Timber Waste Utilization

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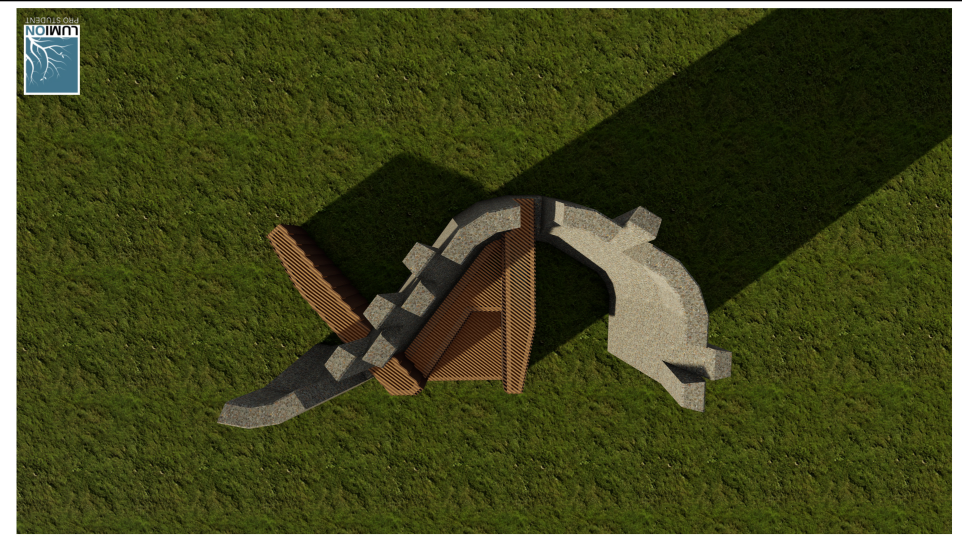
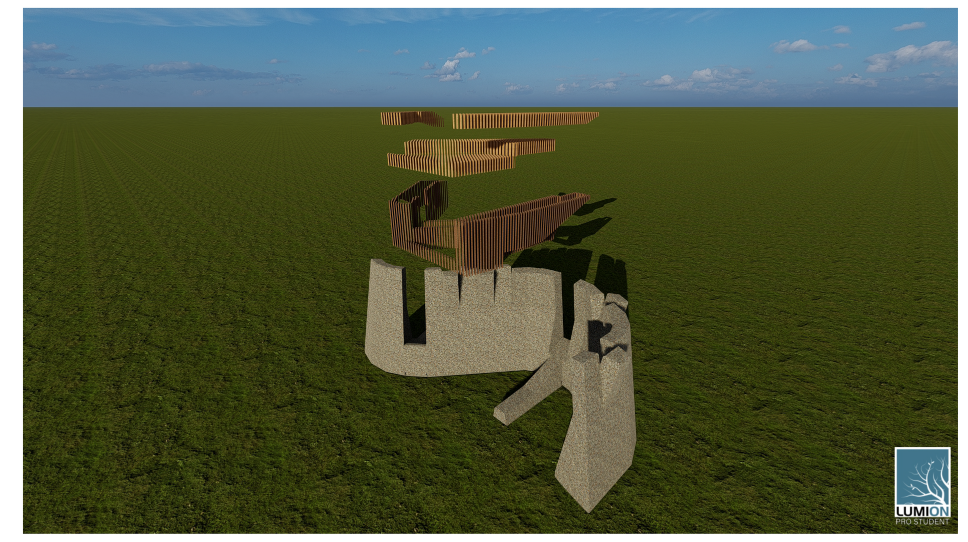
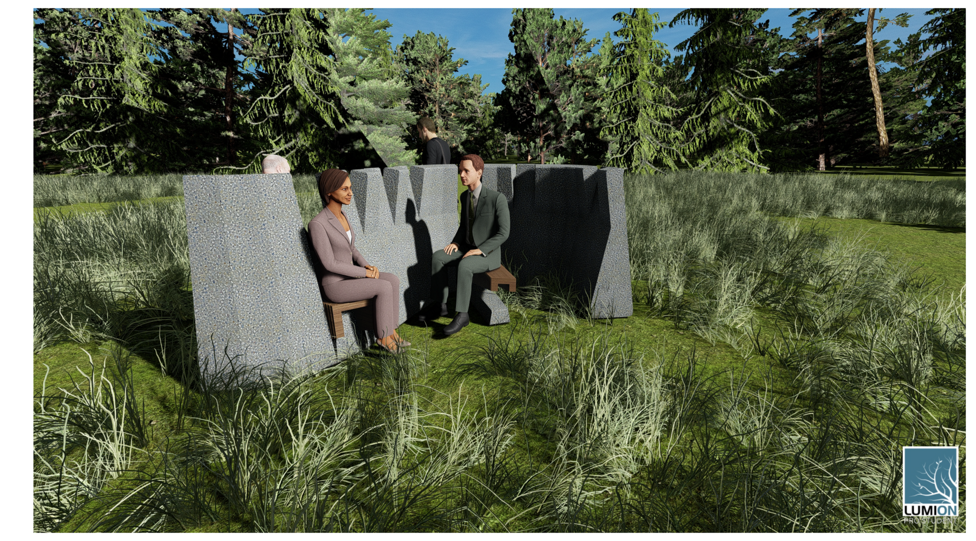
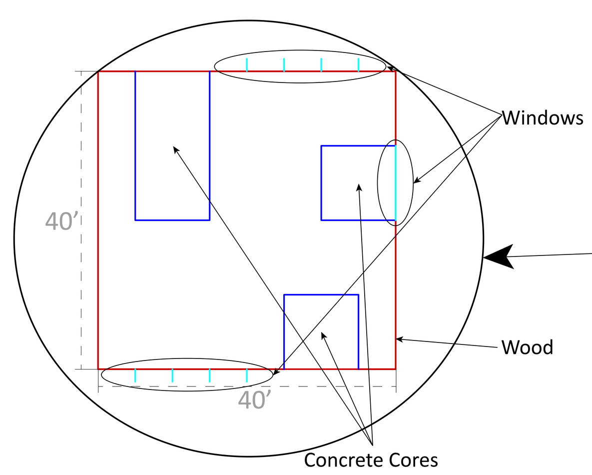
The first project was to design a wooden bench for the concrete wall that is already located on campus in the architecture courtyard. This bench and wall combination is a physical representation of our research related to carbon neutrality and passive environmental systems. The combination of concrete and timber symbolizes the relationship between materials which embodied carbon and materials which sequester carbon, respectively. Embodied carbon is the total carbon released into the atmosphere during a product or material's lifetime. The continual increase of embodied carbon is an issue in contemporary society because carbon gas is one of the primary environmental pollutants. Therefore, we investigated ways to potentially mitigate some of this offput of carbon gas. This, in turn, caused us to research carbon sequestration, which is a process that absorbs and traps carbon within a material. A notable material which can sequester carbon is wood. When a tree is harvested it sequesters the carbon stored at the time of its removal. While this is an effective strategy, it is irresponsible to continuously cut down trees to reduce carbon gases in atmosphere. Resultingly, we decided to utilize waste material produced by a tree farm which must remove every other tree in a row to ensure continued growth of surrounding trees. Using this waste material, we were able to analyze architecture at reduced scales, ranging from this bench to a concept for a cabin. That leads to the second part of the project in which we designed a cabin with a maximum footprint of 1,600 SqFt. We continued to explore the idea of carbon neutrality by attempting to offset the amount of embodied carbon with a material of greater or equal amount of sequestered carbon. In addition to using the same materials to achieve this, we wanted to use a passive system to increase energy output. A passive system is a system in a building which uses sunlight and heat