

# *Building Thickness*

*Joe Sanders and Lewis Bayan Liu*

Arch 3281: BS Studio 01  
Spring 2024

University of Minnesota  
School of Architecture





Project one final shell in natural light and site context.

# Project 1

**Student Team**  
Joe Sanders  
Lewis Bayan Liu

## Project Summary

Project one tasked students with designing and imaging wooden scaffolding systems and hardened fabric shells. For sake of this project shells were defined as surface-resistant forms that gain strength from curvature through tension while hanging from their scaffolding, and compression when hardened and flipped. In previous semesters, this hardening process had been accomplished through wetting fabrics and allowing them to harden in below-freezing temperatures; however, this years irregular climate compelled the student group to explore alternative methods of fabric hardening. Imaging and modeling both played an equal role in the design and exploration process of developing multi-spaced shell structures at a one to one scale.

## Individual Contribution

Compared to project two, project one was more concerned with the design process than any singular material output. Because of this the large of my input can be seen the design ideation process, using simple woodworking techniques to create the scaffolding on which the fabrics would hang, and the cutting and drying of fabrics through use of a variety of methods, including: aggregate-heavy concrete, hair sealing spray, glue and glue mixes, and plaster of varying consistencies.

**Joints and Tectonics**—From Parts to Wholes: Framing scaffolding to hang fabric.

**Surfaces and Topology**—From Liquids to Solids: Form-finding shells to explore space.

## Process:

Teams of 2 students design scaffolding to hang (in-tension) fabric, apply water and other hardening liquids, and flip (in-compression) the models to find forms and define spaces—experiencing and seeing material thickness up close. The range of investigation associated with this process varies across weeks. This iterative process was documented and explored through digital imaging techniques (image sets), which established feedback loops between imaging, physical modeling, and individual notes, drawings, and observations made in Field Journals.

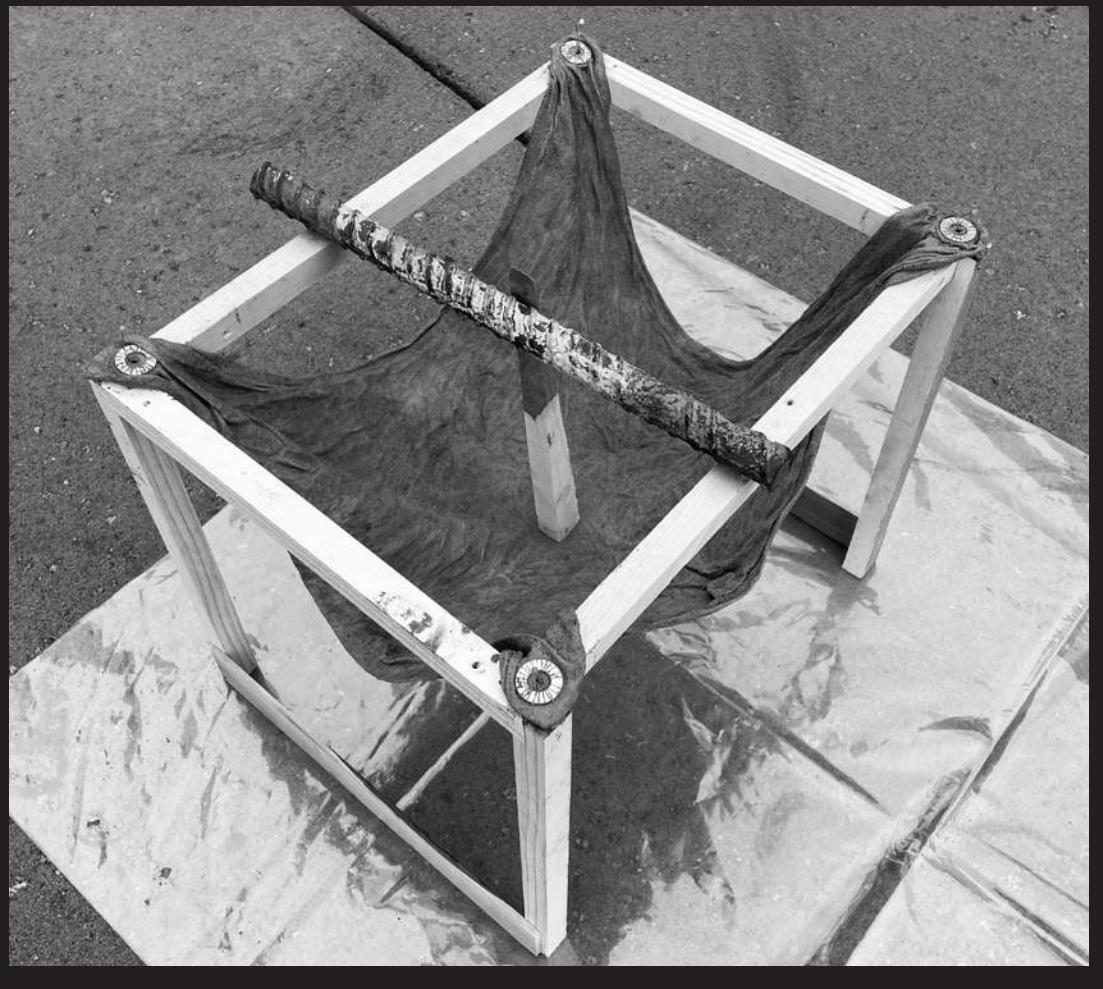
## Outcomes and Challenges:

Each team will design a spatial composition and sequence (2 or more spaces) that explores types of spaces, and potential organizational and ordering strategies. A series of interconnected material challenges or areas of resistance shape this process.

- Transforming “formless” fabric into surface resistant ice shells (forms)
- Thickening fabric through the application of water and subsequent freezing (ice)
- Evaluating local weather and temperature conditions (atmosphere)
- Constructing scaffolding to withstand weather conditions and hang fabric (tension)
- Designing systematic methods of interconnecting scaffolding and fabric (tectonic)
- Flipping frozen models to investigate spatial conditions (compression)
- Composing multiple spaces within the singular formal language of shells (spaces)
- Imaging spaces and material qualities of shells that are seemingly opaque (light)
- Shifting the 1:1 scale of fabric models through the construction of images (scale)



Development process for hanging, hardening, and flipping our first shell design, nicknamed 'octopus', for project one.





