ShellTerra

Reconfigurable Masonry Settlements for Refugees

P5 Presentation

28.06.2022

Architectural Engineering Graduation Studio

Done by

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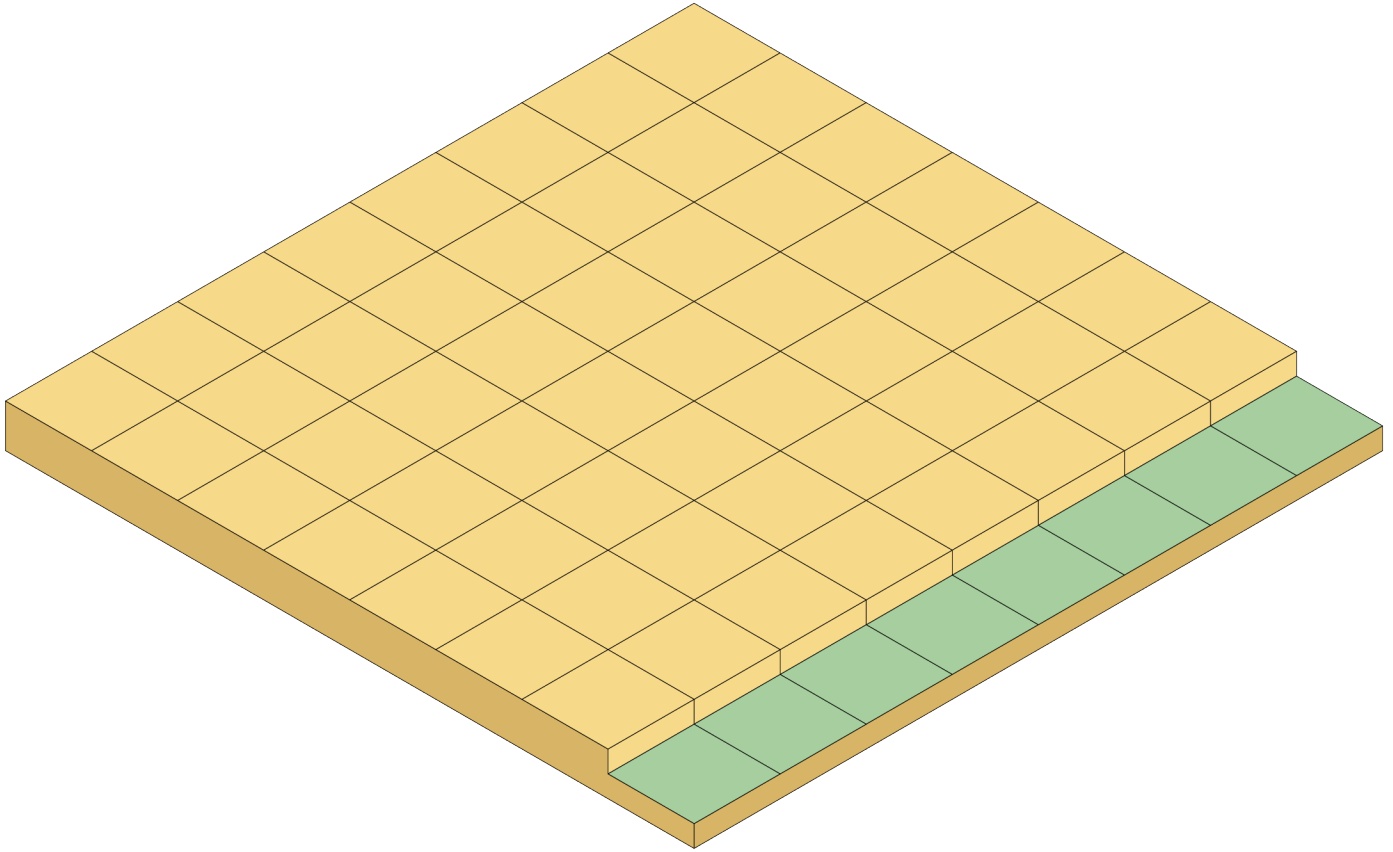
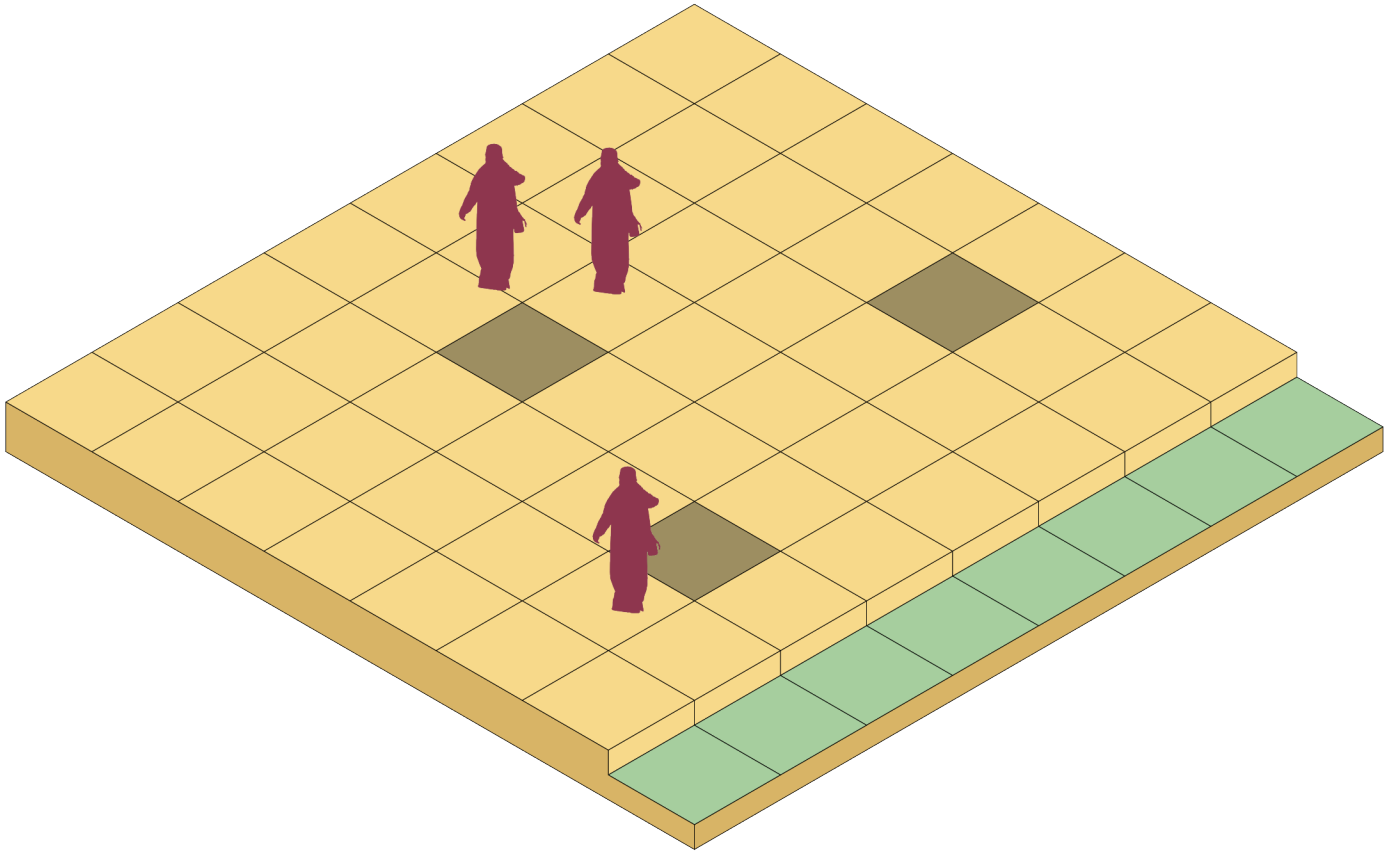
5400945


