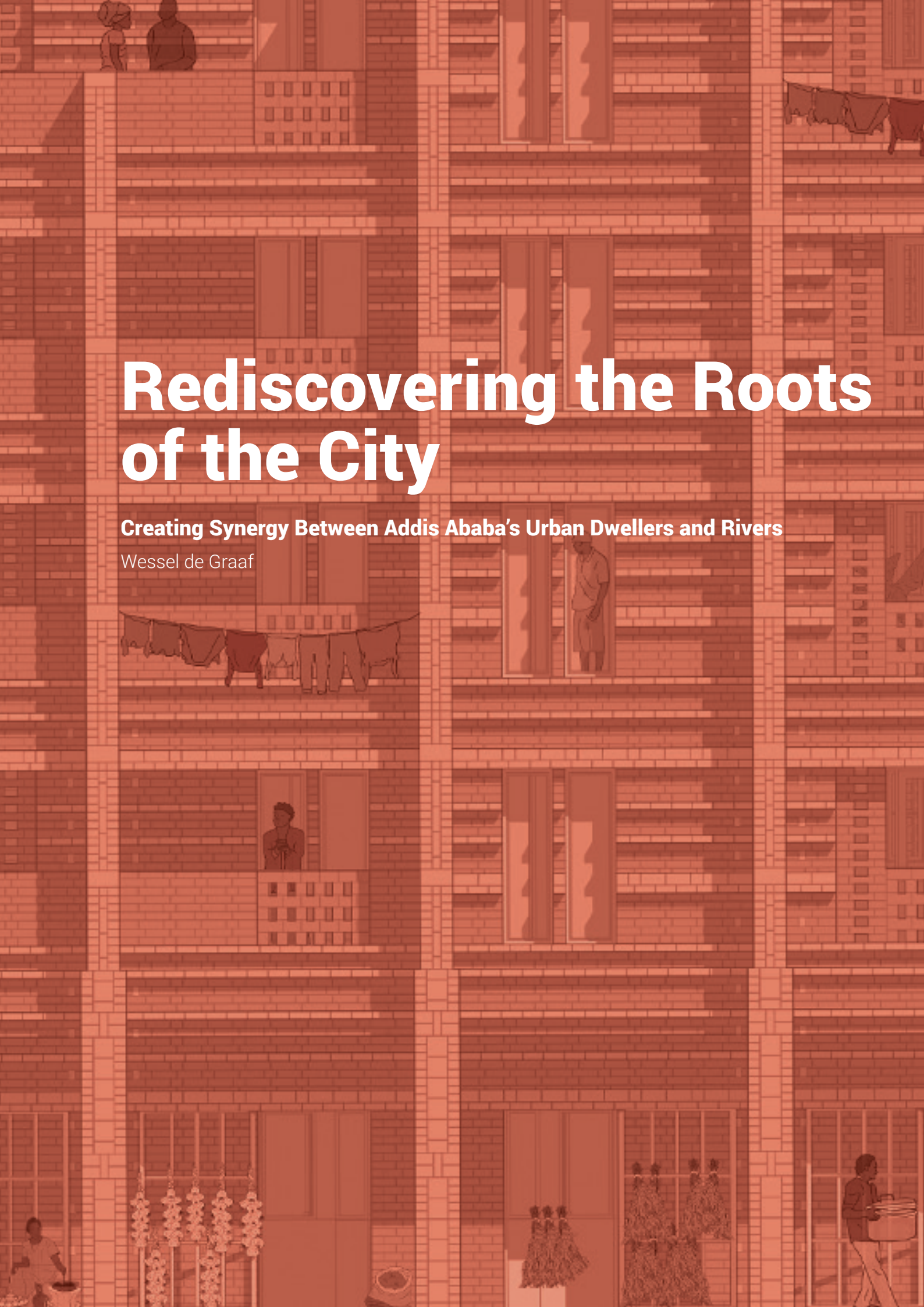

Rediscovering the Roots of the City

Creating Synergy Between Addis Ababa's Urban Dwellers and Rivers

Wessel de Graaf

Rediscovering the Roots of the City
Creating Synergy Between Addis Abba's Urban Dwellers and Rivers

Keywords:
Global housing, Addis Ababa, River culture, Earth, Productive Urban Open Space System, Urban Wetland

Graduation Report
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3 July 2020

Summary
This project seeks for an alternative low-cost housing strategy for the city of Addis Ababa, Ethiopia. The condominium housing scheme is currently implemented everywhere throughout the city. Despite the impressive amount of newly constructed dwelling units, shortcomings of this housing strategy have drastic consequences within the social and environmental domain. It disperses communities, is not inclusive for the very poor and does not respond to environmental issues. This while the natural environment, and in particular the waterbodies of the city, is already under pressure after years of uncontrolled urban sprawl. It has led to massive decline of urban green spaces and extremely polluted rivers having a huge negative impact for the liveability of the city.

The design proposal tries to reconnect the urban dwellers with the rivers of the city in order to create a river culture. A synergetic environment in which people and nature live in harmony. By introducing an urban wetland, nature gets restored, water gets buffered and harvested and it allows people to participate in the ecosystem. By green wedges going deep into the urban fabric, the waterbodies are interwoven in a productive urban open space system supporting the social and economic informal needs of the inhabitants.

The building system, made of earthen blocks and bamboo, is environmentally responsible, supports local economies and forms a versatile modular system. Moreover, the layout allows to be inclusive for all the inhabitants of the redeveloped area and is responsive towards future adaptations by its users.

To conclude, I believe that the project exploits the qualities and properties that the river and the waterbodies possess to the utmost. To the point where it is beneficial for the environment itself and the dwelling landscape in a harmonious way.

Acknowledgements

Although this project is an individual assignment, the support of the people around me, in person or digitally, helped me enormously throughout the process. First of all, I would like to thank my tutors, Ir. Harald Mooij, Ir. Frank Schnater and Dr. Nelson Mota , for the intensive tutor sessions. Their knowledge and way of teaching helped me enormously to broaden my horizon in the field of global housing. Besides, I think it is praiseworthy the way the tutors dealt with the transition to digital education due to the global pandemic.

Also I would like to thank my fellow students within the graduation studio. The common knowledge and discussions improved my design and the field trip was a nice and fun experience.

Finally I would like to thank my parents for taking me back in their house during my graduation period due to COVID-19, Nienke for writing and literature advice and Robin who supported me enormously throughout the process of the whole project.

Table of content

1 Introduction

Motivation
Introduction

Motivation

For various reasons my choice for the implementation of my graduation year fell on the Global Housing Graduation Studio: Addis Ababa Living Lab. First of all, during my studies I experienced for so far a lack of focus on social aspects such as gentrification, participation and community design. With an ethnographic research approach and the topic of housing in a country where the way of living is farfetched to what I am used to, I believe that societal issues will arise during this graduation project and that elaborate social research will be held. Besides, a project in a for me completely unknown context needs rethinking in aspects as technical implementation, climate control and material use. Moreover, I have not done any housing project yet during my study, while I believe it is a rather challenging field within architecture which I would like to discover more thoroughly.

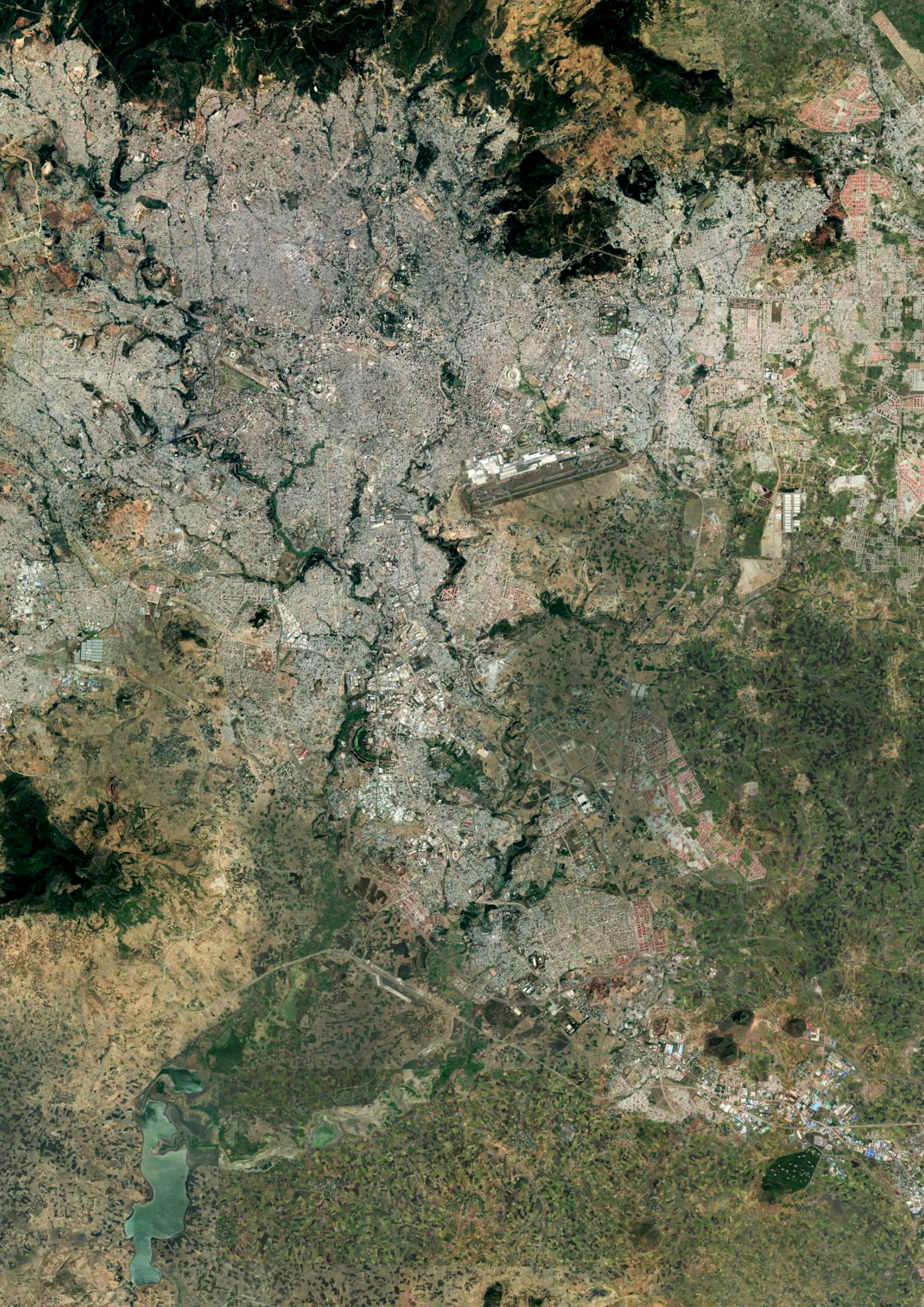
Introduction

As part of the *Global Housing Graduation Studio: Addis Ababa Living Lab* this projects seeks for a solution regarding the enormous housing shortages within the city of Addis Ababa, the capital of Ethiopia. In person I got see how the vast amount of the population lives in sub-standard slum housing conditions and how the government responded since 2004 with the integrated housing development programme, resulting in a post war housing scheme also known as the condominiums. Despite the impressive amount of newly constructed dwelling units, shortcomings of this housing strategy have drastic consequences on residents and the liveability of the city. It disperses communities, is not inclusive for the very poor and does not respond to environmental issues. Besides, during the fieldwork I also noticed the distorted relationship between waterbodies and urban dwellers in the city.

Addis Ababa accommodates many seasonal and perennial rivers having their source just north of the city in the Entoto hills. However, these valuable resources are neglected and got widely polluted downstream along the waterfronts in the city. Besides, they are ignored in urban planning schemes resulting in floods, having a huge negative impact on the daily life within the city. These water-related issues also struck me during visits to other fast emerging cities where I have been before. It made me dig into water-related issues in Addis Ababa and its many connections to dwelling. I realised that the shortcomings in the dwelling landscapes ties into the water related issues. Therefore, this projects proposes an alternative housing strategy which allows densification but also reflects the needs of the people and integrates the existing environment, sepcifically the waterbodies. It will answer the question: How can the dwelling landscape contribute to the development of a healthy 'River Culture' in Addis Ababa and vice versa?

In order to come up with a substantiated design, the first part of this report will consist of an elaborate research on the development of the city in relation to the waterbodies and an ethnographic research on the living conditions in a condominium housing block in Mickey Leland. In the second part, an urban vision will be developed and implemented in the water linked neighbourhood 24Kebele. Here, the vision of the relationship between the dwelling landscape and a river culture will be outlined on various scales.

Figure 1.1
Addis Ababa from satellite
Google earth snapshot



2 Problem statement

Problem statement

Cities in the Global South, and more specifically in Sub-Saharan Africa are growing rapidly. Demographic statistical data indicates that the absolute number of urban population in this region will be tripled by 2050 compared to 2015; The current amount of 400 million urban dwellers will increase towards the 1.2 billion (Spaliviero et al., 2019). Cities in the Global South are urbanizing faster than public authorities can manage which results in a lack of basic infrastructure and services (Van den Brandeler et al., 2019). Moreover, water bodies get invariably ignored by urban planners (Wantzen et al., 2019). This has severe consequences for the biodiversity and human livelihoods that are linked to water in- and outside the urban perimeter (Ibid.). On city scale, the absence of water management in urban-planning schemes and the uncontrolled formal and informal urbanization make rivers become the armpit of the megacity; The water quality of urban streams are uniformly extremely poor, river banks become dump sites and homes for the poorest of the city (Ibid.).

Addis Ababa, the capital city of Ethiopia with a population of approximately 3.4 million, is not an exception (UN-HABITAT, 2011). It is a fast growing city, projected to grow by 3.8 per cent each year in the upcoming 15 years (Ibid.); A city bursting at the seams. Ethiopia is often referred to as the "water tower" of eastern Africa which can be traced back to the capital. Addis Ababa accommodates many seasonal and perennial streams coming together in the little and great Akaki rivers. They feed into the Awash basin, south of the city, and continue to the lakes in the Rift Valley (Hamere & Eyasu, 2017). However, due to fast population growth, uncontrolled urbanization, lack of sanitation infrastructure facilities and poor (industrial) waste management the rivers and streams of the city are highly polluted (Worku & Giweta, 2018). They have simply become the waste dump of the city (Hamere & Eyasu, 2017).

Figure 2.1
Aerial view Addis Ababa

Figure 2.2
Polluted waterbody

These bad conditions are a high threat for human health and the functioning of ecosystems in and around Addis Ababa (Ibid.). Besides, as a result of a lack of adequate attention from the urban planners towards the riverbanks and streams, they have not been integrated in the urban fabric and became occupied by large numbers of informal settlers, who live in very poor conditions, especially during rainy seasons when floods occur (Mekonnen, 2007). Subsequently, the rivers of Addis Ababa are not embedded in the urban fabric and - except as

Figure 2.3
Illigal informal settlement

Figure 2.4
River as waste dump

dumpsite - not accessible for its inhabitants (Local Governments for sustainability Cities Biodiversity Center, 2019). The poor river conditions results in a serious impact on the environmental, social and economic domain in and around Addis Ababa; The ecosystem of the river is already highly damaged, the community's health gets (indirectly) affected and there is an economic loss and negative impact on the country's GDP (Hamere & Eyasu, 2017). To tackle these degradations, the preservation and improvement of the water bodies in the city

Figure 2.5
Communal living

is essential. A development of a 'river culture', an environment in which people live in harmony and respectfully with water, and an acknowledgment of the values of the streams and rivers is required (Wantzen et al., 2019). Therefore, water should be better incorporated into the urban planning schemes (UNESCO / ARCEAU IdF, 2016).

However, to succeed it is crucial to see how this 'river culture' interacts with the dwelling landscape; A landscape that houses its inhabitants and support their (informal) activities and needs.

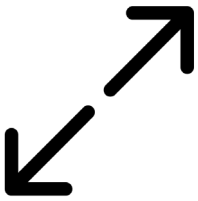
Besides the high percentage of sub-standard slum housing conditions in the city, public facilities accommodating the residents' (informal) activities and needs are lacking in the dwelling landscape (UN-HABITAT, 2011). There is a huge shortage of green space, urban public open spaces and no facilities for urban farming. The lack of green space does not only influence ecosystems but also results in heat island effects across the city (Abebe & Megento, 2016). Urban public open spaces, key contributors for a sustainable community, are neither working properly nor enough available (Birru, 2014). And despite the large amount of families dependent on urban farming, policy makers fail to incorporate urban farming in the urban planning scheme (Duressa, 2007). This number of families probably only increases as result of urbanization and increase of food demand in the city. The consequences of a lack of useful urban public (green) spaces and incorporation of urban farming opportunities become prevalent in the newly build condominiums, where due to standardized spaces and restrictive habitation rules the needs of resettled resident are not met; There are no opportunities for informal activities and income generation (Hassen & Soressa).

The lack of well-planned urban green spaces ties into the problem of mismanaged waterbodies in Addis Ababa, and facing these challenges jointly can be the foundation for a synergetic environment between the urban dwellers and the rivers of the city. Improvements in the dwelling landscape can contribute to the development of a healthy 'river culture' and the other way around. This results in the following research question:

How can the dwelling landscape contribute to the development of a healthy 'river culture' in Addis Ababa and vice versa?

To find a suitable solution for the problem statement and research question stated above this project aims to propose a plan of the implementation of a 'river culture' on a city level. This big scale plan/ vision should tackle also issues regarding the restauration of the water bodies. Moreover, 24 Kebele will be the case study in the city of Addis Ababa in which the embedment and interaction of the 'river culture' with the dwelling landscape will be elaborated and worked out into detail. In the case study, the design proposal should deal with the need of densification of the dwellers and the urgency to create a synergetic dwelling environment between the dwellers and the waterbodies and landscape of the neighborhood. At the same time the design should give a solution for the lack of green space, urban public open spaces and incorporation of urban farming in the urban planning scheme. Moreover, the design should take in consideration the attachment of the current inhabitants' livelihoods towards their neighborhood and the informal activities and income generation of the dwellers (Soressa and Hassen, 2018), aspects which are currently missing in the Integrated Housing Development Programme (IHDP) with problematic consequences for the resettled (Hassen et al., 2018). For the implementation of the design proposal construction methods should be proposed taking into account local building materials and methods.

Figure 2.5
Setup project



City level intervention

- Shows the river culture vision on a city scale

- Tackle issues regarding restoration of the water bodies

Implementation 24 Kebele

- Embedment of interaction of river culture with dwelling landscape worked out into detail

- Seek for balance between a river culture and need of densification

- Solutions for lack of green space, open public space and urban farming

- Dealing with attachment of current inhabitants' livelihoods with 24 Kebele

- Using local building methods and materials

3 Research

Introduction

To get a better understanding of the current housing issues in Addis Ababa and problems occurring due to the neglected waterfronts, a research has been held to substantiate the issues cited in the problem statement. First, there will be a brief elaboration on the history of housing strategies within the city. The second part of this chapter will discuss the development of the city over time in relation with its rivers and the consequences that accompany this. In the third part a case study of a condominium project in Addis Ababa will be held. This study will give insights of the current low-cost housing trends in Addis Ababa and enables to learn from its qualities and shortcomings.

Figure 3.1
Illigal informal settlements along a river with in the back the 40/60 condominium under construction

Brief history of housing in Addis ababa

The current housing situation finds its roots within the history of the city of Addis Ababa. Therefore, this will be briefly discussed to get a better understand of the issues currently present within the city.

This introduction of housing in Ethiopia will focusses itself from 1974 onwards when Derg's socialist regime started to rule the country. The housing situation changed significantly since at that time, all urban land and houses have been nationalised by government led agencies (UN-HABITAT, 2011). The most important was the Kebele administrative, which managed the urban sheds under 100 birr per month. Although the housing supply was now controlled by the government, it was still lacking enormously and unable to meet the large demand. Under the Derg regime the housing stock changed and consisted predominantly of rental housing units (Ibid.).

However, as a reaction on the overthrow of the Derg in 1991, the housing market reformed and became market oriented. The post 1991 housing sector in Addis Ababa was characterized by high housing prices, a very low and poorly maintained housing stock, government owned rental units as low-income housing strategy and the continuation of informal unplanned housing (Ibid.).

This situation continued and led, together with the increase of the urban population, to a dire housing situation within the city; In 2005 about 80% of Addis Ababa's residential areas are considered as slums (UN-HABITAT, 2007). As a reaction the integrated housing development programme has been initiated in 2004. The aim of the programme was to reduce the amount of slum dwellings by 50%, create job opportunities and improve the domestic construction sector (Delz, 2016). In order to meet these goals, the government planned to construct 400,0000 dwelling units. The condominiums, as they are called, is a standard mid-rise housing block type made of reinforced concrete, which enables cost-efficient densification. The condominium system consist of three types which are based on different income groups and stimulates home ownership. In order to own a condominium apartment and receive a loan from the bank, residents should first take part of the lottery system. In this way residents will be linked with an apartment somewhere random in the city. If they are lucky enough to get an apartment, they will have to pay a down payment which height (either way 10%, 20% or 40%) is dependent on the size of the apartment (Tipple & Alemayehu, 2014). However, because of this managerial structure there are several issues arising. First of all, since inhabitants

are highly attached to their current livelihoods, being resettled randomly has problematic social and economic consequences for households (Hassen et al., 2018). Besides, the condominium is not inclusive for all residents, the very low-income households cannot afford the lowest down payment and the loan that comes with it (Delz, 2016). Also the spatial qualities of the condominiums and public spaces are not matching with the lifestyles of the people. The spatial qualities of a typical condominium will be discussed in more detail in the research part of this report.

Although, the enormous amount of units built in the first decade of this century, the IHDP estimated a housing shortfall of 1,200,000 units (Tipple & Alemayehu, 2014). Furthermore, rural migration is increasing at a fast pace (Gardner, 2016) and puts even more pressure on the housing stock of the city.

Figure 3.2
40/60 Condominium under construction

Urban development in relation with waterbodies

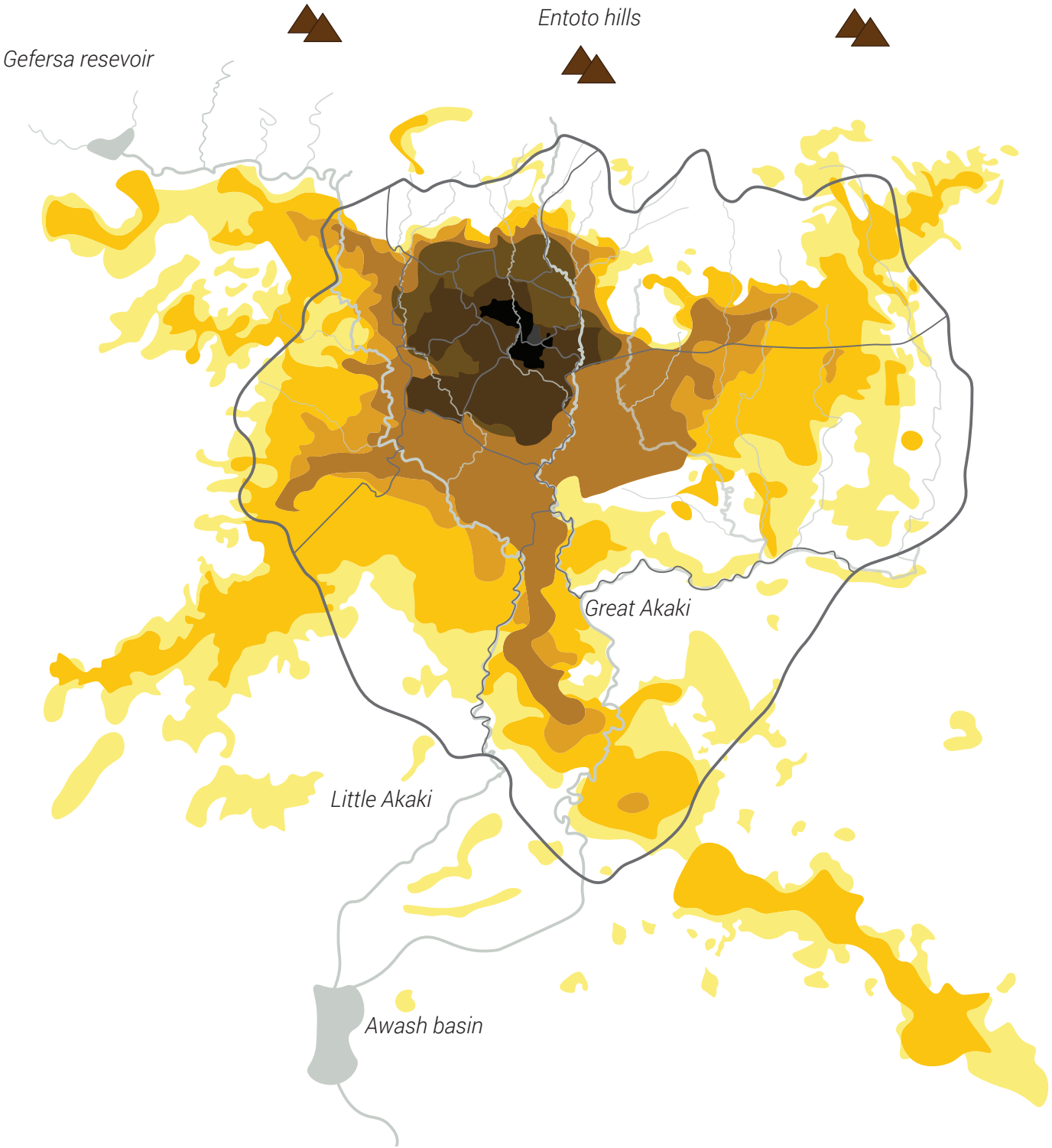
Addis Ababa and urban expansion

As discussed in the problem statement, Addis Ababa is projected to grow rapidly. However, this is not new. The map to the right shows the urban expansion trend from the foundation of the city towards the current state. Already in 2000 the urban fabric has passed its legal city border resulting in ethnic tensions throughout the country (Burke, 2017). Moreover, more and more rivers get 'taken' by the current urban sprawl trends.

What can also be seen on the map are the sources of all the rivers, which are located north of the city, the Entoto hills (or mountains from Dutch perspective). This makes the relation between the city and the rivers exceptional and different from many other cities with waterbodies; Addis Ababa is not depended on settlements or other countries upstream. They get their water directly fresh from the source.

From the Entoto hills the water flows from north to south through the city by seasonal and perennial rivers. All the streams come together via the little and great Akaki river in the awash basin. From there it continues into the Rift Valley.

Figure 3.3
Urbanisation throught time


Entoto hills
Gefersa resevoir
Great Akaki
Little Akaki
Awash basin
Foundation (c. 1887-1936)
The Italian Occupation (1936-1941)
The Imperial Regime (1941-1974)
The Dergue Era (1974-1991)
The Post Dergue Period (1991-1999)
Urbanization (2000-2010)
Globalization (2010-ongoing)

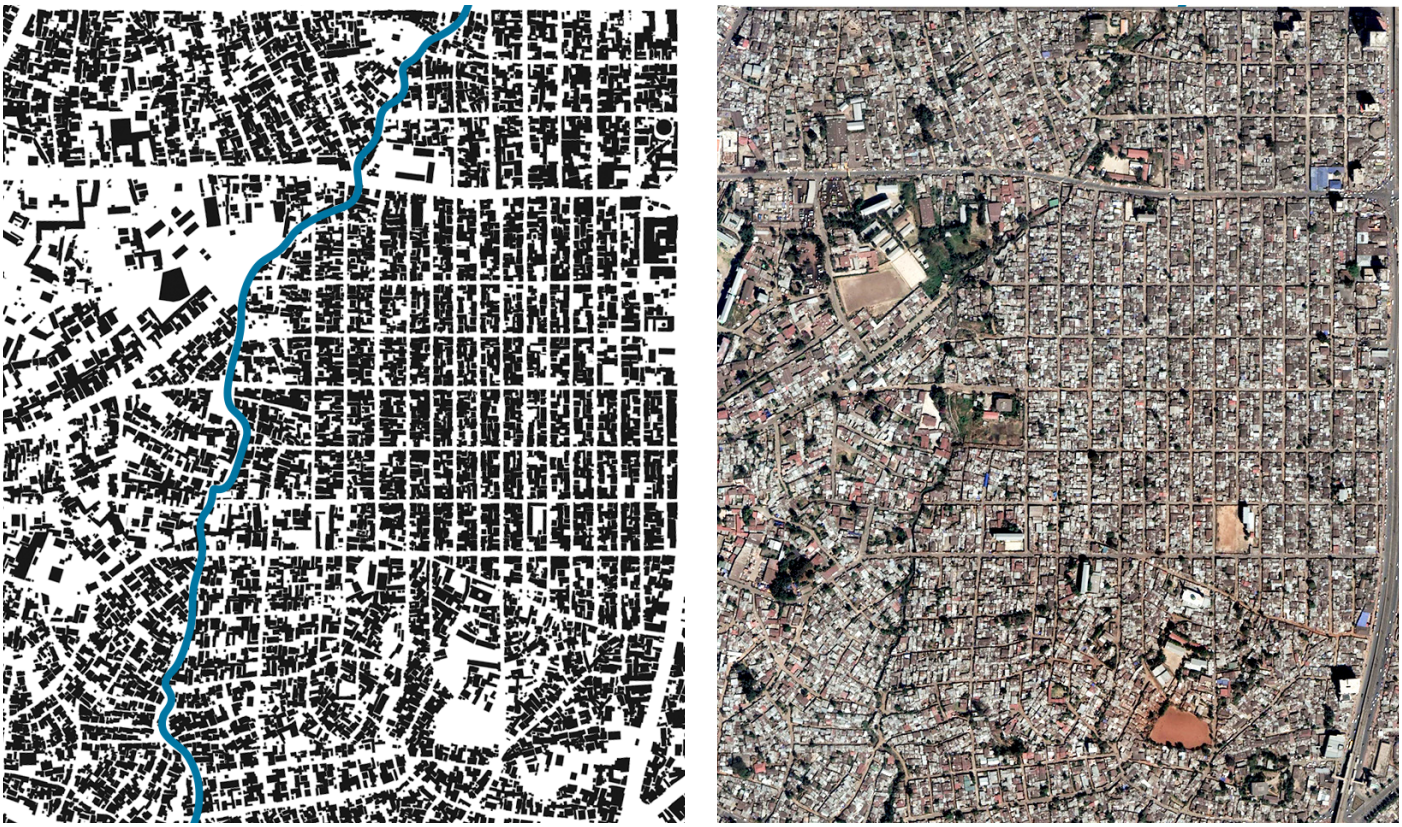


Figure 3.4
Waterbodies ignored by urban planners

The urban fabric and its landscape

The city of Addis Ababa is urbanizing faster than public authorities can manage which results in a lack of basic infrastructure and services. Moreover, water bodies got invariably ignored by urban planners. This become prevalent by studying the urban fabric of the city. The first example, Merkato, a commercial and residential area planned by the Italians during the Italian occupation (van Gameren & Tola, 2017) shows how the urban planners did not integrate the rivers in the urban planning scheme. The rigid grid like urban fabric is not considering in any way the landscape and environment. The river is completely ignored, or as the satellite picture shows, barely visible.

Figure 3.5
Waterbodies encroached by informal urban sprawl

The other example, a neighbourhood close to bole international airport is a typical case of informal urban sprawl. It is the result of a shortage of low cost housing facilities and unplanned waterbodies which are actually seen as wastelands. Waterbodies have been encroached over time by (illegal) informal settlers living in severe circumstances, especially during rainy season when floods occur.

Polluted waterbodies and its consequences

The uncontrolled urban sprawl and the disconnected relation with the rivers and green spaces together with the ignorance of urban planners and policymakers towards the environment, has its consequences on the waterbodies in and around the city. It results in highly polluted rivers which have a negative impact on the liveability of the city.

Reports show how 35% of the solid waste generated by the urban population of Addis Ababa is dumped on open sites, drainage channels and rivers. In addition, a huge amount of domestic, industrial, commercial and institutional waste water gets untreated discharged and ends-up during run offs in the waterbodies of the city (Hamere & Eyasu, 2017).

This pollution of the rivers has huge negative impact on the water quality and thereby on water-linked ecosystems in the city, and further downstream in the Rift valley. Due to the contamination of non-biodegradable toxic heavy metals in surface water, ecosystems gets heavily distorted. Especially the composition of macroinvertebrates in the water gets highly affected due to the deterioration of the water quality (Worku and Giweta, 2018). Moreover, as a consequence of eutrophication, algae and weeds are increasing in numbers and thereby depleting the oxygen level of the waterbodies, decreasing the chance of survival of water-linked flora and fauna (Hamere & Eyasu, 2017).

Figure 3.6
River inaccessible and polluted

The heavy metals present in the rivers also negatively affects human health in and around Addis Ababa. Since the water of the rivers is used for fruit and vegetable production these heavy metals ends up in the food web. Research has shown that urban dwellers around the Akaki Kality industrial zone, got a higher chance of health issues such as coughing, diarrhoea, typhoid and typhus due to the highly contaminated Akaki river nearby. The discharged industrial waste in the river has a large share in this. (Ibid.)

Polluted rivers effects also the economy. First of all it minimizes the total amount of water supply possible making water use more expensive (Worku and Giweta, 2018). Secondly, the use of polluted water for production and consumption results in costs. Consumption leads to health related expenses and for production it decreases both quality and quantity (Hamere & Eyasu, 2017). To put it in perspective, UNESCO (2009) pointed out that on the African continent the lack of access to safe water caused a decrease of the GDP of 5%.

Figure 3.7
River inaccessible and polluted

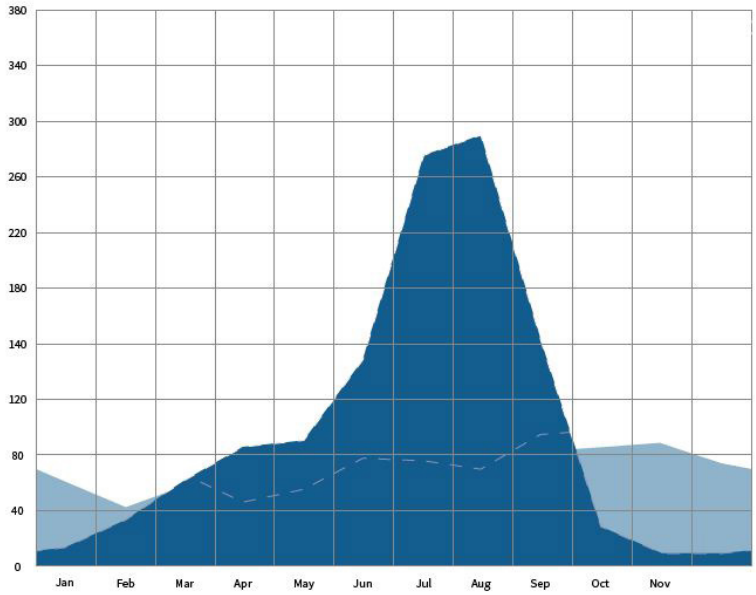
Mismanagement of waterflows: Floods and shortage of potable water

Next to pollution related issues, the rivers of Addis Ababa currently form also a threat concerning floods. Overtime urban flooding got more and more intensified due to extreme climatic events, intense peak hours of rainfall and an increase of impervious area due to urbanisation (Birhanu, Kim, Jang & Park, 2016). In rainy season it regularly disrupts the daily life and especially those living along the rivers end up in dire situations. These housing developments along the rivers together with the use of inappropriate construction materials and poor drainage systems reinforces the current trend of flood increase (World Bank, 2015). To put the amount of rain in Addis Ababa in perspective, the diagram on the right (World Weather Information Service, 2019) shows that more than six months of the year the precipitation in Addis Ababa is higher than in Amsterdam. And just as the waterbodies, this abundance of water is currently a threat for the city instead of an asset.

In the meantime there is a huge shortage of potable water within the city. In the last decade citizens struggled more and more to ensure regular in house clean water supply and with the current trends of climate change and urbanisation researchers expect this to become worse if nothing changes (Terefe, 2019). To by-pass this shortage of water, Addis Ababa should intensify the current sources of water -surface water and groundwater- without over extraction and should seek for new water sources to prevent a water crisis (World Bank, 2015).

Figure 3.8
Rain Patteren Addis Ababa compared with Amsterdam (dashed)

Figure 3.9
A flood during rainy season
Picture by UNDP Haiti


380
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A government response

As response towards the floods, the government started in February this year (2020) the “Addis Ababa Riverside Project” also known as the “Beautifying Sheger Project” (Terefe, 2020). It is prime minister Abiy Ahmed’s billion dollar initiative to fight floods and in particularly beautify the city. The project is located along the Great and Little Akaki rivers stretching a total distance of 51 kilometres. The beautifying sheger project is described as a project that aims to mitigate river floods, create job opportunities in the projects phase, generate riverside economies, increase urban tourism and provide an area in the city for recreation and respite (Ethiopian Embassy Belgium, 2019). It becomes clear that

Figure 3.10
Render from the Beautifying Sheger Project

this project does not address all the water related issues currently present in the city such as the pollution (Hamere & Eyasu, 2017).

On the image on the right it seems as Abiy Ahmed is planning to create a park with allure. It seems to have an artificial character consisting of rivers, neat lawns with trees and concrete. Is this the way to revitalize the rivers? It makes me wonder how the waterbodies of Addis Ababa were before the city was there.

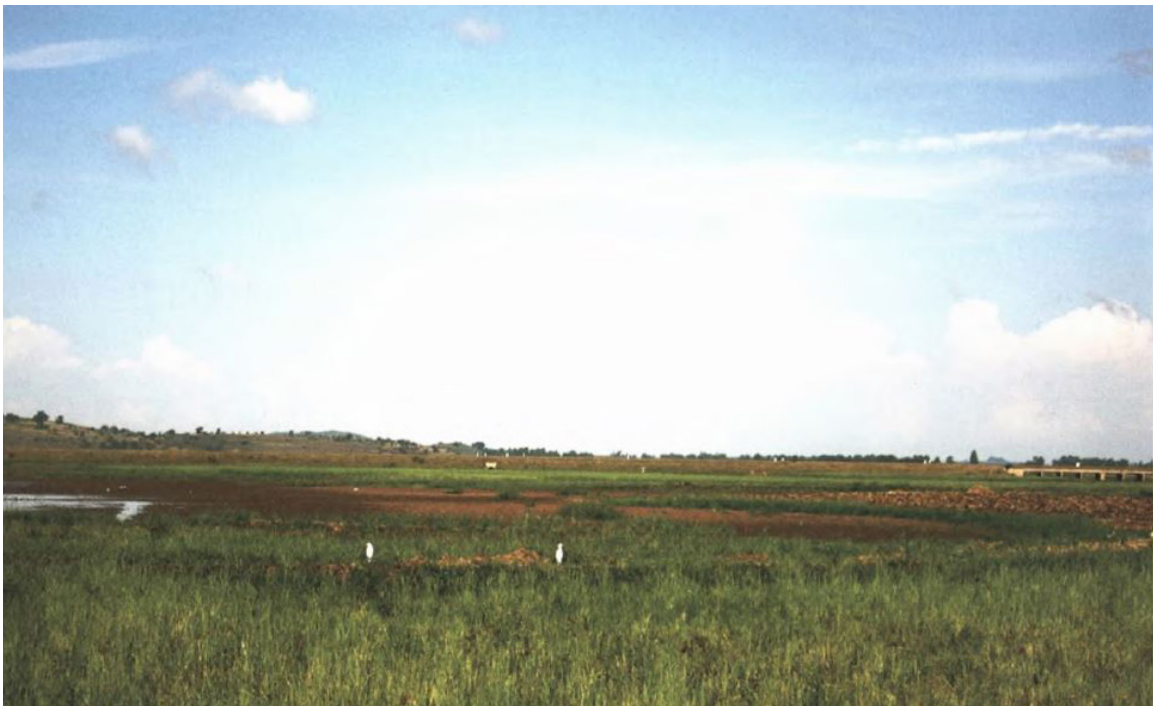
Figure 3.11
Plan from the Beautifying Sheger Project

The natural landscape of Addis Ababa

As a result of the ignorance of urban planners towards the actual environment and the uncontrolled urban sprawl, the state of the landscape and its rivers changed drastically. The natural landscape around the seasonal and perennial streams in Addis Ababa, as they were before the development of the city, can be described as a wetland in the form of marshes and swamps with a temporary or permanent body of water. The landscape mostly contained (low) woody vegetation (trees and bushes), reeds, a wide variety of grasses, rushes, sedges and other herbaceous plants as can be seen on the two images on the right. (Friis et al., 2010).

Figure 3.12
Ethiopian freshwater marshes and swamps and lake shore vegetation Picture retrieved from the Atlas of the Potential vegetation in Ethiopia

Figure 3.13
Ethiopian freshwater marshes and swamps and lake shore vegetation Picture retrieved from the Atlas of the Potential vegetation in Ethiopia



Urban expansion in relation with green spaces

However, the wetland and its vegetation disappeared as Addis Ababa emerged. The following maps shows the relation between the urbanisation over time and the disappearing green spaces throughout and around the city.

The first map shows the green areas in time of the Italian occupation. Agriculture was a big focus of Mussolini during the occupation. Fertile land was promised for Italian settlers, well connected with markets in urban centres. For Addis Ababa this meant that south of the city big plots for agriculture were introduced. Moreover, due to the Italians mechanized agriculture methods has been widespread in Ethiopia during their brief occupation (Sbacchi, 1977).

As a reaction on the famine 1984 due to drought, the government invested exclusively in agriculture. In this period big fields for agriculture, mostly connected with river shores, has been provided around the city of Addis Ababa for the growth of food as can been seen in the second map (Van Gameren & Tola, 2017).

However, as the city expanded rapidly in times of urbanisation and globalisation the amount of green spaces and opportunities for (urban) agriculture drastically decreased, as can be seen on the third map. On the outskirts of the city agriculture plots had to make way for housing projects such as the condominiums and high-end residential projects or has been encroached by informal settlements. This high decrease of forests, wetlands and agriculture plots strengthened the environmental degradation in and around the city and is in strong relation with the decay of the waterbodies. From a 'forest city' Addis Ababa changed to an urban heat island, heating many neighbourhoods across the city (Abebe & Megento, 2016). All these developments has severe consequences environmentally, socially and economically (Hamere & Eyasu, 2017). Or in short; on the liveability of the city.

Figure 3.14
Green spaces 1941

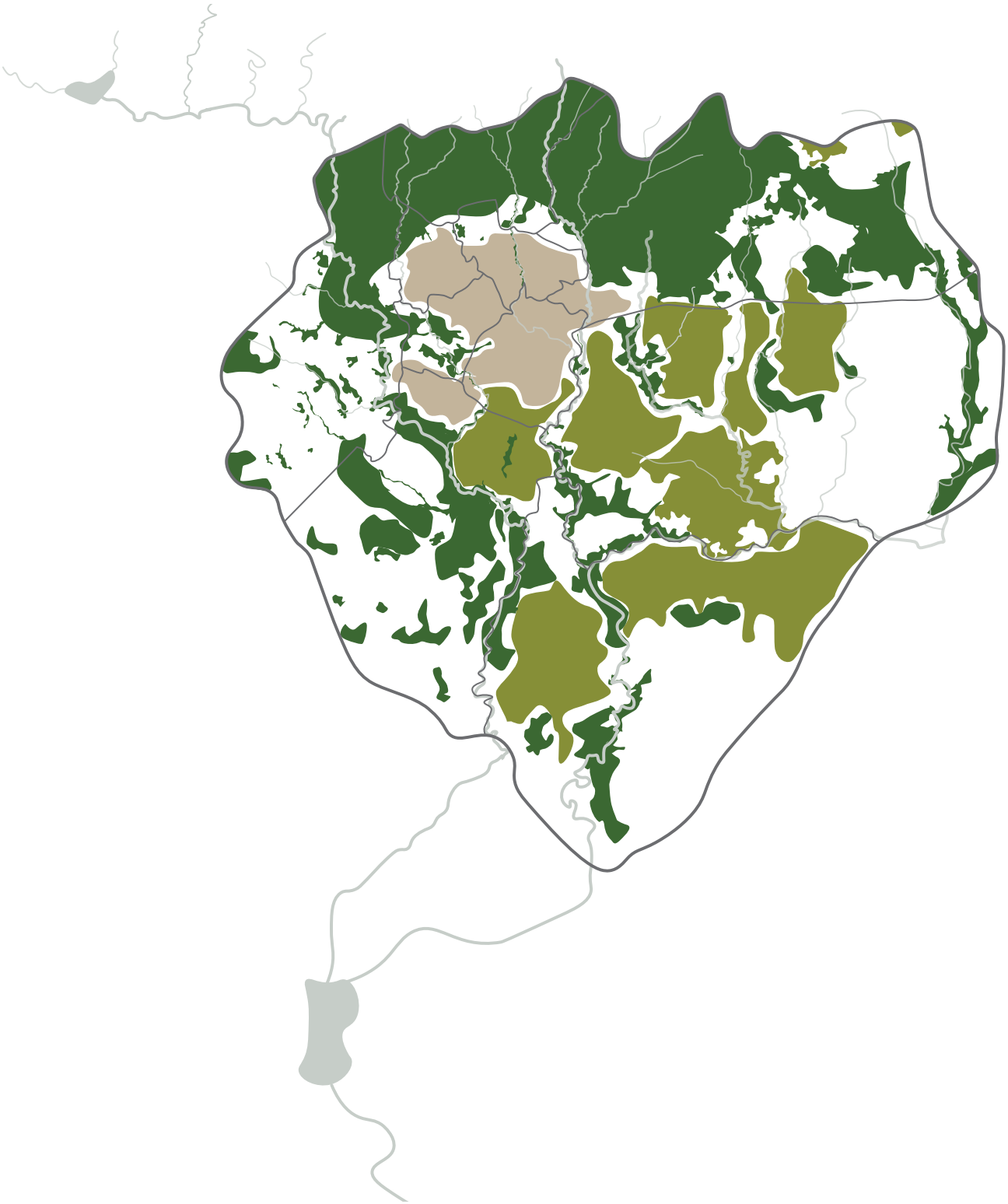


Figure 3.15
Green spaces 1999

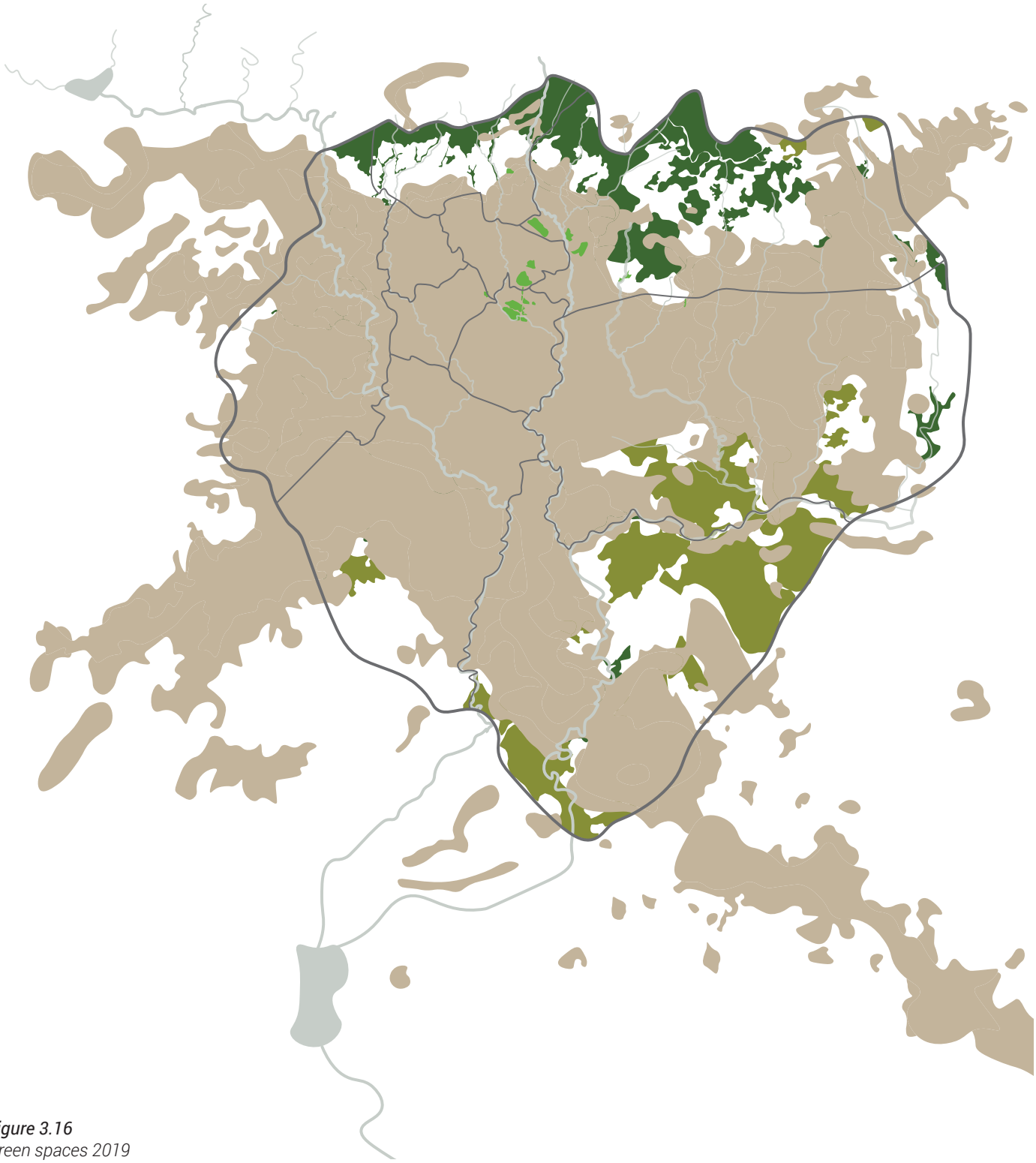


Figure 3.16
Green spaces 2019

Dependence on informal activities and income generation

The dependency on agriculture practices for income in Ethiopia is enormous. As the graph on the right indicates, more than 70% of the employees throughout the country is active within the agriculture sector (World Bank, 2019). This may be related with the high percentage of rural population throughout the country. However, it is not only rural population who are depend on farming opportunities. Many urban residents in Addis Ababa are highly reliant on urban agriculture. The office for the Revision of the Addis Ababa Master Plan stated that more than 51.000 families are directly supported by urban farming and indirectly has an impact on the lives of many other urban residents (Duressa, 2007). This has to do with the fact that urban agriculture contributes in urban poverty alleviation (ibid.). It is practiced as an informal economic sector in a city which is for more than 50% dependent on informal income generation (UNDP, 2018). Moreover, as the Ministry of Finance and Economic Development of Ethiopia (2006) reported, is the poverty gap in Ethiopia between urban areas and rural areas decreasing, due to the increase of urban population living below the poverty line. Hand-in-hand with it, goes an increase in demand for informal income generation.

However, policy makers and urban planners fails to incorporate urban agriculture in the urban planning schemes (Duressa, 2007), as we have seen on the green development maps. But also in general, urban public open spaces in Addis Ababa are not operating properly (Birru, 2014). Moreover, the report of the Ministry of Finance and Economic Development of Ethiopia (2006) stated that the misfunctioning urban development policies are primary reasons for the rise of urban poverty.

Figure 3.17
Employment rates by sectors in Ethiopia

World Bank, 2019d

AGRICULTURE INDUSTRY SERVICES

A condominium case study: Mickey Leland

For the research seminar I carried out an ethnographic research at Condominium site Mickey Leland together with two fellow students; Cristian Rancati and Ludovica Cassina. Based on this collaborative research in the form of a graphic novel, I outlined my own conclusions that have helped me enormously throughout the process of the design of my project. This study will give insights of the current low-cost housing trends in Addis Ababa and enables to learn from its qualities and shortcomings. Moreover, the conclusion and especially the graphic novel give a valuable insight in the daily life of the residents in Addis Ababa. This understanding helped me to design low-cost dwelling units which resonates with local cultural practices.

Figure 3.18
A typical compound

Figure 3.19
View on inner courtyard

The Ethiopian post-war housing scheme. A case study: Mickey Leland.

Mickey Leland arose from The Integrated Housing Development Programme in 2008 on a wasteland in times of huge housing shortage (Brook, 2015). It is a coherent and integral urban design concept. A rubber stamp approach consisting mainly of five-story slab-shaped volumes surrounded by a generous amount of public spaces. It is representative for the current housing trend in Addis Ababa, the Condominium housing. The answer, after an extensive research, of the Ethiopian government towards the same question I will have to deal with. Seeking for a low-cost housing vision within the city. Therefore, it is interesting to investigate how modernistic post-war housing scheme performs and how the people inhabit this type of housing. Are there any issues and/or qualities in this type of a rubberstamp housing scheme? And are there potential ways to tackle these issues?

Figure 3.20
Map of Mickey Leland

Figure 3.21
Axonometric view of visited compound

To examine the livability and inhabitation patterns of this dwelling typology, there will be a focus on several, mainly public centered, domains. Firstly, during the ethnographic research it became clear that the spatial quality of the neighborhood is valued by its users, who are mainly from a lower economic class. They are grateful for the quality of the homes and the spacious public spaces. However, the open spaces are not adequately designed, resulting in neglected (semi) public open spaces; making them a concern rather than an asset. The vast empty zones, acting as wasteland, are not socially activated giving them an anonymous character, also known as 'floating public space' (Van Dorst, 2012). The open spaces are

Figure 3.22
Street with commercially activated plinths

therefore prone for getting neglected by its residents. This becomes prevalent by the polluted open spaces which are occupied by a big number of satellite-dishes. Nevertheless, the inhabitants indicated that they experienced a qualitative sense of community in the neighborhood especially within a territory with clear boundaries. This can be clarified firstly by the social dependency between residents, which is relatively big considering the state's minor social safety net. Moreover, the residents claimed parts of the public space by plotting boundaries, creating recognizable territories and making the environment more legible for visitors and people passing-by, giving more control to the 'owners' (Van Dorst,

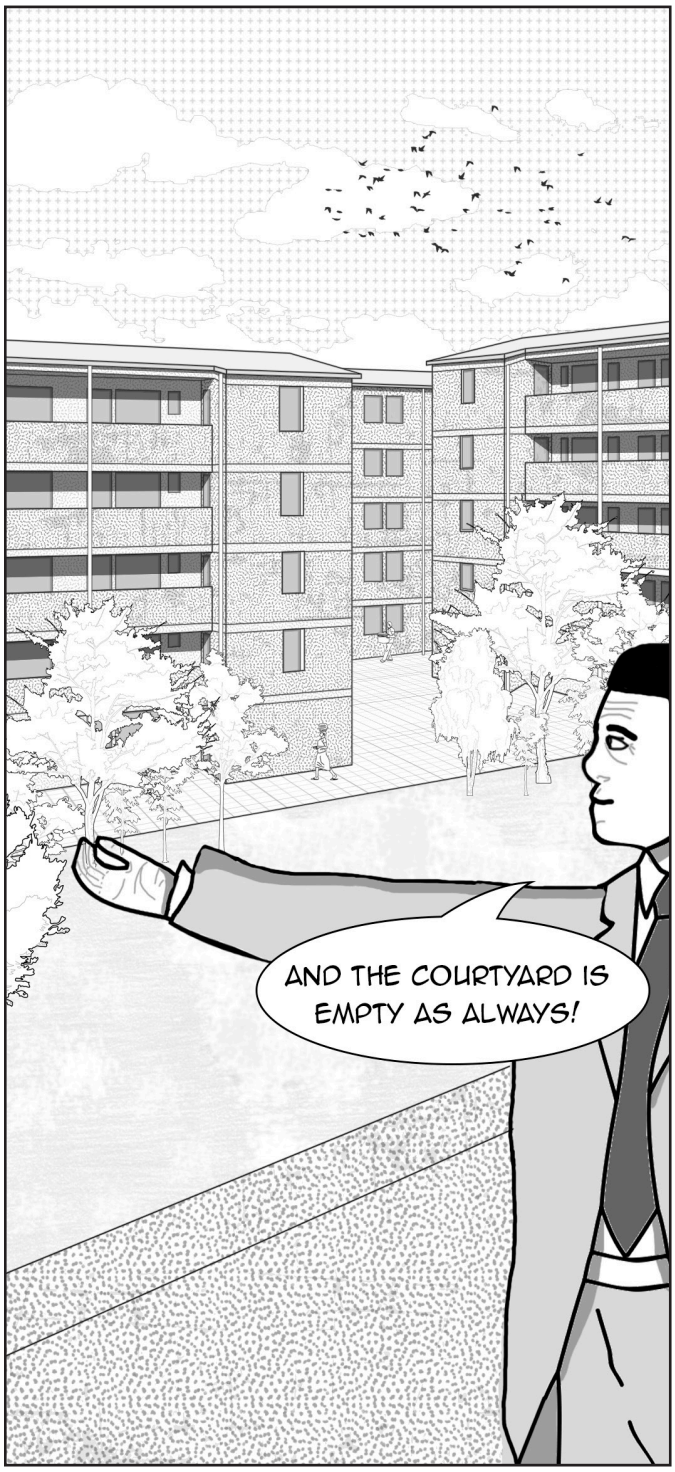
2012). Besides, with commercial activities on the ground floor, the public spaces are socially activated. Moreover, in the core of each dwelling compound a community house is situated serving as multifunctional space for various social activities that, according to the residents, occur regularly. And finally, housing in Mickey Leland is solely ownership based, creating a permanent group of residents. It provides the opportunity to build social networks. All these factors enables residents to create a sense of community.

Figure 3.23
A typical Courtyard active as floating space

The stacked and densified composition of dwelling units in Mickey Leland enabled the development of shared semi-private open spaces. On a large scale in the form of (green) open spaces to smaller scale, and more private interventions, such as galleries. These areas are important for informal activities and income generation. The public (semi-private) open spaces are playing a vital role for the livelihoods of its residents. Due to the shortage of work opportunities, people must find alternative ways to maintain themselves. Therefore, home based businesses enable inhabitants to generate income with a minor starting capital. In Mickey Leland various activities such as laundry service, clothing repairing and food production form house based enterprises. Despite the fact that there are some opportunities, inhabitants indicated that there is a higher demand for homebased businesses, also for the less fortunate. Secondly, the public semi-private open spaces serve as extension of the apartments for informal activities. The traditional way of Ethiopian cooking for example, is on open fire with charcoal and happens desirably outside the apartment. Although the communal space can facilitate this activity, the residents prefer to look for a place as close to their apartment as possible. Moreover, one visited condominium compound constructed a shared vegetable garden in the semi-private open space. In order to be able to carry out these informal activities, residents occupy parts of the public spaces and galleries. However, these shared spaces are not designed for these activities and needs. The gallery for example, is too narrow to function as an access route, a space to cook and to dry clothes at the same time. It results in restrictions for activities on the galleries that people do not adhere to, leading to inconveniences and frustration between residents within the compound and thereby feeding antisocial behavior of its residents (Van Dorst, 2012).

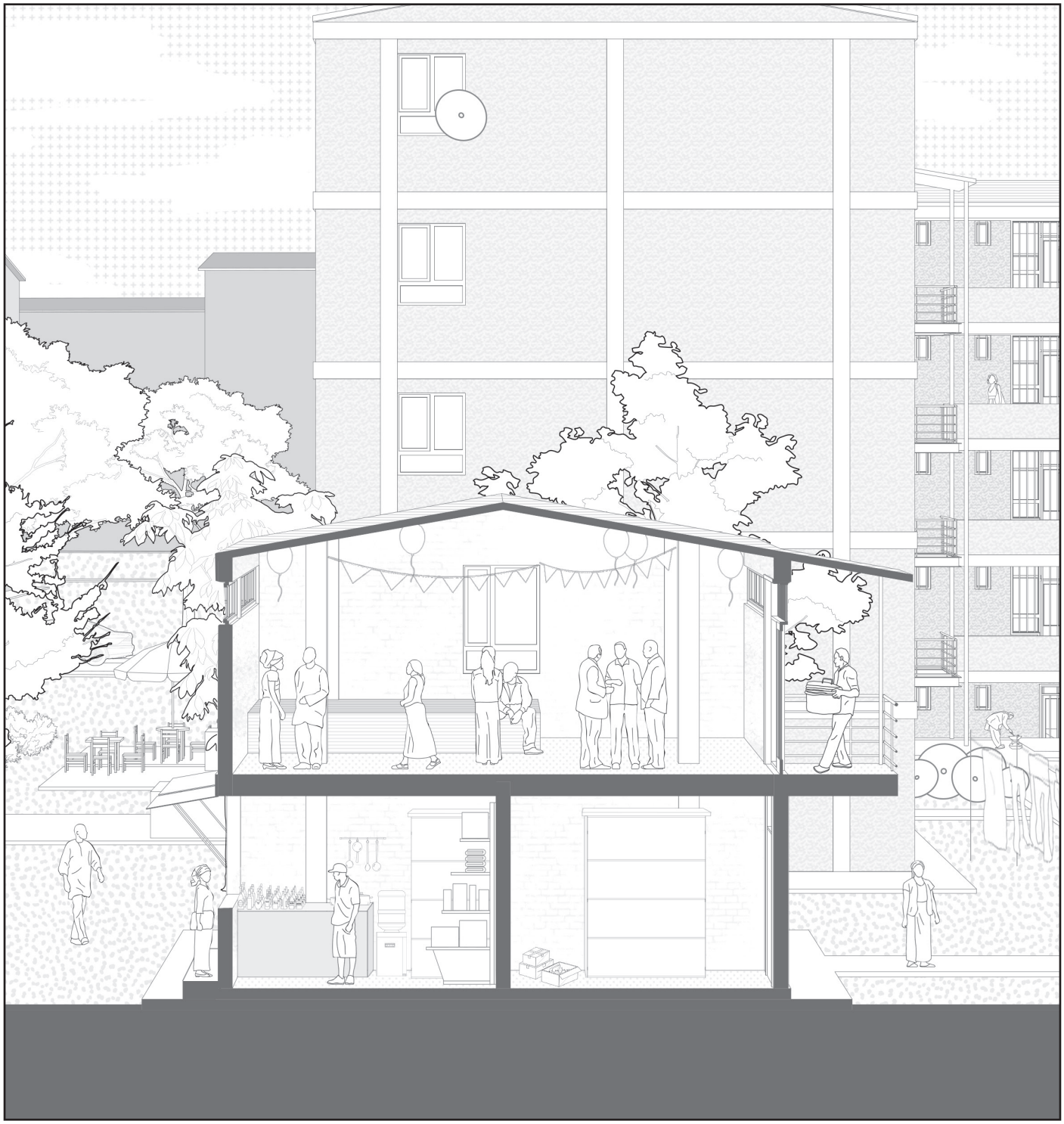
Figure 3.24
The gallery and inner courtyard


FROM OUR GALLERY NOTHING HAS BEEN STOLEN...


