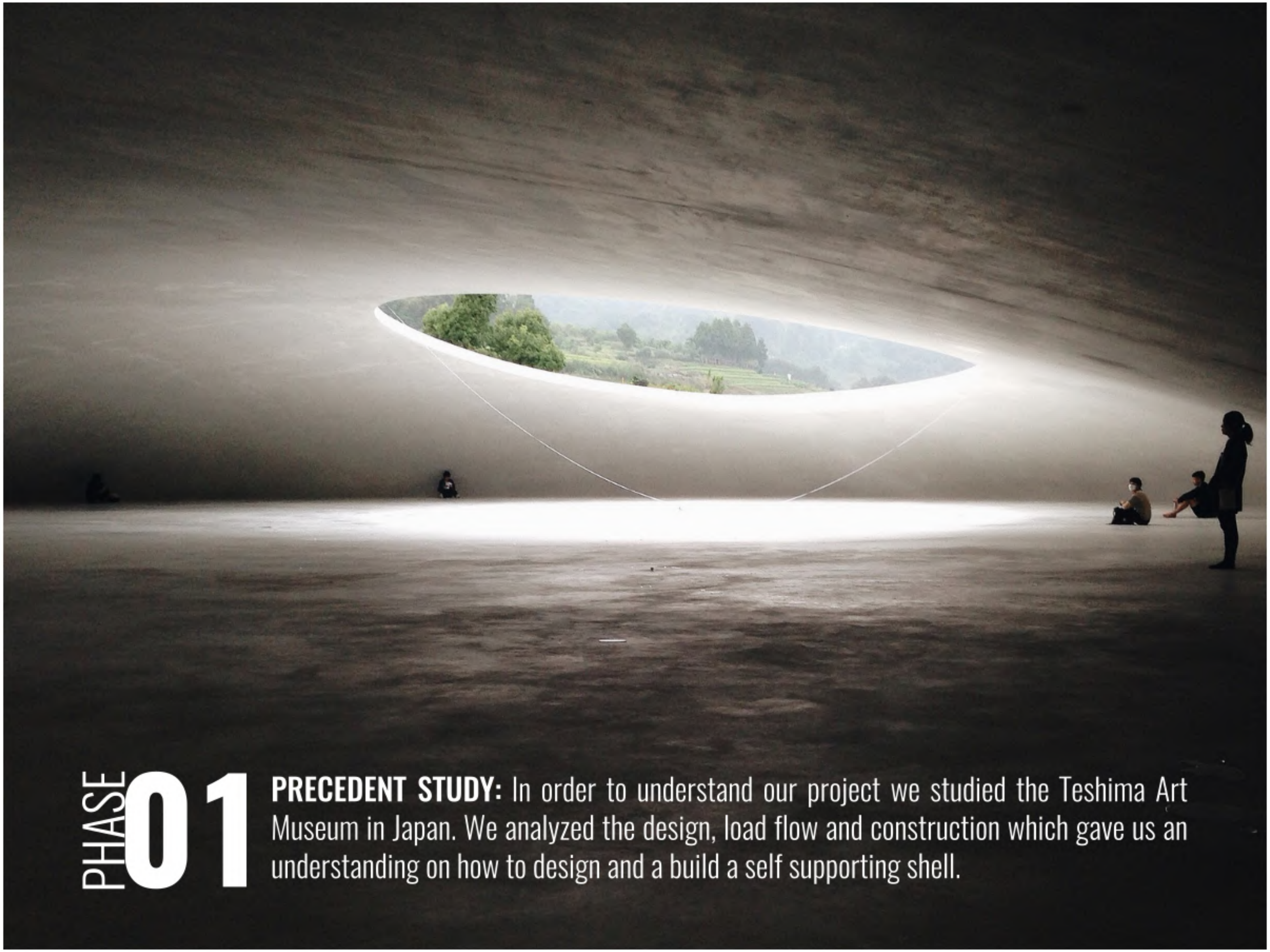
PORTFOLIO

SARA LACK
MELVIN FUENTES


DAMON WILLIAMS
EMMA BARRAZA

CONTENTS

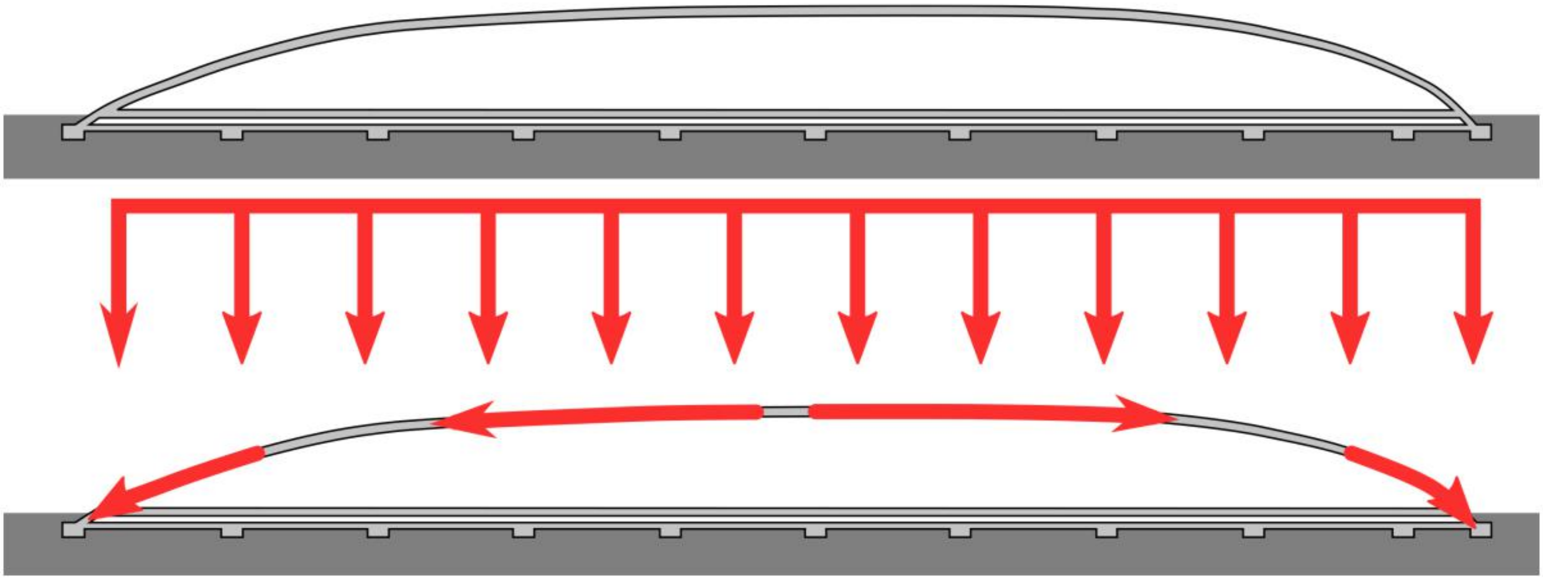


PHASE 01

PRECEDENT STUDY: In order to understand our project we studied the Teshima Art Museum in Japan. We analyzed the design, load flow and construction which gave us an understanding on how to design and a build a self supporting shell.

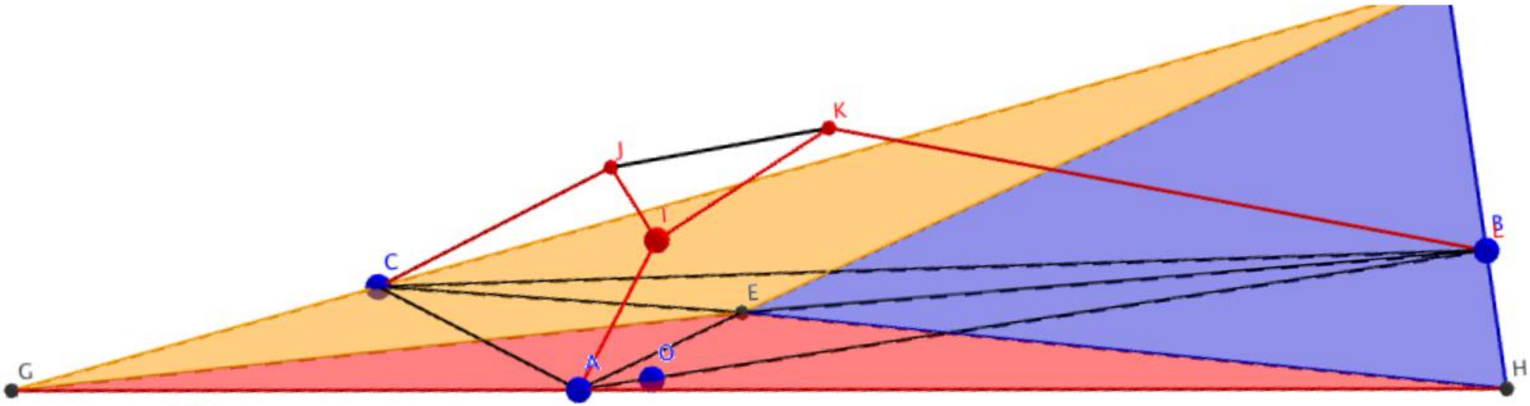
Location: Takamatsu, Kagawa Prefecture, Japan
Built: 2010
Architect: Ryue Nishizawa
Artist: Rei Naito
Dimensions: ~40x60 meters
Materials: 25cm thick concrete

