

SHONATOLA LOW-COST HOUSING

architecture for the people

INCREMENTAL ARCHITECTURE, URBANISM, AND FLOOD-
RESILIENCE AS AN ANSWER TO RAPID URBANISATION



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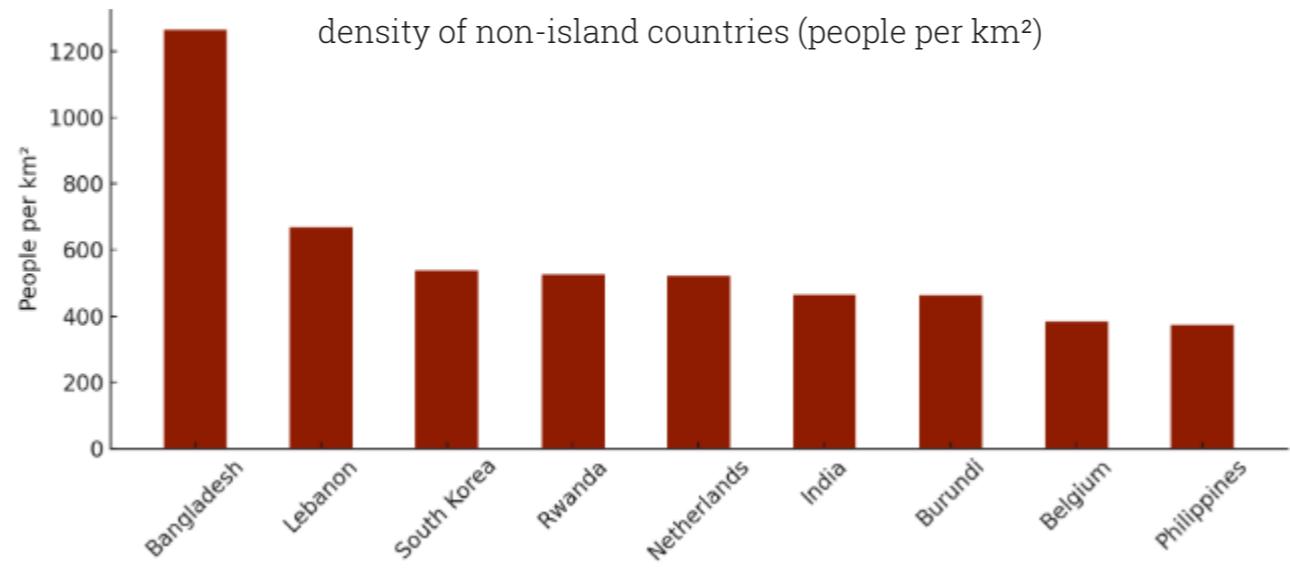
what's the point?

incremental housing and flood-resilience solutions for Bangladesh

**By 2050, 70% of the world will be urbanised
By then, 3 billion people will live in informal settlements**

(United Nations Statistics Division, 2023)

(Hossen, 2023)



Bangladesh is one of the **densest** countries in the world.

Cities are overflowing, leading to the formation of **informal settlements**

(Data from Bangladesh Bureau of Statistics, 2024)



climate change

extreme floods
prolonged droughts
climate-induced migration



**rapid urbanisation
extreme poverty
slum formation
inadequate housing solutions**

research

incremental housing and flood-resilience solutions for Bangladesh

Housing as a verb

housing is not static, but an activity and a vehicle for personal and community development

(Aravena Mori & Iacobelli, 2016; Correa, 1989; Turner, 1972; Wakely & Riley, 2011)

Incremental housing

“A conceptual approach to the design of houses that can **gradually accommodate** vertical and/or horizontal **changes and expansions**, evolving from the initial configuration in a series of increments over time”

(Mota, 2021)

What main lessons can be learned from incremental housing projects from the past?

How can **incremental housing** strategies be made **site-specific** and suited to the **flood-susceptible** context of Sylhet to create affordable, **context-based** housing solutions?

What minimum flood-resilient design measures can be employed in an incremental strategy on an architectural and urban scale?

What social and typological features must be integrated into the design to fit with the way of living for the people of Sylhet?

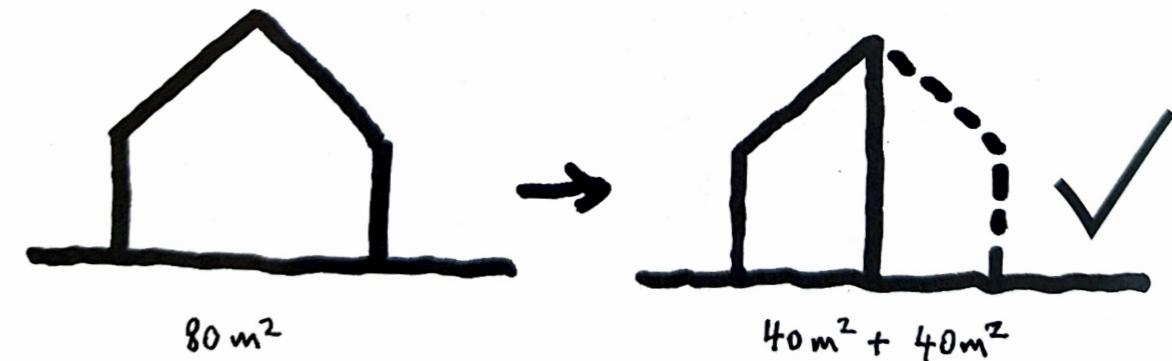
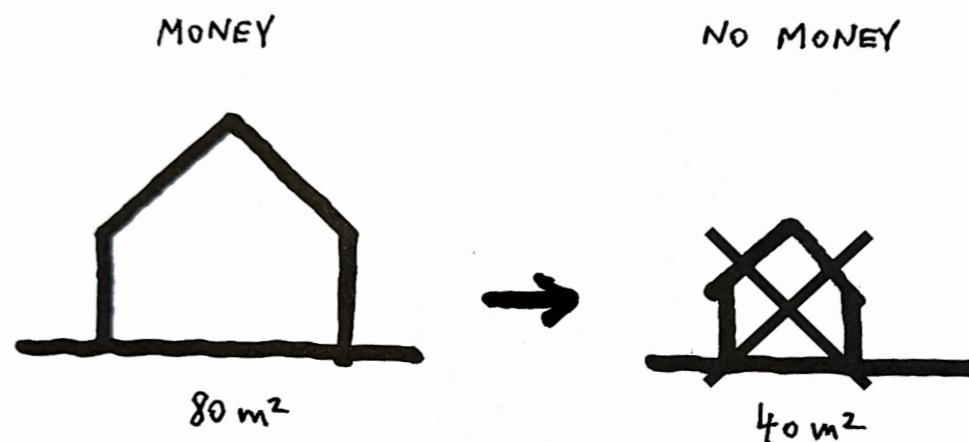
Incremental housing

facilitate affordable and accessible housing through incremental development (physical and financial)

why build fully-developed dwellings for the few?

why not build basic utilities and services of to-be-finished dwellings for the many?

build a sub-standard full house or half a good home?



(Bredenoord et al., 2014; Caminos & Goethert, 1978; Nohn & Goethert, 2017)

(Aravena Mori & Iacobelli, 2016)

Value appreciation

*housing as an **investment** that gains value over time,
instead of just a commodity or social expense.*

Housing becomes a **tool** to **overcome poverty** and not
just a shelter against the environment

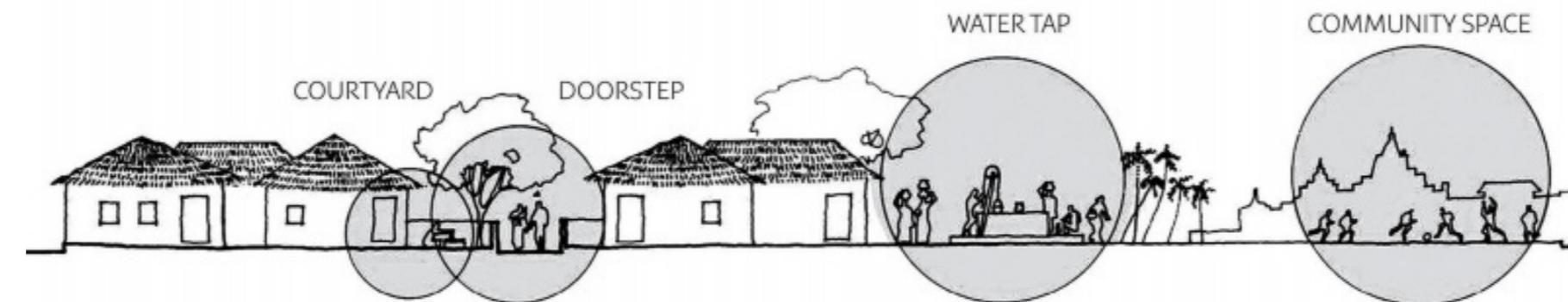
(Aravena Mori & Iacobelli, 2016; Bredenoord et al., 2014; Correa, 1989)

Charles Correa

urban design **facilitates** good living and architecture
neighbourhoods work through hierarchies of spaces

Bill of rights for housing
pluralism
participation
income generation
equity
open-to-sky spaces
disaggregation

(Correa, 1989)



'Hierarchy of Spaces' section by Charles Correa, denoting hierarchy of transitional space in the public realm.

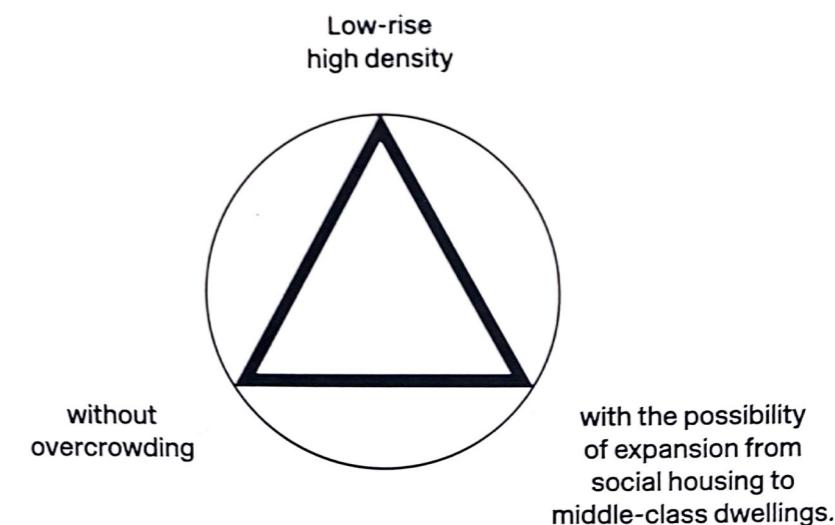
ABC of incremental housing

- A: focus on what is more difficult,
- B: what cannot be done individually
- C: what will guarantee the common good in the future

1. project location that allows density
(*acces to employment*)
2. harmonious growth in time
(*expansions happen thanks to the design, not despite the design*)
3. urban layout: design collective space
4. provide structure for final growth scenario
5. growth scenario of middle class DNA
(*72m², 3 bedrooms, etc.*)

The following projects pursue the goals and principles of *Incremental Housing*.

Make sure you balance:



(Aravena Mori & Iacobelli, 2016)

Managerial strategy

security of tenure

community organisation & participation (bottom-up)

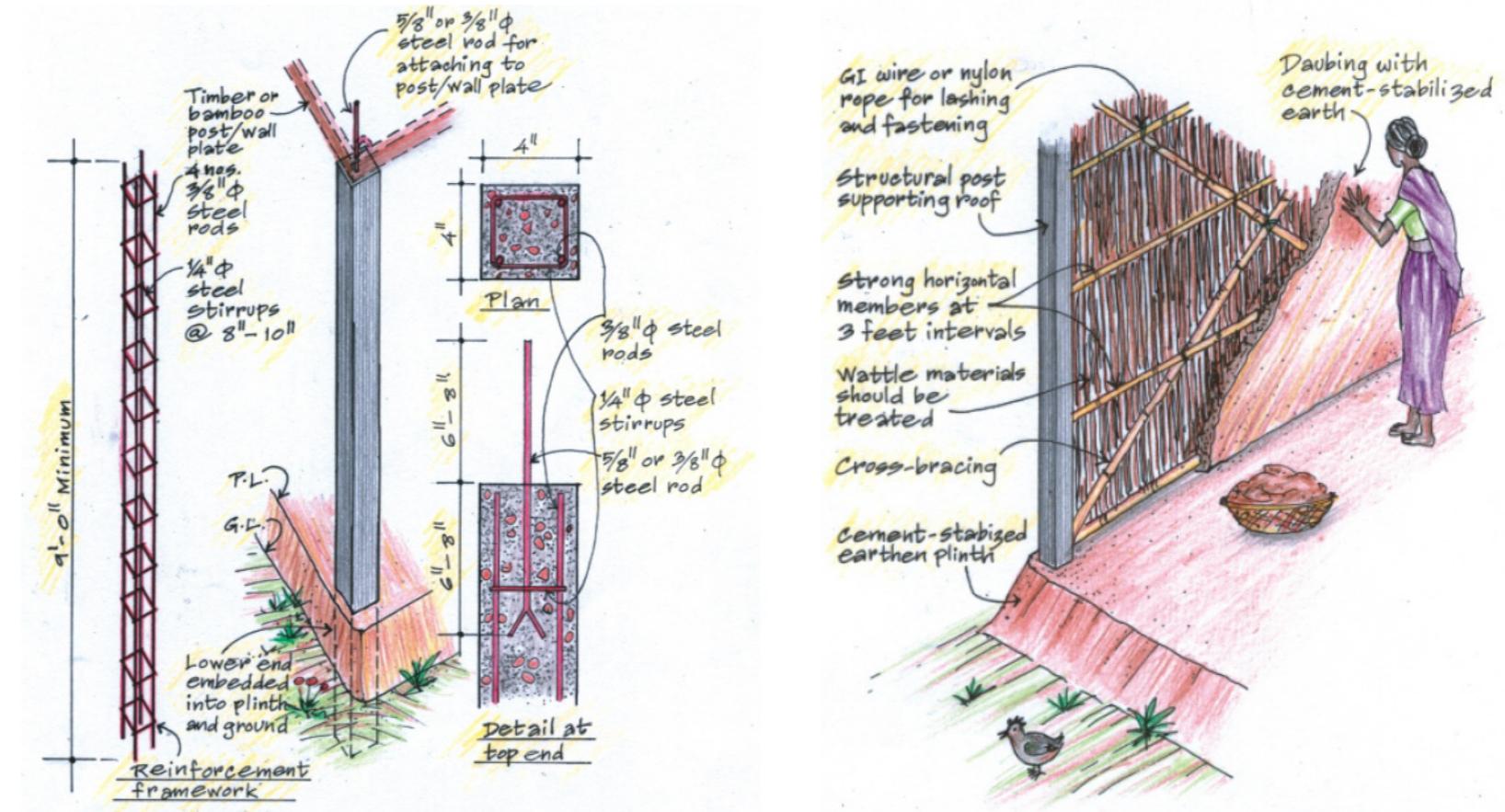
citywide planning (top-down)

long-term management

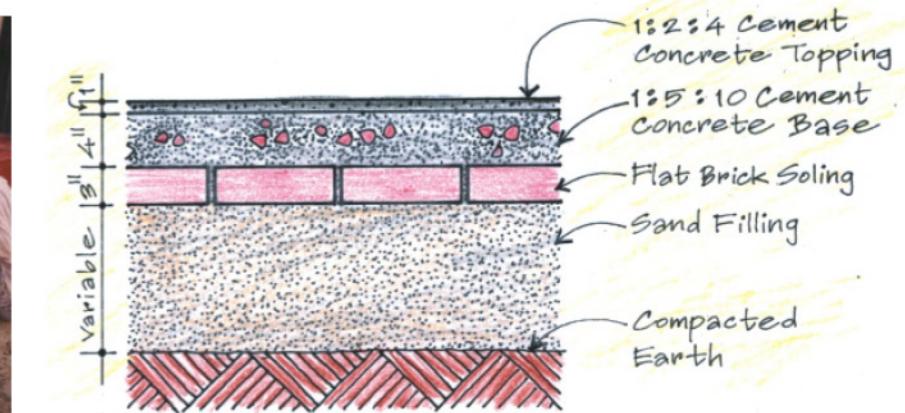
(Wakely & Riley, 2011)

Flood-resilience - small scale

Learn from vernacular architecture
raise plinths
choose building materials based on
longevity and affordability



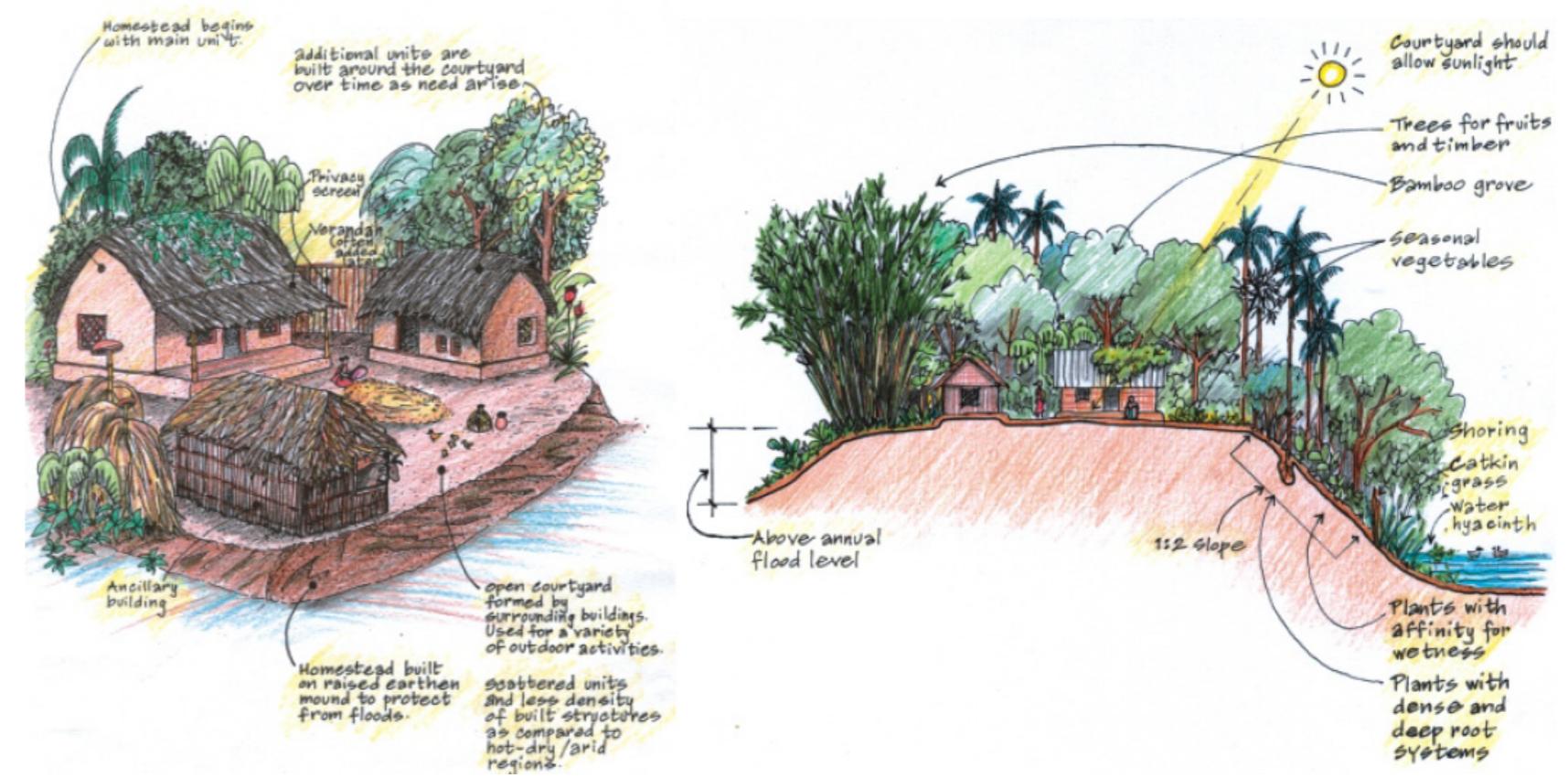
(Ahmed, K. I., 2005)



(Ahmed, K. I., 2005)

Flood-resilience - large scale

work with nature
 utilise wadis and swales
 vegetation
 elevated plinths
 lower-lying public areas



(Ahmed, K. I., 2005)

case studies

incremental housing and flood-resilience solutions for Bangladesh

Quantitative and qualitative analysis

CASE STUDIES

Project	
Architect	
Year	
County	
City	
Site area	ha
Units planned	dw
FSI	
GSI	
dw/ha	dw/ha
incremental ratio	
Initial unit size	m ²
Developed unit size	m ²
Plot size	m ²
Plot dimensions	

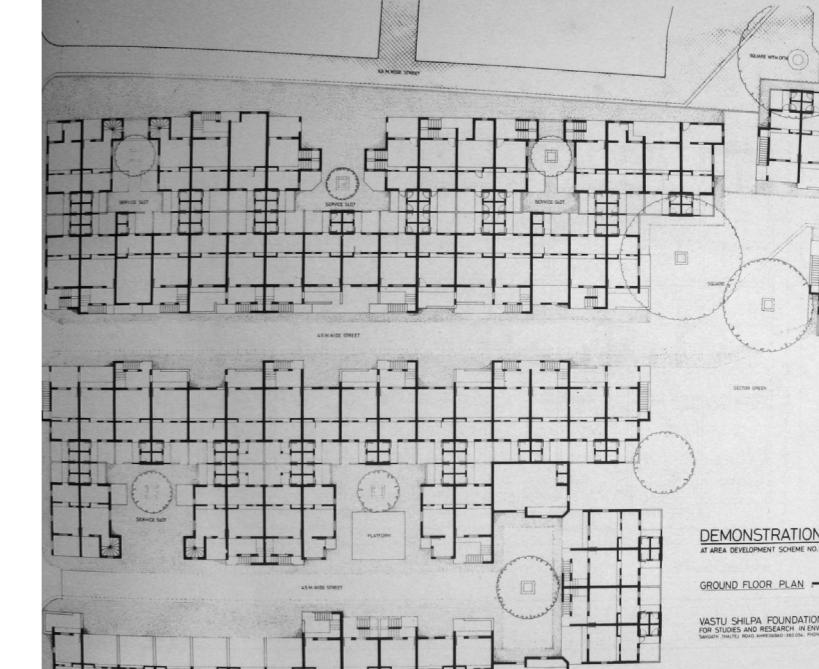
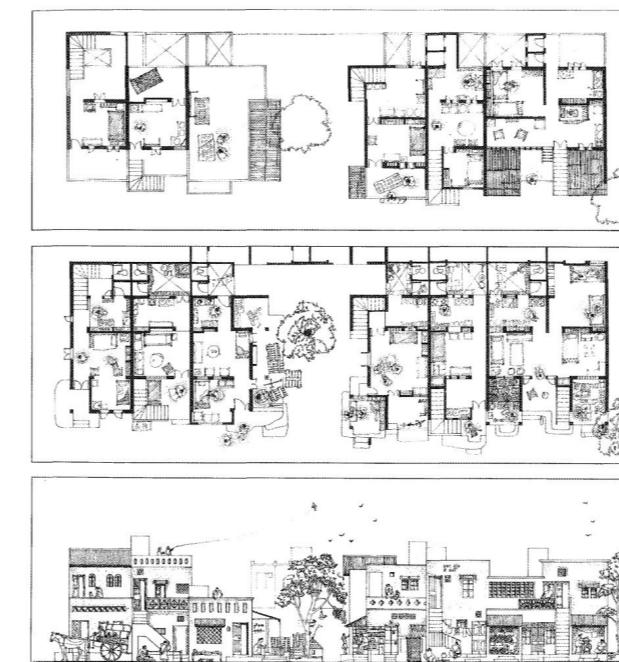
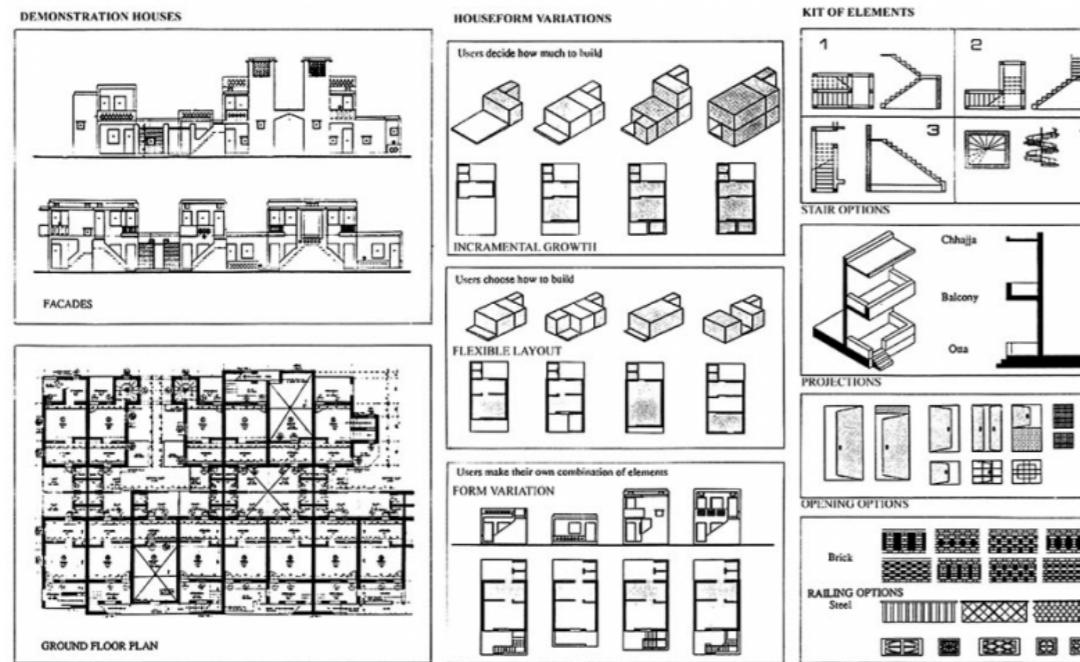
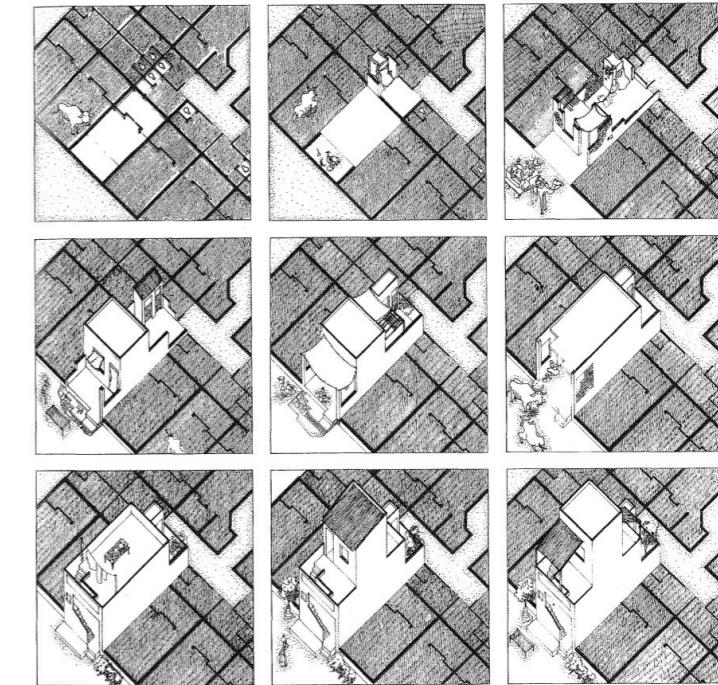
Main Criterion	Sub-Criterion	Description / Indicators
Stakeholders	Initiators, Implementers, End-Users	Who initiated, who built, who lives there?
Mode of incrementality	Incremental strategy	Aided self-help, sites-and-services, core house, slum upgrading, etc.
Urban Design	Integration with city fabric	Infill, edge, new town
	Neighbourhood/block/cluster configuration	Street layout, shared spaces, safety, access
Typology	Dwelling	Detached, row house, duplex, etc.
	Types	Amount of dwelling typologies
Architectural Design	Base unit design	Size, flexibility, climate fit, social logic, expansion areas
	Structural pre-provisions	Which elements were pre-built?
	Plot layout	Footage, description
	Base m ²	Footage, description
	Developed m ²	Footage, description
Density Metrics	FSI (Floor Space Index)	Total floor area / plot area
	GSI (Ground Space Index)	Ground coverage / plot area
	Dwellings per hectare (dw/ha)	Urban density measurement
	Incremental Ratio	Final built area / initial built area
Materials & Construction	Base materials	Local or imported? Vernacular vs industrial?
	Technical DIY-friendliness	Are residents able to build safely? Provisions for future expansions, such as reinforced foundations, etc.

Main Criterion	Sub-Criterion	Description / Indicators
Finance & Affordability	Subsidy & funding model	State, NGO, cross-subsidy, public vs. Private, etc.
	User contribution	Loan, sweat equity, savings group
	Initial cost per unit	In local currency or USD
Governance	Governance structure	Top-down, bottom-up, partnership, community-managed
	Land tenure	Freehold, leasehold, cooperative, informal
	Maintenance framework	Community-managed, municipal, other
Participation & Community Engagement	Type of participation	Co-design, co-production, self-construction, feedback loop
	Timing of participation	Pre-design, during, post-occupancy
	Technical assistance	Was the community given training, workshops, or technical guidance?
Timeframe & Phasing	Urban phasing	Were all base dwellings developed simultaneously? Were additional typologies added for cross-subsidisation?
	Execution of incremental additions	Was phasing planned or emergent? Did the extensions happen within the incremental frame or did they surpass it?
Outcomes & Impacts	Scalability & replicability	Were similar schemes developed elsewhere?
	Barriers & enablers	What helped or hindered replication?
	Livelihood & income generation impacts	Does the project provide income generation opportunities, amenities, etc.
	Overall success	Evaluation on the success or failure of the strategy years after completion
	Main lessons learned	What are the key takeaways for the project?

B.V. Doshi, Aranya Low-Cost Housing

CASE STUDIES

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(Aranya Low-Cost Housing, 1993)

Project	Aranya housing
Architect	Balkrishna Doshi
Year	1989
County	India
City	Indore
Site area	86 ha
Units planned	6500 dw
FSI	0.1-1.8 estimate
GSI	0.1-0.7 estimate
dw/ha	75-150 estimate
incremental ratio	2.0-5.0
Initial unit size	0 - 5 - 20 m ²
Developed unit size	100+ m ²
Plot size	35 - 45 - 80 m ²
Plot dimensions	3,6m x 9m - 5m x 9m

Main Criterion	Sub-Criterion	Notes / Case-Specific Observations
Stakeholders	Initiators, Implementers, End-Users	Indore Development Authority (IDA), Vastu-Shilpa Foundation (B.V. Doshi), HUDCO, World Bank for co-funding dwellers
Mode of incrementality	Incremental strategy	Sites-and-services, core-house (occasionally)
Urban Design	Integration with city fabric	Edge/new ton, Indore outskirts
	Neighbourhood/block/cluster configuration	Hierarchy through network of clusters and courtyards along spine configurations as communal spaces. Central spine of commercial and community facilities. Residential network from central spine. Well-laid out infrastructural network.
Typology	Dwelling	Row houses, core-houses designed for 2 stories
	Types	Variable plot sizes for EWS and LIG groups: Typology 1: serviced plot and sanitary core (>35m ²) for EWG Typology 2: serviced plot and core-unit (>45 m ²) for LIG Additional: middle and higher income apartments for cross-subsidisation.
Architectural Design	Base unit design	Serviced plots and core-houses, min. 35m ² . Sanitary core at private courtyard. Growth from back to the front. Provisions for vertical and horizontal incremental growth. Orientation minimized sun exposure in hot, dry Indore climate. Cross-ventilation.
	Structural pre-provisions	Foundation, toilet, water tap, infrastructure connections, septic tank (per 20 houses), load-bearing walls (in case of core-unit).
	Plot layout	35m ² to 80 m ² . Designated buildable area, small private backcourtyard, frontage onto public or semi-public lane.
	Base m ²	EWG: >35m ² LIG: >45m ²
	Developed m ²	EWG: >35m ² LIG: >45m ²
Density Metrics	FSI (Floor Space Index)	Initial: 0.1 (estimate) Current: 1.0 to 1.8 (estimate)
	GSI (Ground Space Index)	Initial : 0.1 Current: 0.7 (estimate)
	Dwellings per hectare (dw/ha)	150 (estimate)
	Incremental Ratio	2.0-5.0 (estimate), great differences from a single-storyed home to current four-storyed structures.
Materials & Construction	Base materials	Load-bearing brick masonry, concrete slabs and structural elements, local timber, bamboo, and terracotta tiles

Main Criterion	Sub-Criterion	Notes / Case-Specific Observations
	Technical DIY-friendliness	Medium: within grid, local construction techniques and materials through local masons and residents, stub-outs for future plumbing and electricity.
Finance & Affordability	Subsidy & funding model	Public sector initiative with a cross-subsidy model. Profitable scheme for further EWS development. IDA provided land and initial infrastructure funding. Co-funded by HUDCO and the World Bank.
	User contribution	Downpayments and loans based on income per family for base dwellings, sweat equity and savings for incremental additions
	Initial cost per unit	No hard data
Governance	Governance structure	Top-down framework of planning and initial implementation, bottom-up user-driven incremental development and community management.
	Land tenure	Freehold ownership
	Maintenance framework	Municipal for primary infrastructure. Community-managed for shared open spaces at the cluster level, individual maintenance of dwellings.
Participation & Community Engagement	Type of participation	Self-construction
	Timing of participation	Post-occupancy
	Technical assistance	Training centres on industrial, constructional and technical skills. Material banks to feed building activity. Demonstration houses.
Timeframe & Phasing	Urban phasing	Phasing of commercial and high-income dwellings. Subsidisation for low-income dwellings.
	Execution of incremental additions	Emergent and market-driven within incremental framework. Current four-story developments look not like the demonstration houses and push the boundaries of the plot, but do not compromise the communal spaces.
Outcomes & Impacts	Scalability & replicability	No direct copies, but precedent and inspiration for many sites-and-services and incremental housing projects throughout the world
	Barriers & enablers	Enablers: visionary design, extensive research, government support, cross-subsidy, cultural fit, security of tenure Barriers: unforeseen value increase and future affordability, management of incremental growth
	Livelihood & income generation impacts	Income generation for ground floor units. Amenities present in masterplan (school, health centers, and commercial areas)
	Overall success	Successful landmark project, high occupancy and satisfaction, vibrant community life in courtyards and public spaces, economically accessible, however prices quadrupled after completion. Doshi received the Aga Khan Award for Architecture in 1995 for Aranya. Some issues with infrastructure maintenance, variations in construction quality, and potential for overcrowding in some areas as density increases beyond initial projections.
	Main lessons learned	Flexibility; infrastructure; facilitating masterplan housing instead of dictating; cross-subsidisation; income mix; cultural appropriability

Elemental, Quinta Monroy

CASE STUDIES

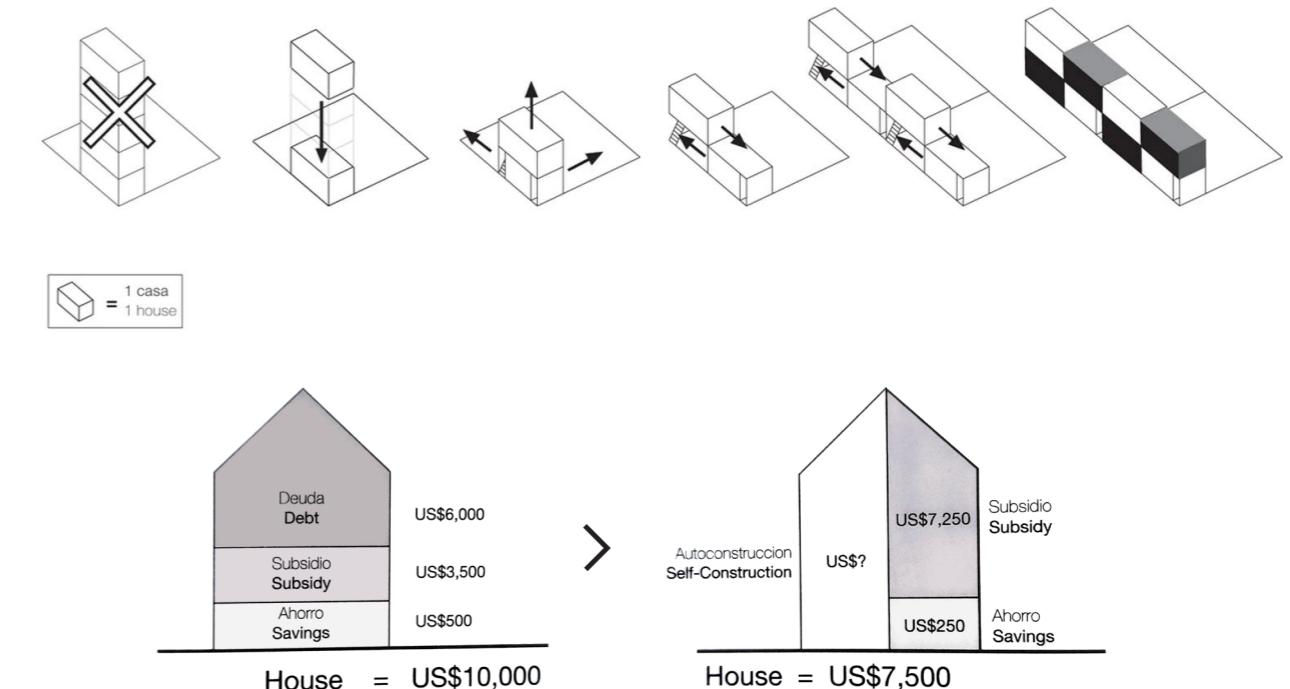


fig.11

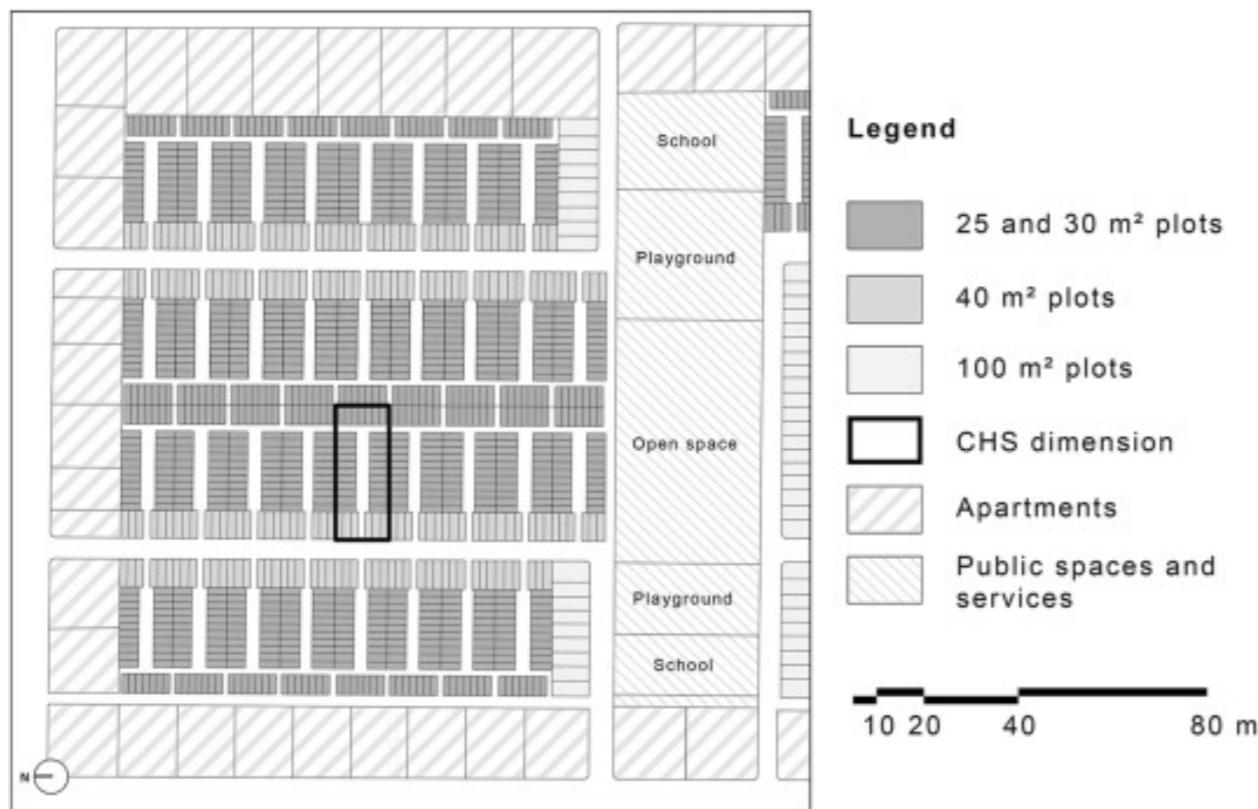
fig.12



(Aravena & Iacobelli, 2016)

MHADA, Charkop sites-and-services

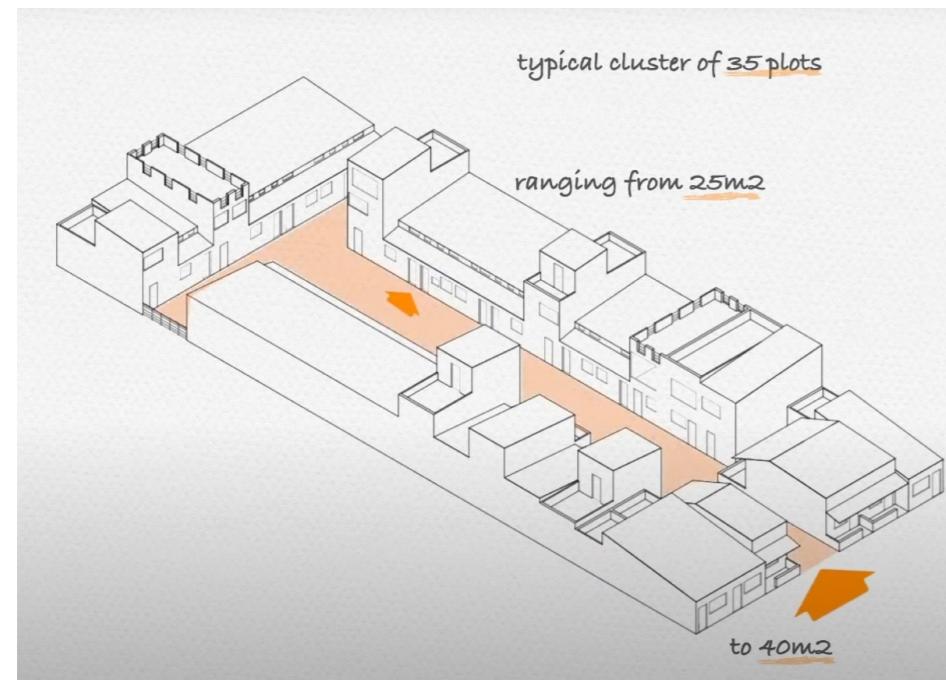
CASE STUDIES



(Testi, 2003)



(Gulyani, 2016)



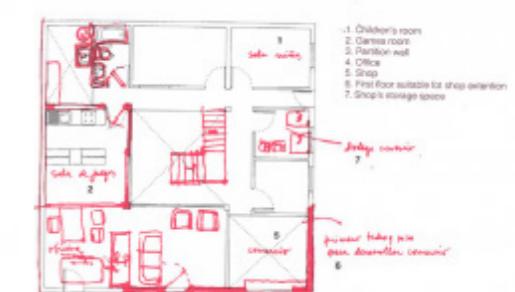
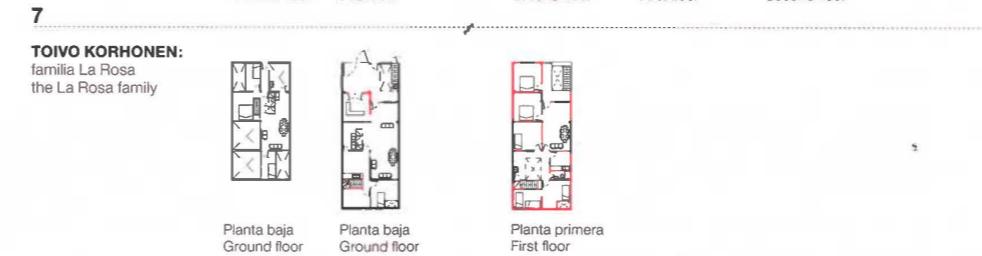
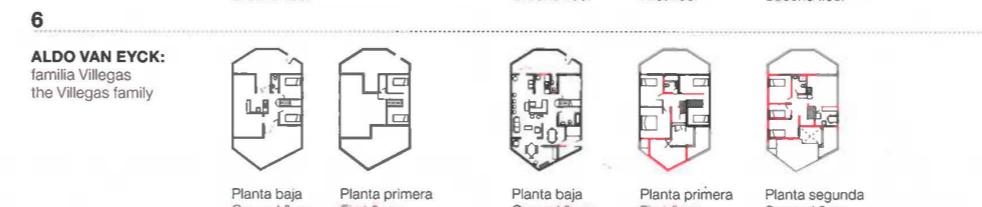
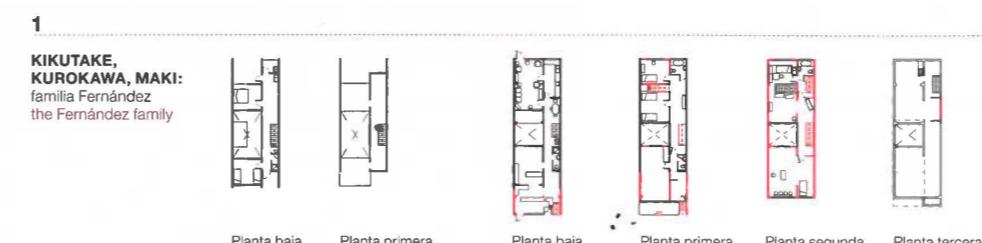
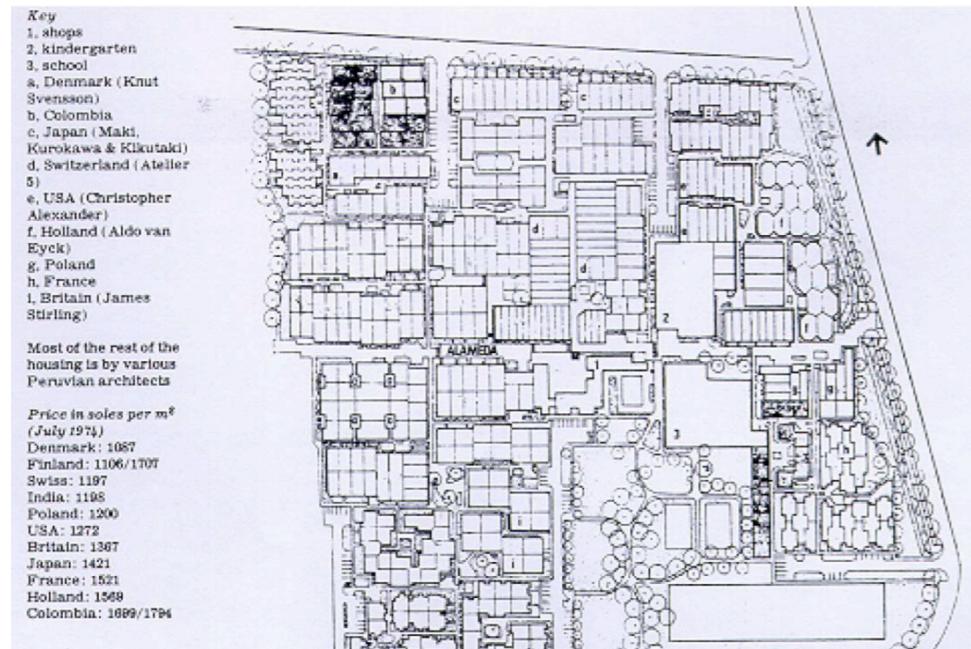
(Blend Ed, 2022)