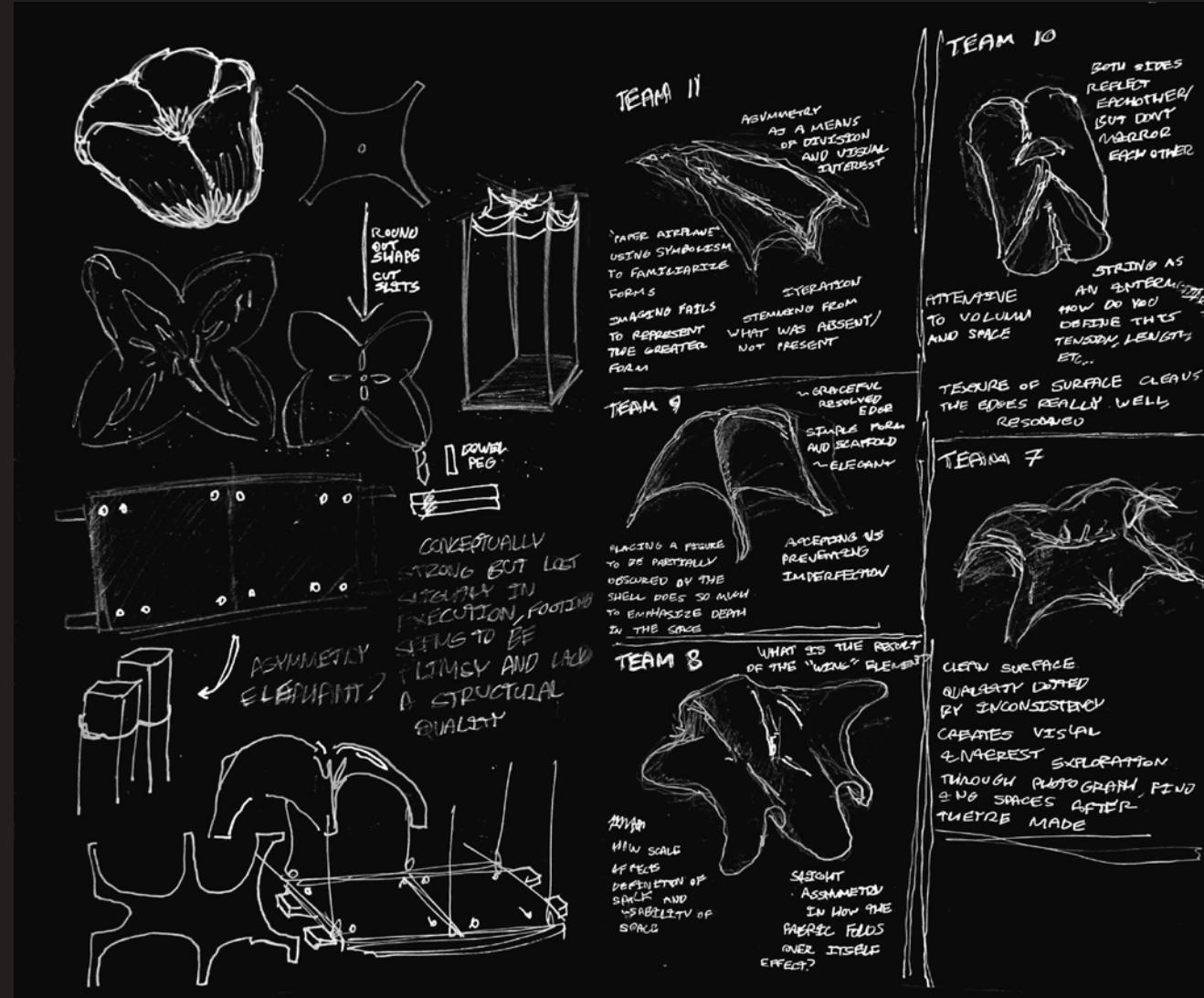
Early imaging derived from the second iteration of our shell design, nicknamed 'ship', attempting to emphasize lighting and scale.



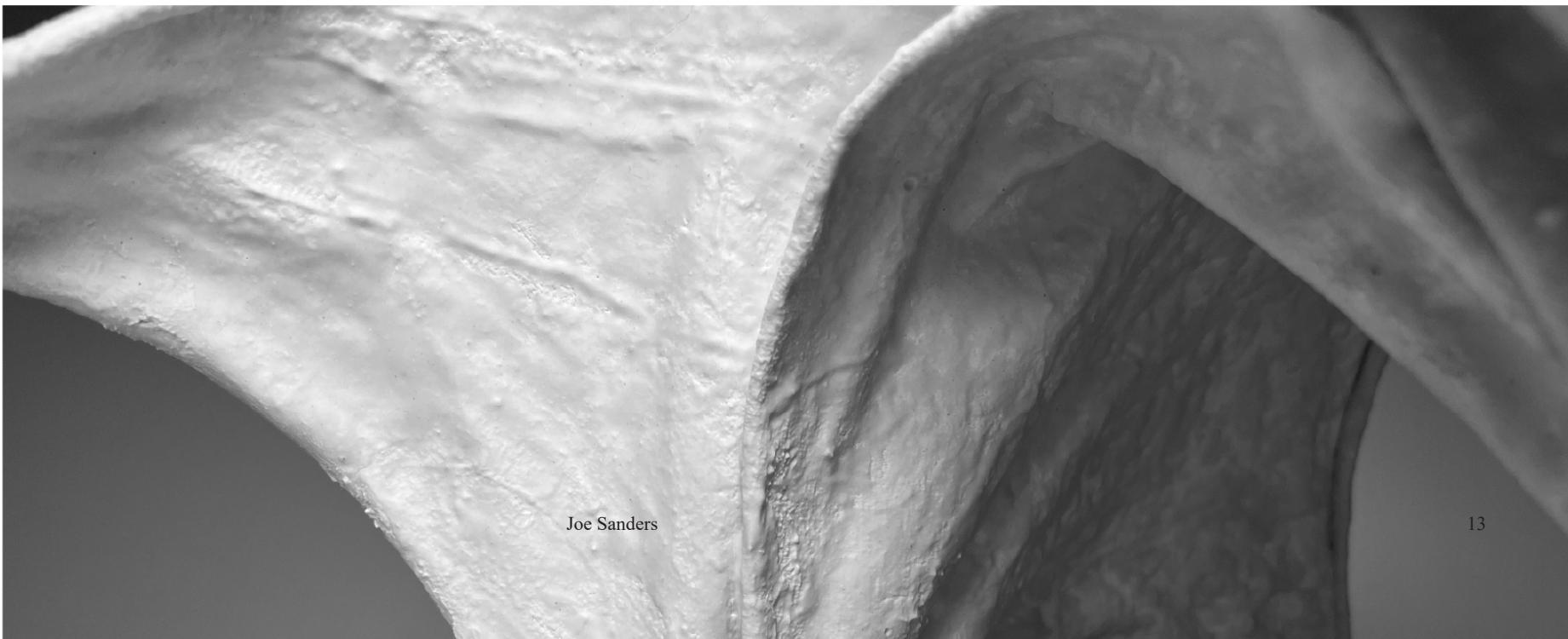
The third and final iteration of our shell design, nicknamed 'wave'.

