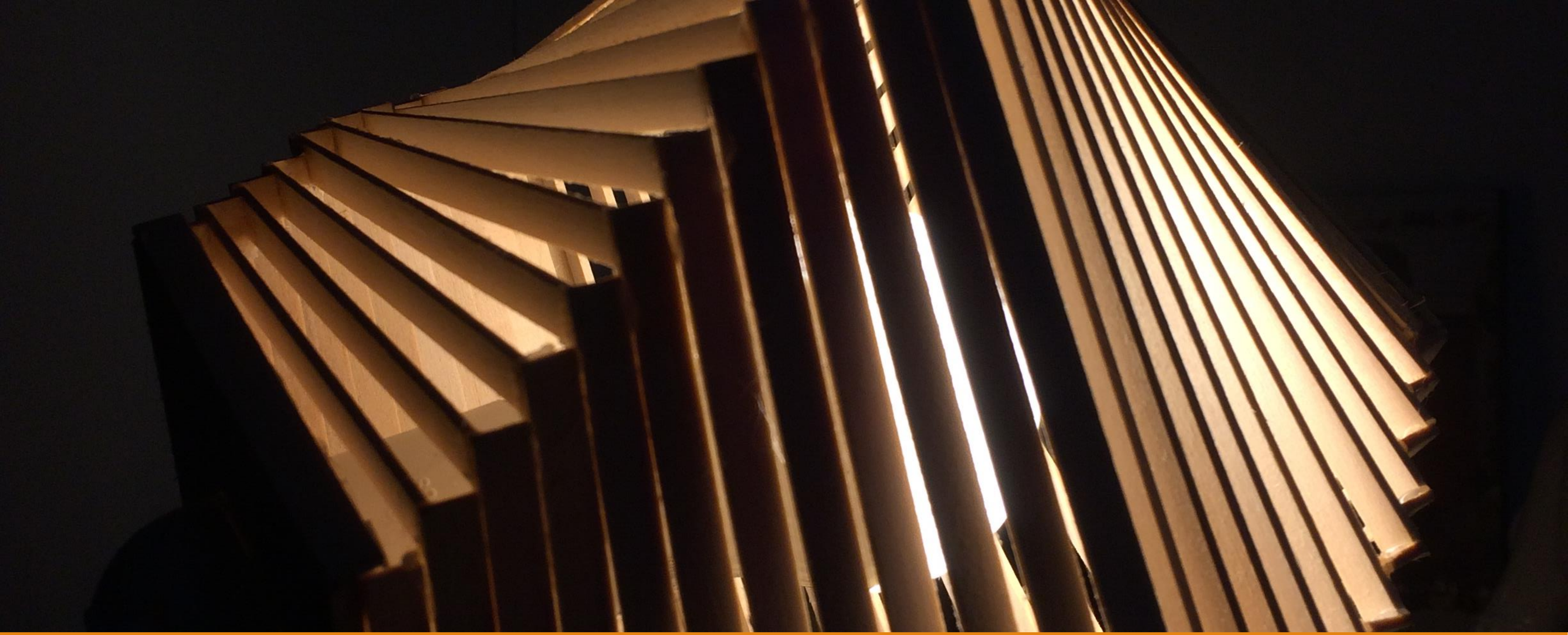


Timber Tectonics in the Digital Age

ELI METCALF'S PORTFOLIO

PROFESSORS MARIAPAOLA RIGGIO AND NANCY YEN-WEN CHENG SPRING 2018

UNIVERSITY OF OREGON
OSU Oregon State University

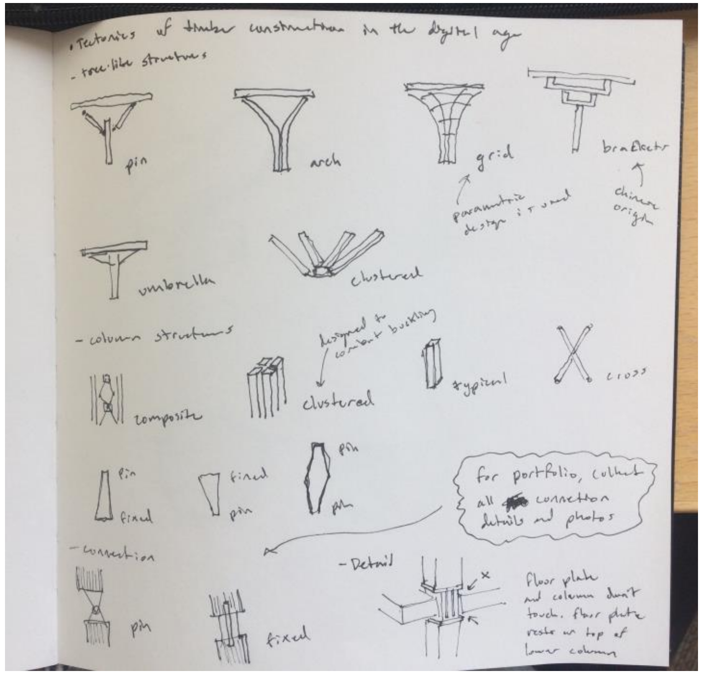
Beams and Columns

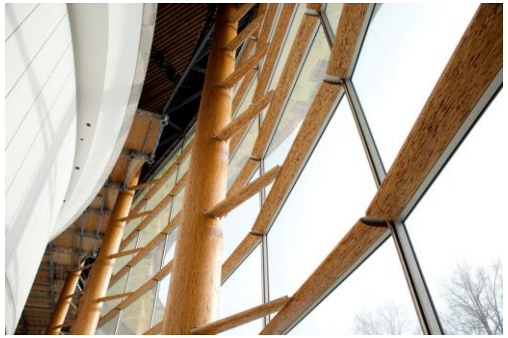
NOTES

This week we learned about different types of beam and column structures. It was generally a review from structures courses I have taken in past years but it still was a welcomed refresher. I was particularly interested in the many tree like column structures developed alongside timber technologies and new wood products. I made notes of the many ways one can form a column, and how particular forms may be used for different program elements or unique forces on the building.

The column structures primarily used in two of the readings assigned this week are particularly interesting to me due to the often lack of creativity in form often prescribed to columns in architecture. Usually, ambitious and dramatic moves in architecture happen at the roof, overall form, or wall level. To see the EXPO-roof in Hanover utilizing a curving column umbrella system is fascinating. The connection from the human scale and ground level to the sprawling grid roof is clear. The same can be said about the Arena Stage's column system. Not only do these huge columns touch the floor at a slender and delicate footing, but they act as mullion supports for the glazing is also compelling.

>> from week 2 readings and lecture: "Arena Stage" : "EXPO Hanover": Lecture by Prof. Mariapaola Riggio