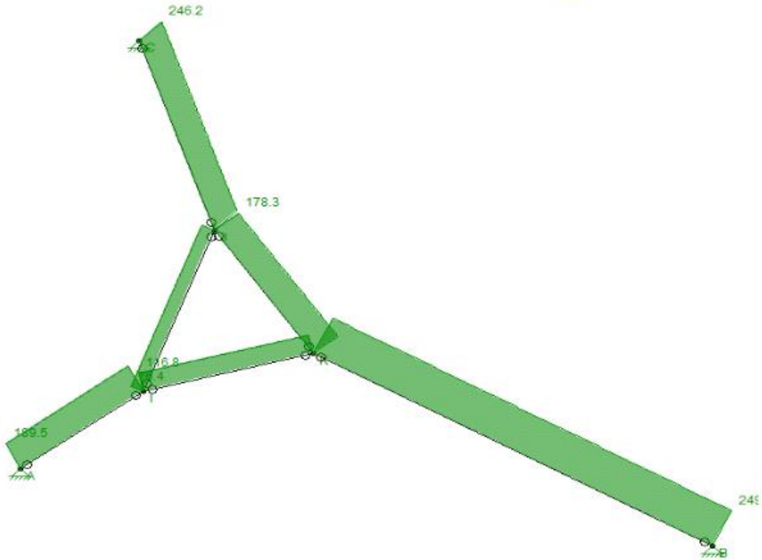
The shallow design made this our choice project to study. The info gathered will help us design a shallow shell.

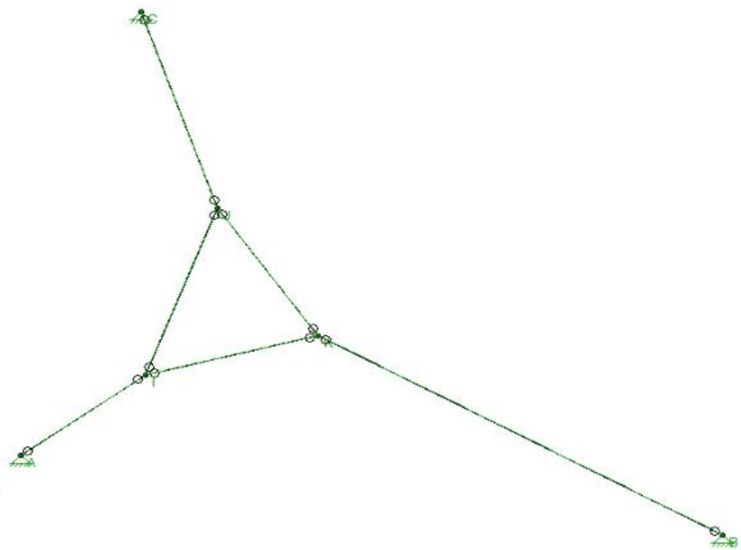


PHASE 02

TRIPOD: To understand how a compression shell works, we studied tripods to analyze how forces would flow down a freeform structure. Designing a tripod would then help guide our design for our final free form design.

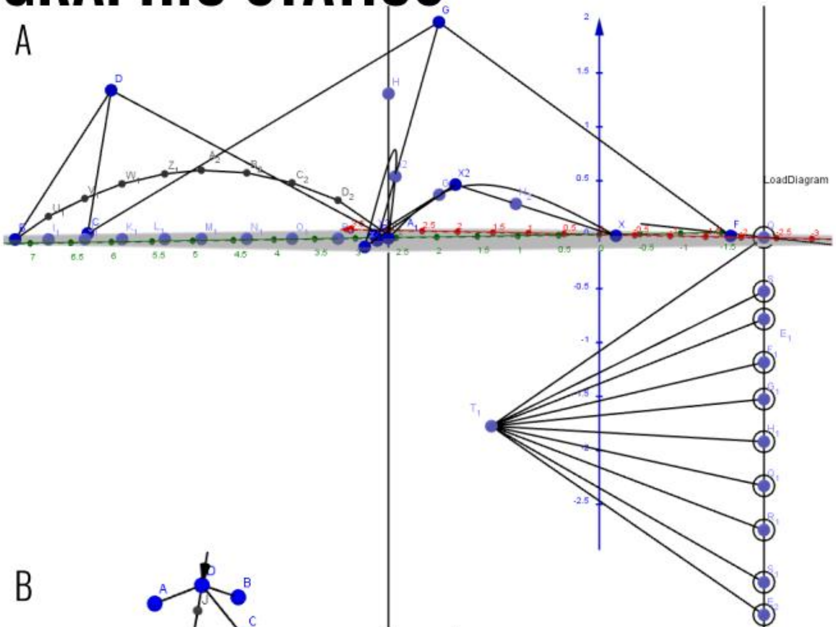






GRAPHIC STATICS

A



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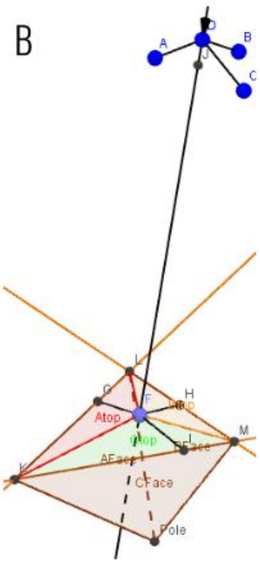
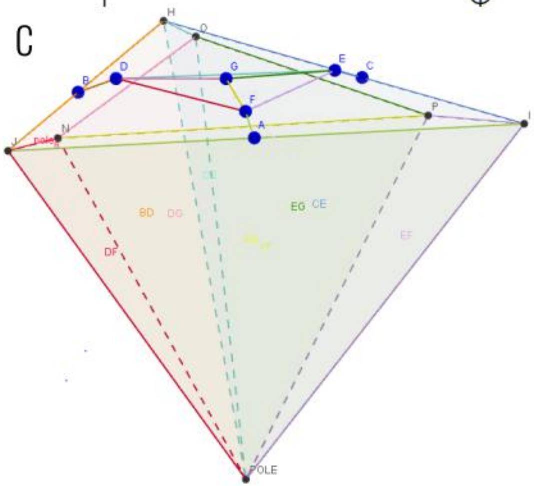


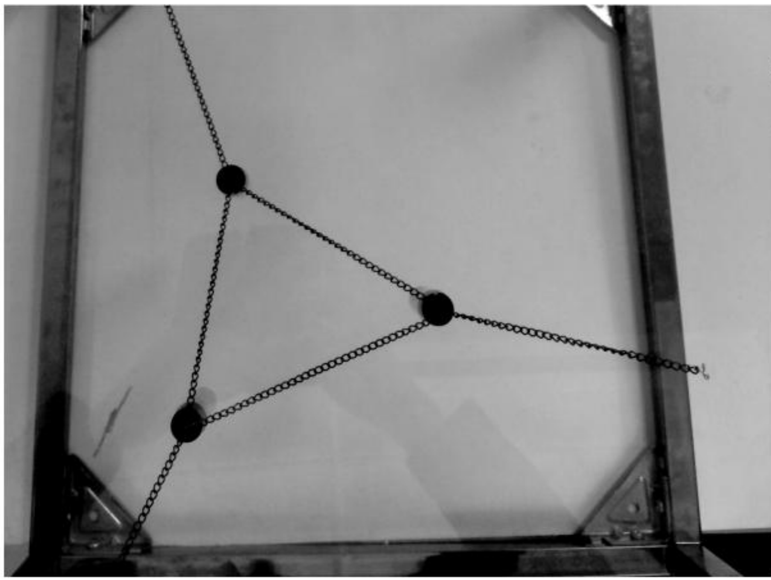
C



A 2-D FUNICULAR
capturing approximate funiculars by splining between three points on two tripods; f nding 2-D funiculars by drawing lines parallel to those on a load diagram through a pole, such that the lines relate to the load diagram and are funicular for those loads.

