

Making a Living

*Integrating income generation schemes into urban housing redevelopment as
foundation for future economic growth and urban densification*



Son Hei Sou

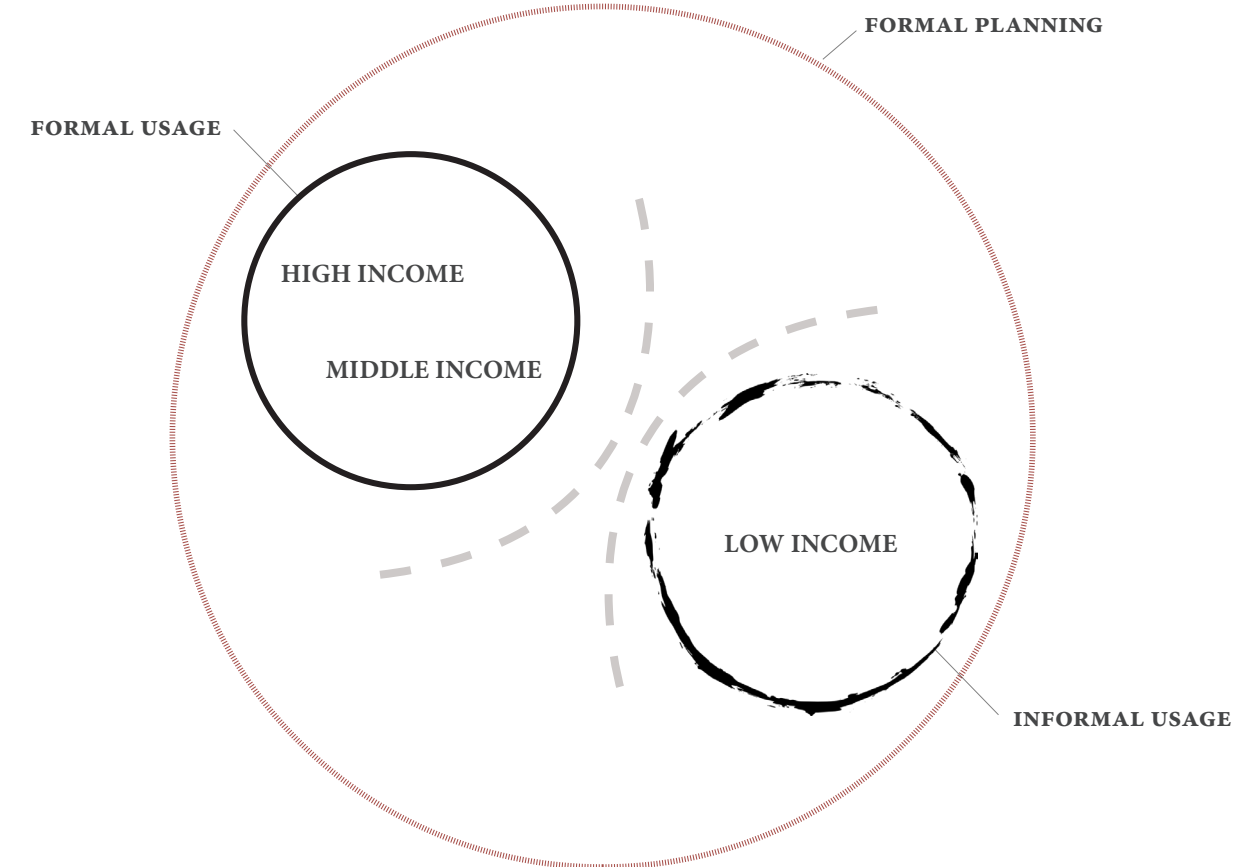
Main problem



The needs of low income households are often not included in the planning by formal institutions.

This results in the friction between the formal authorities and the low income groups as the latter would opt for a more informal ways of usage that are not foreseen by the formal authorities

Solution



The solution is to incorporate the informal lifestyle and usage of the low income households into the formal planning so the informal is not only seen as a problem anymore but as a part of the solution

DESIGN QUESTION

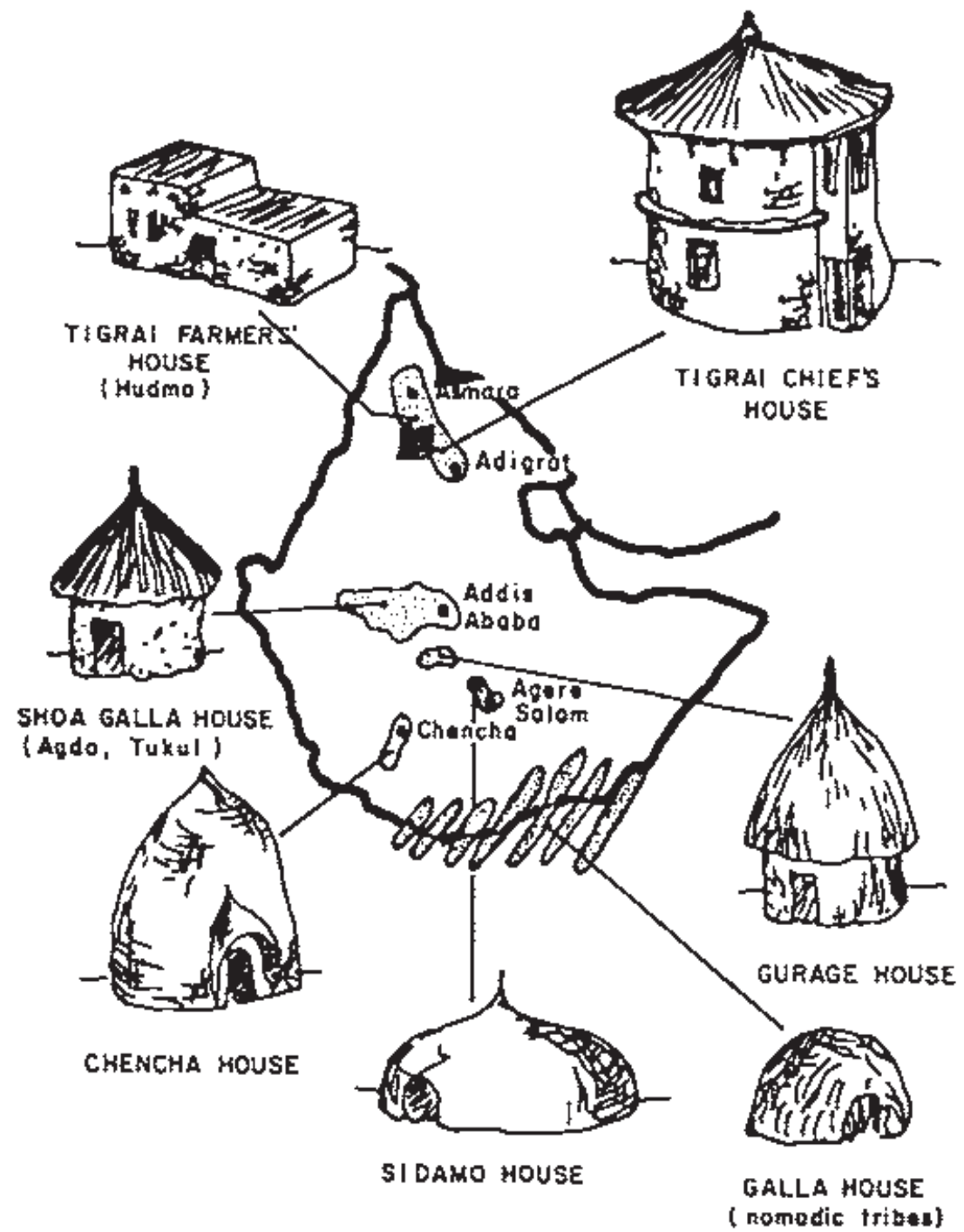
How can *informal income generation* schemes be integrated into urban-housing redevelopment to *economically empower the low-income inhabitants*, while answering to the need for *urban densification* and maintaining the *social fabric* of the existing community?

RESEARCH QUESTION

*How to study the **formally planned city** and the **informally used city**, in order to improve low-income quarters in Addis Ababa?*

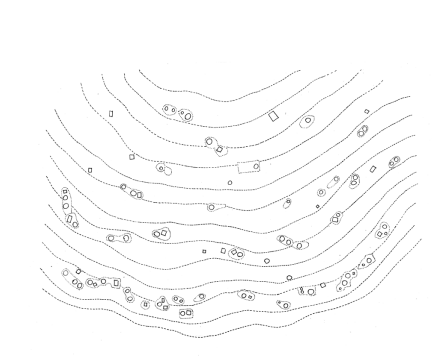
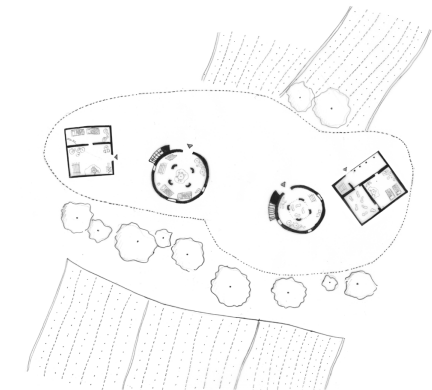
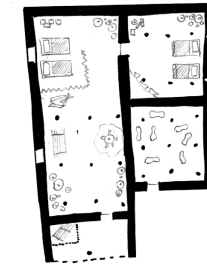
RESEARCH | Planned

geographical housing differences

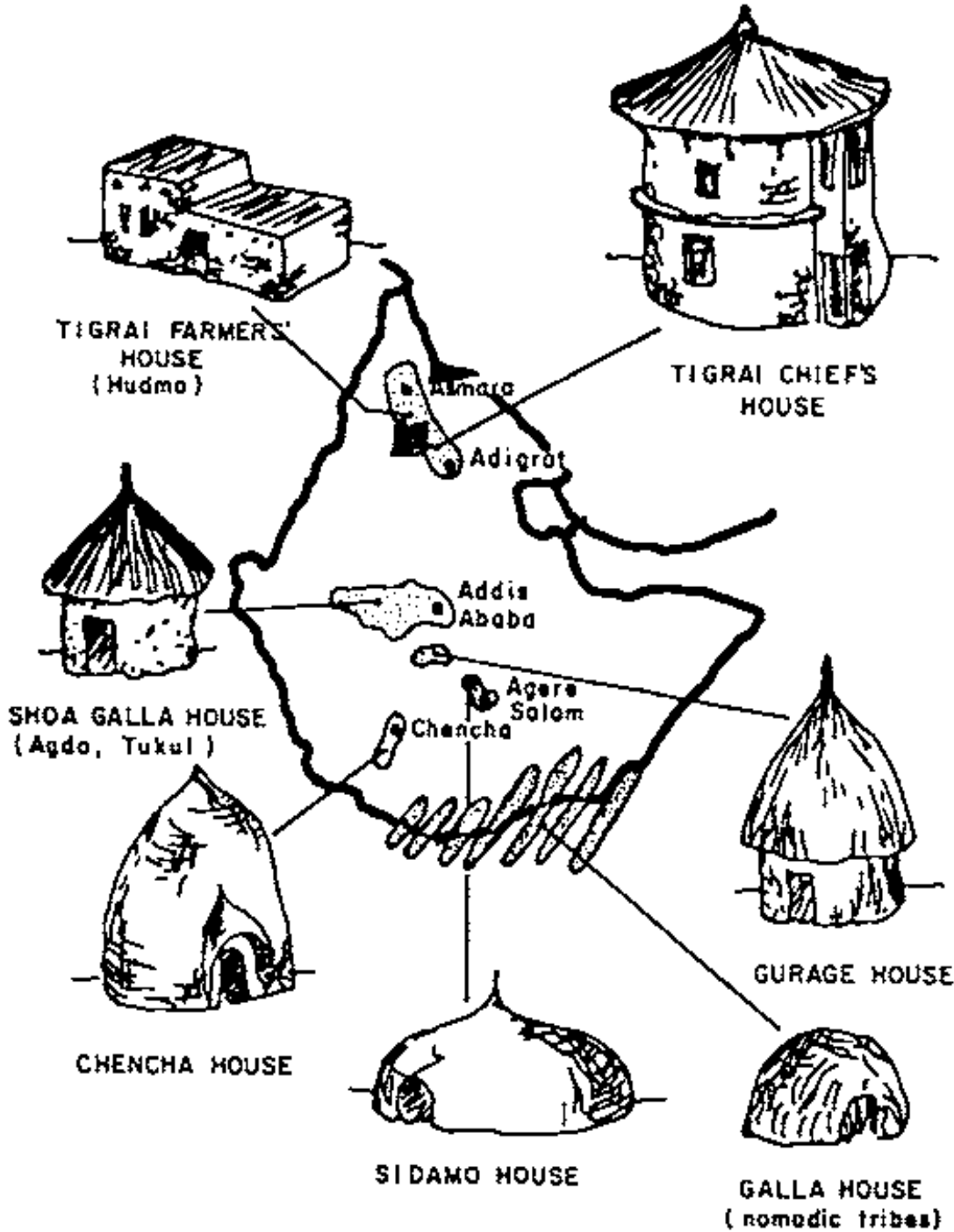


(Buondonno et al., 2020, p.8)

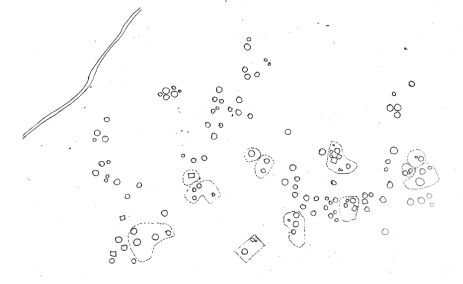
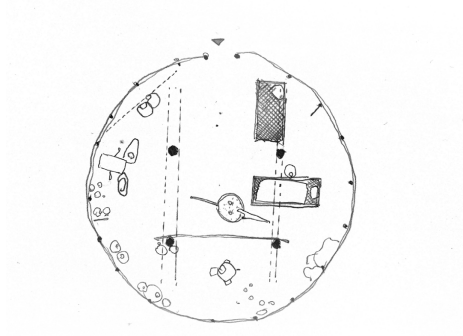
Tigray region



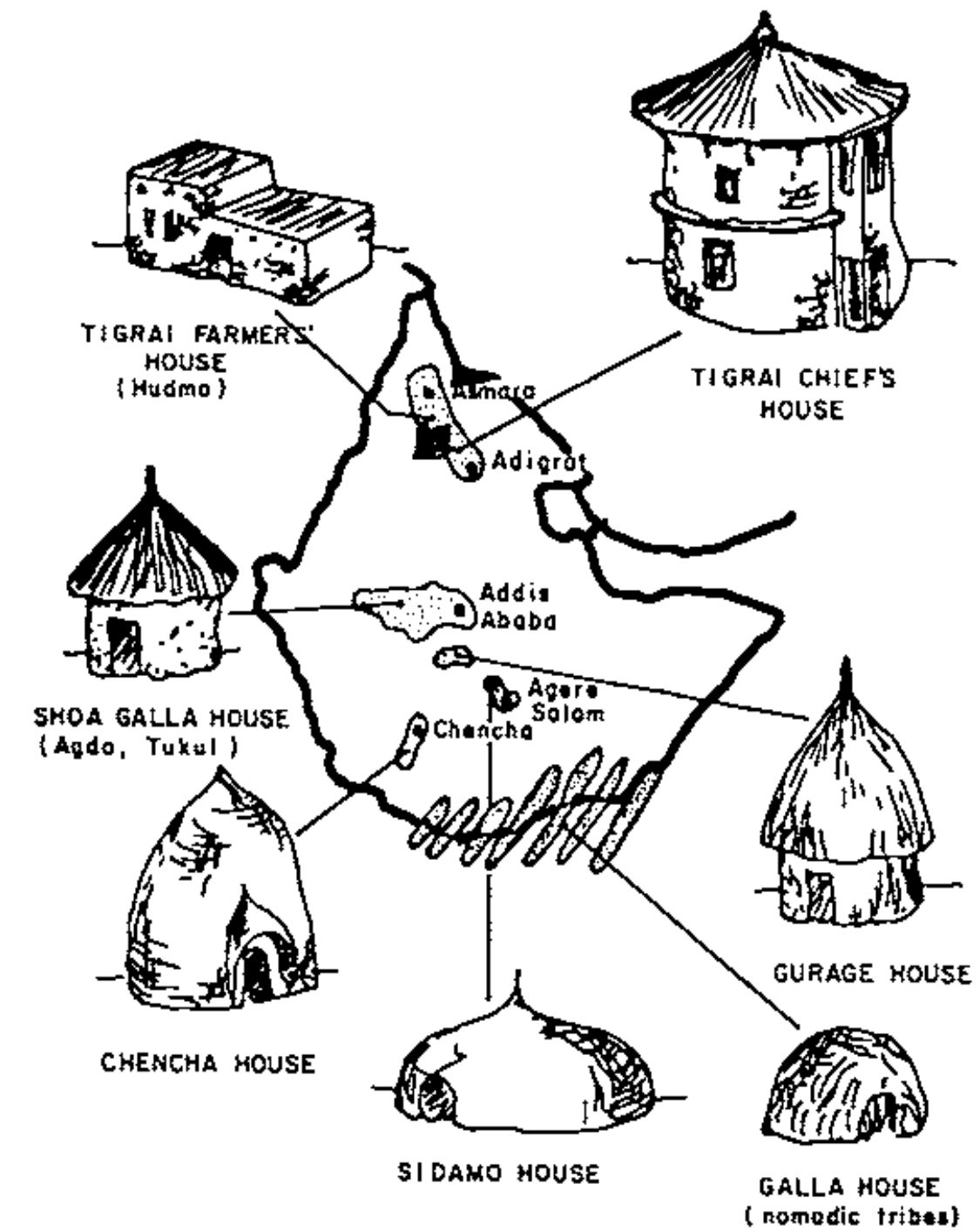
(Buondonno et al., 2020, p.12-13)



(Buondonno et al., 2020, p.8)

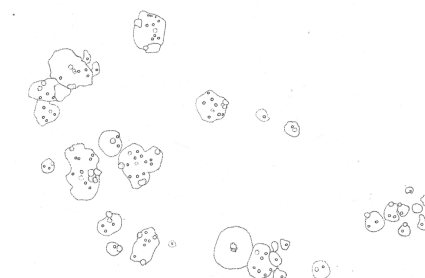
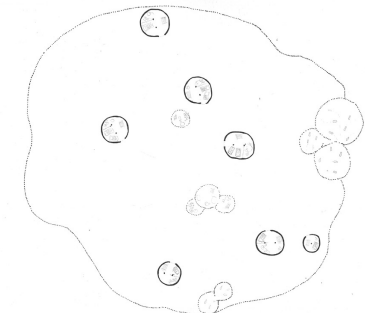
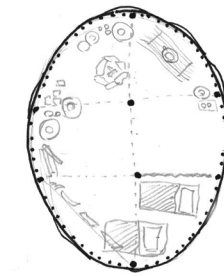


(Buondonno et al., 2020, p.16-17)

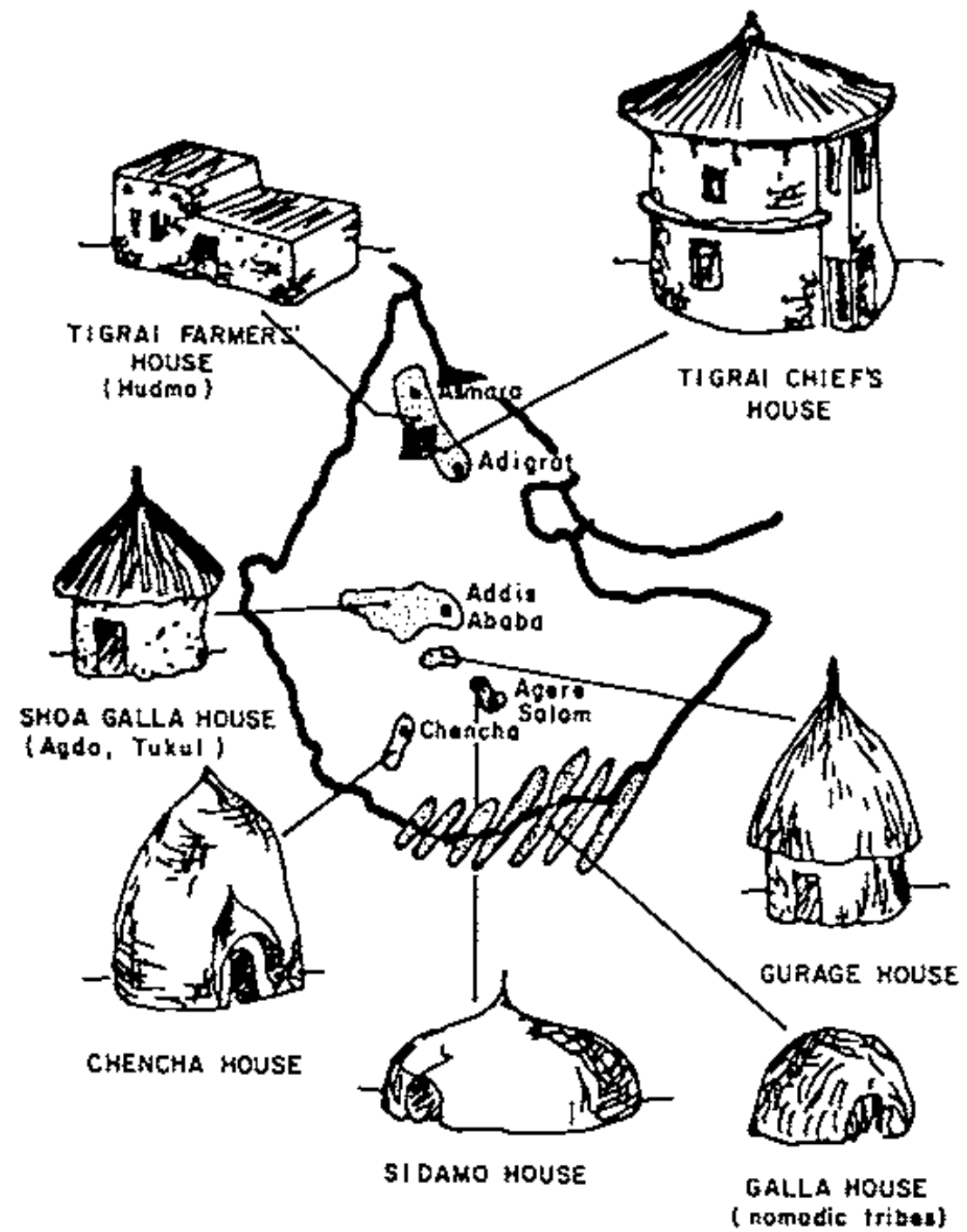


(Buondonno et al., 2020, p.8)

Afar region

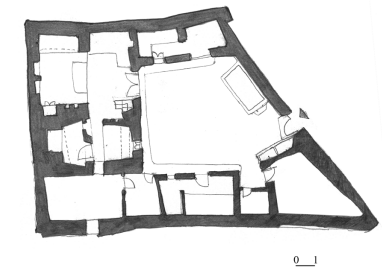


(Buondonno et al., 2020, p.20-21)



(Buondonno et al., 2020, p.8)

Harar region

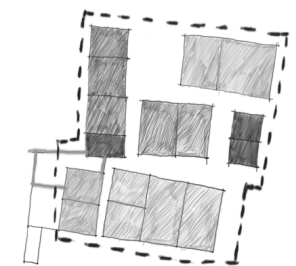
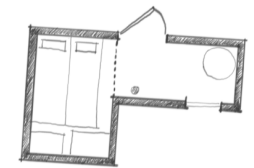
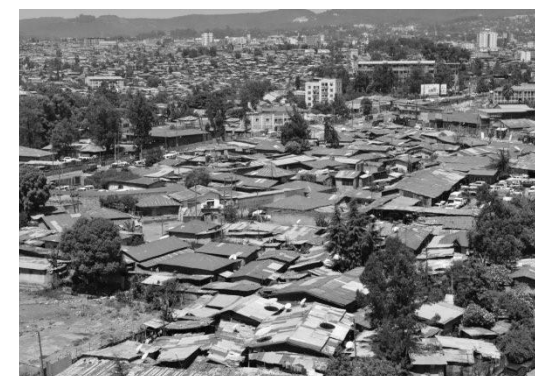


(Buondonno et al., 2020, p. 24-25)

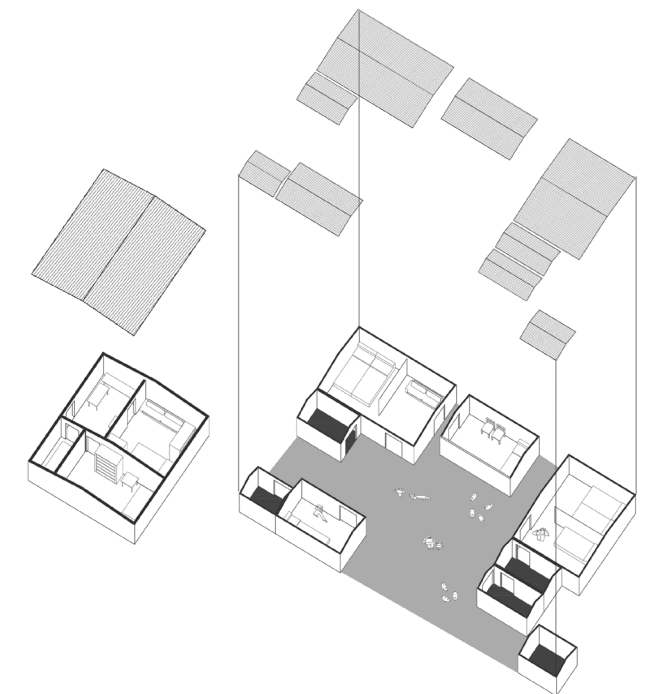
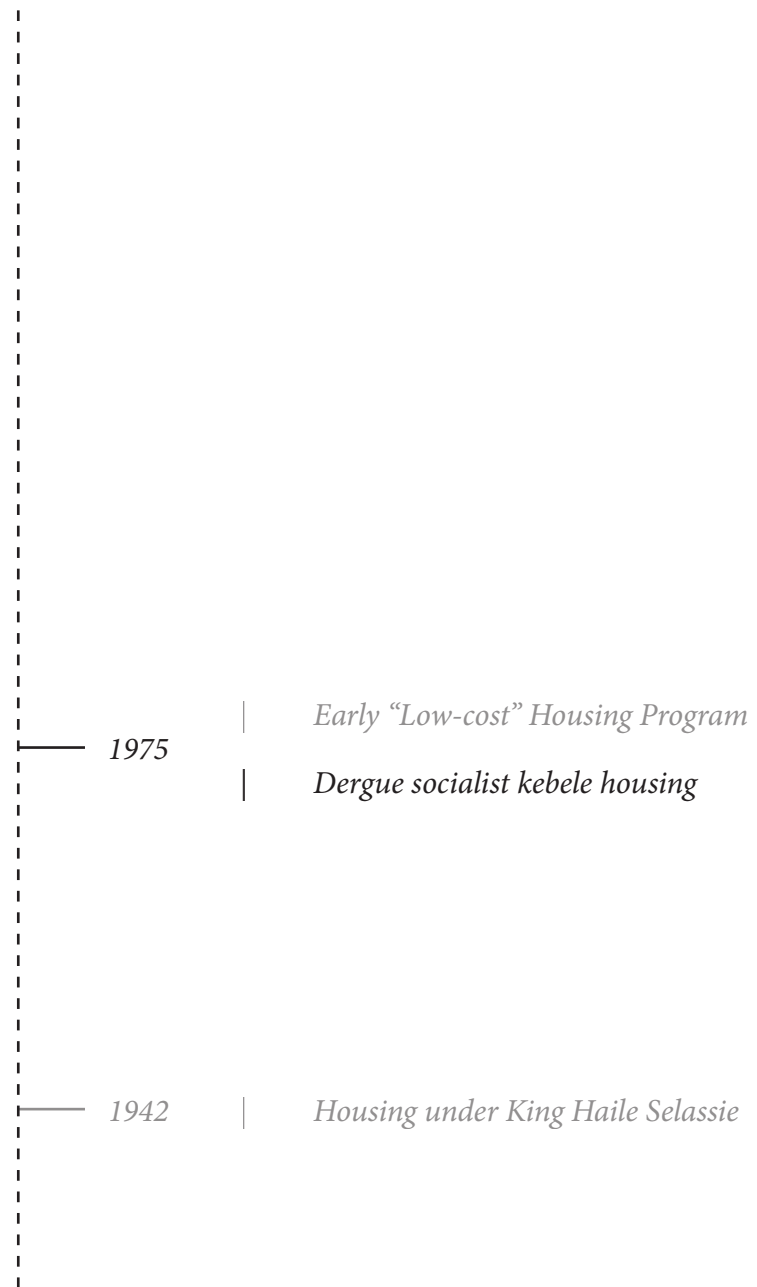
historical housing development

1942

Housing under King Haile Selassie



(Buondonno et al., 2020, p.76-77)



(Buondonno et al., 2020, p. 81-83)



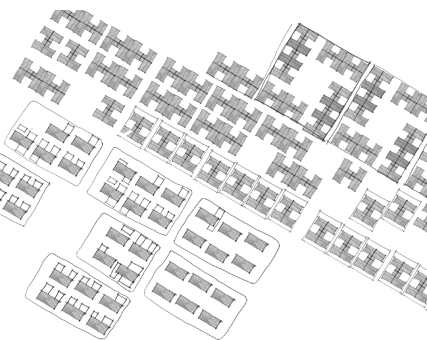
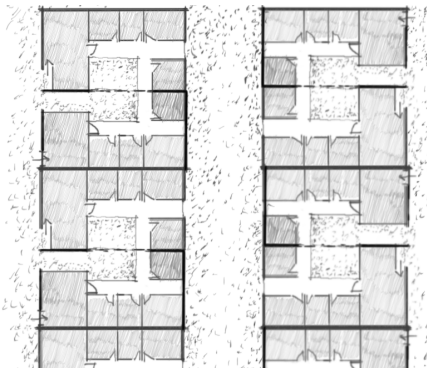
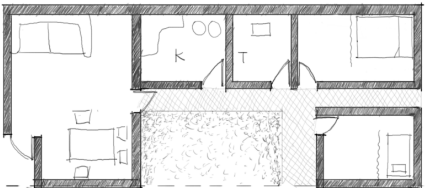
1975

| *Early “Low-cost” Housing Program*

| *Dergue socialist kebele housing*

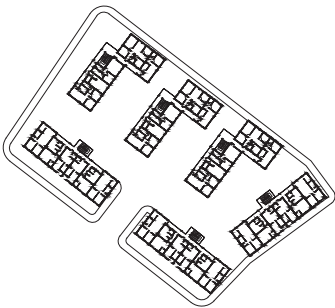
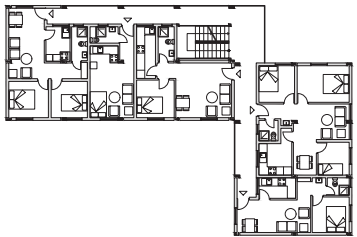
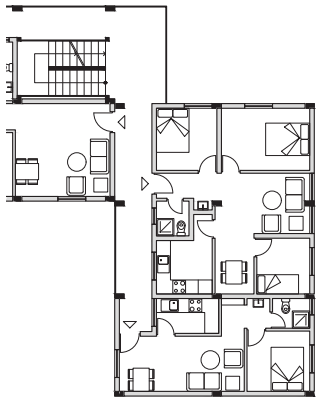
1942

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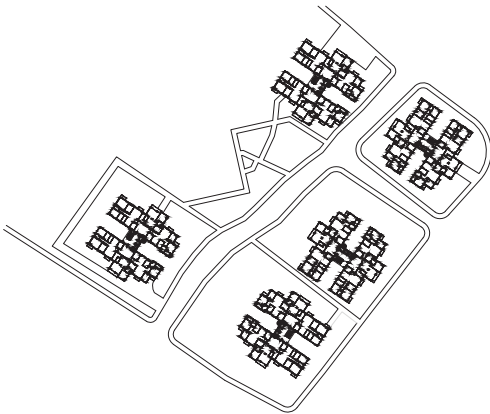
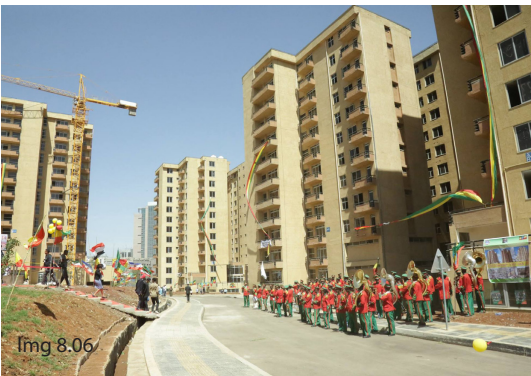
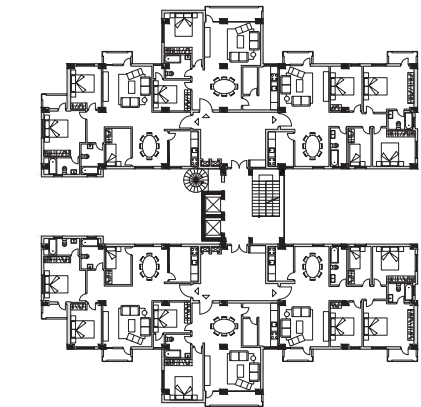
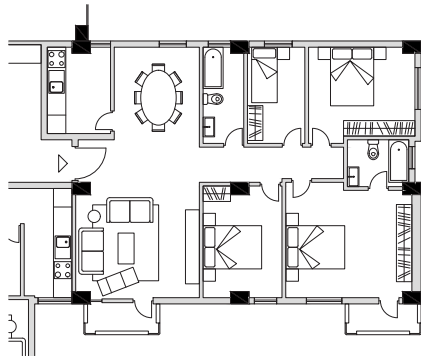
(Buondonno et al., 2020, p.88-89)

2005		<i>The Integrated Housing Program</i>
2002		<i>Grand Housing Program</i>
1975		<i>Early “Low-cost” Housing Program</i> <i>Dergue socialist kebele housing</i>
1942		<i>Housing under King Haile Selassie</i>

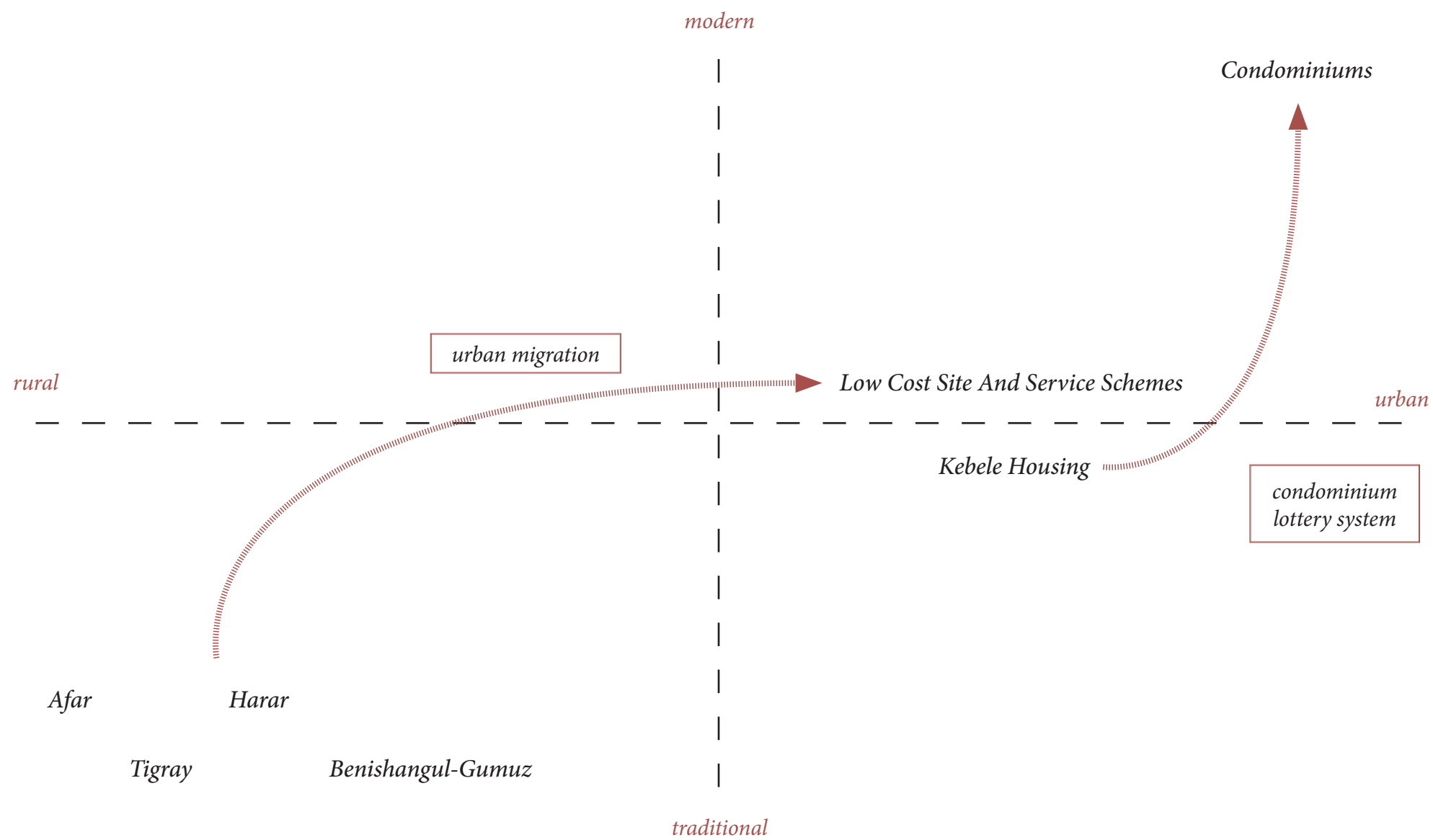


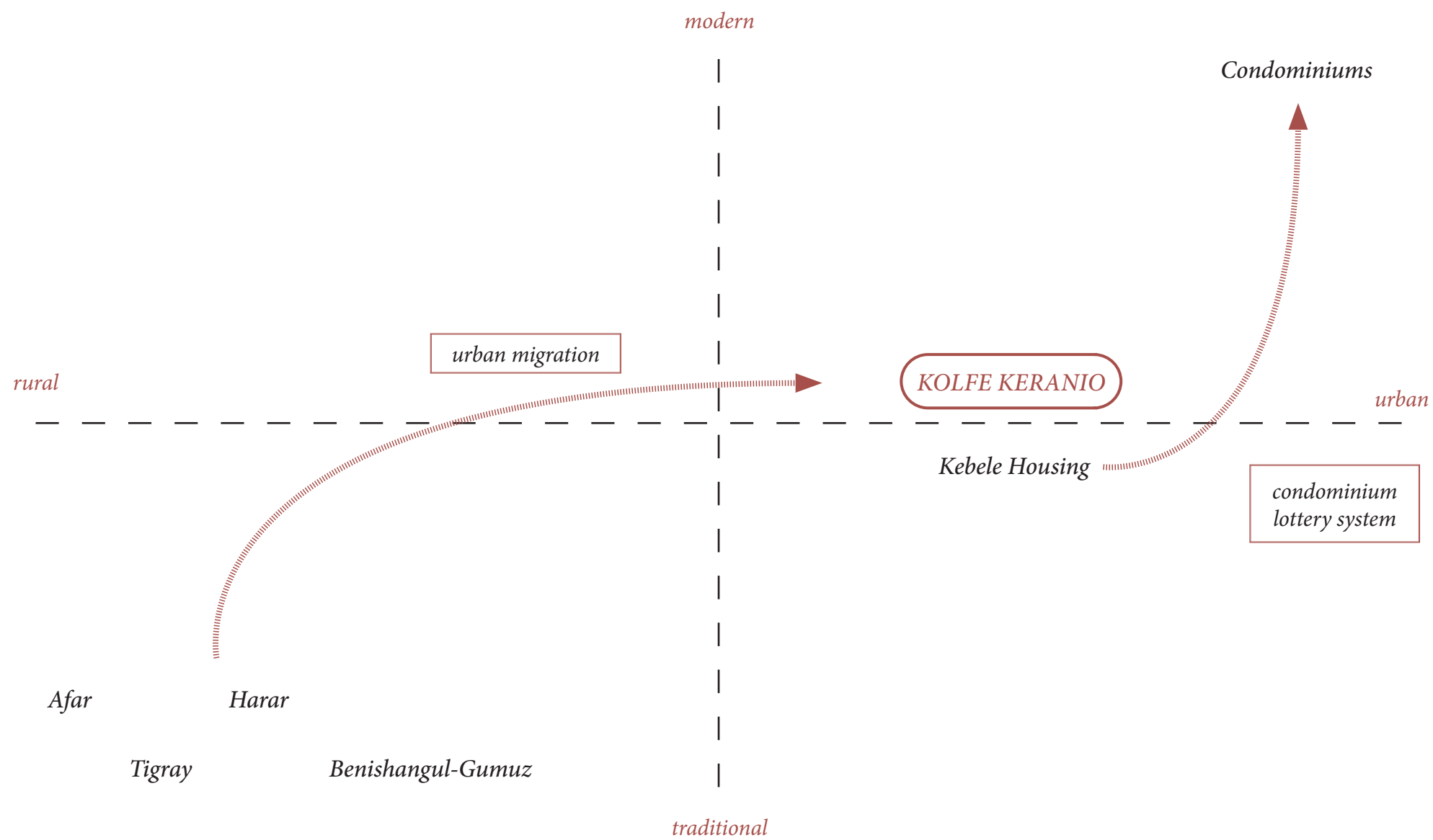
(Buondonno et al., 2020, p.94-95)

2005		<i>The Integrated Housing Program</i>
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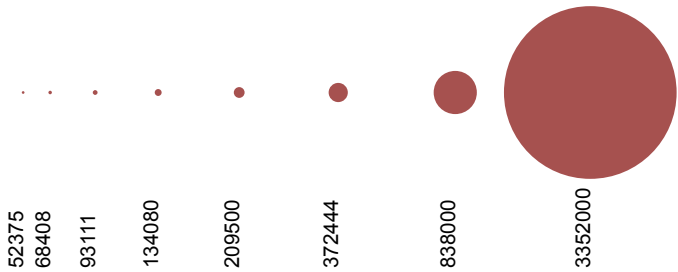
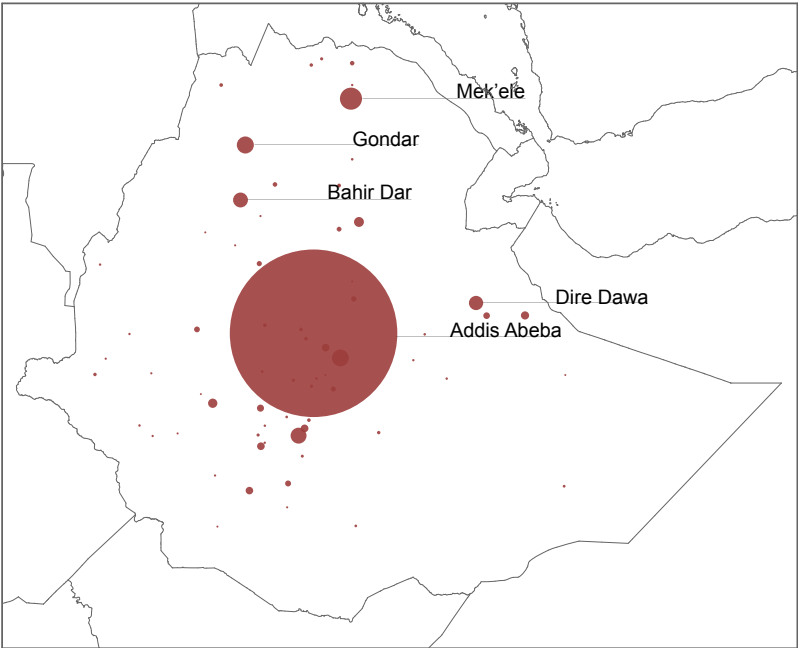
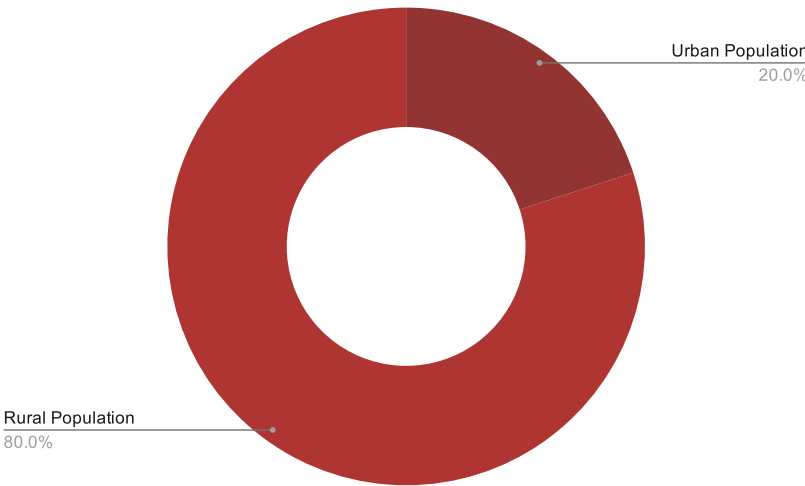
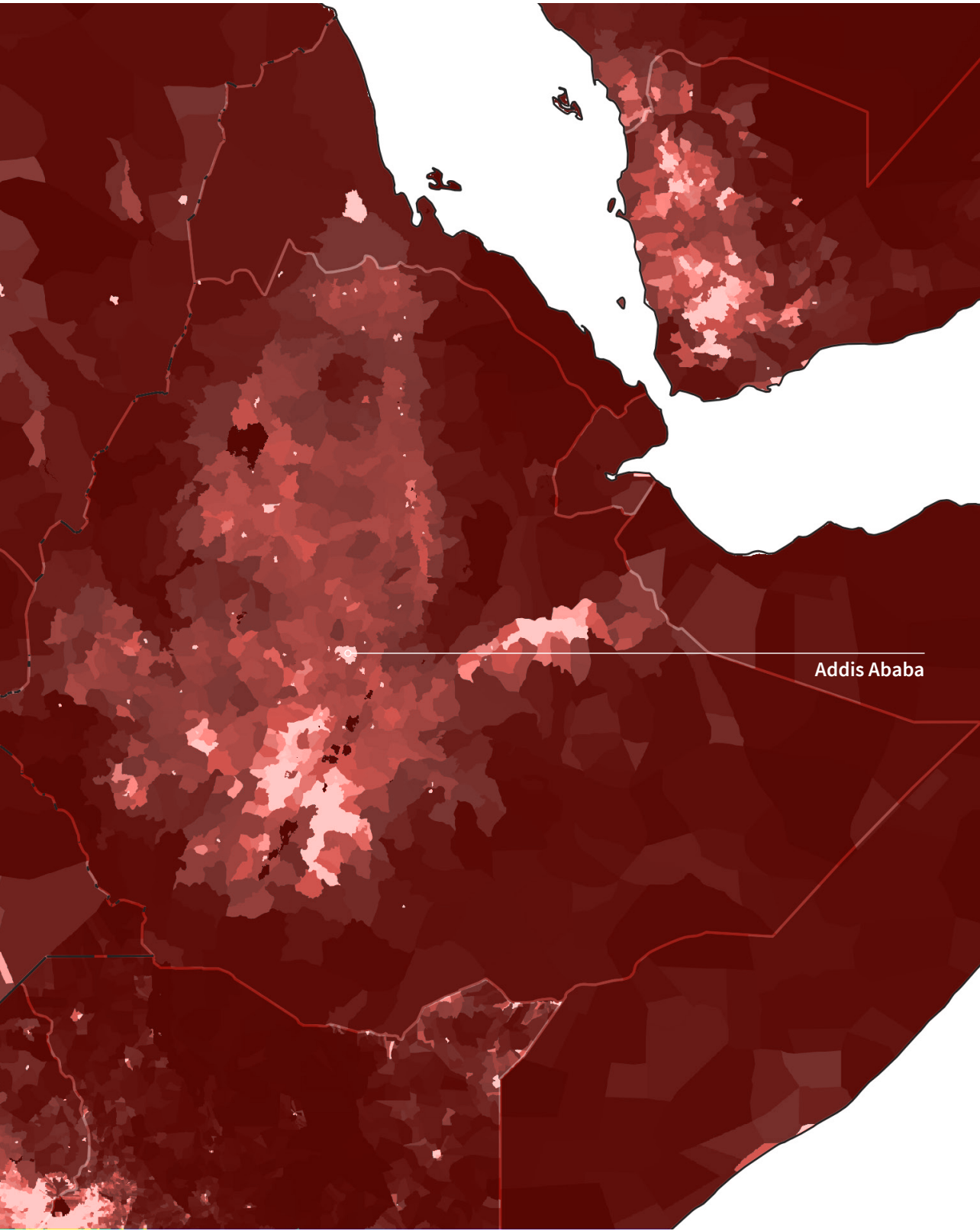
(Buondonno et al., 2020, p. 104-105)





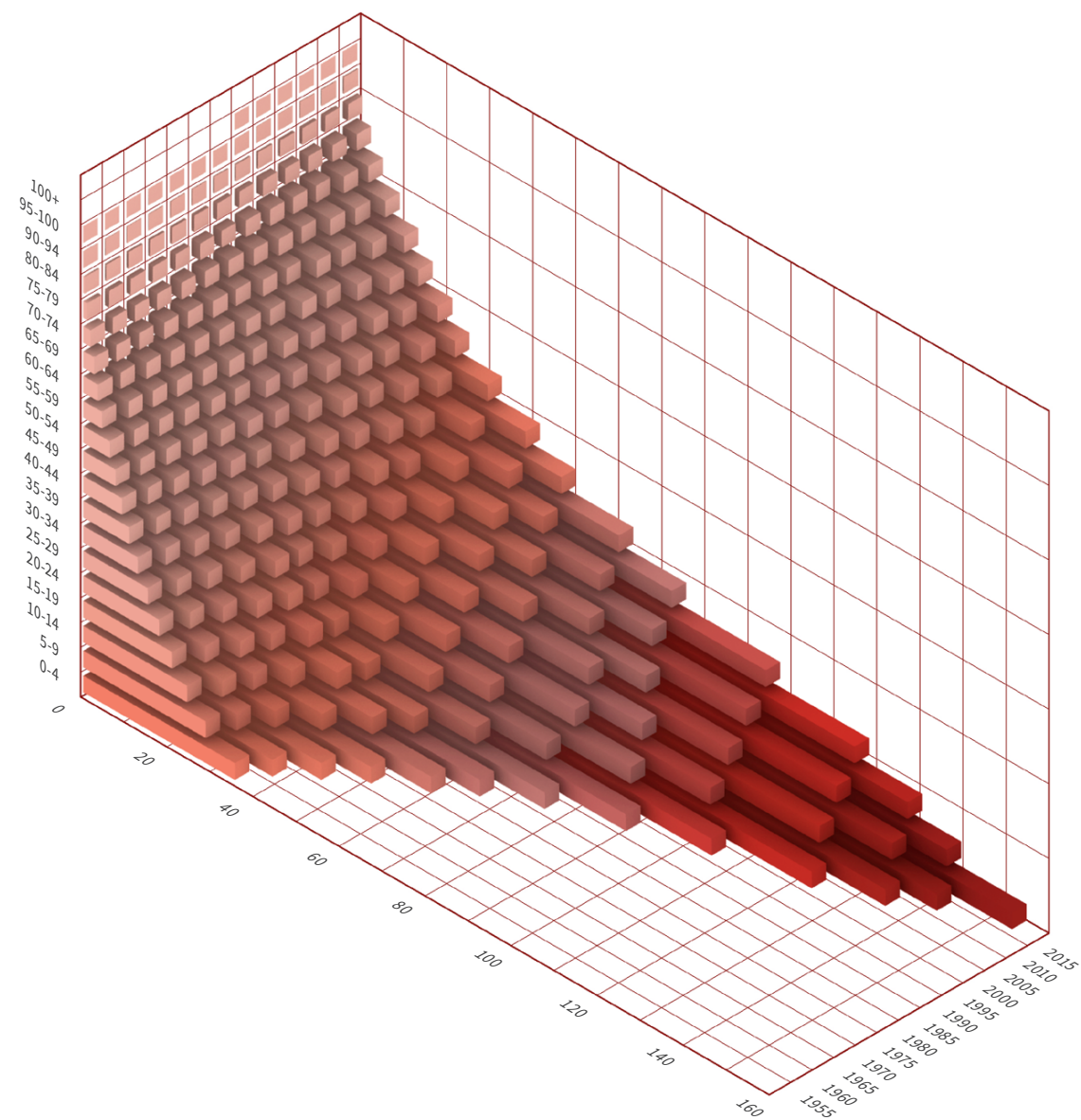
ZOOM IN | Ethiopia





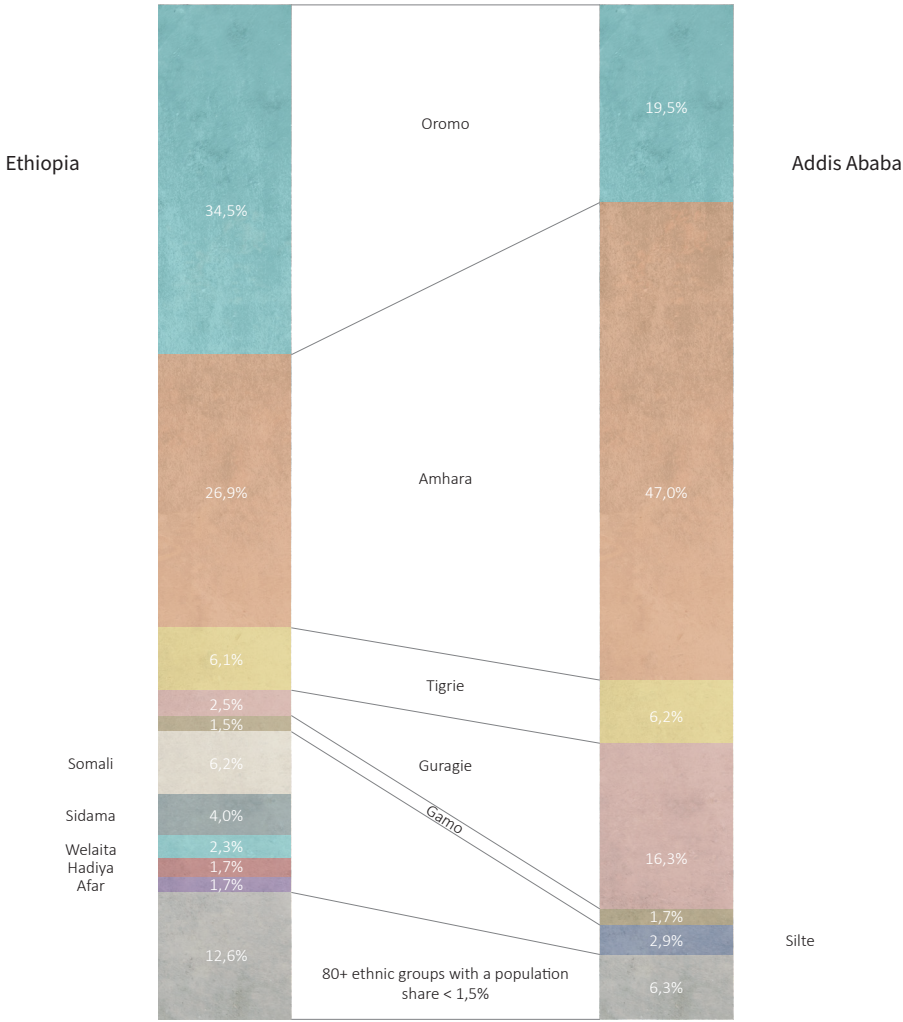
(Barbero et al., 2020, p. 20)

age distribution



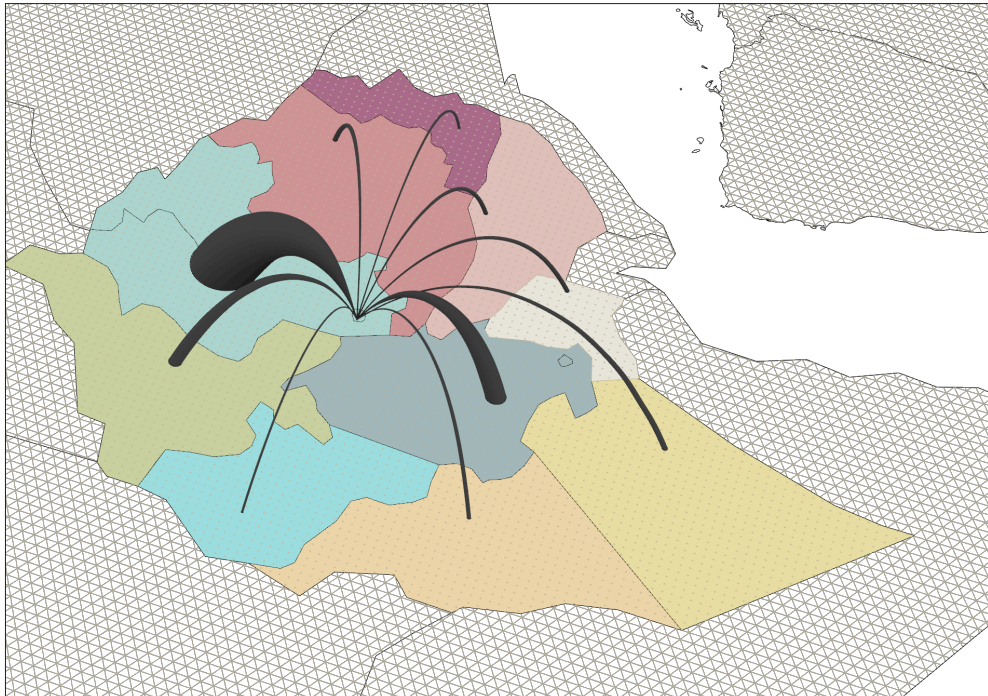
(Barbero et al., 2020, p. 17)

ethnic groups and nationalities



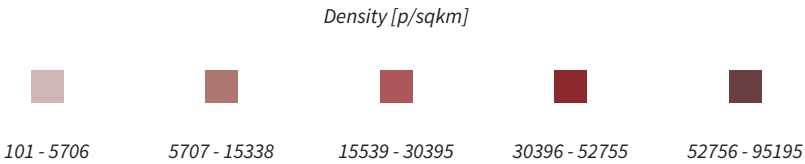
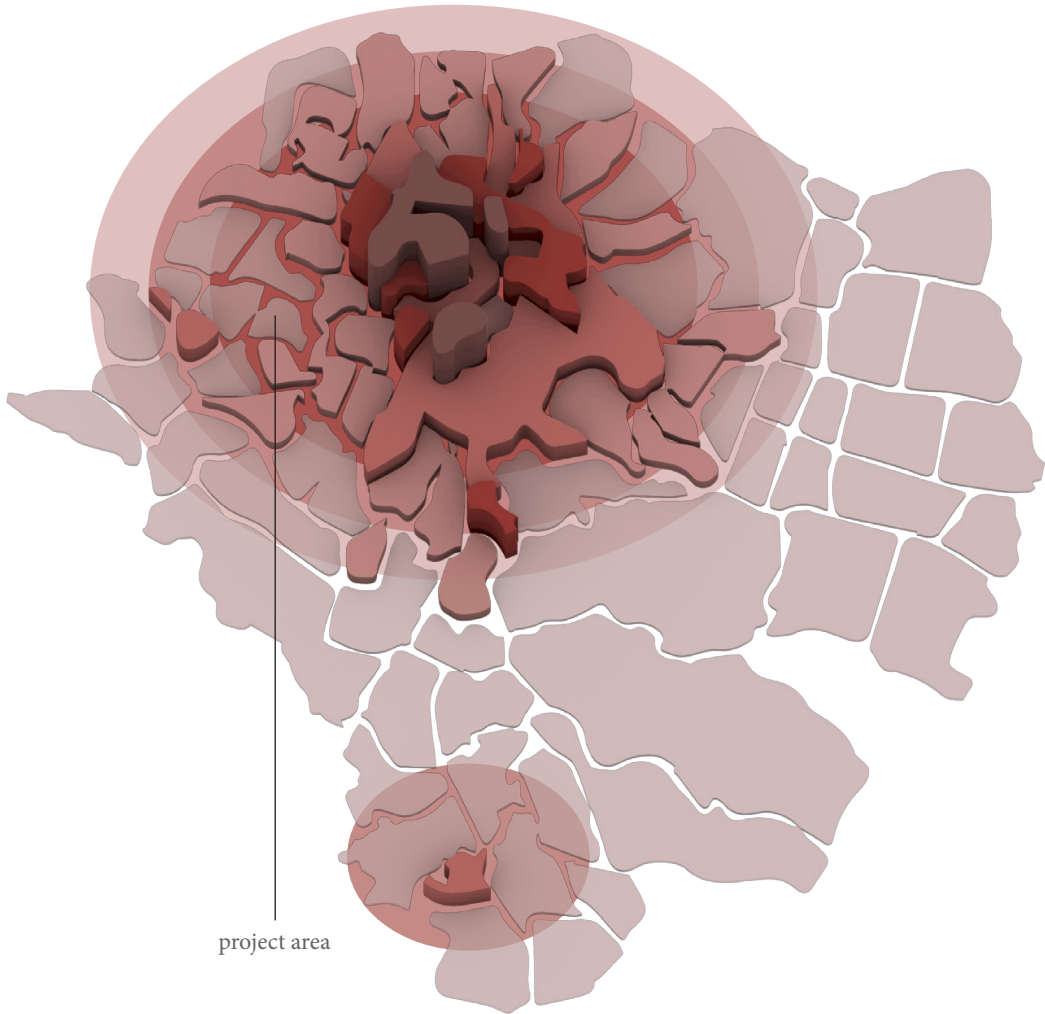
(Barbero et al., 2020, p. 39)

urban migration

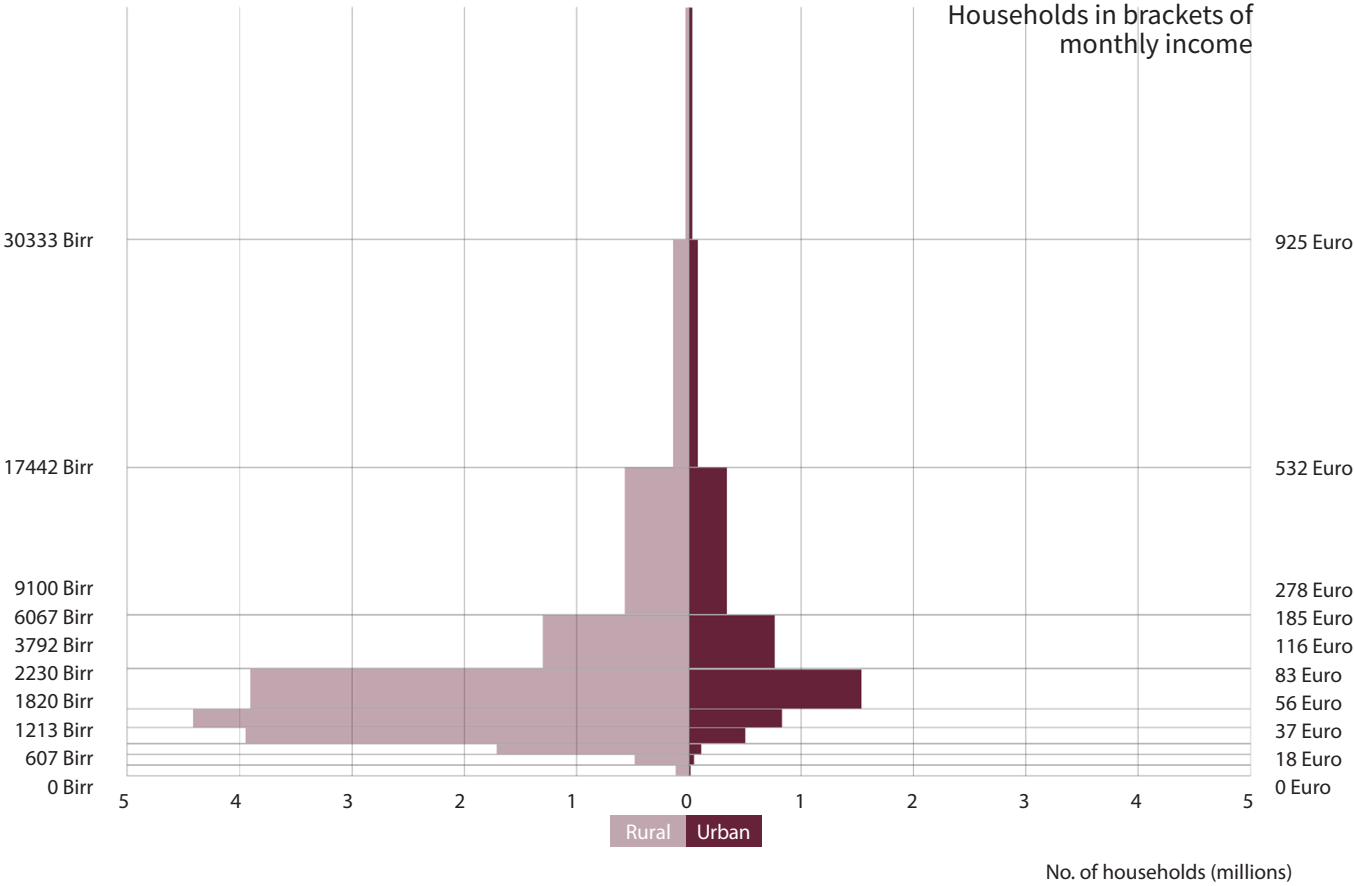


29928	West Oromaria	2366	Amhara	1345	Tigray
8751	East Oromaria	2175	North Somali	964	South Omaria
5790	SNNP	2078	Afar		
2482	North East Somali	1702	South Somali		

density in Addis Ababa

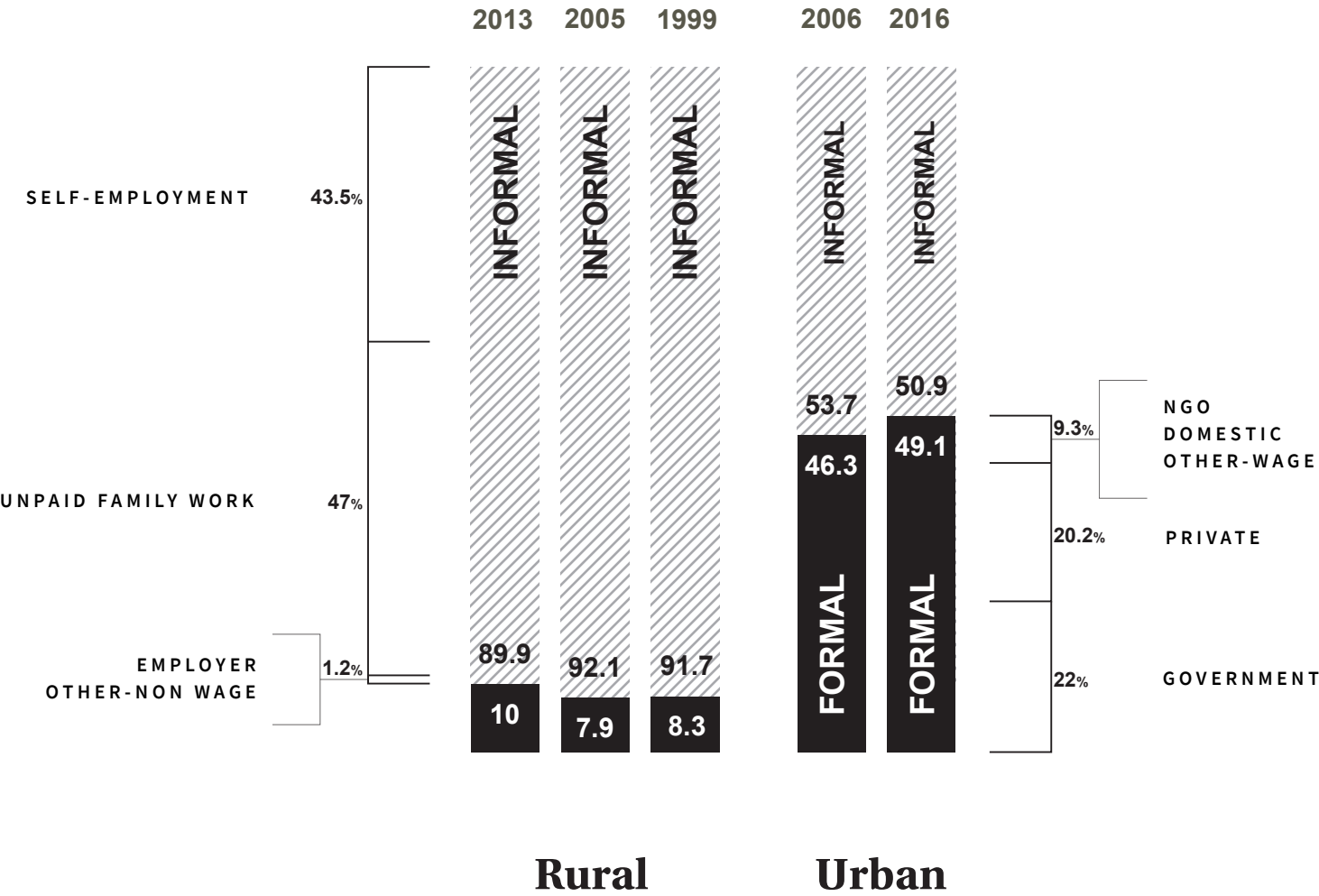


monthly income



(Barbero et al., 2020, p. 53)

informal and formal employment in rural and urban



(Barbero et al., 2020, p. 50-51)