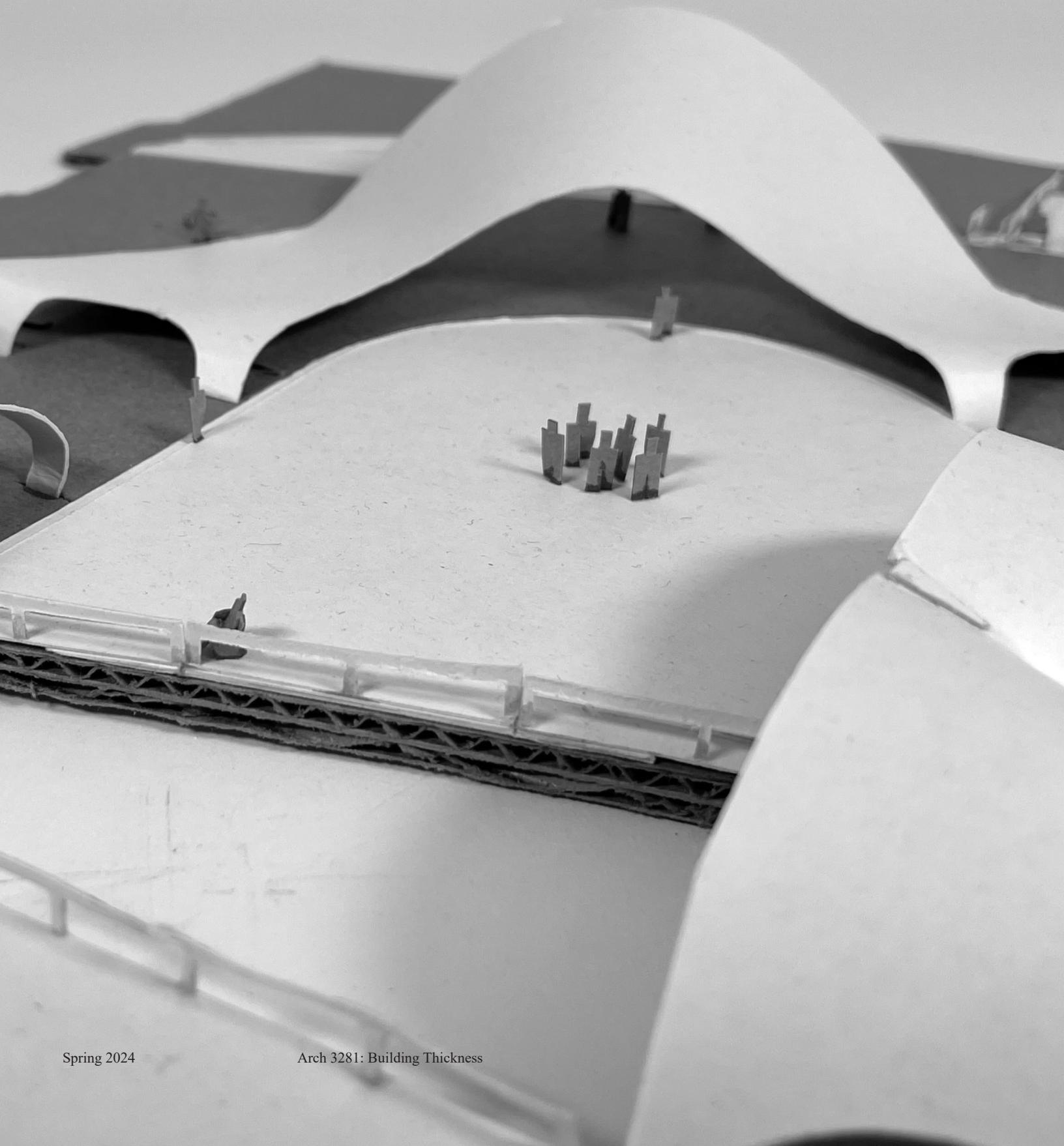
Imaging series derived from the third and final shell iteration.





Material thickness and surface quality imaging.





# Project 2

**Student Team**  
Joe Sanders  
Lewis Bayan Liu

## Project Summary

Project two tasked students to continue exploring shells defined by tension and surface resistance, but with the added consequence of designing in the context of a site. Shells were expected to occupy at least sixty percent of the site and program space and use of space with both human scale and the scale of the sites surroundings in mind.

## Individual Contribution

Me and Lewis largely divided labor between the design and imaging portions of project two. I was largely in charge of shell design in Rhino 7 and the use of Illustrator to create easily readable sections and plans. All physical models including both the  $1=1/16"$  scale (seen to the left) and  $1'=1'$  scale were a joint effort, with Lewis and I contributing equally to the iterative physical modeling process.

## Process (Beyond the Frozen Shells of Project 1)

Pairs of students translate lessons—identifying material and spatial potentials—from Project 1 to design a system of shell structures that define a series of covered spaces (5 or more) to make a public plaza on the University of Minnesota West Bank, adjacent to the West end of the Washington Avenue bridge. The translation will be shaped by expanding the methods of material resistance explored in Project 1. The primary goals of the plaza are to facilitate gathering, movement (people and bikes), and other potential activities that highlight the vibrancy of the site and its prominent public, urban location on the West Bank Campus.

