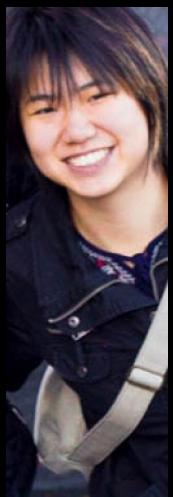


JOIE CHANG
PORTFOLIO



MIT | BSARCH, DESIGN X COMPUTATION
2014 - 2017



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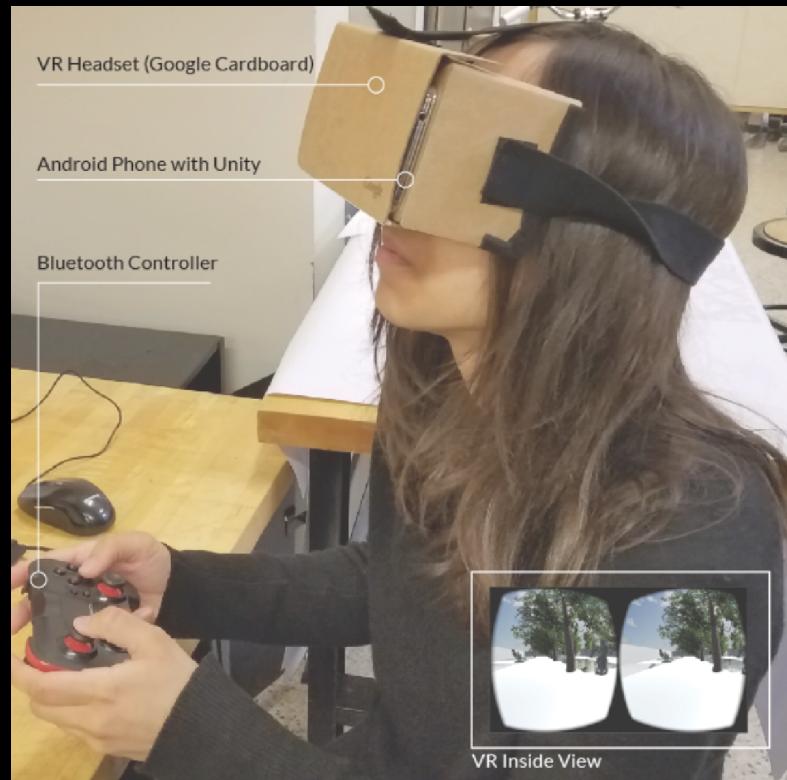
MIT, 2013-2017

Bachelor of Science in Architecture
Design and Computation



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DESIGNING IN VIRTUAL REALITY: TOOLS WITH THE HUMAN FIELD OF VISION

*BSArch Undergraduate Thesis
Spring 2017*

Abstract

Virtual reality, or VR, will be the next common medium for digital visualization. The purpose of this thesis is to explore how designers will use and discover new design methods with the representation in virtual reality. How do computational design tools such as CAD and VR, which are digital representations of the physical, affect our designs of physical space?

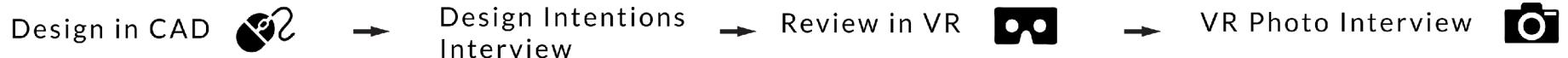
In this thesis, I explore the benefits and shortcomings of VR as a design medium. My first hypothesis claims that VR will excel in representing site context, depth, and scale, in comparison to CAD. The second hypothesis says that VR will encourage a preference for monumentality and open spaces in comparison to a higher packing density of objects in CAD. The third hypothesis claims that designers will prefer 3d models with realistic rendering textures in VR, more so than CAD. The fourth and final hypothesis is that architects, familiar with CAD, can design immersive views just from a 3d omniscient plan without immersion, unlike novices.

The first part of the research is the creation of a proof-of-concept virtual reality design review tool that can be integrated easily into existing design practices. The VR tool allows a user to explore their 3d modeled spaces with full locomotion and visually records their experiences in the space. This VR tool integrates virtual reality into the process of iterative design. Through subject testing, we explore our understanding of how our spatial perception interacts with simulated virtual space and thus affects our manners of designing.

The results led us to several different conclusions. First, intuitive perception of scale and other spatial relationships is easier in VR. Secondly, VR, despite its intimate relation to the human scale, does not promote a preference for large spaces and monumentality. Thirdly, designers slightly prefer realistic rendering textures in VR. Finally, those with architecture training perform slightly better than novices in visualizing 3d immersive views from plans.