ZOOM IN | Kolfe



KOLFE KERANTO





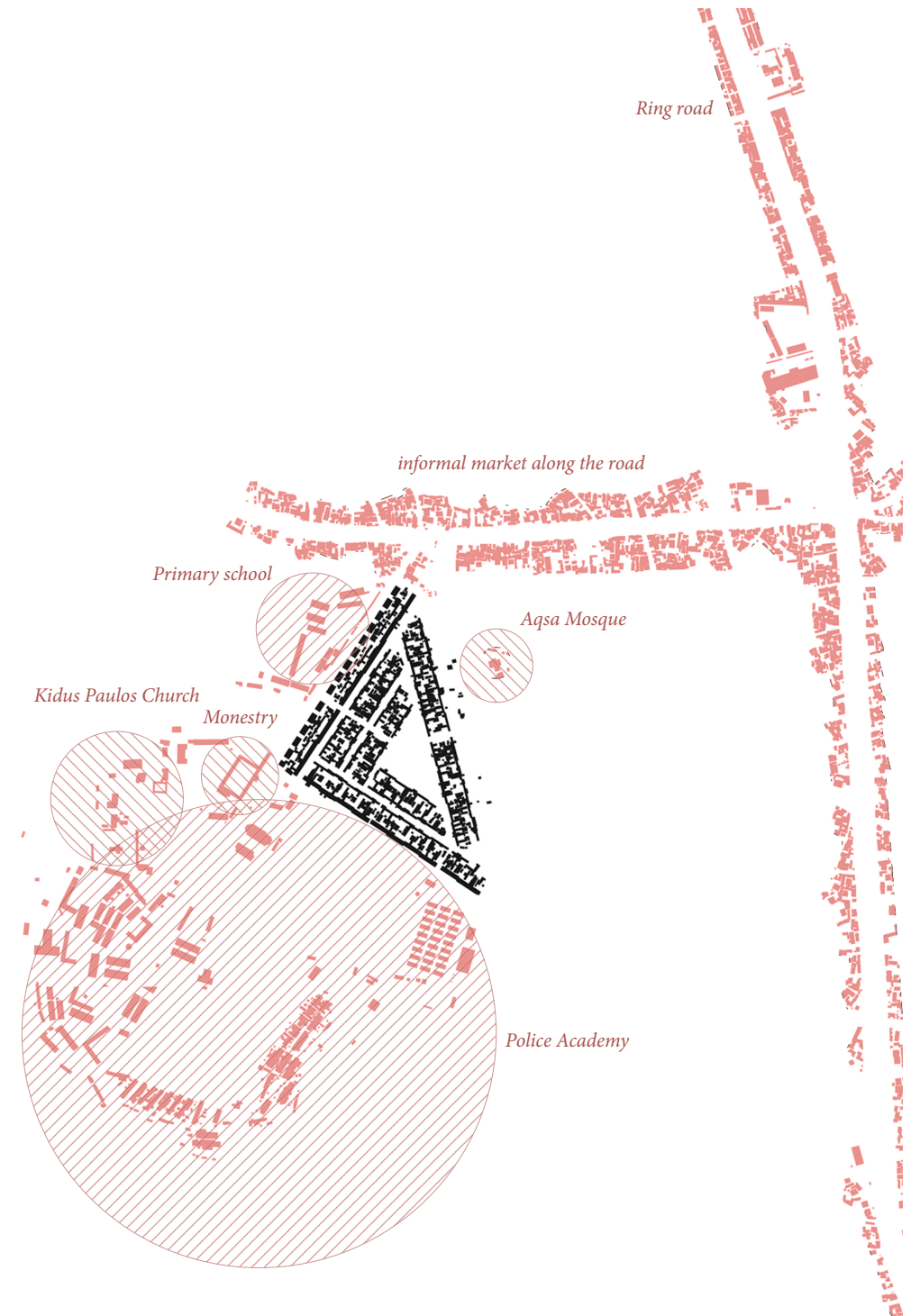
Kidus Paulos Church



Primary school



Aqsa Mosque



Official address
Kolfe Keranio Sub city, Woreda 24, Kebele 09

Development period
late 1980's

Developer
Federal Housing Corporation

Ownership
rent from the FHC; sublease

Gross site area
8,5 Ha

Gross built area
~ 4 Ha

GSI
0,47

FSI
0,47

Number of plots/unit
357 (est.)

Units/ha
2342

Unit typologies
3

Population
2 540 (assume ave. 7/household)

Population/ha
299 (assume ave. 7/household)

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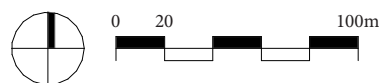
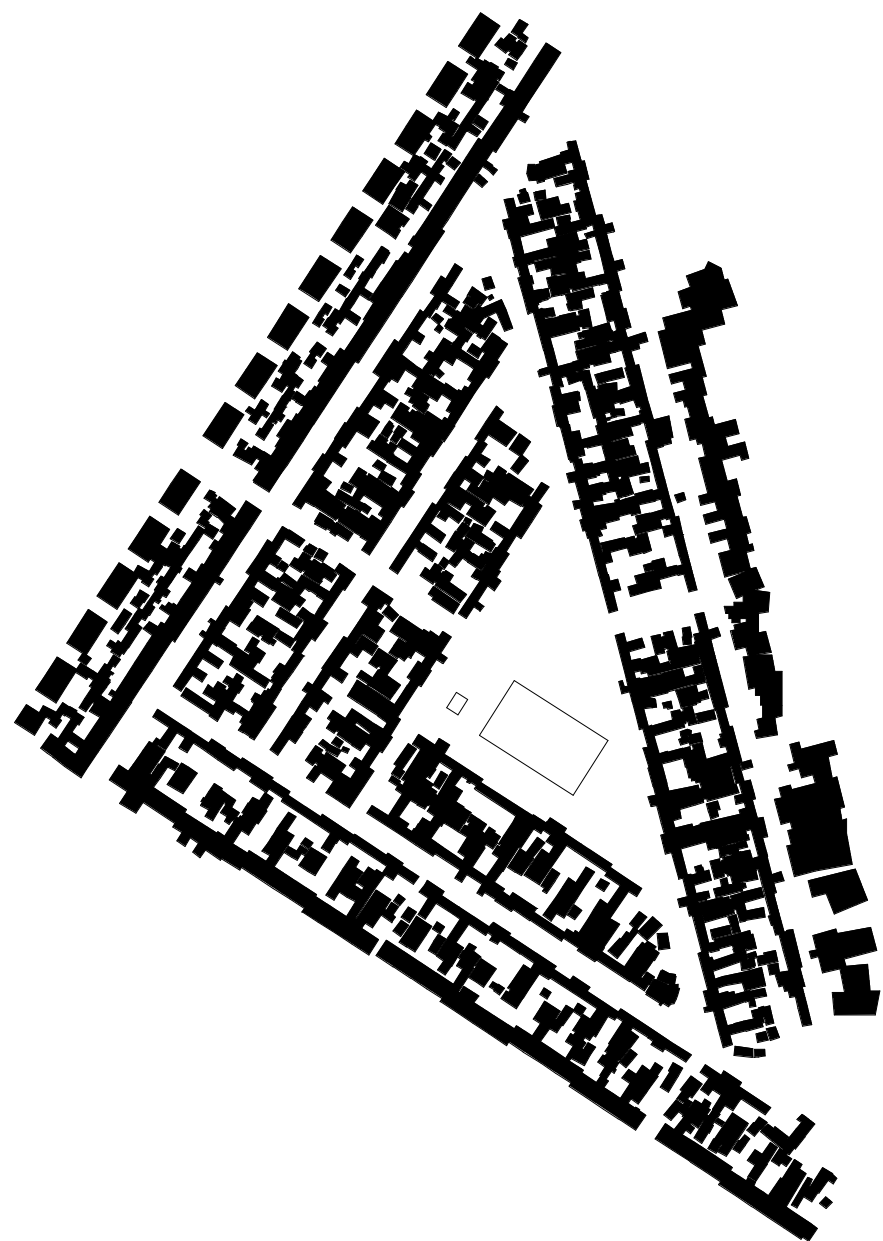
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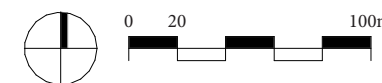
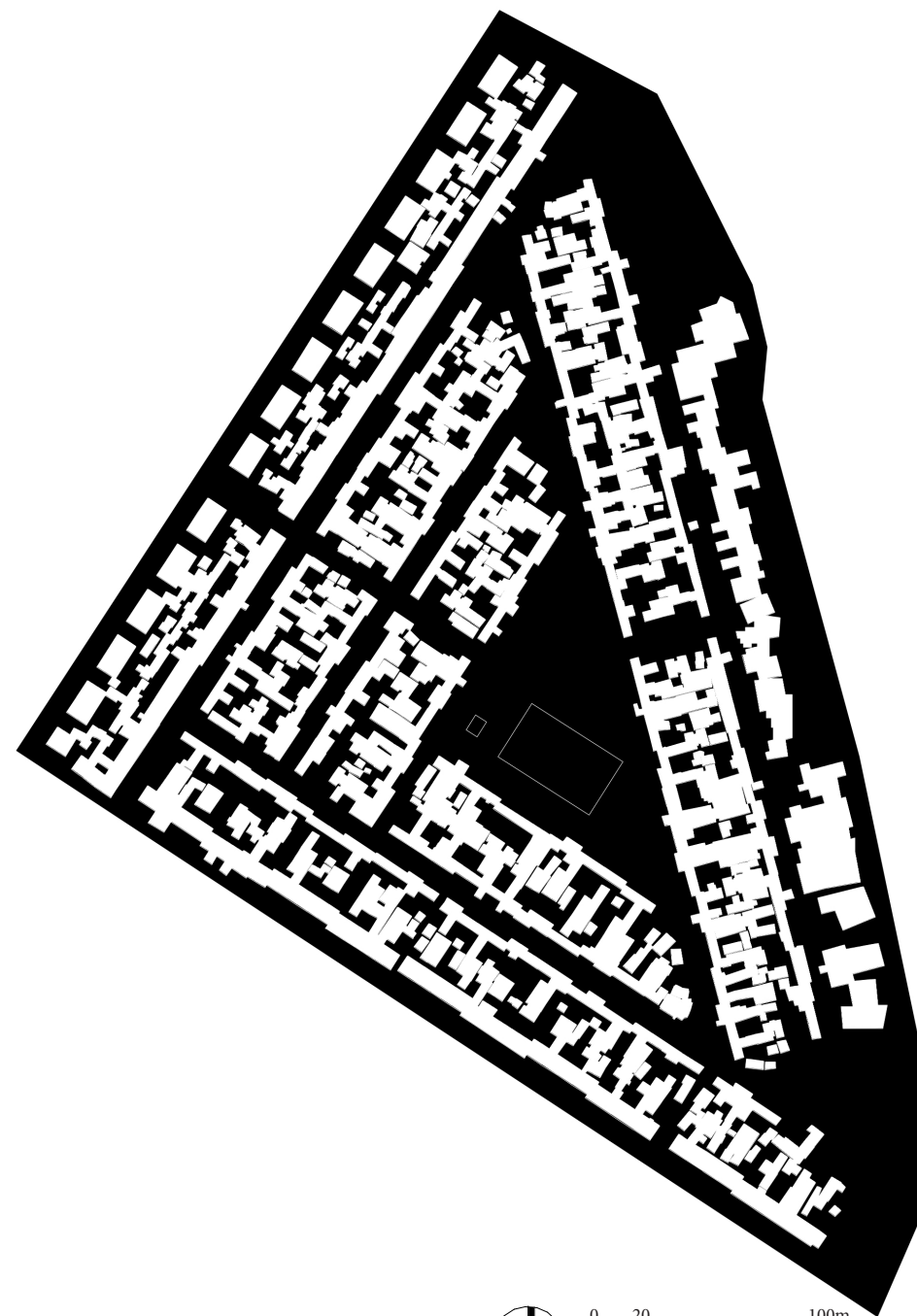
Population
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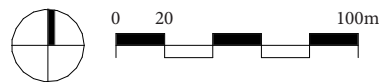
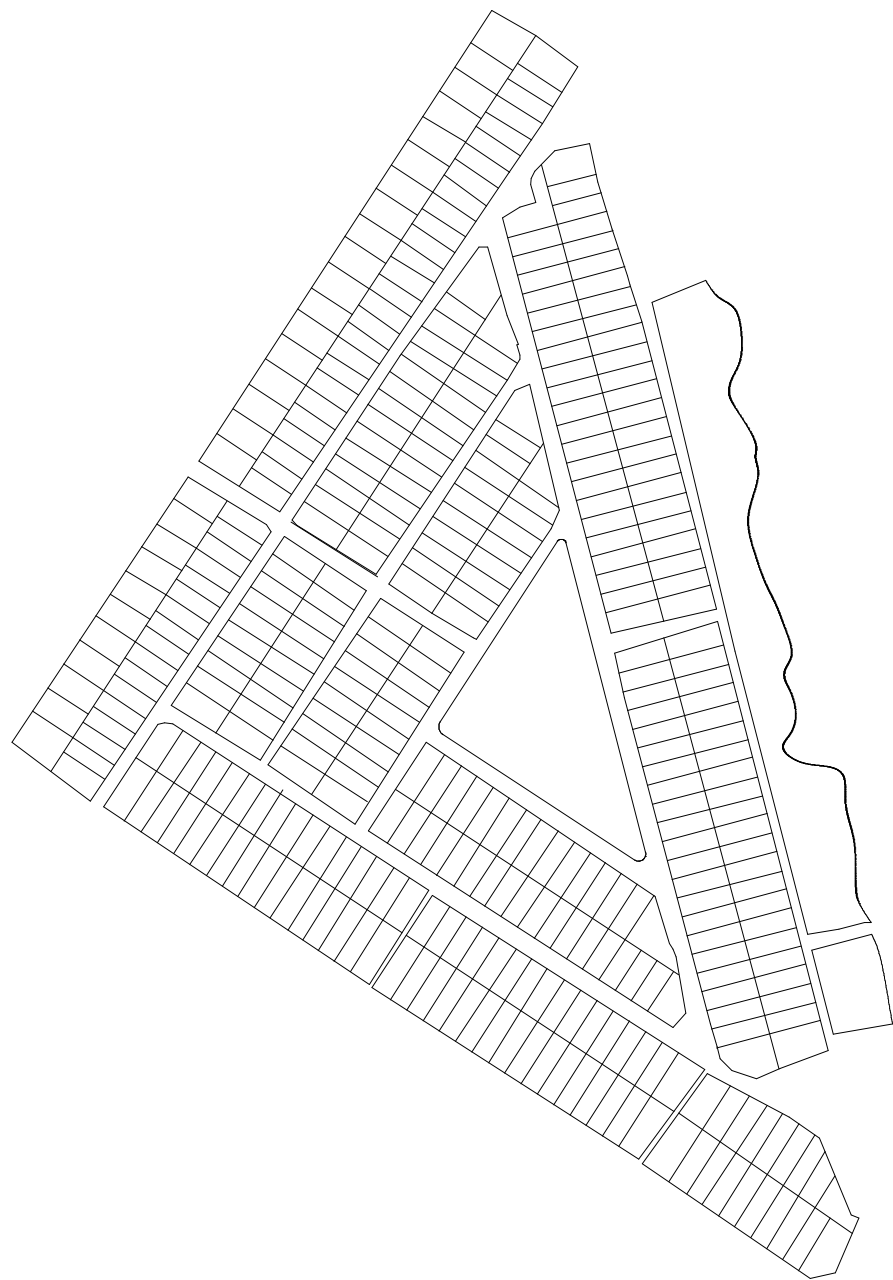
built



unbuilt



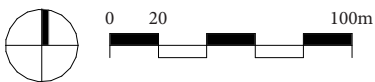
plots arrangement

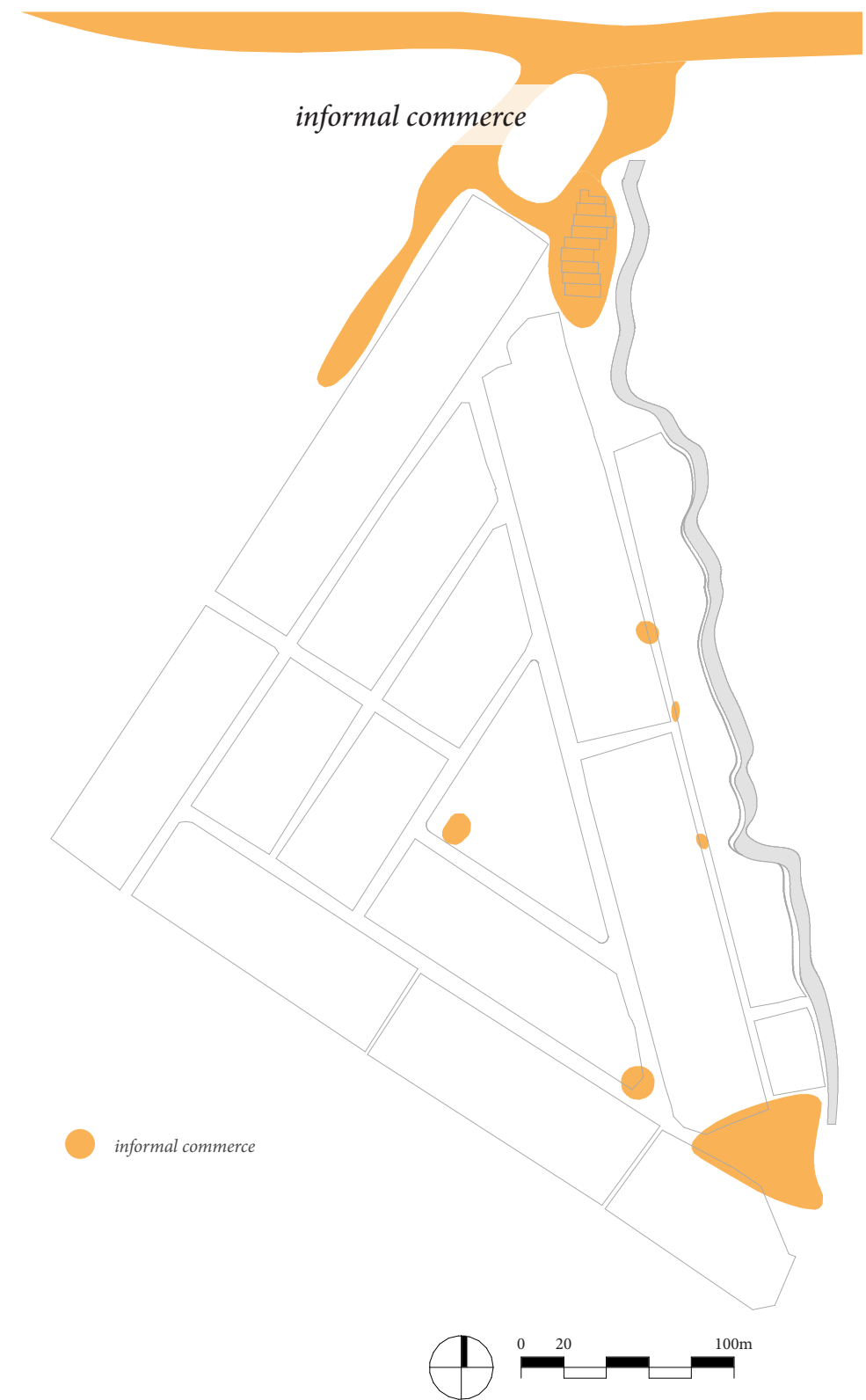
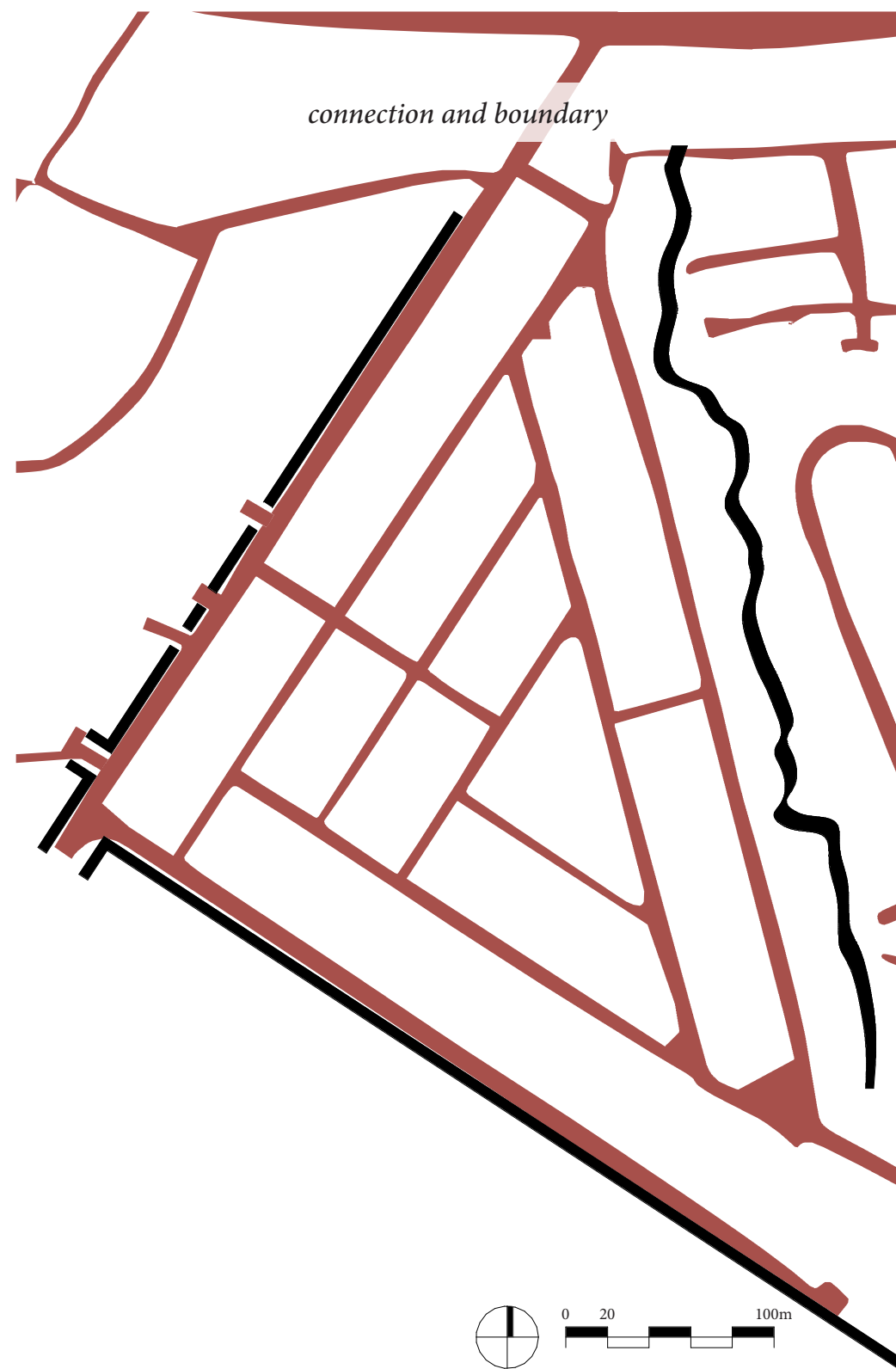


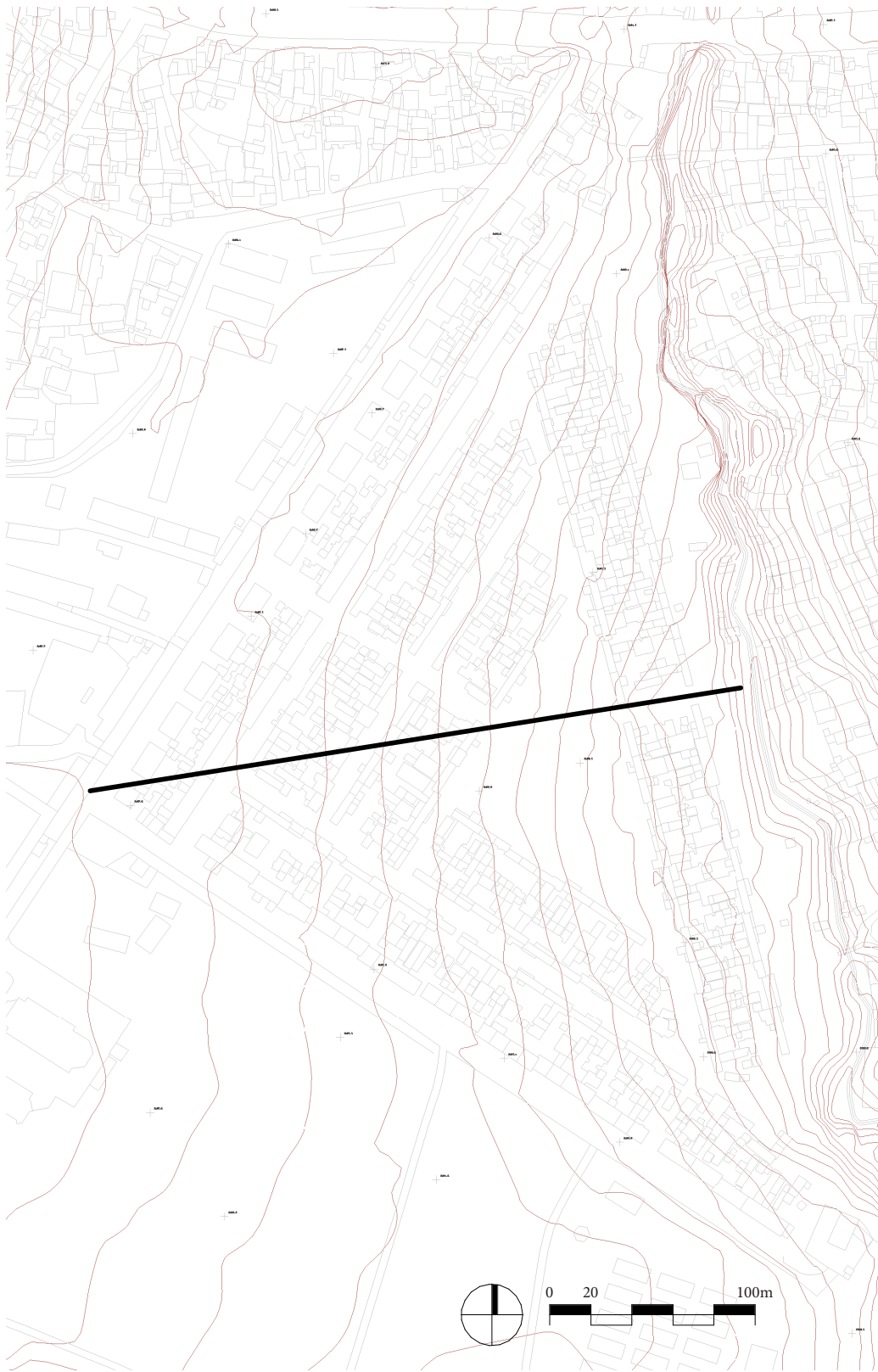
dwelling types



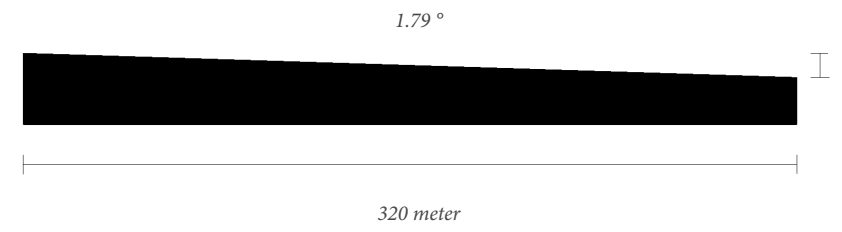
- 3 bedroom core unit
- 2 bedroom core unit
- 1 bedroom core unit
- informal structure

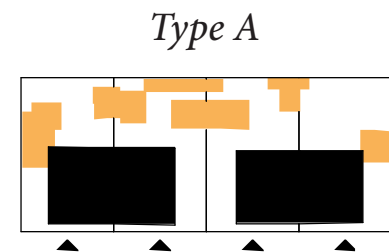






height differences





Type A

Rooms (add. not incl.)
 living room;
 3 bedrooms;
 outdoor kitchen and pit latrine

Plot size
 $12 \times 20 = 240 \text{ m}^2$

Core size
 $8 \times 9,5 = 76 \text{ m}^2$

Ave. extension
 $\sim 36 \text{ m}^2$

Ave. built area incl. extension
 $\sim 113 \text{ m}^2$



Type B

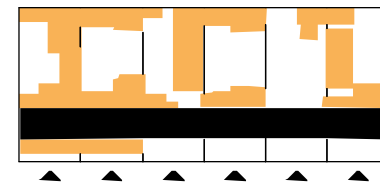
Rooms (add. not incl.)
 living room;
 2 bedrooms;
 outdoor kitchen and pit latrine

Plot size
 $8 \times 20 = 160 \text{ m}^2$

Core size
 $8 \times 7,8 = 62 \text{ m}^2$

Ave. extension
 $\sim 36 \text{ m}^2$

Ave. built area incl. extension
 $\sim 98 \text{ m}^2$



Type C

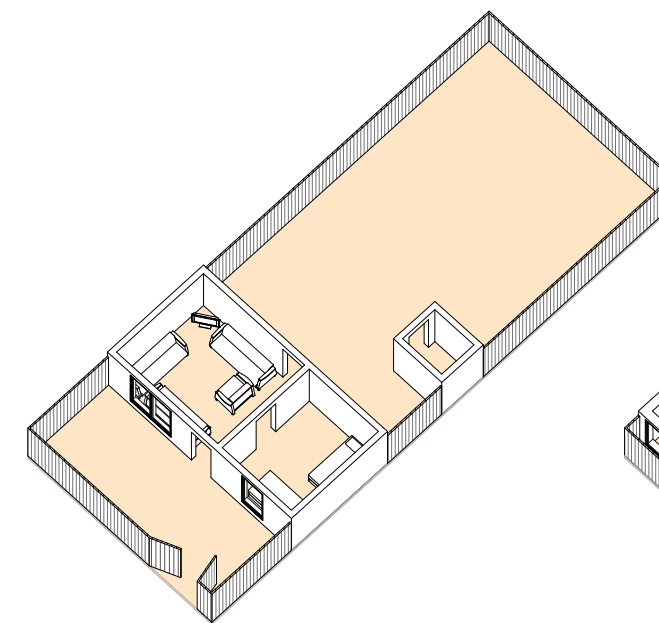
Rooms (add. not incl.)
 living room;
 1 bedroom;
 outdoor kitchen and pit latrine

Plot size
 $8 \times 20 = 160 \text{ m}^2$

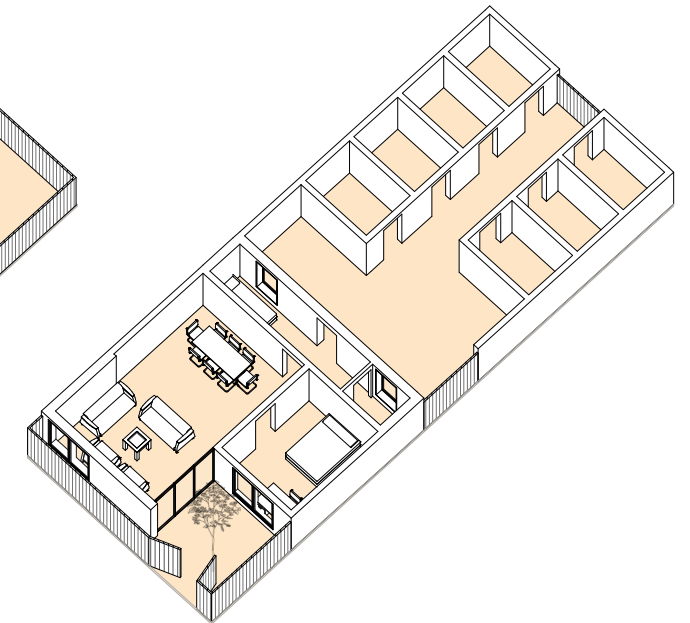
Core size
 $8 \times 4 = 32 \text{ m}^2$

Ave. extension
 $\sim 51 \text{ m}^2$

Ave. built area incl. extension
 $\sim 83 \text{ m}^2$



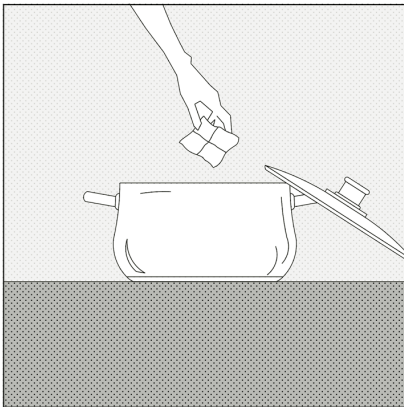
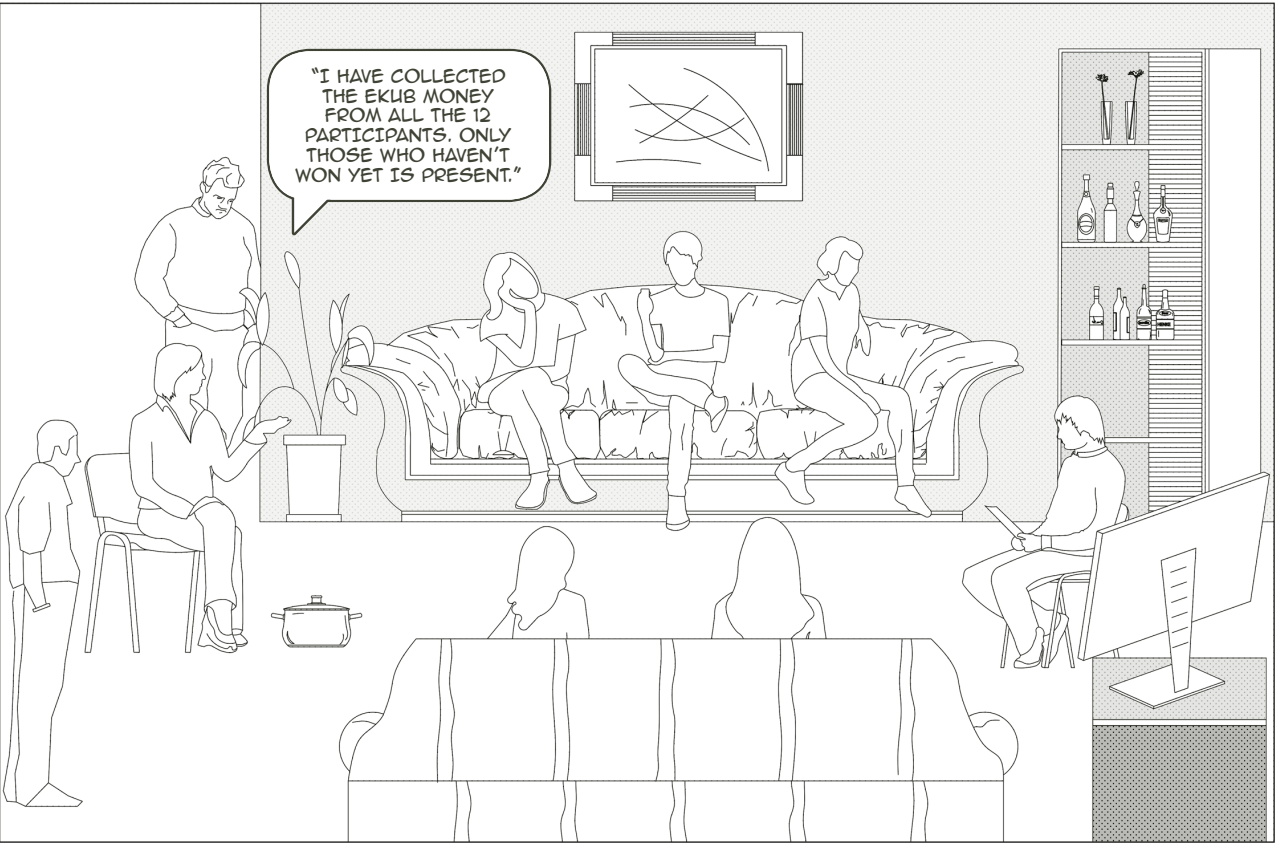
type C - original

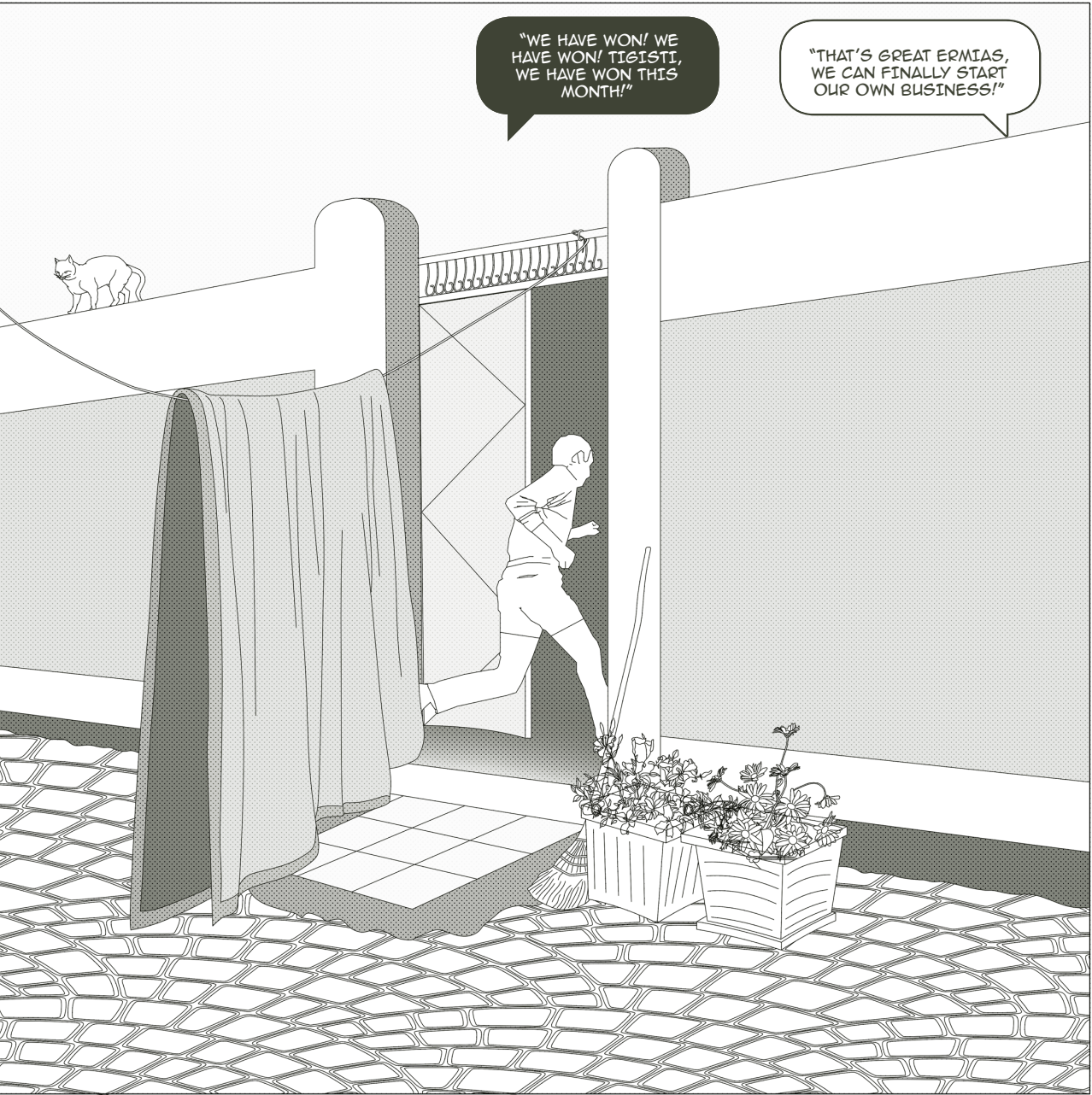


type C - possible extensions

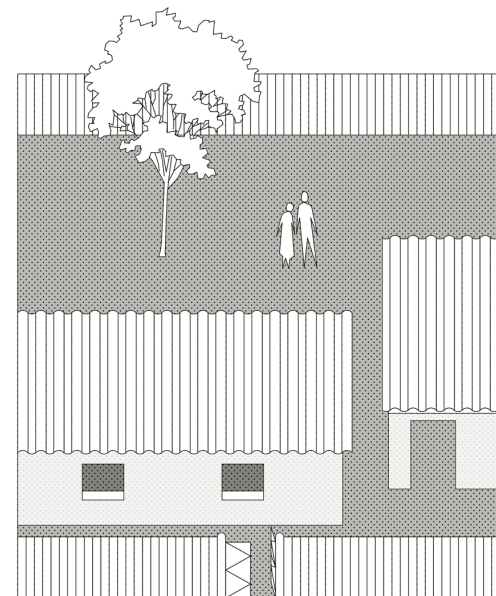
RESEARCH | *Used*

graphic novel

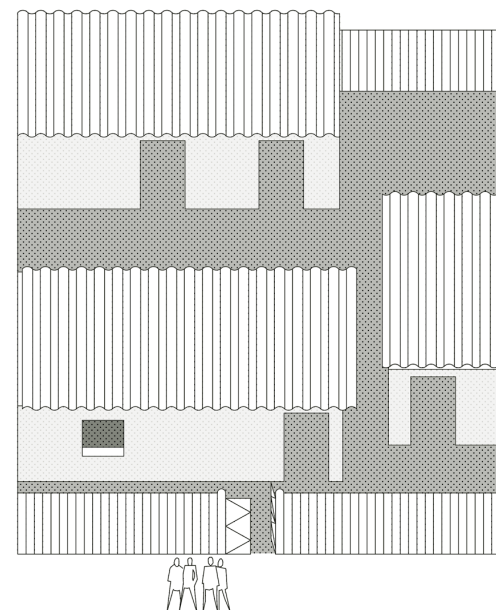


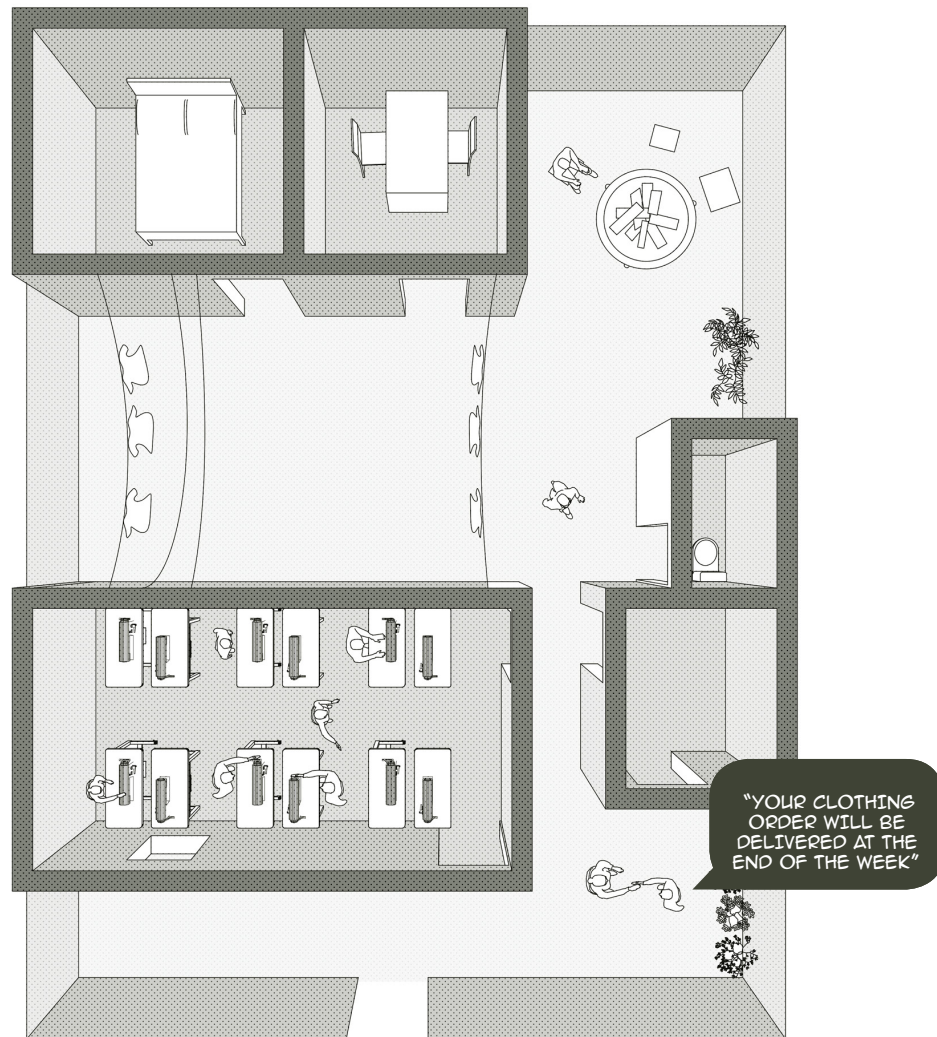


AS AN URBAN MIGRANT FROM THE RURAL AREA, ERMIA'S MARRIED WITH TIGISTI AND START LIVING TOGETHER IN TIGISTI'S OLD FAMILY HOME IN KOLFE. THIS FAMILY HOME HAVE A CORE UNIT WITH TOILET AND KITCHEN ON THE SIDE. THE BIG BACKYARD WAS USED BY TIGISTI TO EARN MONEY BY WASHING CLOTHES FOR OTHERS.

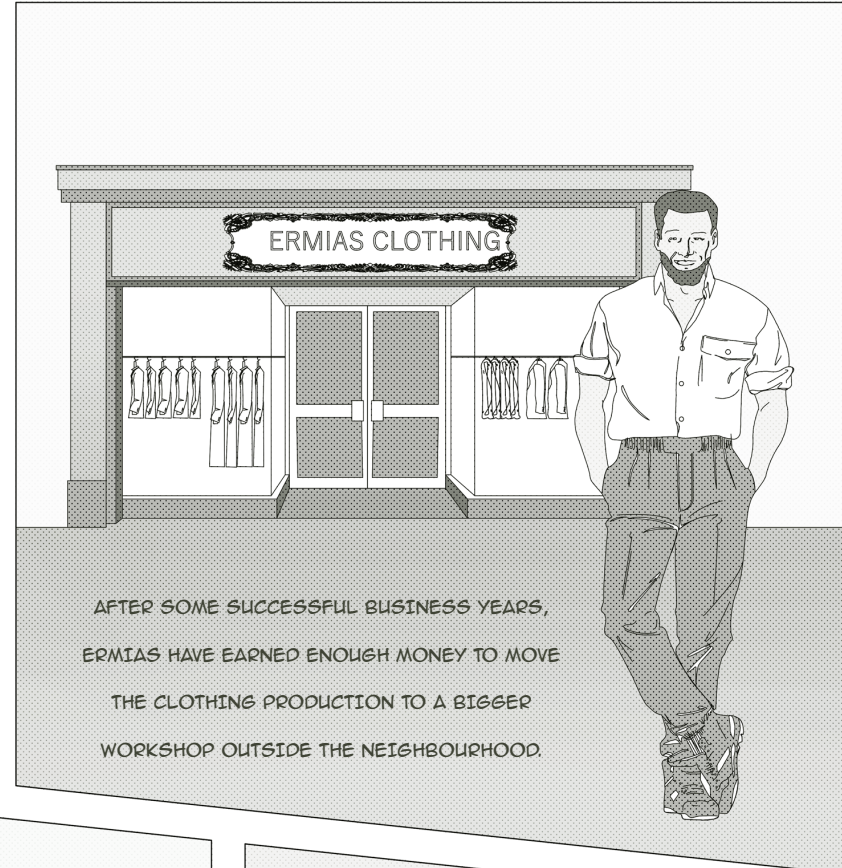


PLANNING ON MAKING MORE MONEY, ERMIA'S WANTS TO ADD NEW BEDROOMS AT THE BACK, AND TRANSFORM THE CURRENT LIVING ROOM/BEDROOM INTO A SEWING WORKSHOP. HERE HE CAN MAKE TRADITIONAL CLOTHINGS TO SELL IN THE BIG MARKET MERCATO. THE MONEY FROM EKUB WAS THE LAST THING ERMIA'S NEEDS TO BEGIN HIS PLAN.





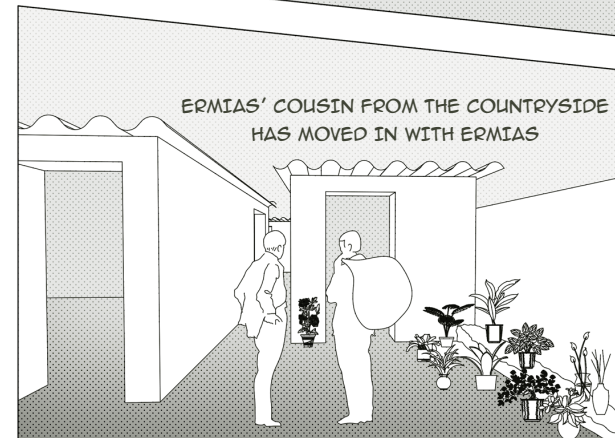
IN THE FOLLOWING YEARS,
THERE HAVE BEEN SOME
CHANGES IN THE LIFE OF
ERMIAS.



AFTER SOME SUCCESSFUL BUSINESS YEARS,
ERMIAS HAVE EARNED ENOUGH MONEY TO MOVE
THE CLOTHING PRODUCTION TO A BIGGER
WORKSHOP OUTSIDE THE NEIGHBOURHOOD.

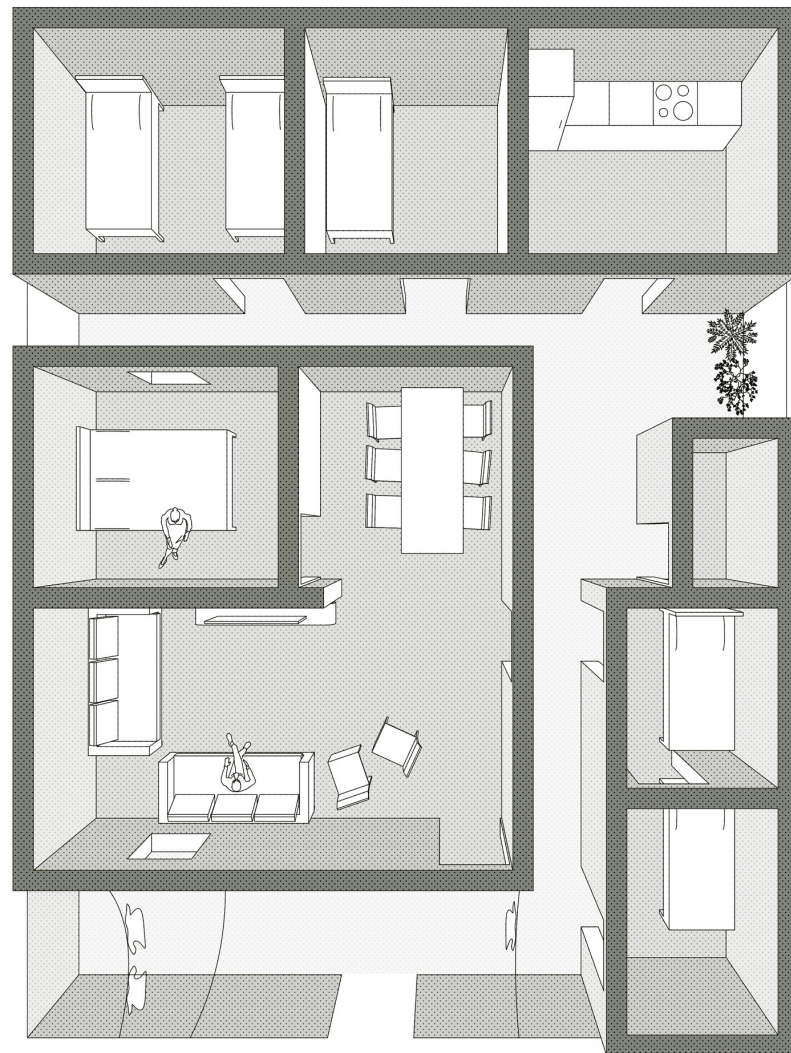


IN THE MEANTIME, TIGISTI
AND ERMIAS HAVE GOTTEN
A NEW CHILD.



