TIMBER TECTONICS

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ARCH 410 // WINTER 2017

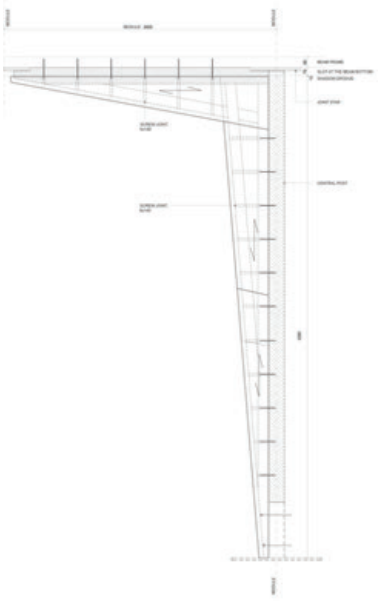
RESEARCH

Maggie's at the Robert Parfett Building in Manchester England

Completed in April of 2016 by Foster + Partners, it won the Arnold Laver Gold Award and Structural within the same year. This place was constructed as a place of refuge to cancer patients that provides support in a suburban-style environment. This establishment is constructed as a "delicate timber lattice structure" with four parallel sheets of LVL trusses. Each truss was assembled with "two diagonally opposed double web elements" and connected with a triangular node.

World Design Capital Helsinki 2012 Pavilion

This pavilion was designed by the Aalto University Wood Studio to enable a multi-function mixed use space. Inspired by this project, we learned that the frame was connected to a central column that anchored it's base below the decking. The frame of was hidden by two sheets of plywood on each side.



Courtesy of World Design Capital Helsinki 2012 Pavilion

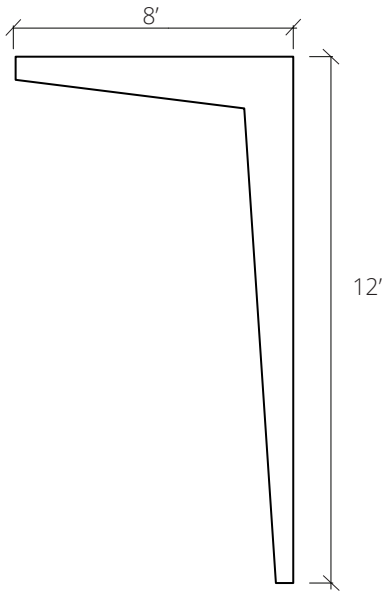
AESTHETIC AND PARAMETRIC DESIGN

AESTHETIC DESIGN

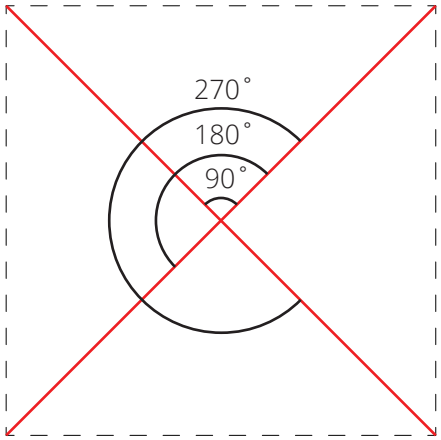
We started by creating a single modular frame. We arrayed the module around an origin to create a perpendicular axis. We proceeded to duplicate this system on a grid, which resulted in a diamond shaped pavilion. To provide shelter from weather, we implemented plastic panels which also allowed light to penetrate though the space. We were inspired by the simple singular form of a timber frame.