(Varma, 2022)

Peter Land, PREVI

CASE STUDIES



Co.Creation.Architects, Jhenaaidah housing

CASE STUDIES

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(Kabur & Farzana, 2021)

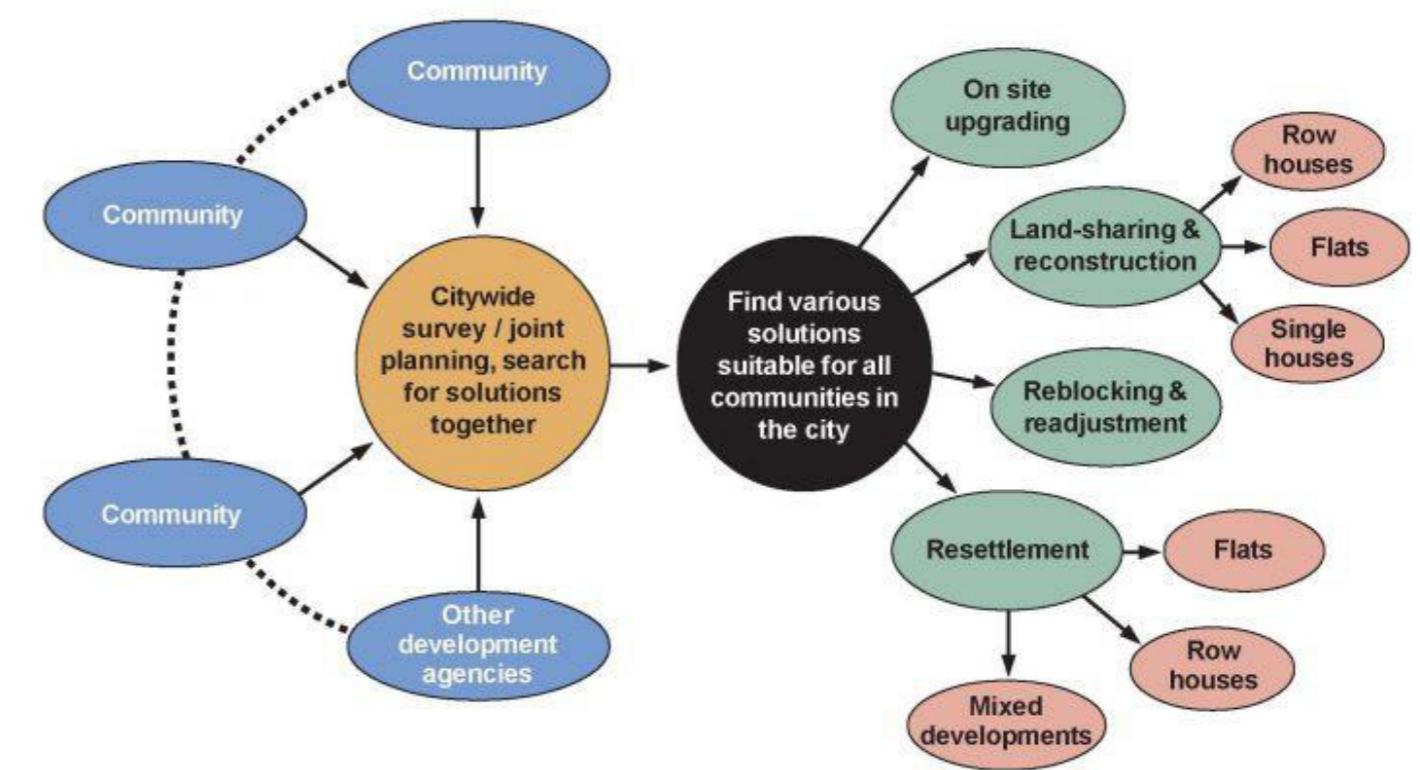
SPARC & Baan Mankong

CASE STUDIES

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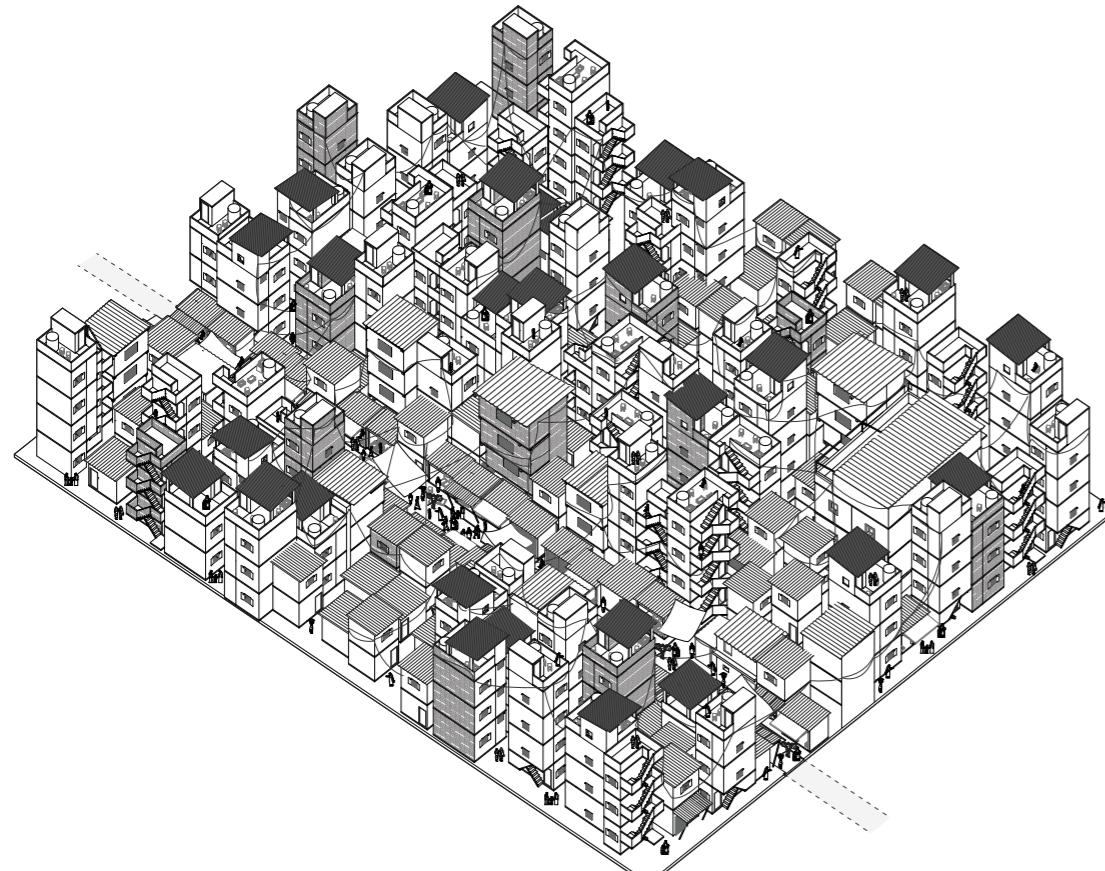
(Patel & Bartlett, 2016)



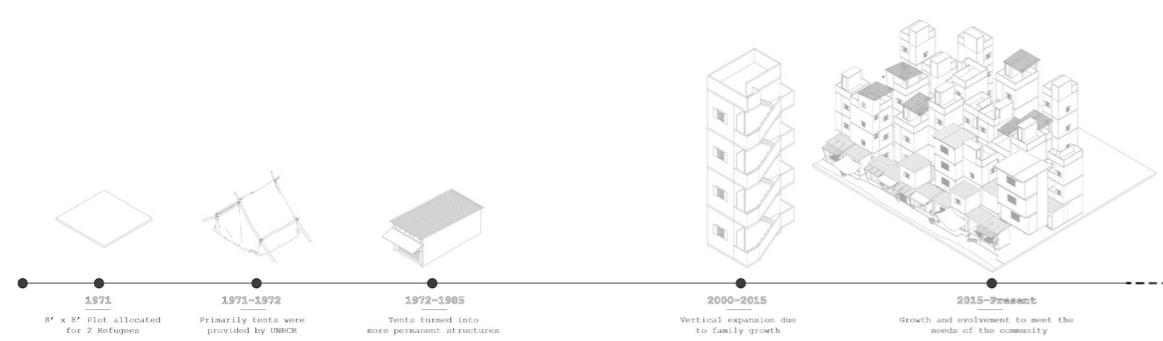
(CODI, n.d.)

Mohammadpur Geneva Camp

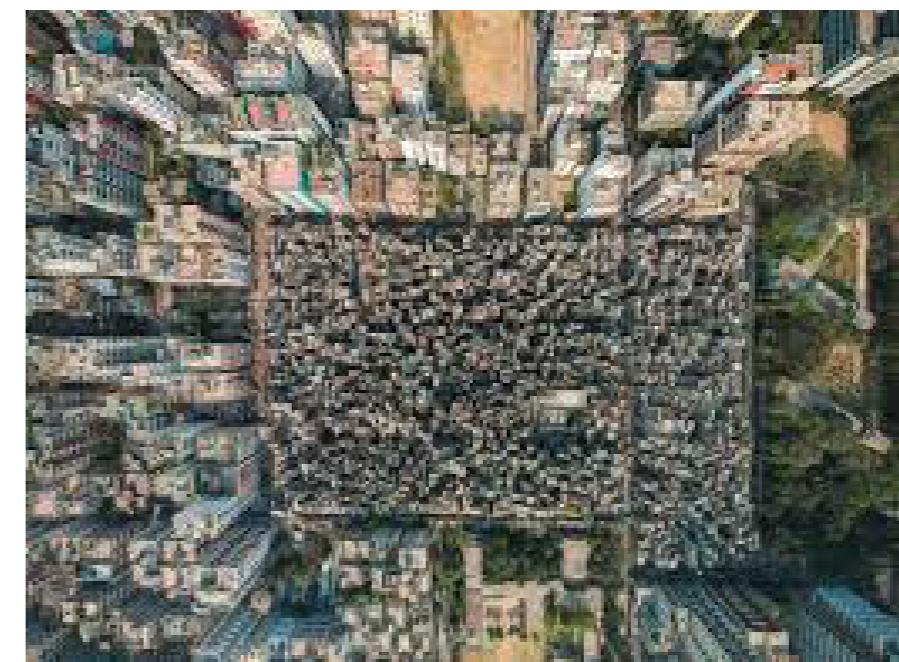
CASE STUDIES



(own work, 2024)



(own work in collaboration with Soediono & Doorn, 2024)



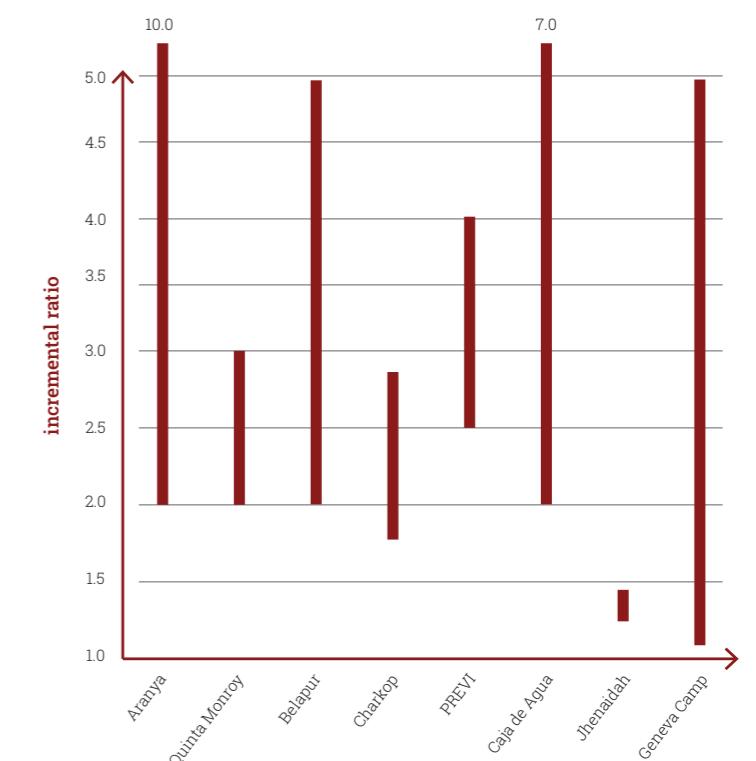
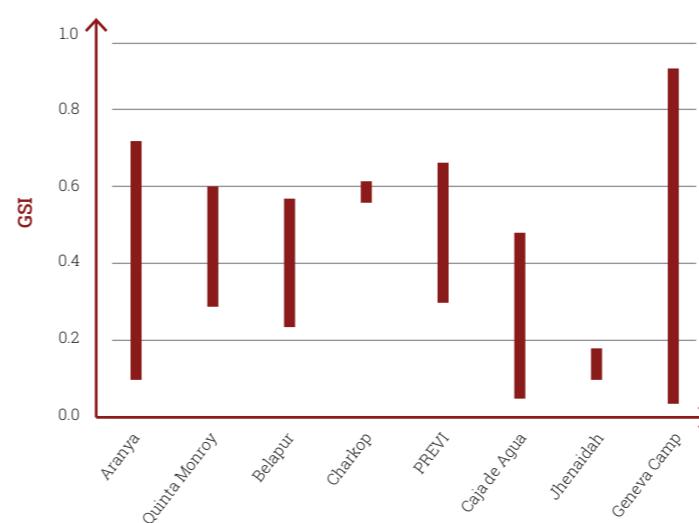
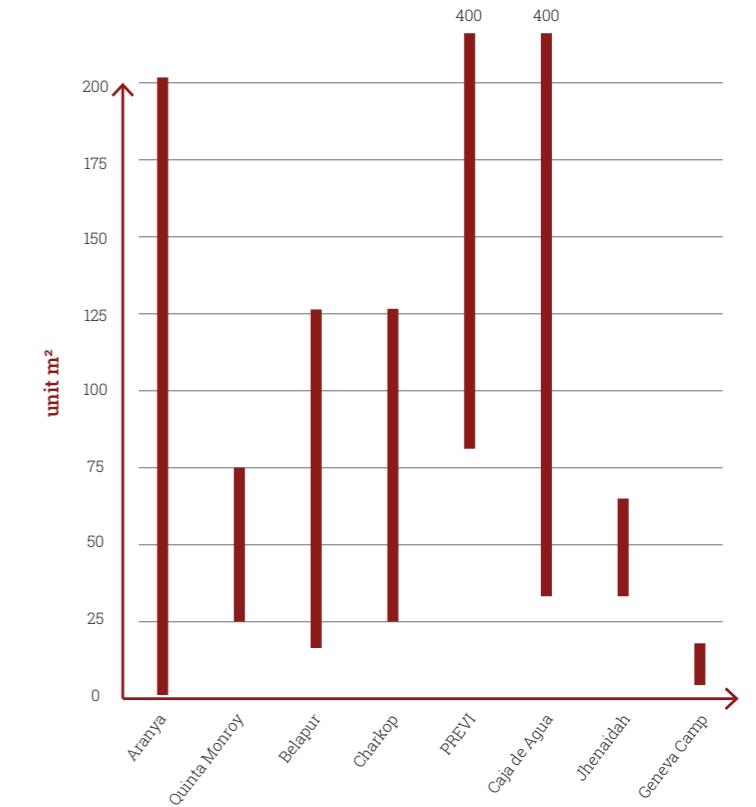
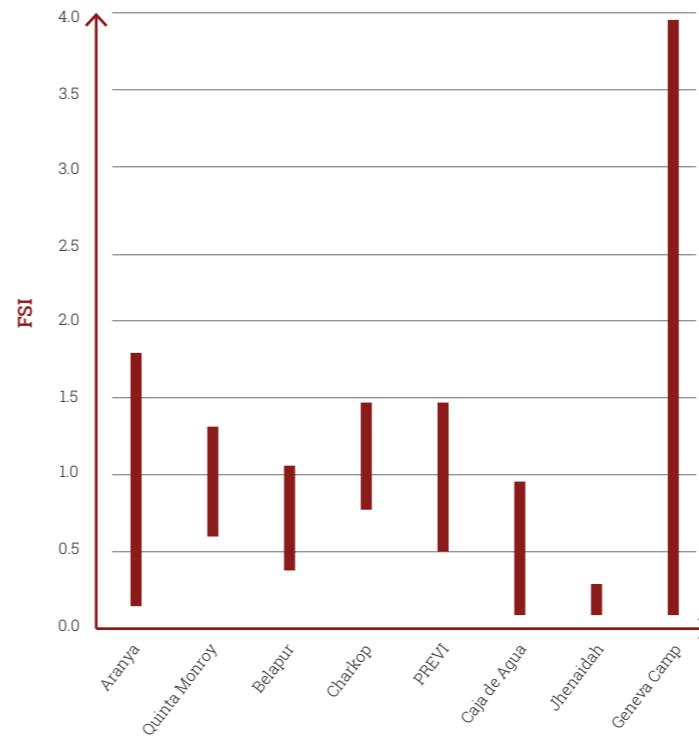
(bdnews24.com, 2024)

Conclusions

CASE STUDIES

DESIGN

- i. Urban design shapes the neighbourhood
- ii. Architecture is flexible
- iii. Law of 'least effort'
- iv. Plot size
- v. Income generation
- vi. Location
- vii. Value appreciation
- viii. Facilitate 'final' scenario

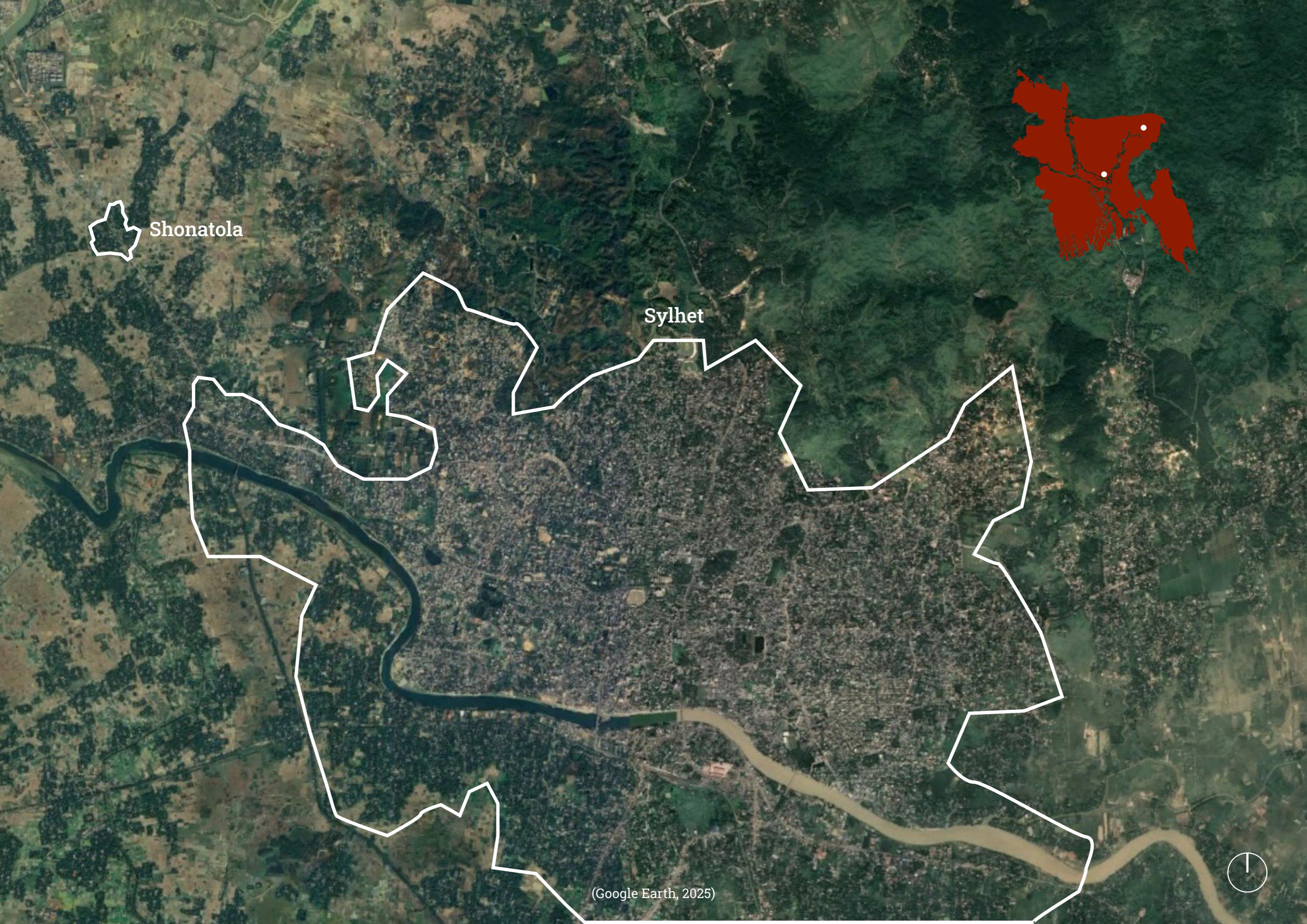


MANAGEMENT

- i. Security of tenure
- ii. Participation
- iii. Community organisation
- iv. Maintenance before, during AND after
- v. Match top-down and bottom-up

site analysis

incremental housing and flood-resilience solutions for Bangladesh



Shonatola

Sylhet

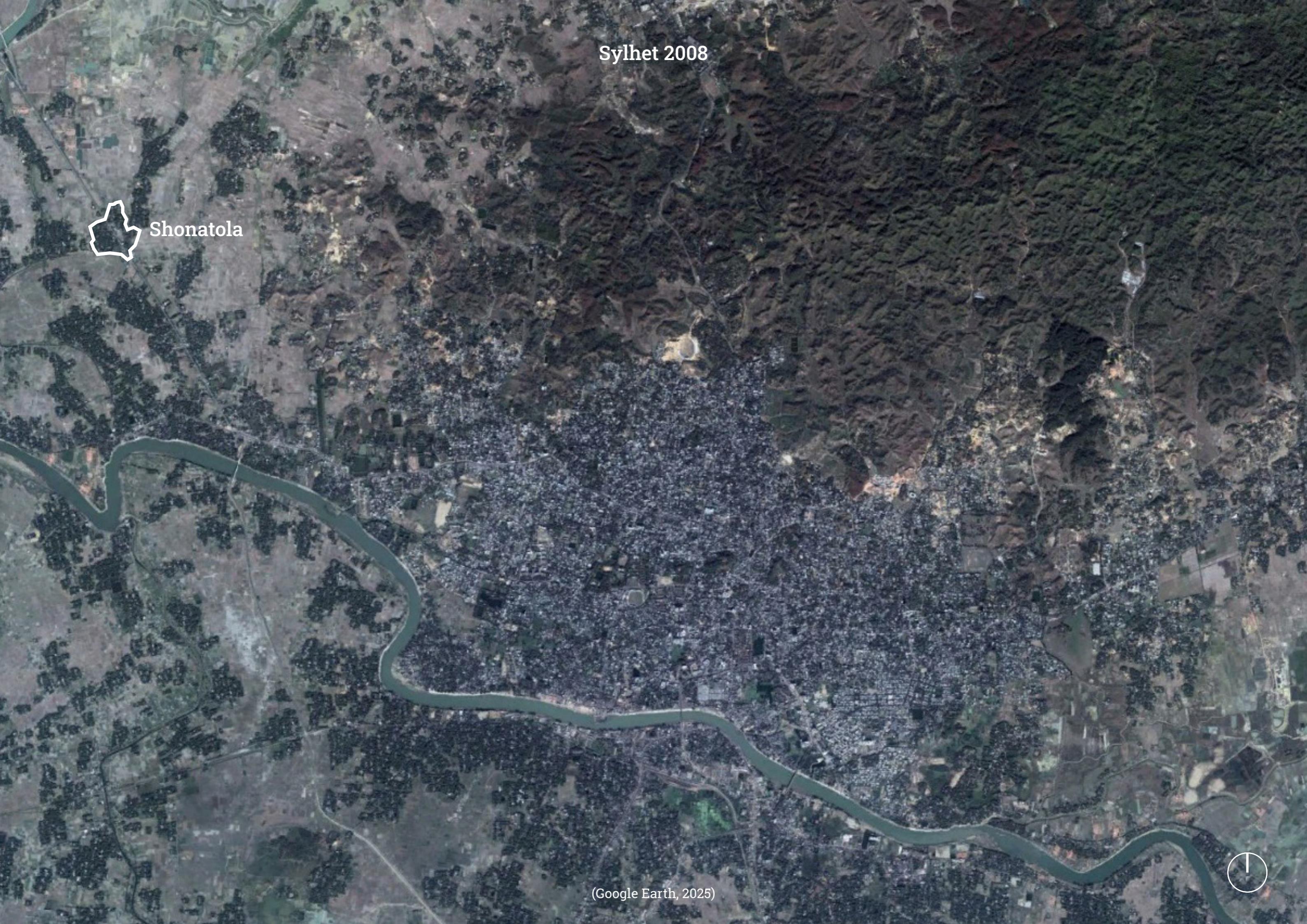
(Google Earth, 2025)

Sylhet 1985



Shonatola





Sylhet 2008

Shonatola

(Google Earth, 2025)



Sylhet 2013

 Shonatola

Sylhet 2019

 Shonatola



Sylhet 2025

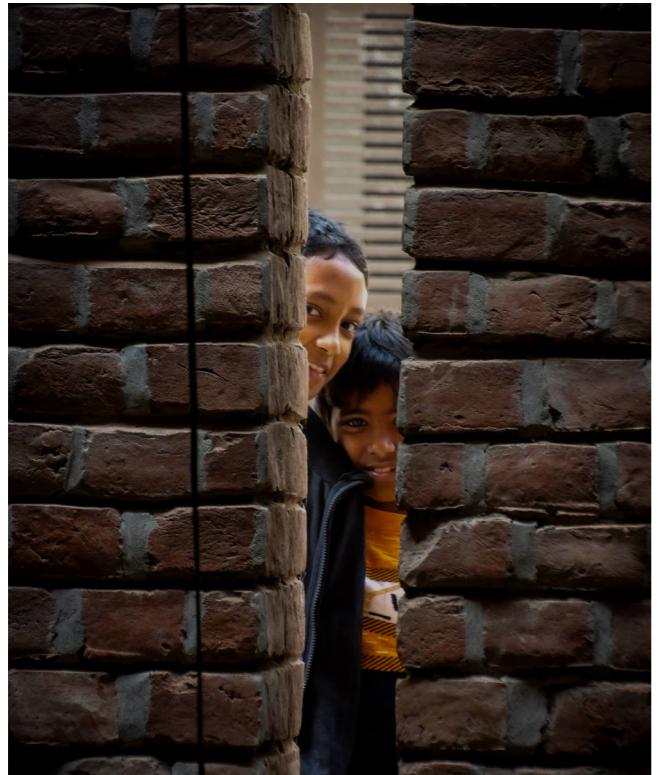


Shonatola

The people

WHO ARE WE DOING THIS FOR?

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(Own work, 2024)

School & mosque

CULTURALLY SIGNIFICANT CLUSTERS



(Own work, 2024)

Bazar

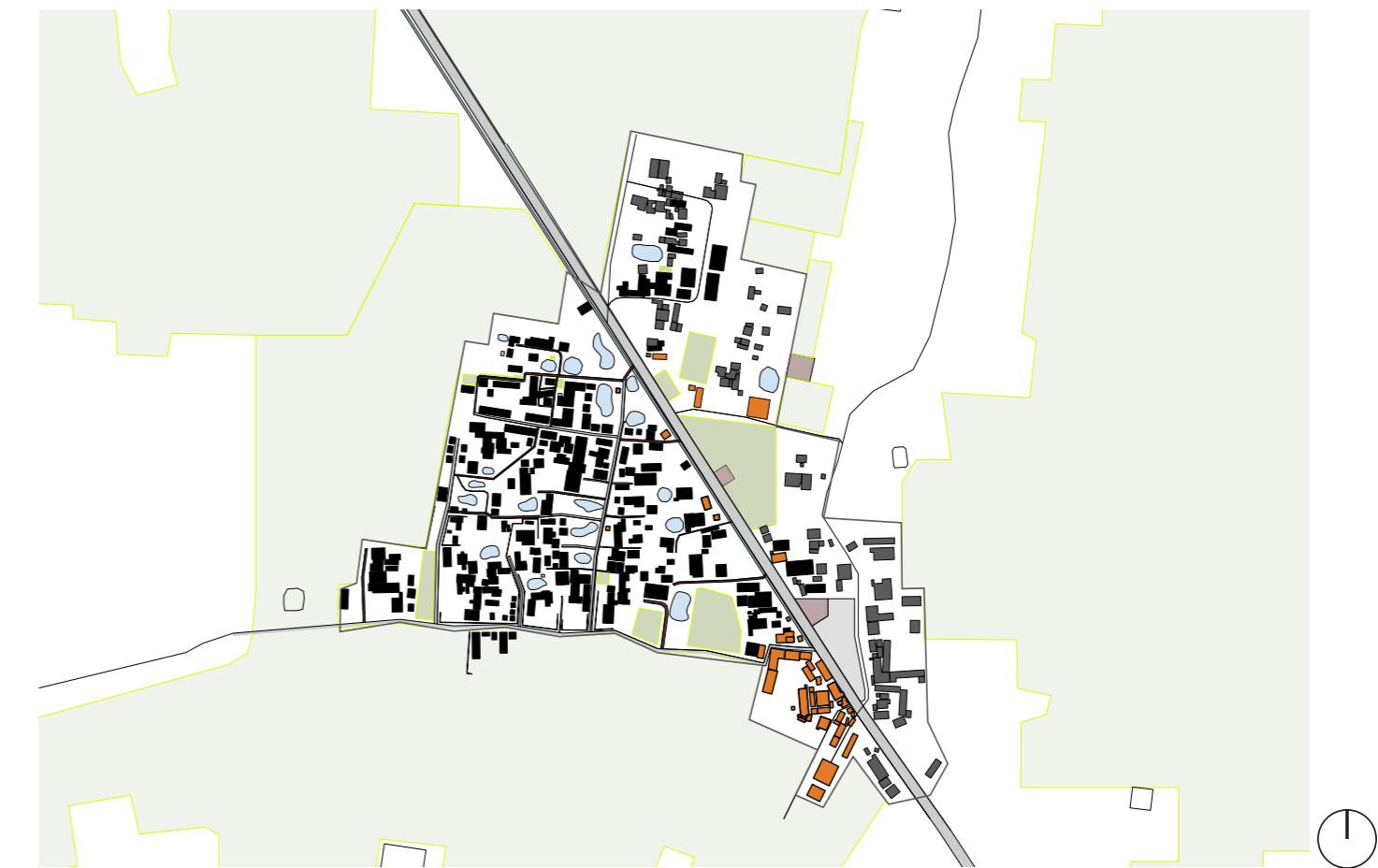
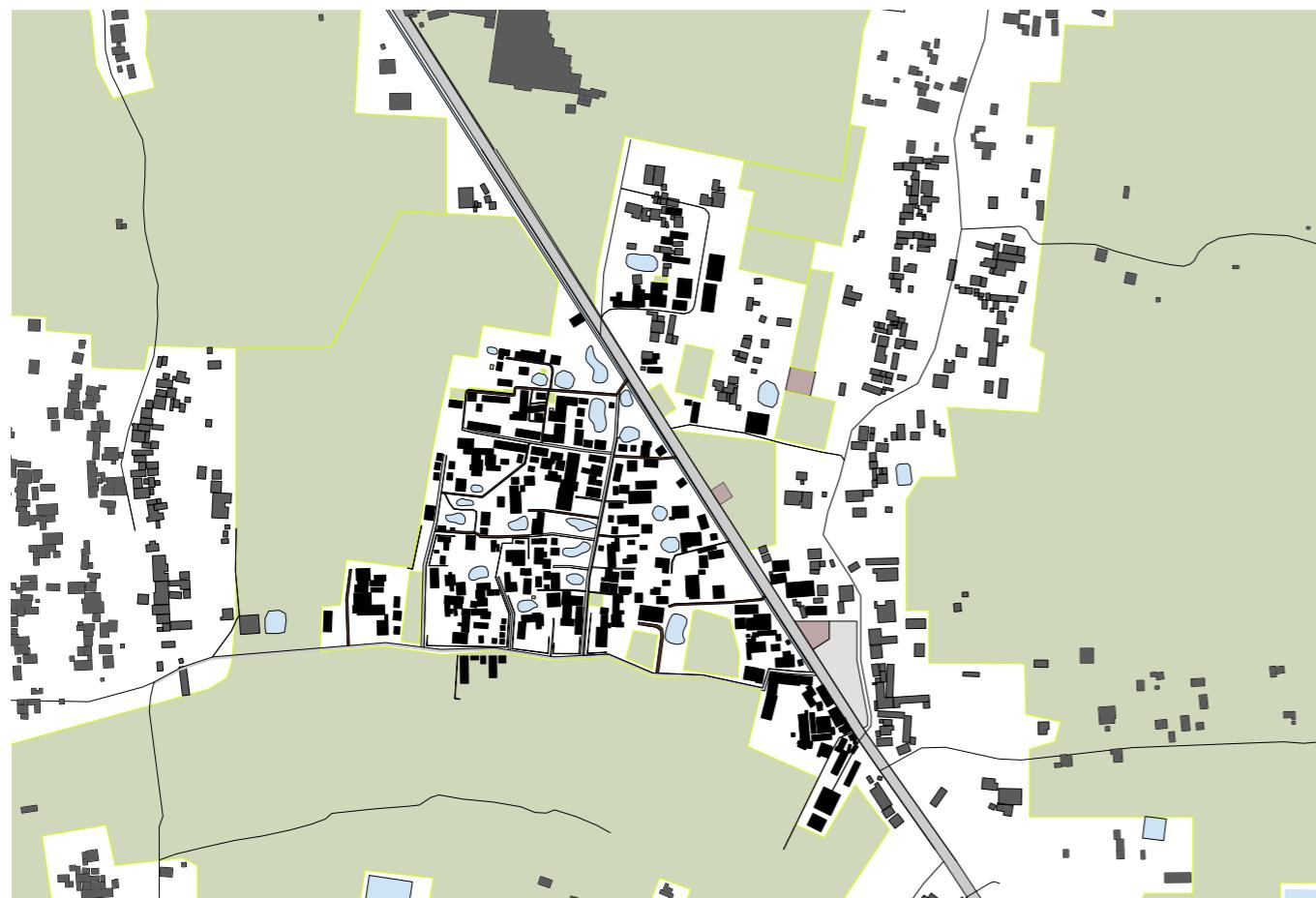
CULTURALLY SIGNIFICANT CLUSTERS



(Own work, 2024)

Land use and amenities

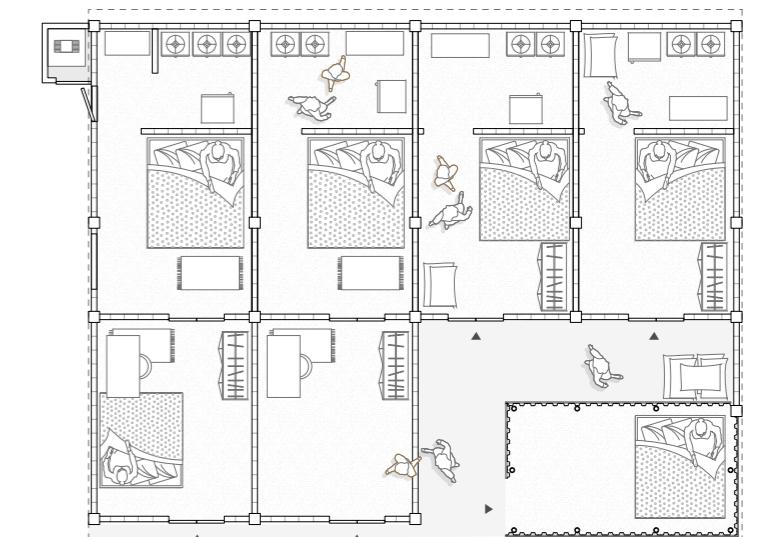
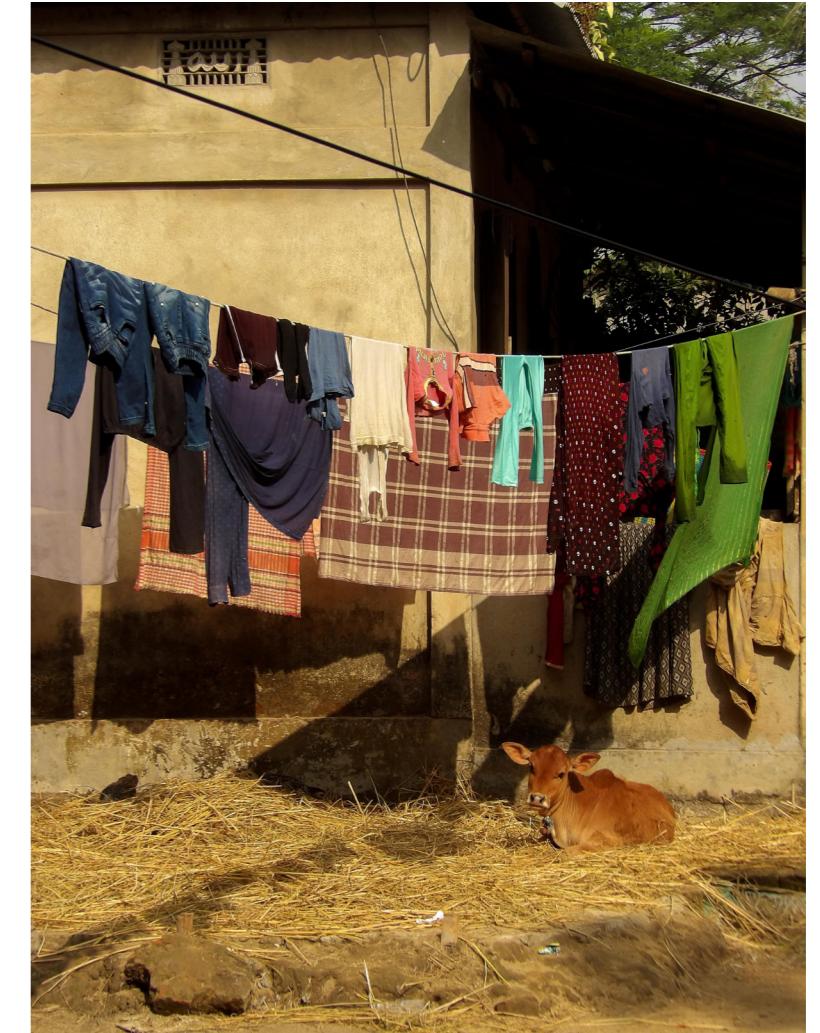
SITE ANALYSIS



Dwellings

COURTYARDS, BUILDING TECHNIQUES, WAY OF LIFE

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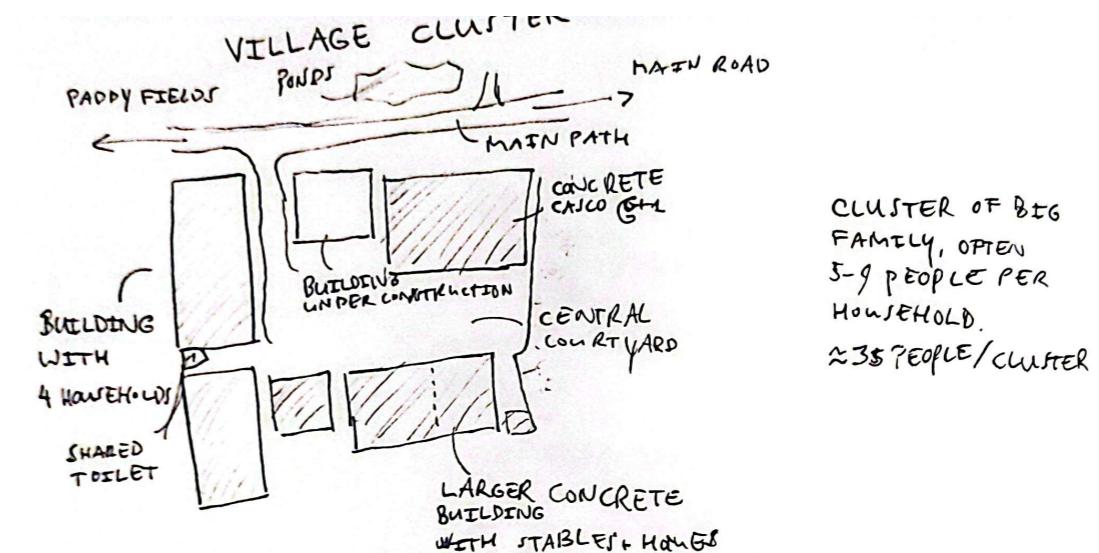
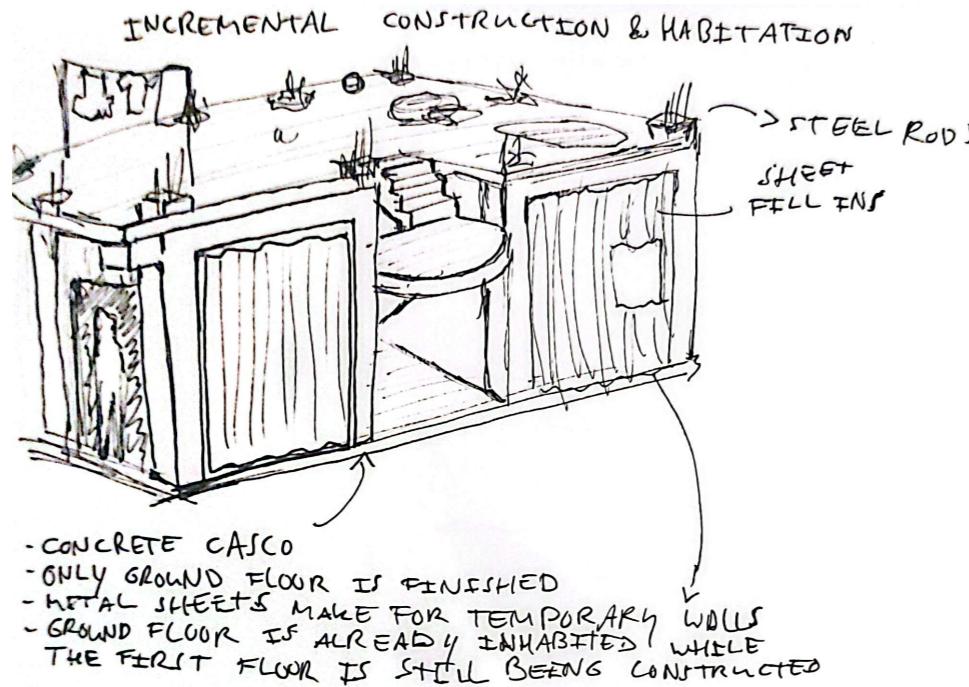


(Own work, 2024)

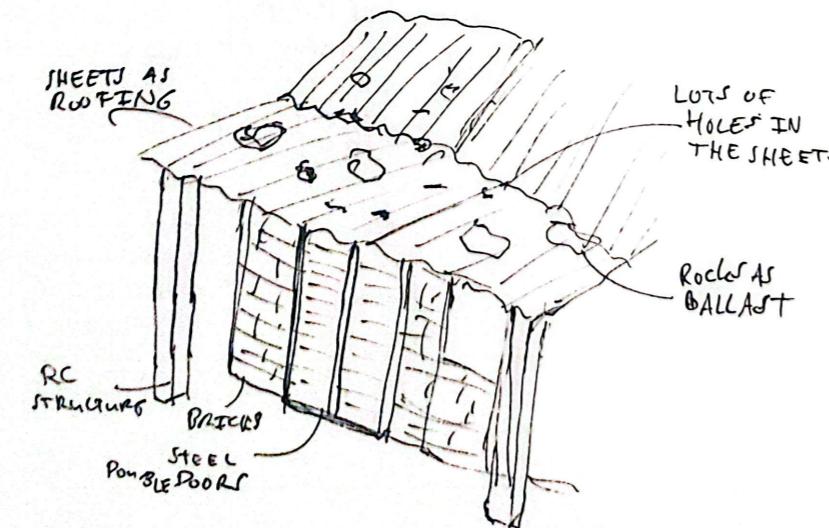
Local typologies and building techniques