ERMIAS' COUSIN FROM THE COUNTRYSIDE
HAS MOVED IN WITH ERMIAS



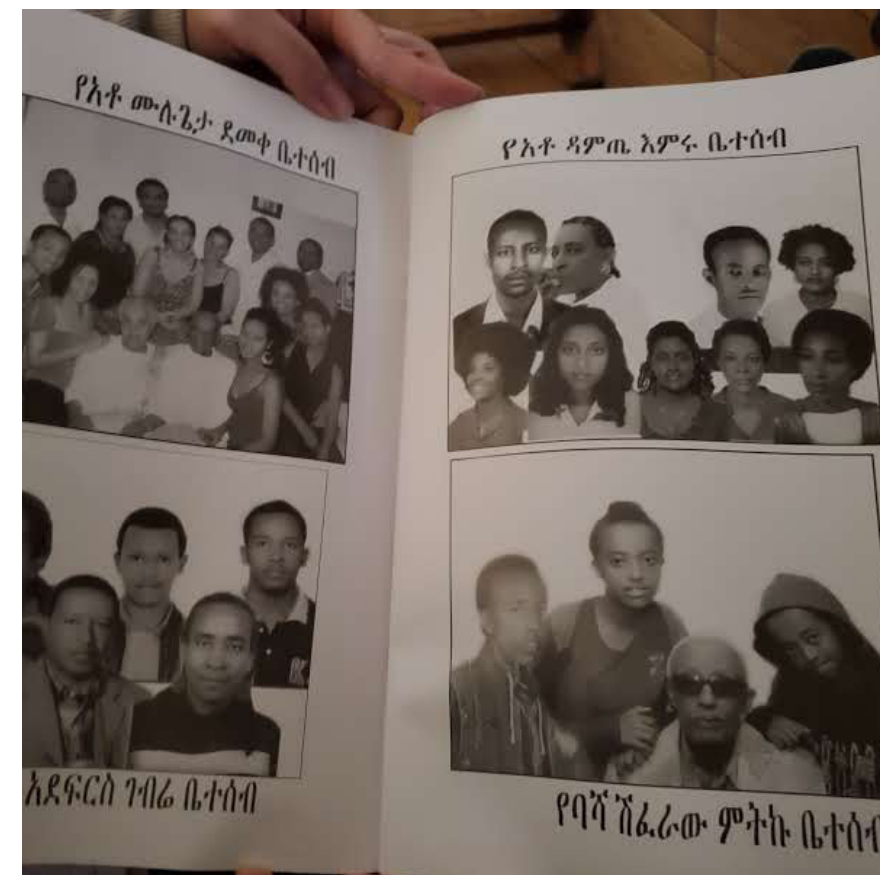


ERMIAHAS CHANGED THE SEWING WORKSHOP BACK INTO A LIVING ROOM, AND ADDED IN A NEW MASTER BEDROOM AND DINING AREA.

MORE SLEEP UNITS ARE ADDED FOR TIGISTI AND ERMIAHAS' CHILD AND ALSO OTHER DISTANT RELATIVES.

THE TRADITIONAL OUTDOOR KITCHEN IS REPLACED BY A MODERN ONE.

IT APPEARS THAT TIGISTI AND ERMIAHAS ARE IN A BETTER LIFE NOW. ONLY SOMETIMES TIGISTI STILL THINK ABOUT THE LARGE COURTYARD THAT THEY USE TO HAVE.



interview



The man who grew the fruit tree

He is an elder in the community, much respected by the people. He is part of the first generation who was relocated to this neighbourhood from the project site of the new Sheraton Hotel. His children are already living on their own. Being part of the community for such a long time, he knows everybody and likes to invite people to his living room to drink coffee. He has 7 rooms build in his courtyard, sublet to workers. In front of his house, he also plants fruit to sell in the market. Combined these incomes with his pension of 1000 Birr, he is still not satisfied, as he wants to make more money to build a bigger house and a large garden where he can plant a lot of fruit trees.



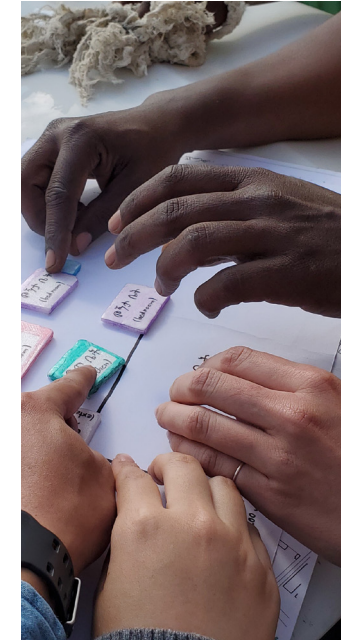
The woman with the best shop in the market

She is a mother of two living in a big compound close to the community market in the south. She rents out part of the compound to two other families. She also owns the little shop outside of the compound. Because the shop is next to the communal market, her business is doing quite good. Her daughter manages the shop while she watches over the baby in the compound. She is worried about one thing. The FHC who managed this area actually doesn't allow shops to be built here. She doesn't know if there is one day when she'll need to tear her own shop down



The woman who can't afford a piece of eucalyptus wood

She grew up in this area and live with her mother and son. She shares the bedroom in the main unit with her mother, and her son sleeps in a standalone room in the courtyard. Her work consists of washing and drying clothes for people in the surrounding neighbourhoods. This work only barely maintains the cost of living of a 3 persons family. She says "I can't do other jobs because I didn't go to school. I also cannot build new rooms to rent out to make money. I can't even afford a piece of eucalyptus wood that is used to build walls."



The man with the only car in the street

He lives in the medium size dwelling type of Kolfe, indicating a relatively good income level. As we walked by, we saw him washing his car with his two children. Its special because we barely saw any car in the neighbourhood. After the interview, we learned that this is actually his work car, leased from his job. He works at the municipality and today he took the car home. He is actually a migrant from the rural area. He came to Addis Ababa and married with his now wife who grew up in Kolfe. When we asked him what he thinks of the city comparing to the rural area he said "I miss the socializing. Back home I will get invited to coffee ceremonies in my neighbours' home. Here I barely know anybody because there is no chance to meet them. Everybody just stays inside their fenced home."



The man who grew the fruit tree

He is an elder in the community, much respected by the people. He is part of the first generation who was relocated to this neighbourhood from the project site of the new Sheraton Hotel. His children are already living on their own. Being part of the community for such a long time, he knows everybody and likes to invite people to his living room to drink coffee. He has 7 rooms build in his courtyard, sublet to workers. In front of his house, he also plants fruit to sell in the market. Combined these incomes with his pension of 1000 Birr, he is still not satisfied, as he wants to make more money to build a bigger house and a large garden where he can plant a lot of fruit trees.



The woman with the best shop in the market

She is a mother of two living in a big compound close to the community market in the south. She rents out part of the compound to two other families. She also owns the little shop outside of the compound. Because the shop is next to the communal market, her business is doing quite good. Her daughter manages the shop while she watches over the baby in the compound. She is worried about one thing. The FHC who managed this area actually doesn't allow shops to be built here. She doesn't know if there is one day when she'll need to tear her own shop down



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"I miss the socializing. Back home I will get invited to coffee ceremonies in my neighbours' home. Here I barely know anybody because there is no chance to meet them. Everybody just stays inside their fenced home."

man who came from the rural area and started to live in Kolfe

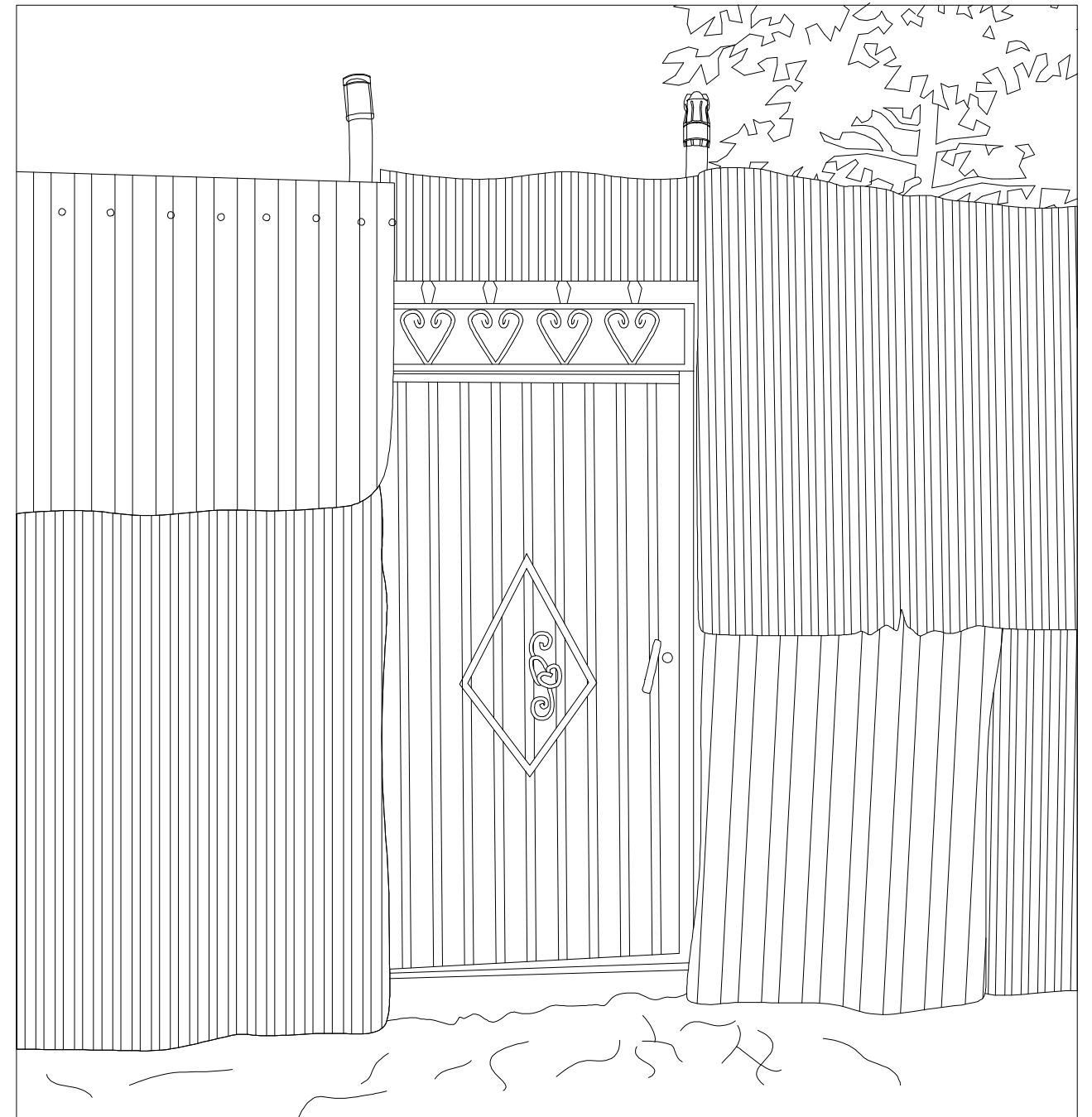


patterns of inhabitation



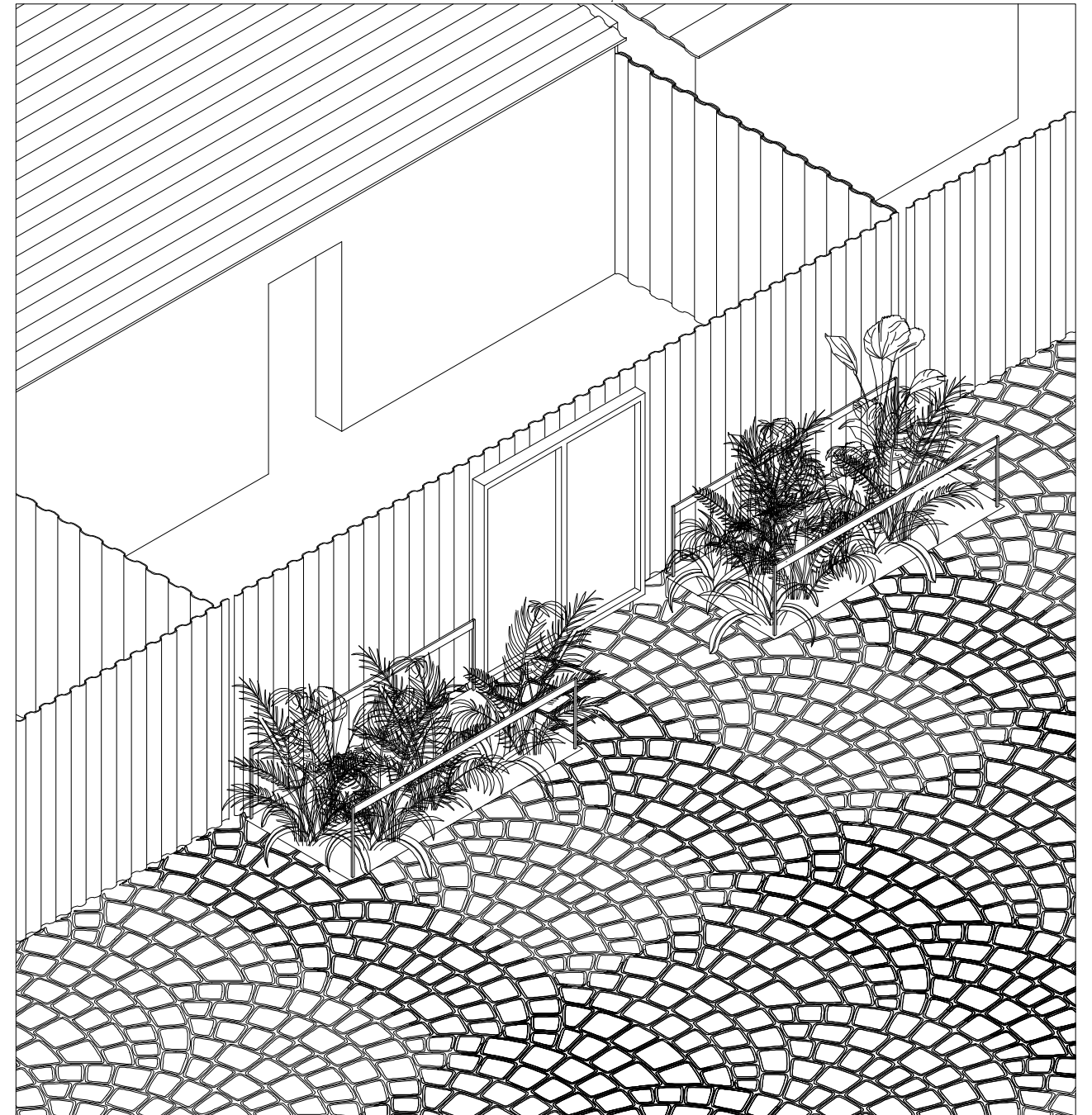


A hard separation between the public street and the private courtyard. The sheets are held up by a eucalyptus wood structure. From the entrance it is visible how people, even with the limited resources, are eager to personalise the entrance by decorated metal work on the door.



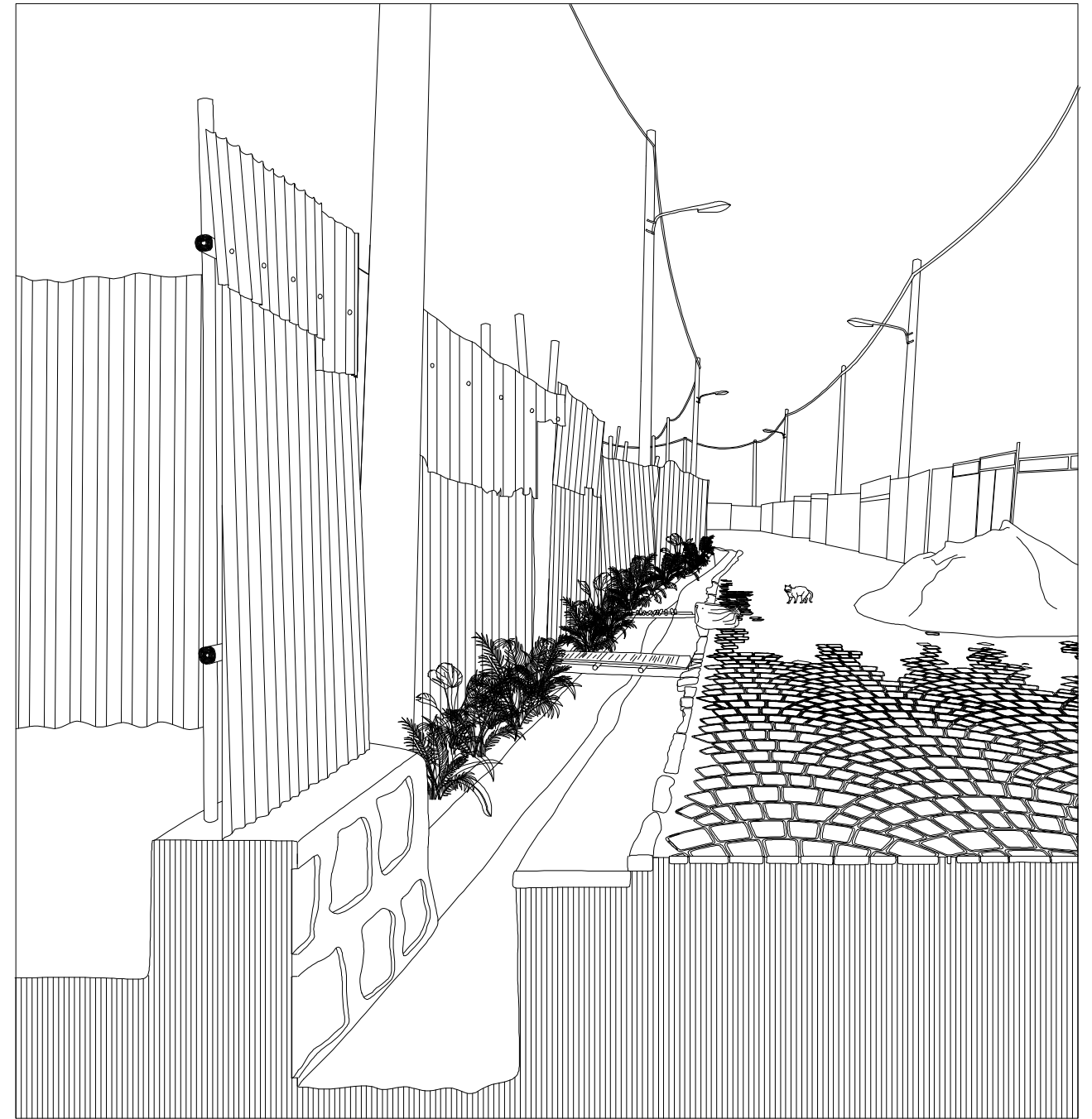


Some of the inhabitants will even choose to claim part of the public space as an additional space for greenery. This shows the desire of the inhabitants to decorate the public space, as well a more informal idea of public ownership.



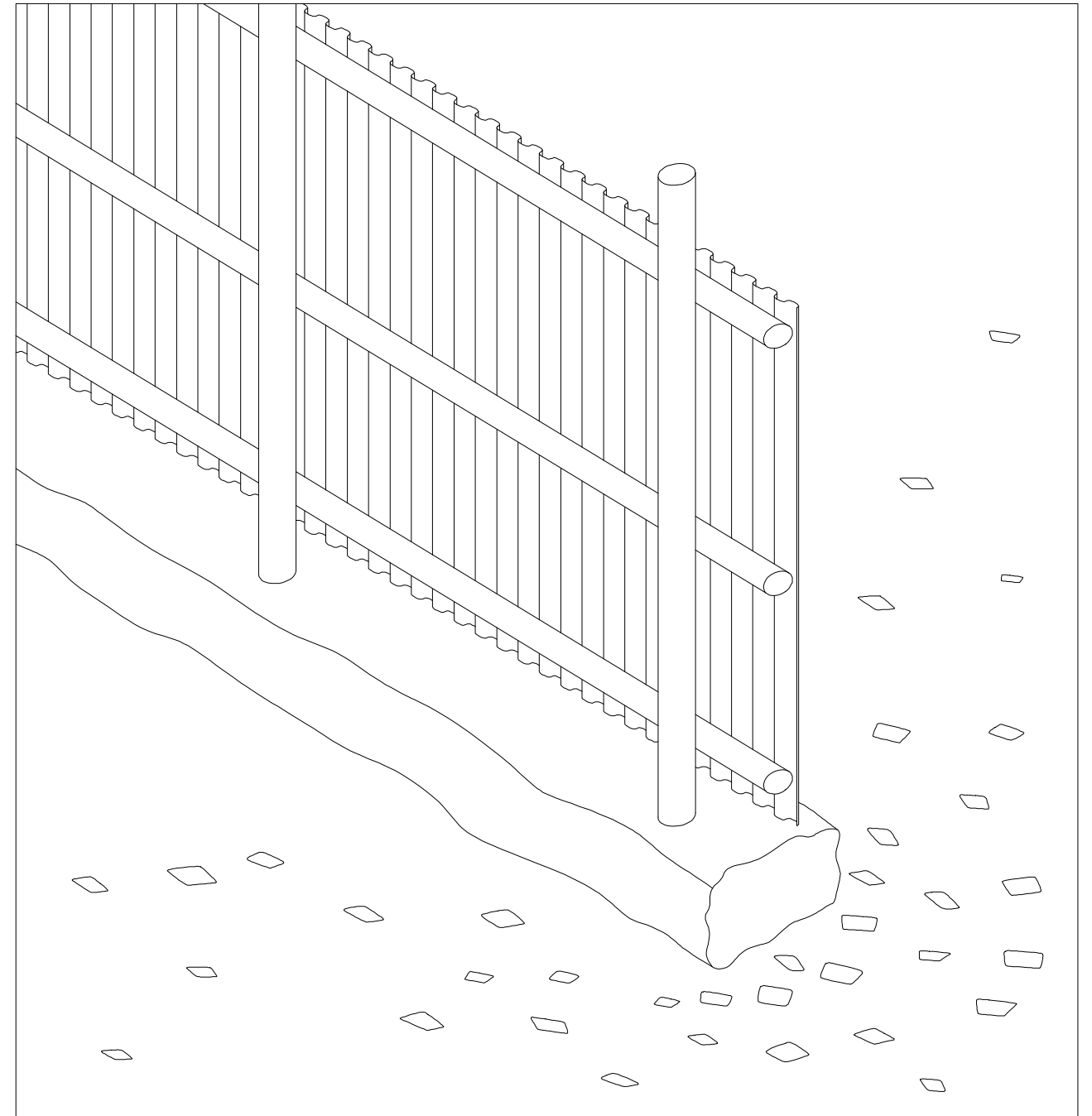


Some inhabitants constructed a concrete slab on the border of the compound as a barrier against rainwater flooding the streets. Later on, the FHC refurbished the streets and laid down a network of open sewers, mitigating the flooding problem. This addition to the border is bridged by the inhabitants through self-made eucalyptus platforms.



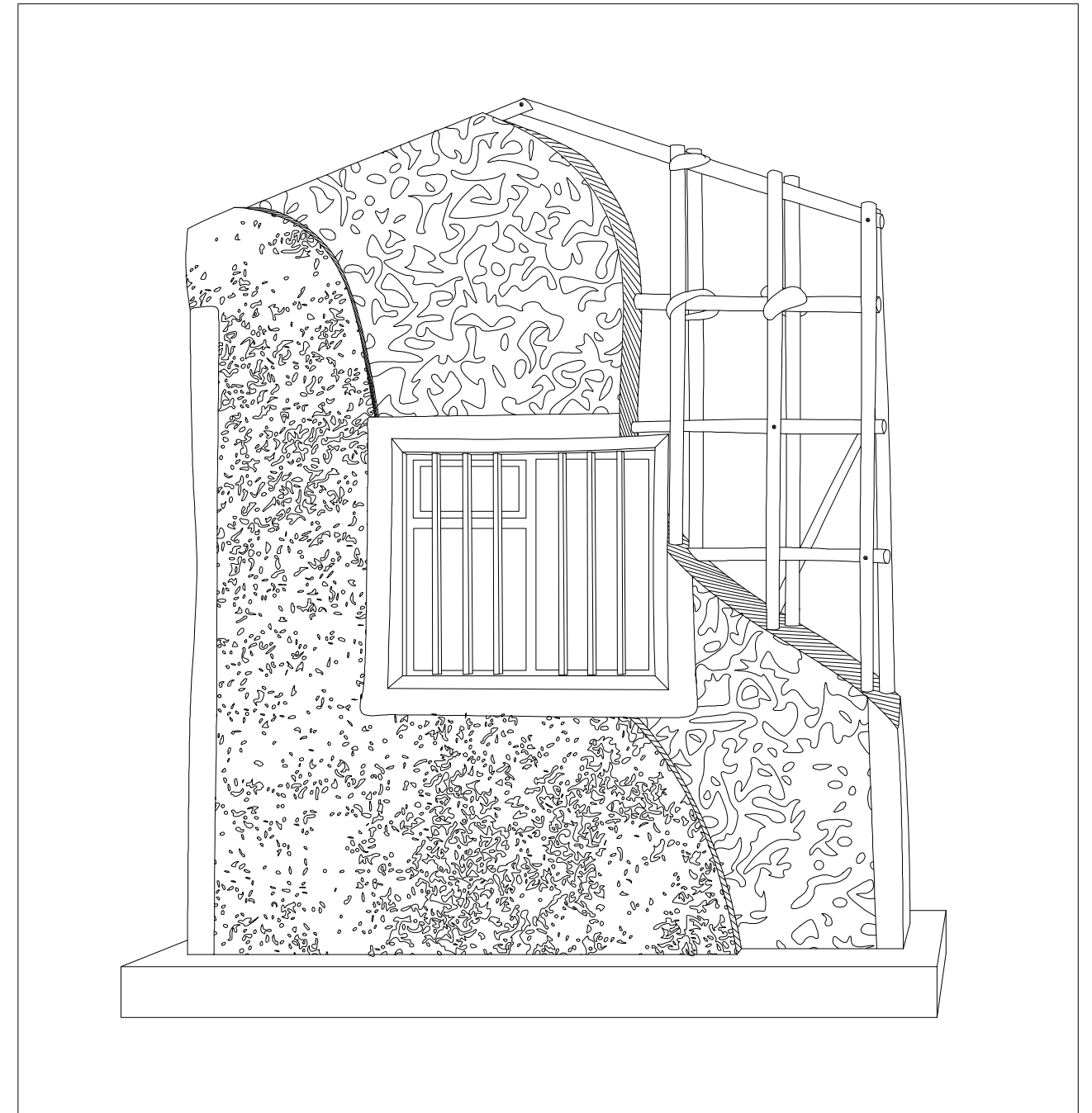


Due to lack of financial resources, most inhabitants are left with the choice of the relatively cheap eucalyptus woods and corrugated iron sheets as construction materials. This building technique is representative of the self-built culture in Ethiopia, as well as the need of low cost, low tech construction methods for low income people.



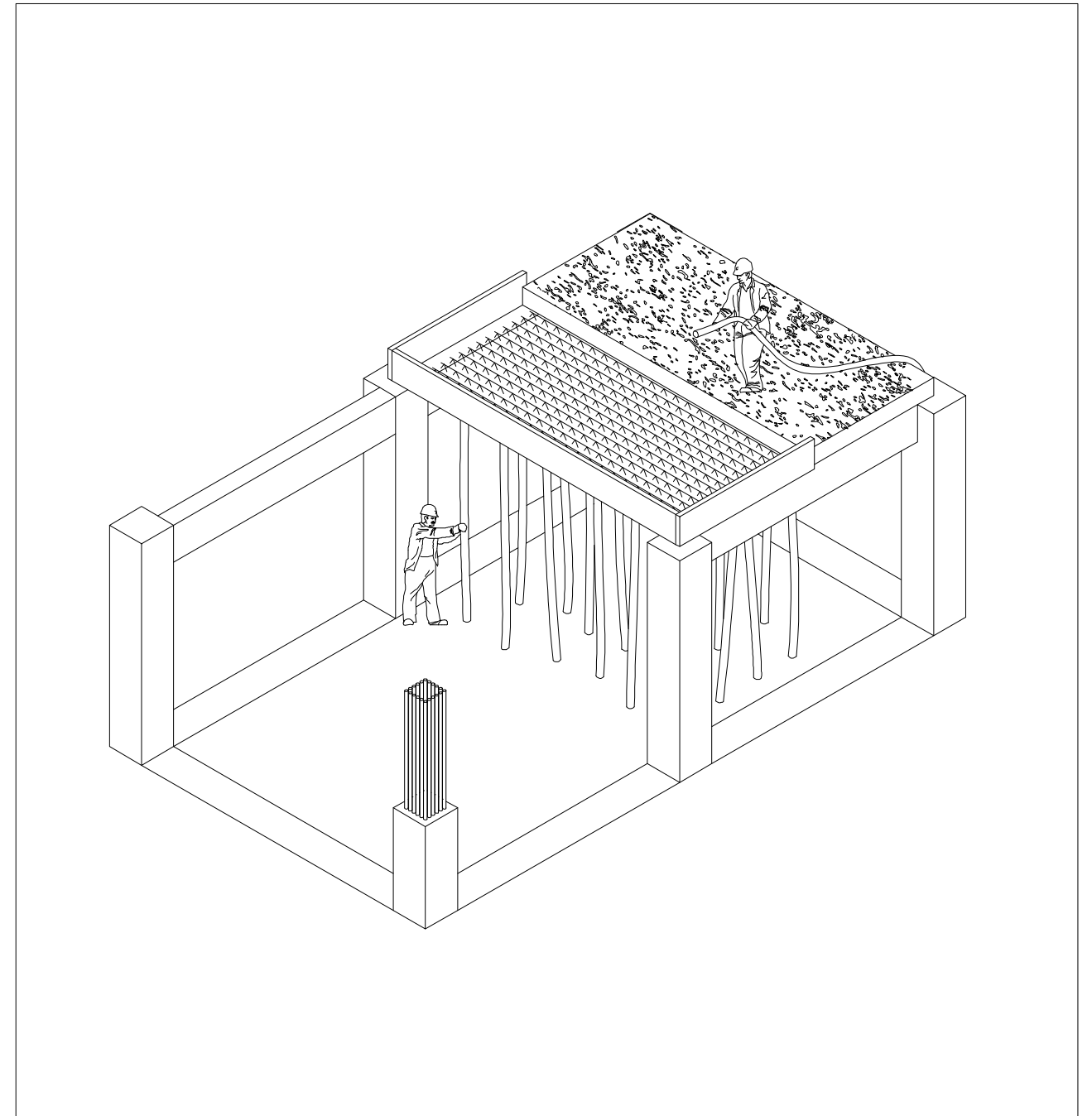


A traditional way of wall construction used throughout Ethiopia is Chika: a load-bearing wall with eucalyptus wood as frame structure and mud as infill. Some people opt to also add a layer of cement plaster on the mud surface as a water barrier.



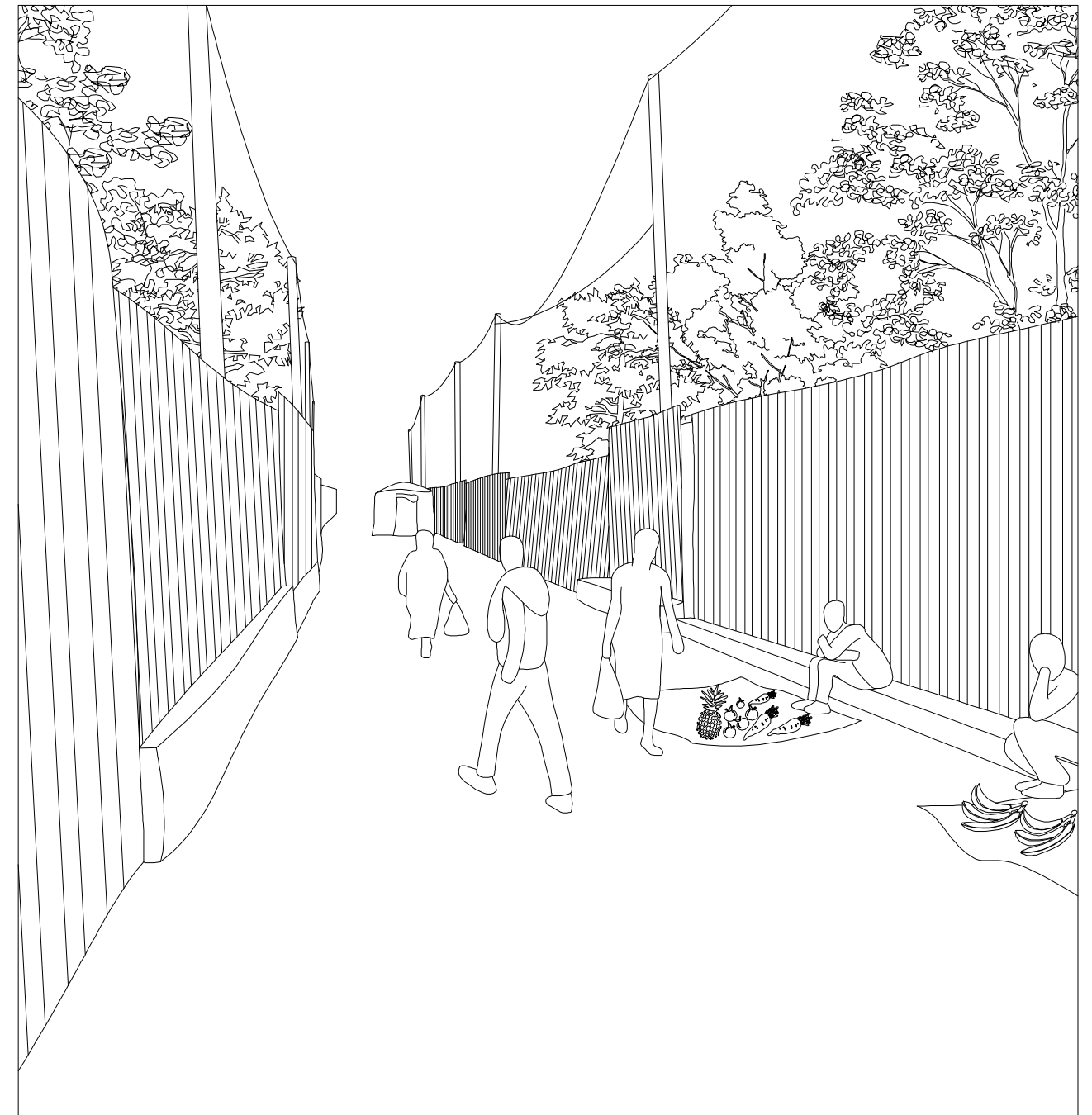


Modernisation of Ethiopia means that housing construction also happens with foreign materials such as cement and steel reinforcement with limited local production capacity. A distinguishing feature is the use of eucalyptus wood as form work support. Also due to lack of finances and cheap labour cost, only few machineries are involved in the building construction. Most of the work are still done by manual labour.



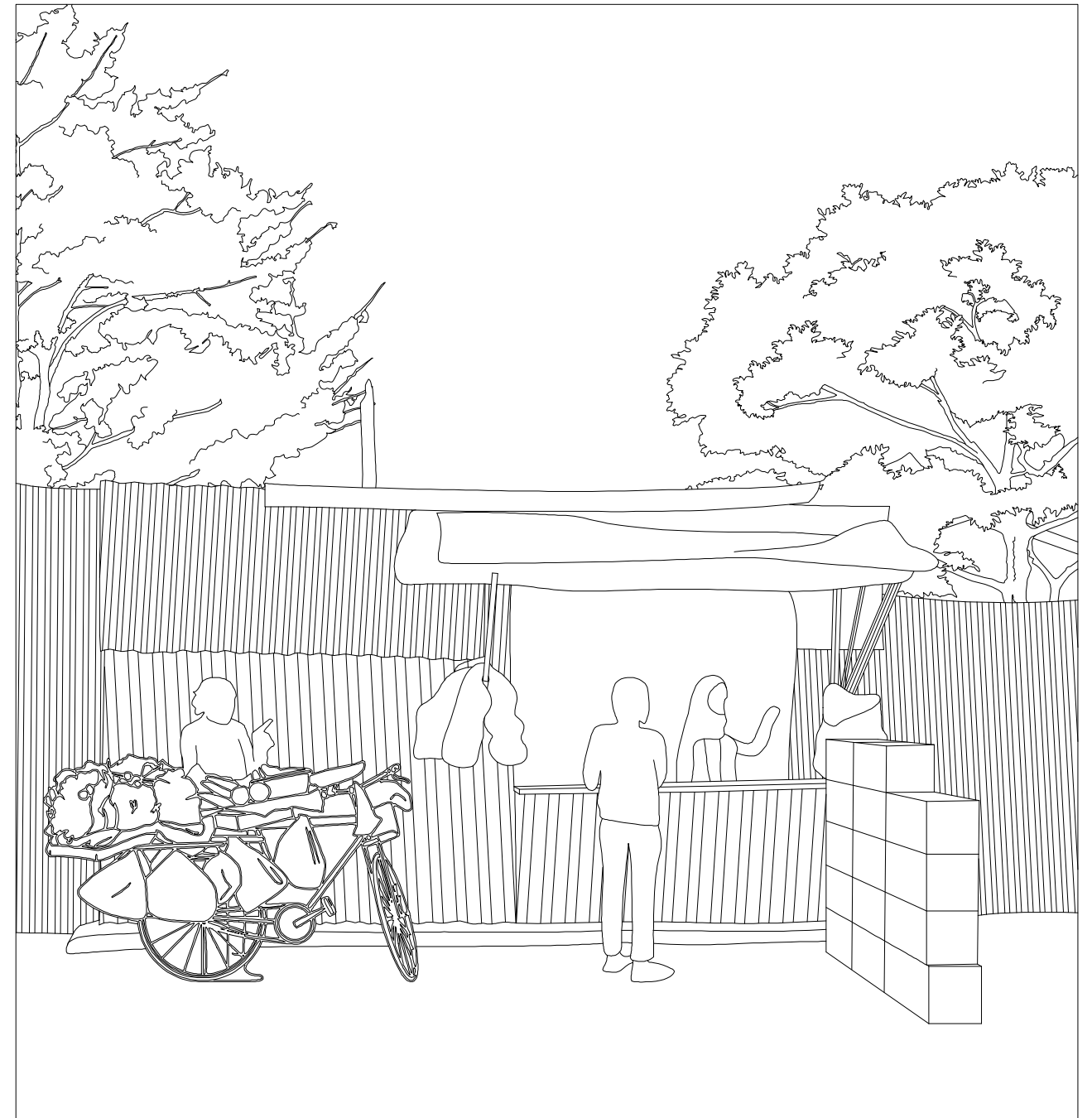


As a form of income generation with a low bar of entry, especially for those with low level of education, street vendor is often a crucial way of earning daily income. Products that are made at home will be sold somewhere nearby. Customers are mostly people from the neighbourhoods close by.





The inhabitant operates the shop from within the compound. The inner courtyard is filled with products, as there is no other space to store. This kind of enterprise is an evolved form of the street vendor as it is also operating in close proximity of the compound but required a larger initial investment.



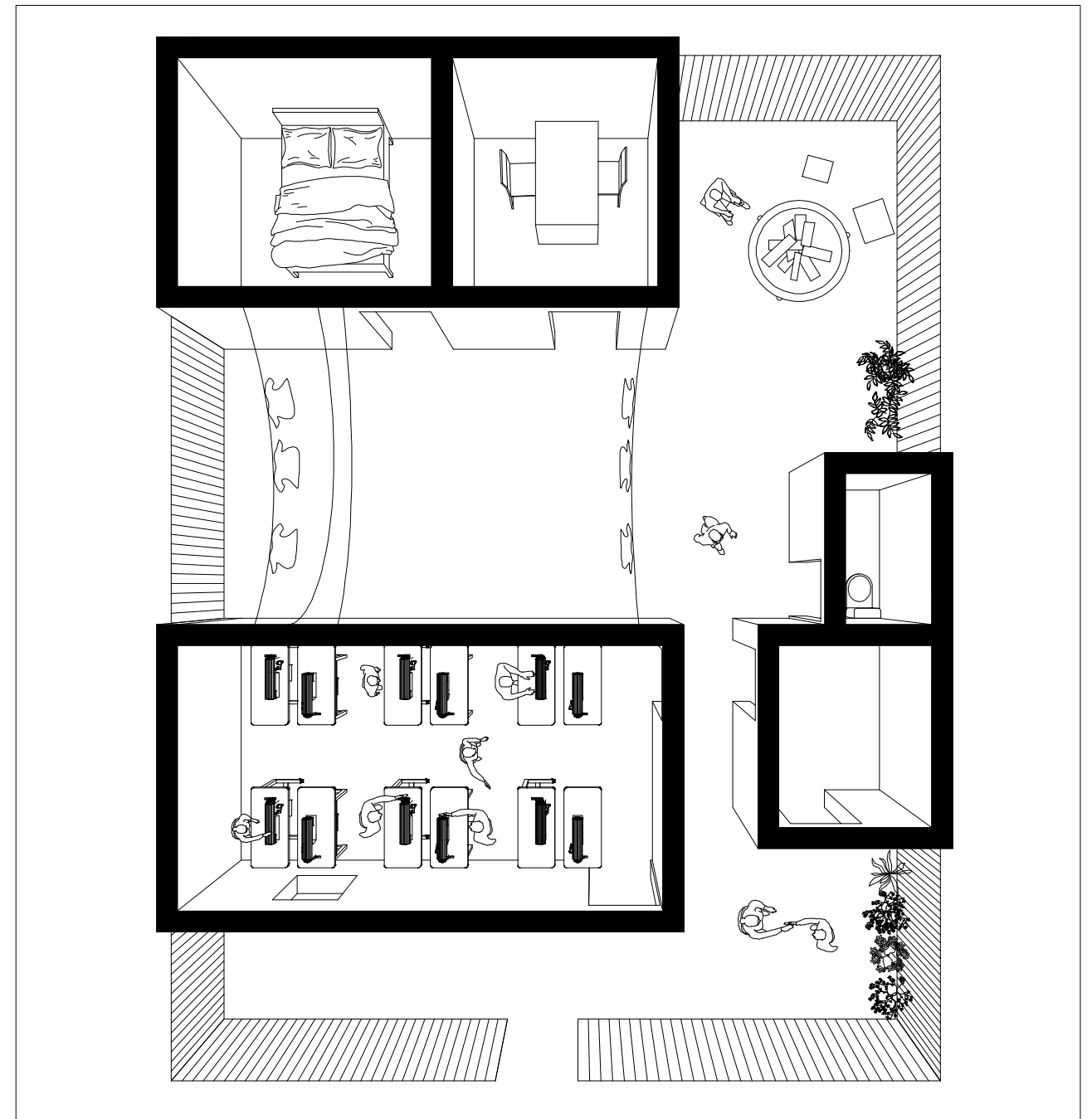


Informal markets serve as a crucial link in the informal economy. Products and services that are done in the private household can be exchanged in the public markets. A wide variety of products will fulfil all the needs of daily lives. These markets are often informally built and organised and thus, an eyesore for government officials.



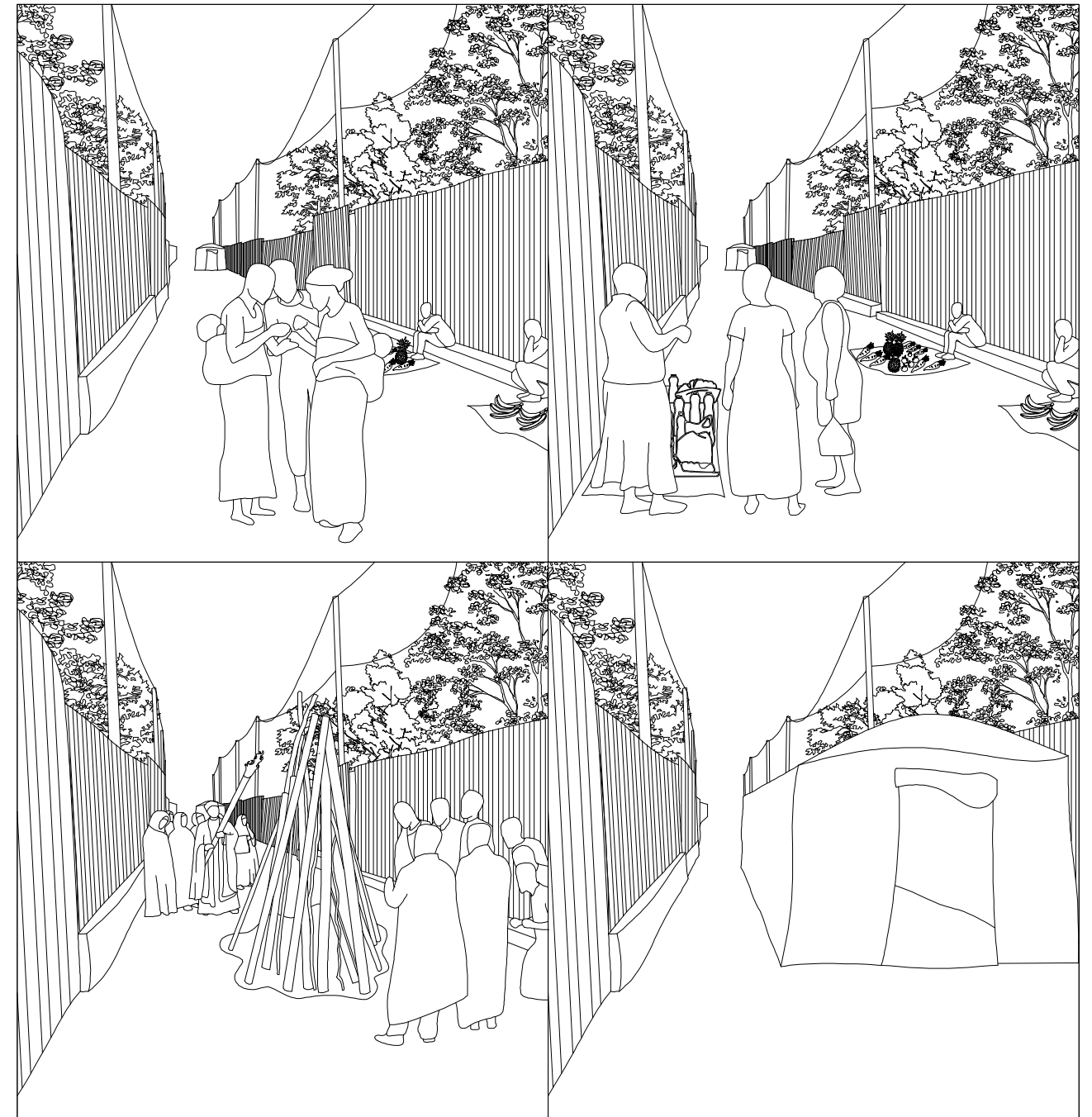


For those with no financial resources or a high level of education, to generate income means to appropriate any resources available. Among those resources is the dwelling space that people live in. An inhabitant can turn part of the compound into a sewing workshop or rent it out to make money. In the Ethiopian context, dwelling space is very much interchangeable with workspace.



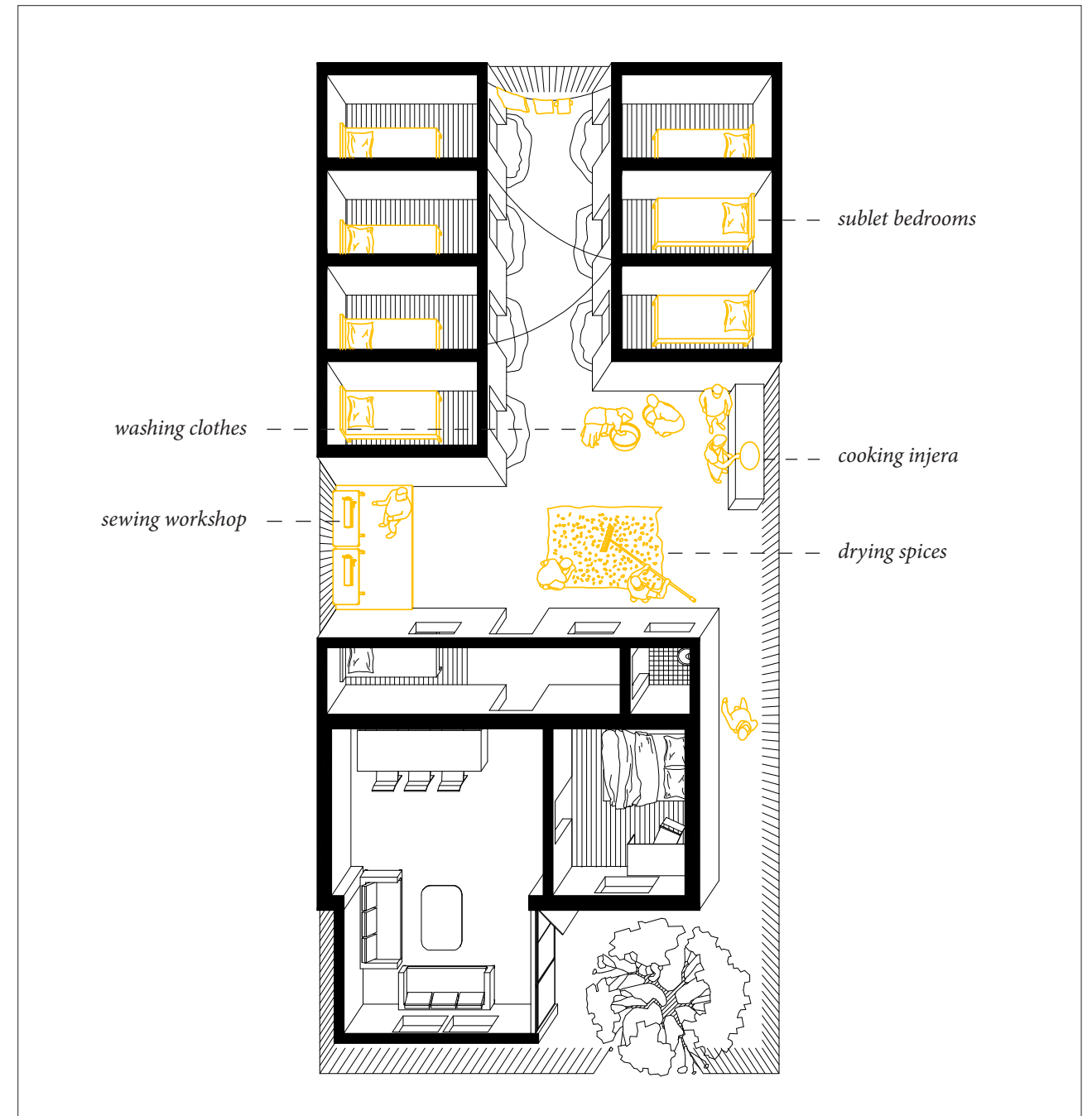


The lack of other public spaces has turned the streets into a multi-functional space. People from different households mingle when they stumble upon acquaintances. The street vendors also create moment of social interaction as both the seller and the customer are also neighbours. The streets are also used for traditional celebrations, such as the Meskel, or as mourning place for the funeral.

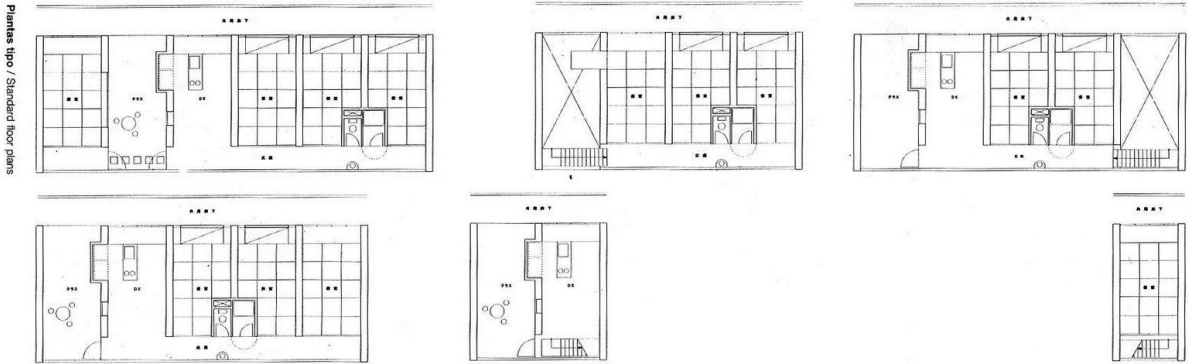
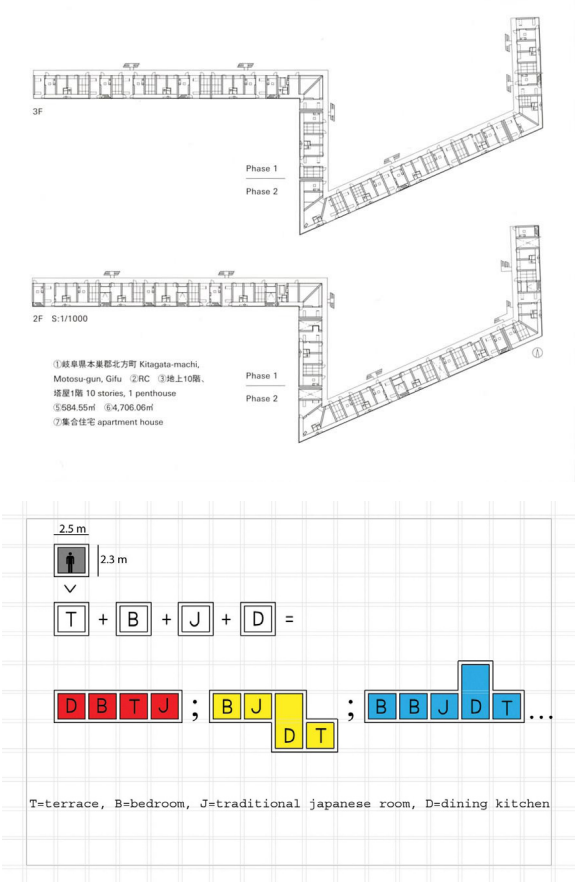




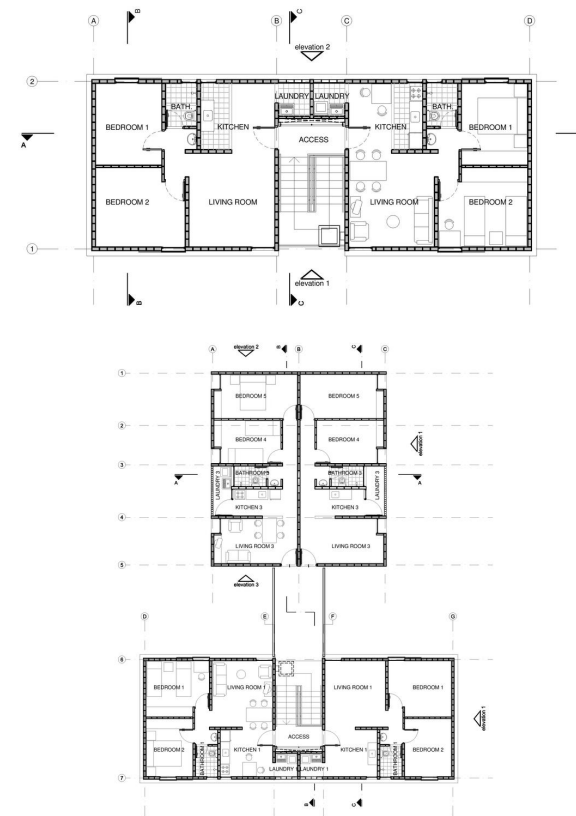
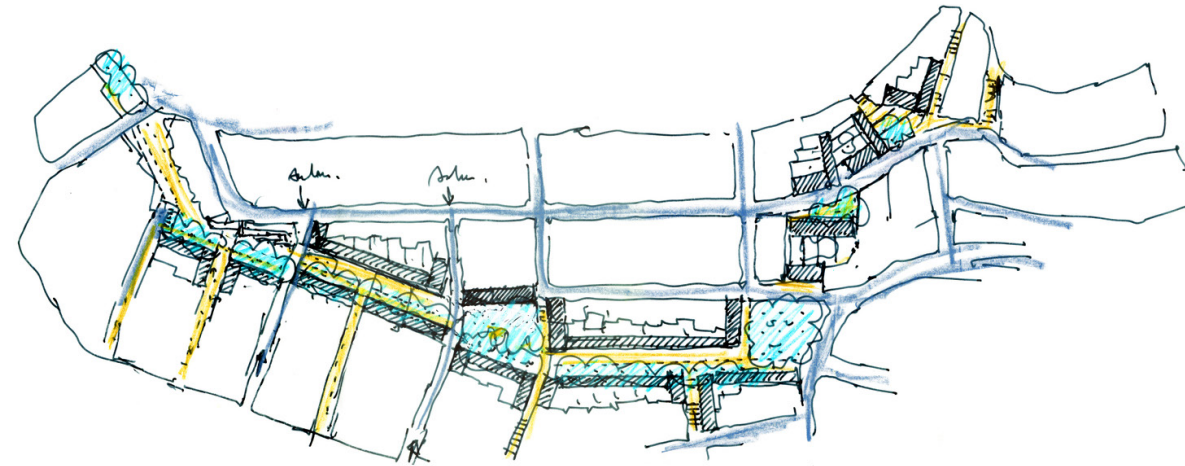
In a single compound defined by the corrugated fences, the number of families can vary. With the possibility of self-adaptation of the house, the owner can decide to expand the house or construct new units on the compound ground to sublet to renters. The private courtyard has turned into a collective outdoor space with a social function.