TU DELFT BK

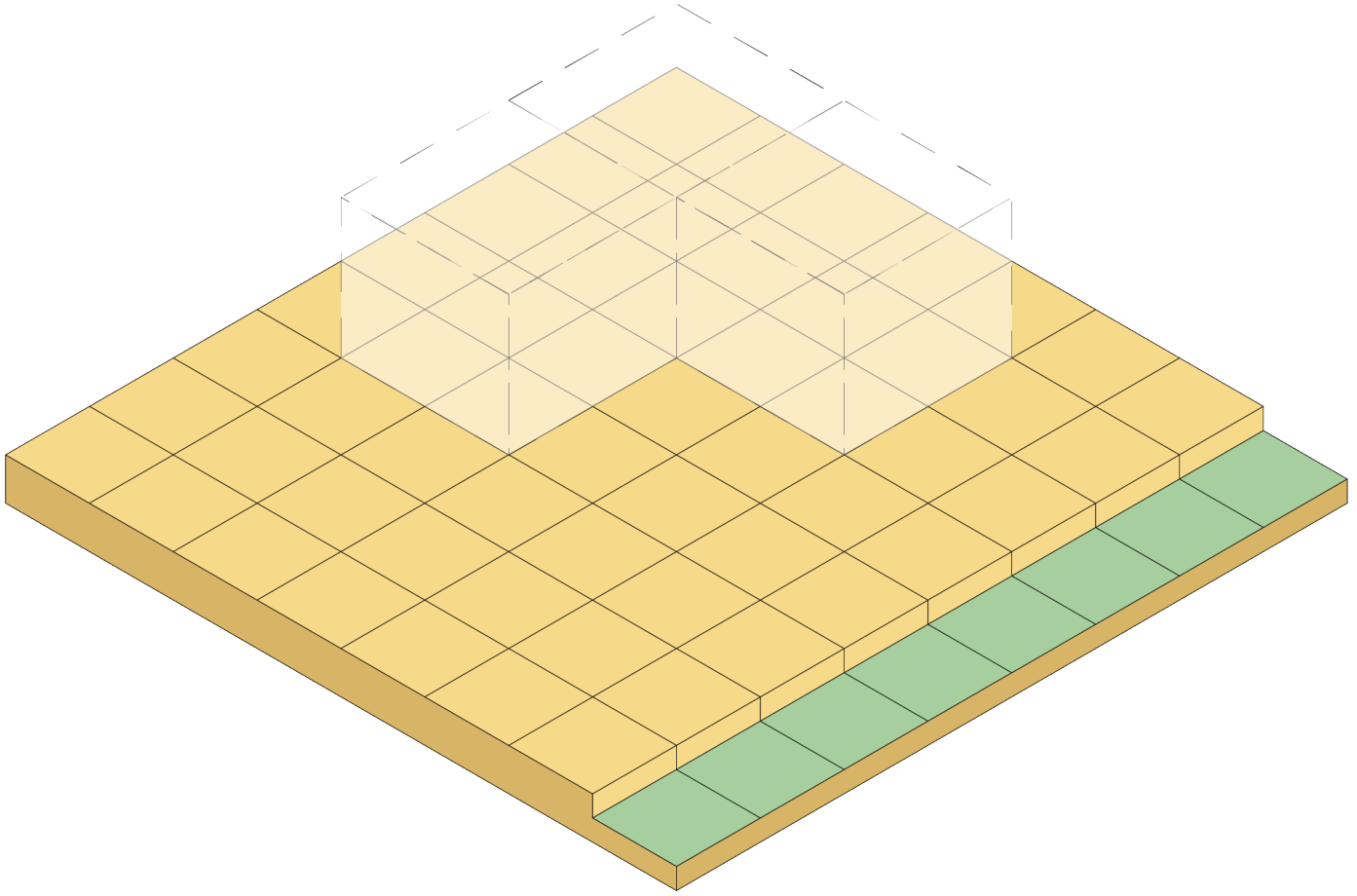
Choice of area



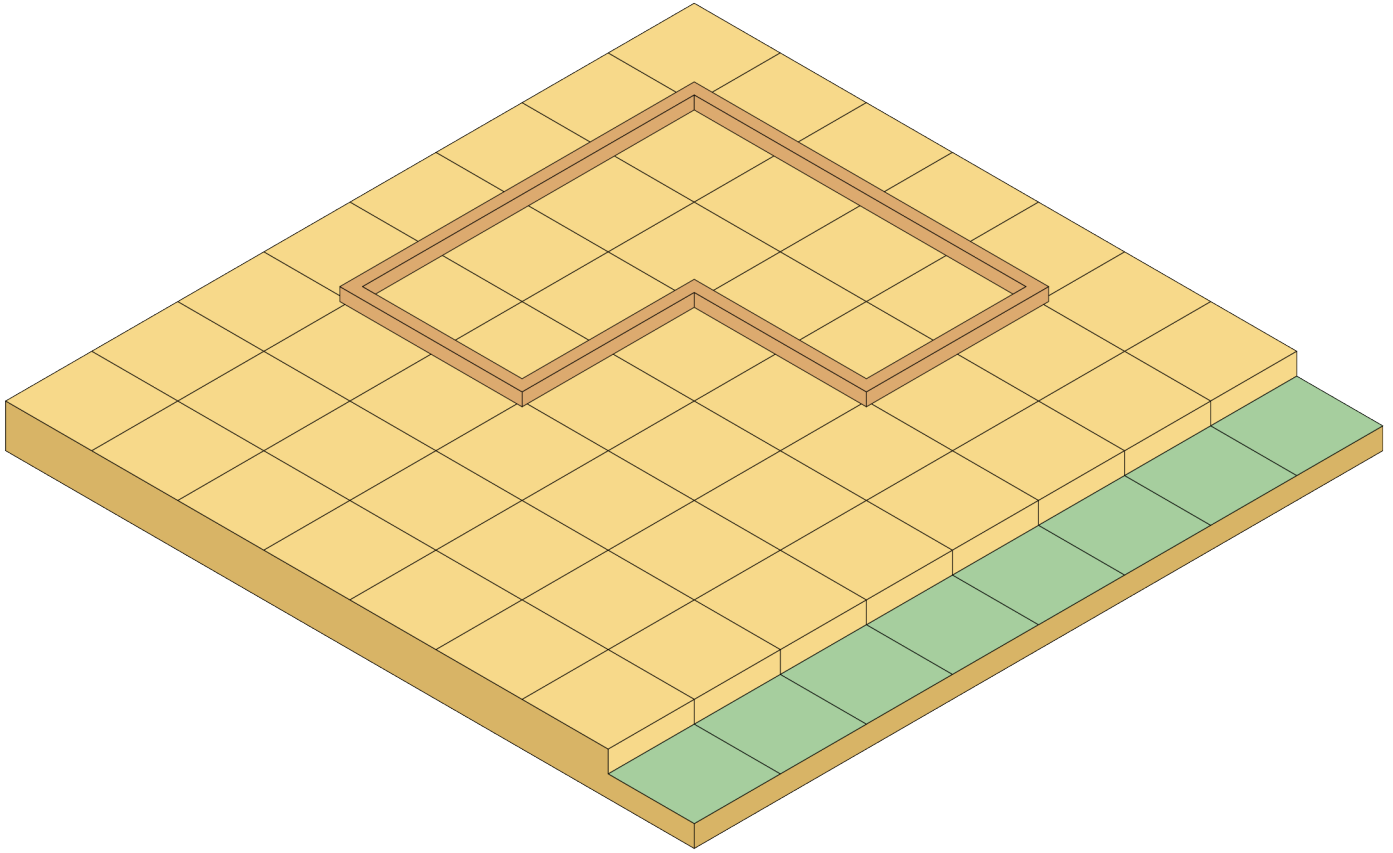
Soil testing



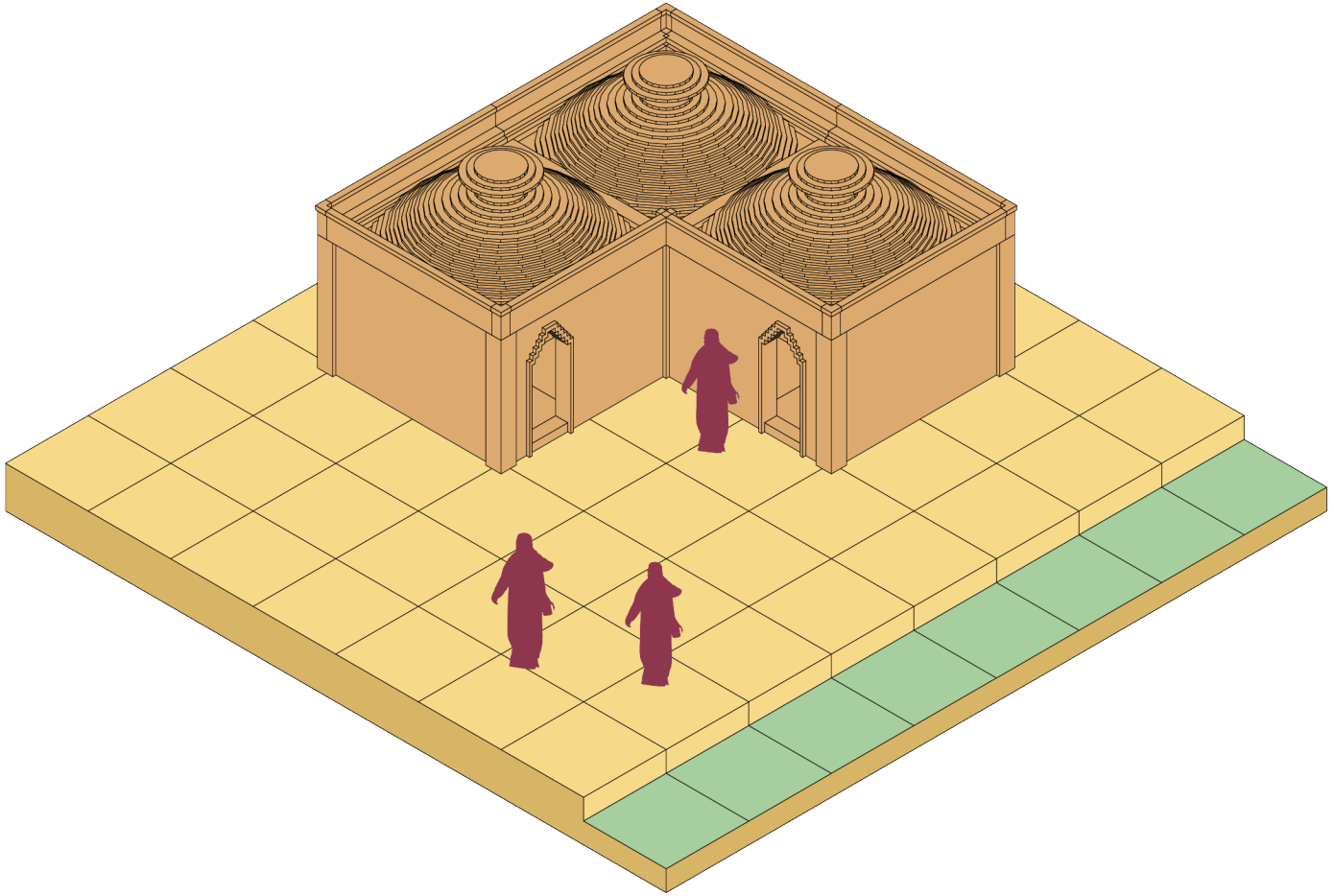
Planning the settlement*



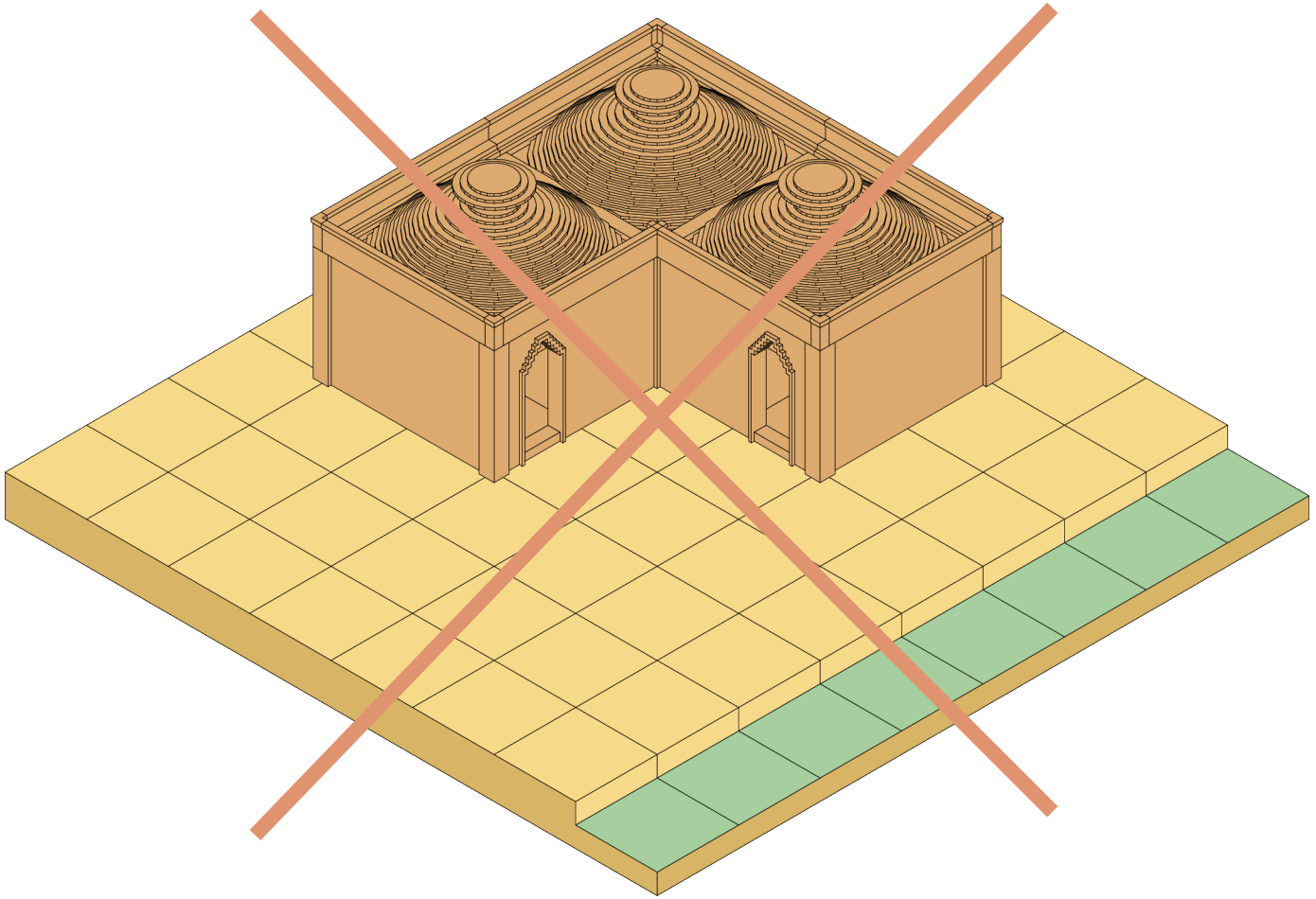
Foundation



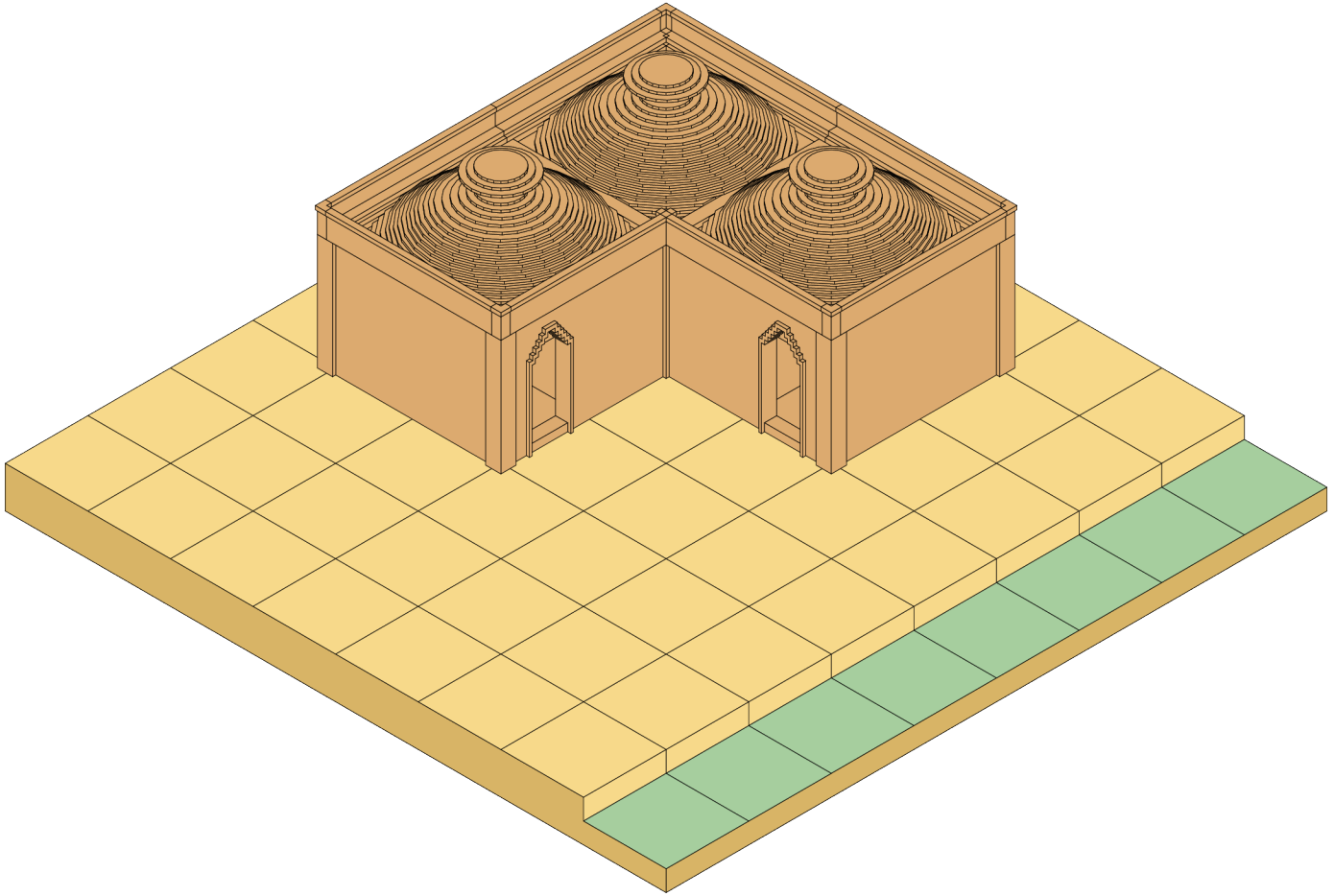
Build shelters



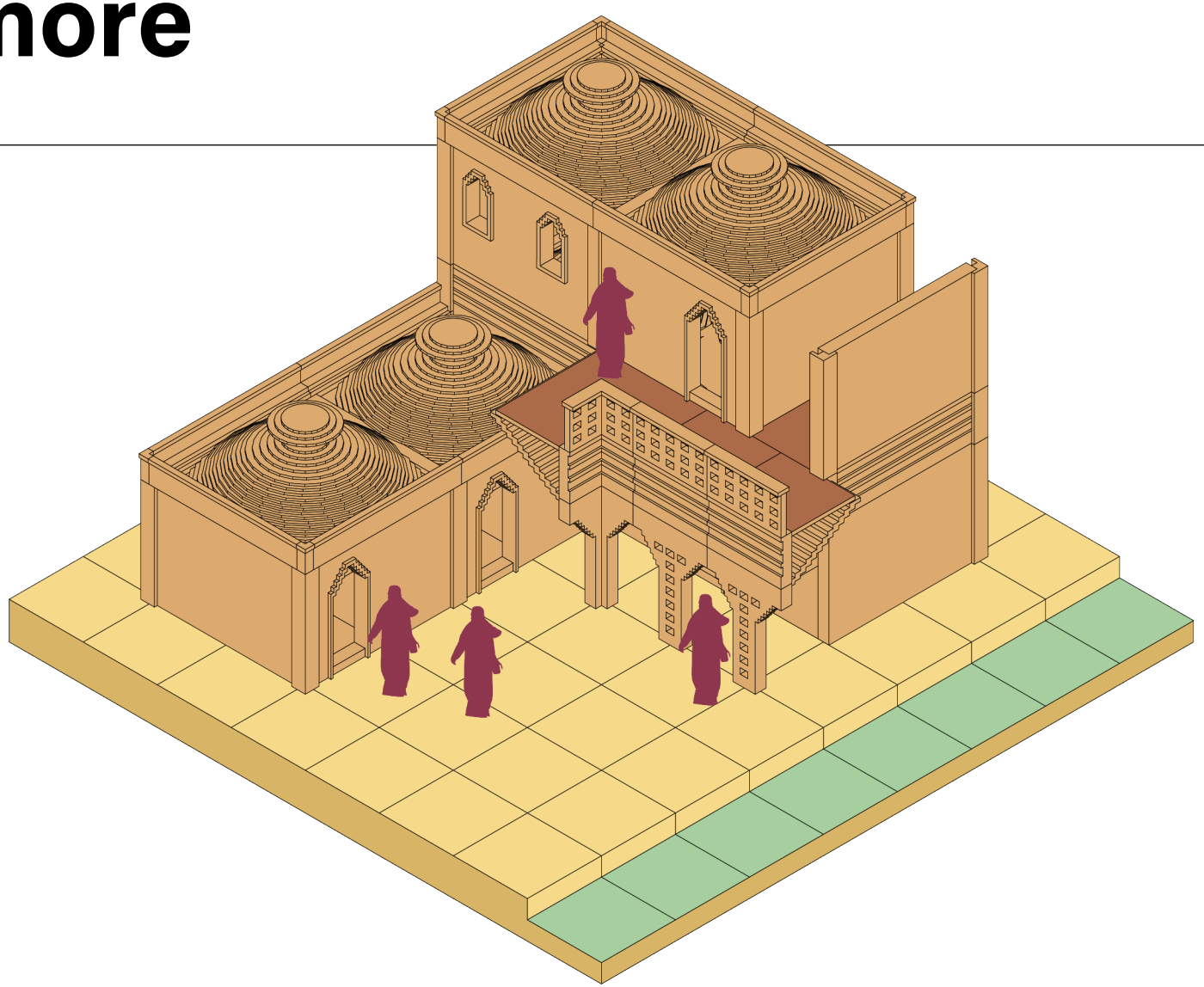
Move away



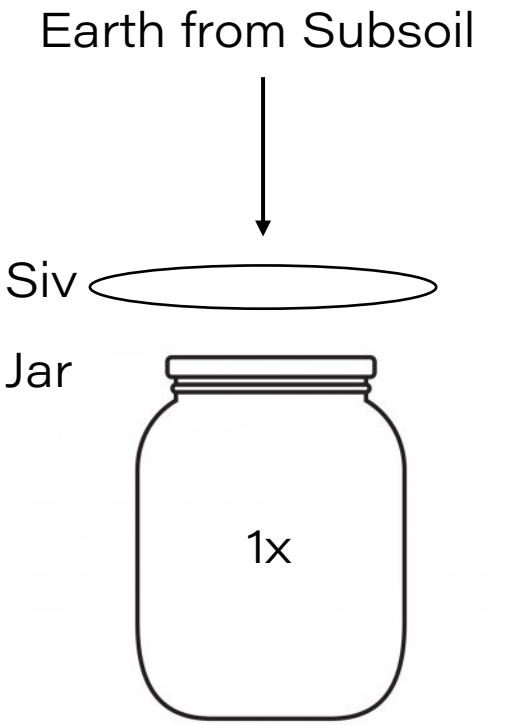
Move away



Build more



Soil Testing



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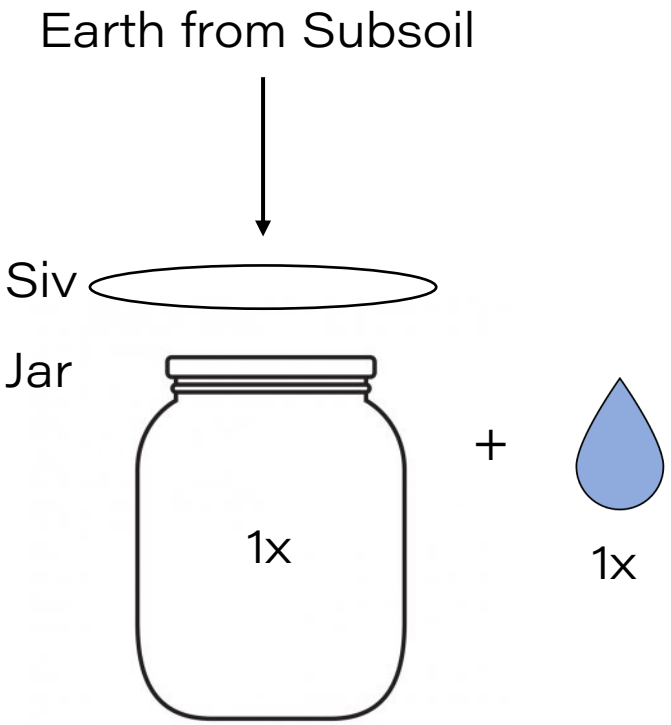

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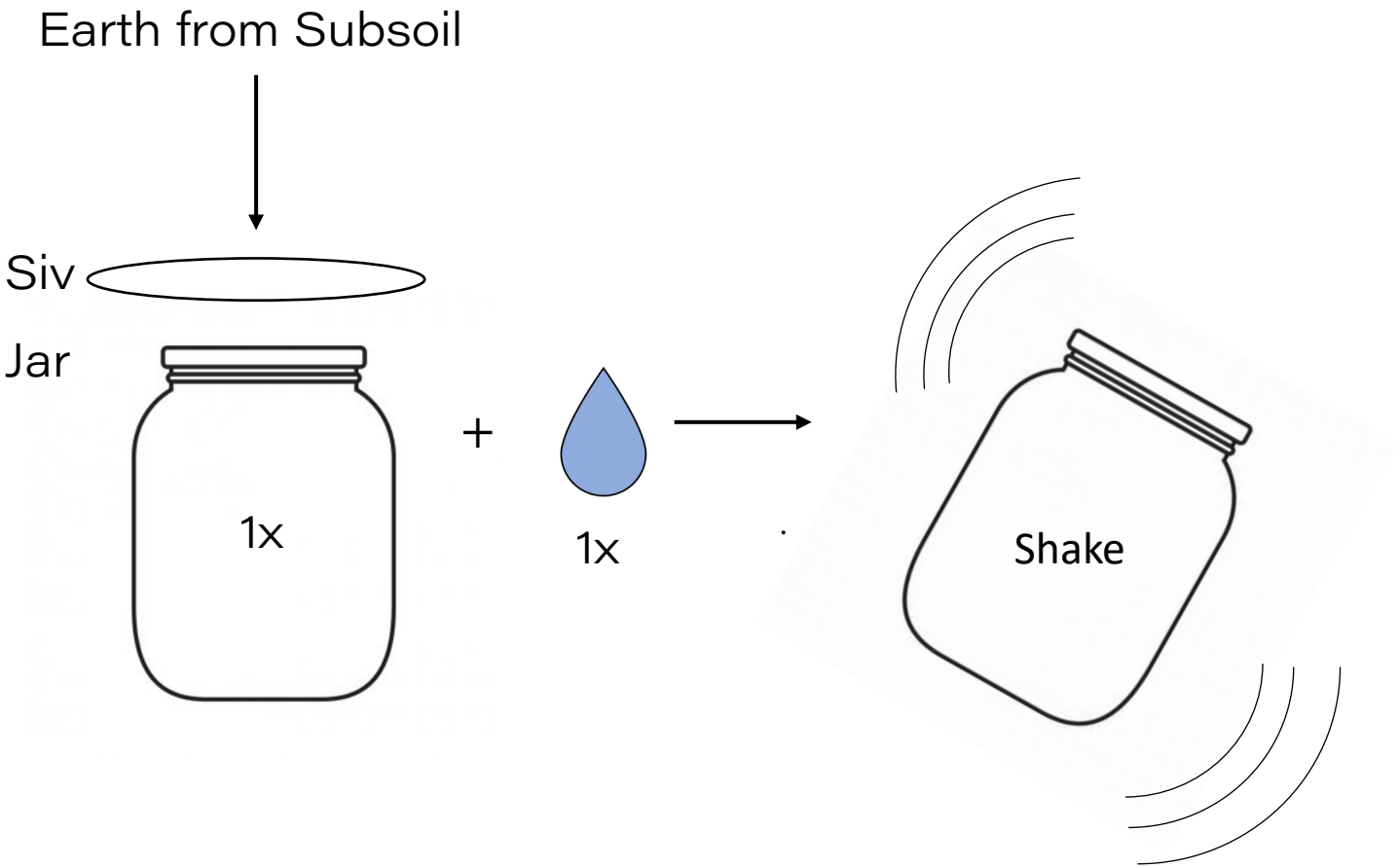

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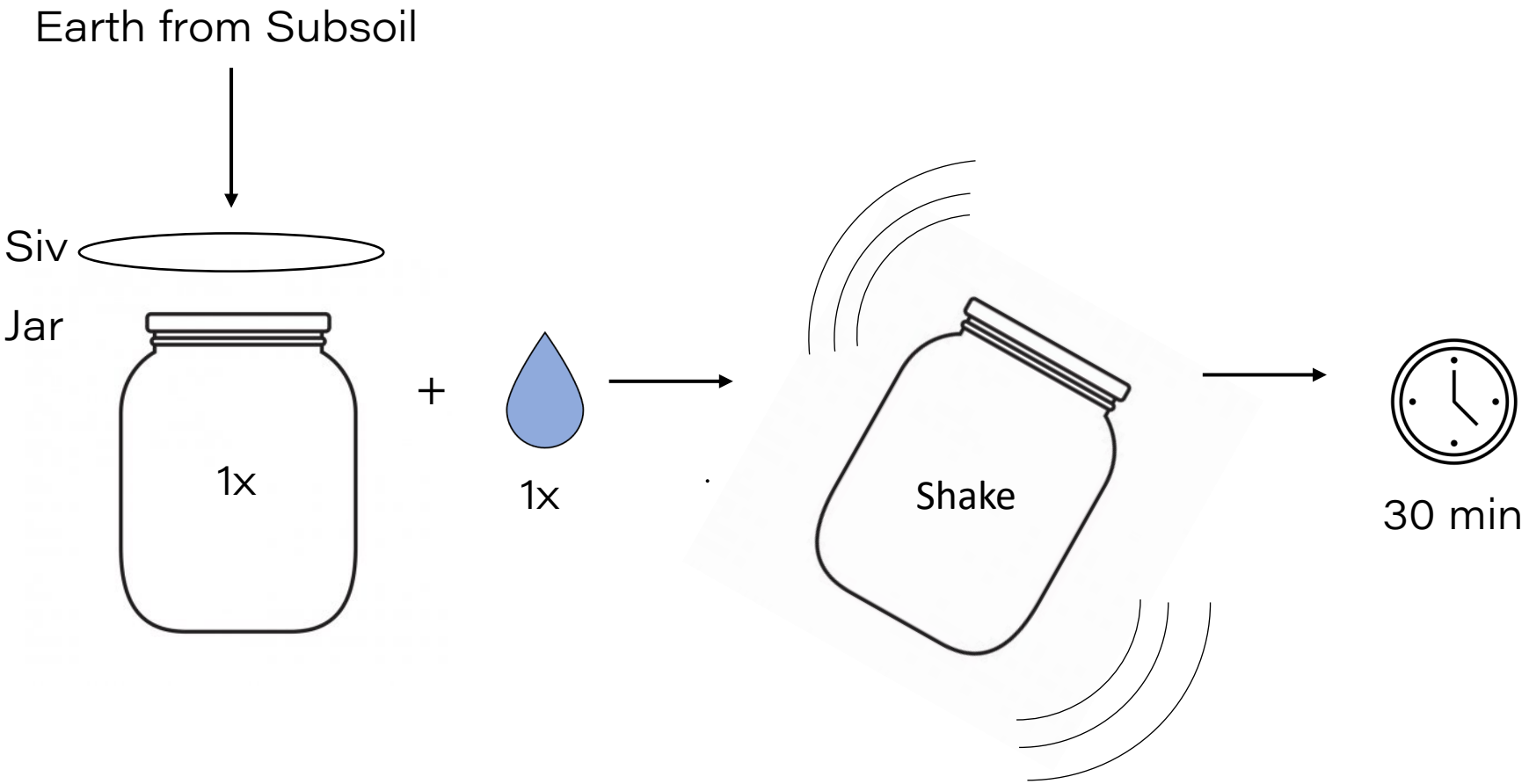
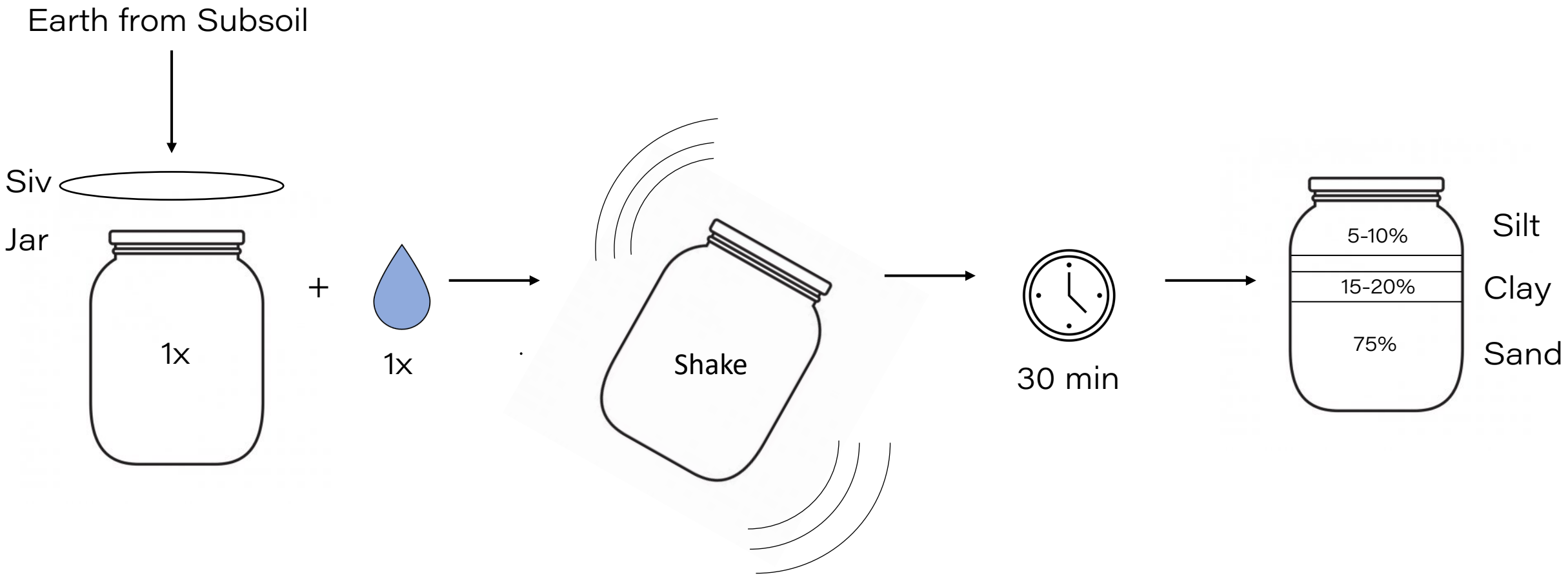
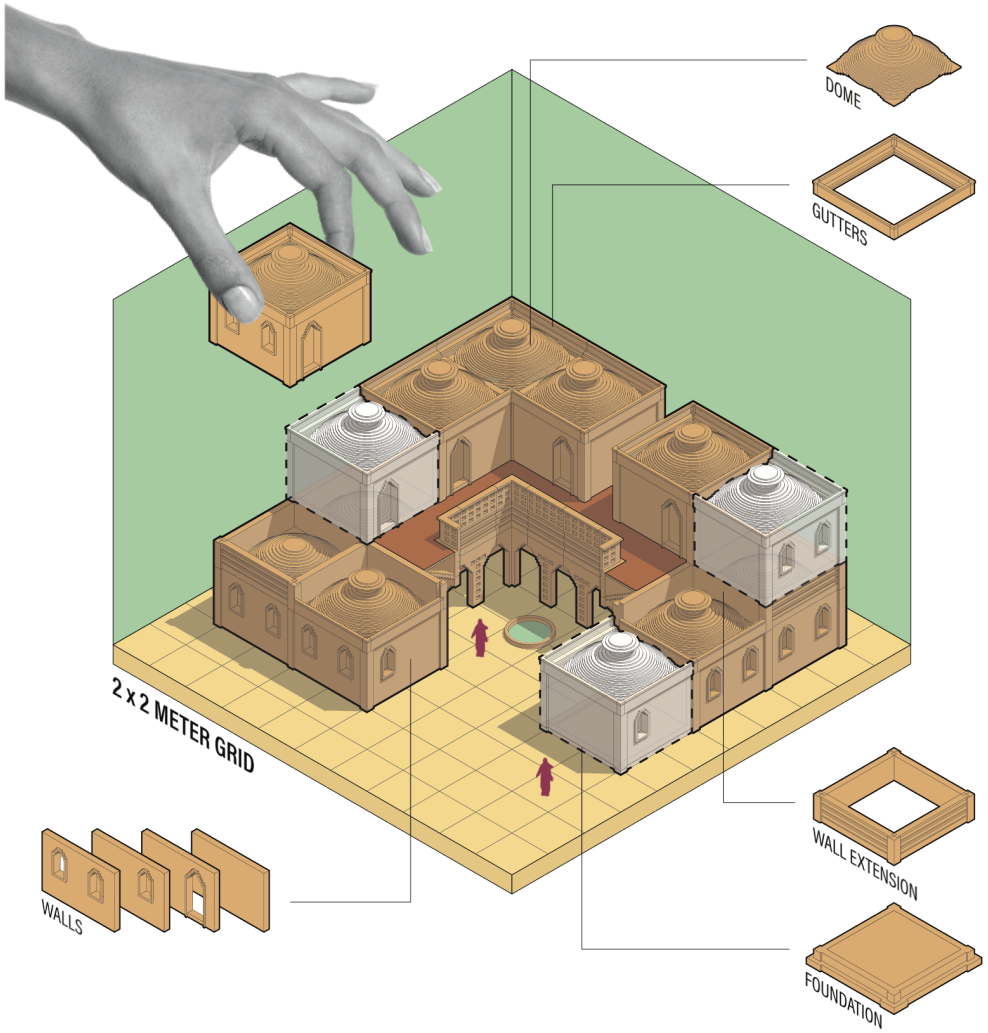
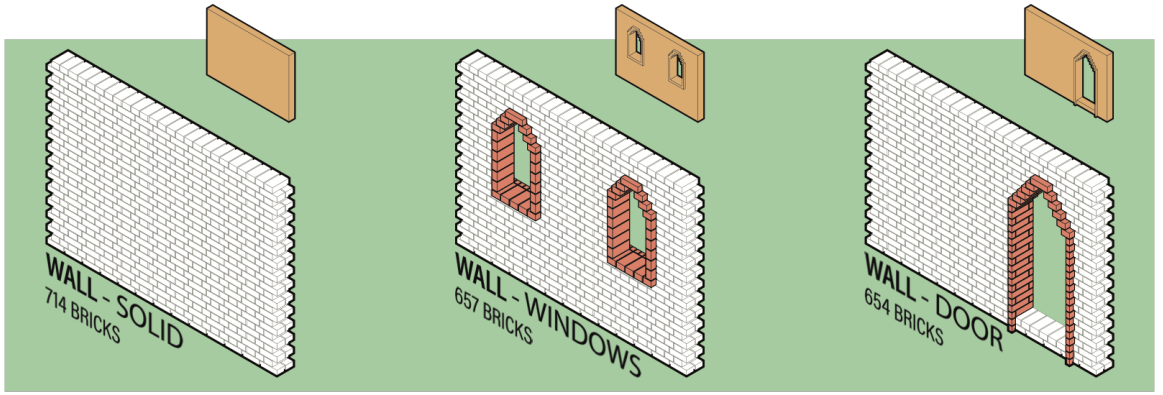