AND THE COURTYARD IS EMPTY AS ALWAYS!

In summary, the five-story flat type of the post-war housing scheme is a logical choice in times of extreme housing shortage. However, with the sole focus on the apartments, a livable dwelling environment is not yet created. In Mickey Leland the residents are grateful for living in qualitative apartments surrounded with spacious public spaces. However, the public spaces became floating spaces; having an anonymous character and therefore prone to be neglected by its residents. The public spaces are not thoughtfully designed, do not reflect the needs of the inhabitants and are not well defined for its users, visitors and passers-by. Meanwhile, during the site visits it became prevalent that there is a need for program serving the informal activities and income generation. I believe that these activities can be the core of the public space program and in this way not only serve the needs of the residents but also facilitate control and a legible public space. In this way residents participate in and have (within a set framework/ design) control over the majority of the outdoor spaces, making the neighborhood socially activated and one that can sustain itself.

Figure 3.25
Communal facility; originally disfunctioning as shared kitchen, now usefull as multi-functional space for special occasions



4 Site introduction: 24 Kebele

Location
Typology 1 FHC densified
Typology 2 Illigal informal settlement

Location

In the late 1980's 24 Kebele has been developed by the FHC, the federal housing corporation, together with help from the Swedish government. It is situated on a potential location in the city; within the ring road and close to Bole, one of the more developed and booming areas in the city. It is enclosed between the ring road and a river and the new stadium and the main airport are close by; It is a prime location in the city.

Figure 3.1
Location in the city

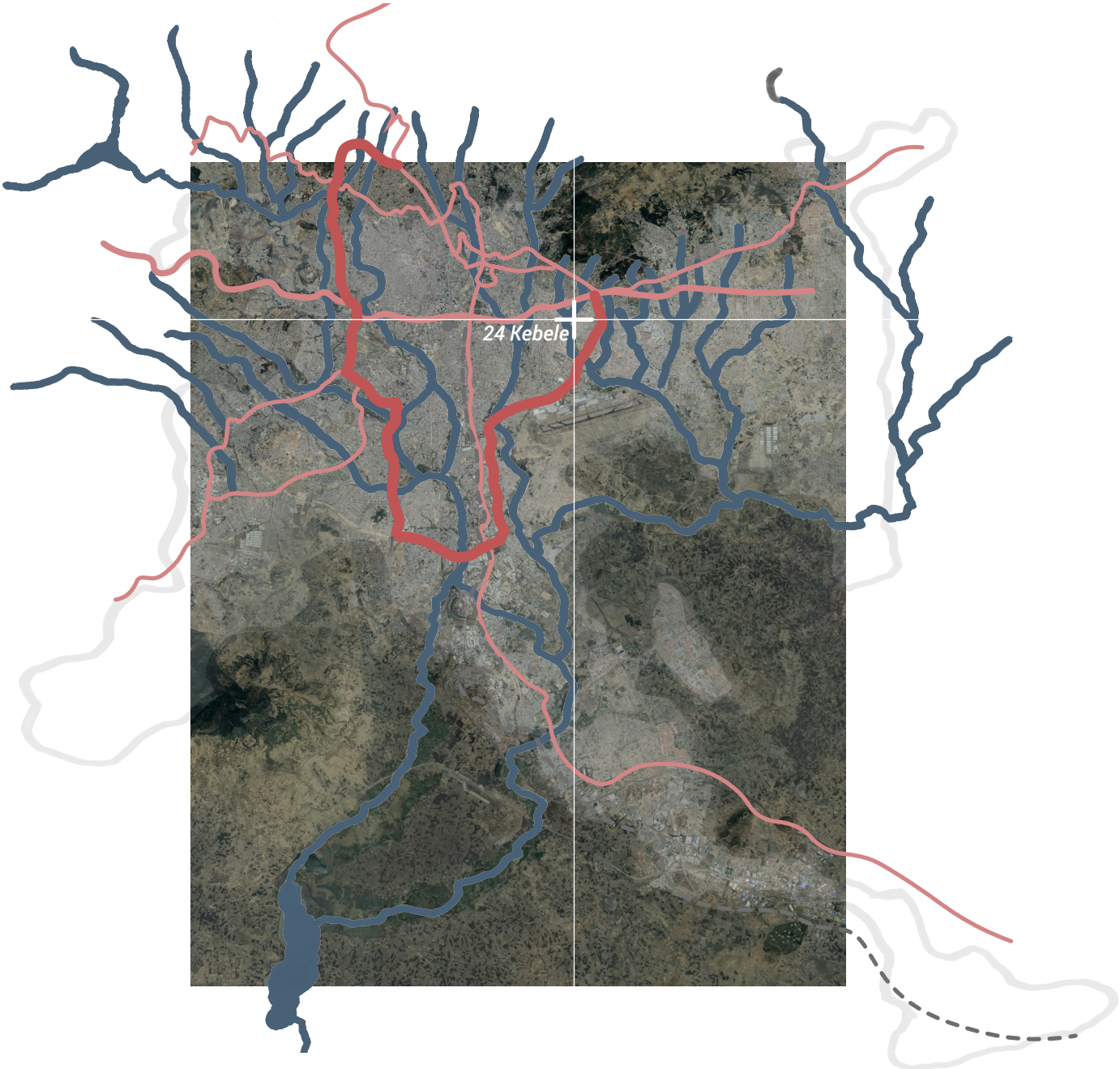

24 Kebele

Figure 3.2
24 Kebele (dashed) located within the ring road close to the new stadium and airport

The neighbourhood consists mainly of one story low rise dwellings except from several private multi-story developments. The river west of the site is, as described in the problem statement, not accessible, polluted and squatted by illegal settlers. In the core of the neighbourhood a soccer field with a community centre is situated. The area west of the soccer field consists of single story, overtime highly informal densified, FHC owned dwellings. They are completely fenced for security purposes. The second housing typology present at the site, can be found along the river and is the informal illegal settlement. These people live in severe circumstances, especially during rainy season when floods occur.

Figure 3.3
Aerial view 24 Kebele

Figure 3.4
Plan focus are

Figure 3.5
Illigal informal settlements along the river

Figure 3.6
Typical street view

Figure 3.7
Primary road of the site is currently under construction

Figure 3.8
Pollution at the outlet of the river towards the new stadium

Typology 1
FHC densified

This typology is predominantly present in the neighborhood. At time of construction it consisted solely of the back-to-back houses with a generous amount of private outdoor space in front of the dwelling unit. However, the main FHC tenants densified their plot, enabling subletting these sheds for income generation purposes. It has led to the situation that three to five families are living on a plot that originally is intended to house one household.

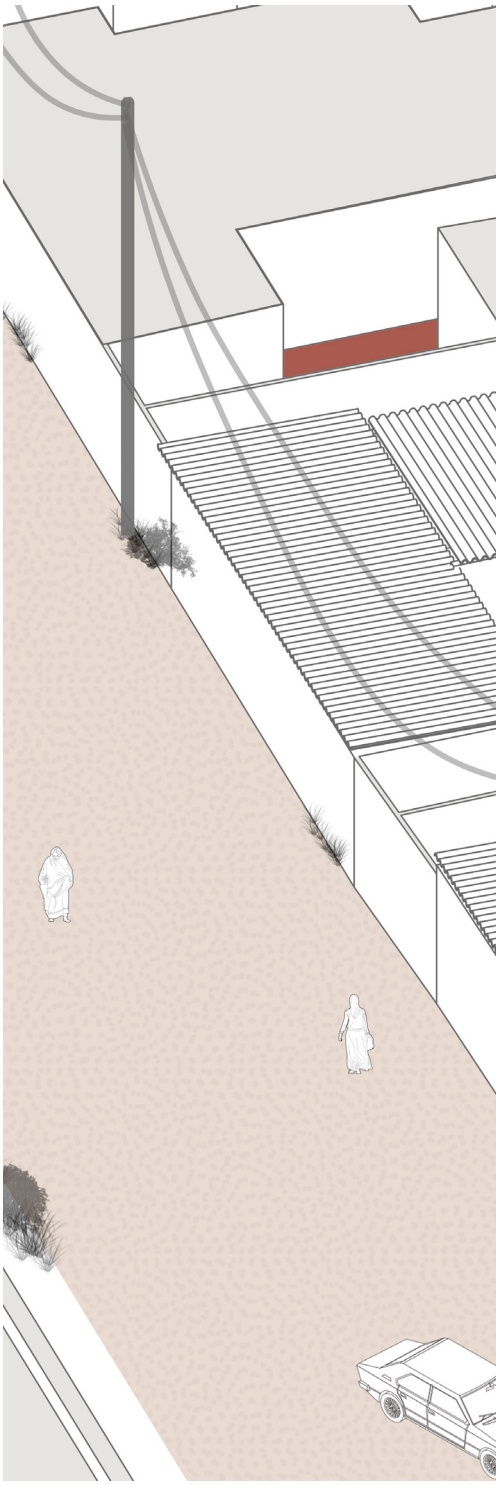
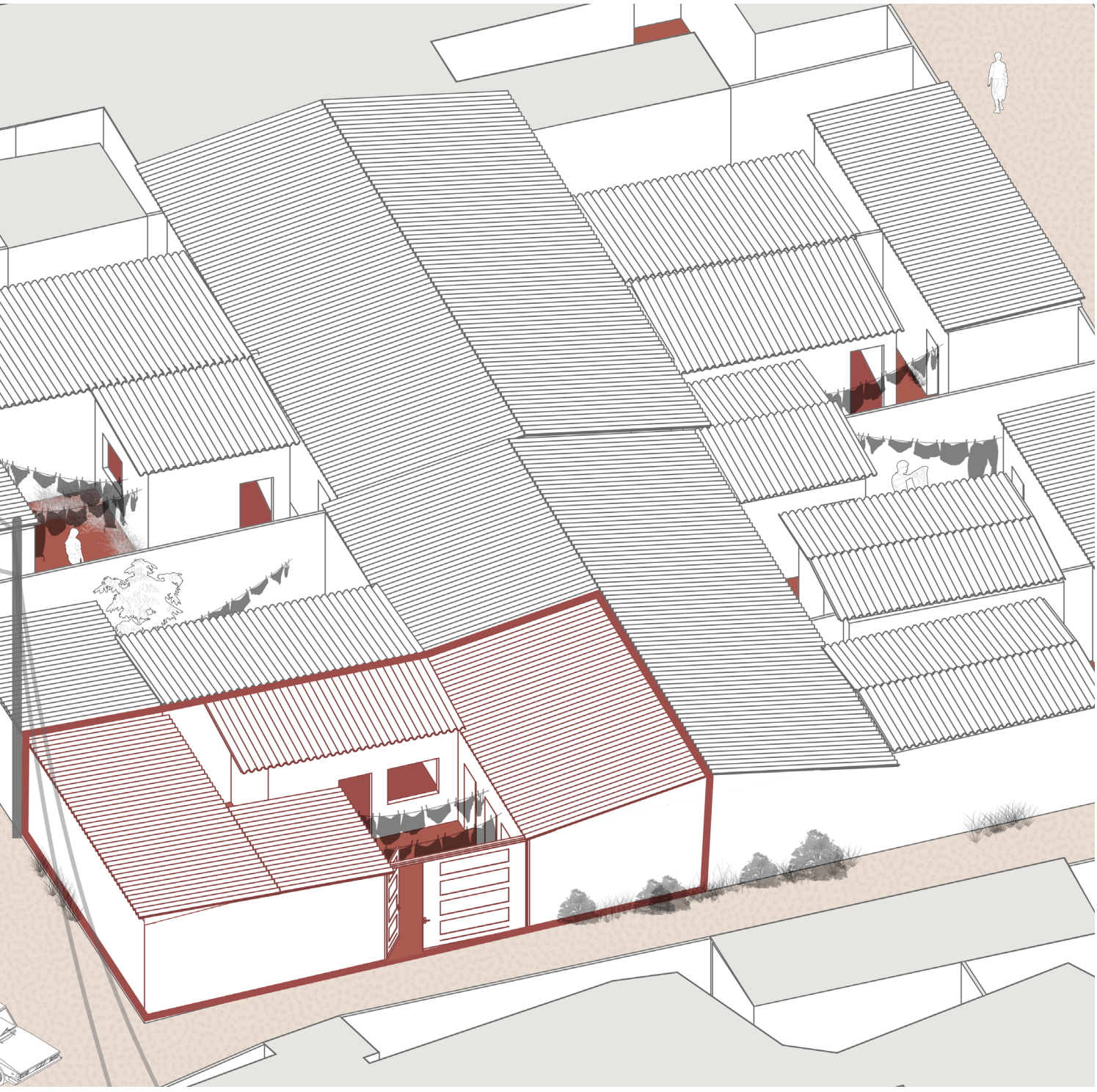


Figure 3.9
Axonometric view of typology 1



Typology 2
Illigal informal settlement

The second typology present on the site, are illegal informal settlements along the river. The households living there occupy illegally a plot of land an have built a number of sheds on it. These too are subleased to other families by the people who originally started to squat the plot of land. During the visit this particular cluster of sheds even kept some cattle for income generation in one of the sheds. However, These people live in severe circumstances, especially during rainy season when floods occur. Moreover, the public authorities are planning in the upcoming five years to evict these people. They looked with fear to the near future in which they probably have to find a new place by themselves.

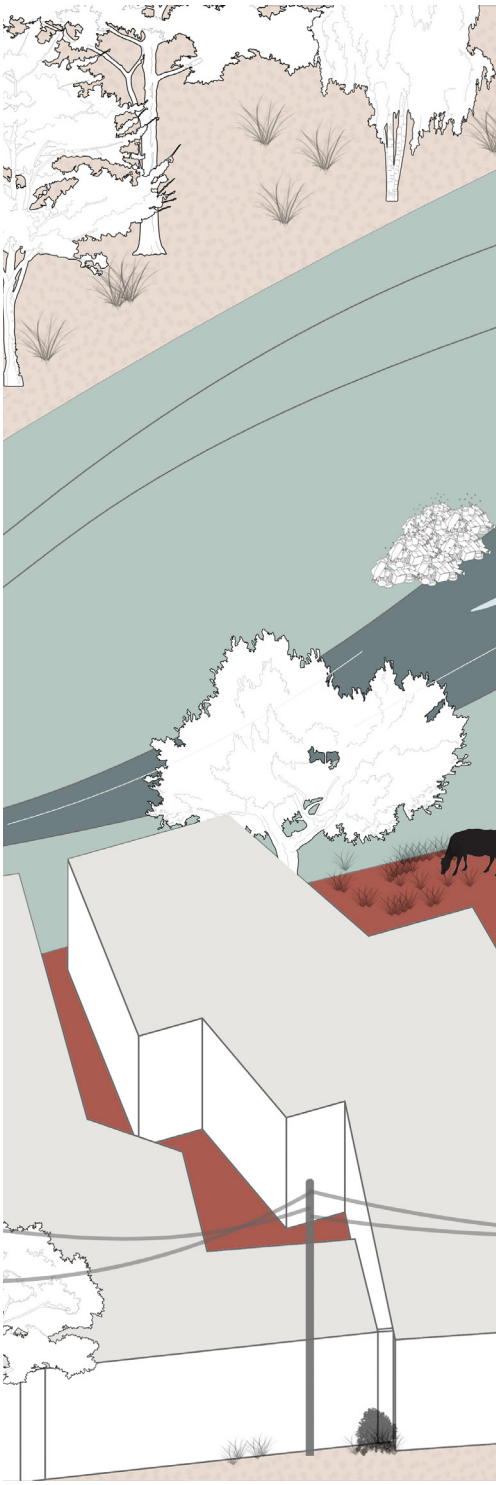
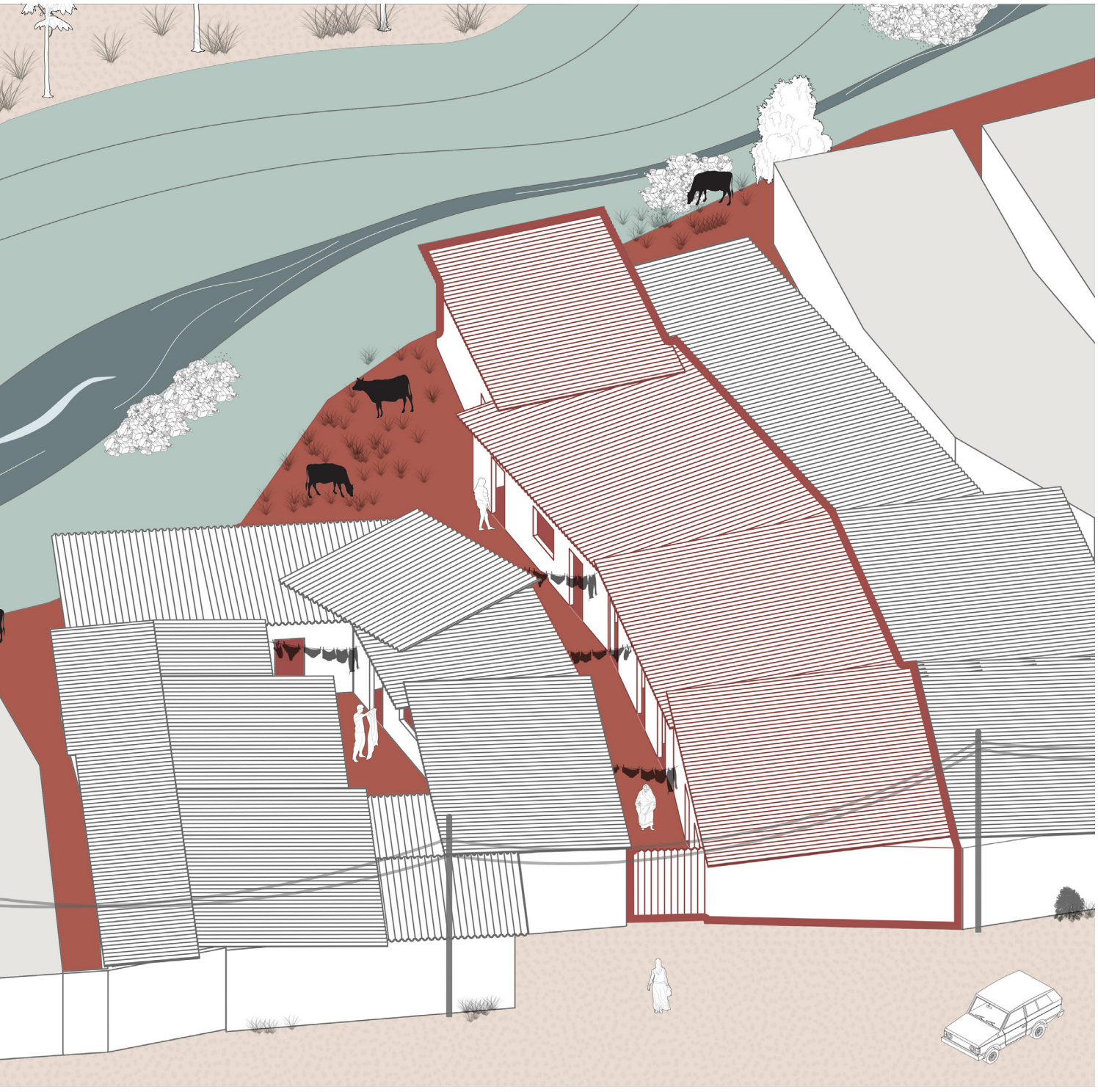


Figure 3.10
Axonometric view of typology 2



5 Design hypothesis

Design Hypothesis

Currently the river is not visible due to the fences on both sides of the street and the illegal settlers occupying the riversides. In the proposal the river will have interaction with the dwelling landscape. New dwelling units will properly houses the current and new residents of 24 kebele. The ecosystem is restored and there are urban farming opportunities. Moreover, green public open spaces serve as places for informal activities and income generation. Is this how 24 Kebele could be?

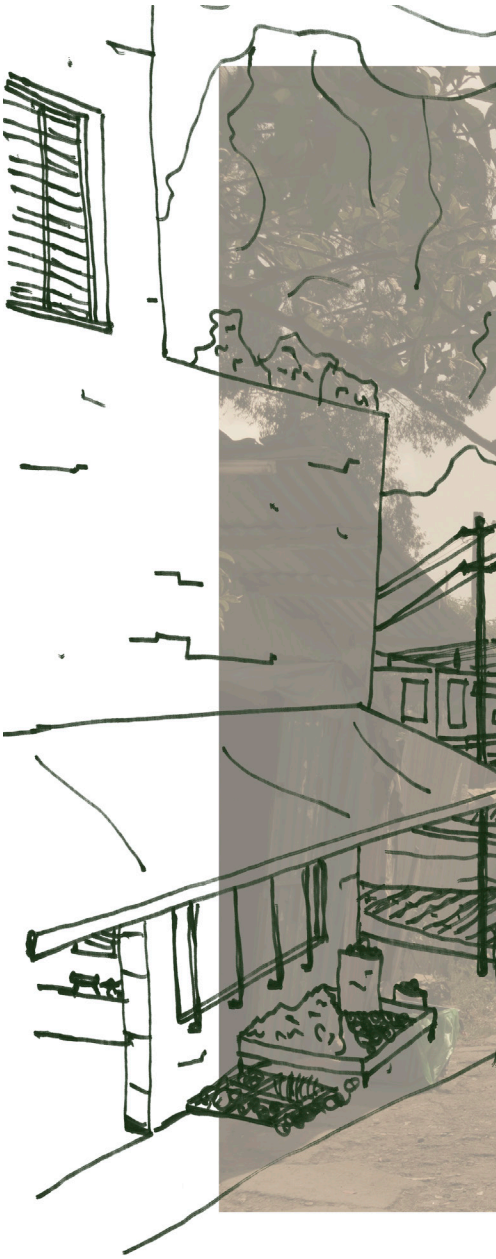


Figure 5.1
Drawing depicting urban vision for 24 Kebele

6 City level intervention

Vision for the waterbodies of Addis Ababa

An urban wetland as solution

Radburn planning principle in 24 Kebele

Vision for the waterbodies of Addis Ababa

Currently the waterbodies of Addis Ababa are the armpit of the city, as discussed before. They serve as waste dump damaging the ecosystem, are not accessible, are surrounded by illegal informal settlements with poor housing conditions and are prone for floods. Floods occur as a result of the current state of the waterbodies. This is not without consequences; It has a huge negative impact on the daily life in the city.

As a reaction the government introduced the Addis Ababa Riverside Project, a billion dollar plan stretching 51 km. It aims to lift the image of the city, create jobs, increase riverside economies and urban tourism and provide recreation areas for its residents. However, I believe this does not help to tackle the current issues and does not create a healthy relationship between the urban dwellers and the rivers. Therefore, a vision for the water bodies of Addis Ababa has been setup consisting of four principles in order to create a healthy river culture. First of all, the waterbodies should function as a buffer by storing water during rainy season. In this way floods will be prevented and the daily life of the urban dwellers will not be drastically interrupted during rainy season. Secondly, it should purify the polluted rivers. This is necessary to transform the waterbodies from an armpit towards an asset of the city. Besides, this is necessary for the third principle; Restoring the waterbodies as they were before. This will

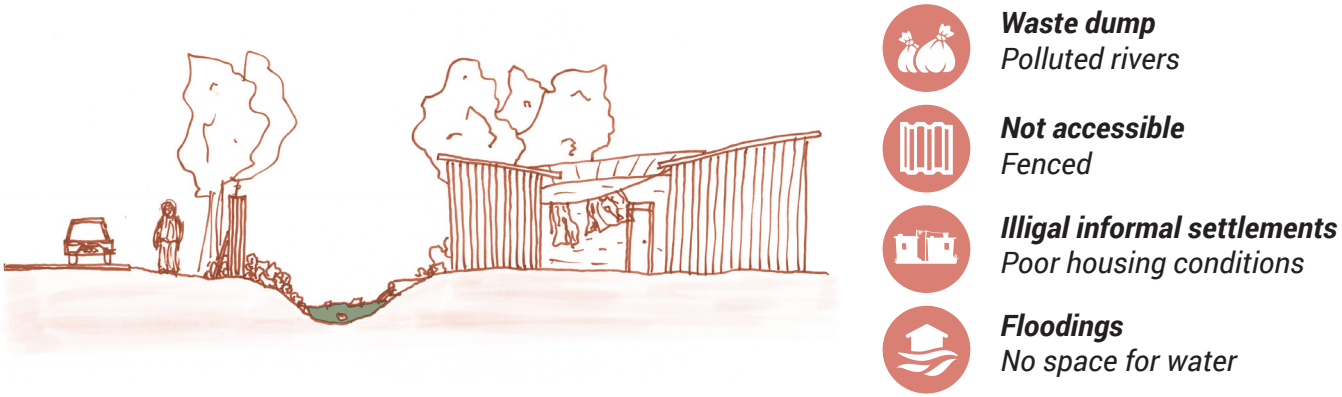


Figure 6.1
Current state of waterbodies

ensure that the nature will maintain itself and restores the historical identity of the rivers. And lastly, the waterbodies should enable participation in the ecosystem by providing qualitative public space and urban farming opportunities for the inhabitants. In this way the rivers and the urban dwellers of the city live in close relation with each other and can sustain itself.

Figure 6.2
Current state

Figure 6.3
As it was before the city was there

Buffer
Store water during rainy season

Purify
Purify polluted water

Restore ecology
Restore nature as it was

Participation in ecosystem
Public space
Urban Farming

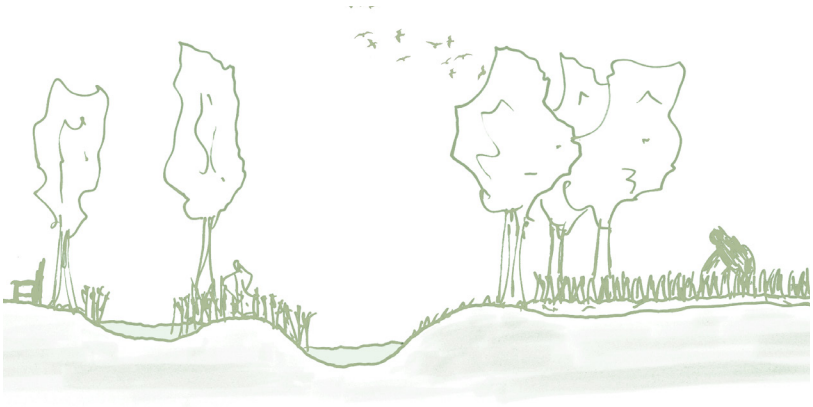


Figure 6.4
Desired state

An urban wetland as solution

An urban wetland could fit in the vision stated before. It can not only store and purify the water in a natural and affordable way using a helophyte filter process (urban green-blue grids, n.d.). It is also able to restore the floodplain ecological system and to create an environment for qualitative public spaces and urban farming opportunities in which the urban dwellers can participate.

The site is located at a location where two water streams are coming together going north to south. It is at the narrowest point of the funnel of the water streams, a place which in the current situation is prone for floods. A buffer zone in the form of an urban wetland, is a logical solution for the waterfront of 24 Kebele since it also restores the ecology as it was. In the first phase, this project would be the first site for the implementation of the urban wetland. However, in the future this can develop along the rivers. Whereby, the green wedges will go into the neighbourhoods to connect the urban wetlands with the urban dwellers.

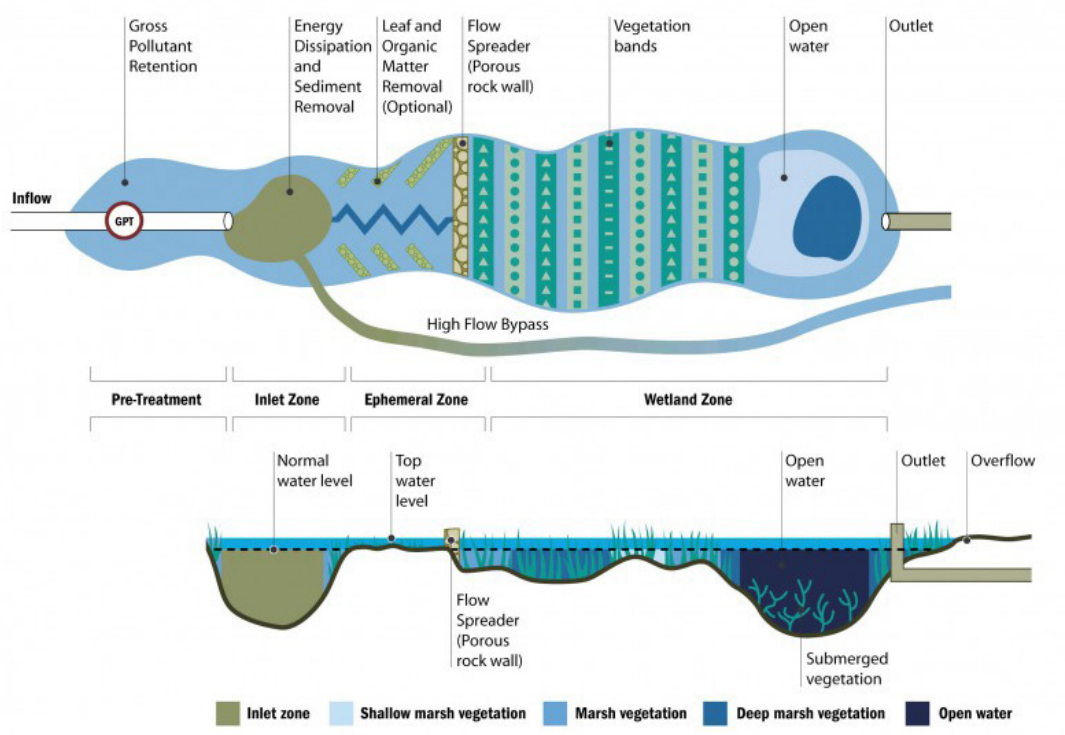


Figure 6.5
Diagram helophyte filter
By atelier GROENBLAUW

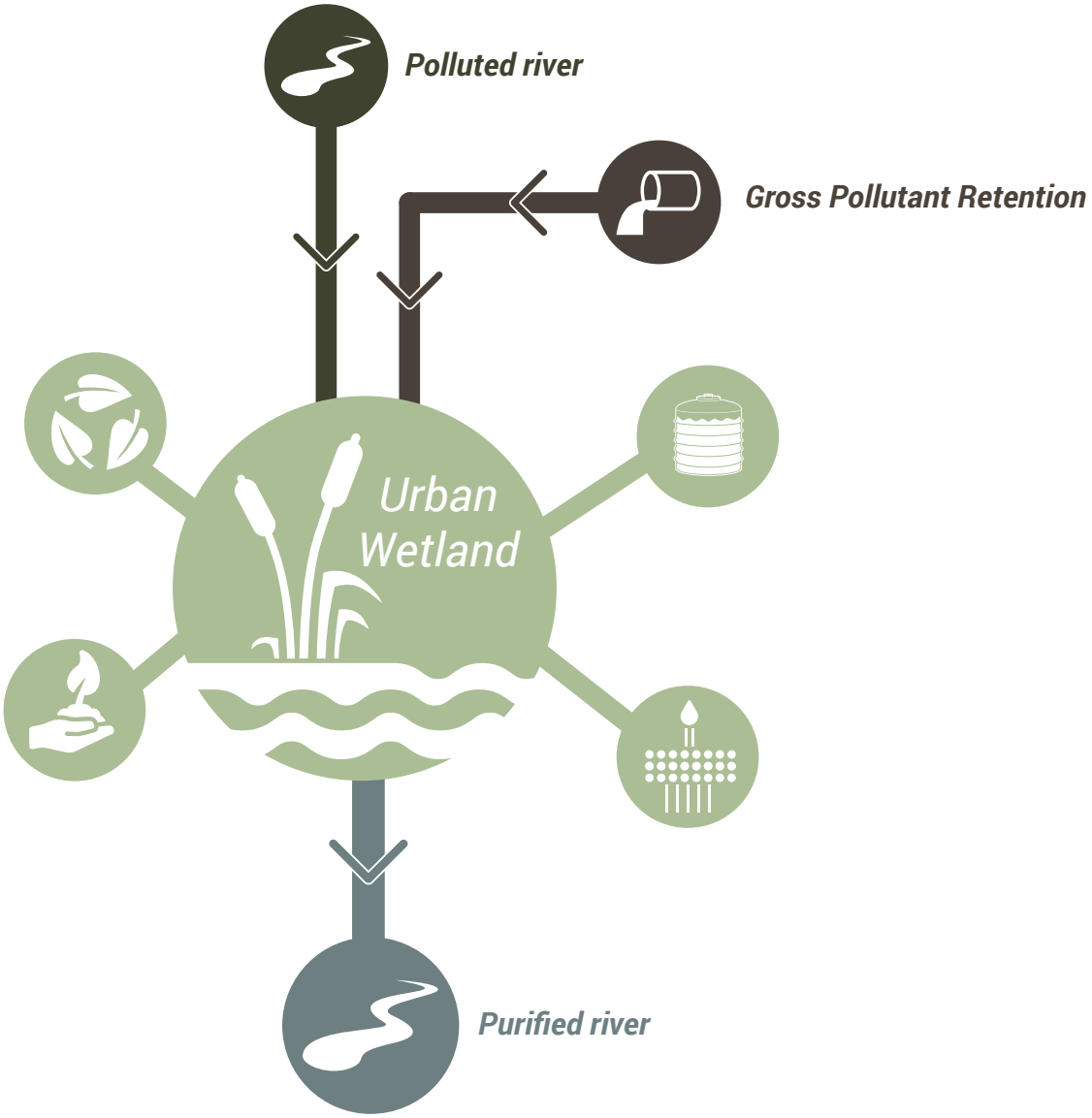


Figure 6.6
Diagram urban wetland

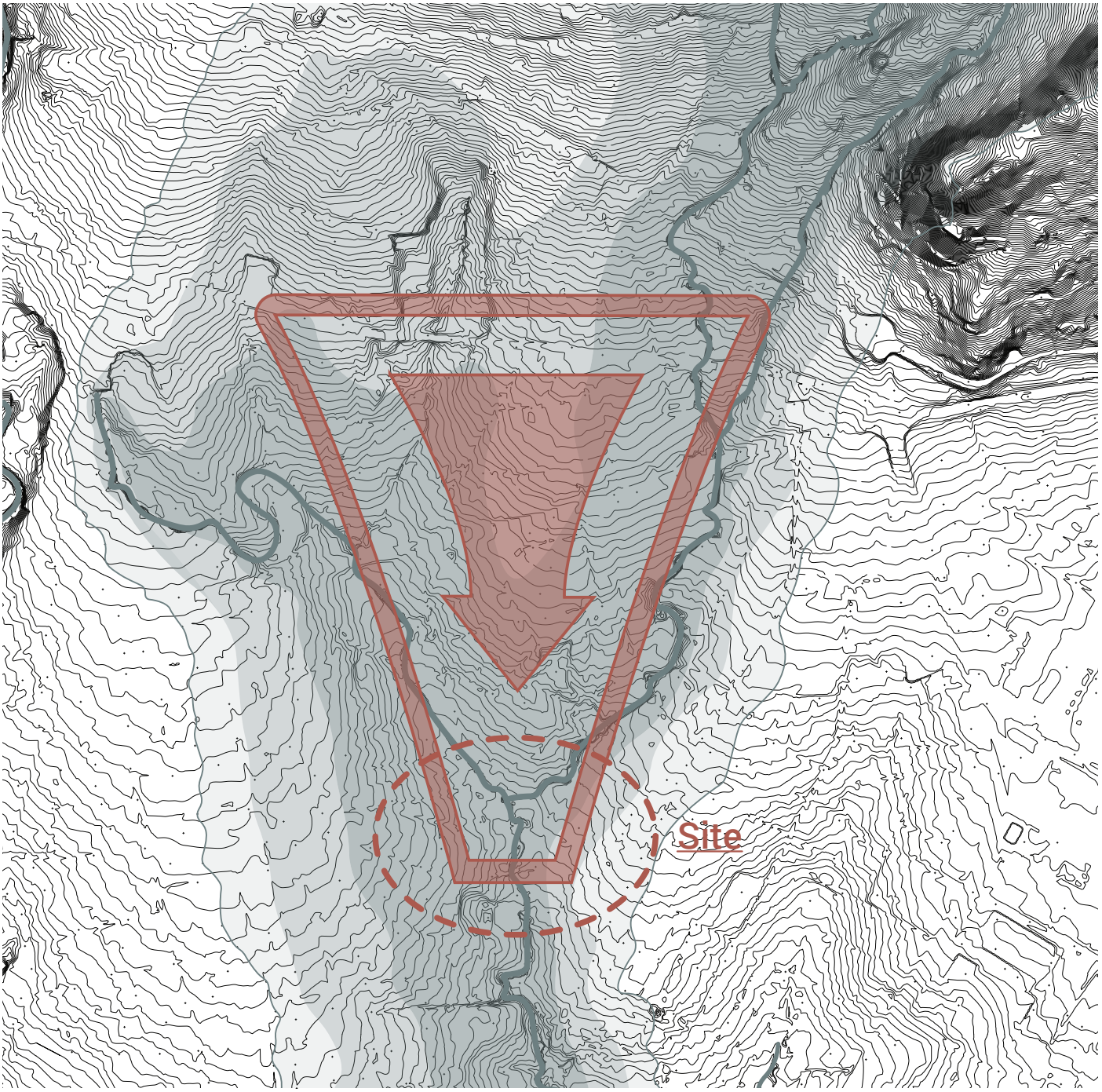


Figure 6.7
The location of the site in relation with the rivers

Figure 6.8
Current state of 24 Kebele

Figure 6.9
First phase of project implementation

Figure 6.10
Possible future development

Radburn planning principle in 24Kebele

For the implementation of the green wedges in 24 Kebele this project aims to follow the Radburn planning principle. This principle, emerged from the garden city movement, focusses on the separation of the parkscape and the lanescape. In this way pedestrians are completely separated from cars and other traffic. Moreover, the planning princple aims to make it possible for pedestrians to go to different social occasions without having to cross streets. Other princples are low-traffic dead end lanescapes and designing with a strong sense for community living (Martin, 2001).

When implementing the Radburn planning principle in 24 Kebele, there is a focus on retaining the current perimeters of the building blocks and infrastructure while introducing the green wedges shown as in the diagram below.

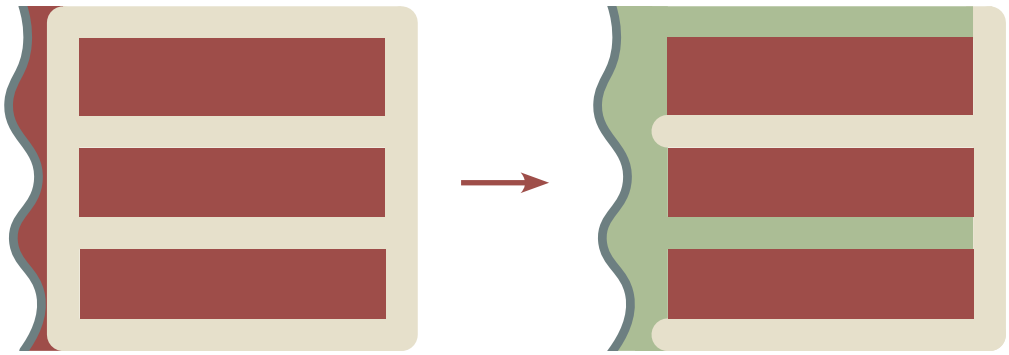


Figure 6.12
Radburn planning applied in 24Kebele but preserving the current urban strucure

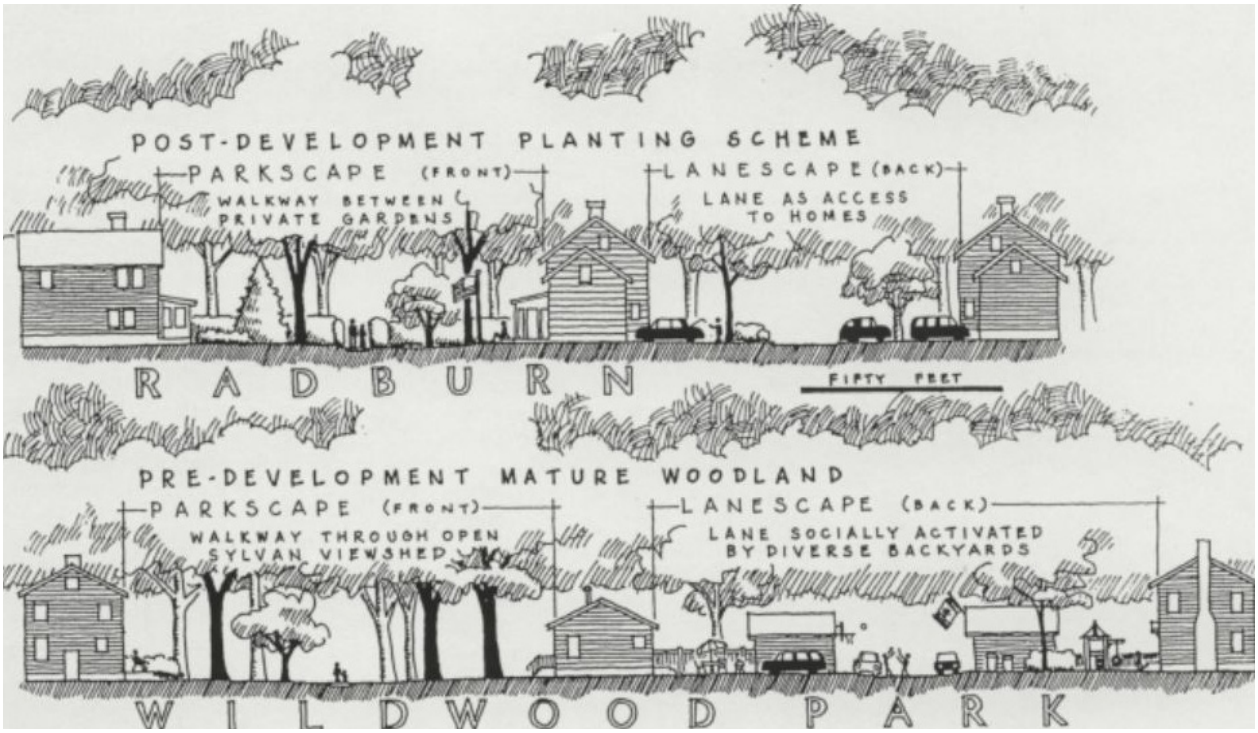


Figure 6.11
Principles Radburn planning princple

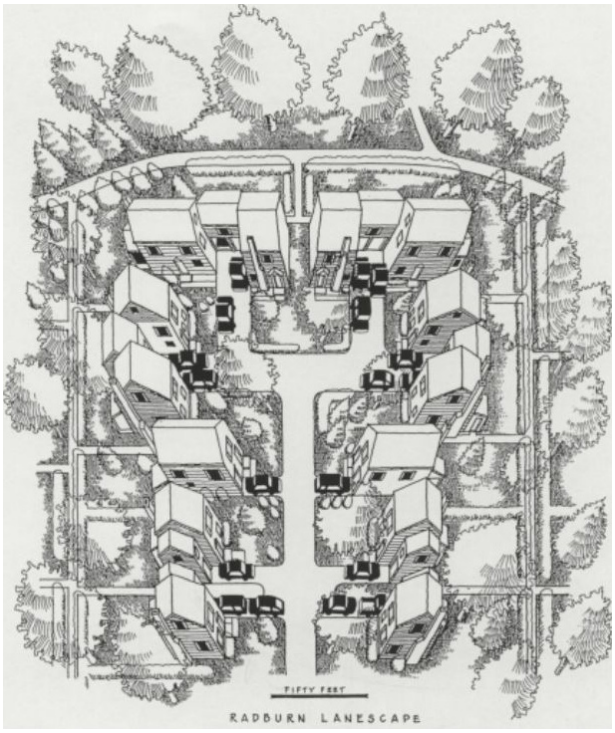


Figure 6.13
Current state

Figure 6.14
New state with the urban wetland and green wedges entering the neighbourhood

7 The productive urban open space system

The urban dwelling block

In the remainder of the project a pars pro toto approach will be used. This means that for the implementation of the urban dwelling blocks a principle will be composed which can be applied at each urban block in 24 kebele. Therefore, in the remainder of the project there will be a focus on one row of urban dwelling blocks from the river until the street. All the facts and figures in the project are based and focused on this pars pro toto approach. Moreover, by elaborating and defining the project as a principle, the projects versatility increases and allows to implement it also at other locations in the city of Addis Ababa, or other places in the world.

Figure 7.1
A pars pro toto approach for the repeating urban fabric structure


0
20
50
100
200

Figure 7.2
Current situation

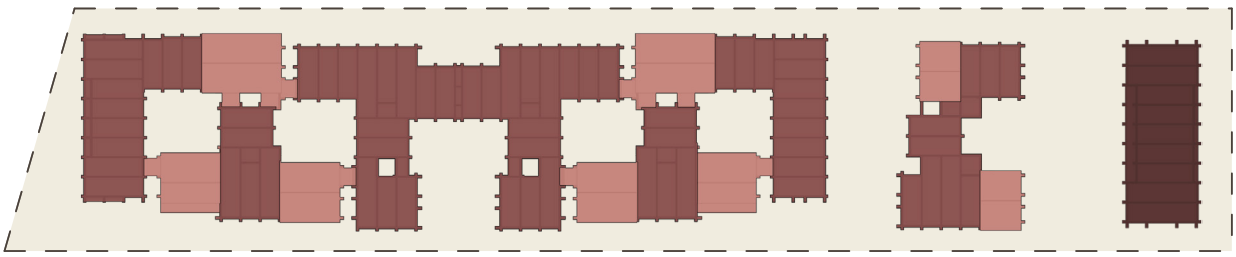


Figure 7.3
New morphology based

In the current situation of the urban block the FSI is 0,4 and it houses circa 160 households, each having on average of 23m2 floor area. Based on the current urban dwelling block a grid is created for the new urban dwelling block in order to respect the current urban fabric. The new morphology enables to expand the public space. Moreover, to ensure that these spaces are spatially qualitative, a hight difference is introduced. The dark coloured compounds will be 5 stories high and the light coloured compounds 4 stories. The darkest dwelling block along the road will be 7 stories high (including one underground level). The height is based on the maximum number of floors in order not to require a lift and to densify as much as possible. With the new urban block the FSI will increase towards 2,7 and the amount of dwellings will be 350 with an average of 50m2: More than twice as much as the current amount

Current situation
FSI: ca. 0,4
Dwel: ca. 160
Average floor area per dwelling unit: ca. 23m2

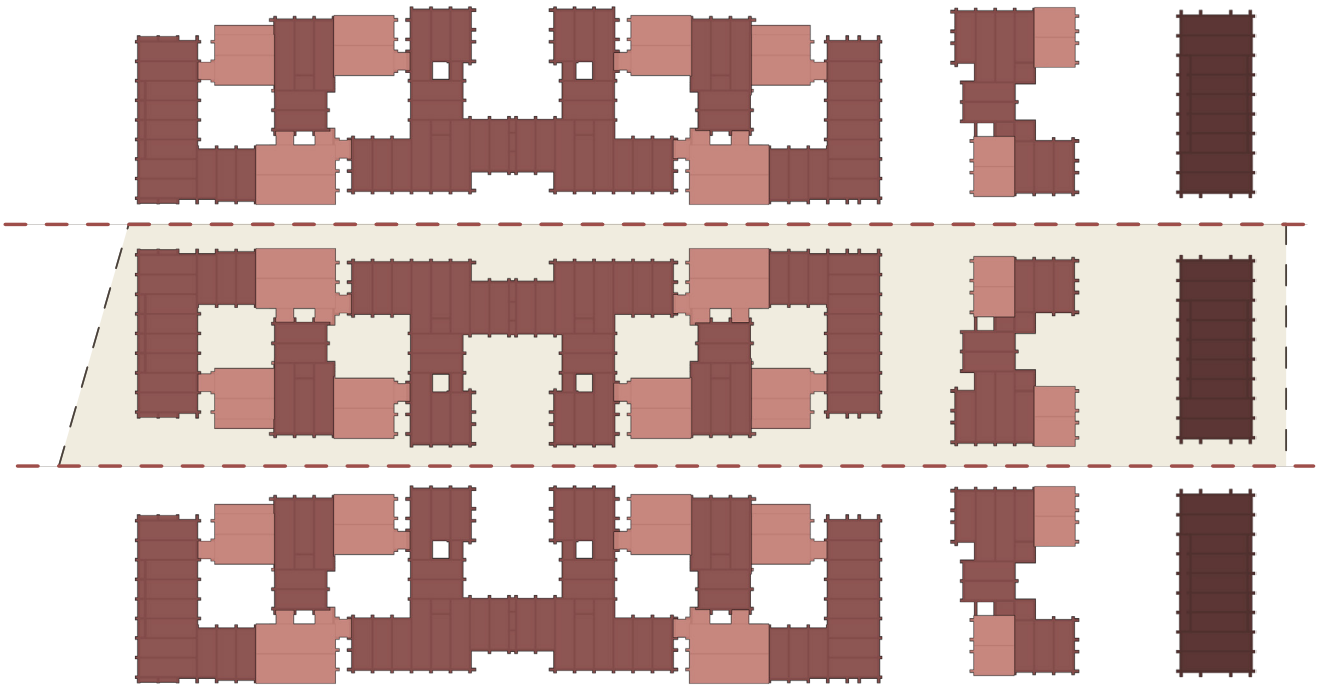


Figure 7.4
New morphology mirrored

New situation
FSI: 2,7
Dwel: 350
Average floor area per dwelling unit: 50m2

of households and average floor aea per dwelling. Moreover, the amount of public space increases substantially.

Due to the morphology, the urban blocks cooperate with each other creating qualitative public spaces and semi-public spaces. Besides, within the urban blocks inner courtyards are created. Because of the staggered composition of the compounds a narrow tunnel effect is avoided and space for qualitative public open spaces can be guaranteed.

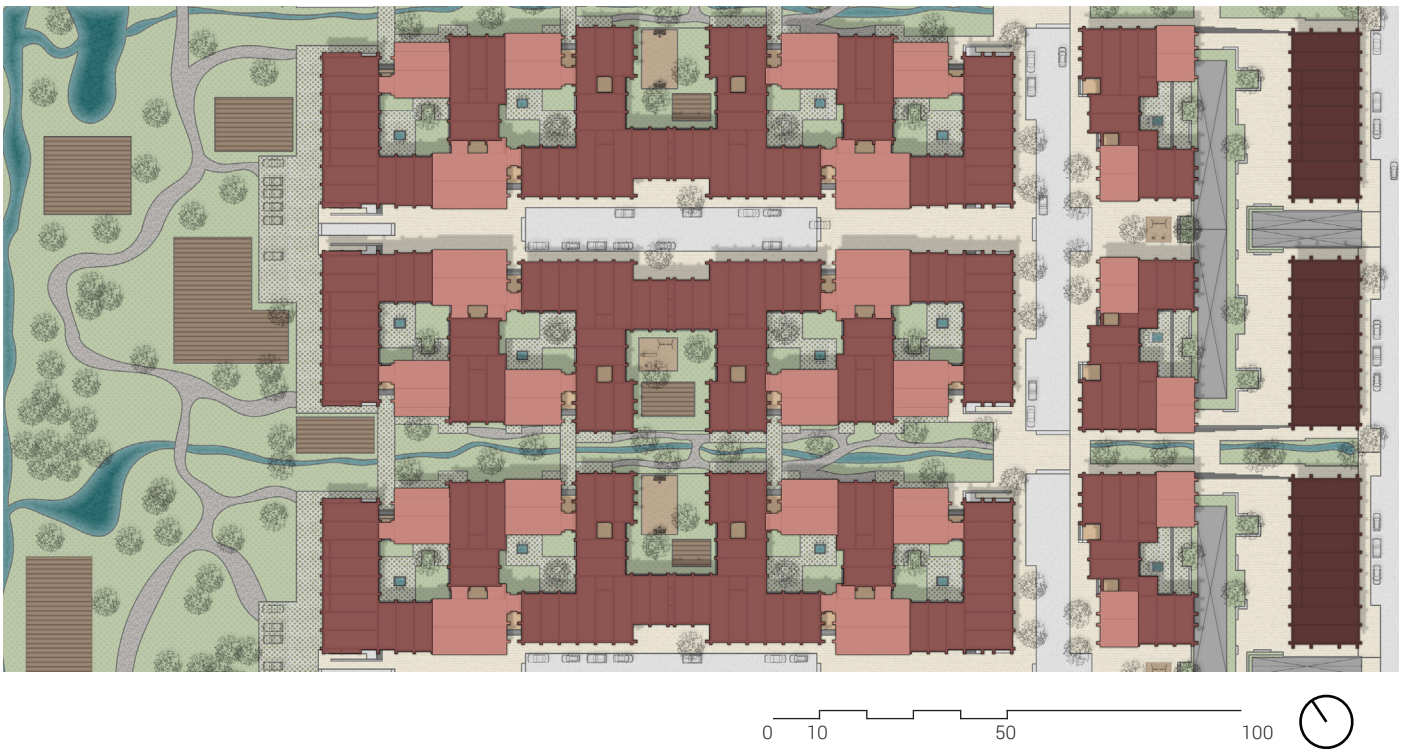
The productive urban open space system

To create qualitative public spaces which will not be anonymous and neglected, it is crucial to prevent 'floating spaces' (Van Dorst, 2012). as discussed in the research part of this booklet. It is a phenomenon which occurs regularly in post-war housing schemes, something that also occurs in the current trend of the condominium housing in Addis Ababa, as the research in Mickey Leland has shown. From this, I concluded that informal needs and activities of the residents could be the core of the public space program and in this way not only serve the needs of the residents but also facilitate control and a legible public space. Therefore, I am seeking for a way in which residents can participate in and have (within a set framework/design) control over the majority of the outdoor spaces, making the neighbourhood socially activated and one that can sustain itself.

In order to create public spaces in which the people of 24 kebele can participate in and is integrated in their daily life patterns, a productive urban open space system is introduced. It differs from 'regular' urban open spaces (or public spaces) in that it is not only accessible by the public but has a strong relation between the environment and the user. It links social, environmental, economic and cultural dimensions within a neighbourhood sustainably (Faragallah, 2018). In this way it allows the residents of 24Kebele to create a sense of belonging and safety with their community.

Based on the ideas of this system a framework for the public spaces is introduced consisting of several elements which reflects the needs of the current inhabitants. For the social and cultural domain household supportive amenities and playground and recreative facilities are introduced. These emerge in the form of secondary seats, shaded gathering spaces, places to wash and dry clothes, playgrounds and multifunctional communal spaces. For the economical demands there are places for fixed and flexible commerce. The communal agriculture and food forests relates

Figure 7.5
The newly introduced master plan with the green wedges, dead-ends, inner couryards and urban wetland



with the environmental, economic and social domains. The new urban scheme with the green wedges, the dead-end street, the inner courtyards and the urban wetland allows to locate these design elements within the public space as shown on the next page.

However I believe that participation is not enough to sustain this system and to reflect the needs of the inhabitants. Citizens power is crucial in order to link the voice of the inhabitants with actual deeds and interventions (Arnstein, 1969). Therefore, the Iddir commission play a vital role within the management of the public spaces. In the chapter 'managerial structure' this will be discussed in more detail.

All together I believe that these design and managerial strategies could be the foundation for a resilient community.

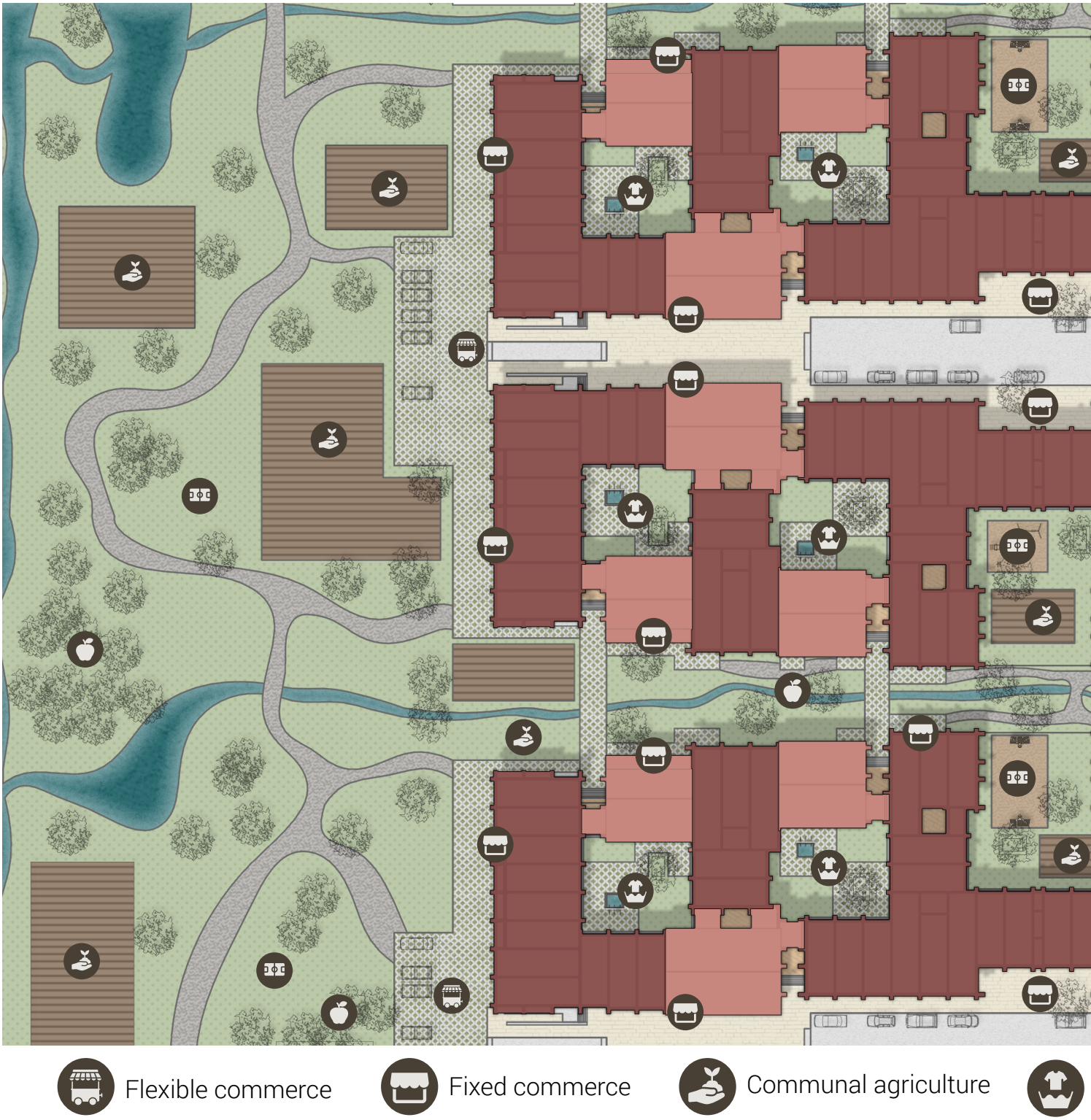
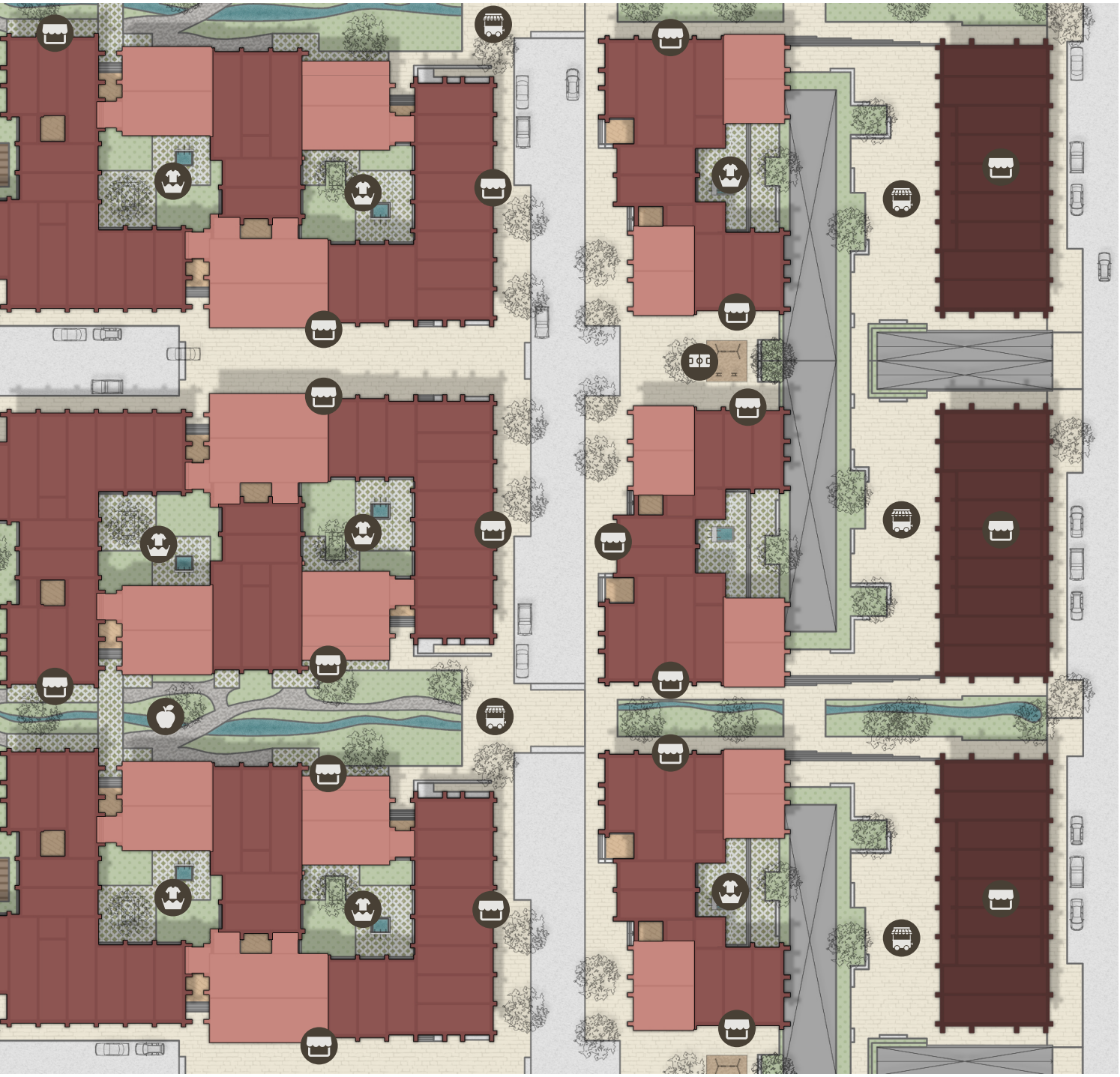


Figure 7.6
The productive urban open space system



Household supportive ammenities

Playground/recreative

Productive forest

Water management

Within the urban scheme elements for a sustainable water regulation have also been interwoven in the design. By introducing the green wedge and green spaces in the inner courtyard, local buffer zones are introduced to prevent floods during heavy rainfall. These buffer zones are connected via natural bioswales to guide the water runoff towards the helophyte filters within the urban wetland. These filters will naturally clean the water and release it in the river.