efficiently to achieve a desired effect on the structure. In our design we implemented a process called evaporative cooling. This system works by coating a material or structure with water, which when evaporated by solar radiation, slowly cools the surrounding space. We are going to implement this technique with the use of three hollow, permeable concrete cores; two measuring 10'x10' and one measuring 10'x20'. After this was established, we began creating multiple wall panels for each core which will attach to and move about the wall in 5' intervals, as seen to the right. Combining these allowed us to create a series of matrixes with more than 2,000 differing permutations related to orientation variation. Next, we tested how these spaces would be cooled by generating thermal diagrams using a program called Energy2D. These diagrams show differences in temperature by creating a thermal gradient based on where they are placed. One of the series is shown to the right. Further right are more detailed versions of the permutations made using a parametric design program known as grasshopper which allowed us to create a script to rapidly generate more detailed iterations. Due to the pandemic, we were forced to continue our work over a digital medium therefore we added a sort of sub project to our research. This project consisted of a tumble design. A tumble design is usually a smaller scaled structure where people can use it in a multitude of different ways in different orientations. You lift it up, rotate it on its side, set it down, now it does something different. Each position has a different microclimate so the user will also feel a slight thermal difference in each one beside the way that they can use it. In our design there are three main differing microclimates in our and this may be due to the shape we used. There is the igloo orientation, the chimney orientation, and the cross-ventilation orientation. We used what we called geometric footballs and we used two of them and the way we created this is by orbiting them around each other and rotating and finally flattening out certain parts so that it may be able to stand on its own. In the different orientations.

