

Makers Bazaar

Week 0

PROBLEMS:

- lack of stable revenue source, lack of urban structure, informal growth of the camp
- unbalanced distribution of infrastructure
- camp as an enclosed community detached from the surroundings (segregation)
- crime and violence

POTENTIALS:

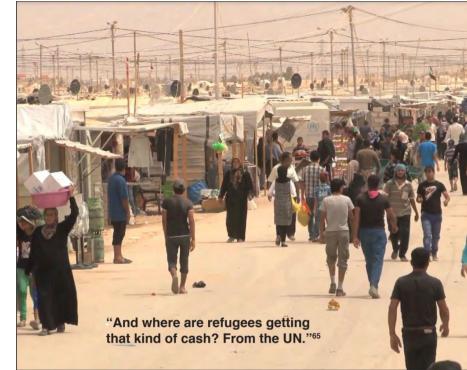
- skills and mercantile drive of the refugees
- informal roads (residents prefer the shortest route)
- different densities of commercial and other activities

PLAN: BIGGER SCALE

Individuate **new centralities** in the camp and build a **system**, using the typology of the Bazaar, that could gradually connect these elements like **neurological network**, creating new work opportunities, increasing safety and at the same time helping restructuring the urban fabric. In each centrality the Bazaar will be combined with **different functions**.

PLAN: SMALLER SCALE

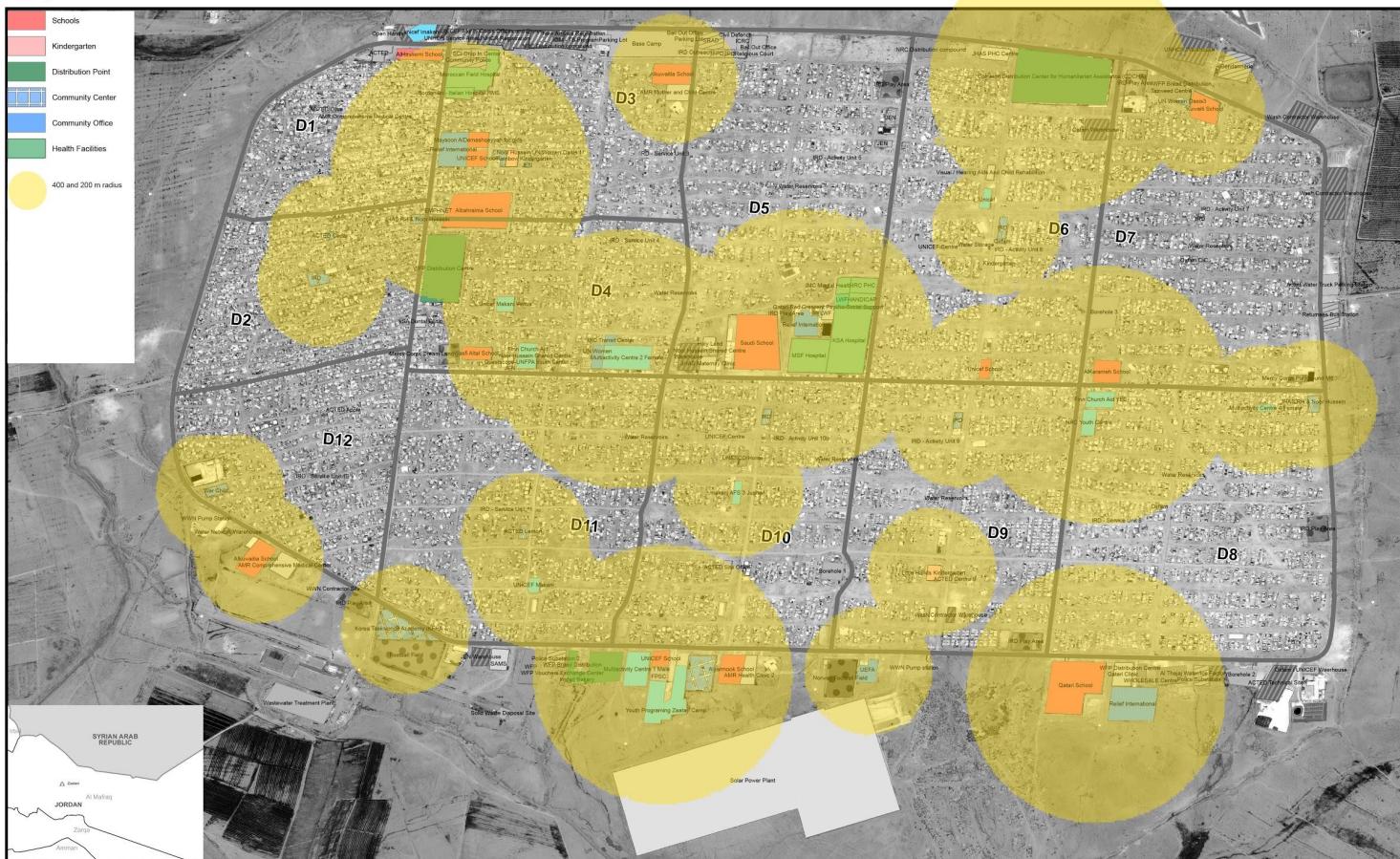
Design one of these centralities (node) and the related urban effect on the camp. We want to focus on the design on a **Bazaar that combines its commercial and social functions with a brick factory** that could help to build new skills in the community. The brick factory is the first centrality because those bricks will then be used to build the others.



"And where are refugees getting
that kind of cash? From the UN."⁶⁵

Zaatari Refugee Camp - Infrastructure and Facilities

May 2019

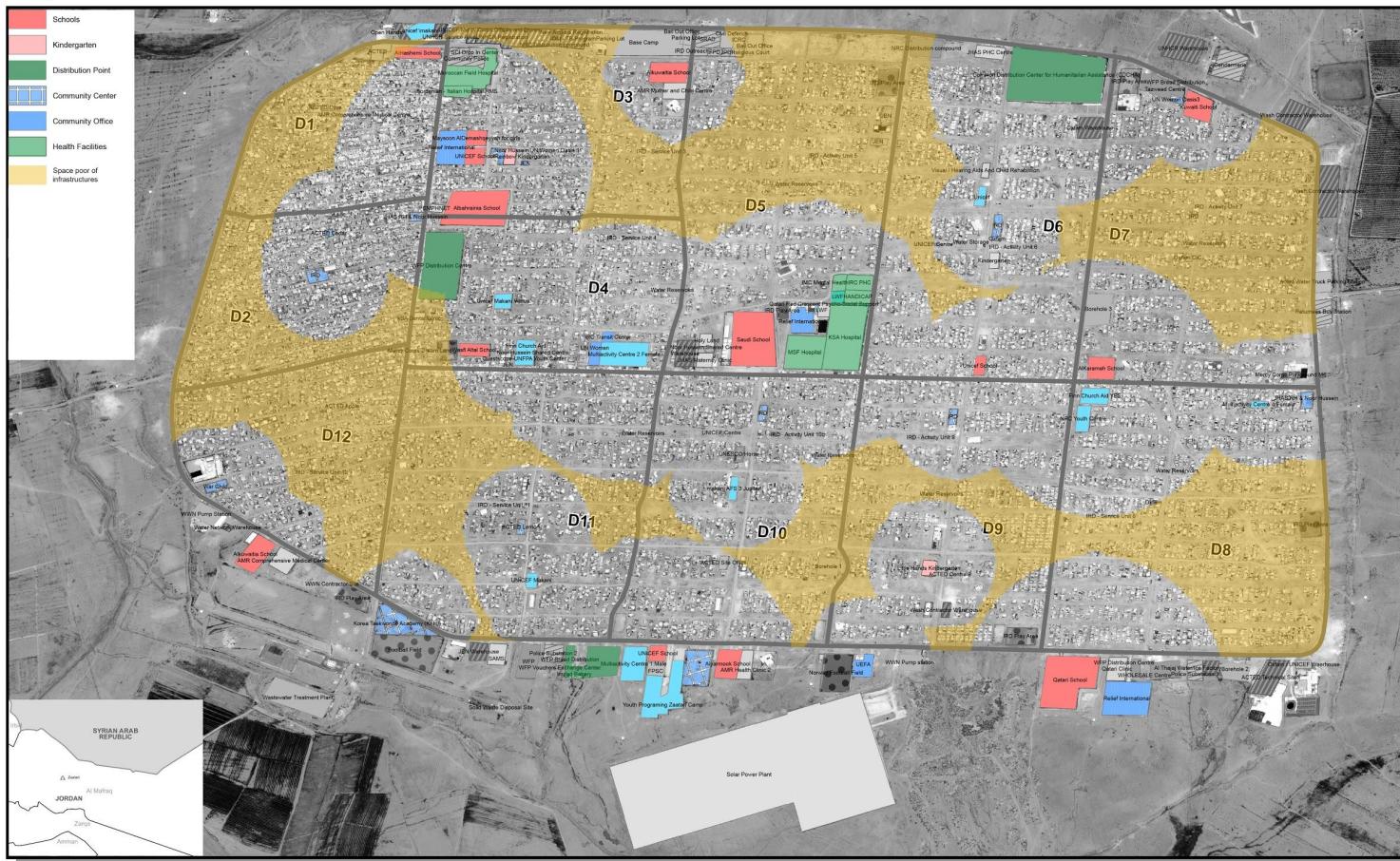


Small = 200m
Big = 400m

The area of influence of schools, distribution centers and youth centers is drawn.

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The space left is considered poor of infrastructures and considered for the interventions.

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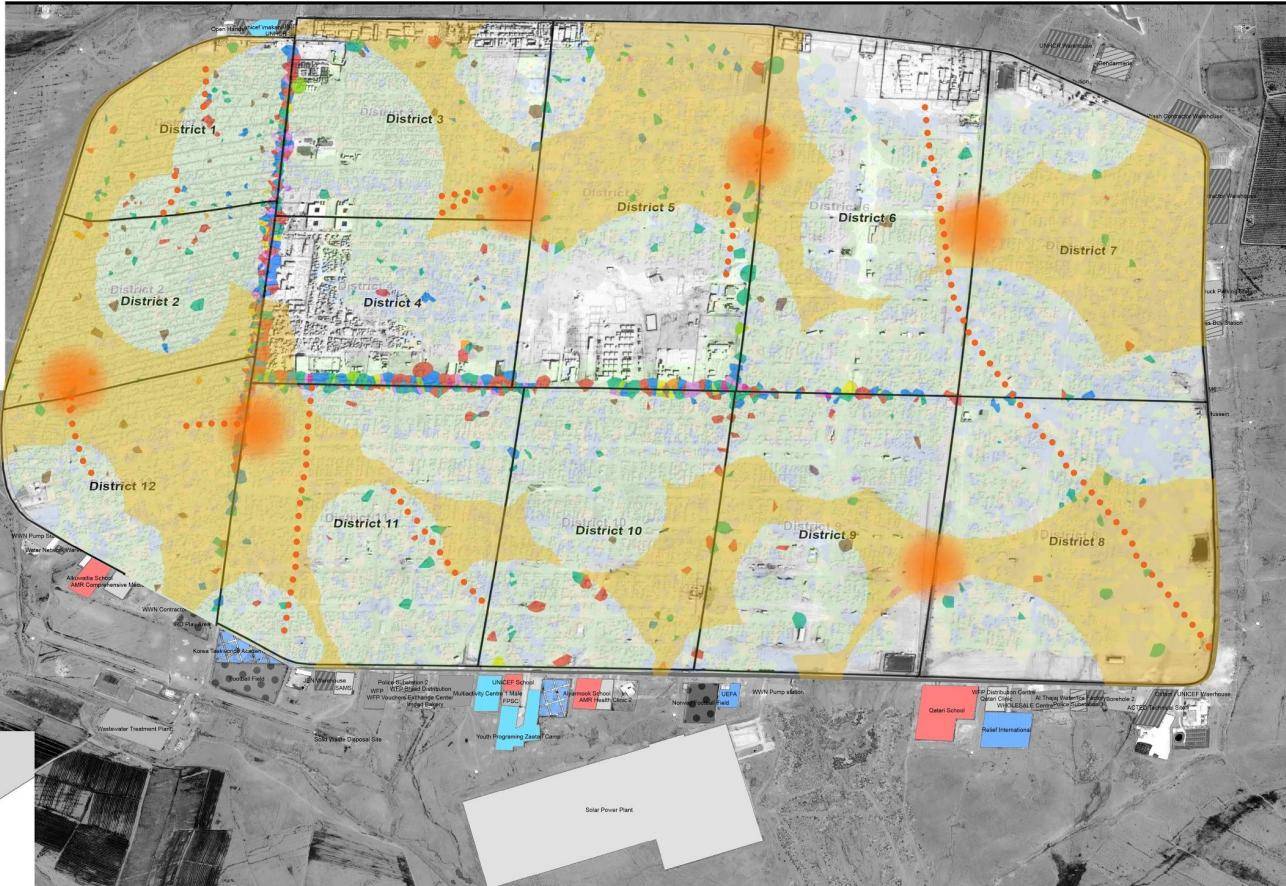
Over time, informal routes were created by people. Spots near them and the district's borders are considered suitable.

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- Supermarket or Minimarket
- Grocery Shop
- Clothes Shop
- Other Type of Shop
- Bakery
- Butcher
- Restaurant
- Space poor of infrastructures
- Informal routes
- Possible centrality



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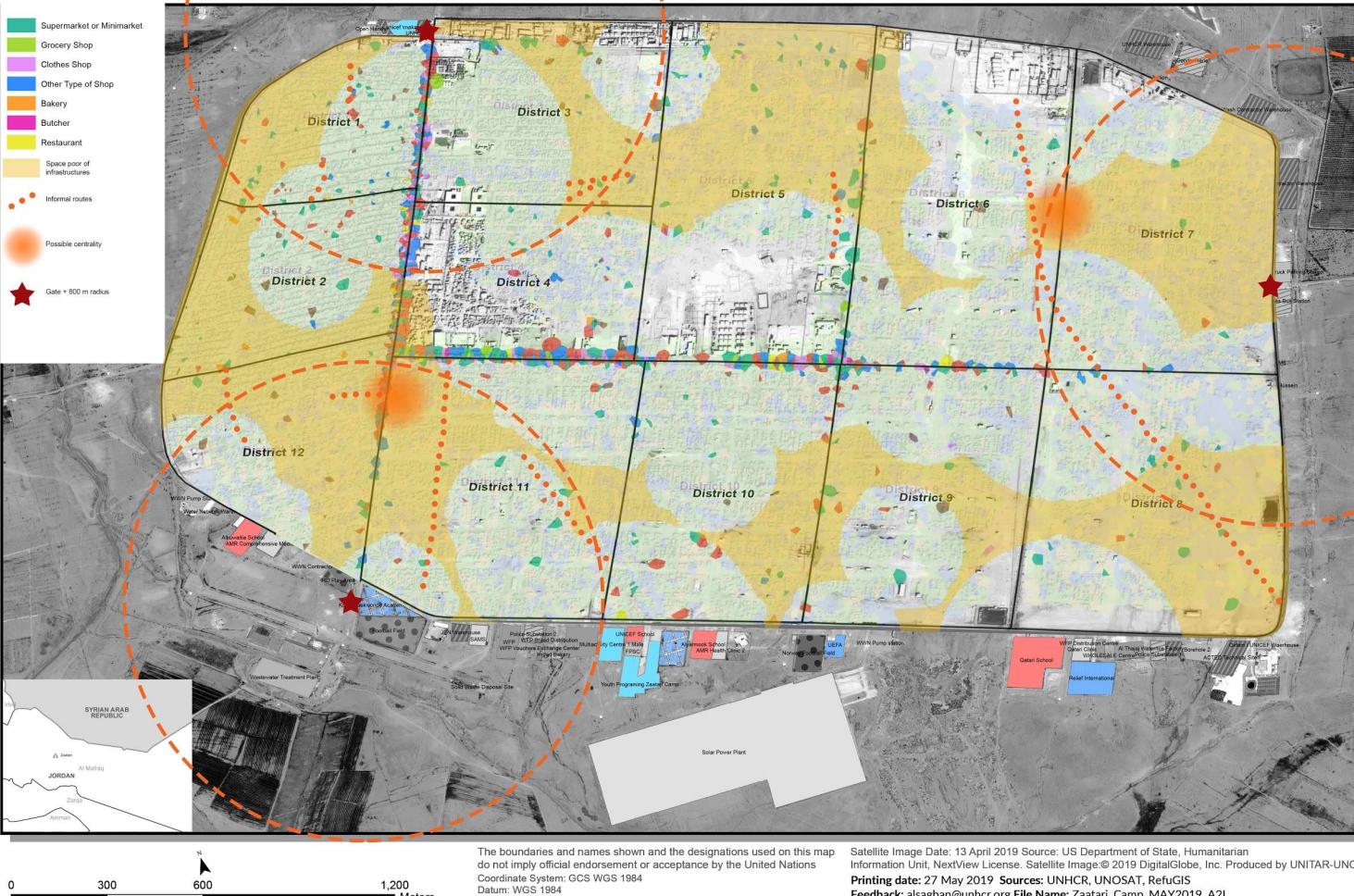
Density of tents and commercial activities is used to evaluate the different spots.

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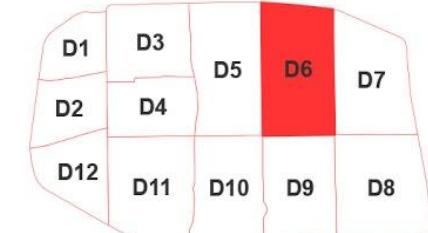
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- Space poor of infrastructures
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- Possible centrality
- Gate + 800 m radius



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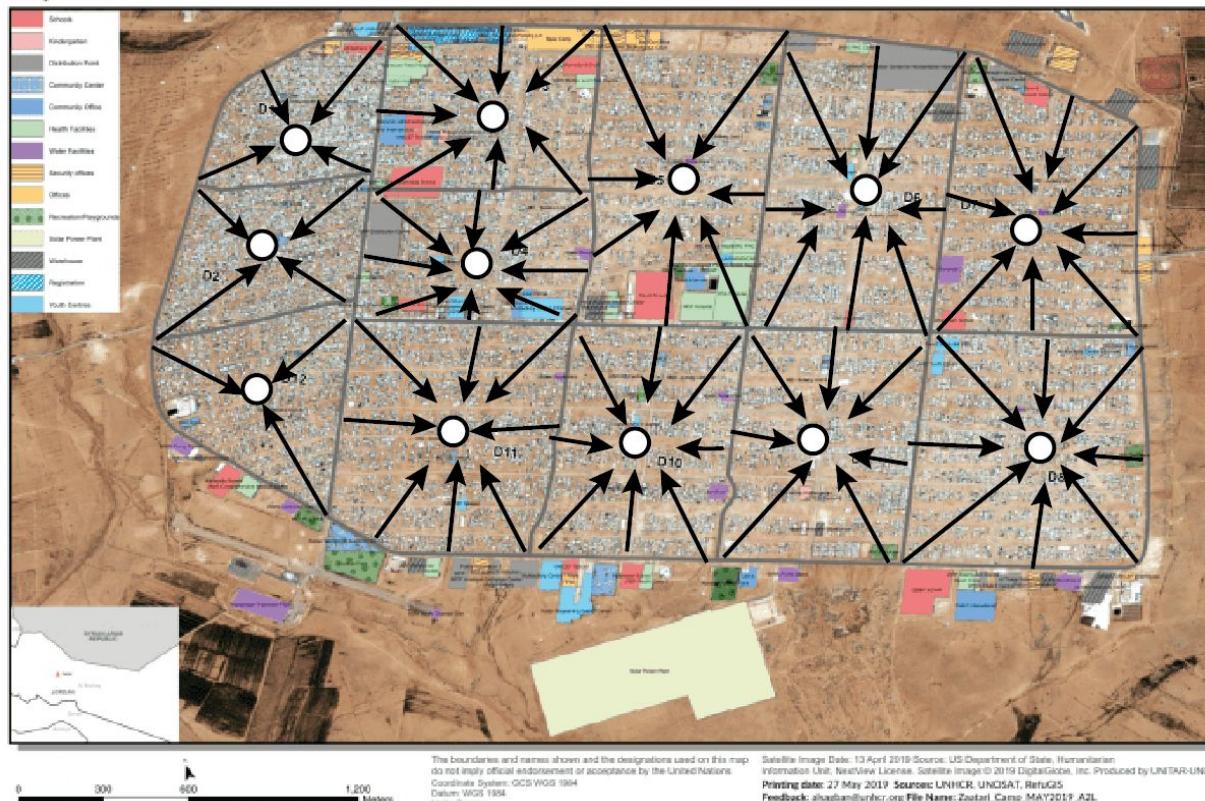
For the first centrality (brick workshop), the distance from the gates is considered. 2 locations are possible.



Possible location in District 6

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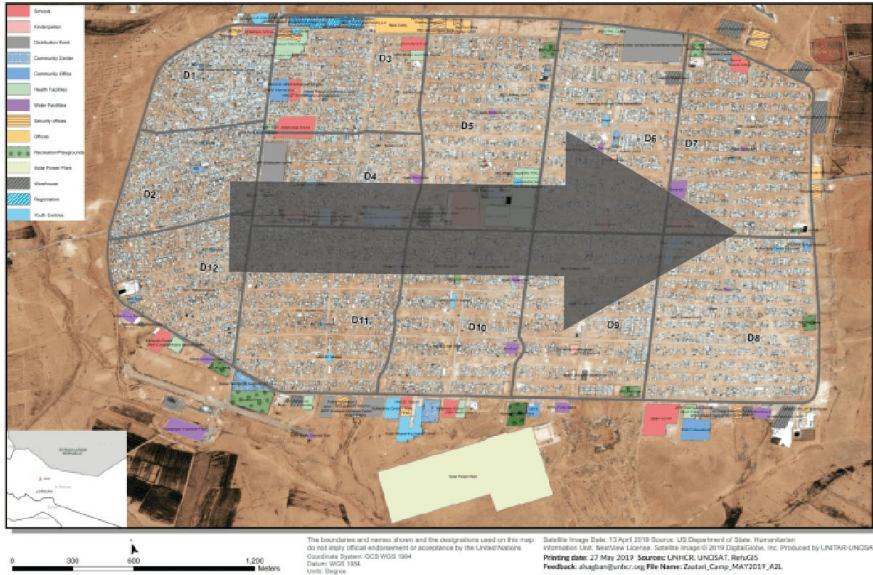
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Possible location nodes - creation of central landmark to create point of attraction close to as much houses as possible to increase traffic in those areas and therefore increase safety.

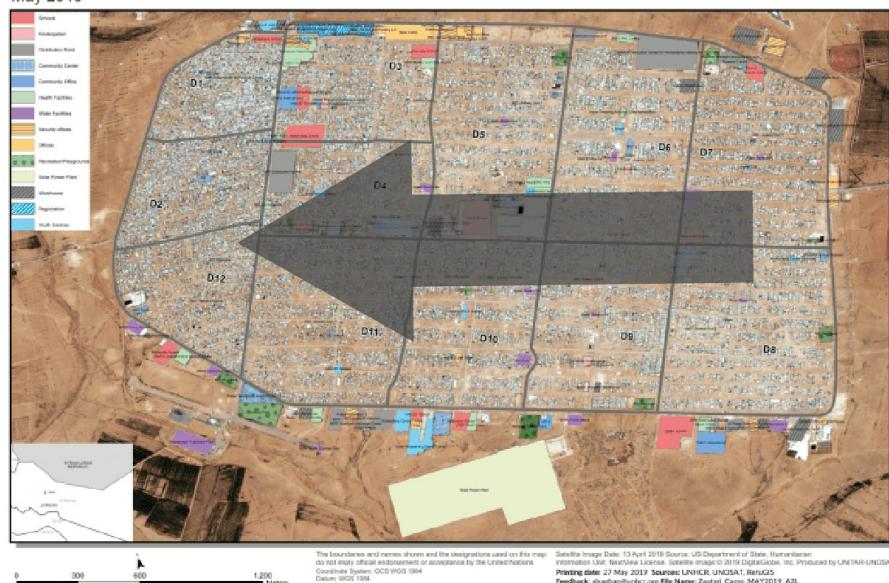
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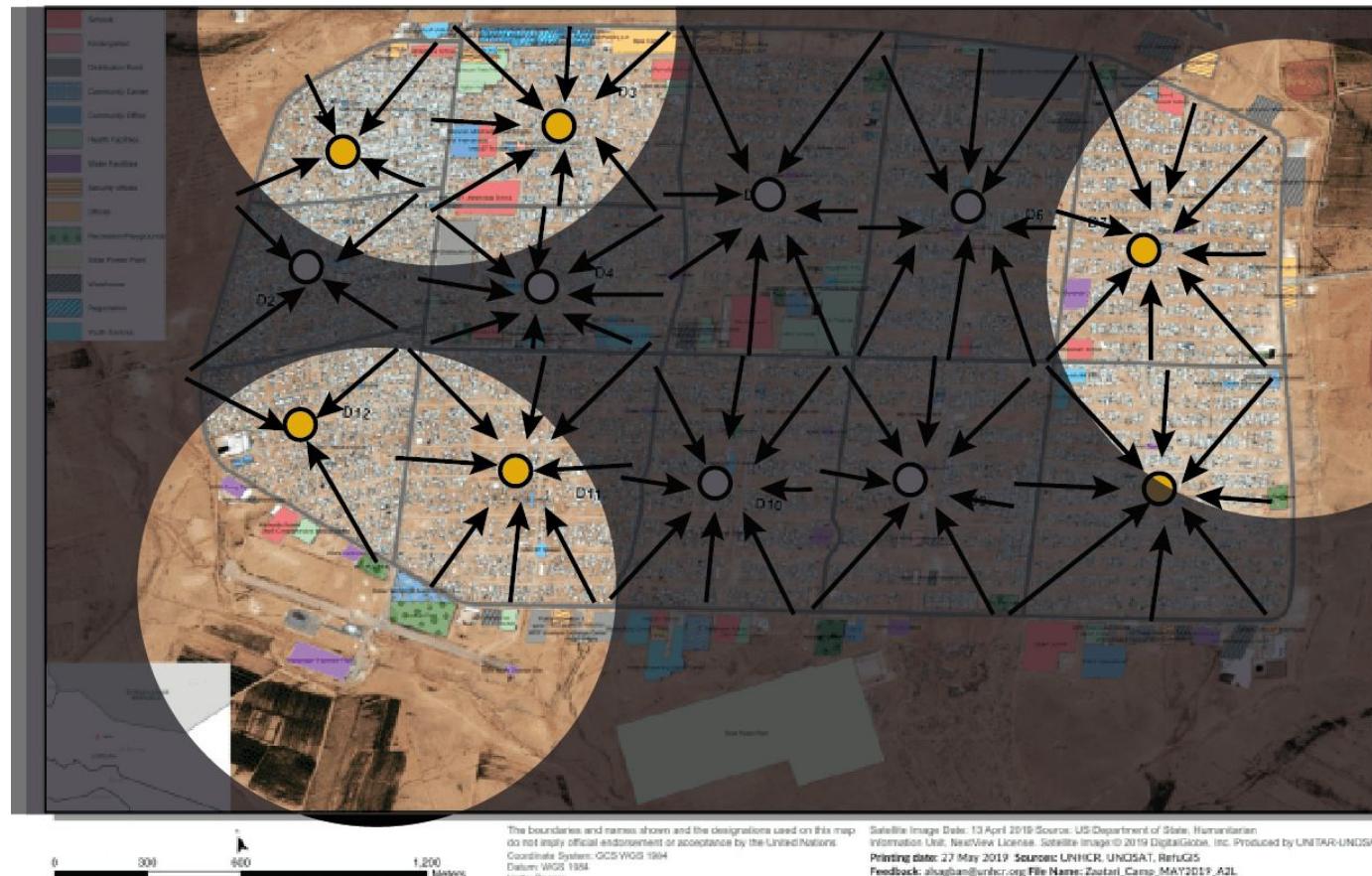
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Possible expansion direction - Expansion from (in this case) left to right in following the natural expansion of the camp. Expansion from right to left is going against the initial expansion direction and therefore create attraction point were no exist at the moment.

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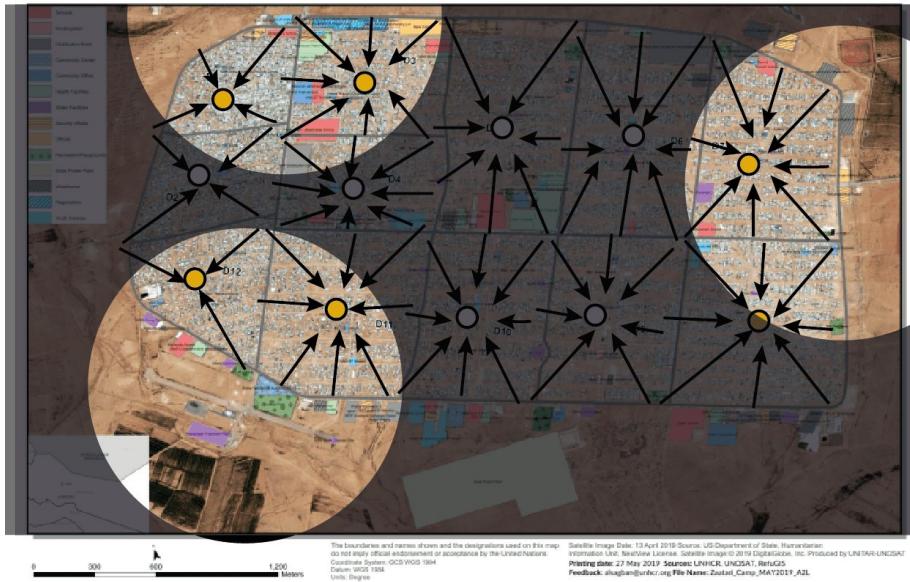
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Combination slide 9 and 11

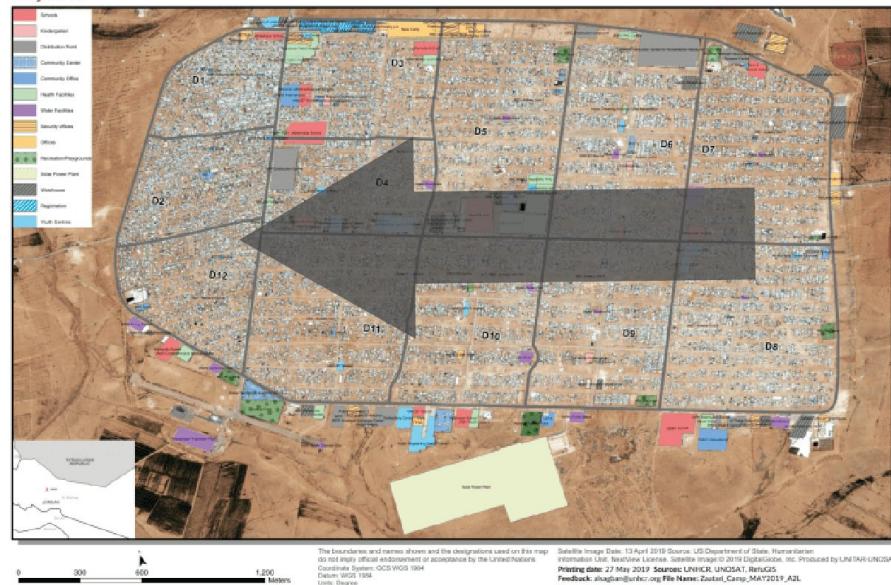
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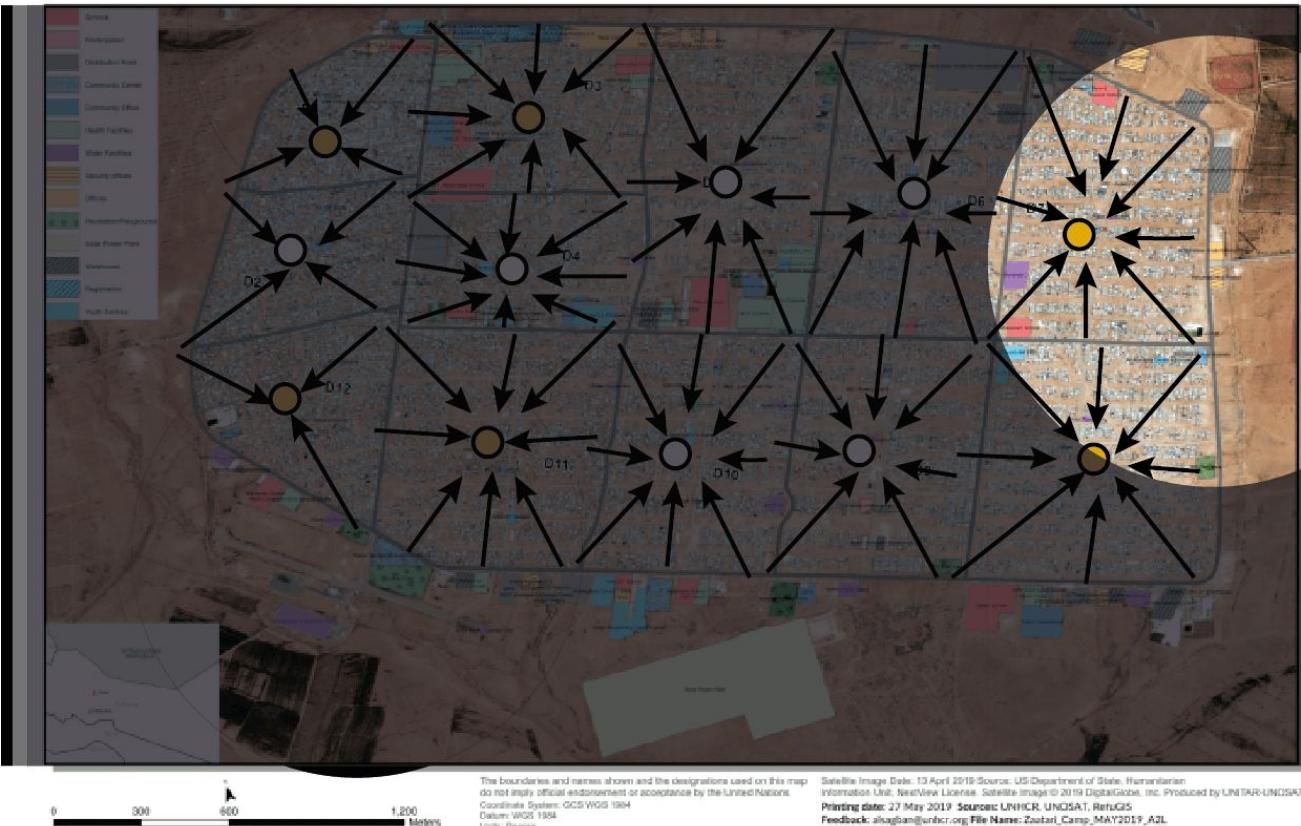
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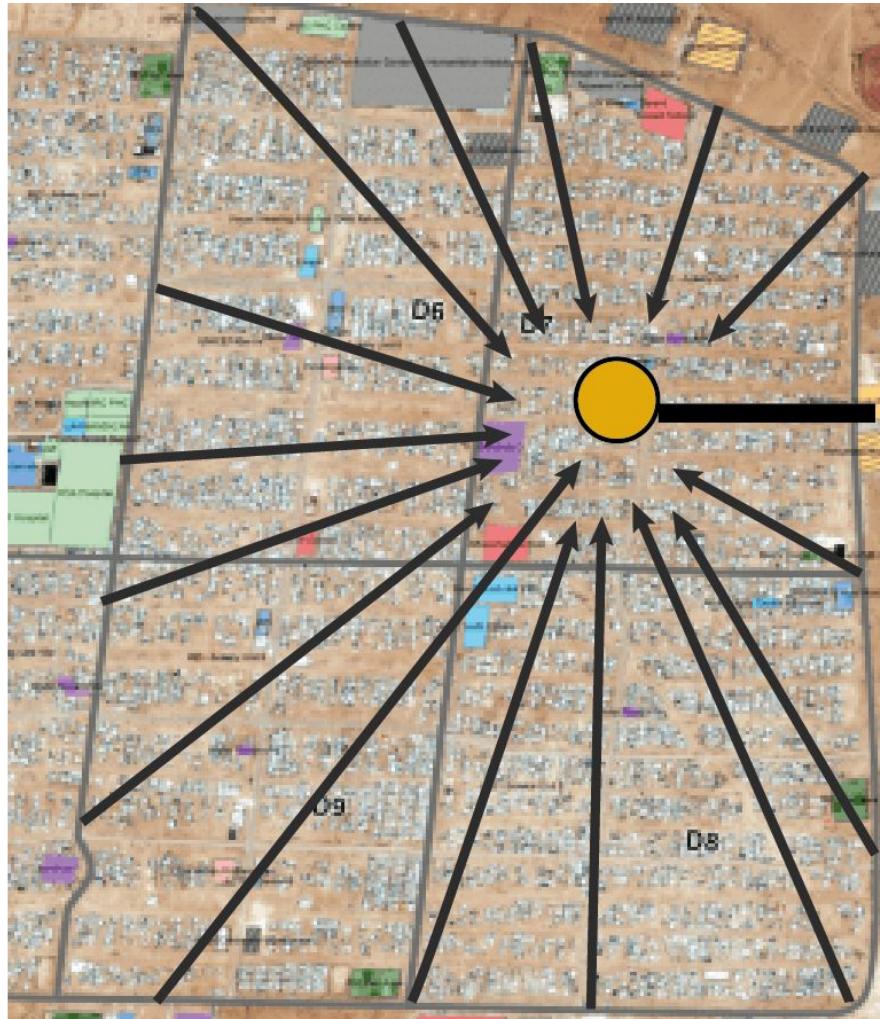


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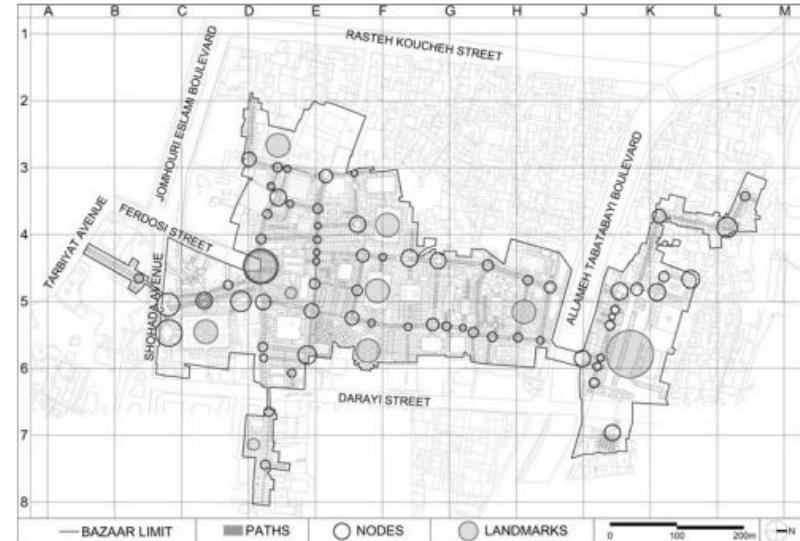
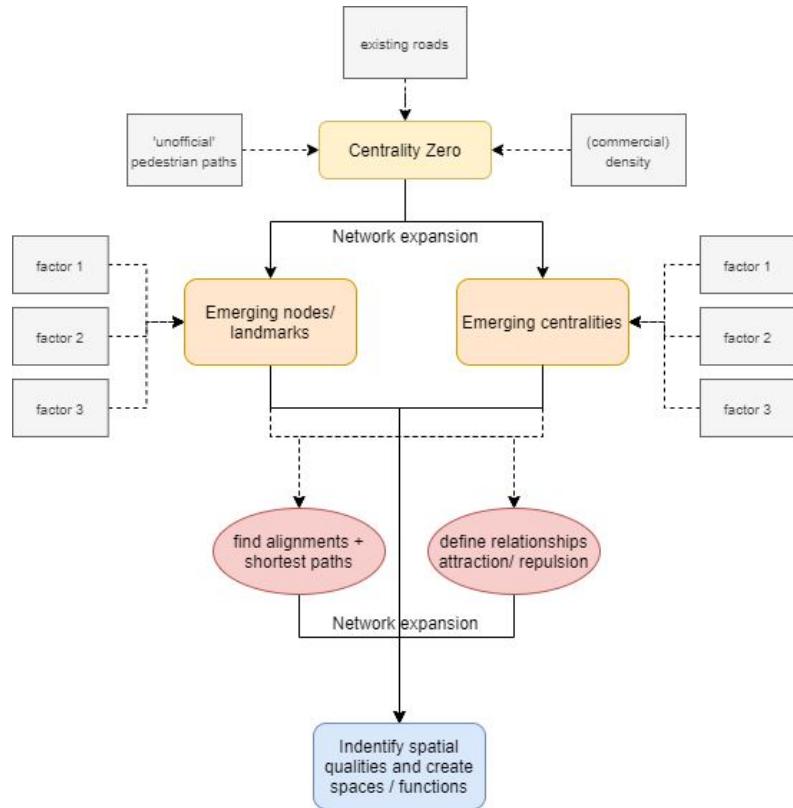
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The creation and expansion of the network

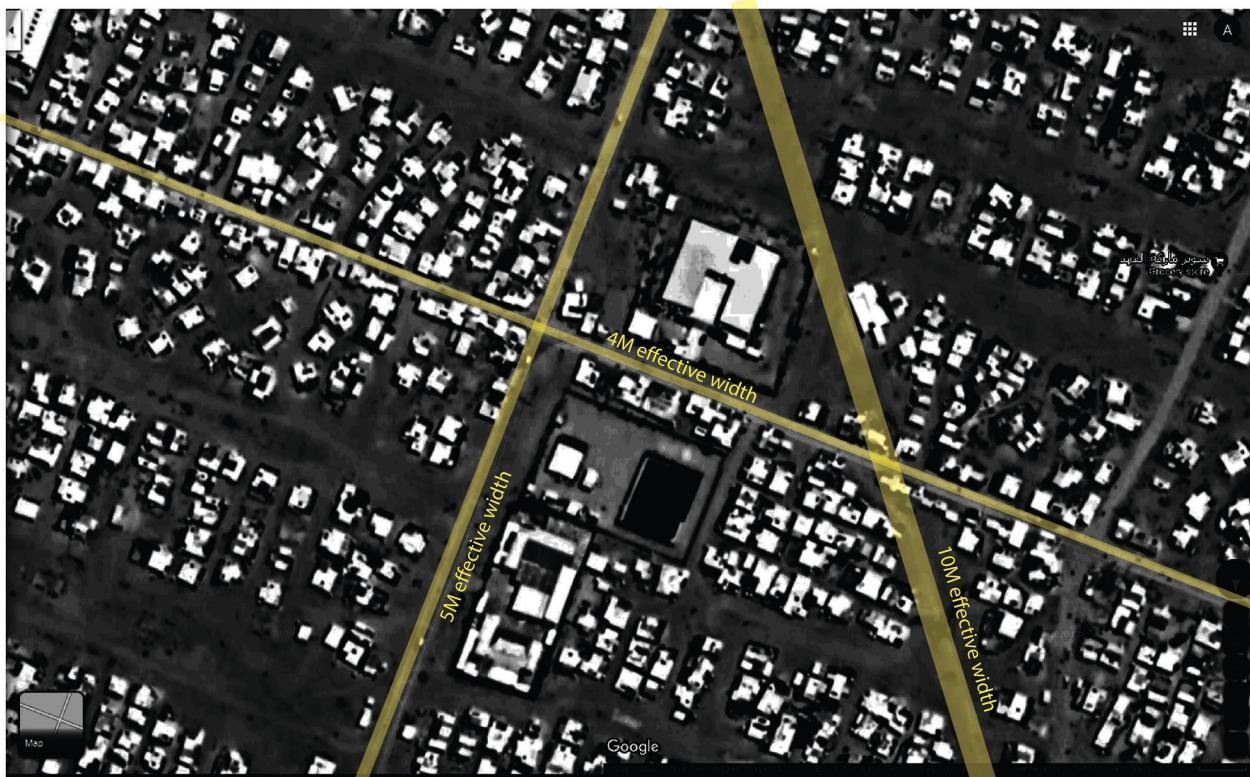


(Tabriz Municipality 2003)
Figure 1: City elements diagram in Tabriz bazaar

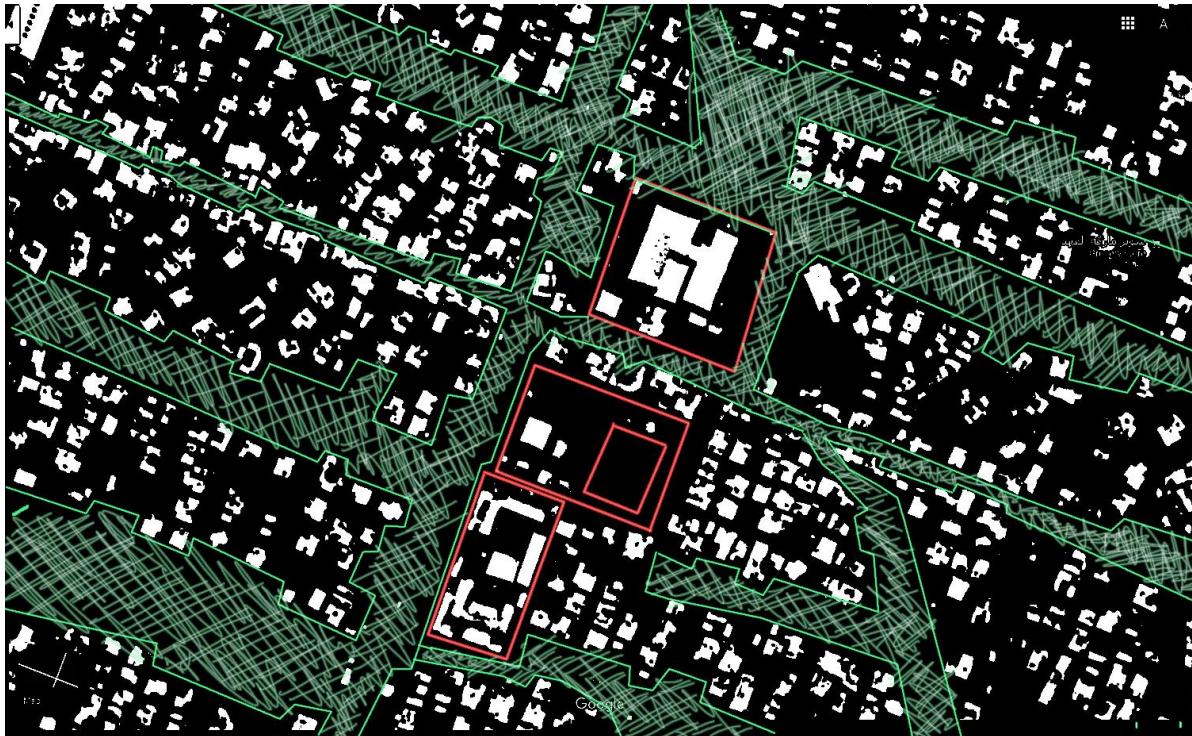
Urban street features



Effective width



Actual width



Makers Bazaar

Week 1

Restructuring Phases

Stage I Makers Bazaar			Stage II Brick Factory			Stage III - Distribution Bazaars			Stage III - Micro Bazaars		
Typology	Selection parameters	Shaping parameters	Typology	Selection parameters	Shaping parameters	Typology	Selection parameters	Shaping parameters	Typology	Selection parameters	Shaping parameters
Responds to vehicular traffic	On main axis roads	Responds to the existing framework, but also suggests a new framework	Large open spaces	On edge of site	Climate and program requirements	Same as first Node	Same as first Node	Catering to day to day activities	Responds to pedestrian traffic	Distributed in all districts	Organic and responds to existing street scape
Strongly defines urban structure	Located closer to the gates/brick factory		Large shaded roof structures	Near the gates		Same as first Node	Same as first Node	Adapts to existing structure	Adapts to existing structure	Narrow roads	
A new centrality	Connects other centralities		Proximity at the gates			Same as first Node	Same as first Node	Not a centrality	Not a centrality	Mosques are a good starting point	
	Preferably wider roads		High traffic of transportation trucks								

-We can derive a parametric logic of all the phases and suggest locations. (some can be manual as well, such as

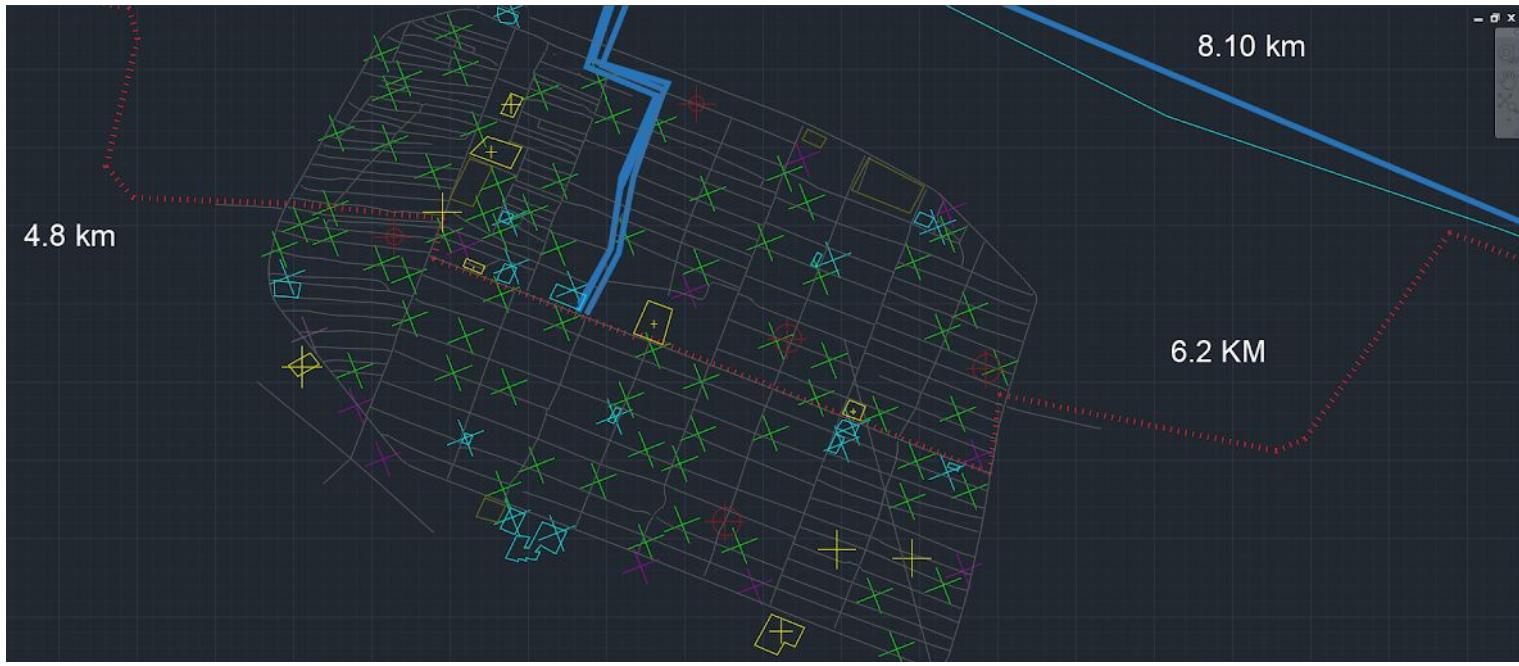
brick factory as there are not many parameters except for location near gate and main roads)

-We detail out only Stage I based on this parametrically derived master plan.(if possible)

-Worst case scenario, we just chose the most interesting node and carry on with life



- A line map of the site and the connectivity to the neighbouring towns.
- Could be useful in identifying potential high traffic roads within the site and to anticipate new ones.
- The location of the makers bazaar and brick factories can be derived based on this new high traffic vehicular roads as it needs to respond to the future.



- Identified the main points of interest which affects our proposal (mosques, schools, youth/activity centers, recreation, water infra and distribution points)
- Information from the points and lines can be used in a script probably.
- Next steps could be adding more info to these poitns and lines(road widths, importance of points of intererest, outlining districts as “boundaries or regions”

Bazaar typology

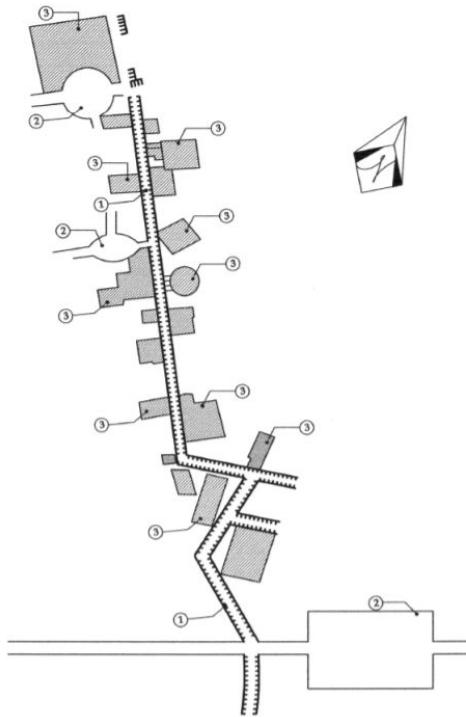
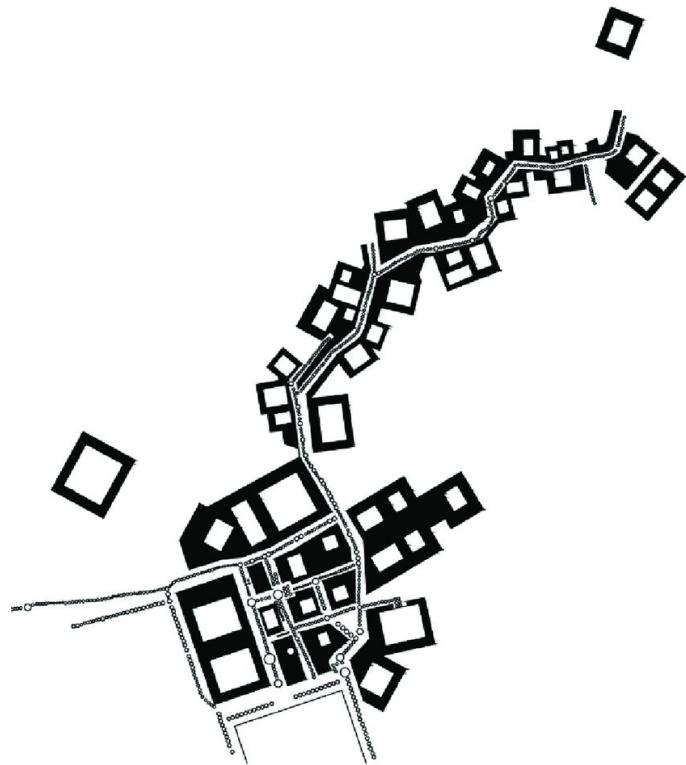
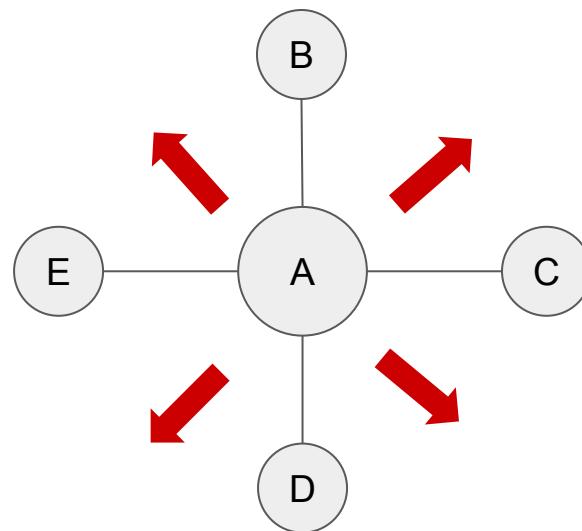
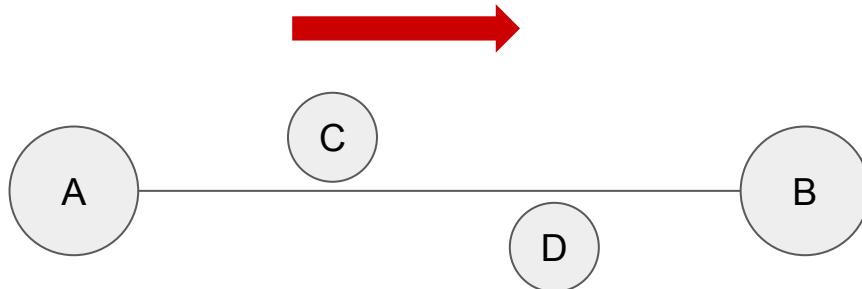


Figure 2, Bazaar of Kashan

- 1- Bazaar as the major street of city
- 2- Major squares of the city
- 3- Public and governmental buildings of city





Most of the important and prestigious buildings as well as governmental ones were always constructed adjacent to it.

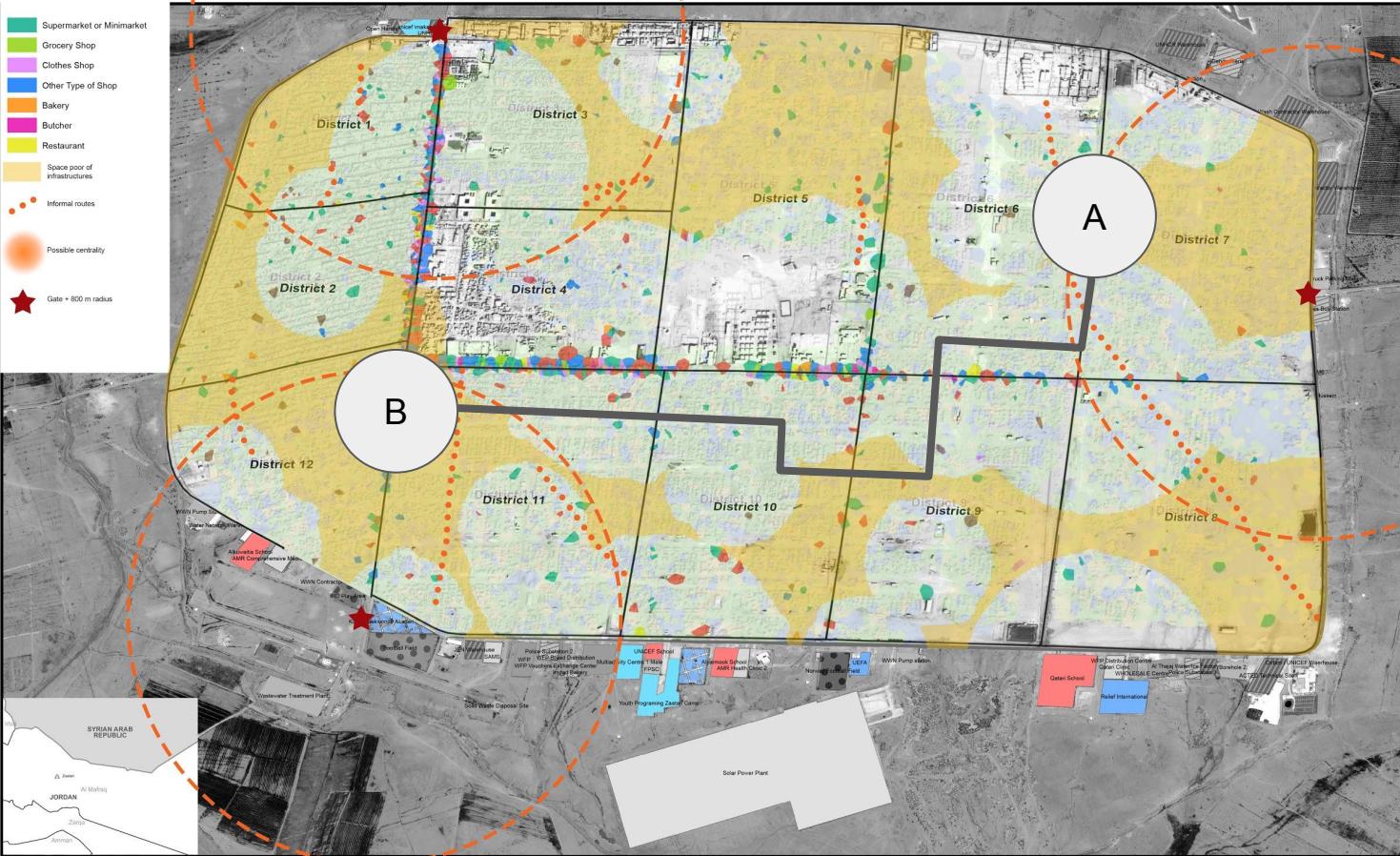
- Covered street, or series of streets and alleyways, lined with small shops grouped by service or product.
- The Arabic suq is a market located on four streets; each in a different direction. So, it is the central market generated by the cross roads.

Zaatari Refugee Camp - Infrastructure and Facilities



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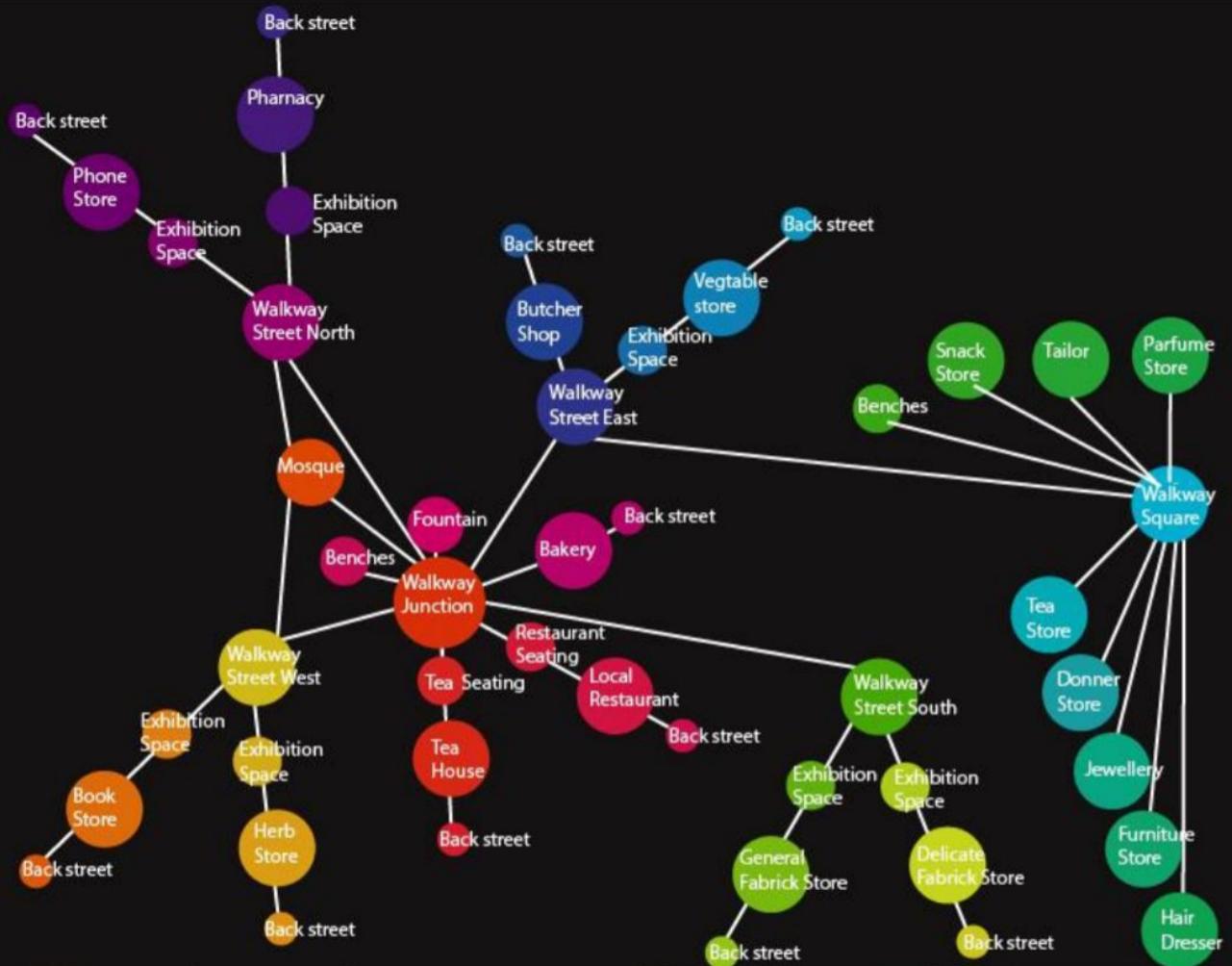
- Supermarket or Minimarket
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- Possible centrality
- Gate + 800 m radius



maybe

0 300 600 1,200 Meters





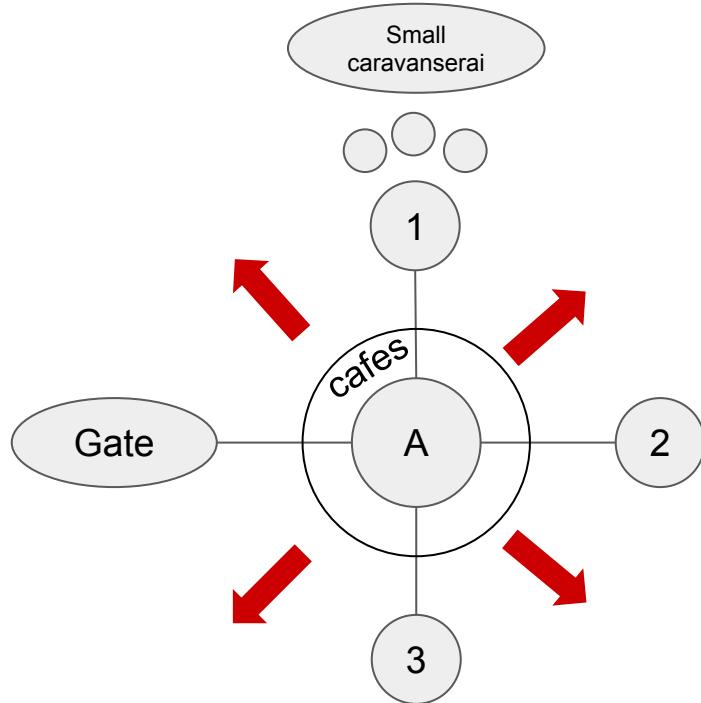
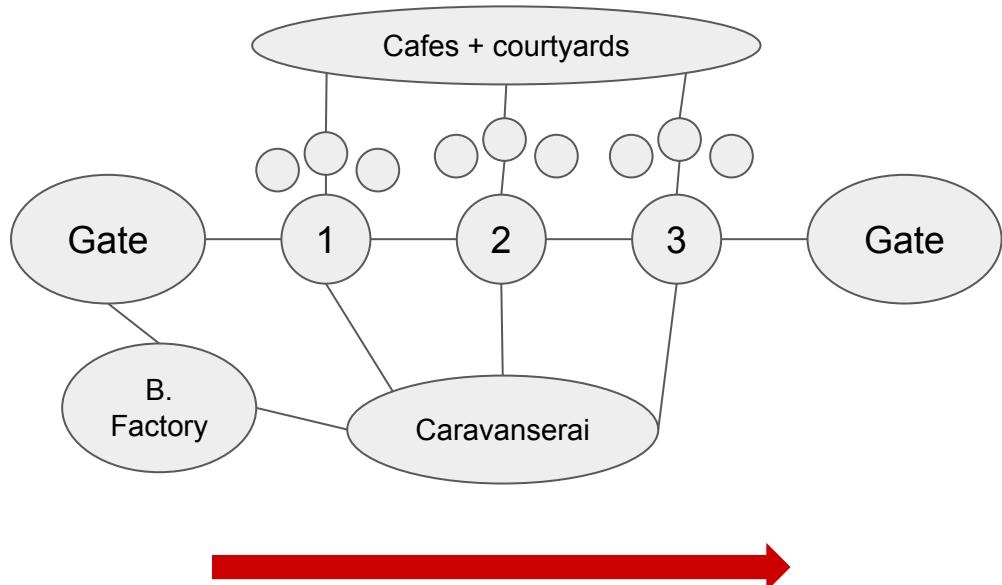
Activities usually divided by group. Only cafes and tearooms are in between the other activities.

What we can do is add bubbles for courtyards and caravanserai.

We could divide the branches maybe in:

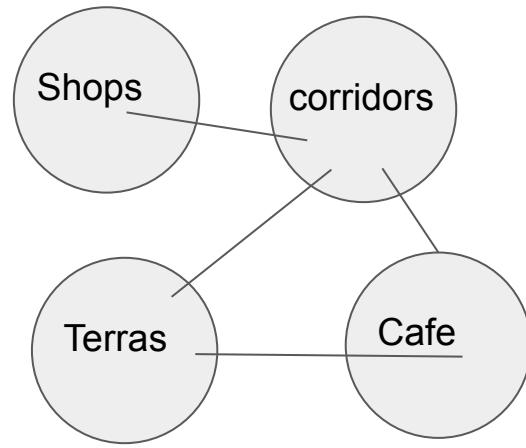
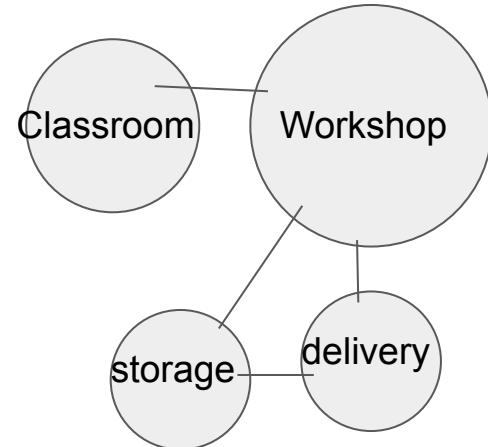
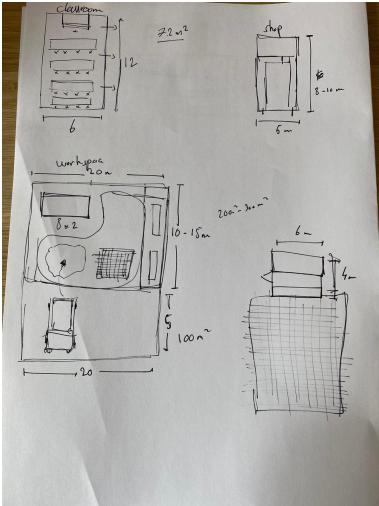
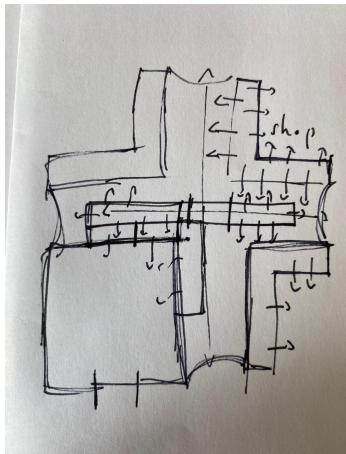
- food
- art
- “science”/tech
- Clothes/Textiles

Starting from options in slide 3

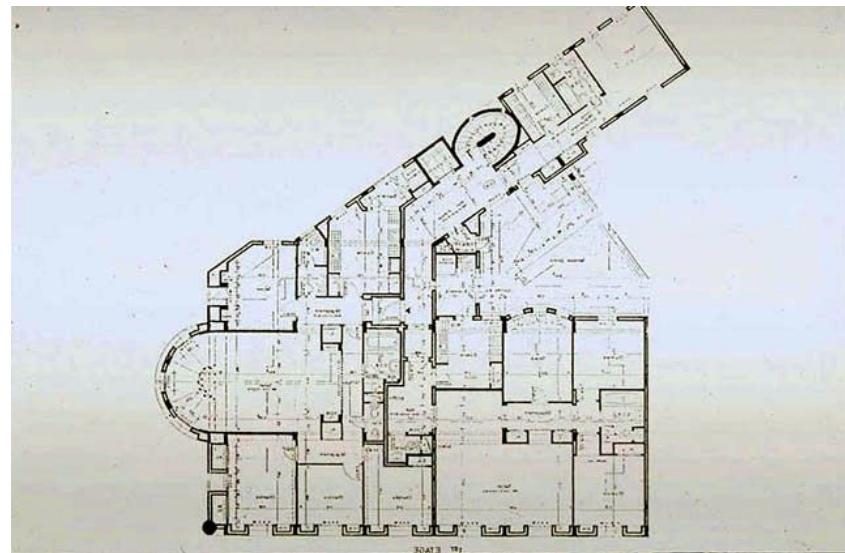
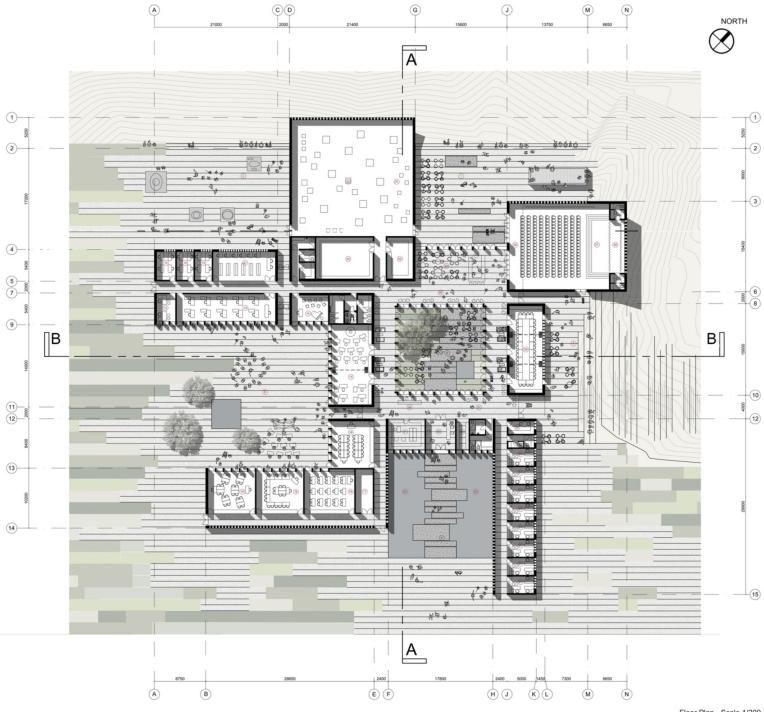


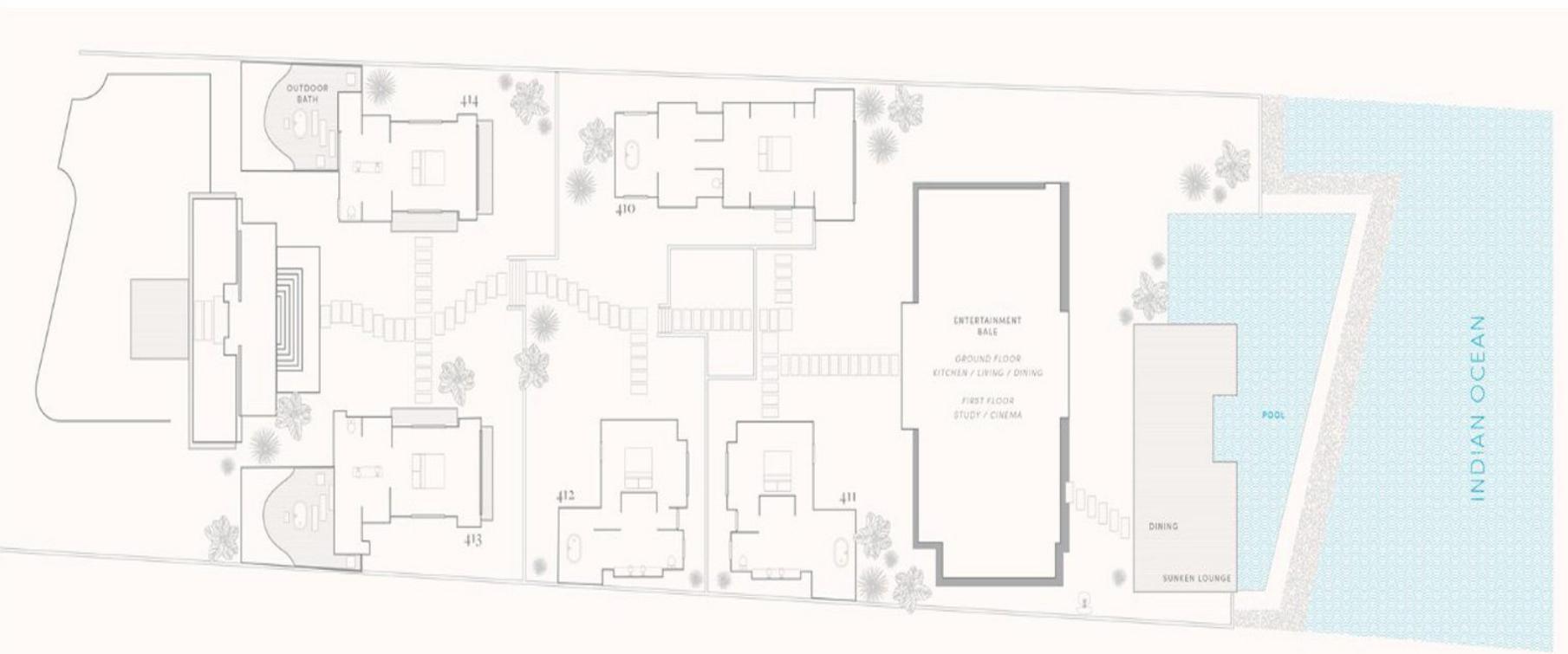
Functions

- Birck workshop
 - classroom x2 - 50m² x2
 - workspace (outside +shade) - 150-200m²
 - space for the trucks to deliver dirt - 50m²
 - storage (tools(safe)/bricks/dirt) - 50m²
- Bazar
 - Shops 10-14m² (1 main opening +safe)
 - cafe (10m² - road side - load of people)
 - terras

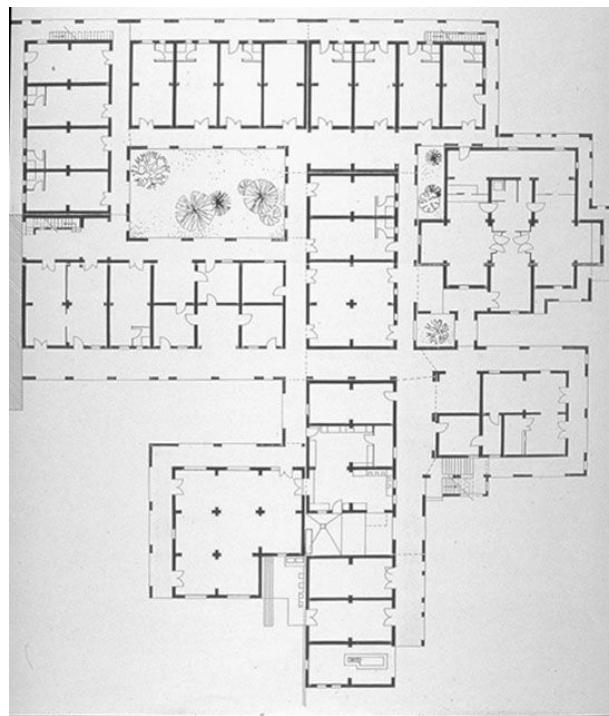
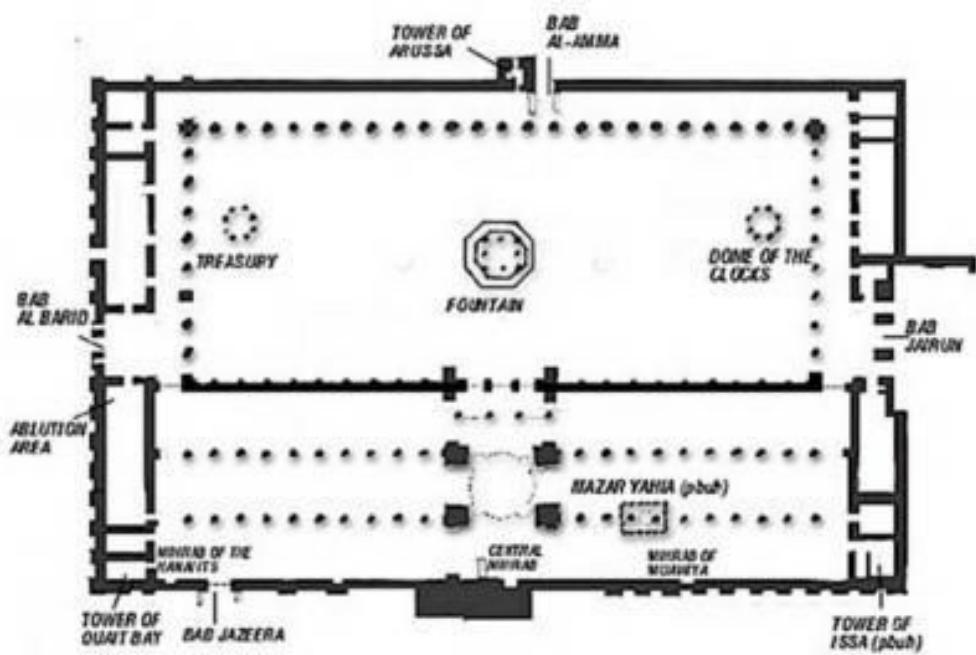


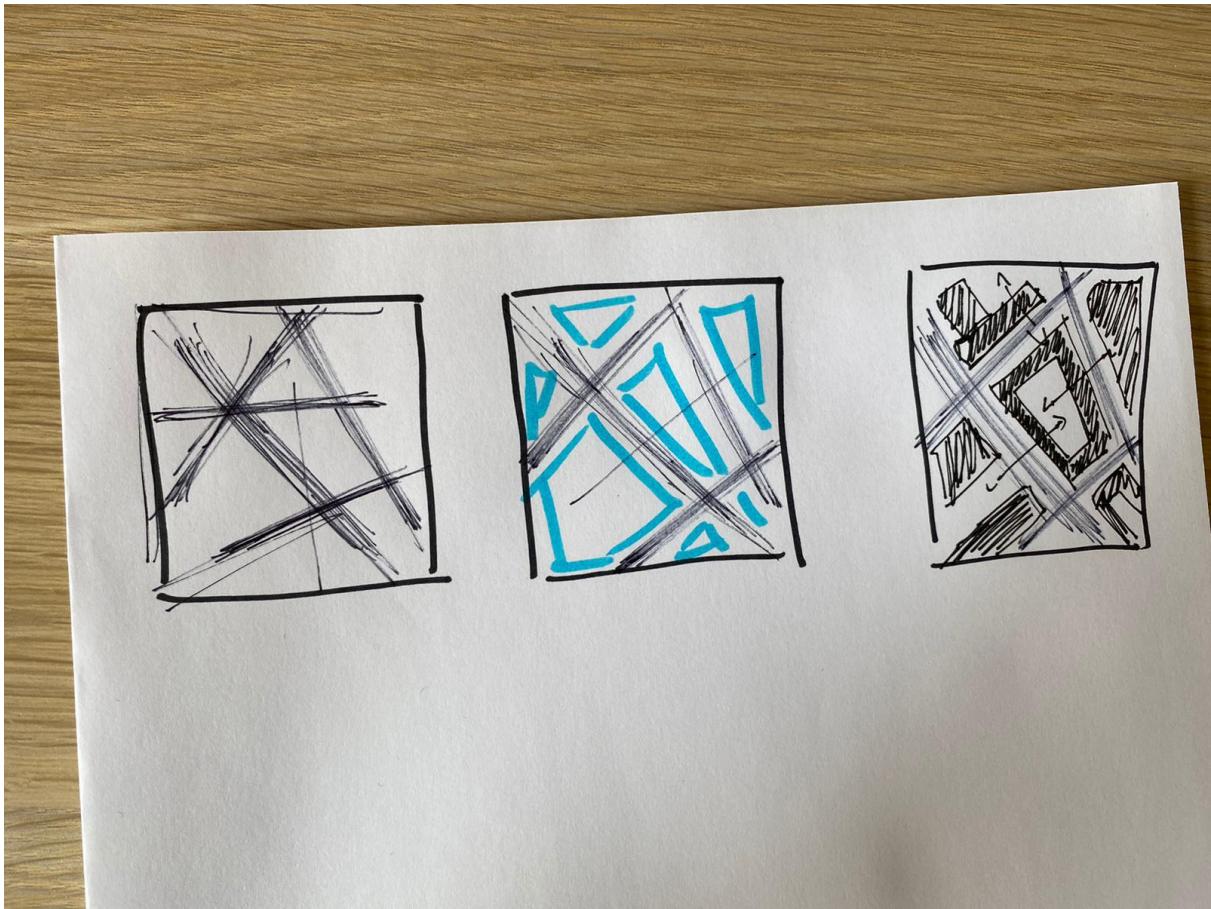
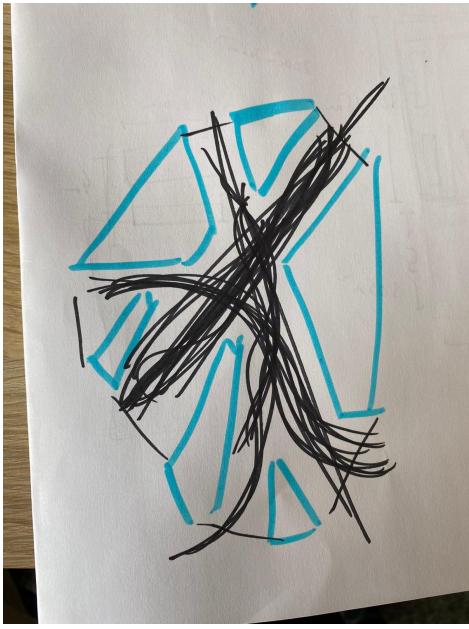
Open or closed

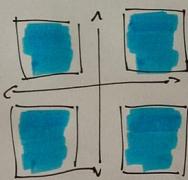
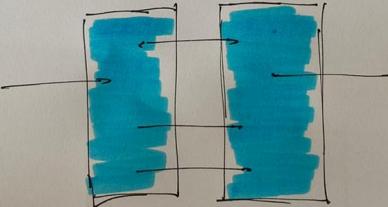
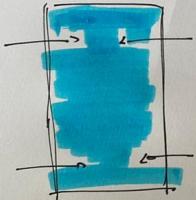
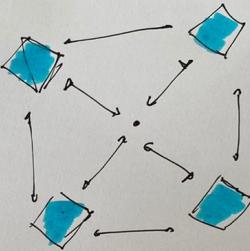
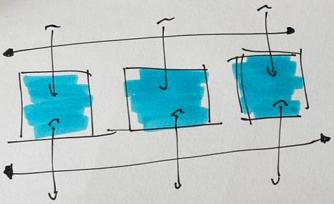




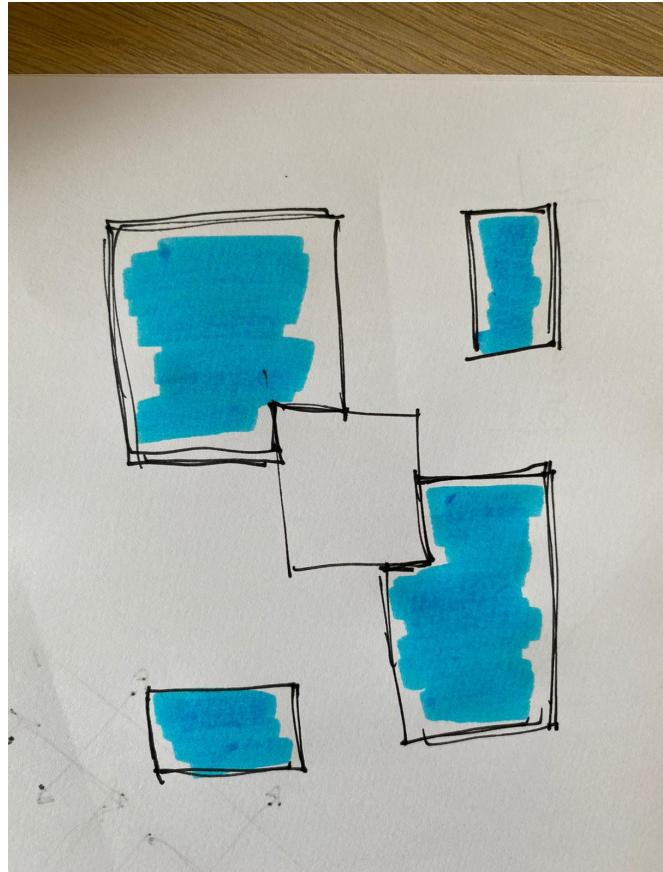
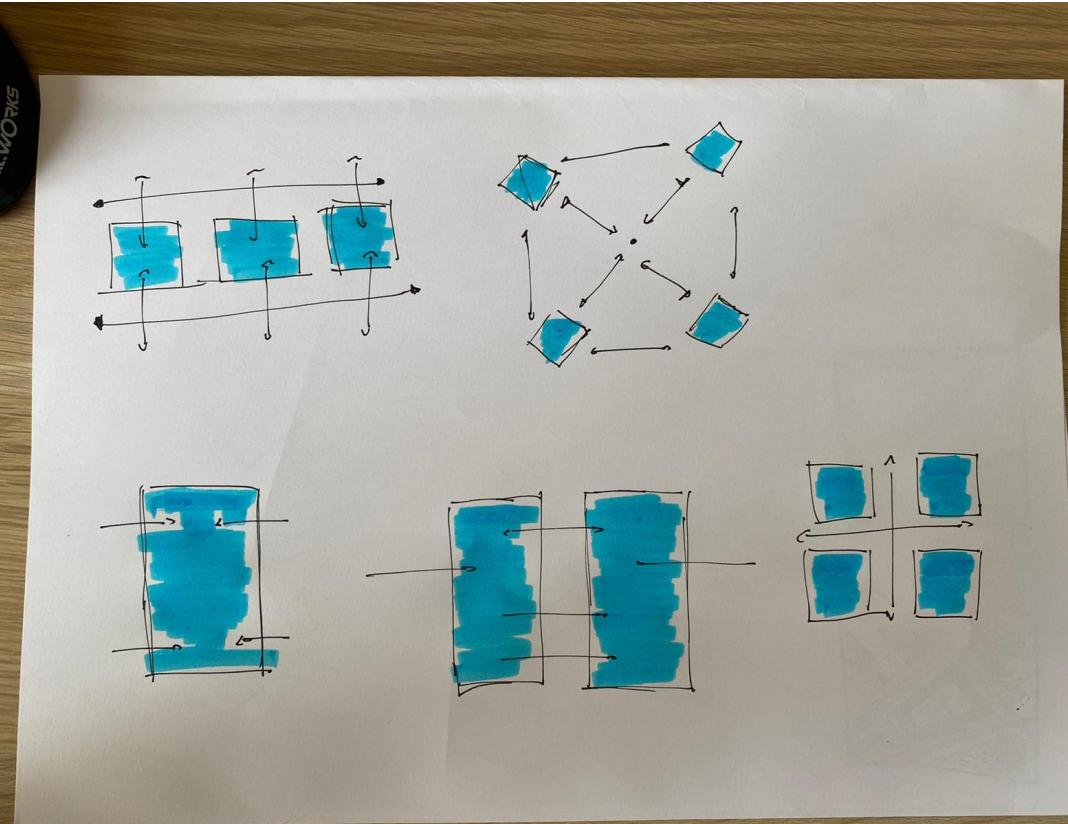
Big or small







LLWOD 11



lack of urban structure

lack of adequate architectural quality (we solve with bricks)/ materials

lack of official employment

lack of infrastructure to apply your school

safety problem

20 words from each one

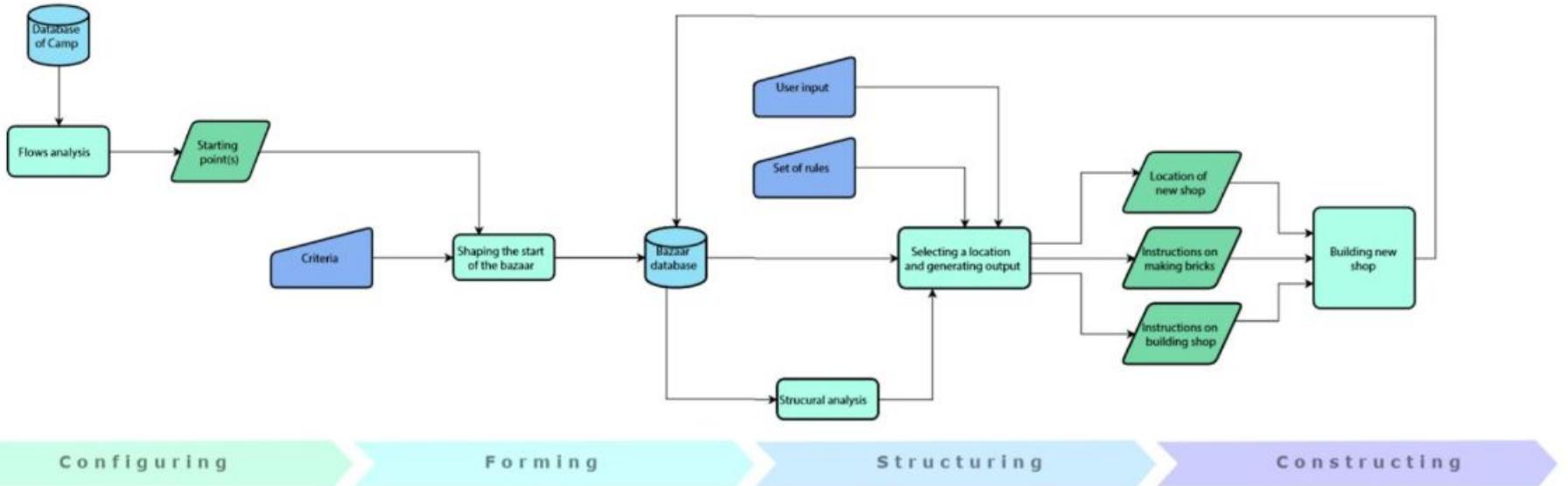


Figure 12: General Flowchart

https://gitlab.com/Pirouz-Nourian/Earthy/-/blob/PreviousStudentWorks/2019-20_Q1/A1_Configuring/Group_2/Week_1_Group2_Assignment1_config.pdf

HYBRID BAZAAR Program

Sl.no	Activities	Space	Area per unit	Height	Volume	Number of units
1	Commercial/Retail	Fully covered, semi covered spaces	16	3	48	
	Brick making				0	
2	Training	Enclosed spaces	16	3	48	
3	Hands-on learning	Large workshops	32	4.5	144	
8	Brick Fabrication workshops	Large workshops		4.5	0	
4	Material Handling	Open space	64	6	384	
5	Storage	Storage racks	64	6	384	
	Additional Functions				0	
6	Pedestrian circulation	Shaded passages	1	-		
7	Vehicular circulation	Open/Shaded spaces	1	-		
10	Social gathering spaces	Shaded spaces with urban furniture?	Ratio	-		
11	Watch tower/water tank tower etc	A interactive lookout space		-		
9	Parking	Shaded spaces	Ratio	-		
12	Sanitation	Toilets		-		

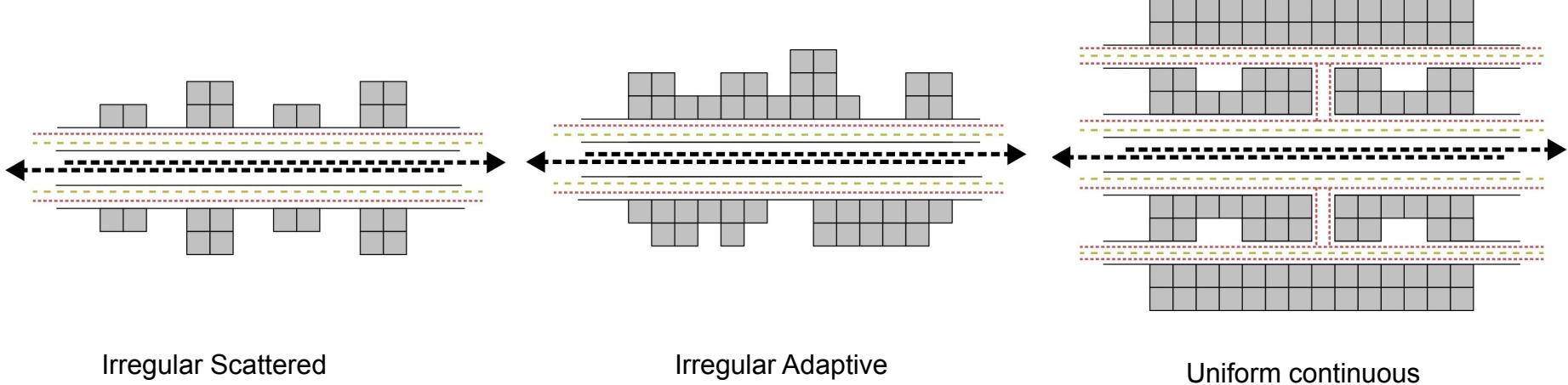
Growth sequence of first node	
1	Training center
2	Workshop/Fabrication lab
3	Factory at the edge of the camp
4	Commercial spaces
5	Social gathering
6	Social services

Growing towards uniformity

Pedestrian paths

Bicycle paths

Vehicular circulation



CONFIGURING

Makers-Bazaar

A system to revitalize the urban infrastructure of the Zaatri Refugee camp

WEEK 1: ASSIGNMENT

Main Design Problems

-Poor Urban planning and infrastructure:

Although the camp has a main grid on which the buildings are distributed, the orientations and alignments of buildings do not seem to follow any rules or standards.

-Lack of architectural quality

The existing buildings are made with cheap and temporary materials which are not robust and do not respond to the extreme climate of the region.

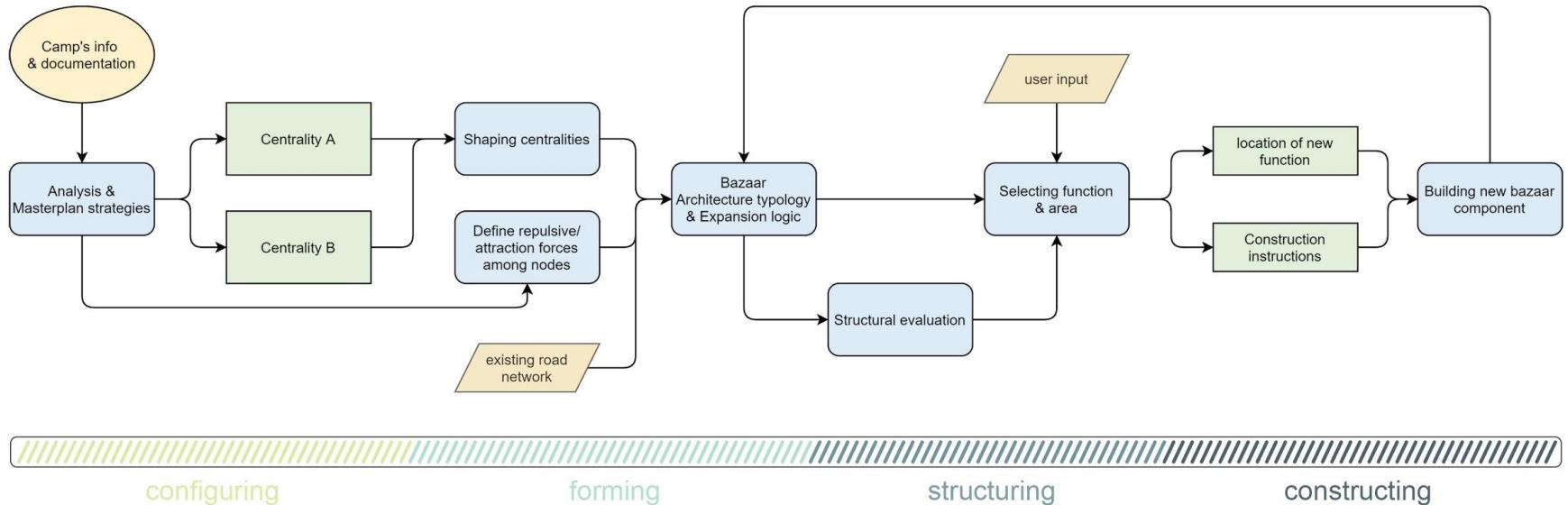
-Economic dependency

Although most of the people in the camp are chivalrous and are self-employed, there is still a dependence of funds from external sources such as the UNHCR or other NGO's which is not sustainable in the long run.

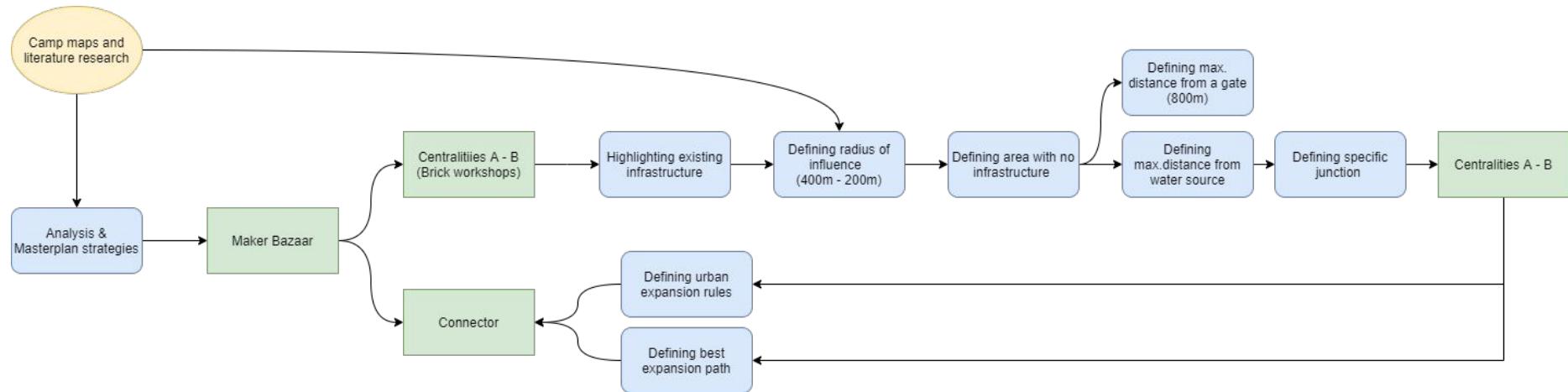
-Unsafe streetscapes and crime

Like most refugee camps, crime rates in the Zaatari camp are high due to large undeveloped patches of land and regions of low activity.

Design Flowchart

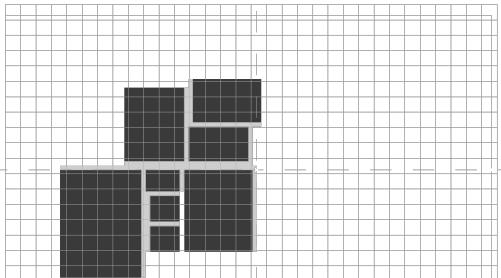
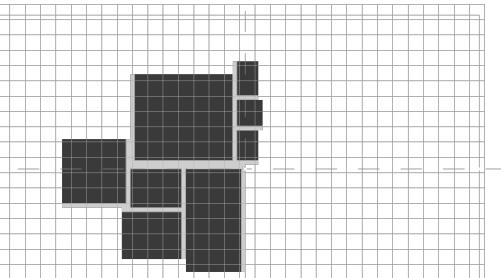
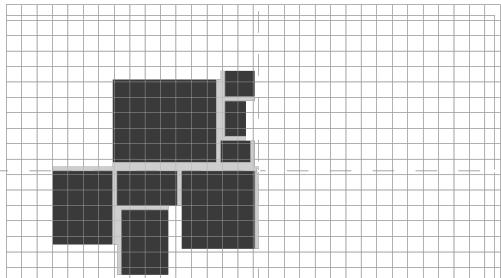
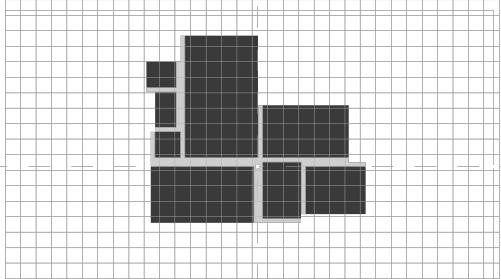
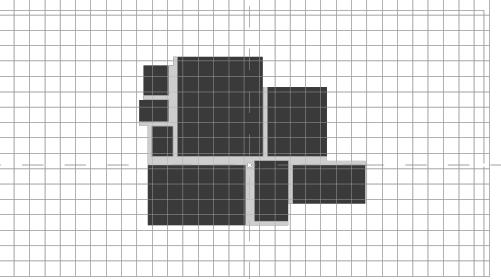
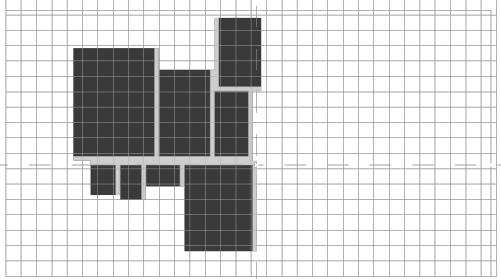
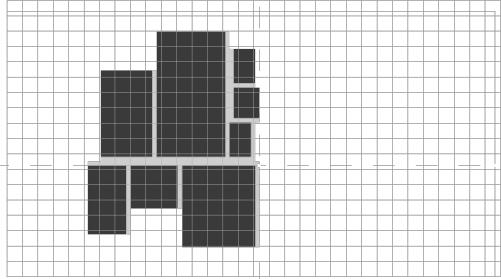
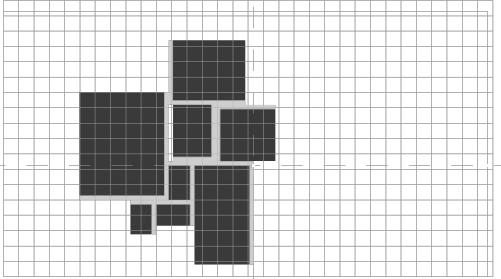
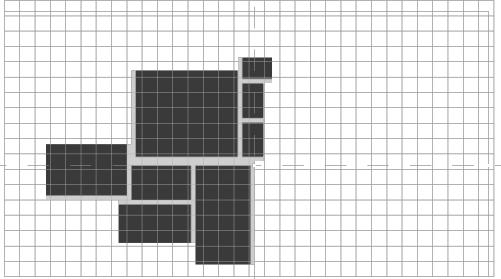


Configuring Flowchart

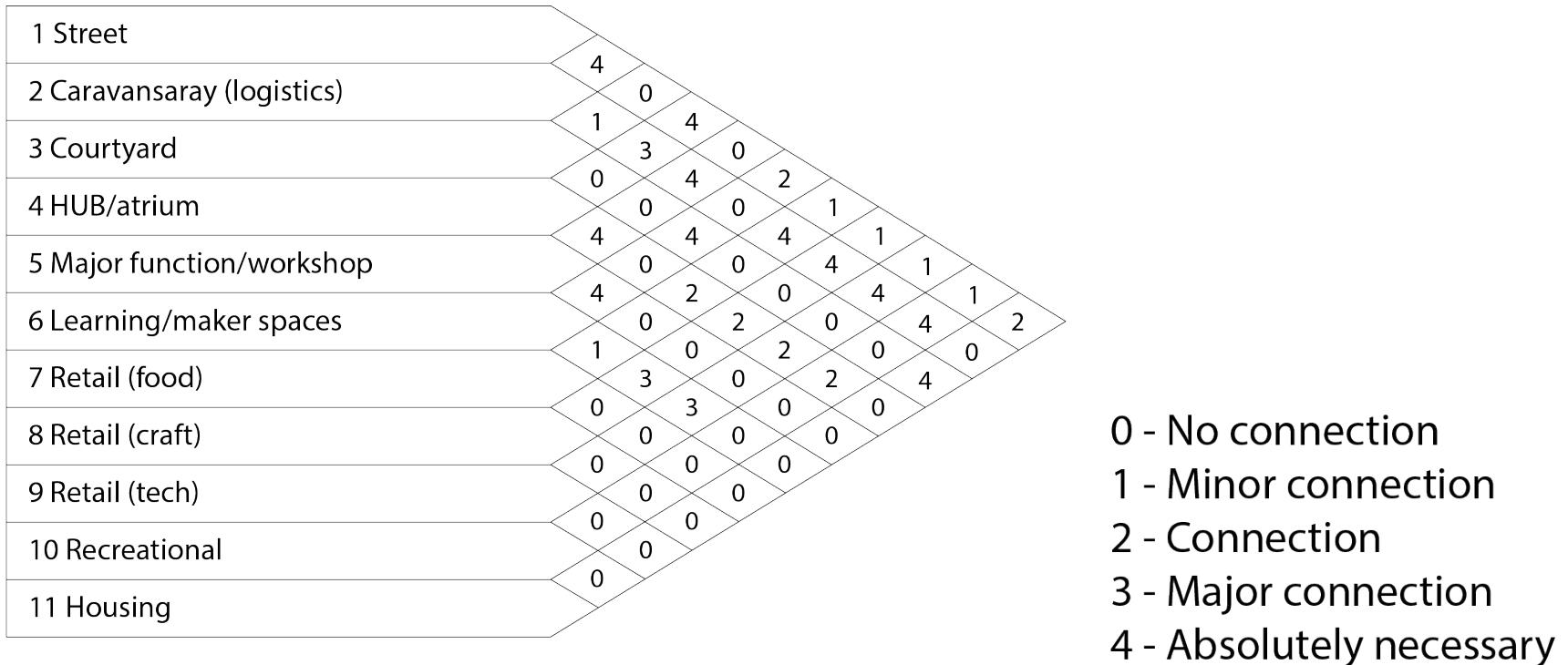


Program of requirements

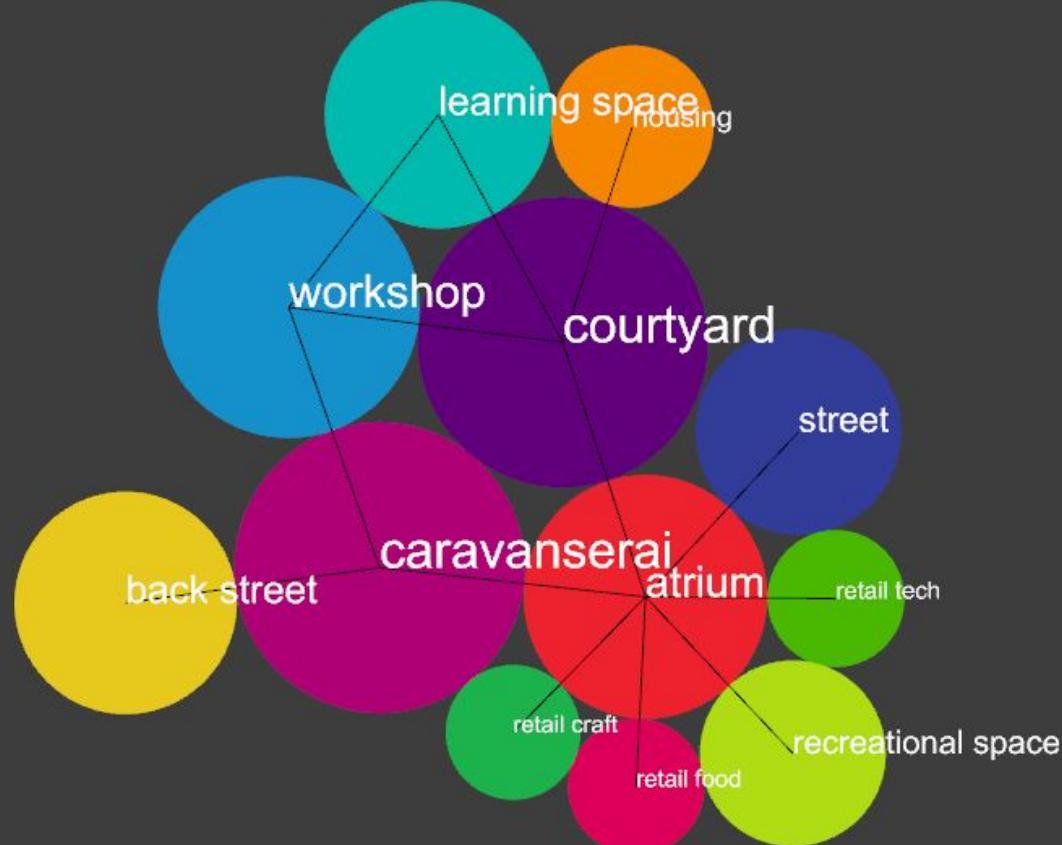
		Area (m2)	Noise (generation)	Definition of space	Open/semi-closed/closed (to sky)	ceiling hight	Day light intensity	Accessibility	Open hours	Main Fonction
Commercial	Food retail	10-14m2	yes	Fixed	closed	2.7m	low	public	During the day	Yes
	Craft	20m2	yes	Fixed	closed	2.7m	low	public	During the day	Yes
	Tech	10m2	yes	Fixed	closed	2.7m	low	public	During the day	Yes
	Recreational	10-40m2	yes	Fixed	closed	2.7m	low	public	During the day	Yes
Logistics	Caravanserai	400m2	yes	Modular	semi-closed	(if roof 5)	high	Private	Always	Yes
	Acces to Road	x	yes	x	open	x	high	Public	During the day	No
	Courtyard	400m2	yes	Modular	closed/semi	(if roof 5)	high	Public	Always	No
	Storage (workshop)	60m2	no	Fixed	closed	2.7m	zero	Private	Never	No
	Storage (shop)	7m2	no	Fixed	closed	2.7m	zero	Private	Never	No
	Hub	100m2	yes	Modular	semi-closed	6-10m	medium	Public	During the day	No
other	Learning space	70m2	no	Modular	closed	3.2m	high	Semi-public	During the day	Yes
	Workshop	150m2	yes	Fixed	semi-closed	4m	high	Semi-public	During the day	Yes



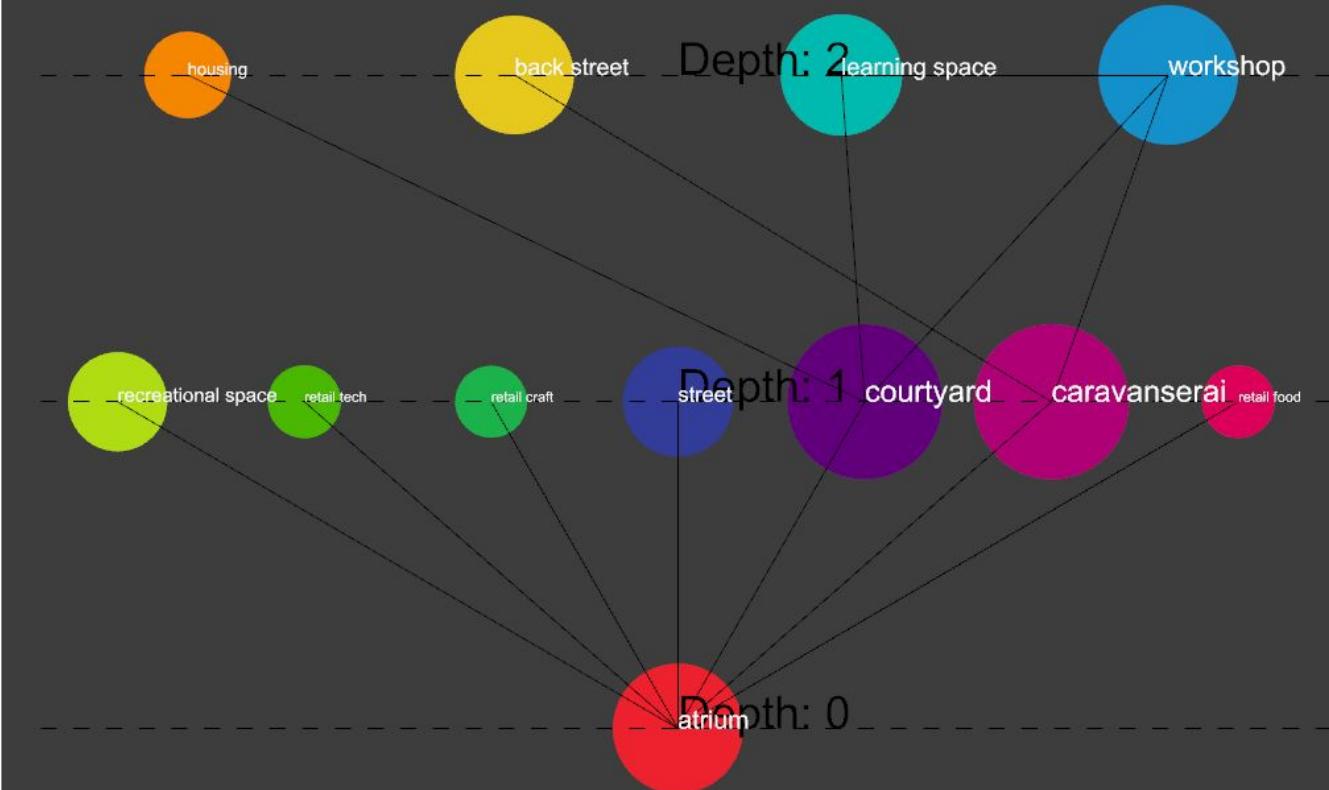
REL CHART



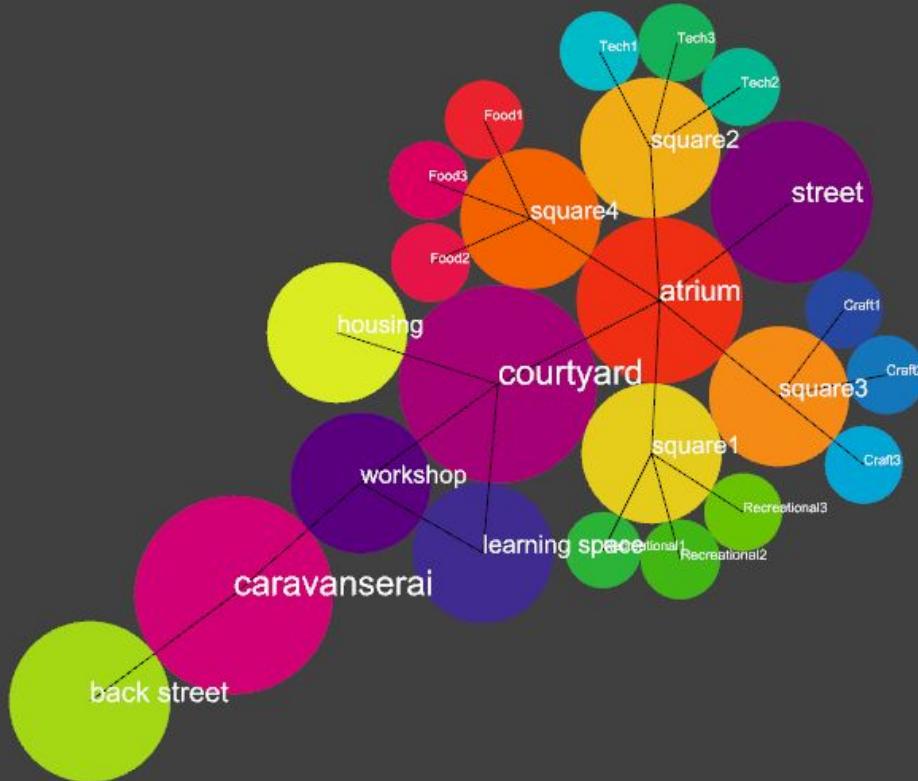
Schematic bubble diagram based on the connections determined through the REL chart.

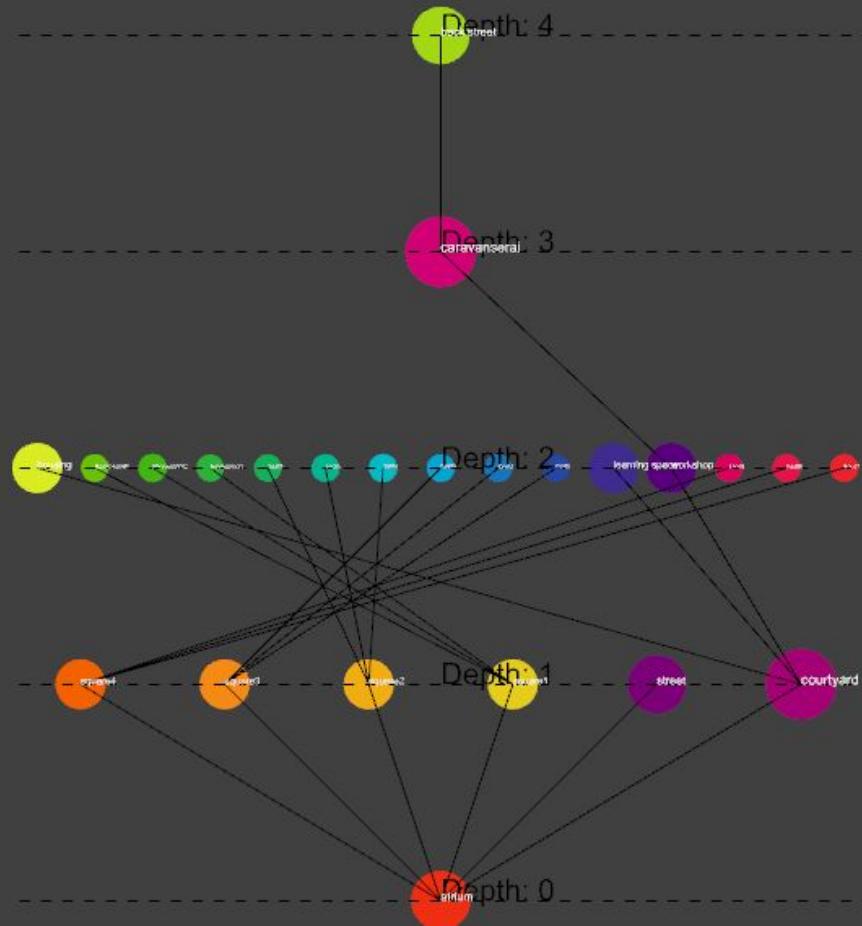


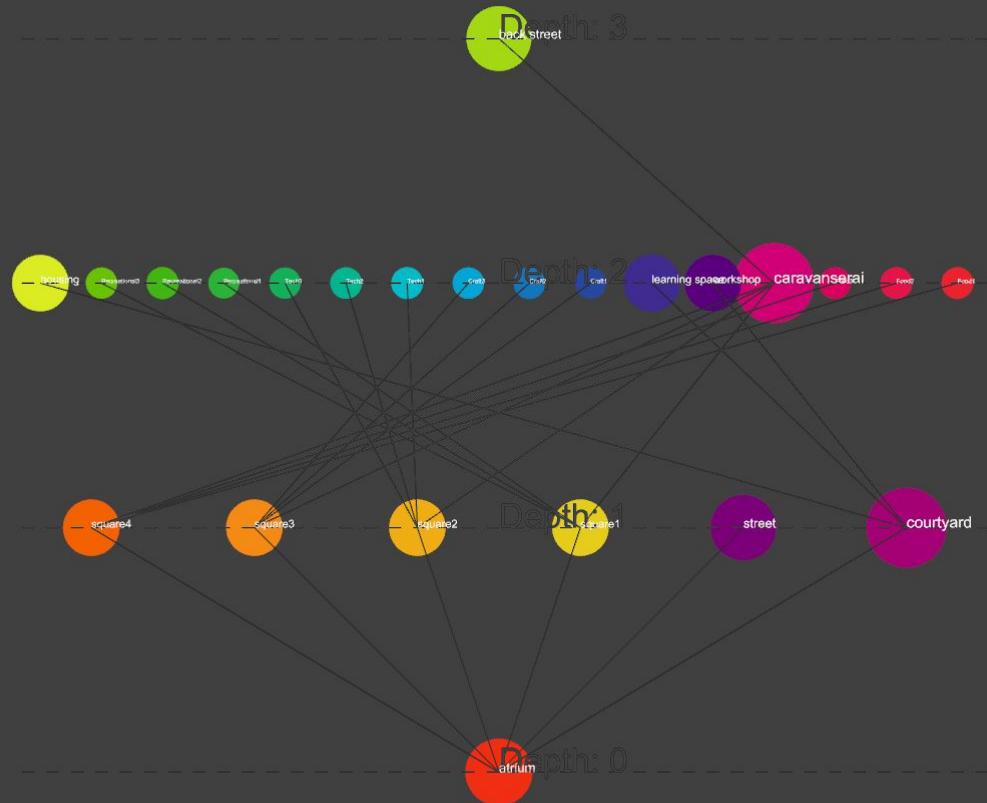
Justified bubble diagram based on the data and relations of the REL chart.