Grass concrete pavers, at places where completely smooth surfaces are not crucial (for example in the inner courtyard and along the green wedge), allows to walk through the public spaces without muddy puddles in rainy season, but maximizes water infiltration. Moreover, water gets as much as possible harvested at the roofs of the building blocks which will be used for household purposes. This alleviates the water pressure during rainy season as well.

The stream of gross pollutant retention from the households will be connected by an underground sewage systems with natural helophyte filters in the urban Wetland to get naturally filtered and later on released in the river.

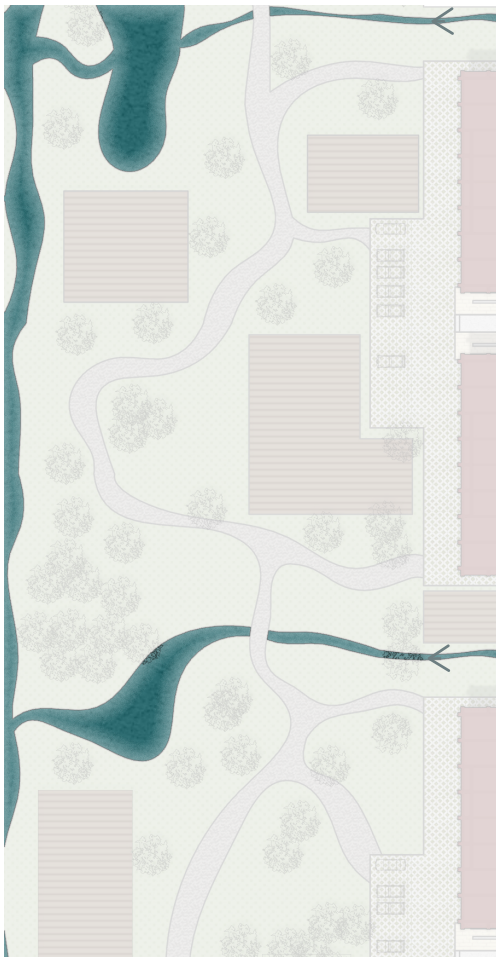
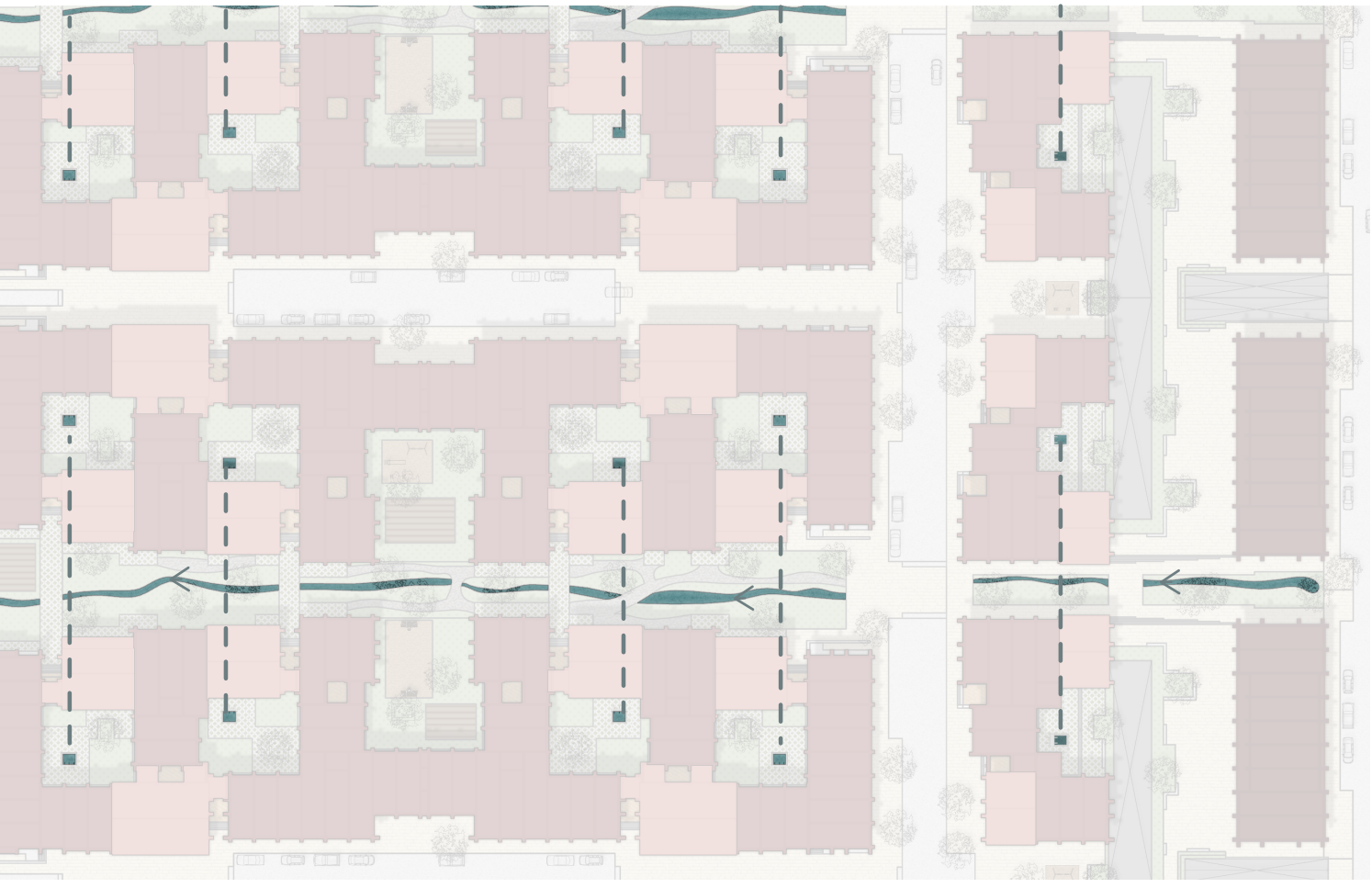


Figure 7.7
Bioswale connects bufferzones with urban helophyte filter and urban wetland



Urban vision implemented

The urban scheme as discussed in this chapter so far is a principle. It could be implemented everywhere along the rivers in Addis Ababa. However, in reality minor local adaptions should be considered to respond as accurate as possible to the local environment. Therefore, a modular system will be introduced which allows to create multiple configurations and makes it a versatile urban system. On the right it is shown how the productive urban open space system is implemented in 24 Kebele at which the urban fabric is responding to its local environment.

Figure 7.8
Urban scheme implemented at the site


0
20
50
100
200

8 Manegerial structure

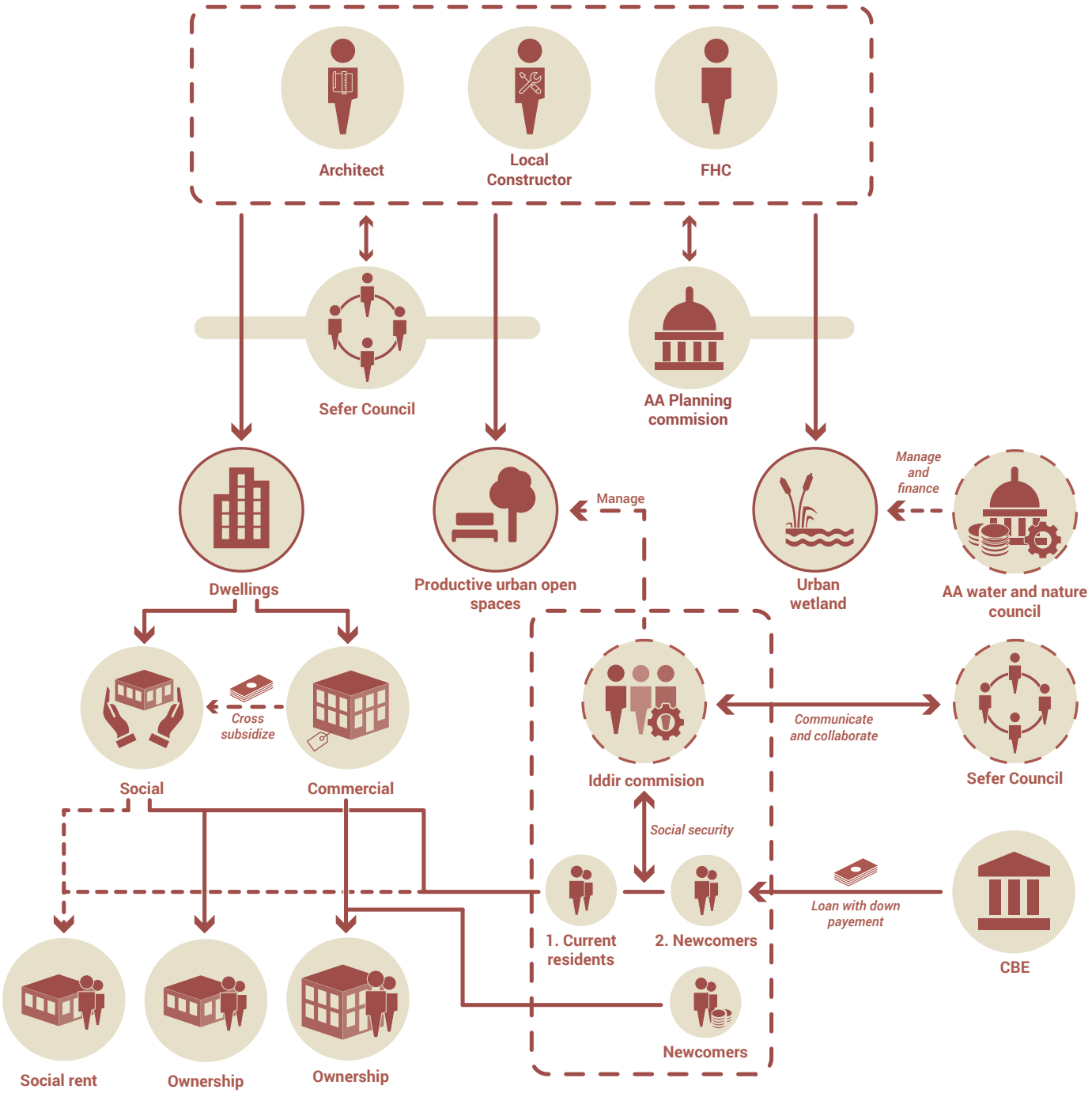
Manegerial structure
Ownership
Phasing

Manegerial structure

On the right the scheme of the managerial structure is displayed. In general the scheme aims to preserve what works and make adaptions to optimize it. Therefore the current condominium system has been used but improved and existing social networks used for participation and managerial purposes. The scheme is set up from the perspective of the architect. The architect forms the design team together with a local constructer and the client, in this case the federal housing corporation (FHC). The Design team is continuous interacting with the Addis Ababa planning commission for the development of the urban wetland. Moreover, the design team works closely together with the sefer council for the design of the communal spaces and dwellings. The sefer council consist of the Iddir commission, local small business owners, local religious spokesmen and a representative from the Addis Ababa planning commission. Spokesmen of the Iddirs present in 24 Kebele, form the Iddir commission. Iddirs are indigenous informal social security arrangements between groups of residents that covers risks such as food shortages, medical expenses, weddings and funerals (Aredo, 2010). Since it is very common to be member of an Iddir for residents, including the Iddirs in the design process and management of the public spaces is an efficient way to include all the different ethnicities within 24Kebele.

For the financing of the social dwelling units the current condominium system has been revived. It is still based on a loan from the CBE with a down payment. The height of the down payment depends on the size of the apartment. However, different from the current system is that it is not a lottery system; Current residents have priority. Moreover, the system includes now also a social rent option to lower the threshold for the very poor. At the moment these households cannot afford to take part of the condominium system. The social renting and ownership apartments are cross-subsidized by apartments for high income households which are sold on the commercial housing market.

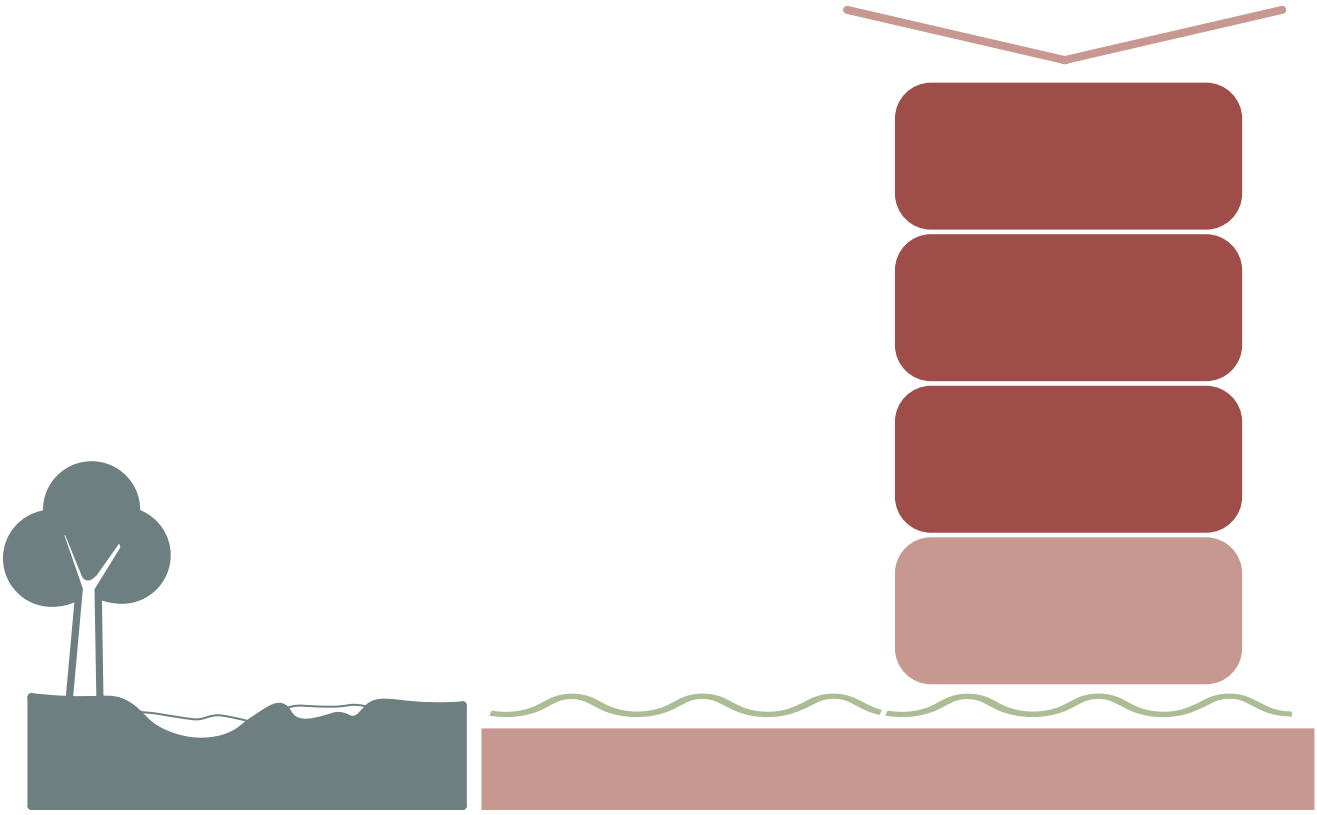
Figure 8.1
Manegerial structure


Architect
Local Constructor
FHC
Sefer Council
AA Planning commision
Dwellings
Productive urban open spaces
Manage
Urban wetland
Manage and finance
AA water and nature council
Cross subsidize
Social
Commercial
Iddir commision
Communicate and collaborate
Sefer Council
Social security
1. Current residents
2. Newcomers
Loan with down payement
CBE
Newcomers
Social rent
Ownership
Ownership

Ownerhsip

Although most of the apartments are ownership based, the area and the structure of the apartment blocks will remain the property of the FHC. However, the Iddir will play a vital role within the management of the communal facilities and public spaces. Since it is crucial to link the voice of the inhabitants with actual deeds and interventions in order to create a productive urban open space system which can sustain itself, the Iiddir commission will have the power over the infill and management of the communal spaces. However, they will need to communicate, collaborate and justify themselves towards the sefer council. The urban wetland is still owned by the government and will be maintained by the Addis Ababa water and nature council.

Figure 8.2
Ownership and management



AA water and nature council | Iddir commision | FHC | Residents

Phasing

For the phasing of the project a plot based redevelopment is proposed. In this way the number of people which have to be resettled outside 24 Kebele is minimized. It follows the following steps:

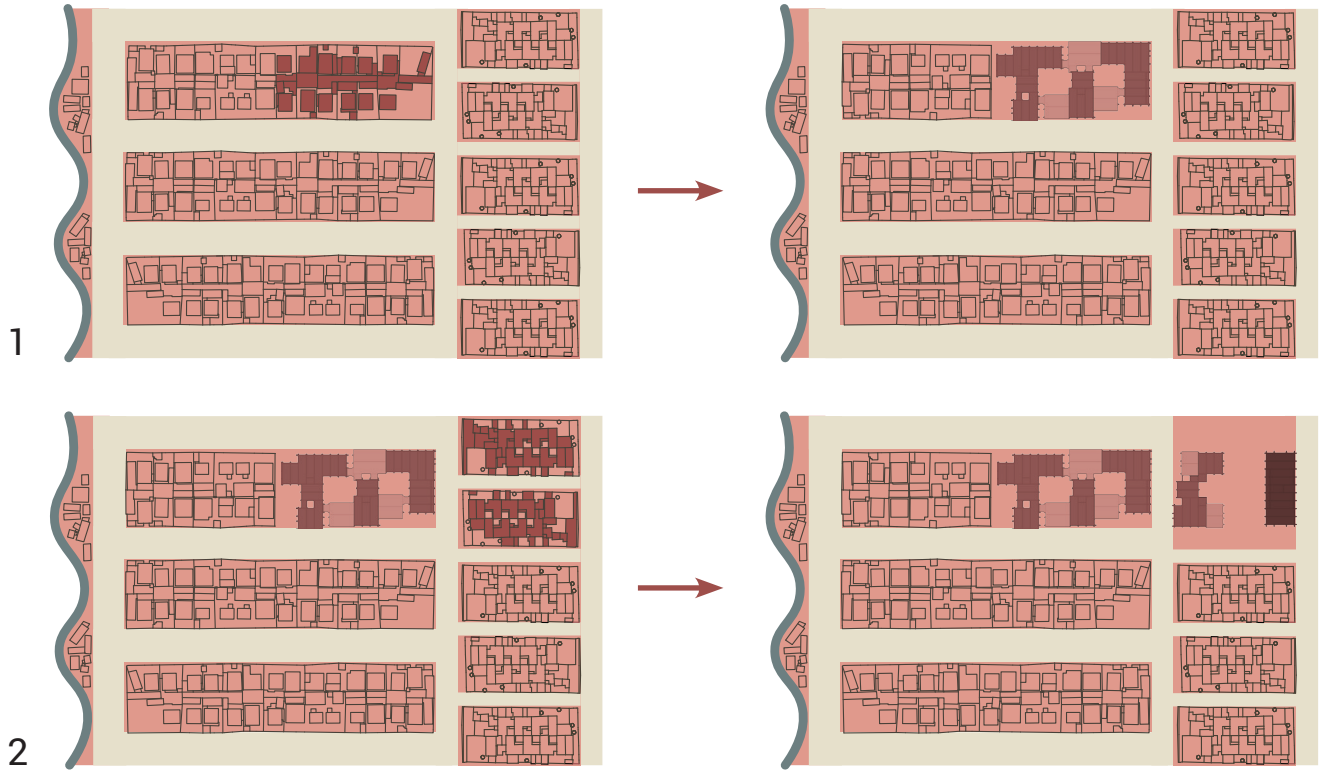


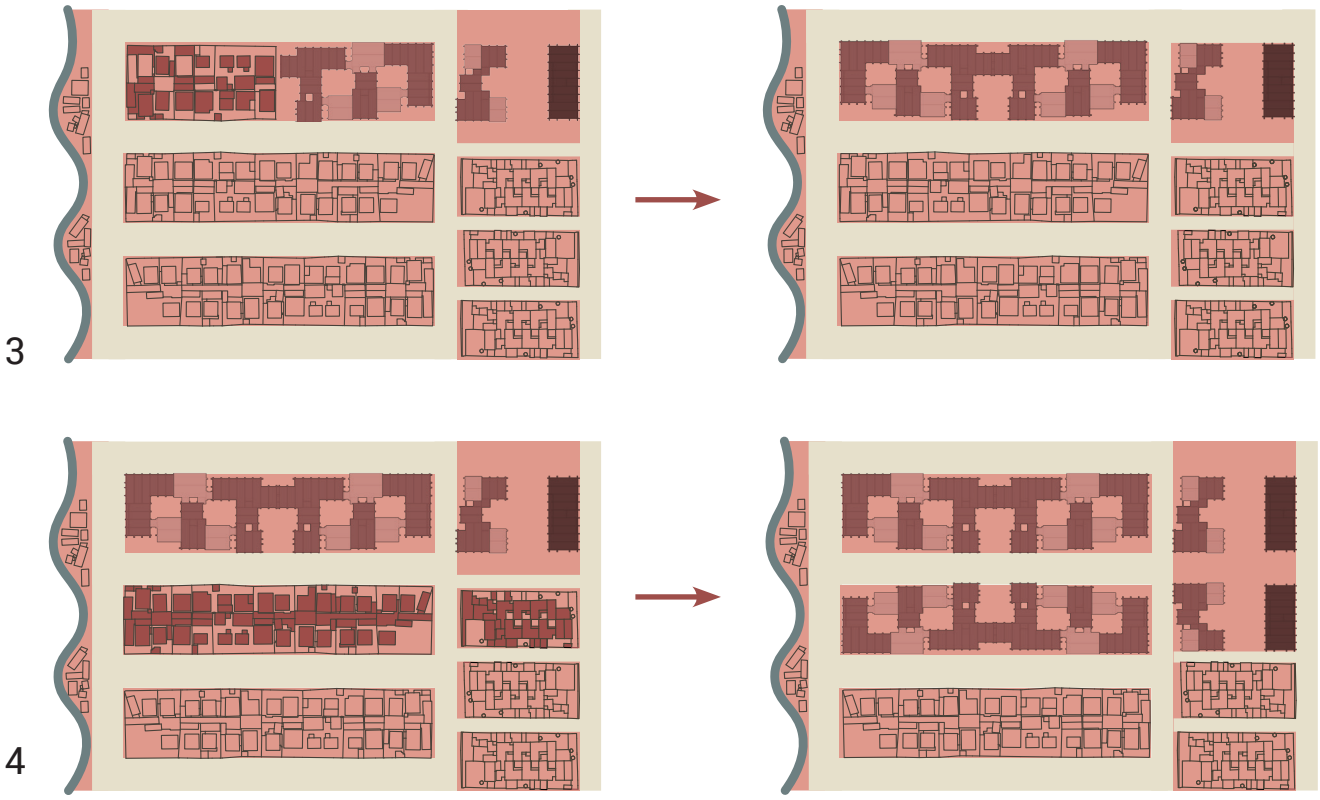
Figure 8.3
Plot based redevelopment

Step 1

- Ca. 50 households resettled in/close to 24 kebele. This is necessary because the neighbourhood is currently completely occupied. However, they have the choice to move back.
- In total 143 new appartments constructed of which 93 empty

Step 2

- Ca. 60 households resettled in newly constructed dwelling unit
- 64 new apartments constructed
- In total 207 new appartments constructed of which 79 are empty



Step 3

- Ca. 50 households resettled in newly constructed dwelling unit
- 143 new apartments constructed
- In total 350 new appartments constructed of which 190 are empty

Step 4

- Ca. 160 households resettled in newly constructed dwelling unit
- 350 new apartments constructed
- In total 700 new appartments constructed of which 380 are empty

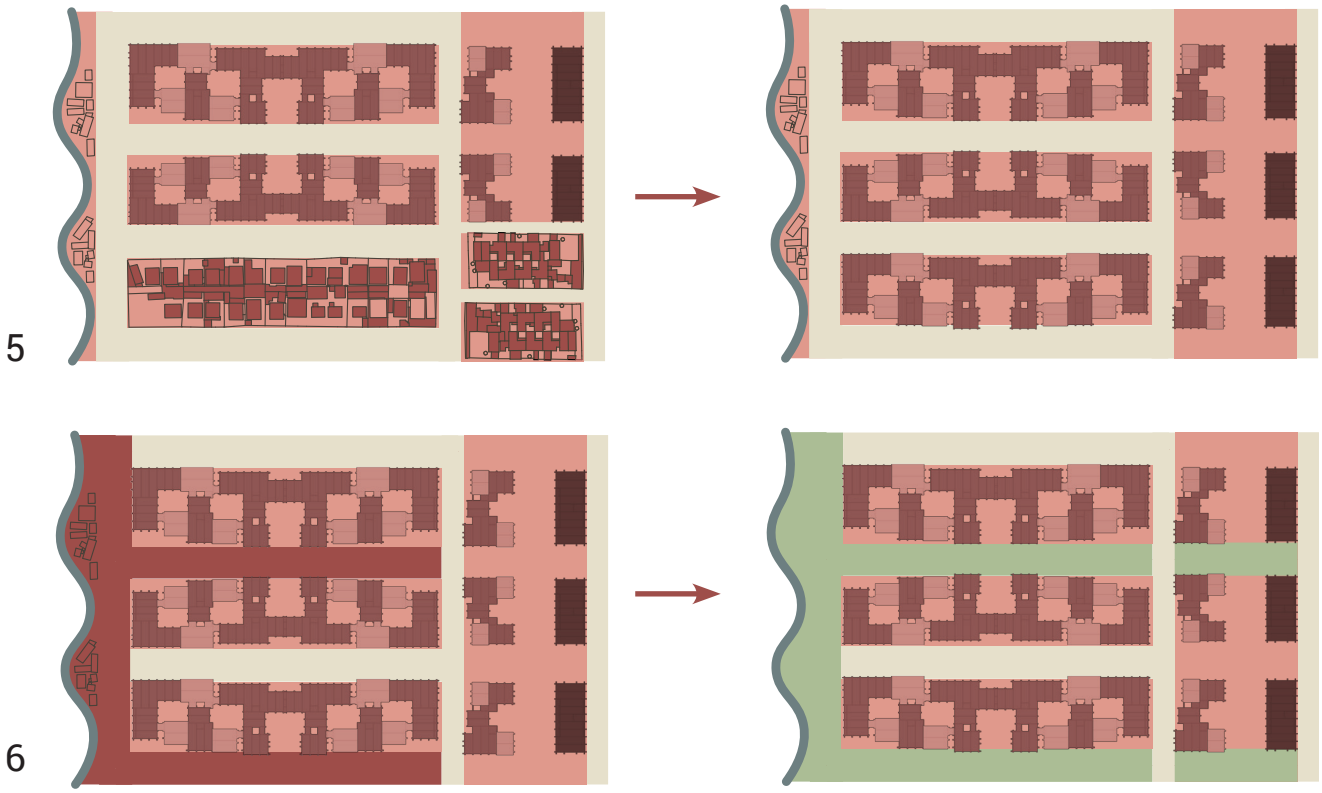


Figure 8.4
Plot based redevelopment

Step 5

- Ca. 160 households resettled in newly constructed dwelling unit
- 350 new apartments constructed
- In total 1050 new appartments constructed of which 570 are empty

Step 6

- Informal dwellers resettled in newly constructed dwelling units
- Construction of urban wetland

9 Materiality and building system

Choice of construction material
Stabilised compressed earth blocks
Building system

Choice of construction material

To make a choice of main construction building material, I first looked at the available construction materials in Ethiopia. From the visit in Ethiopia it became prevalent that the traditional low-cost houses in the country, the so called Chika houses, are made of earth and a timber skeleton (Eucalyptus). These are widespread on the rural areas. However, most modern buildings in Addis Ababa, including the condominiums, consist predominantly of a skeleton from reinforced concrete filled with cement blocks. Modern (laminated) timber buildings were not present in the typical street scene. This has to do with the fact that Ethiopia over the last decades has undergone massive deforestation. For fear of desertification and other environmentally implications, the government is actively counteracting it. However, there is a huge amount of bamboo present in Ethiopia. With its one million hectares of natural bamboo forest, it has the largest bamboo stock on the African continent (Mekonnen et al., 2014). However, this abundance of bamboo is currently not utilized (Ibid.).

Besides if the material is locally present, other aspects are also important regarding the choice of building material. Therefore, three main principles have been set up to give some guidance in making a choice:

1. **Local material**. This is cost efficient and local economies will be supported.

2. **Environmentally responsible**. The building system should have a low carbon oxide footprint and should be durable.

3. **Low tech**. The structure should be able to be constructed and maintained with low skilled labour. It should preferably not need heavy and expensive equipment.

Based on these principles I ranked the materials discussed above in the following order: earth, bamboo, concrete, timber.

Earth

Earth is considered as the most ideal building material. It is a very local and natural material, the earth at the site could for example be used, which results in a low carbon oxide footprint. Moreover, with the material low-tech structures (rammed or masonry) can be constructed, which does not need skilled labour or heavy expensive equipment and are fully reusable. It is proven to be able to build multi-layered buildings with it. Especially Yemen is famous for its earthen structures, but also in Germany, a residential building block of seven stories has been build in 1828 (and is till standing) (Minke, 2013). However, currently there is little knowledge and regulations about building with earth making it a forgotten building material (Ibid.). Finally, it also has very advantageous material properties in terms of

climate regulation. The thick earth structures could function as thermal mass and it is able to balances air humidity (Ibid.). However, pure earthen structures are not able to withstand water. It is crucial to plaster or stabilize the earthen structure when it is exposed to rain.

Bamboo

Bamboo is also present in abundance locally. Moreover, research has shown that in Ethiopia the massive bamboo flowering leads to deaths (of bamboo). Therefore, a sustainable management of the bamboo stock in the country is necessary (Mekonnen et al., 2014). Moreover, if the bamboo is sustainably harvested, it is an environmentally responsible building material; Carbon oxide is stored within the material and if it is designed thoughtfully it is durable as well (Minke, 2012). However, despite the fact that there is no heavy and expensive equipment necessary to build with bamboo, the joints can be quite complicated and is an unknown field within Ethiopia.

Concrete

Although concrete is a very powerful and versatile material it is not matching with the principles. It has quite a big negative impact on the environment with a large carbon oxide footprint. Besides, relatively heavy equipment is necessary for the construction of for example a concrete skeleton. However, it is locally produced; Ethiopia is one of the biggest producers of cement in sub-Saharan Africa (World Highways, 2018)

Timber

The least favoured material is timber. Due to the deforestation happening in Ethiopia it needs to be imported. Therefore it is not stimulating local economies and it increases the carbon oxide footprint. Moreover, laminated timber, enabling to build bigger structures, does need special equipment and expertise to produce, which is not present in Ethiopia.

Figure 9.1
Decision matrix

Stabilised compressed earth blocks

Based on the decision matrix (figure 9.1) I decided to use earth as main construction material. From a practical point of view my focus lay on earthen blocks instead of rammed earth. In this way no large formworks are necessary.

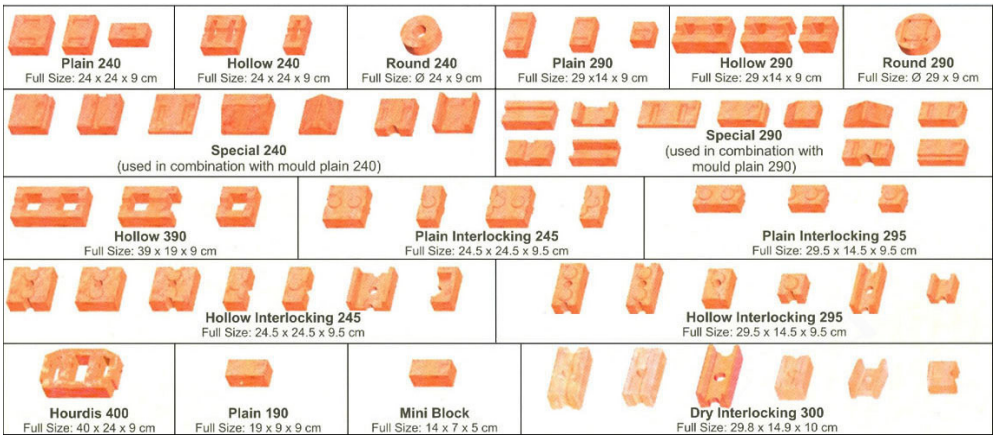
Within the domain of earthen blocks there is the option for adobe, compressed earth blocks (CEB) and compressed stabilised earth blocks (CSEB). Adobes are just plain earthen blocks dried in the sun and have an irregular appearance. The CEB's are also just plain earth, but are mechanically pressed giving them a smoother surface. However, both are not able to withstand rain. And besides, especially adobes does in general not have a wide spread social acceptance, since it is linked with the rural 'poor' houses (Van der Velden, 2007). The compressed stabilised earth blocks (CSEB) contains a stabilizer (cement for example), are waterproof and have a smooth appearance. Therefore, they can account on social acceptance to use as building material for modern buildings. Moreover, the stabilisation makes the blocks advantageous in terms of structural properties and durability in comparison with the adobes and CEB's. The CSEB needs at last a 3% stabilization (Auroville Earth Institute, n.d.), 3,7 times less than a regular cement block (with a mixture of 1:3:5). As a result the costs in terms of raw materials is more then 2,5 times lower compared to cement blocks (Van der Velden, 2007).

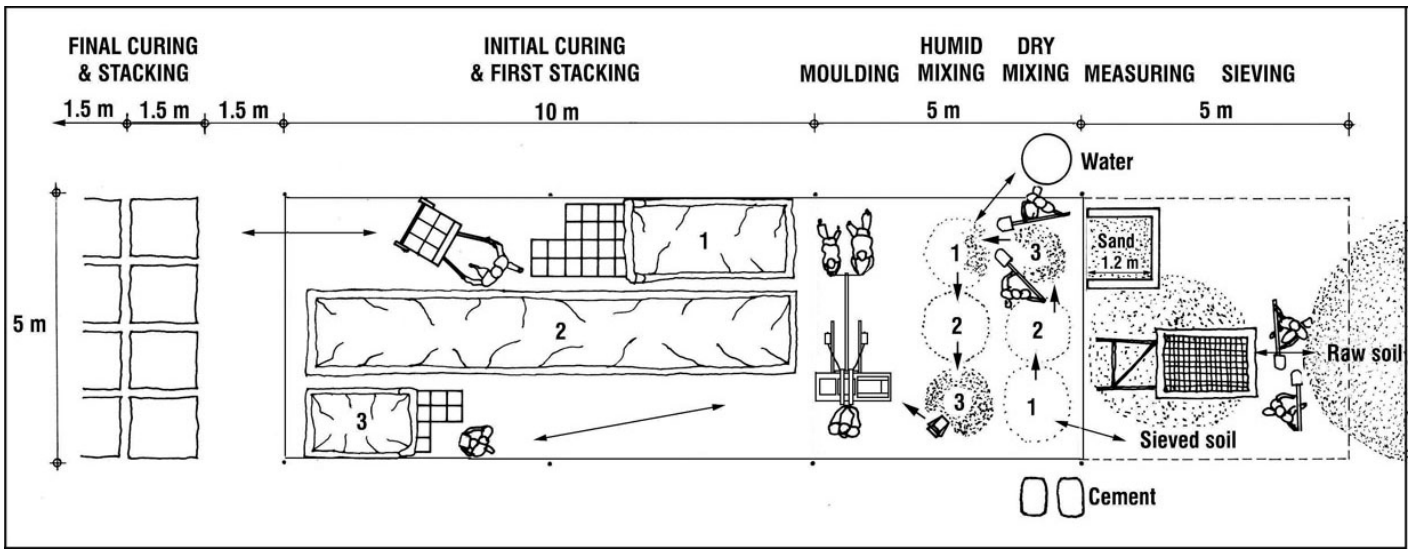
Figure 9.2
Vikas community in Auroville, India

Based on these facts and figures I chose to use the CSEB's as construction material for the loadbearing walls and exterior walls. The non-loadbearing walls, which are not exposed to rain will consist of hollow CEB's. Moreover, the Aurampress 3000 will be used to press the blocks. It is a manual machine which needs to be handled by nine unskilled employees to ensure an efficient process (Auroville Earth Institute, n.d.). This creates a lot of job opportunities for the neighbourhood and city. Moreover, it can create a wide variety of (massive and hollow) blocks which gives more design freedom.

As a reference project I was inspired by the Vikas community apartment block in Auroville. It is a four story high building made of CSEB's (5% stabilised) with a loadbearing wall thickness of 240mm. For the floors it uses masonry vaults consisting of earthen blocks. It is one of the few recent projects which is 4 stories and has earthen blocks as main construction material.

Figure 9.3
Auram press 3000


Plain 240
Full Size: 24 x 24 x 9 cm
Hollow 240
Full Size: 24 x 24 x 9 cm
Round 240
Full Size: Ø 24 x 9 cm
Plain 290
Full Size: 29 x14 x 9 cm
Hollow 290
Full Size: 29 x14 x 9 cm
Round 290
Full Size: Ø 29 x 9 cm
Special 240
(used in combination with mould plain 240)
Special 290
(used in combination with mould plain 290)
Hollow 390
Full Size: 39 x 19 x 9 cm
Plain Interlocking 245
Full Size: 24.5 x 24.5 x 9.5 cm
Plain Interlocking 295
Full Size: 29.5 x 14.5 x 9.5 cm
Hollow Interlocking 245
Full Size: 24.5 x 24.5 x 9.5 cm
Hollow Interlocking 295
Full Size: 29.5 x 14.5 x 9.5 cm
Hourdis 400
Full Size: 40 x 24 x 9 cm
Plain 190
Full Size: 19 x 9 x 9 cm
Mini Block
Full Size: 14 x 7 x 5 cm
Dry Interlocking 300
Full Size: 29.8 x 14.9 x 10 cm


FINAL CURING
& STACKING
INITIAL CURING
& FIRST STACKING
MOULDING
HUMID
MIXING
DRY
MIXING
MEASURING
SIEVING
1.5 m
1.5 m
1.5 m
10 m
5 m
5 m
5 m
Water
Sand
1.2 m
Raw soil
Sieved soil
Cement
1
2
3

Building system

Following the material properties of earthen blocks a building system has been developed which is based on compression. It consist of loadbearing walls spanned by a masonry vault consisting of CEB. The span is just 4 metres because of the limited properties of the CEB. The buttress on both sides enables stability in longitudinal direction and openings for a gallery or loggia in cross direction. This unit can repeat itself in x and y direction (as shown at figure 9.4).

Based on this unit 2 basic structural modules has been created; the basic unit itself and a corner unit. The two modules together allows to create a wide variety of compositions and forms a versatile system in order to fulfil the desired urban vision.

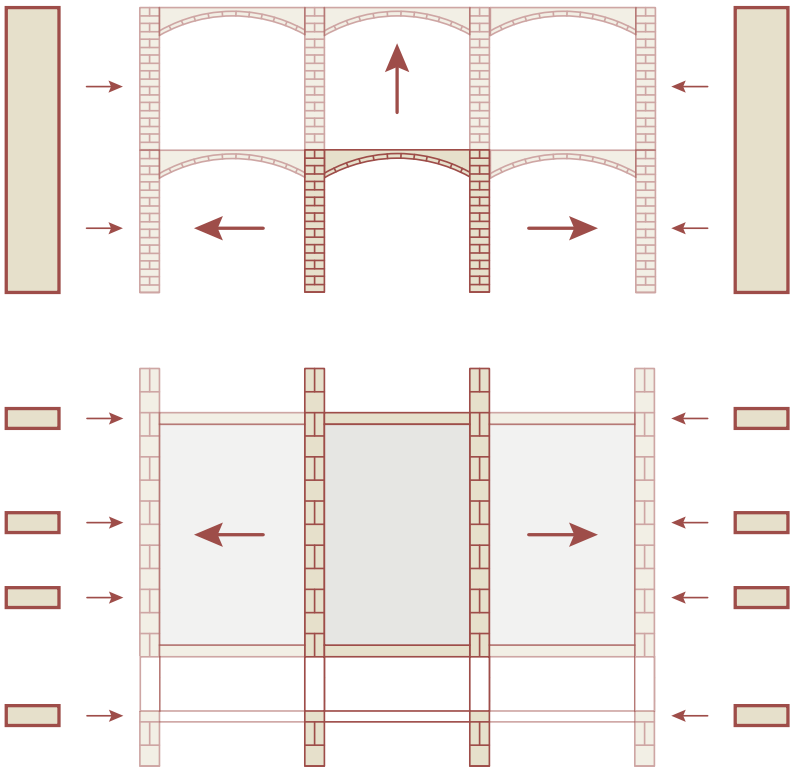


Figure 9.4
Building system

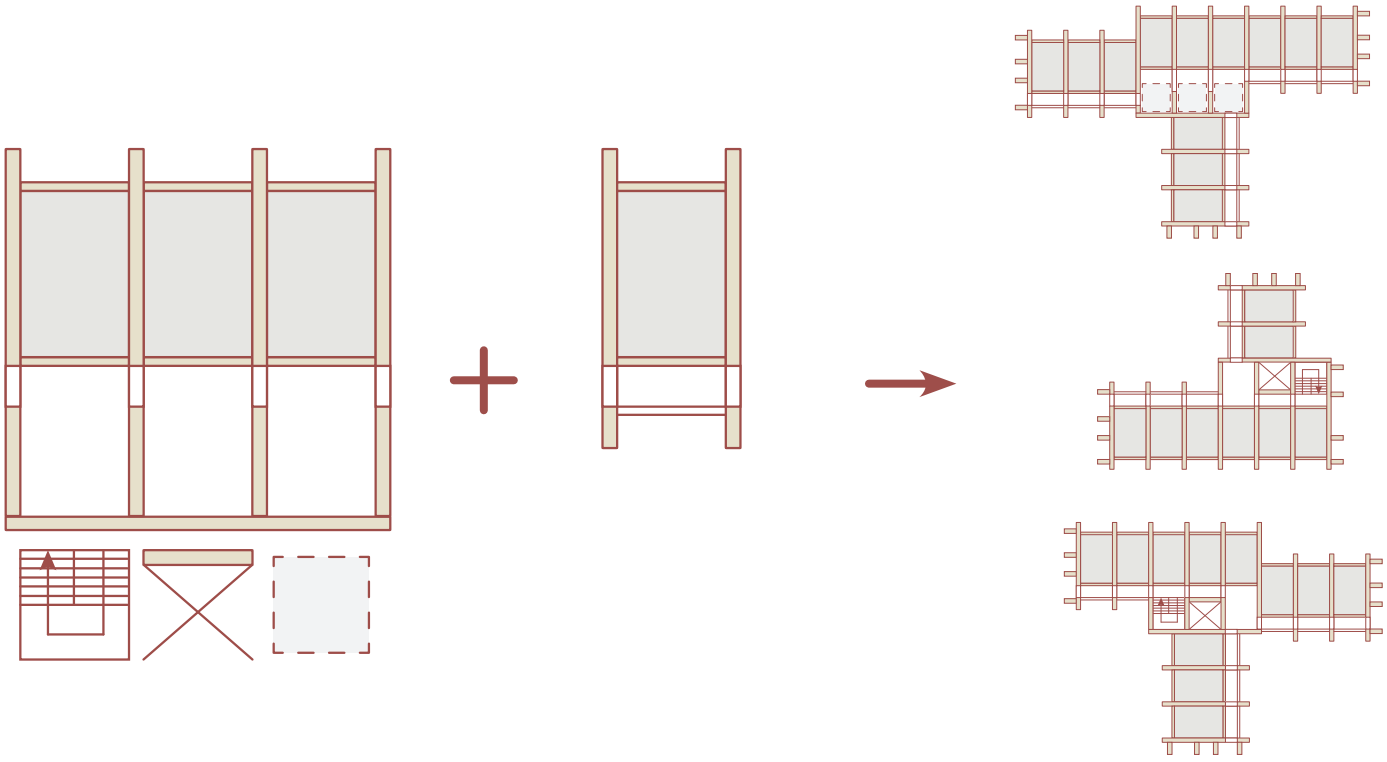


Figure 9.5
Modular versatile system

10 People and typologies

People dwelling flow chart
1-Bedroom 30 m^2
1-Bedroom with shop option 30 m^2
2-Bedroom 45 m^2
2-Bedroom with shop option 45 m^2
3-Bedroom 60 m^2
2-Bedroom commercial 60 m^2
3-Bedroom commercial 75 m^2
Flexibility
Typology distribution

People dwelling flow chart

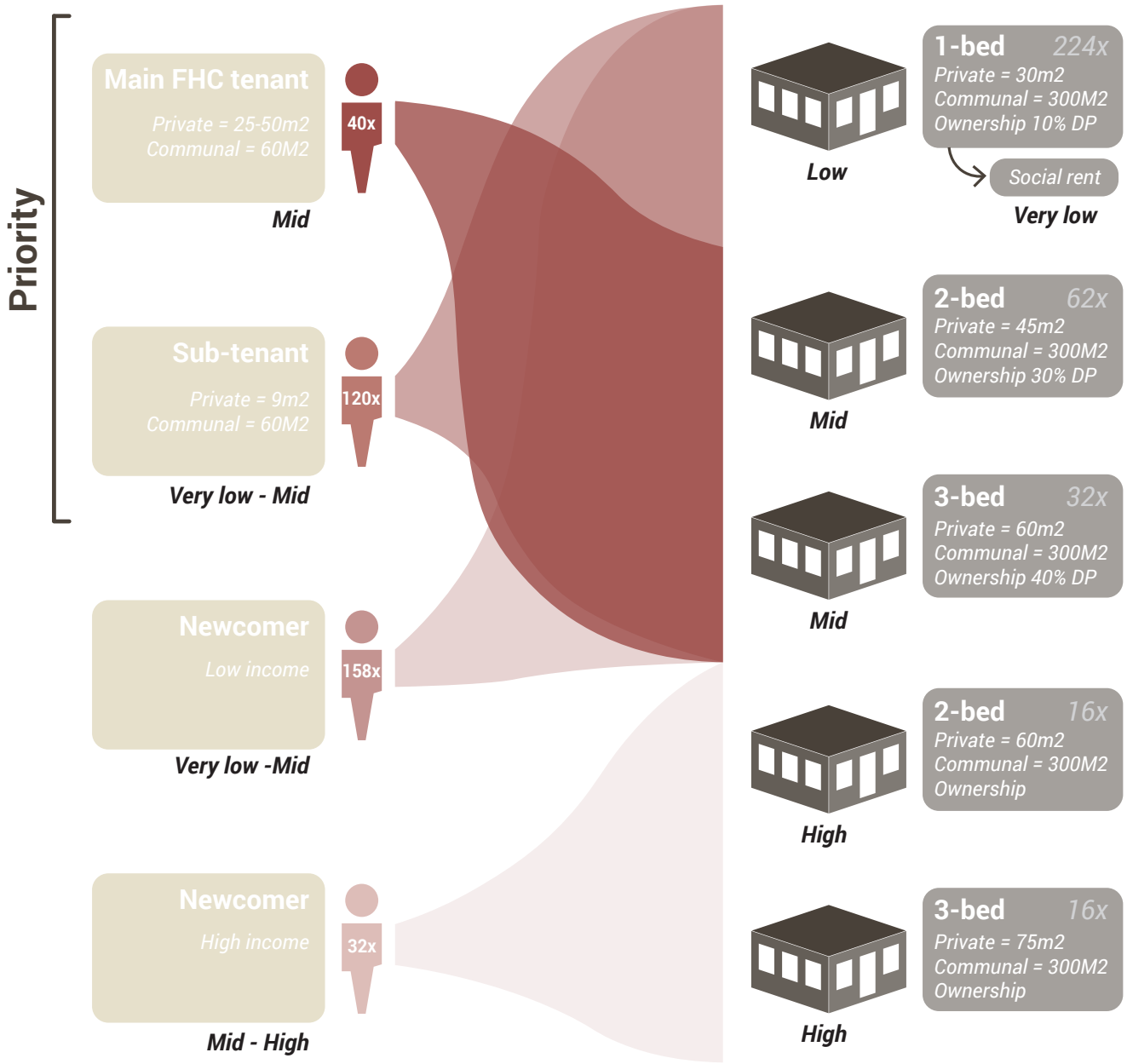
In the redevelopment of 24 Kebele the project aims to relocate all current inhabitants within the site. Therefore, the main FHC tenant and subtenants have priority. Moreover, the wide variety of classes within the neighbourhood should be reflected in the composition of the different dwelling typologies. These can therefore be distinguished into very low, low, mid and high income units. The very low is based on social rent and is a 1-bedroom apartment. The low income is ownership based with a 10% down payment and consist of a 1-bedroom apartment as well. The 2 and 3 bedroom apartments are ownership based for mid income households and have a 30% and 40% down payment. Moreover, more luxurious variants of these typologies will be sold on the free housing market in order to support cross-subsidization.

Besides, the diagram shows how the redevelopment enables current inhabitants to progress on several fronts in comparison with the current situation. First of all, the floor area of the dwelling unit will increase at least with 20%. Moreover, this goes hand in hand with qualitative sanitation amenities, communal spaces and public open spaces.

The numbers in the diagram are based on one urban block from urban wetland to street.

In the following pages the actual floorplans of each typology will be shown. Moreover, later on the flexebility possibilities and the distribution of the typologies throughout the urban masterplan will be discussed.

Figure 10.1
People dwelling flow chart



Current Residents *160 Families*
Newcomers *190 Families*

Total units *350x*

+ Increase floor area by at least 20%
+ Sanitation ammenities
+ Qualitative communal spaces and facilities
+ Qualitative public open spaces

1-Bedroom
30 m^2

Target group
Low to very low income

Payment
Social rent or ownership with 10% DP

Floor area
30 m^2

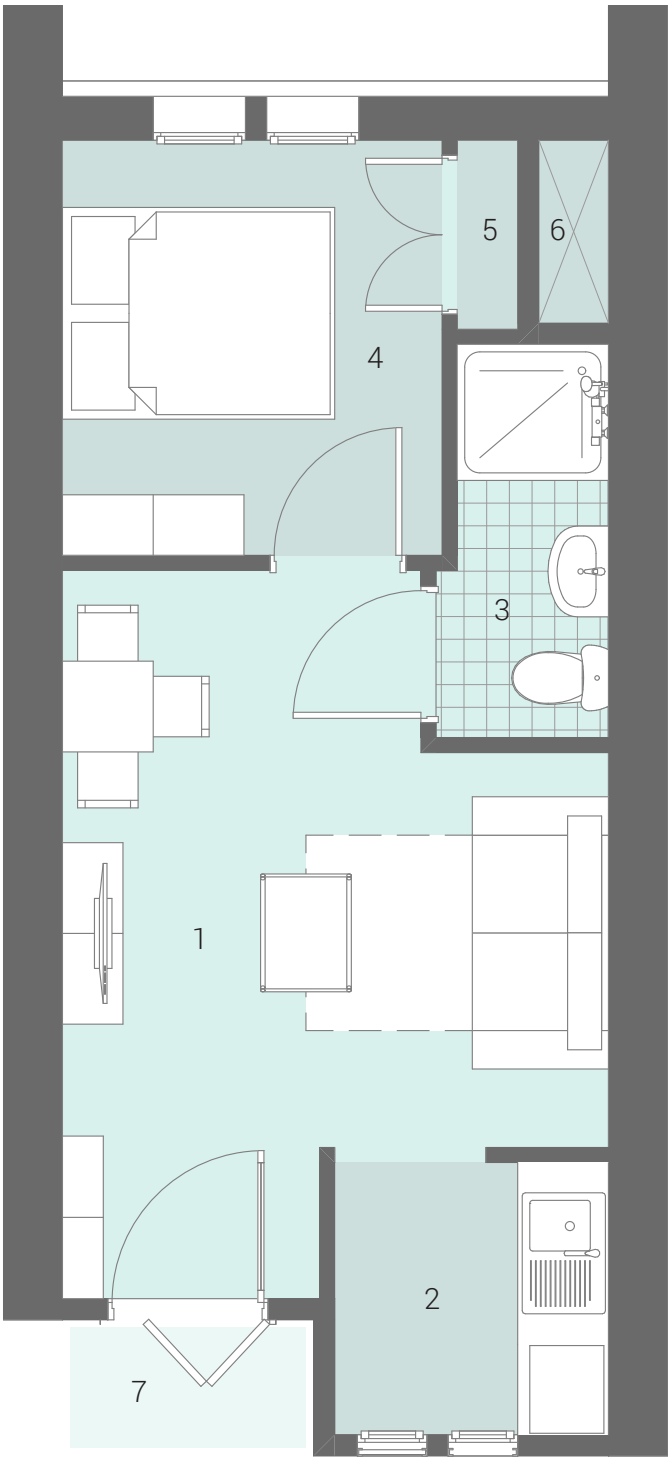
Description
The smallest typology with one master bedroom and sleeping couch in the living room. Inhabitants have options to have an open or closed kitchen. Moreover, there are steel security bars, which can be closed or opened by folding or sliding, in front of the openings towards the gallery. The 1-bedroom typology is located on the intermediate and top floors.

1. Living room
2. Kitchen
3. Bathroom
4. Master bedroom
5. Storage
6. Technical and ventilation shaft
7. Semi-private space
8. Gallery

Figure 10.3
Section perspective from the gallery

Figure 10.2
Plan 1:50

Figure 10.4
Cross-section perspective



8

1-Bedroom with shop option
30 m^2

Target group
Low to very low income

Payment
Social rent or ownership with 10% DP

Floor area
30 m^2

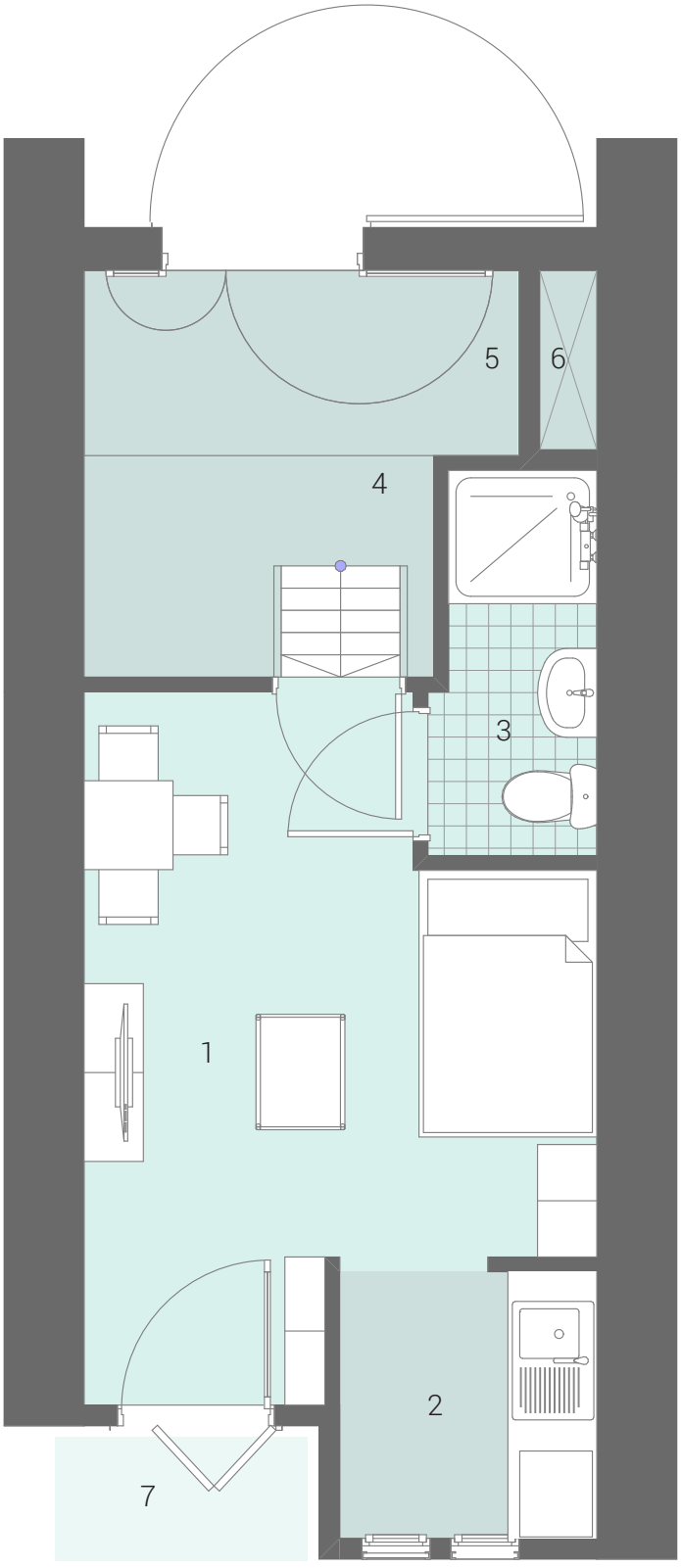
Description
The 1-bedroom apartment has a shop option on the ground floor in the plinth, allowing inhouse income generation. The elevation difference enables extra storage capacity in the shop or bedroom. The shop or bedroom has a Dutch door facing the street. In shop variant this could be used as counter. This door as well has steel security bars, which can be opened and in this way function to hang merchandise on.