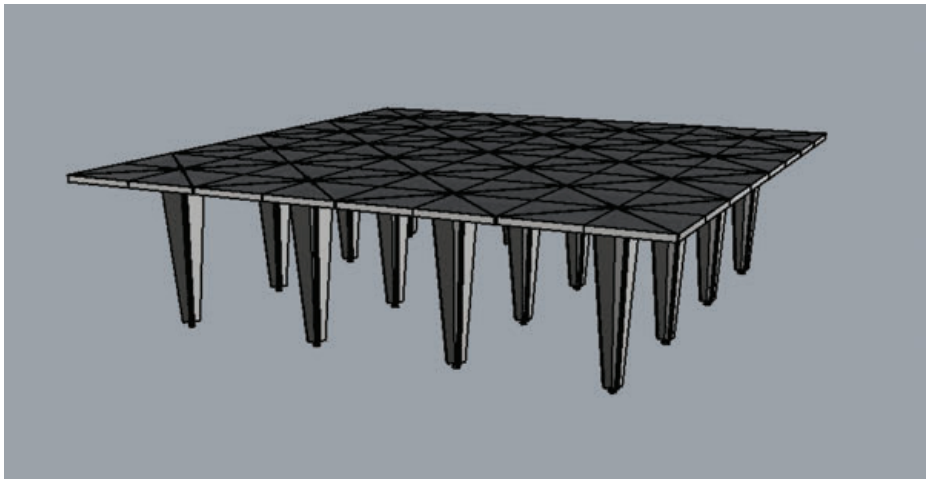
PARAMETRIC DESIGN

We were able to construct our module to multiply on a grid using the box array command. This will allow us to dictate the quantity of the modular structure. We used grasshopper to array the bays in each structure. We could decide how many bays on each structure, which determine the numbers of connections between each bays. We starts from 4 bays and 4 structure in a grid for analysis. Once we are confident in the construction, we will start to expand the idea into a series of structure.