Soil Testing

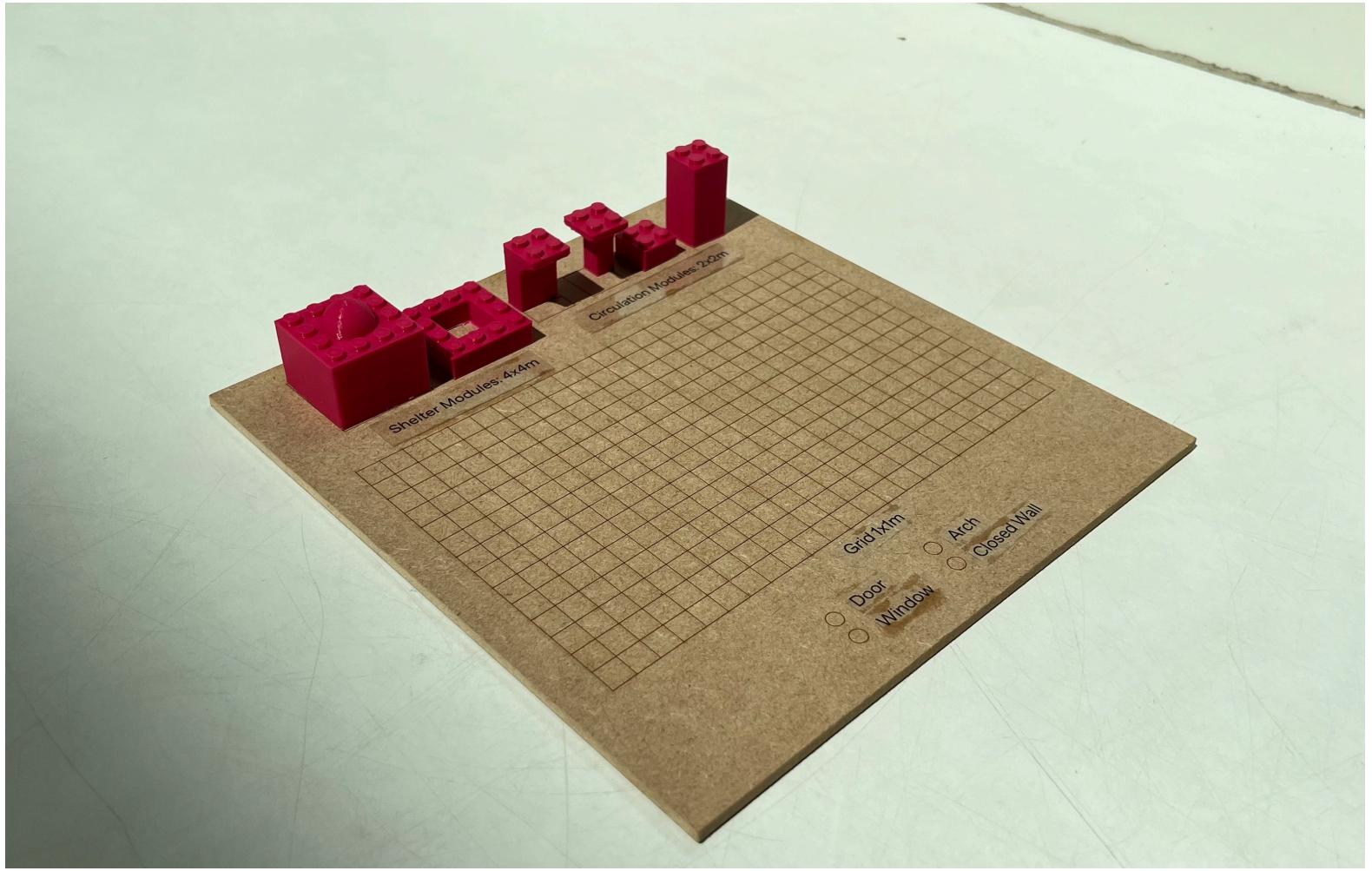


Planning a Settlement

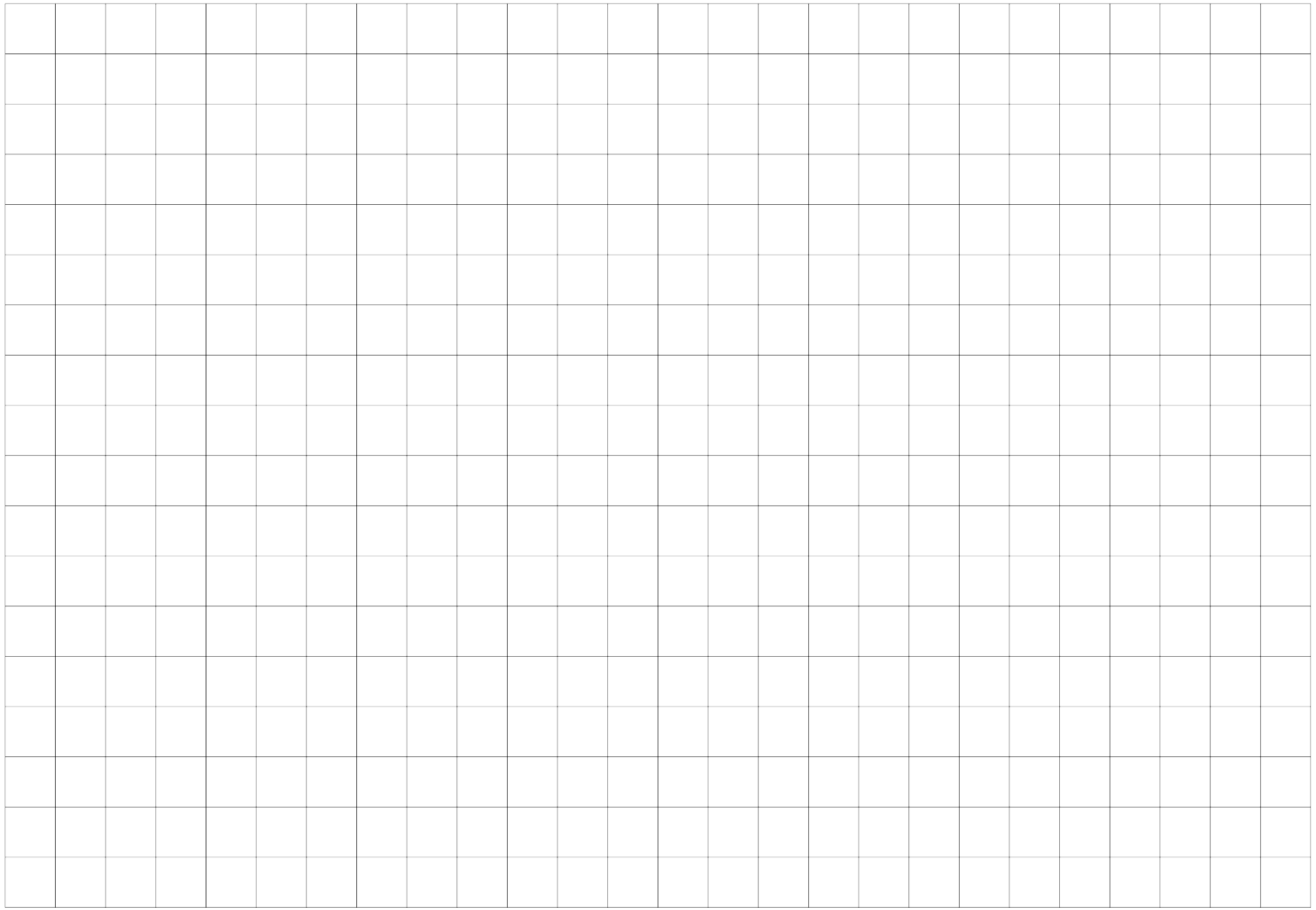




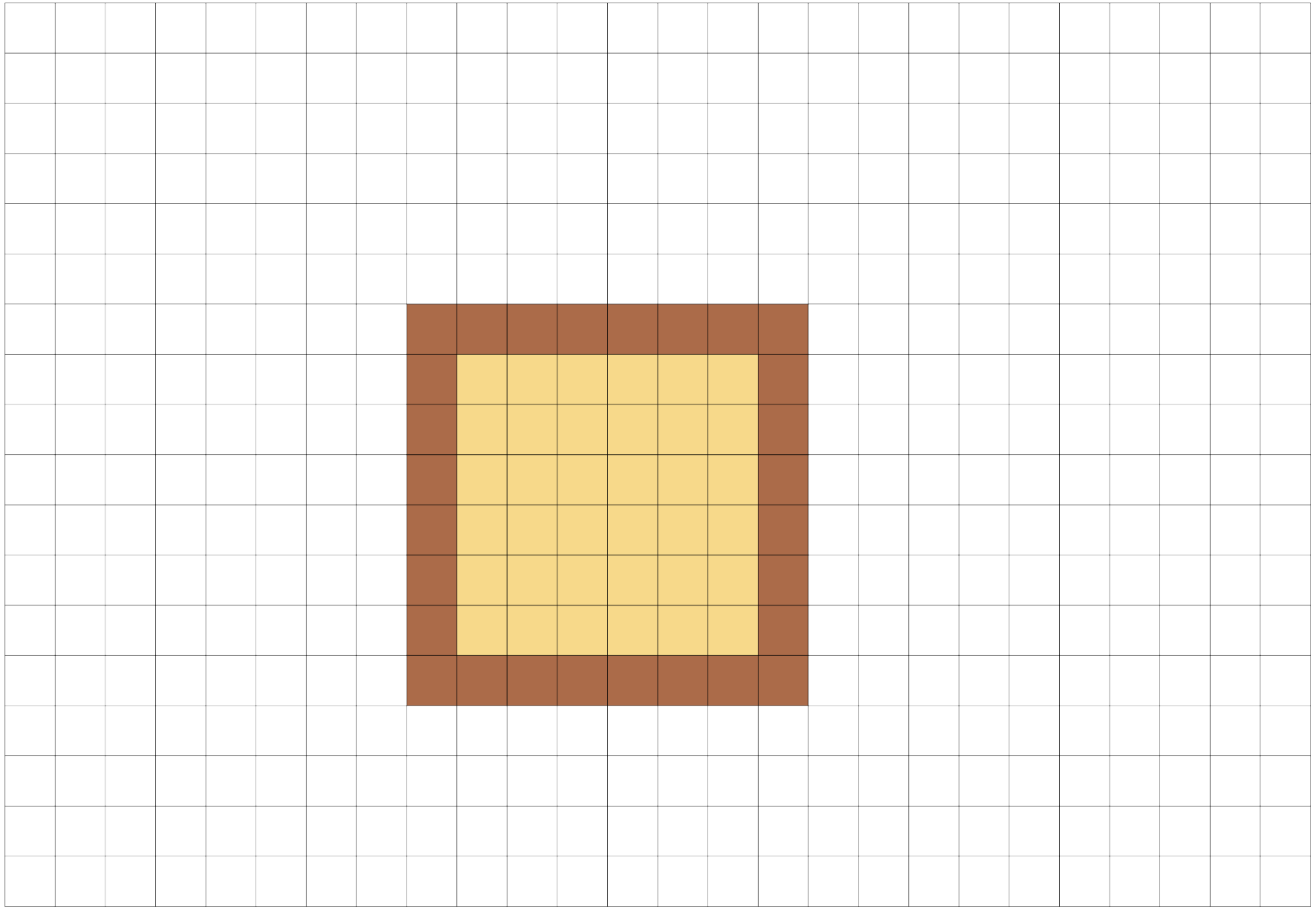
Lego- like pieces



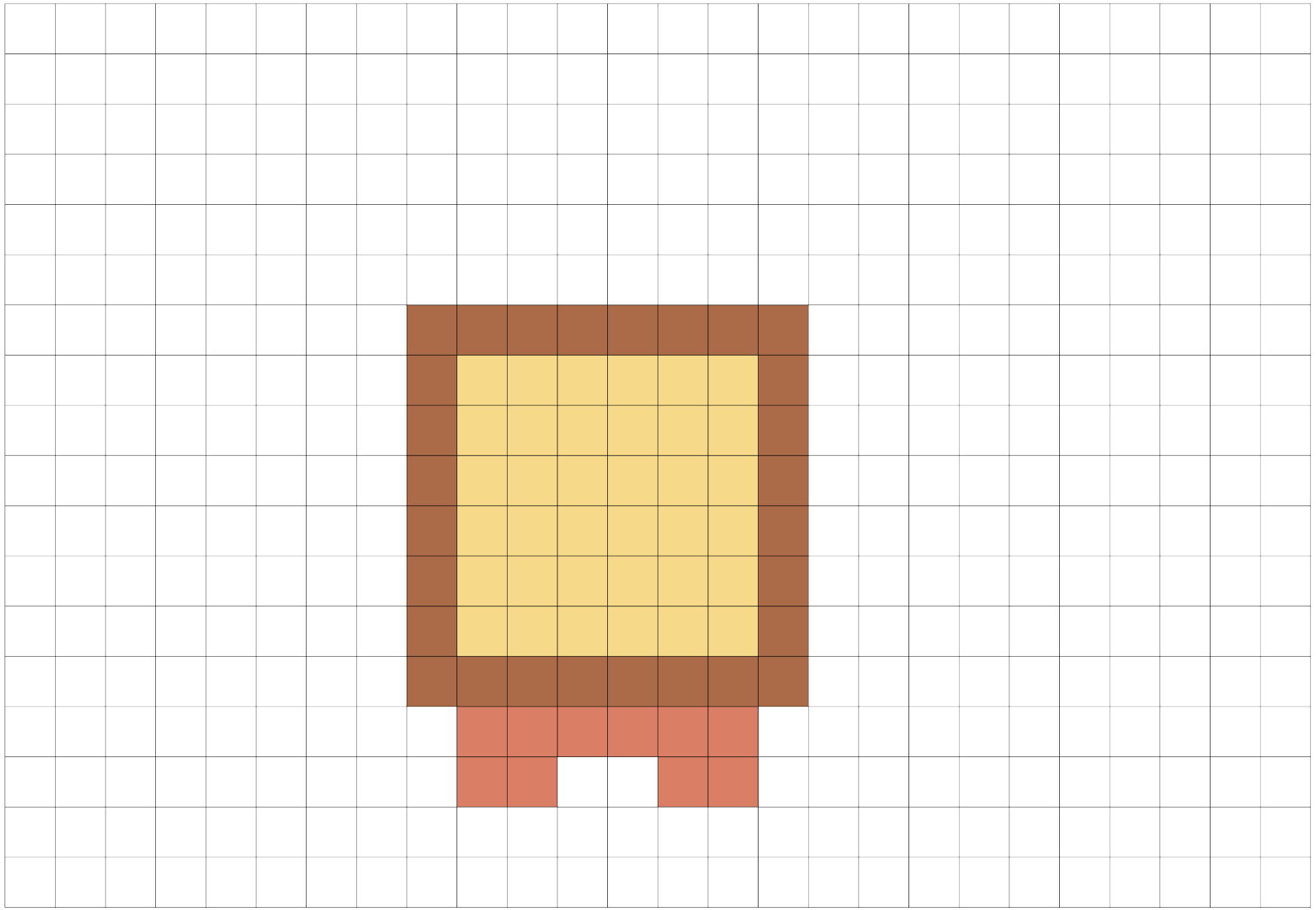
Grid



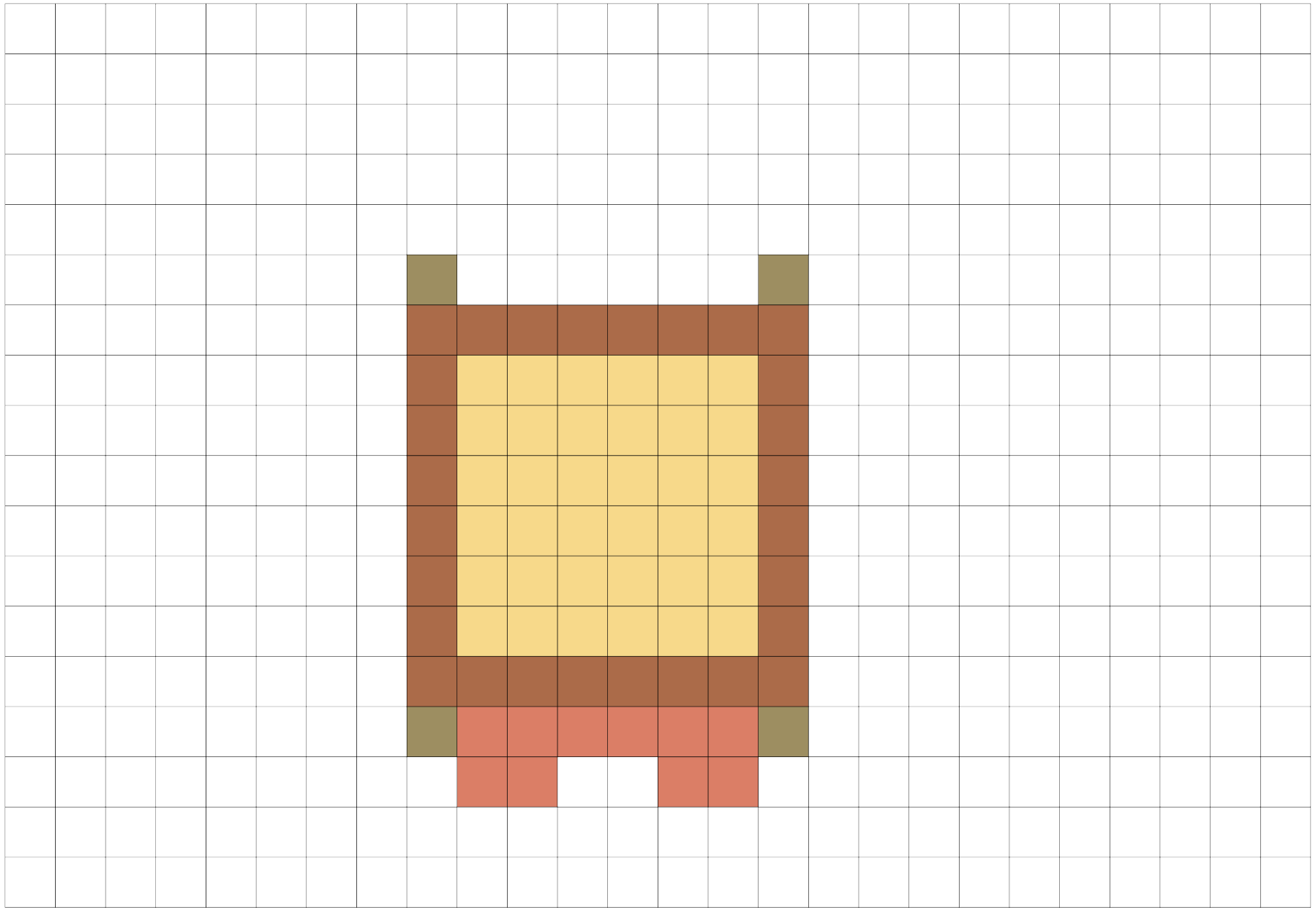
Courtyard and Iwan



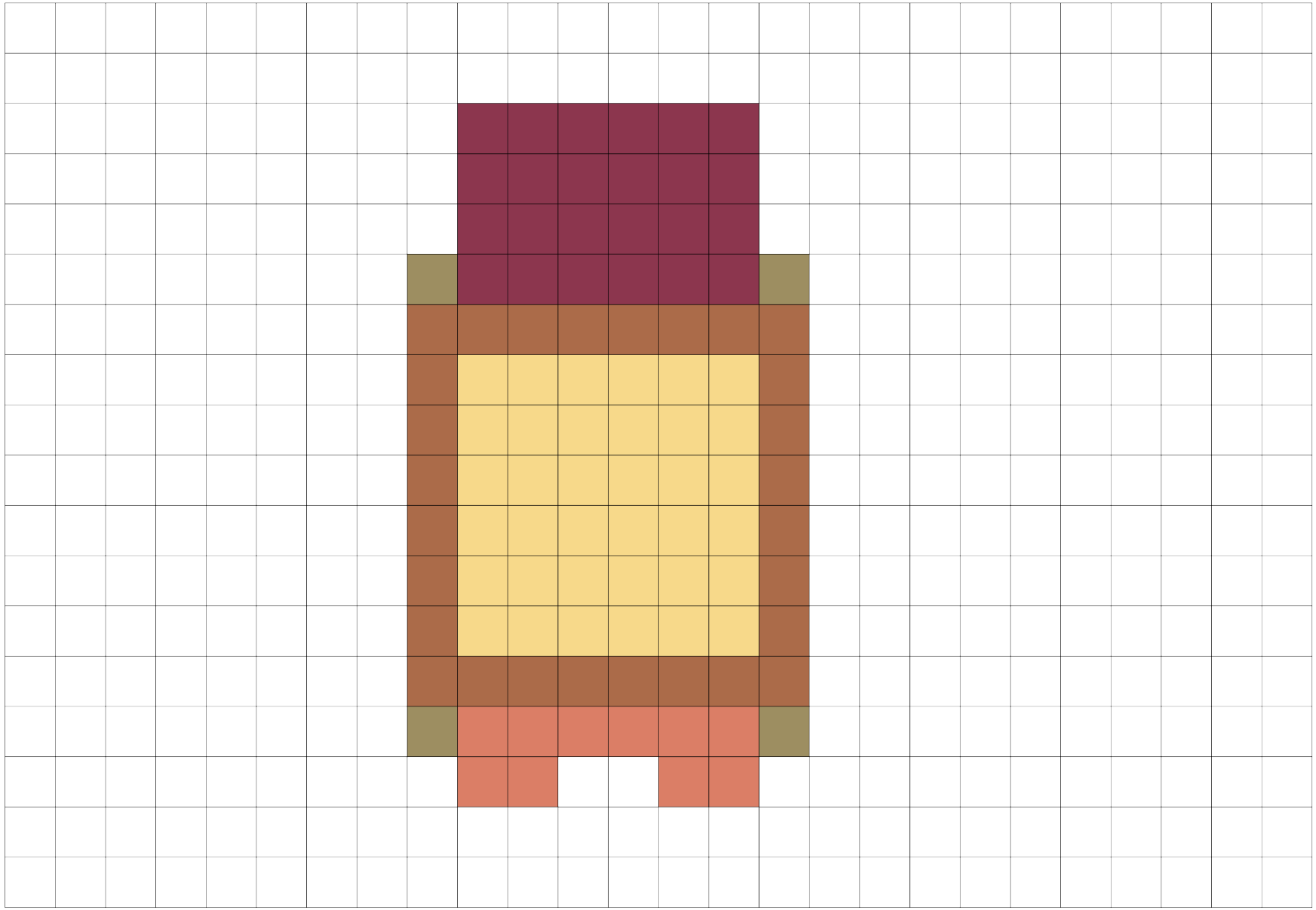
Entrance



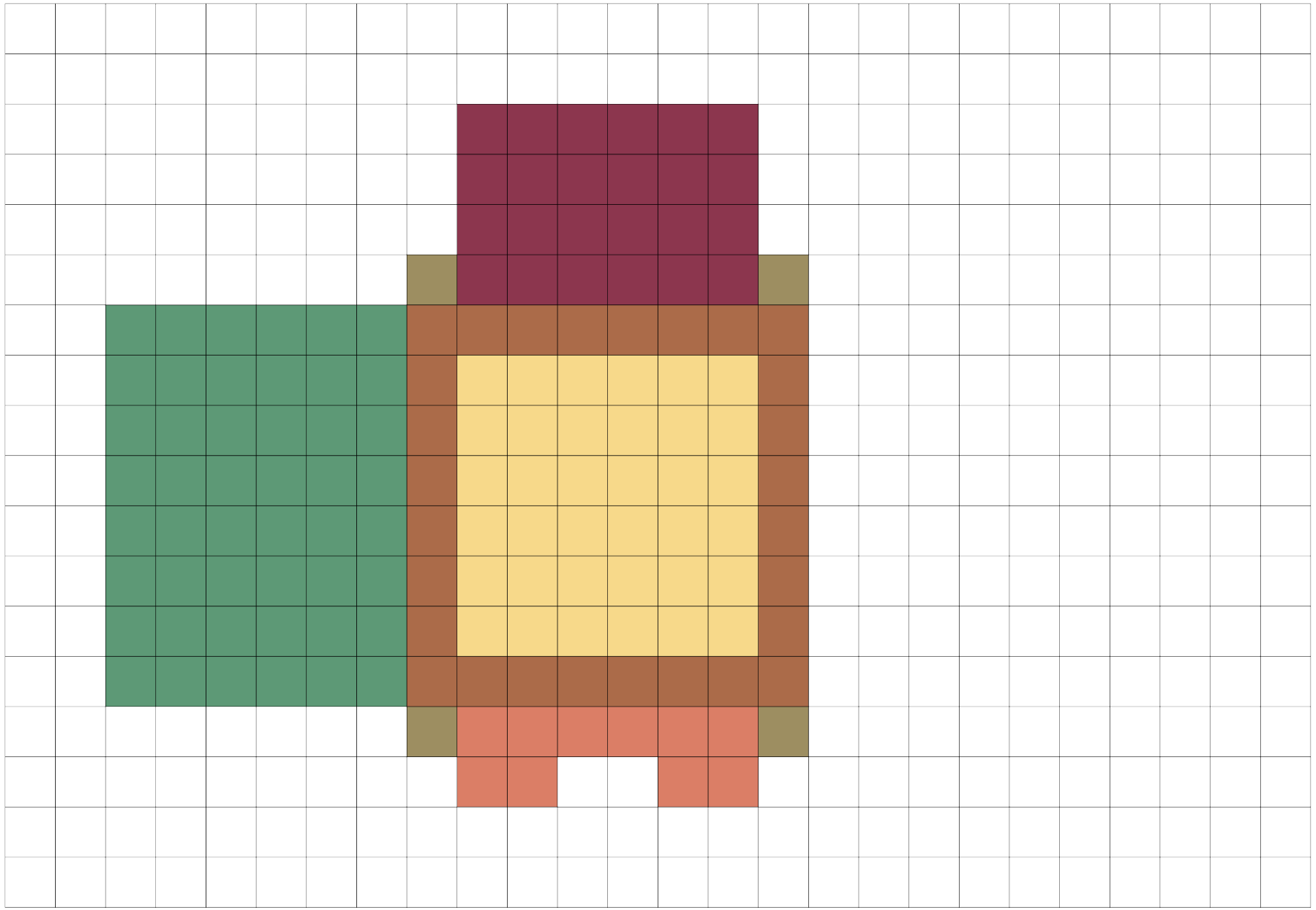
Stairs



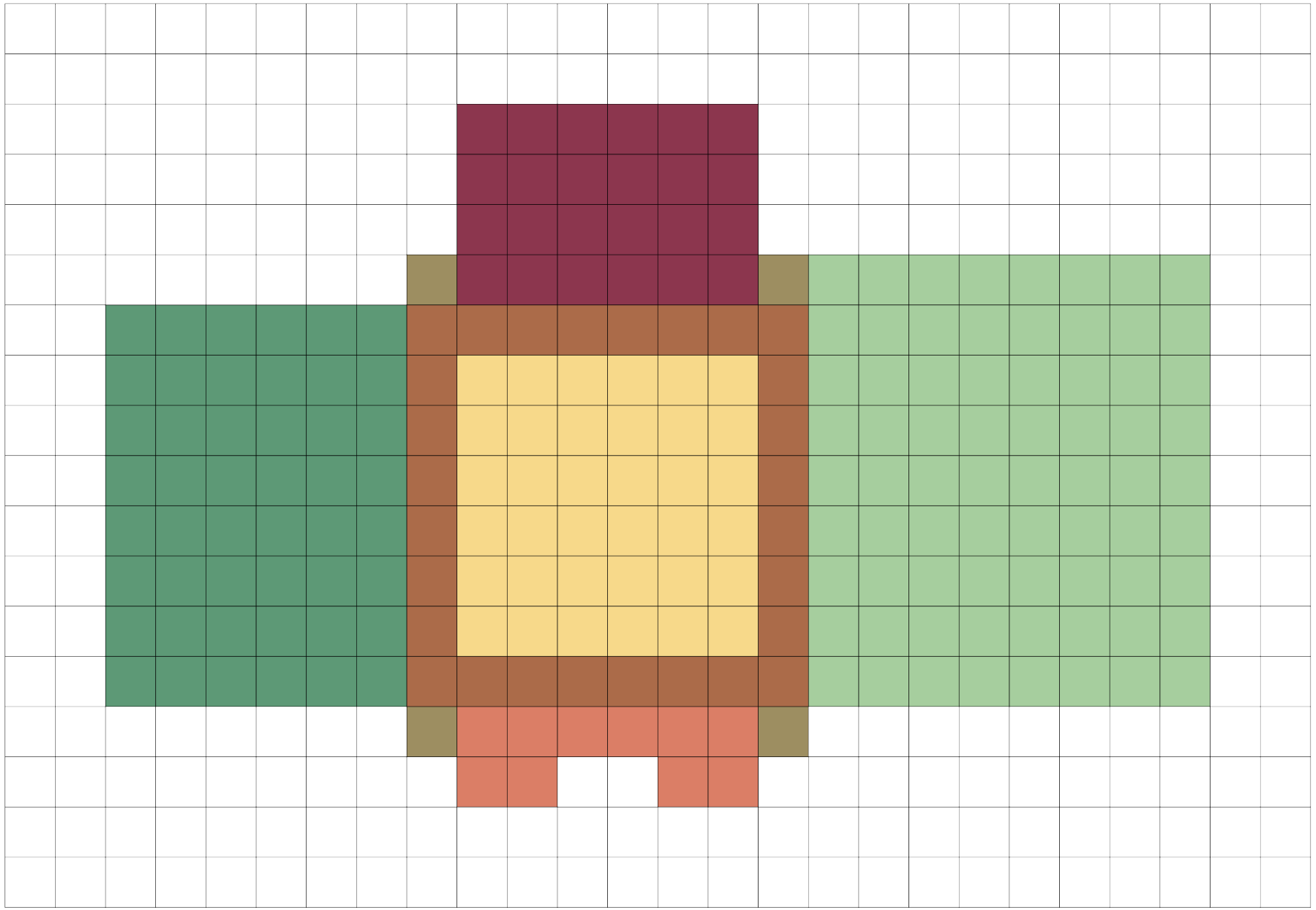
