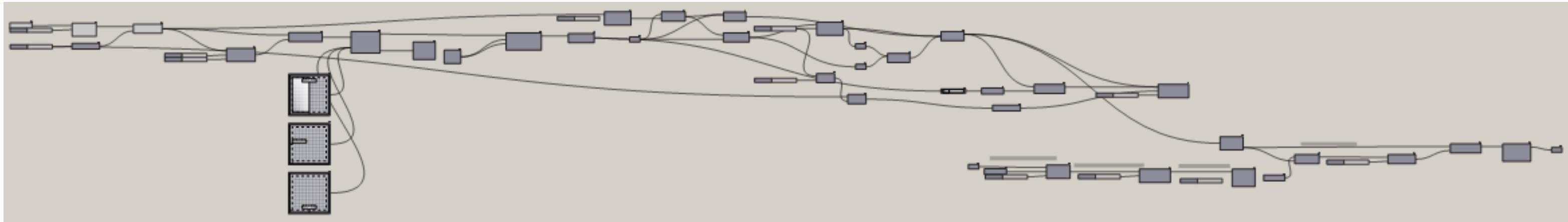


FINAL

# 03 GRASSHOPPER

## DIGITAL MODEL

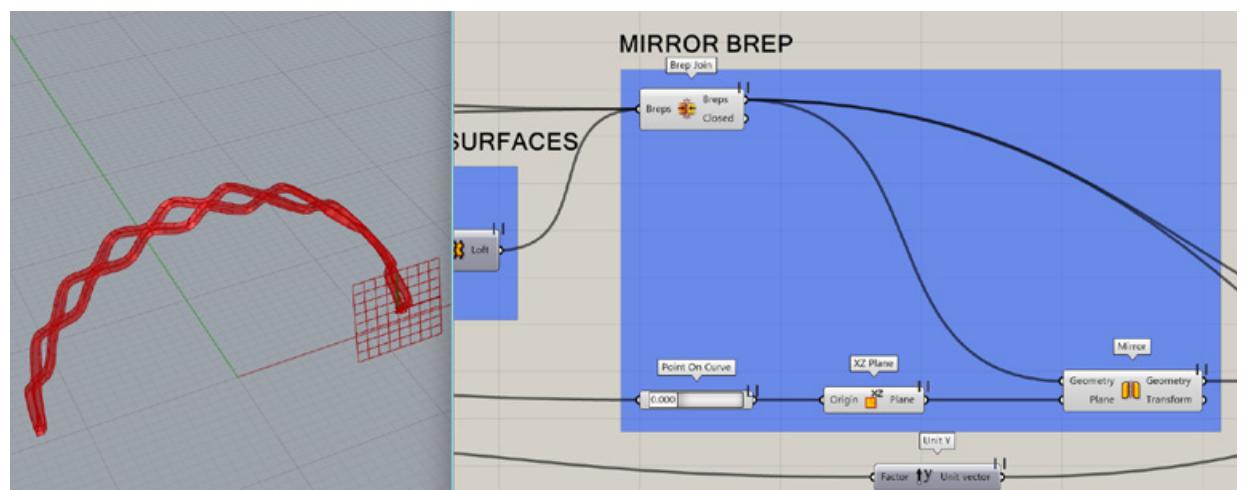
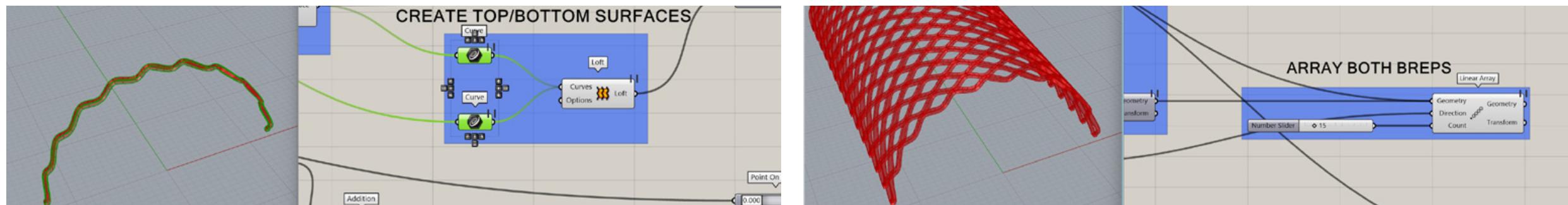
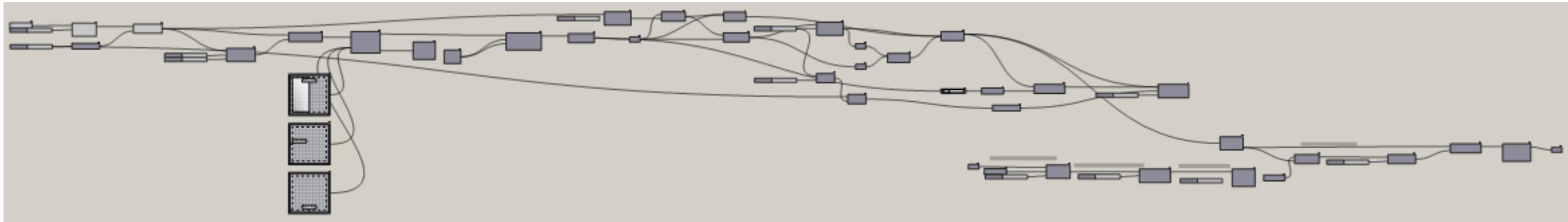
MODEL CREATION IN RHINO Pavillion Structure



