Timber Tectonics in the Digital Age

Joel-Laurent Mbala-Nkanga's Portfolio

PROFESSORS MARIAPAOLA RIGGIO AND NANCY YEN-WEN CHENG SPRING 2018

UNIVERSITY OF OREGON

OSU Oregon State UNIVERSITY

Beams and Columns

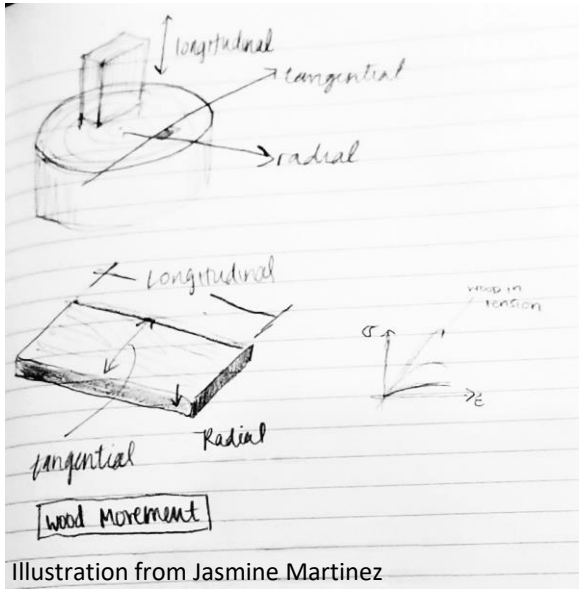
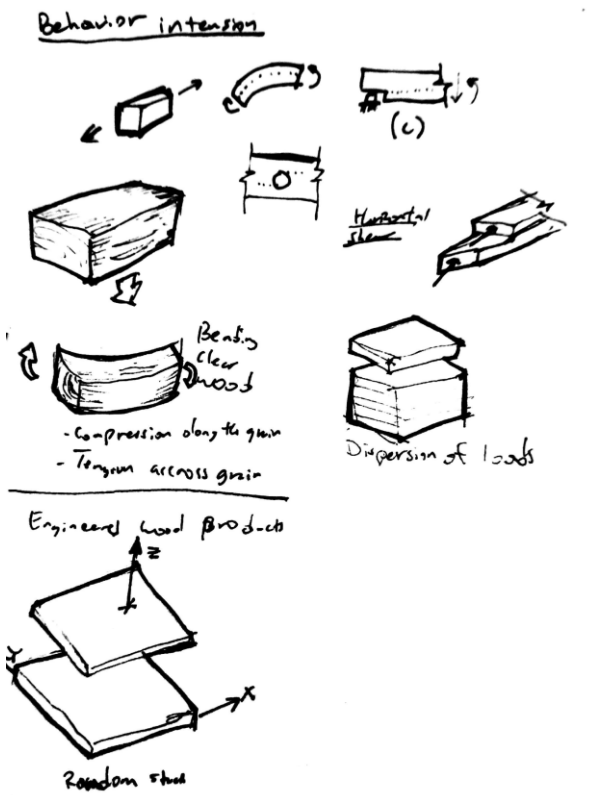
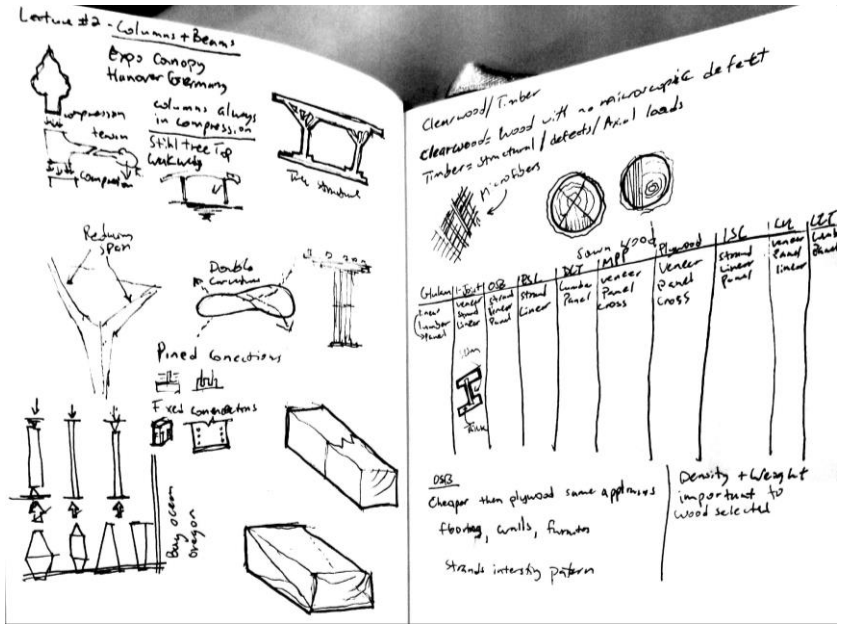
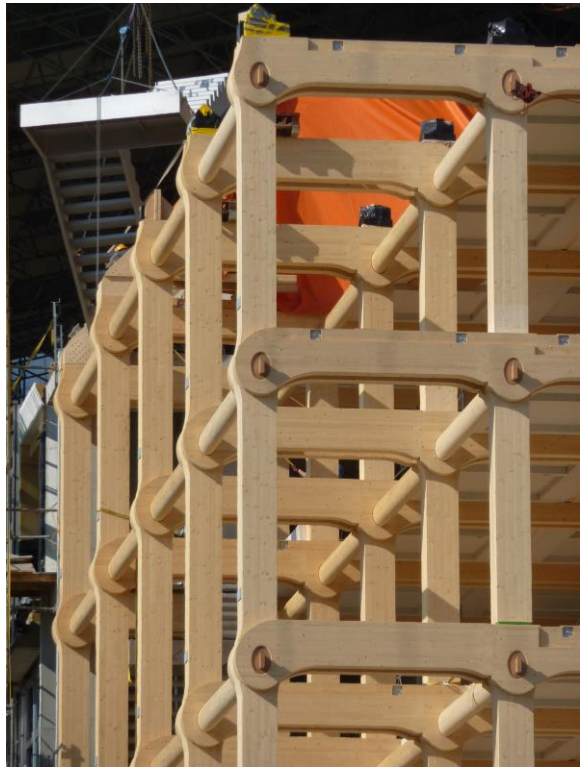


