# Oasis

## For everyone's well being

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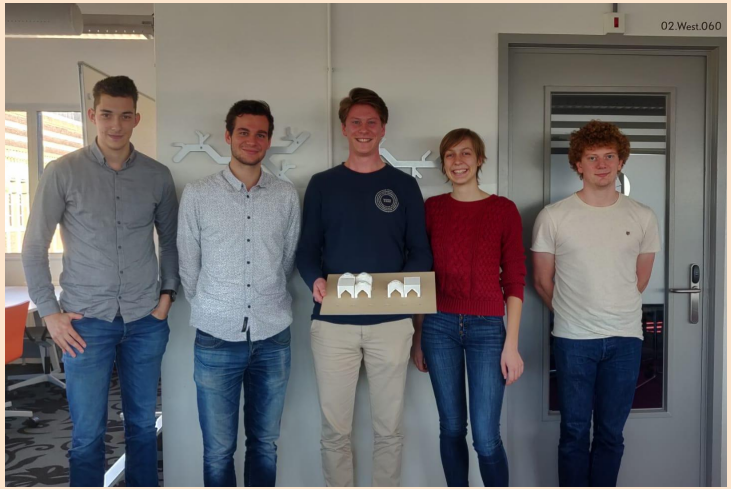
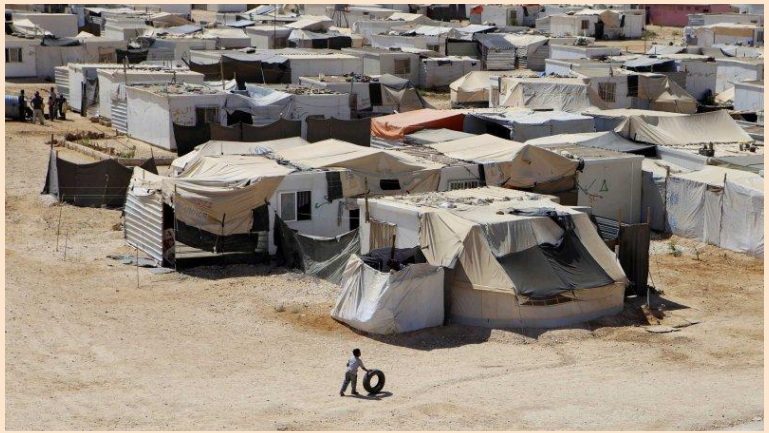
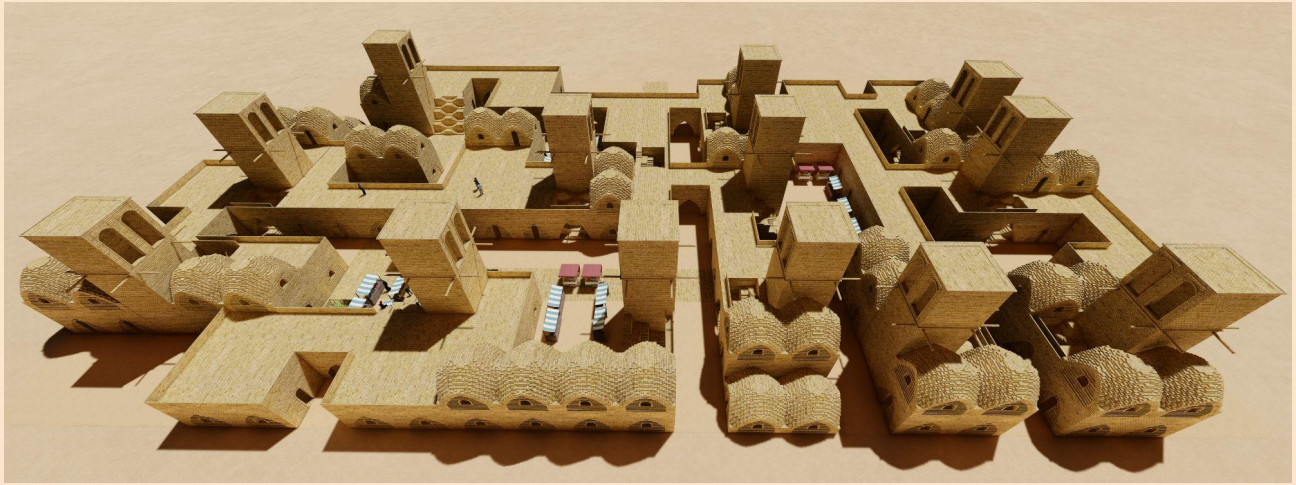


It’s a city

But it’s not a city…

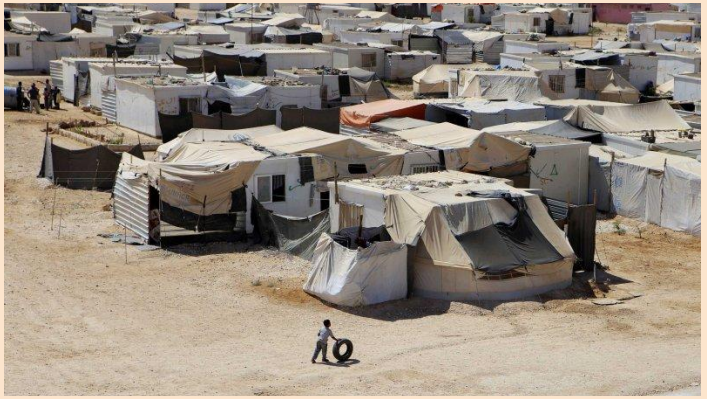




# Analysis

# Problem statement

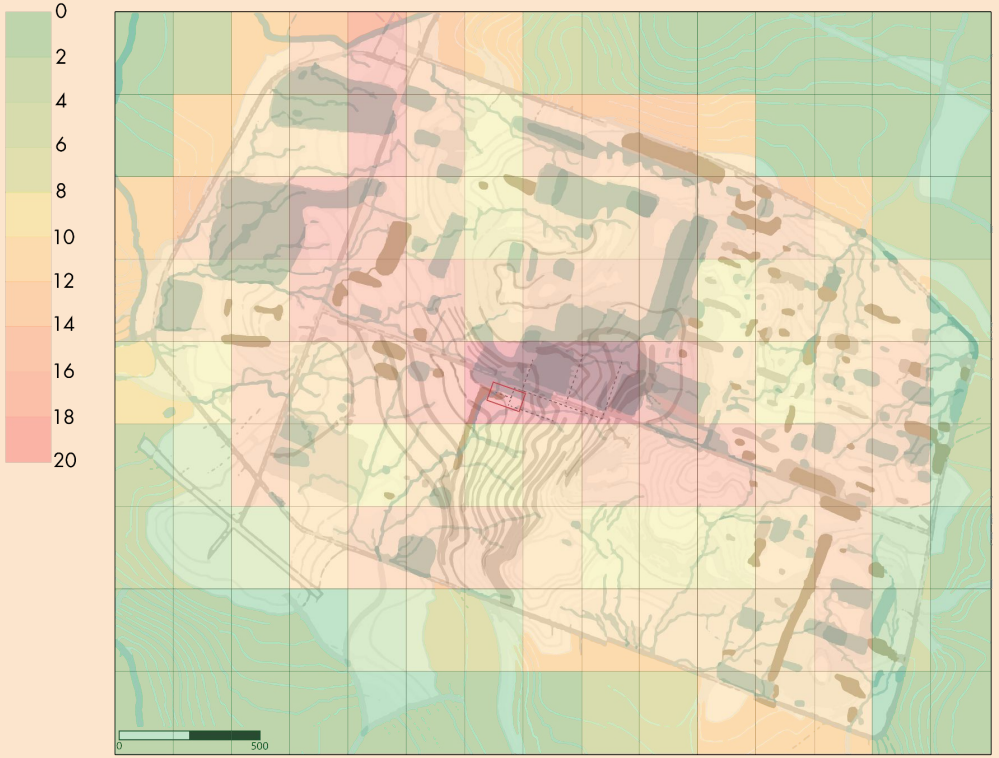
- Low employment rate
  - Boredom
  - Poverty
  - Violence
- Water
  - Flash floods
  - Scarcity



# Location

## Heat map

- Give points to locations
- (0 bad to 5 good)
  - Water
  - Building density
  - Infrastructure
  - Shops

