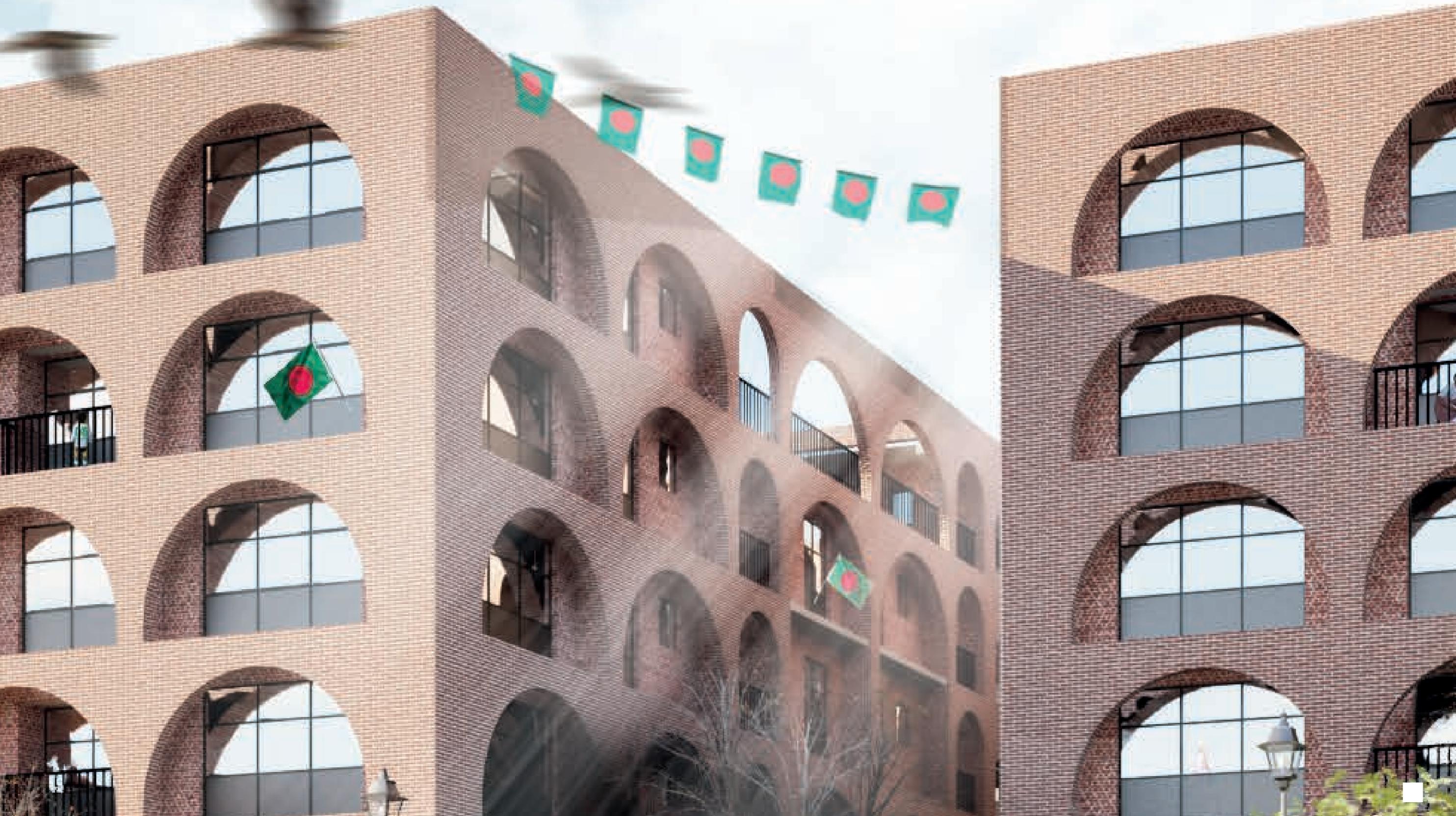


Climate-Resilient and Affordable Housing for Sylhet's Slums

Global Housing
Youri Doorn
5307988



01

01 Problem & Research

- Problem statement
- Research question
- Research
- Design aim

01 Problem Statement



Vulnerable to flooding



Low-quality in low-income housing



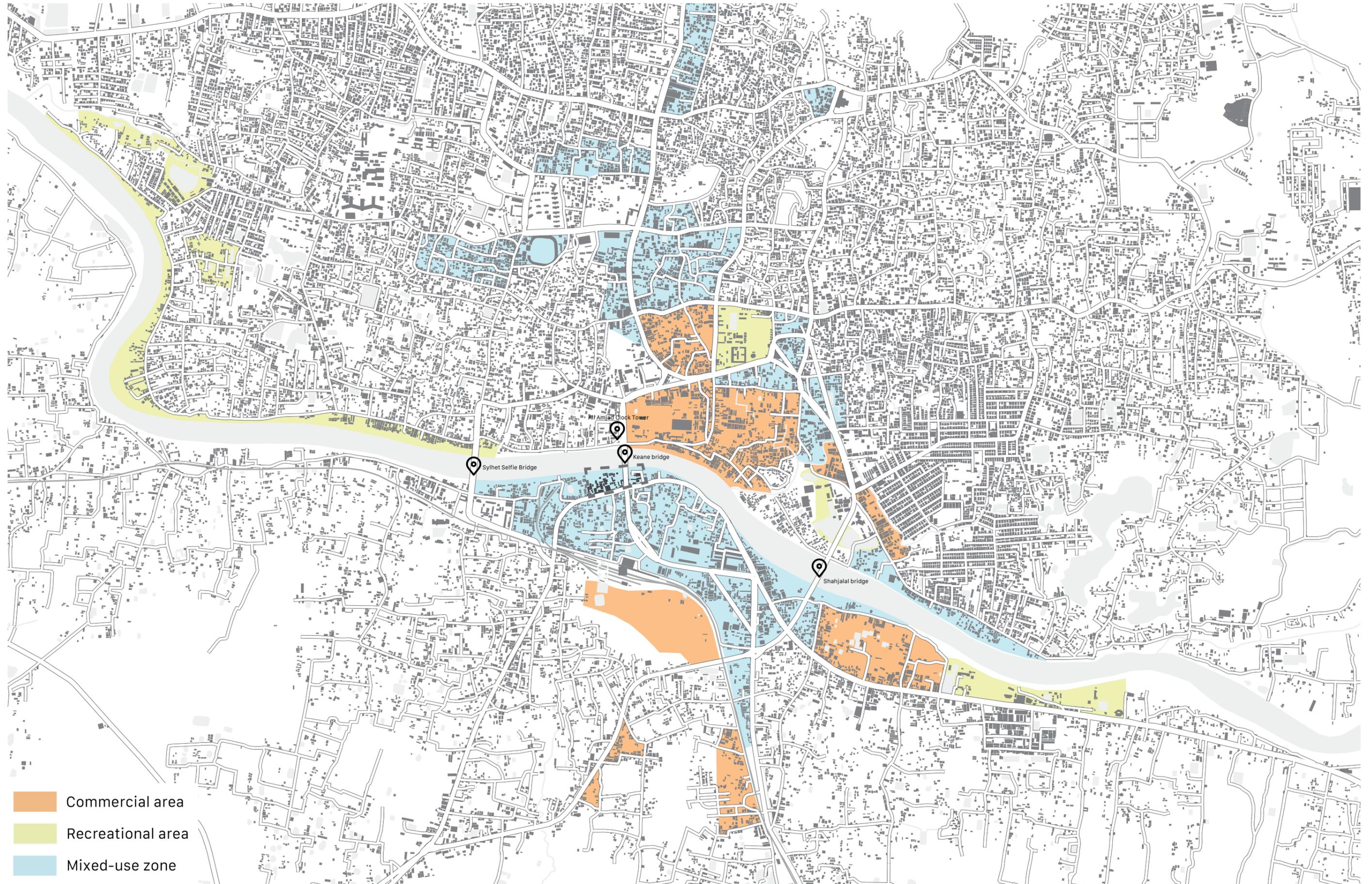
Unsuccessful slum relocation



Lack of flexible and affordable housing

How can *flexible* housing models be designed, ~~using~~
~~*community engagement*~~, enhance *climate resilience*
and *affordability* for slum residents in Sylhet,
Bangladesh, without requiring *relocation*?

01 Situation Sylhet



01 Situation Site

- Hindu Community
- Muslim Community
- Mosque
- Fish market
- Madrasah (Muslim school)
- Shops / Bazar
- Sawmill & Wood workshops



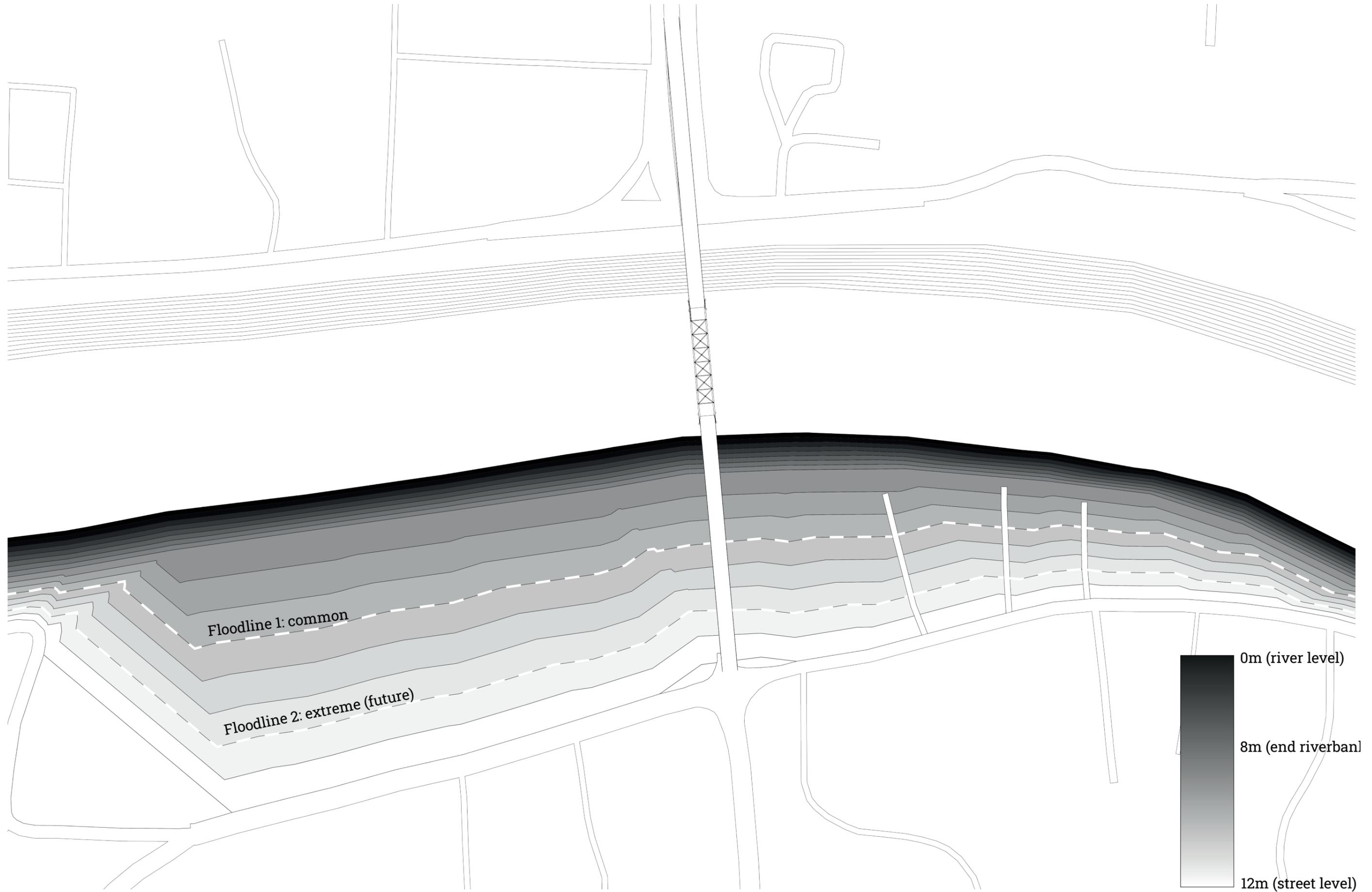




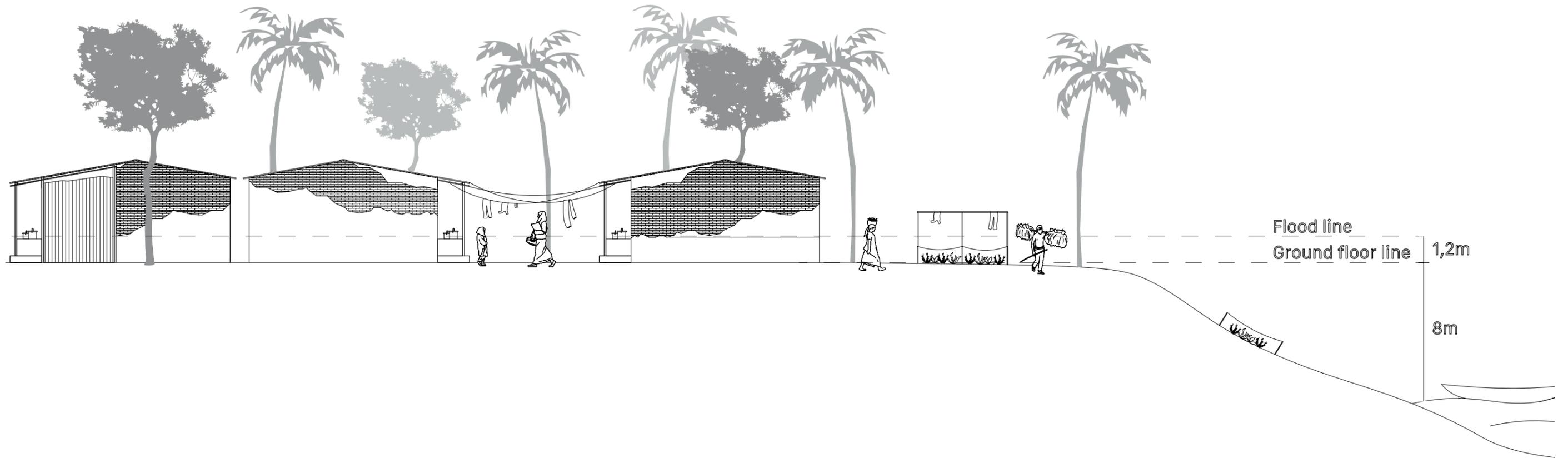




01 Flood map



01 Section Slope of Riverbank & Waterlevel





01 Sweepers Colony

Sanitation work

- Street sweeping
- Public toilet maintenance
- Manual scavenging

Women often face disproportionate hardships

- Gender based discrimination
- Restricted access to resources and opportunities

Income constraints

- Limited earnings is spent on necessities like education and healthcare, leaving little for housing improvements.

Muslim community

- 40 families
- 240 people

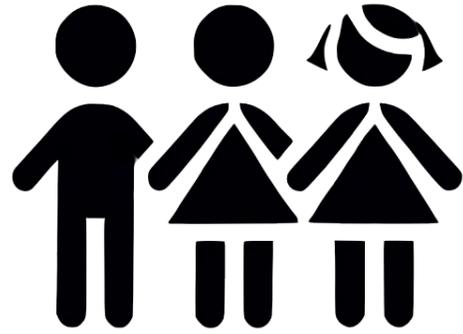
Hindu community

- 20 families
- 120 people

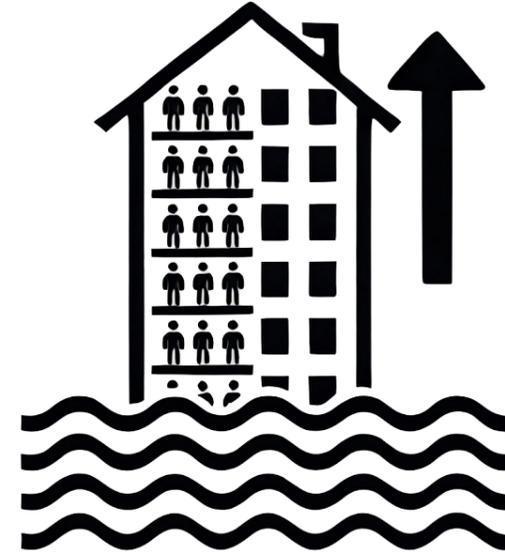




01 Sweepers colony - Desires



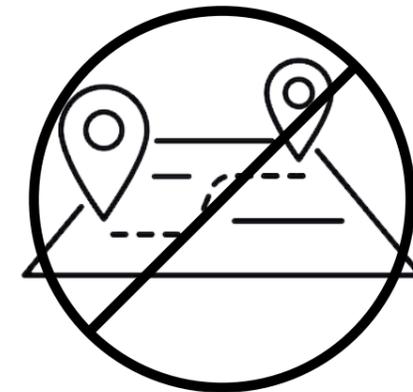
"Children are the most important. They need to be happy"



Live on higher ground

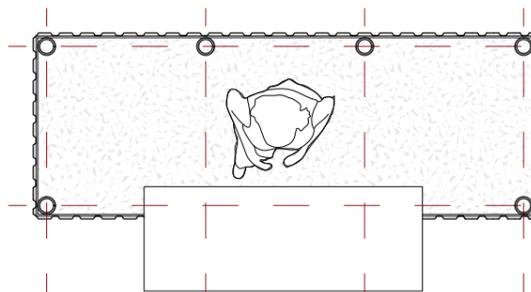
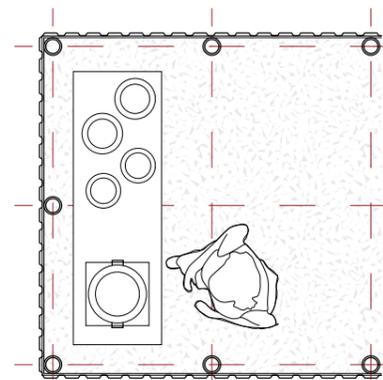
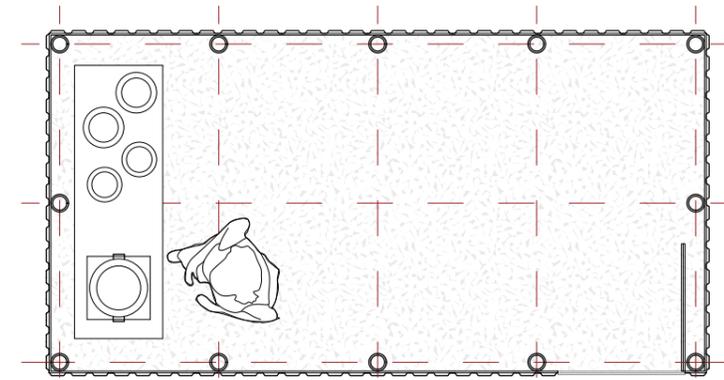
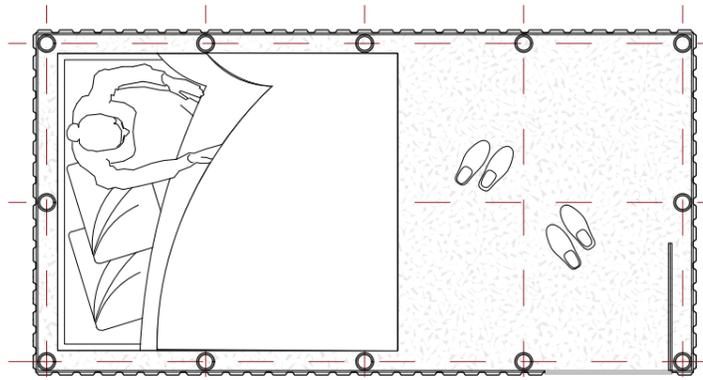
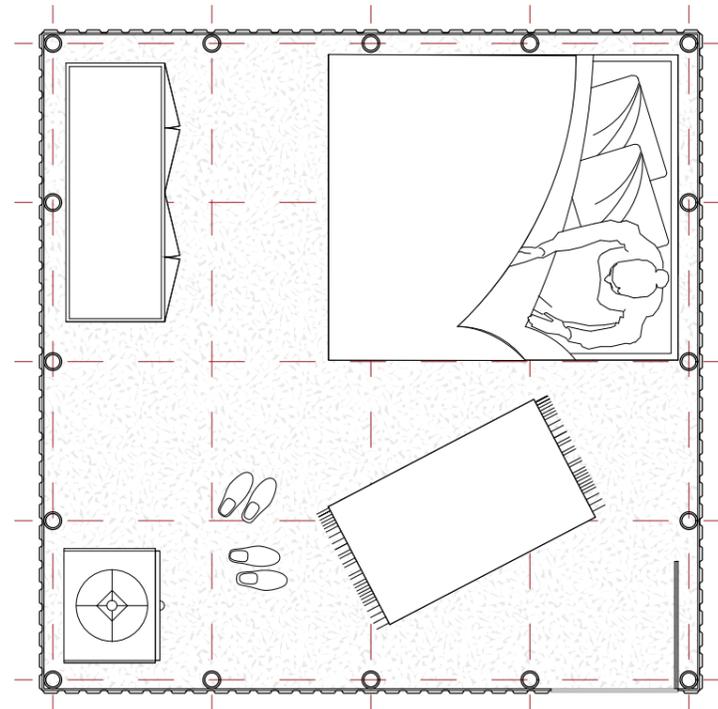


Community space

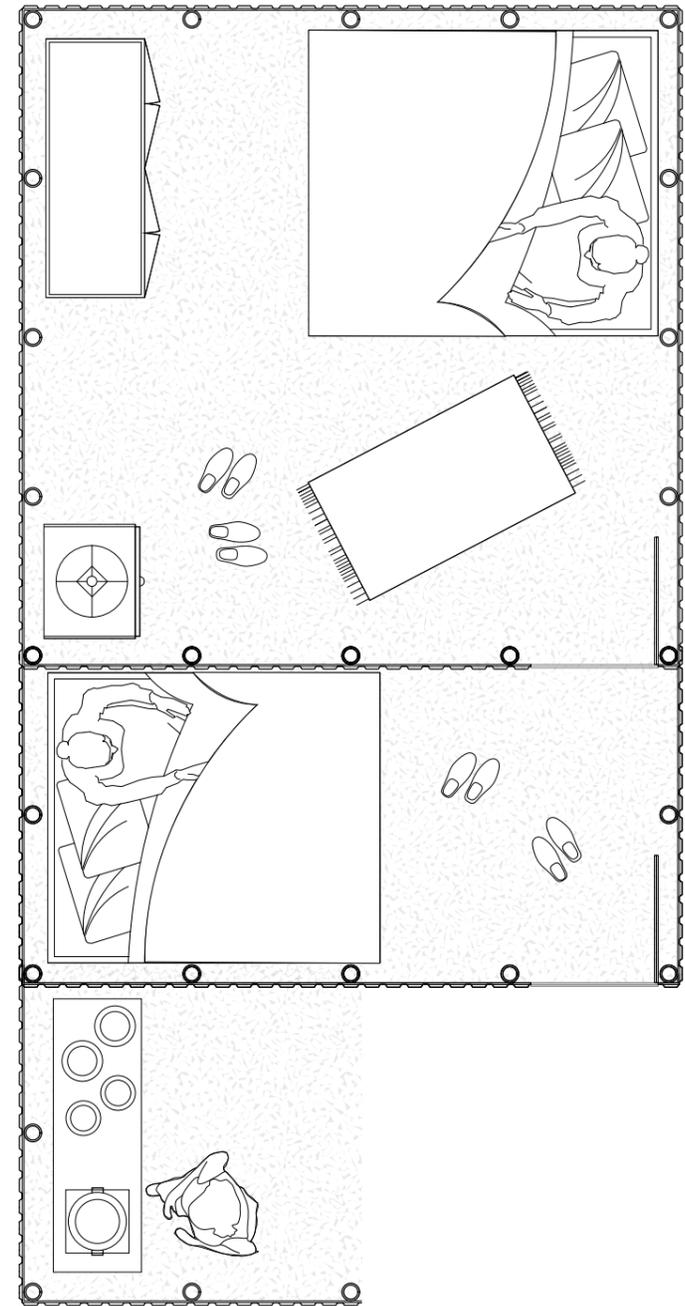
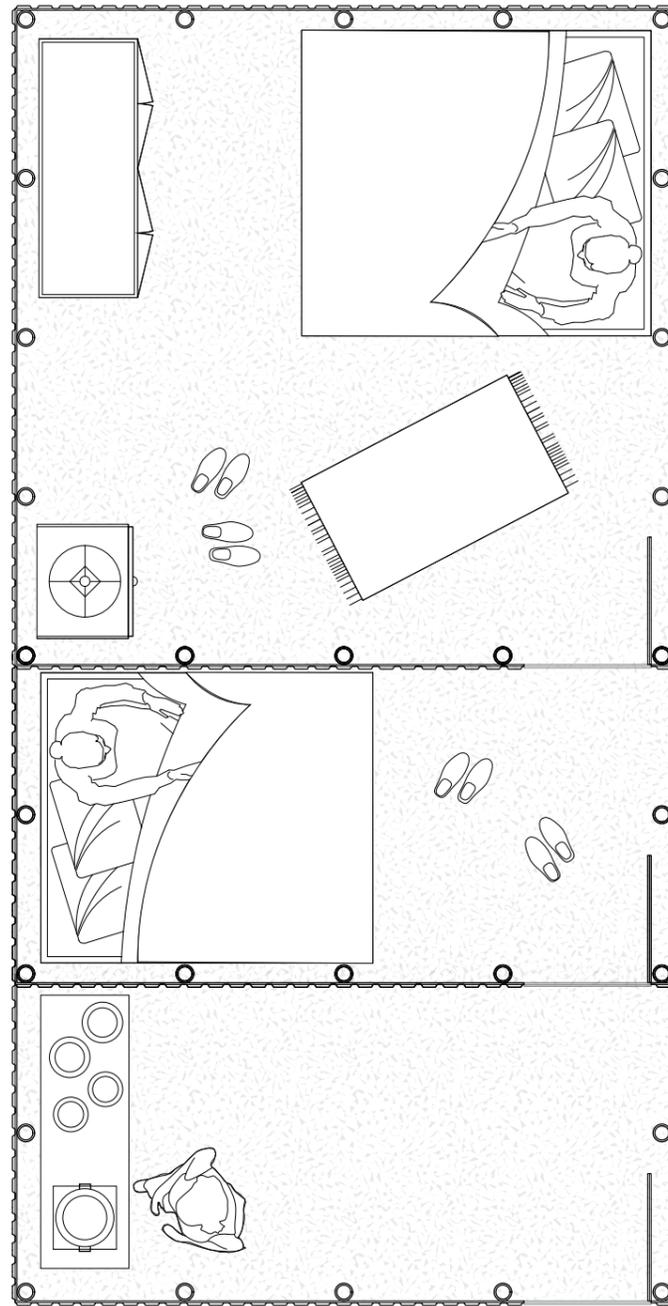
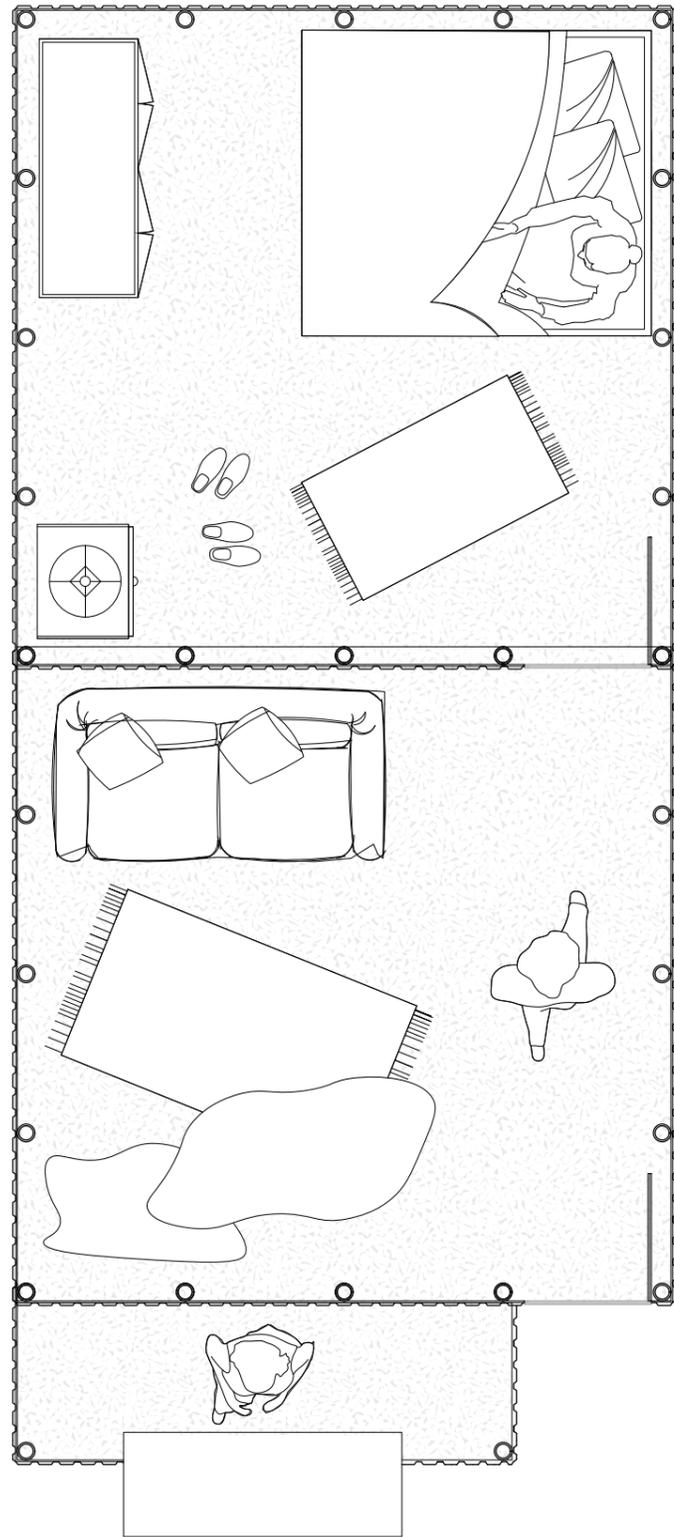


No relocation

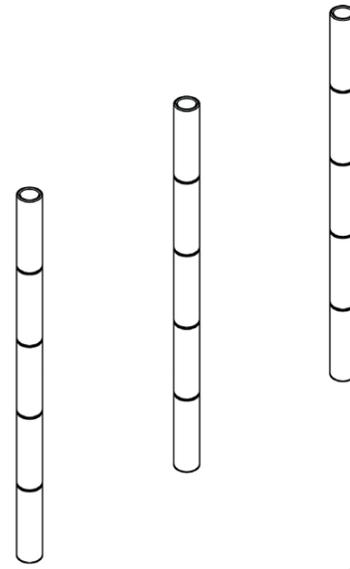
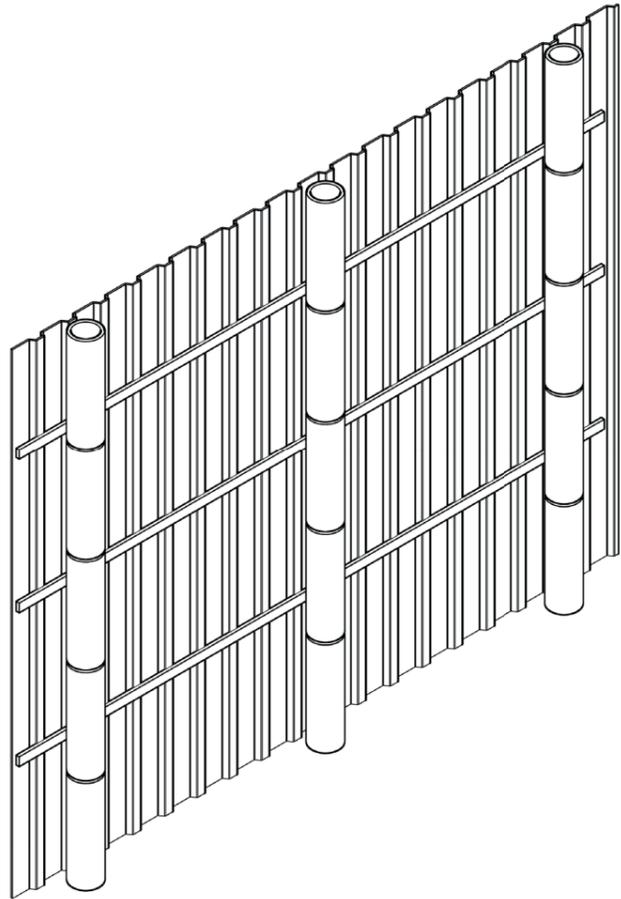
01 Floorplans Muslim Community



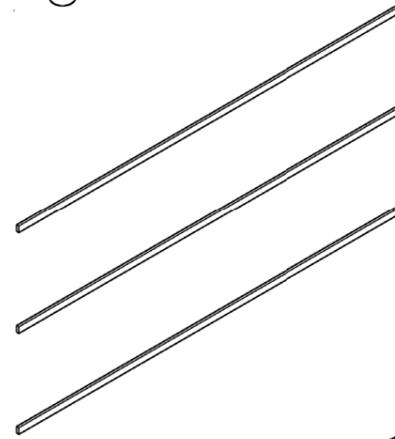
01 Floorplans Configuration Muslim Community