Illustration from Jasmine Martinez





Beams and Columns Case Studies



Tamedia Building
Photo from Archdaily

Office building in Zurich, Switzerland was built in 2013. The design developed joineries from Japanese traditions wit the help of computing.

Structural elements were prefabricated and assembled on site.

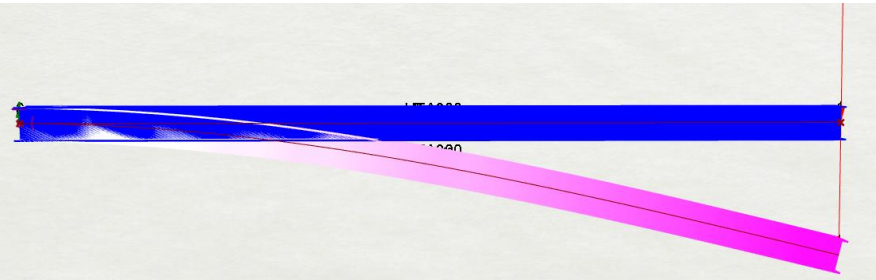
John Hope Gateway

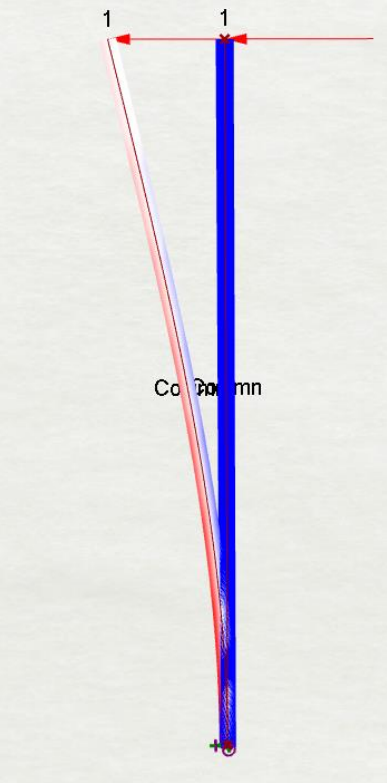
Building designed out of primarily heavy timber. The building was designed in Edinburgh and acts as a threshold to the royal botanic garden in the city.

The building is comprised of laminated glulam beams and columns. The first floor as well as the rood is comprised of CLT.

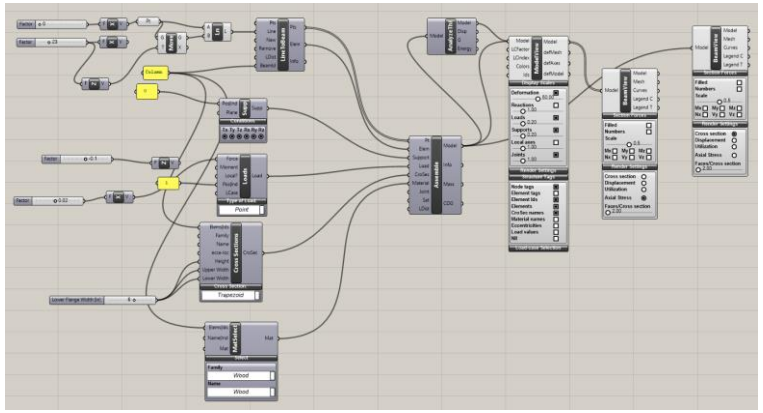
Source: https://www.ads.org.uk/wp-content/uploads/4621_02-john-hope-gateway.pdf

