

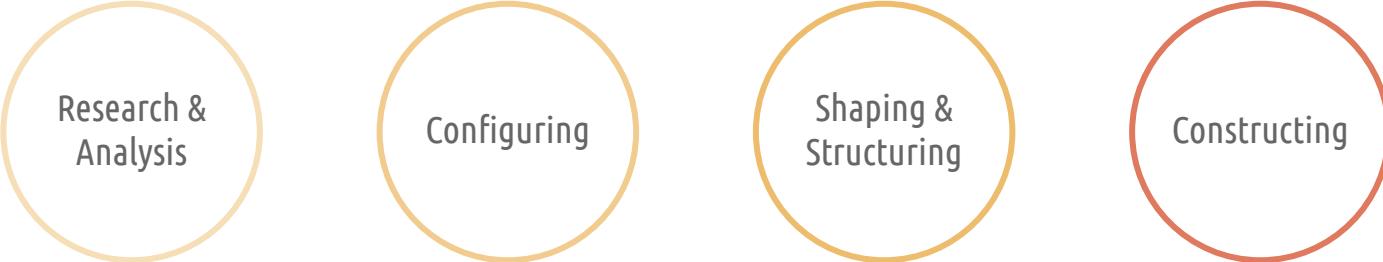
Makers Bazaar

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

Group 1

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Max Ketelaar

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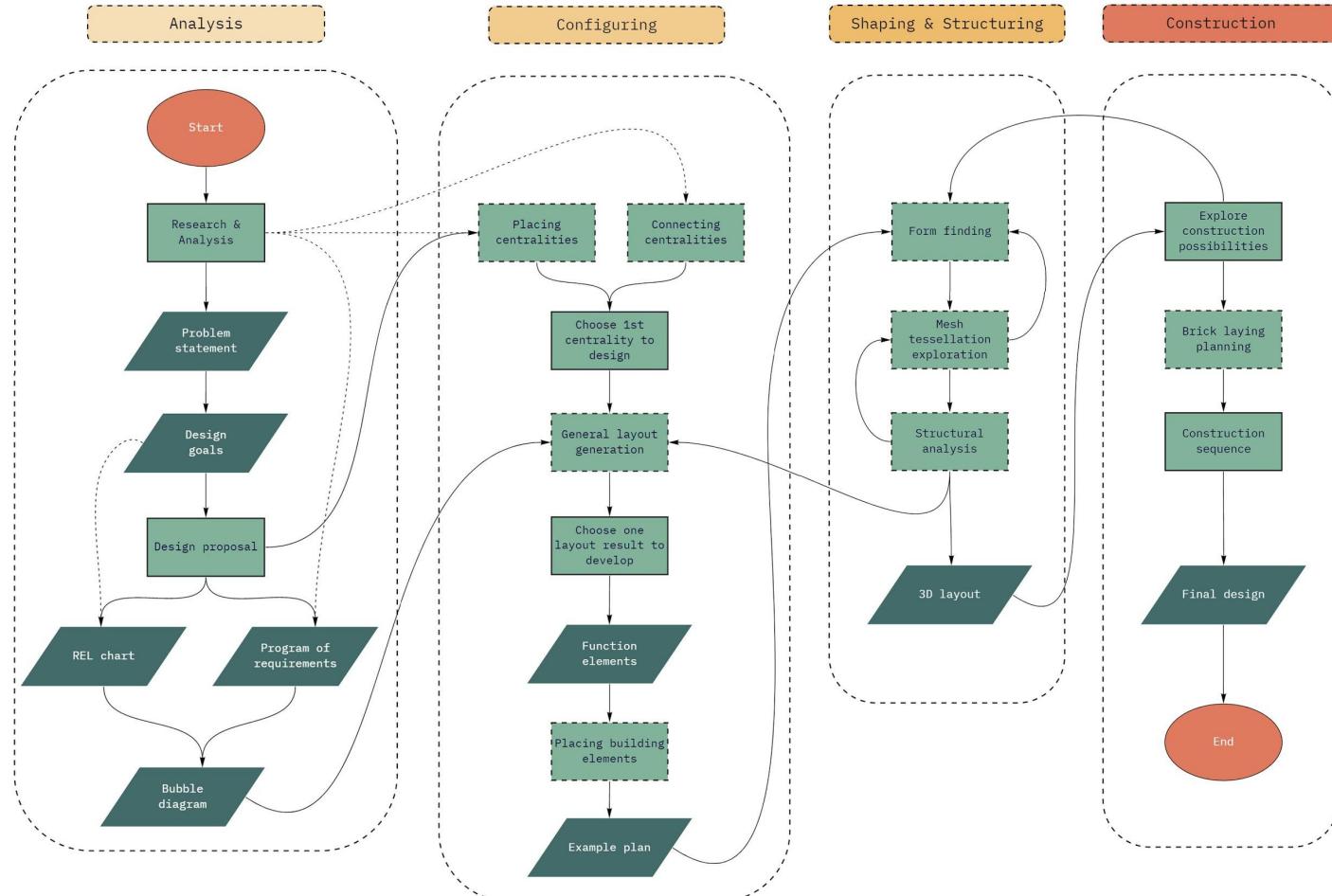


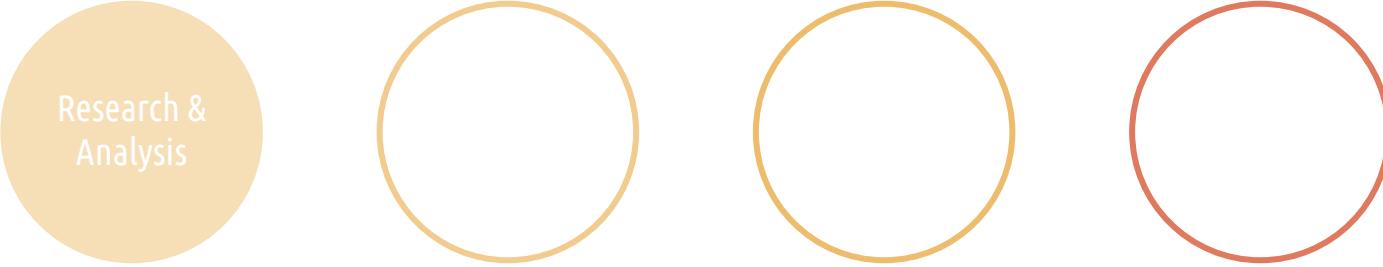
Research &
Analysis

Configuring

Shaping &
Structuring

Constructing





Research &
Analysis

Problems & Potential

- lack of urban structure → informal growth of the camp
- unbalanced distribution of infrastructure
- inefficient education system
- camp as an enclosed community detached from the surroundings
- poor architectural quality due to scarcity of resources

Problems

- skills and mercantile drive of the refugees
- less dense plots near some of secondary roads
- different densities of commercial and other activities
- presence of different vehicular connections and logistic hubs

Potentials

Design Goals

Provide a **system** that could help restructure the urban fabric.

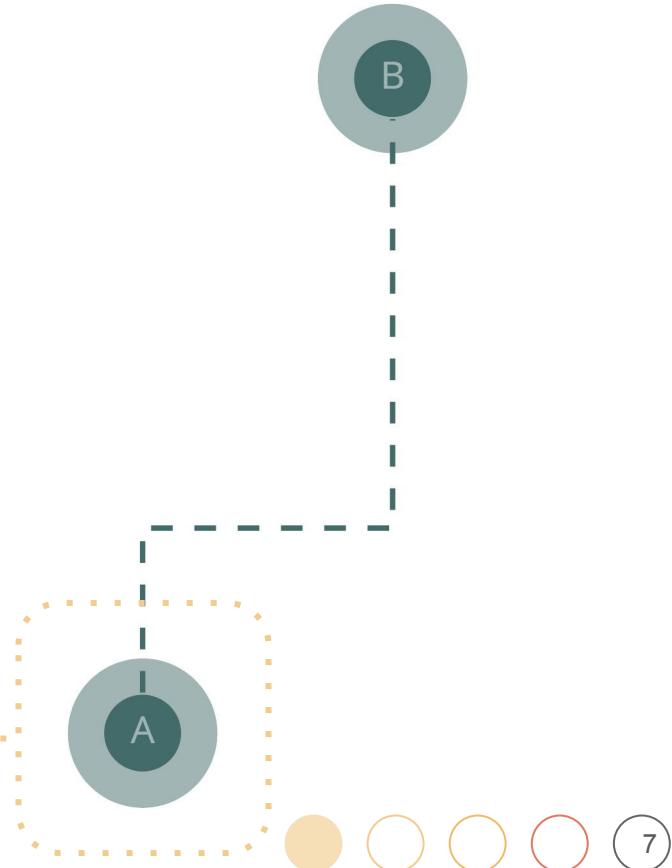
Contribute to the improvement of education and **development of new skills**.

Provide the **means** to improve the architectural quality of the camp.

Design Proposal

Individuate **new centralities** in the camp and build a **system**, using the typology of the Bazaar, that could gradually **connect** these elements.

Design one of these centralities (node) and the related urban effect on the camp. We want to focus on the design of a **Bazaar that combines its commercial and social functions with a brick makers space**.



Development Phases



Phase 1

Training Centers
as centralities



Phase 2

Brick factories



Phase 3

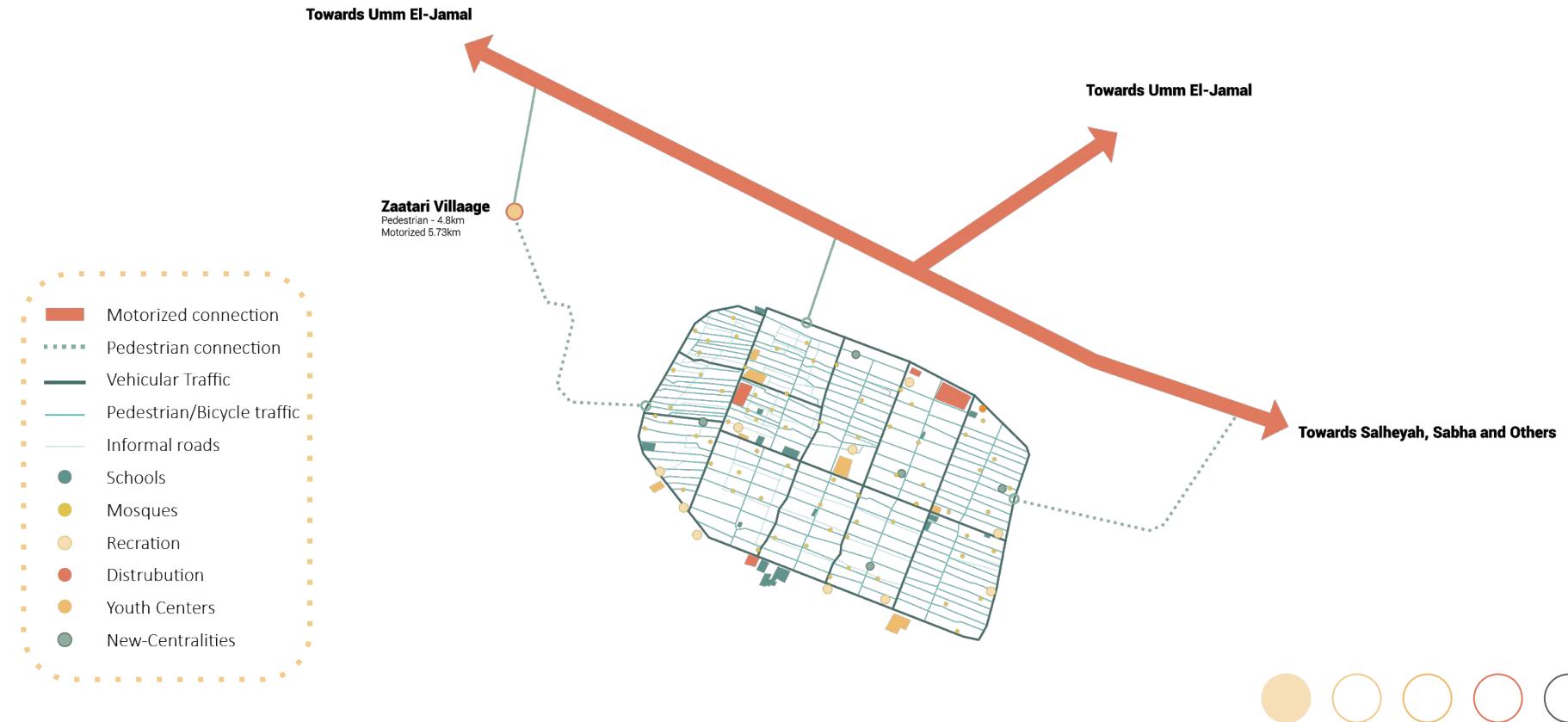
Makers Bazaar

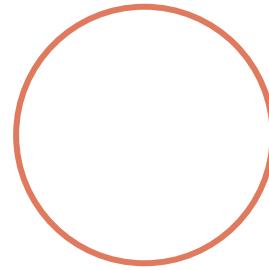
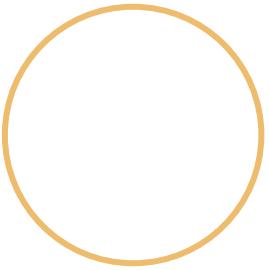
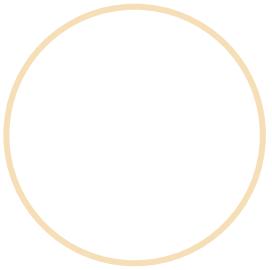


Phase 4

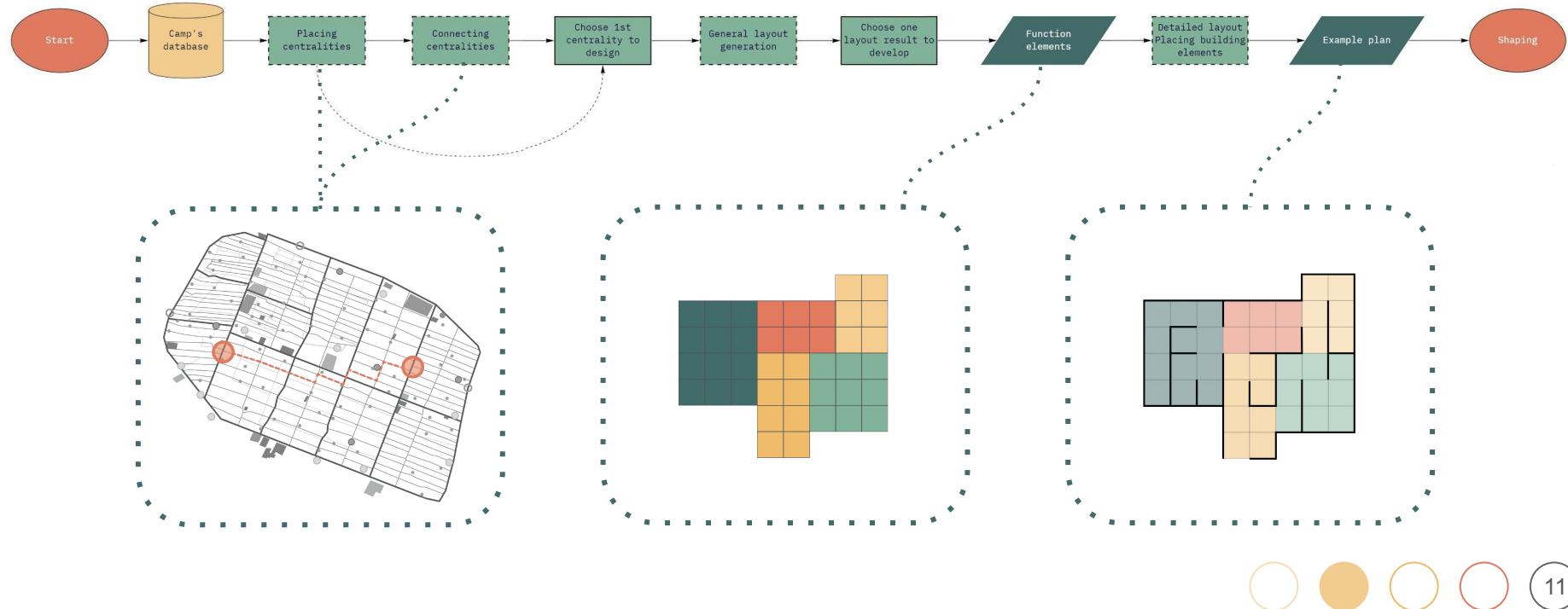
Urban
revitalization

Urban analysis

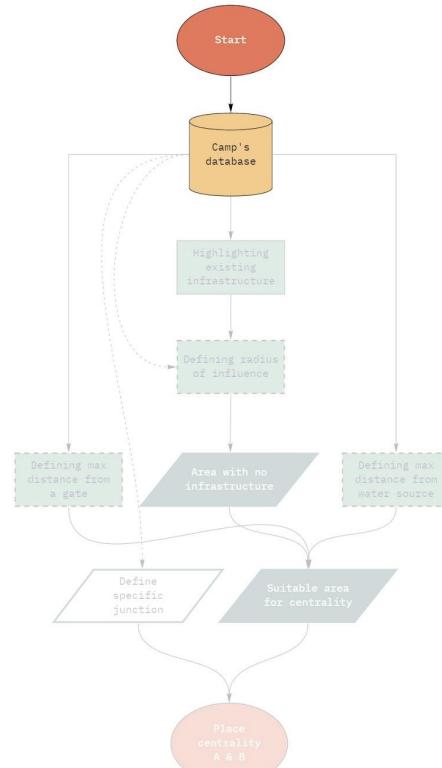
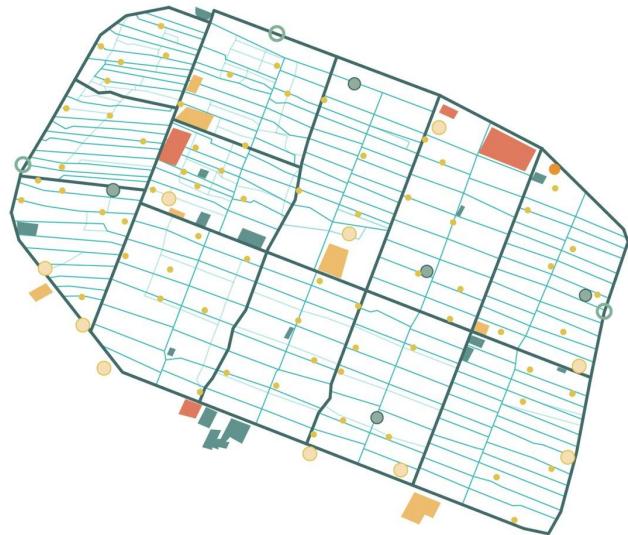




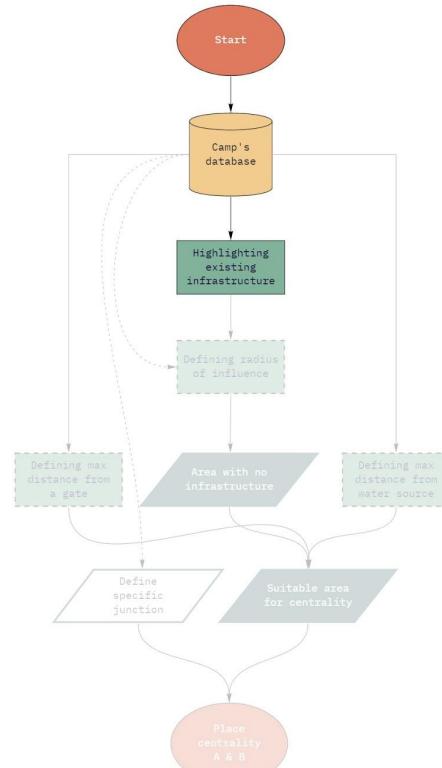
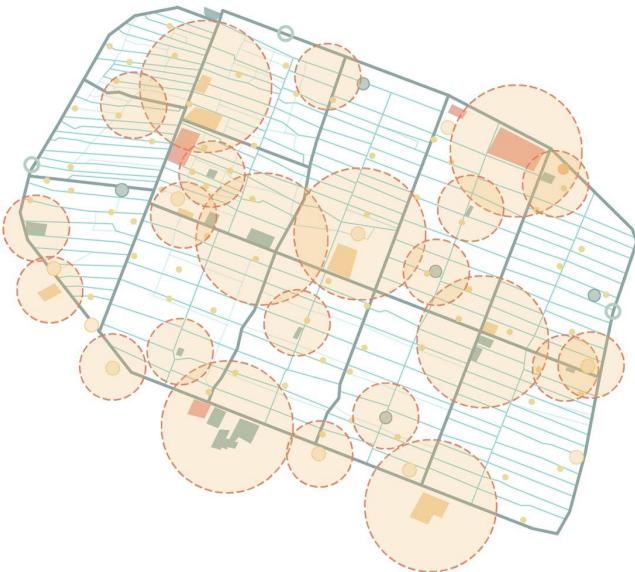
Methodology



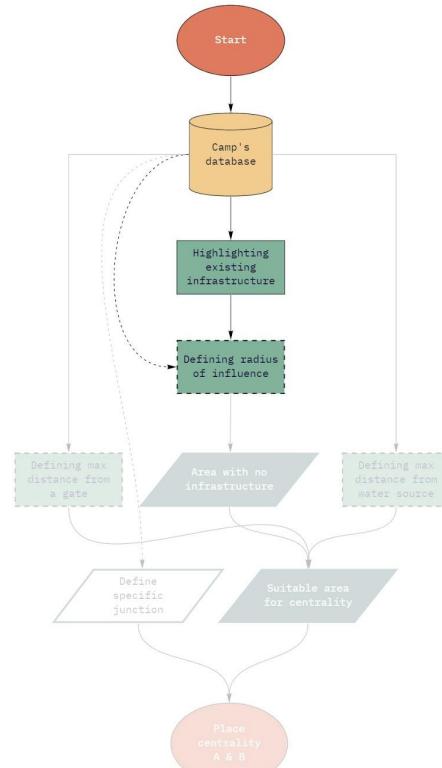
Placing centralities



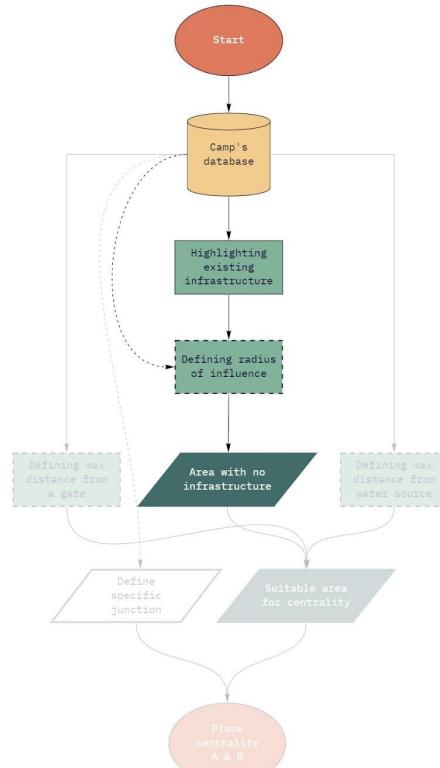
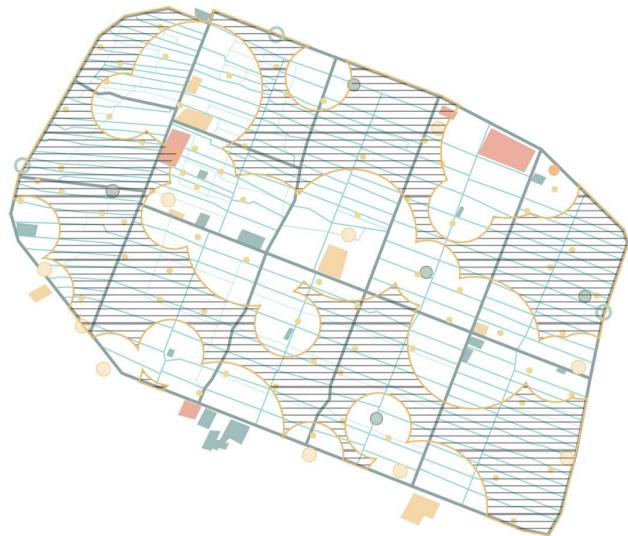
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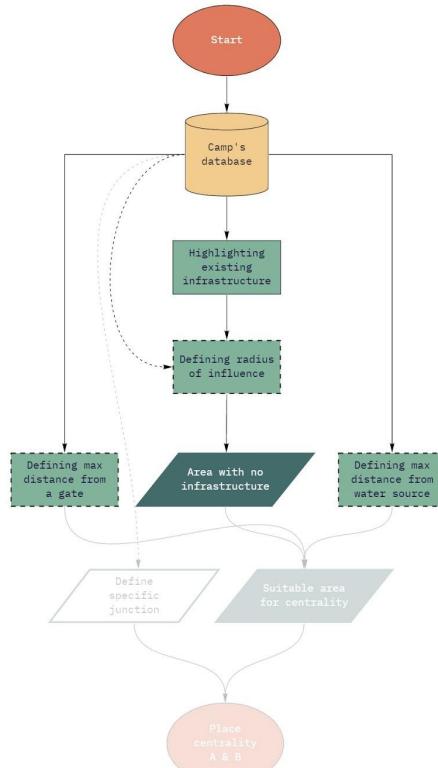
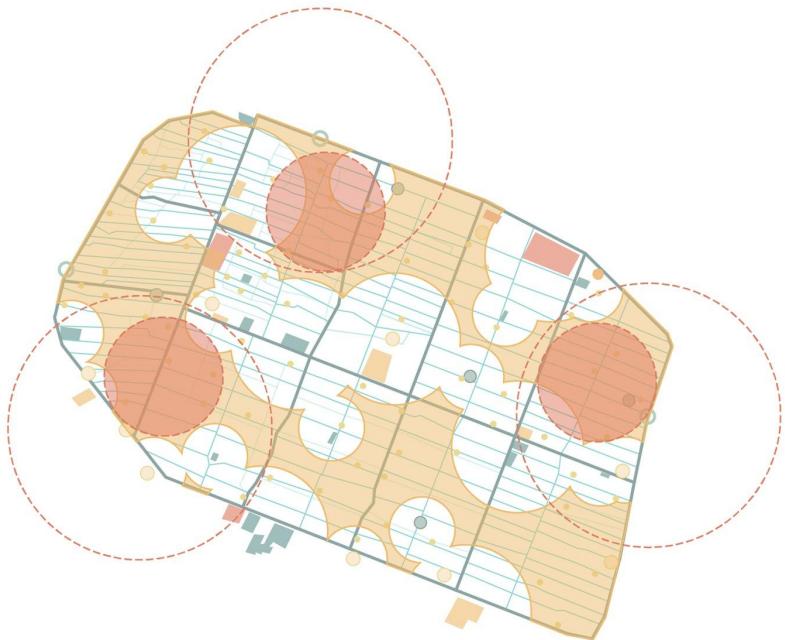
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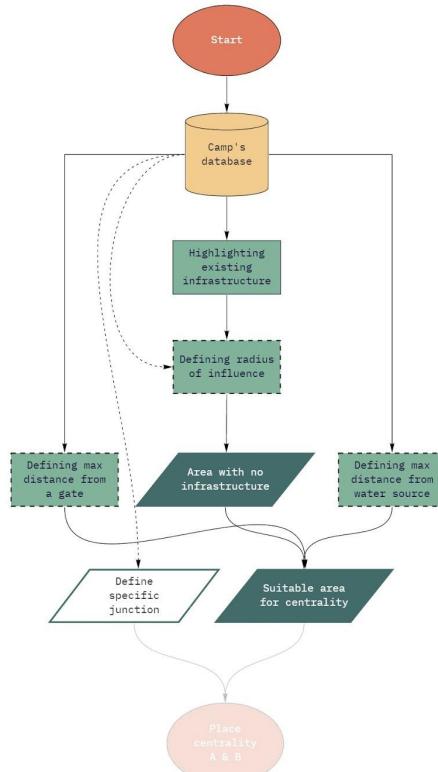
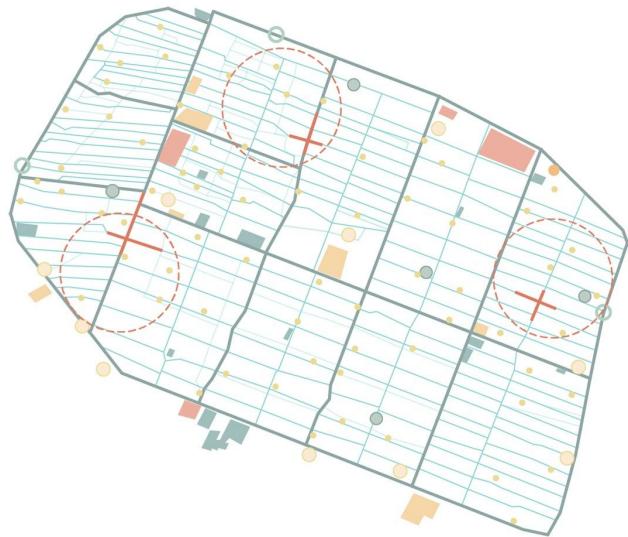
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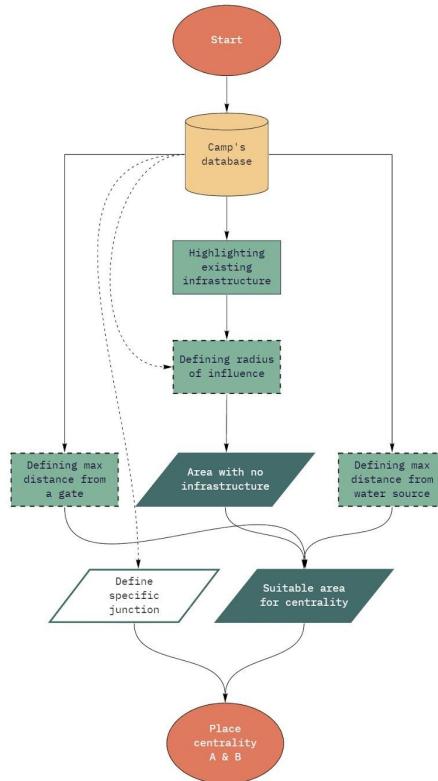
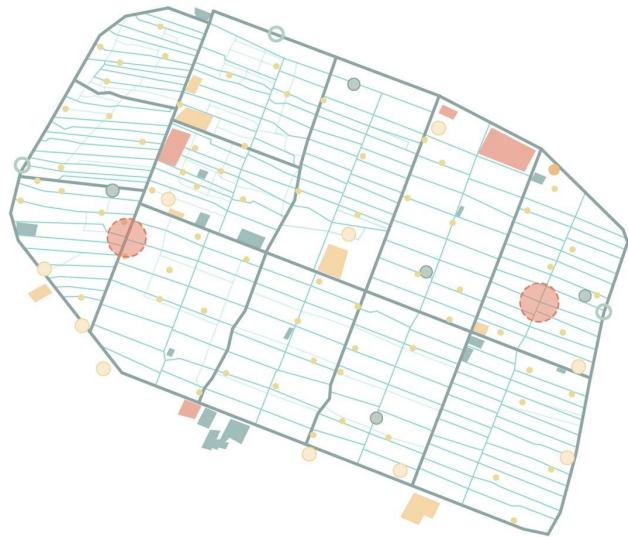
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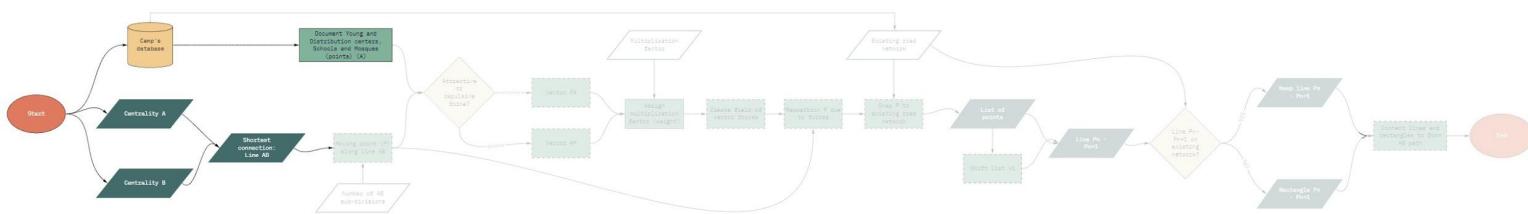
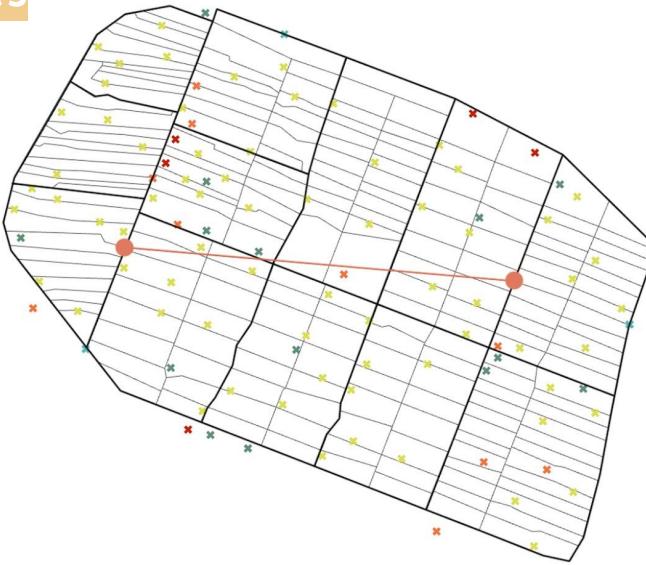
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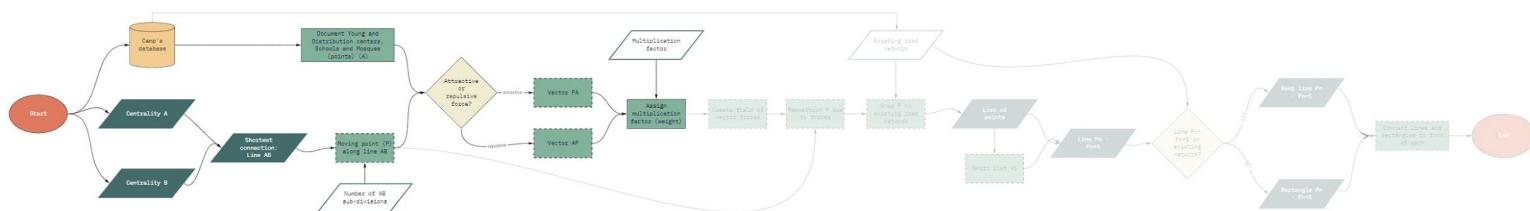
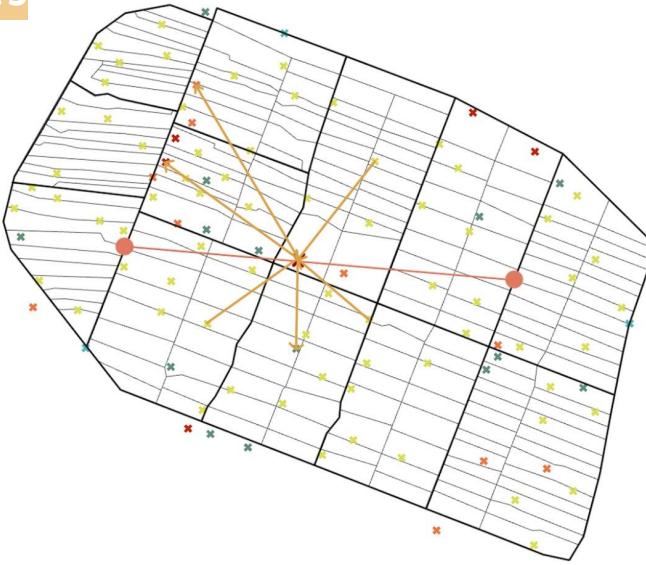
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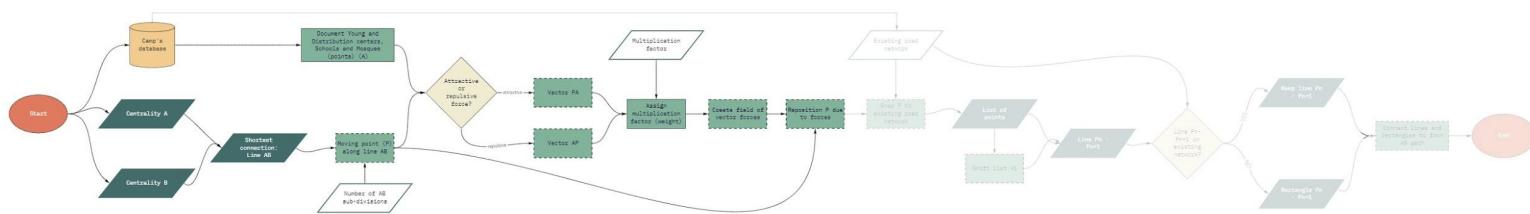
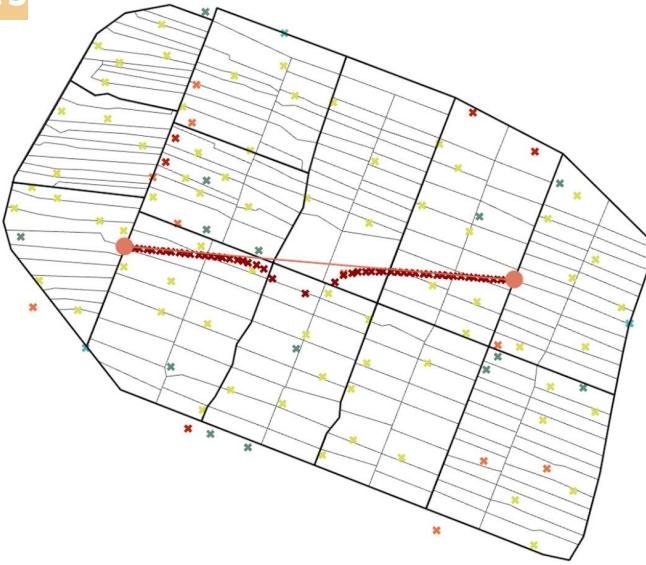
Connecting centralities