SITE ANALYSIS

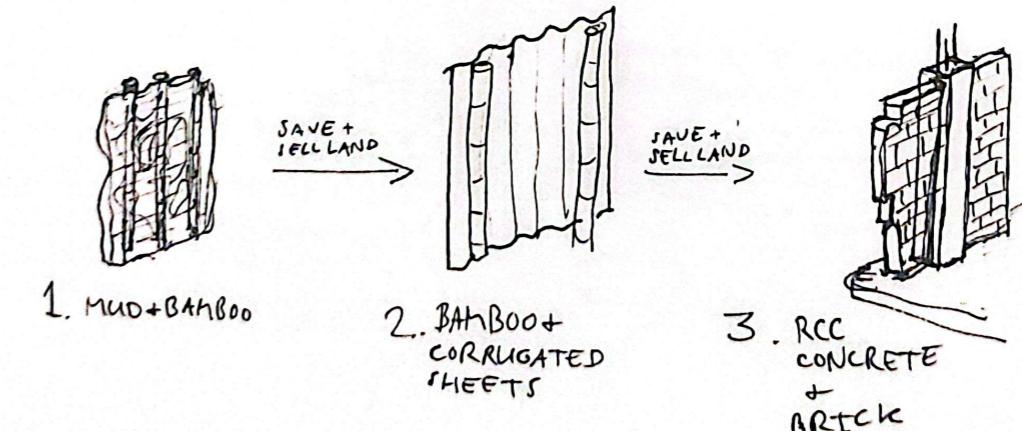
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MOST BUILDINGS USE CORRUGATED SHEETS



BUILDING IN PHASES - INCREMENTAL UPGRADING



Main road

PERI-URBAN TRANSITIONS



(Google street view, 2022)

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(Own work, 2024)

Flood drains

PERI-URBAN TRANSITIONS

44



(Own work, 2024)

Plot-based developments

PERI-URBAN TRANSITIONS

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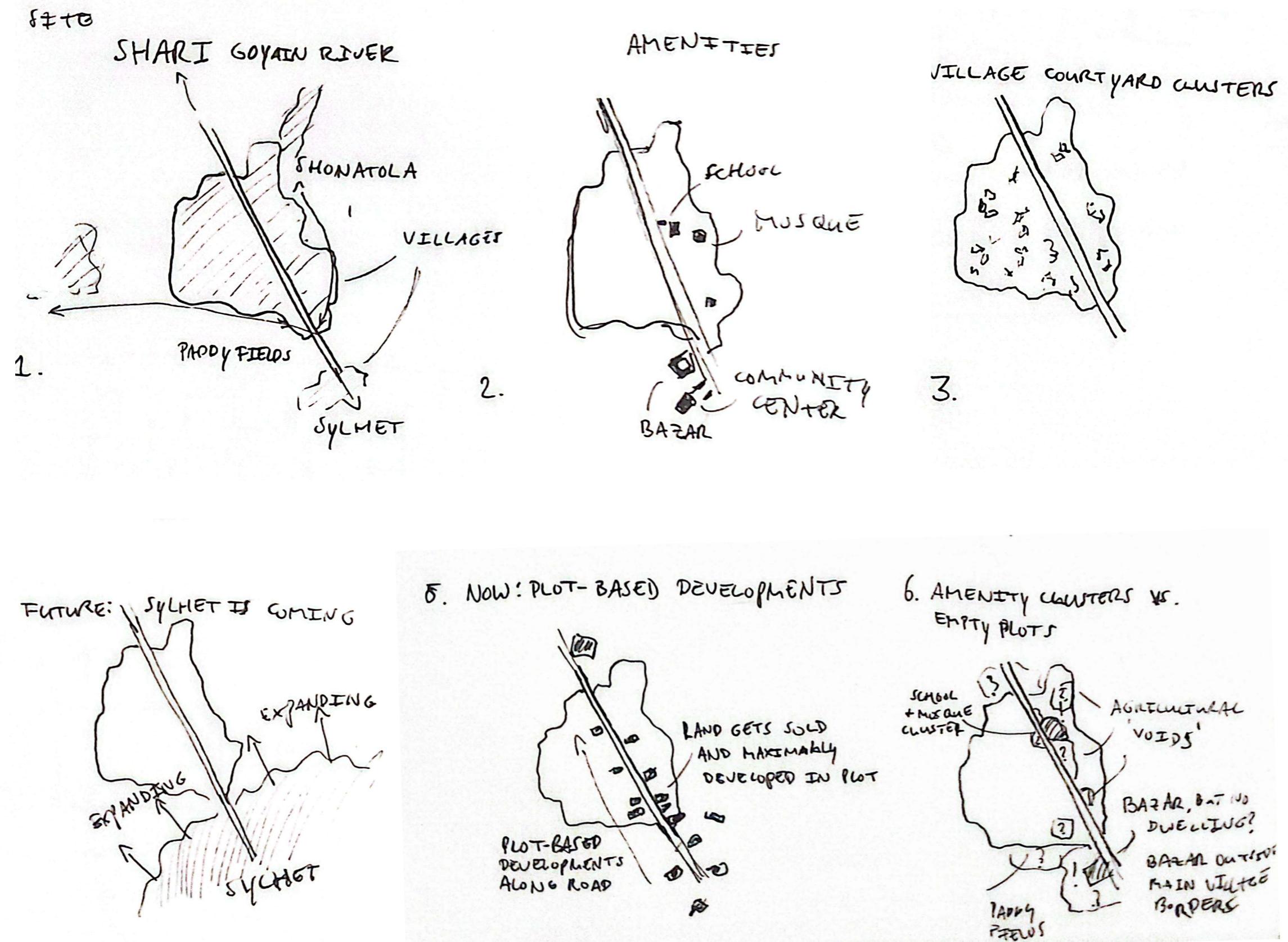


(Own work, 2024)

Main conclusions

SITE ANALYSIS

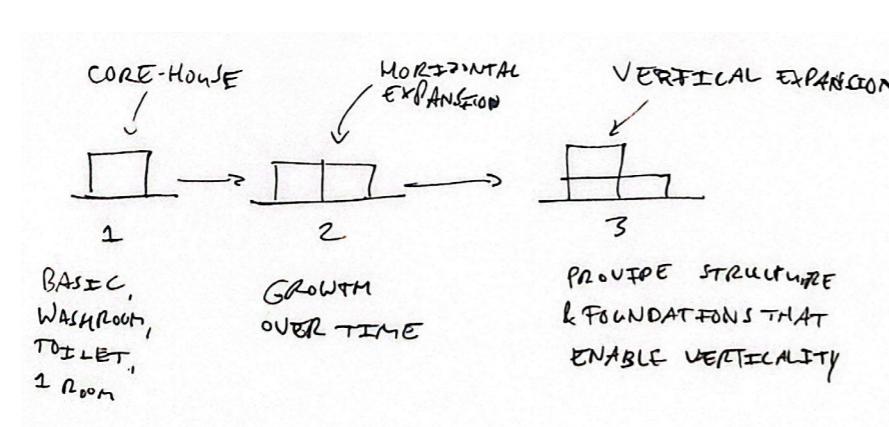
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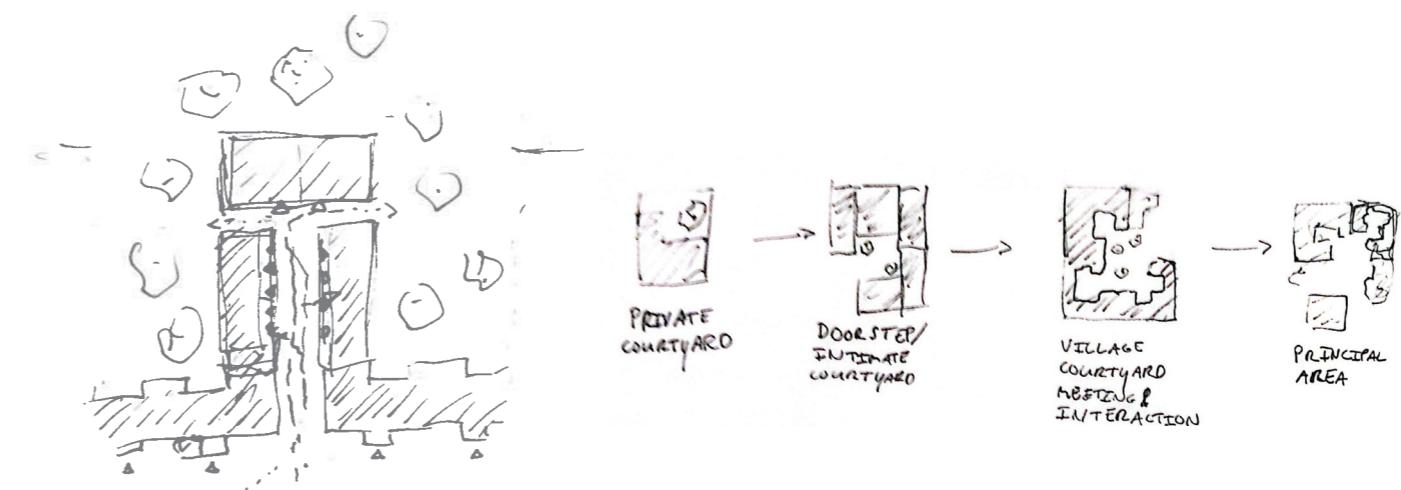
concept

incremental housing and flood-resilience solutions for Bangladesh

INCREMENTALITY

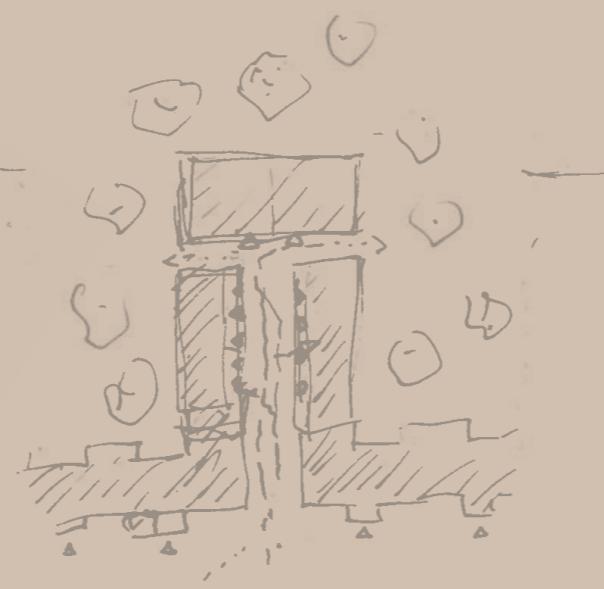


COMMUNITY STRENGTHENING & UPGRADING



- i. site-specific
- ii. community-significant clusters
- iii. cost-effective
- iv. replicability

- i. participation
- ii. collective spaces
- iii. bottom-up & top-down
- iv. individuality
- v. minimise displacement



urban strategy

incremental housing and flood-resilience solutions for Bangladesh

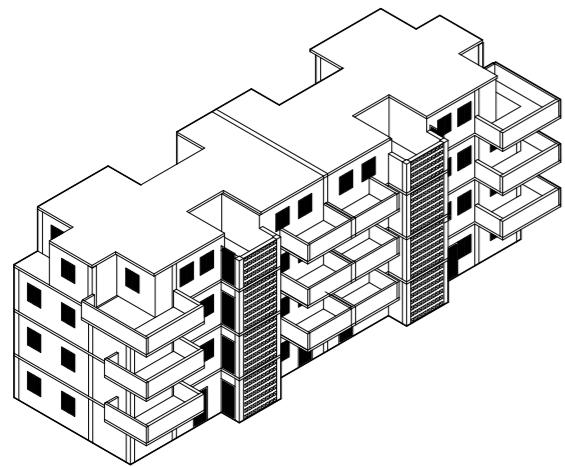




Four typologies for four urban conditions

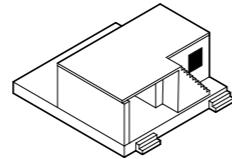
URBAN STRATEGY

51



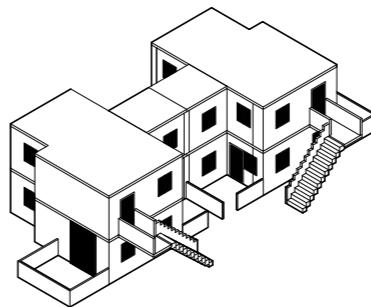
Typology A

along highway
commercial plinth
multi-story
middle-high-income



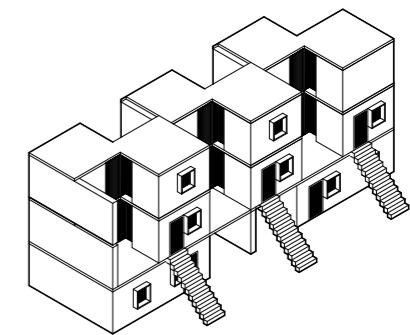
Typology B

in courtyards
core-house
incremental character
lowest income, 'poorest of the poor'



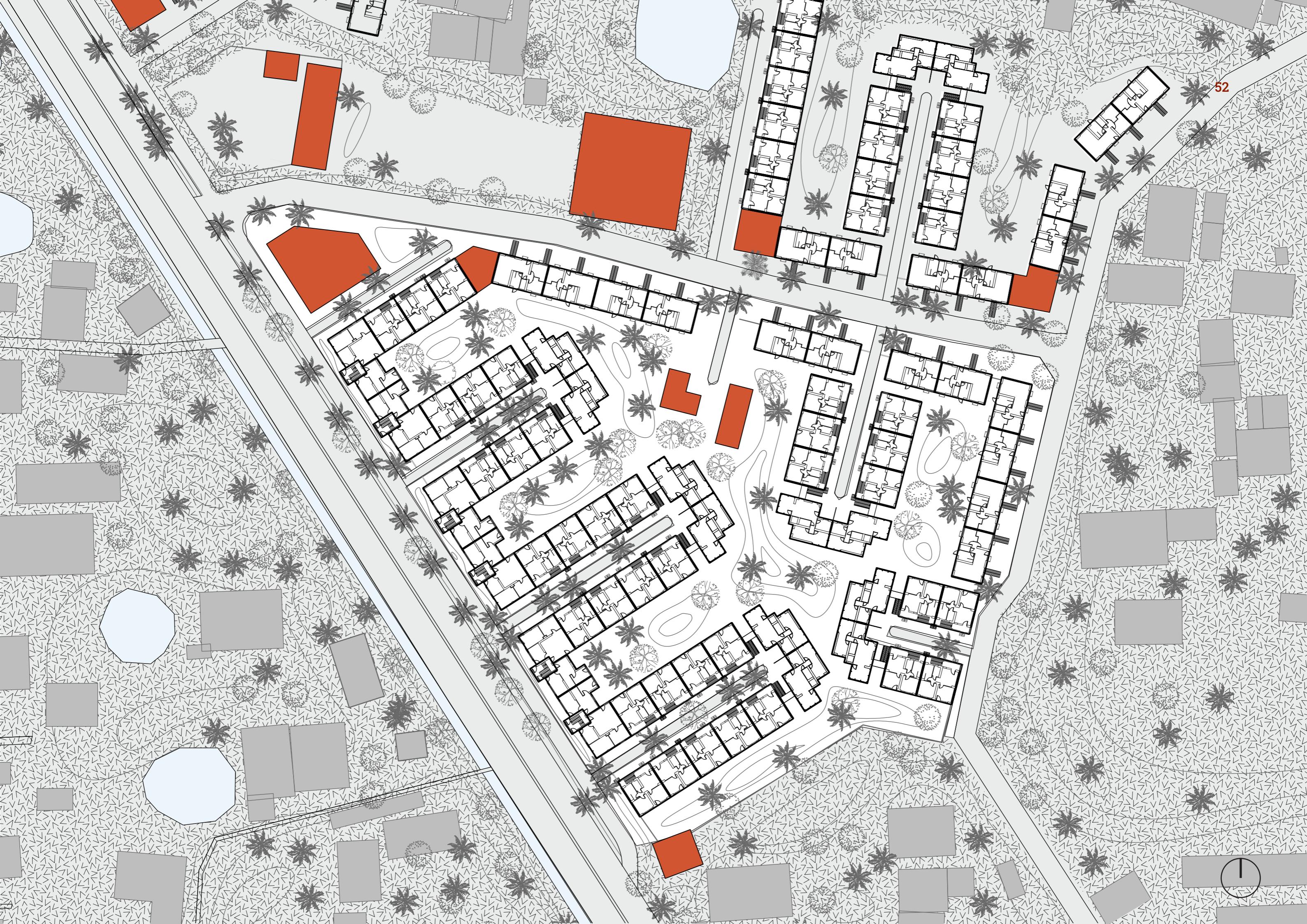
Typology C

end of courtyard
expendable house
incremental character
low income



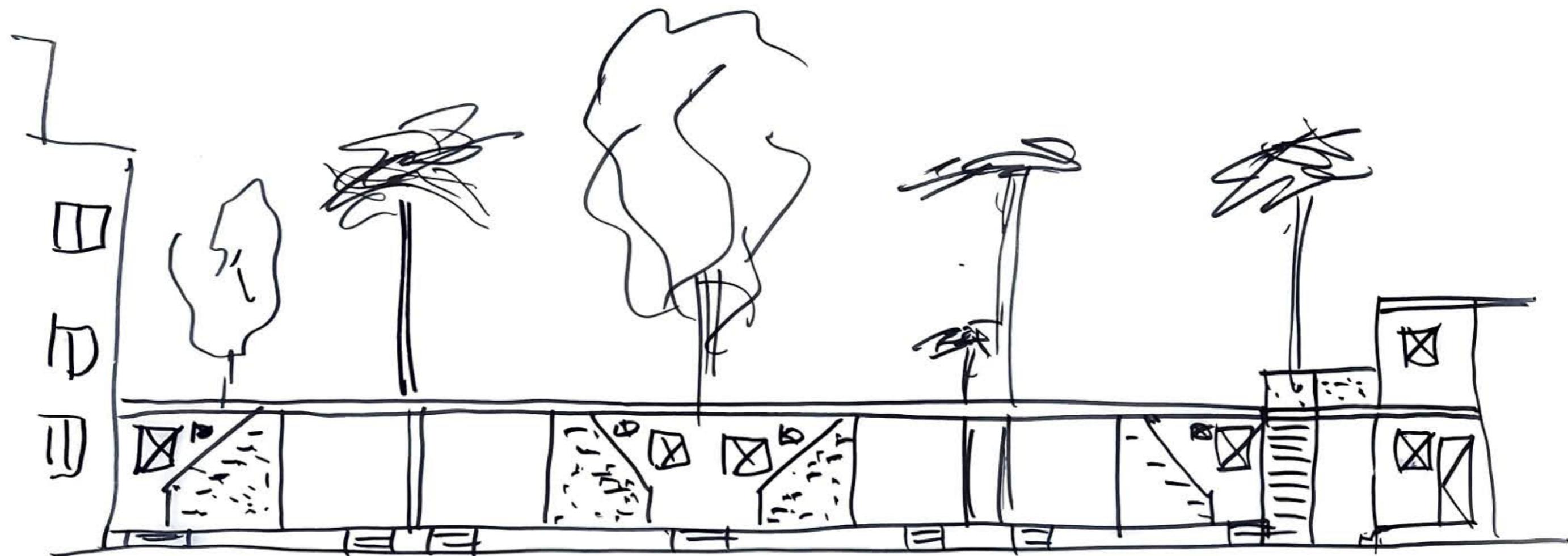
Typology D

along secondary roads
optional commercial plinth
incremental character
low income



Courtyard +0 years (base)

INCREMENTAL CONCEPT



Courtyard +20 years (developed)

INCREMENTAL CONCEPT

54

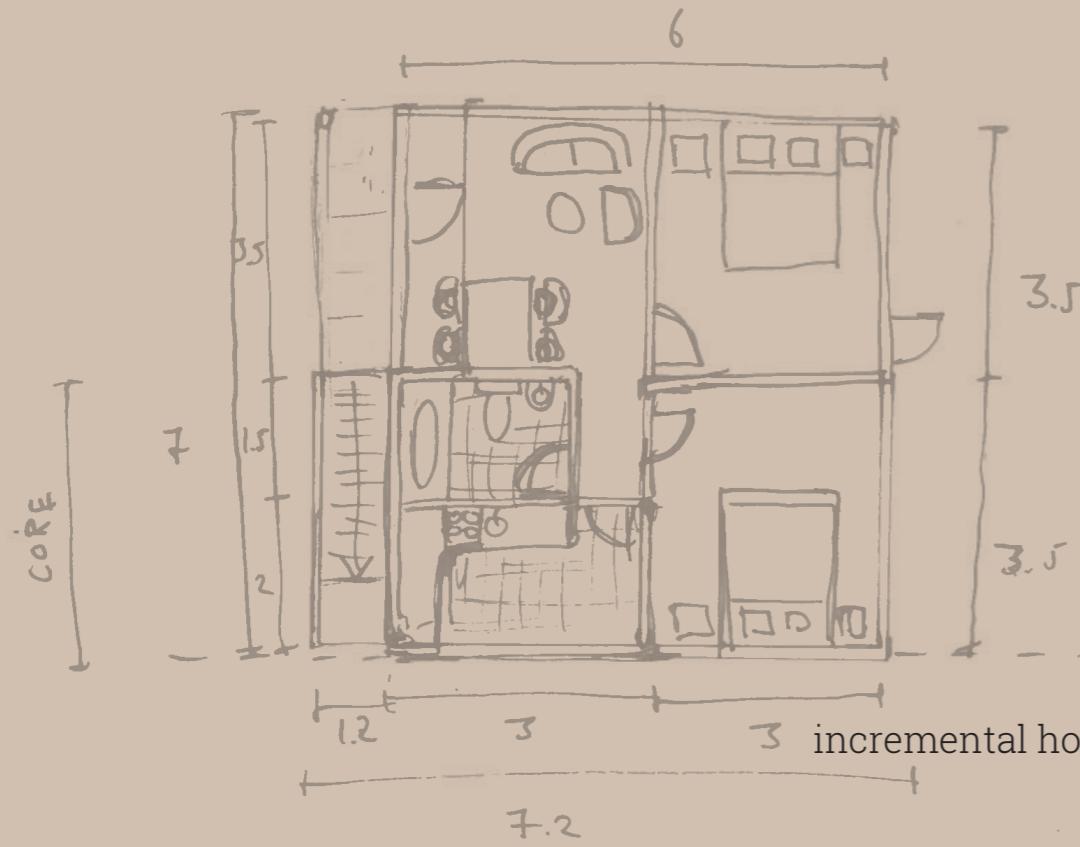


Project impression

ACCESS COURTYARD

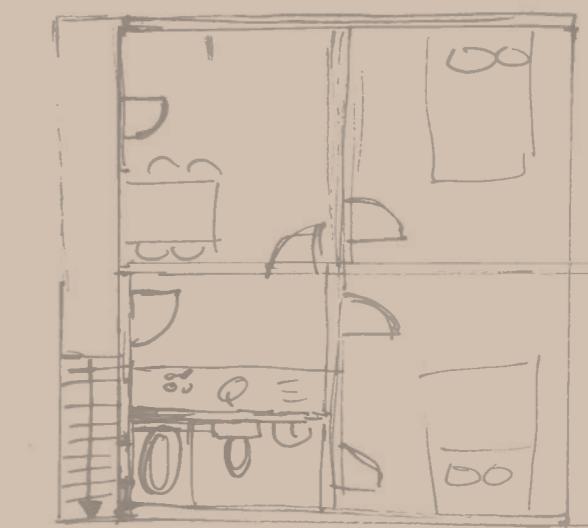
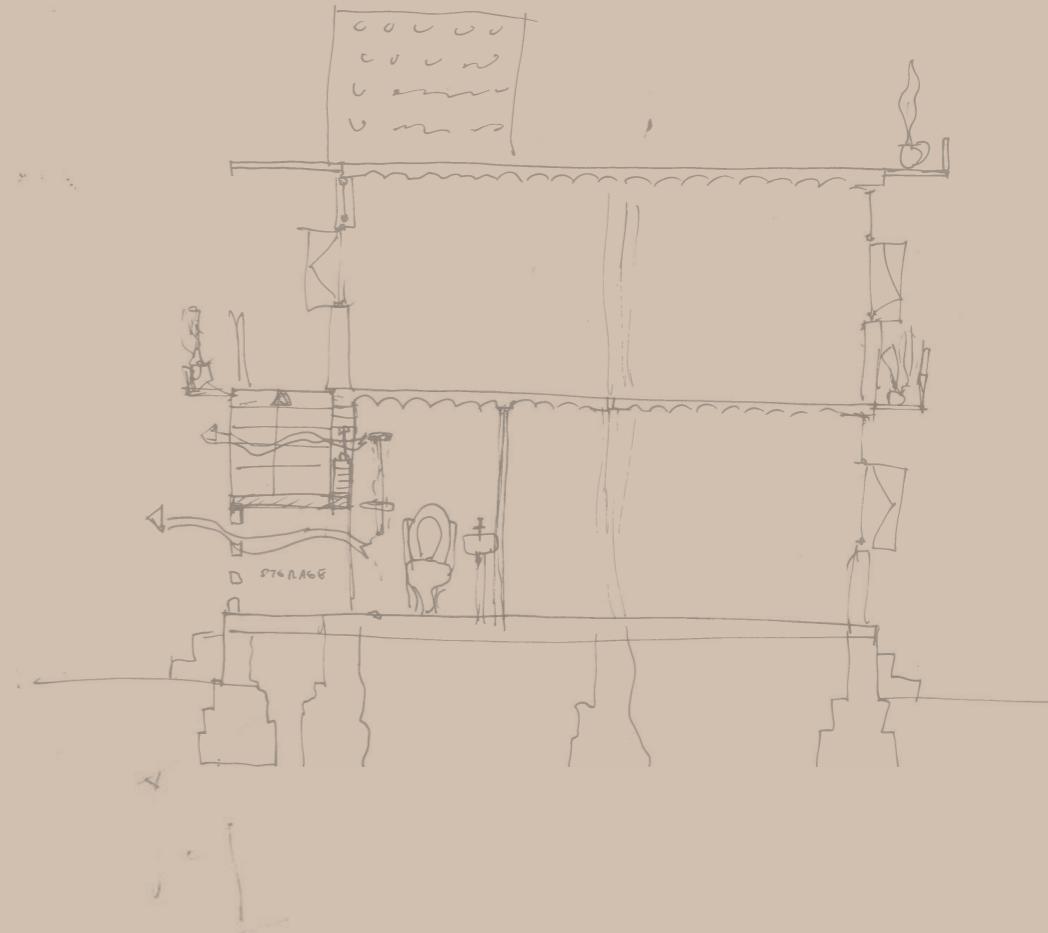
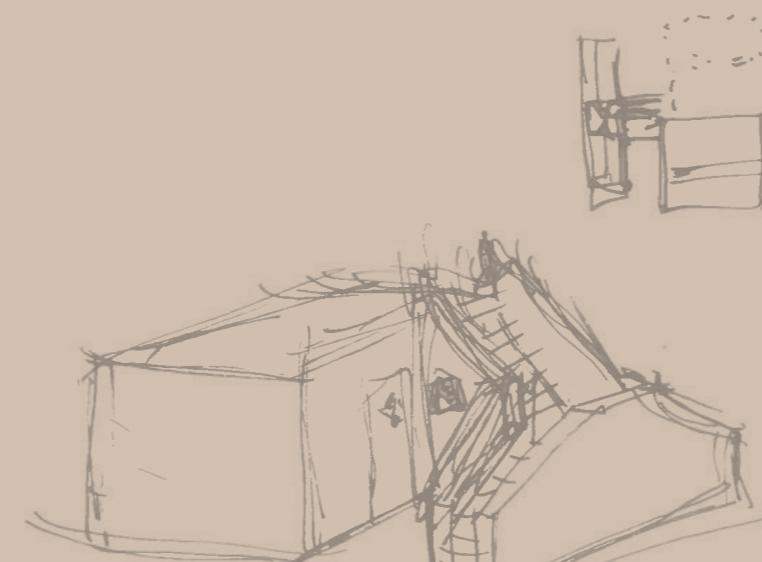
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dwelling unit b

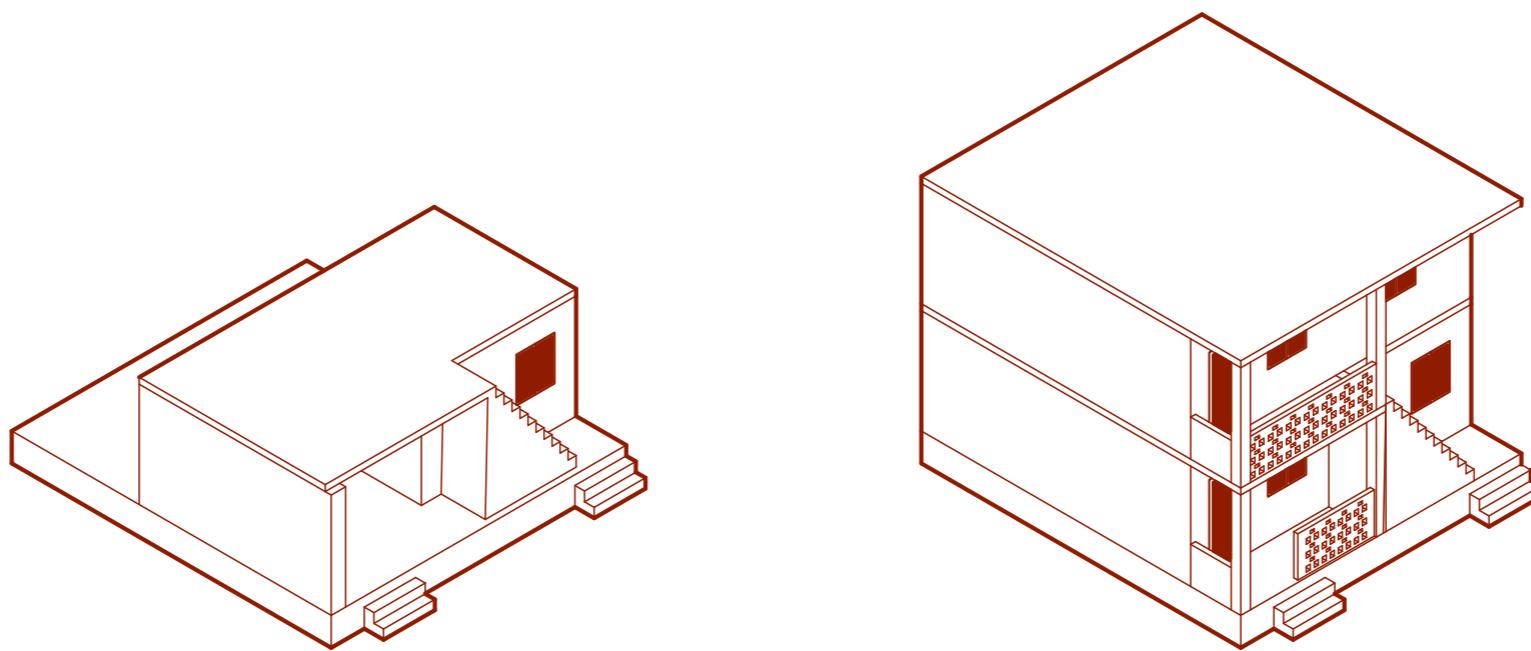
incremental housing and flood-resilience solutions for Bangladesh

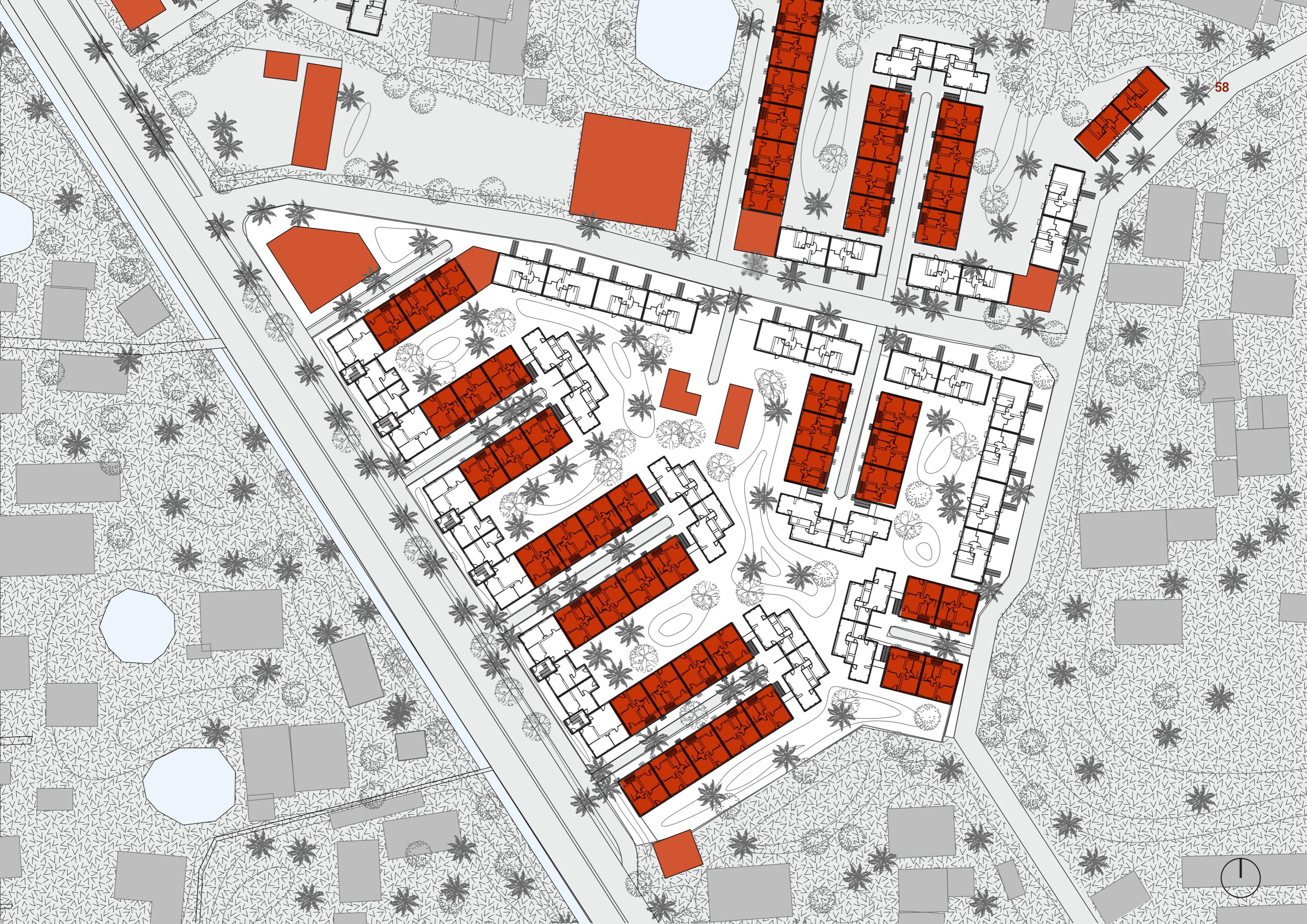


Main incremental housing unit

UNIT B

57

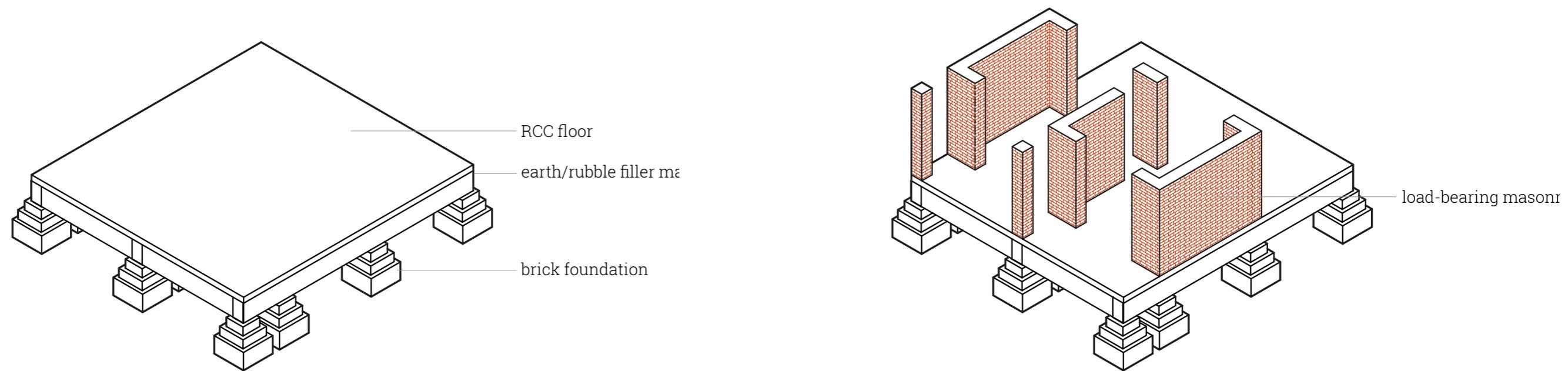




Construction timeline

59

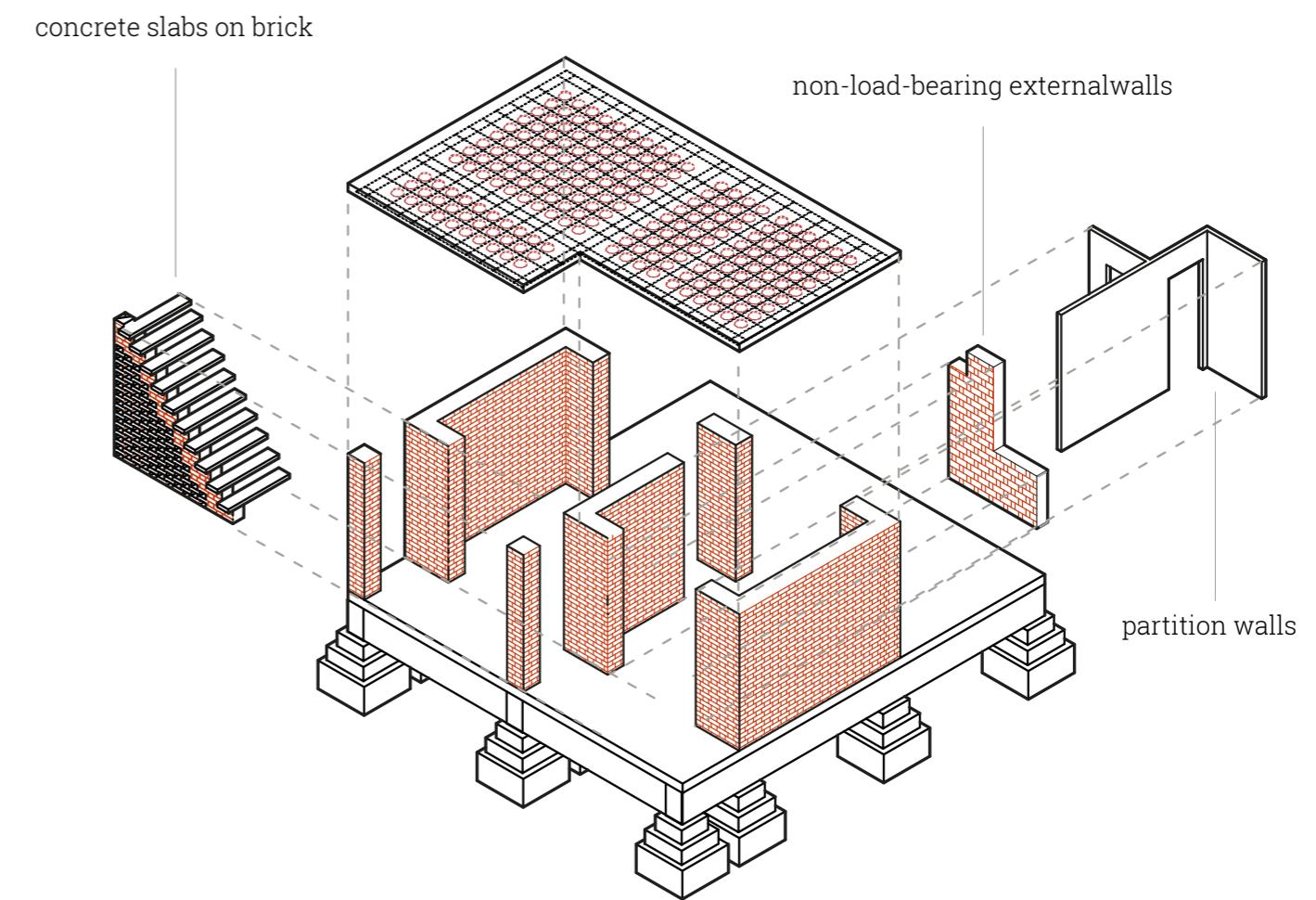
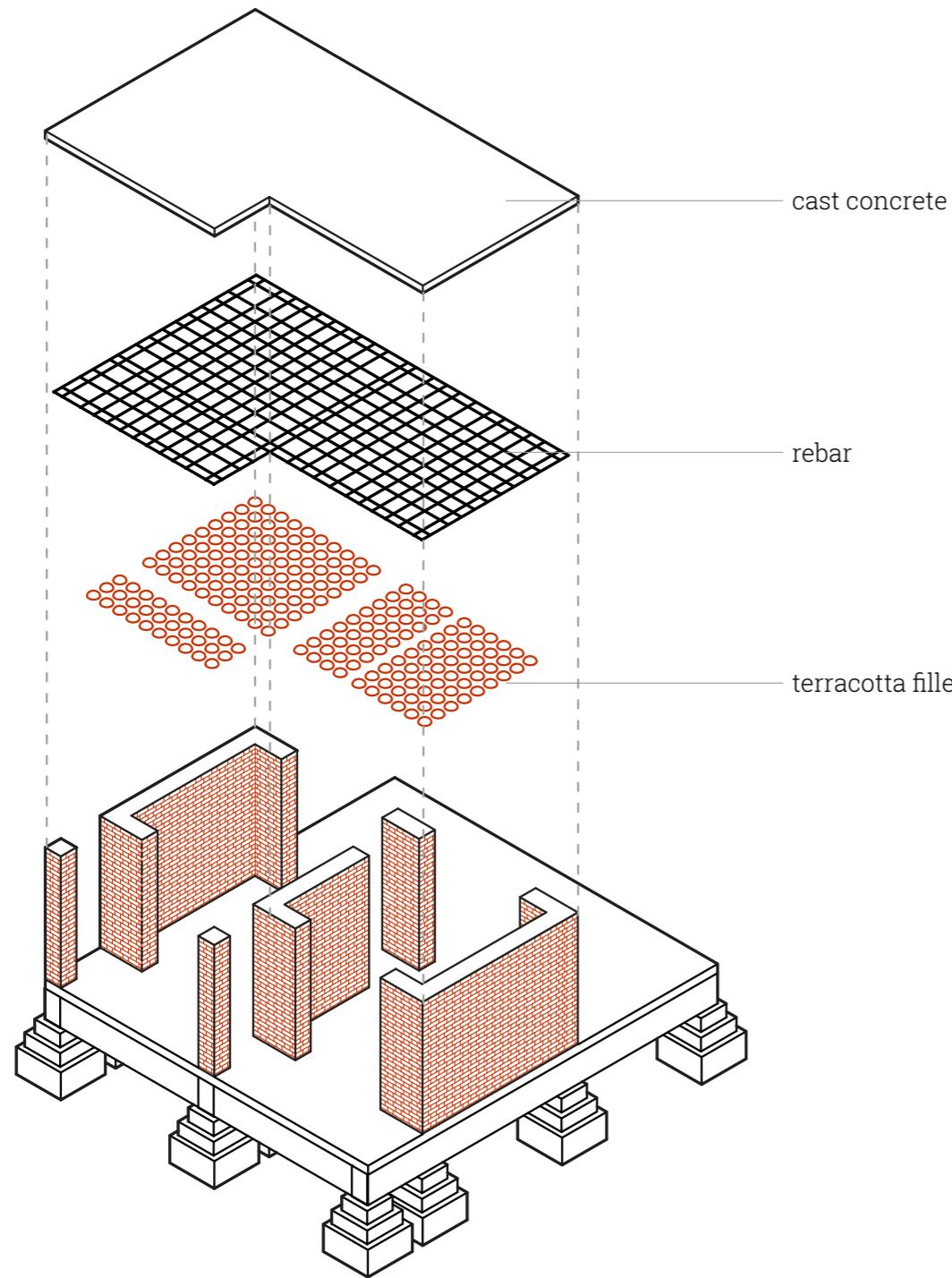
UNIT B