This project illustrates where virtual reality's value and flaws as a digital visualization medium. It examines what manner the mode of representation affects and limits the process of designing and making.

EXPERIMENT DESIGN



Example: Subject 9

Architecture
CAD Familiar
VR Unfamiliar

DESIGN INTENTION:

- Covering Perimeter Walls with Trees
- Circulation Parallel to Narrow Water Strips
- Using Larger Bodies of Water to Create Central Areas Relating to the Sculptures



"the distance is all wrong...too empty"



"...too empty...too much concrete"



"I liked this picture...the layering of elements that were arranged."



"I did not like this...this area seems to be really empty..."

"This space is the size of the Rockefeller Moma Sculpture Garden."

"Really?... It's about vision, not VR, about the wrong sense of scale..."

"I see a large amount of water, sky, trees... [I like] a small thin line of concrete and sculpture... [it's] concrete and art"



"I like this picture because of the perspective it gives..."



"I dislike this one because it was too empty."



"[In contrast to the one before]...similar points of view but less empty...slivers of space"



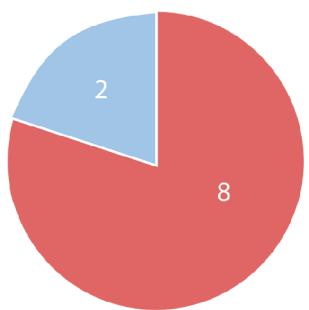
"I liked the picture... it confirmed the idea I had when drawing in 2D...the line of water guides your entrance"



EVALUATIONS

Hypothesis 1:

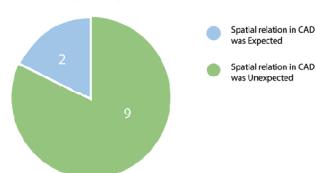
In the VR post interview, which subjects commented on scale?



"It's hard to envision the ground to scale, even if you put a human, it's not the same as seeing it. So I found it way more useful than seeing it from above or the scaled human." - 3

Did Not Misjudge Scale
Misjudged Scale

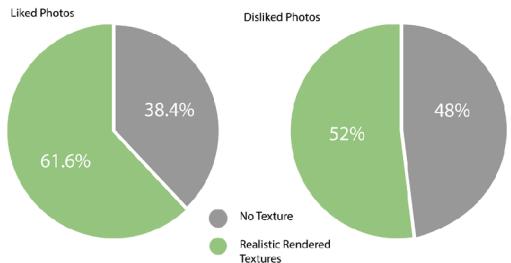
Comments on Photos on Spatial Perception in VR



Conclusion: Intuitive perception of scale and other spatial relationships is easier in VR than CAD.

Hypothesis 3:

Texture Distribution On Models In:



Conclusion: Realistic Rendered textures are slightly more desirable than no textures when viewing in VR.

Photo Commentary Word Analysis:

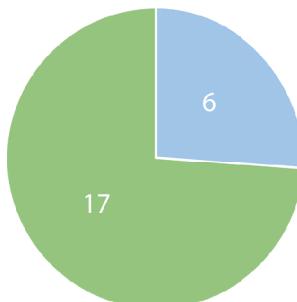
- 13 out of 15 comments on emptiness as critiques within Disliked Photos
- 15 out of 17 comments calling for "more trees"
- 27 out of 32 comments on water calling for "more water"
- 14 out of 20 comments on wall suggesting "removal of wall" or editing the walls

Hypothesis 2:

"[This photo] is also empty. Space felt bigger when you were in it than when you were on the computer." - 5

"[There is] so much empty space. There needs more level changes in the ground. I totally underestimated the amount of space in this area..." - 10

VR Photos Commentary on Open Spaces



Conclusion: VR does not encourage designs with open spaces.

Hypothesis 4:

Architects

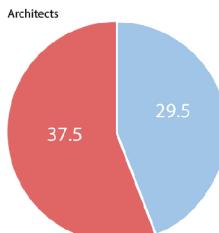
"[The] sense of scale was far more realistic. [I] couldn't realize the actual measurements of the spaces I was designing in top view."

Novices

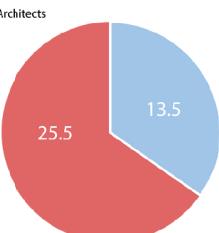
"I did not want to view the sculpture from this angle. I was trying to encourage the person not to look at [the sculpture] but [the trees and walls] didn't actually do anything."

Number of VR Review Photos by:

Architects



Non Architects



Conclusion:
Architects do not perform significantly better than Novices in visualizing 3d views from plans.