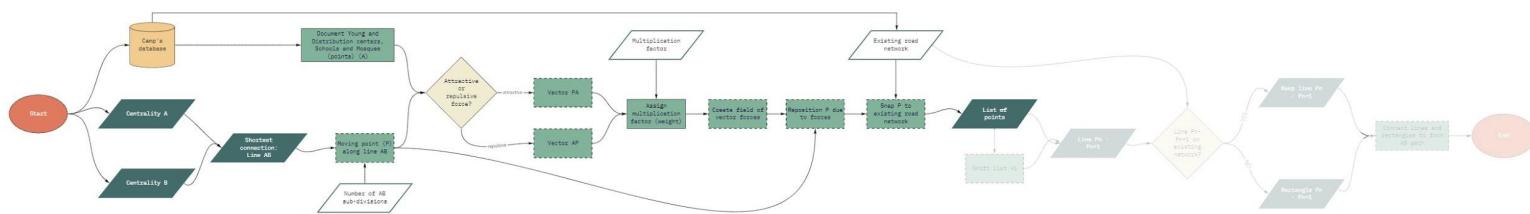
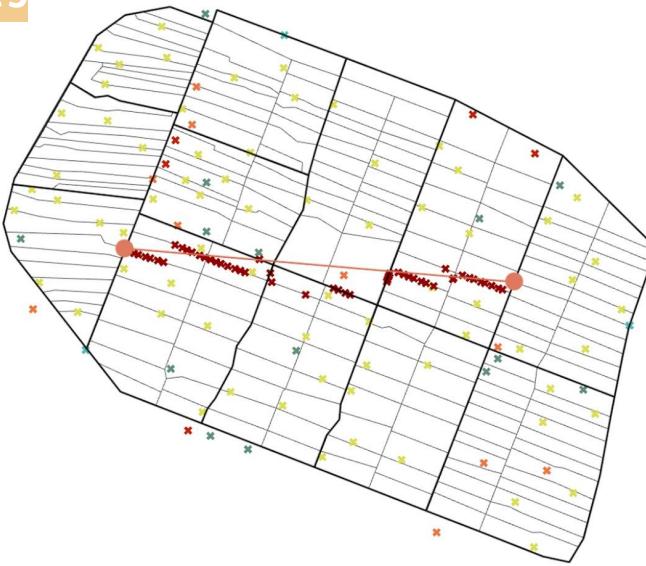
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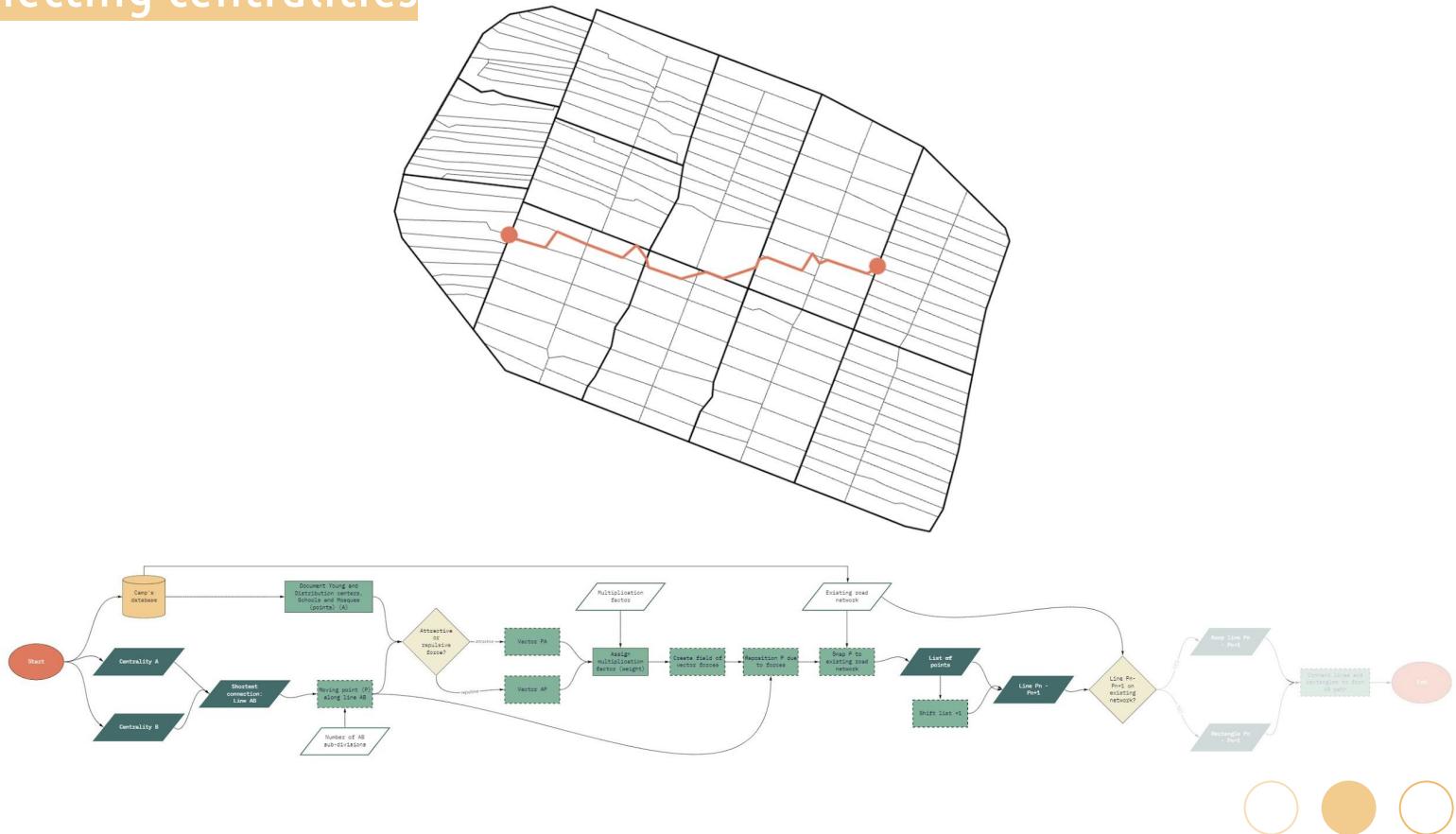
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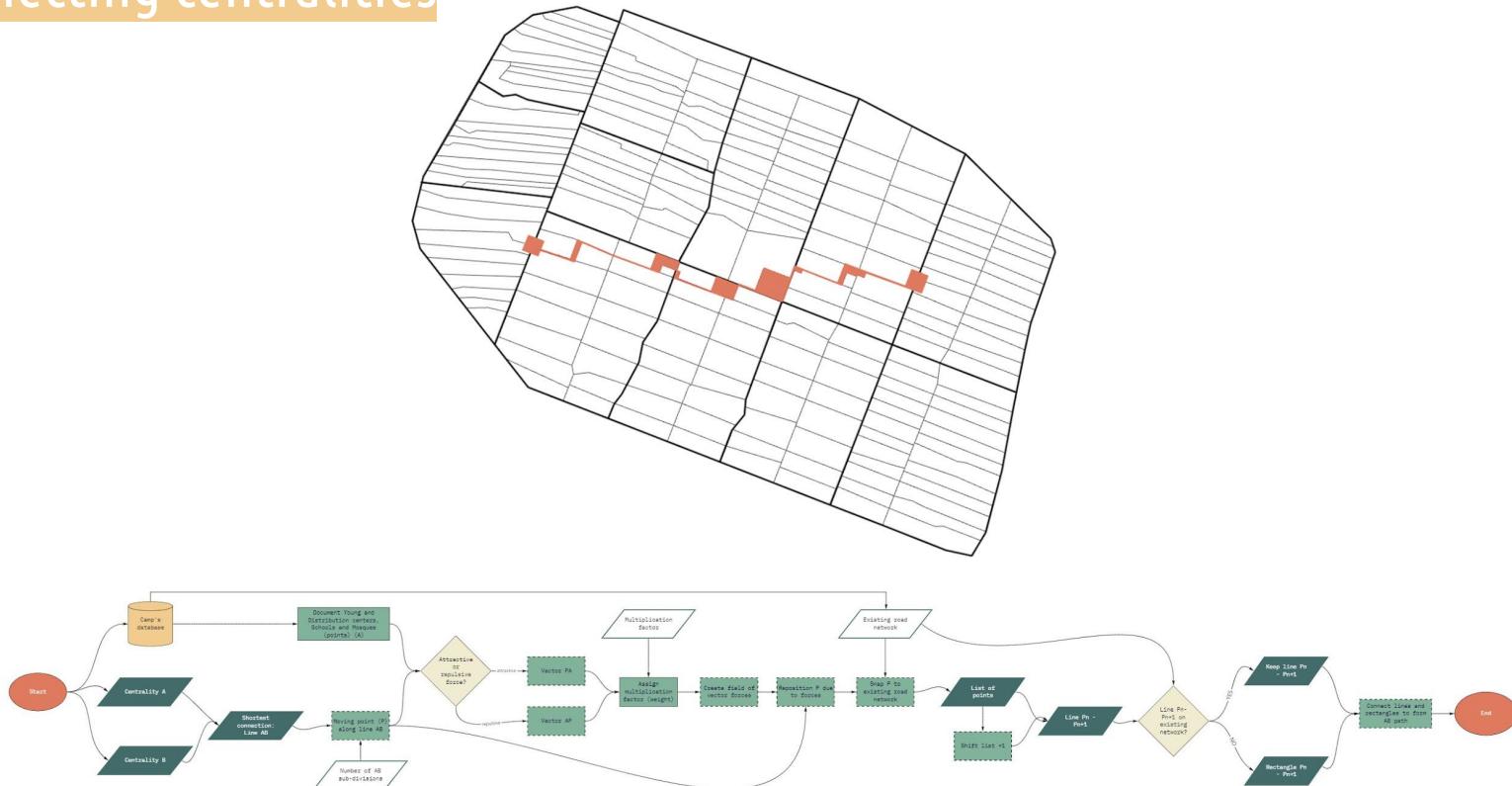
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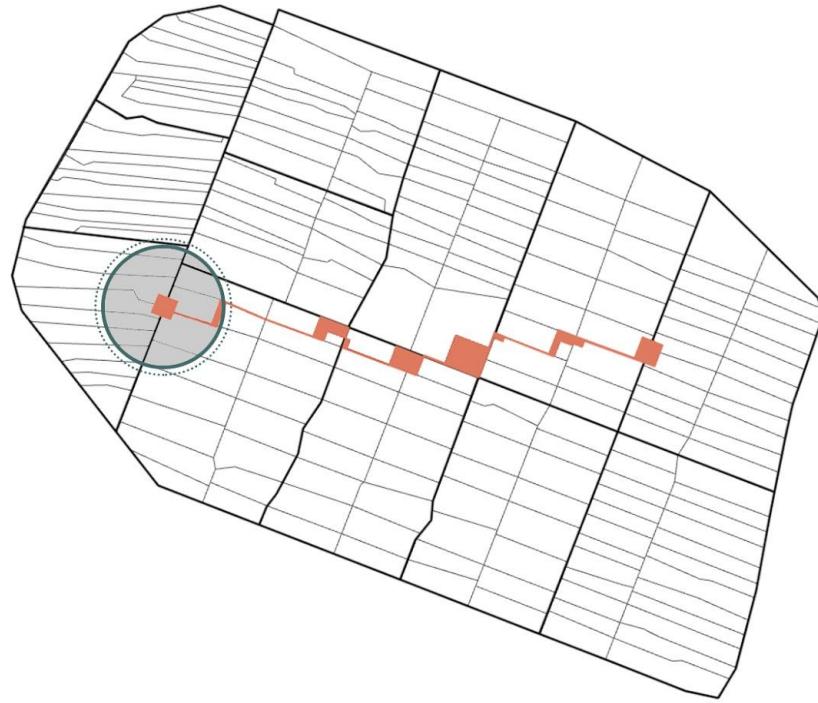
Connecting centralities



Connecting centralities



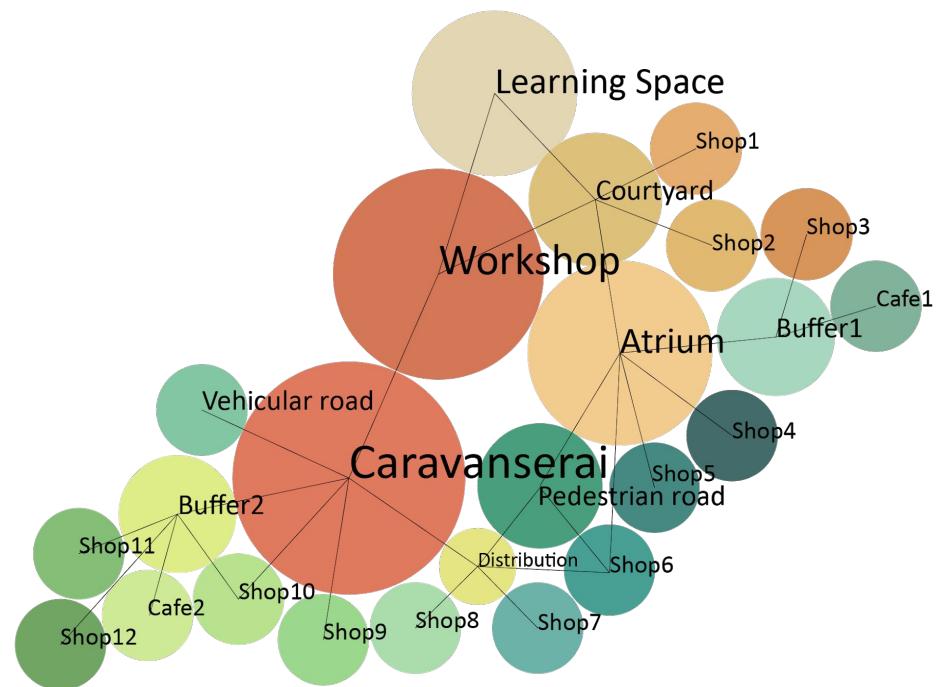
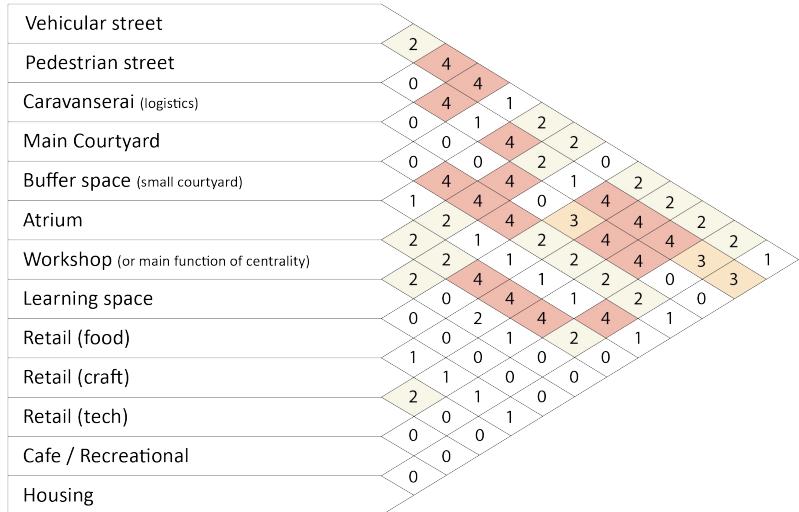
Chosen centrality to design



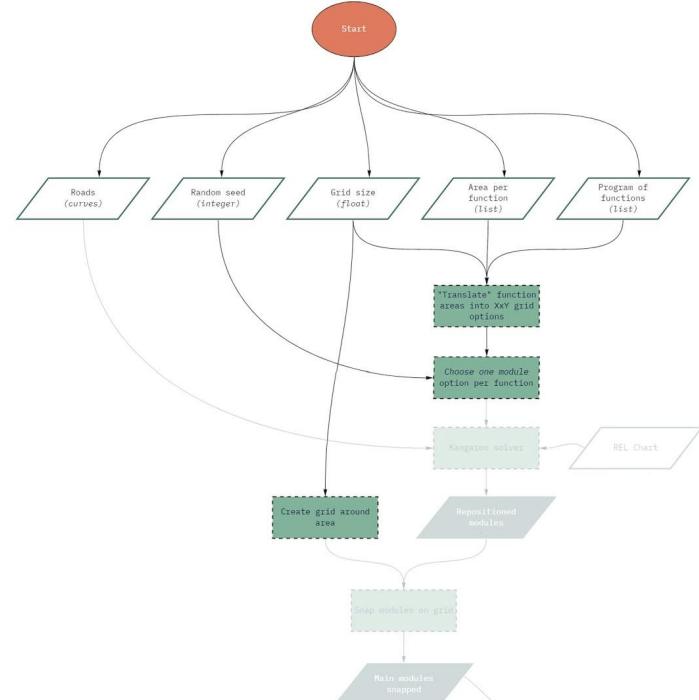
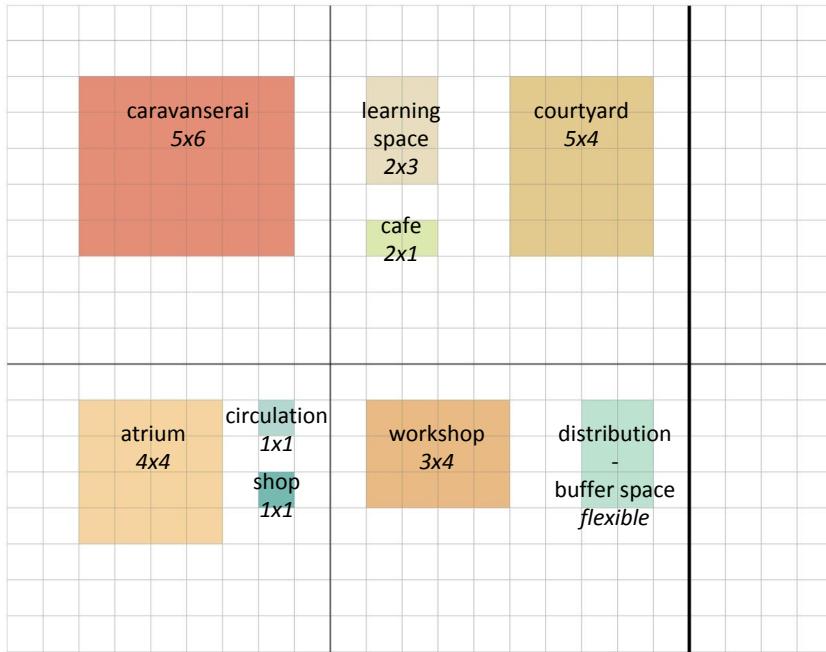
Program of requirements - Table of functions

		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

Program of requirements - REL chart & Bubble diagram

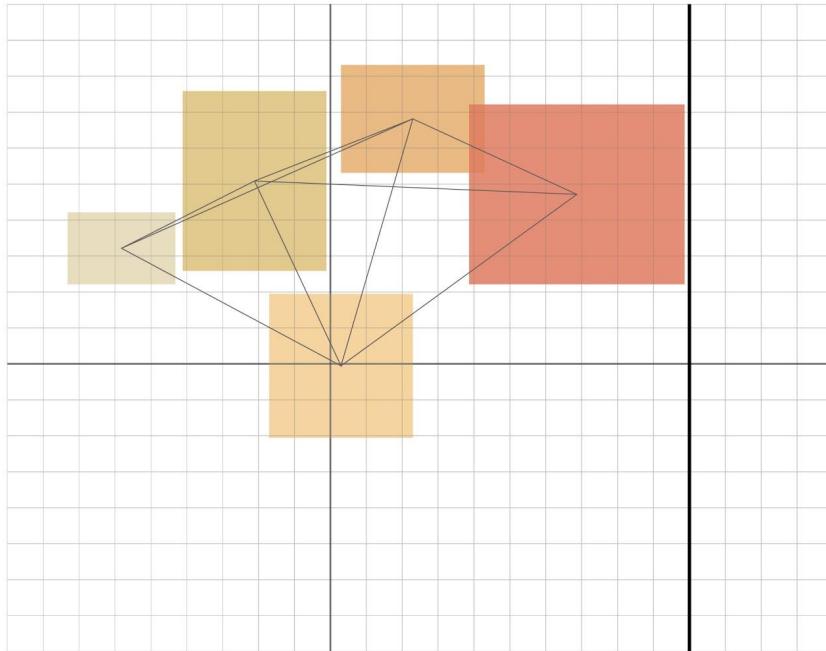


Layout tool - Phase 1 - Function elements

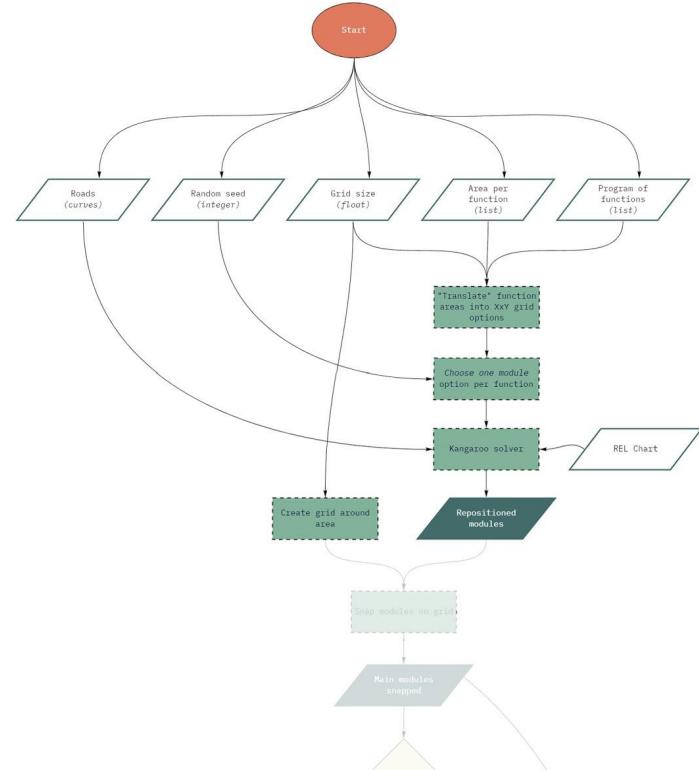


Layout tool - Phase 1 - Step 1.1

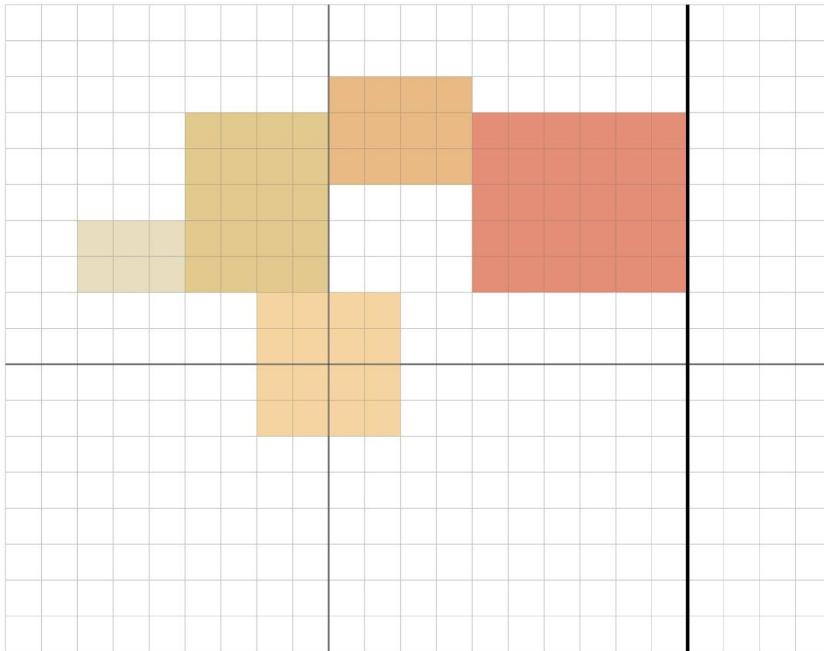
Layout tool - Phase 1 - Function elements



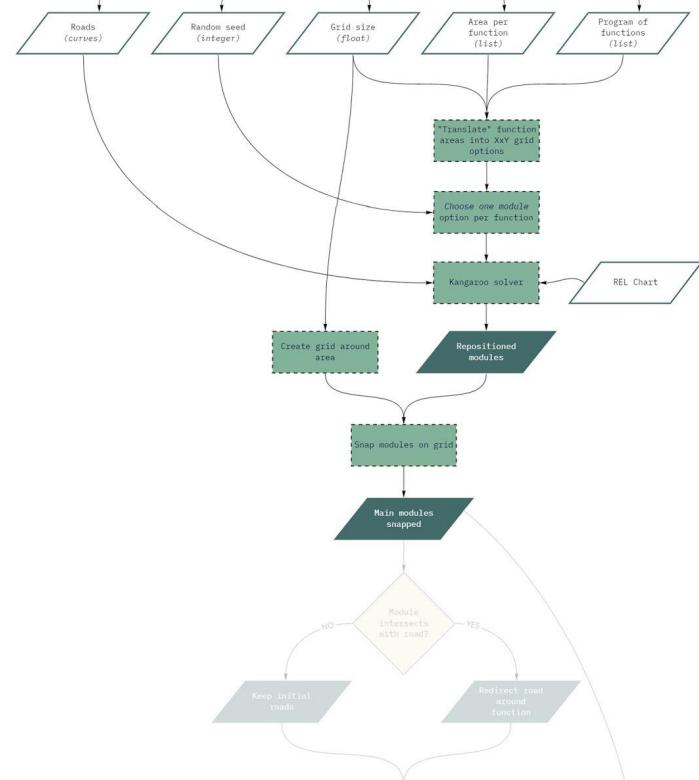
Layout tool - Phase 1 - Step 1.2



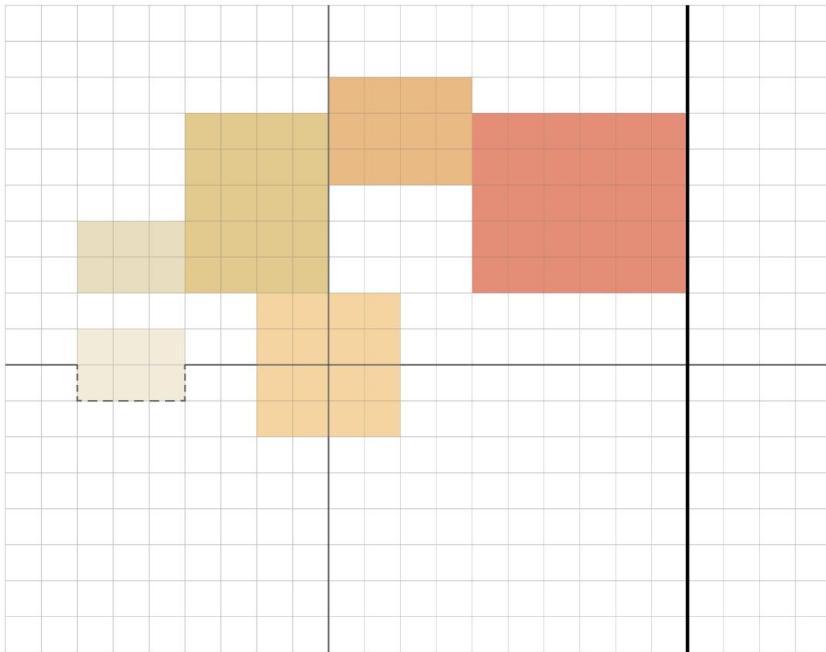
Layout tool - Phase 1 - Function elements



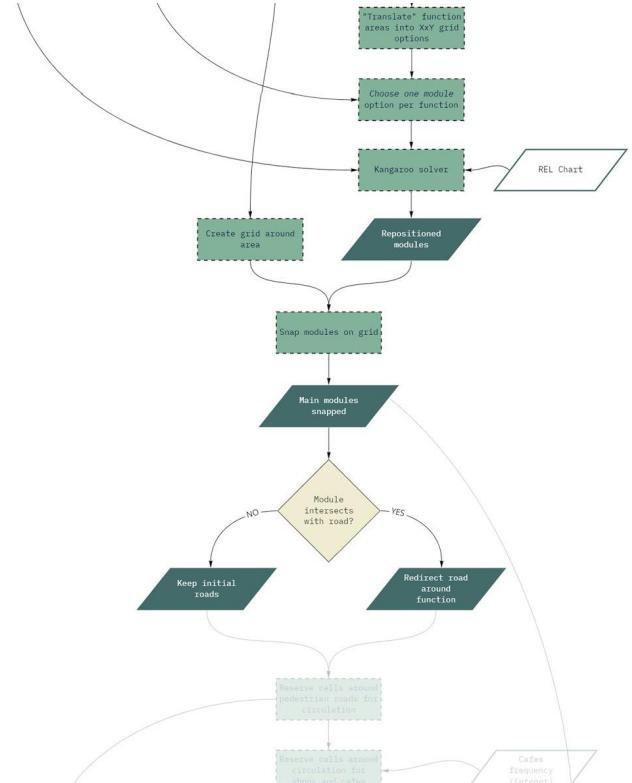
Layout tool - Phase 1 - Step 1.3



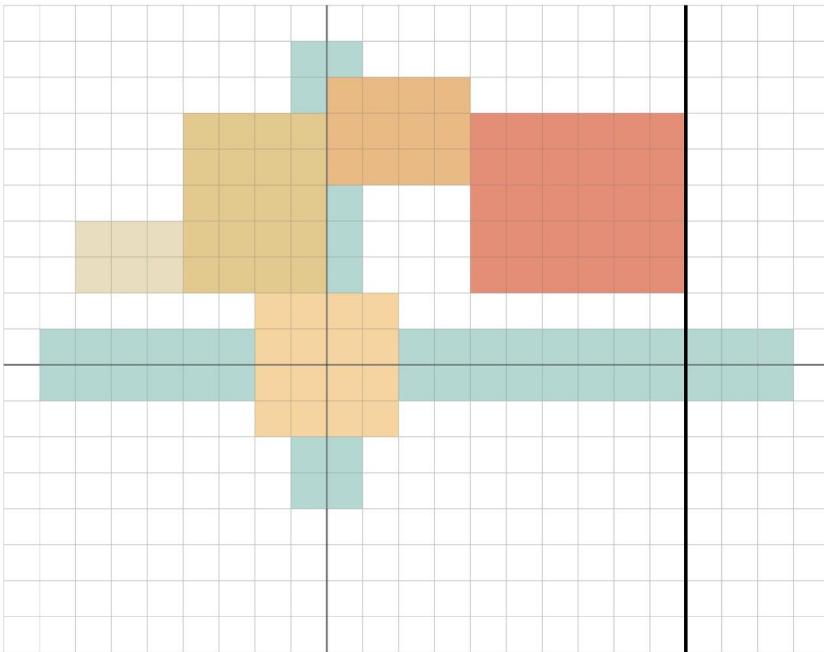
Layout tool - Phase 1 - Function elements



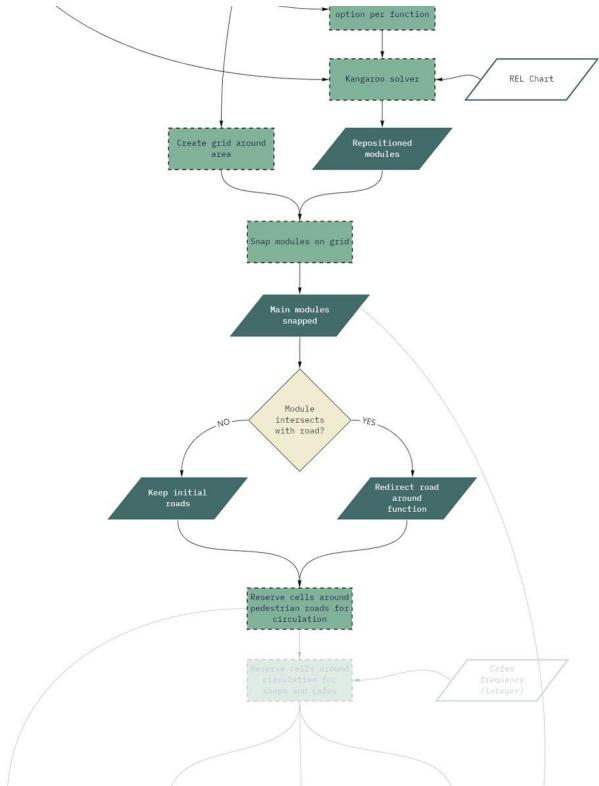
Layout tool - Phase 1 - Step 1.4



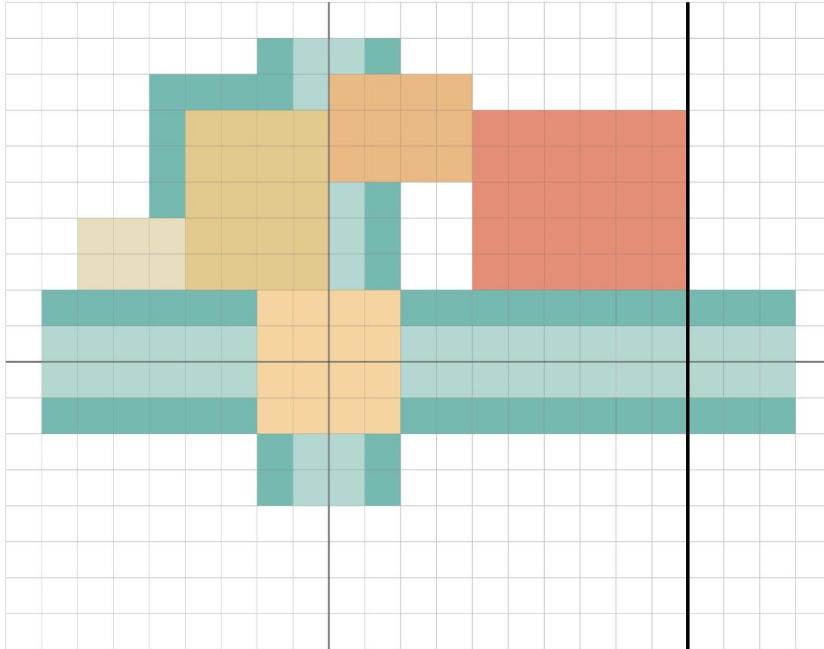
Layout tool - Phase 1 - Function elements