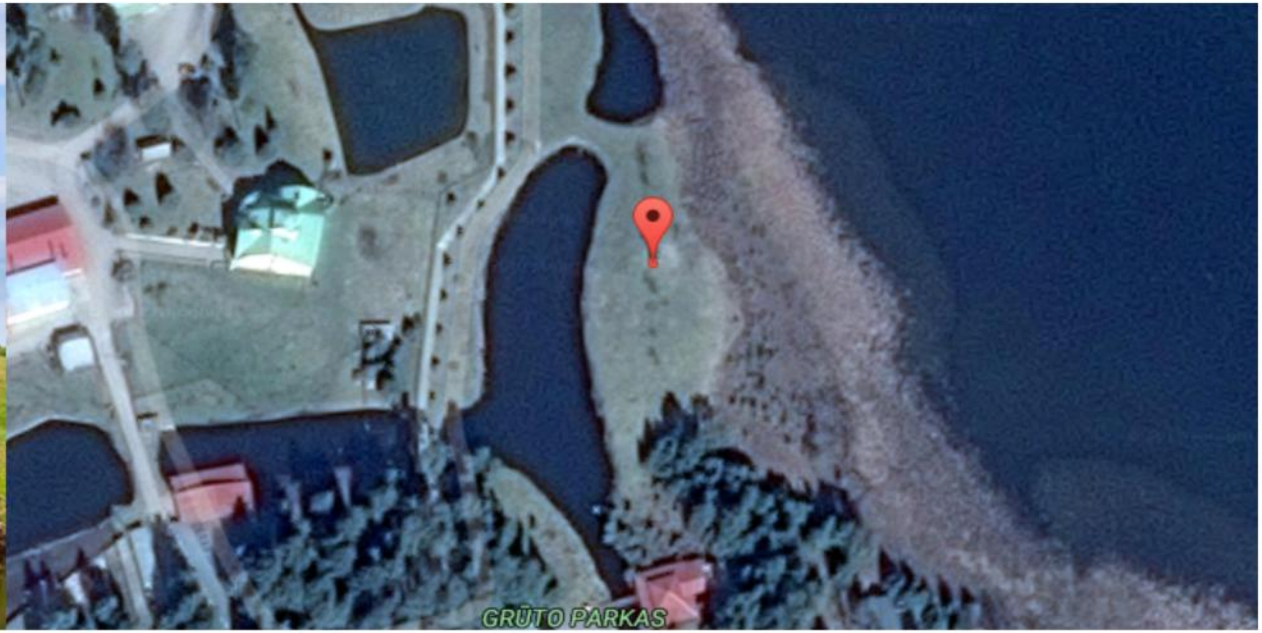
B LATERAL LOAD TRIPOD
graphical static approach to analysing determinate tripod structure with applied lateral load, may also be subdivided as in C

C SUBDIVIDED TRIPOD
graphical statics force polyhedron may be divided along edges to represent subdivision of the form - may be divided as many times as necessary to approach desired form, or in as many ways as necessary to represent support conditions (three, four, etc. supports)

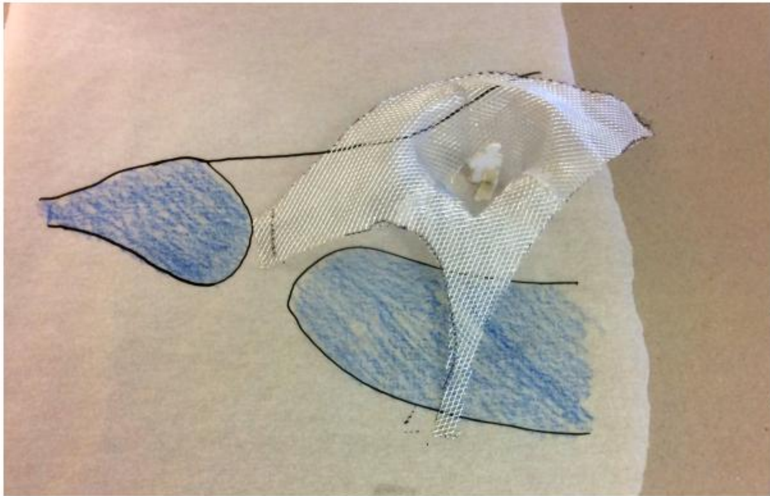


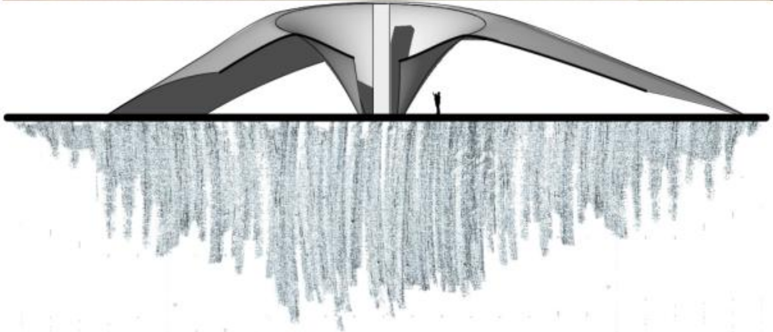
PHASE 03

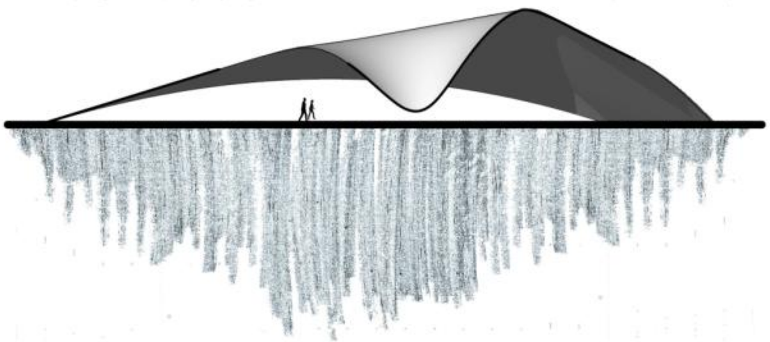
INITIAL DESIGN: The statue is the focus point in this design. The program allows for visitors to walk onto the shell and experience the statue from a different pespective. There will also be space underneath the shell for art installations.

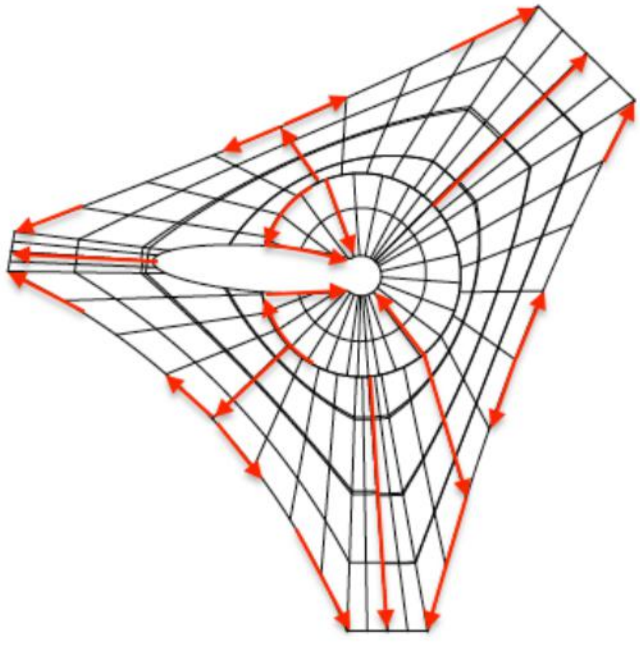


Our project is located in Grutas Park, a sculpture garden of Soviet-era statues and Soviet ideologic relics. The park's curator has requested design teams to reframe the sculptures in the park and provide a cohesive structure of free forms that live along side the sculptures. The design has to allow covered art installations at the base of the monument while also allowing different vantage points from the accessible roof. Our team has taken the requirements into consideration and has developed a concept model that will begin to satisfy these requirements. The design features a center point for the statue which highlights the sculpture. The design also provides a path to the roof so that visitors can view the sculpture from a different view point that was not initially available.