## Challenges and Opportunities

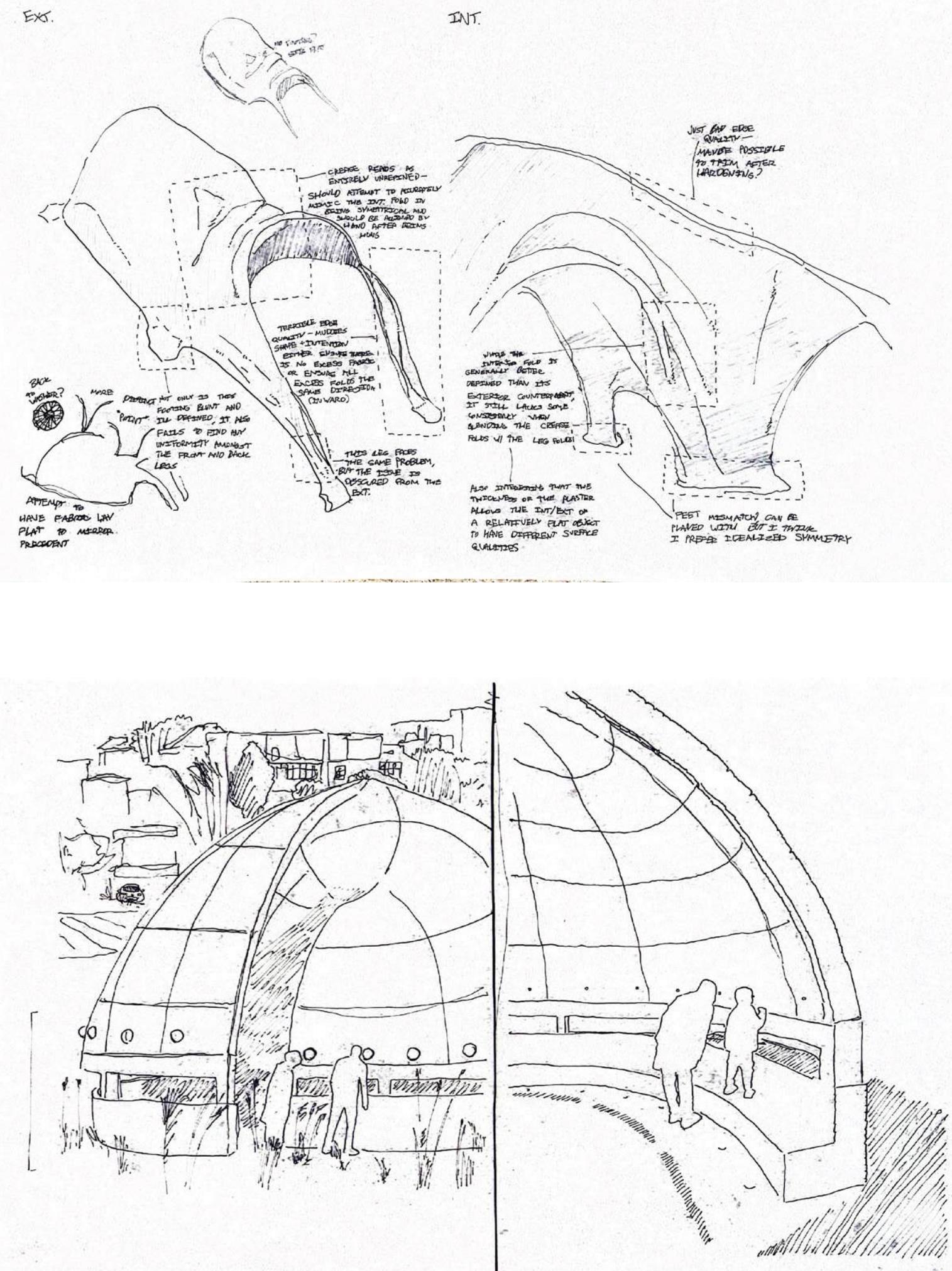
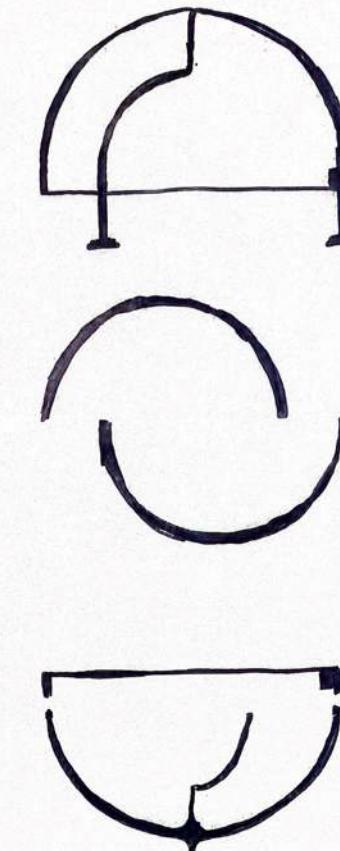
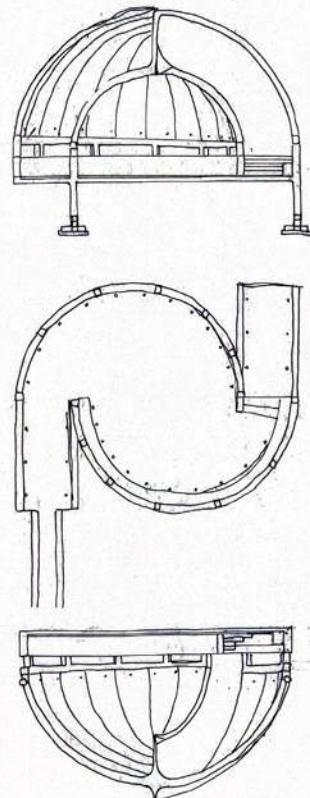
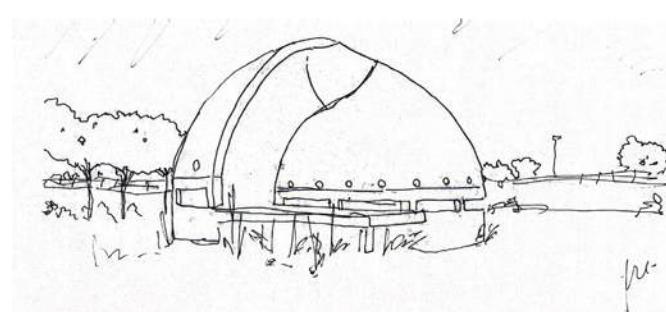
**Spaces and Program**—Understand types of spaces and develop organizational spatial strategies and ordering principles to design spatial sequences and advance the experiential qualities of the project.

**Context**—Understand the infrastructural thickness of the “ground”, including the structural system and column grid that define the construction of the site’s “ground”, while engaging entangled histories of the site with potential futures through present-day observations.

**Digital Processes**—Develop digital modeling and drawing workflows that advance spatial and material exploration through site-specific design decisions.

**Material Possibilities**—Develop material possibilities at 1:1 scale to transform decisions about space, movement, and site context. Focus on testing how material assemblies enable potentials for curvature and making space.

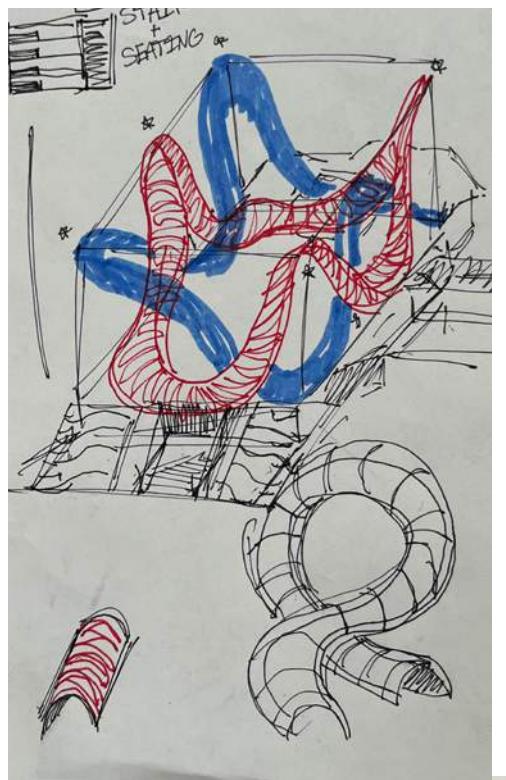
Early work for project two was largely concerned with studying precedent and identifying themes, motifs, and techniques we could incorporate into our work. Our precedent, the Twisted Brick Shell Concept Library can be seen to the right.