Construction timeline

60

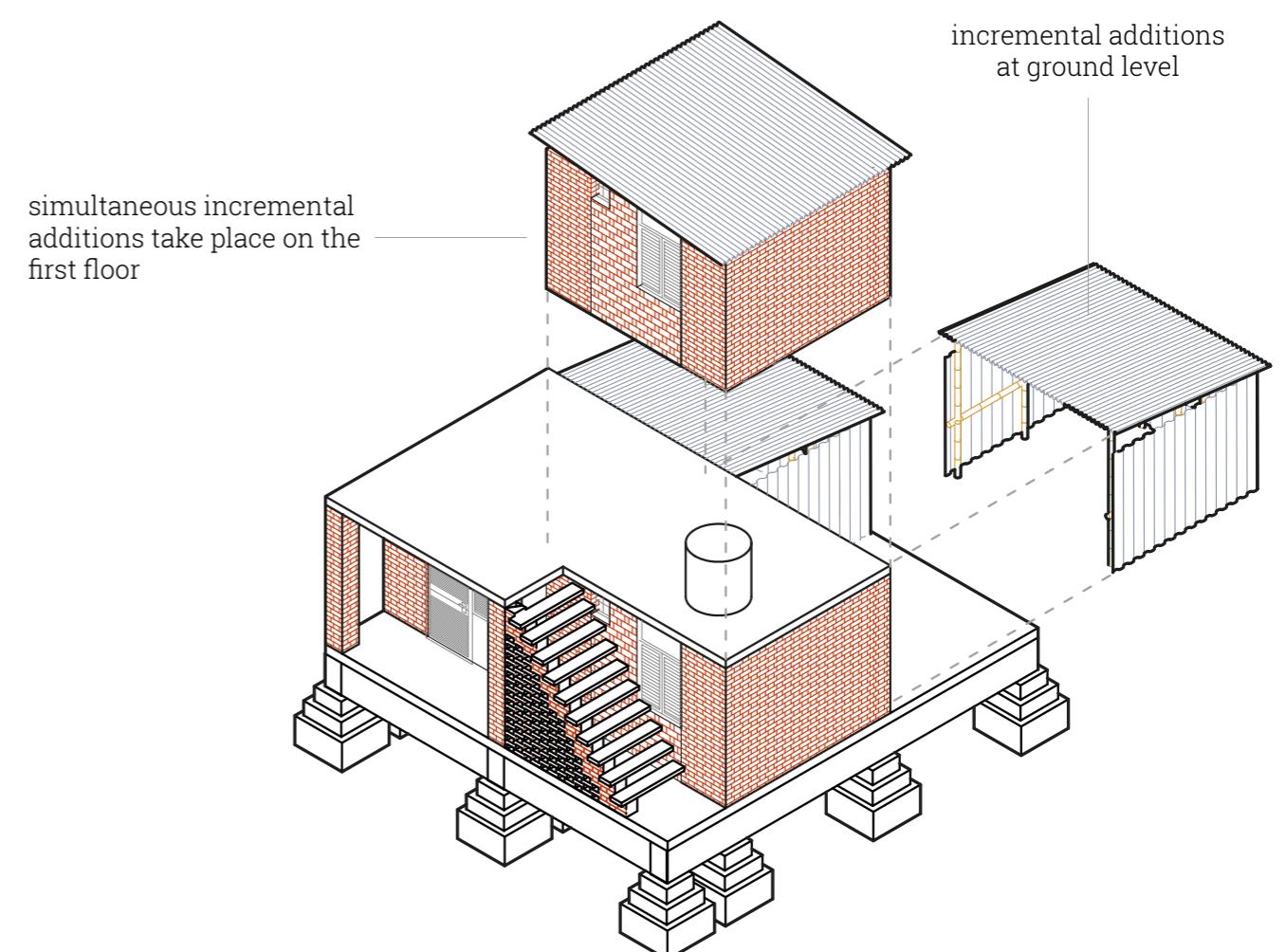
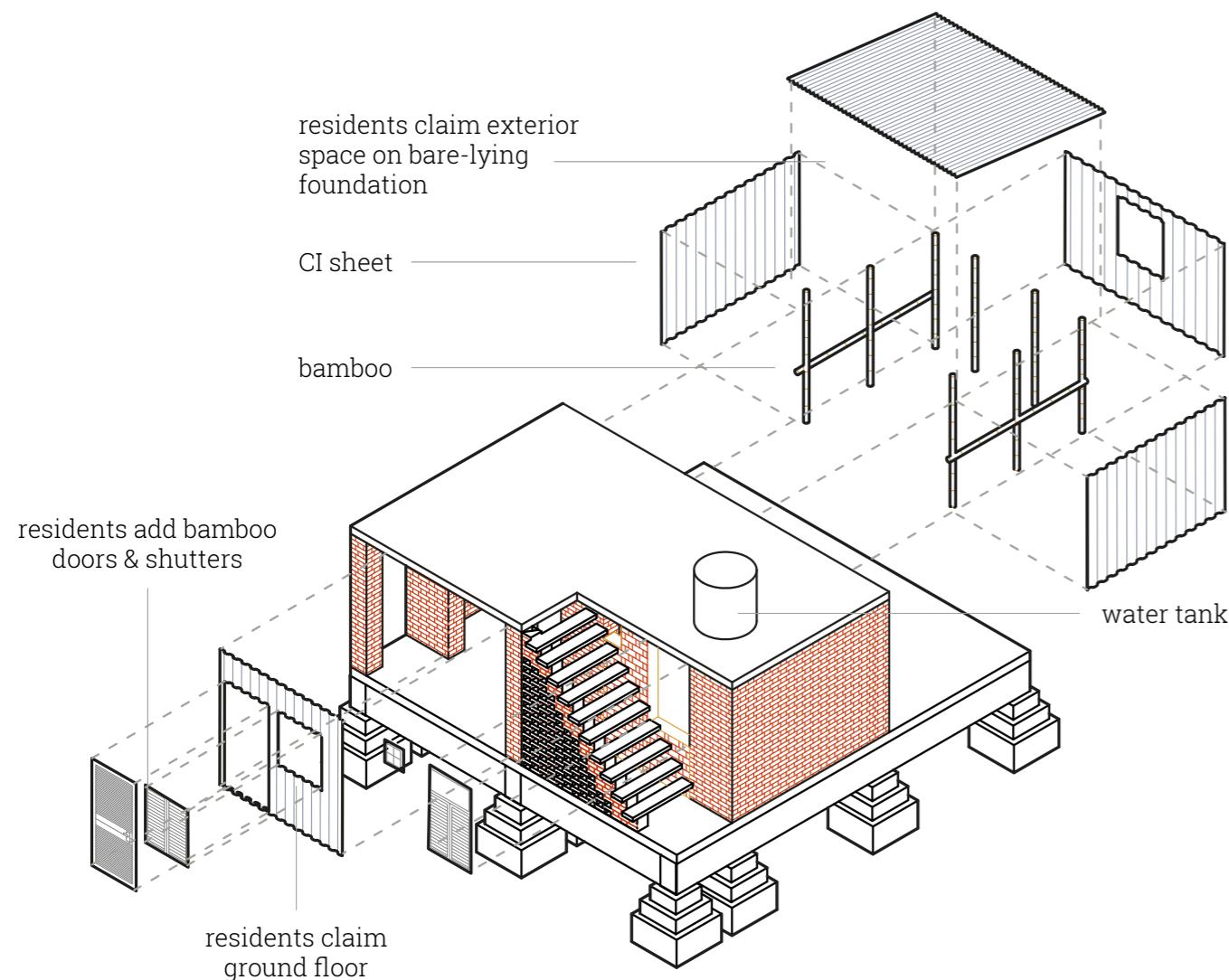
UNIT B



Construction timeline

61

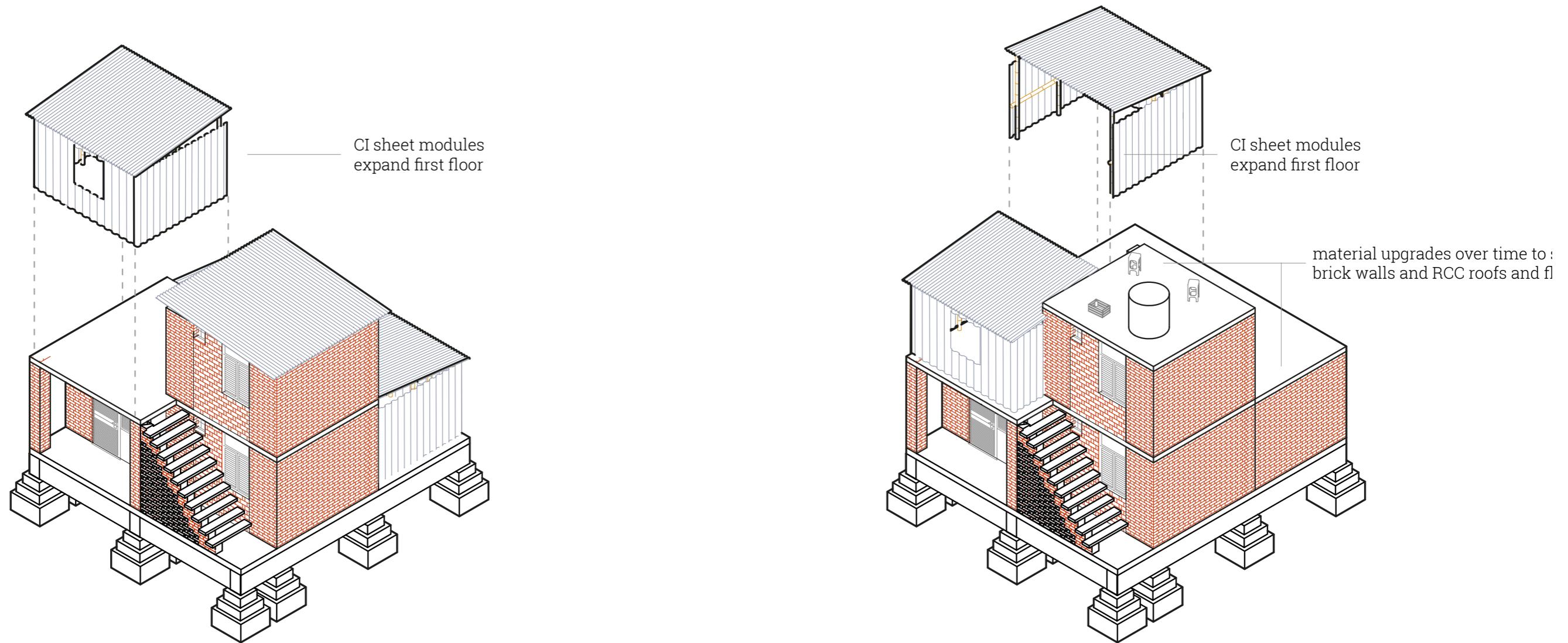
UNIT B



Construction timeline

62

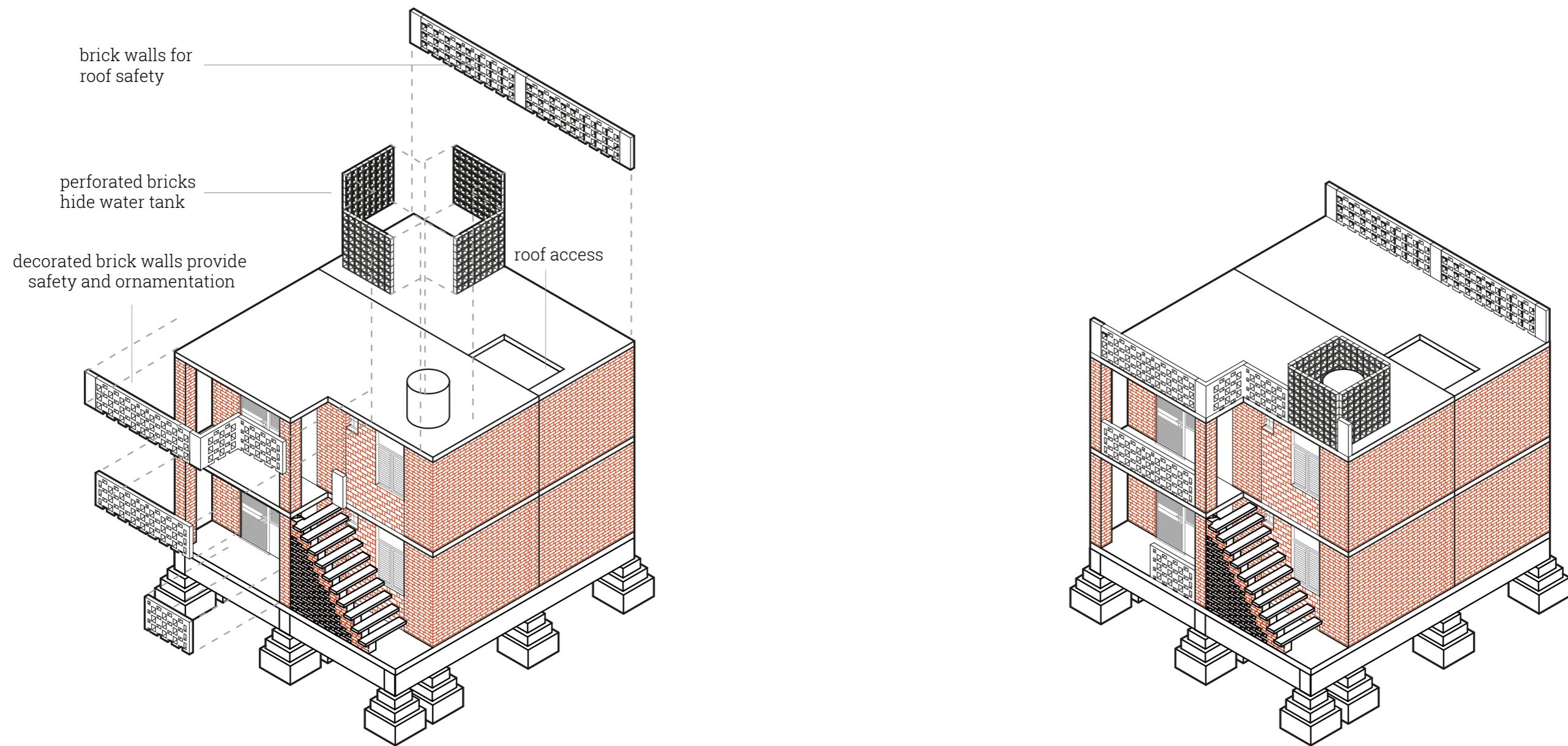
UNIT B



Construction timeline

63

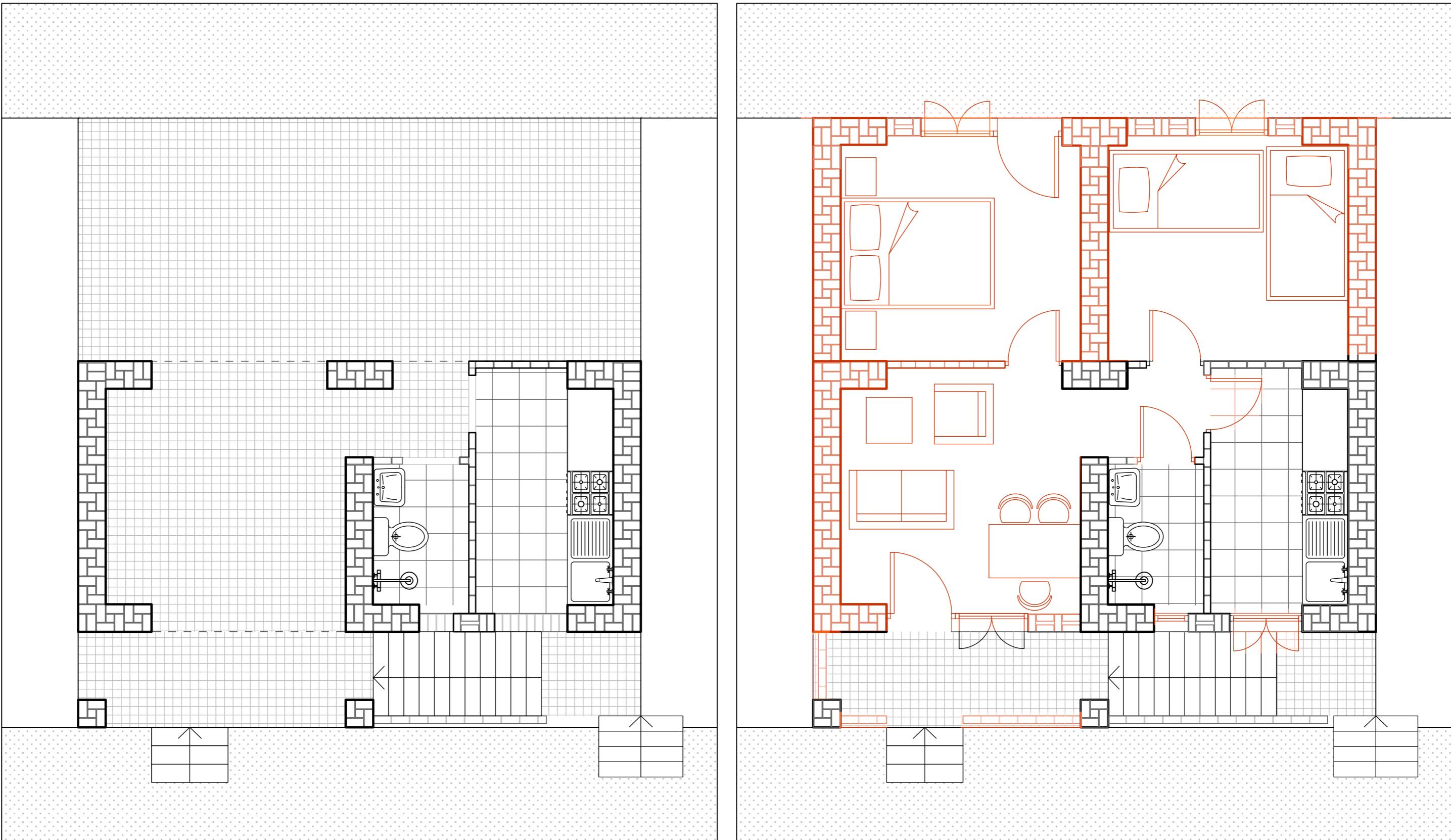
UNIT B



Ground floor

UNIT B

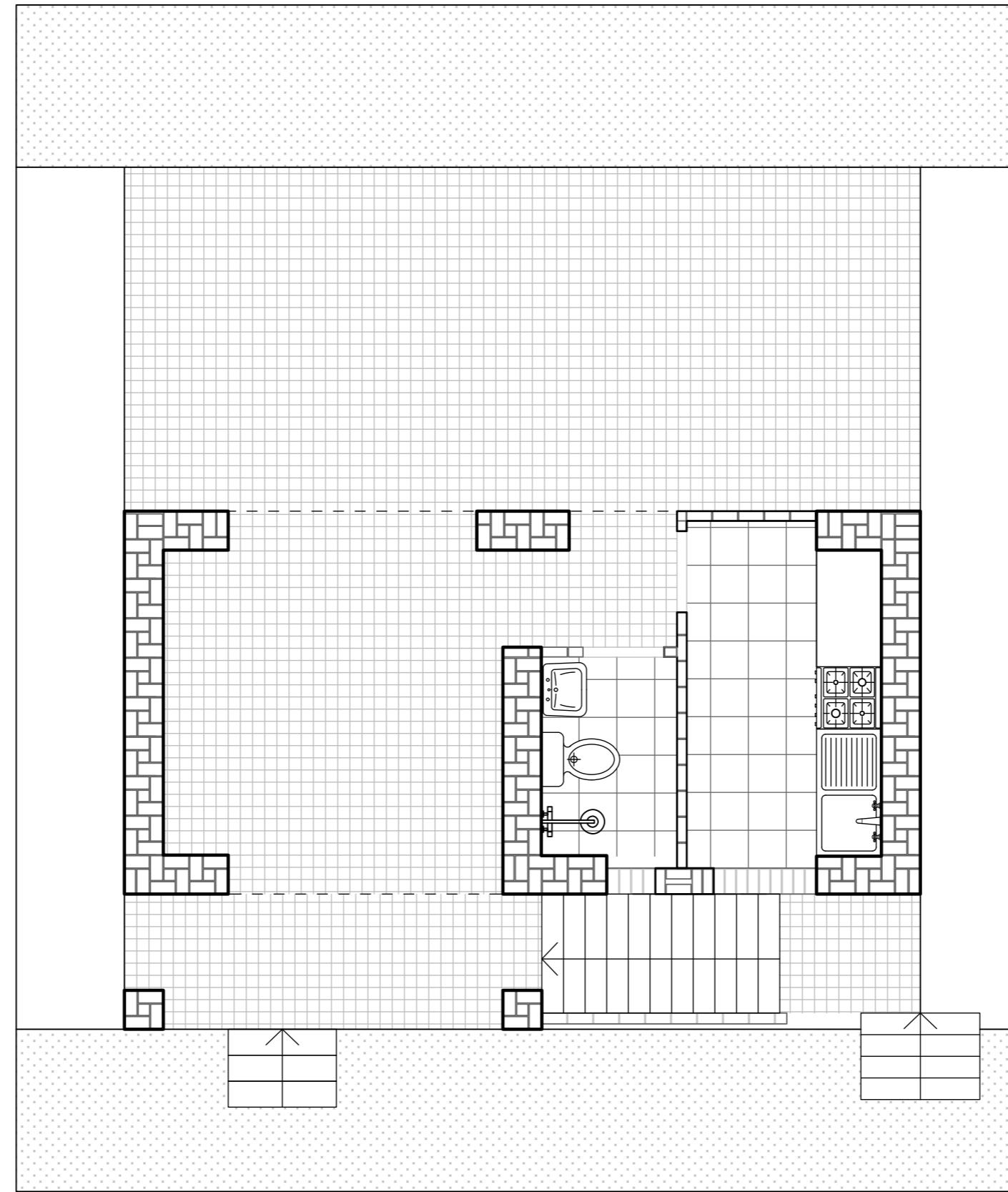
64



Ground floor proposed development

UNIT B

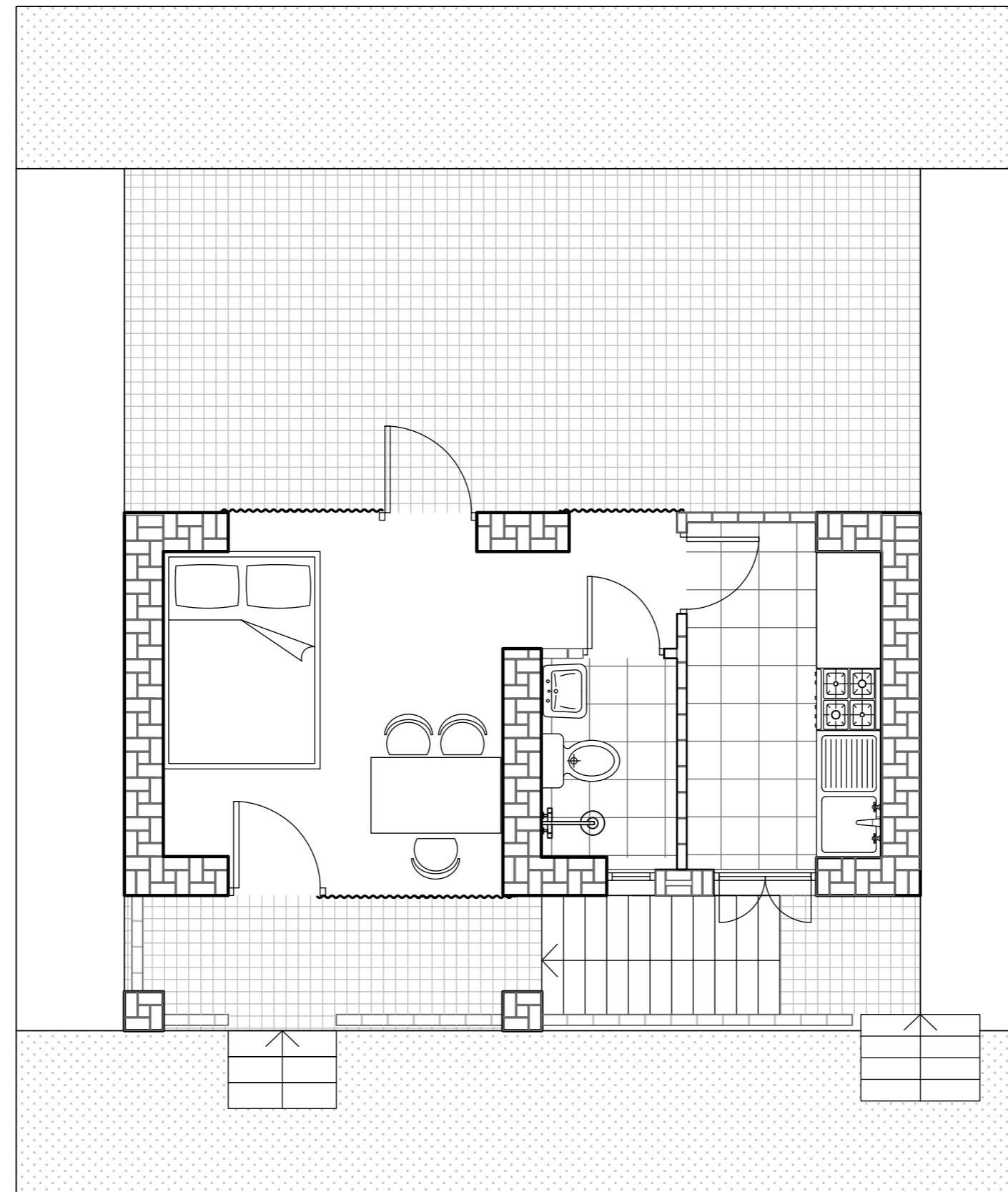
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Ground floor proposed development

UNIT B

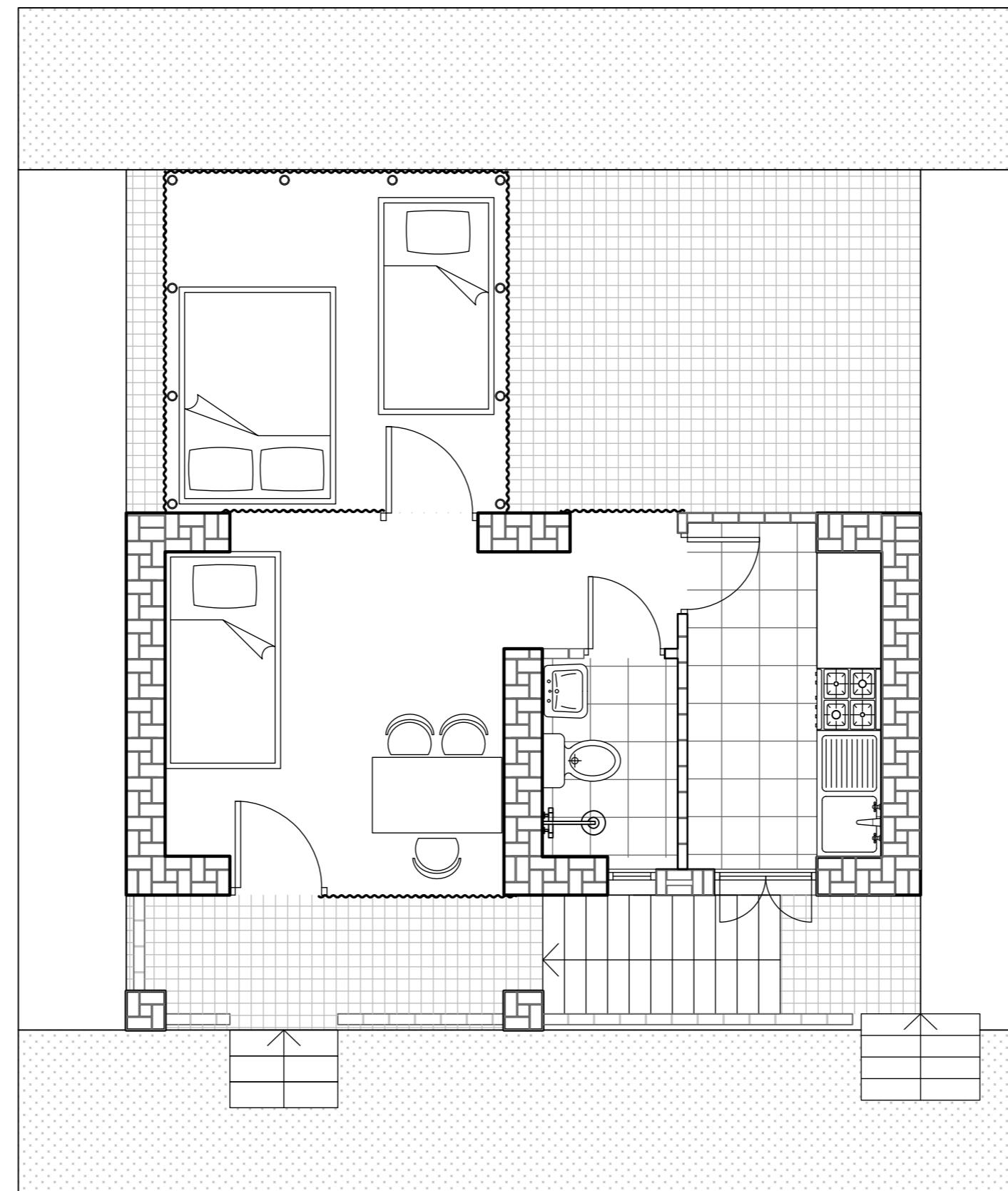
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Ground floor proposed development

UNIT B

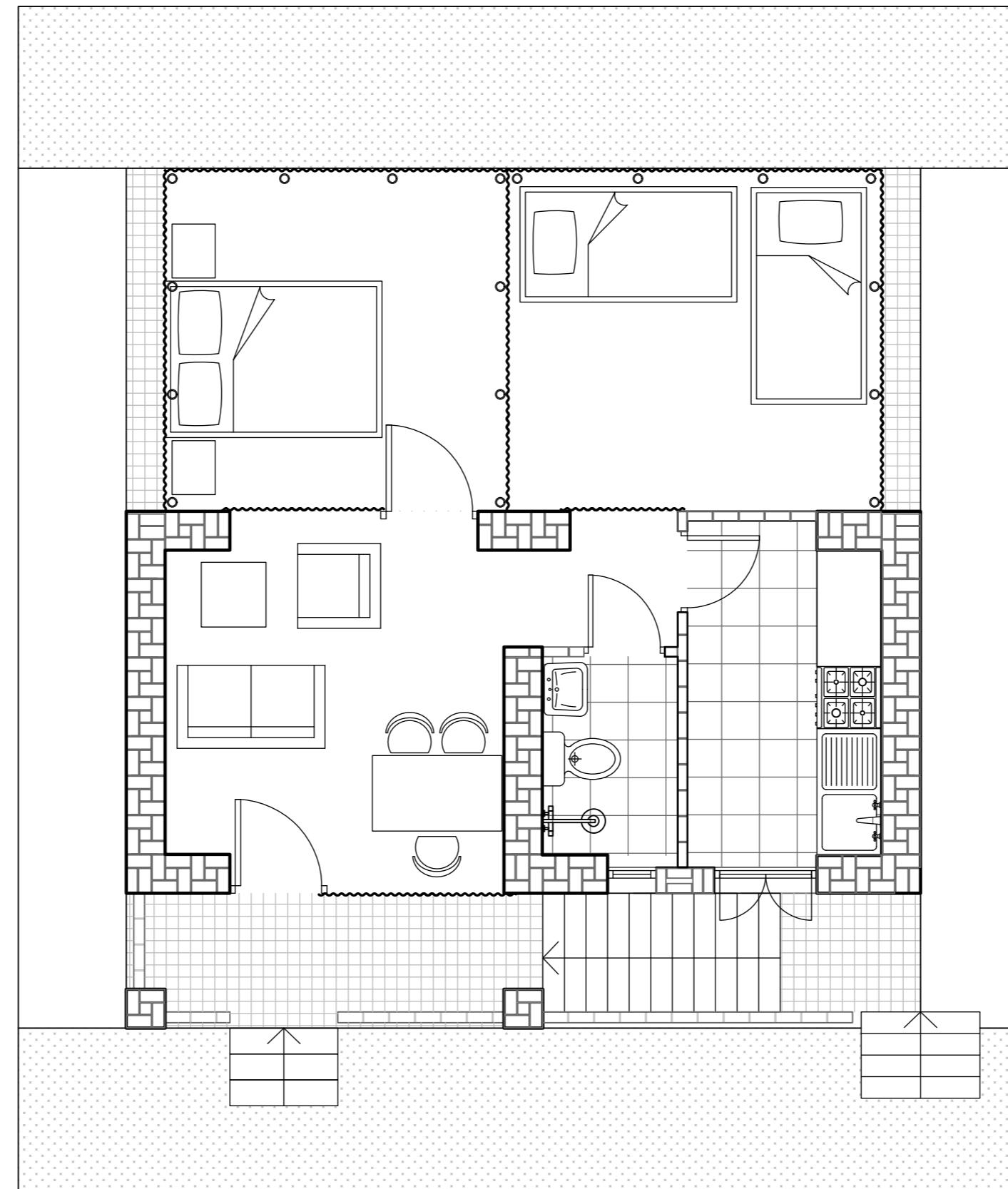
67



Ground floor proposed development

UNIT B

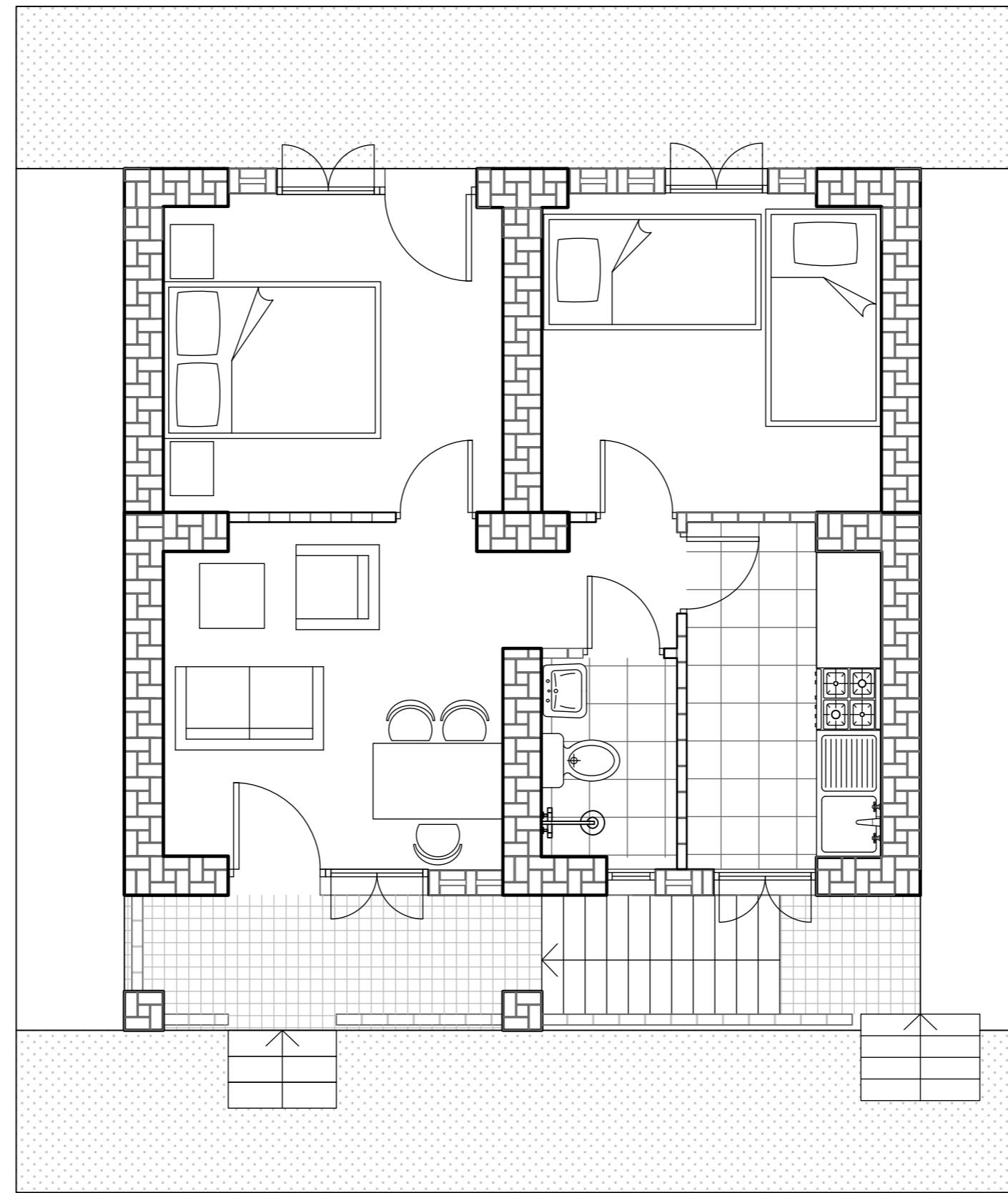
68



Ground floor proposed development

UNIT B

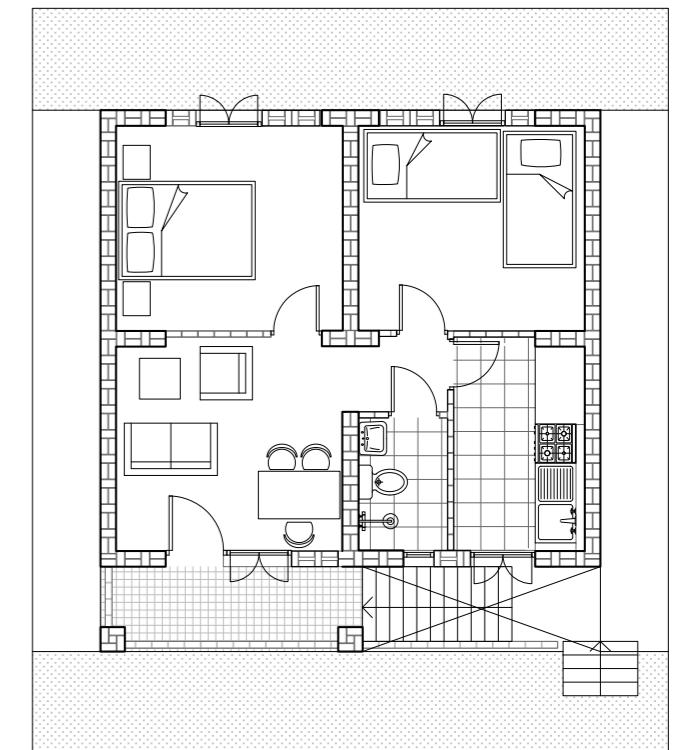
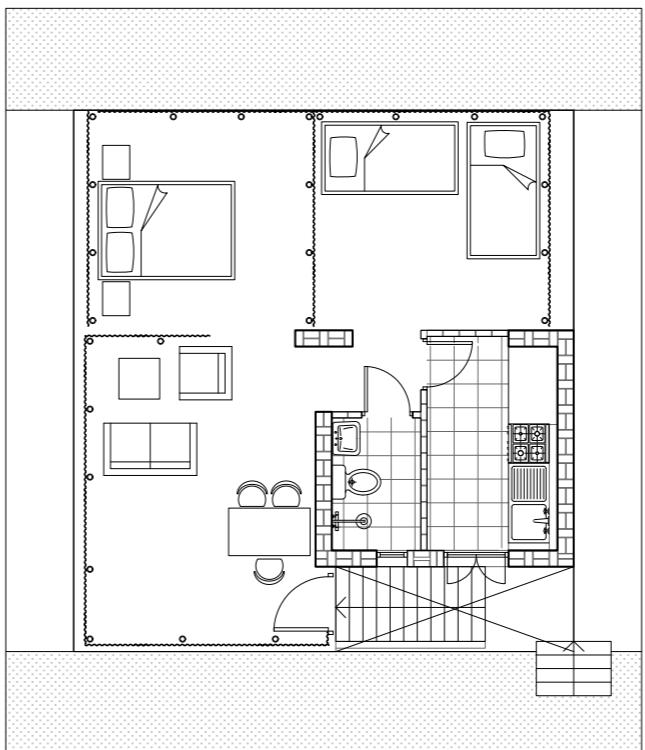
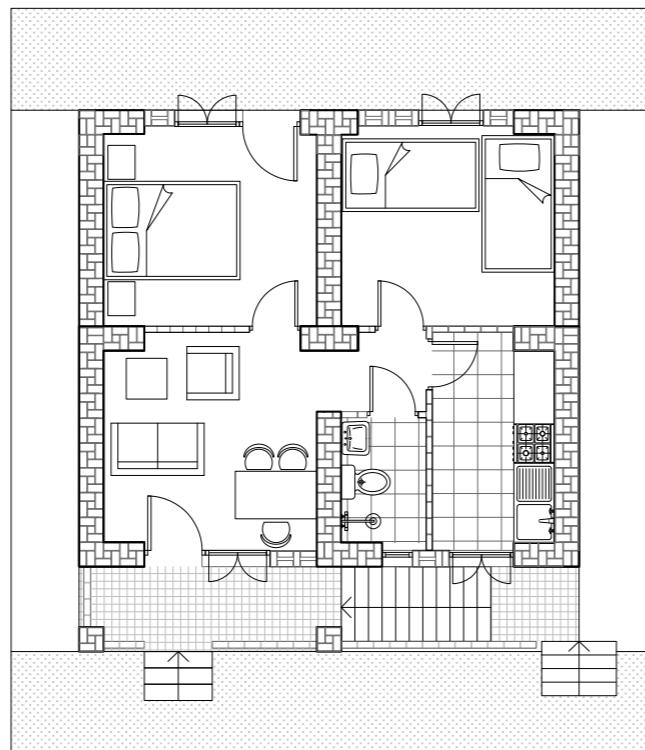
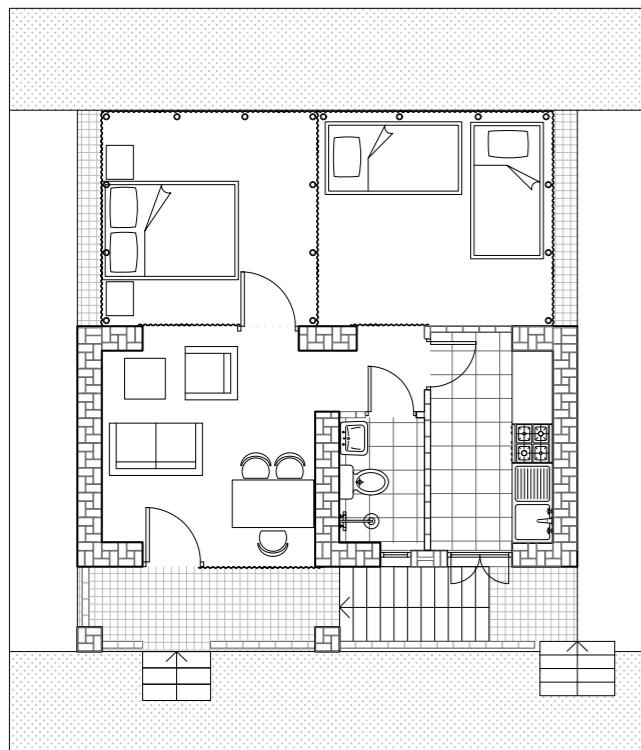
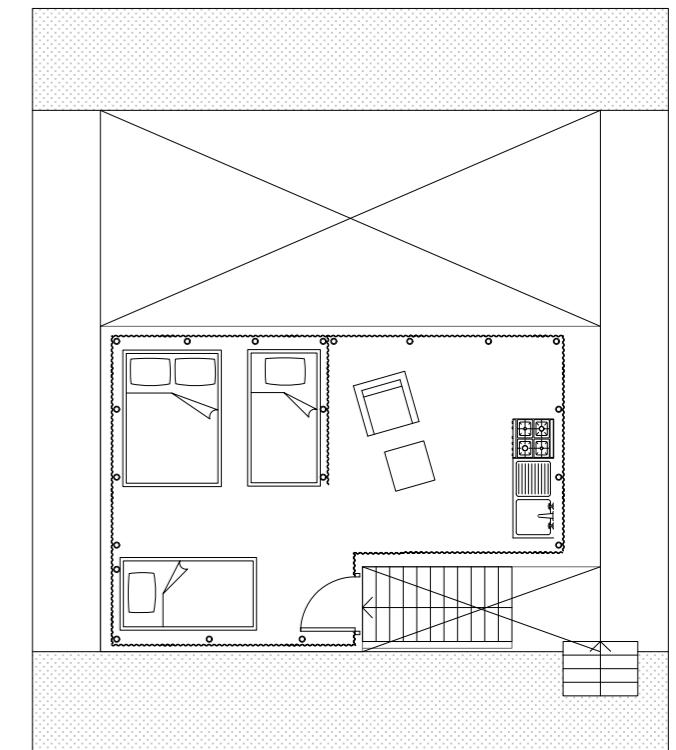
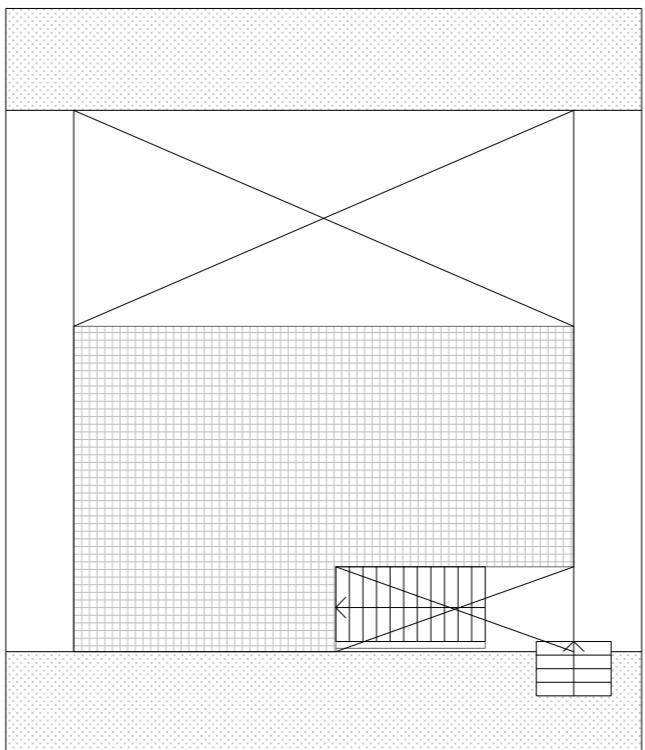
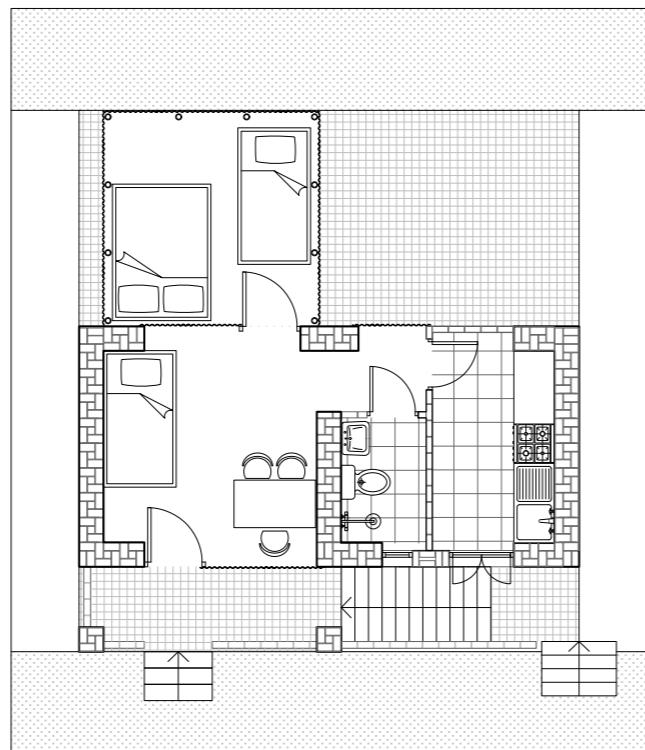
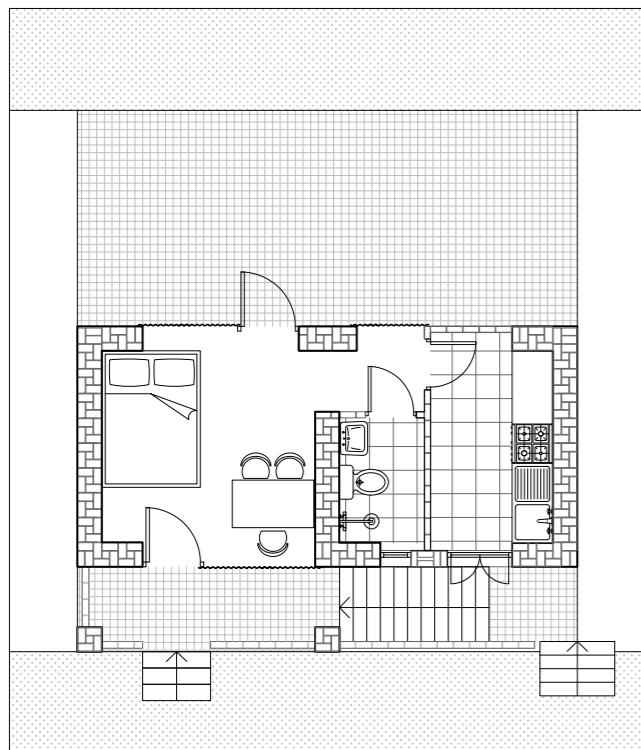
69