1. Living and sleeping room
2. Kitchen
3. Bathroom
4. Master bedroom or shop
5. Storage
6. Technical and ventilation shaft
7. Semi-private space
8. Gallery

Figure 10.6
Section perspective from the gallery

Figure 10.5
Plan 1:50

Figure 10.7
Cross-section perspective



8

2-Bedroom
45 m^2

Target group
Middle income

Payment
Ownership with 30% DP

Floor area
45 m^2

Description
The 2-bedroom apartment includes also a secondary bedroom and a loggia. Moreover, on the gallery houses an extra semi-private space which is elevated making it more private. This could function also as secondary seats serving informal activities such as (traditional) cooking.

1. Living room
2. Kitchen
3. Bathroom
4. Master bedroom
5. Secondary bedroom
6. Technical and ventilation shaft
7. Semi-private space
8. Gallery
9. Loggia

Figure 10.8
Plan 1:50

Figure 10.9
Section perspective from the gallery

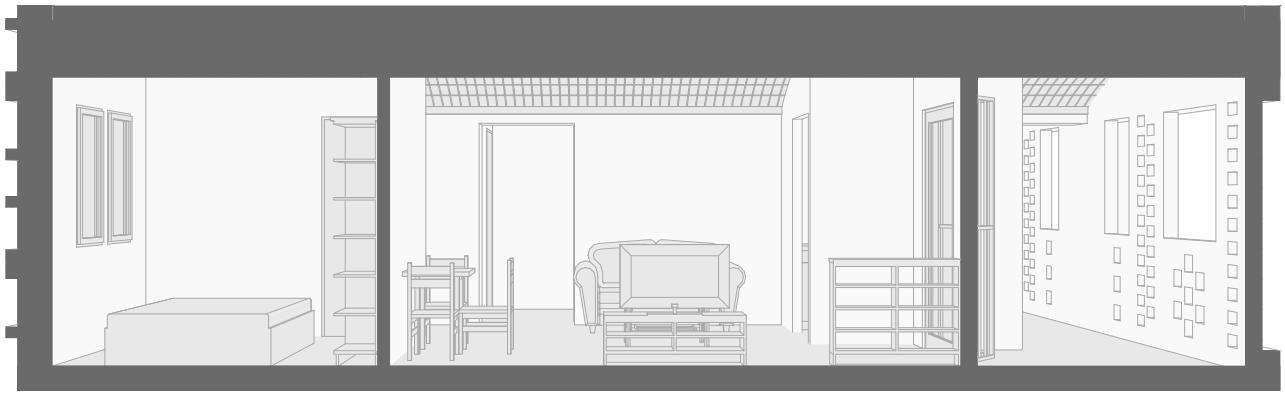
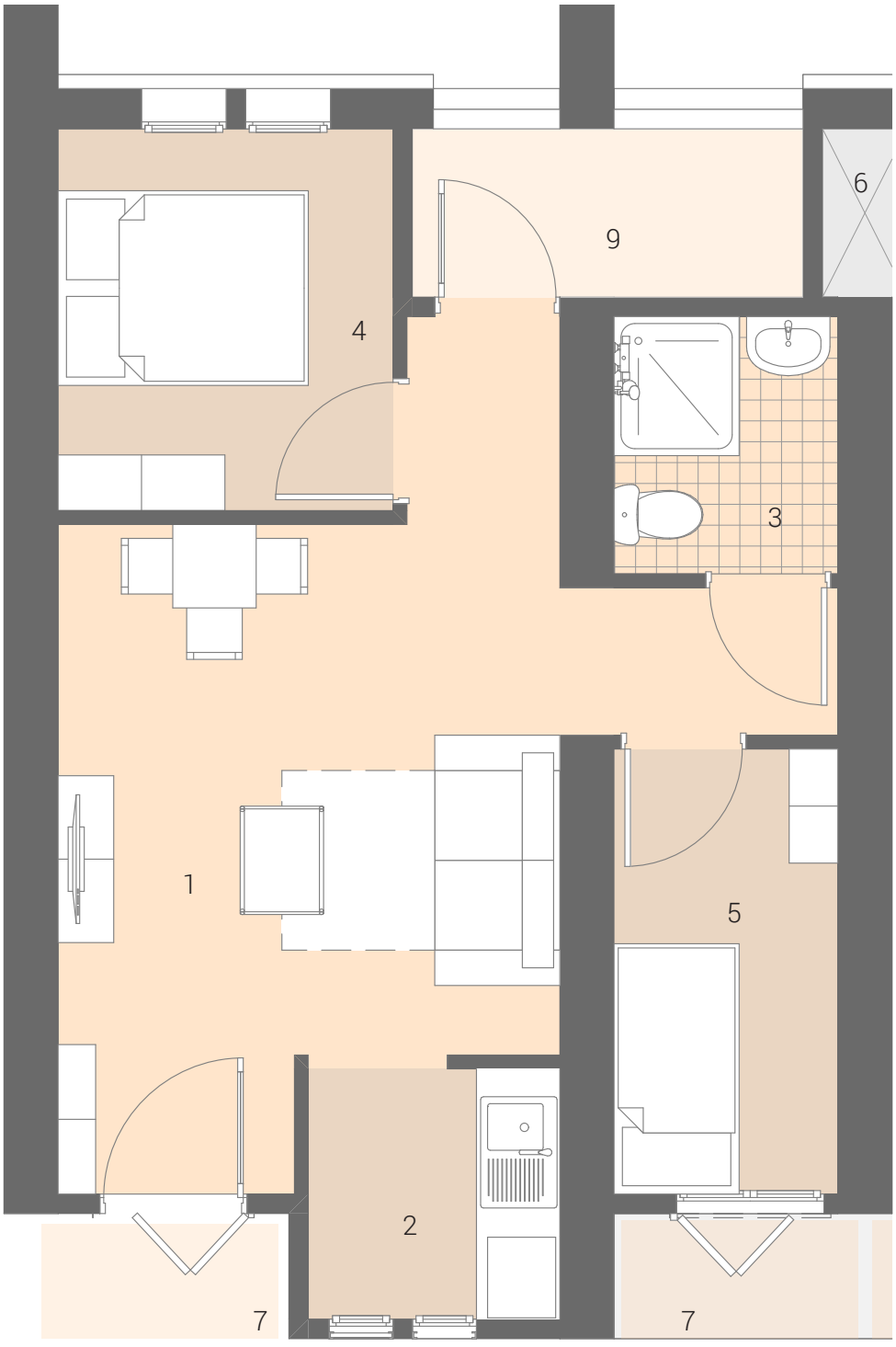


Figure 10.10
Cross-section perspective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2-Bedroom with shop option
45 m^2

Target group
Middle income

Payment
Ownership with 30% DP

Floor area
45 m^2

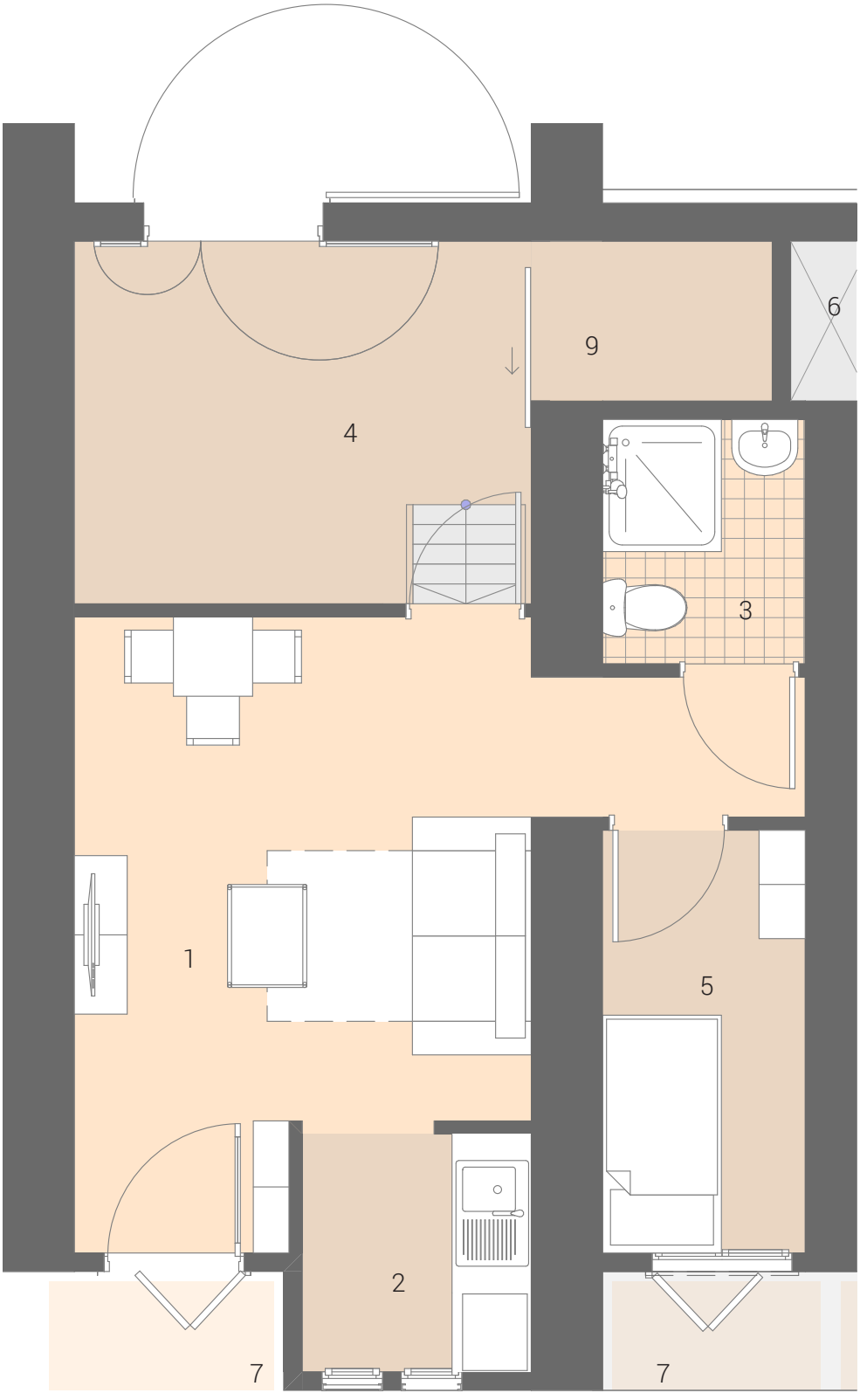
Description
The 2-bedroom apartment has a shop option on the ground floor in the plinth allowing inhouse income generation. The elevation difference enables extra storage capacity in the shop or bedroom. The shop or bedroom has a Dutch door facing the street. In shop variant this could be used as counter. This door as well has steel security bars, which can be opened and in this way function to hang merchandise on.

1. Living room
2. Kitchen
3. Bathroom
4. Master bedroom
5. Secondary bedroom
6. Technical and ventilation shaft
7. Semi-private space
8. Gallery
9. Storage

Figure 10.12
Section perspective from the gallery

Figure 10.11
Plan 1:50

Figure 10.13
Cross-section perspective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3-Bedroom
60 m^2

Target group
Middle income

Payment
Ownership with 40% DP

Floor area
60 m^2

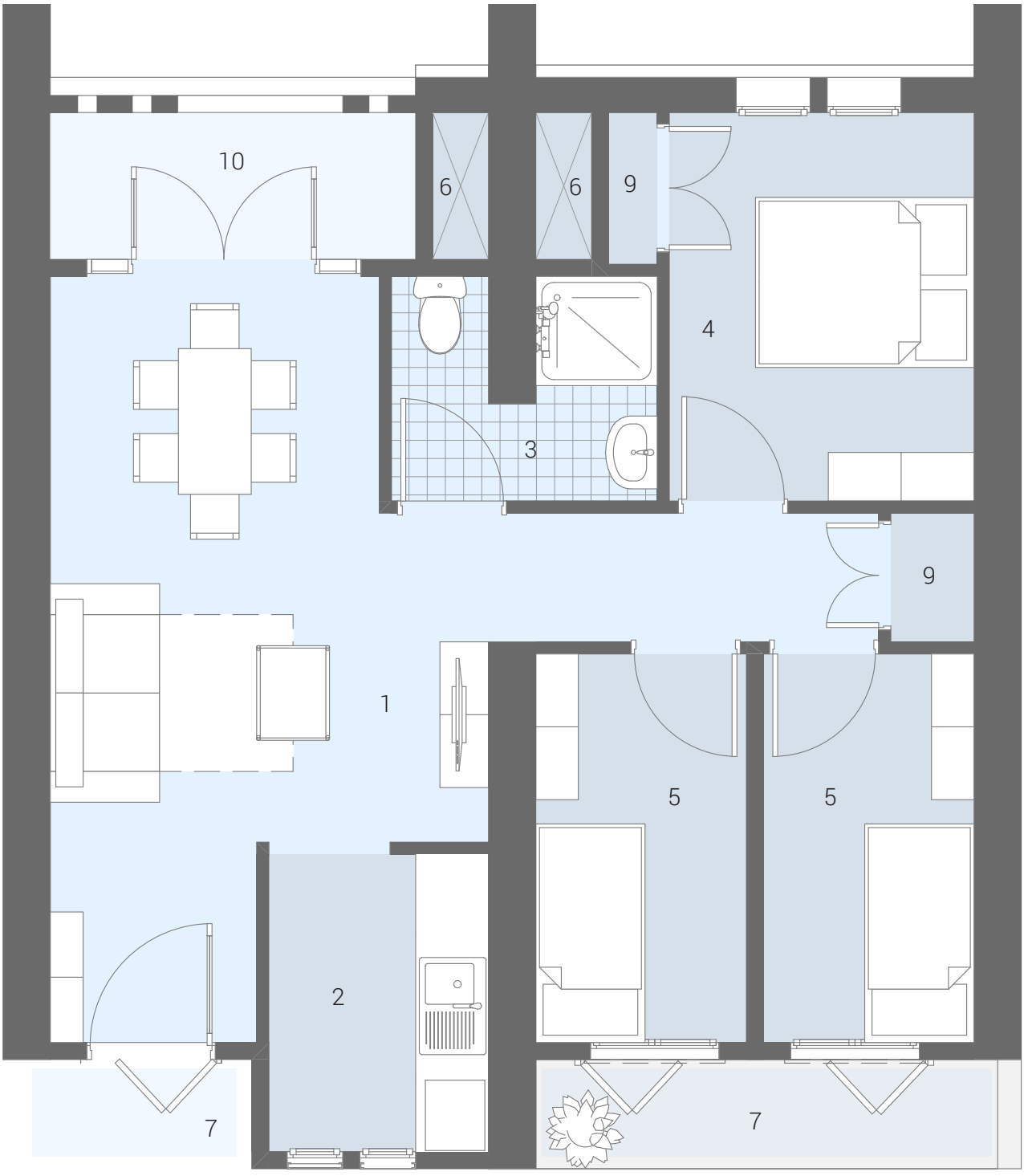
Description
The 3-bedroom type consists of one master bedroom and two secondary bedrooms. The layout of this typology shows clearly how openings in the load-bearing walls have been avoided as much as possible. Moreover, it becomes visible that this typology has a substantial bigger living room and kitchen compared to the one and two bed typologies. And also this typology has a slightly elevated semi-private space on the gallery.

1. Living room
2. Kitchen
3. Bathroom
4. Master bedroom
5. Secondary bedroom
6. Technical and ventilation shaft
7. Semi-private space
8. Gallery
9. Storage
10. Loggia

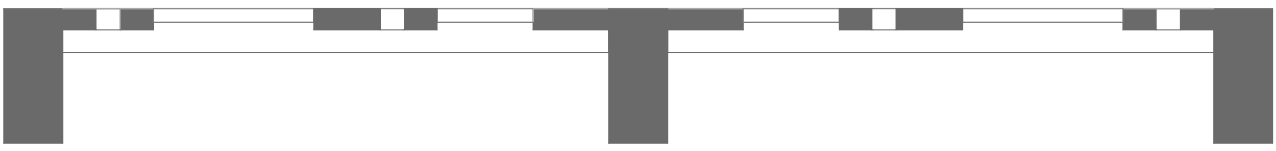
Figure 10.14
Section perspective from the gallery

Figure 10.15
Plan 1:50

Figure 10.16
Cross-section perspective



8



2-Bedroom commercial
60 m^2

Target group
High income

Payment
Commercial market

Floor area
60 m^2

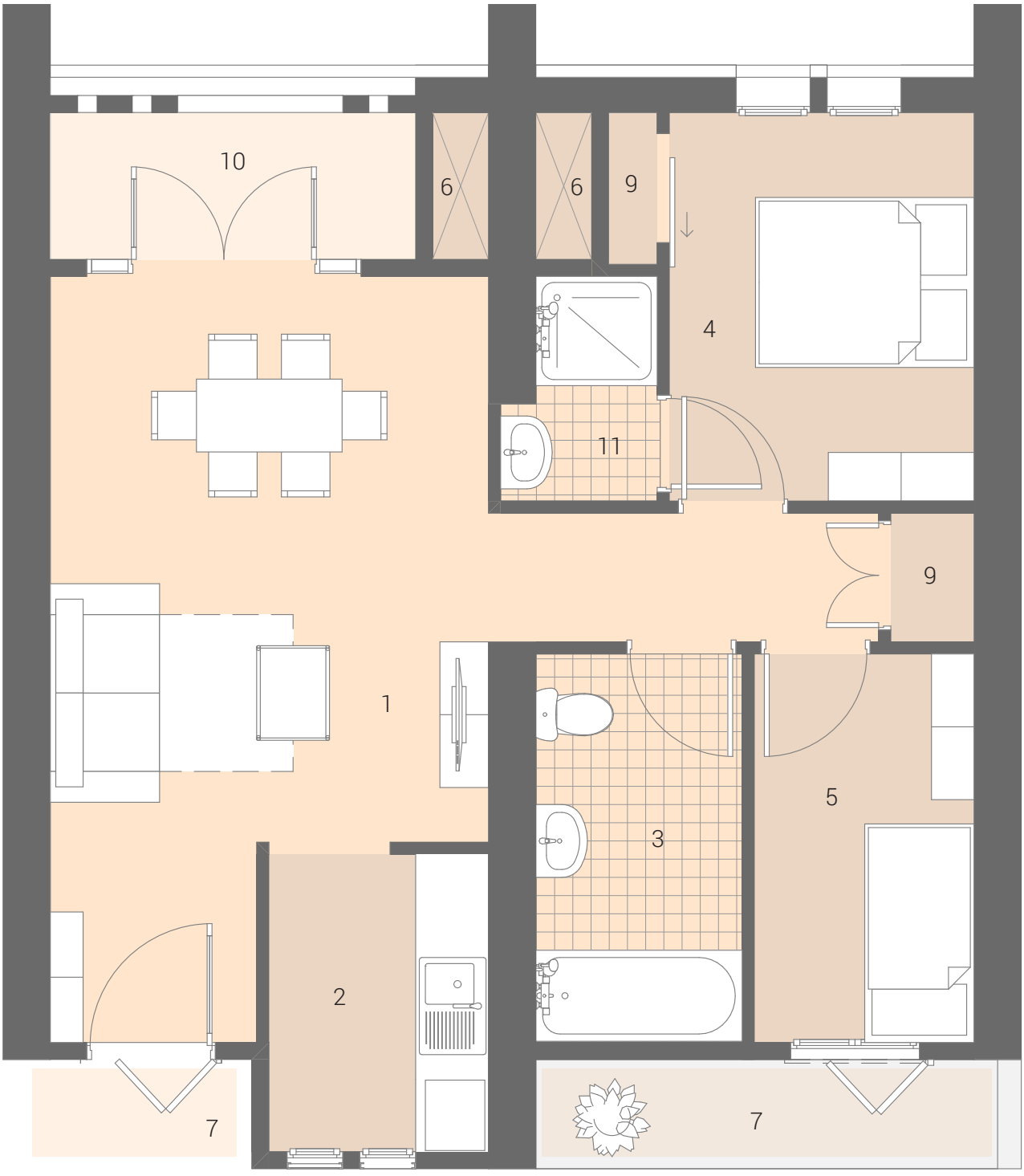
Description
Relatively similar with the 3-bedroom typology. However, instead of a secondary bedroom there is an ensuite bathroom for the master bedroom and the various rooms are all slightly more spacious. Moreover, the windows of the master bedroom are from floor to ceiling, unlike the low-cost typologies where these windows are from middle hight to ceiling.

1. Living room
2. Kitchen
3. Bathroom
4. Master bedroom
5. Secondary bedroom
6. Technical and ventilation shaft
7. Semi-private space
8. Gallery
9. Storage
10. Loggia
11. Ensuite bathroom

Figure 10.17
Section perspective from the gallery

Figure 10.18
Plan 1:50

Figure 10.19
Cross-section perspective



8

3-Bedroom commercial
75 m^2

Target group
High income

Payment
Commercial market

Floor area
75 m^2

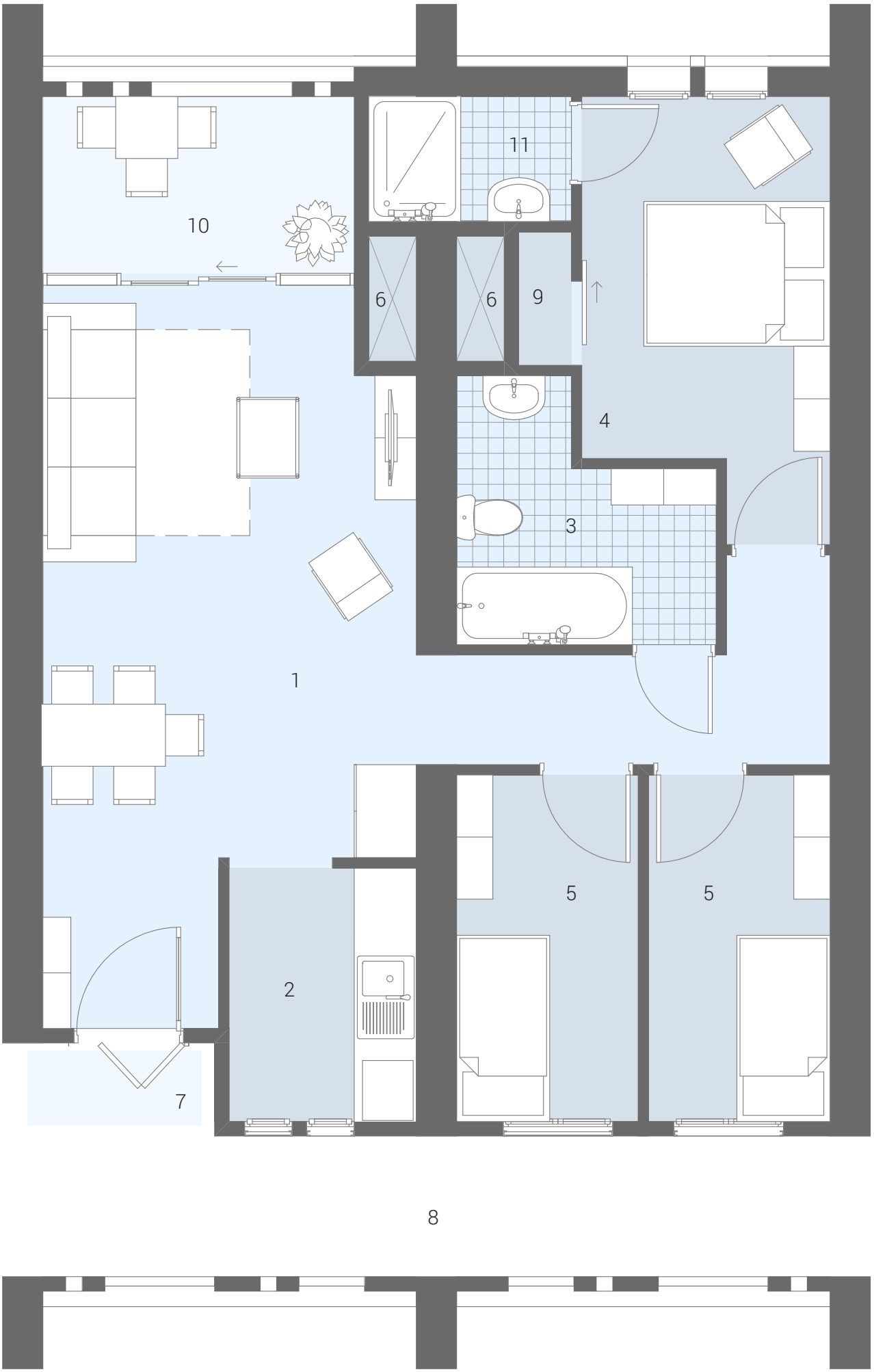
Description
Compared to the low-cost 3-bedroom typology, the commercial variant increases all floor areas of the various rooms. Especially the living room, master bedroom and bathroom increases substantially in size. Besides, the master bedroom contains an ensuite bathroom. This typology expands in both directions compared to the others making that the elevated semi-private spaces at the gallery are not there anymore, hereby it is assumed that the high income households do not need these spaces for informal activities at the gallery.

1. Living room
2. Kitchen
3. Bathroom
4. Master bedroom
5. Secondary bedroom
6. Technical and ventilation shaft
7. Semi-private space
8. Gallery
9. Storage
10. Loggia
11. Ensuite bathroom

Figure 10.20
Section perspective from the gallery

Figure 10.21
Plan 1:50

Figure 10.22
Cross-section perspective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Flexibility

Not only the urban plan, but also the structure and typologies of the dwelling units form a framework in which inhabitants have the opportunity to participate in by enabling possibilities for incremental adaptations. Basically, there are two categories of adaptations which can be done by its inhabitants.

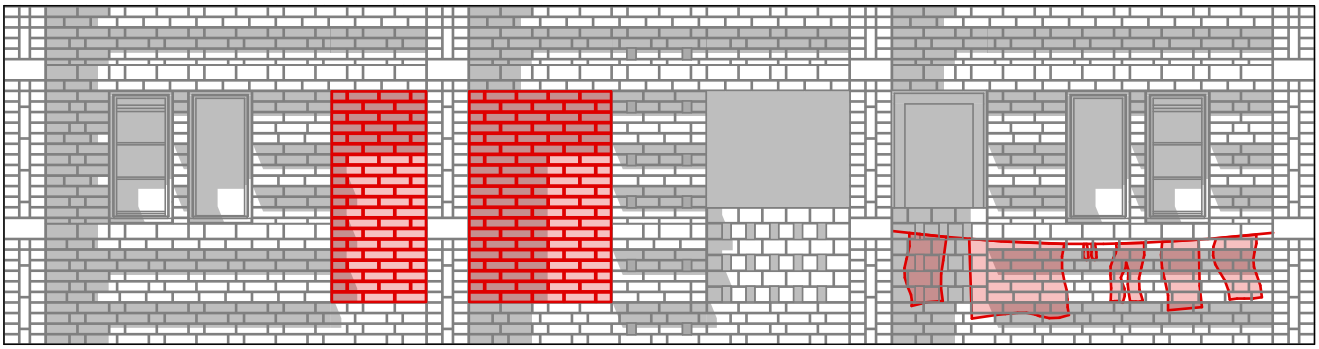
The first are the ones within one typology. The plans can be reconfigured by changing the composition of the inner and exterior walls. The kitchen, for example, can be either way a closed or an open kitchen. But in particular the loggias have a high chance to be adjusted in order to have an other function. Where one can greatly appreciate a private outdoor space, the other can use this valuable floor area to extend the indoor living space for, for example storage or a bigger living room. Besides, the protruding walls allows to span a washing line or to extend the roof of the shop at the ground floor.

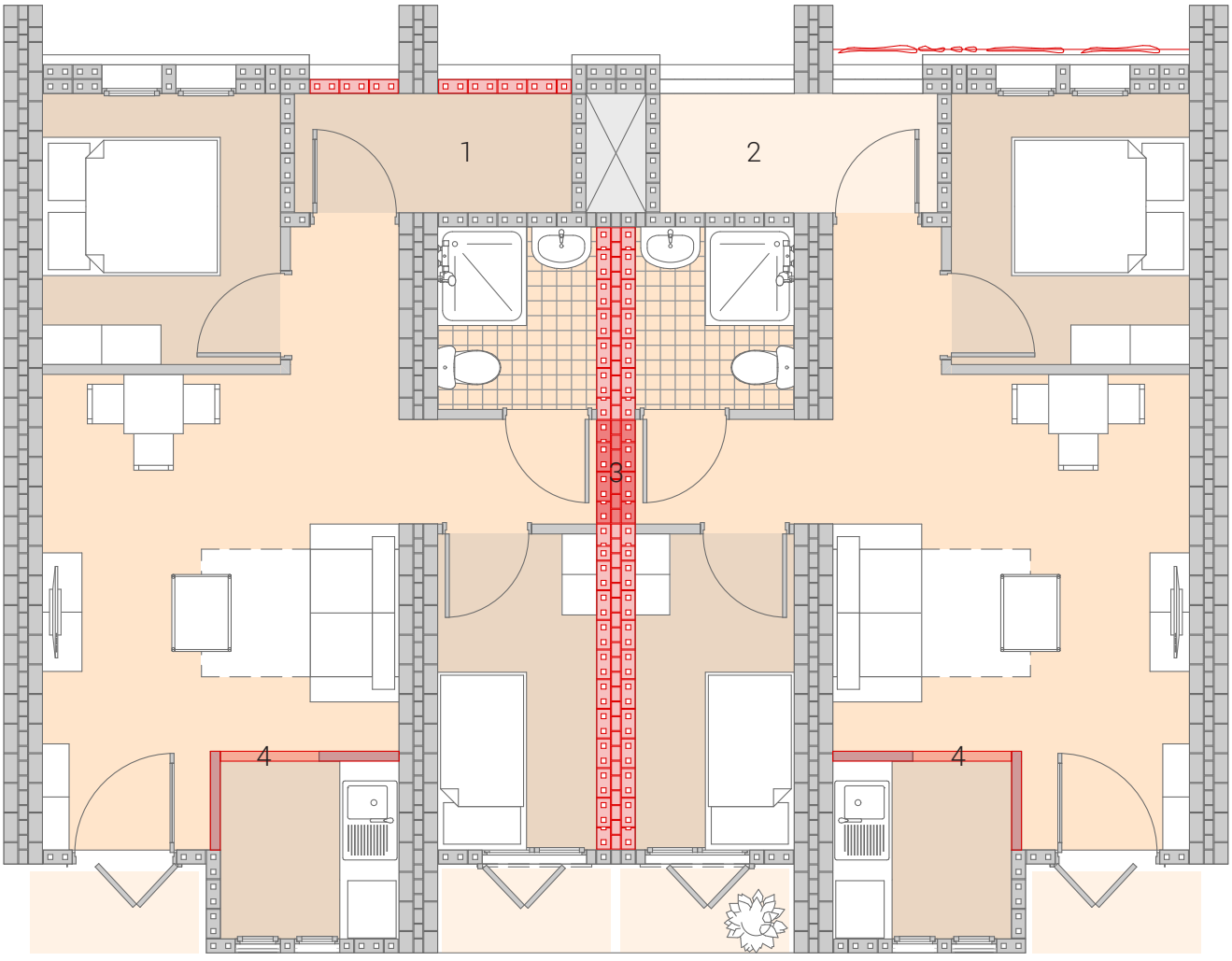
The second category is between typologies. This takes in consideration the incremental growth wishes of households. Therefore, each typology can be extended with its mirrored equal. Since the horizontal tie beams in the loadbearing walls function as lintels as well, it is possible to create openings for duplexity purposes. However, to enable this, the composition of the CSEB needs to have a split joint at the border of these openings. Moreover, the building systems limits the size of these openings to be not more than 2 meters.

In the follow drawings the red lines and hatches shows possibilities for incremental adaptations. Here on the right the 2-bedroom typology and its changeability is shown. The kitchen can be an open or closed one and the loggia could be changed into a storage room. The drawing shows this adaption also in relation with the façade. Moreover, the typology separating wall (which in this case is non load bearing) can be removed. The composition of the CSEB allows to make this extension easy to do, by making split joints at the borders where the corridor of both apartments meet. However, for those who do not mind a bigger renovation the whole wall can be removed.

1. Storage
2. Loggia
3. Non-loadbearing apartment seperating wall
4. Option for closed kitchen

Figure 10.23
Possible incremental adaptations
2-bedroom apartment

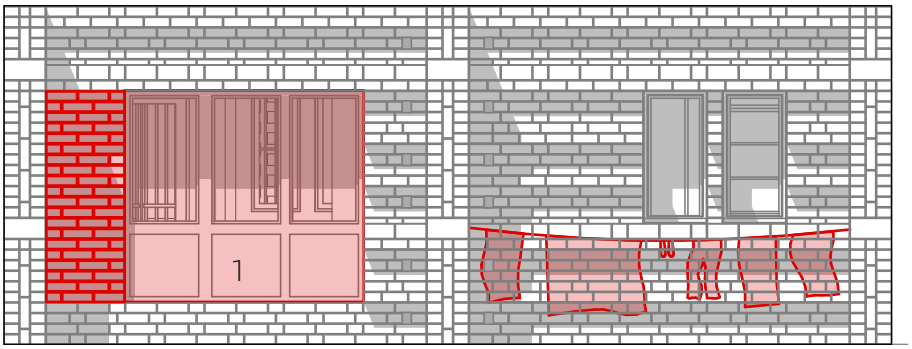


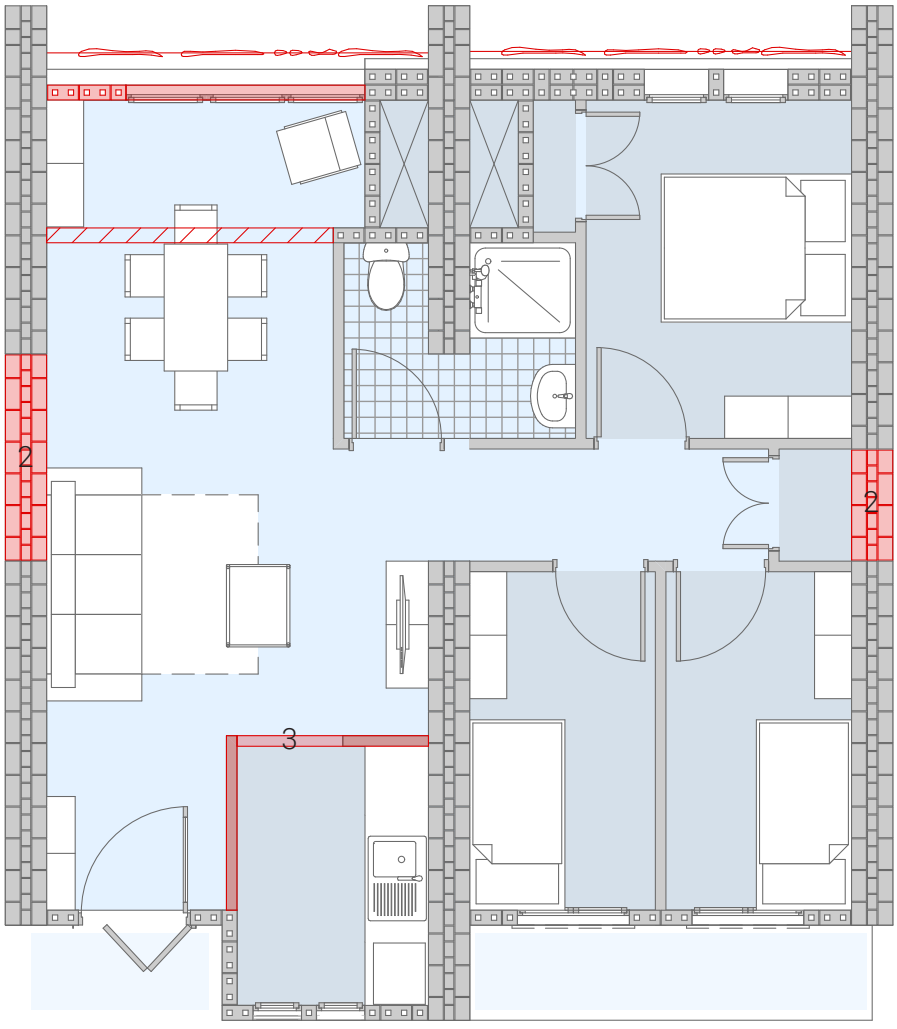

1
2
3
4
4

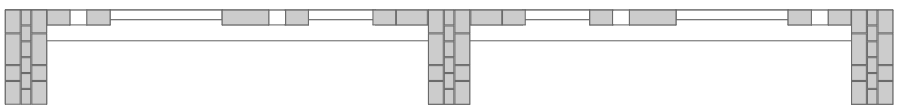
Also the loggia of the 3-bedroom apartment has high probability to be adapted. This example shows how the floor area of the loggia could be used to extend the living room. And just as all the other typologies, the 3-bedroom has the ability to act as a duplex apartment and can be extended with its mirrored neighbouring equal. It is only possible with another 3-bedroom apartment since the distribution of the typologies are done in such a way that each typology are clustered together. This becomes later in this report more clear.

1. Optional facade to extend living room
2. Non-loadbearing apartment seperating wall for duplexity purposes
3. Option for closed kitchen

Figure 10.24
Possible incremental adaptations 3-bedroom apartment


1

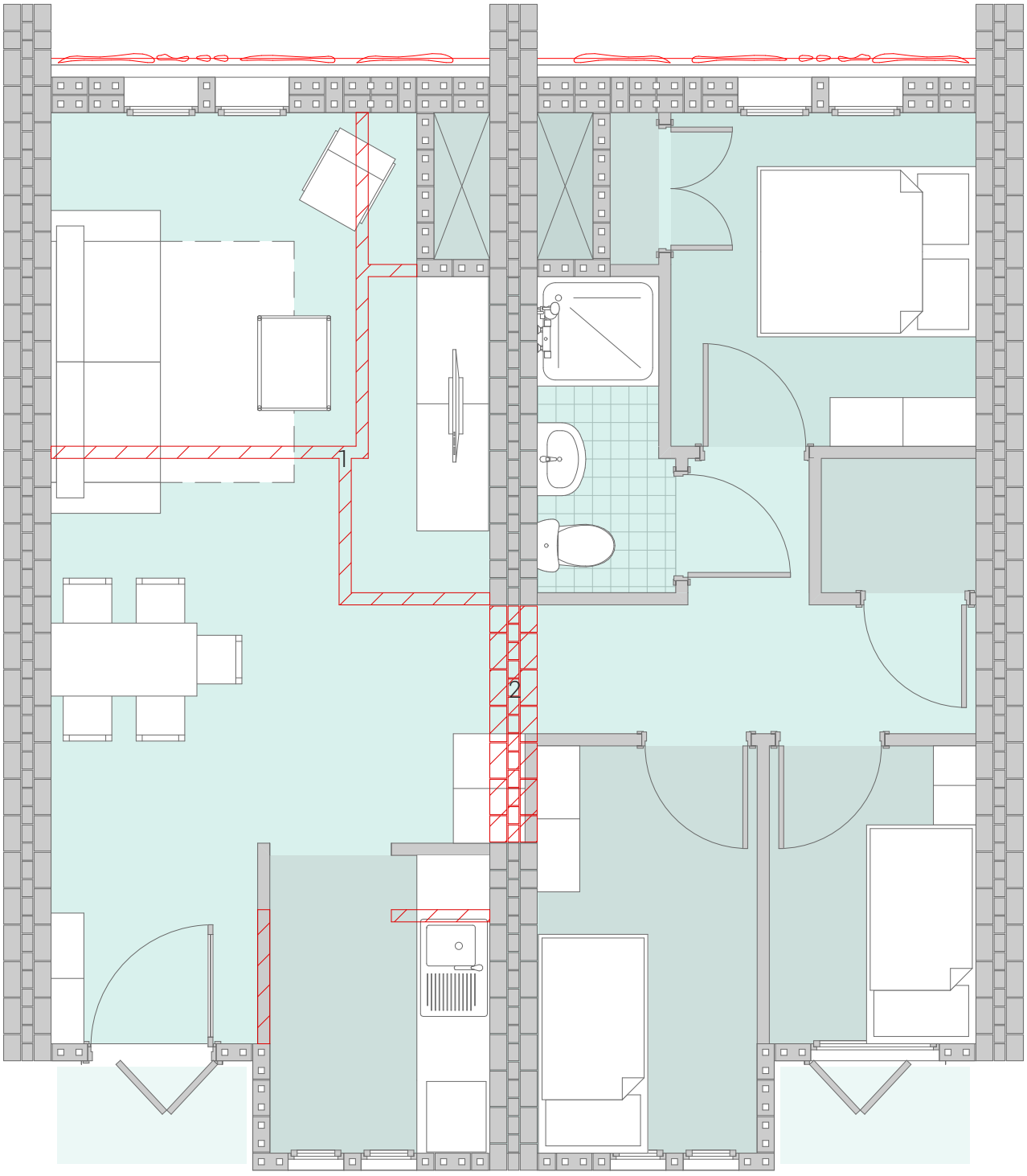

2
2
3

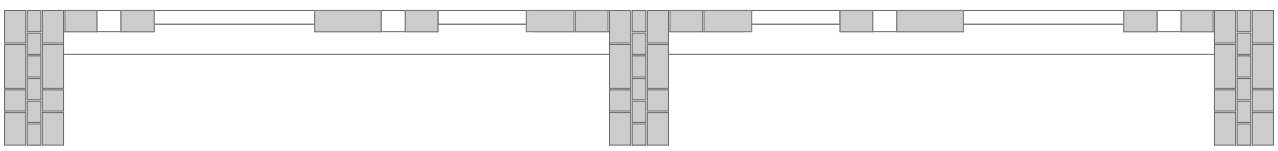


To clarify the duplexity at the right an example is shown. Here a 1-bedroom apartment of 30 m2 can be linked with another 1-bedroom apartment resulting in a 3-bedroom apartment of 60 m2. The duplexity of the typologies makes this project function also in the future when households grow bigger or when their may be a time with more prosperity wanting people to extend their living space.

1. Flexible agrostone panels as interior walls
2. Non-loadbearing apartment seperating wall for duplexity purposes

Figure 10.25
Duplexity 1-bedroom apartment


1
2



Typology distribution

For the distribution of the typologies throughout the urban plan, the needs of the different households (from very low to high income) is considered. Therefore, the low income typologies will be mainly located in the core of the urban block since low income households are more dependent on collective activities in the semi-private public spaces. These spaces support their need for informal income generation and allow their informal way of living. The higher income typologies will be mainly located on both ends of the block since these places are either

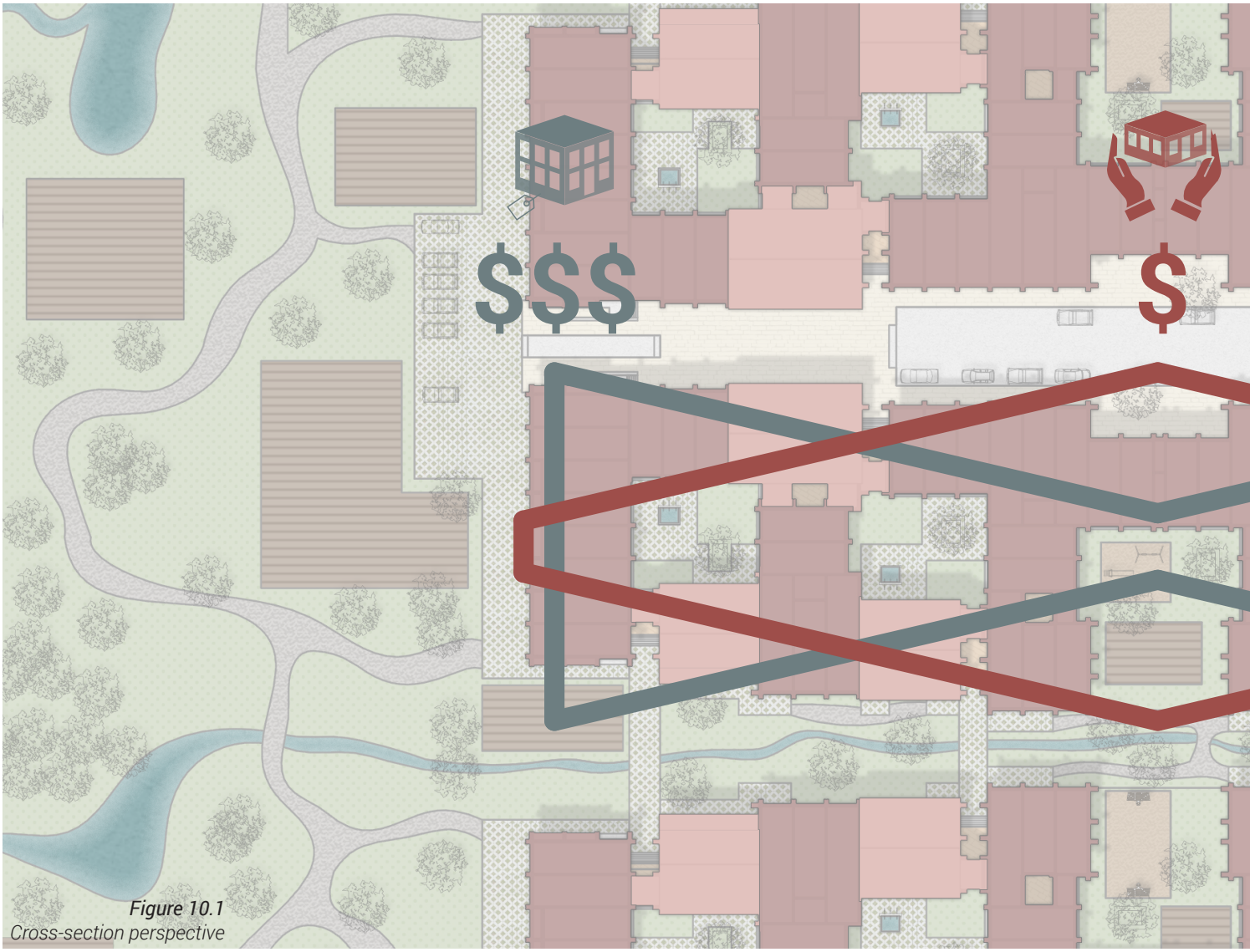
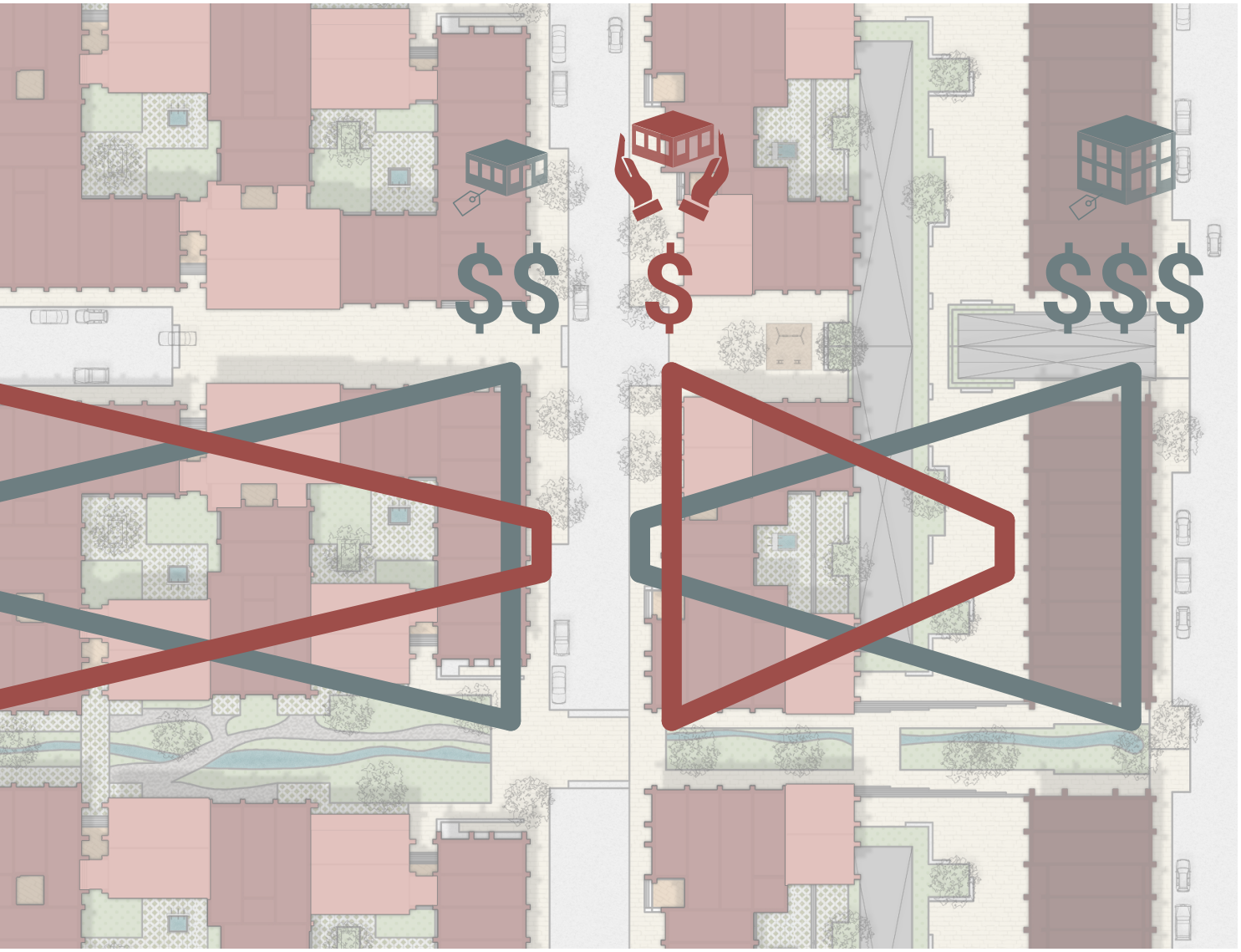


Figure 10.1
Cross-section perspective

connected with the street on an urban level or have a beautiful view over the urban wetland. This has as consequence that these apartments will have a higher value on the commercial market and fit with the more individual life style of higher income households. However, as the diagram shows, the low income households should not be excluded from the urban wetland and street side or the other way around.



11 The green dwelling block

Introduction

In the following chapter, there will be a focus on the dwelling blocks connected with the urban wetland. It is the part of the urban fabric which is in close relation with the urban wetland and the green wedges. The one which will prosper at a calmer pace behind the urban dwelling block connected to the primary road. To find out how the productive urban open space system is actually implemented, also in relation with the typologies, there will be an elaboration first on the plans after which the focus will be put on the different urban spaces: the street, the inner courtyard, the green wedge and the urban wetland. The reading of these urban spaces will be supported with elevations, sections, axonometric and perspective views, etc. In order to get the drawings, especially the plans, on the right scale within this report it focusses itself mainly on the left side of the symmetry axis of the urban block.

Amount of apartments
1-Bedroom 194
2-Bedroom 52
3-Bedroom 24
2-Bedroom own. 8
3-Bedroom own. 8
Total 286

Amenities
Shared rooftop spaces
Inner courtyards
Communal spaces 4
Parking spaces 15

Figure 11.2
Urban plan focus area

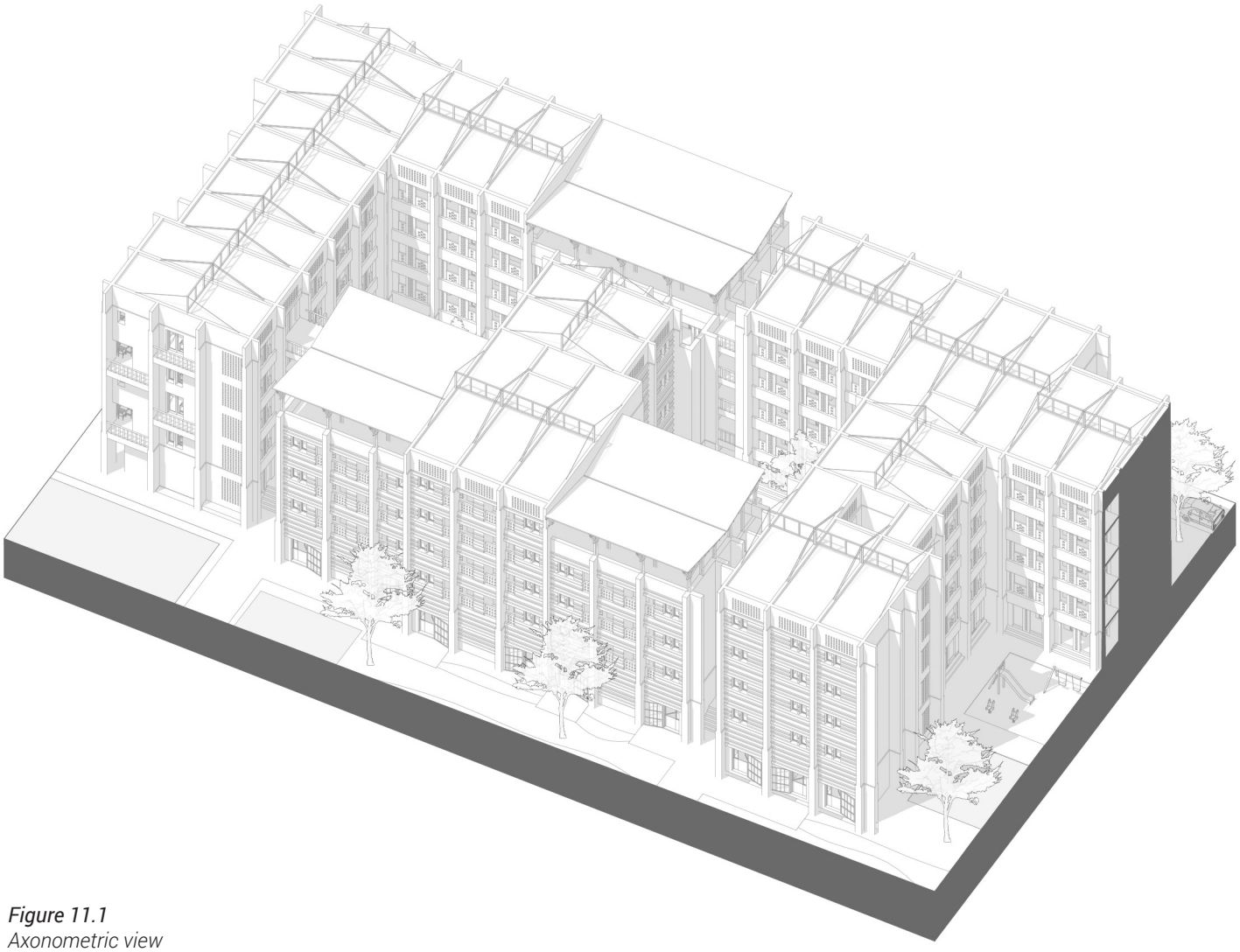


Figure 11.1
Axonometric view

Plan ground floor
Level 0

The ground floor consists solely of one and two bedroom apartments with shop option at the exterior of the urban block. The shops in the plinth enables inhouse income generation and it socially activates the public spaces. The relatively narrow passages throughout the plan allows to meander throughout the urban fabric but secures private atmospheres within the inner courtyards. Windows on the upper floors in the load bearing walls facing these passages together with greenery and stairs interrupting the spaces between the buttresses preserves it to be a safe space.

Besides the apartments, there are also communal multifunctional spaces connecting the inner courtyards. The inhabitants can use these for special occasions such as neighbourhood gatherings, weddings or funerals. By locating these multifunctional spaces in close relation with the inner courtyards makes them easy accessible by the inhabitants and allows to expand towards the inner courtyards during large group gatherings. It contains toilets, storage space and a kitchen to support these activities. Moreover, the Iddir commission will be strongly linked to this and has the option to operate from these spaces.