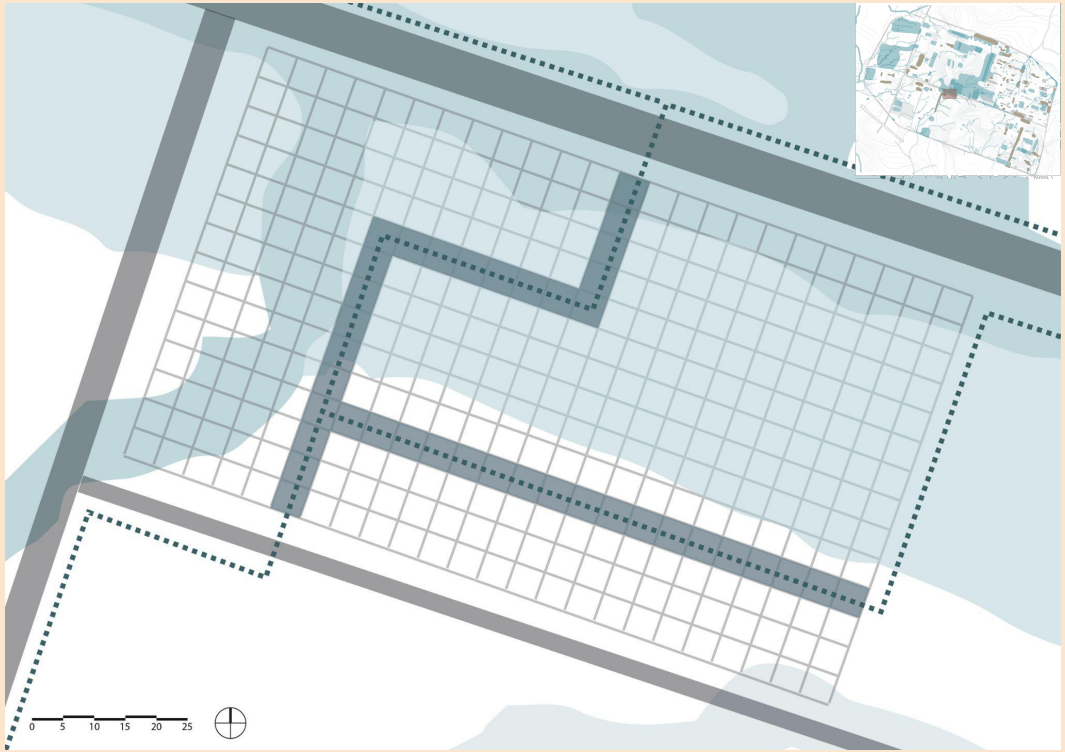


# Water

- Flow of water
- Prevent flooding
- Create channels

# Plot

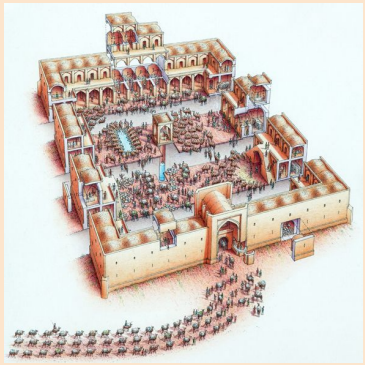
- Store water for local functions



# References

## Bazaar

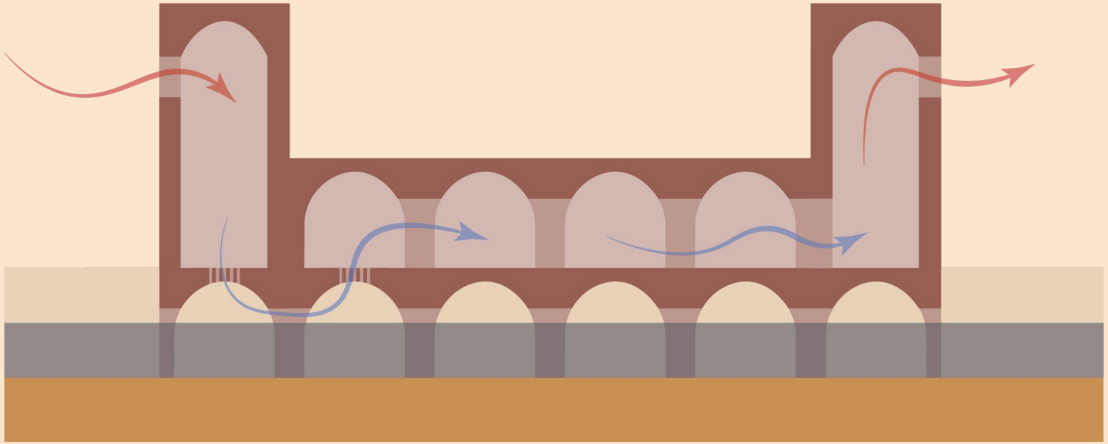
## Caravanserai



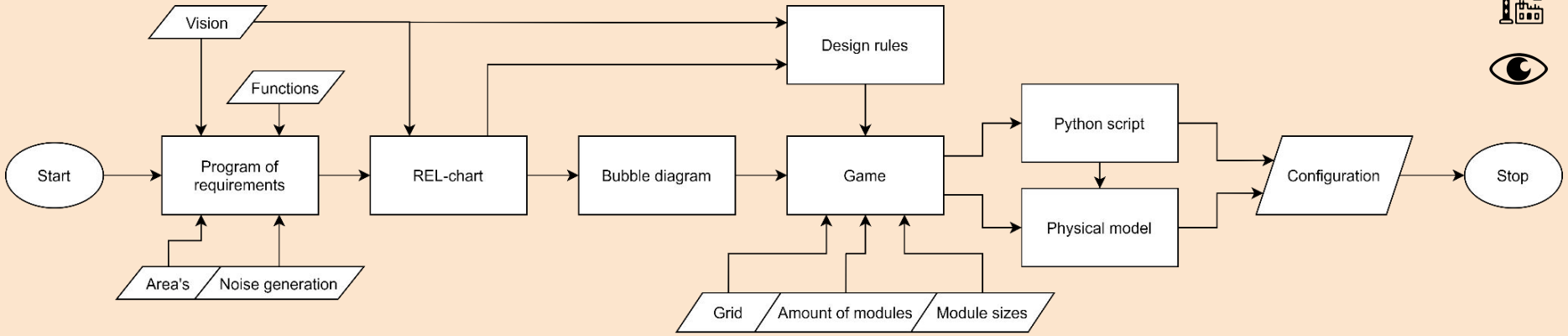
## Indian stepwell

# Wind tower

## Ab Anbar



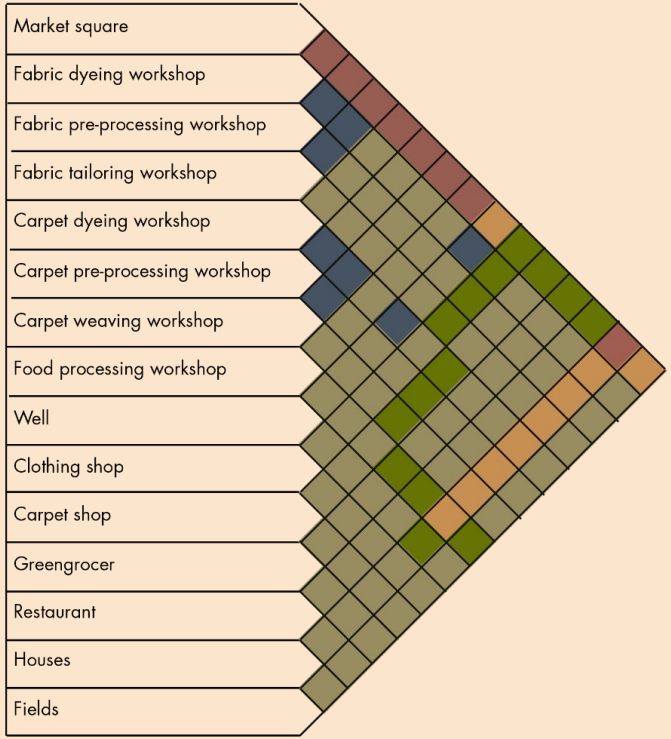
# Configuration

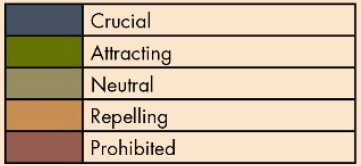


# Program of requirements

- Product chains with water demand
  - Fabrics, carpets and agriculture
- Interests and skills
  - Workshops, retail, etc.
- Living
  - Homes and courtyards

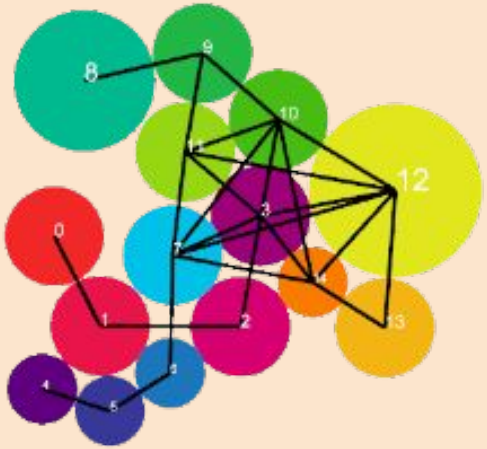
# REL-chart


Market square
Fabric dyeing workshop
Fabric pre-processing workshop
Fabric tailoring workshop
Carpet dyeing workshop
Carpet pre-processing workshop
Carpet weaving workshop
Food processing workshop
Well
Clothing shop
Carpet shop
Greengrocer
Restaurant
Houses
Fields

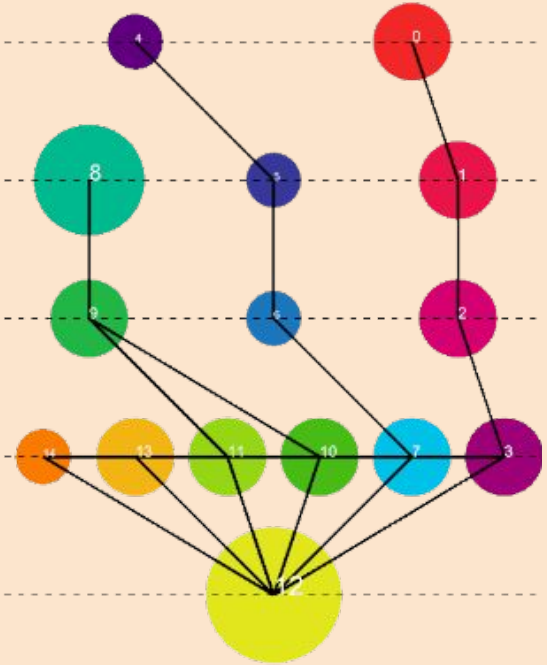

Crucial
Attracting
Neutral
Repelling
Prohibited

# Bubble diagram + Depth chart

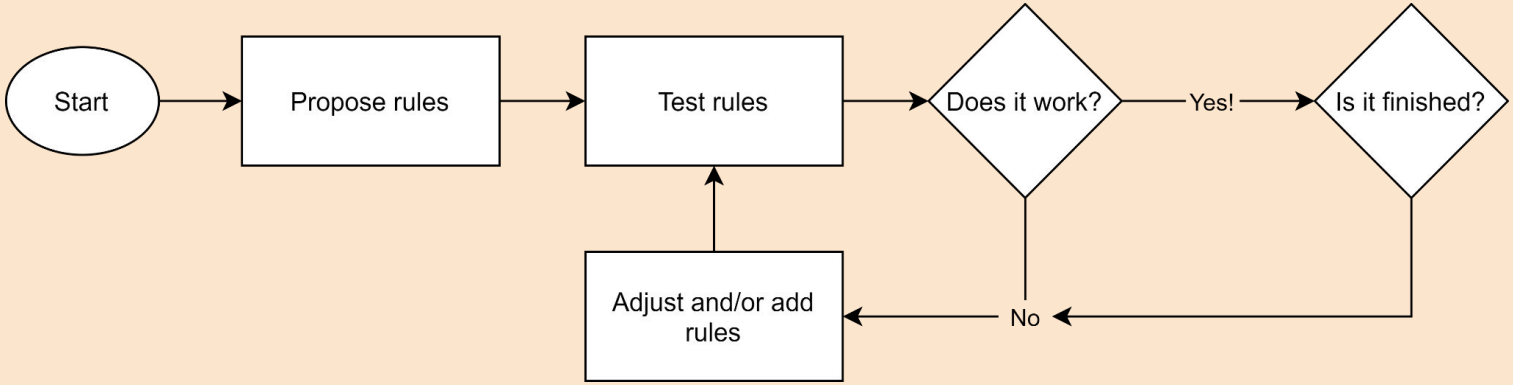
- Highest concentration at squares
- Product chains visible



0. Pre-processing carpet
1. Dyeing carpet
2. Weaving carpet
3. Carpet shop
4. Pre-processing fabric
5. Dyeing fabric
6. Tailor
7. Clothing store
8. Field
9. Food processing
10. Greengrocers
11. Restaurants
12. Market square
13. House
14. Wells



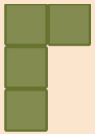
# Design game


Start
Propose rules
Test rules
Does it work?
Yes!
Is it finished?
Adjust and/or add rules
No