Communal Building



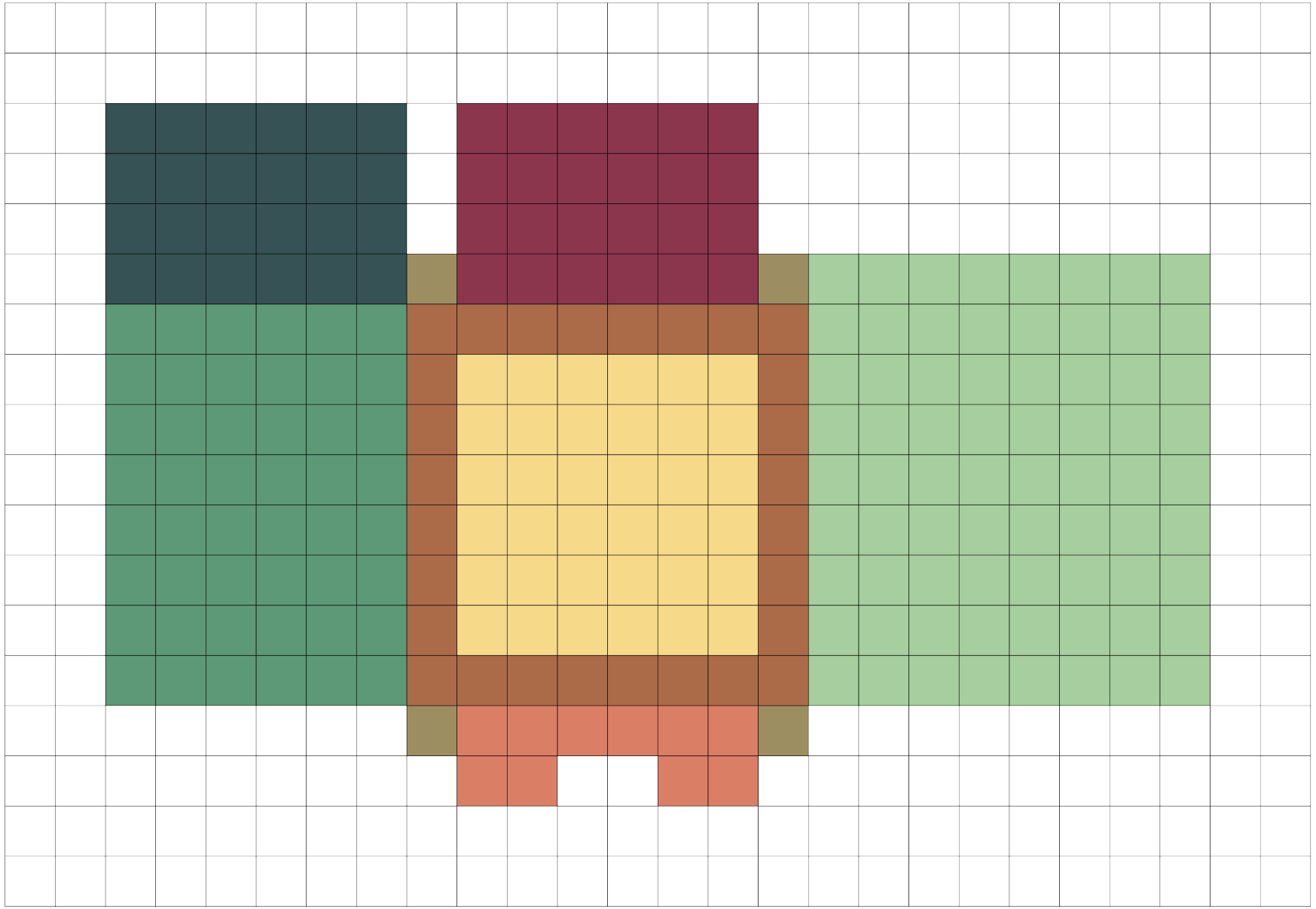
Kitchen



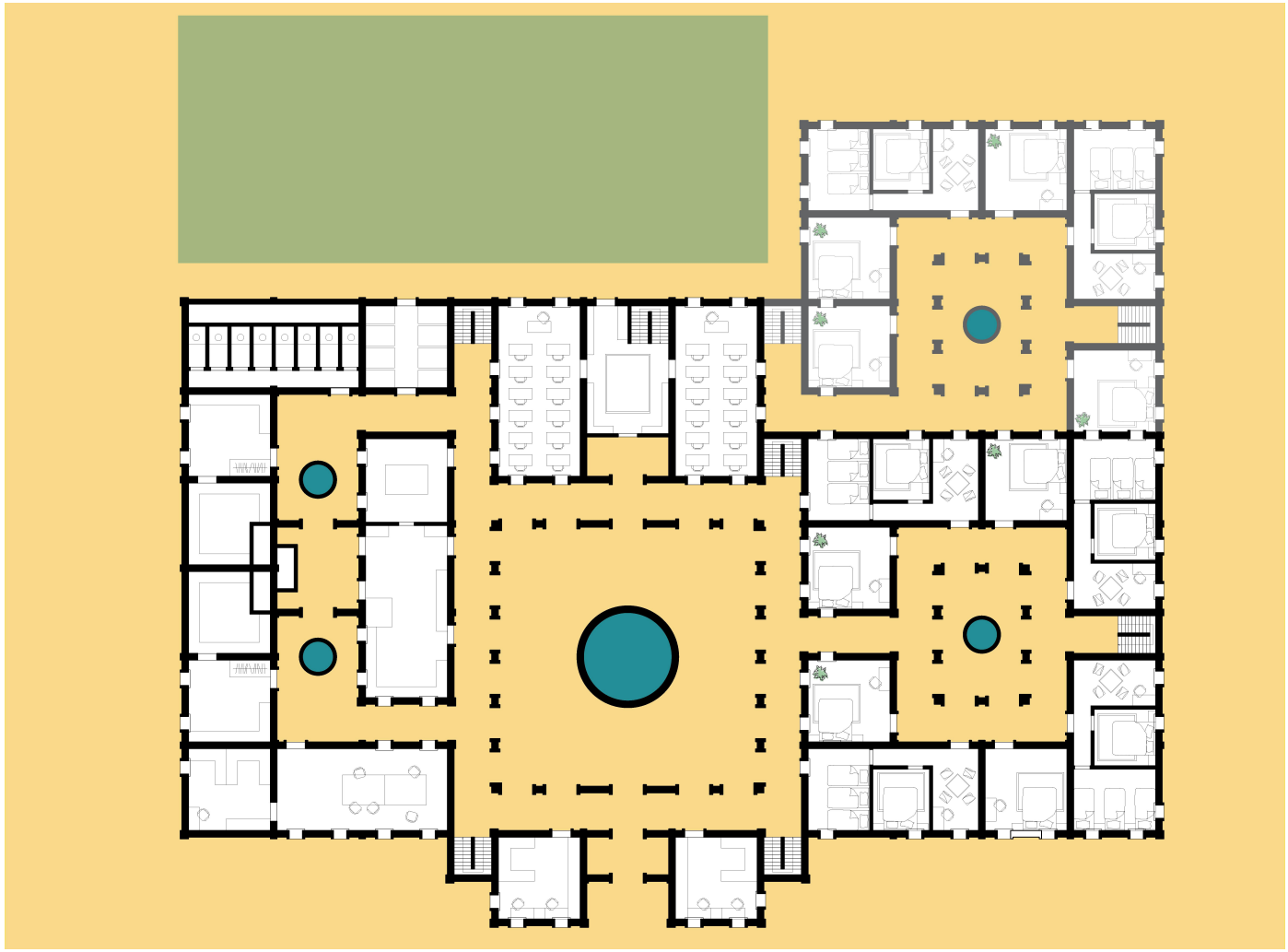
Housing



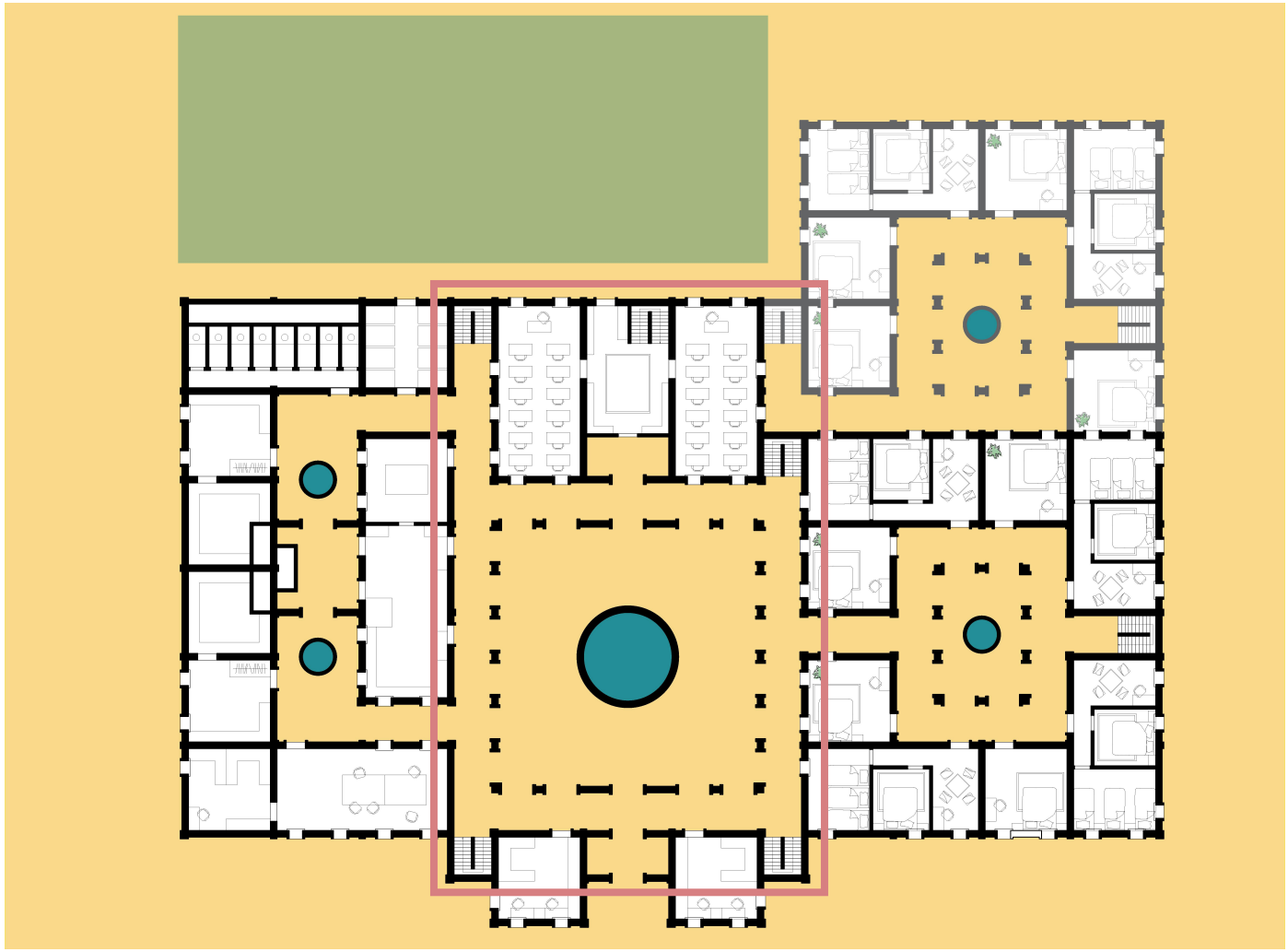
Sanitary



Ground Floor



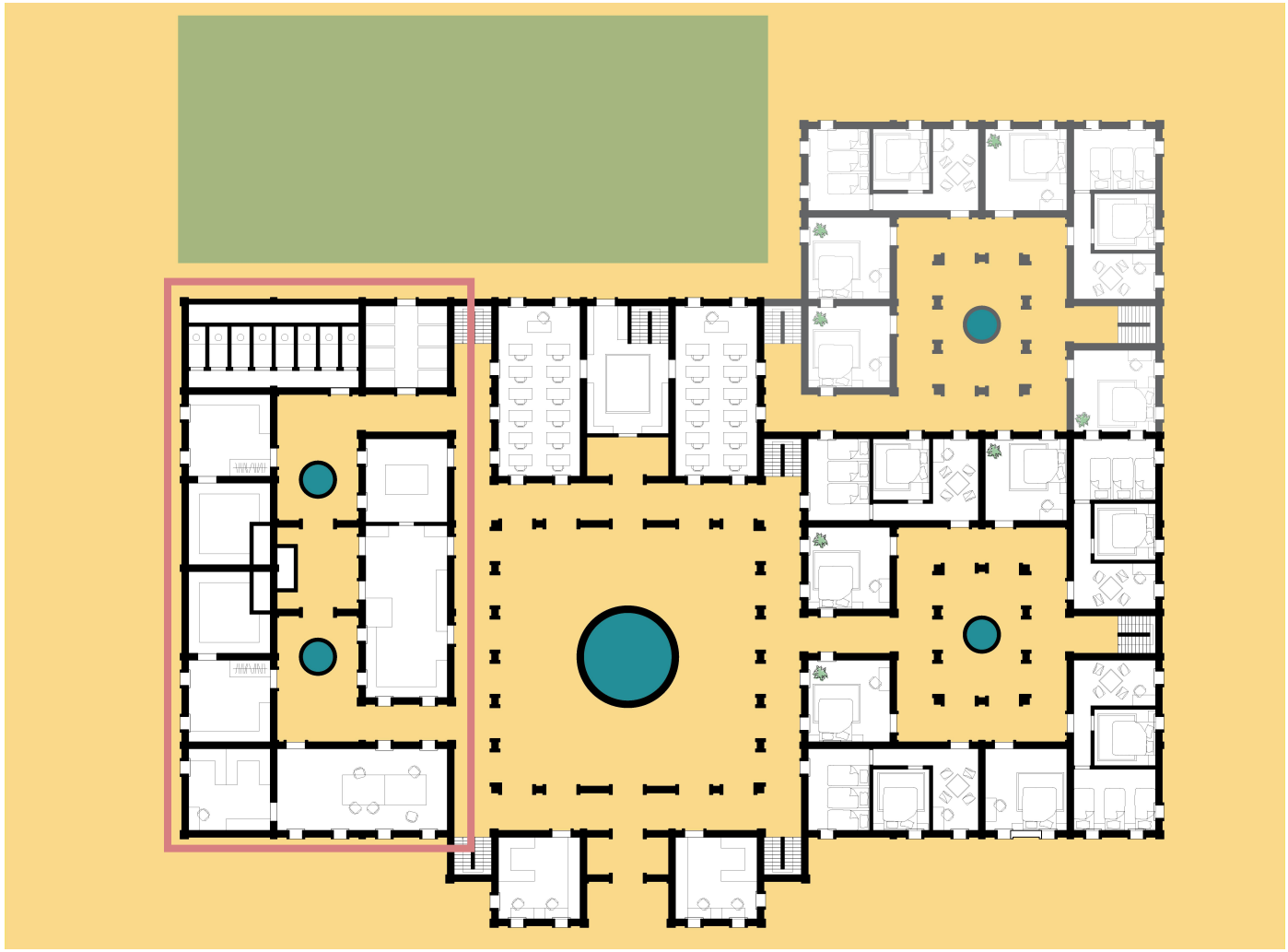
Zoning



Public

- Main courtyard
- Communal multipurpose building
- Communal kitchen

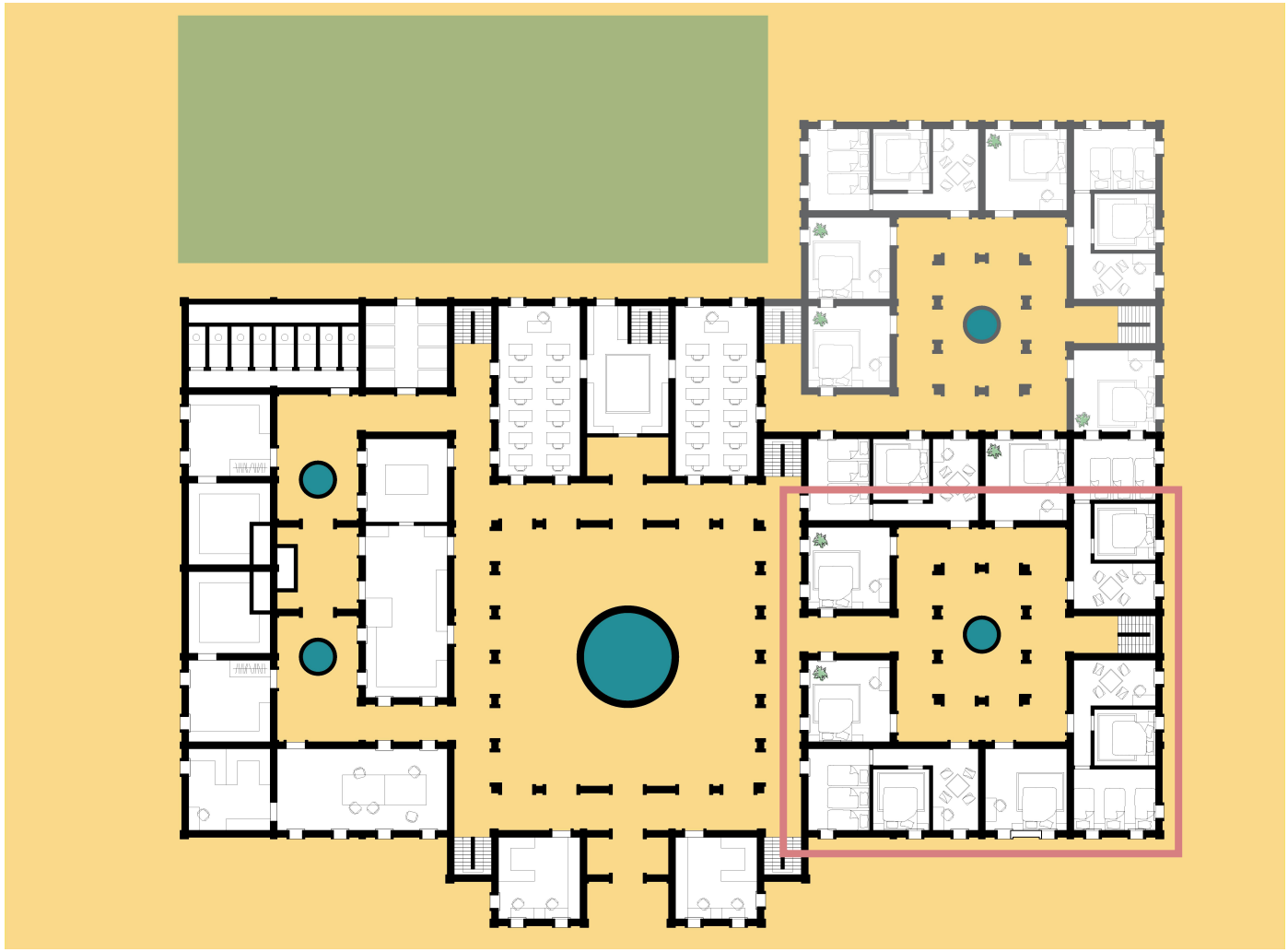
Zoning



Semi – Public

- Bath houses
- Workshop areas