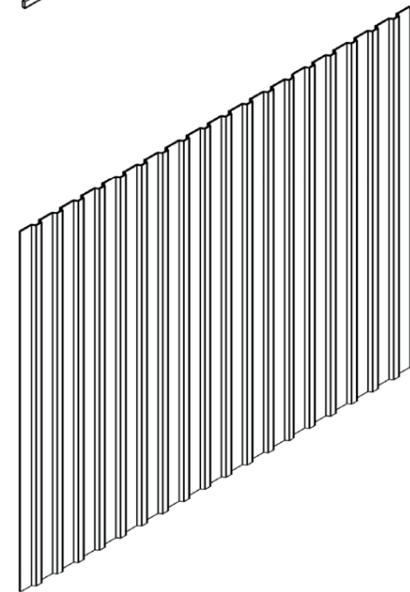
01 Materials Muslim Houses



————— Bamboo structure

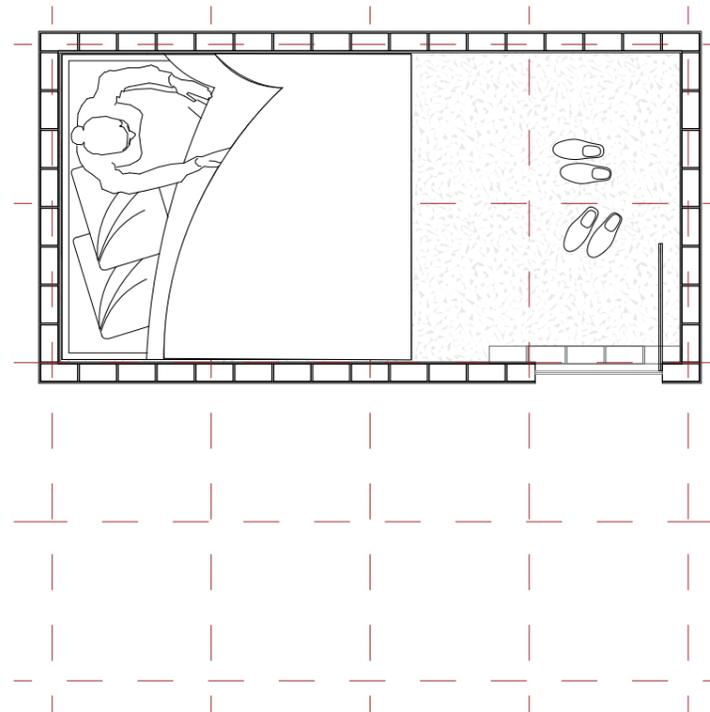
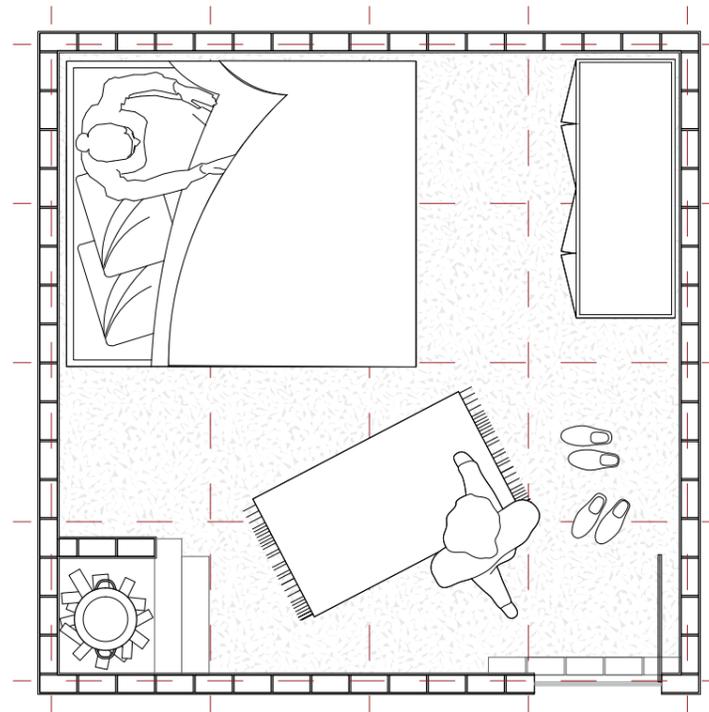


————— Wooden slats

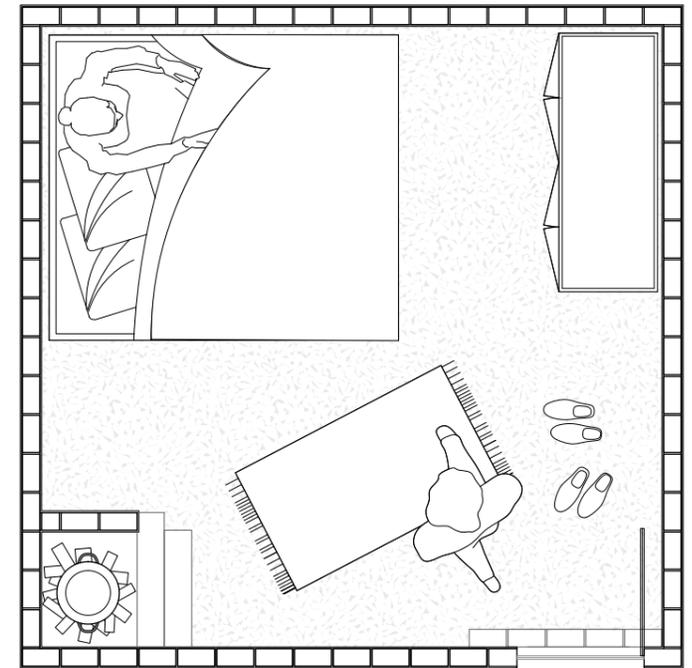
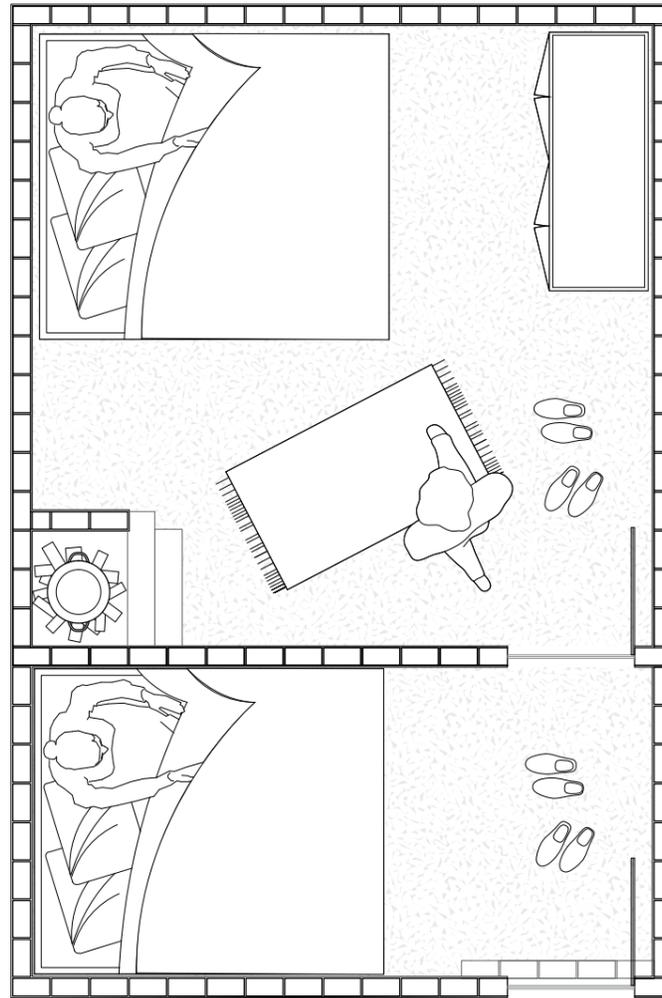
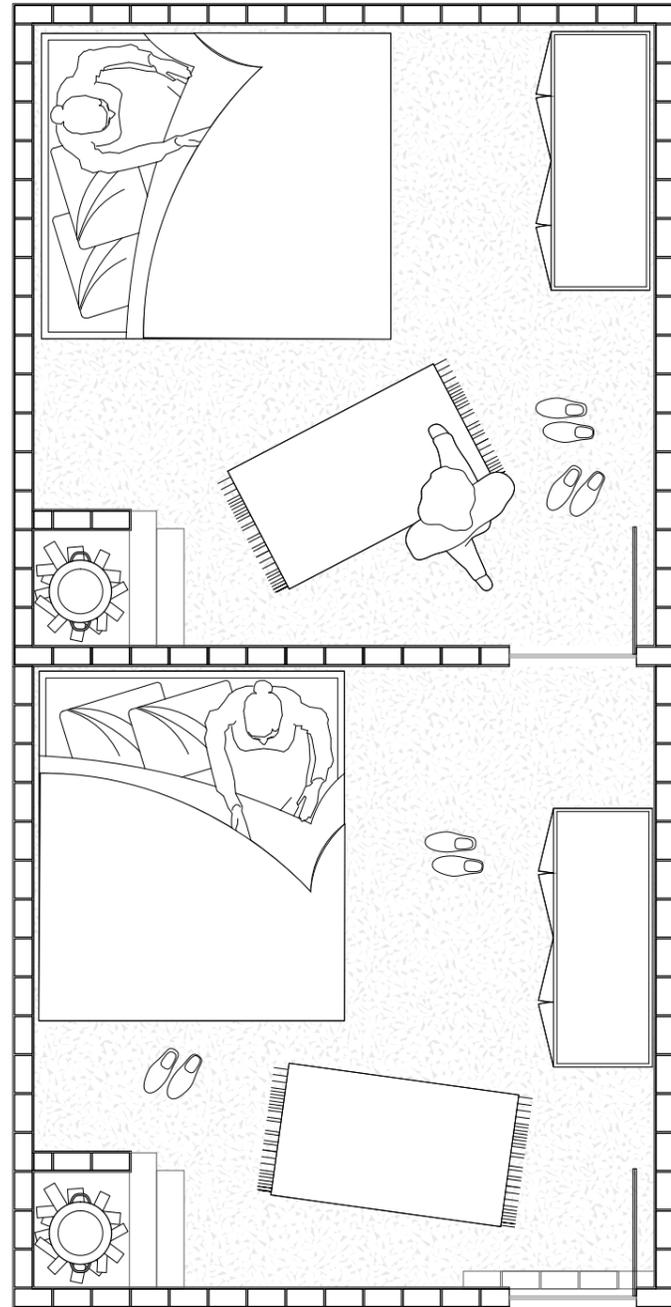


————— Corrugated sheets

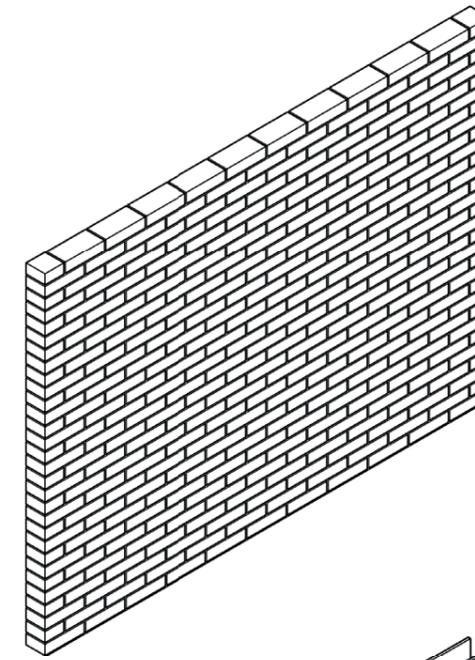
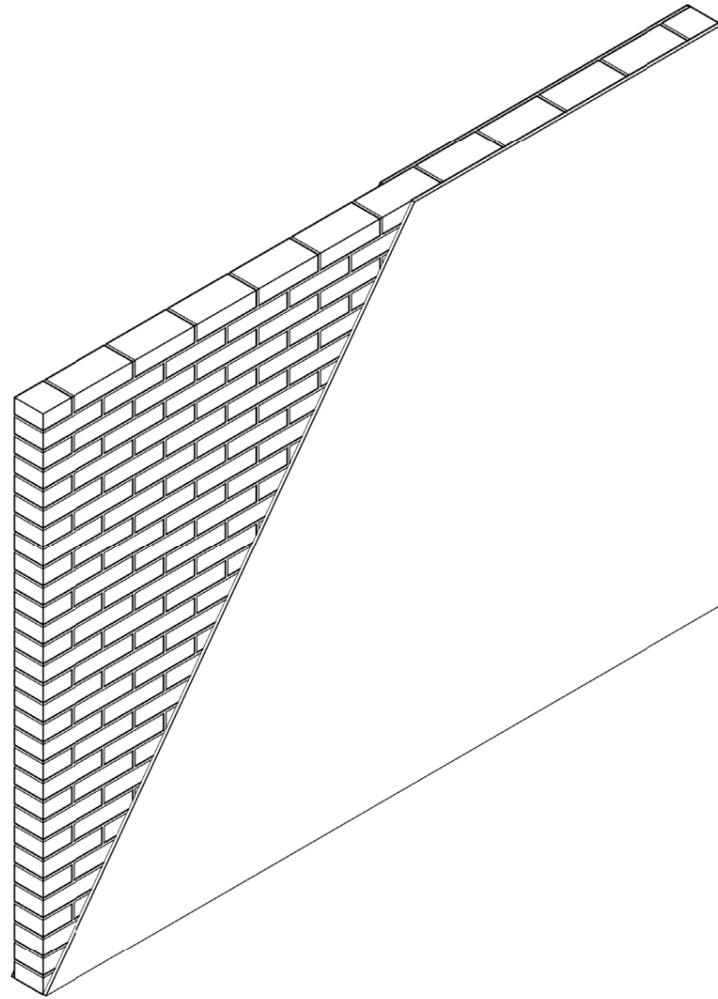
01 Floorplan Hindu Houses



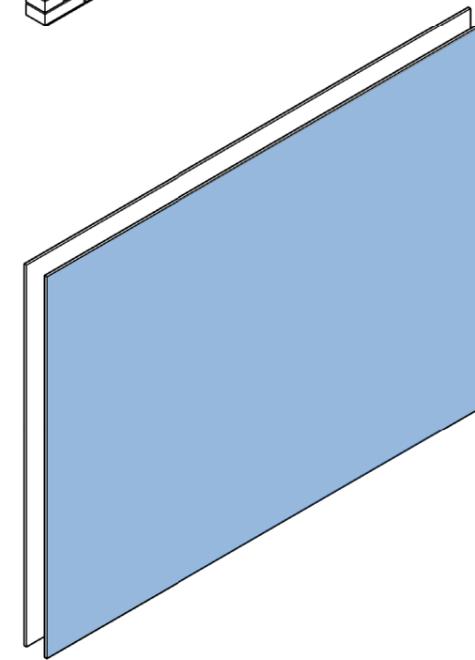
01 Floorplan Configurations Hindu Community



01 Materials Muslim Houses



Brick structure



Concrete plaster
(Painted in colour of choice)

Flexibility in design

- Adapting to growing family needs
- Maximizing limited resources
- Responding to economic pressures
- Flexibility in functions

Respect for the Sweepers Colony

- No relocation
- Affordability
- Maintain cultural and religious practices while respecting community dynamics
- Community space

Transitioning to climate resilience

- No necessity of evacuation and limited impact on residents during flooding
- Floodproof materials and construction

Activated Public Space for the city

- New commercial and recreational area
- Connecting to the Keane Bridge
- Opportunity to extend

02

02 Urban

- Concept masterplan
- Masterplan
- Functions
- Parking
- Circulation
- Section
- Elevation

02 Masterplan concept

-  Build area on raised ground
-  Green area, connects both sides of the bridge (public)
-  Pedestrian promenade (public)
-  Activated public space for the city. Directly accessible from the bridge (public)





02 Masterplan - Functions

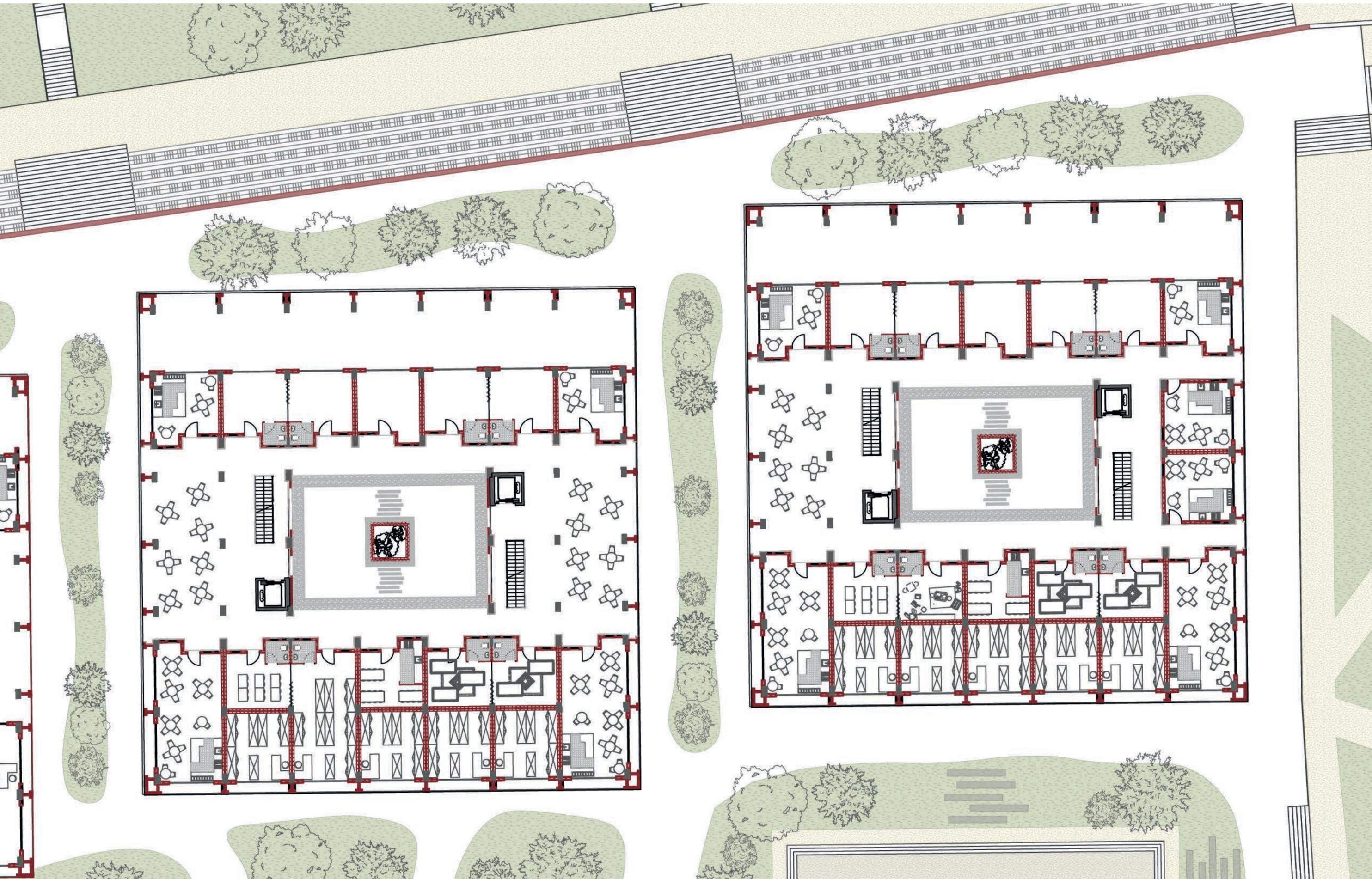
- | | | |
|------|---|---|
| 1-6 | Residential cluster: mid- and high-income | 7-9 floors (70 - 115,9 m2) |
| 7-11 | Residential cluster: low-income | 6 floors (34,7 - 37,8 m2) |
| 12 | Community centre | 2 floors, commercial and social activities |
| 13 | Gravel court | Space dedicated for playing cricket or other sports |
| 14 | Temple | Dedicated for the Hindu community |
| 15 | Central park | Connecting both sides of the bridge, social gathering |



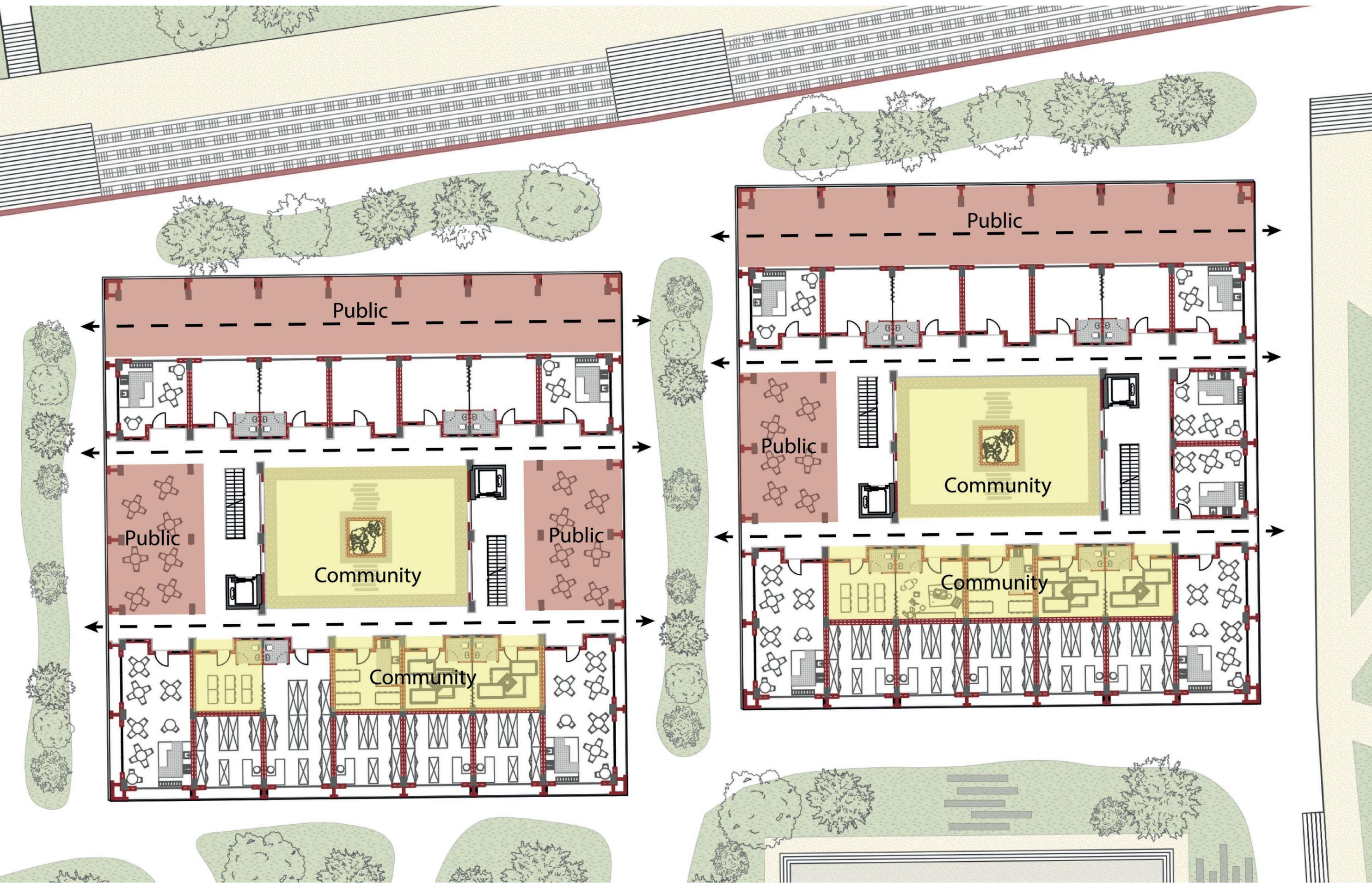
02 Masterplan ground floor



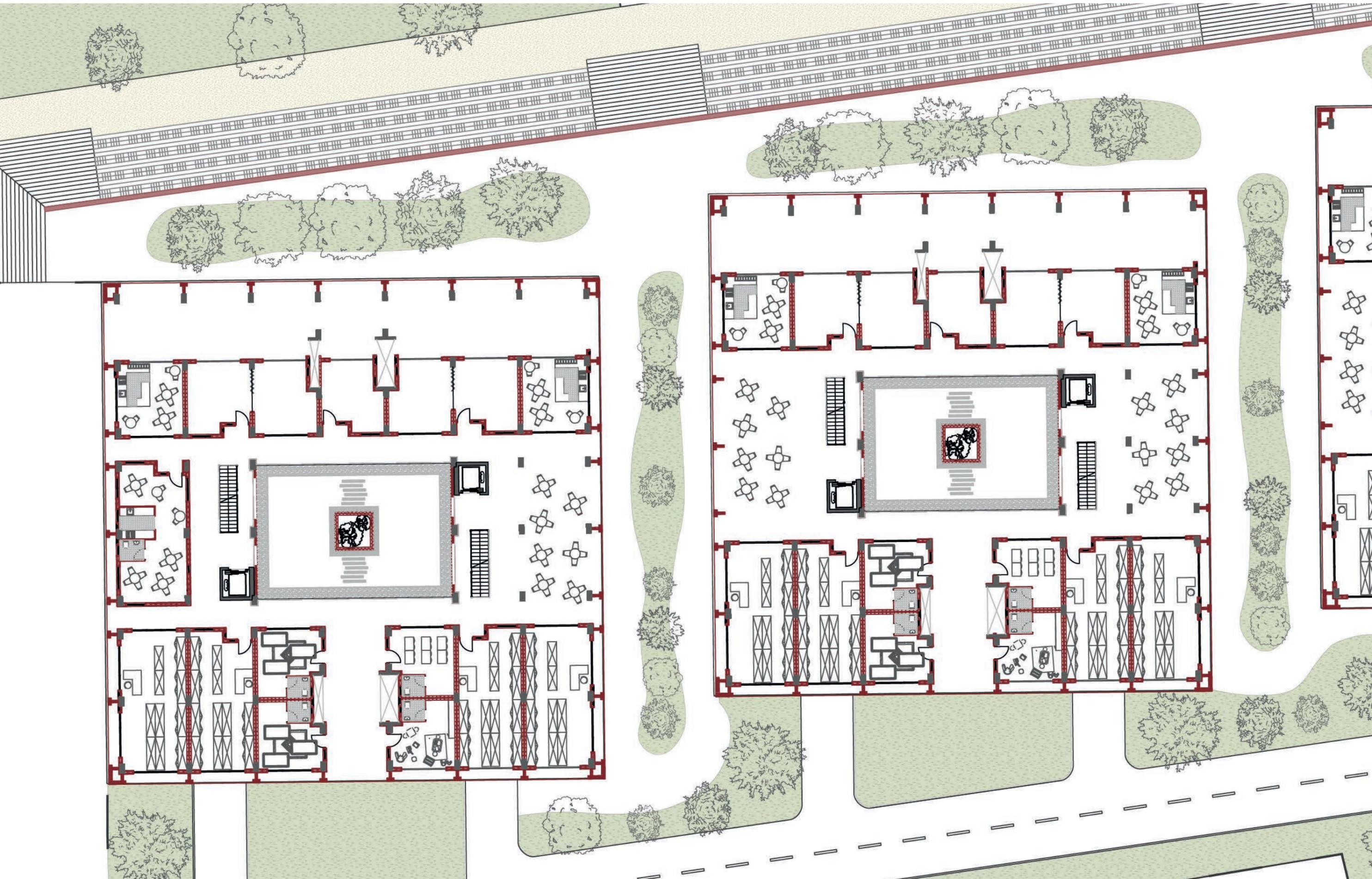
02 Masterplan ground floor - Zoom in



02 Masterplan ground floor - Functions



02 Masterplan ground floor - Zoom in



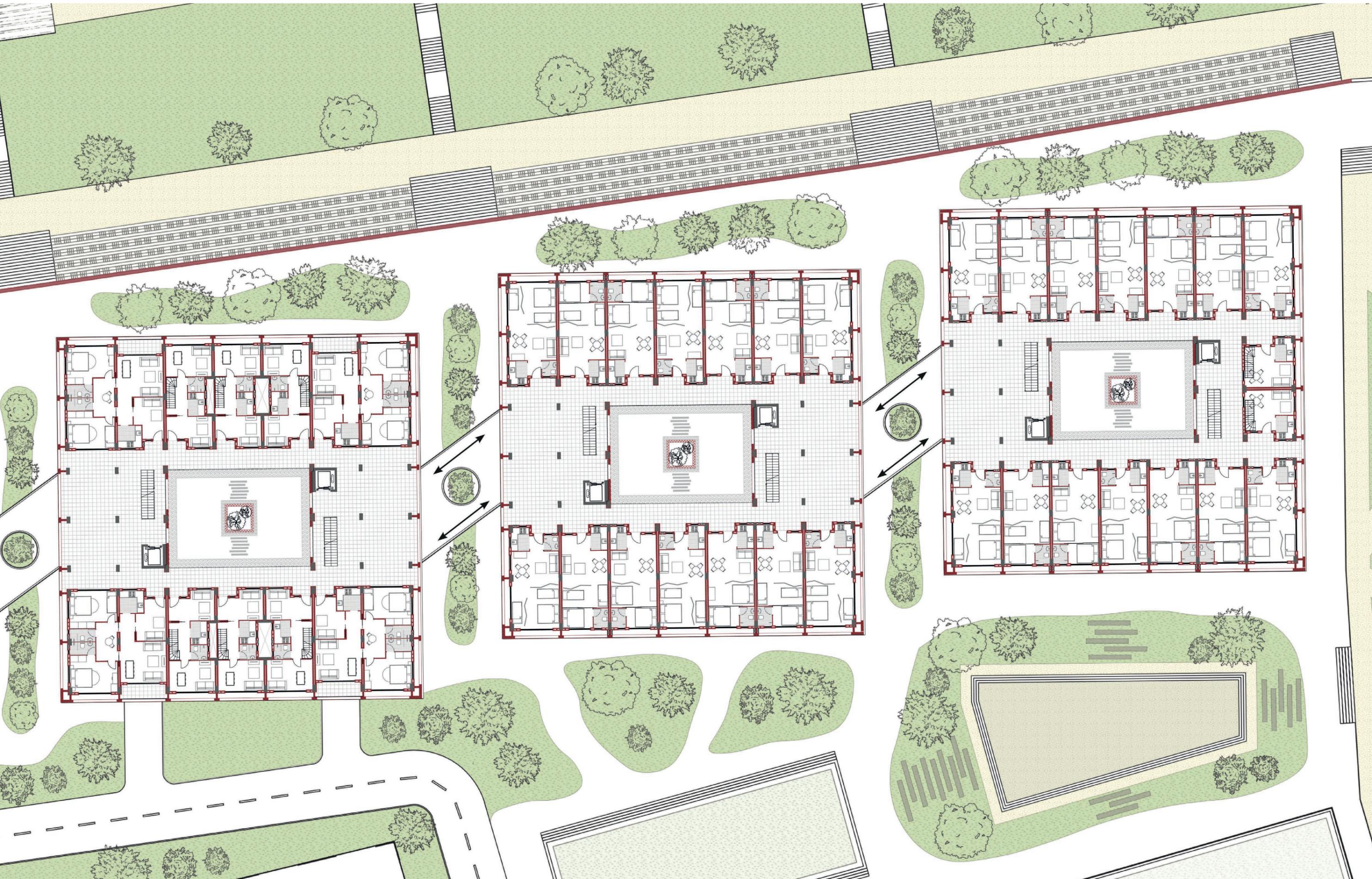
02 Masterplan ground floor - Functions



02 Circulation



02 First floor connections

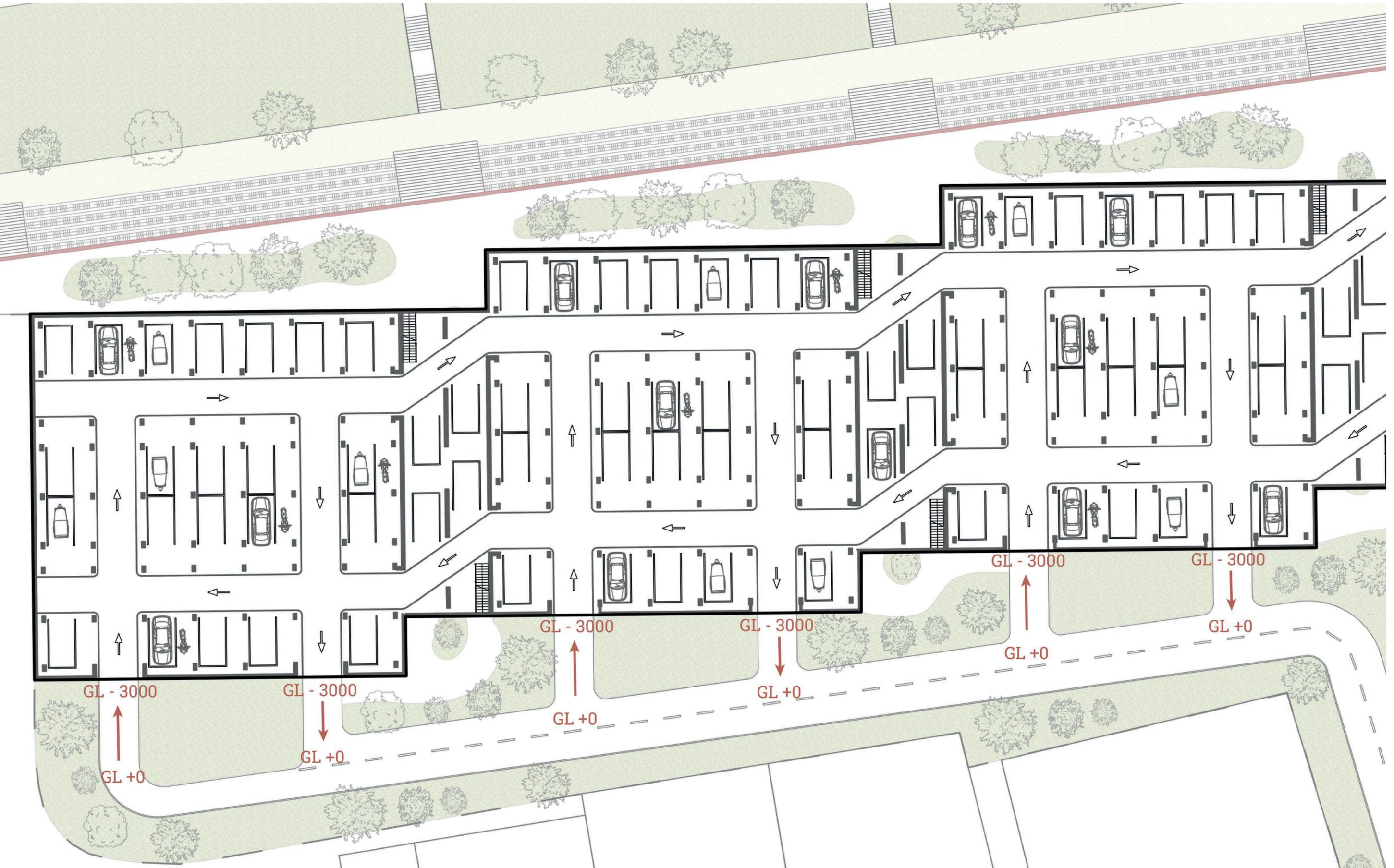




02 Parking - Basement



02 Parking - Ground levels & Layout



02 Masterplan - Ground levels



02 Masterplan - Ground levels



Peace of mind at last' the Bangladeshi villagers digging their way out of the floods

02 Section through the site



02 Section through the site - High water & Ground level

Excavation:

Left side bridge parking: 9670 m²
Right side bridge parking: 3678 m²
Park: 2120 m²