TYPOLOGICAL REFERENCES
Gifu Kitagata Apartment Building / SANAA

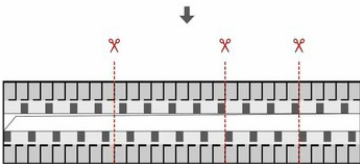


TPOLOGICAL REFERENCES
Jardim Vicentina Urbanization / Vigliecca & Associados

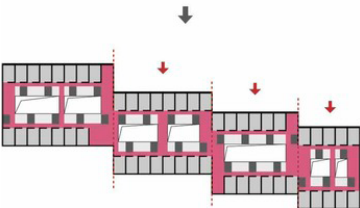




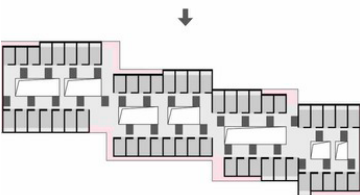
“筒子楼”集体宿舍模式
“TONGZI LOU” COLLECTIVE RESIDENCE TYPOLOGY



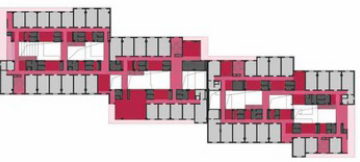
采用“新邻里”共享居住模式，并增加中庭
ADOPT THE NEW NEIGHBOURHOOD MODEL,
AND ADD THE CENTRAL ATRIUM



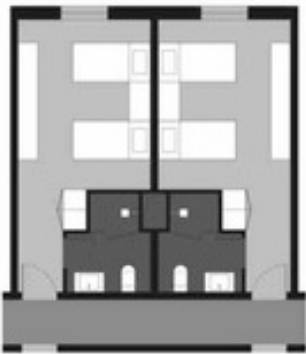
折一为四，以廊、桥、转角开放空间重构公共流线
CUT 1 TO 4, RECONSTRUCT PUBLIC CIRCULATION THROUGH
PASSAGE, BRIDGE AND OPEN CORNER SPACE



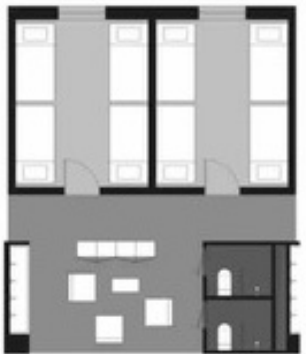
由转角开放空间扩展出室外阳台
EXPAND OUTDOOR TERRACE FROM OPEN CORNER SPACE



四层平面
4th FLOOR

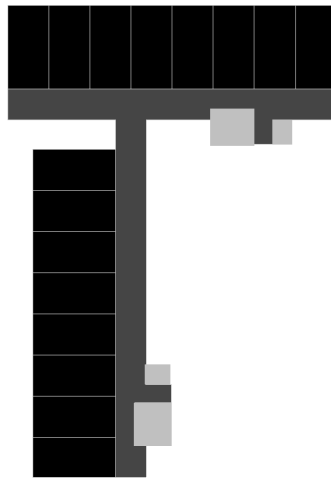


“标间” - 集体居住模式
STANDARD ROOM MODEL

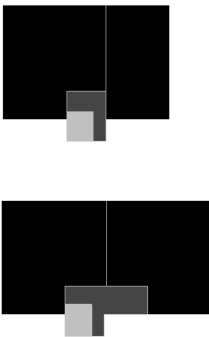


“新邻里” - 共享居住模式
NEW NEIGHBOURHOOD MODEL

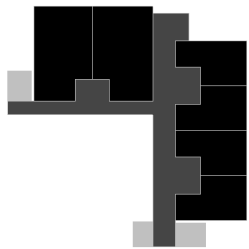
DESIGN | *Urban Strategy*



Type 1
ADAPTIVE MODULAR GALLERY



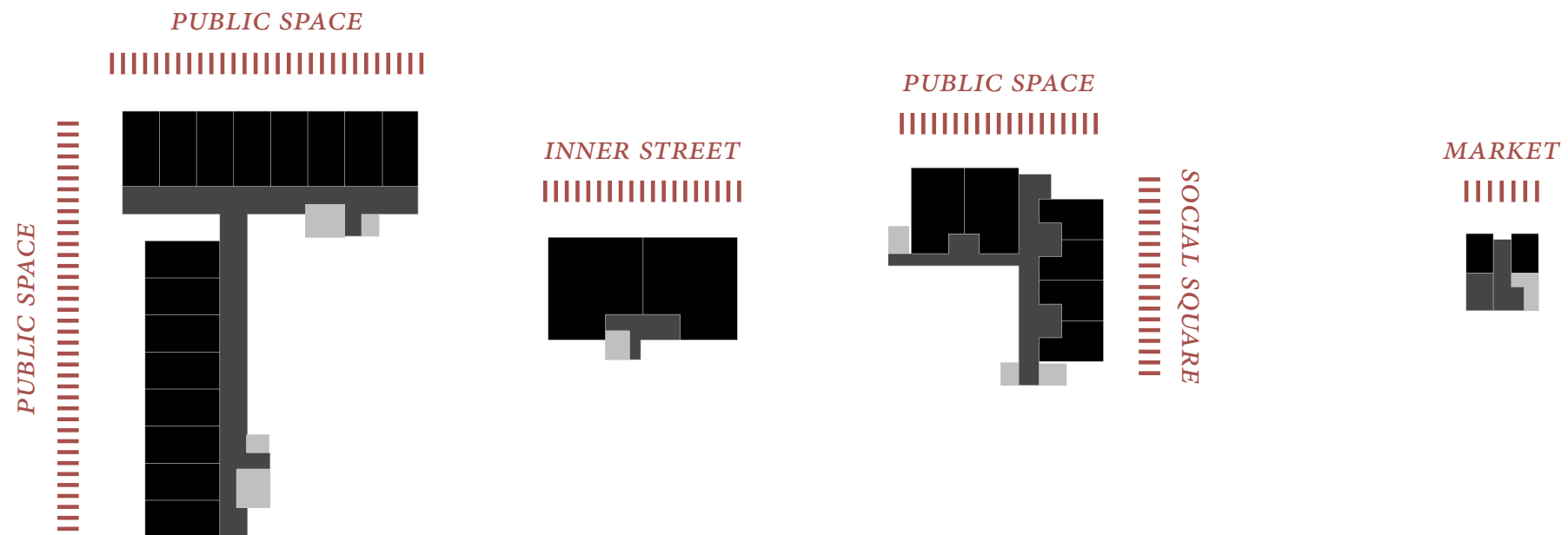
Type 2
MIDDLE INCOME PORTICO



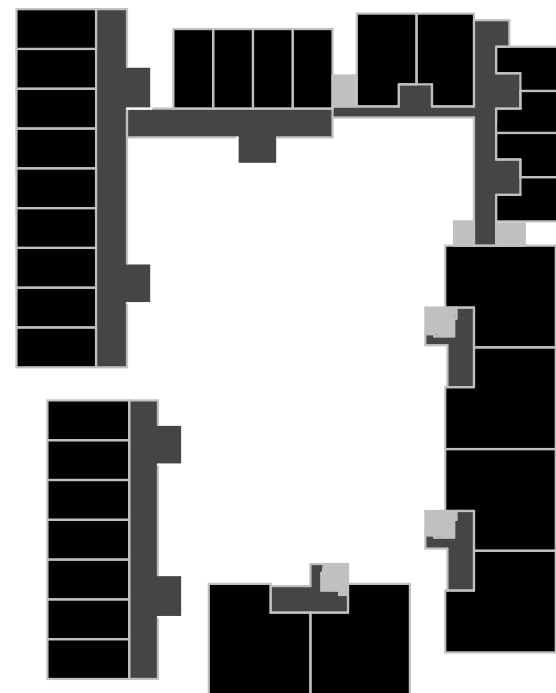
Type 3
URBAN CORNER



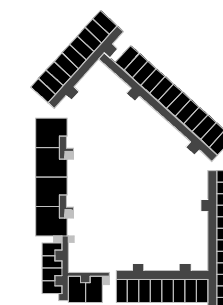
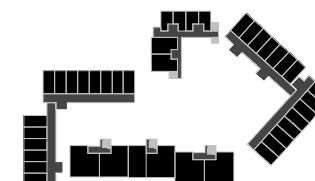
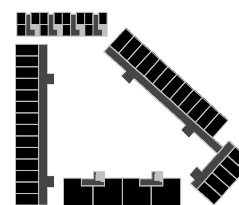
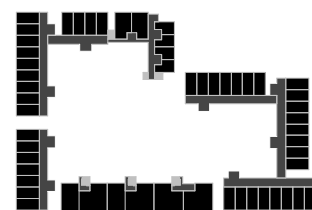
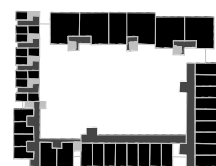
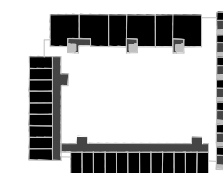
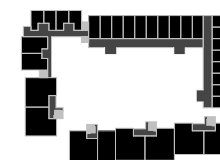
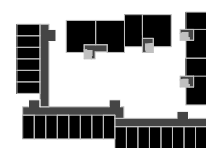
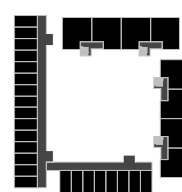
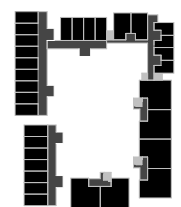
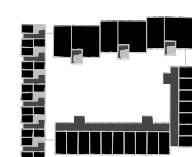
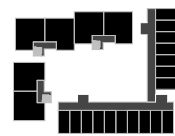
Type 4
WORKERS CO-HOUSING



placement of building type based on their urban surrounding



cluster into courtyard block



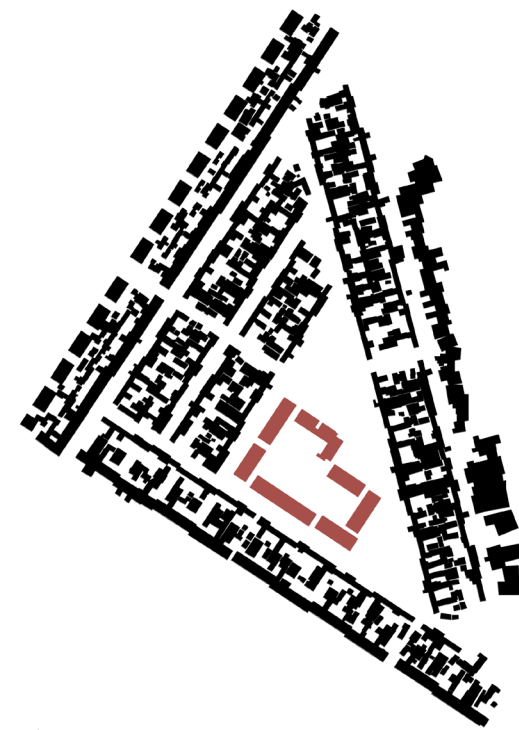




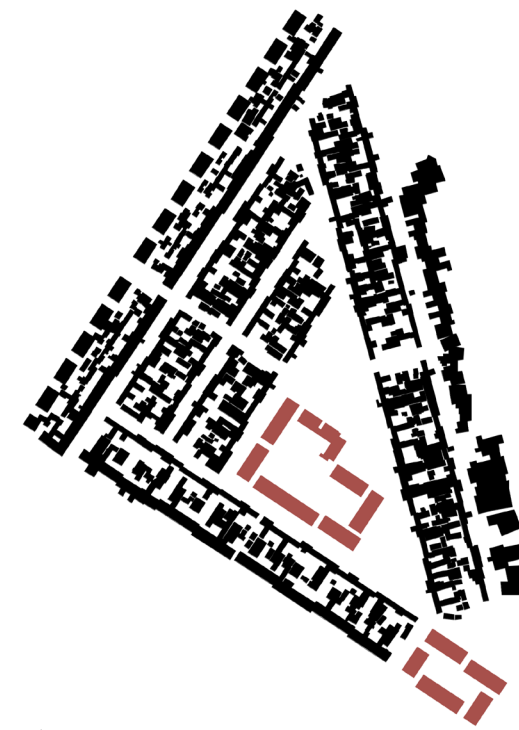
Phase 1



Phase 2



Phase 3



Phase 4



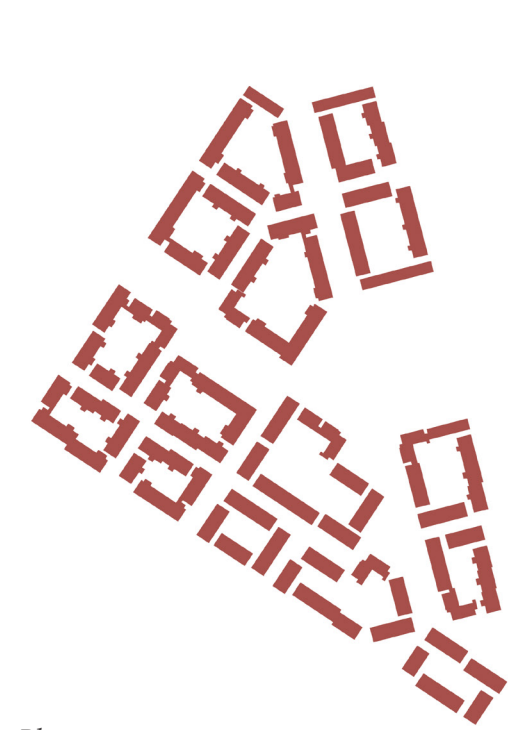
Phase 5



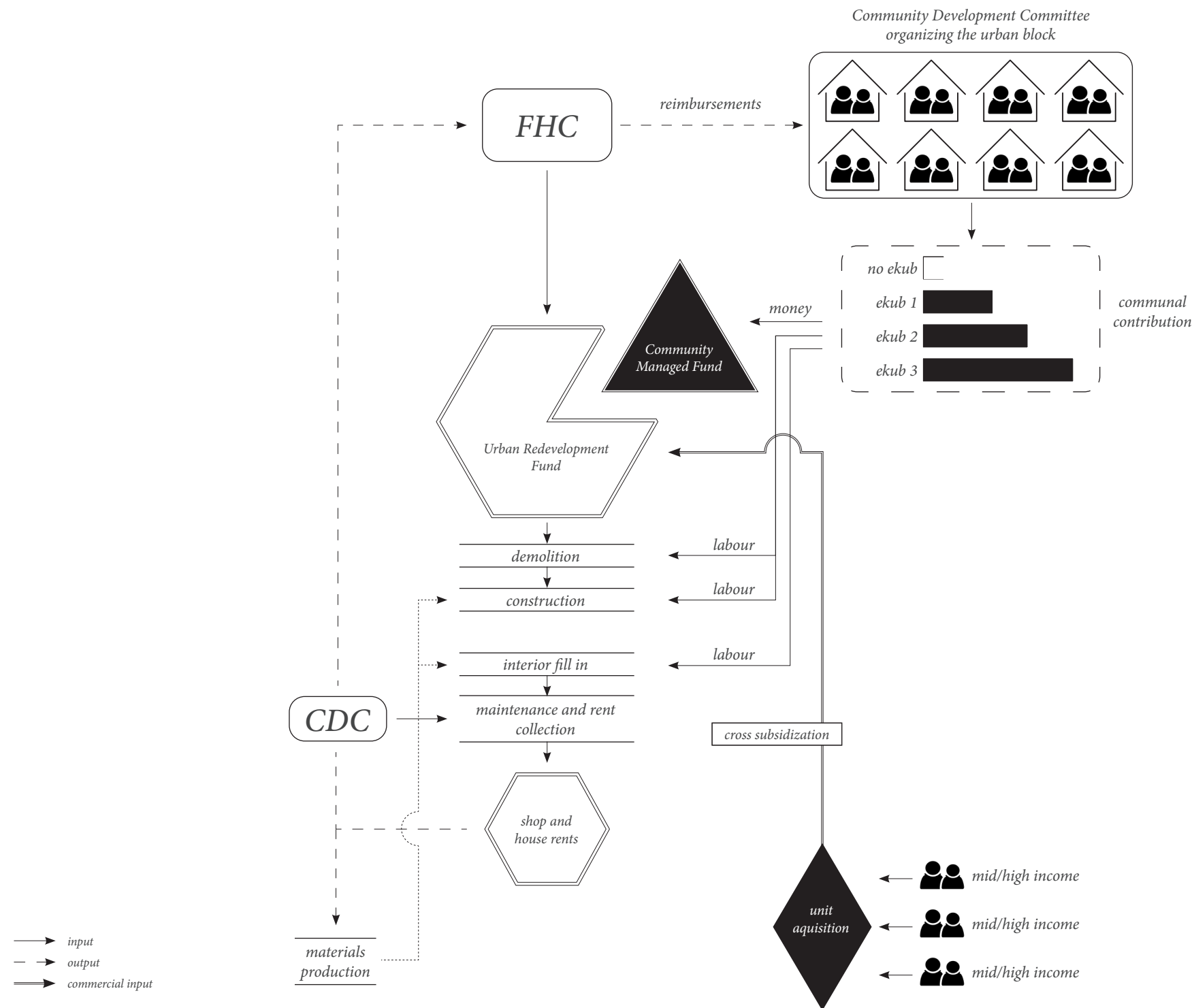
Phase 6

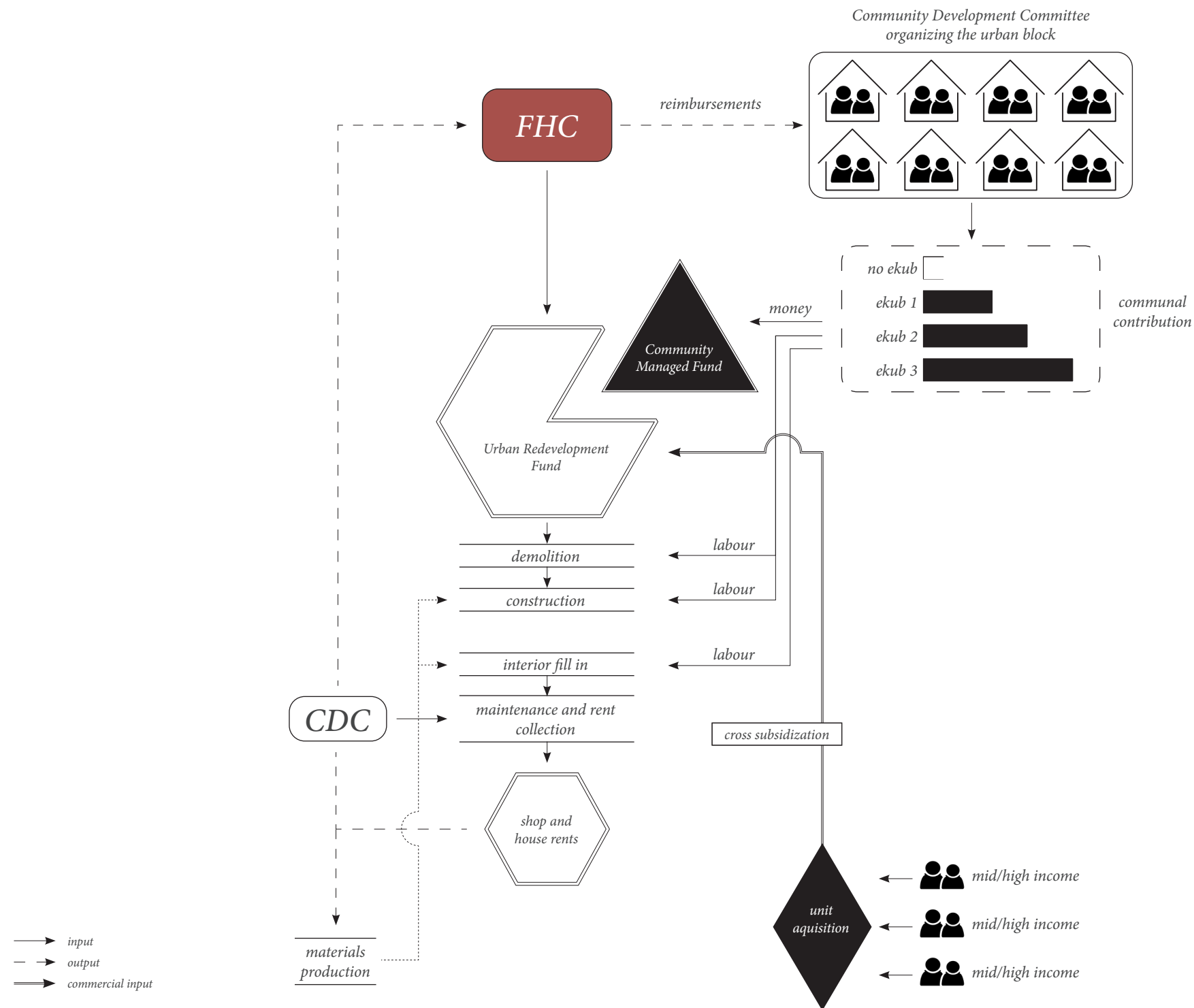


Phase 7

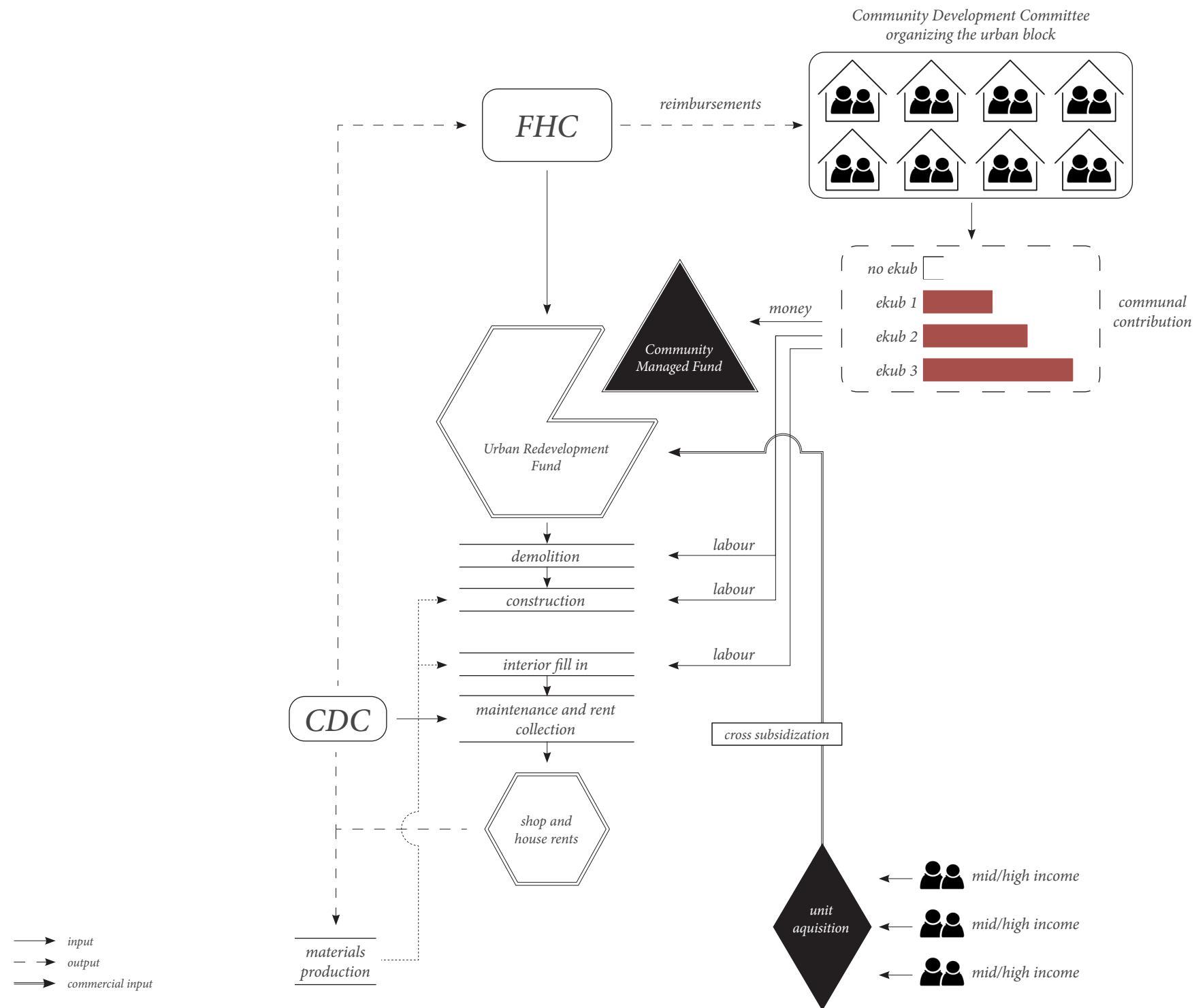


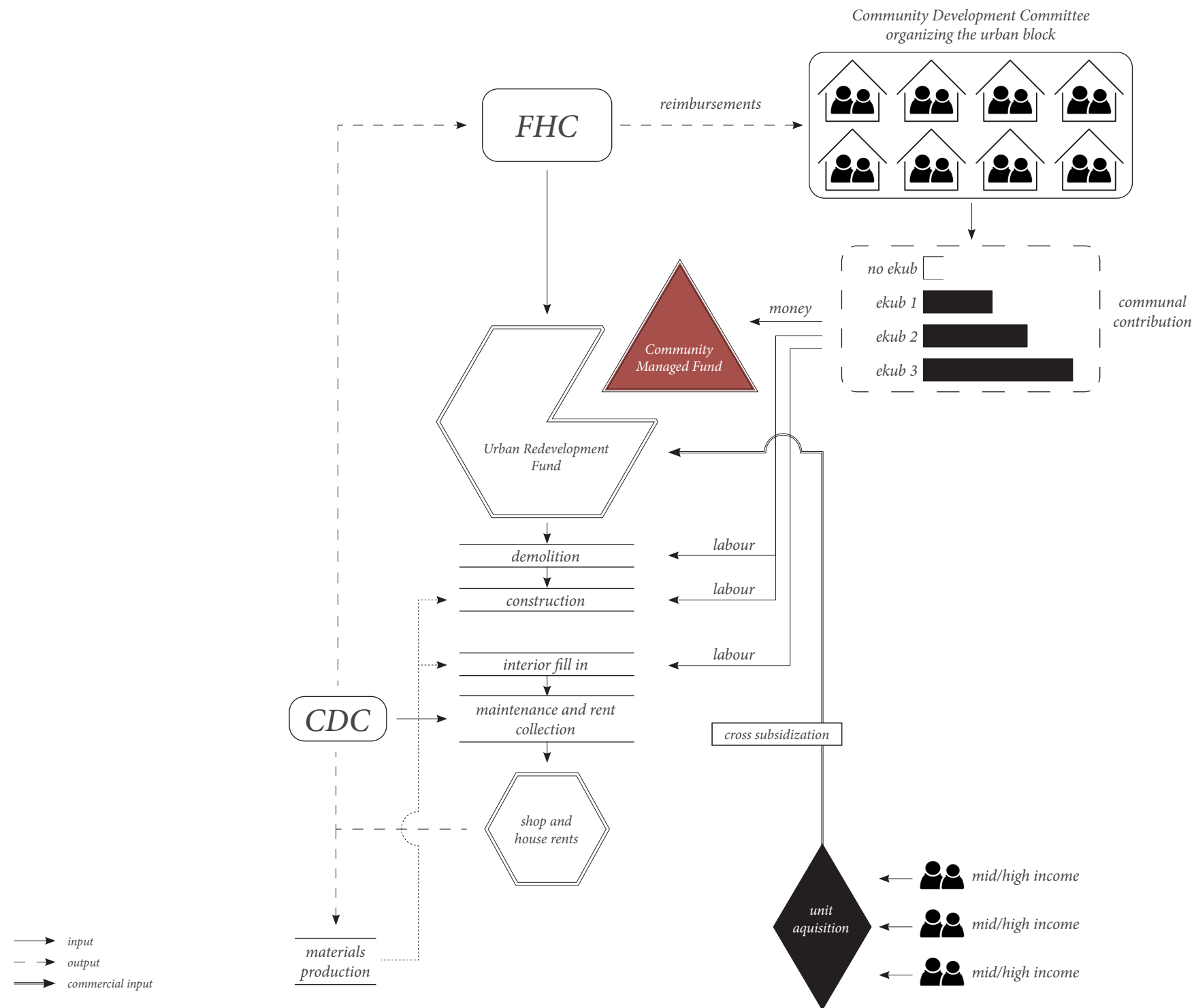
Phase 8

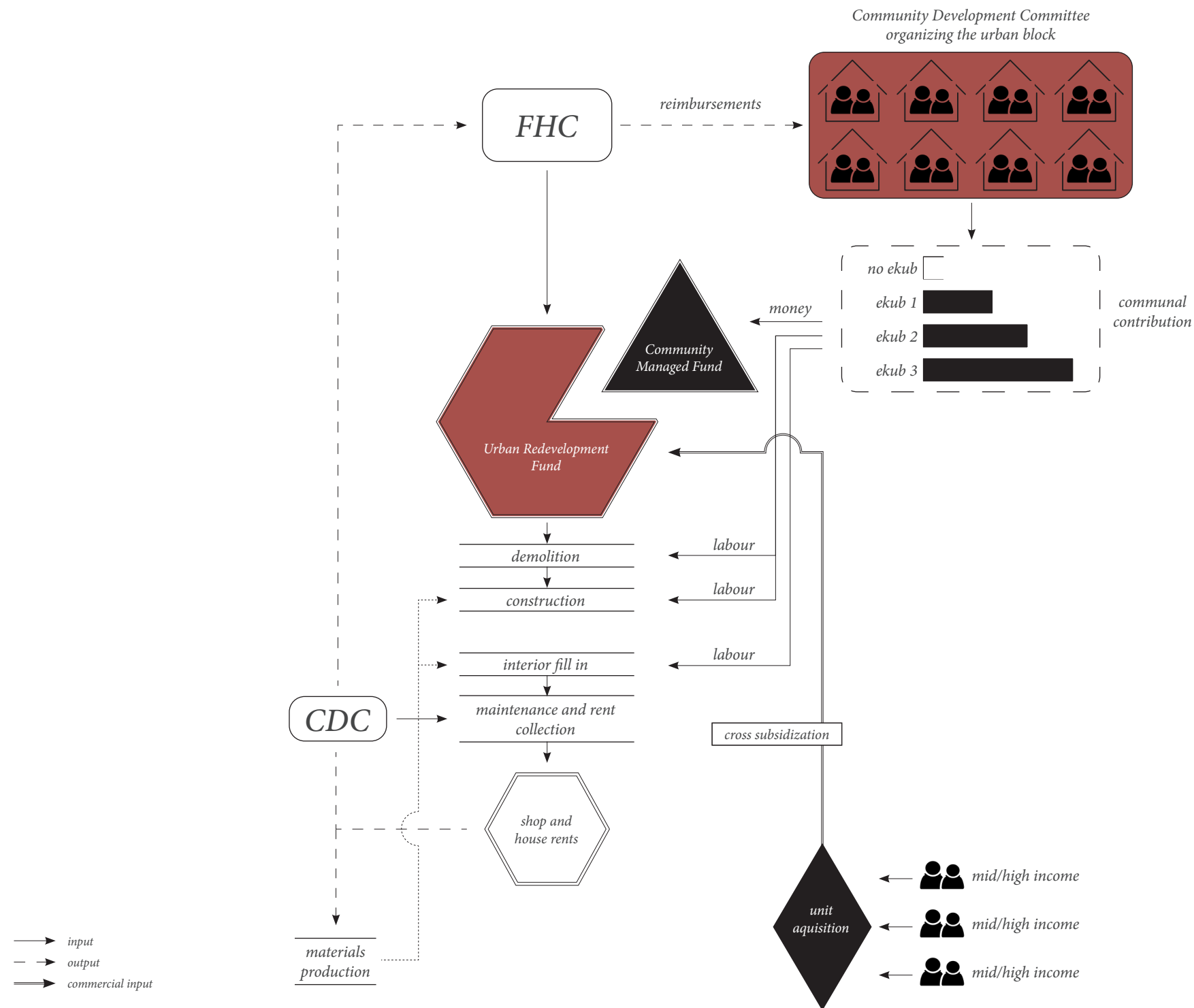


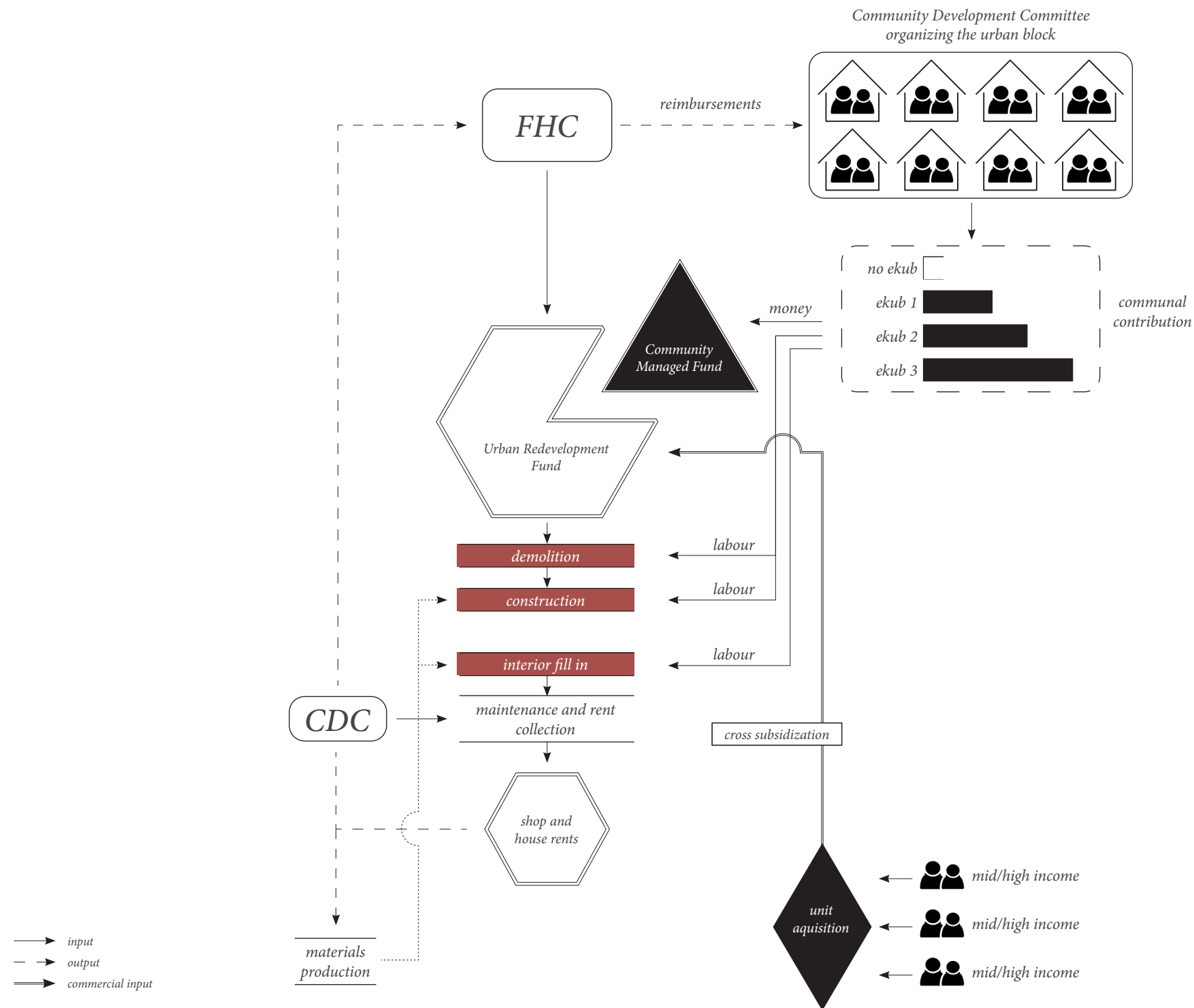


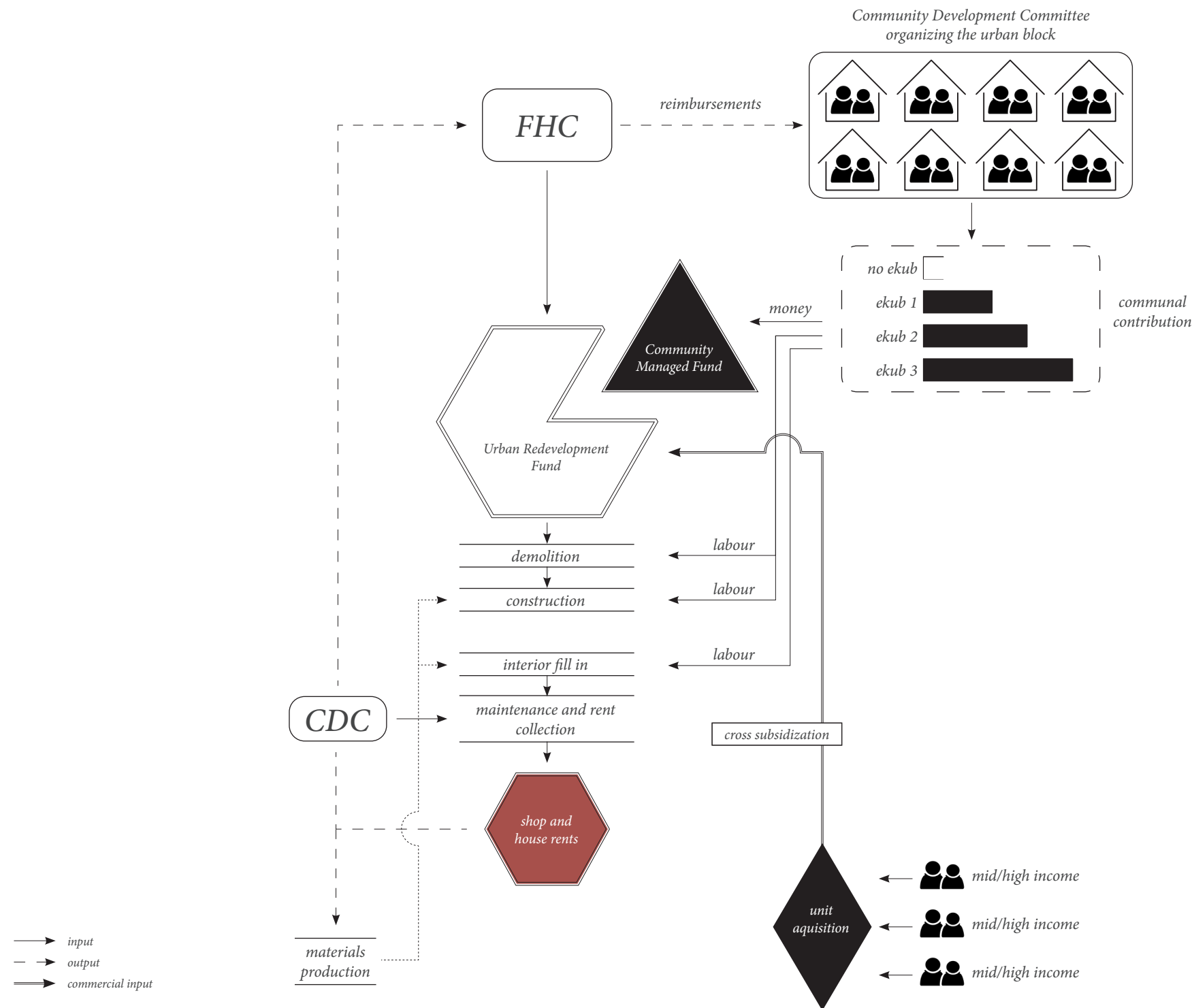












Gross site area
8,5 Ha

Gross built ground area
4 Ha > 2,7 Ha

GSI
0,47 > 0,32

FSI
0,47 > 1,59

Number of plots/unit
357 (est.) > 1296 to 2396*

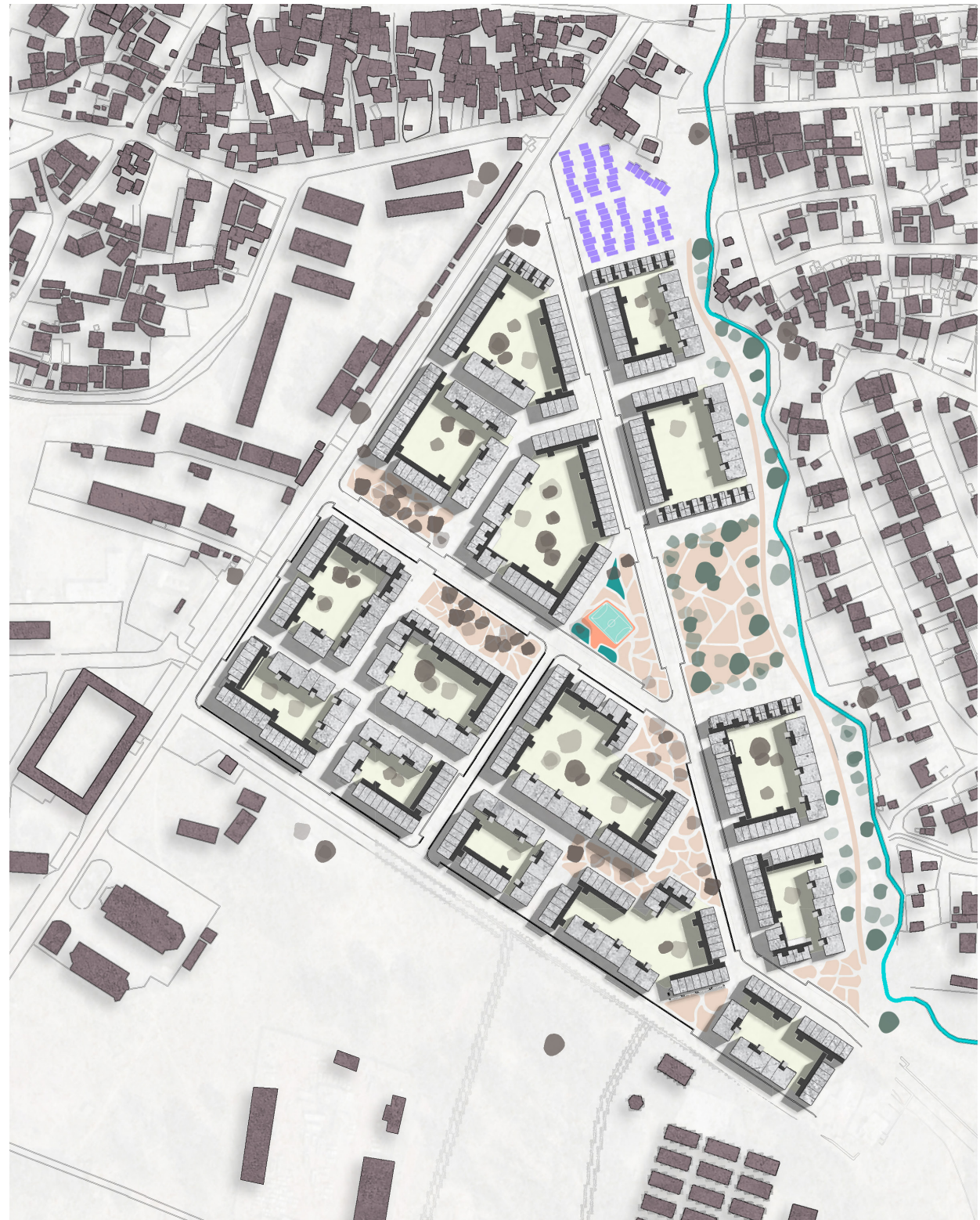
Units/ha
42 > 153 to 282*

Unit typologies
3 > 14

Population
2 540 (est.) > 3318 to 5084**

Population/ha
299 > 390 to 598**

* Large range because of the adaptable unit variation of Type 1
** Range based on low occupancy, 1 person on 2-person-bed, to full occupancy



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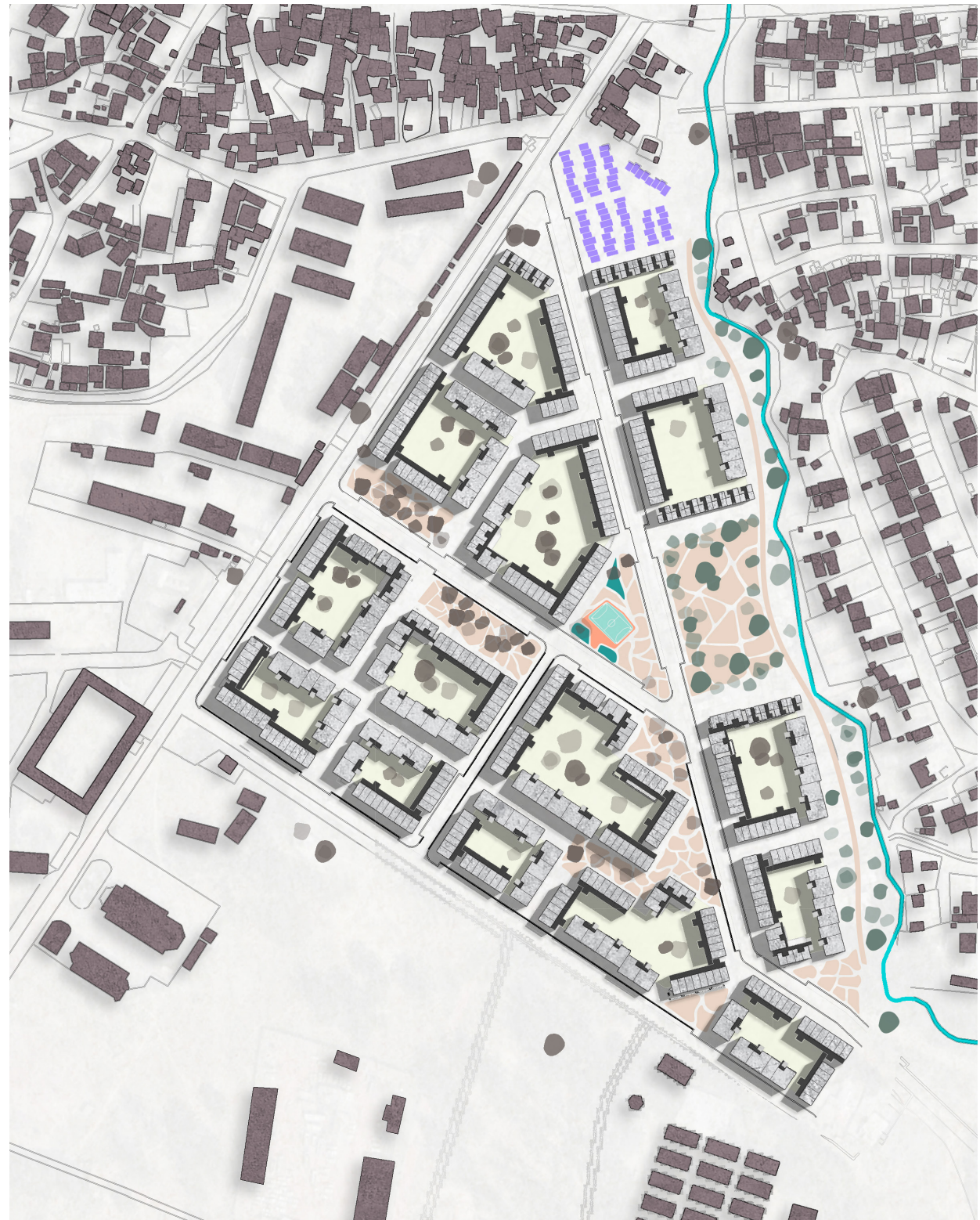
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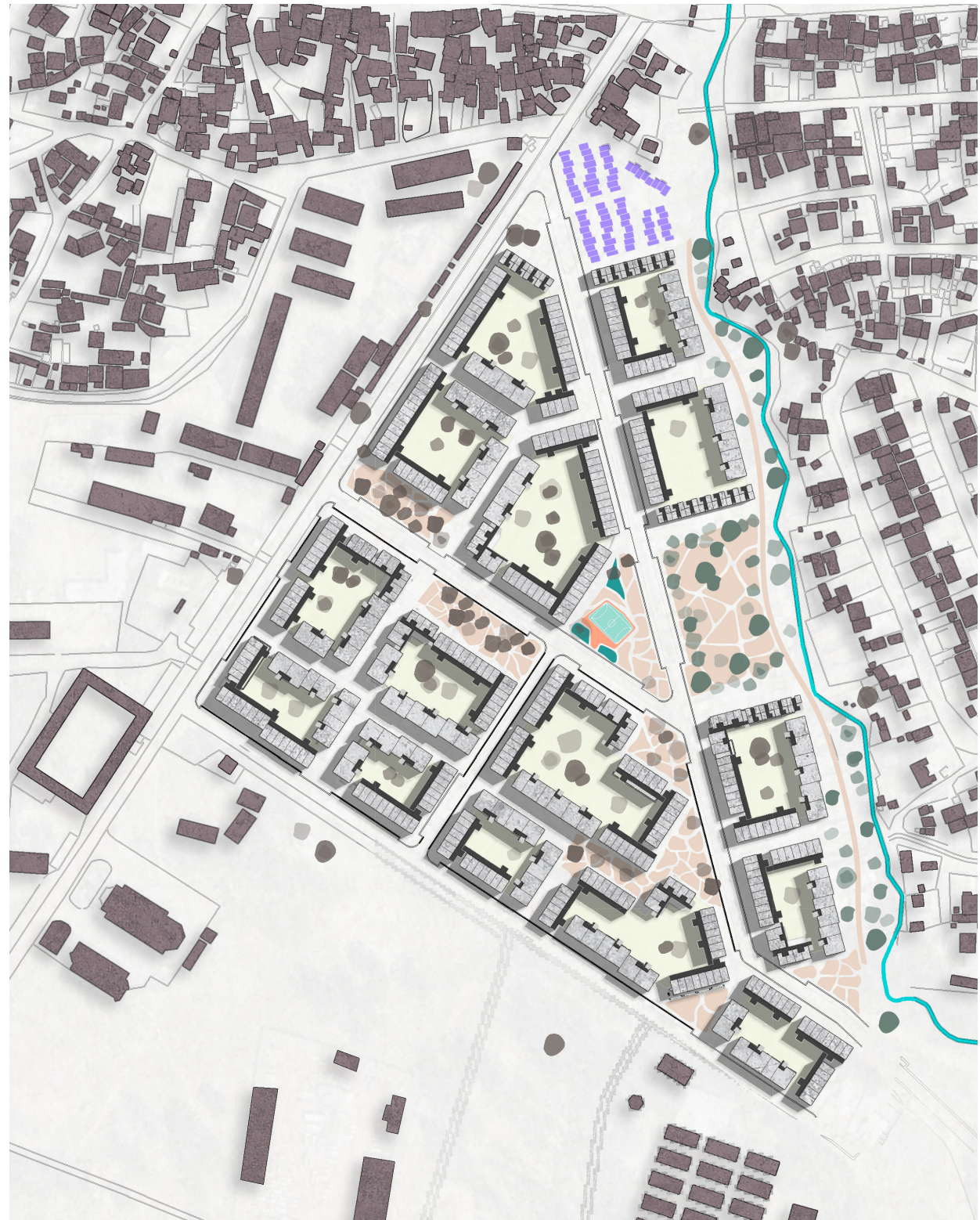
Unit typologies

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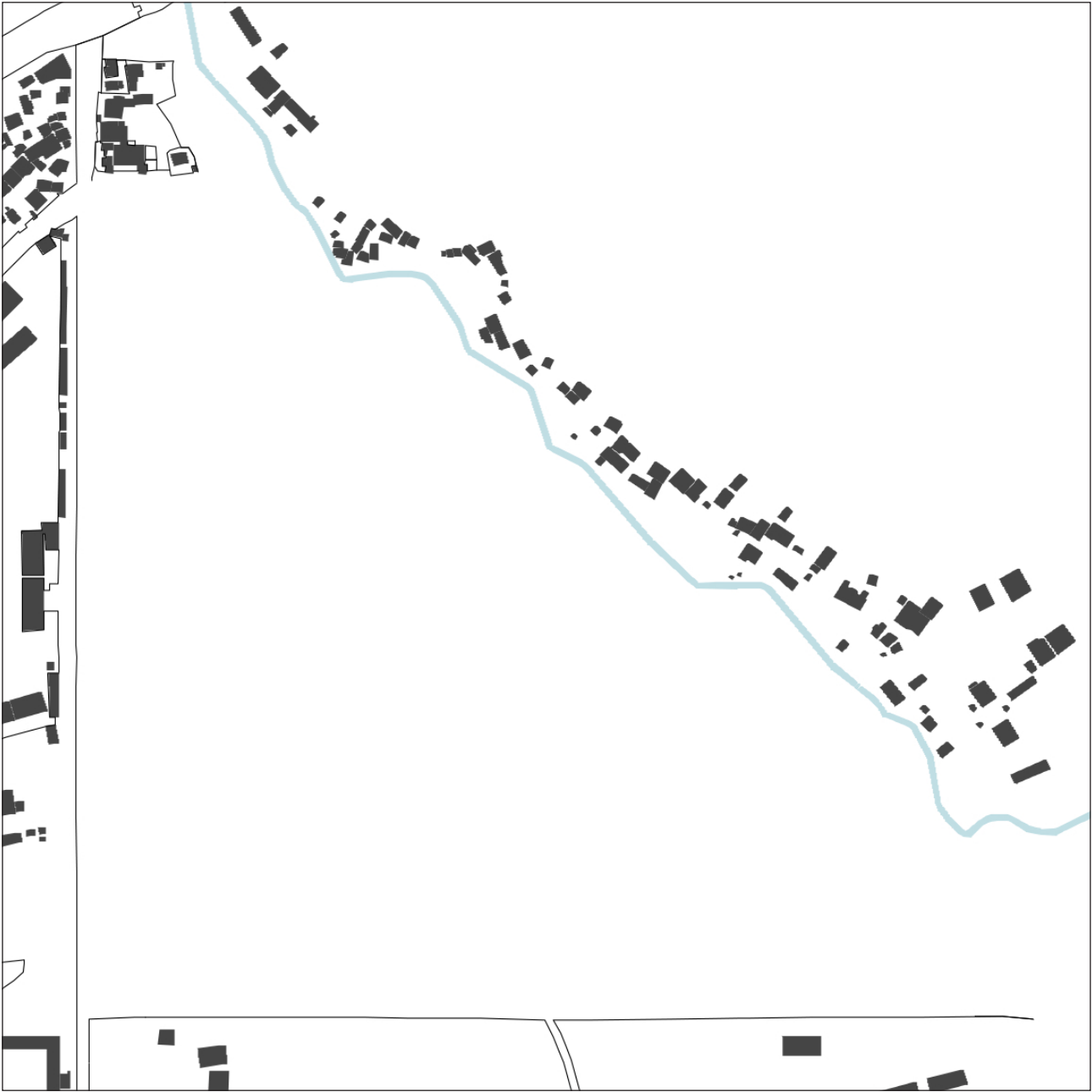
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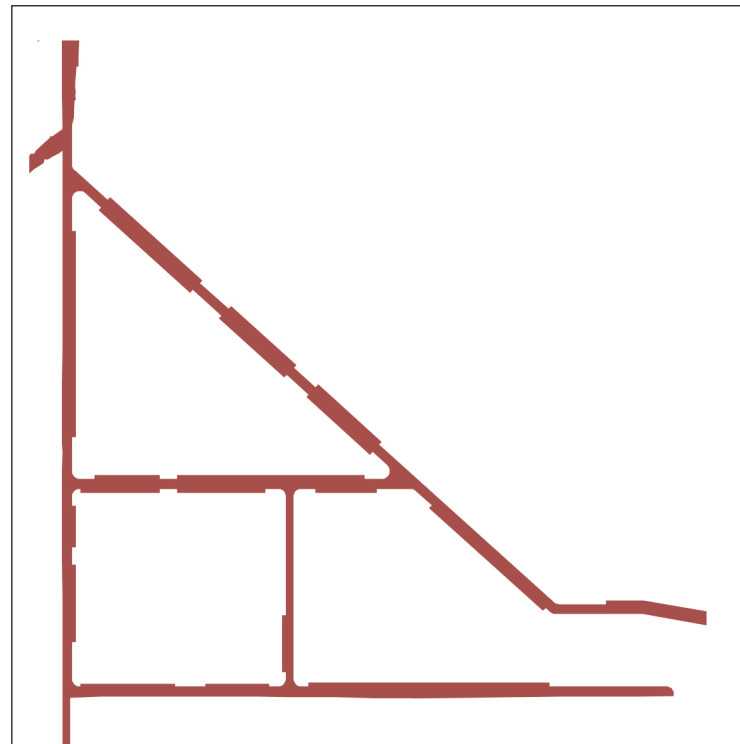
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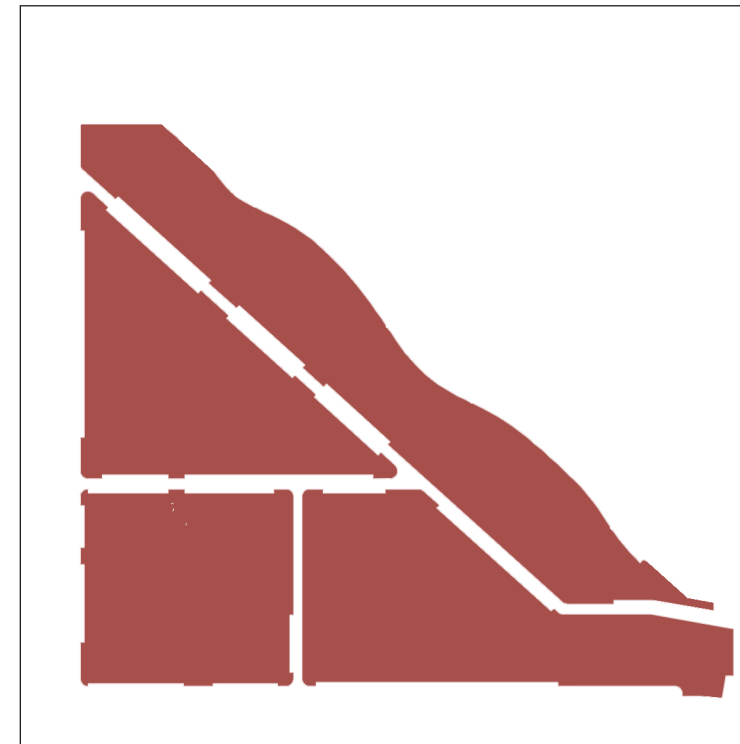
surrounding