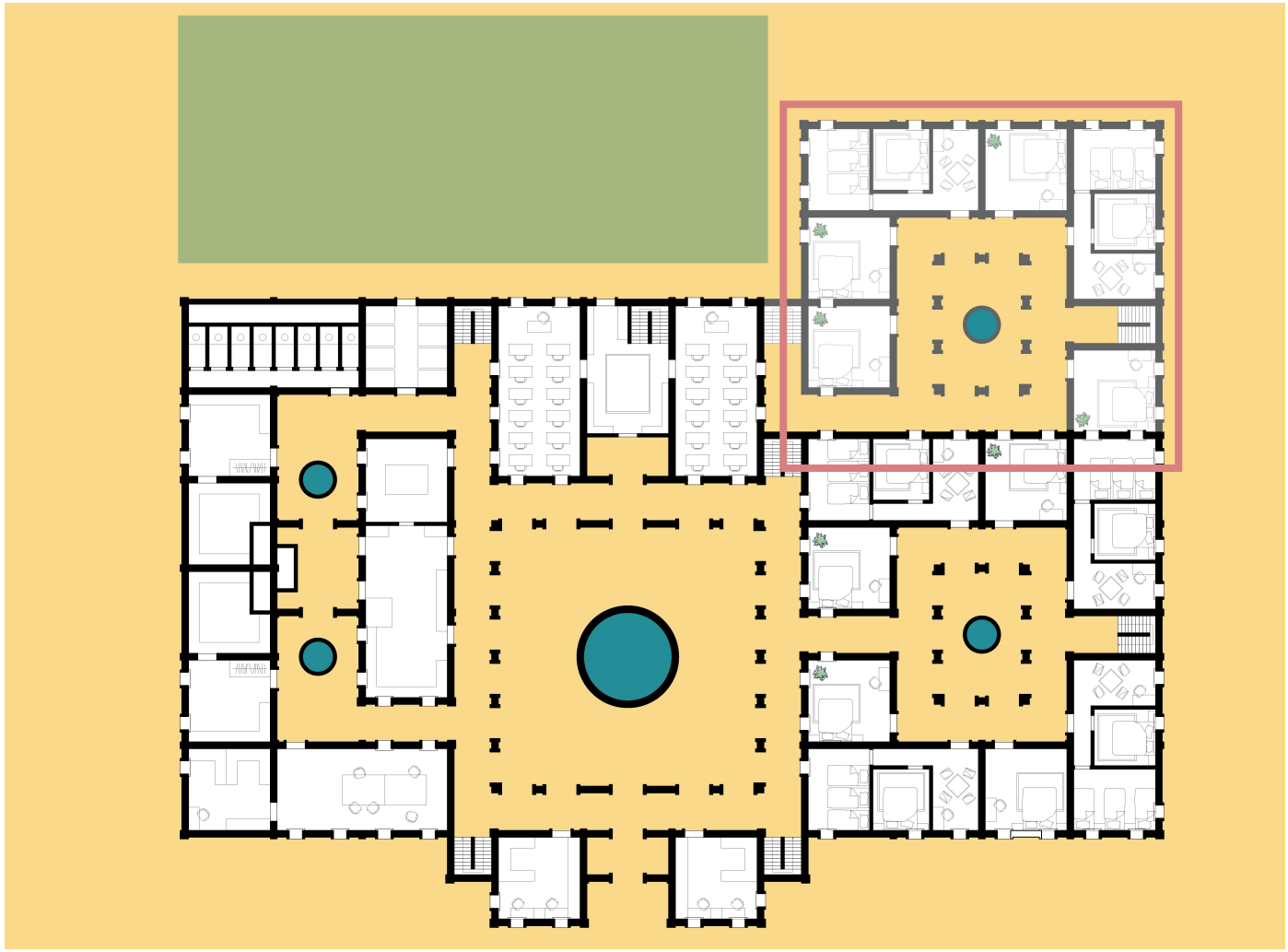
Zoning Floor



Private

- Housing

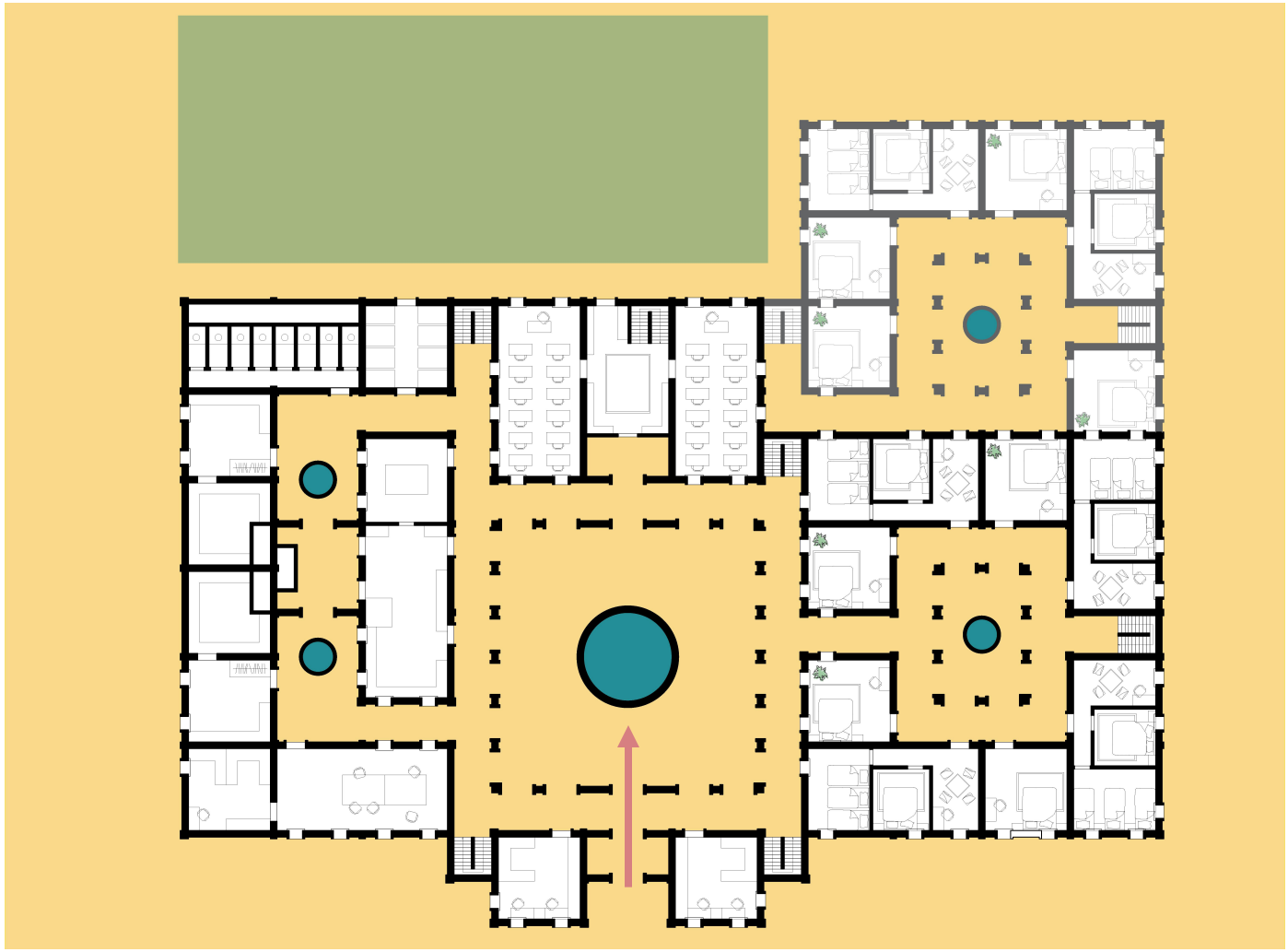
Zoning



Private

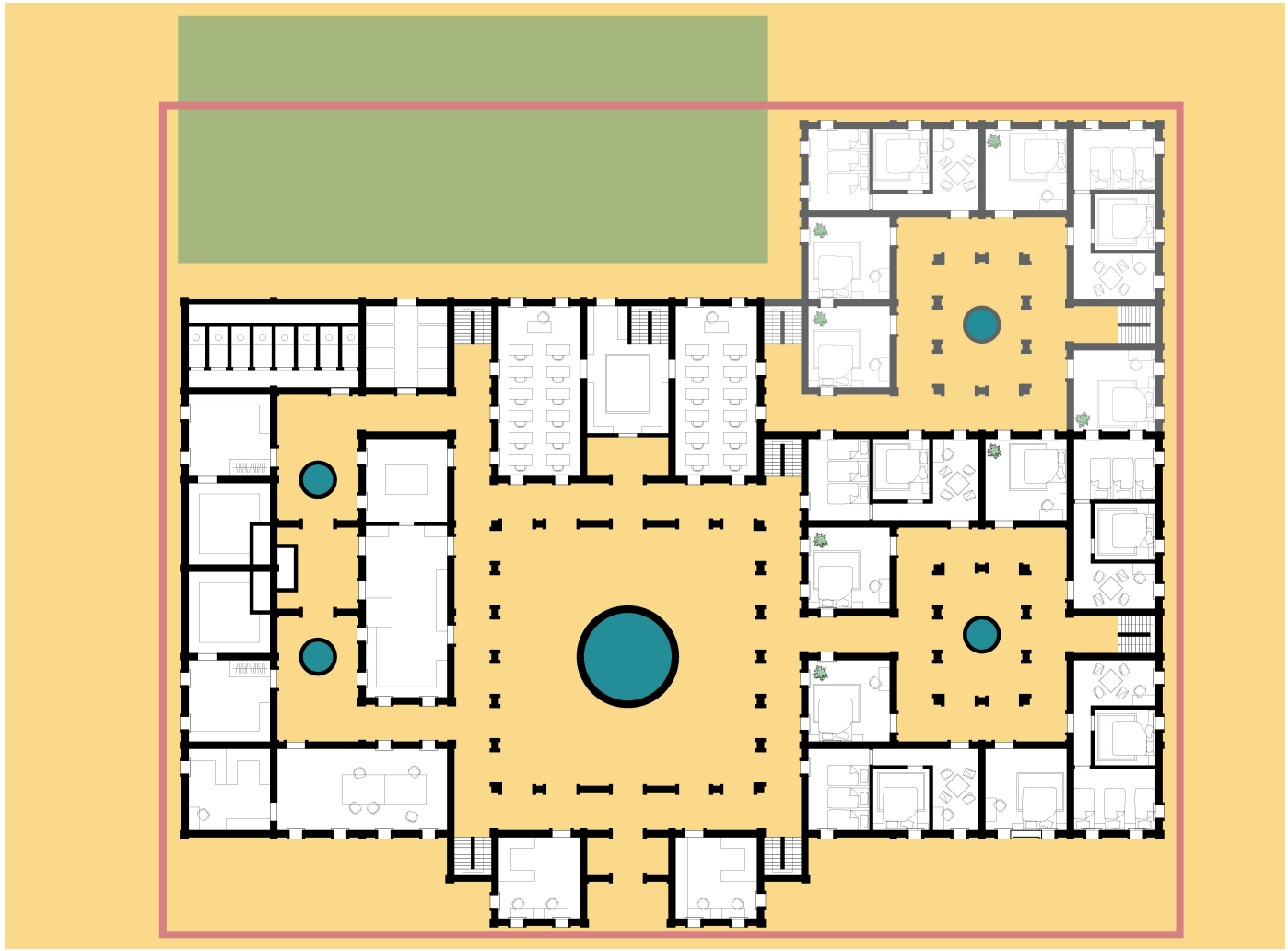
- Possible future extension

Cultural traditions



Clearly defined entrance

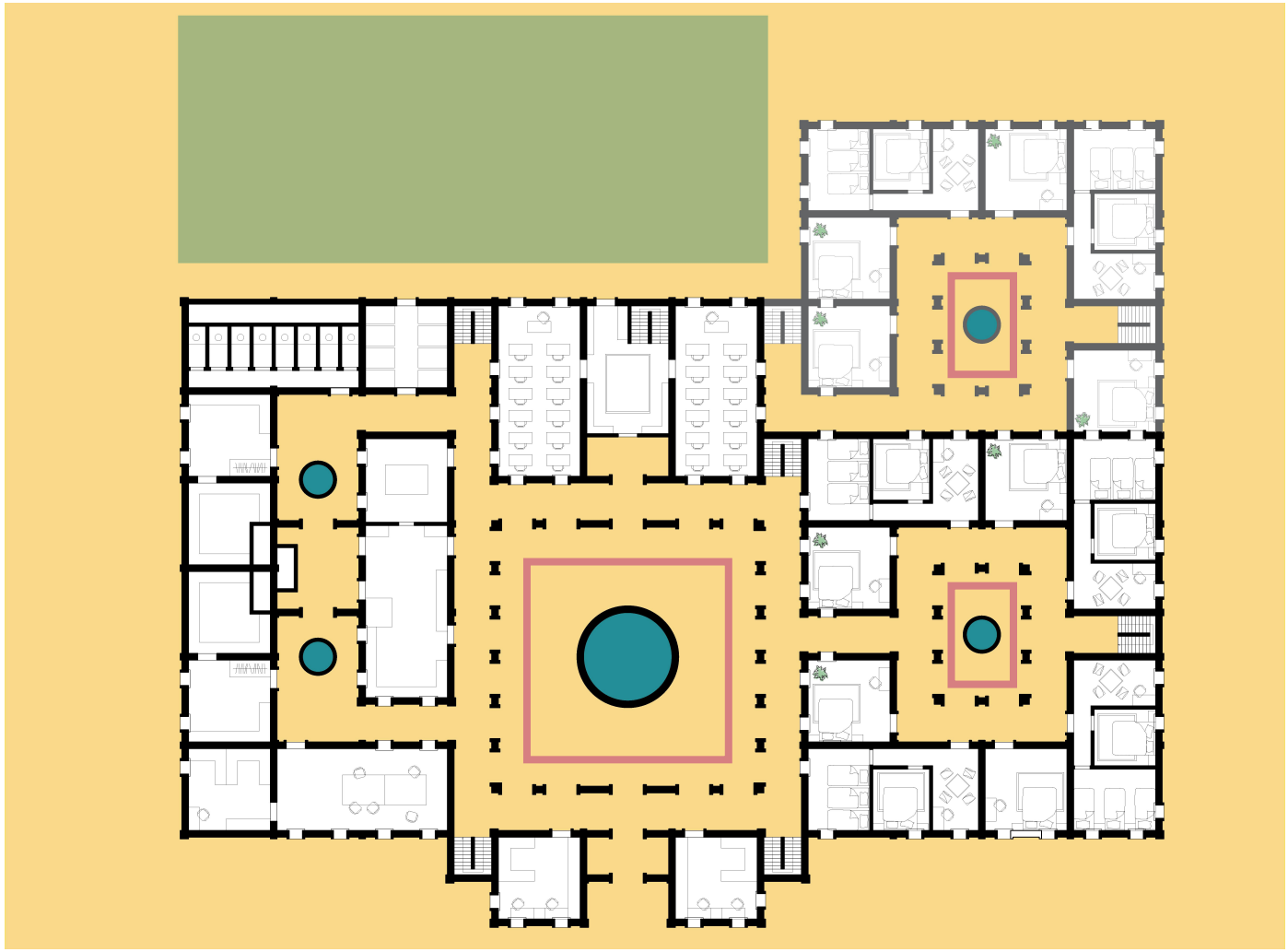
Cultural traditions



Enclosed settlement

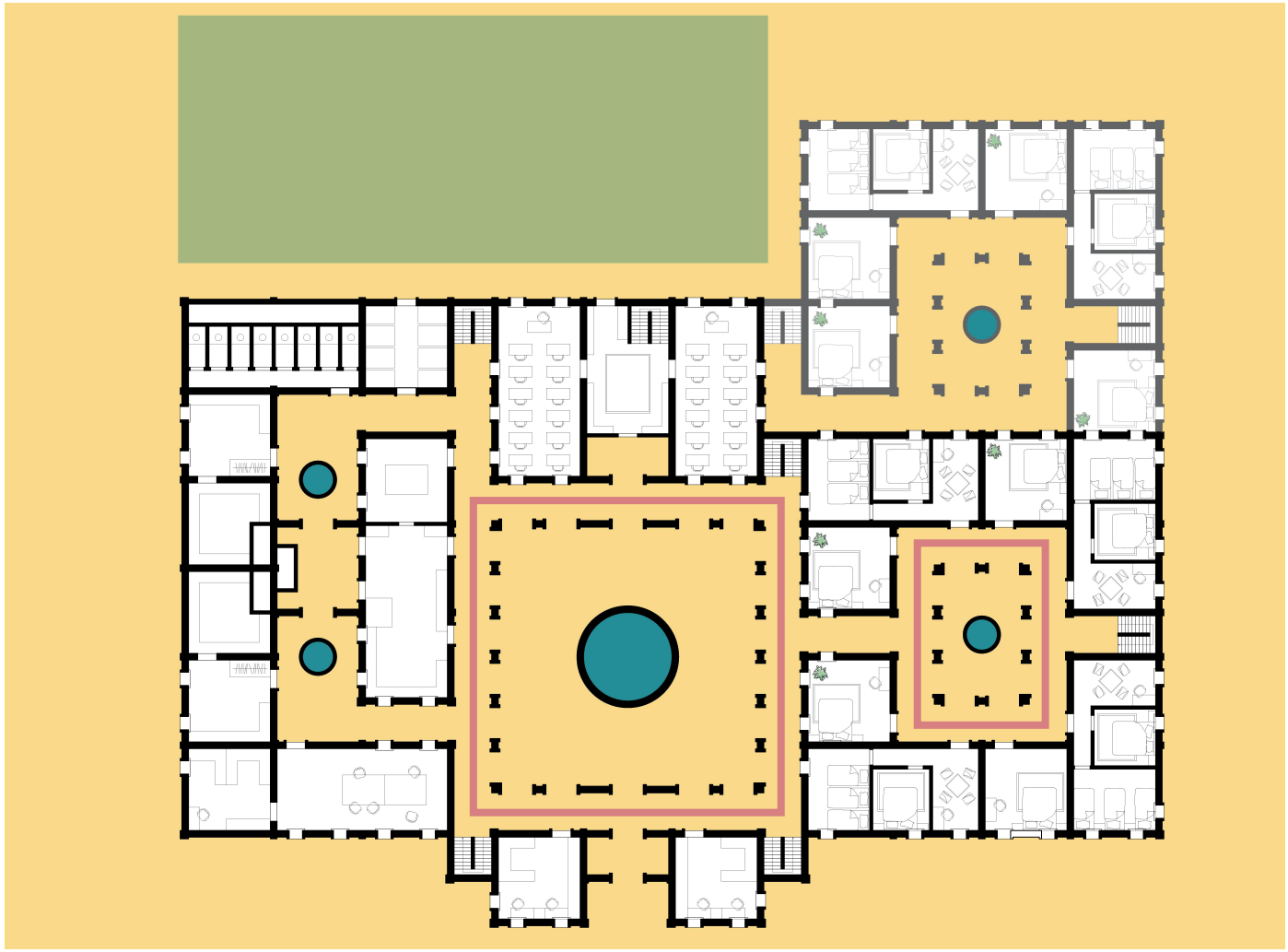
- Defensible space
- Safety
- More comfort