Total: 15468 m²

Amount of soil needed: 15738 m²

Amount of soil shortage: **270 m²**

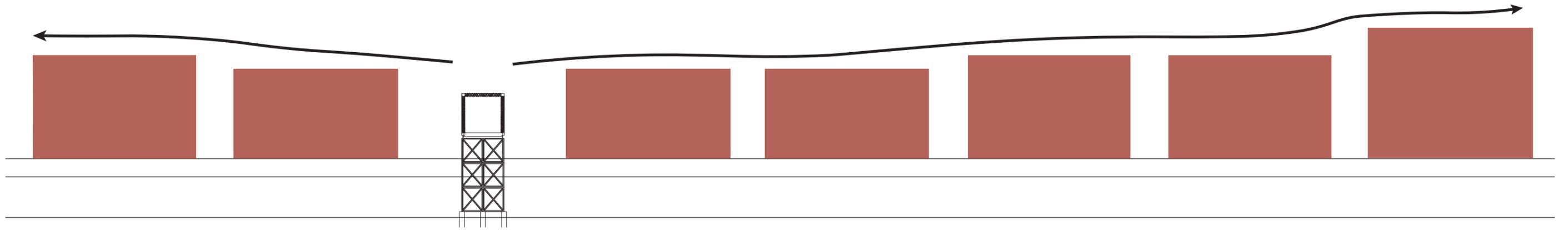
≈ 18 trucks full of soil



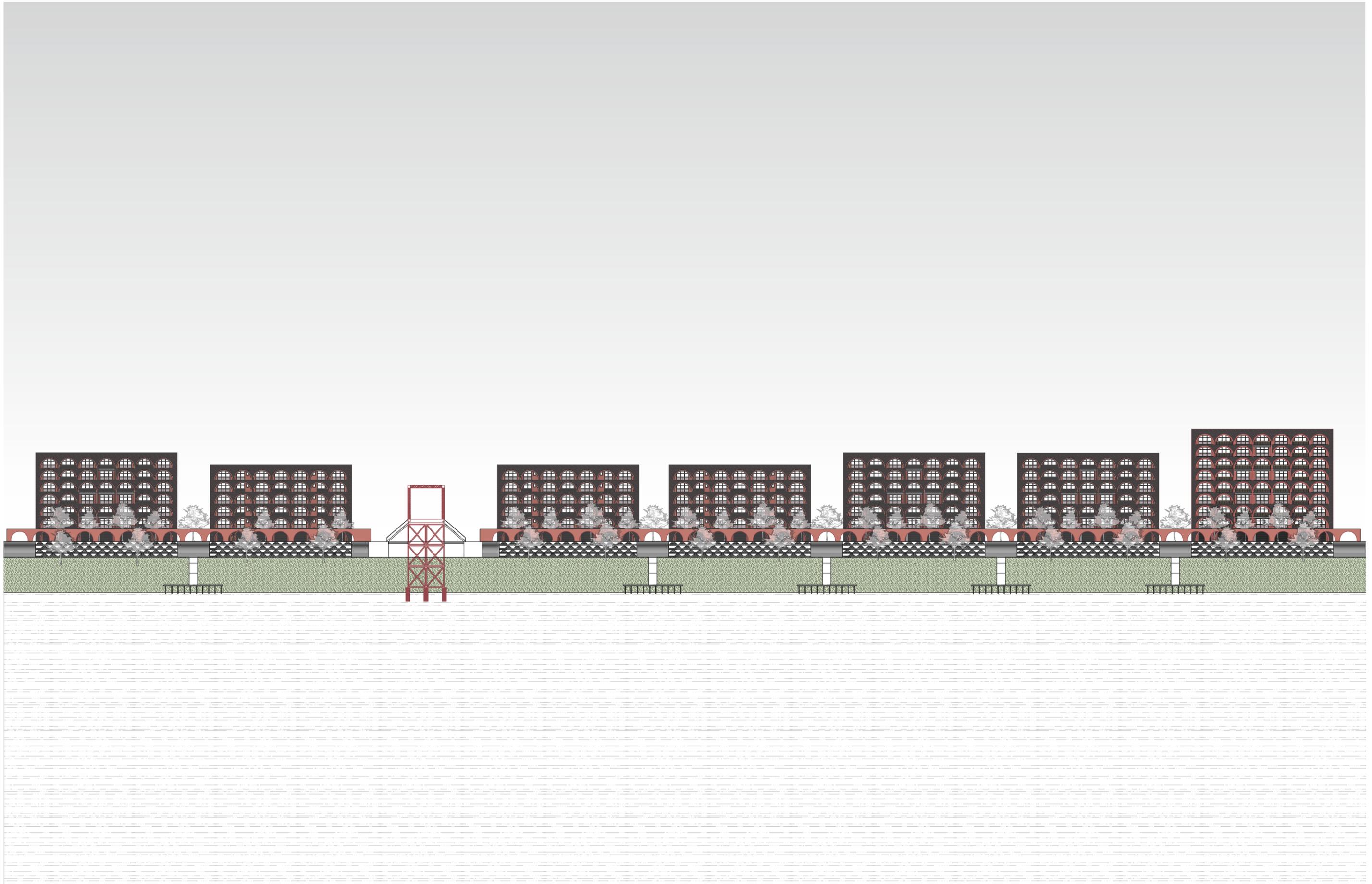




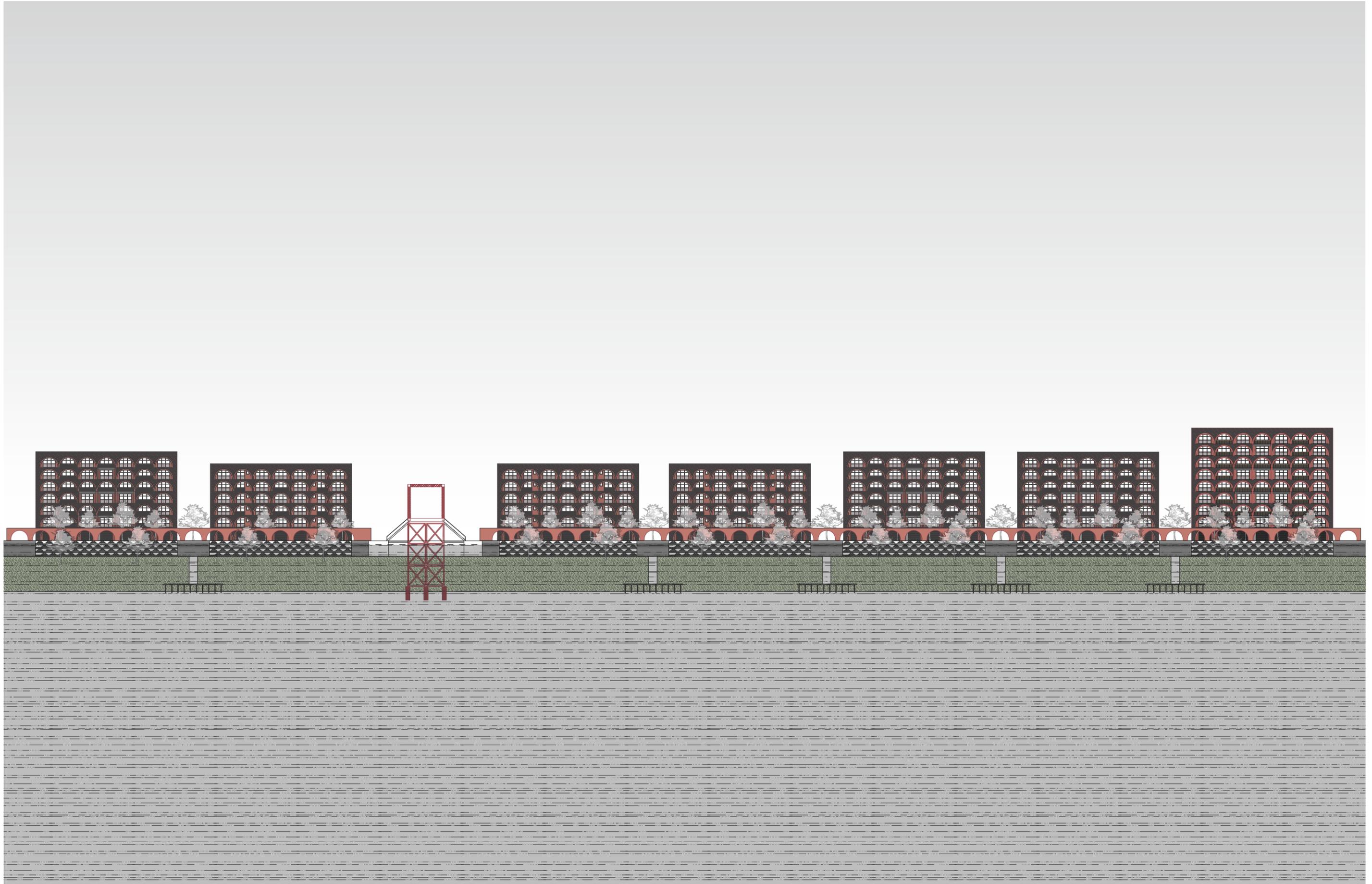
02 Concept Building Heights



02 Elevation river view (North)



02 Elevation river view (North) - High water level

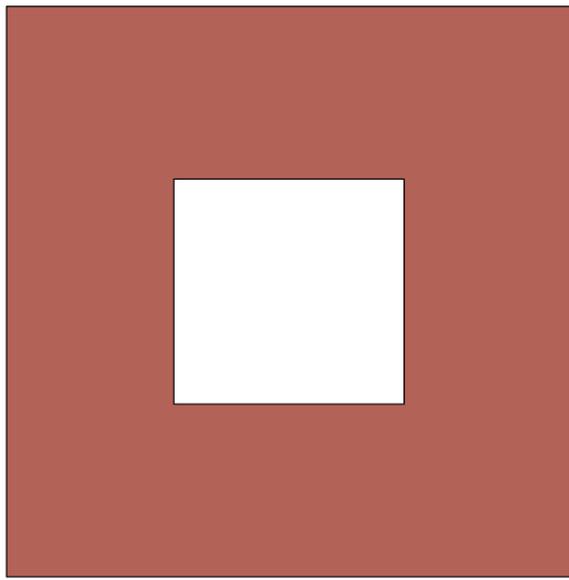


03

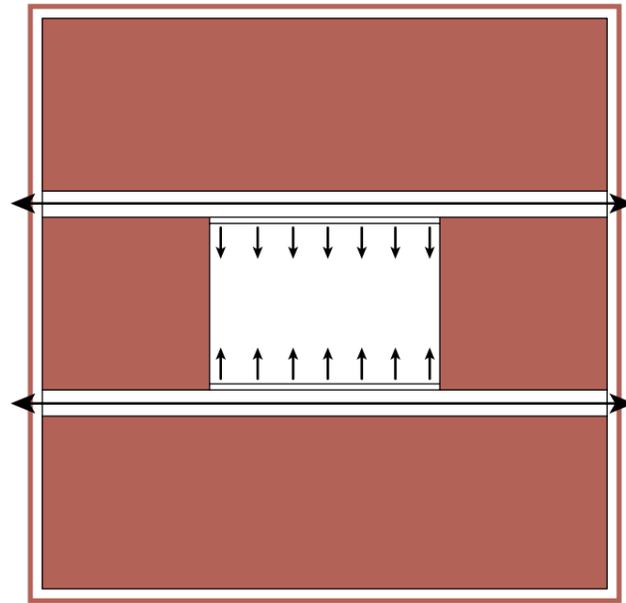
03 Designing Climate Resilient & Affordable Housing

- Concept Cluster
- Low-income housing
- Mid-income housing
- High-income housing
- Section
- Elevations

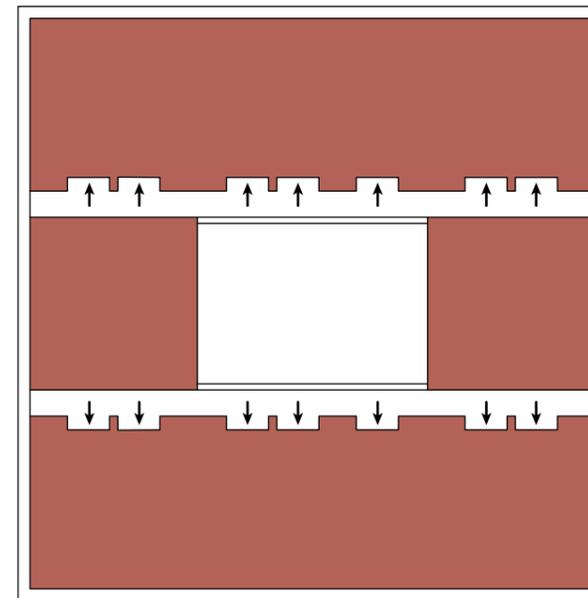
03 Concept Cluster



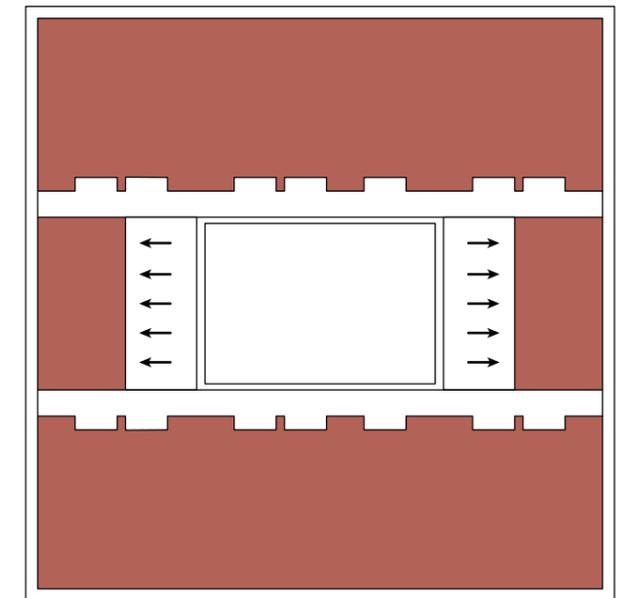
Building mass with a courtyard



Adding a gallery for circulation and ventilation and introducing second facade

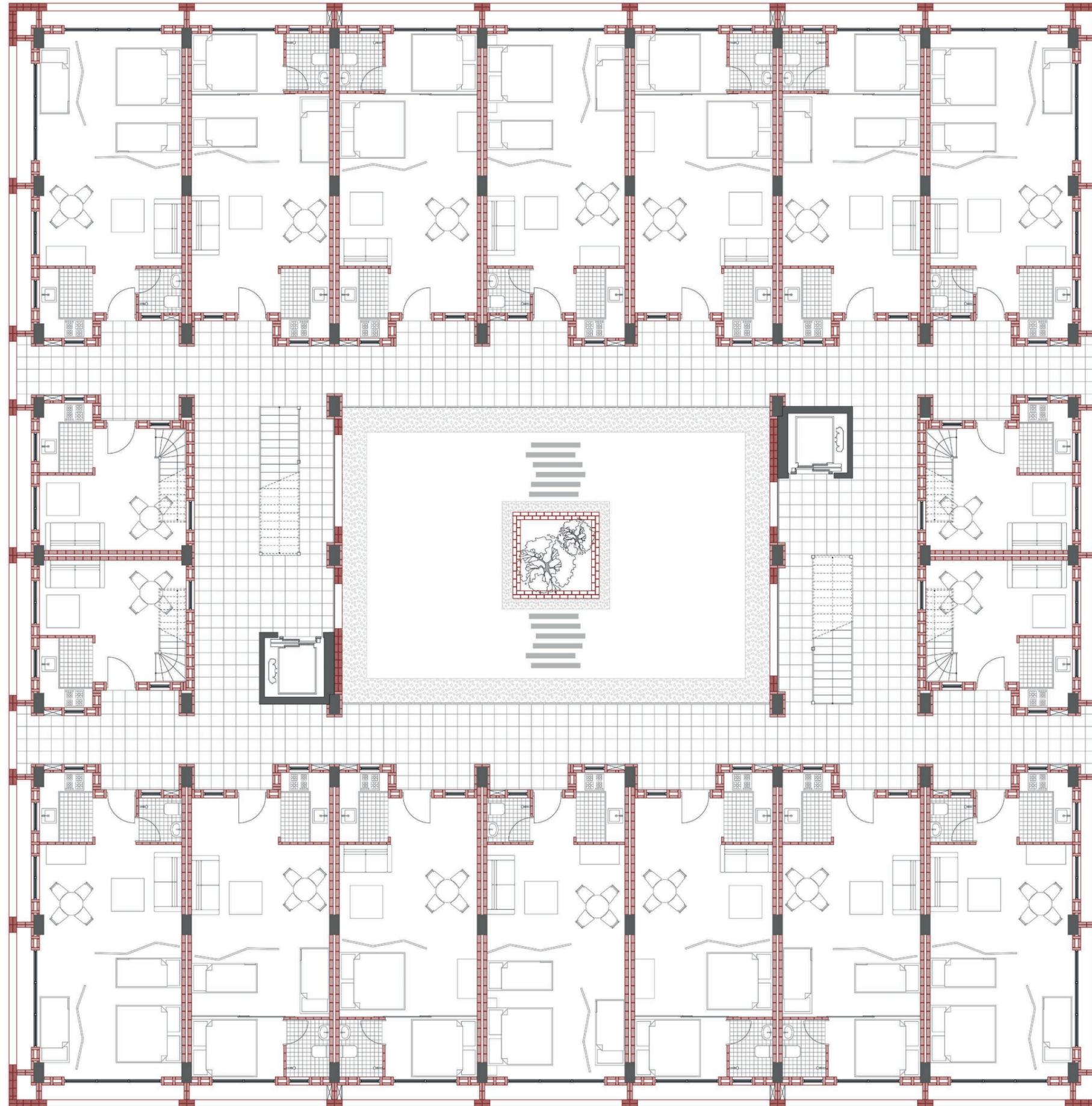


Create private front space per unit

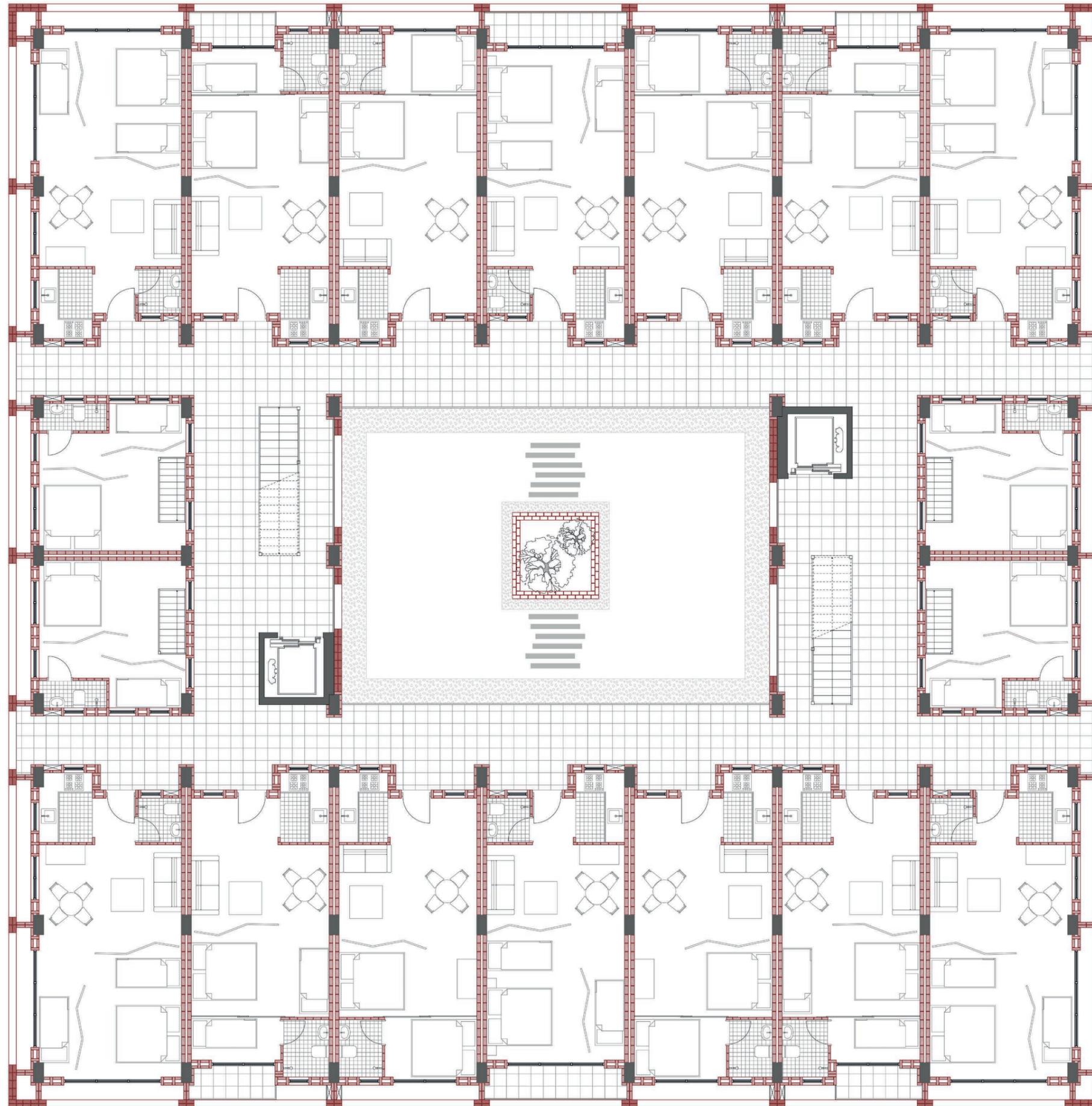


Create vertical circulation space

03 Low-income Housing Cluster - Type A

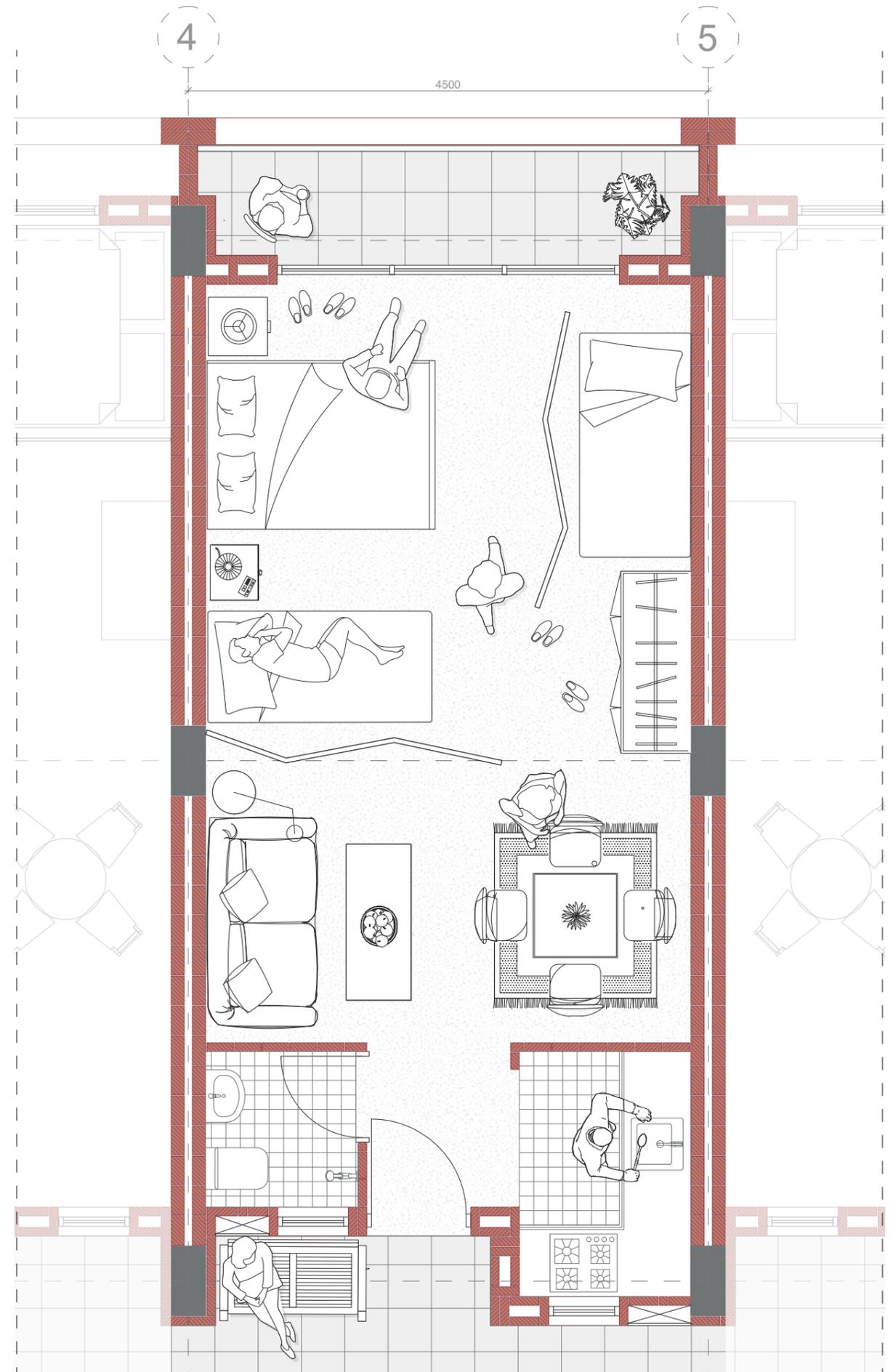
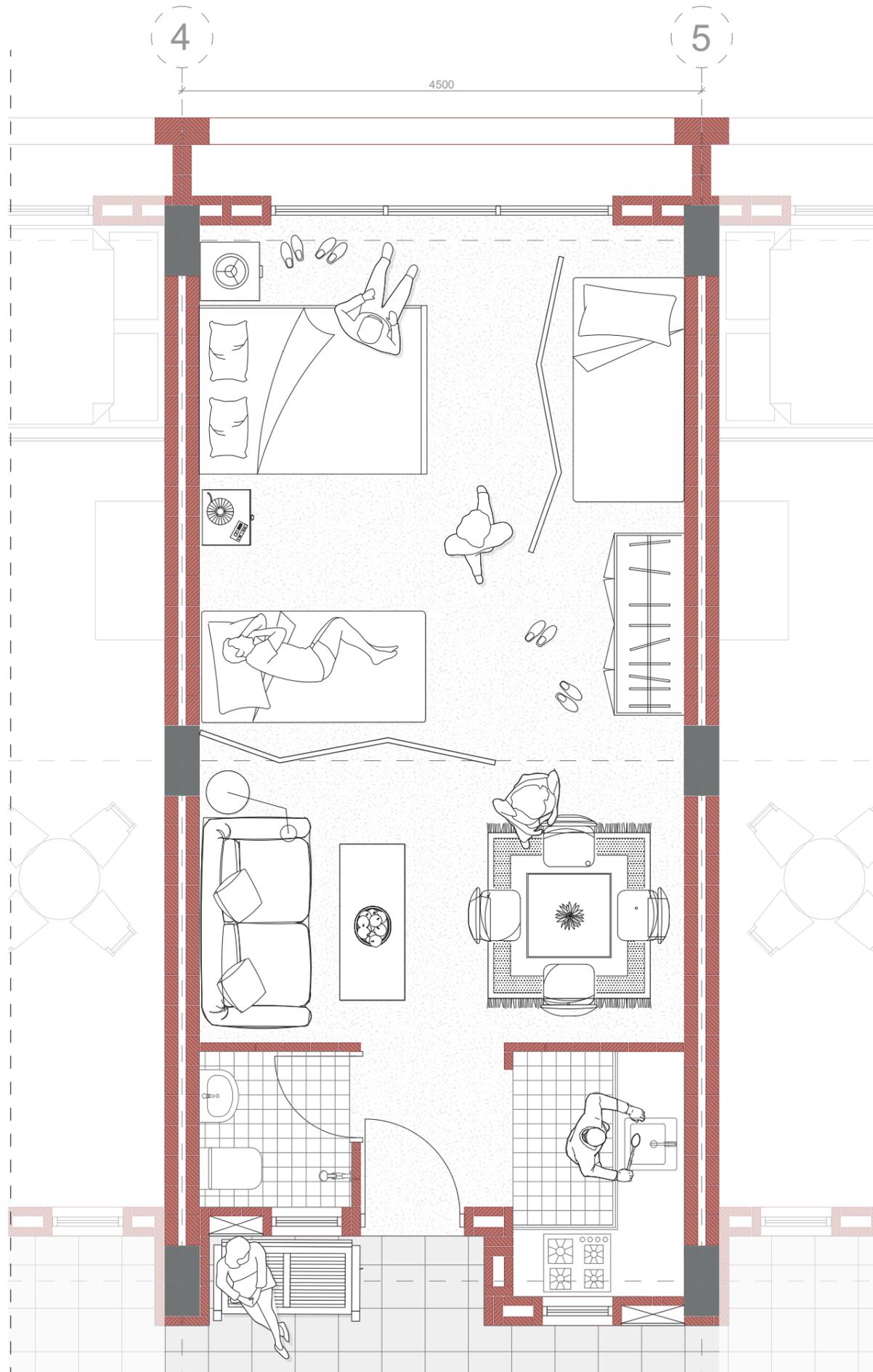


03 Low-income Housing Cluster - Type B

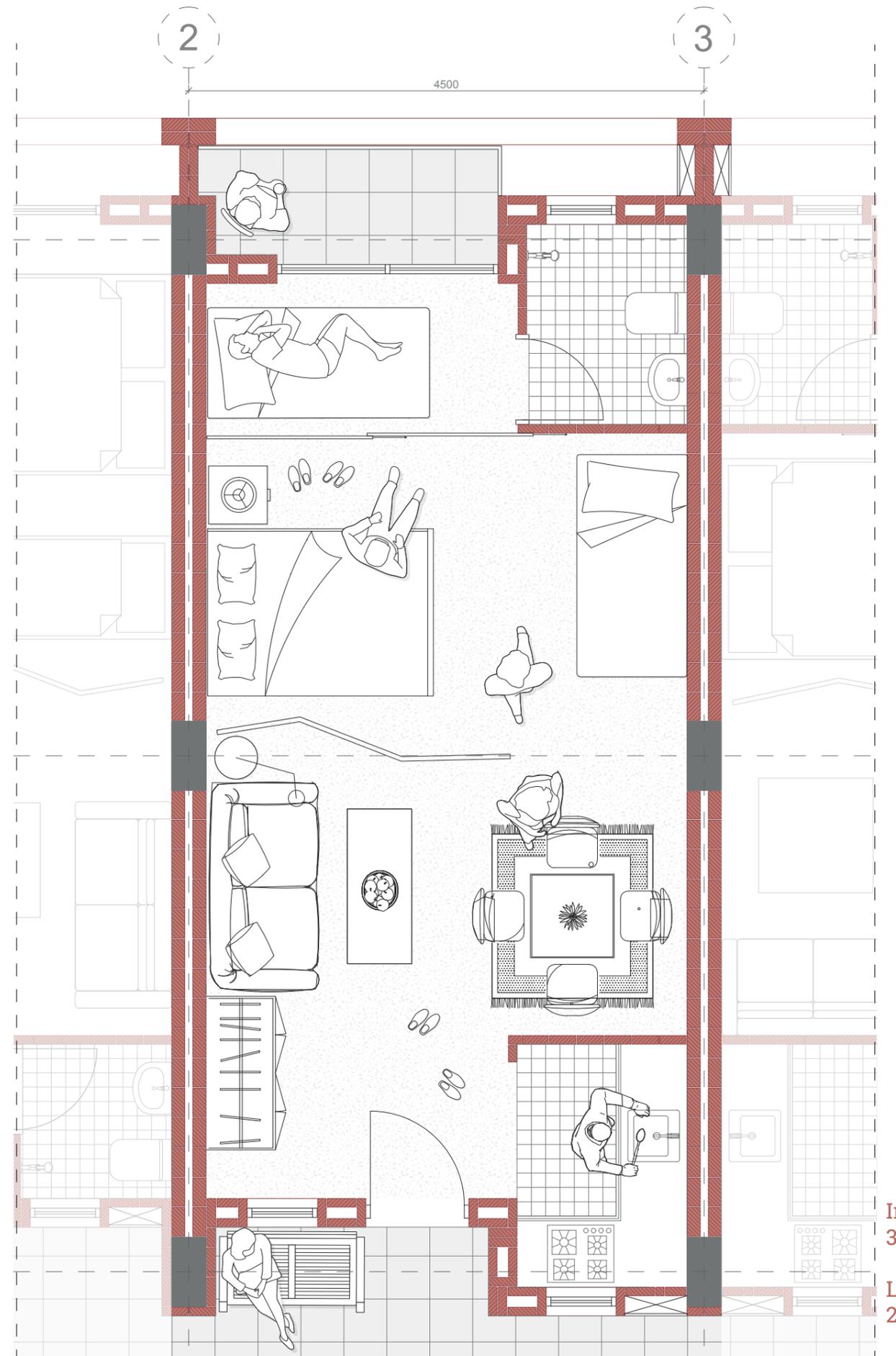
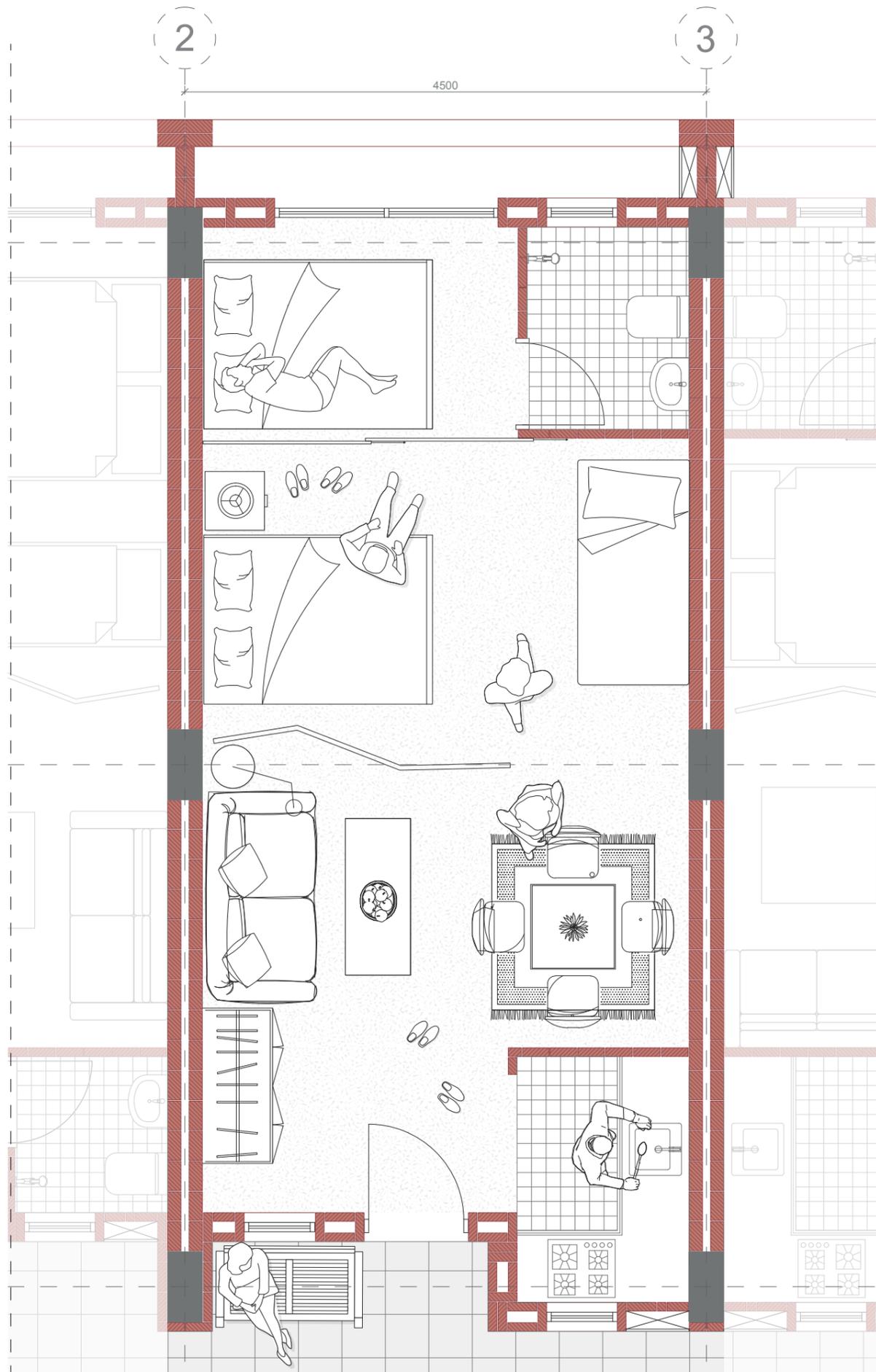