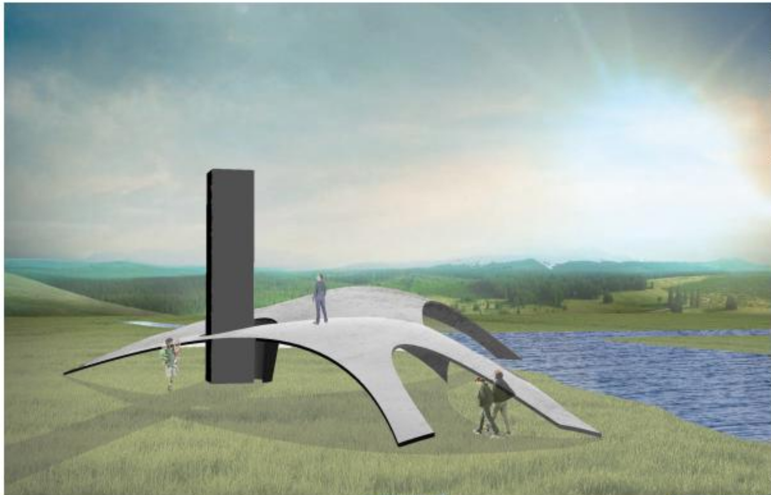


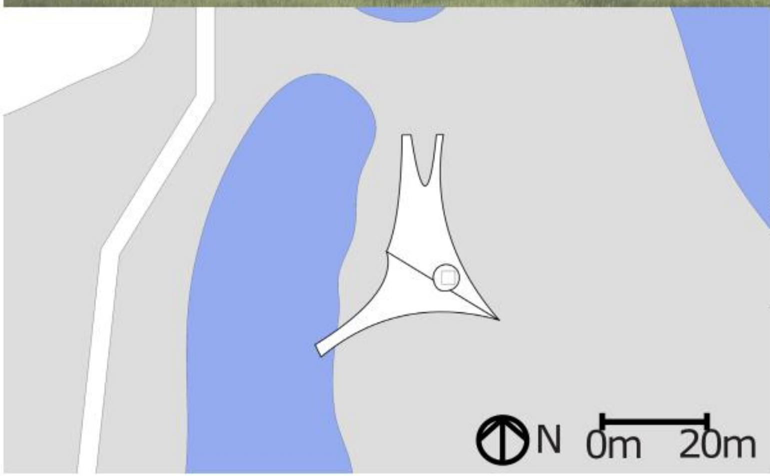


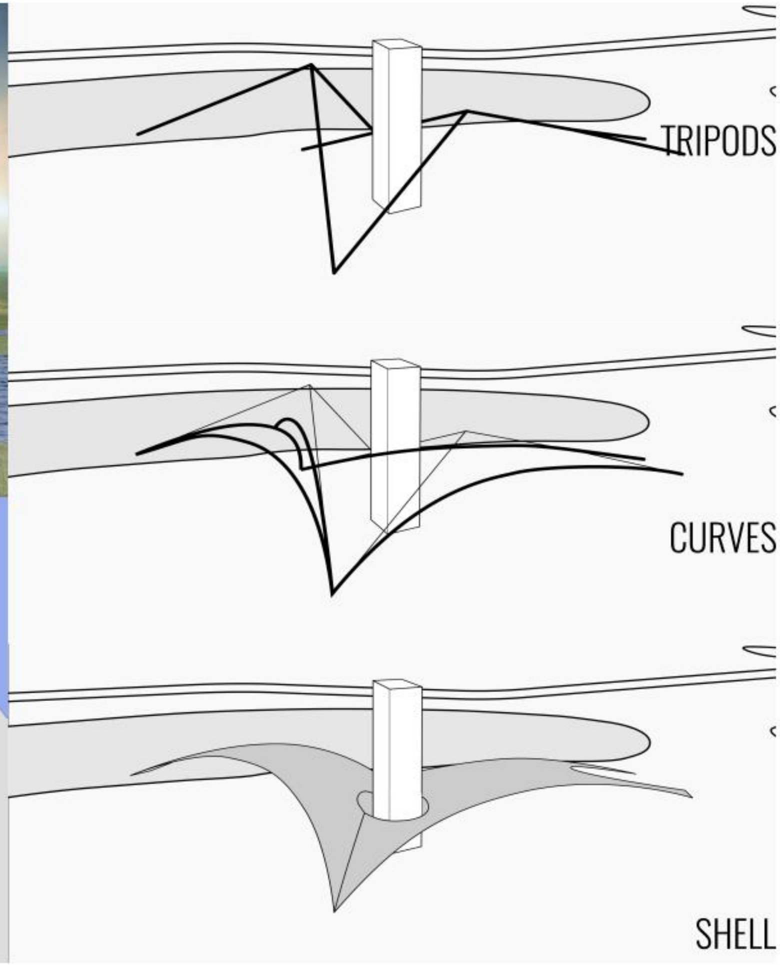


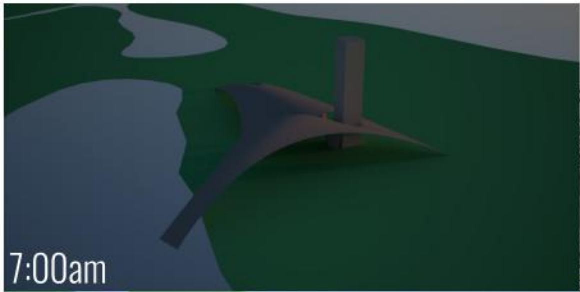
PHASE 04

SECOND DESIGN: After recieving feedback about our inital design we had to make changes in order to create a more impactful contribution to the statue. The new design celebrates the statue without overpowering it.





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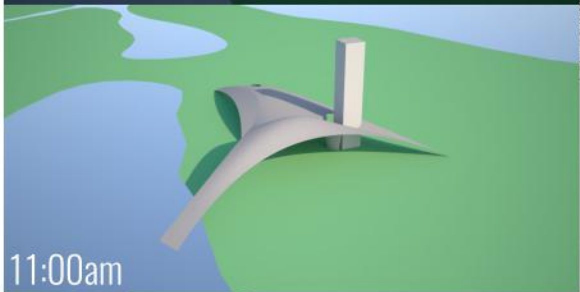
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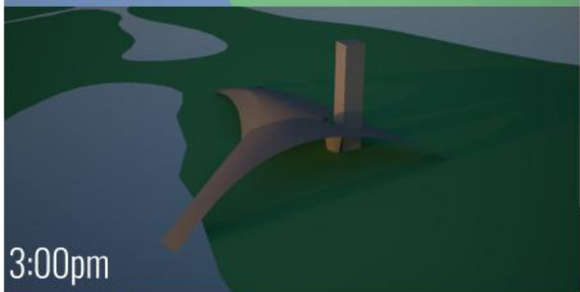
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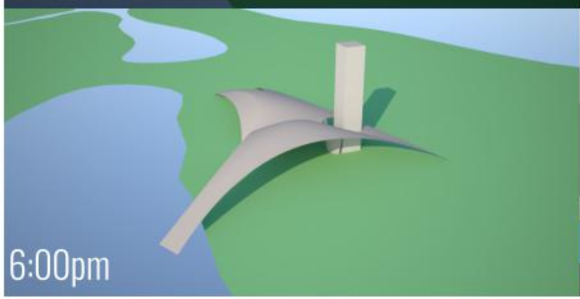
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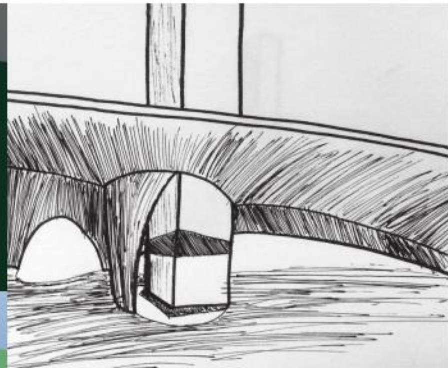
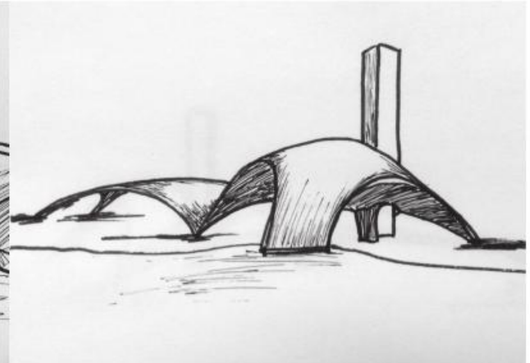
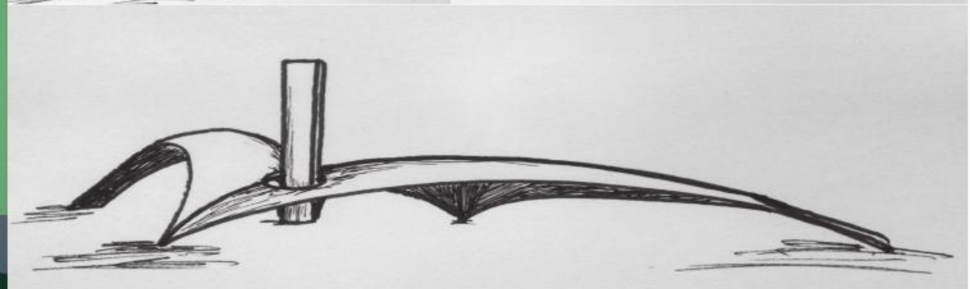