Proposed unit development ground floor - first floor

UNIT B

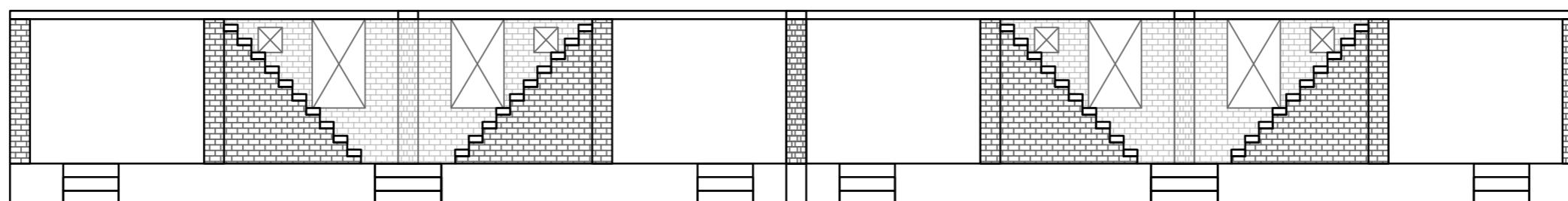
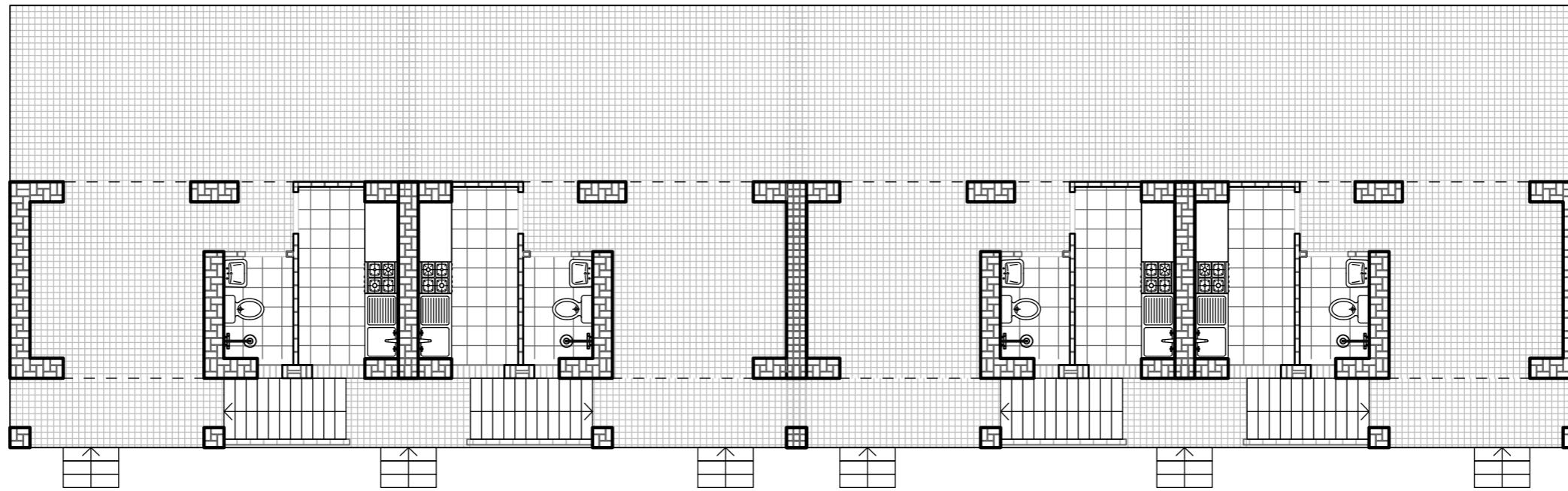
70



Clustered core-housing - base

UNIT B

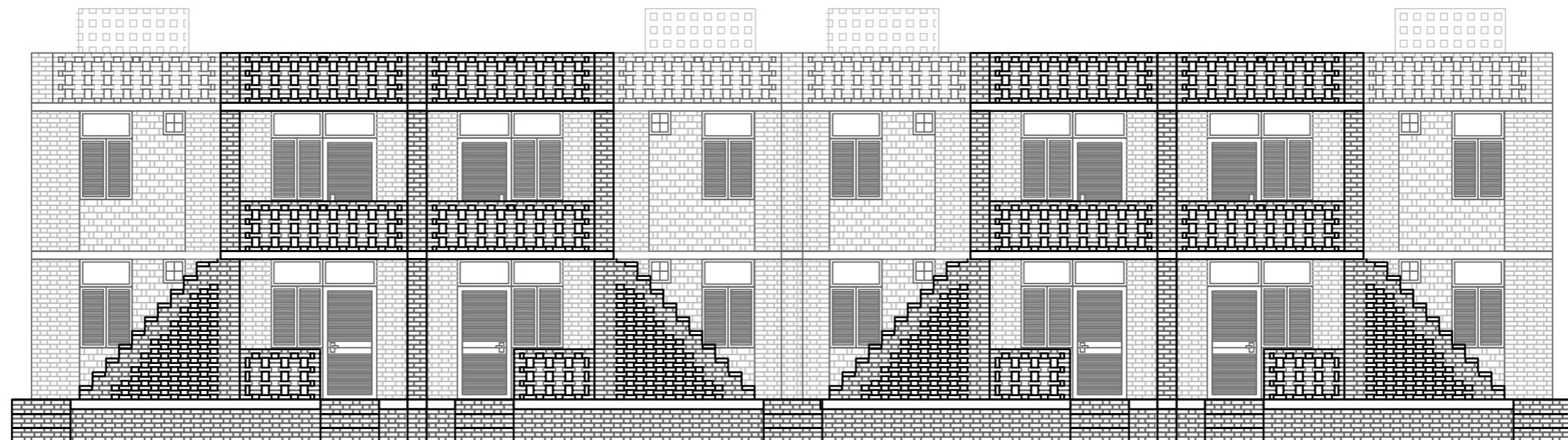
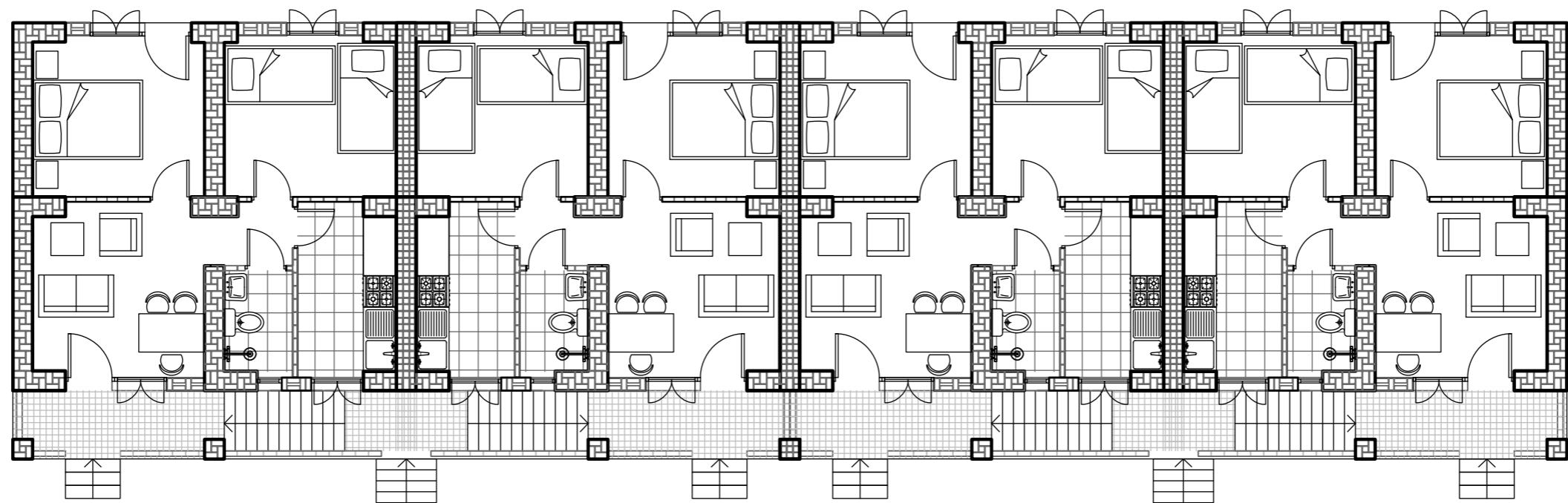
71



Clustered core-housing - proposed development

72

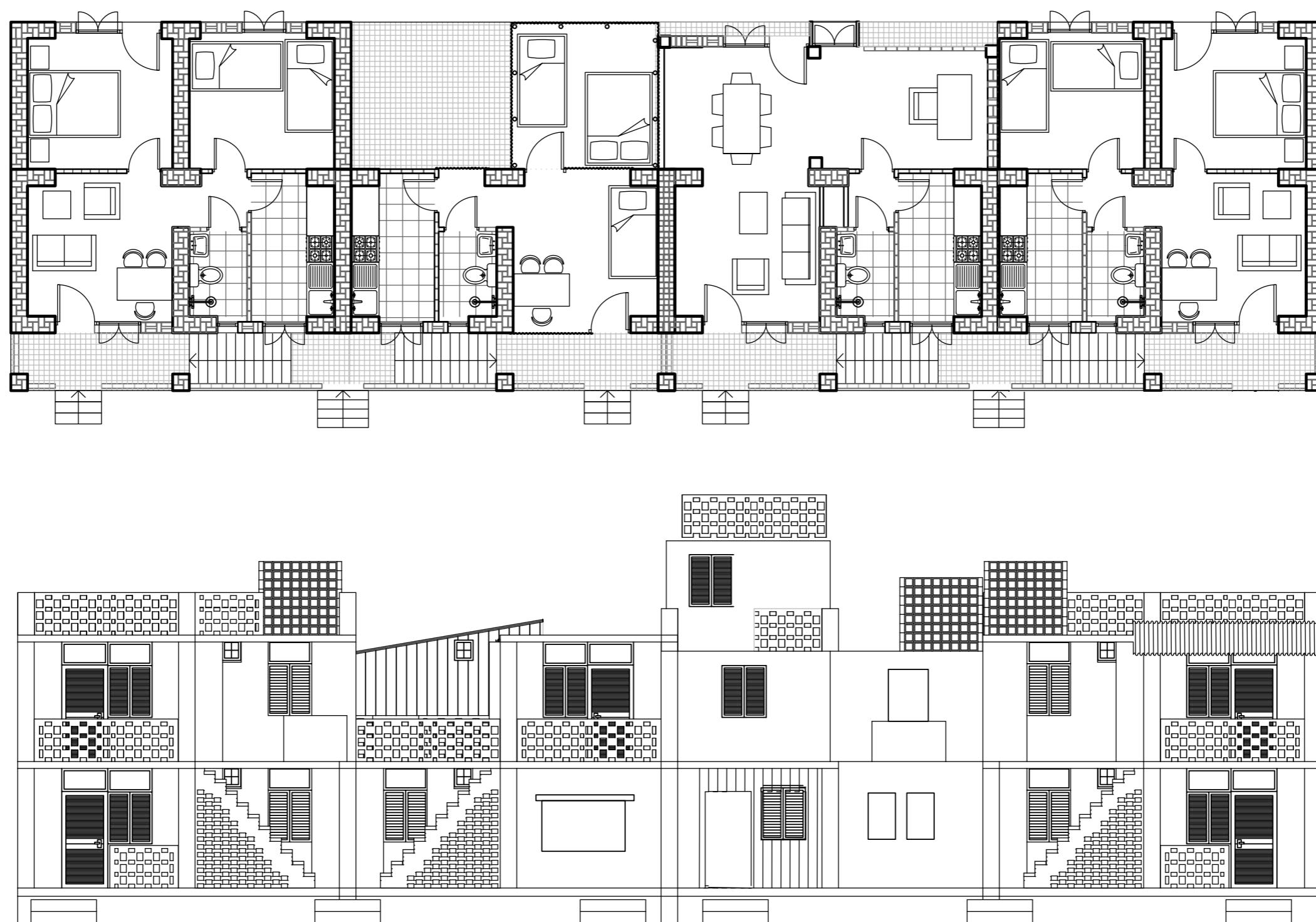
UNIT B



Clustered core-housing - realistic development

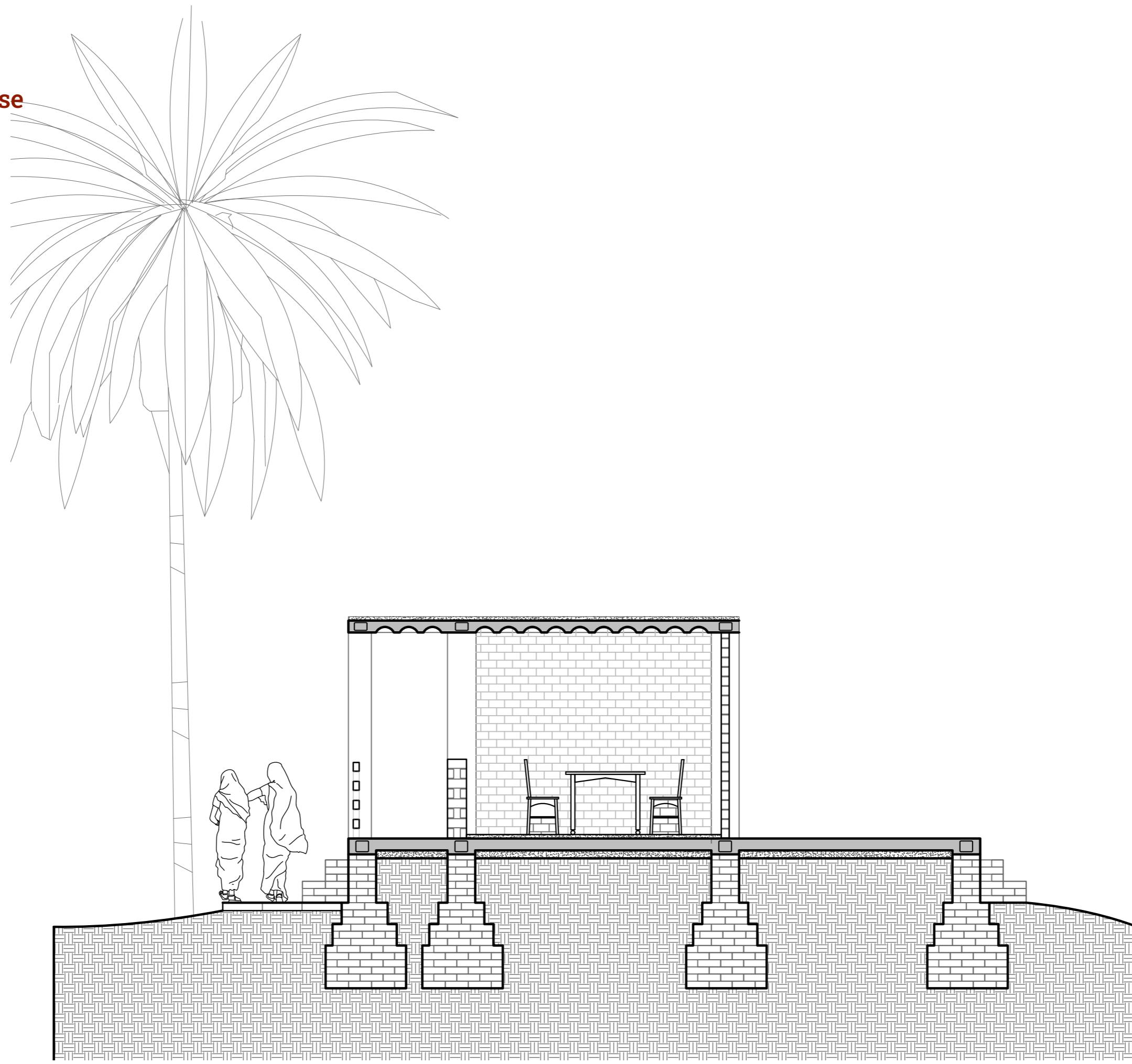
73

UNIT B



Section - base

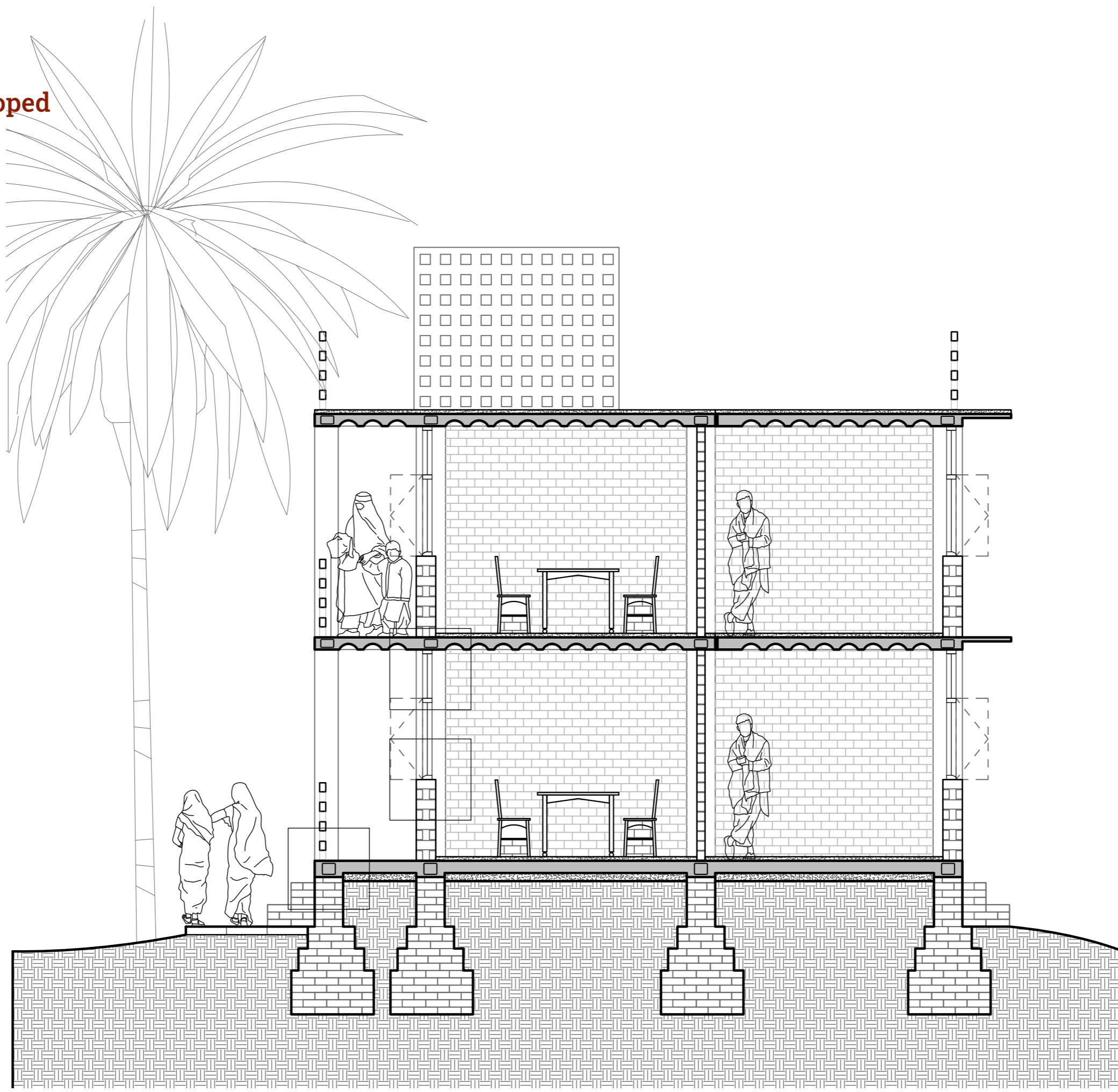
UNIT B



Section - developed

UNIT B

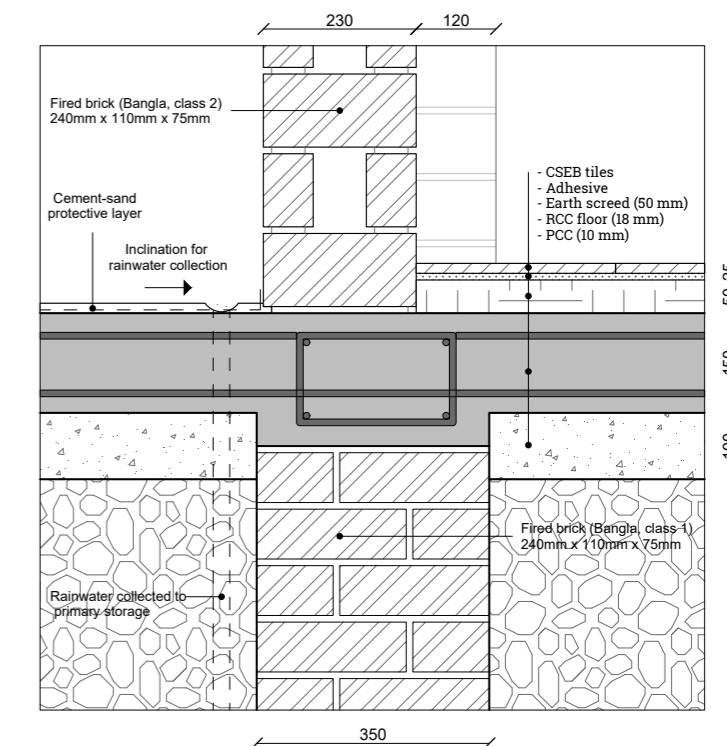
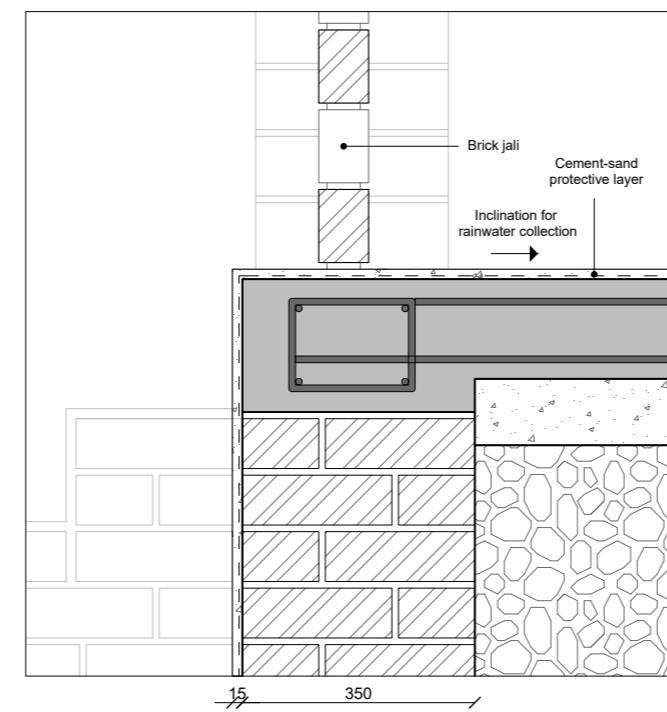
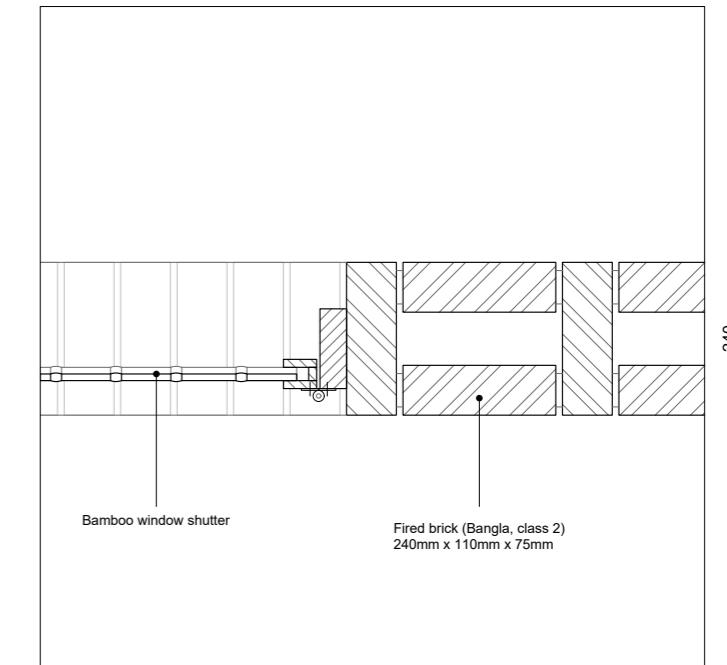
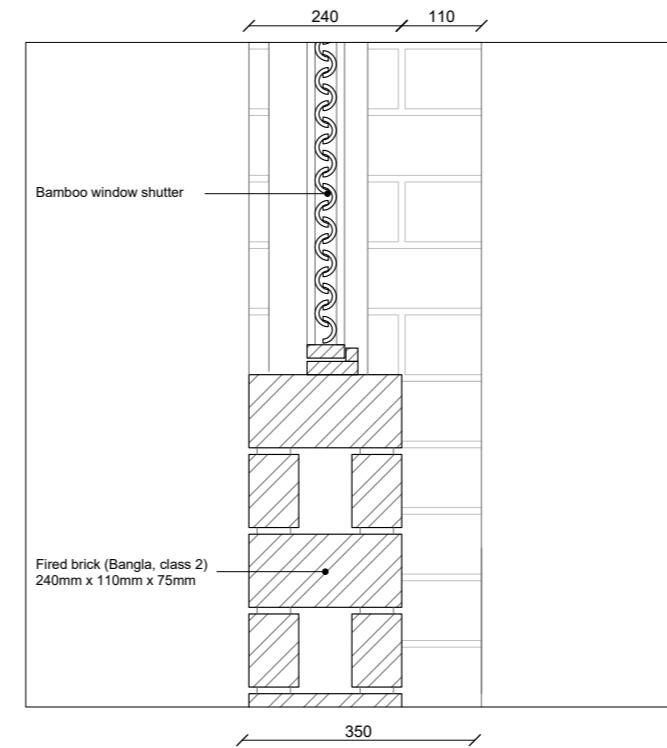
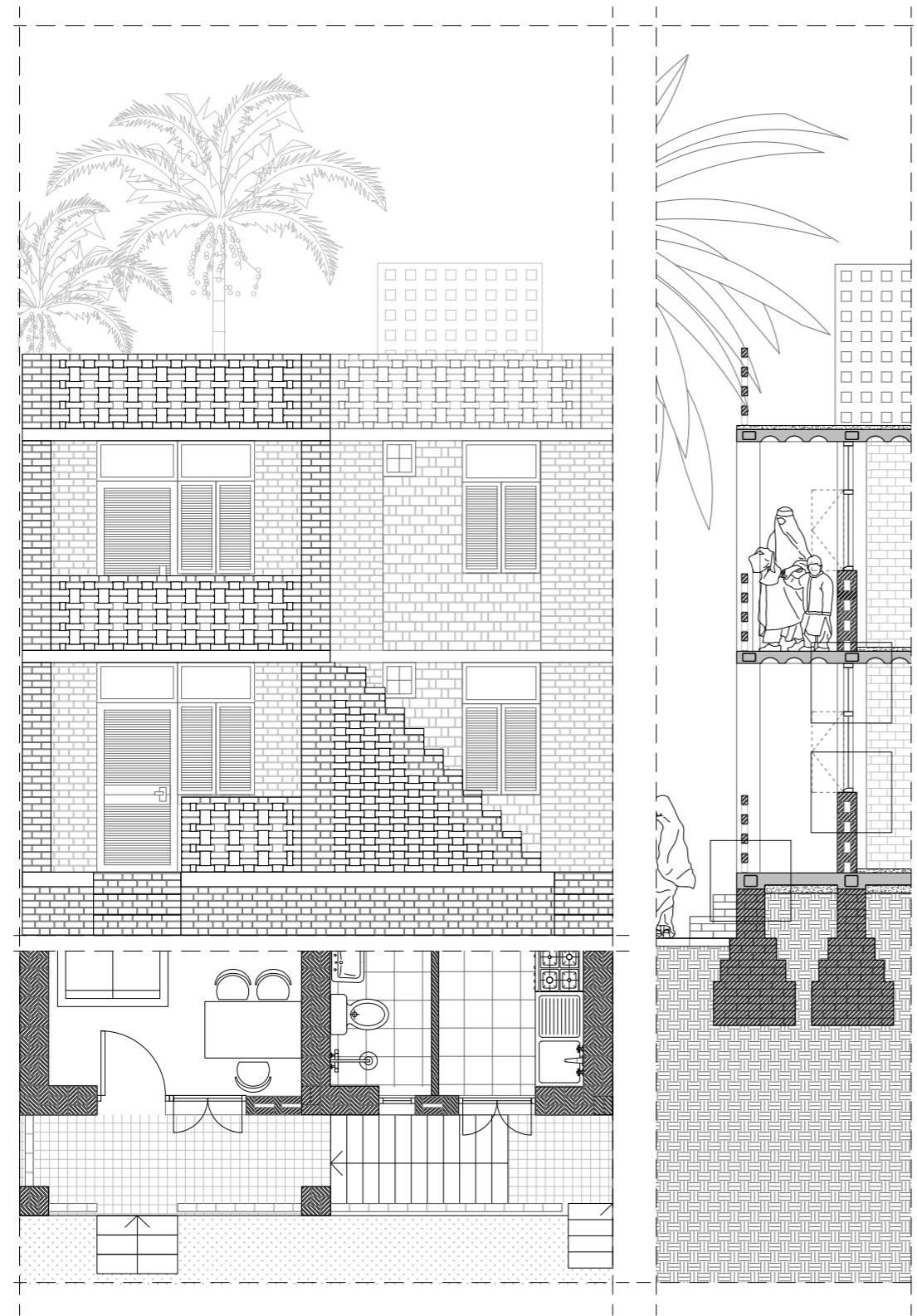
75



Facade fragment & details

76

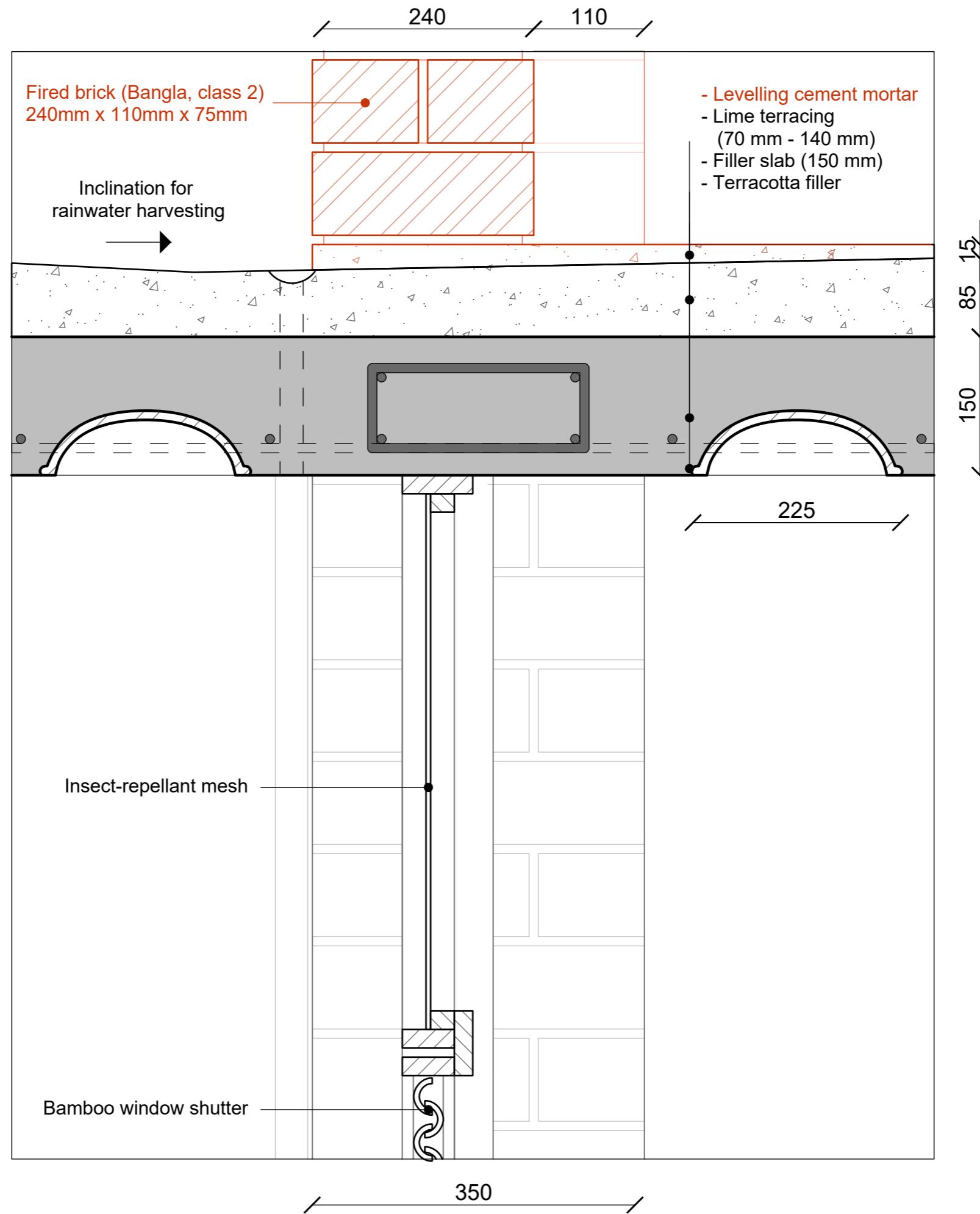
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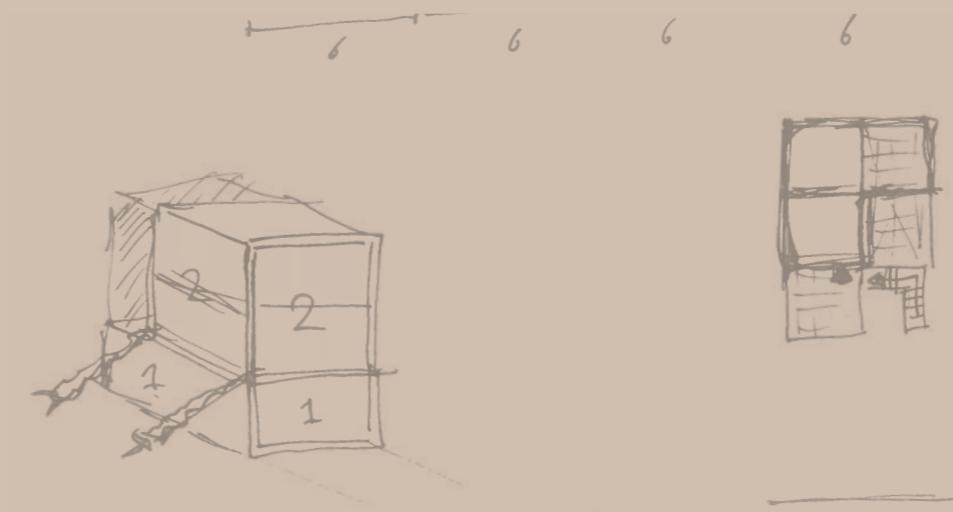
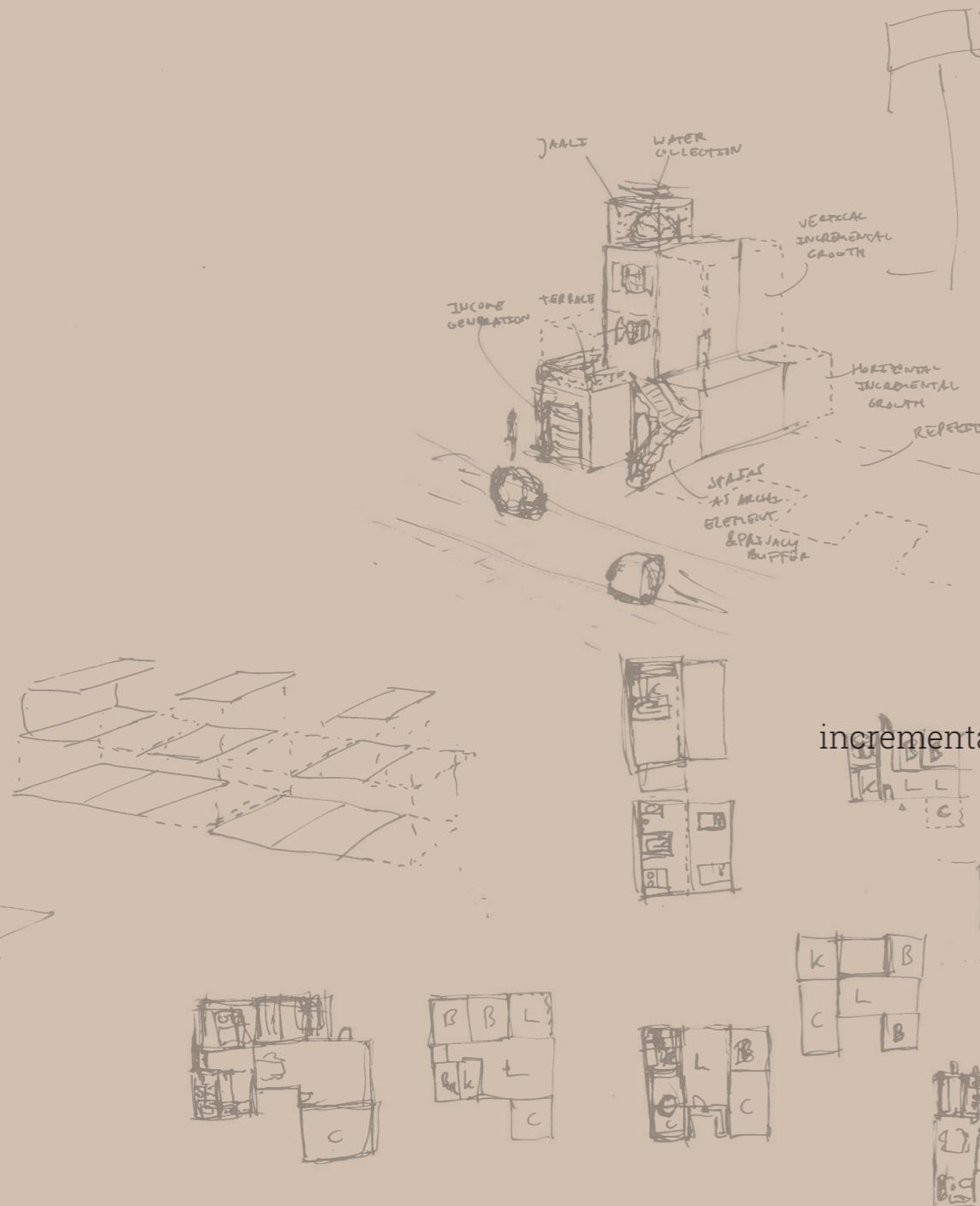