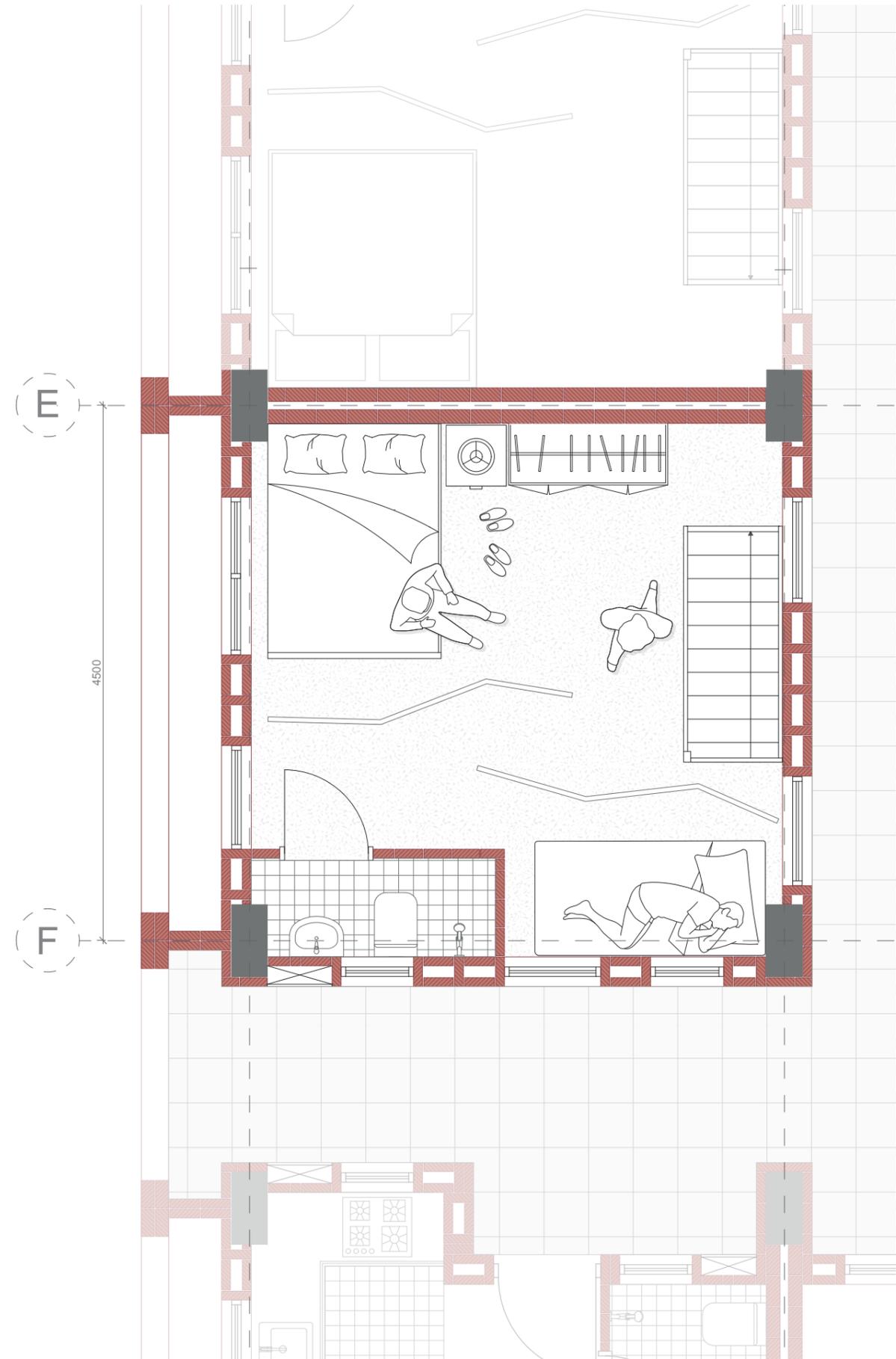
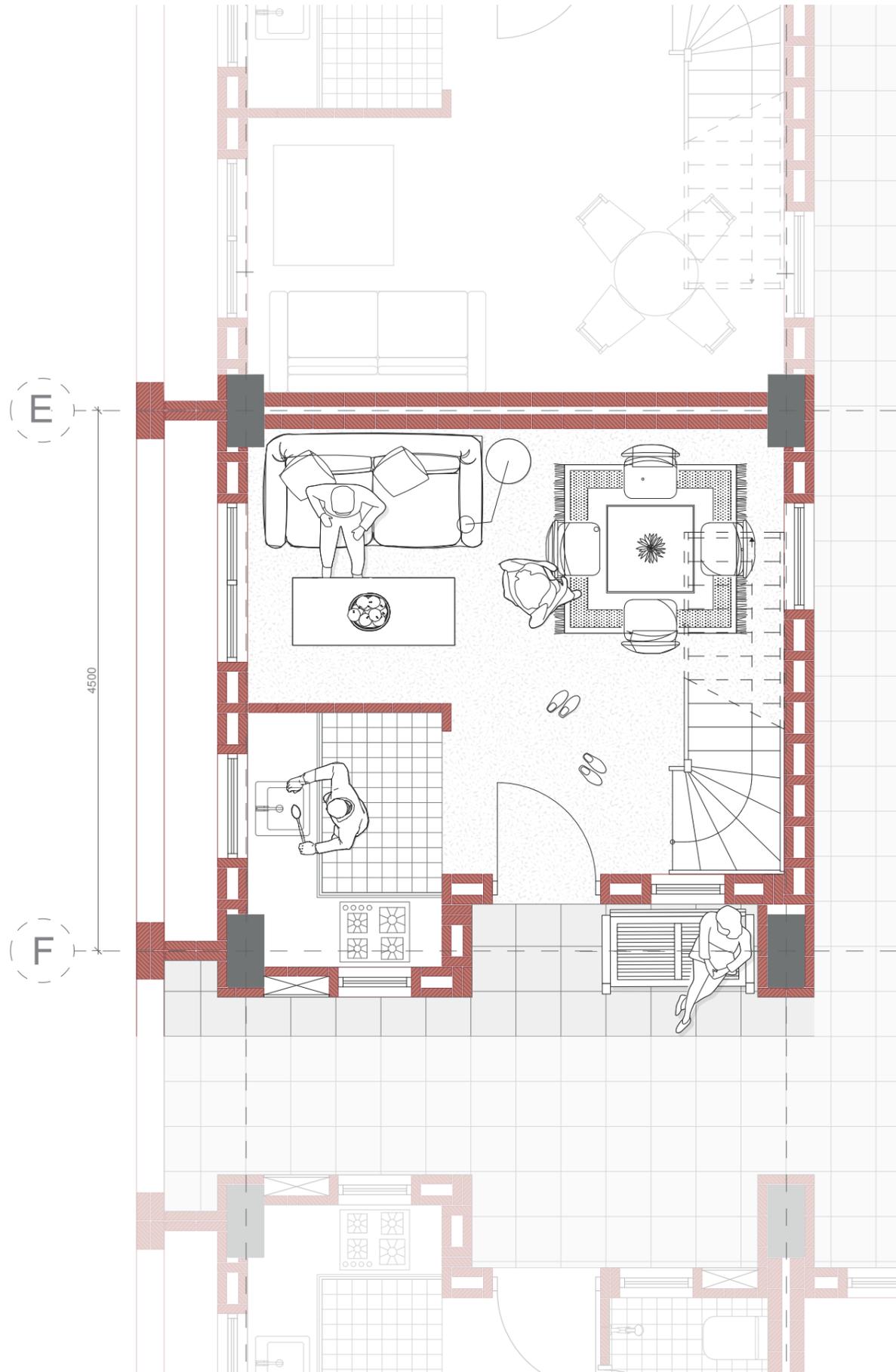
03 Low-income Housing Units - Type A & B



03 Low-income Housing Units - Type C & D



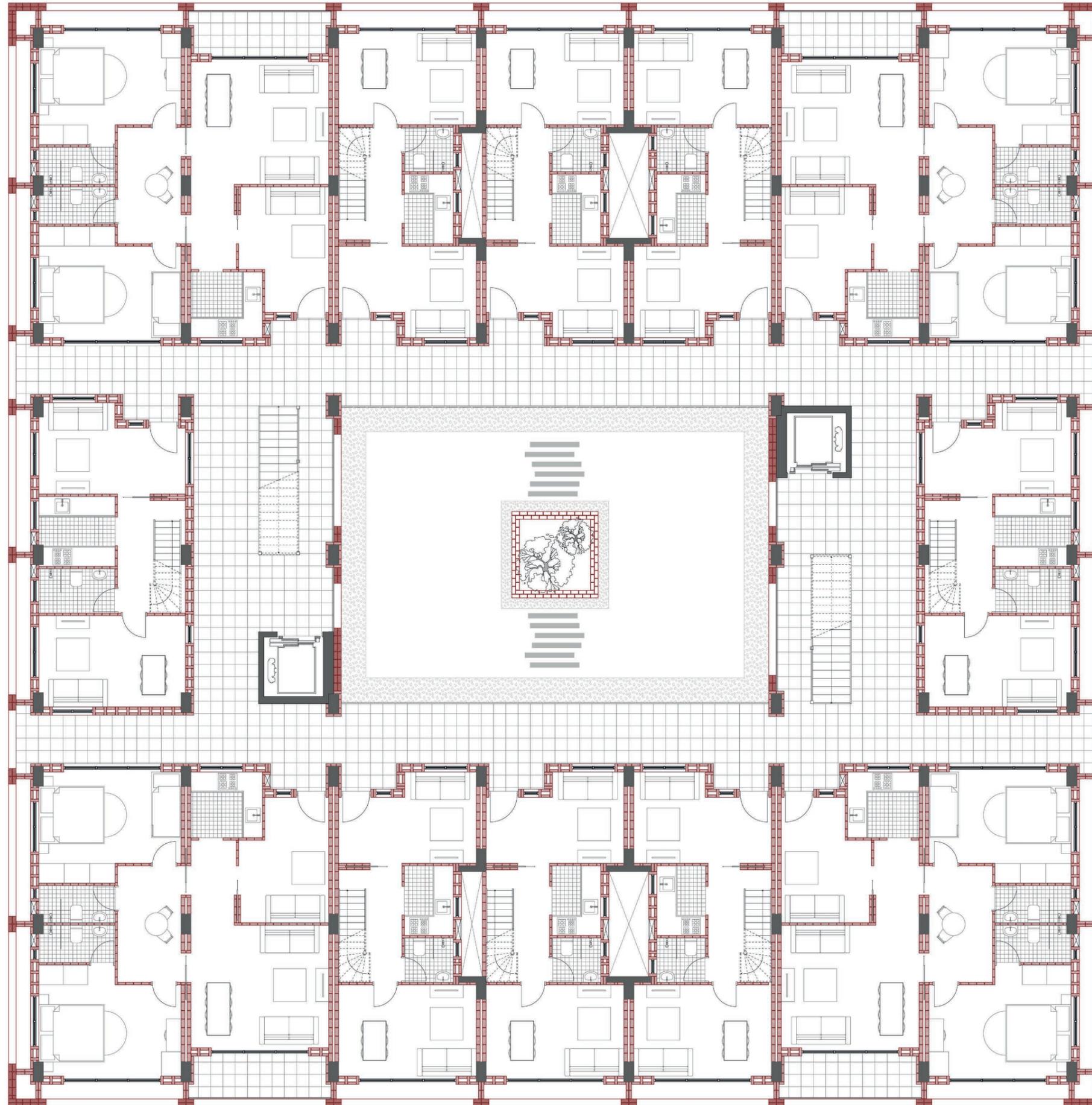
03 Low-income Housing Units - Type E



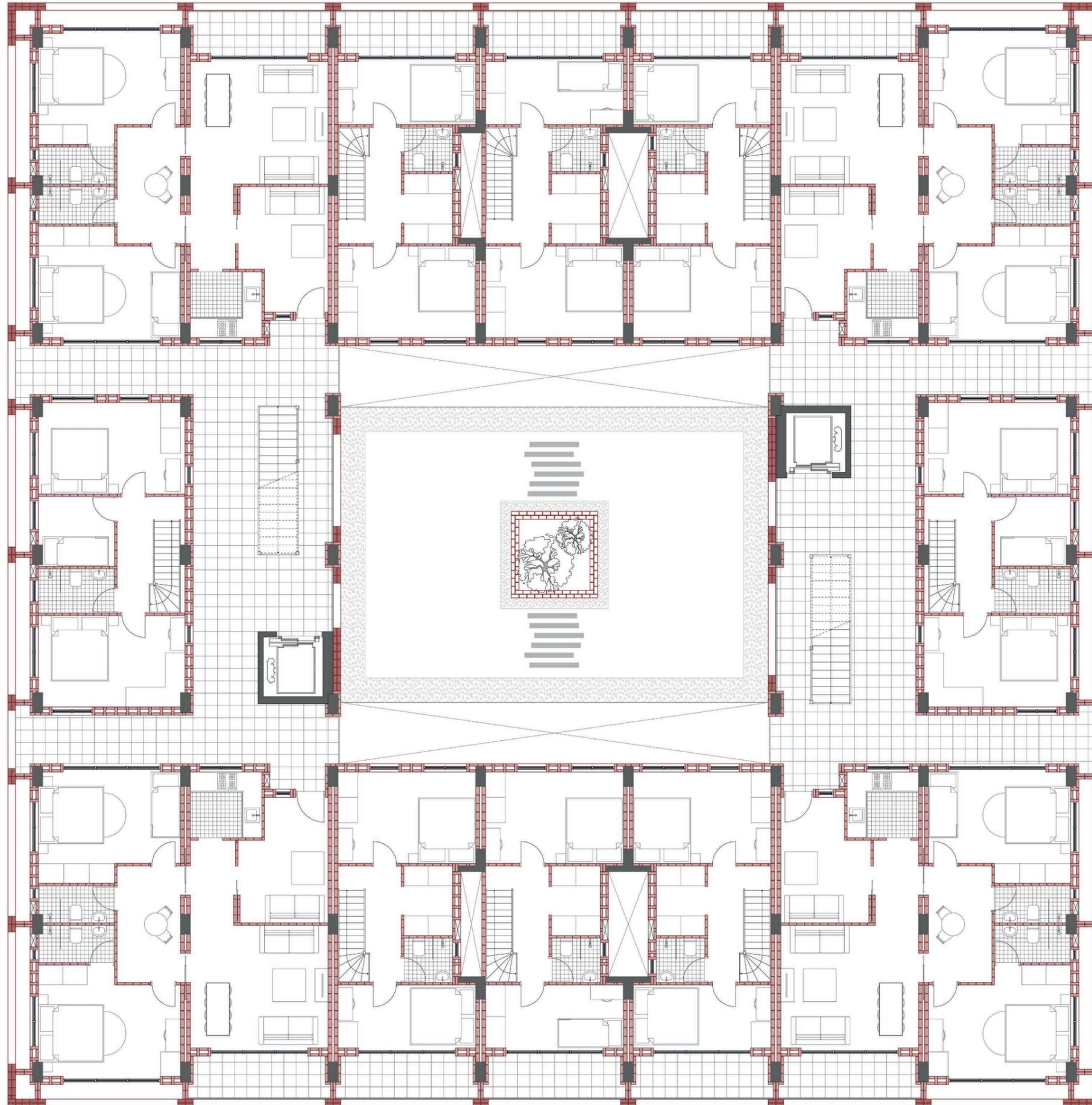
Inside area
37,8 m²

Loggia
-

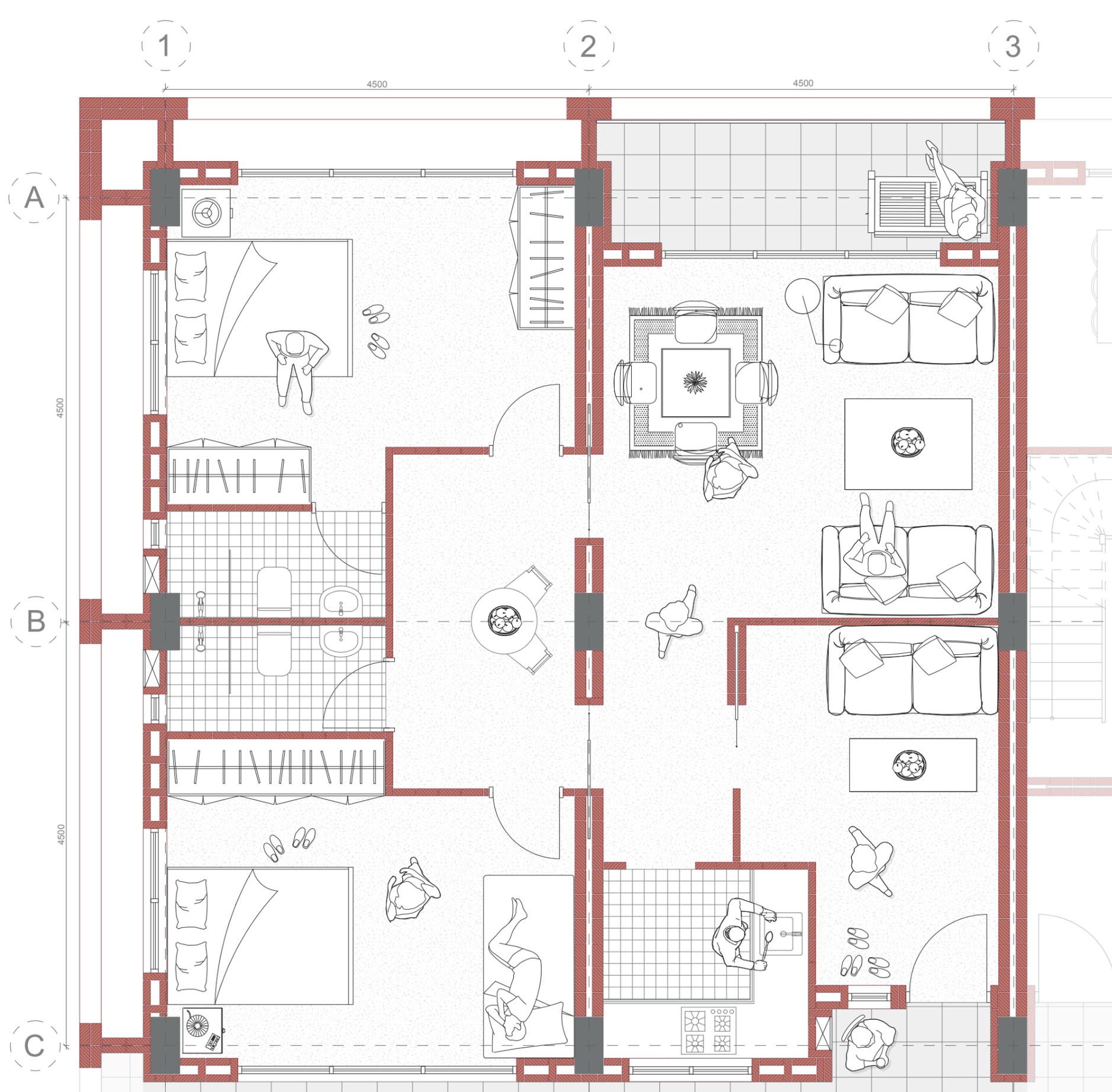
03 Mid-income Housing Cluster - Type A



03 Mid-income Housing Cluster - Type B



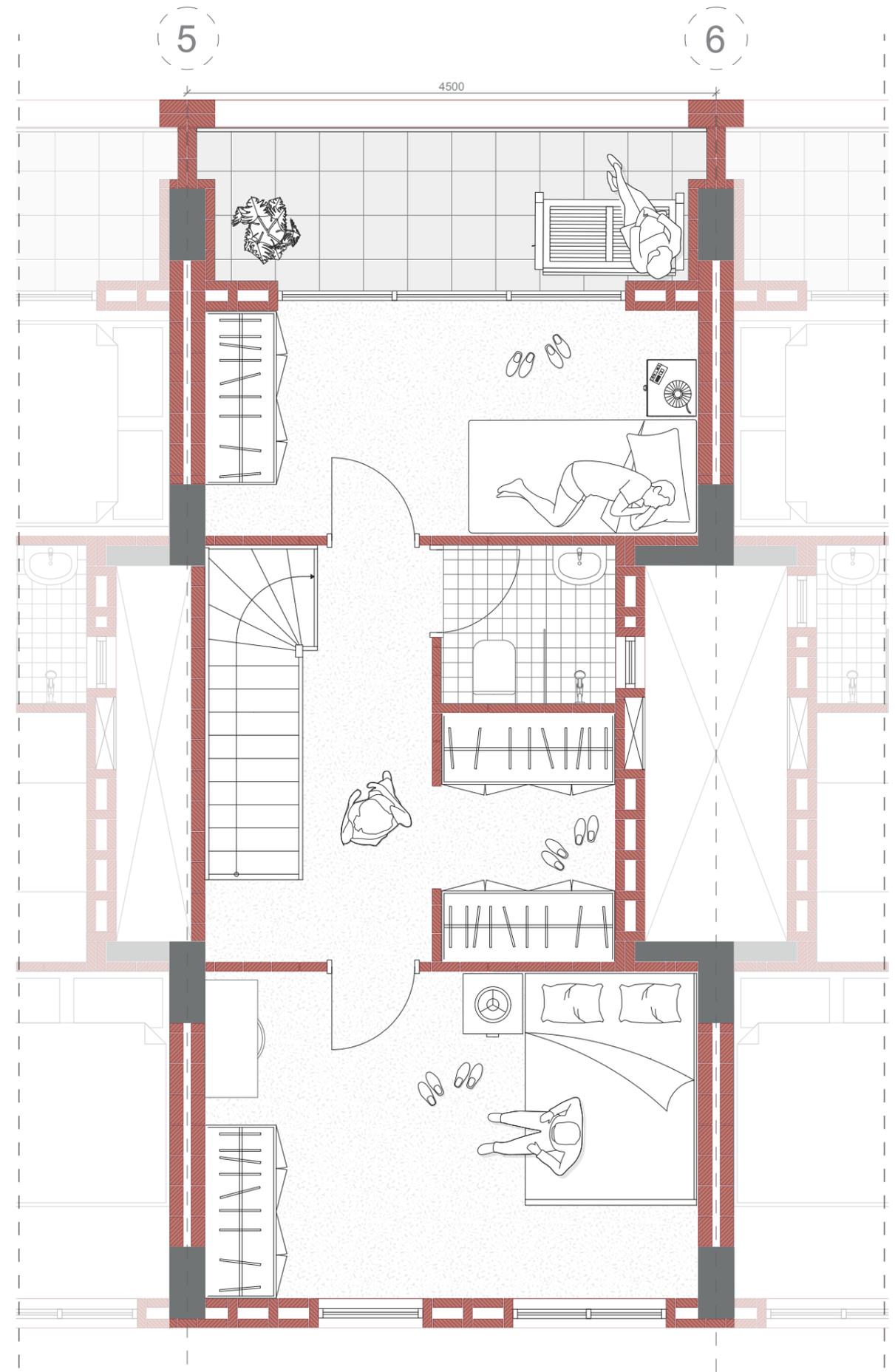
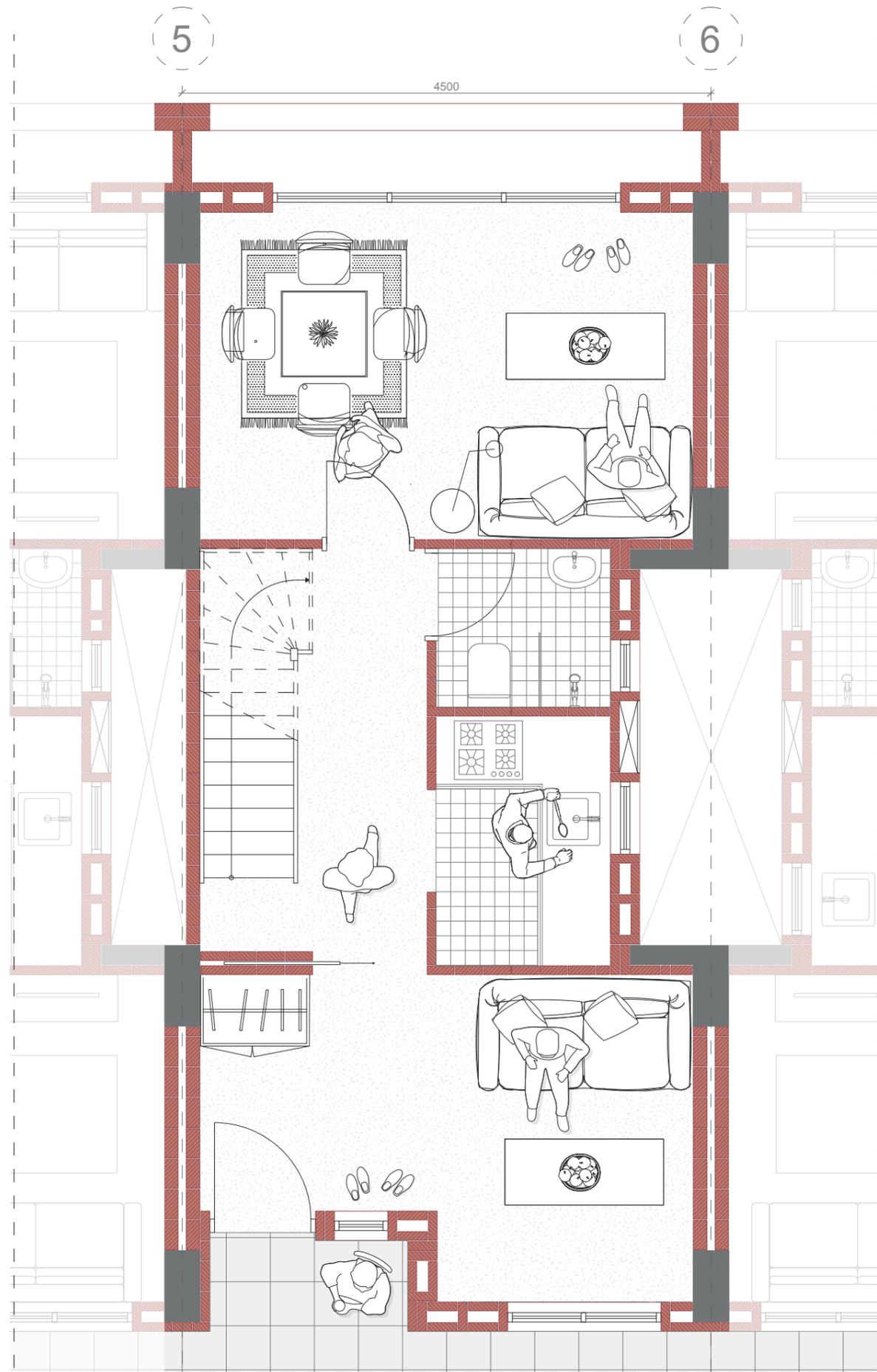
03 Mid-income Housing Unit - Type A



Inside area
70 m²

Loggia
5,5 m²

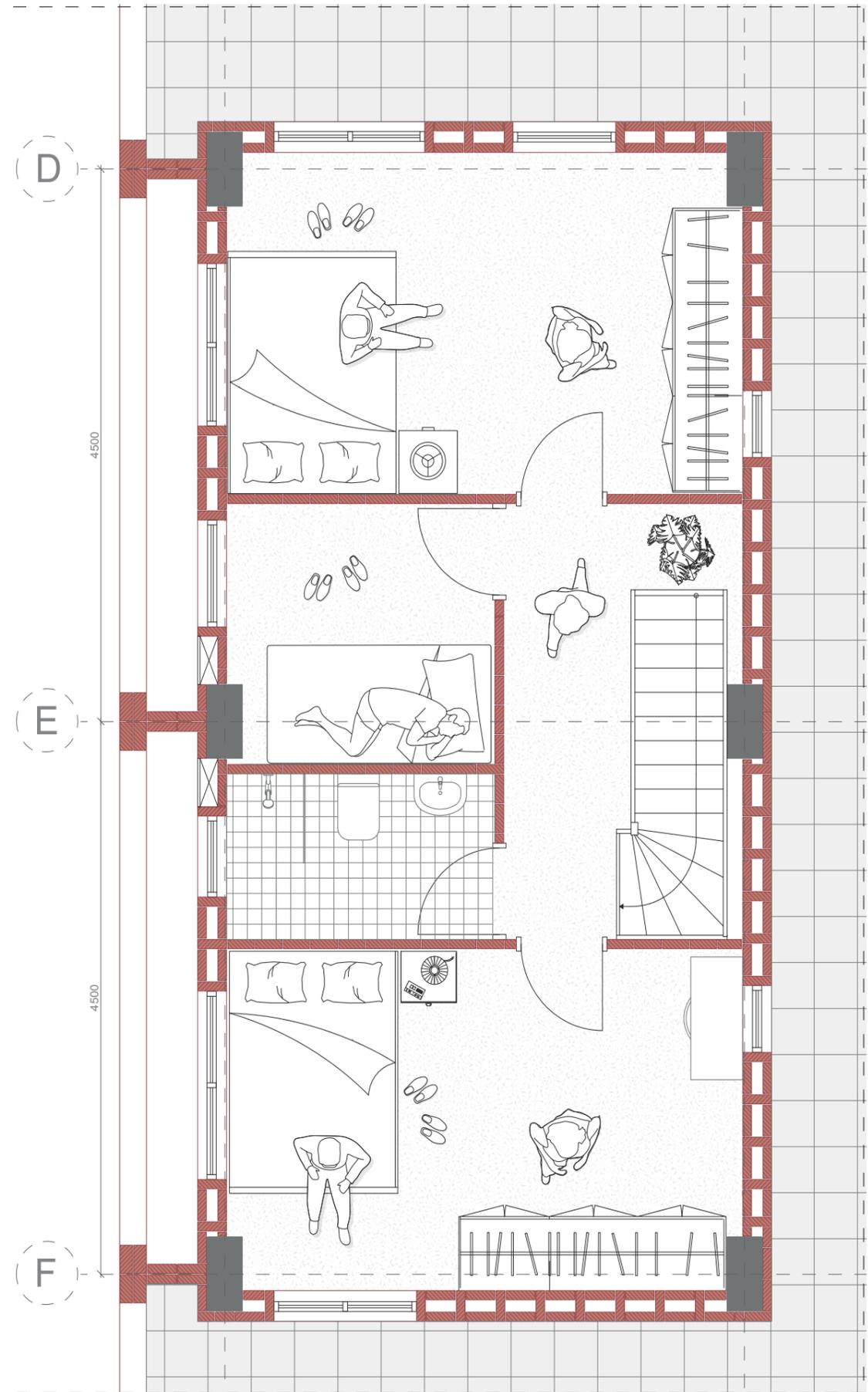
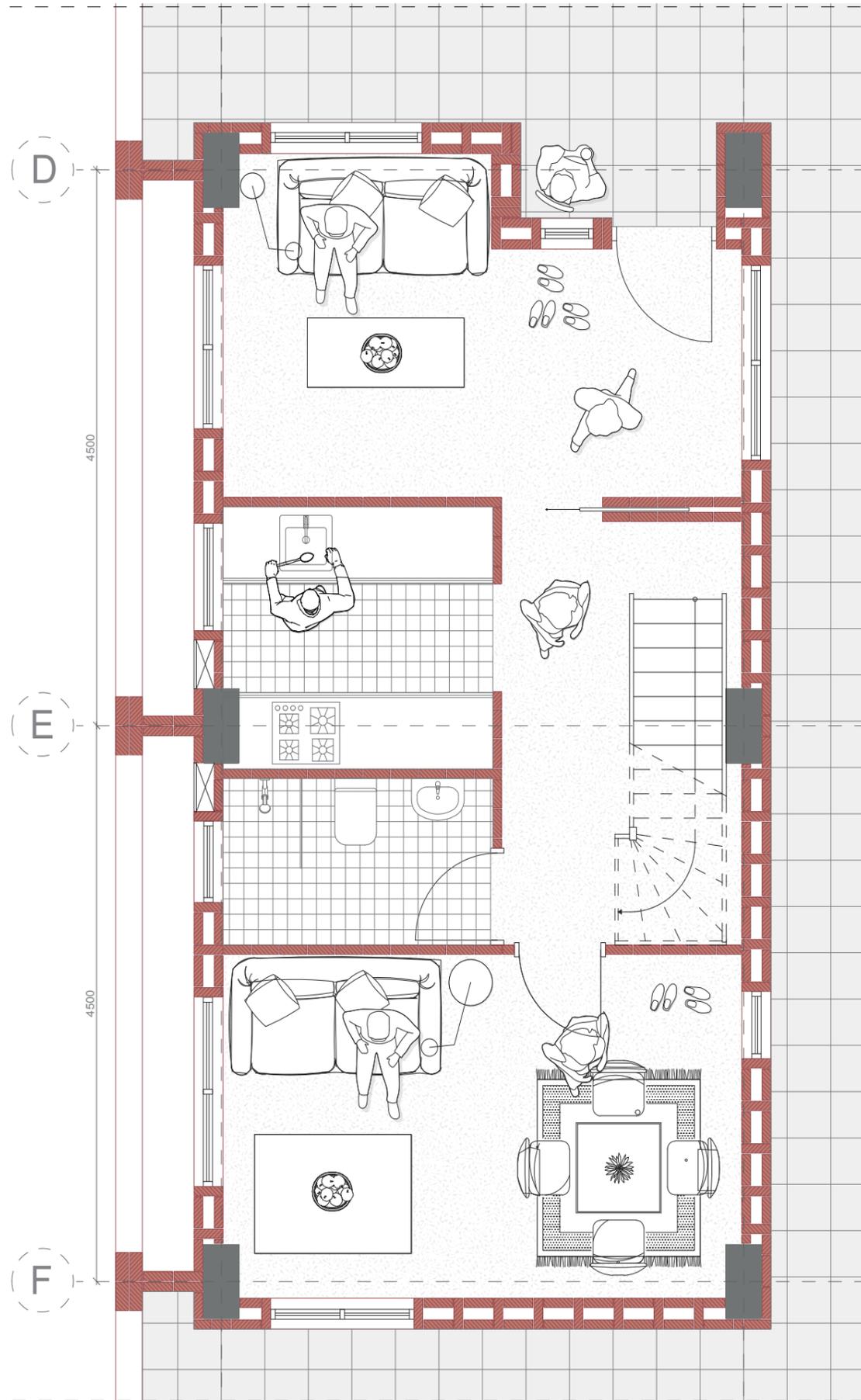
03 Mid-income Housing Unit - Type B