car access



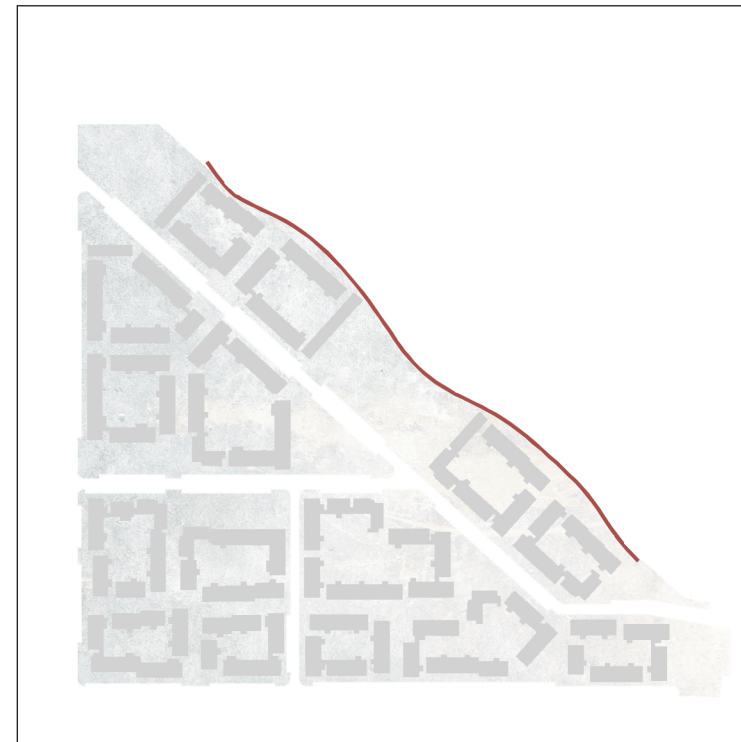
urban divisions



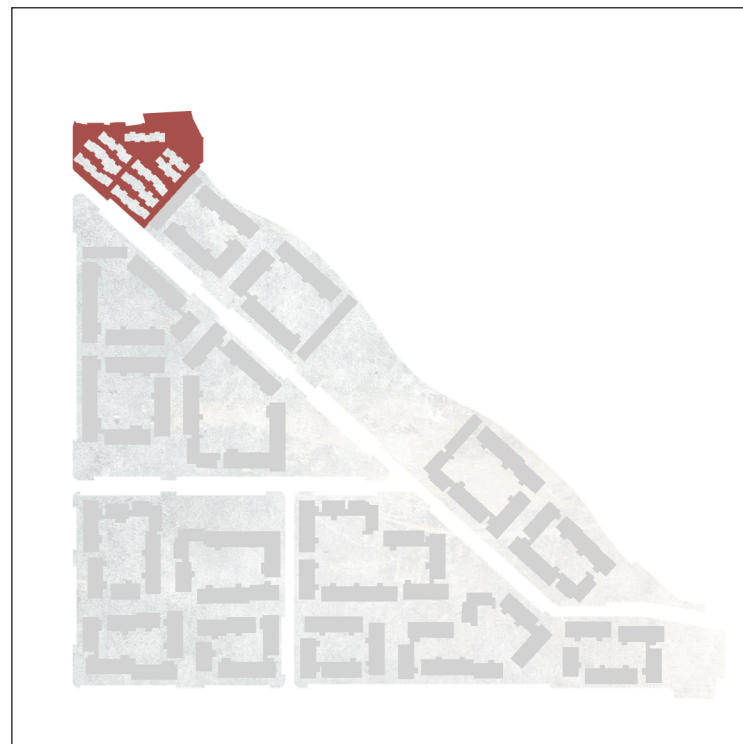
inner streets



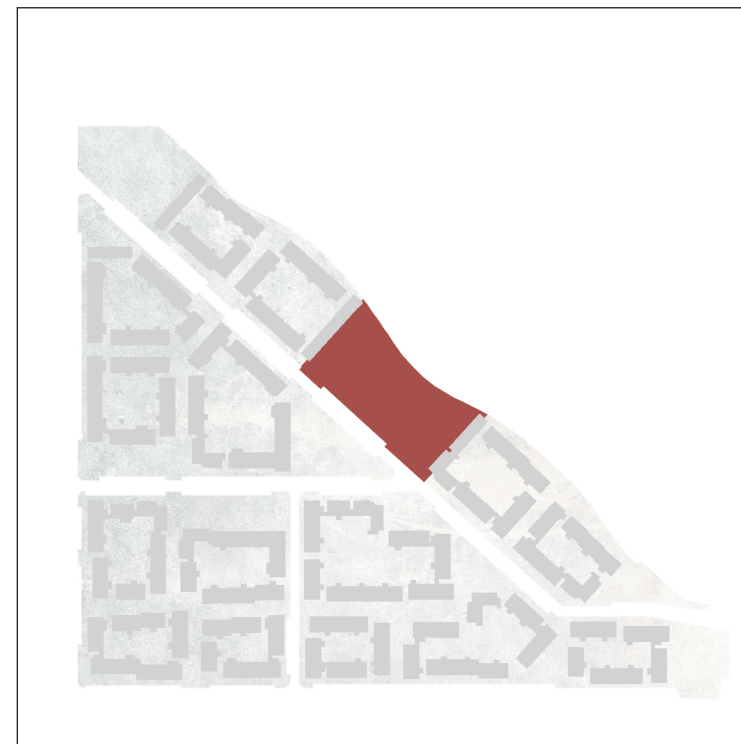
green promenade



market space



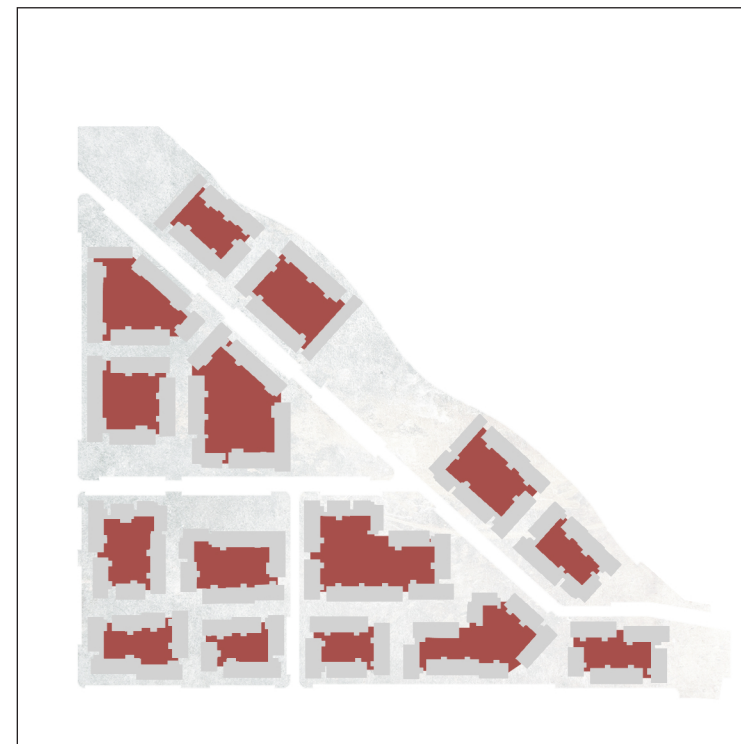
public plaza



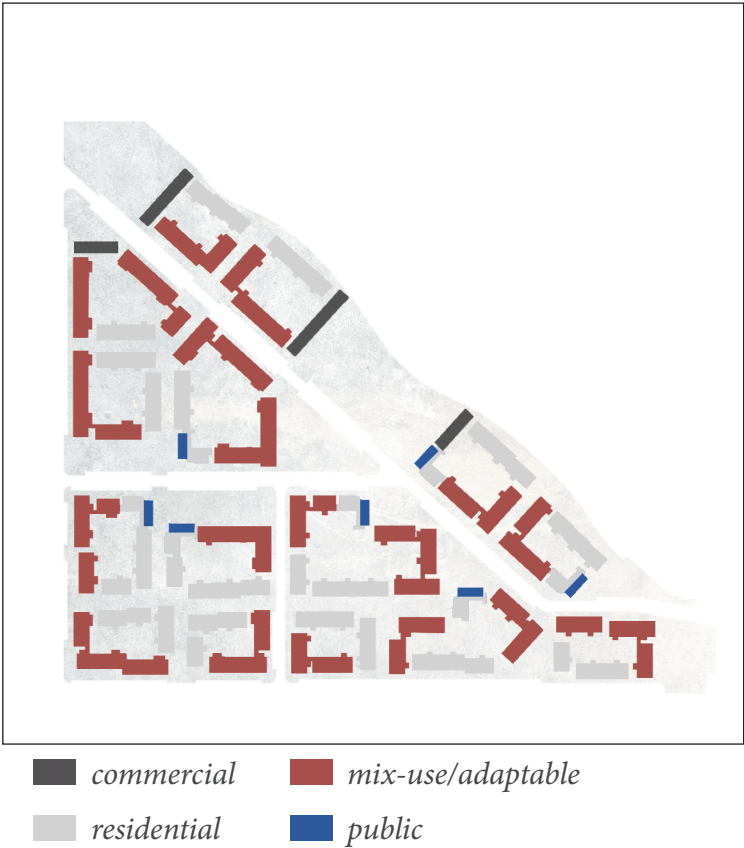
social square



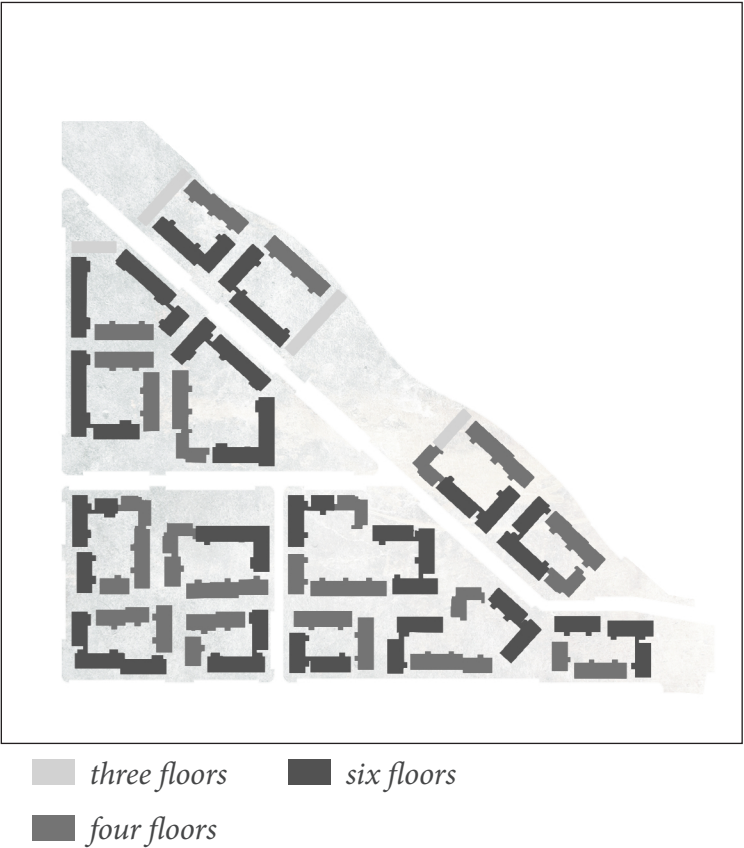
inner courtyards



plinth program



floor count



adaptive modular



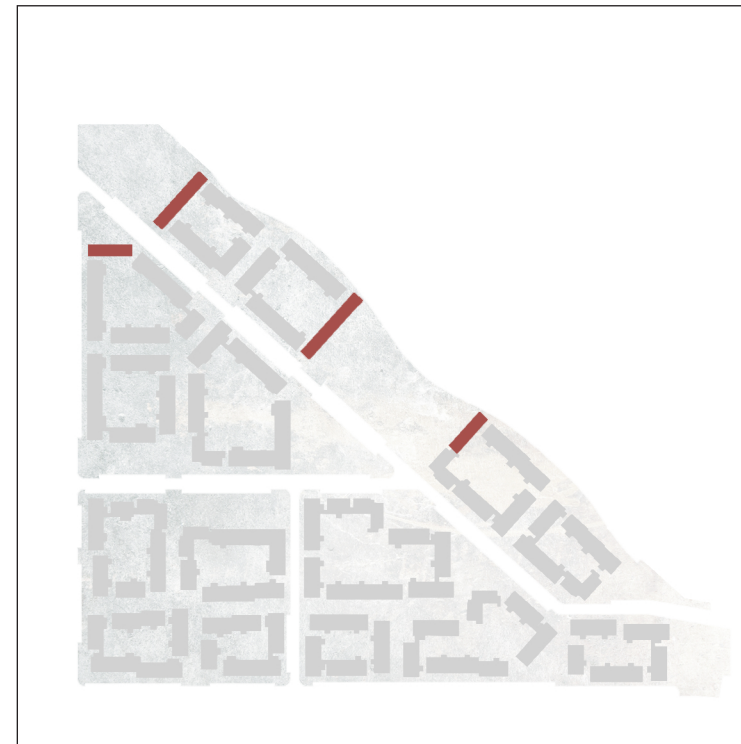
middle income portico



urban corner

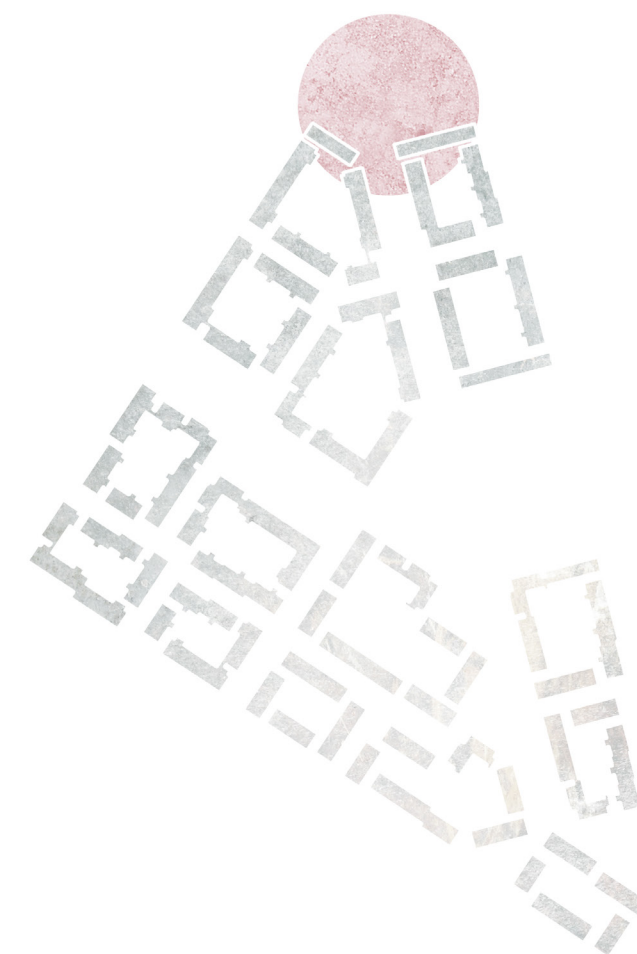


workers co-housing



DESIGN | *Public Spaces*

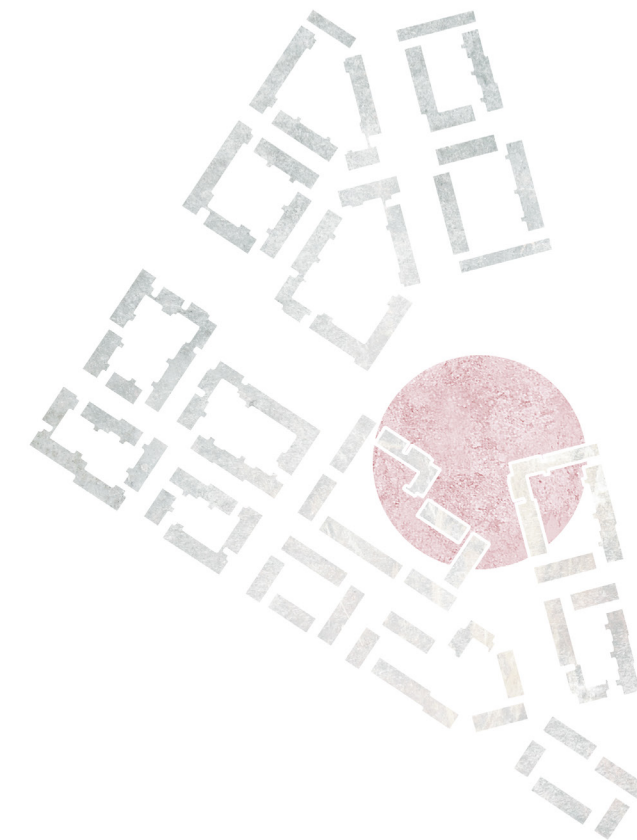
informal market space and social square



informal market space and social square



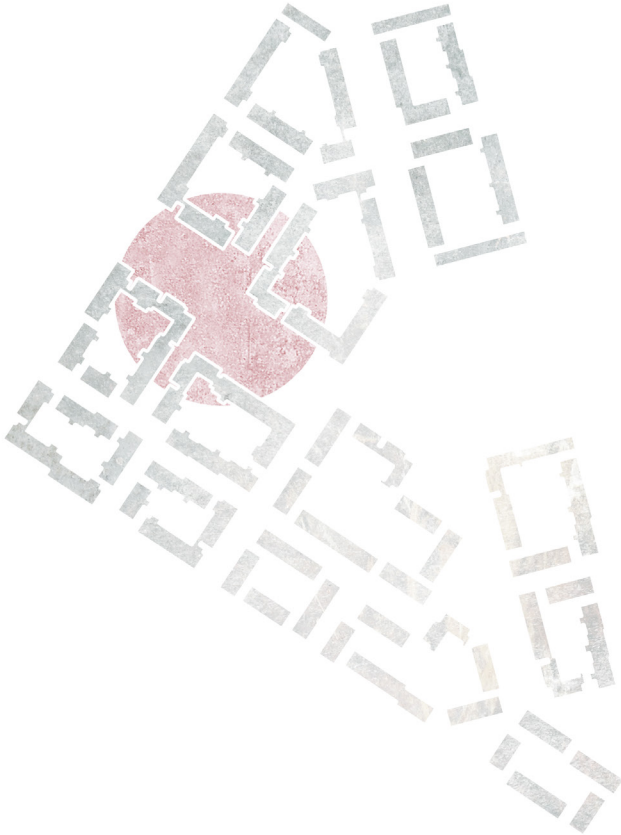
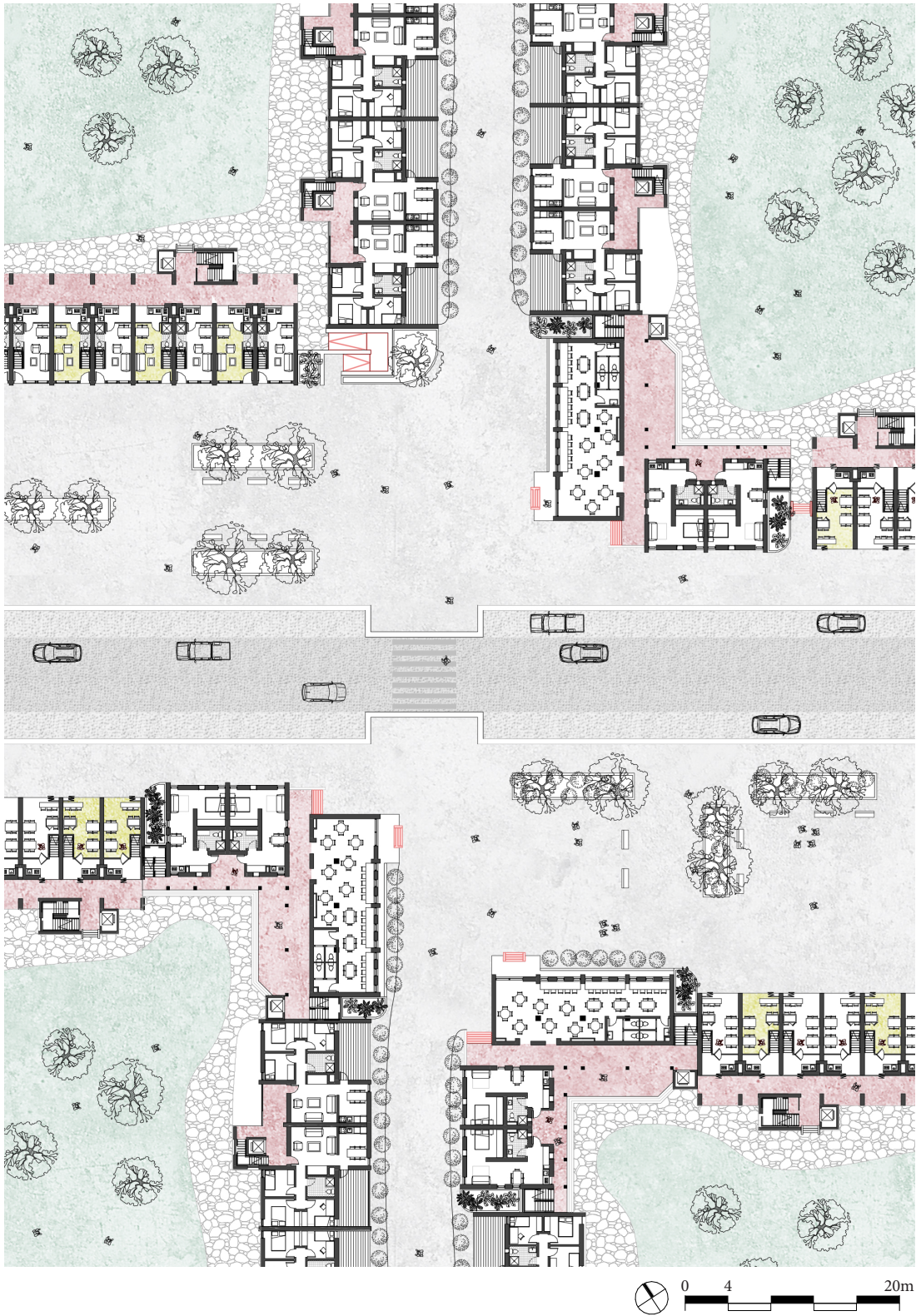
public plaza and social square



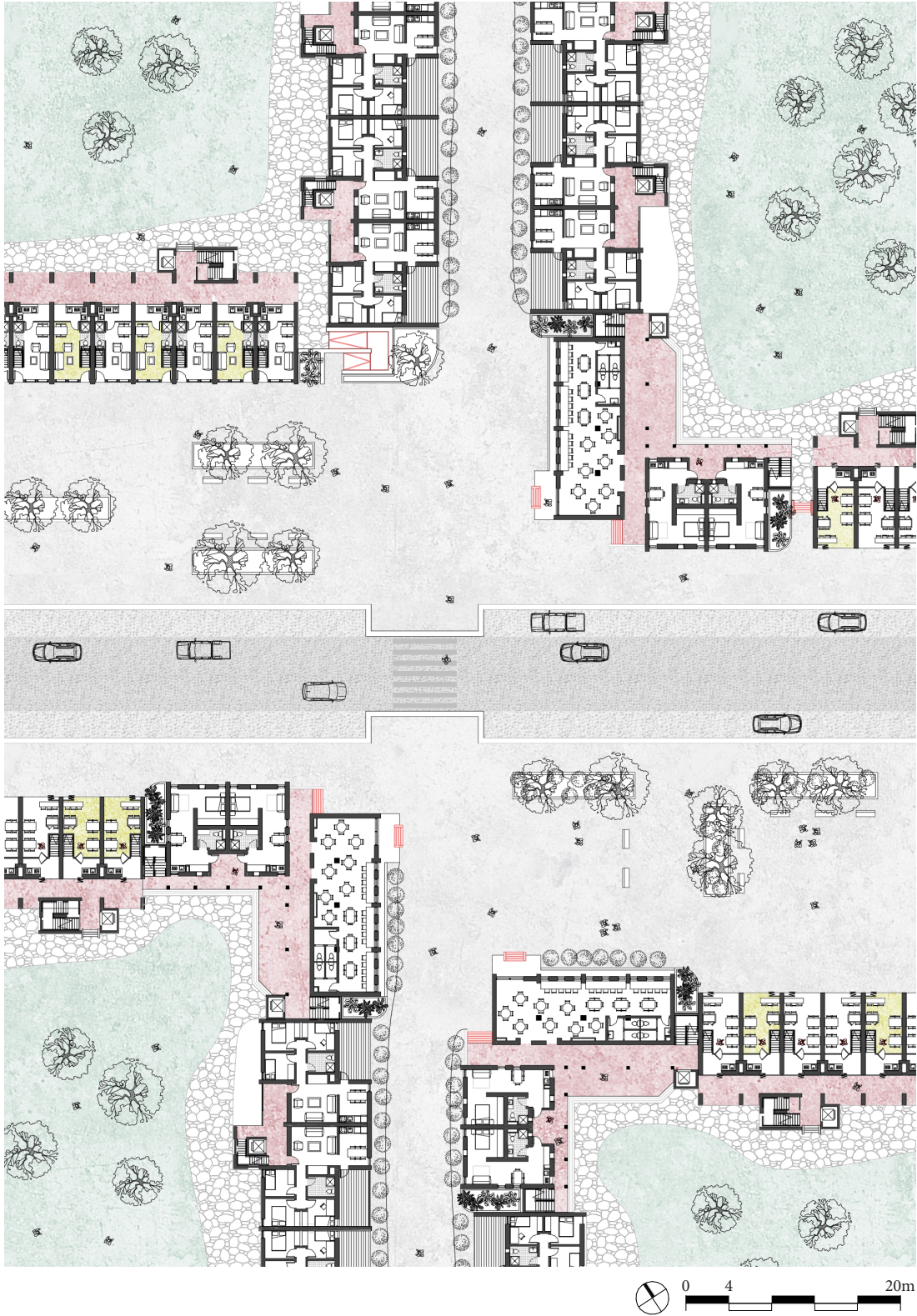
public plaza and social square



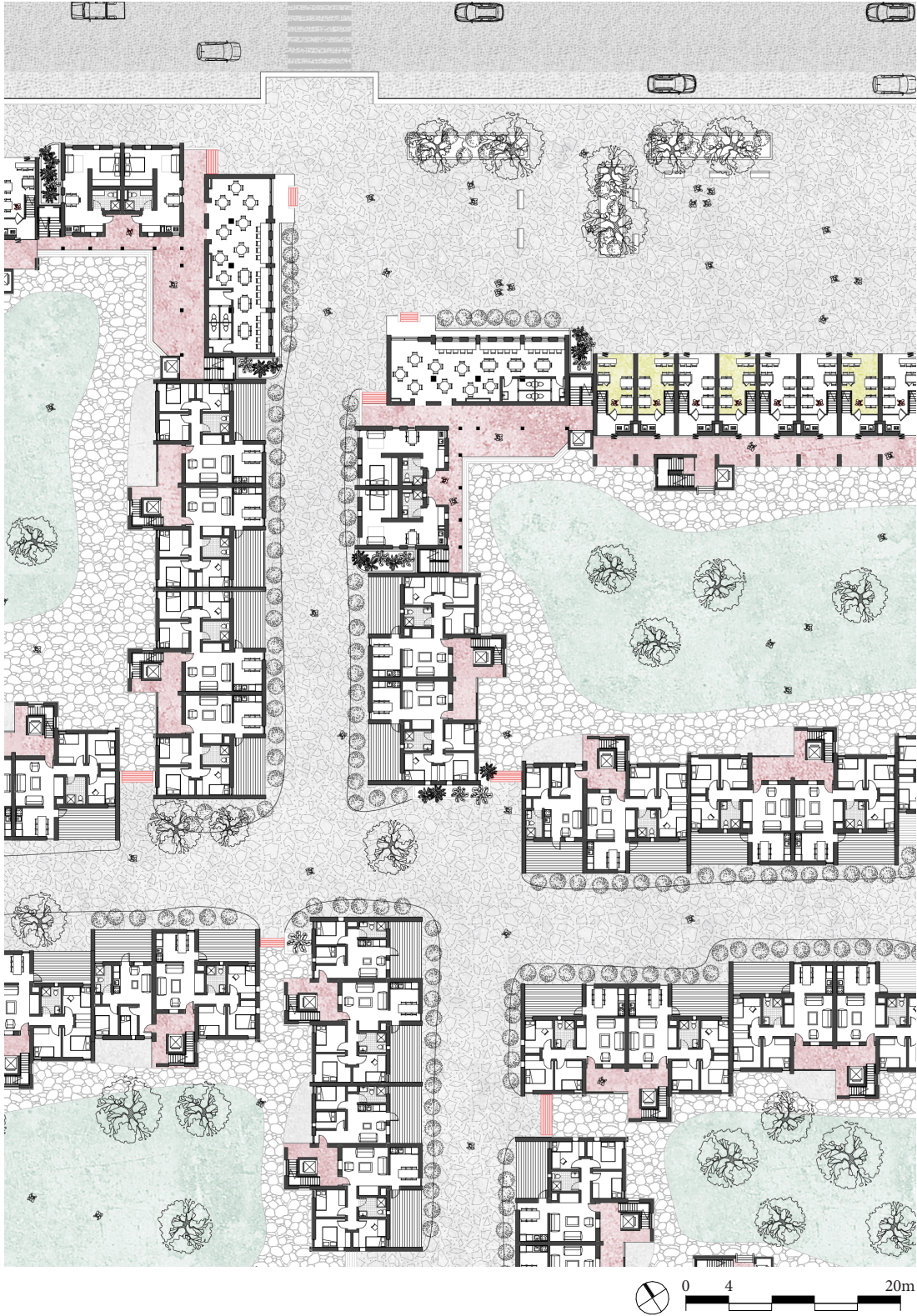
social squares in connection

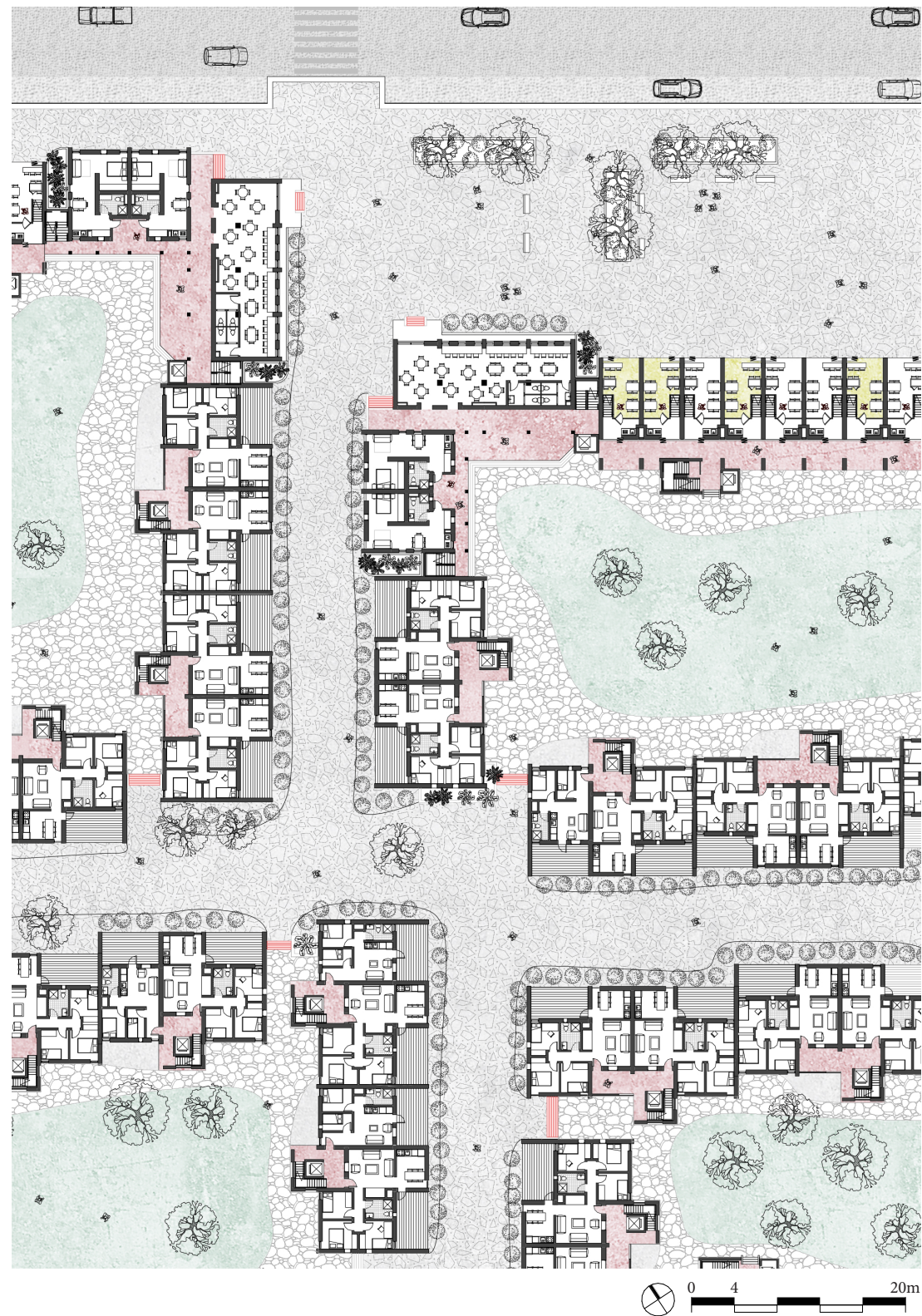


social squares in connection



social squares to the inner streets





social squares to the inner streets

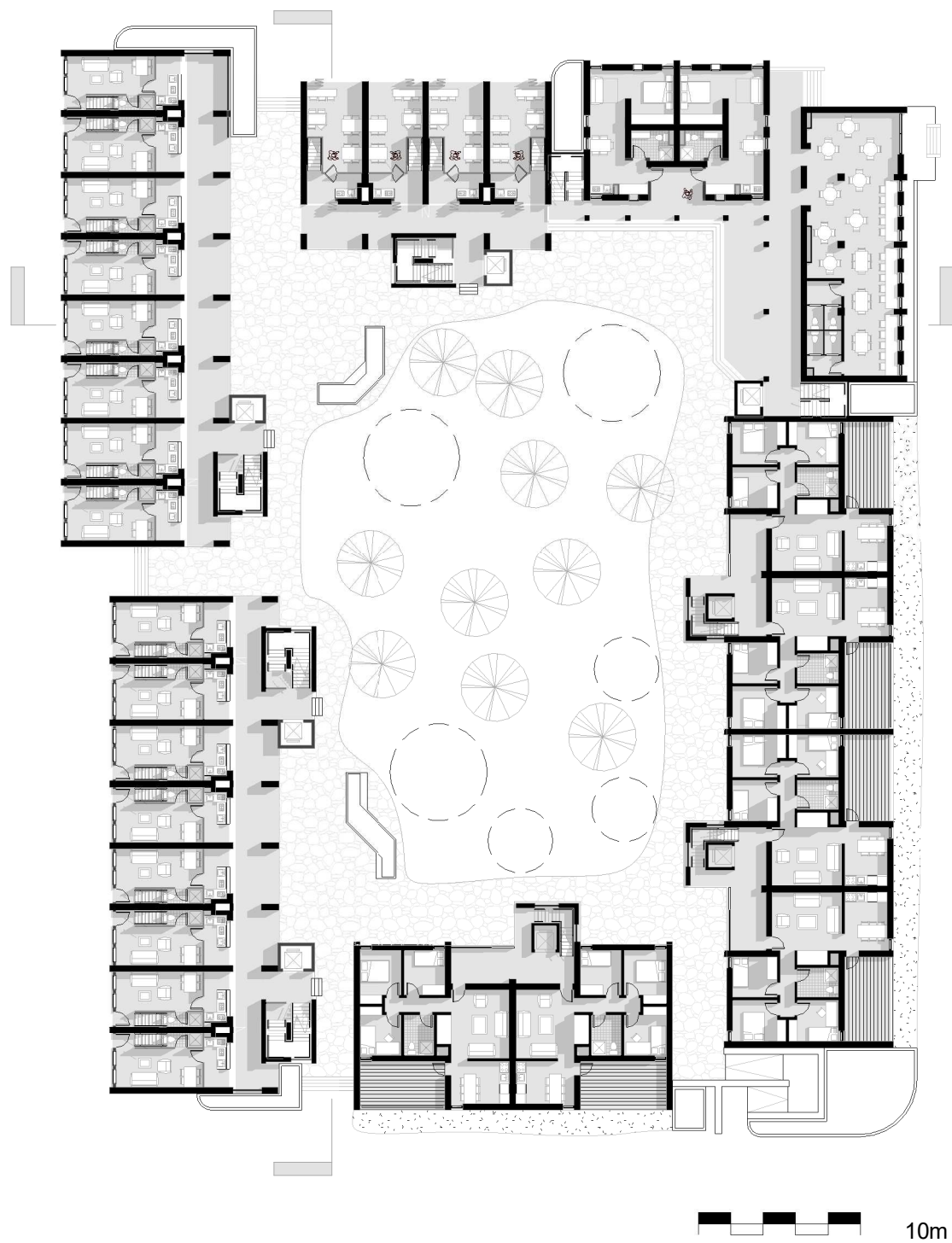


DESIGN | *Courtyard block*





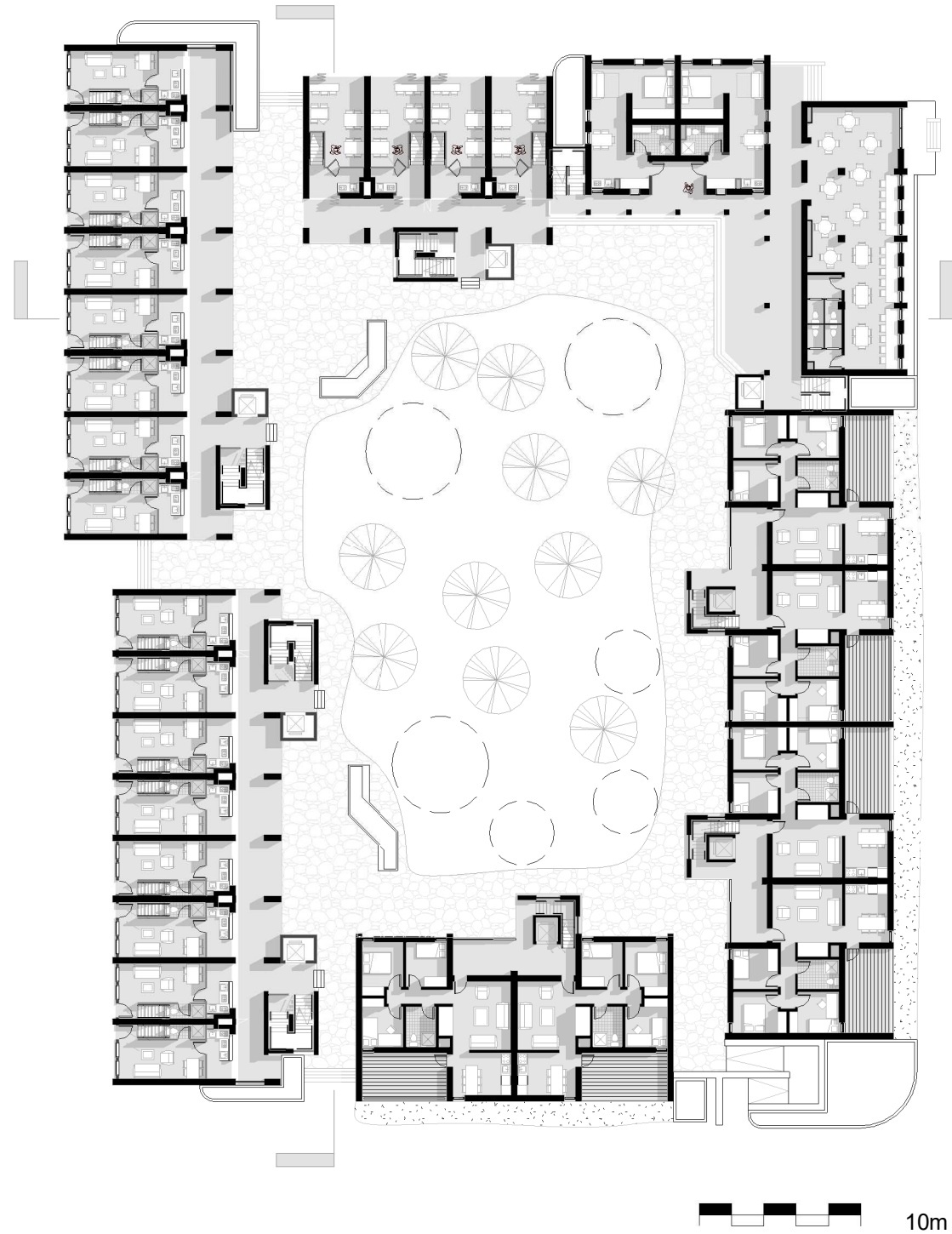




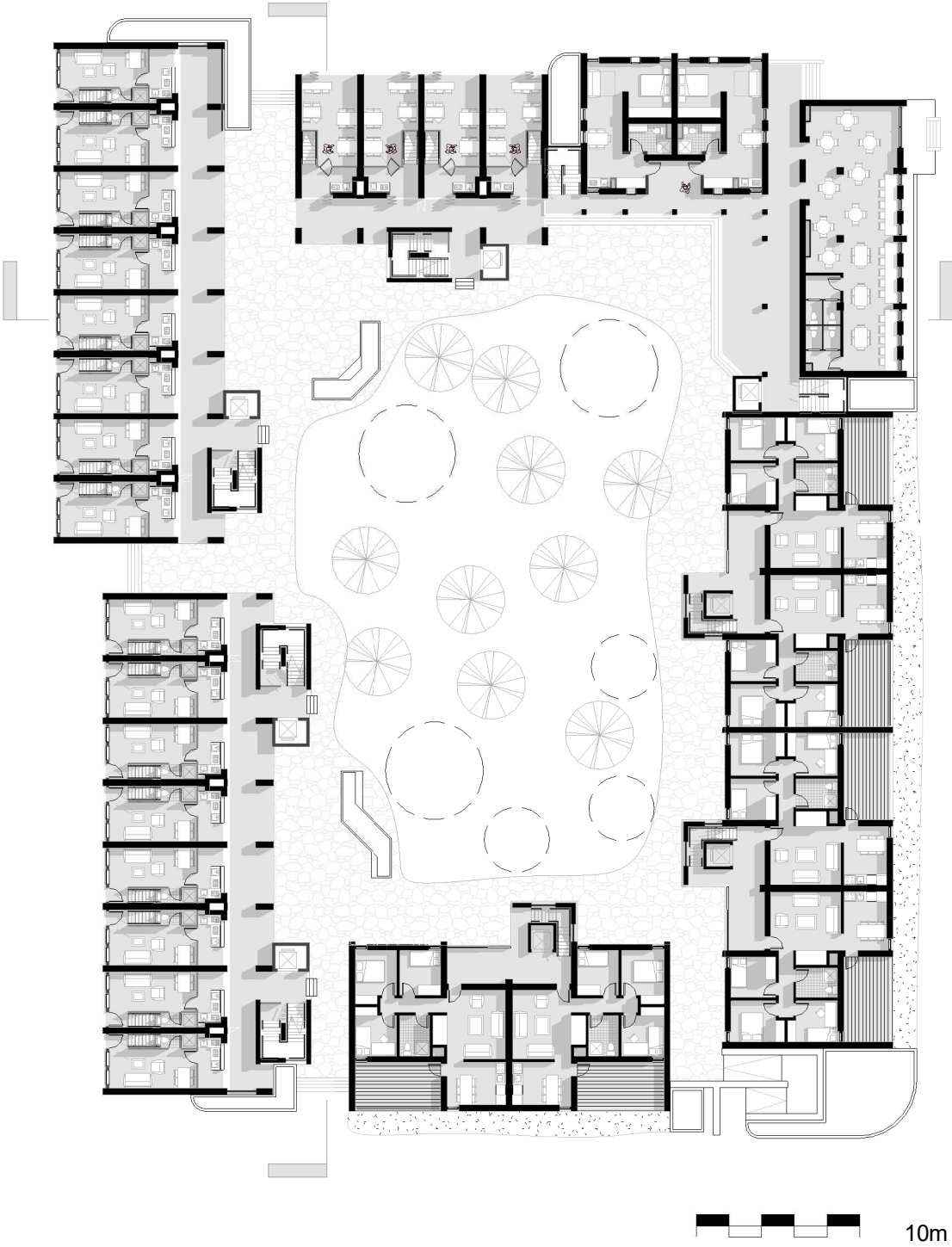
entrance to courtyard



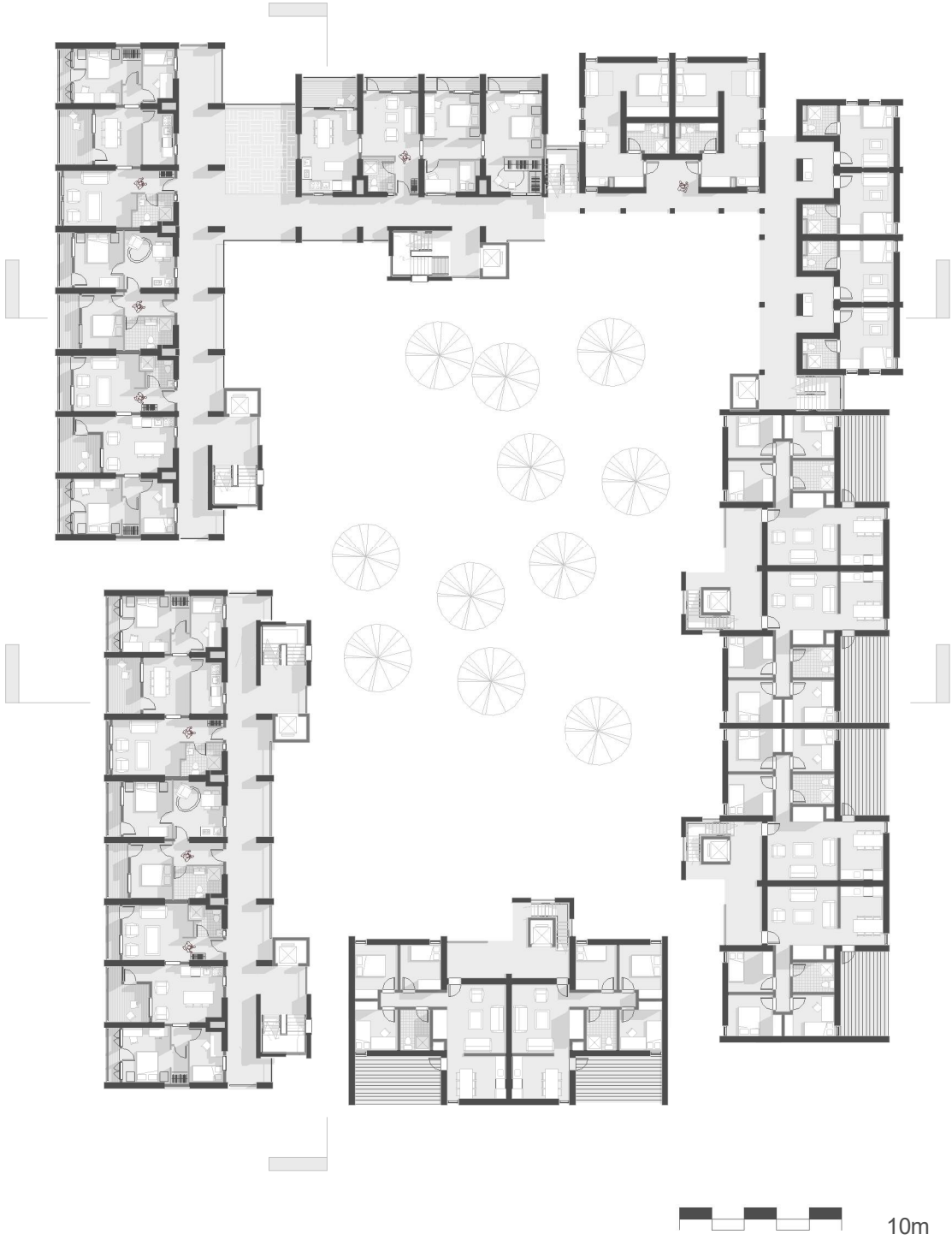
courtyard space

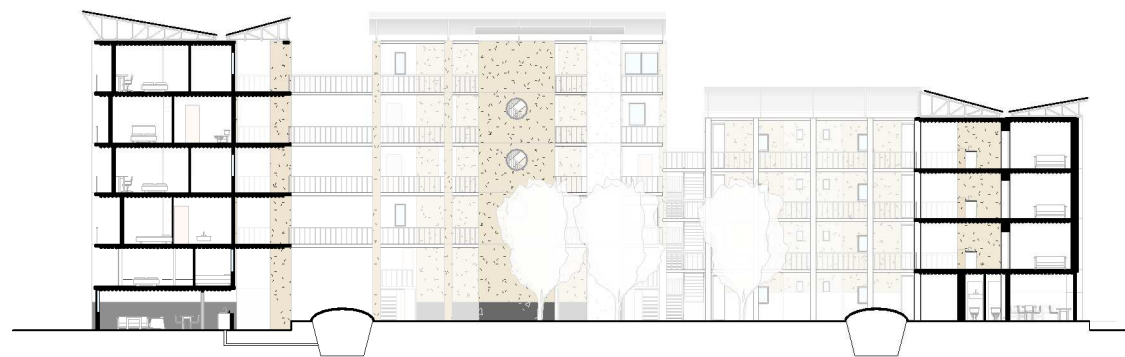
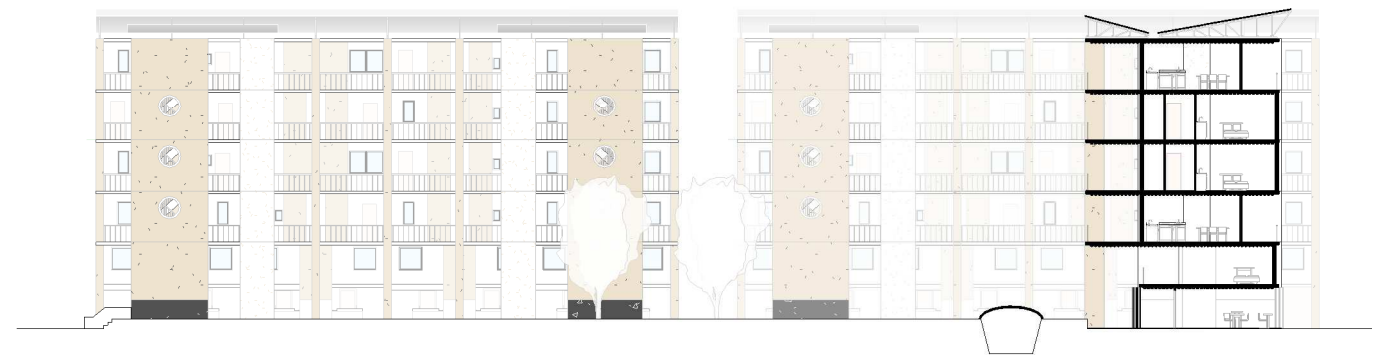
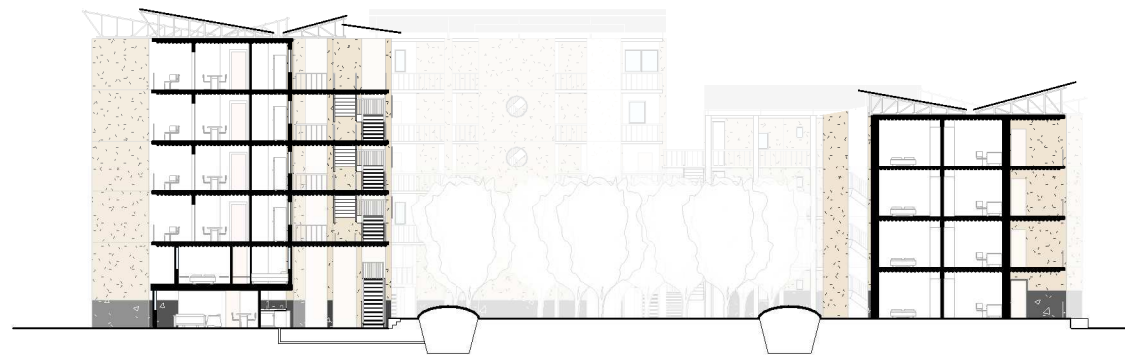


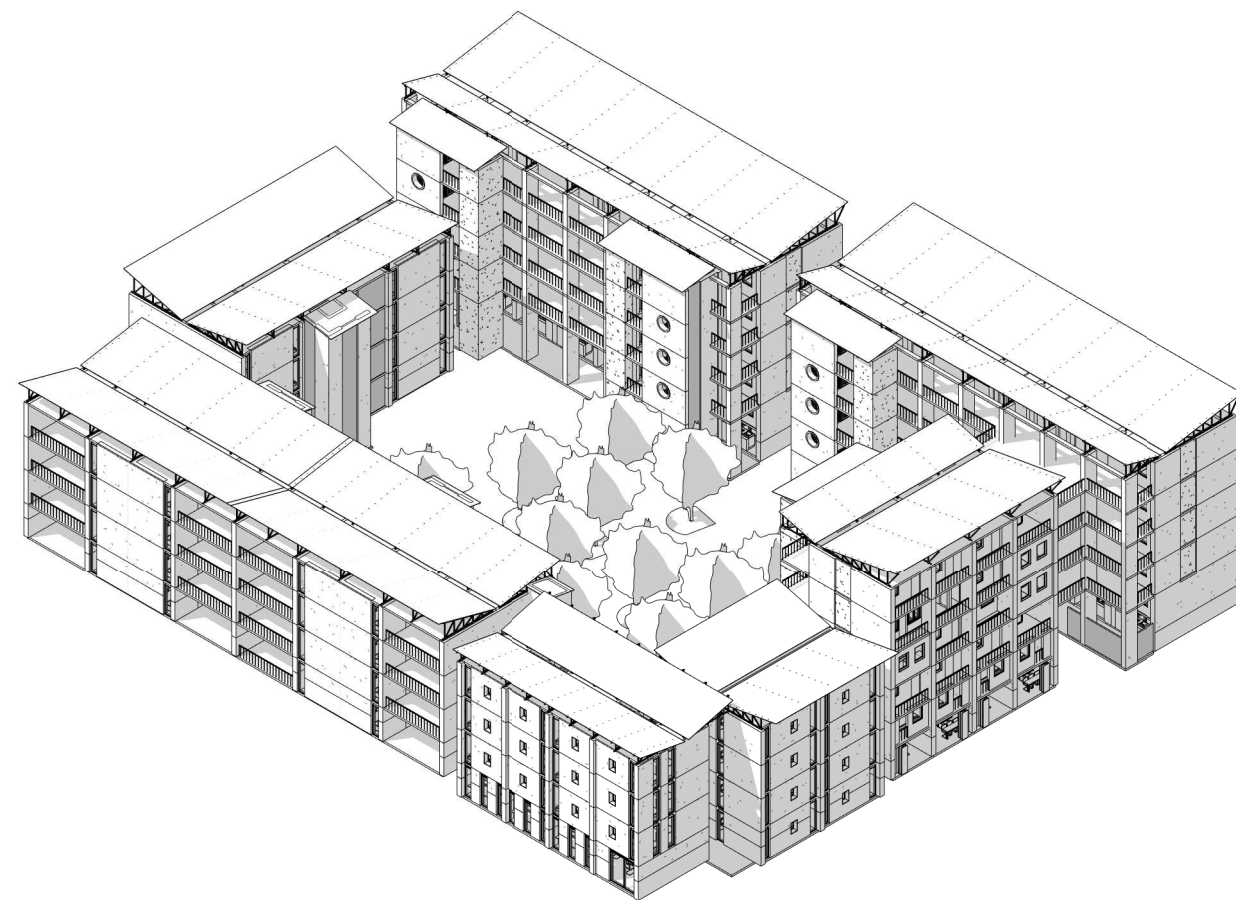
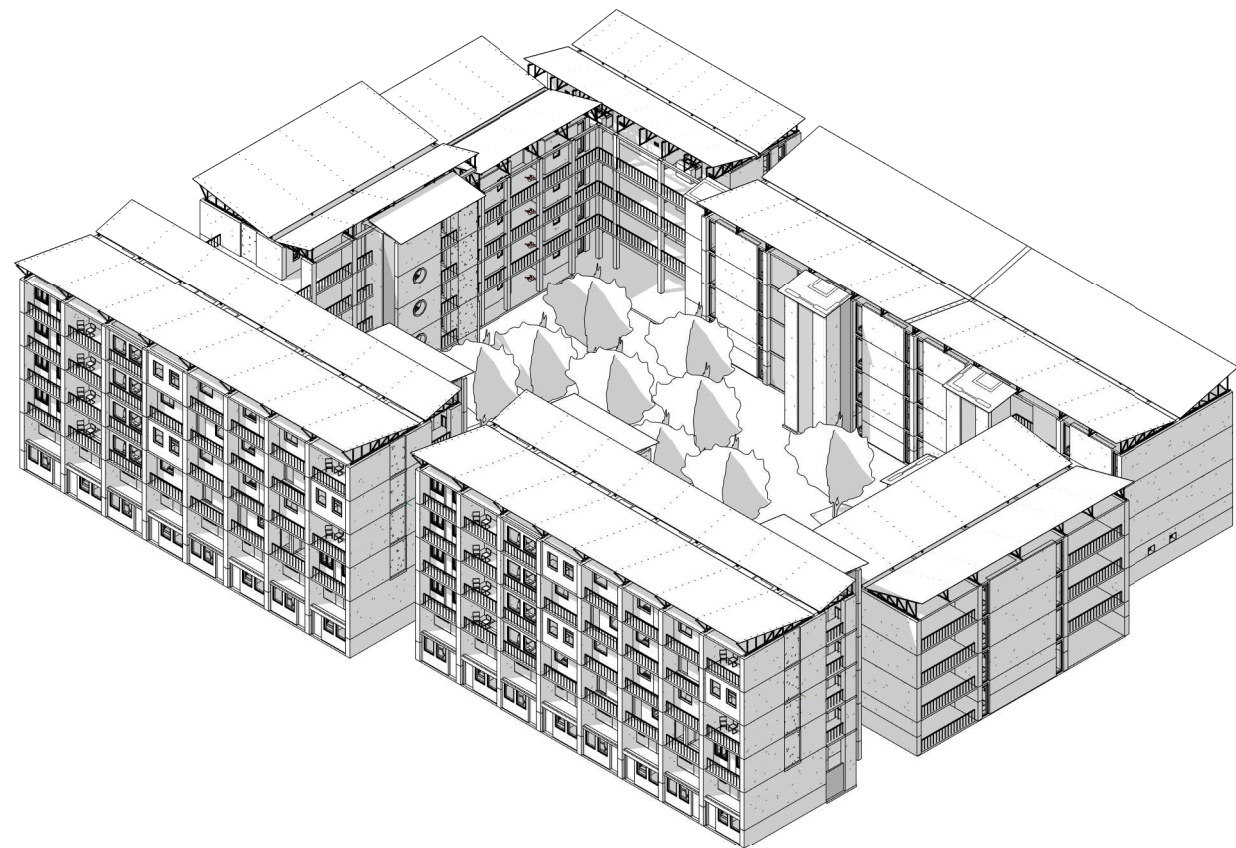
kitchen as a social program

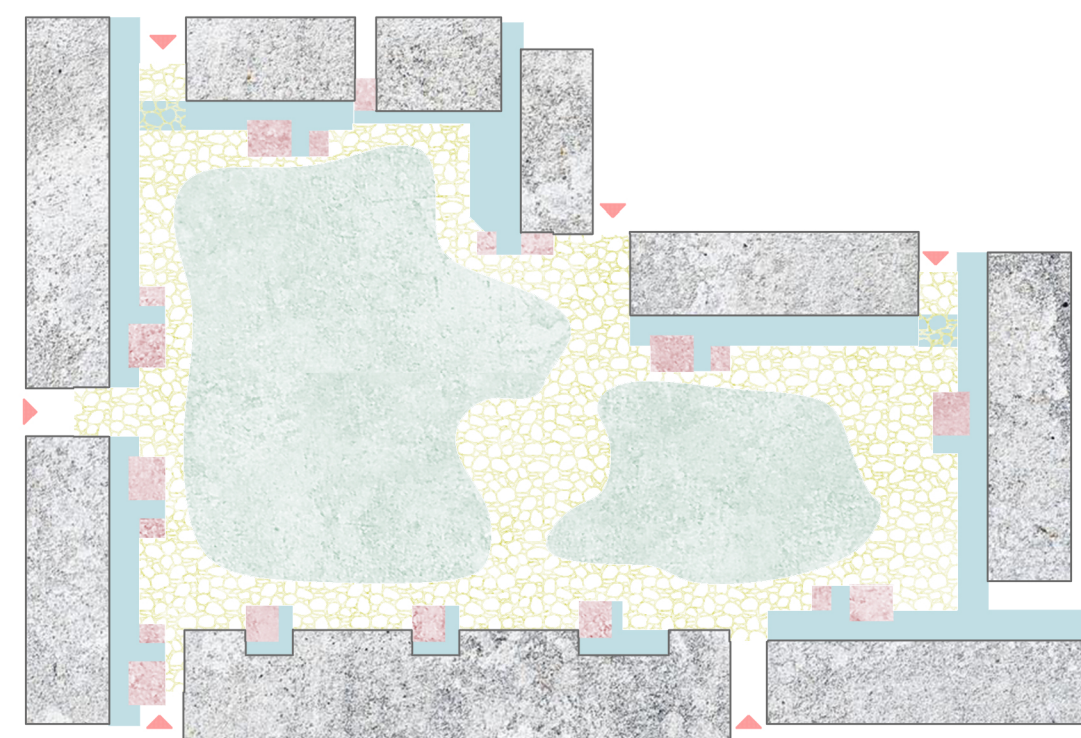
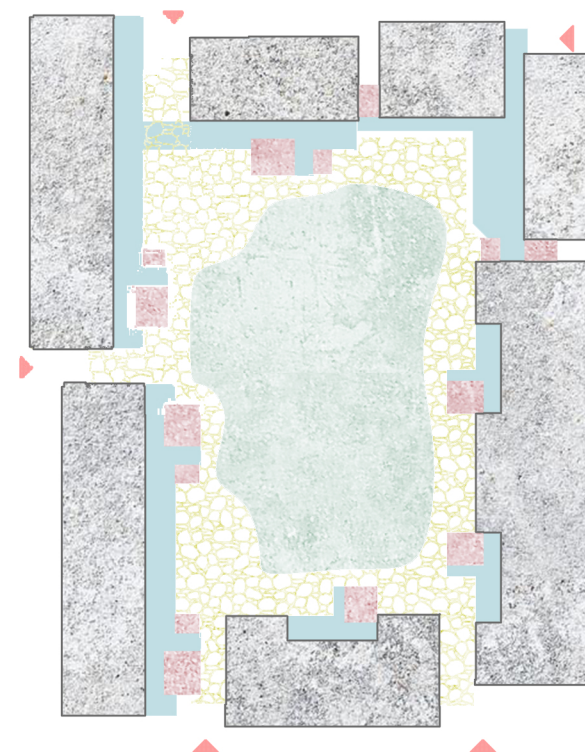
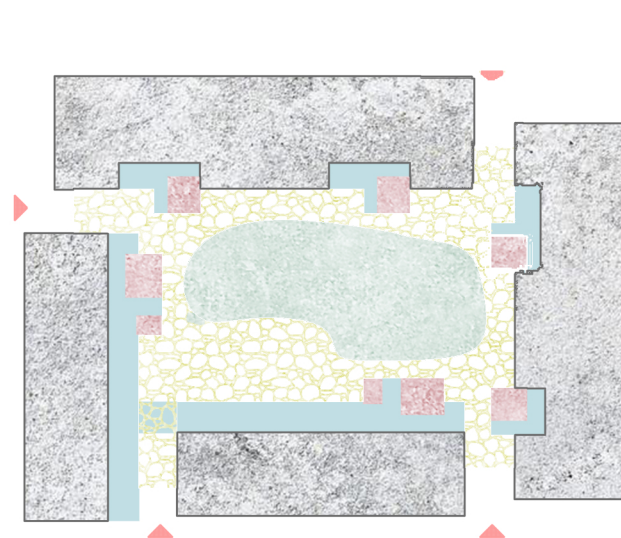






drinking coffee together





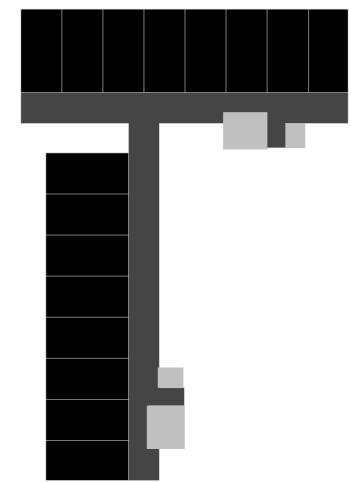




- | | |
|---|--|
|  <i>building</i> |  <i>courtyard path</i> |
|  <i>collective space</i> |  <i>multi-use courtyard</i> |