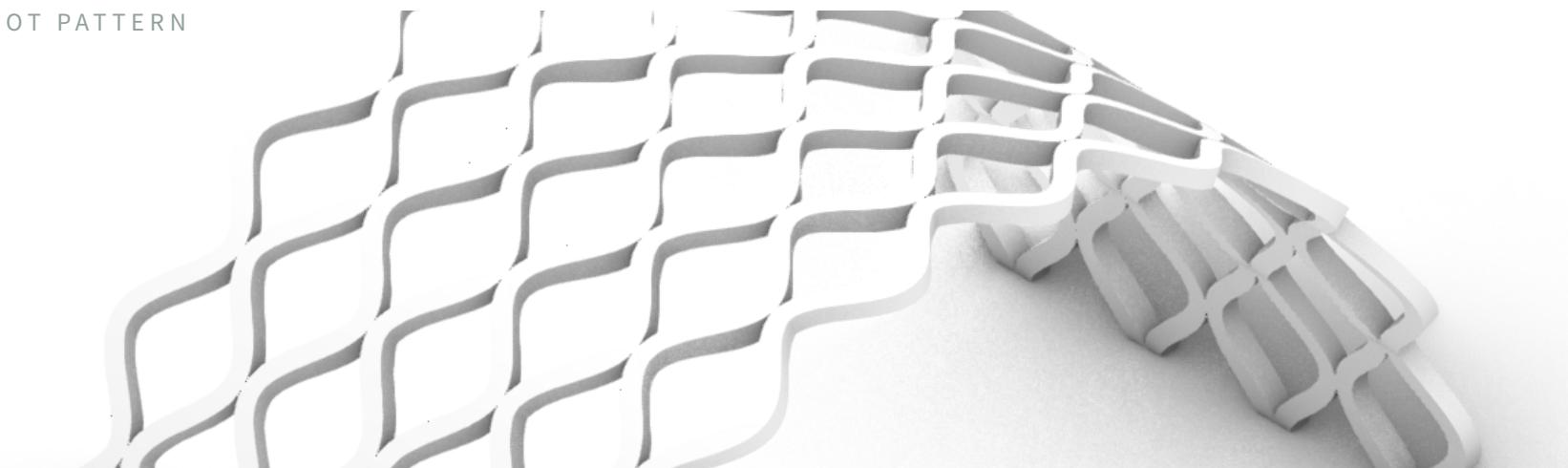
FINAL

# 03 GRASSHOPPER 2 | DIGITAL MODEL

MODEL CREATION IN RHINO Pavillion Structure



PAVILLION KNOT PATTERN

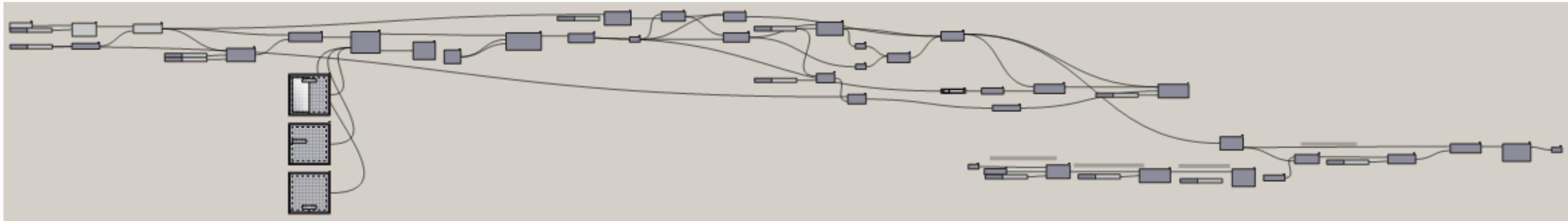


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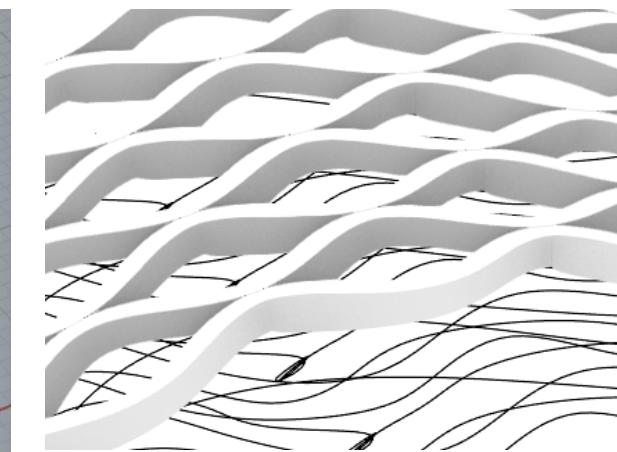
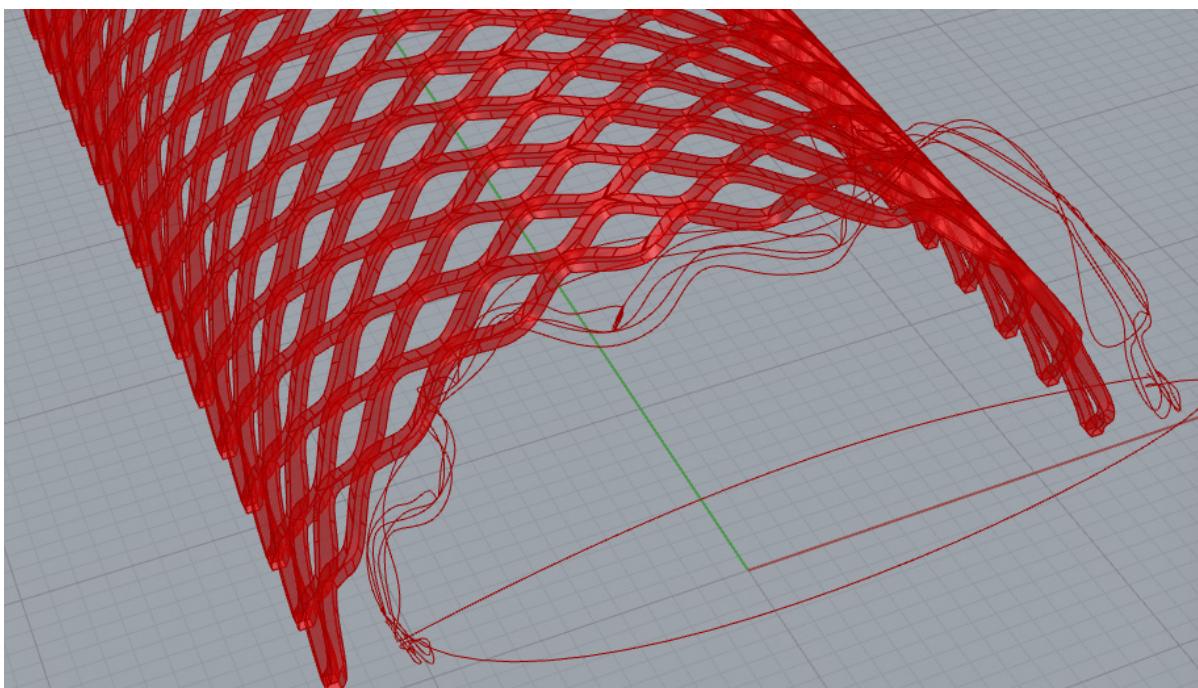
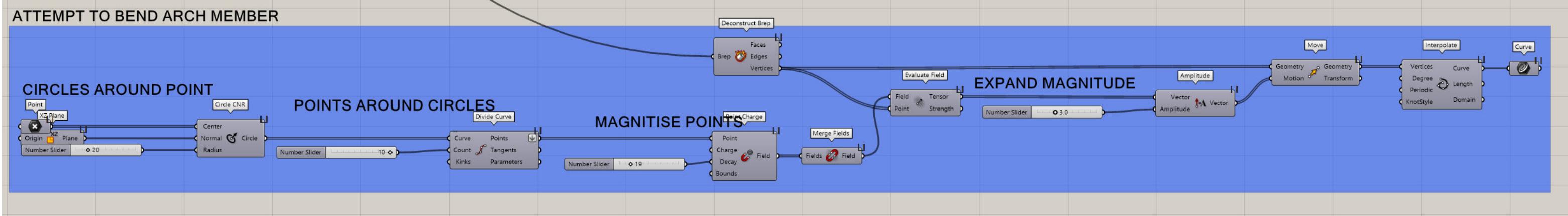
# 03 GRASSHOPPER