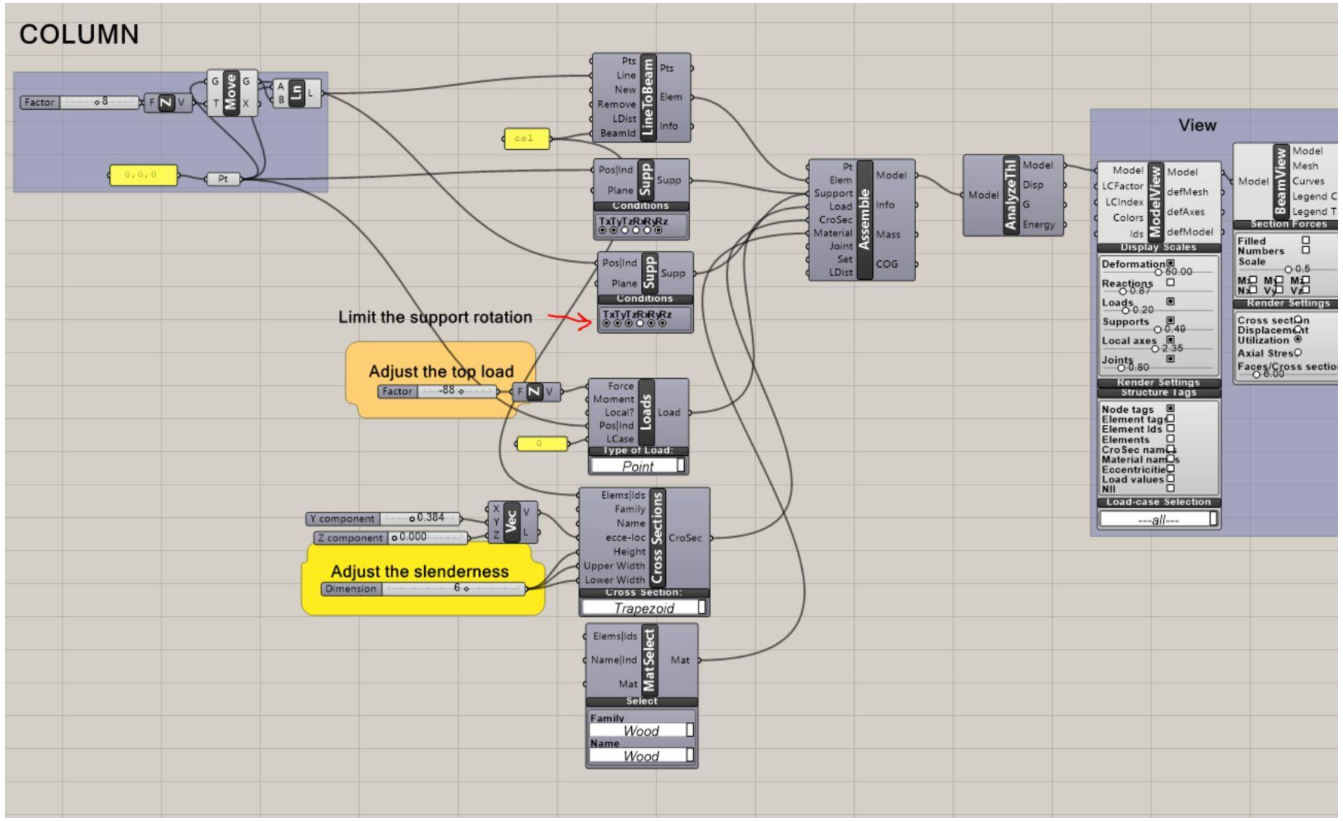
Beams and Columns

KARAMBA

This week I analyzed and interpreted column and beam grasshopper scripts. I explored the uses of each input and played with adjusting the loads and slenderest to test the bending and capacity. The column and beam were essentially the same in script besides the orientation.

I couldn't get my karamba up and running this week on my computer so it made it hard to explore all of what karamba can provide in its interface. I spent a session in the computer lab to finish up work on it. I was much more productive with my time when I received the karamba license for my personal computer.

>> Column example grasshopper script



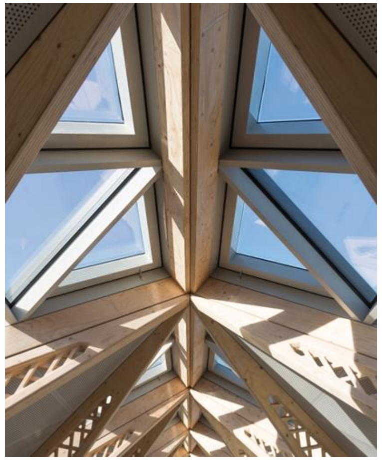
Frames and Trusses

NOTES

This week we learned about different types of frame and truss structures. For the readings, I chose to talk about the Robert Parfett Building in Manchester and the Formby Swimming Pool in Lancashire. For the Parfett Building, the joining connections at the corners of this truss system are the best attribute of the design. The way that the designers decided to hide the hardware of the system lets the truss feel light and natural. I also find the tapering of the members functional while creating delicate connections that feed into the overall design idea. I'm curious to know what the design problem or question influenced the design of the triangular medium between individual truss members. I like the design, but I am curious to know why it was designed in that way.

For the Formby Swimming Pool, an extremely simple yet brilliant timber truss system was used. The main forces on the truss are compressive forces on the top member and the single web member, and the subsequent tension forces held by the steel cable.

>> from week 3 readings: "Maggie's at the Robert Parfett Building, Manchester" : "Formby Swimming Pool, Formby, Lancashire"