Cultural traditions



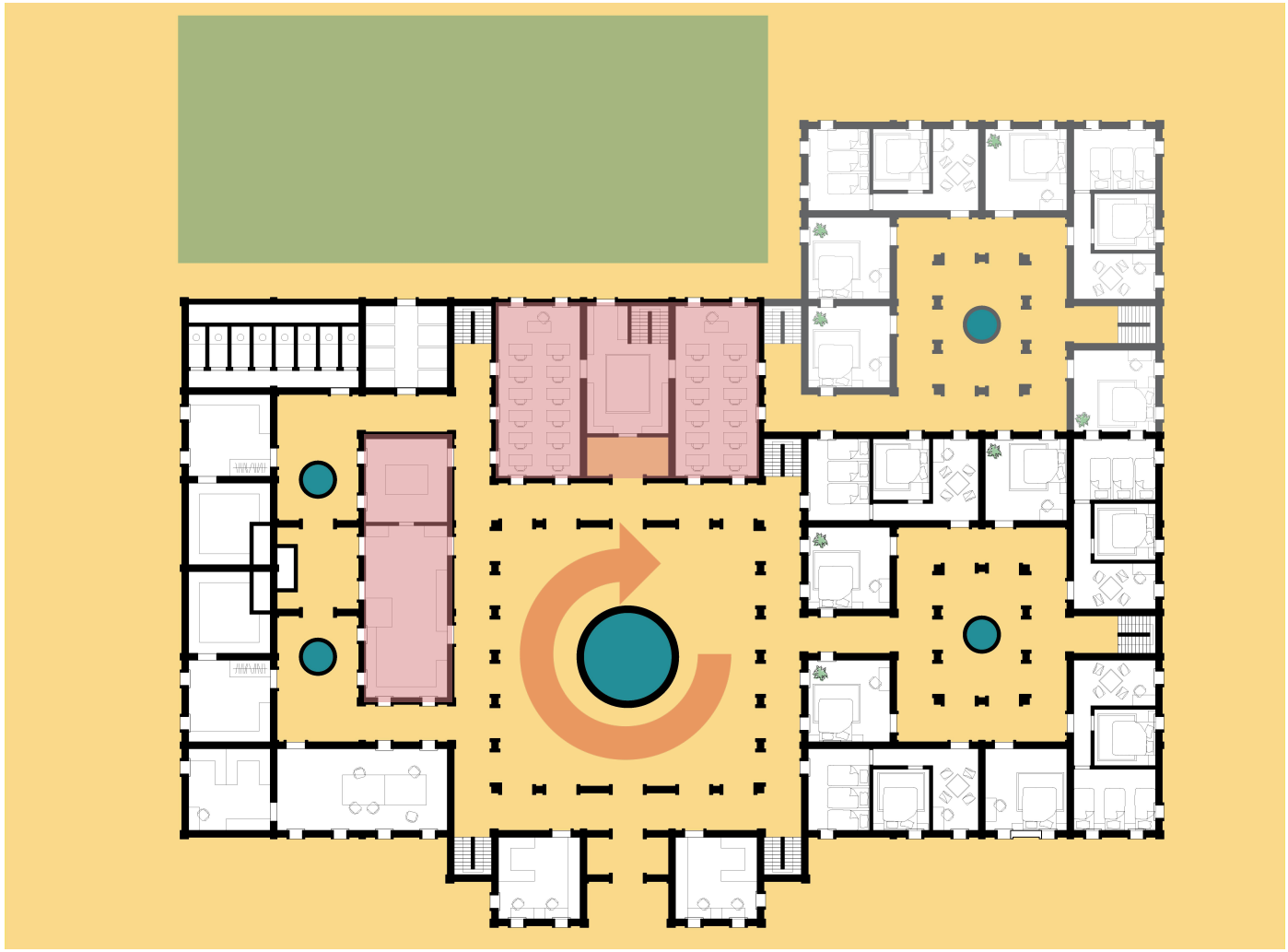
Courtyards

Cultural traditions



Aiwans – pass ways along the buildings with openings towards the courtyard

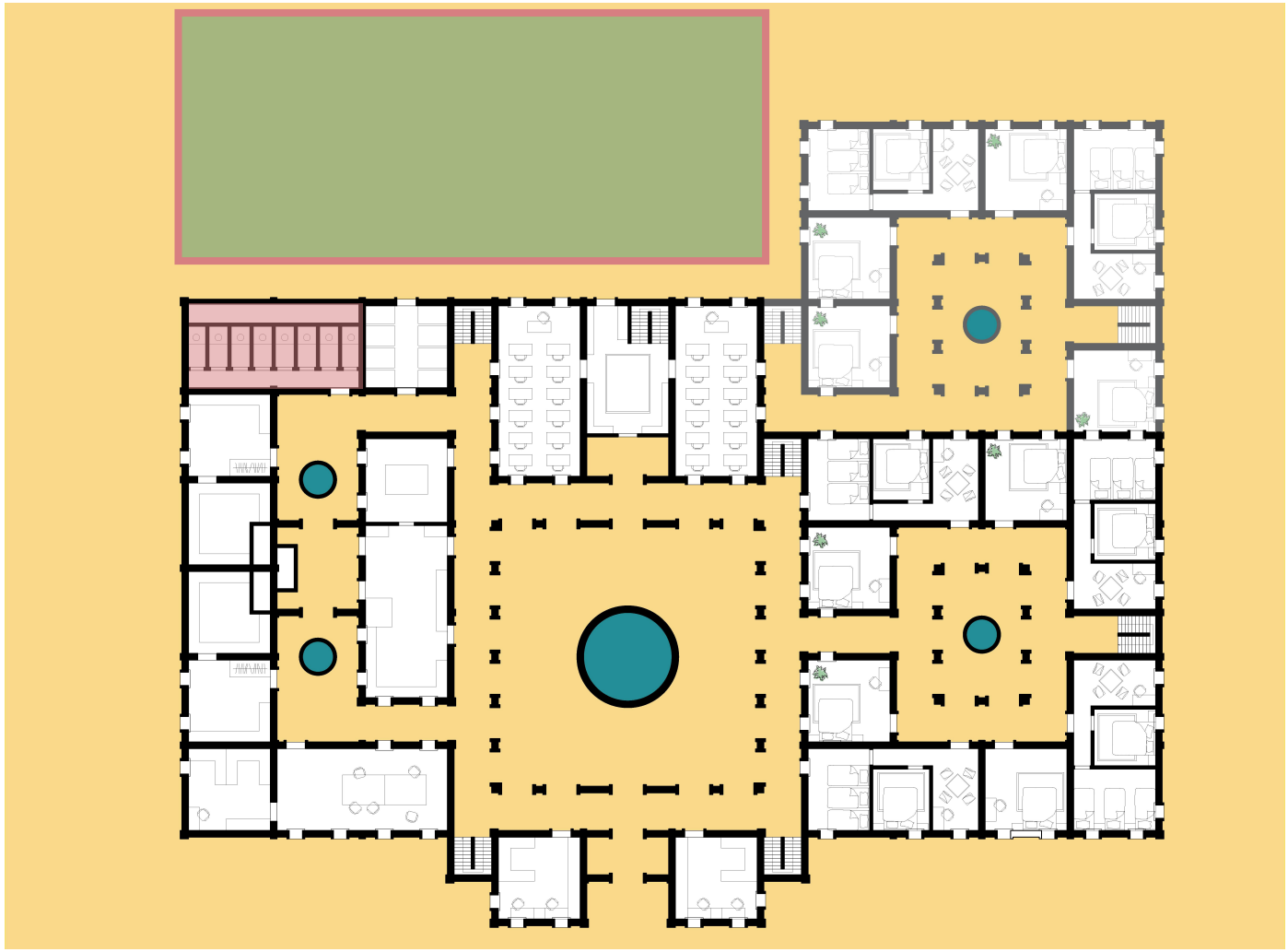
Cultural traditions



Counter clockwise positioning of functions

- Main building (communal building) in the North
- Communal kitchen in the West

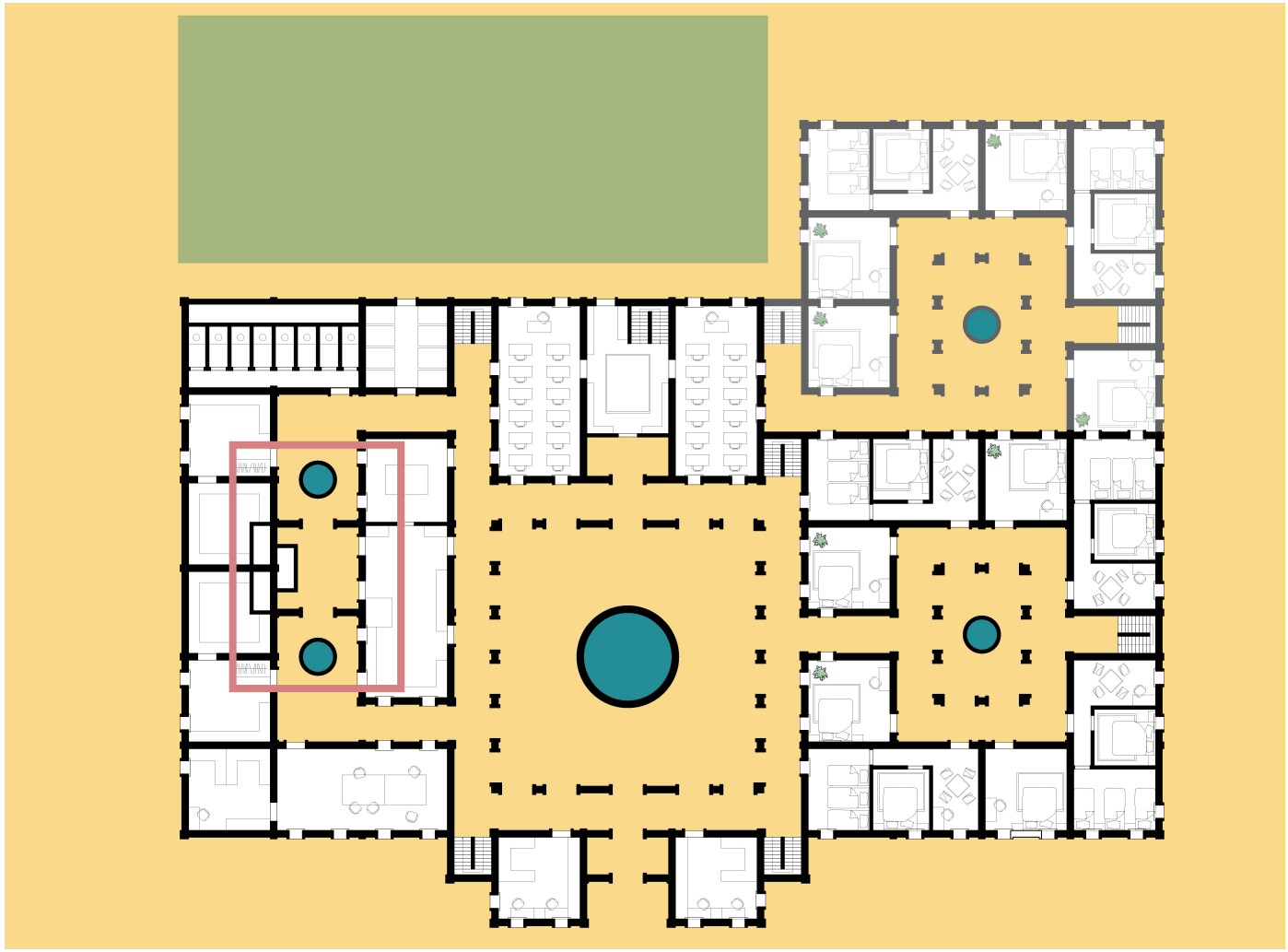
Sustainable flows



Farming

- Local farming
- Utilizing waste for fertilizing

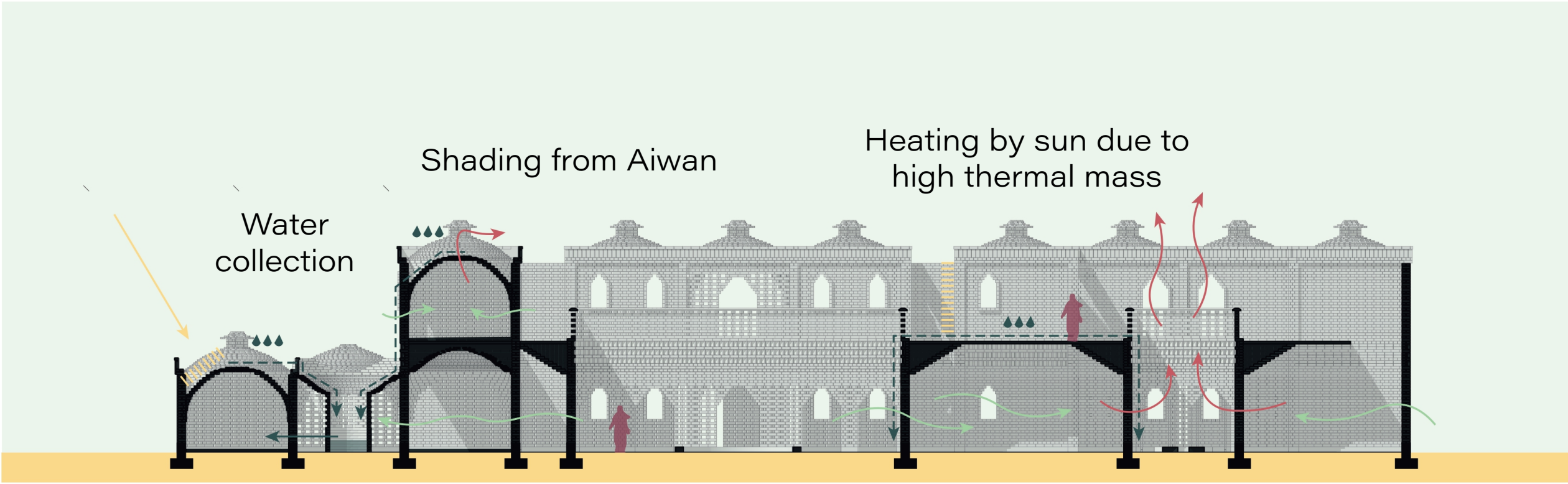
Sustainable flows



Water collection and heating system

Architecture

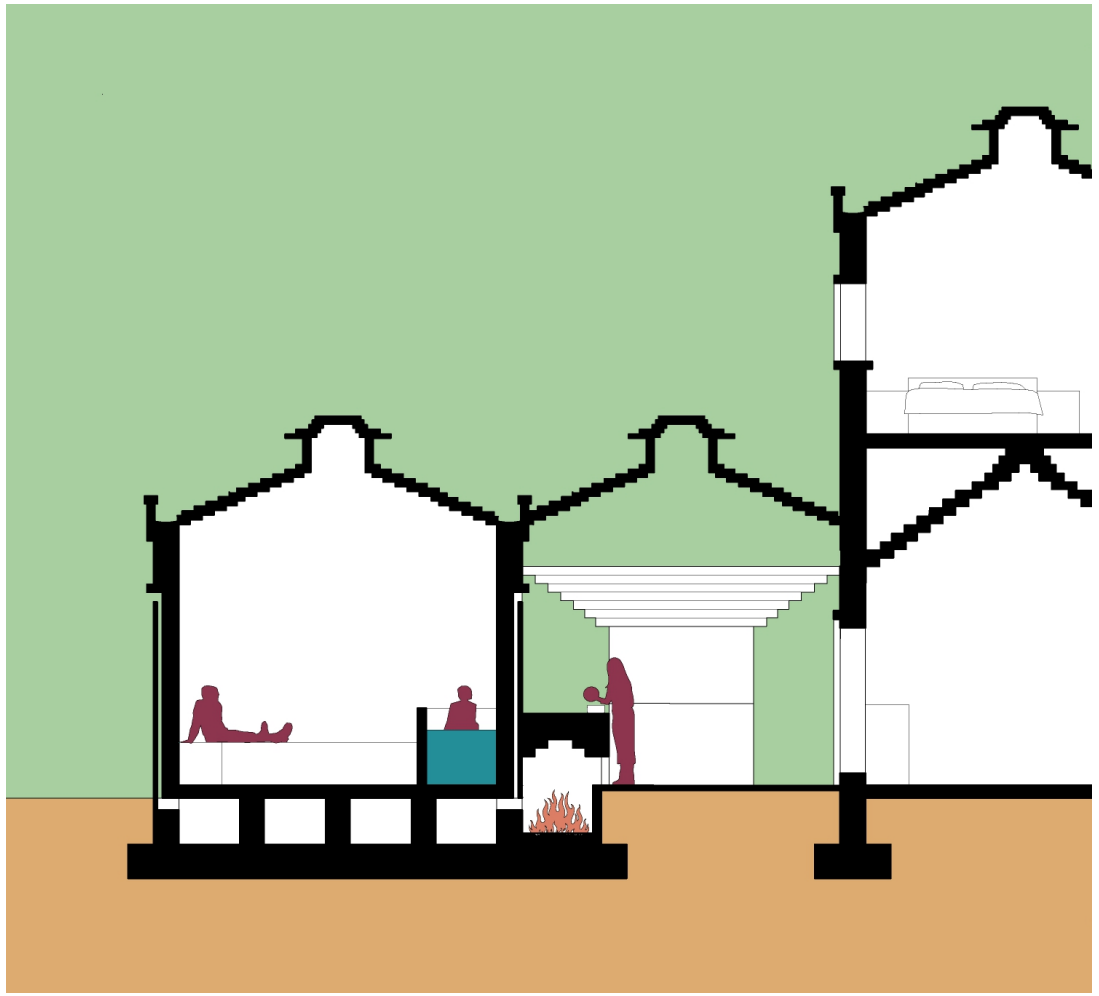
Climate

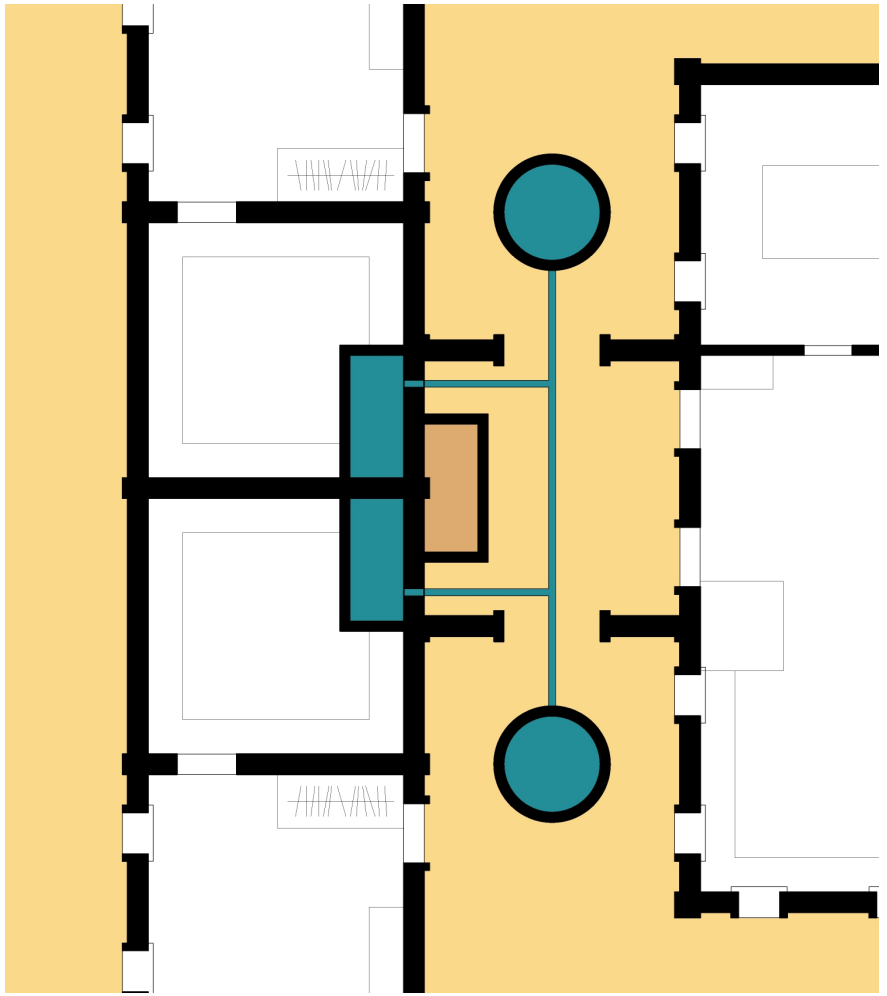


Hypocaust heating system

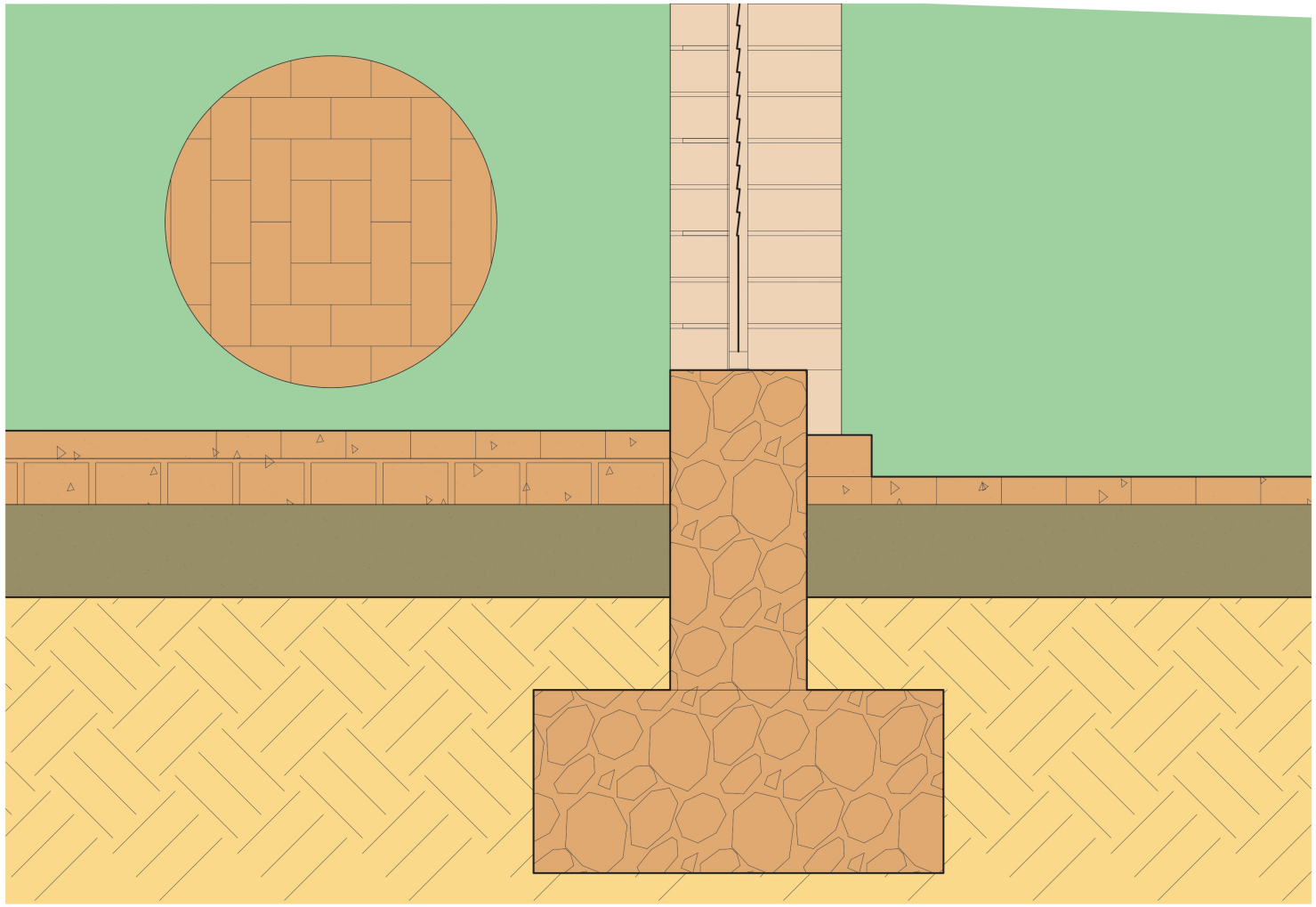
Natural ventilation through the openings