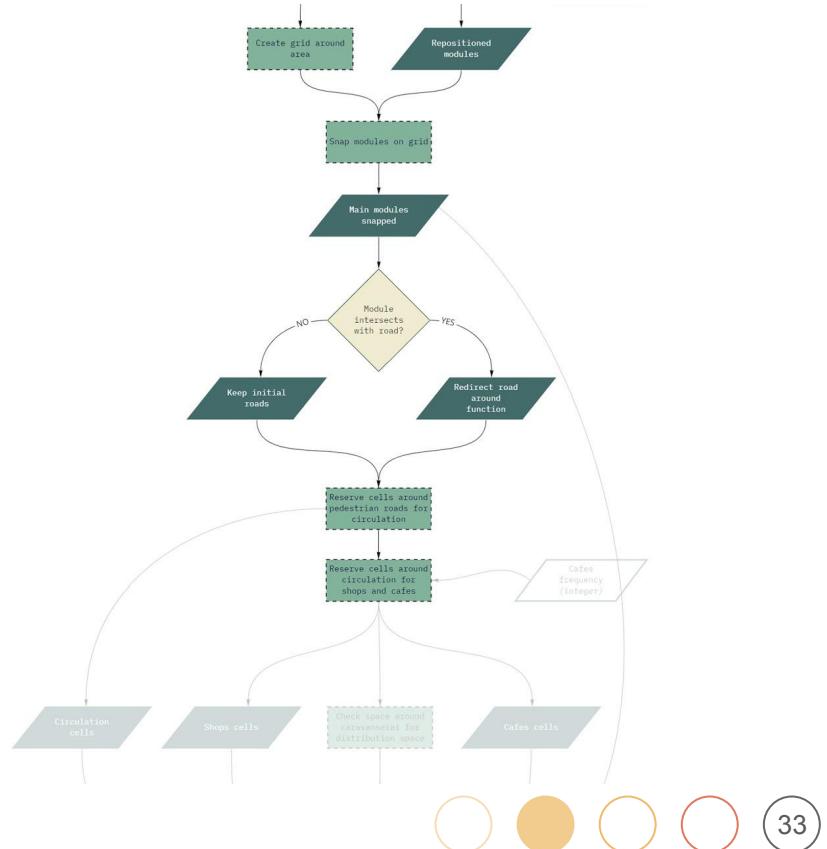
Layout tool - Phase 1 - Step 1.5



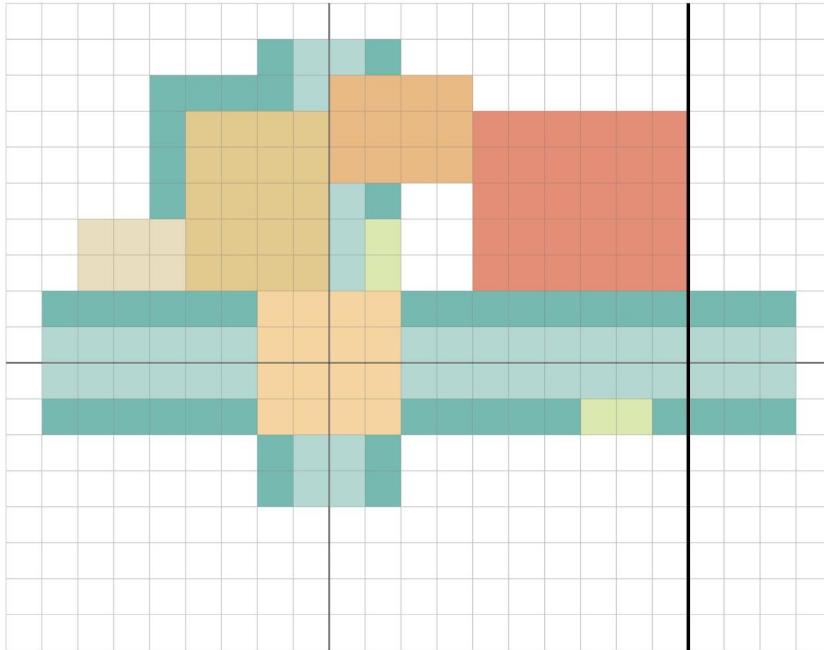
Layout tool - Phase 1 - Function elements



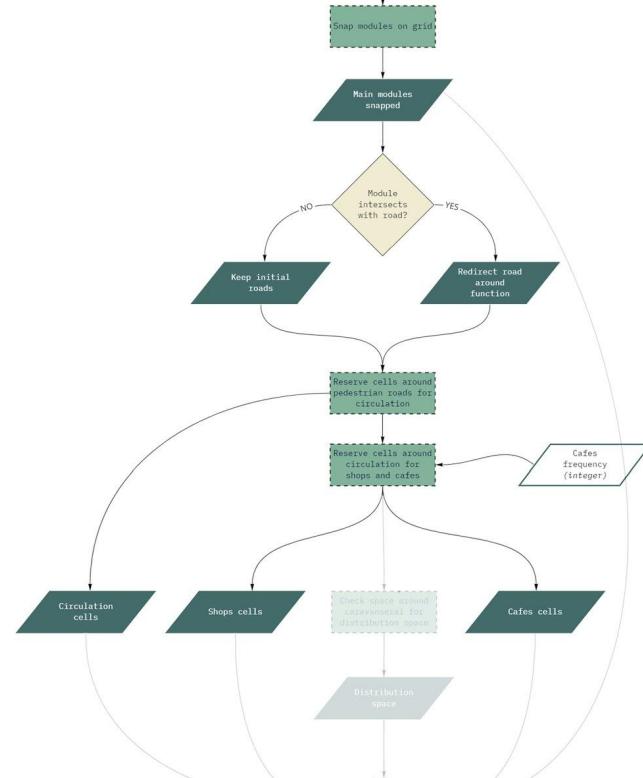
Layout tool - Phase 1 - Step 1.6



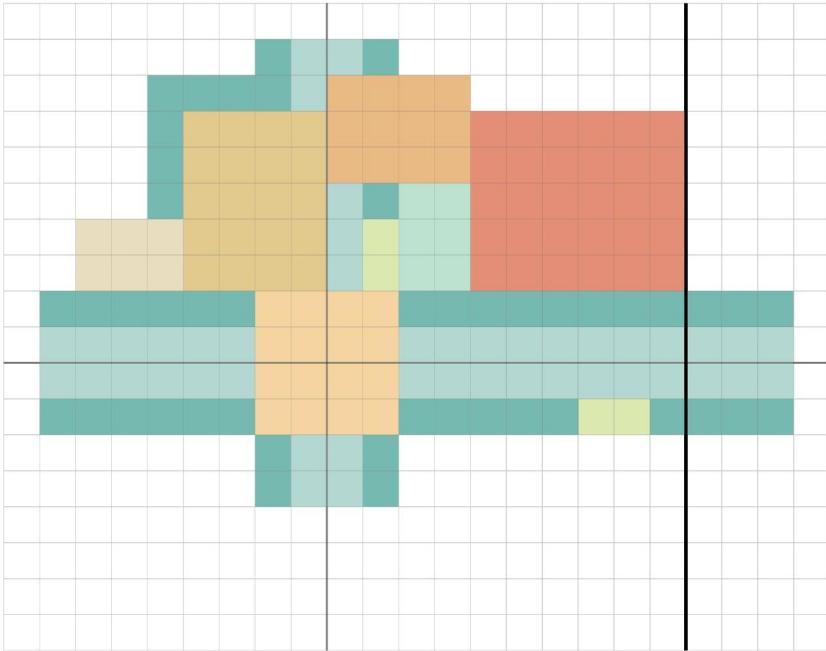
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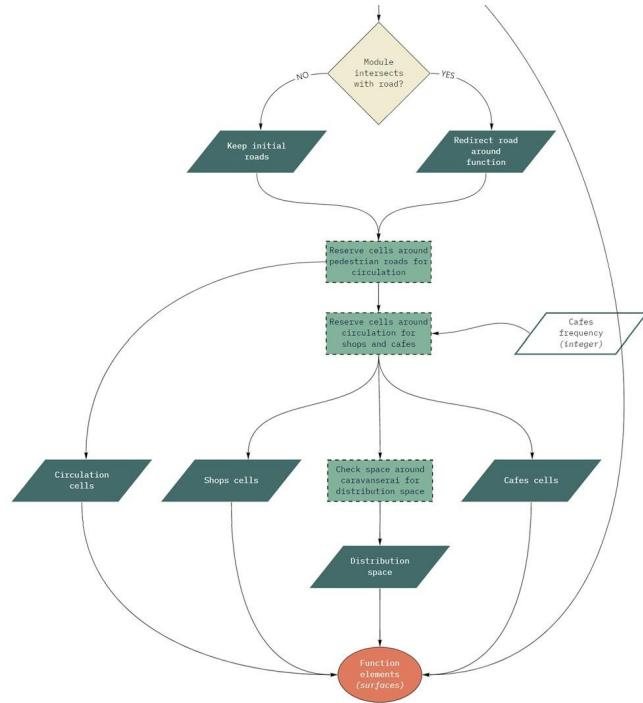
Layout tool - Phase 1 - Step 1.7



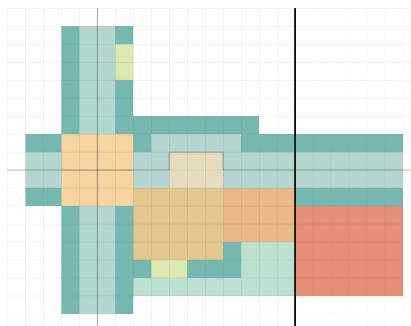
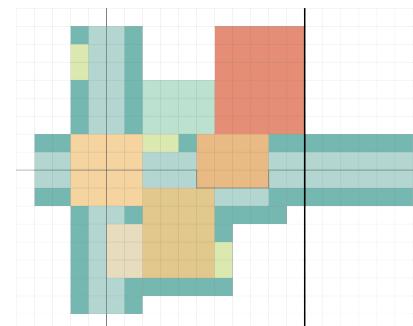
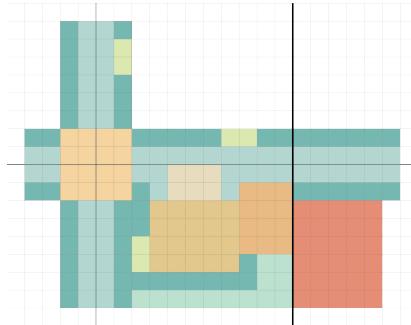
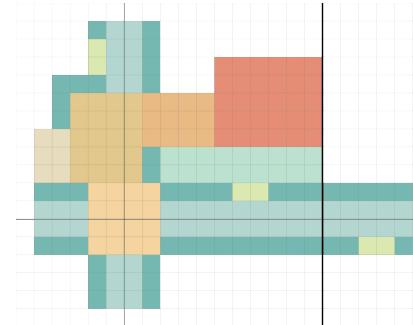
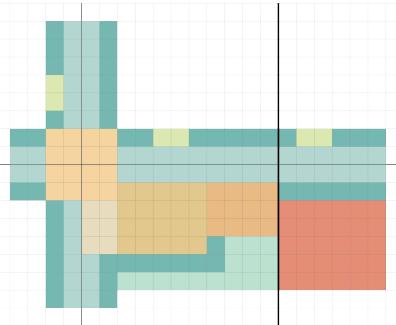
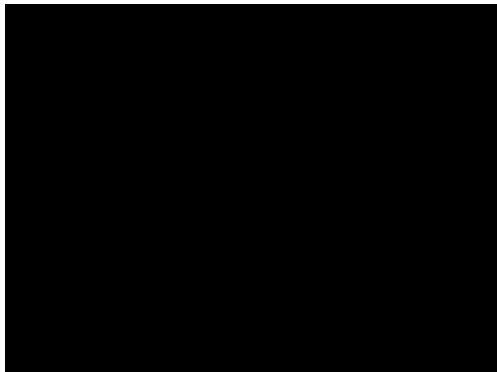
Layout tool - Phase 1 - Function elements



Layout tool - Phase 1 - Step 1.8

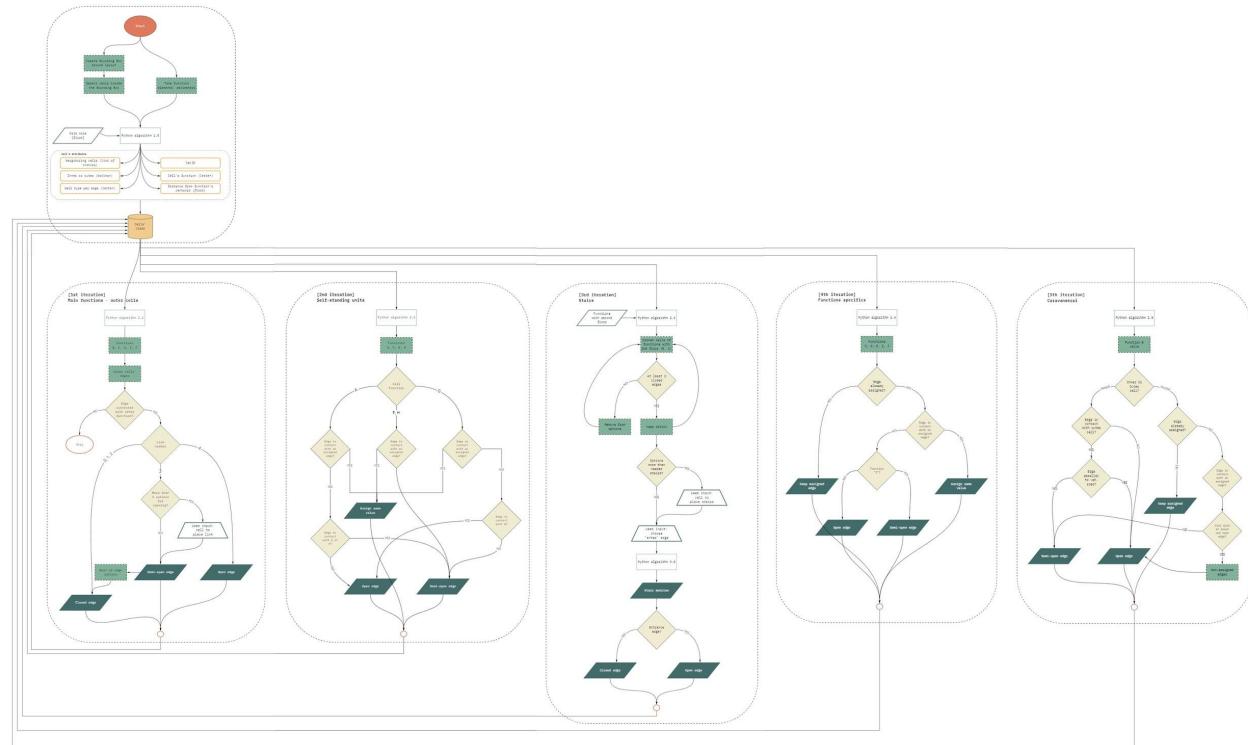


Layout tool - Phase 1 - Demonstration & Alternatives



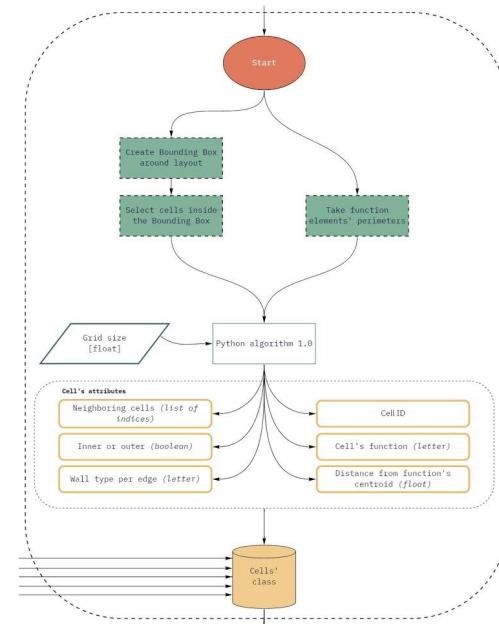
Functions' configuration alternatives

Layout tool - Phase 2 - Building modules

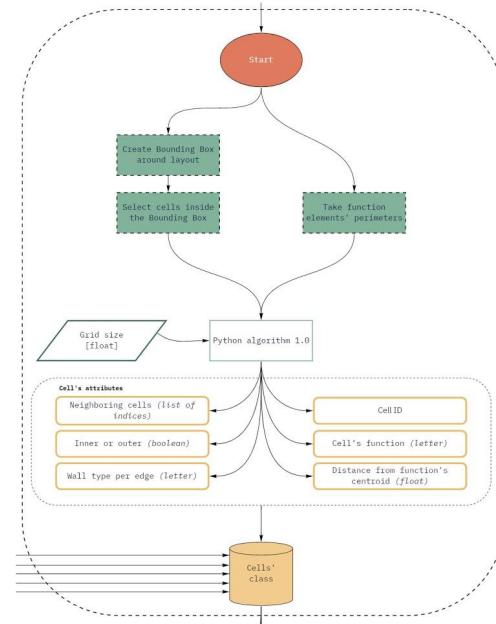
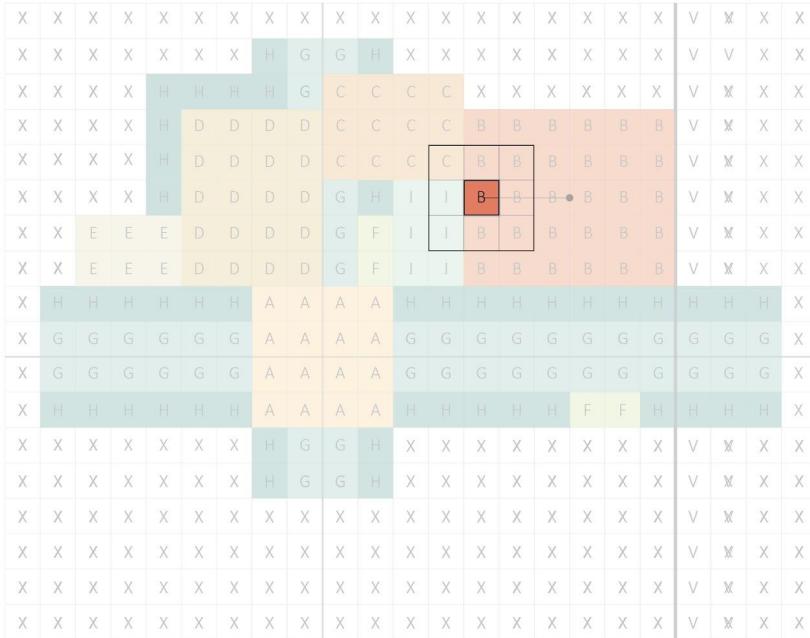


Layout tool - Phase 2 - Building modules

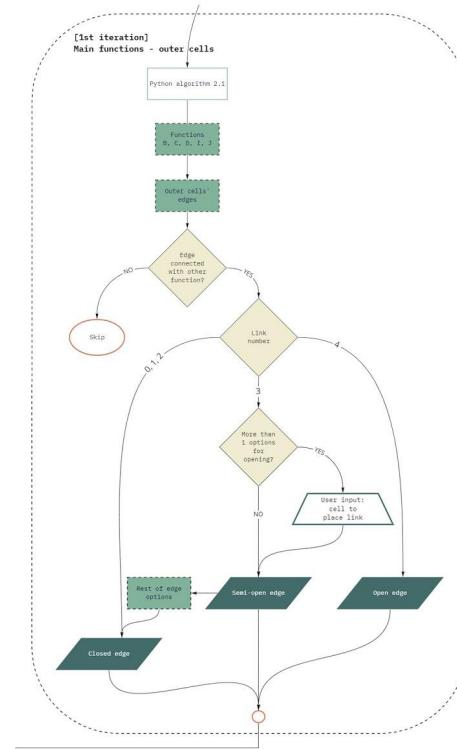
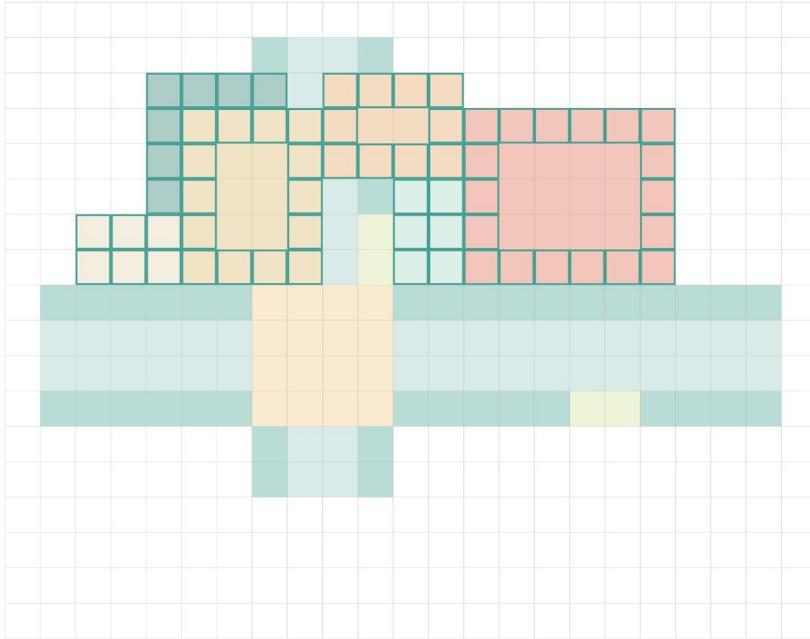
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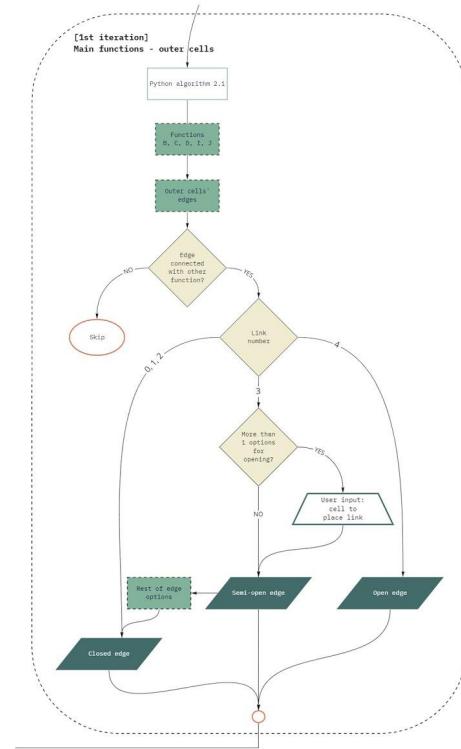
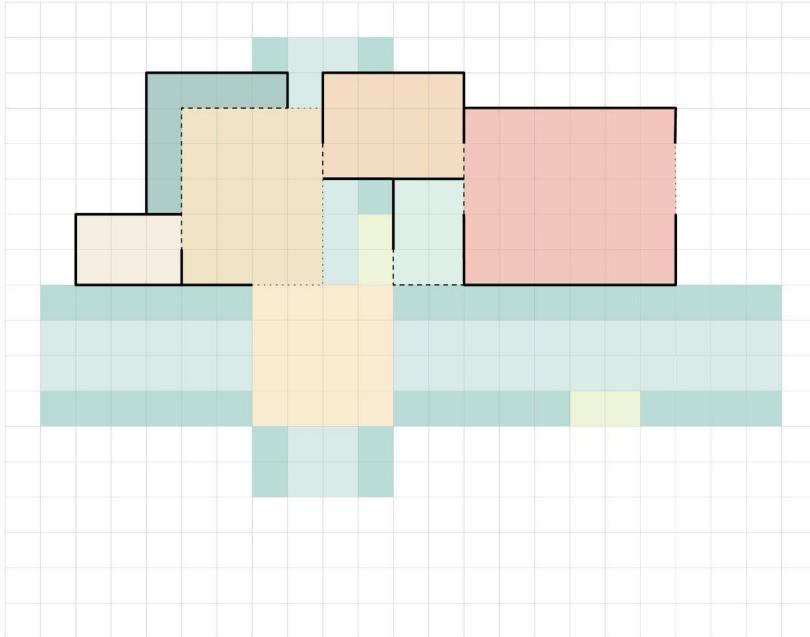
Layout tool - Phase 2 - Building modules



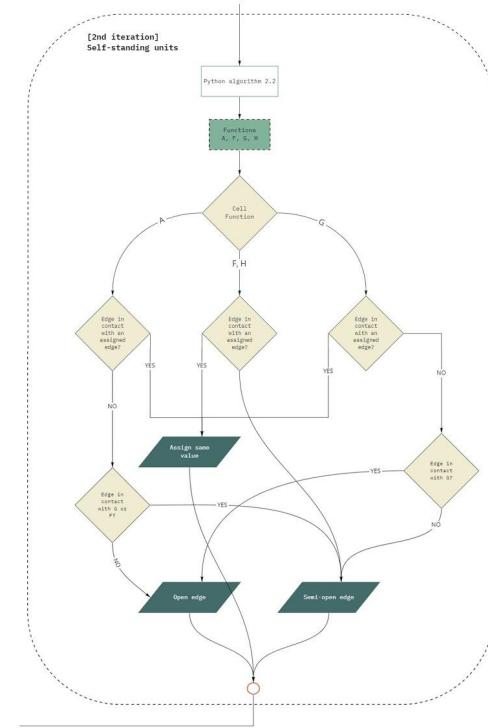
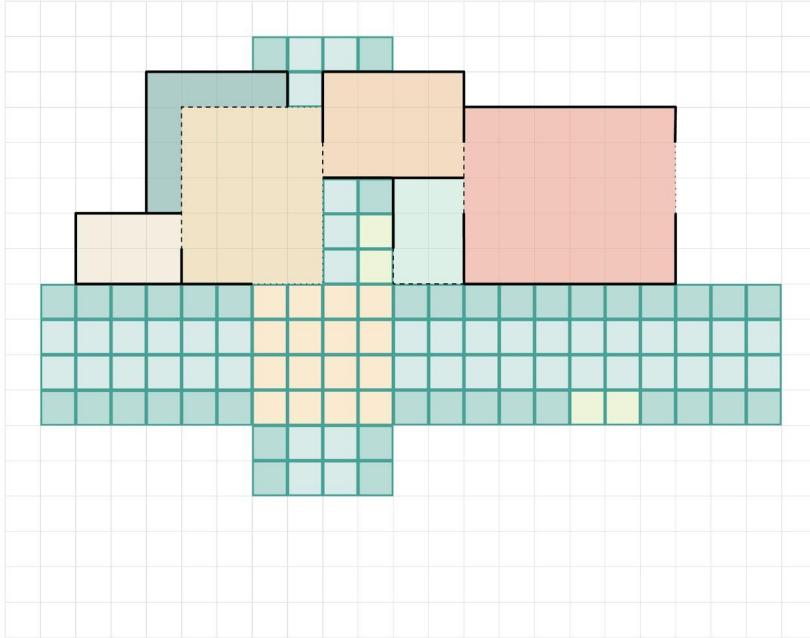
Layout tool - Phase 2 - Building modules



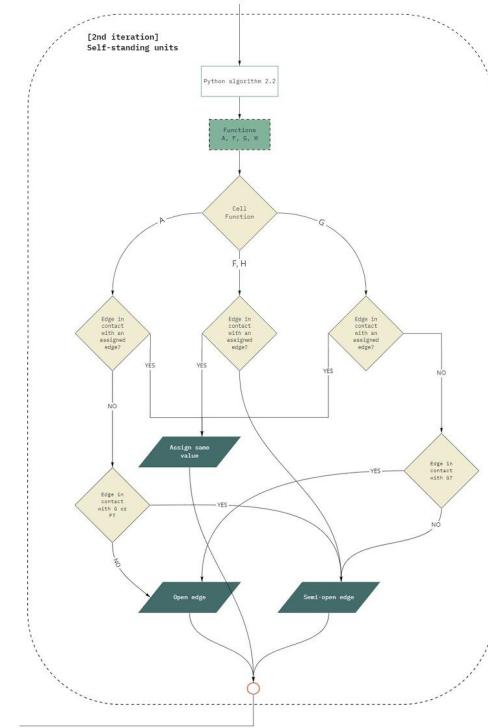
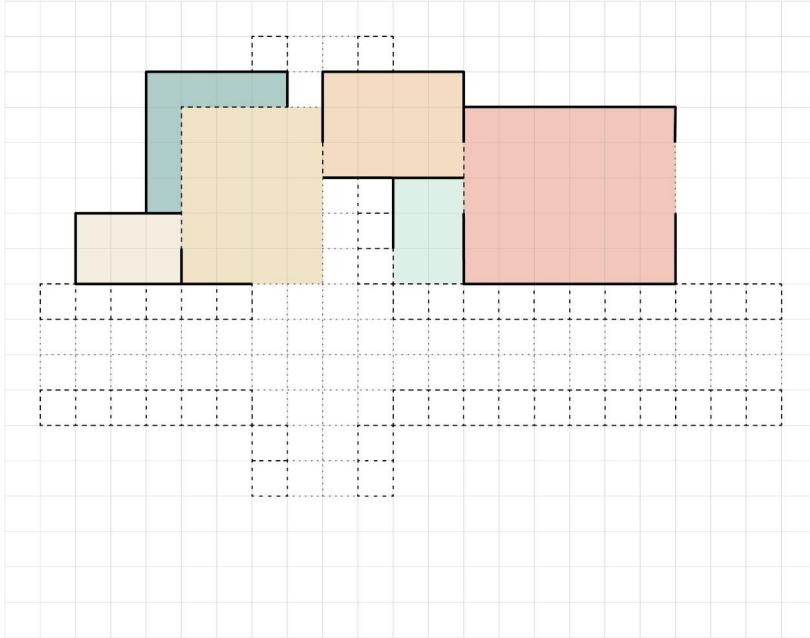
Layout tool - Phase 2 - Building modules



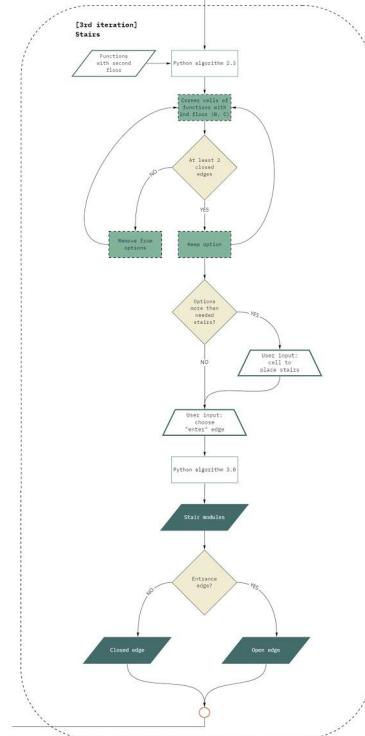
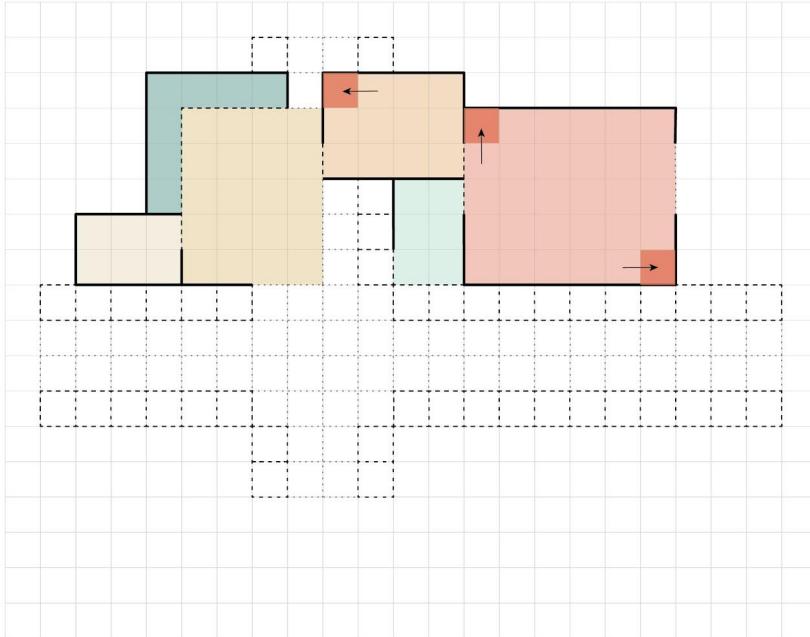
Layout tool - Phase 2 - Building modules



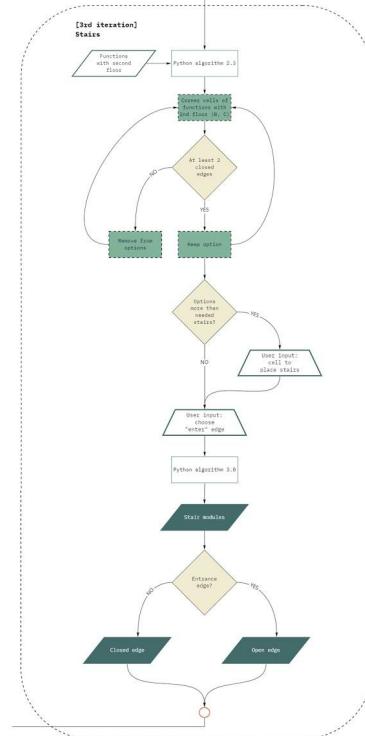
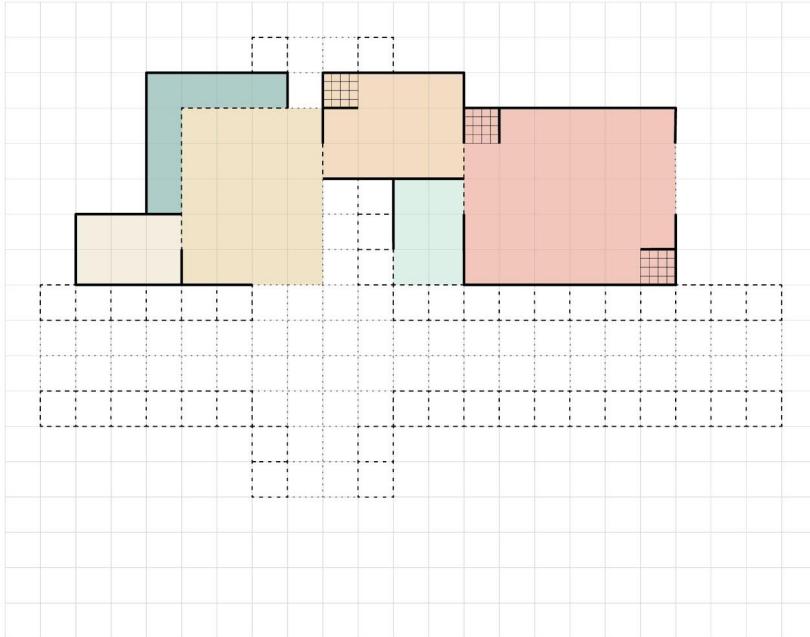
Layout tool - Phase 2 - Building modules