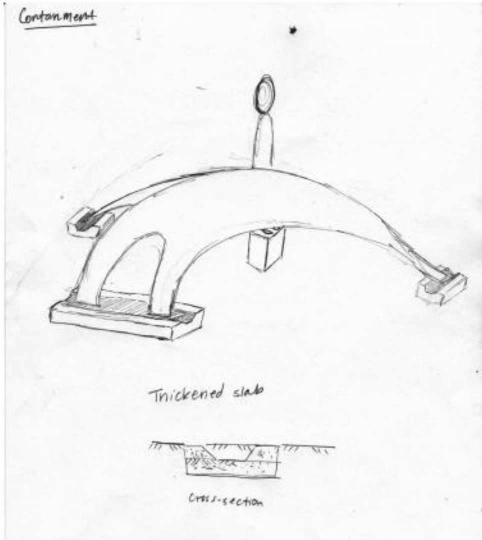


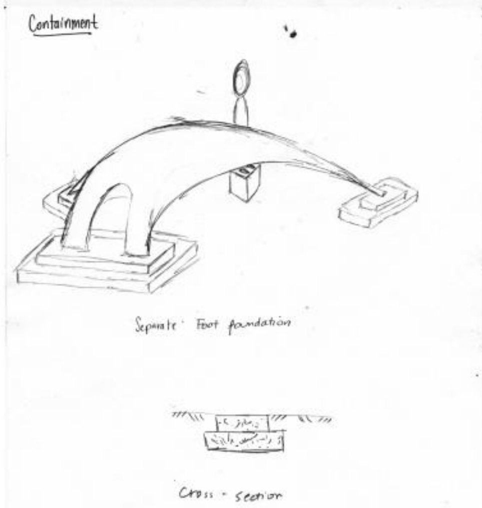



EAST SECTION

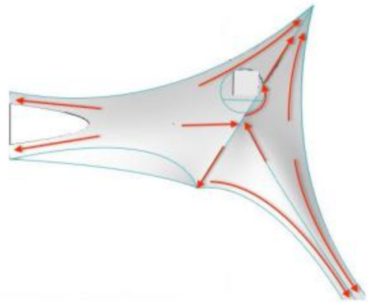

NORTH SECTION

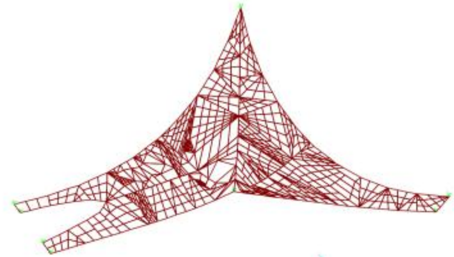
Structural Analysis

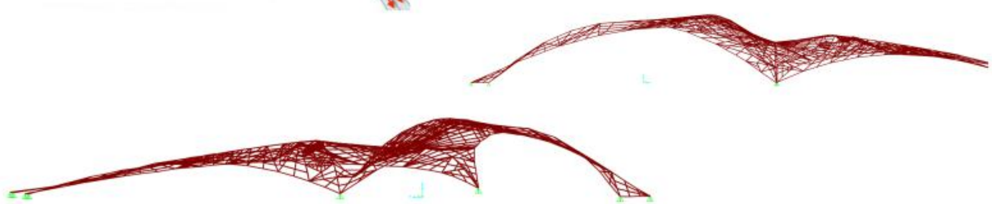




weight: 659.7k   shell thickness: 12″
max height: 5.4m   footprint: 615sqm







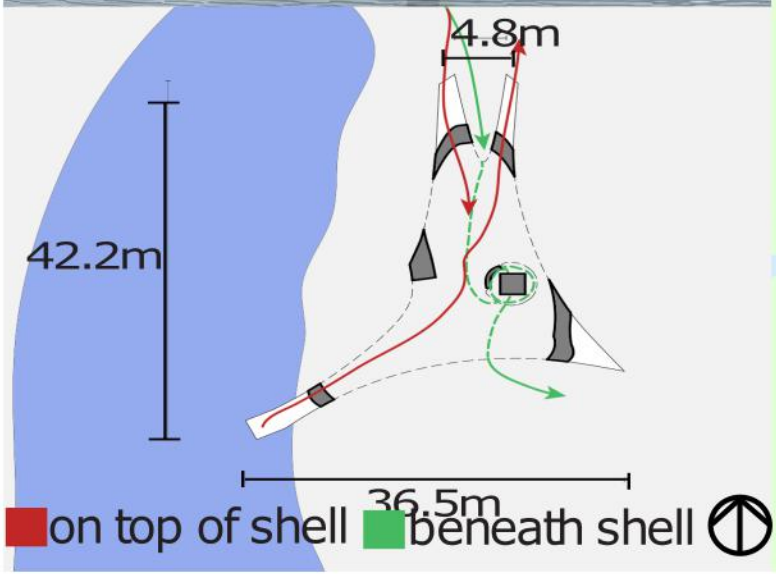
Reactions (K)

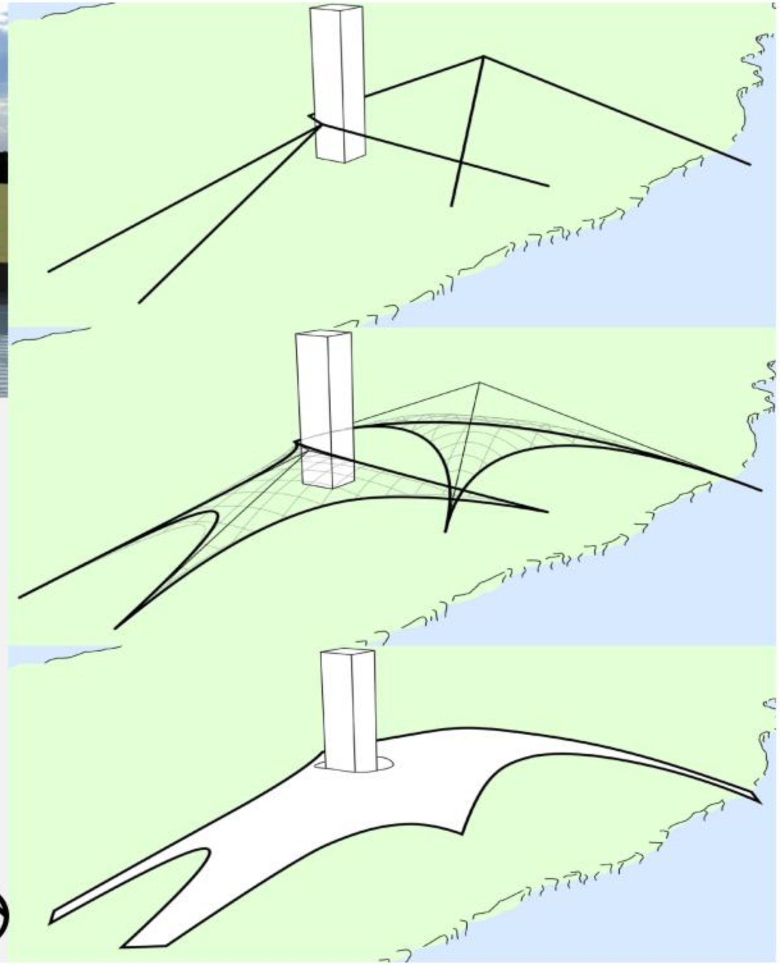
Joint	Load Case	X	Y	Z	Thrust (K)
A	DEAD	14.8	-24.6	1.0	28.7
B	DEAD	317.8	17.1	272.0	418.7
C	DEAD	-407.0	299.7	174.6	534.7
G	DEAD	36.9	-8.1	19.6	42.5
H	DEAD	99.4	104.8	66.3	158.9
N	DEAD	-20.5	-92.2	43.4	104.0
O	DEAD	-6.6	-130.6	32.3	134.7
P	DEAD	-34.8	-166.0	50.6	177.0

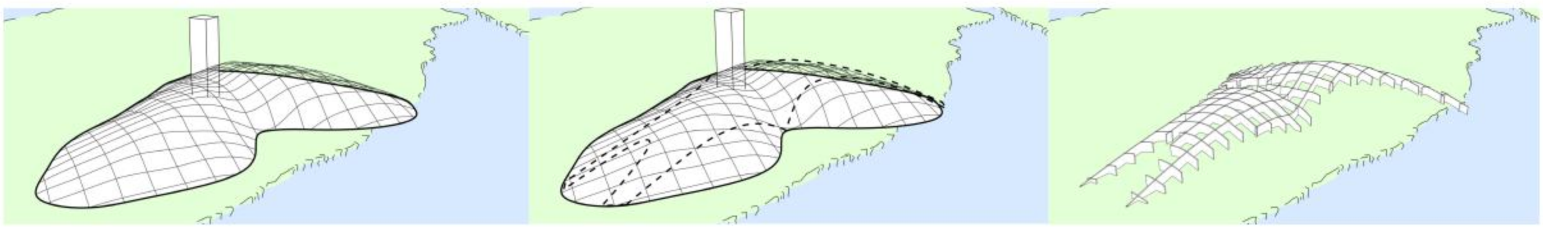
Largest Dead Load Displacement: 0.95 in.