DIGITAL MODEL

POTENTIAL TO MOVE FURTHER Pavillion Structure



ATTEMPT TO BEND ARCH MEMBER

**CONTINUATION**

- Adding curving singled out arch's, once or arrayed
- **Goal** was to have an arch member curve out of the pattern for potential seating
  - Most successful attempt
    - Magnitize points from assign 02
  - Other attempts
    - Bend, point, & spatial deform components

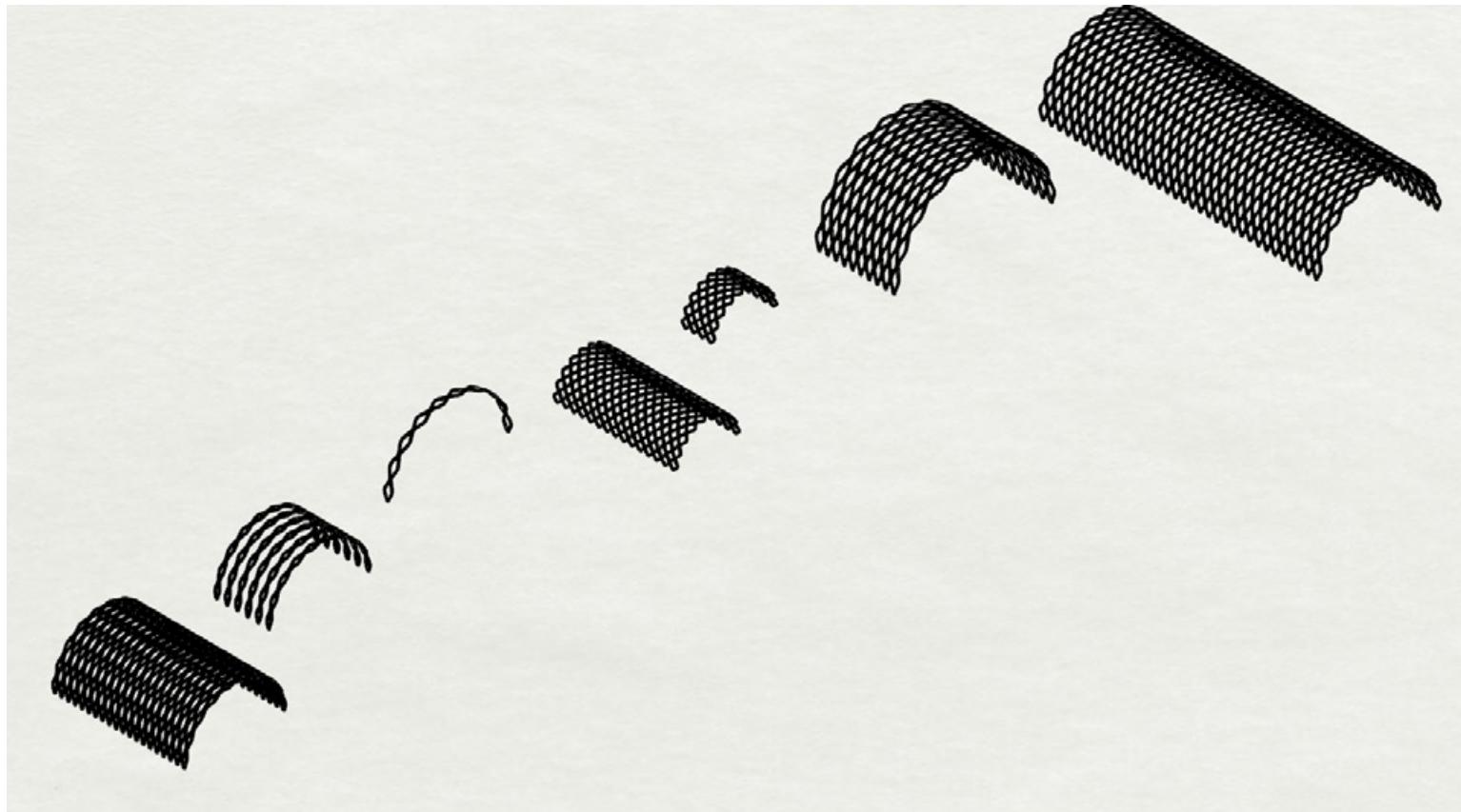
FINAL

## 03 PERSPECTIVES

## DIGITAL MODEL

INITIAL IDEAS DERIVED FROM ASPEN TREE

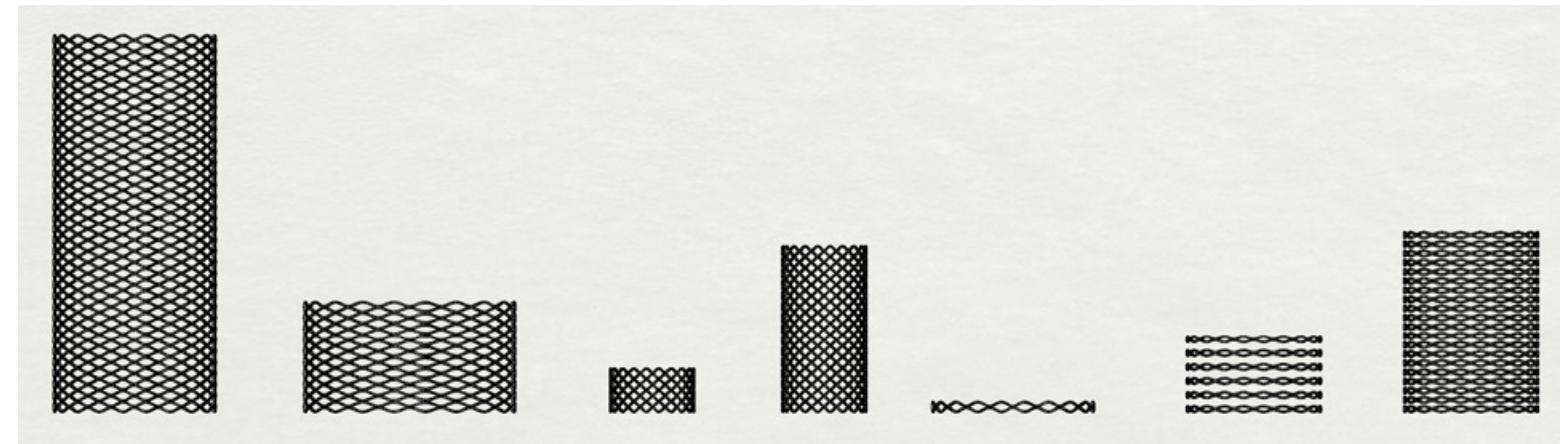
DESIGN VARIATIONS



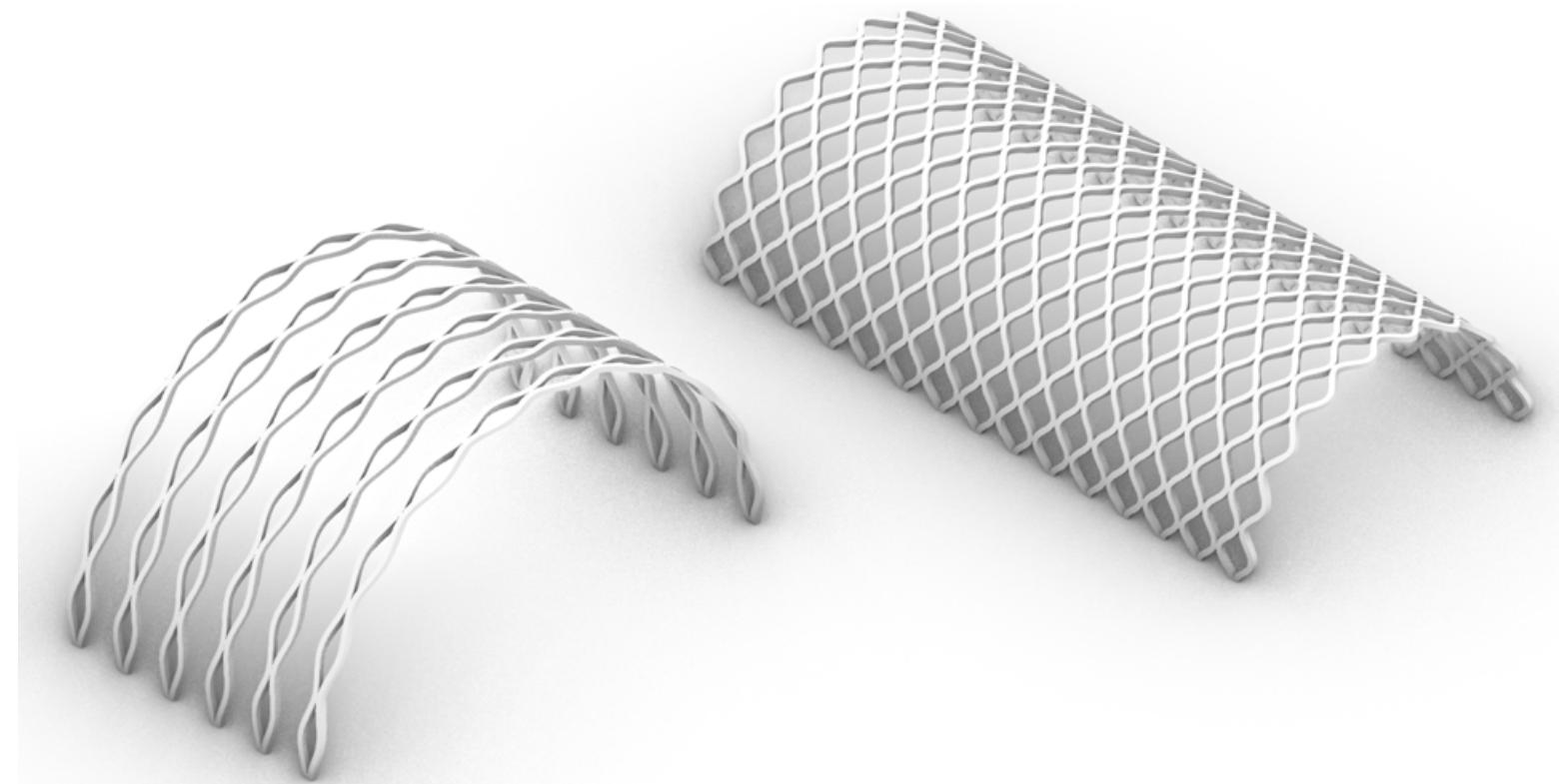
## PARAMETERS

1. WIDTH OF MEMBERS ON ARCH
2. DEPTH OF MEMBERS ON ARCH
3. NUMBER OF ARCHES
4. HOW SPREAD APART ARCHES ARE
5. HEIGHT OF ARCH