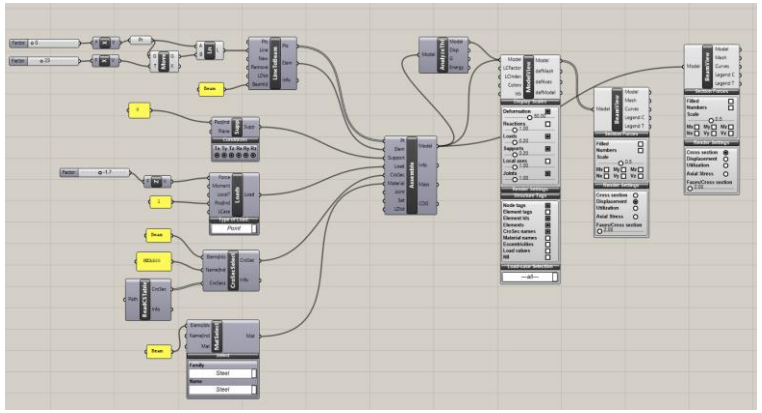
Beams and Columns Grasshopper Files



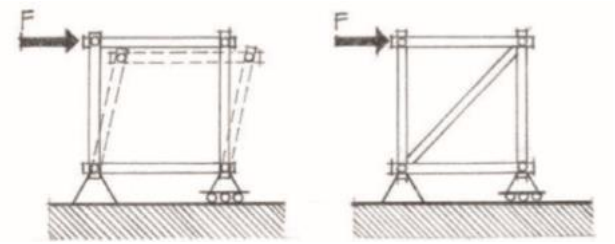


The theme throughout this term has been to work on grasshopper strictly, witouth relying on the rhino part of the computer to make anything. This will allow me to regain my understanding of grasshopper. In these two examples, simple columns and beams were built up in grasshopper, and then plugged in the Karamba expect of it.



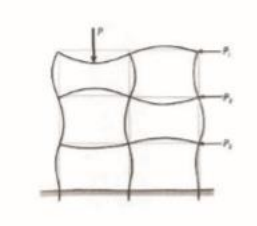


Trusses and Frames



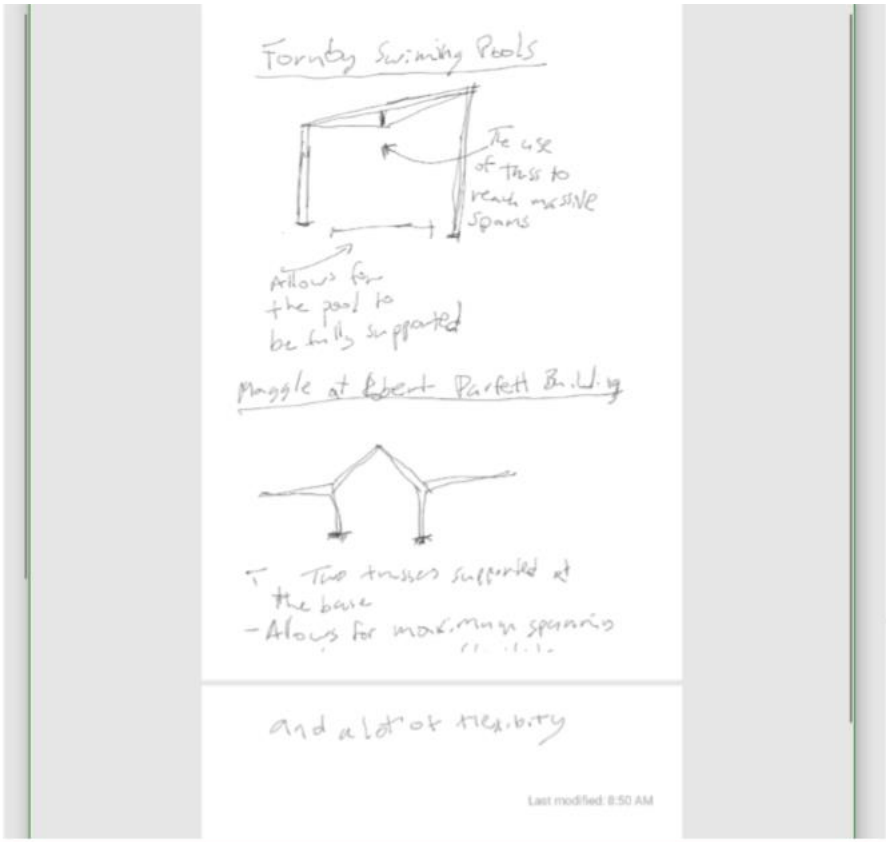
- Contains mostly members acting in axial forces.
- Exterior elements tend lie in the same plane.

- Structural systems distribute loads through linear members in patterns.
- Loads are better off being directed at points rather then the central parts of a column or beam.



- It makes sense for this to be multiple frames, multiple frames allow for the members to resist lateral loads better.
- Exterior elements tend lie in the same plane.