Detail V4

UNIT B

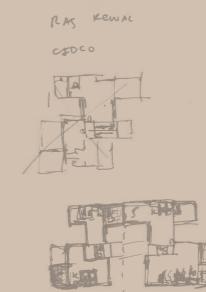
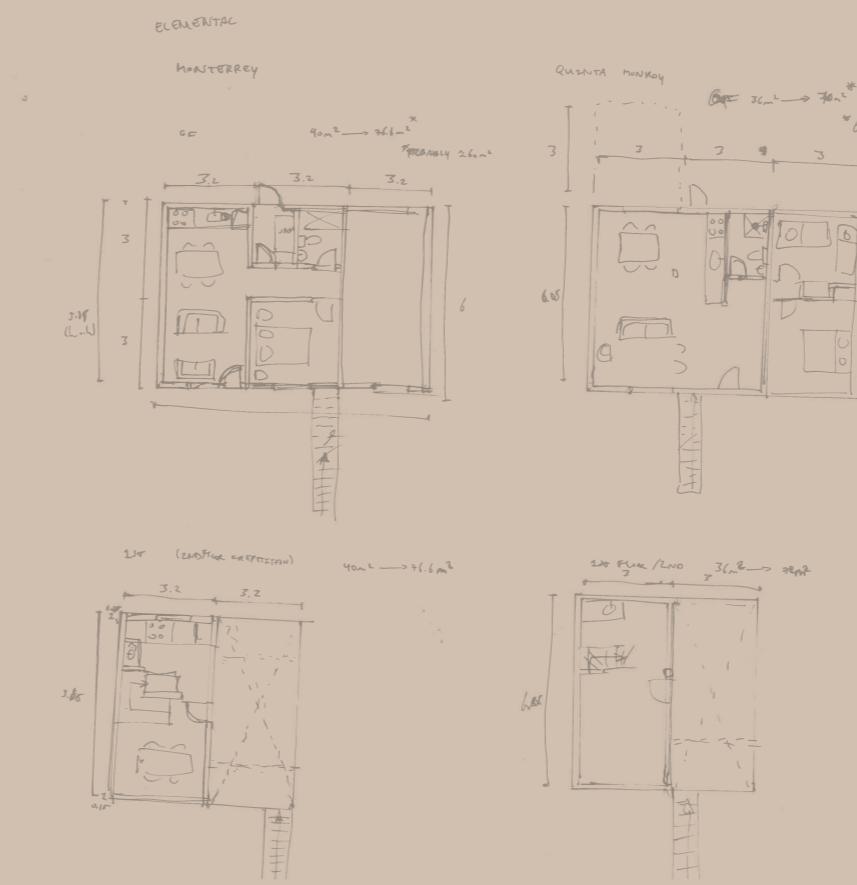
77





dwelling unit d

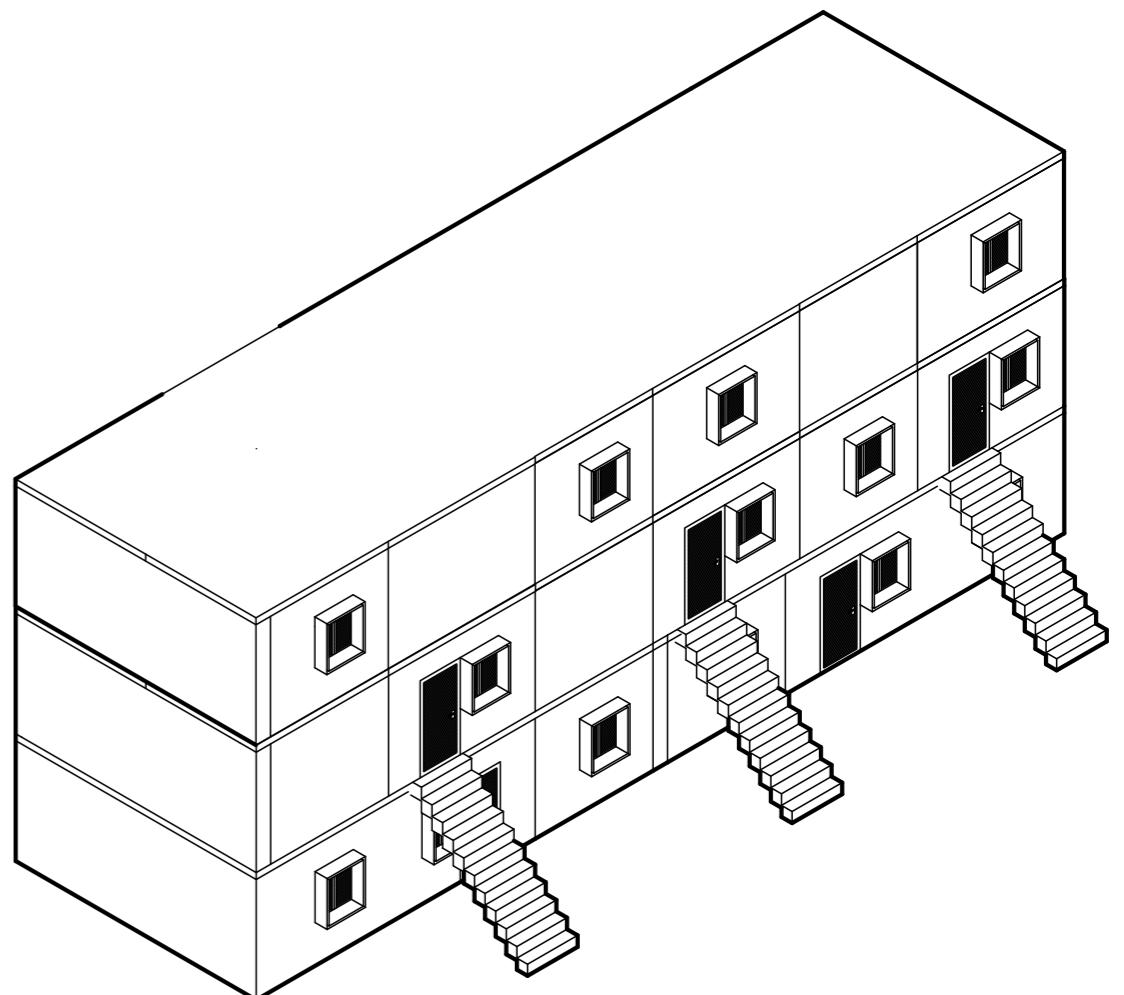
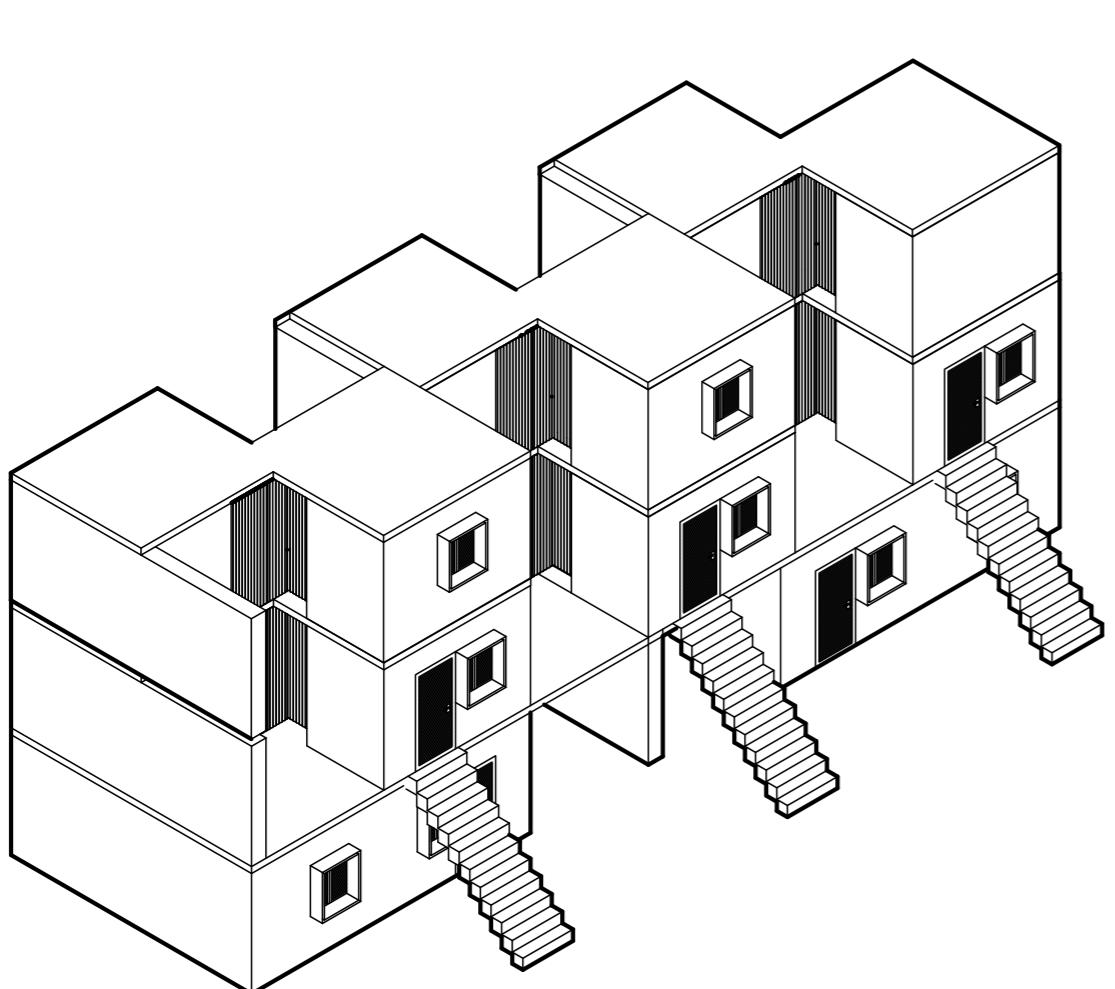
incremental housing and flood-resilience solutions for Bangladesh

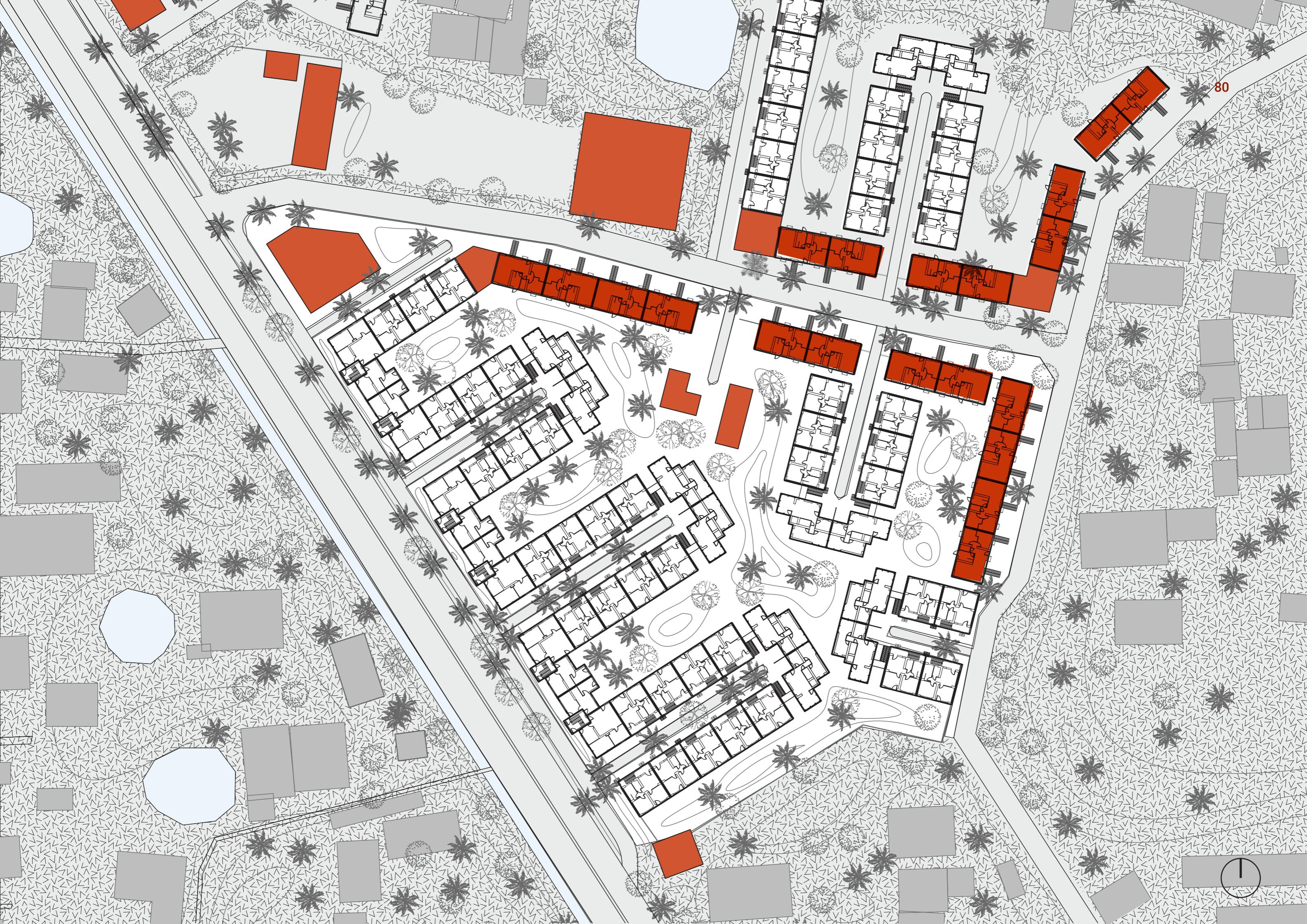


Secondary incremental housing unit

Unit D

79

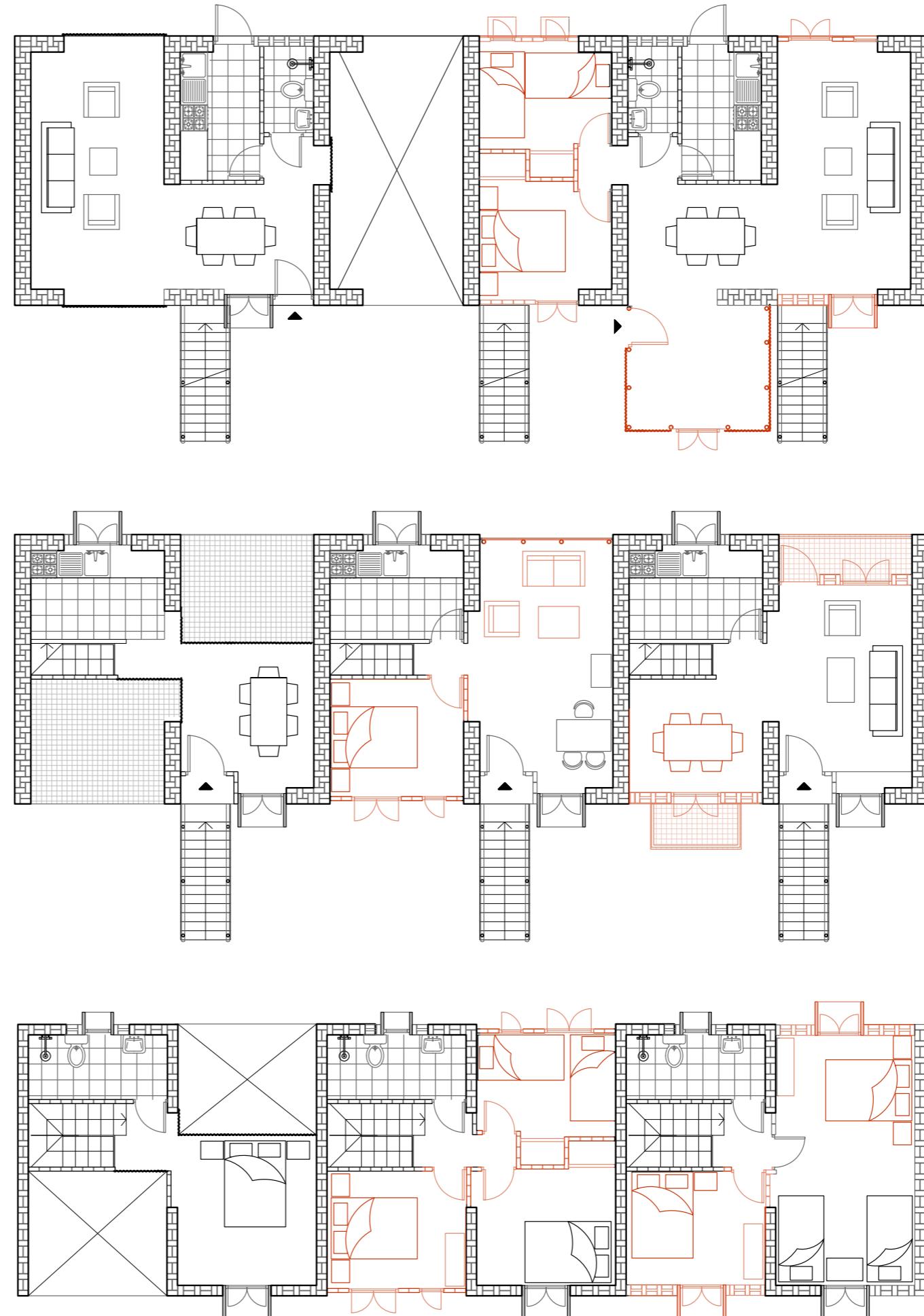




Floorplans base (left) and developed (right)

UNIT D

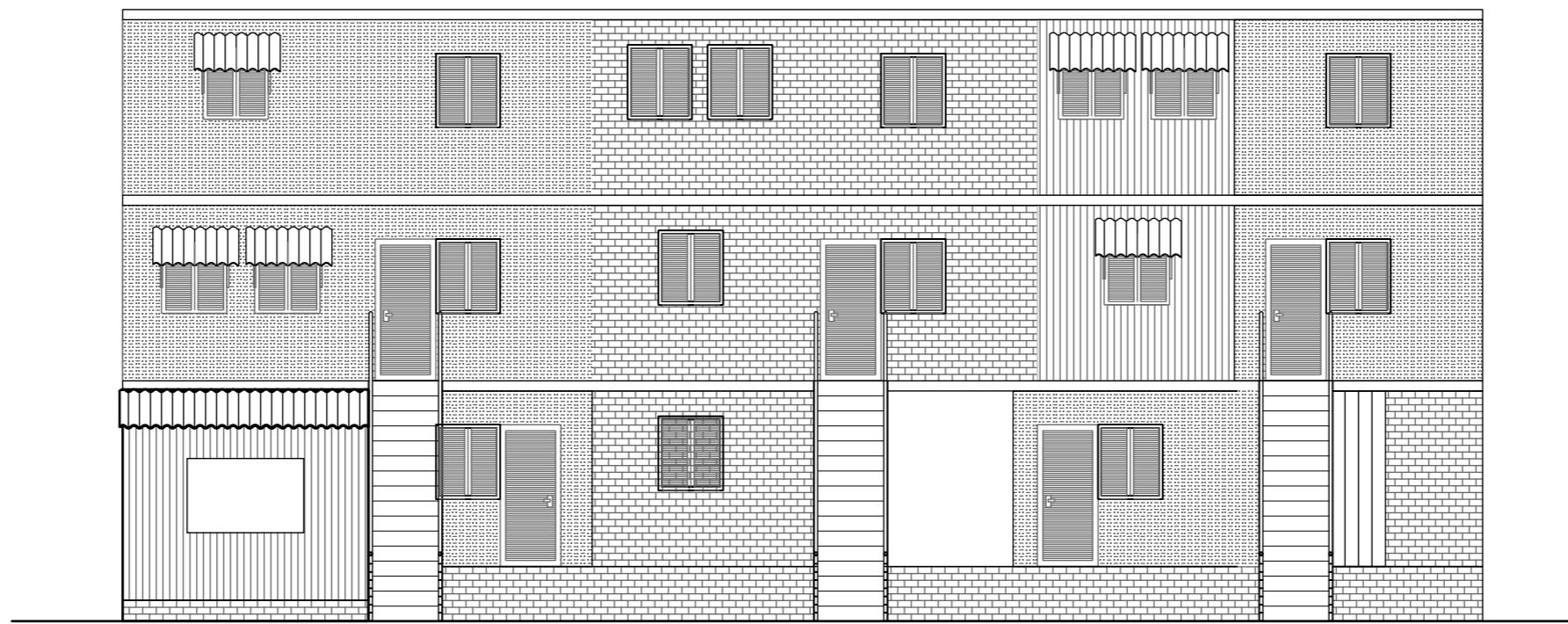
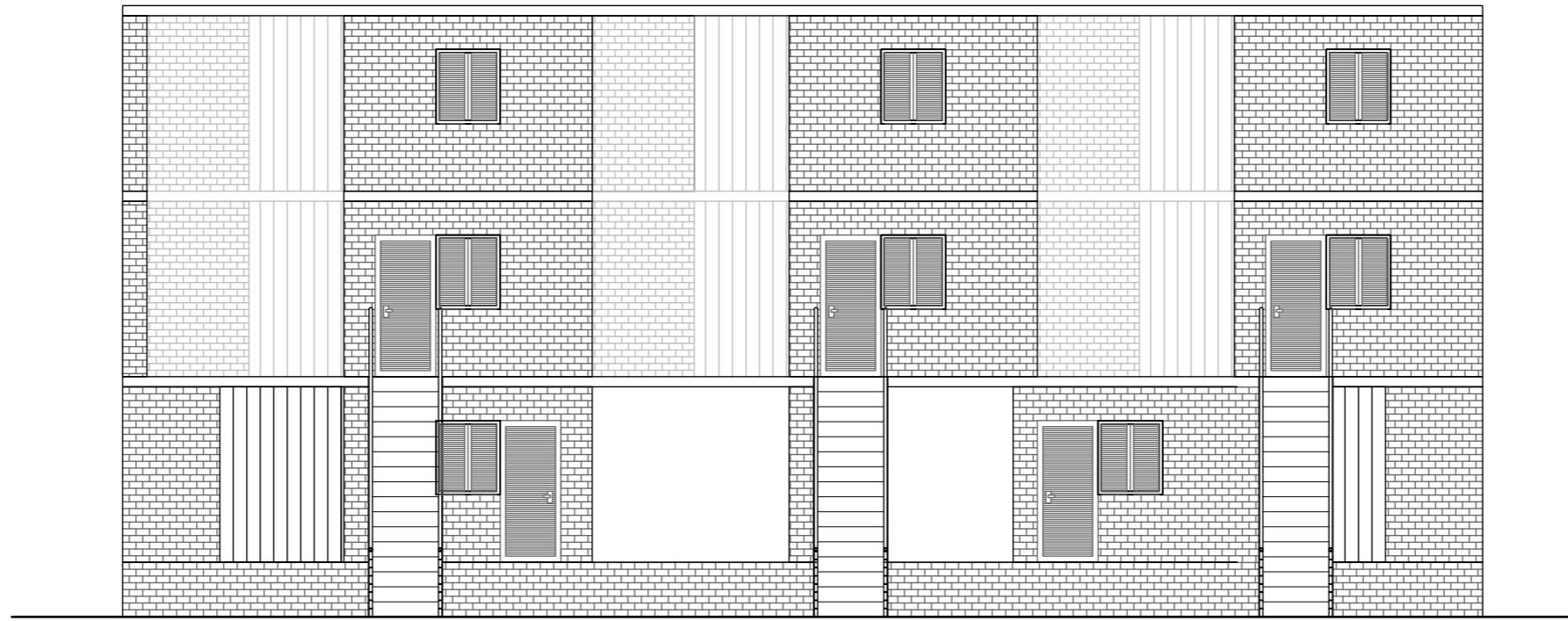
81



Elevation base (top) and developed (bottom)

82

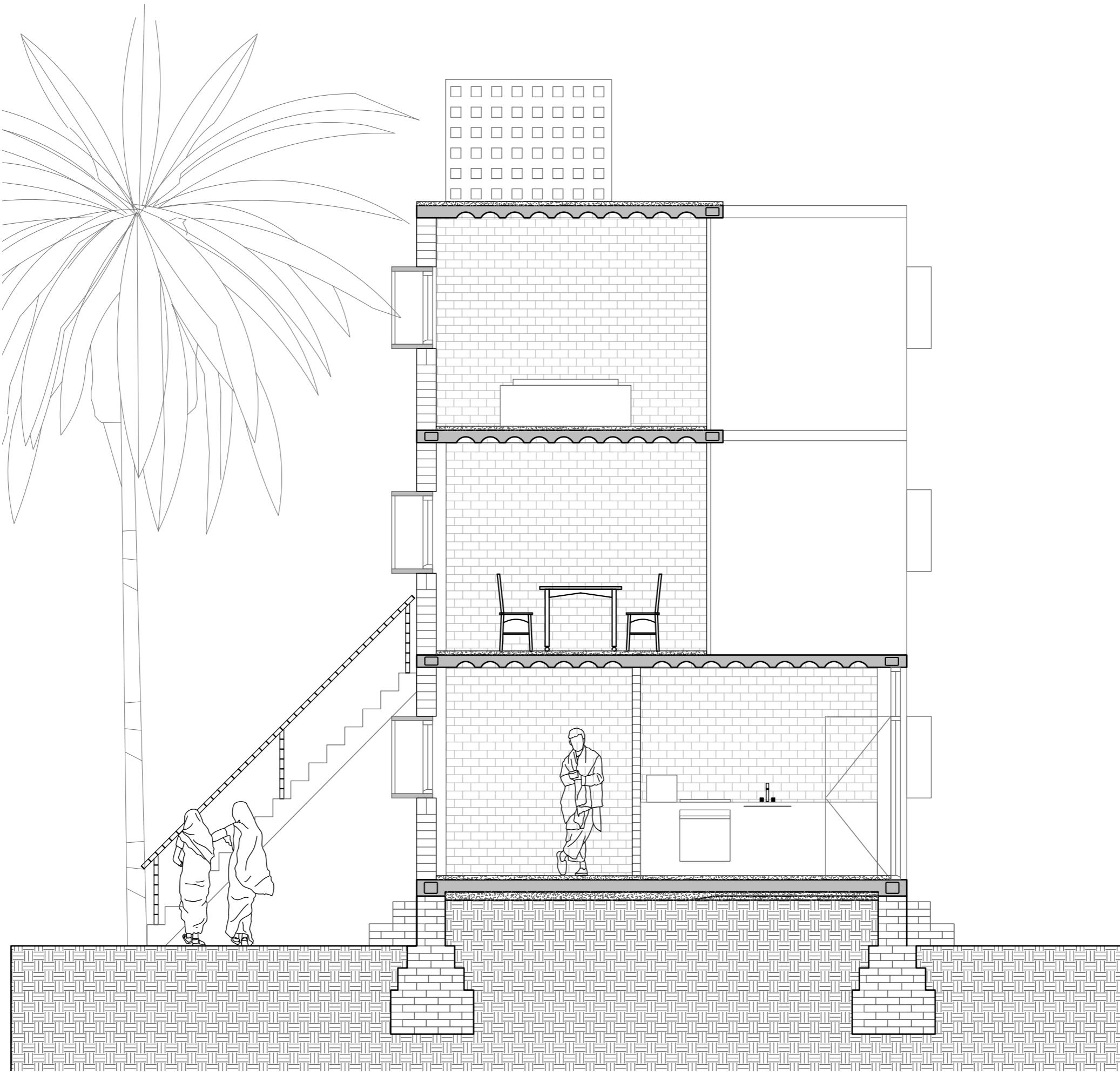
UNIT D



Section - base

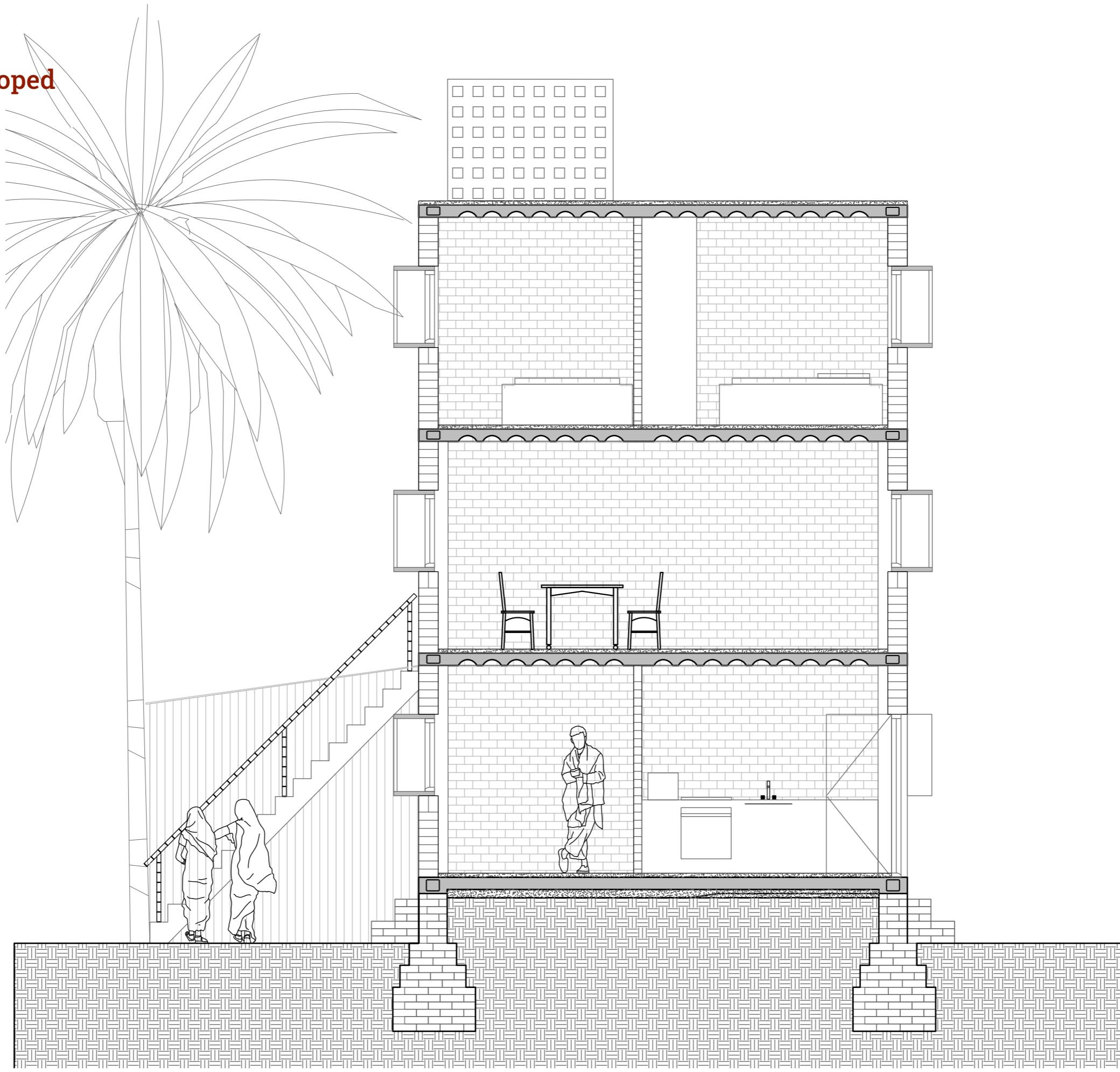
UNIT D

83



Section - developed

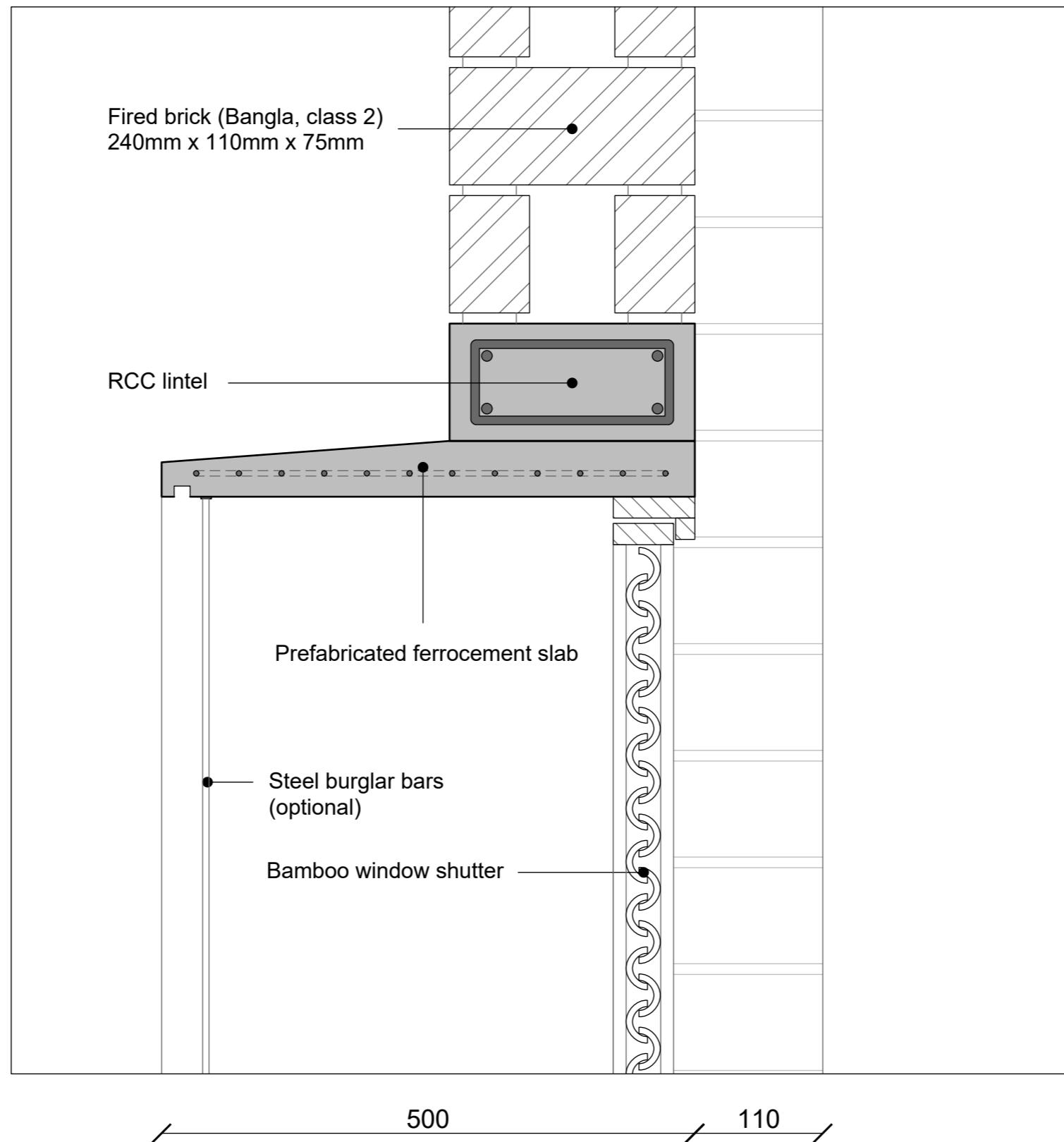
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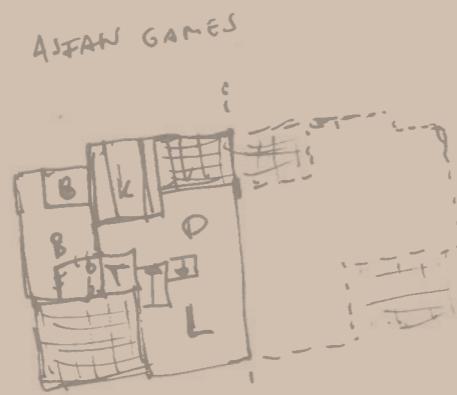


Detail V5

UNIT D

85





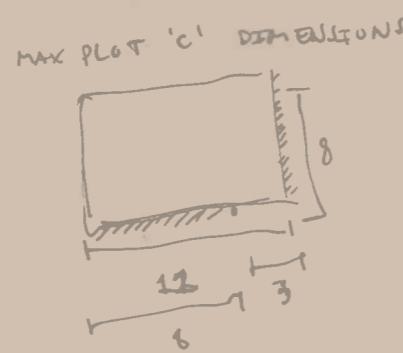
ASIAN GAMES

Type C = Low/Middle Income

LARGE BASE $(36 + n^2)$

15 16 17

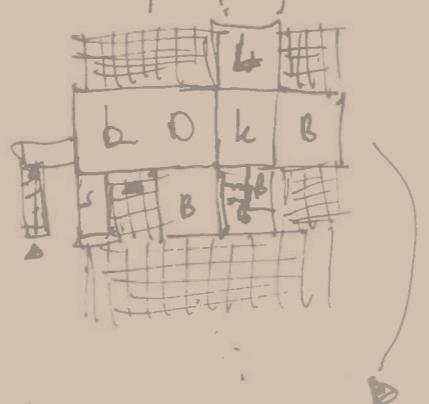
ROOM FOR SMALL ADDITIONS



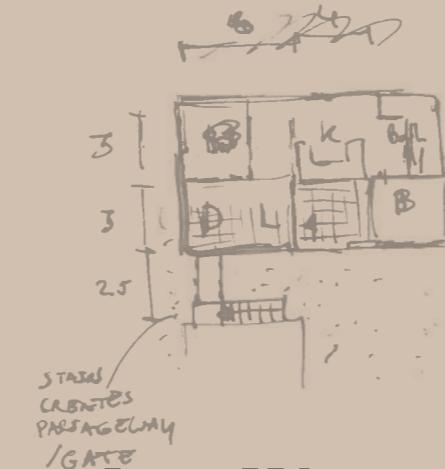
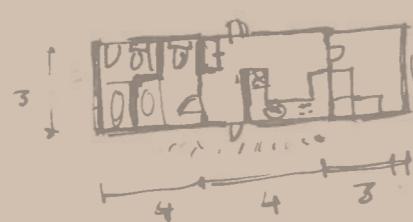
MAX PLOT 'C' DIMENSIONS



ECIL



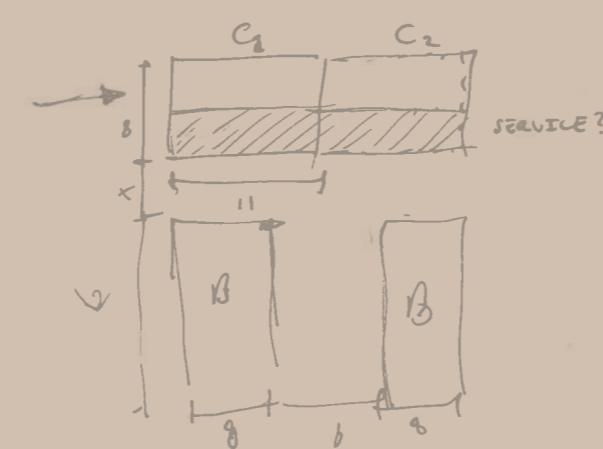
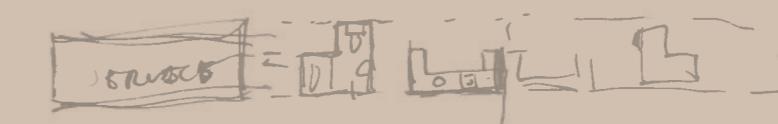
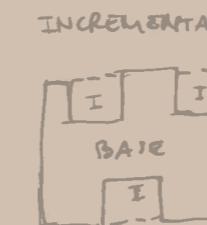
Service Code



STAINS /
CRENTES
PASSAGELM
/GATE

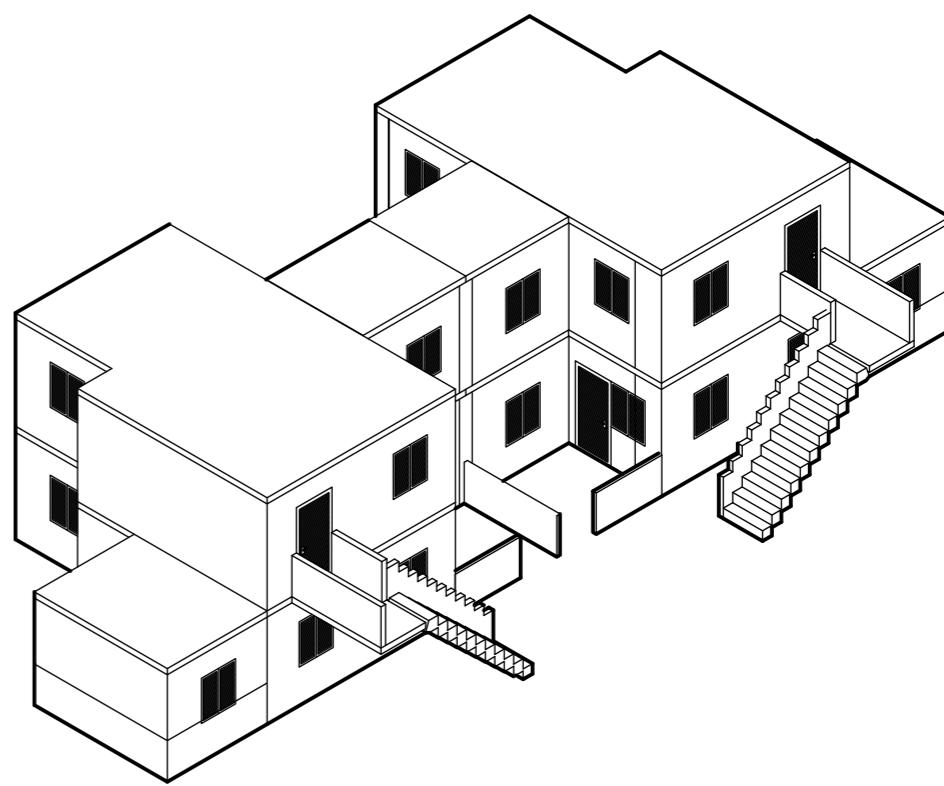
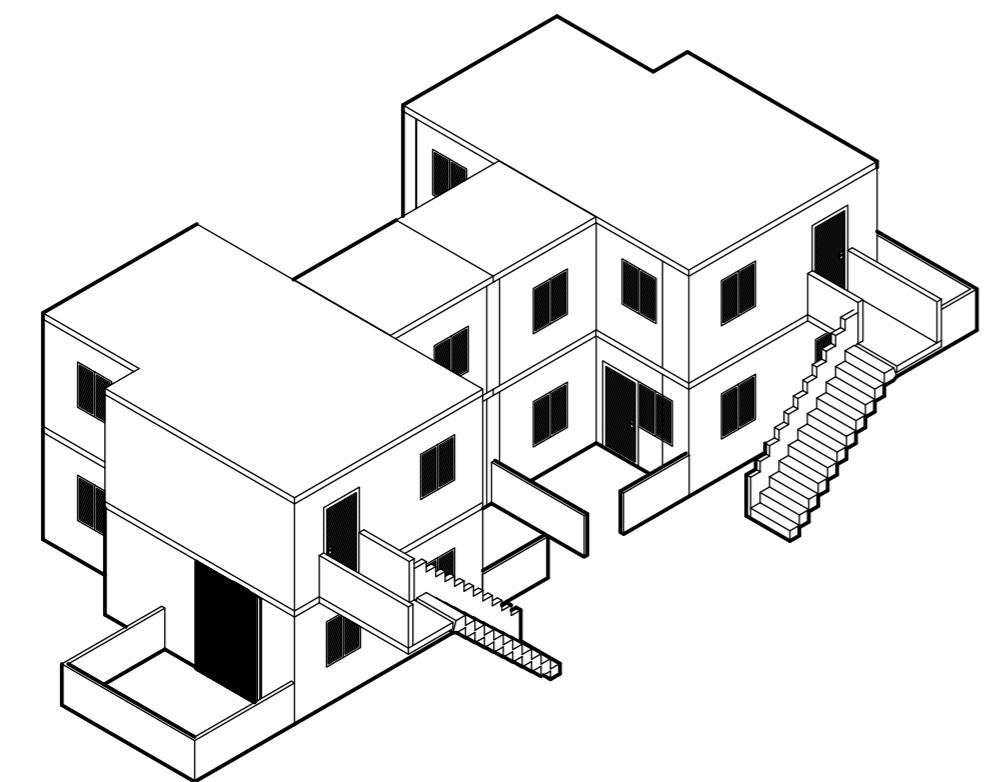
dwelling unit c

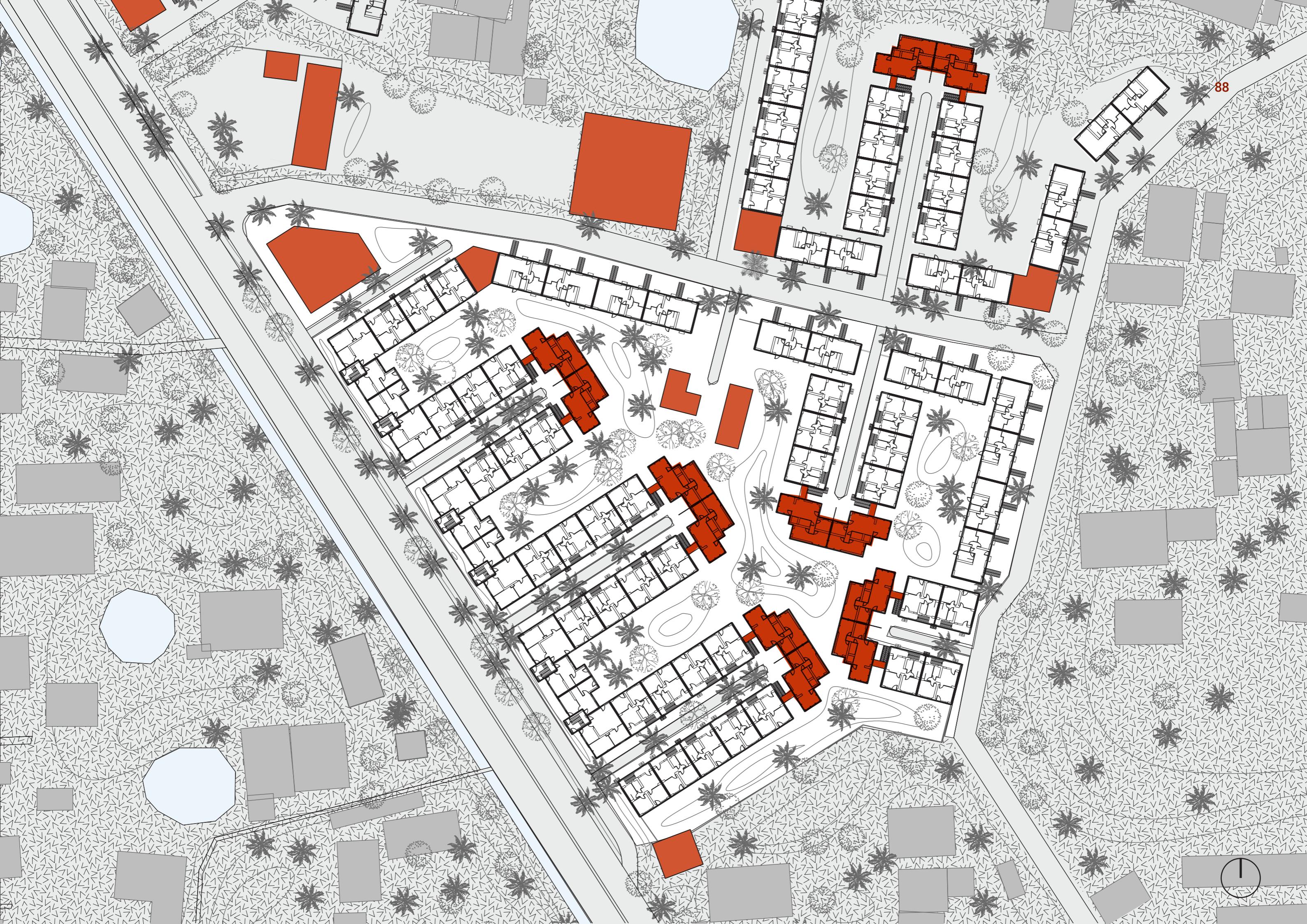
incremental housing and flood-resilience solutions for Bangladesh