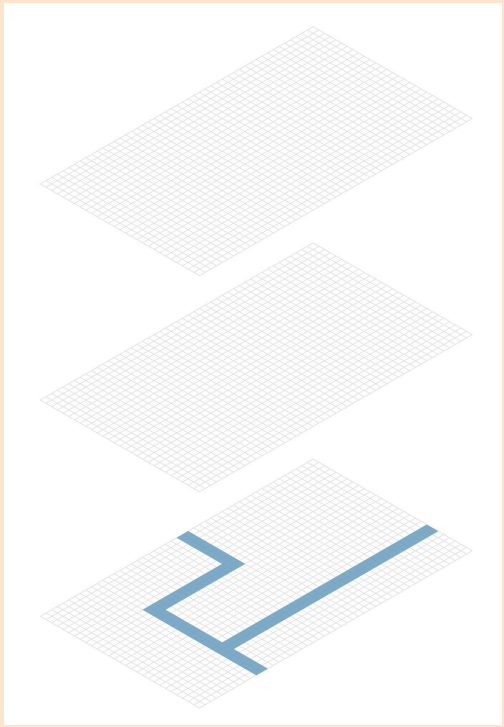
# Explanation placement of functions

Water

Shape: 1 * X



Manual input



+1

Ground

-1

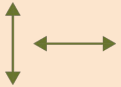
# Explanation placement of functions

Merchant road

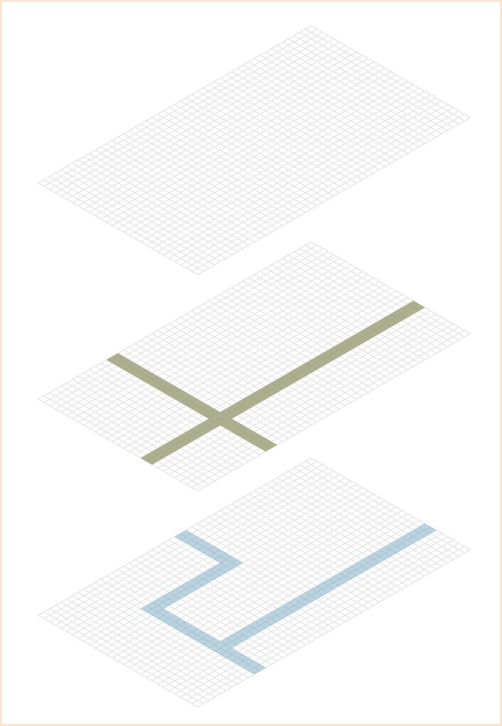
Shape: 1 * X

Next to water 

Central



1 vertical, 1 horizontal



+1

Ground

-1

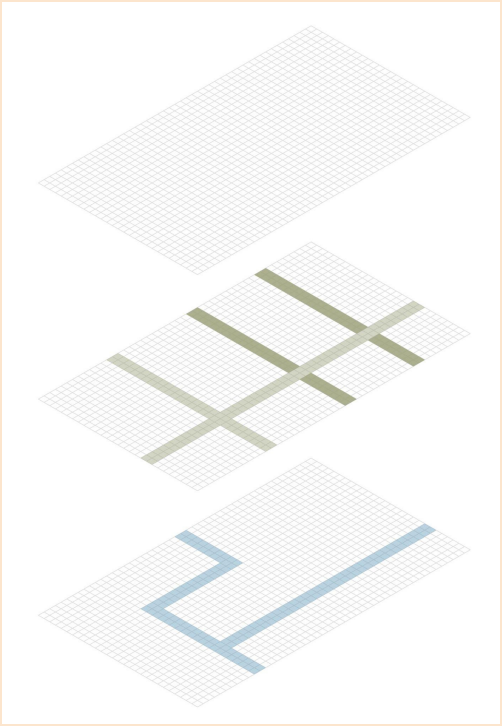
# Explanation placement of functions

Sub-roads

Shape: 1 * X

Space between roads and boundaries is evenly divided

2 vertical



+1

Ground

-1

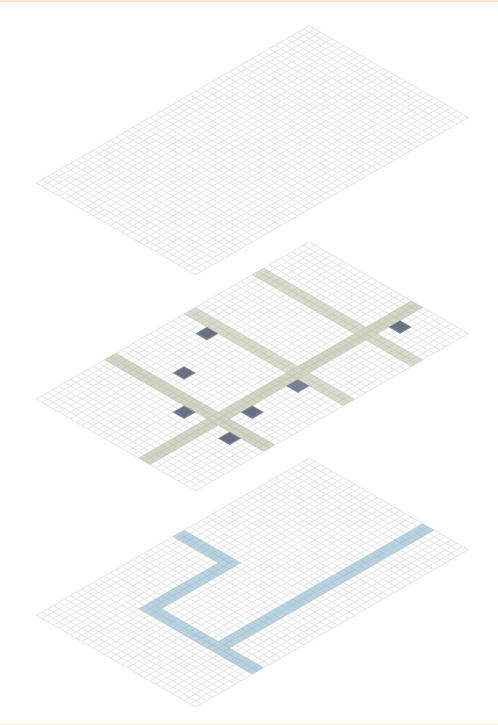
# Explanation placement of functions

## Wells

Shape: 1 * X

On top of water

Space between wells is evenly divided



# Explanation placement of functions

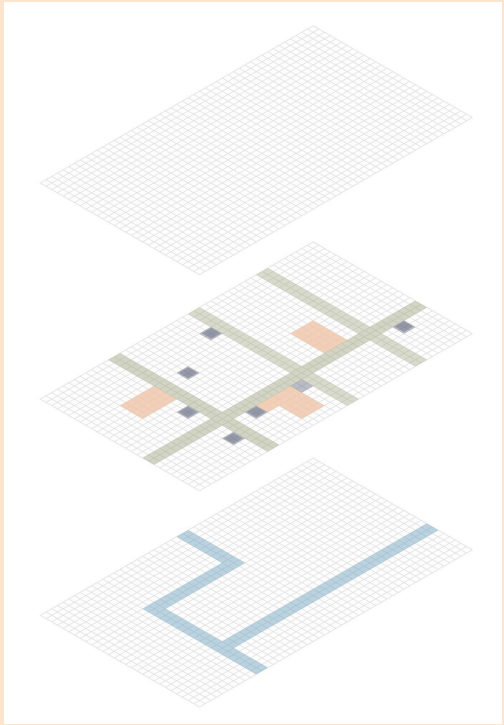
## Squares

Shape: 2 * 3

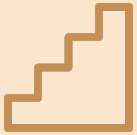
Next to main road

Space between squares is evenly divided

Not next to sub-road



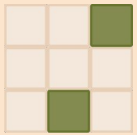
# Explanation placement of functions



Stairs

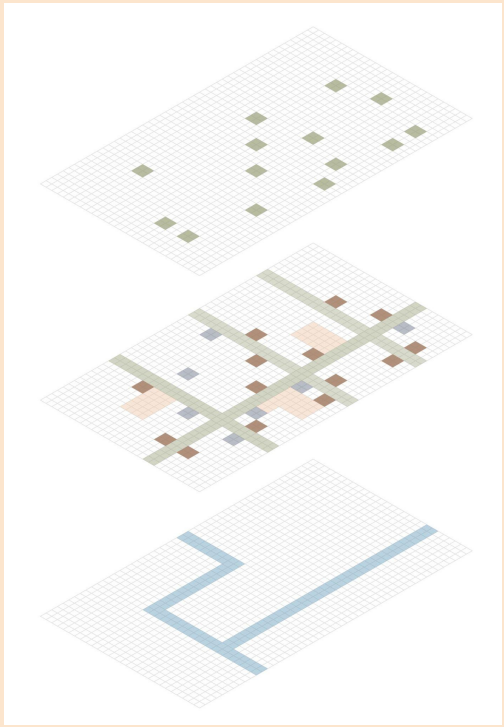
Shape: 1 * X

Next to main road



2 per block

Central



+1

Ground

-1

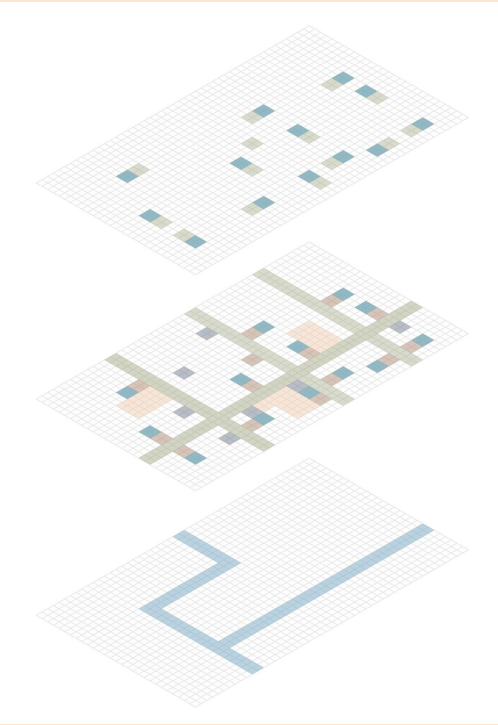
# Explanation placement of functions

Wind towers

Shape: 1 * X

Next to stairs

Not next to road



# Explanation placement of functions

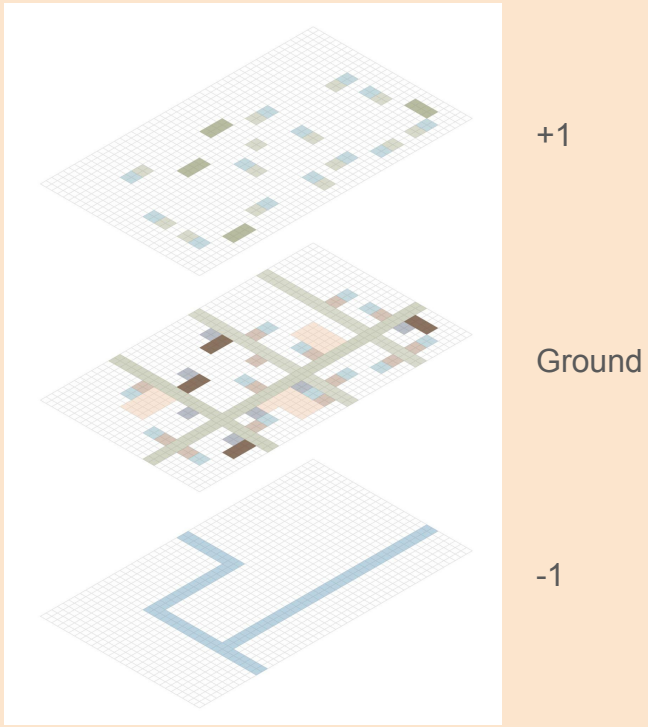
Water workshops

Shape: 1 * 2

Next to main road 

Not close to square 

Close to well 



+1

Ground

-1

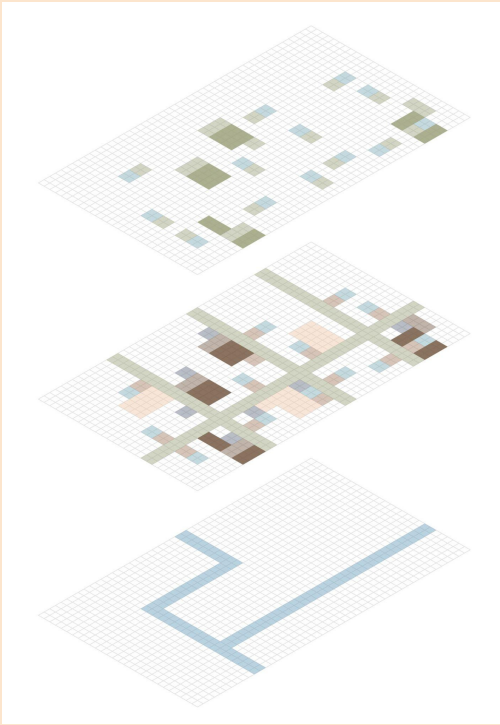
# Explanation placement of functions

Workshops

Shape: 1 * 2

Next to main road

Next to water workshop



+1

Ground

-1

# Explanation placement of functions

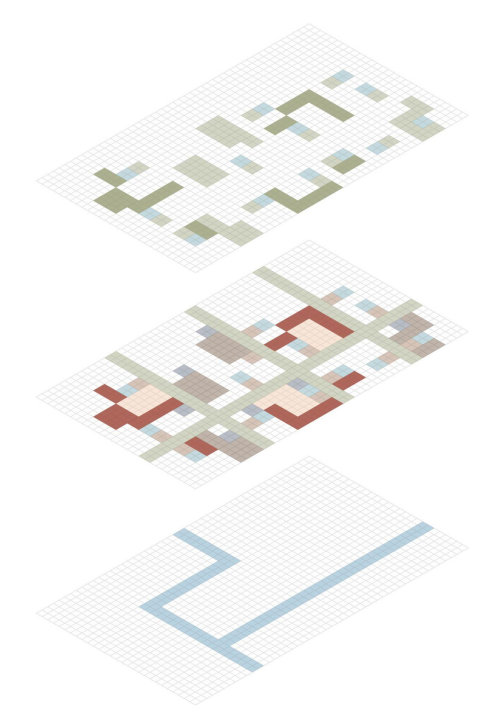
Shops

Shape: 1 * 2

Next to square

Next to main road

Close to workshop



+1

Ground

-1

# Explanation placement of functions

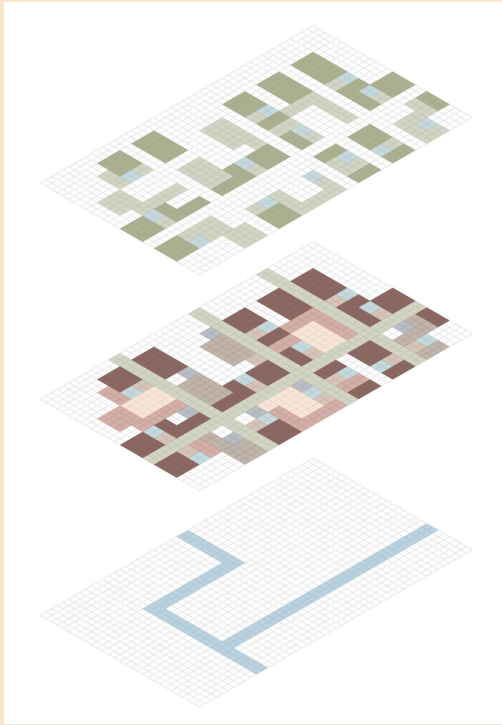
Houses ground floor

Shape: 1 * 2

Next to sub-road

Close to stairs

If not possible on ground floor, place on first floor



+1

Ground

-1

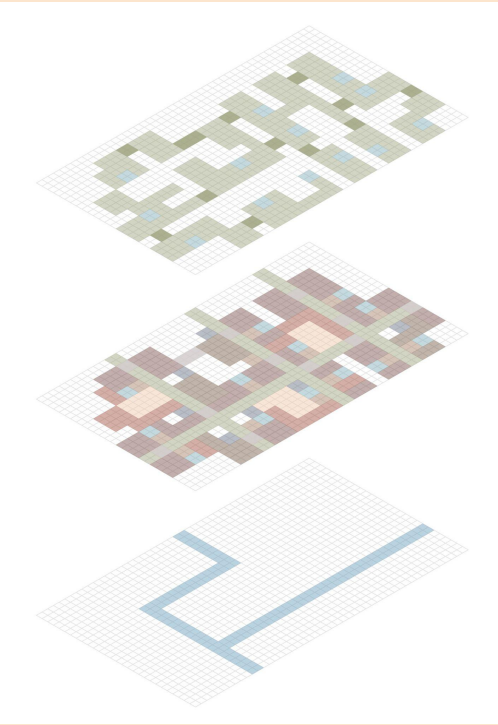
# Explanation placement of functions

Bridges

Shape: 1 * X

Locate accessible roofs

Connect all building blocks



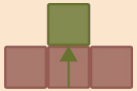
# Explanation placement of functions

Houses first floor

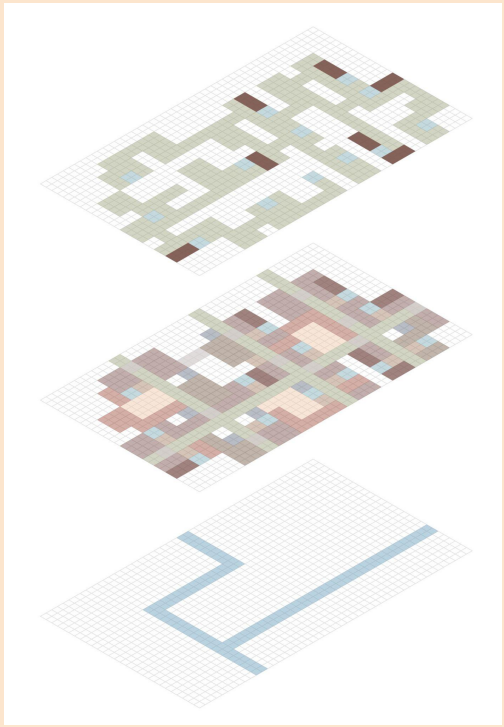
Shape: 1 * 2

Next to sub-road 

Close to stairs 