Reading Notes



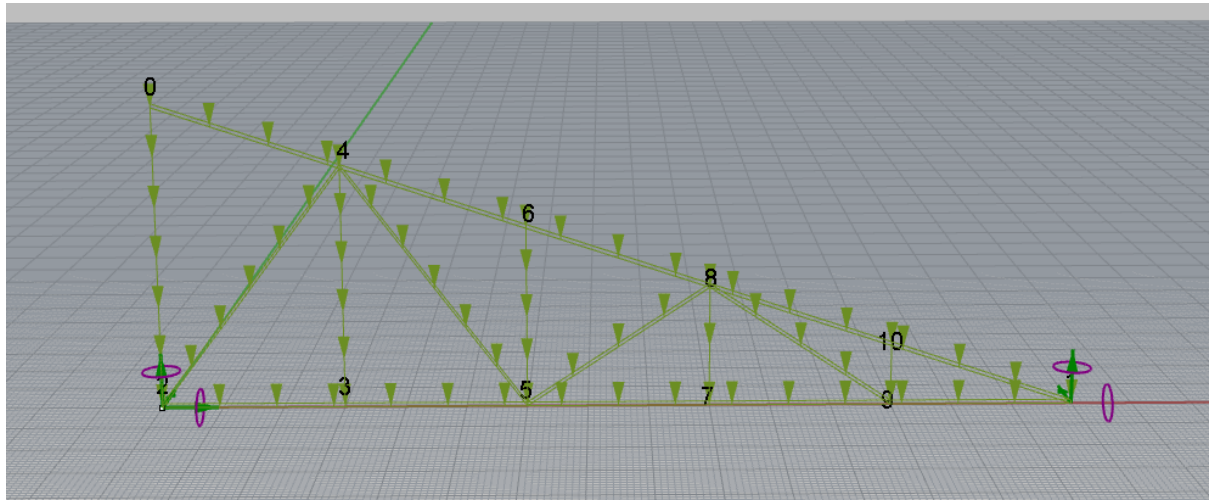
Trusses and Frames Case Study

Maggie's Centres
Foster + Partners

The project was based around the idea of maximizing sunlight due to the location of the project. This project is ideal for he trusses and frames part of the weeks due to the fact that the building successfully incorporates the use of the truss for one of its biggest strengths, which is the ability to span long distance.

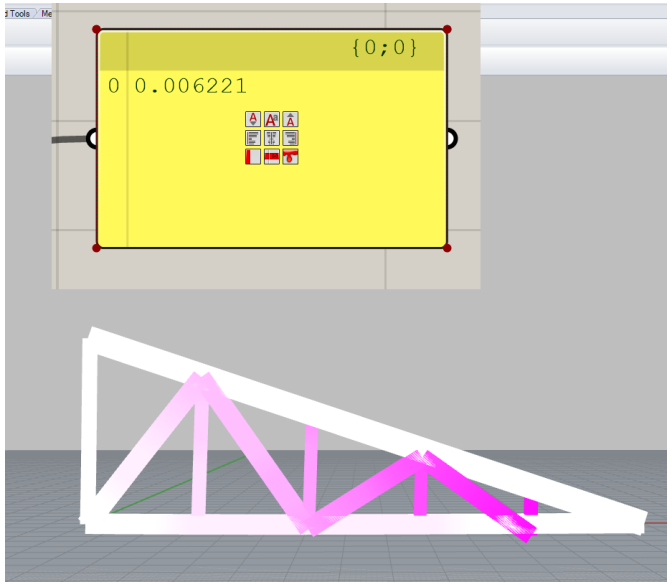
- The truss is currently spanning the roof, to allow more sunlight. The spanning also allows for the designers to add spaces that can maximize views as well.

Frames and Trusses Gh Files

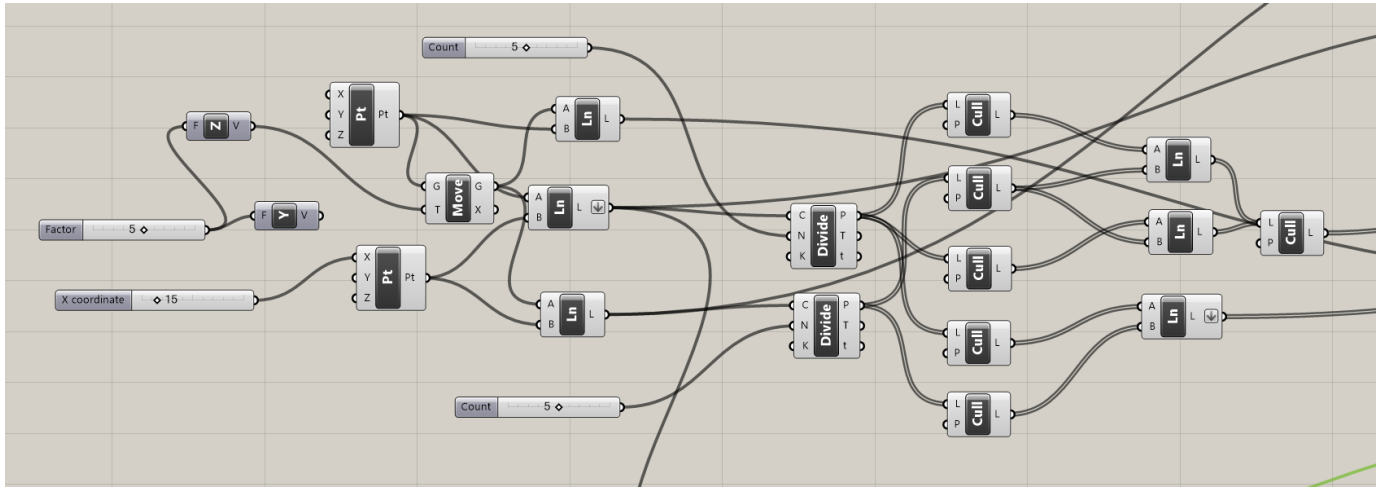


Like the majority of work I do in this portfolio, my first Goal was to build up the model completely out of Rhino Grasshopper to allow for the truss to be as parametric as Possible.

- After the geometry was built, it was plugged into Karamba using the existing script that was handed out in class.
- In doing this, I realized the most difficult aspect of putting most things into Karamba is making sure the lines are all split.