Tertiary incremental housing unit

UNIT C

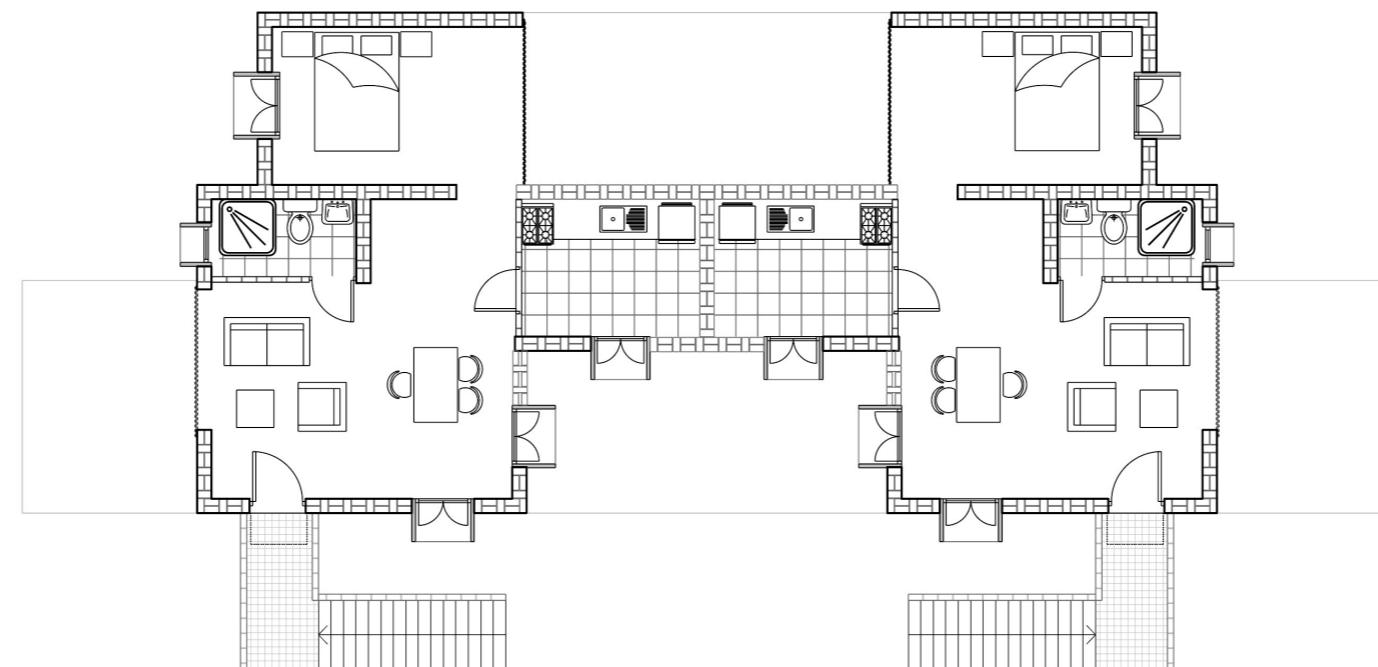
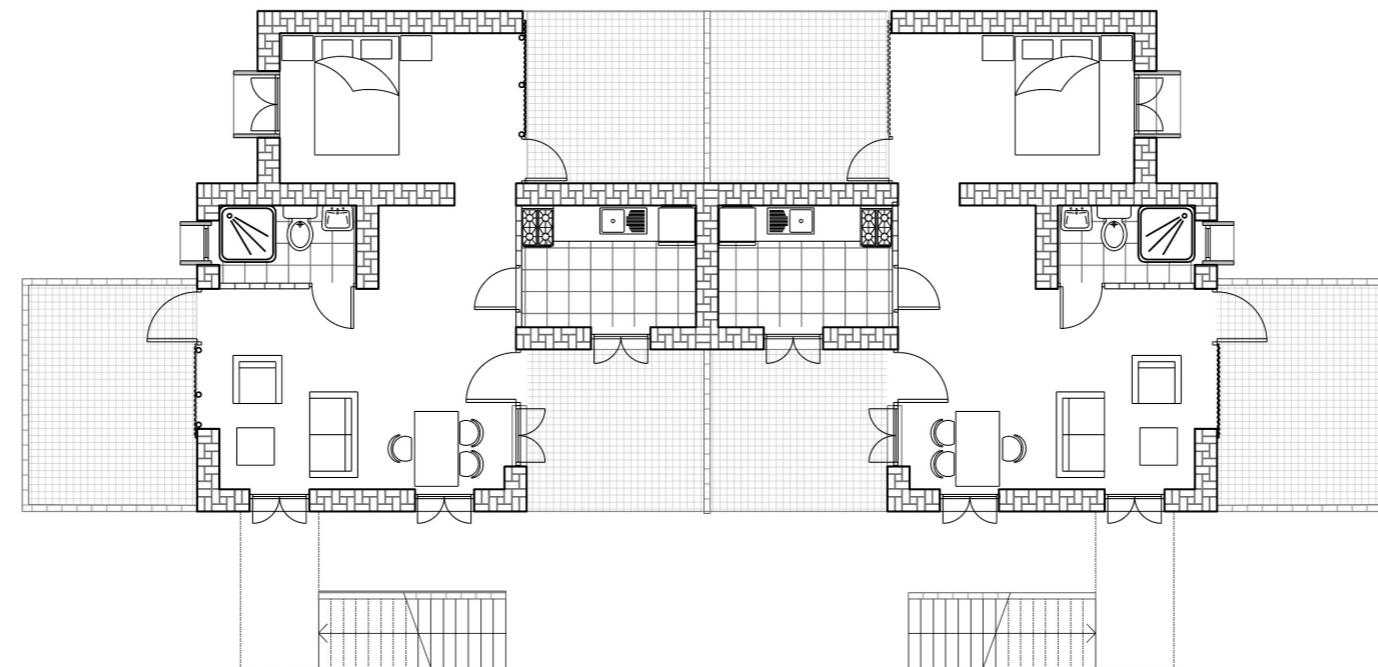




Floorplans ground (top) and first floor (bottom) - base

89

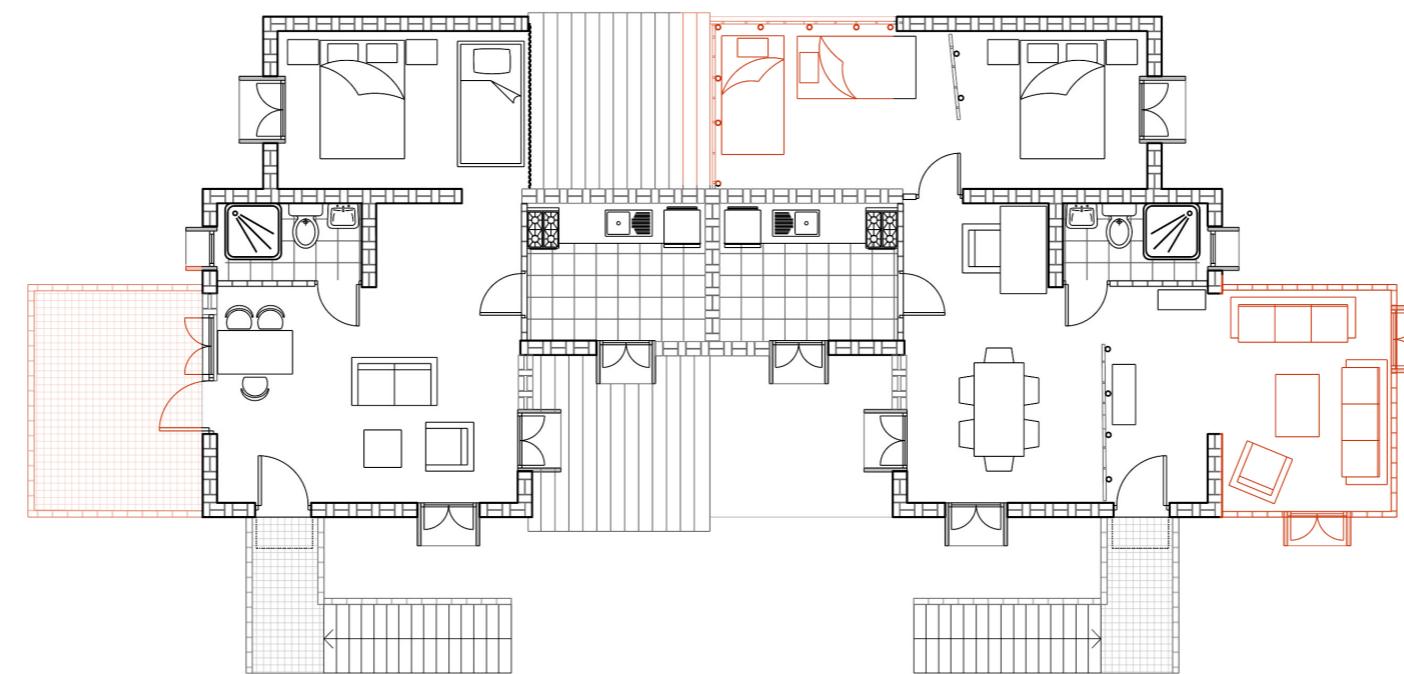
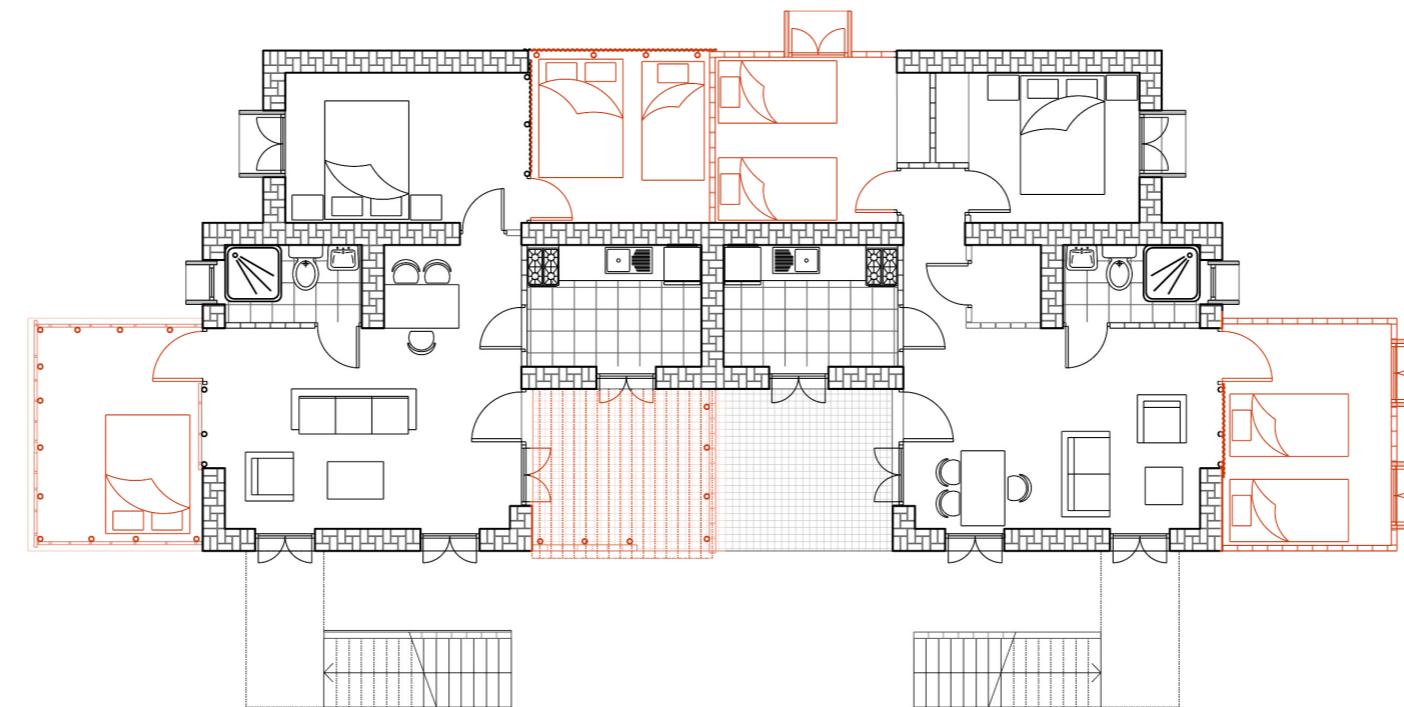
UNIT C



Floorplans ground (top) and first floor (bottom) - developed

UNIT C

90

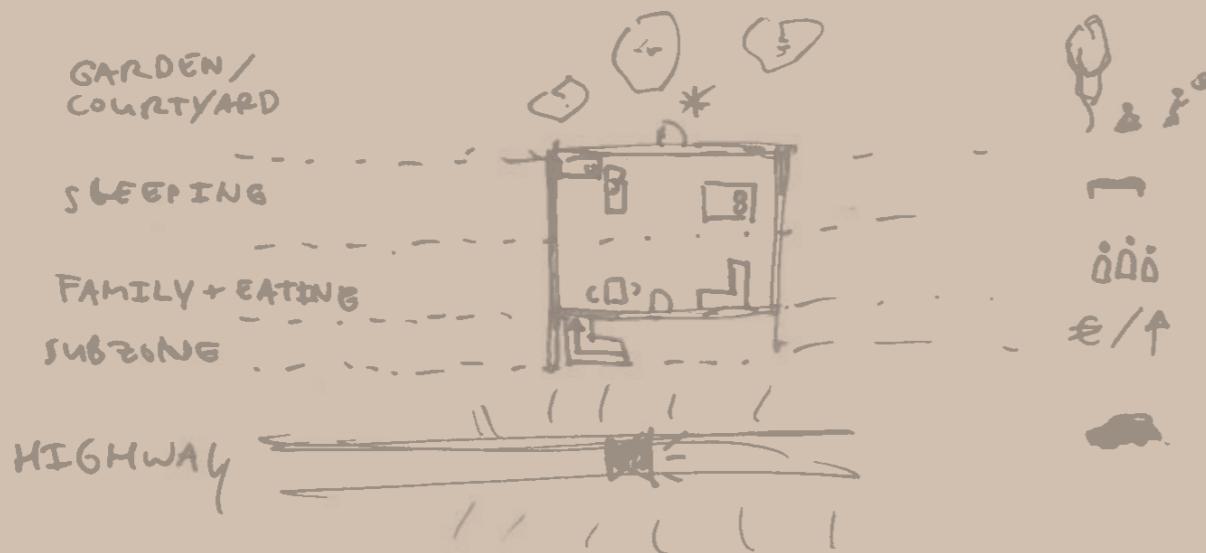




dwelling unit a

incremental housing and flood-resilience solutions for Bangladesh

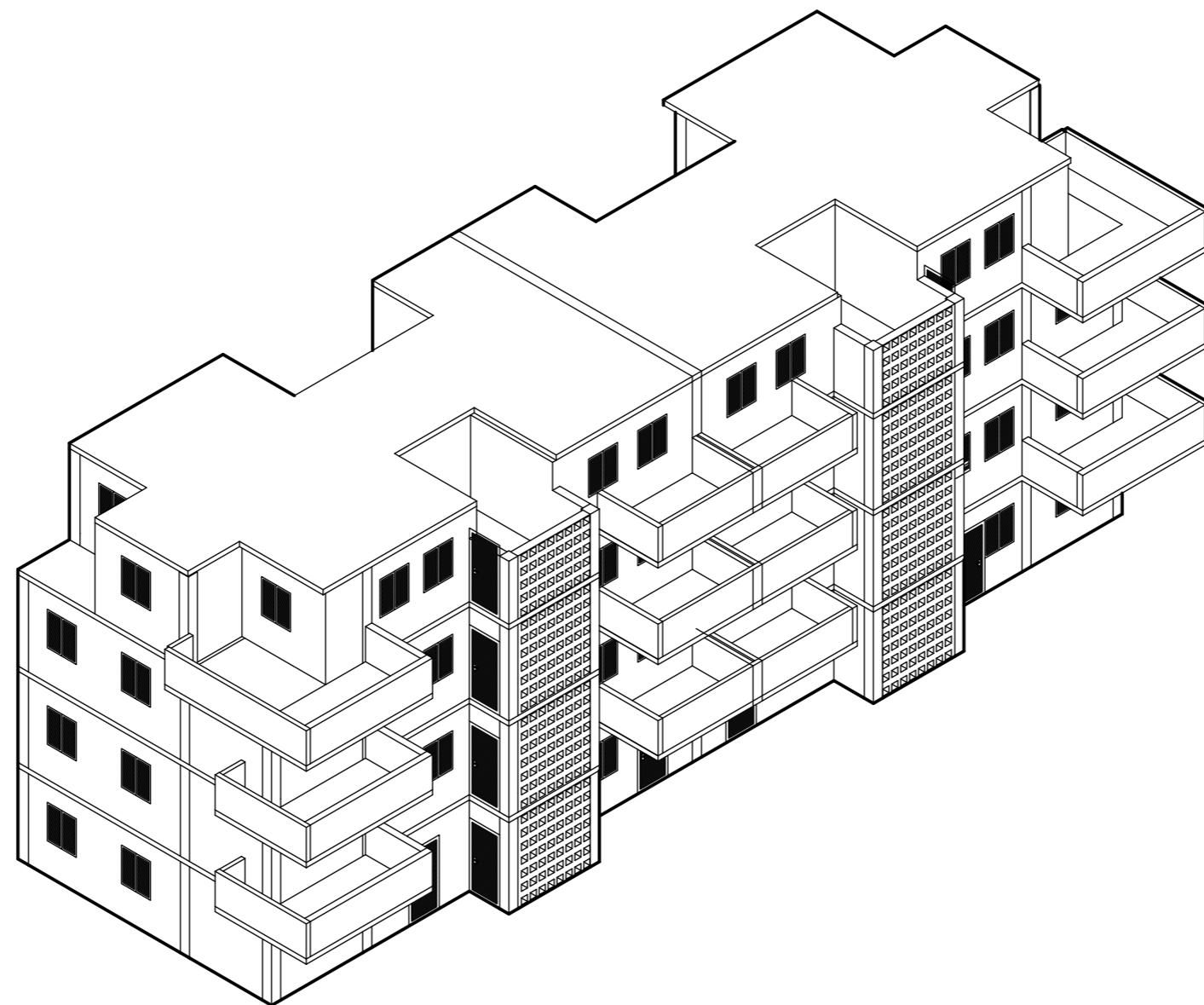
HIERARCHY OF SPACES

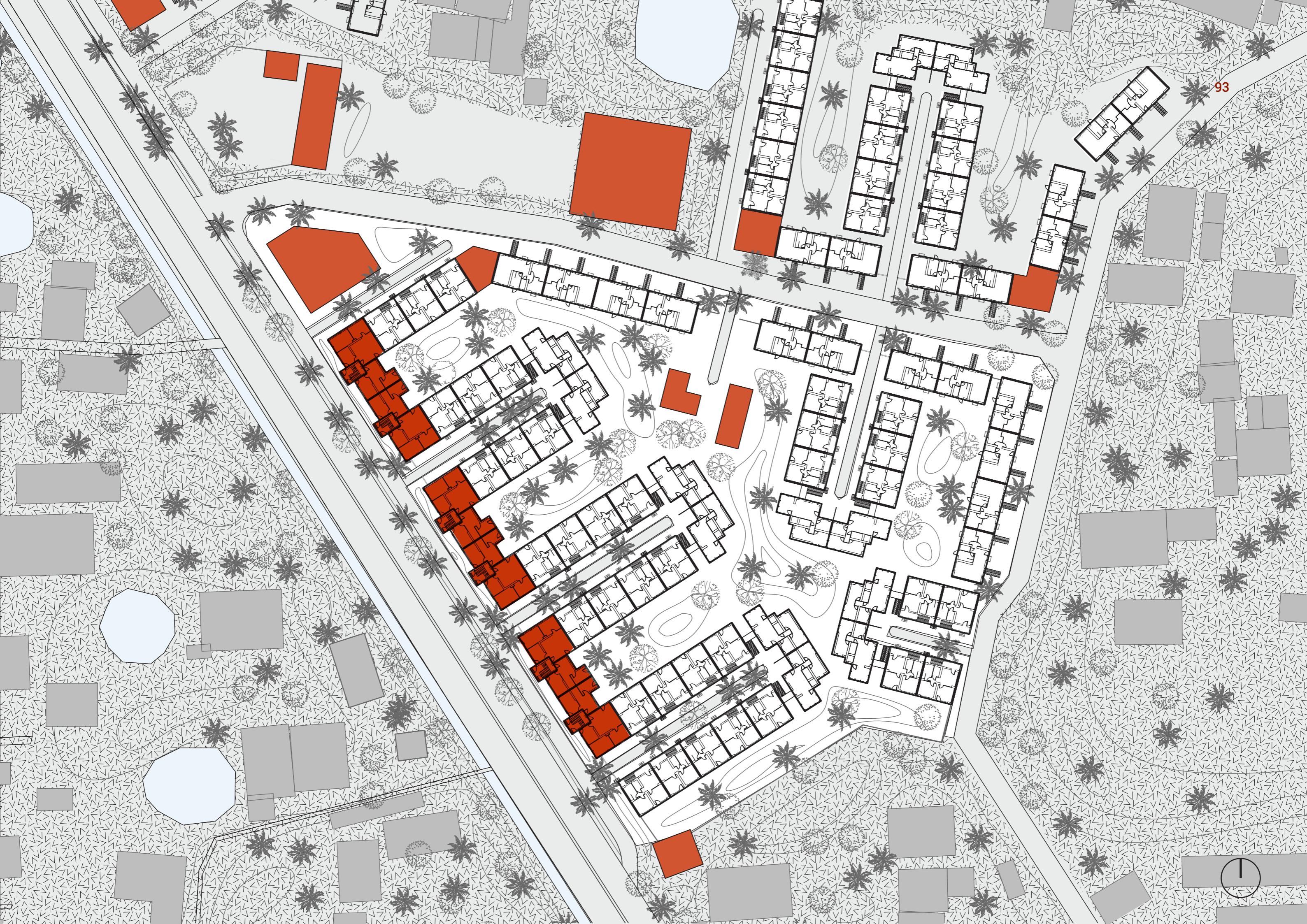


High- middle-income apartment typology

92

UNIT A

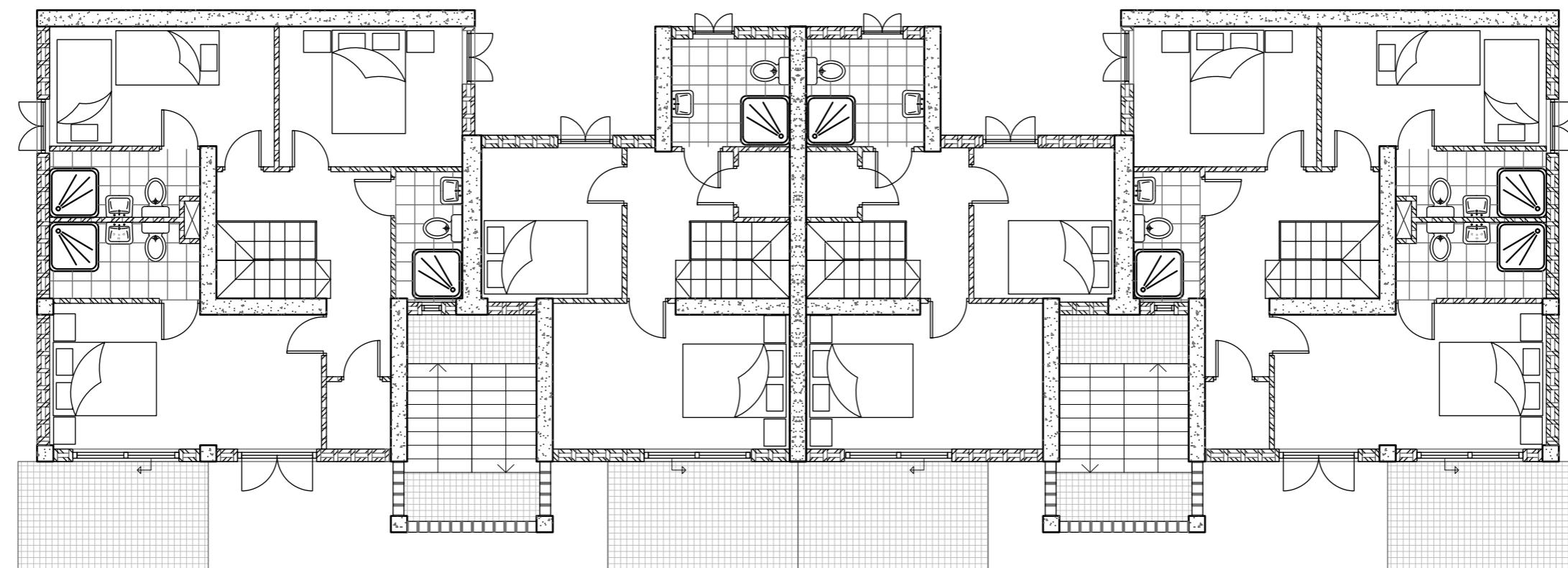
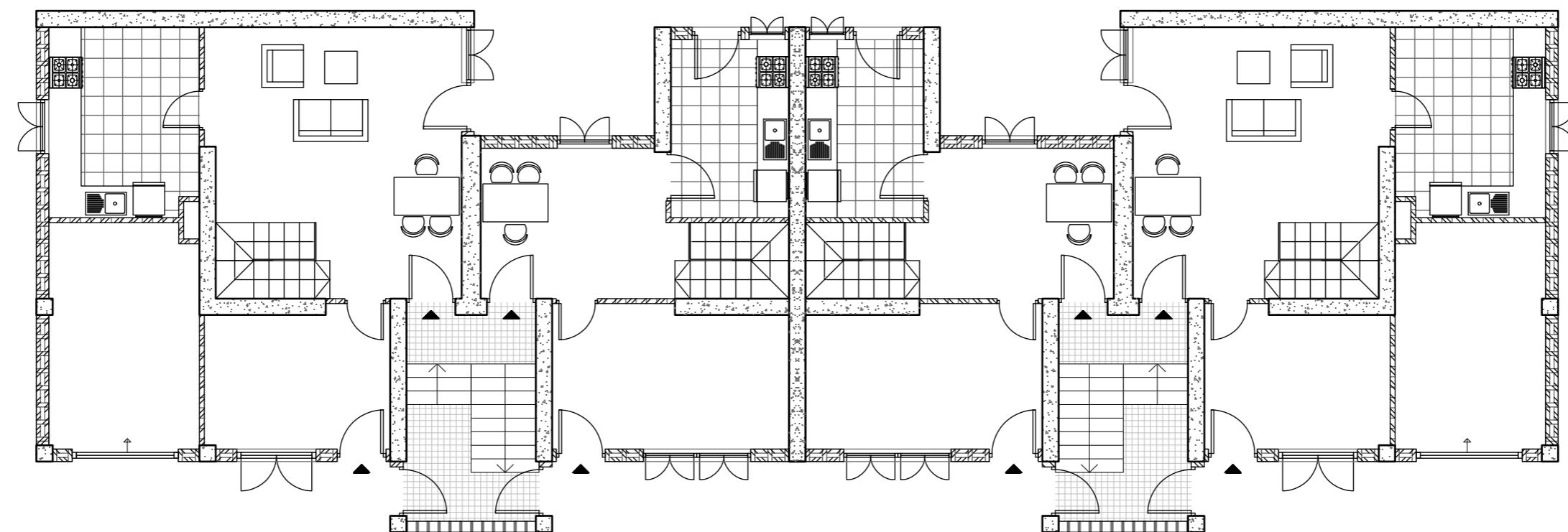




Ground floor (top) and first floor (bottom)

94

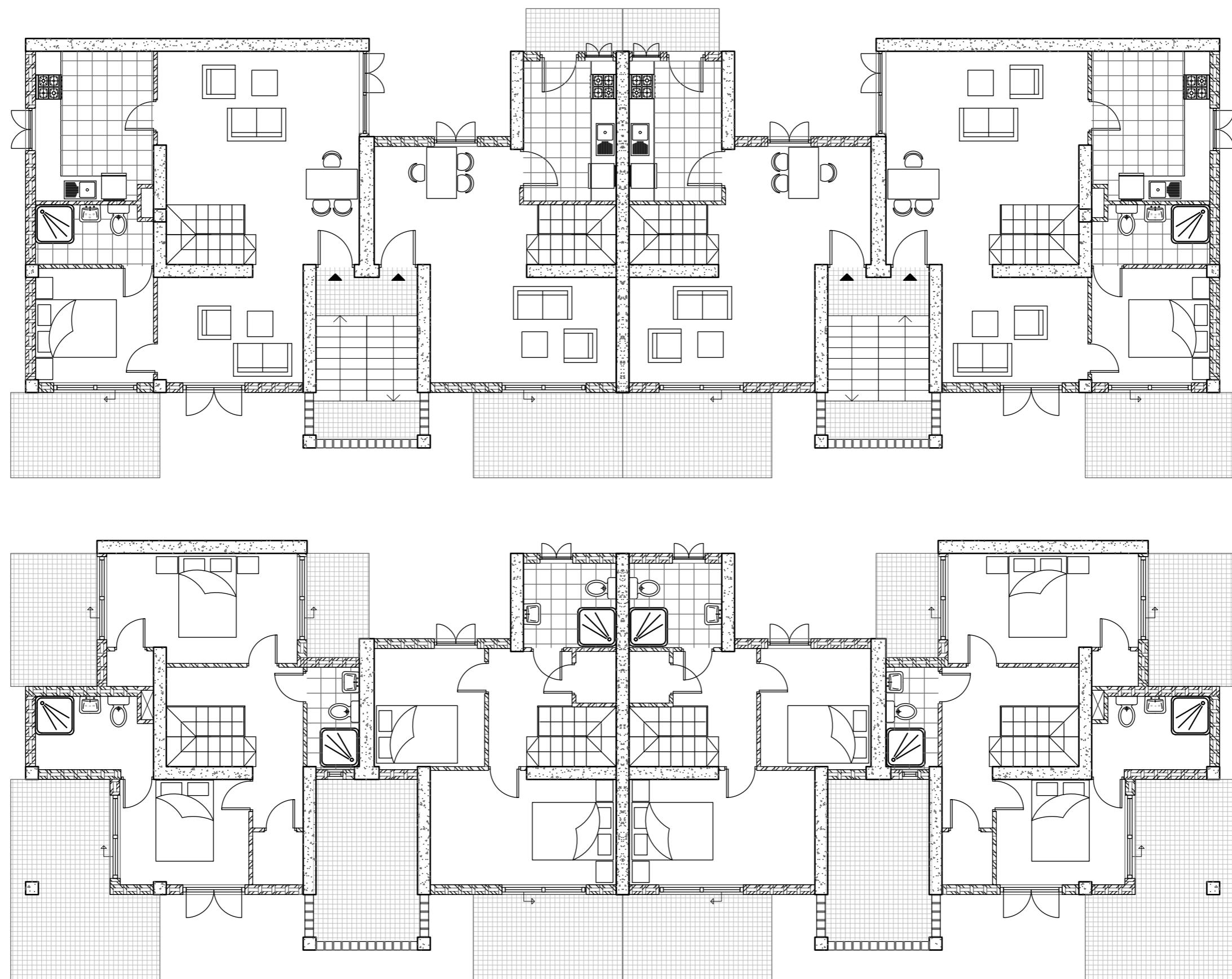
UNIT A



Second floor (top) and third floor (bottom)