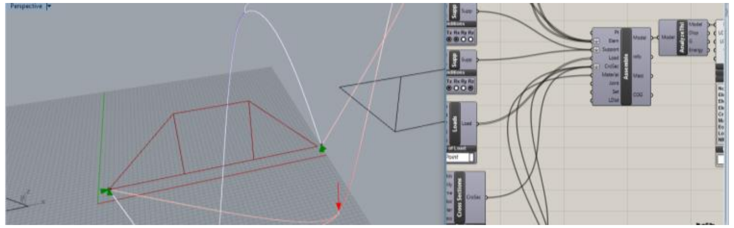


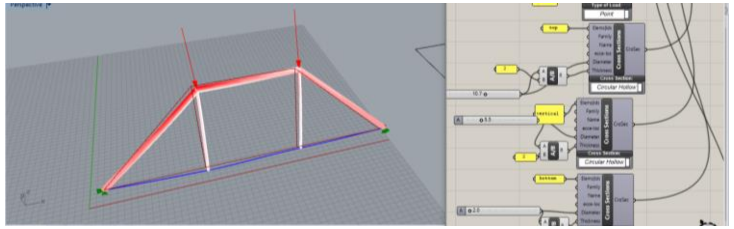
Frames and Trusses

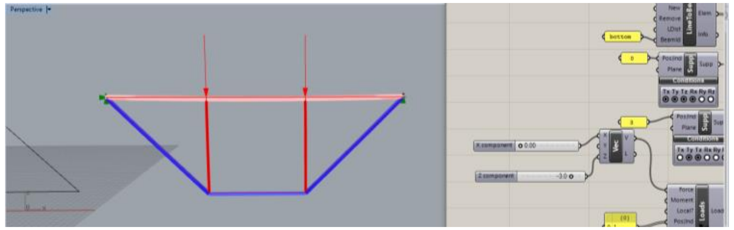
KARAMBA

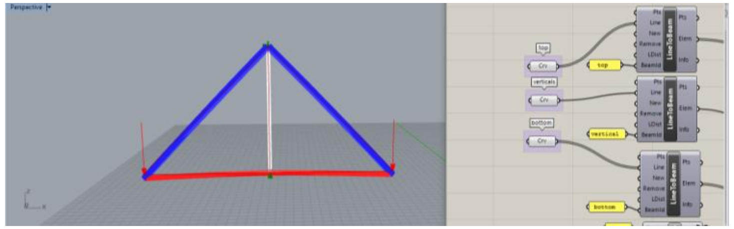
This week I analyzed and interpreted frame and truss grasshopper scripts. I explored the uses or each input and played with adjusting the loads and slenderest to test the bending and capacity. In these screenshots I tested a number of different typical truss structures. I also struggled with the script at first, but then I realized the units were wrong.

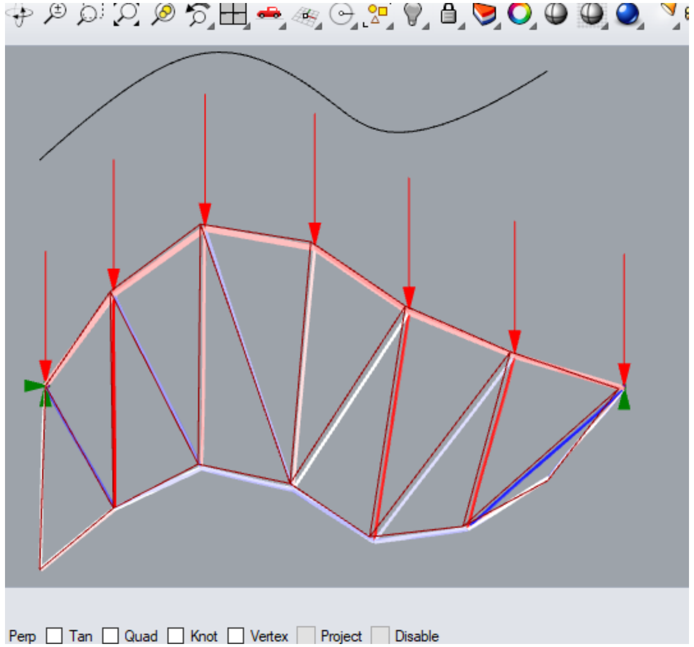
I also played with making my own trusses and analyzing them. It was interesting to start with aesthetic choices for member arrangement then see if they could stand up.