Inside area
71,5 m²

Loggia
5,5 m²

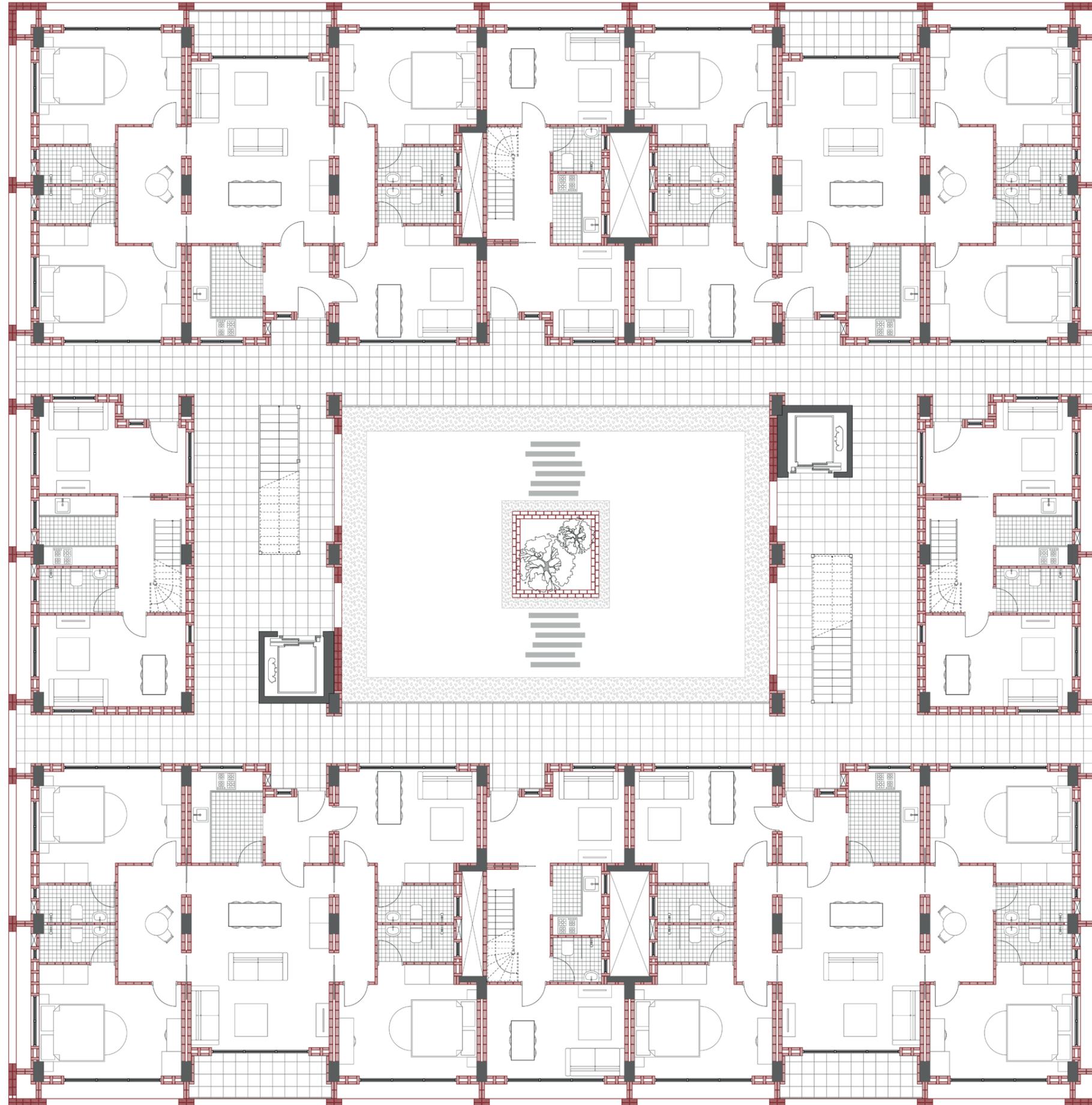
03 Mid-income Housing Unit - Type C



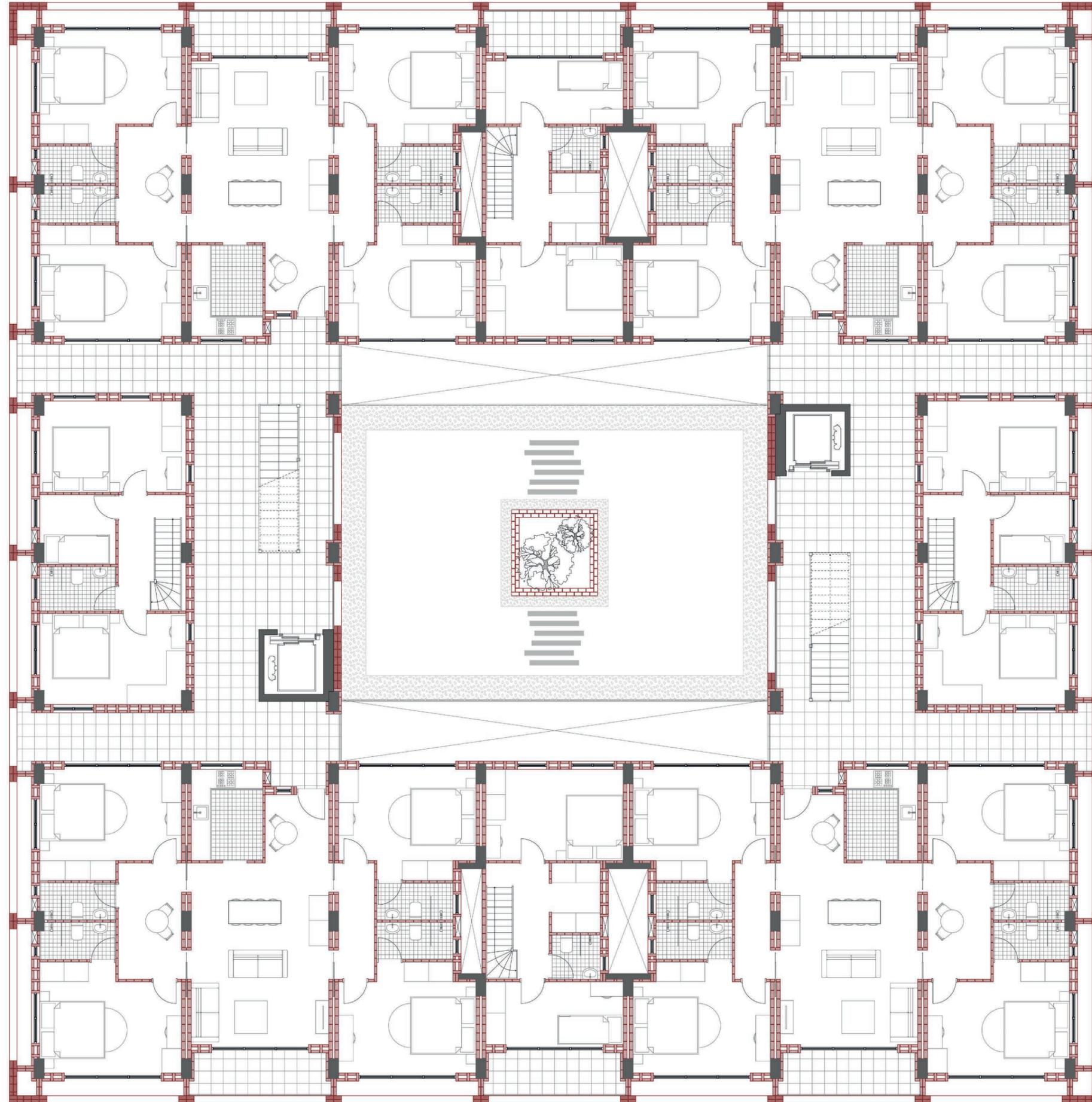
Inside area
80,4 m²

Loggia
-

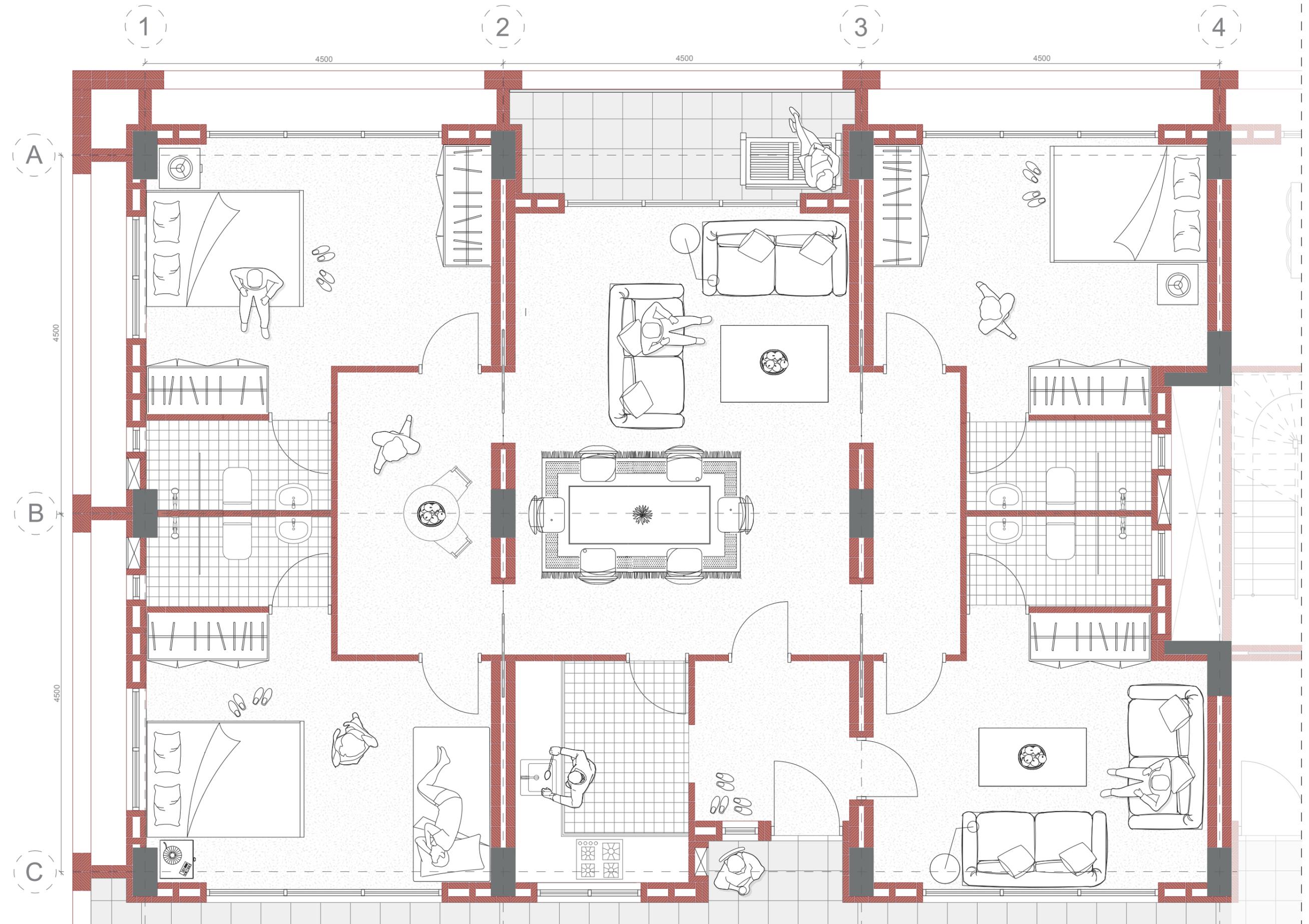
03 Mid- and High-income Housing Cluster - Type A



03 Mid- and High-income Housing Cluster - Type B



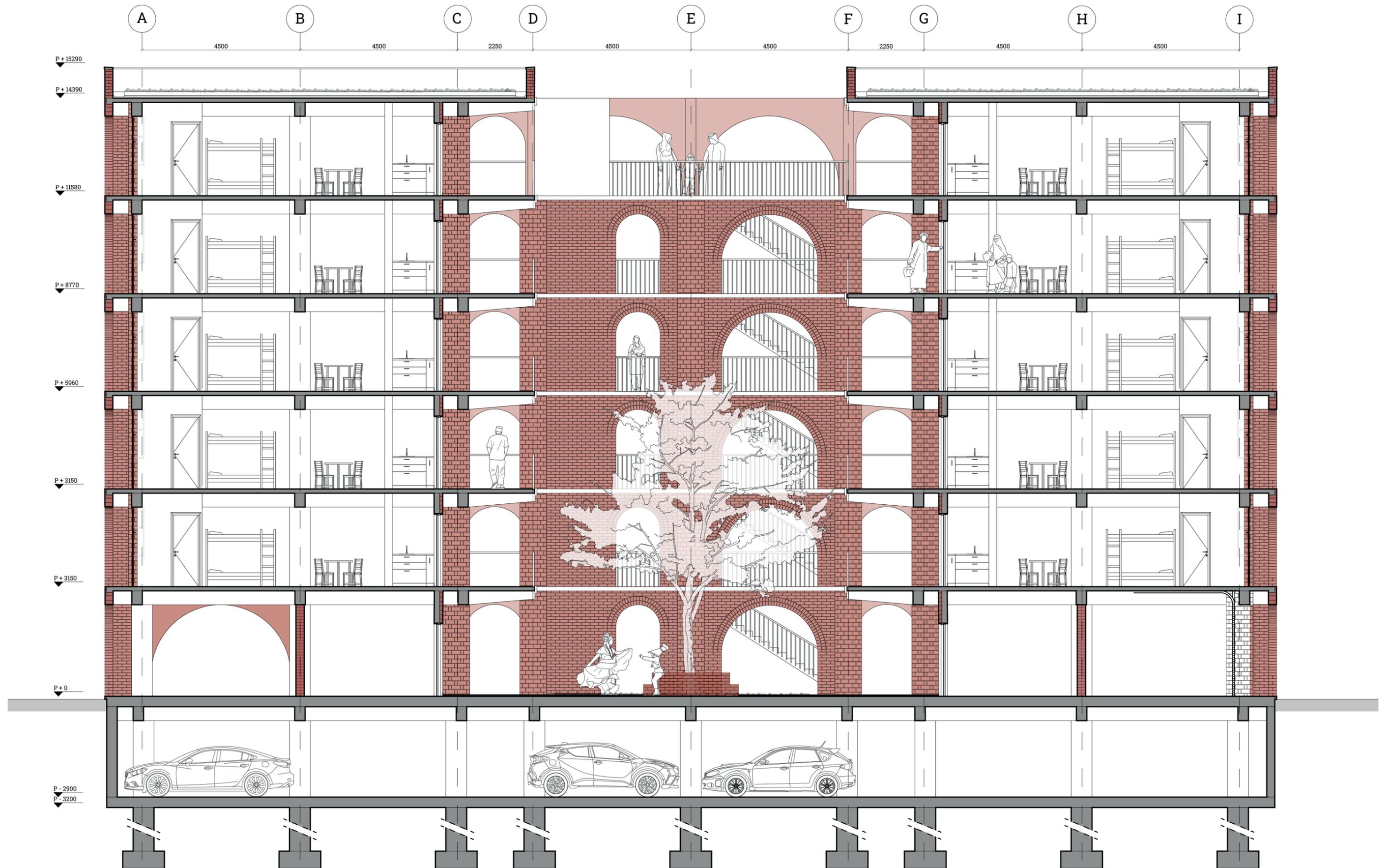
03 High-income Housing Unit - Type A



Inside area
115,9 m²

Loggia
5,5 m²

03 Sections



03 Elevations Low-income Cluster



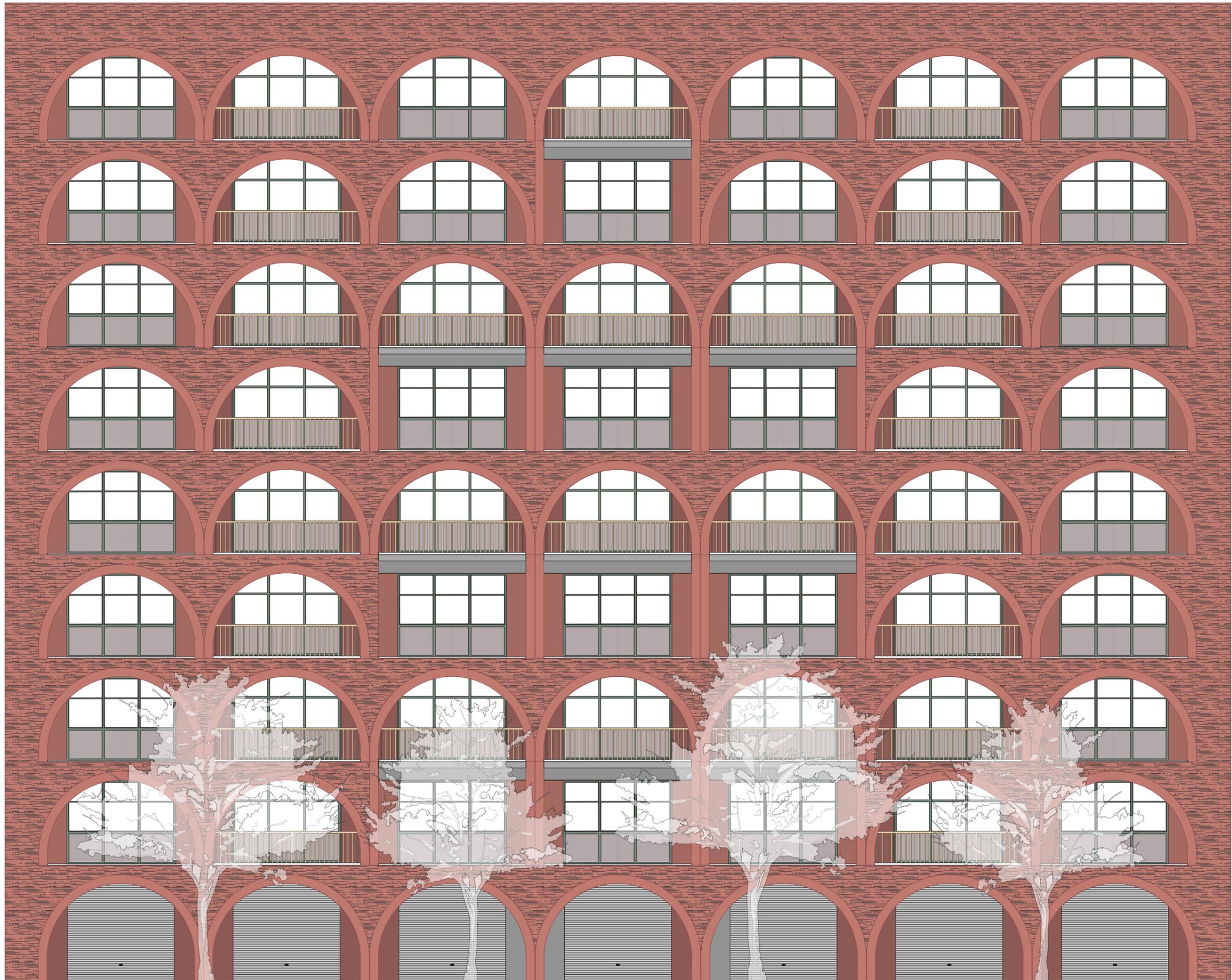
03 Elevations Low-income Cluster



03 Elevations Low-income Cluster



03 Elevations Mid- and High-income Clusters



03 Elevations Mid- and High-income Clusters



03 References Facade



Ayub National Hospital in Dhaka, Bangladesh by Louis I. Kahn



Capitol Complex in Dhaka, Bangladesh by Louis I. Kahn

04

04 Technology

- Materials
- Principle structure
- Construction process
- Environmental strategy
- Facade

*BRAC aims to disseminate the handbook among government, multilateral and private sector organisations, donor agencies, NGOs, practitioners, community-based organisations, micro-finance institutions, and others willing to support new housing or rehabilitation projects for low-income urban communities. We believe that this handbook will offer a guideline for **low-cost and resilient construction in low-income urban settlements of Bangladesh.***

Principles for low-cost house construction:

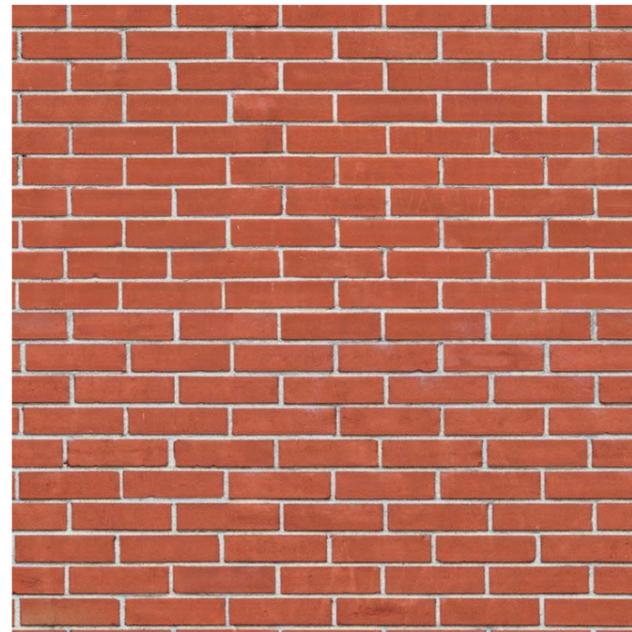
- Optimum use of space
- Use of exposed brick (no plaster)
- Reconsidering wall thickness
- Use of locally available materials
- Reuse of materials (where feasible)

04 Materials



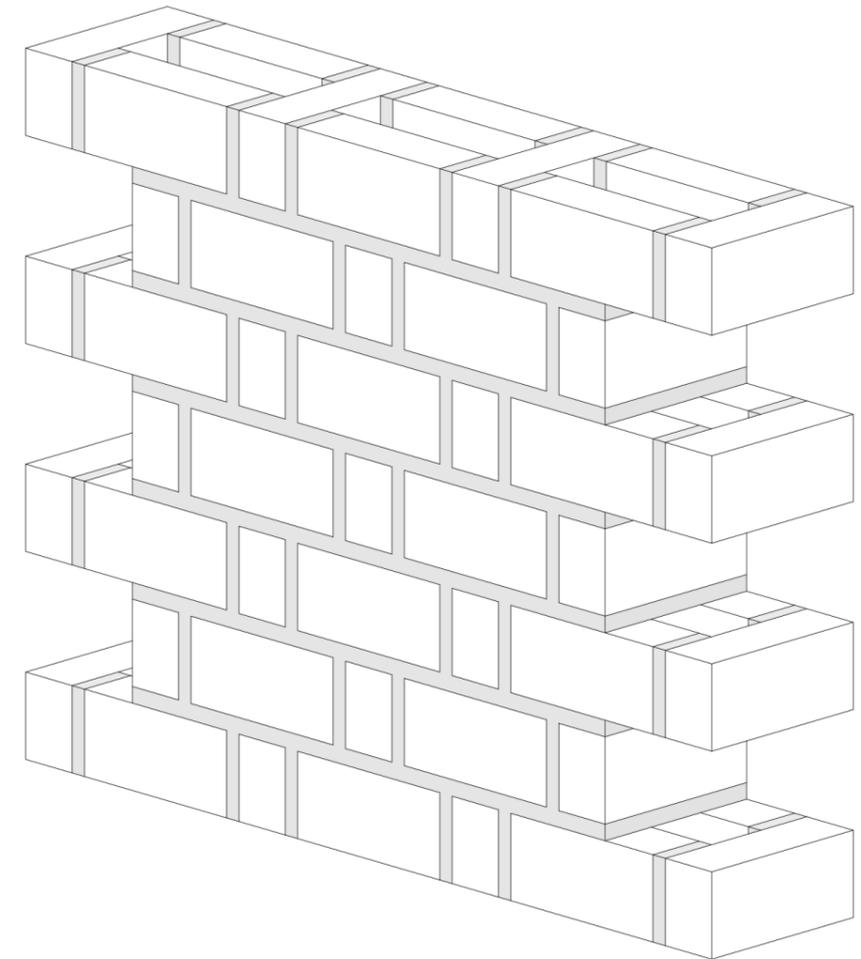
Concrete

Frame structure



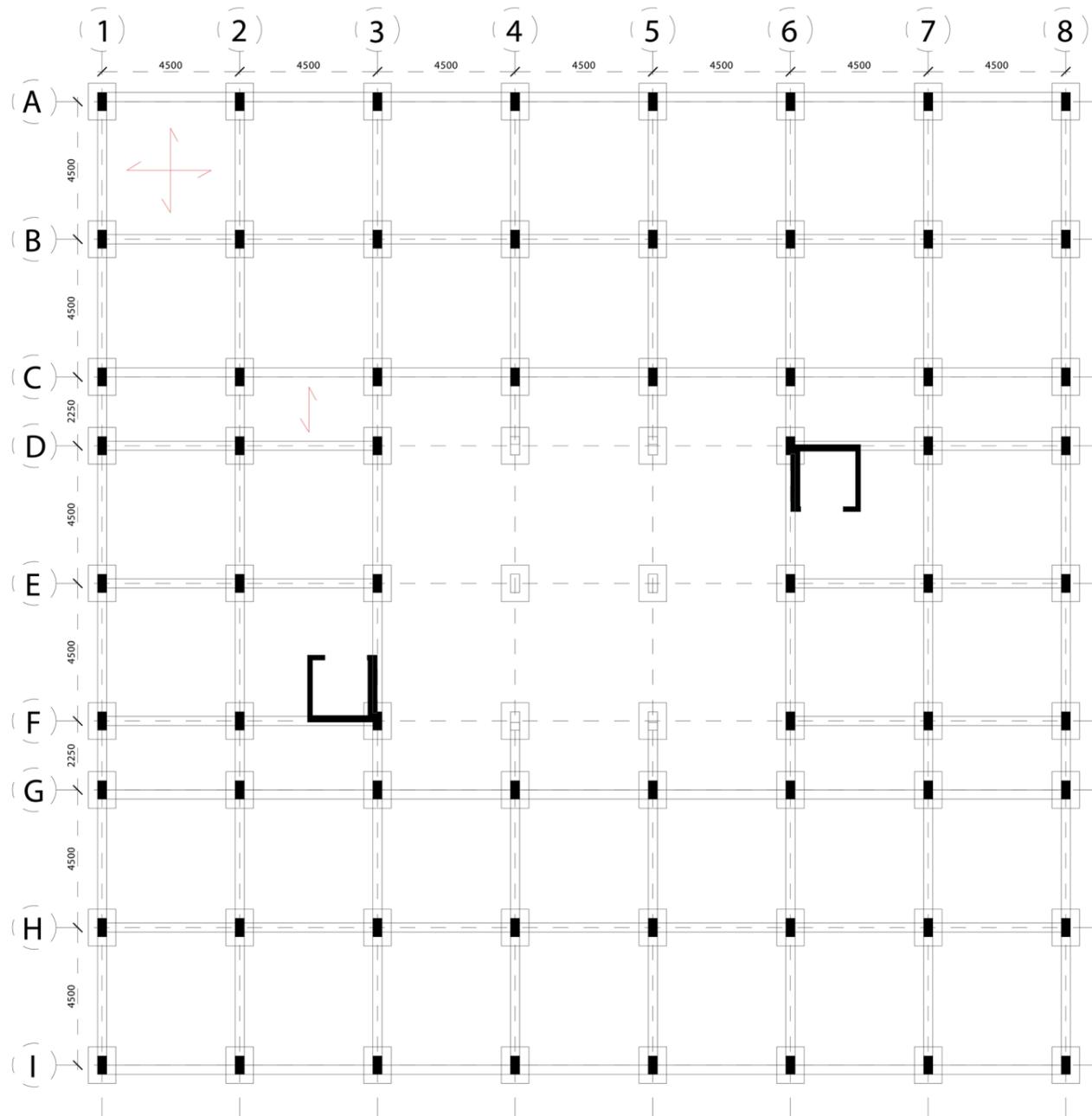
Red brick

Infill

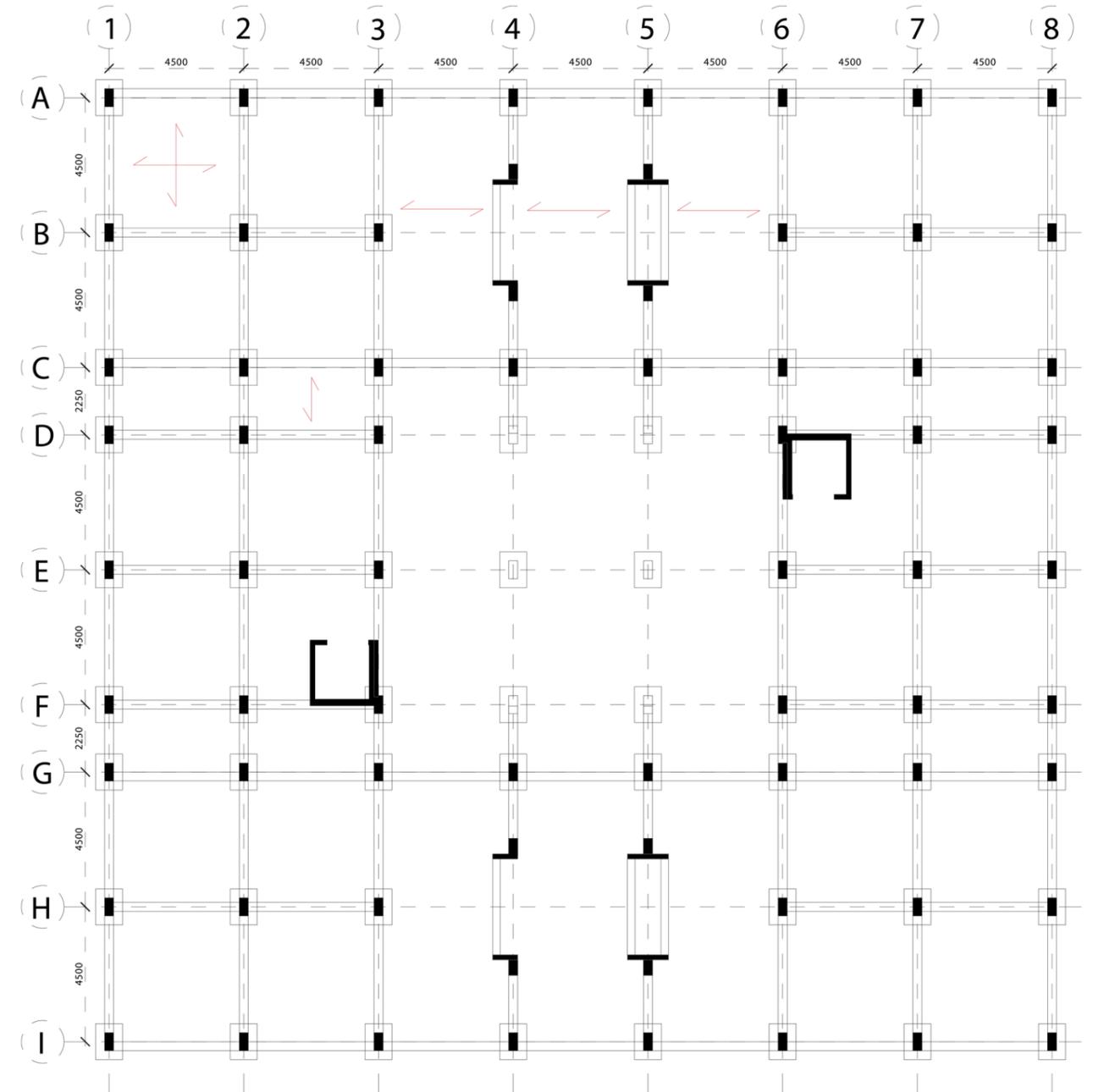


Rat trap bond

04 Principle structure - Structure floorplans

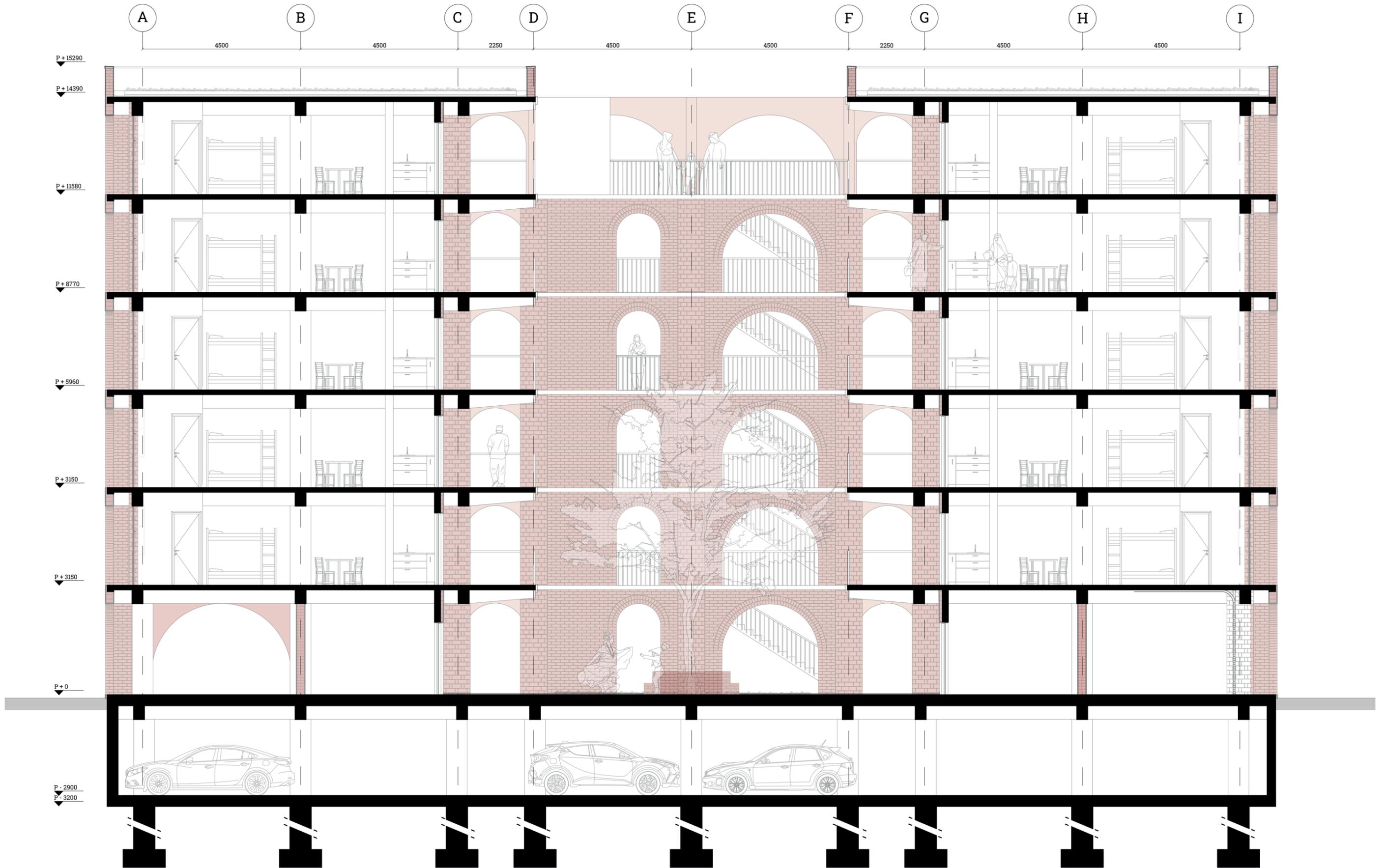


Low income cluster

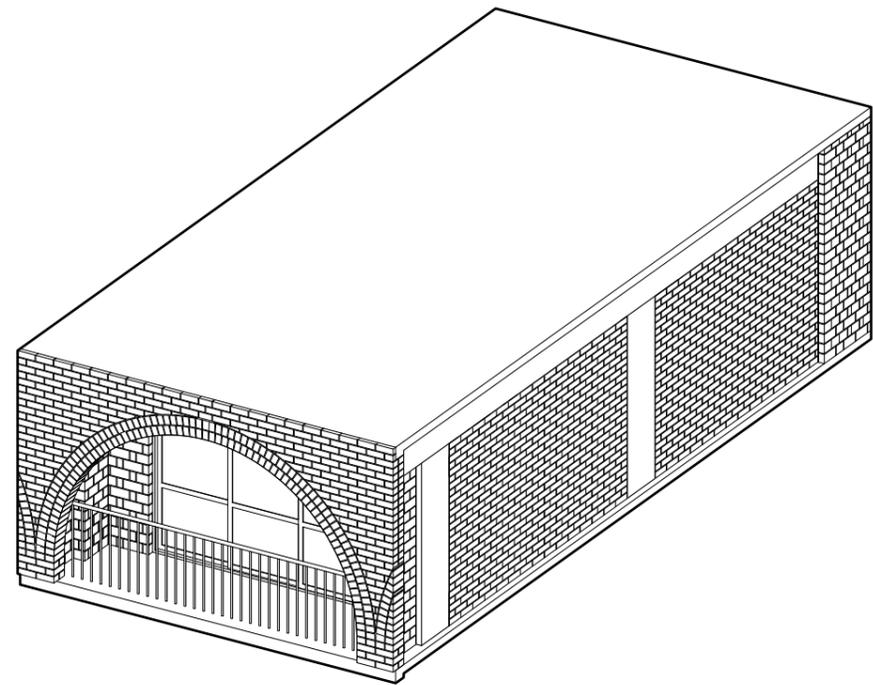


Mid- and high-income cluster

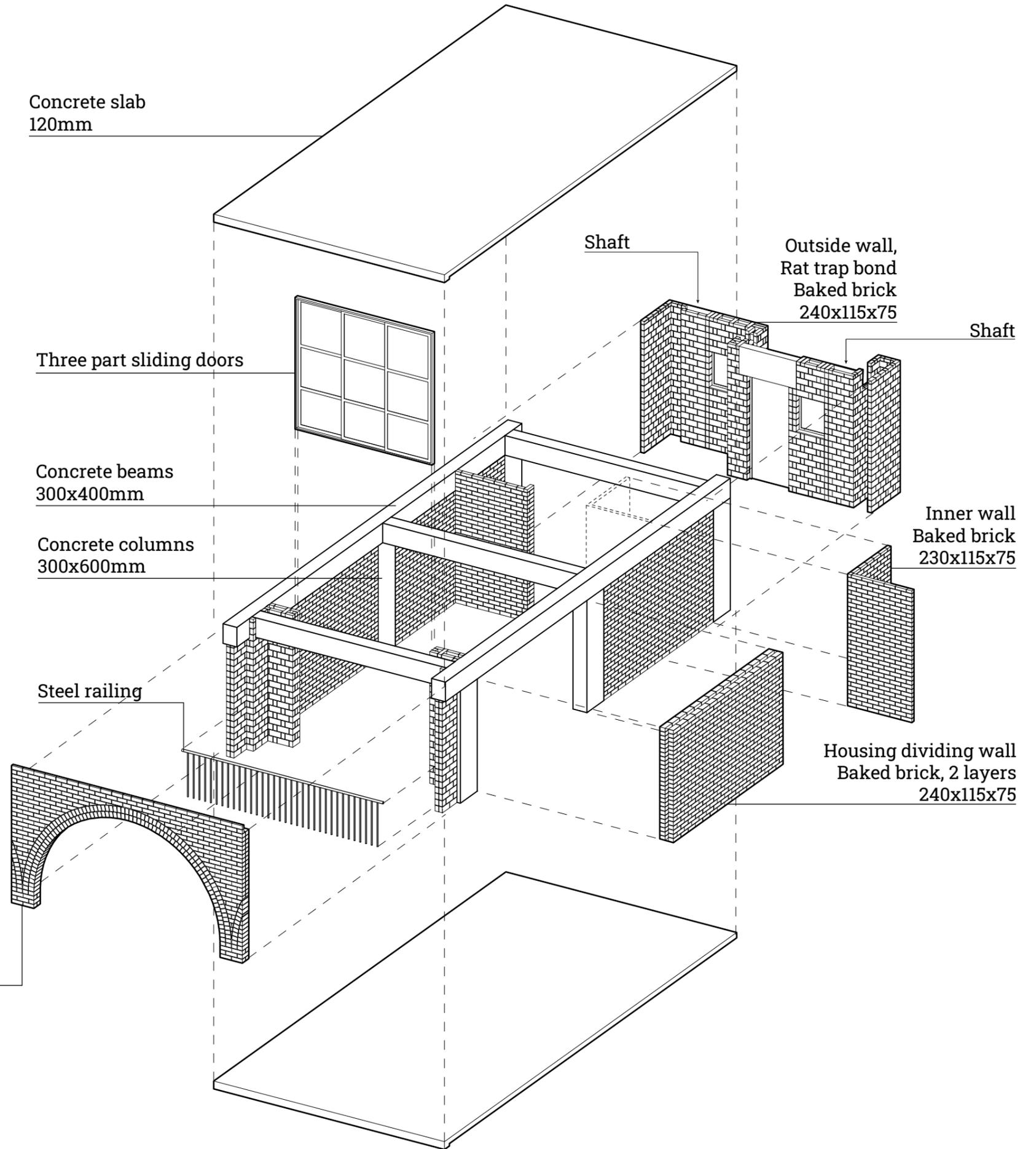
04 Principle structure - Structure section