If not possible on ground floor, place on first floor



+1

Ground

-1

# Explanation placement of functions

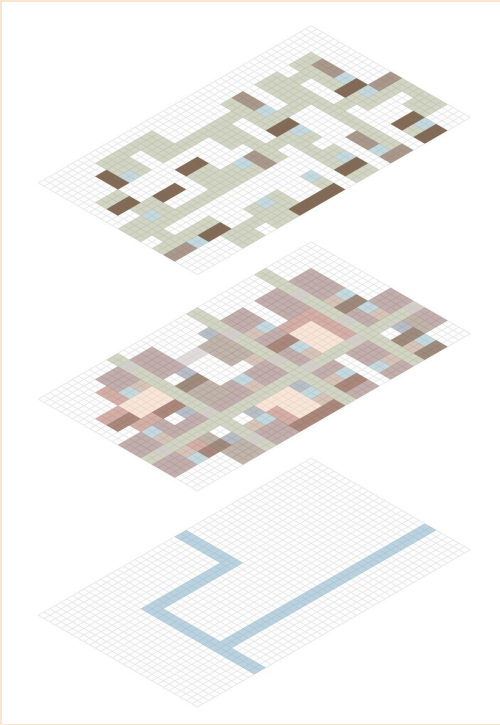
## Food processing

Shape: 1 * 2

Close to stairs

Close to shops

Not close to houses



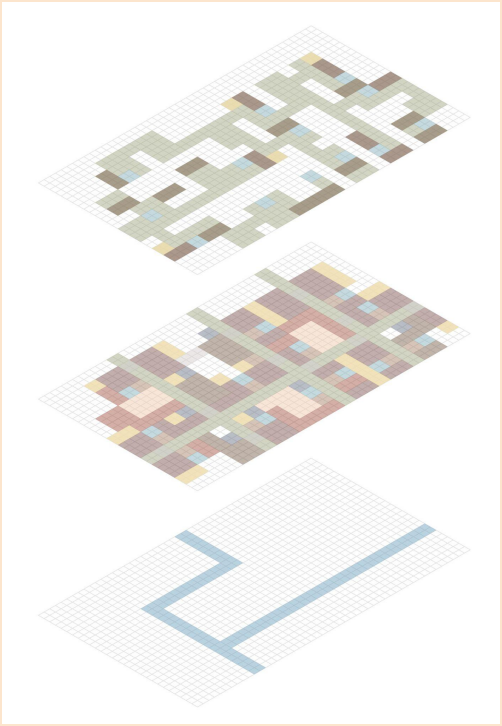
# Explanation placement of functions

## Courtyards

Shape: X * X

All homes get a courtyard

Not close to roads



+1

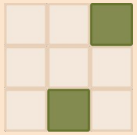
Ground

-1

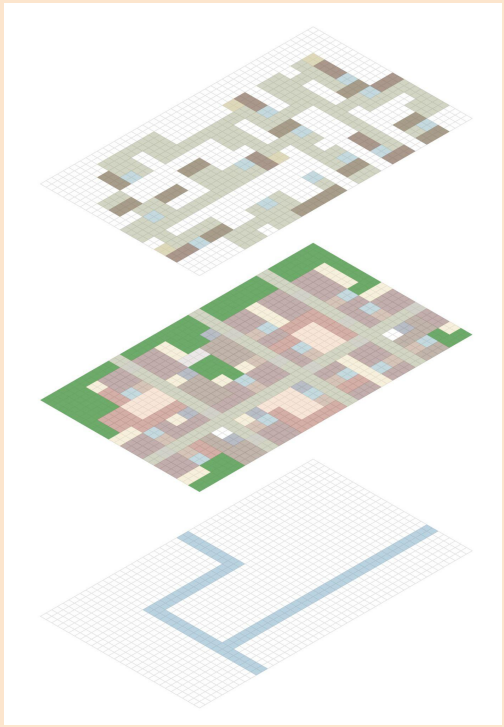
# Explanation placement of functions

Fields

Shape: X * X



All voxels without
functions become fields



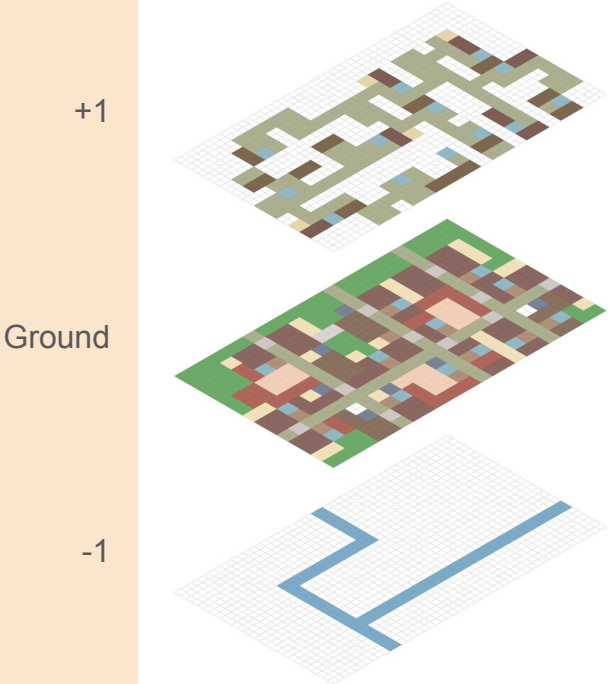
+1

Ground

-1

# Explanation placement of functions

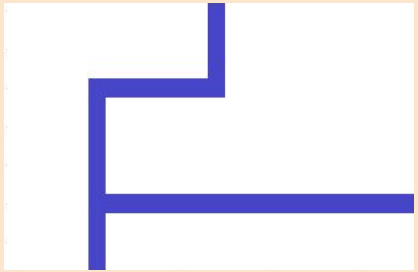
Full program



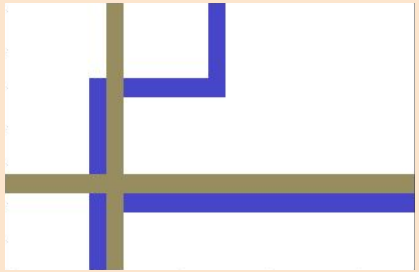
# Physical

Play, test, repeat

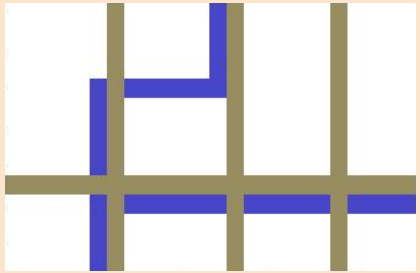
# Python



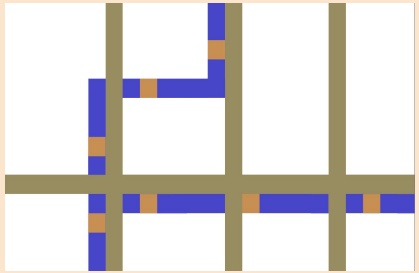
Water



Merchant roads



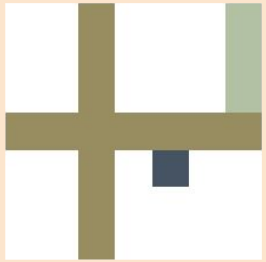
Sub-roads



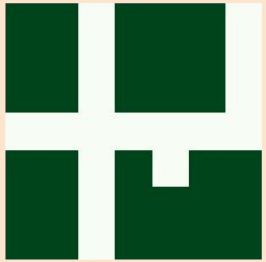
Wells

# Python

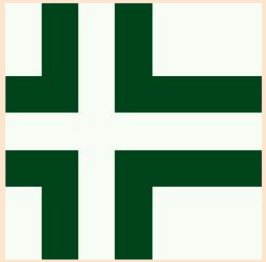
Neighbour stencil



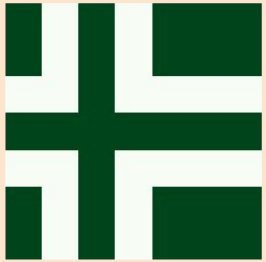
Starting point



Free space



Neighbours street

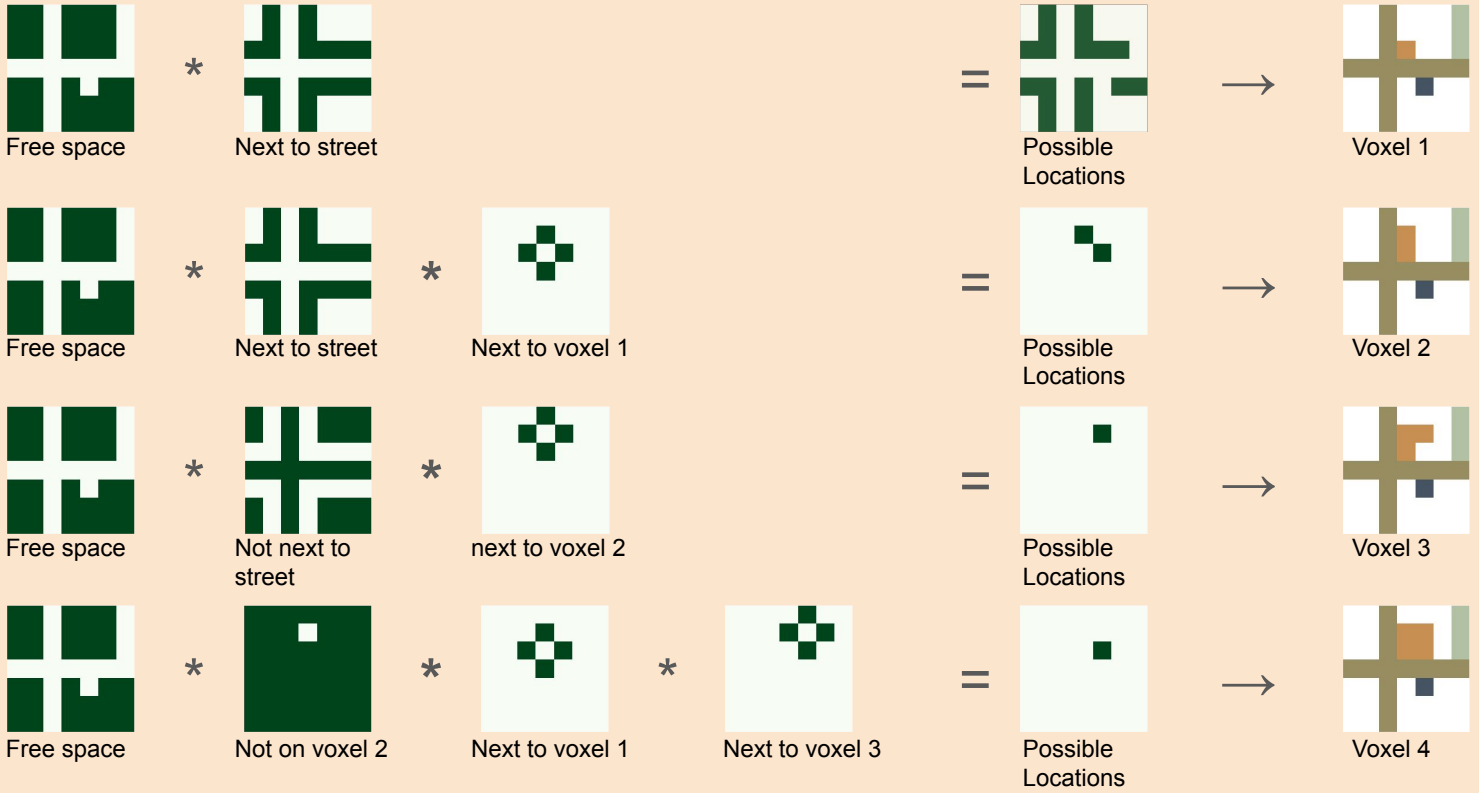


Not neighbours of street

Roads
Sub-roads
Wells

Possible locations

# Python

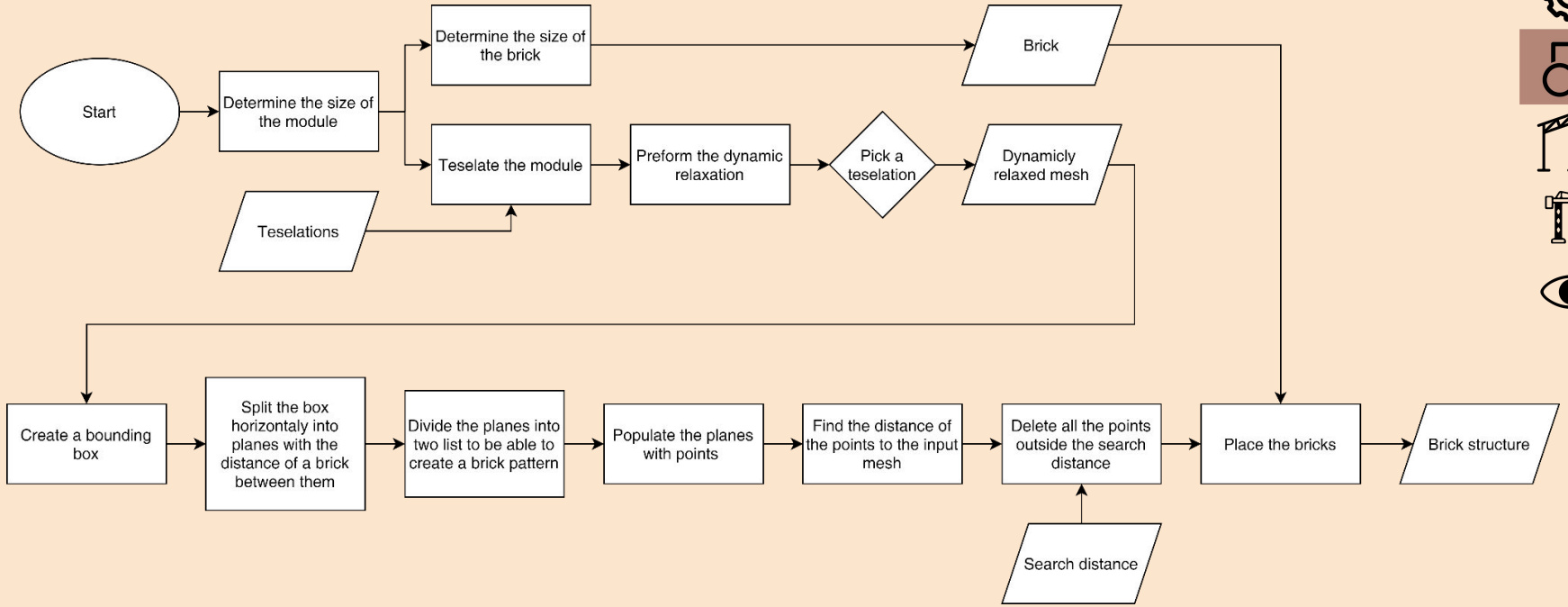

Free space
*
Next to street
=
Possible Locations
→
Voxel 1
Free space
*
Next to street
*
Next to voxel 1
=
Possible Locations
→
Voxel 2
Free space
*
Not next to street
*
next to voxel 2
=
Possible Locations
→
Voxel 3
Free space
*
Not on voxel 2
*
Next to voxel 1
*
Next to voxel 3
=
Possible Locations
→
Voxel 4
Roads
Sub-roads
Wells
Square
Possible locations

# Python

Roads
Sub-roads
Wells
Square

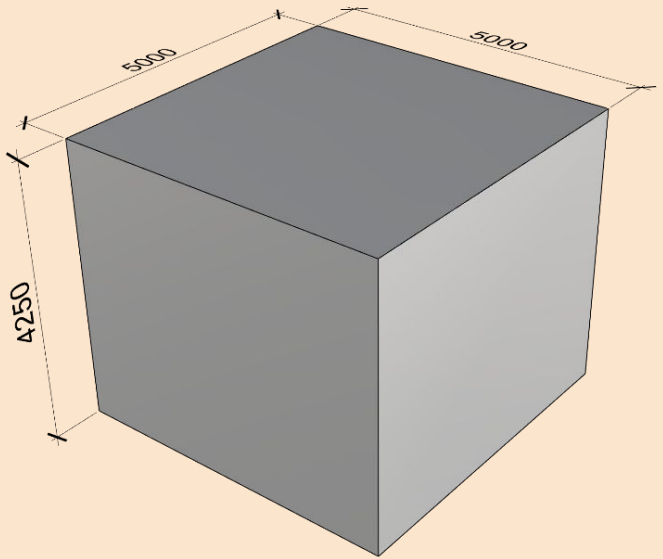
Possible locations

# Shape


Start
Determine the size of the module
Determine the size of the brick
Brick
Teselate the module
Preform the dynamic relaxation
Pick a teselation
Dynamicly relaxed mesh
Teselations
Create a bounding box
Split the box horizontaly into planes with the distance of a brick between them
Divide the planes into two list to be able to create a brick pattern
Populate the planes with points
Find the distance of the points to the input mesh
Delete all the points outside the search distance
Search distance
Place the bricks
Brick structure