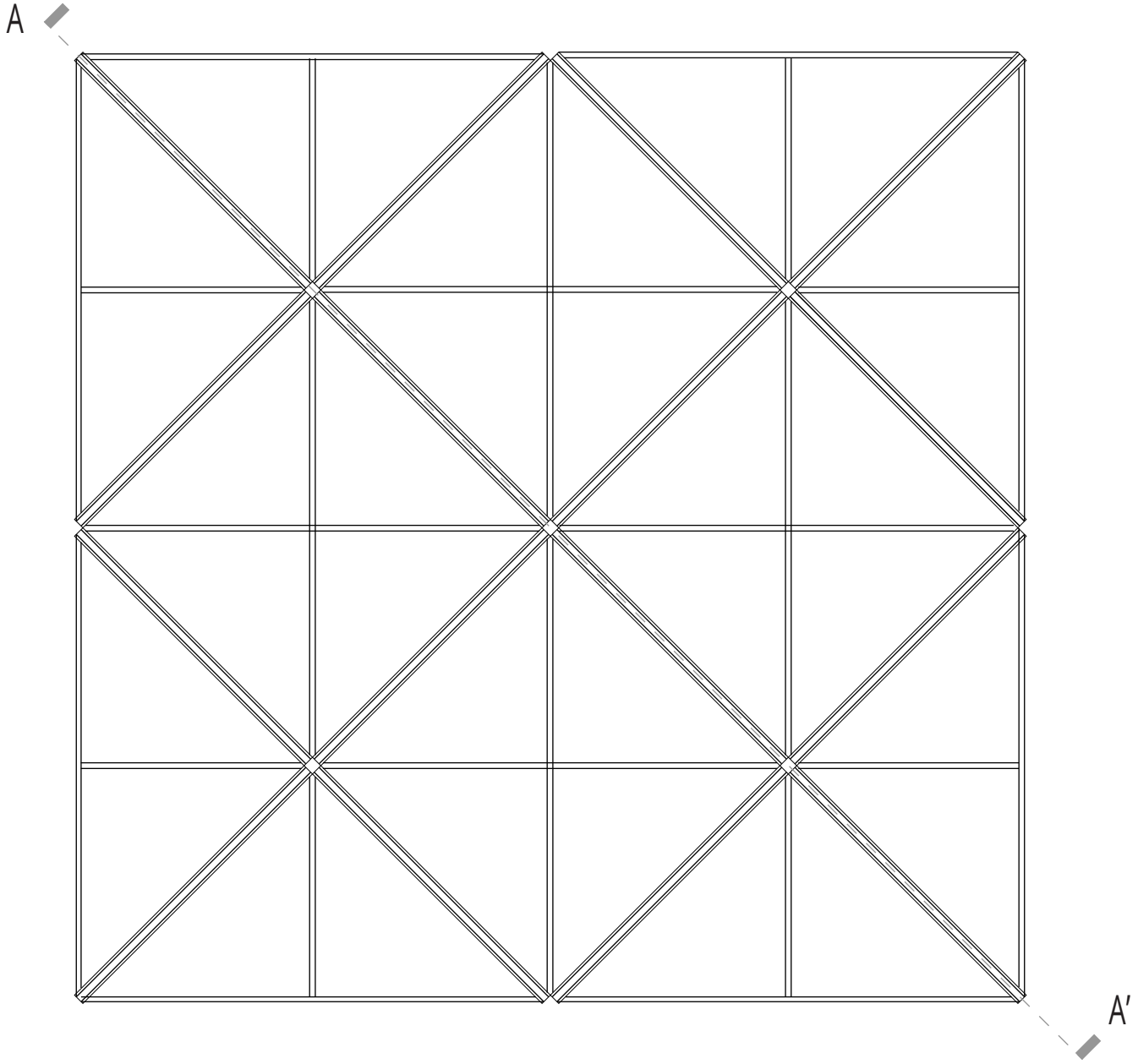


TOP VIEW



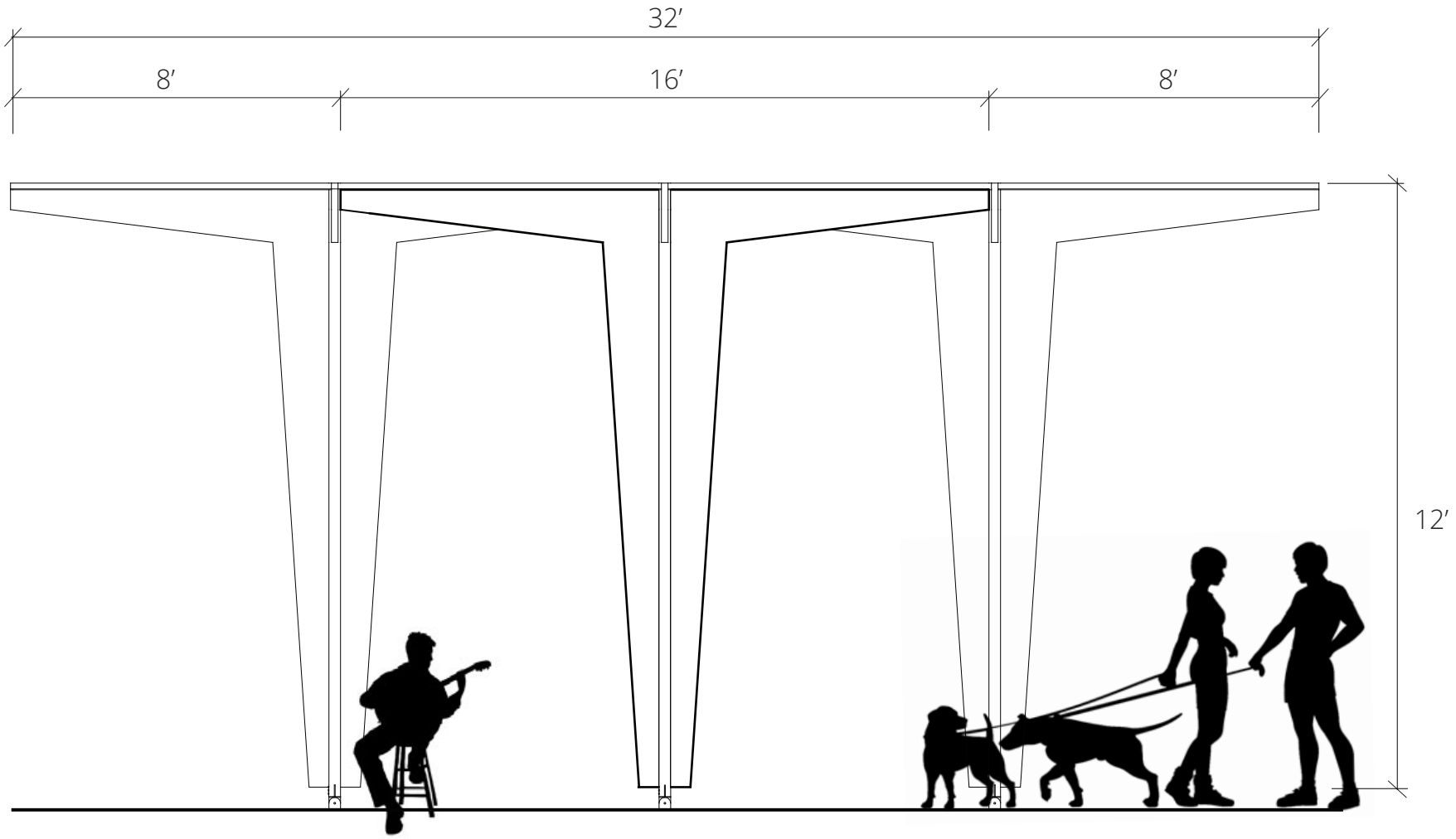