More detailed bubble diagram. Relation between retail and caravanserai is missing.







Justified final diagram.
Caravanserai is
connected also to the
retail spaces.

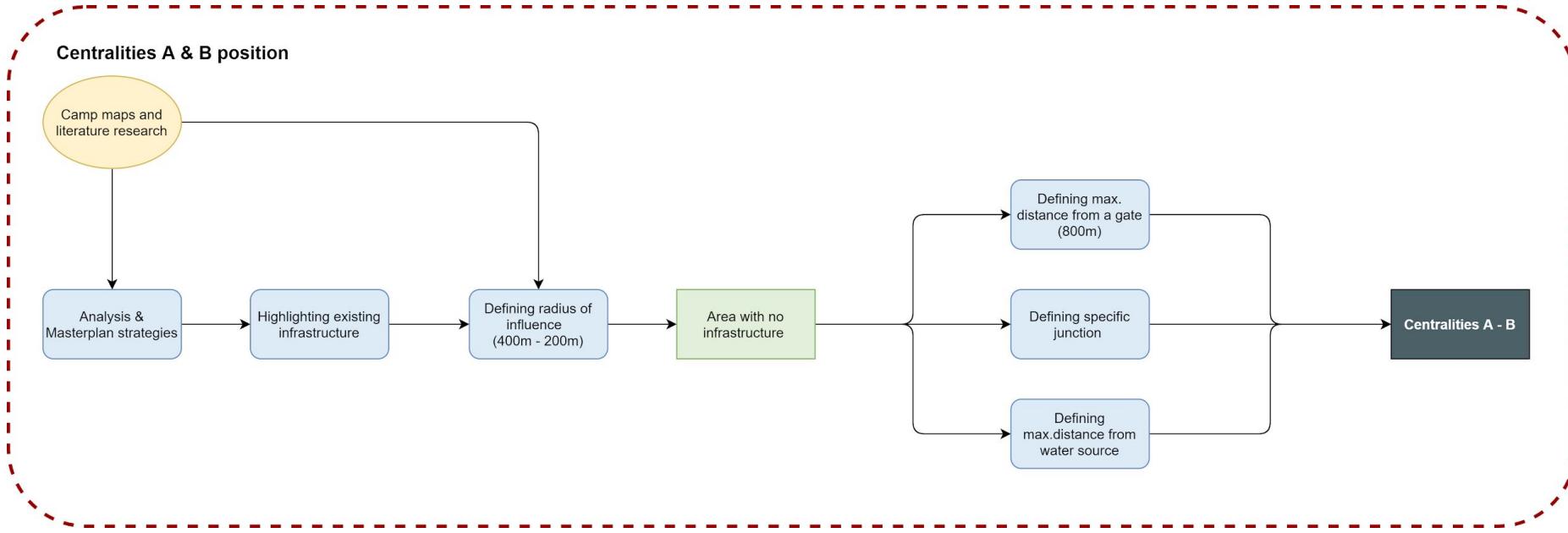
SHAPING

Makers-Bazaar

A system to revitalize the urban infrastructure of the Zaatri Refugee camp

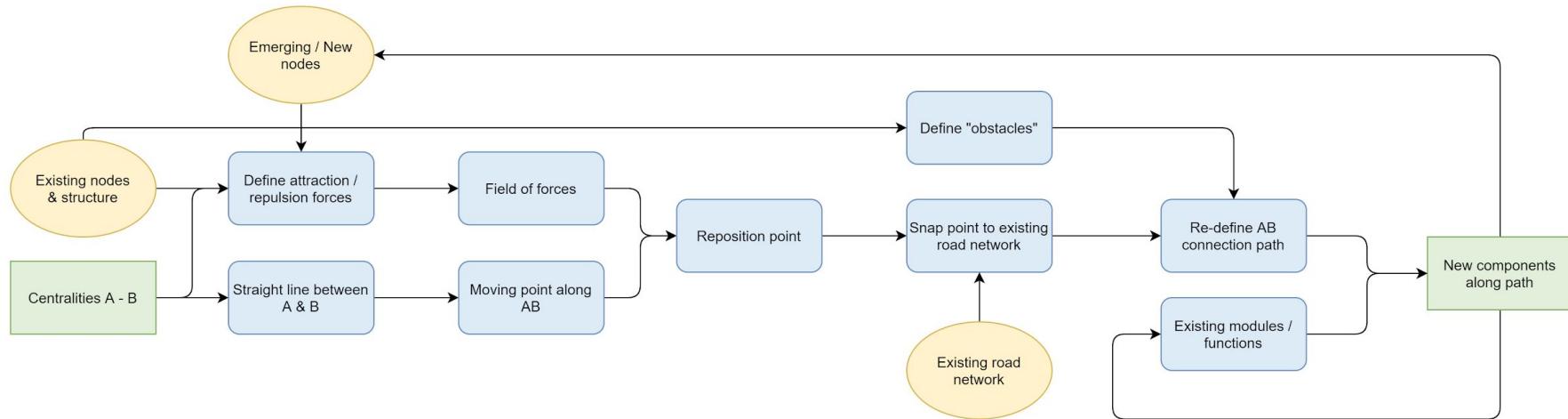
WEEK 2

Centralities position



Expansion strategy

Expansion strategy



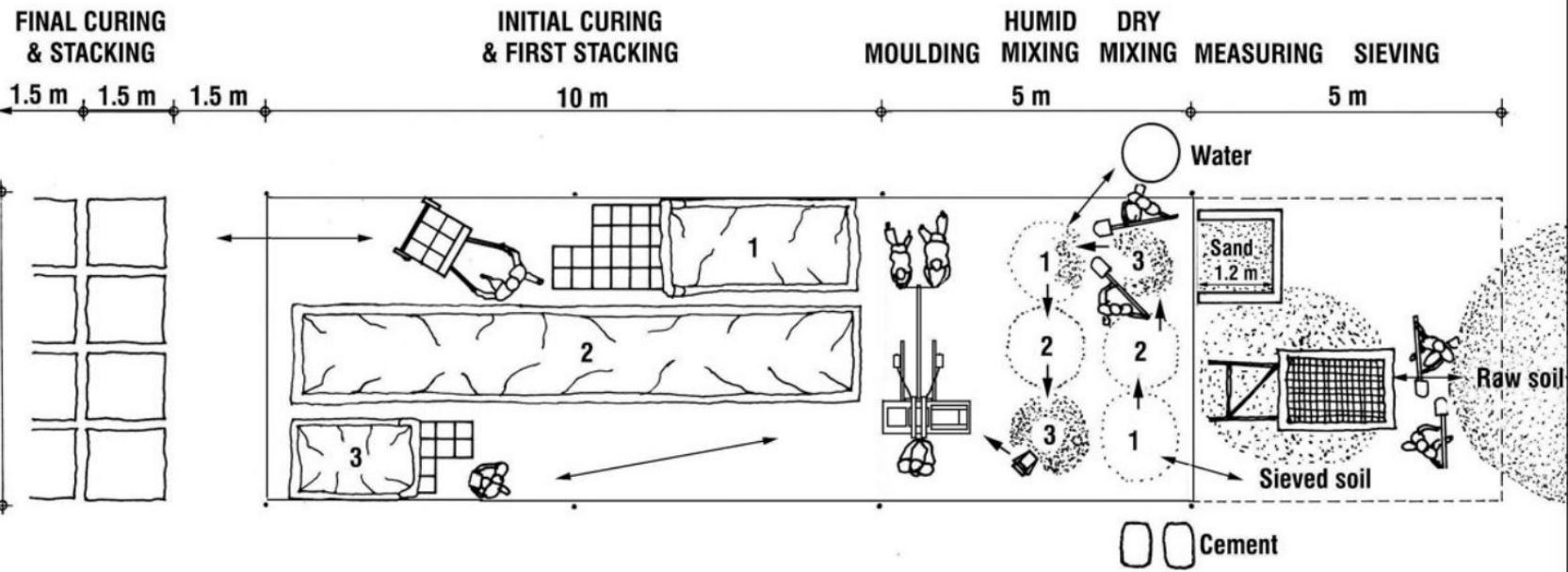
Brick specs

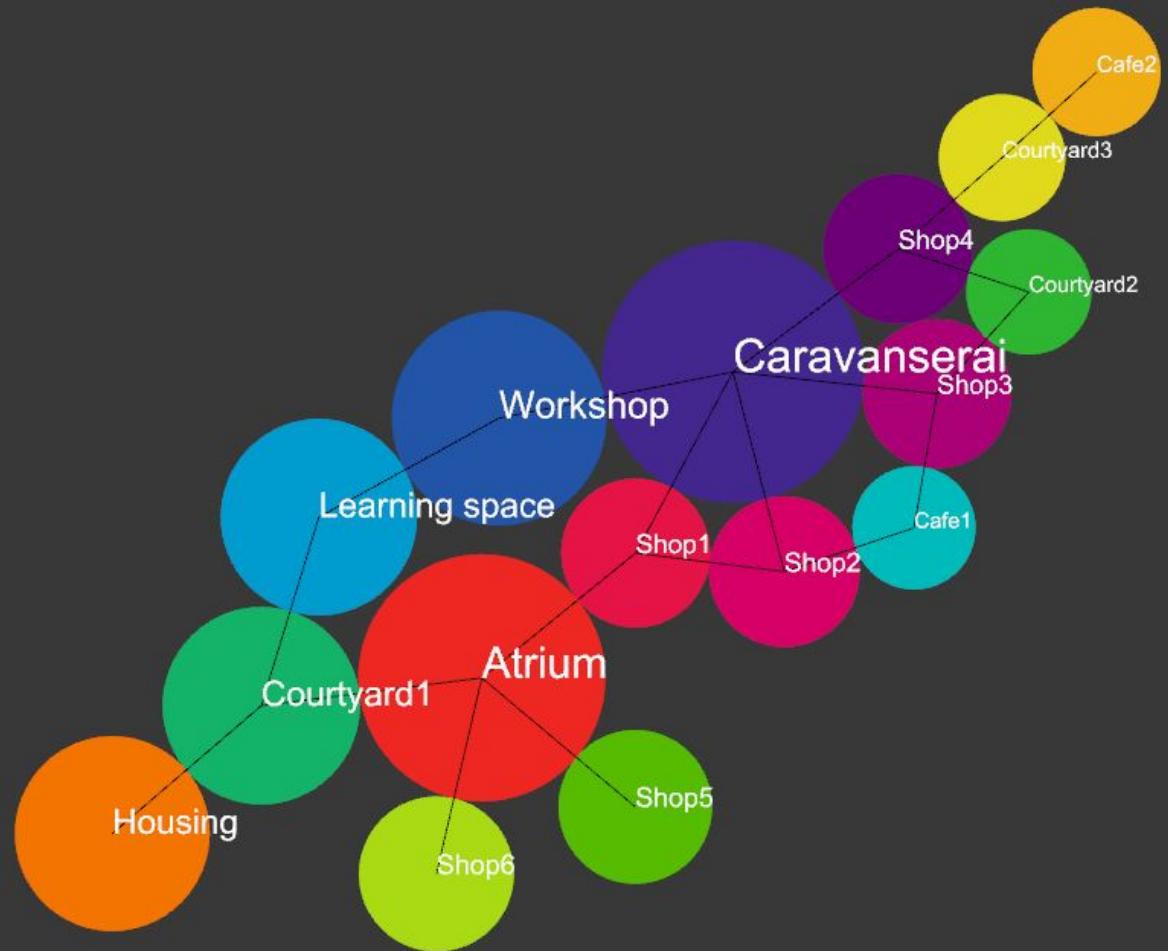
Sl no	Item	Units	Amount
1	Number of houses	nos	14166.66667
2	Number of bricks per house	nos	15000
3	Total Number of bricks required	nos	212500000
4	Number of bricks by machine/day	nos	850
5	Number of bricks per year	nos	310250
6	Number of machines for 5 years	nos/5 years	136.9863014
7	Size of one machine	Size	1.85X1.6X1.85
8	Area of one machine(20X5m)	sq.m	100
9	Area required for 136 machines	Sq.m	13698.63014
10	SQRT AREA	Sq.m	117.0411472

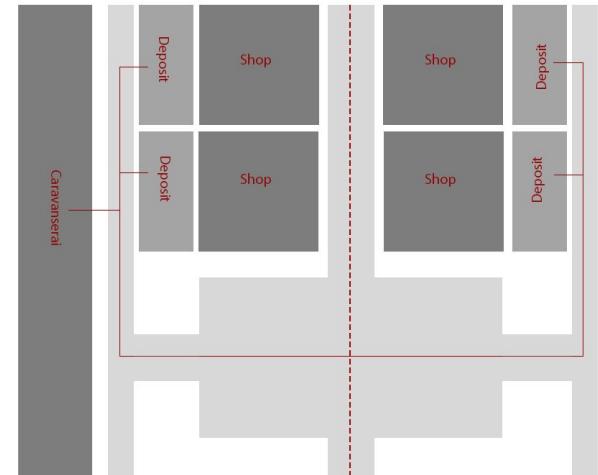
Brick size

Size of brick 1 290X140X190

Size of brick 2 140X115X90

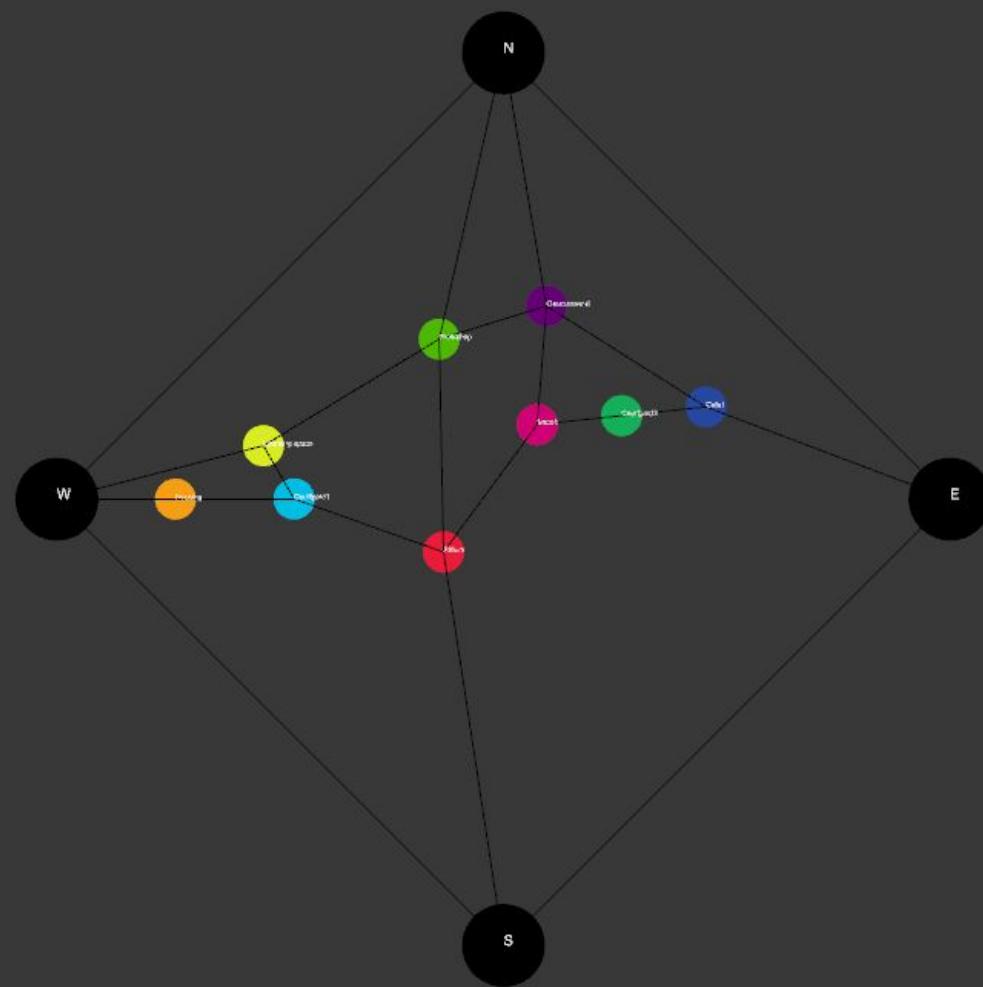






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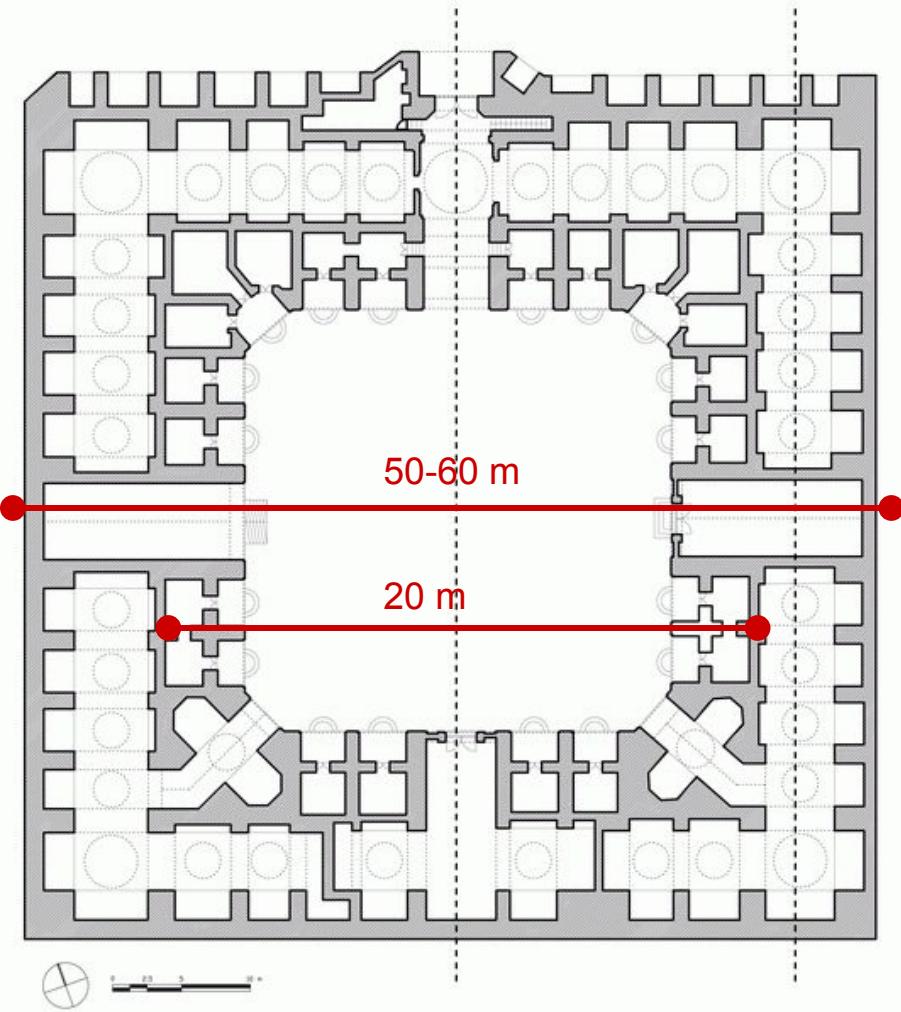
- 0 Atrium
- 1 Shop1
- 2 Caravanserai
- 3 Cafel
- 4 Courtyard1
- 5 Courtyard2
- 6 Workshop
- 7 Learning space
- 8 Housing





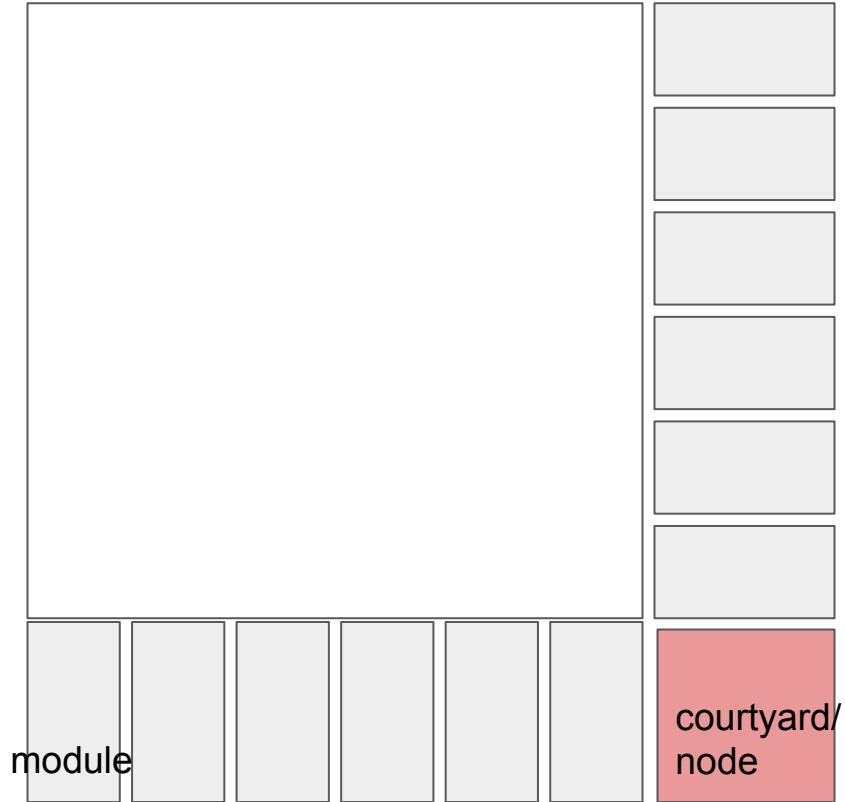


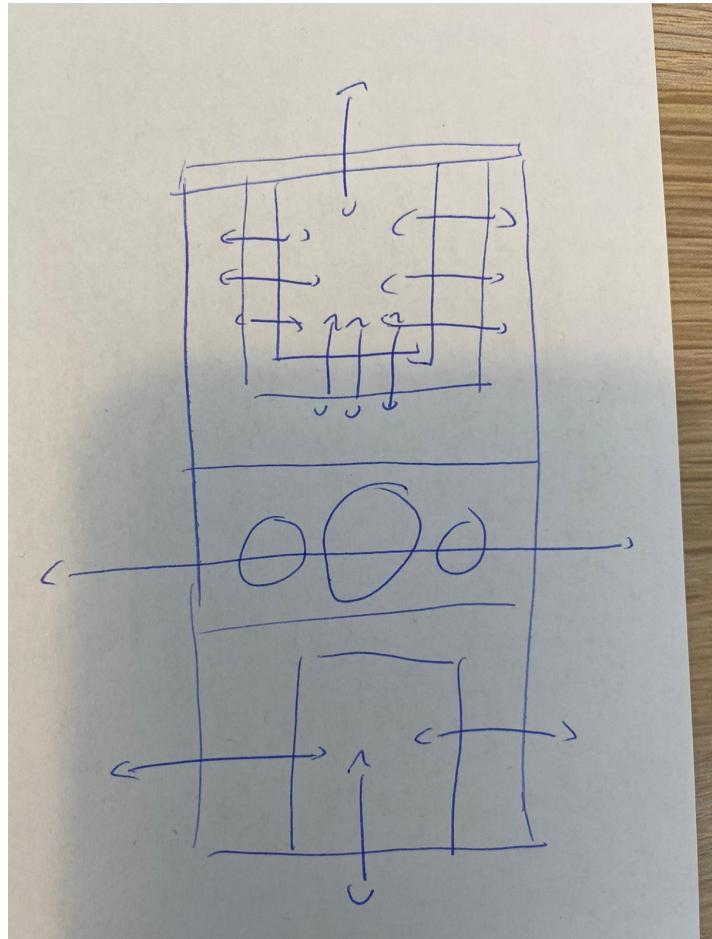
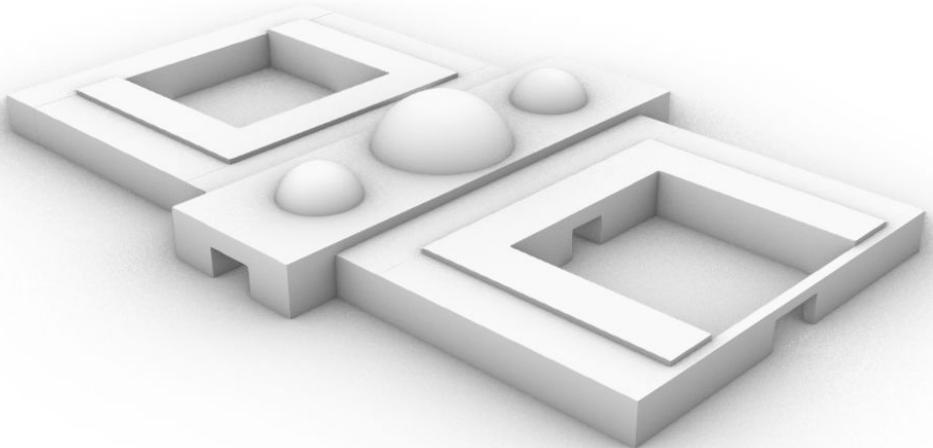


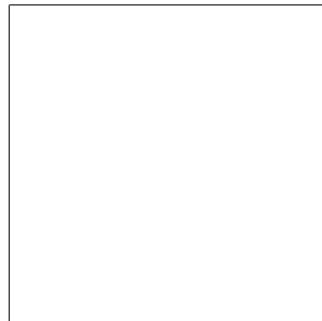
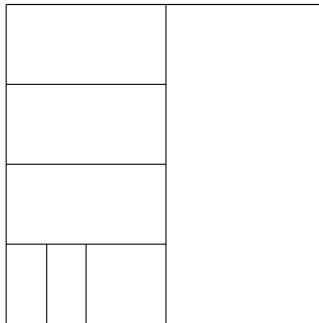


400 m = 5 minutes radius

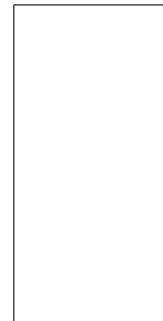
100 m = 1 minute radius (100 m between 2 landmarks seems too much)







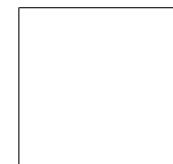
400 m²



200 m²



150 m²



100 m²

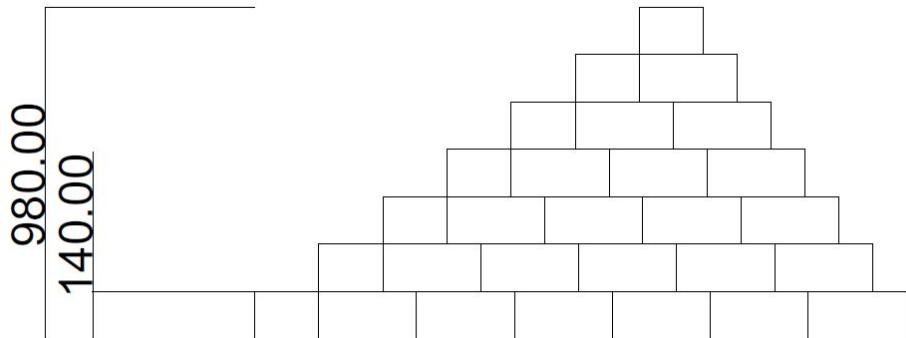
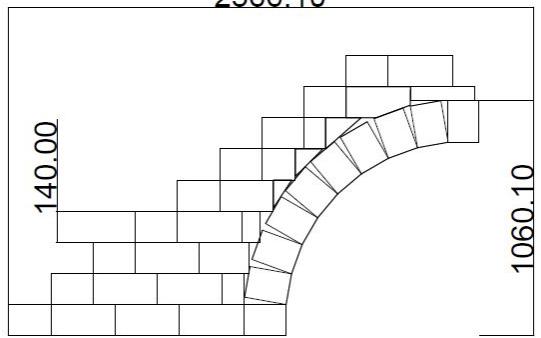


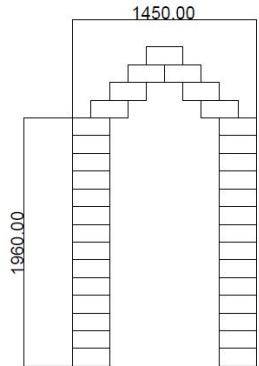
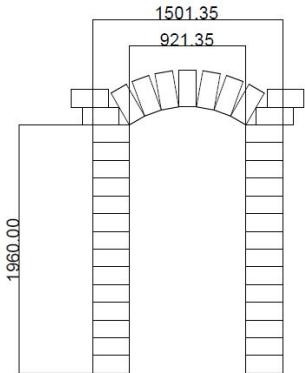
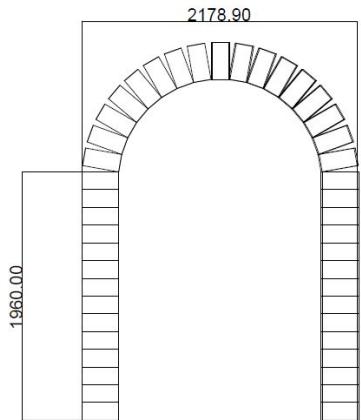
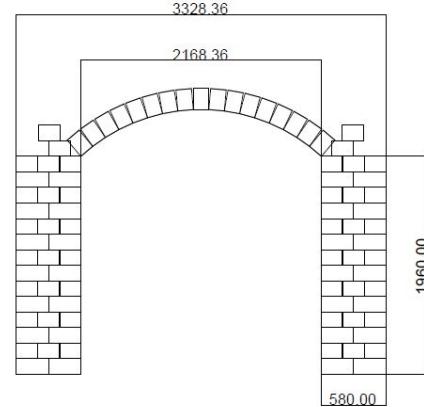
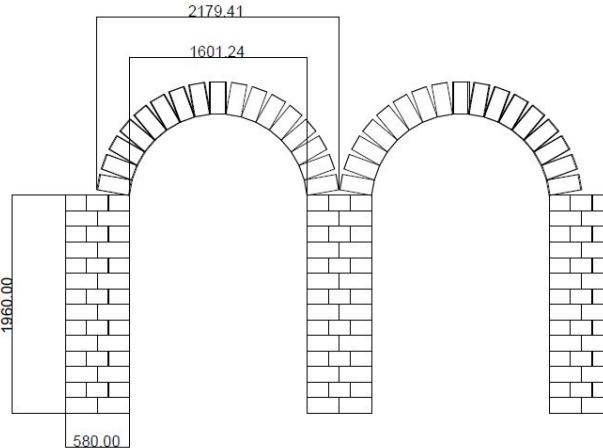
50 m²



25 m²

12.5 m²







Shops



Atrium



Workspace

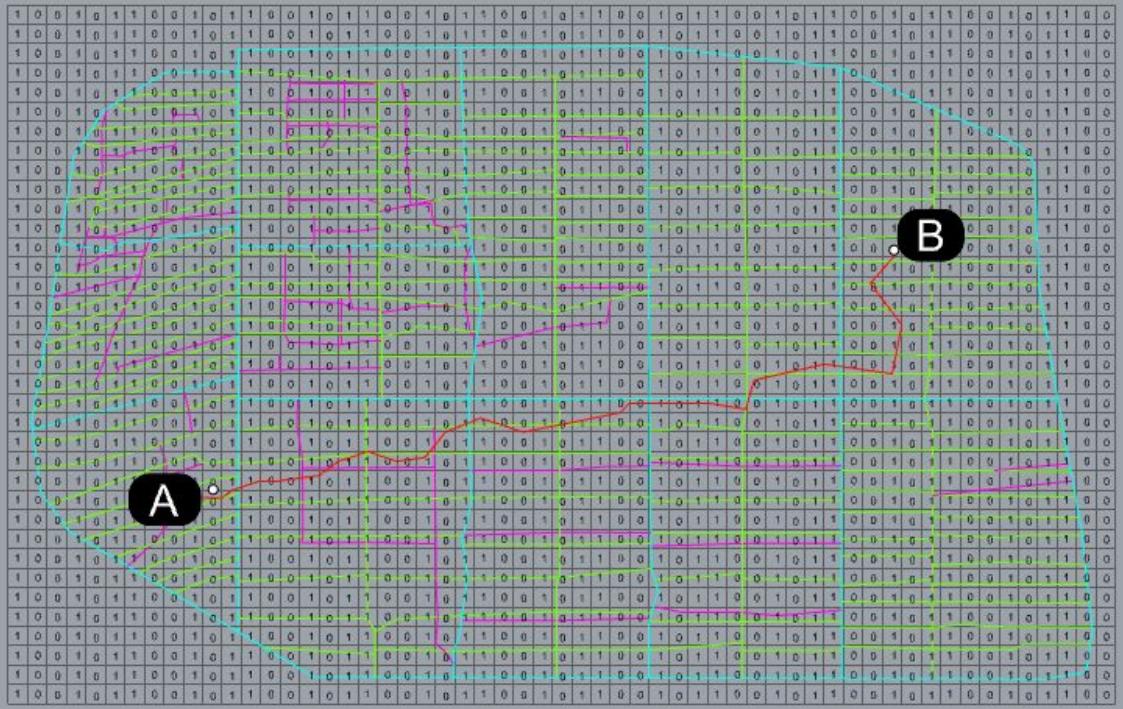


Brick factory

Grid Example

Urban Level

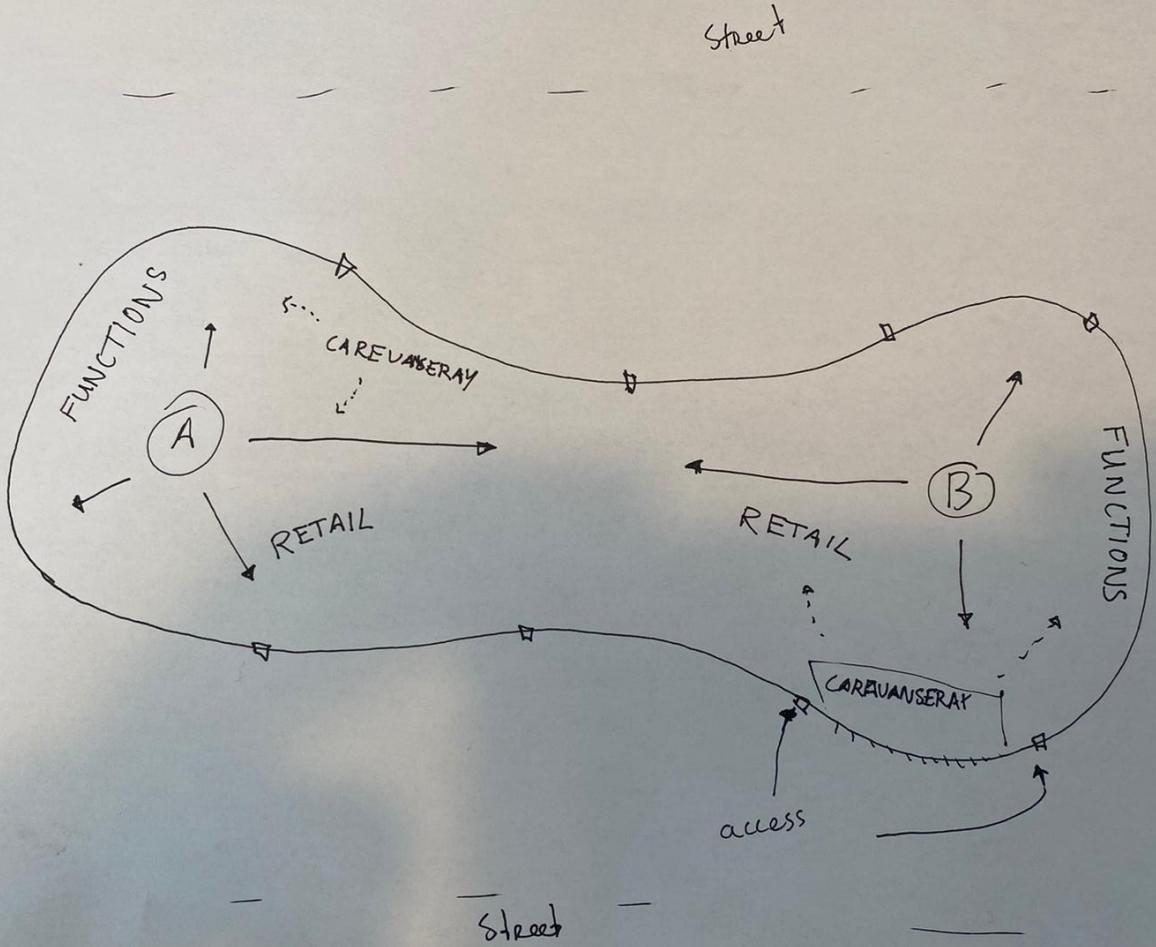
500mx500m

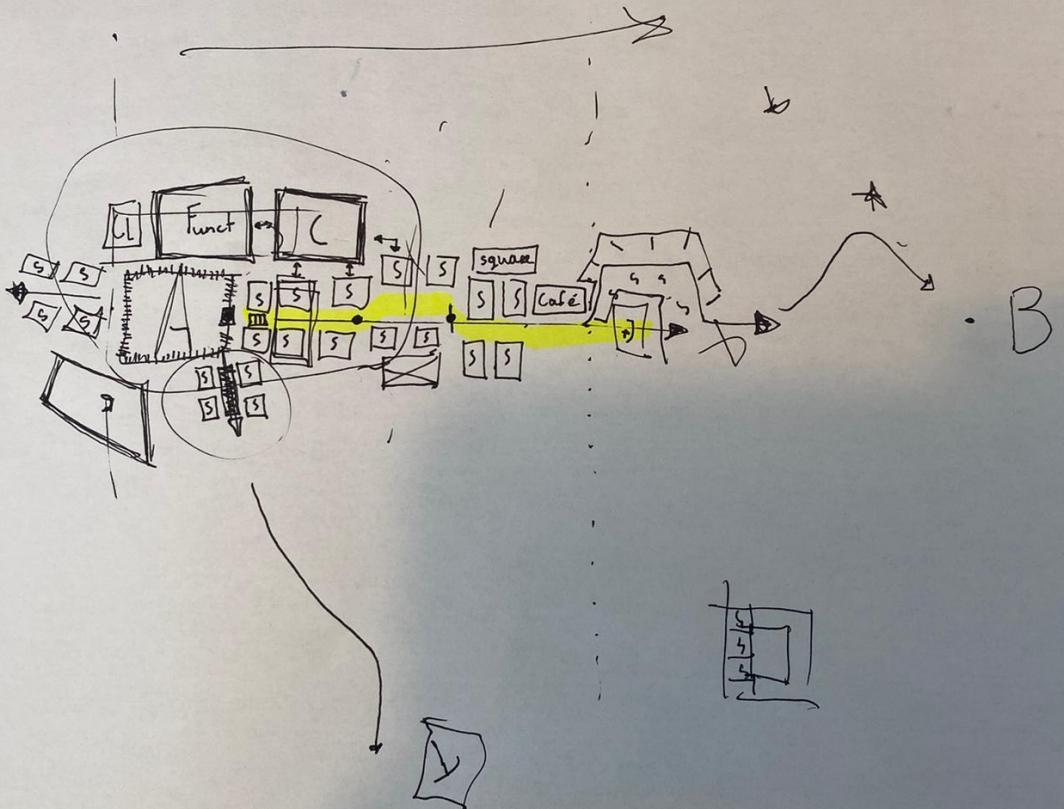




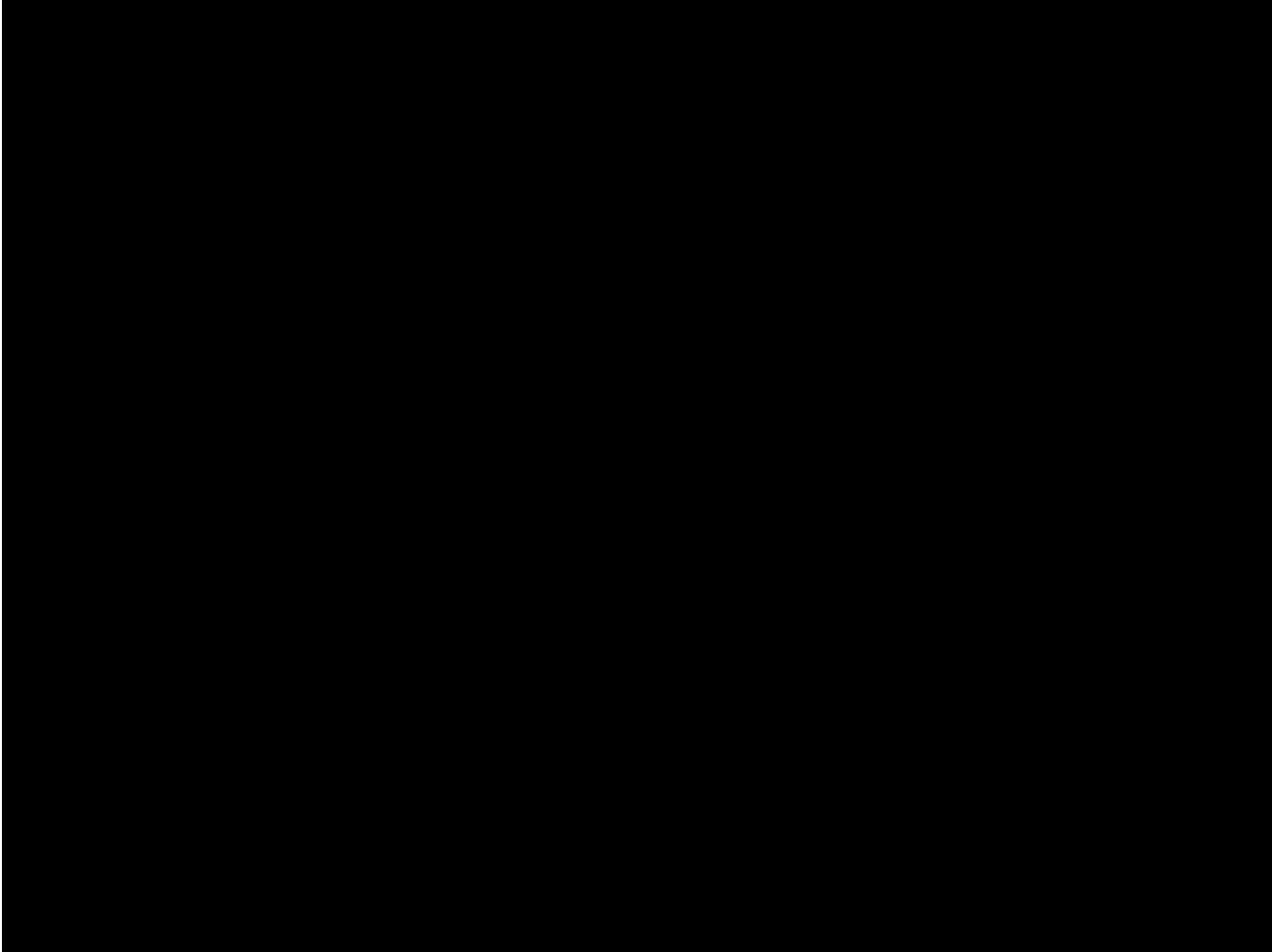
Building categorization

- Based on size?
- Based on age?
- Based on permanency ?



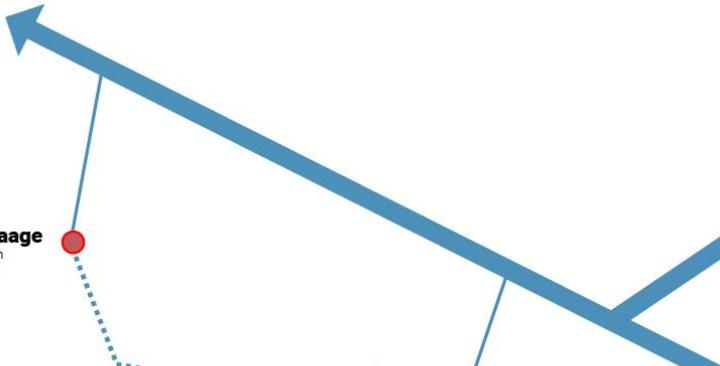


Video dvIpt



Towards Umm El-Jamal

Motorized 7.89km



Zaatari Villaage

Pedestrian - 4.8km
Motorized 5.73km



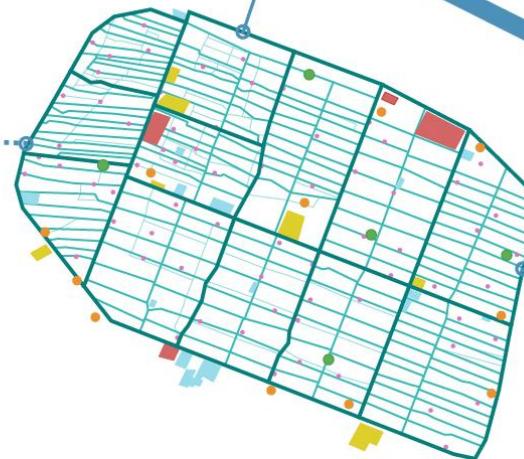
Towards Umm El-Jamal

Motorized 7.89km



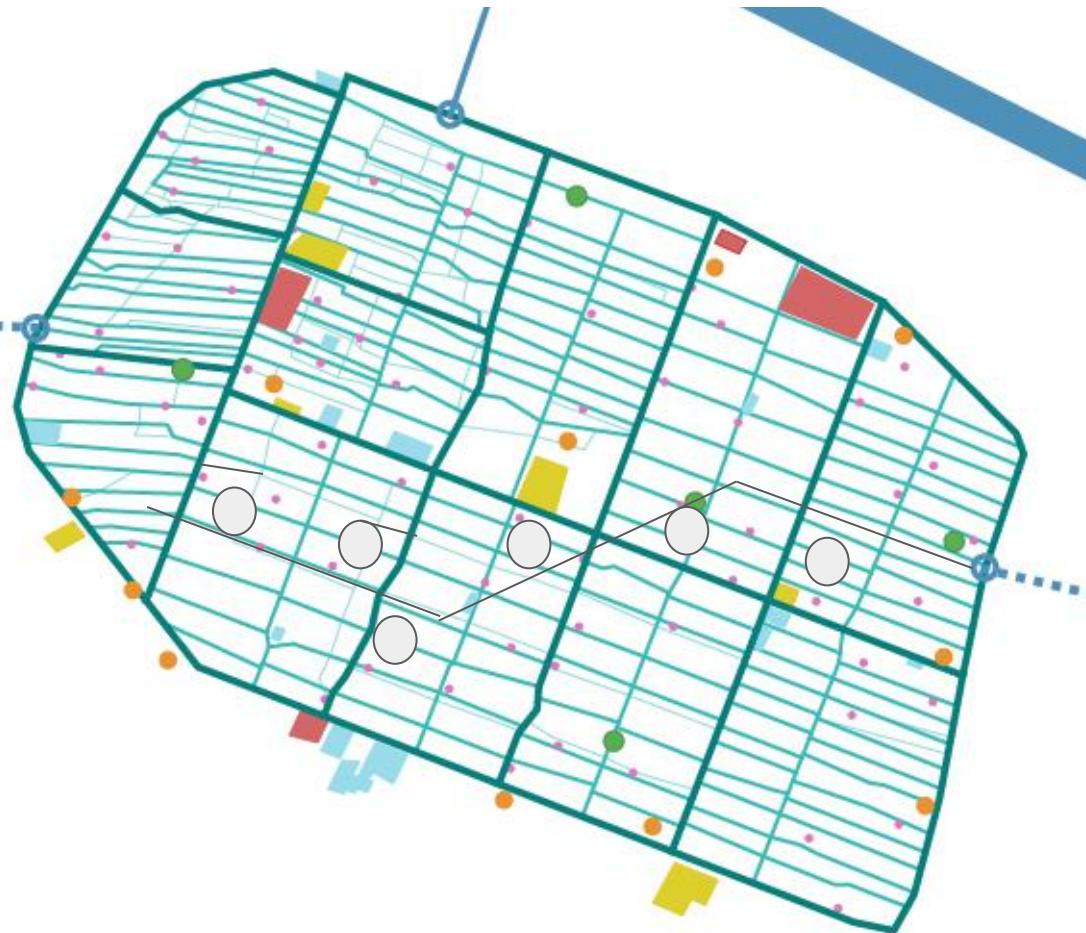
Towards Salheyah, Sabha and Others

Motorized 7.89km



LEGEND

- | | |
|--------------------|------------------------------|
| ● Schools | — Motorized connection |
| ● Mosques | ··· Pedestrian connection |
| ● Recreation | — Vehicular Traffic |
| ● Distribution | — Pedestrian/Bicycle traffic |
| ● Youth Centers | — Informal roads |
| ● New-Centralities | — New-Centralities |



LEGEND

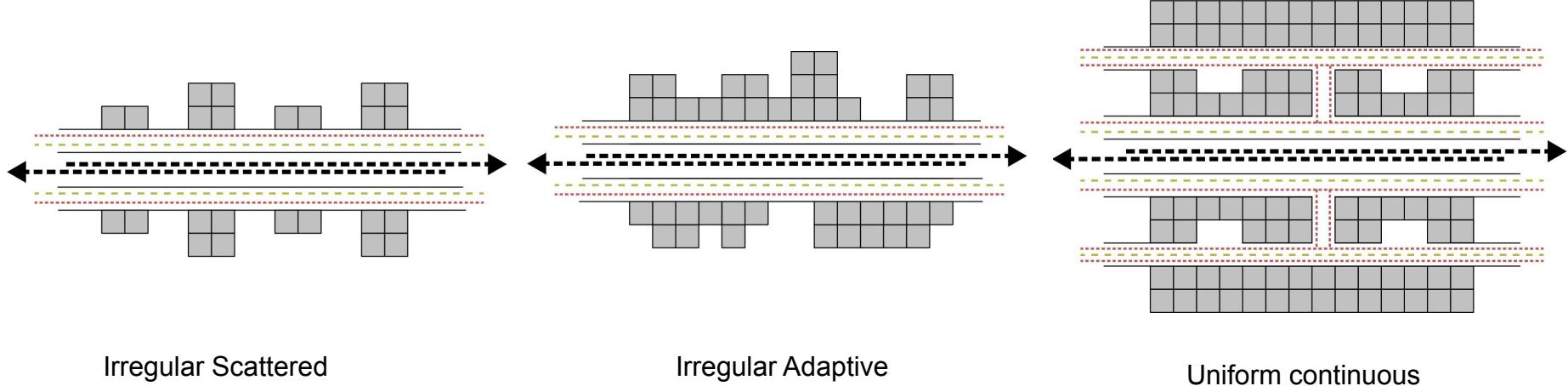
- | | |
|--------------------|------------------------------|
| ● Schools | — Motorized connection |
| ● Mosques | ··· Pedestrian connection |
| ● Recration | — Vehicular Traffic |
| ● Distribution | — Pedestrian/Bicycle traffic |
| ● Youth Centers | — Informal roads |
| ● New-Centralities | |

Growing towards uniformity

Pedestrian paths

Bicycle paths

Vehicular circulation

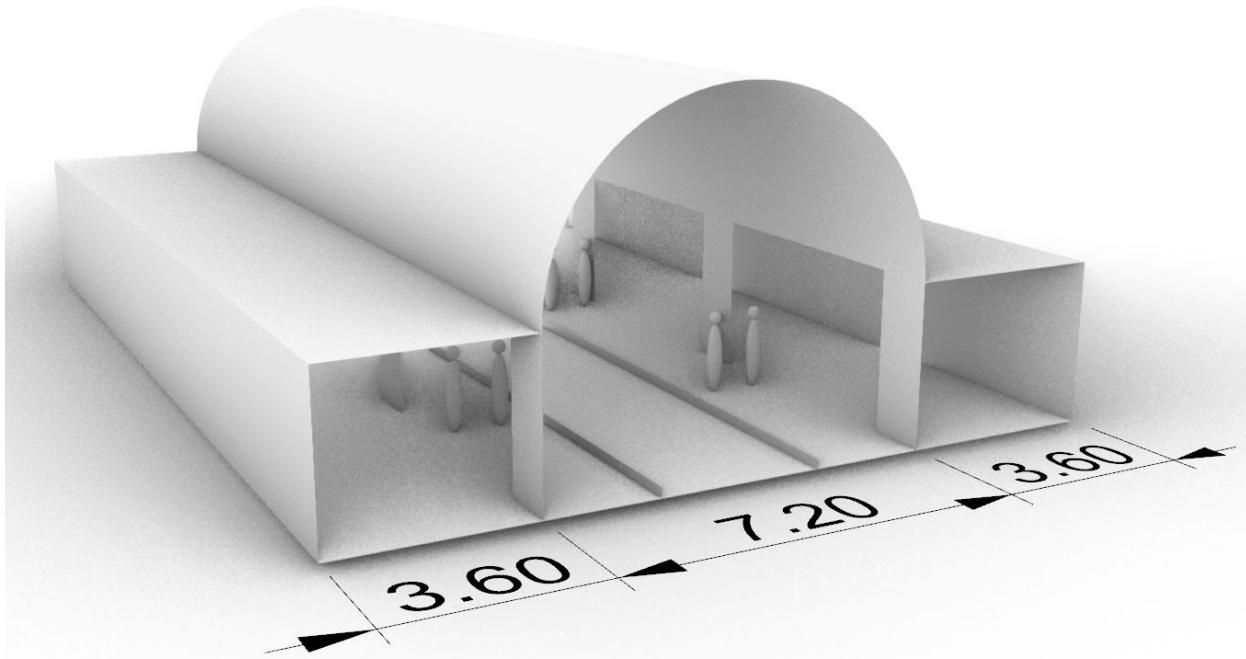
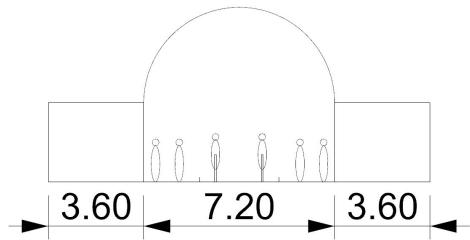


Irregular Scattered

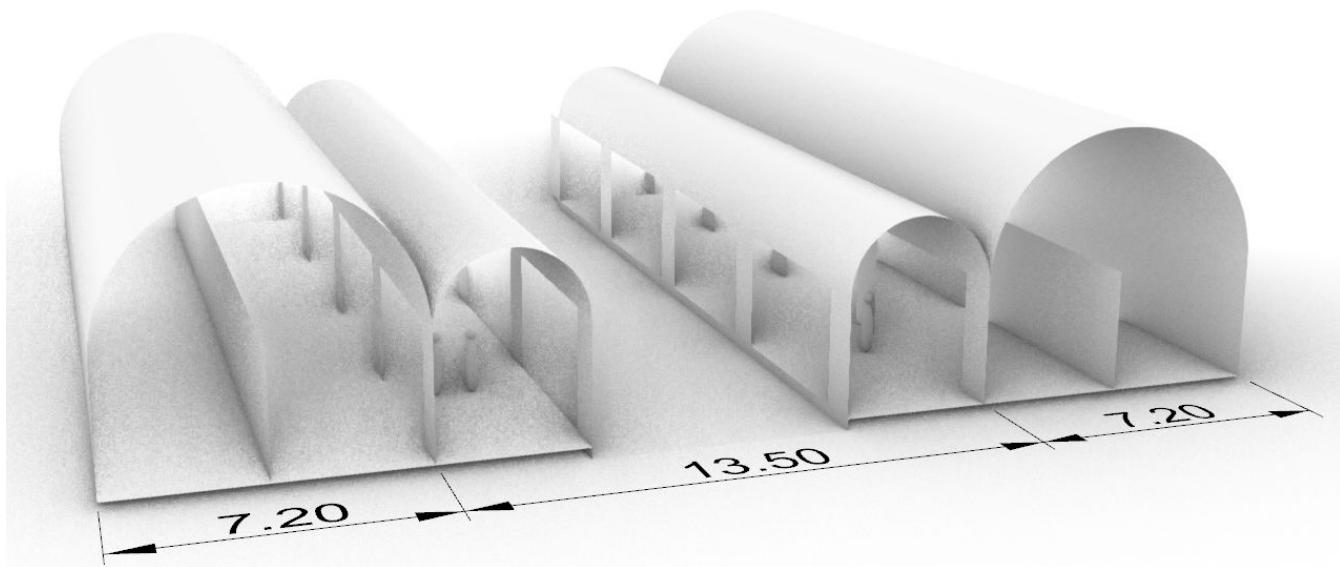
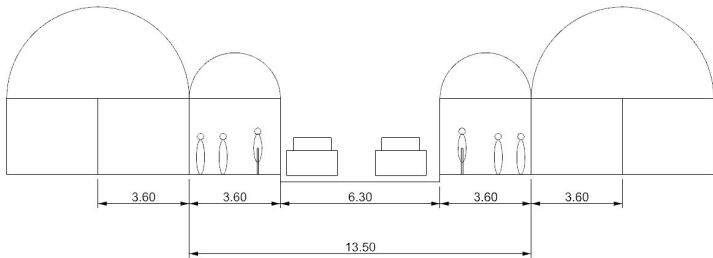
Irregular Adaptive

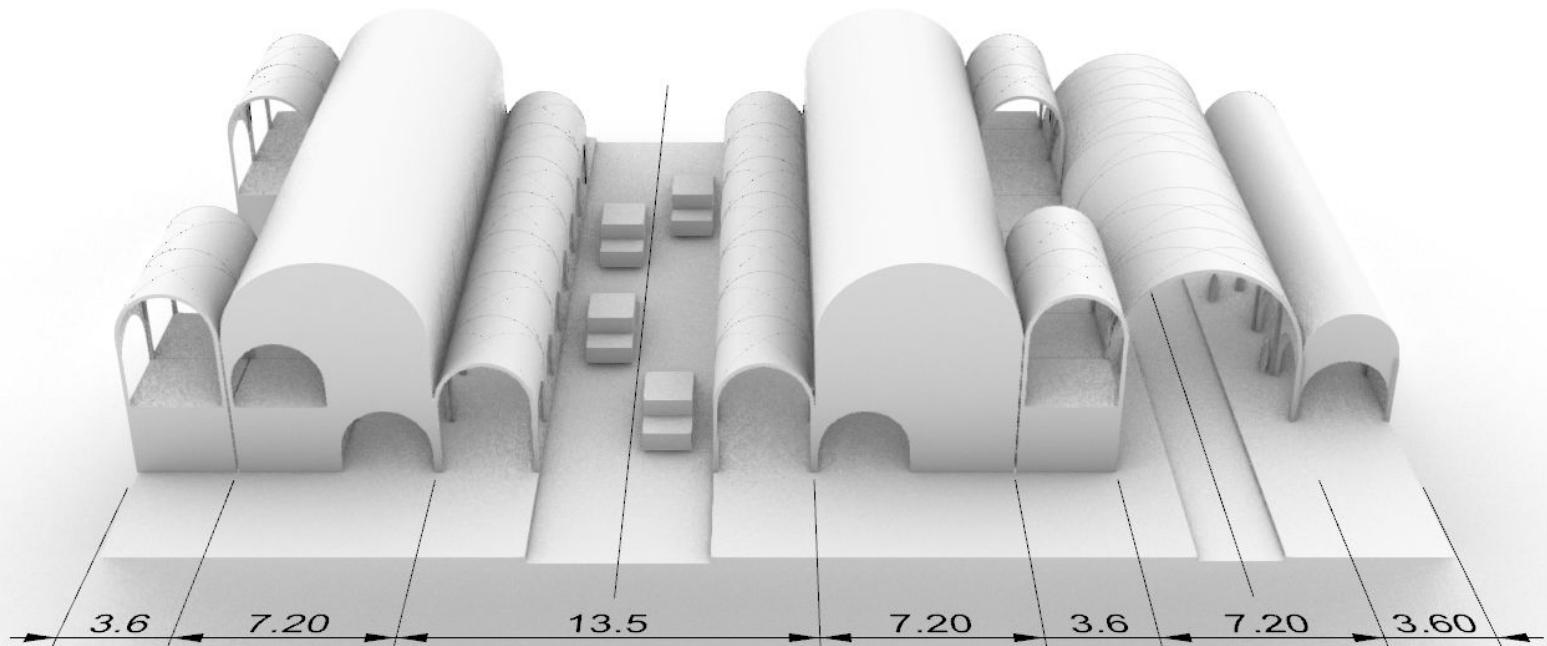
Uniform continuous

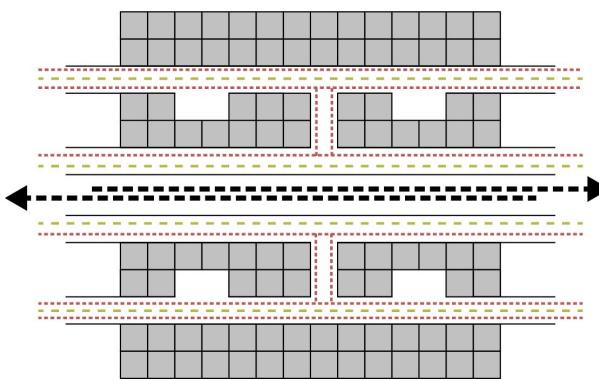
Pedestrian Bazaar (secondary roads)



Vehicular Bazaar (Primary roads)







categorizing voxels based on

distance from road

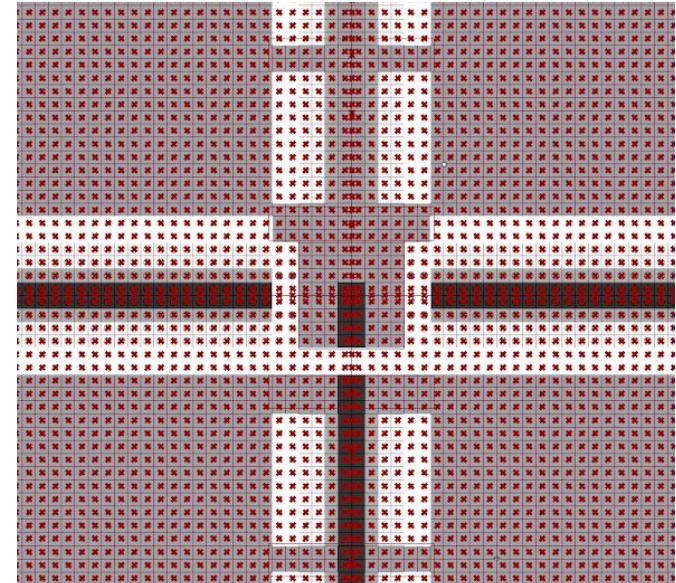
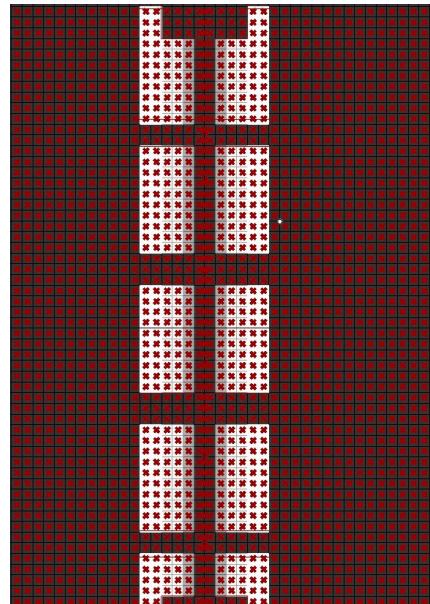
-Buildings

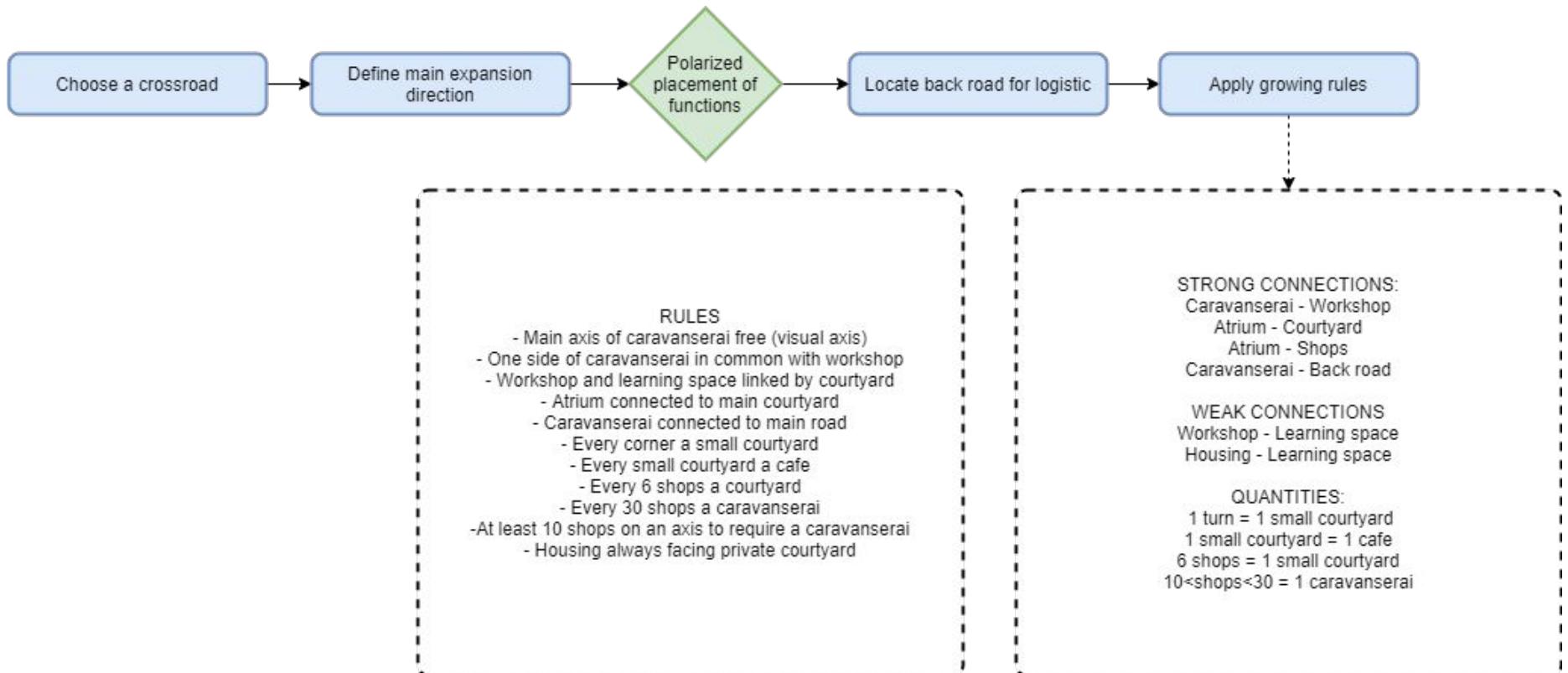
-Road

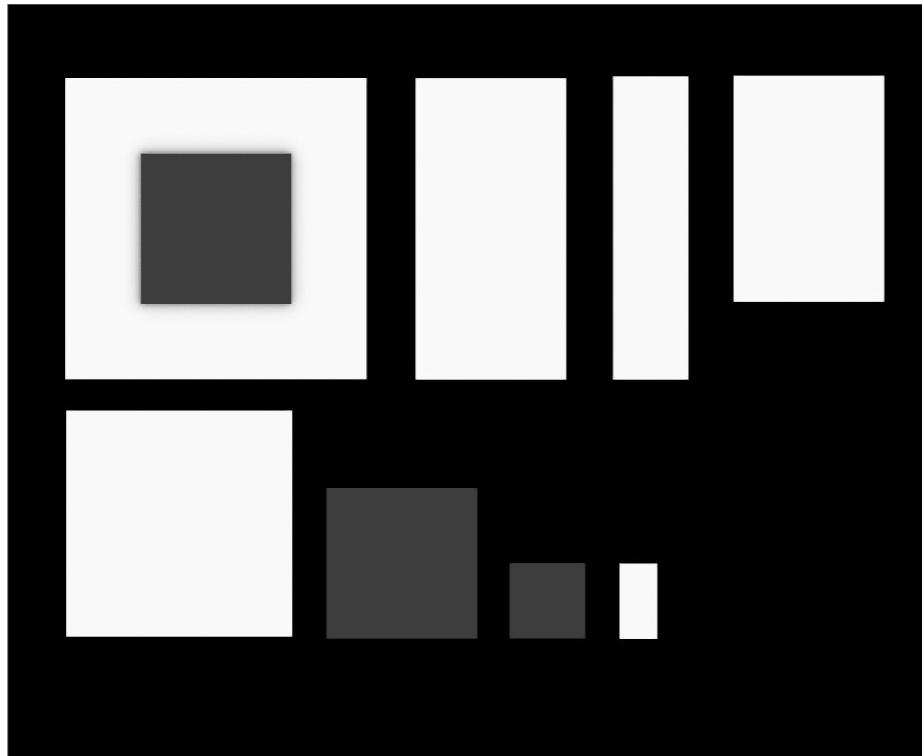
-Footpath

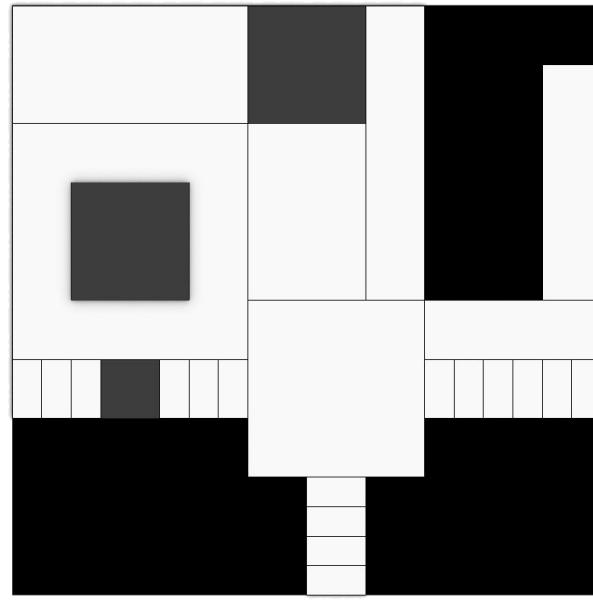
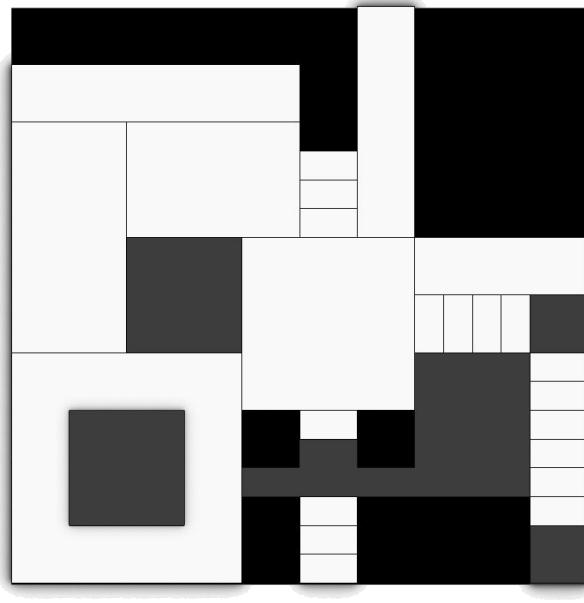
Straight roads

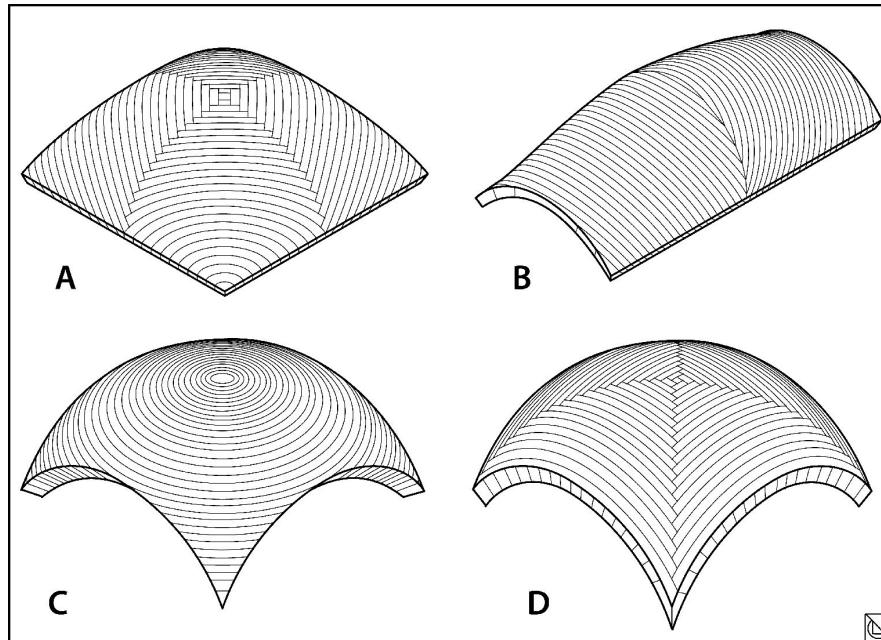
Crossroads











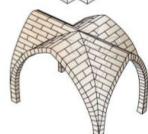
Is this too difficult to build?



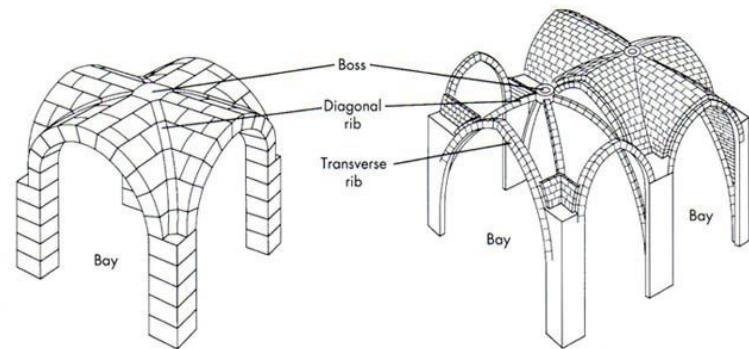
Barrel vault

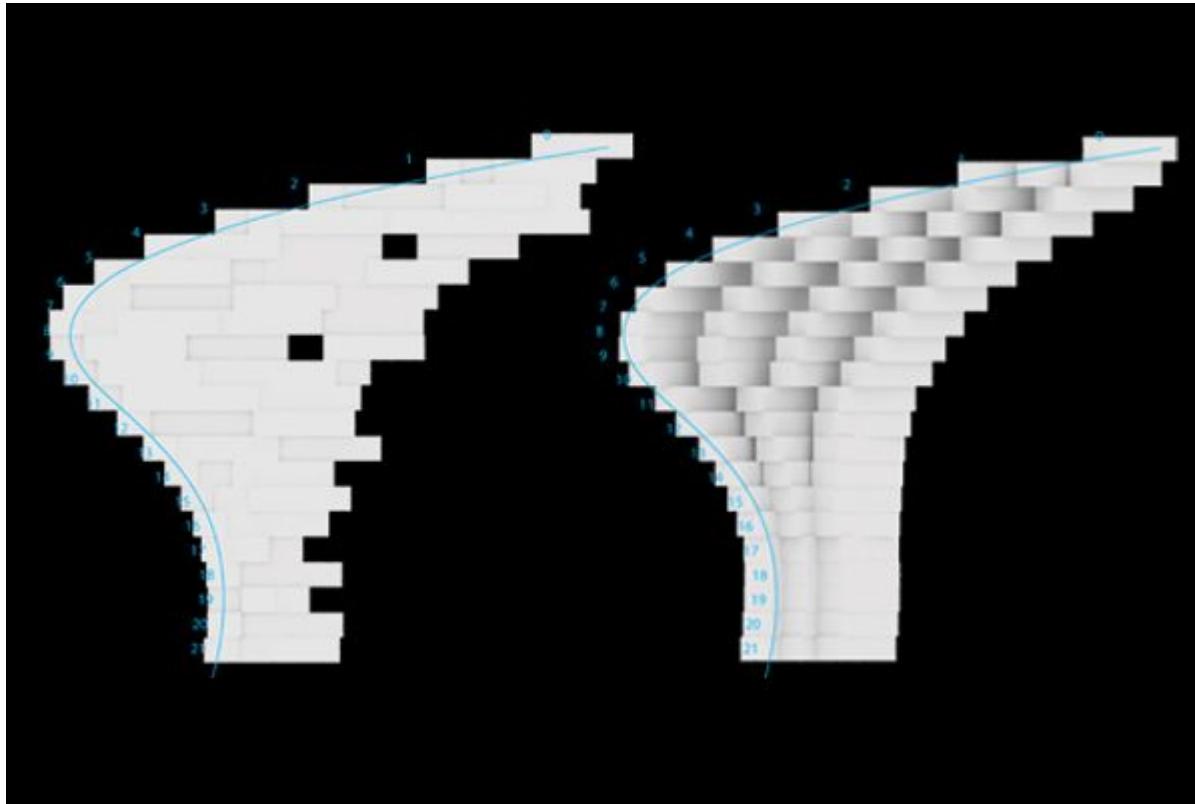


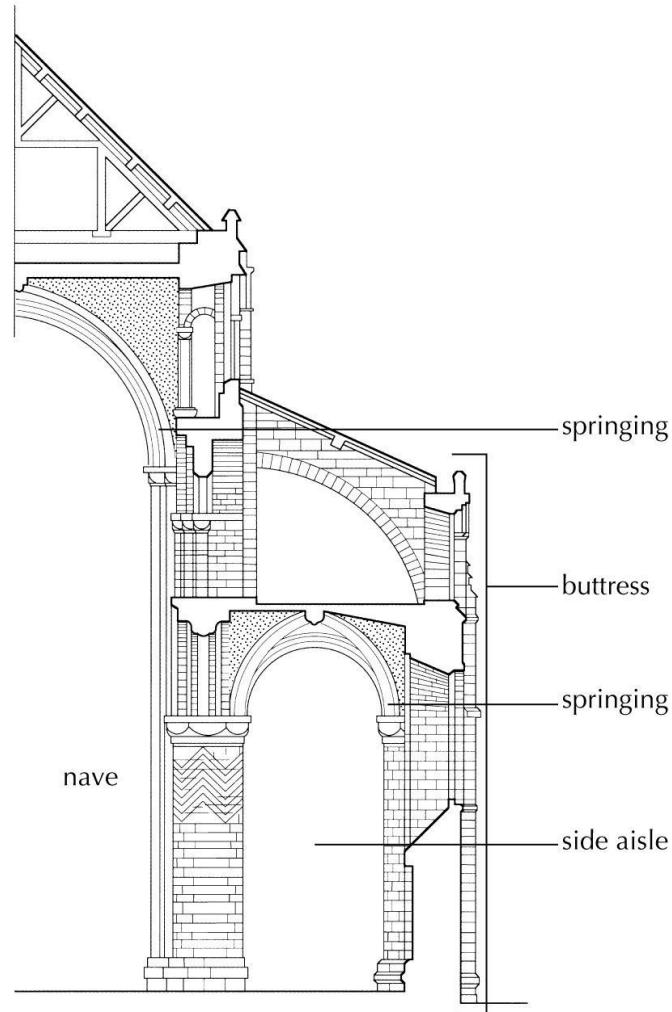
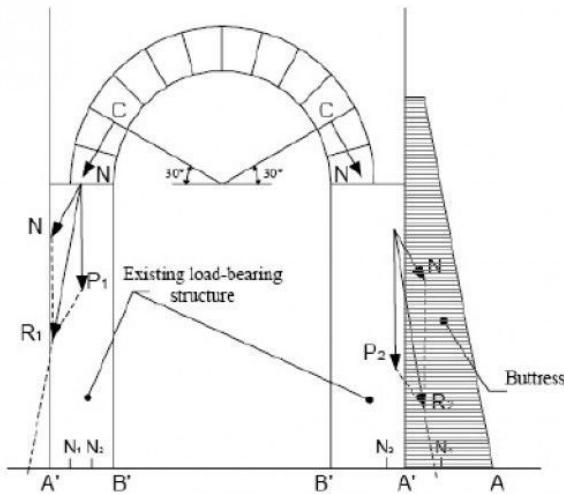
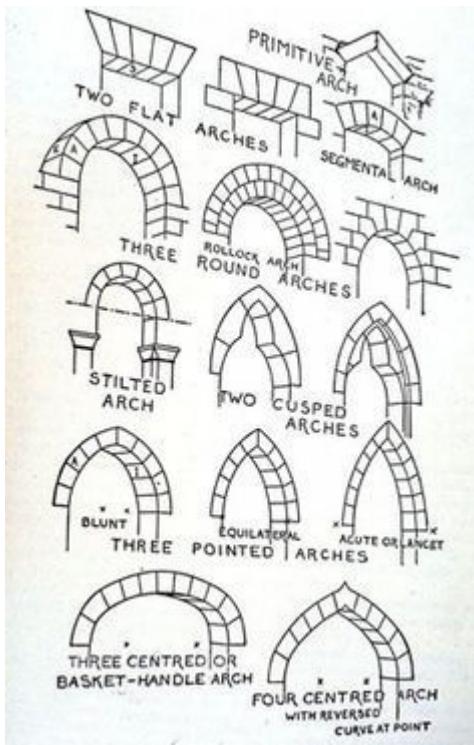
Groin vault

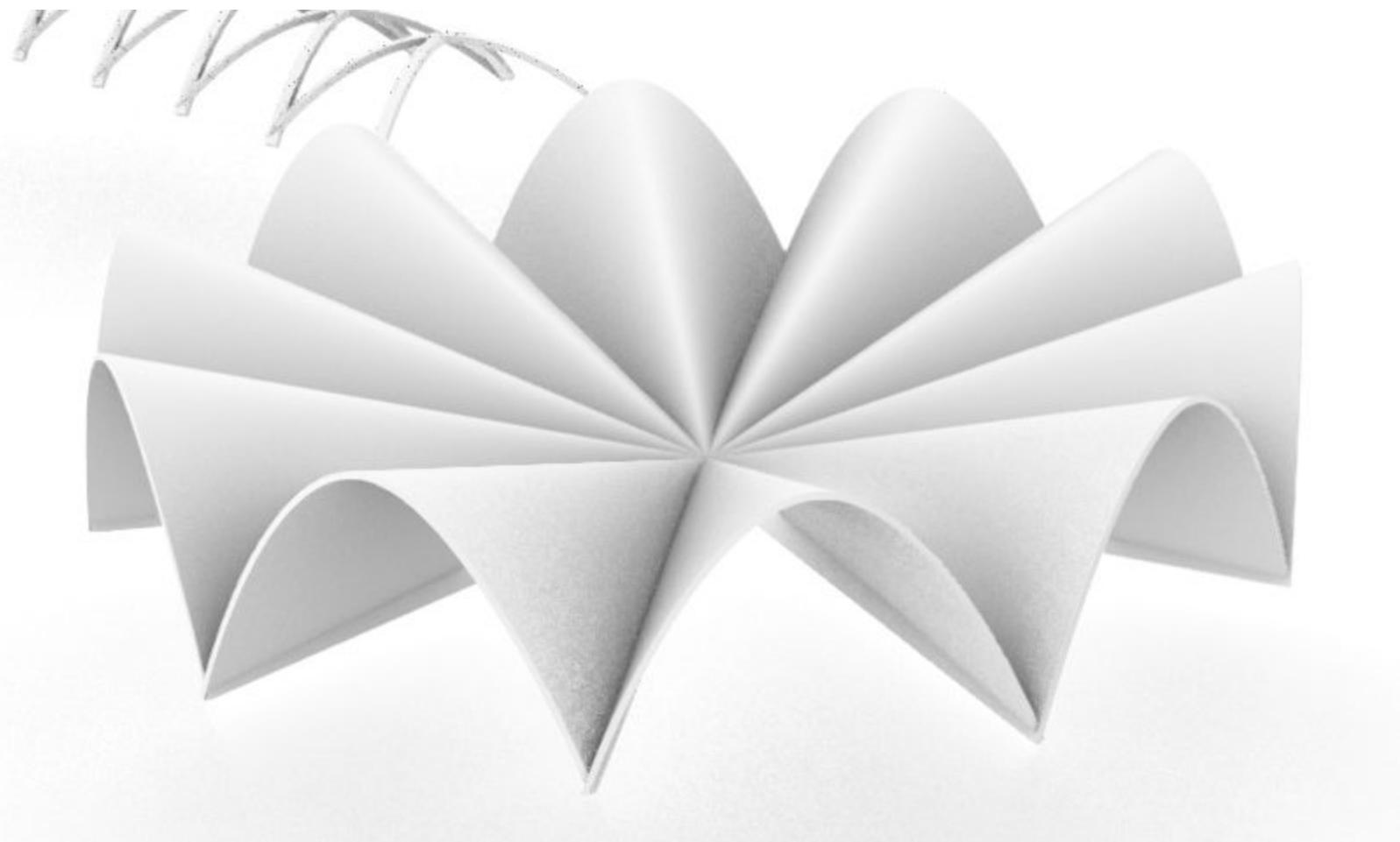


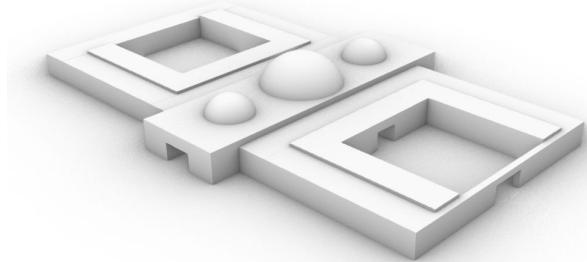
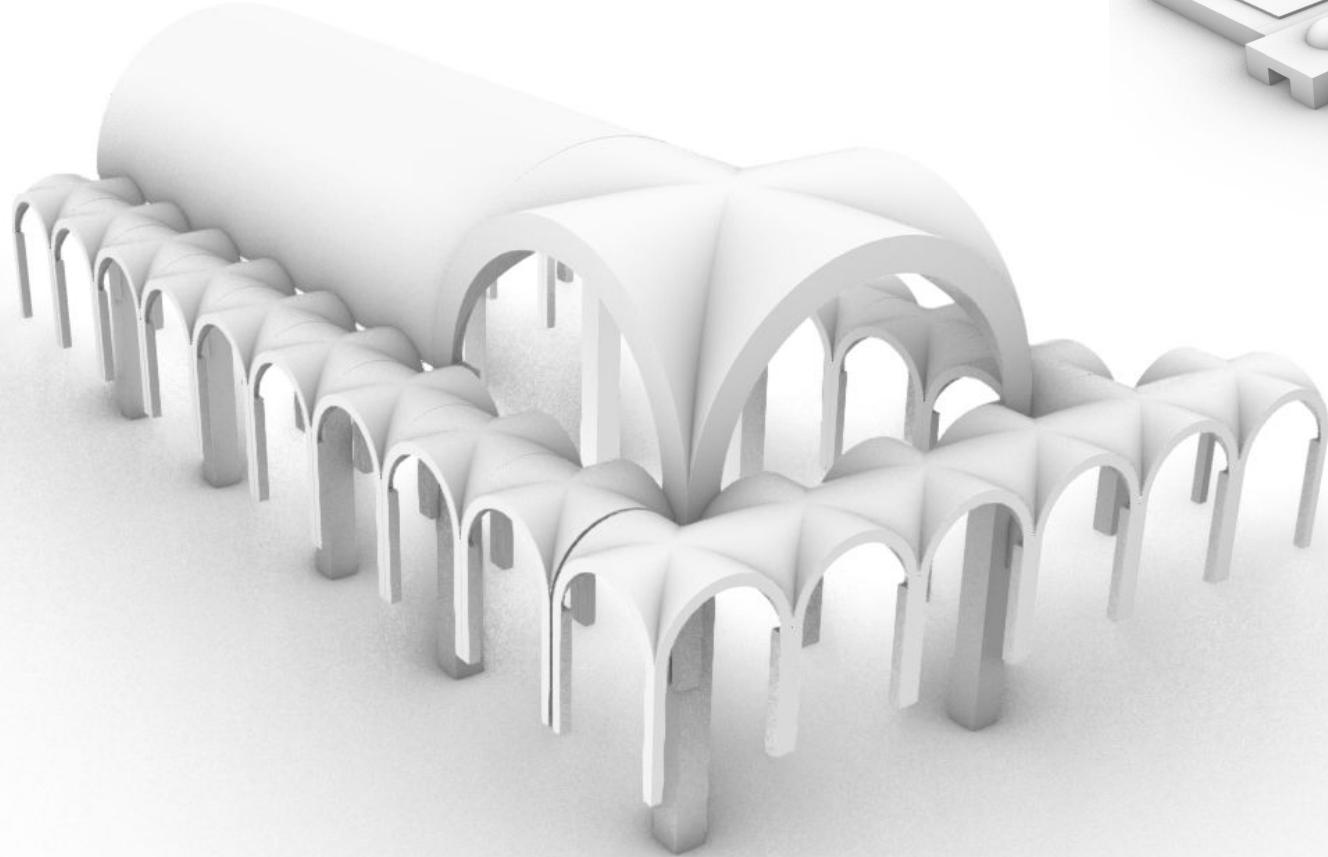
Rib vault

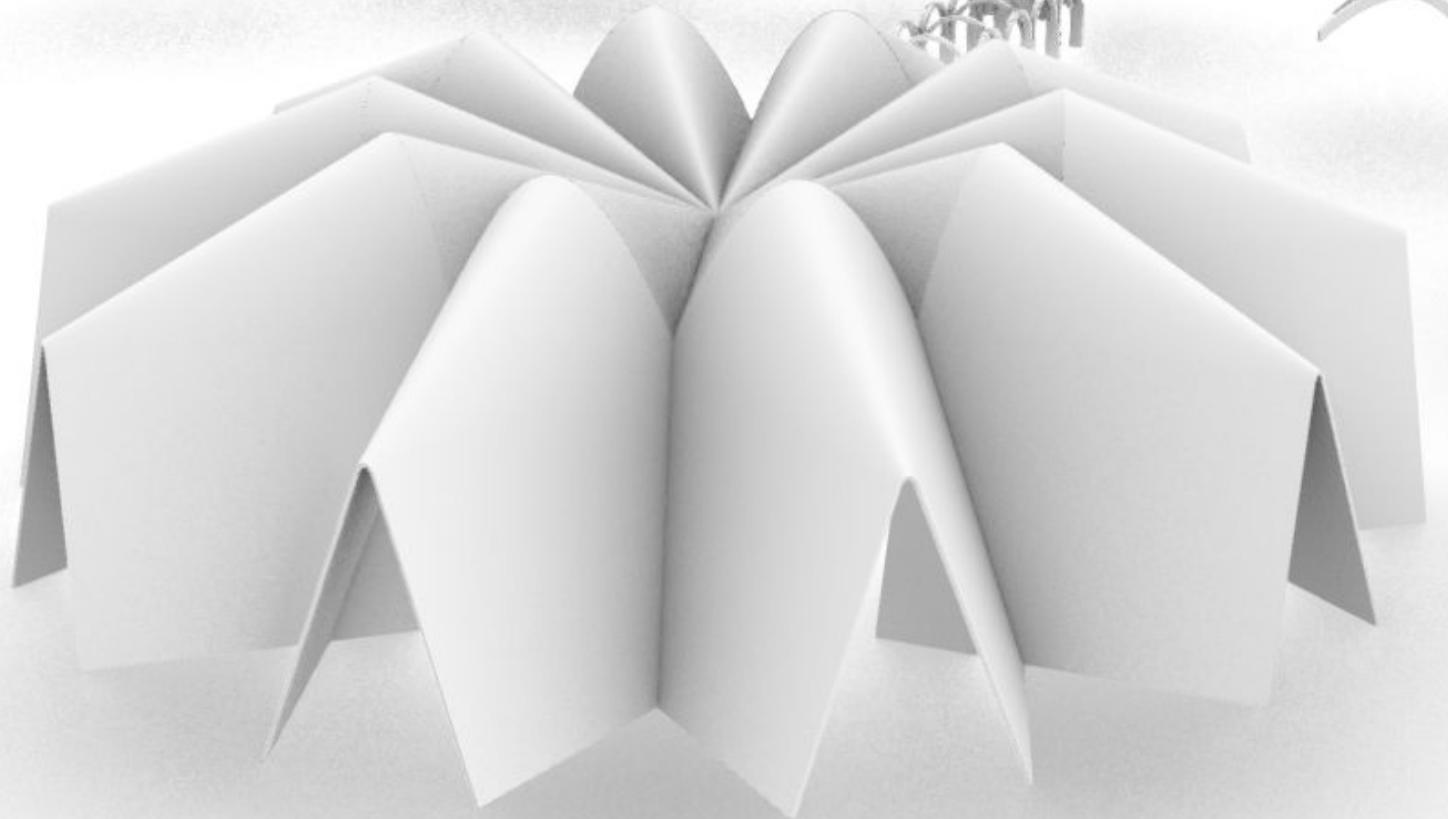












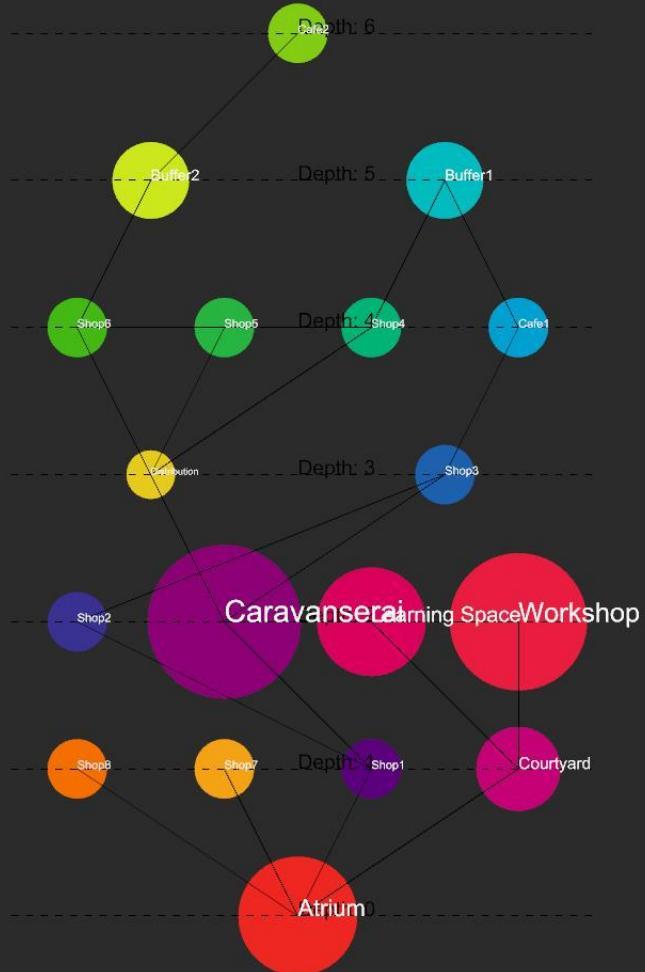
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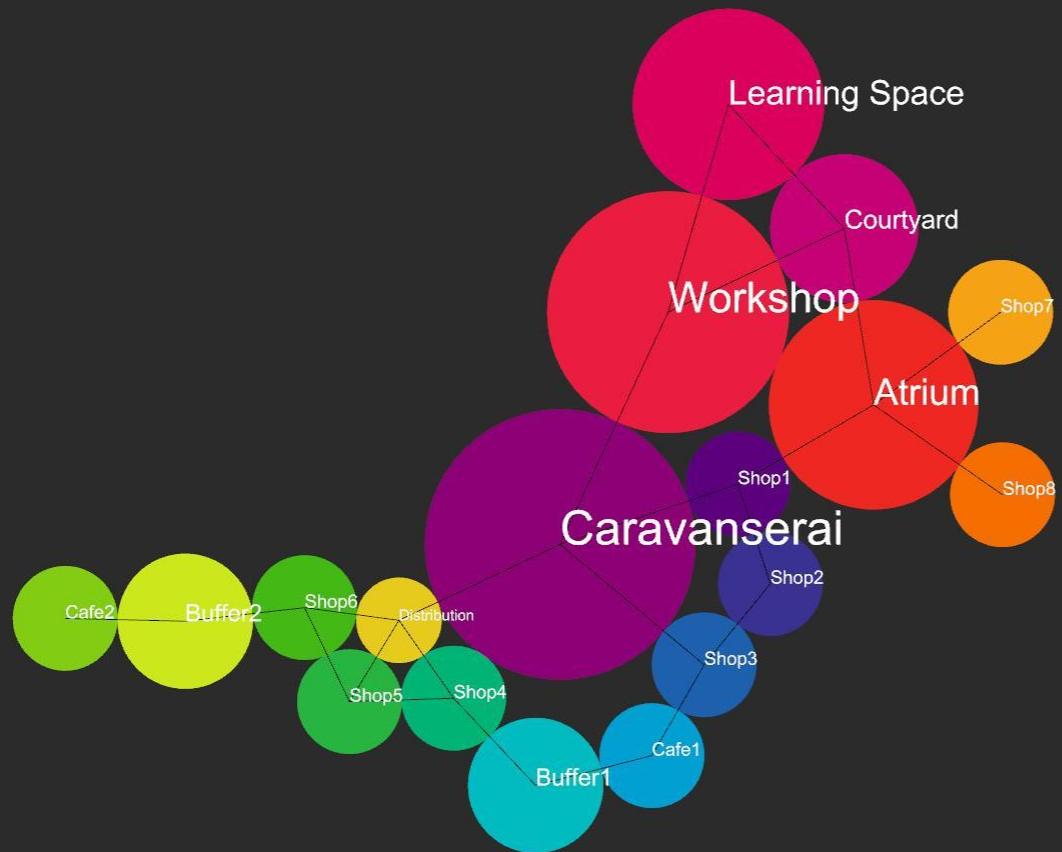
Nice refs:

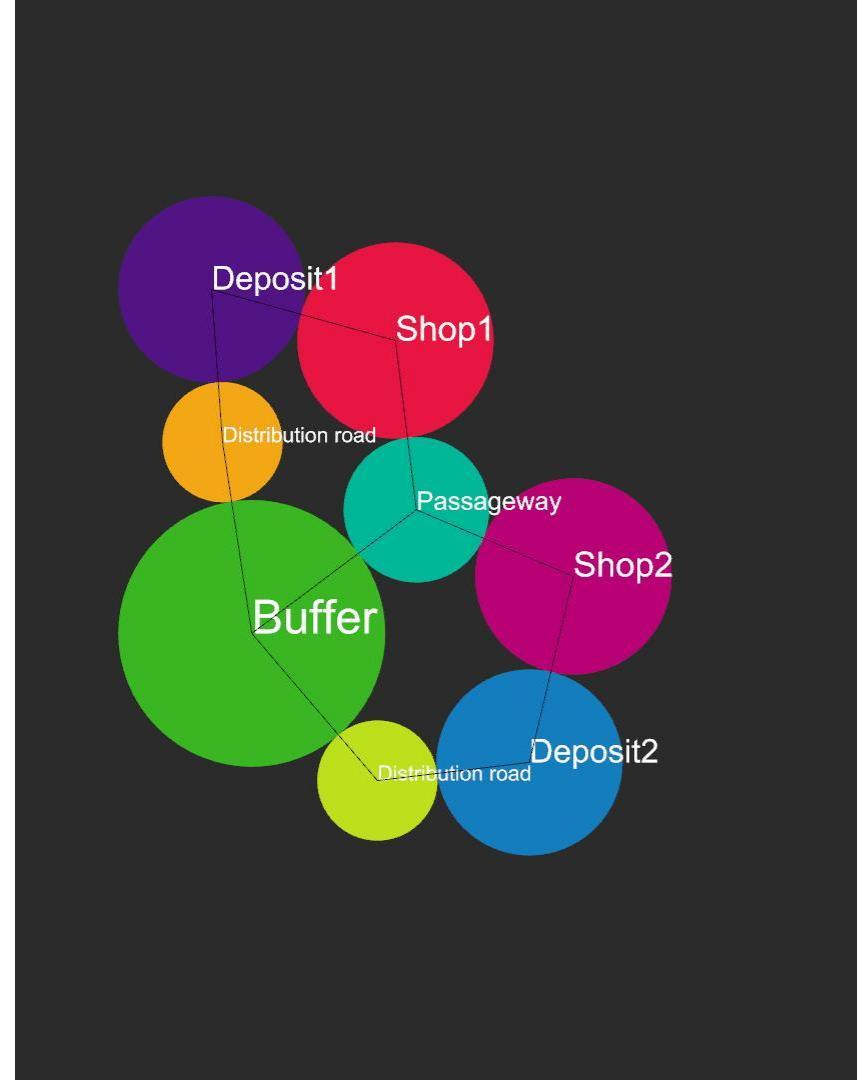
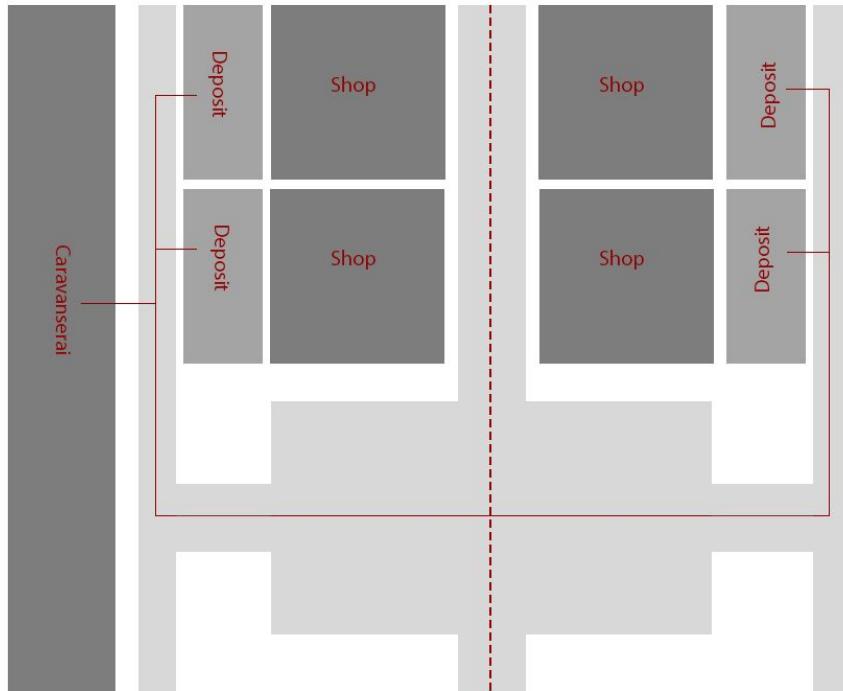
<http://www.k-w-y.org/Crazy-Vaults>

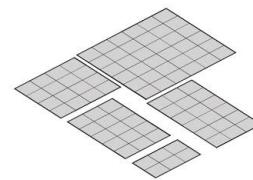
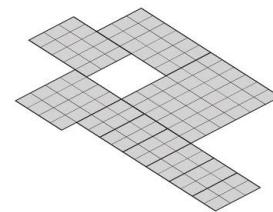
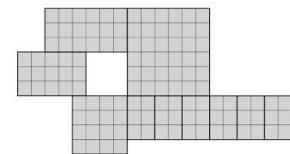
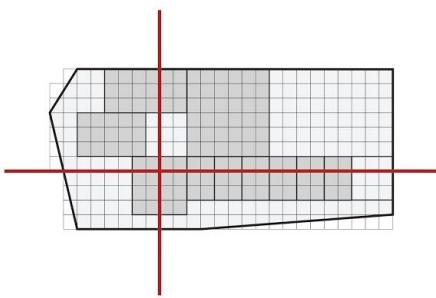
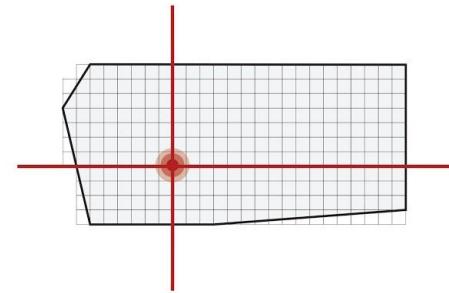
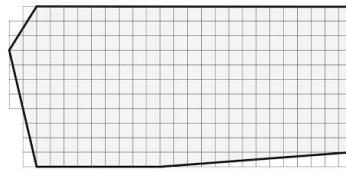
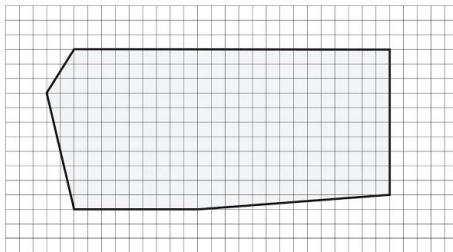
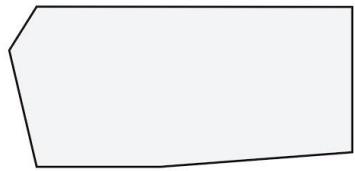
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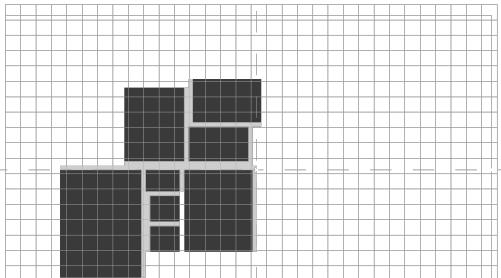
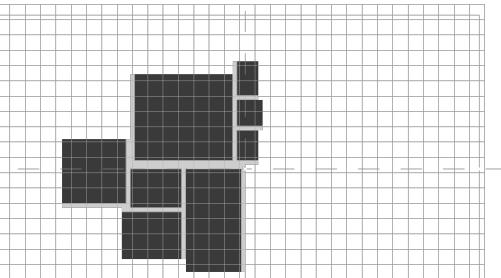
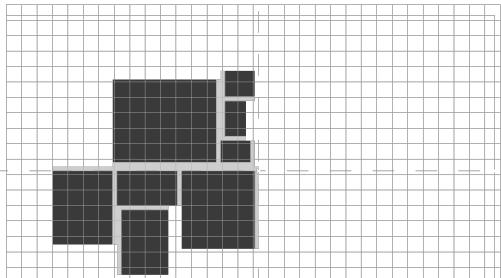
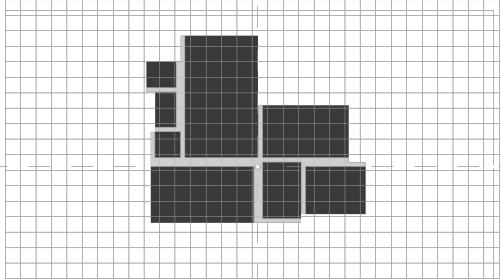
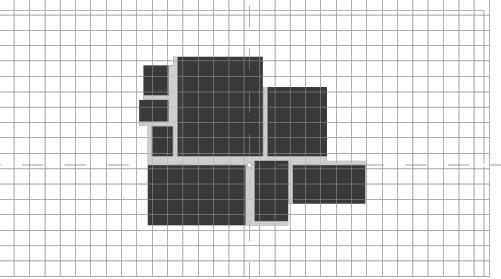
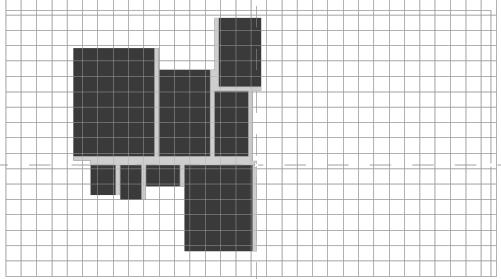
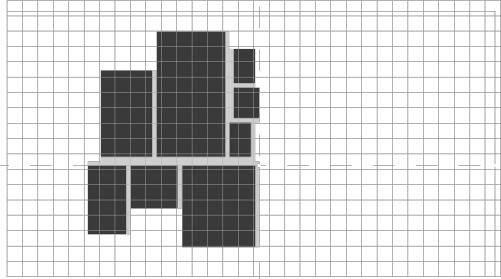
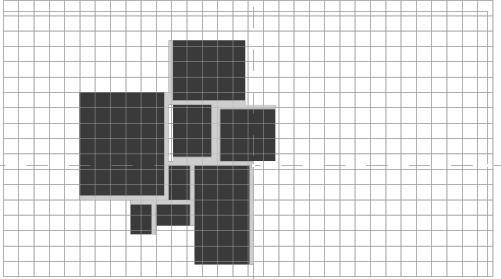
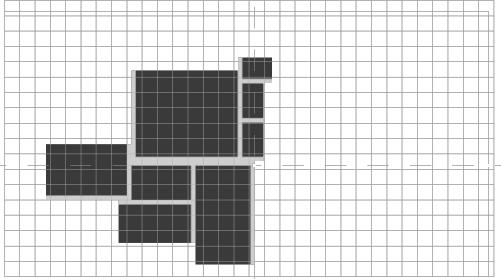
		Area (m2)	Noise (generation)	Definition of space	Open/semi-closed/closed (to sky)	ceiling height	Day light intensity	Accessibility	Open hours	Main Function
Commercial	Food retail	10-14m2	yes	Fixed	closed	2.7m	low	public	During the day	Yes
	Craft	20m2	yes	Fixed	closed	2.7m	low	public	During the day	Yes
	Tech	10m2	yes	Fixed	closed	2.7m	low	public	During the day	Yes
	'Café / Restaurant	10-40m2	yes	Fixed	closed	2.7m	low	public	During the day	Yes
Logistics	Caravanserai	400m2	yes	Modular	semi-closed	(if roof 5)	high	Private	Always	Yes
	Access to Road	x	yes	x	open	x	high	Public	During the day	No
	Storage (workshop)	60m2	no	Fixed	closed	2.7m	zero	Private	Never	No
	Storage (shop)	7m2	no	Fixed	closed	2.7m	zero	Private	Never	No
Others	Atrium	200m2	yes	Modular	semi-closed	6-10m	medium	Public	During the day	Yes
	Learning space	150m2	no	Modular	closed	3.2m	high	Semi-public	During the day	Yes
	Workshop	200m2	yes	Fixed	semi-closed	4m	high	Semi-public	During the day	Yes
	Housing	30m2	no	Modular	closed	2.7m	medium	Private	x	No
Connectors	Buffer space	50m2	yes	Modular	open	x	high	Public	During the day	No
	Courtyard	100m2	no	Modular	open	x	high	Semi-public	During the day	No
	Passageway	x	yes	x	closed	6-8m	low	Public	During the day	Yes





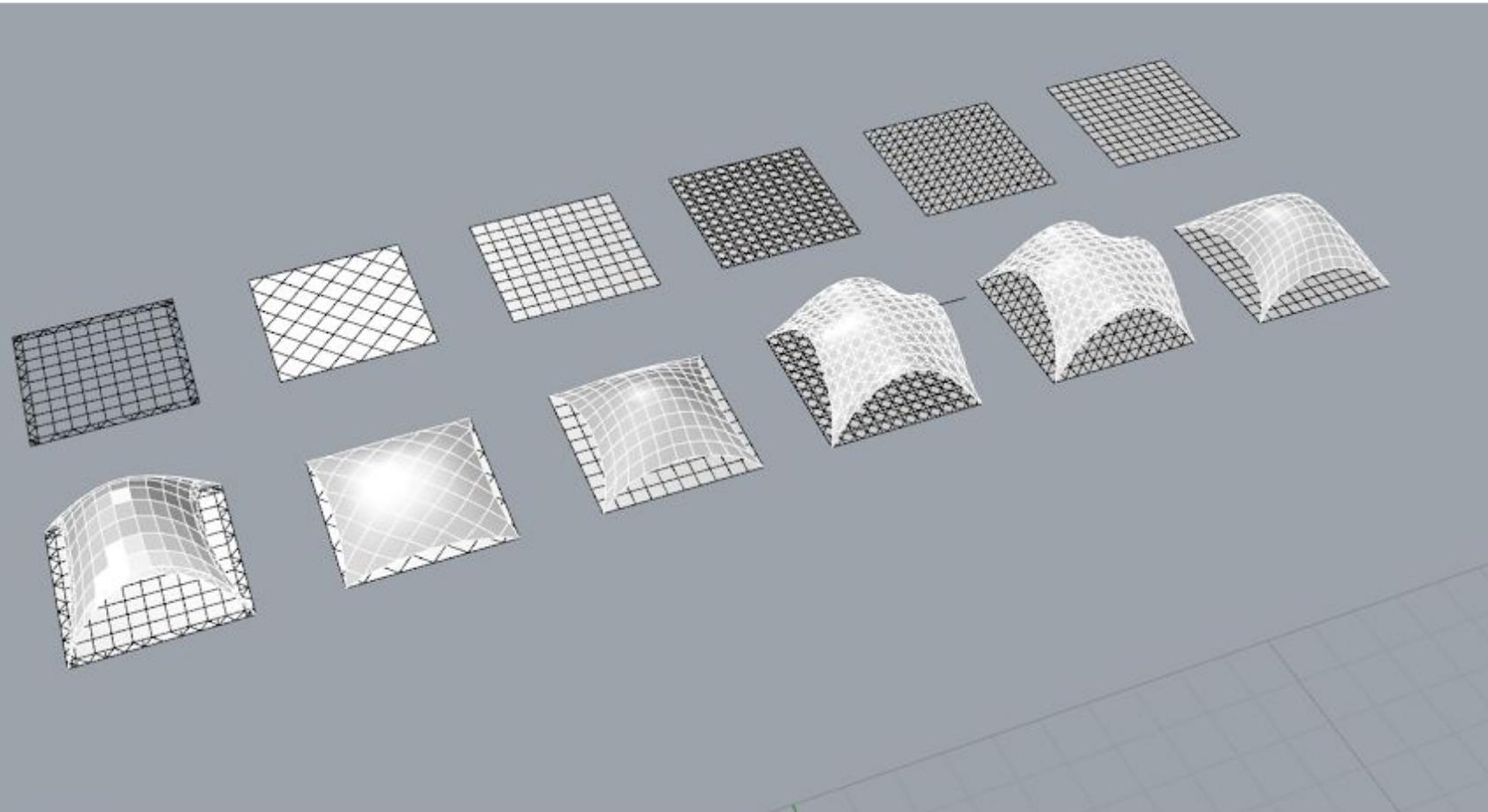


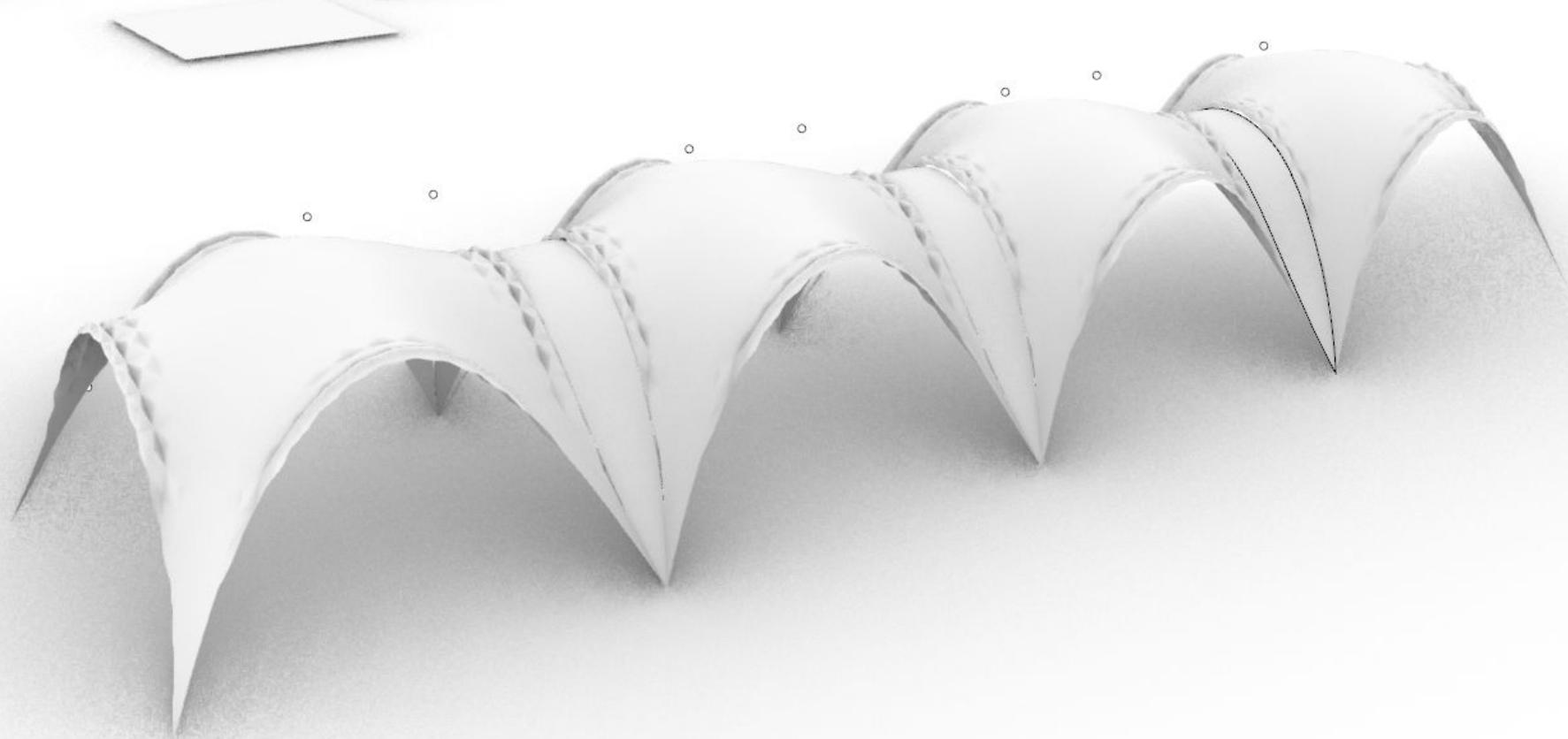






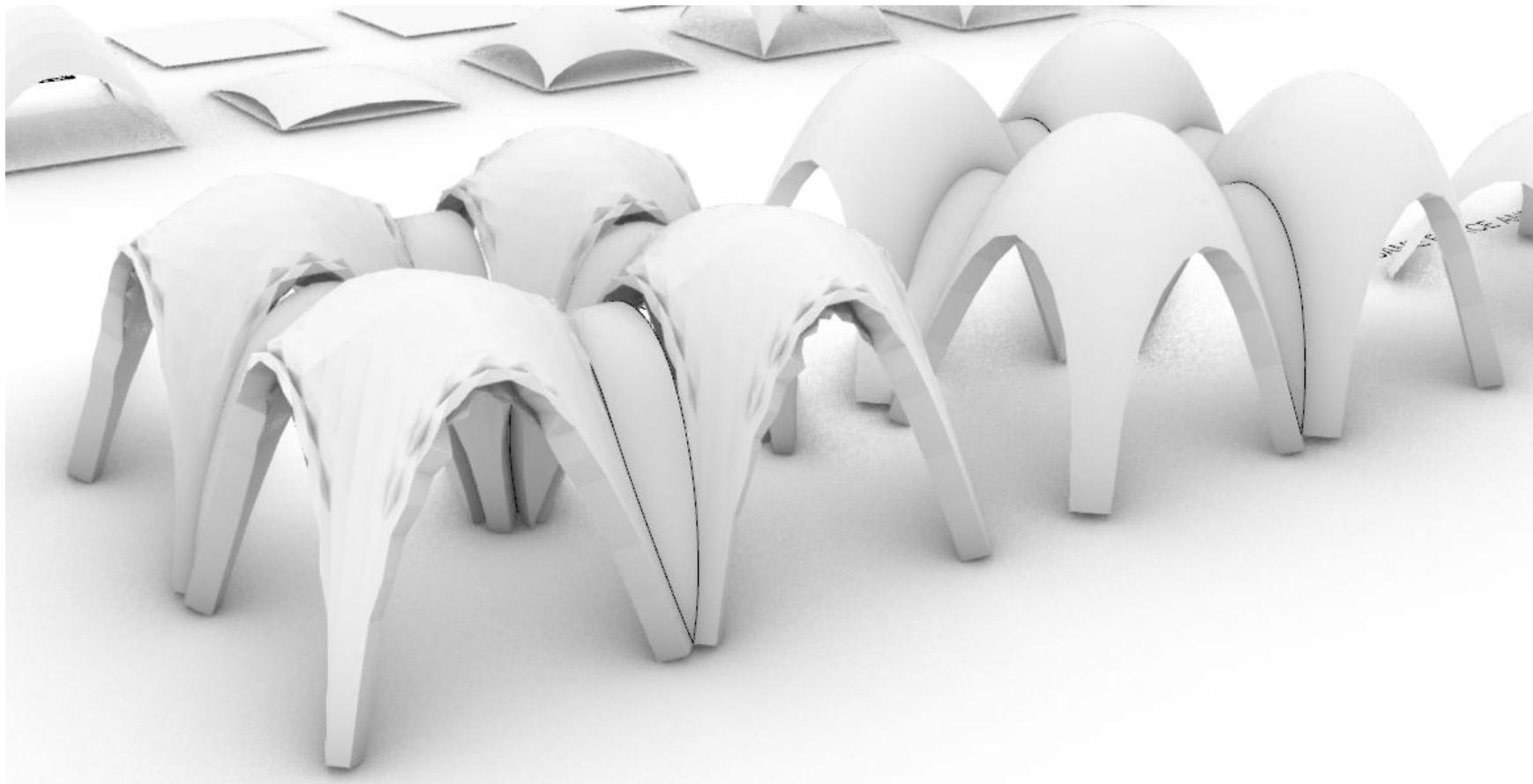


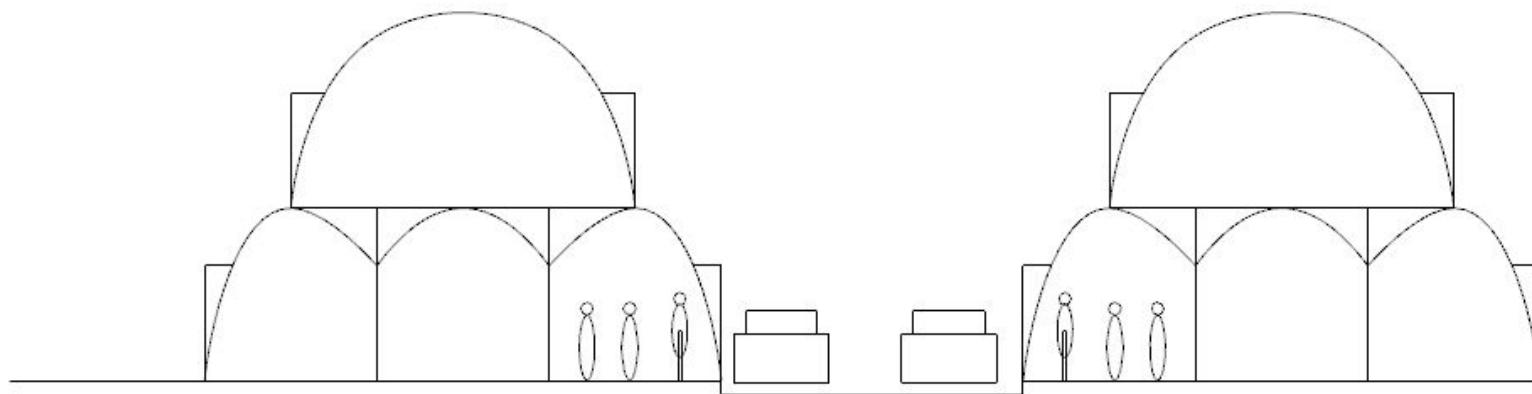
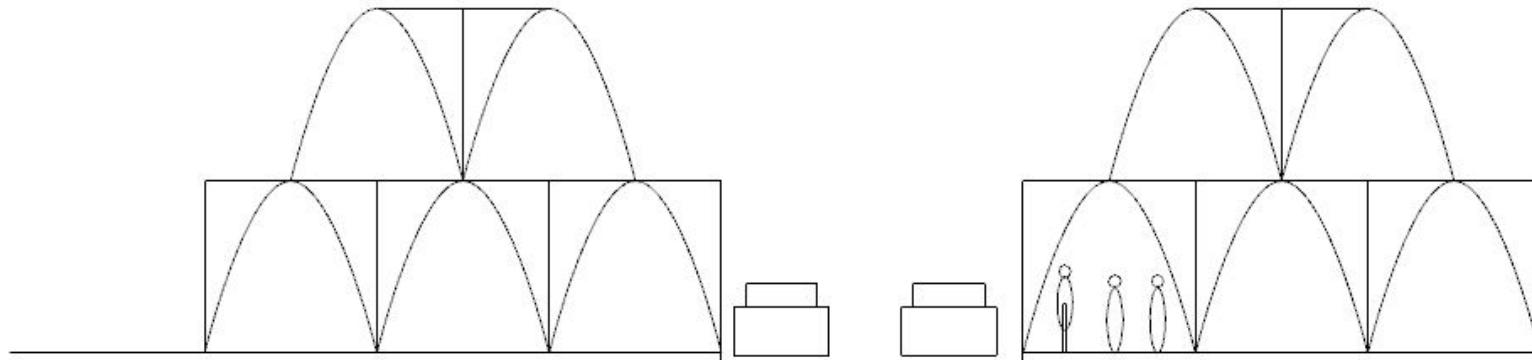