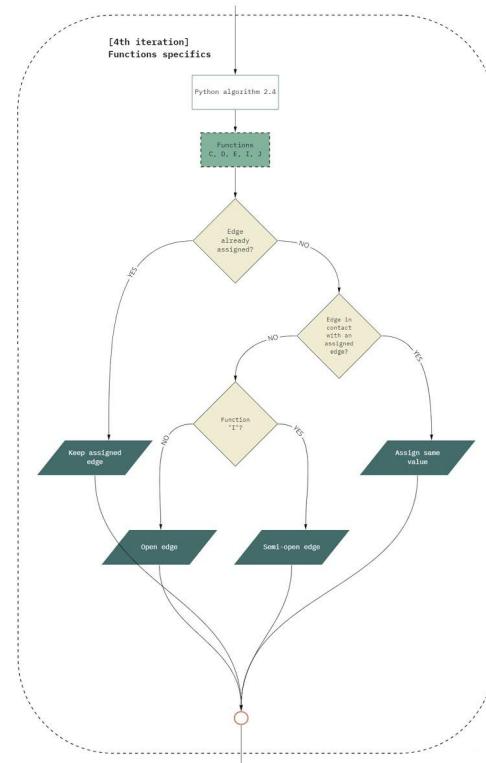
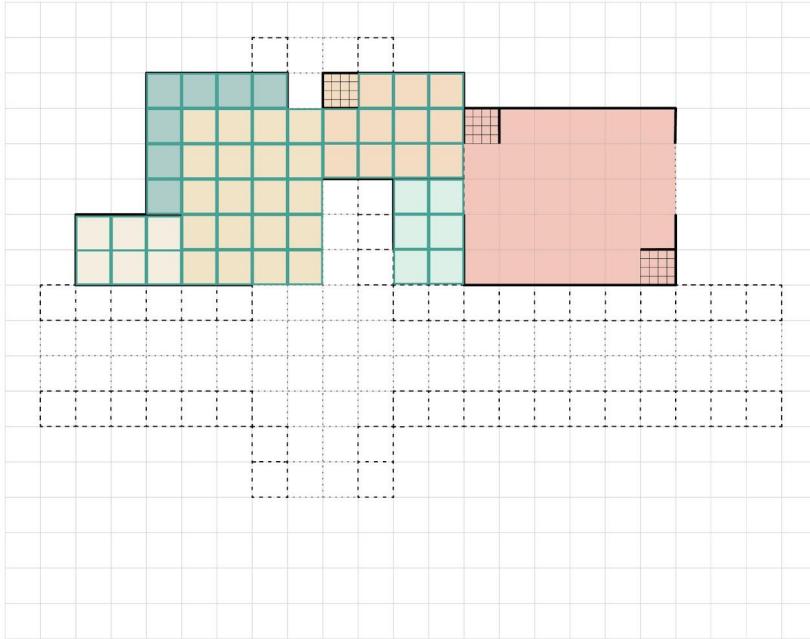
Layout tool - Phase 2 - Building modules



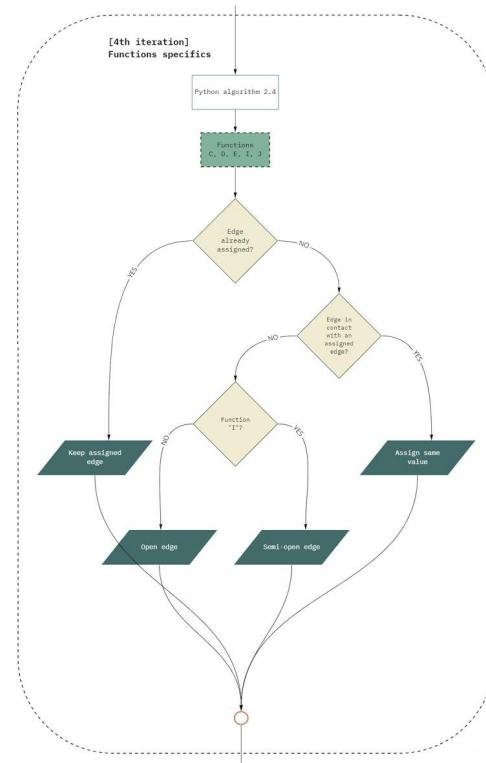
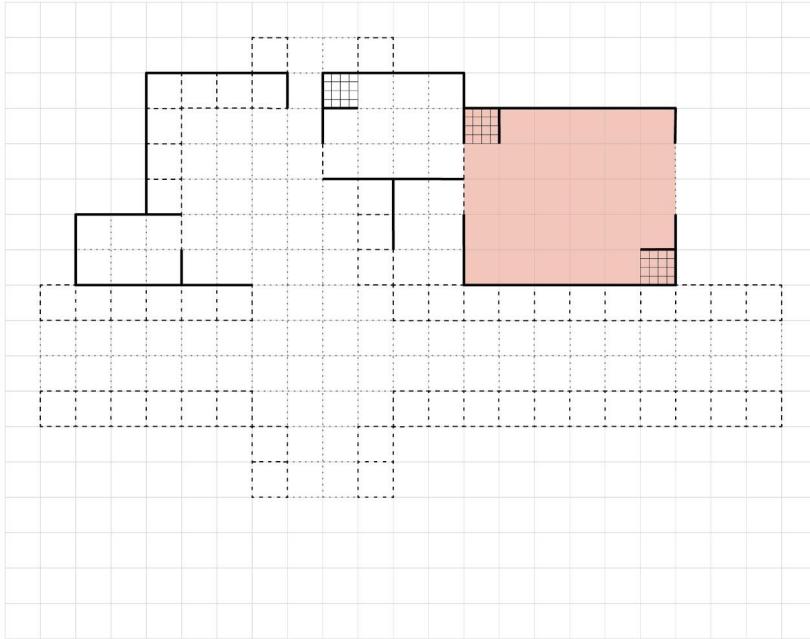
Layout tool - Phase 2 - Building modules



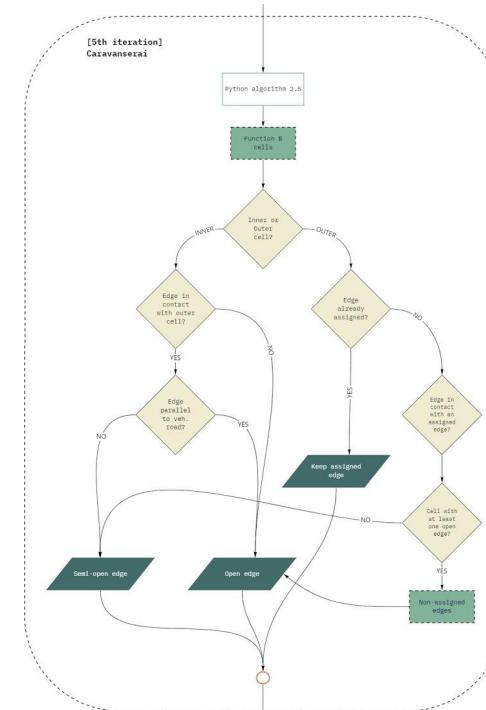
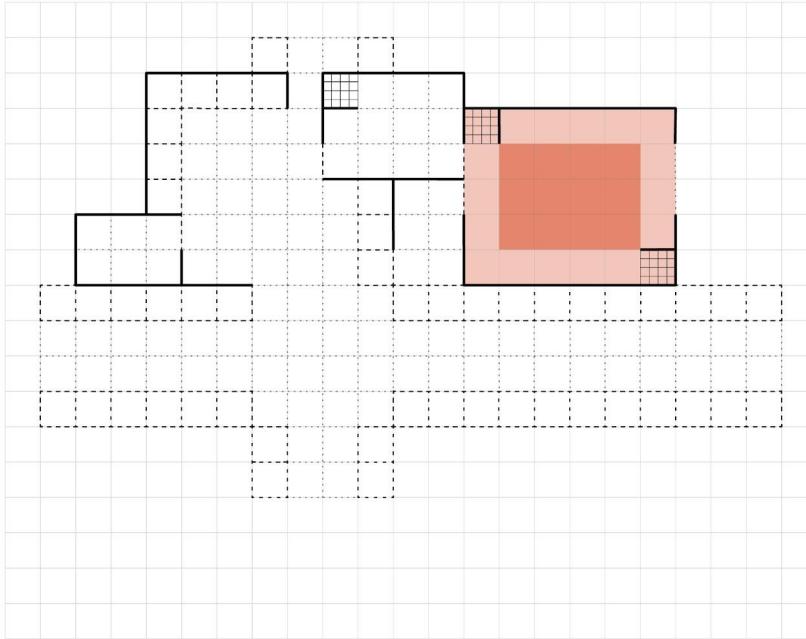
Layout tool - Phase 2 - Building modules



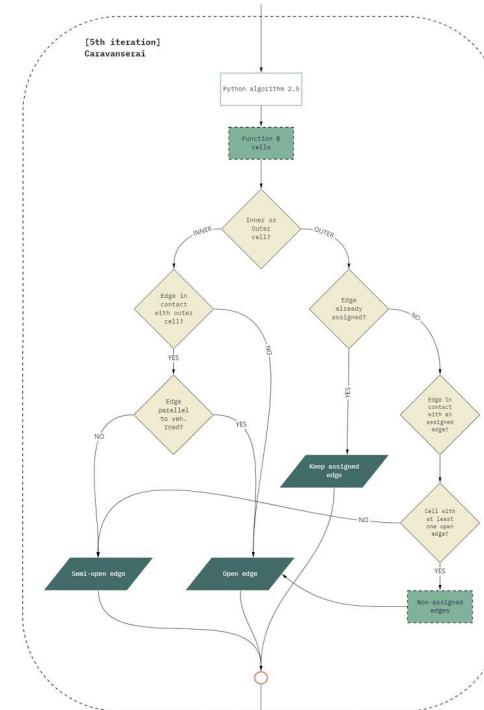
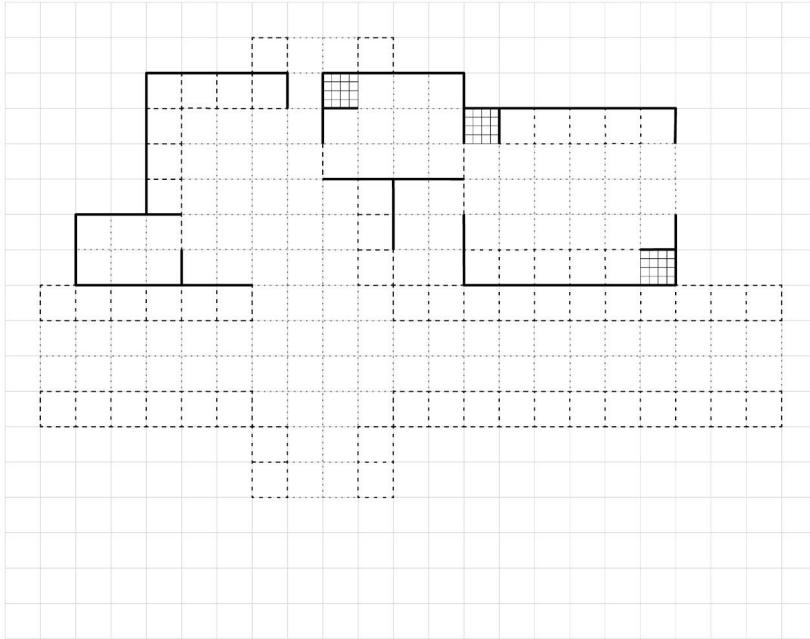
Layout tool - Phase 2 - Building modules



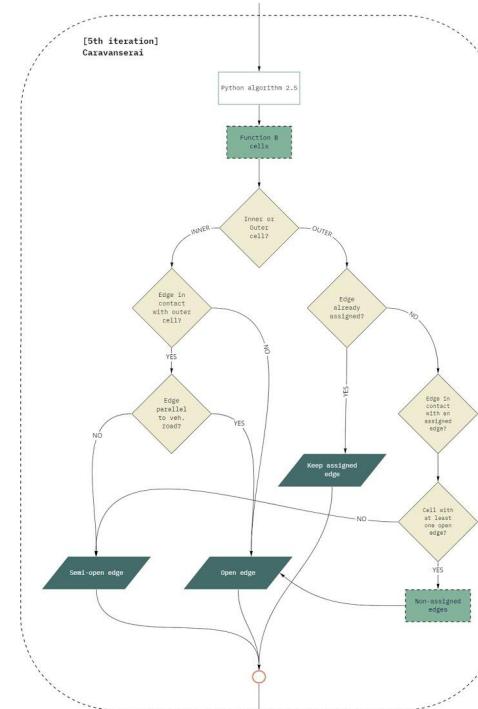
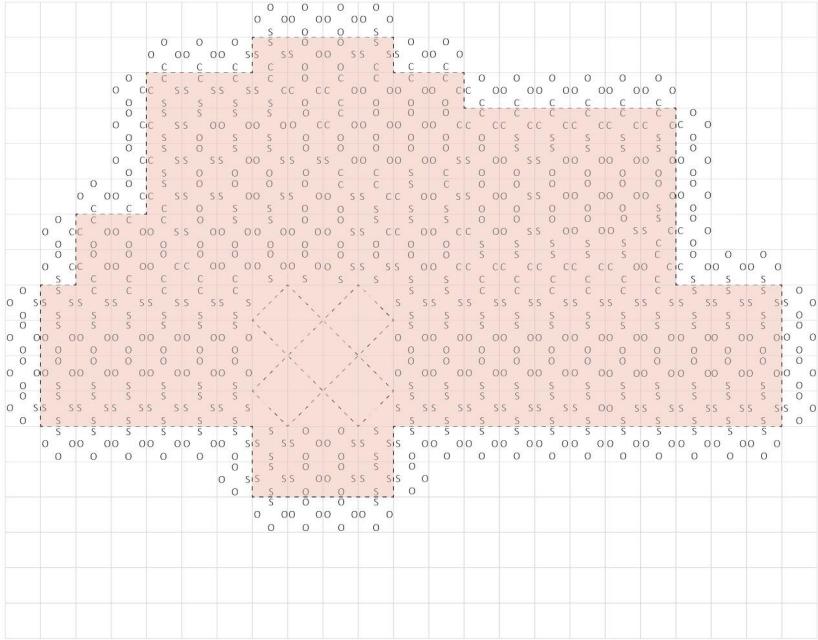
Layout tool - Phase 2 - Building modules



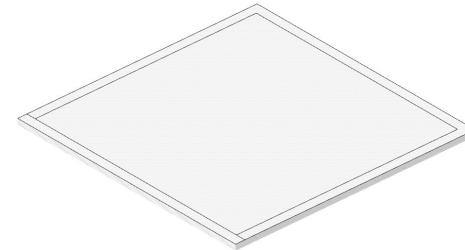
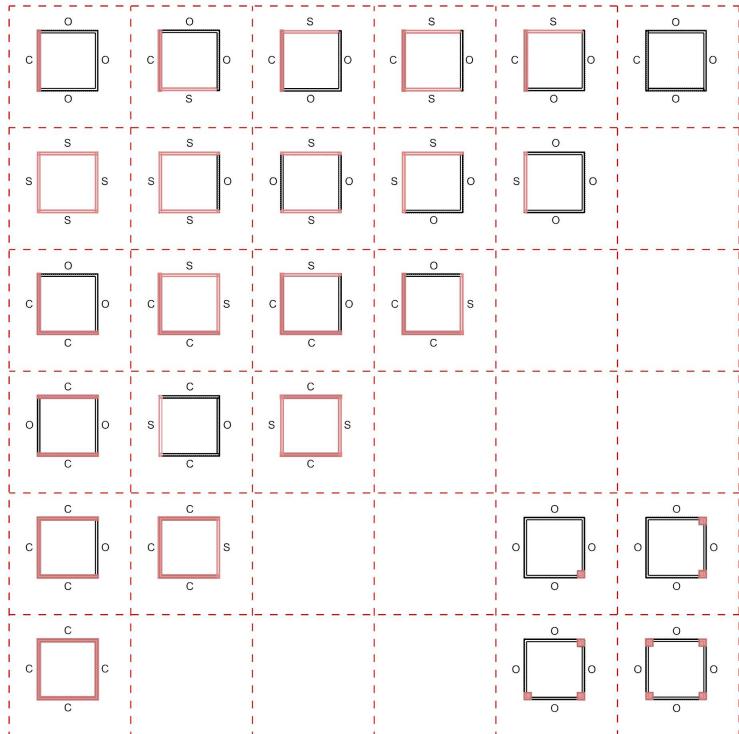
Layout tool - Phase 2 - Building modules



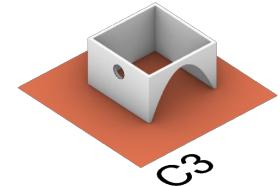
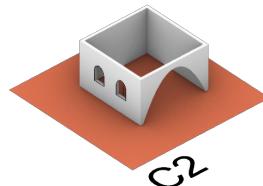
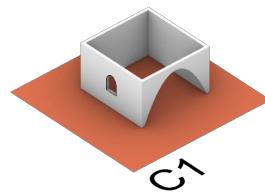
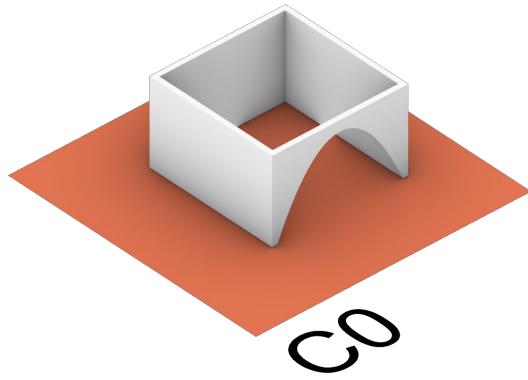
Layout tool - Phase 2 - Building modules



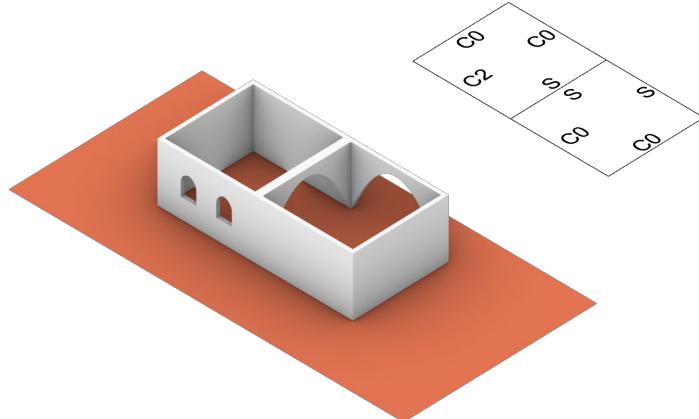
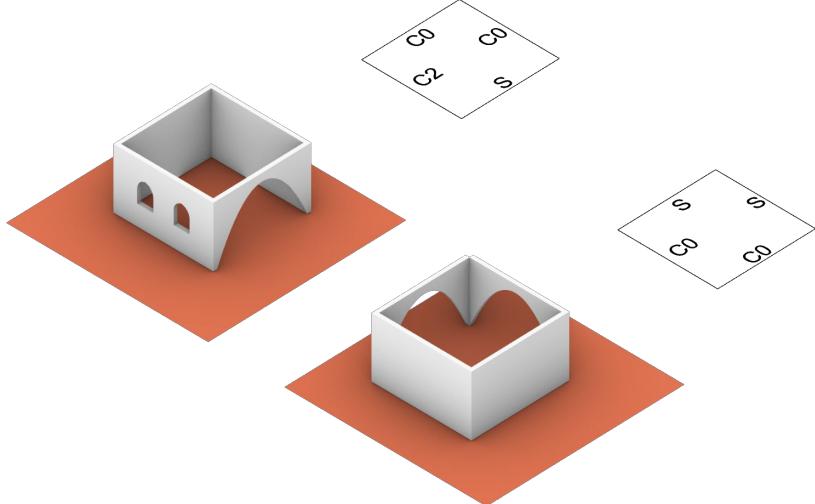
Building elements - Wall modules



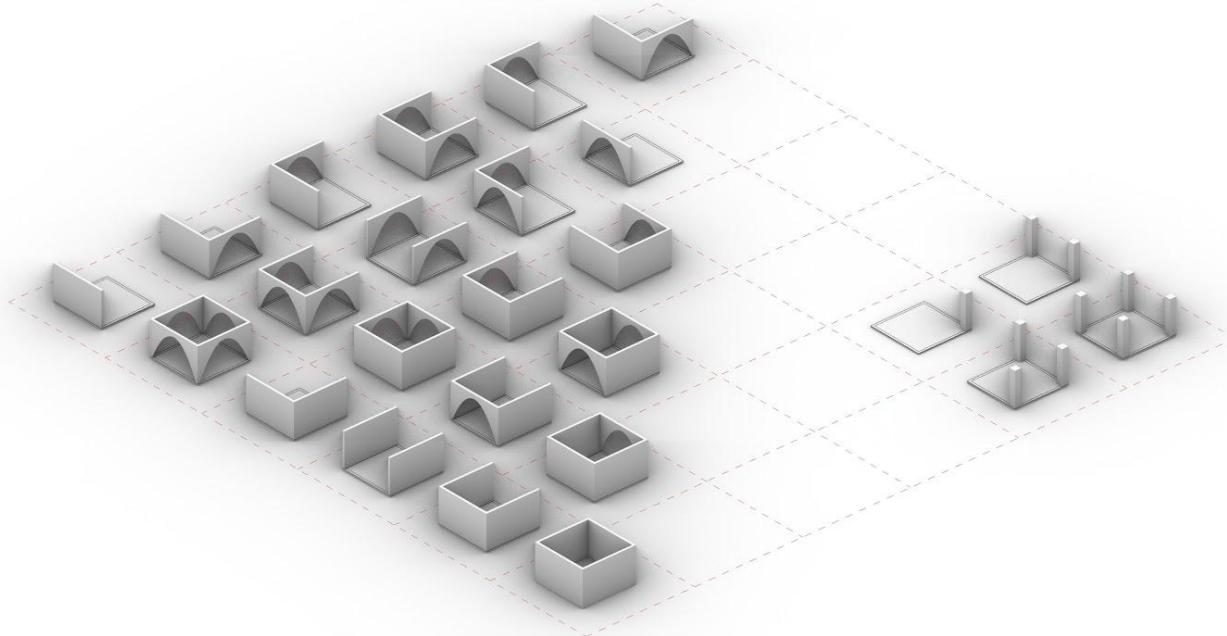
Building modules - Wall modules



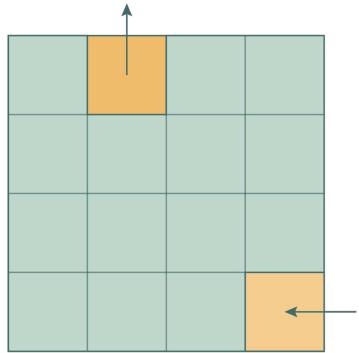
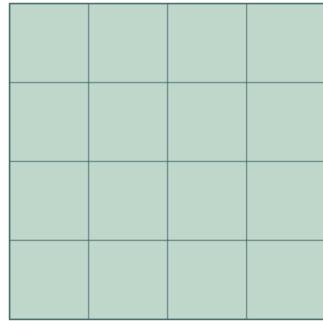
Building modules - Wall modules



Building modules - Wall modules library

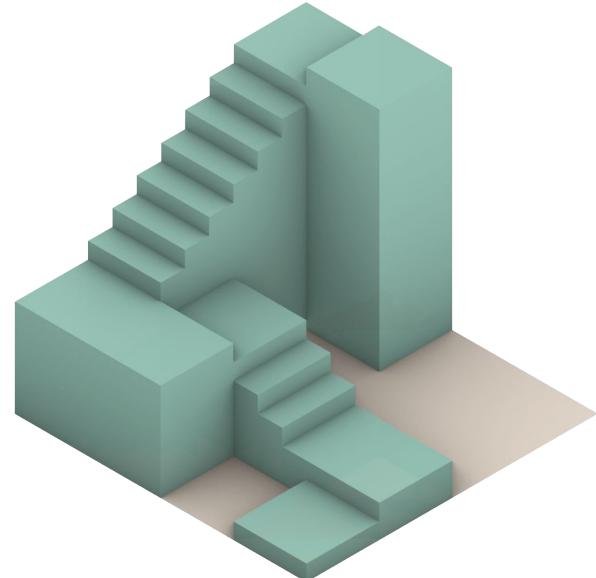


Building modules - Stair modules

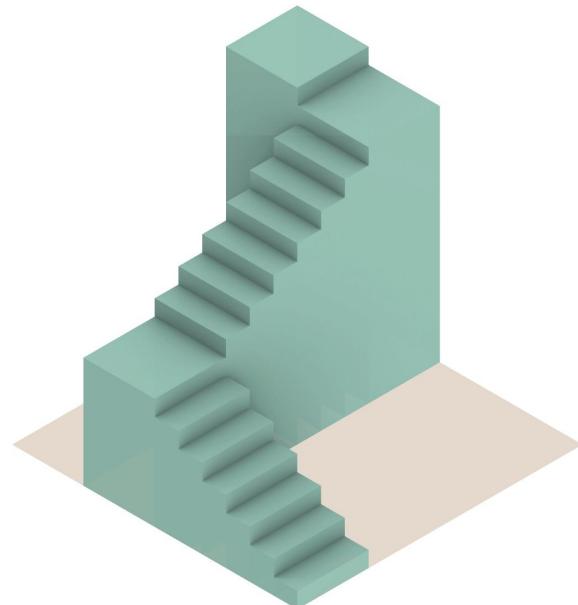


8	9		
7			
6	3	2	1
5	4		0

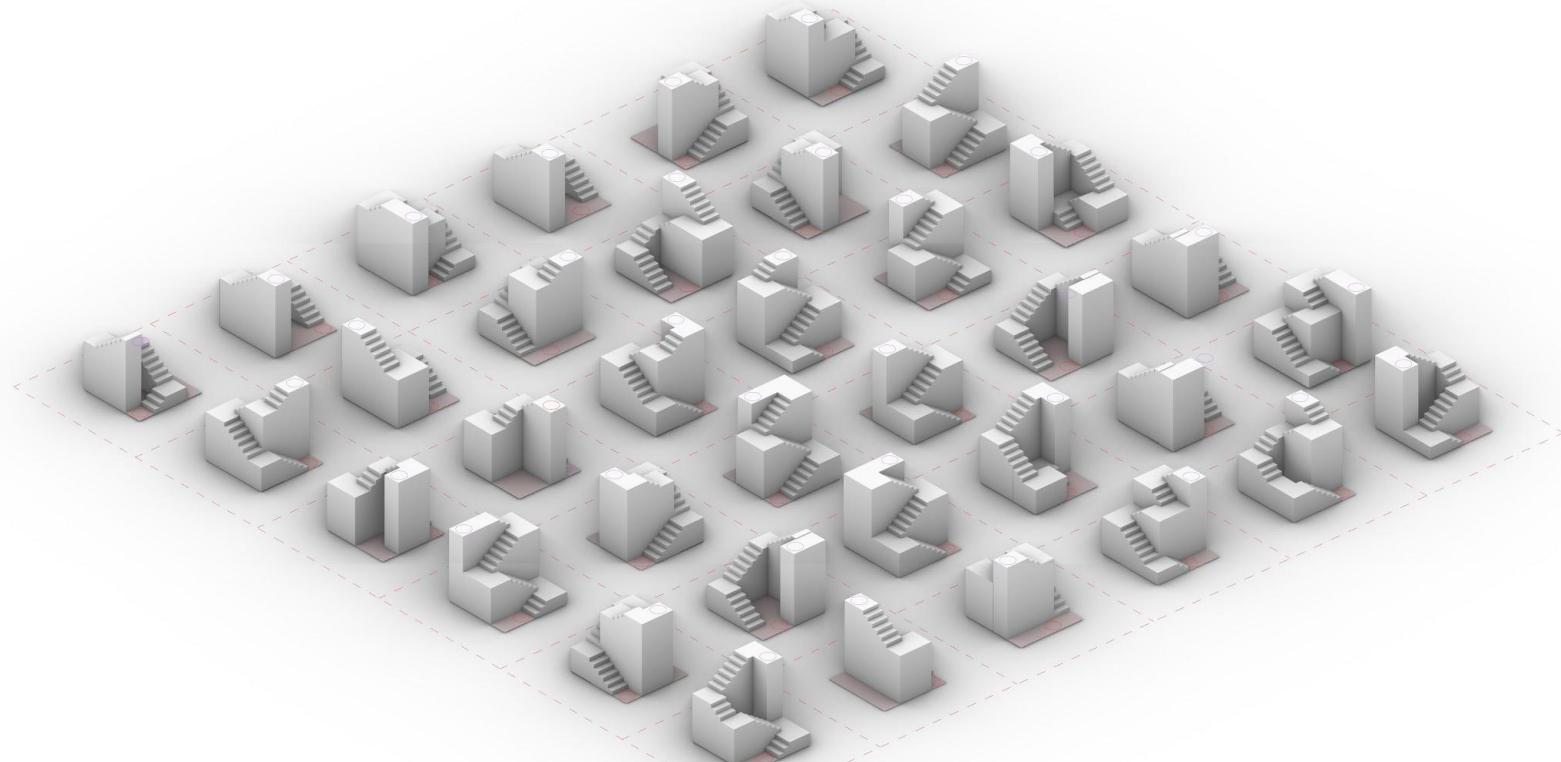
13	14		
12			
11			
10			
9			
8			
7			
6	5	4	3
	2		1
			0



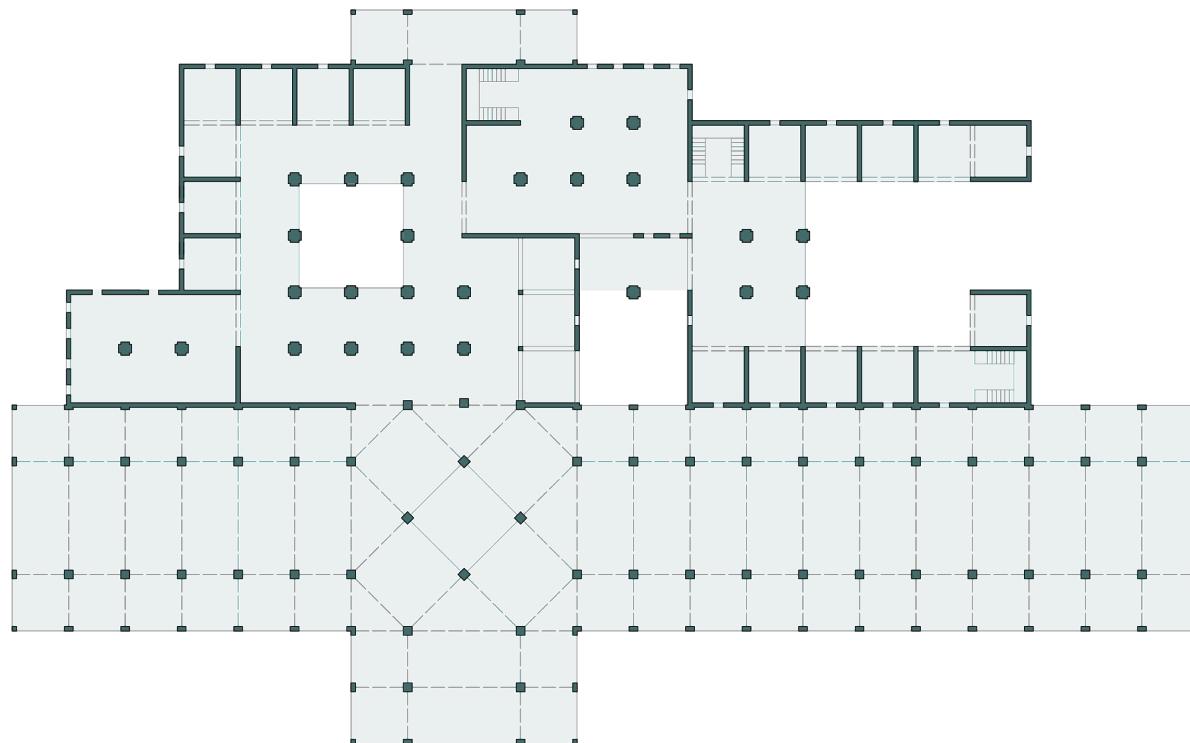
Building modules - Stair modules

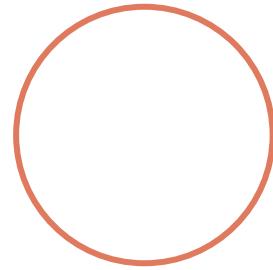
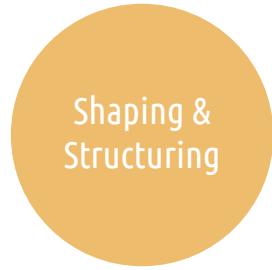
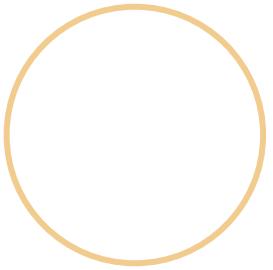
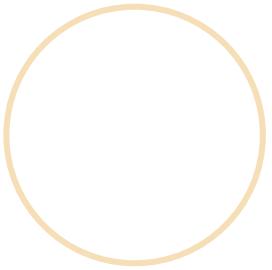