CEILING PLAN



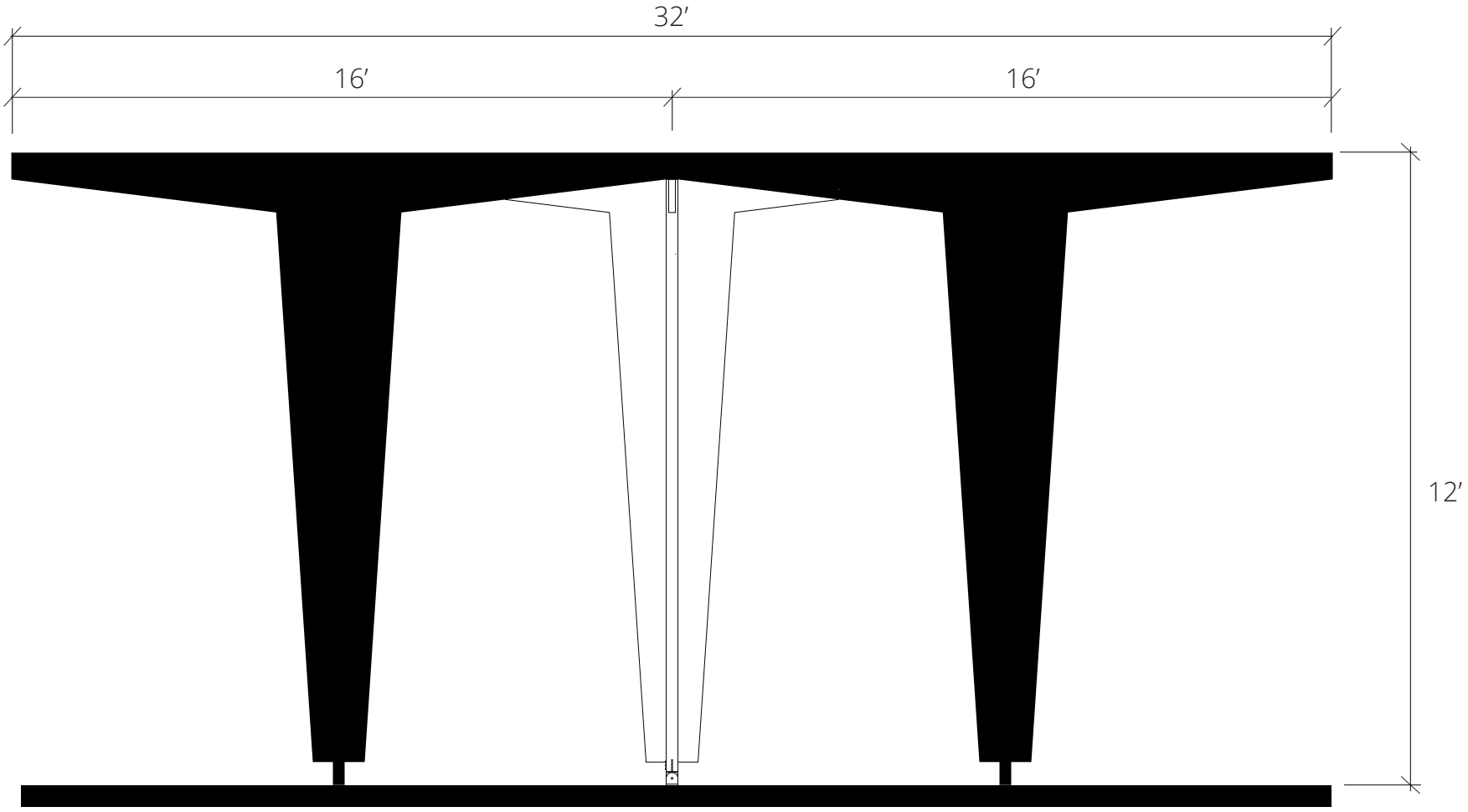
SCALE: 1/4" = 1' - 0"