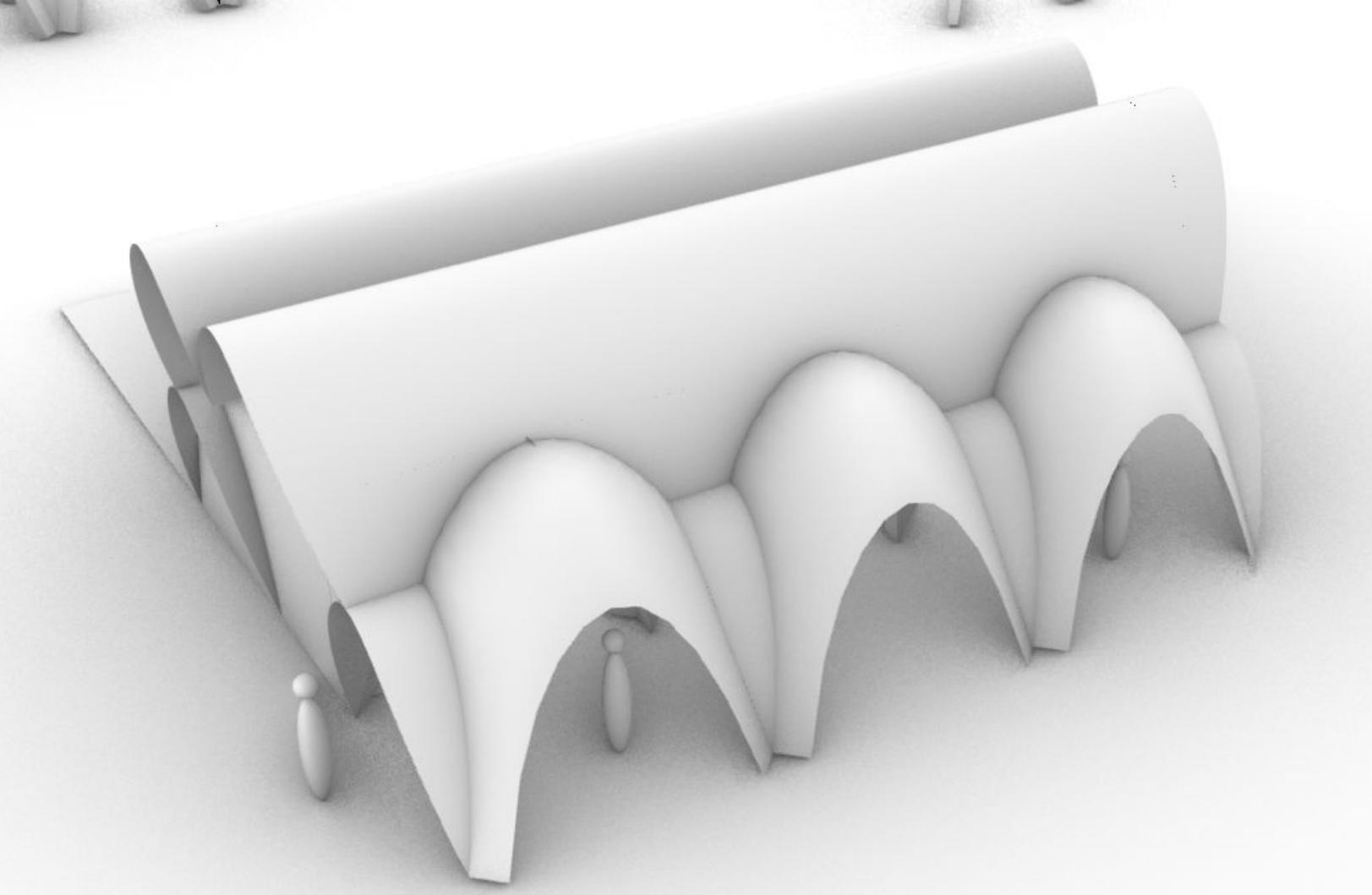


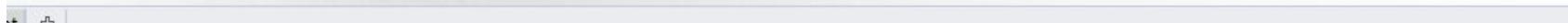
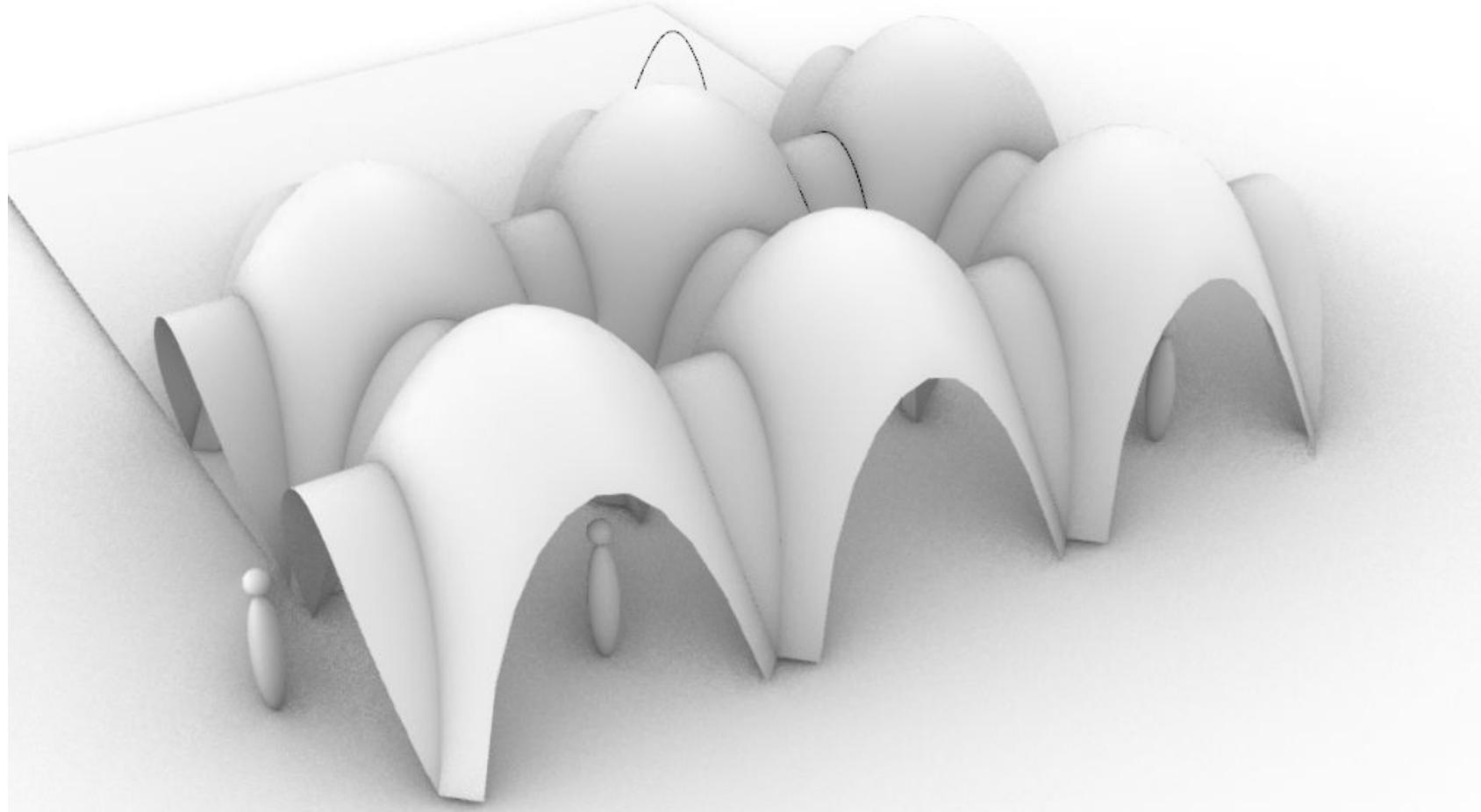


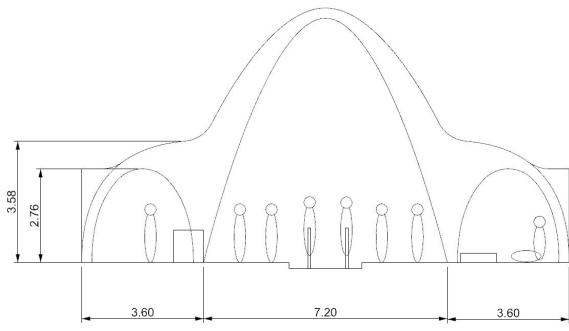


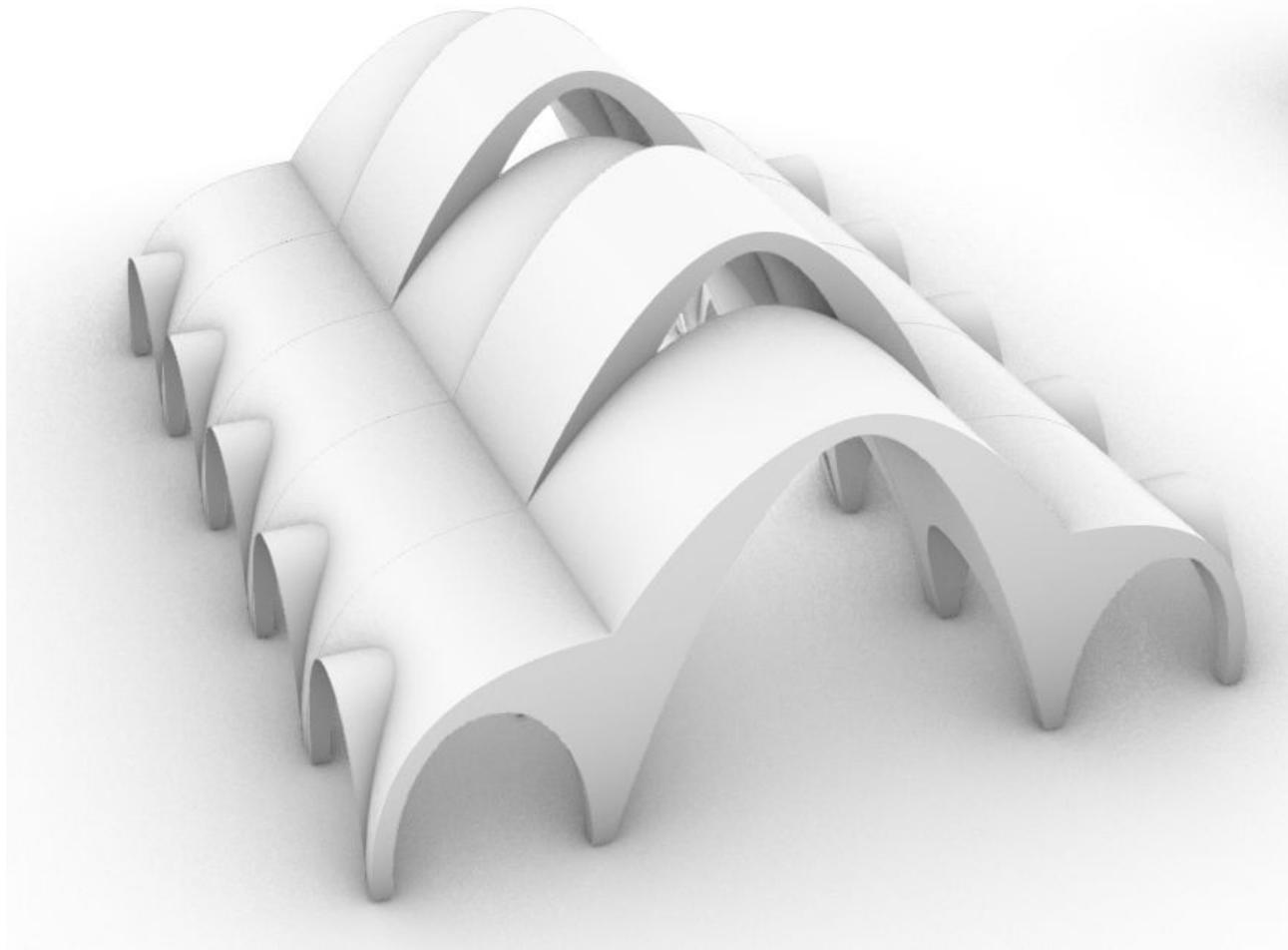


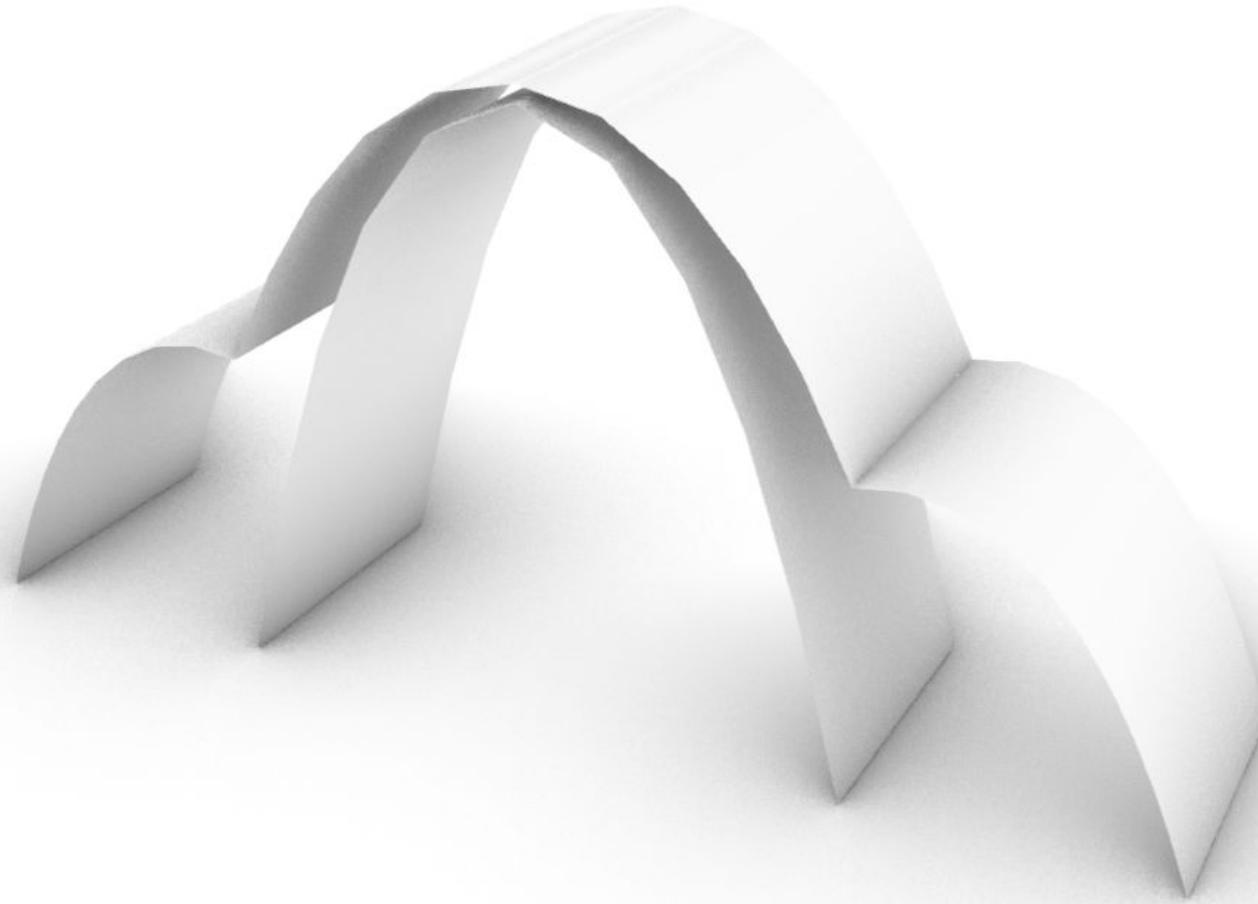


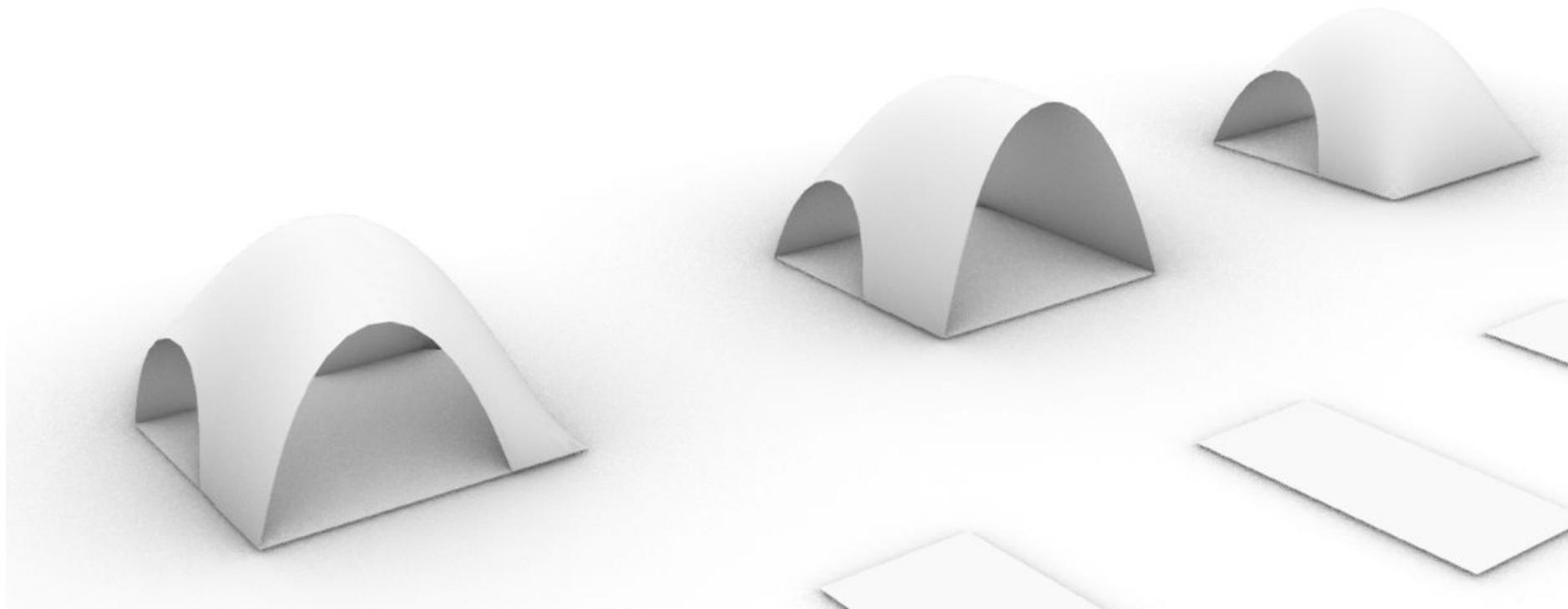


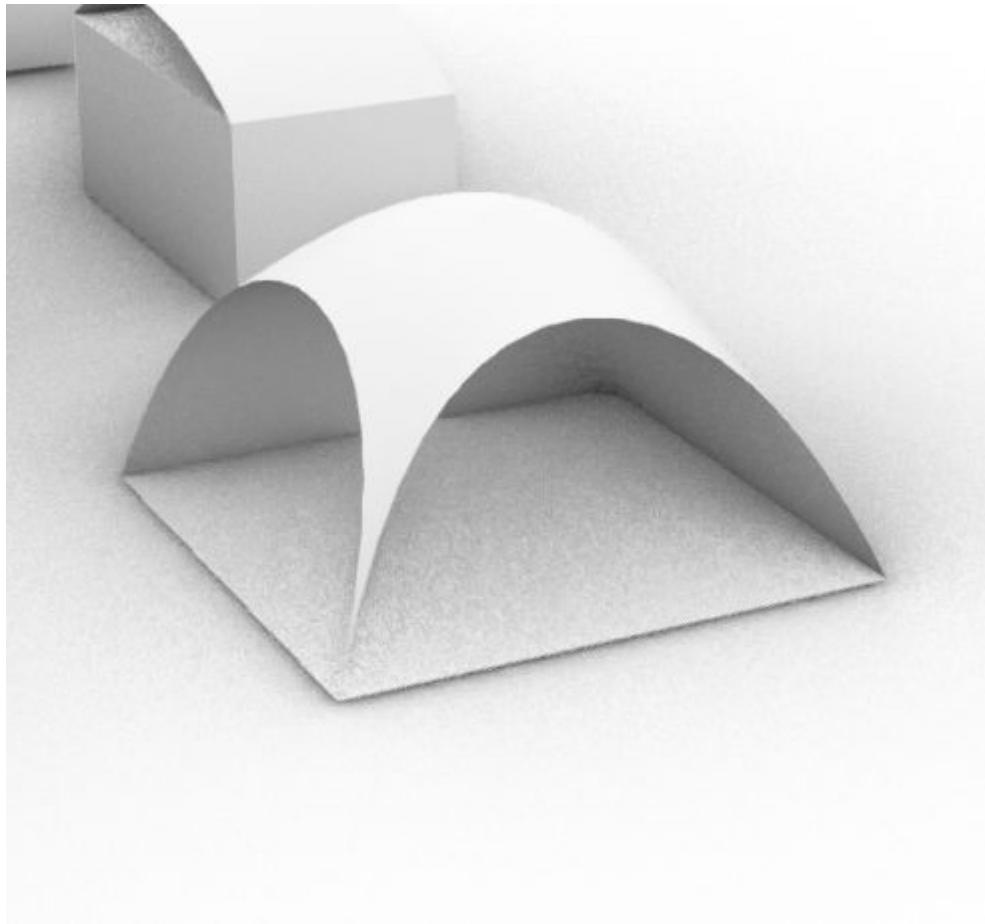


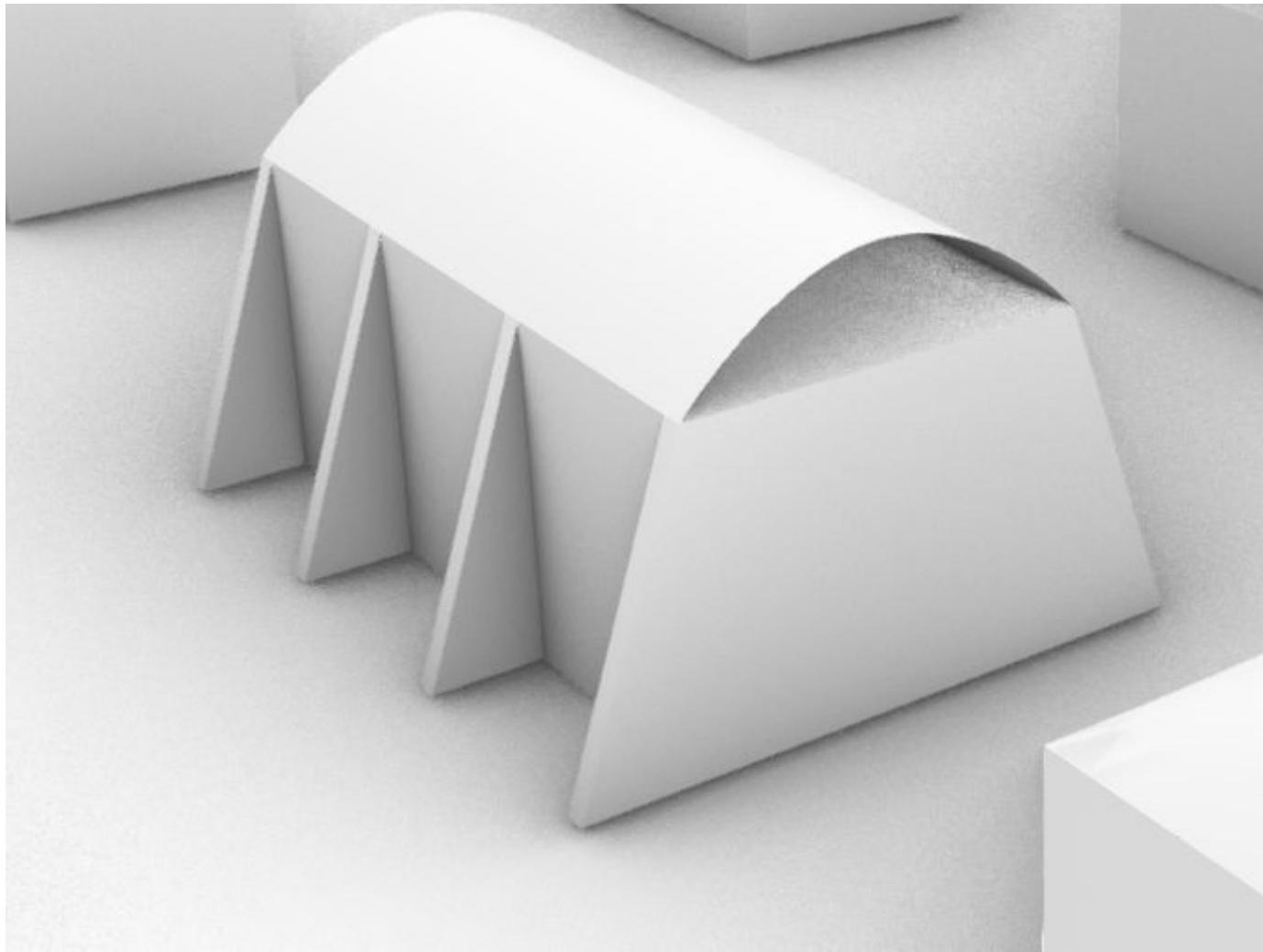


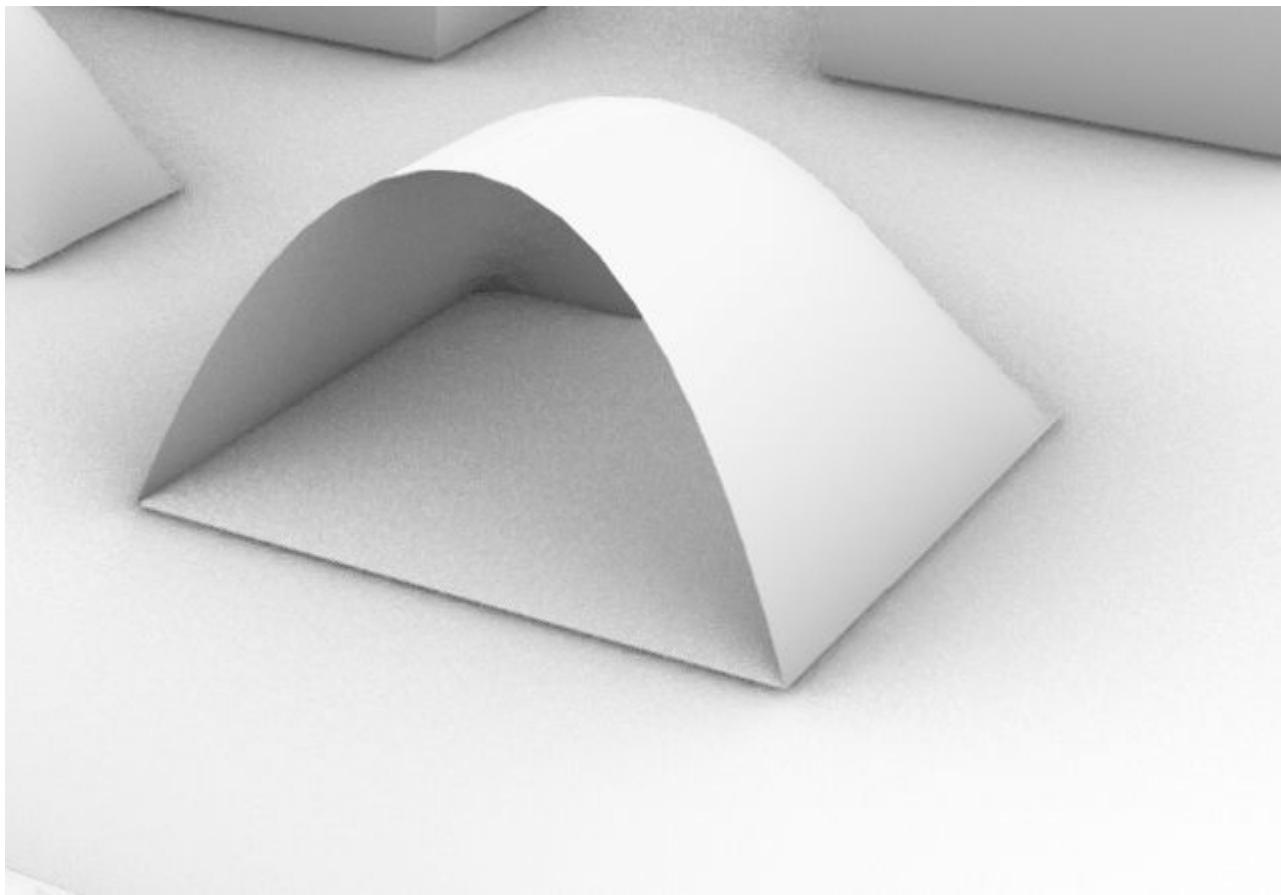


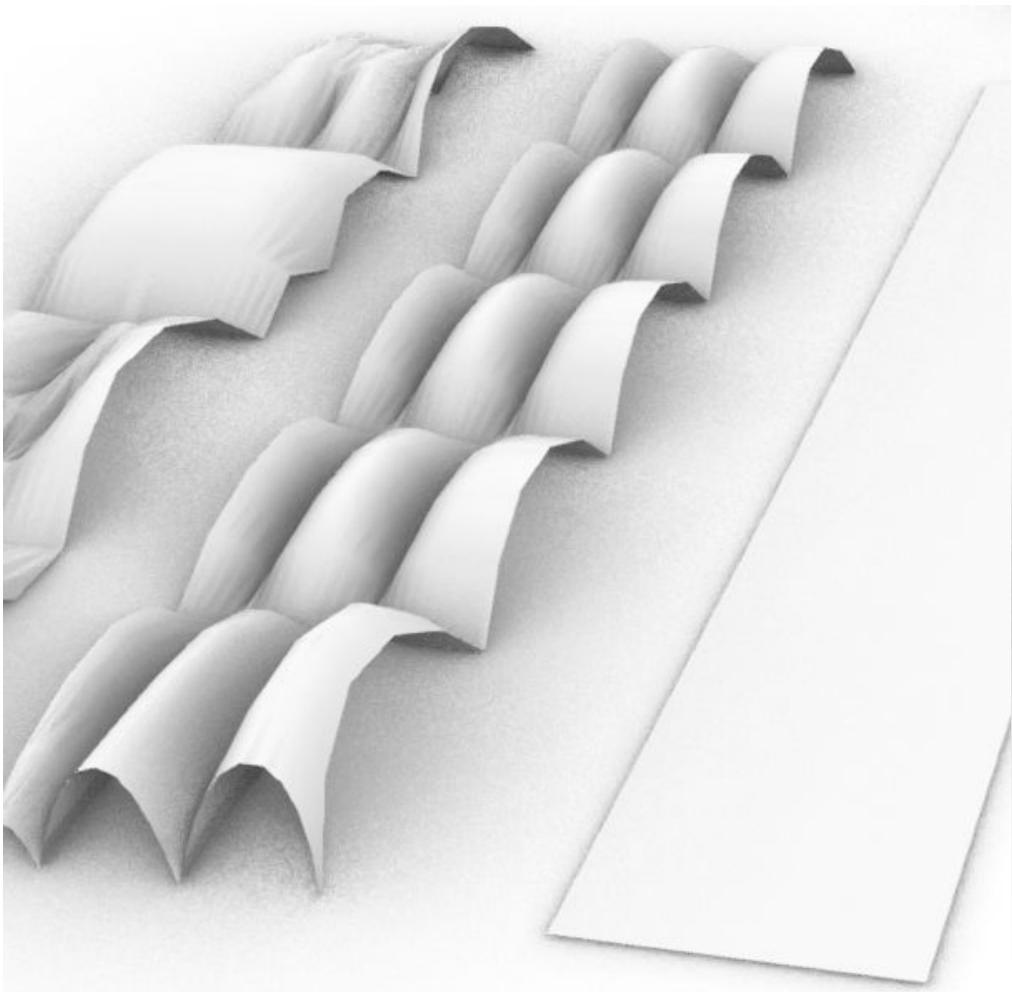


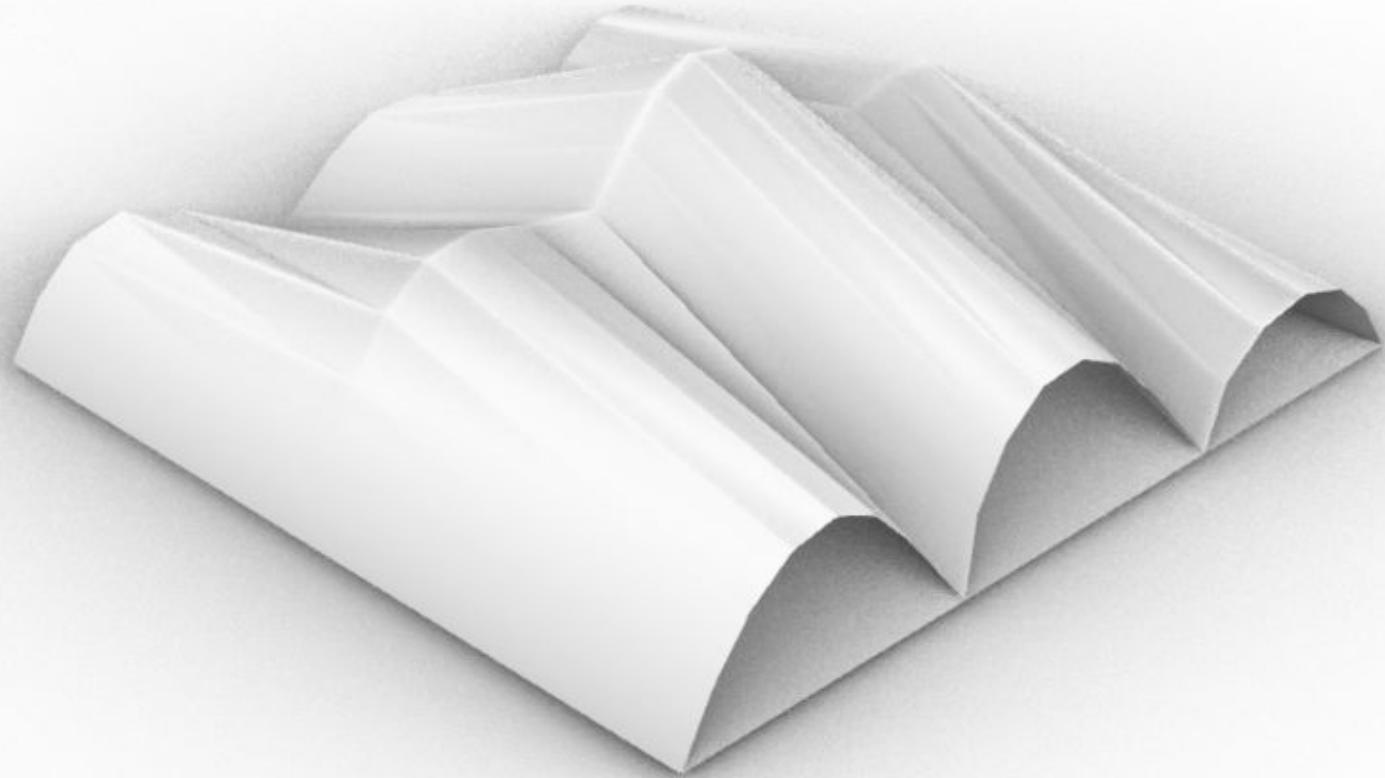


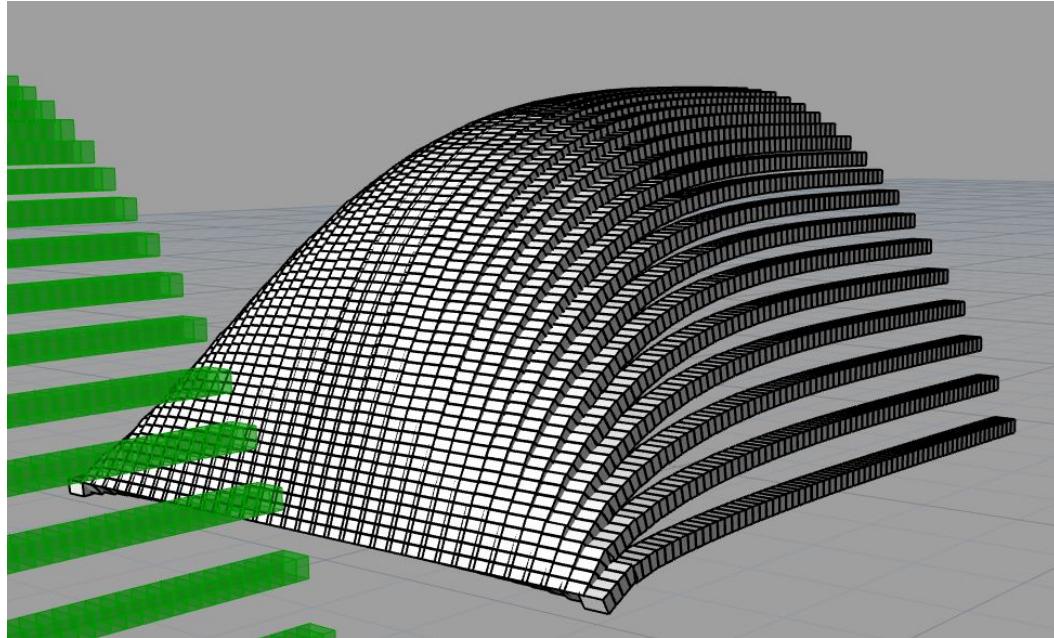


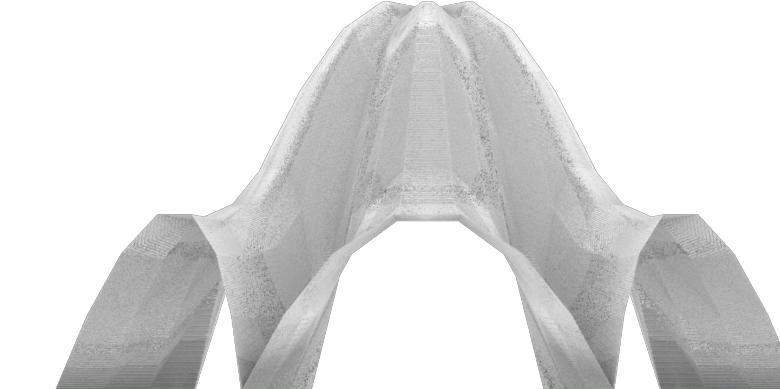
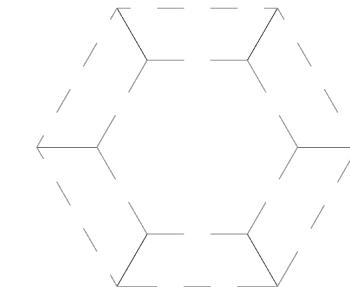
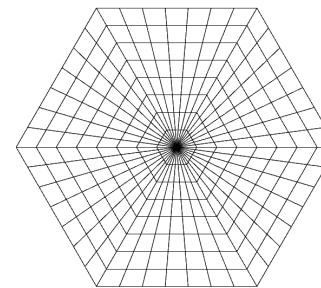
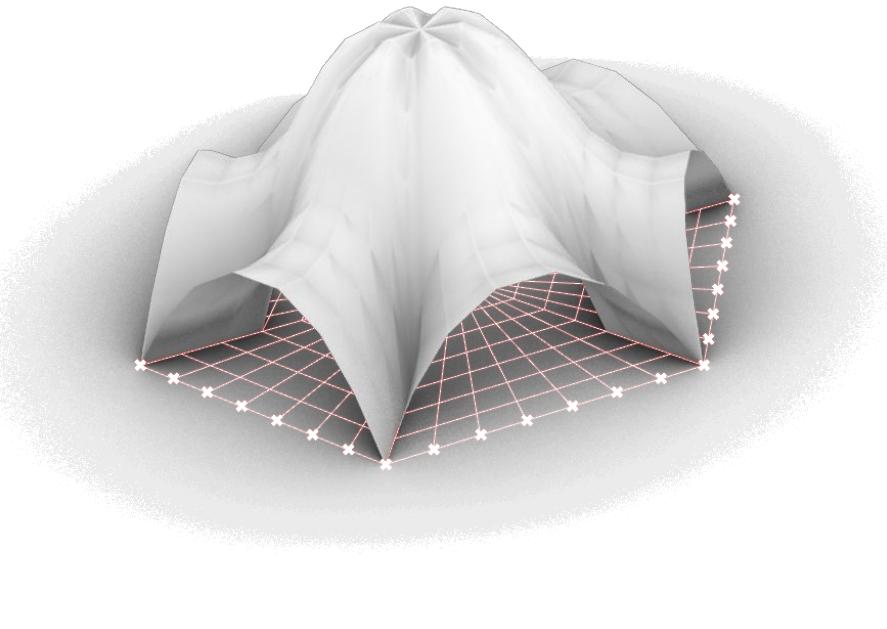
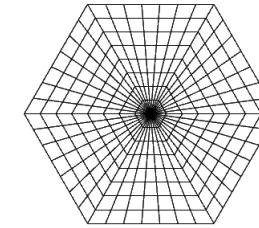
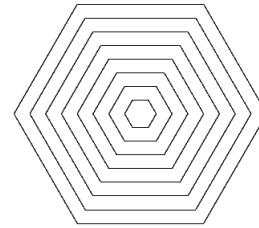
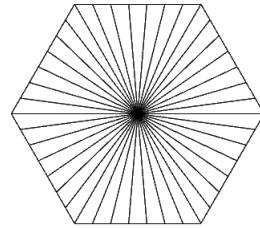
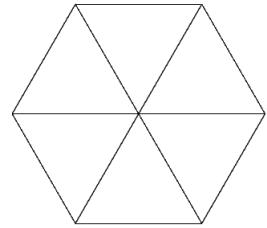
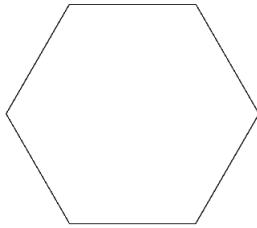


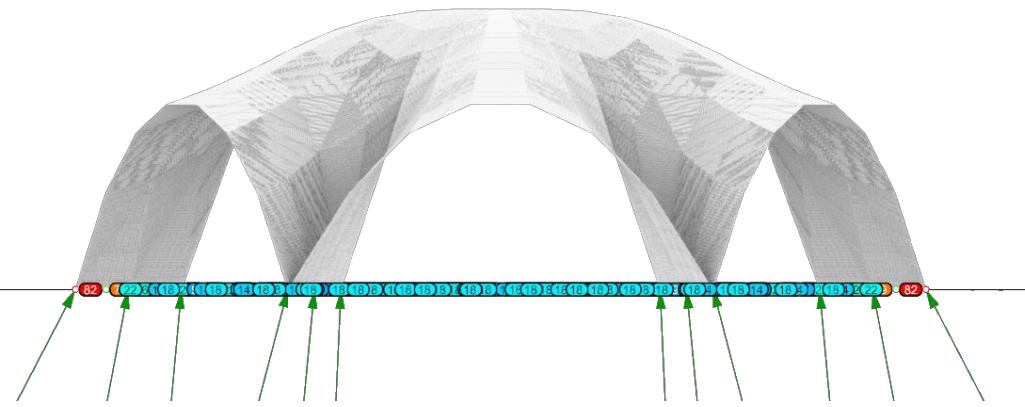
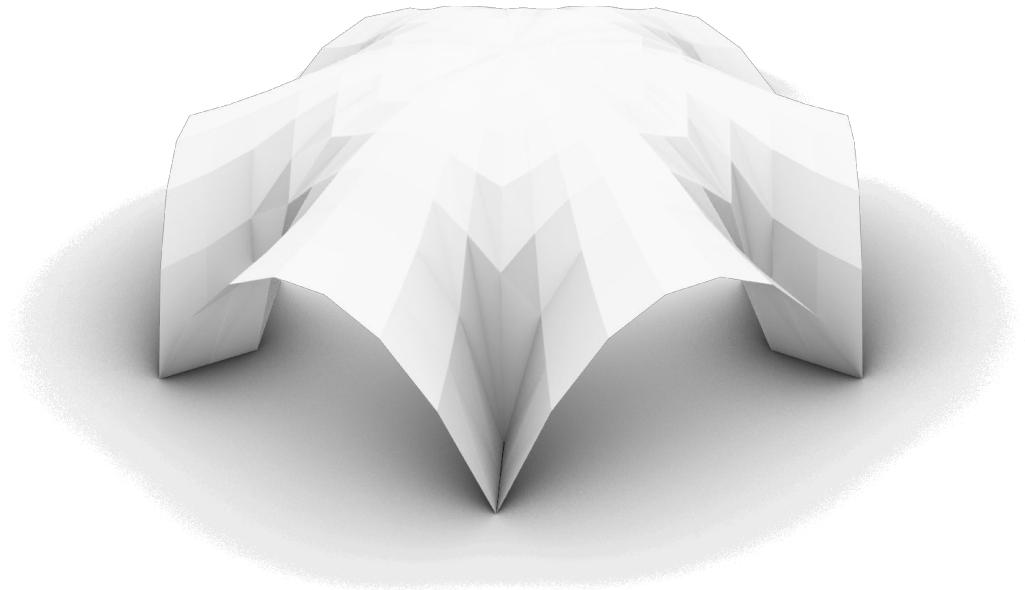


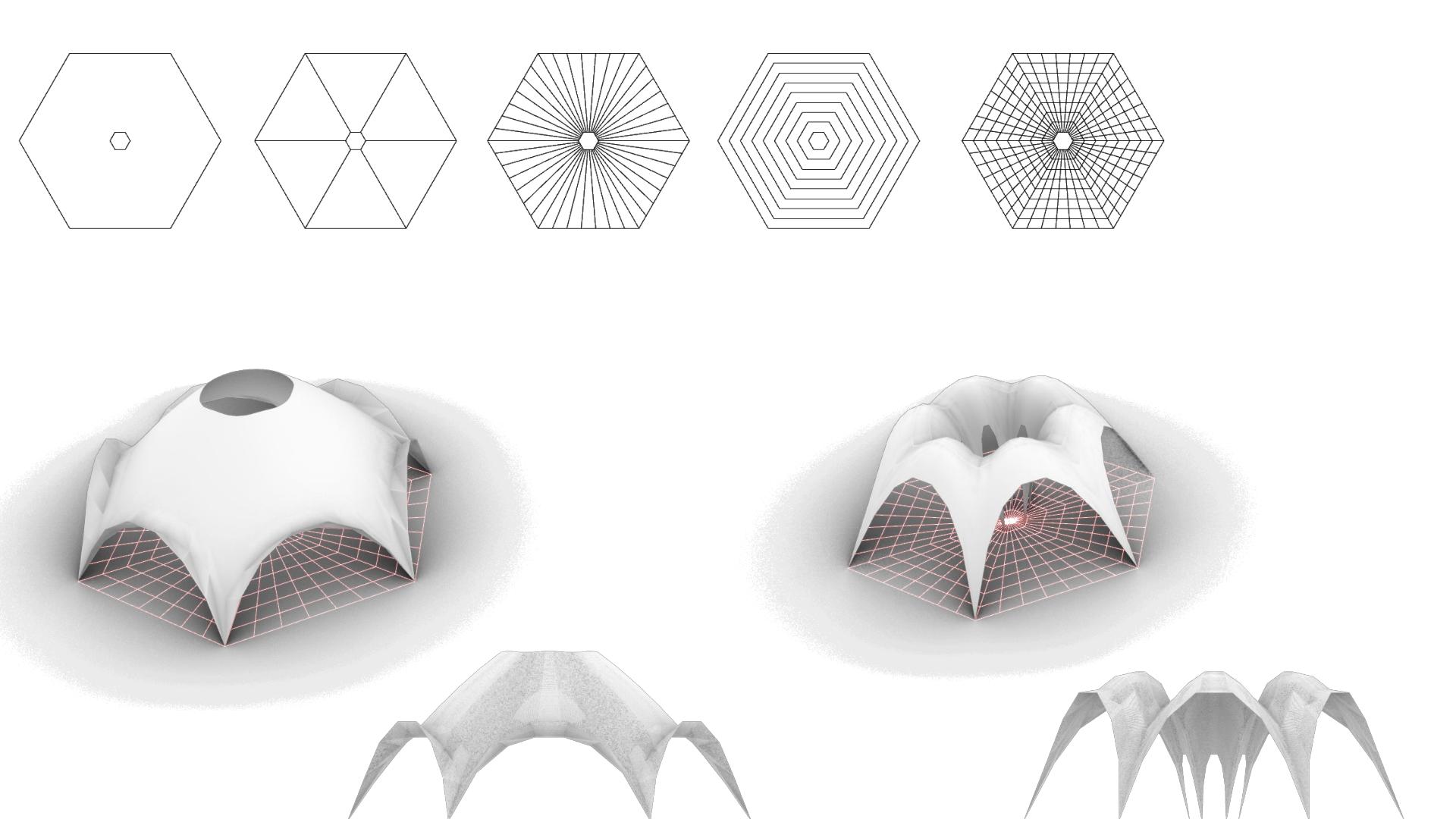


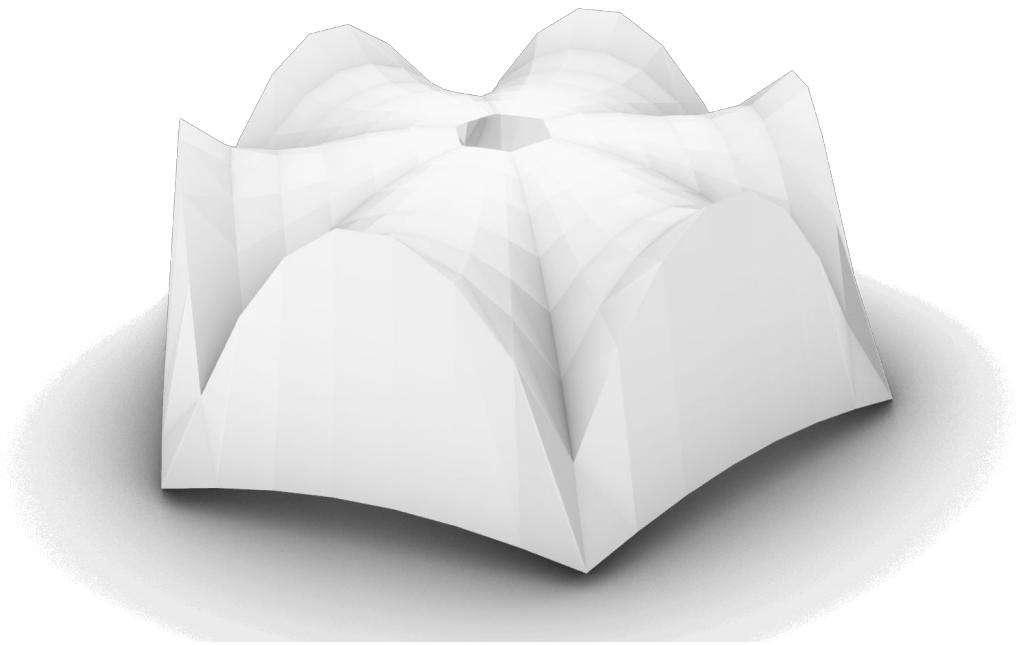
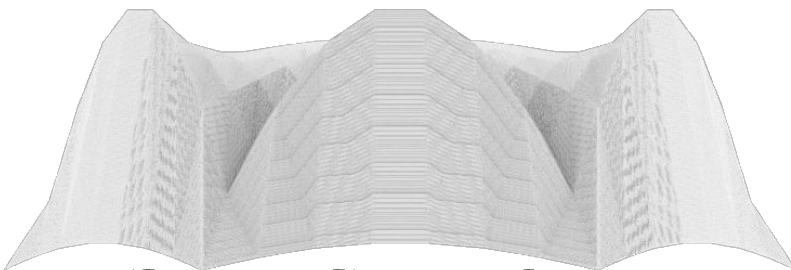


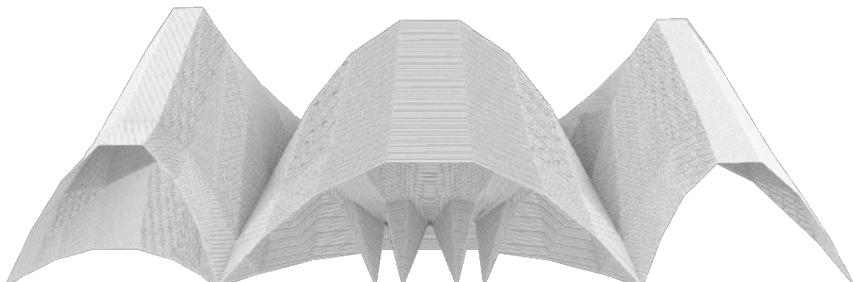
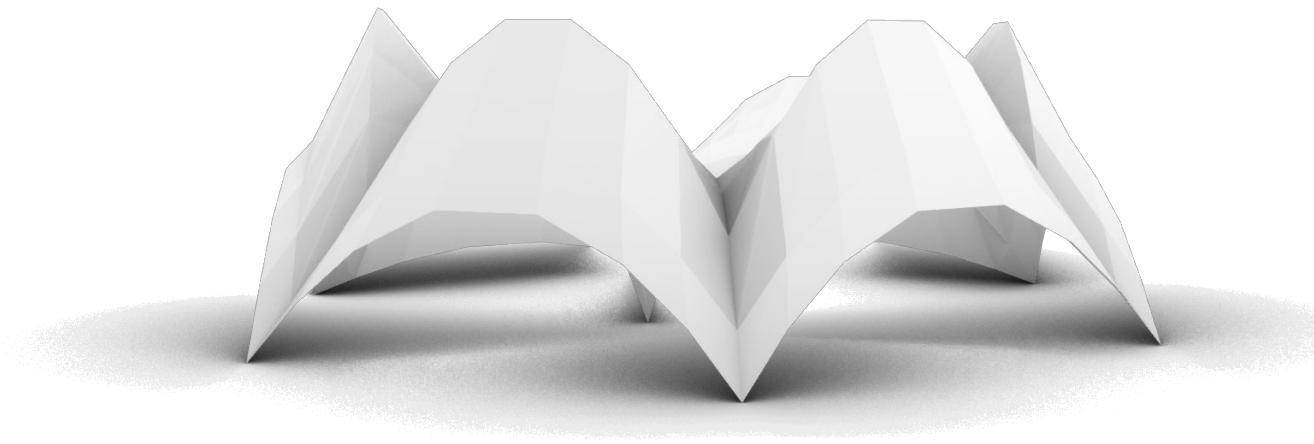


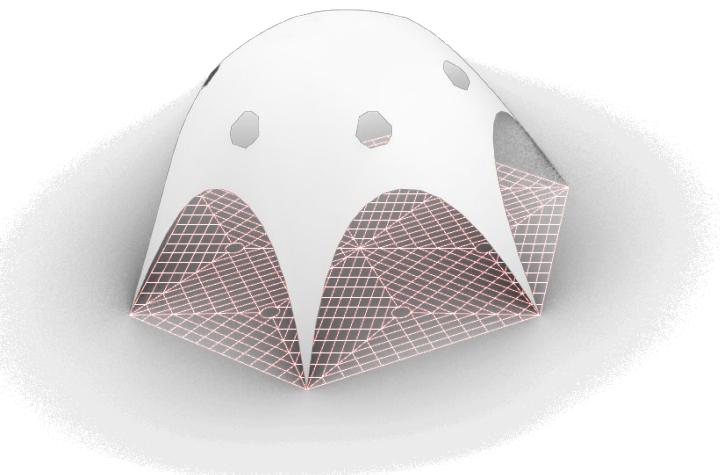
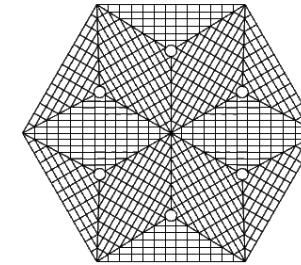
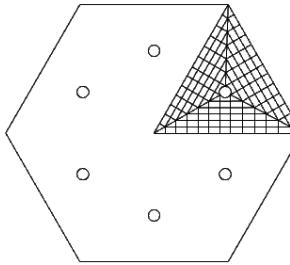
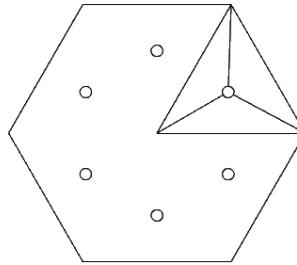
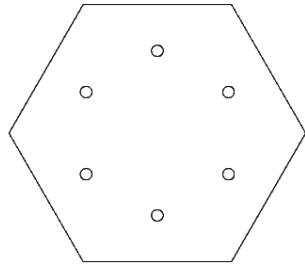


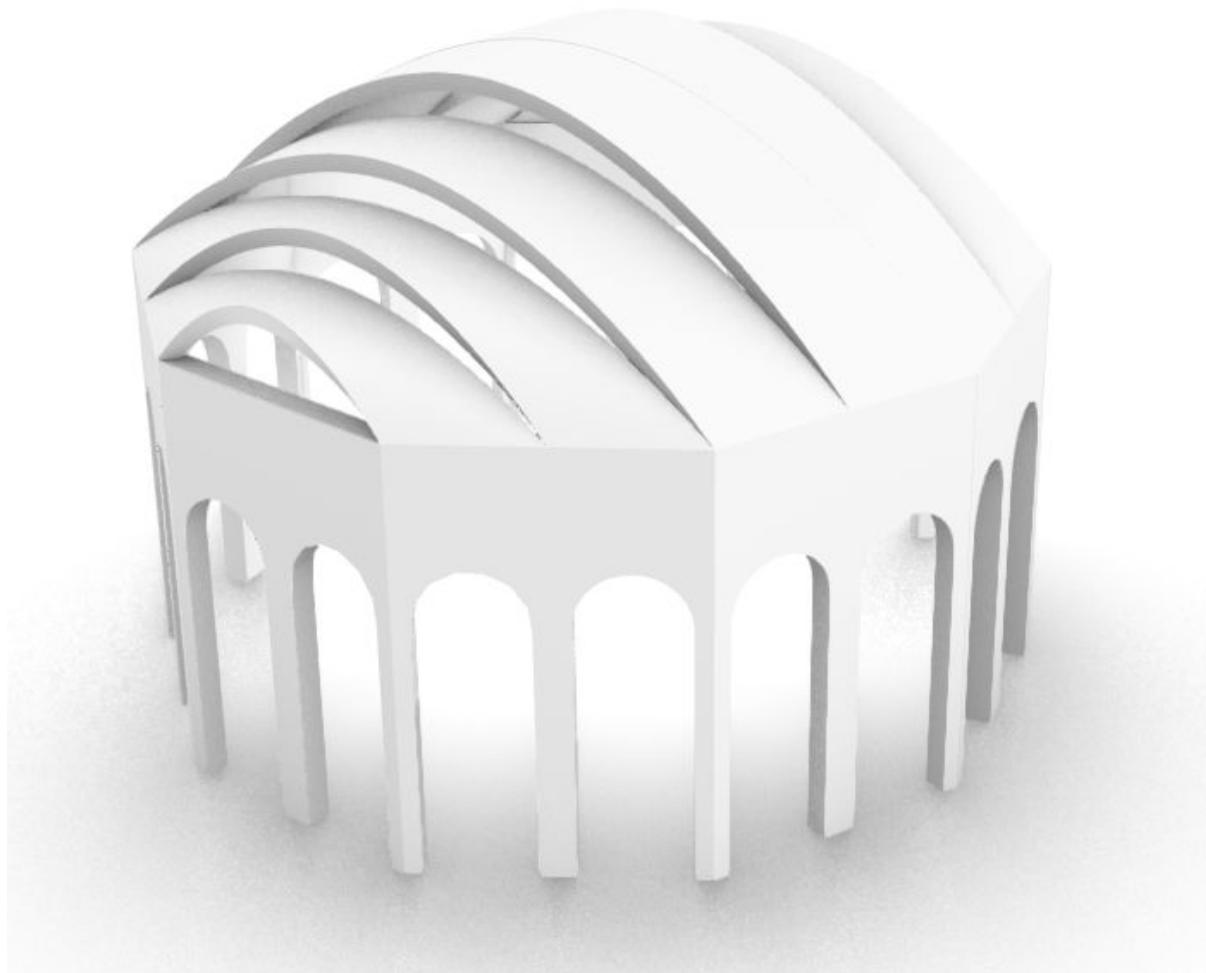


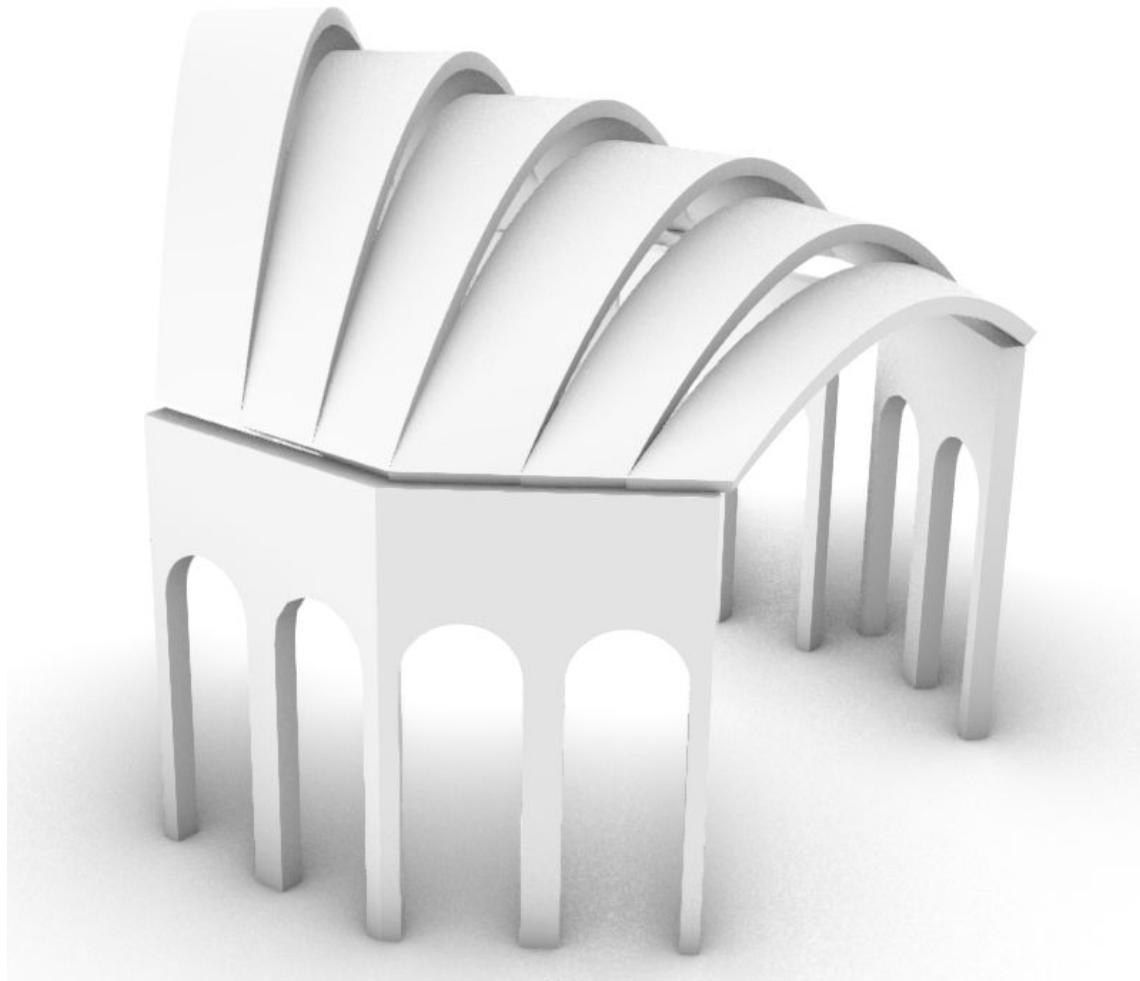


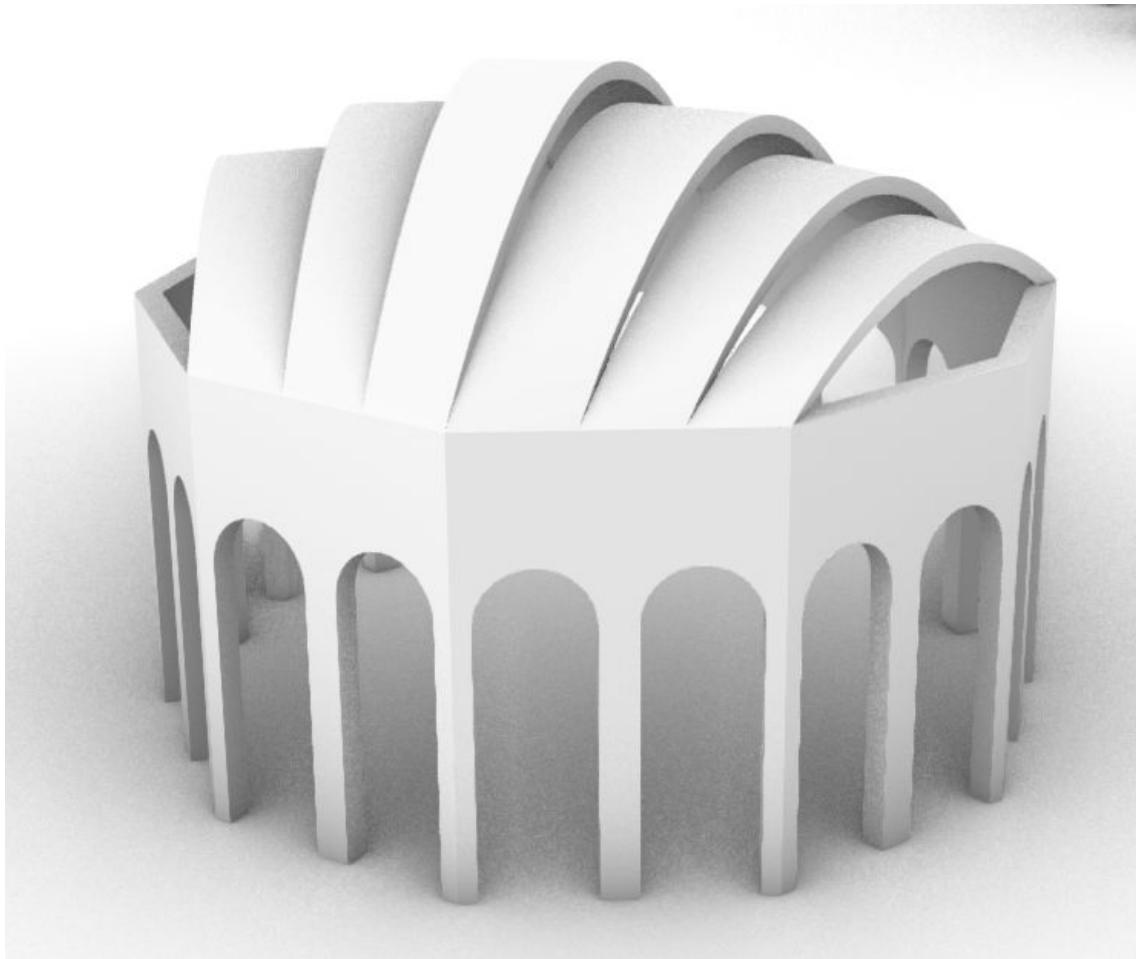


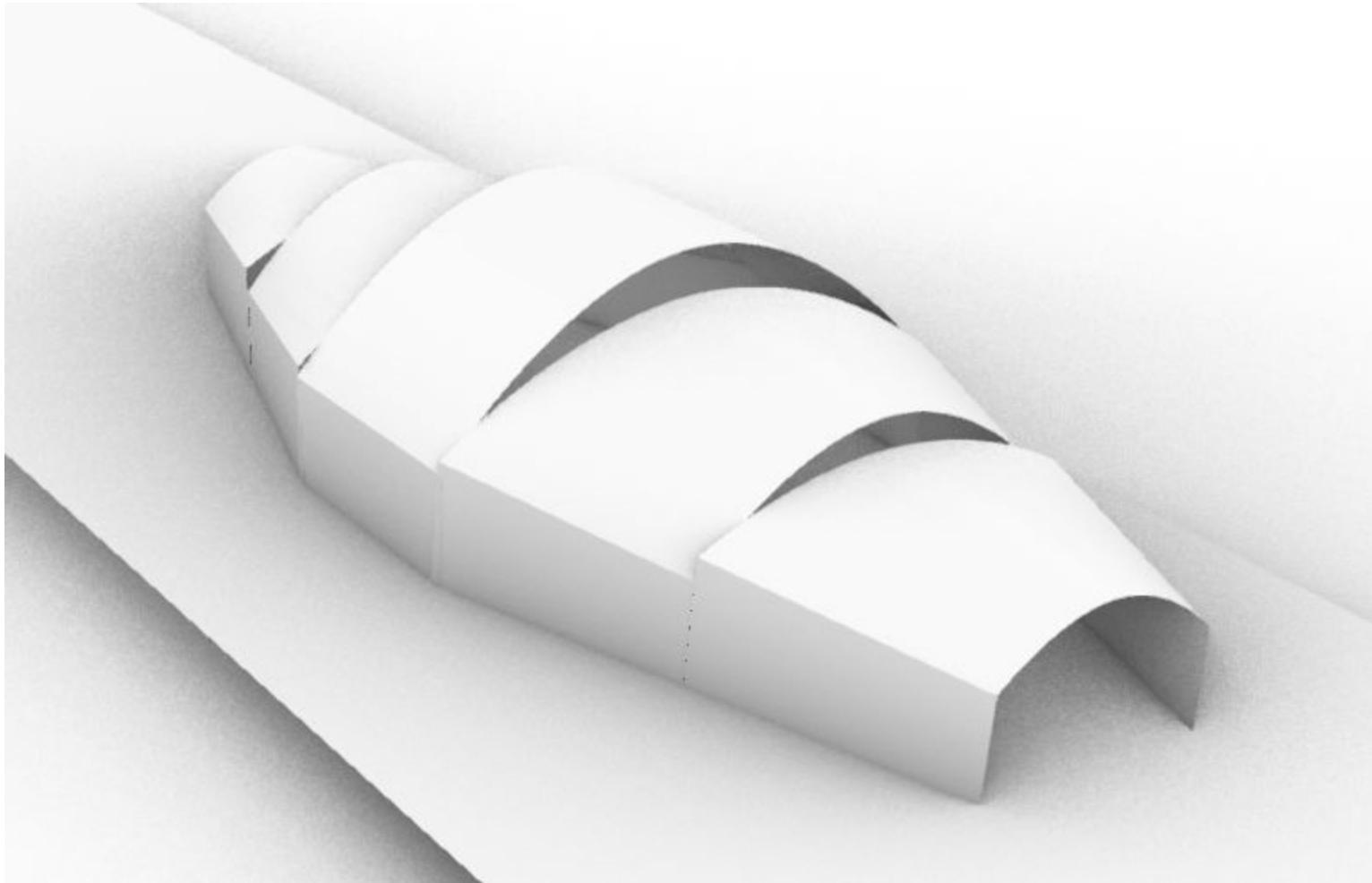


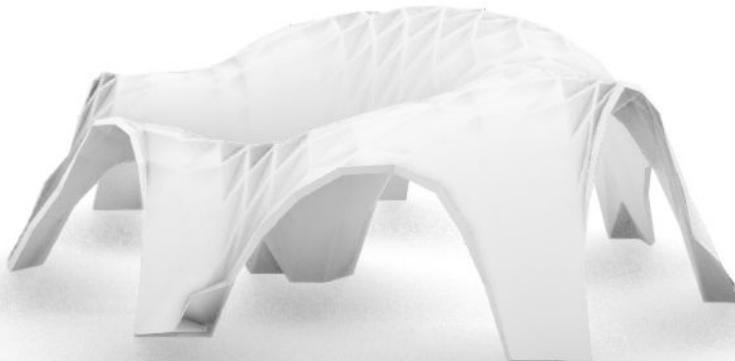


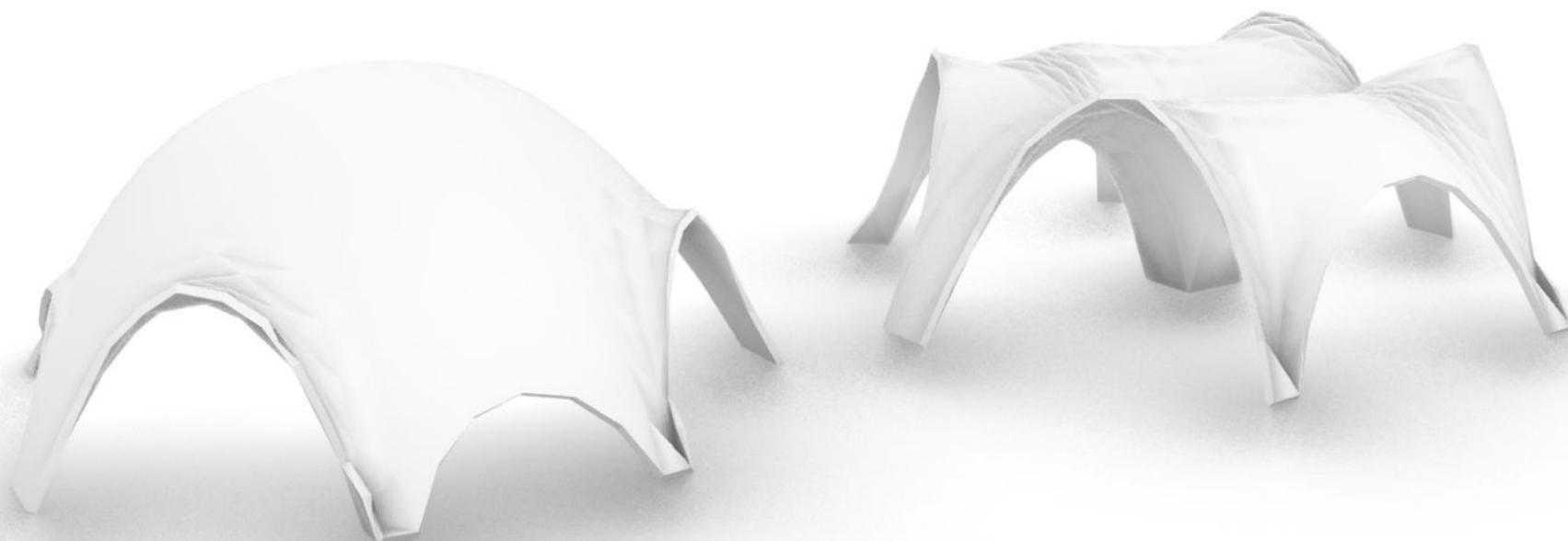


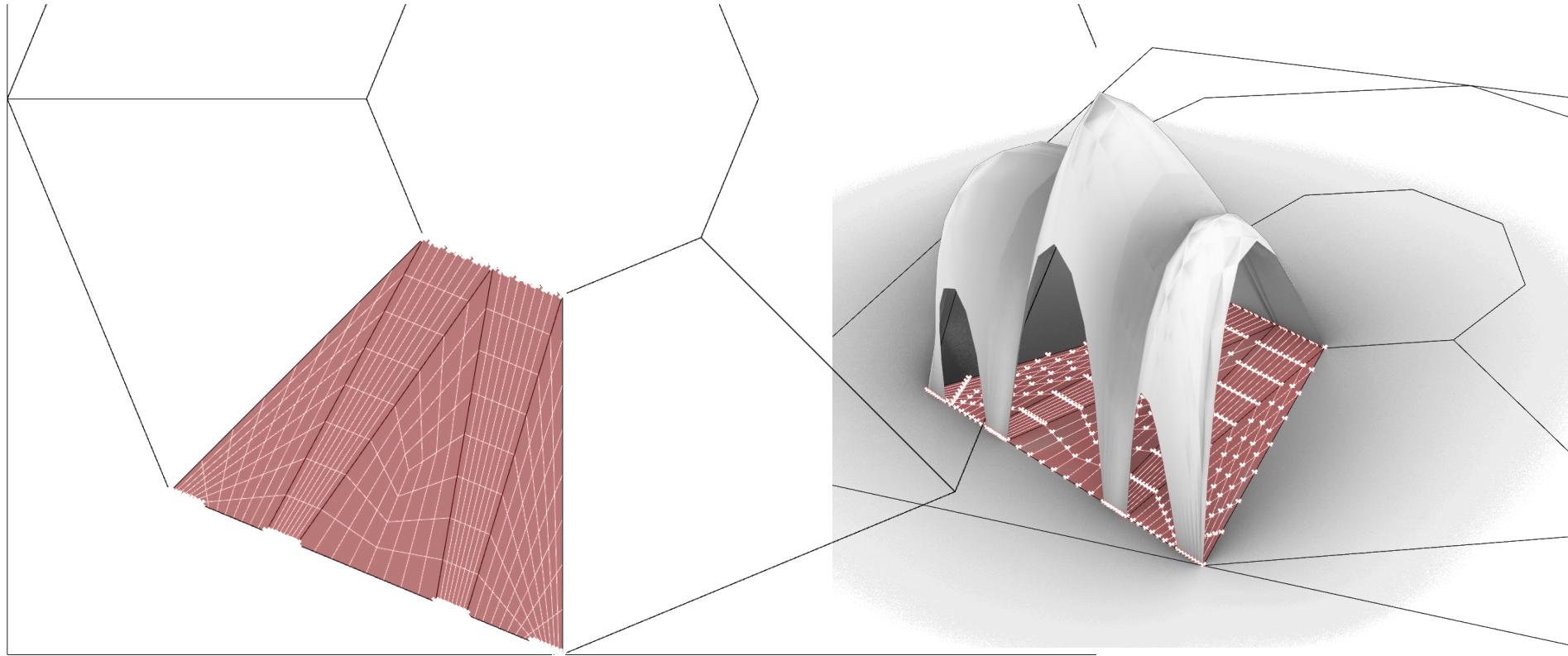


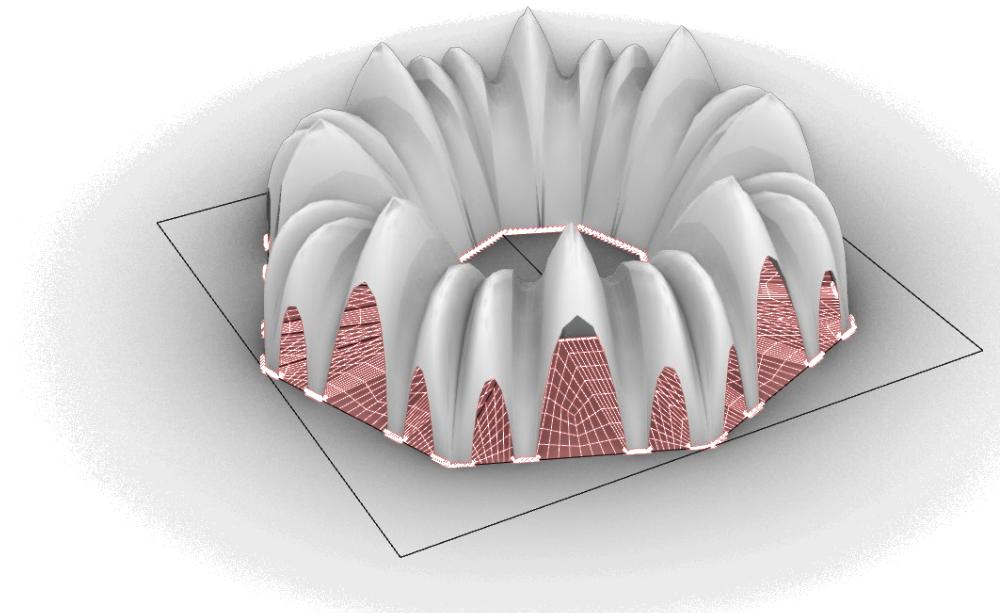


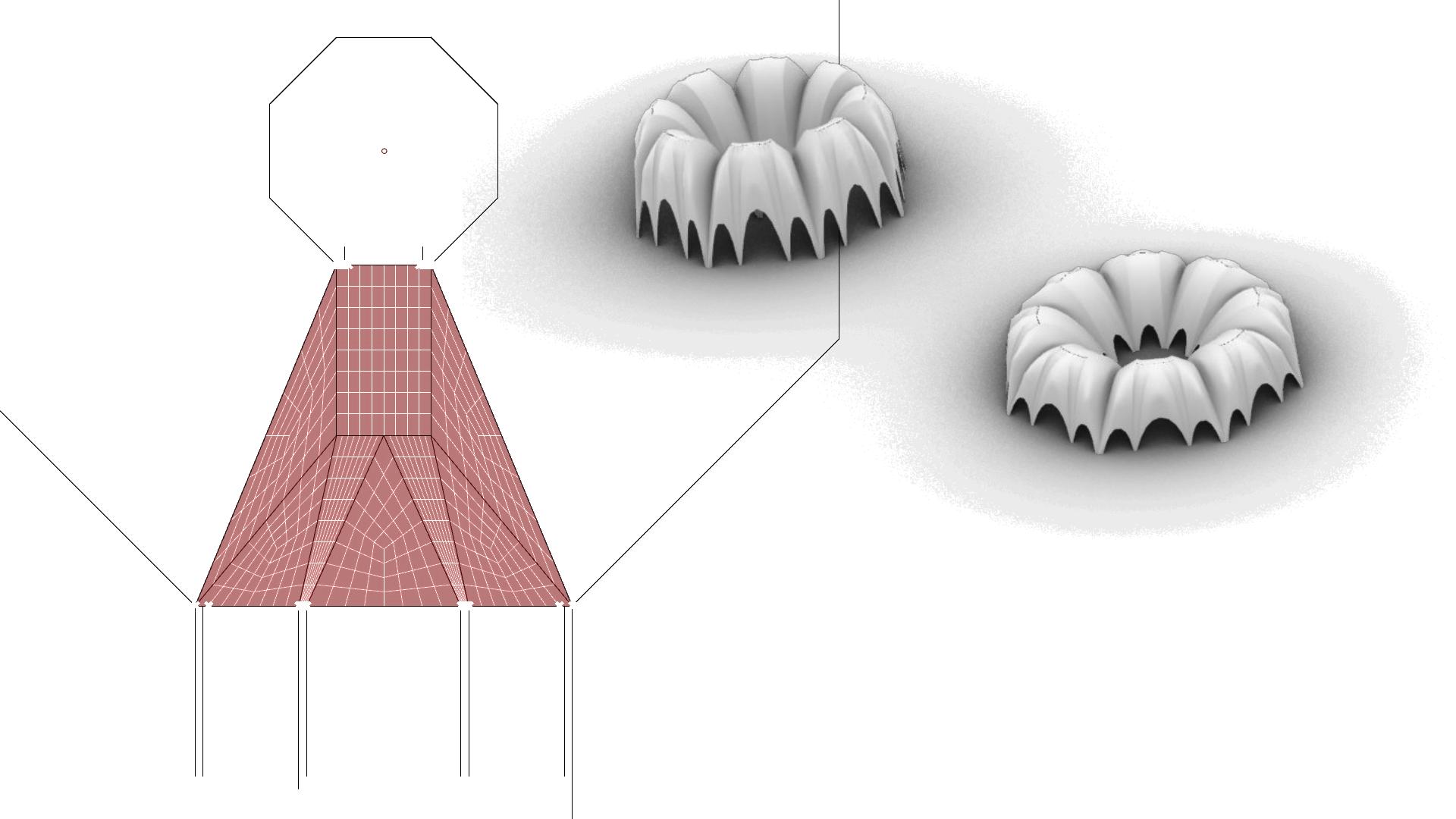


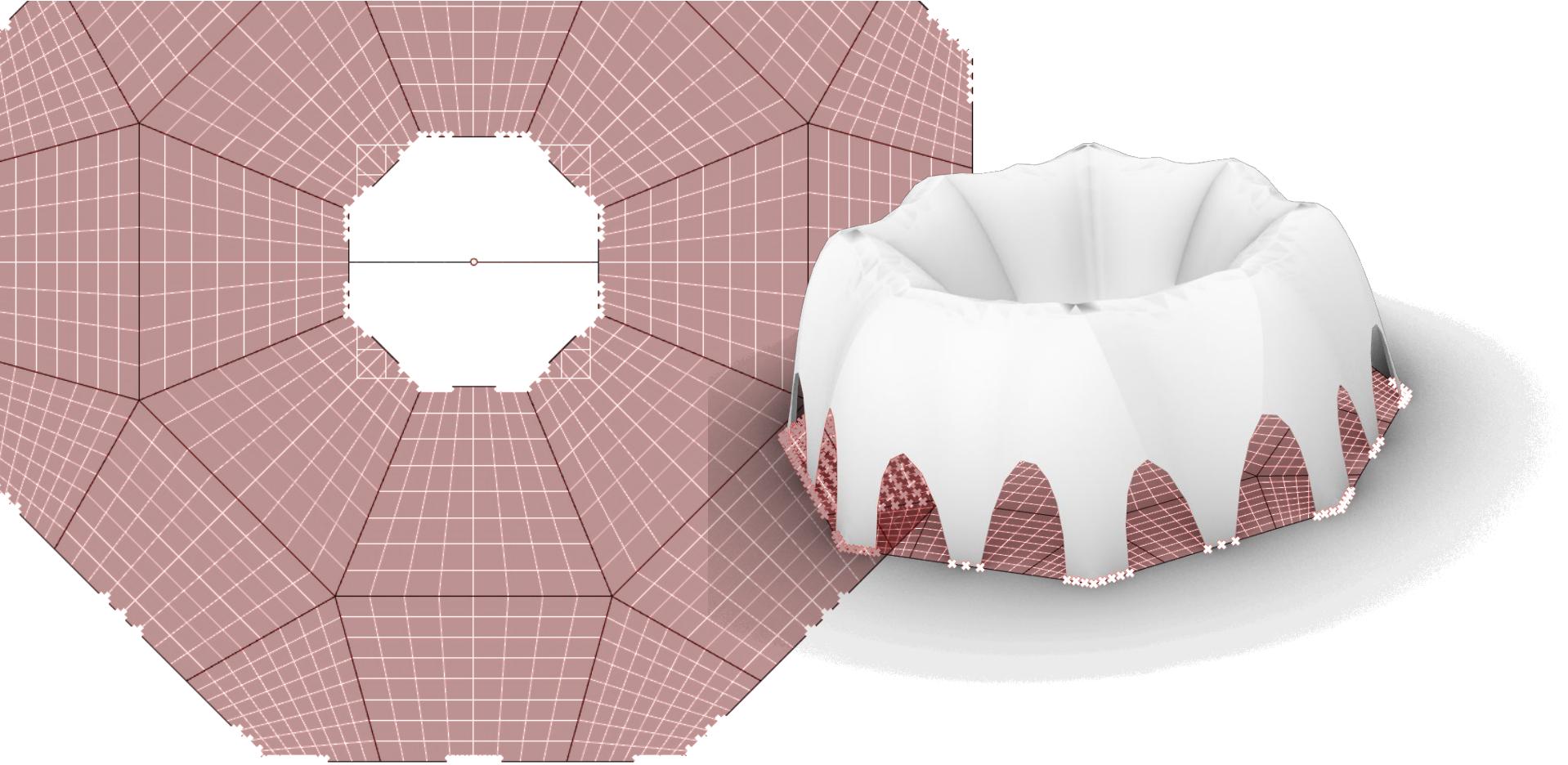


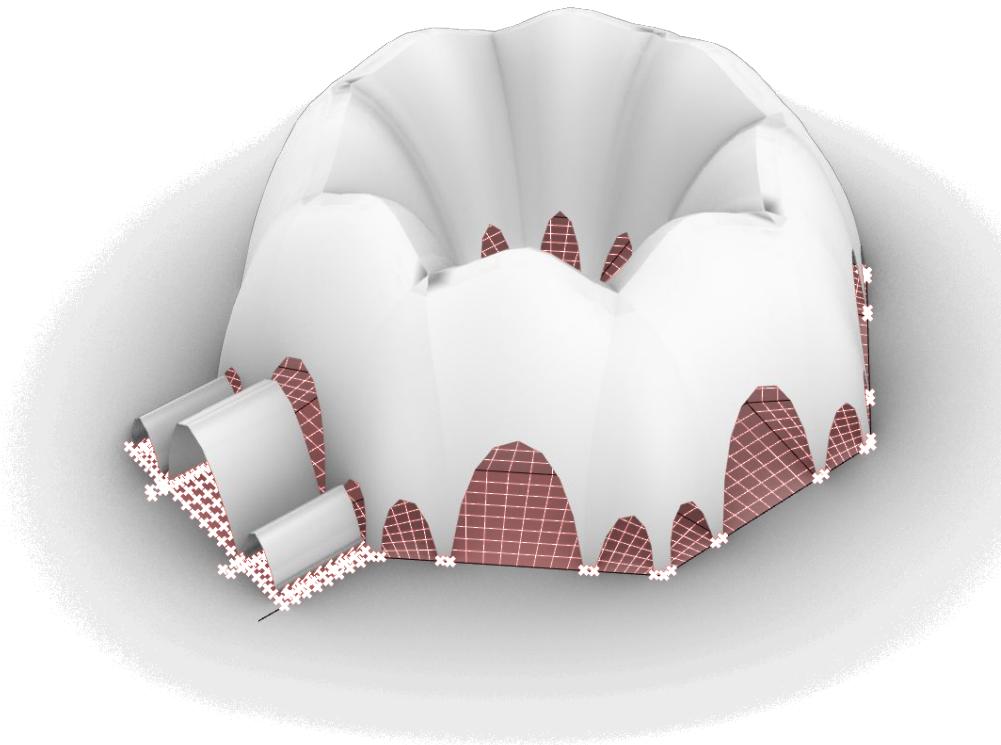
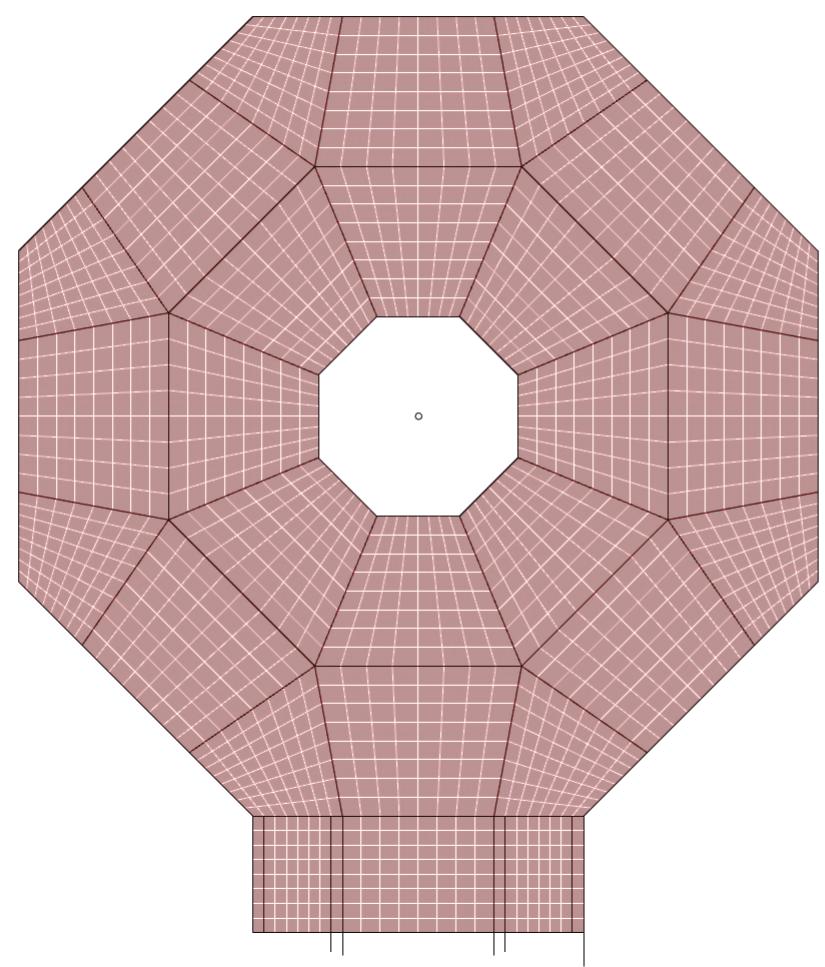










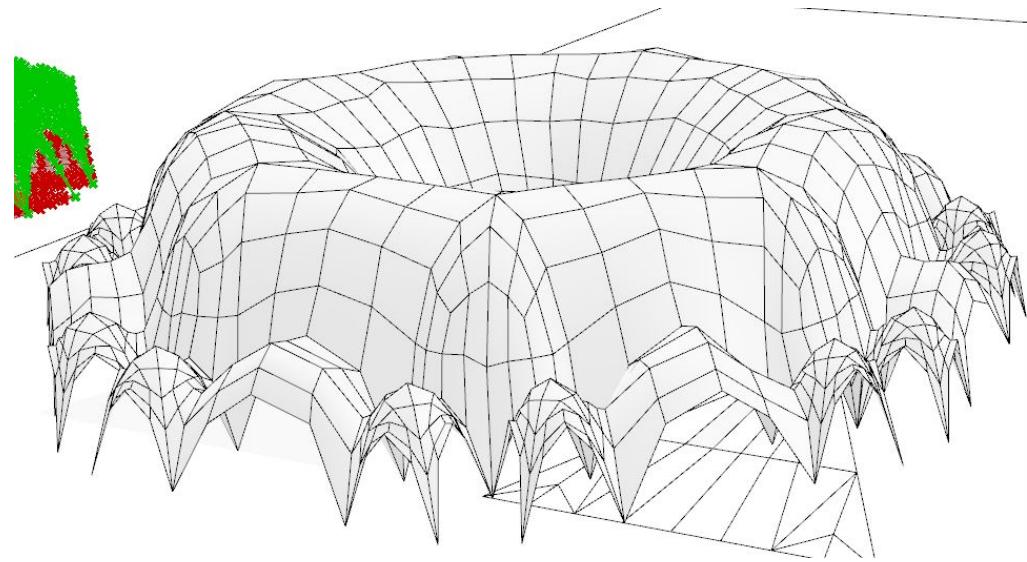


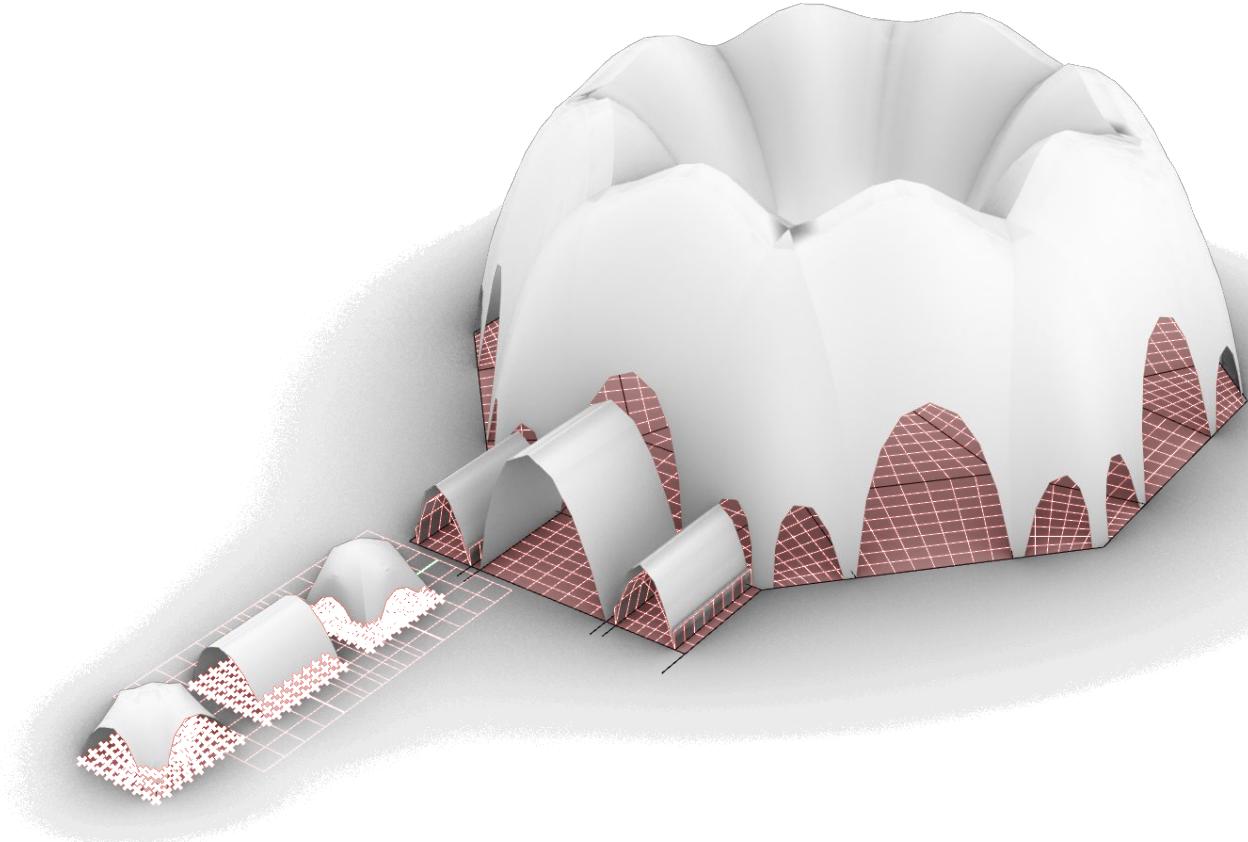
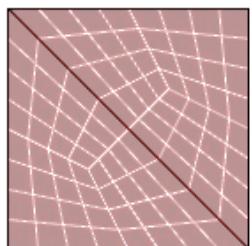
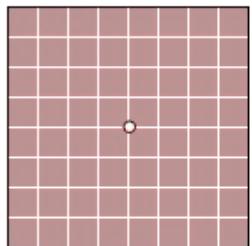
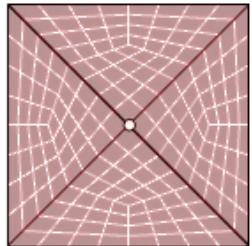
1000m²

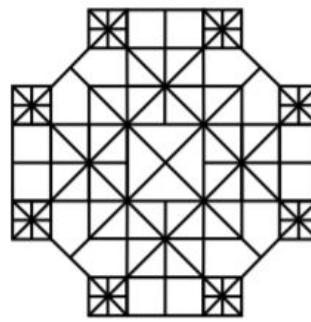
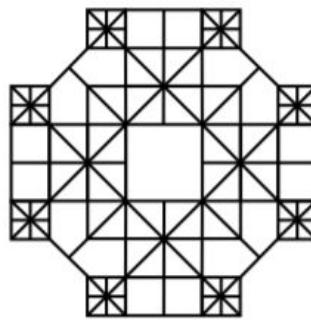
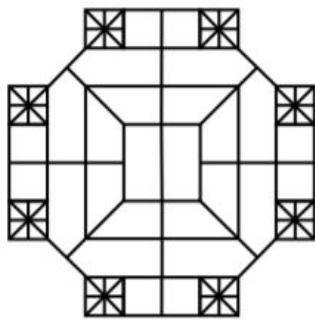
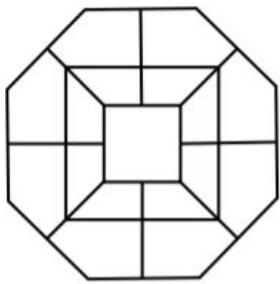
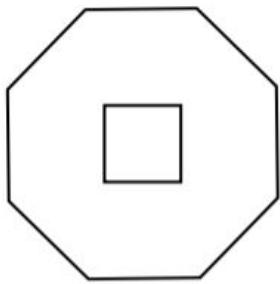
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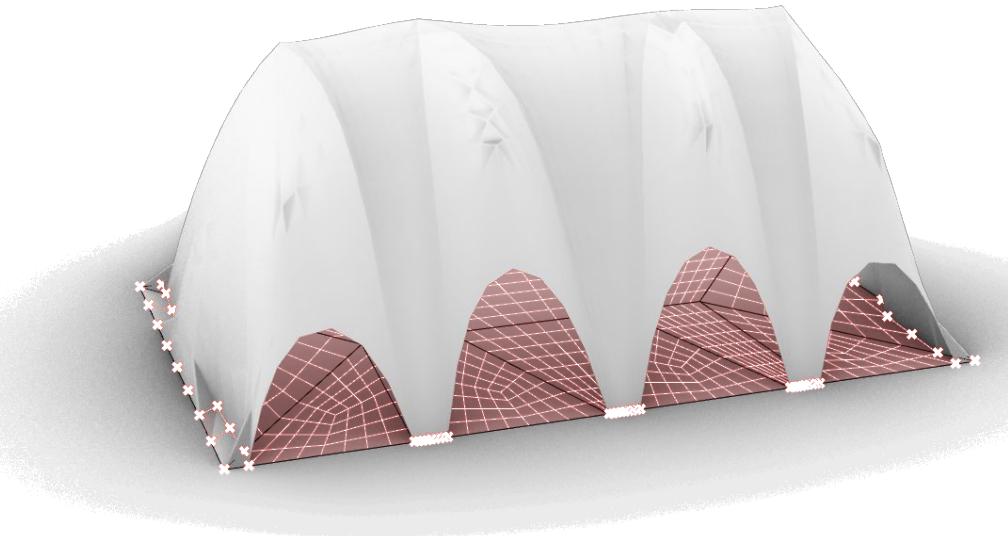
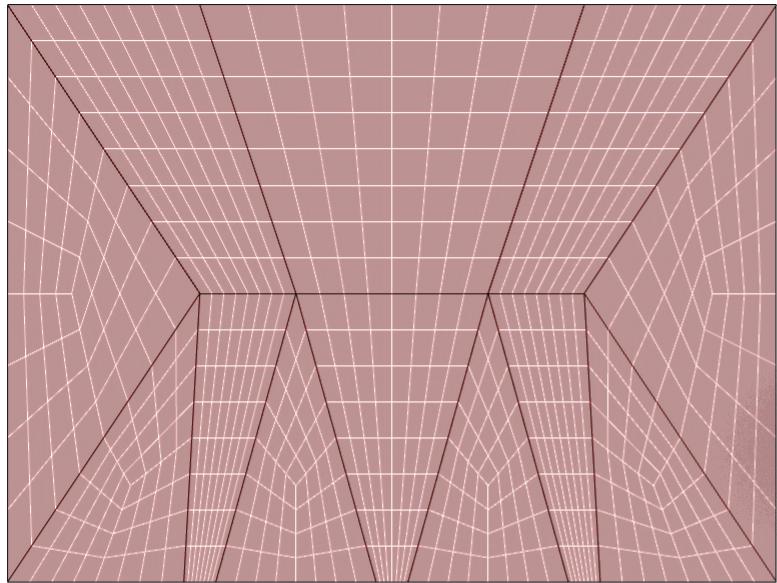
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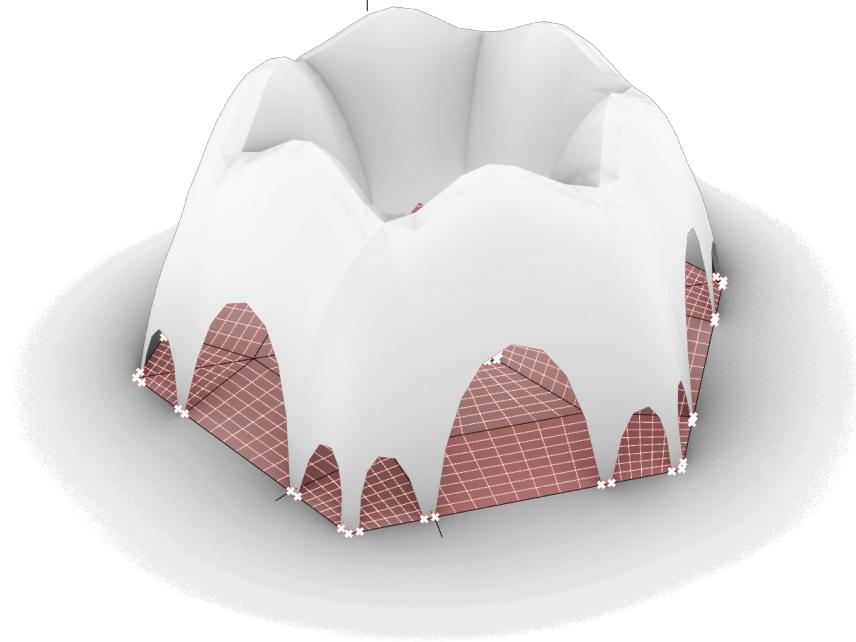
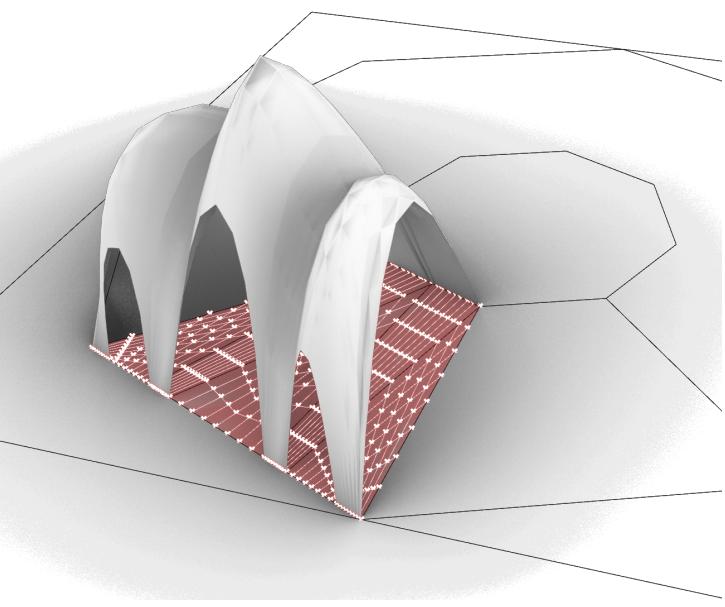
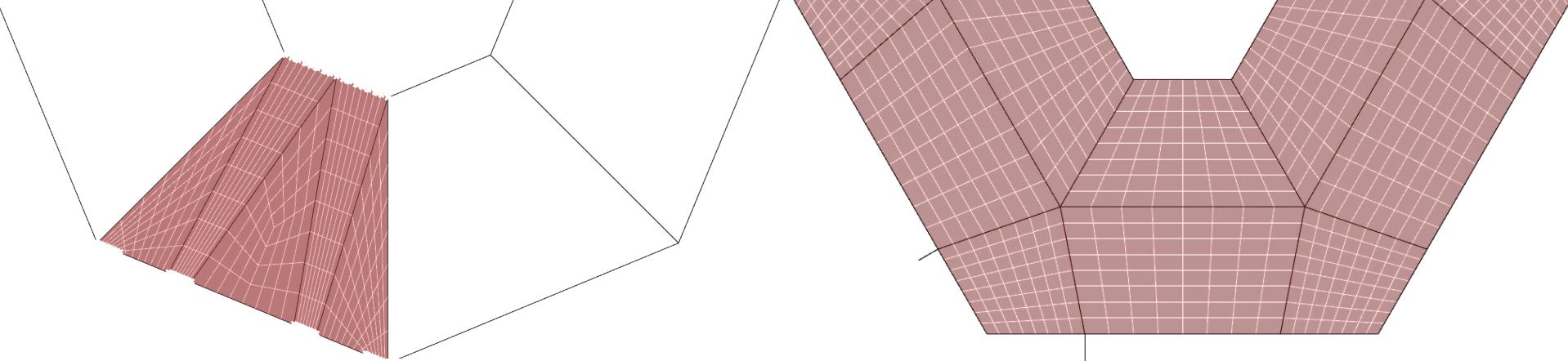
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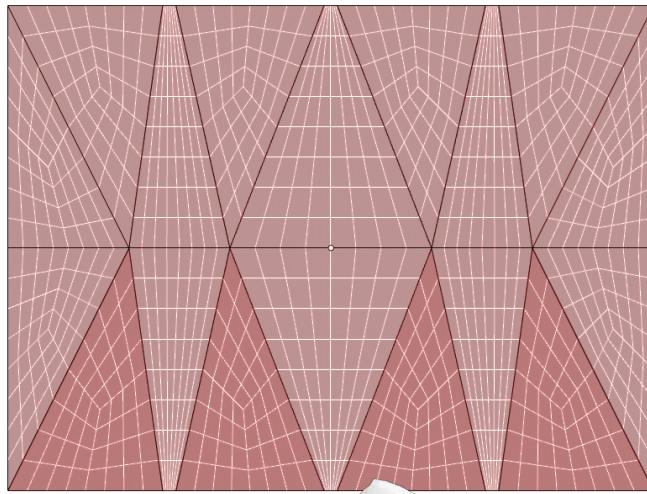
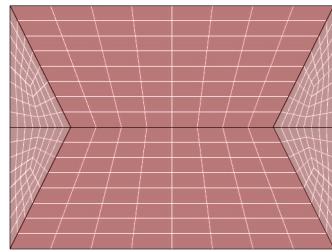
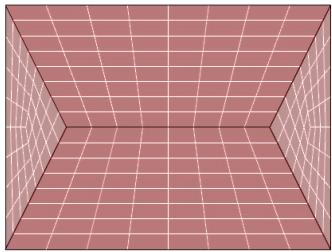
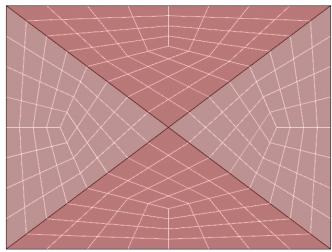


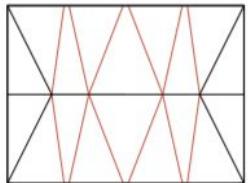
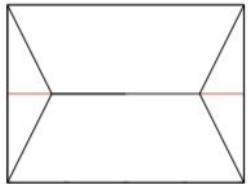
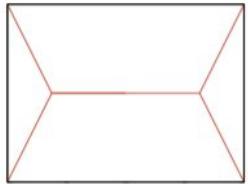


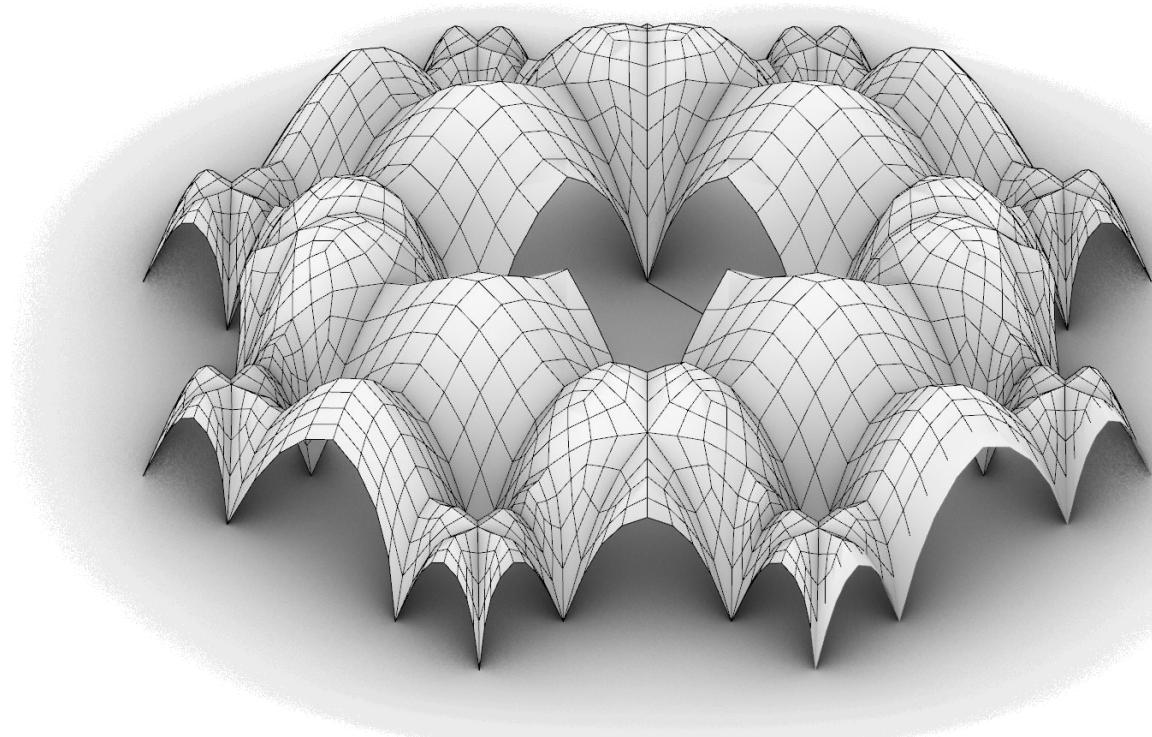
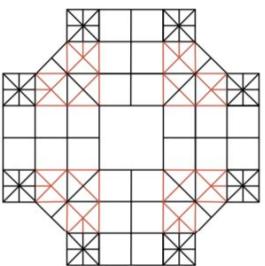
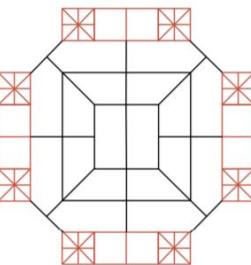
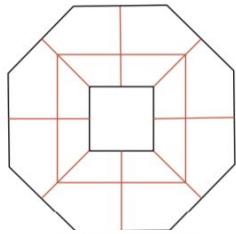
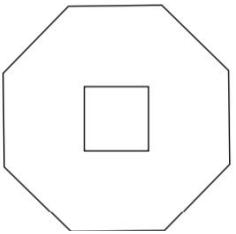


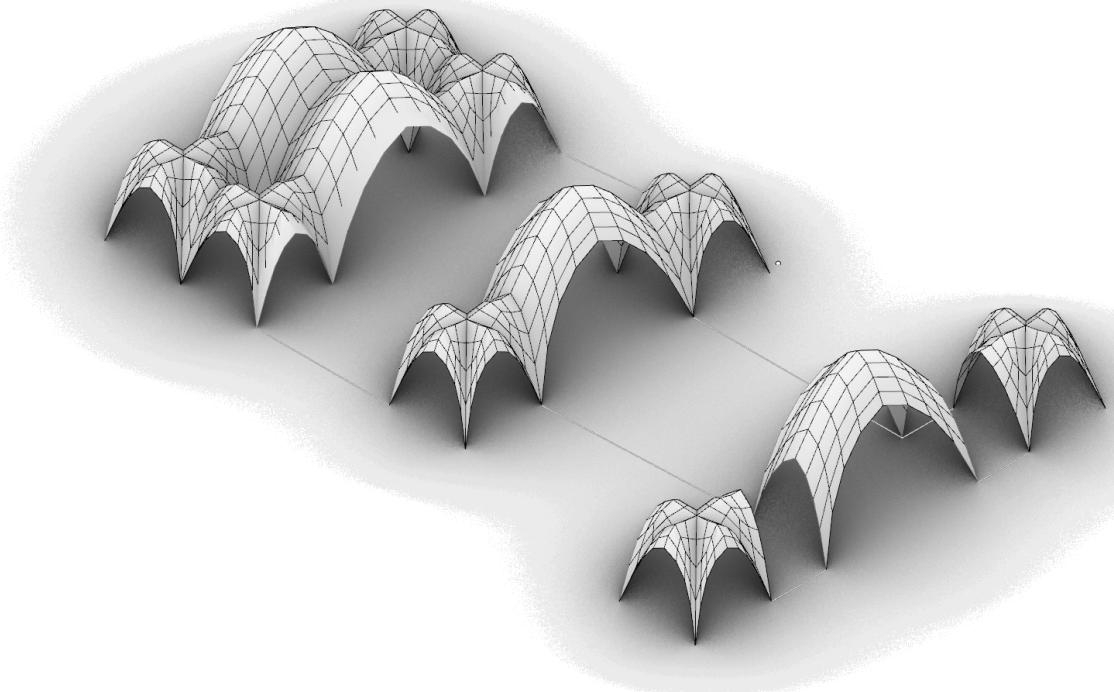


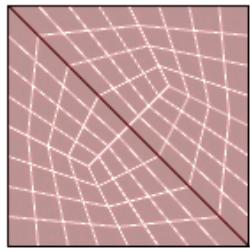
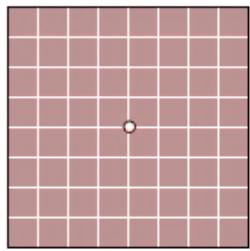
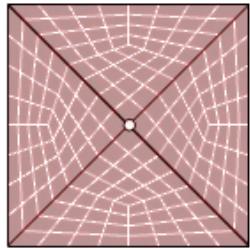






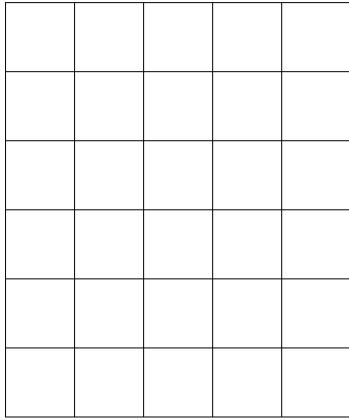




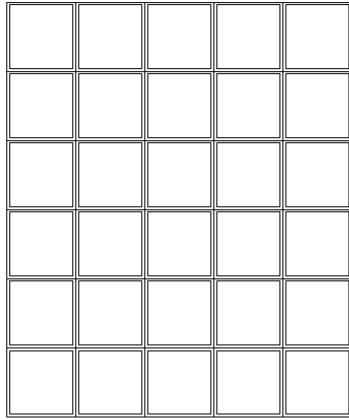


After mid-term

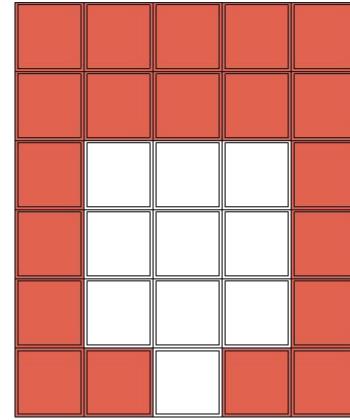
Week 6



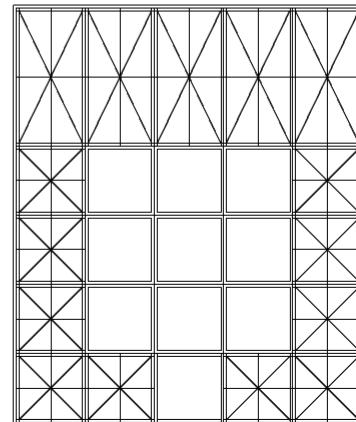
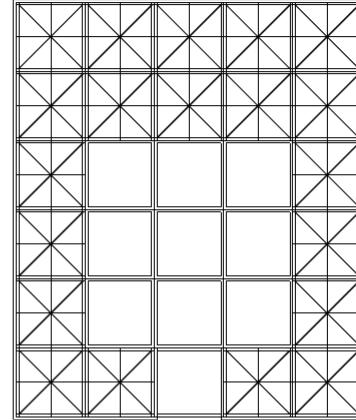
grid from layout tool



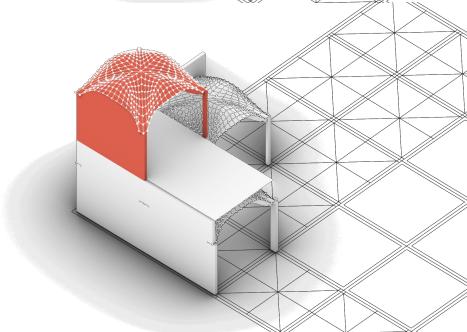
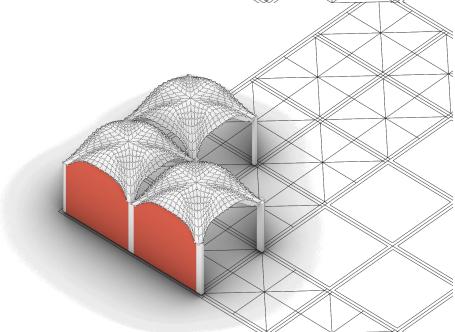
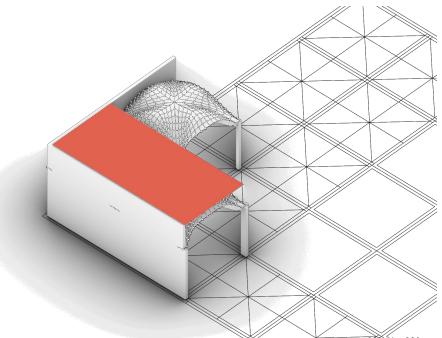
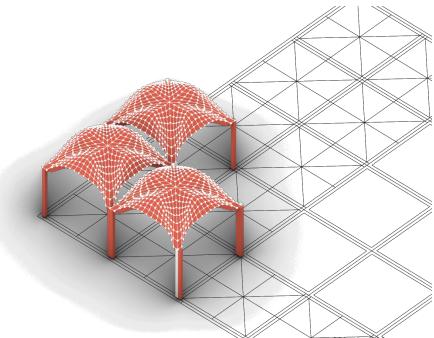
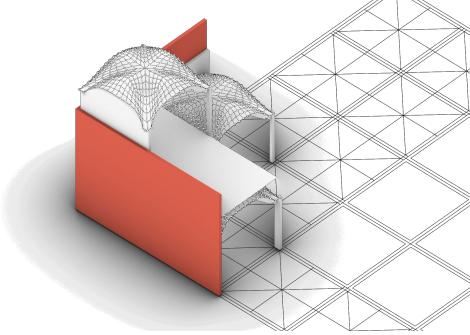
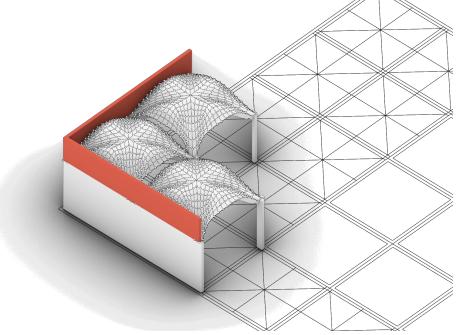
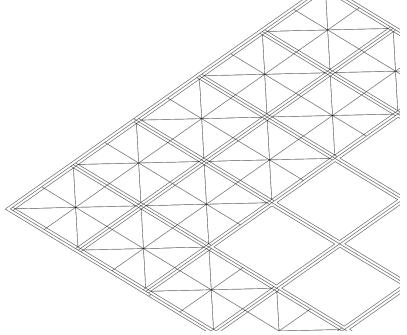
tartan grid



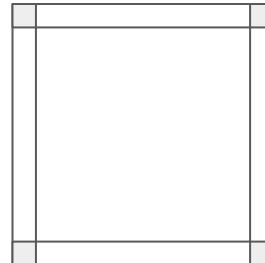
open and closed

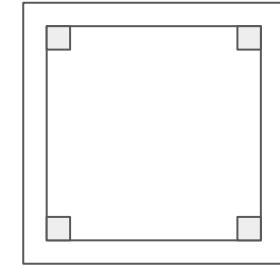
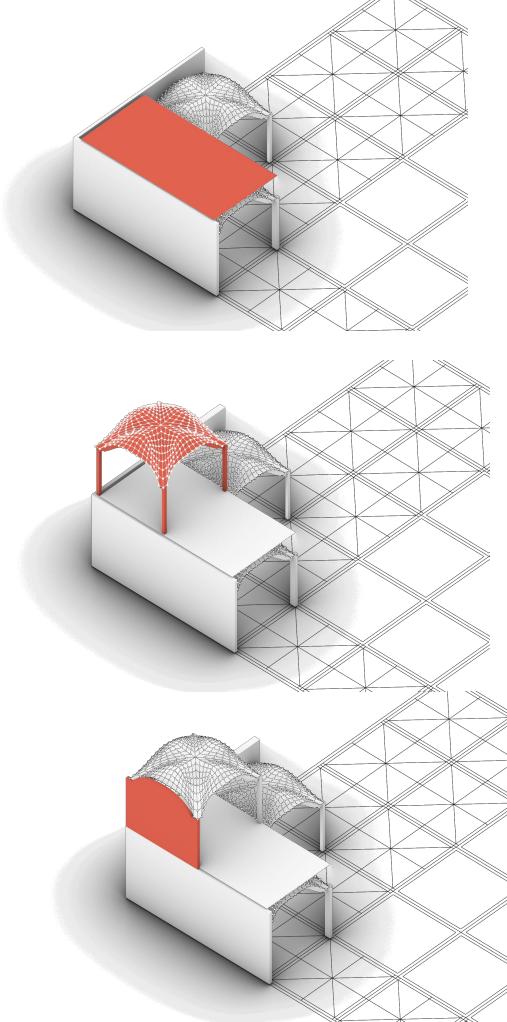
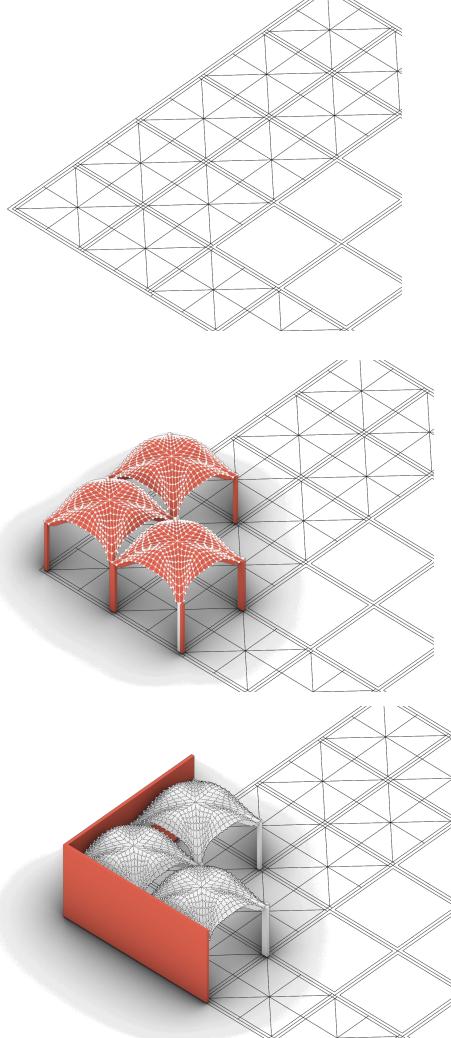


tessellations

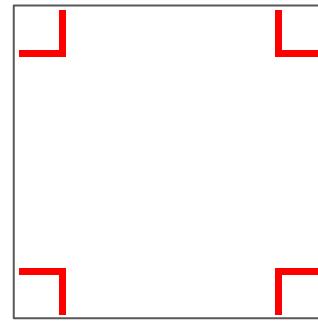
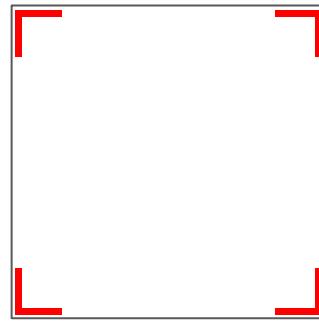
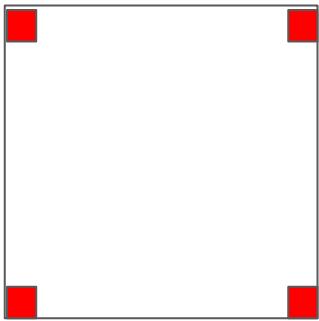


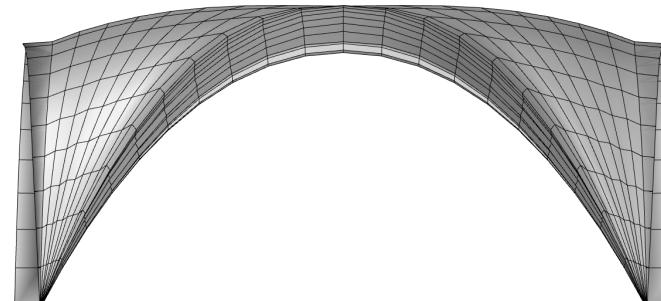
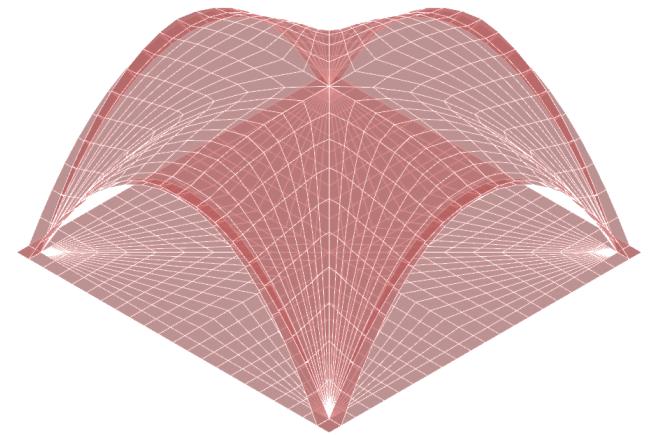
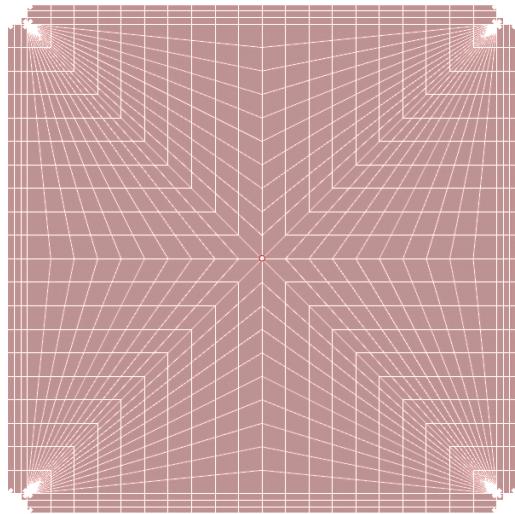
- connecting vaults to have continuous roof
- infill of 15 cm + external layer?
- 15 cm column is enough?