Building modules - Stair modules library

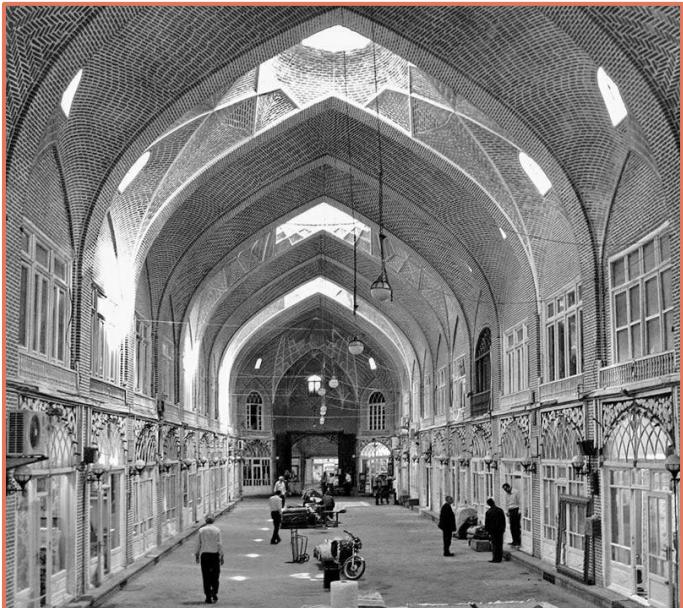


Floor plan - Chosen example





Building system - Concept



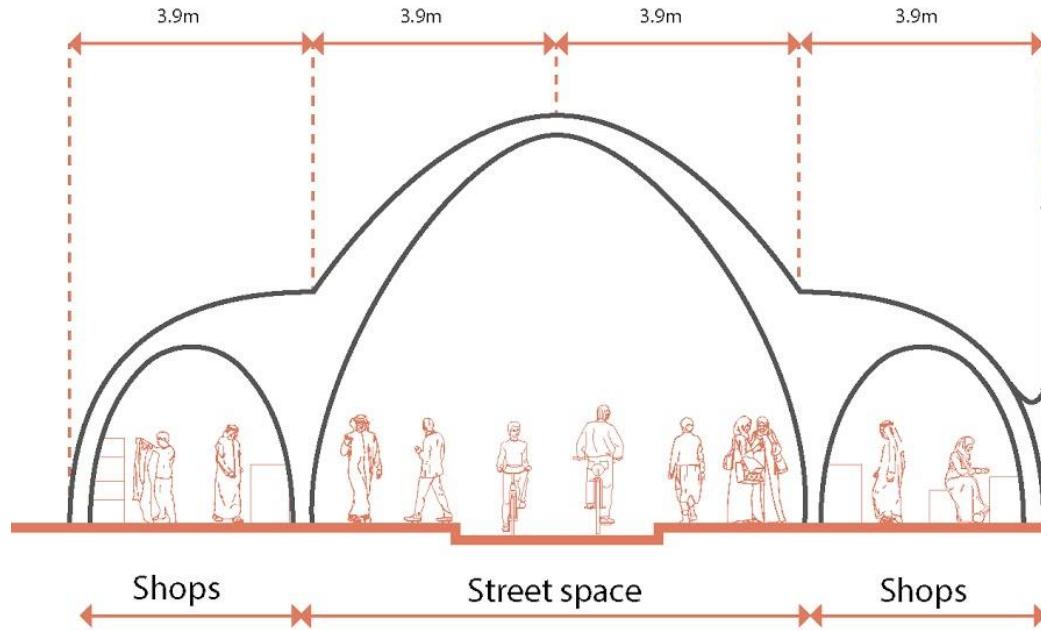
Structured

+

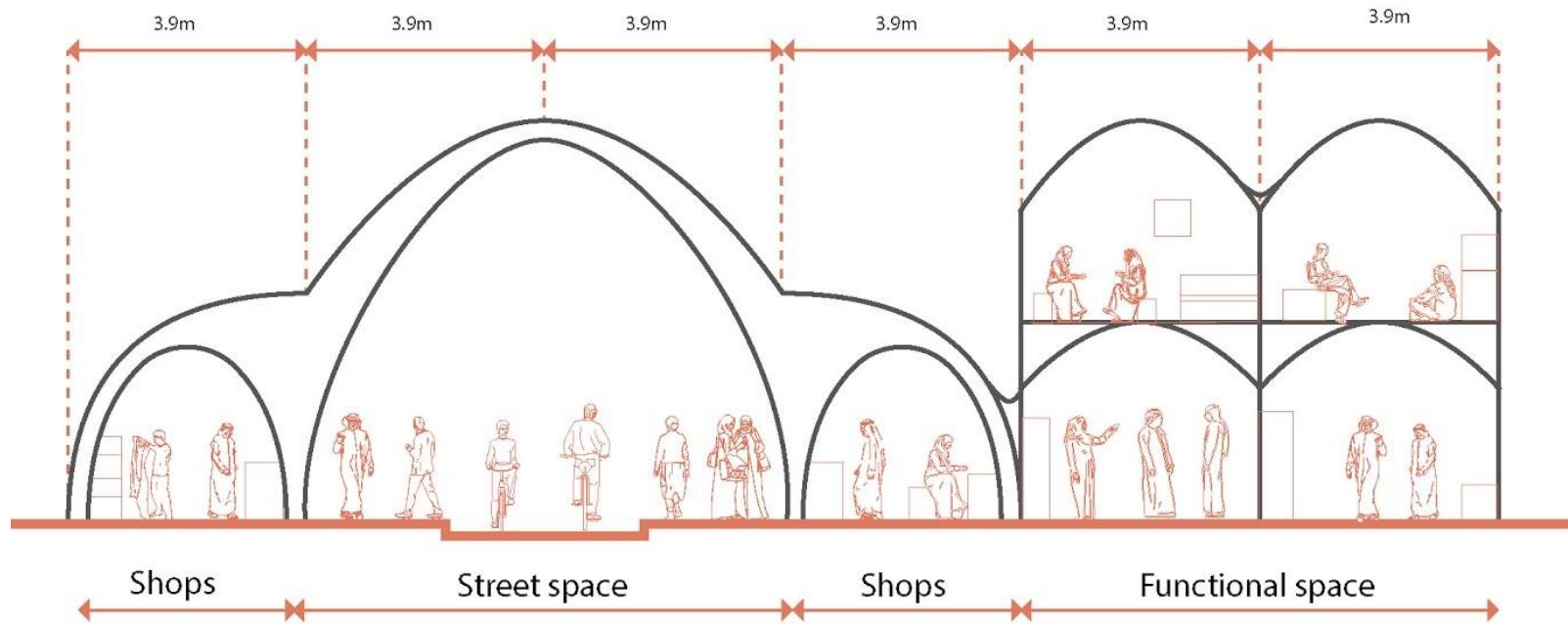


Informal

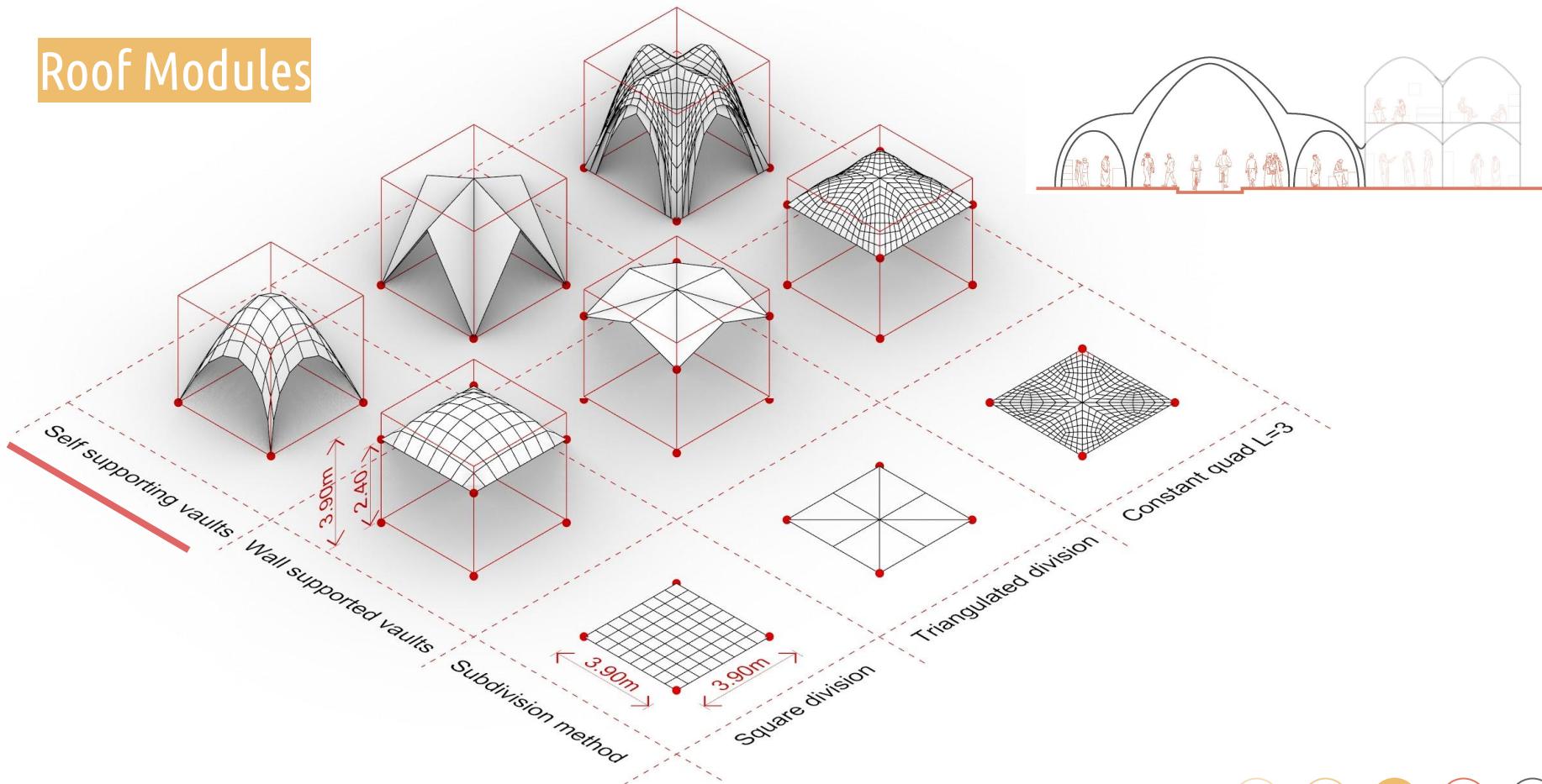
Roof modules - Concept



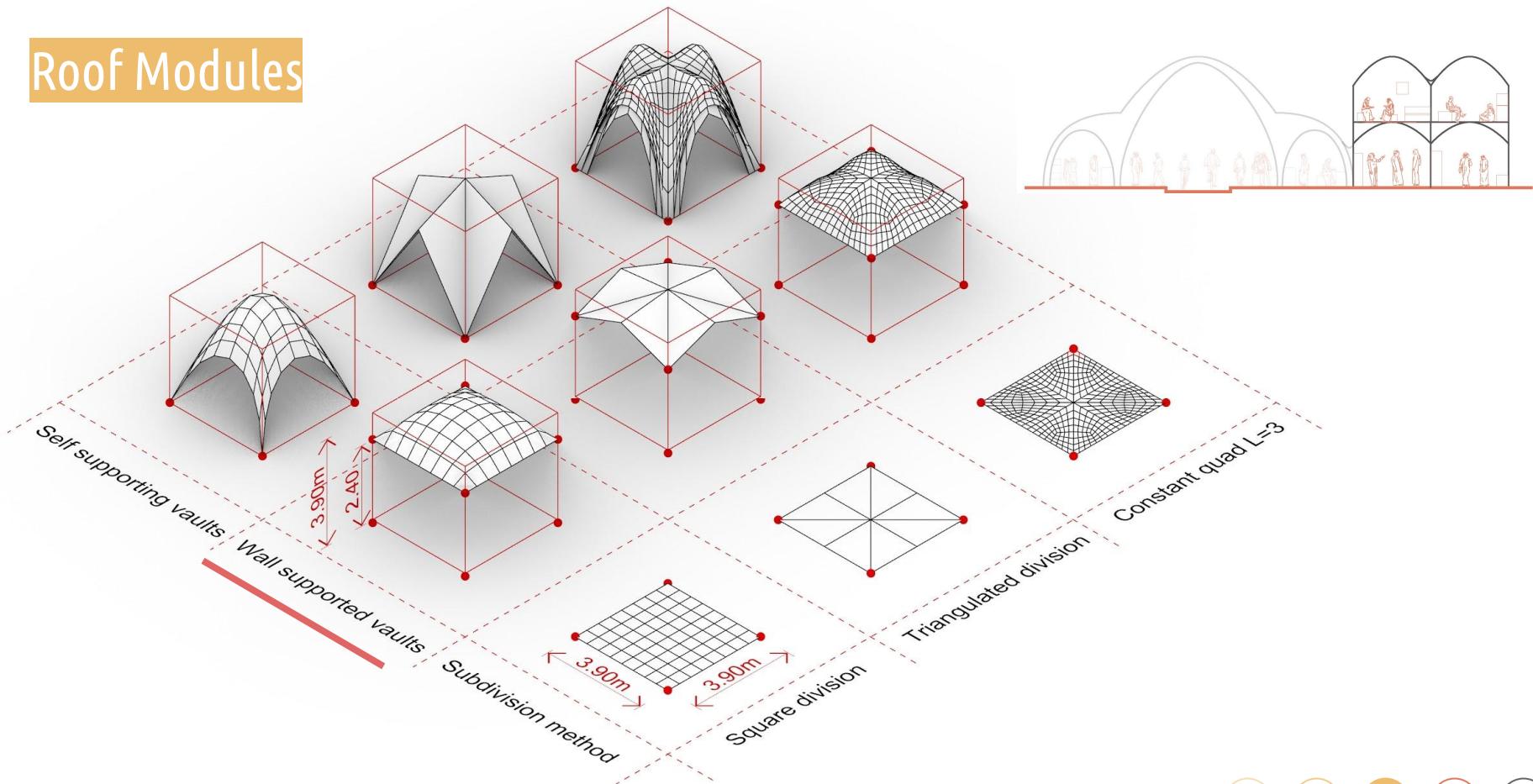
Roof modules - Concept



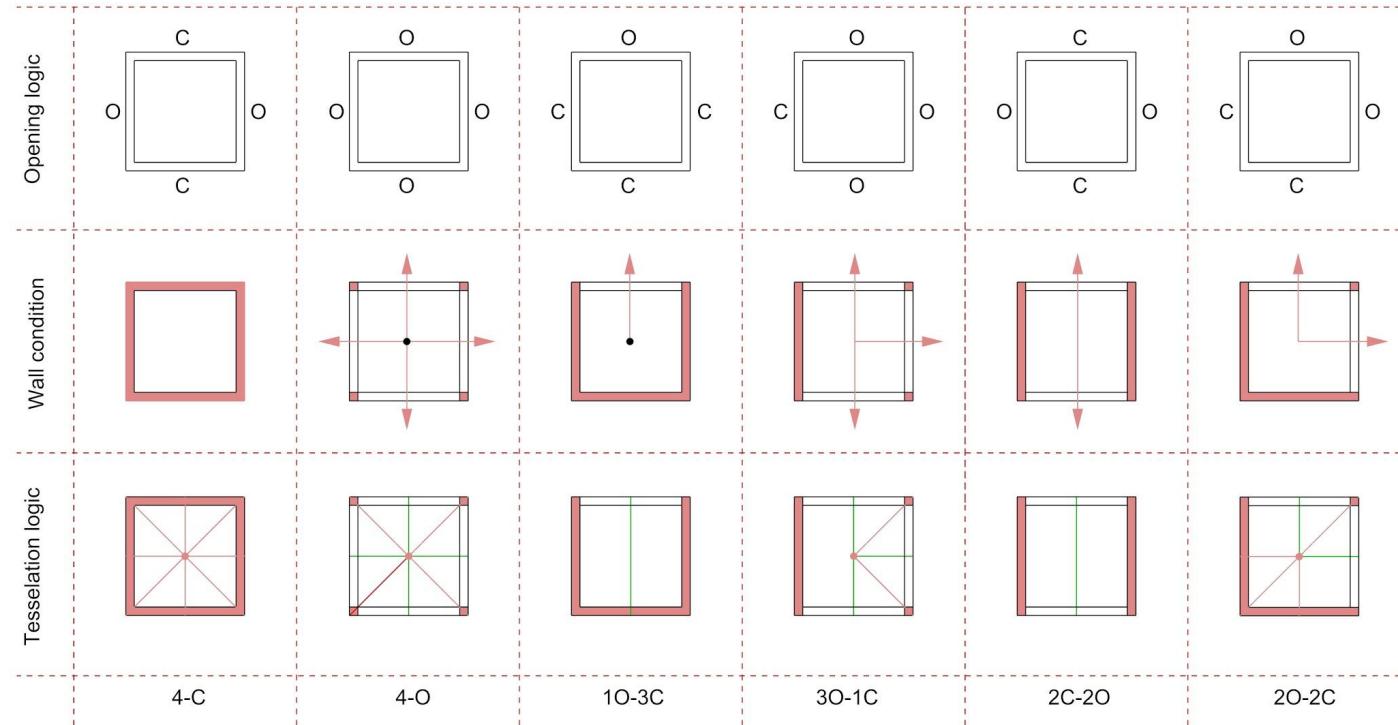
Roof Modules



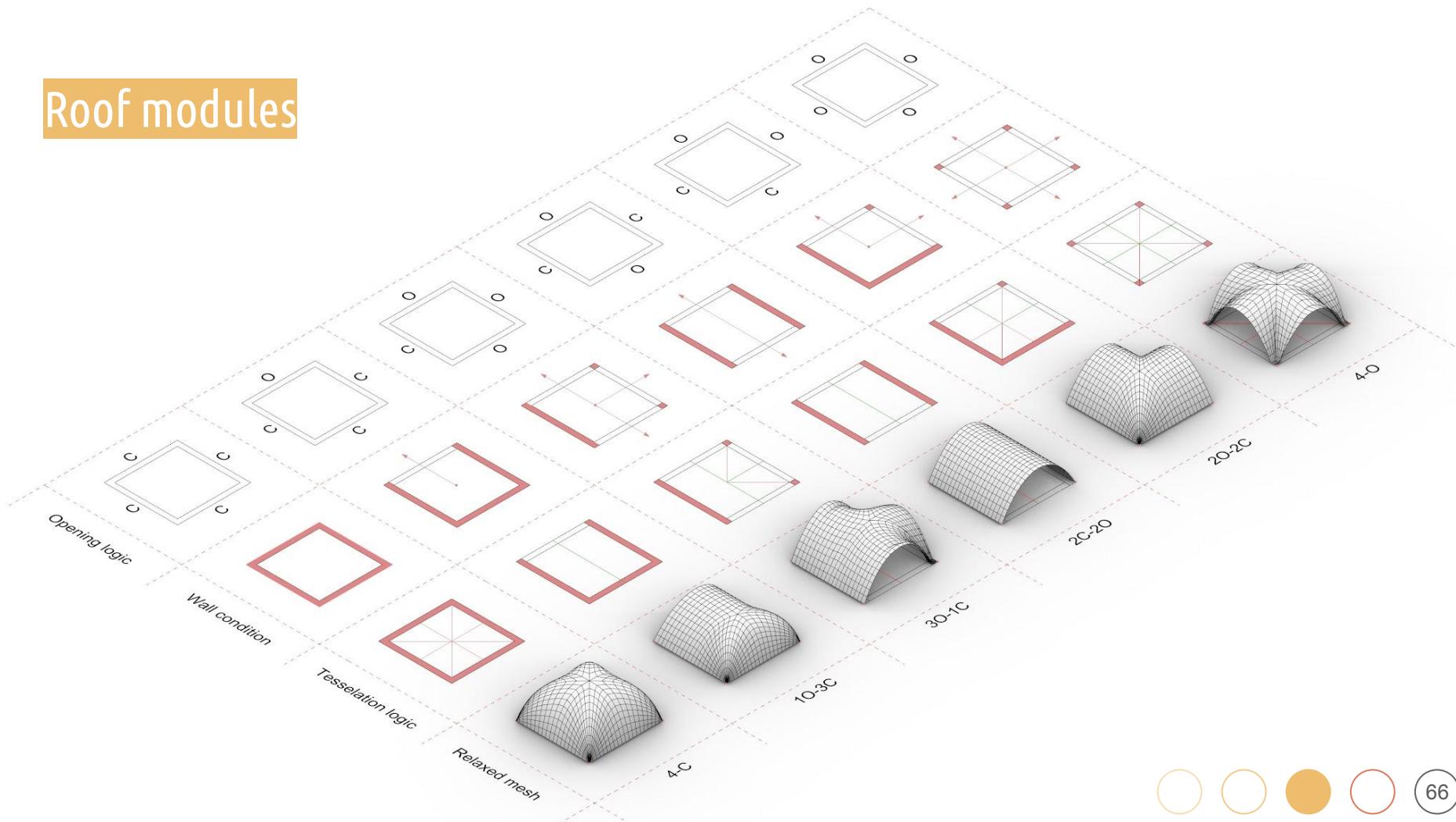
Roof Modules



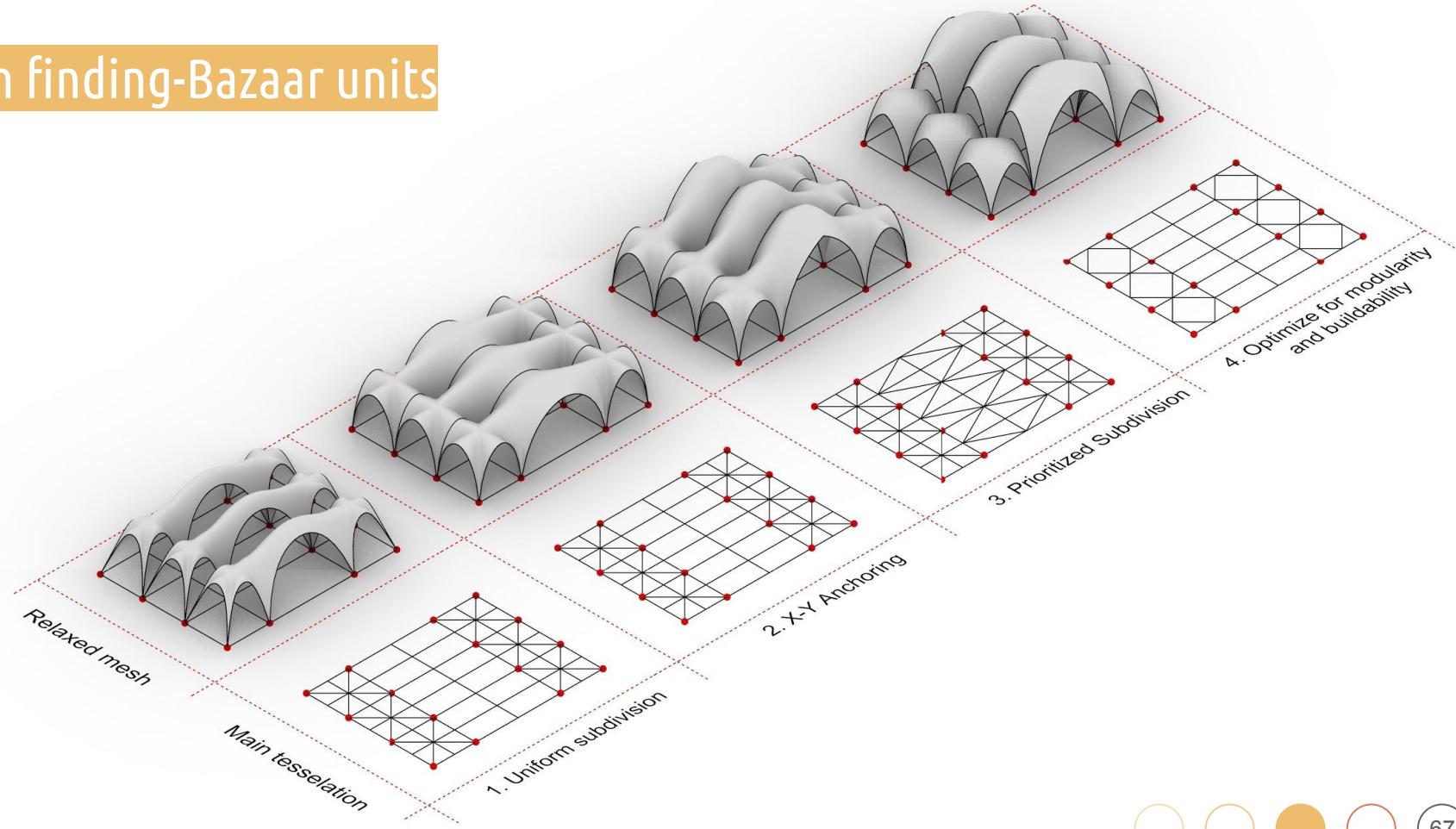
Tesselation logic



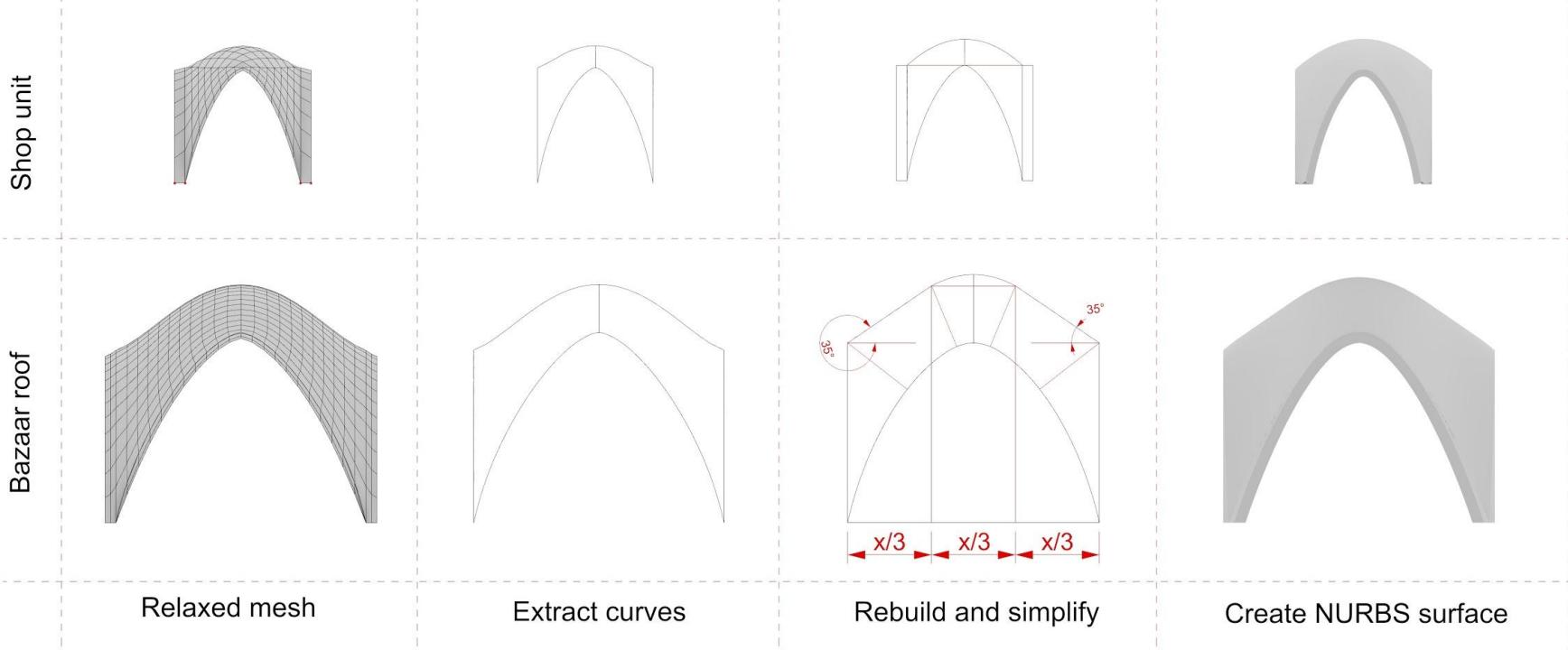
Roof modules



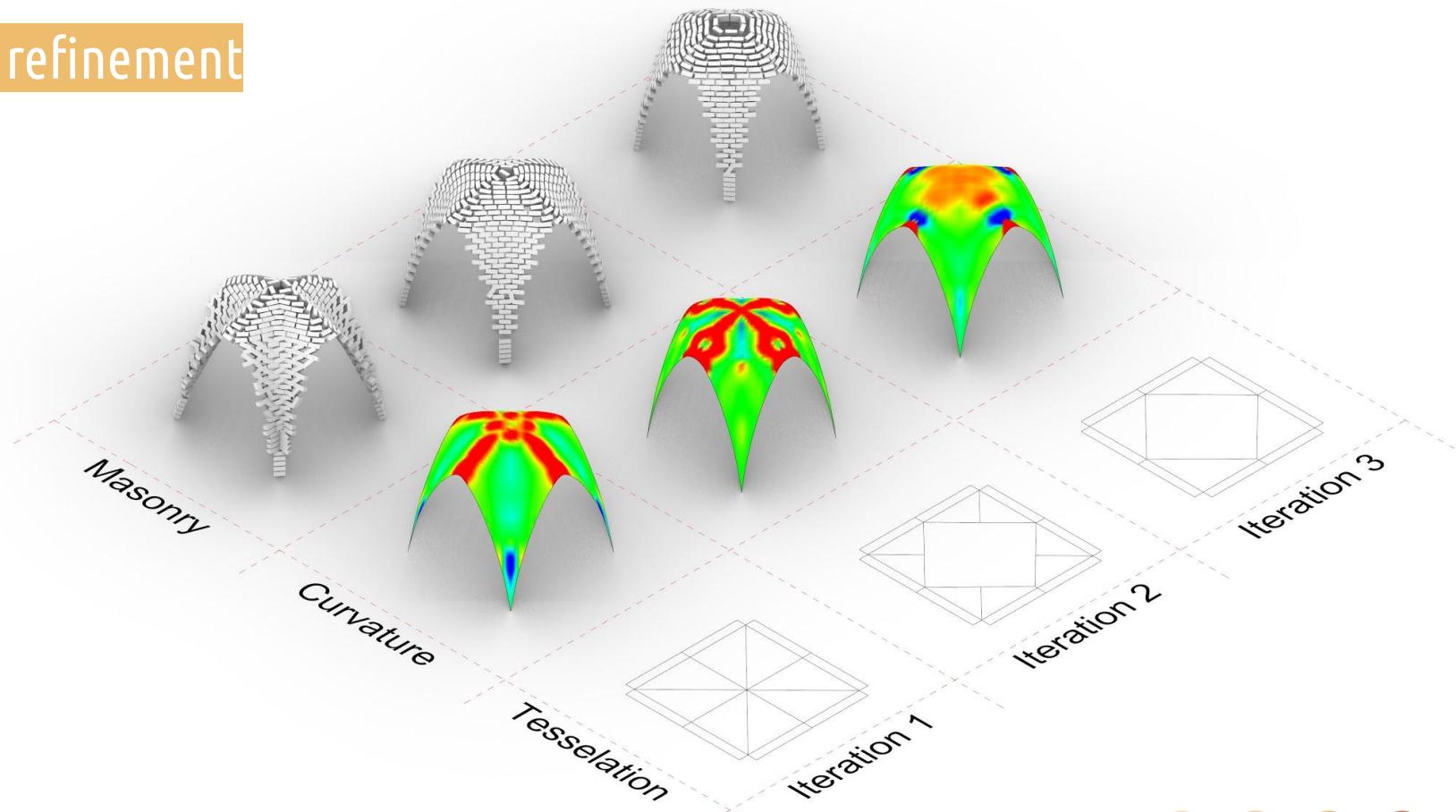
Form finding-Bazaar units



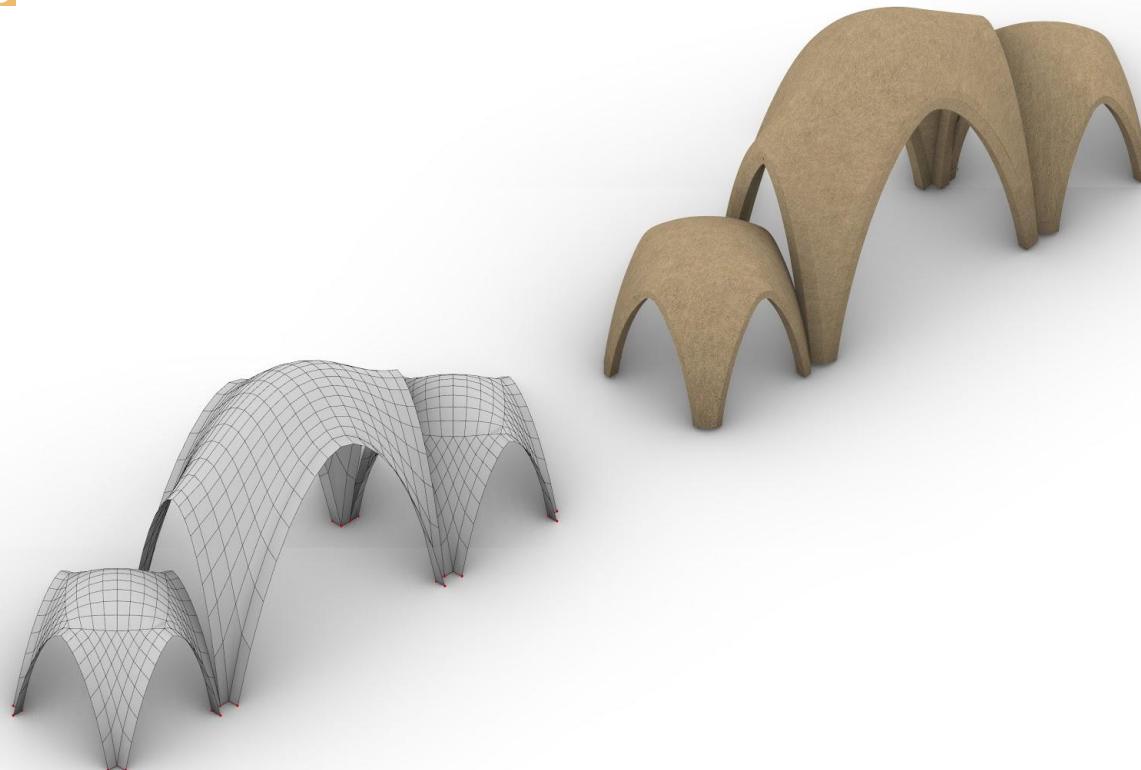
Mesh to Nurbs workflow

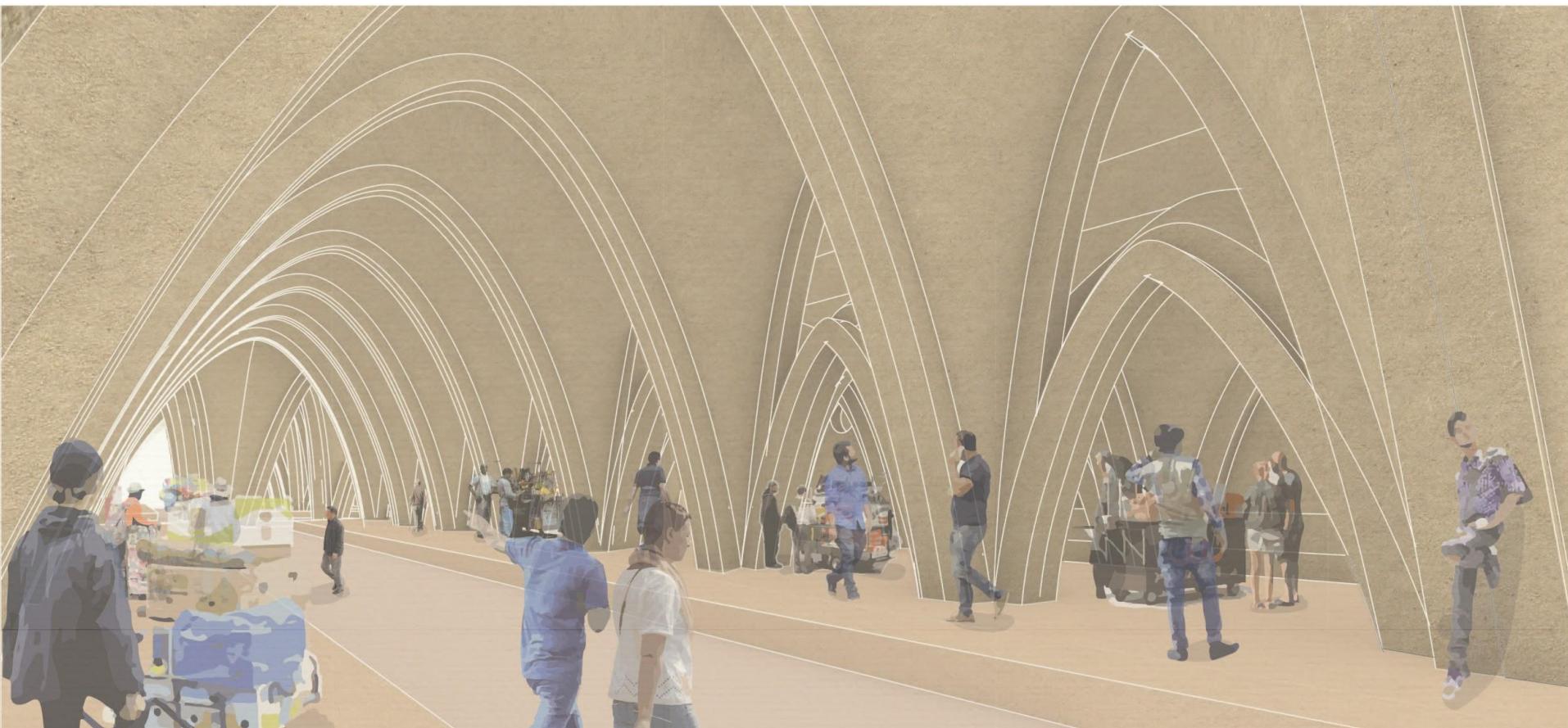


Form refinement

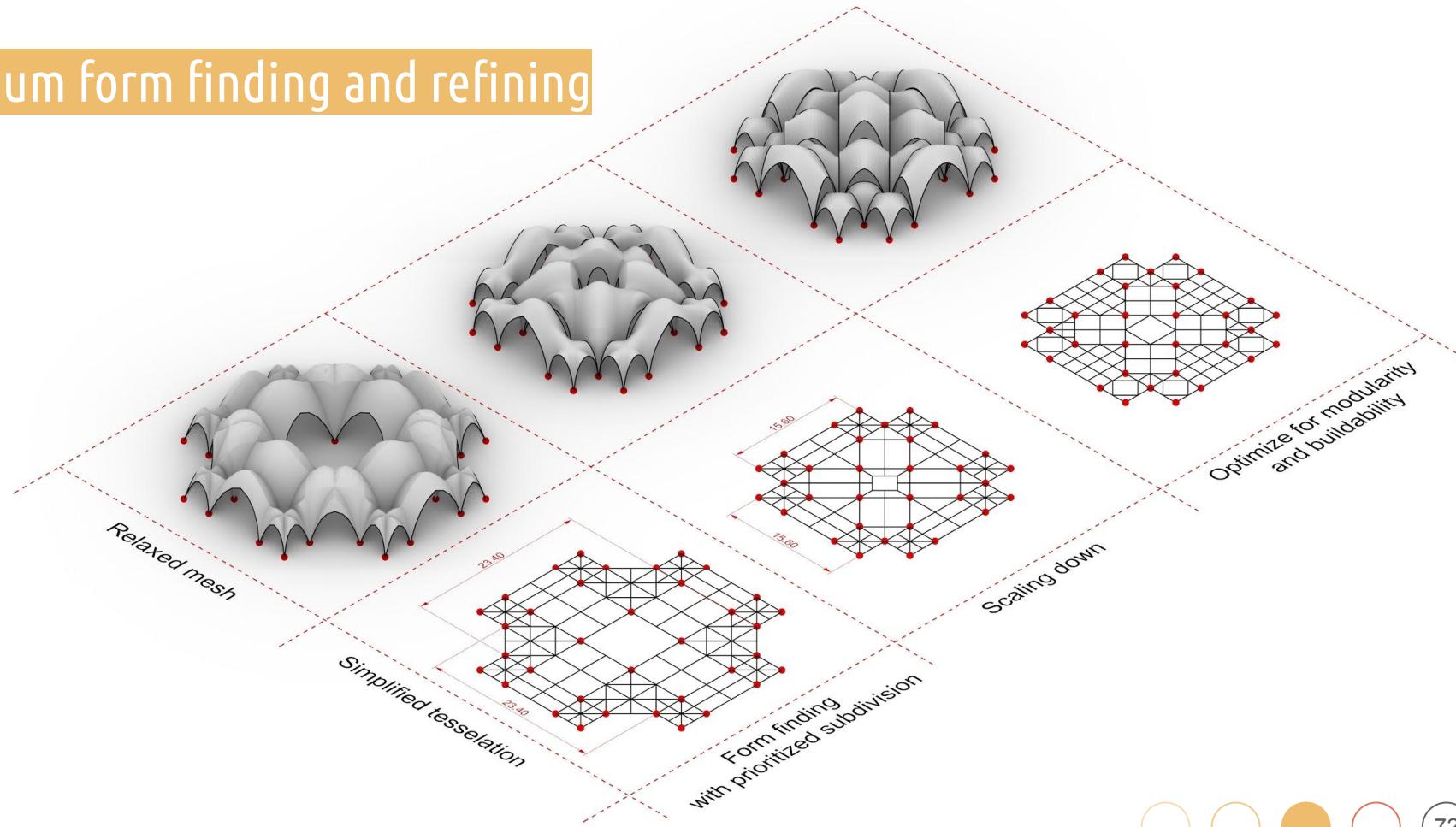


Form refining

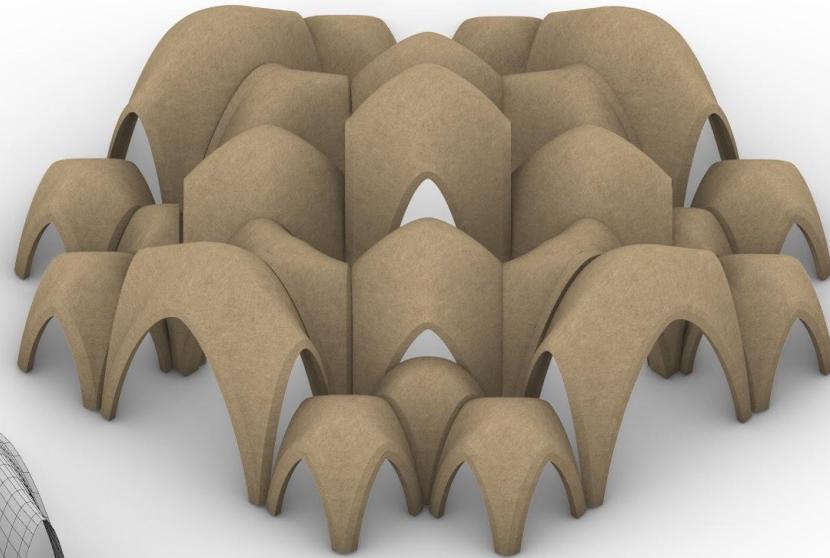
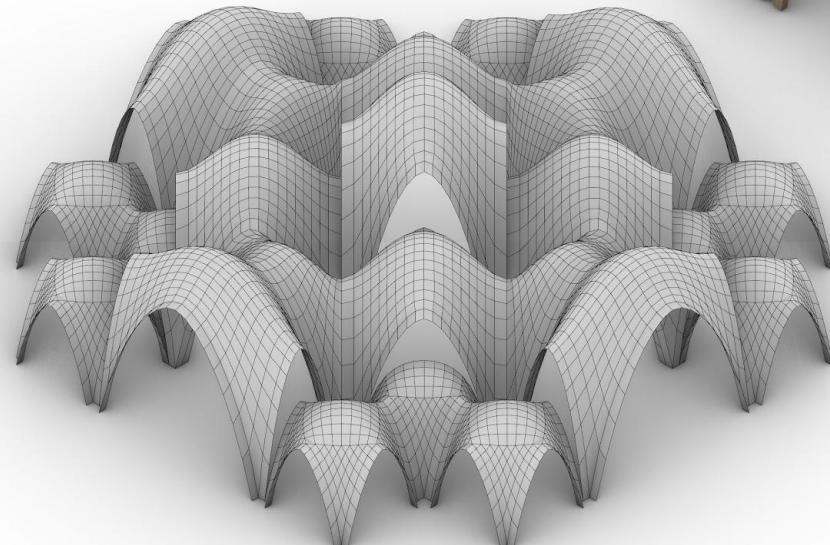




Atrium form finding and refining

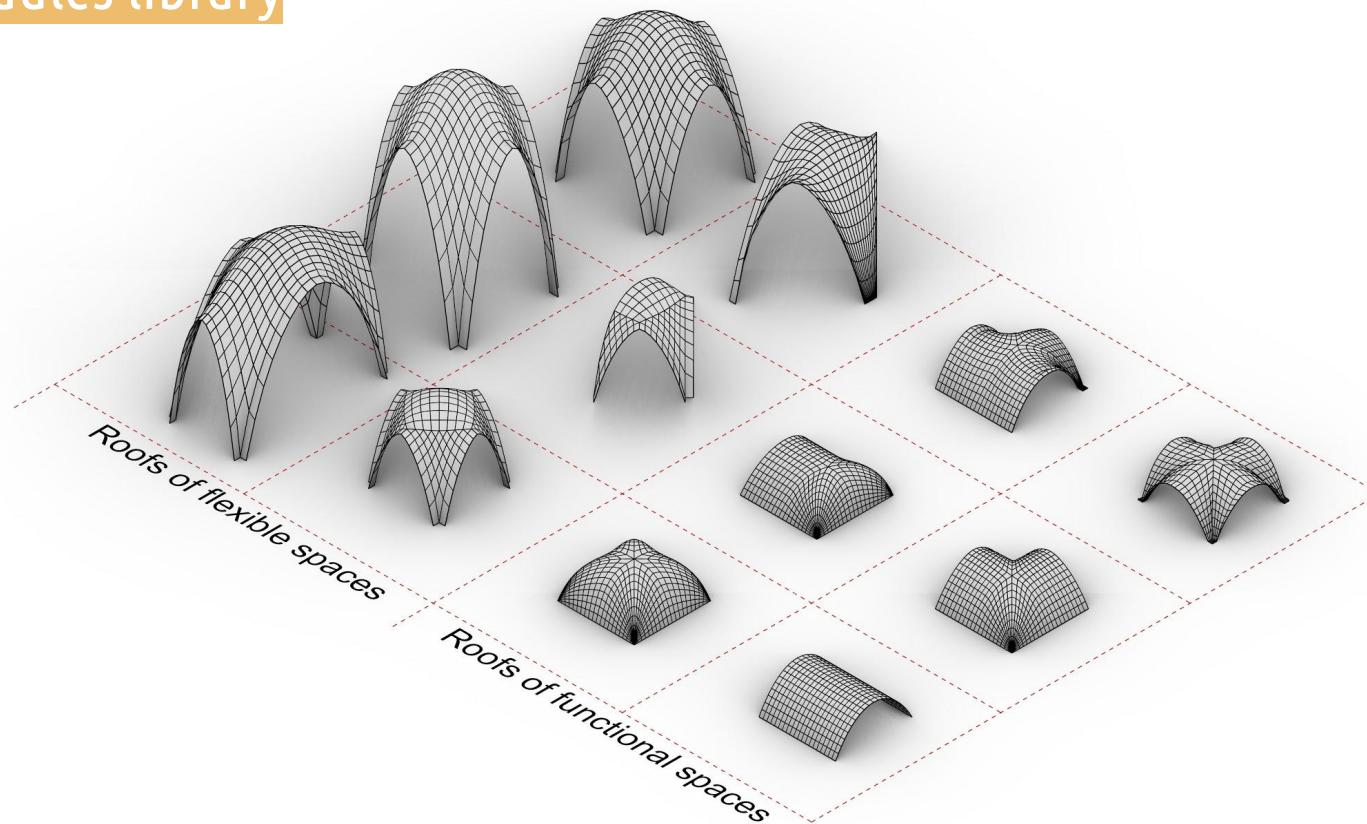


Atrium form finding and refining

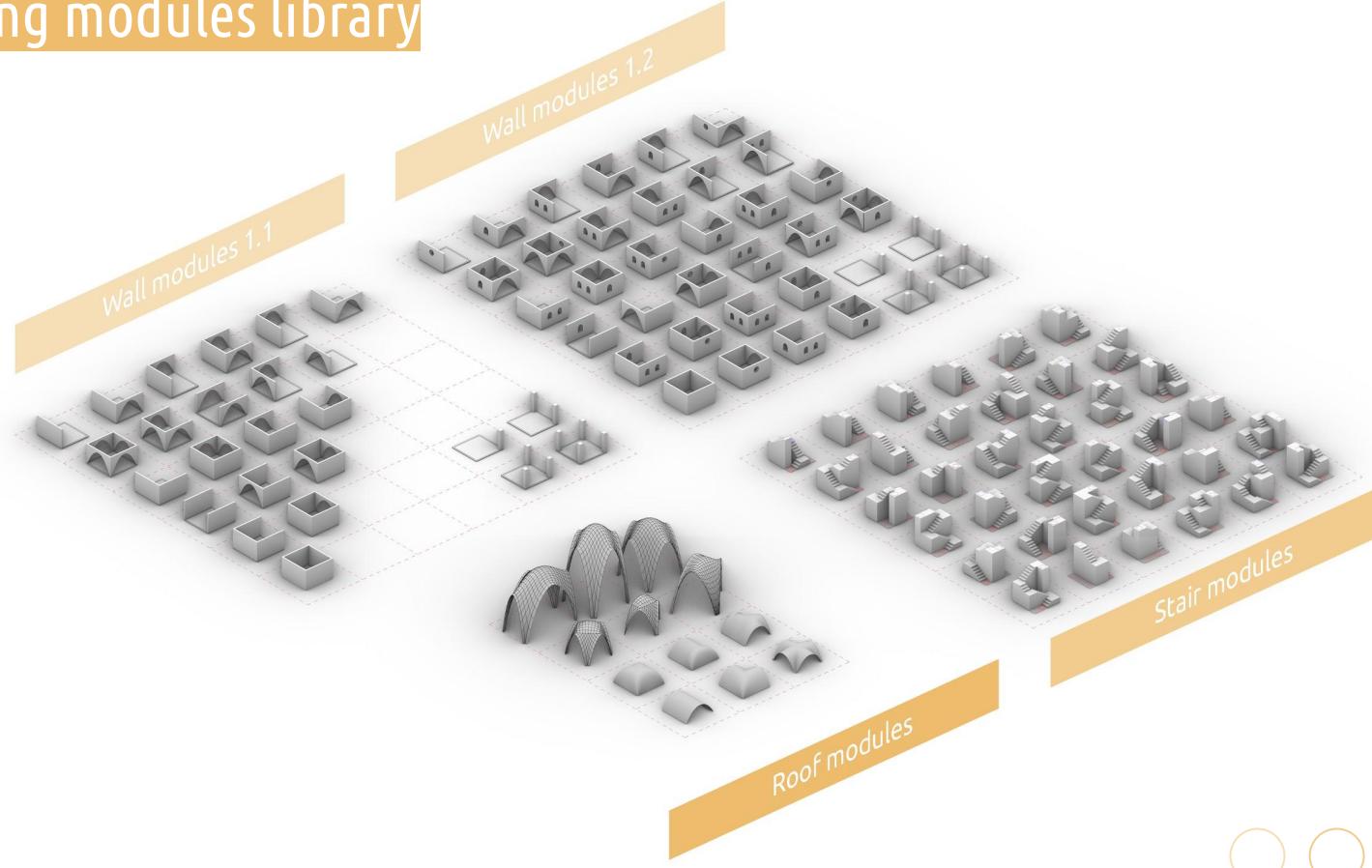




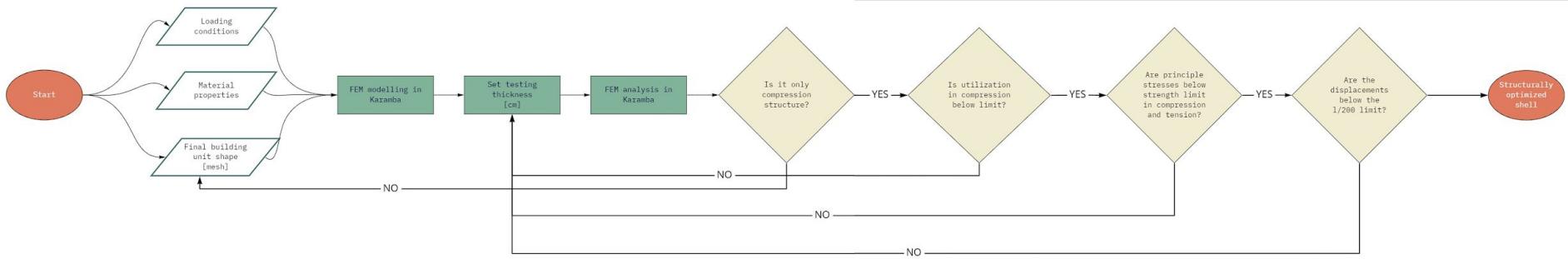
Roof modules library



Building modules library



Structural analysis



Material properties

Density [kg/m3]	1700
Young's modulus [MPa]	210
Compressive strength [MPa]	3
Tensile strength [MPa]	0,3

Loading conditions

Load case	Magnitude [kN/m2]	SF
L0	/	1,2
L1	2	1,5
L2	0,2	1,5

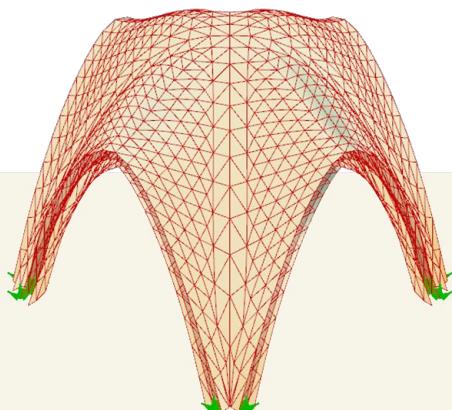
Structural analysis - Shop



Thickness [cm] : 30

Only compression shape

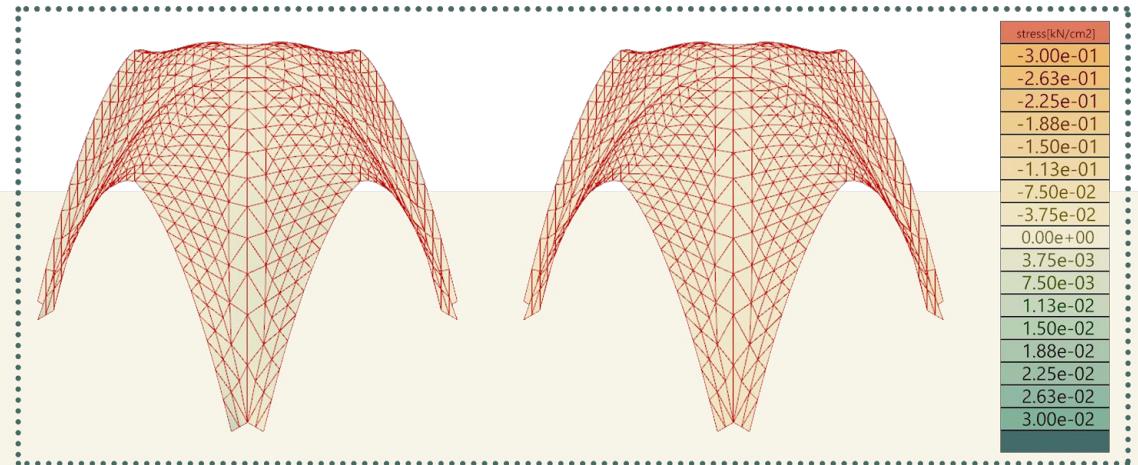
Utilization [%]



Stress evaluation
Principal direction 1 [MPa]

Stress evaluation
Principal direction 2 [MPa]

stress [KN/cm ²]
-3.00e-01
-2.63e-01
-2.25e-01
-1.88e-01
-1.50e-01
-1.13e-01
-7.50e-02
-3.75e-02
0.00e+00
3.75e-03
7.50e-03
1.13e-02
1.50e-02
1.88e-02
2.25e-02
2.63e-02
3.00e-02

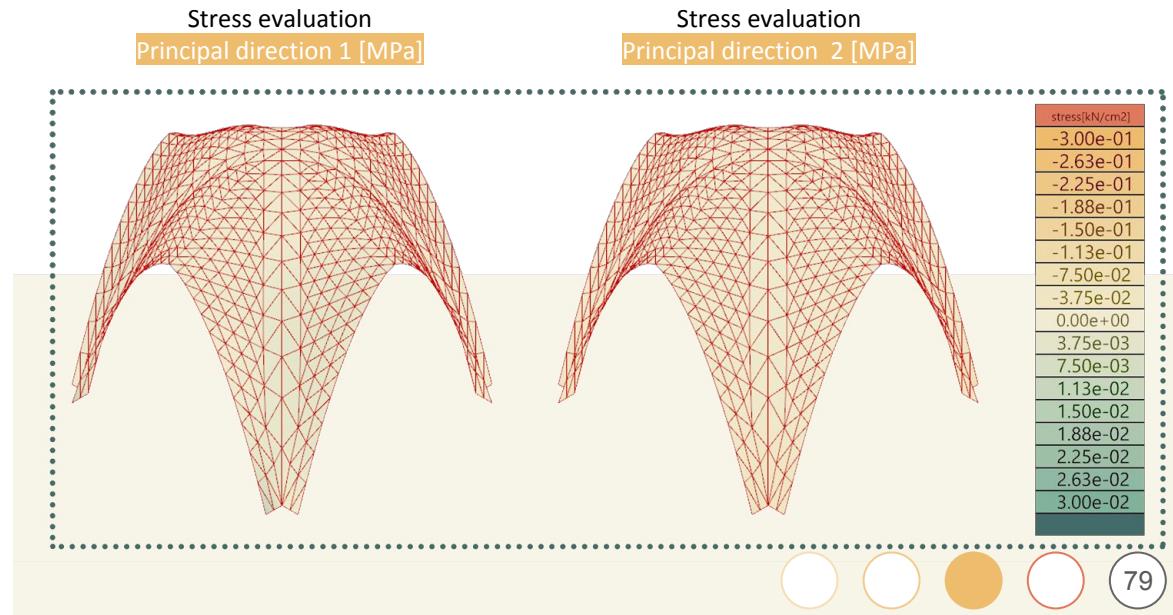


Structural analysis - Shop



Principal stress 1 [MPa]	Material strength [MPa]
