1 Prototype 3

For our third prototype, we elected to use CAD software (specifically SolidWorks) to design an overall, final model for our building, factoring in every aspect of our design, preliminary engineering calculations, and all feedback we've received to create an ultimate display of our refined design concept. Furthermore, we have finally brought our semester-long project to fruition for this prototype: creating a functional VR simulation of our building, such that on Design Day, judges and audience members will be able to experience walking around in our building for themselves. We cannot create a life-sized model of our building, but we can provide the next best thing.

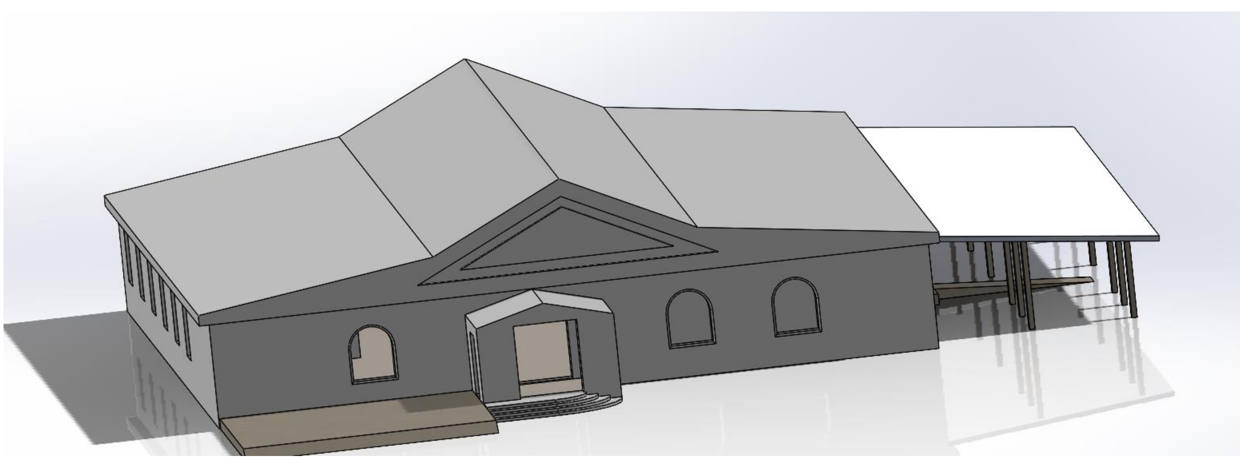
1.1 Preface:

This document will cover the aspects of our refined design as opposed to our previous overall design, as well as the development process of our VR simulation.

1.2 Prototype Test Results:

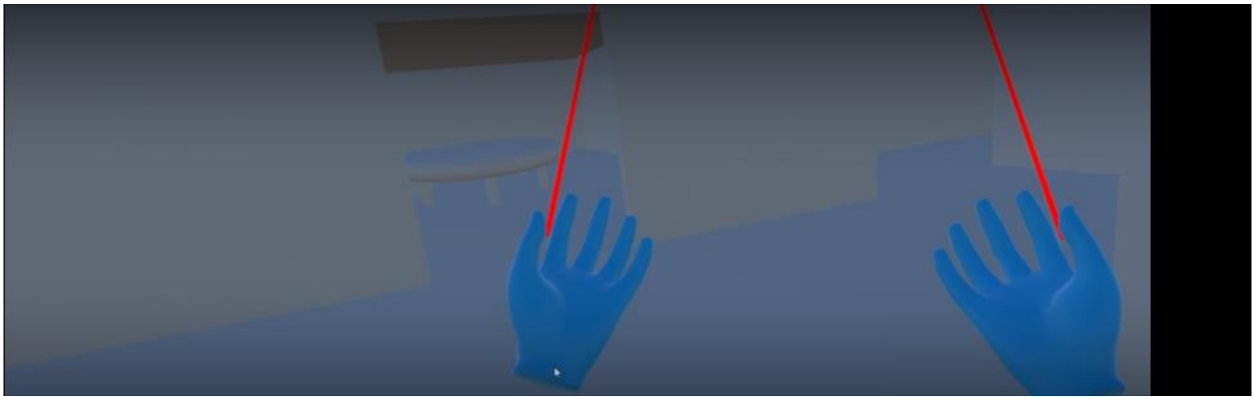
<u>Comprehensive Model:</u>

A 3D model that captures all key, immutable aspects of our building design concept.



<u>VR Simulation:</u>

A system made in Unity to allow users to experience our building design concept for themselves during Desing Day and beyond.