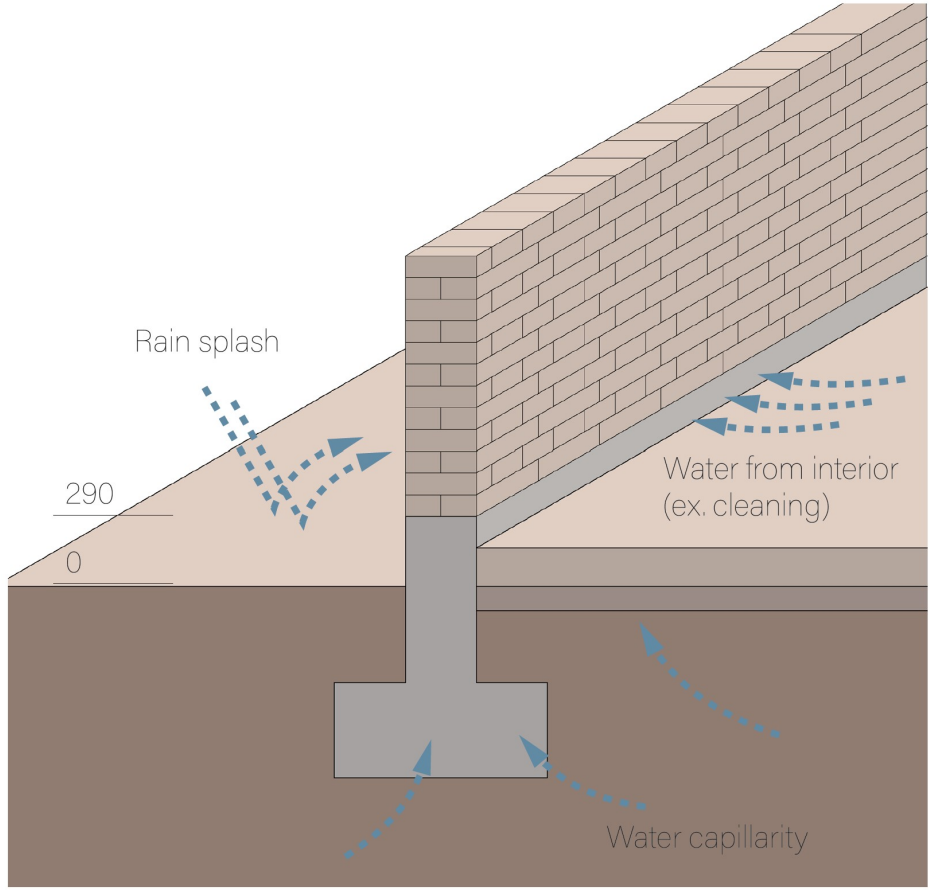
Hypocaust



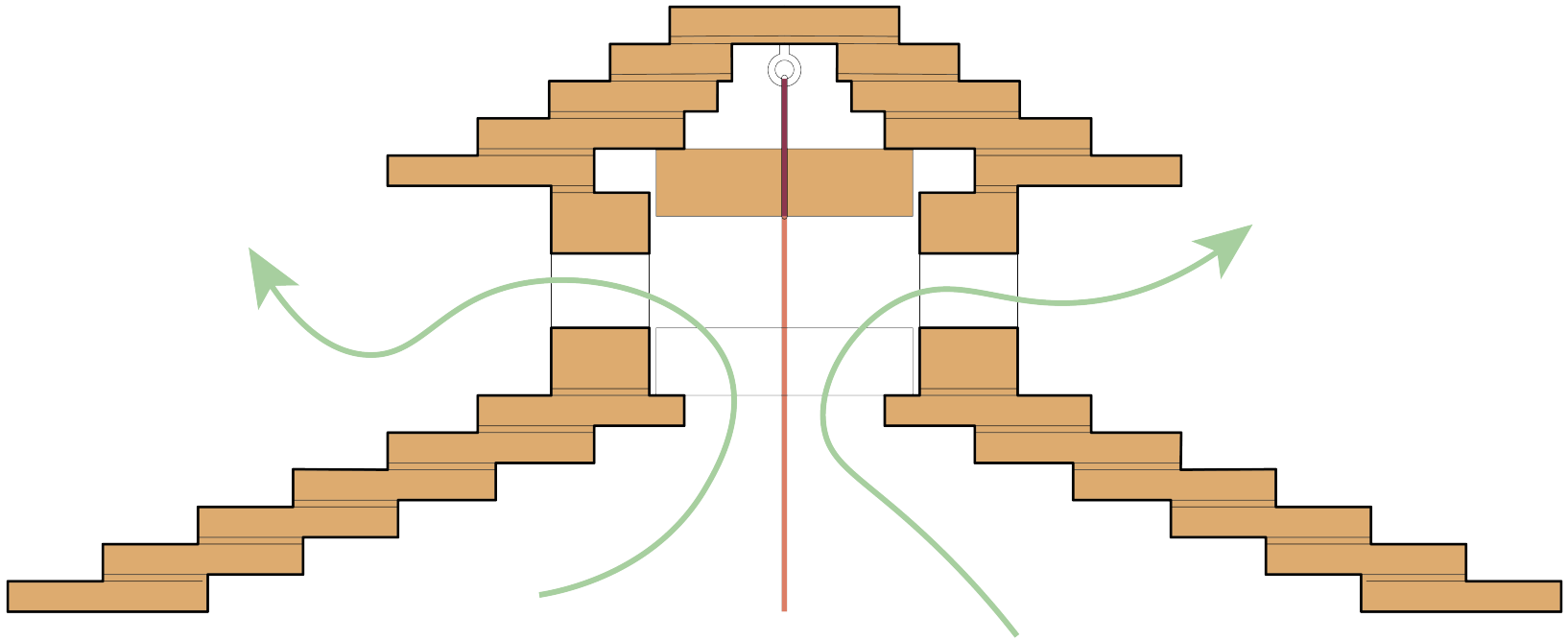


Foundation

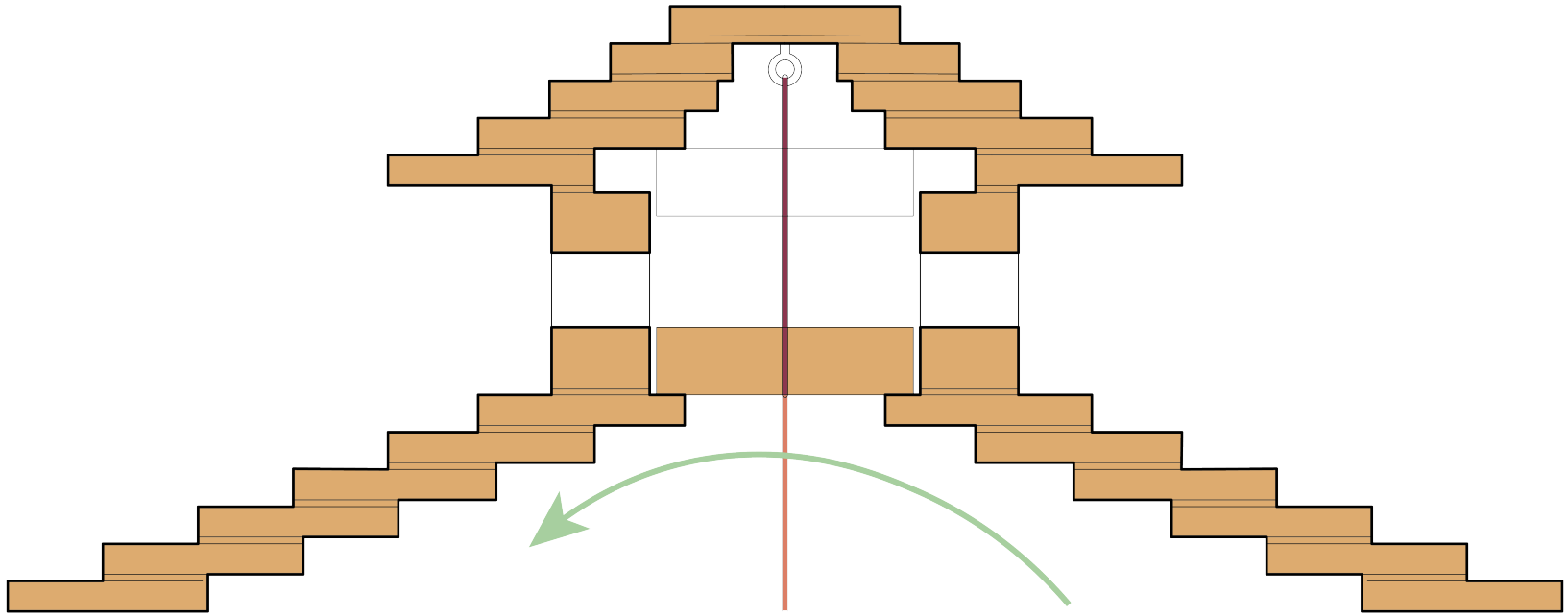



Rain splash
290
0
Water from interior
(ex. cleaning)
Water capillarity

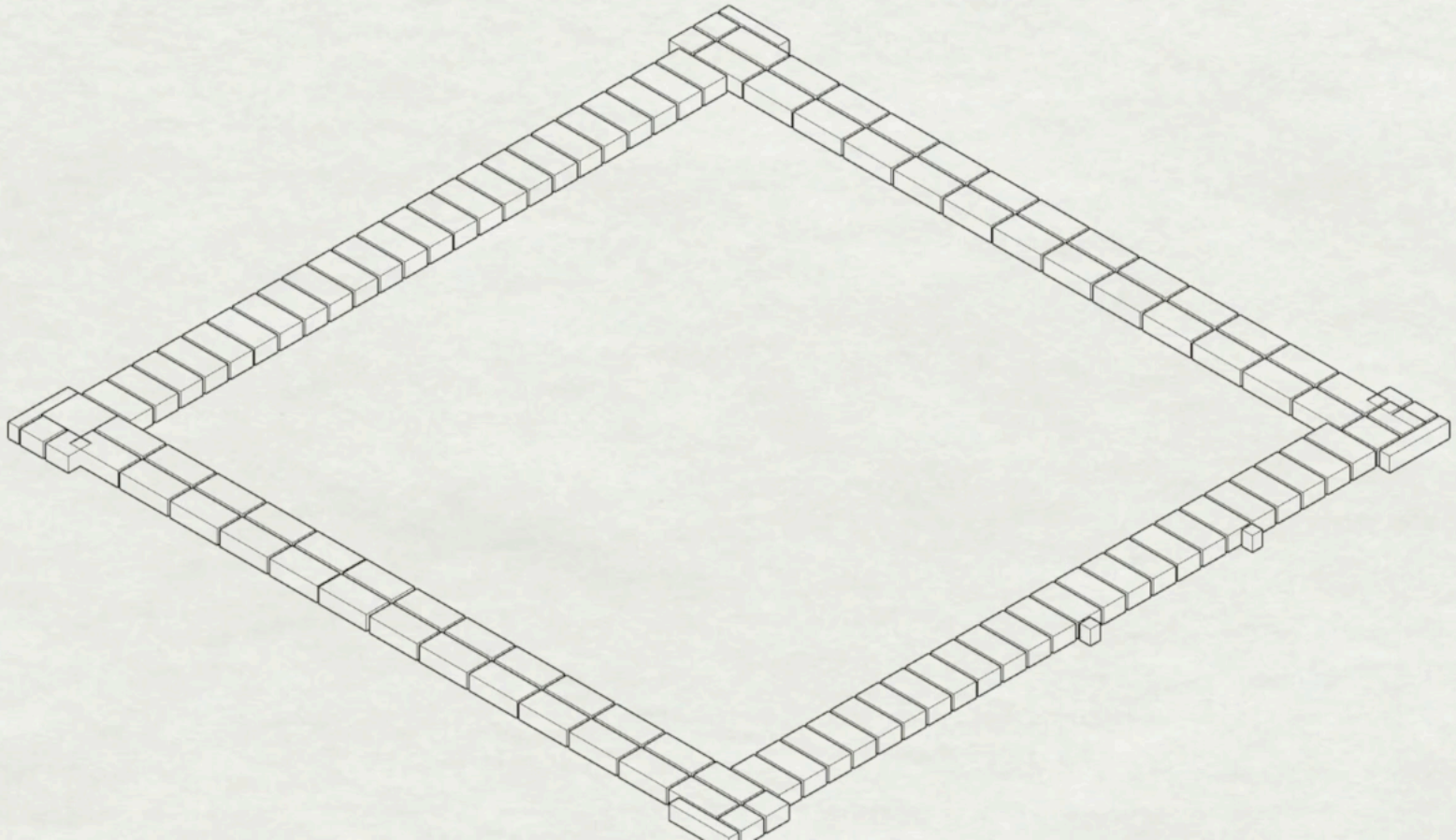
Ventilation | Open



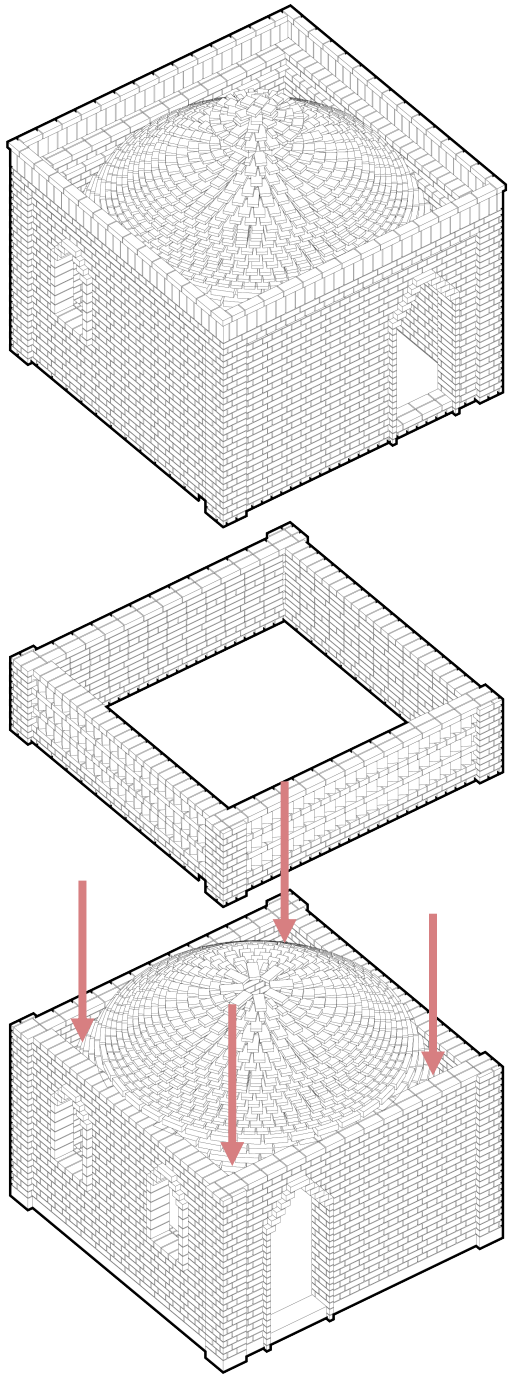
Ventilation | Closed



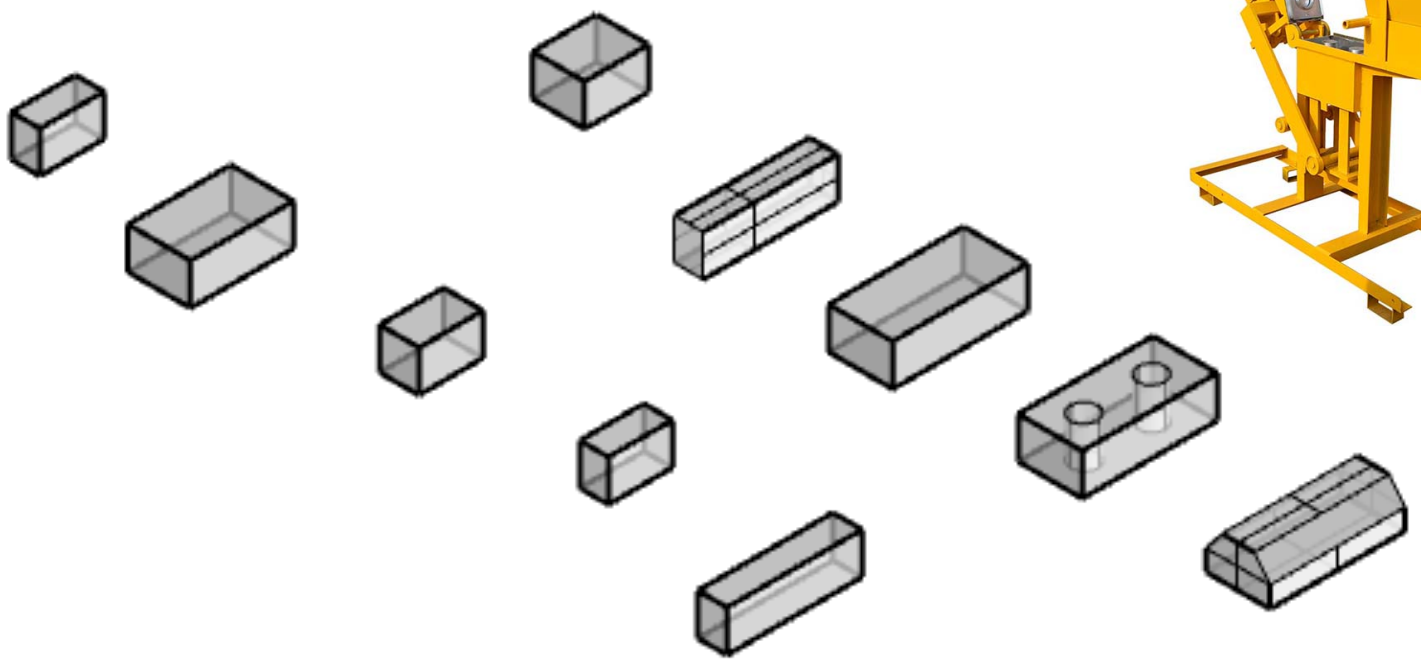
Construction



Construction

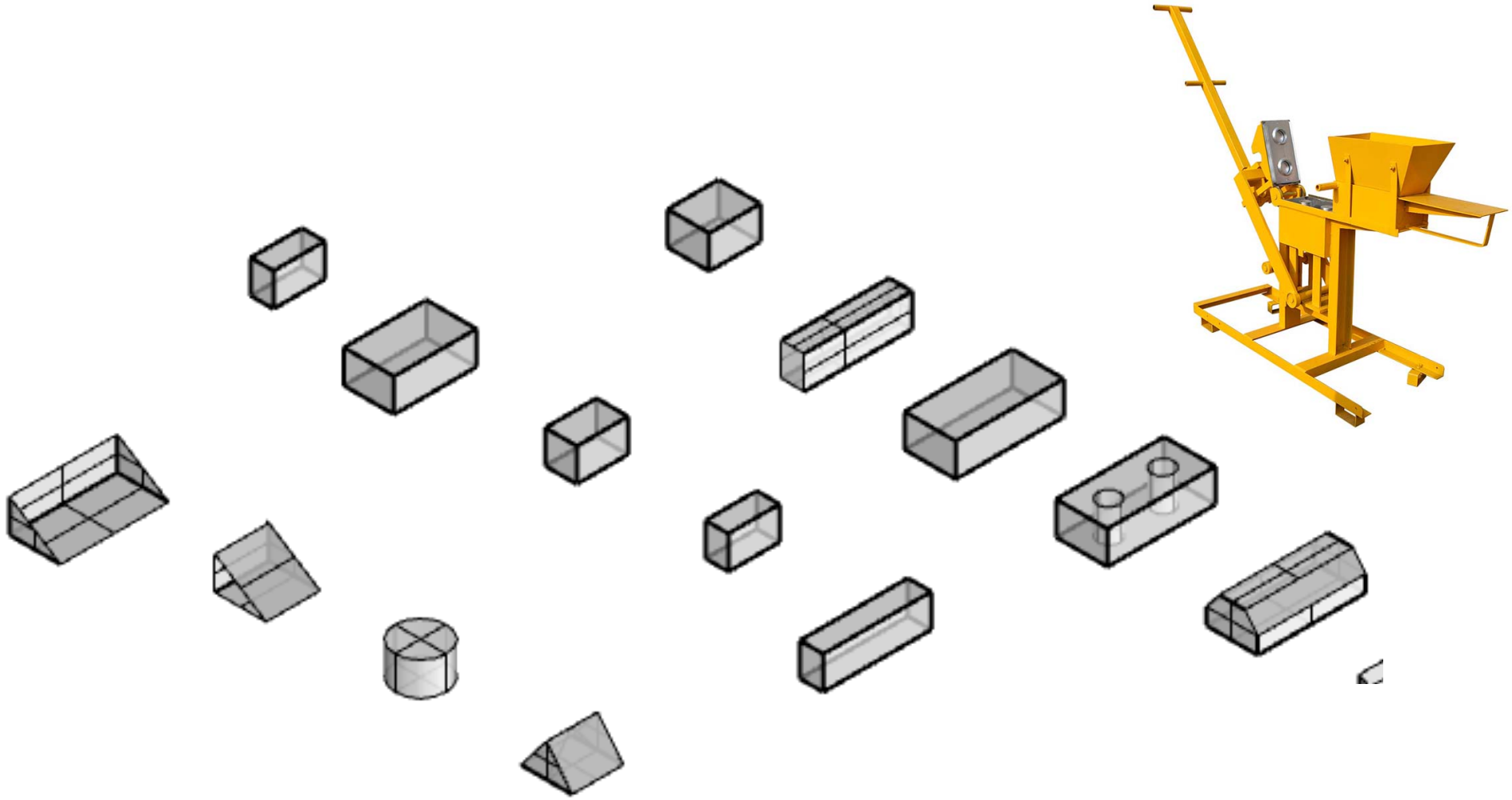


Earth Blocks



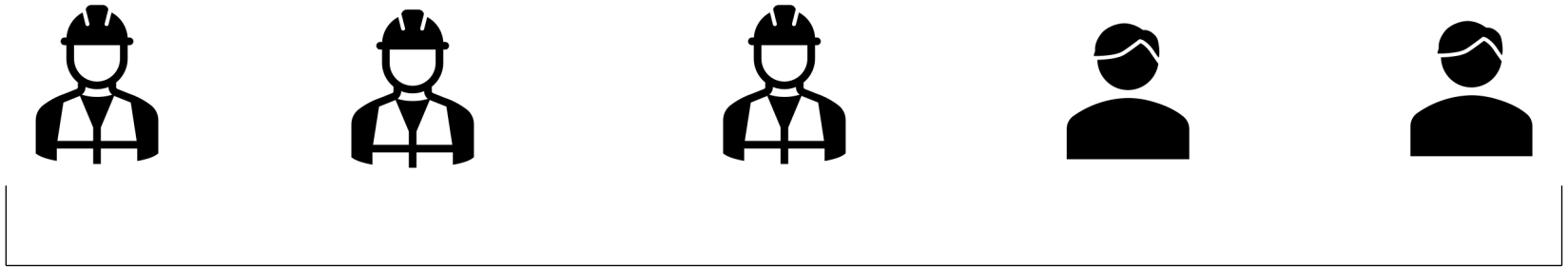
- CEB Blocks
- 11 Total
- 295 x 140 x 90 mm
- 1 Block = 7 kg