VARIATIONS PLAN VIEW



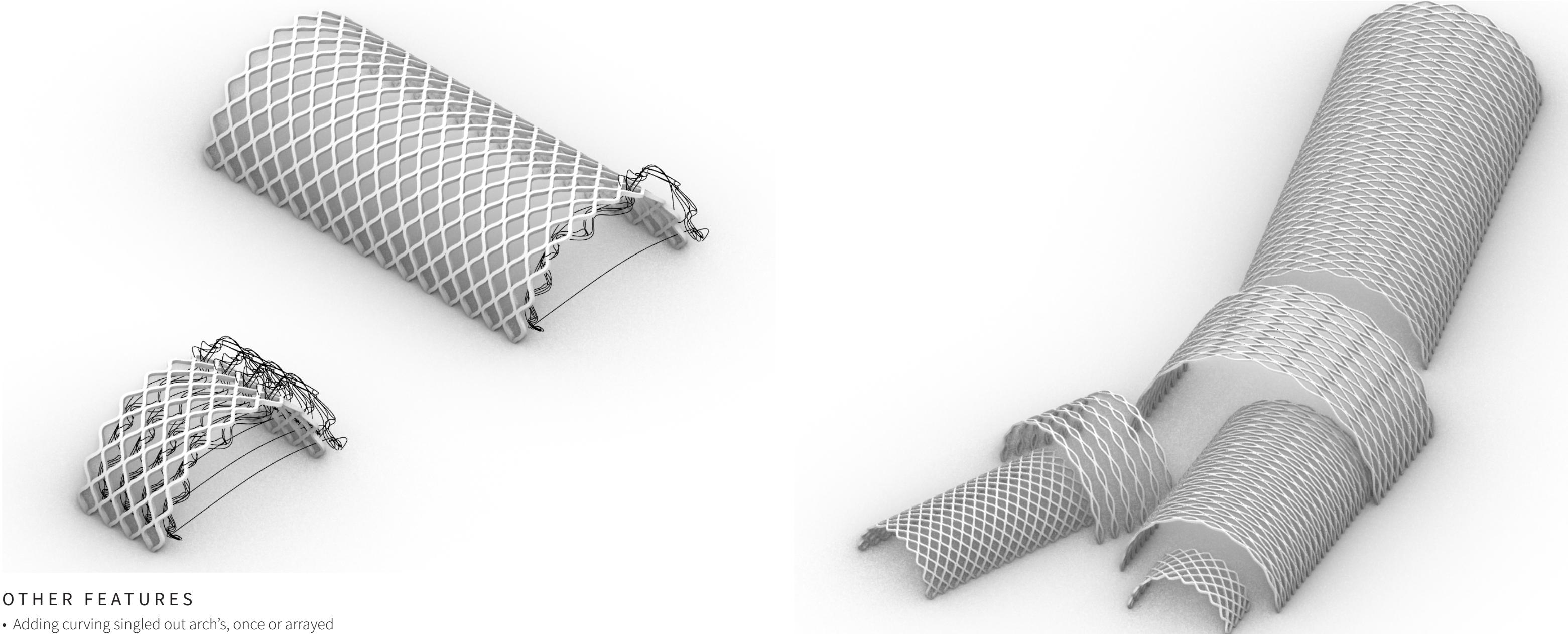
ENLARGED SELECT VARIATIONS



FINAL

## 03 PERSPECTIVES

DIGITAL MODEL



## OTHER FEATURES

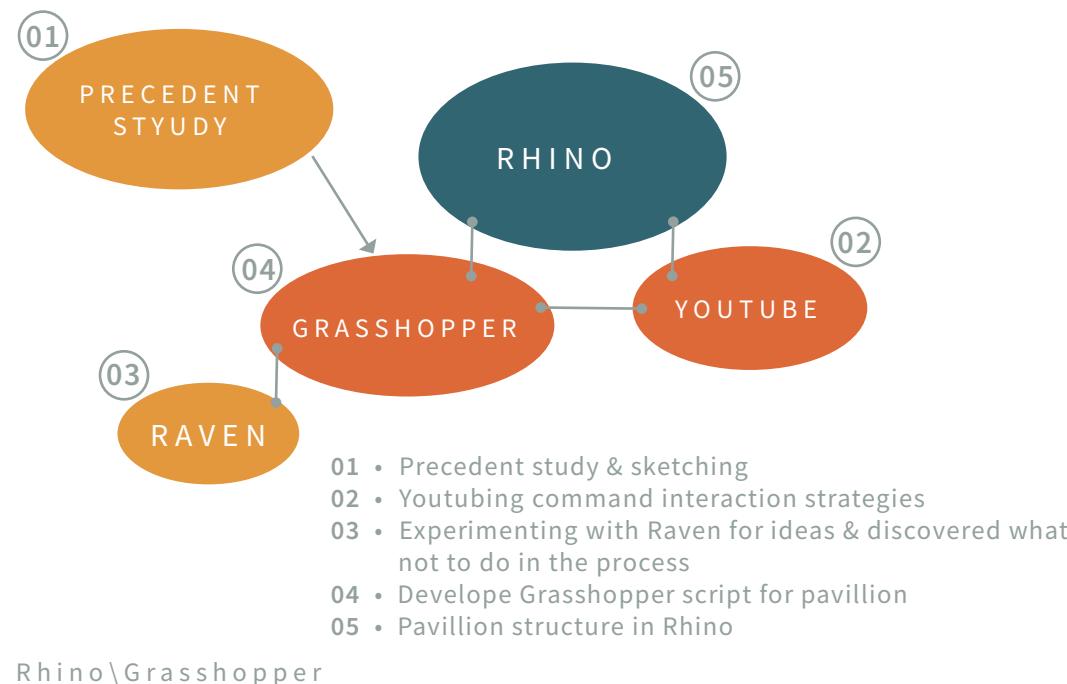
- Adding curving singled out arch's, once or arrayed
- Opportunity to connect different versions of pattern to expand pavillion

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## 03 REFLECTION

## DIGITAL MODEL

WORK FLOW DIAGRAM



SUMMARY

- STEP 01:  
Sketch and get inspiration for what to create.
- STEP 02:  
Research precedents for the design & similar Grasshopper scripts.
- STEP 03:  
Experiment & develop Grasshopper script.
- STEP 04:  
Contemplate future iterations that would further push the design.
- STEP 05:  
Take screenshots of variations & reflect on process.

This workflow highlights the process of digital modeling of a parametric system. I spent a large amount of time looking at precedents and trying to find what excited me. Thinking about moving away from mimicking a knot directly on a paneled surface, I aimed to find a pattern or system that would define space not just from one plane. I could see this pavilion structure as a shading system over a pathway or as a bird watching site. In the future, it could be interesting to curve select arches for seating or other uses. Considering a shell or how climate analysis could begin to interact with the system could also advance this concept further.

Using parametric methods shifted the way I approach design by reframing geometry as something dynamic rather than fixed. Instead of modeling a single outcome, I began modeling relationships that allow the design to flex and adjust as new information emerges. Working in Grasshopper pushed me to think less about the object as a whole and more about constructing a system that could generate multiple variations with intention.

FINAL

04 RENDER

LIBRARY



FINAL

04 RENDER

EXTERIOR LOBBY

**TWINMOTION**

Learning how to use Twinmotion was quite different than other render softwares I've used in the past. I really enjoyed the many settings to play with while it does take time to adjust them. The aspects more similar to a camera made me really inspired and I can't wait to keep learning about them!