PROMENADE

4.023 Architecture Design Studio I

Fall 2015

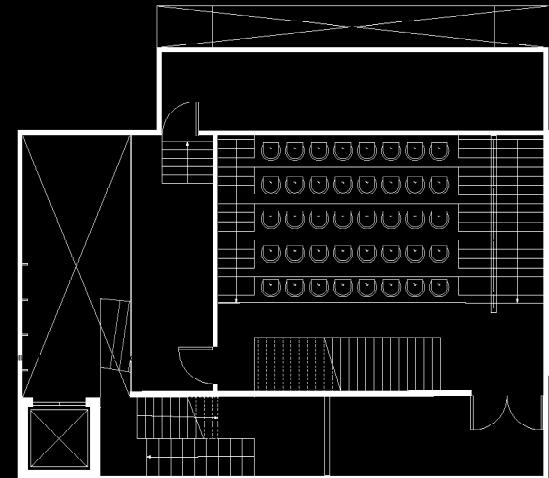
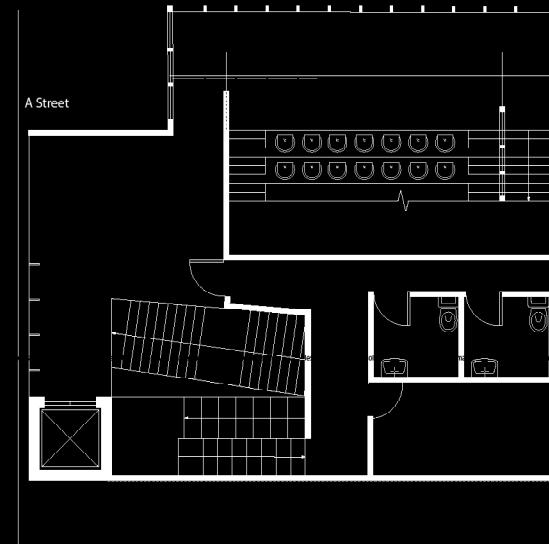
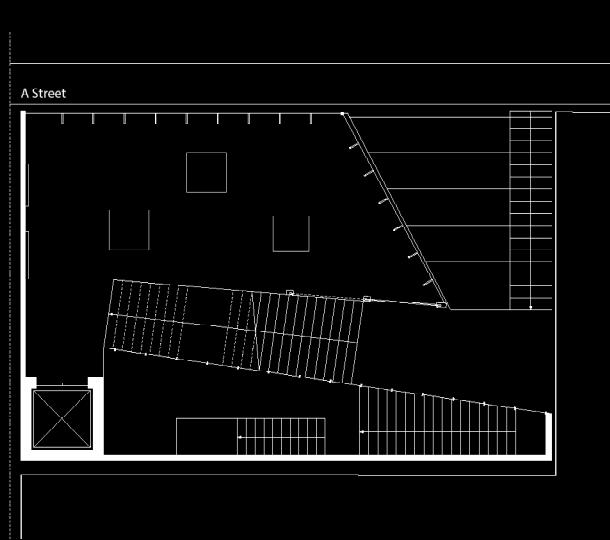
This project's aim was to design a public art gallery that acted as a method of circulation between Summer and A Street in South Boston. Due to the site's condition and the necessity for two street entrances at differing elevations, I centered my building's theme on circulation as an experience.

Beginning at the lower A Street entrance, the building's staircase was open to the public and wrapped around the temporary art gallery. The large glass walls of the gallery allowed art to be viewed while ascending to the Summer Street level. Even casual passerby could then see the changing gallery displays, tying into the integration of circulation into program. In the performance hall, the public stairs ascend along the same rake as the theater steps, blending the circulation into the room. The cafe also becomes a space carved out by stairs, giving it two distinct levels of occupation.

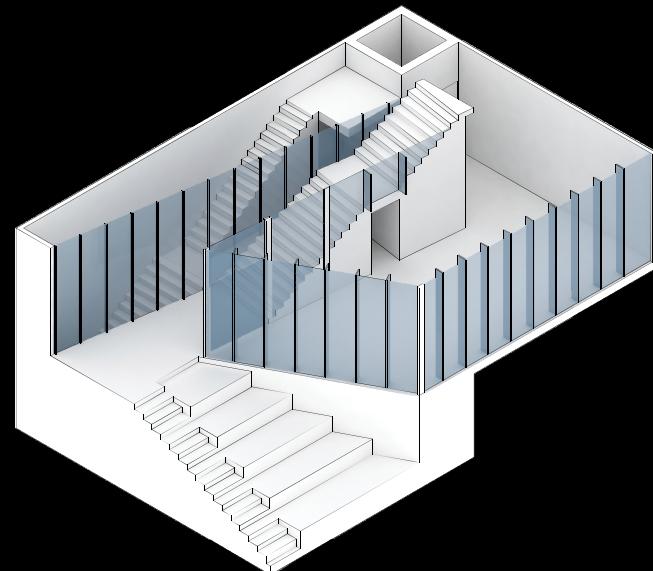
At the top of Promenade is the public terrace and the permanent art gallery. The piece to be displayed was Do Ho Suh's Staircase V, a replica of his New York apartment stair made of translucent red fabric that hangs from the ceiling.