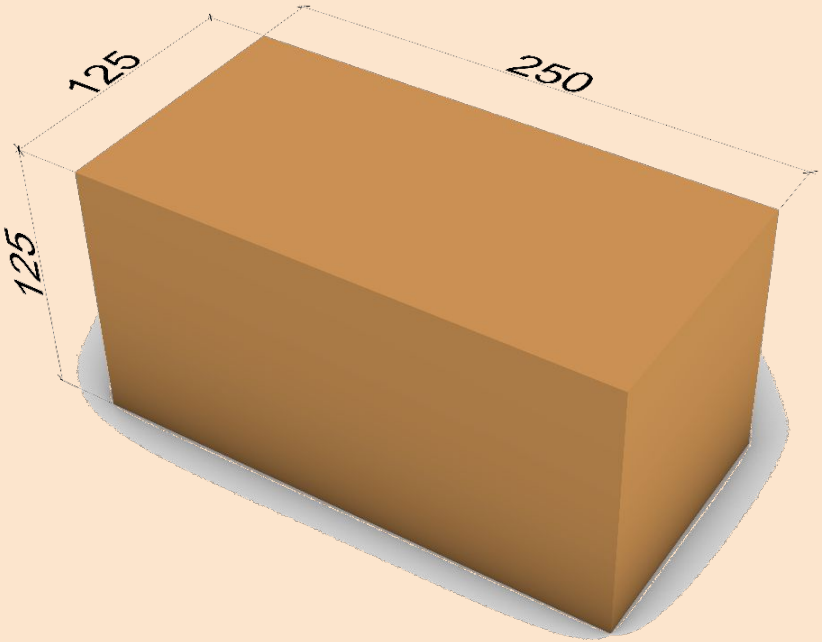
# Module size

- 5m x 5m x 4,25 m (l*w*h)
- Self Standing (structurally)
- Modular in all directions
- Wide enough to be a street



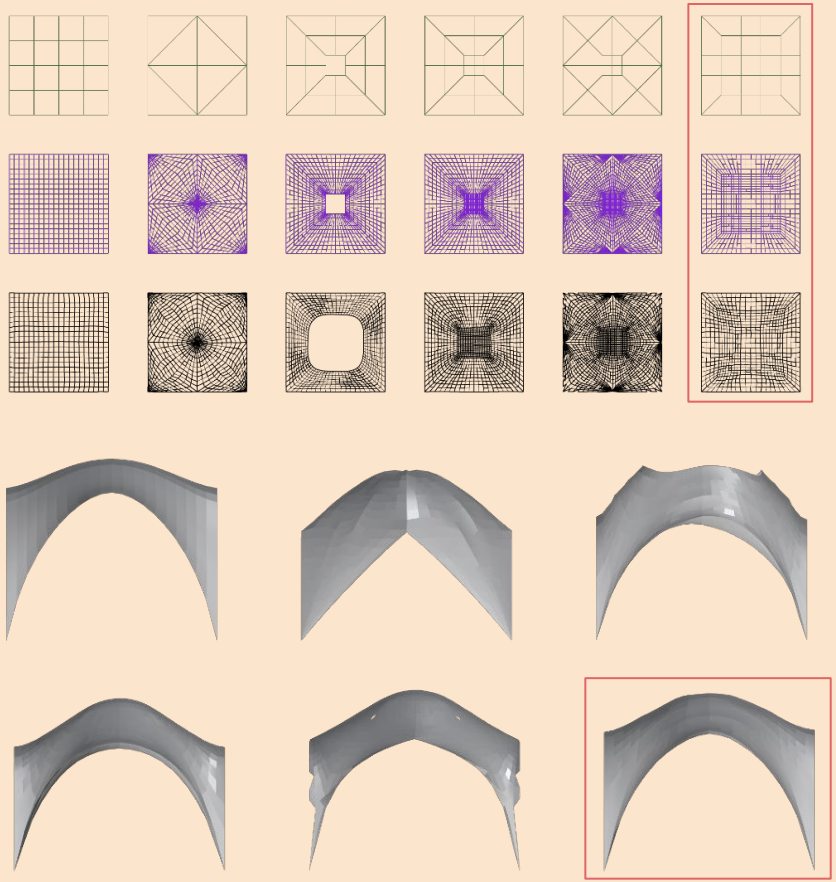
# Brick size

- Fits within 5m x 5m grid in length and width
- Two times as long as wide. Has the ability to make squares

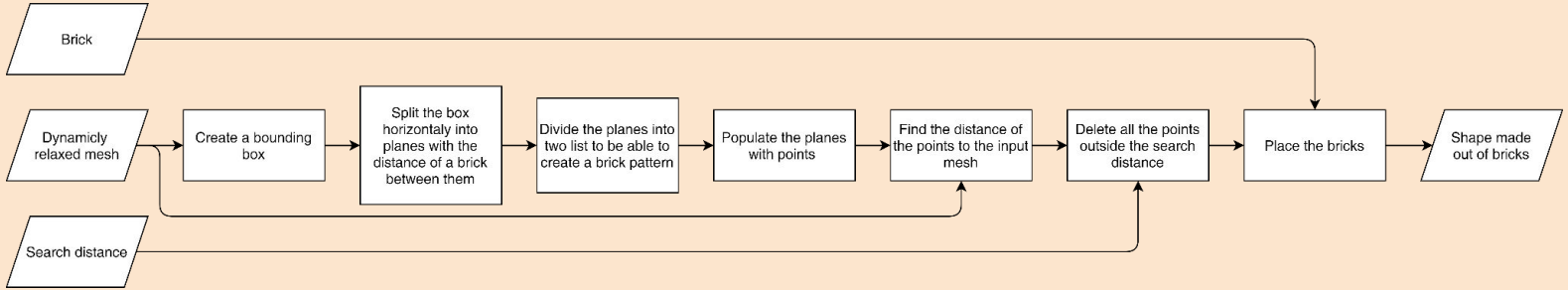


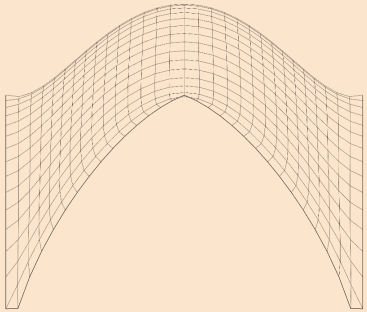
# Tessellation

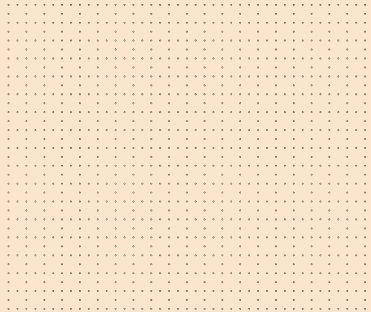
1. Standard square tessellation
2. Diagonal lines between the anchors in the corners
3. From corners to centre with open centre
4. From corners to centre with closed centre
5. Diagonal lines from anchors and between midpoints of the arcs
6. Square centre with diagonals from the corners

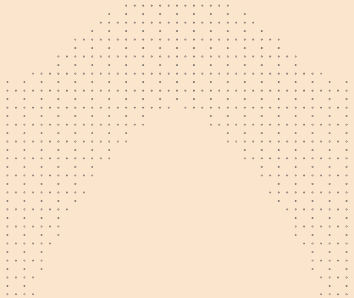


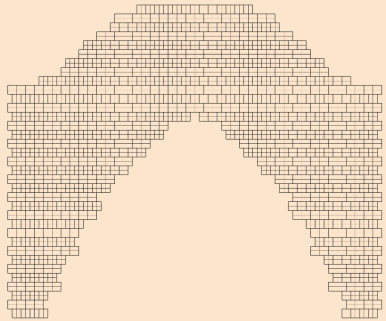
# Placement of the bricks



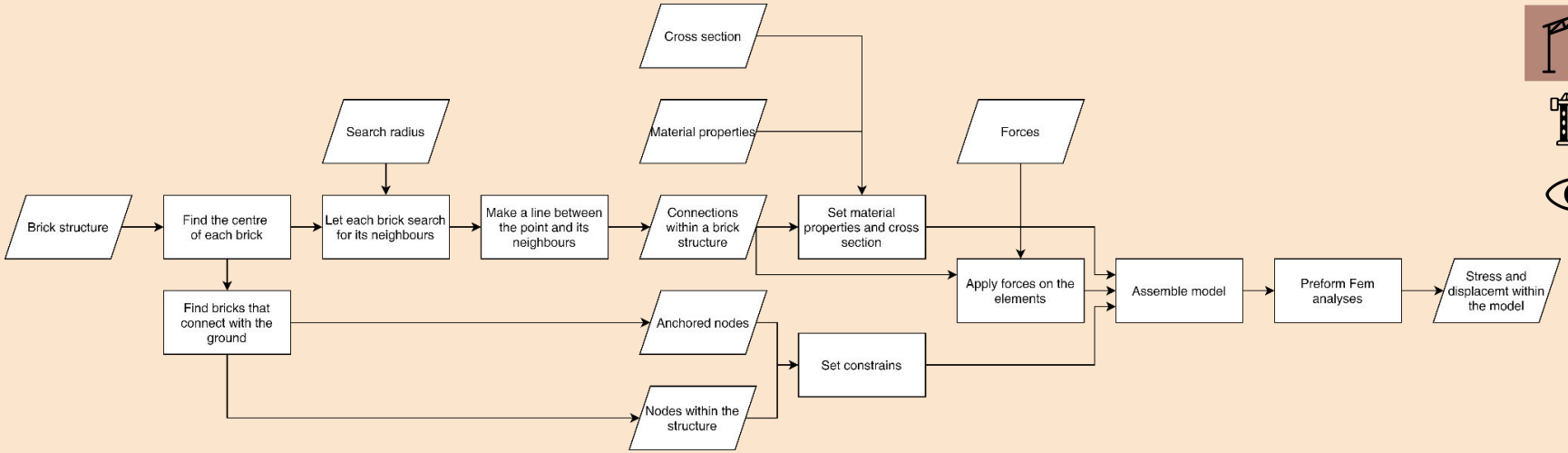









# Structure

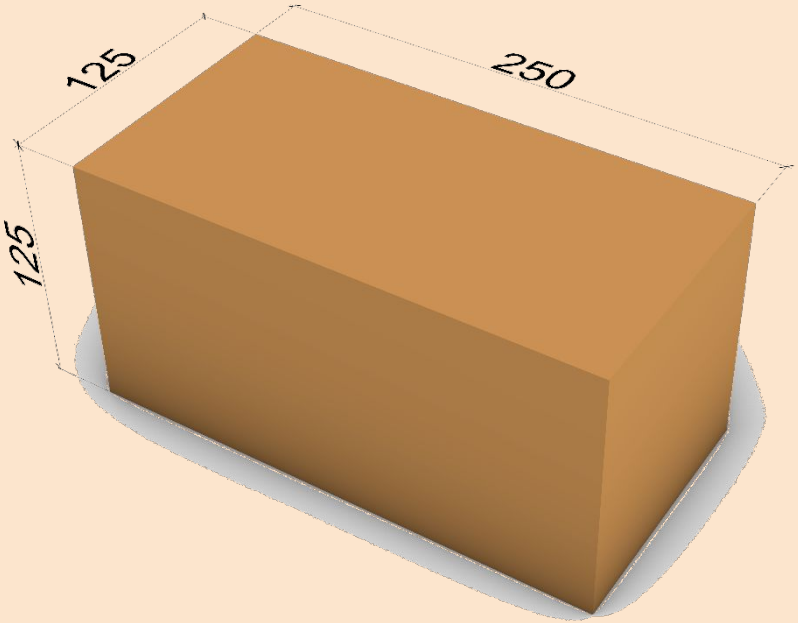

Brick structure
Find the centre of each brick
Let each brick search for its neighbours
Search radius
Make a line between the point and its neighbours
Connections within a brick structure
Cross section
Material properties
Set material properties and cross section
Forces
Apply forces on the elements
Assemble model
Preform Fem analyses
Stress and displacemt within the model
Find bricks that connect with the ground
Anchored nodes
Nodes within the structure
Set constrains

# Material properties brick

Water+clay+Fine sand

| | |
|---|---|
| Young’s modulus | 76 N/mm2 |
| Compressive strength | 2,1 N/mm2 |

*found in the material tests of Earthy 19 (Jannat_Al_Tohr has average results when comparing it to other reports)



# FEM analysis

- 40 to 60% added weight
- Modeling arches in a truss structure (figure 1)
- Truss causes tension (figure 2)