Compression	0,17
Tension	0,22
Principal stress 2 [MPa]	Material strength [MPa]
Compression	1,06
Tension	0,00

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]	0,1
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]	0,46



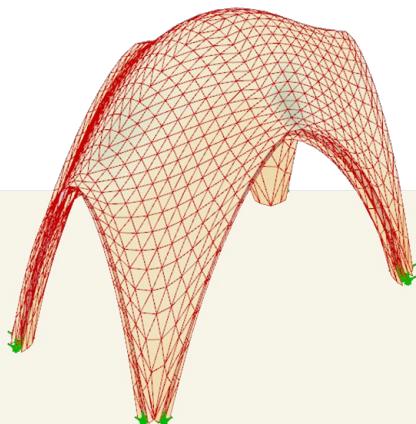
Structural analysis - Bazaar



Thickness [cm] : 40

Only compression shape

Utilization [%]

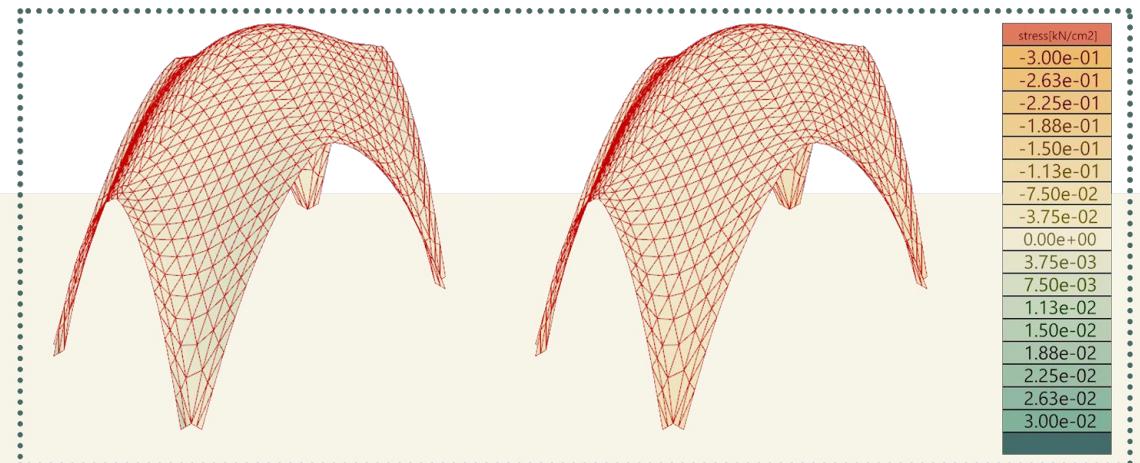


Stress evaluation

Principal direction 1 [MPa]

Stress evaluation

Principal direction 2 [MPa]

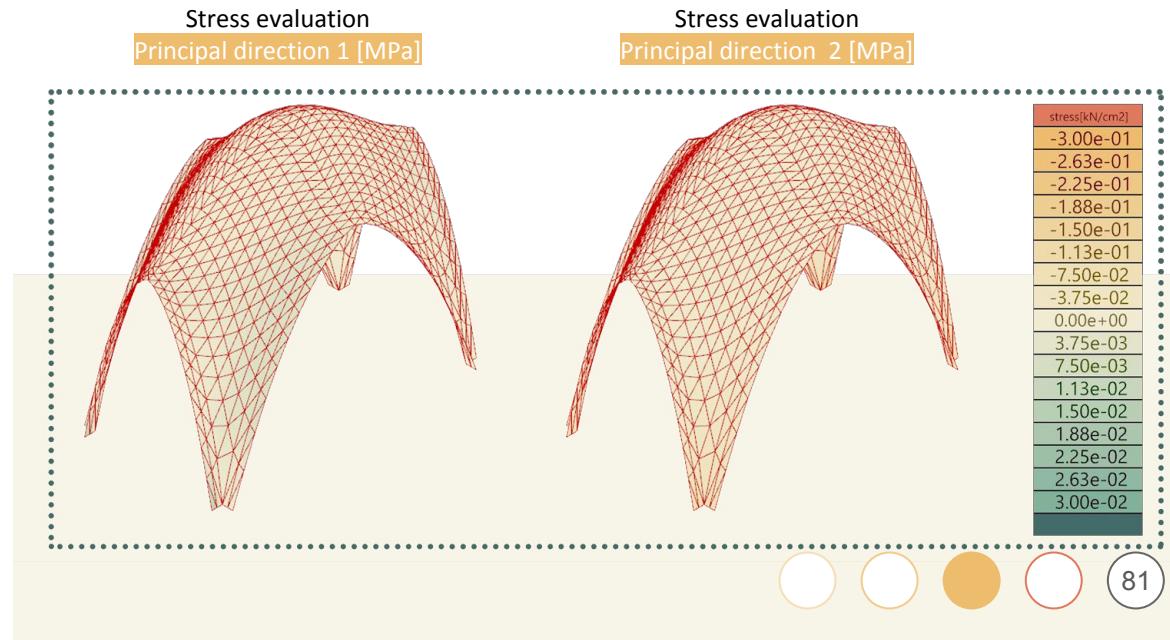


Structural analysis - Bazaar



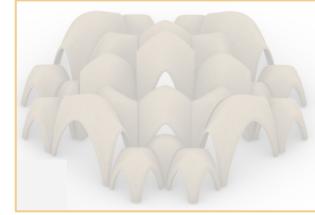
Principal stress 1 [MPa]	Material strength [MPa]
Compression	0,17
Tension	0,22
Principal stress 2 [MPa]	Material strength [MPa]
Compression	1,08
Tension	0,00

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



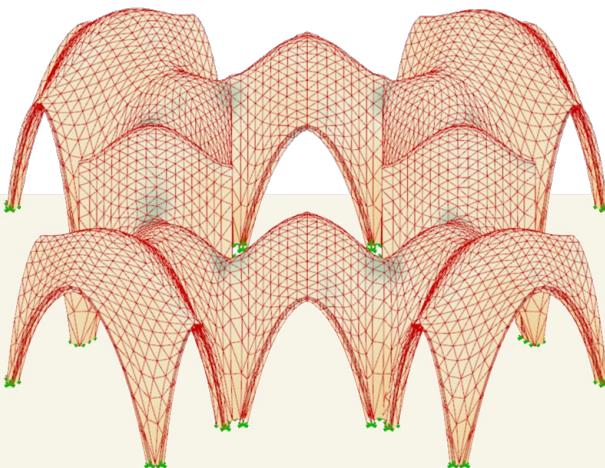
Structural analysis - Atrium

Thickness [cm] : 40



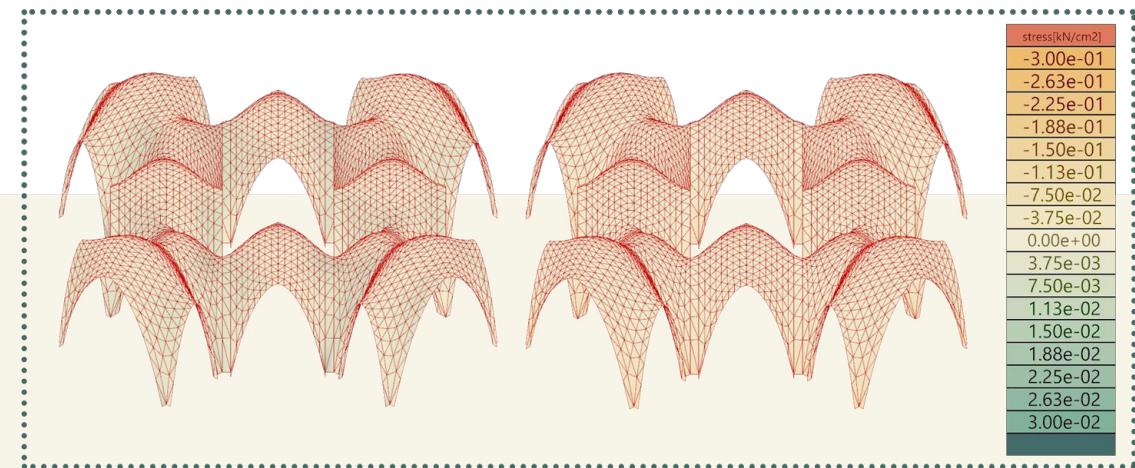
Only compression shape

Utilization [%]

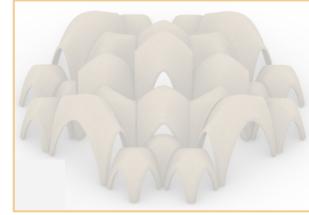


Stress evaluation
Principal direction 1 [MPa]

Stress evaluation
Principal direction 2 [MPa]



Structural analysis - Atrium

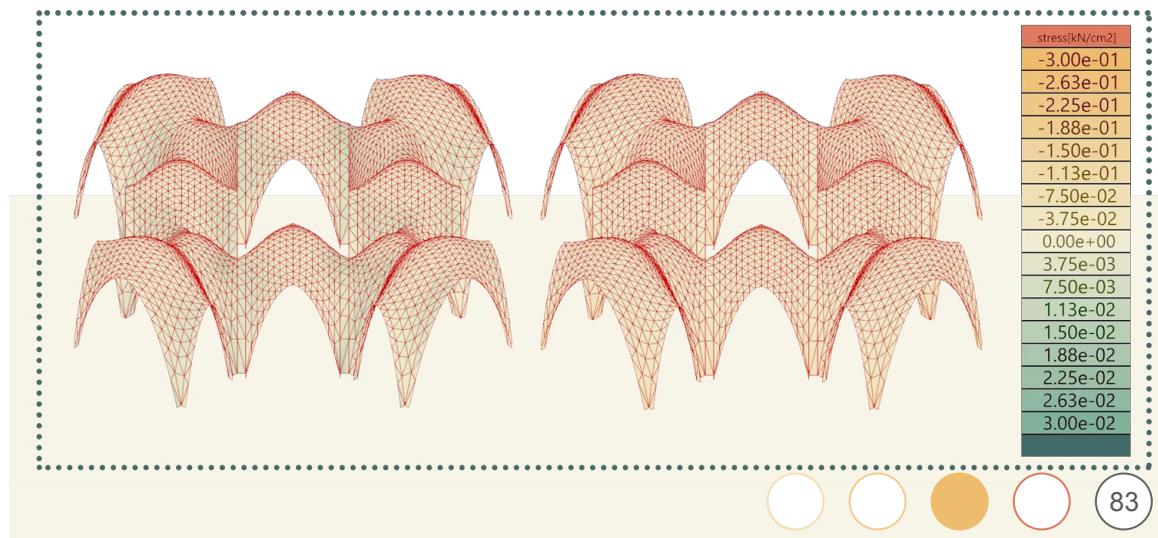


Principal stress 1 [MPa]	Material strength [MPa]
Compression	0,18
Tension	0,30
Principal stress 2 [MPa]	Material strength [MPa]
Compression	1,08
Tension	0,06

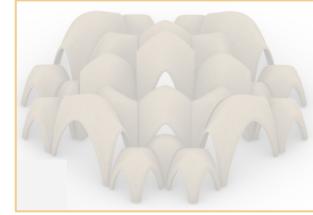
Span (l) [cm]	720
Limit	l/200
Max displacement [cm]	3,6
L0	
Δx [cm]	0,28
Δy [cm]	0,28
Δz [cm]	0,78
L1	
Δx [cm]	0,14
Δy [cm]	0,14
Δz [cm]	0,39
L2	
Δx [cm]	0
Δy [cm]	0,54
Δz [cm]	0,37
Max possible displ.	
Δx [cm]	0,42
Δy [cm]	0,96
Δz [cm]	1,54

Stress evaluation
Principal direction 1 [MPa]

Stress evaluation
Principal direction 2 [MPa]

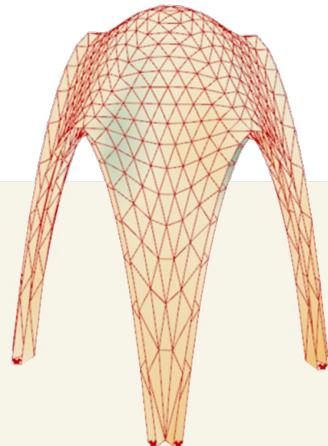


Structural analysis - Atrium

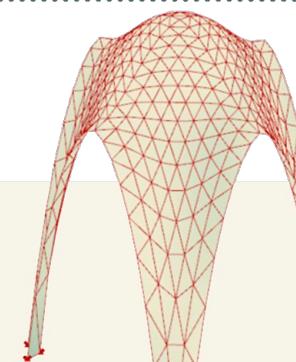


Thickness [cm] : 60

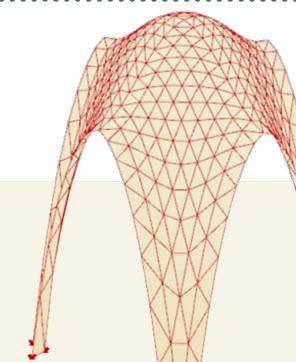
Only compression shape
Utilization [%]