PHASE 05

REFINEMENT: After analyzing our structure we have refined it to fix issues that were addressed. We also further developed the containment ideas and design intention. All in preperation for our midreview and in preperation for construction.

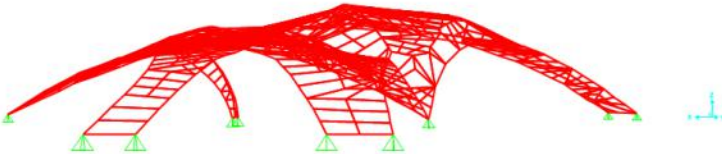


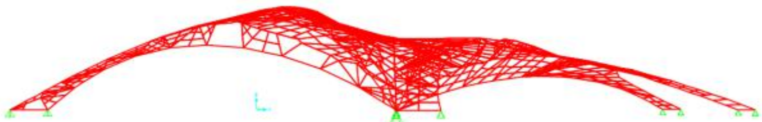


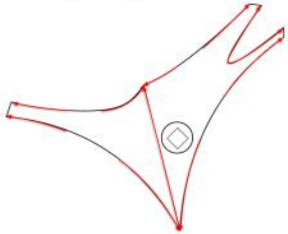


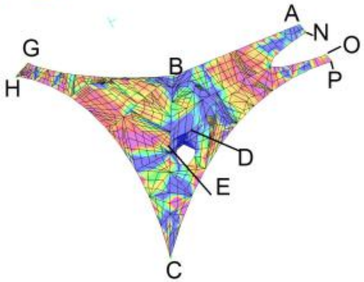
S t r u c t u r a l A n a l y s i s

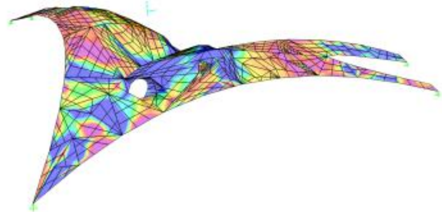
weight: 1481kN shellthickness:15.2cm
max height: 5.4m   footprint: 615sqm

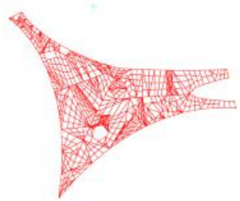












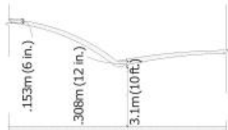
Reactions (kN)

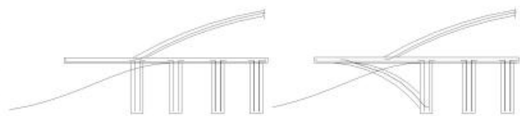
Joint	X	Y	Z	XY Thrust
A	101	-190	30	215
B	610	356	958	706
C	-1341	950	593	1643
G	268	8	133	268
H	379	440	253	581
N	-96	-408	190	419
O	-32	-527	136	528
P	-147	-685	209	701
E	166	159	402	230
D	91	-103	150	138

Largest Dead Load Displacement: 22mm

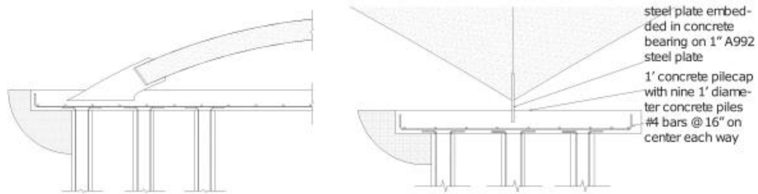
thrust containment

shell thickness   water foundation option A and B



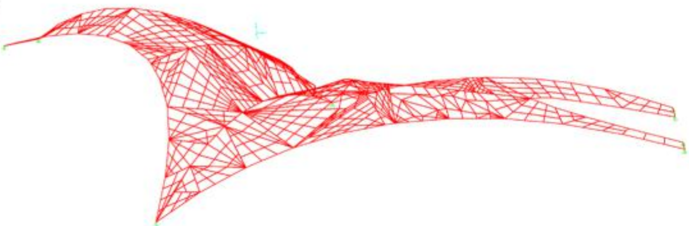


blade connection and foundation



FEM Mesh Development

1



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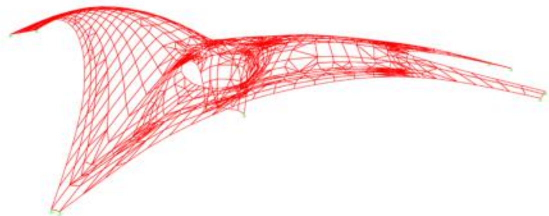

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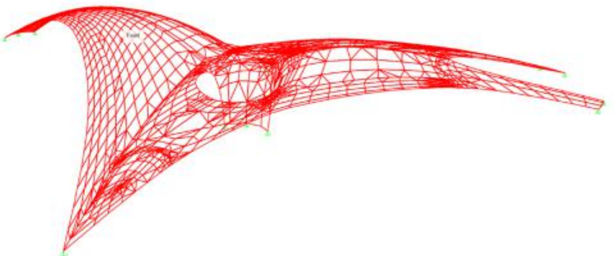

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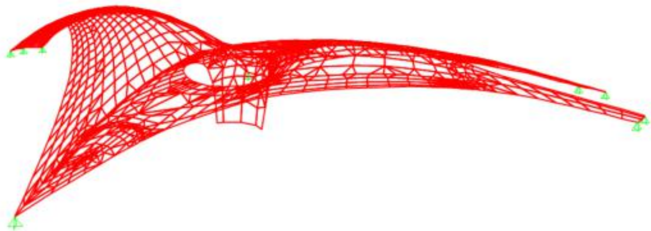

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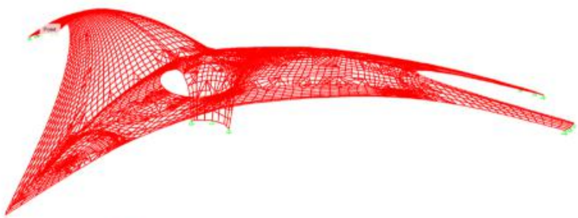

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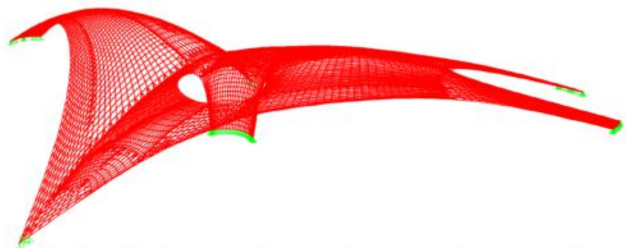


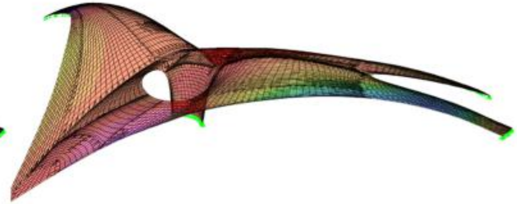
7

Modelled with layered membranes (no bending stif - ness) for top and bottom concrete layers and perpin- dicular rebar layers, and with a shell (include bending stif ness) for middle layer of concrete. Materials are A185 WWM conforming to ACI 318 minimum reinforc- ing ratio and 4 ksi concrete.