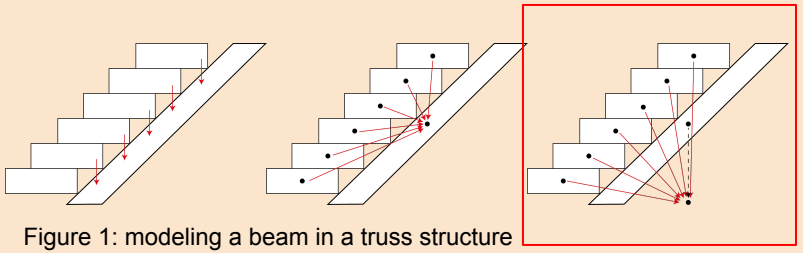


Figure 1: modeling a beam in a truss structure

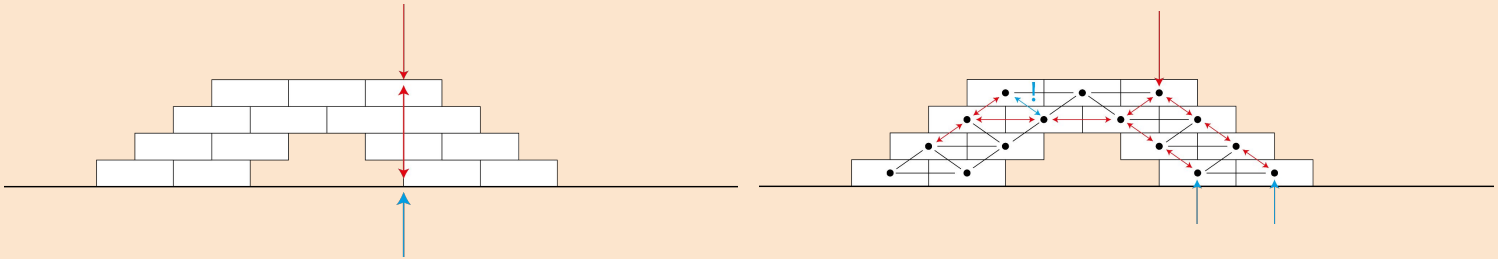
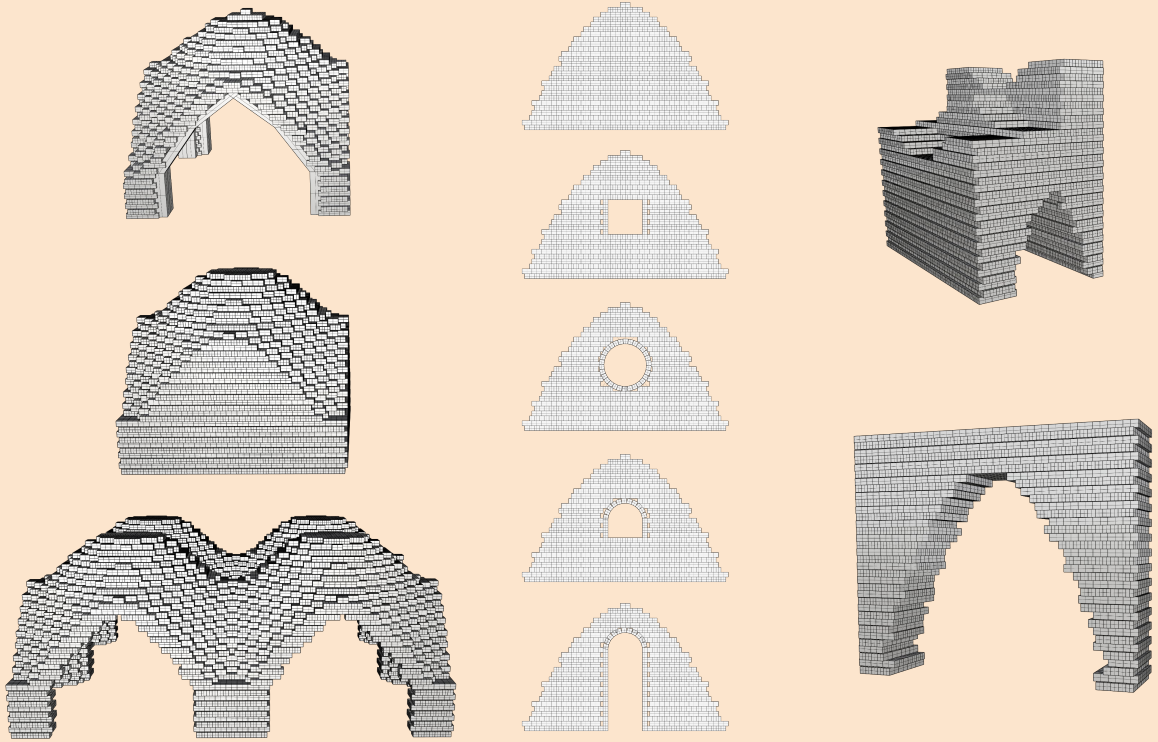


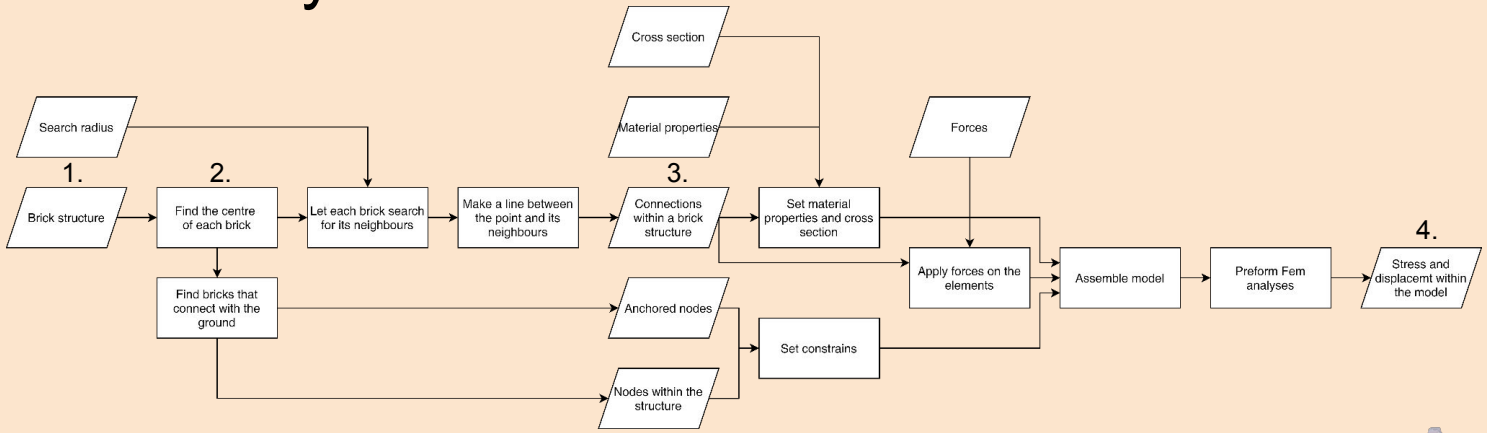
Figure 2: Tension in a truss structure

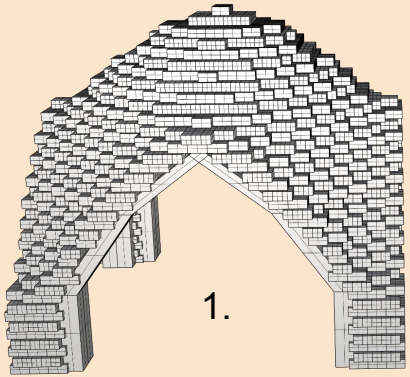
# Inventory of analysed parts



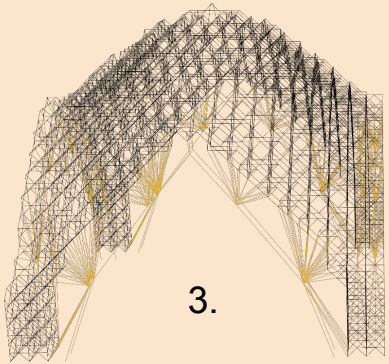
- 3 shells
- 5 walls
- 2 parts of the stairs

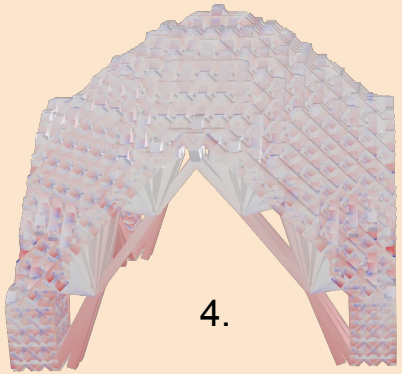
# Structural analysis method



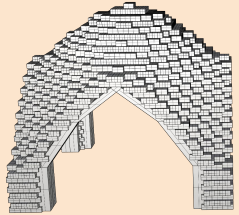



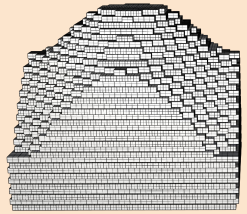


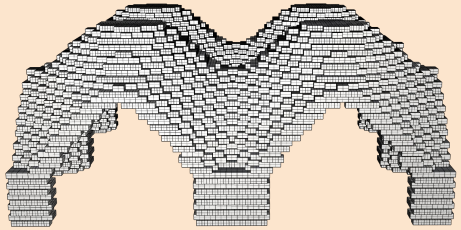


# Module







1. Module without walls

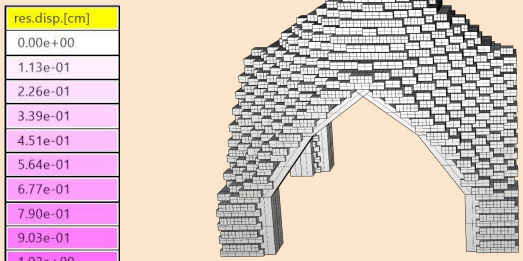
   - Load from the second floor
   - Load from the infill of the ground floor

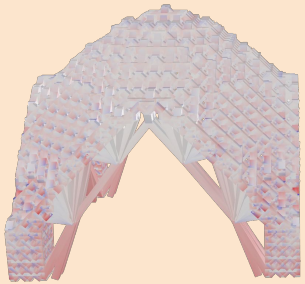
2. Module with walls

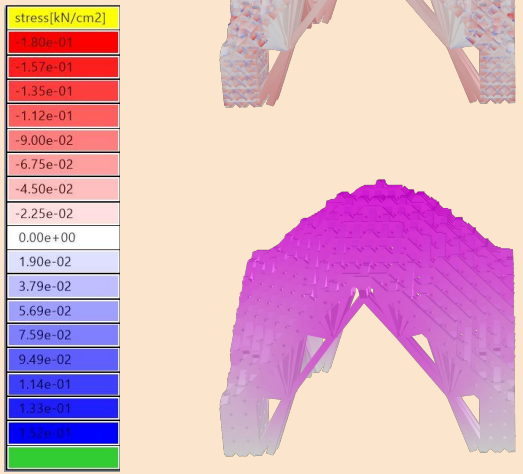
   - Same loads as without walls
   - Walls to help with the stress distribution

3. Four modules

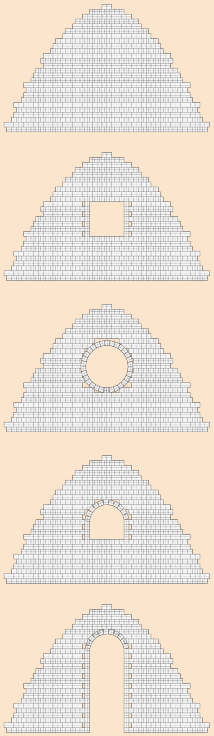
   - To analyse the centre column



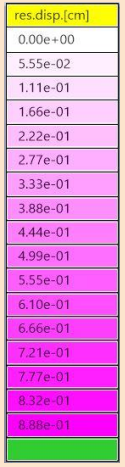



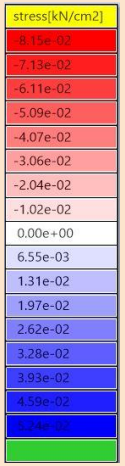


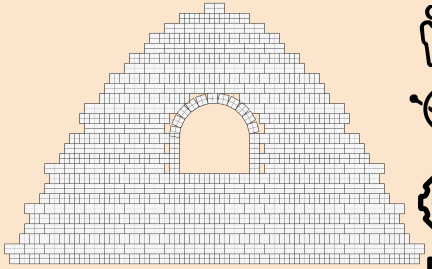
# Walls

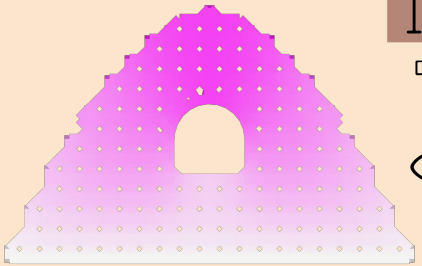


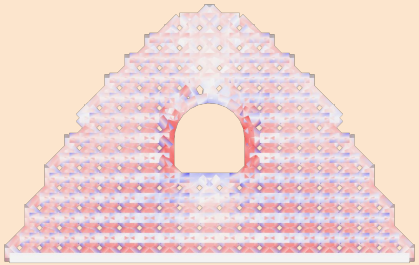
1. Wall without openings
    - Wall between functions
2. Walls with windows
    - Wall with square window
    - Wall with round window
    - Wall with combination window
3. Wall with door



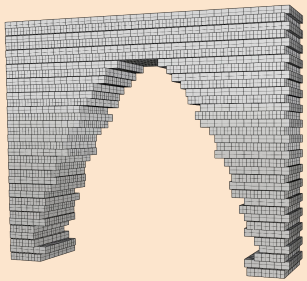







# Stairs

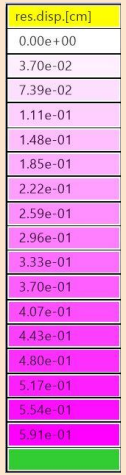


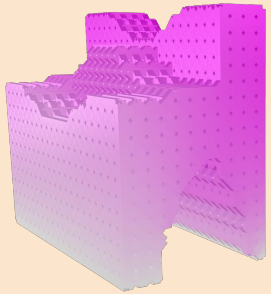
1. Walkway under the stairs

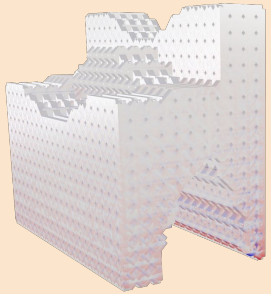
   - high weight due to massive structure
   - relative low temporary loads