Maximum Deflection

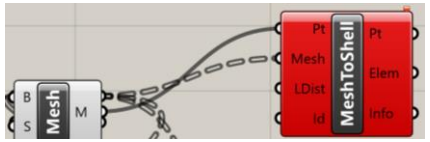


Date: 5/20/2018

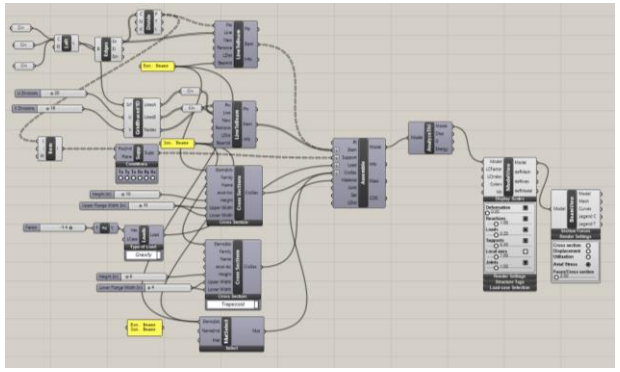
Domes / Arches

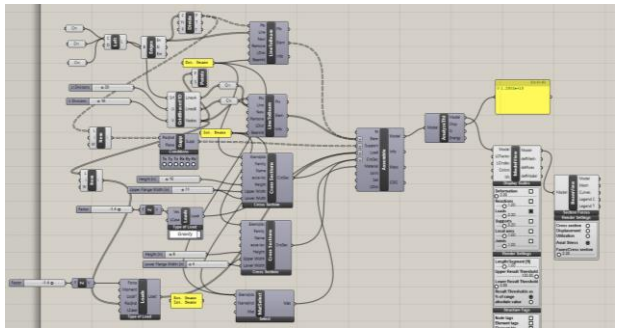
For the Domes and arches, I decided to highlight the experimentation I did with arches, creating an arch in grasshopper through creating three curves, and running a loft through all three.

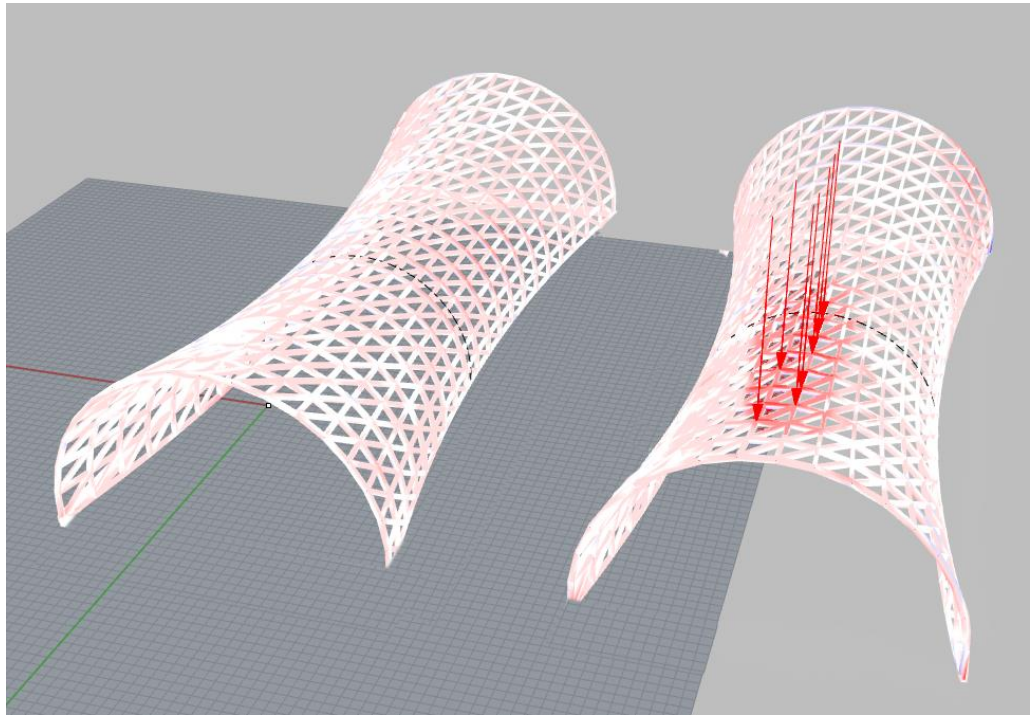
Initially I tried to analyze them as shells, and kept landing in the red:



So a grid was added to the shape of The arch to make it no longer red, and forces were then applied to the top of the arch via point loads. Surprisingly enough, there was barely any displacement throughout.







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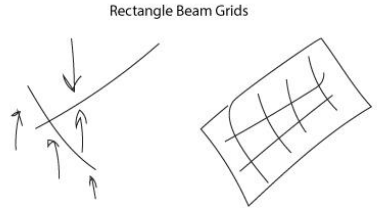
Shells and Gridshells

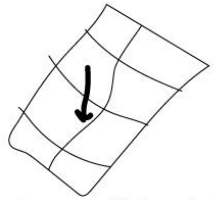
Zurich Zoo Elephant Habitat

The structure, which was designed by Zurich based firm Markus Schietsch Architekten was built withstand 15 tons of force from the animals inside the shell. The building houses 90,000 square feet of programing with a nature inspired shell roof made up primarily of wood. The shell spans 260 feet and is comprised of 550 uniquely shaped CLT layers.