Amount of apartments
1-Bedroom 50
2-Bedroom 12
3-Bedroom 0
2-Bedroom own. 0
3-Bedroom own. 0
Total 62

Amenities
Inner courtyards
Communal spaces 4
Parking spaces 15

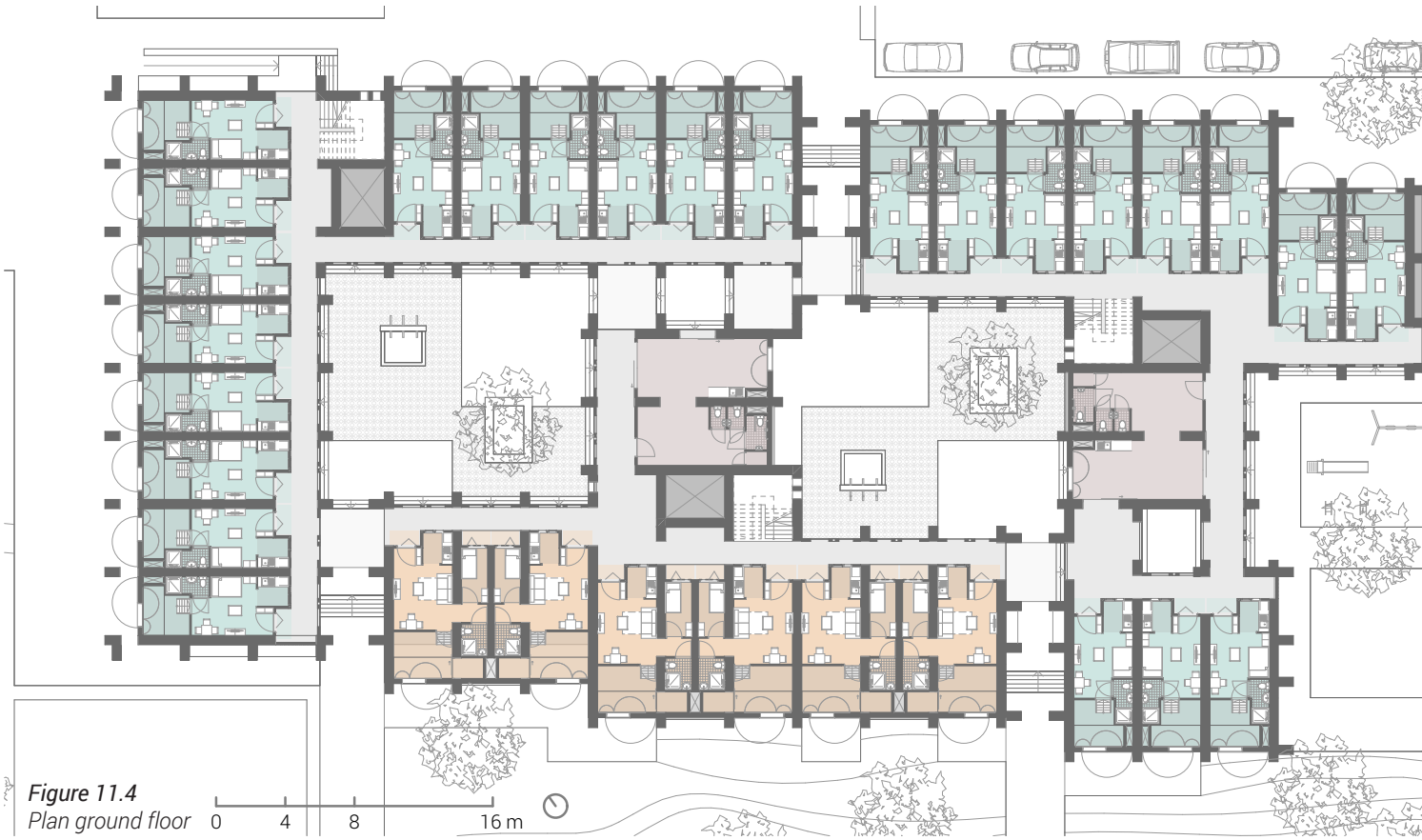


Figure 11.4
Plan ground floor

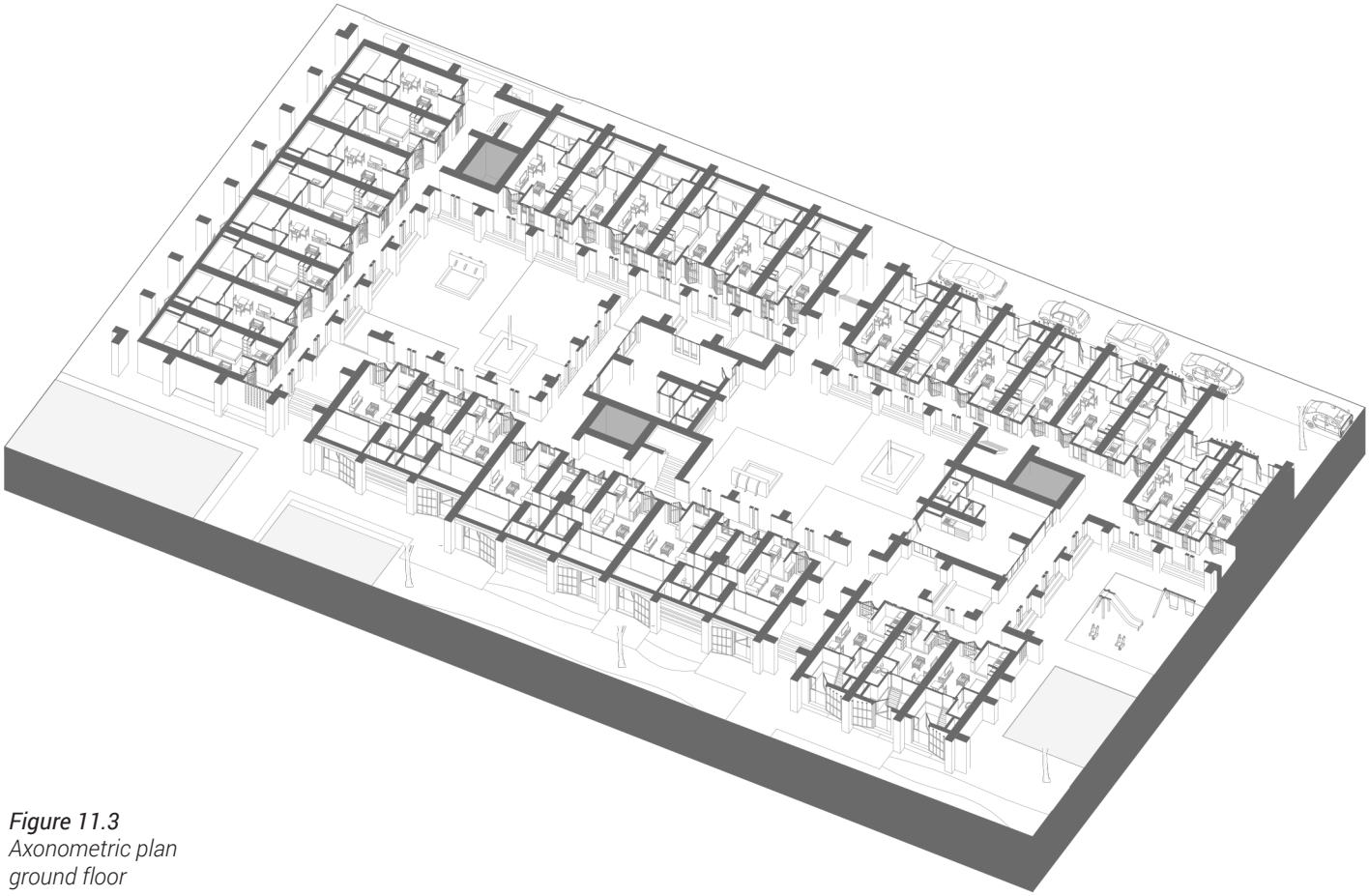


Figure 11.3
Axonometric plan
ground floor

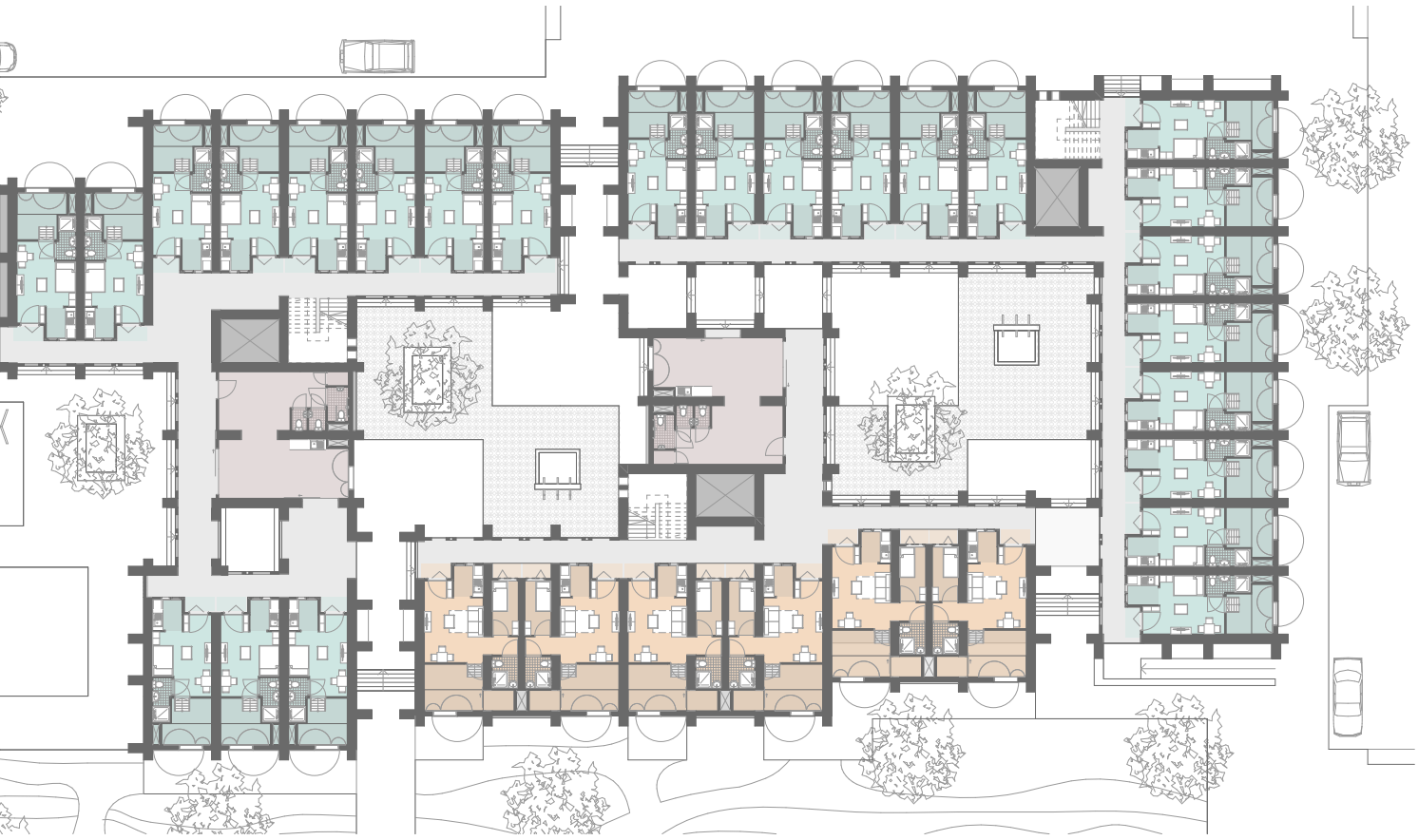
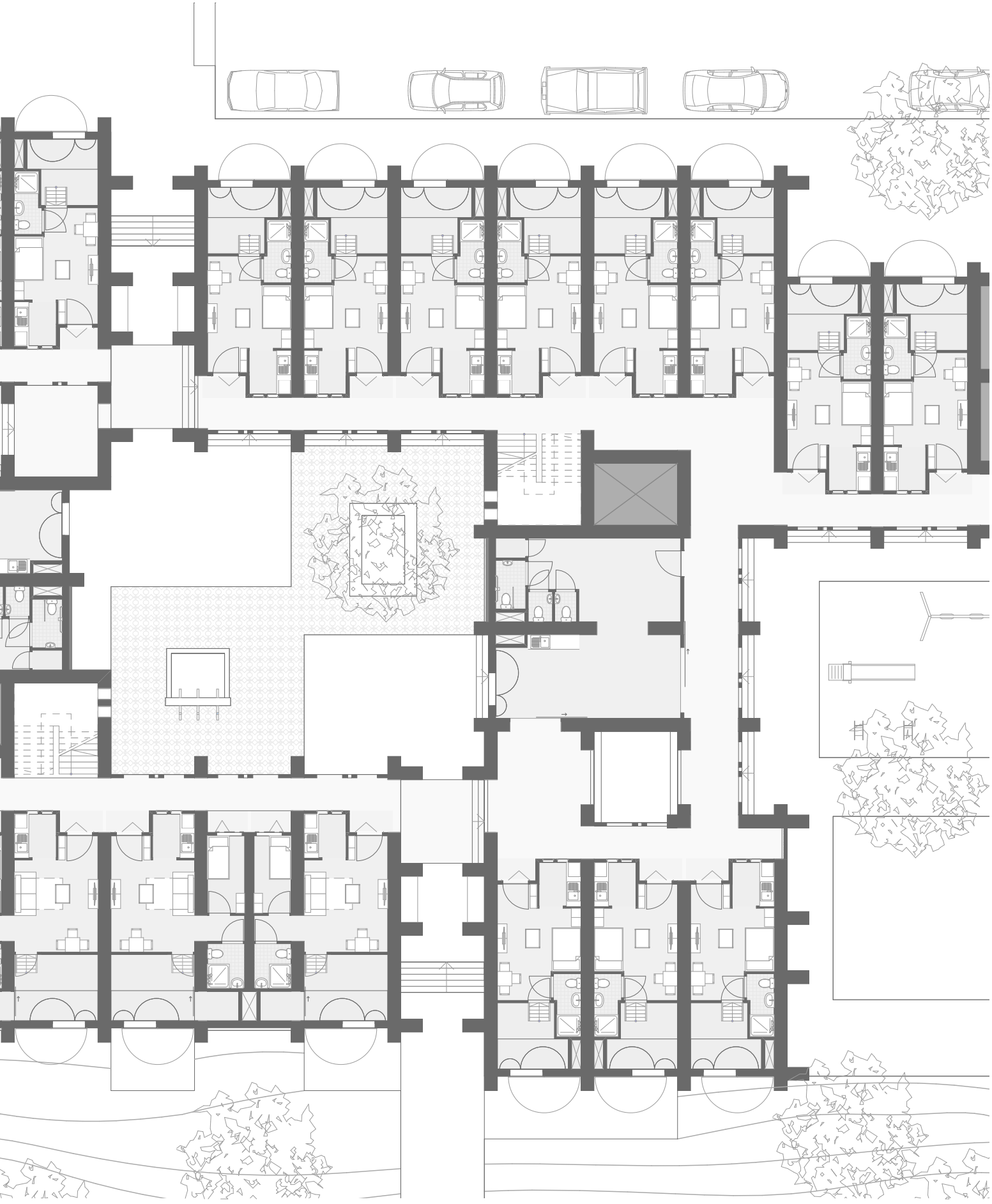


Figure 11.5
Plan ground floor left side
1:200



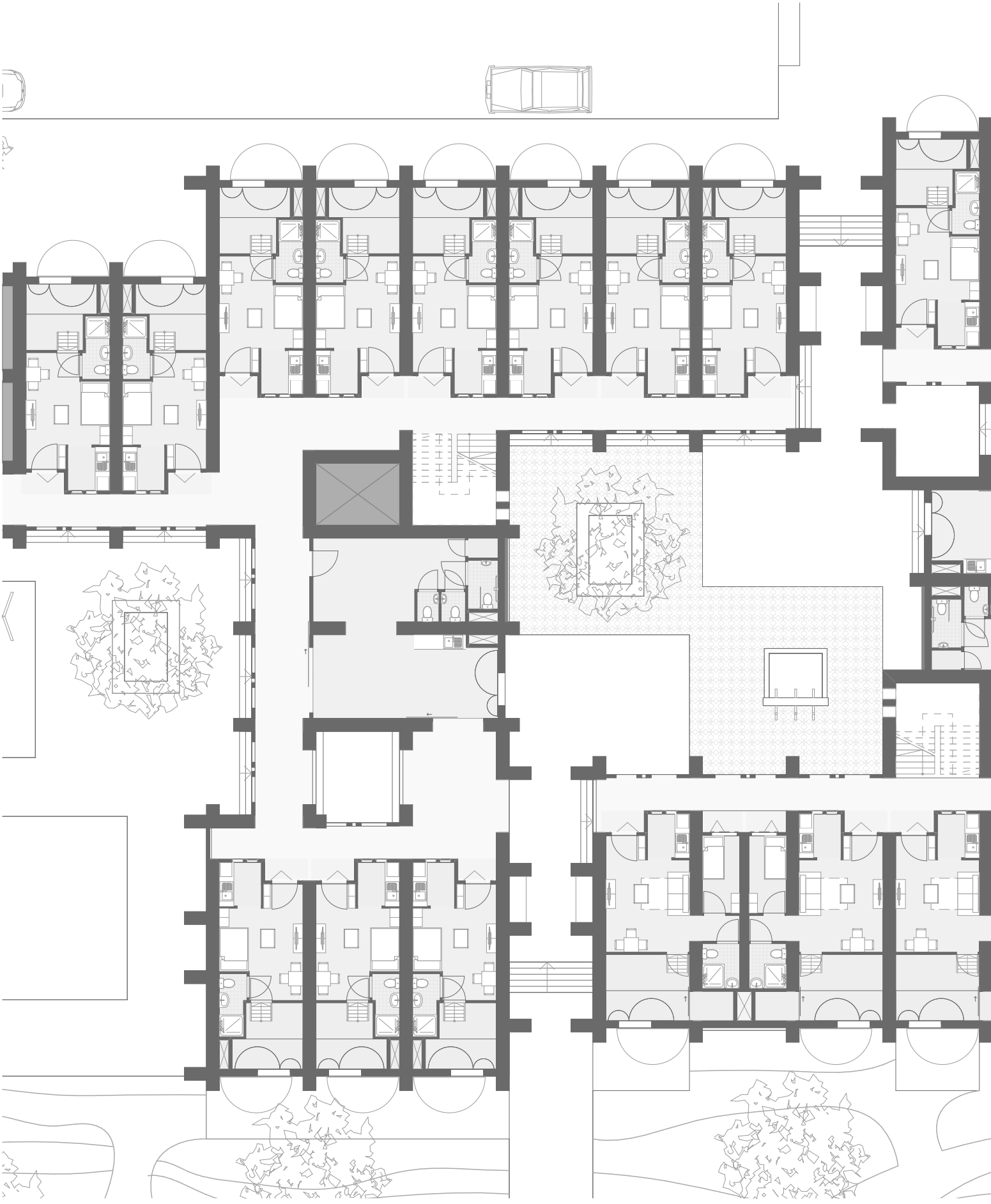
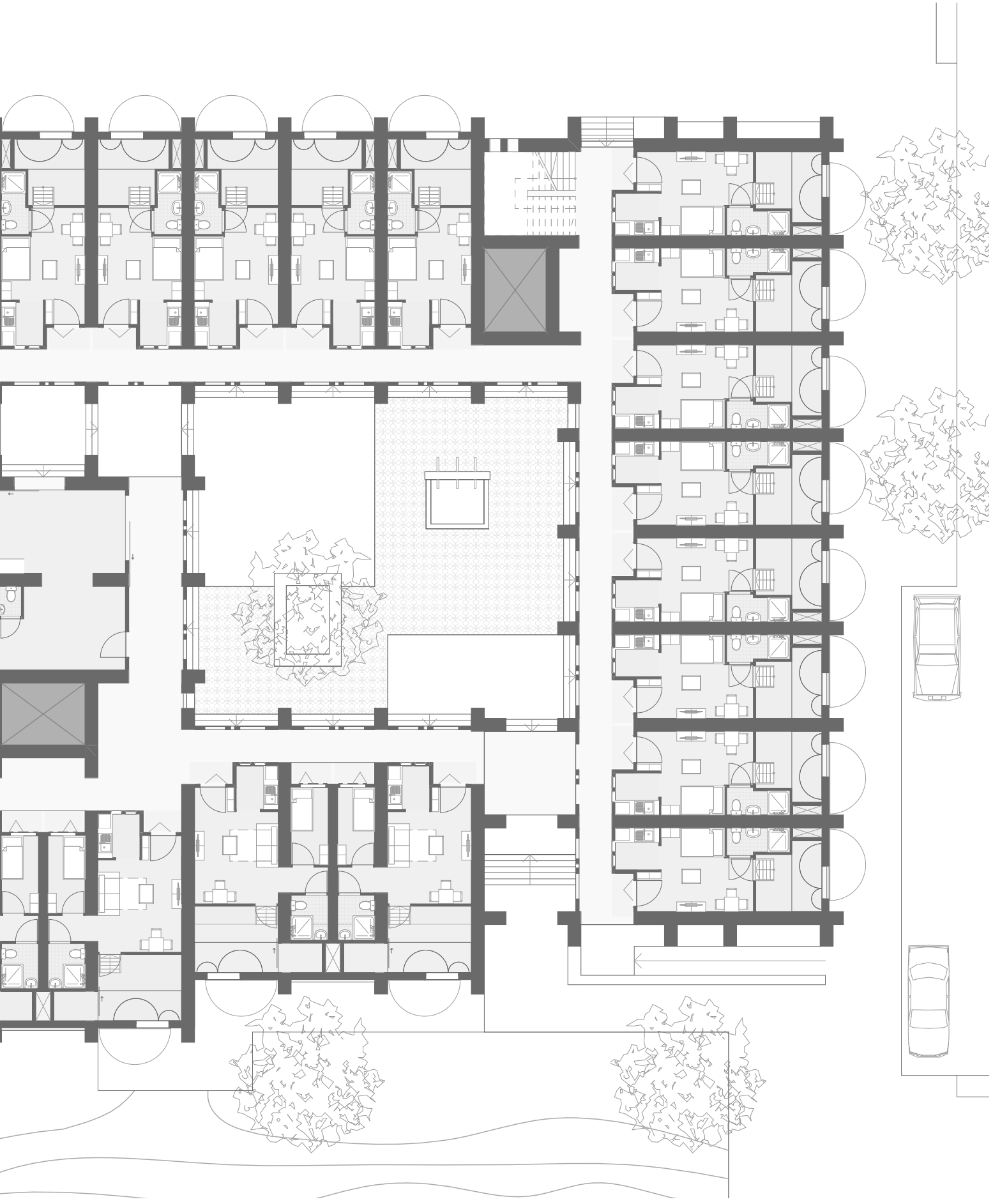


Figure 11.6
Plan ground floor right side
1:200



Plan intermediate floors
Level 1-3

The distribution of the typologies becomes clearly prevalent at the intermediate floors. The owner-occupied apartments are located at the urban wetland side consisting of 3-bedroom apartments and 2-bedroom apartments with a generous amount of private outdoor space. As the green wedge becomes more narrow, the typologies decrease in floor area step by step towards the low income typology.

The stairs and elevator shaft are positioned diagonally relative to each other for fire escape and efficient routing purposes. Since the maximum amount of floors of the urban block is GF +4 no elevator is obligated. However, it is taken in consideration to be able to install an elevator in the future.

The plan also clearly shows how the gallery in front of each apartment widens, functioning as extra shared 'outdoor' space and thereby serving informal activities such as traditional cooking or washing clothes.

Amount of apartments

1-Bedroom	38
2-Bedroom	12
3-Bedroom	6
2-Bedroom own.	2
3-Bedroom own.	2
Total	60

Figure 11.8
Plan intermediate floors

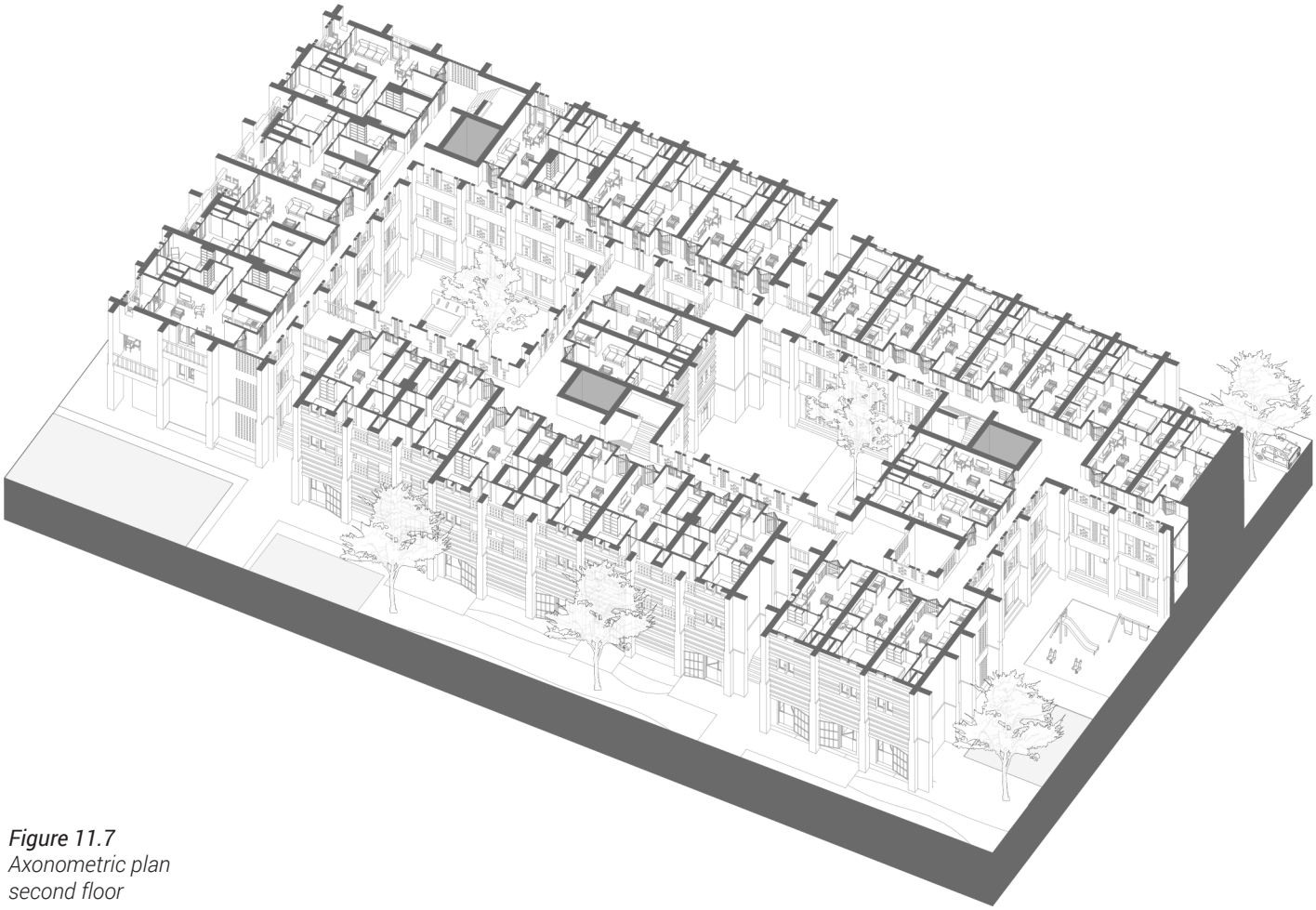


Figure 11.7
Axonometric plan
second floor

Figure 11.9
Plan level 1 left side
1:200

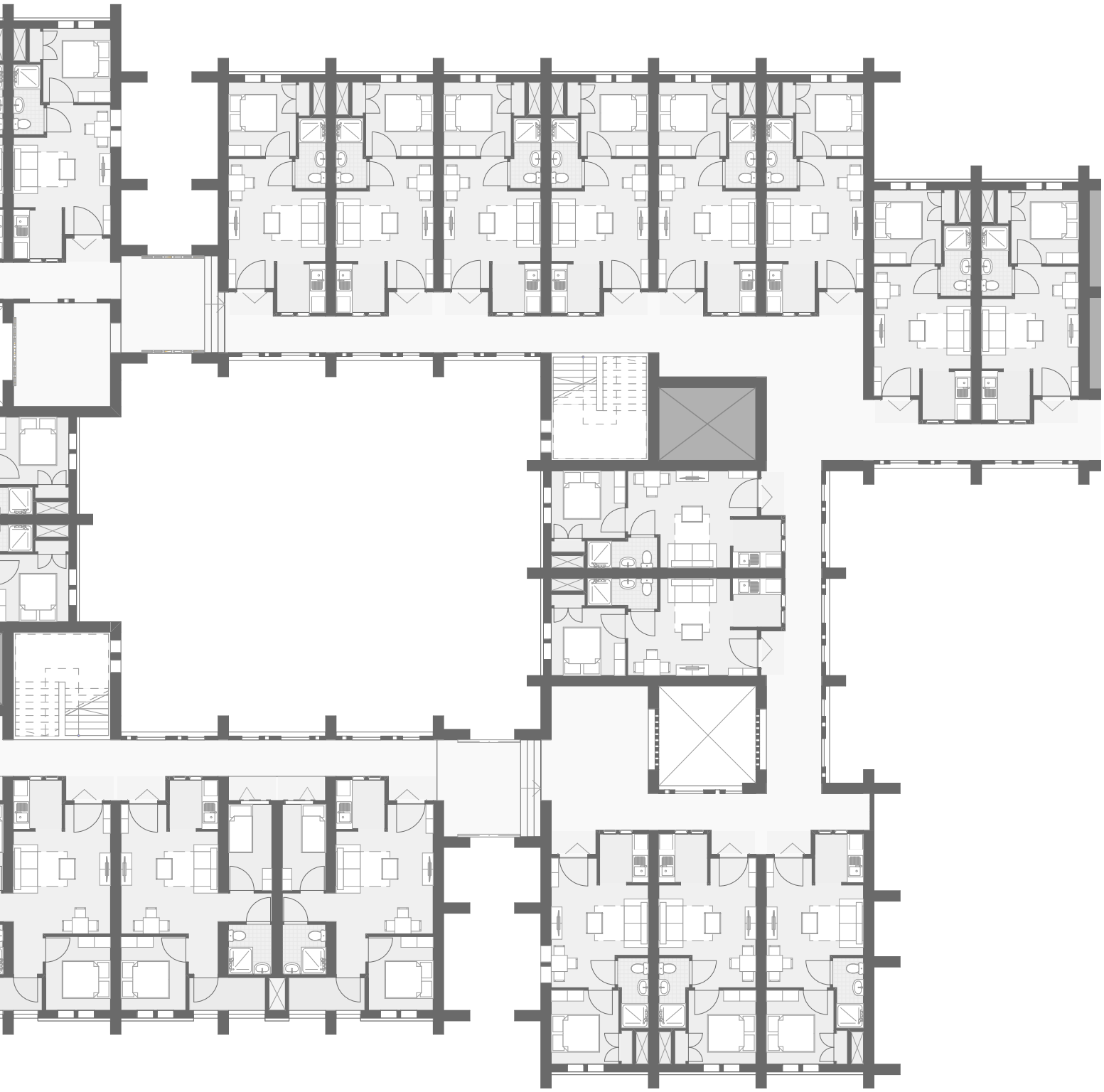
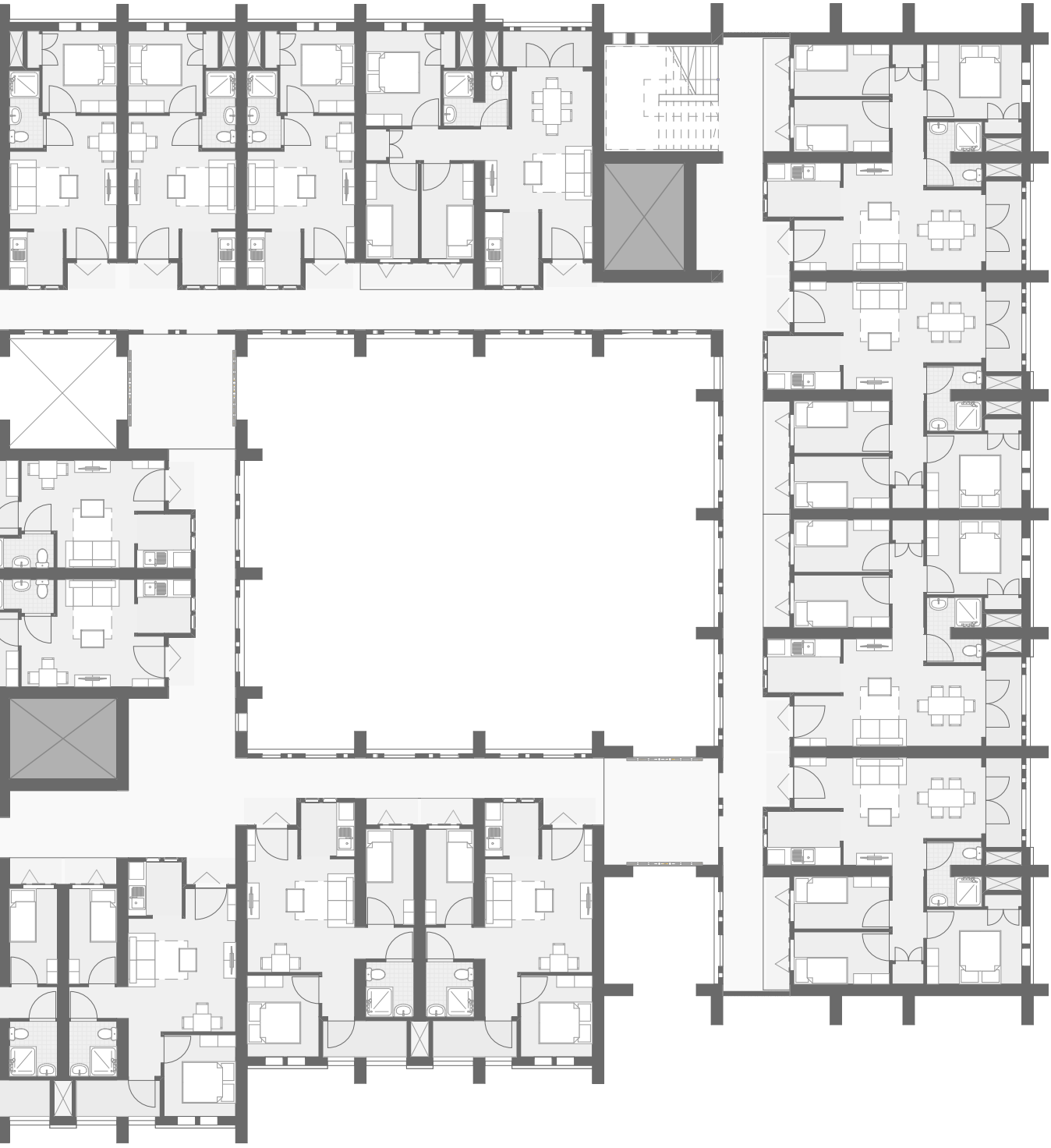


Figure 11.10
Plan level 1 right side
1:200



Plan top floor
Level 4

On the top floor several units have made way for a shared rooftop space. These spaces functions as a place to gather for social purposes but also serves as a household supportive amenity for washing and drying clothes.

Moreover, these open rooftop spaces functions as ‘breathing spaces’ on an urban level both literally and figuratively. Especially the street side becomes less dense and in this way opens up on the top floor. While it also allows ventilation throughout the building block to ensure favourable climate conditions in the dwelling units.

Amount of apartments
1-Bedroom 30
2-Bedroom 4
3-Bedroom 2
2-Bedroom own. 2
3-Bedroom own. 2
Total 40

Amenities
Shared rooftop spaces

Figure 11.12
Plan top floor

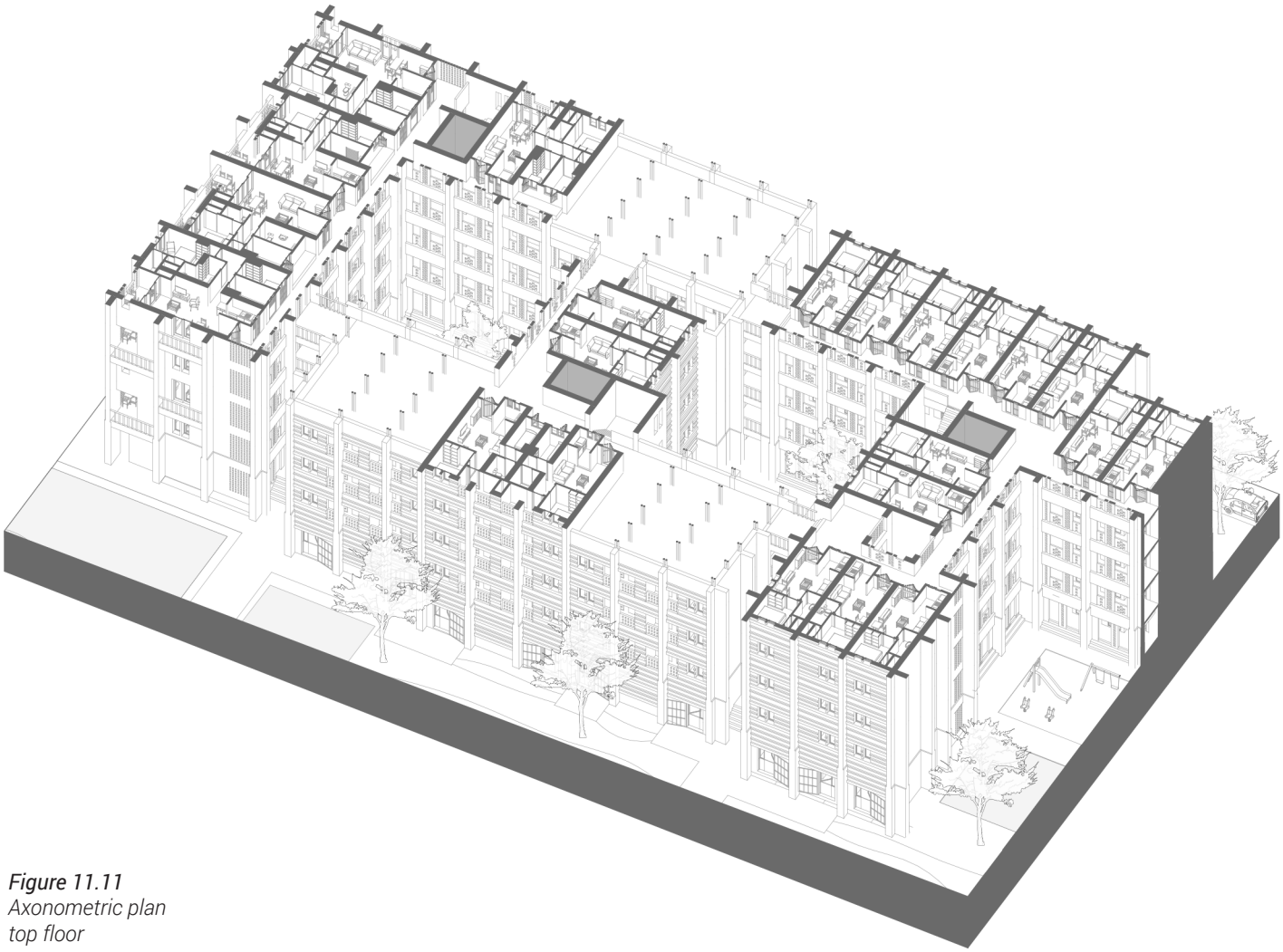
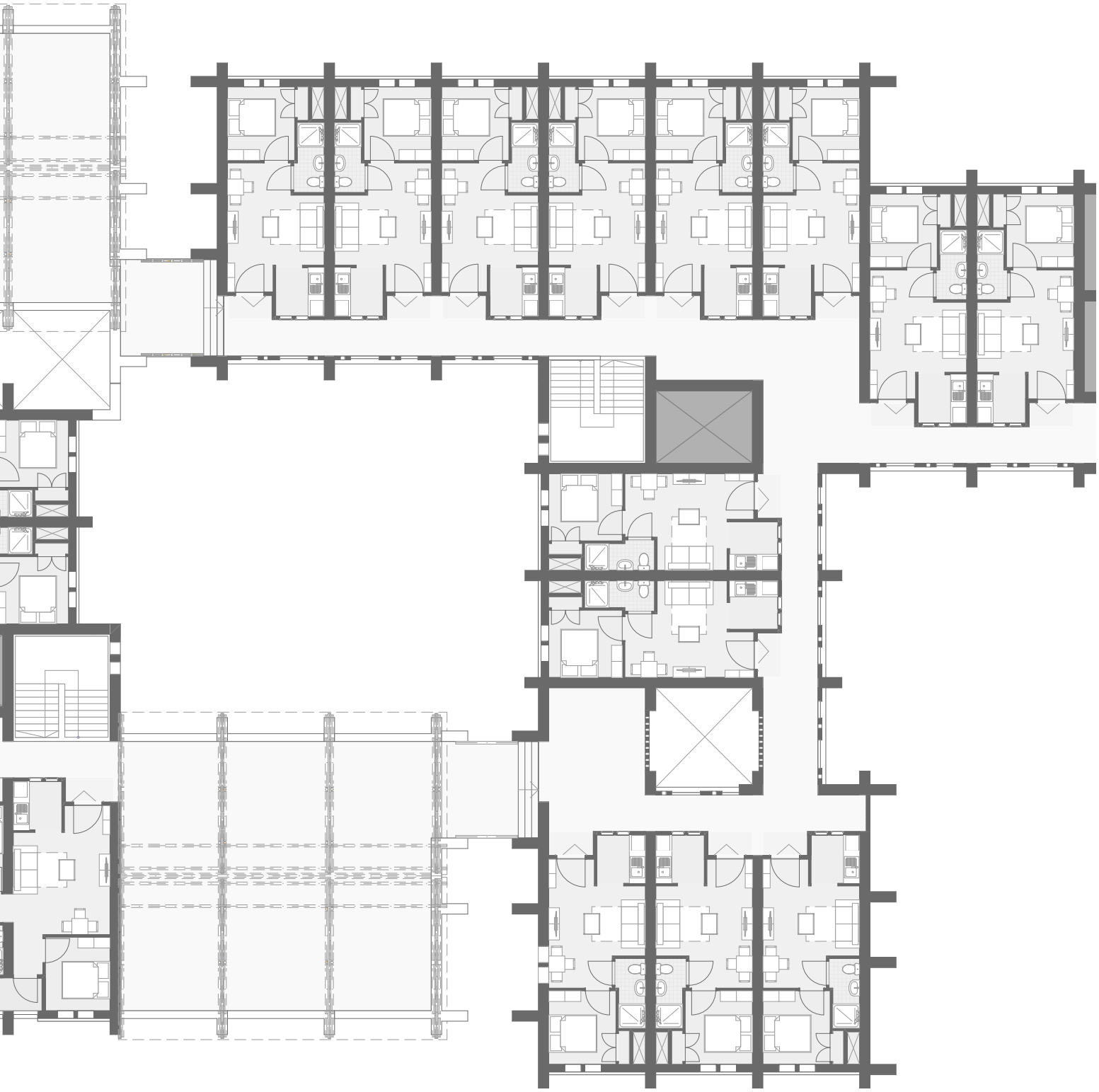


Figure 11.11
Axonometric plan
top floor

Figure 11.13
Plan level 4 left side
1:200



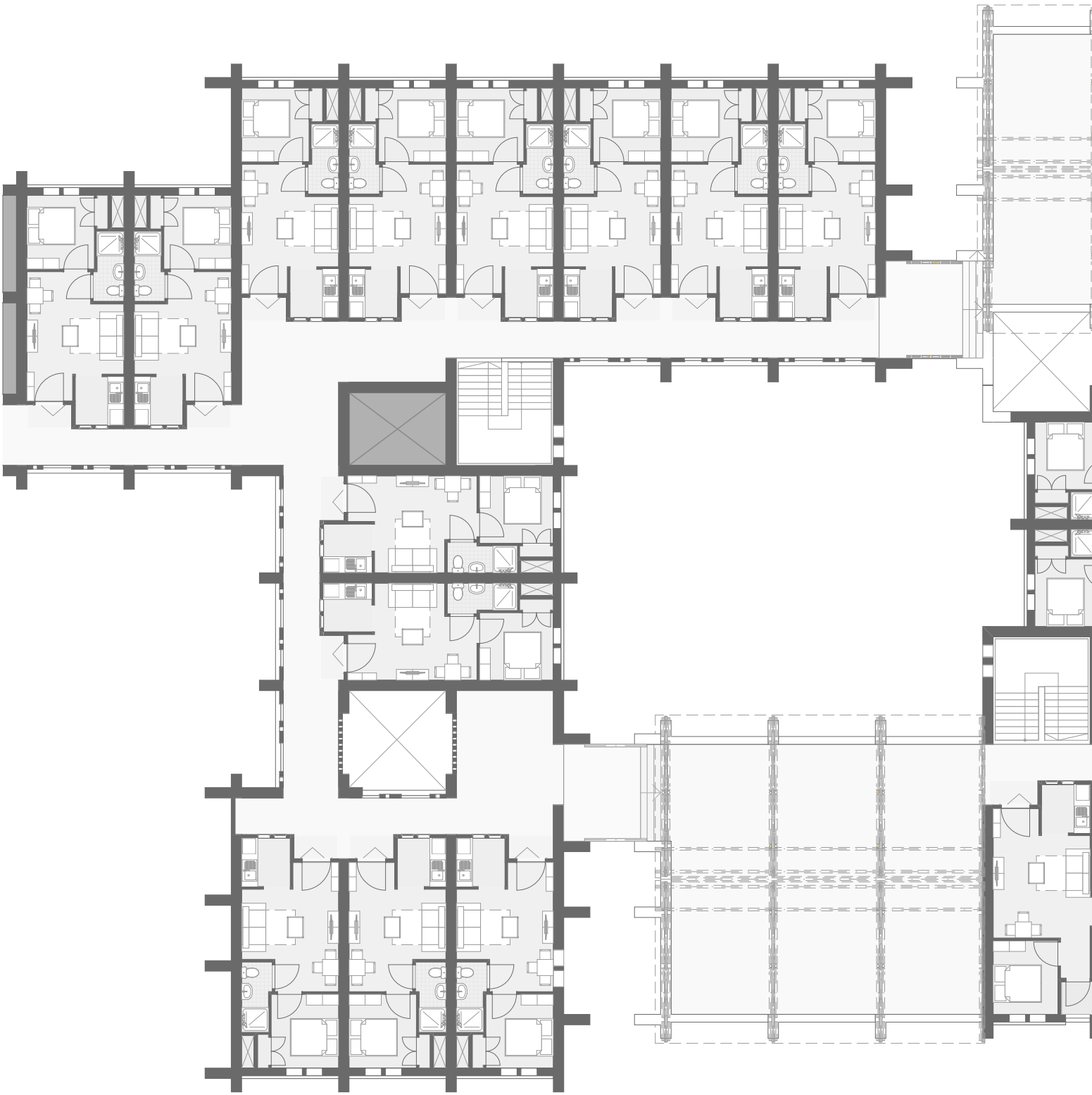


Figure 11.14
Plan level 4 right side
1:200

Street side

Although the street is accessible by car, the way of paving indicates that they are guests with pedestrians having a clear priority. Moreover, as a dead-end the street becomes clearly restricted for cars. This makes the street permitting and/or perhaps inviting for social activities supporting the inhabitants and thereby securing a qualitative atmosphere.

Shop options in the plinth allows inhouse income generation and socially activates the street. The Dutch farmer doors in the plinth could be either way used as closed façade of a bedroom or as counter of a shop. The security steel bars secures a safe living environment within the apartments on the ground floor but could fully opened, also function to display merchandise. Besides, the protruding load-bearing walls creates extra space in front of the shops enabling the shop owners to have extra space to sell and show their products.

The following pages gives an atmosphere of the bricked façade. Moreover, it shows the state of the building right after construction and its possible transformation in five years. The protruding loadbearing walls gets utilised by shop owners and inhabitants. Besides, inhabitants of a 3-bedroom apartment (top right corner of the façade) decided that the loggia should made its way, in order to expanded their living room.

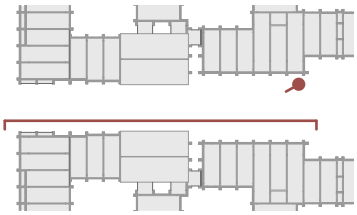


Figure 11.15
Atmospheric impression street side

Figure 11.16
Elevation street side
1:200

Figure 11.17
Elevation streetside right after delivery
1:100

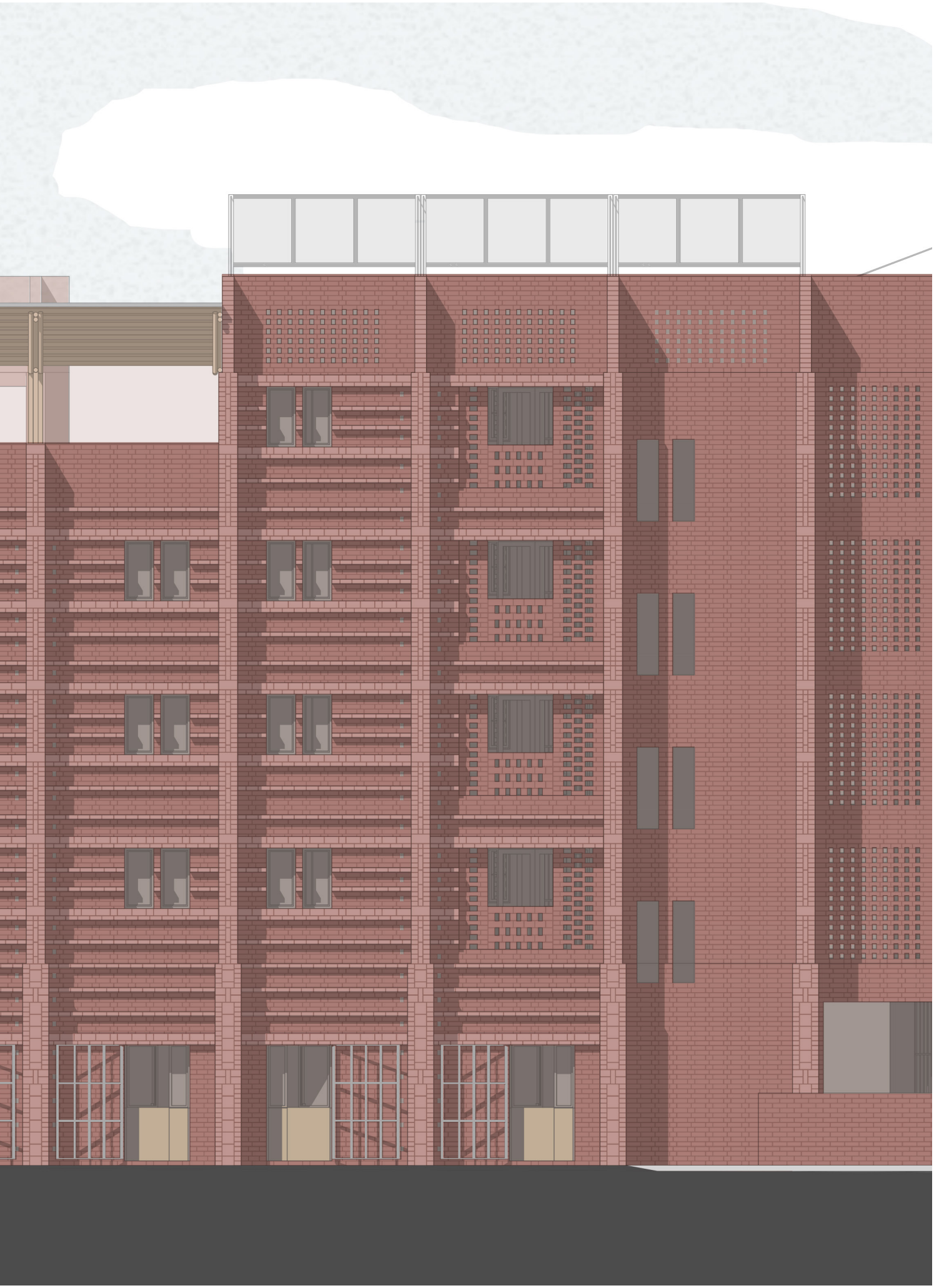


Figure 11.18
Elevation streetside
5 years after delivery
1:100

In the middle of the street the public space expands, giving extra space for street-bound activities such as a small market or a terrace/gathering space. Besides, this also creates space to park cars and it prevents a narrow tunnel effect throughout the street.

As can be seen in the drawing below, natural light will always reach the street (in the periods around noon) due to the high sun in Addis Ababa.

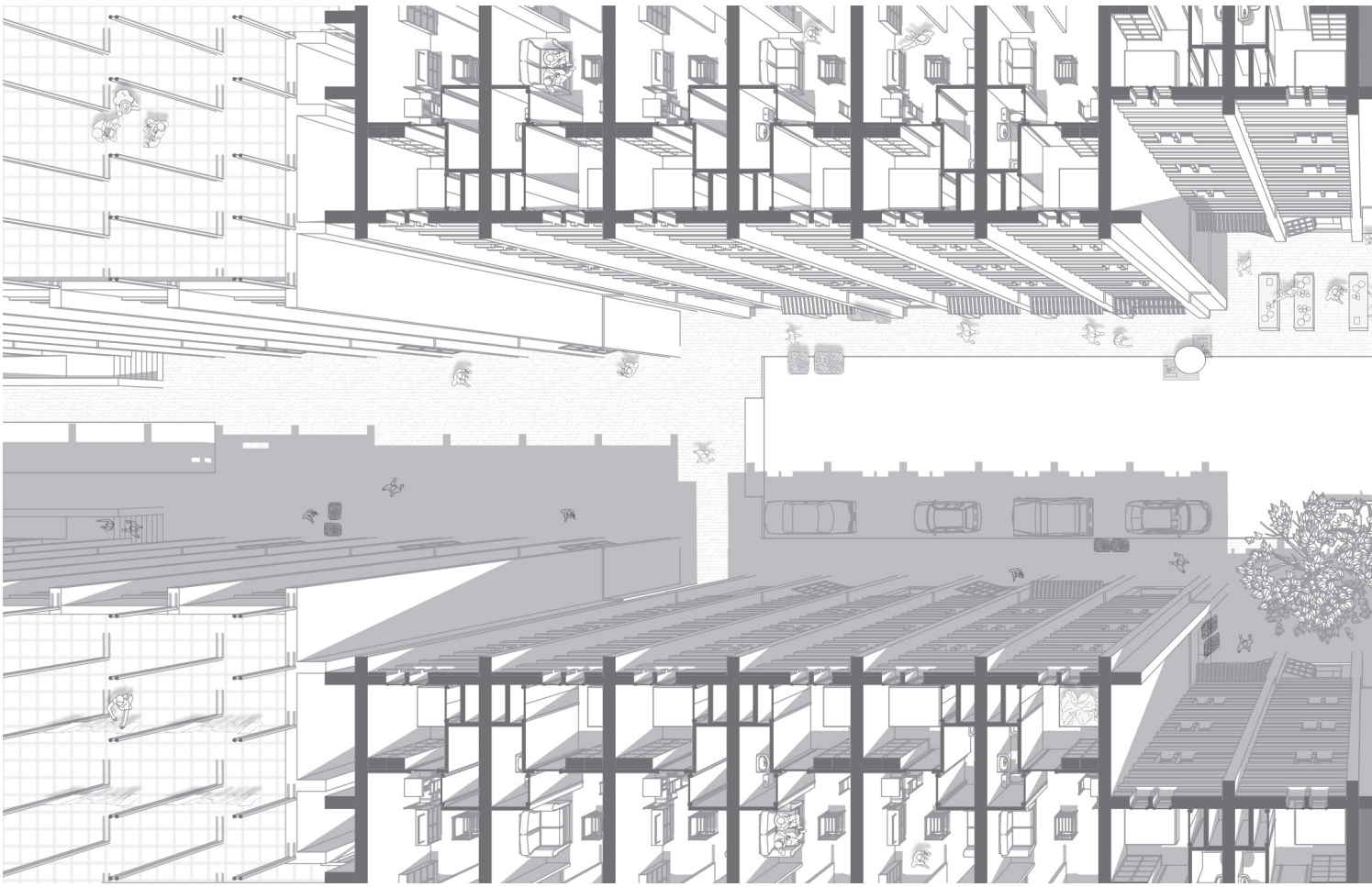
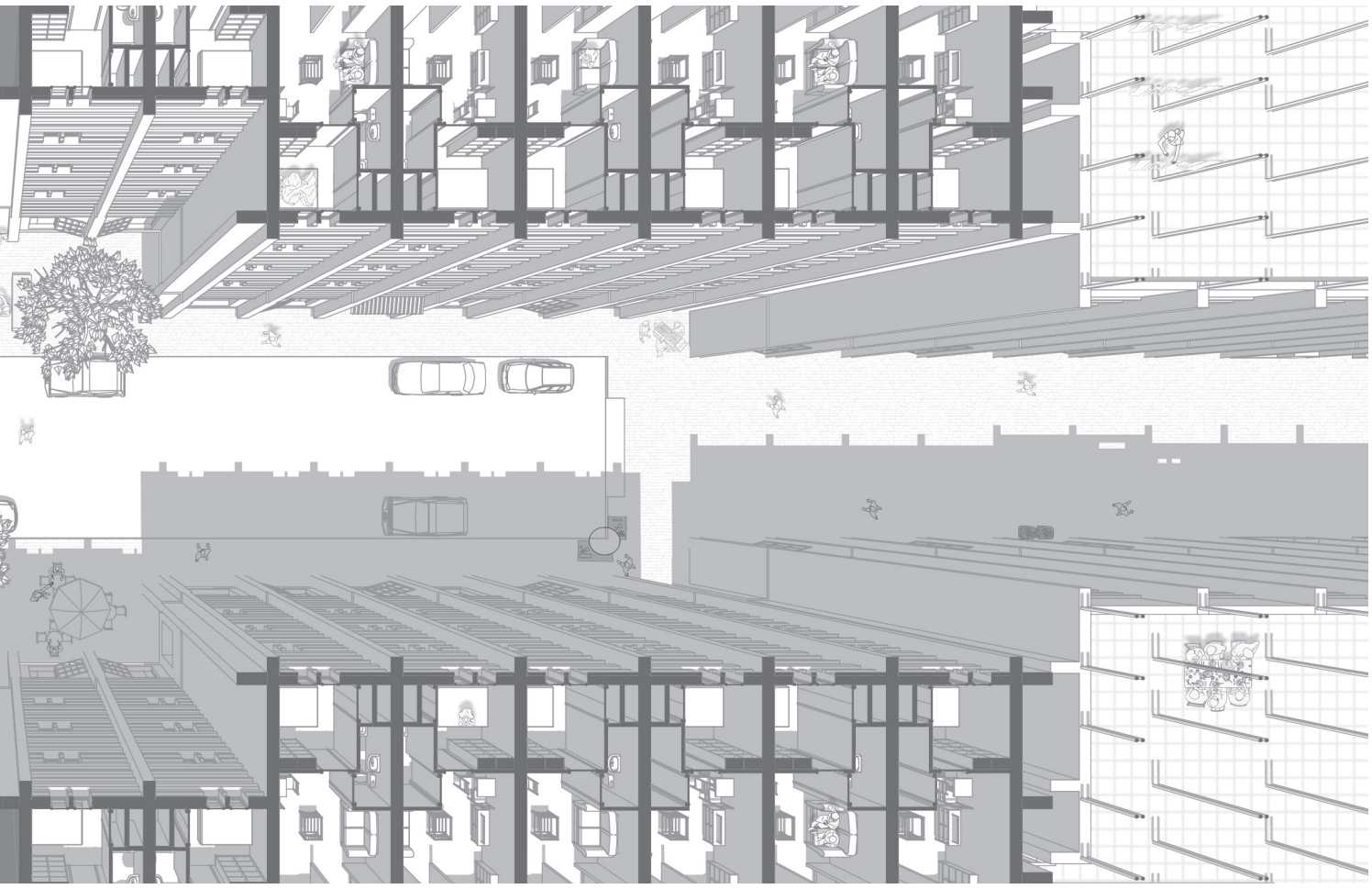


Figure 11.19
Plan perspective street side



Inner courtyard

The inner courtyard is a place for the inhabitants of the surrounding dwelling units. The relatively narrow entrances secures the semi-private atmosphere of this shared outdoor space. It houses a tree, water pump and it is slightly lowered relative to the gallery, creating secondary seating's in the form of stairs along the edges. The tree is planted in an elevated planter serving as a piece of shaded furniture. The water pump is connected with the underground water storage and forms a supportive household amenity (a place to wash clothes or bigger artefacts).

The communal multifunctional spaces are facing both neighbouring inner courtyards allowing maximum floor area for special occasions such as a wedding or a funeral. Moreover, in this way these communal spaces belong even more to everyone and they become more functional.

All these (minor) design strategies makes the inner courtyard a functional space for the inhabitants and keeps it from becoming a floating anonymous space.

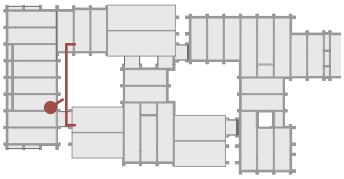


Figure 11.20
Section perspective inner courtyard

Figure 11.21
Atmospheric impression inner courtyard

The section perspective on the previous page and the elevation on the right illustrates how the design strategies functions when the building is in use. Besides, it becomes prevalent that all the galleries are facing the inner courtyard making it more socially activated and allowing extra social control.

The inner courtyard is paved with grass concrete pavers allowing water infiltration as much as possible but also securing a walk crossing the inner courtyard without going through muddy puddles during rainy season.

The bridges connecting the structural independent units and the roof structure are made of bamboo. The differentiating materialization (relative to the CSEB) prevents the apartment blocks becoming a megastructures.

Because of the high position of the sun in Addis Ababa the inner courtyard will always be sunny around noon (as shown in the section perspective). The tree will therefore, secure extra shaded gathering spaces throughout the day.

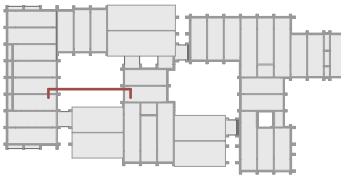


Figure 11.22
Elevation inner courtyard
1:100

The gallery together with the bamboo bridges allow efficient and diverse routing options throughout the dwelling blocks. The plan perspective clearly illustrates how the gallery widens in front of the apartments creating space for informal activities such as washing clothes and traditional cooking. The elevated floors at the 'coves' of the gallery makes it a semi private space for the adjacent apartment and simultaneously serves a piece of (vandal-proof) furniture.

The windows and doors facing the gallery all have steel security bars to secure safety for the inhabitants. These can all be open or closed by sliding or folding.