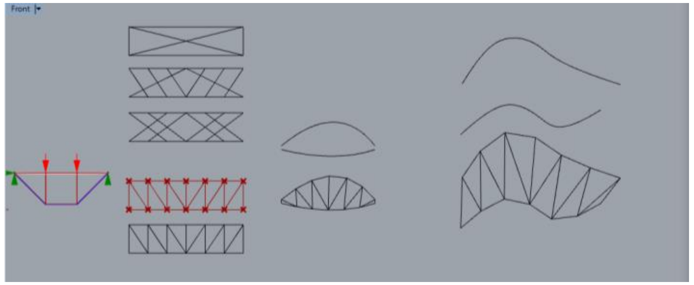










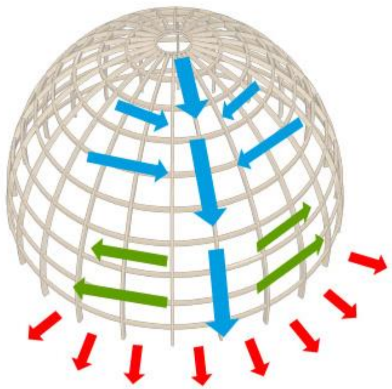


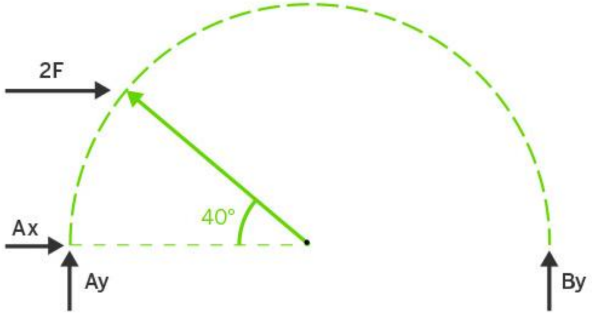
Date: 5/21/18 Topic: TIMBER TECTONICS

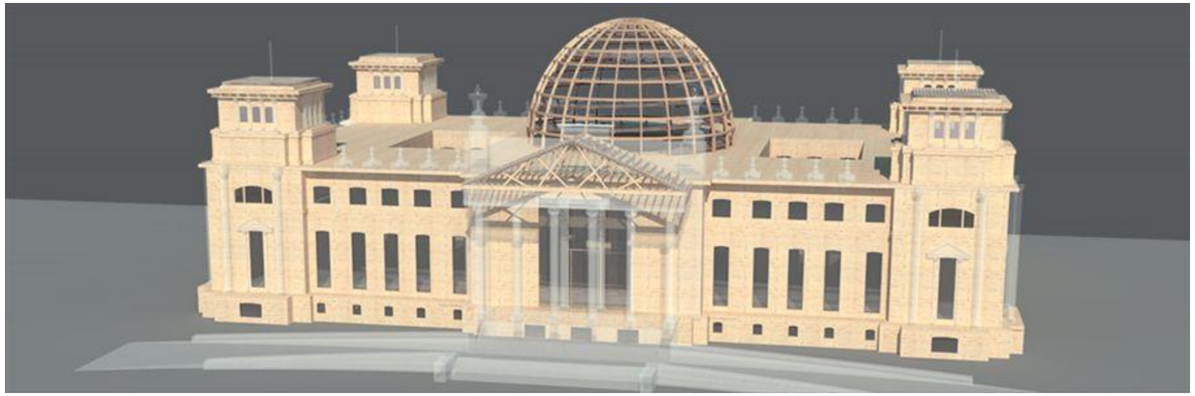
Arches and Domes

NOTES

This week I researched arch and dome structures. I found that the wooden dome of the Reichstag is a great example this compression system. The curved wood takes the compression from the loads while tension rings made from the same wood keep its from. Thanks to its shape, the dome is a very stiff structure in itself. The shape resembles that of a compression arch. Basically, the wind load or resistance would not be a problem due to the unified geometry. Another positive of this structure type is that when several compression arches are used, the outside pressure mostly creates compression to members instead of bending moment.