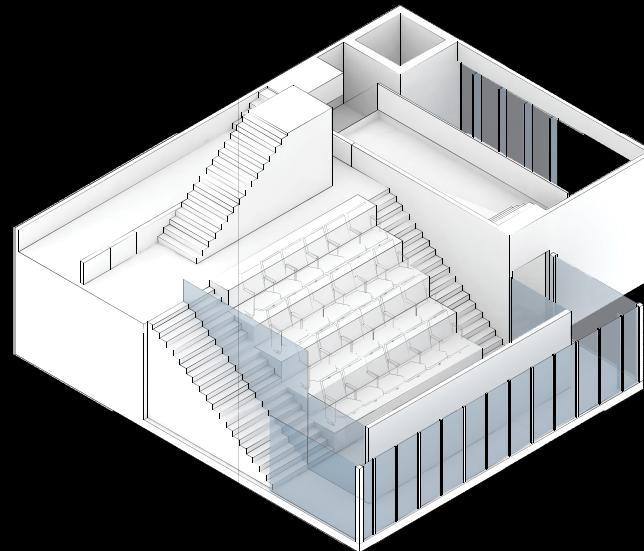
Plans



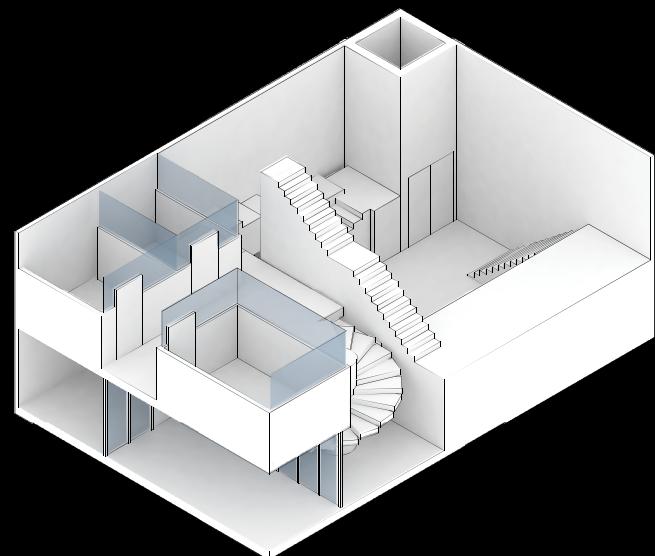
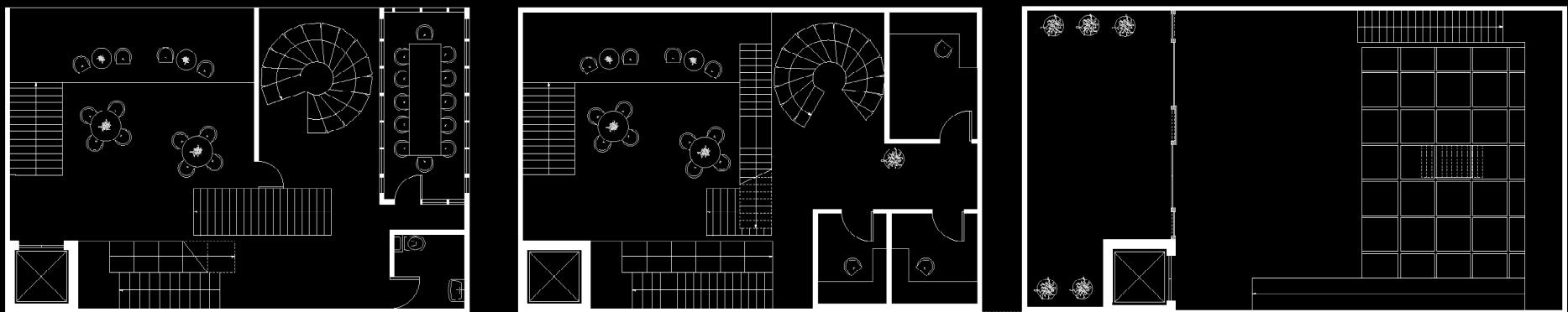
Axonometric Drawings