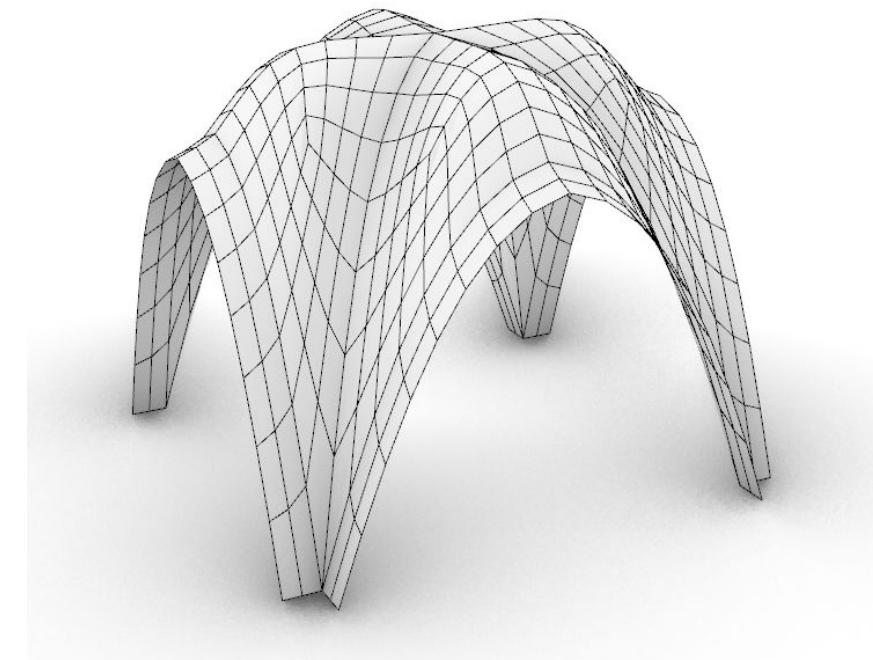
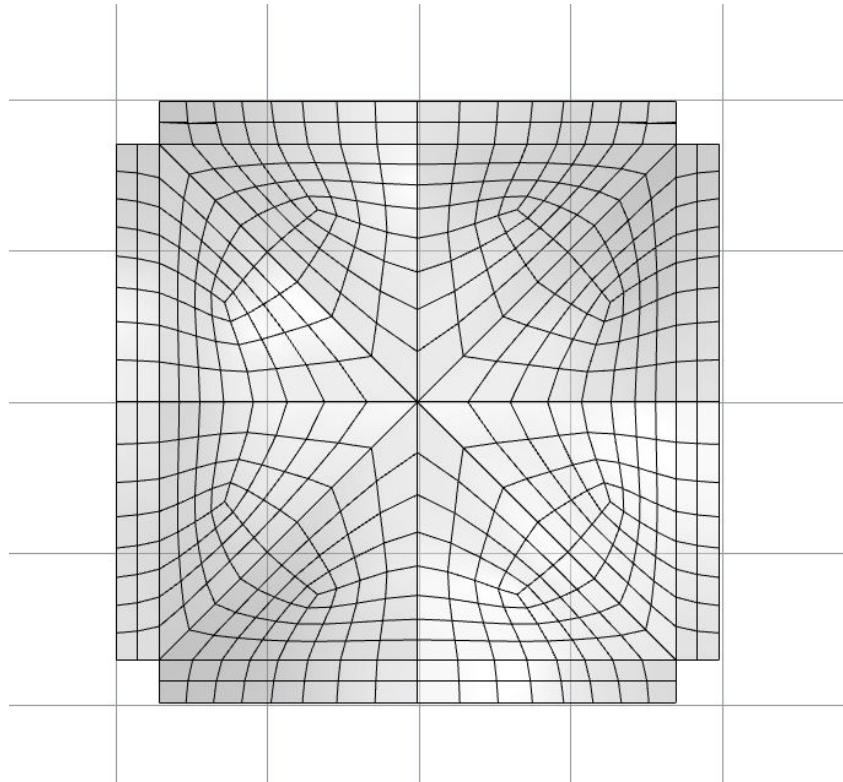


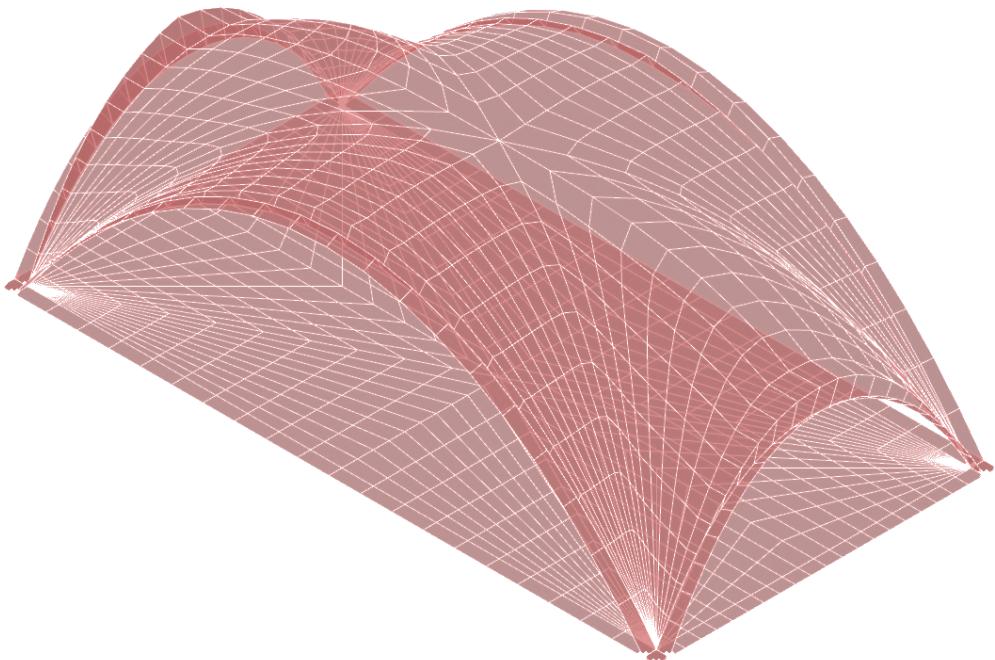
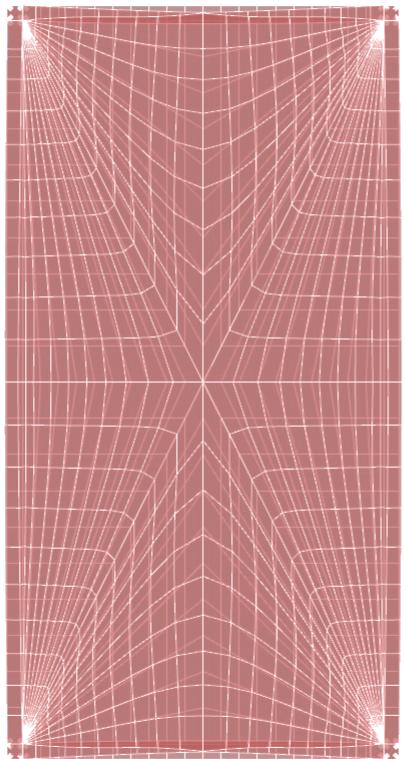


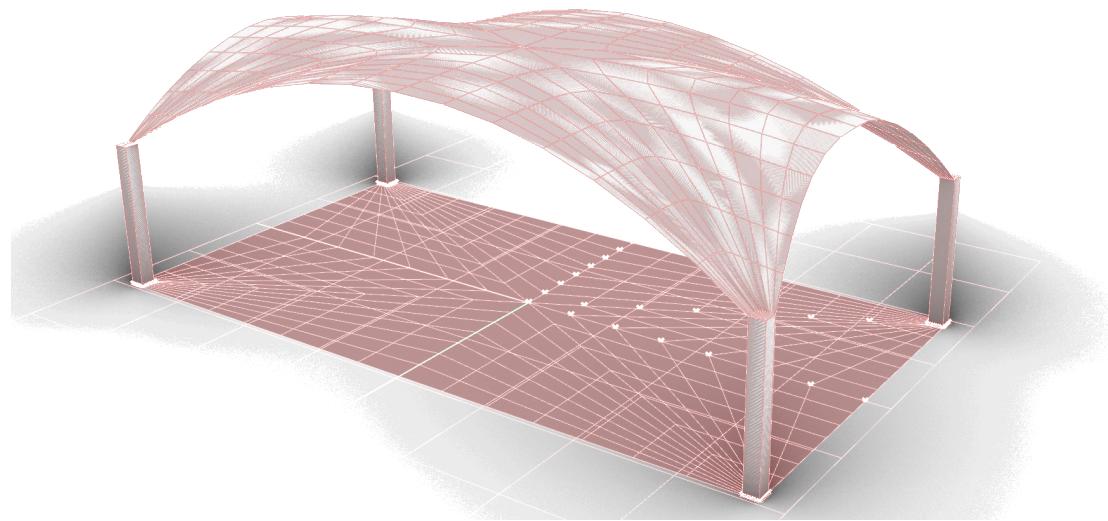
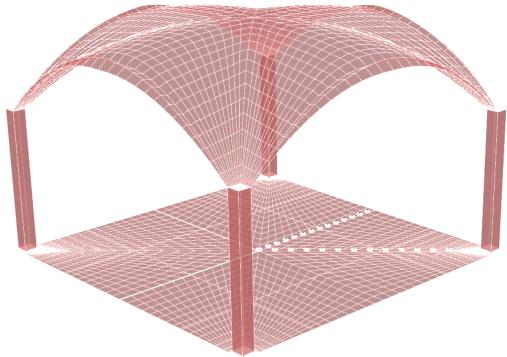
- less steps, maybe easier
- simple rectangular modules, not connected to the roof tessellation
- 15cm (?) or extra offset to make them 30

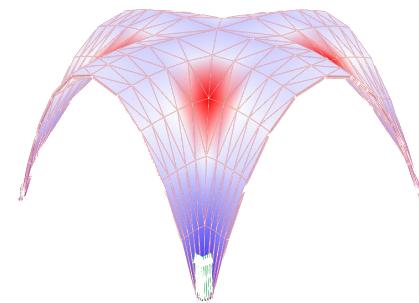
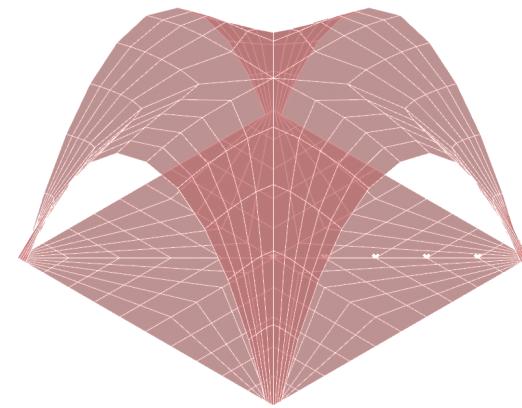
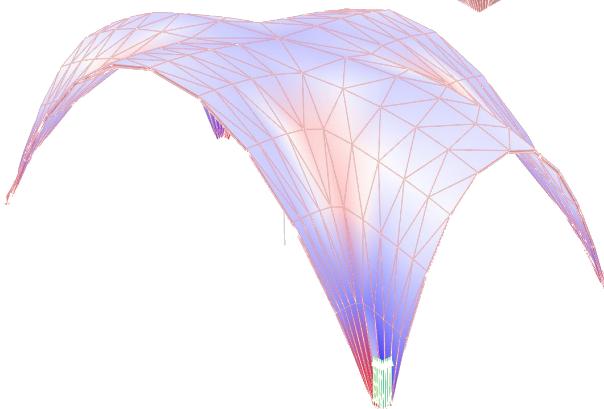
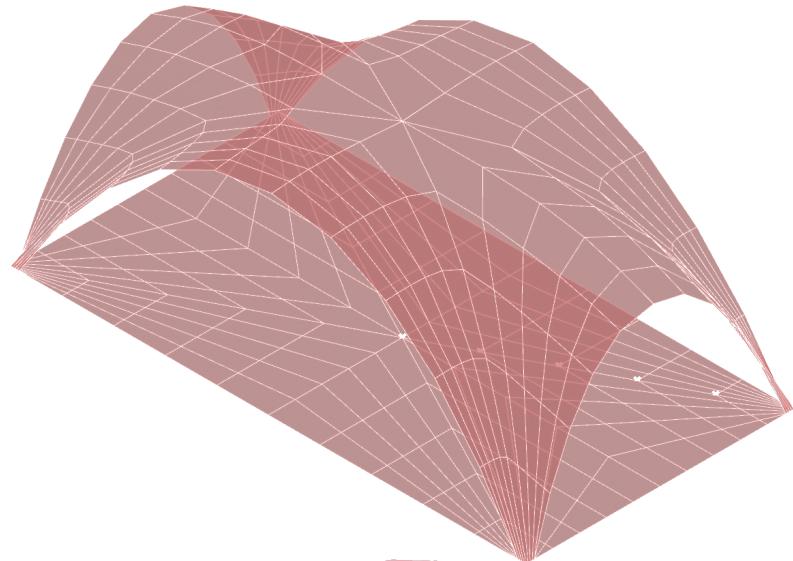


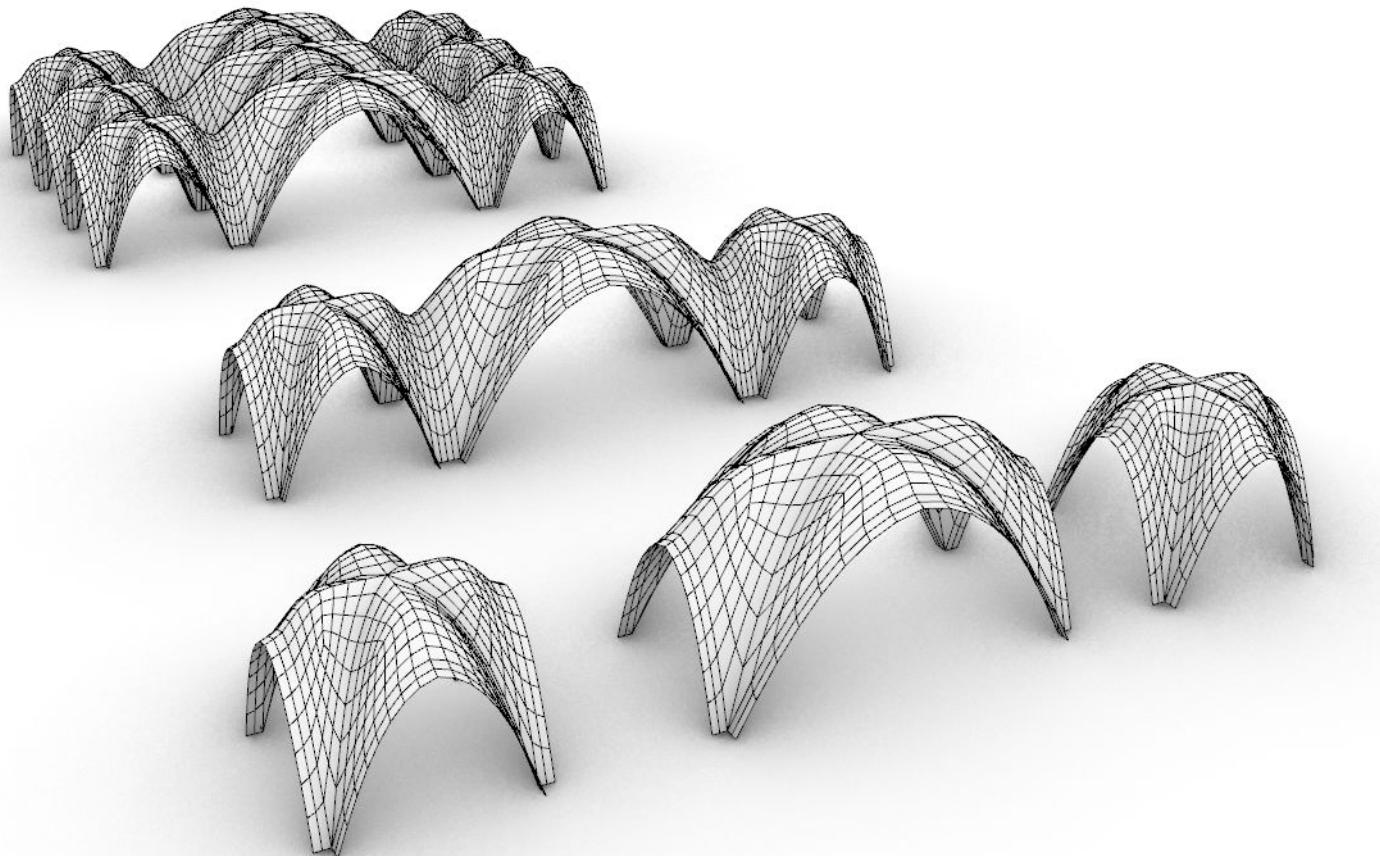


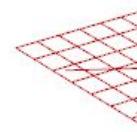
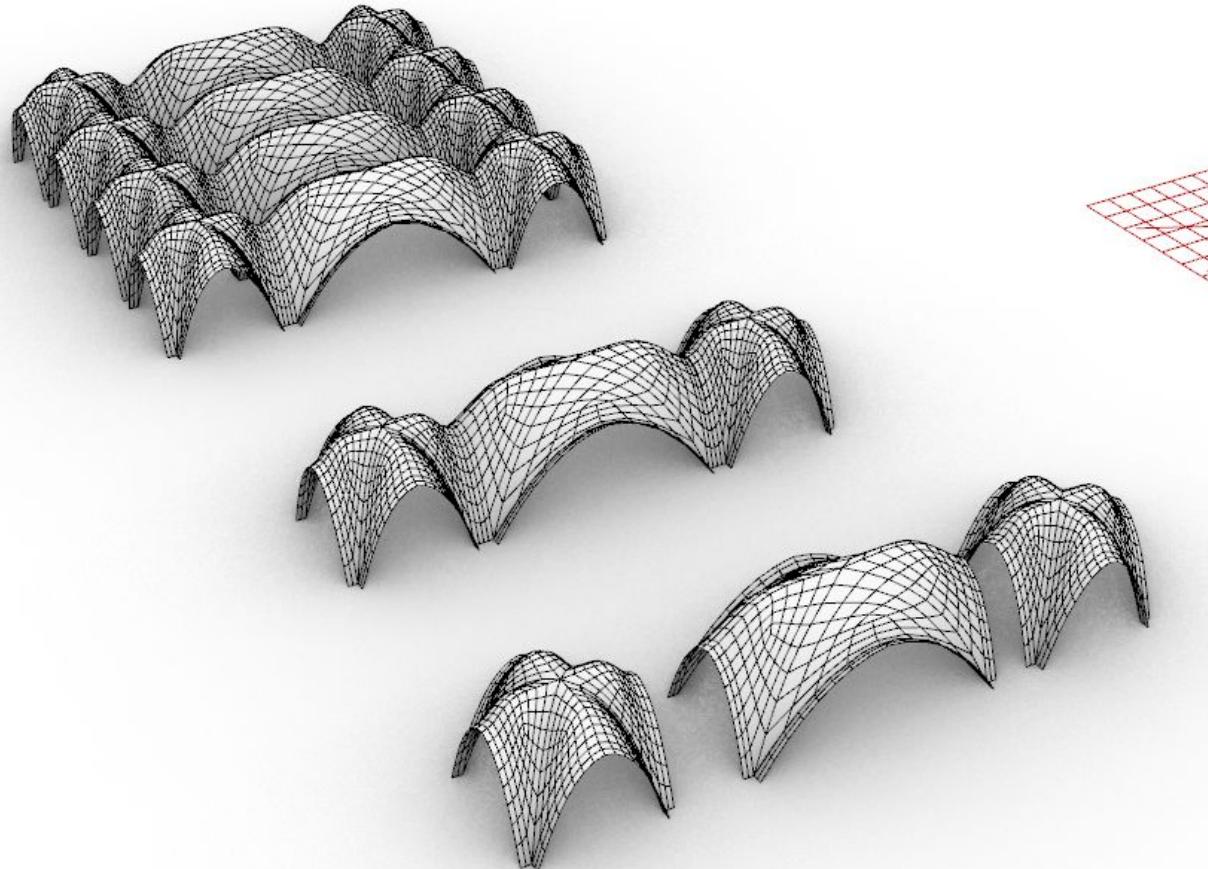


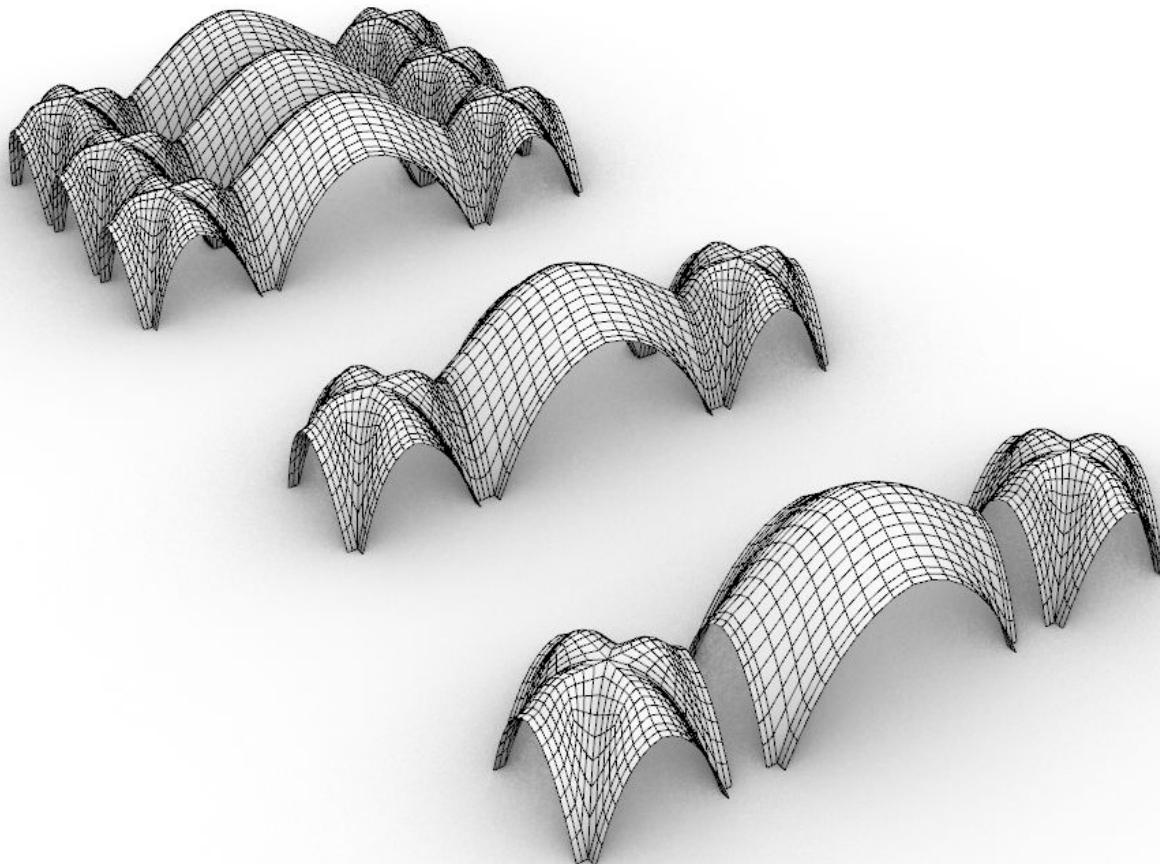
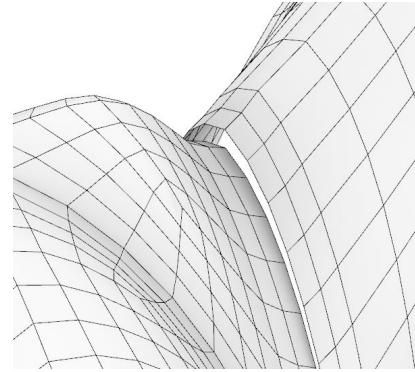


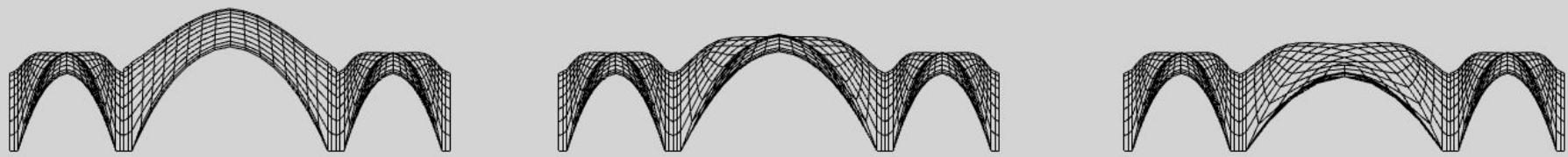


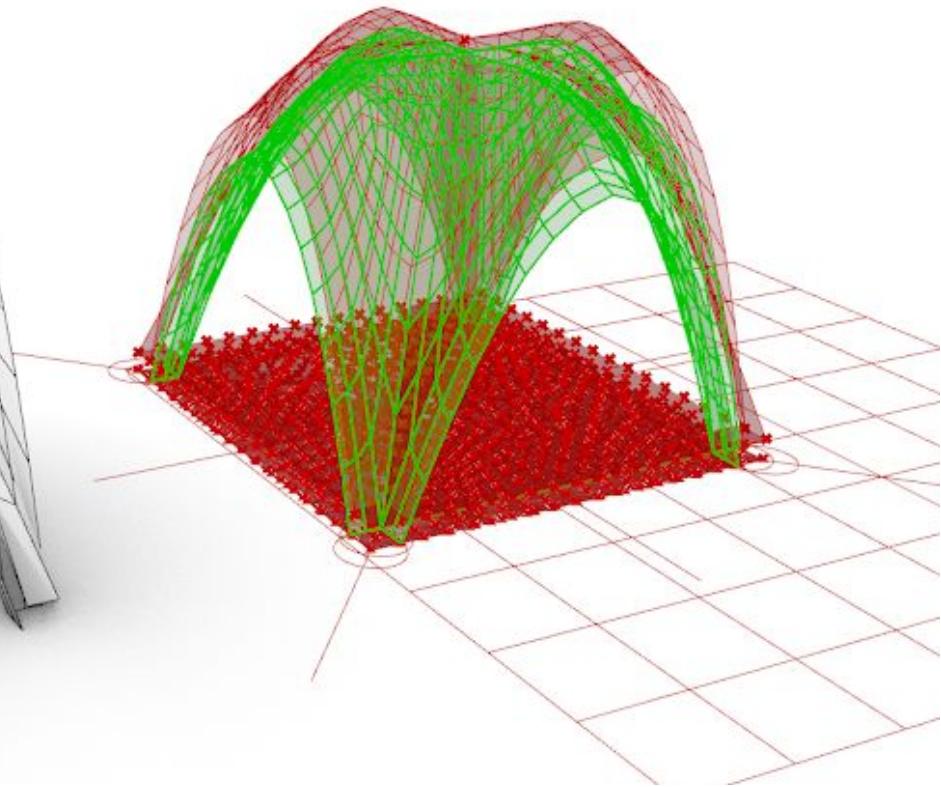
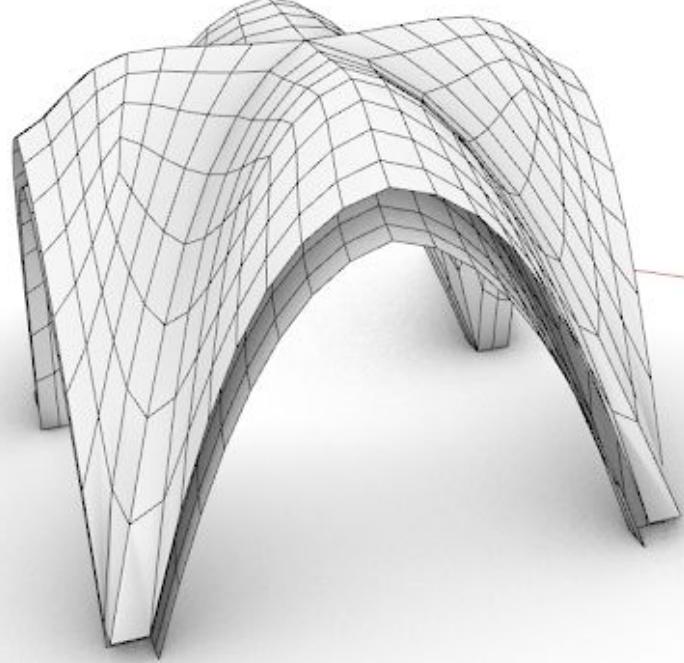






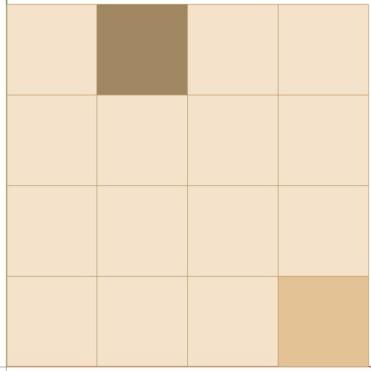
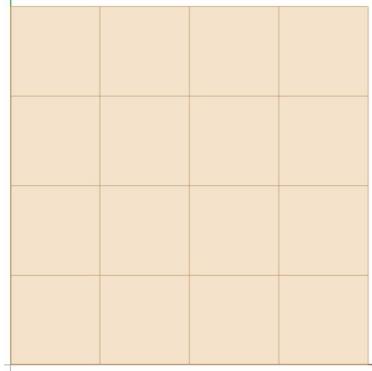




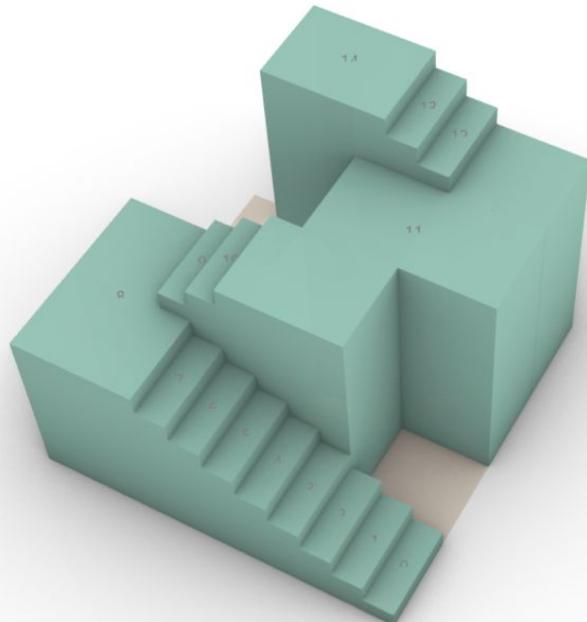
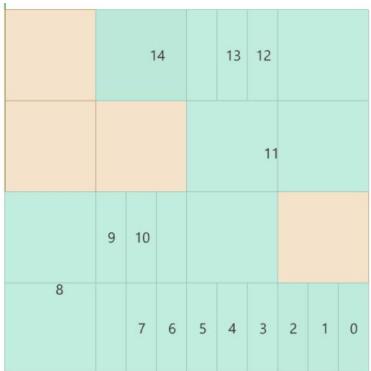


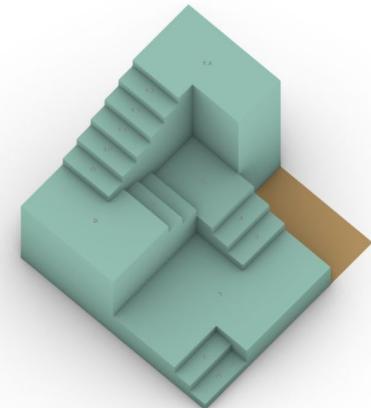
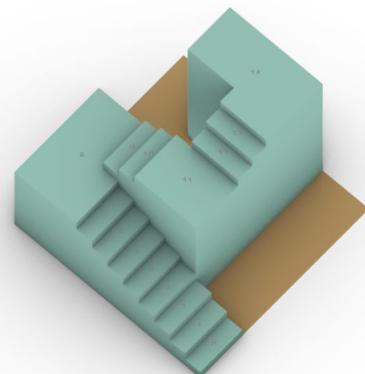
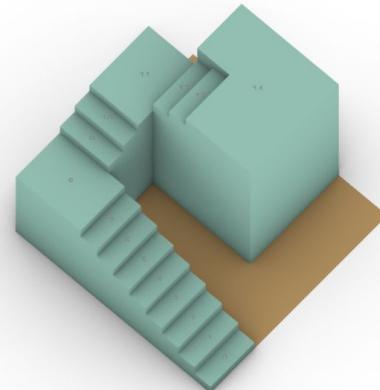
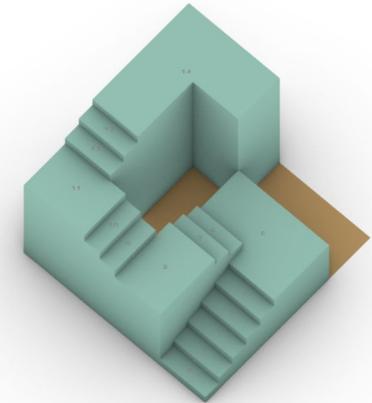
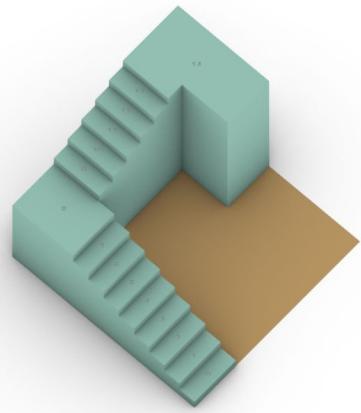
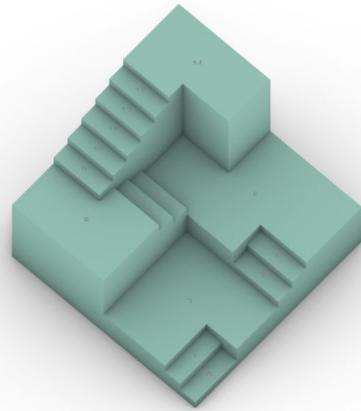
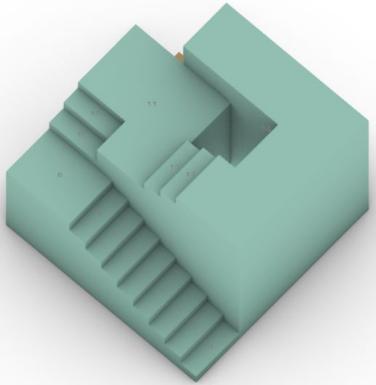
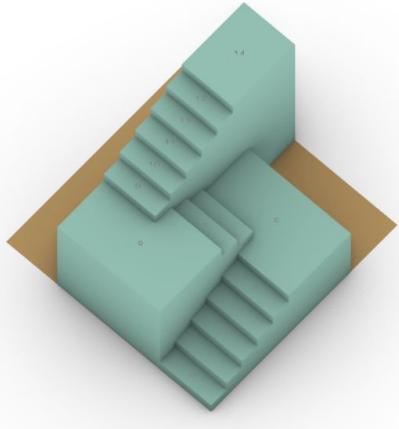
Building elements

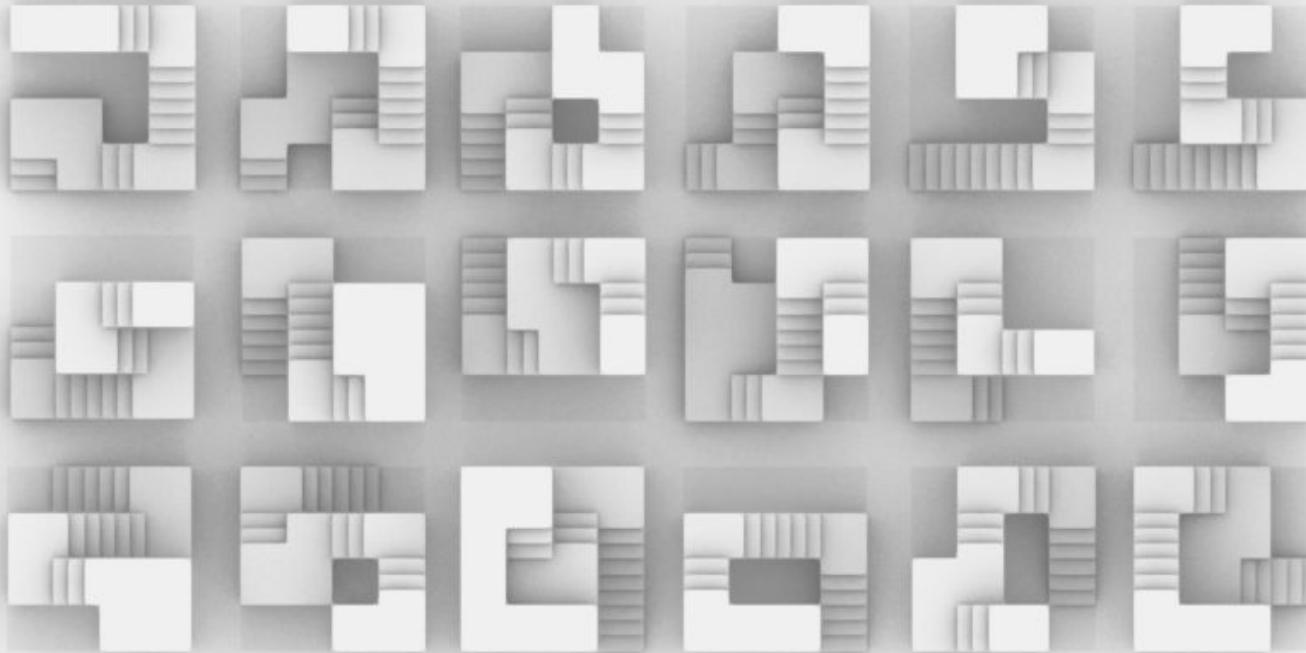
Stairs

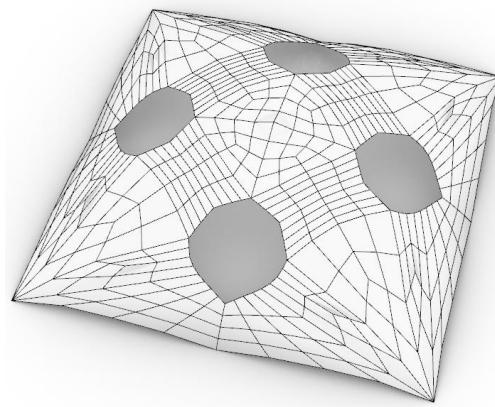
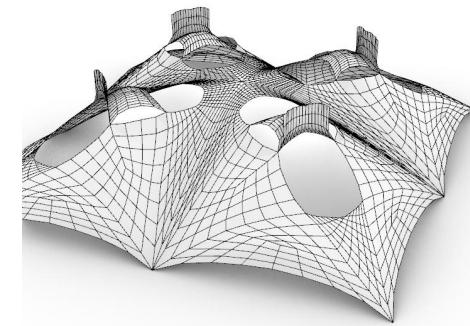
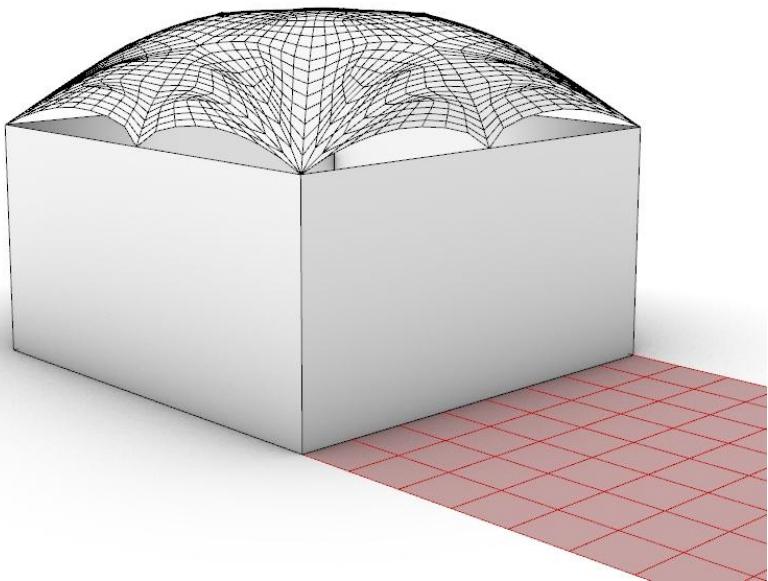


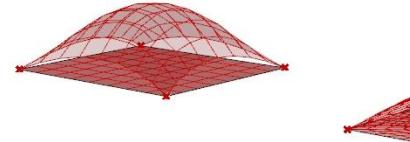
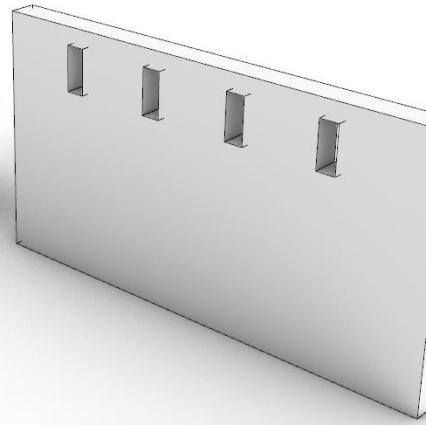
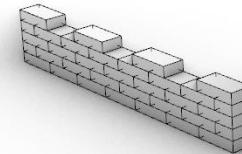
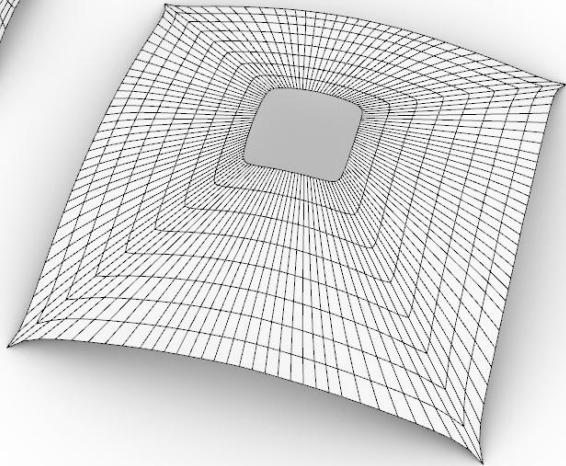
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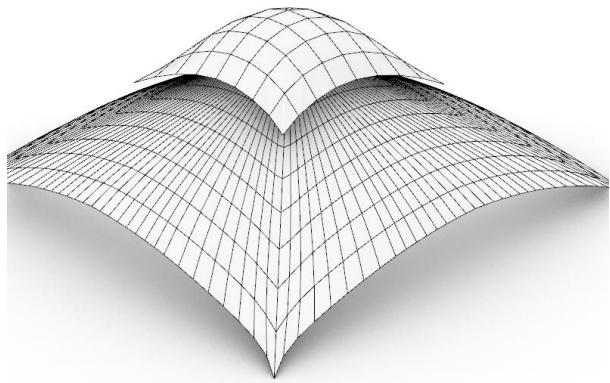
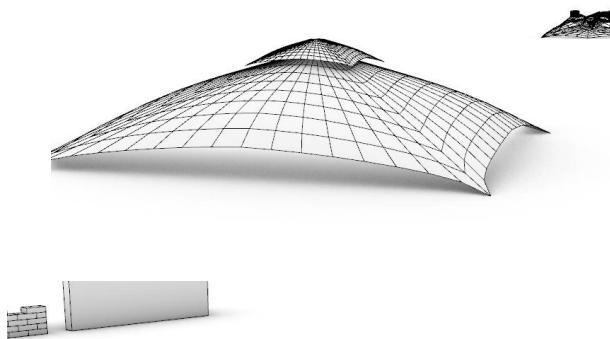
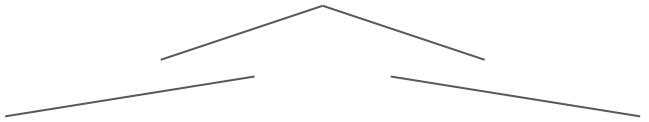
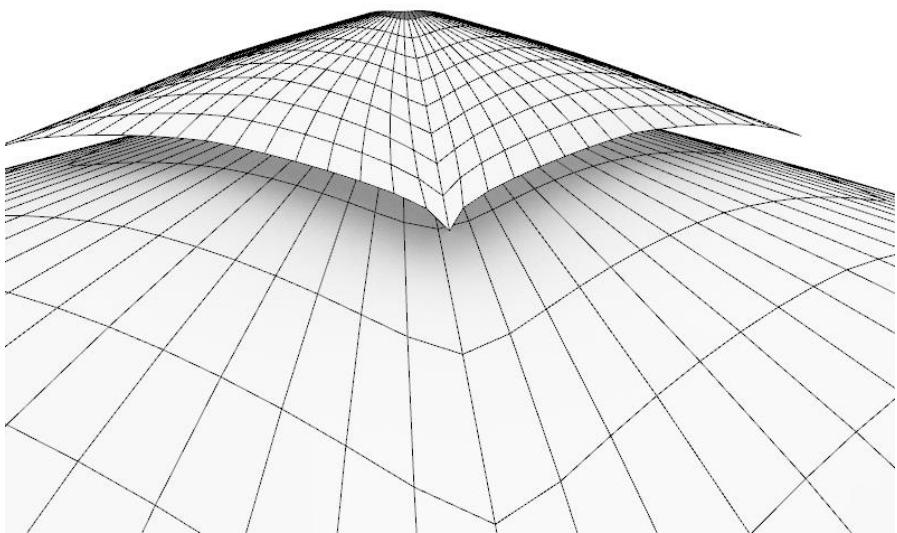


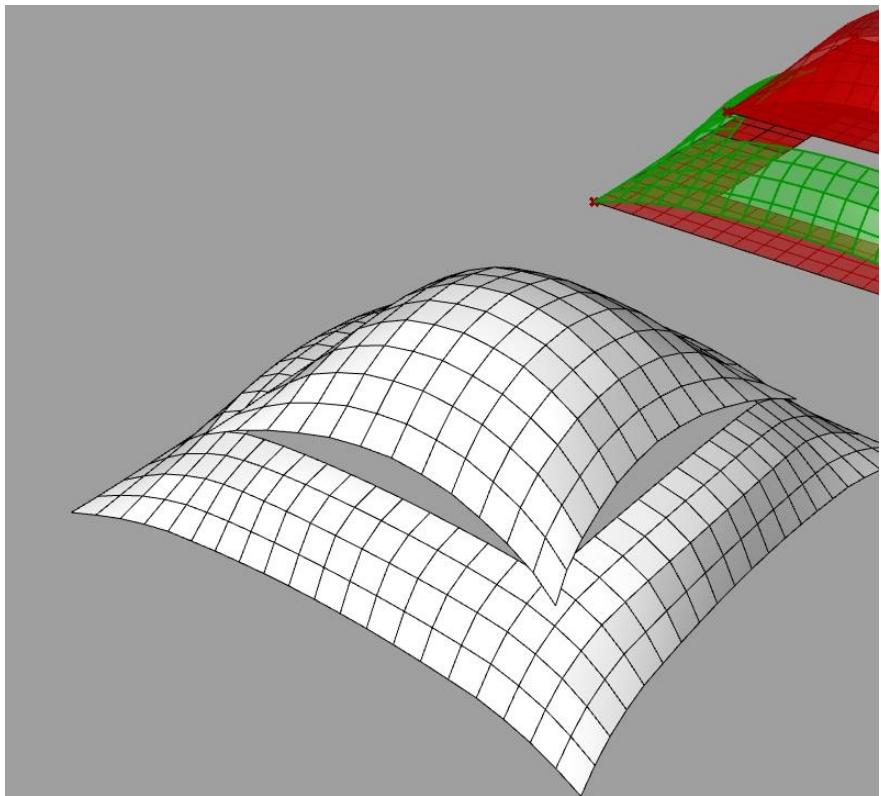


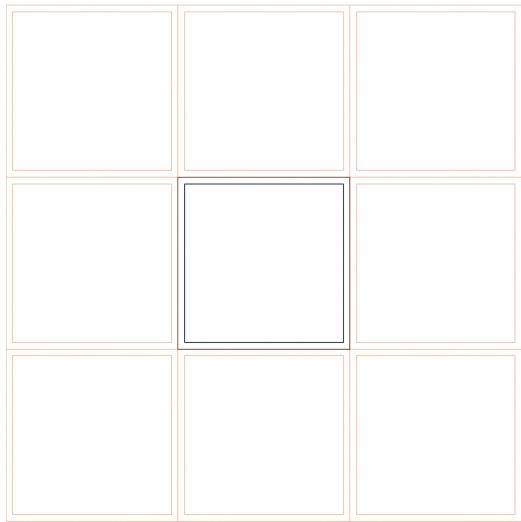




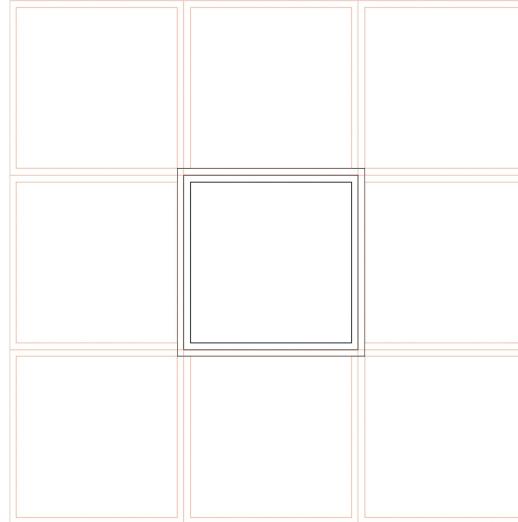




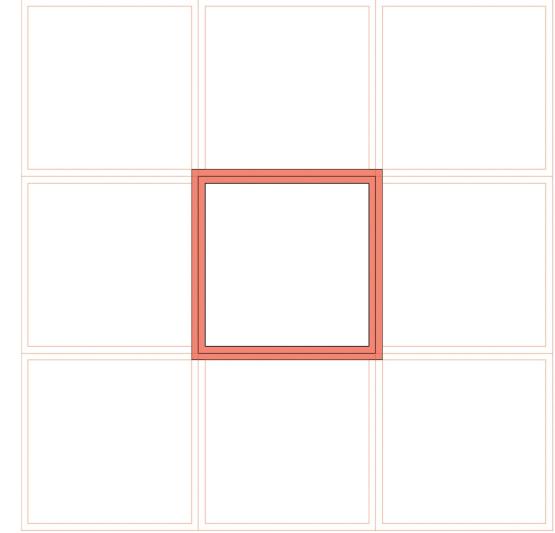




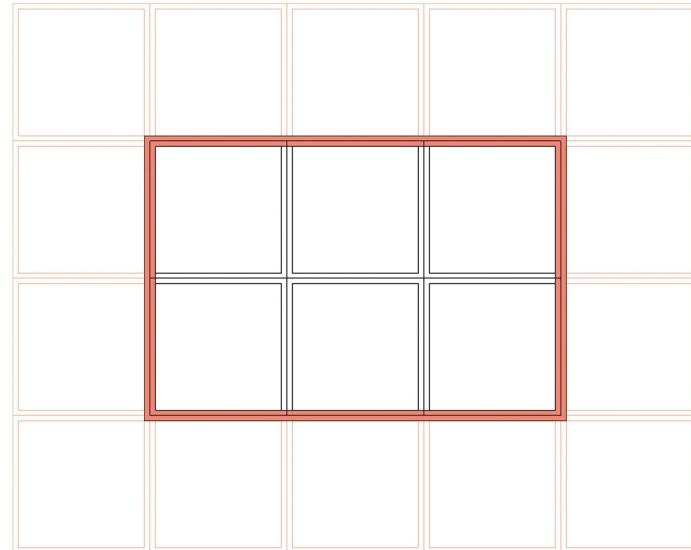
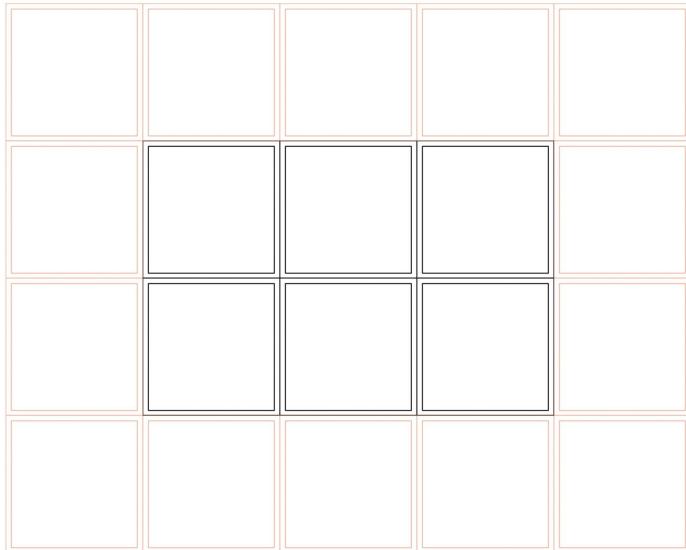
half-wall thickness offset in
each grid cell (Building unit)

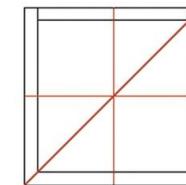
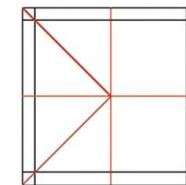
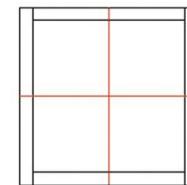
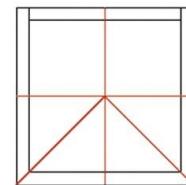
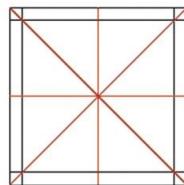
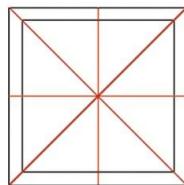
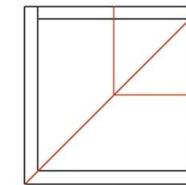
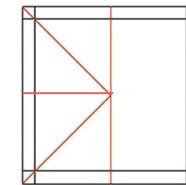
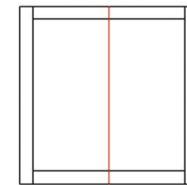
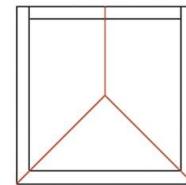
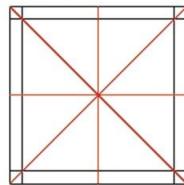
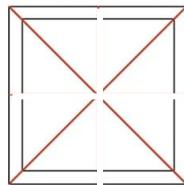
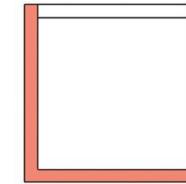
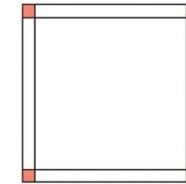
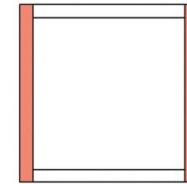
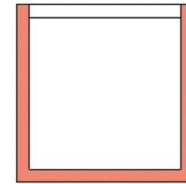
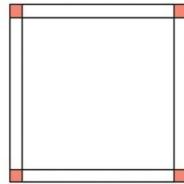
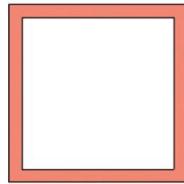
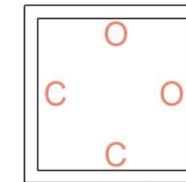
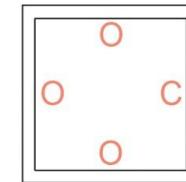
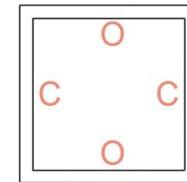
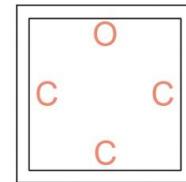
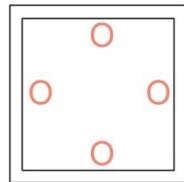
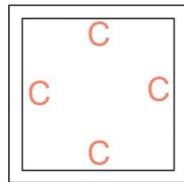


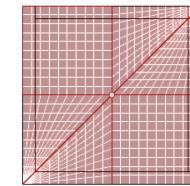
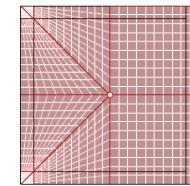
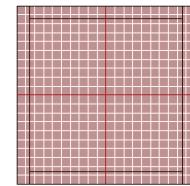
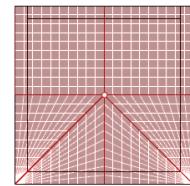
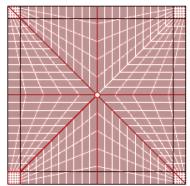
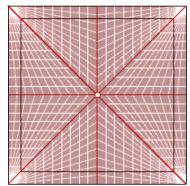
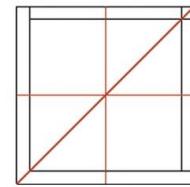
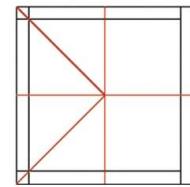
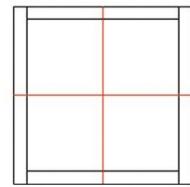
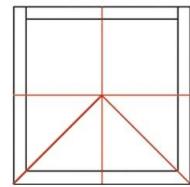
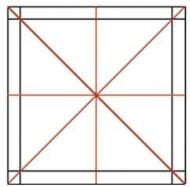
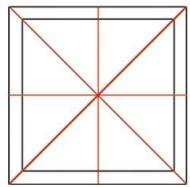
half-wall thickness offset in
surrounding cells

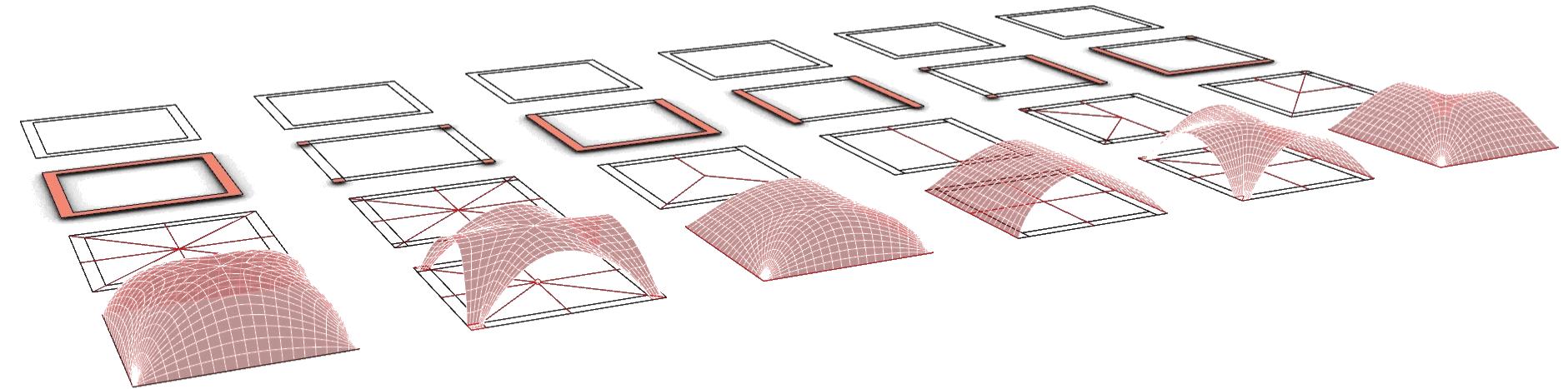


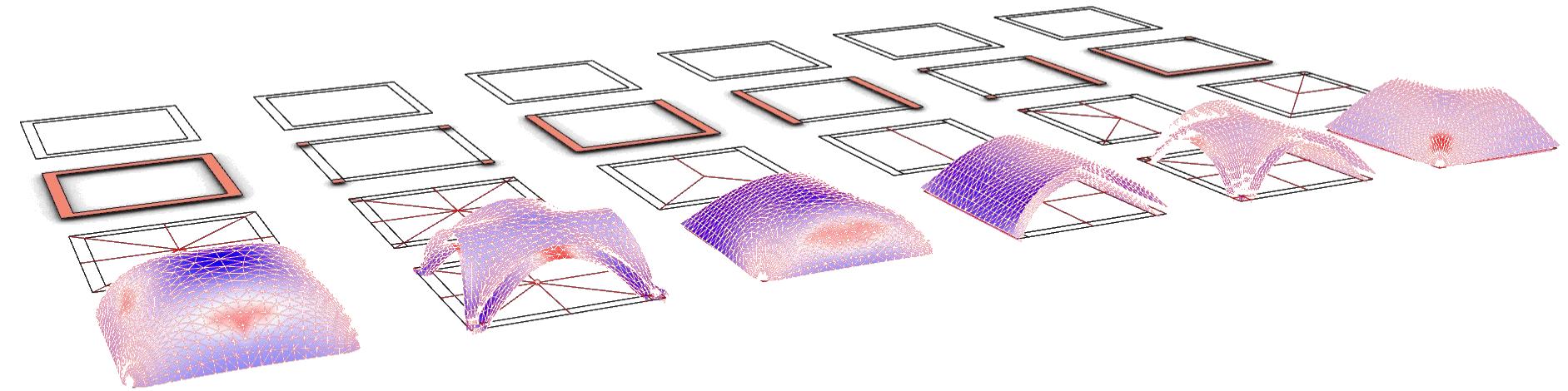
Merging 2 cells offset
creates wall thickness
(self standing building unit)

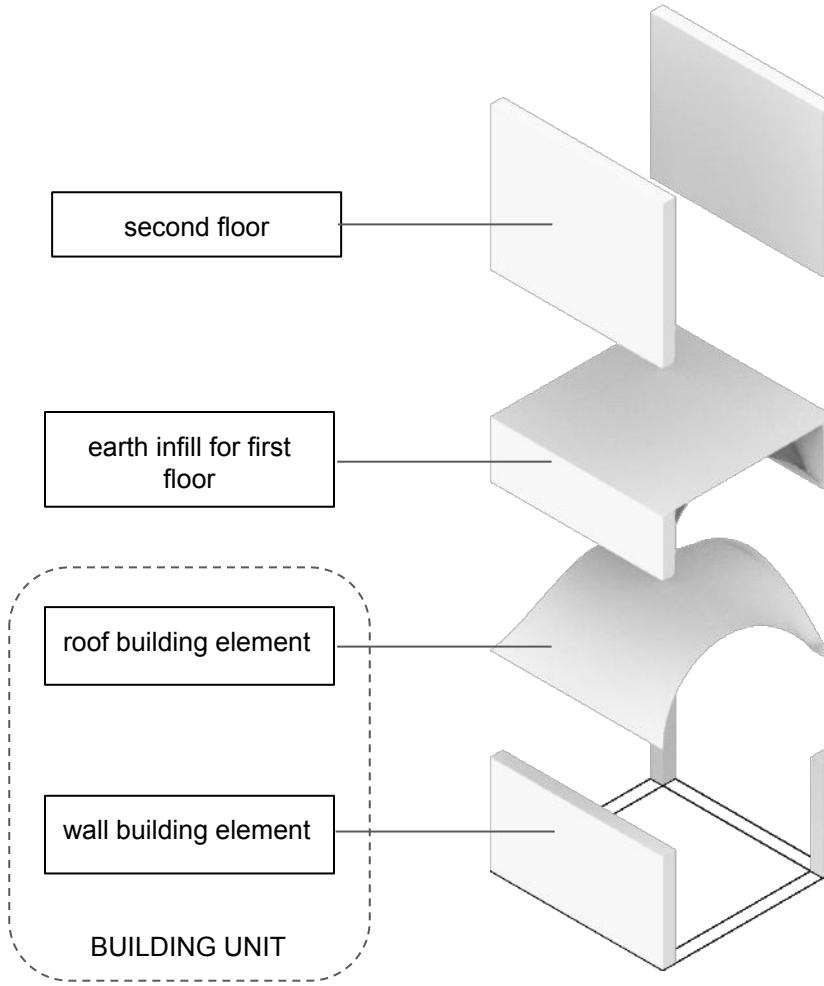
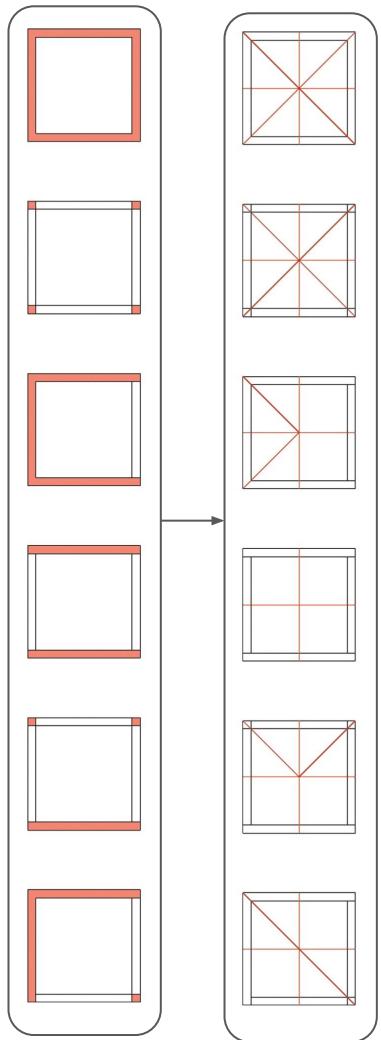


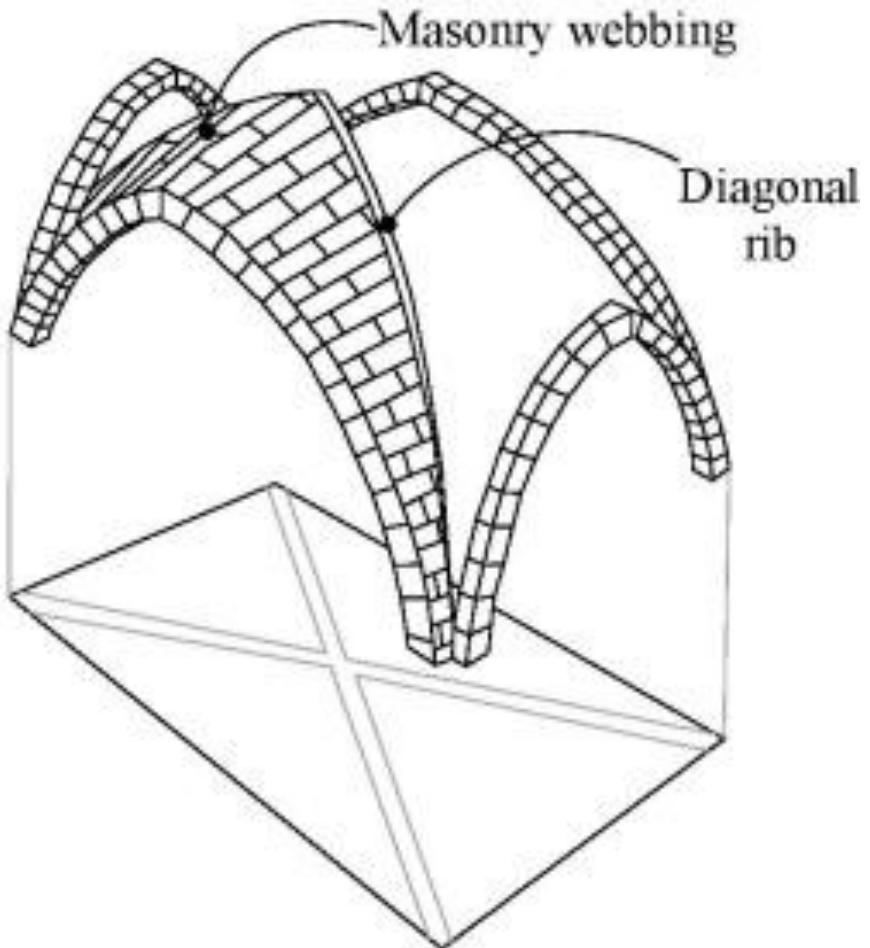












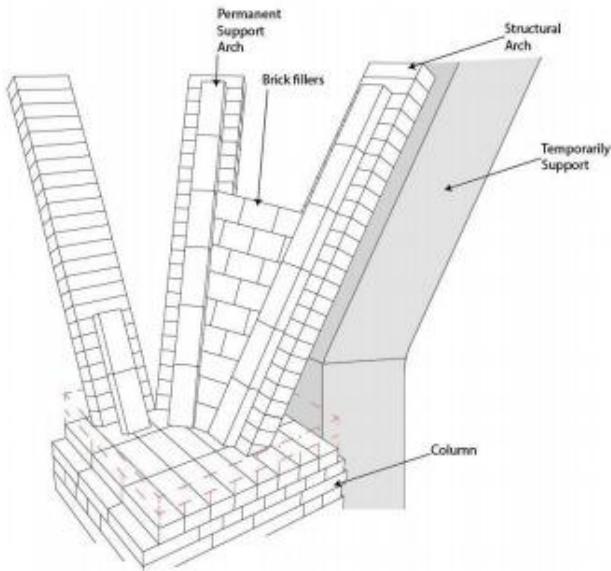
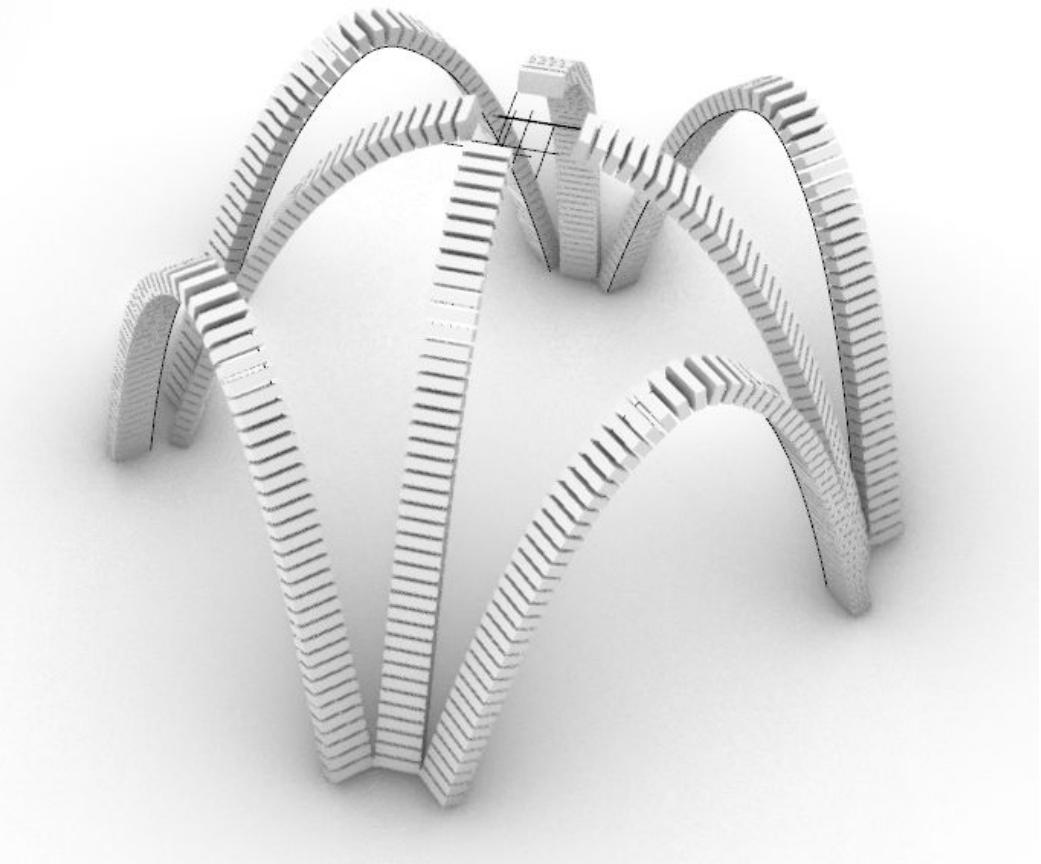
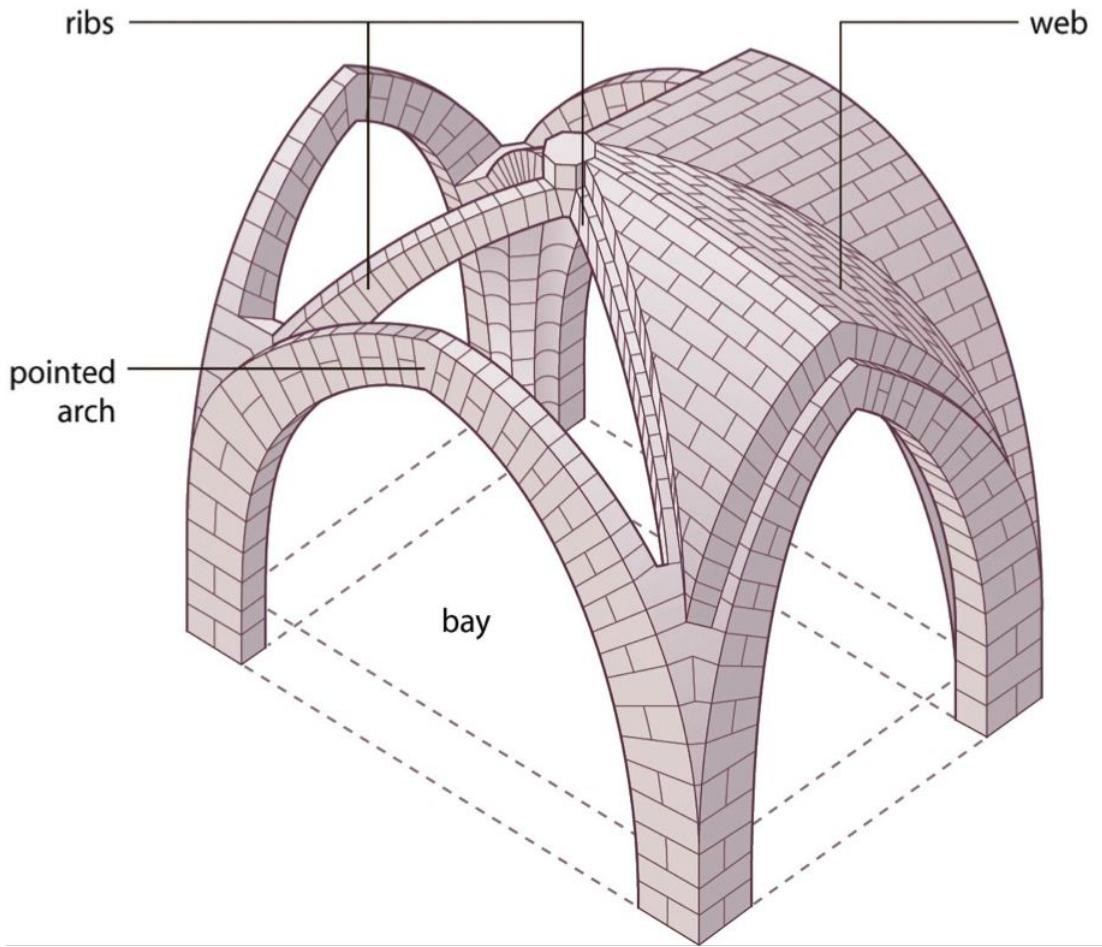
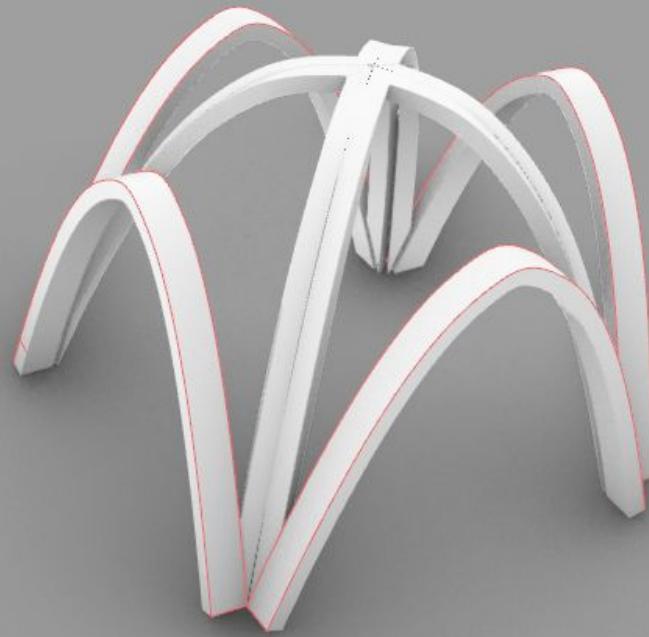
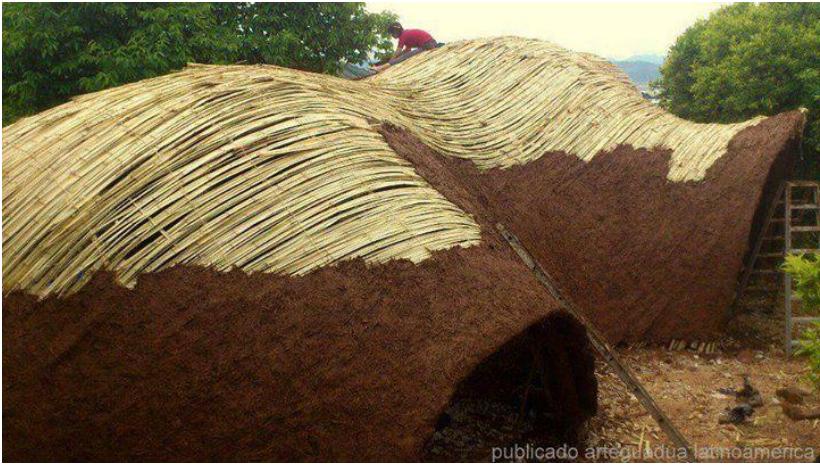


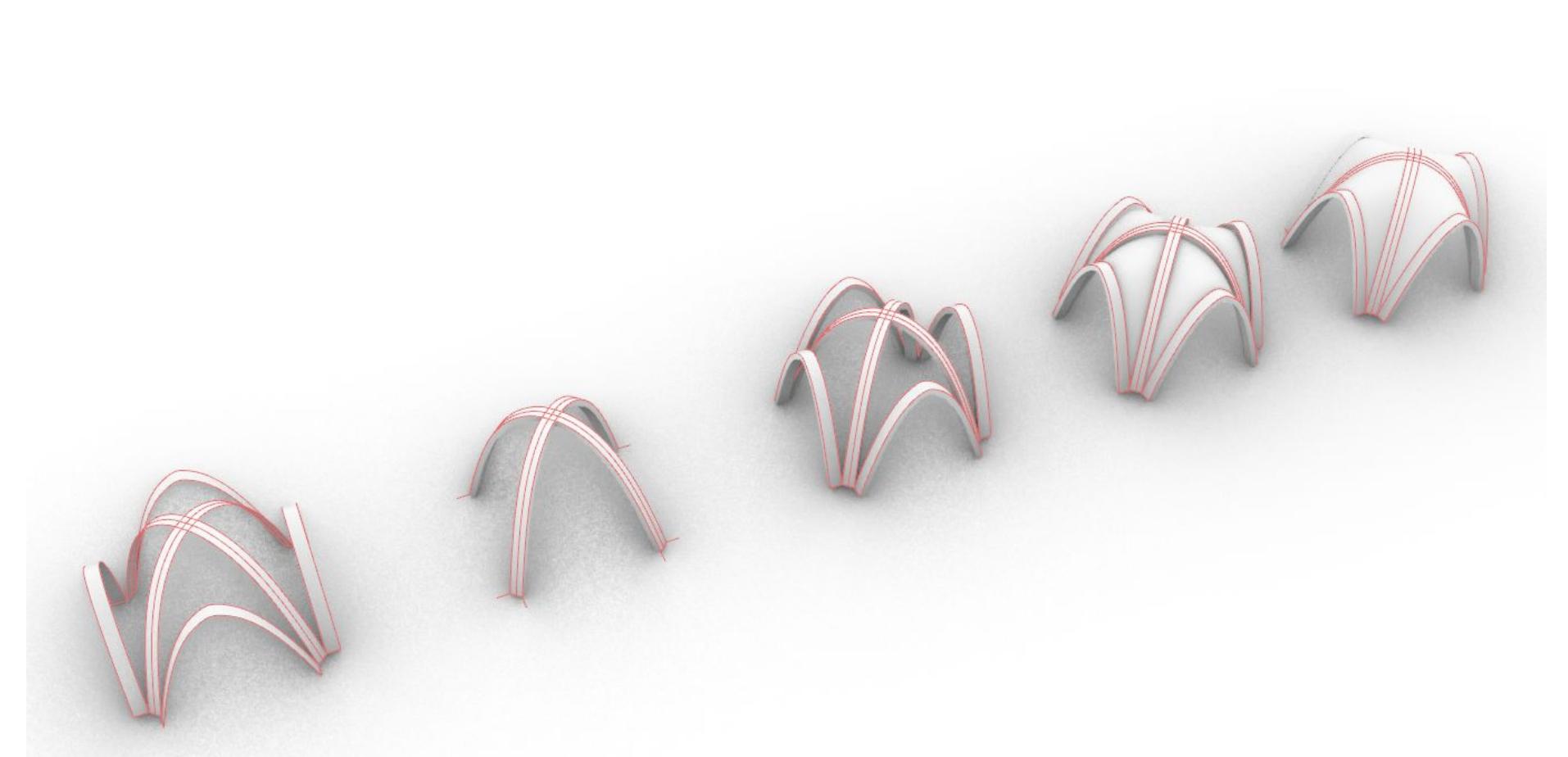
Figure 9: Building the rib arch with supports. Right picture retrieved from ForumHouse (2016).

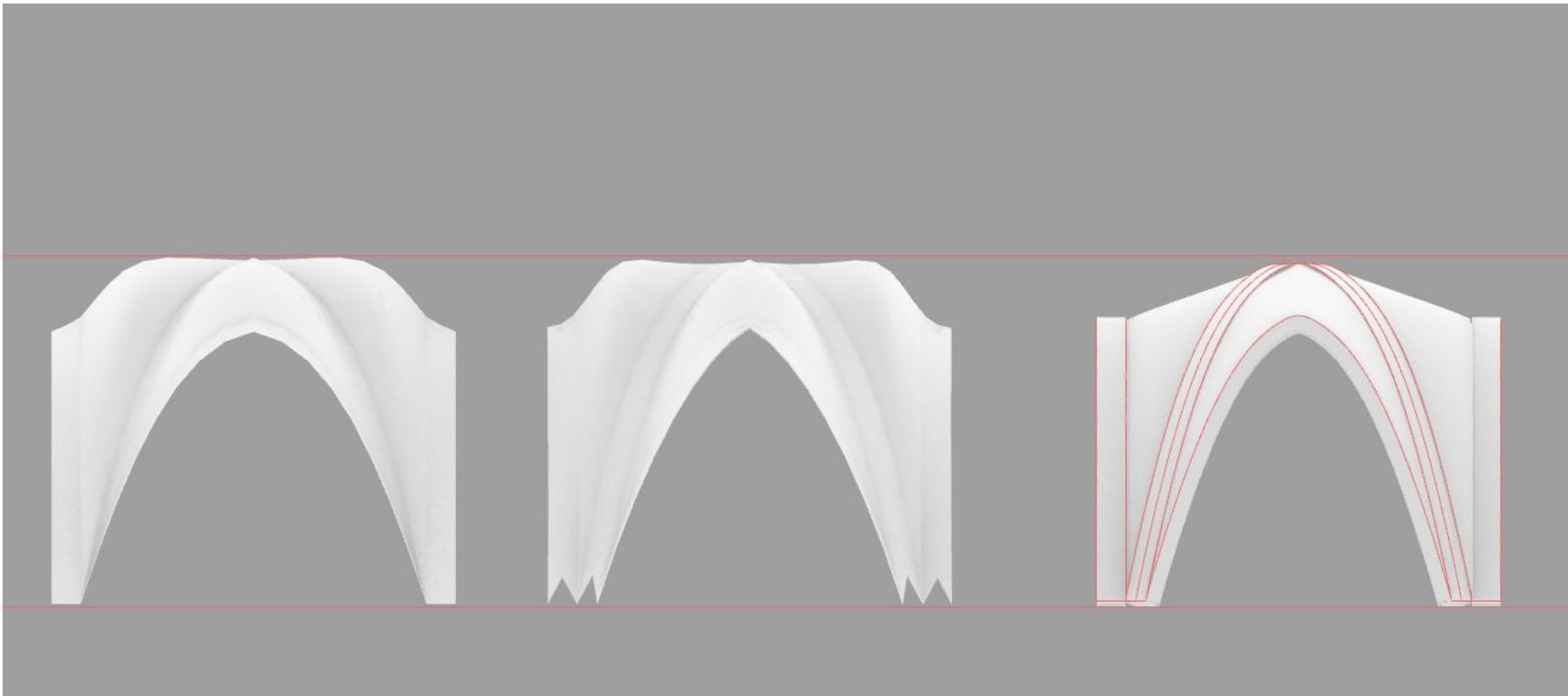


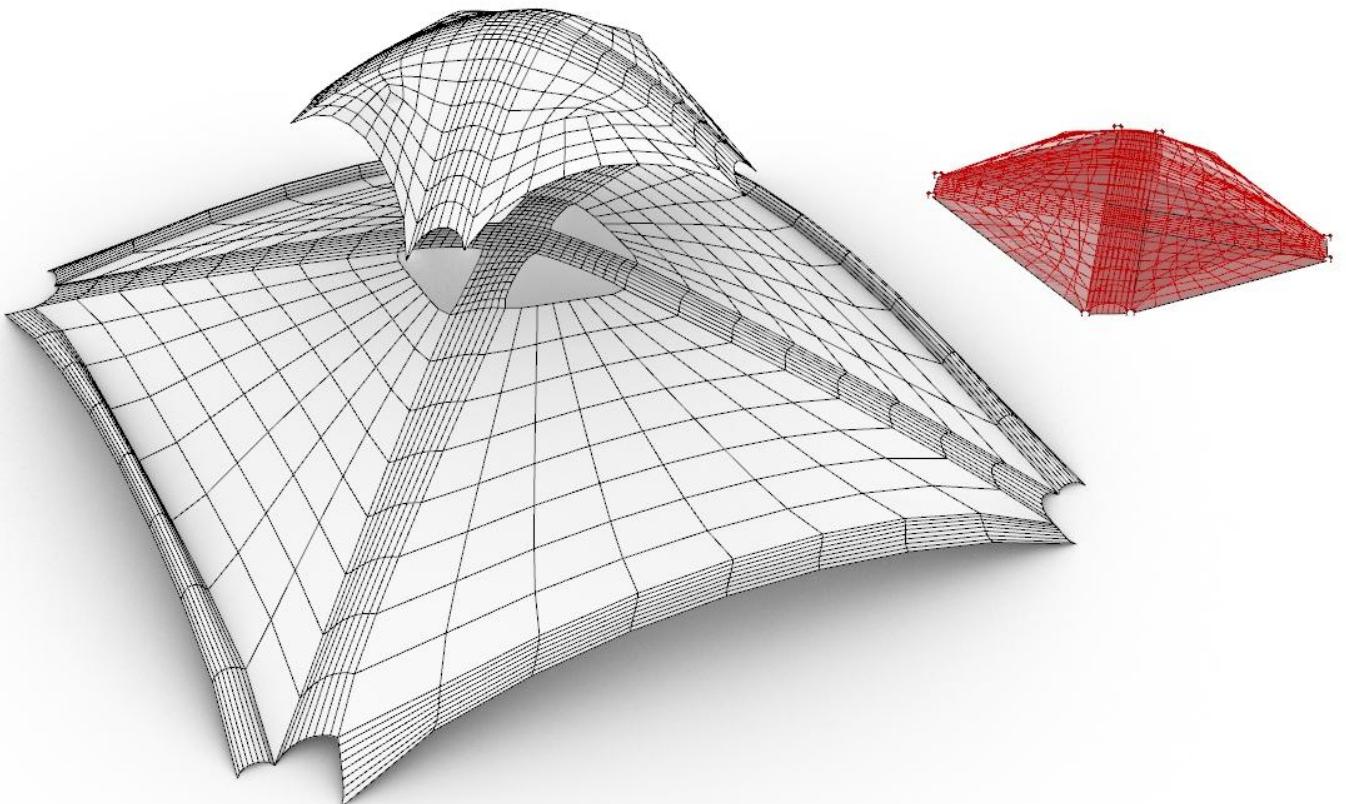


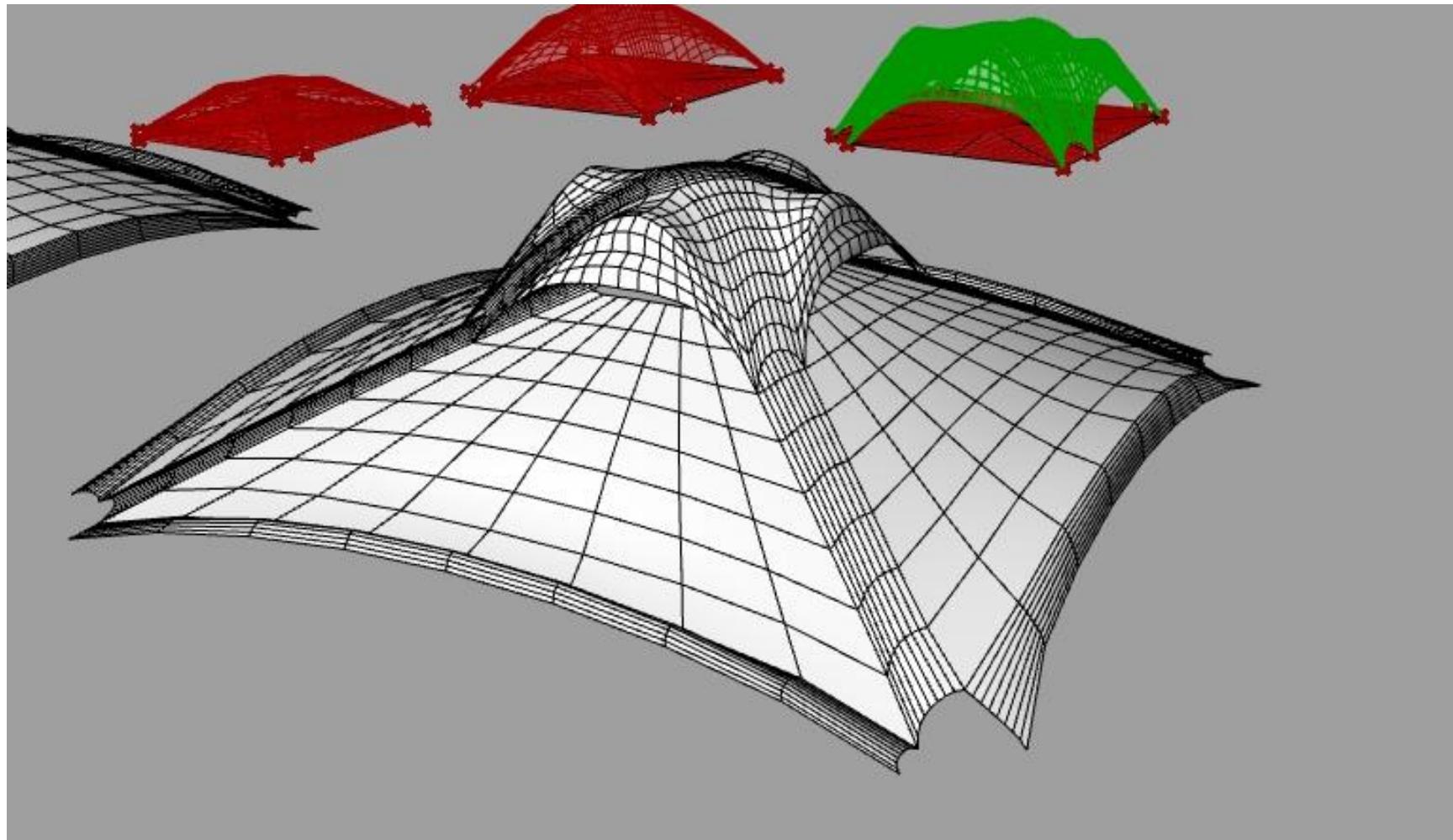


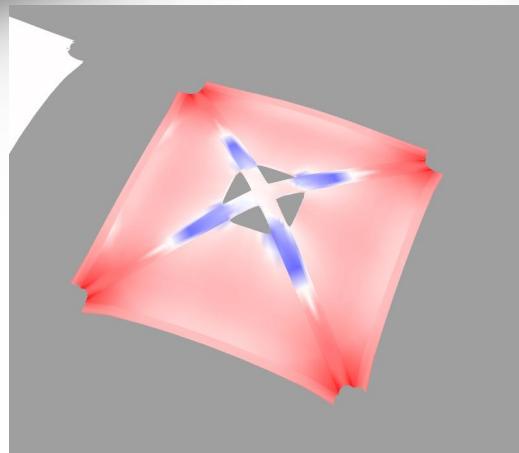
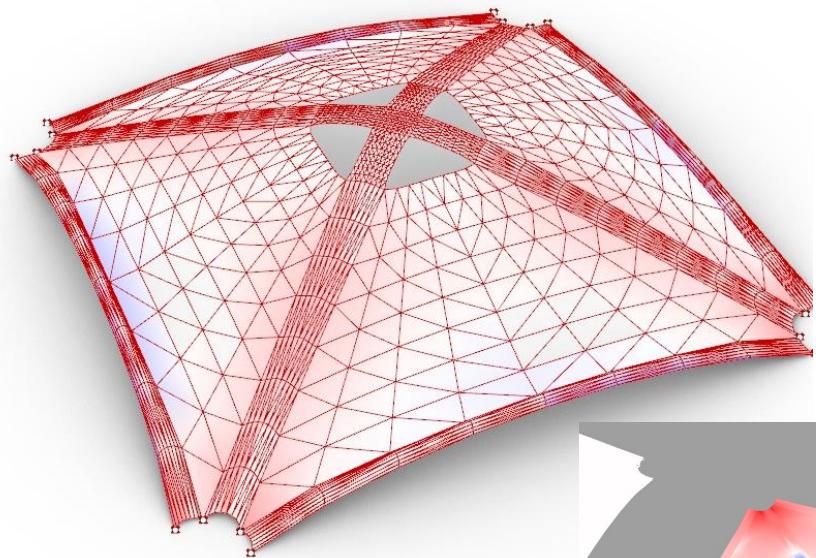


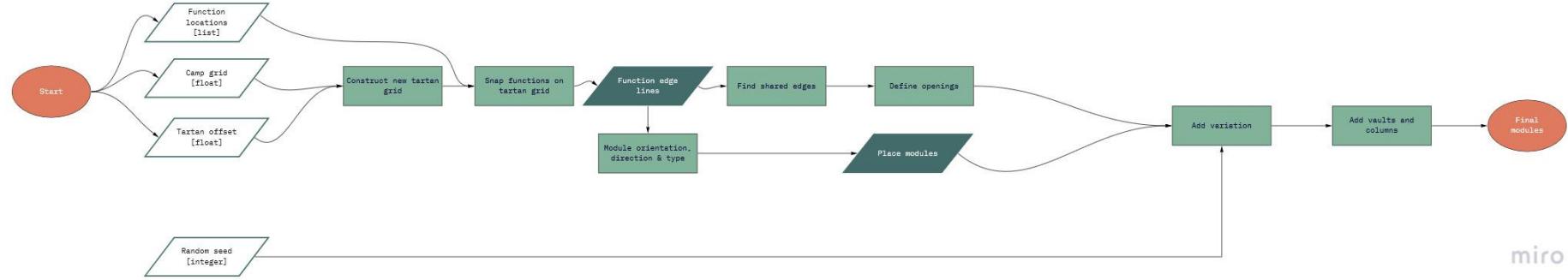




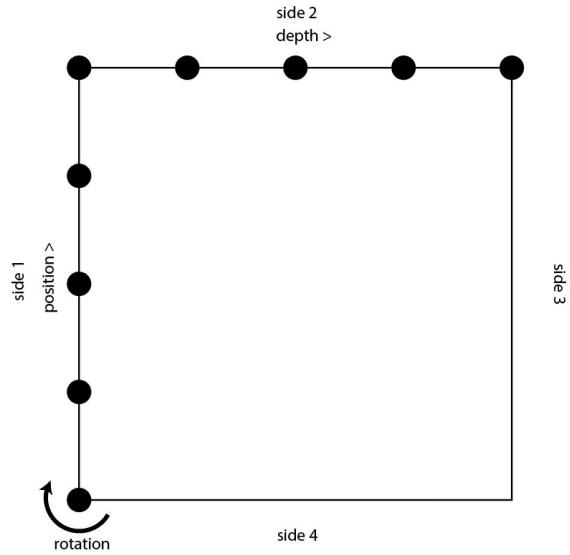






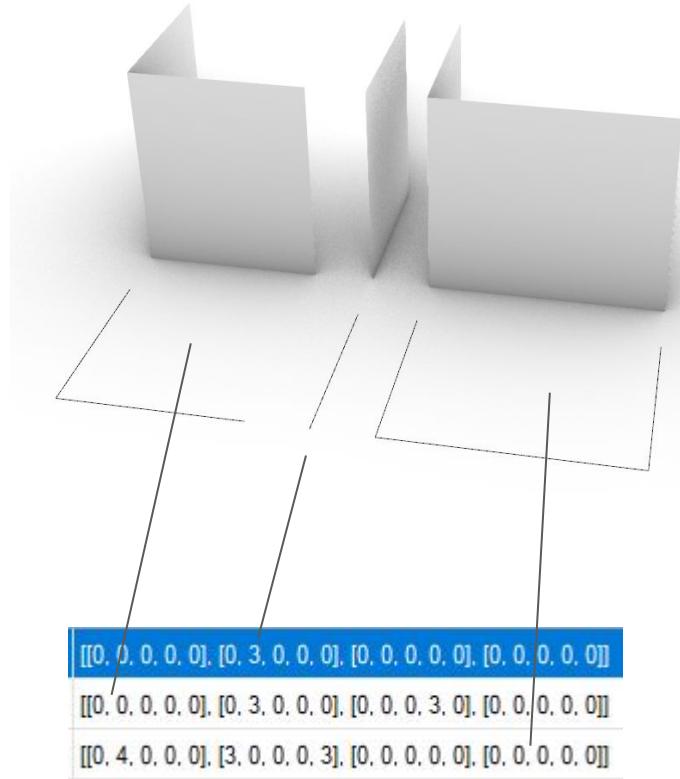


miro



Required for modules:

- module type (L, I, C)
- depth
- position
- rotation
- flipped

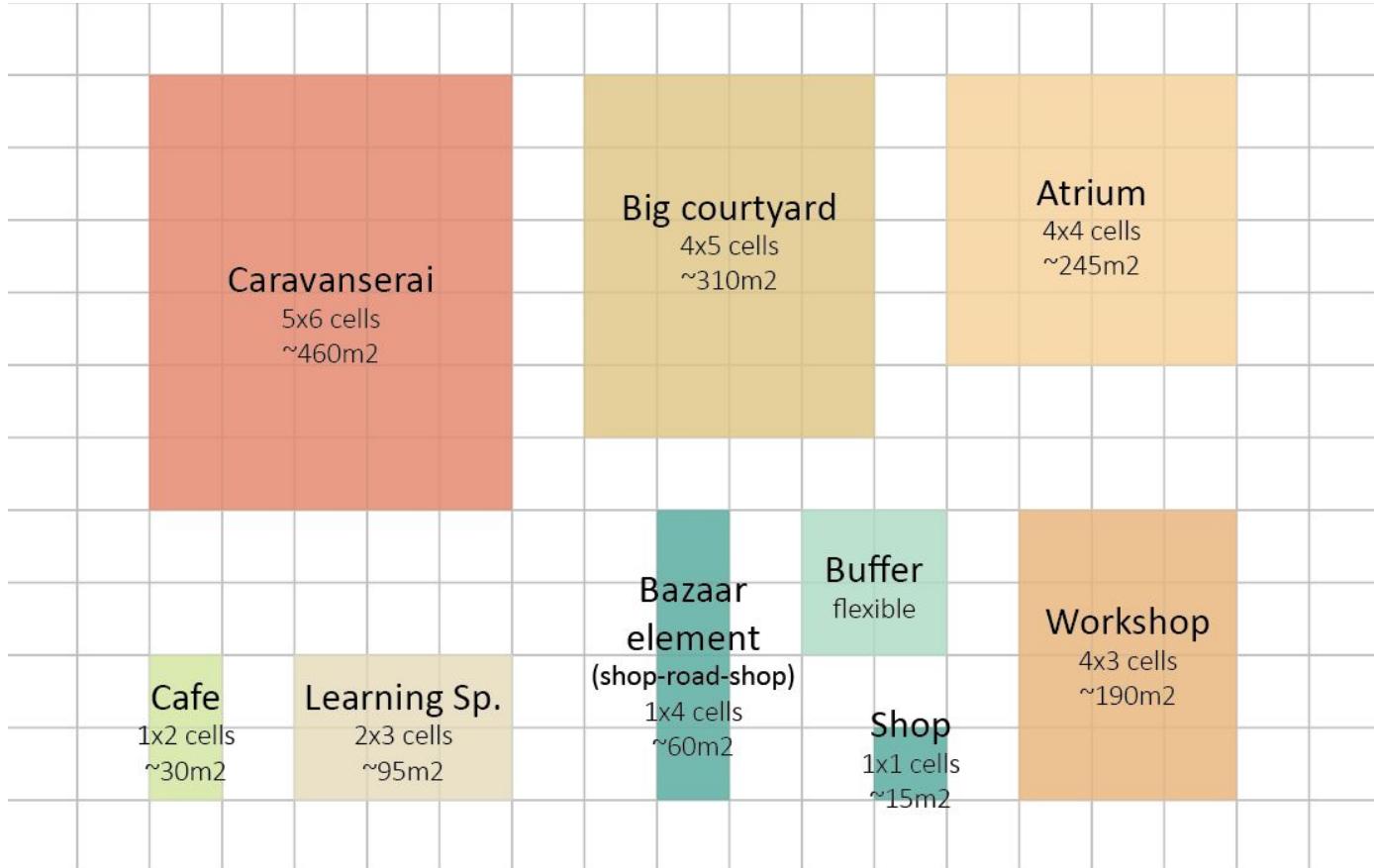


Source	Brick type	Pressing method	Density [kg/m3]	Compressive strength [MPa]	Tensile strength [MPa]	Young's modulus [MPa]	Poisson ratio	Yield strength [MPa]
Physical, Mechanical and Durability Properties of Soil Building Blocks Reinforced with Natural Fibres	Soil block stabilised with fibres	Pressure gauge	1780	2,1	0,3			
Mechanical properties and hygroscopicity behavior of compressed earth block filled by date palm fibers	Compressed earth blocks filled with palm fibres (5% cement)	Hydraulic press	1450	8	0,85			
https://drive.google.com/drive/folders/1W6HZ98too09CpRV0TCg3f7NfmmkMGkIJ	CEB		1700 - 2200	1 - 4				
Thermal and Structural Properties of Compressed Earth Brick (Laterite Soil)	CEB	Hydraulic press	1687,2	14,8				
Analysis of the mechanical properties of compressed earth block masonry using the sugarcane bagasse ash	CEB with sugarcane bagasse ash	Mechanical press	1930 - 2020	2,42				
Group 1 (Earthy 2019-2020)				6	0,6	80		
Group 2 (Earthy 2019-2020)			1452	3		211	0,3	
Group 5 (Earthy 2019-2020)			1500			150		1,3

Week 7

Configuration - Layout updates

Function modules according to the new grid (3.9 x 3.9)



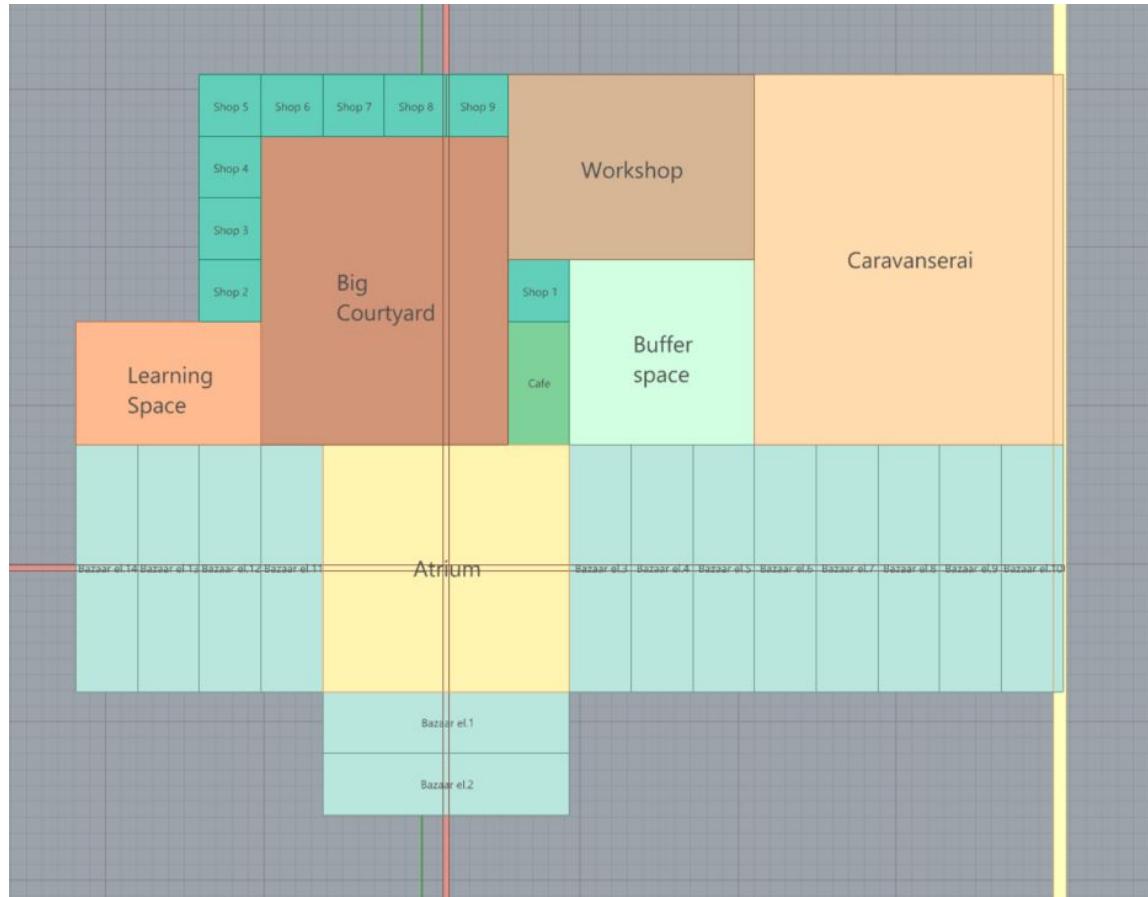
Adjustments and improvements to Layout tool

The image shows a screenshot of a software interface for urban planning or architectural layout design. On the left, a grid-based map displays a building footprint with various rooms labeled: 'Big Courtyard', 'Workshop', 'Caravanserai', 'Learning Space', 'Buffer space', and 'Atrium'. The map includes a legend for room types and a color key for different categories. On the right, a configuration panel titled 'Geometry' contains several tabs: 'Primitive', 'Input', and 'Output'. The 'Input' tab is active, showing parameters for the layout process:

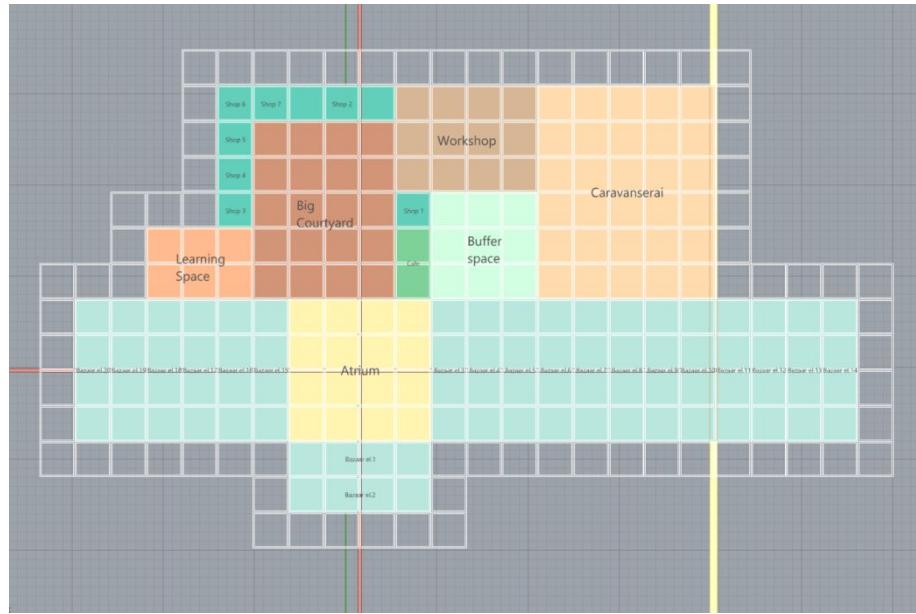
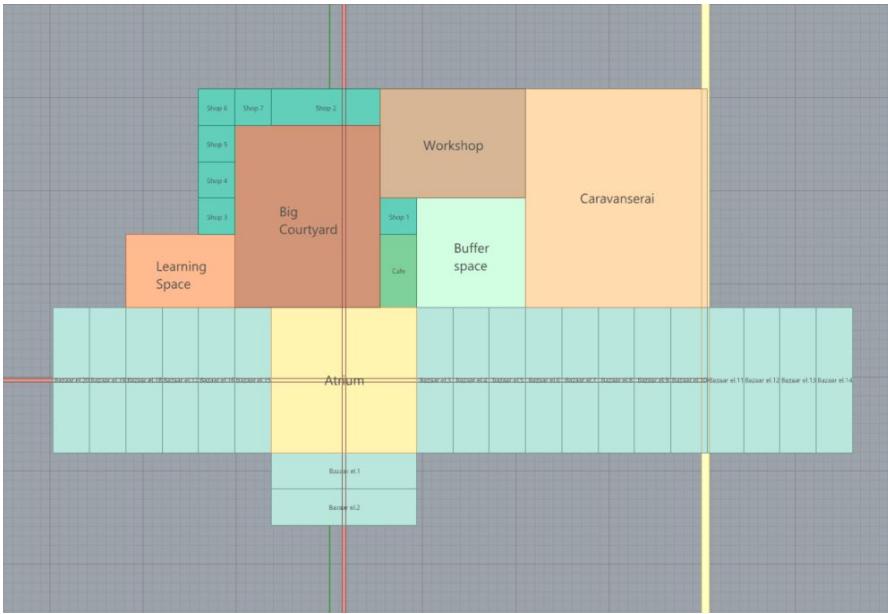
- How many per function:**
 - Caravanserai: 1
 - Courtyard: 1
 - Atrium: 1
 - Workshop: 1
 - Learning space: 1
 - Small shop: 1
 - Big shop: 1
 - Cafe: 1
- Program of functions:**
 - Caravanserai
 - Courtyard
 - Atrium
 - Workshop
 - Learning space
 - Small shop
 - Big shop
 - Cafe
- Min area per function:**
 - Caravanserai: 450
 - Courtyard: 350
 - Atrium: 240
 - Workshop: 150
 - Learning space: 100
 - Small shop: 80
 - Big shop: 60
 - Cafe: 40
- Grid size:** 3.0
- Random seed:** 28
- Reset configuration**
- Run solver**
- Toggle TRUE**
- Bazaar elements (side):** 4
- Bazaar elements (entrance):** 2
- Cafes next to Atrium:** 2
- Wall thickness:** 0.3

At the bottom right, a message indicates: "Save successfully completed... (110 seconds ago)".