ELEVATION



SCALE: 1/4” = 1’ - 0”

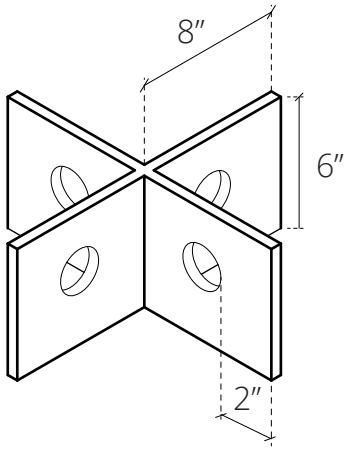
SECTION



SCALE: 1/4” = 1’ - 0”

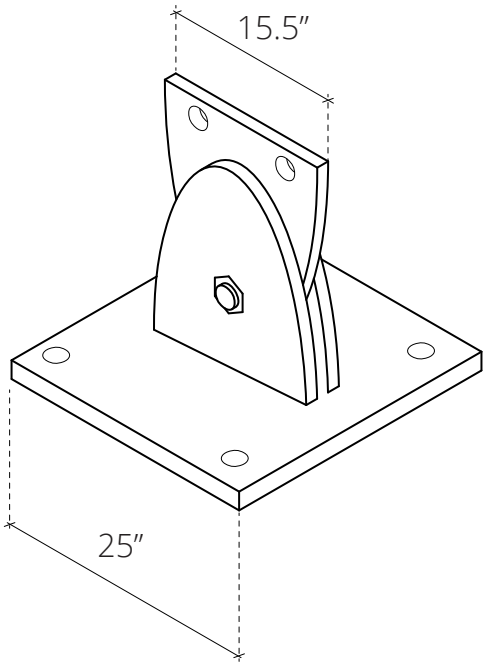
JOINTS: MEMBER CONNECTION

INTERSECTING BEAM CONNECTION



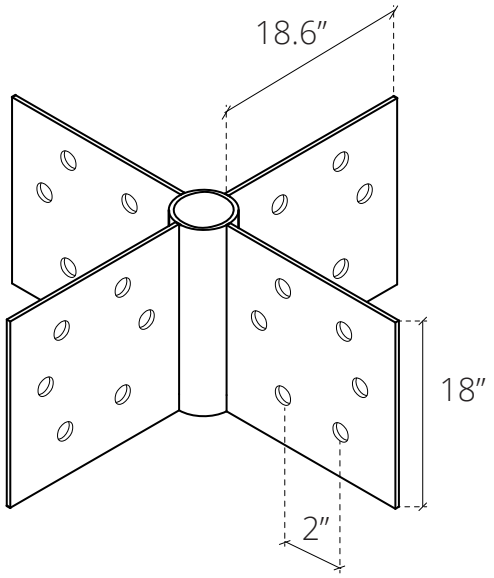
Pin connection connecting all 4 beams at center.