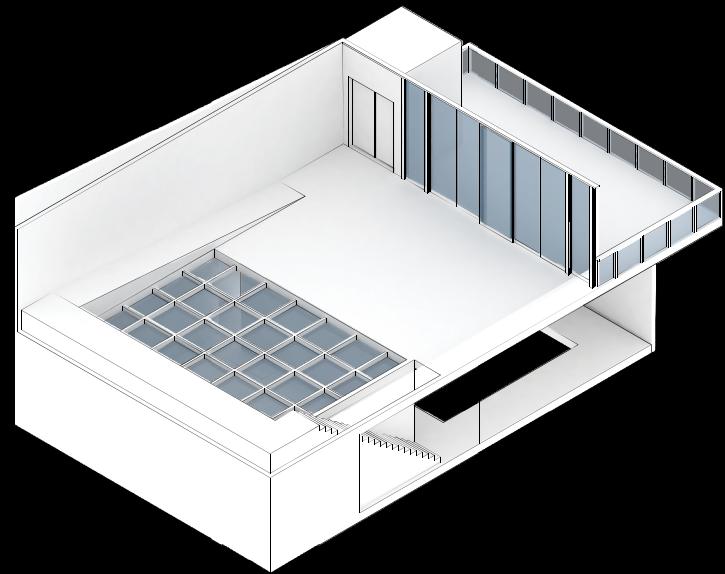
Temporary Art Gallery



Performance Hall



Cafe and Offices



Permanent Art Gallery and Terrace

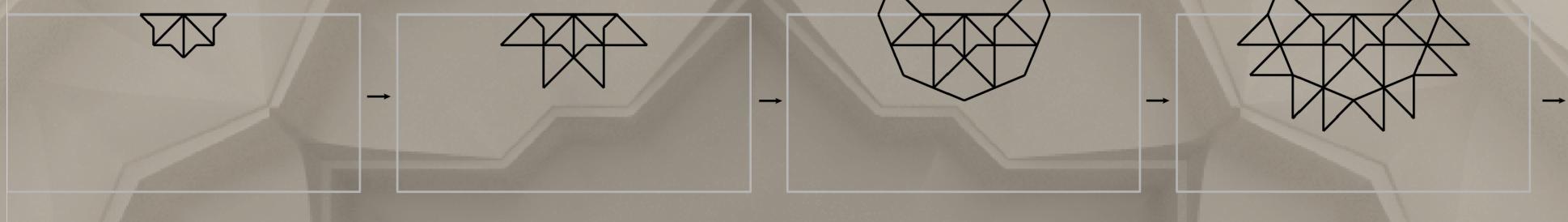


Temporary Art Gallery, Rendering

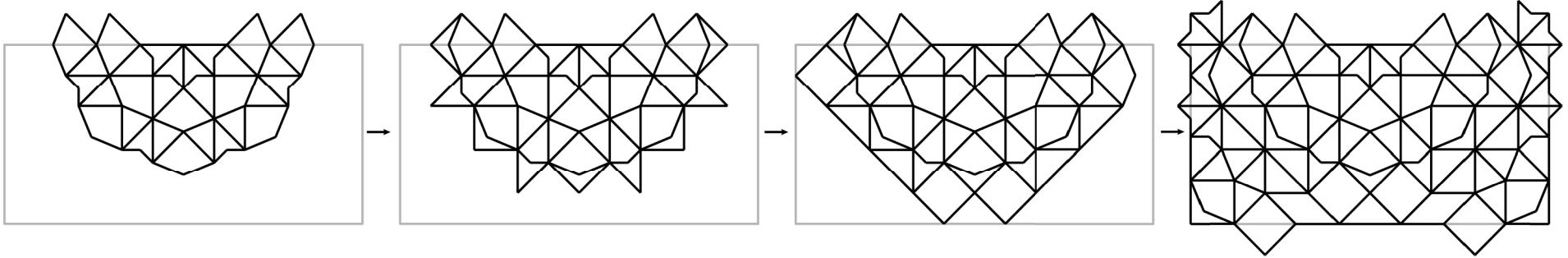


Performance Hall, Rendering

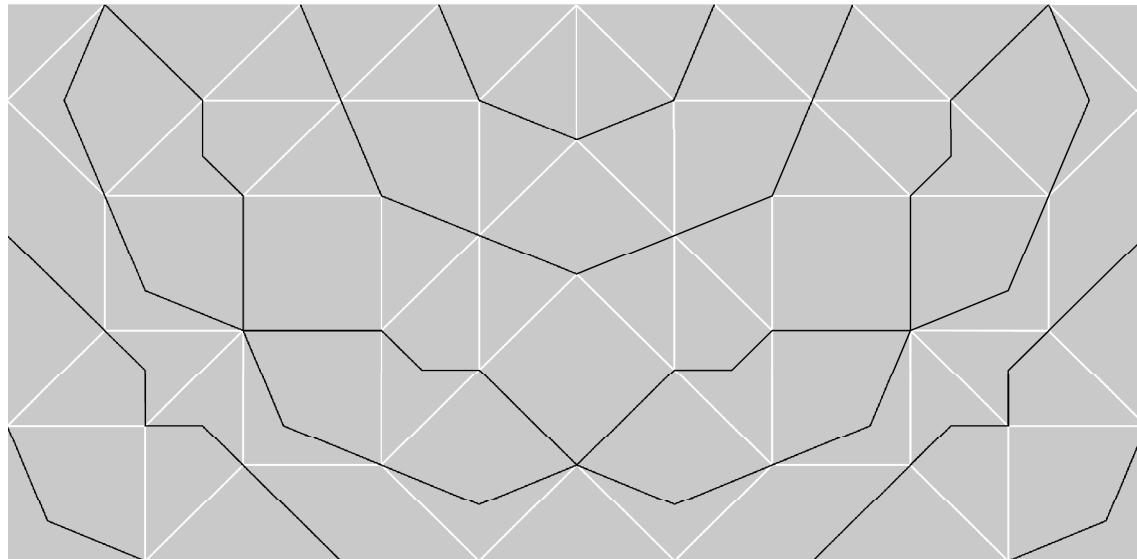
Muqarnas Vault Plan Generation



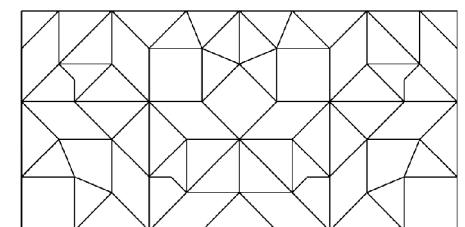
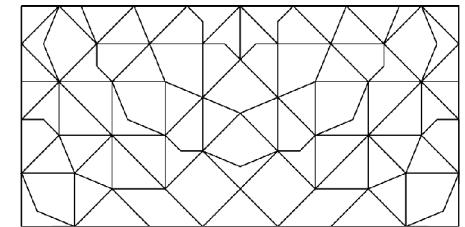
Vault Muqarnas Rendering



Half Vault Muqarnas Plan with Layer Lines Highlighted in Black



Grammar Variations:

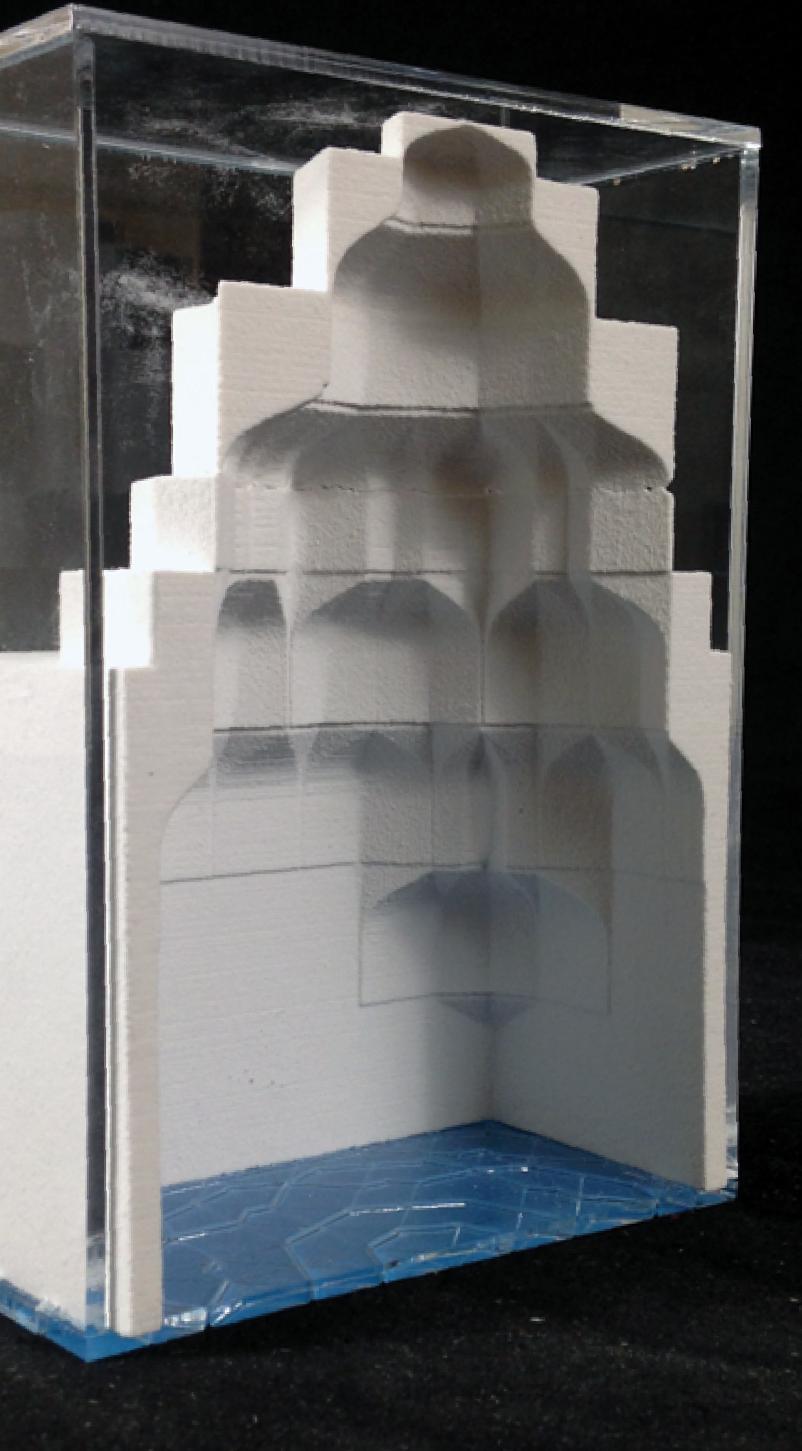


MUQARNAS SHAPE GRAMMARS

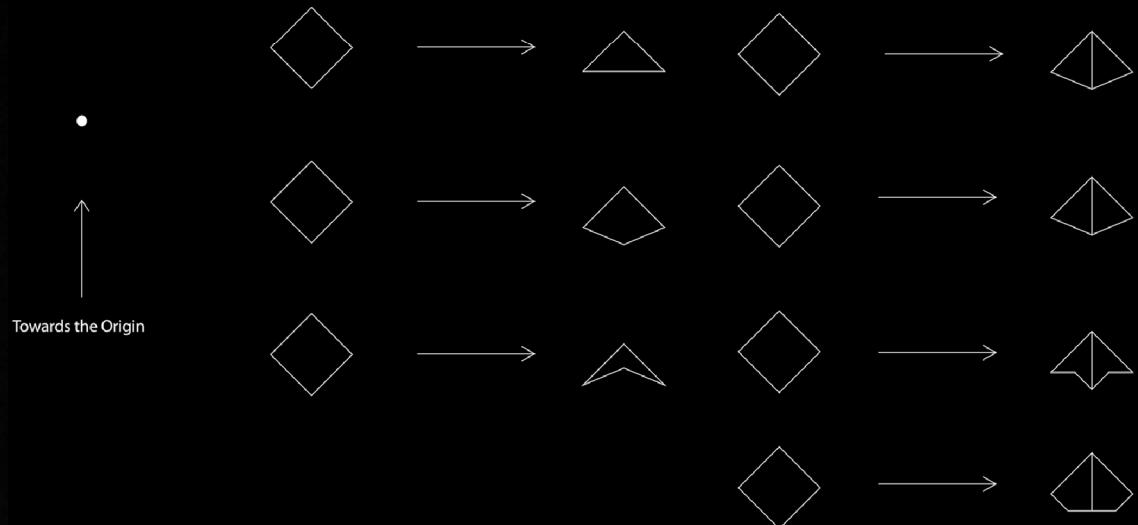
4.522 Visual Computing II

Spring 2016

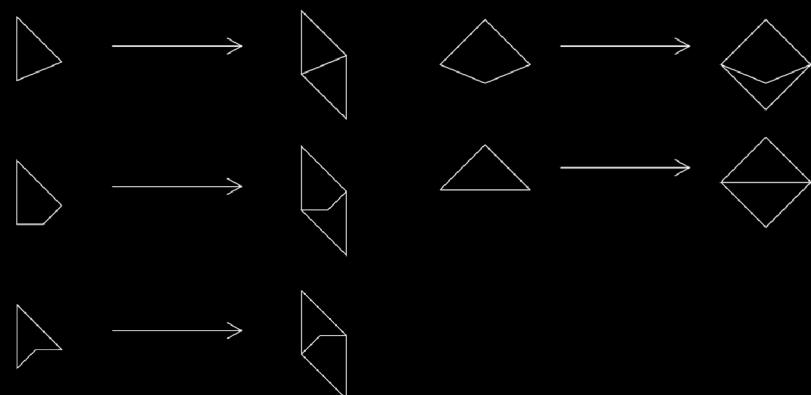
Muqarnas refer to an Islamic architectural form known for their geometric complexity and beauty. They can be created through the planar projection of geometric plans into steeping layers of niche cells. I embarked on an involved study of muqarnas from their historical examples and methods of construction to the newest mathematical understandings. Through architectural and historical review, I created a grammar that encoded all the rules for a family of muqarnas defined by al-Kashi as curved muqarnas. From this grammar I could then generate new plans with original designs. All these plans could then be translated into the final 3D forms through another set of rules I defined.