DESIGN | *Building types*

Type 1: Adaptive modular

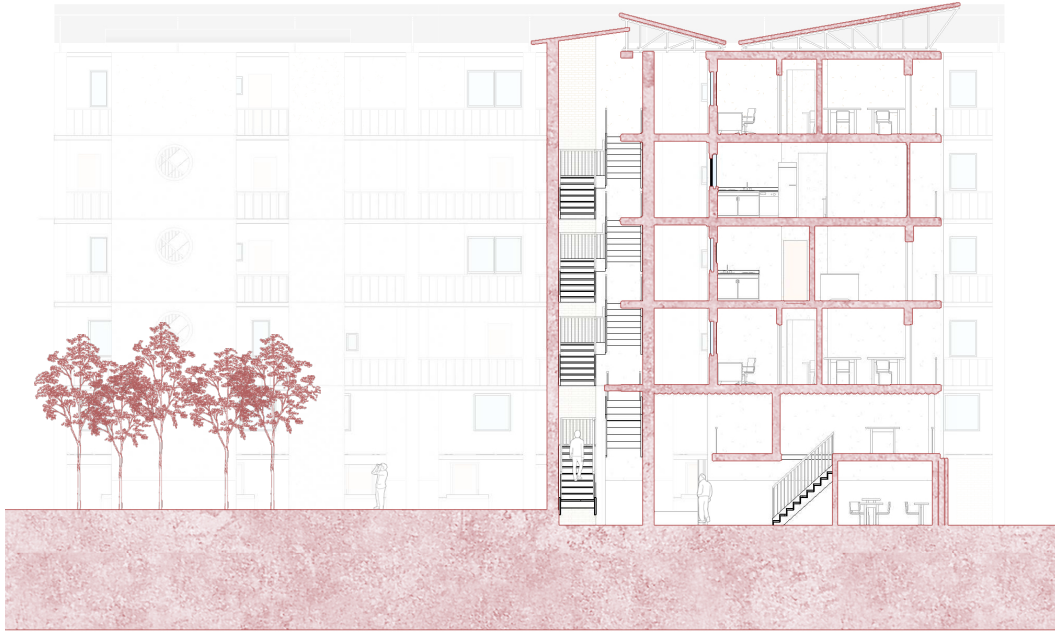


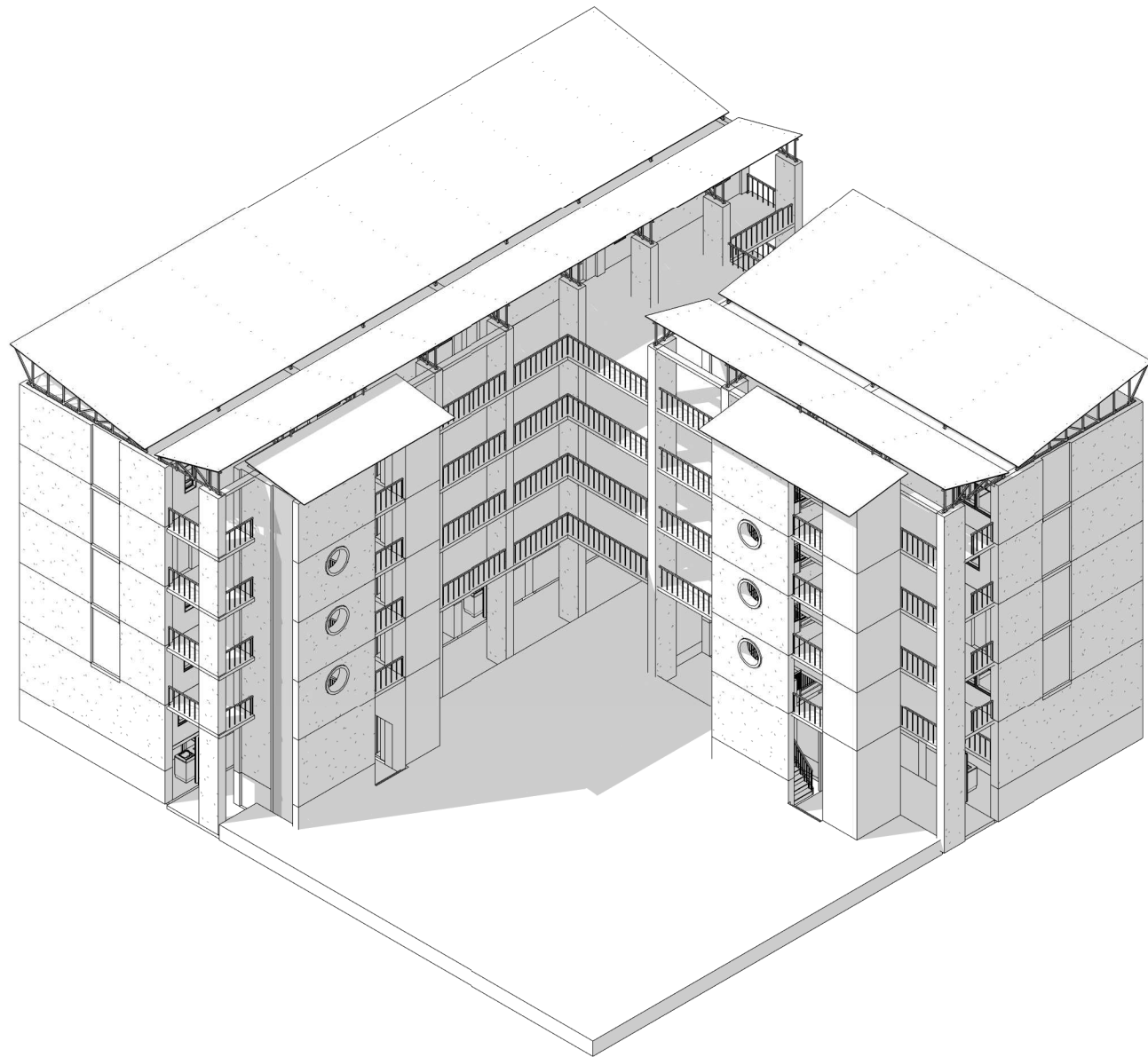


adaptability of units

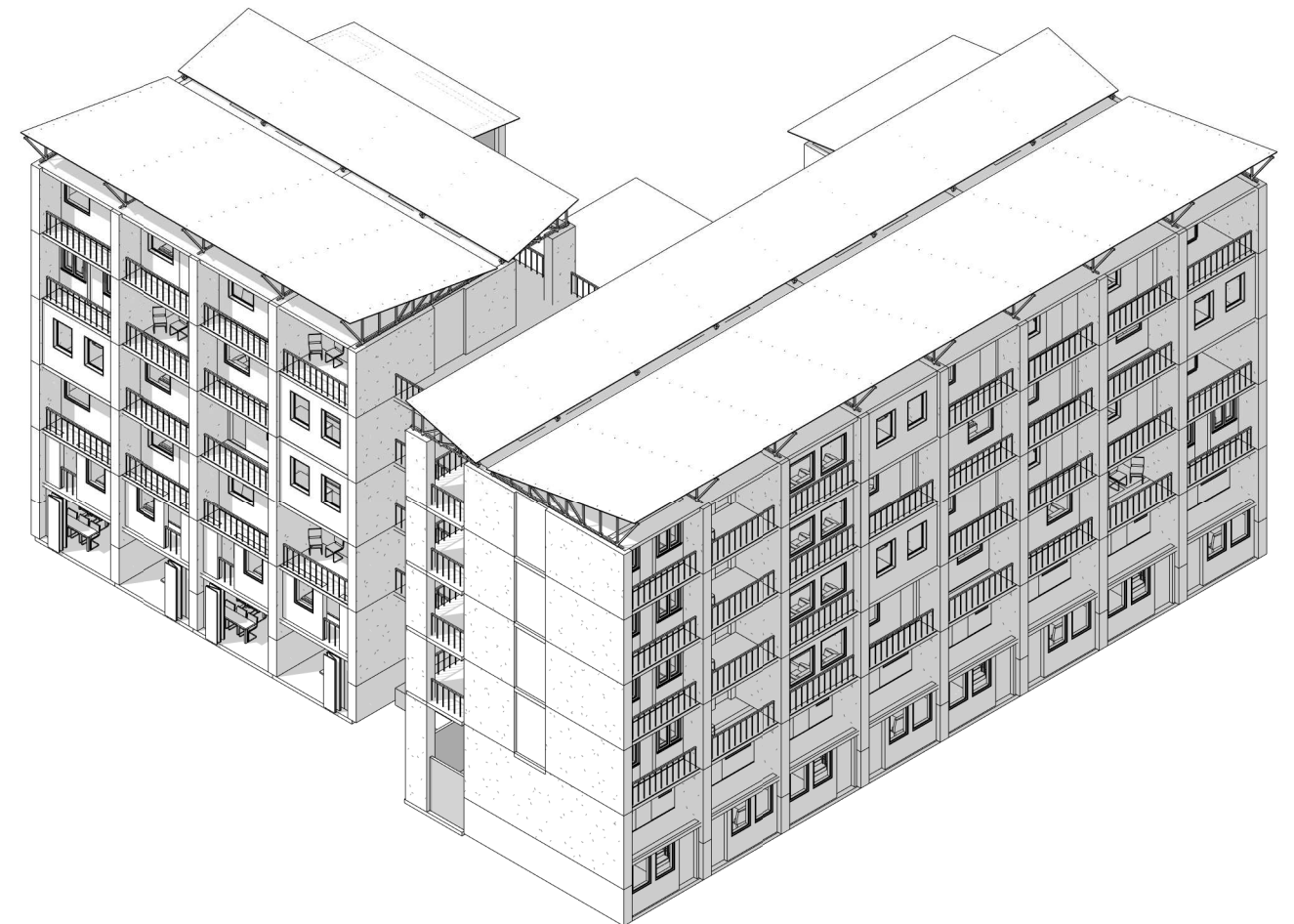


elevation and section





inner courtyard



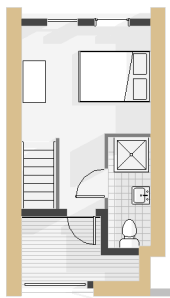
public street facade

units - ground floor maisonette

SHOP ADAPTATION

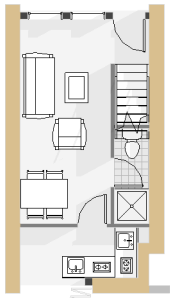


0F
29 m²

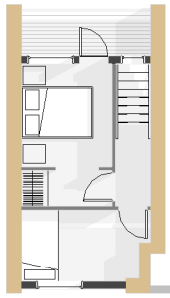


1F
29 m²

RESIDENTIAL ADAPTATION



0F
29 m²



1F
29 m²

units - upper floor adaptation possibilities



29 m²



58 m²



58 m²



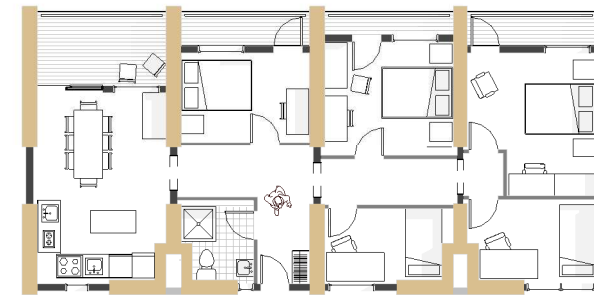
87 m²



87 m²

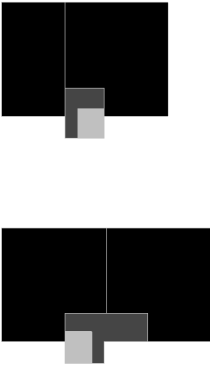


116 m²



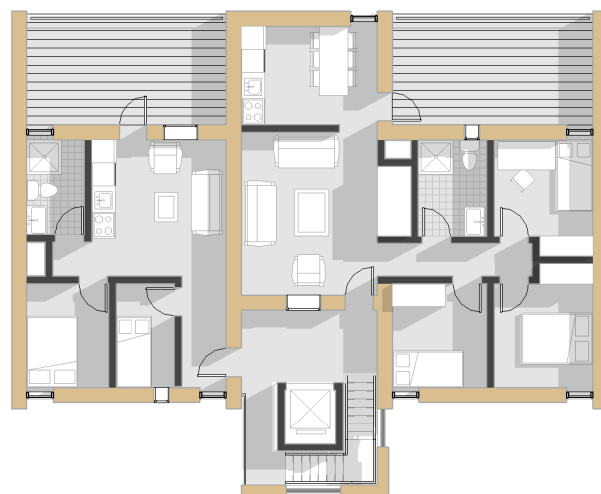
116 m²

Type 2: Middle income portico

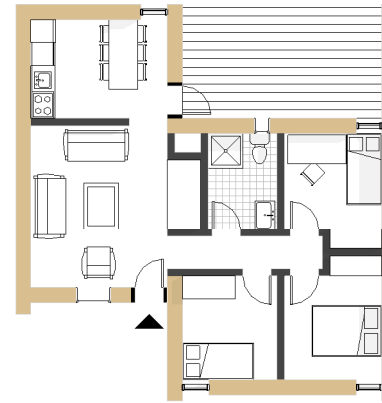




Type AA



Type AB

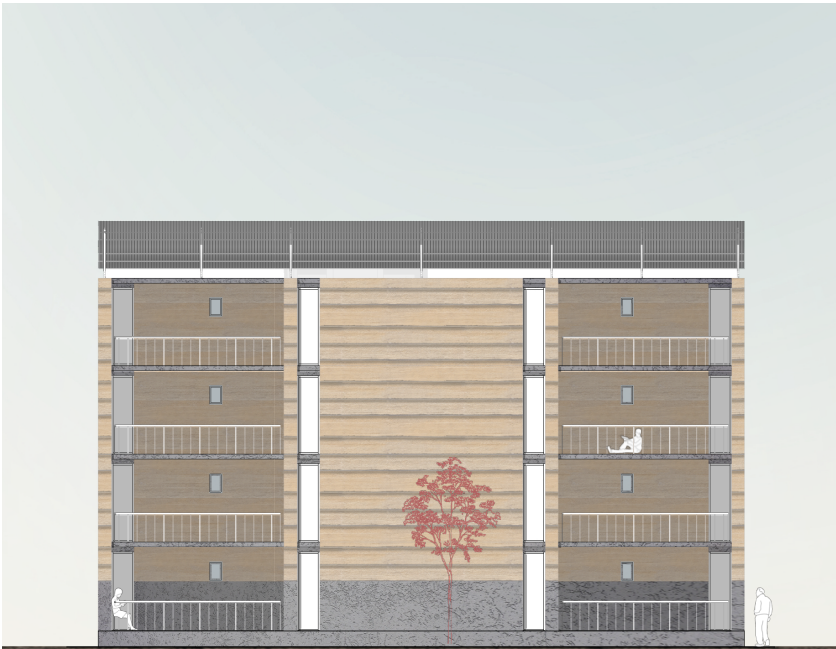


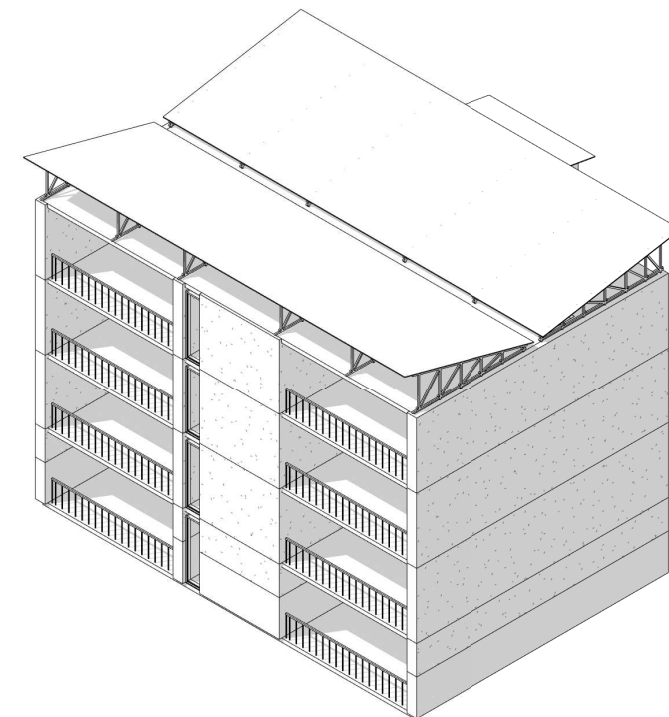
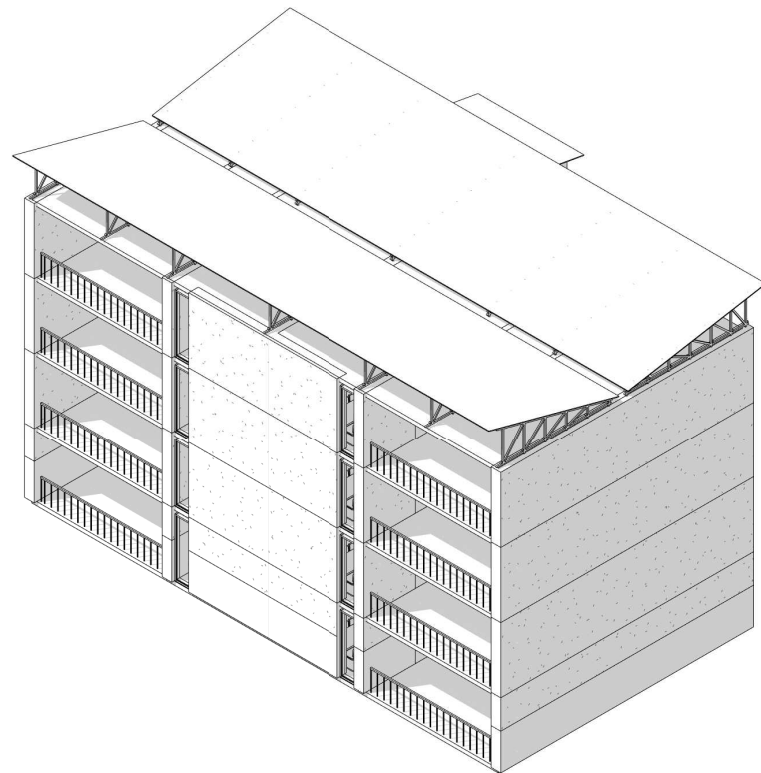
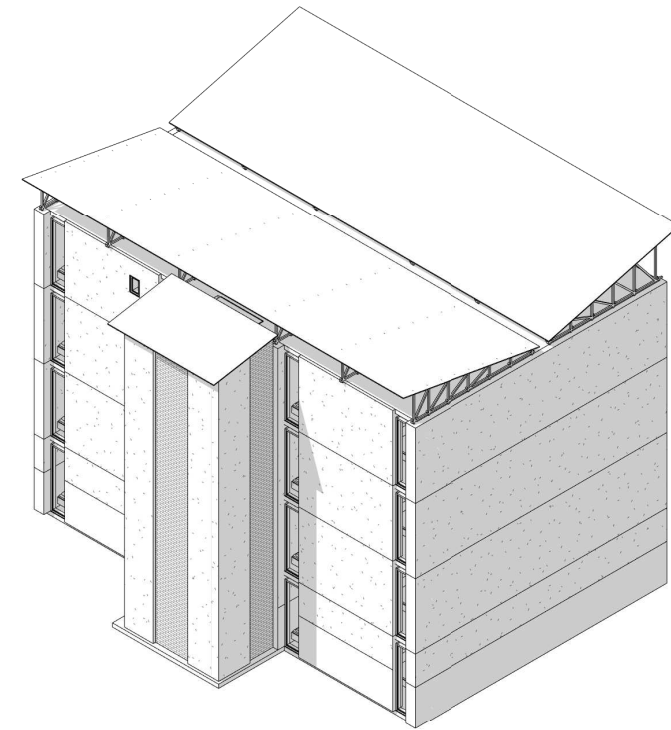
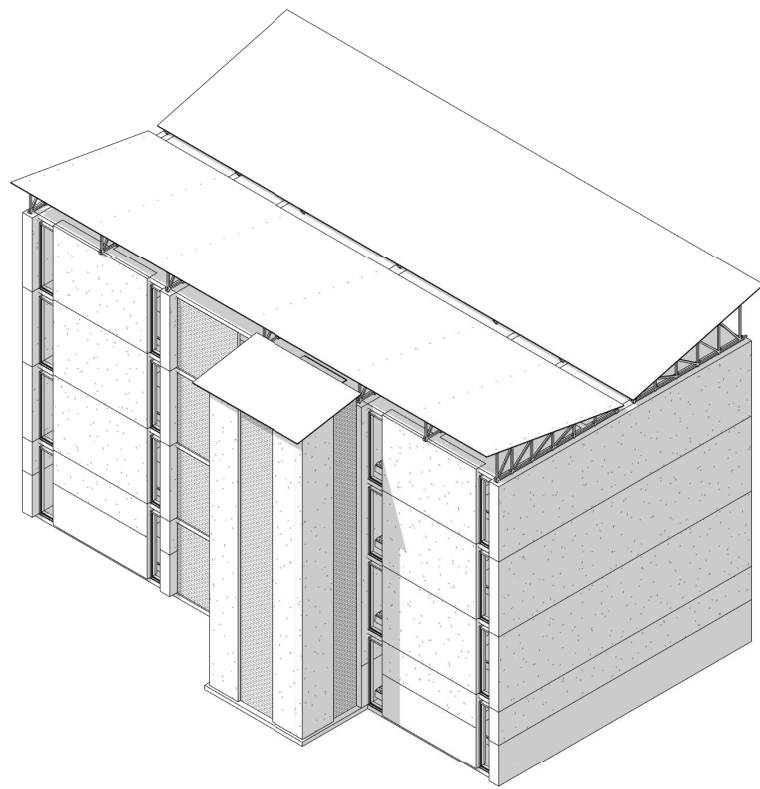
Unit type A
90 m²



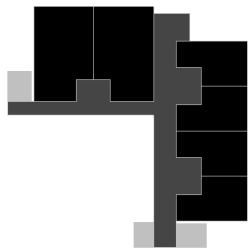
Unit type B
58 m²

elevation and section



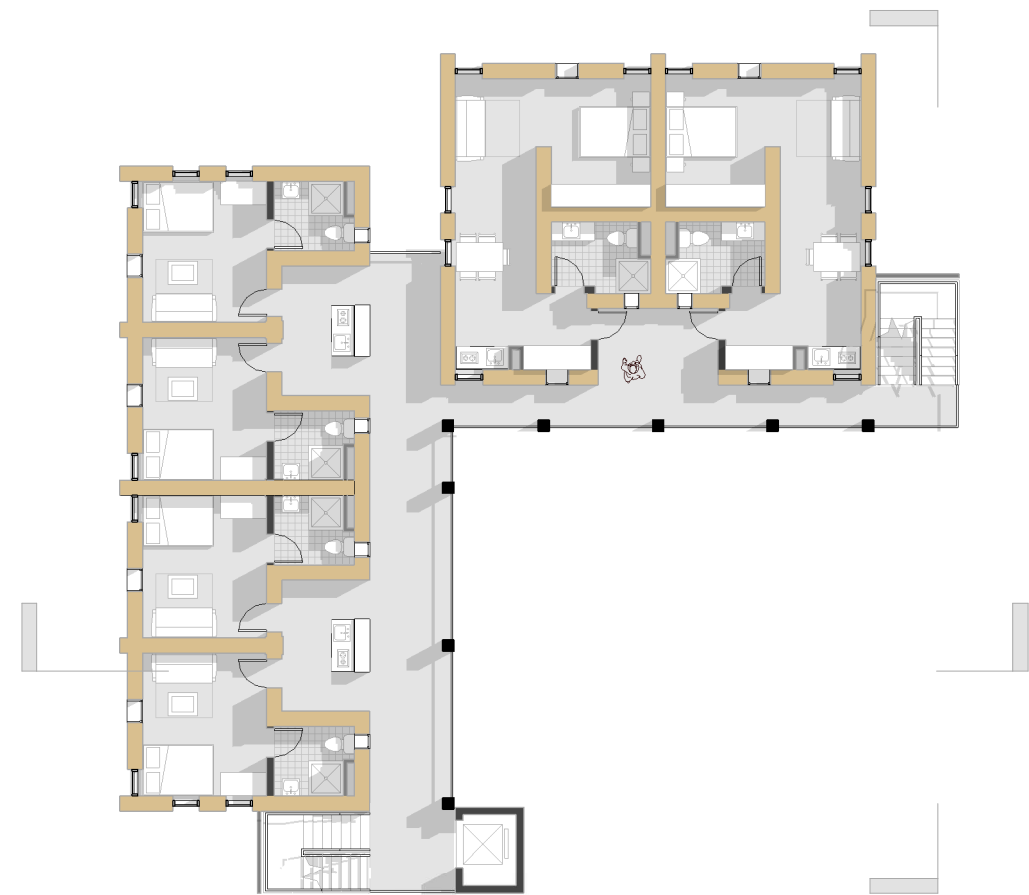


Type 3: Urban Corner



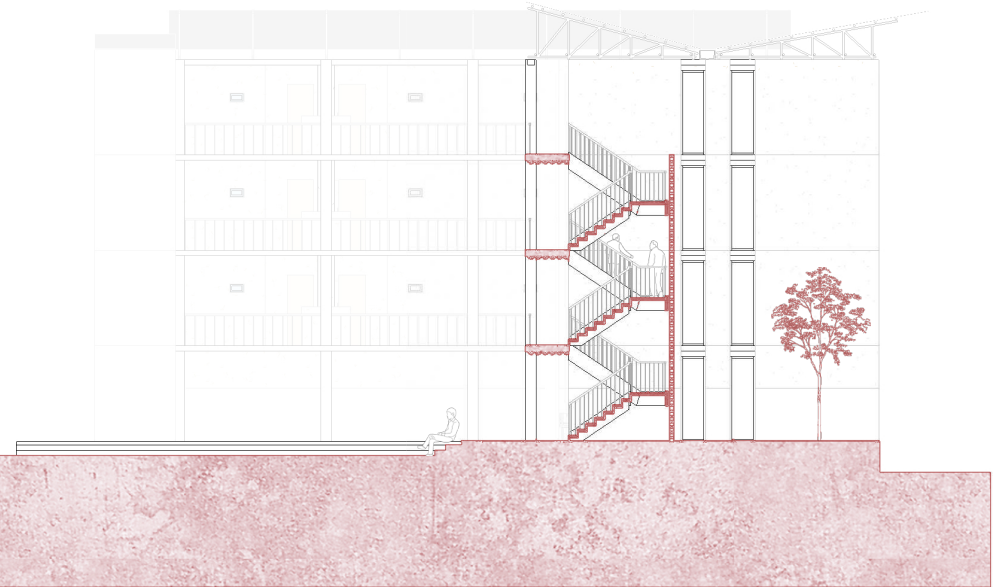
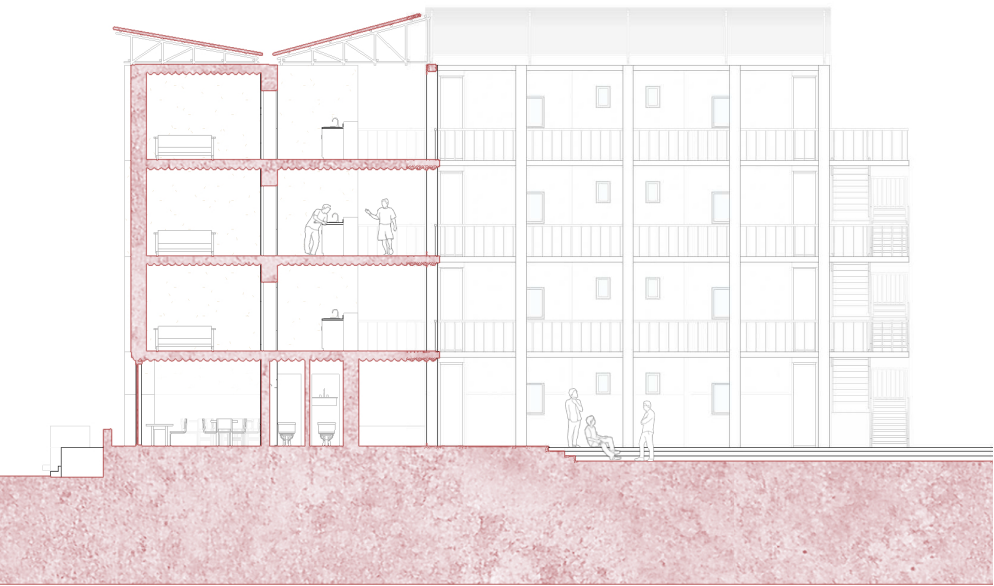


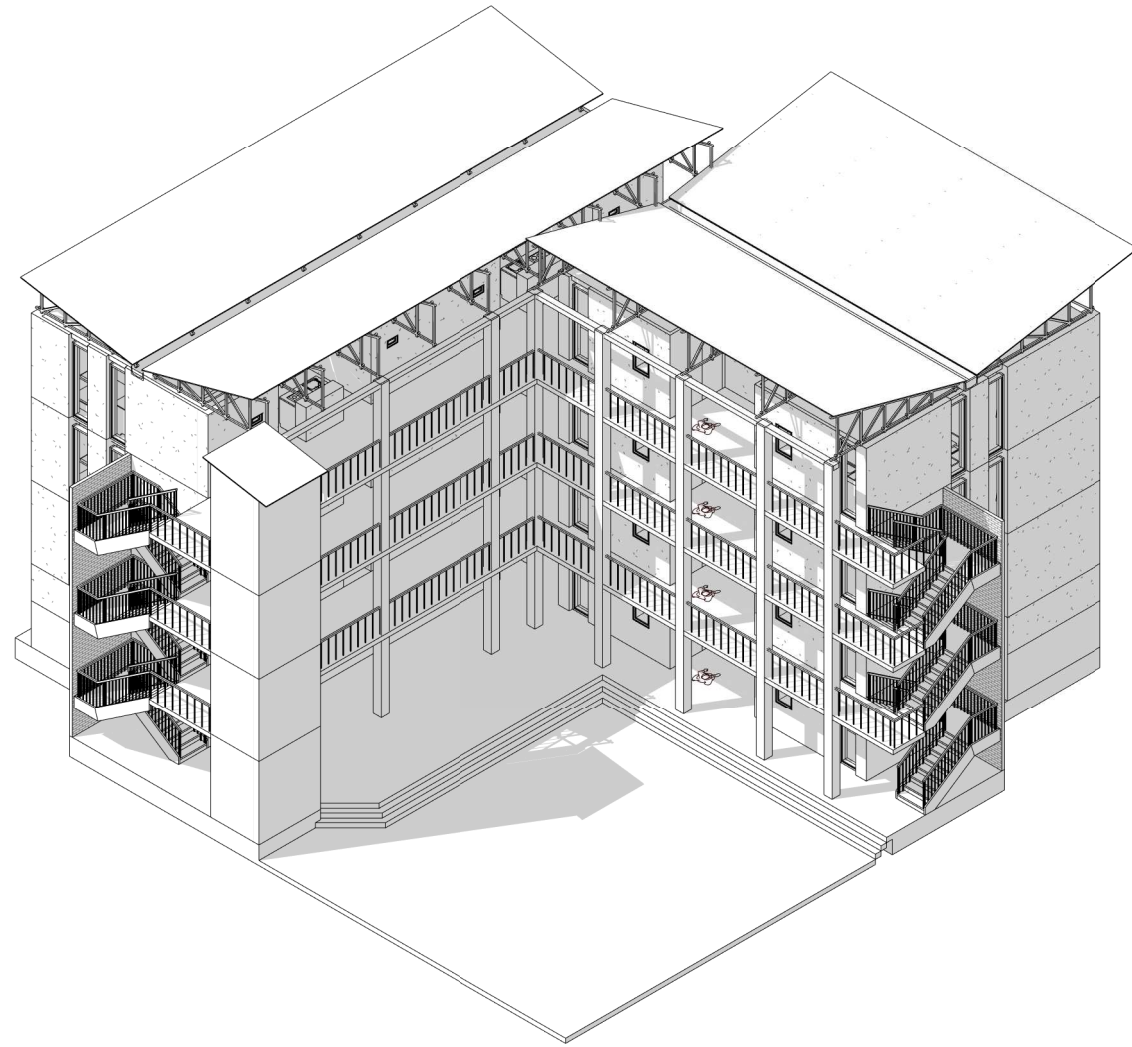
ground floor



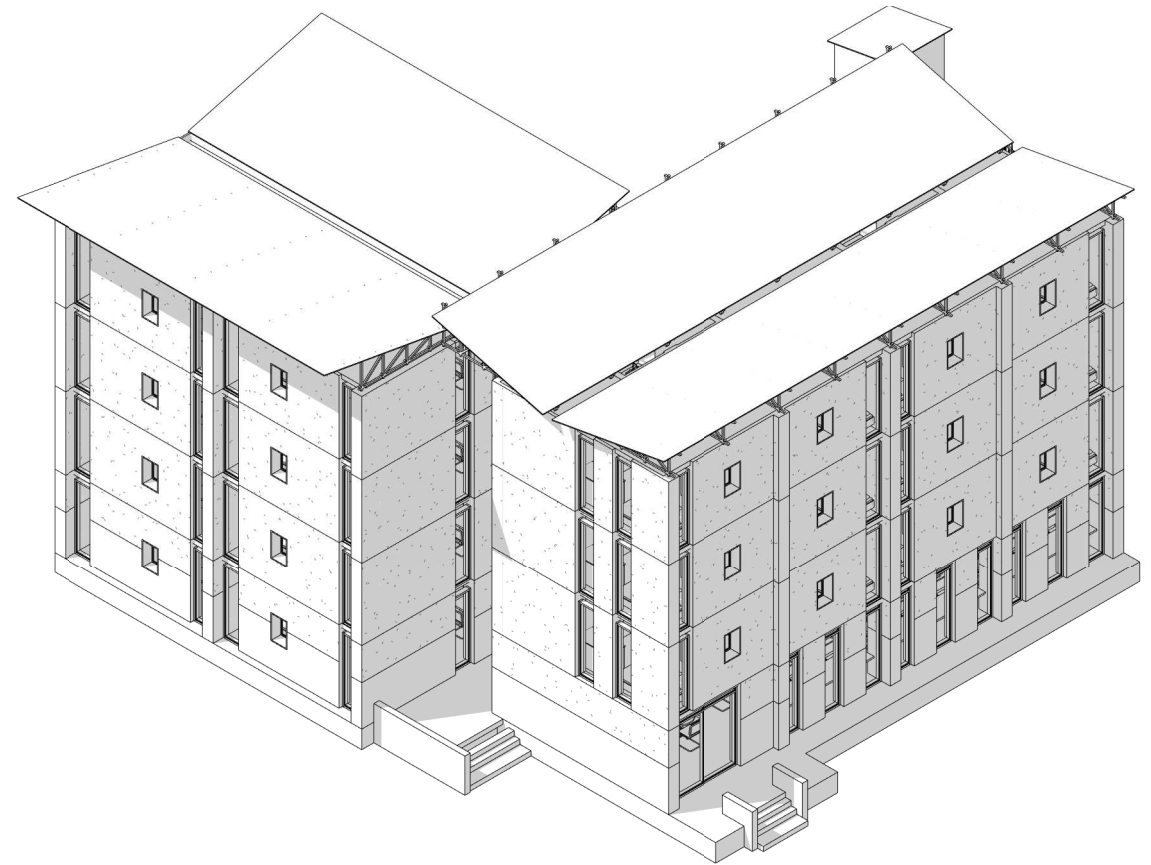
typical upper floor

elevation and section

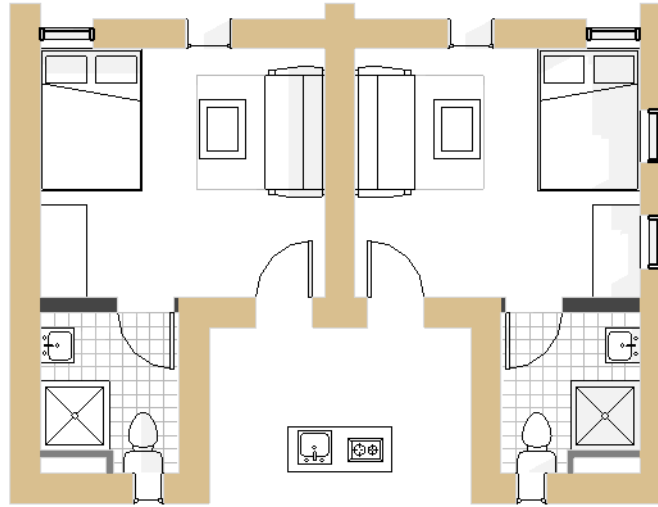




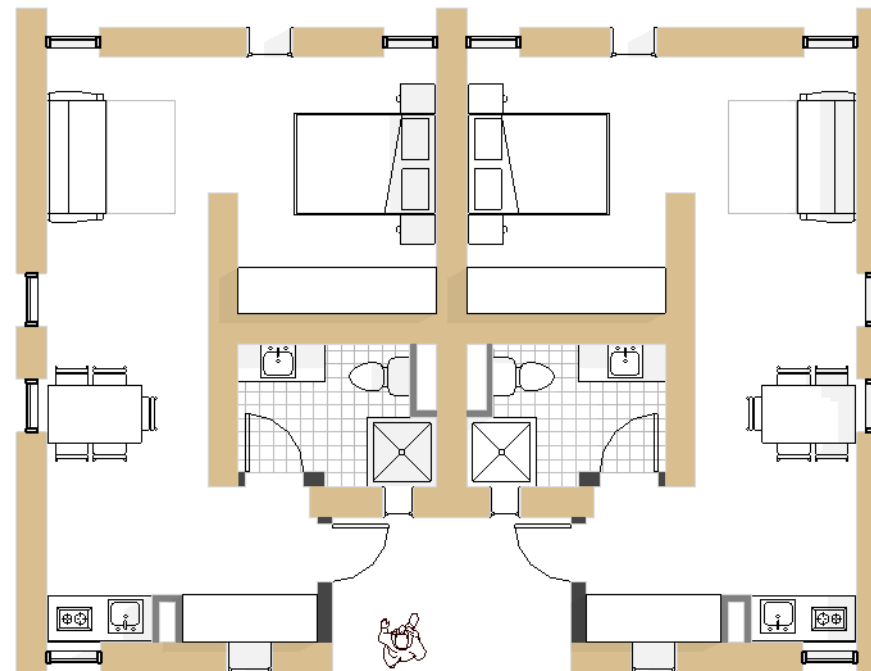
inner courtyard



public street facade



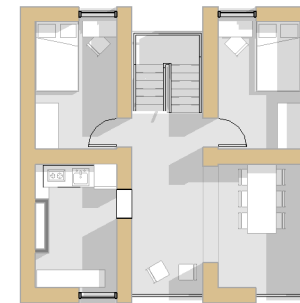
22 m²



43 m²

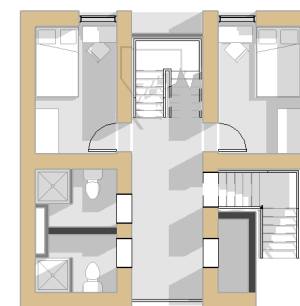
Type 4: Workers Co-Housing





2F

bedroom unit
10 m²

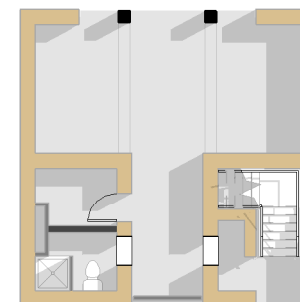


1F

shared kitchen
9,5 m²

shared dining space
17,8 m²

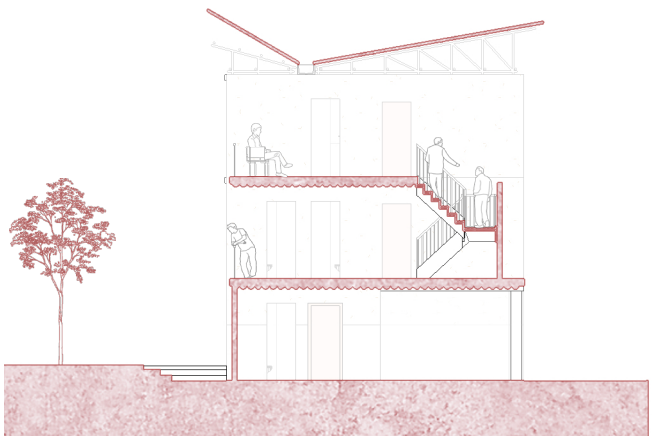
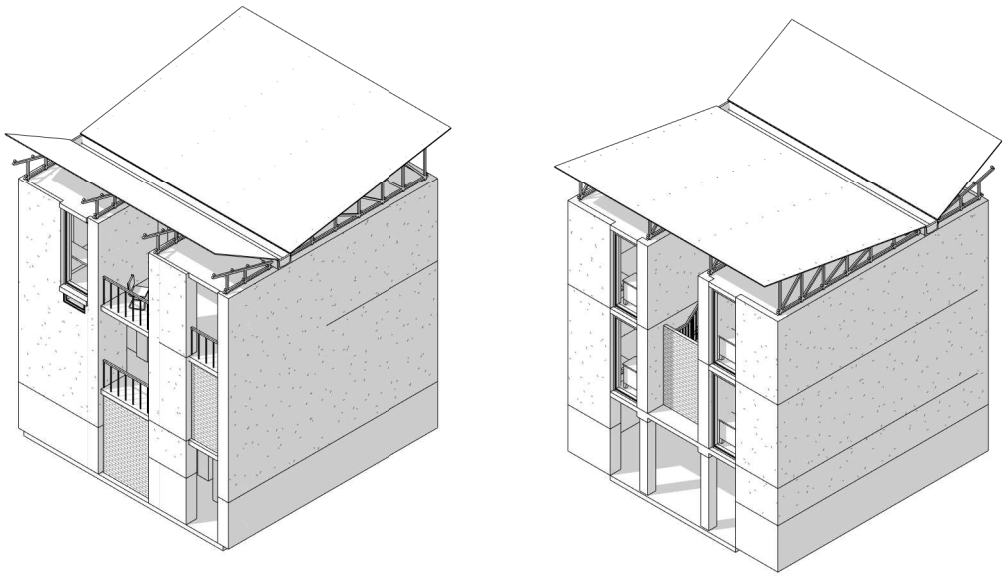
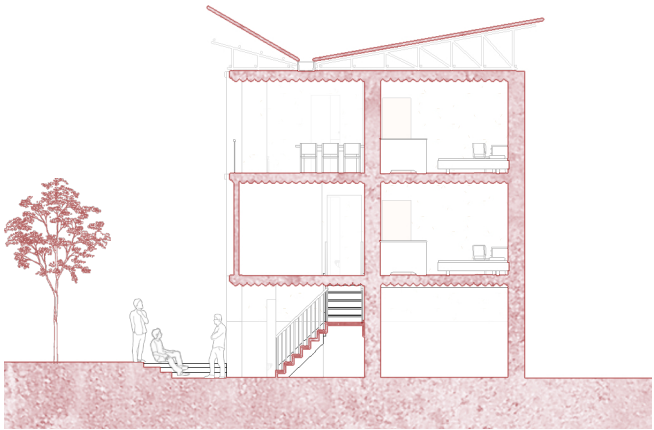
shared wash room
9,5 m²



0F

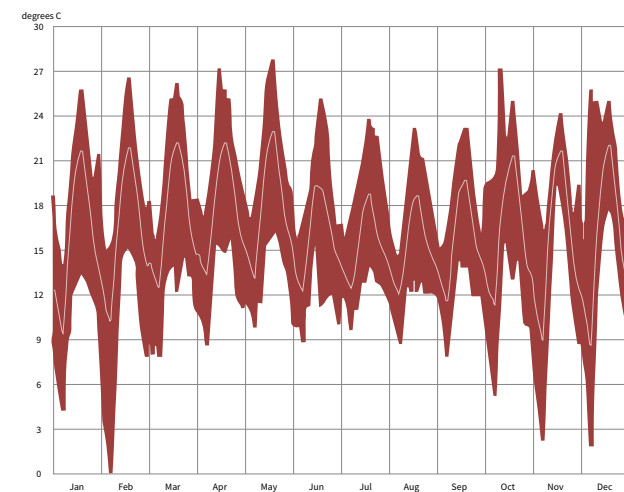
shop plinth
46 m²

elevation and section

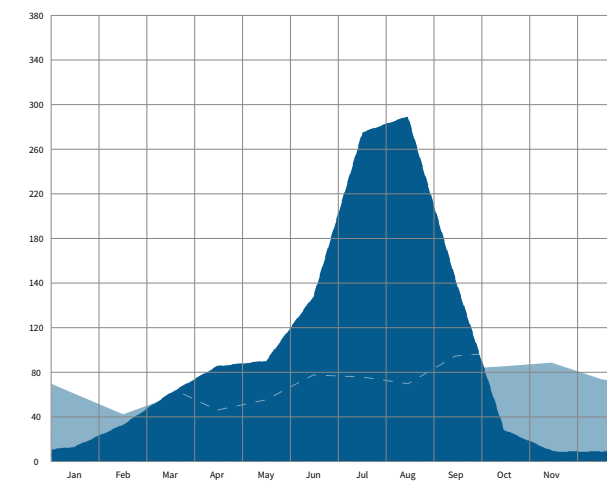


DESIGN | *Building Technology*

Climate challenges

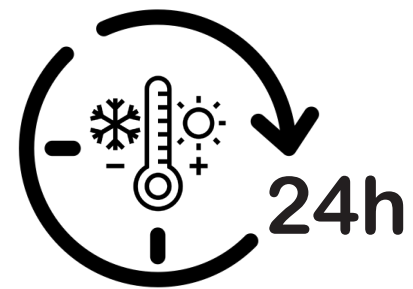


(Barbero et al., 2020, p. 6)



(Barbero et al., 2020, p. 8)

Climate challenges



*alleviating day/night temperature
differences*



*utilise the monsoon season as
solution for drought*

Stabilised rammed earth wall



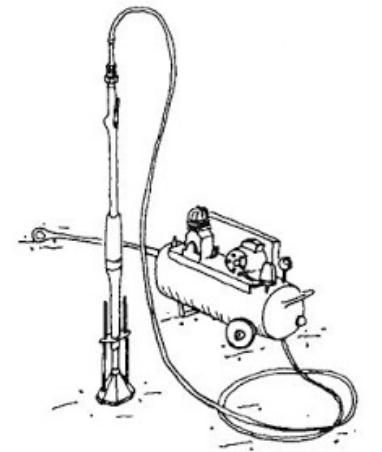
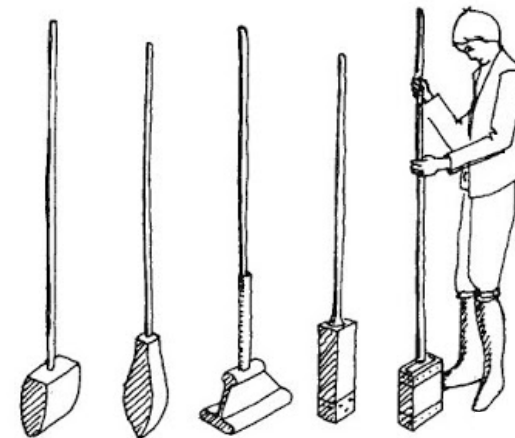
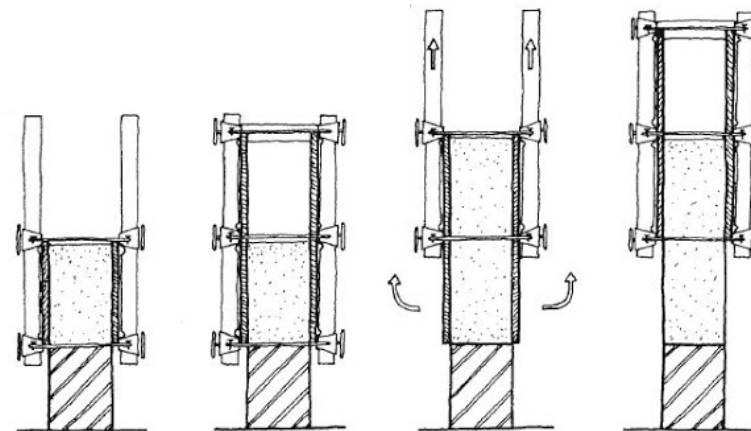
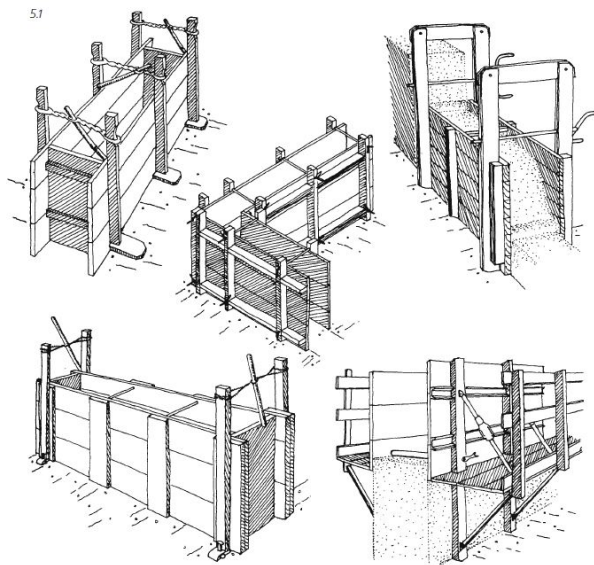
mining the soil

mixing with cement

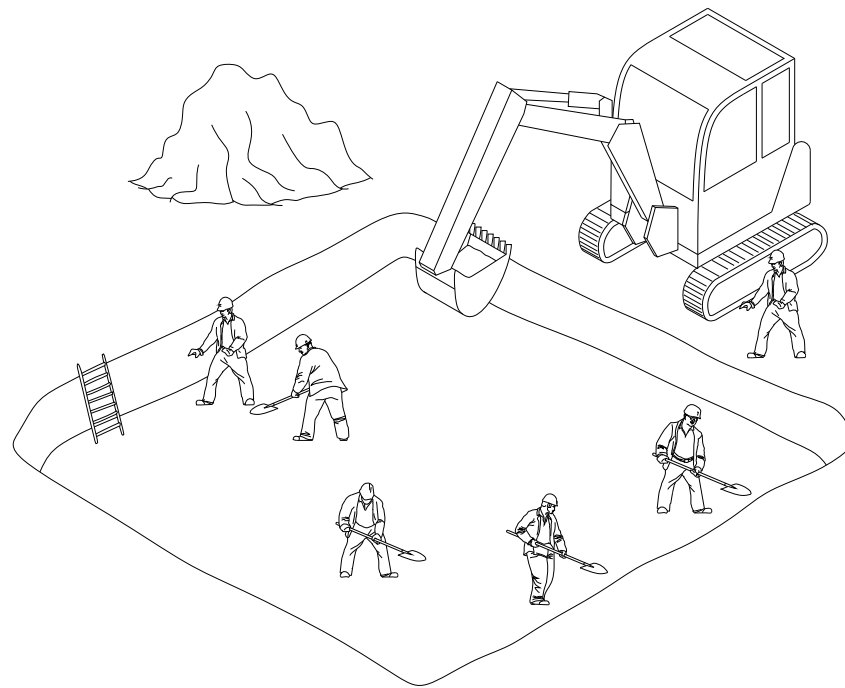
transport to location

pouring into the form work and start ramming

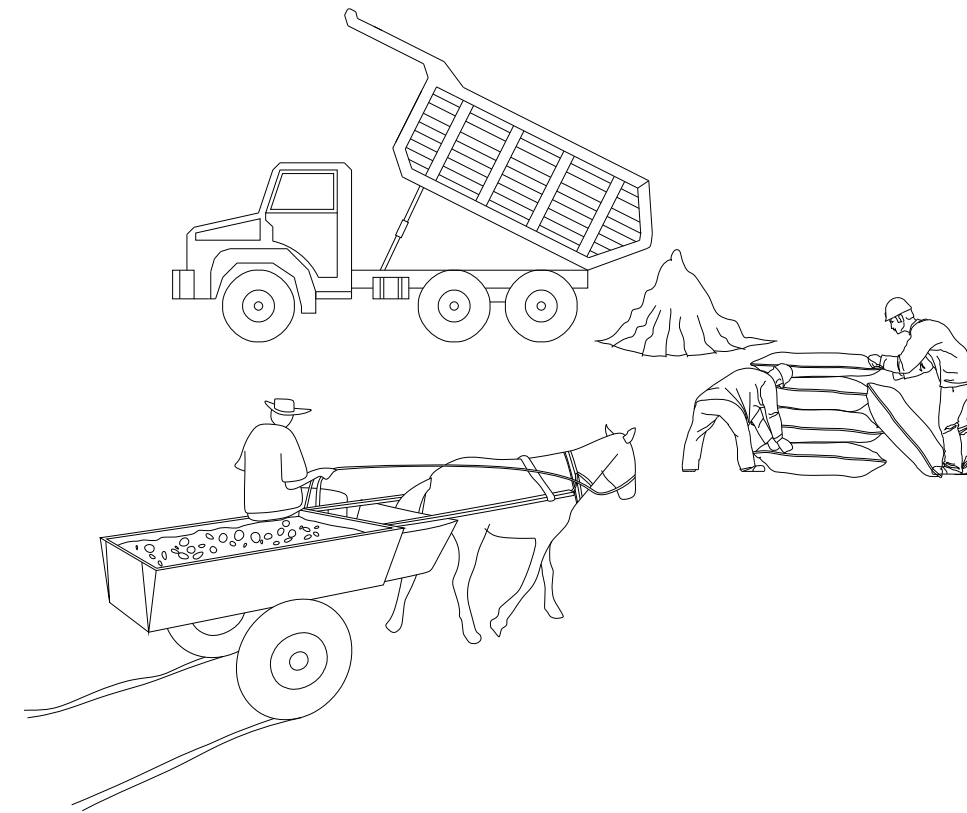
take away the form work after completion