2. Bridge over the start of the stepwell

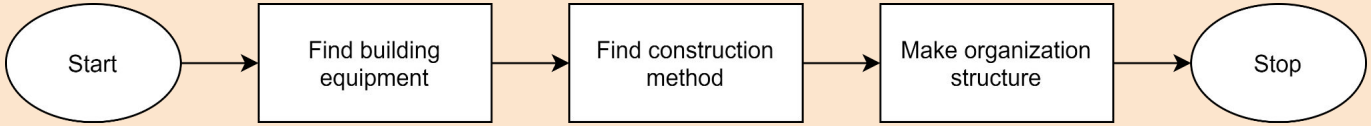
   - high arc





# Construction



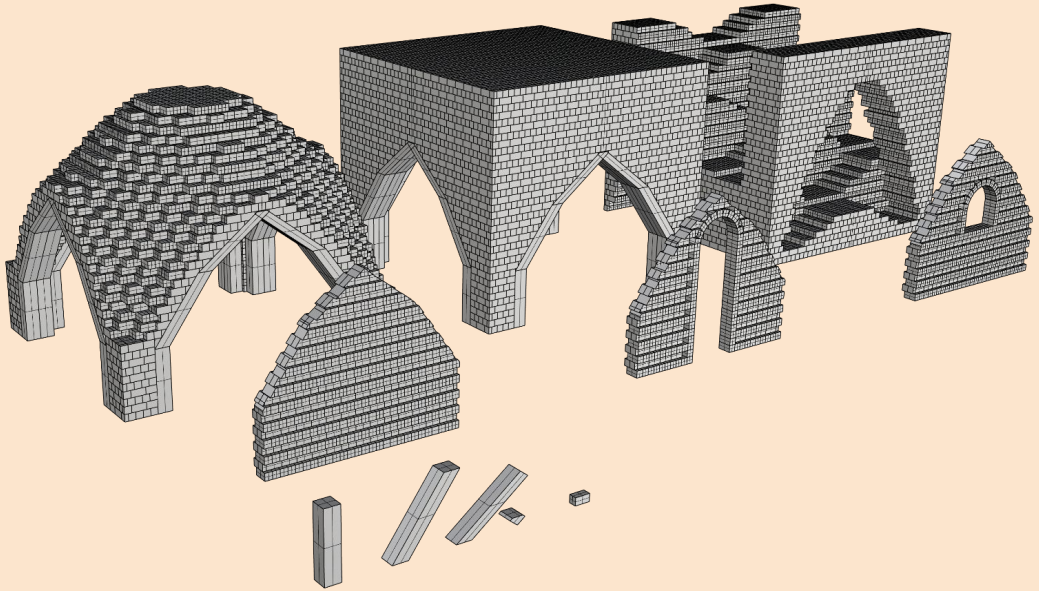
# Material Analysis

For the modules CEB-bricks are used:

For the Foundation, rammed earth is used within a mould.

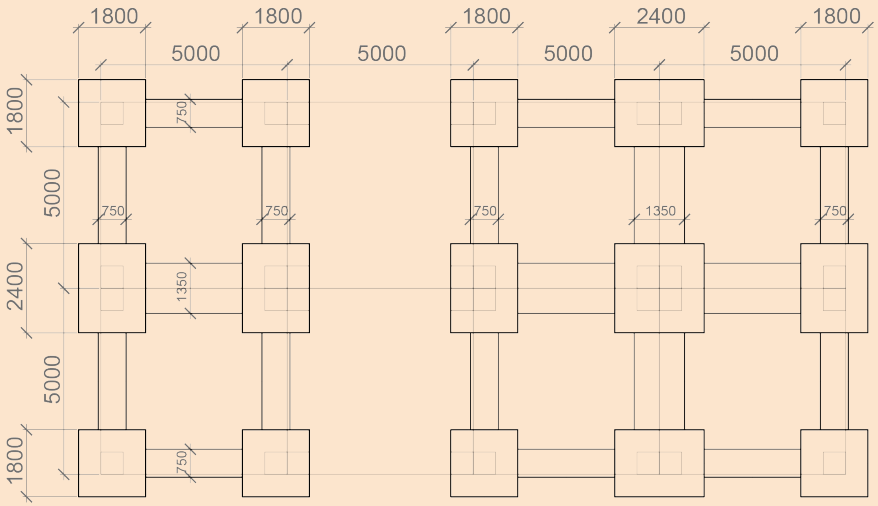
# Collection of parts

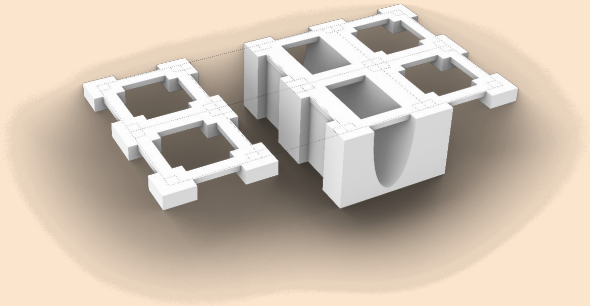
- 2 modules
- 1 stairwell
- 3 wall types
- 4 building elements

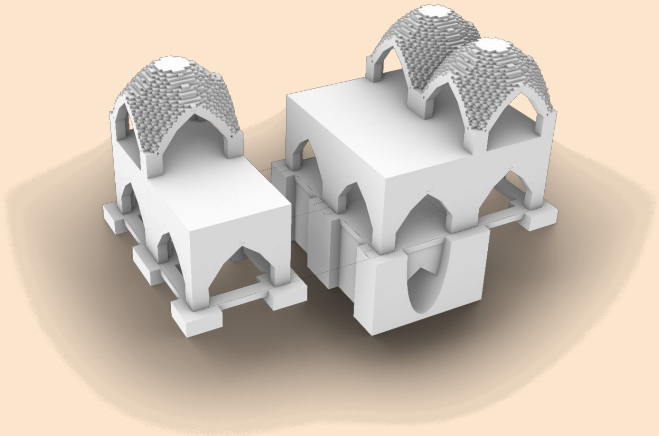


# Foundation

- Rammed earth



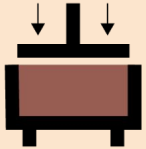


# Manual

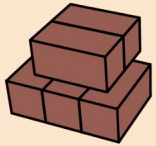
1. Dig out shape for foundation.

2. Fill foundation mould with rammed earth

3. Press bricks into brick mould



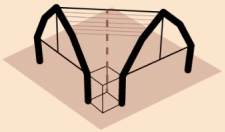
4. Place bricks with a partial overlap.



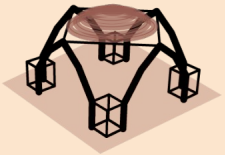
5. Build corners with partial overlap

6. Build a mould to build an arch.

7. Follow wire to place bricks

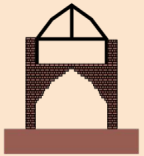


8. Finish dome on top



9. Build vertical walls to make a horizontal floor

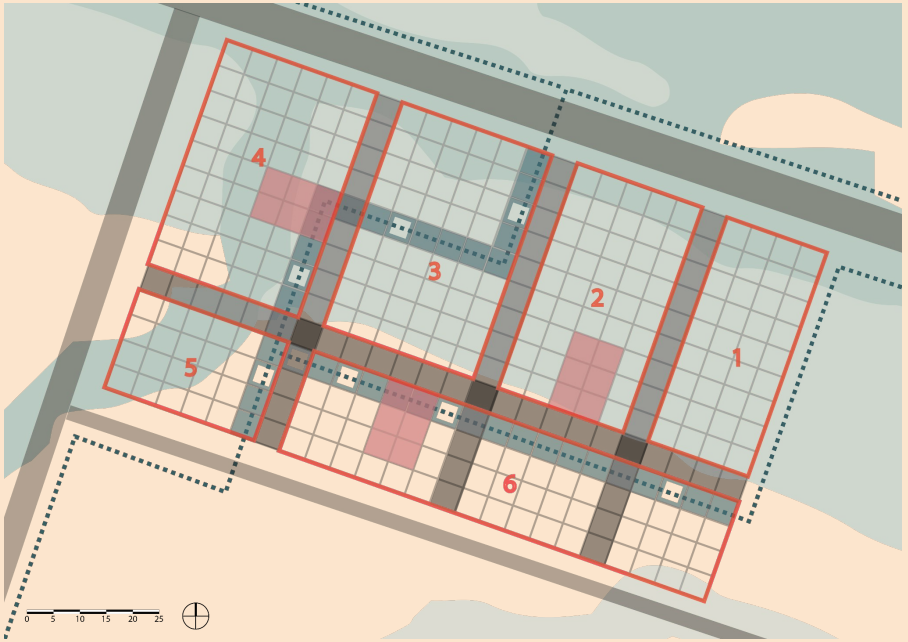
10. Build another module on top



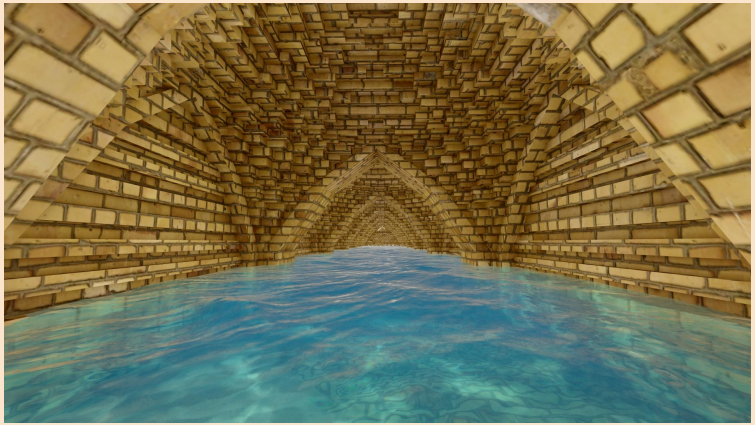
# Module video

# Organization method

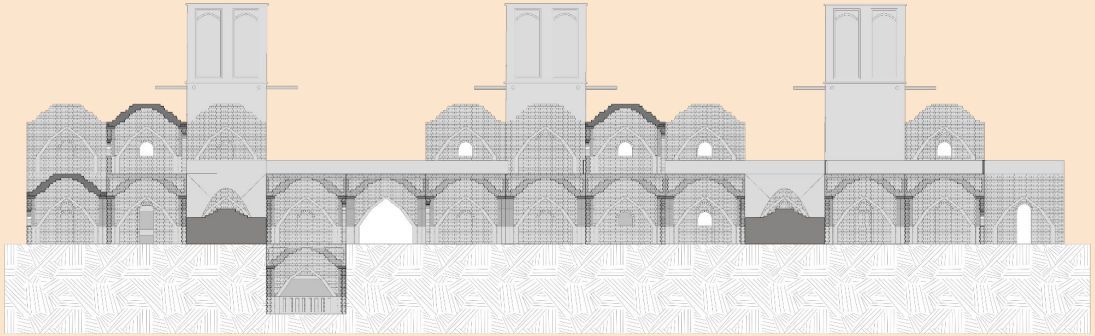
- Local organisation
- Use Squares to produce bricks and store equipment.
- Roads are used for transportation.
- On every square a container is placed with construction equipment.