Angle Substitution Rules



Substitution + division Rules



OHM Bus SHELTER

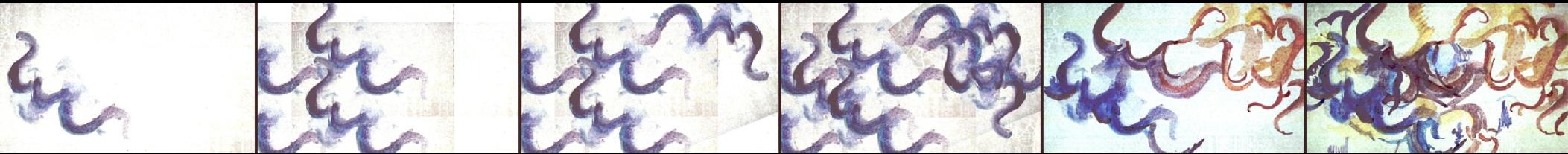
4.500 Intro to Geometric Modeling

Fall 2014

The bus shelter design provides shelter while evoking the environment around it. The ribs of the bus shelter allow for natural daylighting and clear vantage points for its inhabitants. The space in between the ribs would be glass to give a view both inside and outside the shelter. One would sit with their back to the glass, nestled amid the sensations of rain, snow, or sun while remaining protected.

The digital model was generated in Rhino with Grasshopper. The physical model was a powder 3D print from ZCorp.





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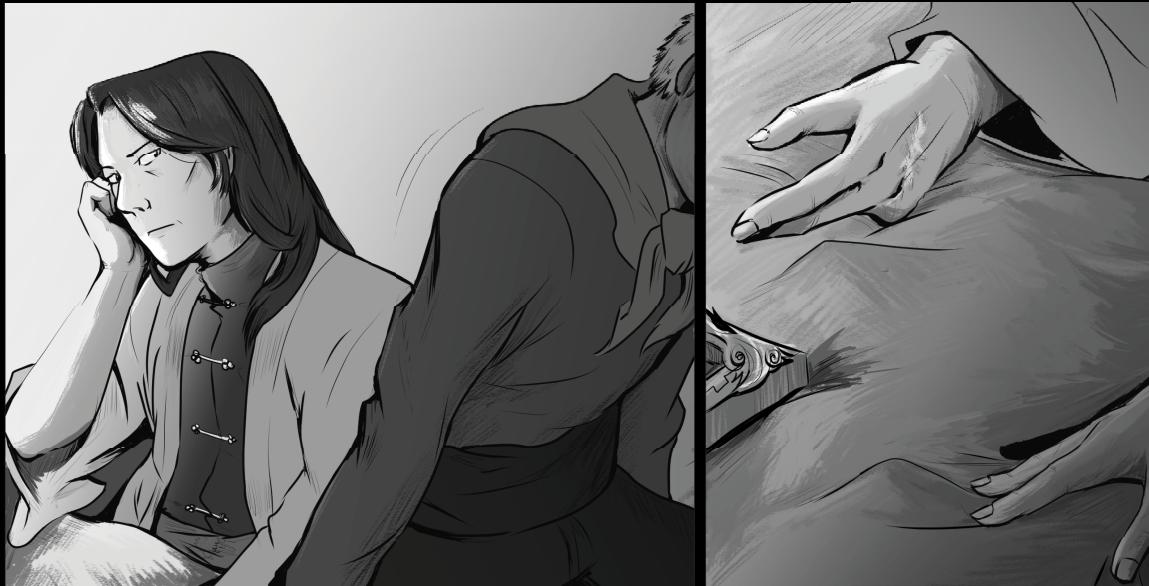
BROADENED DRAWING-SCAPE

UROP with the Design and Computation Group

Fall 2015

The Broadened Drawing-Scape project sought to intermarry the intuitive and ‘painterly’ method of hand drawing with the high-precision and ‘designerly’ method of algorithmic drawing. We aimed to create an environment that would allow the designer access to both these methods of drawing. We created a process to preserved the richness and tactility of hand drawing while utilizing the powerful replication and editing tools of coding. In collaboration with Onur Yuce Gun, I scripted in Processing a program that used camera capture to extract strokes from hand drawing. These strokes or ‘primitives’ could then be manipulated in a code environment, such as in arrays, rotations, or scaling. Then the design could be passed back into hand drawing to further the process.

Through manipulating the scripts and creating drawings, we reached new understandings of pattern usage, shape grammars, and designerly drawing. The water color samples are examples of my works produced by this drawing process in the Broadened Drawing-Scape.



The Last Summer (Sample)

2016 - present



Done in Photoshop. A section of my ongoing personal comic project exploring narratives about life after war, loss, and mentorship. Written under the mentorship of Marjorie Liu.