Stabilised rammed earth wall

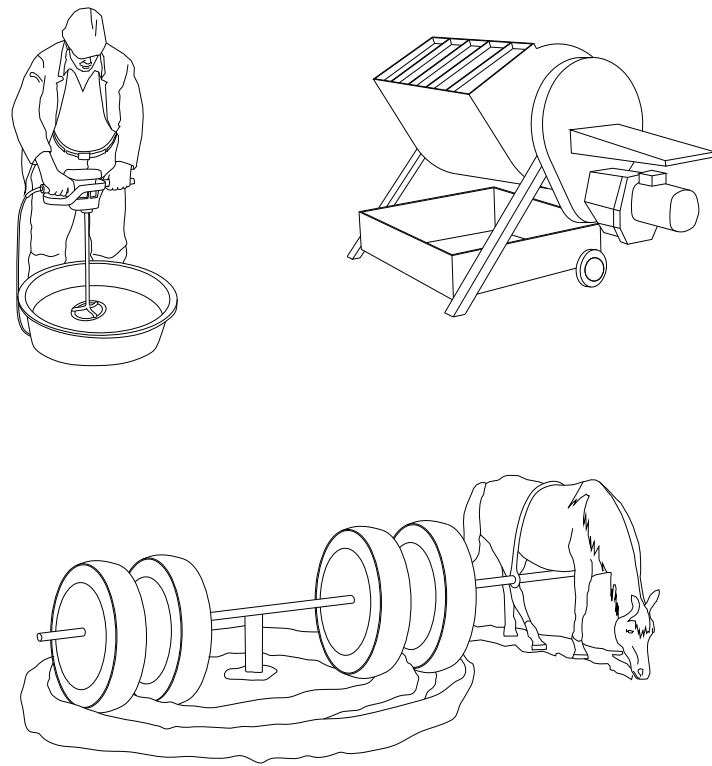


STEP 1 - MINING SAND

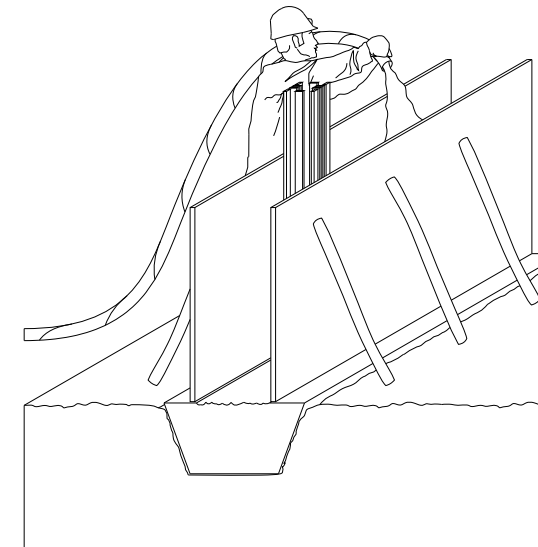


STEP 2 - TRANSPORTING CLAY, GRAVEL AND CEMENT

Stabilised rammed earth wall

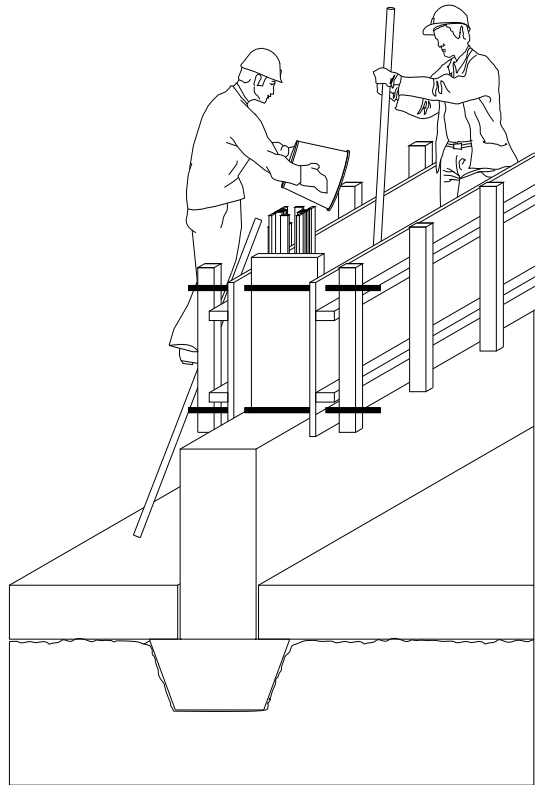


STEP 3 - MIXING

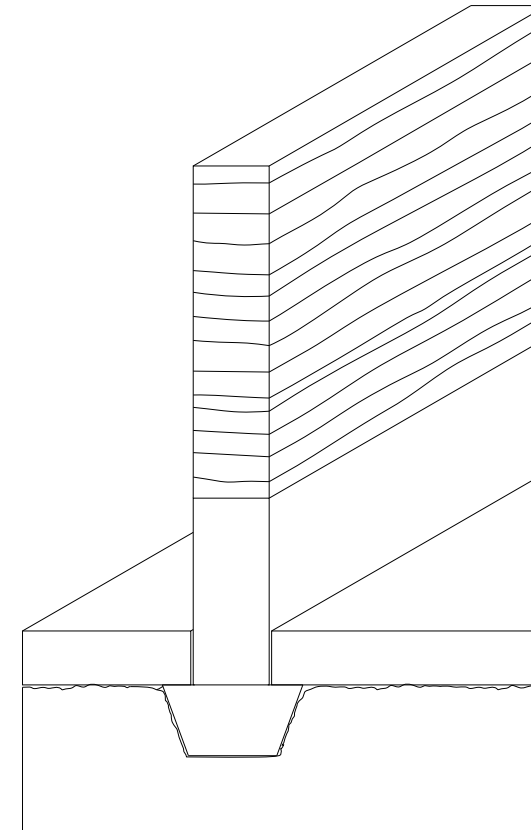


STEP 4 - CONCRETE BASE WALL

Stabilised rammed earth wall

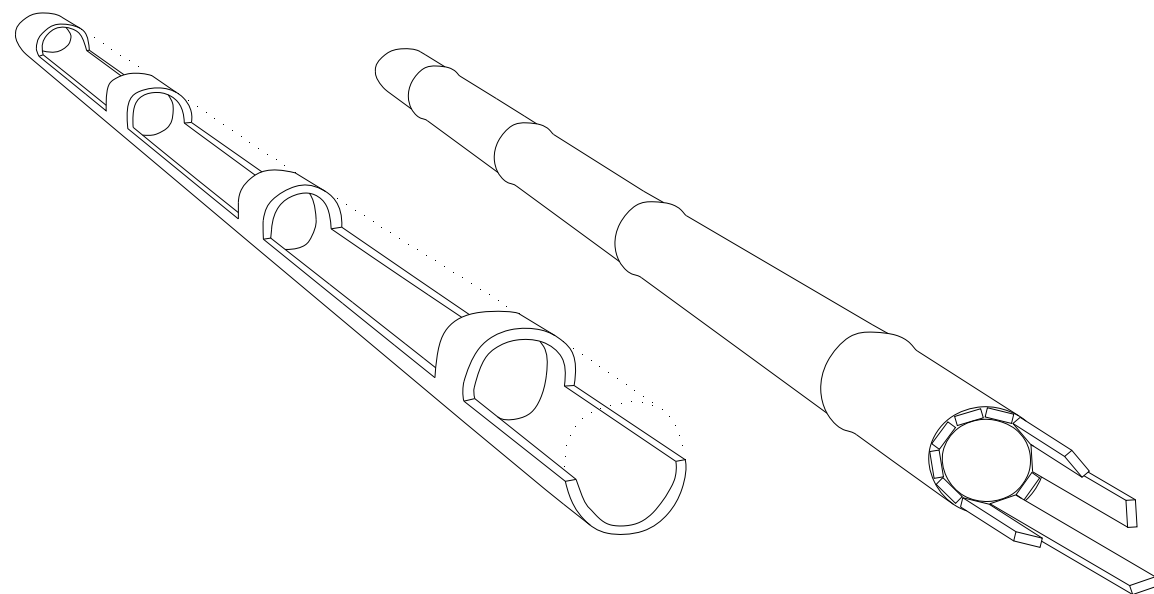


STEP 5 - RAMMING

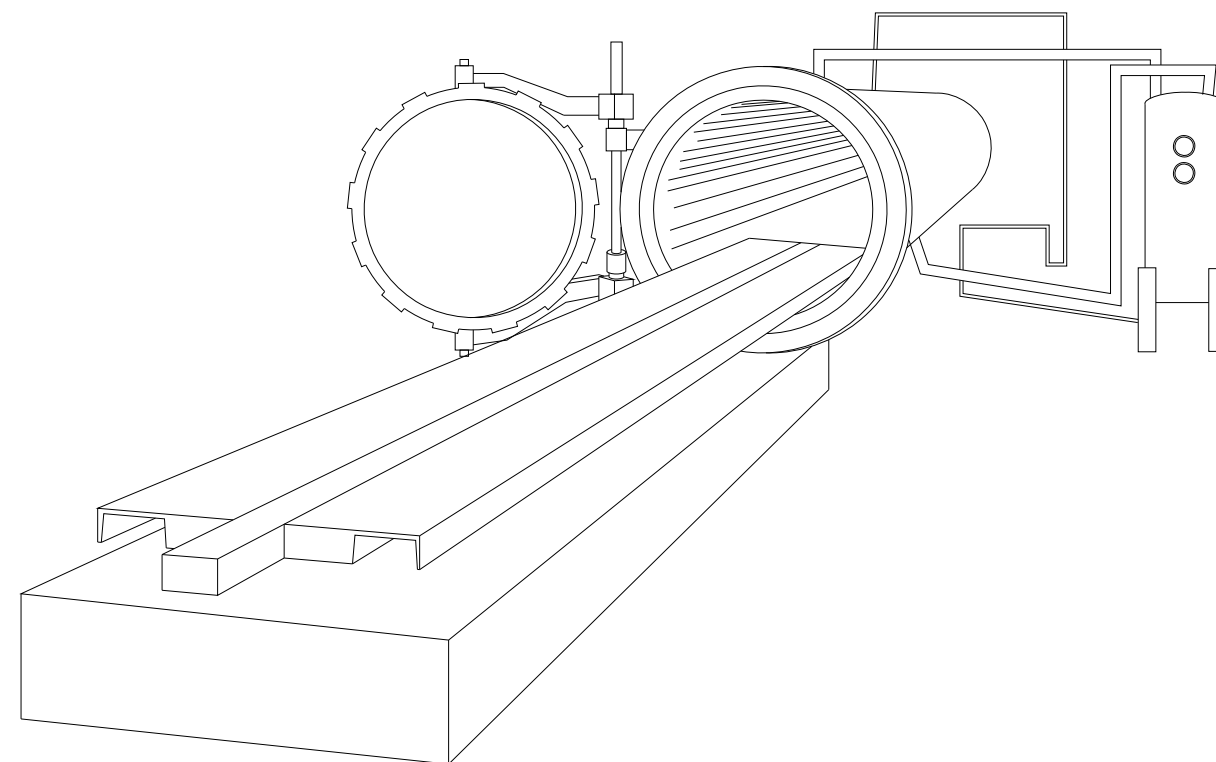


STEP 6 - DRYING

Bamboo lost form work

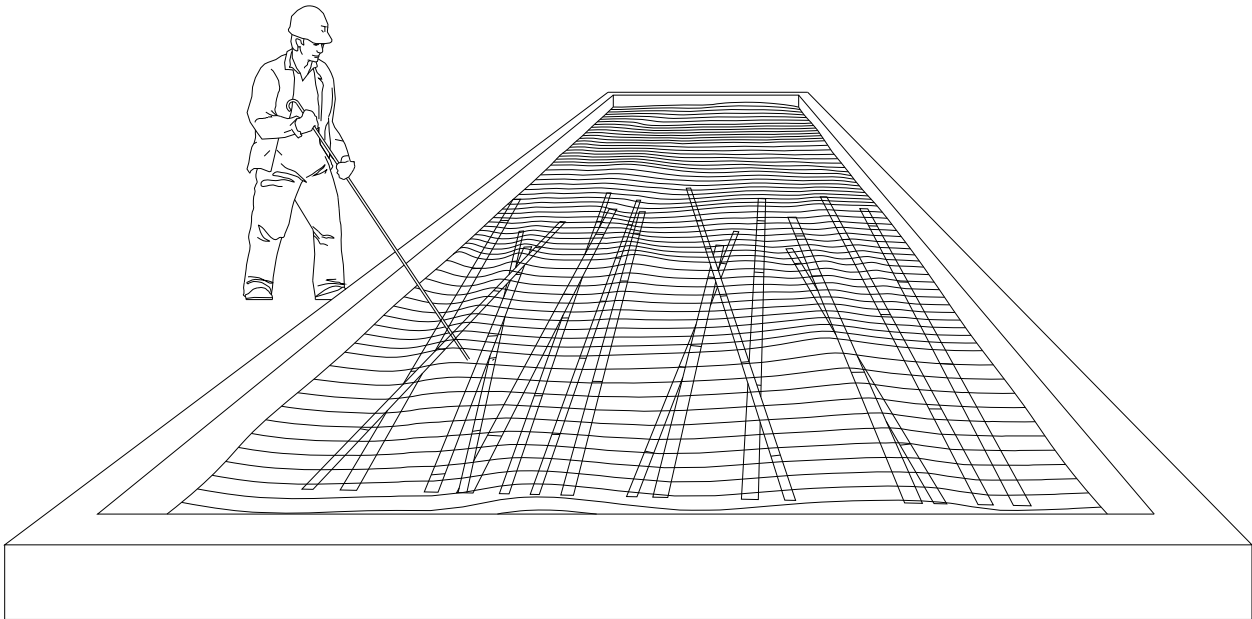


STEP 1 - CUTTING

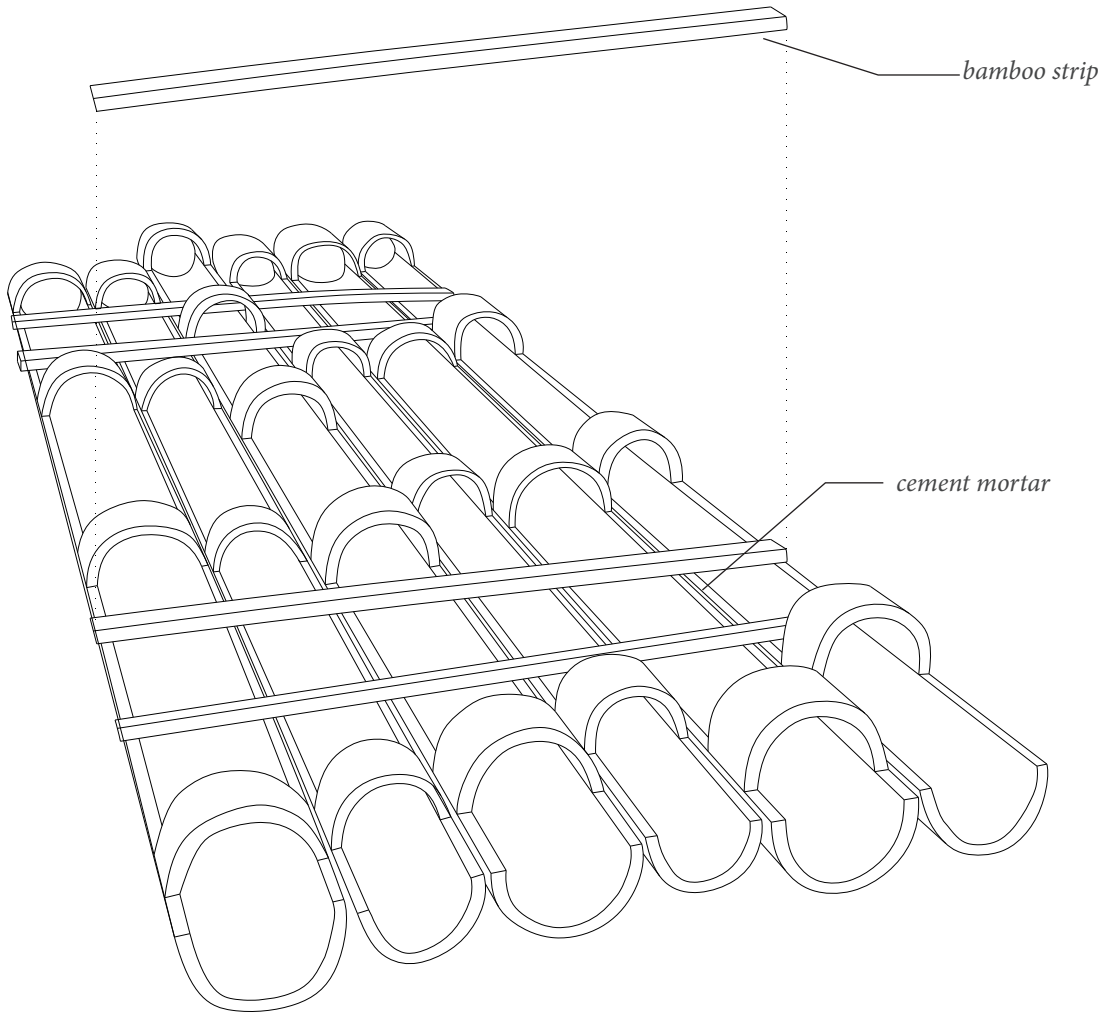


STEP 2 - PRESSURE TANK

Bamboo lost form work

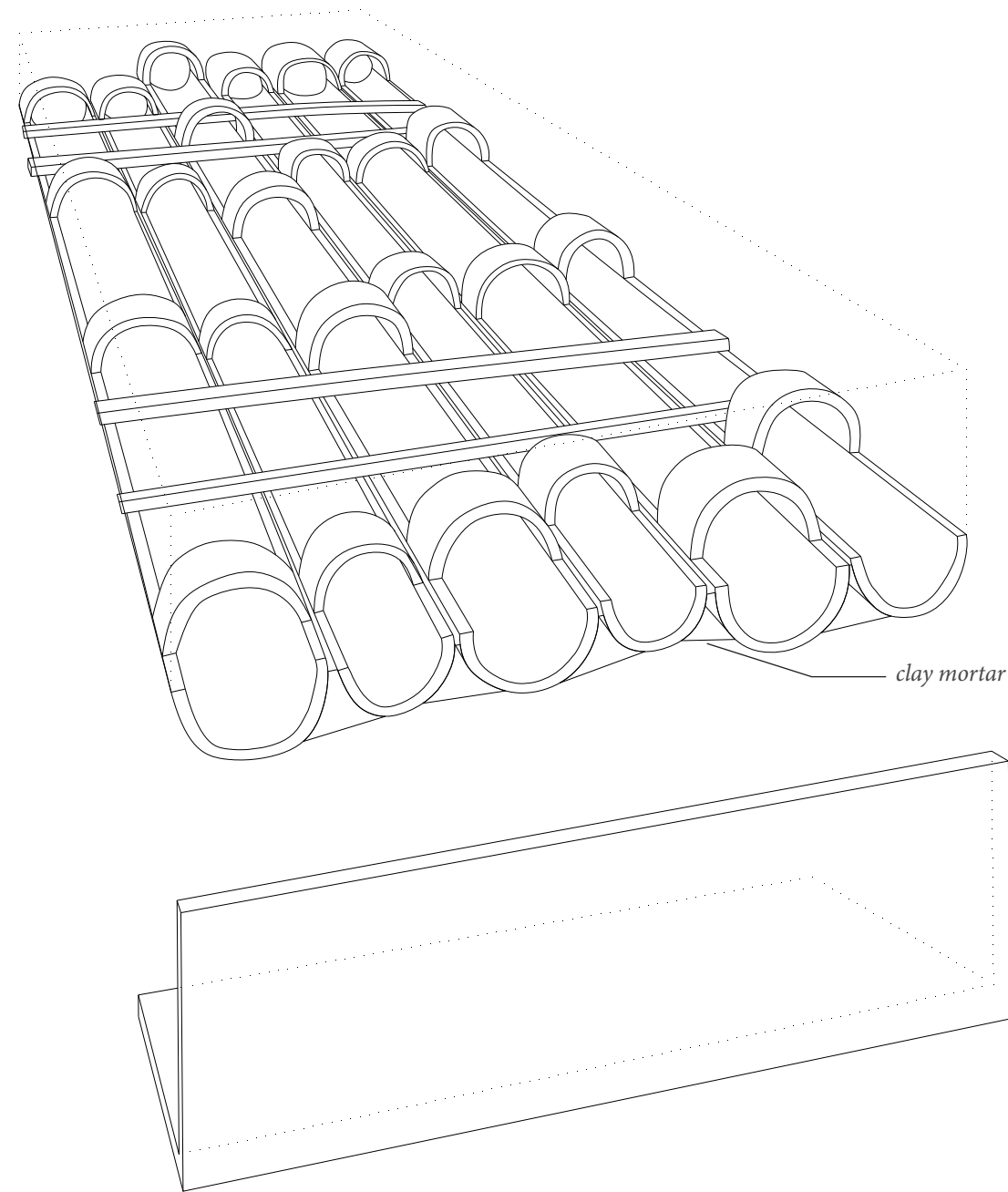


STEP 3 - TAR COATING

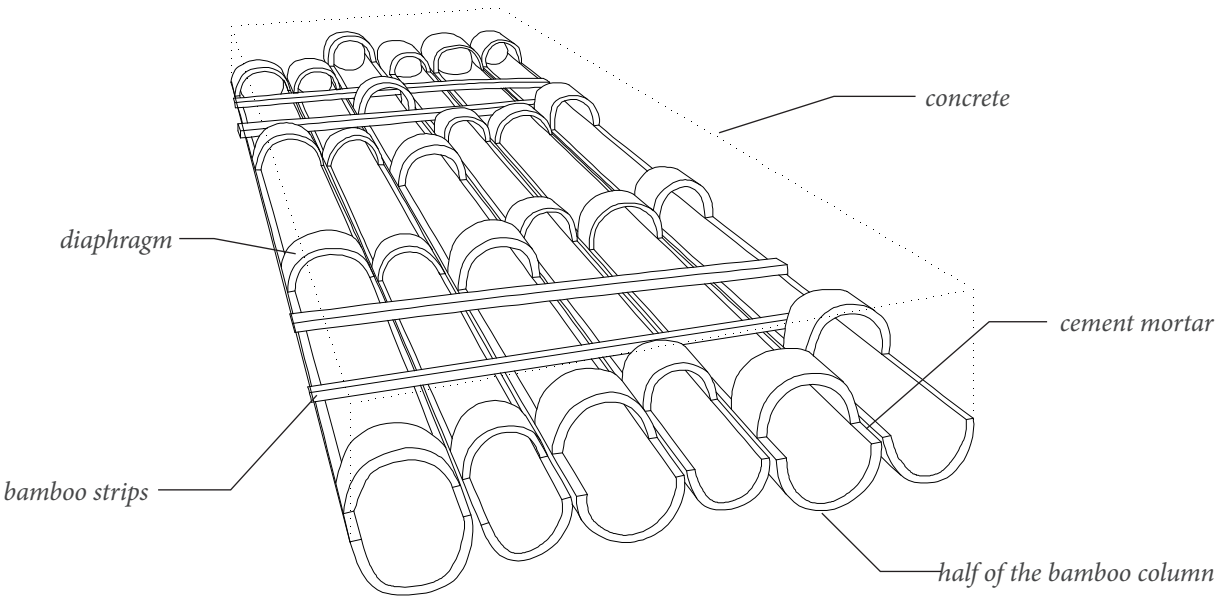


STEP 4 - ASSEMBLING THE FORM WORK

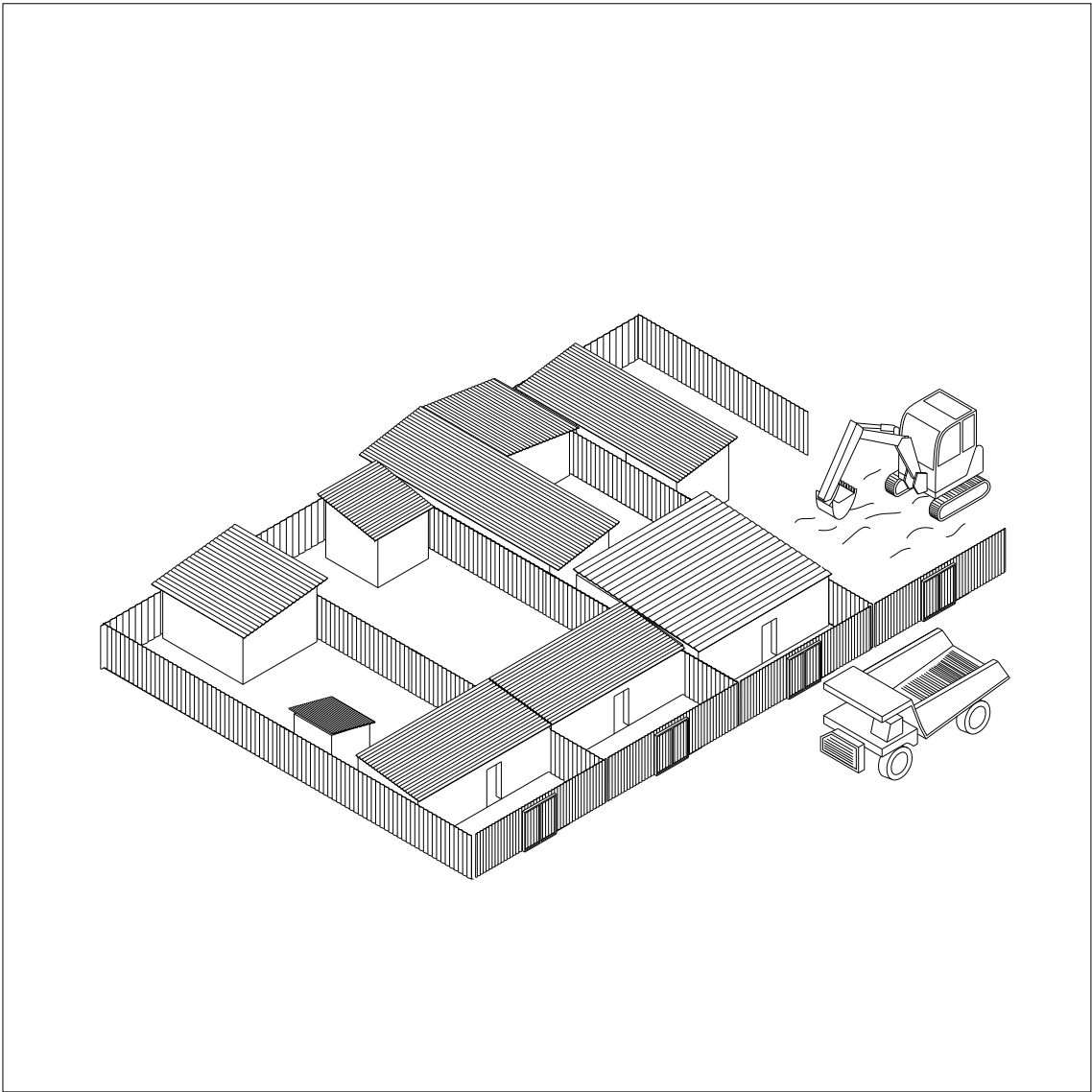
Bamboo lost form work



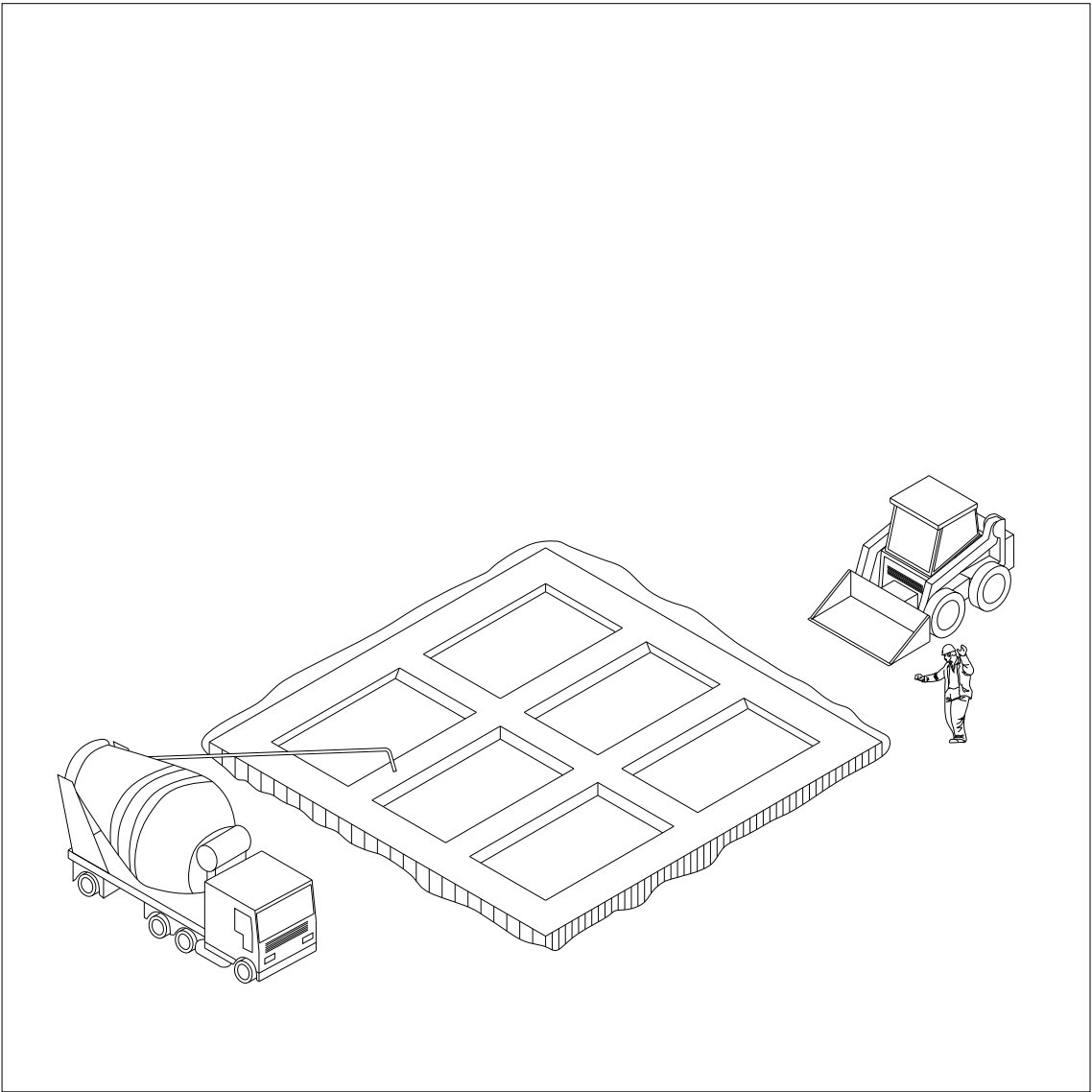
STEP 5 - CLOSING THE GAPS



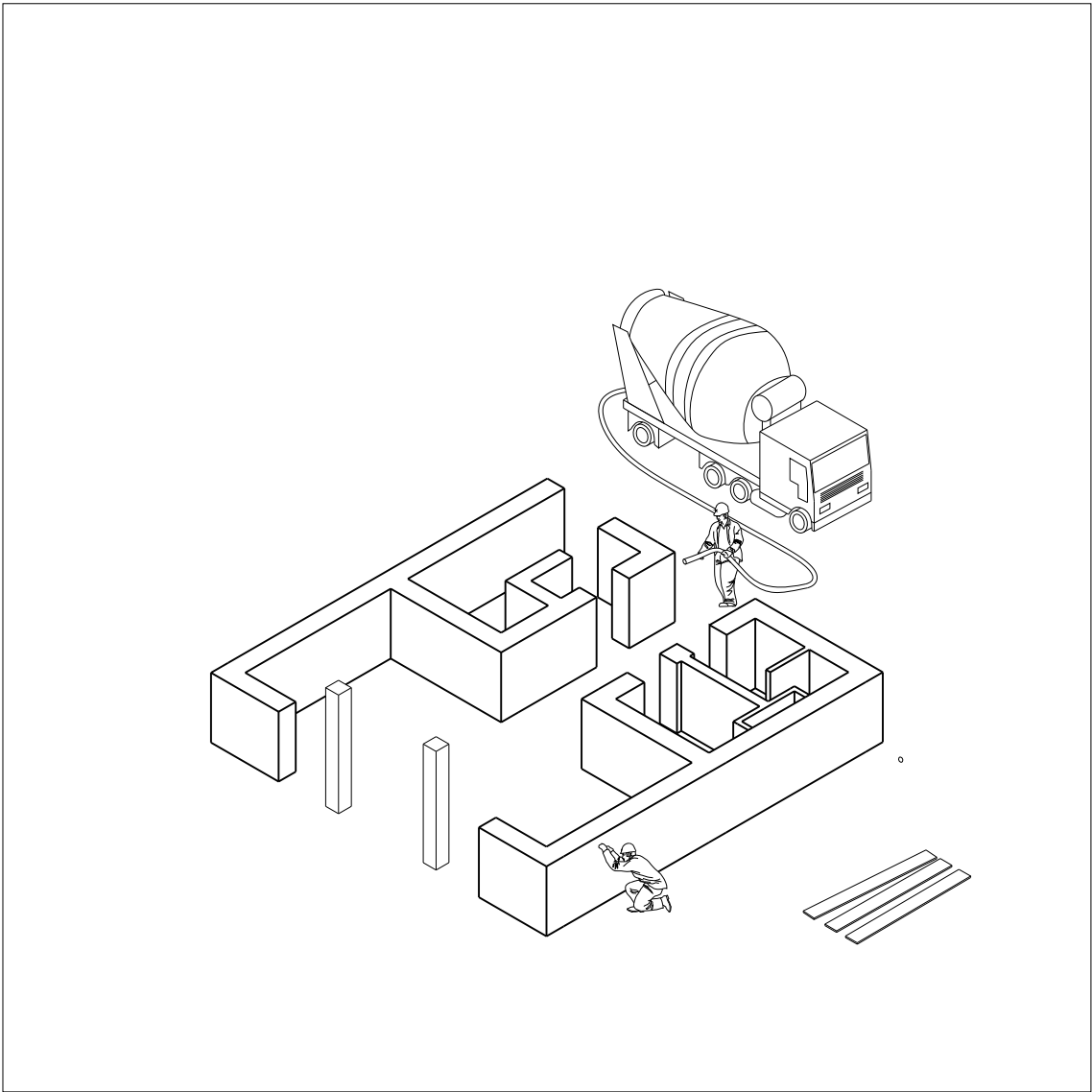
Construction process



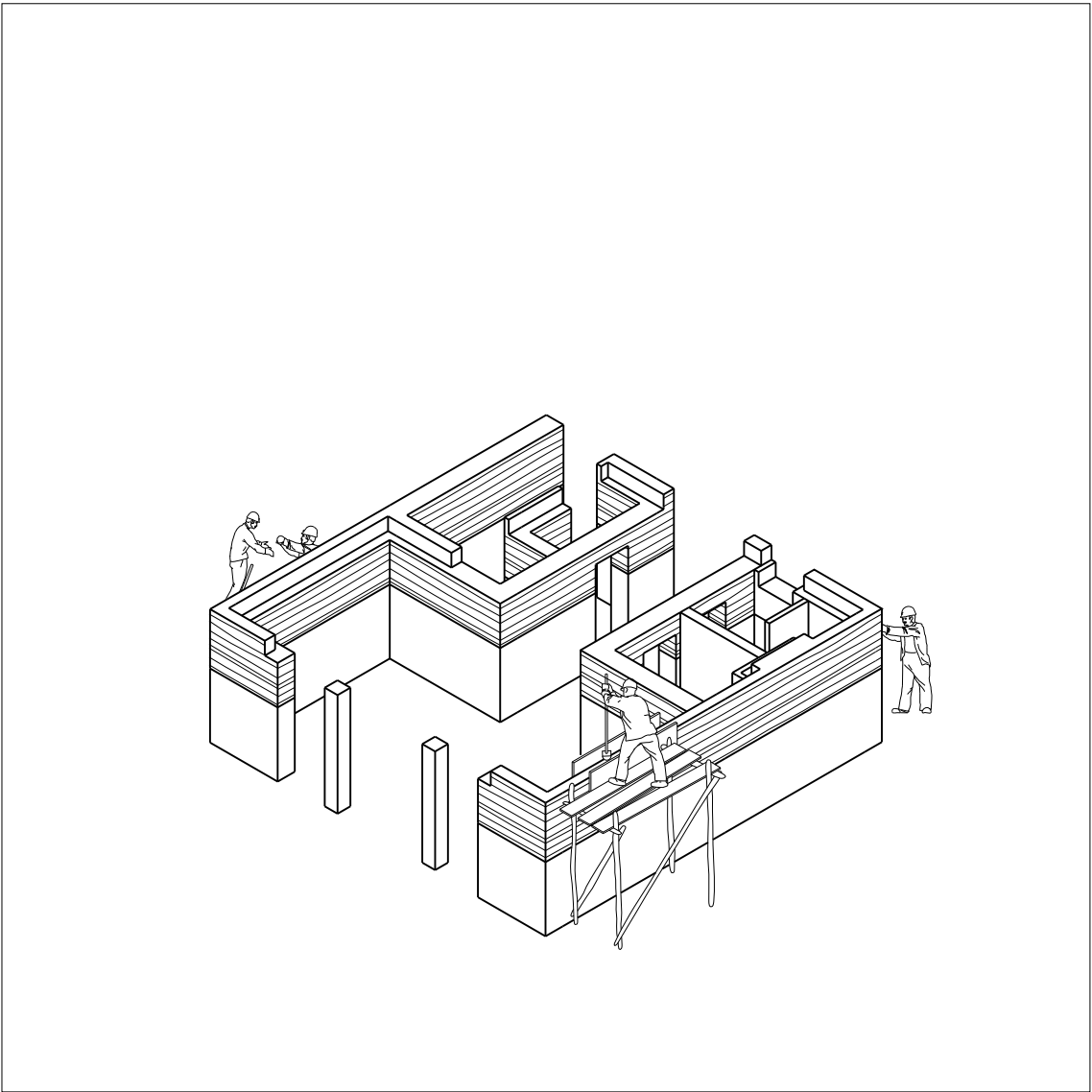
STEP 1 - DEMOLISION



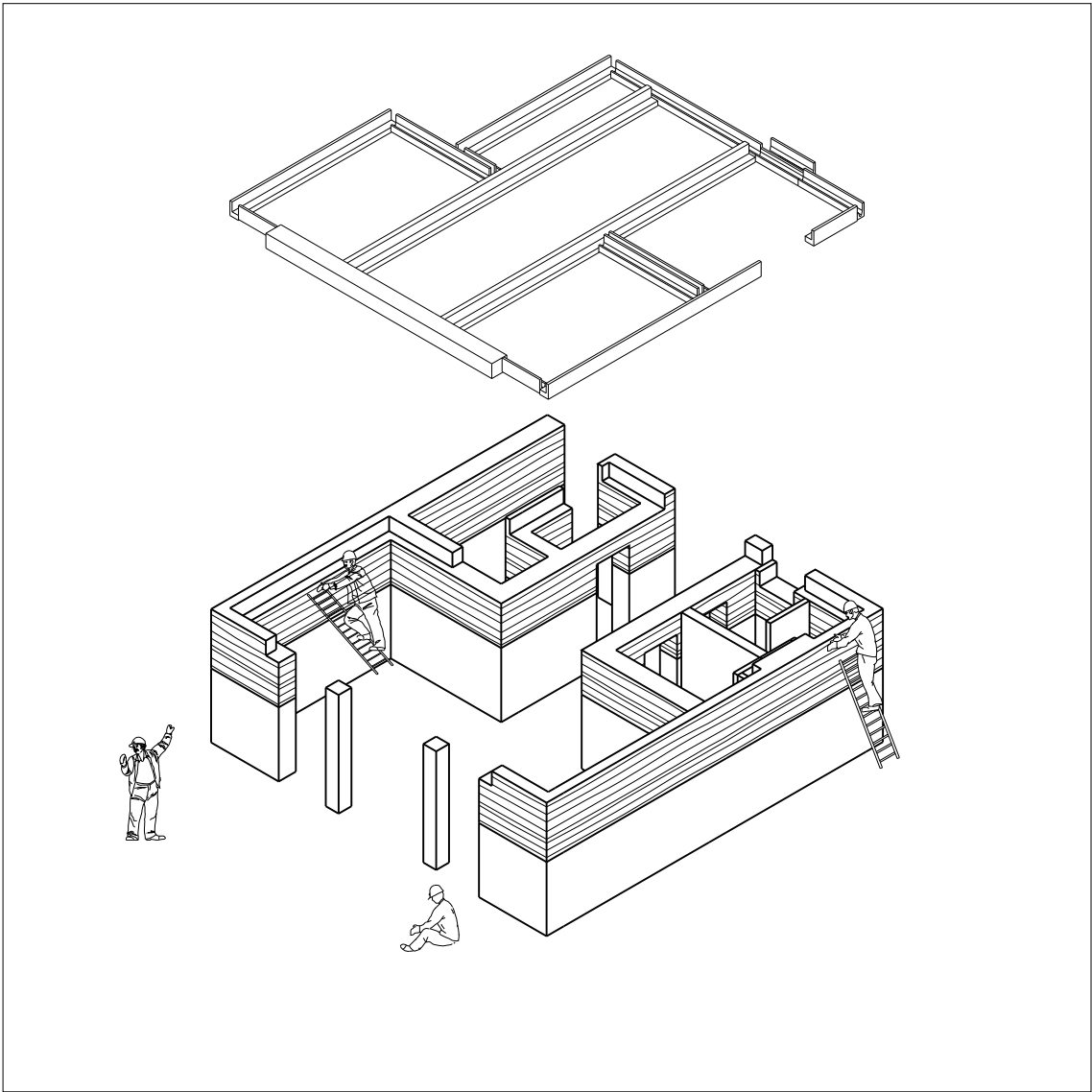
STEP 2 - CONCRETE FOUNDATION AND FLOOR



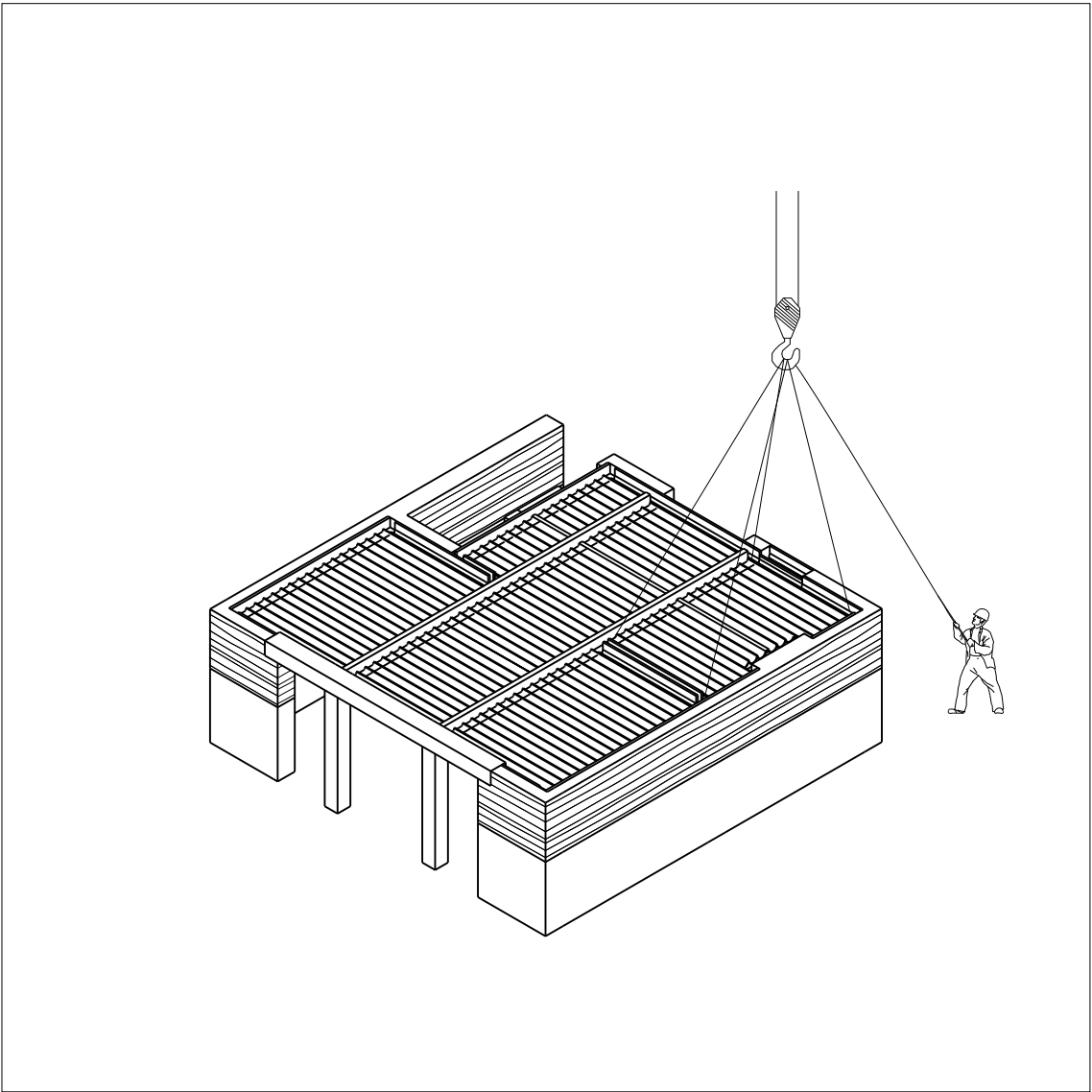
STEP 3 - CONCRETE COLUMNS AND BASE WALLS



STEP 4 - RAMMED EARTH

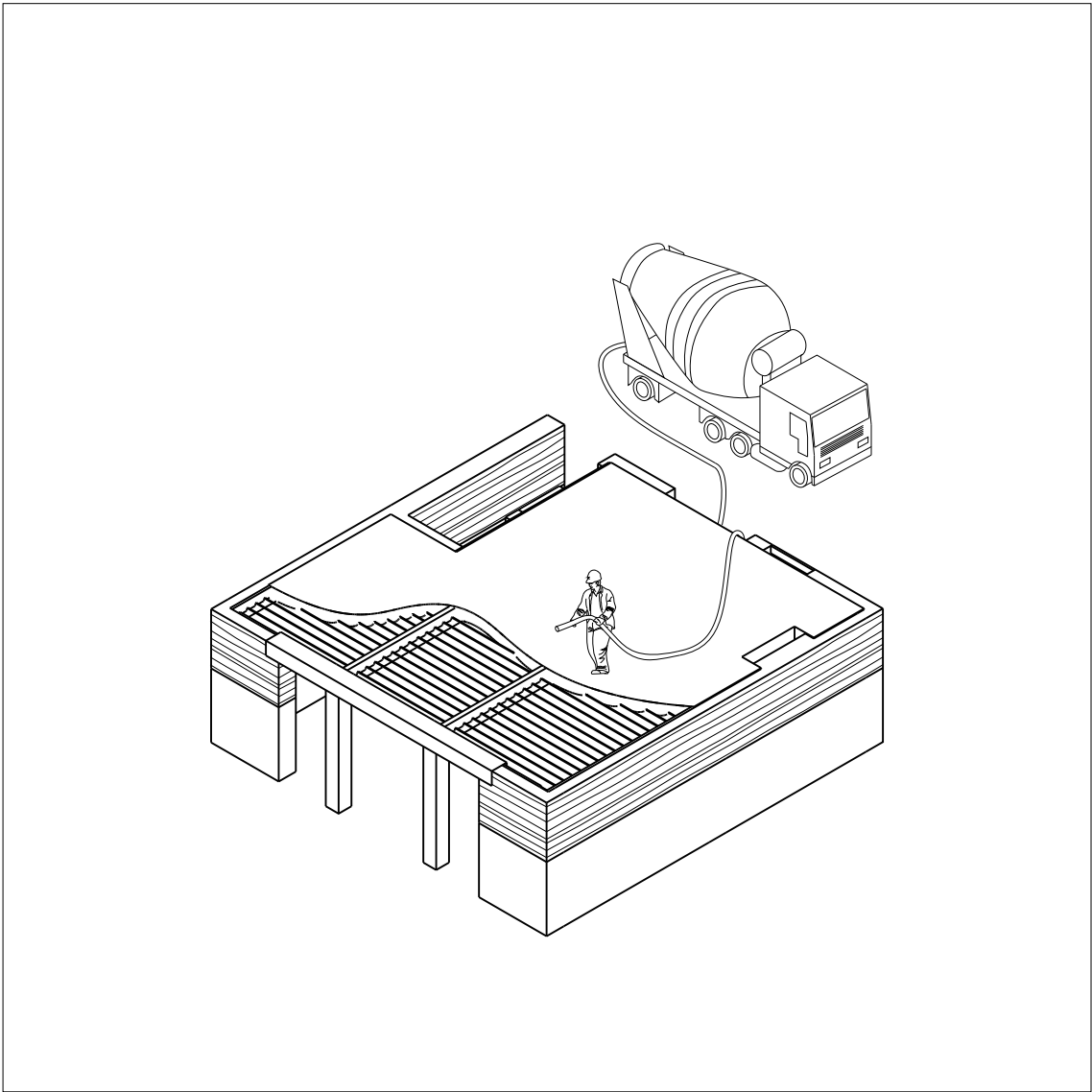


STEP 5 - PREFAB BOND BEAMS

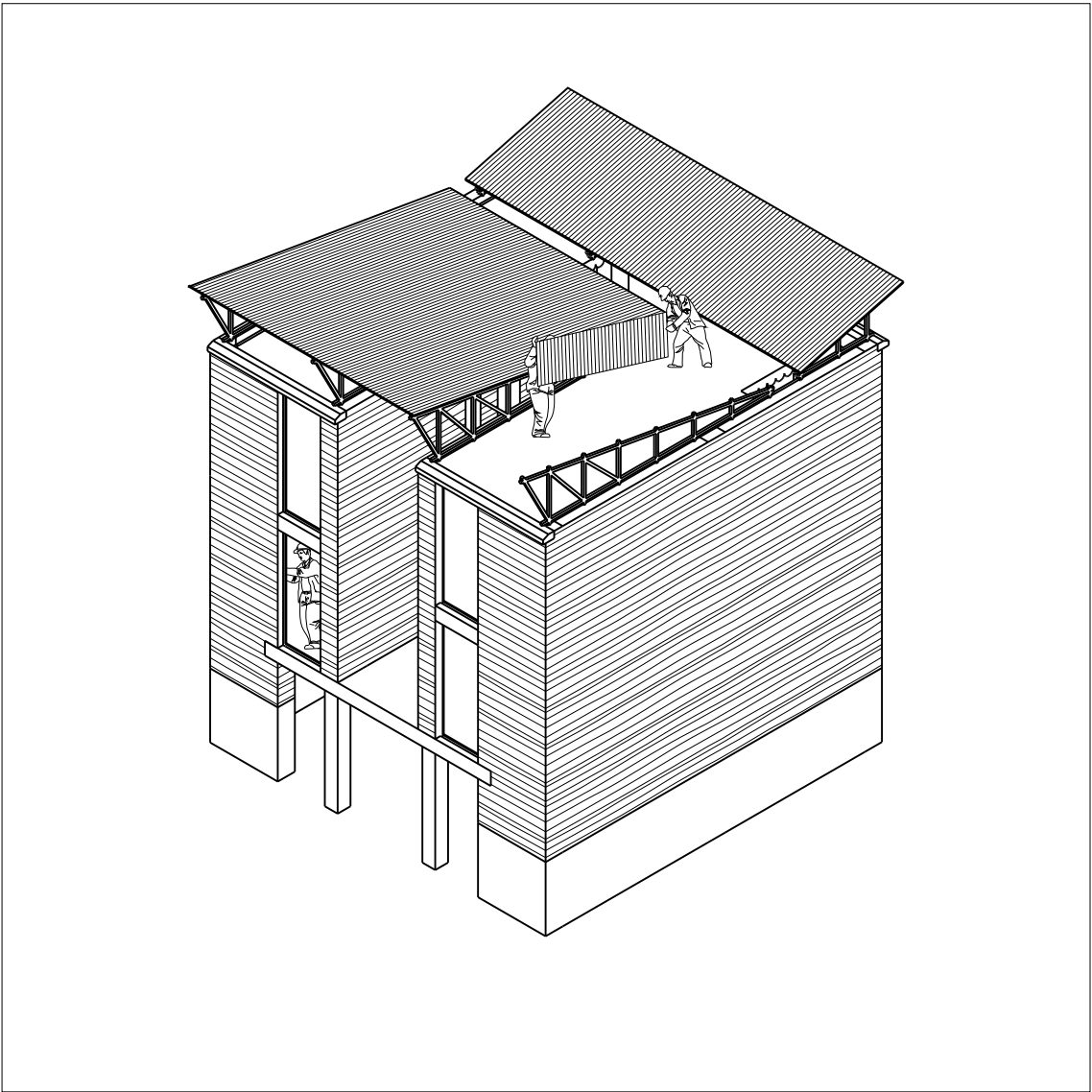


STEP 6 - BAMBOO LOST FORM WORK

Construction process

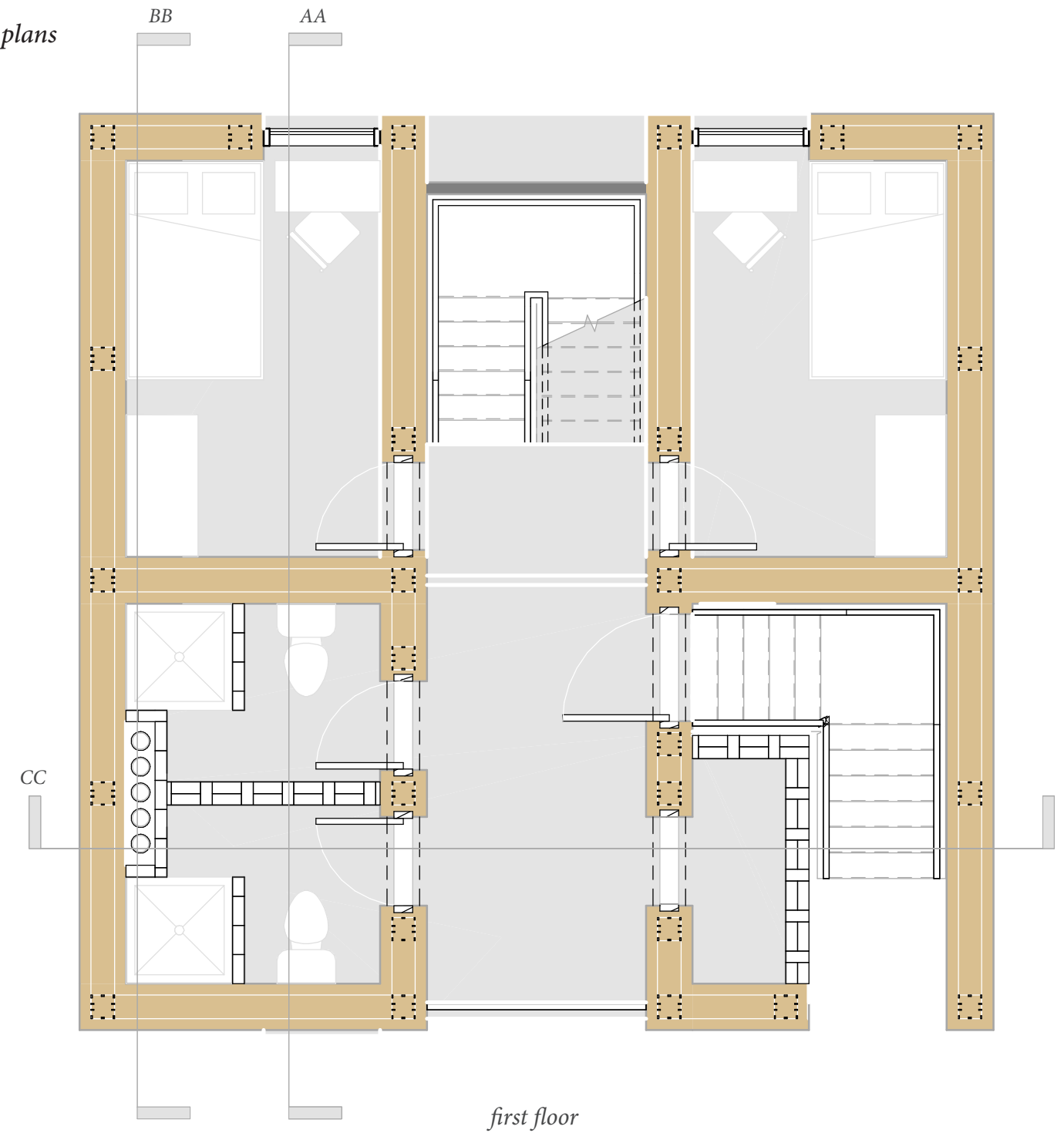
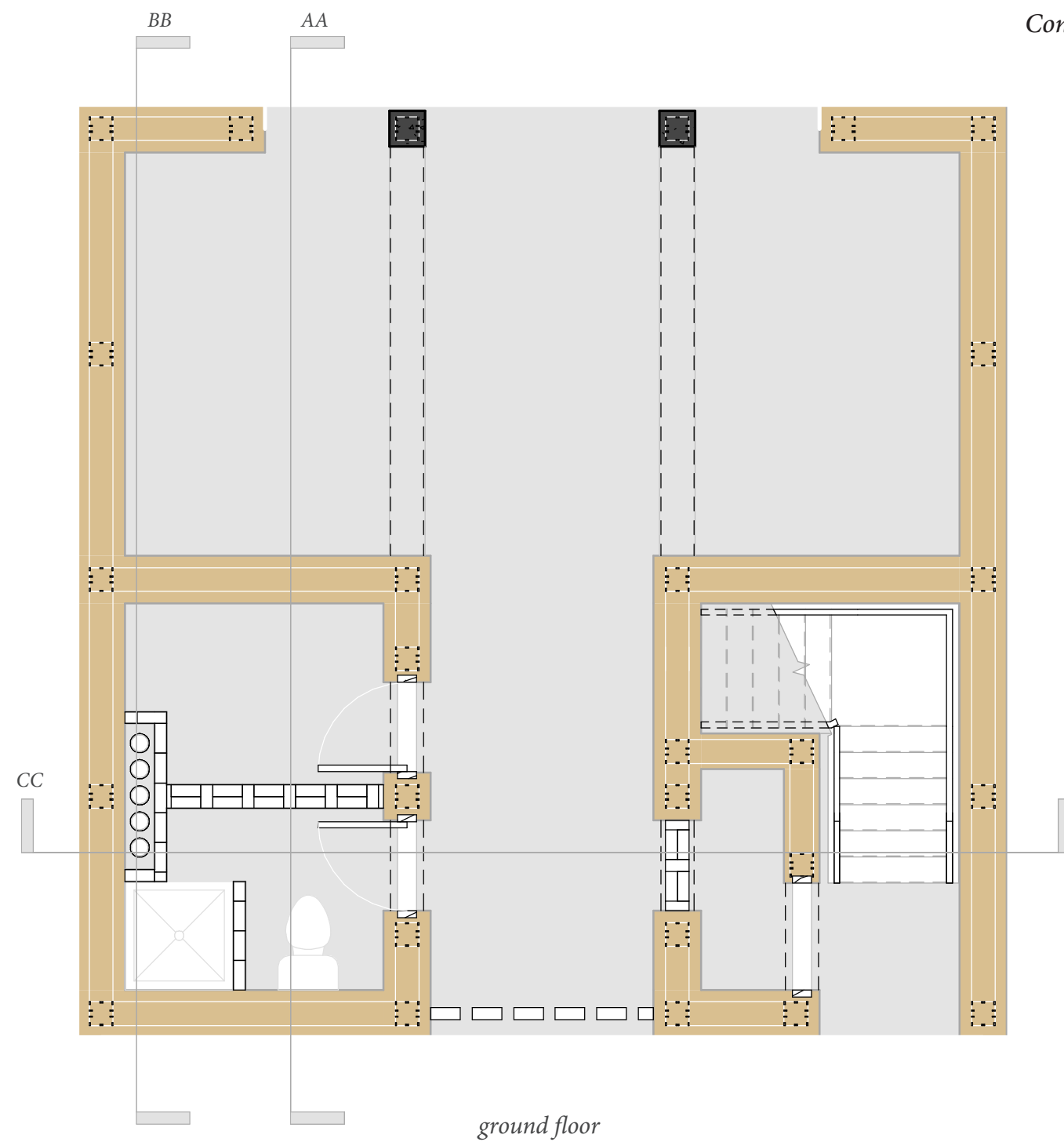