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## 04 RENDER

## DINING HALL



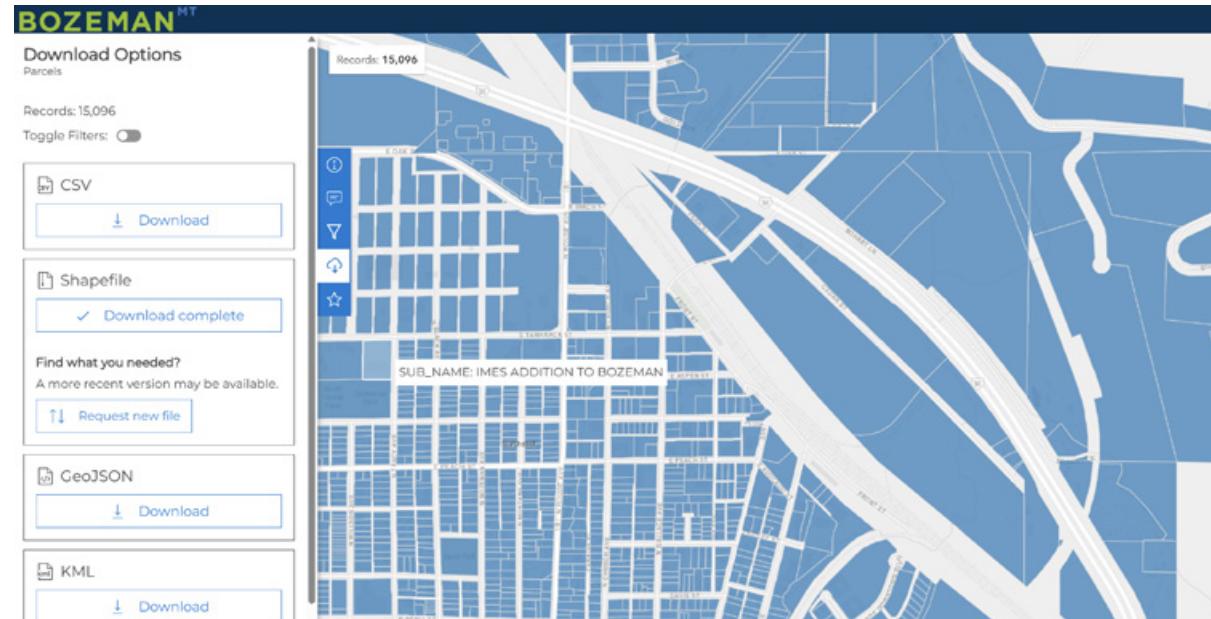
FINAL

# 05 RESOURCES

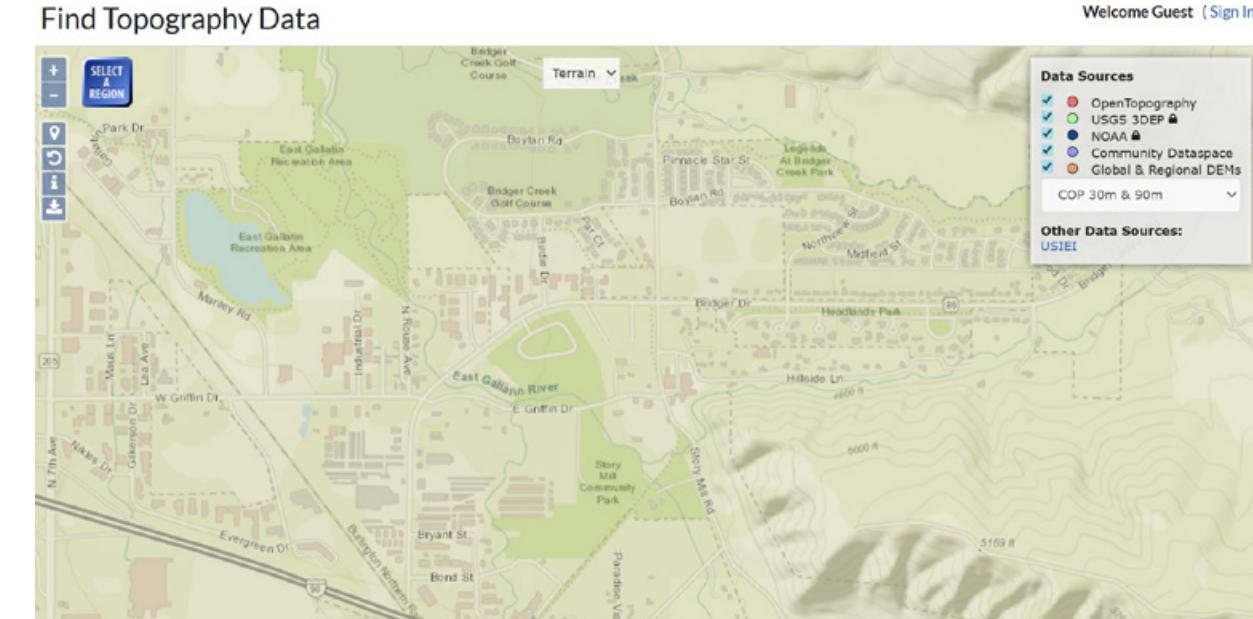
## REFERENCES & NOTES

### SITE MODELING LiDAR and Physical Fabrication

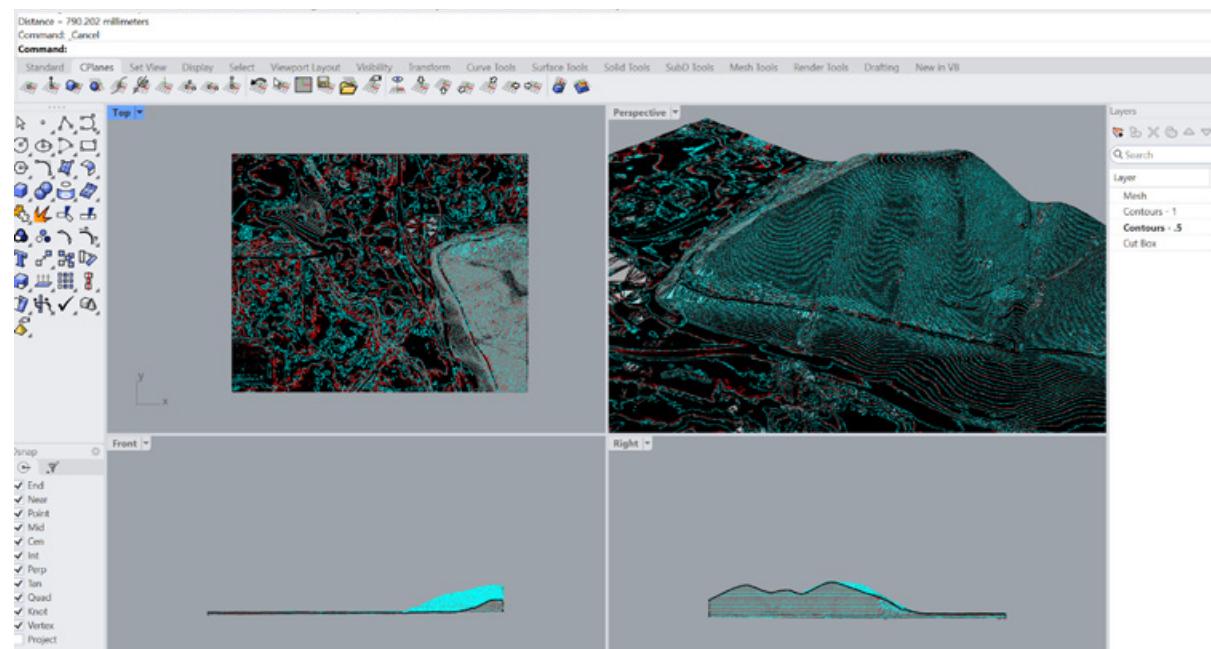
#### DOWNLOAD PARCELS FROM CITY



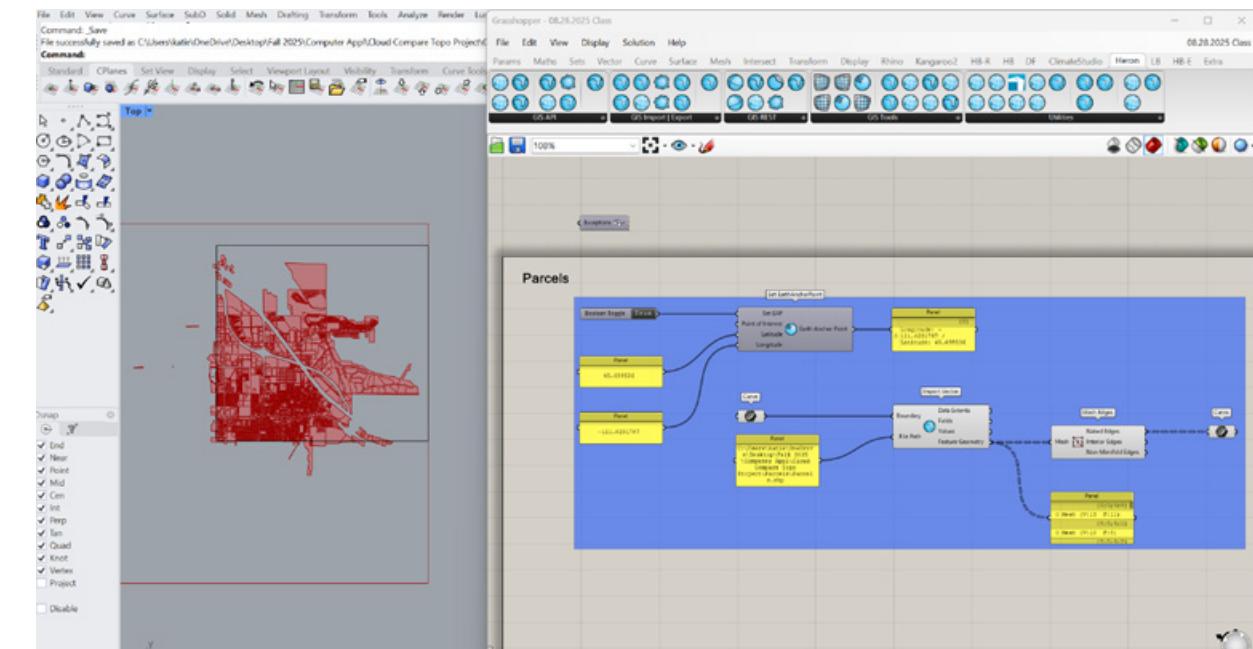
#### DOWNLOAD POINT CLOUD FROM CITY



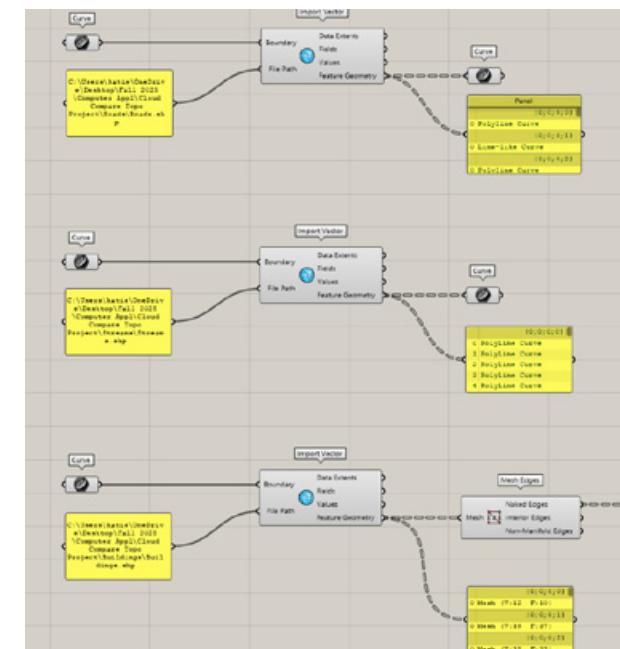
#### TOPOGRAPHY MESH



#### GRASSHOPPER IN RHINO



#### LINK PARCELS, ROADS, ETC.



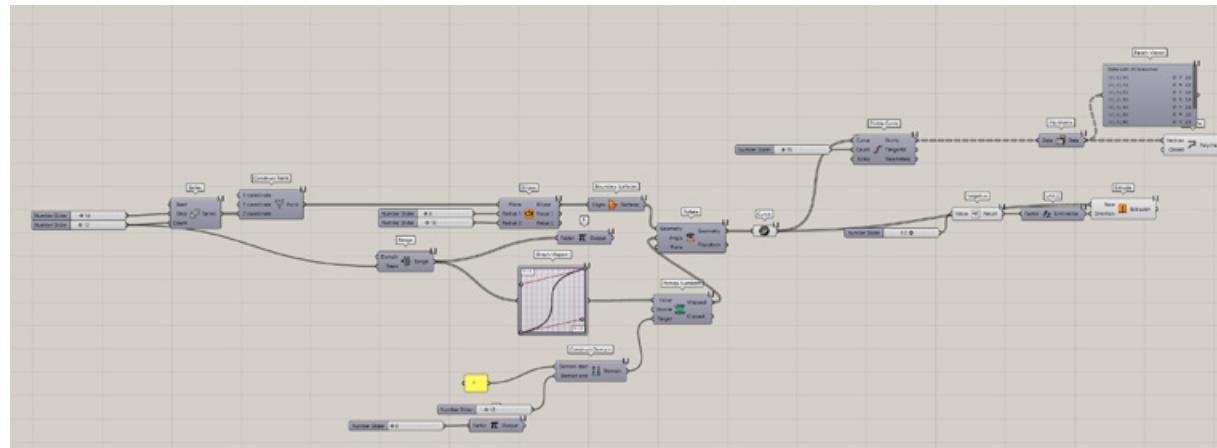
FINAL