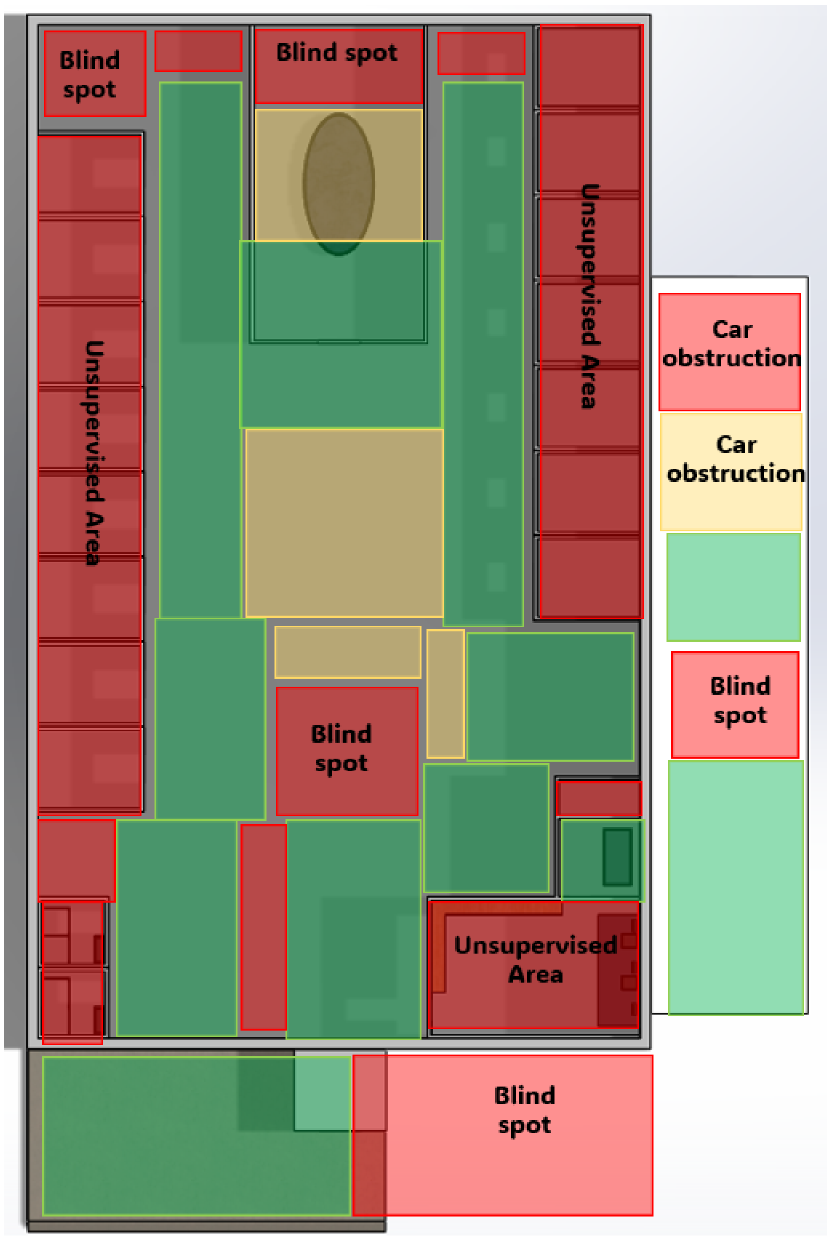


1.3 Result Analysis:

For this prototype, we set out to complete 'Version 2' (referred to as V2 hereafter) of our building model, an entirely separate CAD assembly which redesigns all major aspects of the building design, from footprint size to room arrangement. We factored in three layers of analysis into our redesign:

First, using our data from Prototype 1, we identified rooms that were excessively large or were problematic blind spots. The heatmap produced in that prototype analysis was useful for this, shown below:

<u>Heatmap:</u>



Legend:

No Effective Coverage

Minimal Coverage

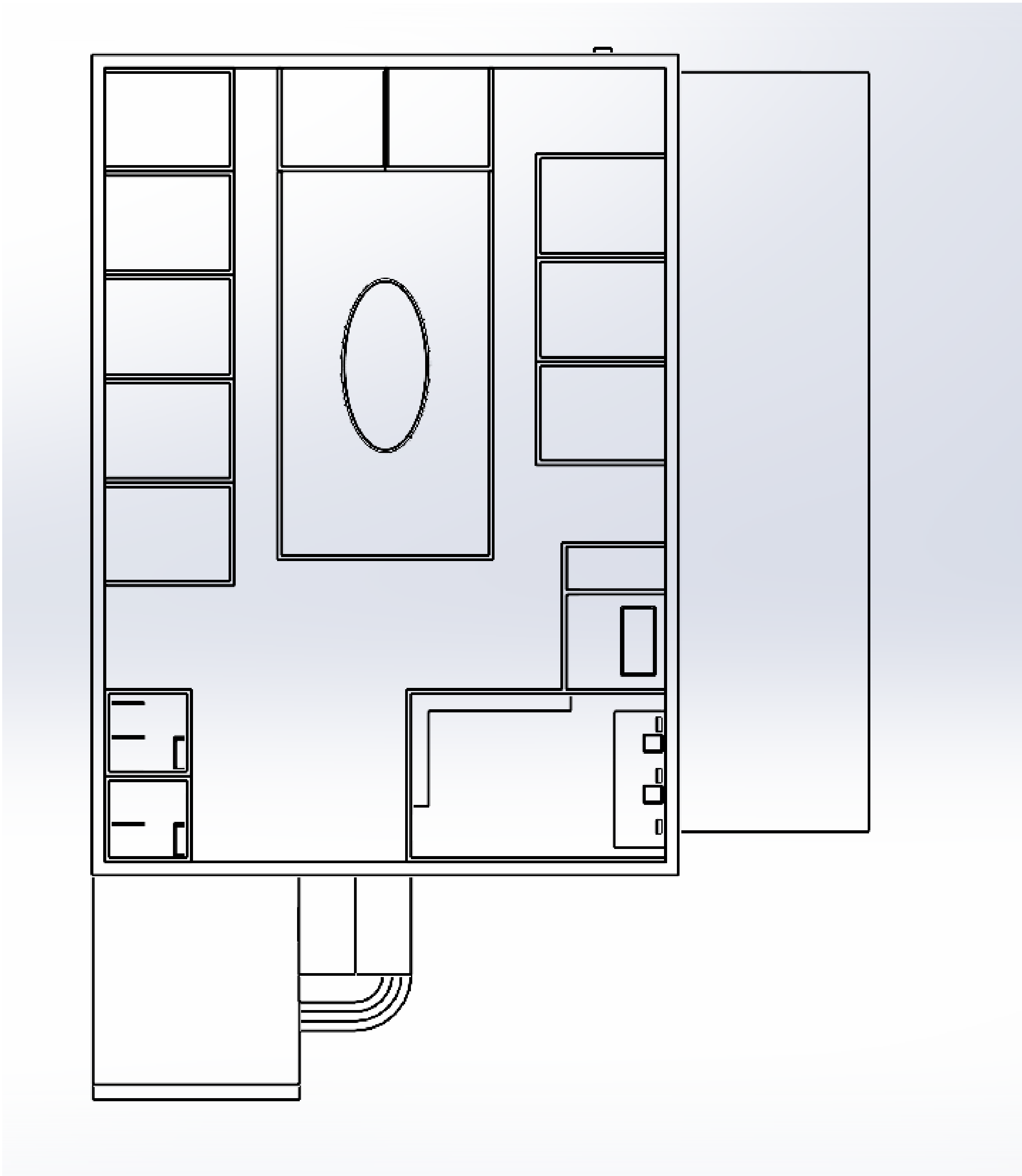
Acceptable Coverage

We found that the common space was too large for its own good, as well as a lack of supervision being revealed in the plant lab and lean-to covered parking spaces. We redesigned the building's structure to minimize these blind spots, and added in a camera to our security plan inside the plant lab and outside on the upper-left corner of the lean-to covered parking space.

Additionally, using our feedback from Client Meeting 3, we identified key aspects of our design that must be retained, and key aspects that must be changed. These are listed here:

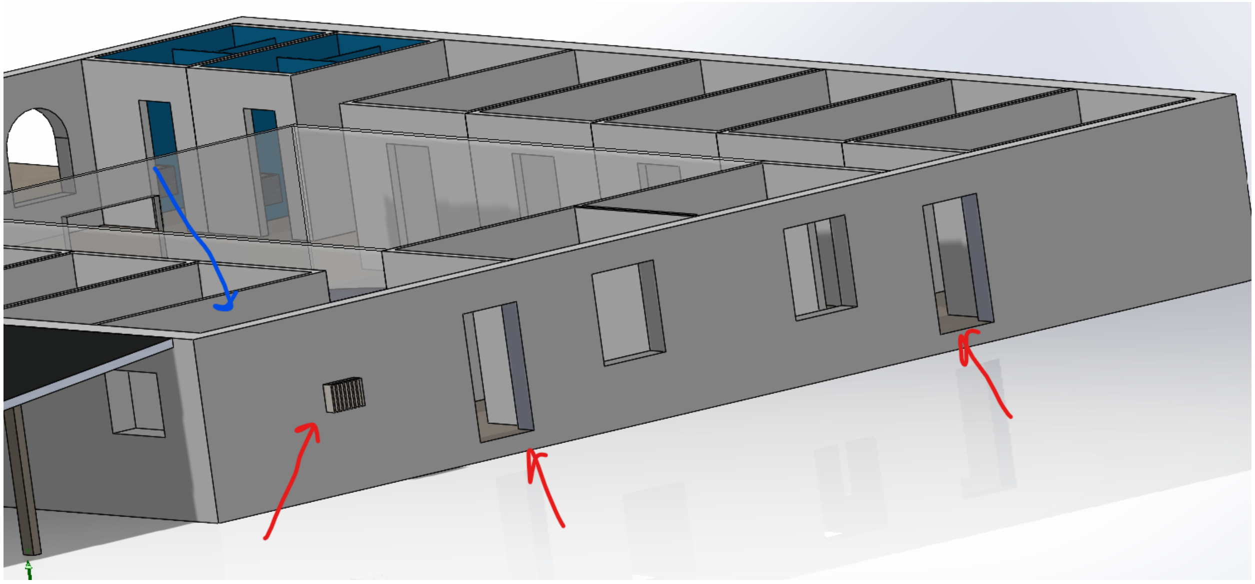
- The building's overall design is appealing.
- Our design's high amount of office space was desirable.
- The lab being connected to the lean-to covered loading dock was desirable.
- The storage room and antechamber system was appealing.
- The common space, being mostly empty, should be reduced to keep costs low or use the space more efficiently.
- The lab and kitchen require ventilation systems if they are to be included in the building itself.
-

We factored in the feedback into V2 accordingly. The highest priority task was to reduce the common space's wasted size, so we opted to reduce the number of offices without reducing the total effective office space significantly. Our reasoning is that by reducing the office count from 15 to 10, we can have 5 permanent single-offices and 5 more double-offices, each accommodating two people. This was done because our offices are already rather expansive, but also because the client mentioned that only 5 of the employees would be regular, year-round office users – and the extra 10 potential office spaces are unlikely to be fully used at all times. Thus, this system allows us to avoid wasting space on empty, large offices where a double-office would do. We also adjusted the position of two offices to be behind the meeting room, both making it more central and minimizing the footprint of the building. The new layout is shown here:



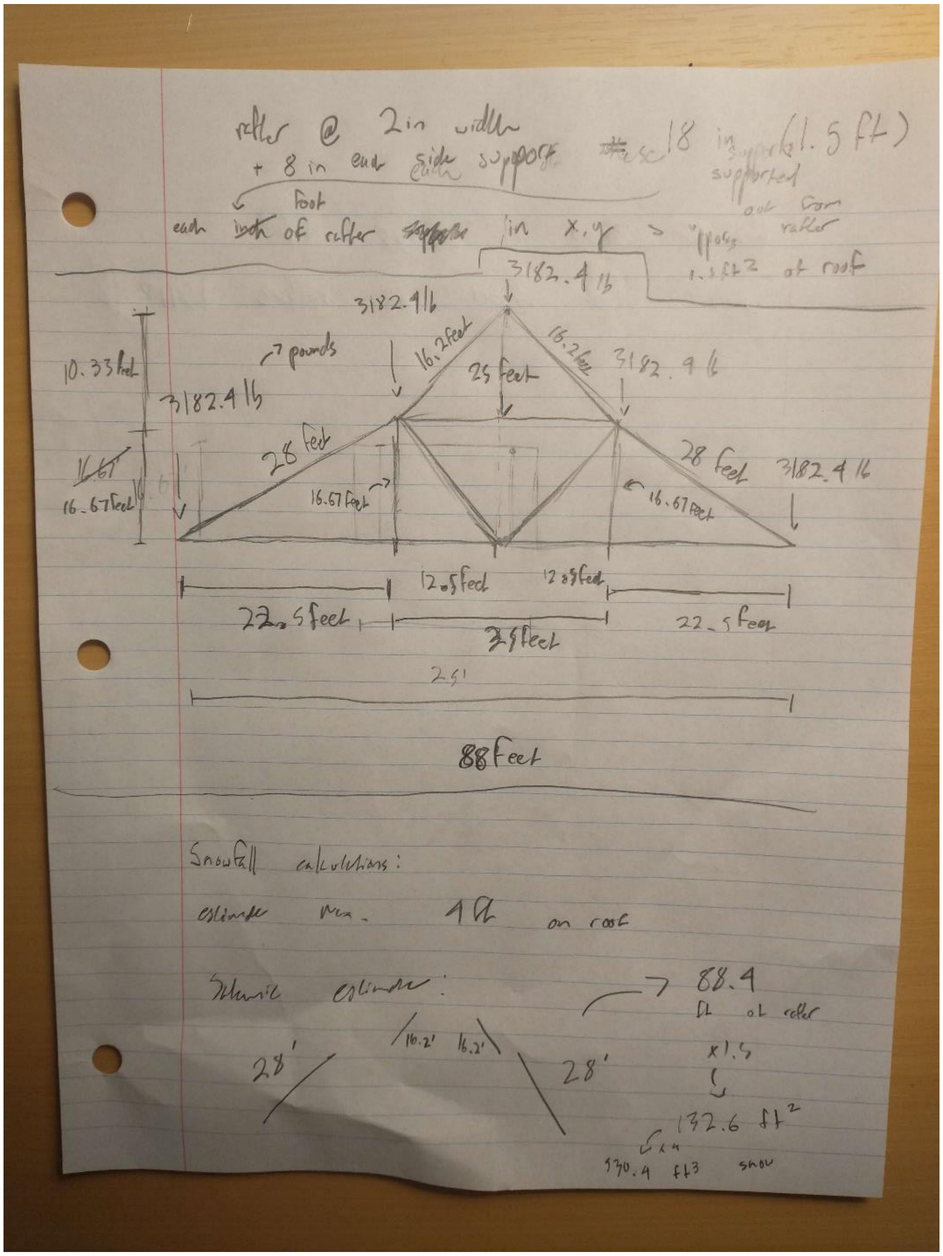
Through this process, the building's footprint (not including lean-to or offshoots in the bottom of this picture) was reduced to 95ft x 68ft, down from V1's size of 146ft x 88ft – a serious reduction in both costs and inefficiencies.

We also included an AC unit and fire exits near the kitchen to represent the safety features desired, though these features are difficult to represent adequately in our chosen medium of SolidWorks. The kitchen space is indicated by the blue arrow, and our AC unit and fire exits are indicated by the red arrows.

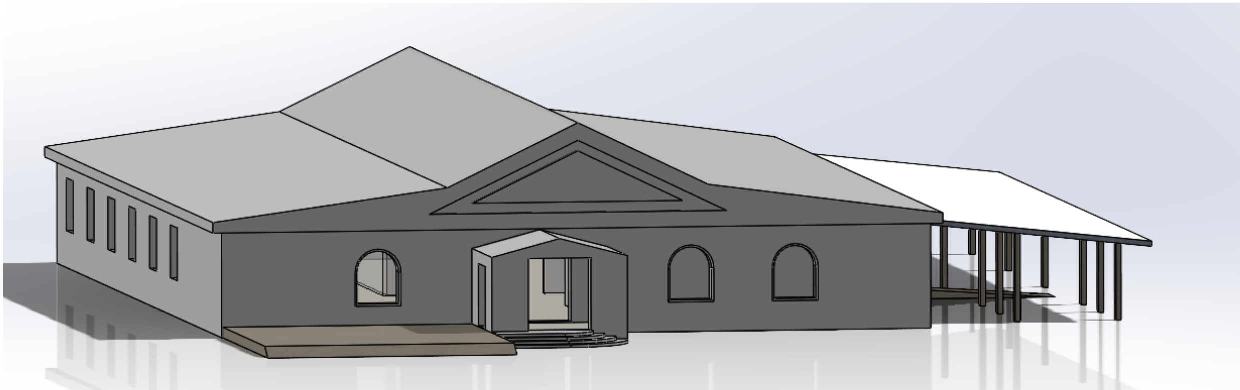


Small cosmetic changes were also made, such as the height of interior rooms being lightly adjusted, aesthetic circular steps being added to the front of the building, and