STEEL PLATE PIN CONNECTION



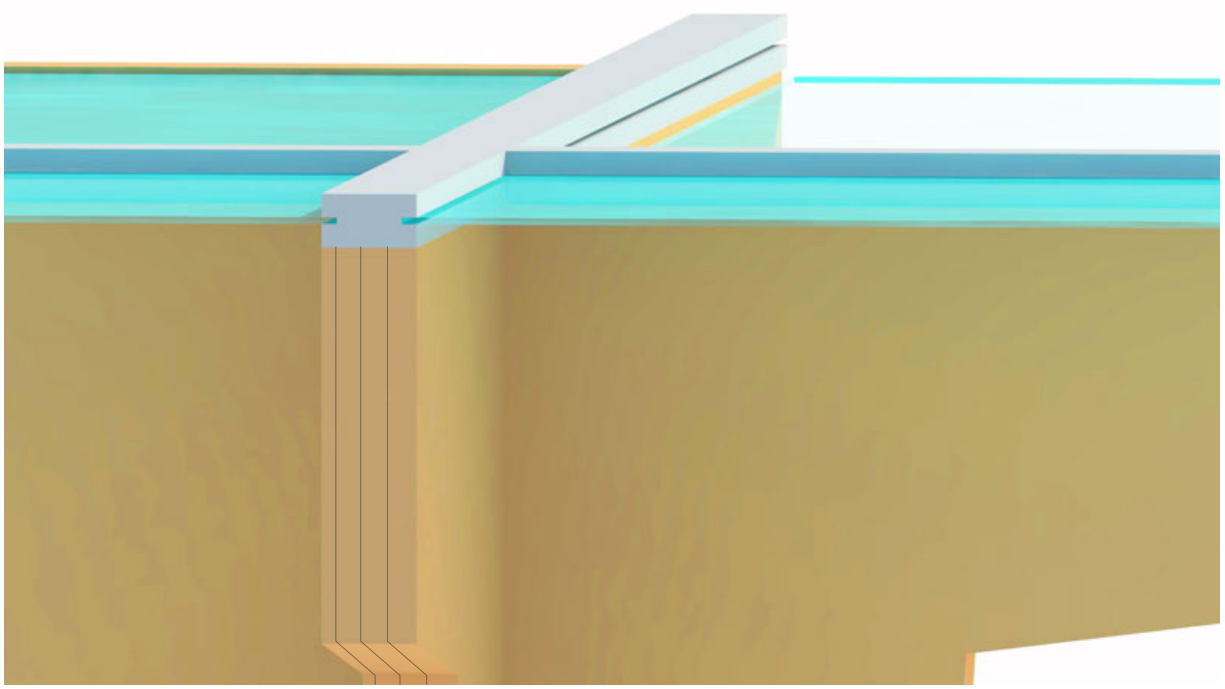
Pin connection connecting columns to steel plate. The Steel plate is anchored to the concrete foundation.