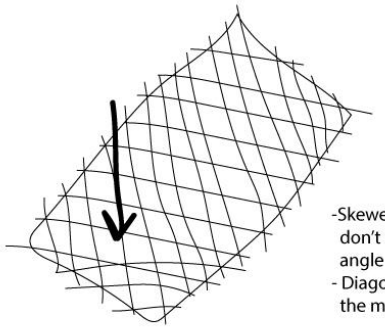
http://www.architectmagazine.com/technology/detail/-kaeng-krachan-elephant-park-shell_o



- Simply supported beams, right angles of each other
- They must deflect by same amount at intersection
- Stiffer beams absorbs a greater share of the load

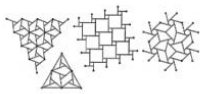


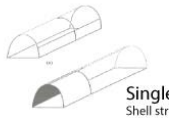
- Every beam on top of the beams heading in one direction are continuous and flexible
- Must be connected at each intersection point
- Grid structure consists of two or more intersecting parallel beam systems, each systems being interconected



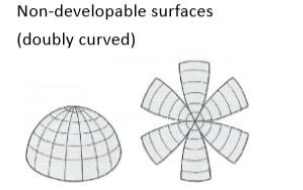
Diagrids

-Skewed Grid where lines don't intersect at right angle
- Diagonal pattern stiffens the members



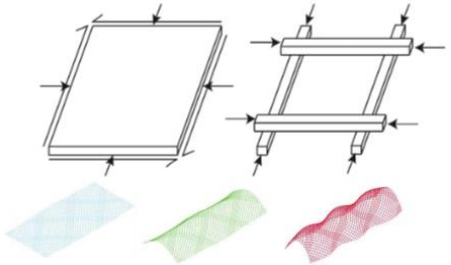


Single Curve Surface
Shell structure form

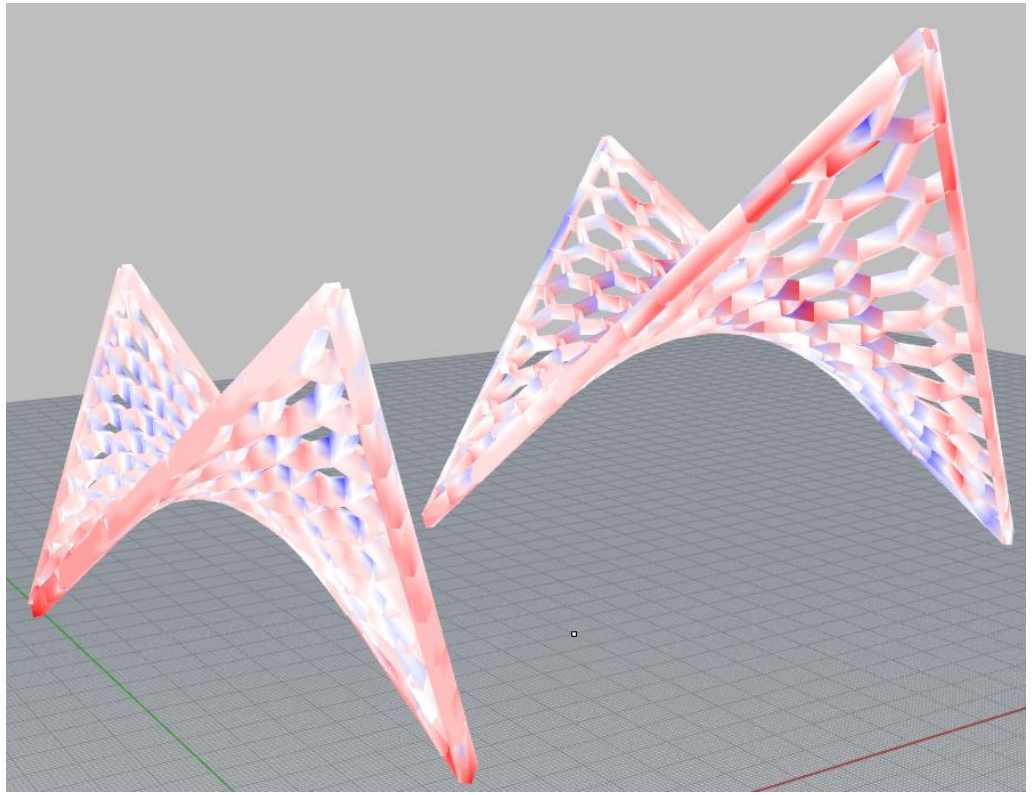


Shell:
- 3 Dimentional structure that resists loads through structure
- Only pure membrane fields are developed