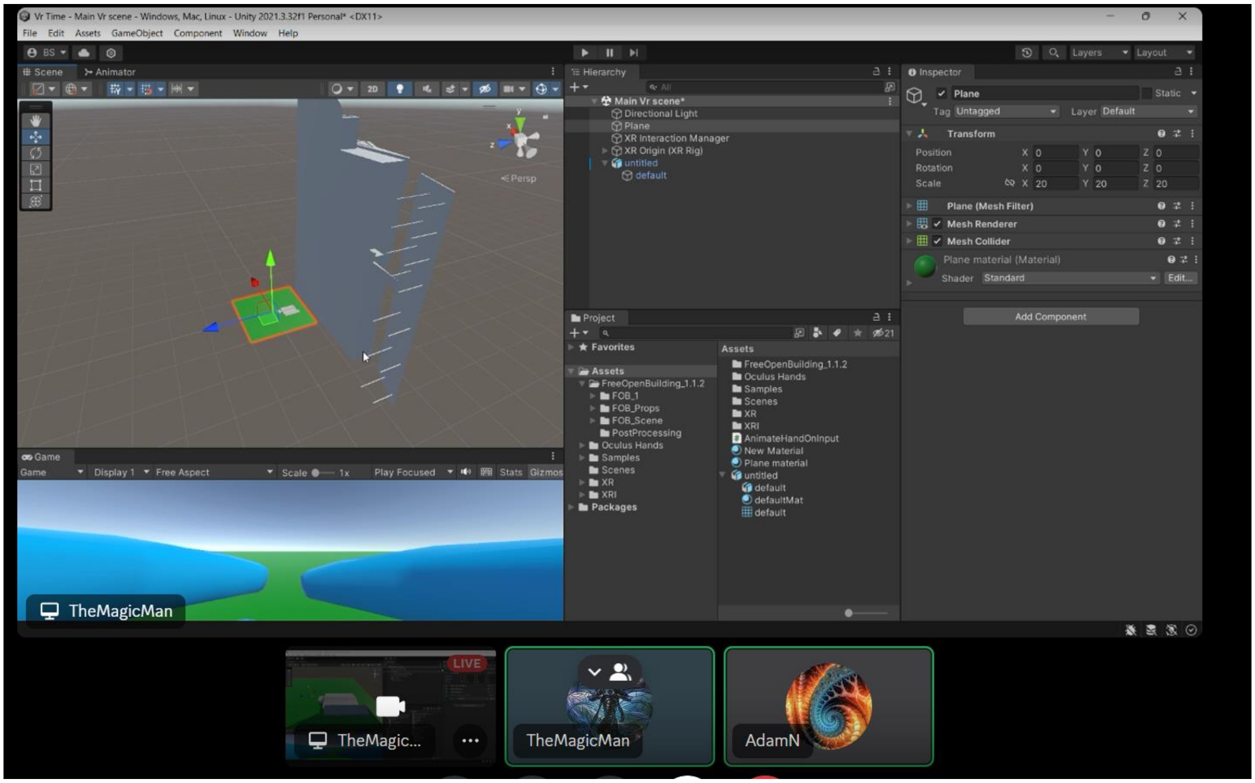
Finally, using approximative calculations for the load-bearing capabilities of our roof truss, we found that we can greatly reduce the size of both the roof and its beams without bringing any risk to the structural integrity of the building:



We were able to determine that the width of our beams could be reduced significantly, and that our overall roof size & steepness were wildly in excess of requirements, especially with the client feedback we received on reducing our building's wasted footprint, all of which led to V2 having a significantly smaller roof.



Our VR simulation, while currently texture-less, is fully functional, with scaling and collision established, as well as a movement scheme. It was programmed in the Unity engine, using models ported over from our SolidWorks design. We plan to texture it using Blender or similar software in the coming days to get it presentation-ready. The unity file has been included in this deliverable submission for posterity. Below are some images of our testing (and some bugs we found along the way):