Earth Blocks



- CEB Blocks
- 11 Total
- 295 x 140 x 90 mm
- Additional blocks for more possibilities in customization
- Only press needs to be transported

Speed of construction



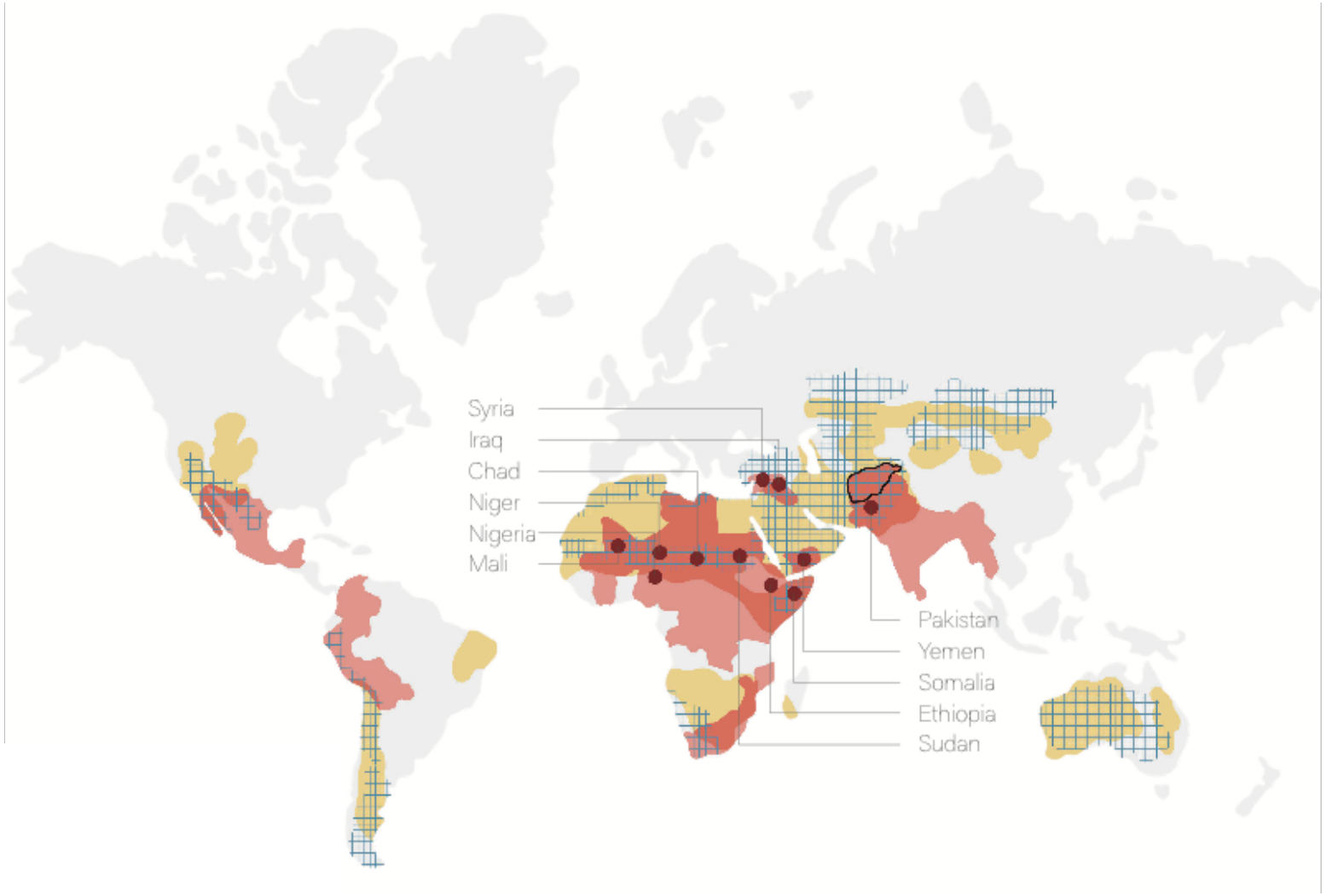
9 m^2/day

5 - 7 days

275 days

- Generally 4-5 people in a team
- 1 chief mason
- 2 masons
- 1-2 helpers

Possible Application



Sand and Clay Availability

Arid Climate

Internal Displacement

Possible Application Countries

The End

Thank you for your attention

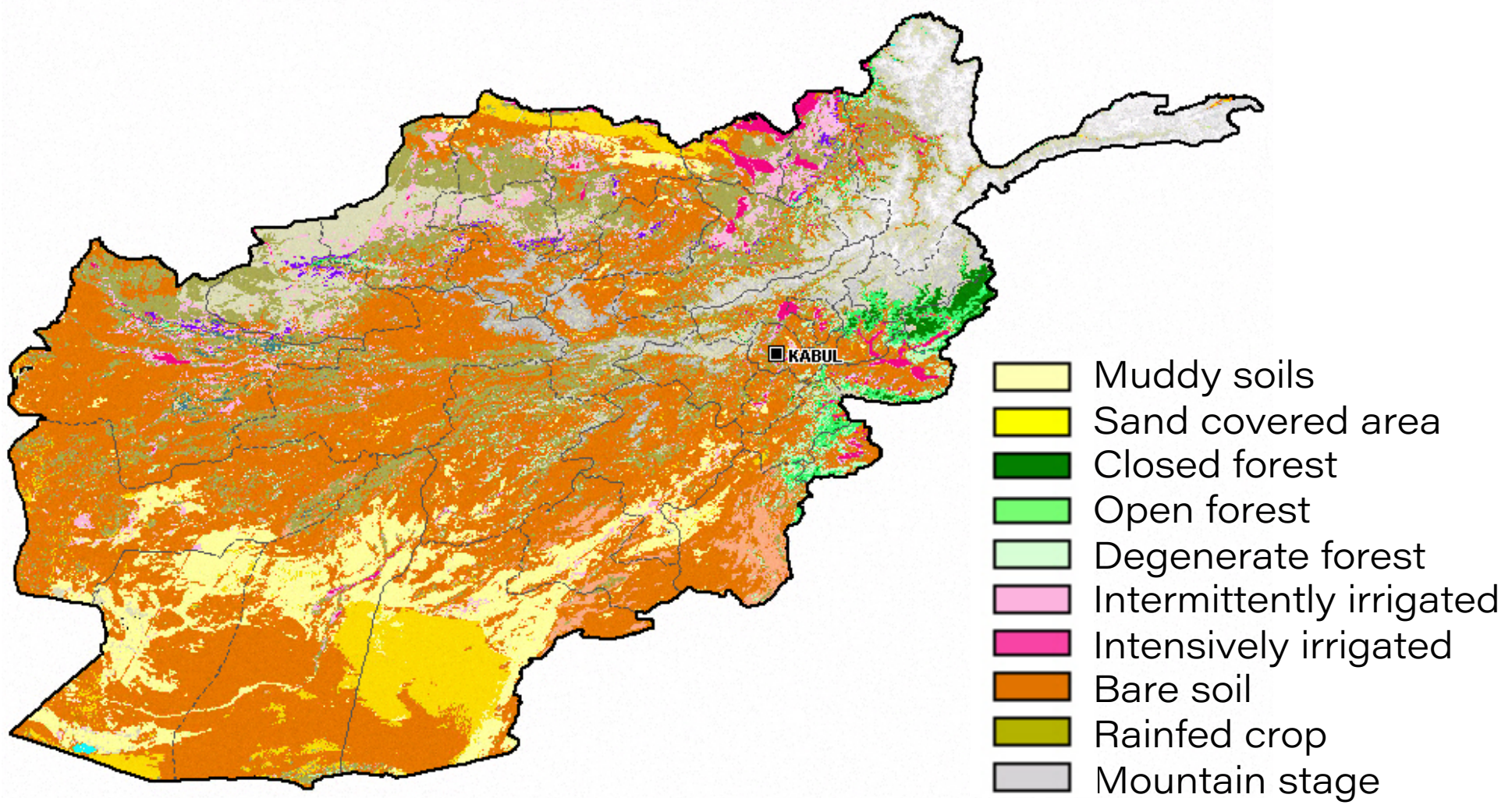
Earthy materials

Source: 48th Infantry Brigade Combat Team

- Mud houses – traditional types of structures in Afghanistan
- Clay mixed with chopped straw
- Clay bricks

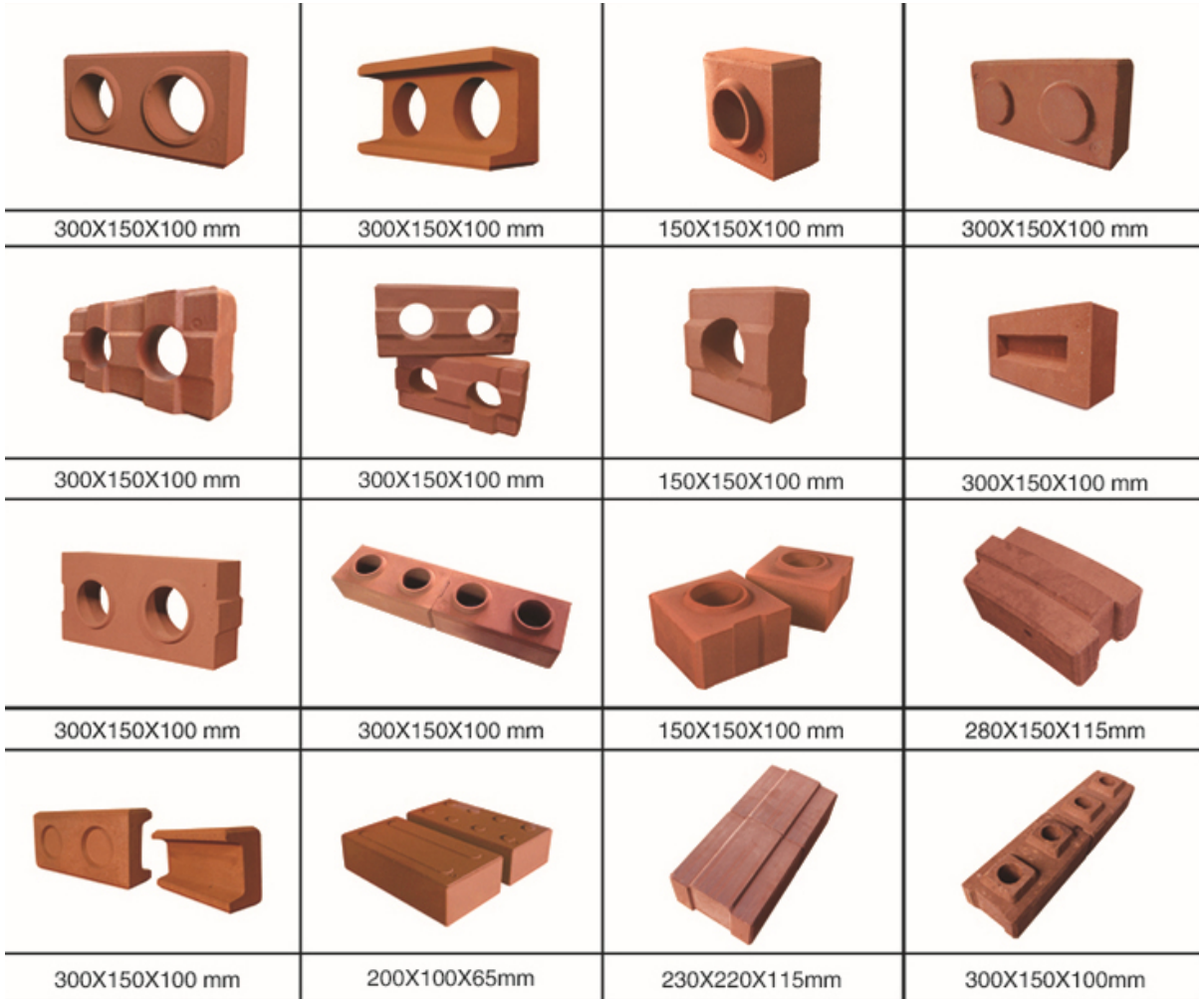
Land composition

Source: UNEP



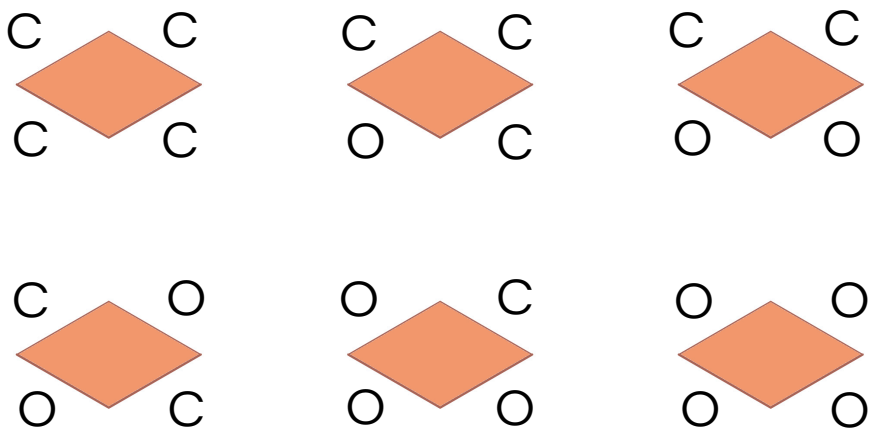
- Composition rammed earth block: gravel, sand, silt, clay
- A lot of available material in Afghanistan

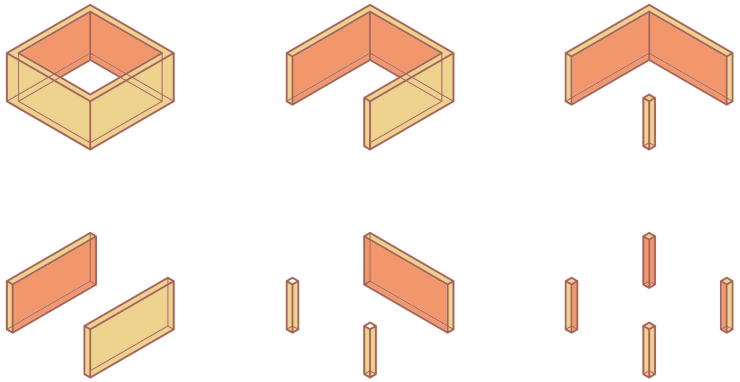
Earthy blocks

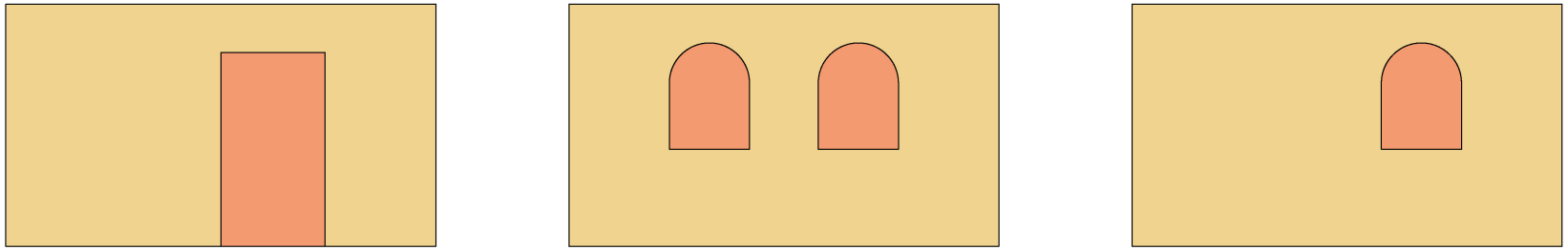


- Compressed earthy blocks
- Compression machine can be transported and easily used
- Different shapes possible

Modular design







- Modules depending on openness
- Grid 4 x 4 m

Gamification

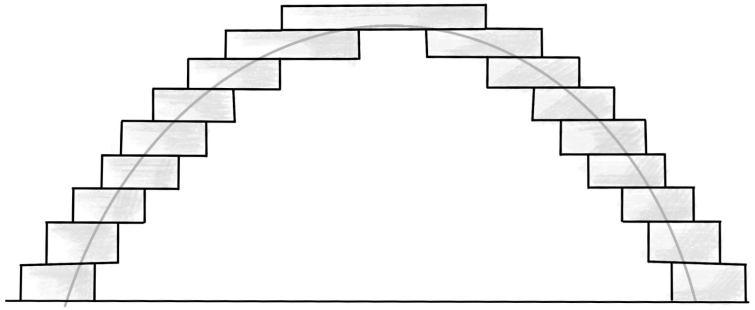
- Example – Lego blocks
- Different outcomes from the same given set of blocks

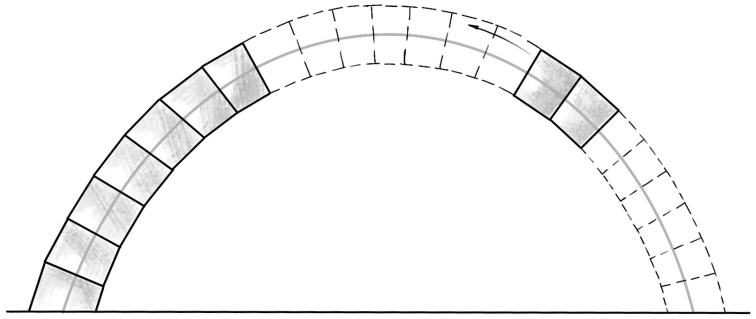
Client

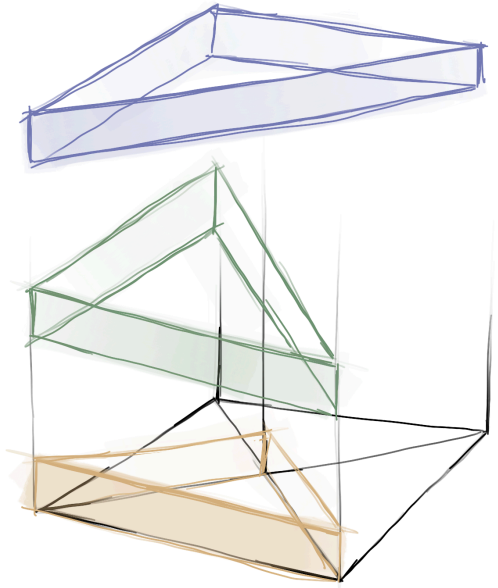
- UNHCR – currently providing shelters

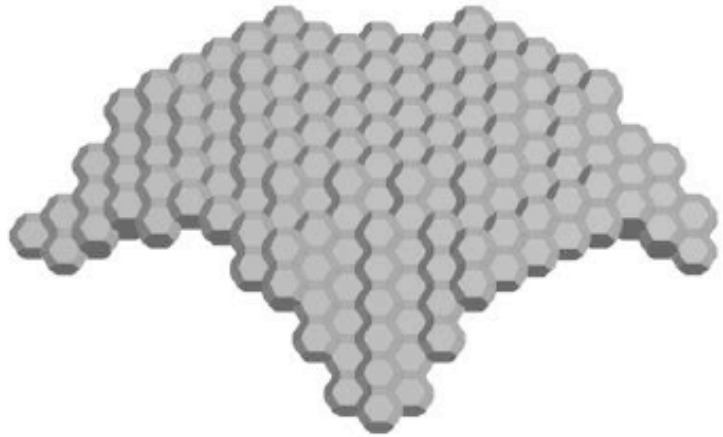
- Non-governmental organizations
- International Committee of Red Cross (ICRC)
- International Federation of Red Cross (IFRC)
- Other UN international organizations
- The host community

2.5D VS 3D









Left:

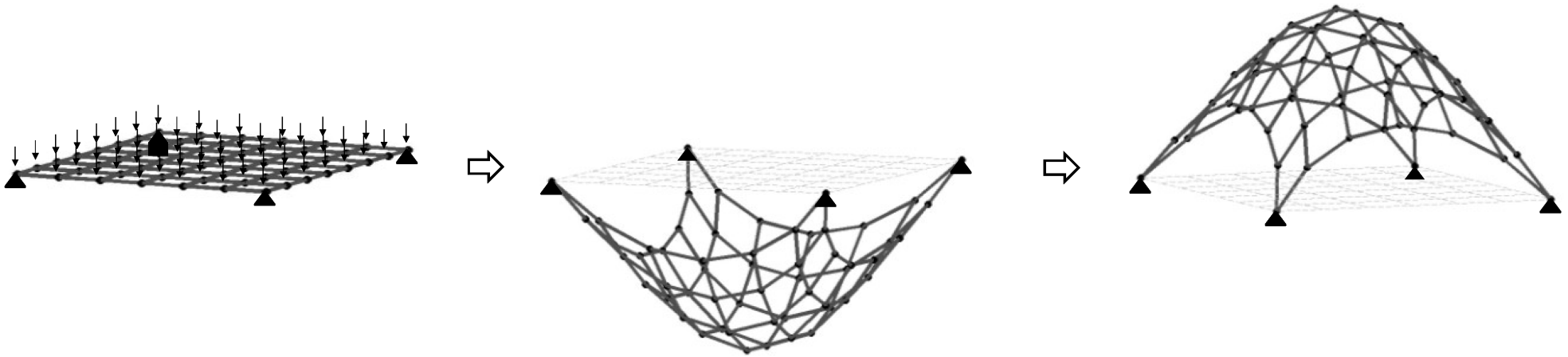
- 2.5D (LEGO) approach
- 2D tessellation, extruding the blocks

Right:

- 3D (gothic) approach
- 3D space tessellation with polyhedra

Dynamic relaxation

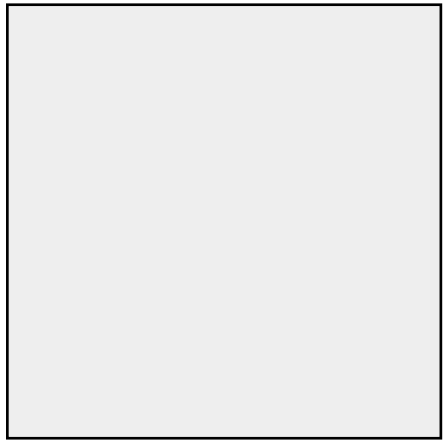
Source: Dialectic Form Finding of Passive and Adaptive Shading Enclosures



- Adding the acting loads (self weight) and let the form “relax” to find a shape in which it will reach equilibrium
- Equations of motion with fictions masses and damping

Shelter Standard

Source: UNHCR emergency standard, UNHCR shelter catalogue



Single shelter "module"

- Min 4.5 m^2 to 5.5 m^2 living space per person
- Min 2 m at the highest point

- Climate allows for kitchen and dining facilities to be positioned outside for use during the warm months

1. Define the dimensiality of the shelter projection on the 2D plane (plan)