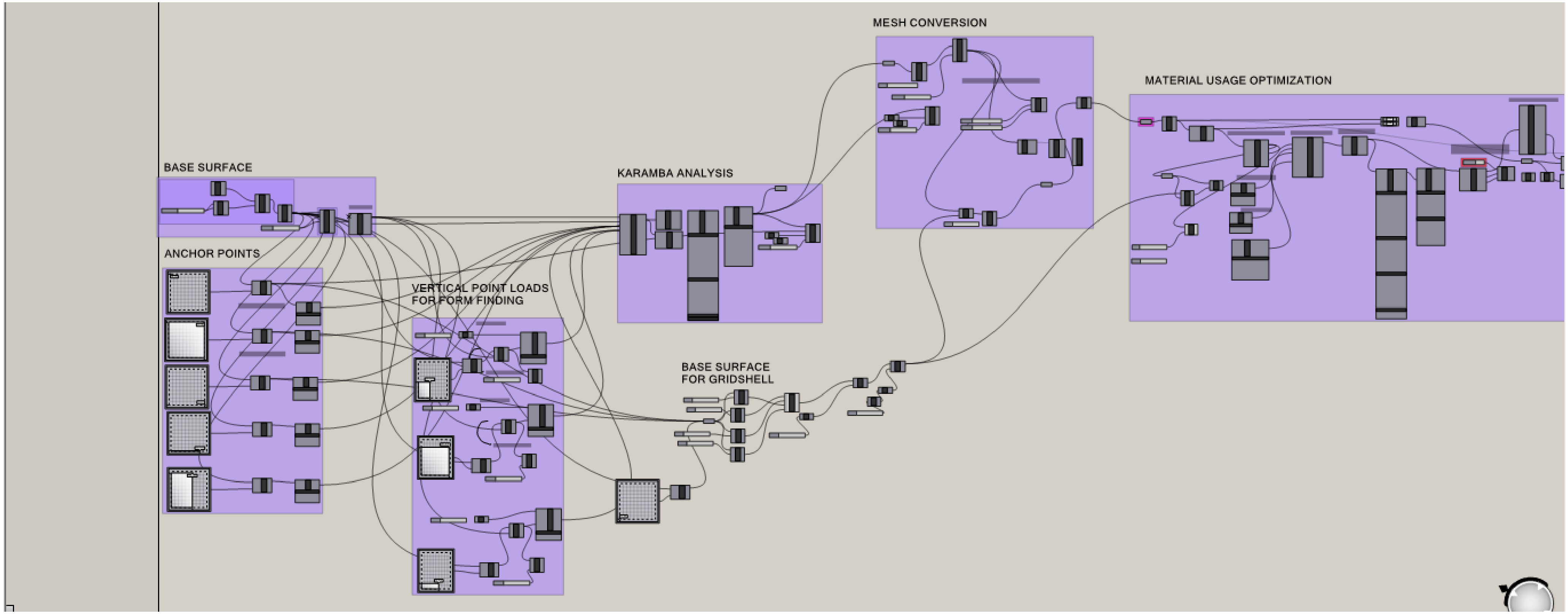




Arches and Domes

KARAMBA

This week I analyzed and interpreted arch and dome grasshopper scripts. I also worked with my group to develop a script for our gridshell structure.



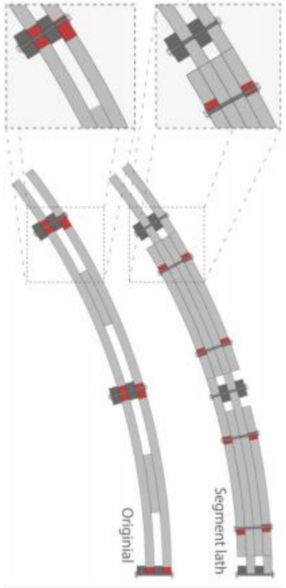
Diagrids, Shells, and Gridshells

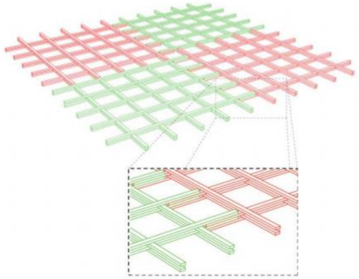
NOTES

The suggested reading of this week that was most relevant to our design was the modular grid shell system. This system combines our design ideas with a easy to assemble framework. To utilize a diagrid system we wish for the system to be easily assembled and disassembled. We found that the strained system of assembly would be best. But what could help in our assembly would be to use modular pieces that centered around nodal connections.

We plan to have our design in a layered grids system. The layered nature of the structural system, together with the fact that the post-forming process requires the layers to have freedom to slide along each other during construction, causes there to be nodal connections. Once the final shape of the structure is obtained when raised, the bolts can be tightened and the desired clamping force applied to the connection while the shear blocks will address the shear forces.

>> from "INTRODUCING THE SEGMENT LATH - A SIMPLIFIED MODULAR TIMBER GRIDSHELL BUILT IN TRONDHEIM NORWAY"