Adjusted rules and new grid



Adjusted rules and new grid



COURTYARD

LEARNING
SPACE

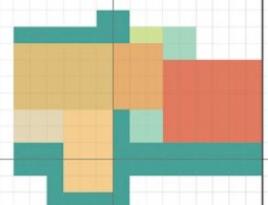
ATRIUM

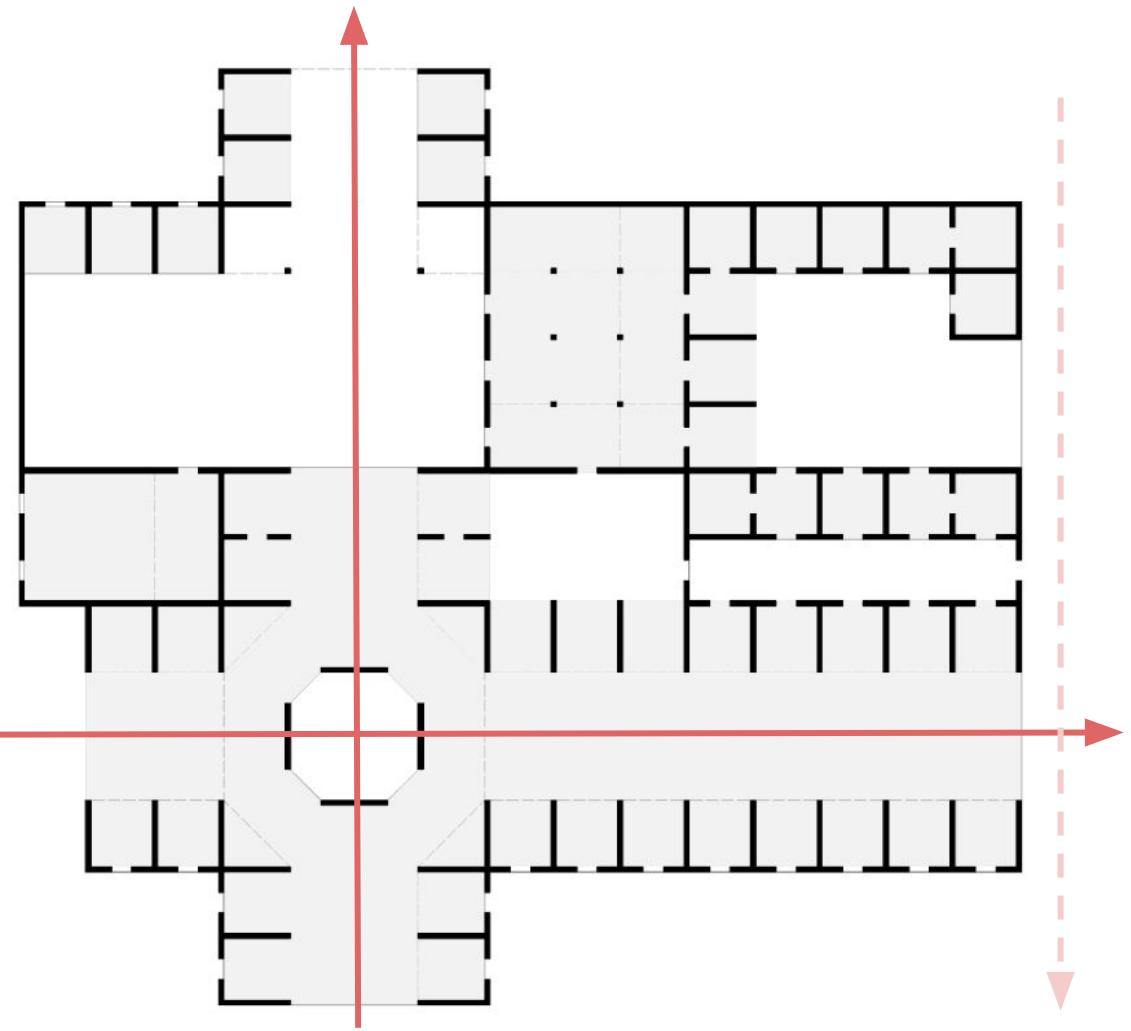
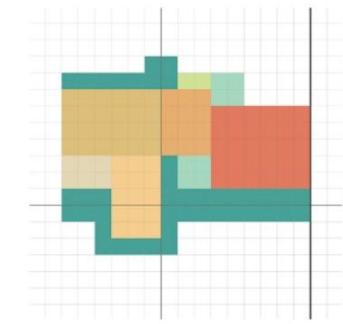
WORKSHOP

BUFFER CY

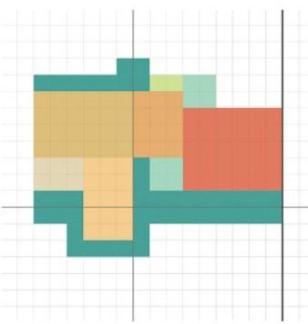
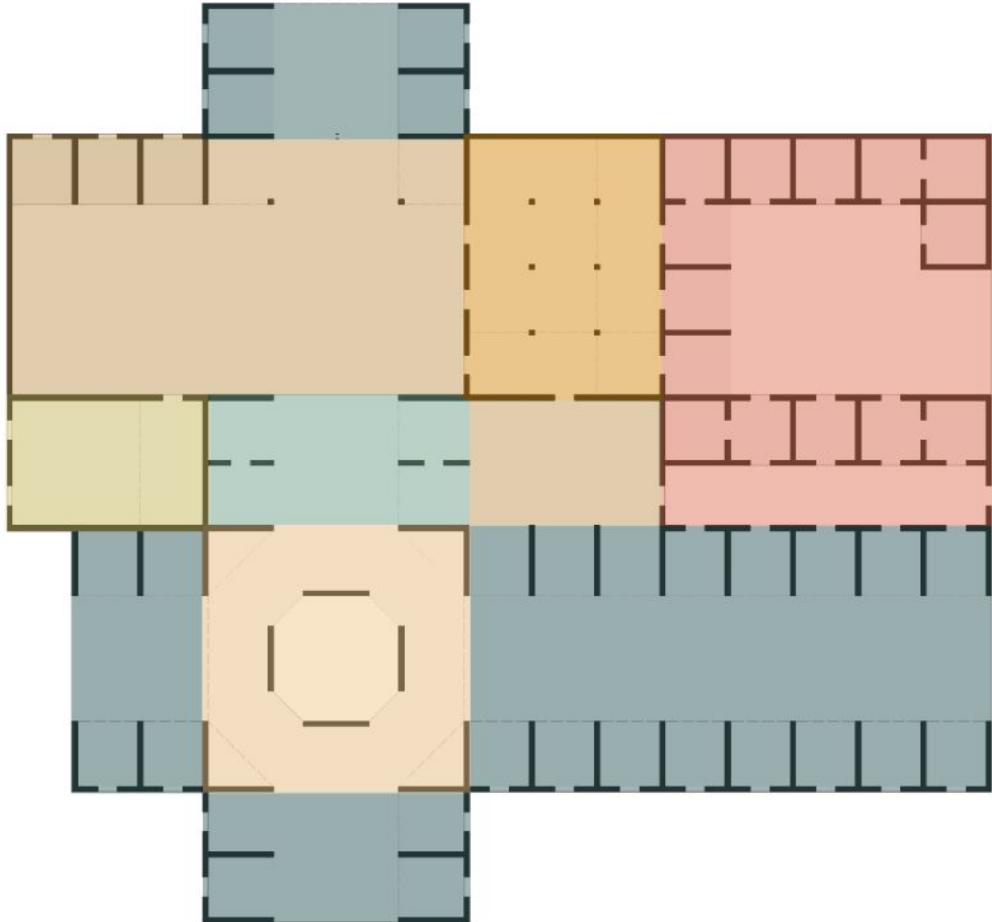
CARAVANSERAI

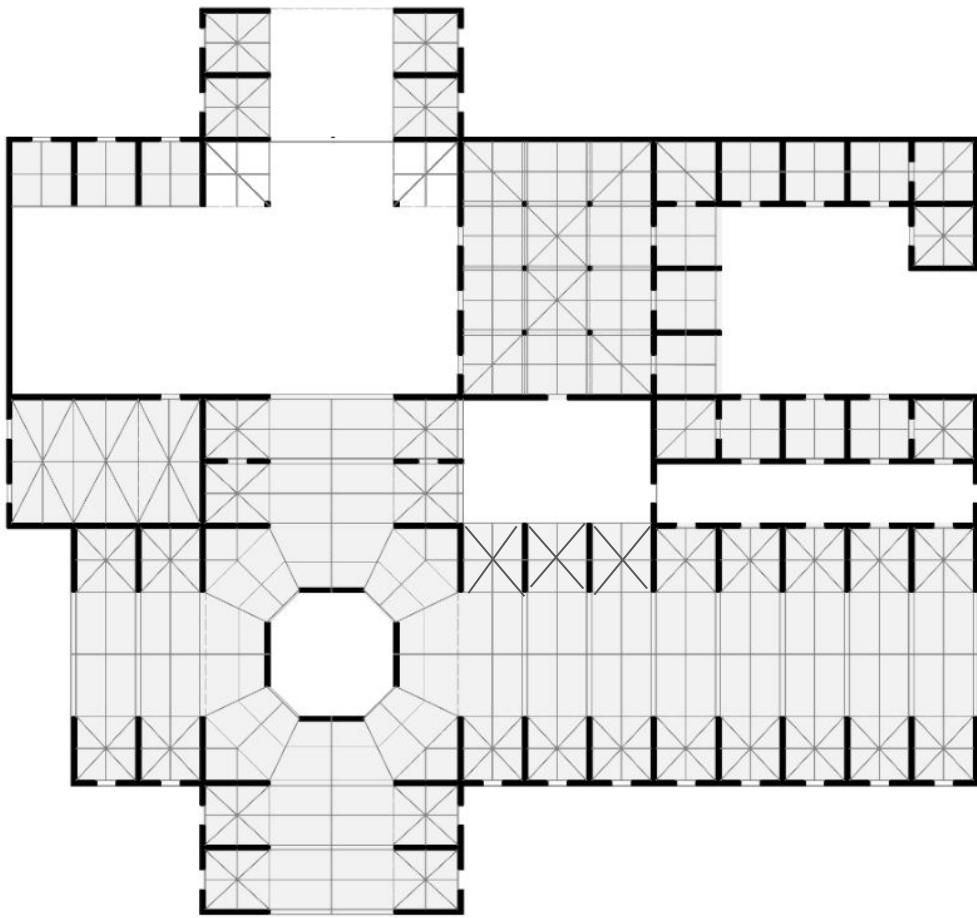
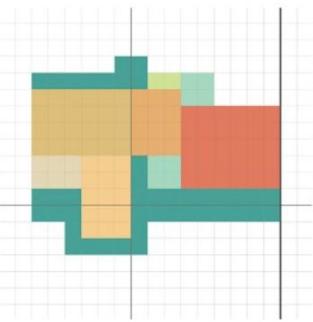
BAZAAR SHOPS



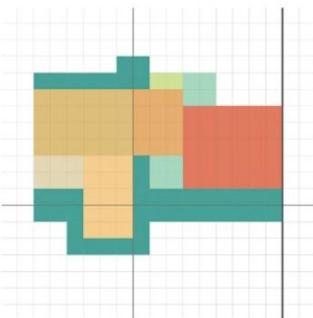
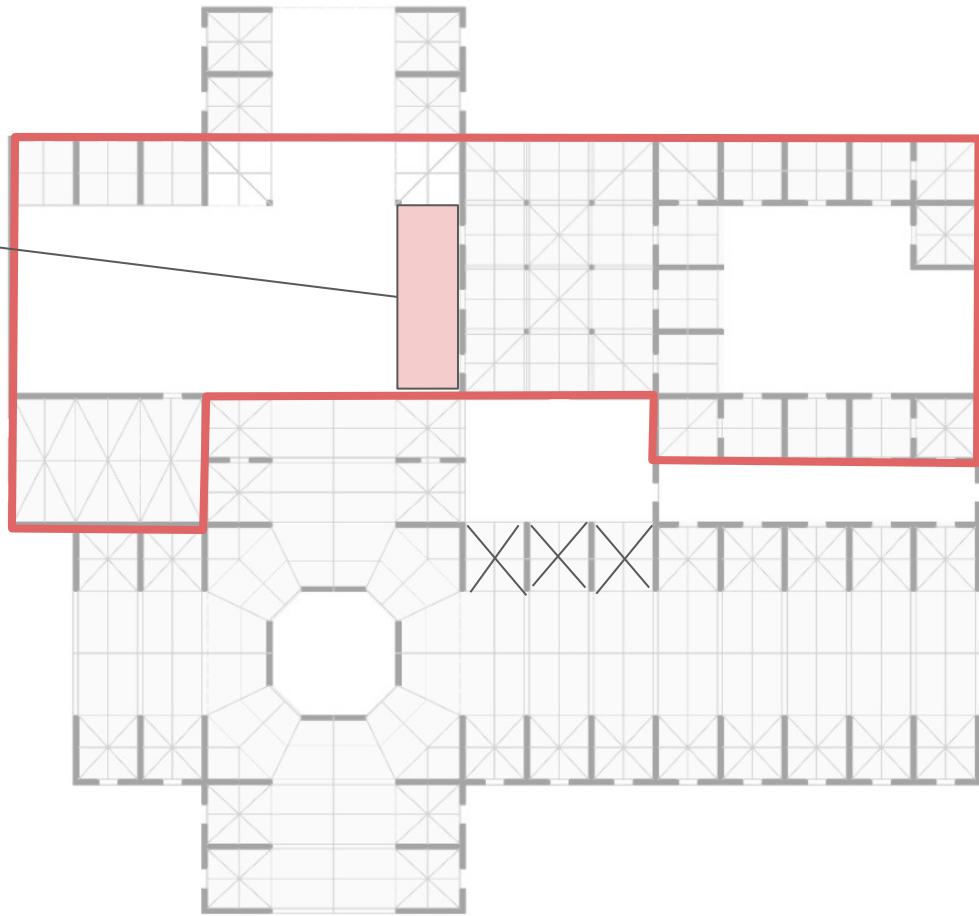


- Caravanserai
- Bazaar shops
- Atrium
- Cafès
- Learning space
- Workshop
- Courtyards





Arcade, buffer condition to be added



Building elements

from building modules to function modules

Why is LEGO so popular?



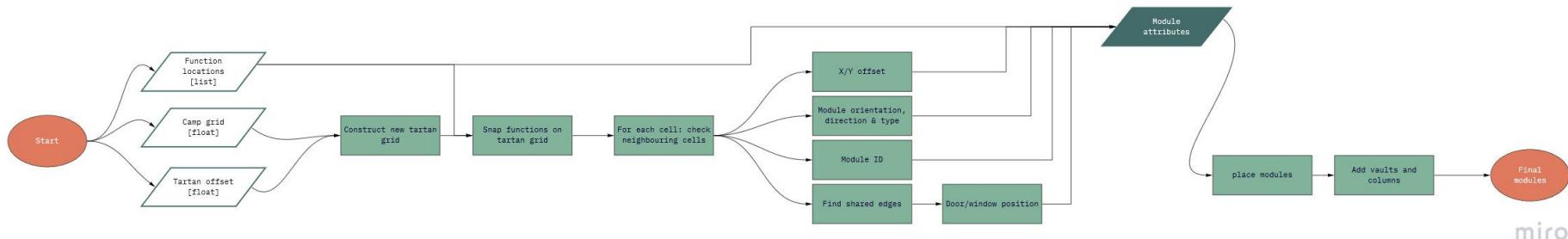
And you can not make mistakes... because the rules are so simple...

We should have super simple rules as well, no mistake can be made

RULES NEXT SLIDE

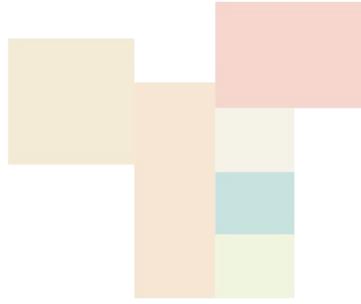


Updated module laying tool

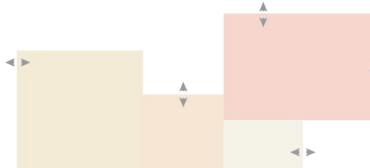


miro

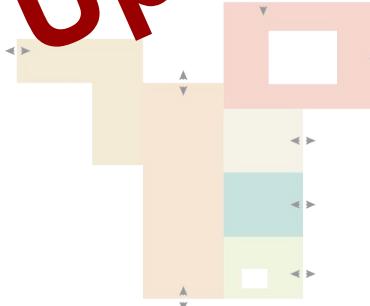
1. Programme is defined.
2. Connections to outside are defined.
3. Areas without roofs are defined.
4. Interior layout is defined.
5. Connections between layout are defined.
6. Obligatory supports are placed where the distance between supports is bigger than 7200mm.



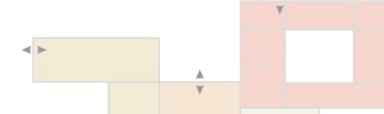
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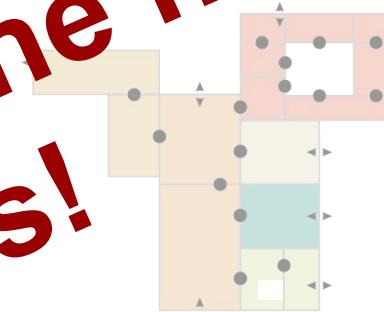
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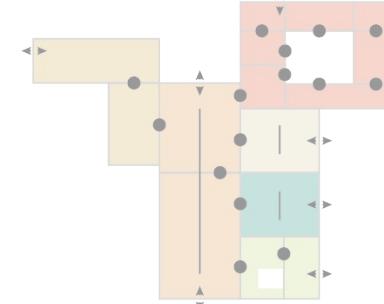
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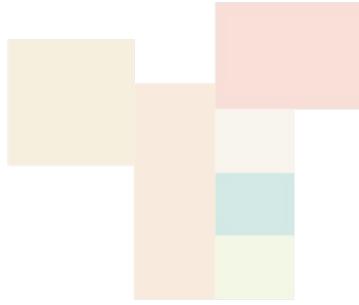
Updated in the next slides!

"BOARDGAME"

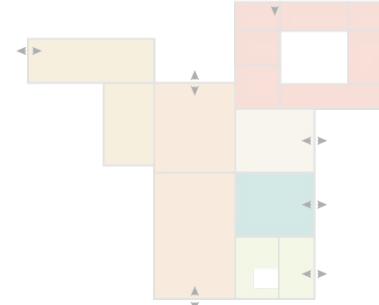


7. Place the modules however you like based on the rules the board has

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2. Connections to outside are defined.
3. Areas without roofs are defined.
4. Interior layout is defined.
5. Connections between layout are defined.
6. Obligatory supports are placed where the distance between supports is bigger than 7200mm.



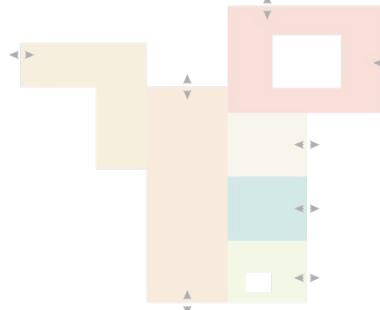
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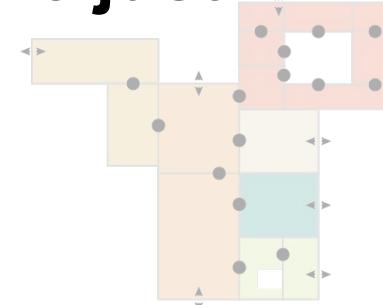
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We are not designing we just define the rules...

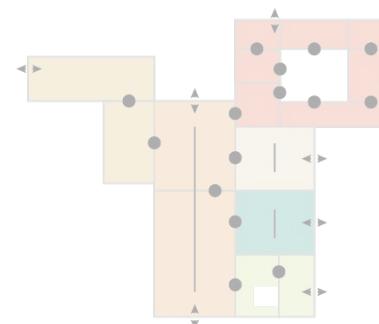
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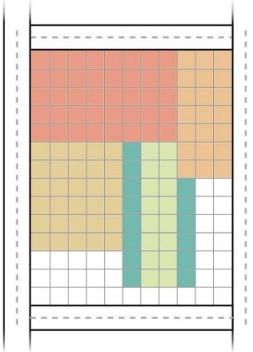


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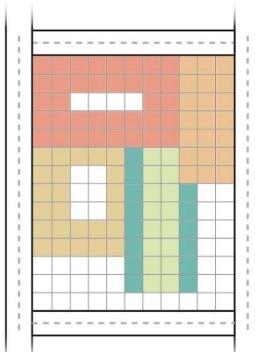


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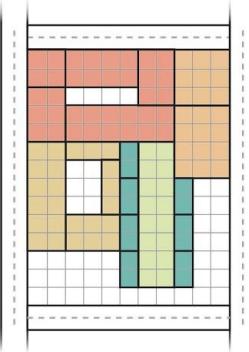




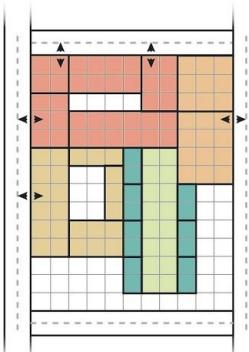
1. Programme is defined.
Rules :
- Based on 3.6x3.6 cells
- Based on m2
- Based predetermined connection between spaces.



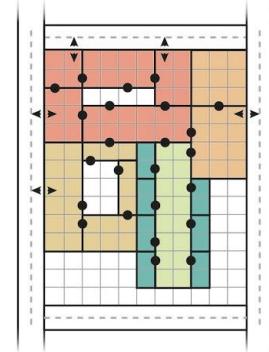
2. Areas without roofs are defined.
Rules :
- The open area needs to be more than 2 cells from the road.
- It can not be more than 50% of the cells of a space.
- Only can be applied to :
- Courtyard
- Caravanserai
- Buffer zone



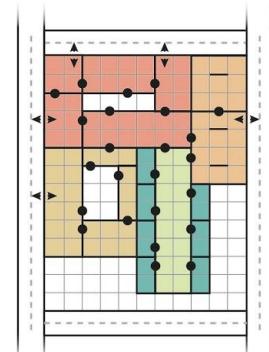
3. Interior Layout is defined.
Rules :
- Bigger then 2x1 cells
- Smaller then 4x4 cells
-



4. Connections to outside are defined.
Rules :
- Opening is connected to pedestrian street.
- Opening is mini 1 cell (3.6x3.6) away from corner of the space.
- 1 Opening every 4 cells in the same space.
- Max 4 Openings per space.



5. Connections between layout are defined.
Rules :
- Mini 1 opening per space
- Mini 1 opening to 'open-areas'
- Mini 1 opening between between predefined programme connections.

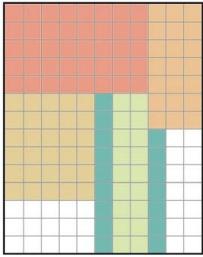


6. Obligatory supports.
Rules :
- Add support if space is bigger then 3x3 cells.

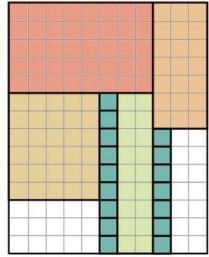
- how do we make sure this work well with tessellation?

Purple text = yet to be confirmed

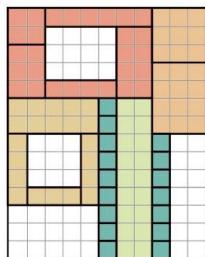
yes,



1. Programme is defined.
Rules :
- Based on 3.9x3.9 cells
- Based on m2
- Based predetermined connection between spaces.



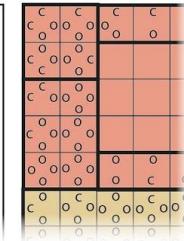
2. Interior Layout is defined.
Rules :
- Follows the line of the predetermined programme.



3. Interior Layout is defined.

Rules :
- Always 1 connection
- When a "courtyard" is added it can not be bigger then :
- 60% Caravanserai
- 60 % for Courtyard
- 30% for the rest
- At least one connection with predefined function (bubble diagram).

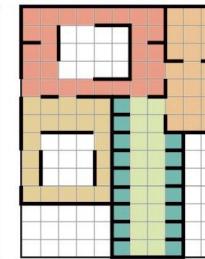
Cara = max 12 cells
Courtyard = 6 max



4. Openings are defined.

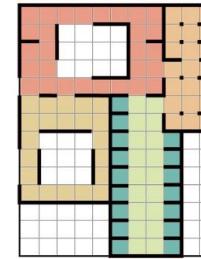
Rules :
- At least one opening per space.
- no openings on exterior corners
- Opening to exterior only to pedestrian road.

support 1x1 just not in learning space and workshop. There 1x2 possible



5. Walls are placed.
Rules:

- o+o = open
- c+o = open
- c+c = closed



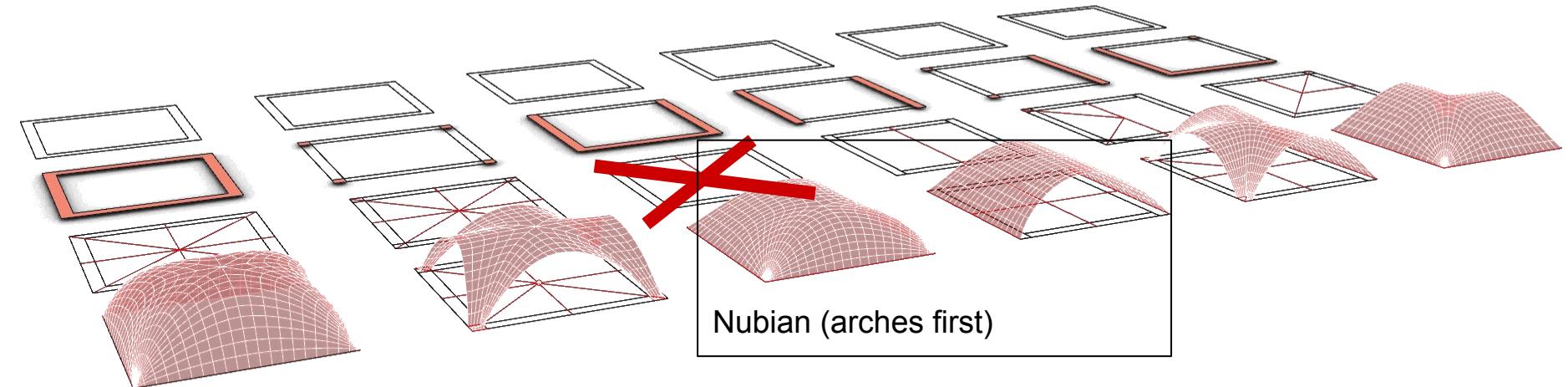
6. Supports
Rules:

- If a space bigger then 3x3 cells has no walls support needs to be added.

We miss rules for :

- supports
- 0.5 walls
- stairs

Building elements - Roofs



1

2

3

4

5

6

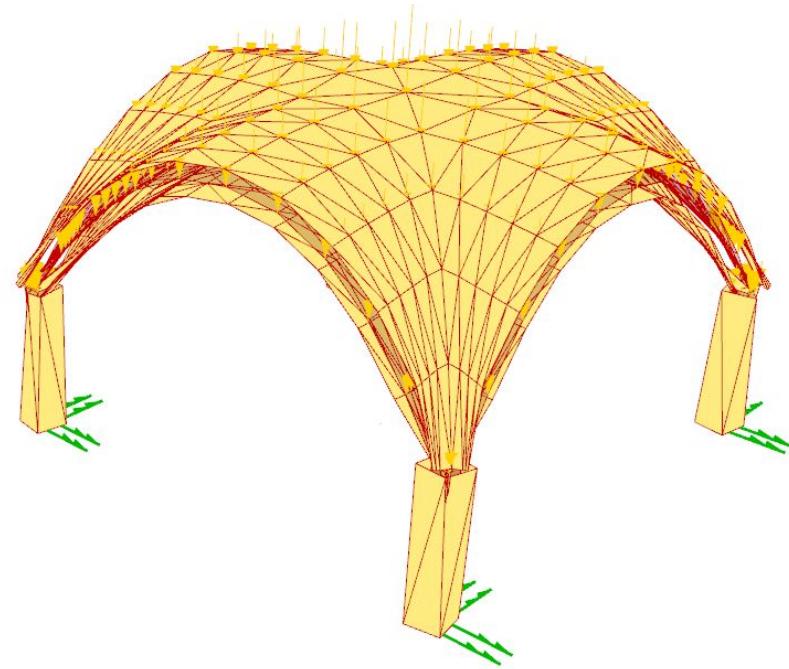
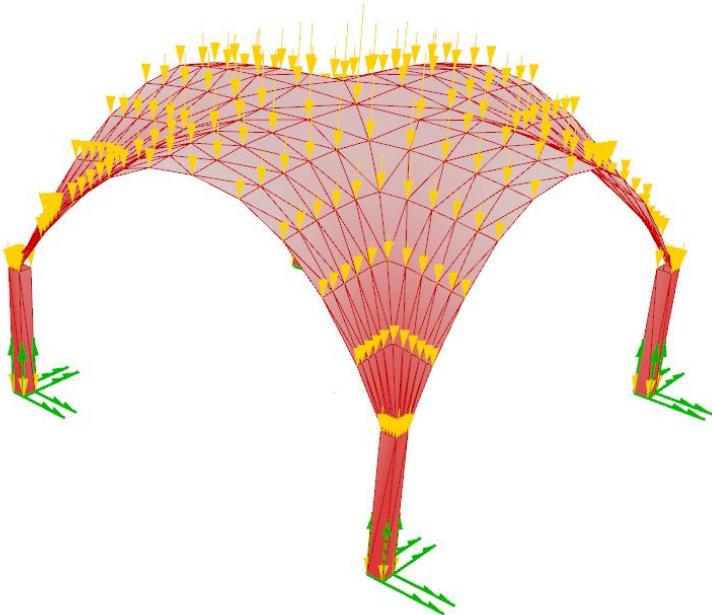
Roof type	Buildability	Linearity	Centrality	Suitable for arcade	Features
1	+	--	++	--	Good landmark, low surface-volume ratio
2	--	+	+	+	Good landmark, possibility of side openings
3	++	-	-	--	End of linear path
4	++	++	--	+	Ideal for paths and corridors
5	-	+	-	++	Ideal for paths and corridors open on one side
6	-	-	-	+	Corner piece of a path

Buildability as most important requirement: when possible use roofs 3 and 4

Roof 1 relatively easy to build and good landmark.
Used for stairs roof

Roof 5 best for arcades

Roof 2 most general option as expected



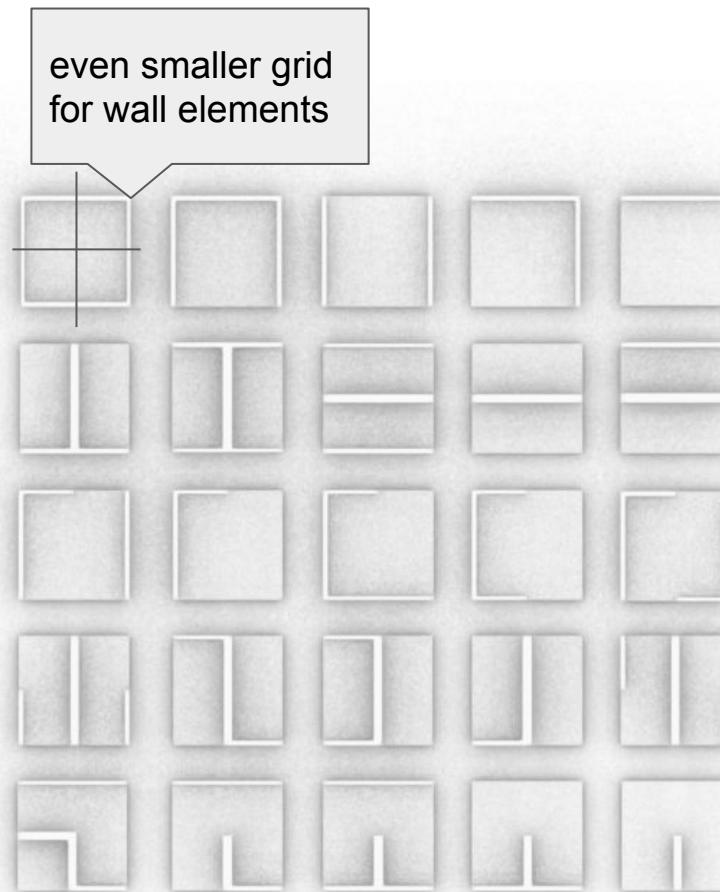
gravity load + live load
starting size of 15x15
to keep stresses below limit we need an
offset of around 25 cm

65x65 column

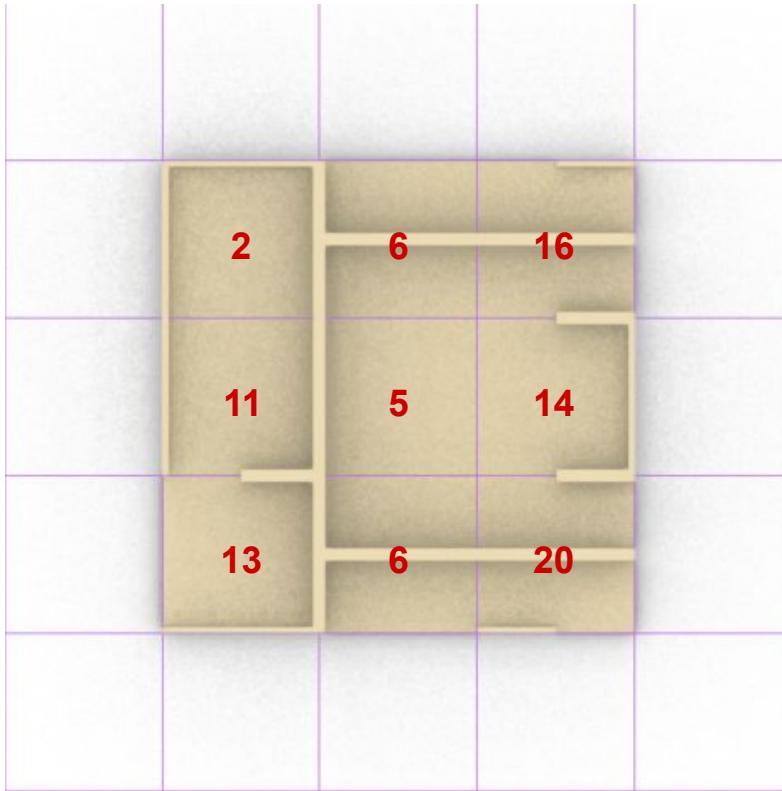
(to be further checked in more
refined models)

Building elements

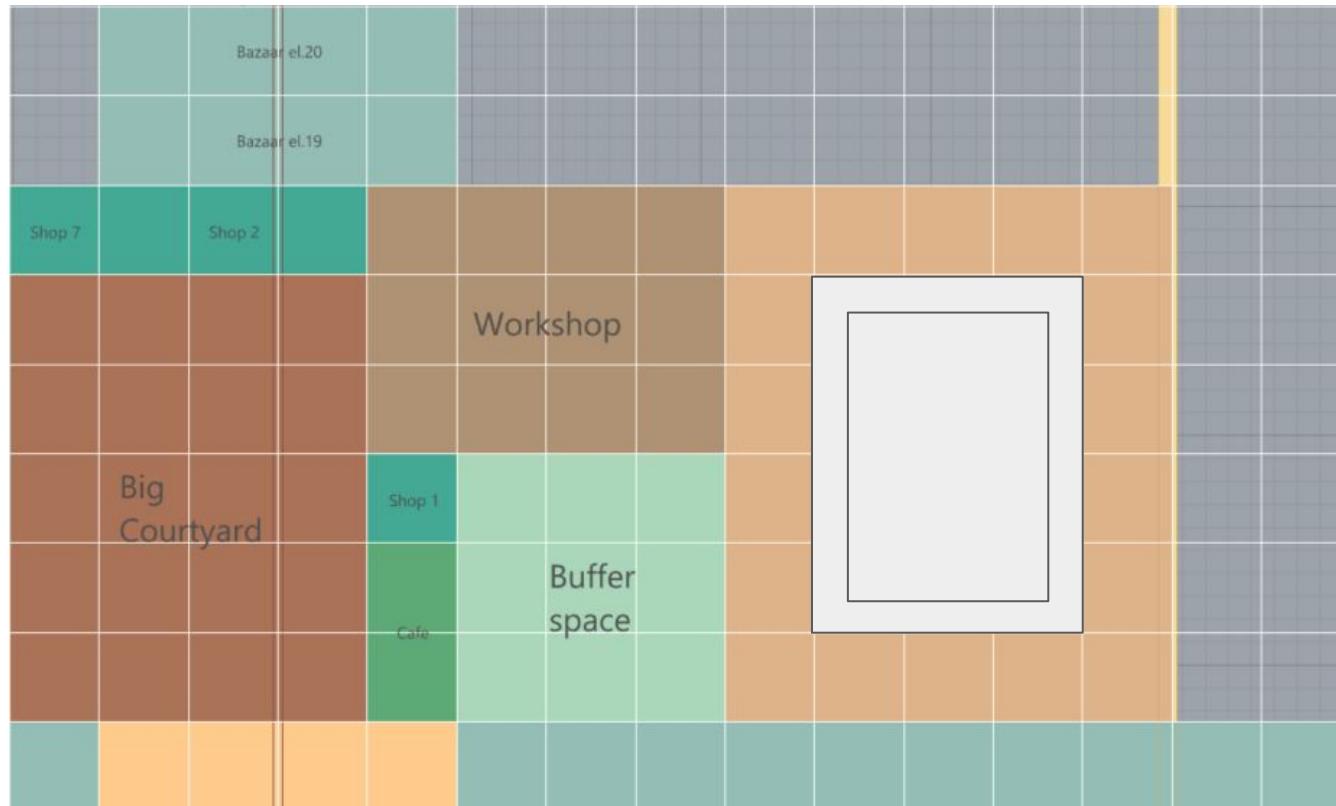
1. Walls
2. Stairs
3. Roofs



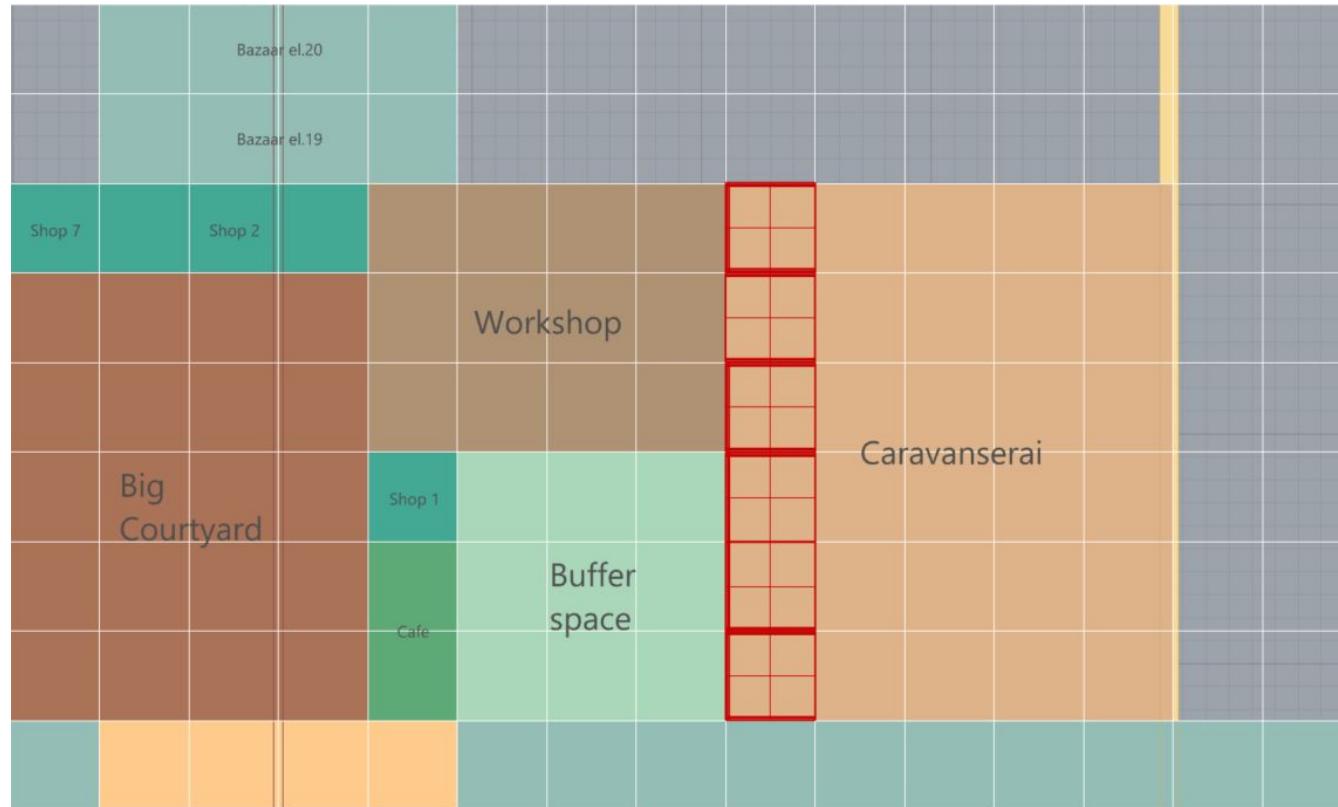
Building elements - how to place them to form function modules



Building elements - how to place them to form function modules



Building elements - how to place them to form function modules



Building elements - how to place them to form function modules



Module layout tool:

1. Neighbour attribute checker
2. Openings
3. Wall type
4. (X-Y offset)
5. (Edge points)
6. (Arcades)

Neighbours

Accesses own and neighbouring attributes for any cell

Pseudocode:

Neighbour(grid, row, column): # can be used in for loops to go over all points

If grid[row][column] is not on edge of matrix:

Above = grid[row-1][column]

Below = grid[row+1][column]

Left = grid[row][column-1]

Right = grid[row][column+1]

Self = grid[row][column]

Return above, below, left, right, self

```
boundaries = [
    [0,0,0,0,0],
    [0,1,1,1,0],
    [0,1,1,1,1],
    [0,1,1,1,0],
    [0,0,1,0,0],
    [0,0,1,0,0]] #

def neighbours(grid, currentrow, currentcol):
    ...empty = 0
    ...m = currentrow
    ...n = currentcol
    ...row = len(grid)
    ...col = len(grid[0])
    ...
    ...if m != 0: above = grid[m-1][n]
    ...else: above = empty
    ...
    ...if m != row-1: below = grid[m+1][n]
    ...else: below = empty
    ...
    ...if n != 0: left = grid[m][n-1]
    ...else: left = empty
    ...
    ...if n != col-1: right = grid[m][n+1]
    ...else: right = empty
    ...
    ...self = grid[m][n]
    ...return above, below, left, right, self

a = []
for i in range(len(boundaries)):
    for j in range(len(boundaries[0])):
        a.append(neighbours(boundaries,i,j)) :
```

Openings

Finds wall openings in walls. Needs connection requirements (i.e. REL chart)

Pseudocode:

```
ConnectionList = REL chart # the required connection strength per function to any other function
```

```
Openings(cell, row, column):
```

```
    a = neighbours(grid=function, row, column)[row][column]
```

```
    If a[-1] + a[0] or a[1] or a[2] or a[3] = connectionList: # checks the neighbouring functions to see if connection is on REL chart
```

```
        Opening = 0 or 1 or 2 or 3 # saves the side of the cell's opening location
```

```
return opening # note: no positioning of the opening on the wall defined yet, for this the offset is needed as well
```

Wall type

Finds wall type and orientation according to cell and neighbouring attributes

Pseudocode:

WallType(row, column):

```
list = neighbours(grid, row, column)
sum = list[0]+list[1]+list[2]+list[3] # the total amount of neighbours the cell has
if list[row][column][-1] = 1: # the current cell has a wall
    if sum = 4: type = internal
    if sum = 0: type = external
    if sum = 1: type = U-shape, orientation = neighbour # the side of the cell that has a neighbour
    if sum = 3: type = I-shape, orientation = neighbour(empty) # the empty neighbour
    if sum = 2 and left&right or above&below: type = II-shape, orientation = neighbour(empty) # the first empty neighbour
    else: type = L-shape, orientation = neighbour(empty1,empty2) # needs two empty neighbours to find orientation
return type, orientation
```

XY offset

Offsets wall in x and y direction according to cell and neighbouring attributes

Pseudocode:

```
XYoffset(cell): # only offsets straight wall sections between L-shapes, offsets are negative increments perpendicular to cell orientation
    if neighbours(grid = type, cell)[-1] = l-shape: # own cell is l-shape
        if neighbours(grid = offset, cell[-1]) != 0: # meaning there is AN offset already in the previous cell
            offset[cell] = offset[cell-1] # the previous cell's offset
        if neighbours(grid = function, cell) = street # if the neighbouring cell is street (not main road but backstreet that can be smaller)
            offset = offset+1 # extra offset to create thinner backstreets
    return offset # to do: include window/door positions
```

Edgepoints

Opens up the edges of the building more where possible

Pseudocode:

Edgepoints(cell):

 if **neighbours**(grid = type, cell) = L-shape: # cell is a corner cell

 if **neighbours**(grid = function, cell)[0+rot] and **neighbours**(grid = built, cell)[1+rot] = public: # two neighbouring adjacent cells have a public function

return cell, 1

 else: **return** cell, 0 # returns cells to receive extra openings

Arcades

Adds arcades around buffer spaces

Pseudocode:

```
Arcades(cell): # only offsets straight wall sections between L-shapes, offsets are negative increments perpendicular to cell orientation
    if neighbours(grid = type, cell)[-1] = l-shape: # own cell is l-shape
        if neighbours(grid = function, cell[rot+1]) = courtyard: # The neighbour perpendicular to the orientation is a public space
            arcade = cell[rot+1] # adds an arcade to the public space along the edge of the building
    return arcade
```

Cell attributes

Per cell:

1. Cell ID
2. Module type
3. Rotation
4. X offset
5. Y offset
6. Opening position
7. Window position
8. Function (caravanseray, workshop, courtyard, empty, etc.)
9. (variant)
10. (comment)

Stair modules:

Input:

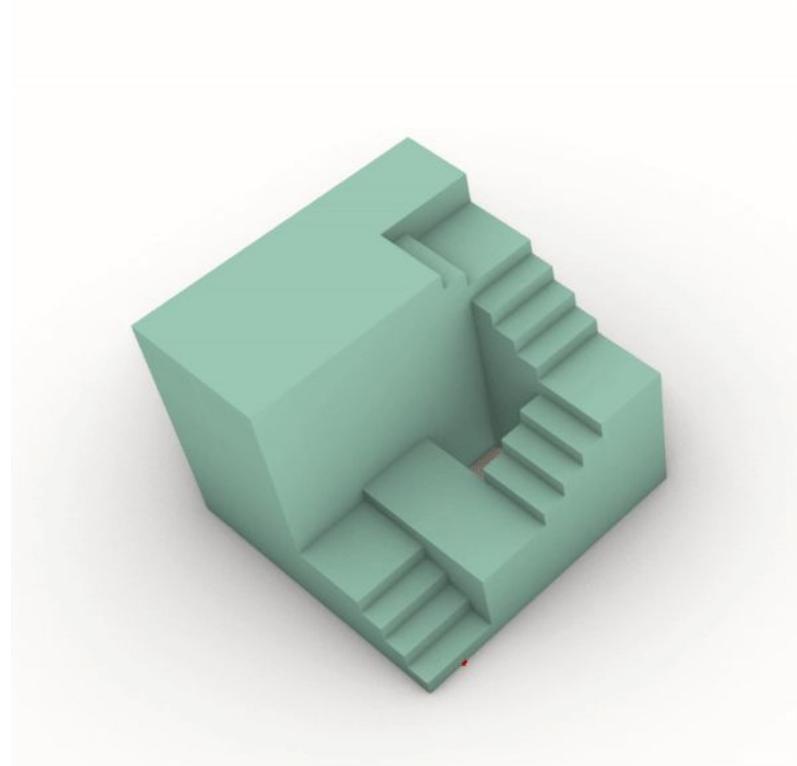
1. Starting point
2. Ending point

Can select according to:

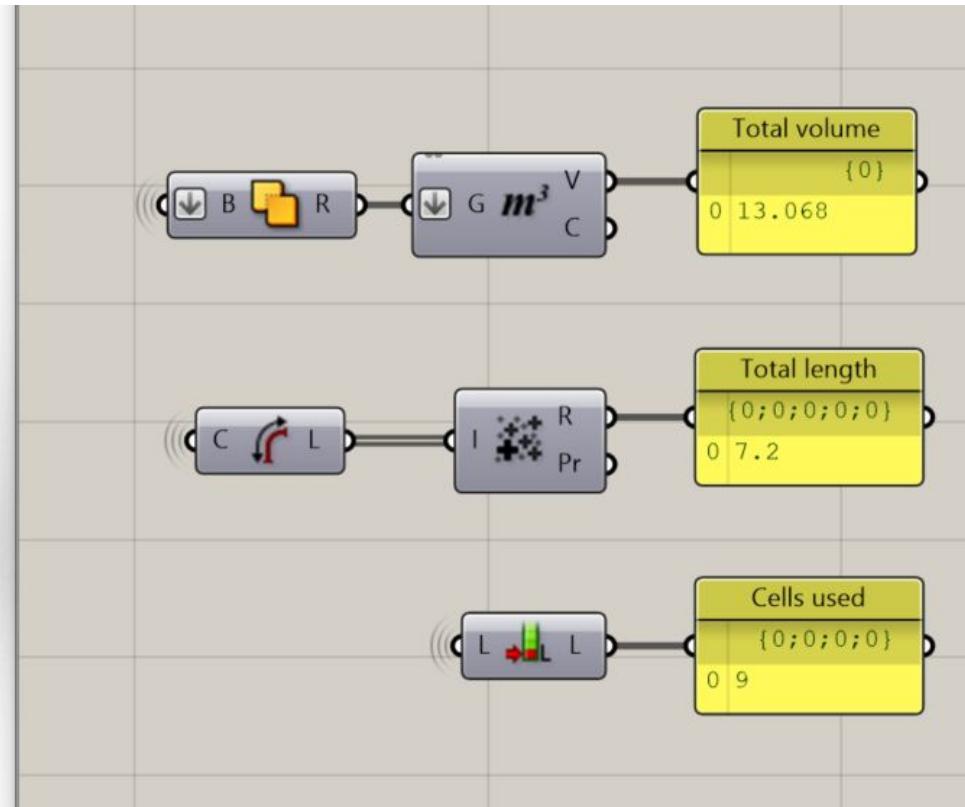
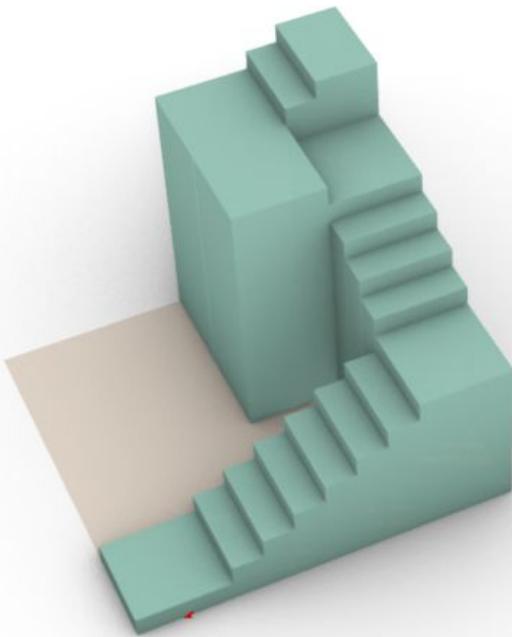
1. total length
2. total volume
3. number of cells used

Pending:

- link with module laying tool

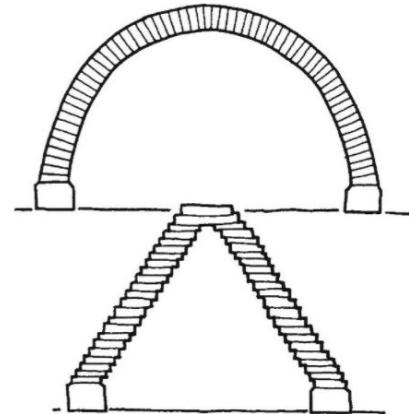
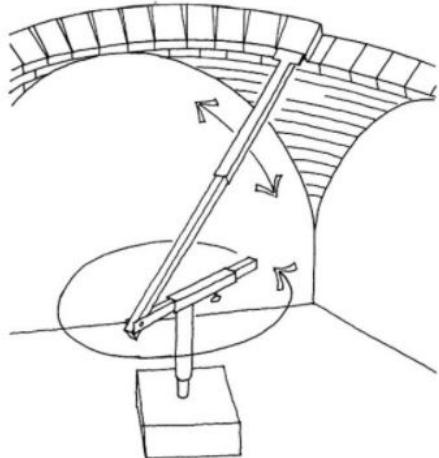
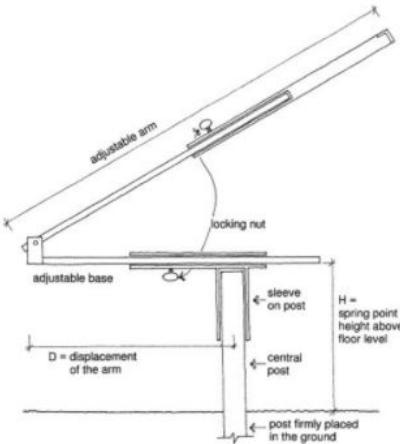
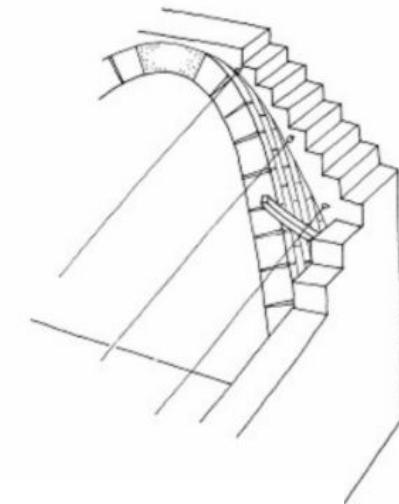
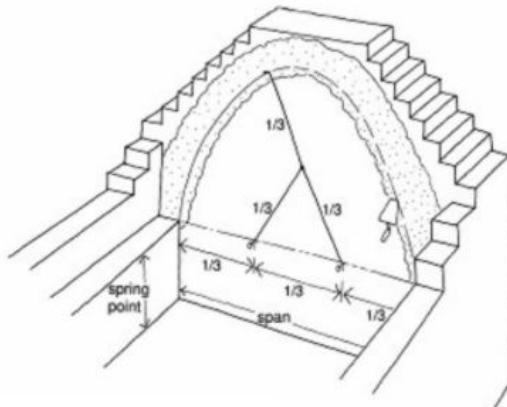
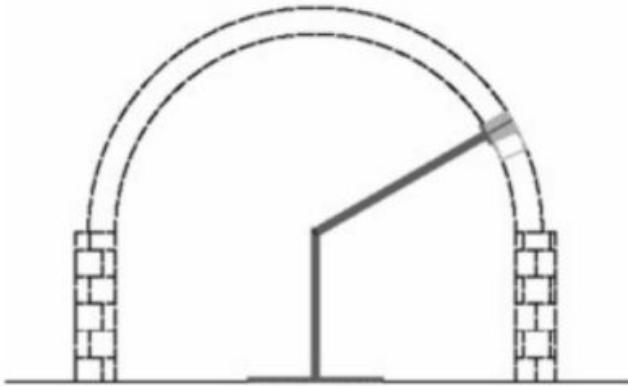


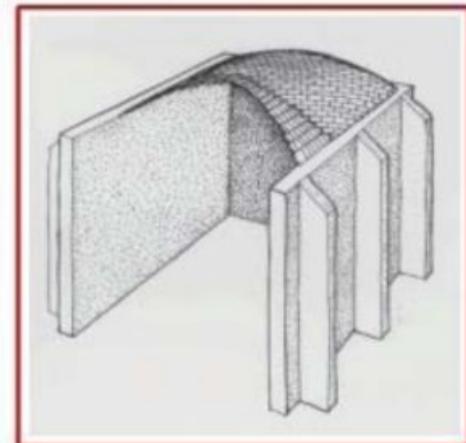
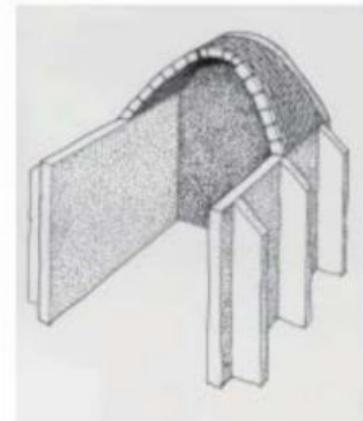
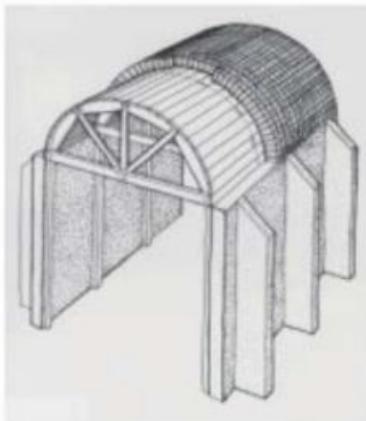
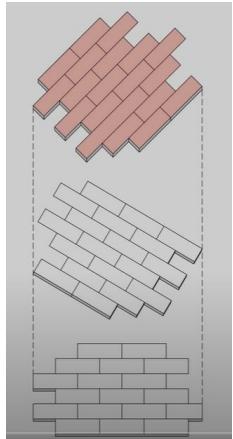
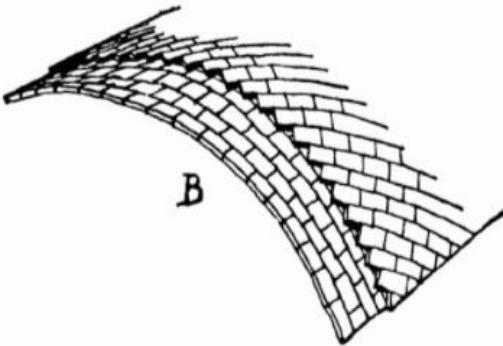
Stair modules:

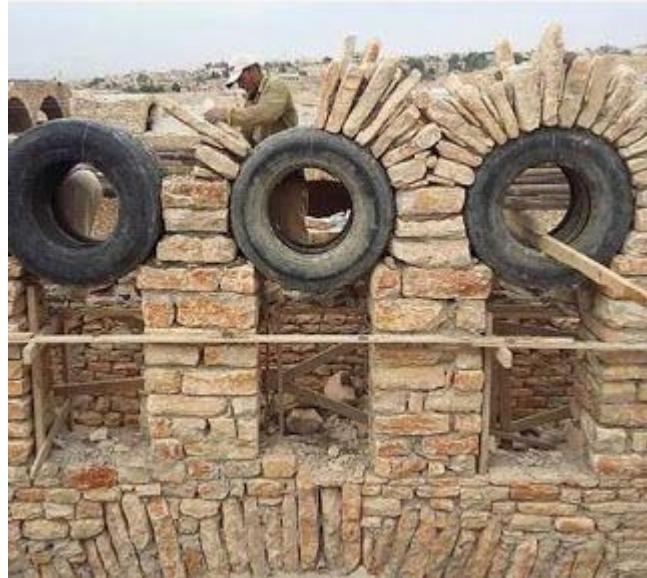


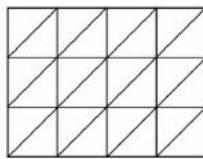
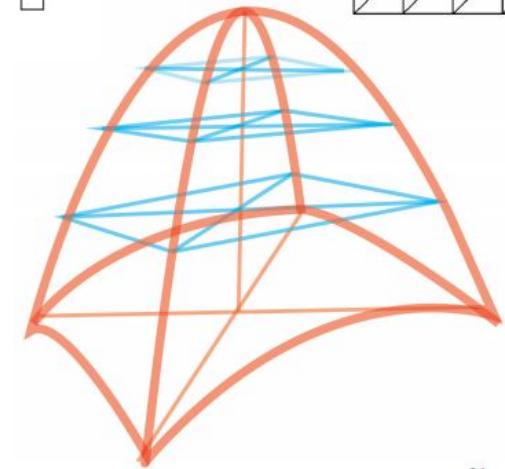
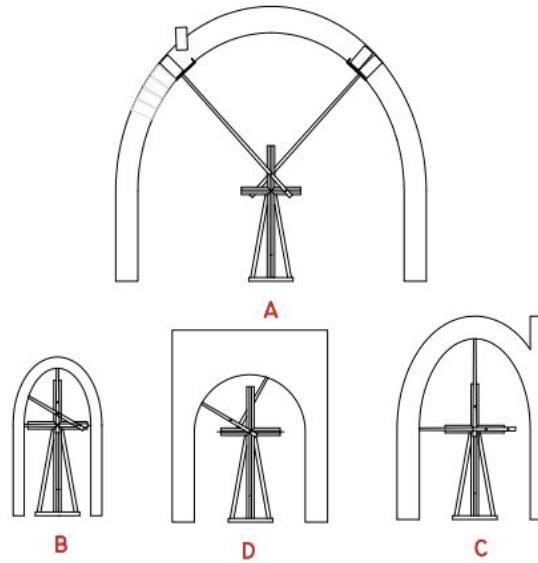
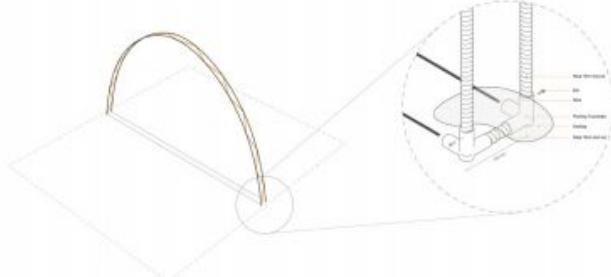
Construction

NUBIAN VAULT

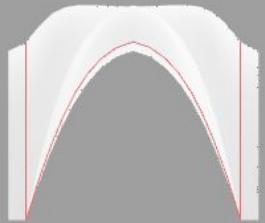




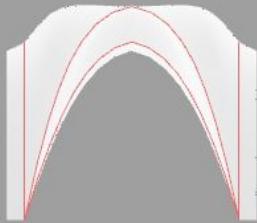




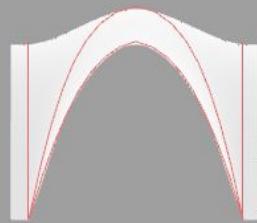
Relaxed mesh



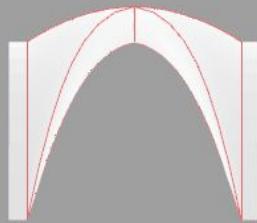
Extract main curves



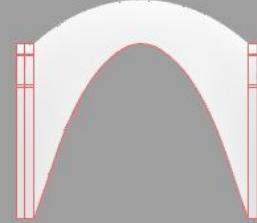
Srf with cross-brace

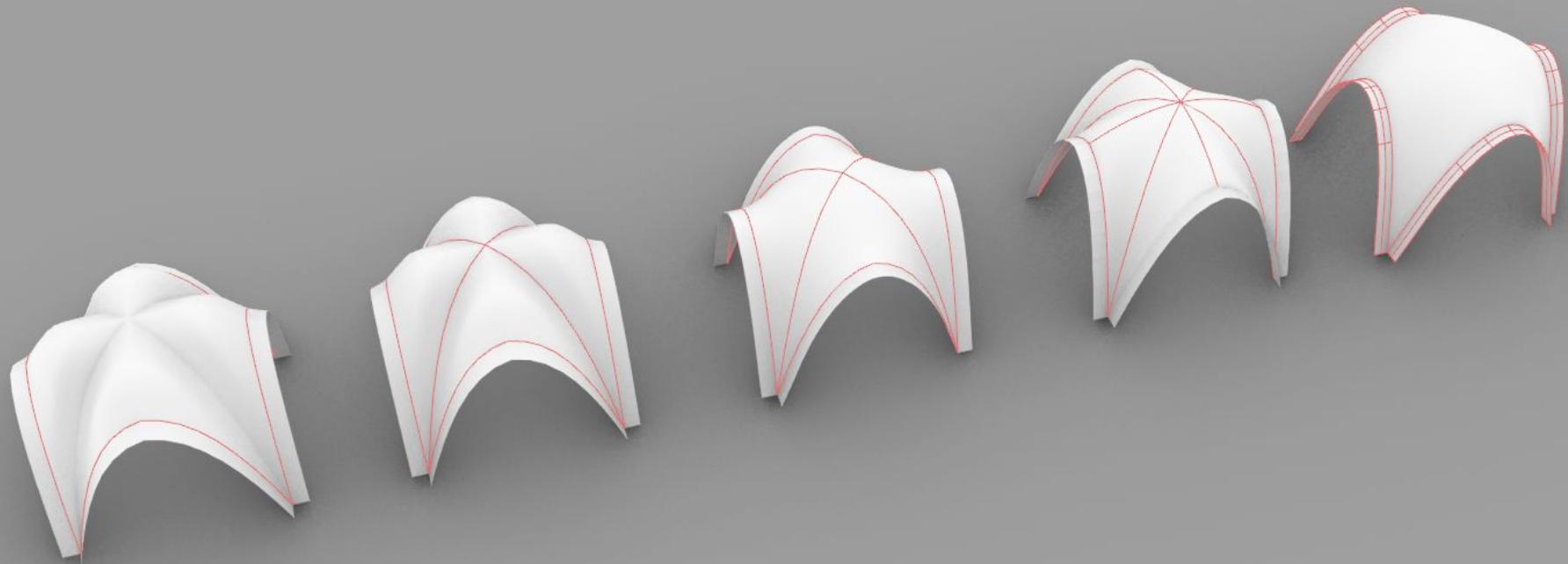


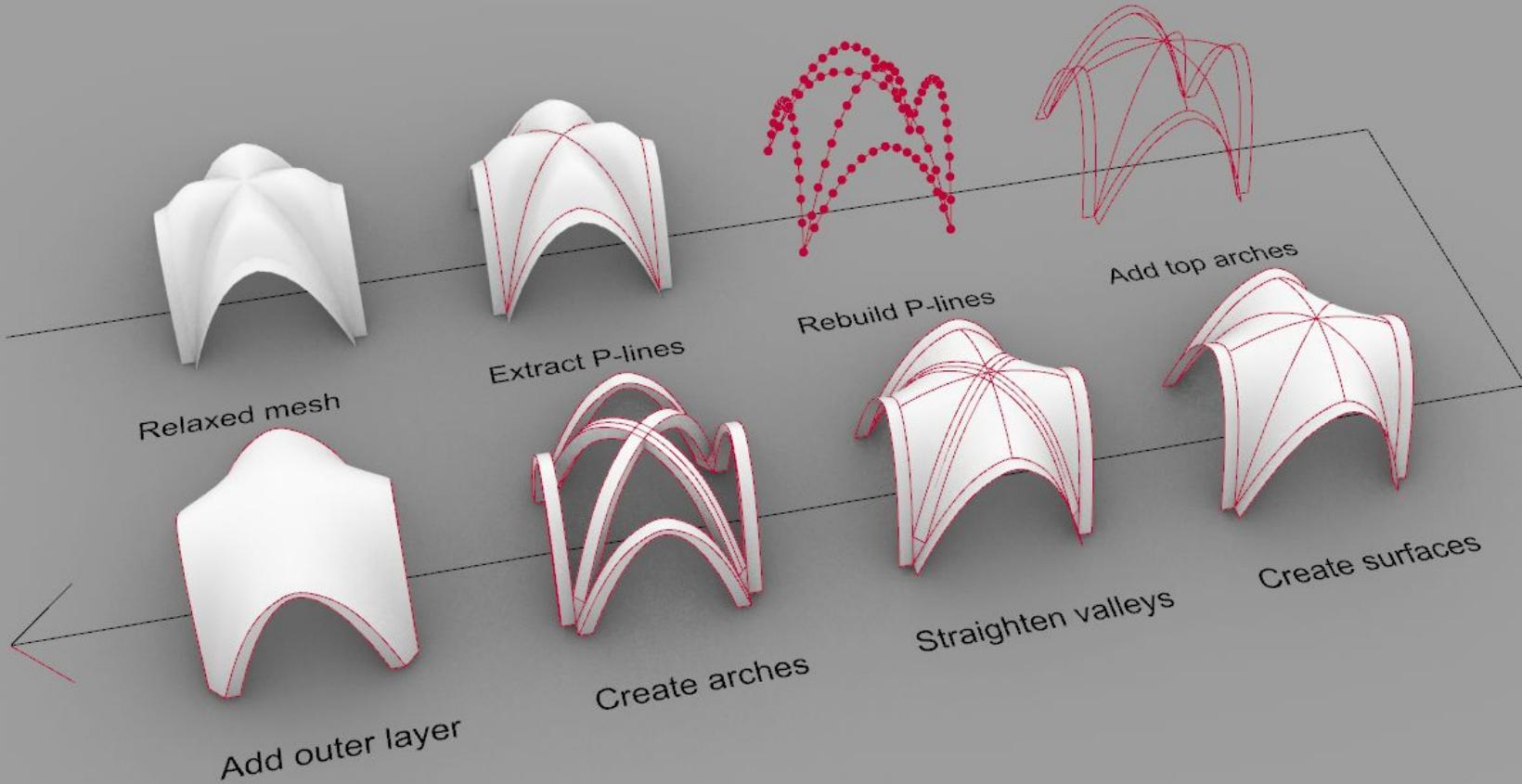
Srf with cross brace
and top arch

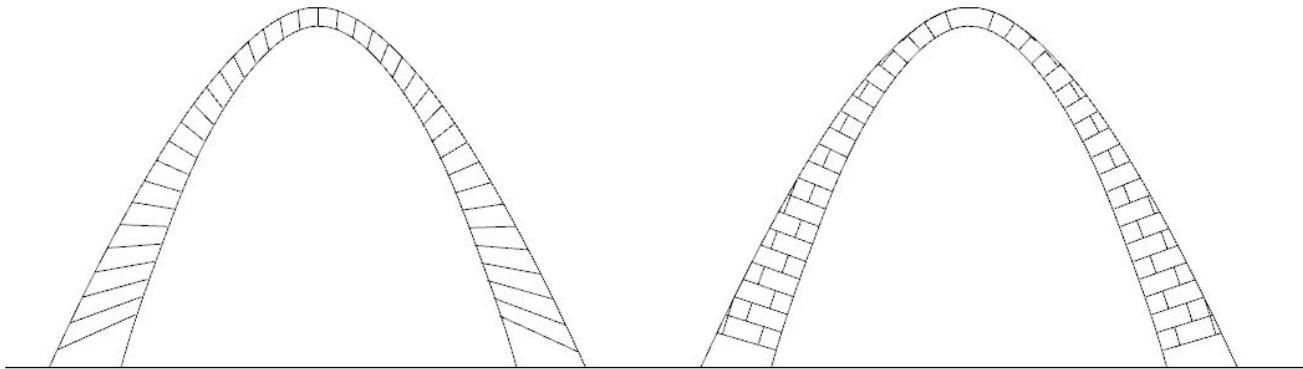
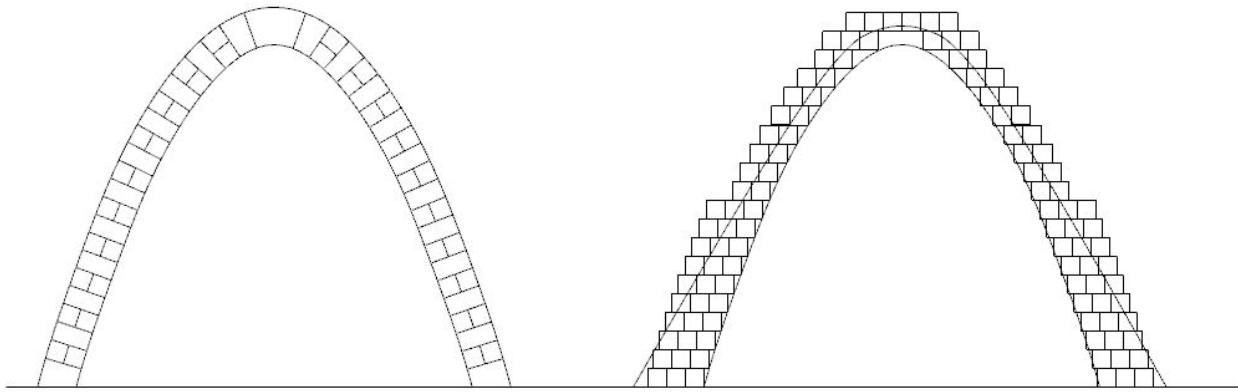


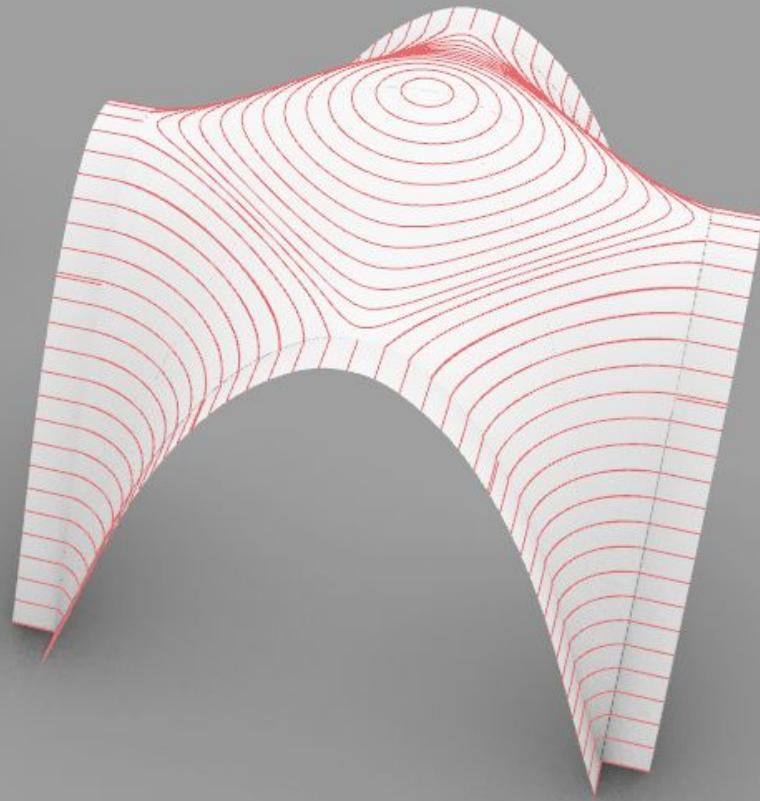
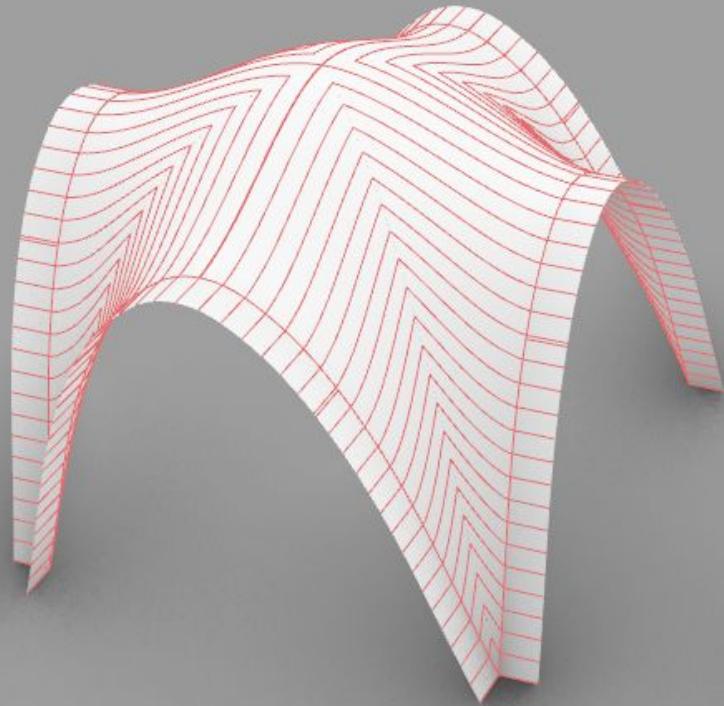
Srf without cross brace











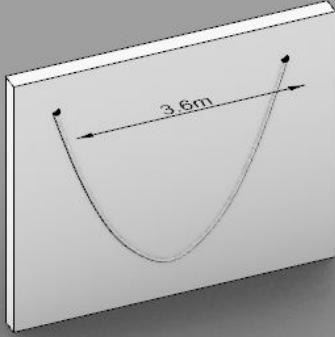


Use skills of local fabricators



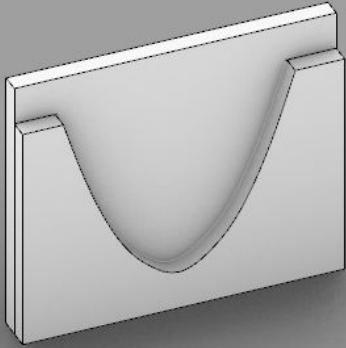
Use discarded
corrugated sheets



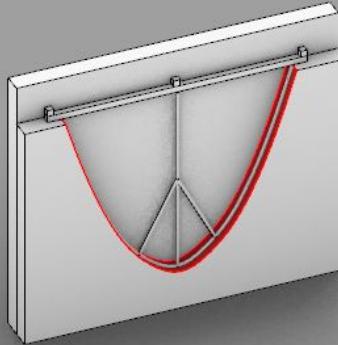


Mark points on wall

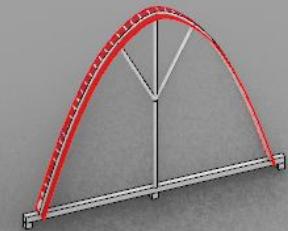
Suspend, rope,
pipe or chain



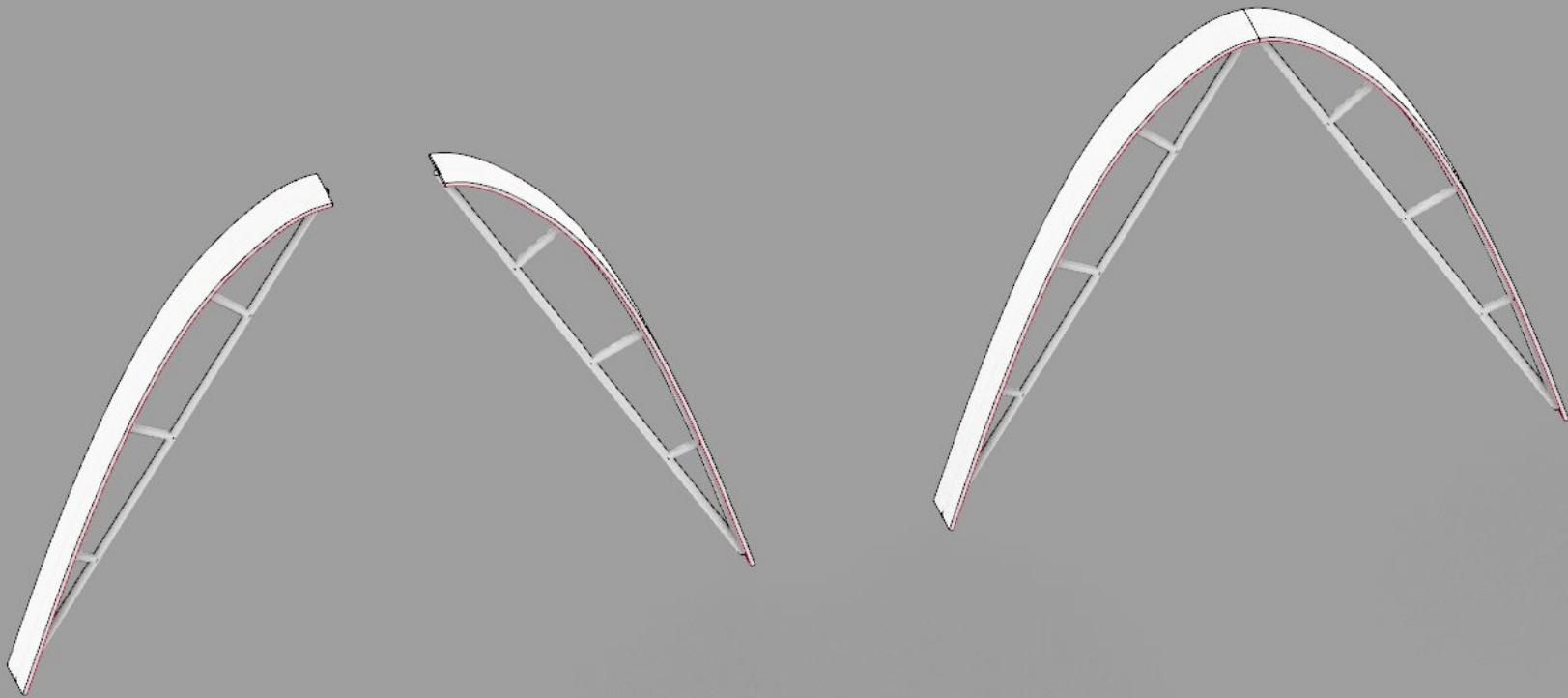
Construct
wall with dry blocks
along the curve

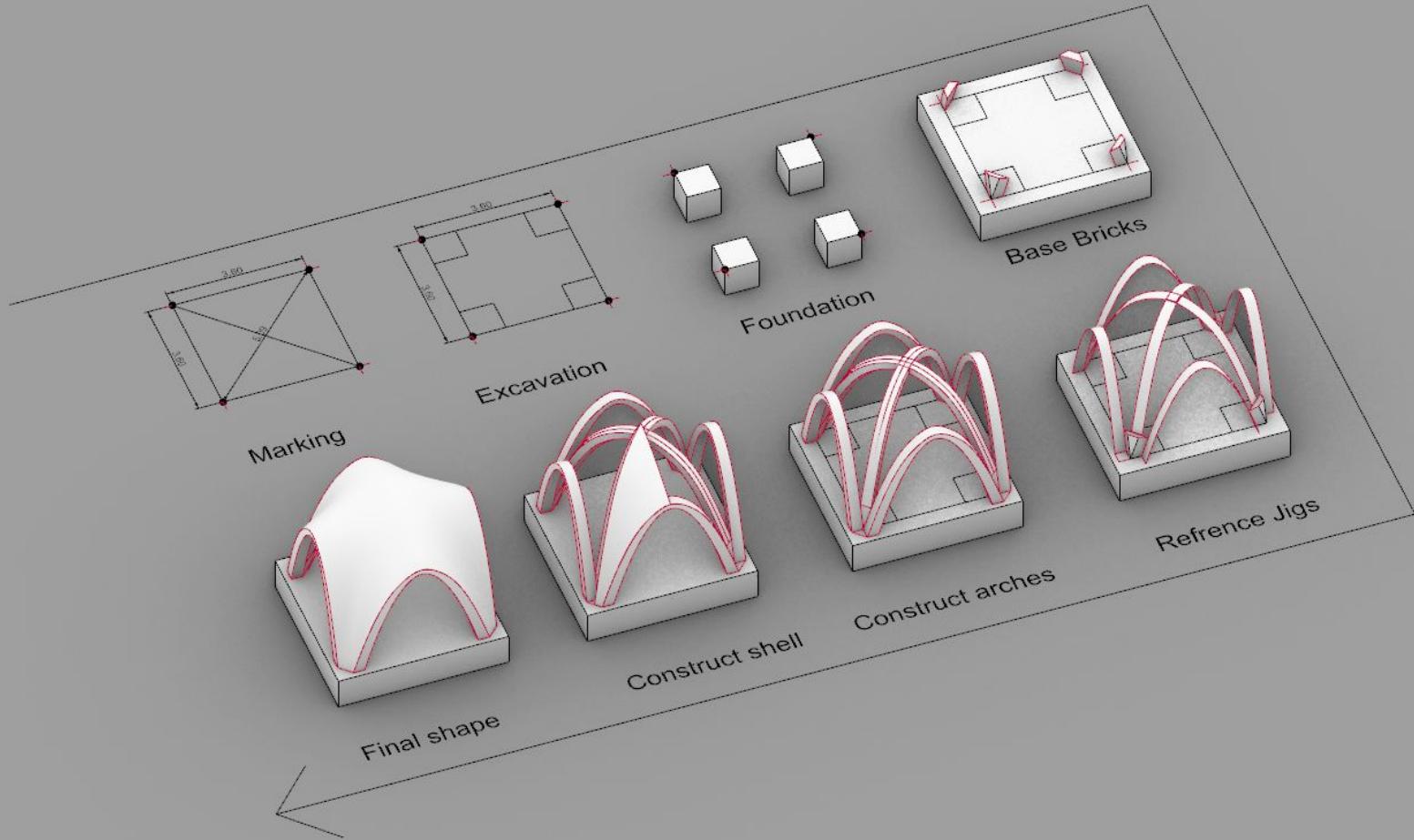


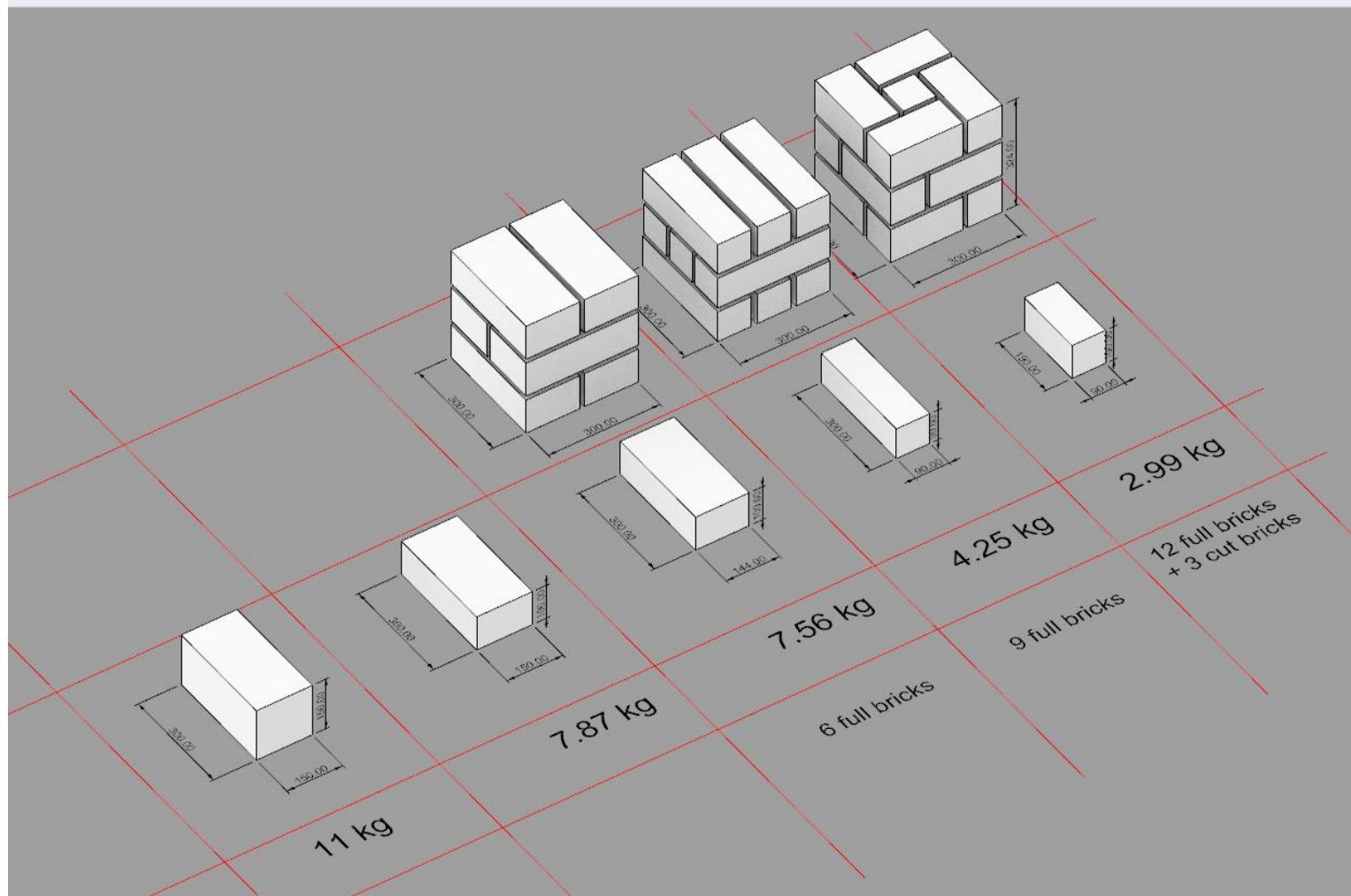
Fabricate jig module

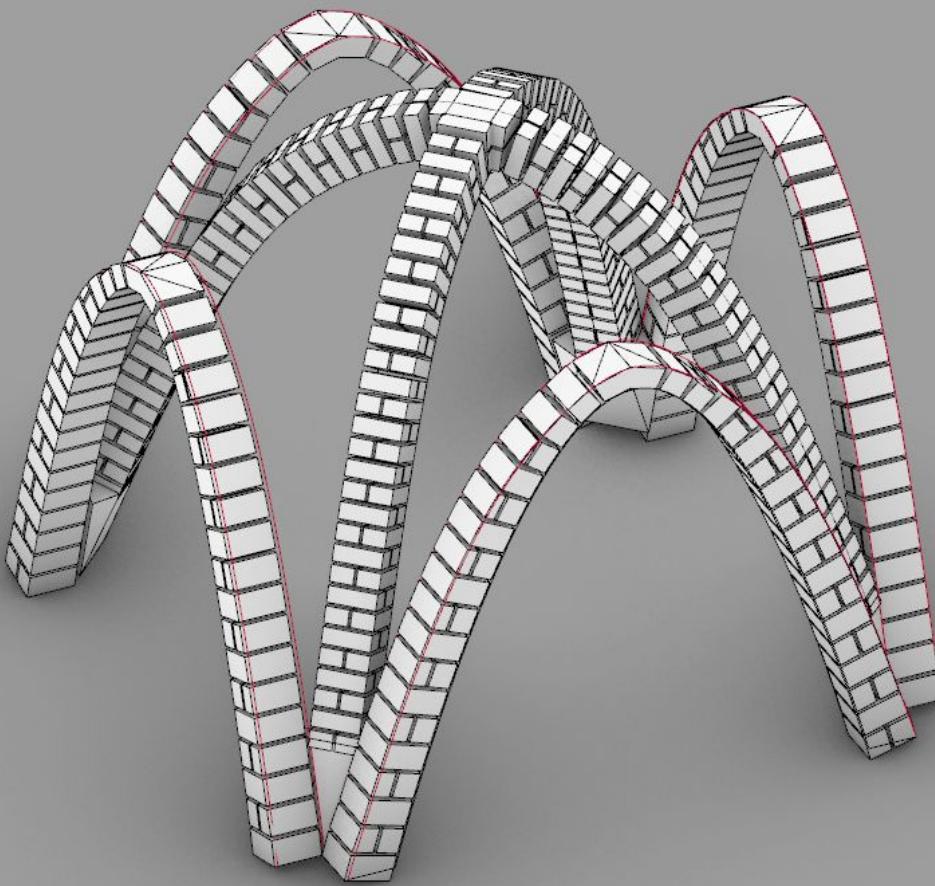


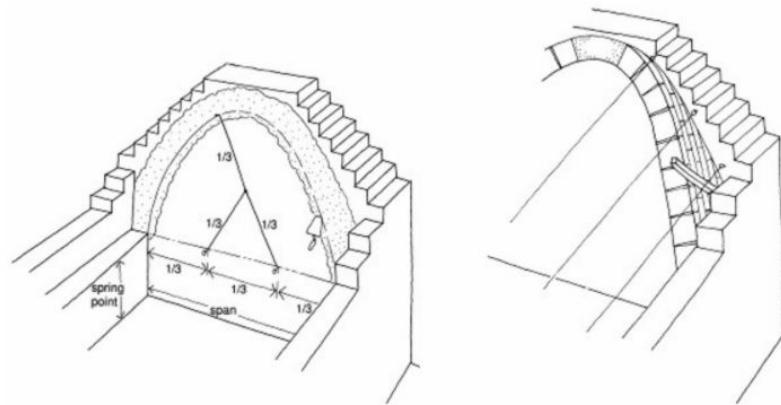
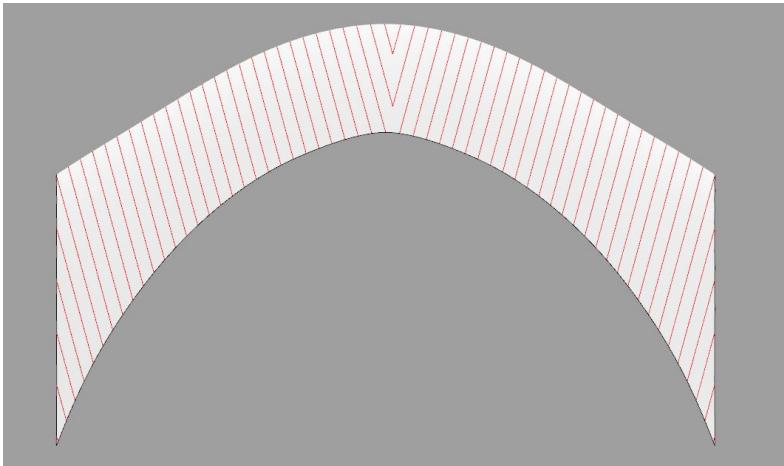
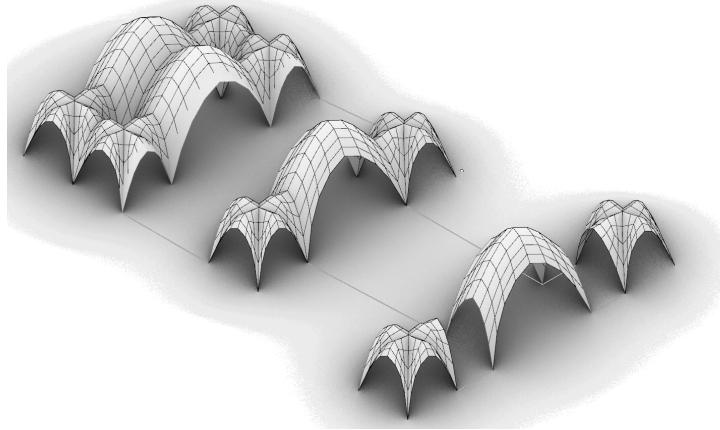
Final jig

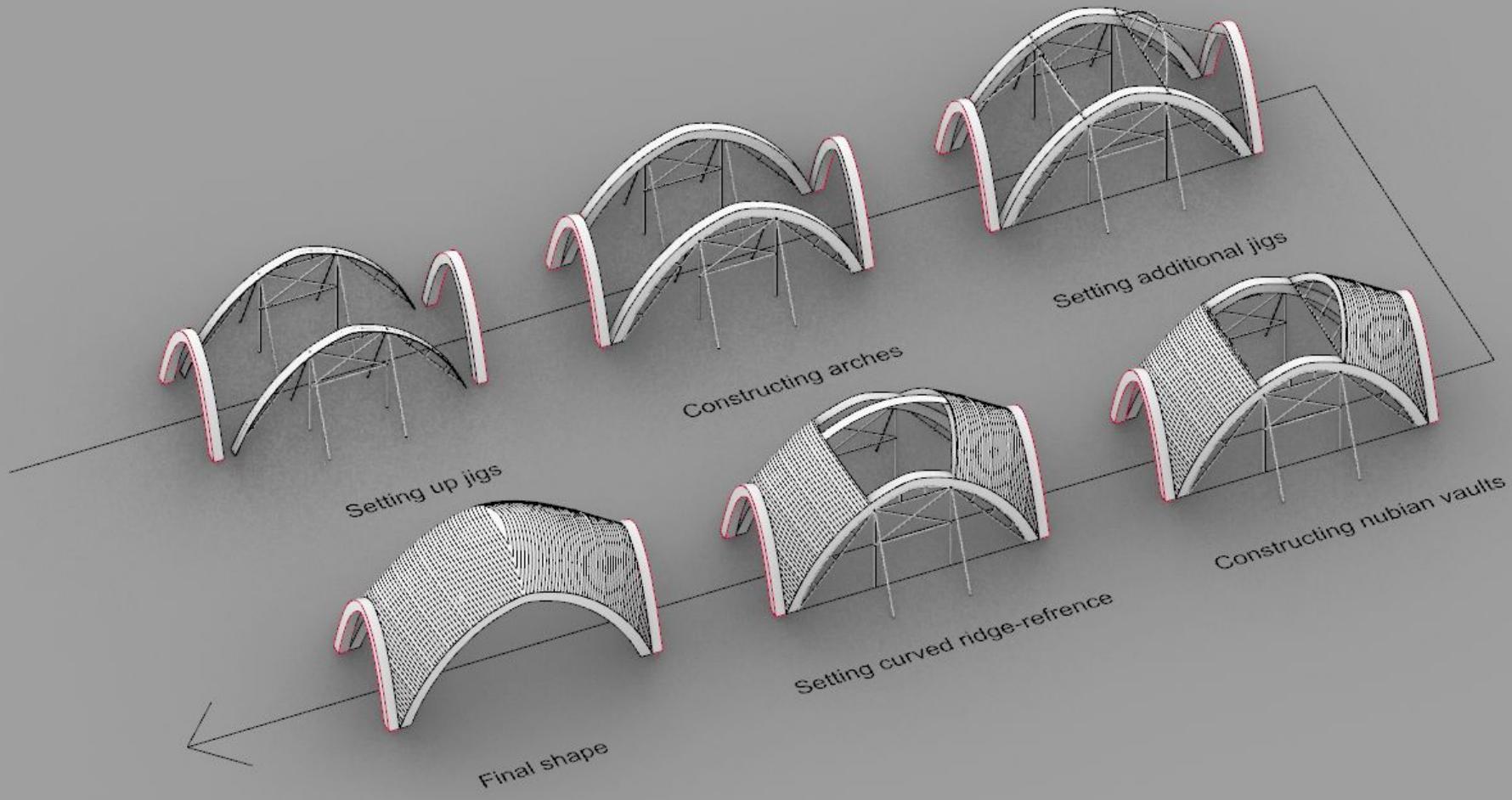


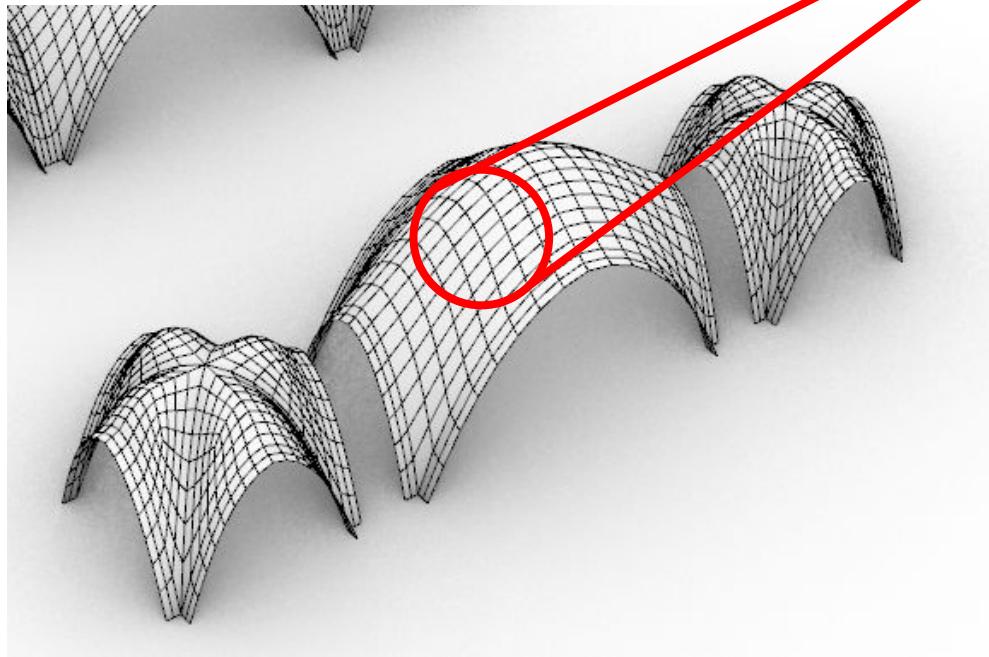




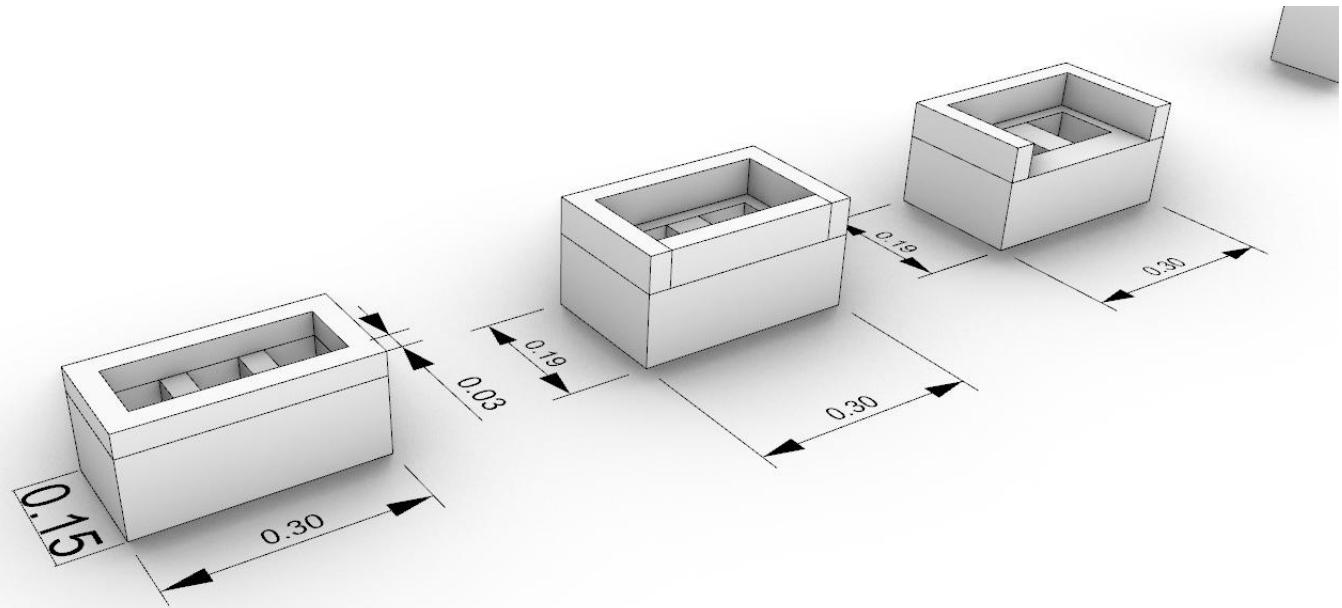


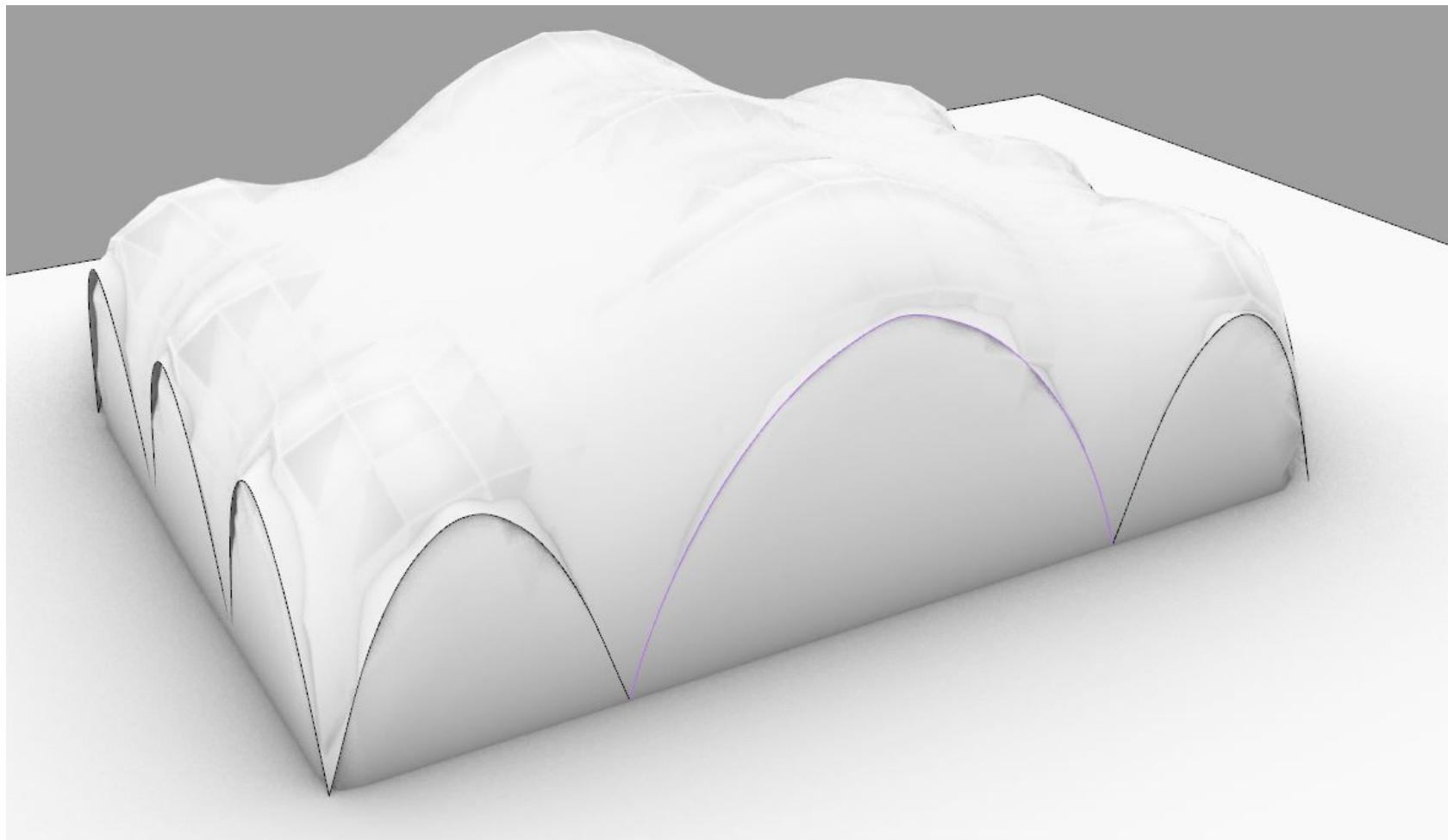


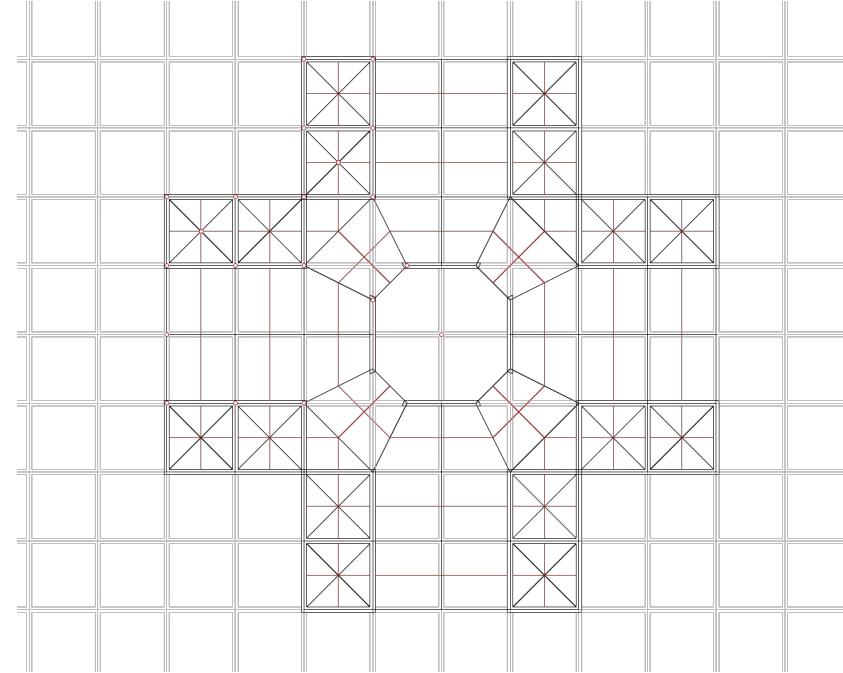
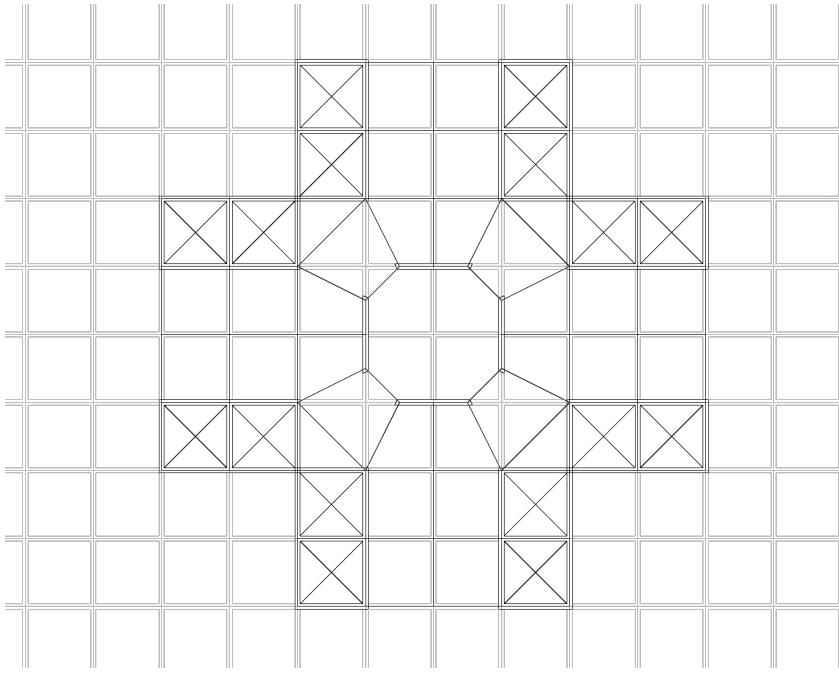




Light In
Air out

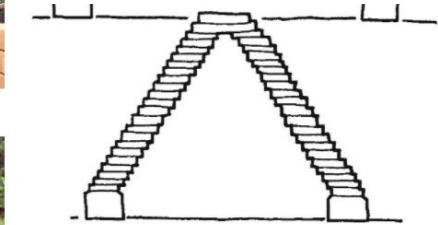






we should fill this up
probably. we can simulate
the outer shape by draping
a mesh over it using
kangaroo

open for light?



Starting the conical vault in the corner



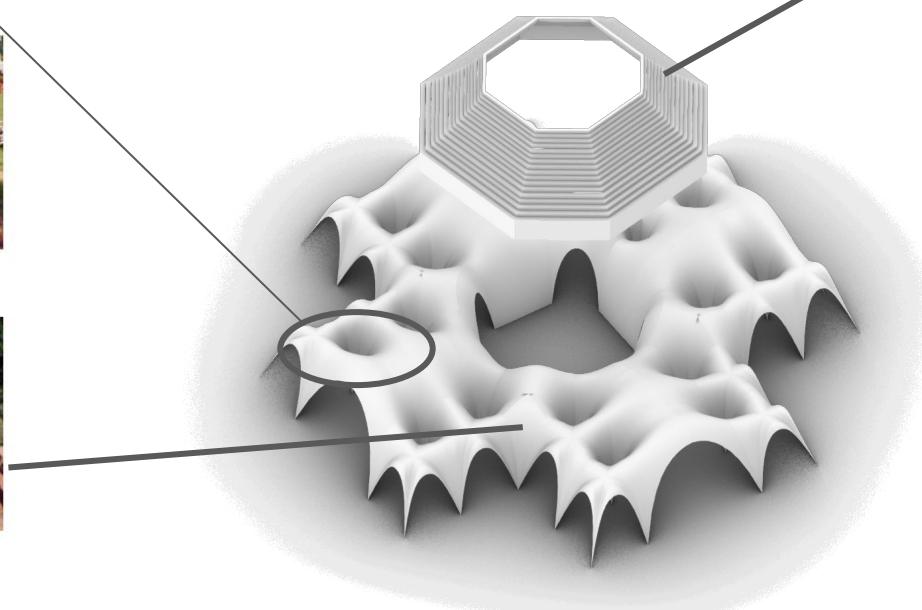
Building the conical vault in the corner

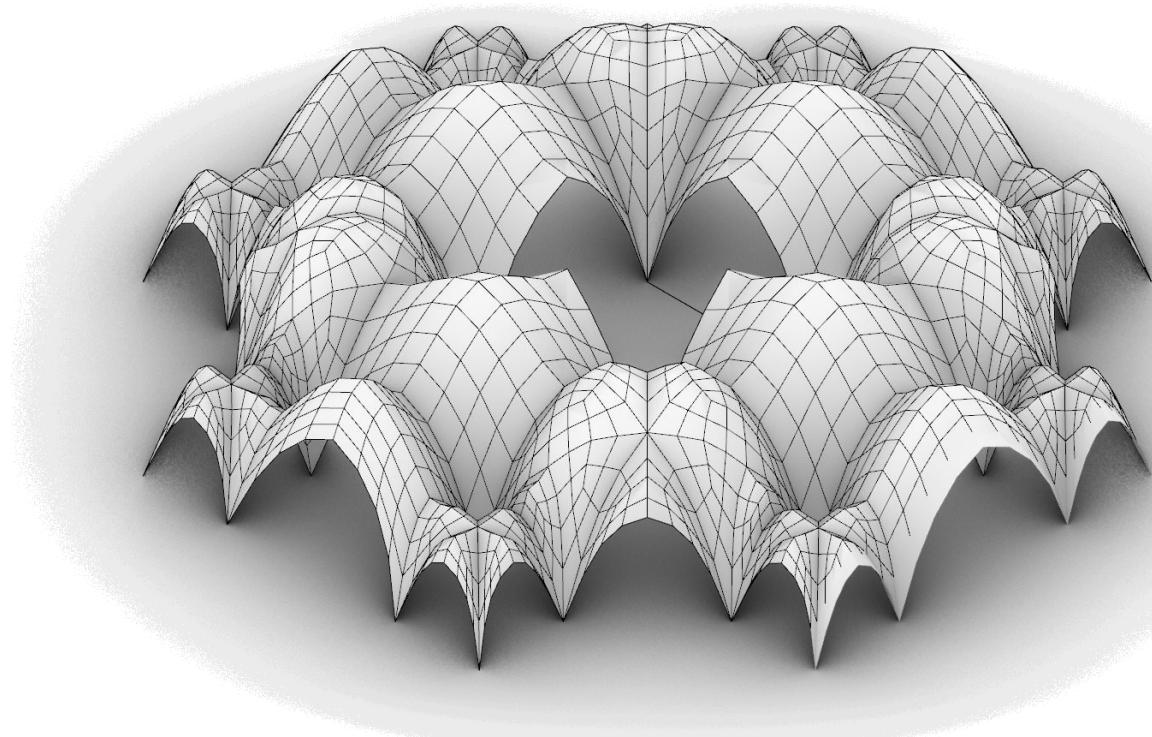
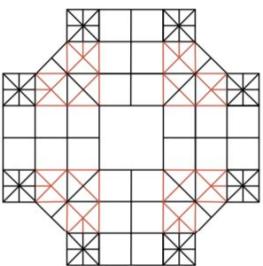
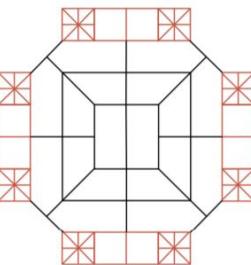
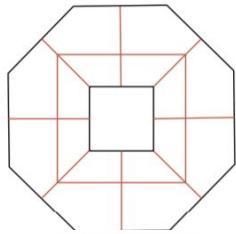
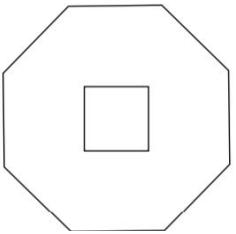


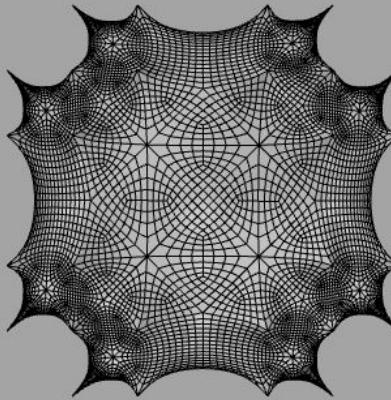
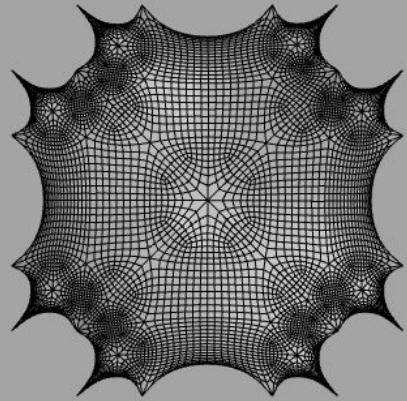
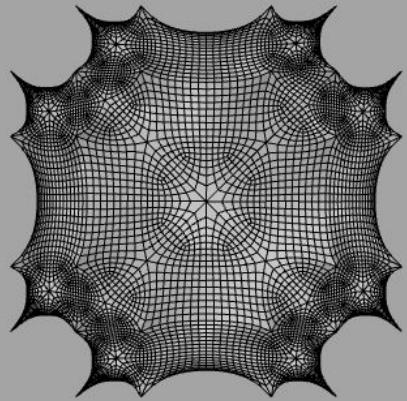
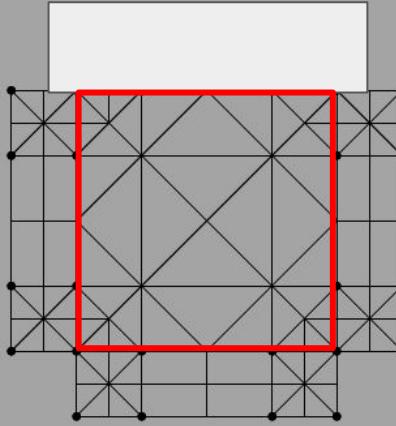
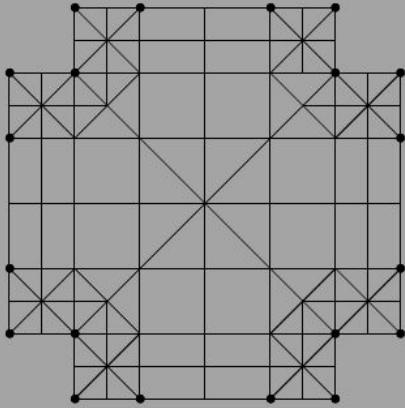
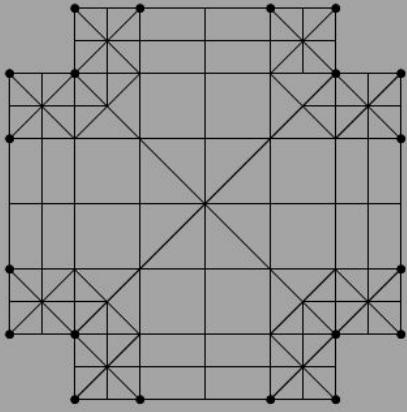
Building the squinche

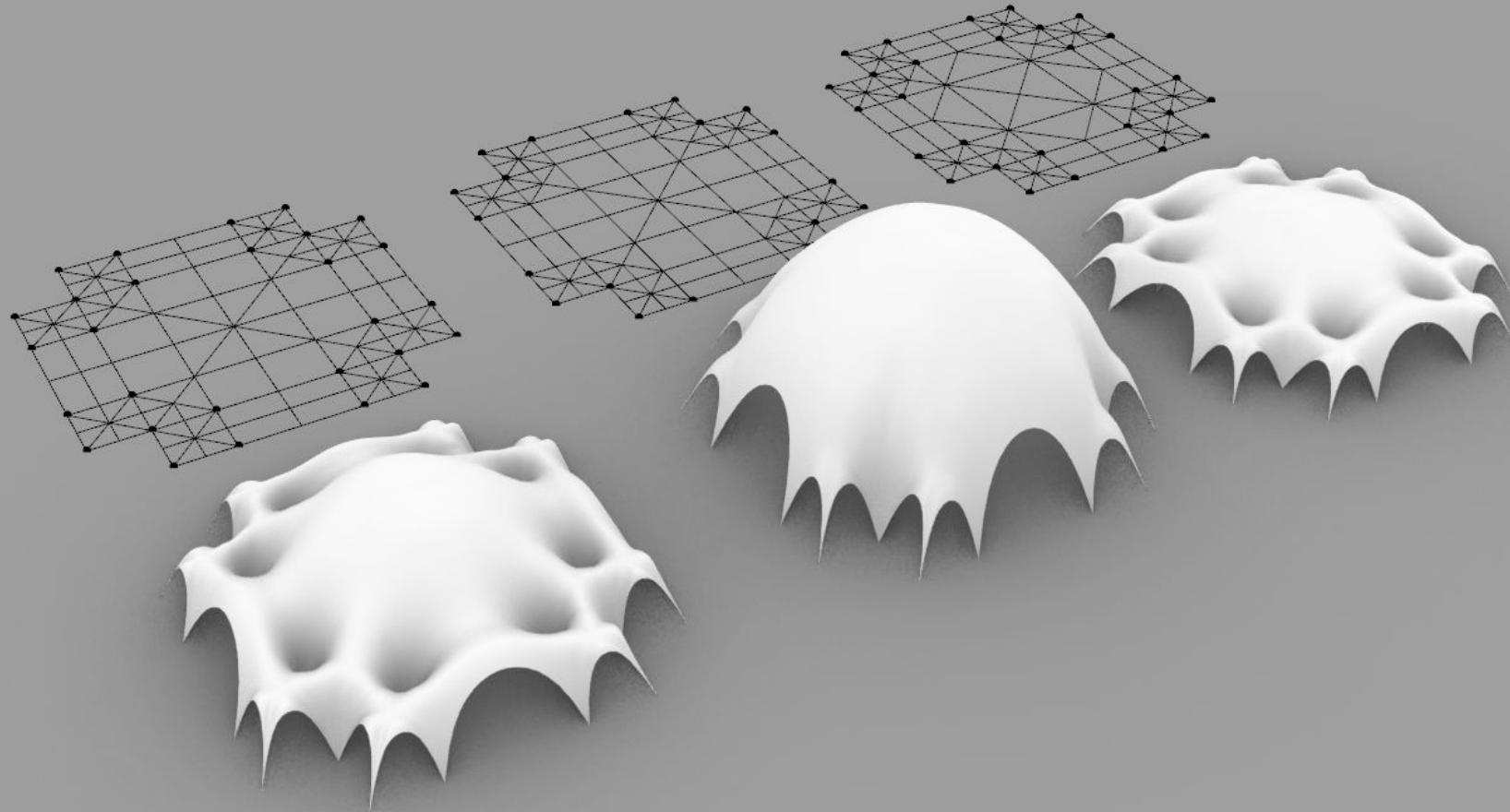


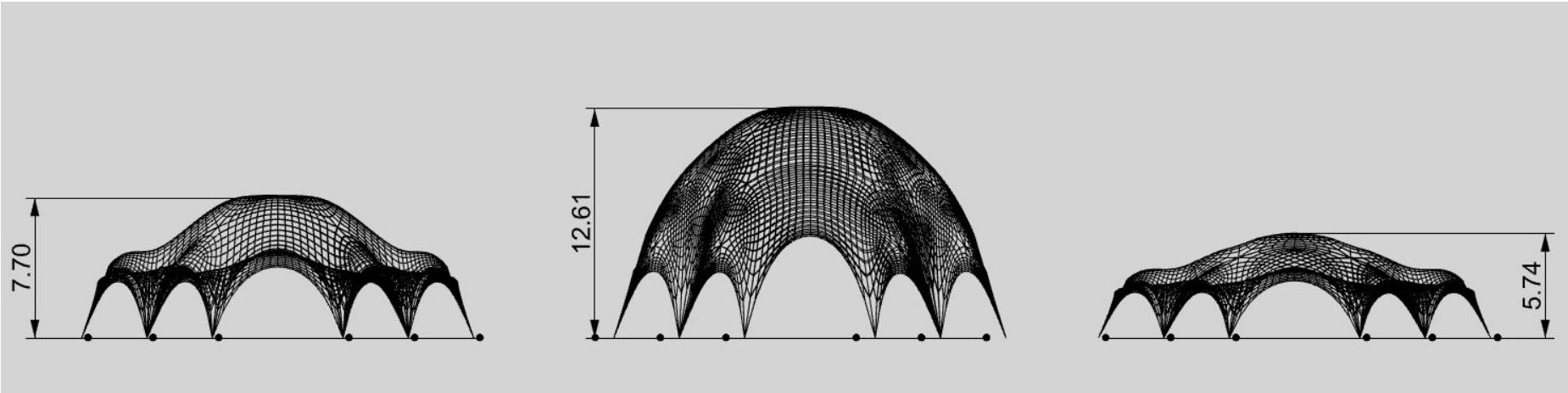
Squinche in progress

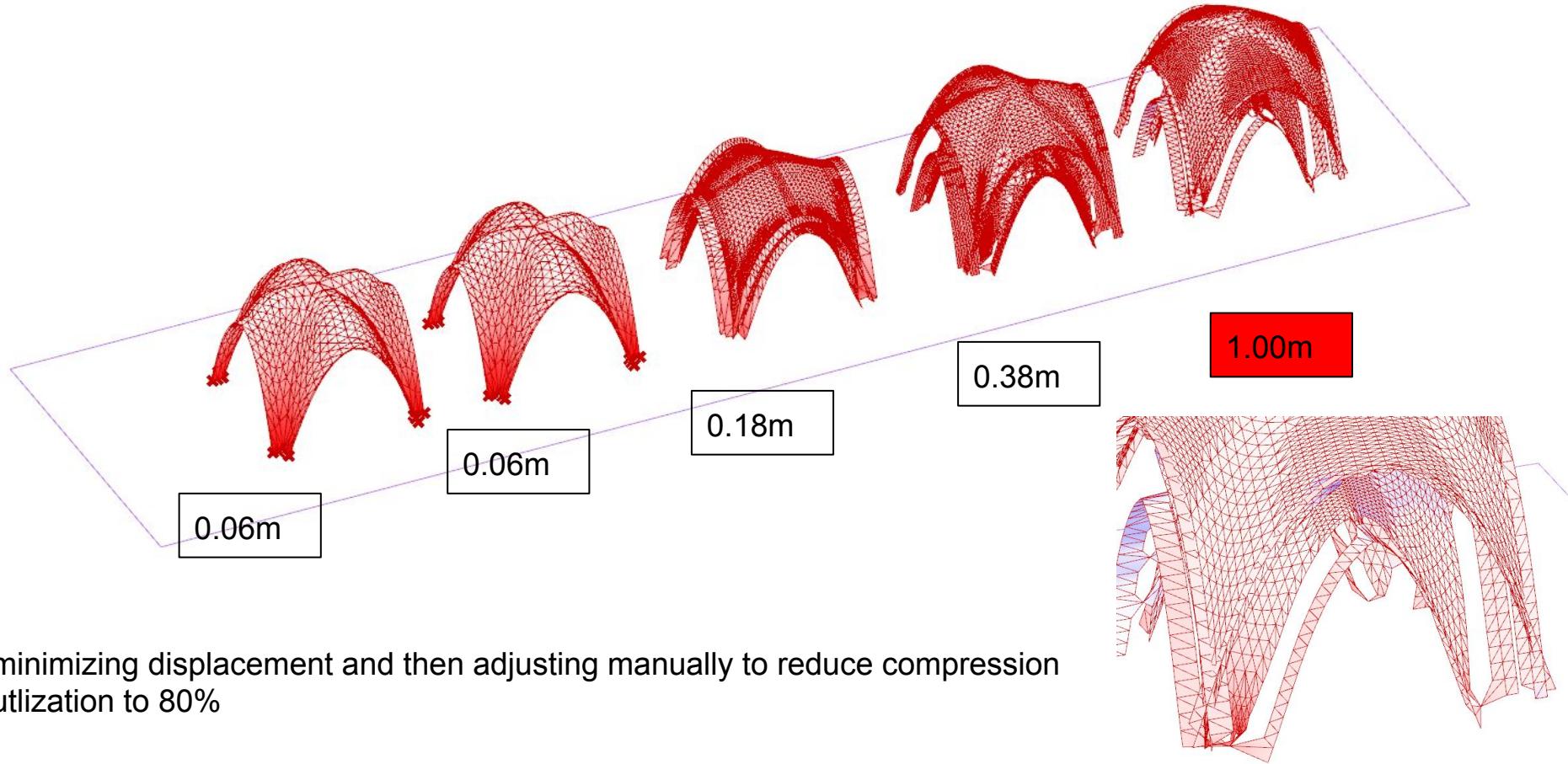


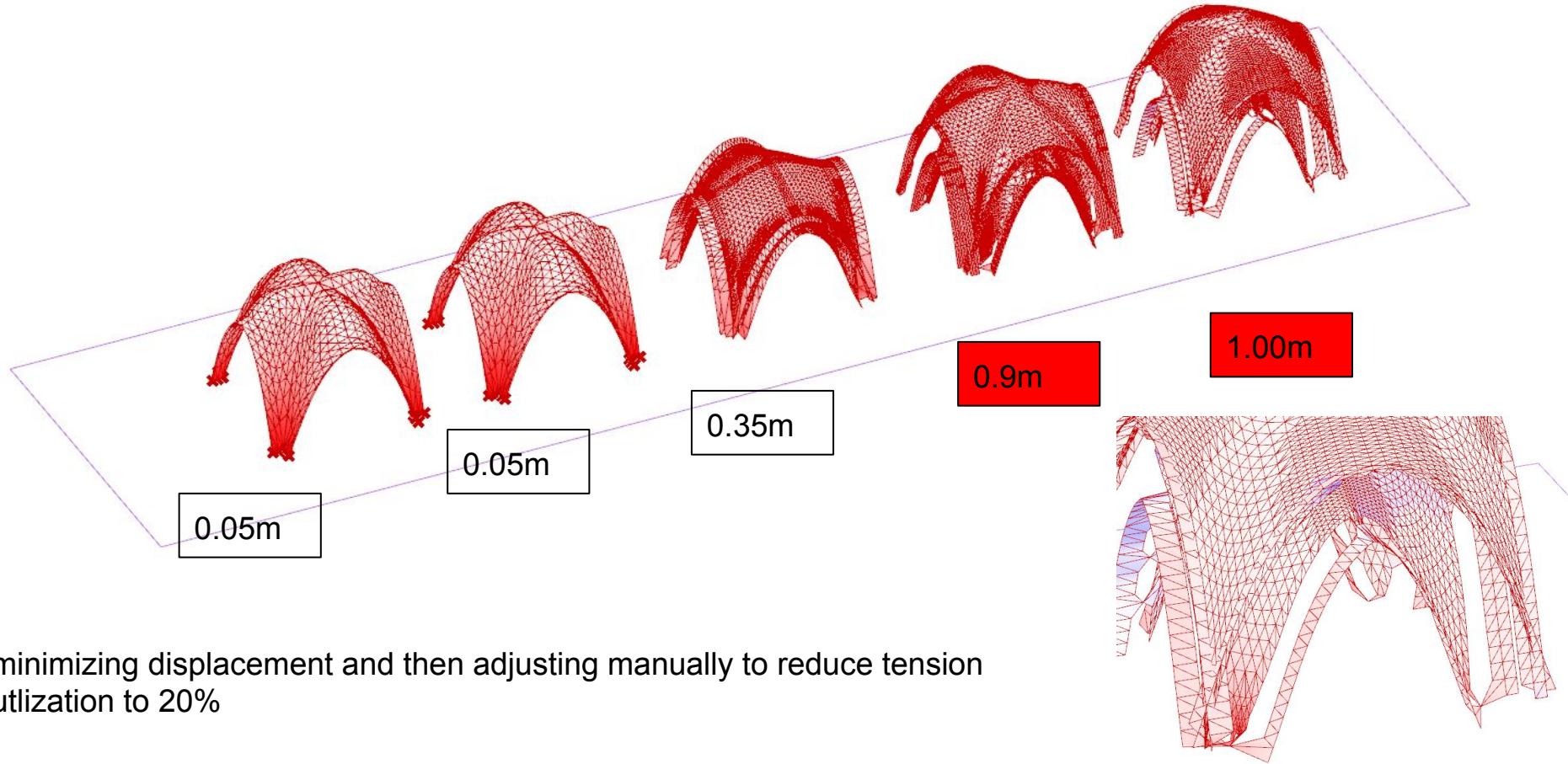


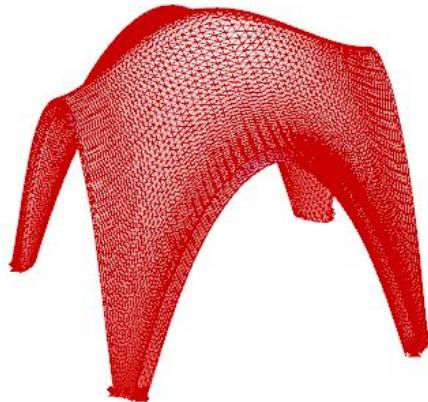








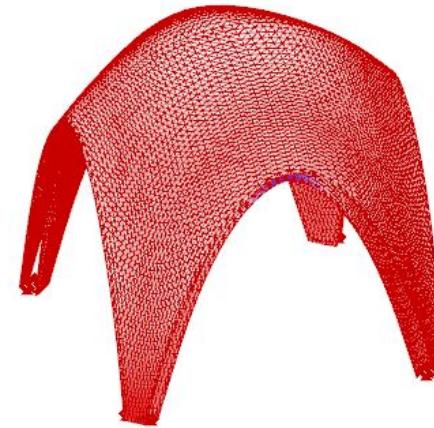




0.17m



0.22m



0.24m

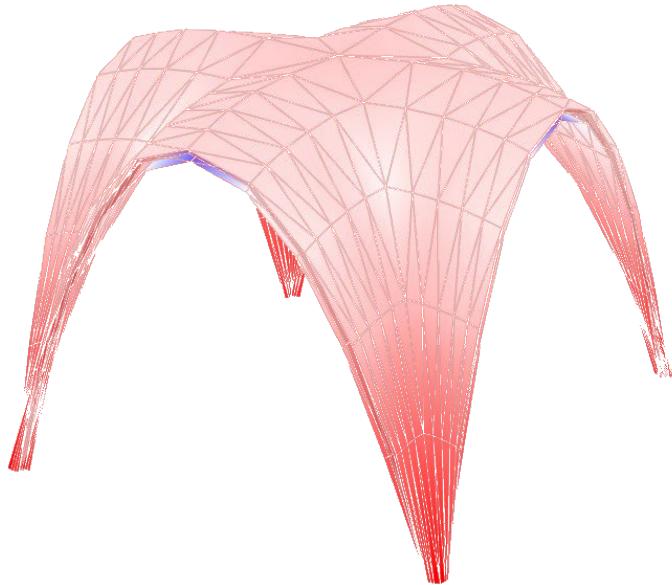
minimizing displacement and then adjusting manually to reduce tension utilization to 20% and compression utilization to 80%

Loads:

- self weight (SF of 1.2)
- Live load of 3 kN/m² (SF of 1.5)

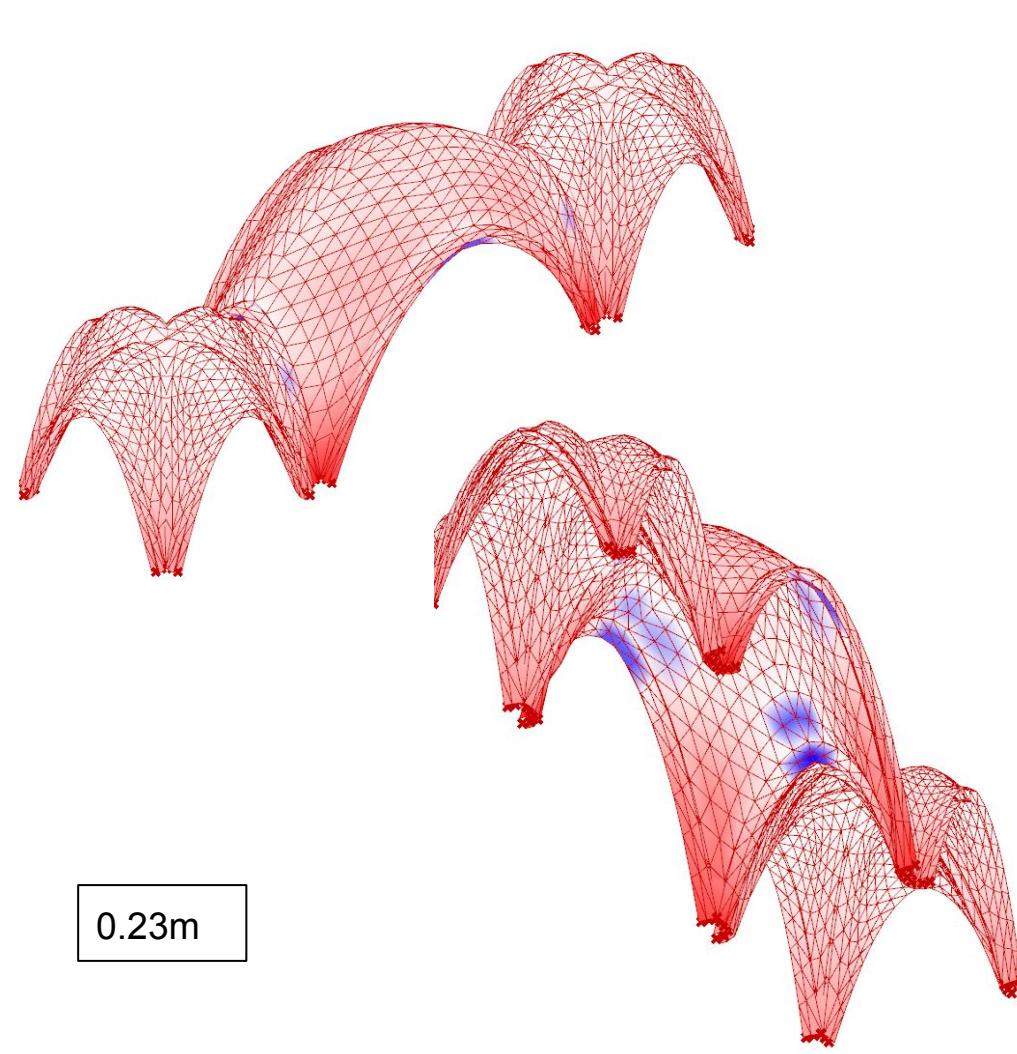
Material prop:

- E = 150 MPa
- Density = 1452 kg/m³
- Yield strength = 1.3 MPa

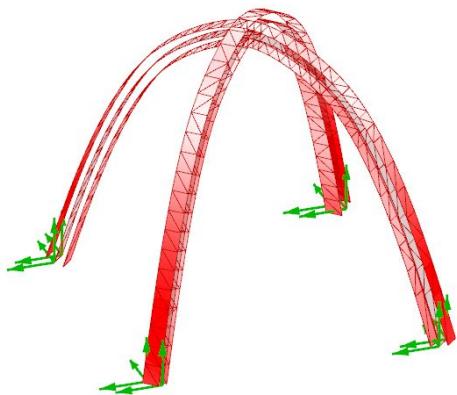
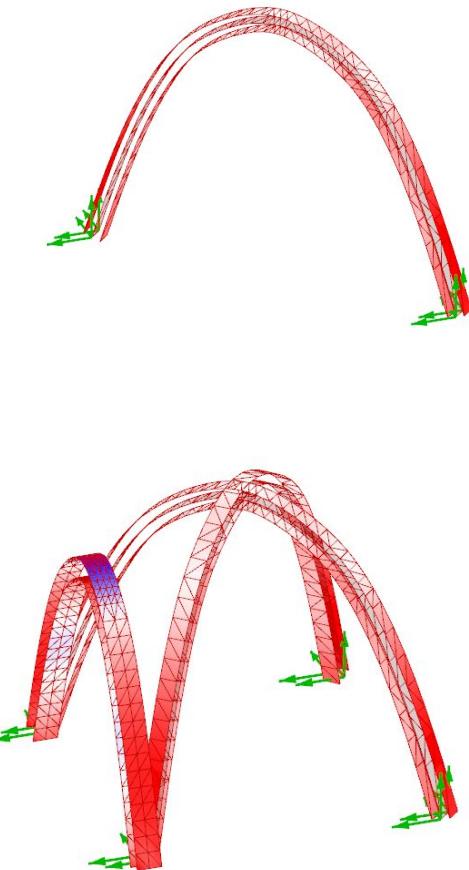


0.13m

meets both conditions of previous slides

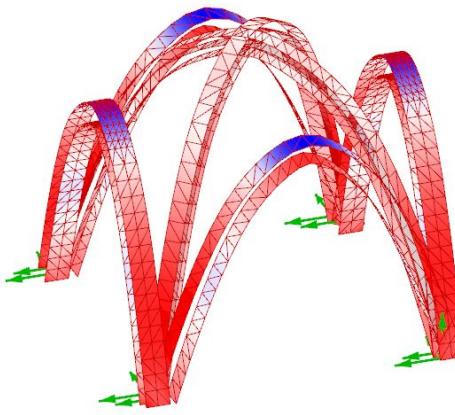
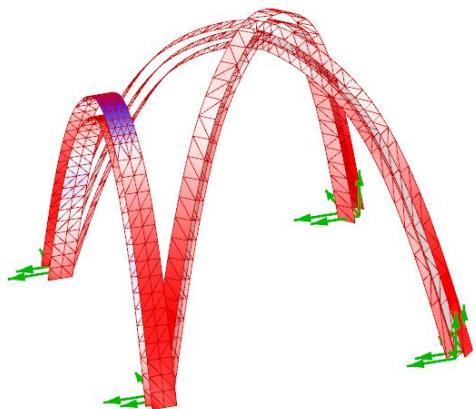


0.23m



Only gravity load (SF of 1.2)
Utilization in compression
<10%

Utilization in tension <5%



thickness of 0.24 as the complete shell.

weird tension ?