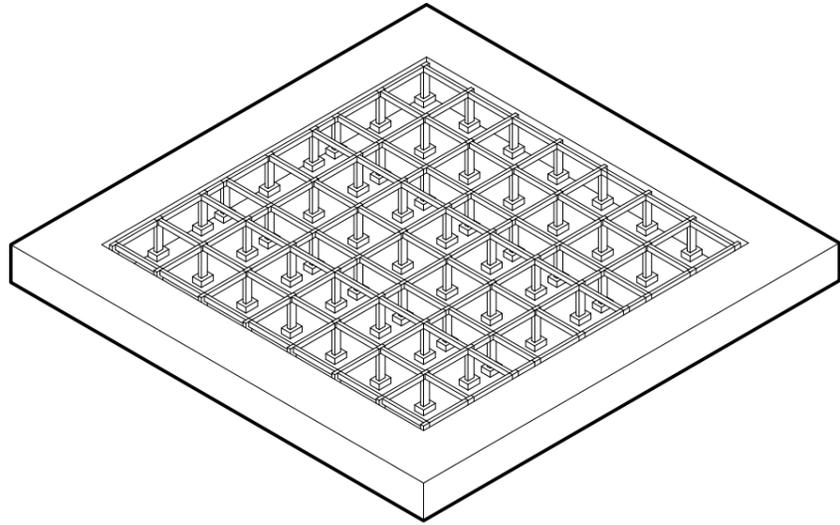
04 Principle structure - Unit materials



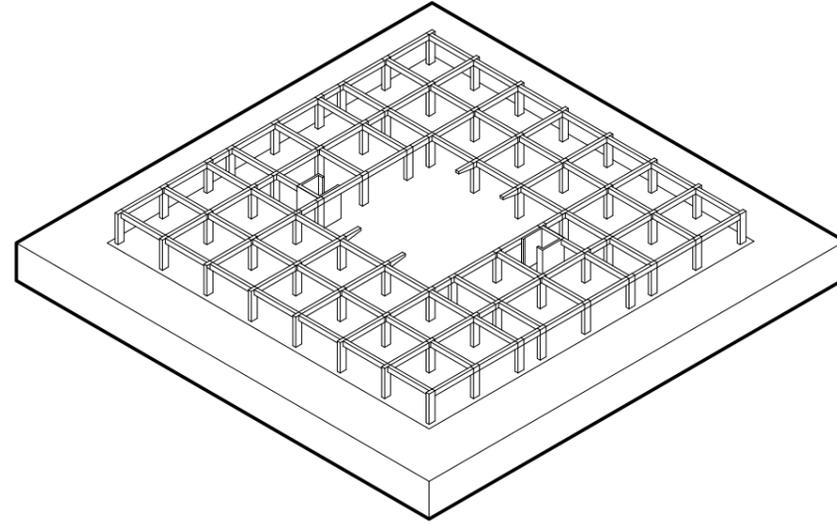
Low-income unit with balcony



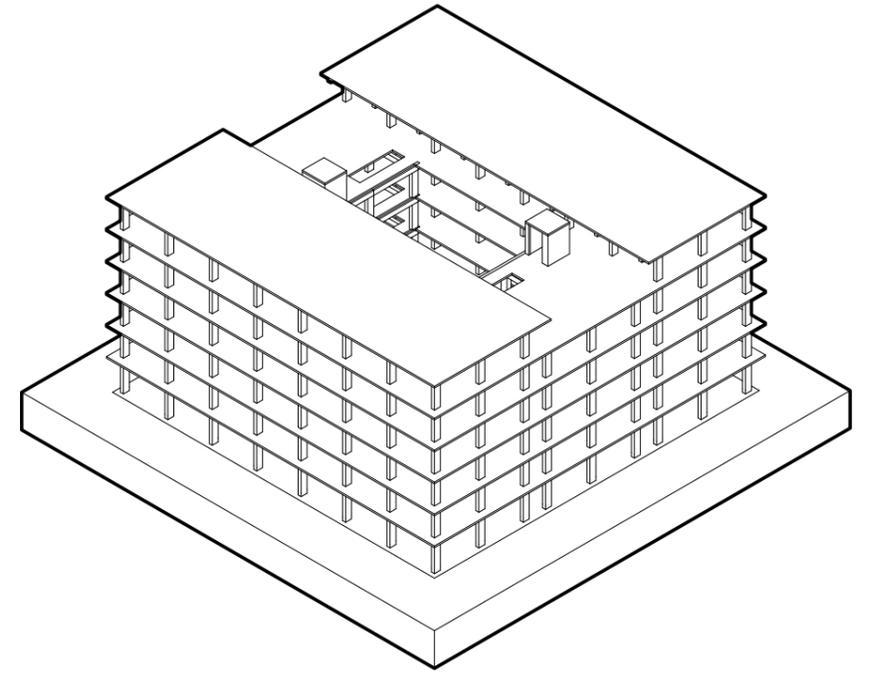
04 Construction process



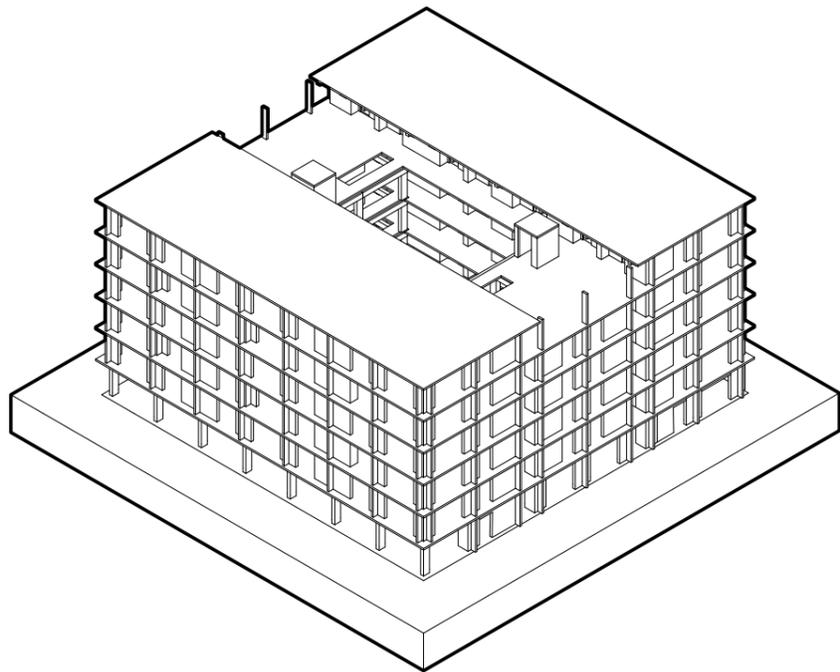
Excavation & Concrete foundation



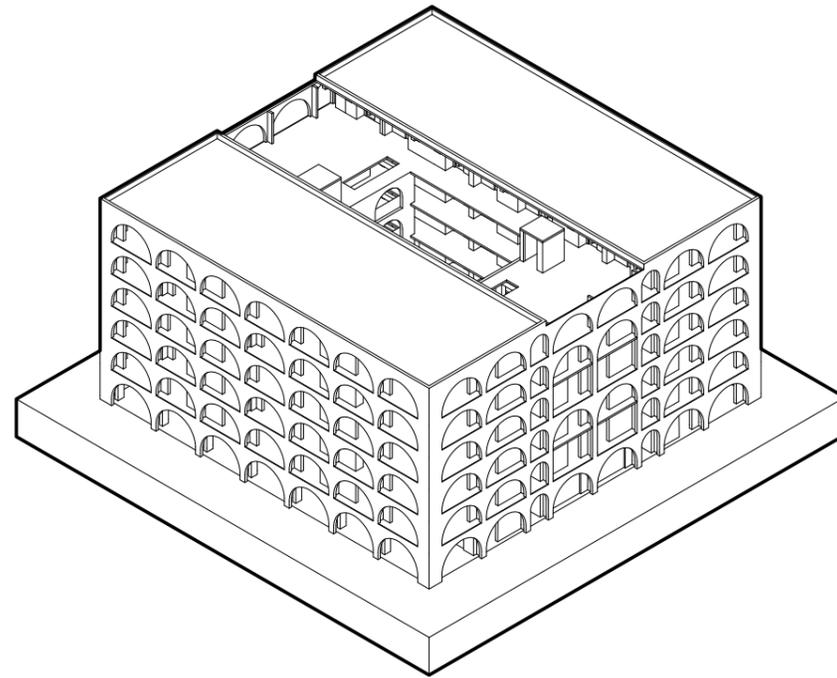
Concrete structure one floor



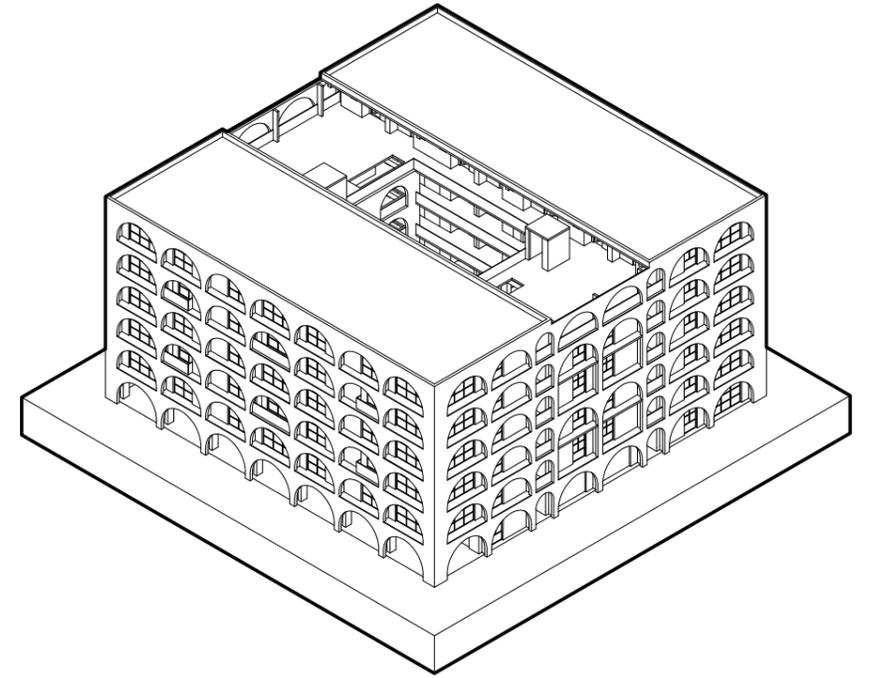
Repeated on each floor



Inner and outer brick walls placement

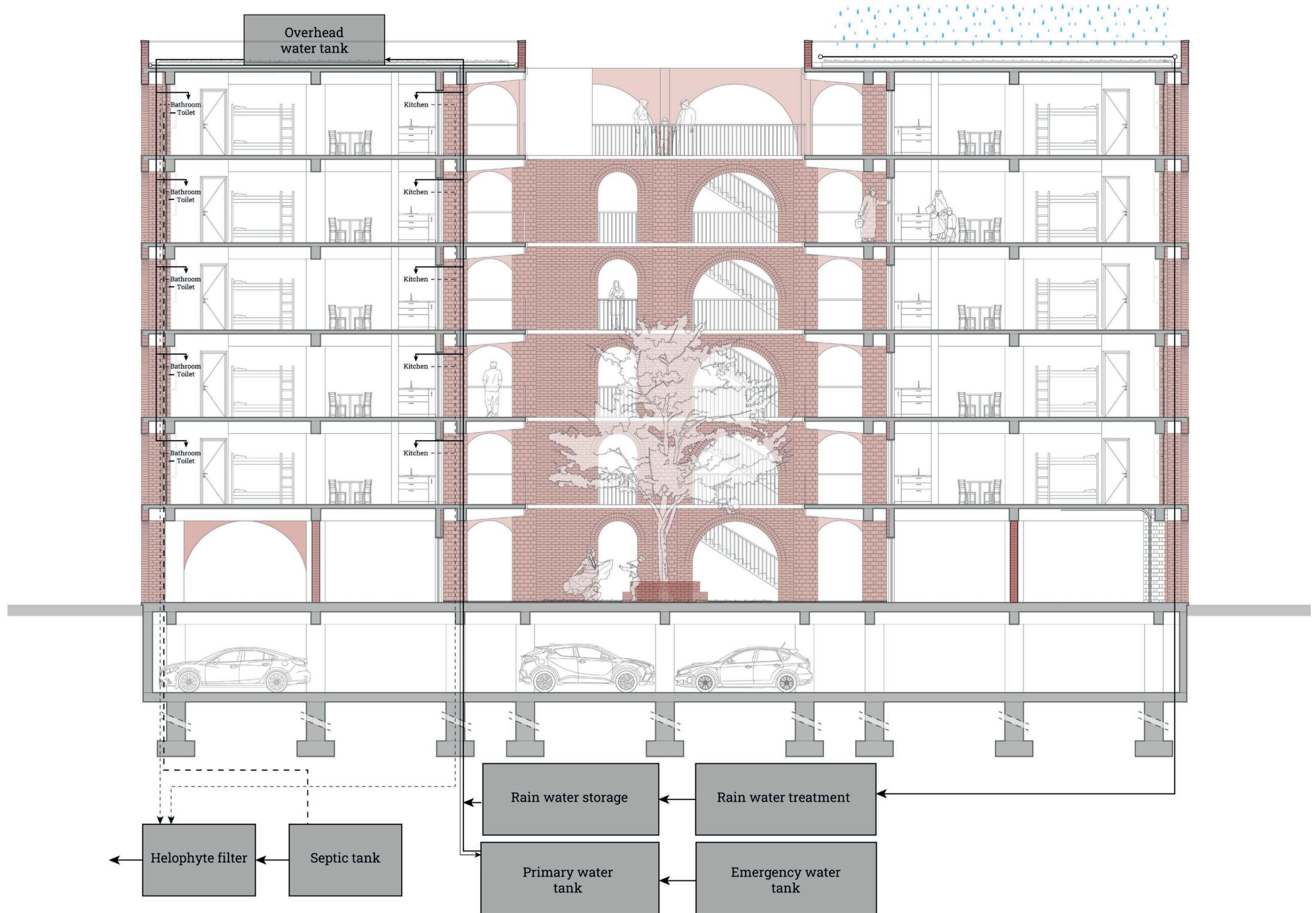


Second brick facade placement

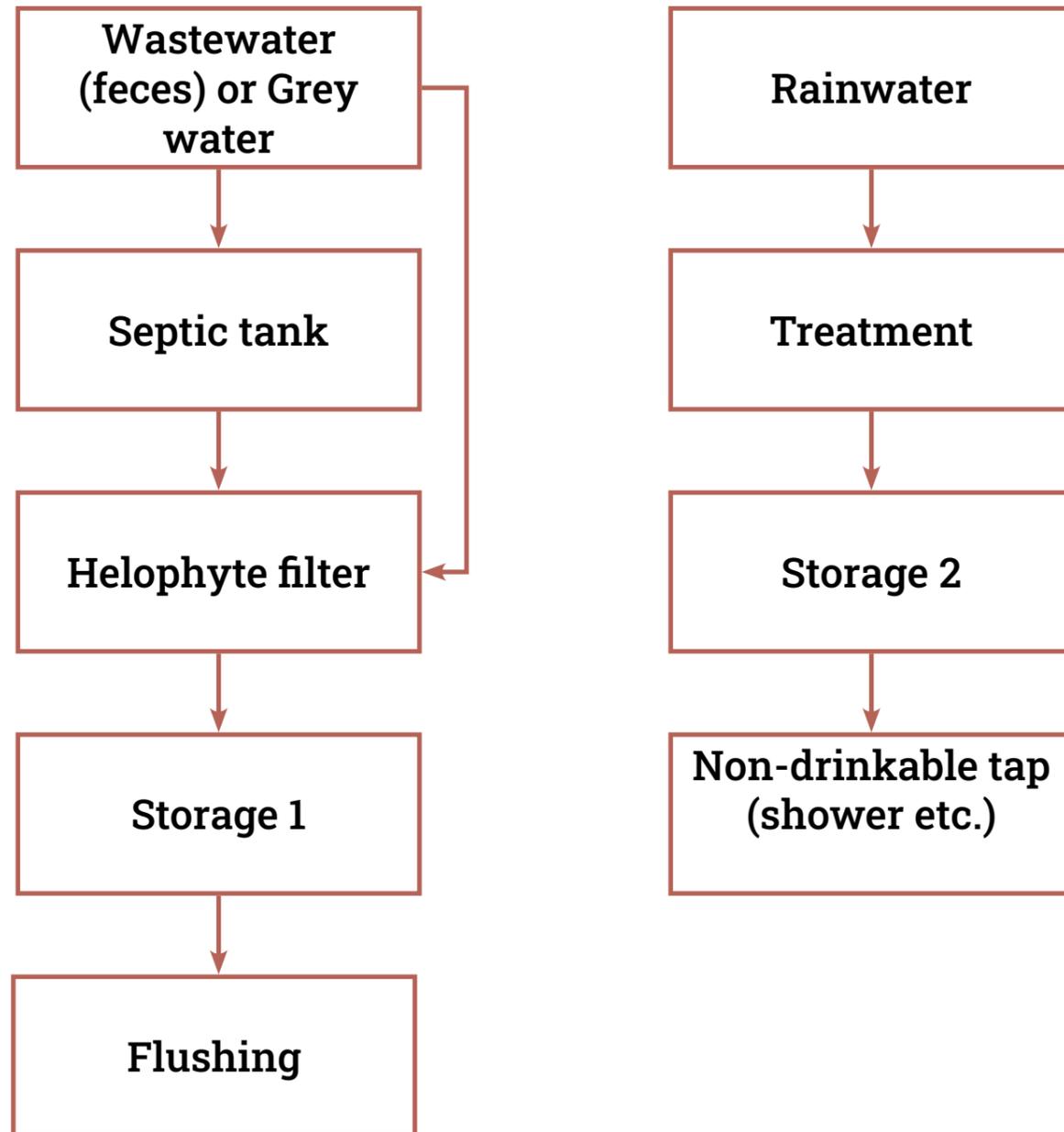


Windows, doors and railings placement

04 Environmental Strategy - Water Conservation



04 Environmental Strategy - Water Conservation



Roof area of cluster: 650m²
 Maximum rainfall per day: 303,6mm
 Collection rate: 50-70%

Maximum collection capacity:
 $650 \times 0,3 \times 0,7 =$ **136m³**

Number of residents (estimation): 370
 Water consumption per person: 100L/day

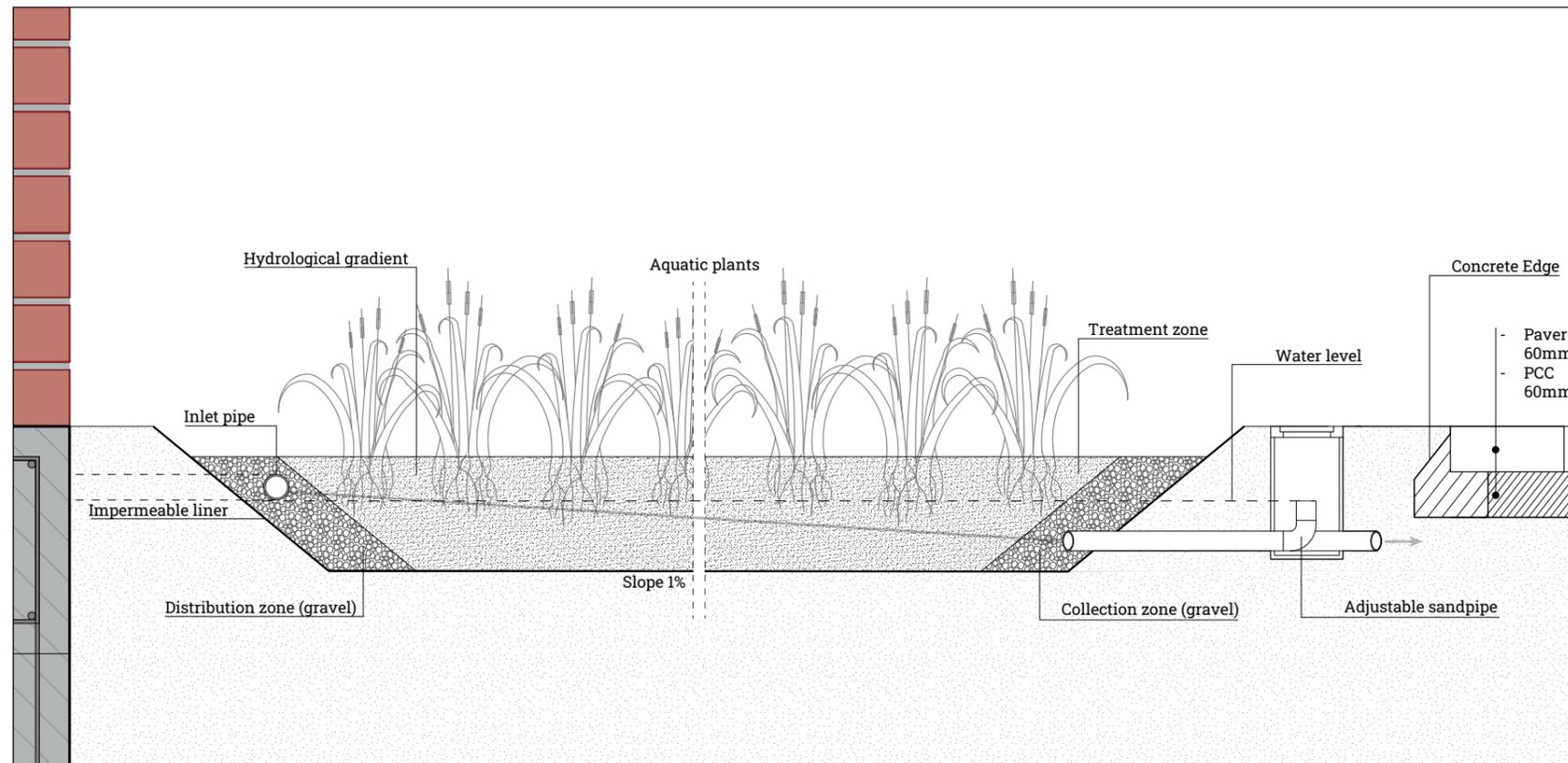
Water consumption per cluster per day
 $370 \times 100 =$ 37.000L = **37m³**

Reusability 60-80%

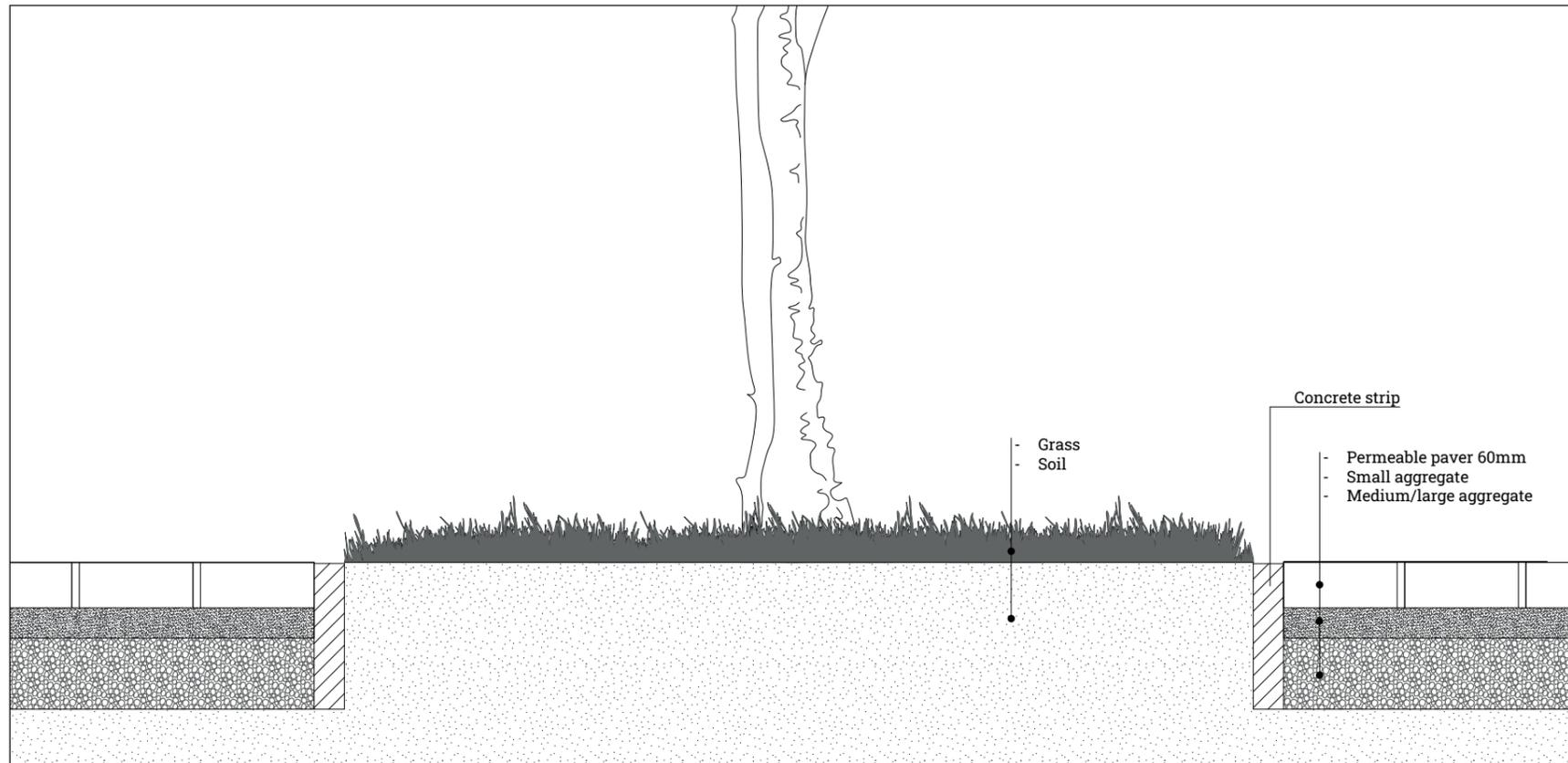
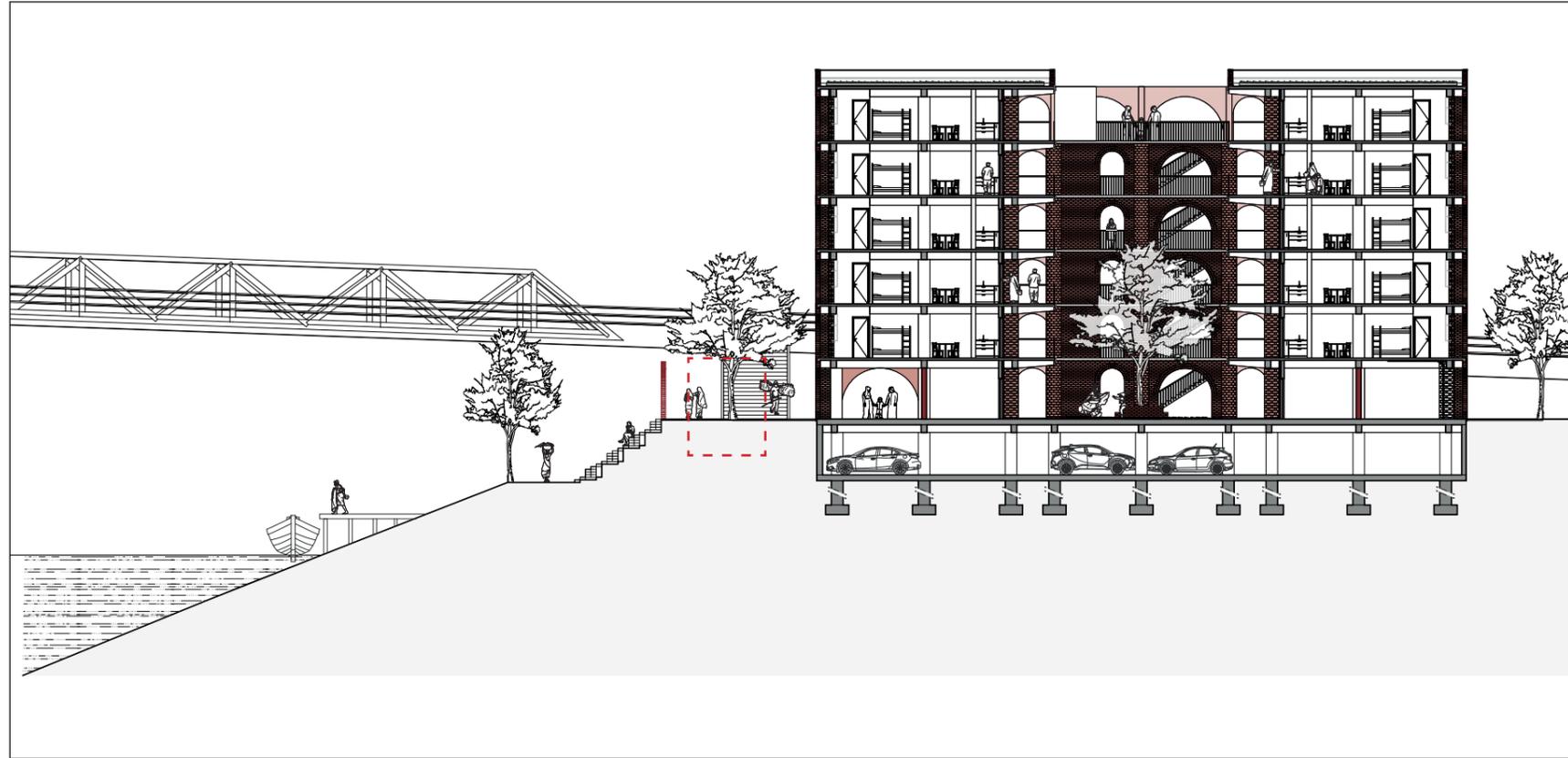
04 Environmental Strategy - Water management



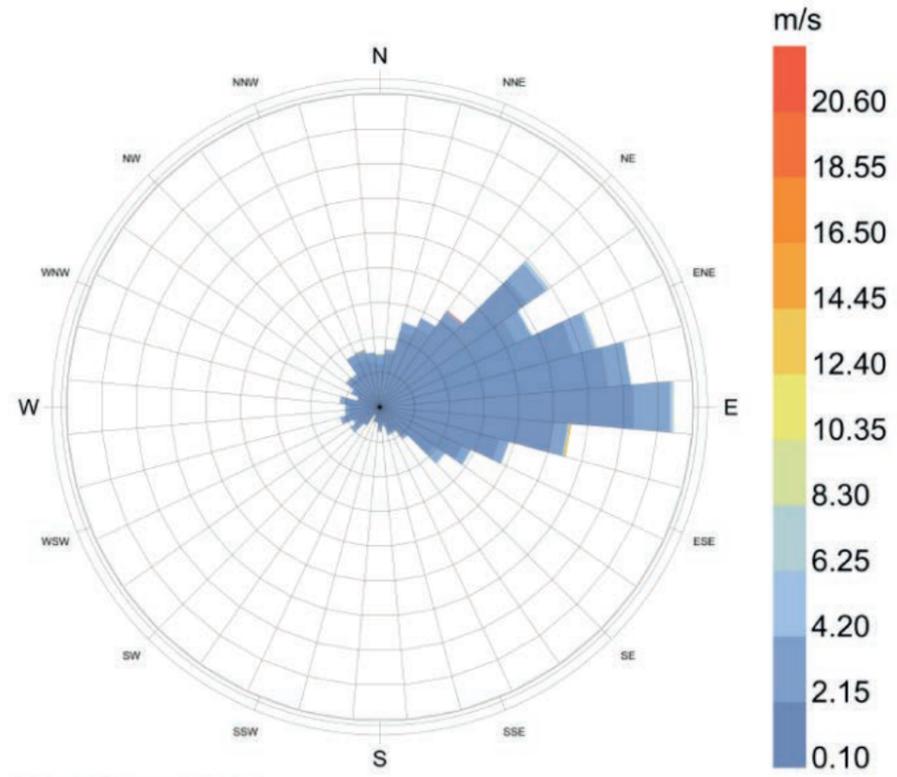
04 Environmental Strategy - Water conservation