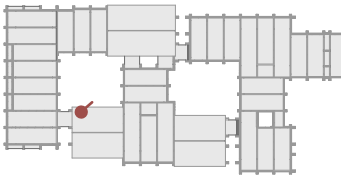
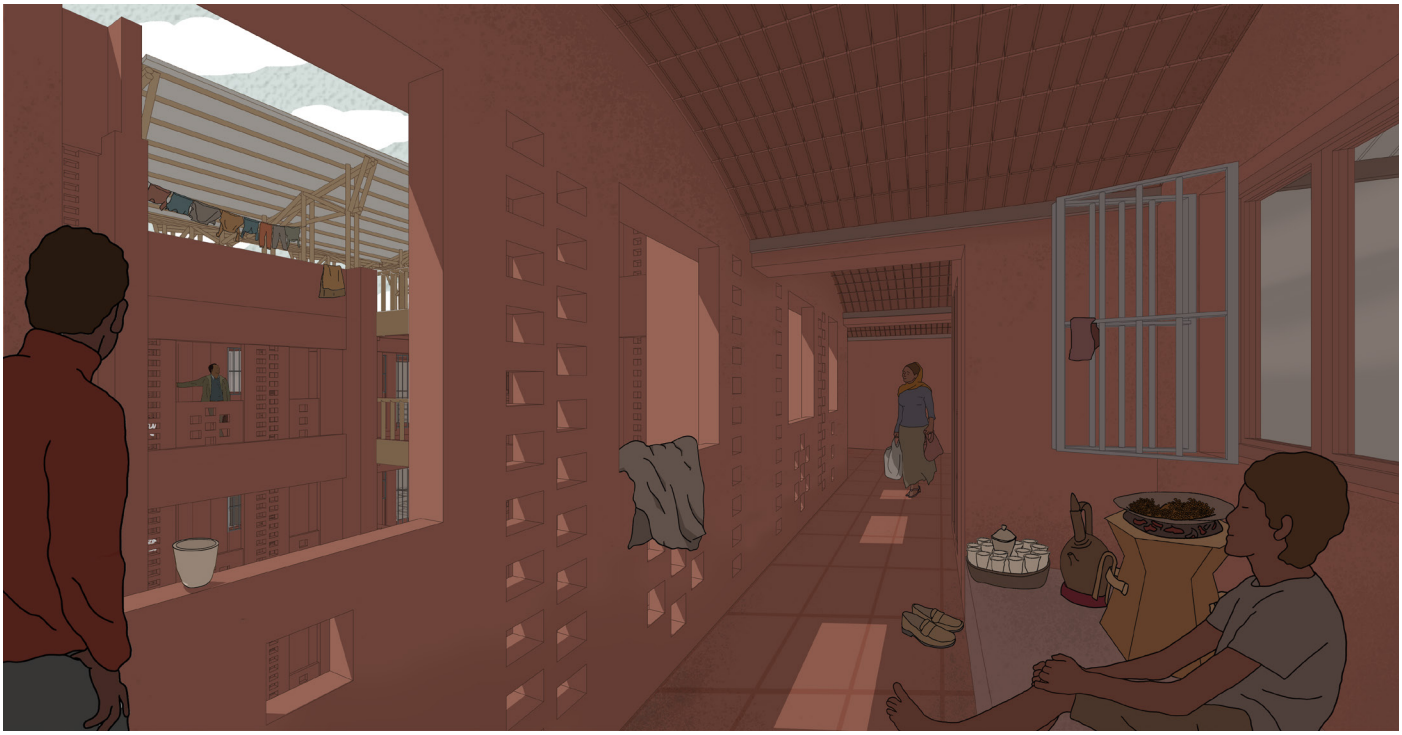
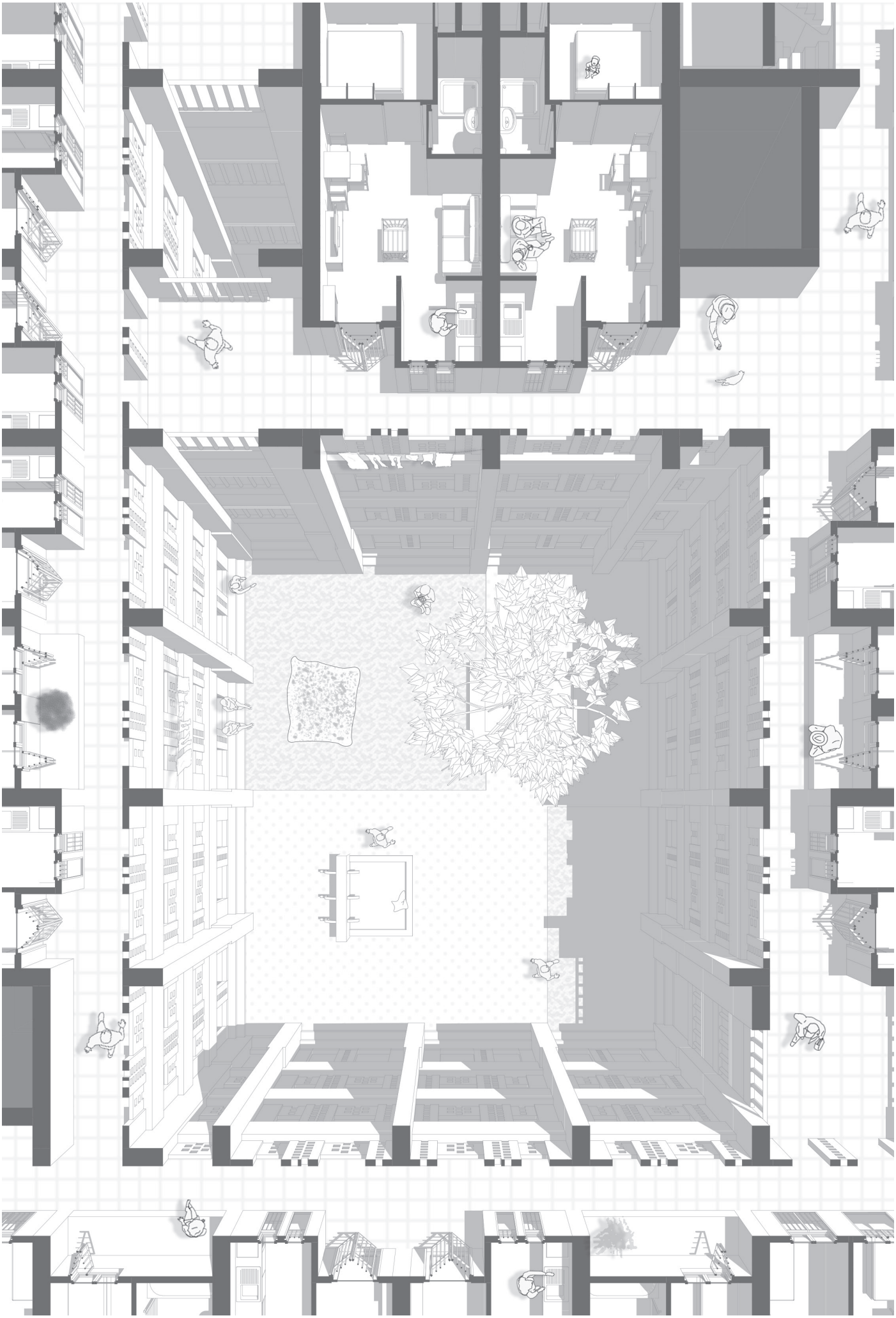


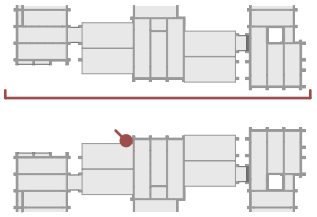
Figure 11.23
Plan perspective gallery

Figure 11.24
Atmospheric impression gallery





Green wedge



The urban block allows the green wedge to become wider and smaller. The withdrawing of the façade in this way creates, enough space for the bioswale, walking paths, greenery, agricultural and recreational areas. The bioswale is centre line of the green wedge, which is on both sides flanked with walking paths and greenery. Excluding the major access routes, these walkways will initially consist of gravel. However, inhouse shop owners facing the green wedge on the ground floor, could consider the use of grass concrete pavers in front of their inhouse-shop to prevent the emergence of muddy puddles during rainy season. This could be arranged in consultation with the Iddir committee.

In elevation it becomes prevalent how the high income apartments on the side of the urban wetland have window openings in the loadbearing walls. Besides, the buttresses are used to hang balconies in between.

Figure 11.26
Elevation green wedge
1:200

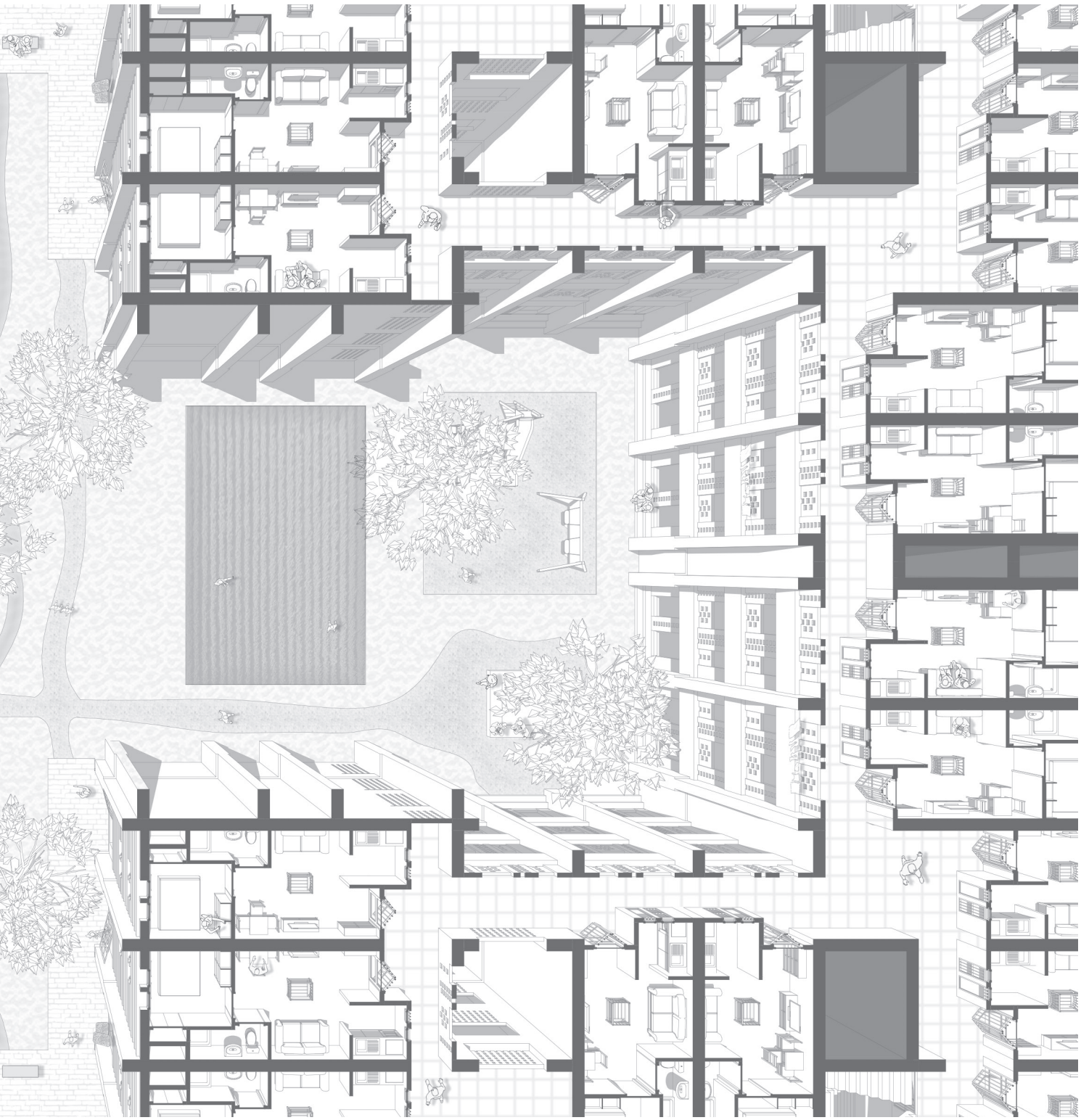
In rainy season the bioswale will be saturated with water and will split the green wedge in two. Therefore, the paths on both sides are regularly connected, in order to cross the bioswale. However, in dry season it will completely dry up with which this barrier will disappear. The differentiation between wet and dry season can be seen in the following pages.

At the core of the green wedge a courtyard is created (See image 11.28). These courtyards are socially controlled by the surrounding apartments. It thus creates an ideal space where children could play and communal activities such as communal gardening can take place. In this way it forms also a connection between the two building blocks situated on both sides of the green wedge.

Figure 11.26
Green wedge and urban wetland during rainy season.

Figure 11.27
Green wedge and urban wetland during dry season.

Figure 11.28
Couryard greenwedge serving communal activities for low income households.



Urban wetland

The dwellings on the side of the urban wetland are facing the river as much as possible. On the ground floor it consist of 1-bedroom apartments with a shop option for the low income households. On the upper floors the apartments sold on the commercial market are situated. The high income households have floor to ceiling windows and have spacious loggias and balconies. On both corners the 3-bedroom apartments are located and in the core the two 2-bedroom apartments with a generous amount of outdoor space. The higher income households are able to park their car in front of their apartment. These parking lots are integrated in the wide pavement in front of the shops by grass concrete pavers. This makes a gradual transition from greenery towards street and the wide pavement allows the inhouse shops and flexible commerce to have a terrace or market. This makes the edge of the urban wetland, along the plinth of the dwelling blocks, socially activated. Together with the food forests, the agricultural and recreational areas the urban wetland becomes a place where the people can participate in.

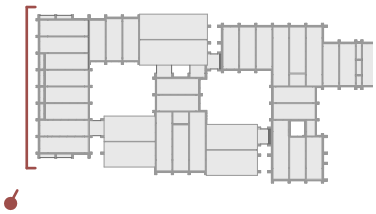


Figure 11.29
Elevation urban wetland
1:200

Figure 11.30
Elevation urban wetland
1:100

Figure 11.31
Atmospheric impression from the urban wetland

12 The urban dwelling block

Introduction

This part of the urban plan is more active on a city level and aims to connect the urbanity with the urban wetland. This transitional block is characterized with on the eastern side a seven stories high apartment block consisting of two stories of commercial units along the primary road, an underground story connected with the parking garage and dwelling units sold on the commercial market on the upper floors. The western side of this area consist of a low cost housing block connected with the side road, following the same spatial principles as the dwelling block discussed before. In between these blocks an elevated square is situated forming together the urban dwelling block. Just as in the previous chapters there will be first an elaboration on the plans after which the main streets side, the inner square, the parking garage and the side street will be explained.

Amount of apartments
1-Bedroom 30
2-Bedroom 10
3-Bedroom 8
2-Bedroom com. 8
3-Bedroom com. 8
Total 64

Amount of shops
Shops 10-22

Amenities
Parking spaces 32
Storage facilities 33
Toiletblocks 2
Inner courtyard
Communal spaces

Figure 12.1
Focus are of urban plan

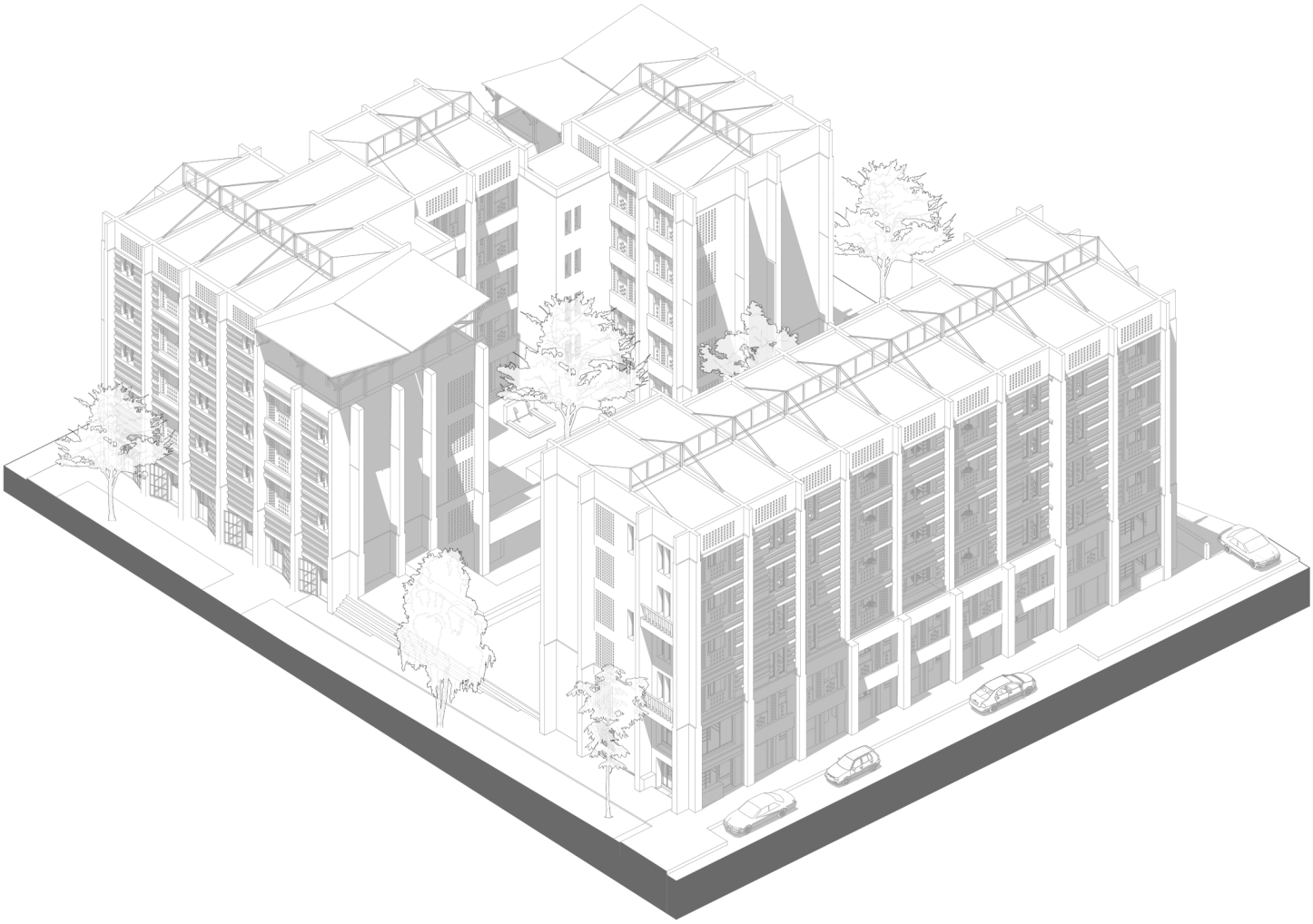


Figure 12.2
Axonometric view of focus area

Plan basement
Level -1

The basement of the eastern dwelling block is connected with the underground parking lot. These parking spaces are meant to ensure the possibility for the high class house owners to be able to park their car secure.
Moreover, in the basement there are storage facilities for the house and shop owners. The two toilet blocks are meant for the shop owners and possibly their customers.
At the delivery an elevator will be installed enabling houseowners to go by elevator from basement to their living floor. At all public floors the elevator will only be accessible by home and shop owners.
On both ends of the building a stair is located.

Amenities
Parking spaces 32
Storage facilities 33
Toiletblocks 2

Figure 12.3
Plan basement and parking garage

0 4 8 16 m

These will probably only used as fire escapes by the residents. However, the stairs connecting the basement, ground and first floor are publicly accessible in order to connect the shops on the first floor with the ground floor and the toilets. In order to keep the area for the inhabitants safe and separate from the public zones steel security bars/doors are installed and located on tactical positions.

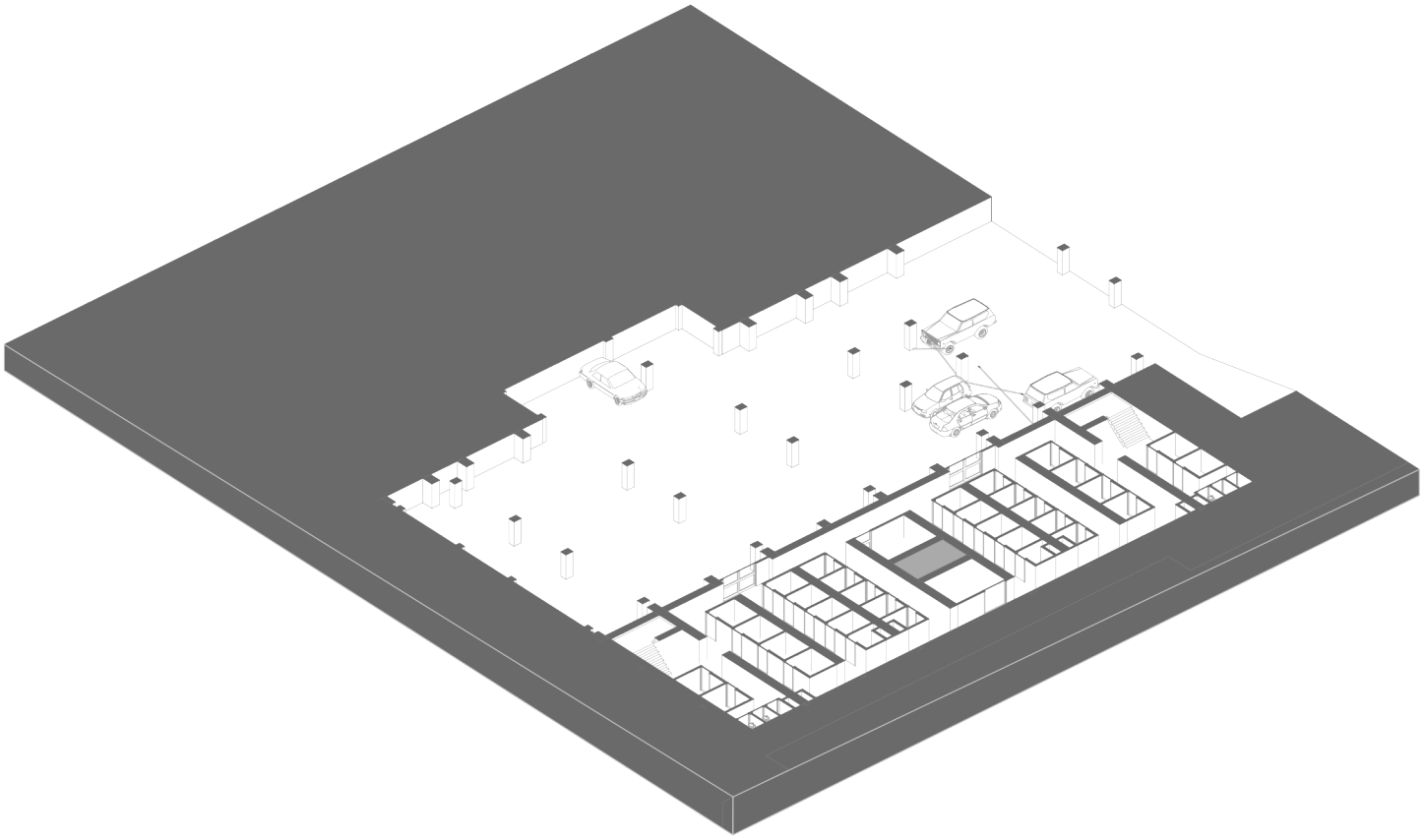


Figure 12.4
Axonometric plan basement and parking garage

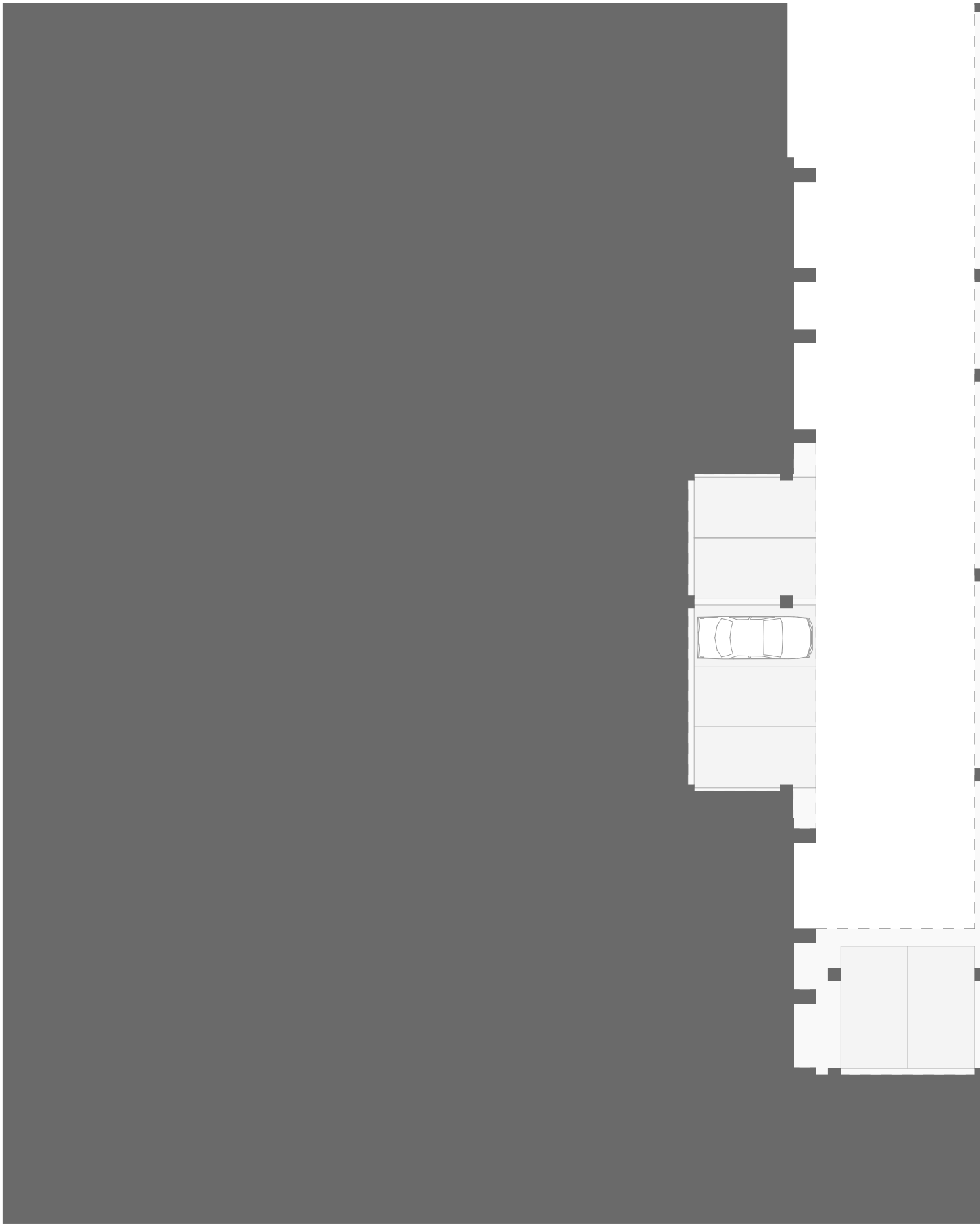


Figure 12.5
Plan Parking garage Level -1
1:200

Plan ground floor
Level 0

The eastern building block consist solely of shops and commercial activity on the ground floor. For flexibility purposes cut-outs in the loadbearing walls are located in such a way that shops can merge and thereby increase in floor area. The inner square is connected with he shops in the plinth and thereby extends the possibilities for commercial activity and terraces and gives space for flexible commerce. The entrances towards the stairs can be closed off by steel security bar doors when the shops on the upper floors are closed. It prevents that unwanted people could enter the first floor or basement in the evening and night.

Amount of apartments
1-Bedroom 8
2-Bedroom 2
3-Bedroom 0
2-Bedroom com. 0
3-Bedroom com. 0
Total 10

Amount of shops
Shops 5-11

Amenities
Communal space
Inner courtyard

Figure 12.6
Plan ground floor

The western building block has a communal multifunctional space connected with a ‘dead-end square’ (on the top left corner). This makes the dead-end square a place which interlocks the two neighbouring low-cost housing blocks and creates a safe space for children to play or for communal activities to take place. The inner courtyard keeps its private atmosphere due to the special barrier between the inner square and the inner courtyard. In general the western block is designed following the same principles discussed in the previous chapter. Therefore, in the remainder of this chapter it will be less apparent in the explanations.

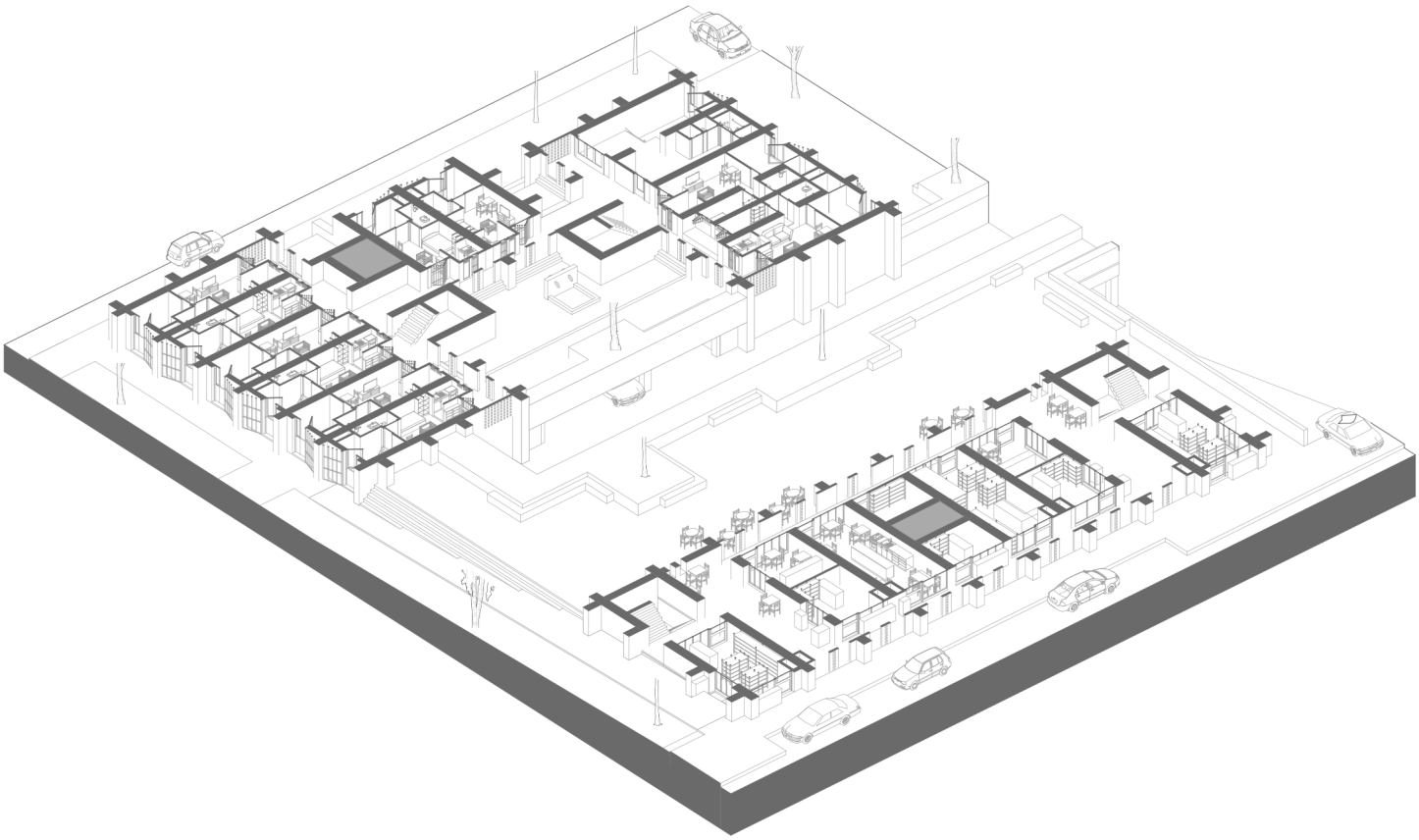


Figure 12.7
Axonometric plan ground floor

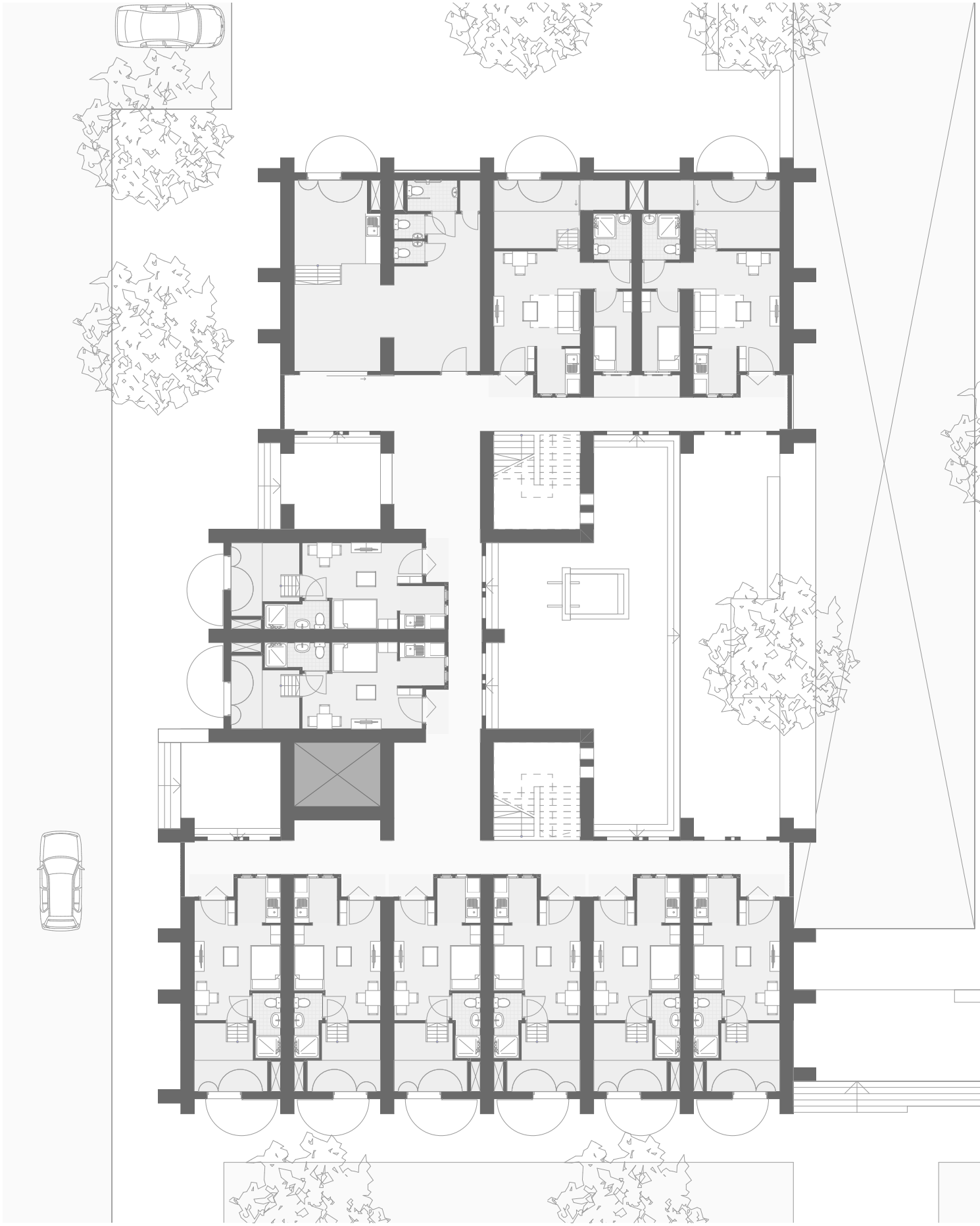
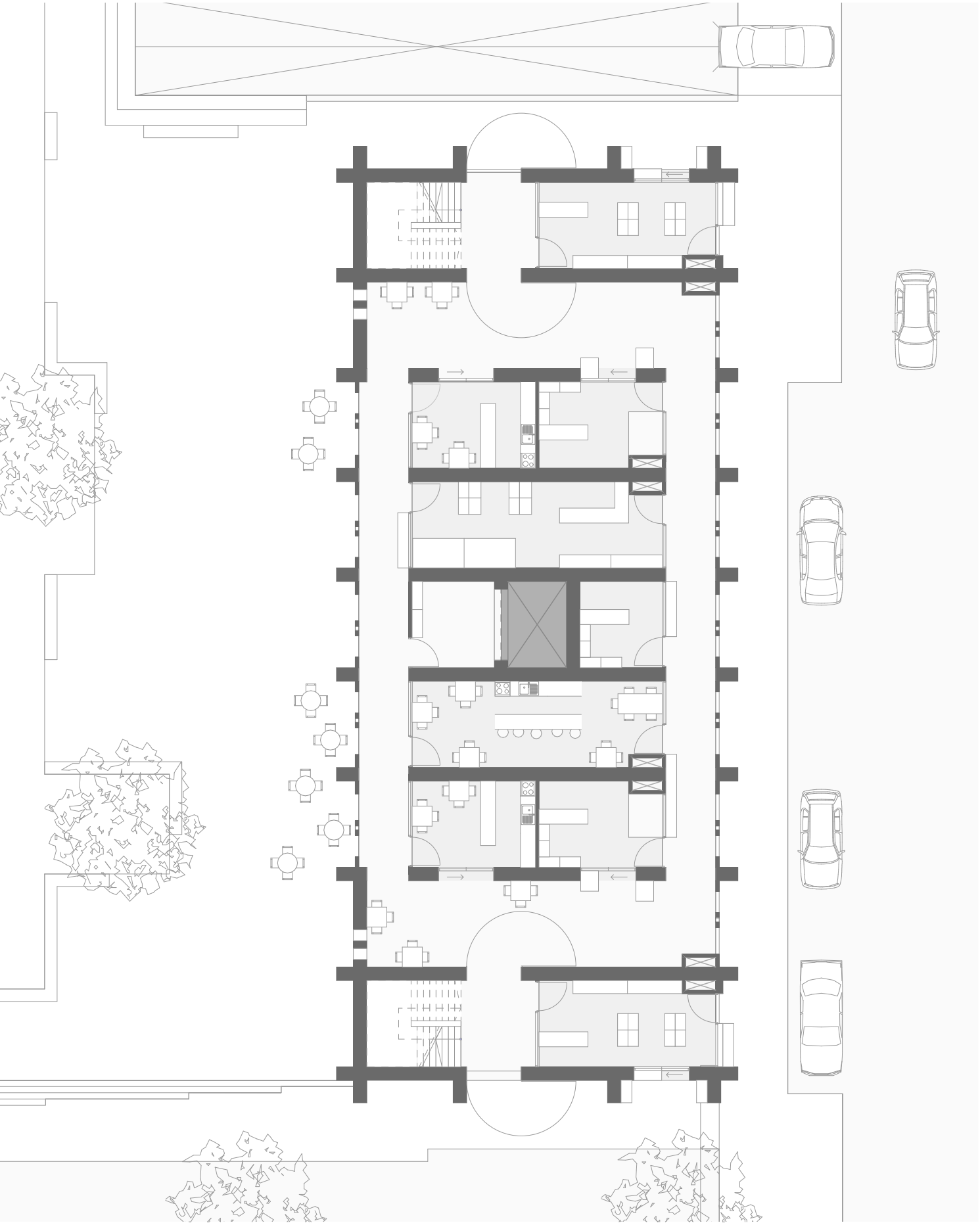


Figure 12.8
Plan ground floor level 0
1:200



Plan
Level 1

To extend the commercial opportunities along the primary road shops are also situated on the first floor at the eastern building block. Just as on the ground floor cut-outs in the loadbearing walls are located on tactical positions for flexibility purposes. The amount of shops can therefore vary between five and eleven.

The western building bock consist solely of social housing based on ownership and social rent.

Amount of apartments
1-Bedroom 6
2-Bedroom 2
3-Bedroom 2
2-Bedroom com. 0
3-Bedroom com. 0
Total 10

Amount of shops
Shops 5-11

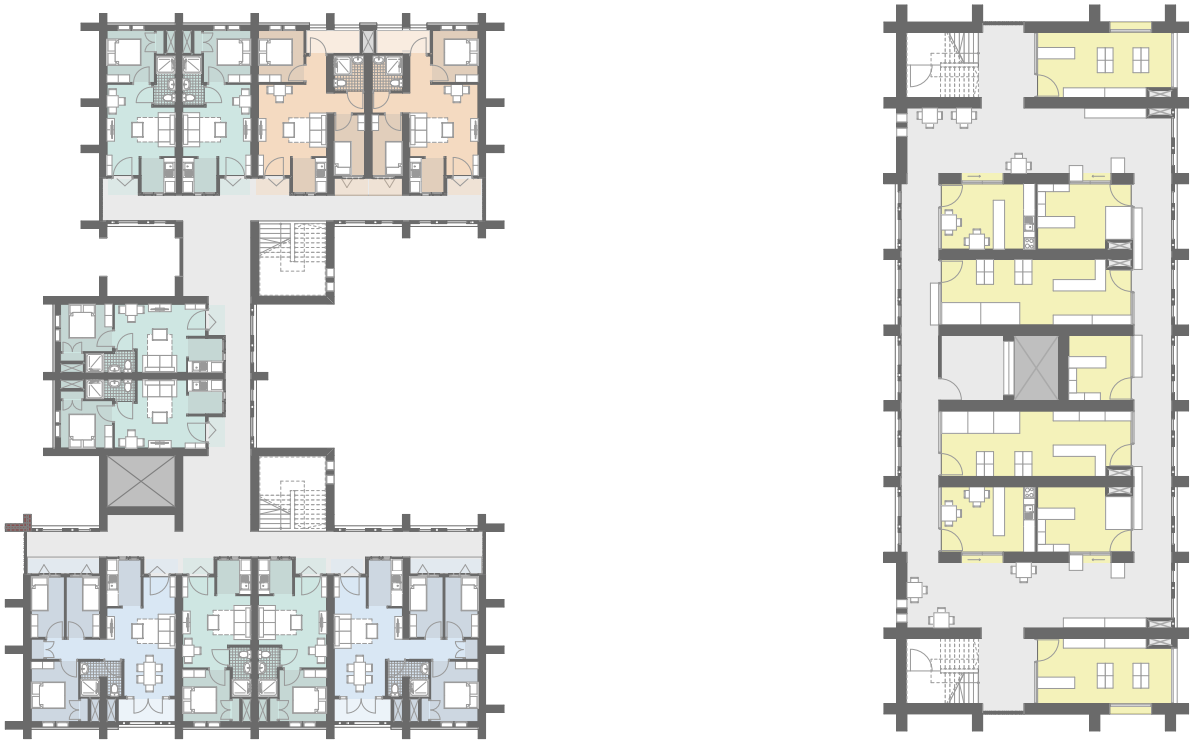


Figure 12.9
Plan level 1

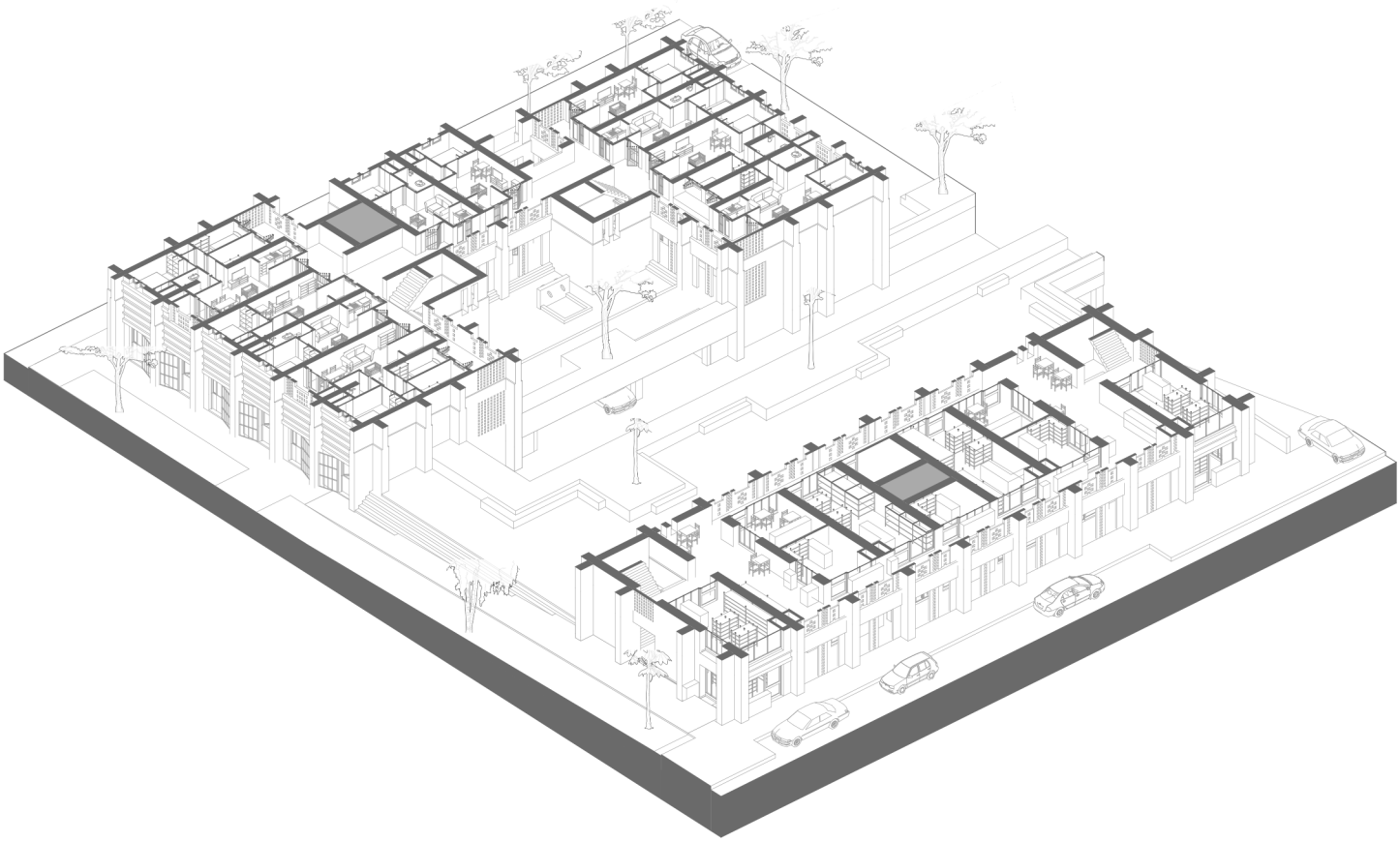
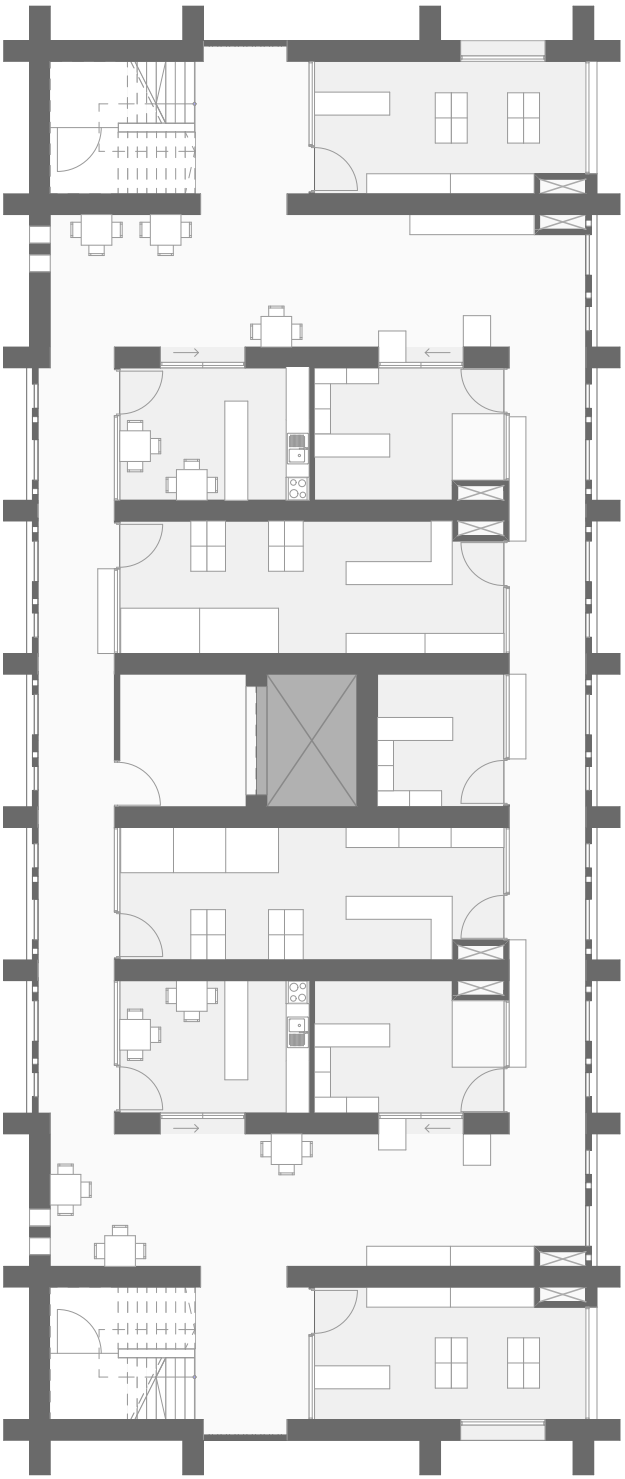


Figure 12.10
Axonometric plan level 1

Figure 12.11
Plan level 1
1:200



Plan
Level 2-3

From floor two onwards apartments, sold on the commercial market for high income households, are situated throughout the plan of the eastern building block. On both ends a 2-bedroom apartment is located and in the middle the 3-bedroom typology. Of which one has an extra room (behind the elevator).

The apartments on both ends have extra windows in the loadbearing walls and alternately per floor a balcony.

Moreover, all the apartments have an extra storage space on the gallery next to the stairs.

Amount of apartments

1-Bedroom	6
2-Bedroom	2
3-Bedroom	2
2-Bedroom com.	2
3-Bedroom com.	2
Total	14

Figure 12.12
Plan level 2-3

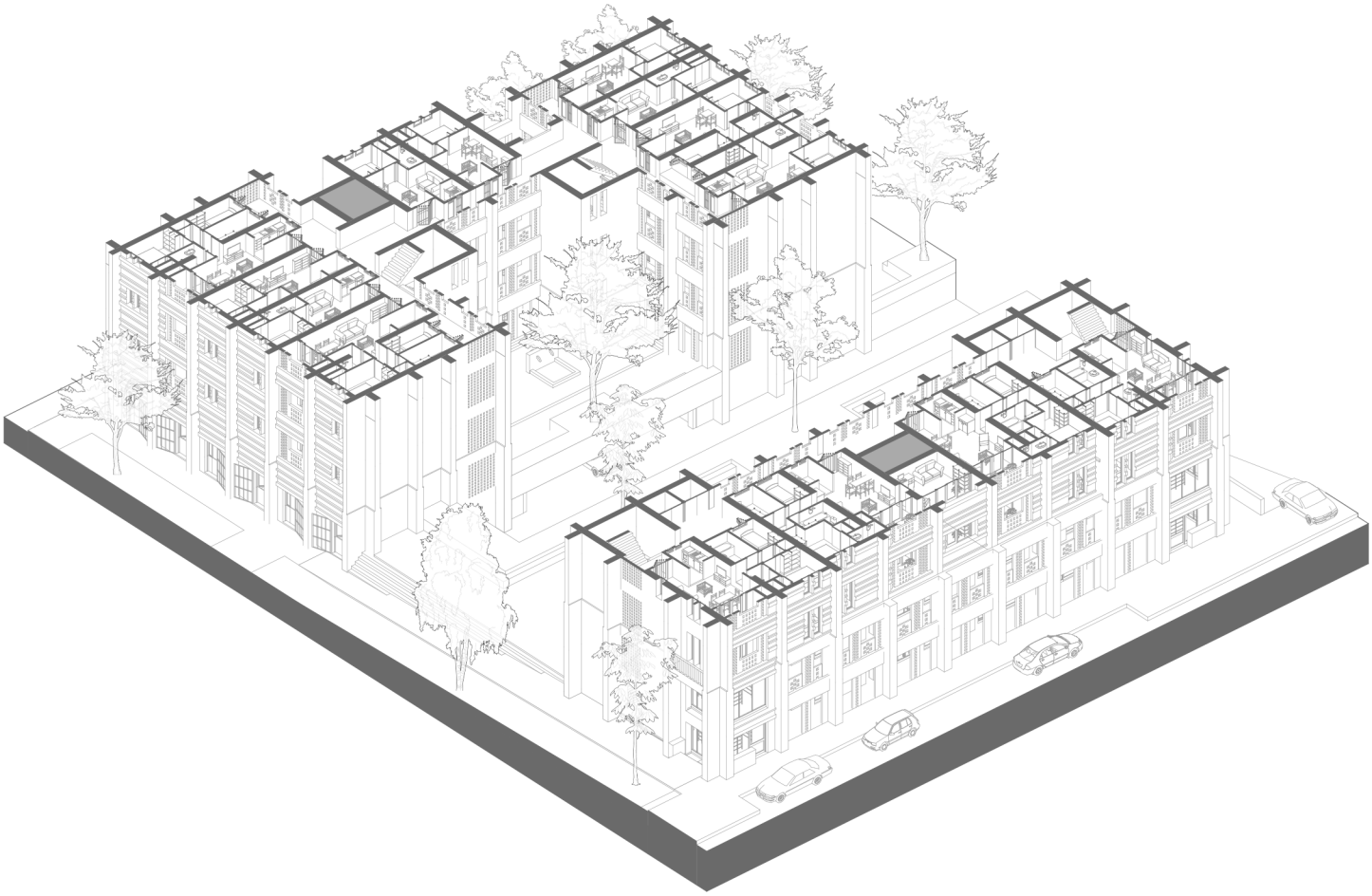
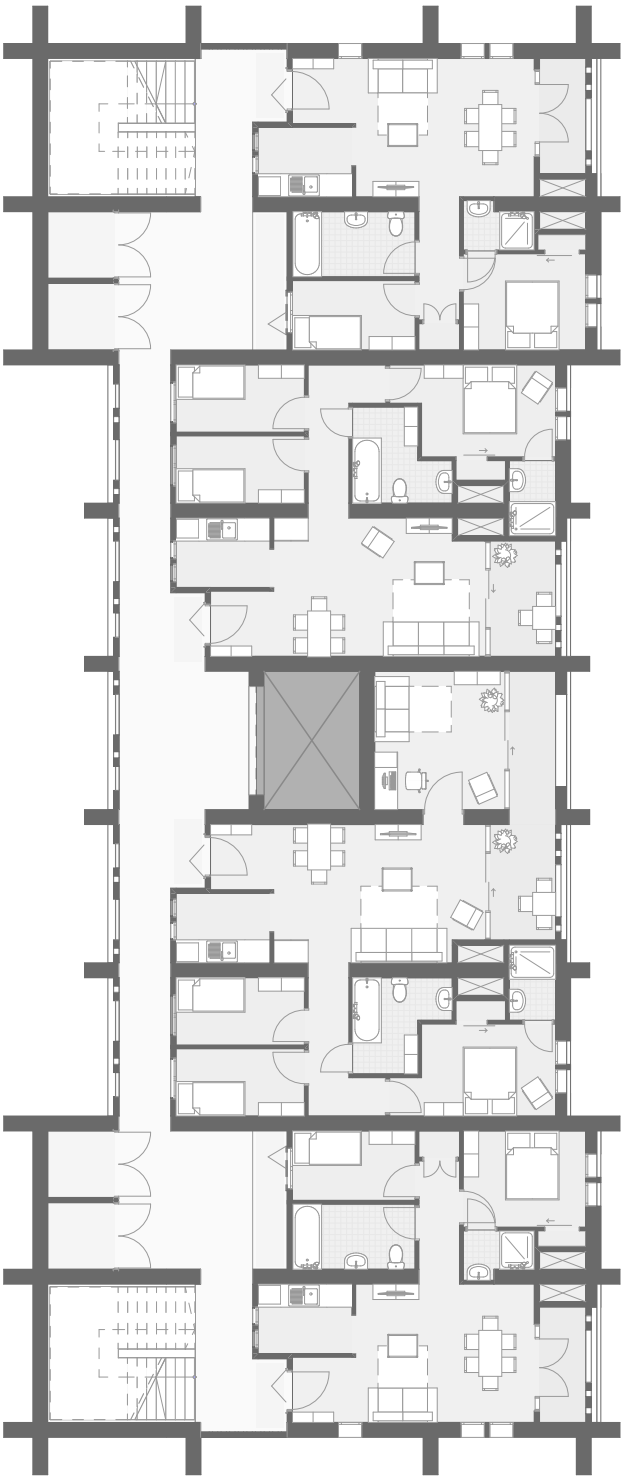


Figure 12.13
Axonometric plan level 2-3

Figure 12.14
Plan level 2
1:200

Figure 12.15
Plan level 3
1:200



Plan
Level 4

On the fourth floor rooftop spaces are located on the western building block serving household activities and social gatherings. Moreover, the bamboo roof structures of these rooftop spaces give a more diverse view on the street and green wedge.

Amount of apartments
1-Bedroom 4
2-Bedroom 2
3-Bedroom 1
2-Bedroom com. 2
3-Bedroom com. 2
Total 11

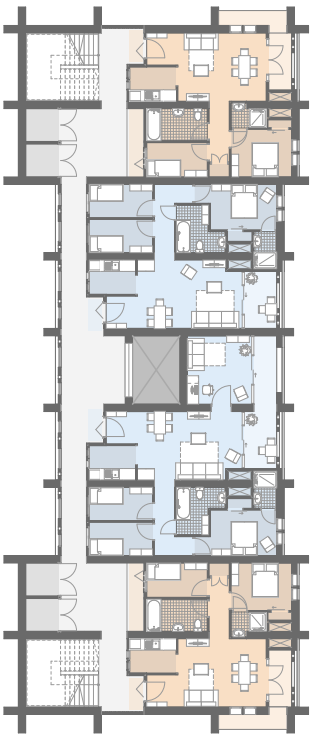


Figure 12.16
Plan level 4

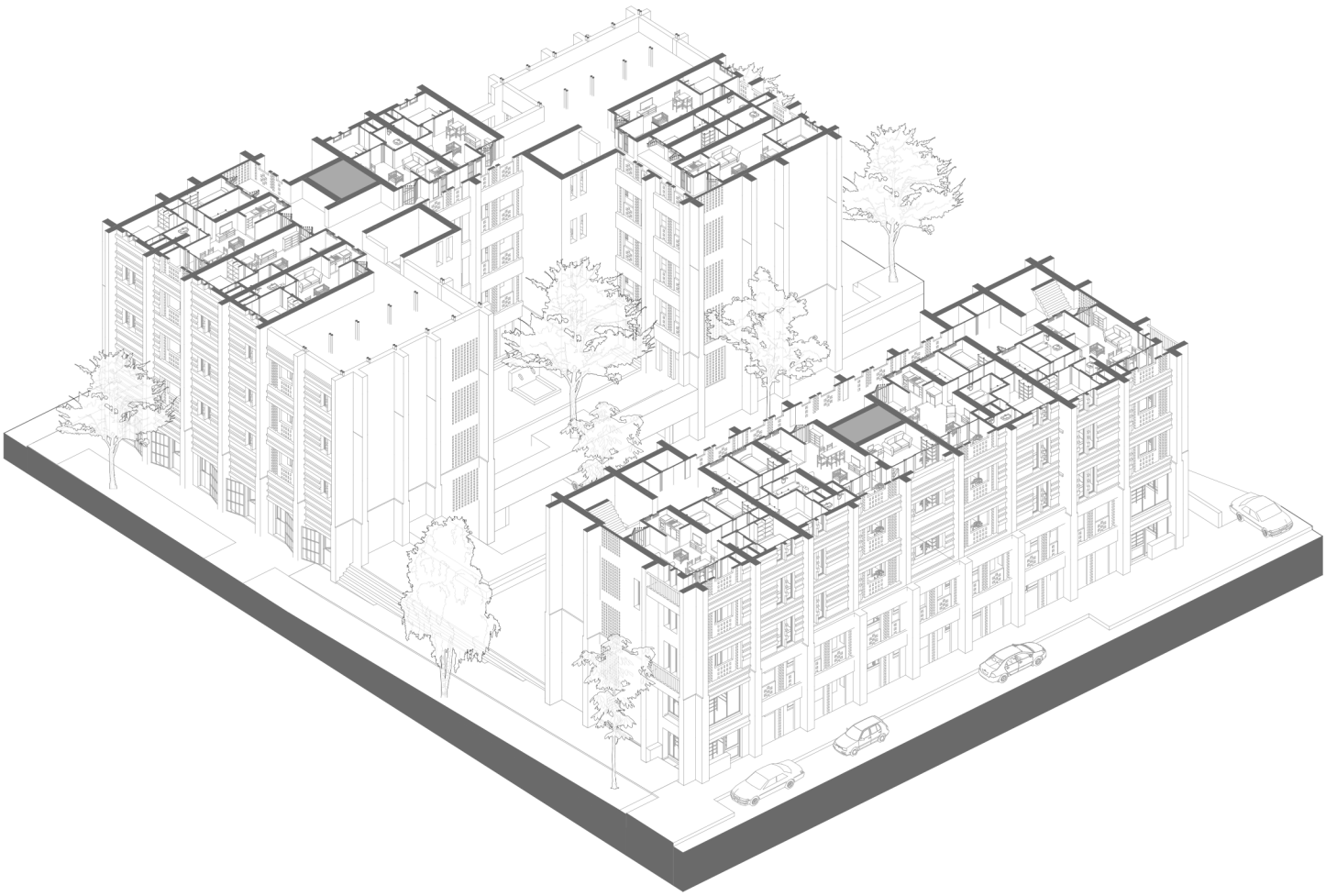
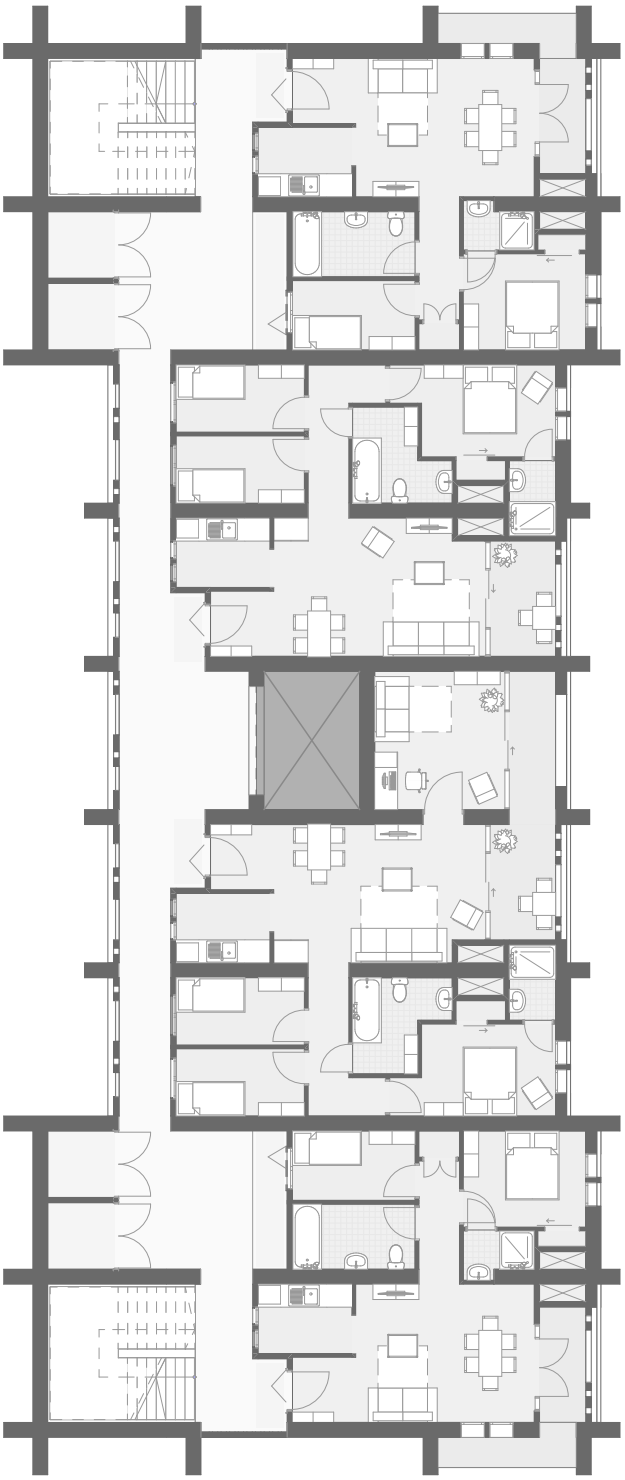


Figure 12.17
Axonometric plan level 4

Figure 12.18
Plan level 4
1:200



Plan
Level 5

The fifth floor is the top floor for the eastern building block. Due to the height of the this building an elevator will be installed directly. For routing efficiency, the elevator is located in the centre of the building.