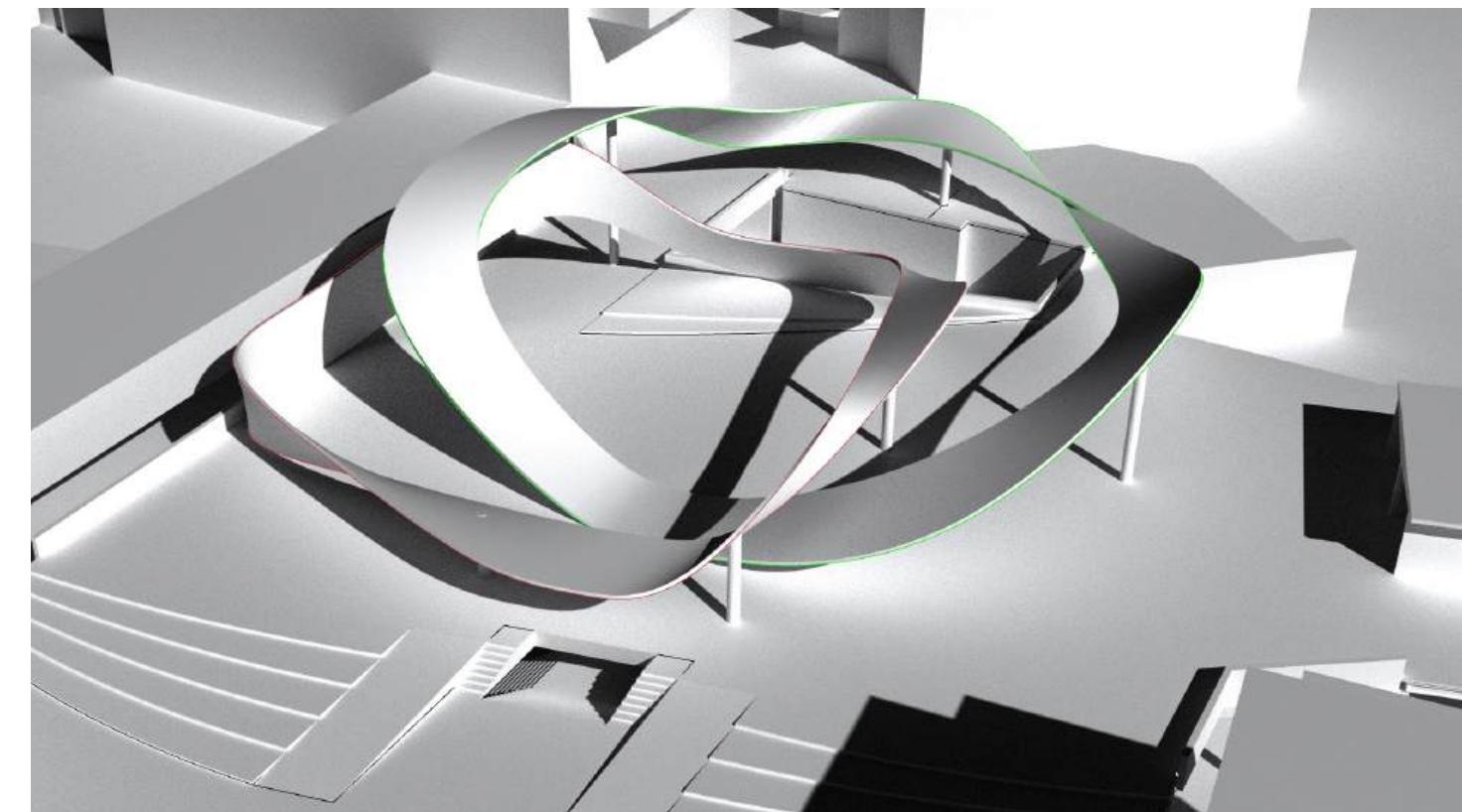
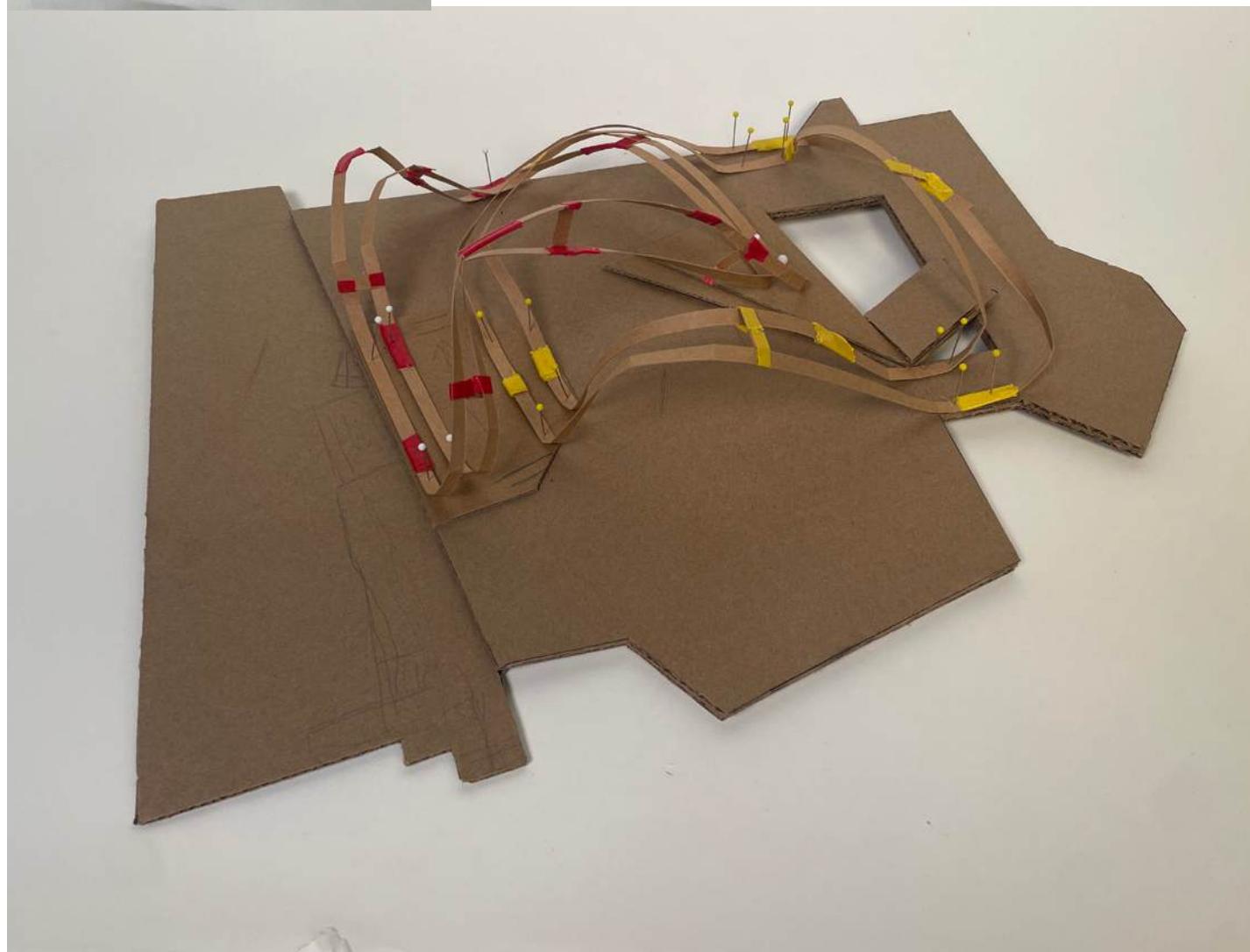