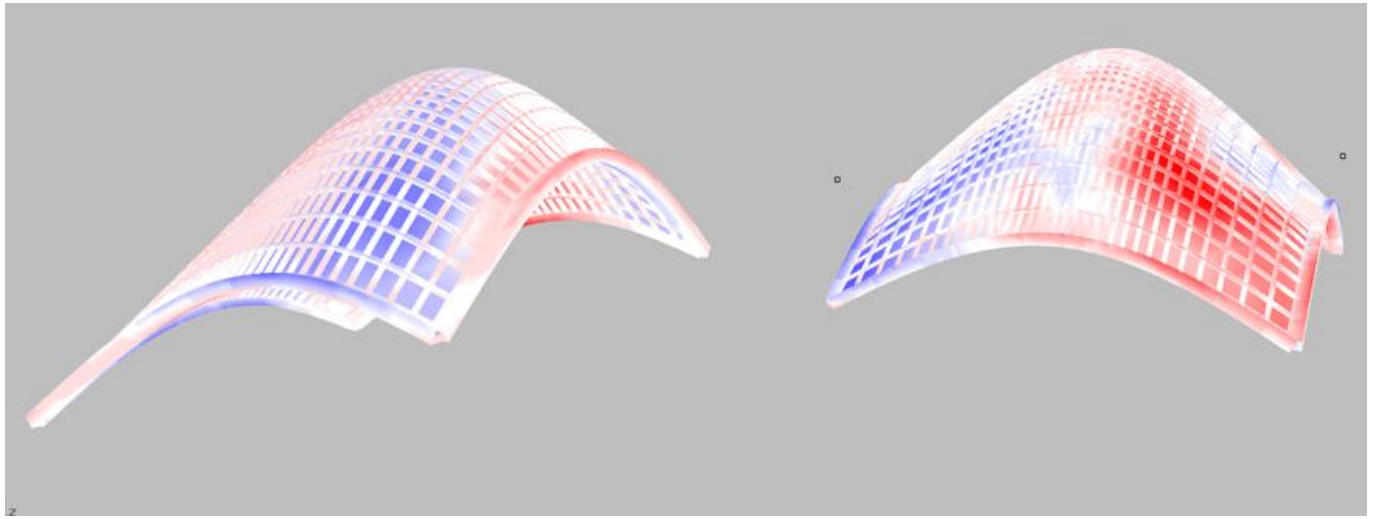
Gridshells



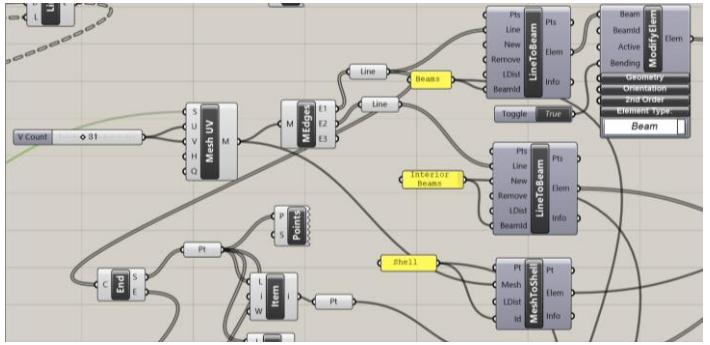
Grasshopper Tests



In this script, a grid was first created, and then the Surface was altered and the grid was altered to Match what was happening to the surface.



With this script it was the opposite. Where a shell was first made Through the use of a loft command over points. Afterwards the Shell and the grid were both analyzed.



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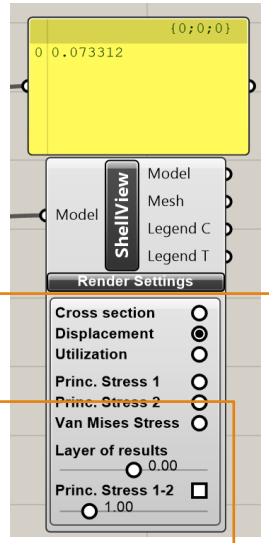
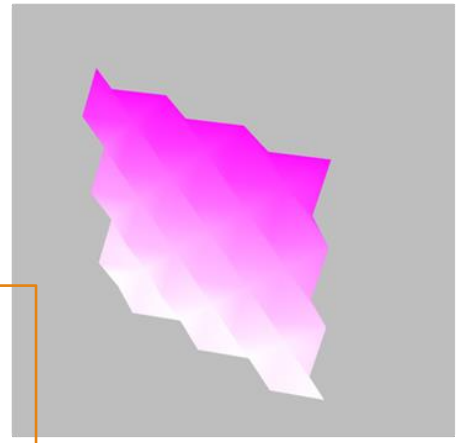
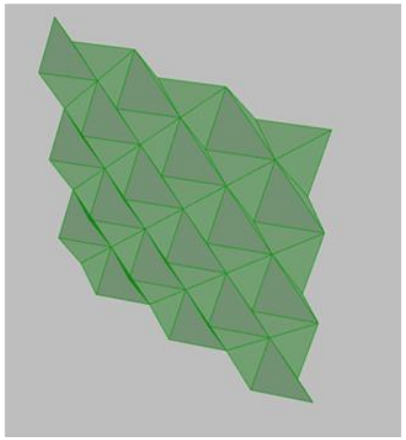
Folded Structure

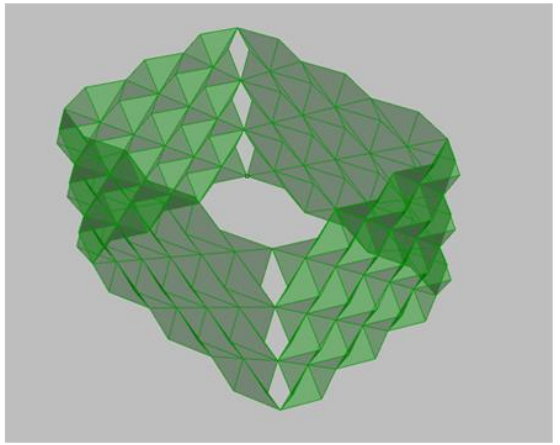
For the folded surface week I decided to revisit my origami structure that I shared at the beginning of class, and this time I made the script in grasshopper. Taking the concept of creating a surface and then folding that surface.

The next step in the process is about Closing the gaps in each corner, but I did manage to pull all the needed supports, loads, etc, in order to be able to measure it's success with Karamba.