Amount of apartments
1-Bedroom 4
2-Bedroom 2
3-Bedroom 1
2-Bedroom com. 2
3-Bedroom com. 2
Total 14

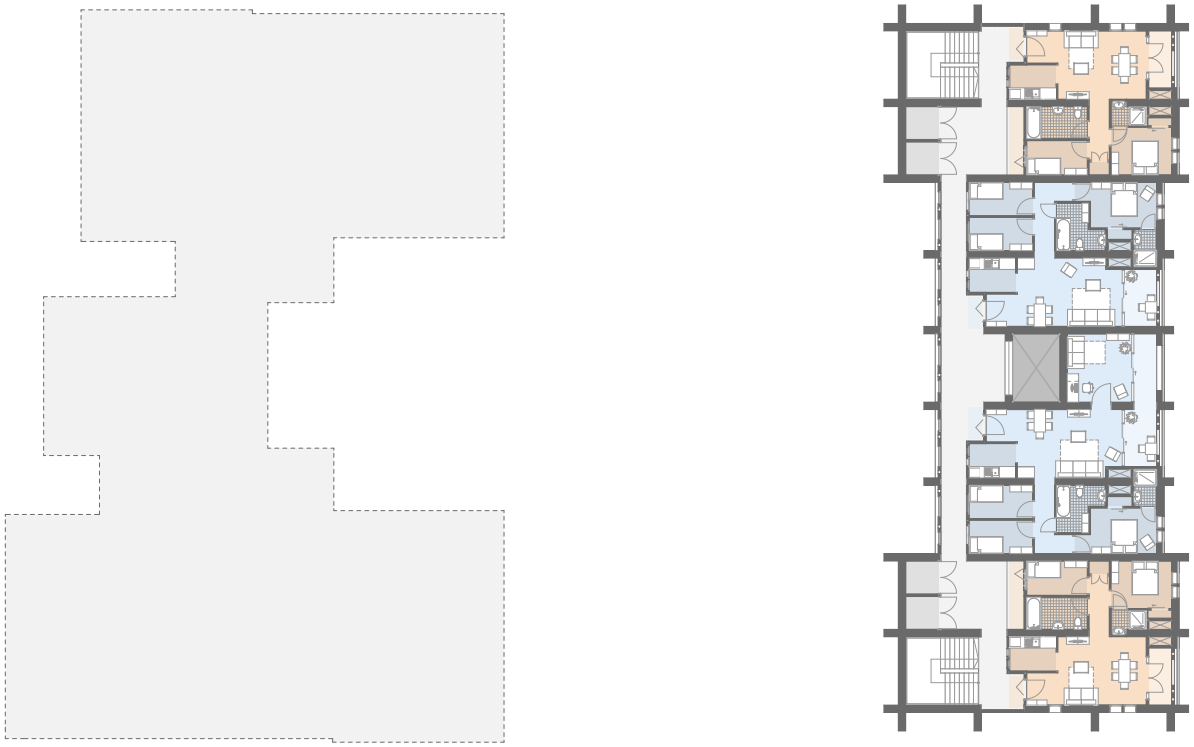


Figure 12.19
Plan level 5

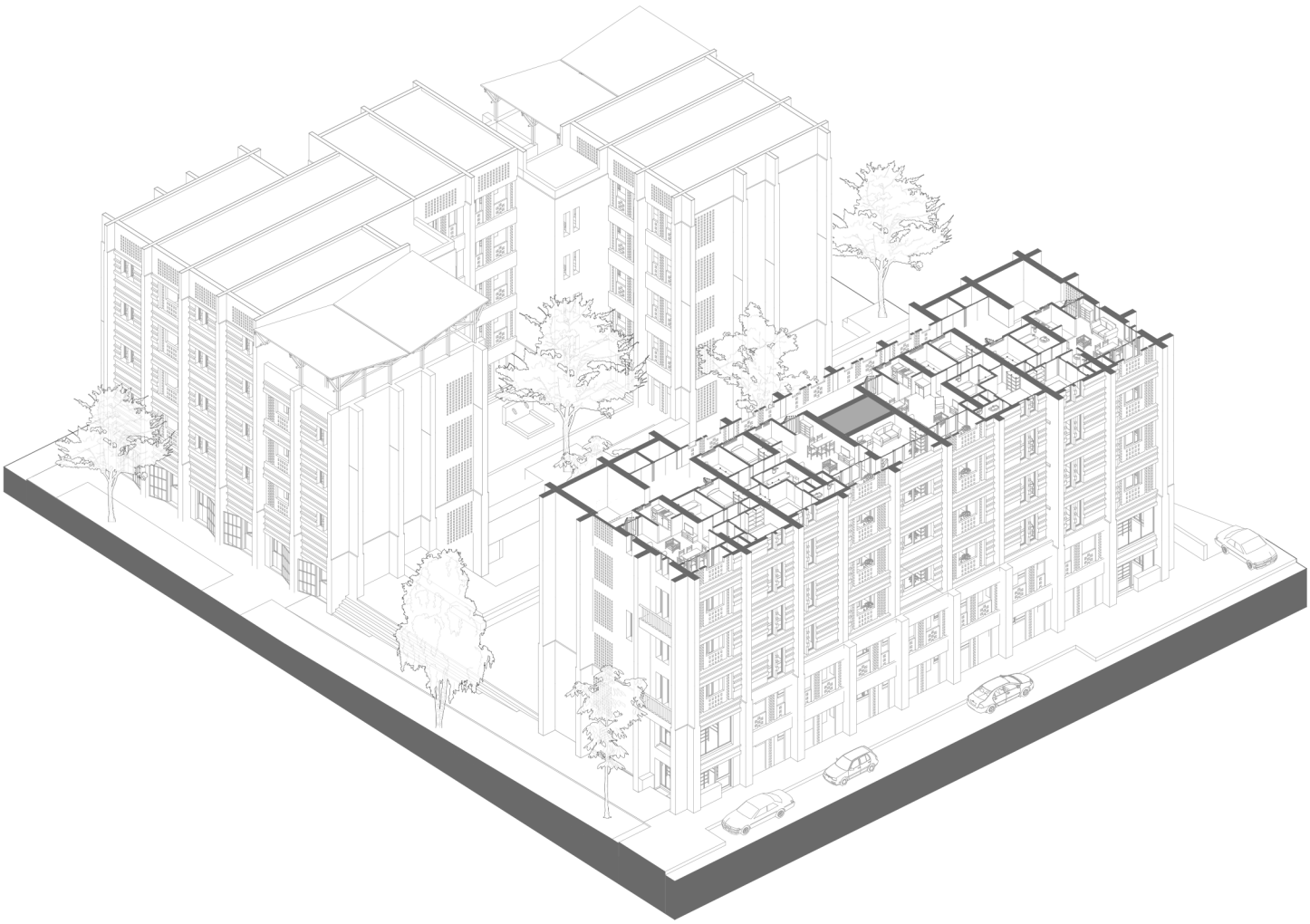


Figure 12.20
Axonometric plan level 5

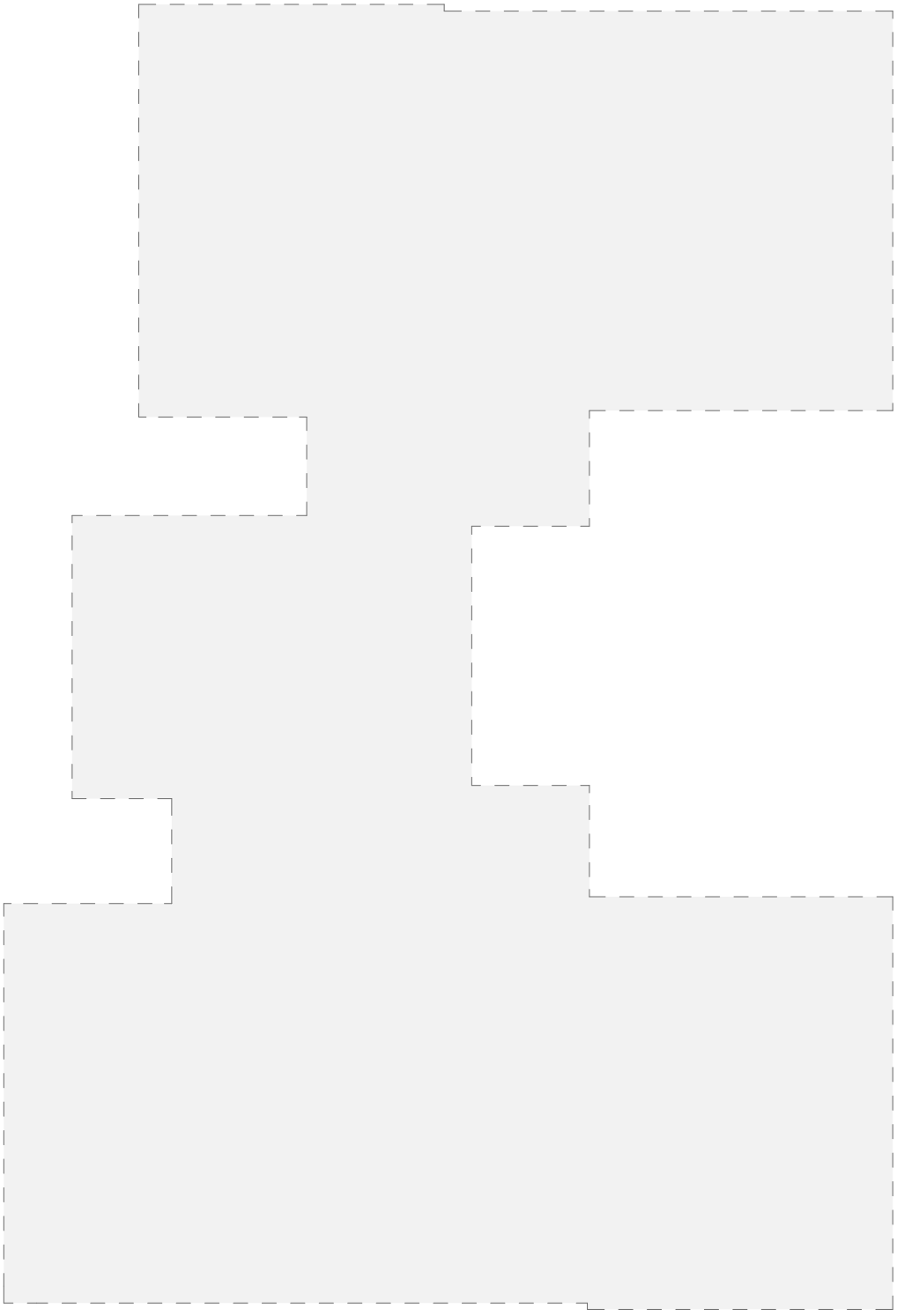
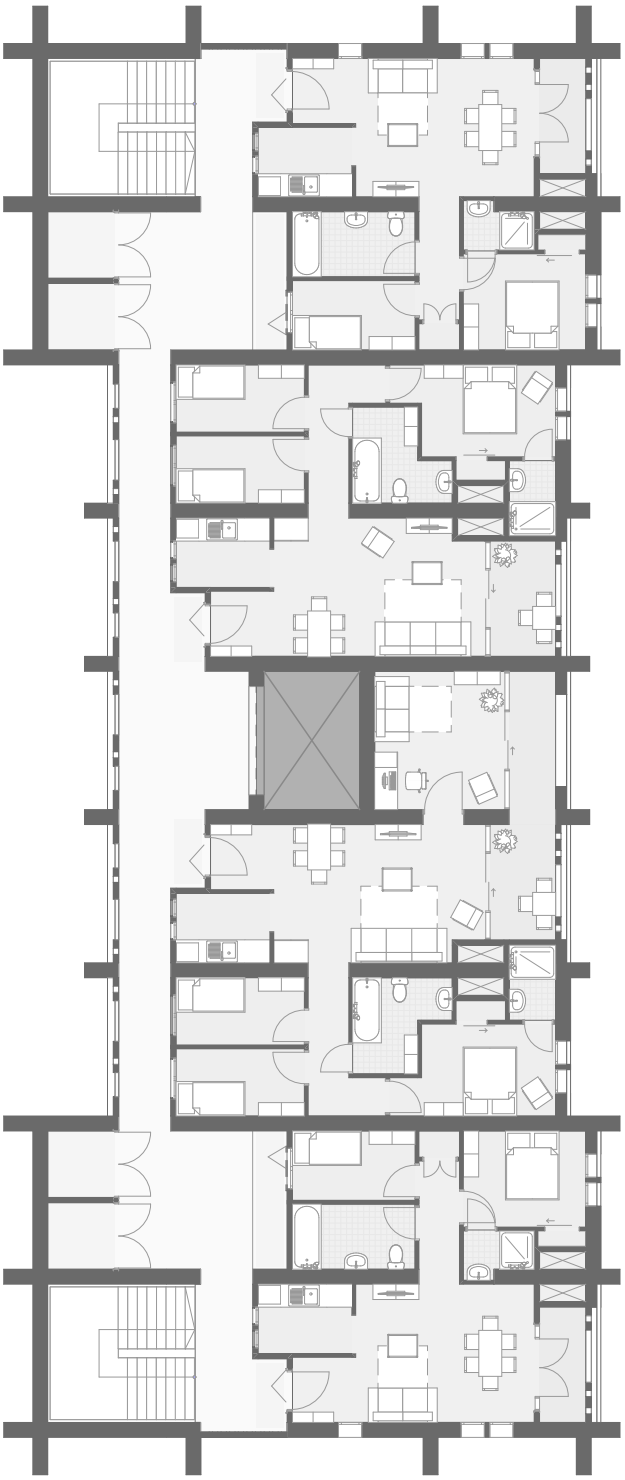


Figure 12.21
Plan level 5
1:200



Main street

At the main street the building expands the pedestrian area inside the building and creates a covered pedestrian and commercial zone in front of the shops. The protruding loadbearing walls form an extra strip for shops to sell their merchandise.

In elevation the shop floors are clearly distinguishable from the apartments. Moreover, the facades of the apartments are slightly shifted inwards to prevent a very colossal image from the main street side.

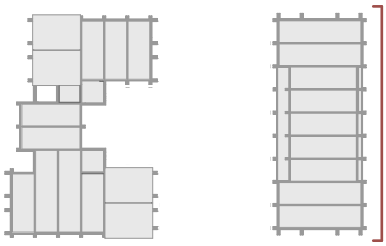


Figure 12.22
Elevation main street side
1:200

Figure 12.23
Elevation main street
1:100

Inner square

The inner square extends the possibilities for commercial activities. However, compared to the side of the primary road, the inner square has a more quiet and relaxing atmosphere, with no passing cars. Instead, it is a much greener space connected with the urban wet land by the green wedge.

The vide together with the elevated planters and its greenery creates a spatial barrier between the inner square and the inner courtyard. This secures a semi private atmosphere within the inner courtyard without the use of fences. In addition, this will allows natural light to reach the parking garage.

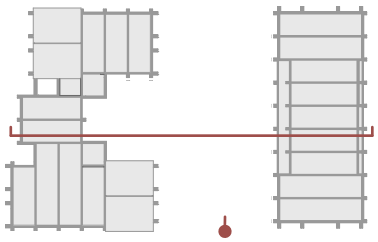
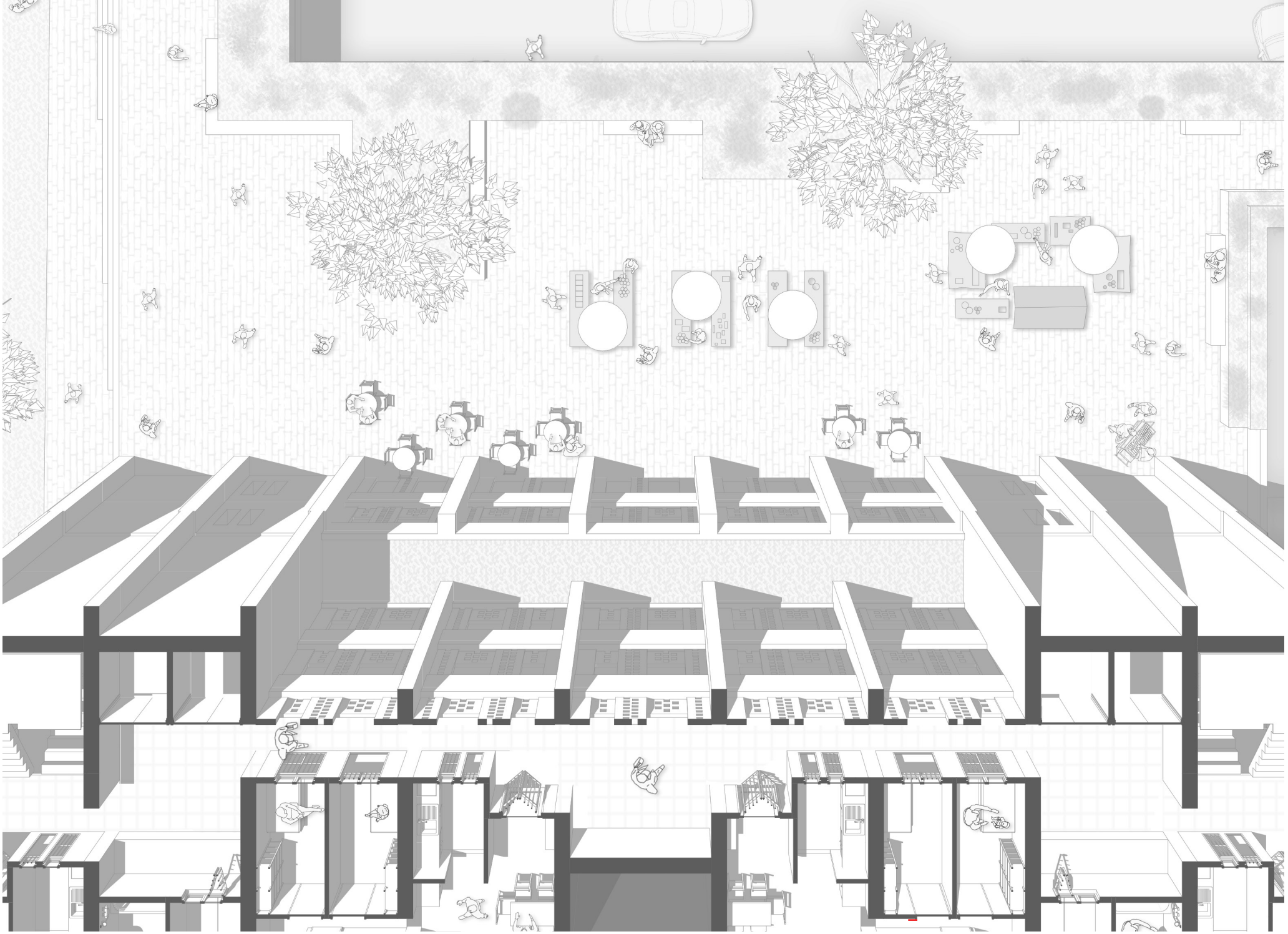


Figure 12.24
Atmospheric impression inner square

Figure 12.25
Section inner square 1:200

Figure 12.26
Plan perspective



Parking garage

The parking garage is initially only accessible for inhabitants and shop owners in the eastern dwelling block enabling a secure and assured parking space. Natural day light enters the parking garage ensuring a qualitative atmosphere. Moreover, it makes the parking garage more multifunctional. If there is no need for car parking this space could be used as a covered market for example.

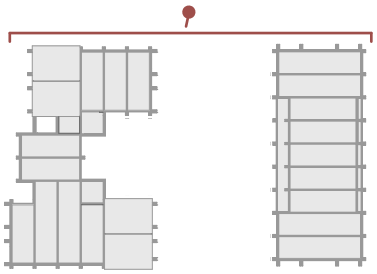
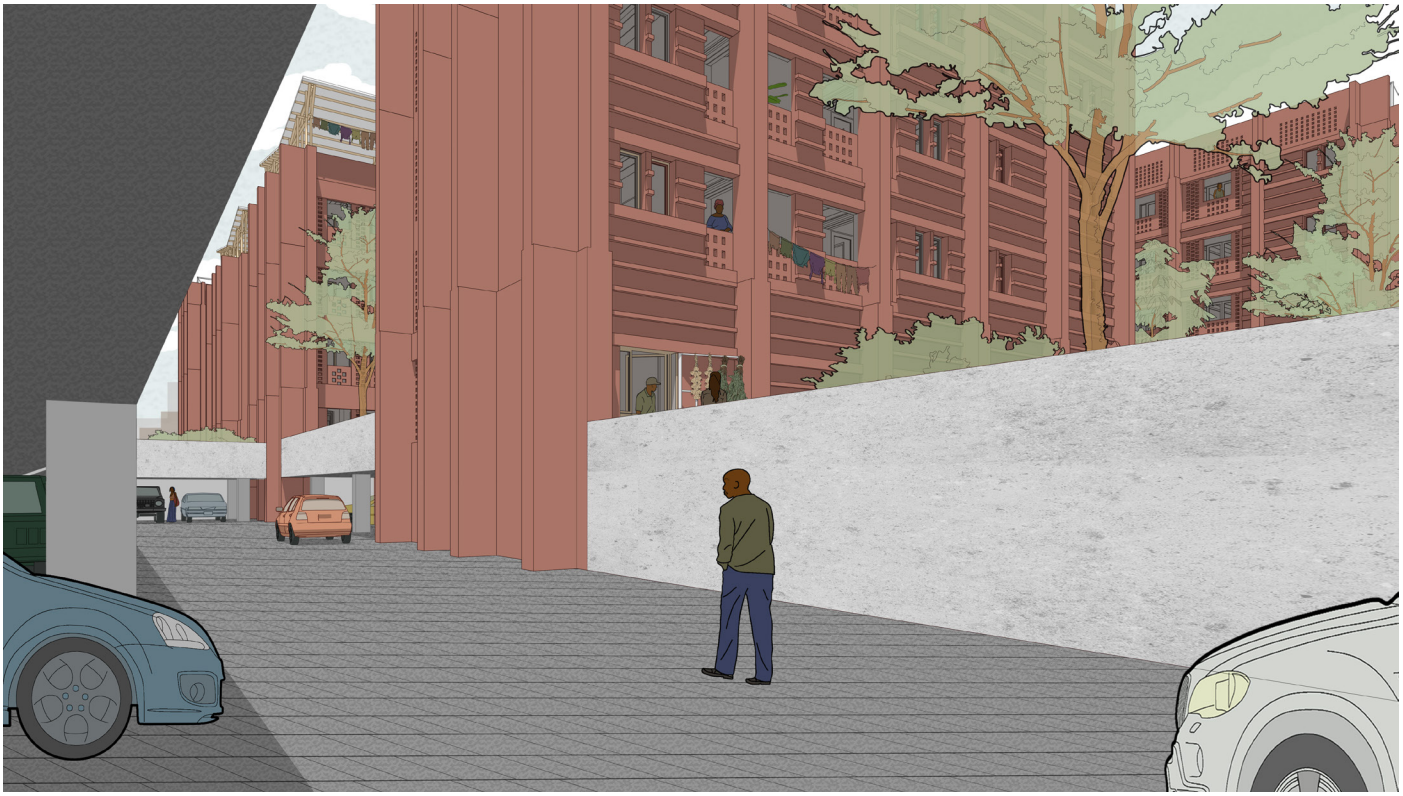


Figure 12.27
Atmospheric impression parking garage

Figure 12.28
Street side elevation 1:200



Side street

The side street is the street that connects the green building block with the urban dwelling block. It is the access road connecting all the dead-ends and has parking opportunities on both sides. On the atmospheric impression below it becomes visible how the 'dead-end square' becomes a communal space connecting two apartment blocks (and how this space could be a secure space for children to play).

The spaces between the buttresses of the construction could be utilized in the form of greenery, benches, or flexible commerce.

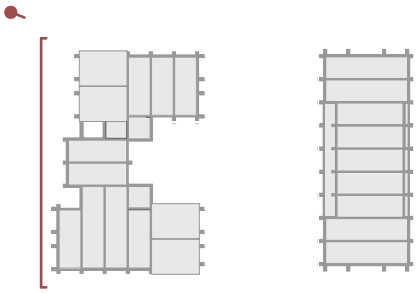


Figure 12.29
Atmospheric impression
Side street with dead-end communal square

Figure 12.30
Side street side elevation
1:200

Figure 12.31
Plan perspective
Inner square

The green wedge continuous until the main street. It is a continuous pedestrian area and when it crosses the side street, the priority remains for pedestrians (see atmospheric impression below).

Inhouse commercial activities in the plinth socially activates the green wedge and prevents it to become an anonymous space. Moreover, the elevation shows how the stair across the entire width of the inner square connects the green wedge with the core of the urban block. The extension of the green wedge makes that the urban wetland intertwines deep into the urban fabric.

Figure 12.32
Atmospheric impression
Side street and green wedge

Figure 12.33
Green wedge side elevation
1:200

13 Building technology

Unit princple
Structural principle
Climate
Water flow
Longitudinal section 1:100
Detail foundation 1:20
Detail bamboo column foundation 1:5
Detail water catchment 1:5
Detail eaves 1:10
Cross section 1:100
Detail eaves 1:10
Detail Dutch door 1:10
Detail exterior wall 1:10
Detail gallery 1:10

Unit principle

The apartment blocks basically consist of one unit, that repeats itself with minor adjustments here and there. Therefore, the principles of one unit (with one spacing between two gridlines (4 m) and one floor height (3,2 m) will be discussed more elaborate in the upcoming chapter to get a better understanding of the technological aspects interwoven with the design. Therefore, the technical aspects of one unit in relation to construction, heat, air/humidity, light and acoustics will be discussed in more detail.

Construction

From the exploded axonometric view of one unit, one can see how the interior floor is slightly higher than the gallery floor in order to prevent indoor water damage when there is water on the gallery. The loadbearing walls consist of three layers of CSEB (3% stabilised) which are hold together by through stones (CSEB, 3%). The horizontal tie

1. Sand fill
2. Adobe tiles flooring
3. Loadbearing wall
4. Horizontal tie beam
5. Natural stone springer blocks
6. Masonry vault
7. Natural stone slabs
8. Technical and ventilation shaft
9. Flexible steel security bars
10. Through stones
11. Street facade
12. Inner courtyard facade
13. Gallery facade
14. Technical space
15. Agrostonepanels

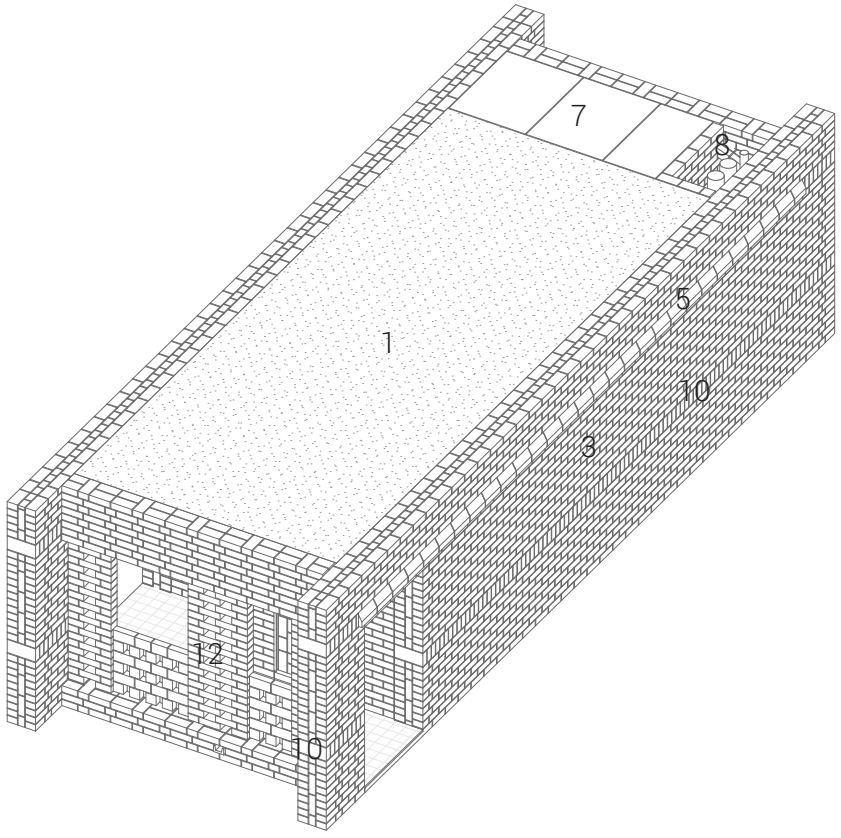


Figure 13.1
Axonometric view one unit

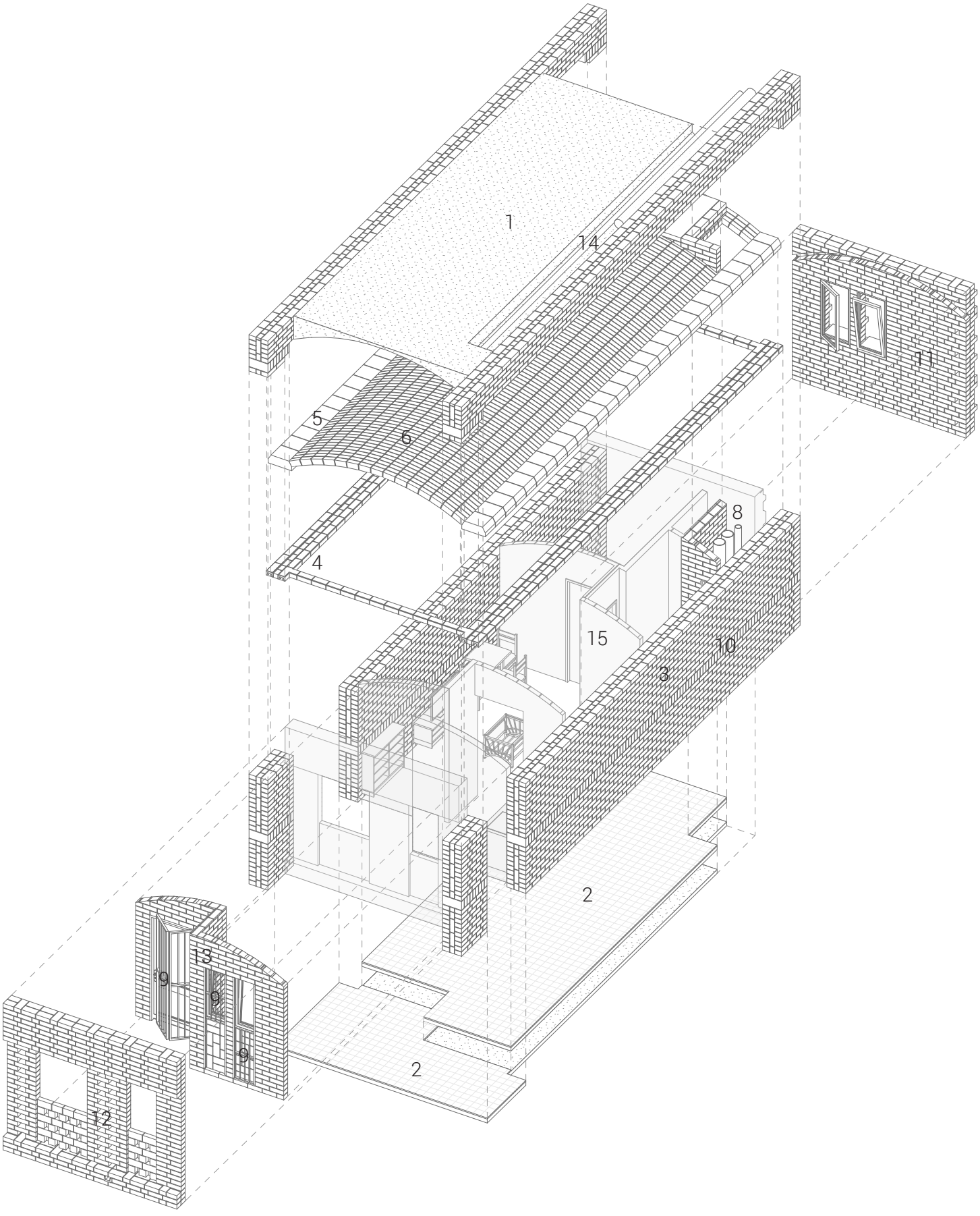


Figure 13.2
Exploded axonometric view one unit

beam together with the natural stone springer blocks, are there to support the masonry vault (CSEB). On top of the vault there is a layer of sand to stabilize the vault since their constructive properties and stabilization are based on compression from an as much as possible equally distributed pressure load. In the layer of sand technical installation openings are made for the bathroom and kitchen. These technical spaces are in connection with the technical shaft which will be utilized for ventilation purposes of the bathroom as well. In order to create this technical shaft and to continue the vault, non-constructive vaults are placed along the technical shaft (since the vault cannot rest on the technical shaft because it is non-loadbearing). These 'constructive gaps' of the non-constructive vaults are spanned by natural stones. The natural stones rest on constructive vaults (see image 13.3). Moreover, de exterior facades are carried by the constructive vaults (see image 13.3) to prevent thermal cracking in vertical direction.

The low-cost agrostone panels for the interior walls are easy to install and remove, which increases the flexibility of the unit. Agrostone panels are produced in Addis Ababa and consist of agricultural wastes as fillers, magnesium-based chemicals as binders and fibreglass as reinforcement (Taffese, 2012). Right after construction the apartment will be delivered relatively empty, in this way people can decide themselves whether they would like to, for example plaster or stuck the interiors.

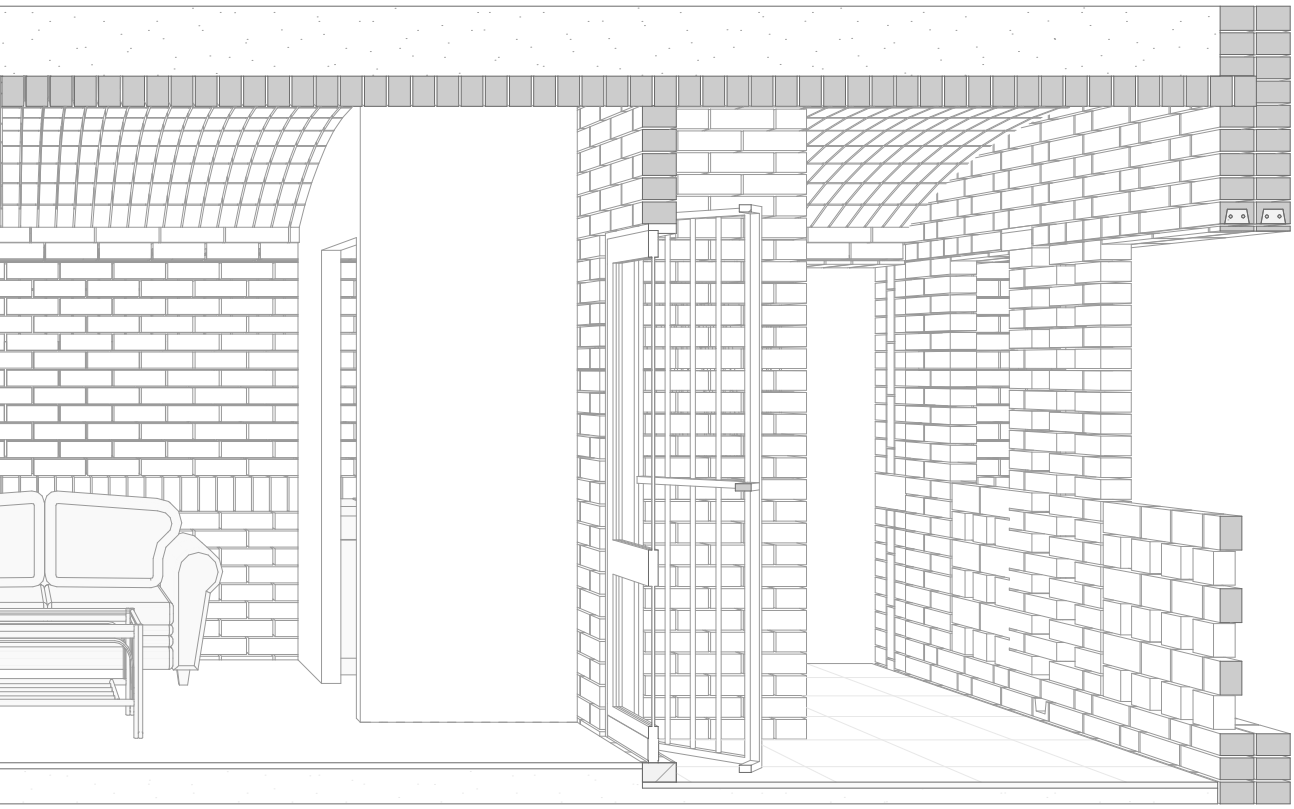
Figure 13.3
Section perspective one unit

Heat

From the visit in the newly constructed condominiums became prevalent that central heating in Addis Ababa is not usual since it was not present. The overall average temperature in Addis Ababa is throughout the whole year around 16 degrees Celsius with warm days and cool nights. The warmth of the day can be stored in the thick adobe walls which can heat the apartment in the night. This works also the other way around; So the coolness of the night can be stored in the adobe walls and will cool down the apartment during the day. Therefore, no central heating is necessary. However, people could always decide to heat (or cool) their apartment on electricity.

Air/humidity

In the unit, cross ventilation is possible as shown in image 13.4. People can decide to open or close doors and windows to ventilate (or not) the apartment. All the bathrooms are in direct relation with either way the exterior wall or ventilation shaft (which is always in connection with the outdoor) allowing natural ventilation (non-mechanical). Moreover, because CSEB is a relatively porous material, it has the capacity to absorb and desorb humidity. In this way the CSEB walls are able to balance the indoor humidity when it is too high or too low (Minke, 2013).



Light

The plans of all the different typologies are in such a way configured that each room has a window, allowing natural light to reach all the rooms. The CSEB walls do not allow big window openings, especially in the loadbearing walls. However during the day, and in particular around noon it is crucial to prevent direct sunlight to reach the apartment in order to prevent overheating. Therefore, the CSEB exterior façades, which are in direct contact with sunlight, are stacked in such a way that it has a serrated profile on the exterior. It casts shade on the façade itself and prevents direct sunlight around noon, the warmest moment of the day, to enter the building. The altitude of the sun around noon varies throughout the year between 75 and 85 degrees in Addis Ababa. Based on these numbers the depth and height of the windows are determined (see image 13.3).

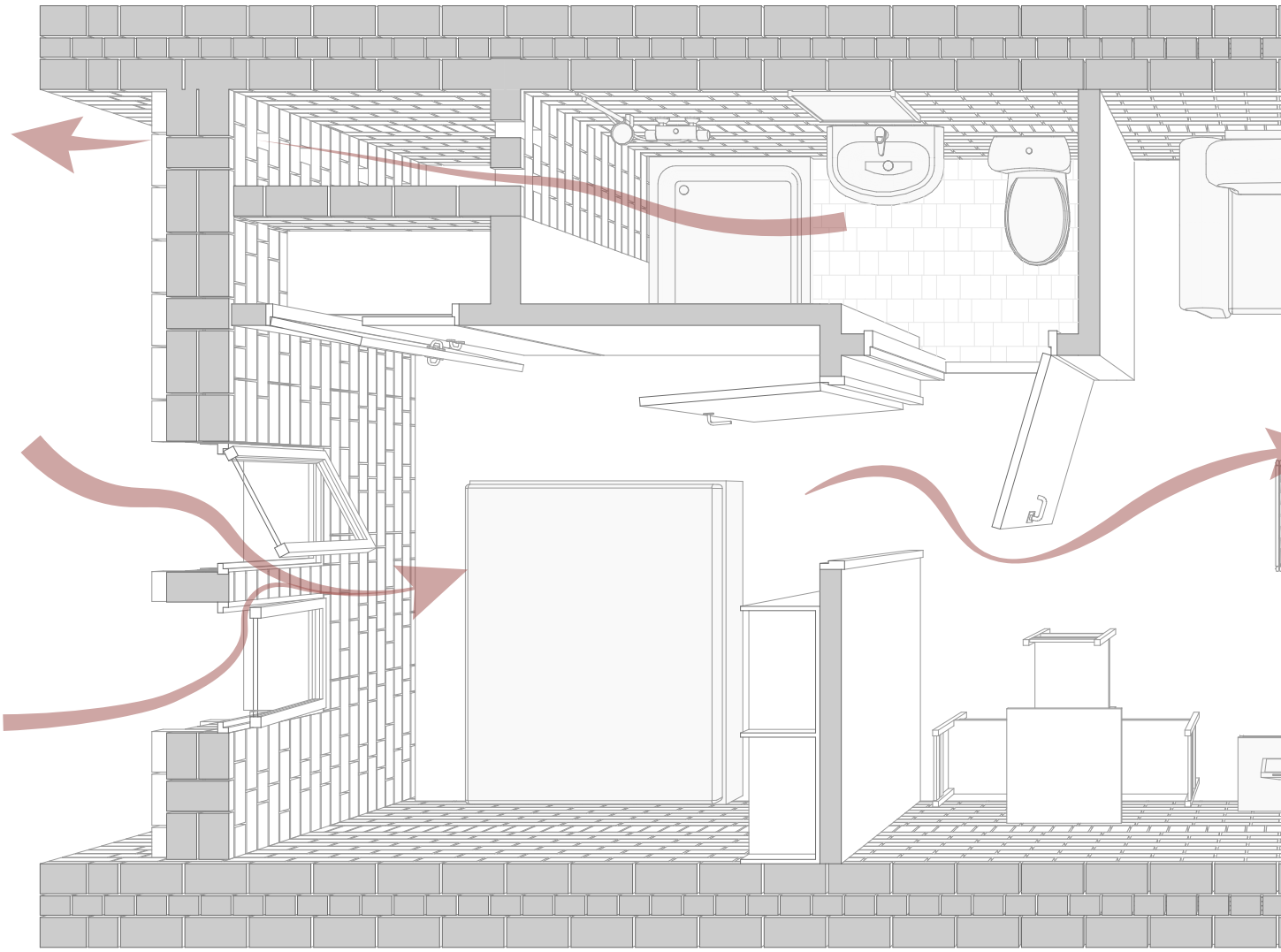
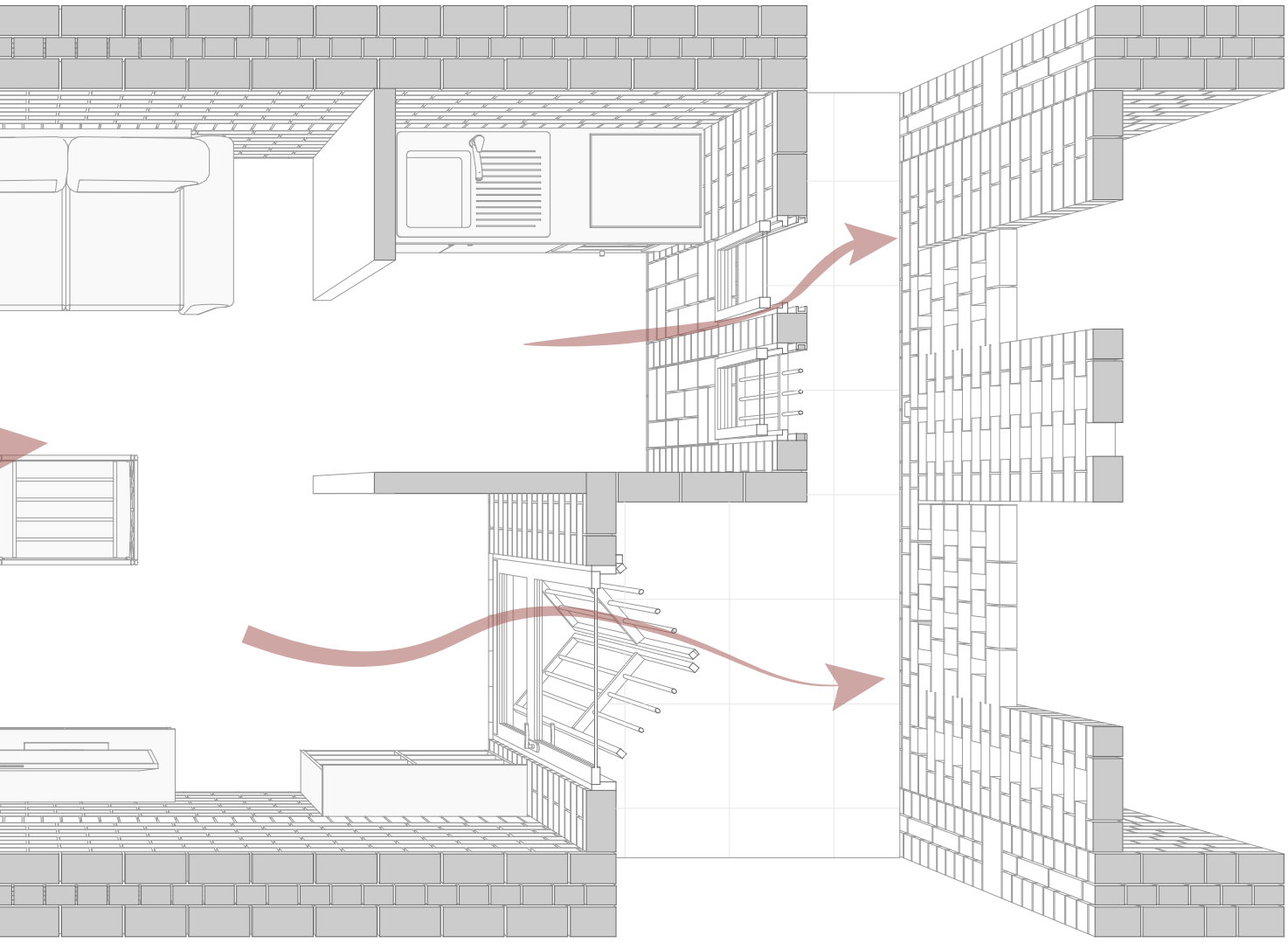


Figure 13.4
Plan perspective one unit

Acoustics

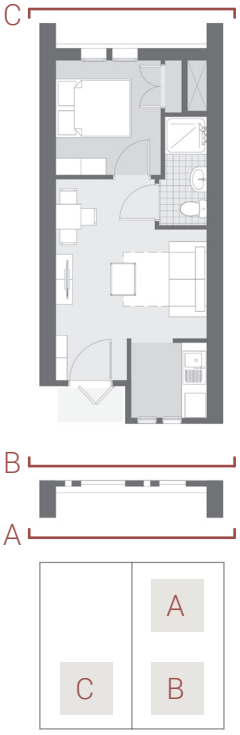
To prevent noise disturbance between the apartments, the house dividing CSEB walls consist of three layers, whereby continuous seams throughout the cross-section are avoided. Instead, the bricks have an overlapping bond (see image 13.4) which is constructively more powerful but also difficult to penetrate for noise.



Each unit has 3 types of exterior façades. The serrated façade is double layered, which is necessary for climatic and structural reasons (as discussed on the previous pages). The double layered facades are stacked following the monk bond principle. This gives a dynamic expression but also fixates the two layers together. Along the technical shaft small openings are made in the façade in order to ventilate the bathrooms.

The façade of the entrance of the apartment contain doors and windows with timber frames. Besides, steel security bars are integrated in the façade which can be opened or closed by folding or sliding.

The façade of the gallery is as transparent as possible. However, it is also important that the horizontal tie beam should be integrated in the façade (just as with the serrated façade). Therefore, perforated walls are used to support the horizontal tie beam. Besides, there is an emergency drainage to prevent water damage along the gallery.



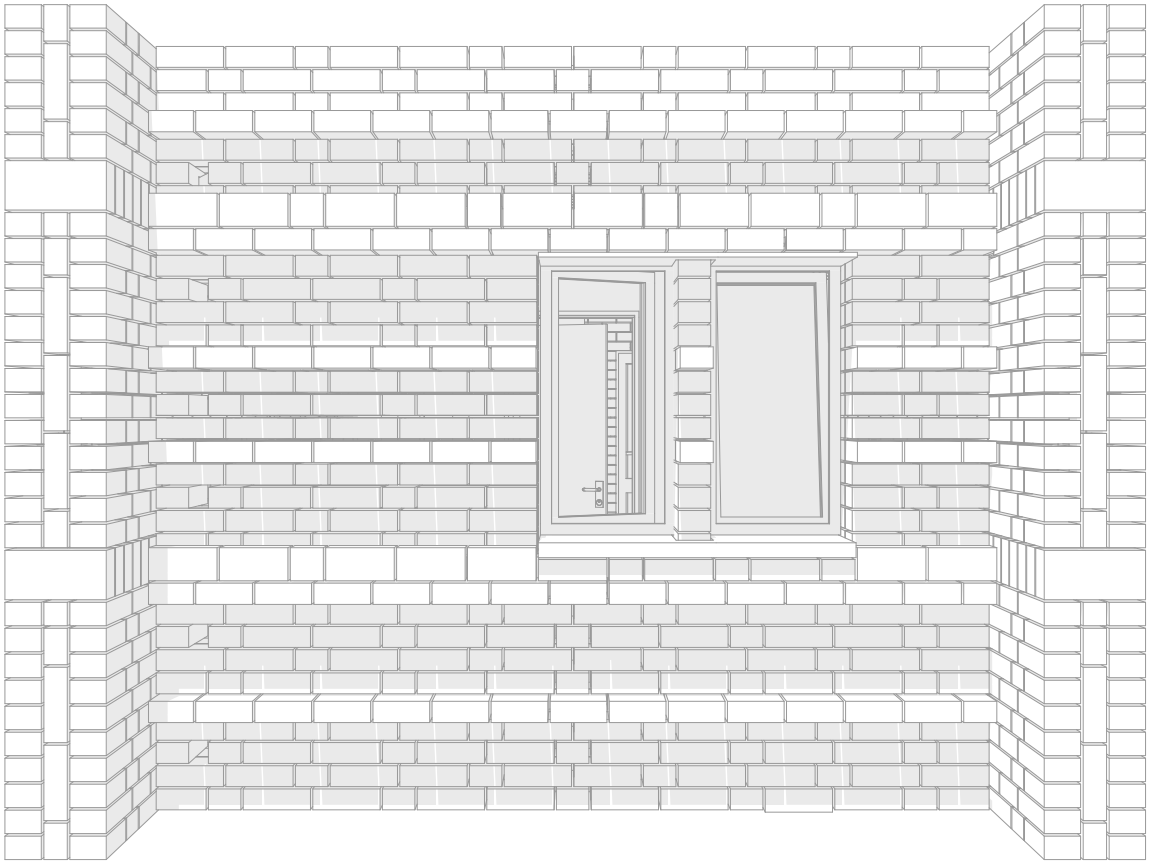


Figure 13.5
Serrated facade

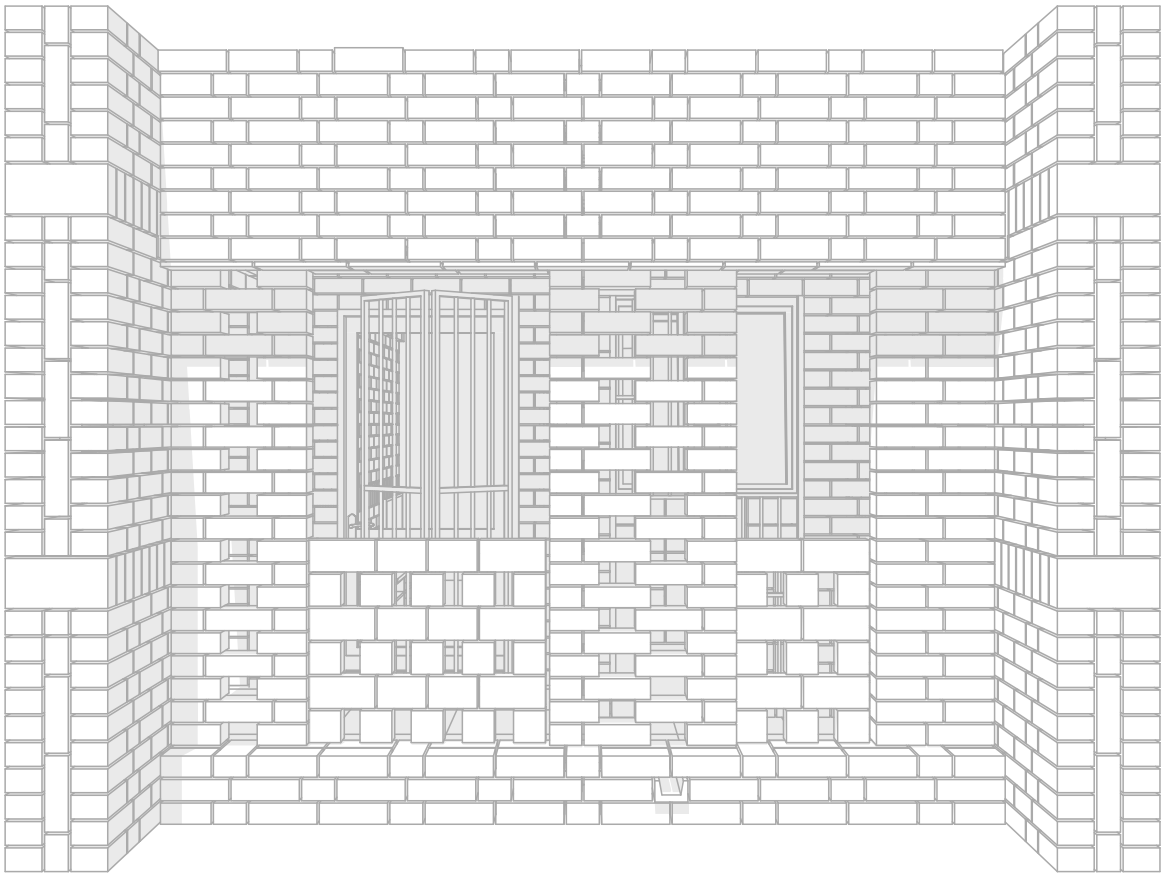


Figure 13.6
Gallery facade

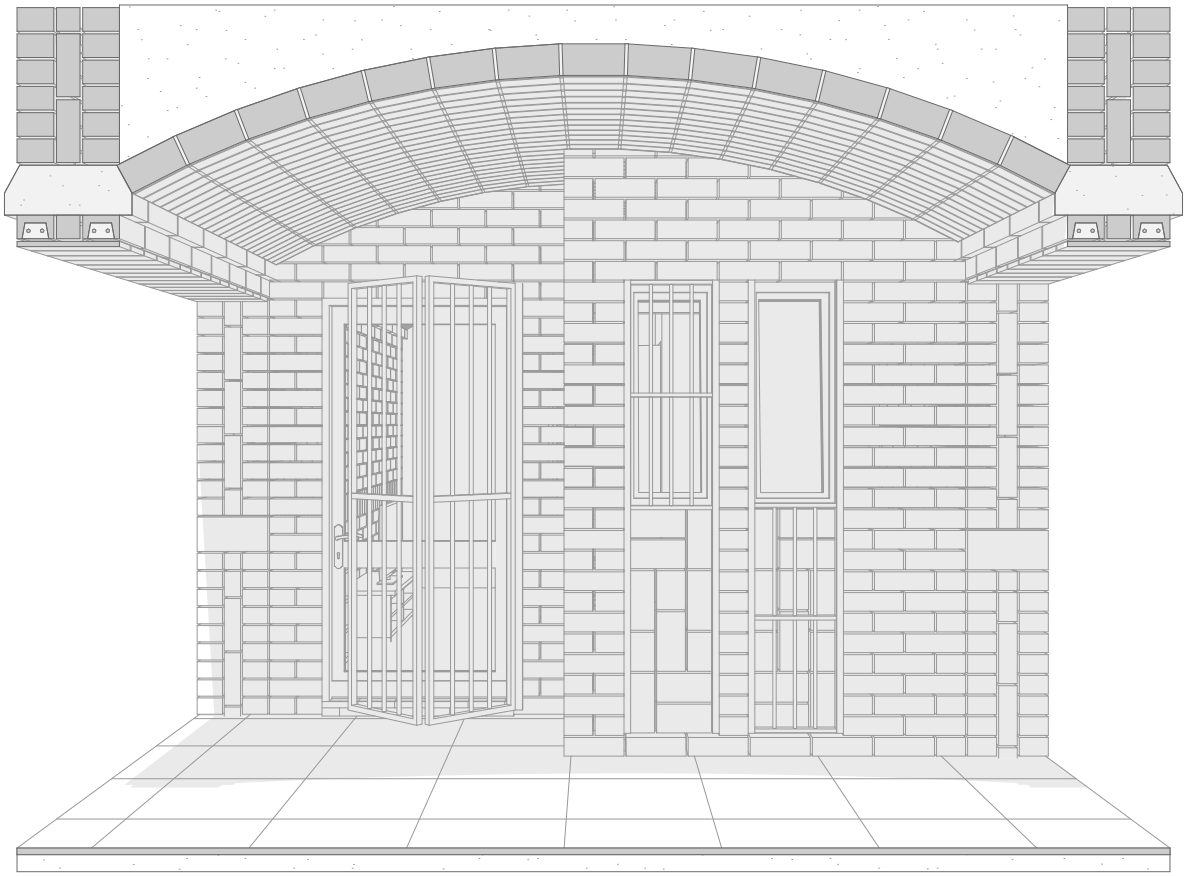


Figure 13.7
Entrnece apartment facade

Structural Principle

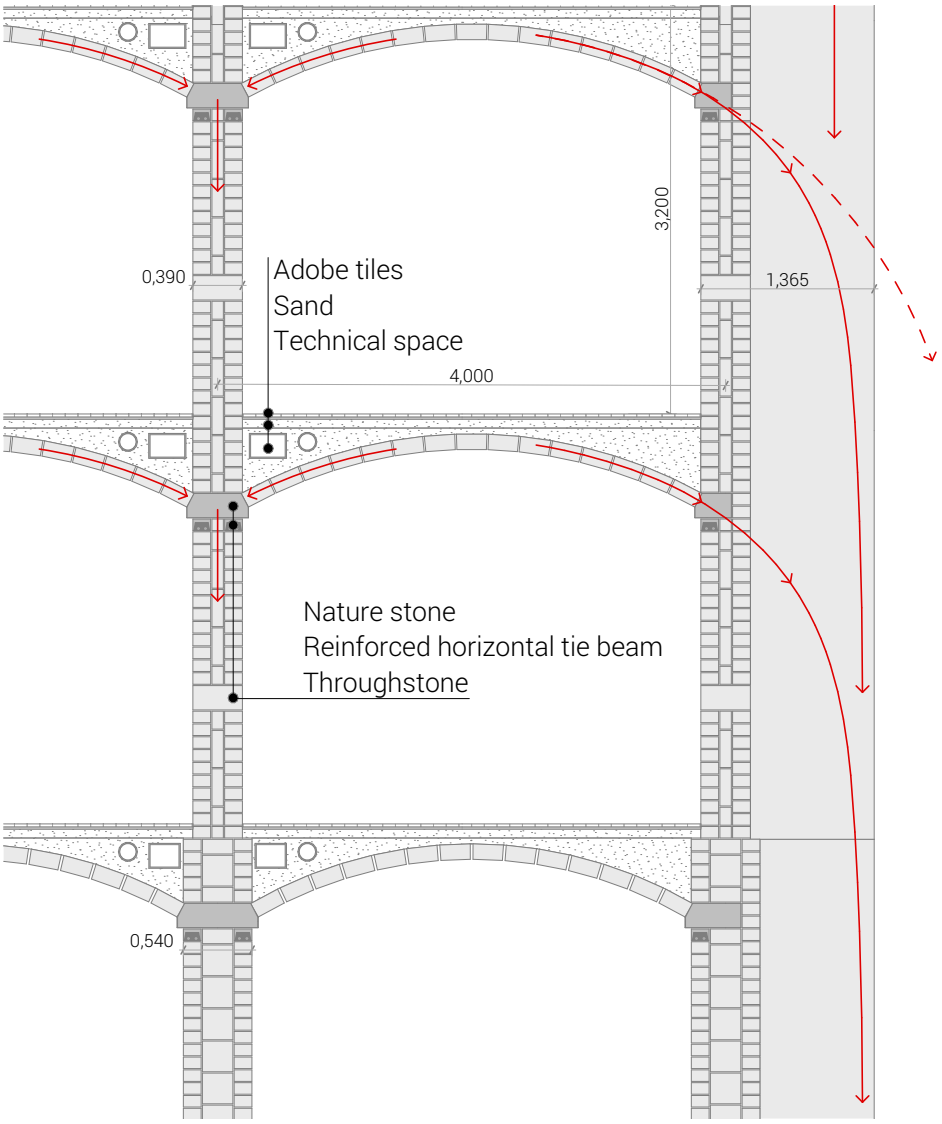


Figure 13.8
Structural princple in section

The loadbearing walls develops in thickness along its height; so the higher you get, the slimmer the wall. It means that the ground floor has a wall thickness of 540 mm, the floors one until four a thickness of 390 mm and the walls of the water harvesting roof a thickness of 240 mm. The 390 and 540 wall consist all of 3 layers of CSEB (with the minimum stabilization of 3%) which are hold together by through stones. The masonry vault, which is not exposed to rain, will consist of CEB (so 0% stabilized). The vaults rest on natural stone blocks. Right underneath these stones the horizontal tie beams are located. It is a composite of CSEB, concrete and reinforcement. It works as a ring beam for one unit and increases the loadbearing capacity and helps to bear the thrust

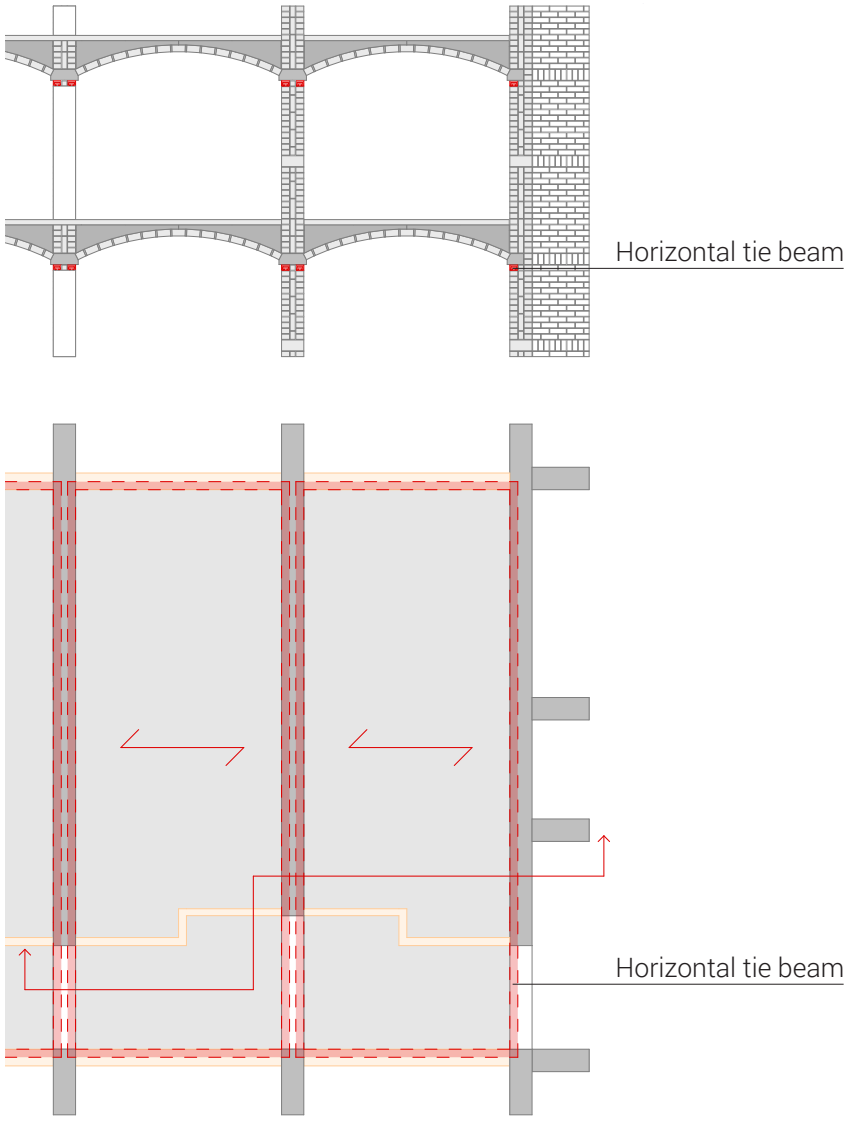


Figure 13.9
Structural princple in plan

of the arch. Moreover throughout the structure it functions also as a lintel at openings in the loadbearing walls and exterior walls. To bear the thrust of the arch on both ends of the building buttresses of one meter are introduced.