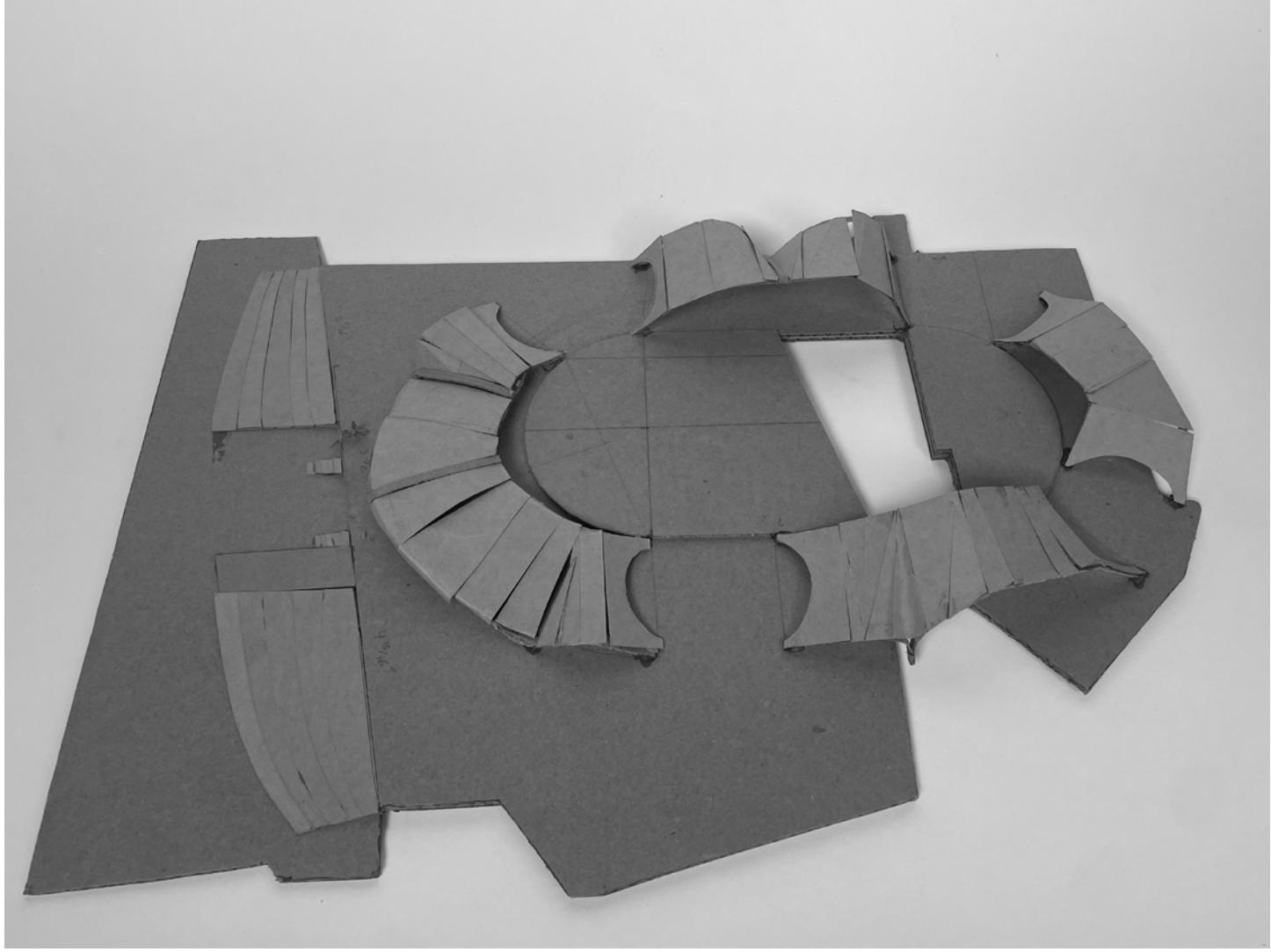
The initial iteration for our 1' = 1' material scale model.