Stress evaluation
Principal direction 1 [MPa]

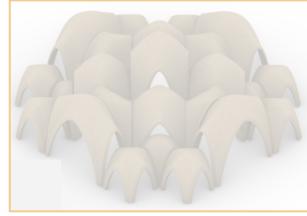


Stress evaluation
Principal direction 2 [MPa]



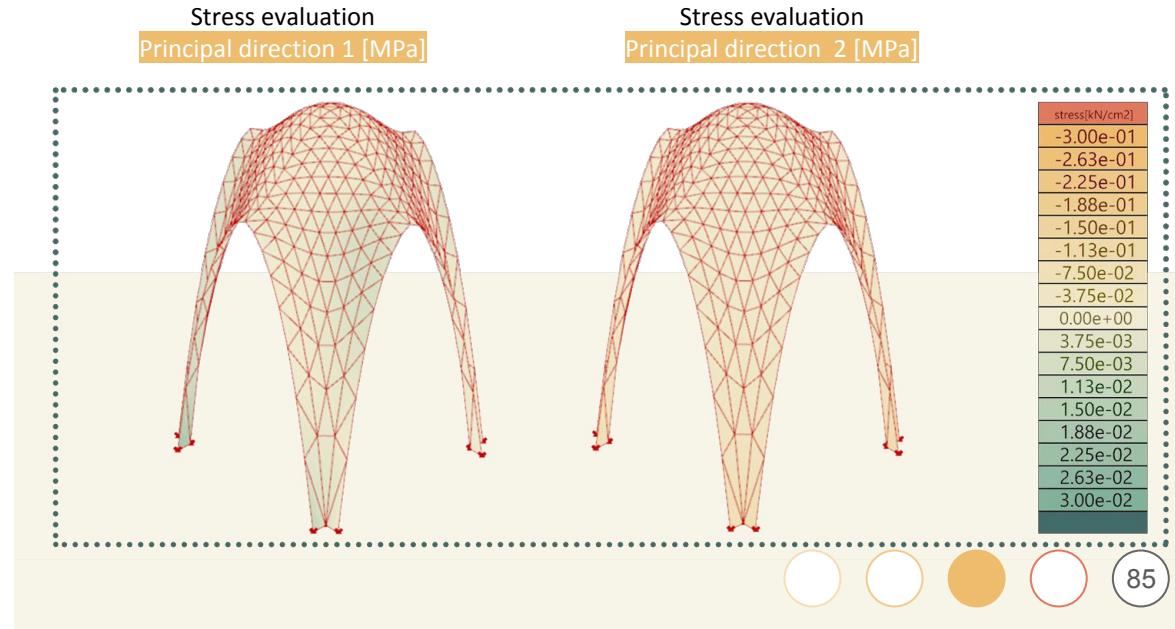
stress [KN/cm ²]
-3.00e-01
-2.63e-01
-2.25e-01
-1.88e-01
-1.50e-01
-1.13e-01
-7.50e-02
-3.75e-02
0.00e+00
3.75e-03
7.50e-03
1.13e-02
1.50e-02
1.88e-02
2.25e-02
2.63e-02
3.00e-02

Structural analysis - Atrium



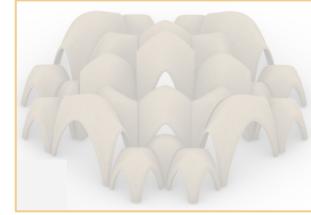
Principal stress 1 [MPa]	Material strength [MPa]
Compression	0,07
Tension	0,23
Principal stress 2 [MPa]	Material strength [MPa]
Compression	1,00
Tension	0,03

Span (l) [cm]	640
Limit	l/200
Max displacement [cm]	3,2
L0	
Δx [cm]	0,26
Δy [cm]	0,26
Δz [cm]	0,81
L1	
Δx [cm]	0,13
Δy [cm]	0,13
Δz [cm]	0,40
L2	
Δx [cm]	0
Δy [cm]	0,74
Δz [cm]	0,43
Max possible displ.	
Δx [cm]	0,39
Δy [cm]	1,13
Δz [cm]	1,64

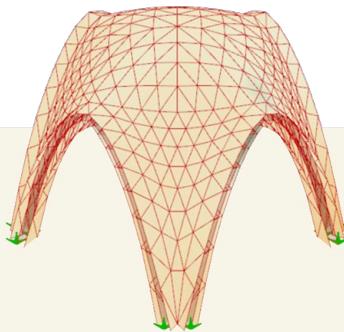


Structural analysis - Atrium

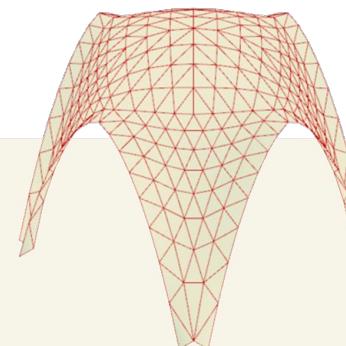
Thickness [cm] : 30



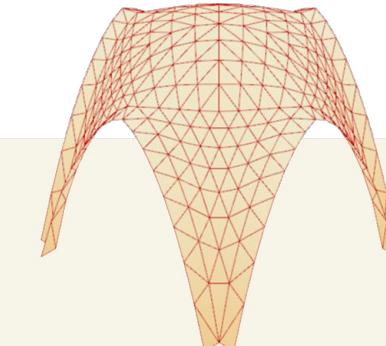
Only compression shape
Utilization [%]



Stress evaluation
Principal direction 1 [MPa]



Stress evaluation
Principal direction 2 [MPa]



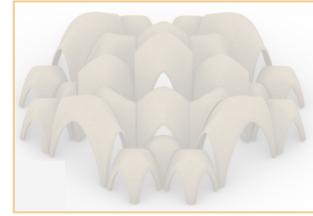
stress [kN/cm ²]
-3.00e-01
-2.63e-01
-2.25e-01
-1.88e-01
-1.50e-01
-1.13e-01
-7.50e-02
-3.75e-02
0.00e+00
3.75e-03
7.50e-03
1.13e-02
1.50e-02
1.88e-02
2.25e-02
2.63e-02
3.00e-02



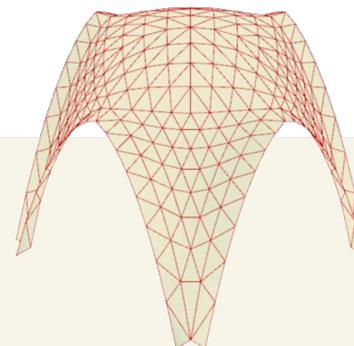
Structural analysis - Atrium

Principal stress 1 [MPa]	Material strength [MPa]
Compression	0,08
Tension	0,14
Principal stress 2 [MPa]	Material strength [MPa]
Compression	0,52
Tension	0,00

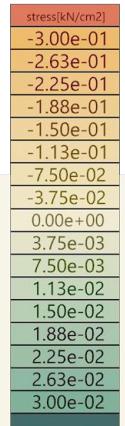
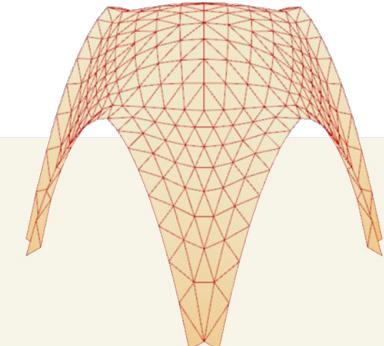
Span (l) [cm]	640
Limit	l/200
Max displacement [cm]	3,2
L0	
Δx [cm]	0,04
Δy [cm]	0,04
Δz [cm]	0,20
L1	
Δx [cm]	0,02
Δy [cm]	0,02
Δz [cm]	0,10
L2	
Δx [cm]	0
Δy [cm]	0,05
Δz [cm]	0,08
Max possible displ.	
Δx [cm]	0,06
Δy [cm]	0,11
Δz [cm]	0,38



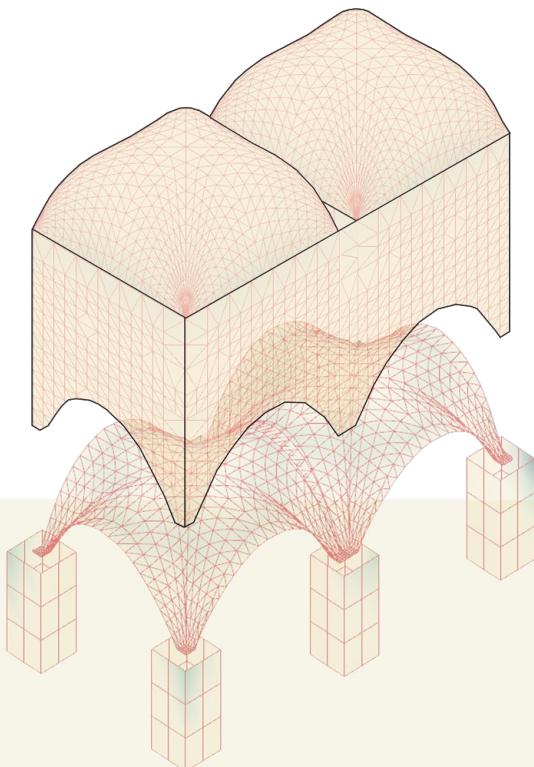
Stress evaluation
Principal direction 1 [MPa]



Stress evaluation
Principal direction 2 [MPa]



Structural analysis - Vertical elements

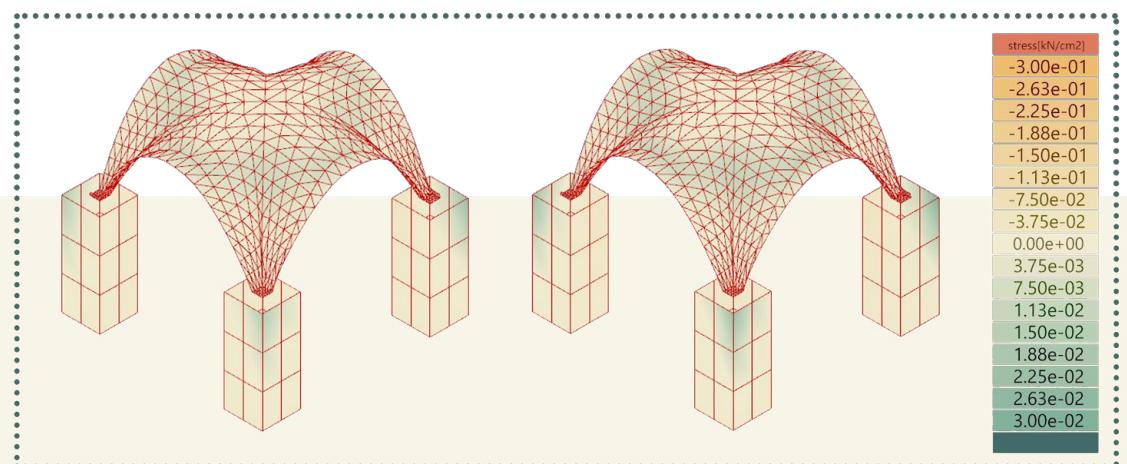


Columns [cm] : 90x90
Walls thickness [cm] : 30

Axial stress 1 storey [MPa]	Material strength [MPa]
Compression	0,37
Tension	0,30
Axial stress 2 storeys [MPa]	Material strength [MPa]
Compression	0,48
Tension	0,30

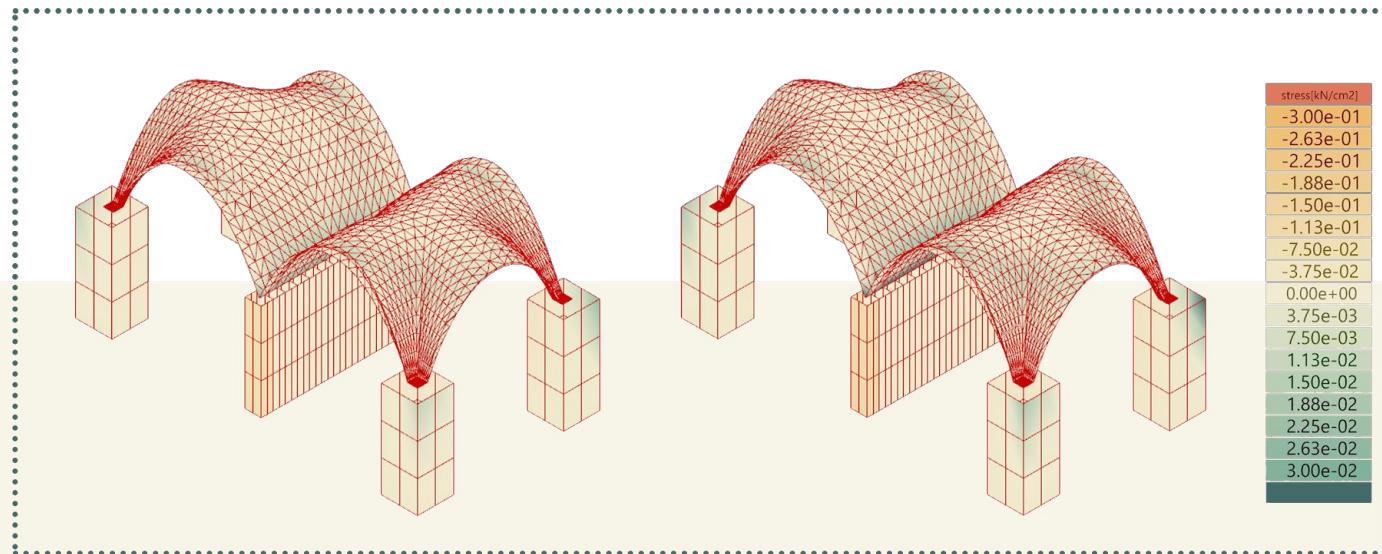
Axial stress evaluation
1 storey loading [MPa]

Axial stress evaluation
2 storeys loading [MPa]



Structural analysis - Wall elements

Axial stress evaluation
1 storey loading [MPa]

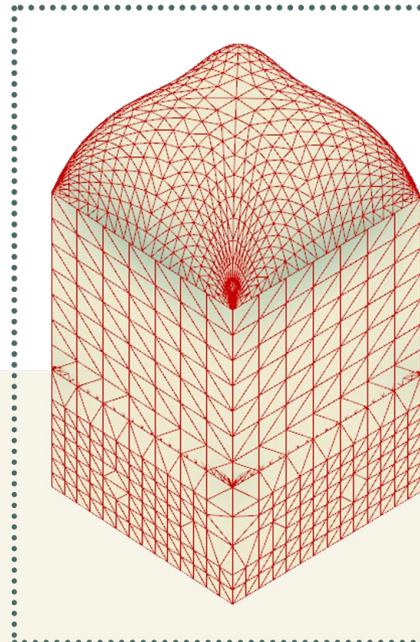


Axial stress evaluation
2 storeys loading [MPa]

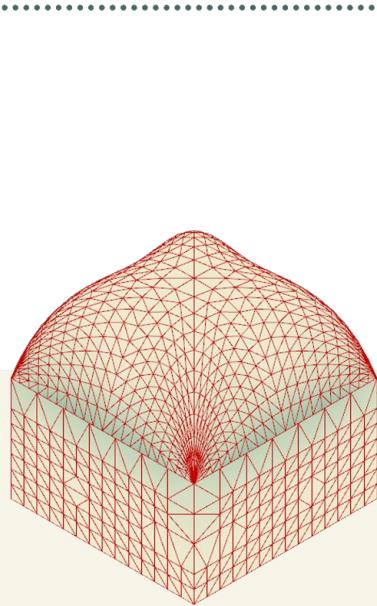
Axial stress 1 storey [MPa]		Material strength [MPa]
Compression	1,42	3,00
Tension	0,24	0,30
Axial stress 2 storeys [MPa]		Material strength [MPa]
Compression	1,80	3,00
Tension	0,30	0,30

Structural analysis - Wall elements

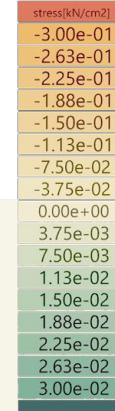
Axial stress evaluation
1 storey loading [MPa]



Axial stress evaluation
2 storeys loading [MPa]



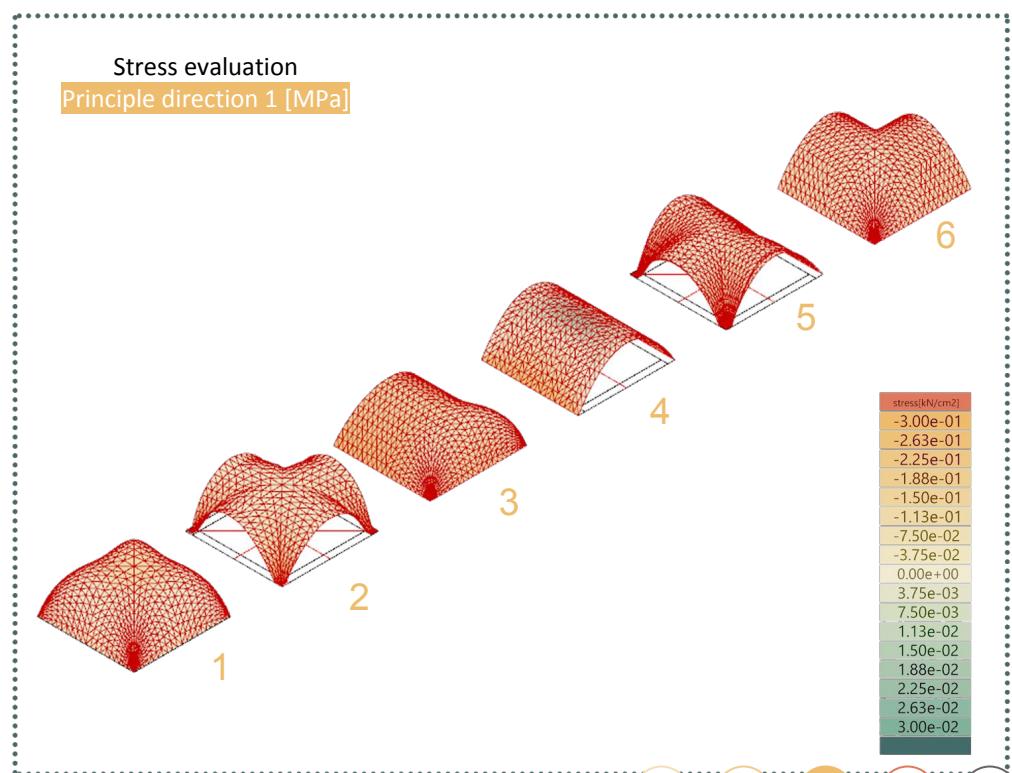
Axial stress 1 storey [MPa]	Material strength [MPa]
Compression	3,00
Tension	0,30
Axial stress 2 storeys [MPa]	Material strength [MPa]
Compression	3,00
Tension	0,30

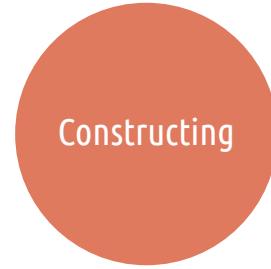
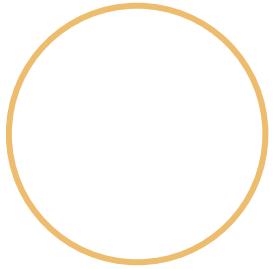
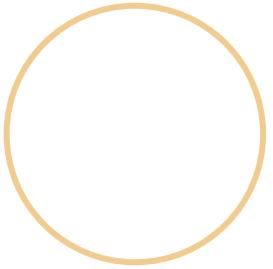
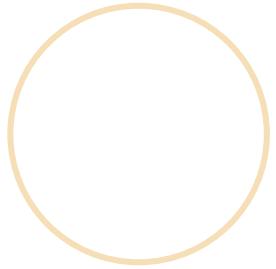


Structural analysis - Roof elements

Thickness [cm] : 30

Roof type	Displacements			Principal stress 1 [MPa]		Principal stress 2 [MPa]	
	x	y	z	Compression	Tension	Compression	Tension
1	0,03	0,03	0,18	0,12	0,03	0,13	0,03
2	0,05	0,05	0,41	0,21	0,08	0,46	0,03
3	0,04	0,03	0,14	0,07	0,02	0,15	0,00
4	0,03	0,01	0,12	0,03	0,01	0,15	0,00
5	0,21	0,04	0,28	0,25	0,22	0,49	0,00
6	0,06	0,08	0,24	0,18	0,11	0,47	0,02





Materials - Bricks



Ingredients

Standard mixture

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



Mix them

Press them



Cure them

Let dry in shadow for 7 days before use

Curing happens until 28th day

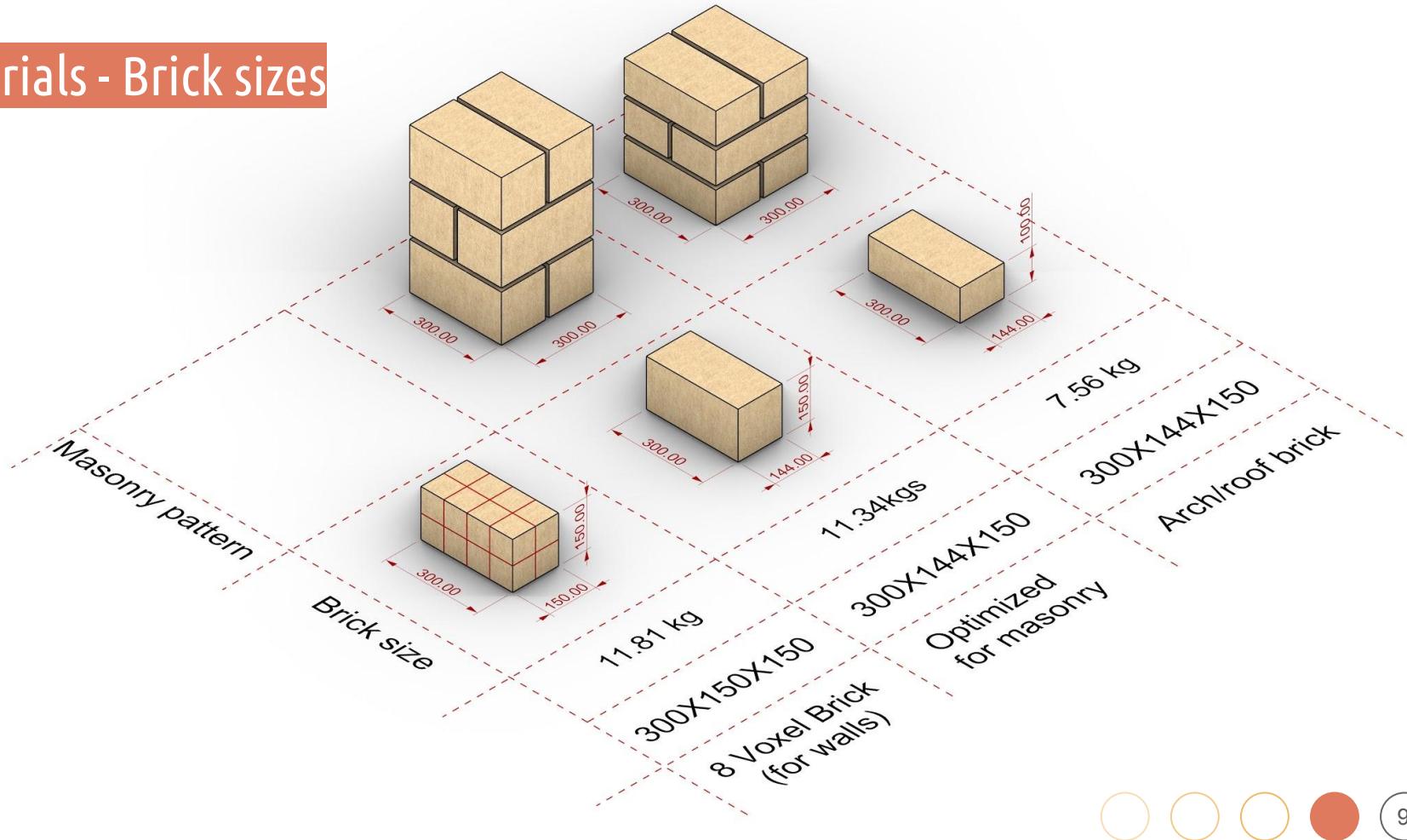


After-drying waterproofing:

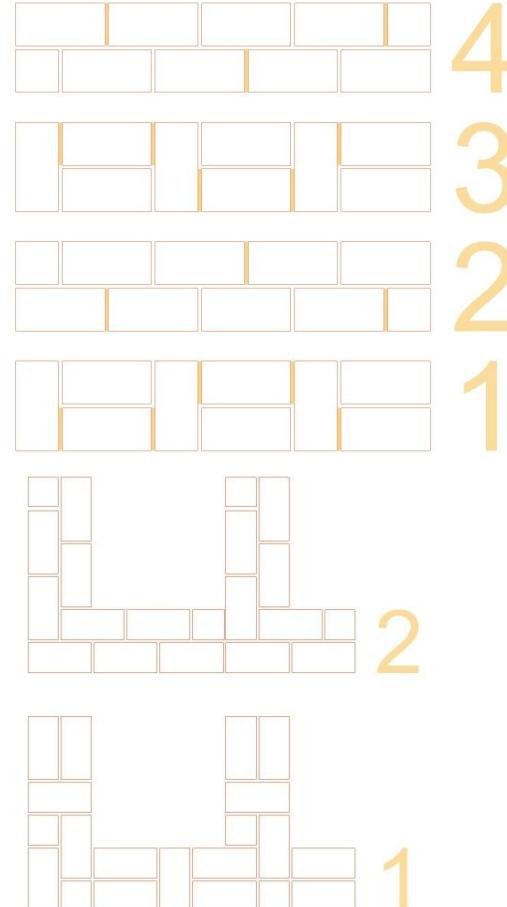
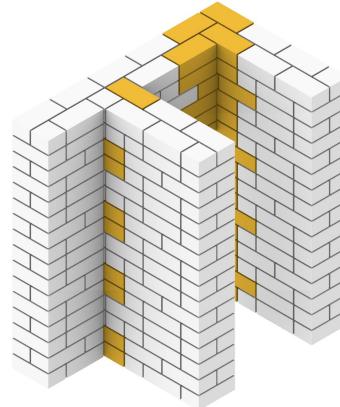
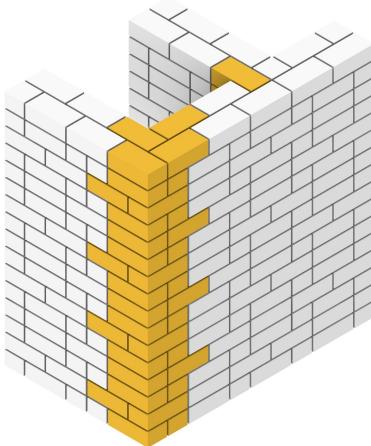
(Based on availability)

Linseed oil
Hydraulic lime
Animal fat

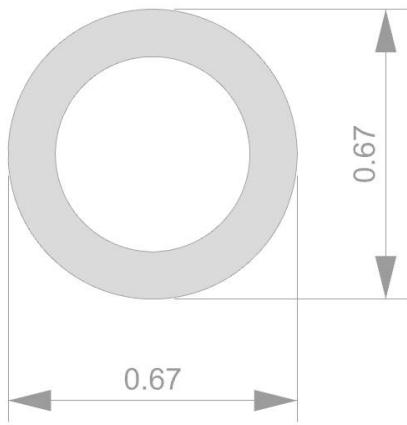
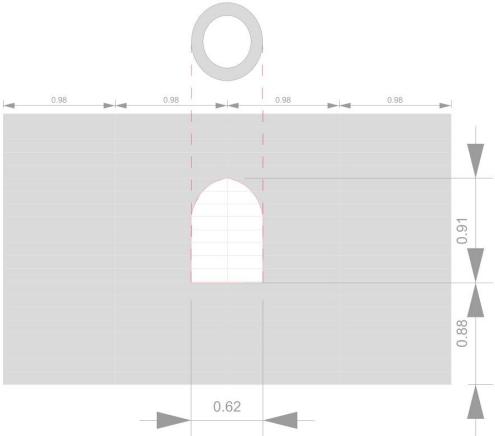
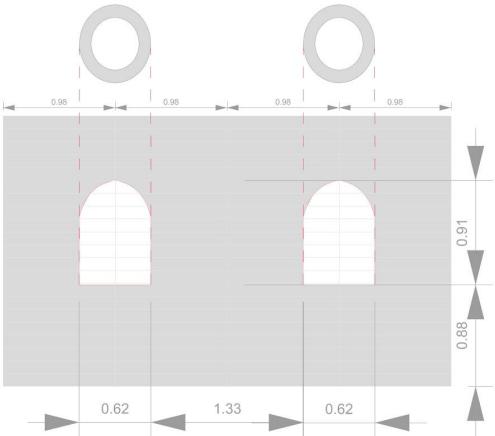
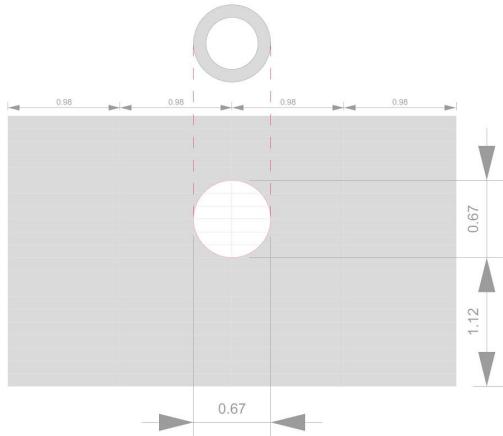
Materials - Brick sizes



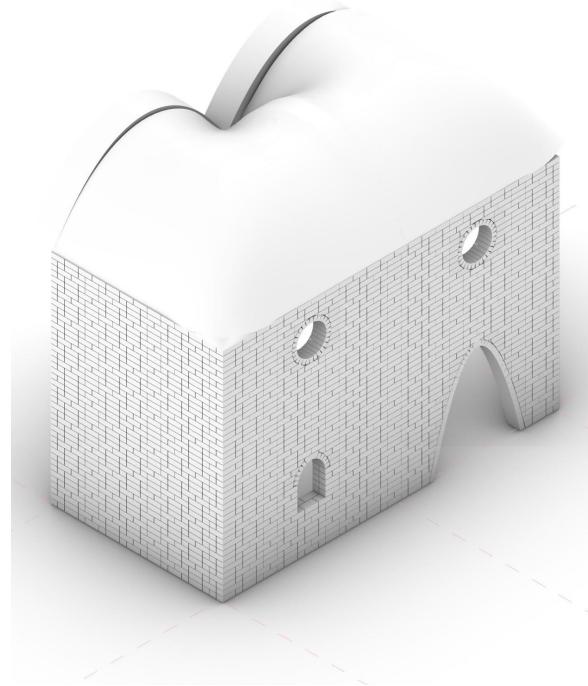
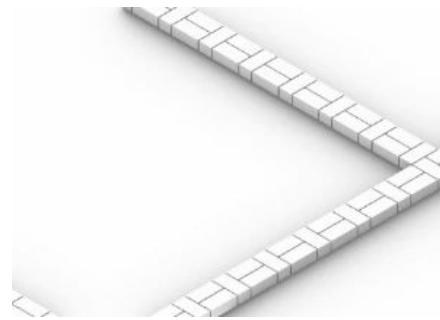
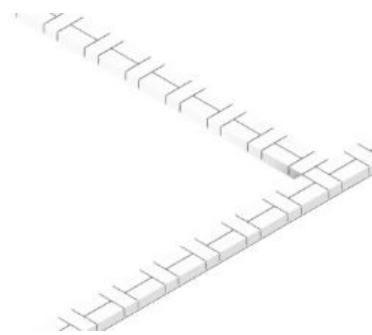
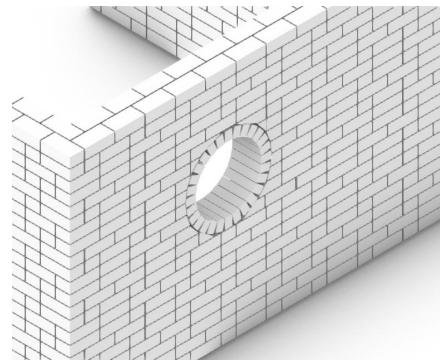
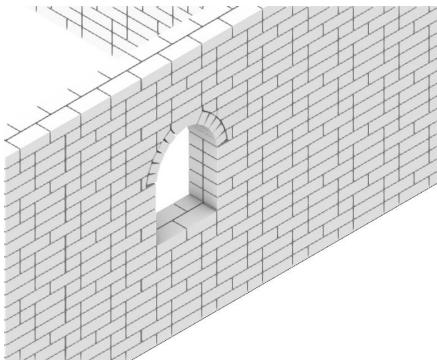
Brick layout walls



Wall Openings



Window



Materials-for catenaries



1. Steel cutting machine



6. Right angle



2. Drilling machine



7. Measuring tape



3. Welding jig



8. Rope/chain/hose pipe



4. Discarded steel pipes/sections



9. Nails



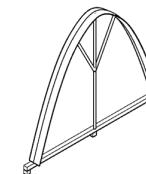
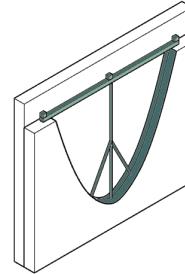
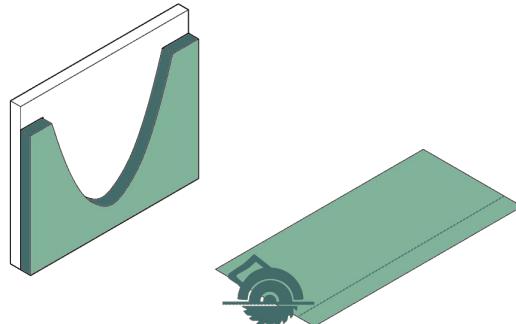
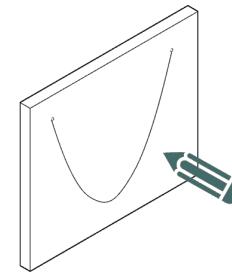
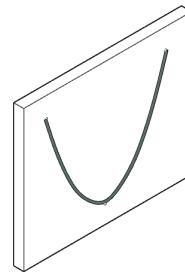
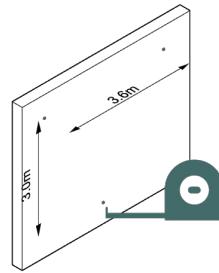
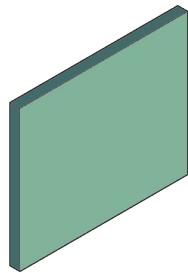
5. Corrugated sheets