## 05 RESOURCES

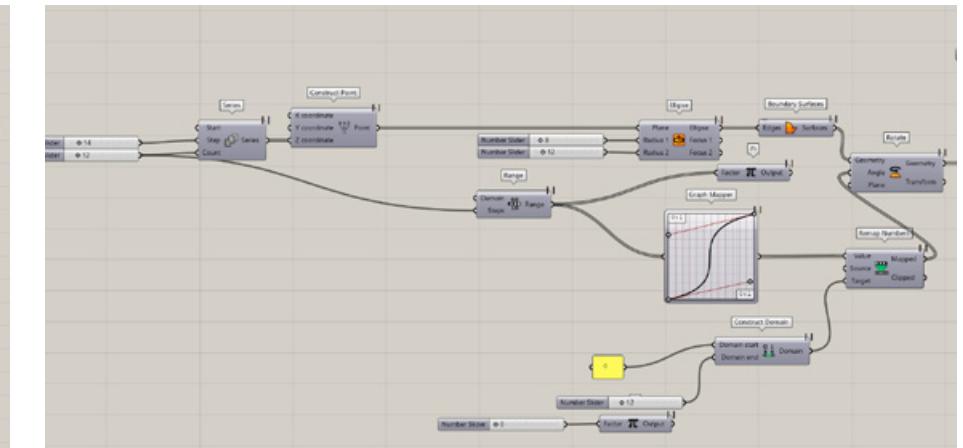
## REFERENCES &amp; NOTES

## GRASSHOPPER Tower Design

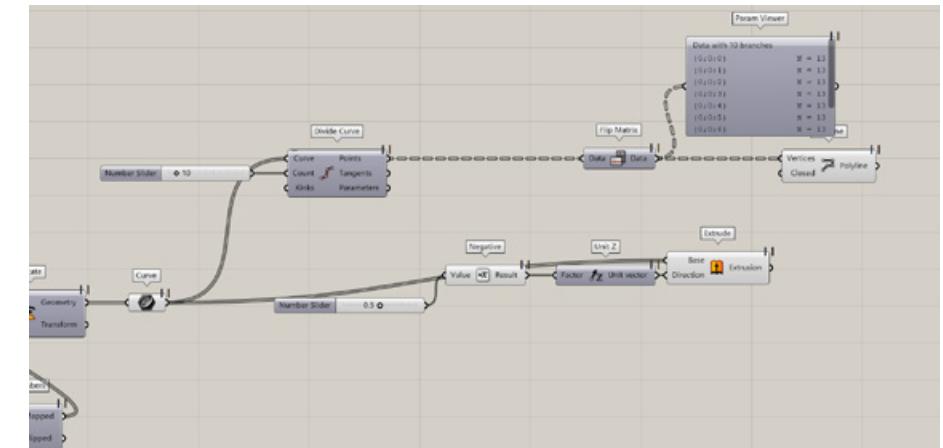
ENTIRE SCRIPT



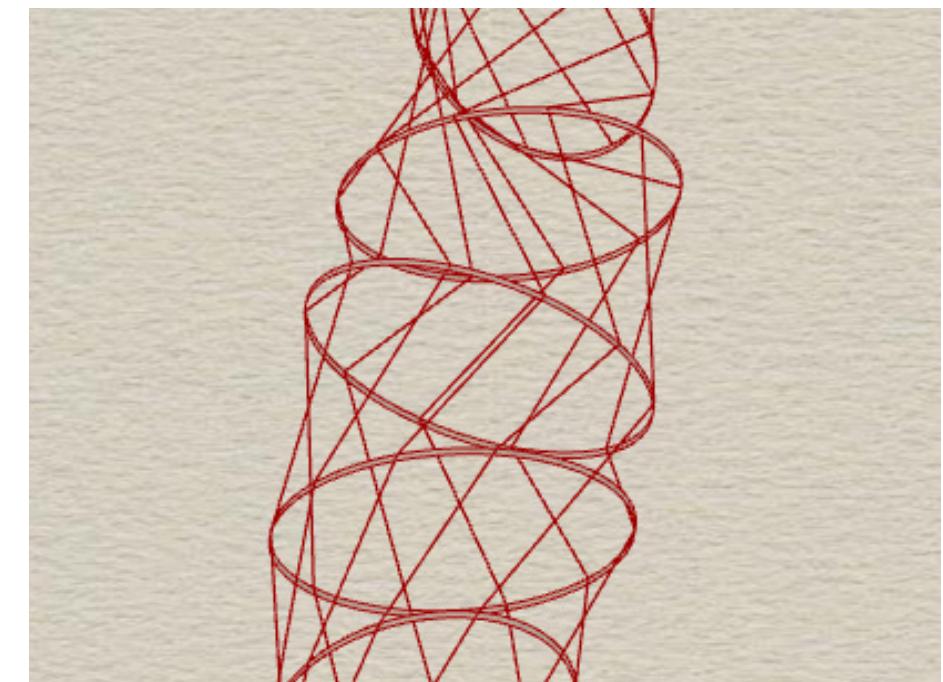
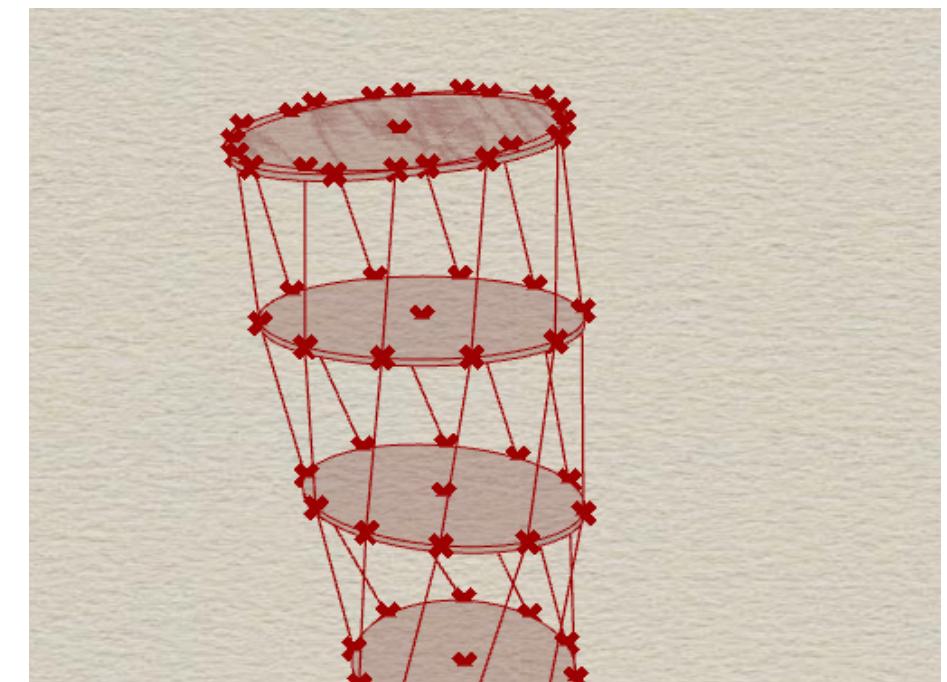
LEFT SIDE



RIGHT SIDE



RHINO SCREENSHOTS



FINAL

# 05 RESOURCES

## REFERENCES & NOTES

### Generative Landscapes

<https://generative-landscapes.com/?query-0-page=6>

### Furniture

<https://www.hermanmiller.com/resources/3d-models-and-planning-tools/product-models/>

### Beautiful Renders

<https://www.mir.no/>

### Hydra for Grasshopper Scripts

<https://hydrashare.github.io/hydra/>

### CG architect

<https://www.cgarchitect.com/?ref=unita/>

### Be Curious! - Paper and stick

<https://www.youtube.com/watch?v=UXENKmAUL0E>

### The Vignelli Cannon

<https://www.rit.edu/vignellicenter/sites/rit.edu.vignellicenter/files/documents/The%20Vignelli%20Canon.pdf>

### McNeel Forum

<https://discourse.mcneel.com/c/grasshopper/2>

### Twinmotion Renders

John Creation 38 Youtube Videos

### Kangaroo Plugin

Daniel Piker Youtube Videos

### Cities as Gardens for Growing People

Thomas Heatherwick Youtube Video

### The Third and The Seventh

Alex Roman Youtube Video

Thank you!