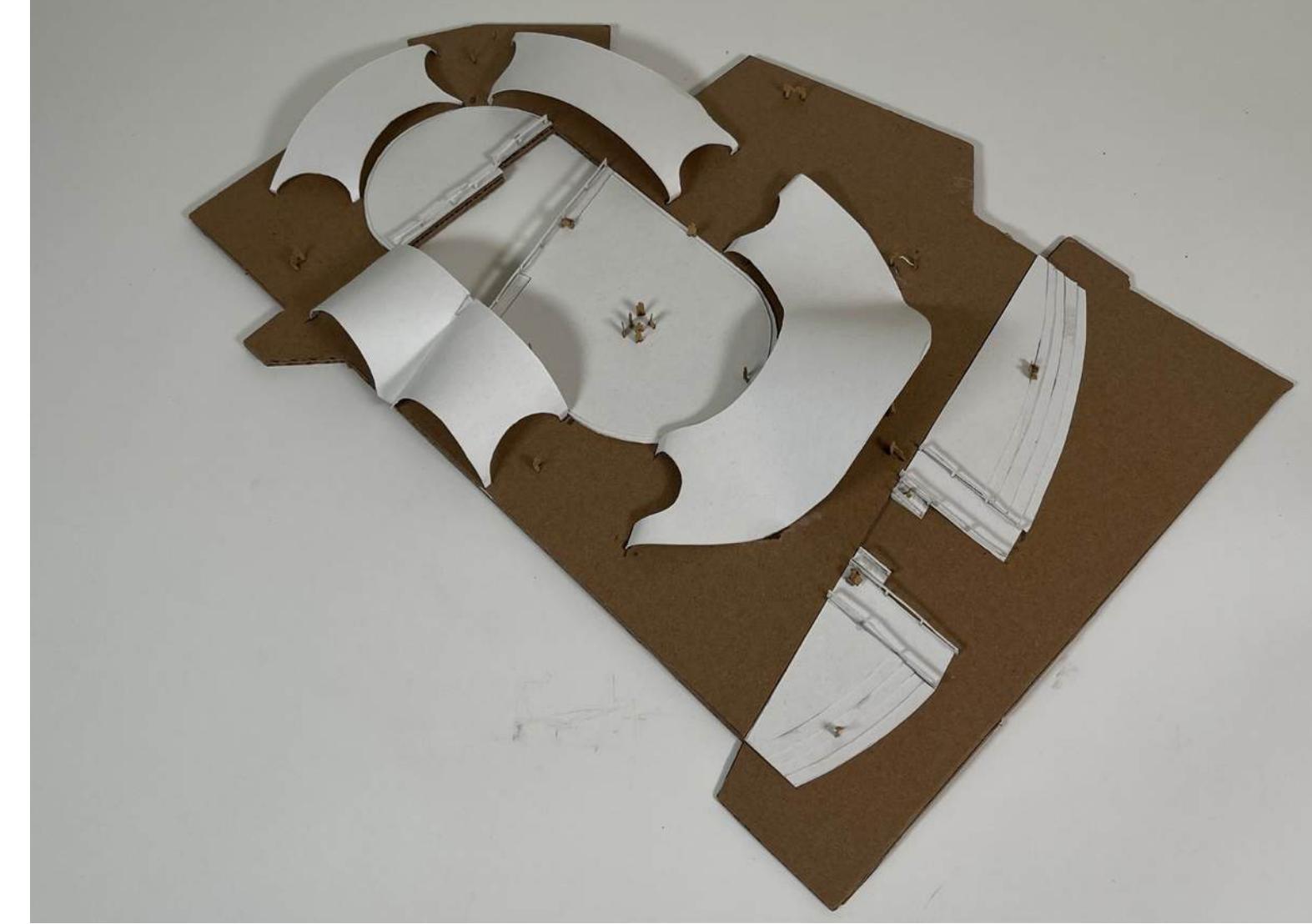
Early iteration of our final shell design.





Spring 2024

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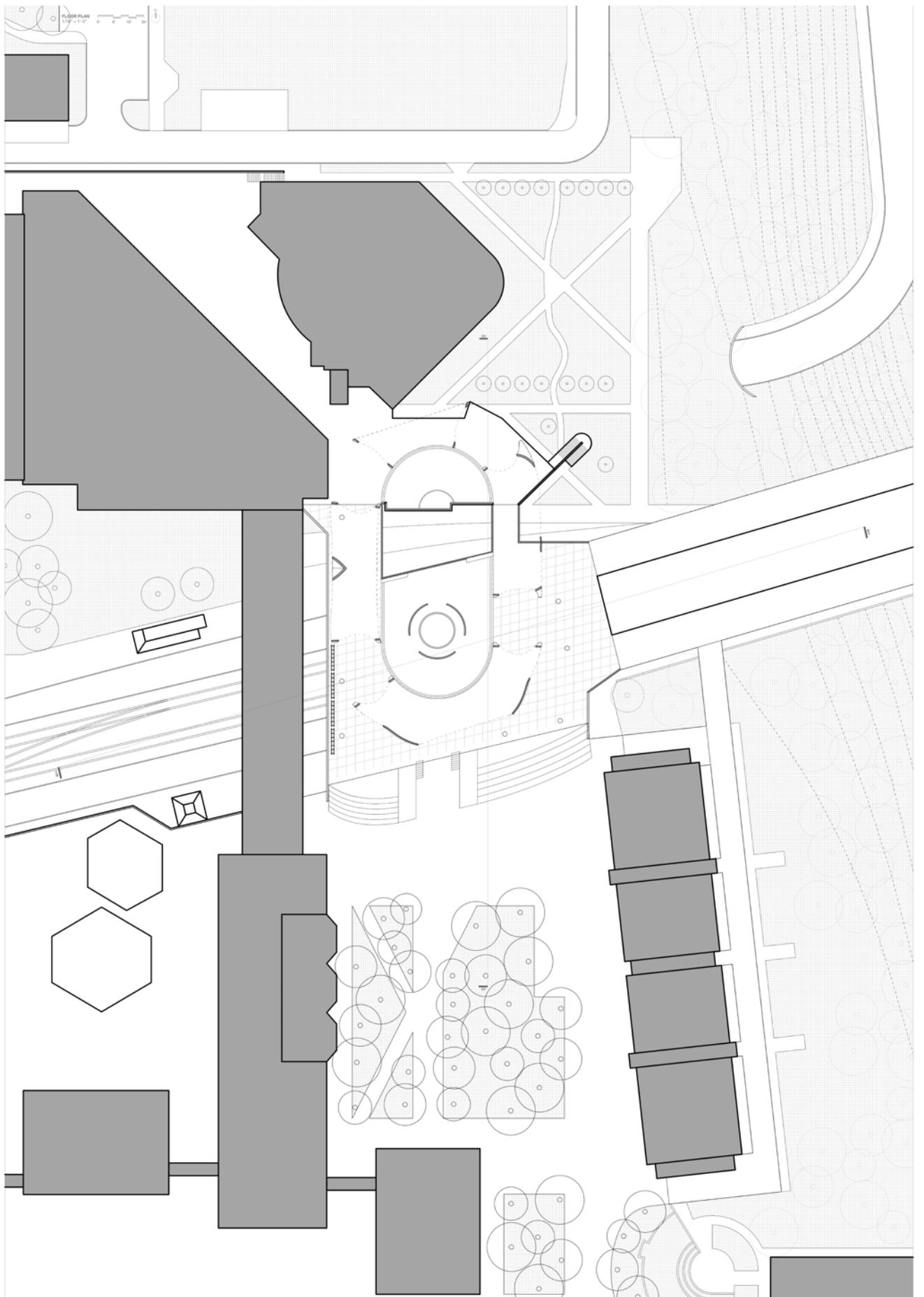
Final project two shell design and process work.