95

UNIT A





water management

incremental housing and flood-resilience solutions for Bangladesh

Water retention main cluster

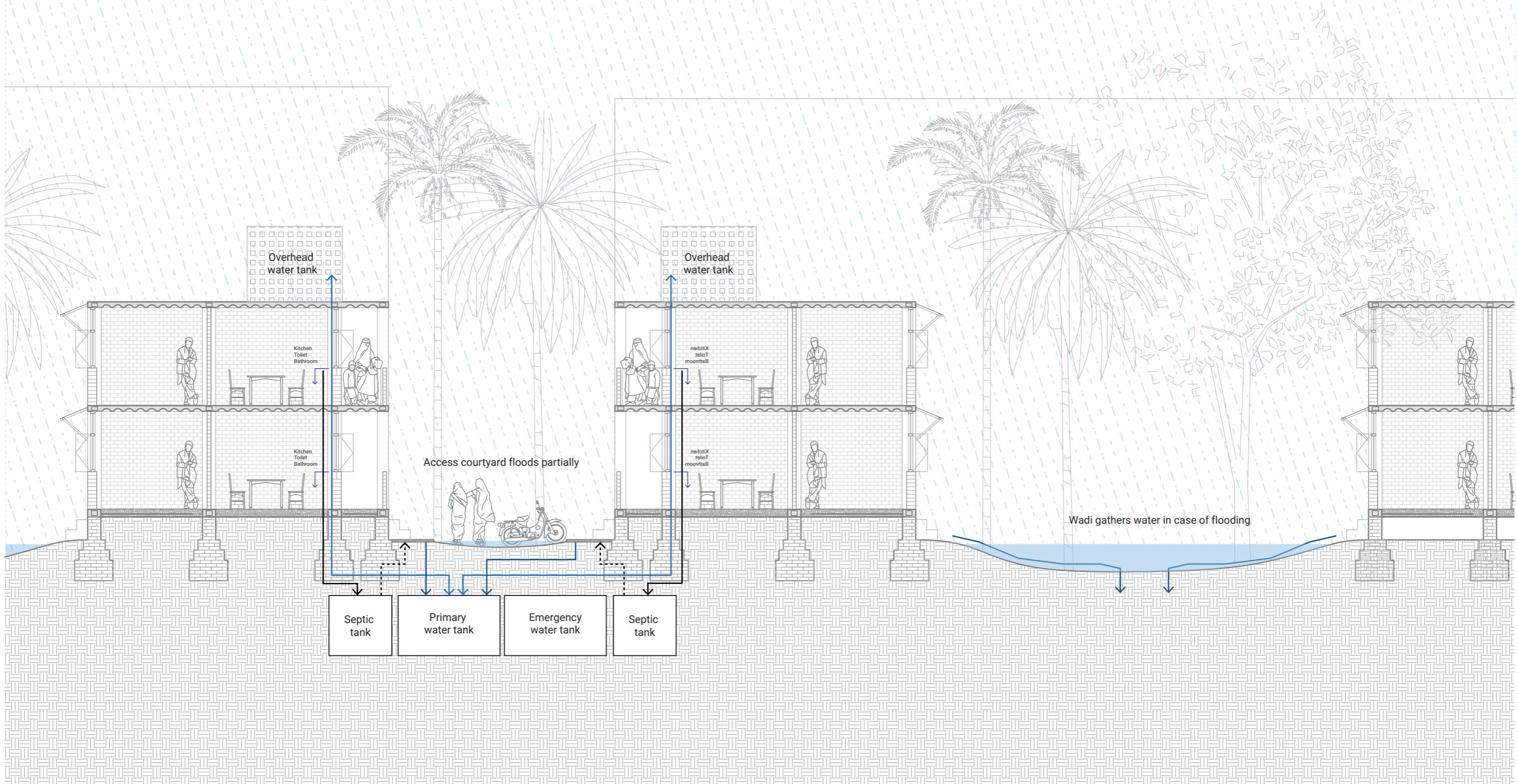
WATER MANAGEMENT

98



Climate section monsoon

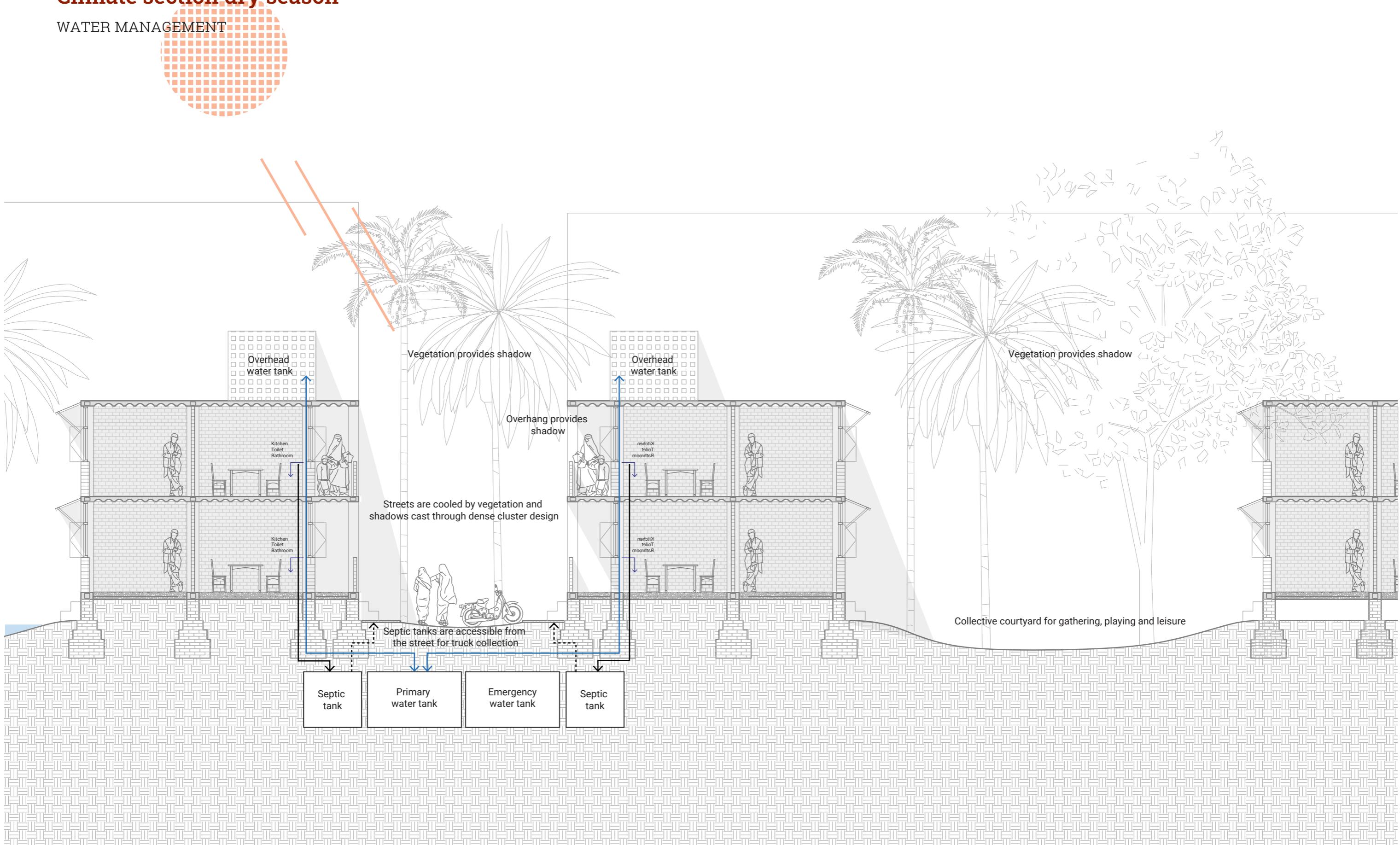
WATER MANAGEMENT

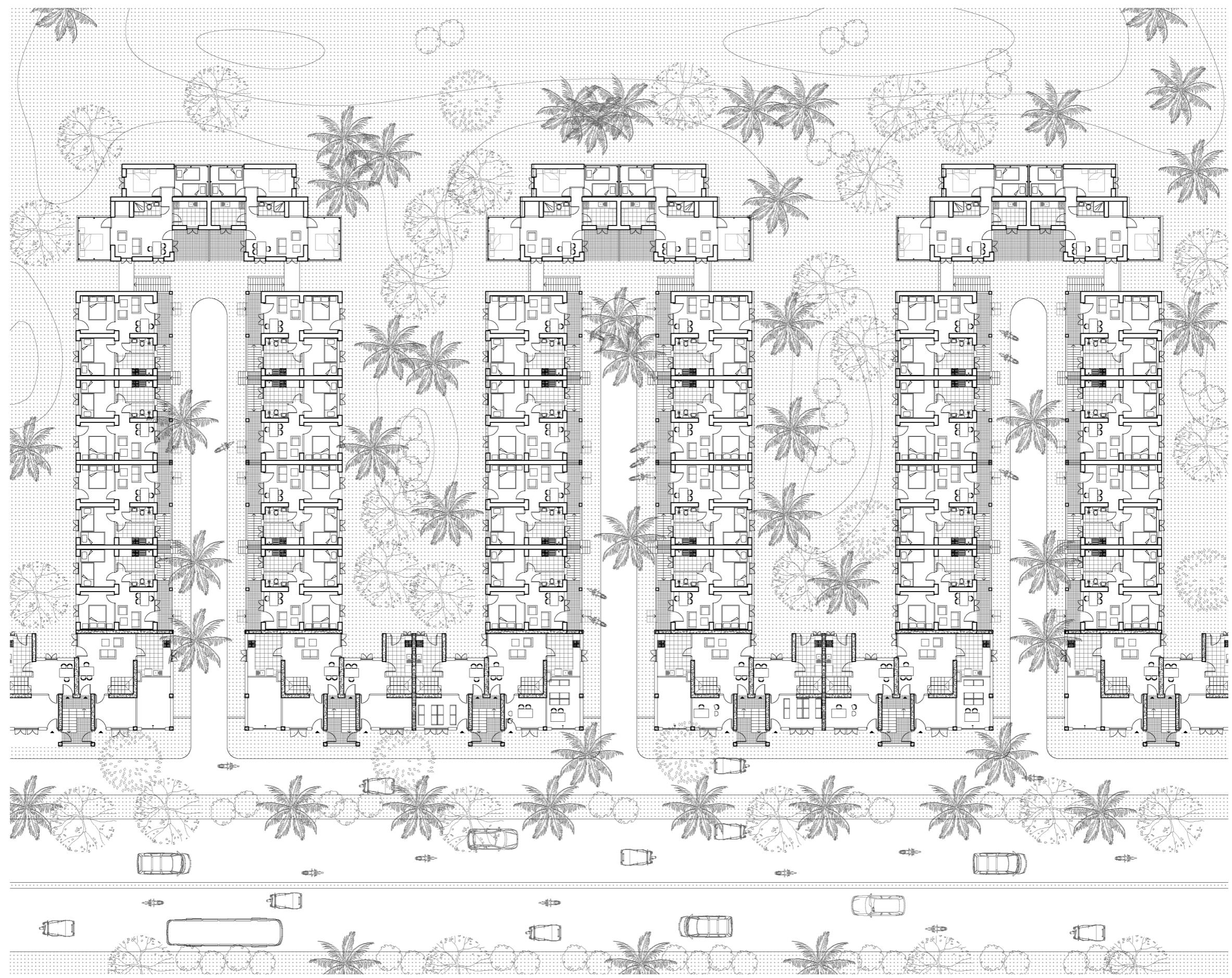


Climate section | dry season

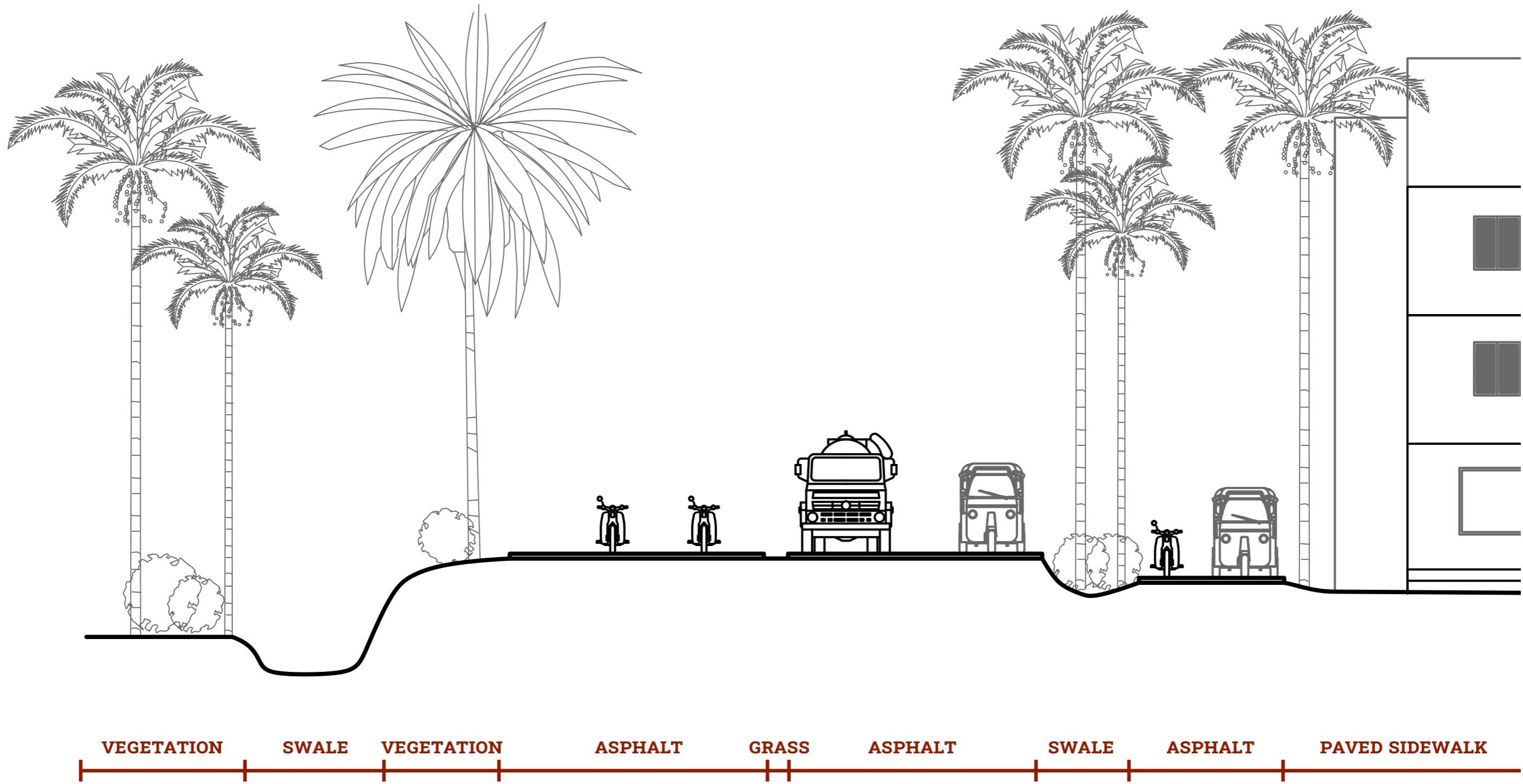
100

WATER MANAGEMENT





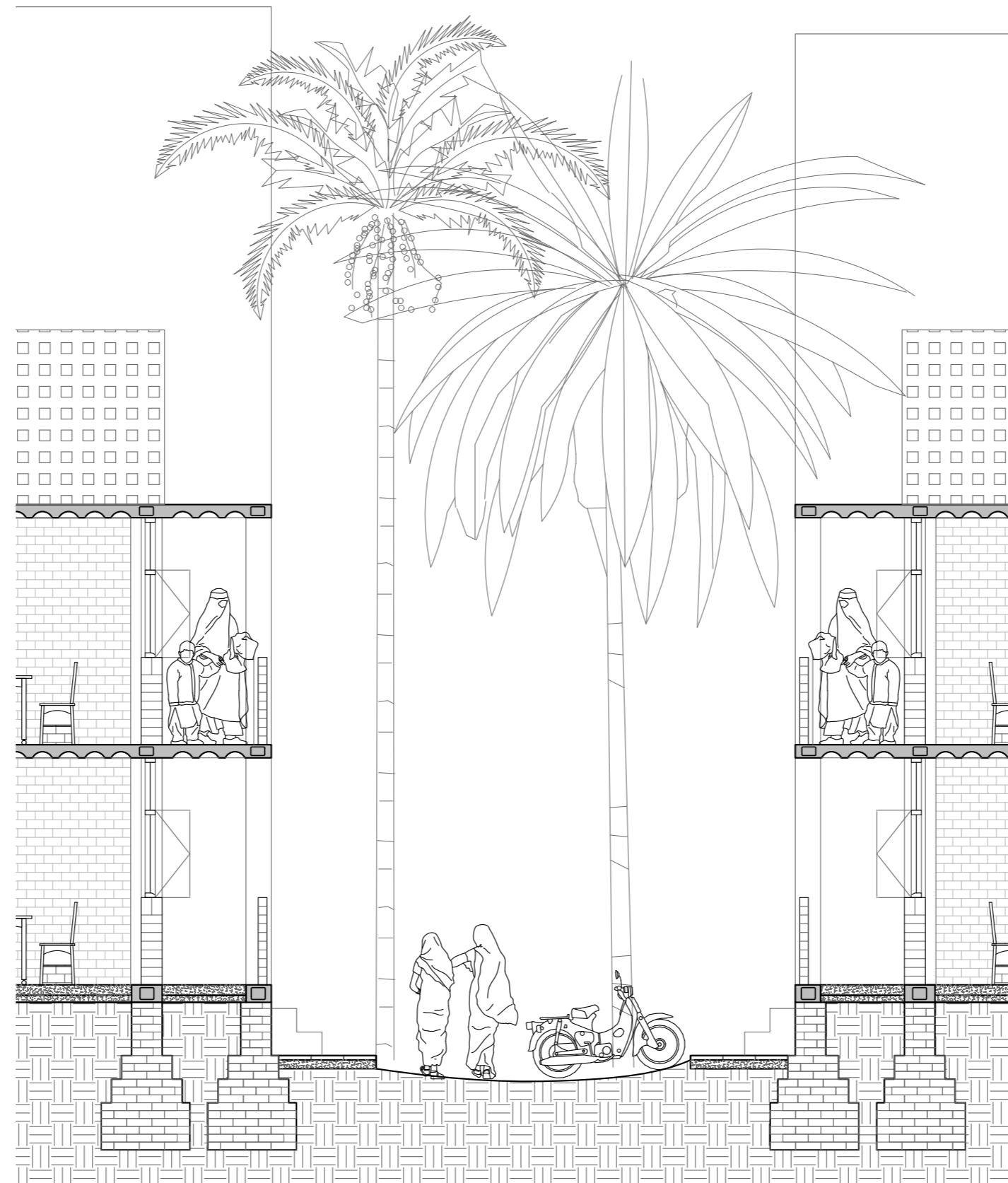


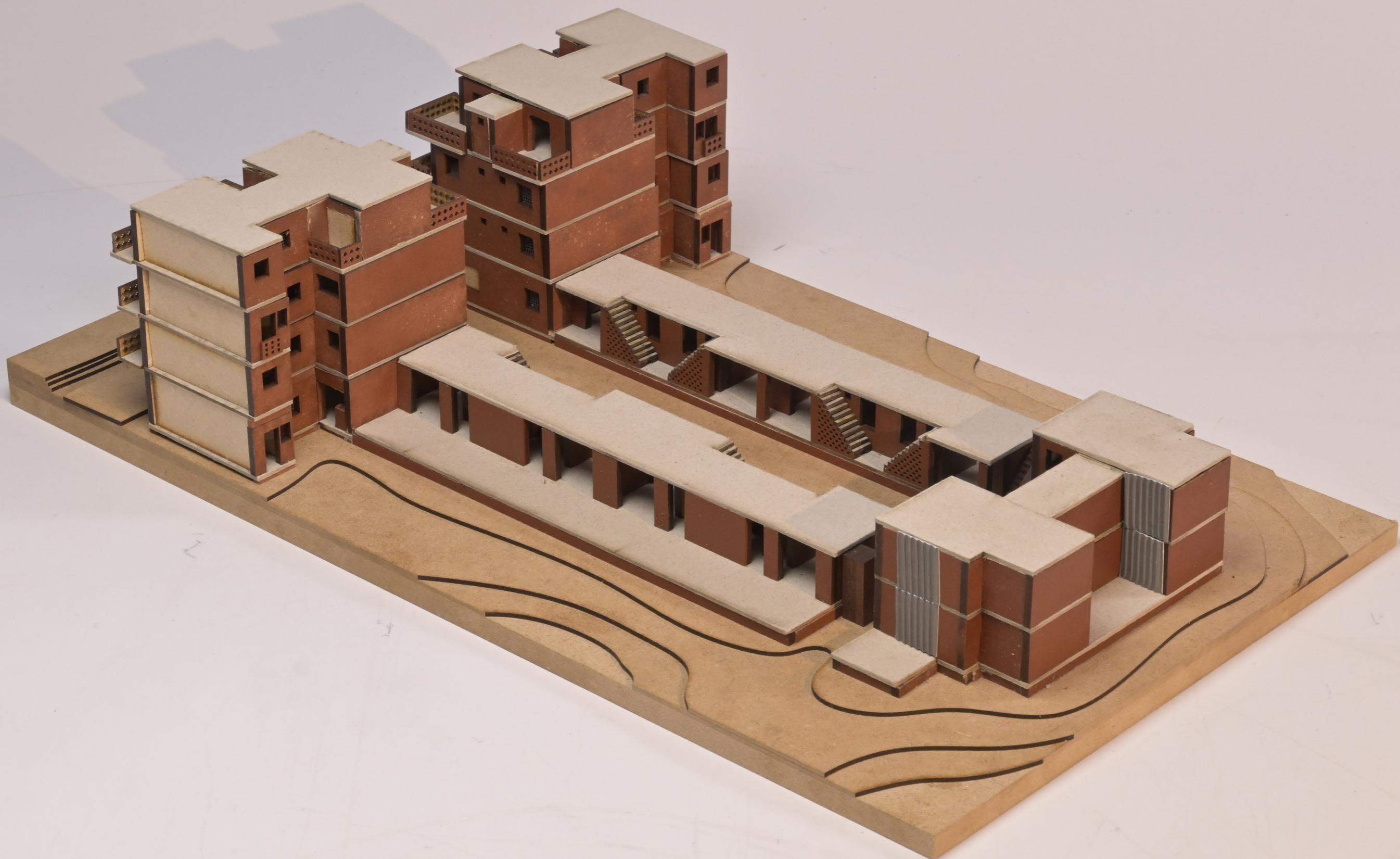


Courtyard

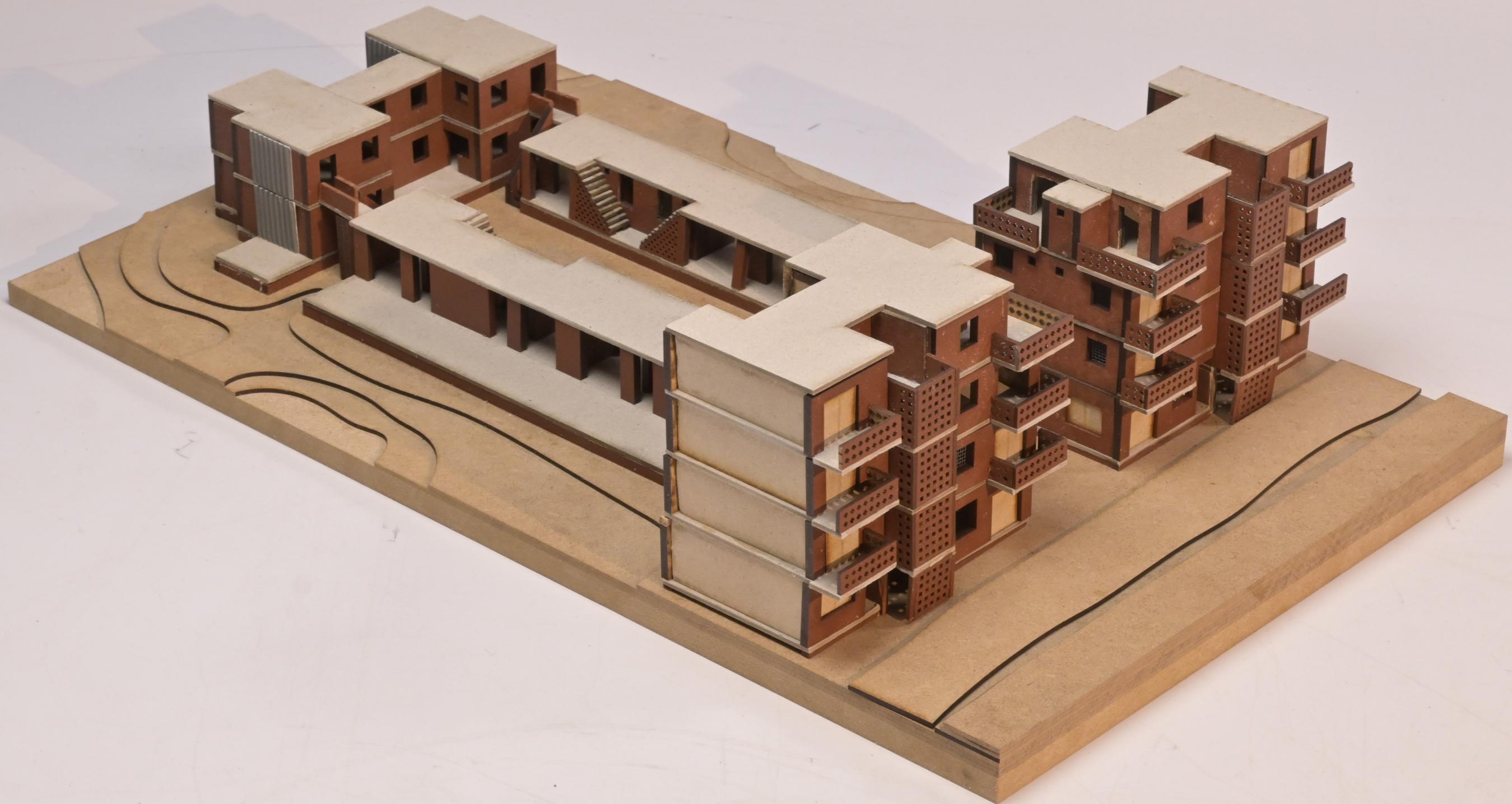
STREET SECTIONS

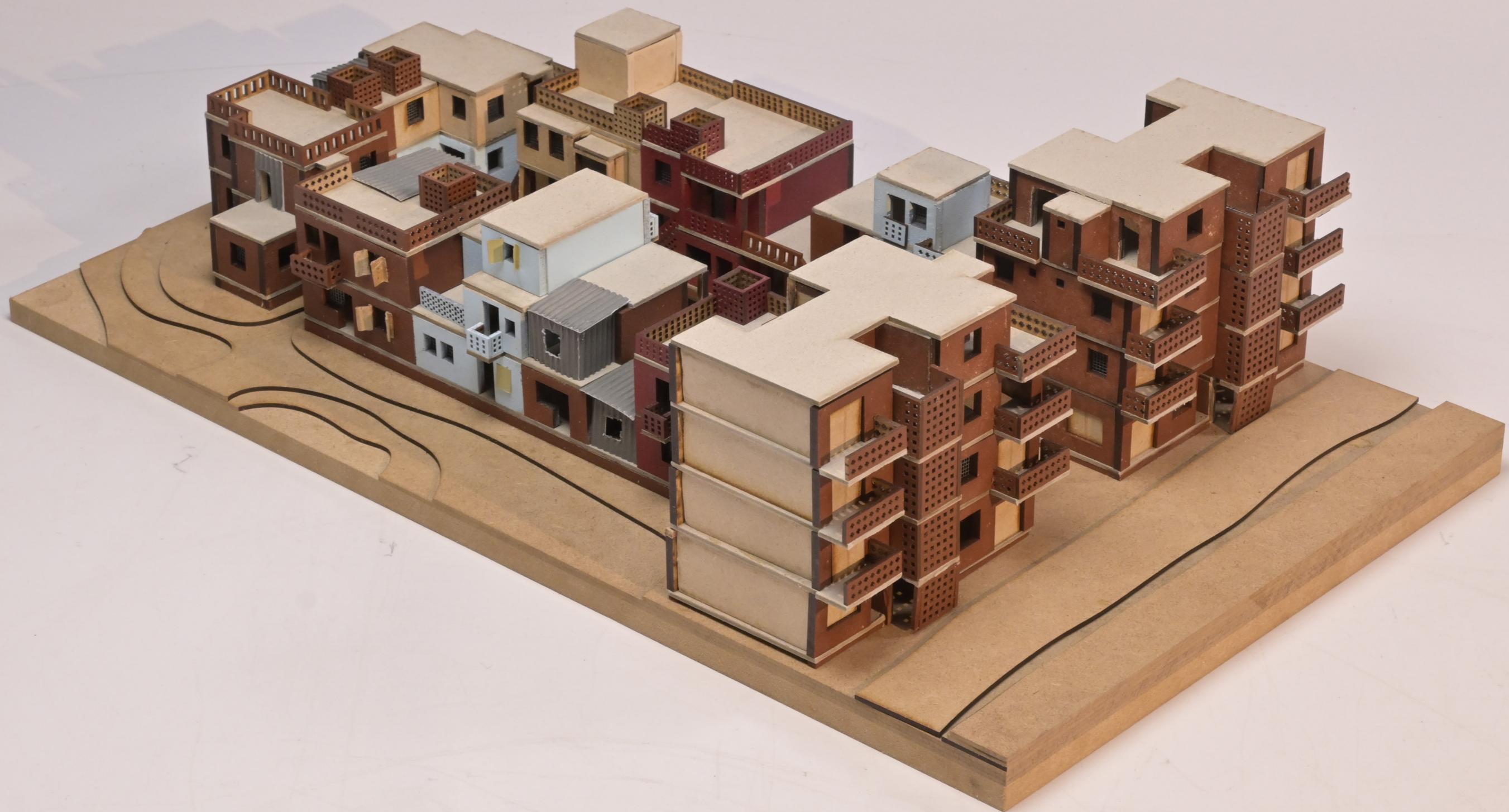
104

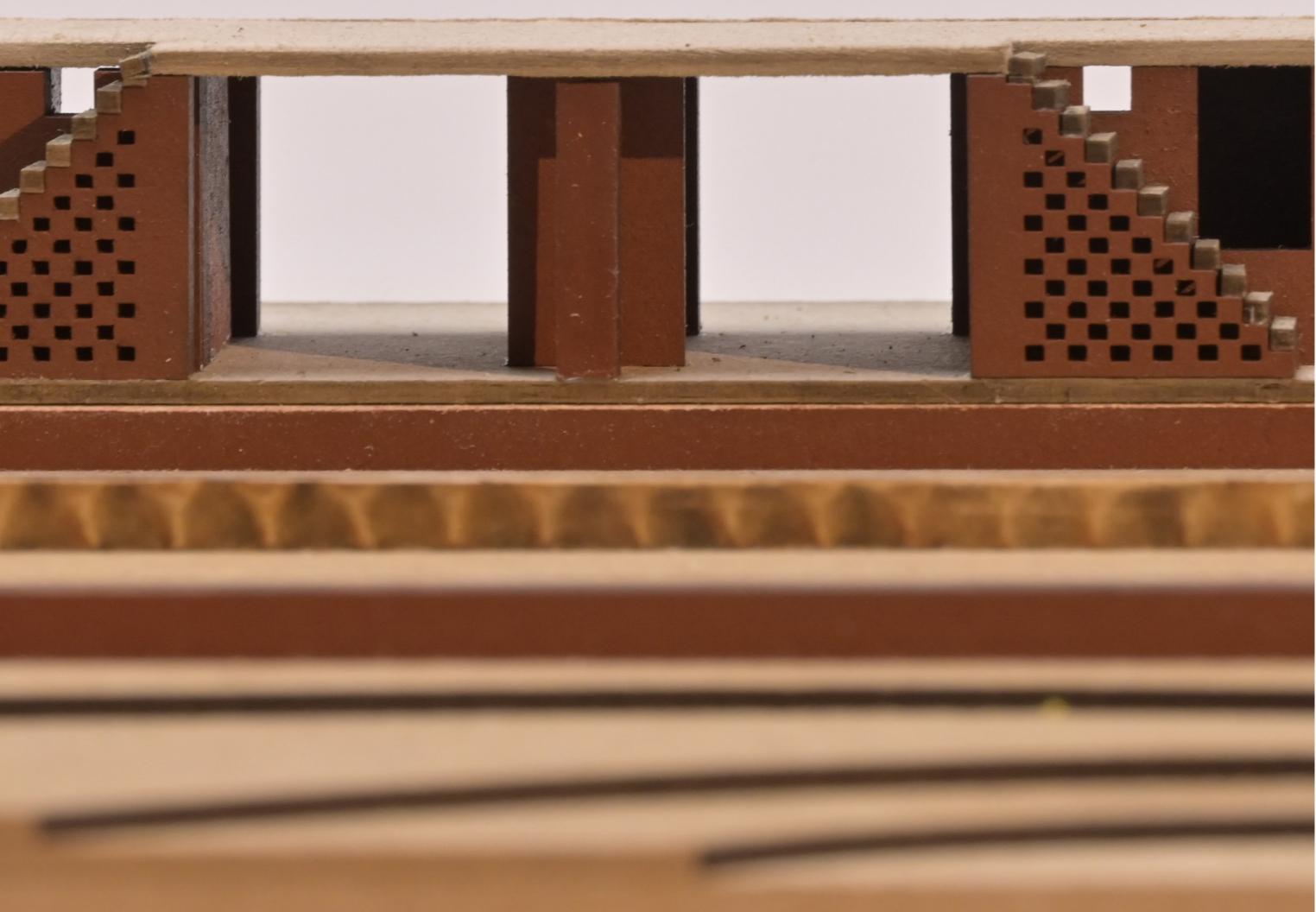












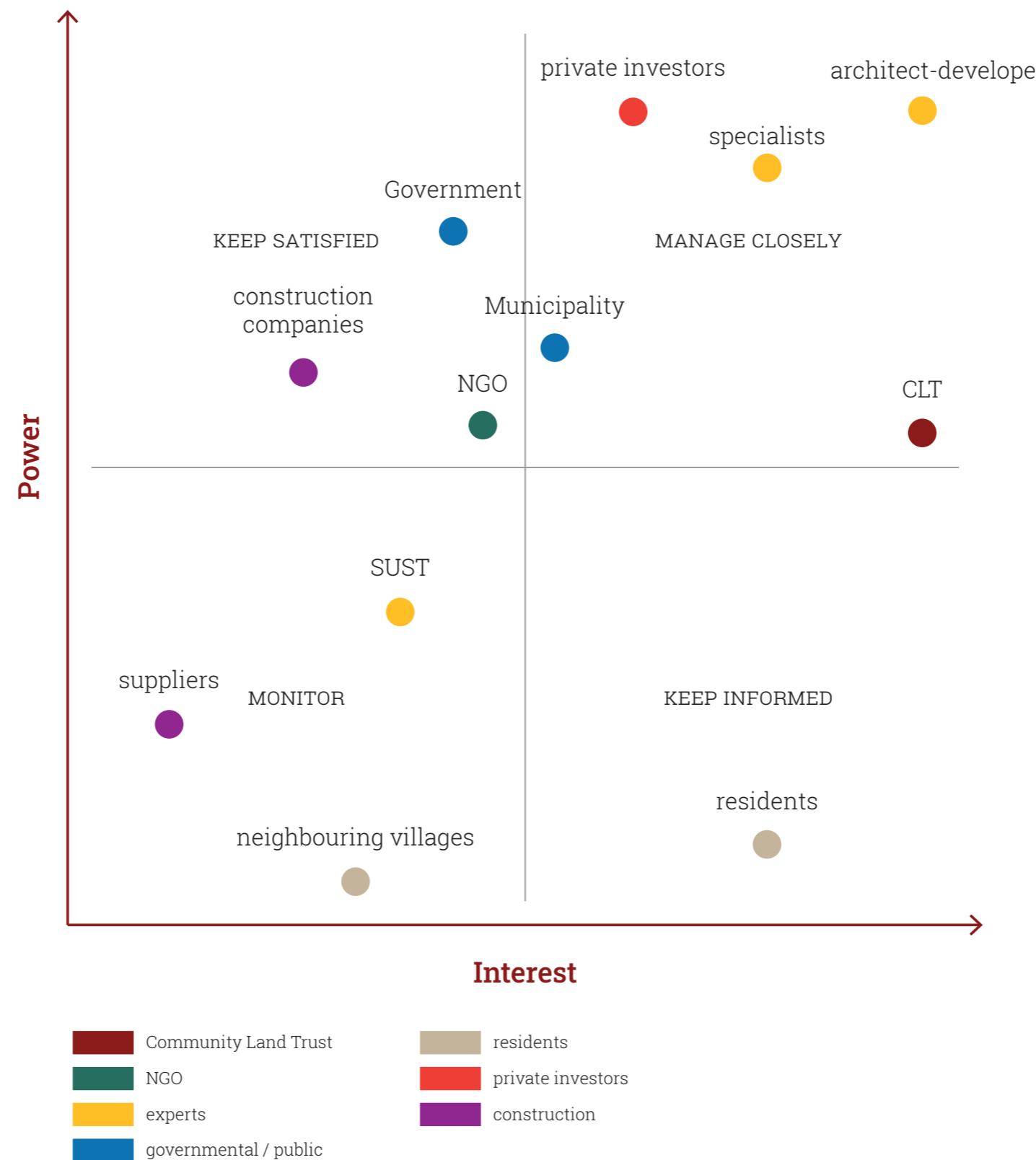
management

incremental housing and flood-resilience solutions for Bangladesh

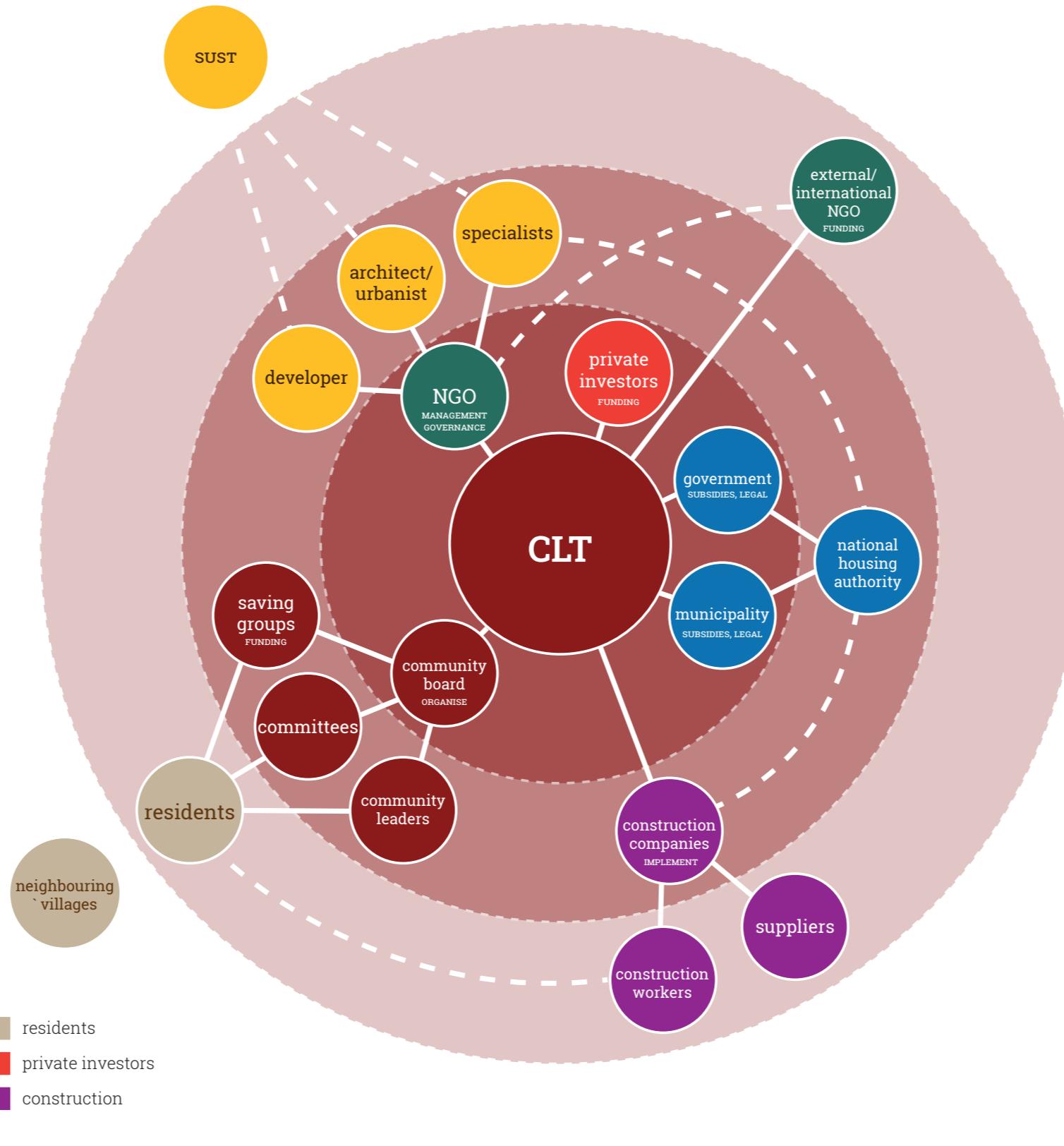
Stakeholder analysis

111

MANAGEMENT



MANAGEMENT



Phasing

MANAGEMENT

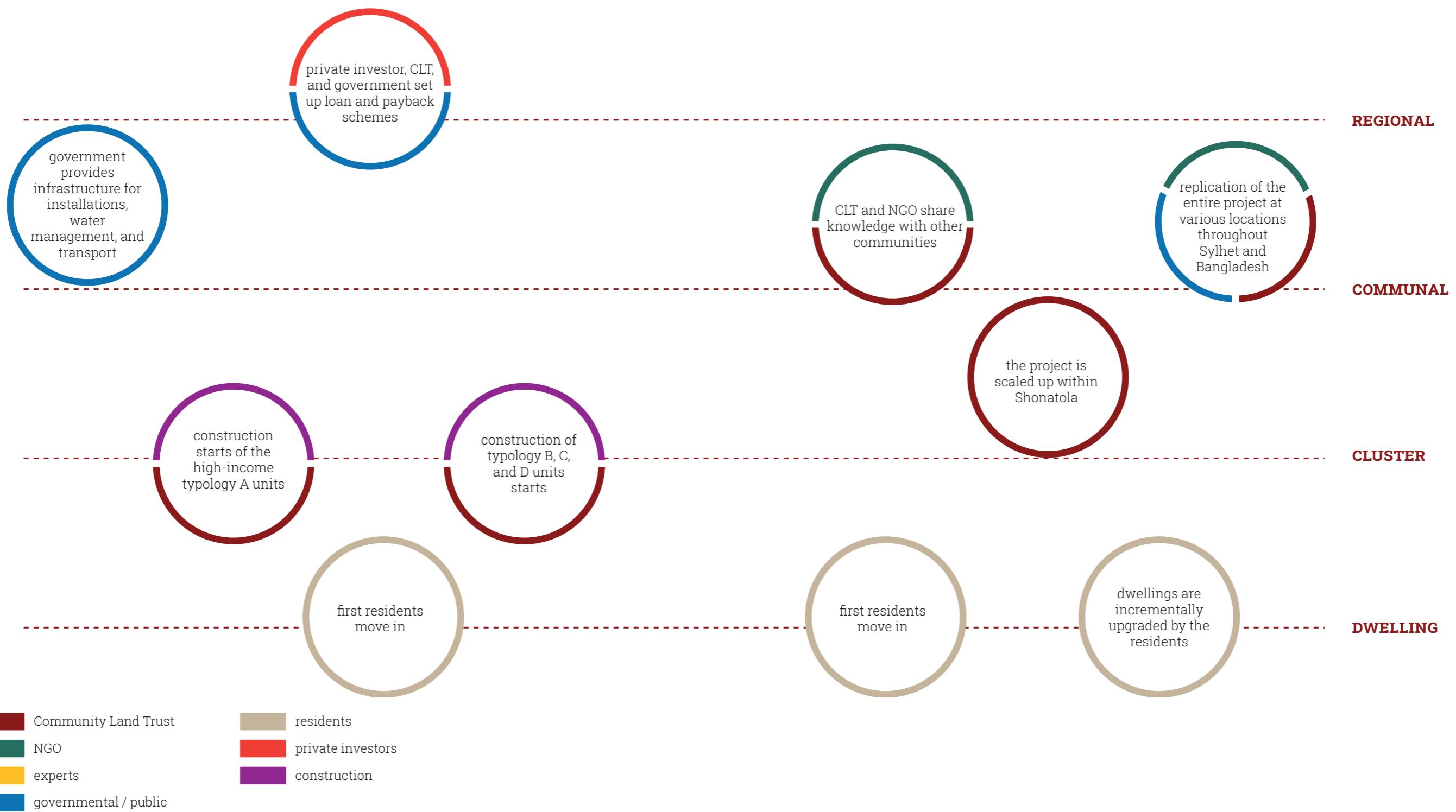
113



Phasing

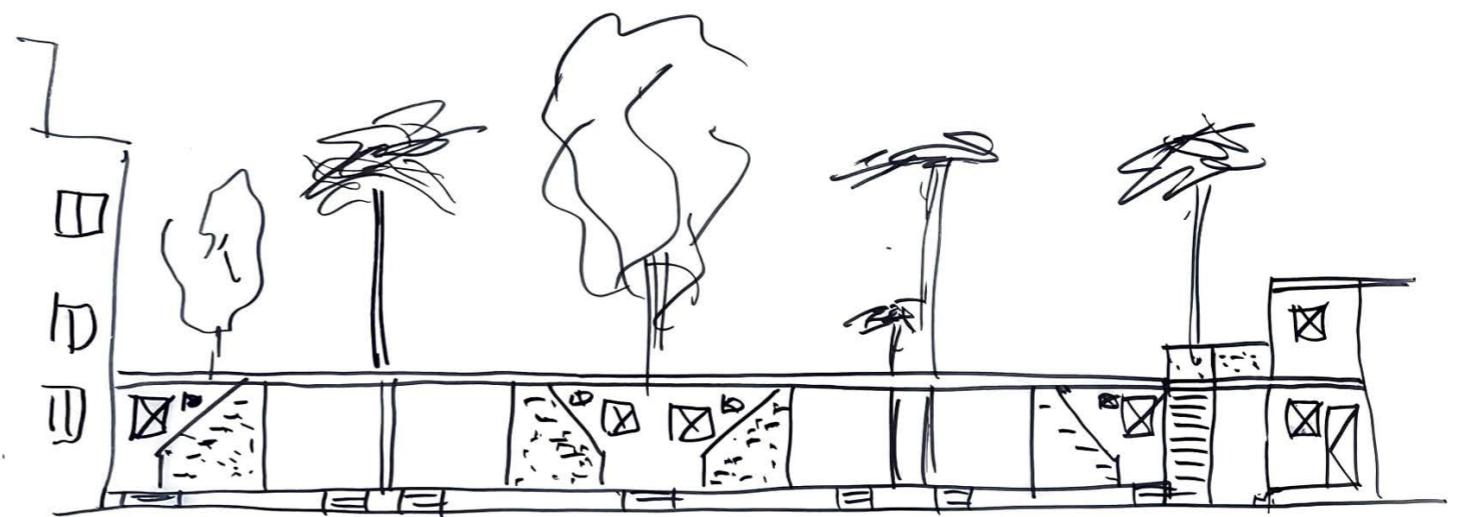
MANAGEMENT

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CONSTRAINTS

- i. Incremental growth only within the plot
- ii. Maximum $G + 2$
- iii. No direct reselling of plots,
leasehold turns freehold



MAX GROWTH

COST-EFFICIENCY MEASURES

- i. incremental financing
- ii. clustered infrastructure
- iii. local material & construction
- iv. filler-slab roofs
- v. sweat labour

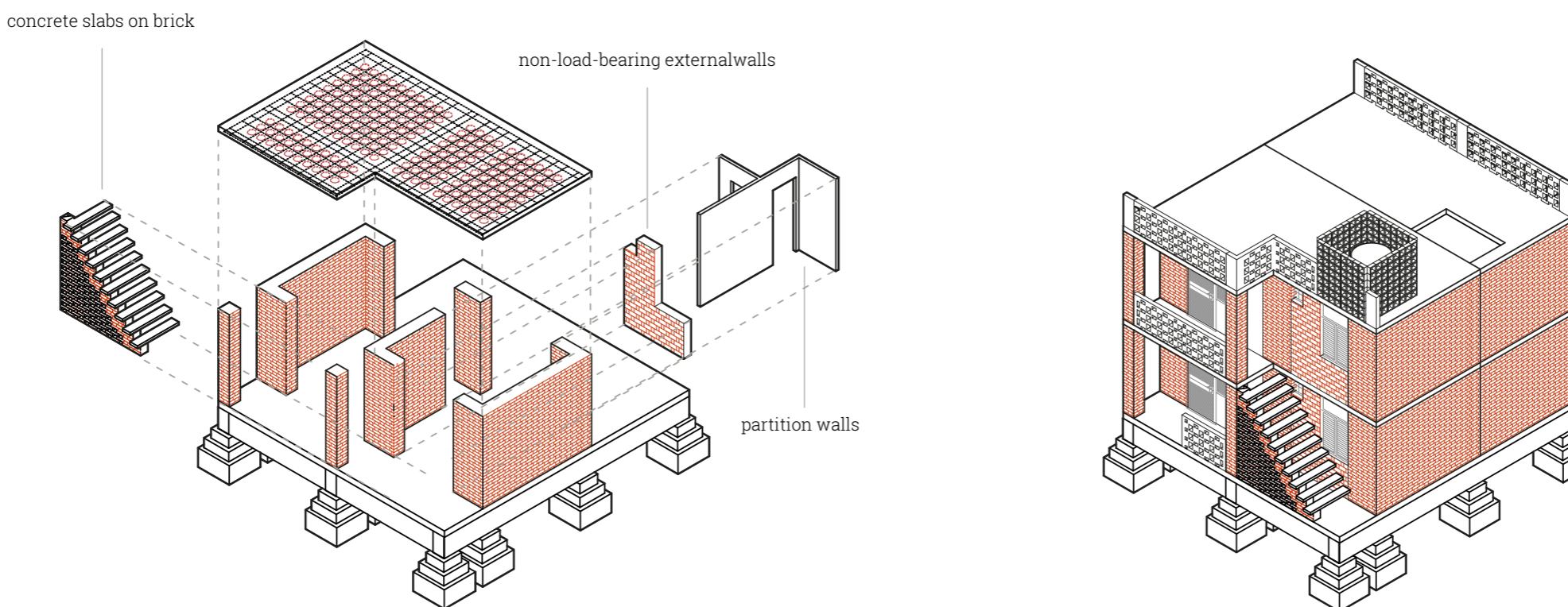
traditional building costs

3500 BDT/sq. ft. (€83,83/m²)

Shonatola low-cost housing

2500 BDT/sq. ft. (€59,88/m²)

close to **30%** cost decrease
in addition to incremental financing

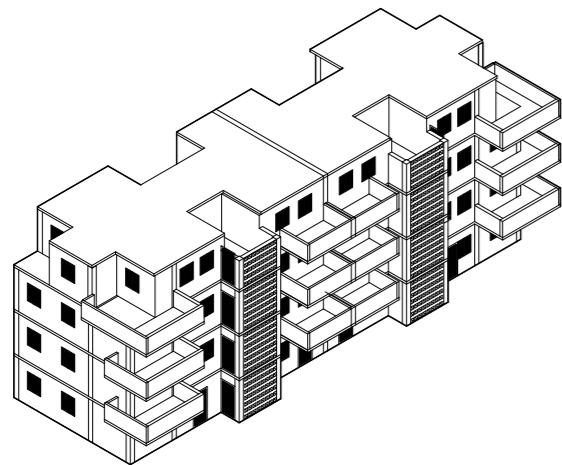


reaching low-income groups that would not have been
able to own a house in the traditional housing market

The numbers - building level

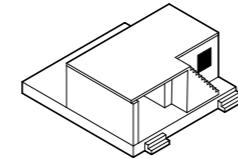
117

MANAGEMENT STRATEGY



Typology A

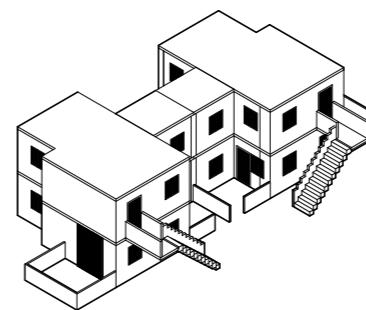
A1 (2x) 122 m² (24 m² retail)
A2 (2x) 75 m² (12 m² retail)
A3 (2x) 106 m²
A4 (2x) 122 m²



Typology B

B1 (base) - 12 m²
(developed) - 47 m²
incr. growth: 35 m²
B2 (base) - 0 m²
(developed) - 47 m²
incr. growth: 47 m²

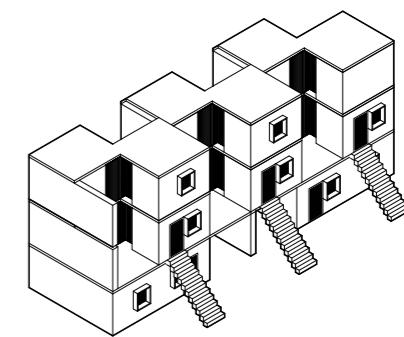
total floor area: 856 m²



Typology C

C1 (2x) (base) - 47 m²
(developed) - 73 m²
incr. growth: 26 m²
C2 (2x) (base) - 47 m²
(developed) - 73 m²
incr. growth: 26 m²

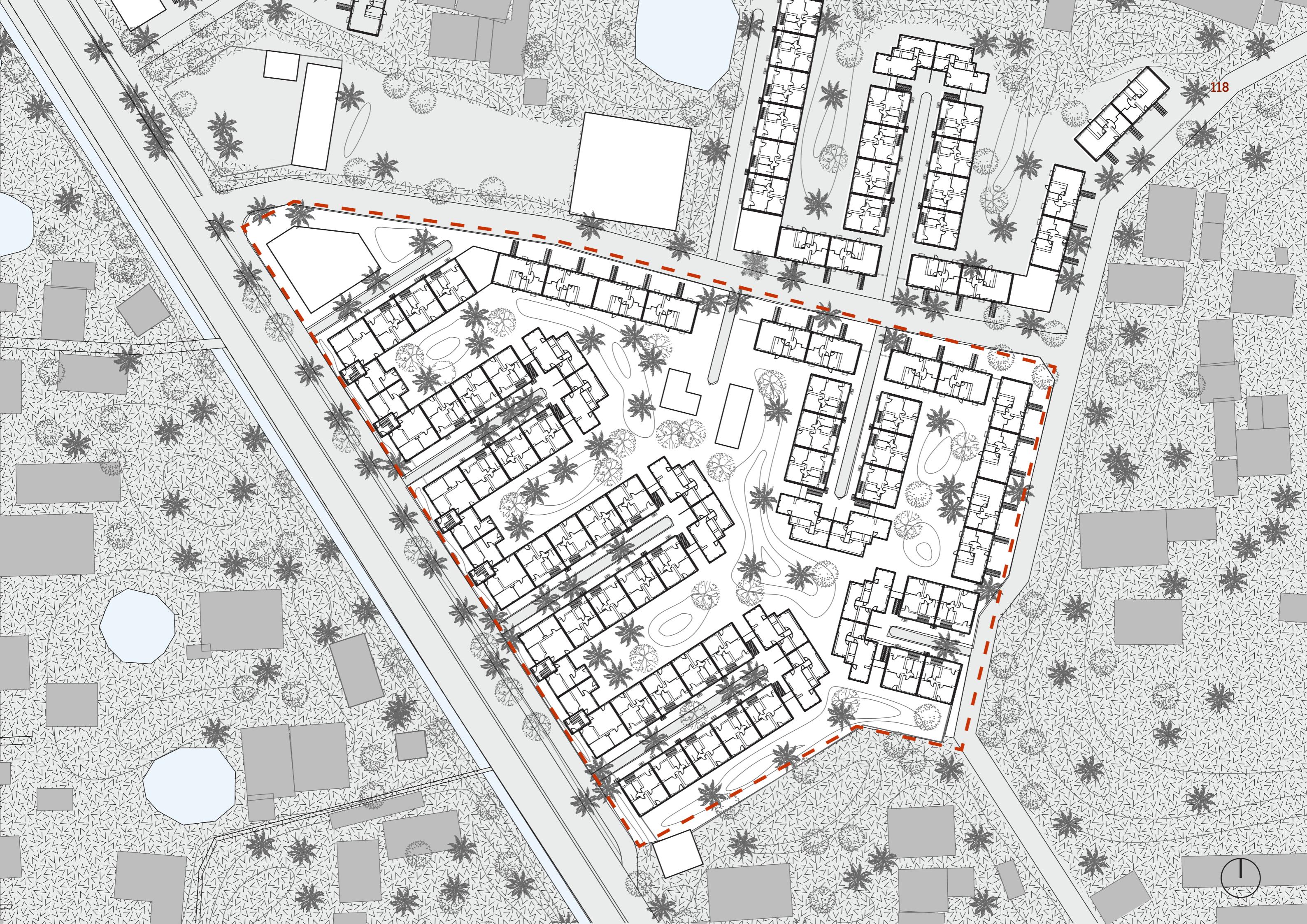
total floor area: 292 m²



Typology D

D1 (2x) (base) - 40 m²
(developed) - 72 m²
incr. growth: 32 m²
D2 (3x) (base) - 40 m²
(developed) - 80 m²
incr. growth: 40 m²

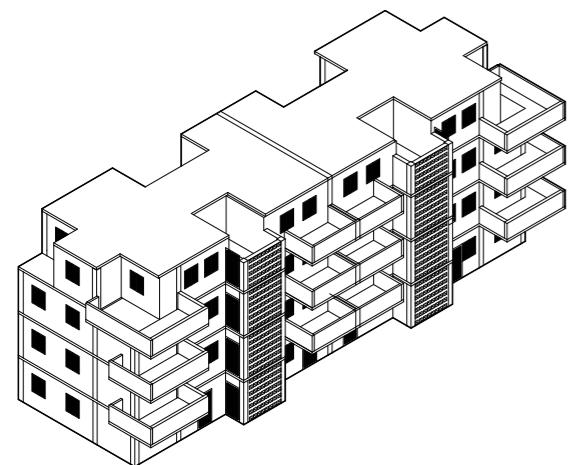
total floor area: 432 m²



The numbers - cluster level

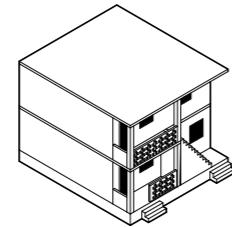
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MANAGEMENT STRATEGY



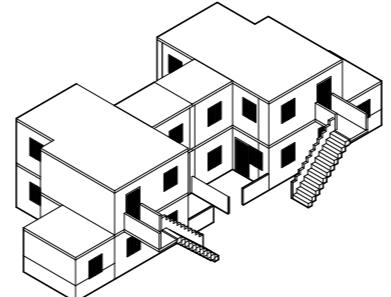
Typology A

3x (24 dw)



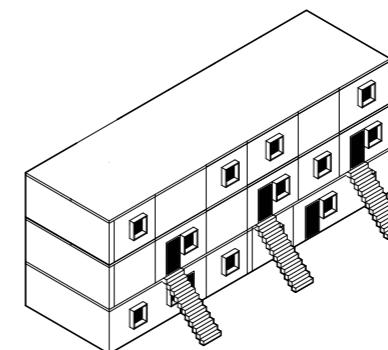
Typology B

36x (72 dw)



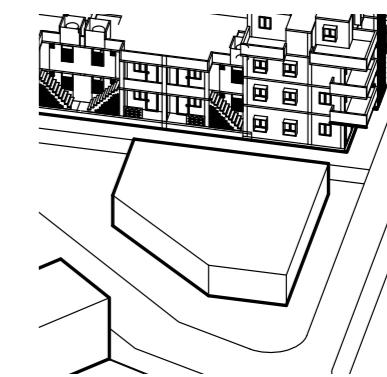
Typology C

5x (20 dw)



Typology D

6x (30 dw)

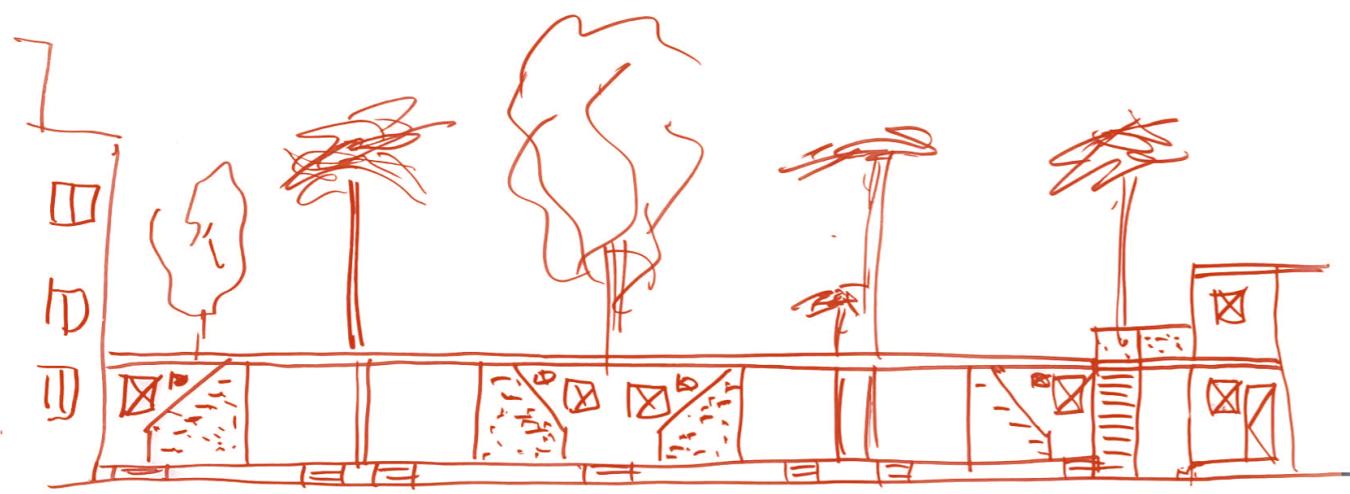


Amenities

361 m²

total ground area	10.306 m ²
total built area	4.313 m ²
total floor area	11.562 m ²
total dwellings	146 dw

GSI	0,42
FSI	1,12
dw/ha	142





thank you for your attention

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