Table 3

Average percentage composition per area category at Zaatari camp in 2015. Source: MoMA (2015b).

Waste categories (%)	High populated Districts	Low populated Districts	Commercial Area	Zaatari (Average)	Average MSW in Municipalities ^a
Organics	55.84	52.60	49.65	52.70	59
Paper and cardboard	5.60	3.74	17.67	9.00	14
Plastics	11.39	13.23	13.91	12.85	10
Leather, wood, textile and rubber	11.57	13.99	5.10	10.22	10
Metal	3.69	3.70	7.08	4.82	5
Aluminum	0.27	0.32	0.65	0.41	
Glass	0.90	0.81	2.04	1.25	4
Inert material	0.04	0.37	0.23	0.22	5
Special Waste (Hazardous, etc.)	0.17	0.45	0.20	0.28	6
Miscellaneous-Bread	0.35	0.41	3.09	1.28	
Miscellaneous - Nappies	10.18	10.38	0.38	6.97	
Total	100.00	100.00	100.00	100.00	

^a Average MSW compositions percentages in the 100 Municipalities in Jordan.

Top 3 waste streams in the camp (focus on commercial area as we design a bazaar):

- Plastic not useful as reinforcement
- Organic fibers or paper as possible reinforcement

Introducing recycling and separating waste flows as a practice in the camp ?

- straw (increase in compressive and tensile strength)
- leaf fibers
- waste residuals
- sheep wool (increase in flexural strength and compressive strength) availability?



Standard Mix	
clay	30%
fine sand	30%
coarse sand	40%
water (weight of 1)	10%

Brick Type	Code	Clay (%)	Fine Sand (%)	Coarse Sand (%)	Additive		Water (%)	Weight of mixture (Kg)
					Type	%		
Adobe	A1 – A-11	30%	30%	40%	-	-	10%	10.8
Adobe+Straw	S1-S4	30%	30%	40%	Straw	1% by volume	10%	11.3
Adobe + Woodchips	WD1-WD3	30%	30%	40%	Wood Chips	1% by volume	10%	4.17
Adobe + PaperPulp	PP_1-PP_5	25%	25%	-	Paper Pulp	50%	-	6
Adobe + Straw+Strach	SM_01-SM05	30%	30%	30%	Straw	1% by volume	10%	9

Mixture

Solid materials

Clay 30%

Fine sand 30%

Coarse sand 40%

Water 10%

Paper pulp apparently had drying problems

Adobe +
PaperPulp

Adobe +
Straw+Strach

Brick Type	Mean E [MPa]
Adobe Bricks	10.63
Adobe + Straw	12.37
Adobe + Wood Chips	11.3
Adobe+Straw+Starch	17.5

Group 1 last year

Brick Type	Mean [N/mm ²]
Adobe Bricks	1.33
Adobe + Straw	2.7
Adobe + Wood Chips	2.1
Adobe+Straw+Starch	5.8

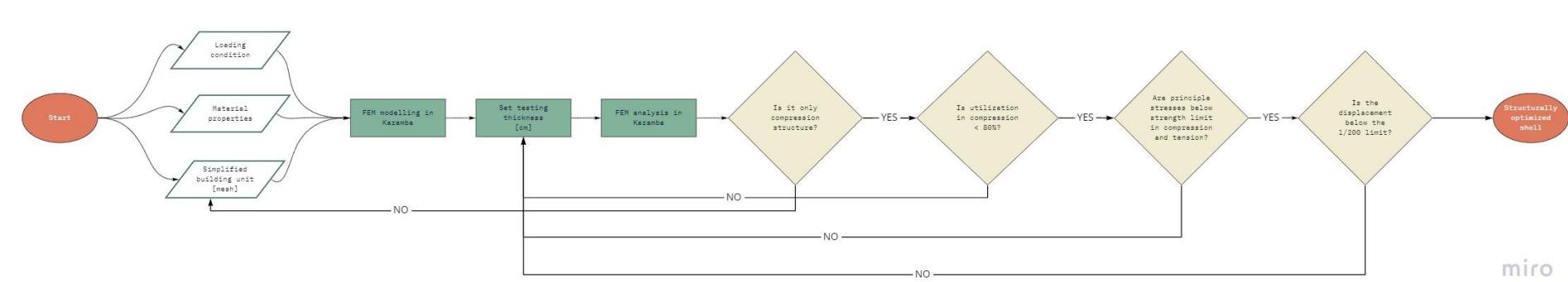
Compressive stress [N/mm²]

	Adobe only						Straw		Wood chip		Sorghum	Feathers
	All	Limited range	Limited 0-5000mm ²	Limited 5000-7500mm ²	Limited 7.500-10.000mm ²	Limited 10.000-15.000mm ²	Limited 15.000+ mm ²	All	All	All	All	All
Min	0,06	1,07	1,49	1,39	3,70	0,84	0,06	2,28	1,22	0,97	0,93	
Max	24,23	6,93	24,23	12,94	11,26	8,83	3,35	10,48	7,55	1,61	7,95	
Average	4,19	2,75	10,51	4,00	7,31	2,87	1,03	5,00	3,50	1,13	3,75	
Median	2,13	2,13	9,01	2,62	6,79	1,47	0,76	3,81	2,84	1,04	3,25	
st. dev	4,46	1,50	8,33	3,46	3,39	3,02	0,86	2,32	1,83	0,24	2,49	
Correction factor	1,96	1,96	2,78	2,13	2,23	2,16	2,16	1,96	2,12	2,57	2,37	
n	60,00	32,00	5,00	16,00	11,00	14,00	14,00	22,00	17,00	6,00	8,00	
Correction	1,13	0,52	10,35	1,84	2,28	1,74	0,50	0,97	0,94	0,25	2,09	
Min Stress	3,07	2,23	0,16	2,16	5,04	1,13	0,53	4,03	2,56	0,87	1,66	
Max Stress	5,32	3,27	20,86	5,84	9,59	4,61	1,53	5,97	4,44	1,38	5,84	
Safety factor	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	
Min Stress incl. factor	1,53	1,12	0,08	1,08	2,52	0,56	0,27	2,02	1,28	0,44	0,83	
Max Stress incl. factor	2,66	1,63	10,43	2,92	4,80	2,30	0,77	2,99	2,22	0,69	2,92	
Physical test result				Complete destroyed				Shape mostly remained	Complete destroyed	Complete destroyed	Shape mostly remained	

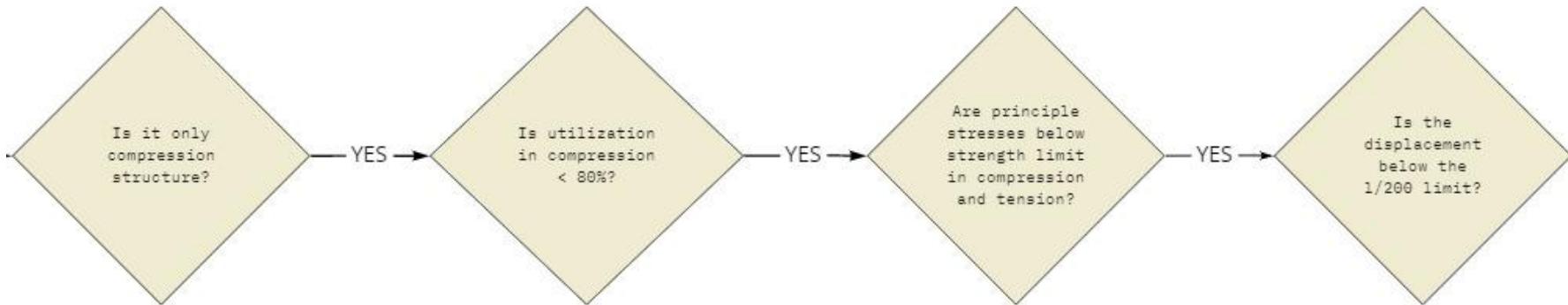
Young's Modulus [N/mm²]

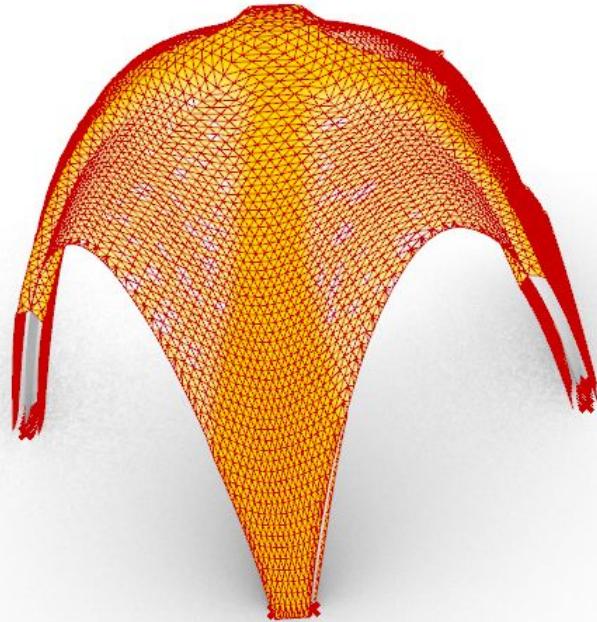
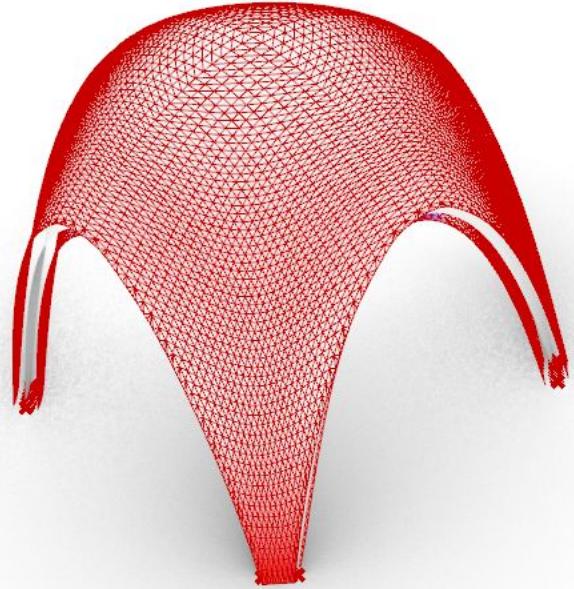
	Adobe only	Straw	Wood chip	Sorghum	Feathers
	All	All	All	All	All
Min	6,62	15,44	13,72	9,23	11,54
Max	647,00	174,63	141,12	16,85	55,70
Average	68,13	63,64	54,05	14,36	30,40
Median	25,22	55,94	50,74	15,99	24,37
st. dev	115,08	41,27	36,74	3,14	15,69
Correction factor	1,96	1,96	2,20	2,78	2,37
n	42,00	22,00	12,00	5,00	8,00
Correction	34,80	17,24	23,33	3,90	13,15
Min E-modulus	33,33	46,40	30,72	10,46	17,25
Max E-modulus	102,94	80,89	77,38	18,26	43,55

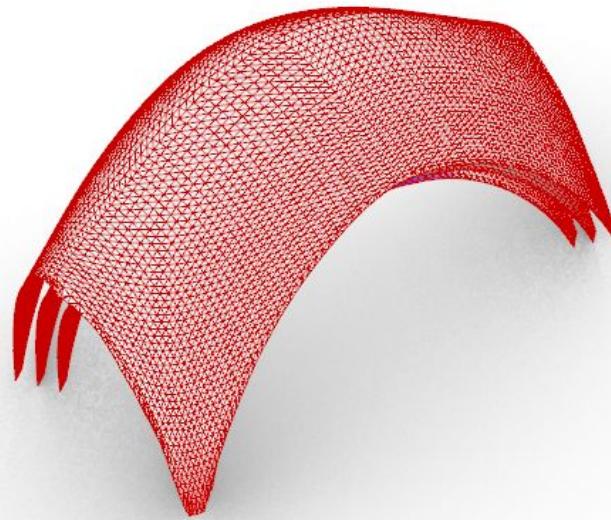
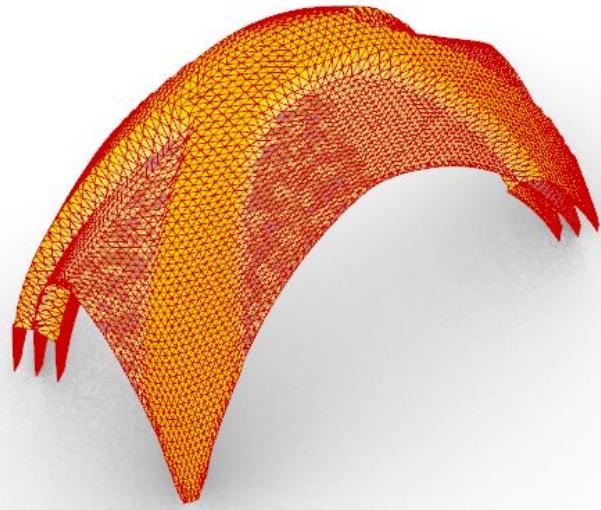
Group 2 last year



miro







max compressive strength = 3 MPa
max tensile strength = 0,3 MPa

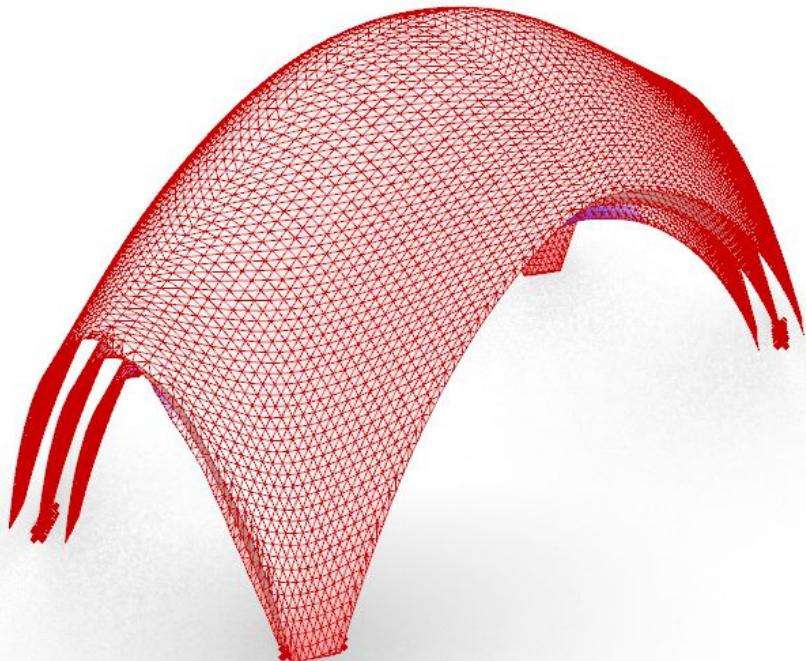
In this case ($t = 50$ cm)

Principle stresses in compression:

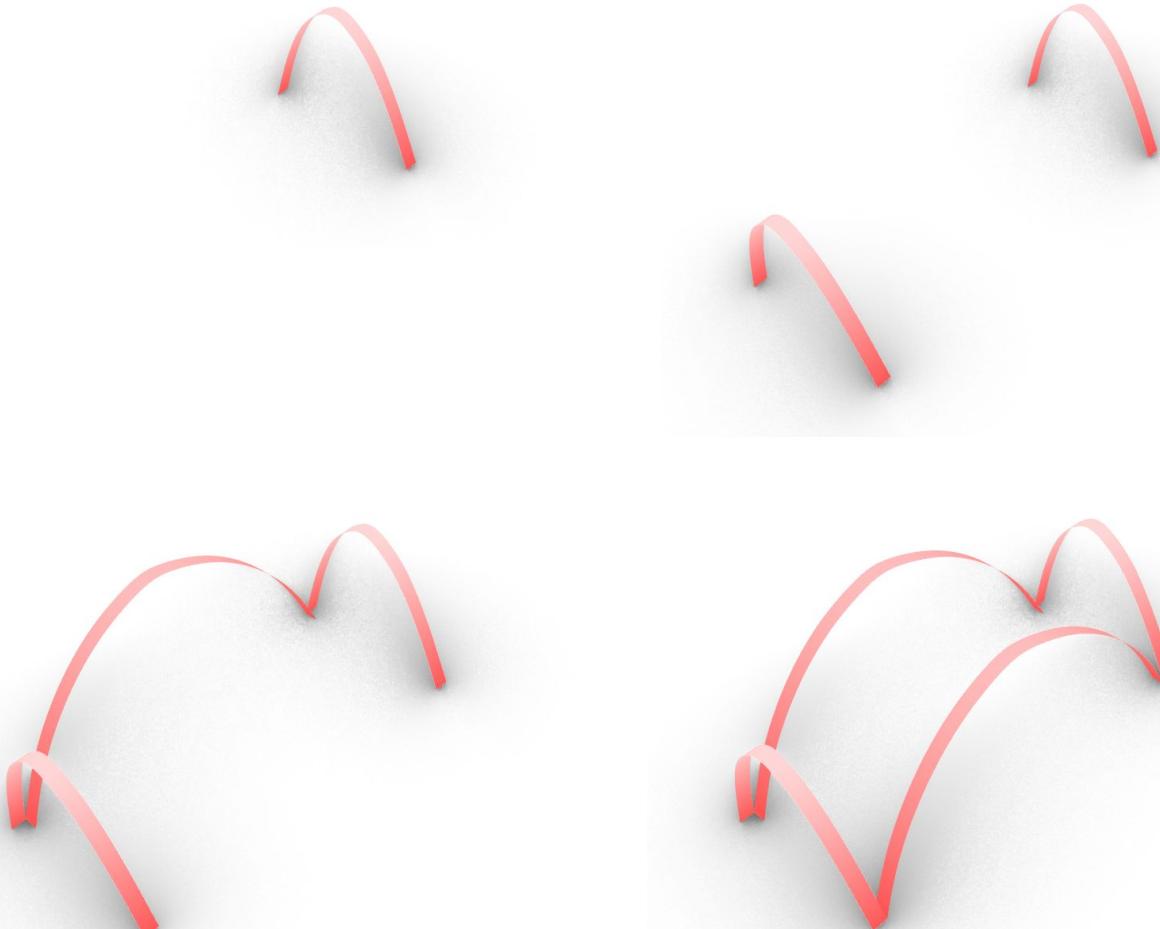
1. 0,3 MPa (10%)
2. 1,36 MPa (45%)

Principle stresses in tension:

1. 0,18 MPa (60%)
2. 0,019 MPa (6%)



for $t = 25 \text{ cm}$
Compressive strength = 3 MPa
Tensile strength = 0,3 MPa

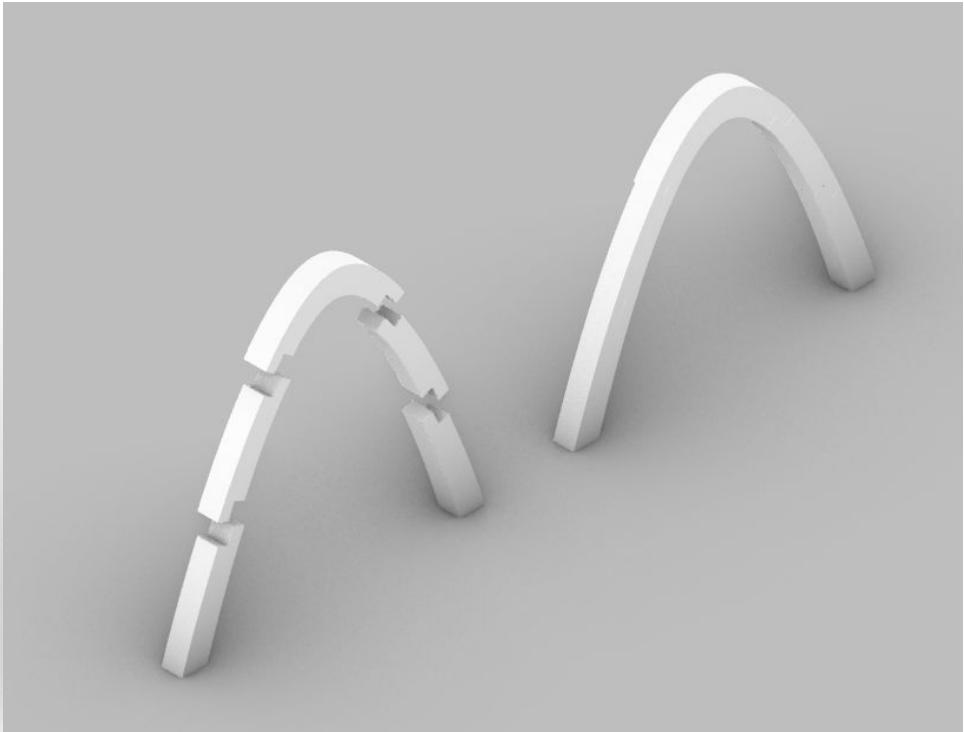
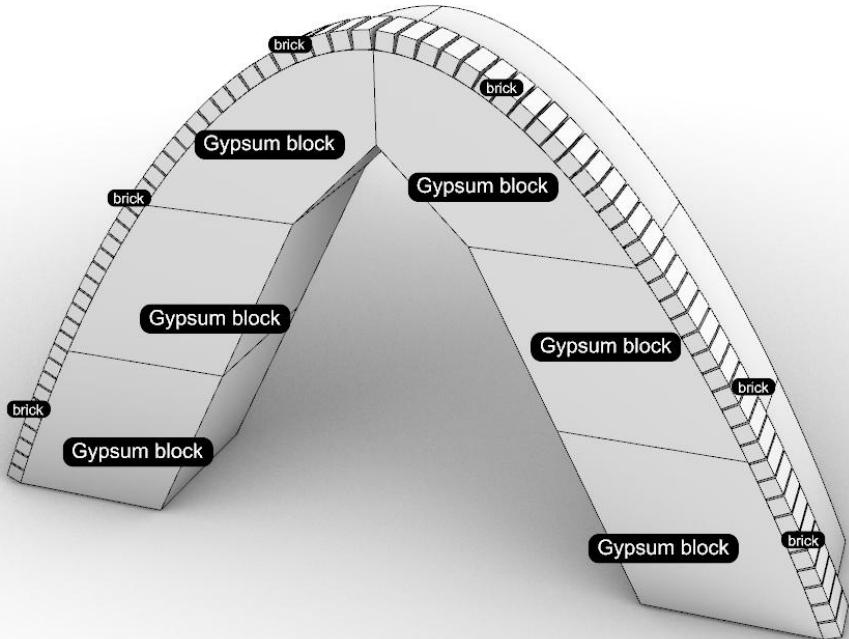


Arch1 (small)
Compressive princ. stresses:
1. 0,016 MPa (0,5%)
2. 0,098 MPa (3,2%)
Tensile princ. stresses:
1. 0,0018 Mpa (0,6%)
2. 0 Mpa (0%)

Arch2 (big)
Compressive princ. stresses:
1. 0,023 MPa (0,7%)
2. 0,14 MPa (4,6%)
Tensile princ. stresses:
1. 0,051 Mpa (17%)
2. 0,0029 Mpa (0,9%)

Gypsum 1.6g - cm²

1mx1mx50cm gypsum block 1cm shell = 24kg

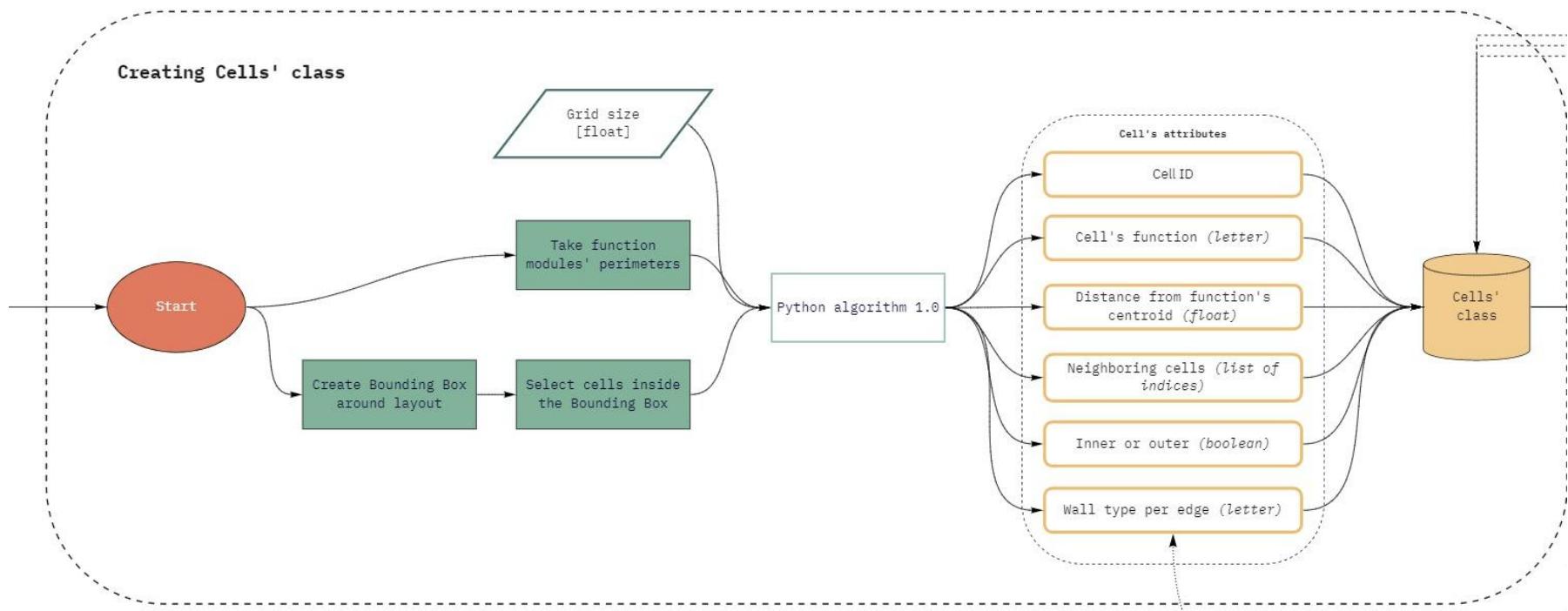


Week 8

Configuration - Layout

Building elements placement

Create cells' class



Iterate through cells and assign functions, calculate distance from function's center

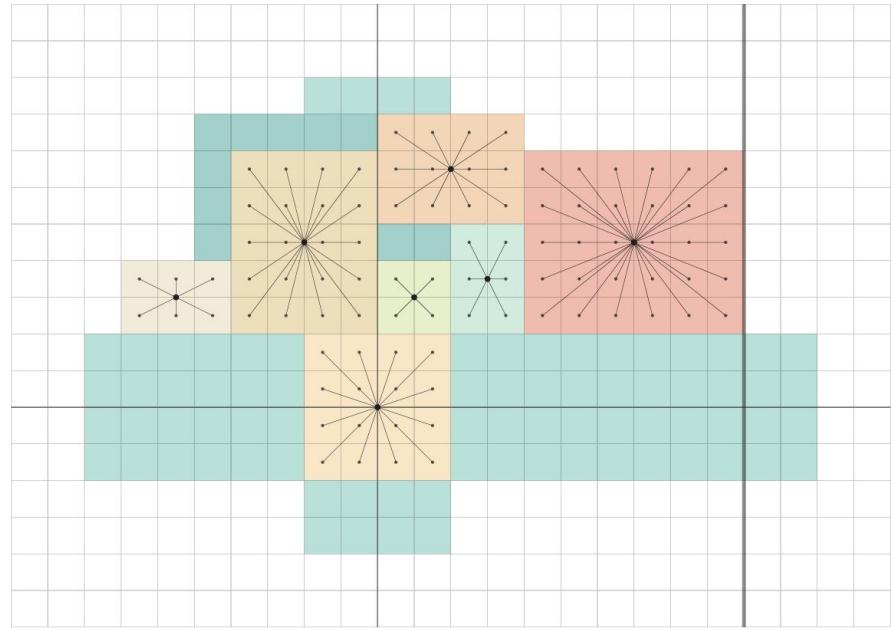
- A - Atrium
- B - Caravanserai
- C - Workshop
- D - Courtyard
- E - Learning space
- F - Cafe
- G - Bazaar element
- H - Shop
- I - Buffer Space

```
1 import rhinoscriptsyntax as rs
2 import math
3
4 #Definition to find min and max X&Y from function's perimeter
5 #and to check if one point is inside these bounds
6 def FuncBounds(perimeter, check_pt):
7     vertices = []
8     listX = []
9     listY = []
10    if type(perimeter) is not list:
11        vertices = rs.PolylineVertices(perimeter)
12        for ver in vertices:
13            listX.append(ver.X)
14            listY.append(ver.Y)
15        if check_pt.X > min(listX) and check_pt.X < max(listX) and check_pt.Y > min(listY) and check_pt.Y
16        return True, None
17    else:
18        for i, per in enumerate(perimeter):
19            vertices = rs.PolylineVertices(per)
20            for ver in vertices:
21                listX.append(ver.X)
22                listY.append(ver.Y)
23            if check_pt.X > min(listX) and check_pt.X < max(listX) and check_pt.Y > min(listY) and check_
24            return True, i
25        else:
26            listX = []
27            listY = []
28        return False, None
29
30
31 #Definition to calculate distance between two points
32 def PtDist(pt_a, pt_b):
33     dist = math.sqrt( ((pt_a[0]-pt_b[0])**2) + ((pt_a[1]-pt_b[1])**2) )
34     return dist
```

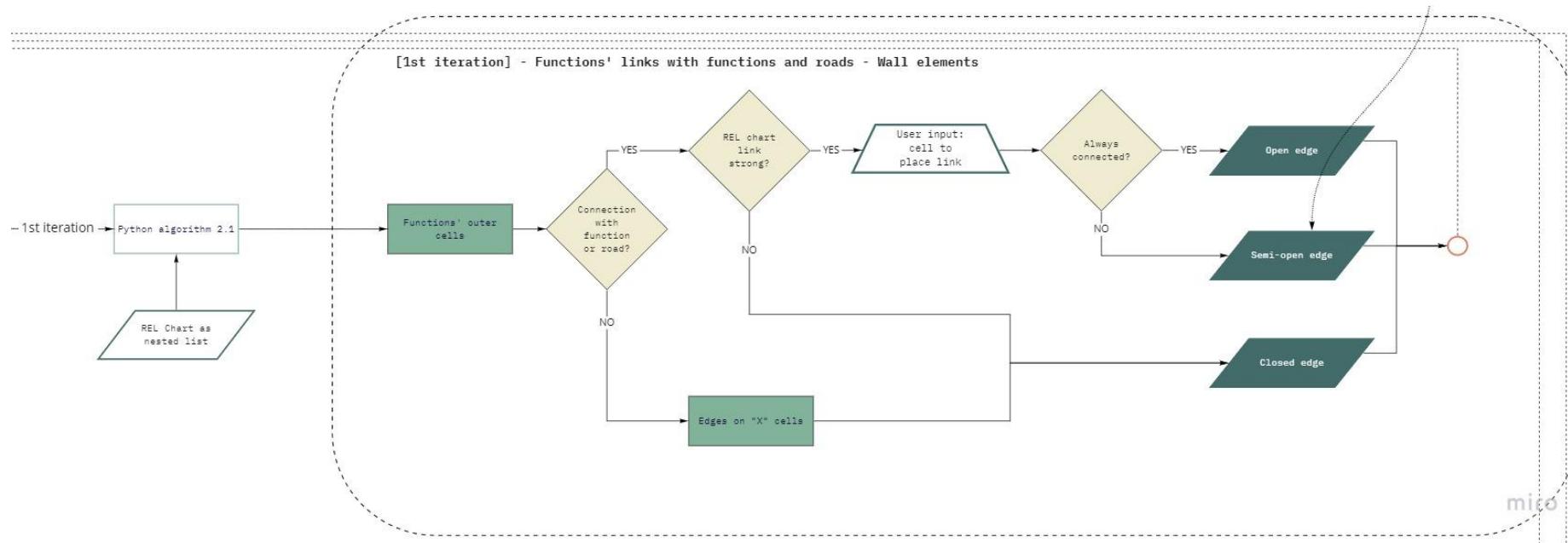
16 0	16 X
17 11.370356	17 G
18 9.943088	18 G
19 9.943088	19 G
20 11.370356	20 G
21 0	21 X
22 0	22 X
23 0	23 X
24 0	24 X
25 0	25 X
26 0	26 X
27 0	27 X
28 0	28 X
29 0	29 X
30 0	30 X
31 8.273149	31 G
32 6.166441	32 G
33 6.166441	33 G
34 8.273149	34 G
35 4.360333	35 E
36 4.360333	36 E
37 0	37 X
38 0	38 X
39 0	39 X
40 0	40 X
41 0	41 X
42 0	42 X
43 0	43 X
44 0	44 X
45 6.166441	45 G
46 2.757716	46 G
47 2.757716	47 G
48 6.166441	48 G
49 1.95	49 E
50 1.95	50 E

check for the functions of the neighboring cells

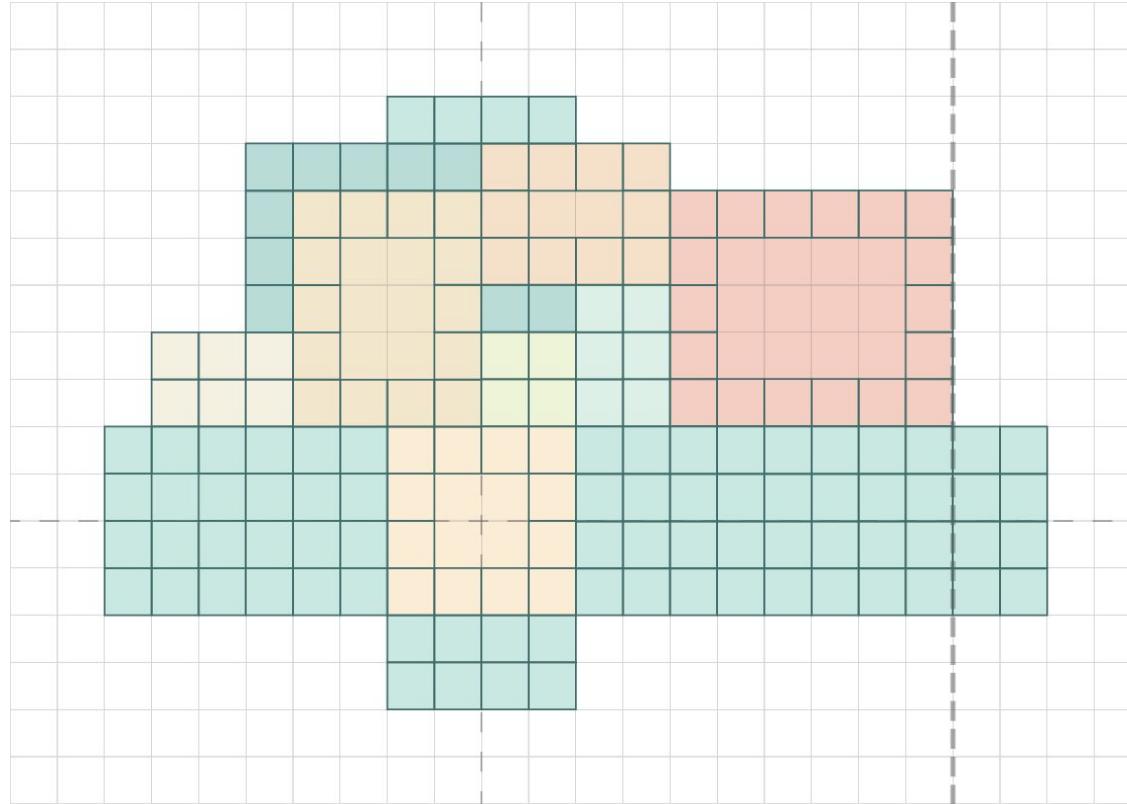
```
def neighbours(grid, currentrow, currentcol):
    ....empty = 0
    ....m = currentrow
    ....n = currentcol
    ....row = len(grid)
    ....col = len(grid[0])
    ....
    ....if m != 0: left = grid[m-1][n]
    ....else: left = empty
    ....
    ....if m != row-1: right = grid[m+1][n]
    ....else: right = empty
    ....
    ....if n != 0: below = grid[m][n-1]
    ....else: below = empty
    ....
    ....if n != col-1: above = grid[m][n+1]
    ....else: above = empty
    ....
    ....self = grid[m][n]
    ....return left, above, right, below, self
```



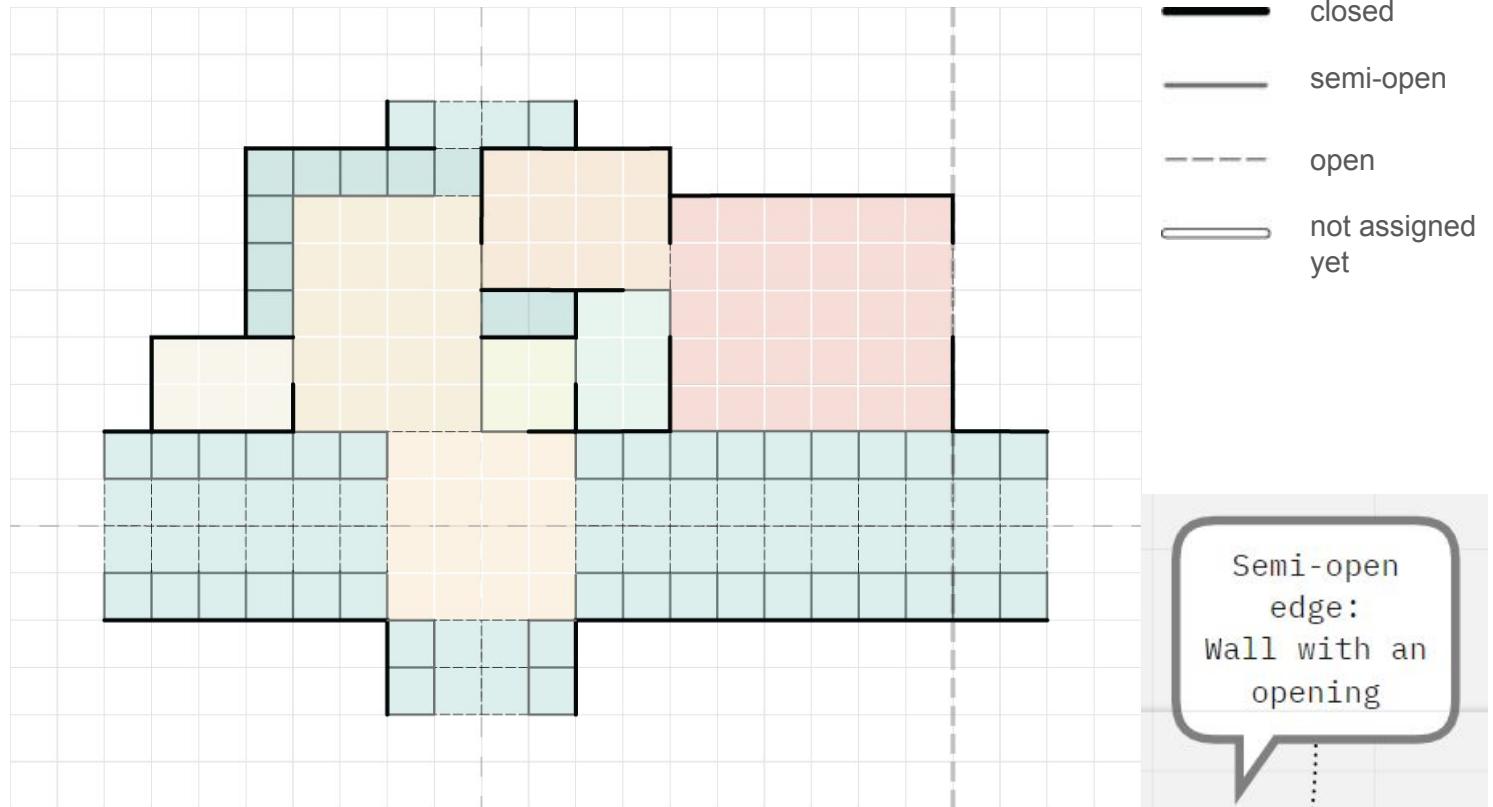
Placing building elements - Iteration 1



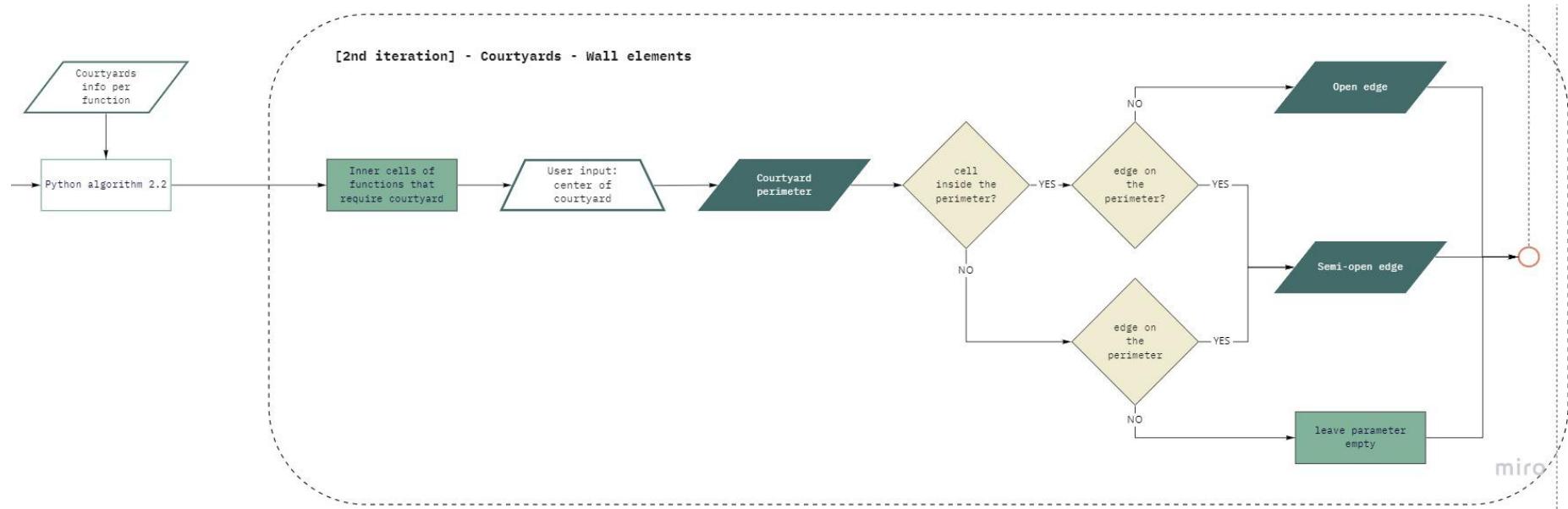
Placing building elements - Iteration 1



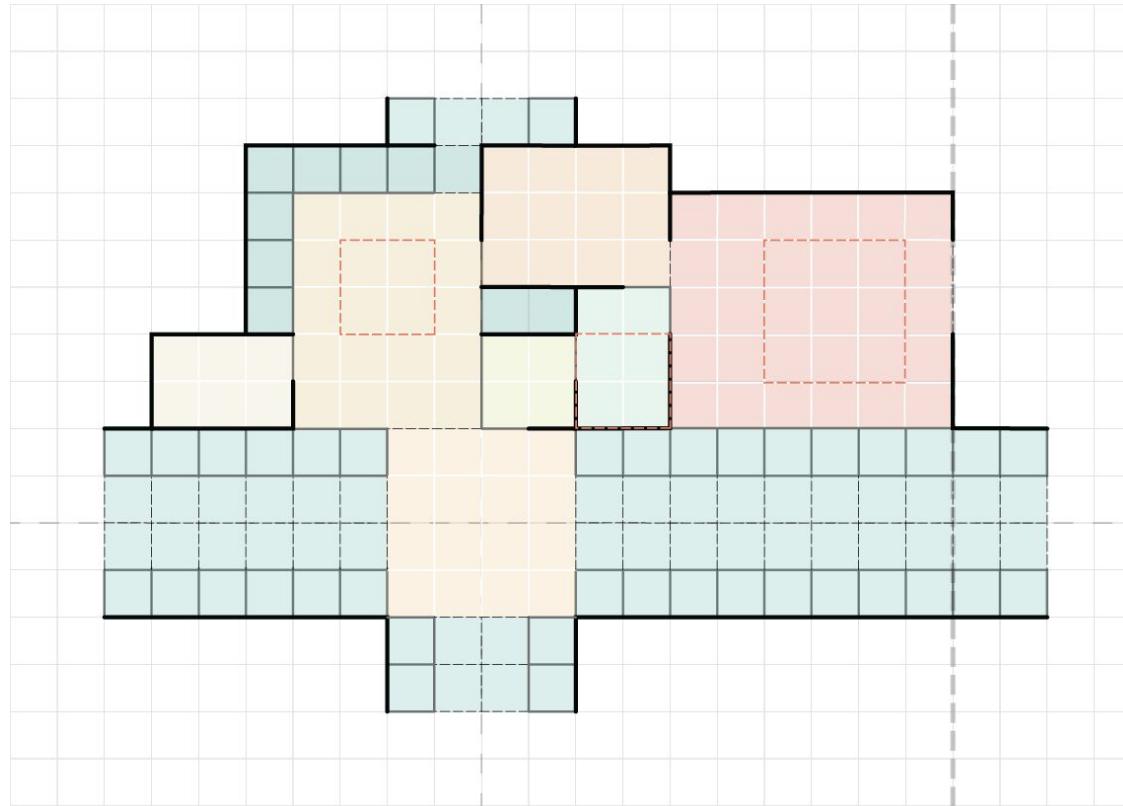
Placing building elements - Iteration 1 - Wall elements



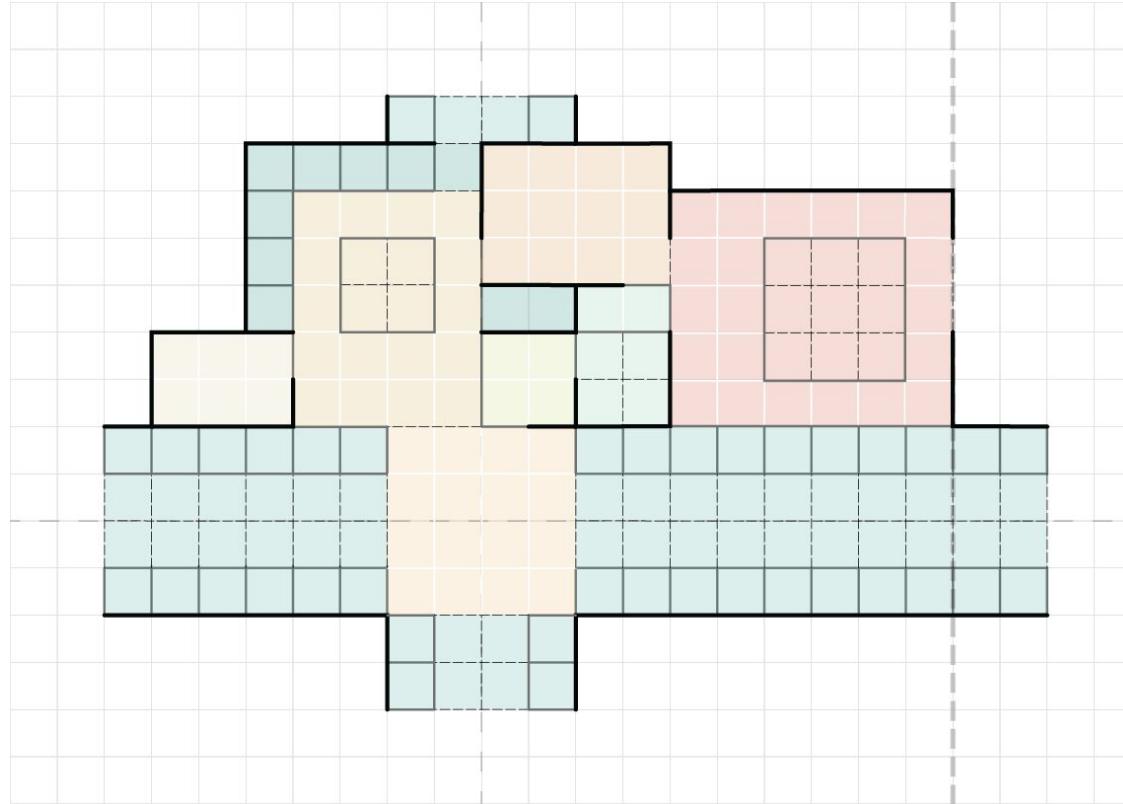
Placing building elements - Iteration 2



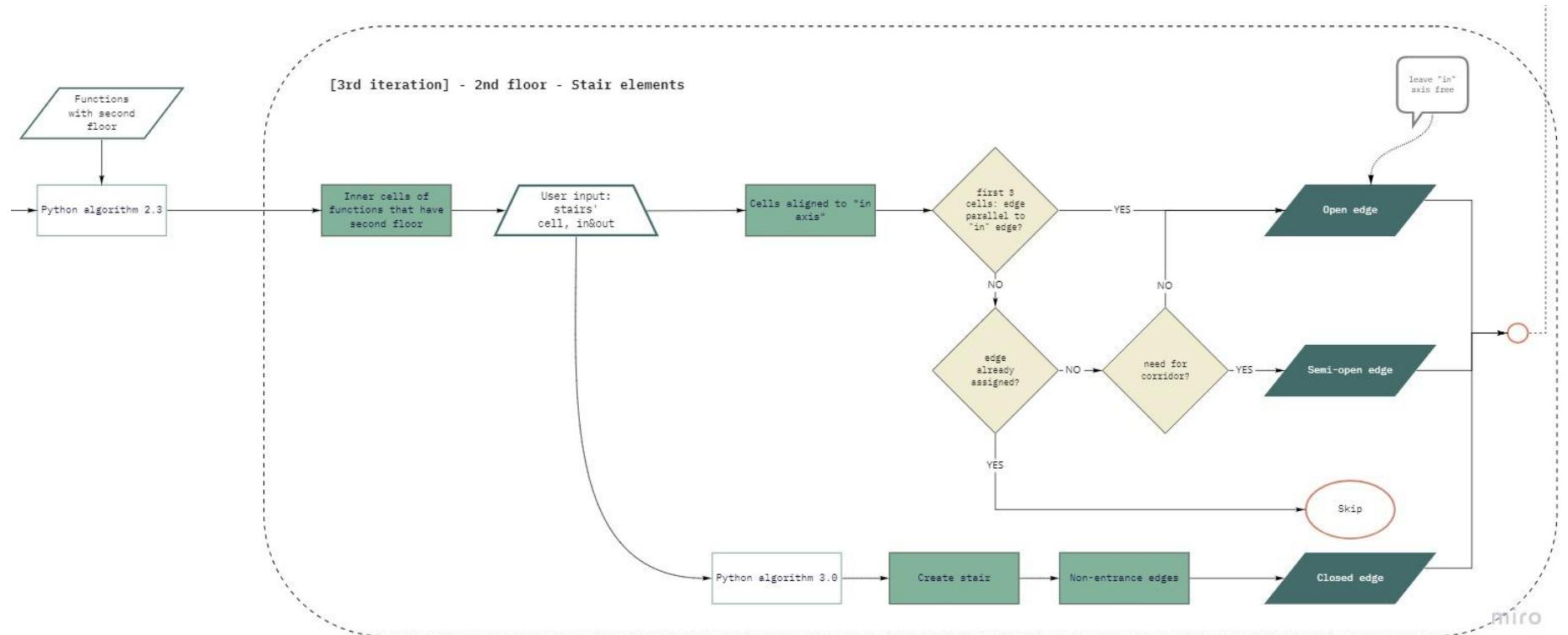
Placing building elements - Iteration 2



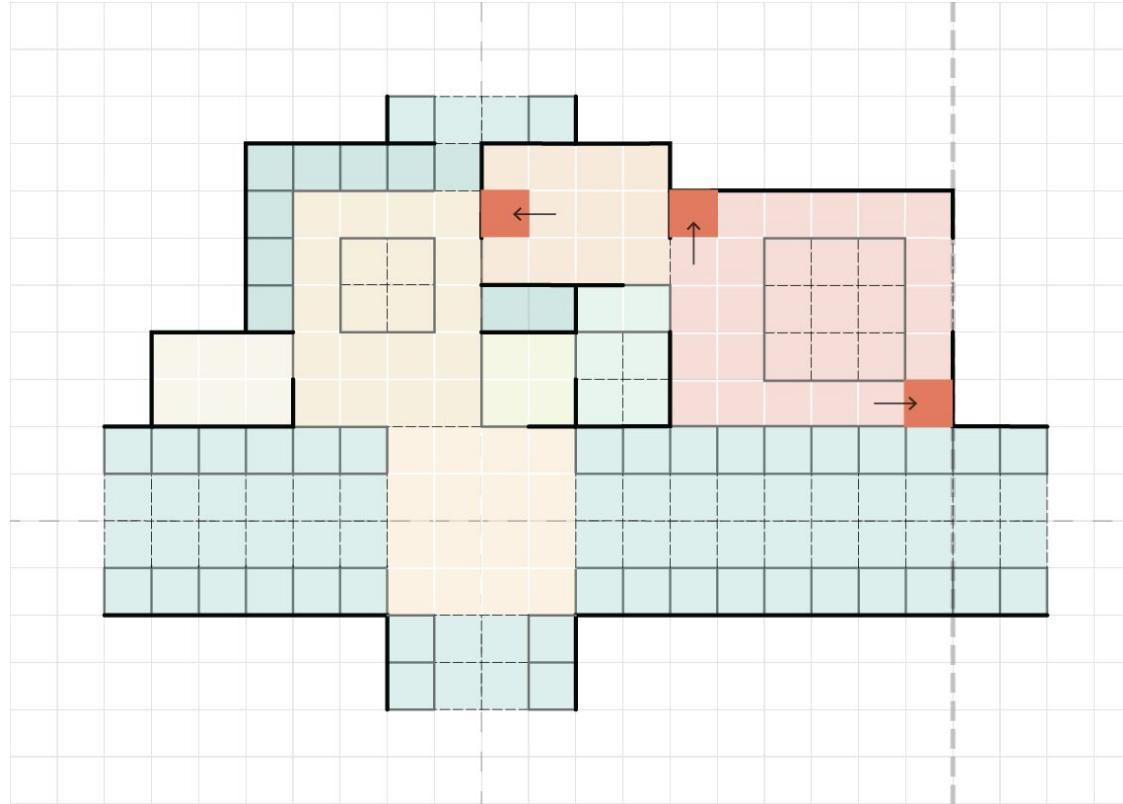
Placing building elements - Iteration 2 - Wall elements



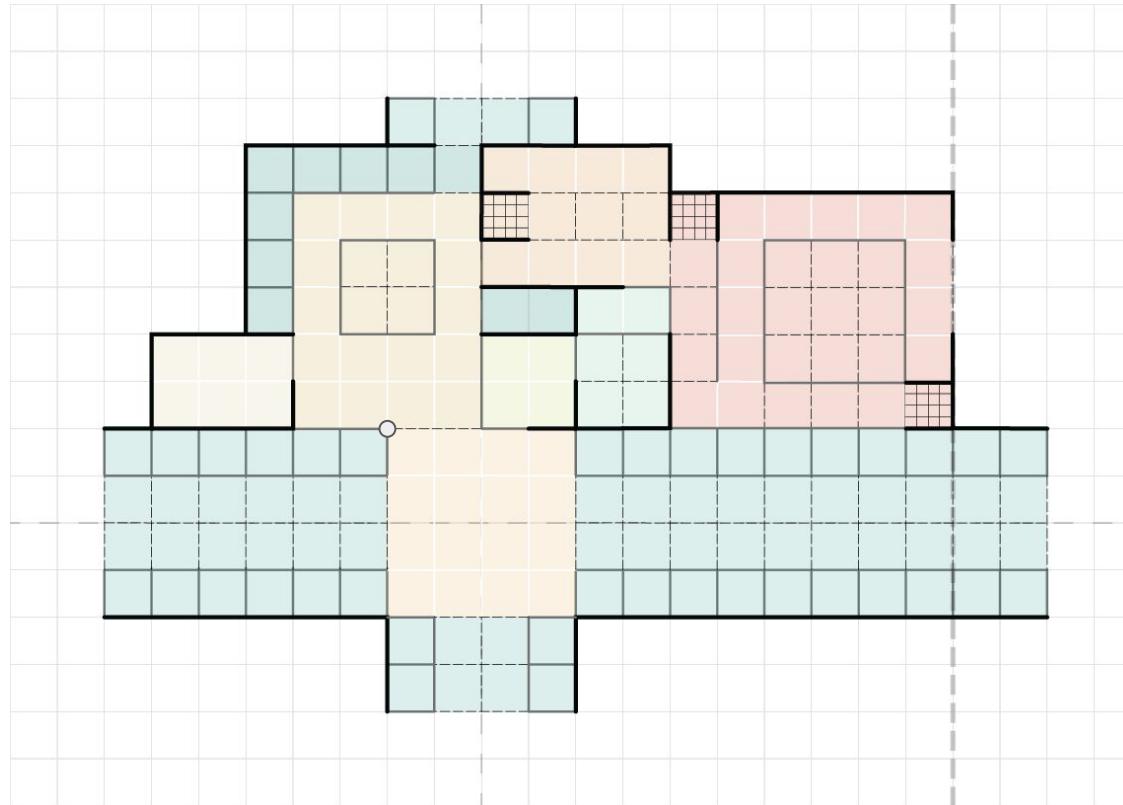
Placing building elements - Iteration 3



Placing building elements - Iteration 3



Placing building elements - Iteration 3 - Stair & Wall elements

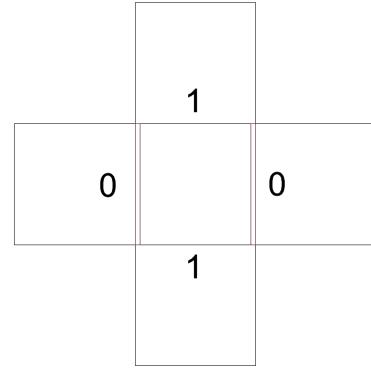


Placing building elements - Iteration 4

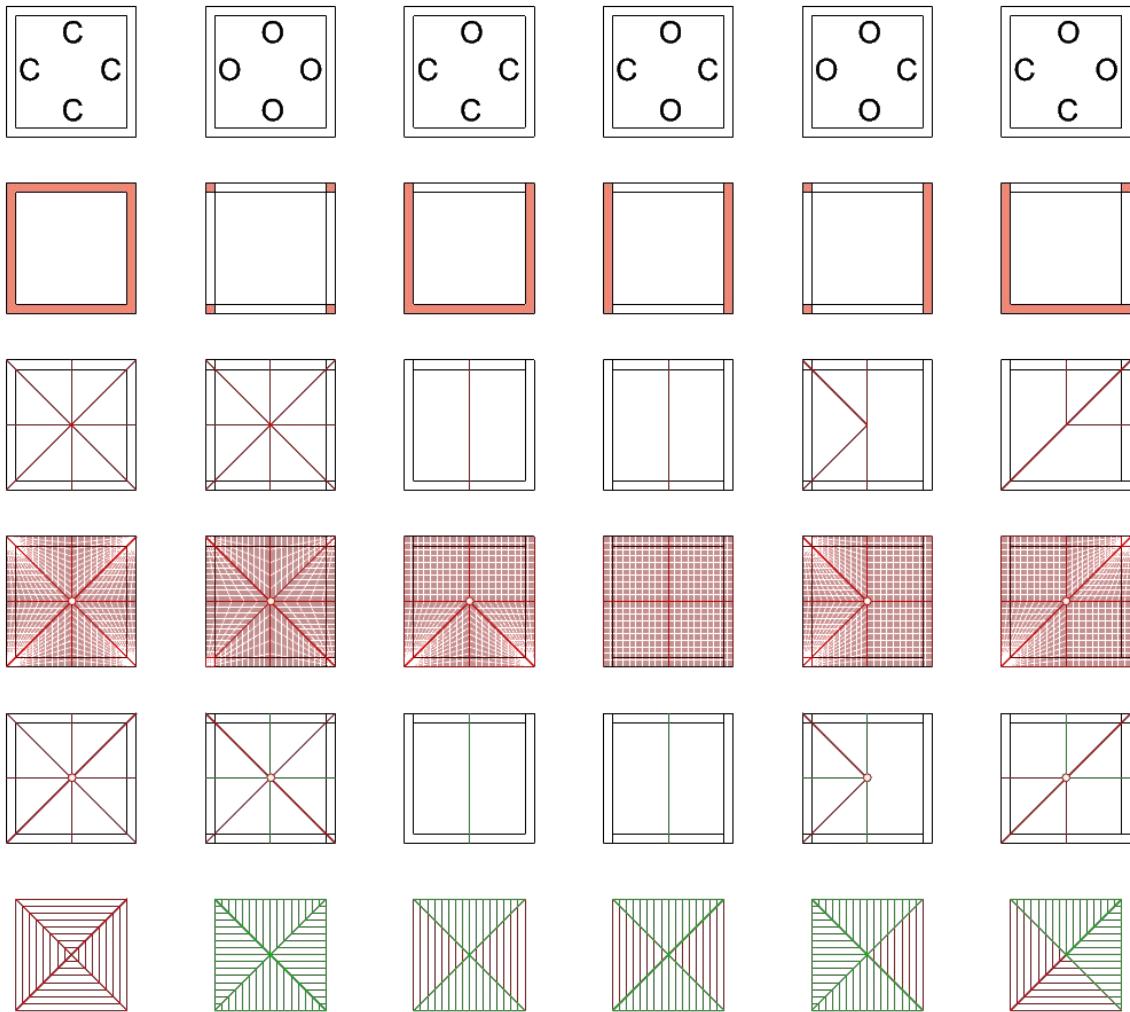
To be continued...

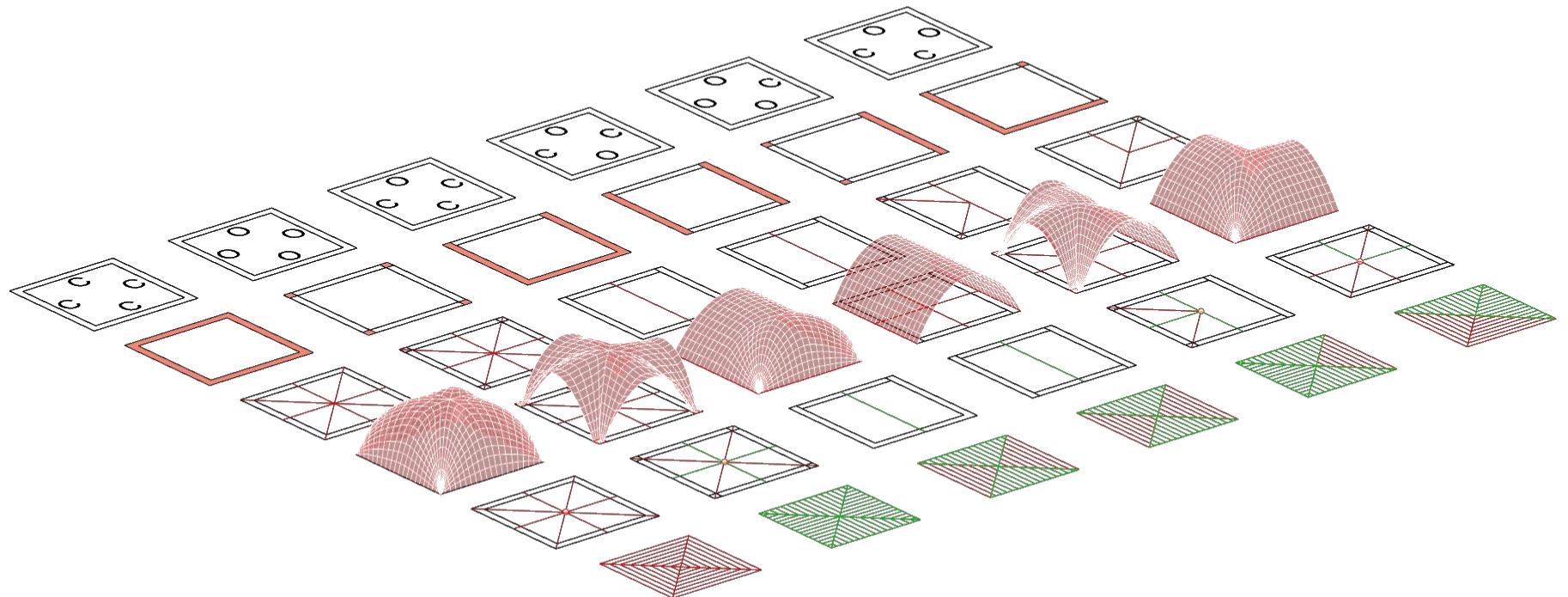
(rest of non-assigned edges and roof elements)

Building elements - Roofs

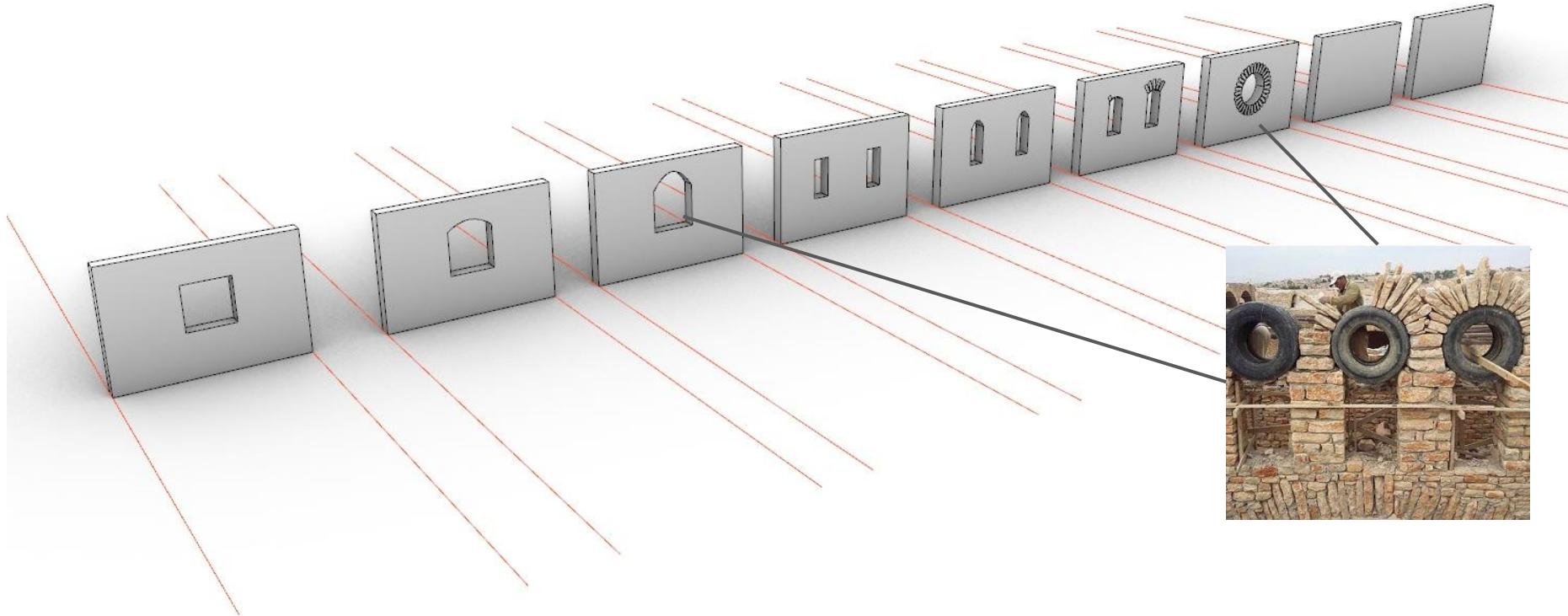


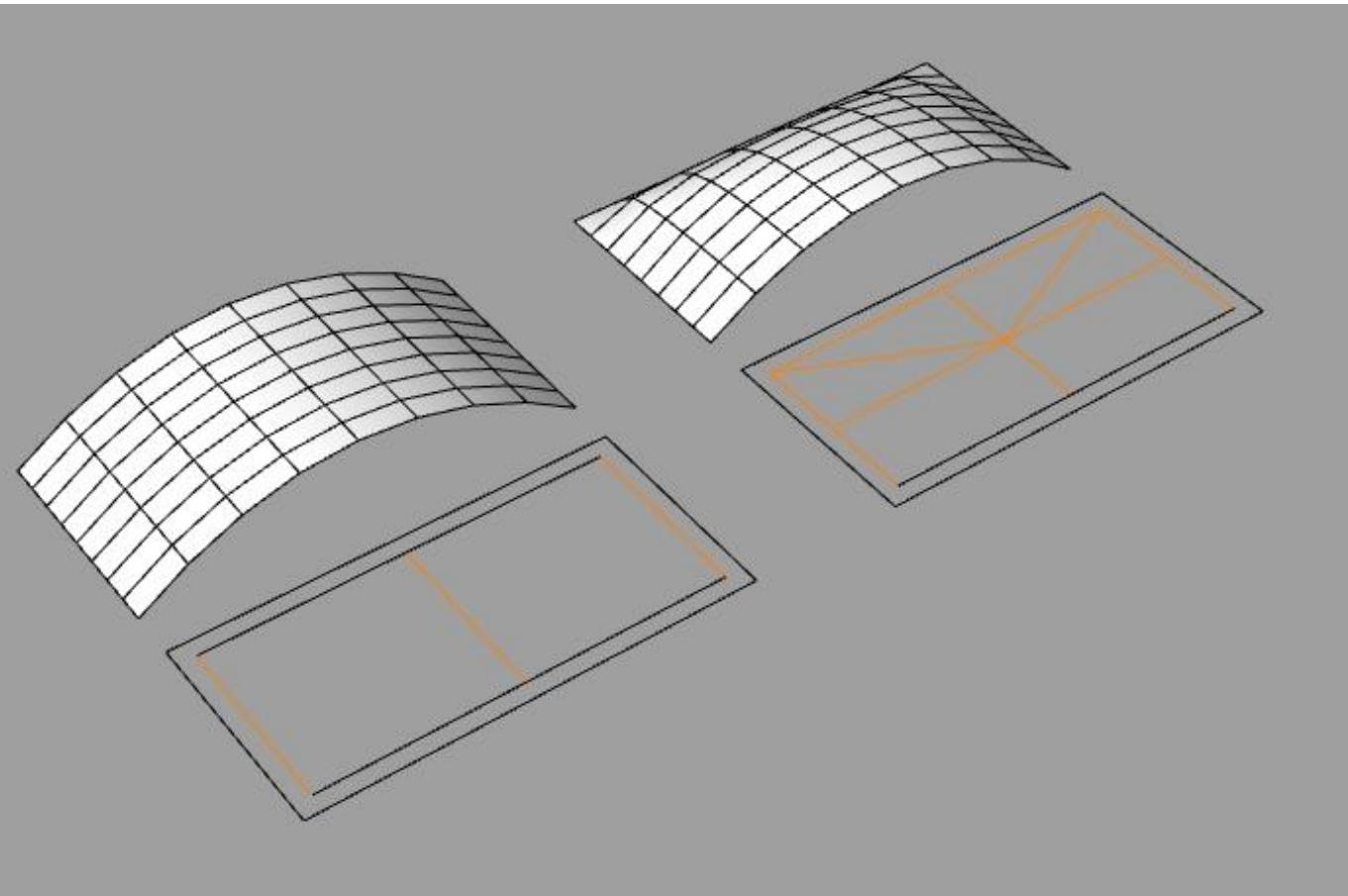
$O = 1$
 $C = 0$



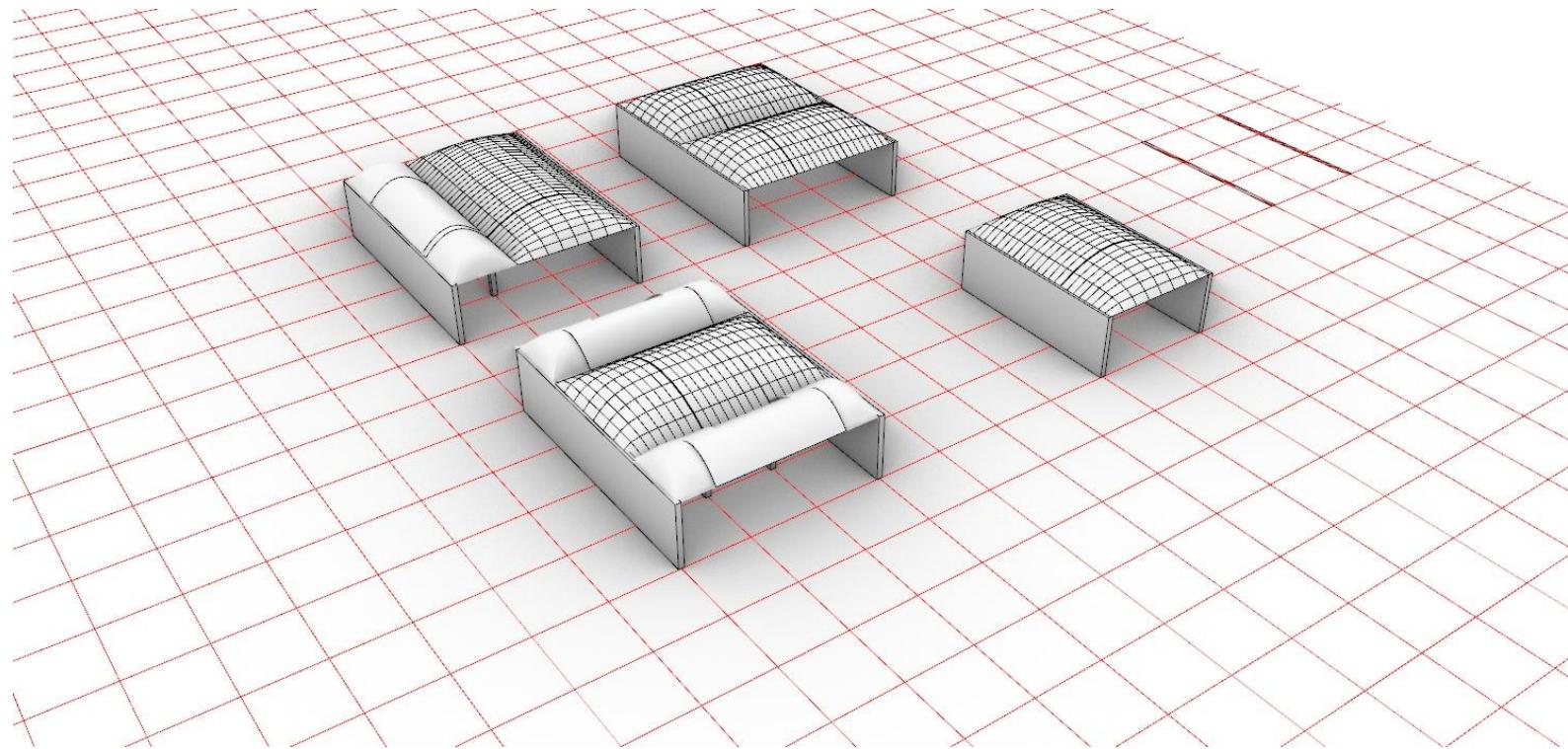


Opening options





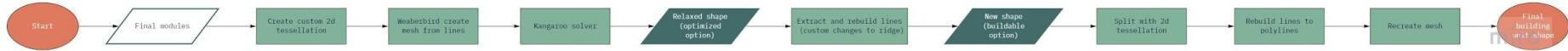
Workshop + learning space

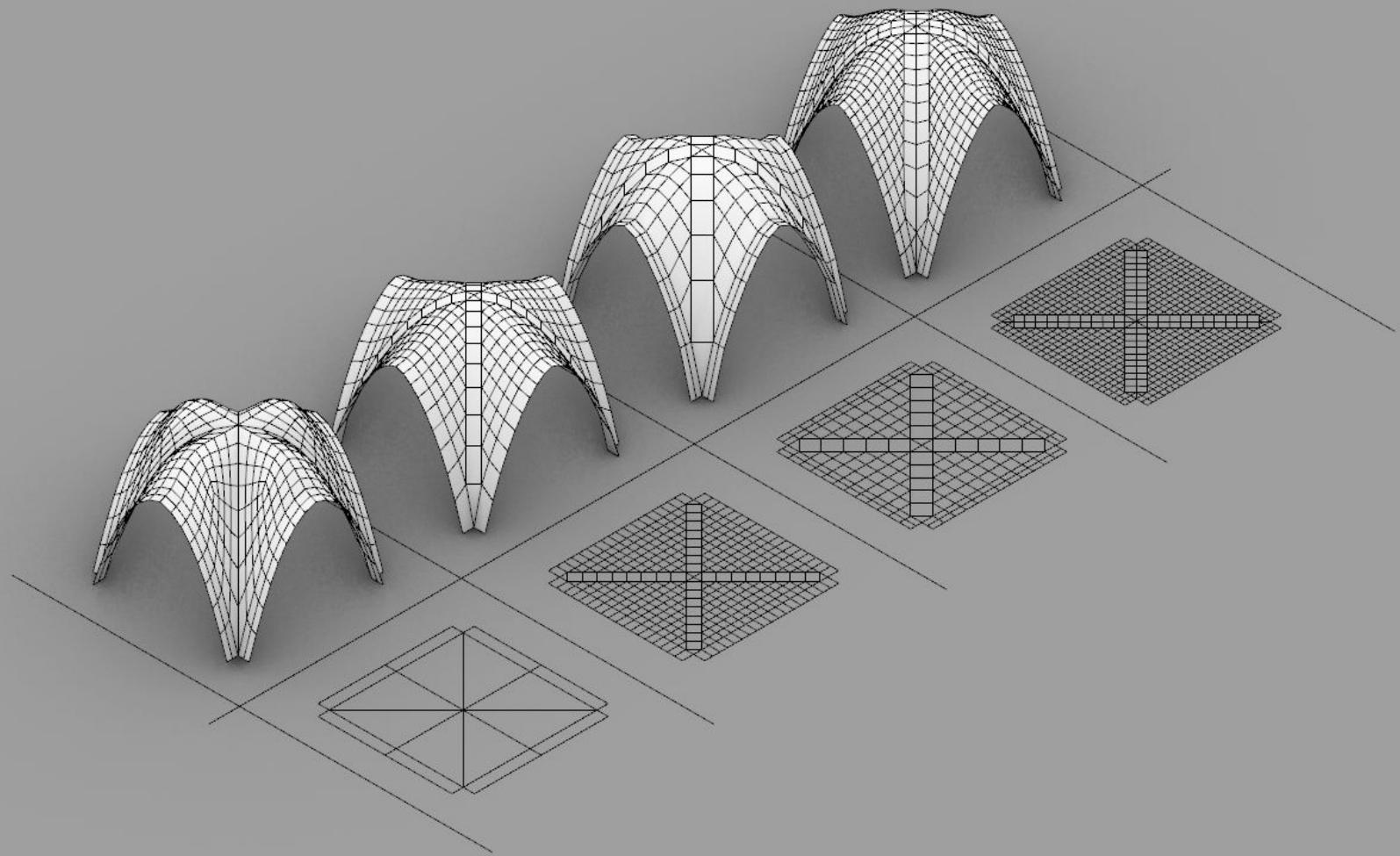


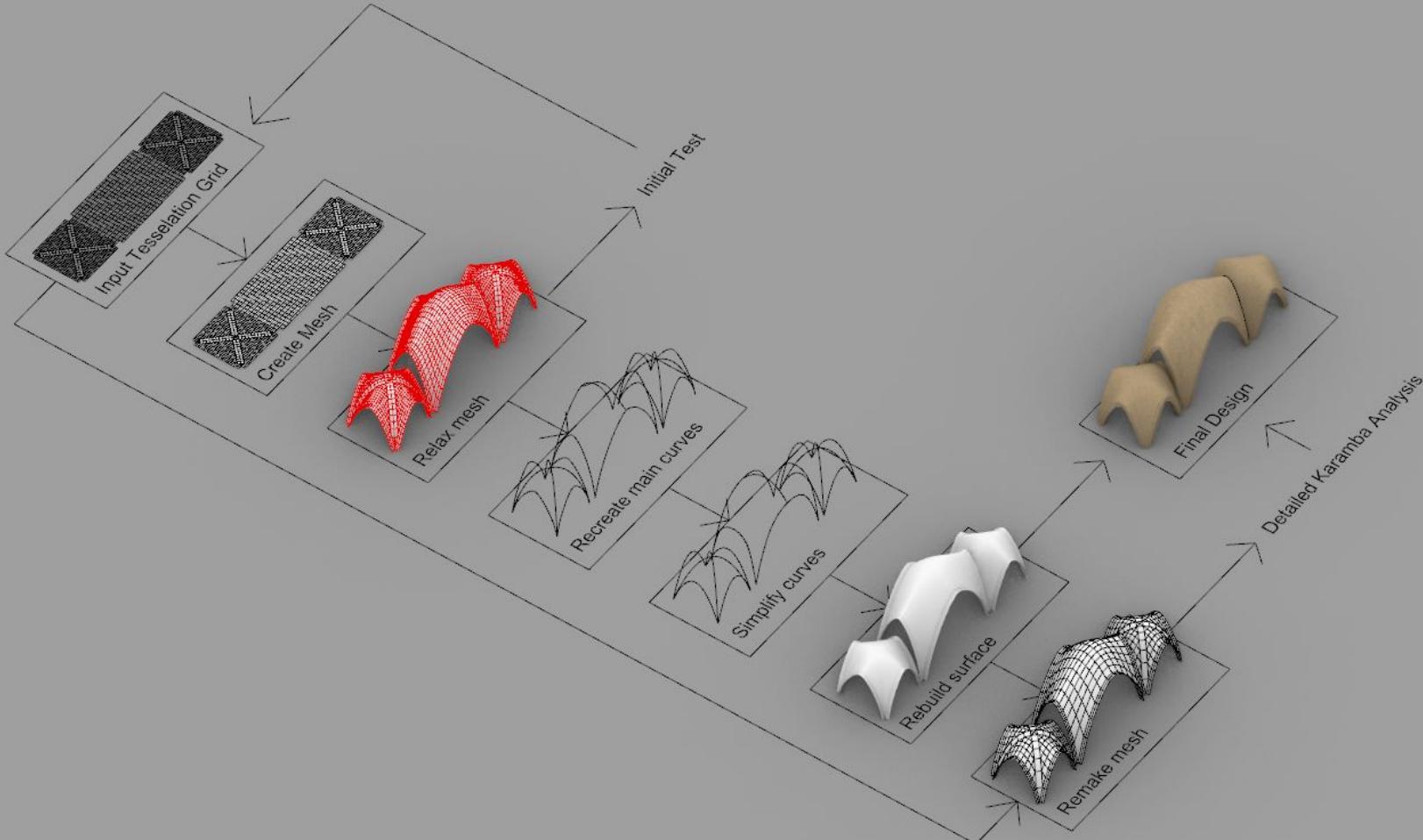
Shaping

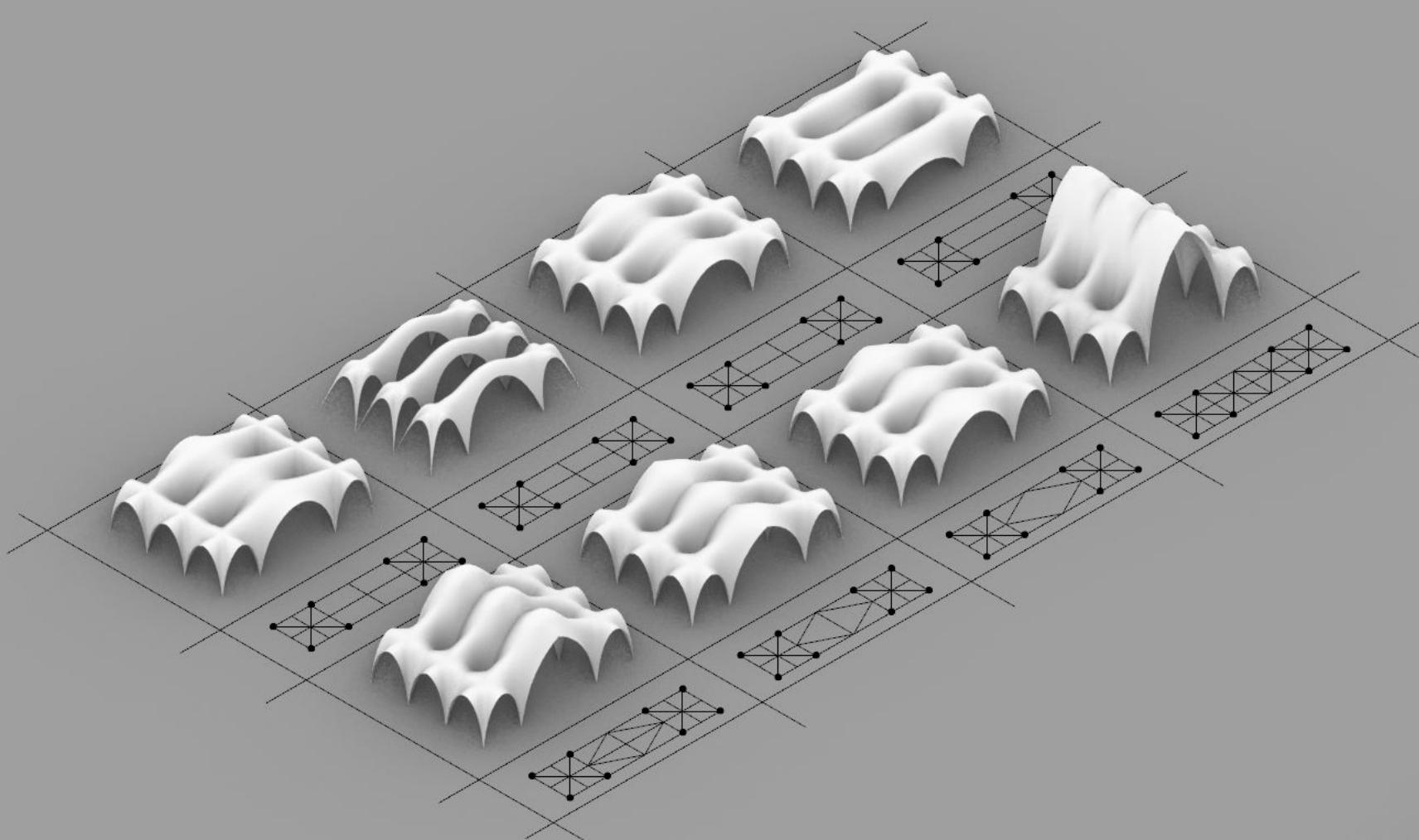
Final meshing workflow

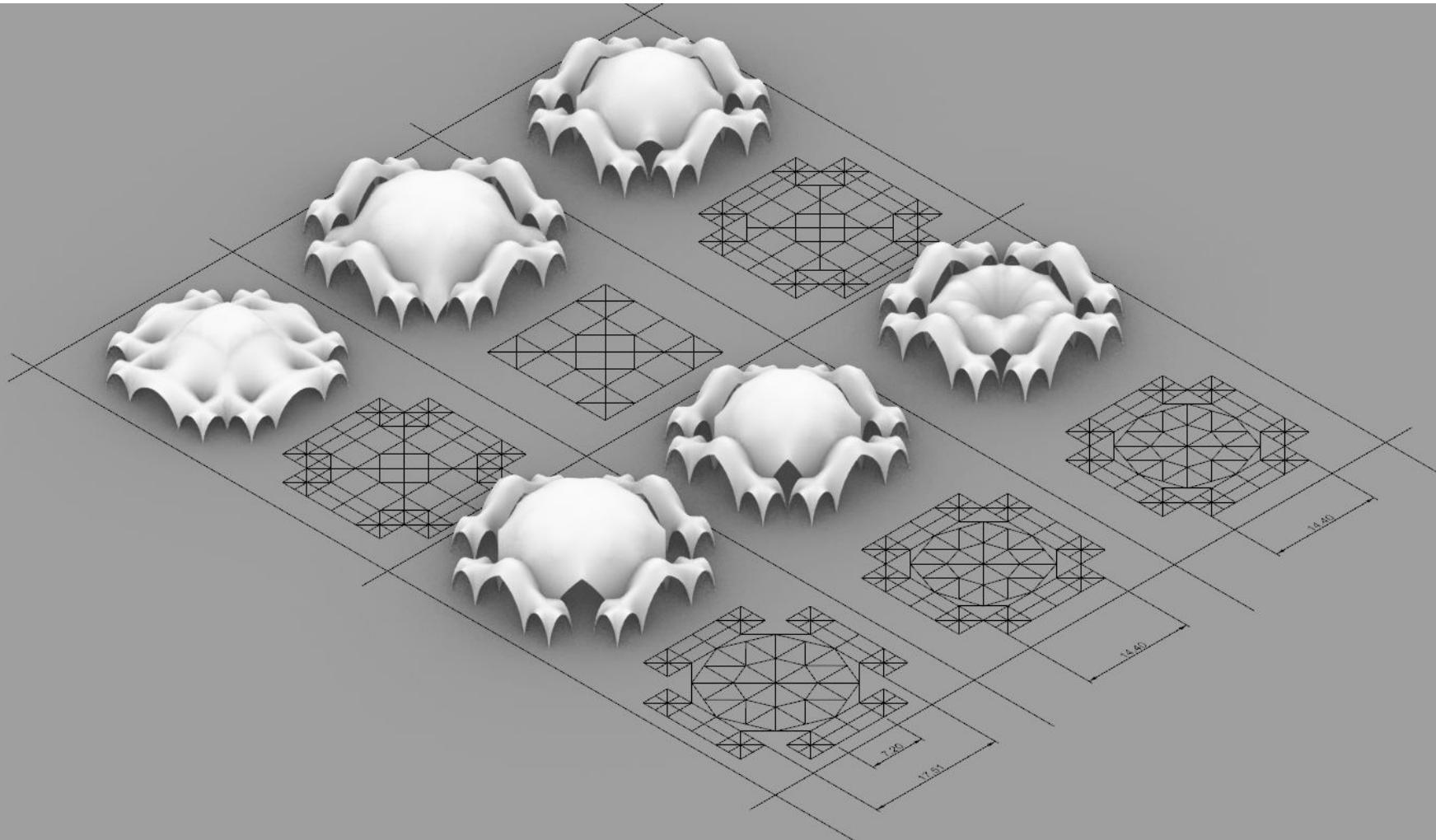
- Create custom 2d drawing of tessleation
- Create mesh from lines
- Relax the mesh(optimized option)
- Extract the lines
- Rebuild the lines. make custom changes to ridge
- create new shape(buildable option)
- split new surface with 2d tessellation
- rebuild lines to polylines
- recreate the mesh with new shape for analysis

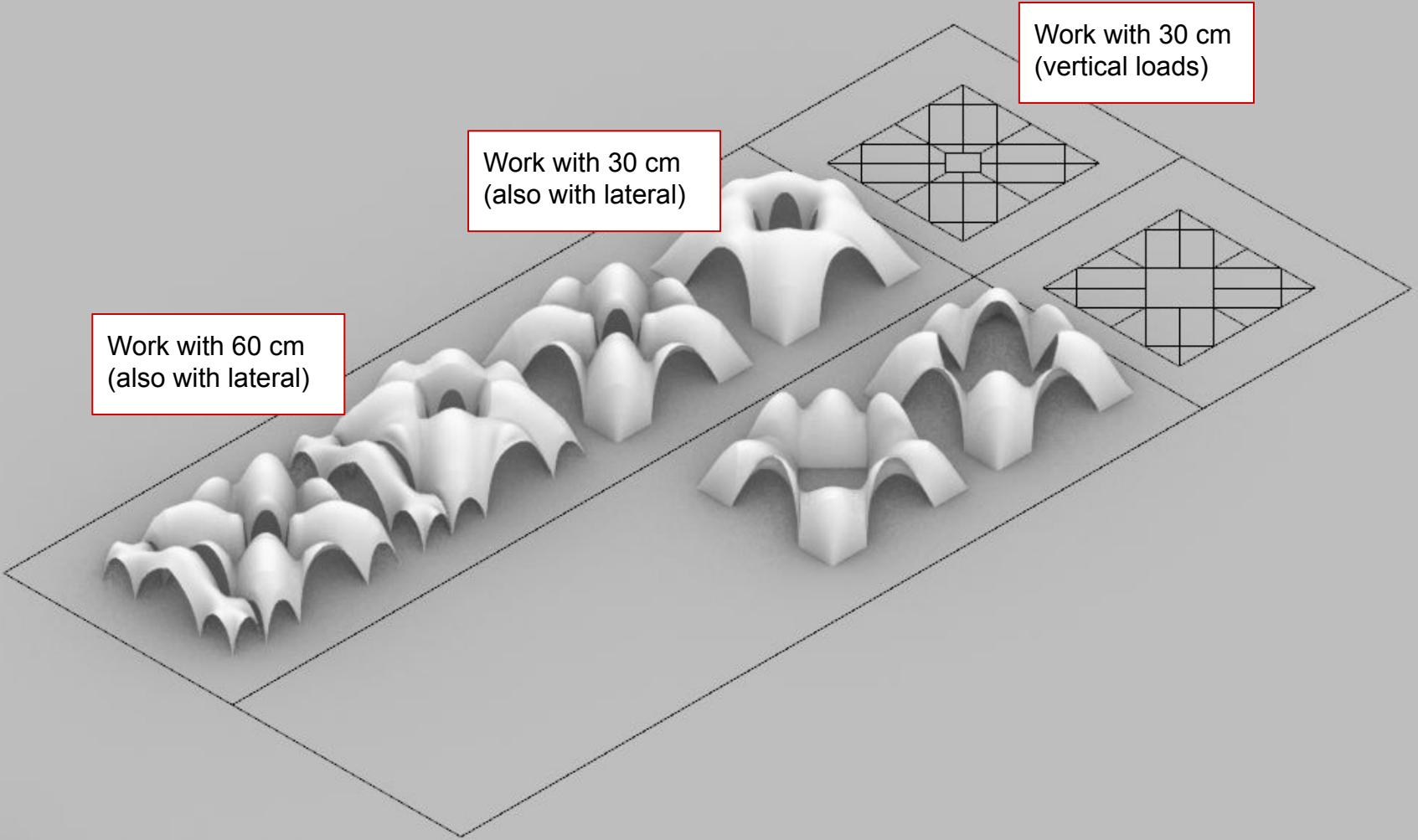












Structure

max compressive strength = 3 MPa
max tensile strength = 0,3 MPa

Low for CEB, higher SF

max displacement = l/200

Material properties

E = 230 MPa (from literature on CEB)

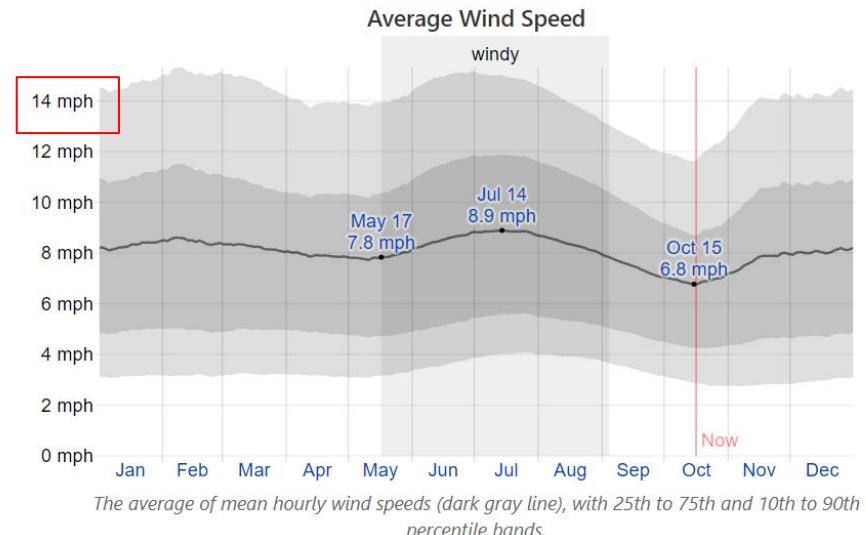
Density = 1700 kg/m³ (from literature)

Load combination

Gravity load*1.2 + Live load*1.5 + Wind load*1.5

Live load = 2 kN/m²

Wind load = 0.5 kN/m²



Thickness: **10 cm** (brick 30x15x10 cm)

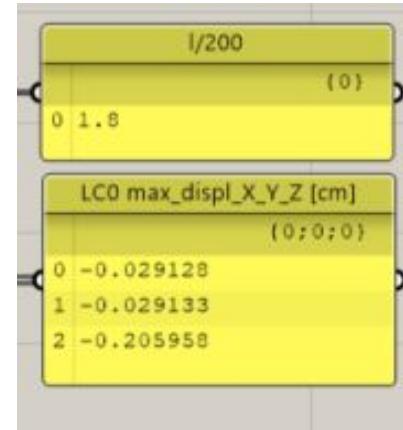
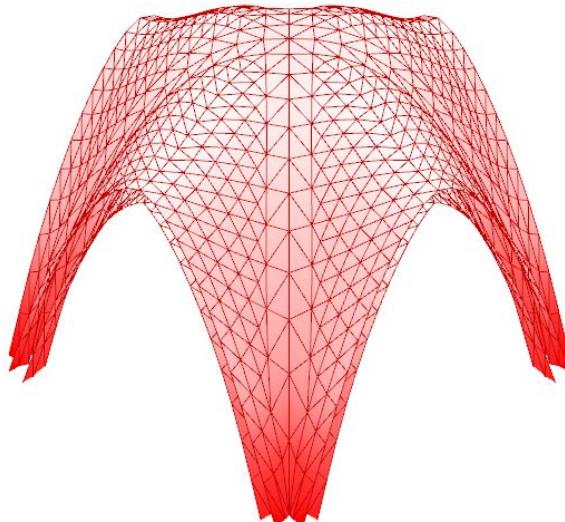
Only vertical loads

Princ. stresses 1 [MPa]:

- 0.13 compr.
- 0.03 tens.

Princ. stresses 2 [MPa]:

- 0.71 compr.
- 0.00 tens.



Thickness: **15 cm** (brick 30x15x10 cm)

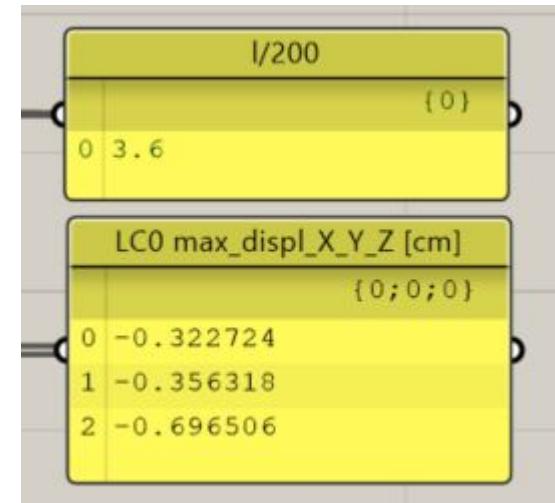
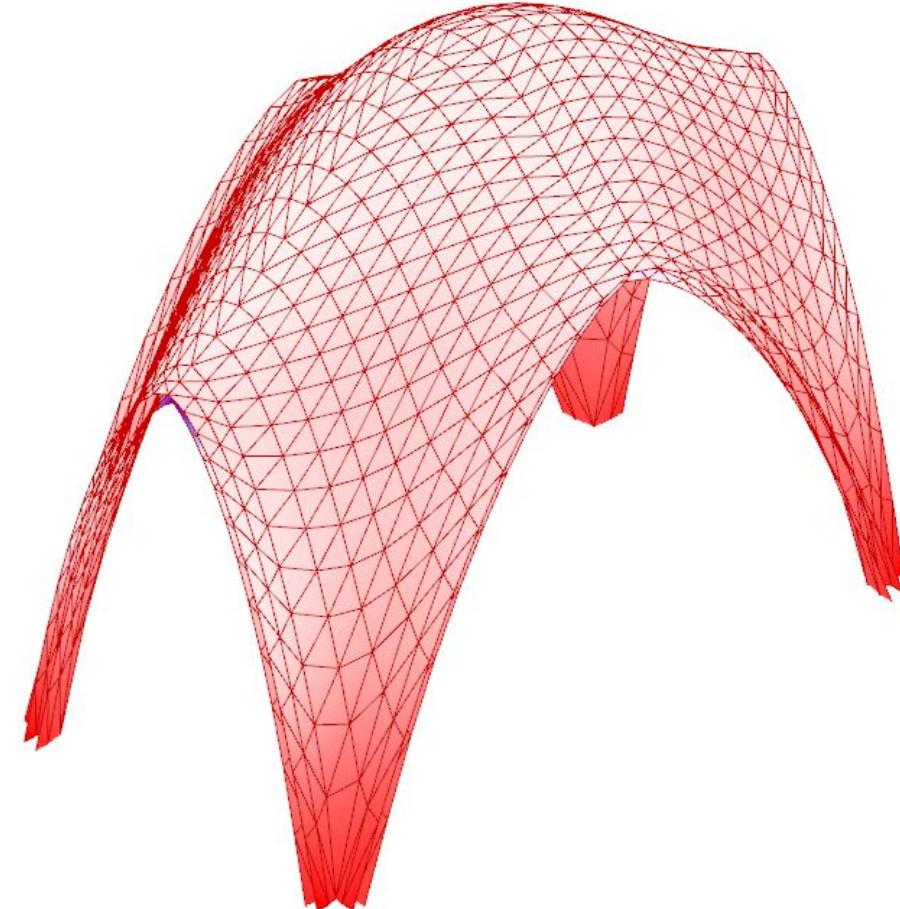
Only vertical loads

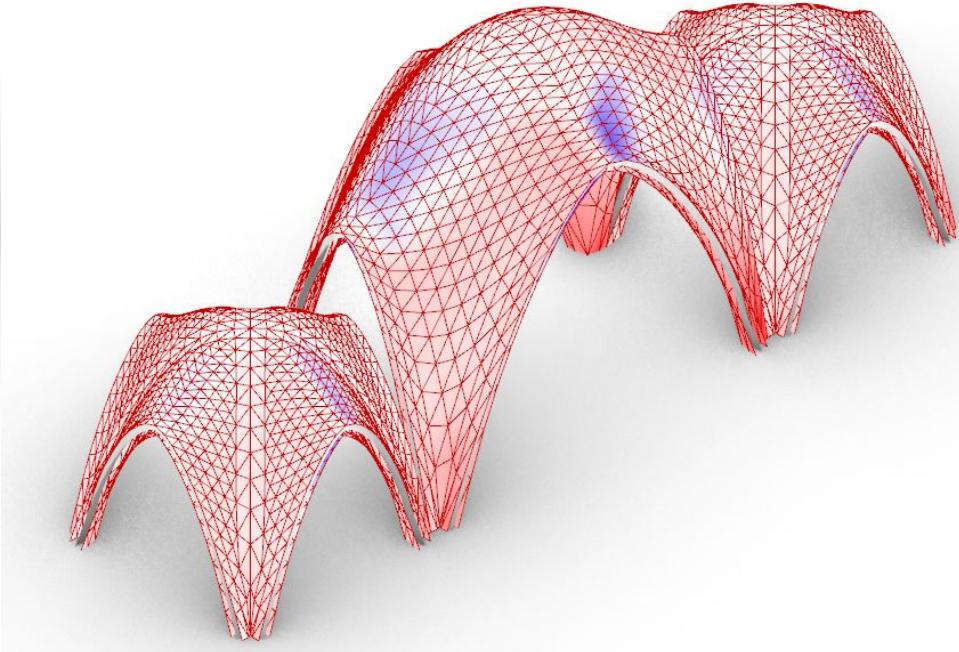
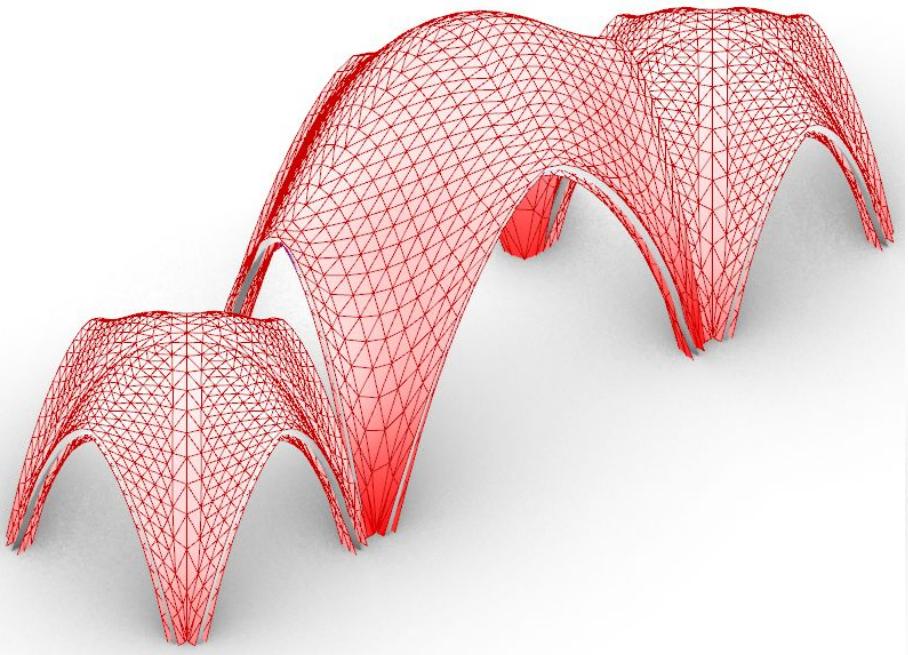
Princ. stresses 1 [MPa]:

- 0.20 compr.
- 0.14 tens.

Princ. stresses 2 [MPa]:

- 1.19 compr.
- 0.02 tens.





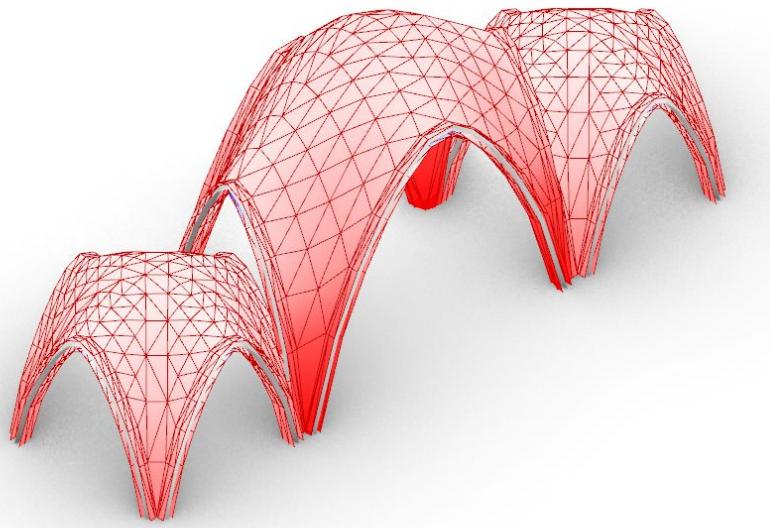
Thickness: **30 cm** (brick 30x15x10 cm)
With lateral load

Princ. stresses 1 [MPa]:

- 0.18 compr.
- 0.28 tens.

Princ. stresses 2 [MPa]:

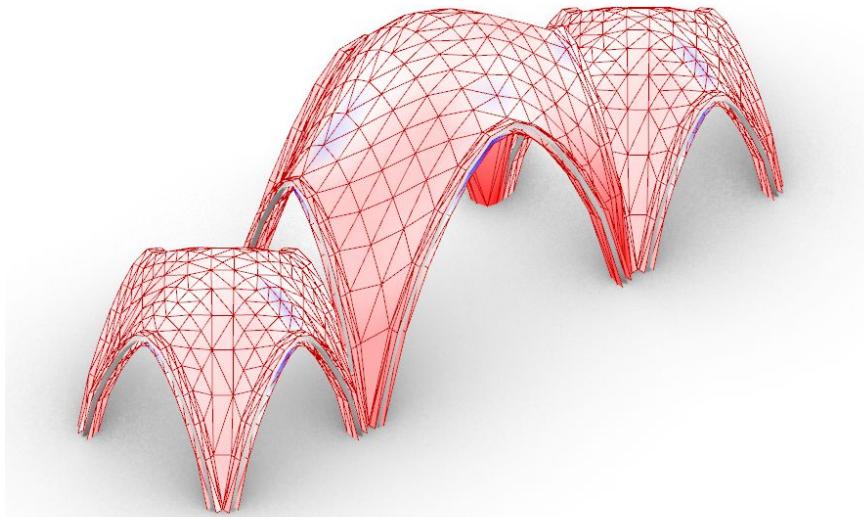
- 1.21 compr.
- 0.02 tens.