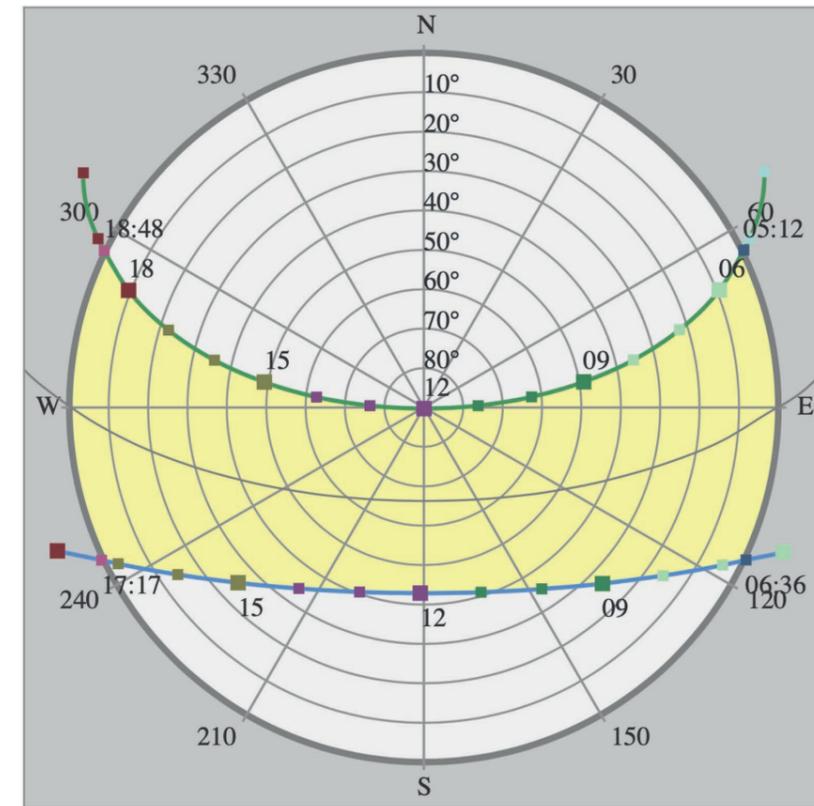
04 Environmental Strategy - Greenery



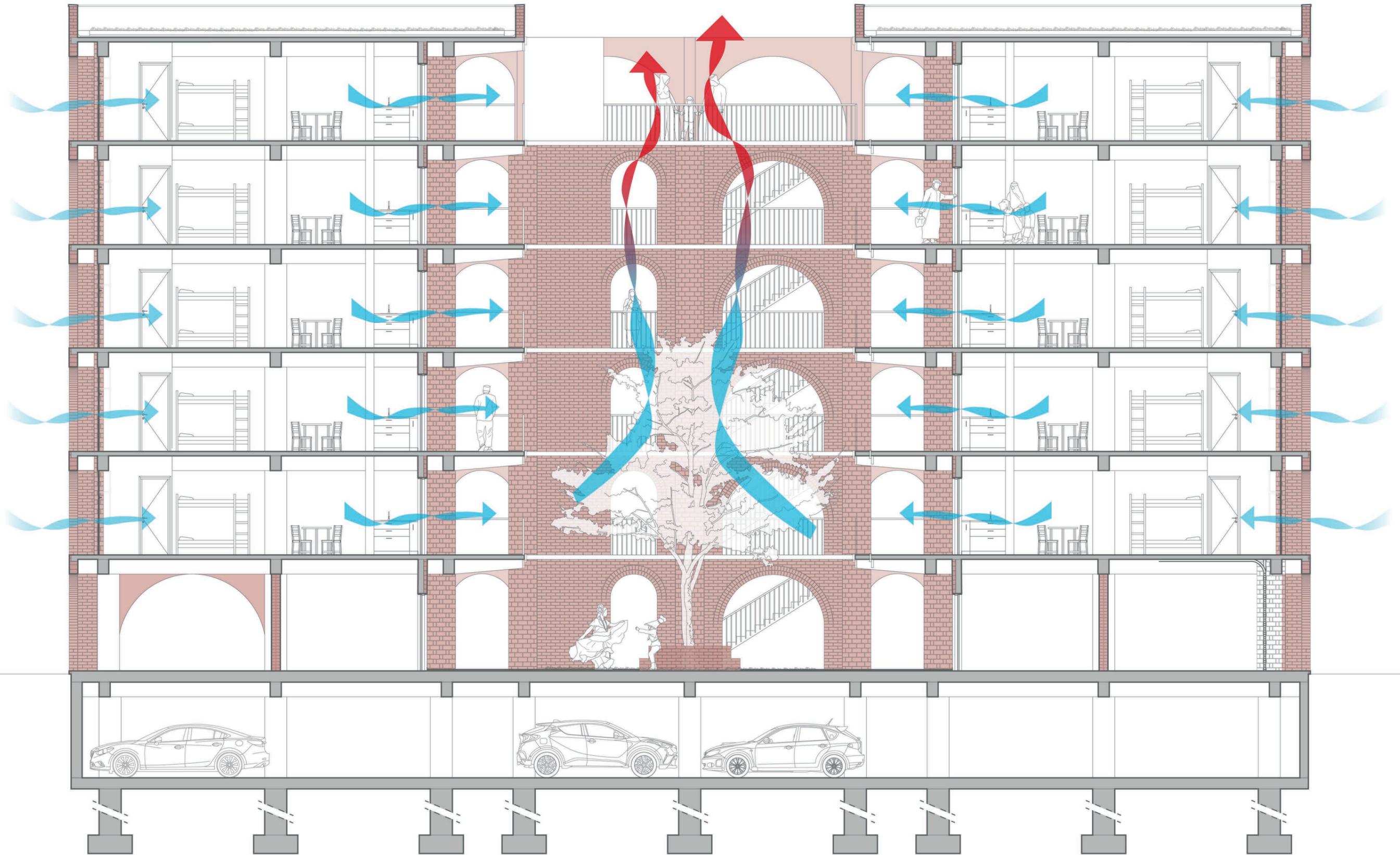
04 Environmental Strategy - Ventilation & Sun path



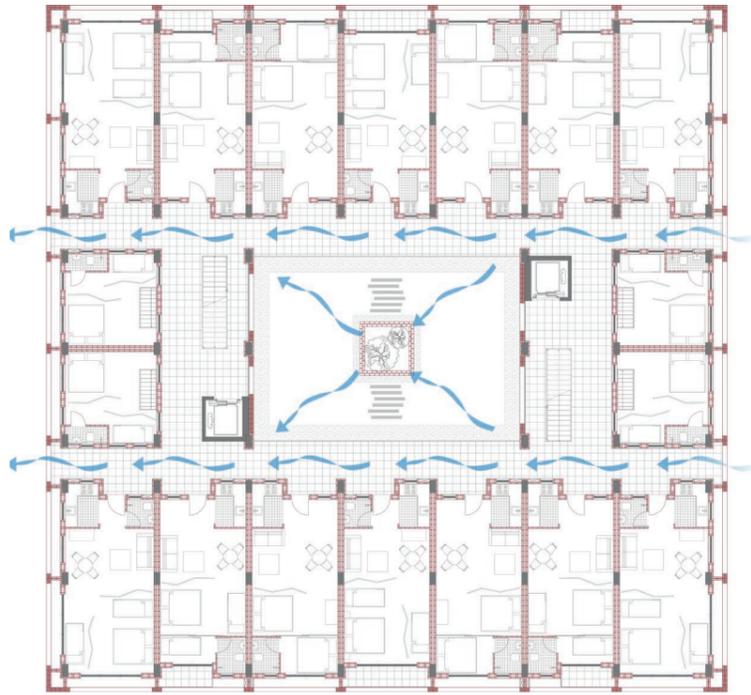
Wind Speed (m/s)
 city: Sylhet
 country: BGD
 time-zone: 6.0
 source: SRC-TMYx
 period: 1/1 to 12/31 between 0 and 23 @1
 Calm for 5.14% of the time = 218 hours.
 Each closed polyline shows frequency of 1.2% = 50 hours.



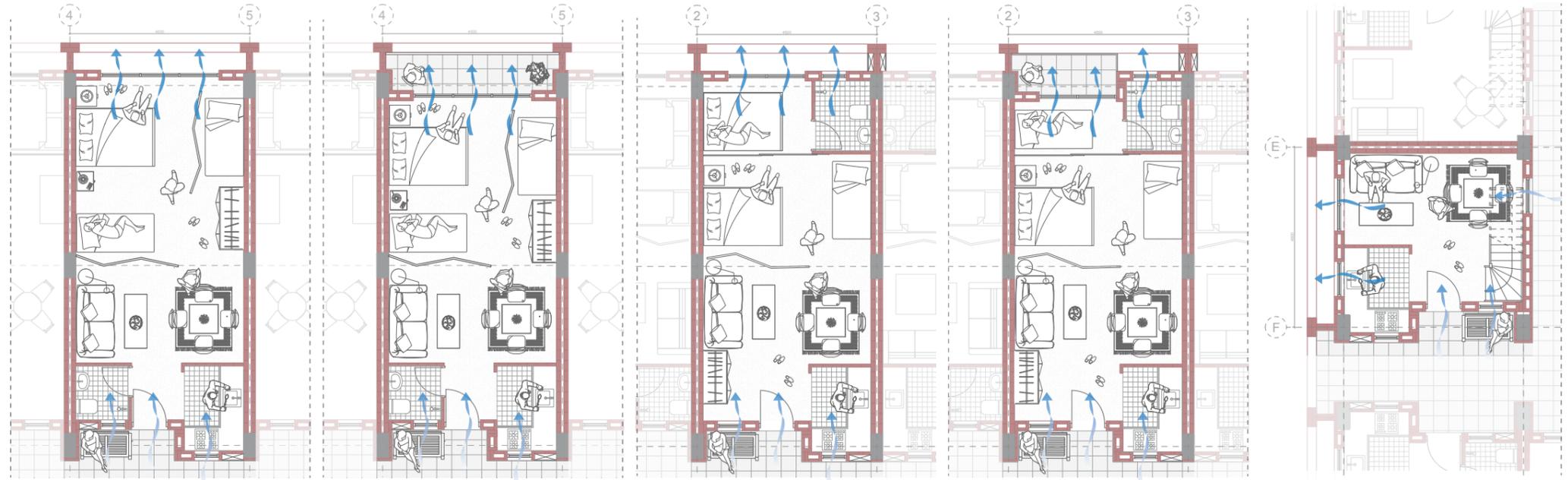
04 Environmental Strategy - Ventilation



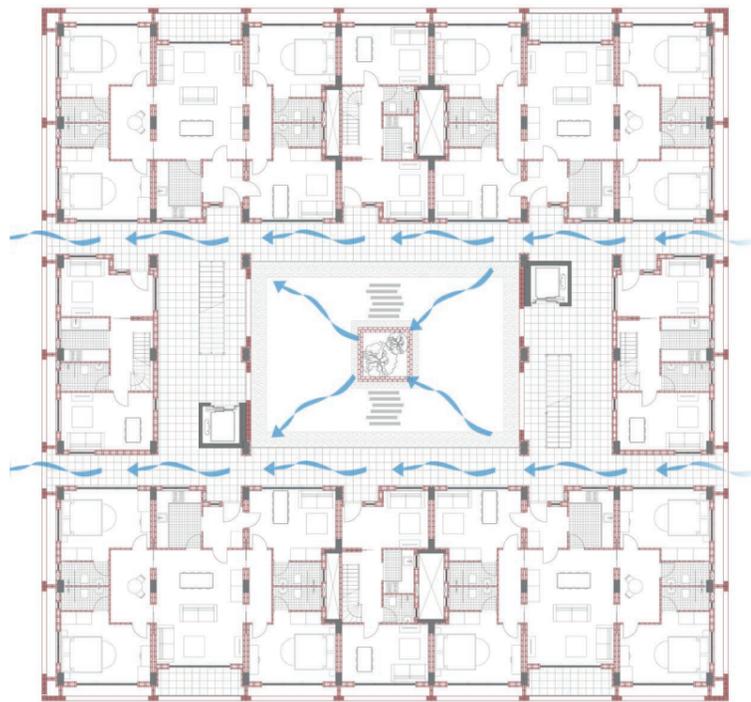
04 Environmental Strategy - Ventilation



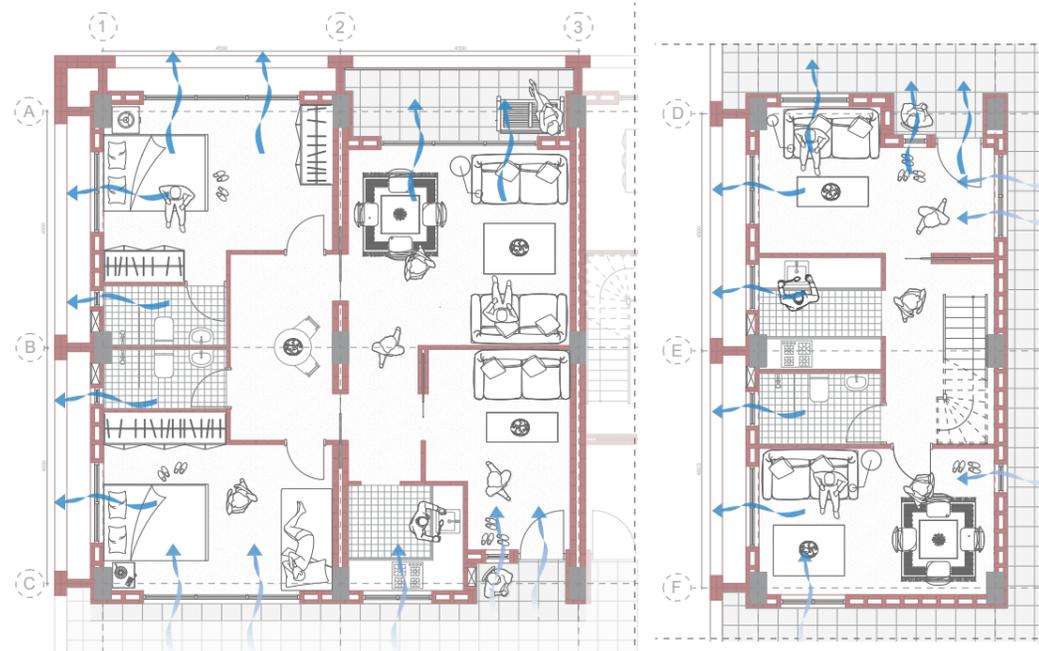
Cross ventilation at low-income cluster



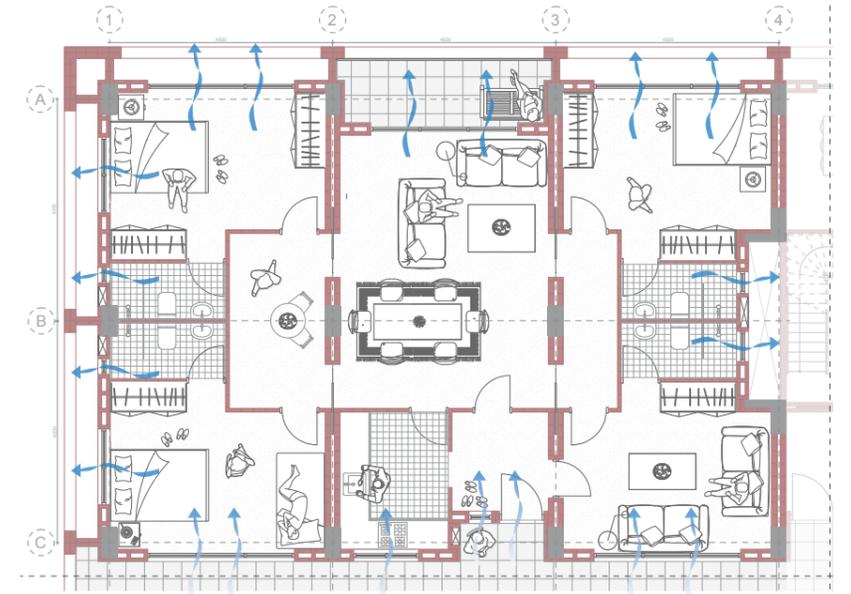
Passive ventilation in low-income housing units



Cross ventilation at mid- and high-income cluster

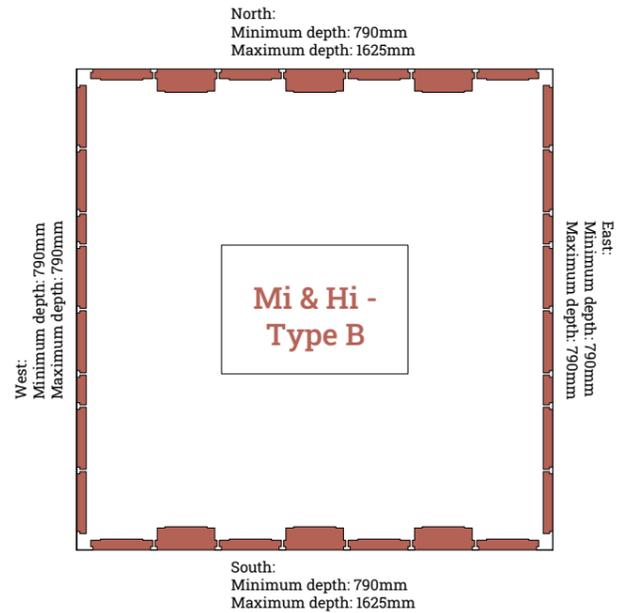
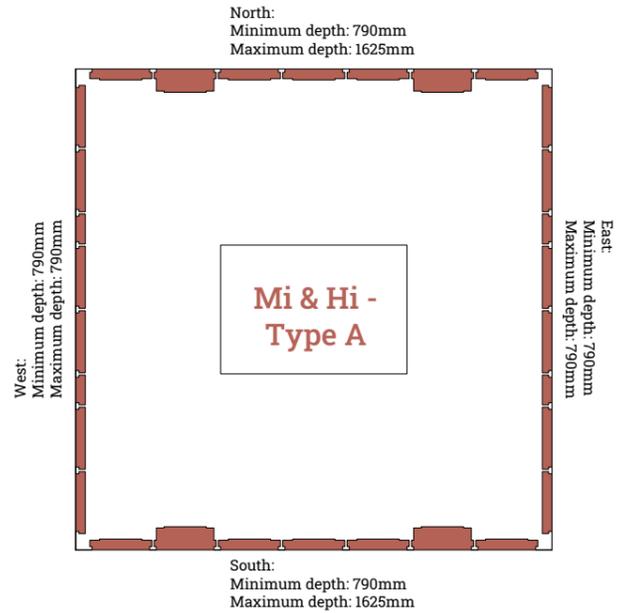
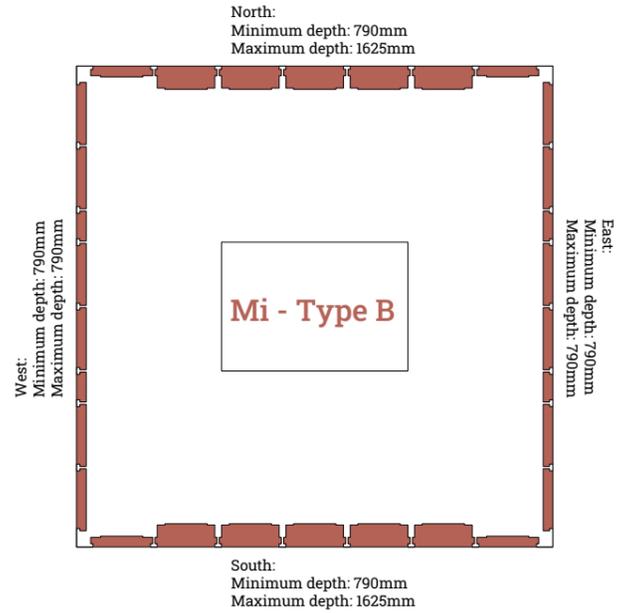
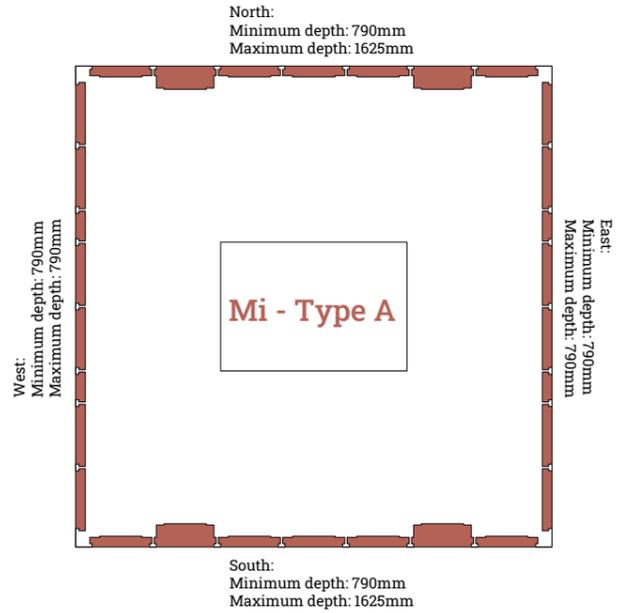
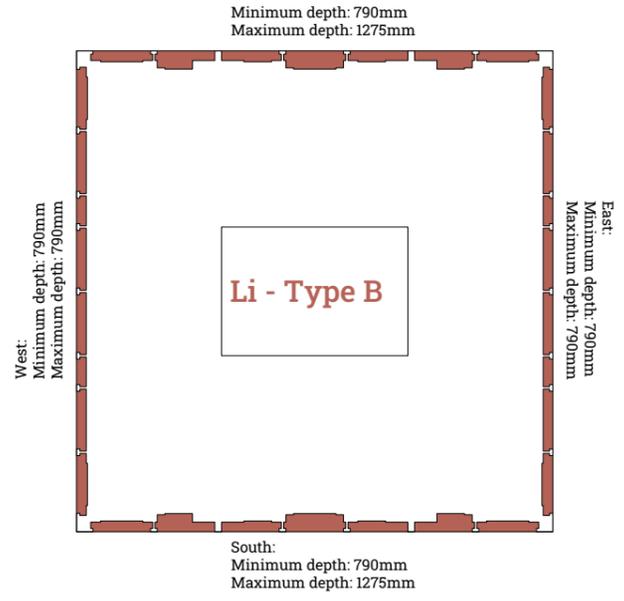
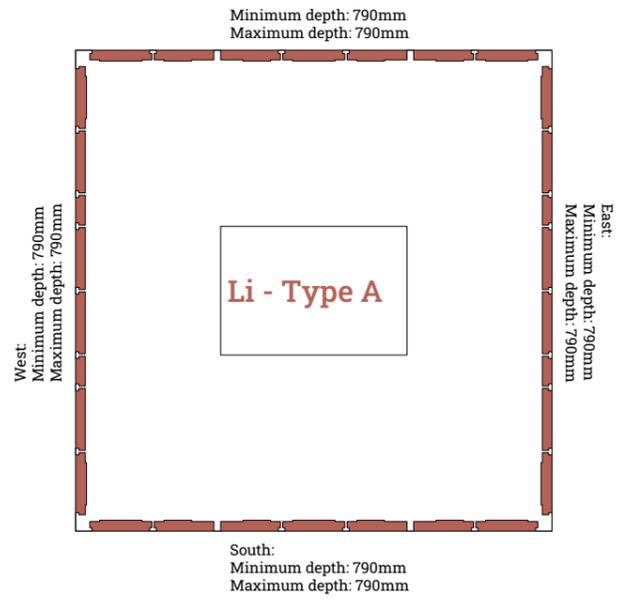


Passive ventilation in mid-income housing units



Passive ventilation in high-income housing unit

04 Environmental Strategy - Solar protection



Shading

Depth: 790mm
Minimum angle sun: 30°

Depth: 1275mm
Minimum angle sun: 43°

Depth: 1625mm
Minimum angle sun: 50°

South
Sep-Feb

West
May 13:00-18:00

East
May 06:00-11:00

South
Nov-Jan

West
-

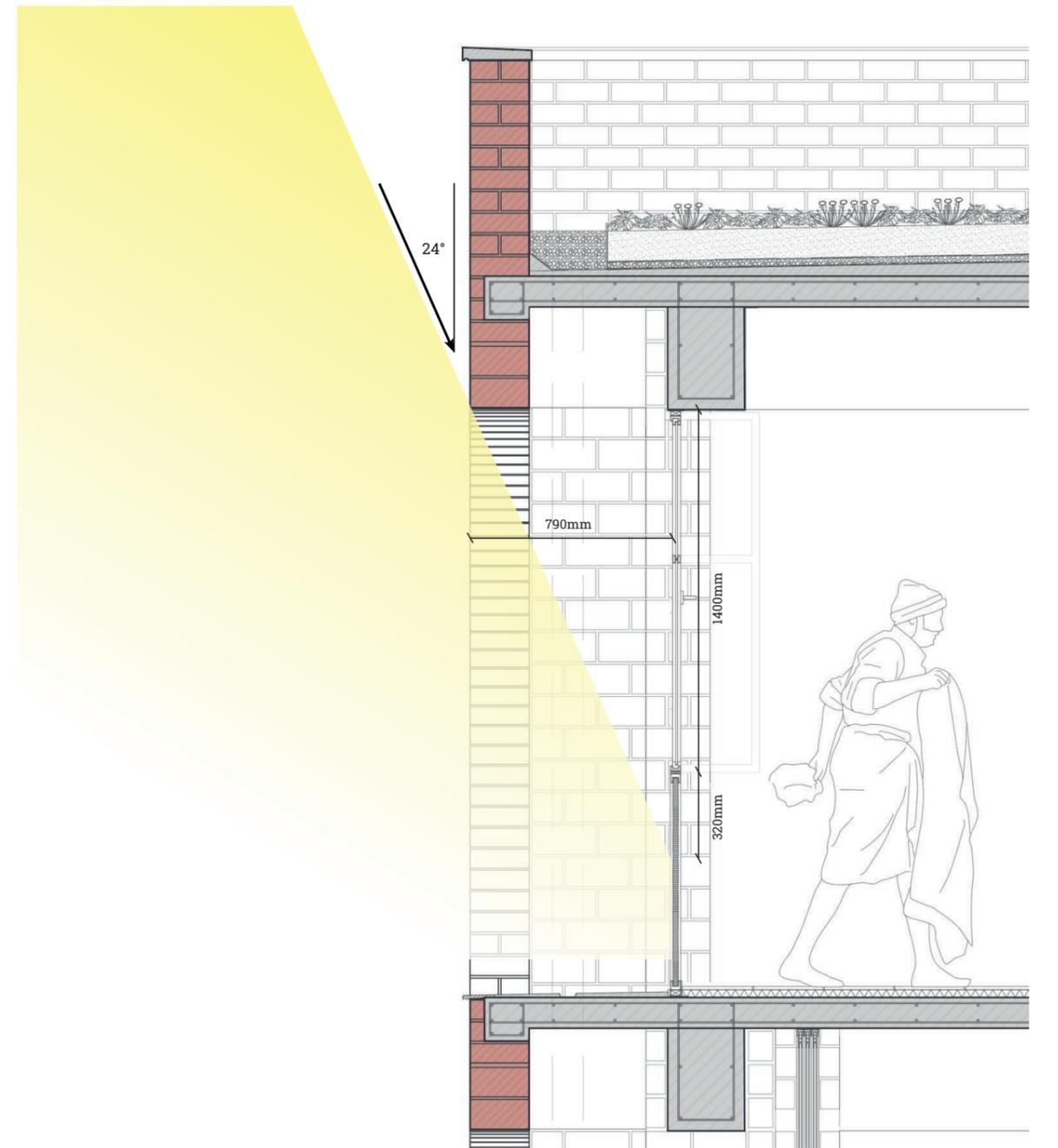
East
-

South
-

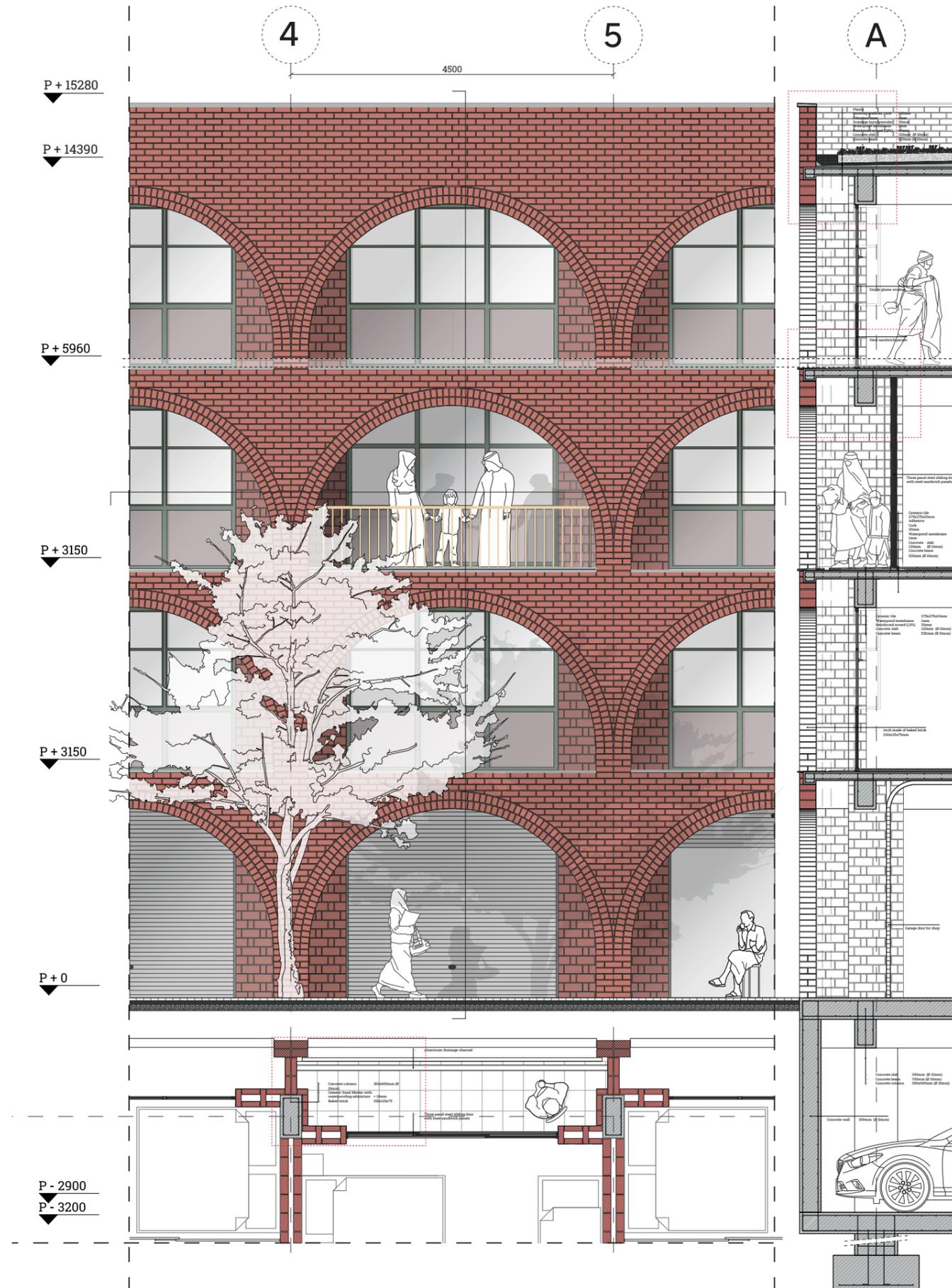
West
-

East
-

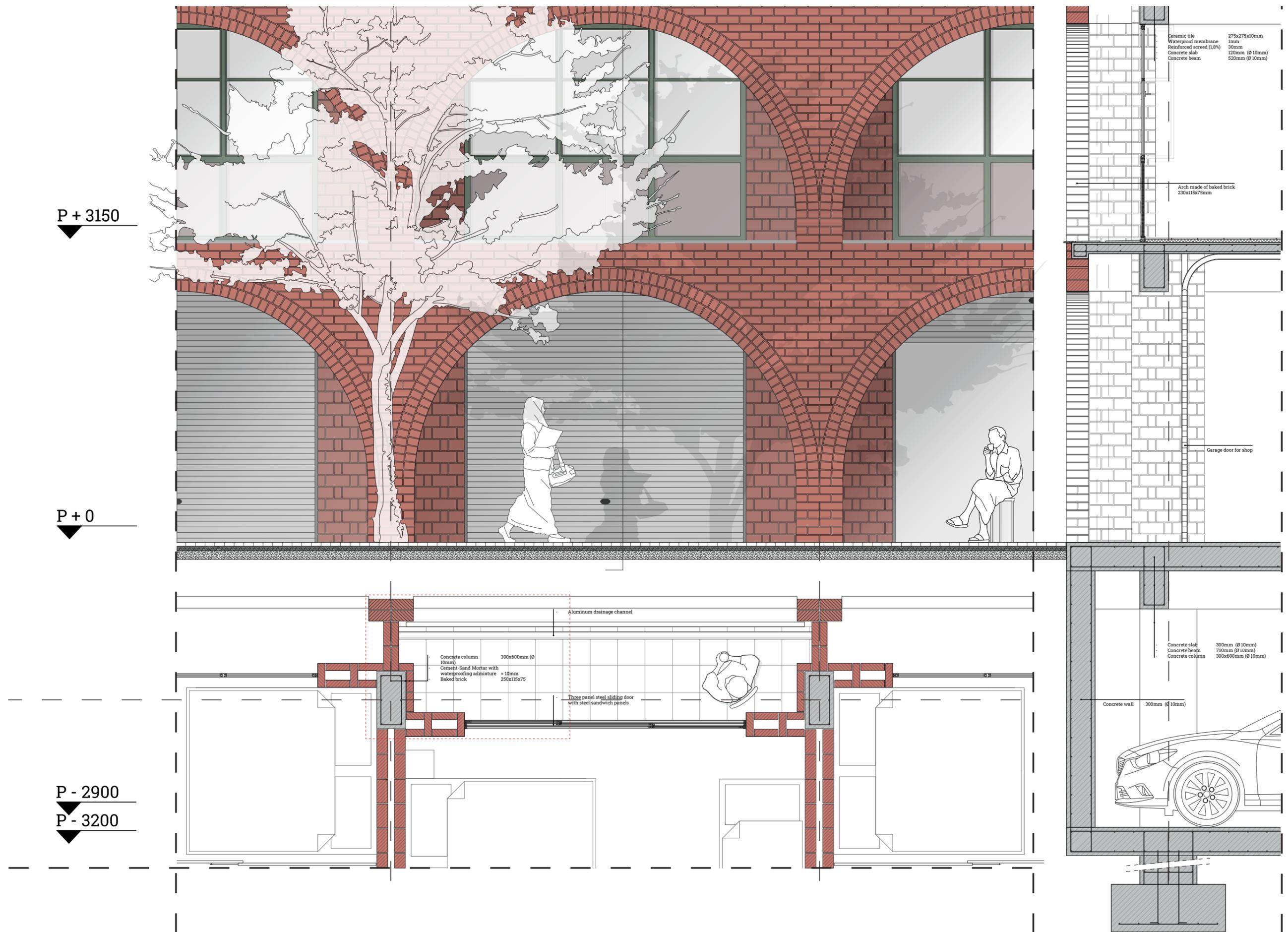
Average sun angle south



04 Fragment



04 Fragment



P + 3150

P + 0

P - 2900

P - 3200

Ceramic tile 275x275x10mm
 Waterproof membrane 1mm
 Reinforced screed (1,8%) 30mm
 Concrete slab 120mm (Ø 10mm)
 Concrete beam 520mm (Ø 10mm)