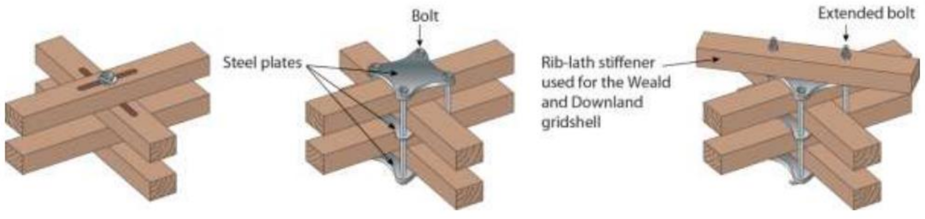
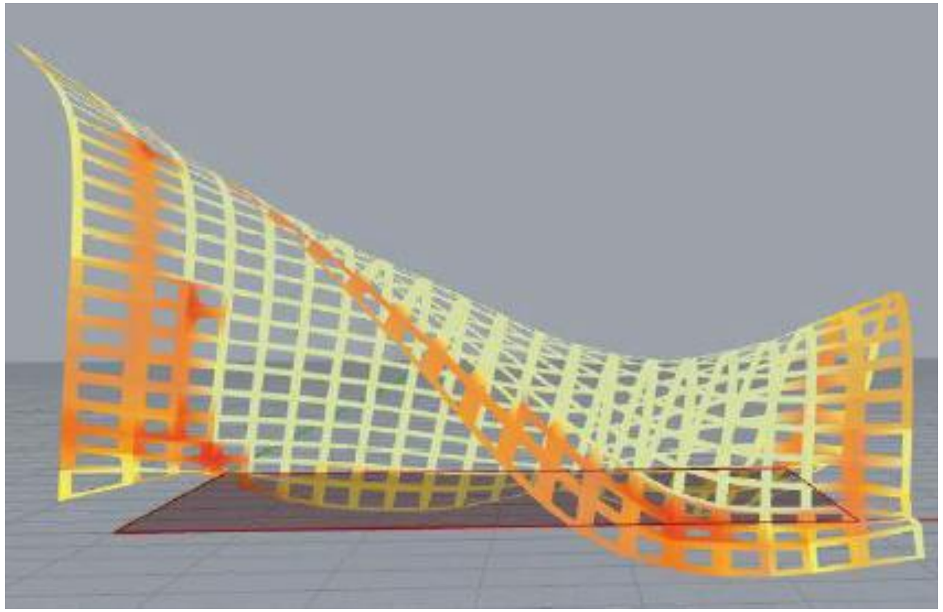


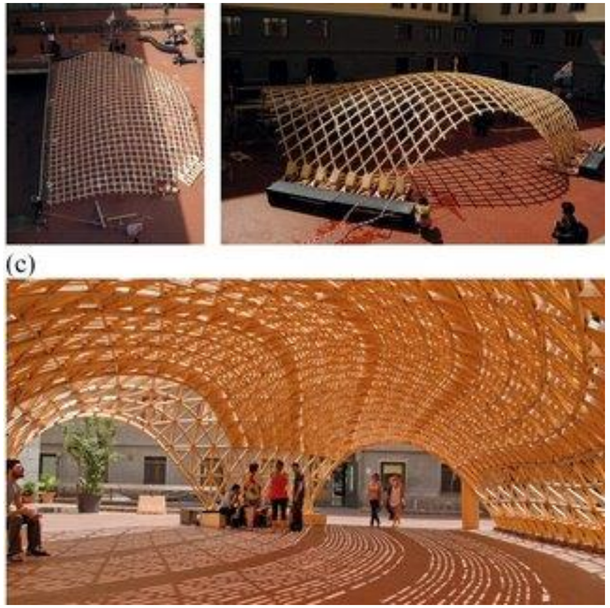
Figure 1. 9 Connection detail. Left: Slotted hole connection. Middle: Pattented nodal connection. Right: Pattented nodal connection with rib-lath stiffener (Harris *et al.*, 2003a) p31,32