Final mesh - Only vertical loads:

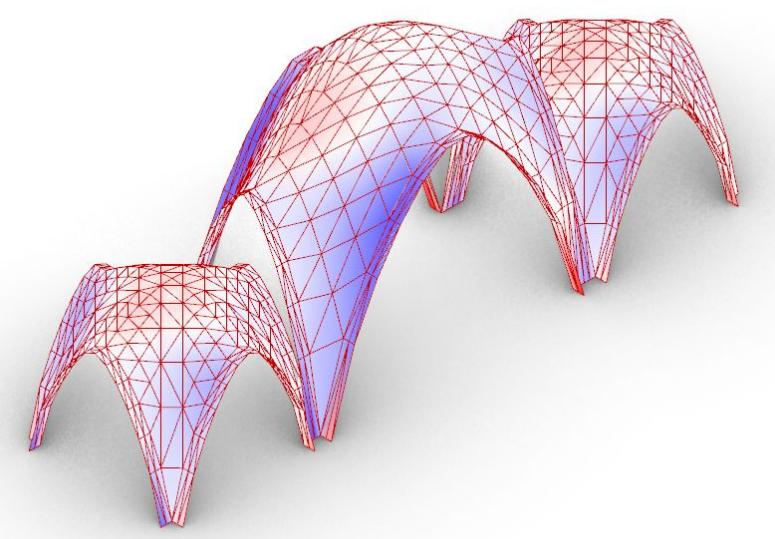
$t = 25$ cm

Only compression



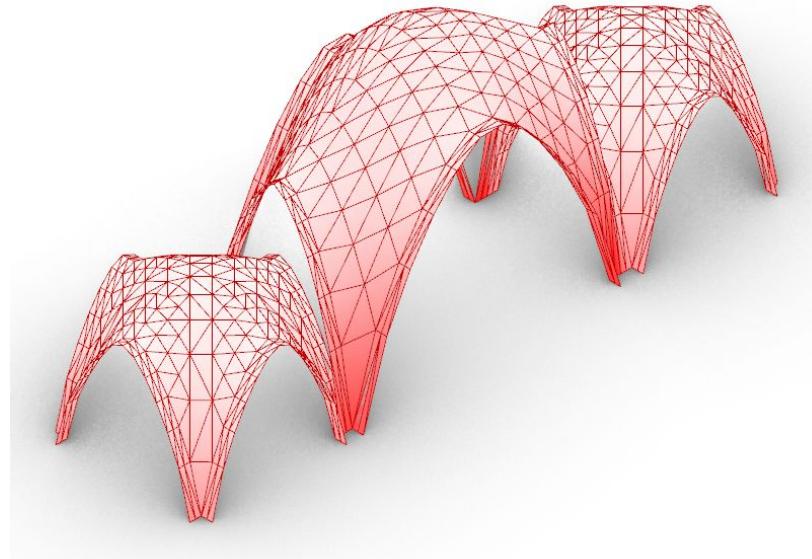
Final mesh - With lateral loads:

$t = 25$ cm



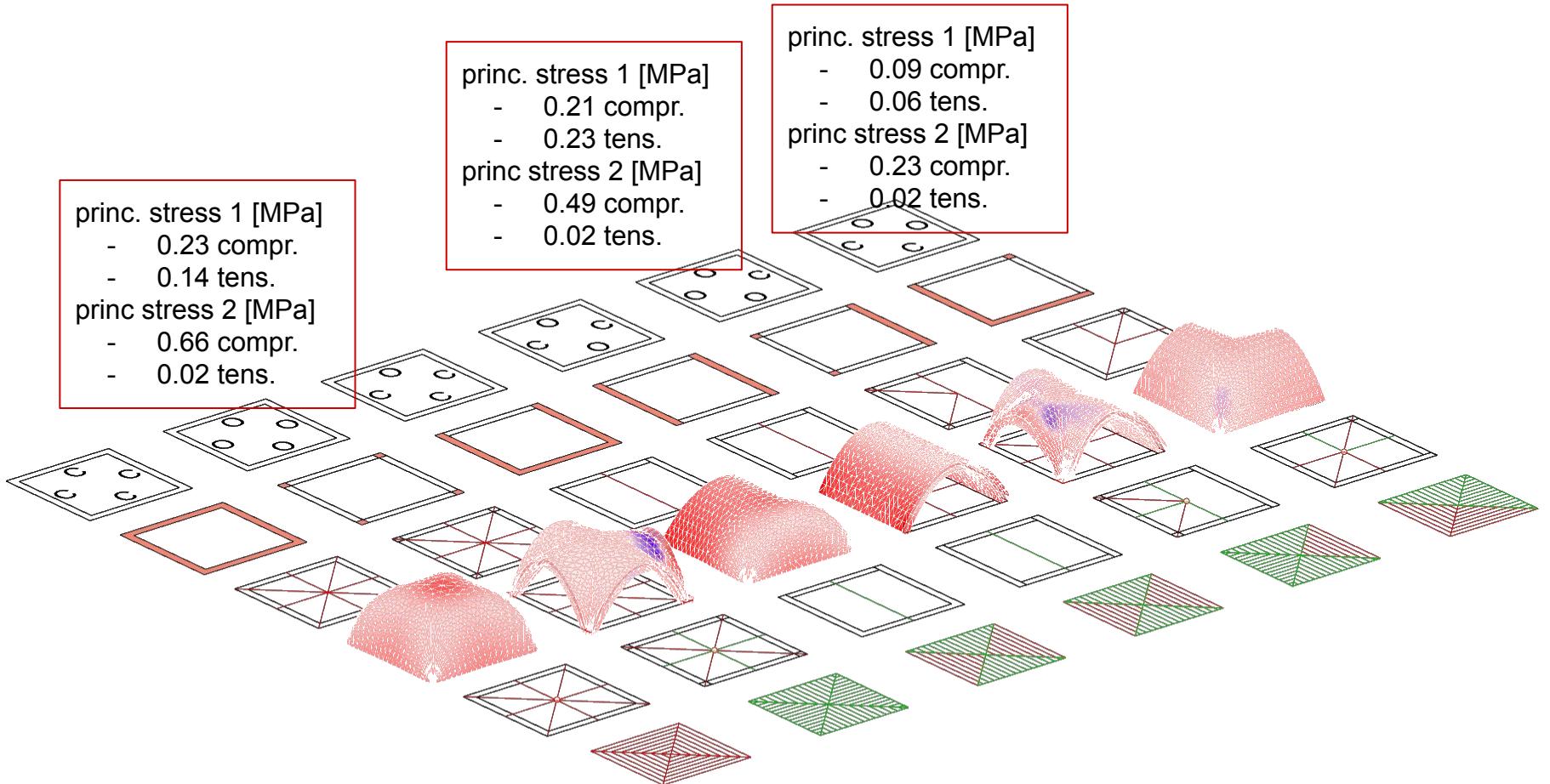
Principle stresses 1 ($t=25\text{cm}$):

- 0.15 MPa compr.
- 0.15 MPa tens.

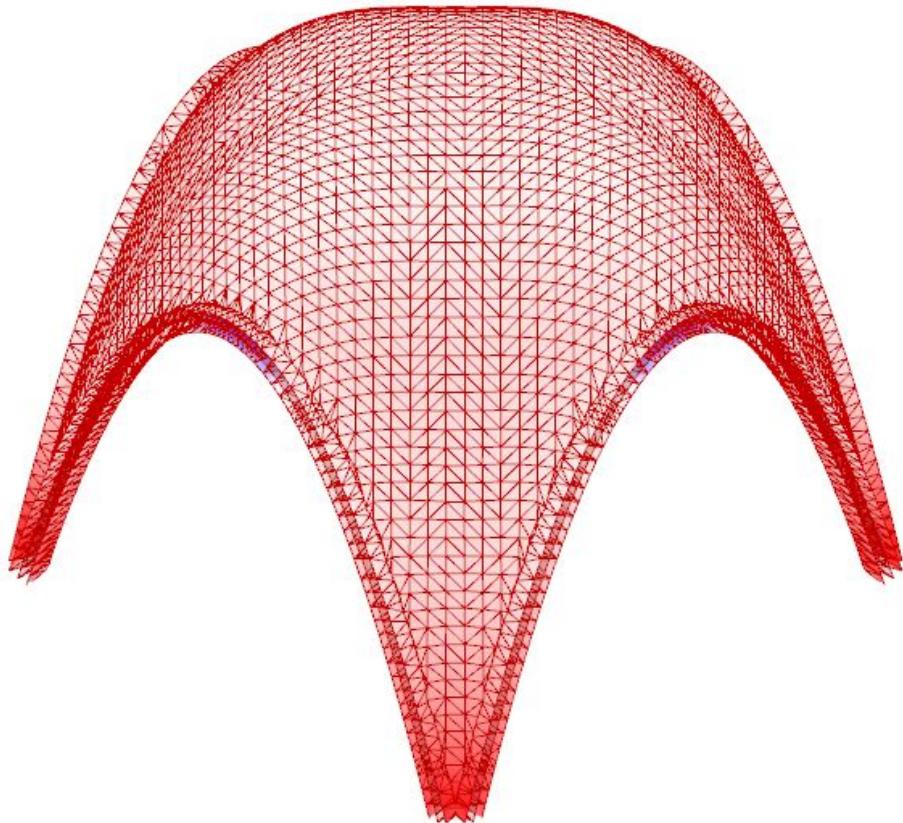


Principle stresses 1 ($t=25\text{cm}$):

- 0.87 MPa compr.
- 0.02 MPa tens.



30 cm height



Atrium
 $t = 30 \text{ cm}$
No lateral loads

Princ. stresses 1:
- 0.21 MPa compr.
- 0.26 MPa tens.

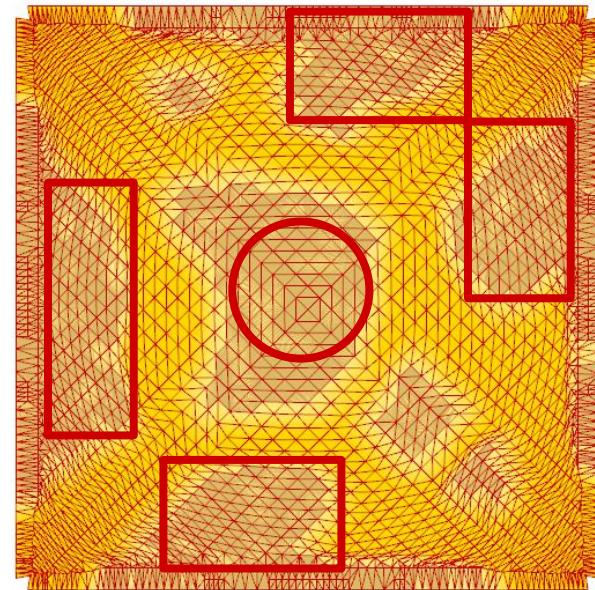
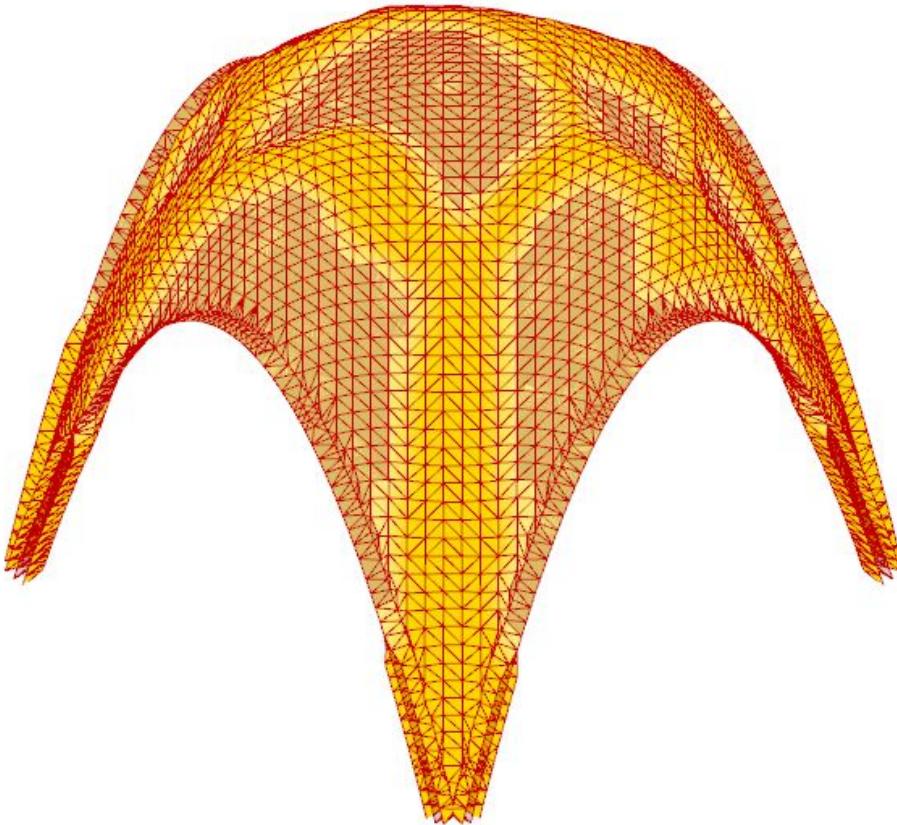
Princ. stresses 2:
- 1.52 MPa compr.
- 0.07 MPa tens.

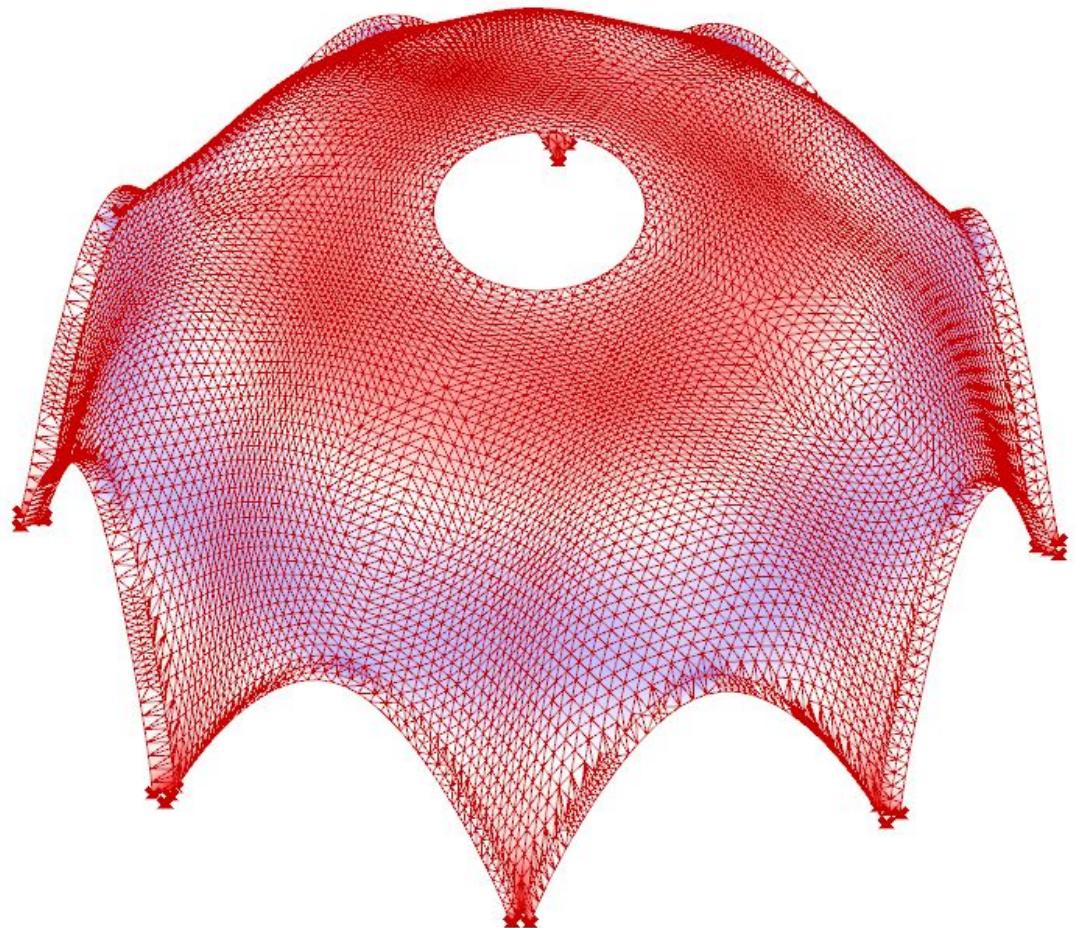
With lateral load
 $t = 65 \text{ cm}$

Princ. stresses 1:
- 0.29 MPa compr.
- 0.28 MPa tens.

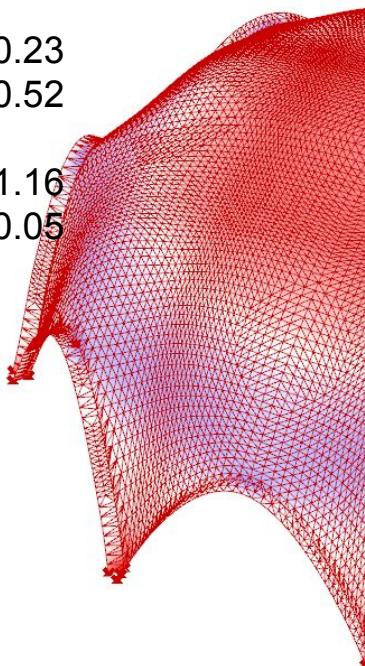
Princ. stresses 2:
- 1.31 MPa compr.
- 0.01 MPa tens.

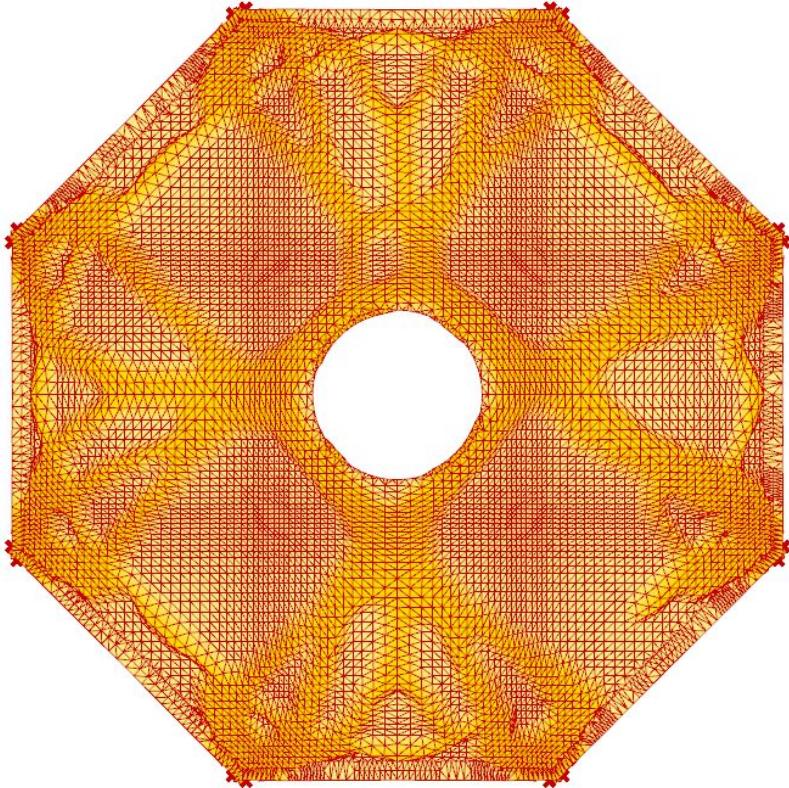
Target mass: 50%

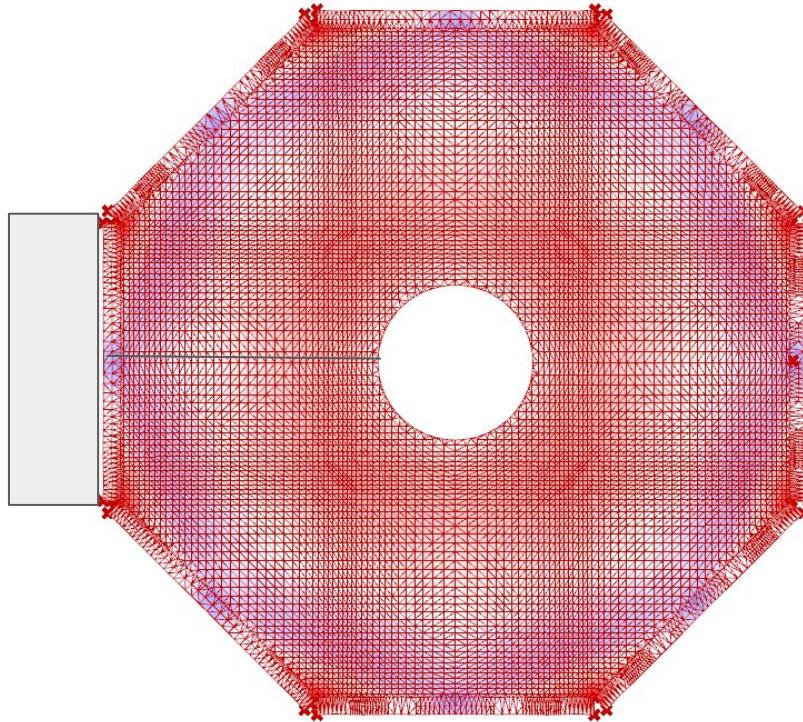
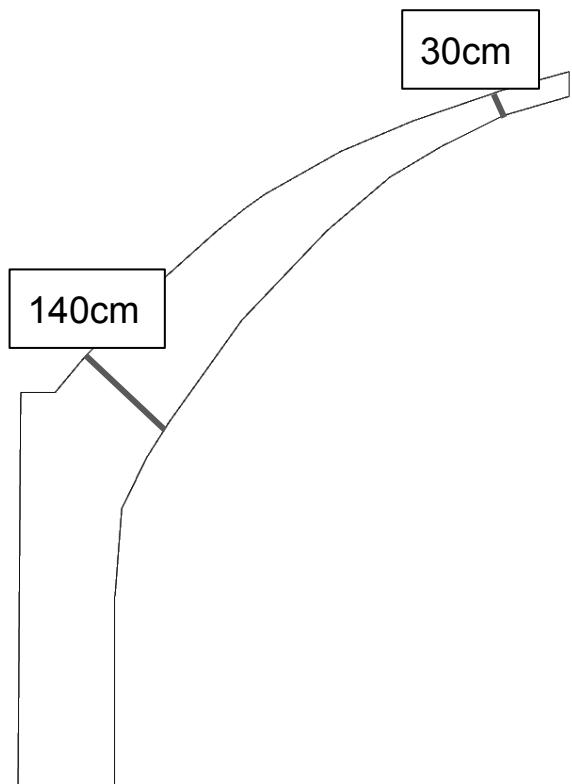




0.31
0.49 0.23
0.52
1.47
0.04 1.16
0.05

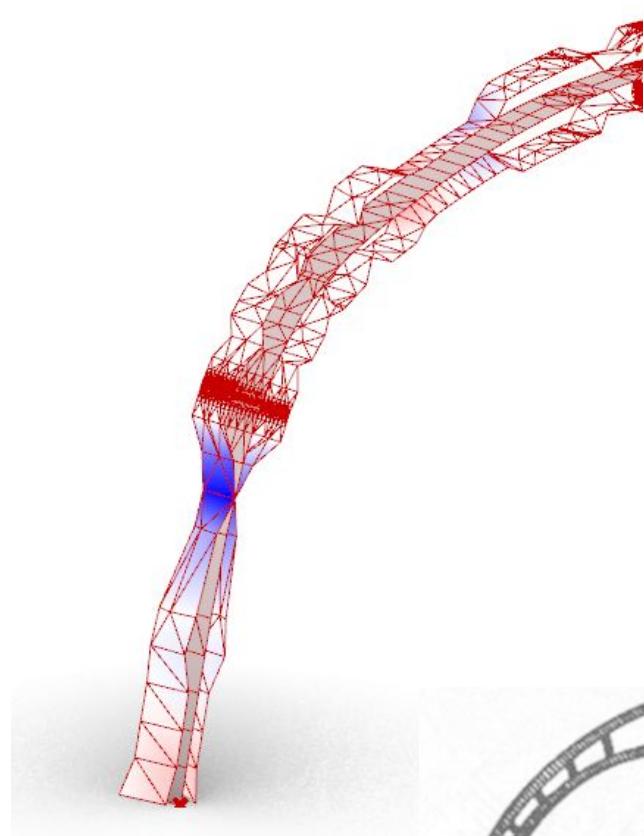
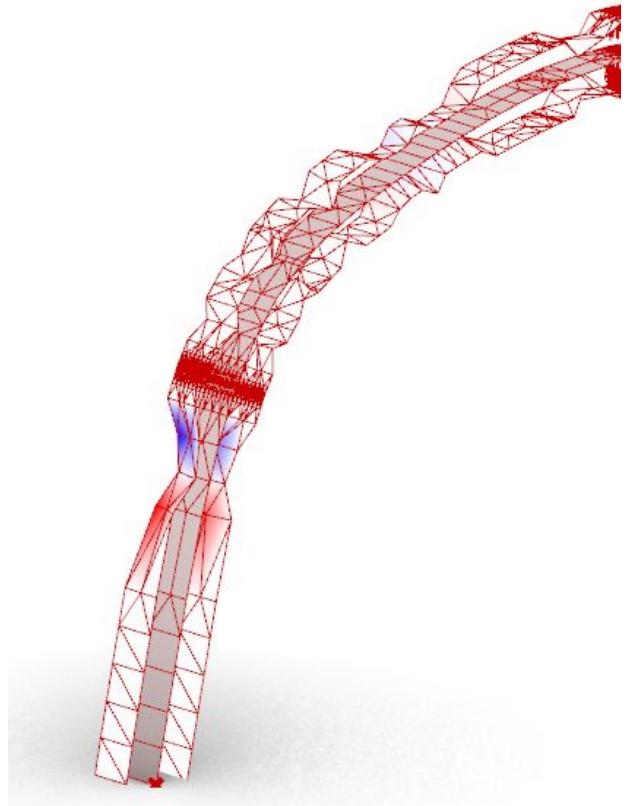
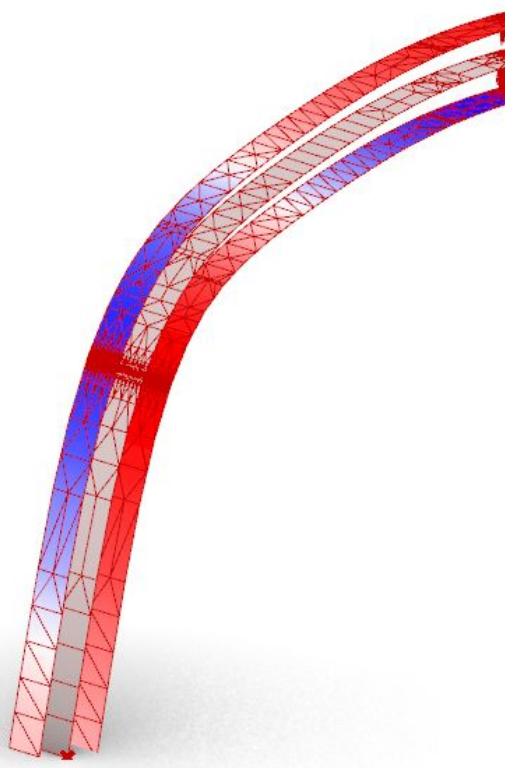


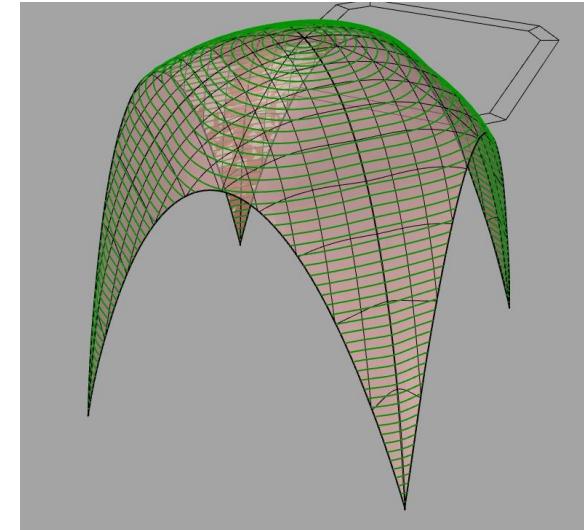
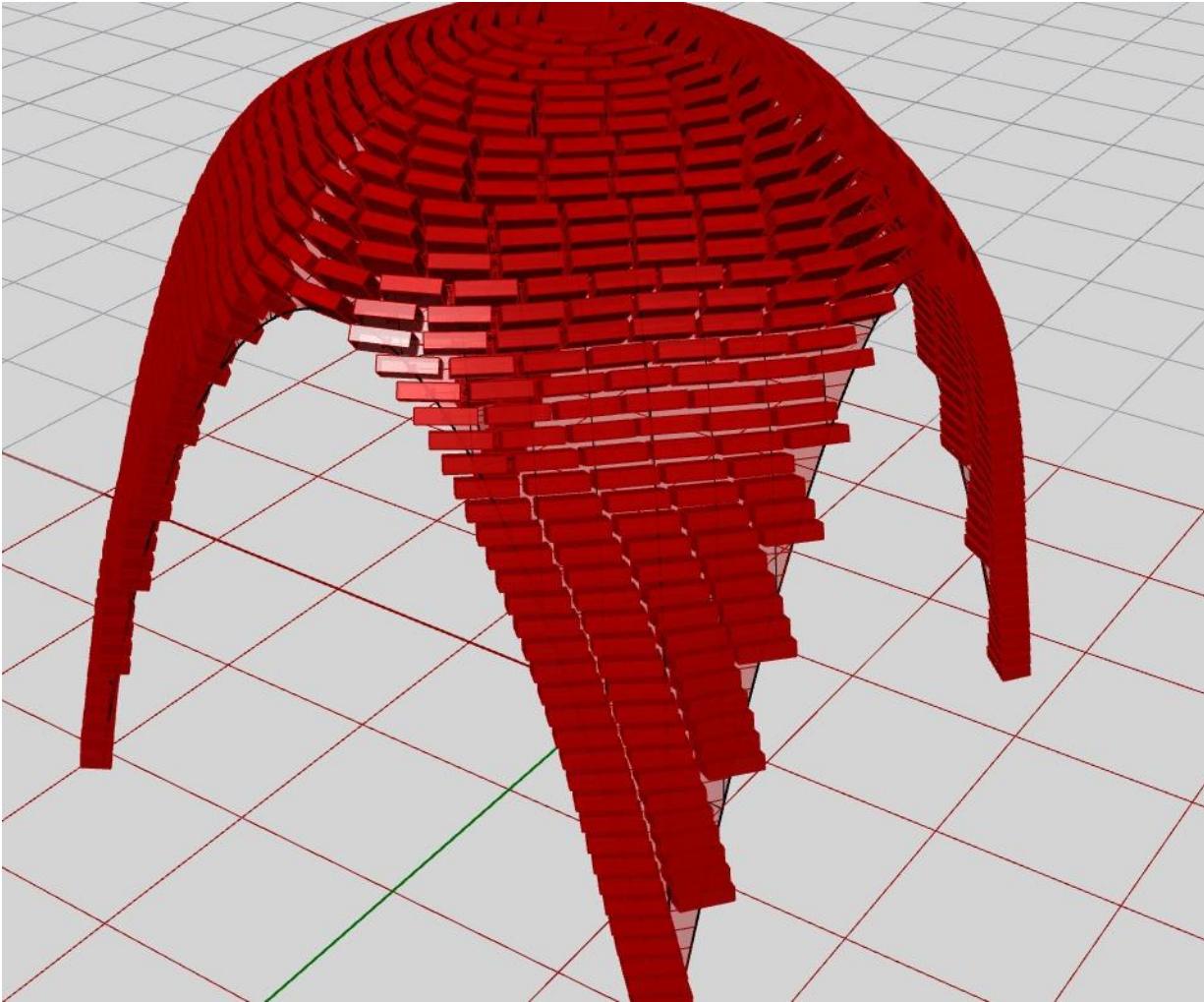


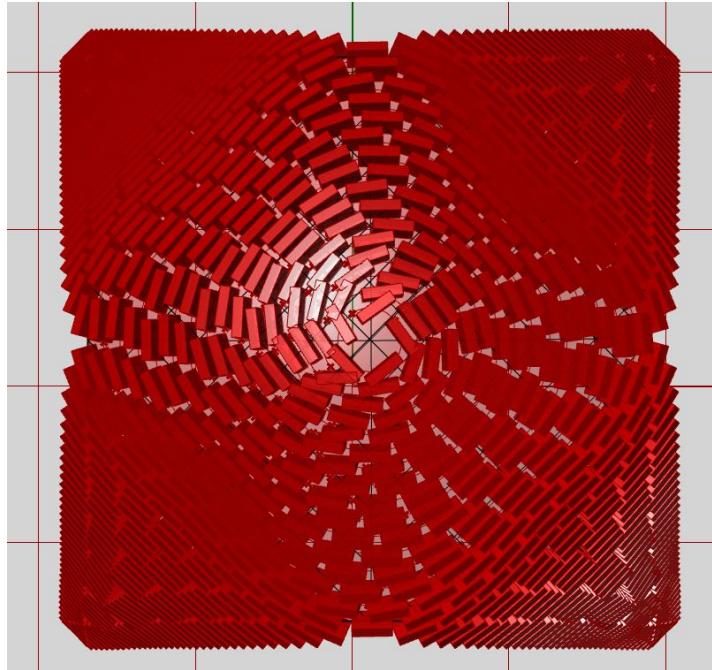
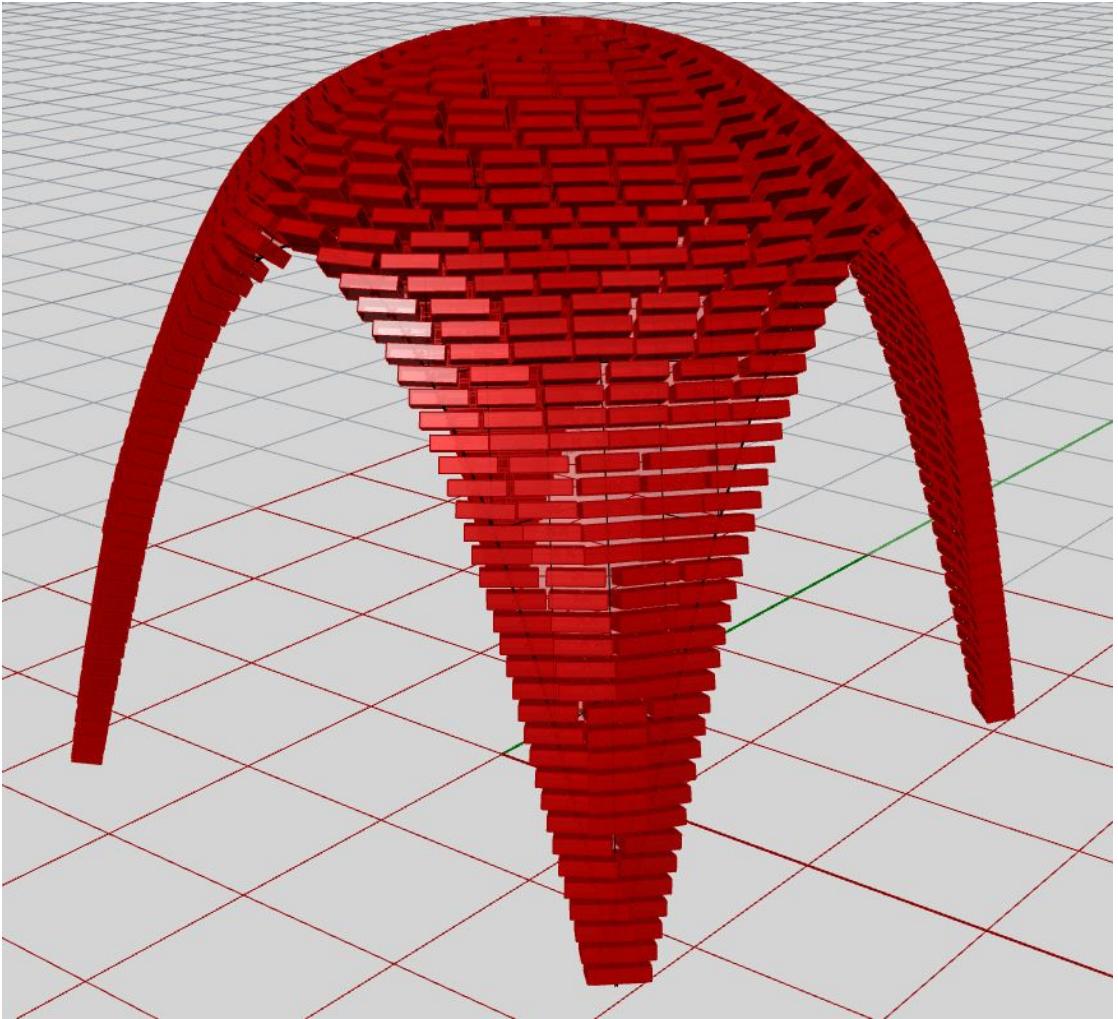


highest stress compr. ($t=30$ cm)
1.94 MPa

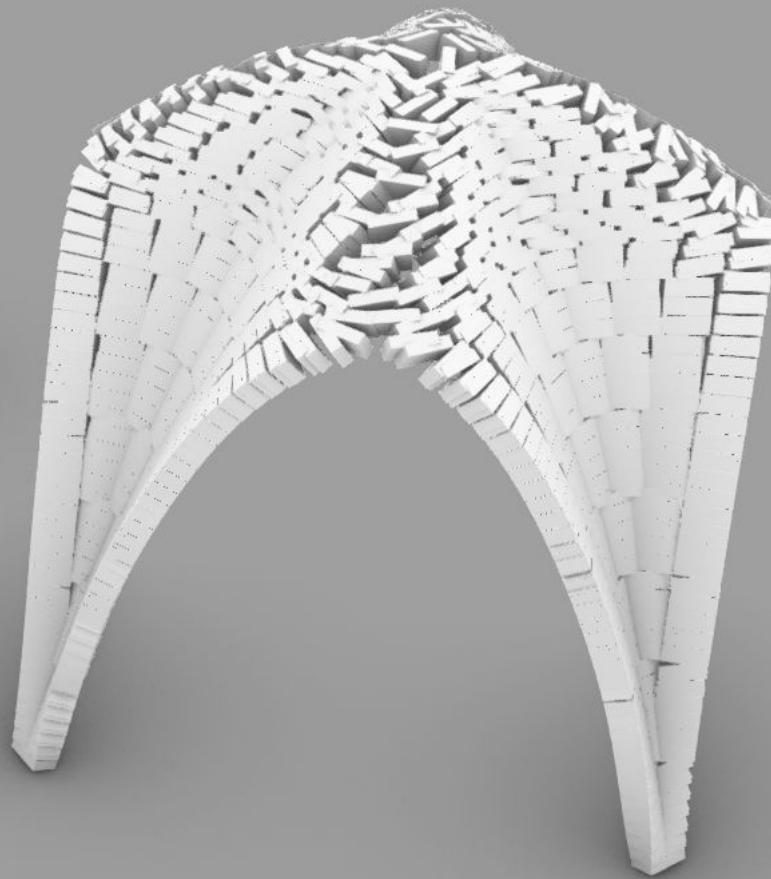
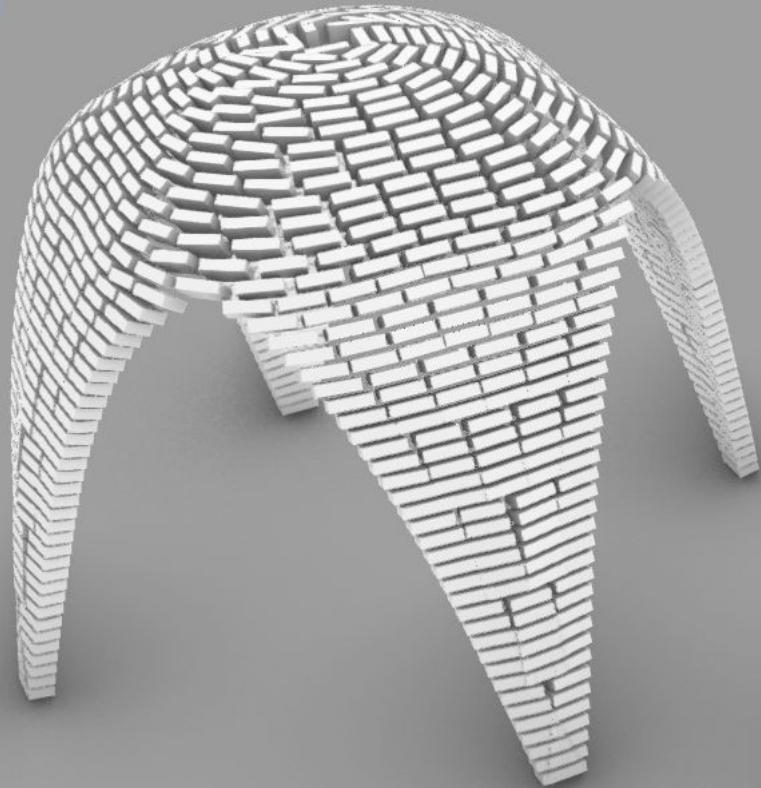
Highest stress tens. ($t = 140$ cm)
0.29 MPa







tive ▾



Construction



1. Steel cutting machine



2. Drilling machine



6. Right angle



3. Welding jig



8. Rope/chain/hose pipe



4. Discarded steel pipes/sections



9. Nails



5. Corrugated sheets



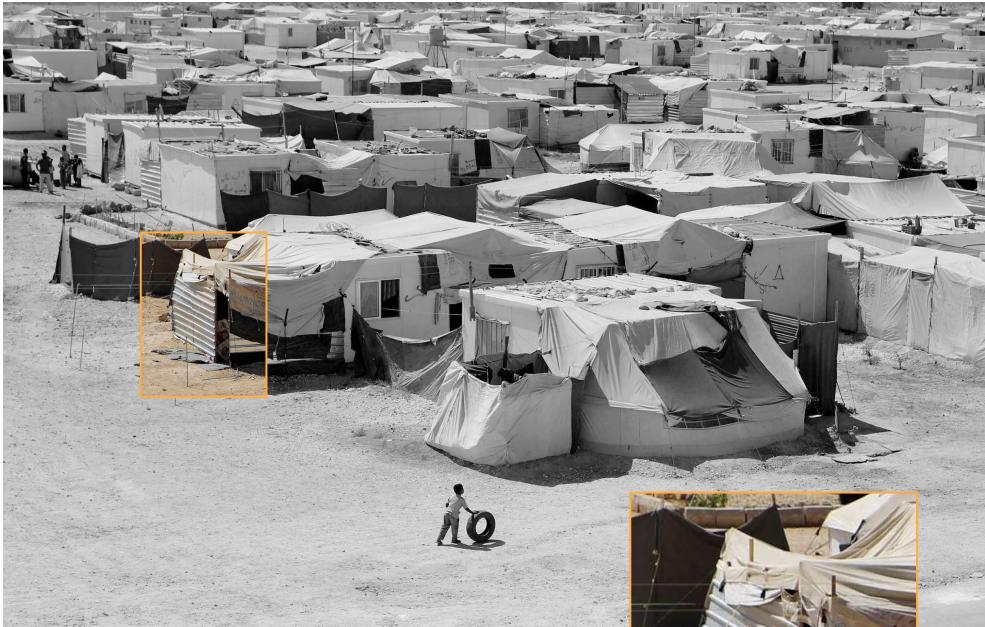
10. Waste wood pieces



Angle Grinder
(Cutting machine)



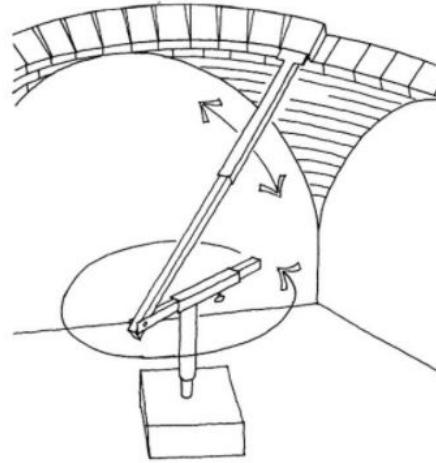
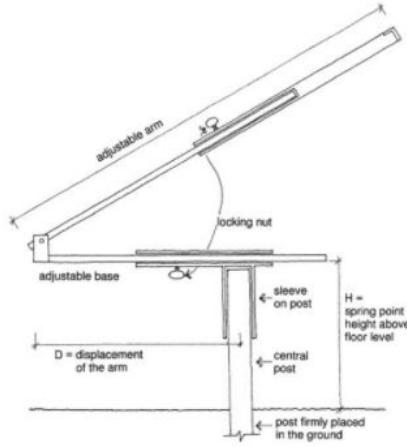
Welding machine

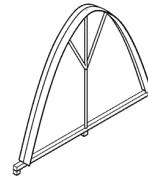
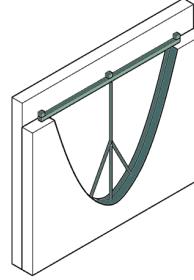
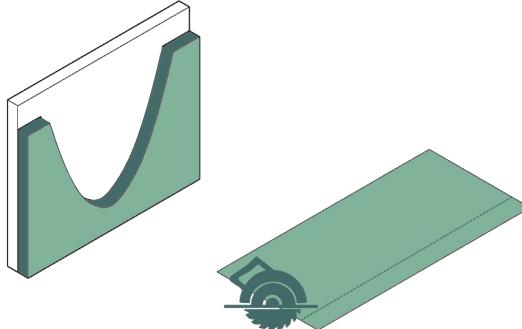
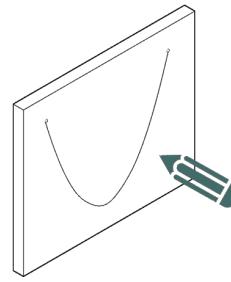
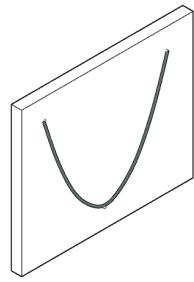
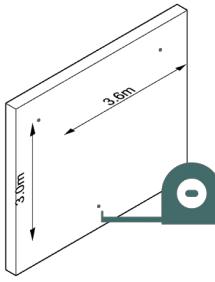
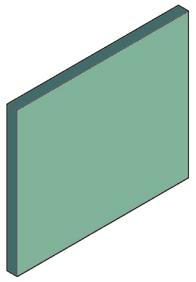


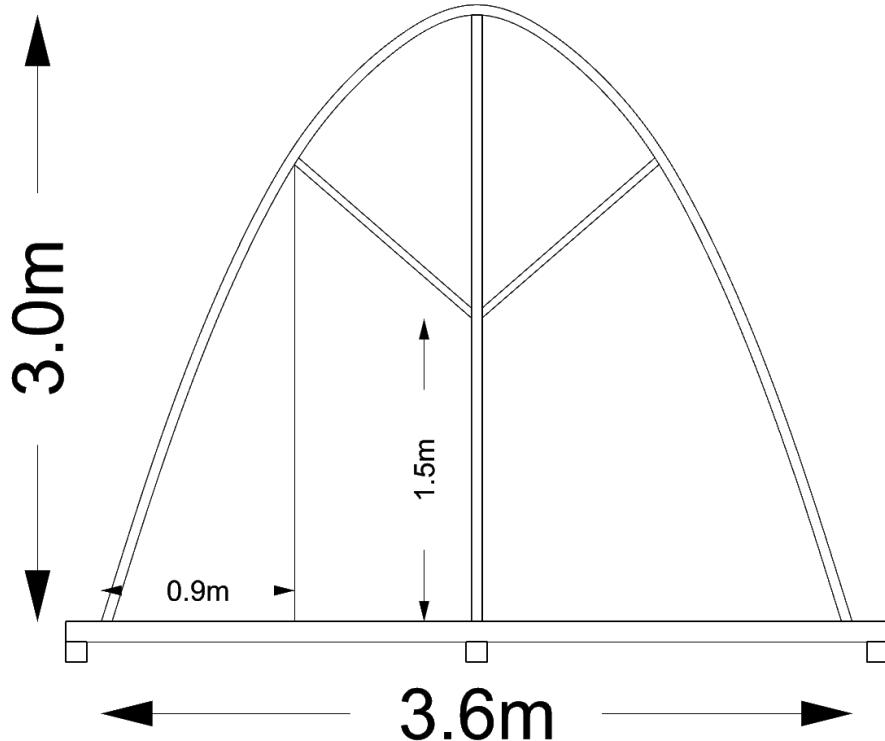
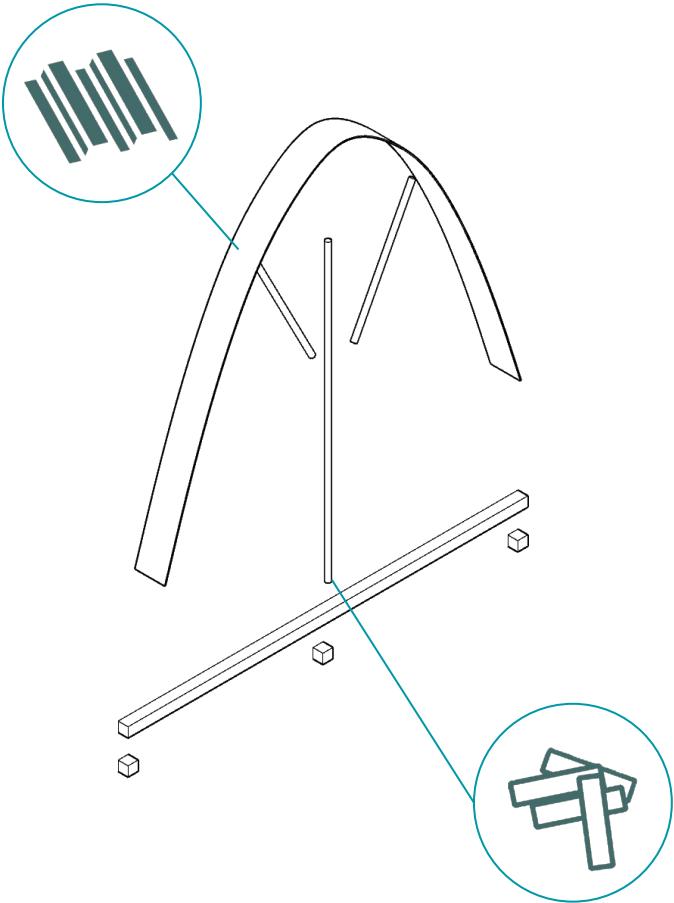
Use skills of local fabricators

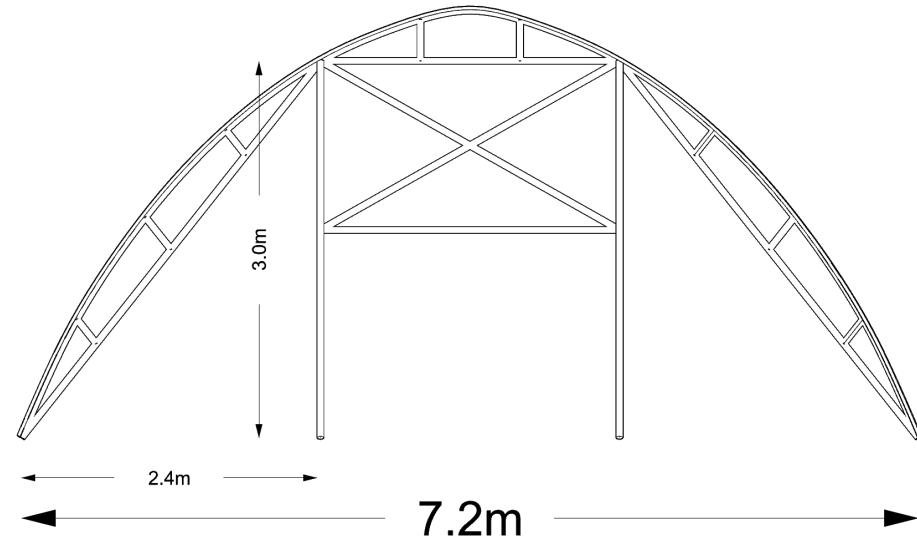
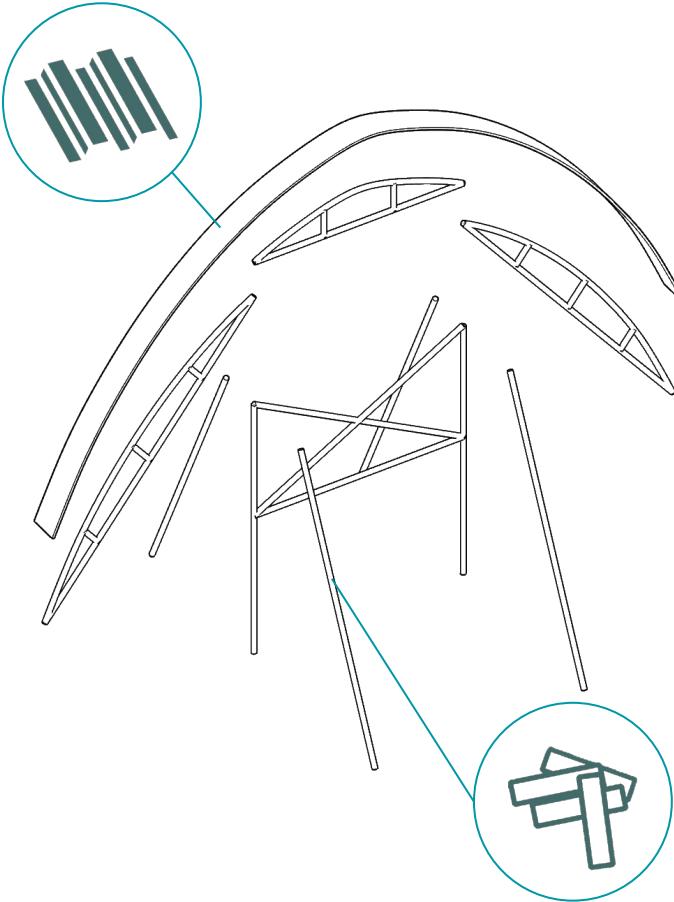


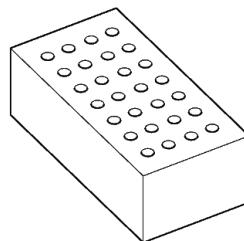
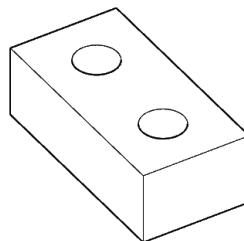
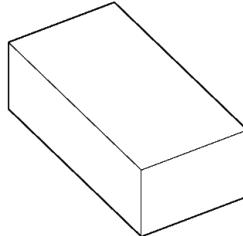
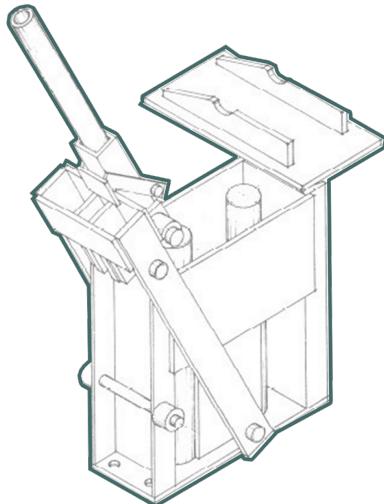
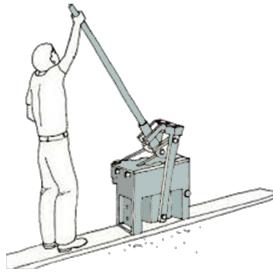
Use discarded
corrugated sheets











Mixture

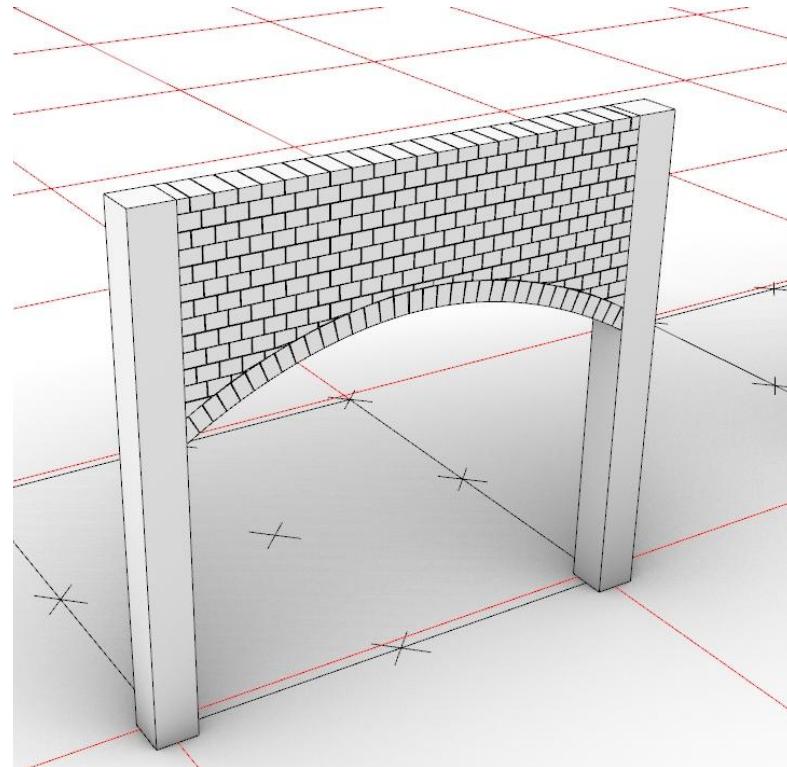
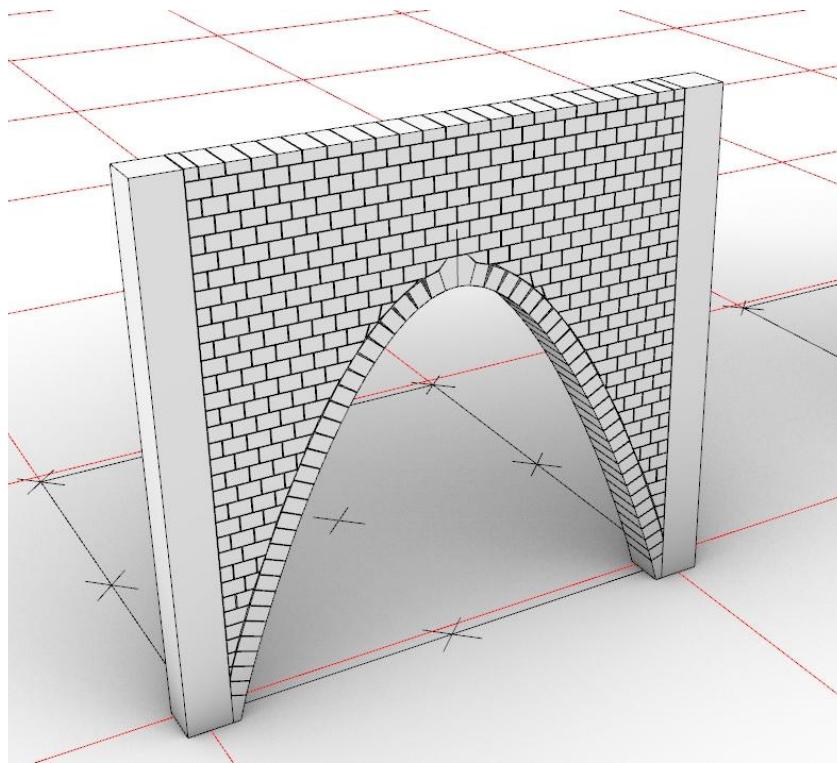
Solid materials

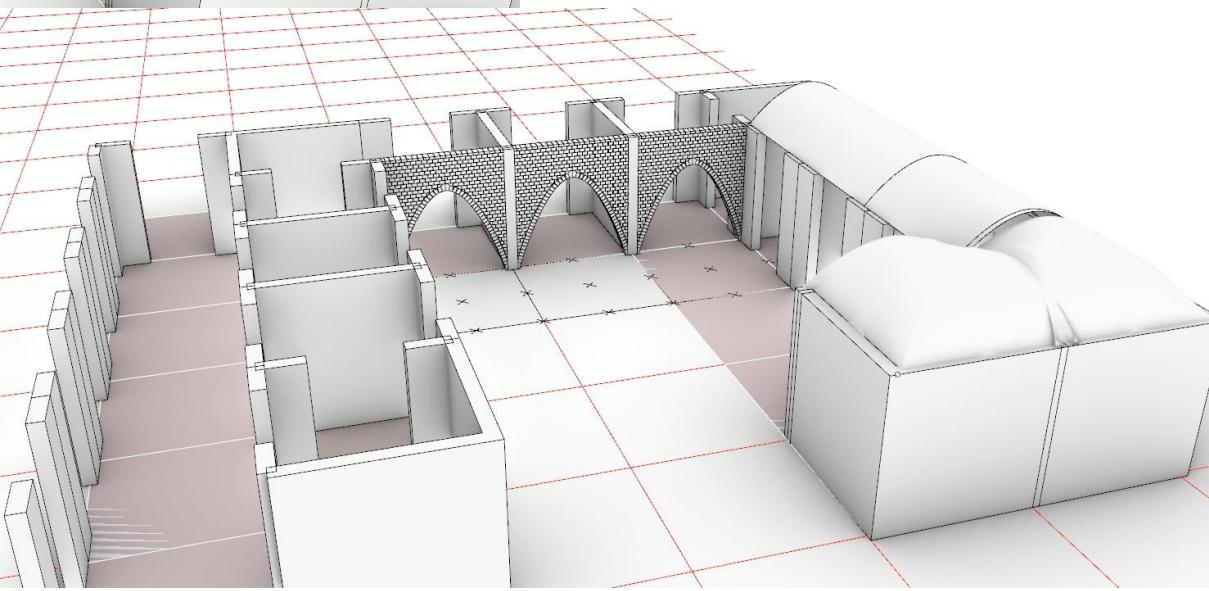
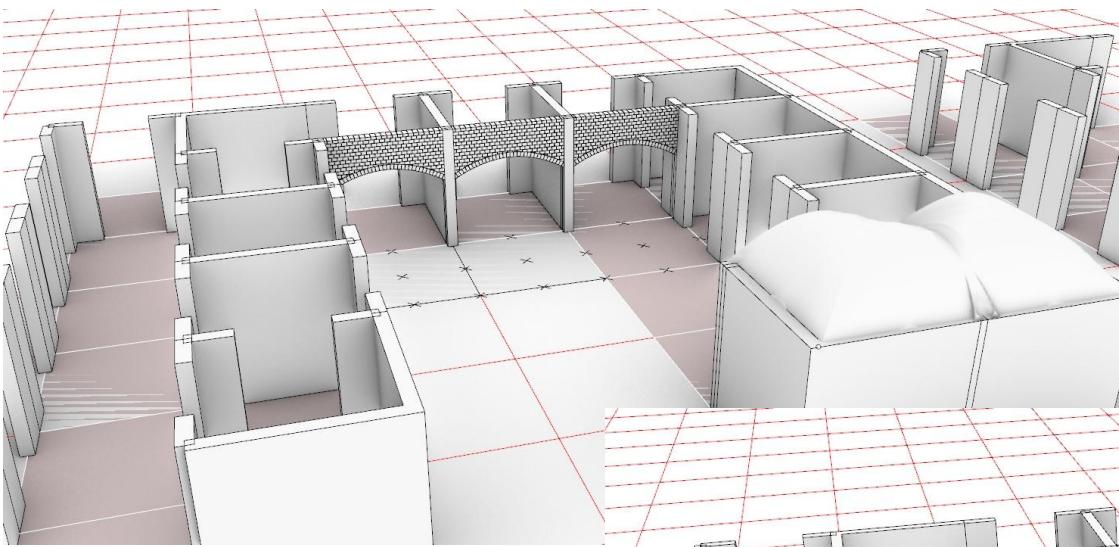
Clay 30%
Fine sand 30%
Coarse sand 40%
Water 10%

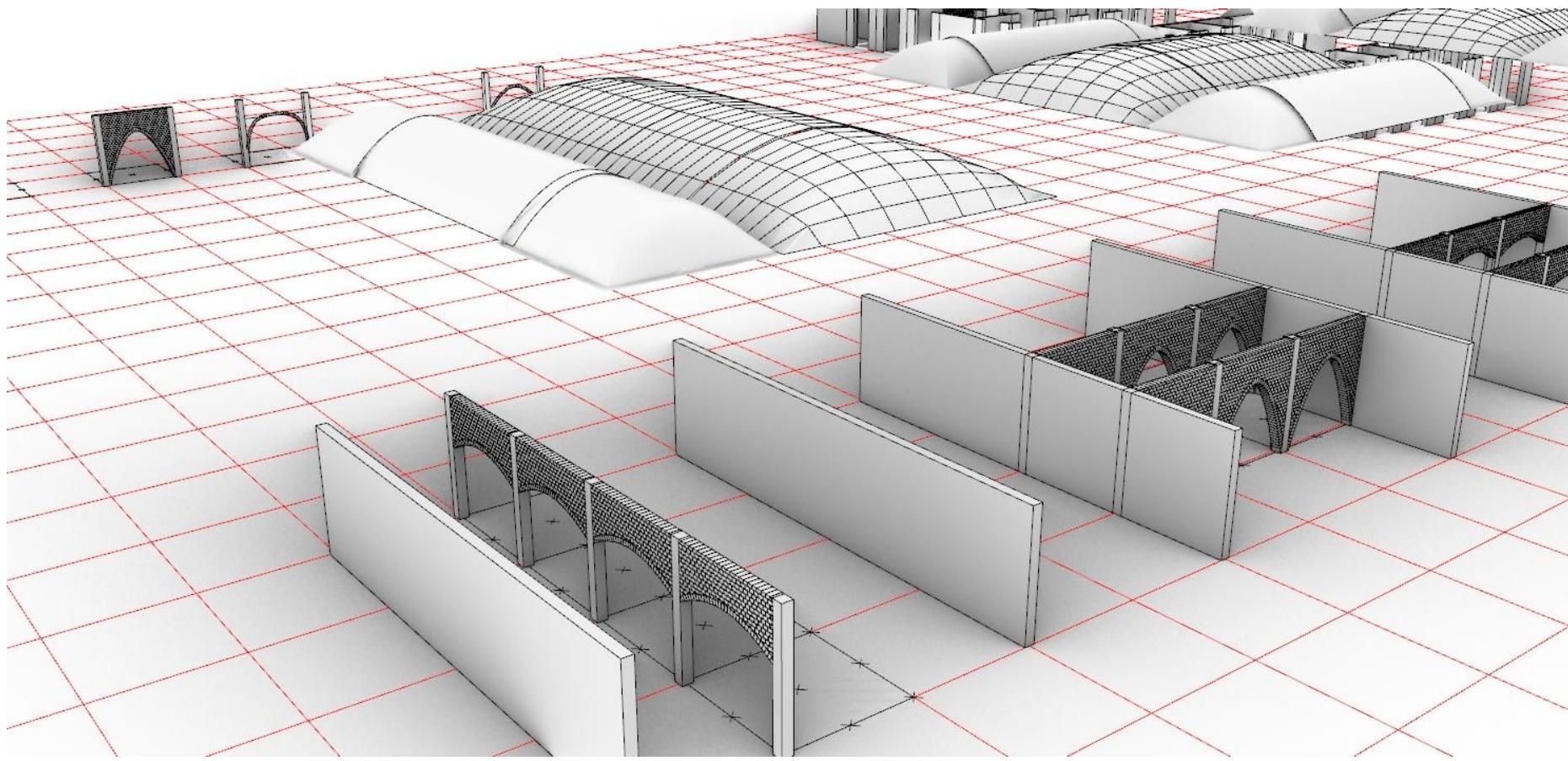
Possible reinforcements

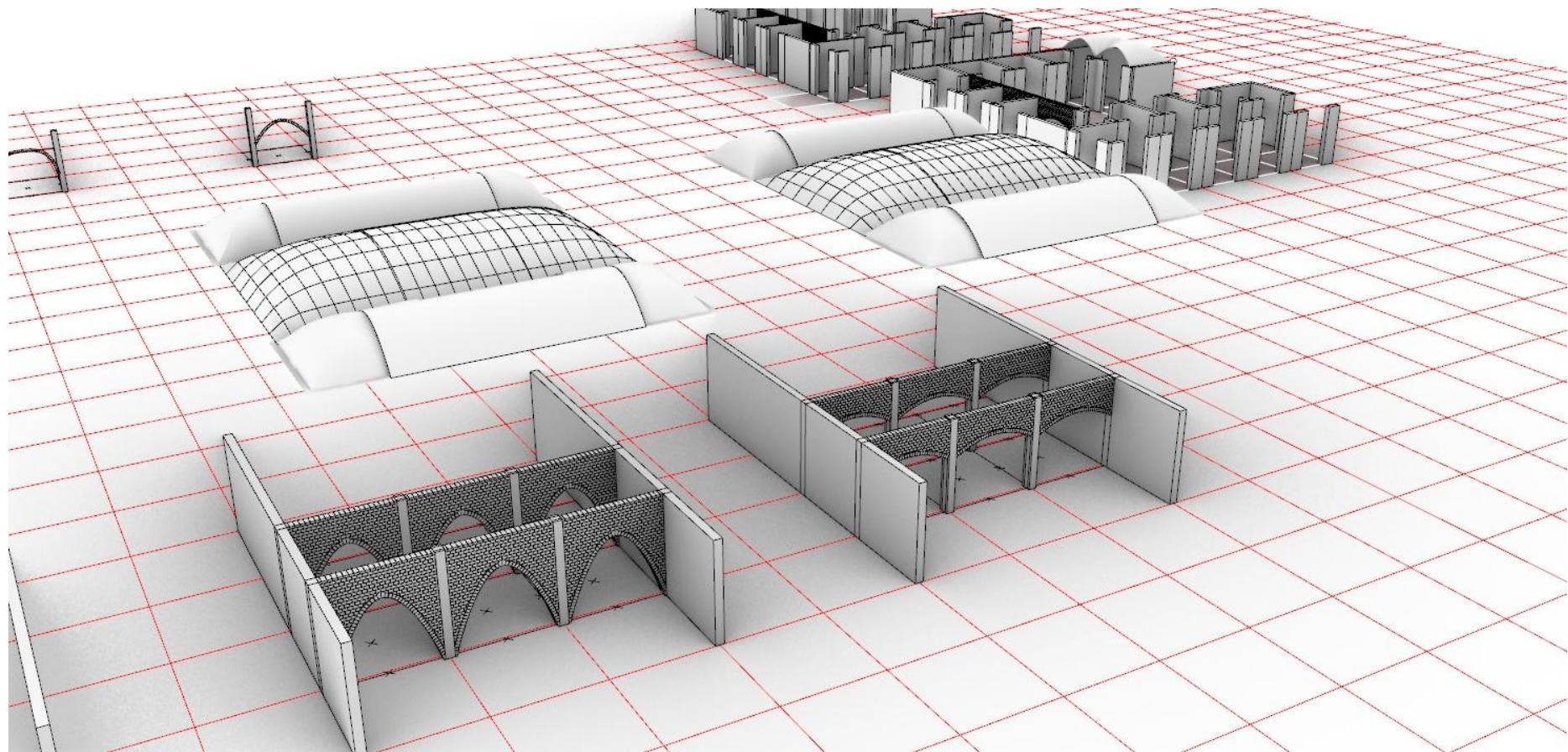
Straw 1%
Paper pulp 1%
Textile fibres 1%

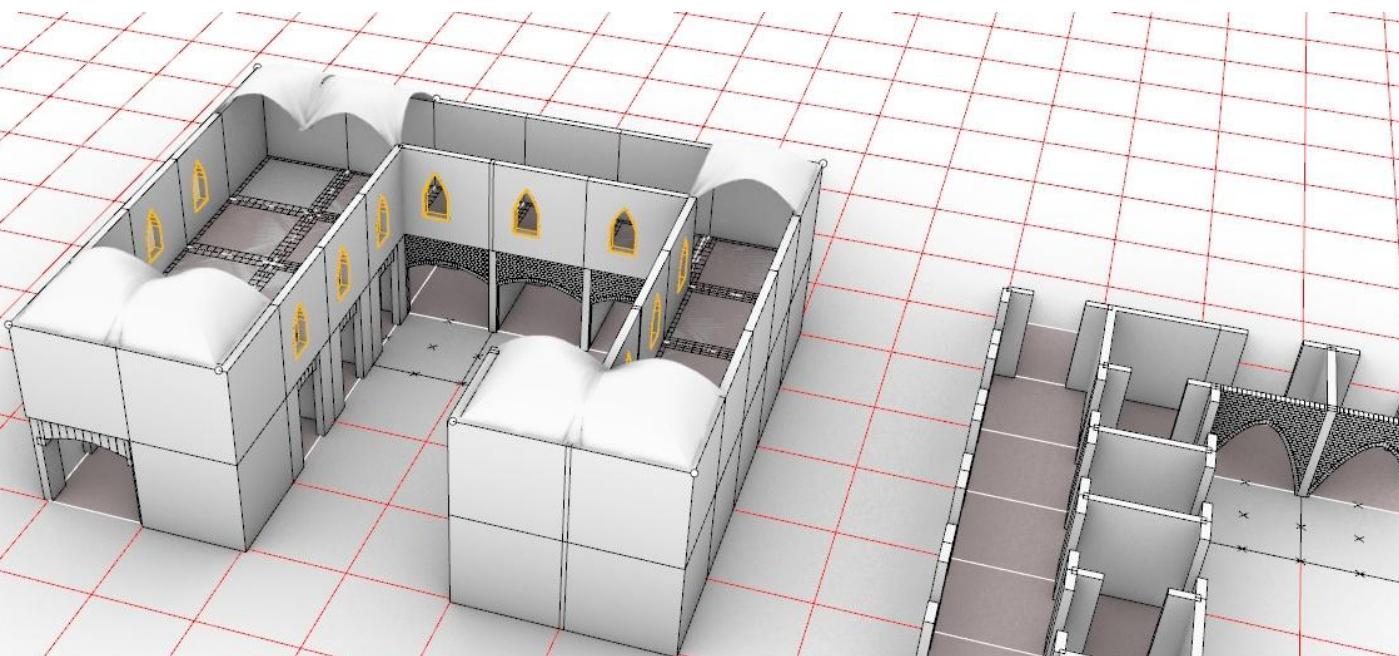


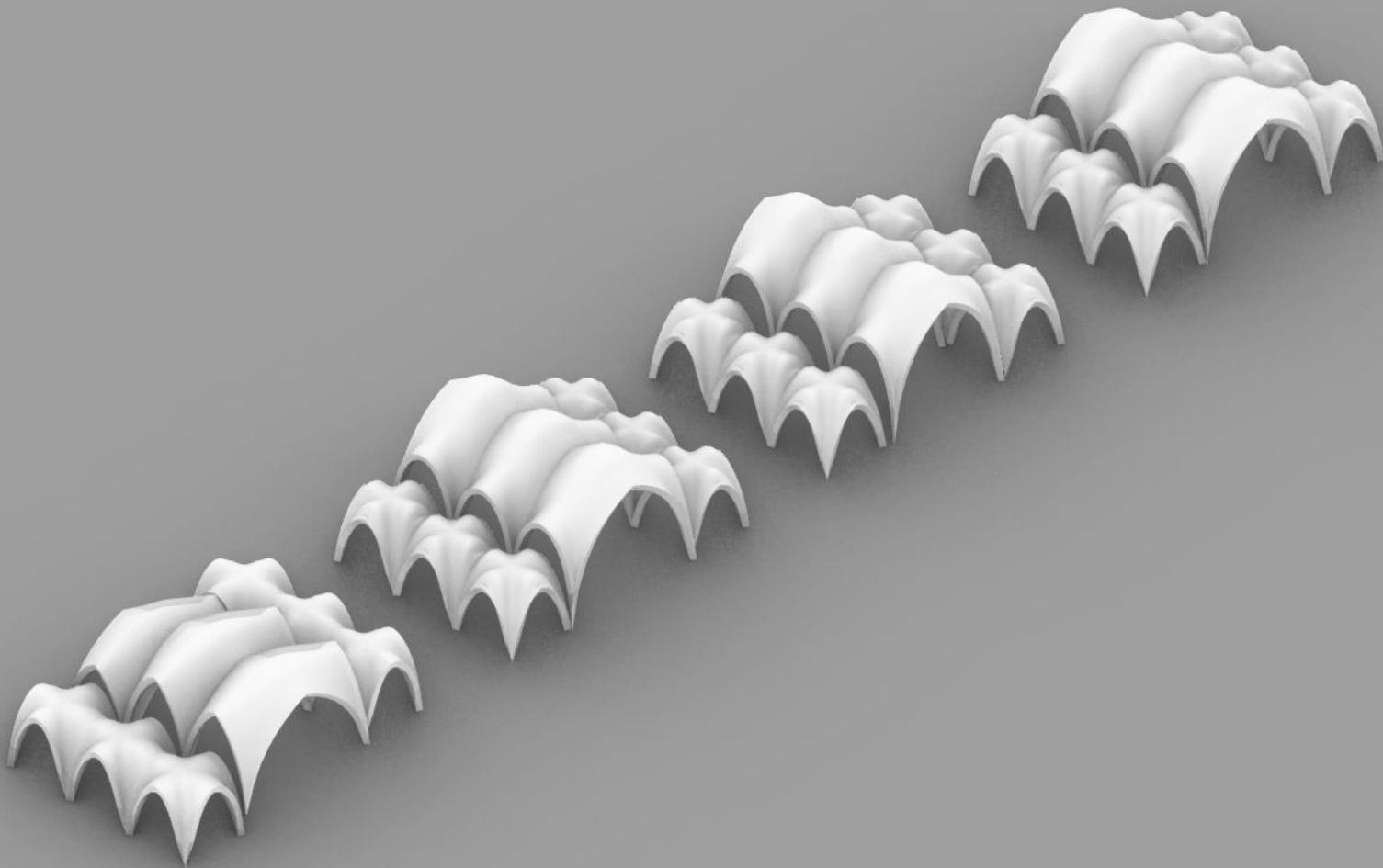


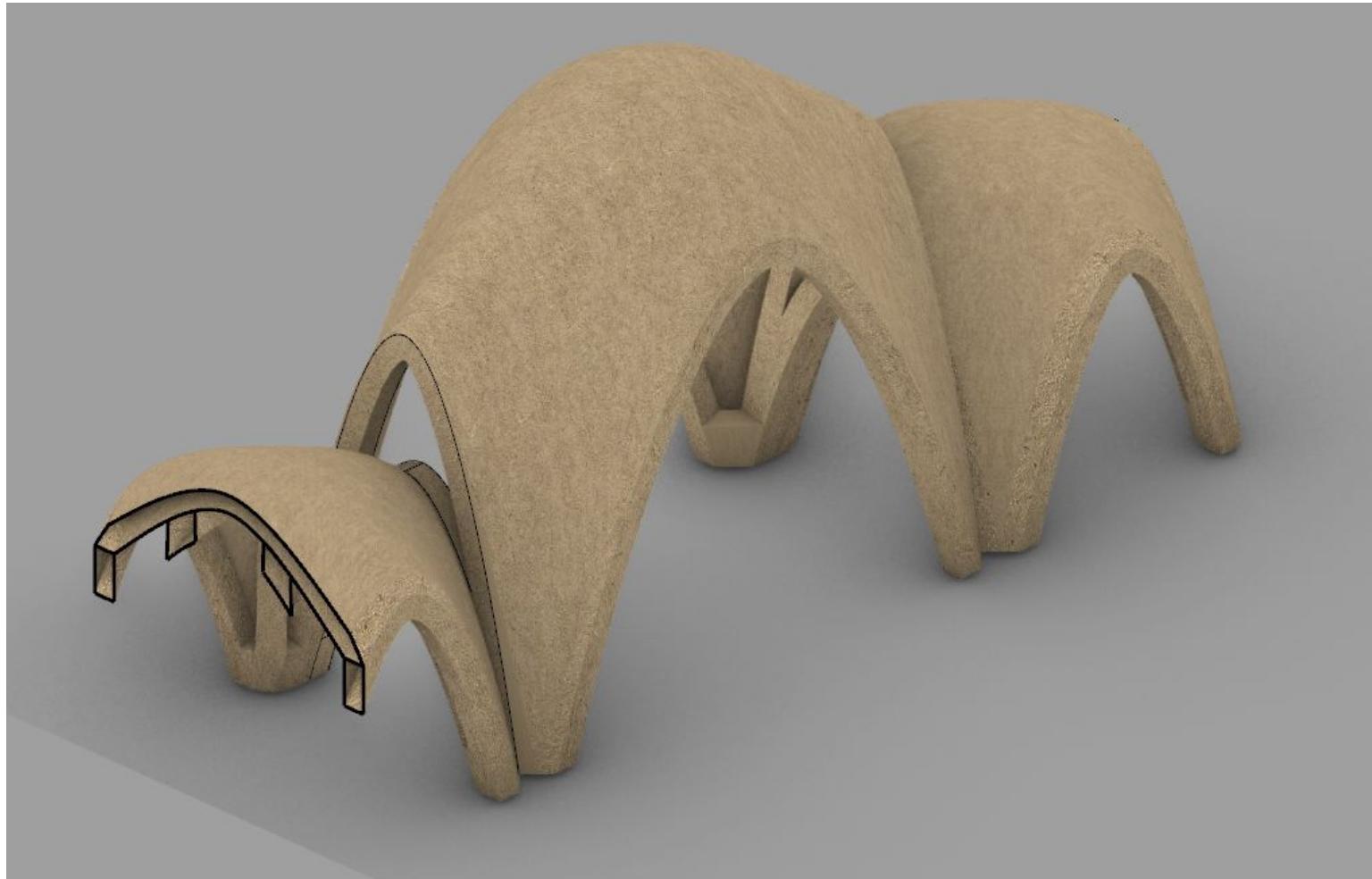


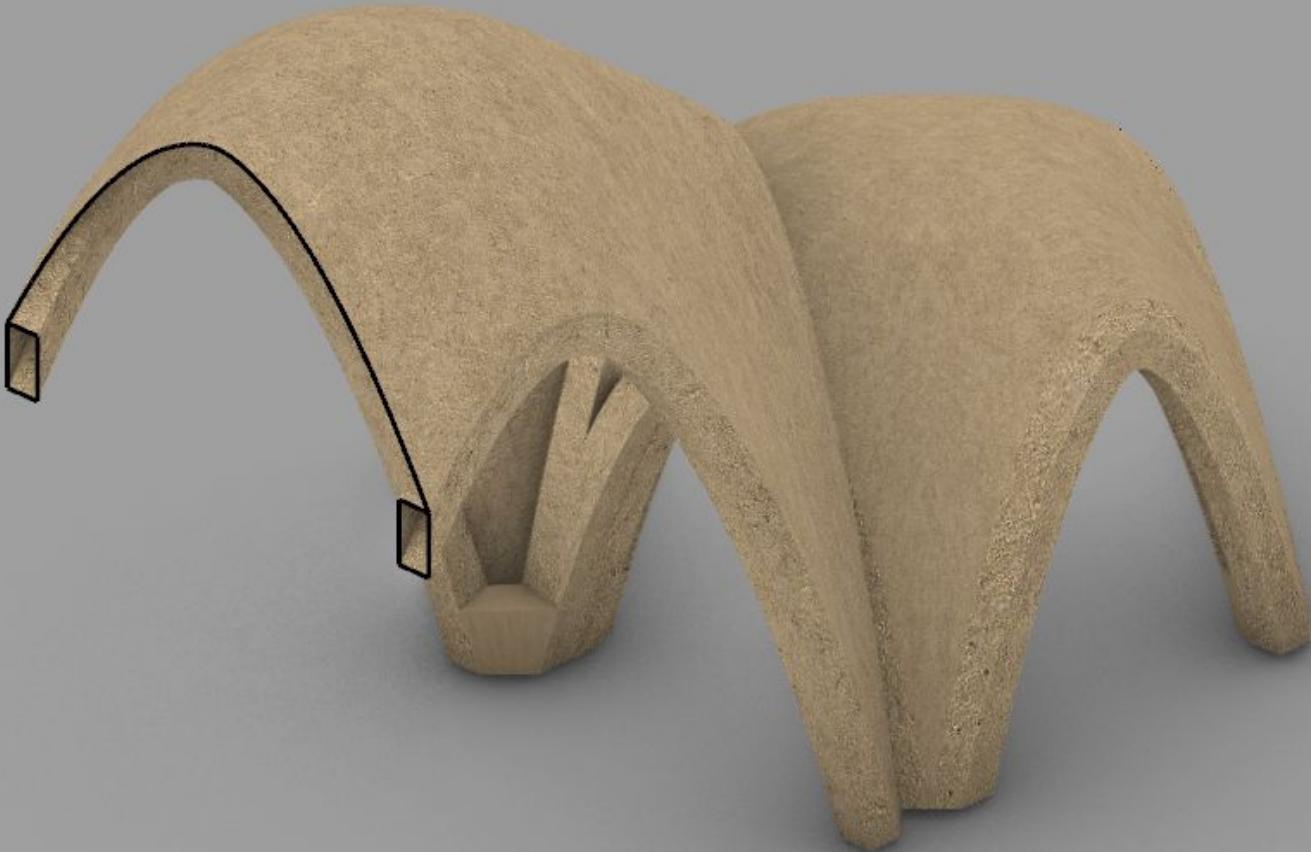


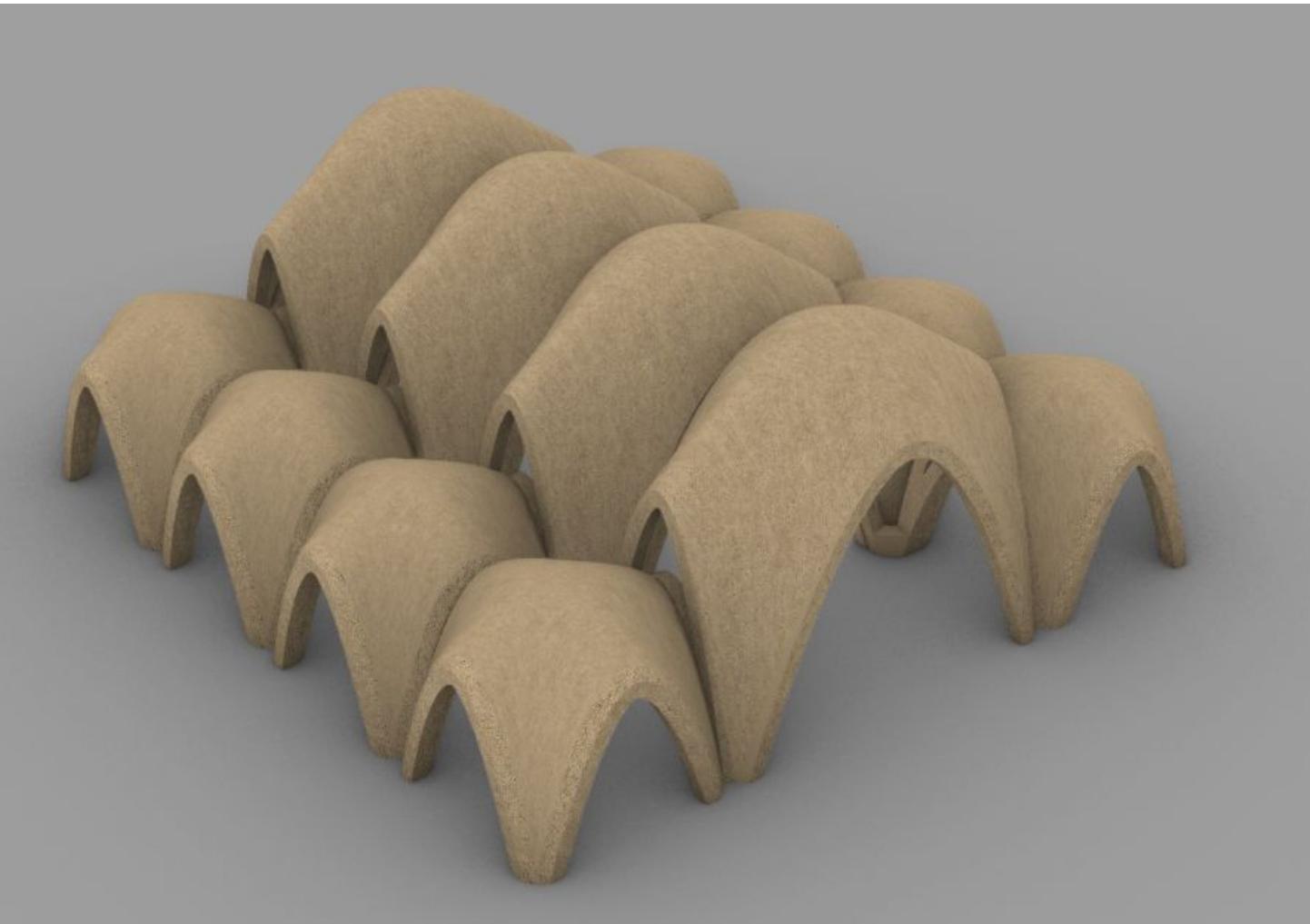




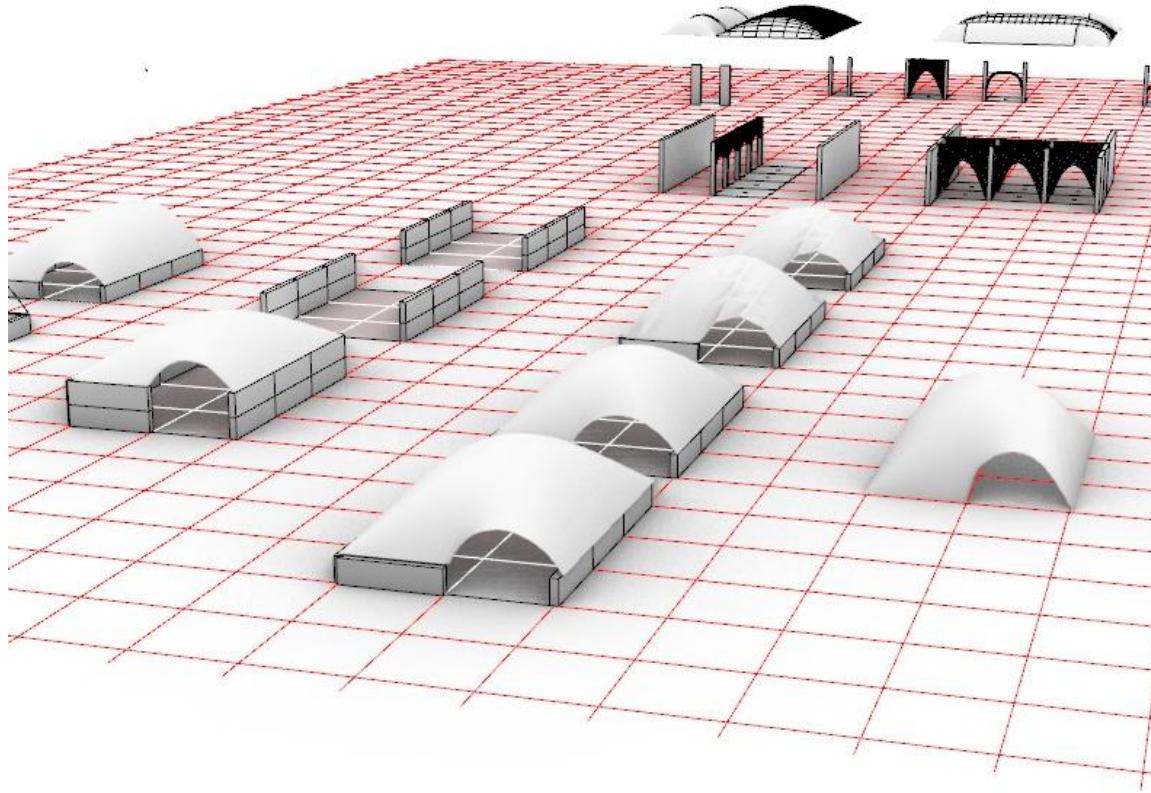




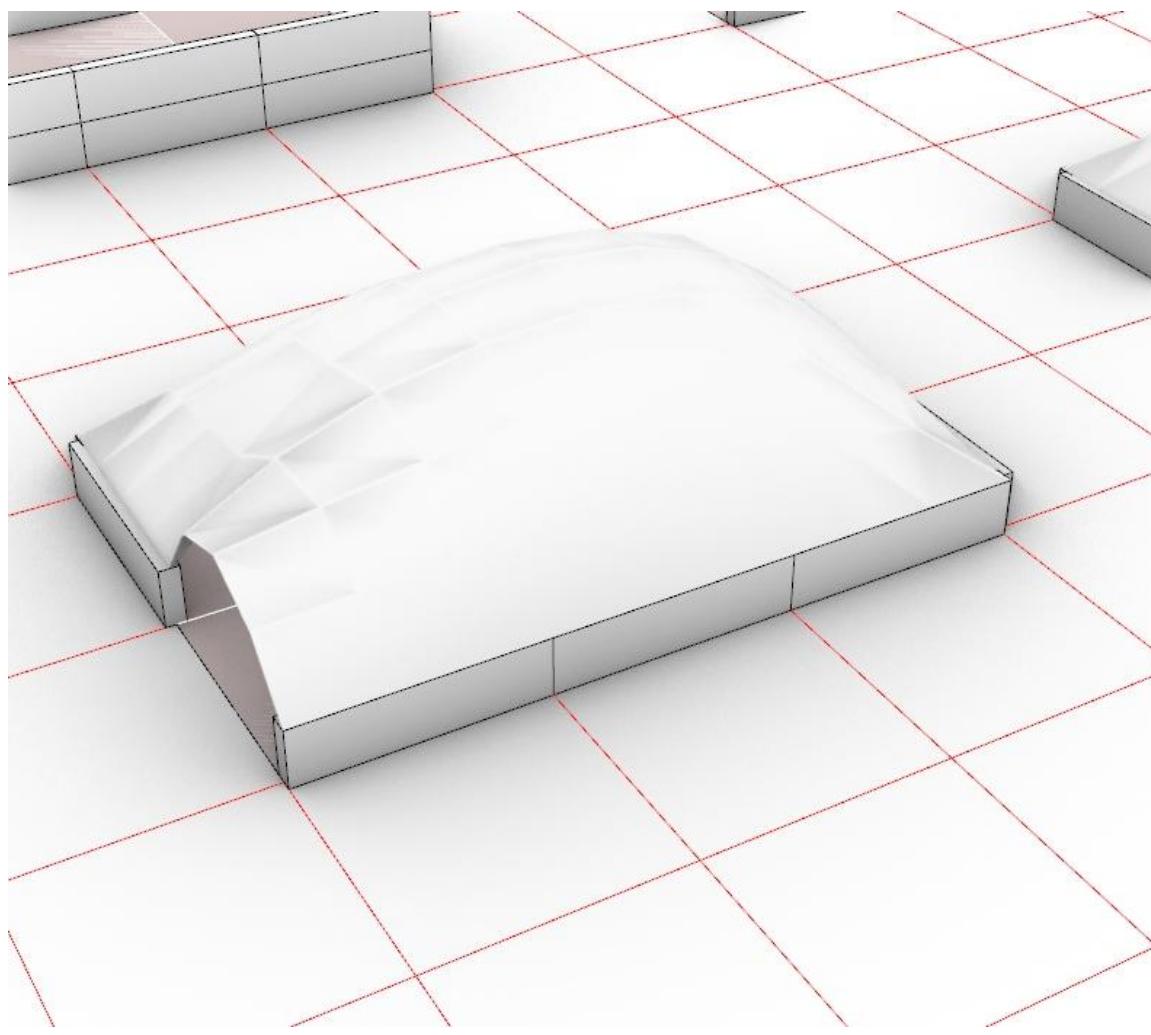






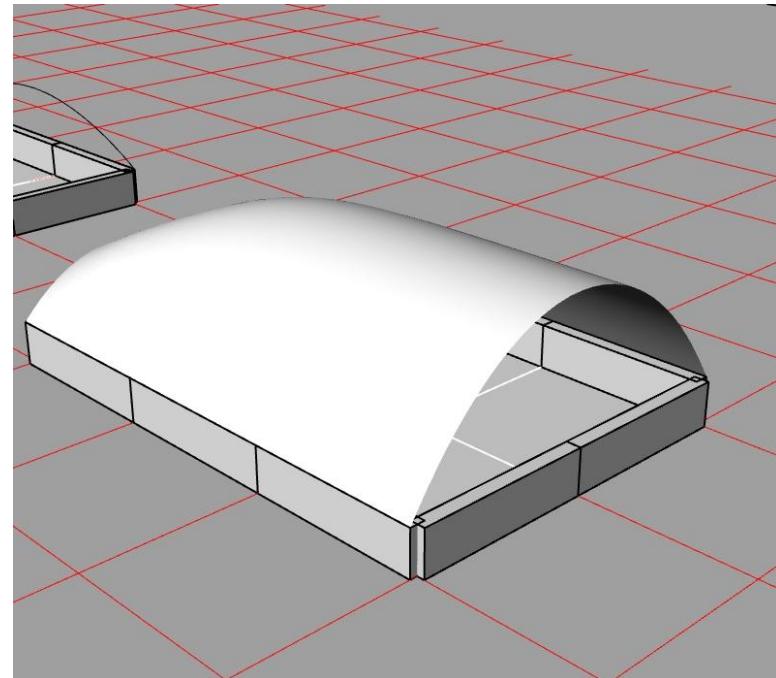
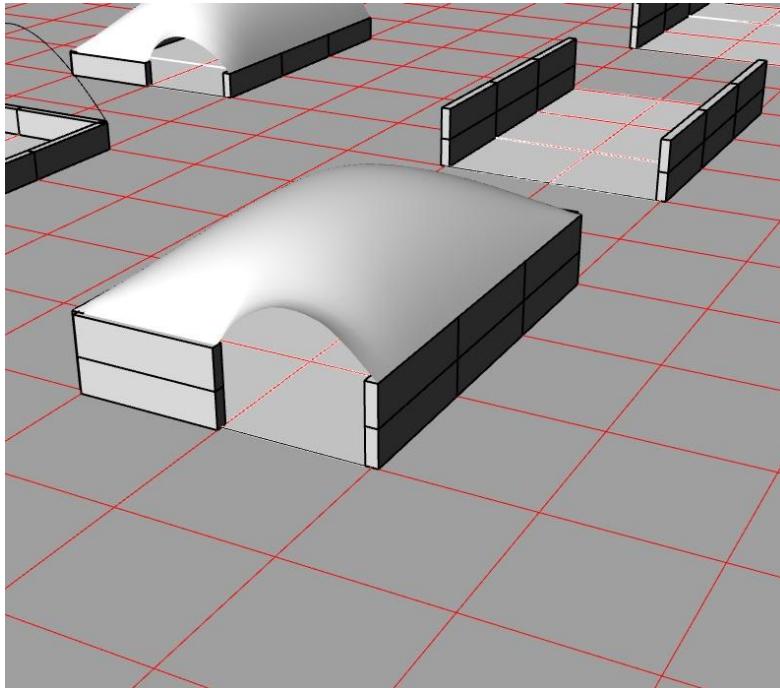


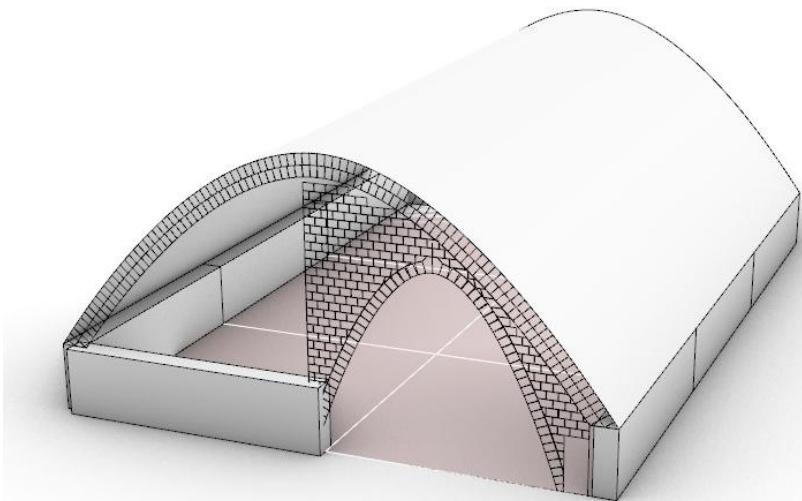
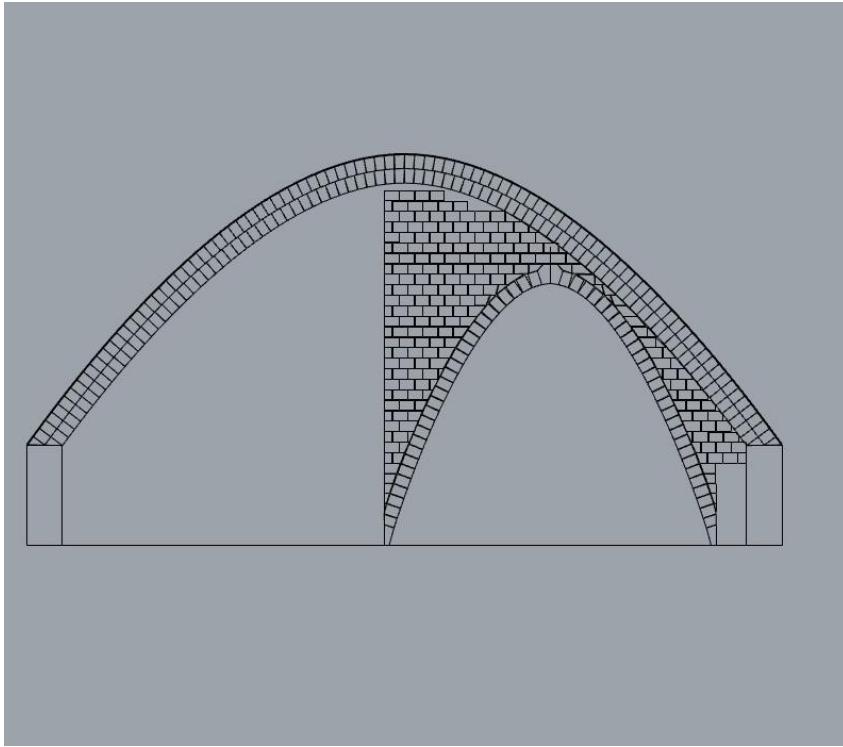
Learning space



Learning space

Learning space





Learning space
1m wall + arched roof

max compressive strength = 3 MPa
max tensile strength = 0,3 MPa

Low for CEB, higher SF

max displacement = l/200

Material properties

E = 230 MPa (from literature on CEB)

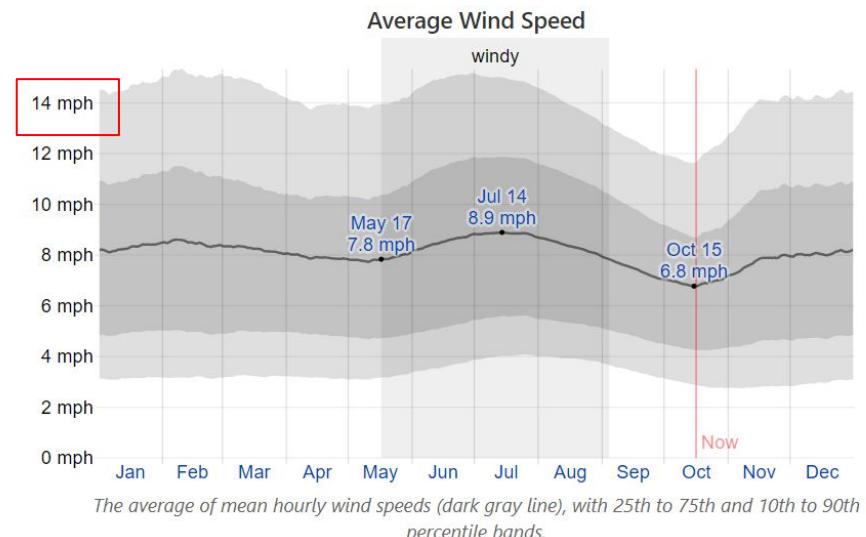
Density = 1700 kg/m³ (from literature)

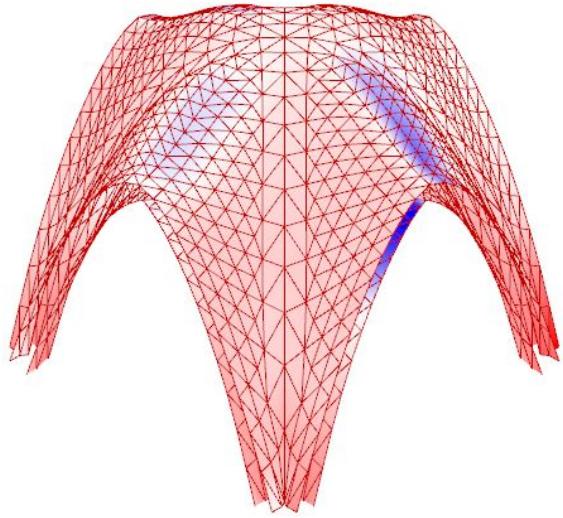
Load combination

Gravity load*1.2 + Live load*1.5 + Wind load*1.5

Live load = 2 kN/m²

Wind load = 0.5 kN/m²





Thickness: **25 cm** (brick 30x15x10 cm)

With lateral load

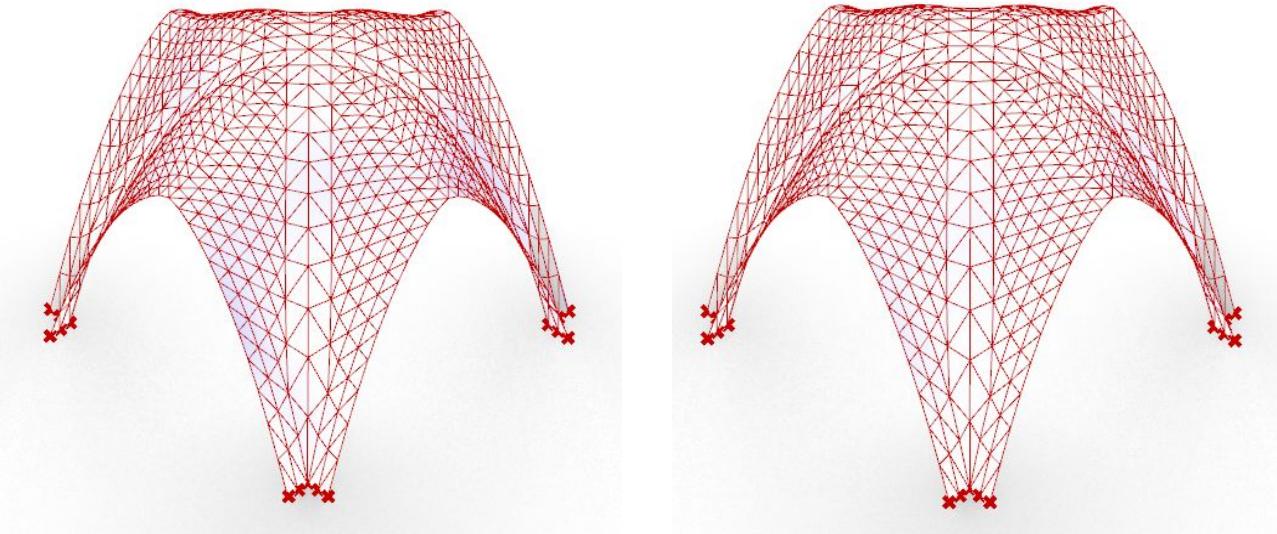
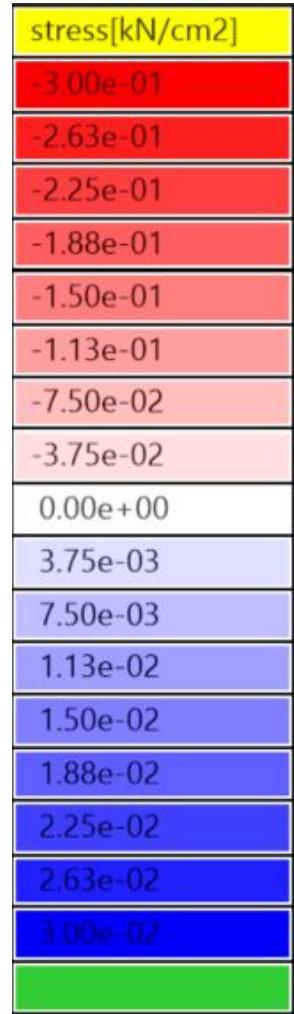
Princ. stresses 1 [MPa]:

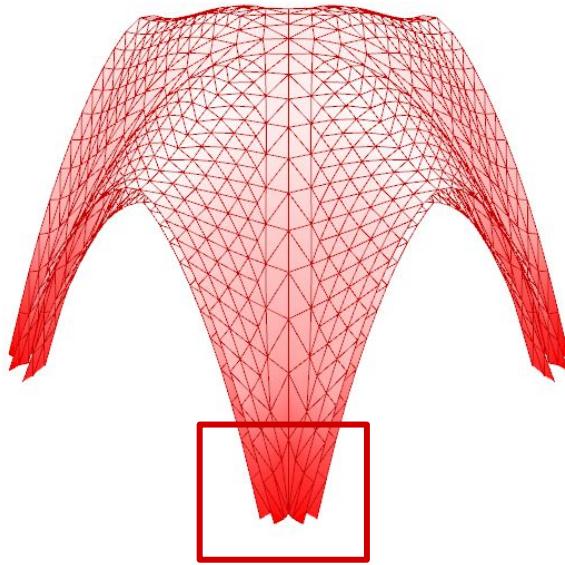
- 0.09 compr. (**max 3MPa**)
- 0.24 tens. (**max 0.3 MPa**)

Princ. stresses 2 [MPa]:

- 0.74 compr. (**max 3MPa**)
- 0.00 tens. (**max 0.3 MPa**)

Span (l) [cm]	360
Limit	l/200
Max displacement [cm]	1,8
L0	
Δx [cm]	0,04
Δy [cm]	0,04
Δz [cm]	0,21
L1	
Δx [cm]	0,02
Δy [cm]	0,02
Δz [cm]	0,12
L2	
Δx [cm]	0
Δy [cm]	0,11
Δz [cm]	0,15
Max possible displ.	
Δx [cm]	0,06
Δy [cm]	0,17
Δz [cm]	0,48





Thickness: **30 cm**

Base brick area: **$30 \times 30 \text{cm} = 900 \text{ cm}^2$**

Mass: **$15,630 \times 10^3 \text{ kg}$**

Load on support: $148,59/4 = 37,14 \text{ kN}$

$$\text{axial_stress} = N/A = 37,14/900 = 0.041 \text{ kN/cm}^2$$

SF = 1.4

$$\text{Actual axial_stress} = 0.042 \times 1.4 = 0,059 \text{ kN/cm}^2 = \text{0,6 Mpa}$$

Princ. stresses 1 [MPa]:

- 0.09 compr.
- 0.24 tens.

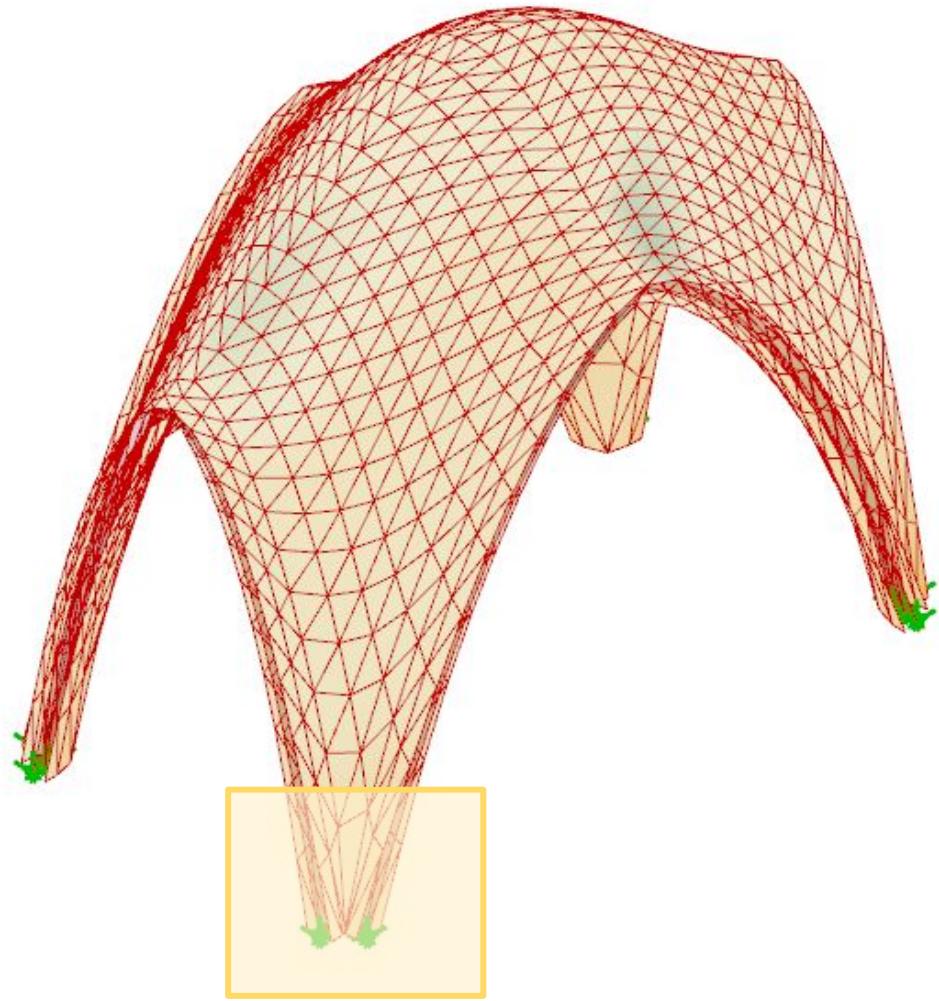
Princ. stresses 2 [MPa]:

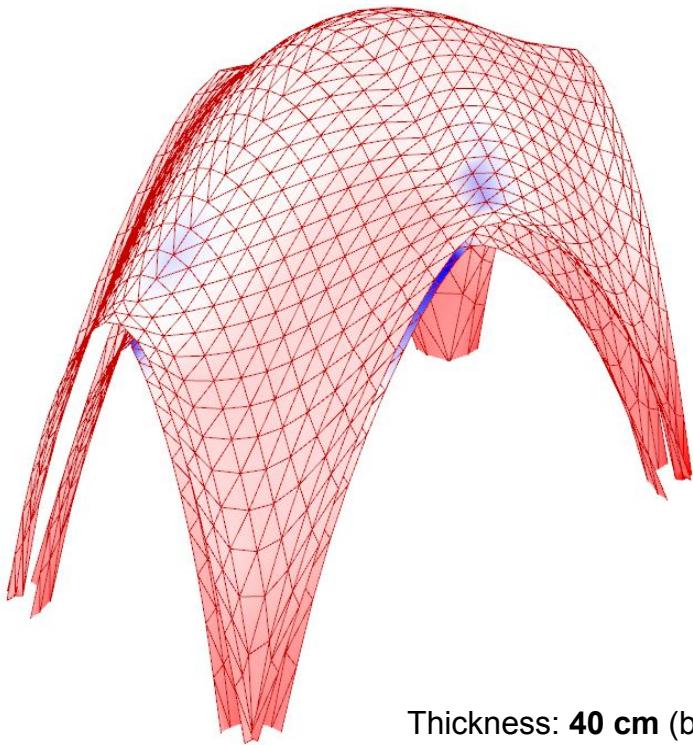
- **0,74 compr.**
- 0.00 tens.

9,3 m³

15,819 e3 kg

$$\text{Average SF} = (1.5 + 1.5 + 1.2)/3 = 1.4$$





Thickness: **40 cm** (brick 30x15x10 cm)

With lateral load

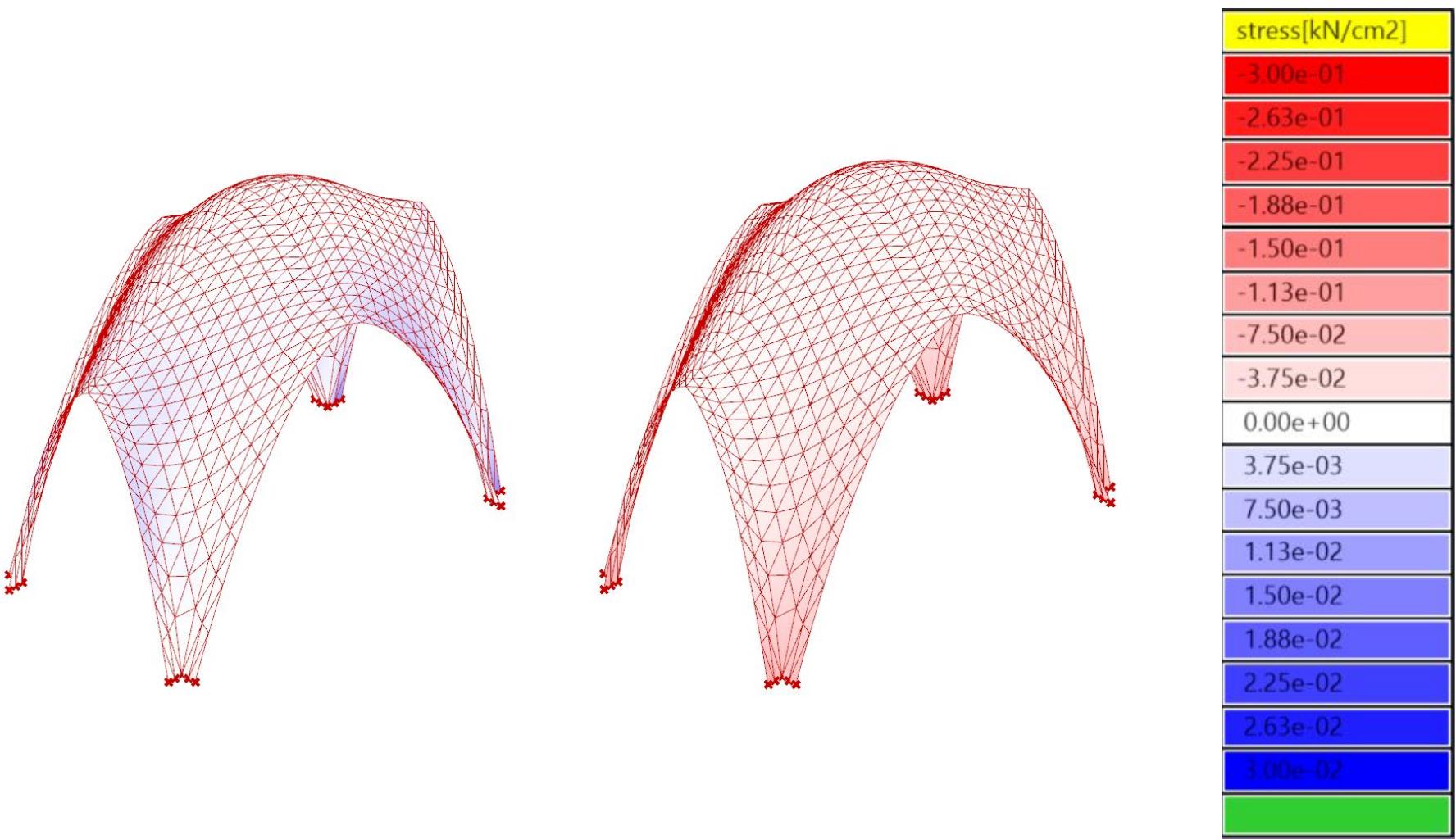
Princ. stresses 1 [MPa]:

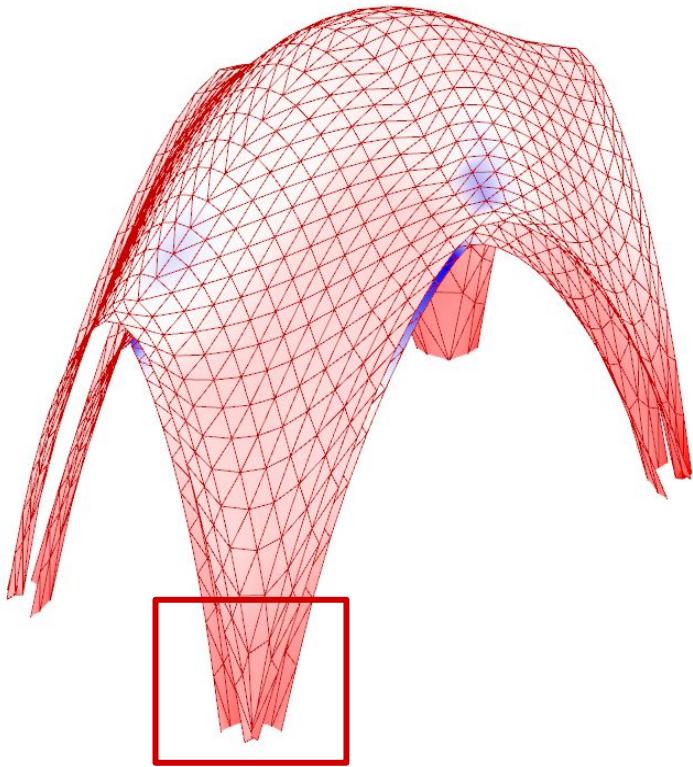
- 0.17 compr. (max 3MPa)
- 0.22 tens. (max. 0.3 MPa)

Princ. stresses 2 [MPa]:

- 1.06 compr. (max 3MPa)
- 0.01 tens. (max. 0.3 MPa)

Span (l) [cm]	720
Limit	l/200
Max displacement [cm]	3,6
L0	
Δx [cm]	0,18
Δy [cm]	0,12
Δz [cm]	0,64
L1	
Δx [cm]	0,06
Δy [cm]	0,04
Δz [cm]	0,23
L2	
Δx [cm]	0
Δy [cm]	0,20
Δz [cm]	0,21
Max possible displ.	
Δx [cm]	0,24
Δy [cm]	0,36
Δz [cm]	1,08





Thickness: **40 cm**

Base brick area: **$40 \times 40 \text{cm} = 4800 \text{ cm}^2$**

Mass: **$43,233 \times 10^3 \text{ kg}$**

Load on support: $423,68/4 = 105,92 \text{ kN}$

$$\text{axial_stress} = N/A = 105,92/1600 = 0.022 \text{ kN/m}^2$$

SF = 1.5

0.033

$$\text{Actual axial_stress} = 0.066 * 1.4 = 0,092 \text{ kN/m}^2 = \text{0,9 Mpa}$$

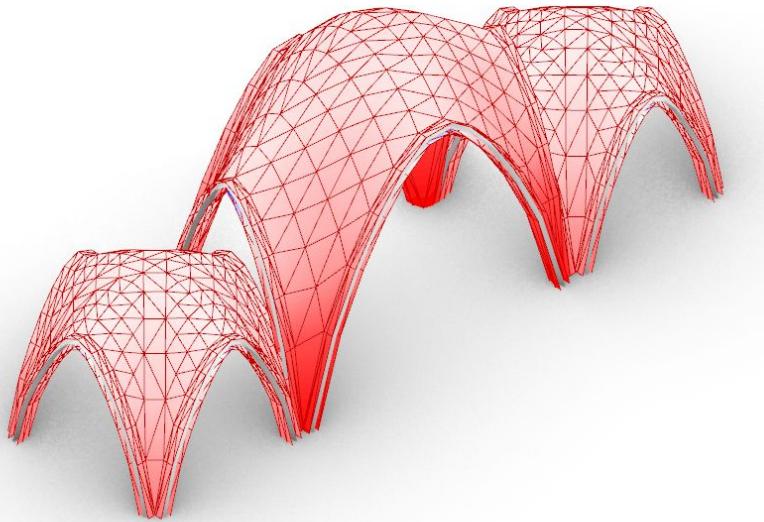
Princ. stresses 1 [MPa]:

- 0.17 compr.
- 0.22 tens.