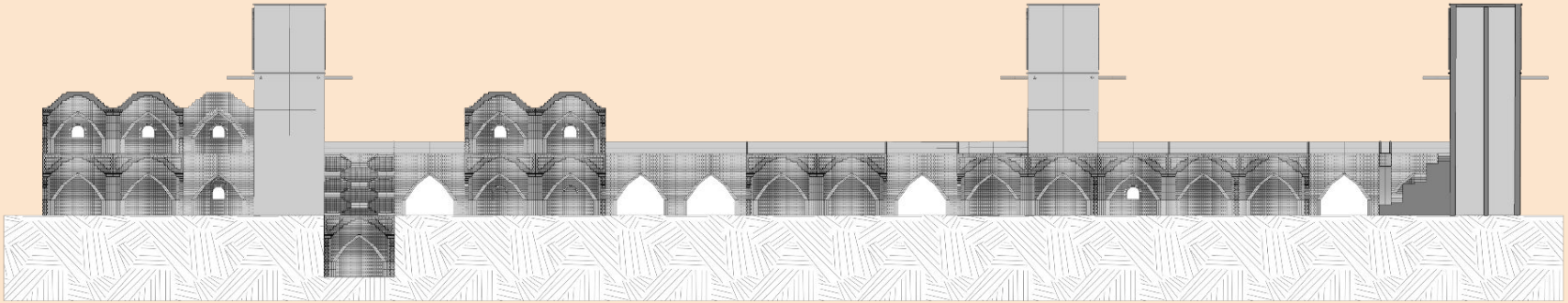
# Visuals



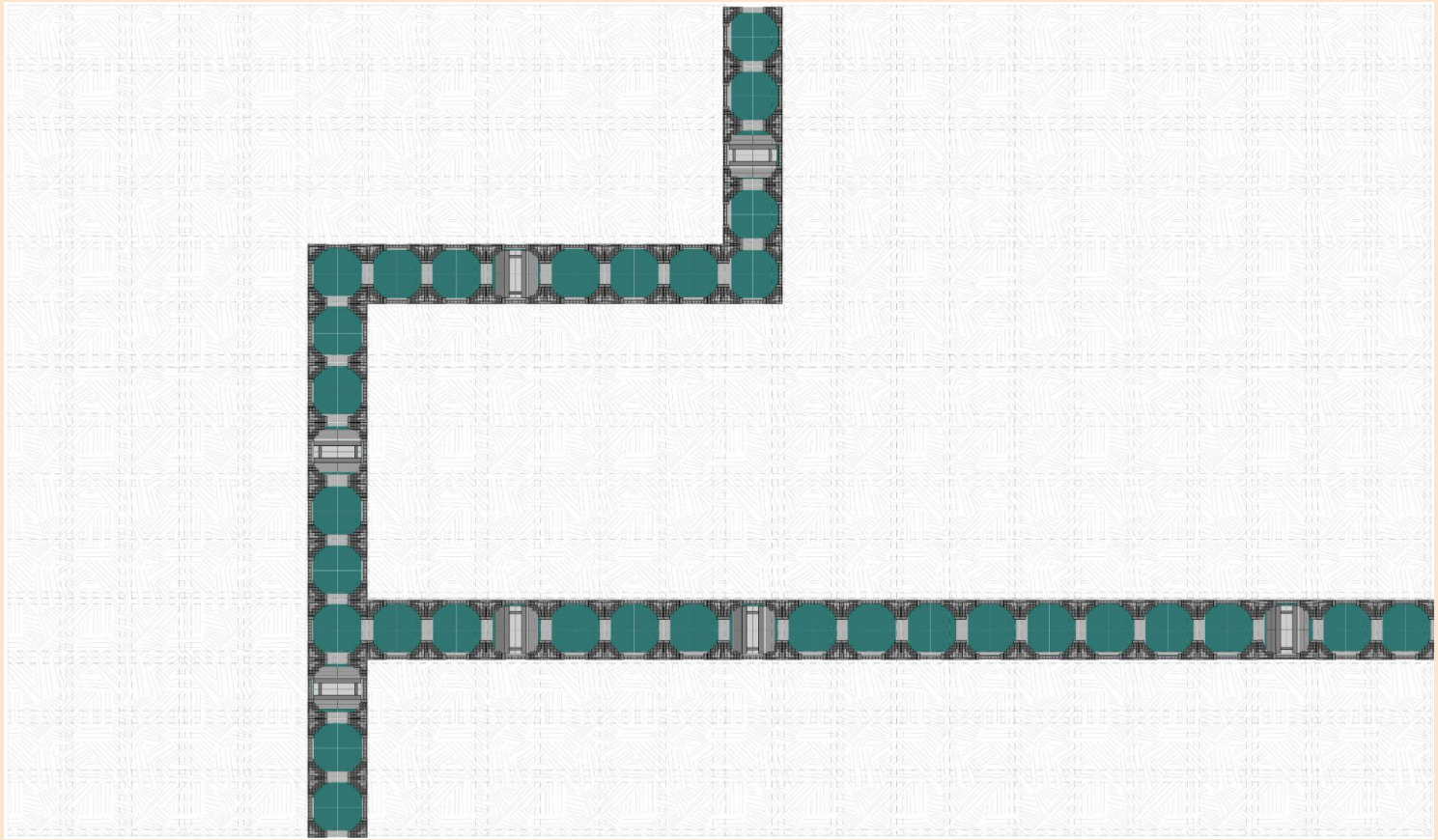
# Section

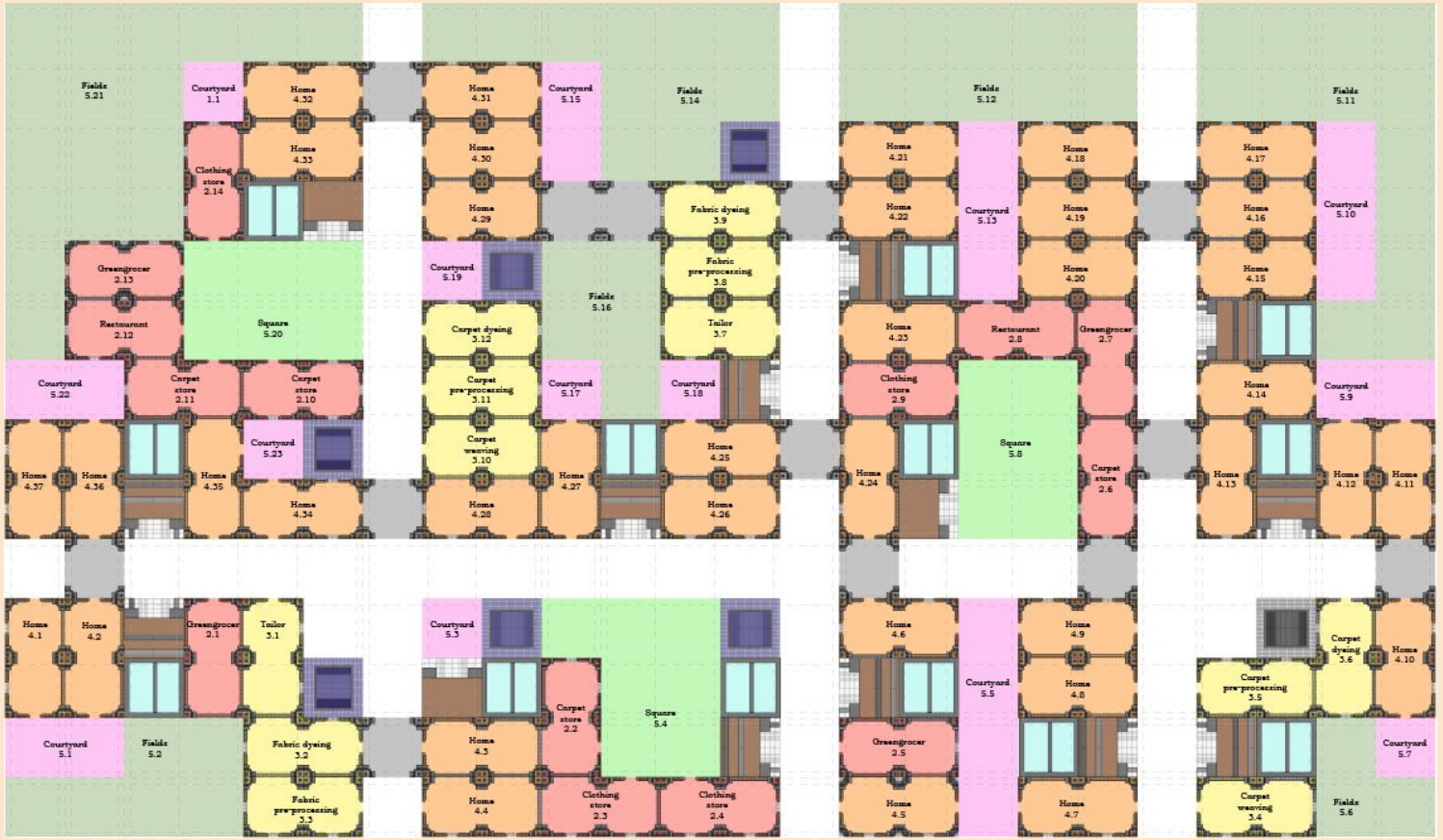


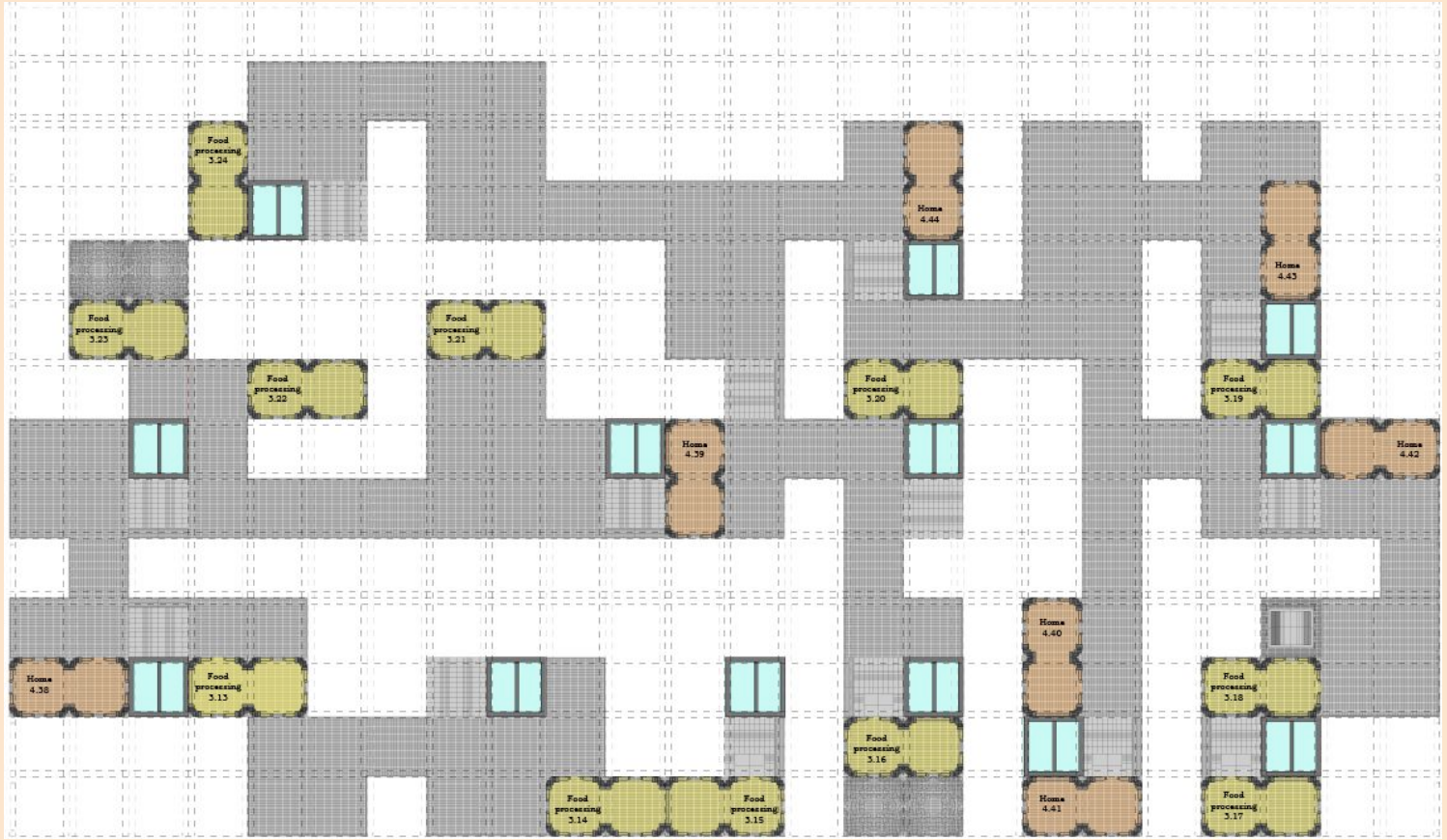
Cross section



Longitudinal section




Fields 5.21
Courtyard 1.1
Home 4.32
Home 4.33
Clothing store 2.14
Home 4.31
Home 4.30
Home 4.29
Courtyard 5.15
Fields 5.14
Fabric dyeing 3.9
Fabric pre-processing 3.8
Tailor 3.7
Courtyard 5.19
Carpet dyeing 3.12
Carpet pre-processing 3.11
Carpet weaving 3.10
Fields 5.16
Courtyard 5.17
Courtyard 5.18
Home 4.25
Home 4.26
Home 4.27
Home 4.28
Fields 5.12
Home 4.21
Home 4.22
Courtyard 5.13
Home 4.18
Home 4.19
Home 4.20
Restaurant 2.8
Greengrocer 2.7
Home 4.23
Clothing store 2.9
Square 5.8
Carpet store 2.6
Home 4.24
Fields 5.11
Home 4.17
Home 4.16
Home 4.15
Courtyard 5.10
Home 4.14
Courtyard 5.9
Home 4.13
Home 4.12
Home 4.11
Greengrocer 2.13
Restaurant 2.12
Square 5.20
Courtyard 5.22
Carpet store 2.11
Carpet store 2.10
Courtyard 5.23
Home 4.37
Home 4.36
Home 4.35
Home 4.34
Home 4.1
Home 4.2
Greengrocer 2.1
Tailor 3.1
Courtyard 5.1
Fields 5.2
Fabric dyeing 3.2
Fabric pre-processing 3.3
Courtyard 5.3
Carpet store 2.2
Square 5.4
Home 4.3
Home 4.4
Clothing store 2.3
Clothing store 2.4
Home 4.6
Courtyard 5.5
Home 4.9
Home 4.8
Greengrocer 2.5
Home 4.5
Home 4.7
Carpet dyeing 3.6
Home 4.10
Carpet pre-processing 3.5
Courtyard 5.7
Carpet weaving 3.4
Fields 5.6


Food processing 3.24
Food processing 3.25
Food processing 3.22
Food processing 3.21
Home 4.39
Home 4.38
Food processing 3.13
Food processing 3.14
Food processing 3.15
Home 4.44
Food processing 3.20
Food processing 3.16
Home 4.40
Home 4.41
Home 4.43
Food processing 3.19
Home 4.42
Food processing 3.18
Food processing 3.17

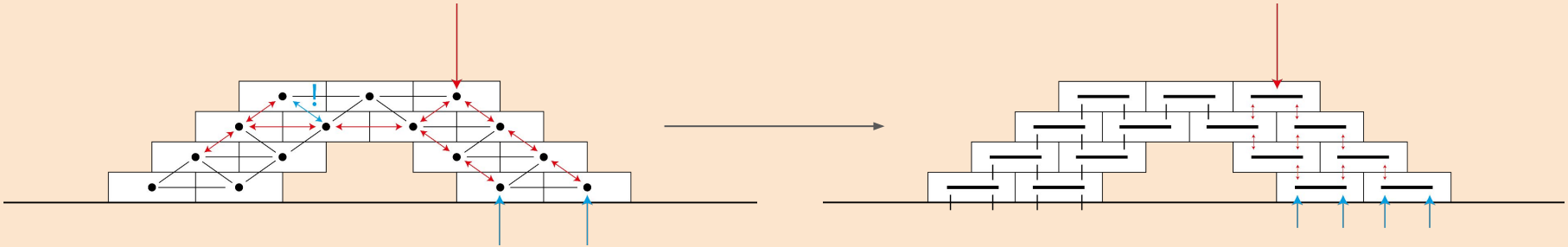
# Reflection and Future steps

# Reflection

- Find balance between architect and programmer.
- As we were struggling with all of the software during the project we were not able to finish all the work we set out to do.
- Preventing tension in a structure requires you to rethink the way you can use a material and the shapes you can make in a structure
- Translating thoughts into rules a computer can understand can be quite difficult

# Future steps

- Give scores to configurations to test rules
- Make a fully functional Python script
- Rethink brick size
- Rethink the structural analysis



# Questions

# Water needed

- Fabric dyeing → 5m2/y → 6 $m^3$/y
- Carpet yarn dyeing → 12 /y → 33 $m^3$/y
- Growing crops → 40kg/y → 100 $m^3$/y
- Total → **139 $m^3$/y**

- Floods → 44,297 $m^3$/y
- Local storage capacity → **2,925 $m^3$/y**