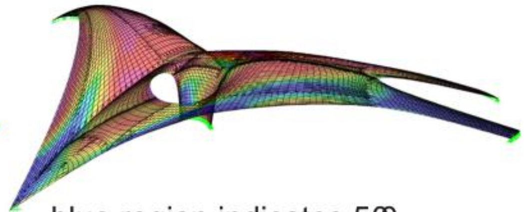
Load Cases

Dead + Concentrated Live Load

load on path to oculus and around oculus, 40 psf

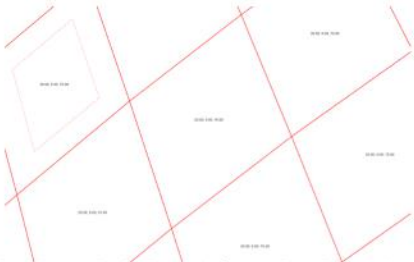


max displacement = 0.212 in., OK

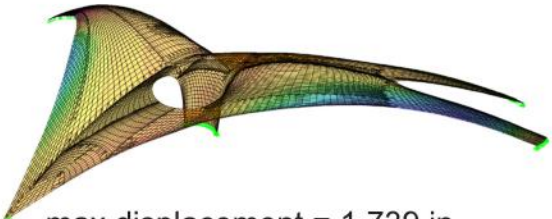


blue region indicates 500 psi, potential stability problem

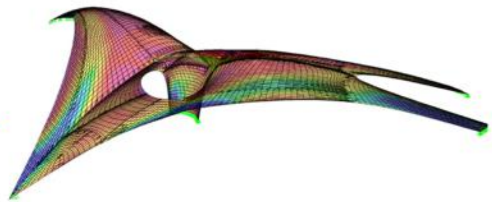
Dead + Lateral Load



X-direction load (equivalent lateral force) of 20 psf and dead weight

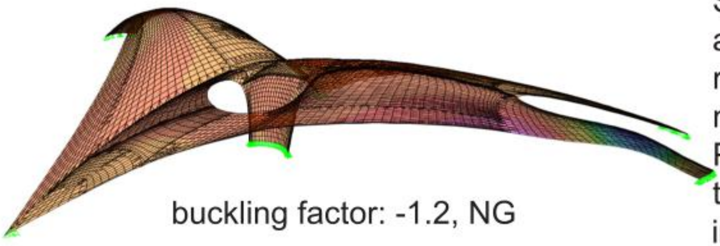


max displacement = 1.739 in., shape performs worse for lateral loads than vertical



blue - 500 psi

Dead + Eigenbuckling Analysis



buckling factor: -1.2, NG

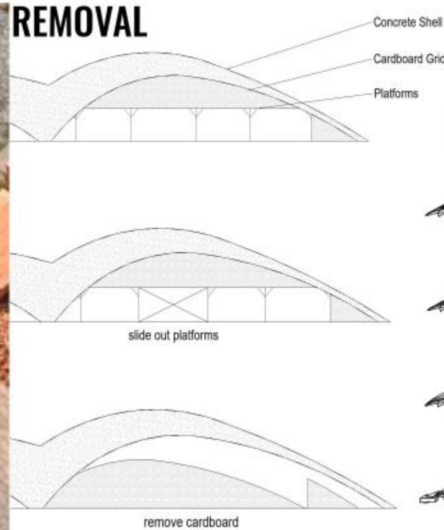
Conclusions

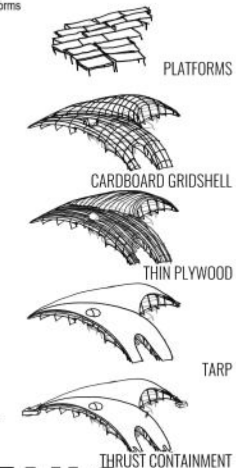
Structure may be succeptible to buckling, although stress and def ection results seem reasonable. We believe these results are a function of the shape of our shell rather than modelling inaccuracies, although both may contribute. Possible solutions include revising shell form at the entrance, where stress and buckling issues arise, or providing a stiffer section

PHASE **06** **CONSTRUCTION PROPOSAL:** After finalizing our design we developed a construction plan in order to make this a reality. we proposed two ideas: one idea to build the life size structure and another idea to construct the scale model.

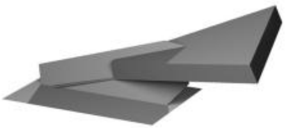
TIMBREL VAULTING BY BLOCK RESEARCH GROUP

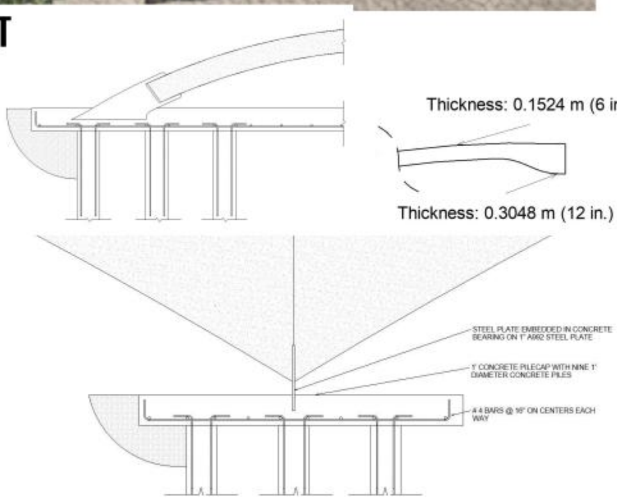
REMOVAL





THRUST CONTAINMENT

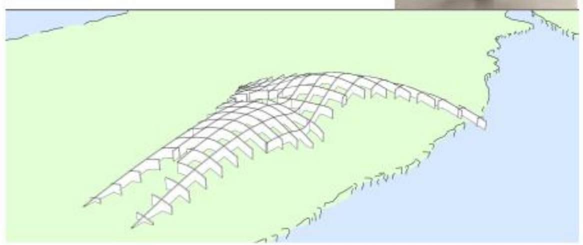




GRIDSHELL DETAILS

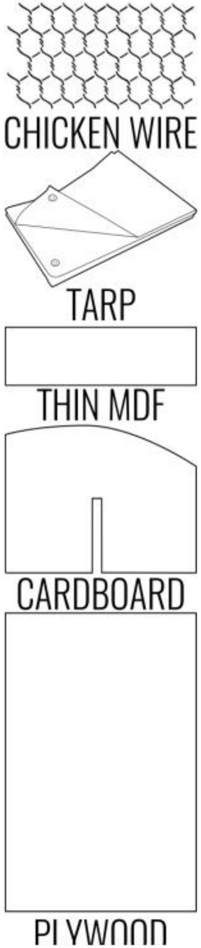
Material: Heavy duty double-walled cardboard or plywood