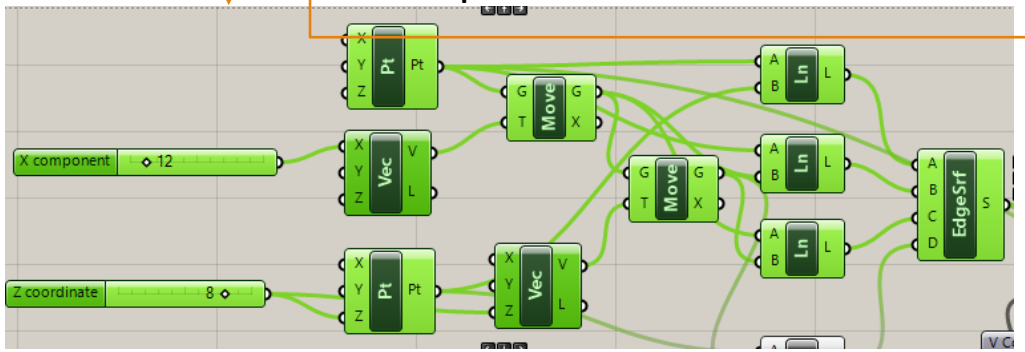




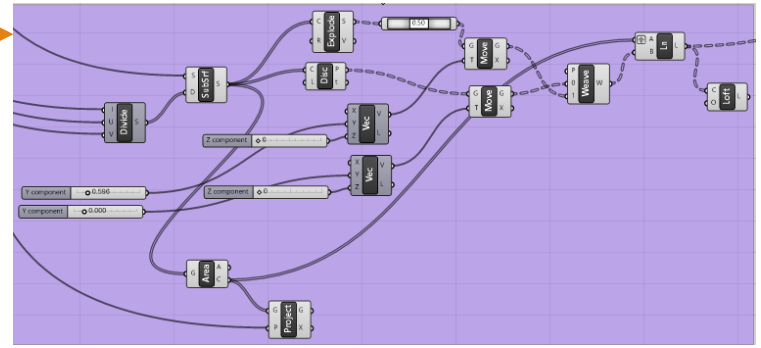




Script of Surface



Script of Folding the Surface



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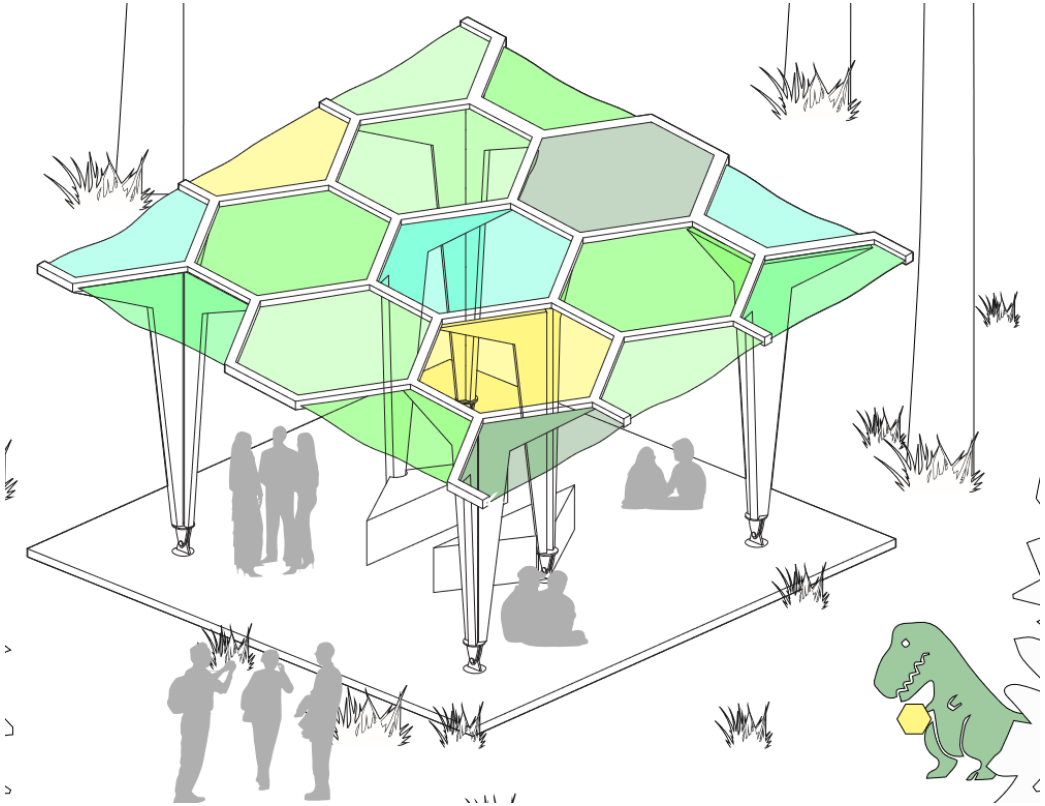
Design Reflection



The team and myself made a conscious effort to show the many things we've learned and apply them to our overall design. Coming into this term the area where I knew the least amount was to do with heavy timber, and the many different kinds of timbers available to use. In making this design, I was challenged to spend time looking at all kinds of ways to fabricate the structure using different timber panels. I have learned a lot about wood panels that would be available to me. In addition, the class challenged me to spend more time learning how to properly do a grasshopper script from scratch. While I already had a solid understanding of grasshopper, it has evolved in this class.

Moving forward the group has decided to remove the current shapes of the objects and replace them with a triangular grid, something that has already done that. We have also worked out a solution to the issue of bracing the columns at the top of the structure.

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Credits

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