FLITCH PLATE CONNECTION



6 Holes are used to create a fixed connection between columns and beams.

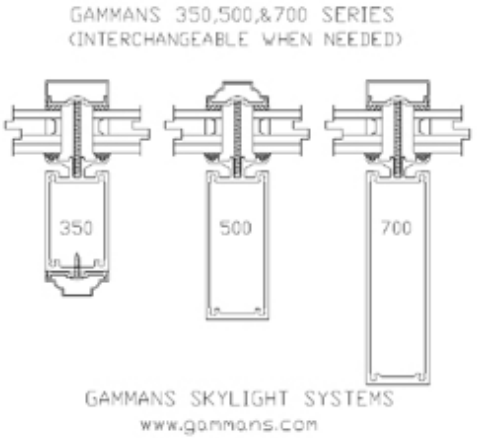
JOINTS: ROOFING



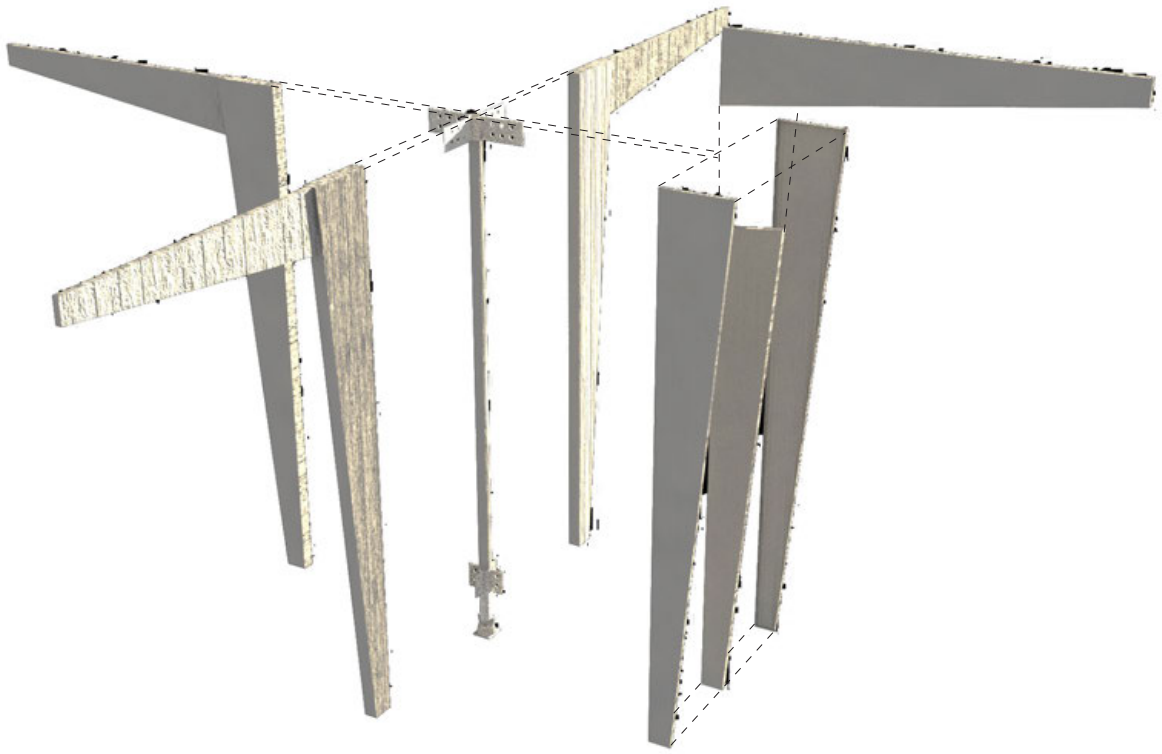
ROOFING:

Plastic sheets lay a top a recessed portion of the frame. This inset secures the plastic to the structure.

An alternative method for plastic panel application would be to use structural silicon joints to connect the plastic sealant. This technique would avoid exposing the wood.