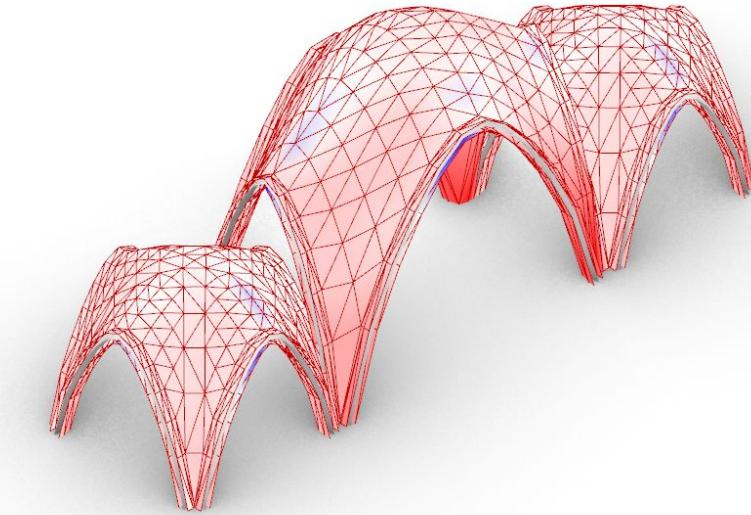
Princ. stresses 2 [MPa]:

- **1.06 compr.**
- 0.01 tens.

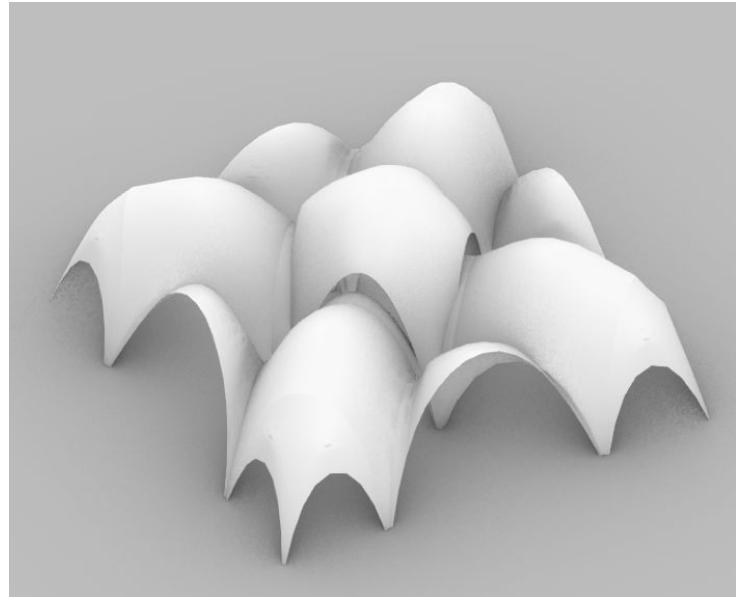
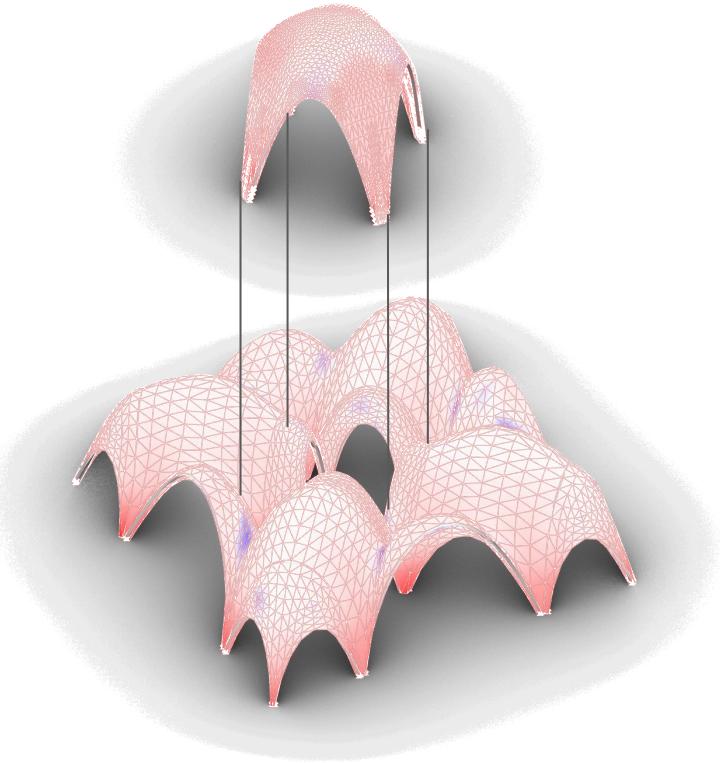
0,045

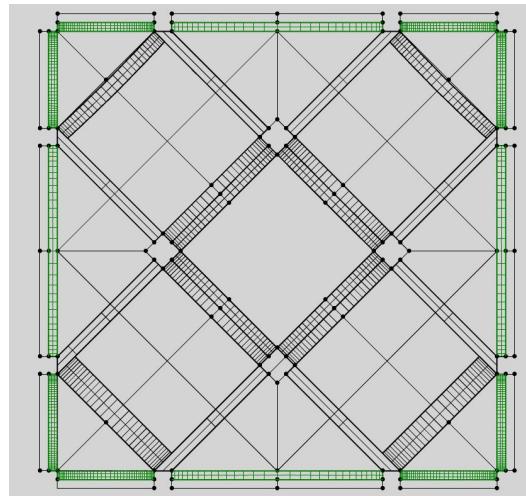
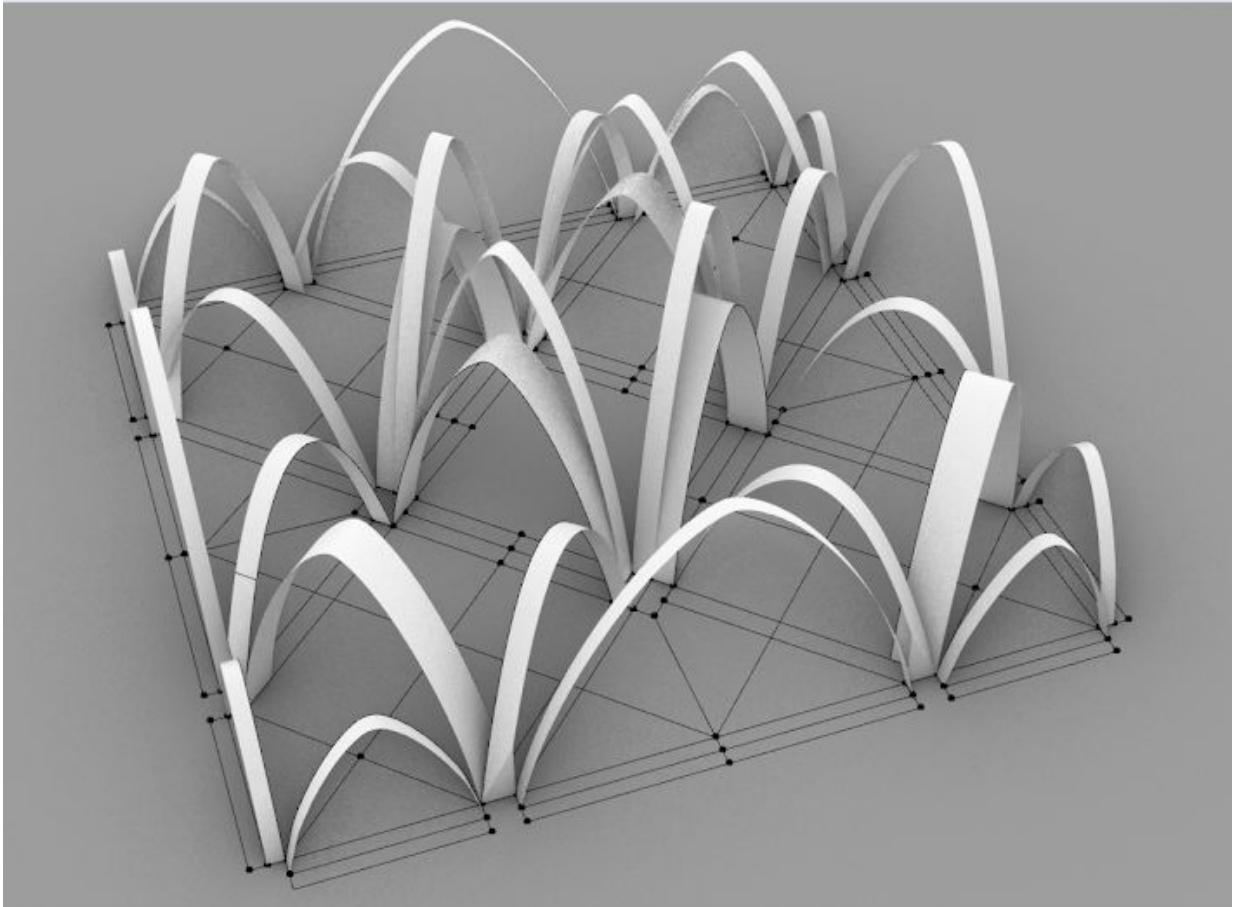


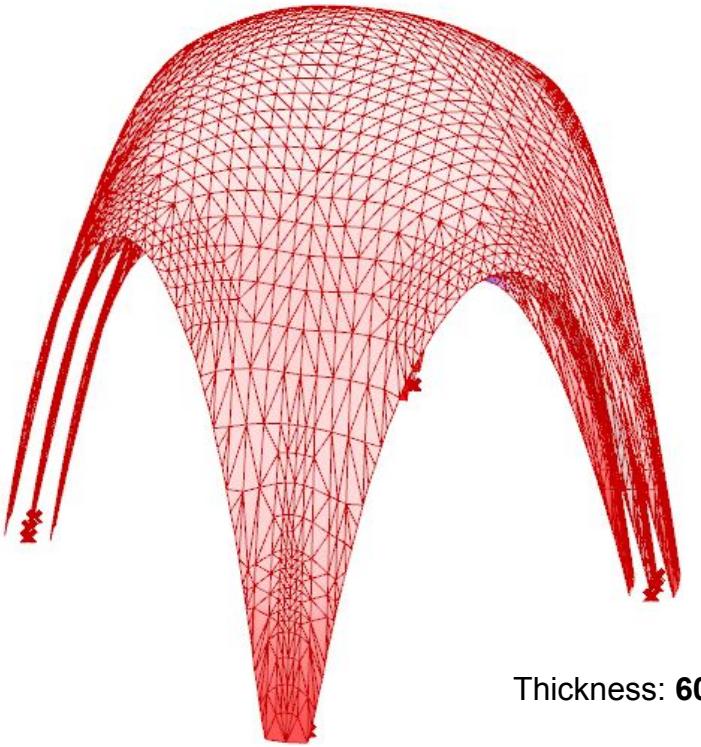
Final mesh - Only vertical loads



Final mesh - With lateral loads







Thickness: **60 cm** (brick 30x15x10 cm)

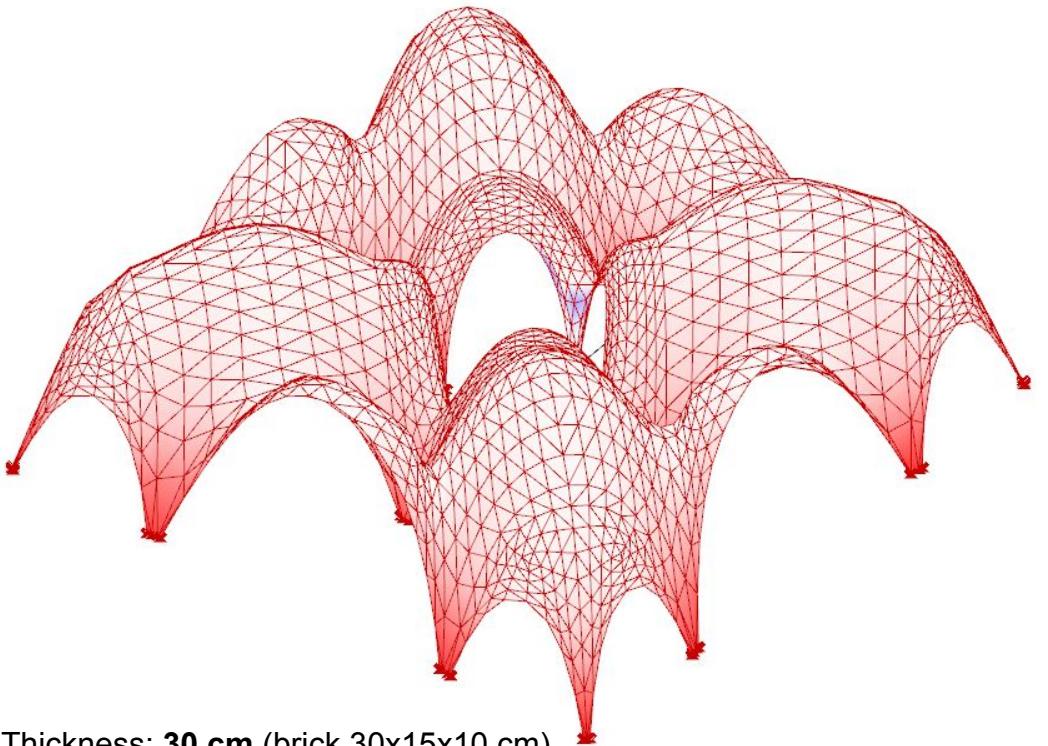
Princ. stresses 1 [MPa]:

- 0.21 compr. (max 3MPa)
- 0.30 tens. (max. 0.3 MPa)

Princ. stresses 2 [MPa]:

- 1.01 compr. (max 3MPa)
- 0.04 tens. (max. 0.3 MPa)

Span (l) [cm]	610
Limit	l/200
Max displacement [cm]	3,05
L0	
Δx [cm]	0,58
Δy [cm]	0,53
Δz [cm]	0,95
L1	
Δx [cm]	0,14
Δy [cm]	0,13
Δz [cm]	0,23
L2	
Δx [cm]	0
Δy [cm]	0
Δz [cm]	0
Max possible displ.	
Δx [cm]	0,72
Δy [cm]	1
Δz [cm]	1,18



Thickness: **30 cm** (brick 30x15x10 cm)

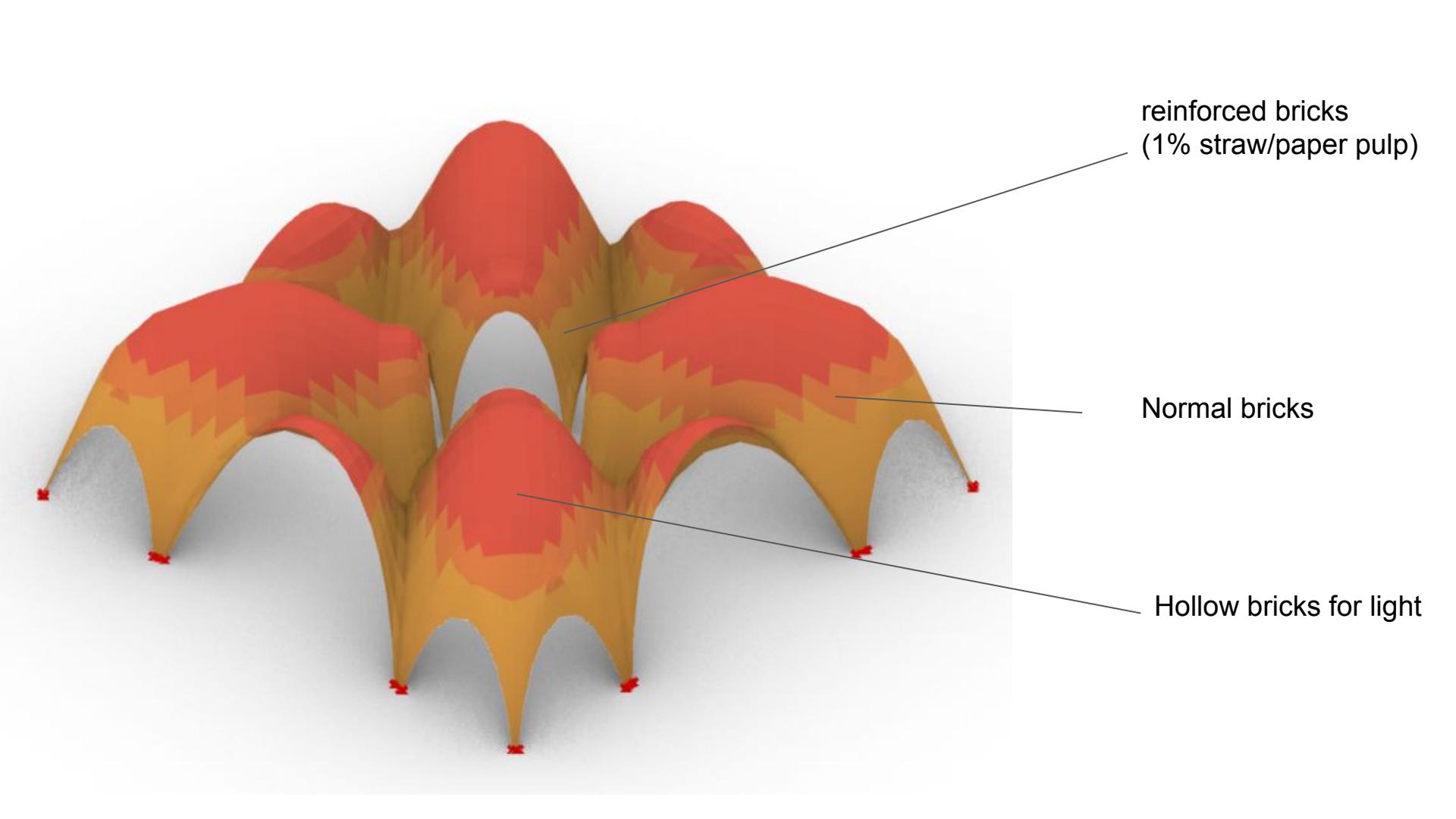
Princ. stresses 1 [MPa]:

- 0.36 compr. (max 3MPa)
- 0.26 tens. (max. 0.3 MPa)

Princ. stresses 2 [MPa]:

- 1.52 compr. (max 3MPa)
- 0.05 tens. (max. 0.3 MPa)

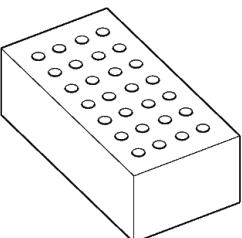
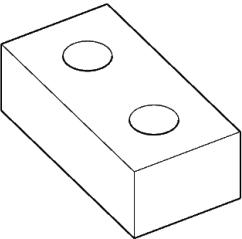
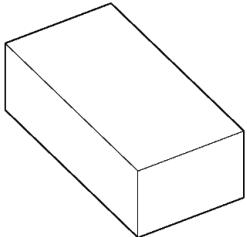
Span (l) [cm]	720
Limit	l/200
Max displacement [cm]	3,6
L0	
Δx [cm]	0,17
Δy [cm]	0,32
Δz [cm]	0,93
L1	
Δx [cm]	0,08
Δy [cm]	0,15
Δz [cm]	0,46
L2	
Δx [cm]	0,01
Δy [cm]	0,10
Δz [cm]	0,20
Max possible displ.	
Δx [cm]	0,26
Δy [cm]	0,57
Δz [cm]	1,59



reinforced bricks
(1% straw/paper pulp)

Normal bricks

Hollow bricks for light



Mixtures

Standard mixture

Clay 30%

Fine sand 30%

Coarse sand 40%

Water 10%

Reinforced mixture

Standard mixture

+

Straw 1%

Paper pulp 1%

Textile fibres 1%

Waterproofing

After drying additives

Linseed oil

Hydraulic lime

Animal fat

Mud plaster

Clay 60%

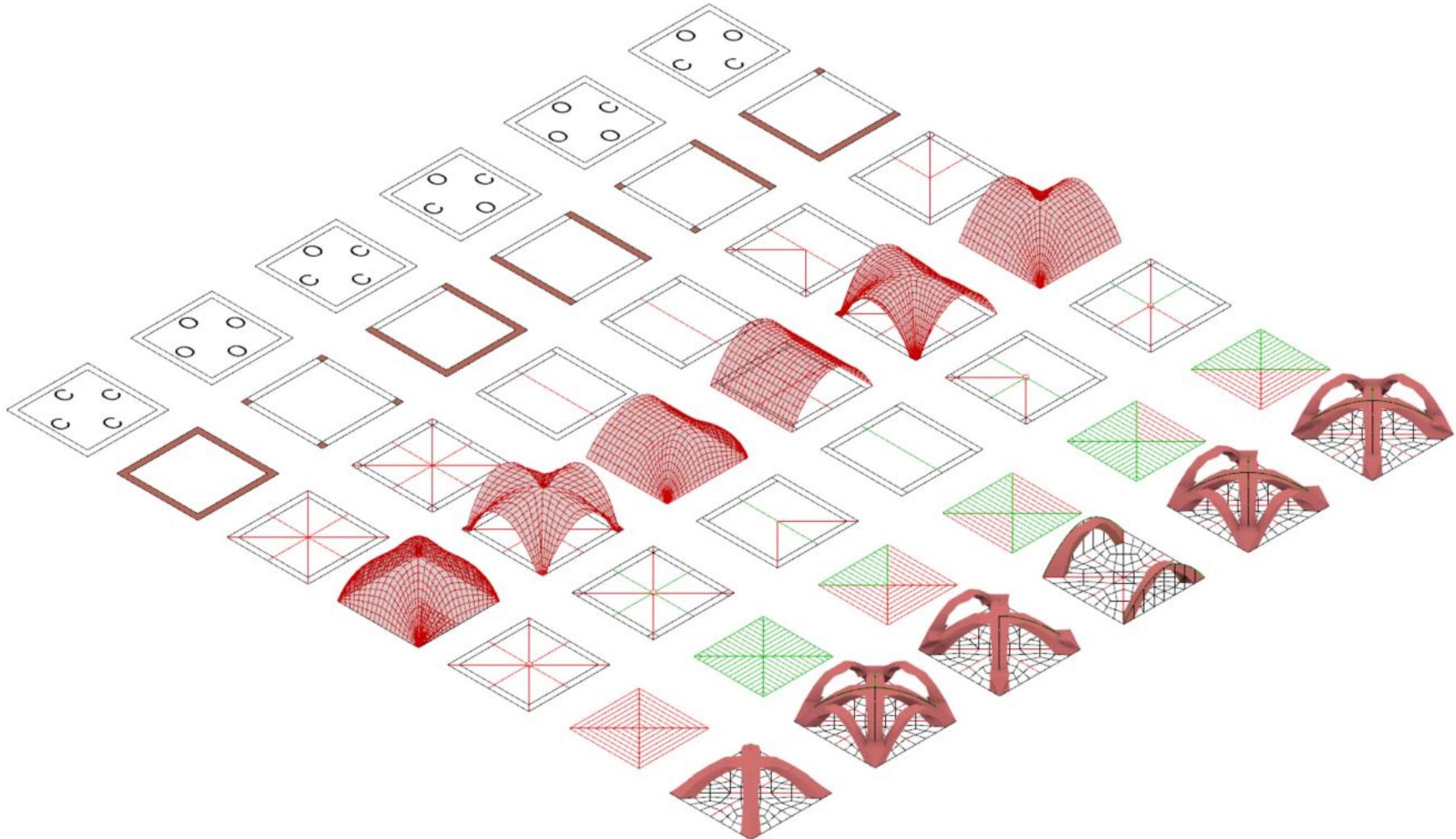
Fine sand 20%

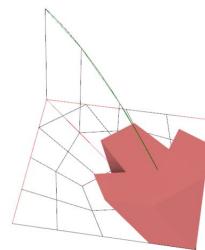
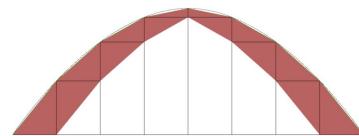
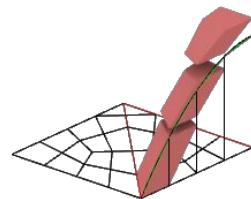
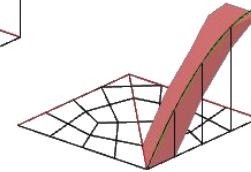
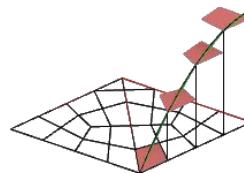
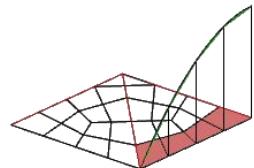
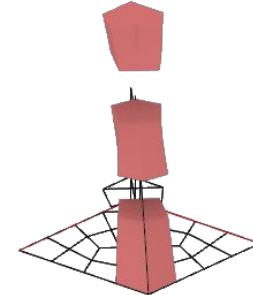
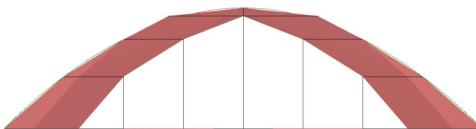
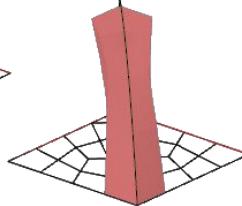
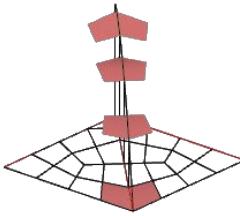
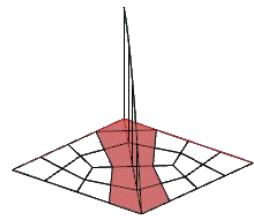
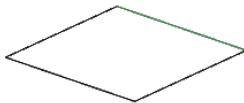
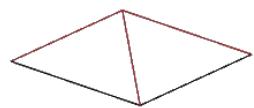
Coarse sand 20%

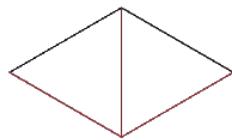
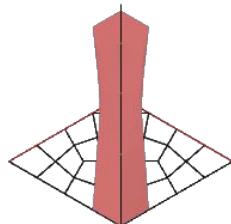
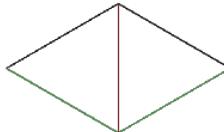
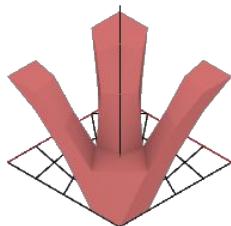
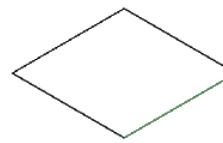
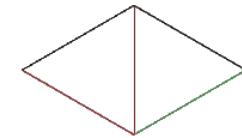
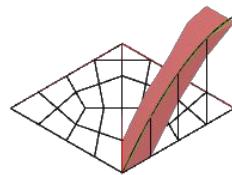
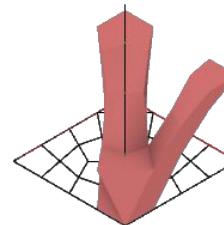
Water 20%

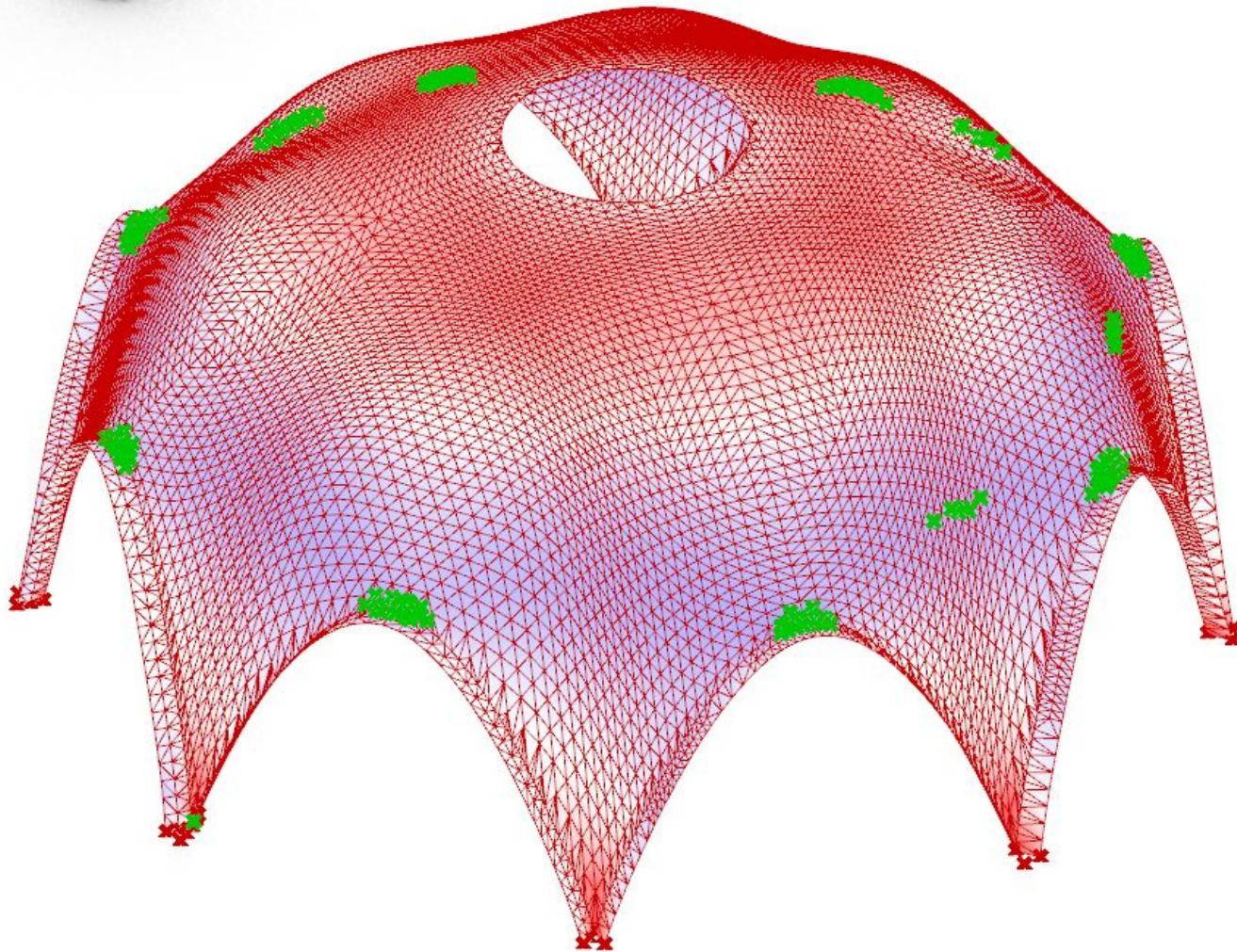
Whitewashing (?)

clay + water + gypsum

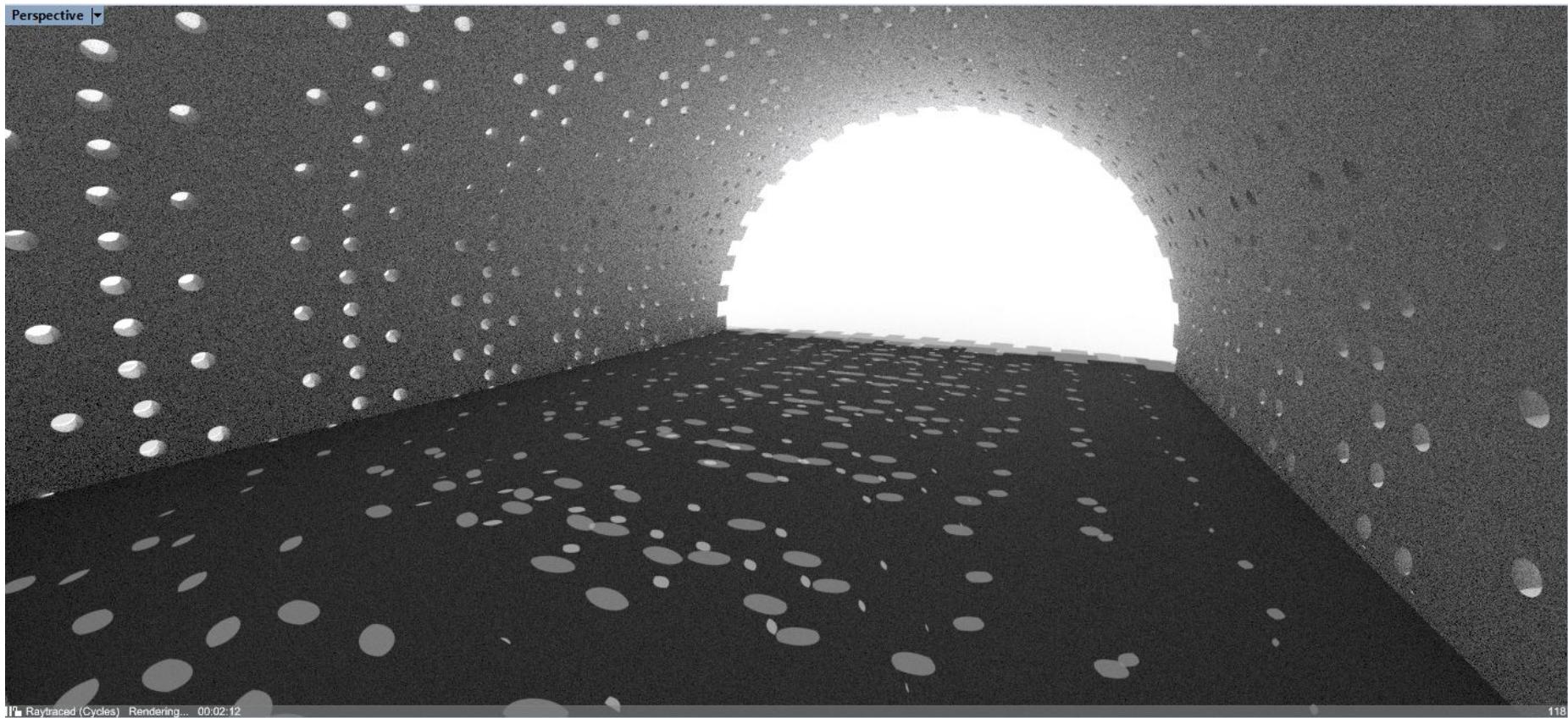








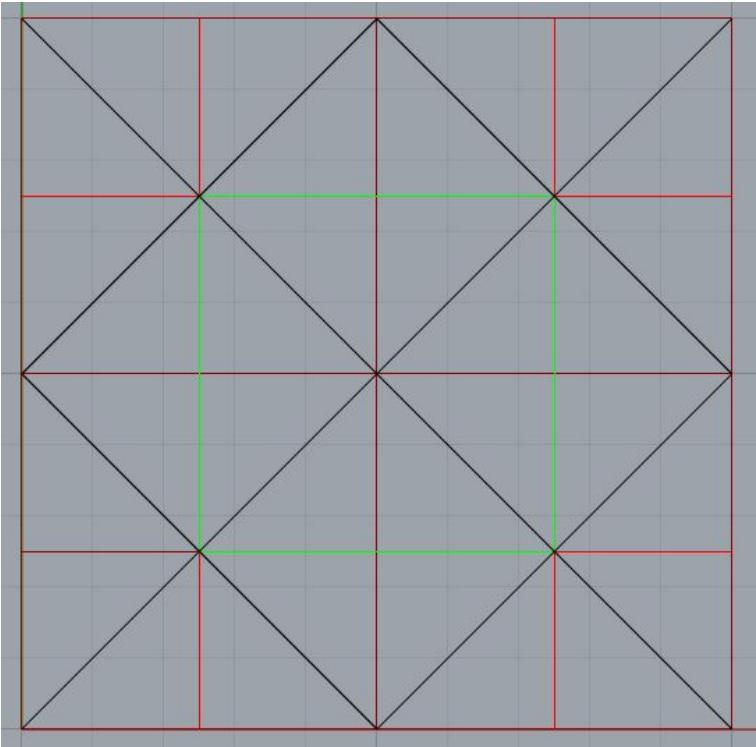
Perspective ▾



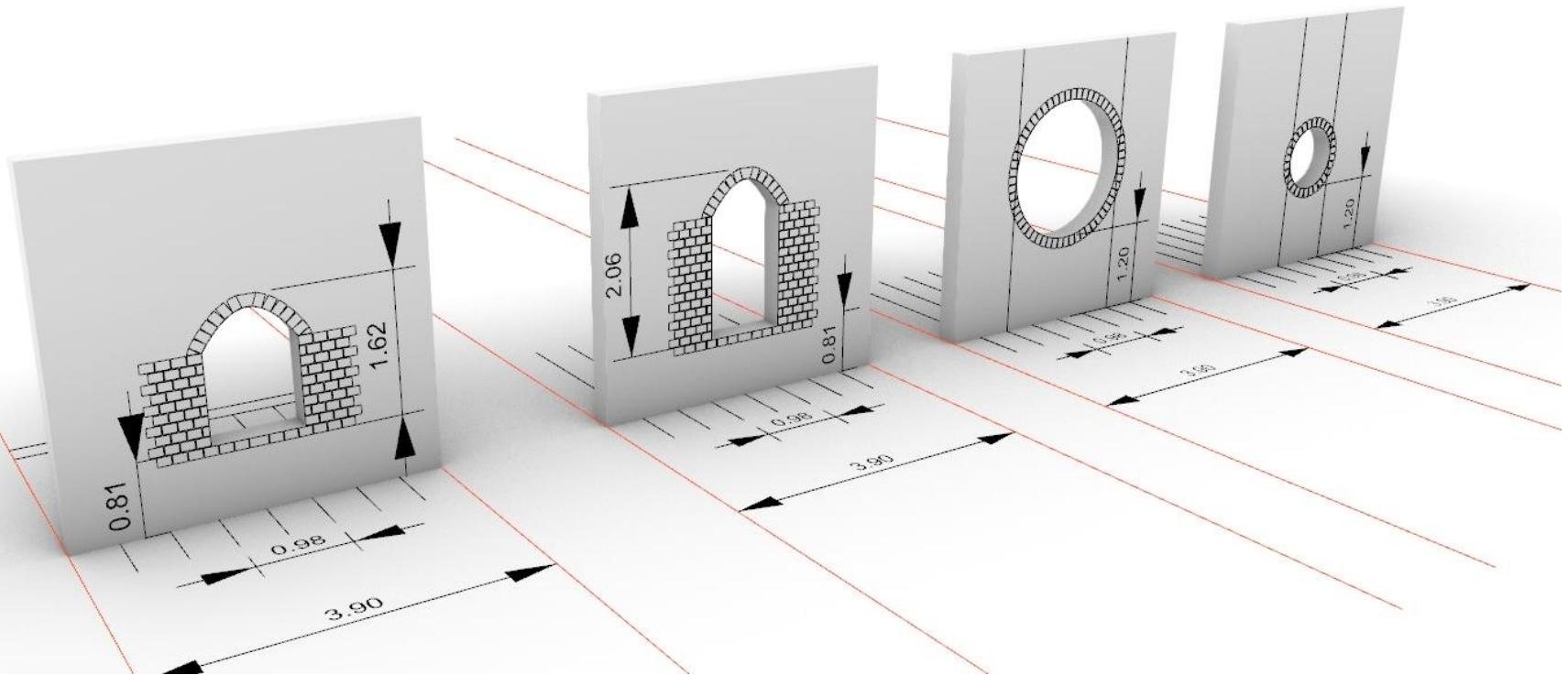
Raytraced (Cycles) Rendering... 00:02:12

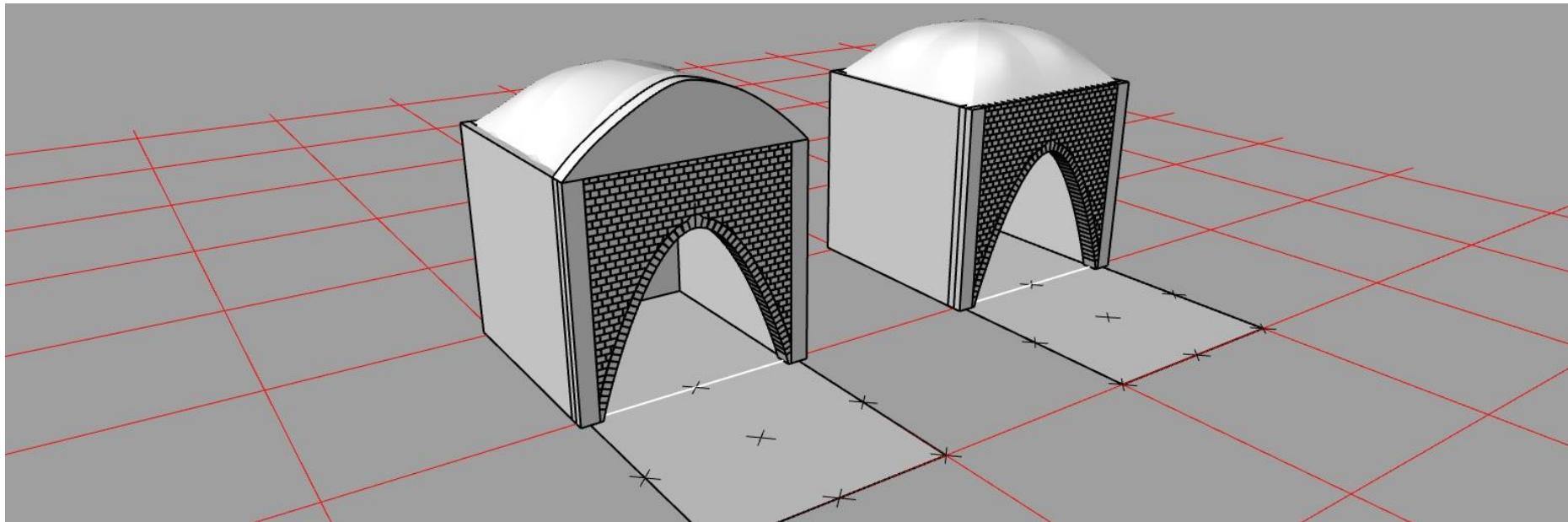
118

50% brick w/ holes - no diffusion

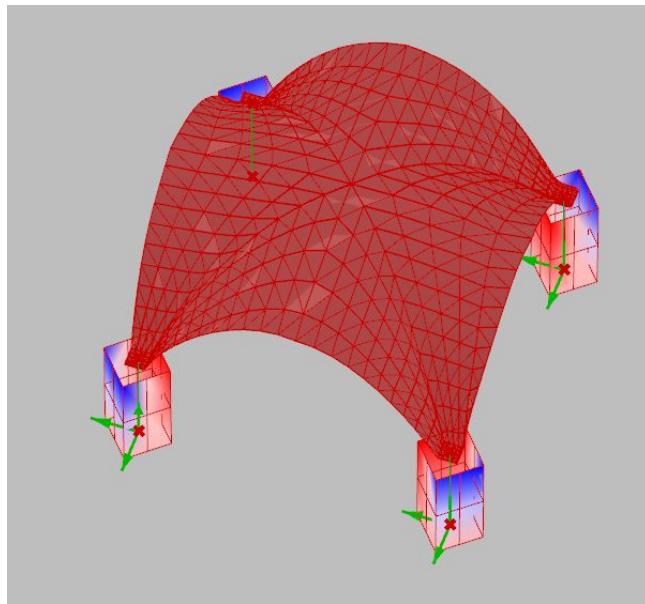
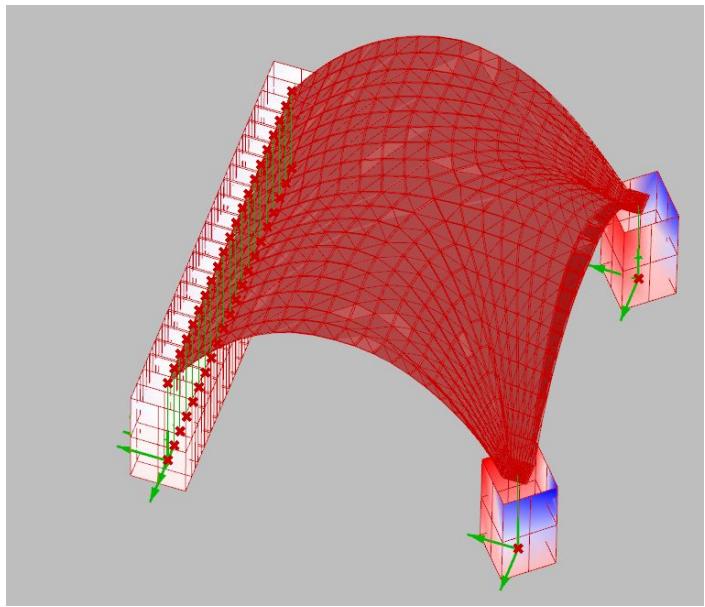


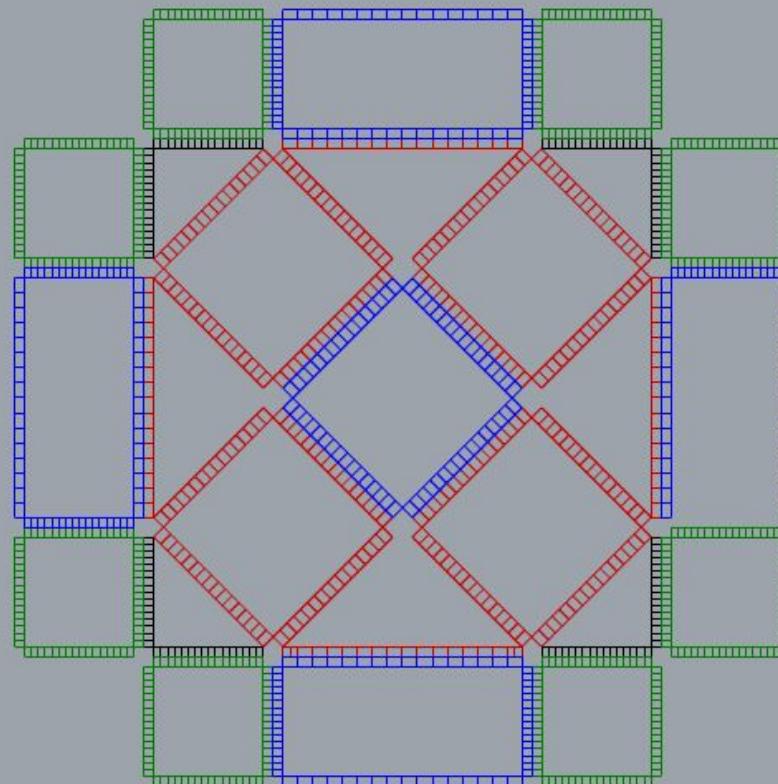
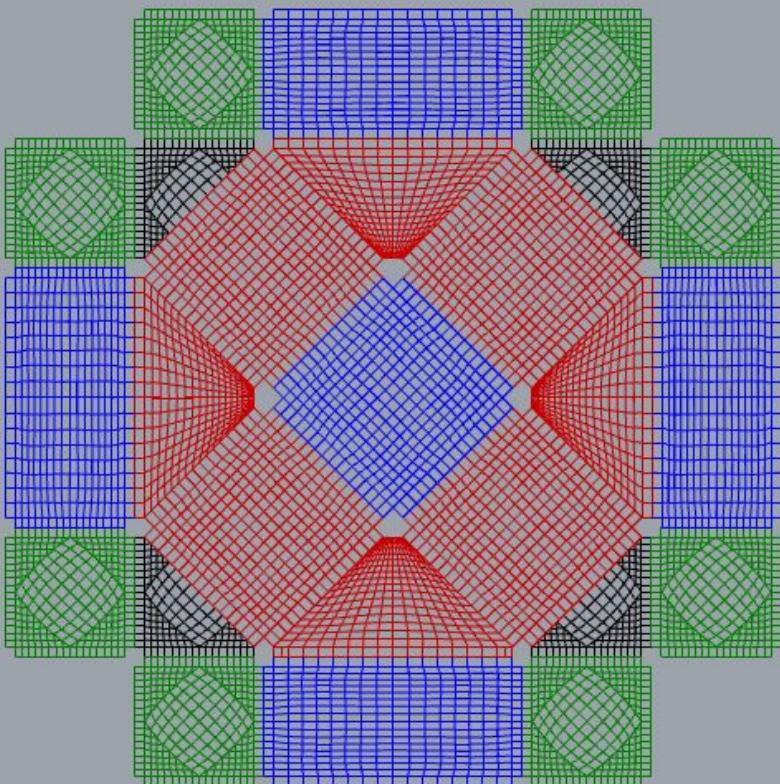
automatic tessellation based on open/closed

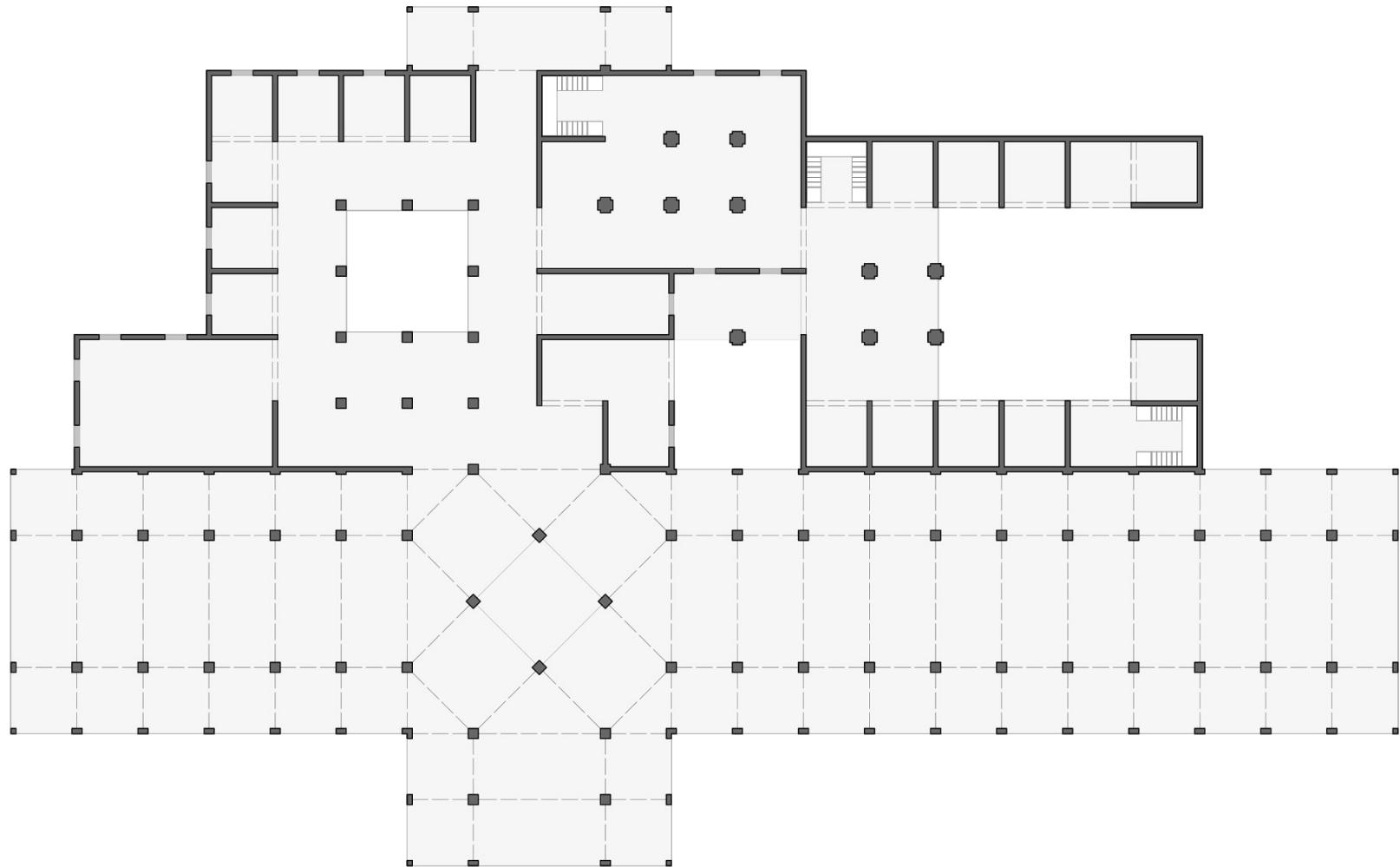


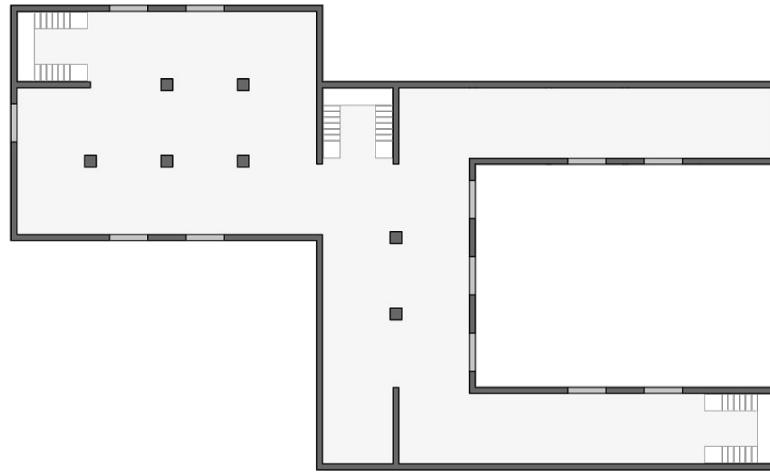


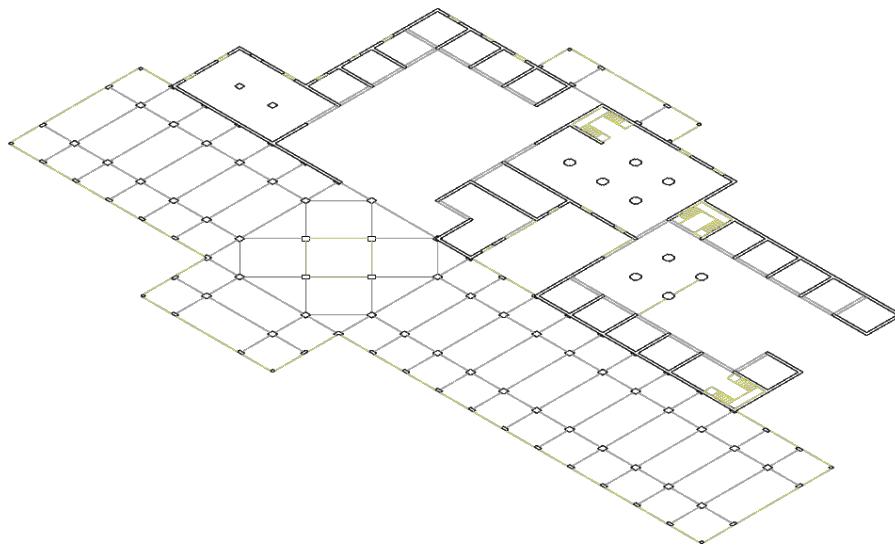
What happens in this case?

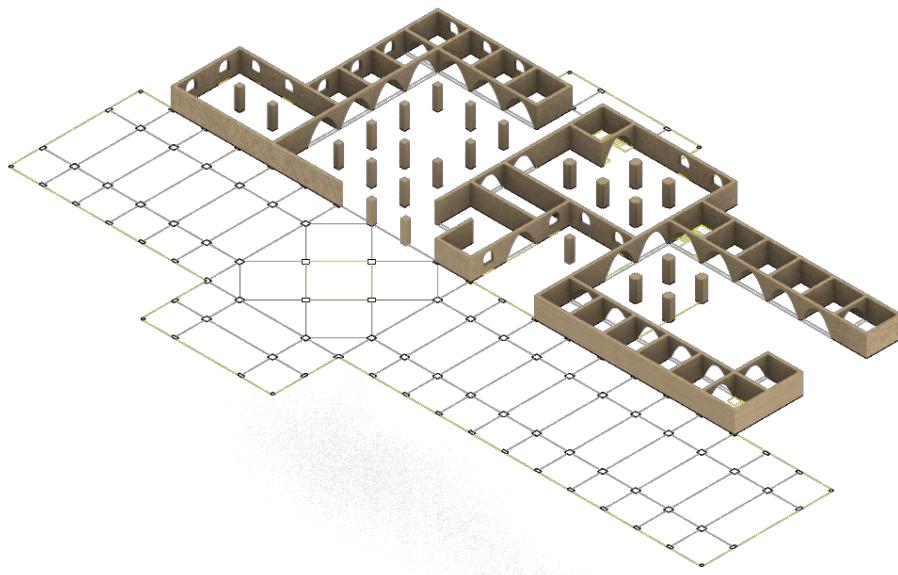


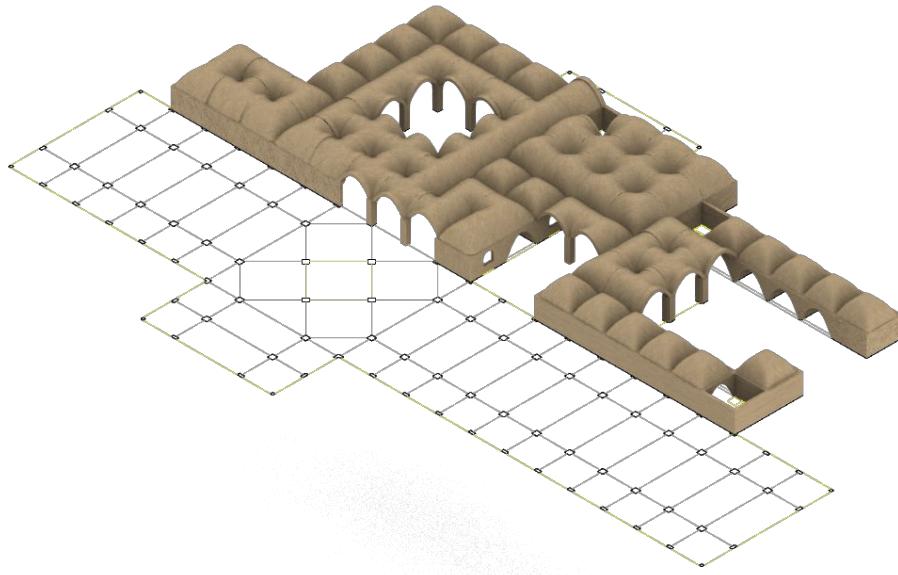


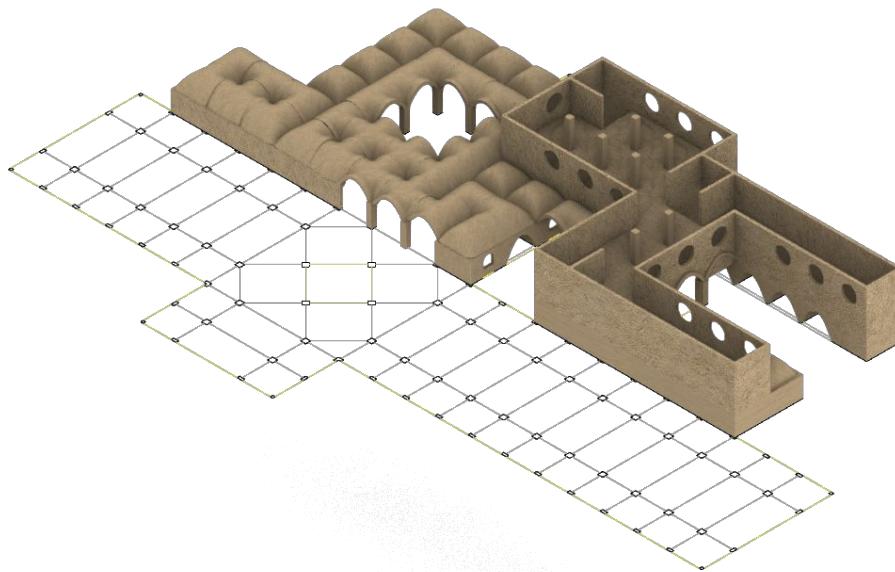


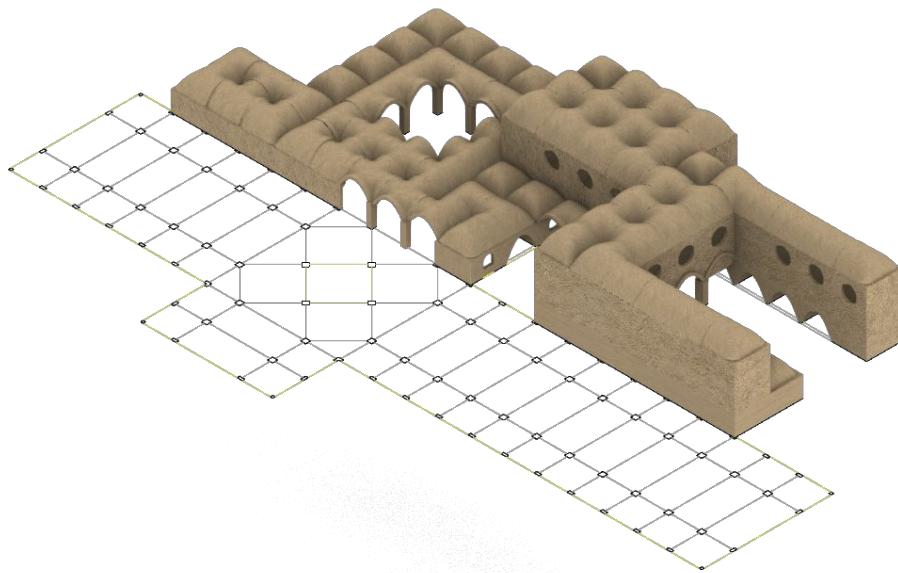


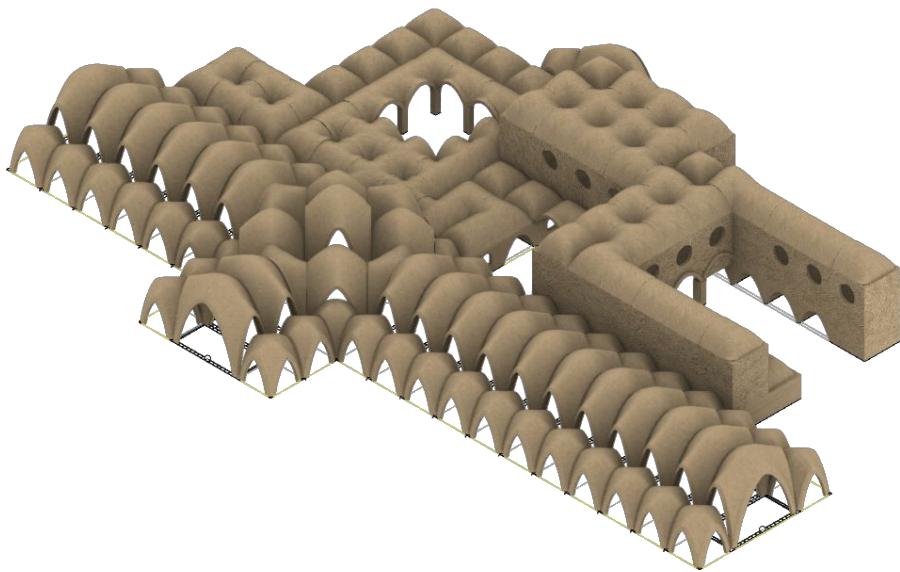


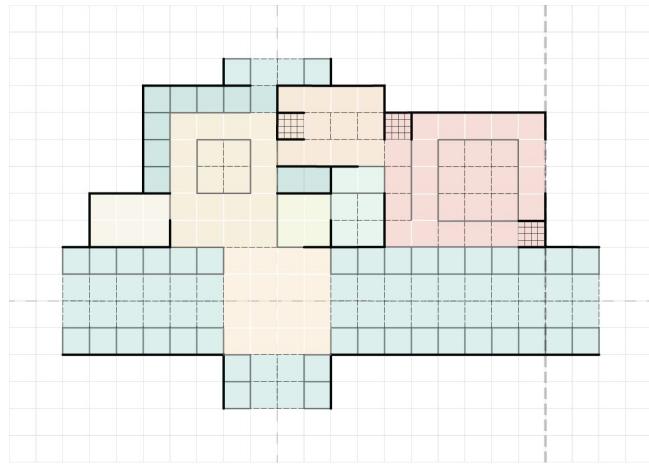
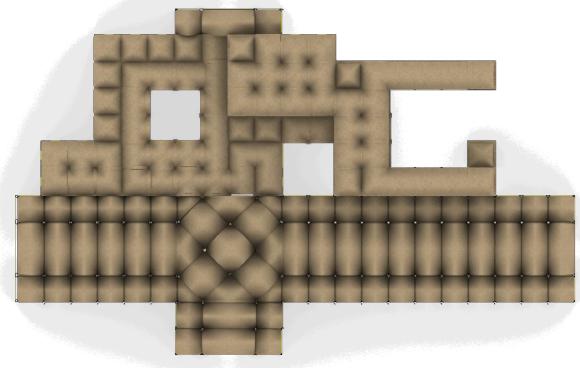


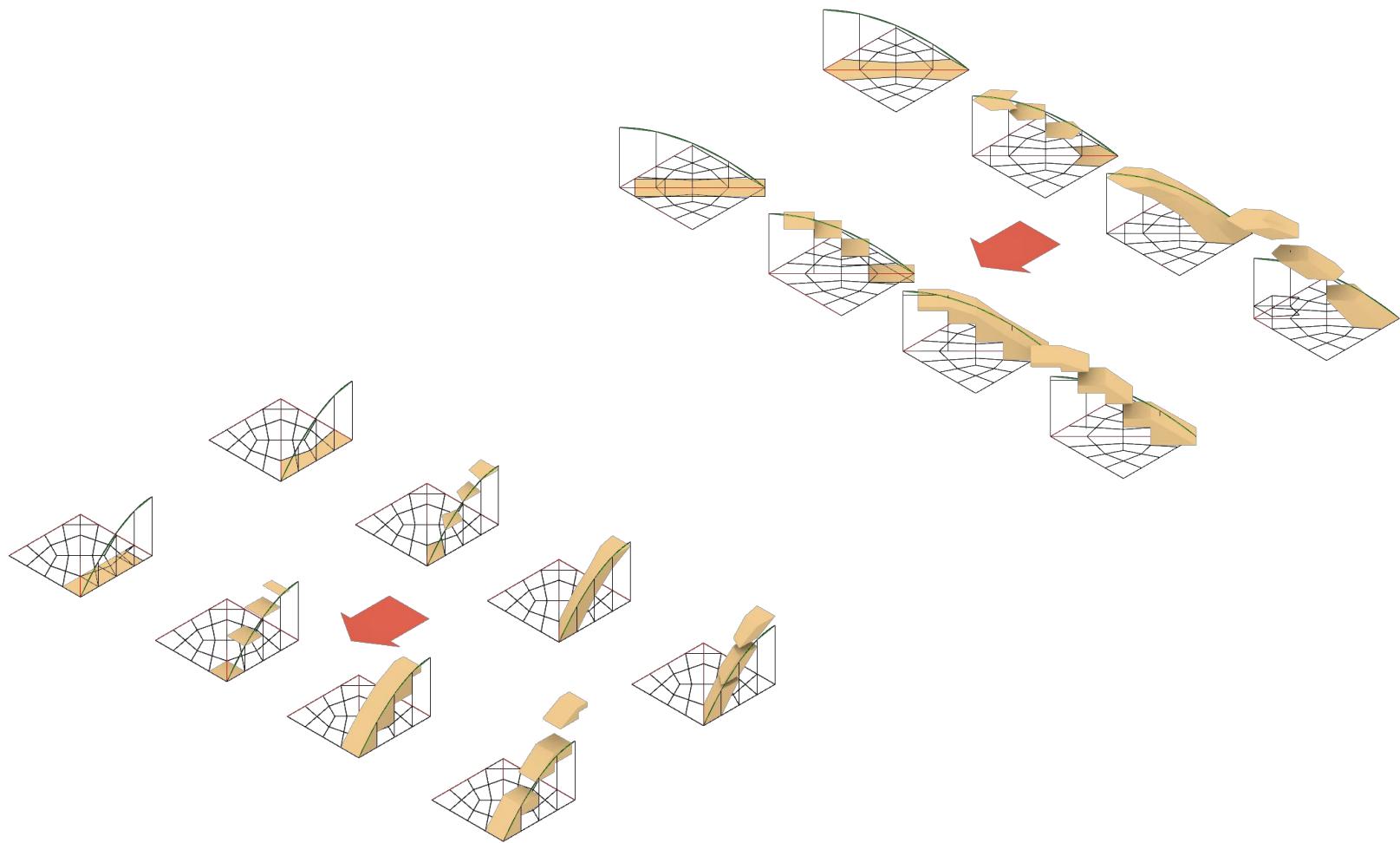


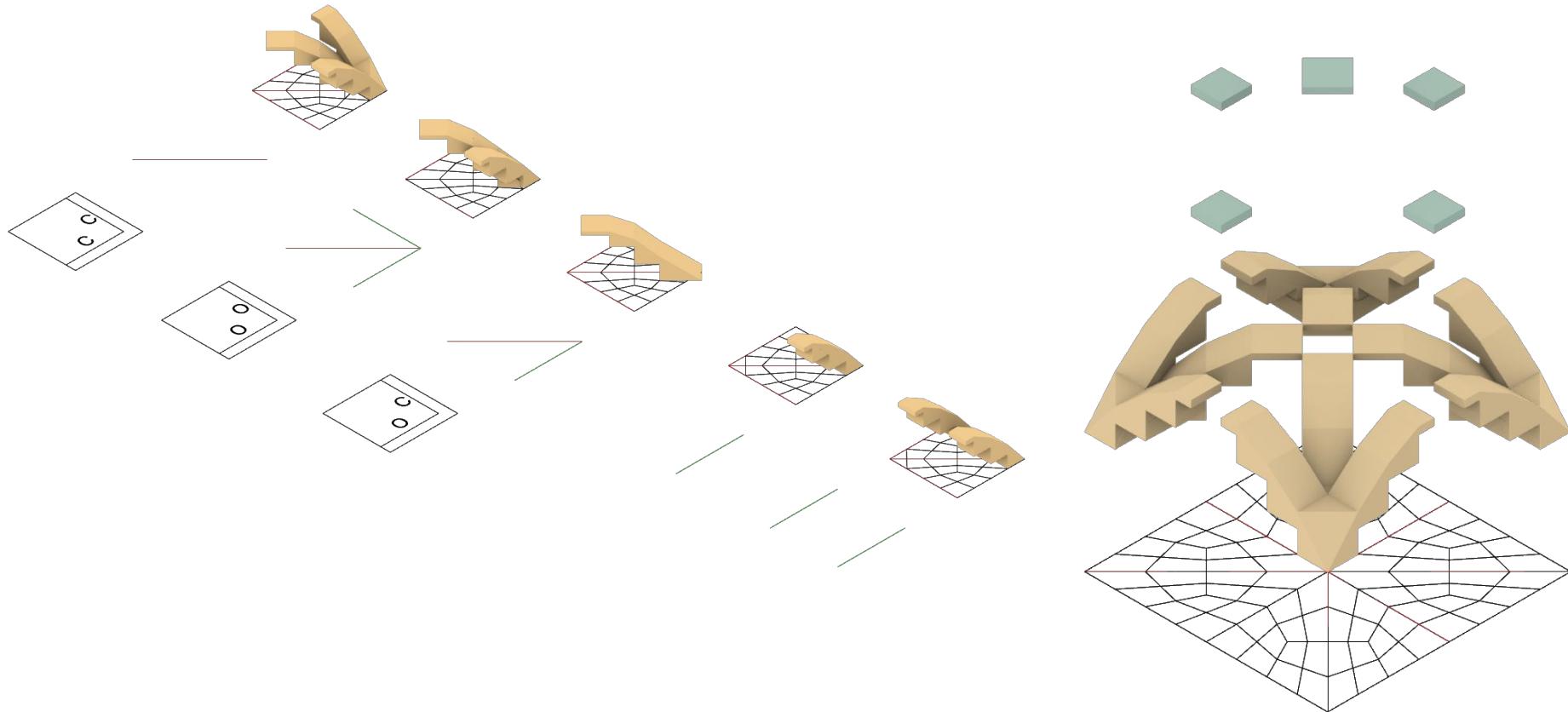


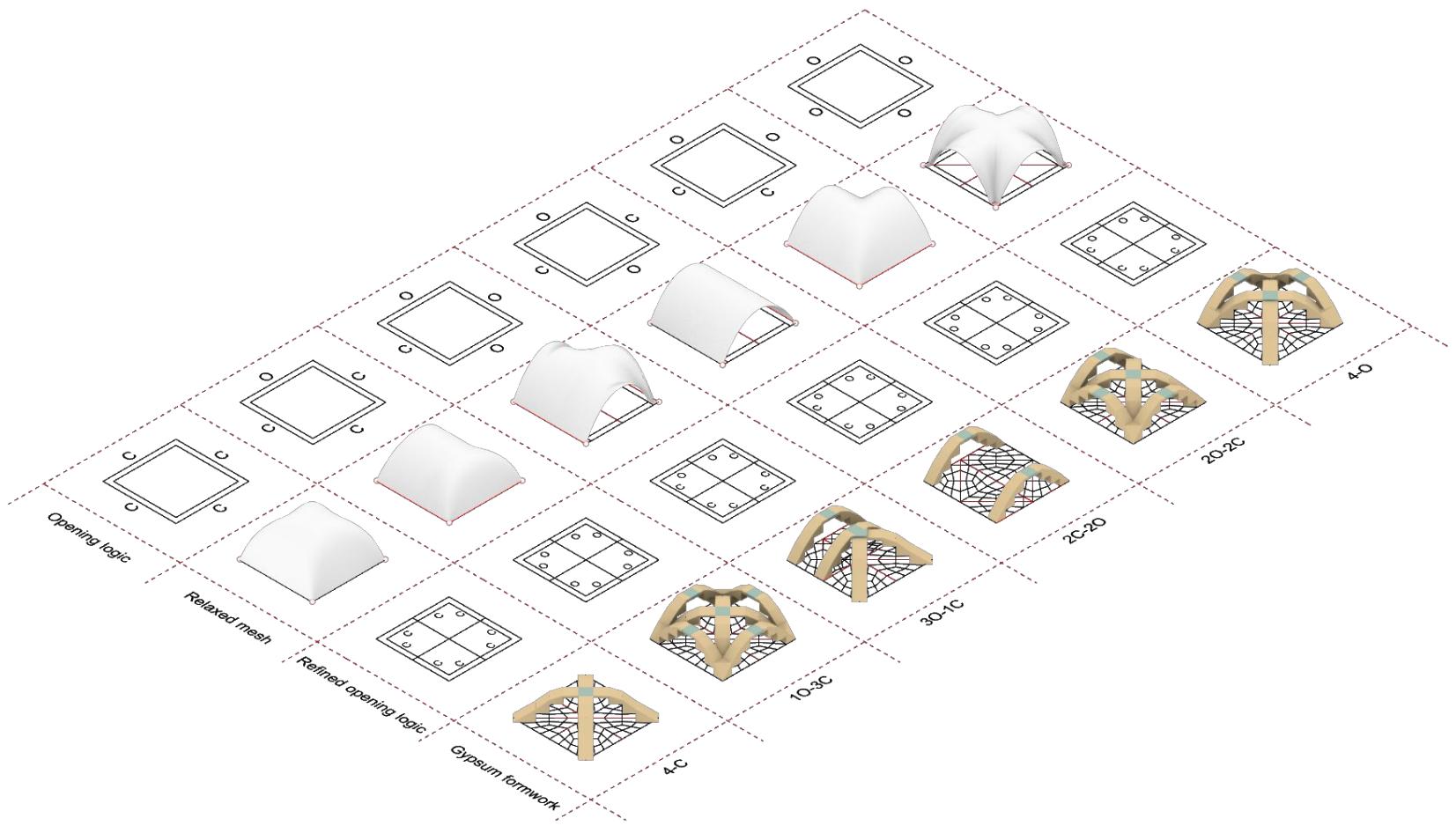












Openings

Door elements → defined by first iteration of layout tool (Semiopen)

Window elements → Is it logistic? No need for window to the outside
Is it anything else? At least one window

Where?

Check if side opposite to the door is connected to the outside (cross ventilation)
(Check distance from door, from longest to shortest)

How many?

Cells < 3 → 1

For each 3 cells an opening (If possible)

Which type?

Is it ground floor or first floor? 2 openings classification

Jali pattern or not?

User input (choice among library of patterns)

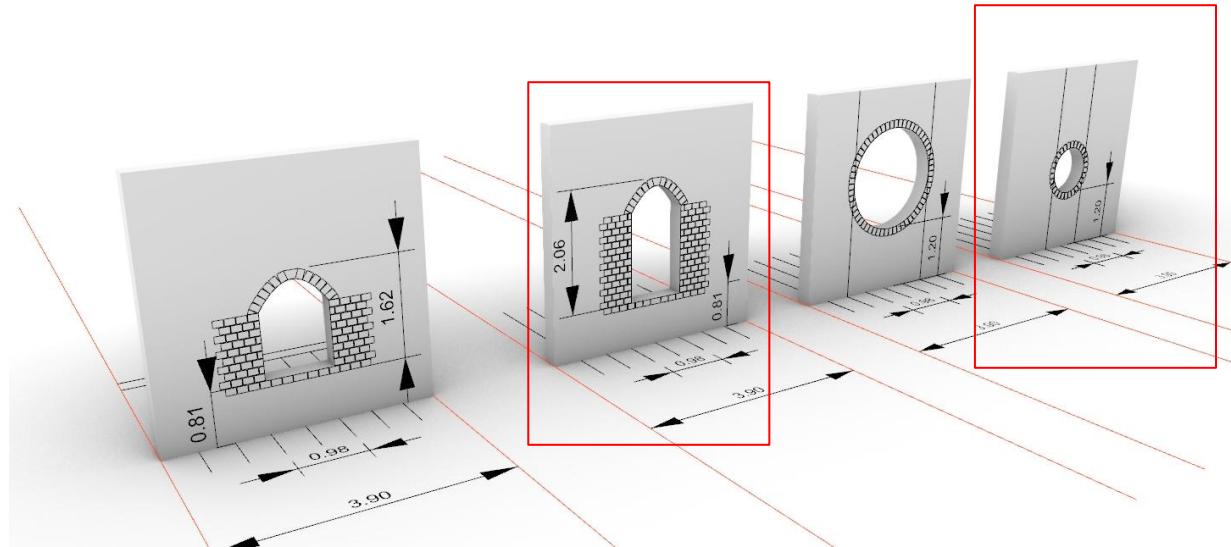
Openings

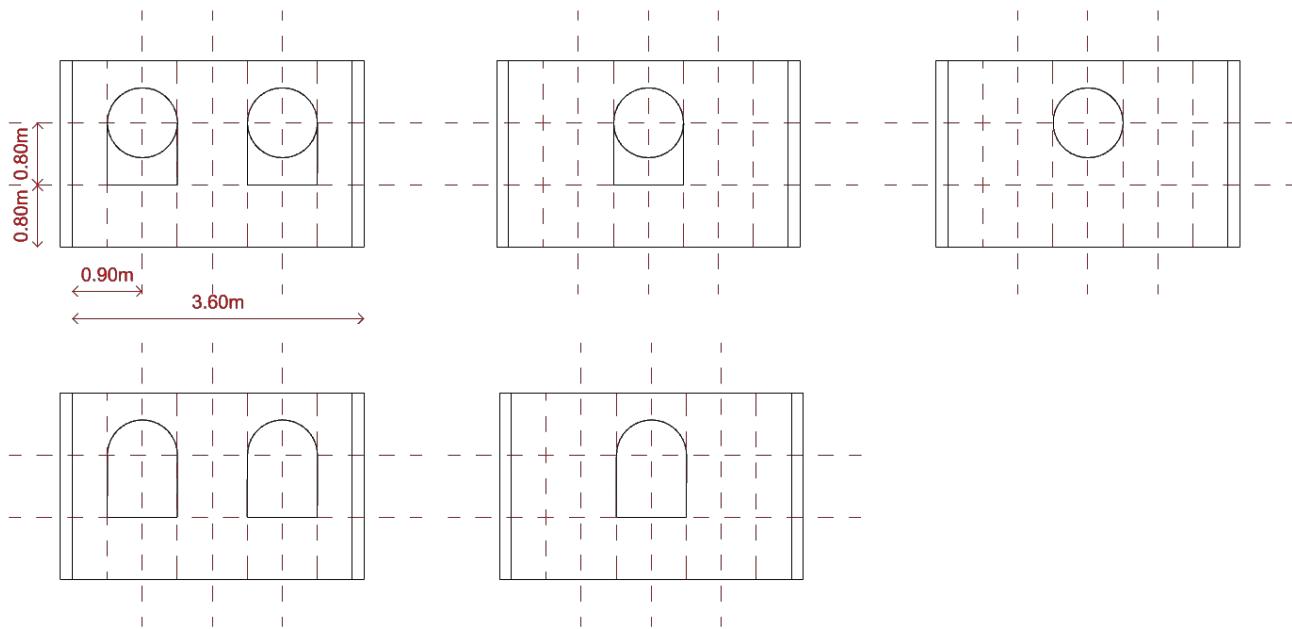
Door elements → defined by first iteration of layout tool (Semiopen)

Window elements → Does the cell border with the outside or with a courtyard? → Opening

Does it only need ventilation? (Logistic), High circular opening
Does it need light? Normal windows (2 windows per module)

Jali pattern? User input





Daylight + Ventilation

Ventilation

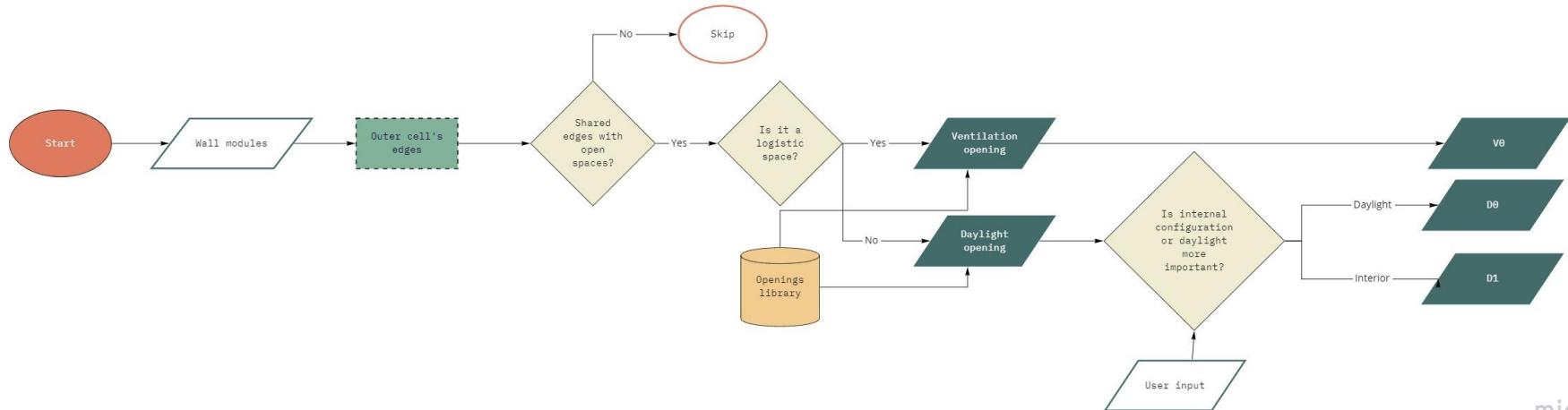
higher daylight

D0

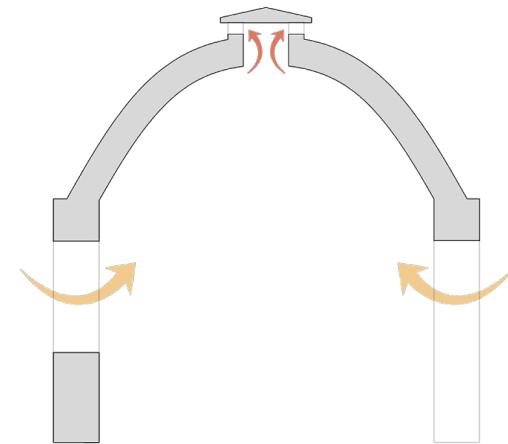
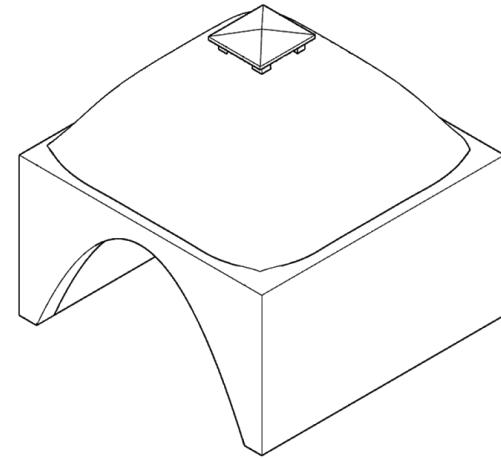
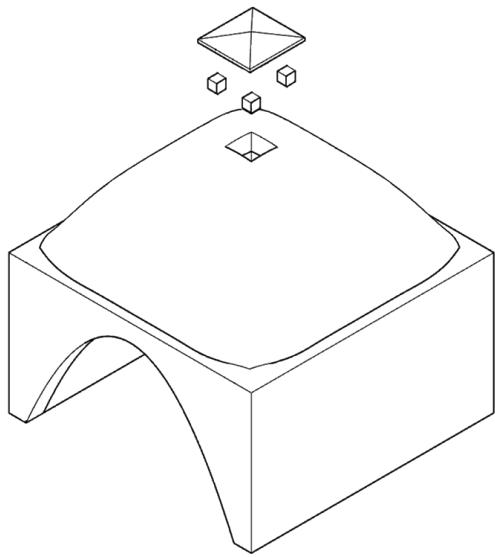
higher freedom
for interior
configuration

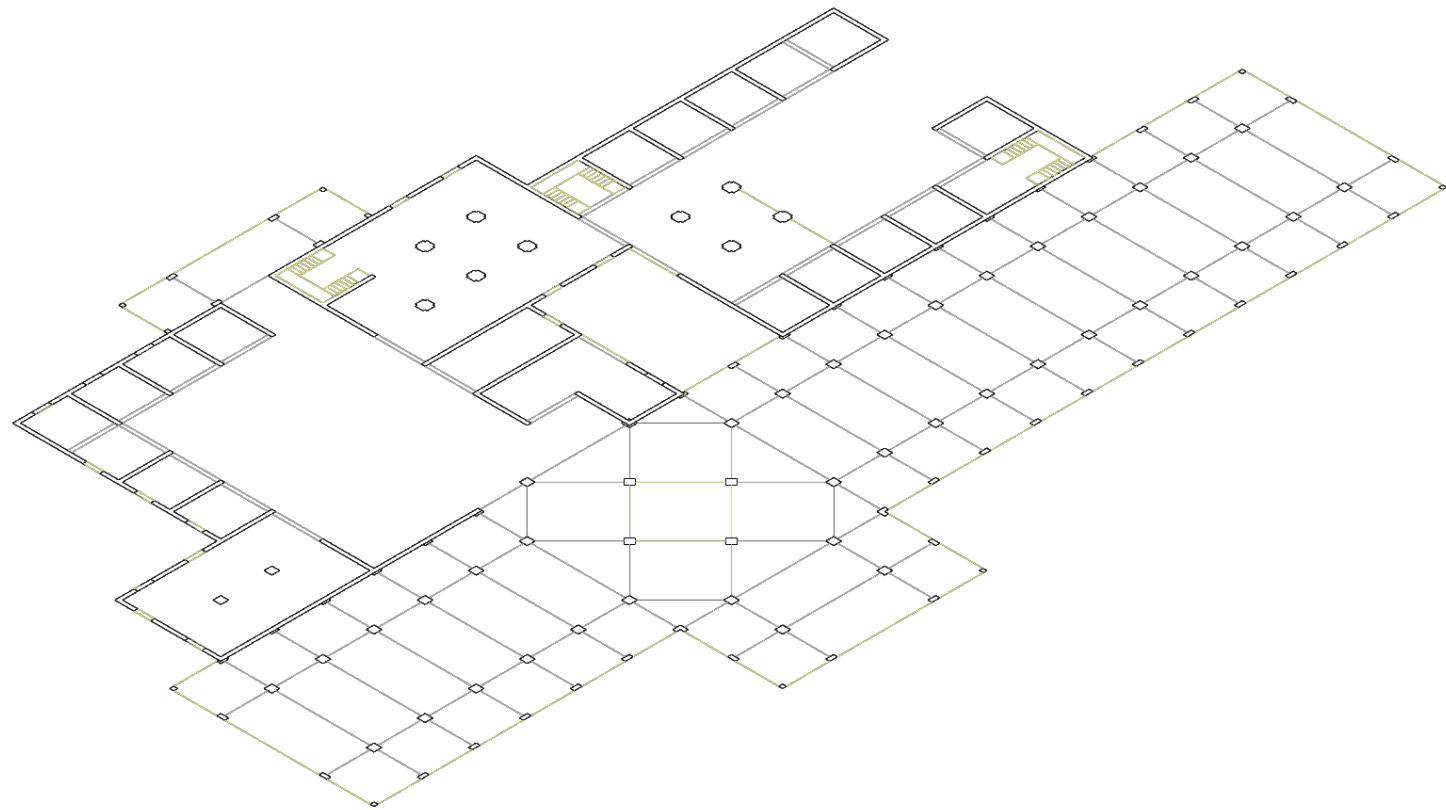
D1

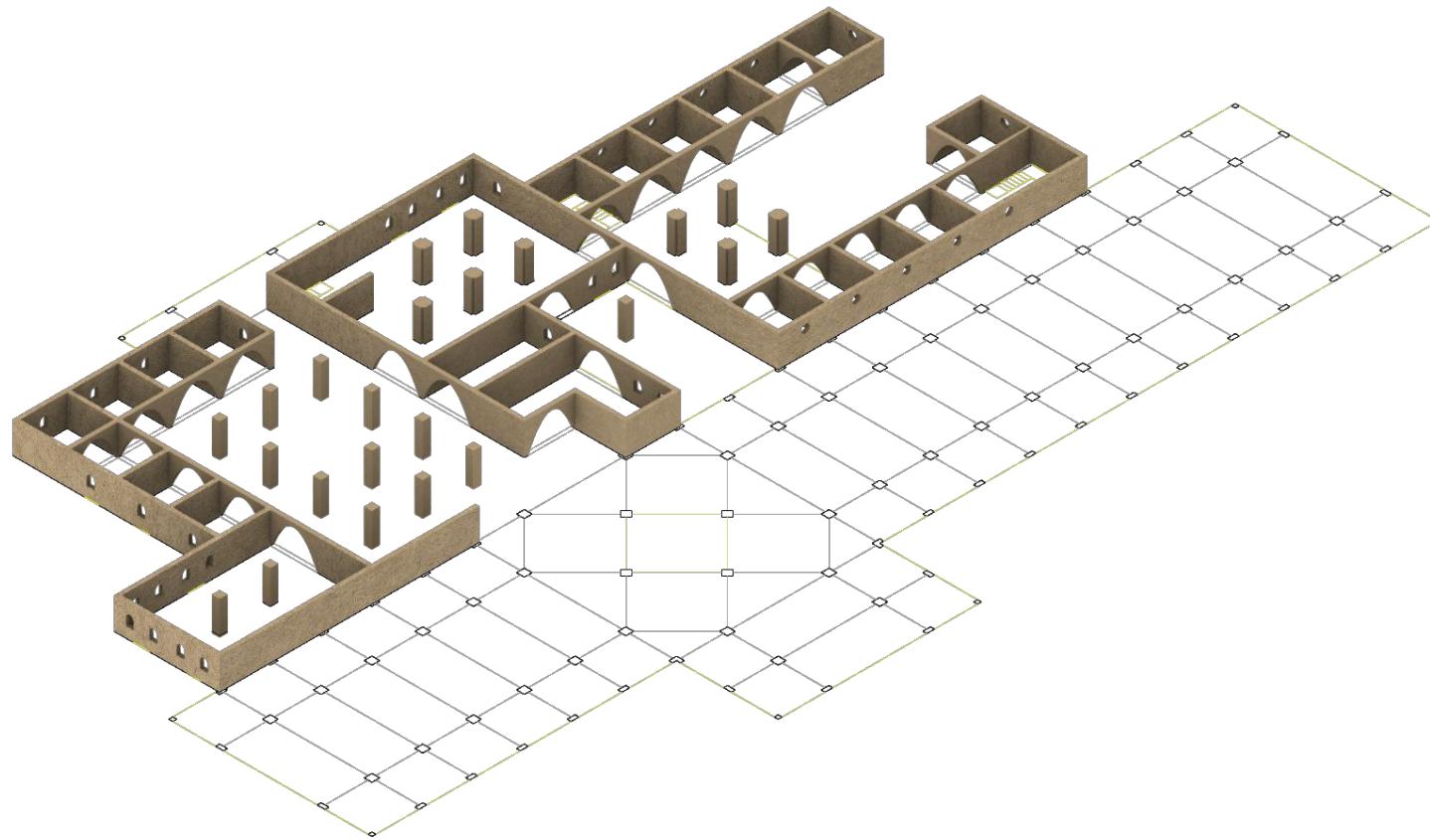
V0

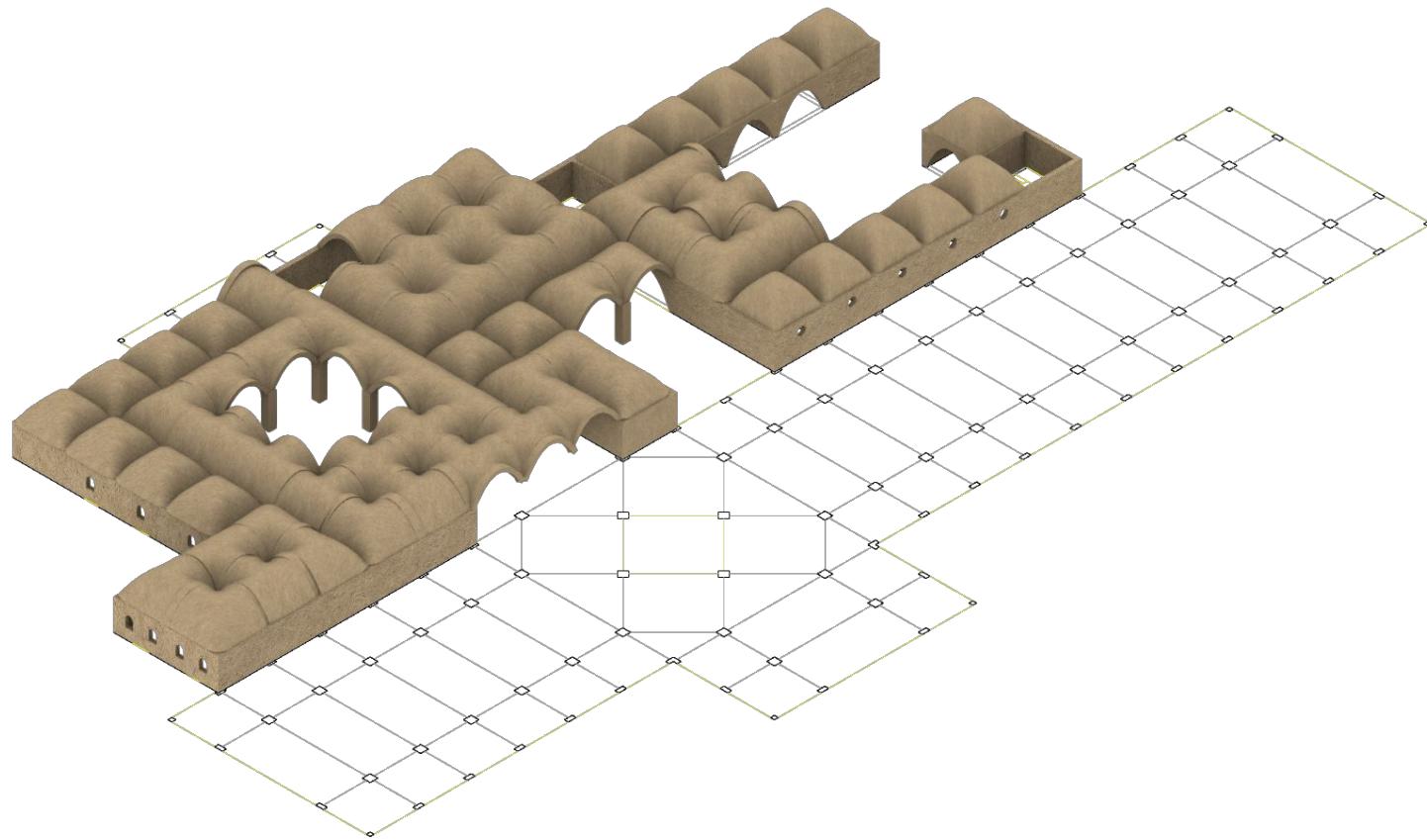


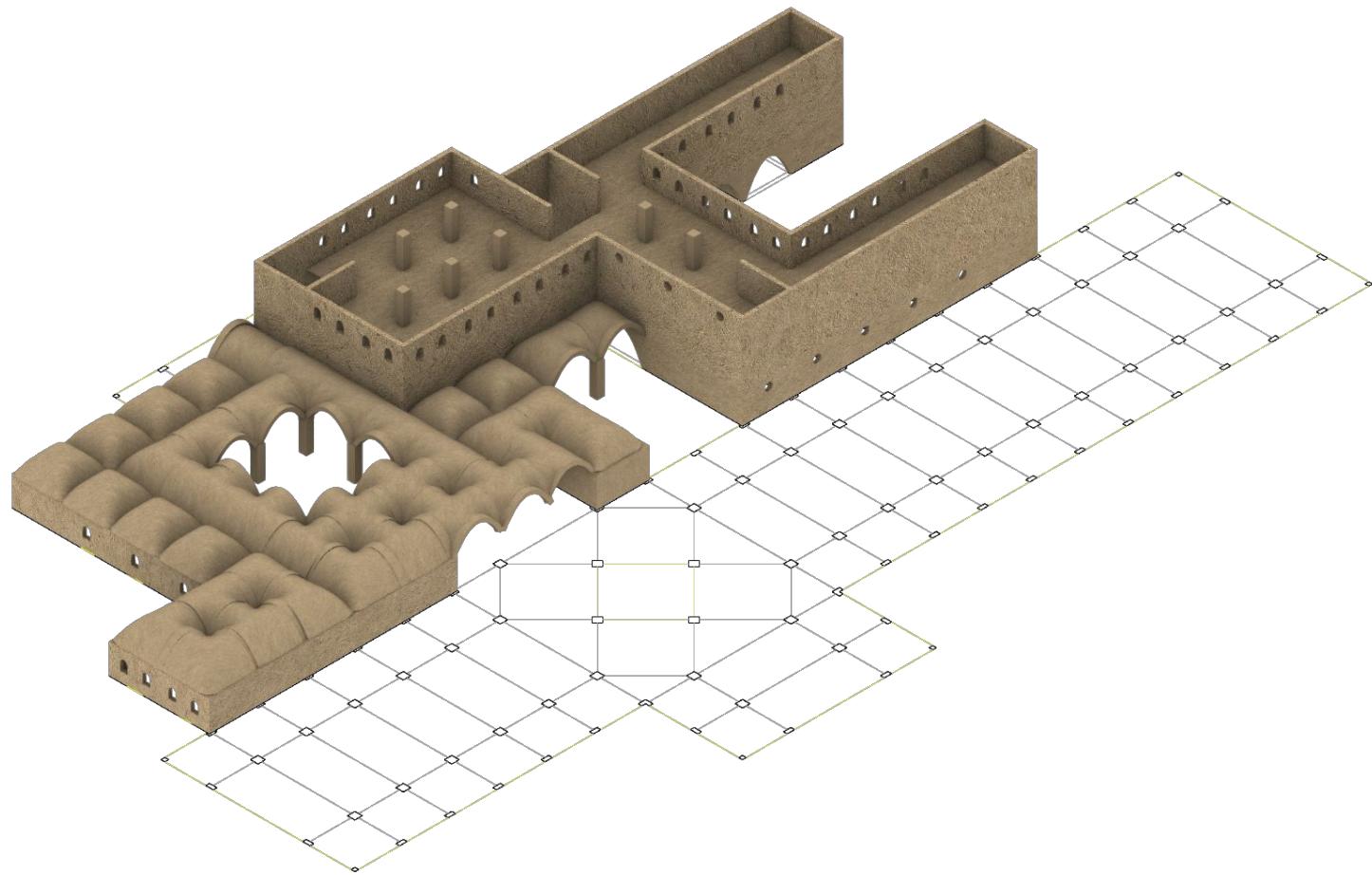
miro

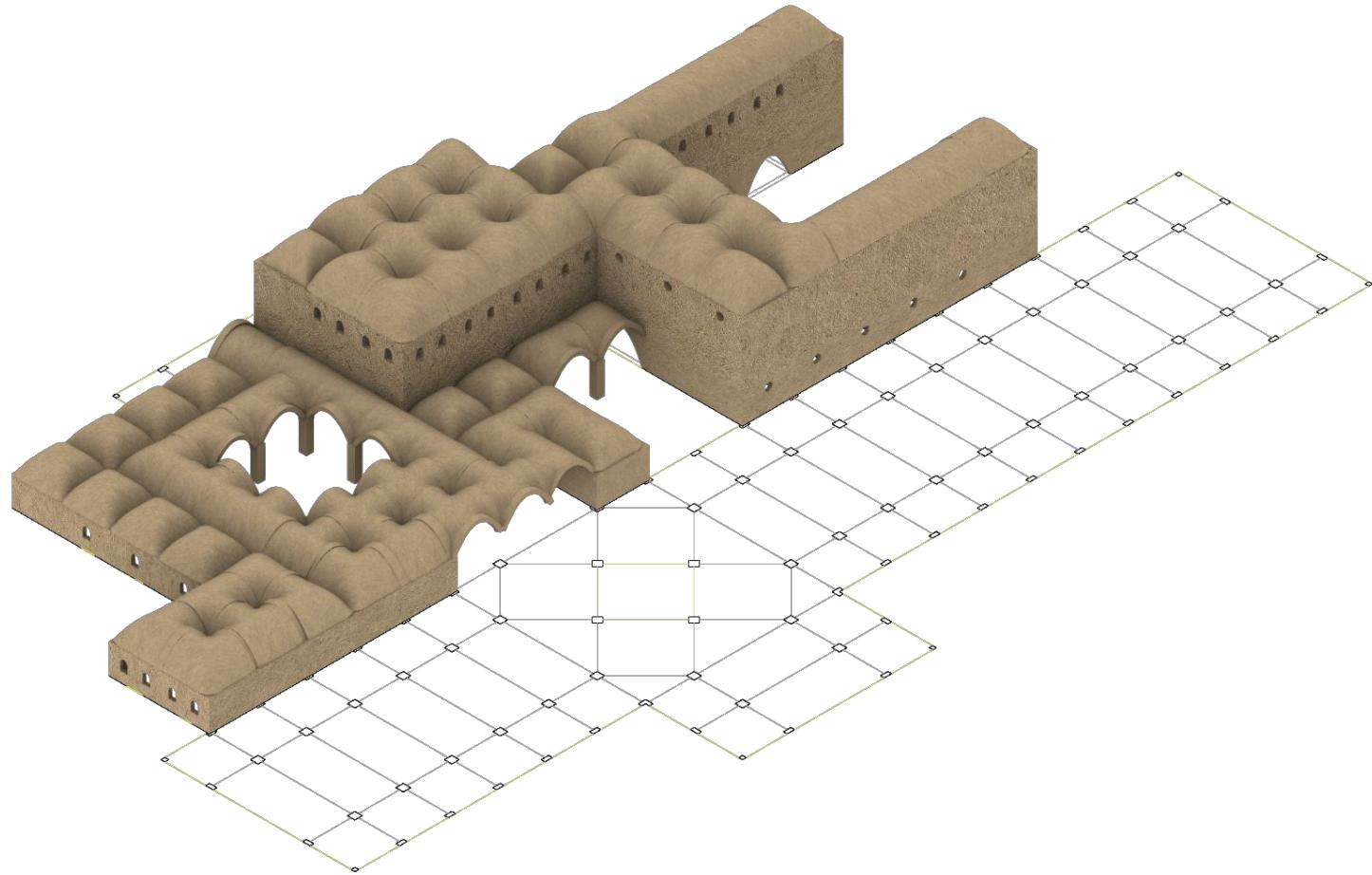


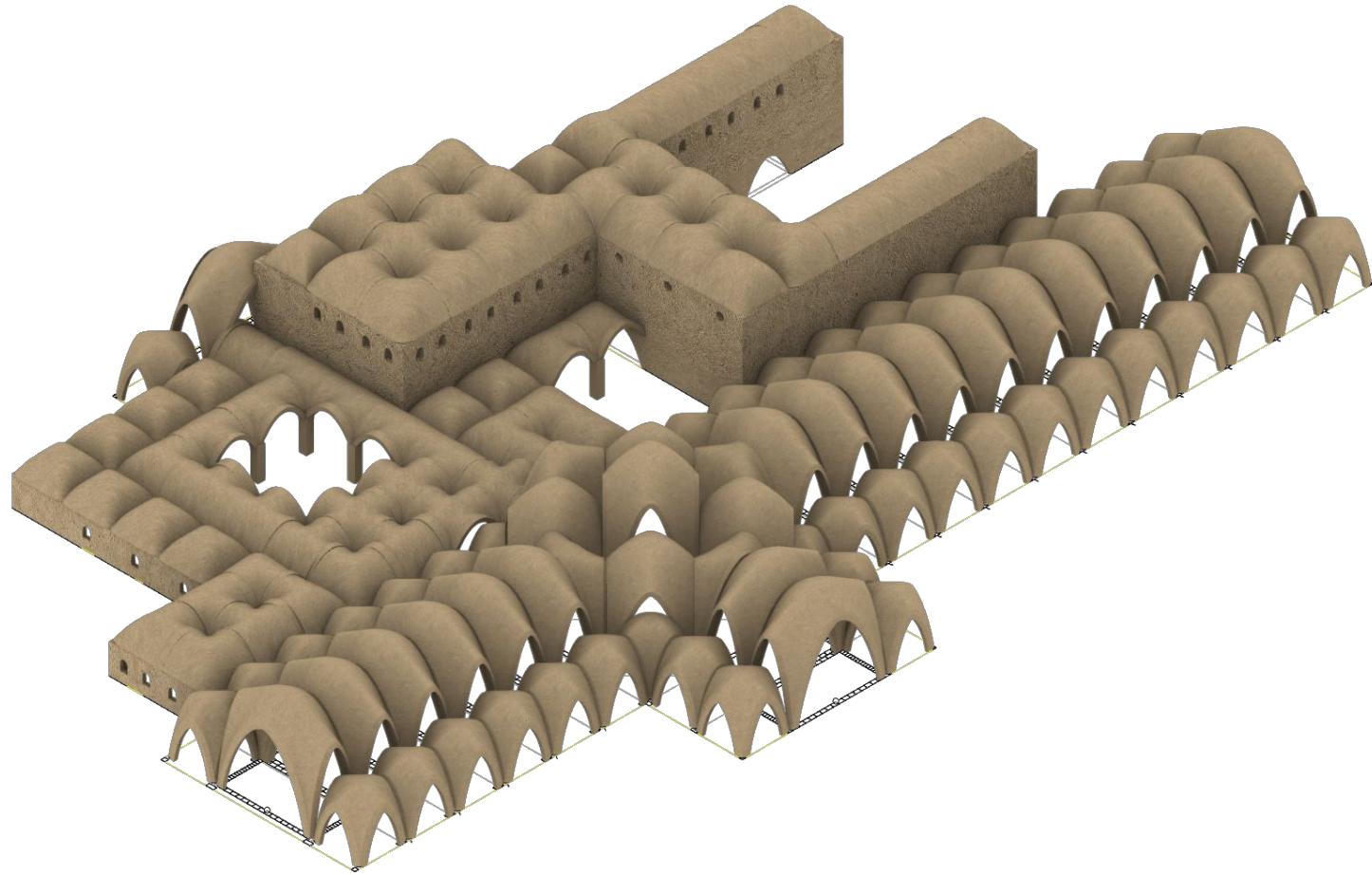


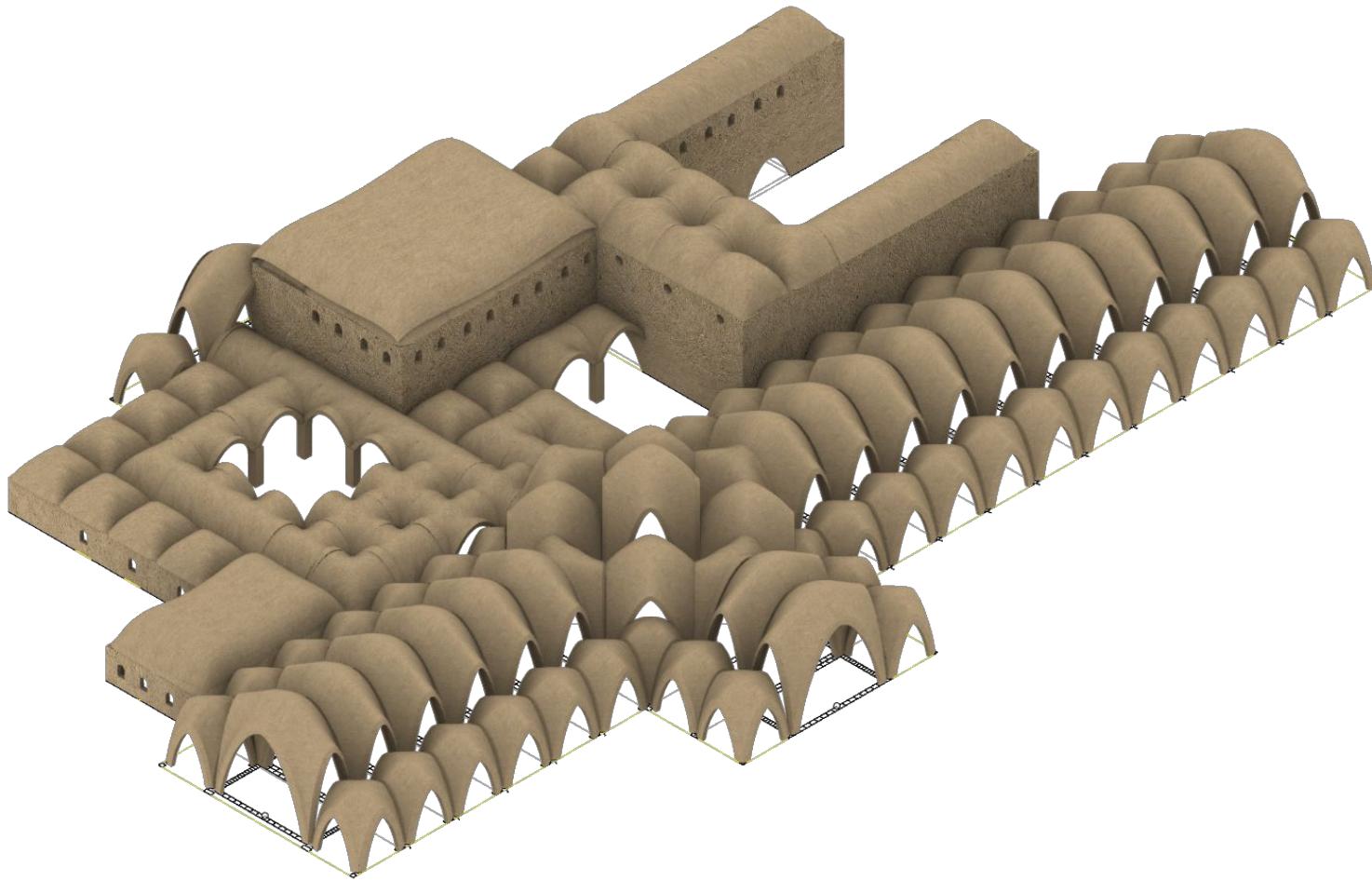


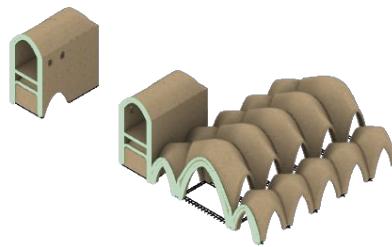


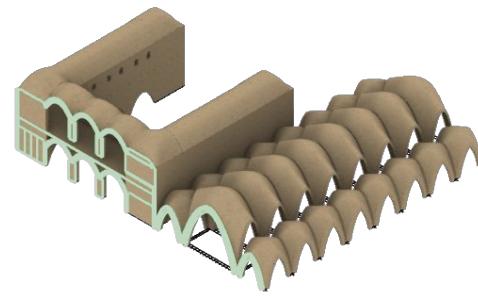


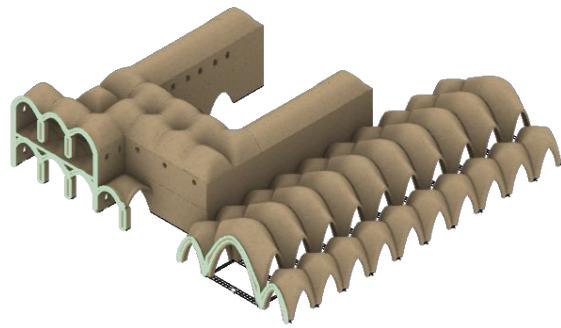


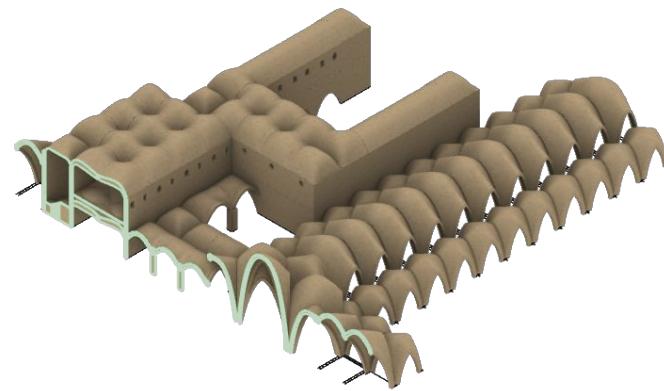


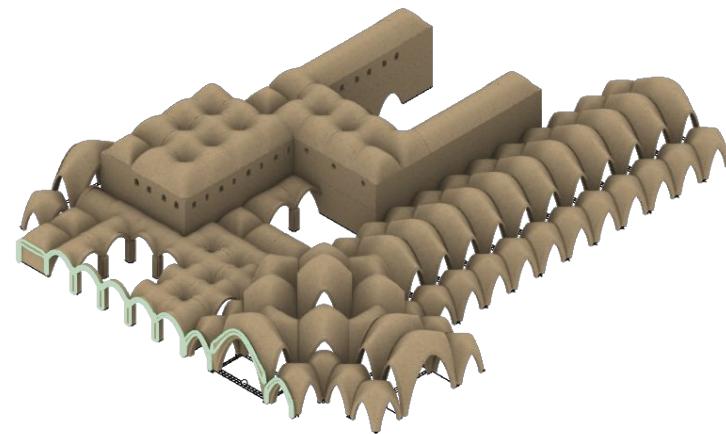


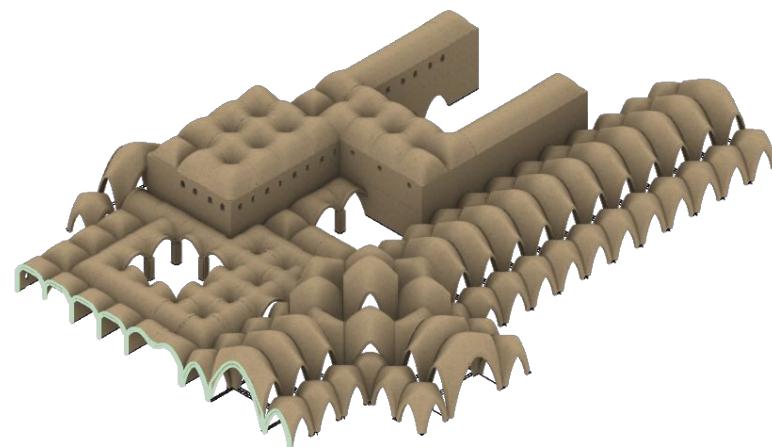


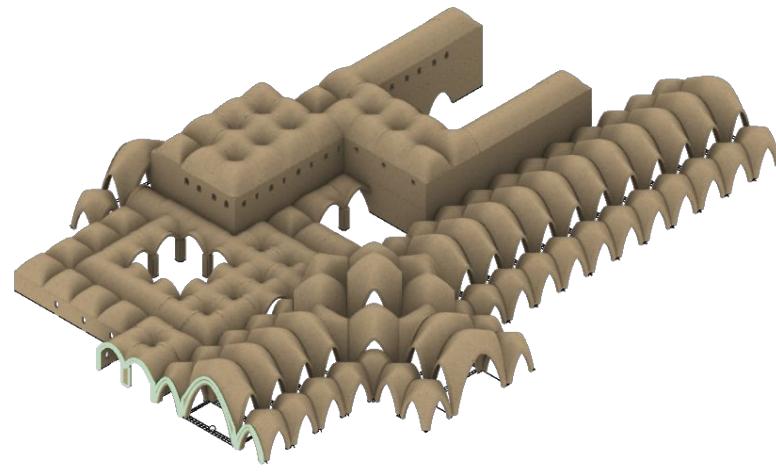


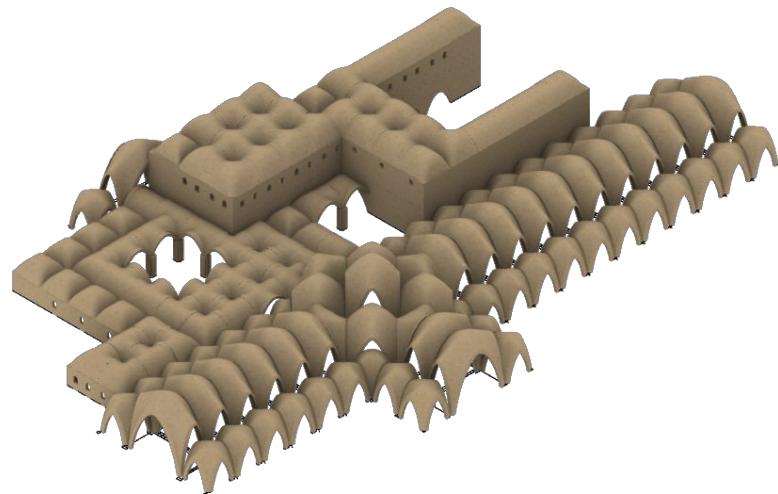


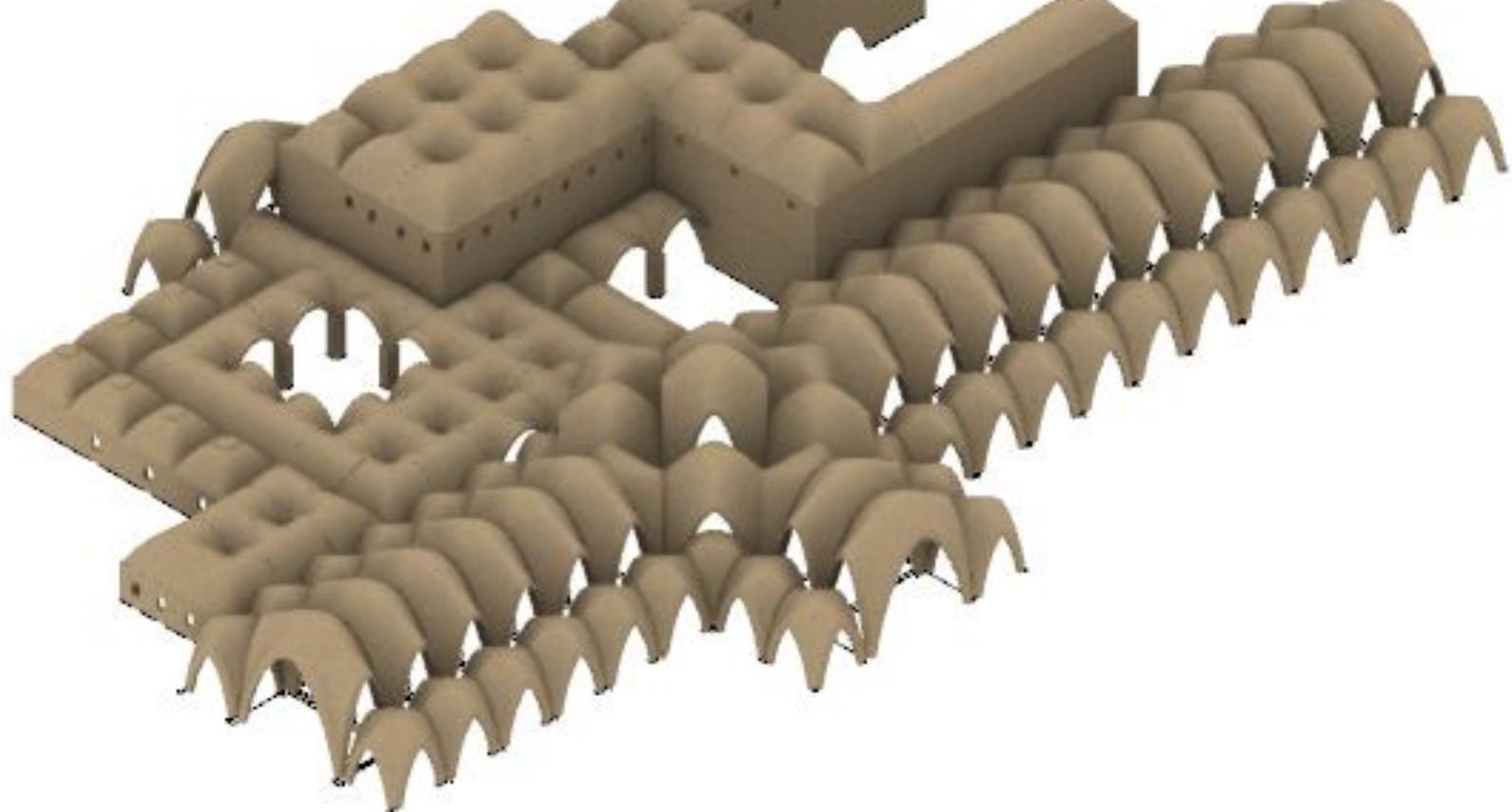












Makers Bazaar

A system to revitalize the urban infrastructure of
the Zaatri Refugee camp



Students :

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Daniel Simon

Leonardo Caldogni

Max Ketelaar

Coordinator :

Dr.Ir. P. Nourian

Instructors:

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Dr. Ir. Fred Veer

Dr. Ir. PirouzNourian

Ir. Hans Hoogenboom

Ir. Dirk Rinze Visser

Ir. Shervin Azadi

Ir. Frank Schnater