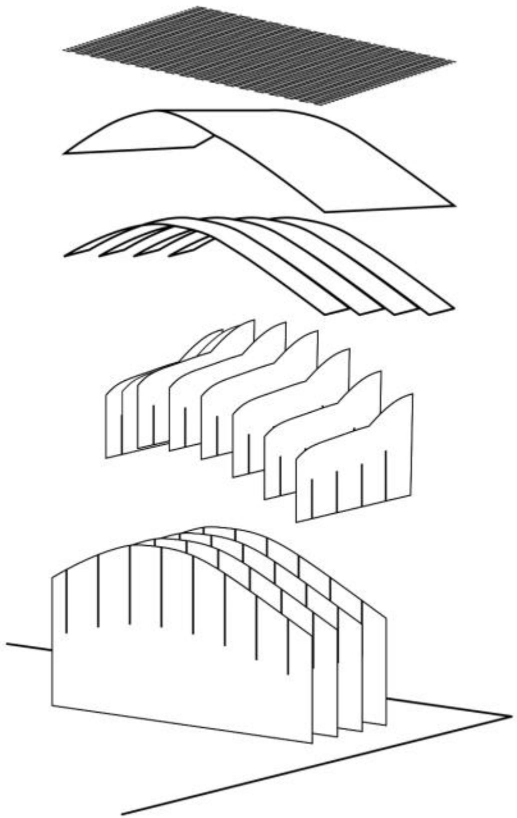
Frequency: 6" spacing

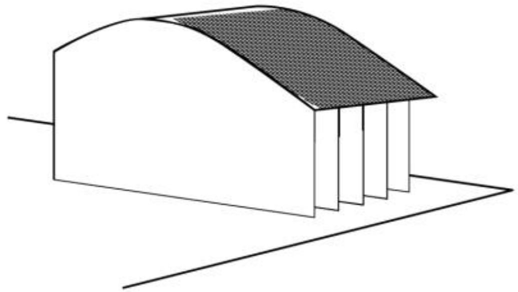


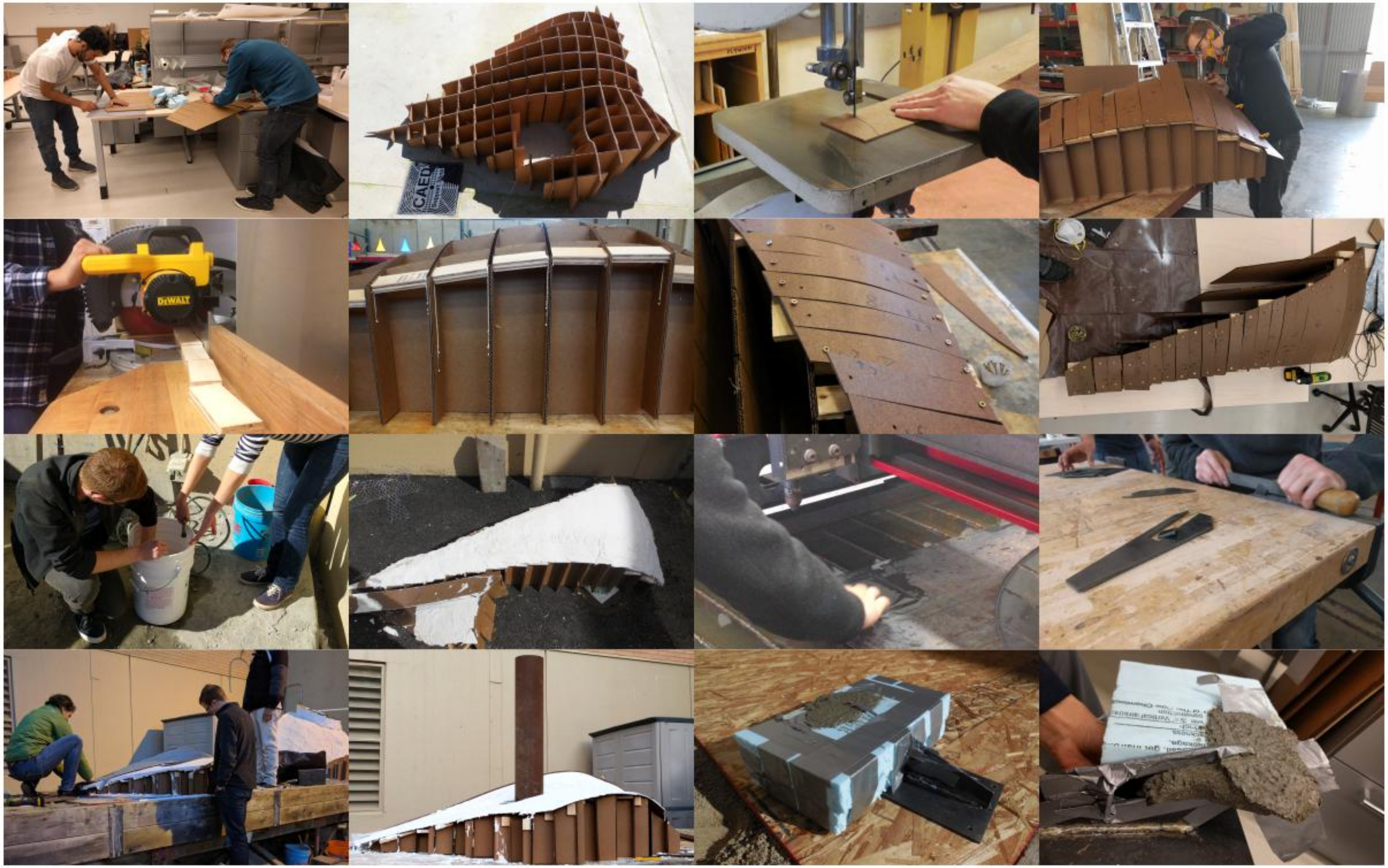
PHASE 07

CONSTRUCTION: After getting our construction proposal approved we began to work on making it a reality. We followed the plans we made but ran into some complications along the way and so we had to make some minor alterations that ended with great results.



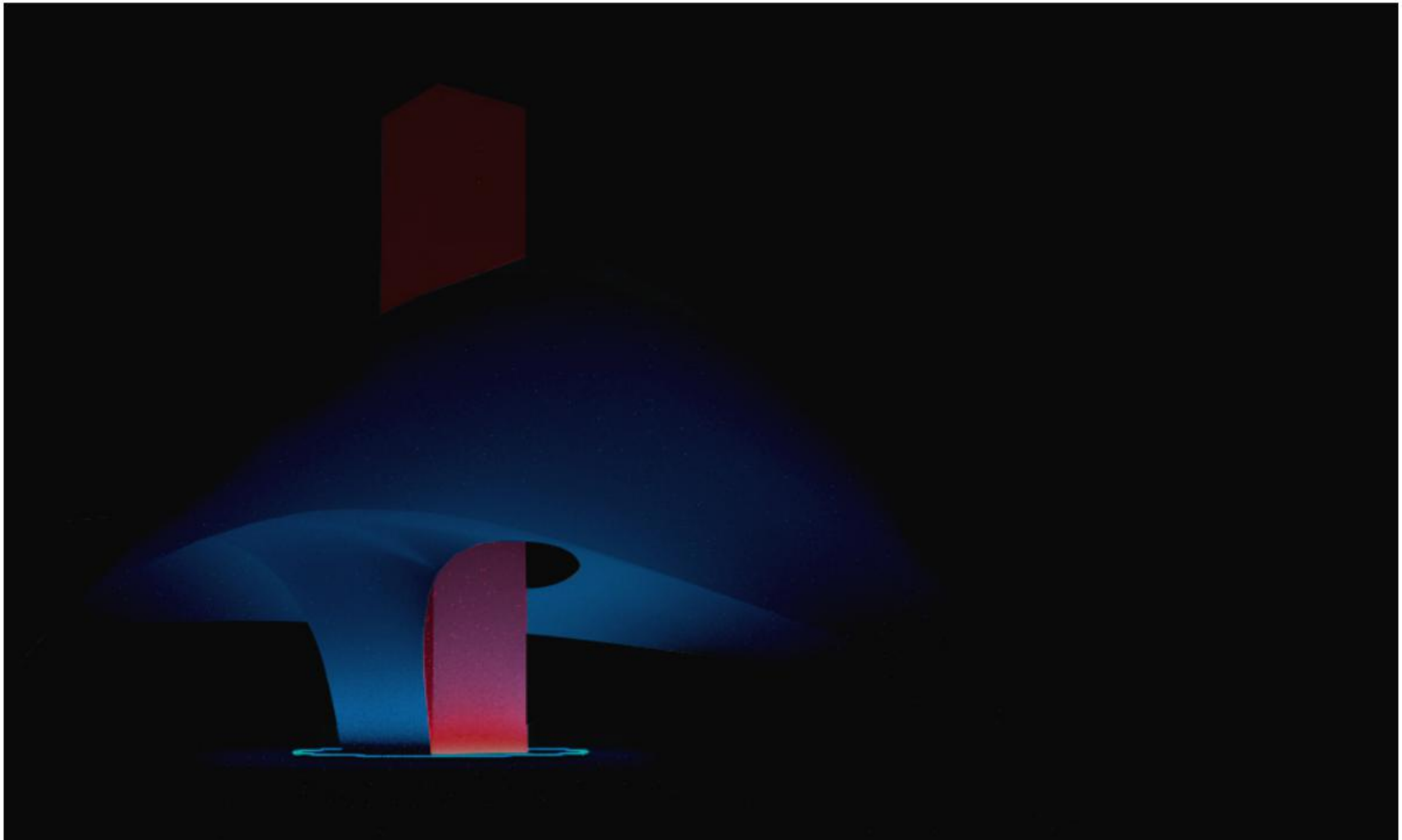






To begin, we used our 3D Rhino model and made a laser cur file to obtain the gridshell pieces. After constructing the gridshell we attached wooden blocks that would be used as the tie down position for our strips of particle board. Once the strips were attached we added a layer of plaster on top in order to fill in gaps. We then tested our supports.

Once the formwork was done we poured a layer of concrete and then we placed a layer of wiremesh and added another layer of concrete on top of that. We let the concrete cure for a week and we then removed the formwork from underneath which came out very easily from one side and the other side had to be soaked with water in order to remove it.

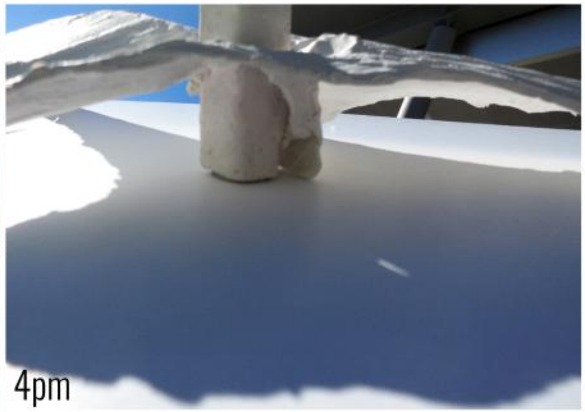


PHASE 08

LIGHTING: After completing our shell we were given the task to add lighting to our model in order create a new environment during the night. The added lighting will create an amazing transition from daylight to artificial lighting that will highlight the statue.

DAYLIGHT CONDITIONS

As shown by the daylight studies of our shell, the oculus around the statue creates changing shadow patterns thatdraw attention to Skye's Mother. The two main spaces under the shell, which are used for art exhibits, remain shaded formost of the day allowing for equal light-ing conditions for the different exhibits.



INTERIOR SHADOWS