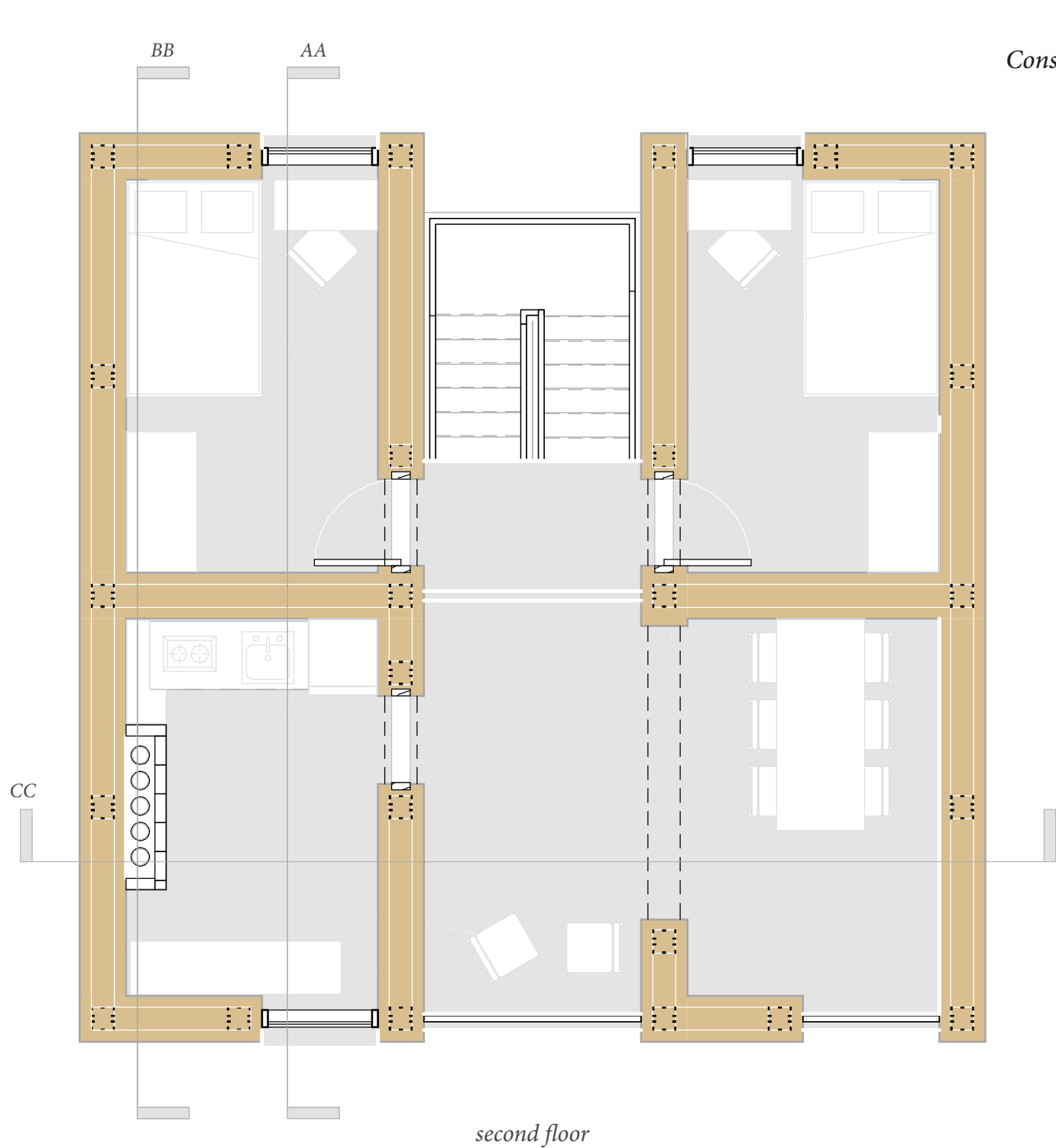
STEP 7 - CAST IN SITU CONCRETE FLOOR



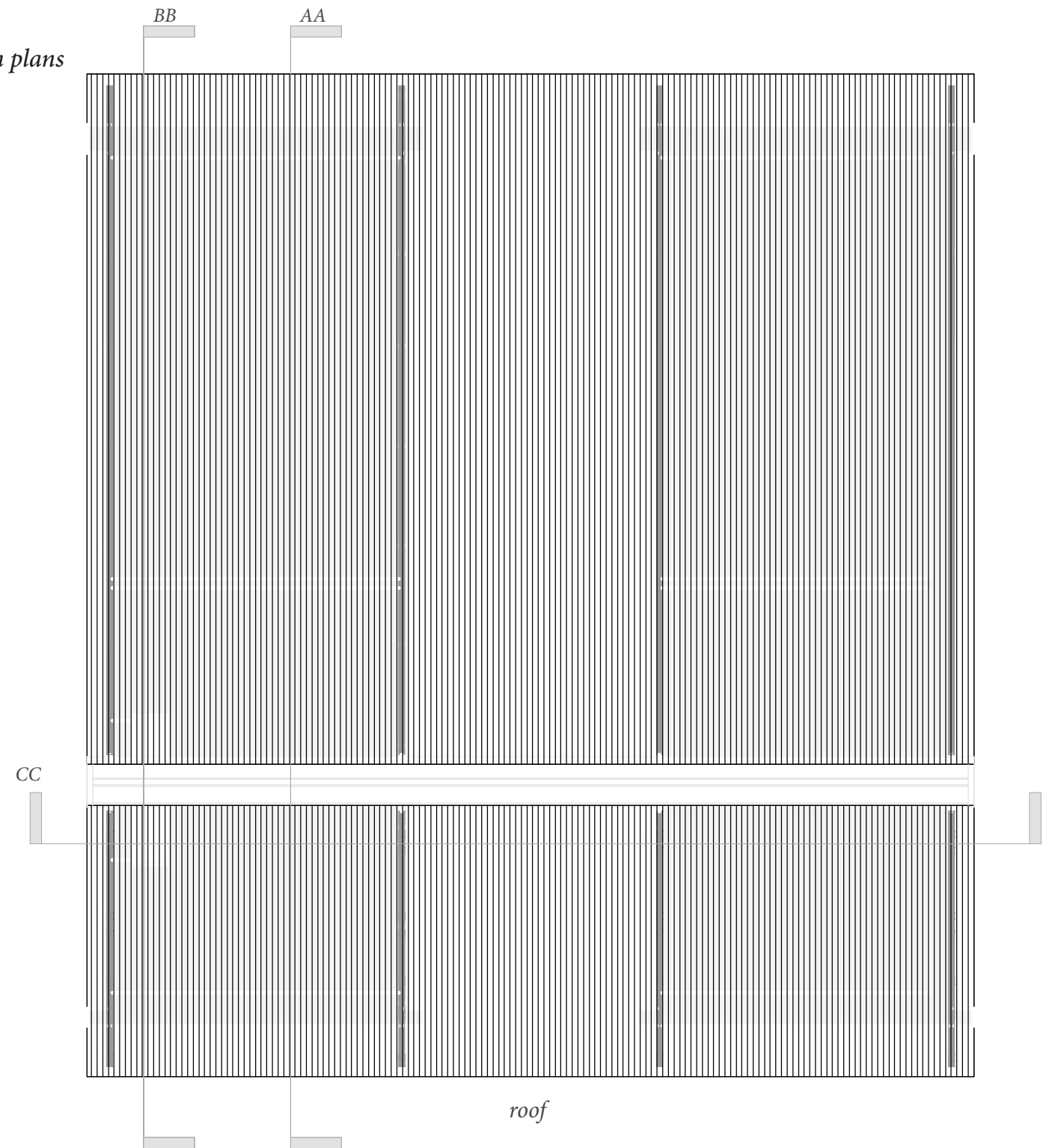
STEP 8 - WINDOWS AND ROOF FINISHING

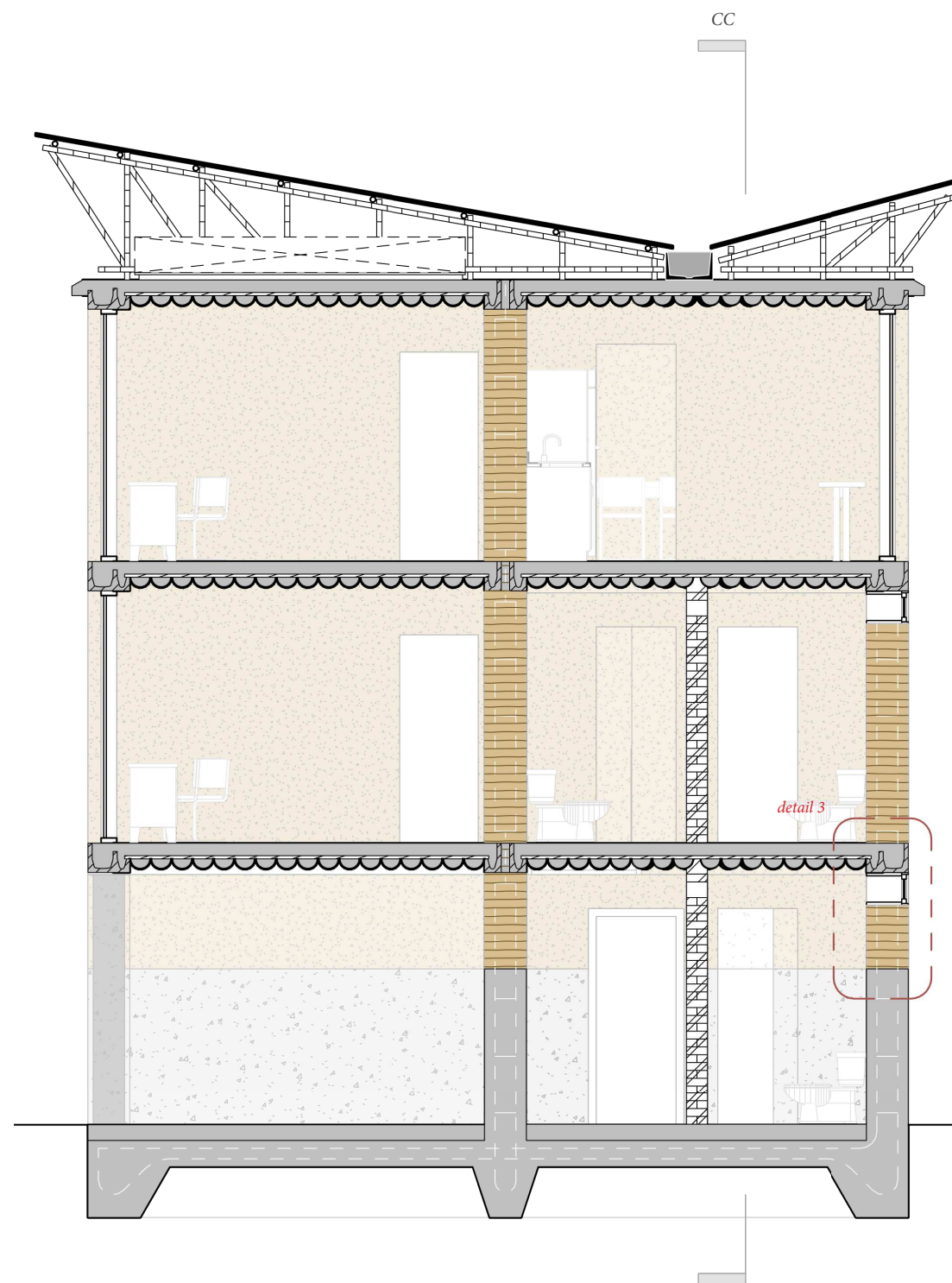
Construction plans



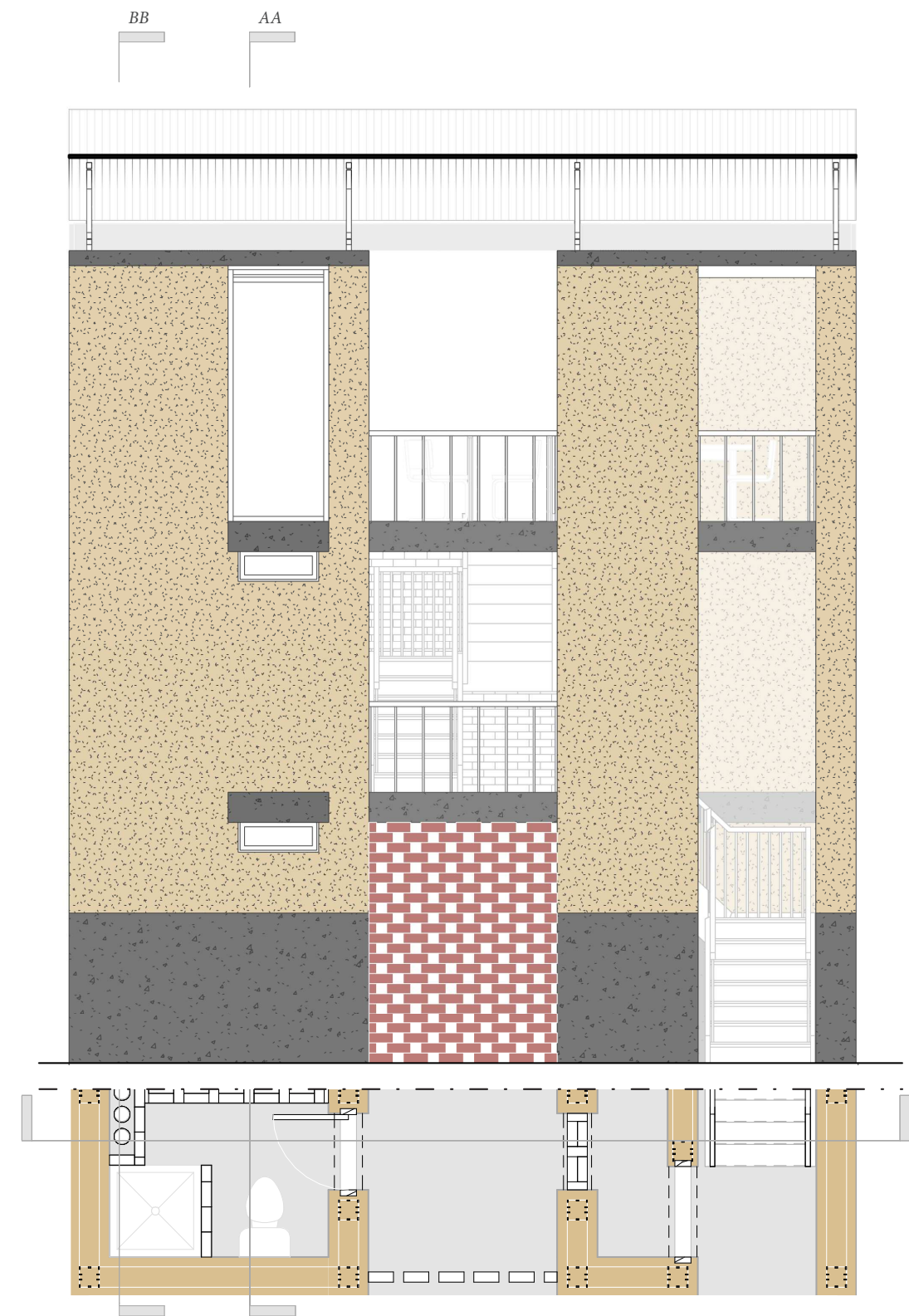


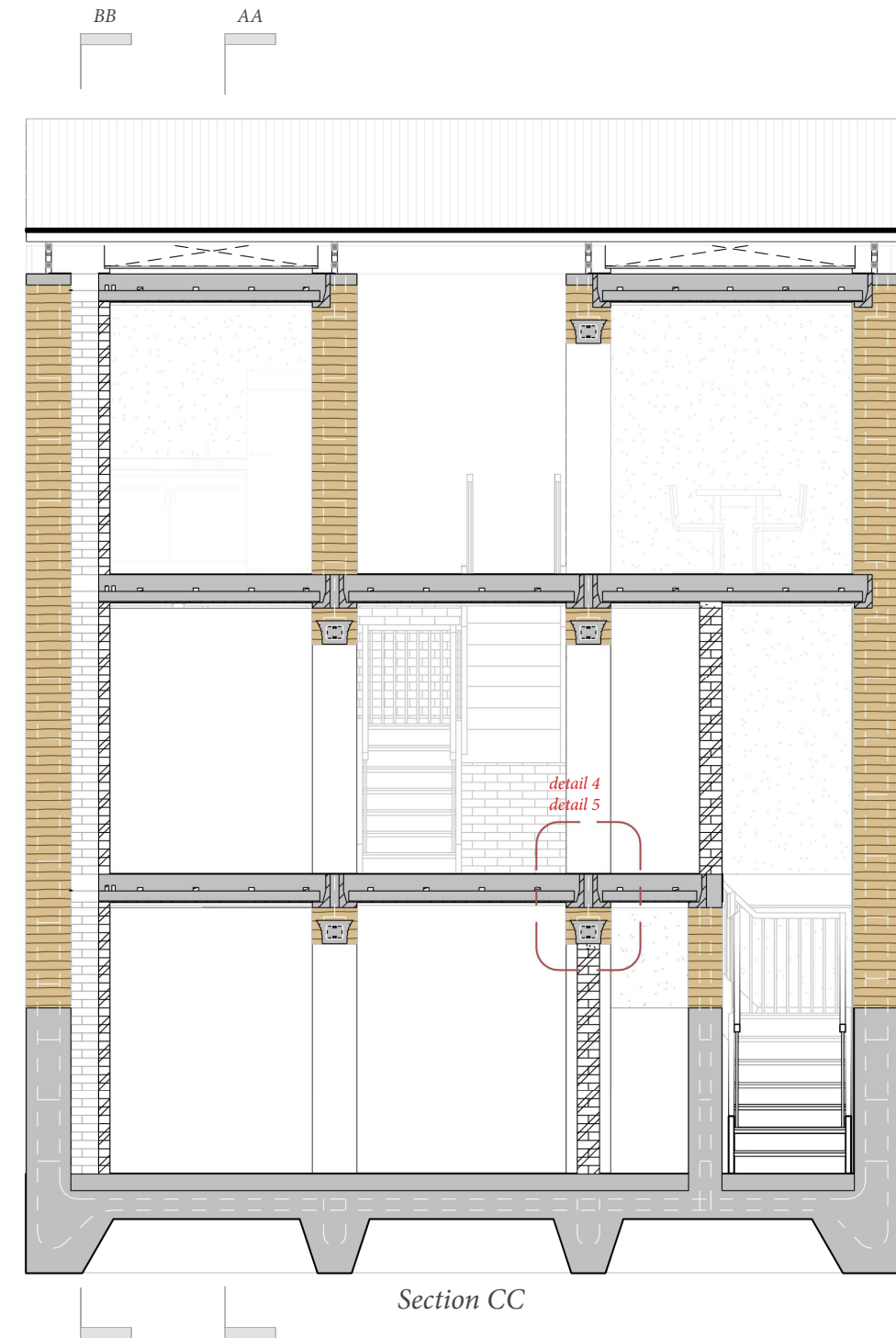
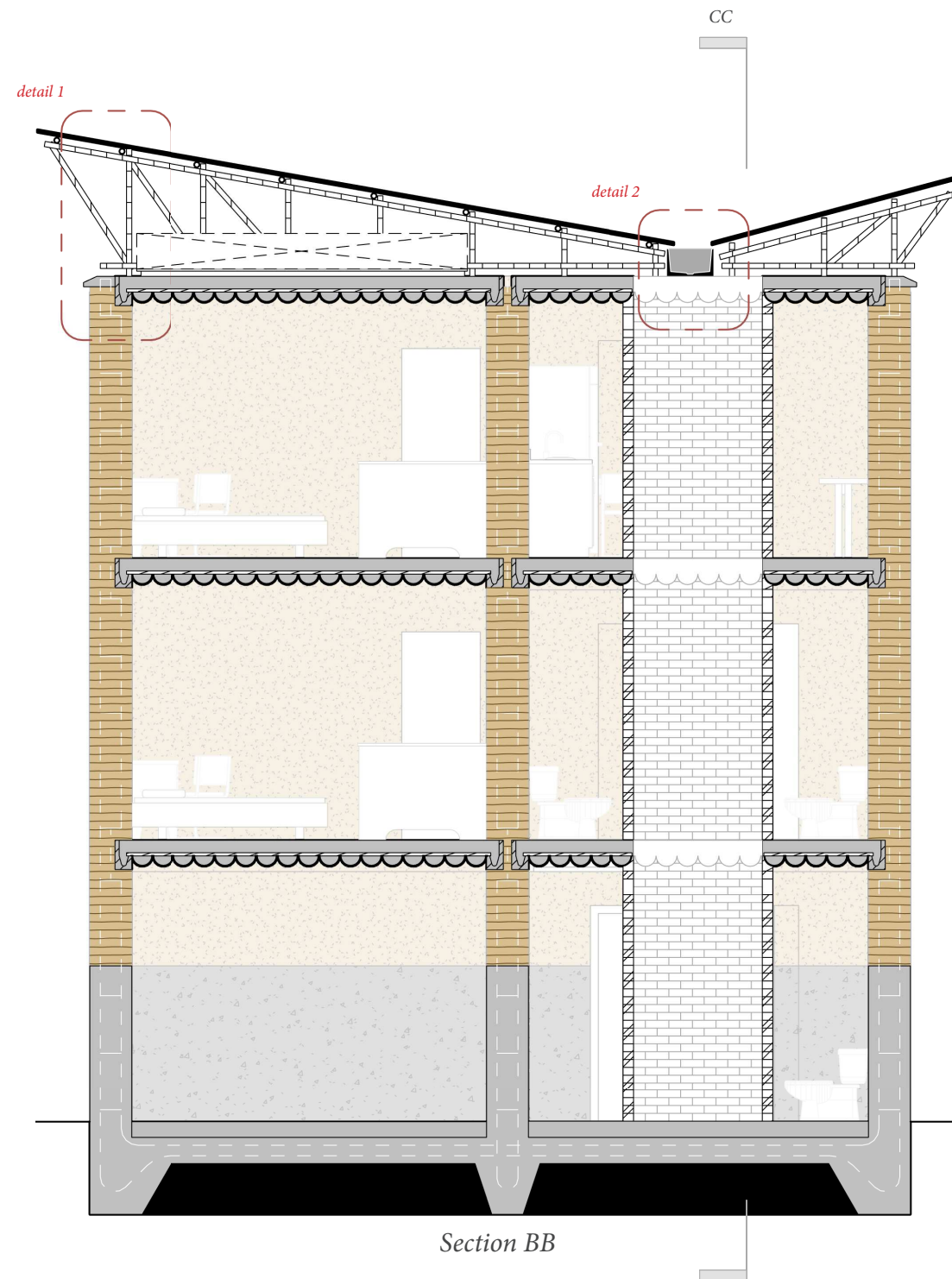
Construction plans



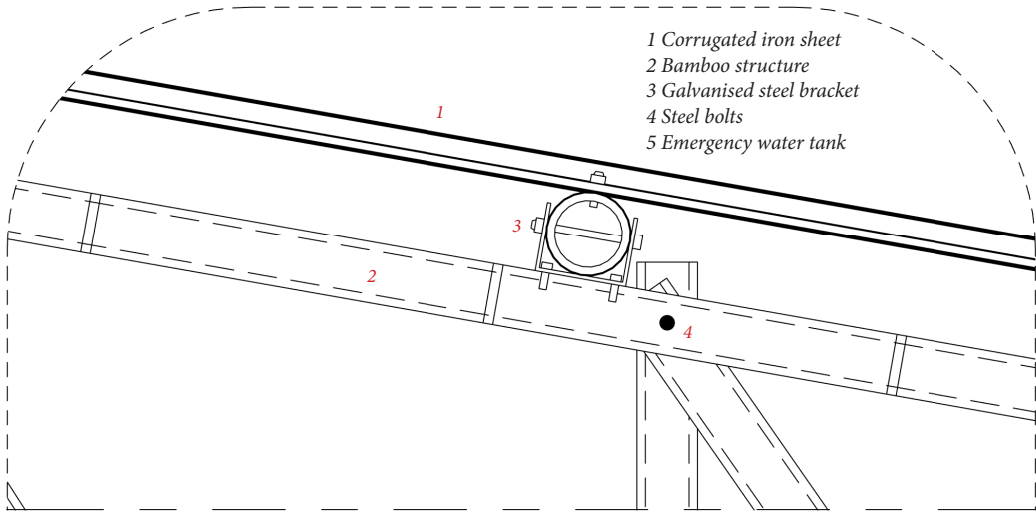


Section AA

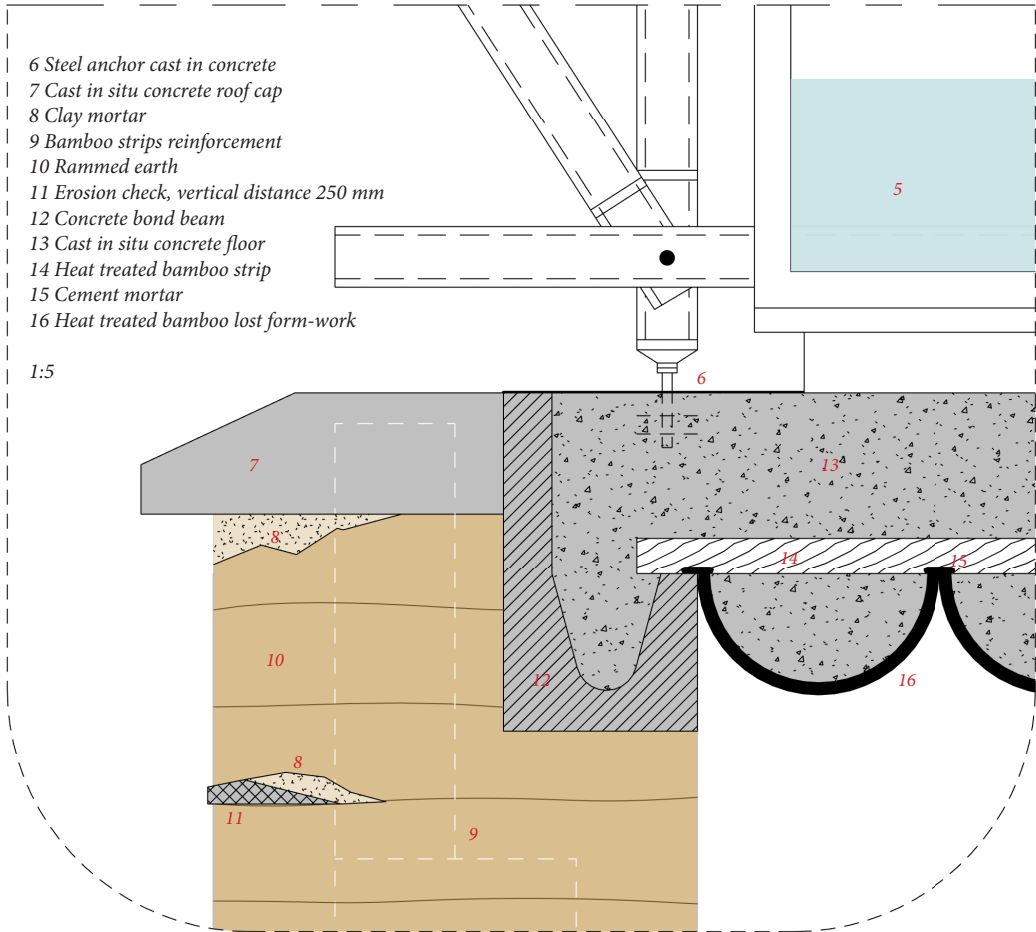




Detail 1 - Roof



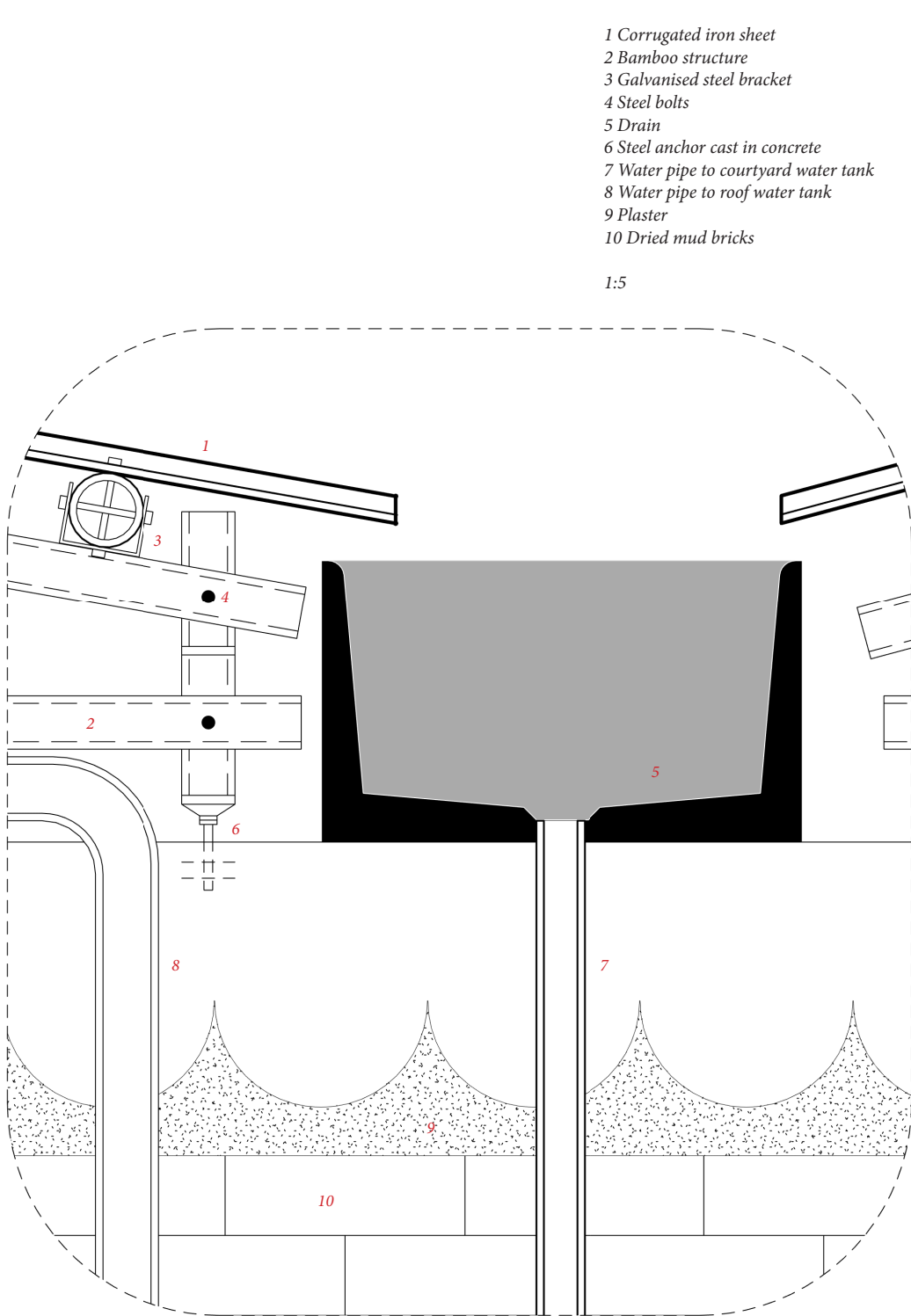
- 1 Corrugated iron sheet
- 2 Bamboo structure
- 3 Galvanised steel bracket
- 4 Steel bolts
- 5 Emergency water tank



- 6 Steel anchor cast in concrete
- 7 Cast in situ concrete roof cap
- 8 Clay mortar
- 9 Bamboo strips reinforcement
- 10 Rammed earth
- 11 Erosion check, vertical distance 250 mm
- 12 Concrete bond beam
- 13 Cast in situ concrete floor
- 14 Heat treated bamboo strip
- 15 Cement mortar
- 16 Heat treated bamboo lost form-work

1:5

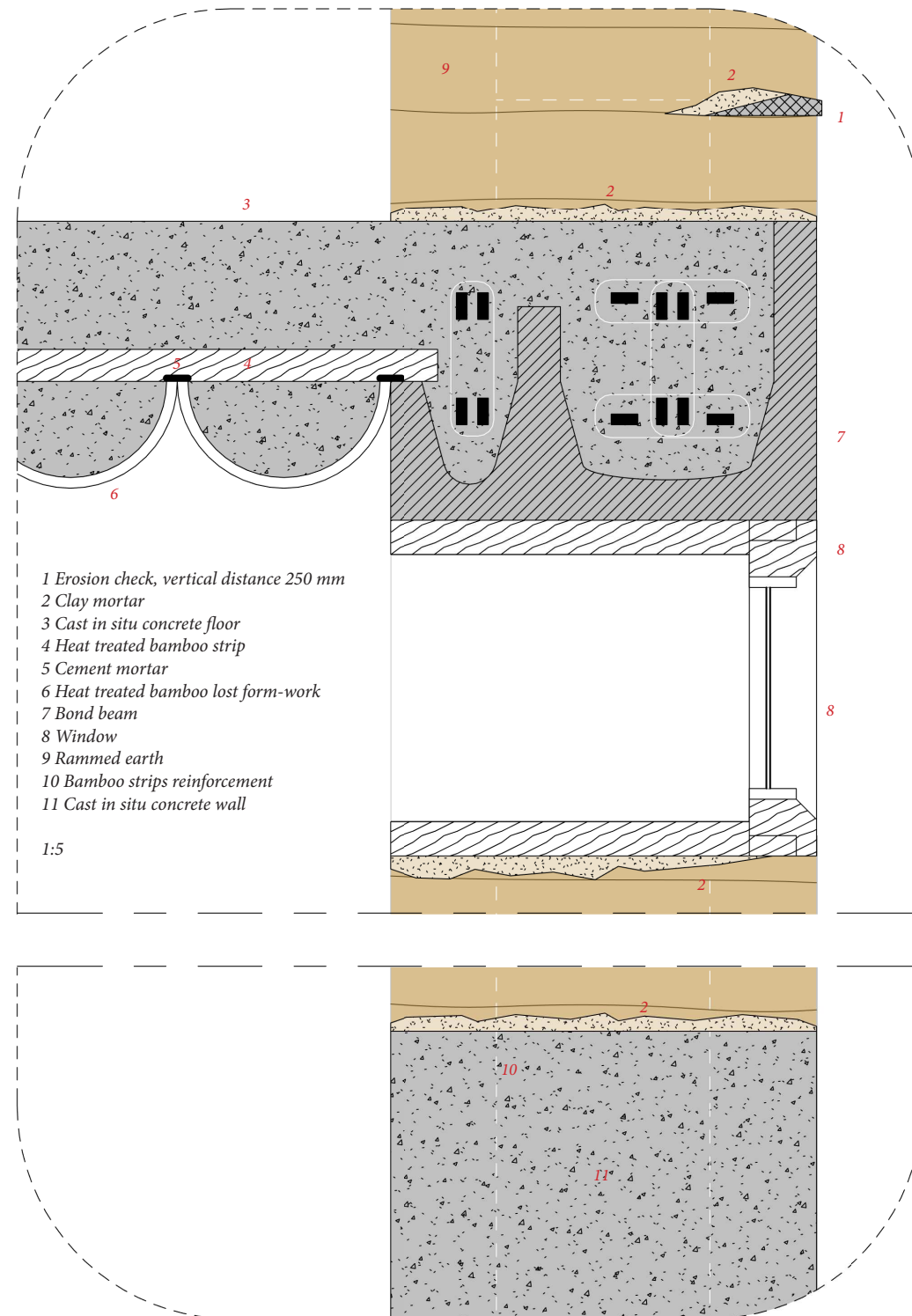
Detail 2 - Drainage



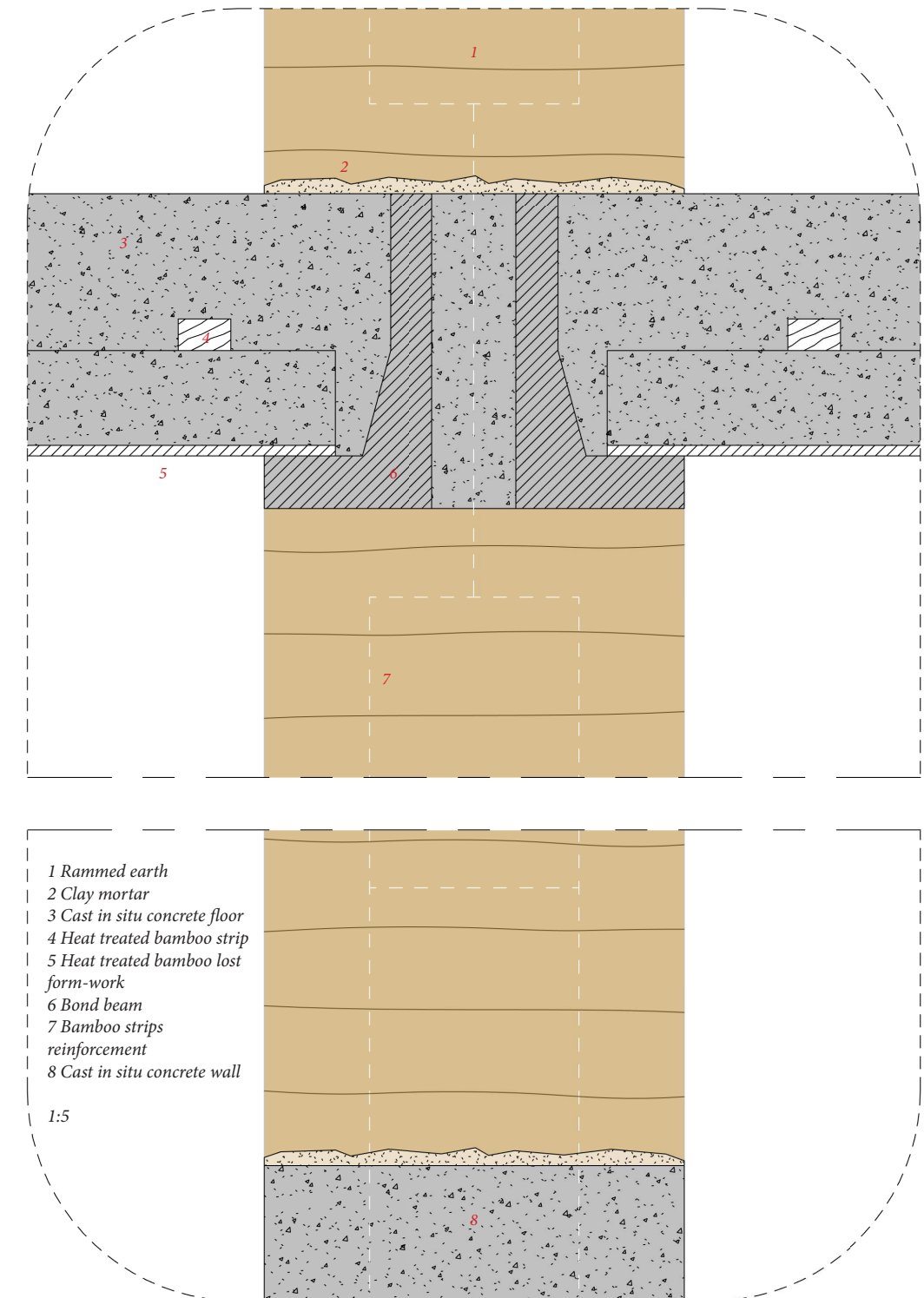
- 1 Corrugated iron sheet
- 2 Bamboo structure
- 3 Galvanised steel bracket
- 4 Steel bolts
- 5 Drain
- 6 Steel anchor cast in concrete
- 7 Water pipe to courtyard water tank
- 8 Water pipe to roof water tank
- 9 Plaster
- 10 Dried mud bricks

1:5

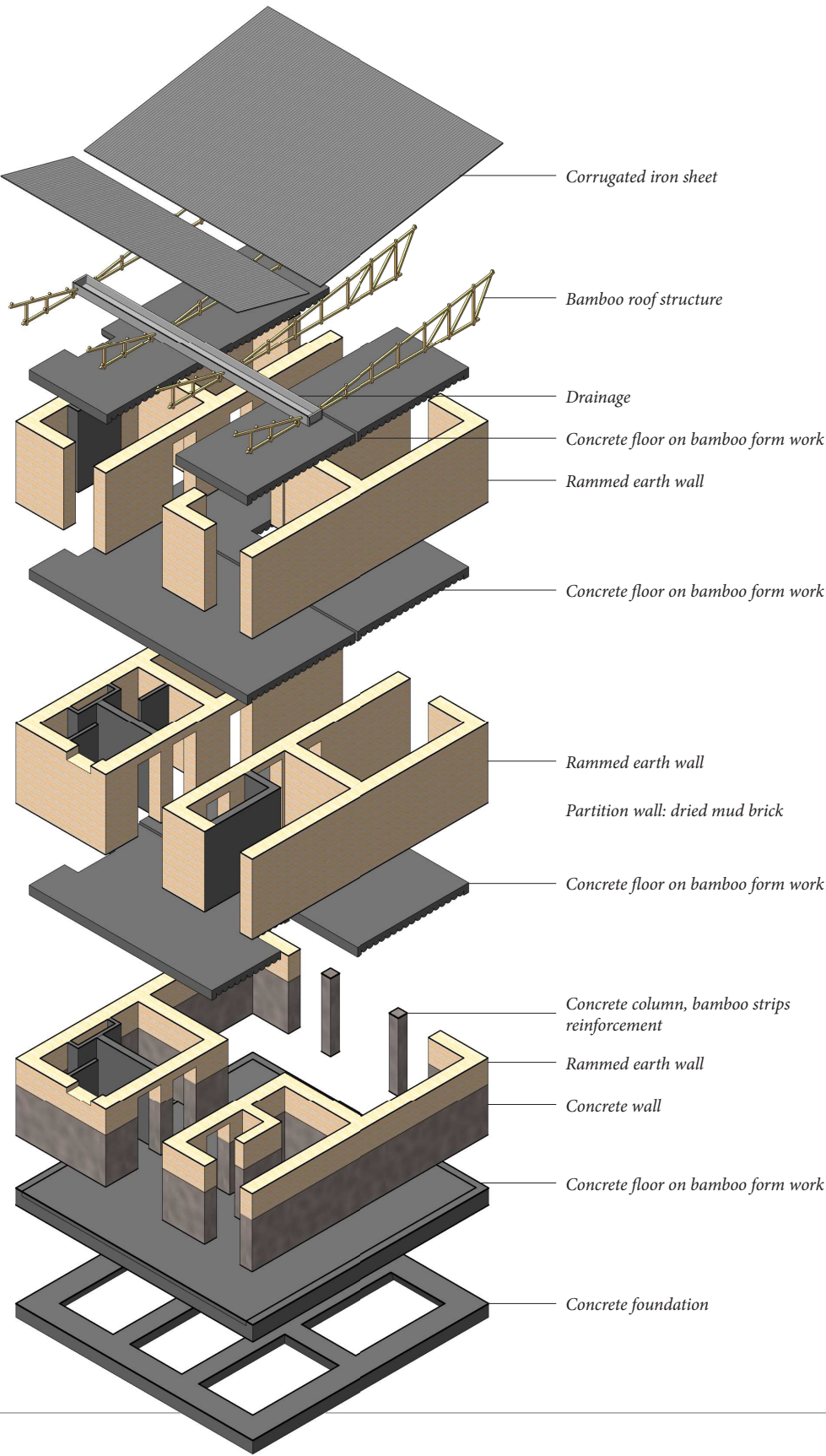
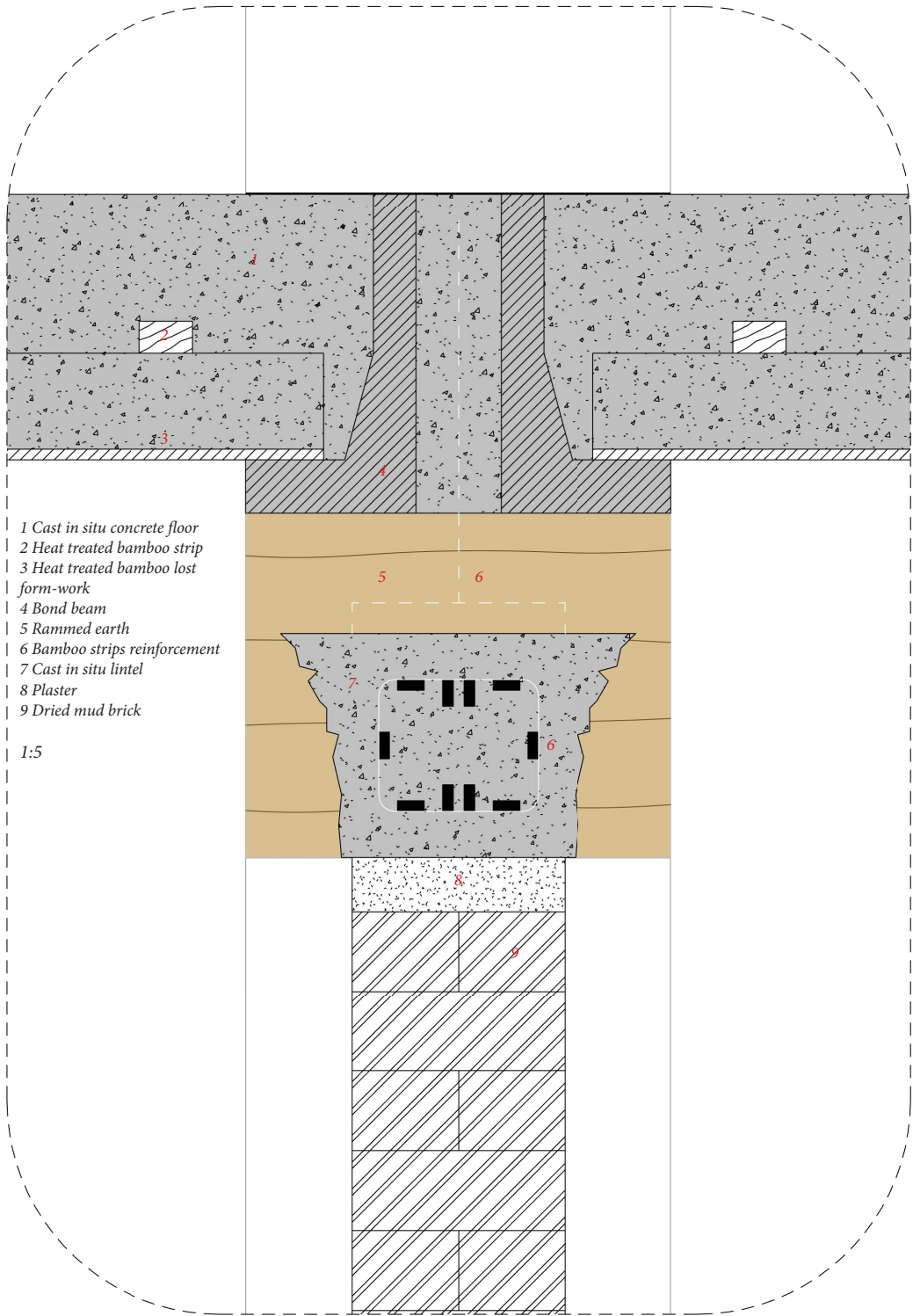
Detail 3 - Window



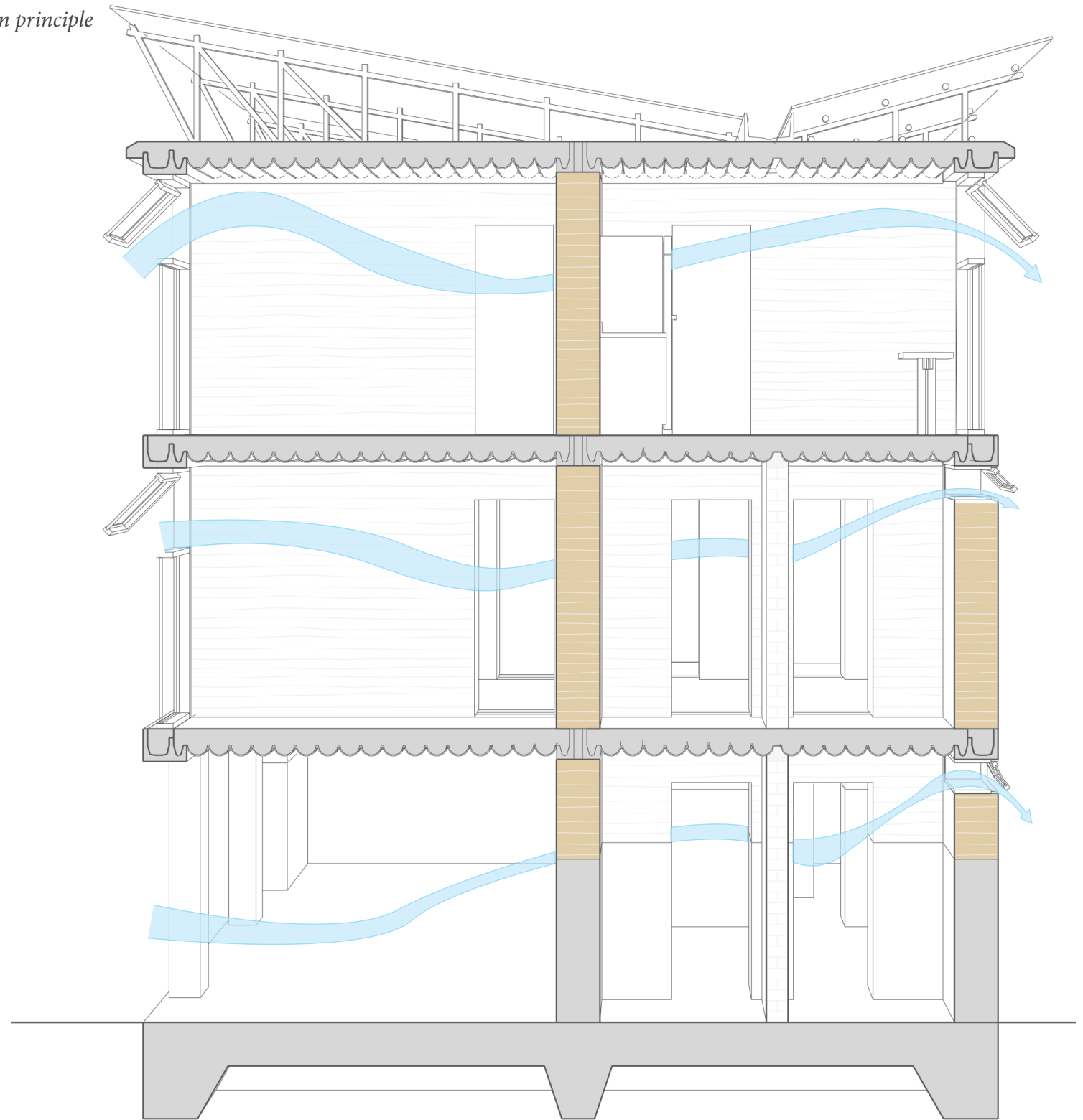
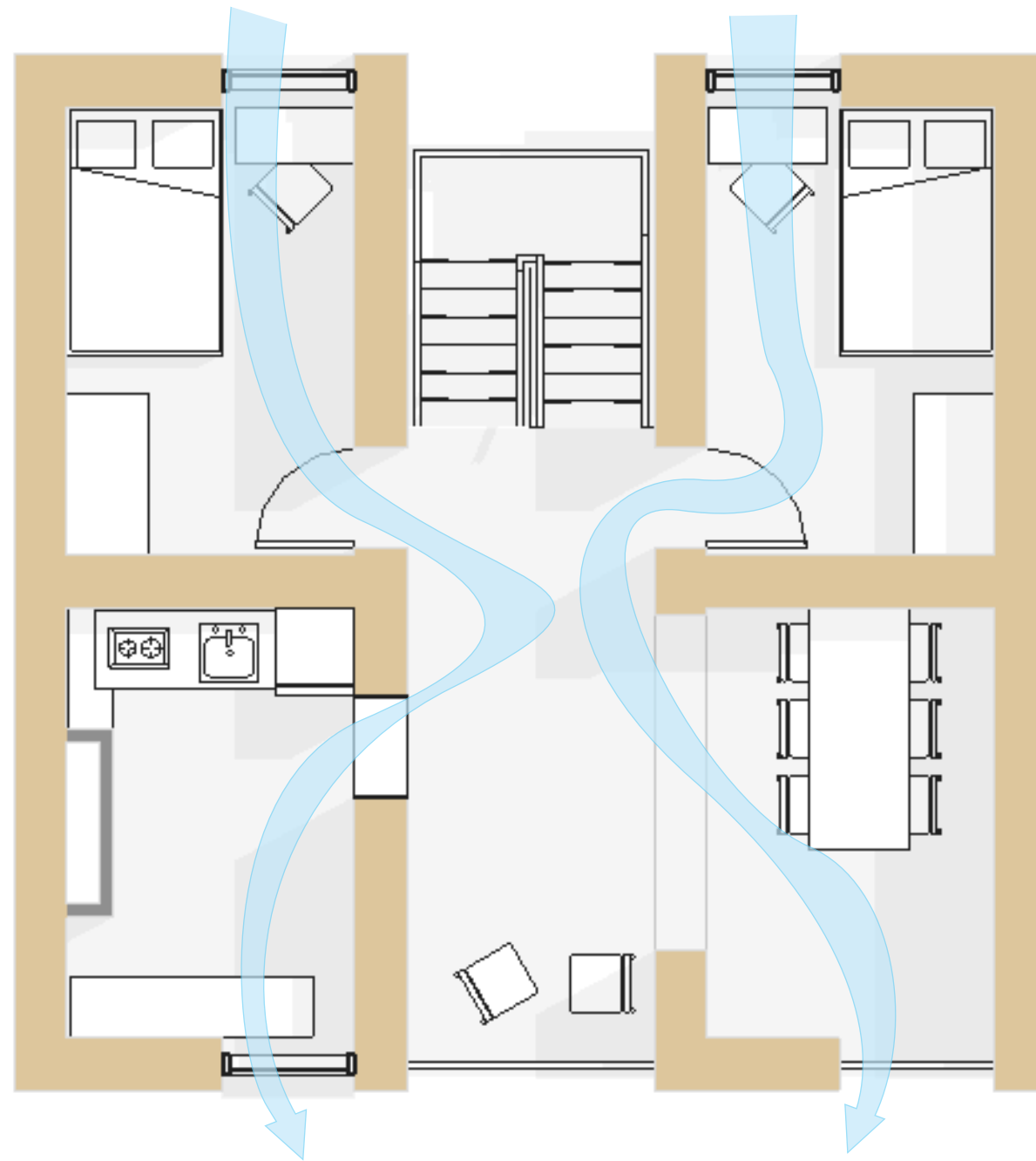
Detail 4 - Load Bearing Wall



Detail 5 - Lintel

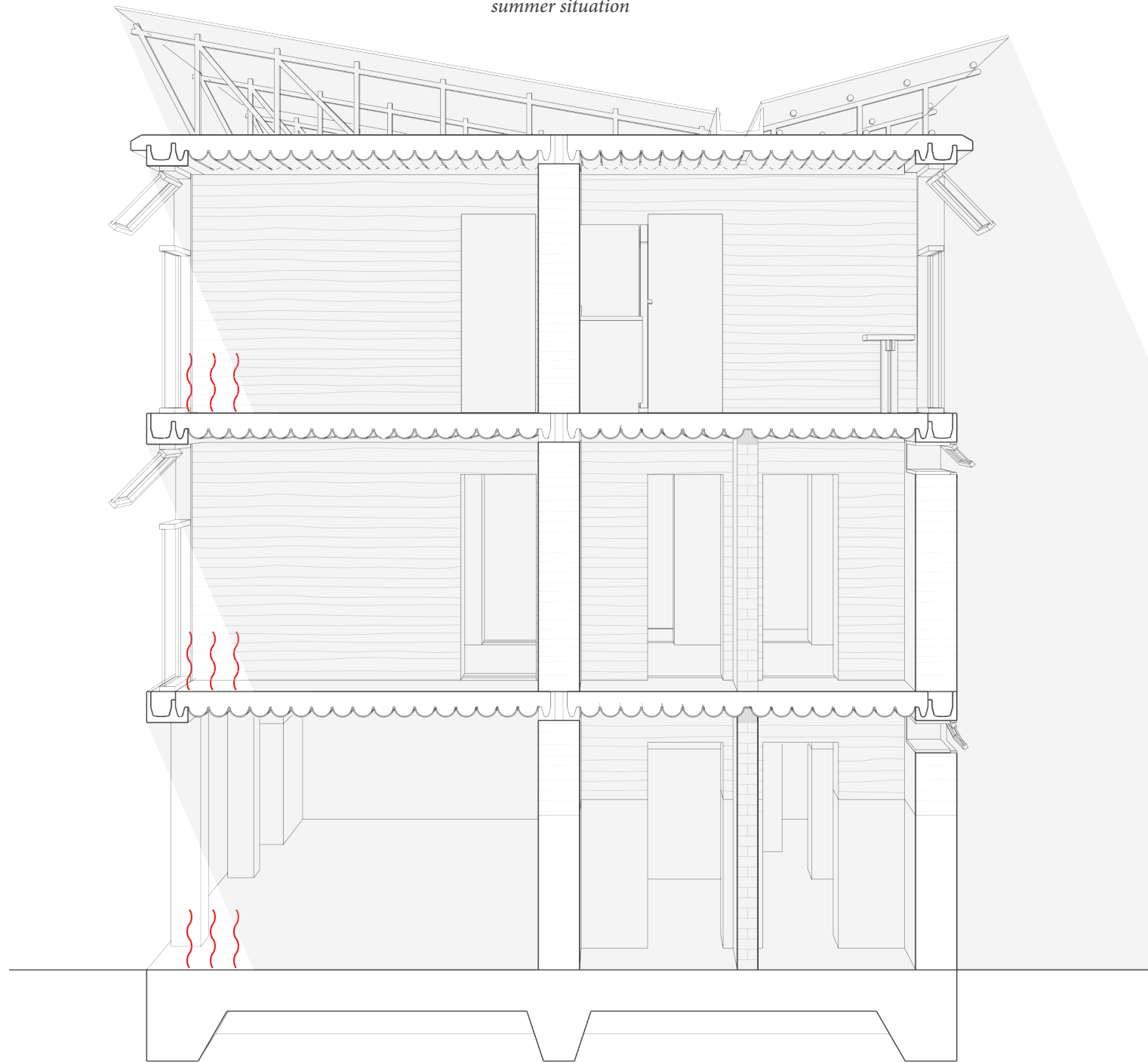


Ventilation principle

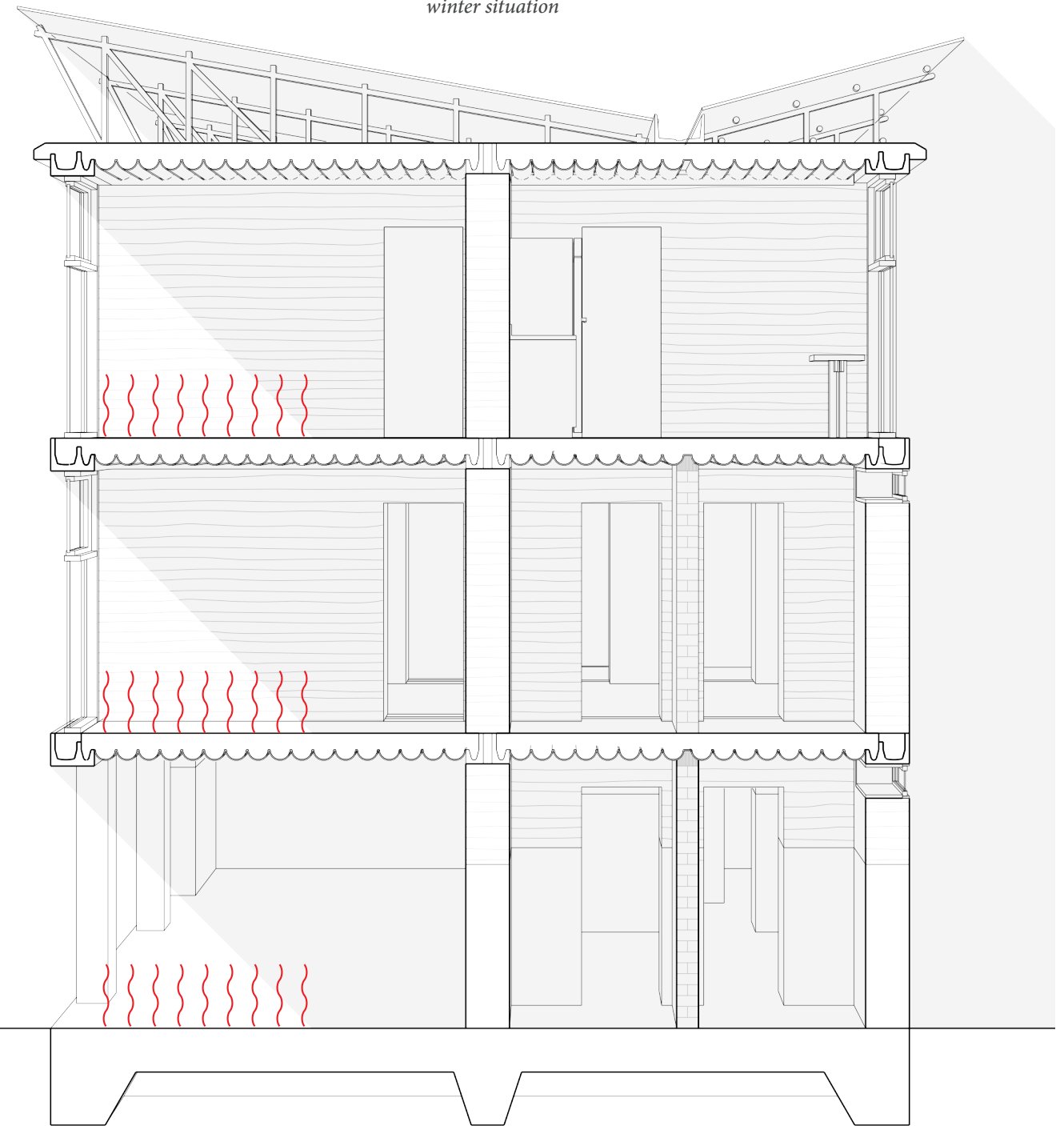


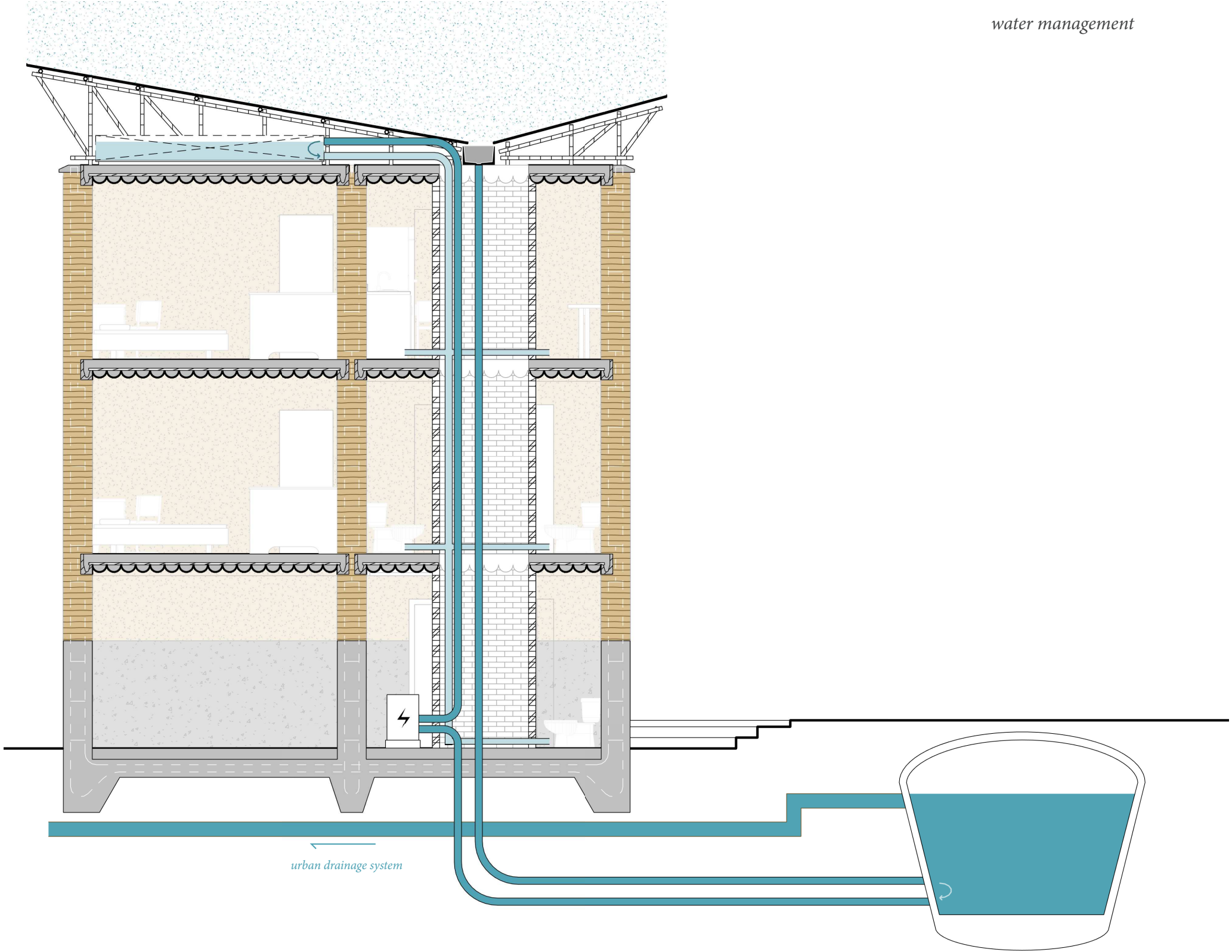
Shading and heating

summer situation



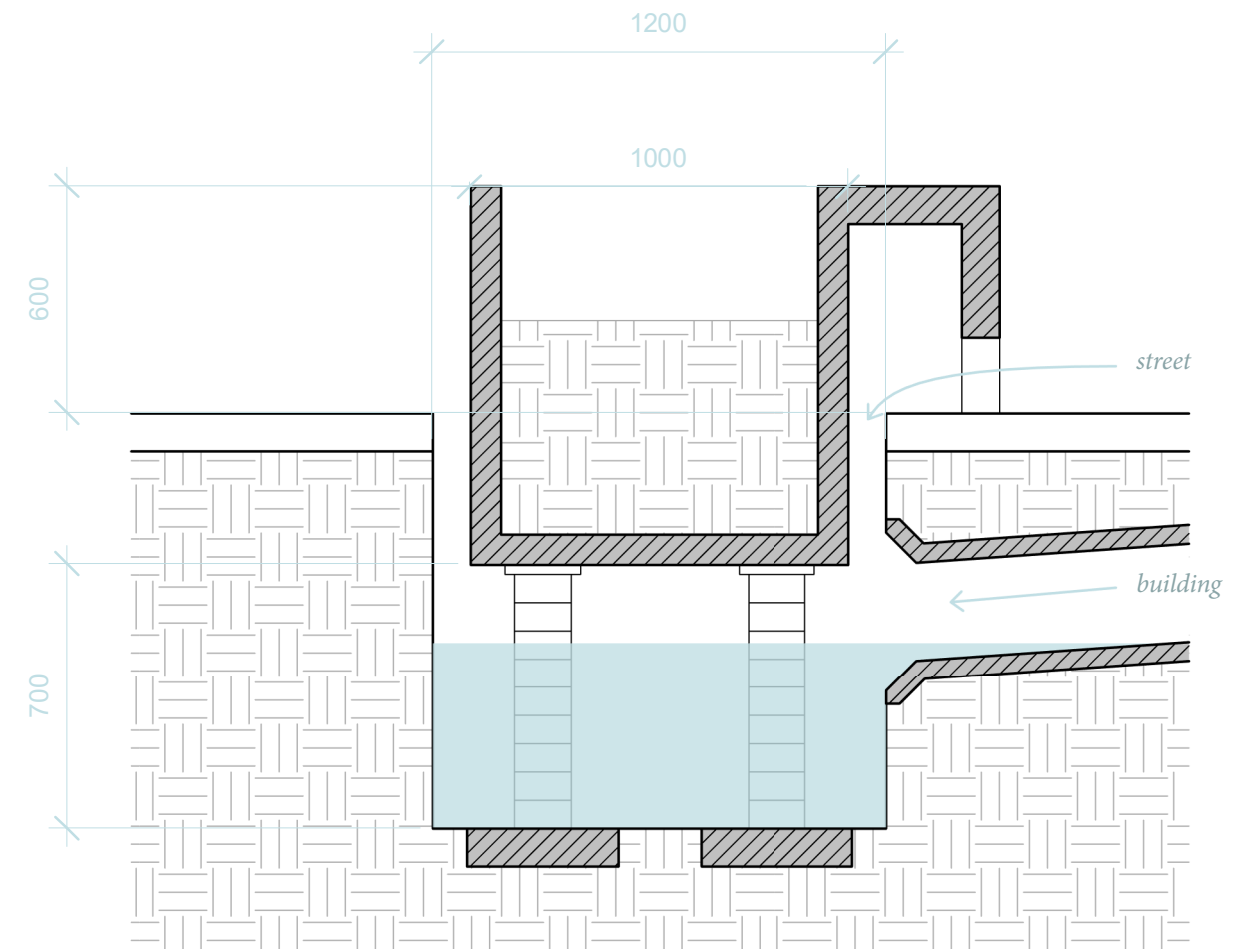
winter situation







water management



TO CONCLUDE ...





thank you