CONSTRUCTIBILITY: FRAME

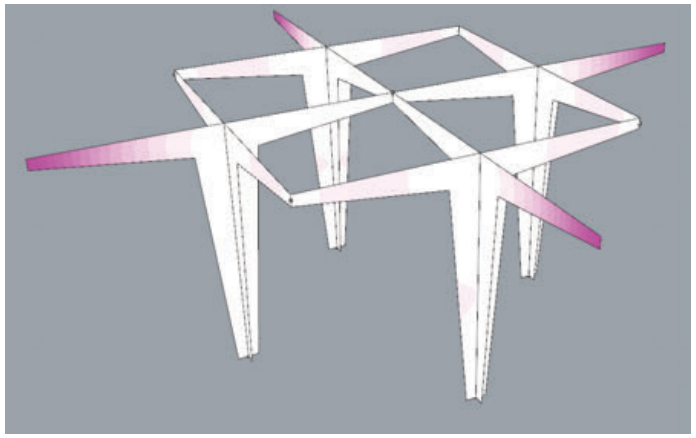


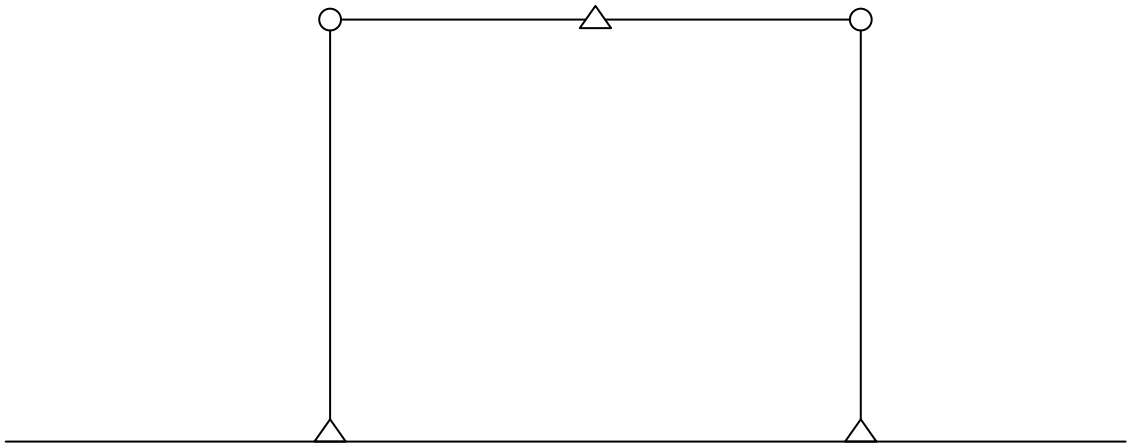
THE FRAME

The frame is constructed with three layers and sandwiched together. The middle layer is composed of a 1 1/2" thick LVL sheet and will fabricated with a CNC machine to make up shape of the beam and column. The two outer layers hold up the middle layers and is constructed from 1/2" thick LVL. The product is the bound together by adhesives and then subjected to heat and pressure (Gurvich). Once the assembly of four members are complete, they all connect to the central 4" diameter column and are fastened together with a flitch plate along the top and the base of the column.

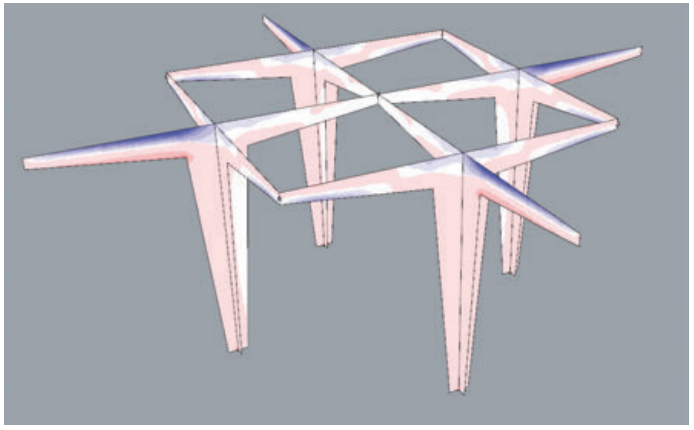
STRUCTURAL EFFICIENCY

DEFLECTION





STRESS



After plugging the model into karmaba, we found that the cantilever beams were subjected to the most stress. The intersecting beams at the center of the model were the least stressed area. We found that the beams facing inward were supporting each other through pinned connections. In terms of the cut outs (from prior iterations) we analyzed that only a small portion within the structure could be cut out, therefore forgoing the design aspect.

The overall structure was based on three hinge connections. We have four pin connections at the base of the column and 5 pin connections at the beams. This will allows us to withstand lateral loads in any given direction.

MATERIAL

The materiality of the pavilion was decided based on constructibility and aesthetic design.

LVL Properties

- High Strength
- Light Weight
- Cost effective

Frame:	Outer Frame:	LVL Sheet; Common: 1/2”
	Middle frame:	LVL Sheet; Common: 2-1/2”
Column:	x1; 4 x 4