Vr Time - Main Vr scene - Windows, Mac, Linux - Unity 2021.3.32f1 Personal* <DX11>
File Edit Assets GameObject Component Window Help
Scene
Animator
Hierarchy
Main Vr scene*
Directional Light
Plane
XR Interaction Manager
XR Origin (XR Rig)
untitled
default
Inspector
Plane
Static
Tag Untagged
Layer Default
Transform
Position
Rotation
Scale
Plane (Mesh Filter)
Mesh Renderer
Mesh Collider
Plane material (Material)
Shader Standard
Add Component
Project
Favorites
Assets
FreeOpenBuilding_1.1.2
FOB_1
FOB_Props
FOB_Scene
PostProcessing
Oculus Hands
Samples
Scenes
XR
XRI
Packages
AnimateHandOnInput
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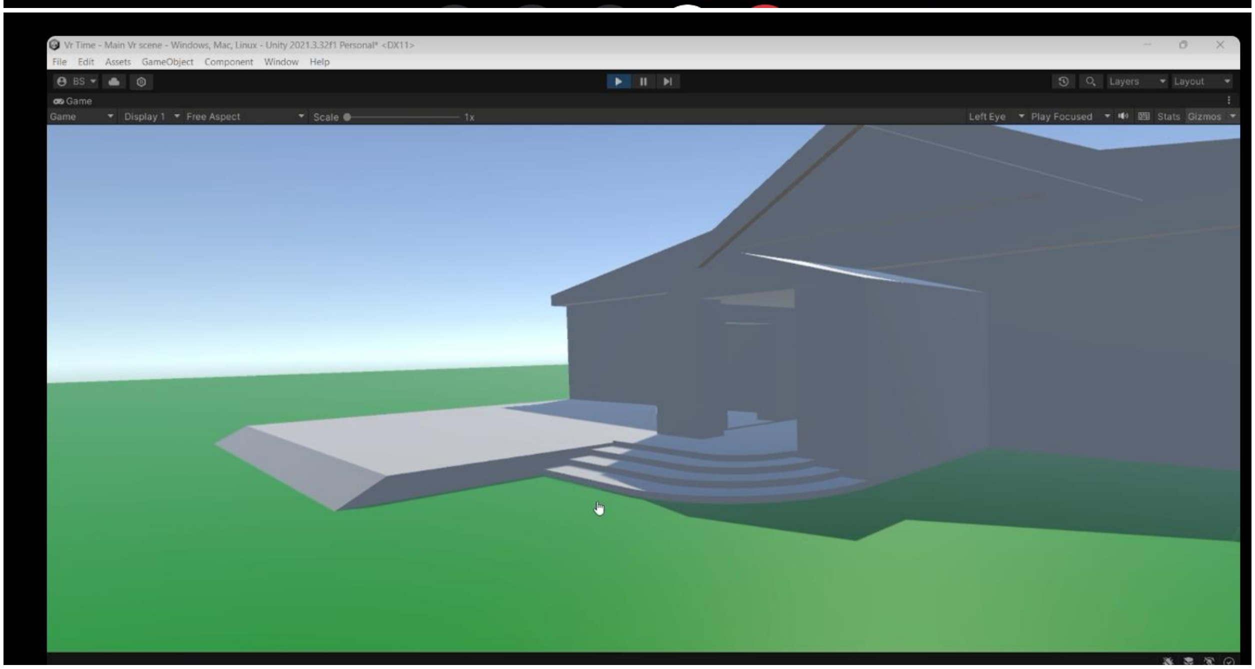
Vr Time - Main Vr scene - Windows, Mac, Linux - Unity 2021.3.32f1 Personal* <DX11>
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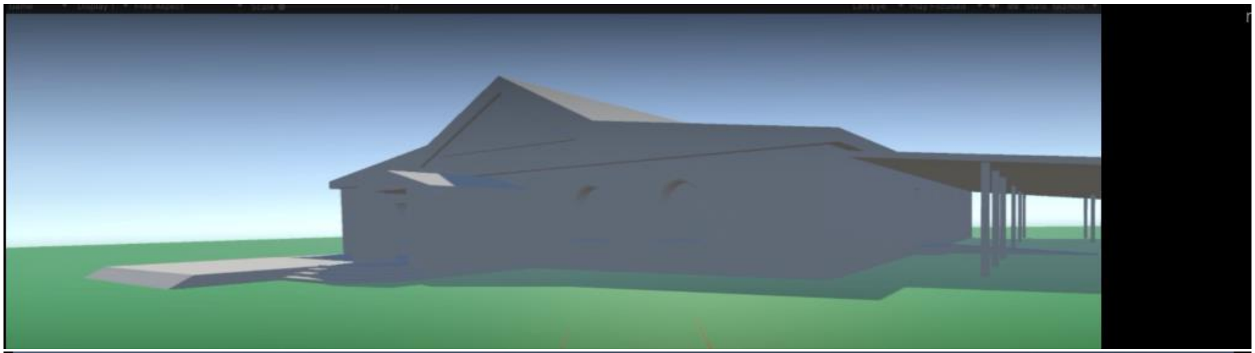