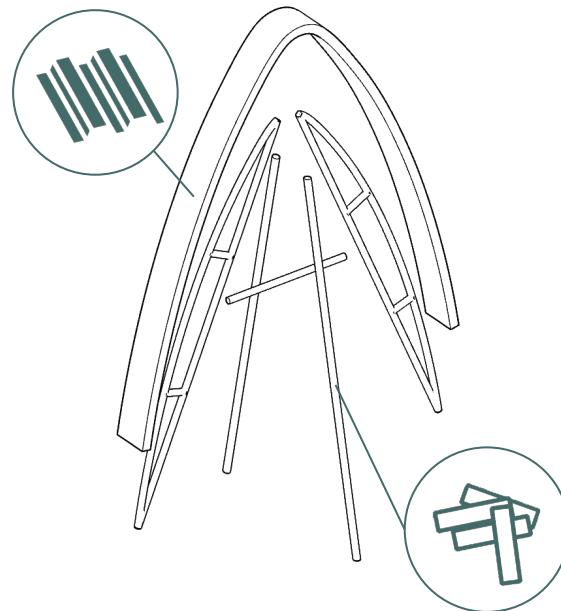
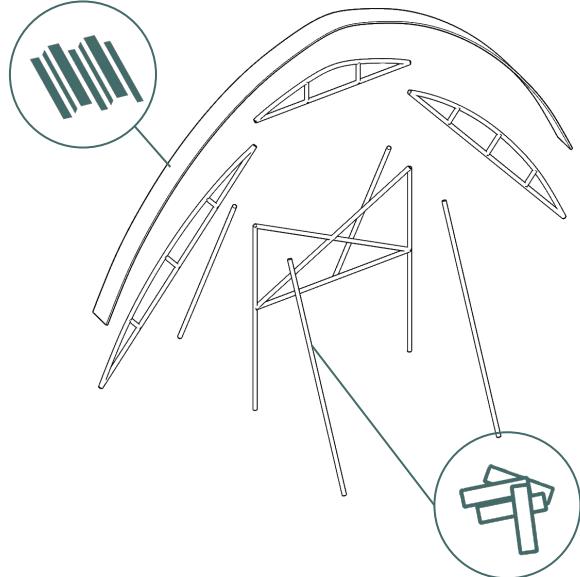
10. Waste wood pieces



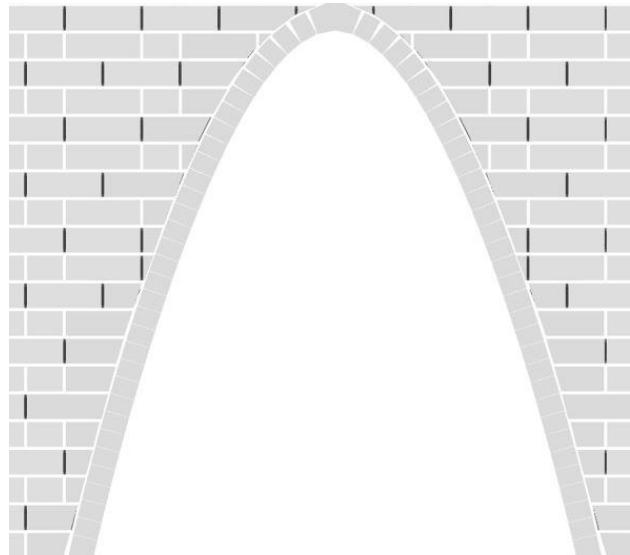
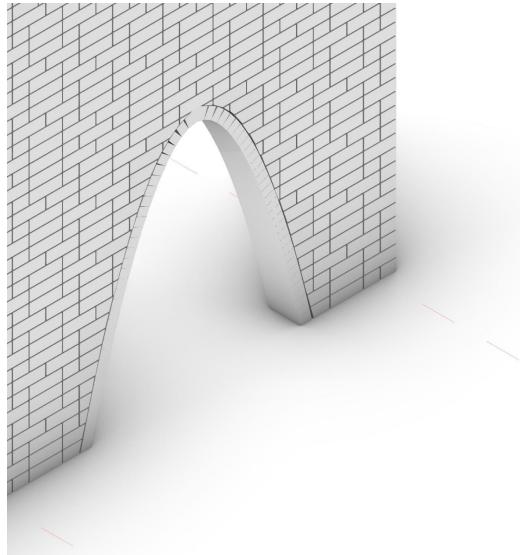
Equipment



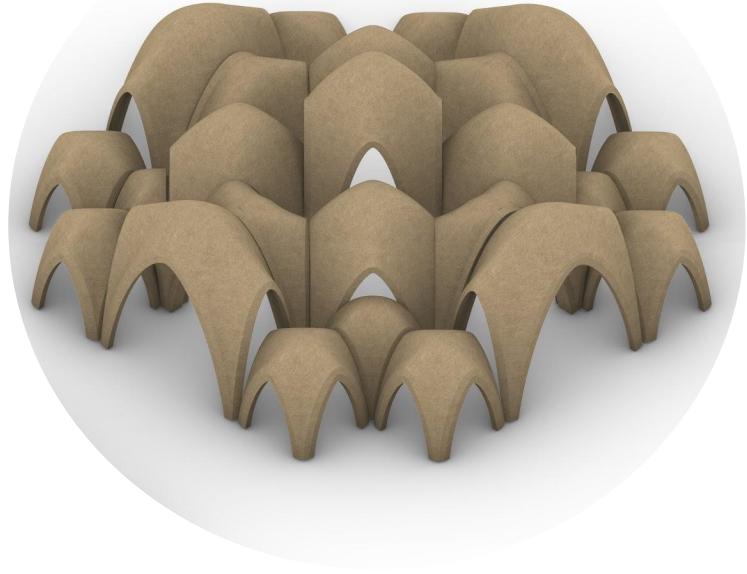
Materials-for catenaries



Doors



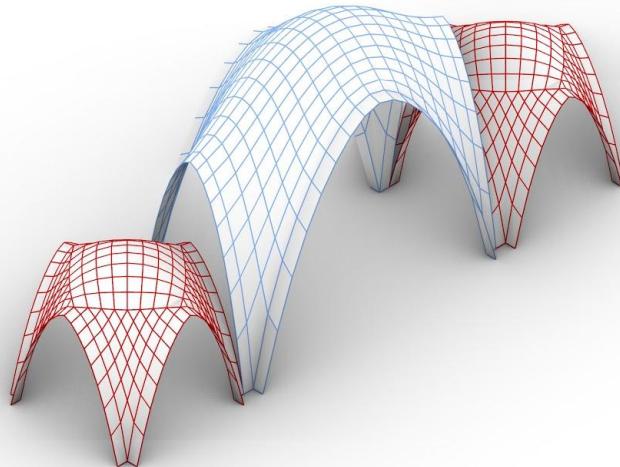
Construction process - Bazaar and Atrium



Construction process - Bazaar

● Sail Vaults

● Arched Nubian Vaults



Construction process-Shops



Construction process-Shops



Construction process-Bazaar



Construction sequence-Bazaar

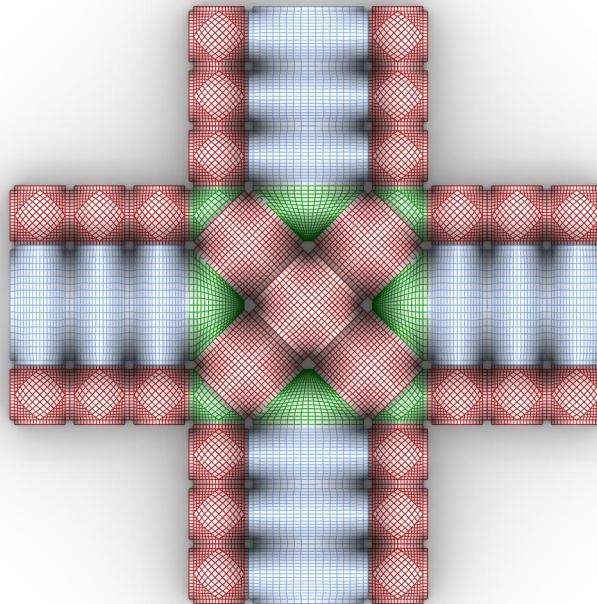


Construction sequence-Atrium

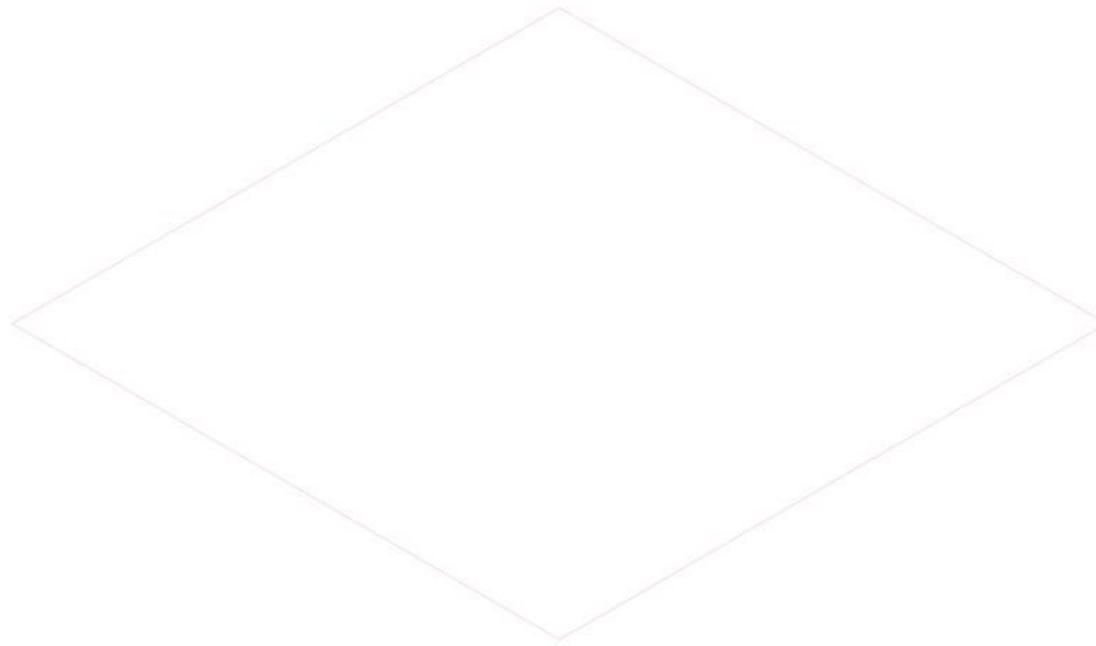
● Sail Vaults

● Pendentives

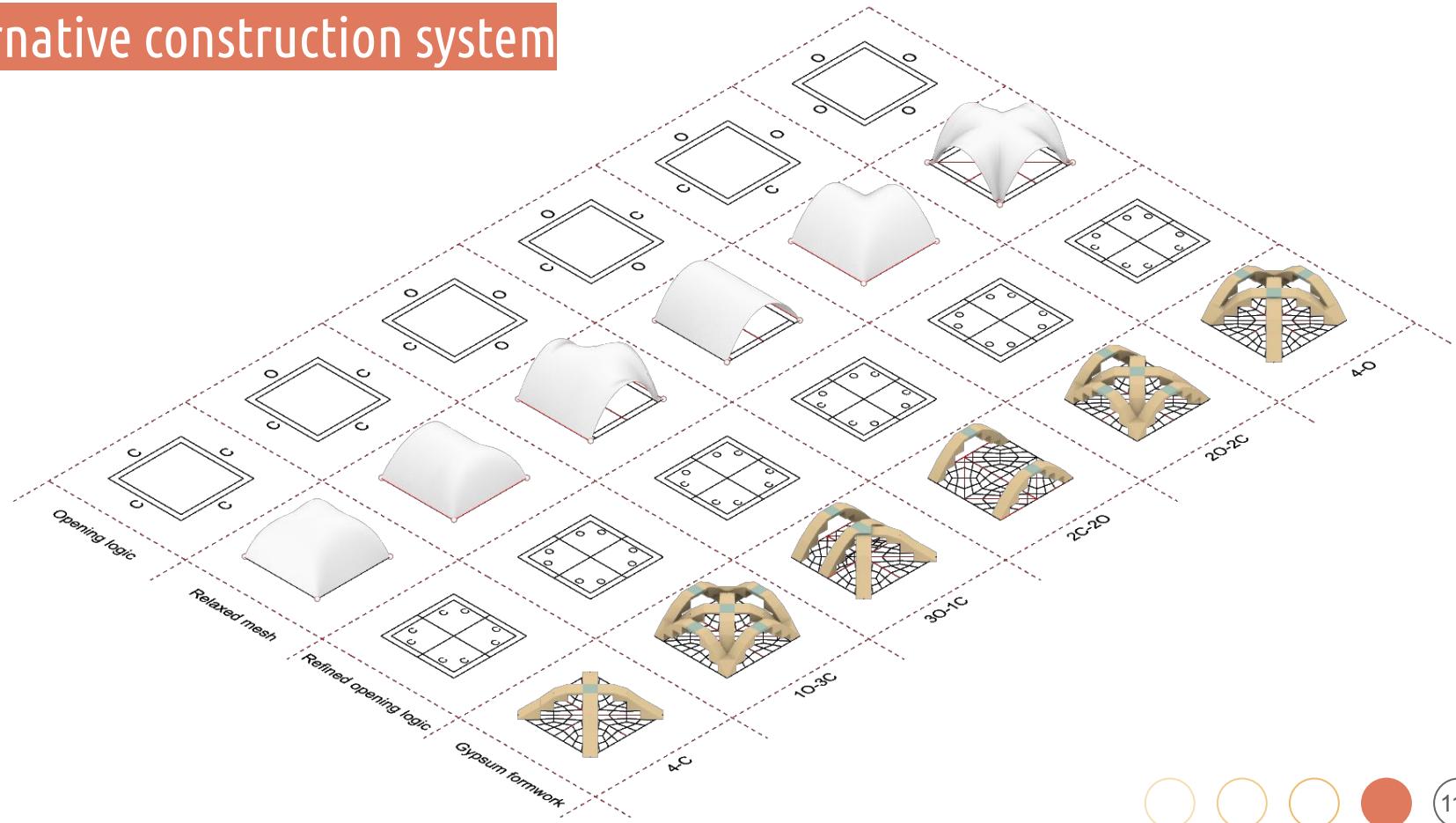
● Arched Nubian Vaults



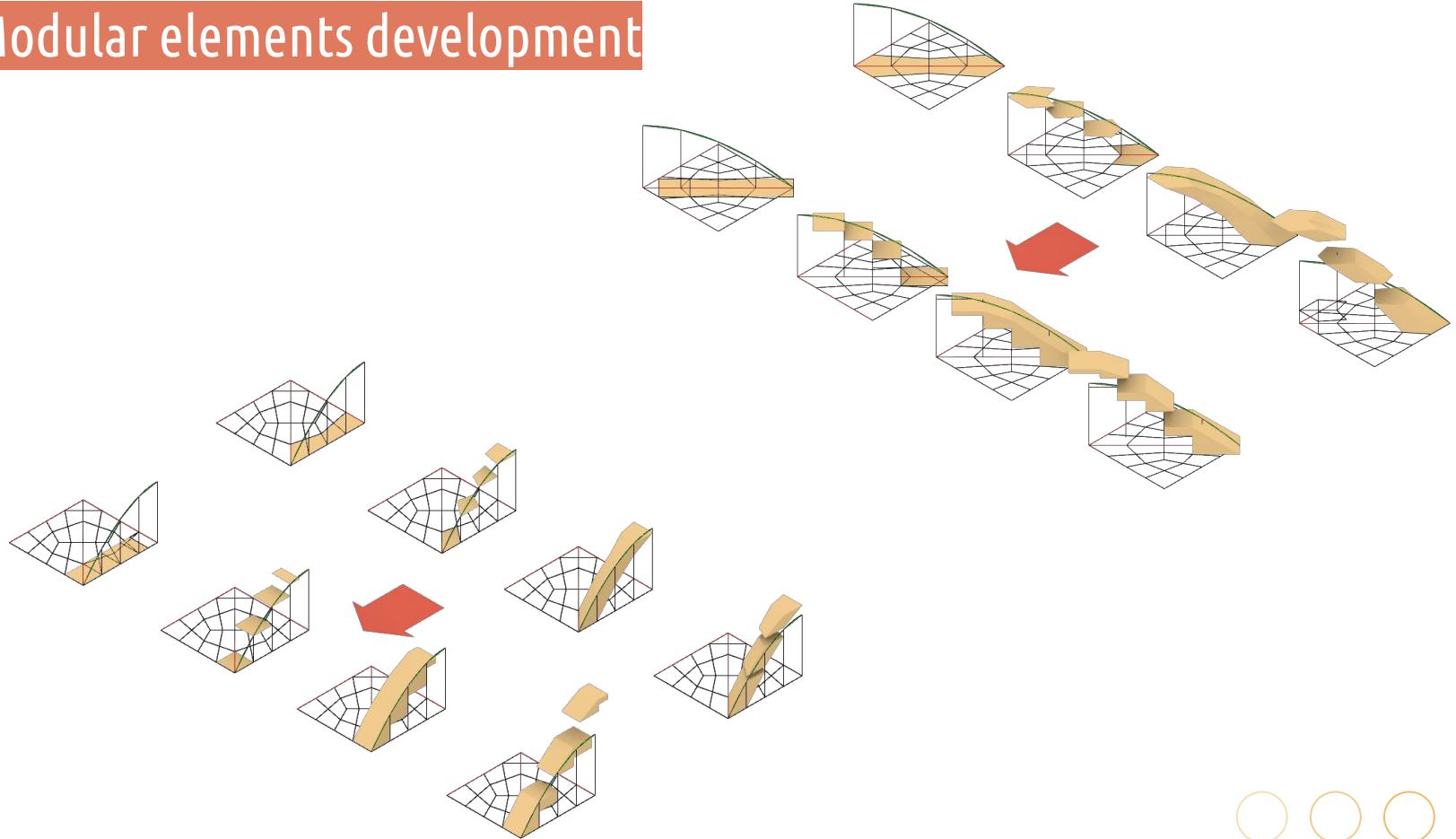
Construction sequence-Atrium



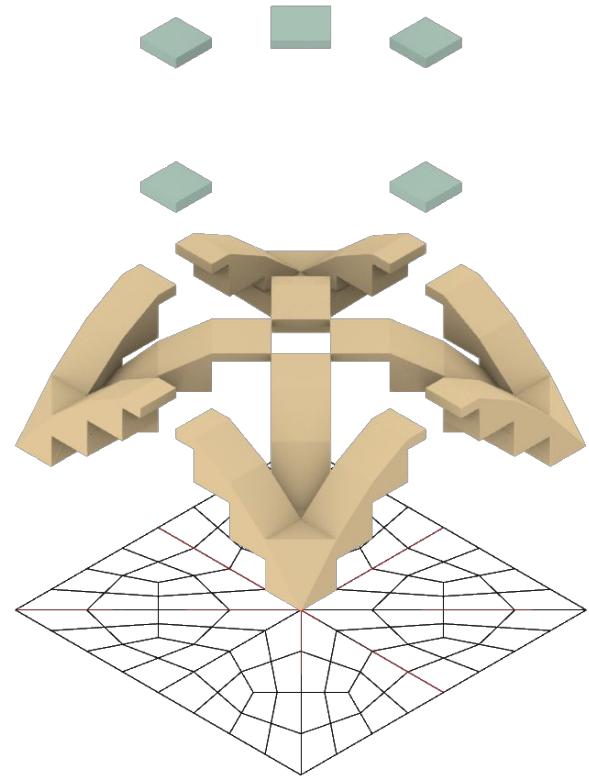
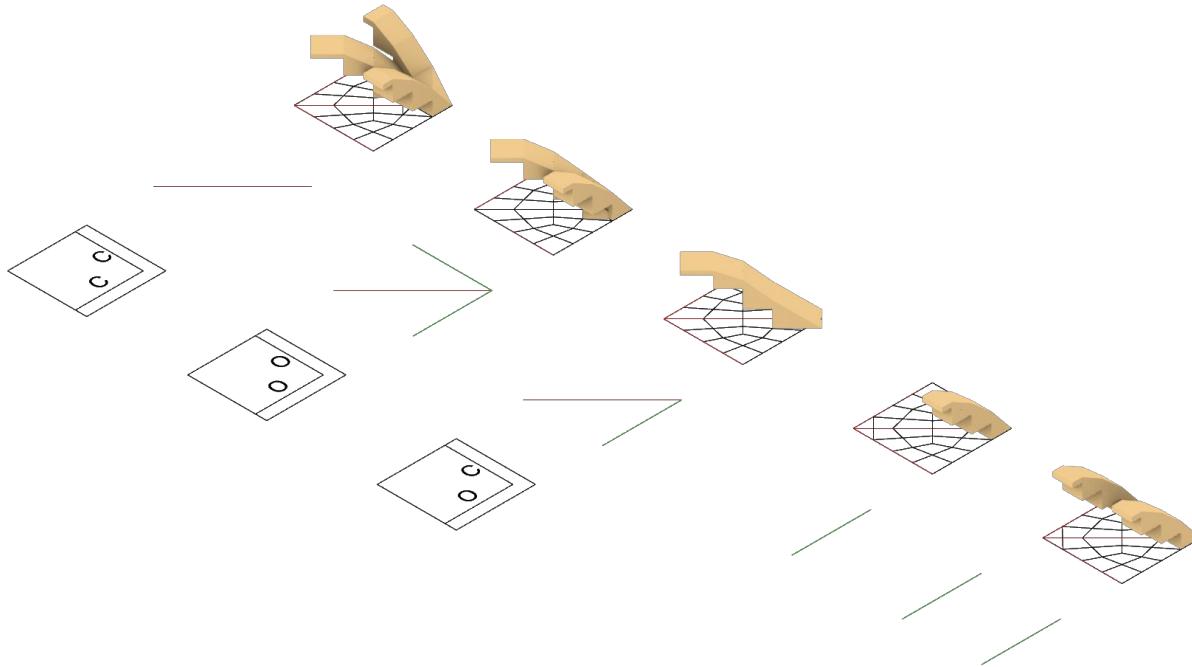
Alternative construction system



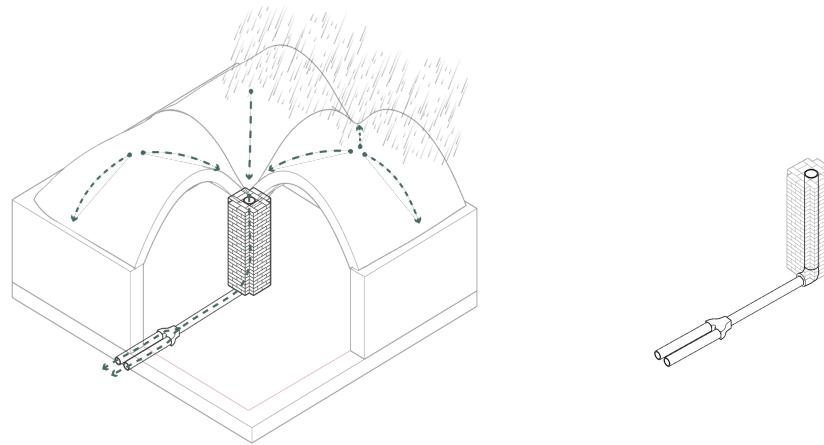
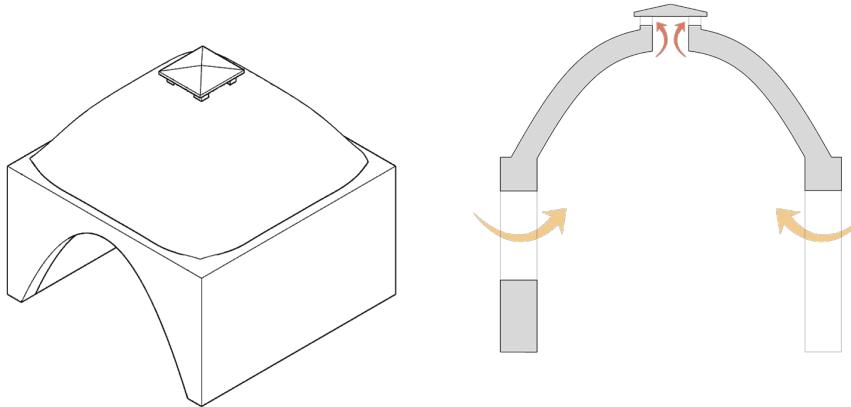
Modular elements development



Modular elements classification



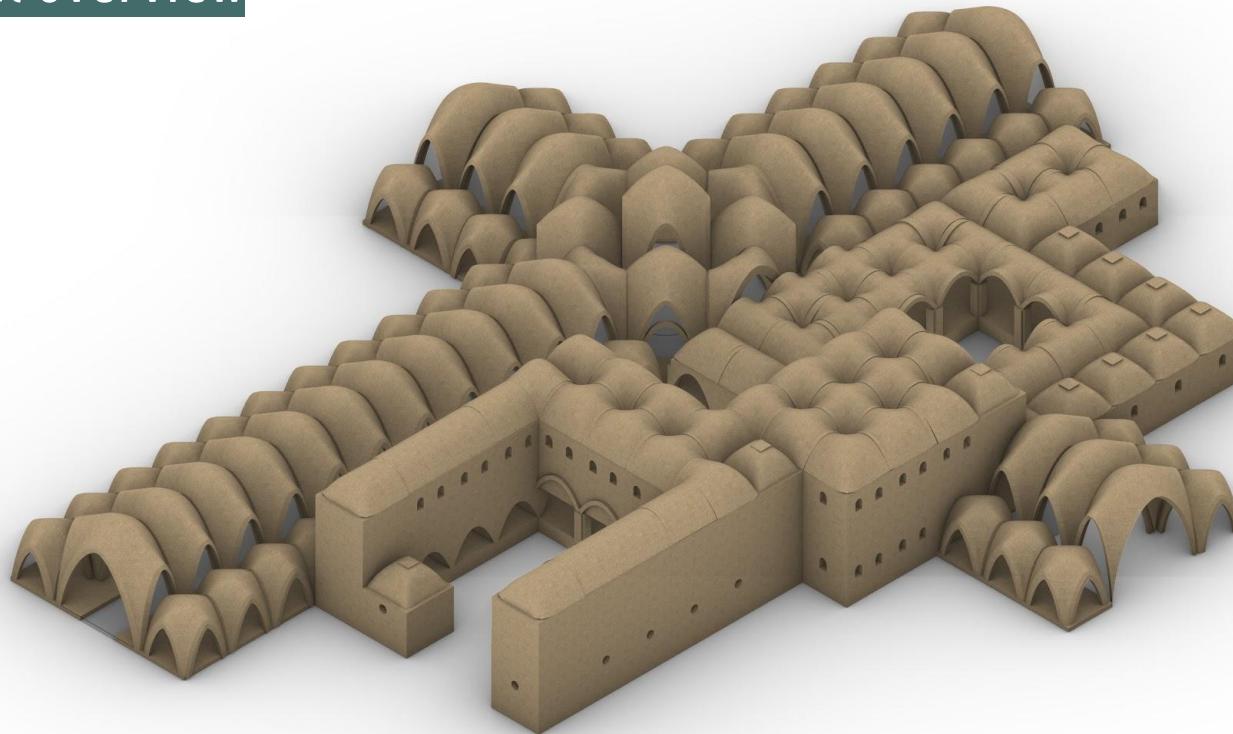
Details



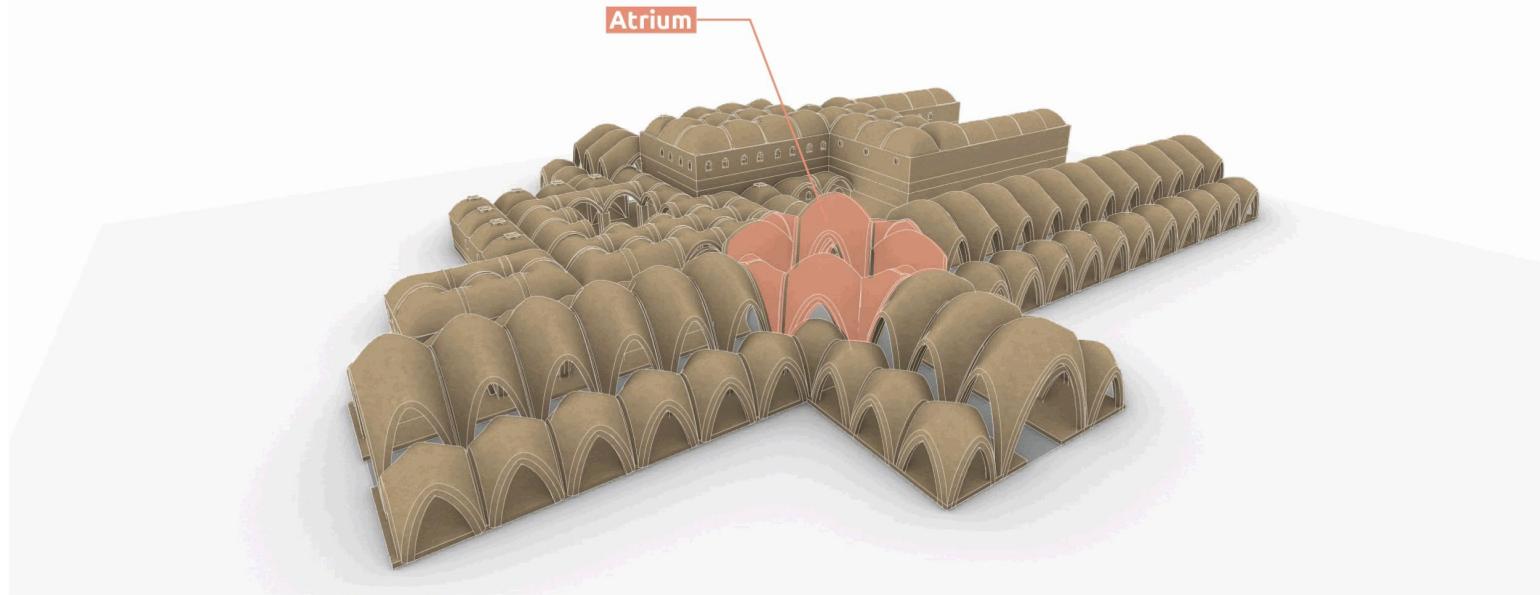


Conclusion

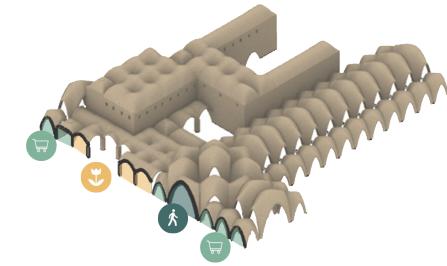
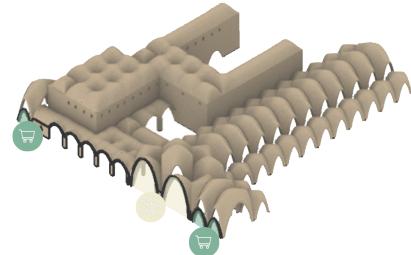
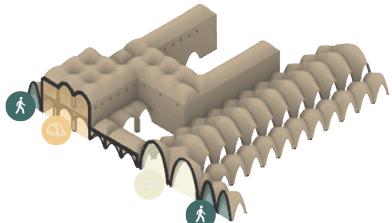
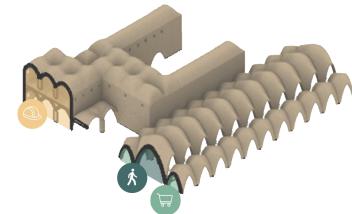
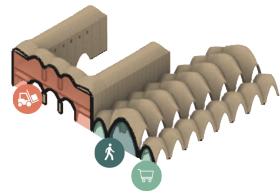
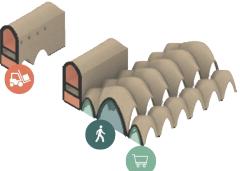
General overview



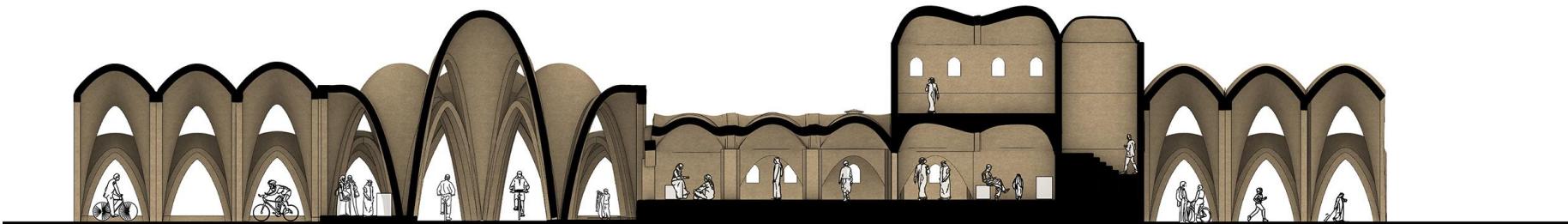
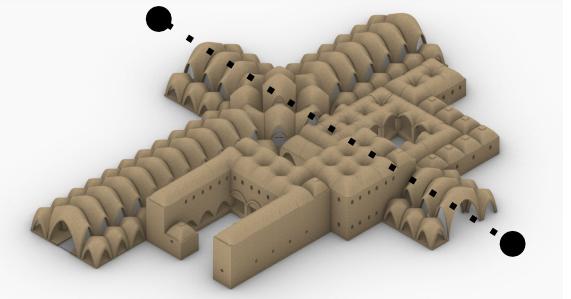
General overview



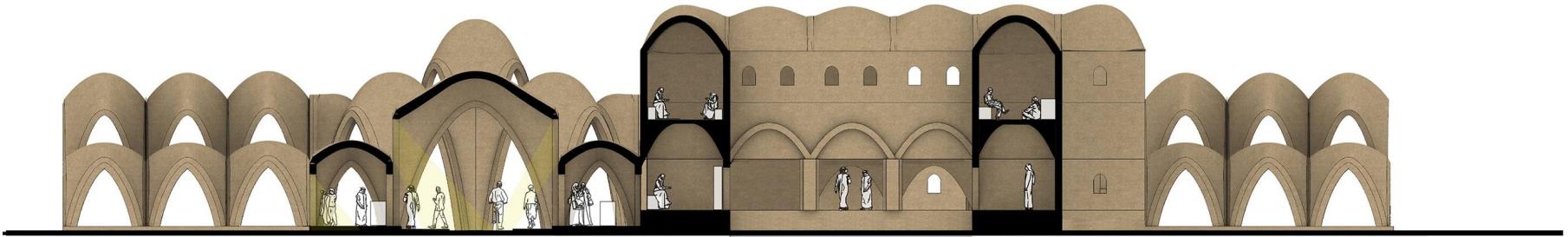
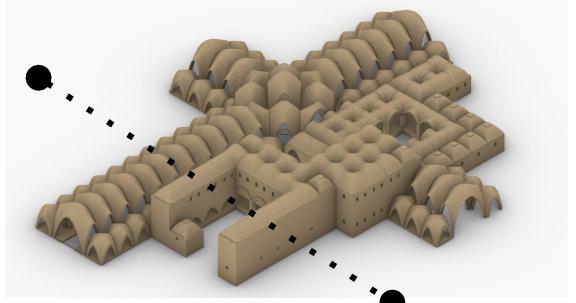
General overview



General overview



General overview







Further development

- urban growth algorithm → how the bazaar expands from A to B and how it affects the urban structure
- connect the layout tool with the modules placement computationally → turn it into a digital board game
- account for many other “road situations” in the tool

Configuration

- More control of max height criteria in dynamic relaxation.
- streamlined and automated dynamic relaxation to brick generating workflow.
- Incorporate more parameters, including external parameters(daylight, hydrology) for roof tessellations.

Form finding

- rainwater management → implement water discharge strategy in roof elements configuration logic
- climate design → implement orientation in wall elements configuration logic
- construction system → evaluate gypsum availability and feasibility of alternative construction system

Detailing



Questions?

Thank you!