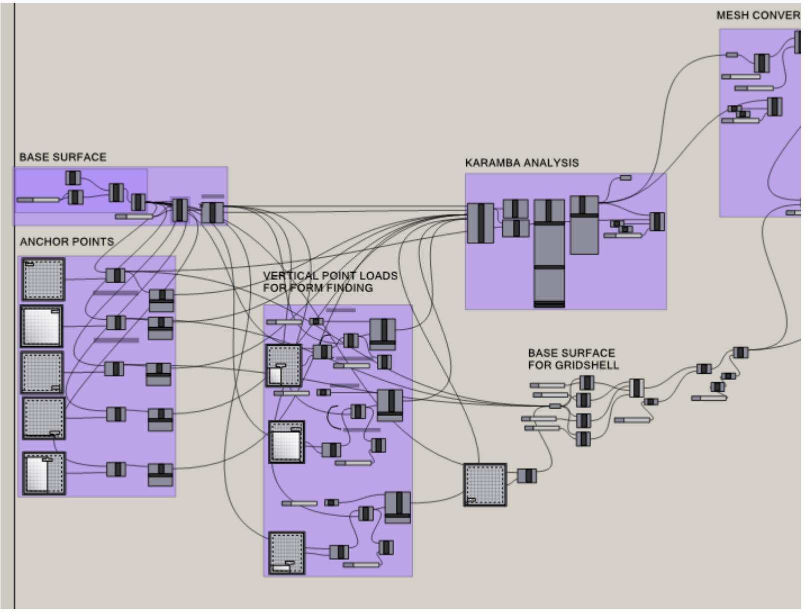
Diagrids, Shells, and Gridshells

KARAMBA

This week we continued to work with our gridshell. This is the model that we had so far in our group project. We are still trying to figure out the form in relation to building structure and type of connections. As of week 5, we plan to use a flat grid system that we raise from the ground and connect to form curvature. The structure is first made on the ground, which makes it relatively easy to assemble all the laths and connect them together, then bent to the desired shape and fixed at its supports. For our project, we would connect one edge of our square system to the ground then bend it so that the curvature lifts up one corner as a cantilever and fixes the other corner on the ground in an arch.







Plates and Folded Plates

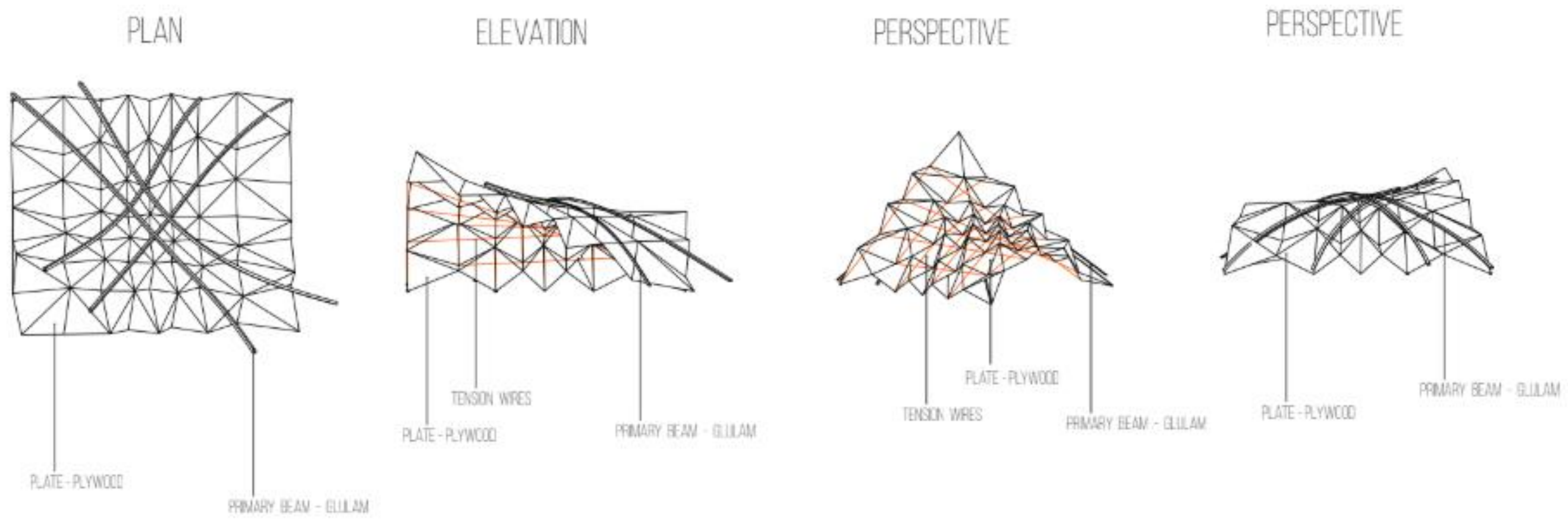
NOTES

This week coincided with our change of building structure from gridshell to folded plate for our team project. We still plan to use elements of a gridshell structure but combine it with folded plates to make essentially a 3d truss system. We are still working out the kinks of this design decision. Folded structures have the unique opportunity to be able to be assembled, disassembled and moved efficiently. Combining these building types could lead to some interesting discoveries.

Plates and Folded Plates

KARAMBA

We have been exploring folded geometries through our team project. We are currently figuring out how to make a 3d truss system with folded plates, glulam compression members and tension wires. Through karamba, we have been analyzing the structural capacity of our design, adding and subtracting supporting members to optimize the overall system.



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Credits

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