Joe Sanders

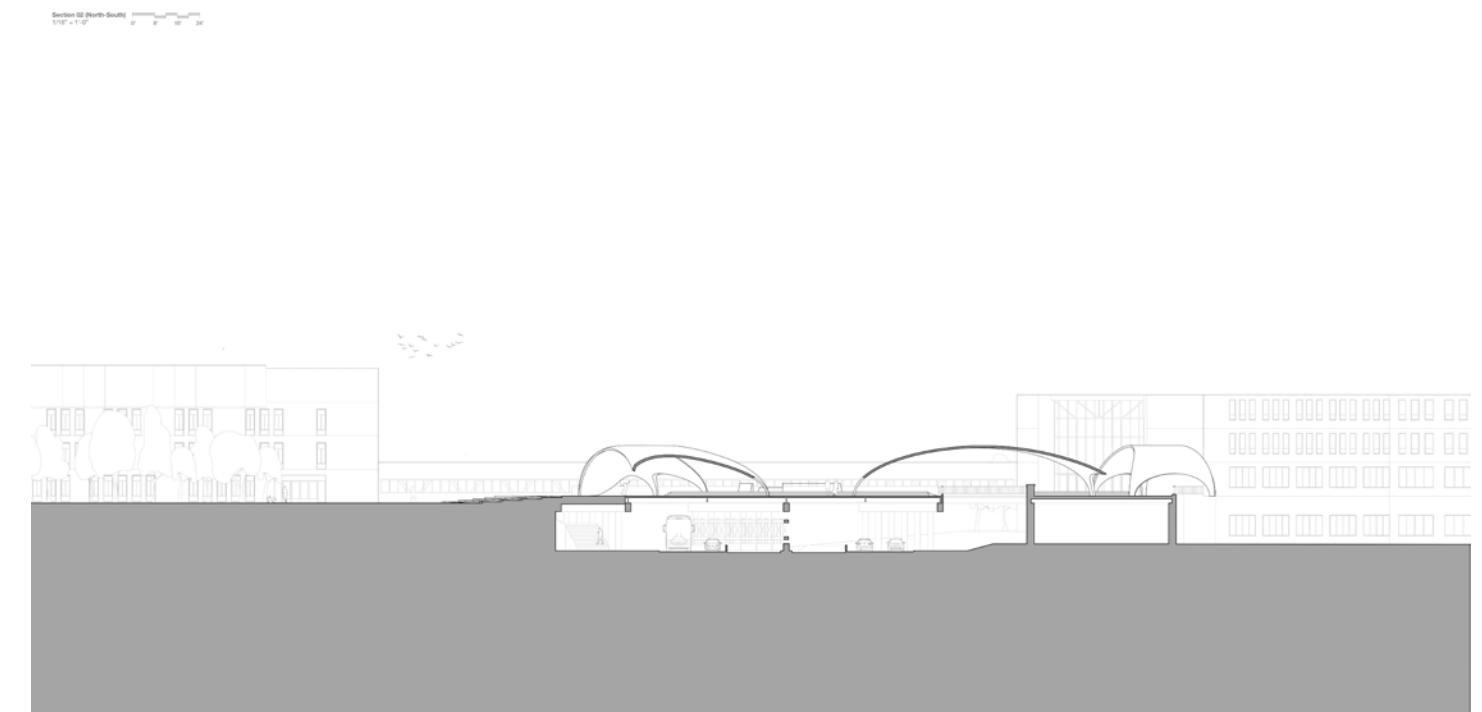


23

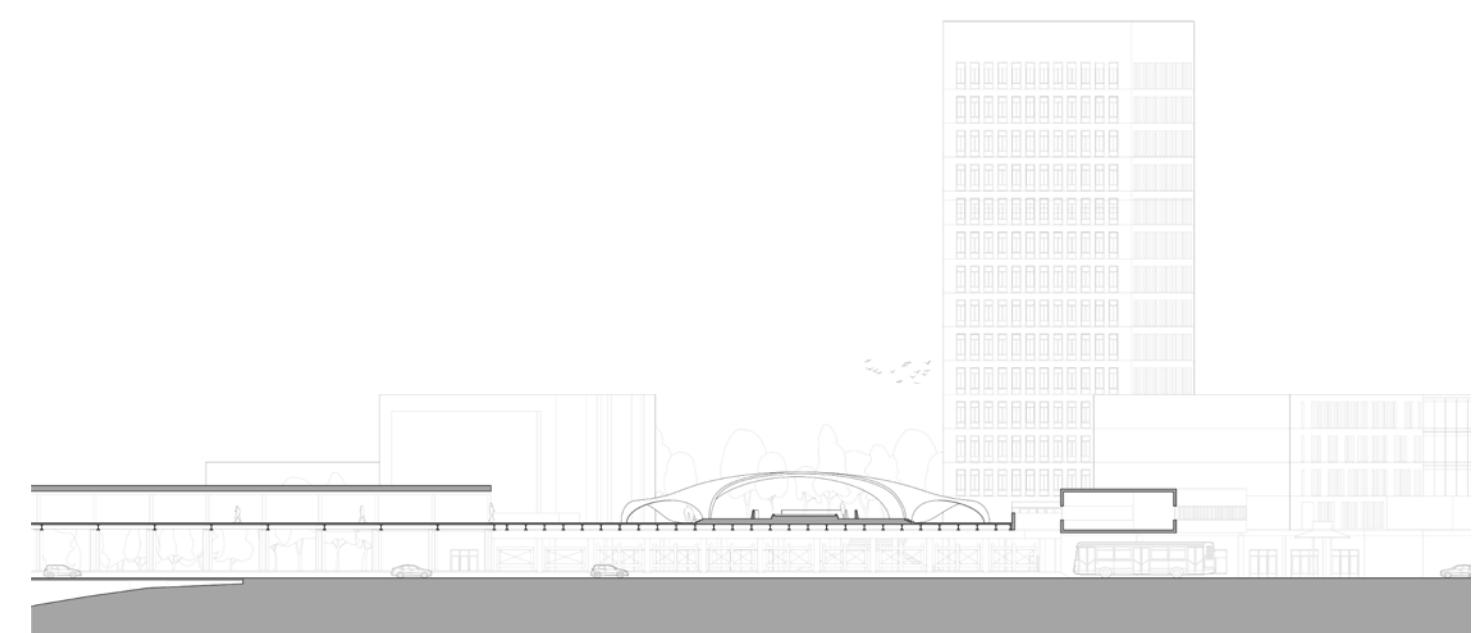


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Final design plan and section.



Joe Sanders