Part One: Bench and Concrete Wall

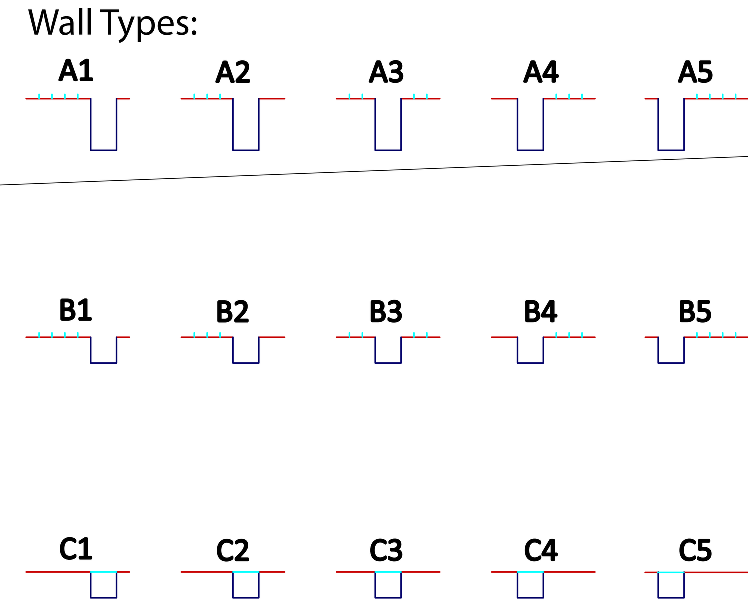


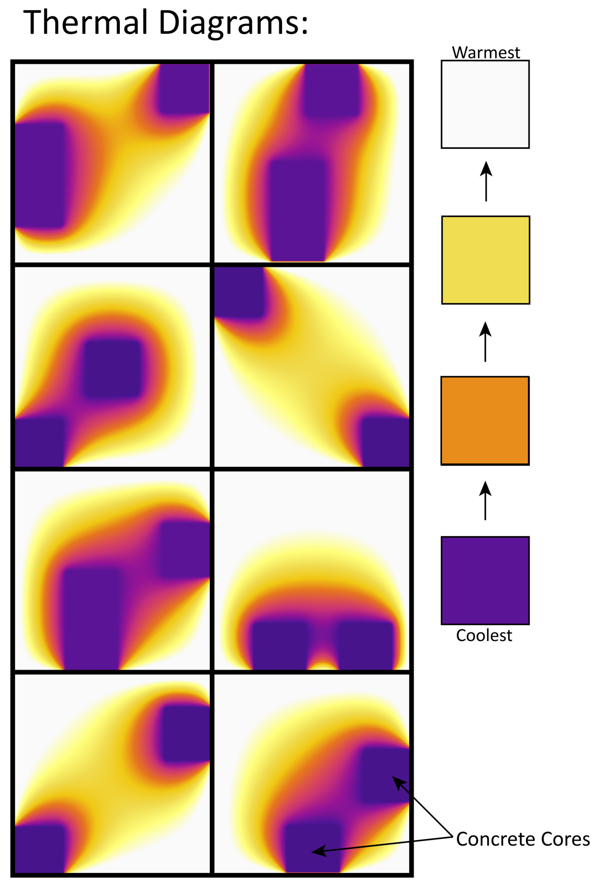
Part Two: Small Cabin



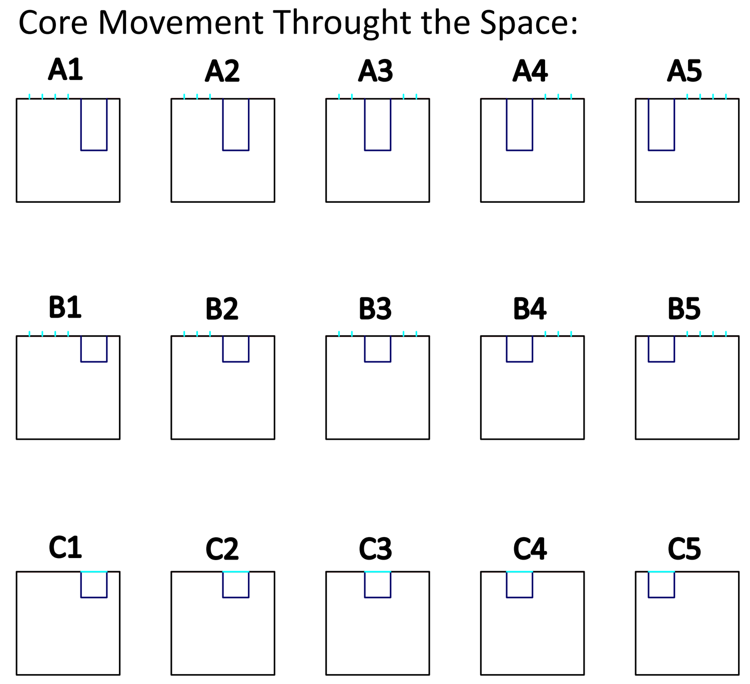
Wall Types:



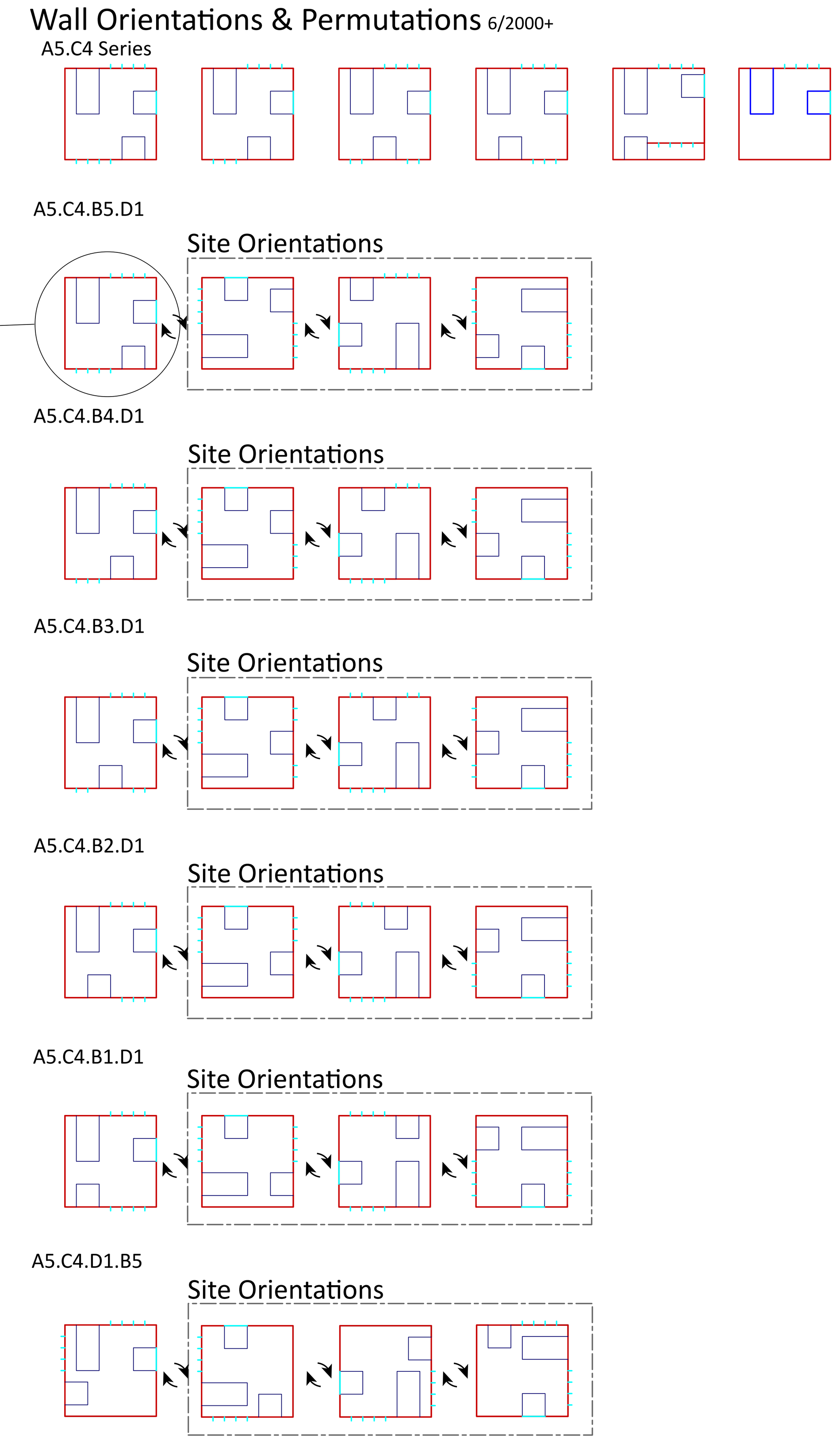
Thermal Diagrams:

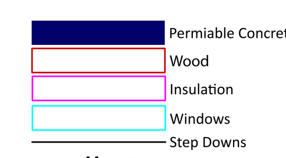


Core Movement Througth the Space:



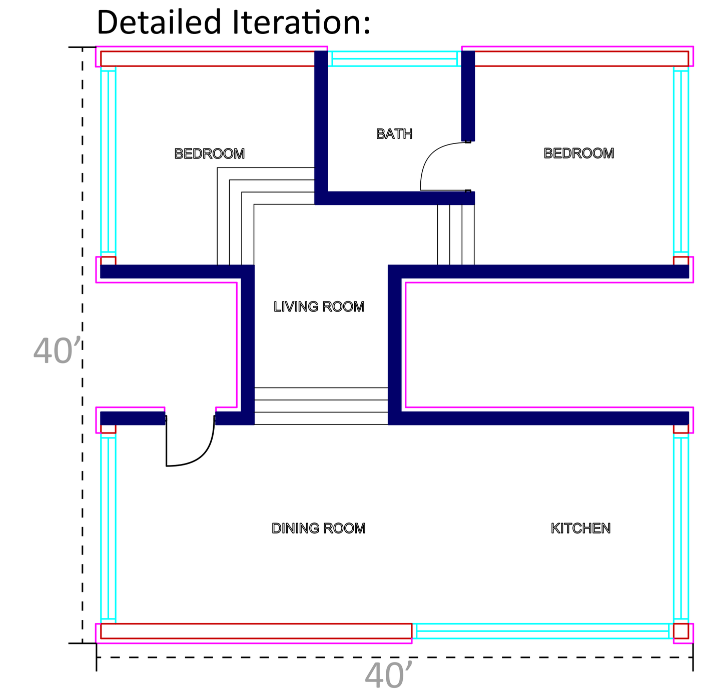
Wall Orientations & Permutations 6/2000+





Walls Types:

Detailed Iteration:



Iterations:

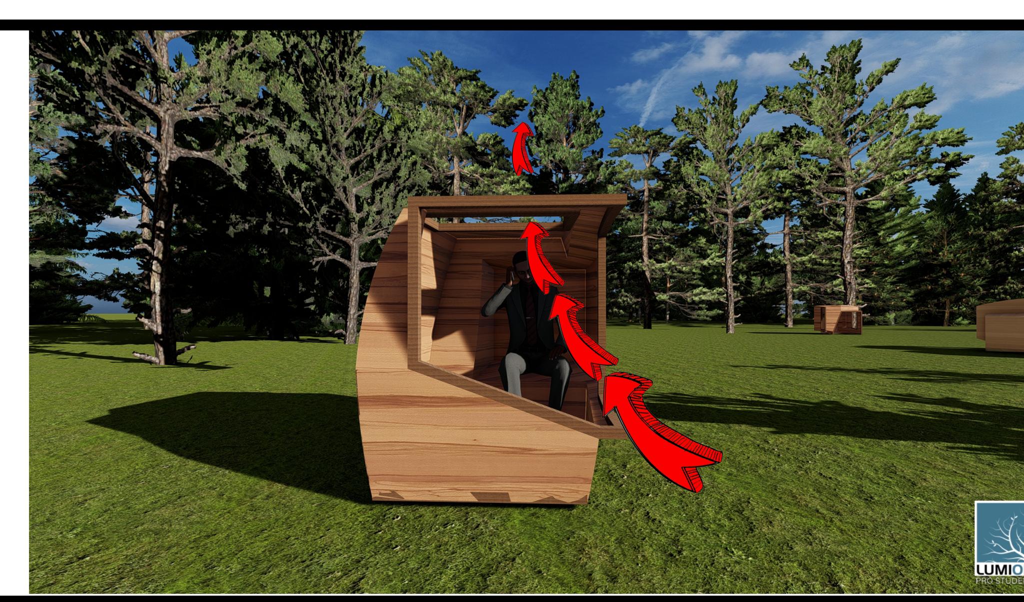
Part Three: Tumble Design

Igloo

The igloo would generally be warmer as it had no holes in the top of the orientation for heat to escape.

Chimney

For the chimney it would generally be cooler due to the openness as well as the opening at the top.



Cross-Ventilation

Finally with the cross-ventilation orientation the temperature would be more moderate as you would have airflow on the sides to come through it but there wouldn't be an opening on the top.