Arch made of baked brick
 230x115x75mm

Garage door for shop

Concrete column 300x600mm (Ø 10mm)
 Cement-Sand Mortar with waterproofing admixture = 10mm
 Baked brick 230x115x75

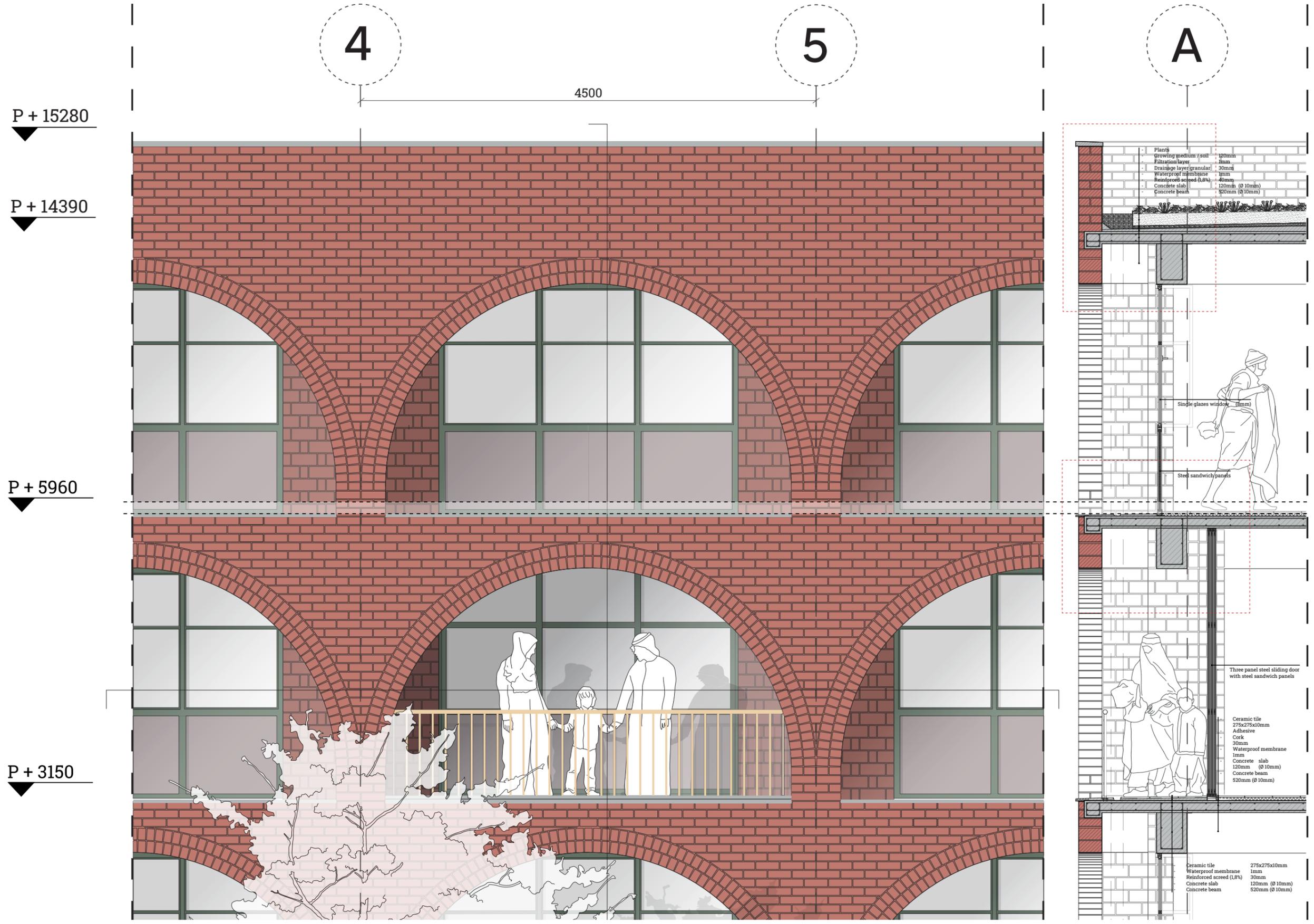
Three panel steel sliding door with steel sandwich panels

Aluminum drainage channel

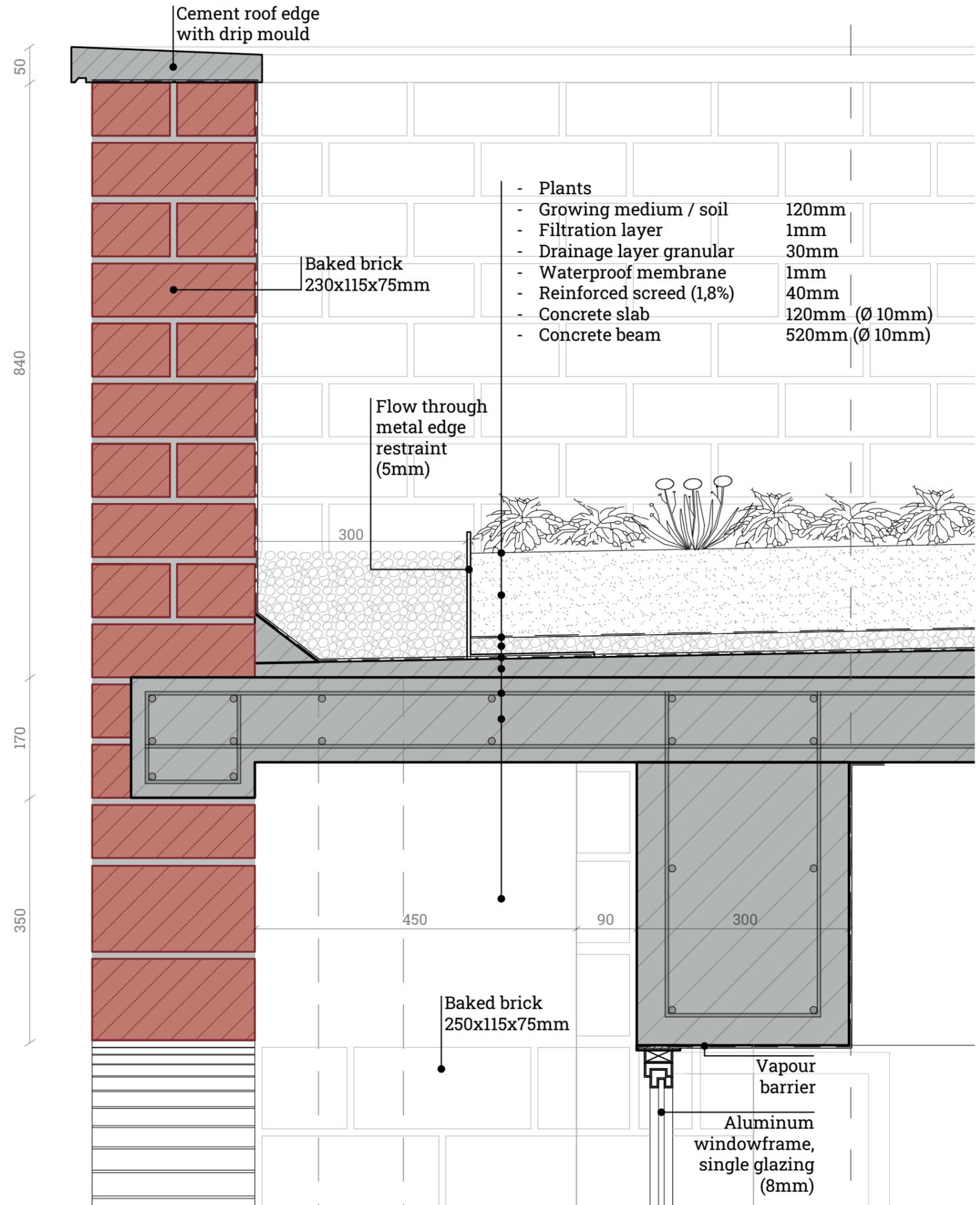
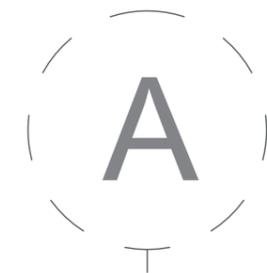
Concrete slab 300mm (Ø 10mm)
 Concrete beam 700mm (Ø 10mm)
 Concrete column 300x600mm (Ø 10mm)

Concrete wall 300mm (Ø 10mm)

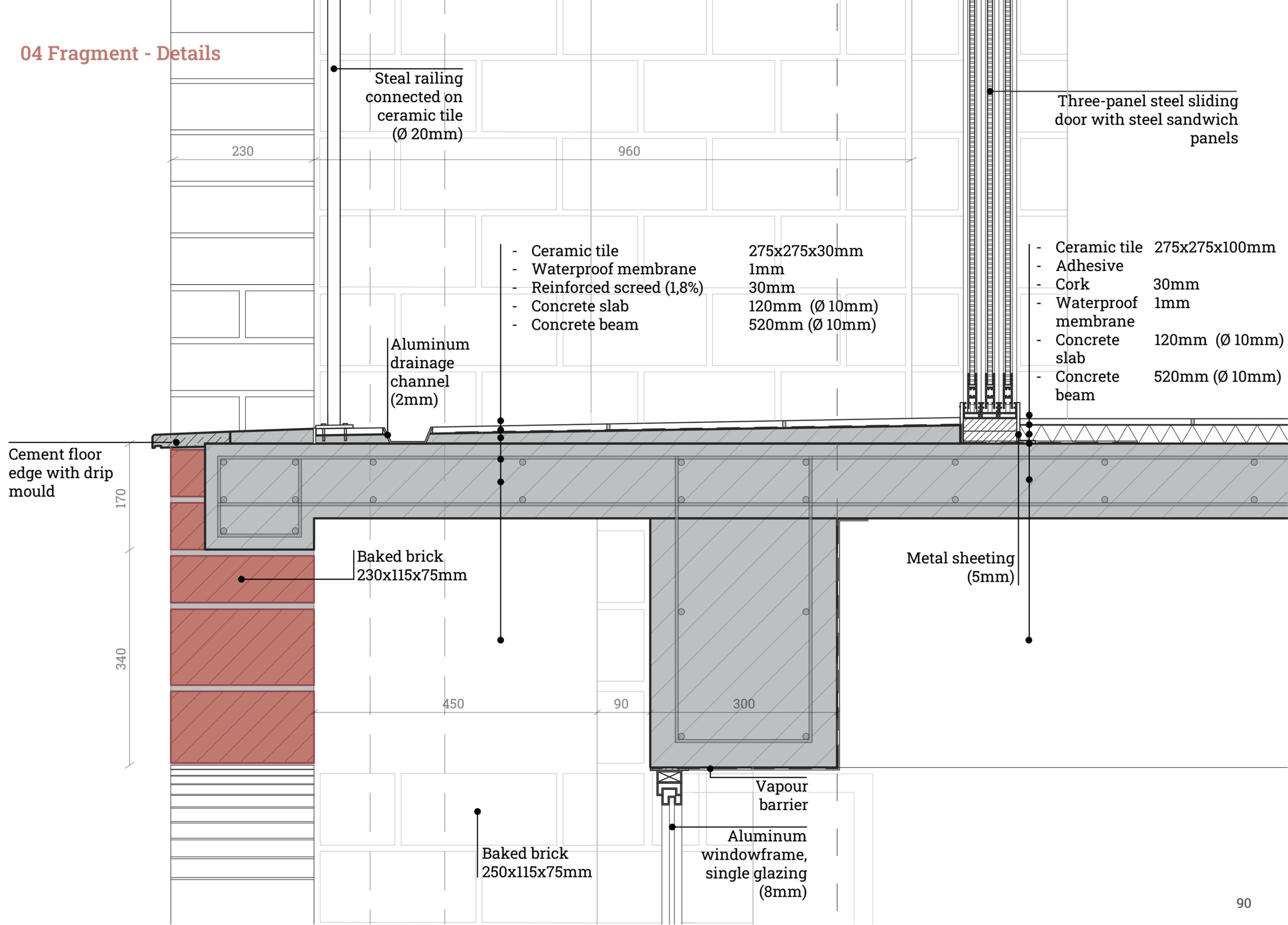
04 Fragment



04 Fragment - Details



04 Fragment - Details



Steel railing
connected on
ceramic tile
(Ø 20mm)

Three-panel steel sliding
door with steel sandwich
panels

230

960

- Ceramic tile 275x275x30mm
- Waterproof membrane 1mm
- Reinforced screed (1,8%) 30mm
- Concrete slab 120mm (Ø 10mm)
- Concrete beam 520mm (Ø 10mm)

Aluminum
drainage
channel
(2mm)

- Ceramic tile 275x275x100mm
- Adhesive
- Cork 30mm
- Waterproof membrane 1mm
- Concrete slab 120mm (Ø 10mm)
- Concrete beam 520mm (Ø 10mm)

Cement floor
edge with drip
mould

170

Baked brick
230x115x75mm

Metal sheeting
(5mm)

340

450

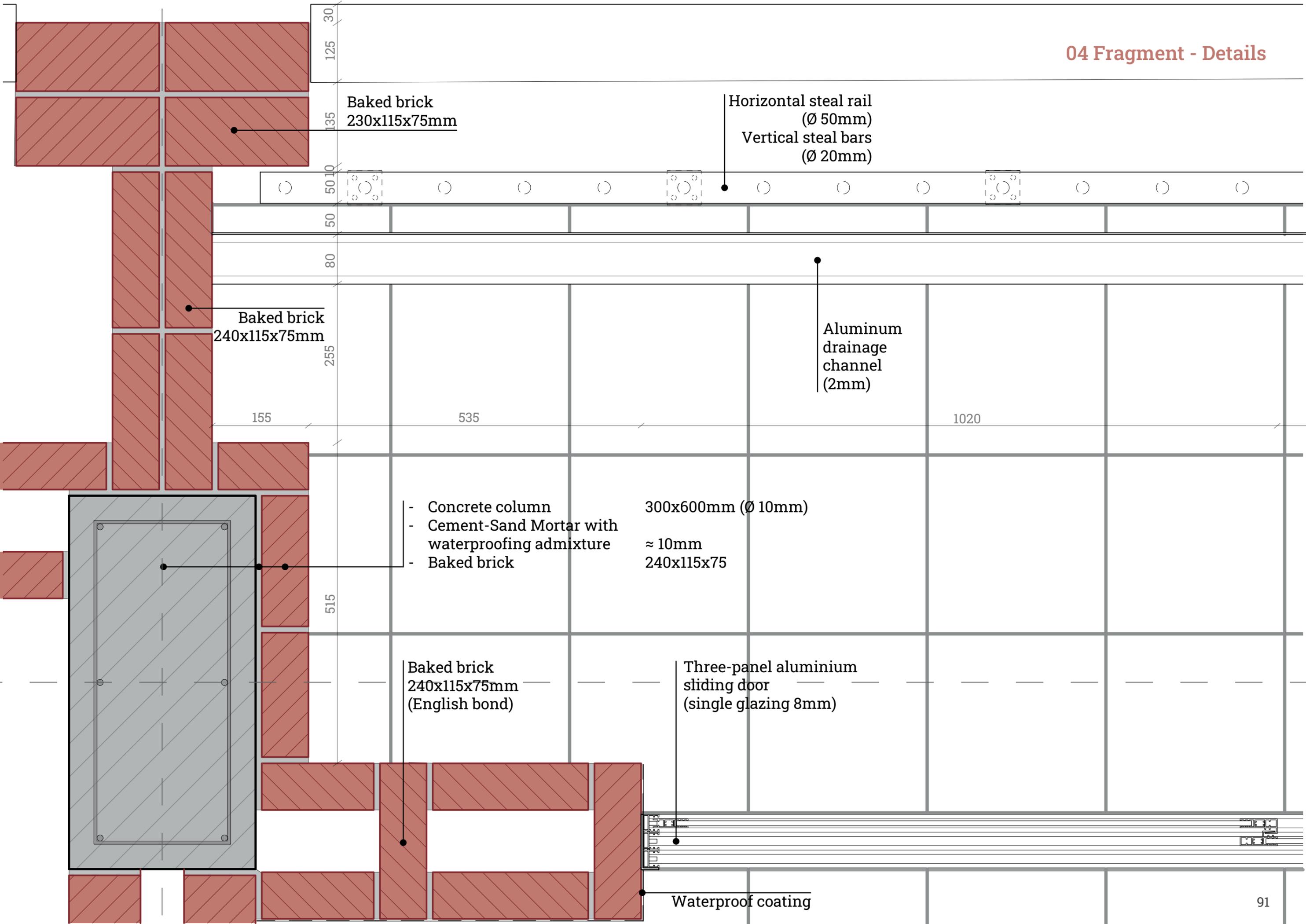
90

300

Vapour
barrier

Aluminum
windowframe,
single glazing
(8mm)

Baked brick
250x115x75mm



Baked brick
230x115x75mm

Horizontal steel rail
(Ø 50mm)
Vertical steel bars
(Ø 20mm)

Baked brick
240x115x75mm

Aluminum
drainage
channel
(2mm)

- Concrete column 300x600mm (Ø 10mm)
- Cement-Sand Mortar with waterproofing admixture ≈ 10mm
- Baked brick 240x115x75

Baked brick
240x115x75mm
(English bond)

Three-panel aluminium
sliding door
(single glazing 8mm)

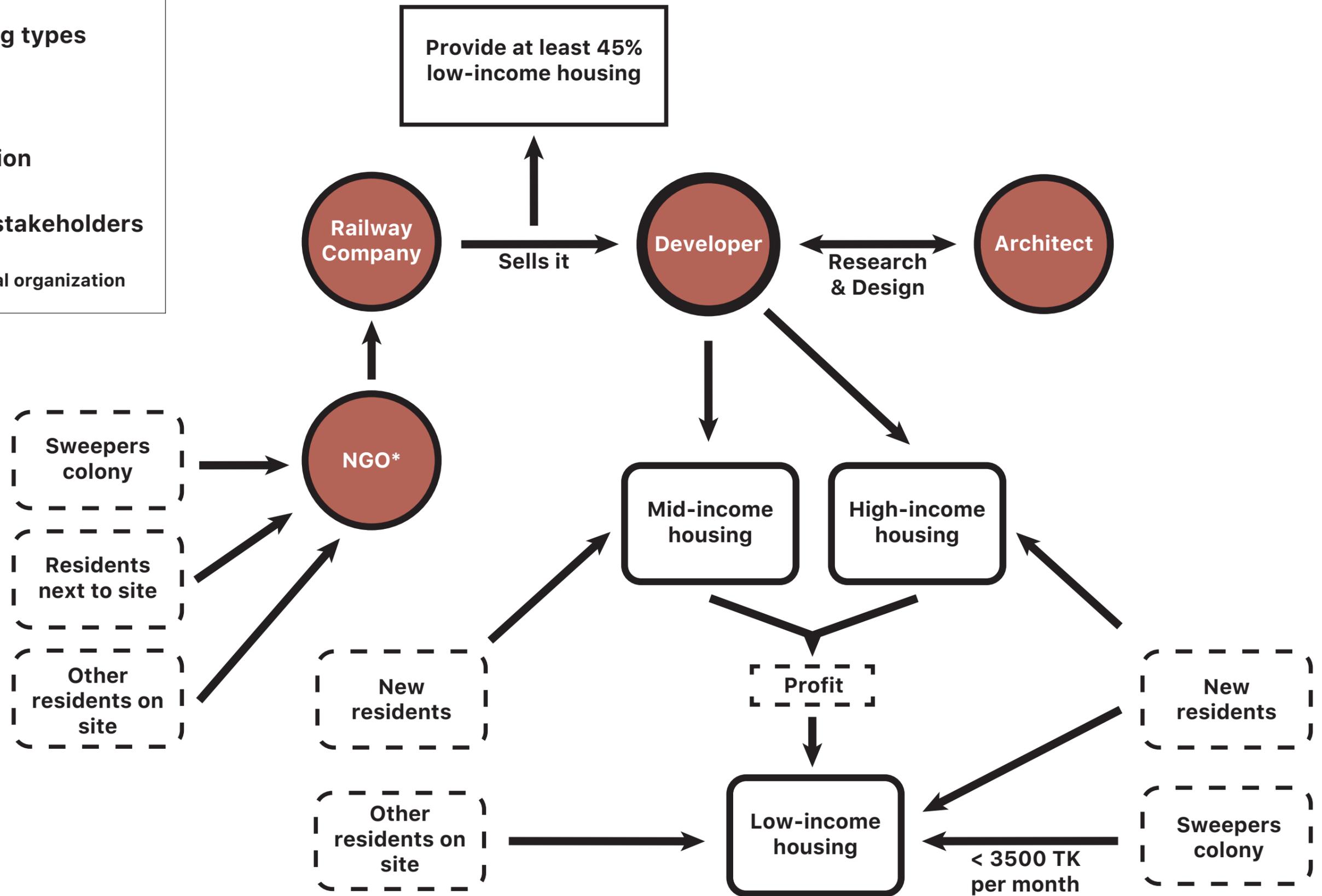
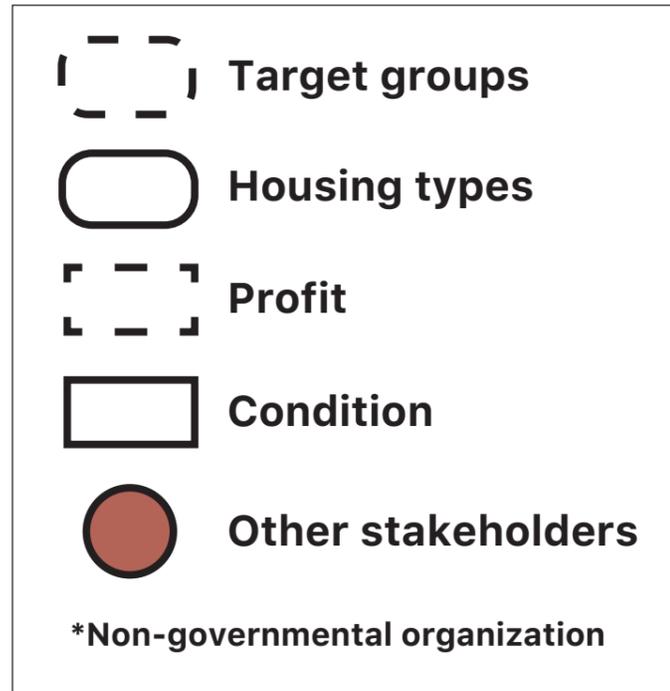
Waterproof coating

05

05 Managerial Strategy

- Financial model
- Phasing
- Abacus

05 Financial model



05 Financial model

Main function list

Low-income housing

Unit	Area	Area loggia	Units
Type A	36,8 m2	-	150
Type B	34,7 m2	4,1 m2	50
Type C	36,8 m2	-	200
Type D	35,6 m2	2,5 m2	100
Type E	37,8 m2	-	36
			Total units
			536
			Total area (inside)
			19.536 m2 (46,7%)

Estimated construction costs
965.850.000 Tk

Mid-income housing

Unit	Area	Area loggia	Units
Type A	70 m2	5,5 m2	104
Type B	71,5 m2	5,5 m2	90
Type C	80,4 m2	-	38
			Total units
			232
			Total area (inside)
			16.770 m2 (40,1%)

High-income housing

Unit	Area	Area loggia	Units
Type A	115,9 m2	5,5 m2	48
			Total units
			48
			Total area (inside)
			5.562 m2 (13,2%)

Estimated construction costs
1.381.380.000 Tk

Selling costs
2.762.760.000 Tk (ROI 100%)

Shops

Area	Units
38 m2	24
18,9 m2	90
Total units	
114	
Total area	
2613 m2	

Cafes / Restaurant

Area	Units
38 m2	26
18,9 m2	14
Total units	
40	
Total area	
1.253 m2	

Parking

Parking spots
130 (46,4%)

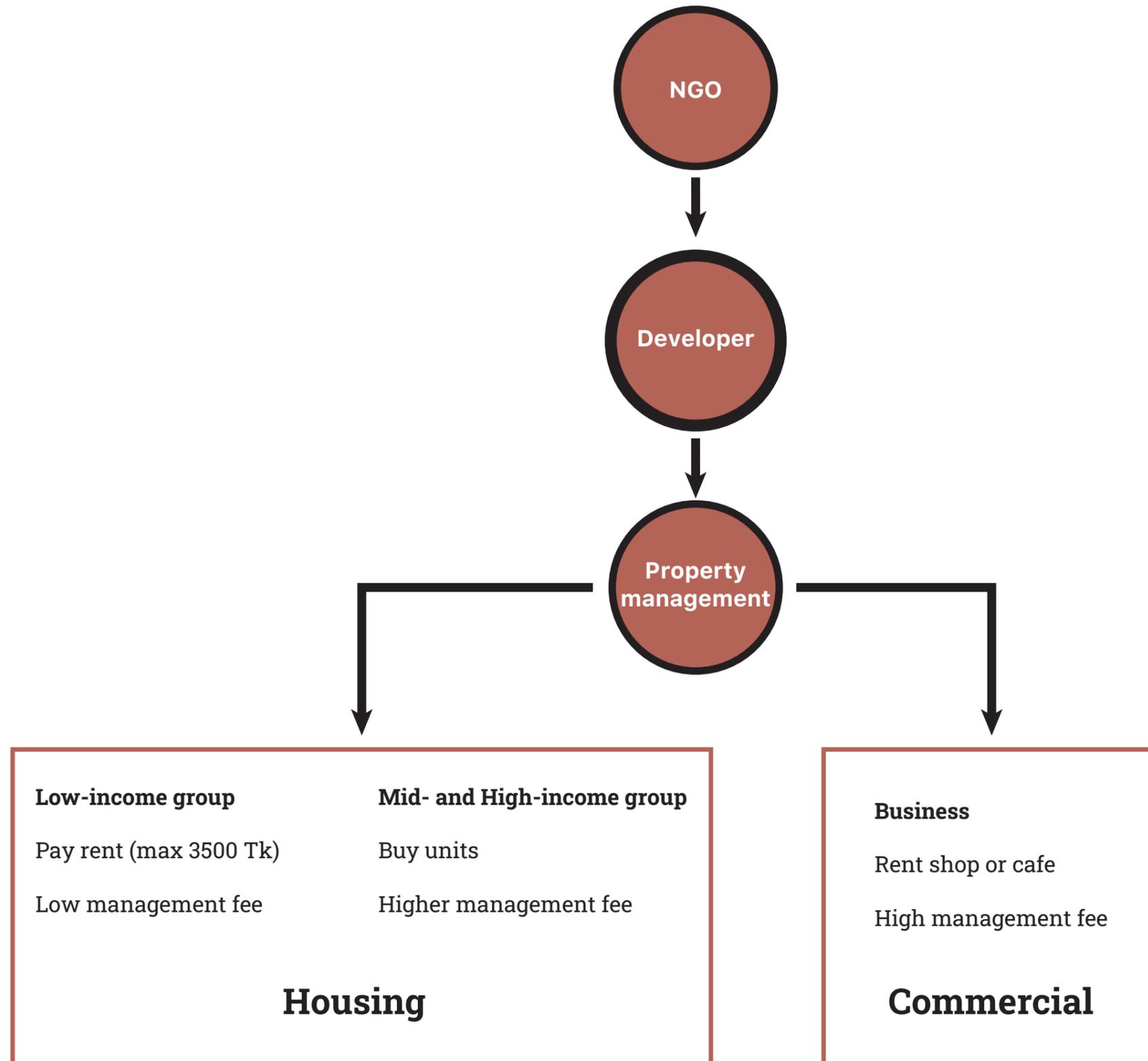
Total area
6447 m2

05 Abacus

	Previous situation	New Development
Area	3,41 ha	3,14
FSI	0,22	2,11
GSI	0,17	0,32
Unit / ha	17	239
Low income	60	536
Middle income	-	232
High income	-	48



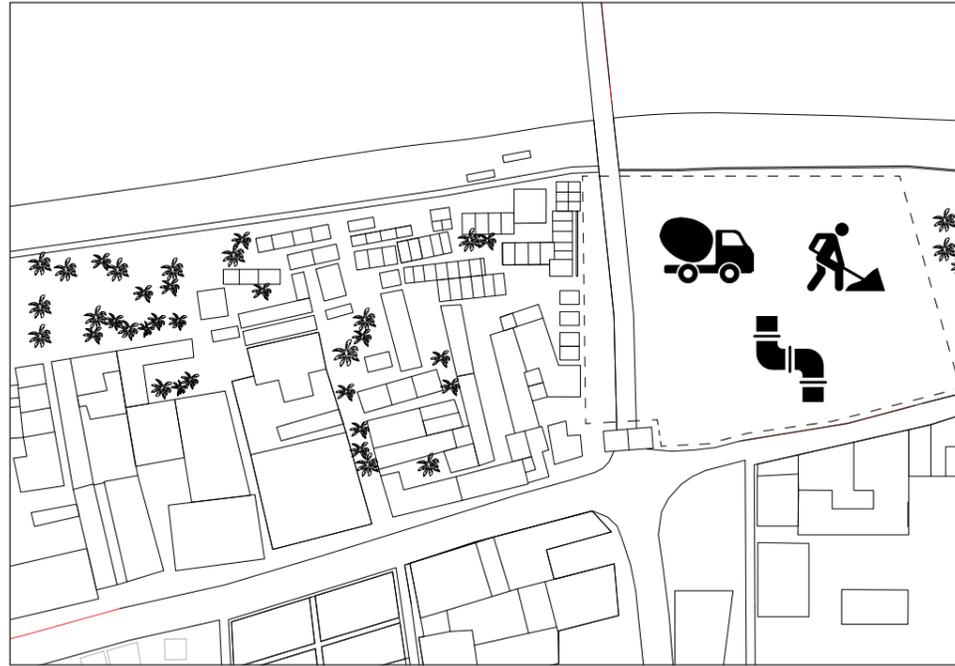
05 Financial model - Maintenance



05 Phasing



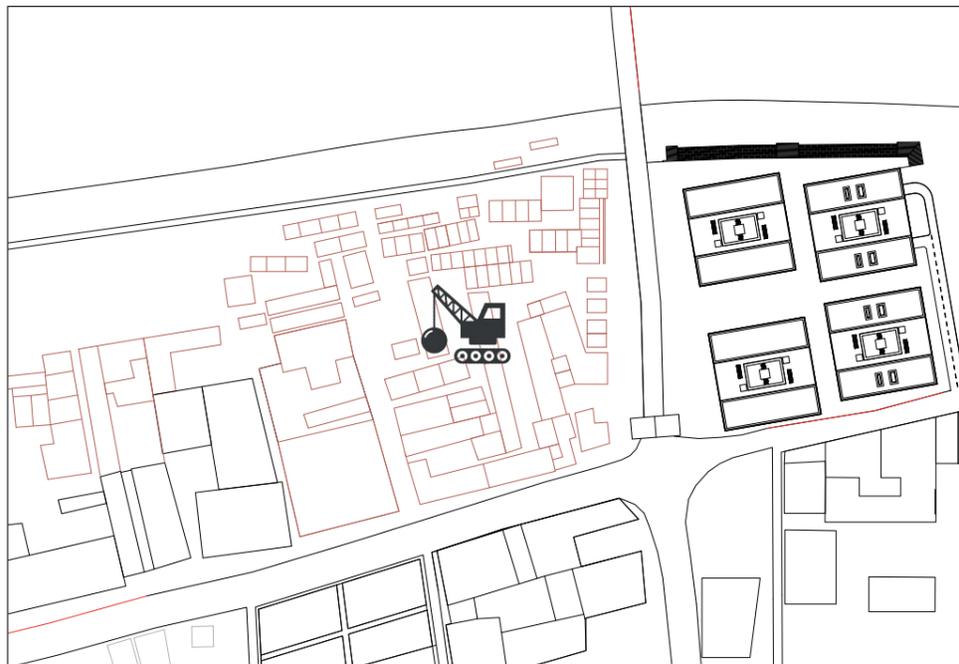
1. Demolition (Sawmill area)



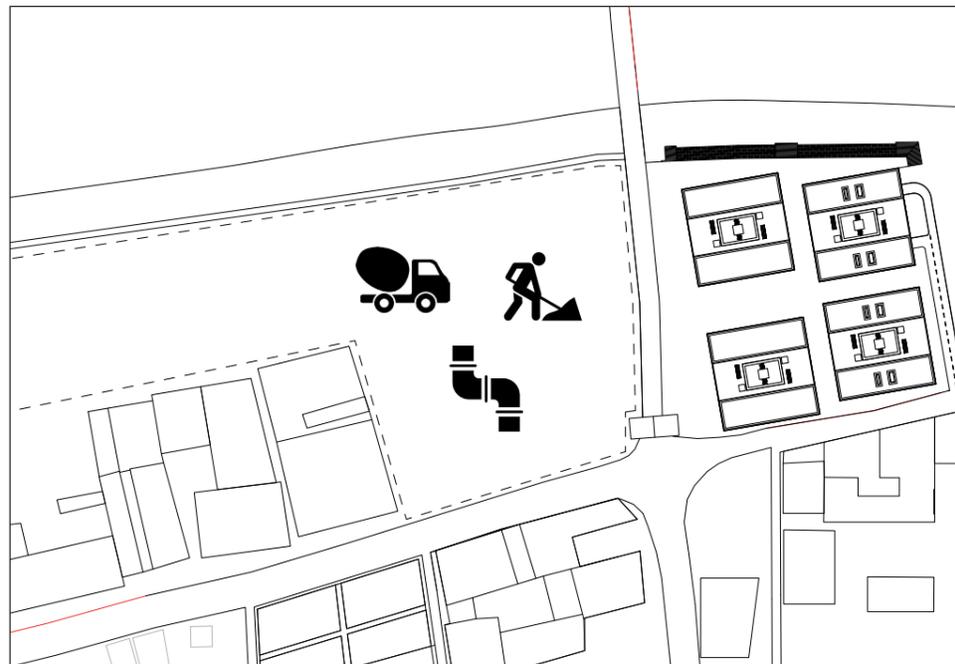
2. Excavation and infrastructure installation



3. Clusters construction, Sweepers colony can move in



4. Demolition (Sweepers Colony)



5. Excavation and infrastructure installation



6. Clusters construction, people can move in

05 Phasing - 6. Landscaping



06

06 Impressions