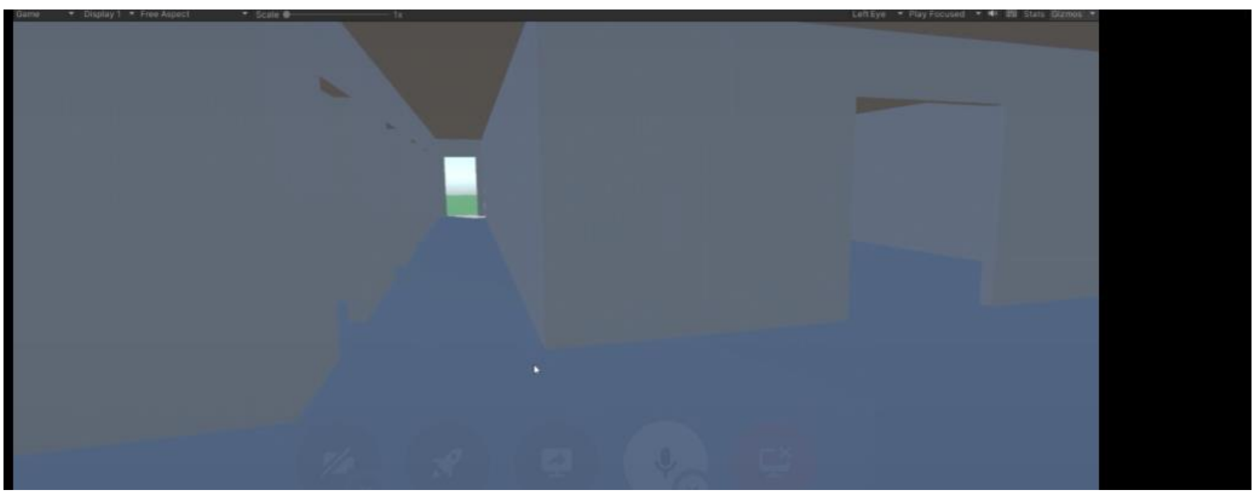

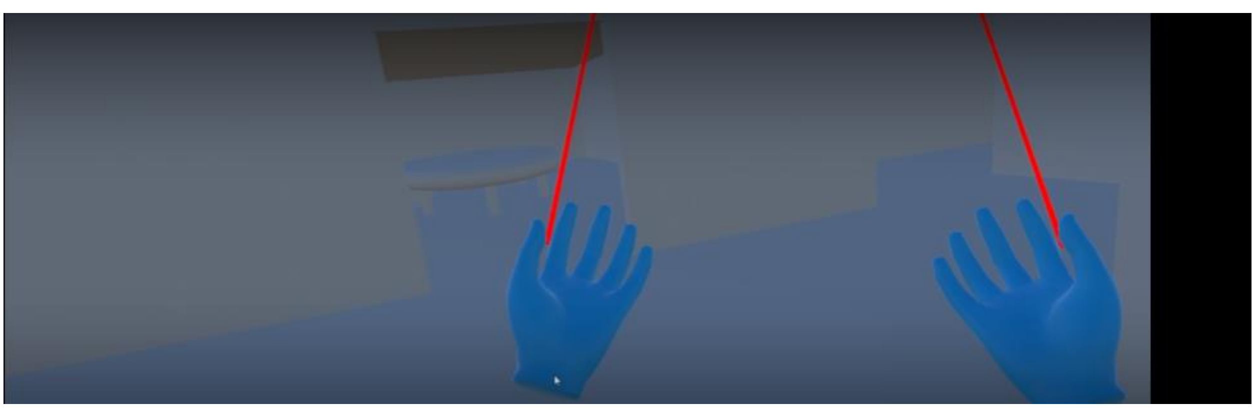

1.4 Prototype Analysis Conclusions:

Overall, our final prototype represents a comprehensive overview of our insightful and well-developed final building design. The VR system has allowed us to make countless small changes due to things we wouldn't have noticed in a system like SolidWorks, such as adjusting the heights of tables or the widths of doors, editing ramps or pillar sizes – all of this is only possible through the first-person view offered to us by this simulation. It therefore represents the ultimate final comprehensive prototype for a building – as even an intricate physical scaled-down model can only tell you so much about what it's like to walk around a building.

Our team feels ready for the upcoming Design Day presentation, with much work still to be done to polish our work in time for the 30th. We are confident our work will be well-received.

1.5 Wrike Link:

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=P7TpXpWQsQLuxDZWoSlnsK6X9s5wiEAU%7CIE2DSNZVHA2DELSTGIYA