To prevent cracking the structure is divided in structurally independent units with a maxim length or width of 40-45 meters, as can be seen on the next page. Each unit has loadbearing walls in 2 direction to ensure stability. For circulation purposes bamboo bridges are introduced. They rest on the loadbearing walls of both structurally independent units and the floors are connected with expansion joints.

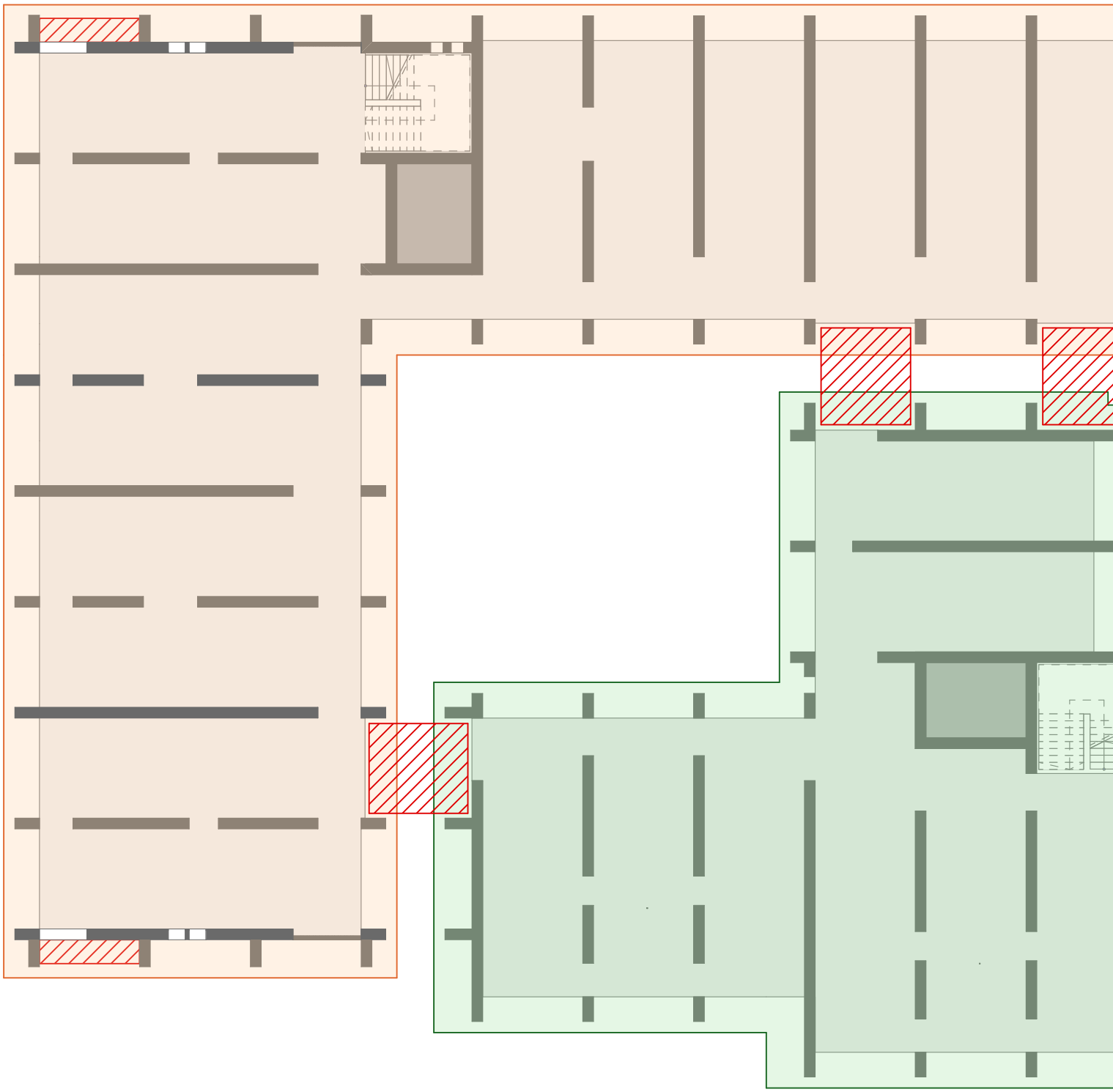
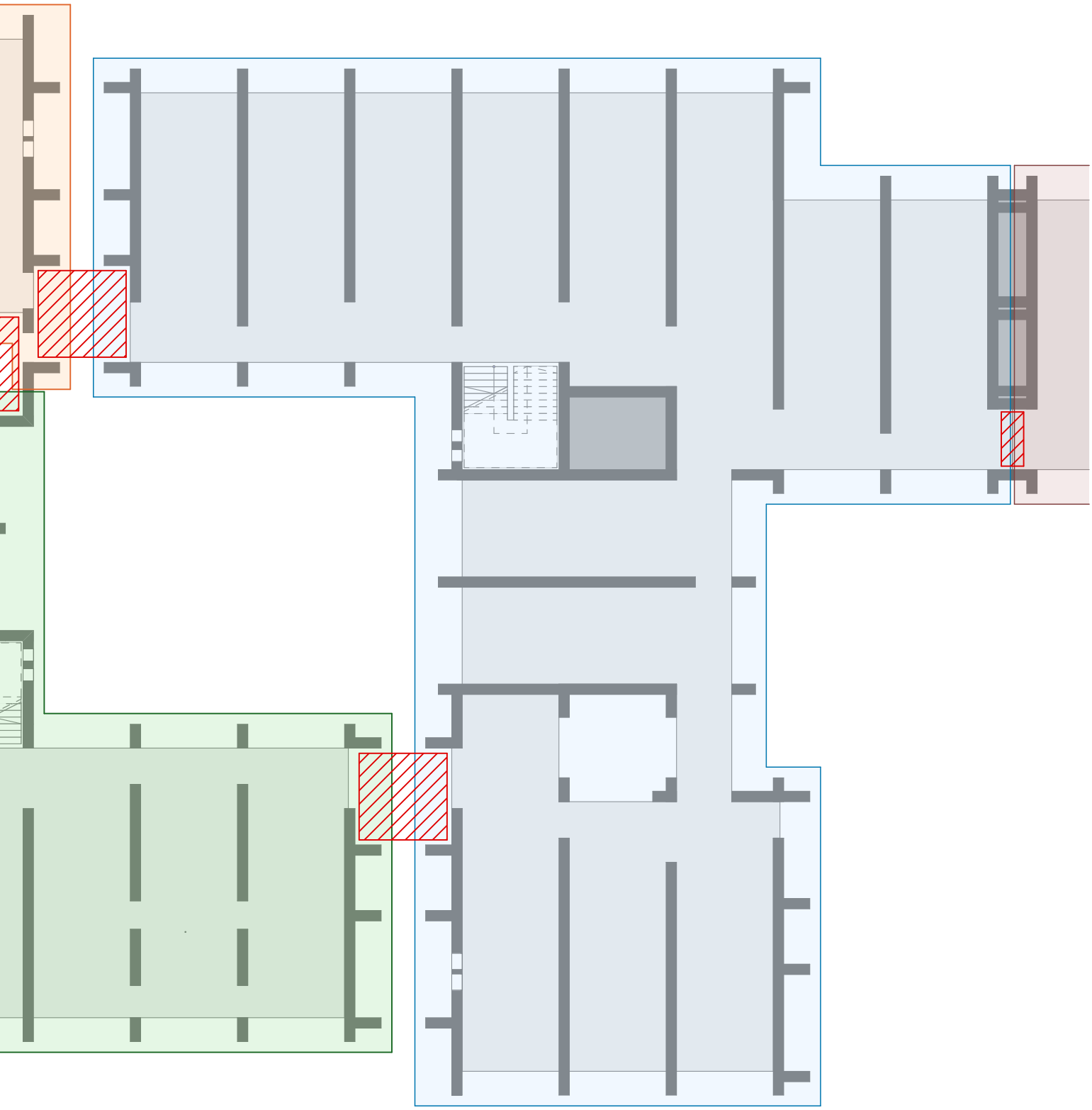


Figure 13.10
Stability diagram
1:200



Bamboo bridge or balcony

Climate

Climatic interventions on building block scale are also present. Throughout the whole building cross-ventilation is possible. The double layered roof prevents the upper apartments from overheating and helps to harvest water and store it in water tanks on top of the building. Due to the relatively high sun altitude there is always sun reaching the inner courtyard. The slightly lowered inner courtyard prevents, in emergency situations during rainy season, water from going onto the gallery and into the apartments on the ground floor. Moreover

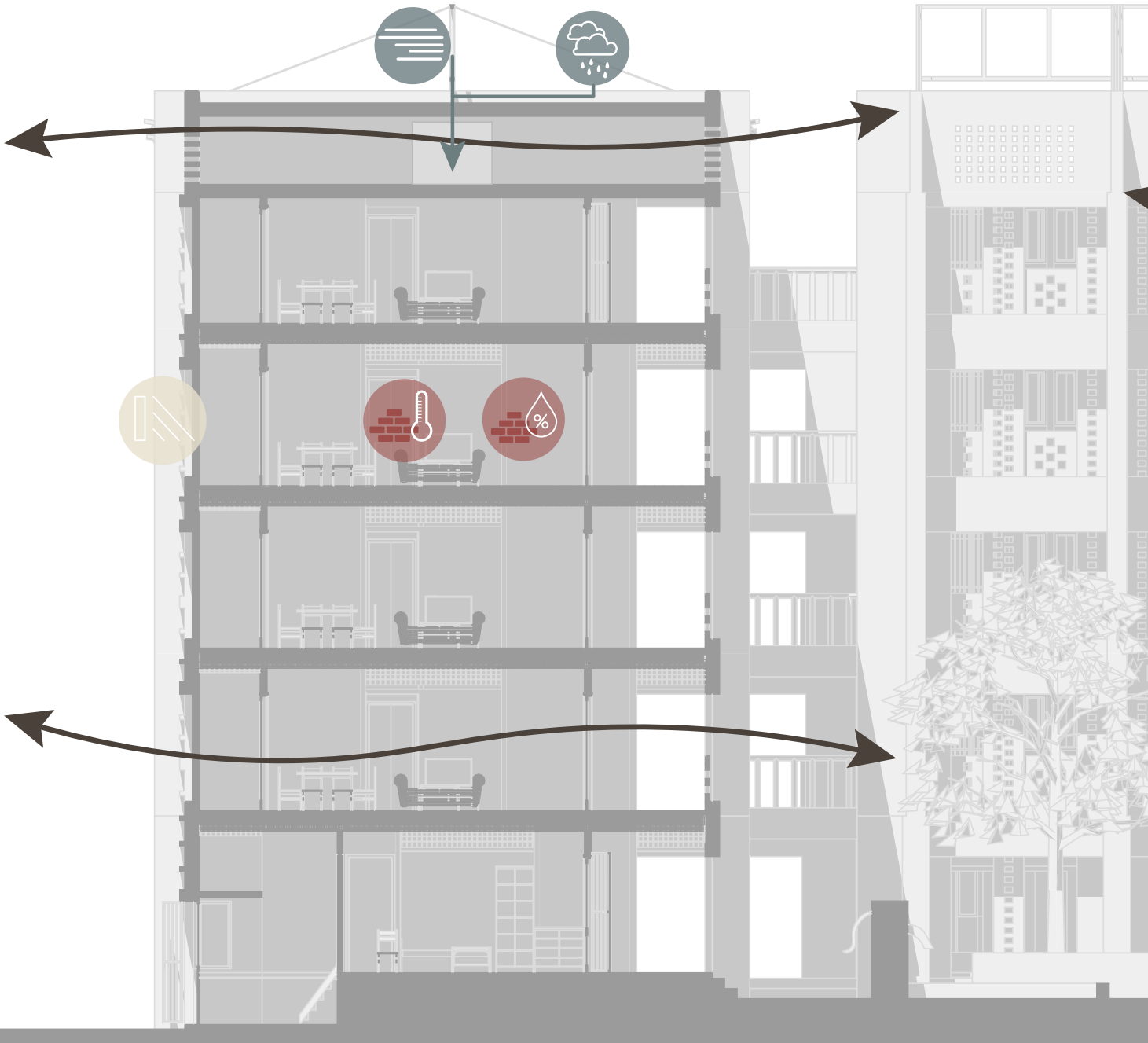
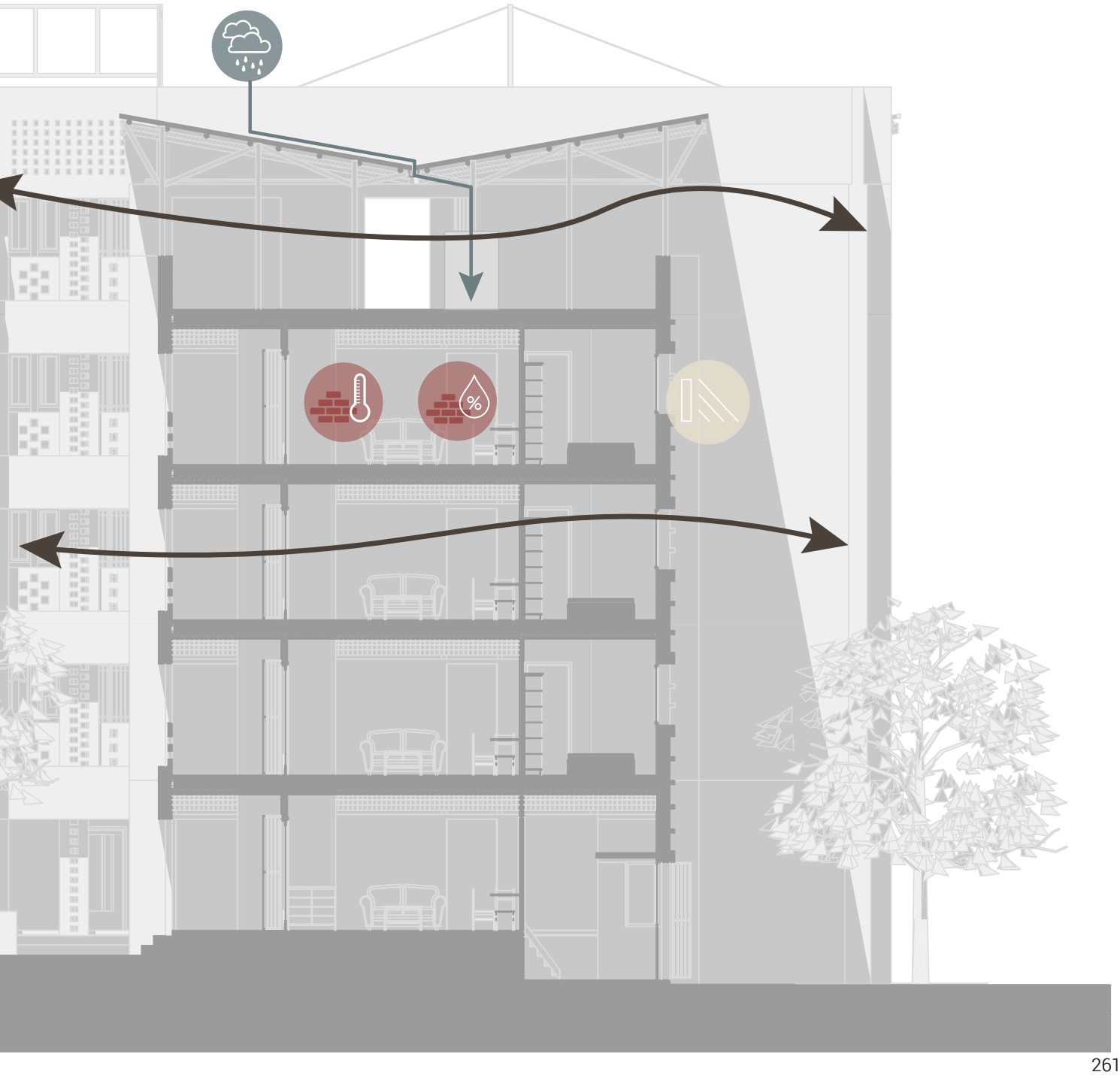


Figure 13.11
Climate diagram

the buttress and protruding loadbearing walls cast extra shade during the day on the façade. And finally the thick earthen structure allows to store heat. In this way it transmits the coolness of the night during day time and the other way around. This is especially useful in Addis Ababa with its hot days and chilly nights. The earthen structure also helps to balances air humidity throughout the building.



Water flow

During the site visit in Addis Ababa it became apparent that there is a huge shortage of water. Therefore, the project aims to collect water as much as possible. All the roofs will harvest rain water and catch fog from the air with fog harvesting devices. The harvested water will be stored in a water tank on top of the building in the double layered roof. In this way the water can be distributed over the apartments connected with the same technical shaft as the water tank just by gravity. The water tank on top the building has a capacity of 2000 litres, to serve 10 families one full day with water, assuming an average of 4 persons per family with an water usage of 50 litres per person. During rain season when there is an overflow of water, the water will be stored in the underground water tank. When the water tank on rooftop is empty water gets mechanically pumped up from the underground water tank. Wastewater will be transferred to the helophyte filters in the urban wetland after which the water could be released in the river (see figure 13.13). To make this system functioning the 'wet rooms' needs to be located at the side of the loadbearing wall which is in connection with the technical shaft as shown in figure 13.12.

To be able to harvest fresh water also during the dry periods of the year fog harvesting devices will be installed on the rooftops. These devices are low-tech passive systems catching water droplets in the air. The system consist of a steel frame and a polyester mesh. It is already proven to be a successful water harvesting technology in Ethiopia by the Warkatower (warkawater, 2019). They have installed several of these Warkatowers throughout the country. Research on the effectiveness of fog harvesting devices varies extremely; From an average of 6 L/m2/day (amount of liter water harvested per square meter mesh per day) from a fog harvesting device in Chile to an average of 30 L/m2/day in Oman (Klemm et al., 2012). However, I believe a research done in South Africa is relatively in the same circumstances as in Addis Ababa; a mountains region higher than 1700 m above mean sea level. The yield of the fog harvesting device there 'exceeded' the 10 l/m2/day (ibid). If I assume the harvesting devices in my project will have a yield of 10 l/m2/day, it means that with the 375 m2 of mesh present in my project I could harvest 1,368 million litres each year. That is 5,4%

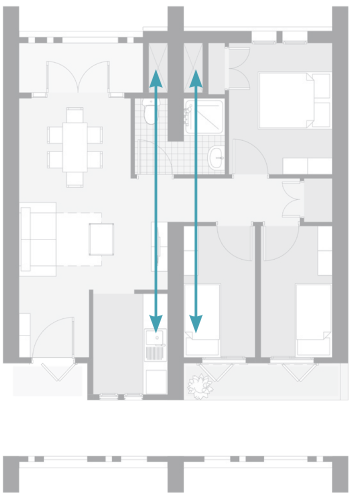
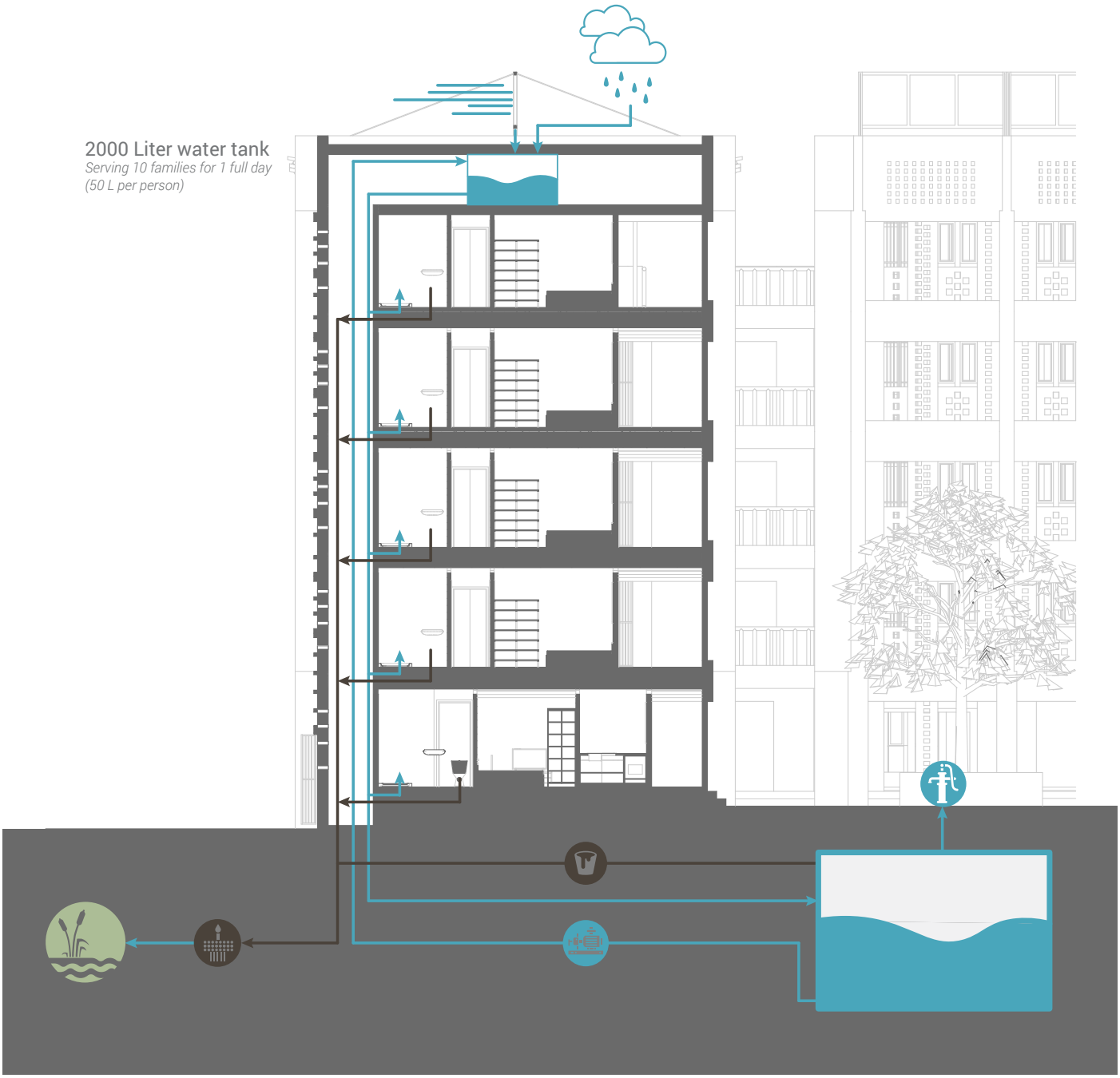


Figure 13.12
Wet rooms should be positioned in line with the technical shaft

Figure 13.13
Water flow throughout the project

of the total need of the 349 households that the project houses throughout the year (which is 25,477 million litres per year) and 21,8% of the amount of rainwater harvested by the roofs of the water throughout the year (which is 6,291 million litres per year).



Longitudinal section 1:100

In the longitudinal section it becomes prevalent how the loadbearing wall gets slimmer the higher you get. The roof of the top floor is made of bamboo. In this way the buttresses on the fourth floor act only as additional weight for the bearing of the thrust forces of the vaults on the lower floors. The bamboo roofing is possible because it is not an apartment separating floor and thus does not to be acoustically isolated.

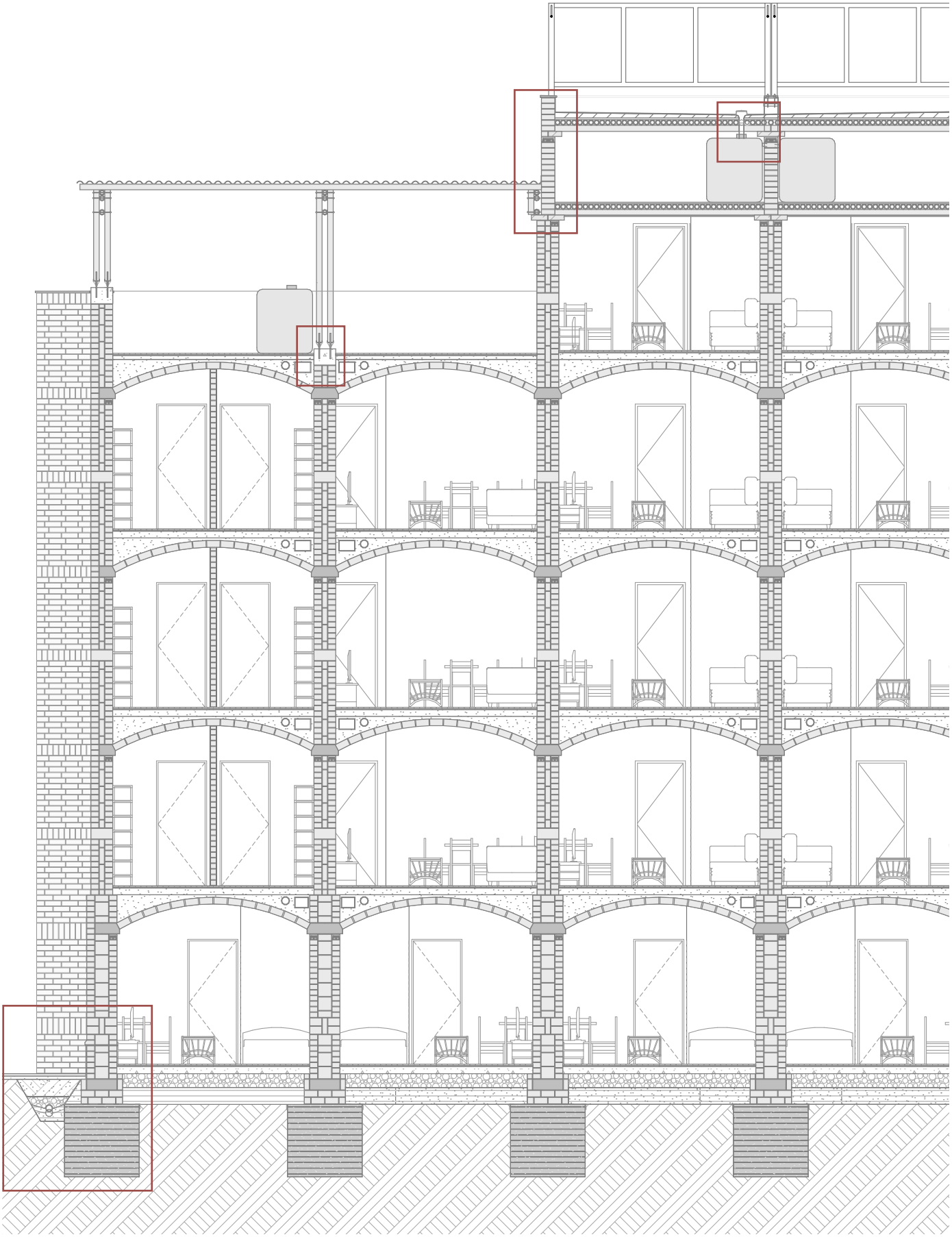
Detail foundation 1:20
The foundation consist of stabilized (5%) rammed earth. The water resistant layer prevents rising damp in the construction and to prevent use of concrete the ground floor consist of a layer of clay, pebbles, sand, screed and on top adobe tiles. Just about the ground a continuous zinc plate are placed throughout the whole horizontal section of the wall to be able to check for termites.

Detail bamboo column foundation 1:5
The bamboo structure that covers the rooftop spaces rest on a steel profile. Poured concrete through a hole in the bamboo column together with bolts connects the bamboo column with the steel profile. The steel profile is connected with the concrete foundation by a steel bar with set nuts.

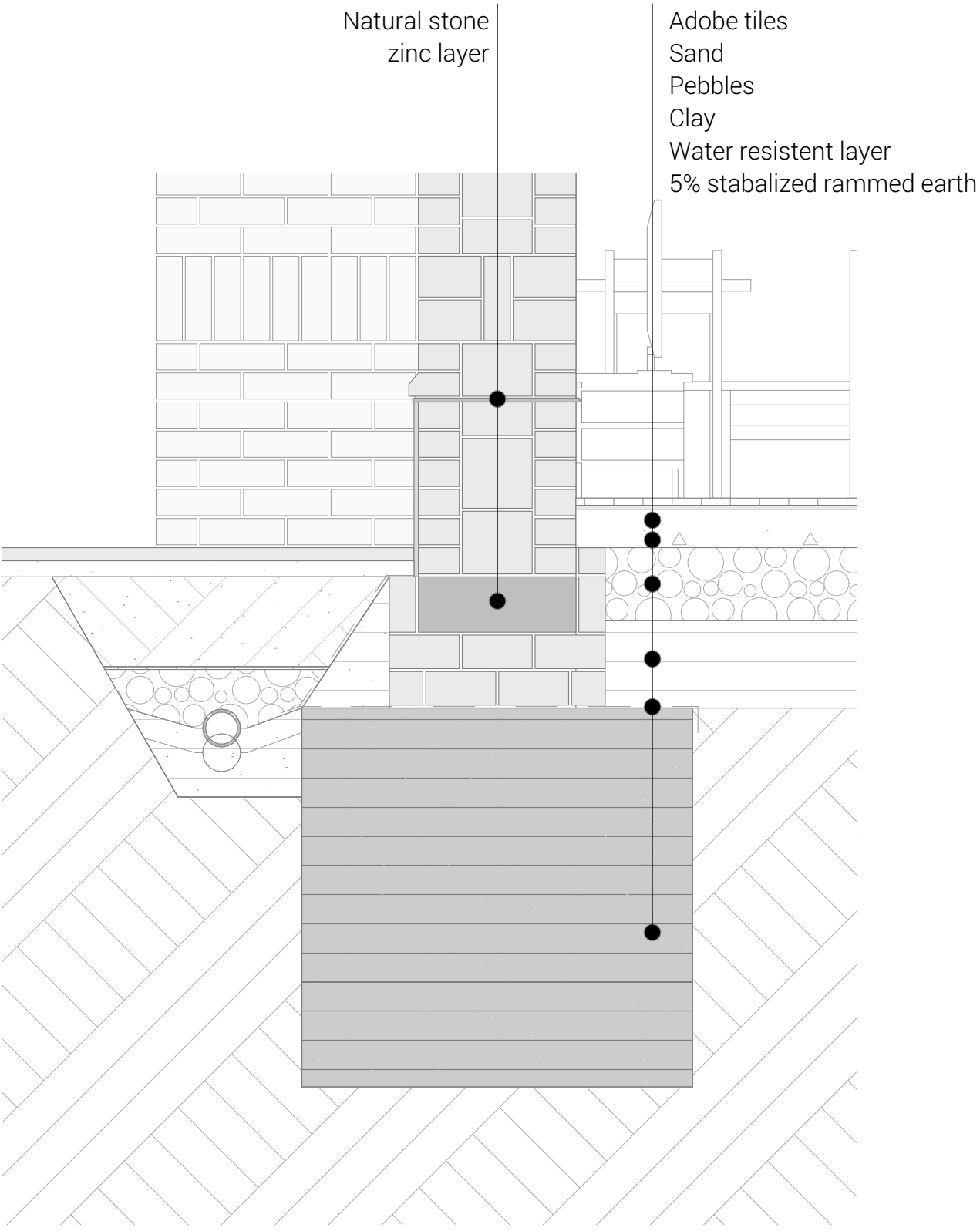
Detail water catchment 1:5
The roof consist of bamboo beams in two directions topped with a layer of plywood and isolation with a slope. On the isolation a layer of epdm is glued. In this way the roof is as clean as possible since water gets used for household purposes. The roof slabs are carried by natural stones.

Detail eaves 1:10
Where the bamboo roof structure meets the brick wall, decreases the wall in thickness (from 390 to 240). This allows to rest the bamboo truss of the roof structure on the loadbearing wall (just slightly off the centre line). To withstand pushing wind from below on the corrugated metal sheets, the bamboo truss is anchored with the loadbearing wall by a steel profile. A zinc plate anchored in the masonry joint prevents water leakage between the corrugated metal sheet and masonry loadbearing wall.

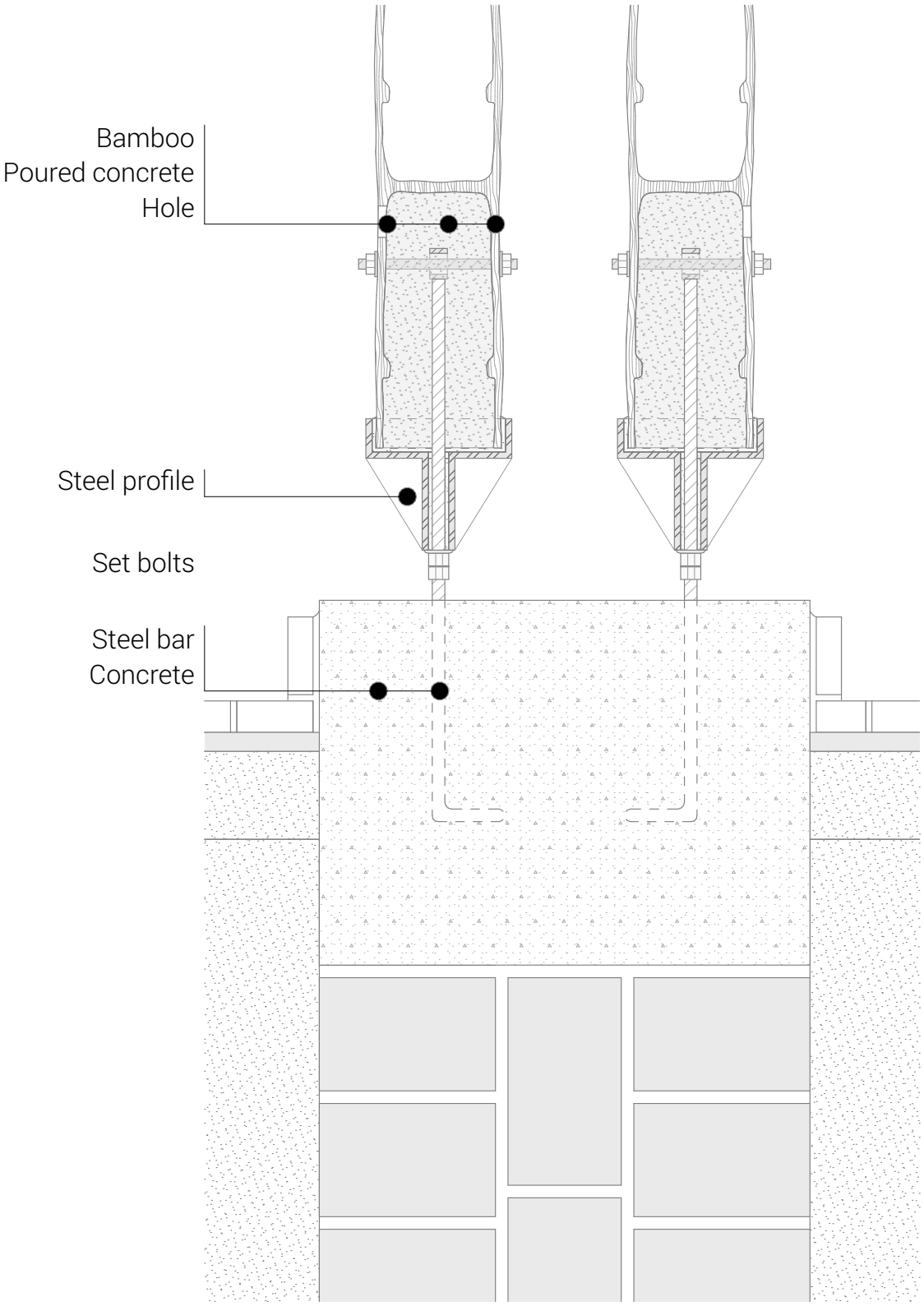
Figure 13.14
Typical longitudinal section 1:100



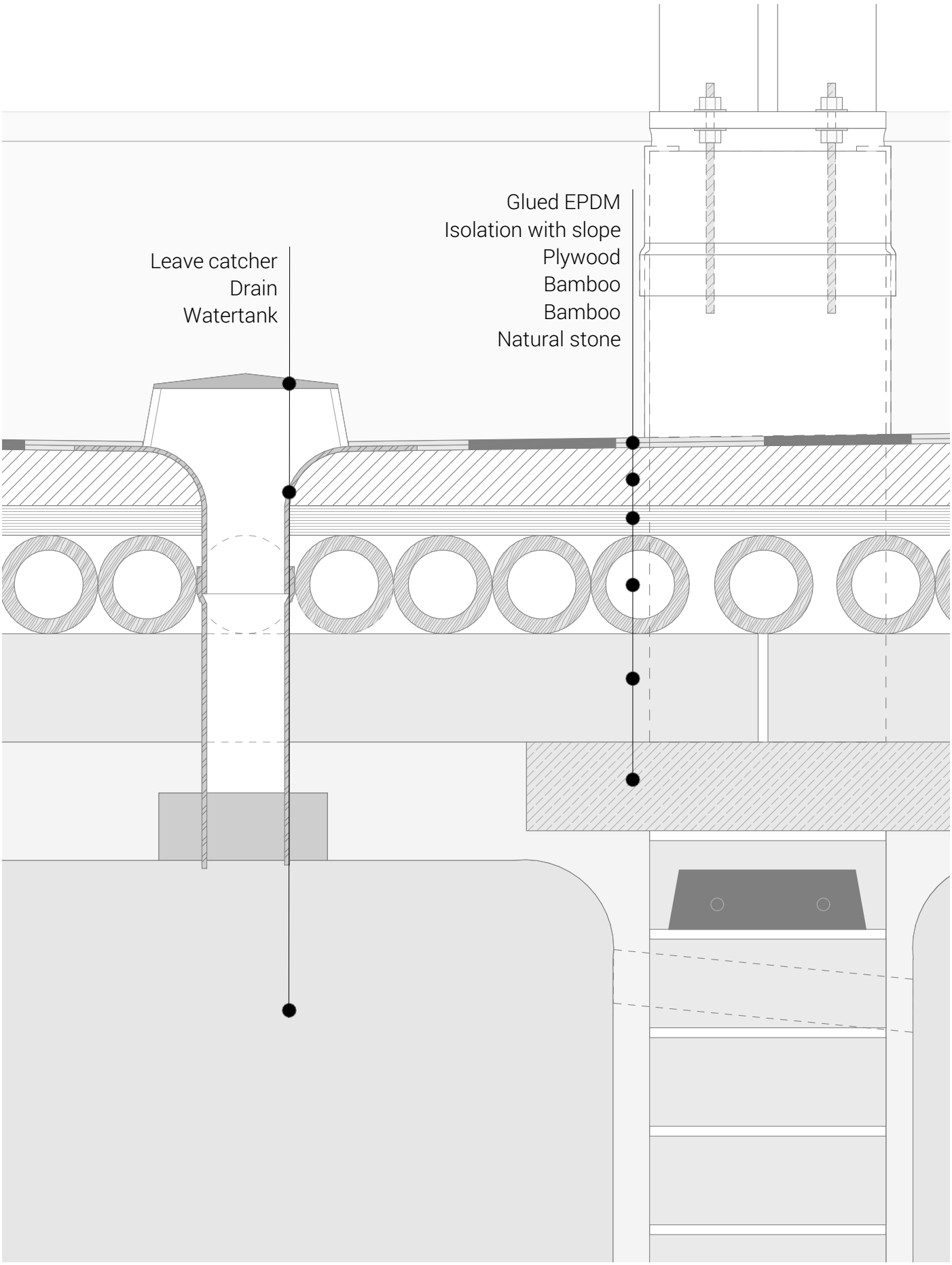
Detail foundation
1:20



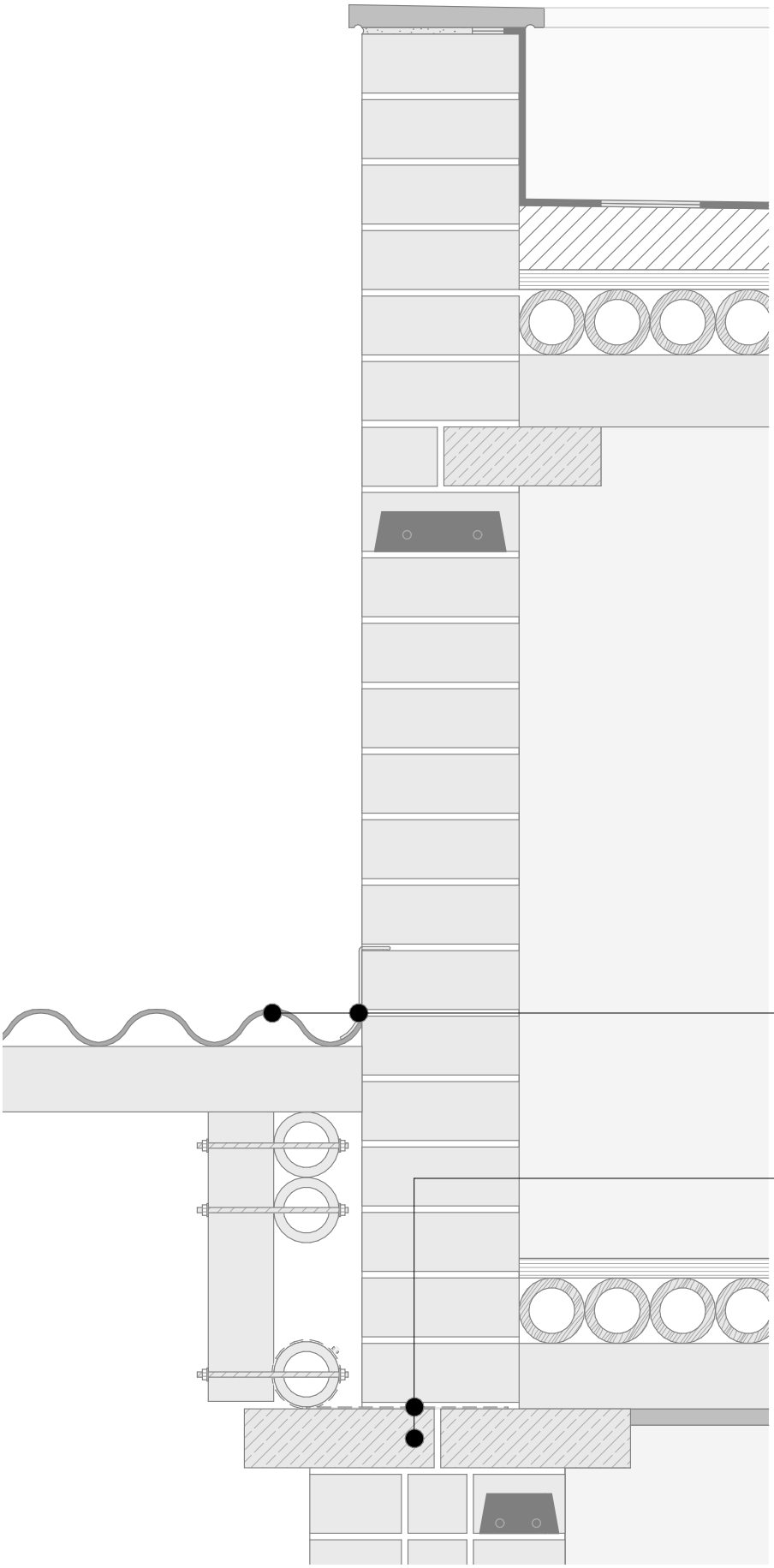
Detail bamboo collumn
1:5



Detail water catchment
1:5



Detail eaves
1:10



Cross section
1:100

The cross section shows how the ground floor apartment has a difference in floor hight. At the following page the relation between the technical cross section and the architectural appearance of the façade is shown.

Detail eaves 1:10
This detail shows how the fog catchers are connected by steel ropes with the loadbearing walls. Emergency water drainage is integrated at the eaves if there is an overload of rainwater. Moreover, the perforated façade is shown, allowing cross ventilation through the double layered roof. Besides, it becomes prevalent how the bamboo floors consist of two layers of bamboo in perpendicular directions and how they are finished with multiplex and gypsum boards.

Detail Dutch door 1:10
The Dutch door (or also known as farmer door) is used for the 1 and 2 bedroom apartments on the ground floor with a shop option. The upper part of the door can be separately opened from the bottom part. With dashed lines the opening lines are shown. Moreover, the steel security bar door which can be opened or closed is mounted on the exterior of the façade. The timber frame of the Dutch door are connected by a steel profile and stone plugs with the façade. On the bottom it is covered with a sloped threshold and on the top with a CSEB tile (3% stabilized). The foundation consist of CSEB's (5% stabilized) and a water resistant layer is installed to prevent rising water from the ground penetrating the wall.

Detail exterior wall 1:10
In this detail it becomes clear how the exterior wall is carried my the masonry vault, hereby set blocks are necessary. This allows vertical expansion gaps and prevent cracks in the façade The non-constructive vault (present because of the technical shaft), is spanned by a natural stone . The vault is topped with a layer of sand and screed and finished with adobe tiles. The double glazed windows with timber frames are hinged on the side and at the bottom. It allows to clean the window and ventilate with different positions (one more secure than the other). The double layered windows prevents noisy sounds from the street to enter the bedroom. And since the windows are placed on the inside of the wall the timber frames will be less affected by rain and will require minimal maintenance. Also here the timber window frame is connected by a steel profile and stone plugs with the façade. The steel profile is covered by an CSEB tile or CSEB window sill (both 3% stabilised).

Detail Gallery 1:10
The gallery detail shows the difference in floor hight and the integrated sliding steel security bars. Also here the double glazed window with timber frame is hinged on the side and at the bottom allowing a variety of ventilation positions, some more secure than others. In the façade of the gallery emergency drainage is implemented as well. The perforated balustrades are visible and the integration of the horizontal tie beam and lintel with the façade. They both are a composite of CSEB (3% stabilised), concrete and steel reinforcement, in order to bear the tension forces.

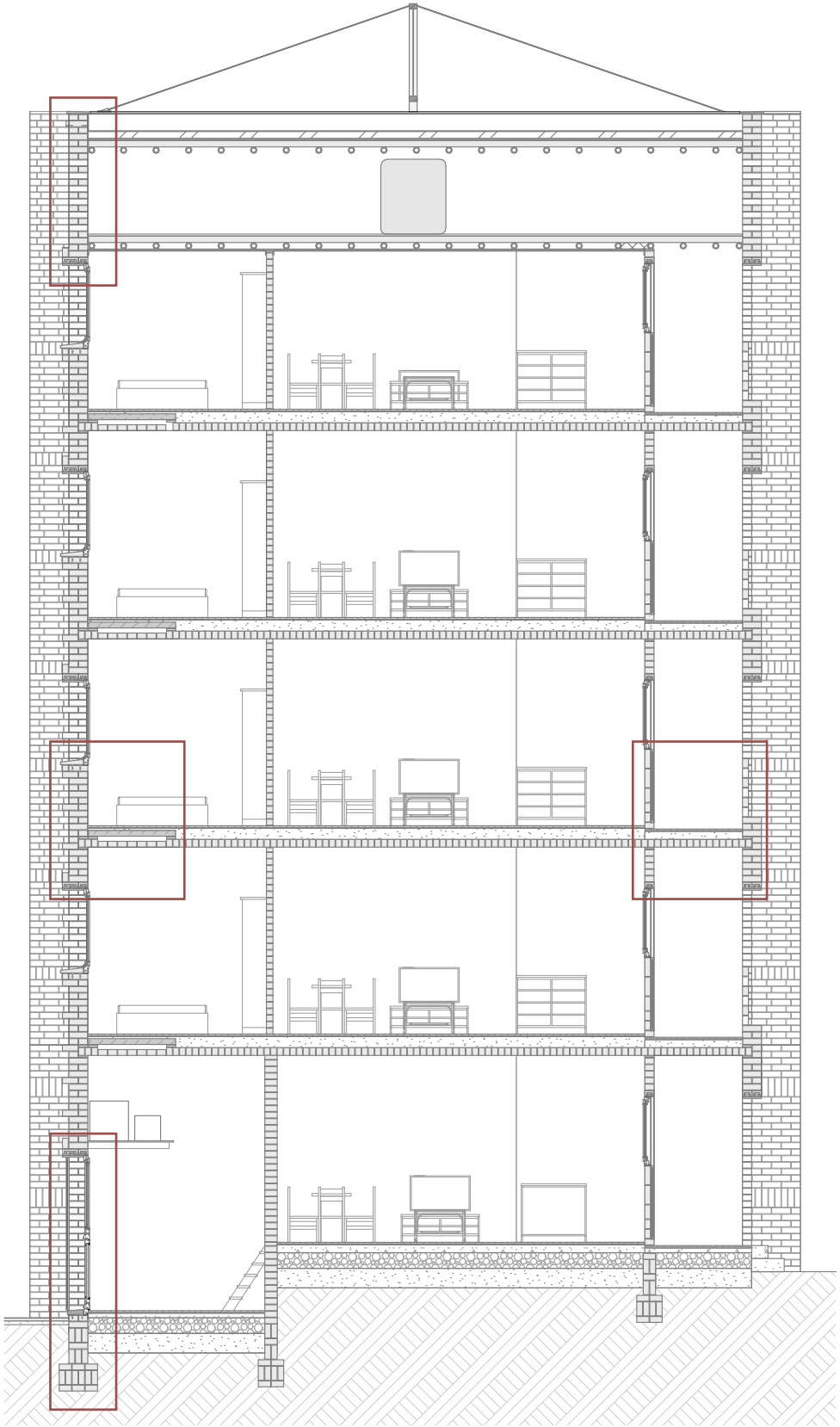


Figure 3.15
Cross section
1:100

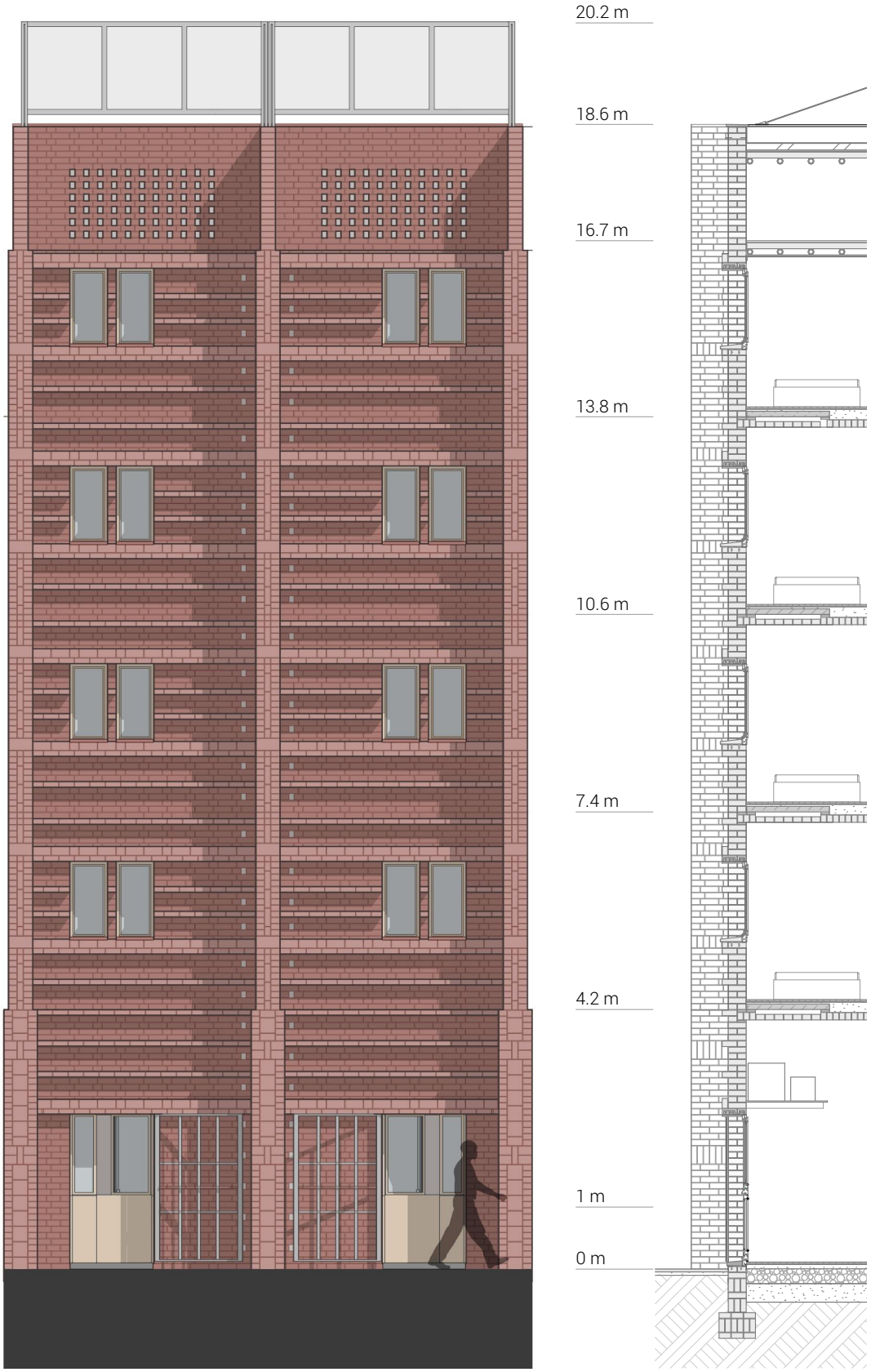
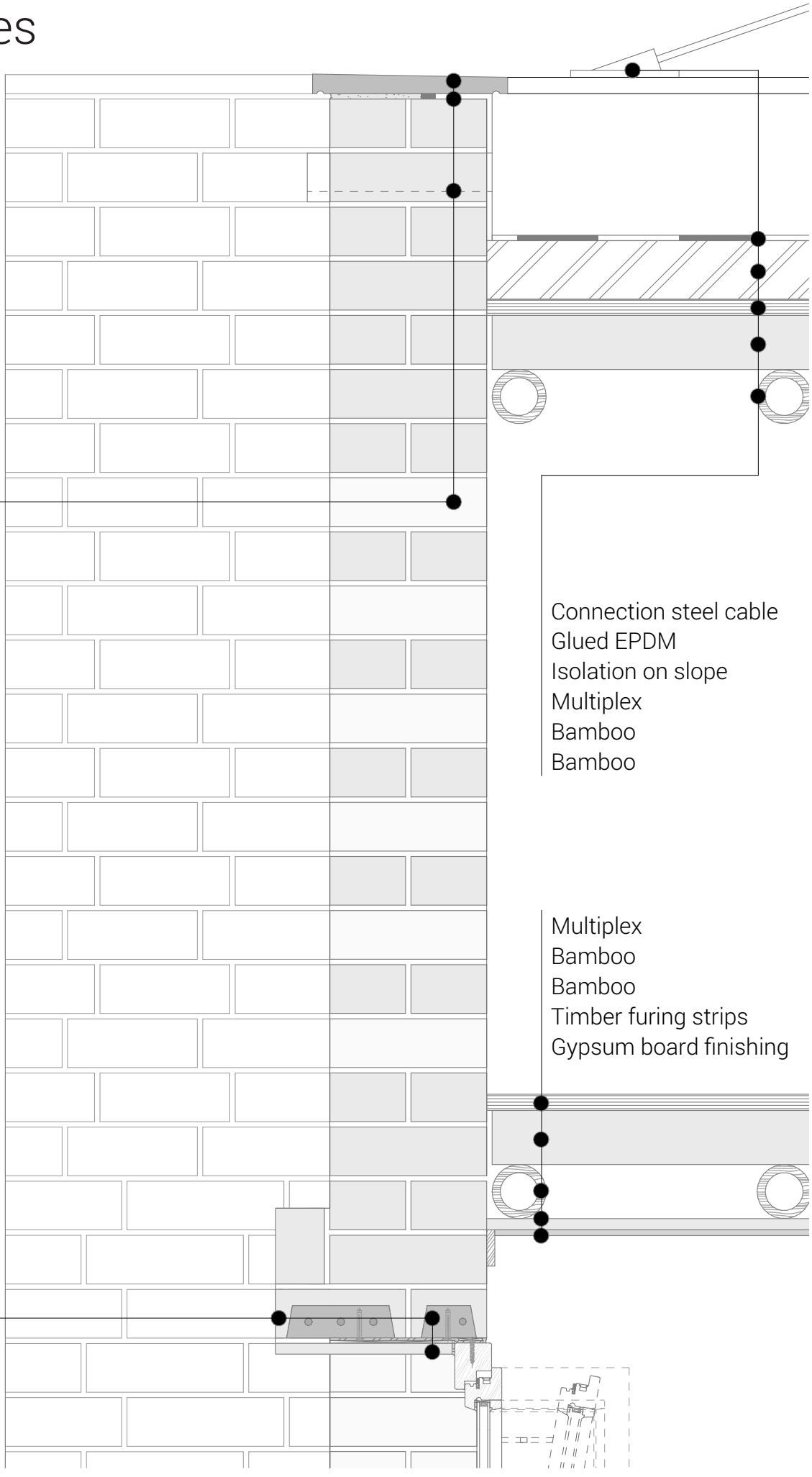


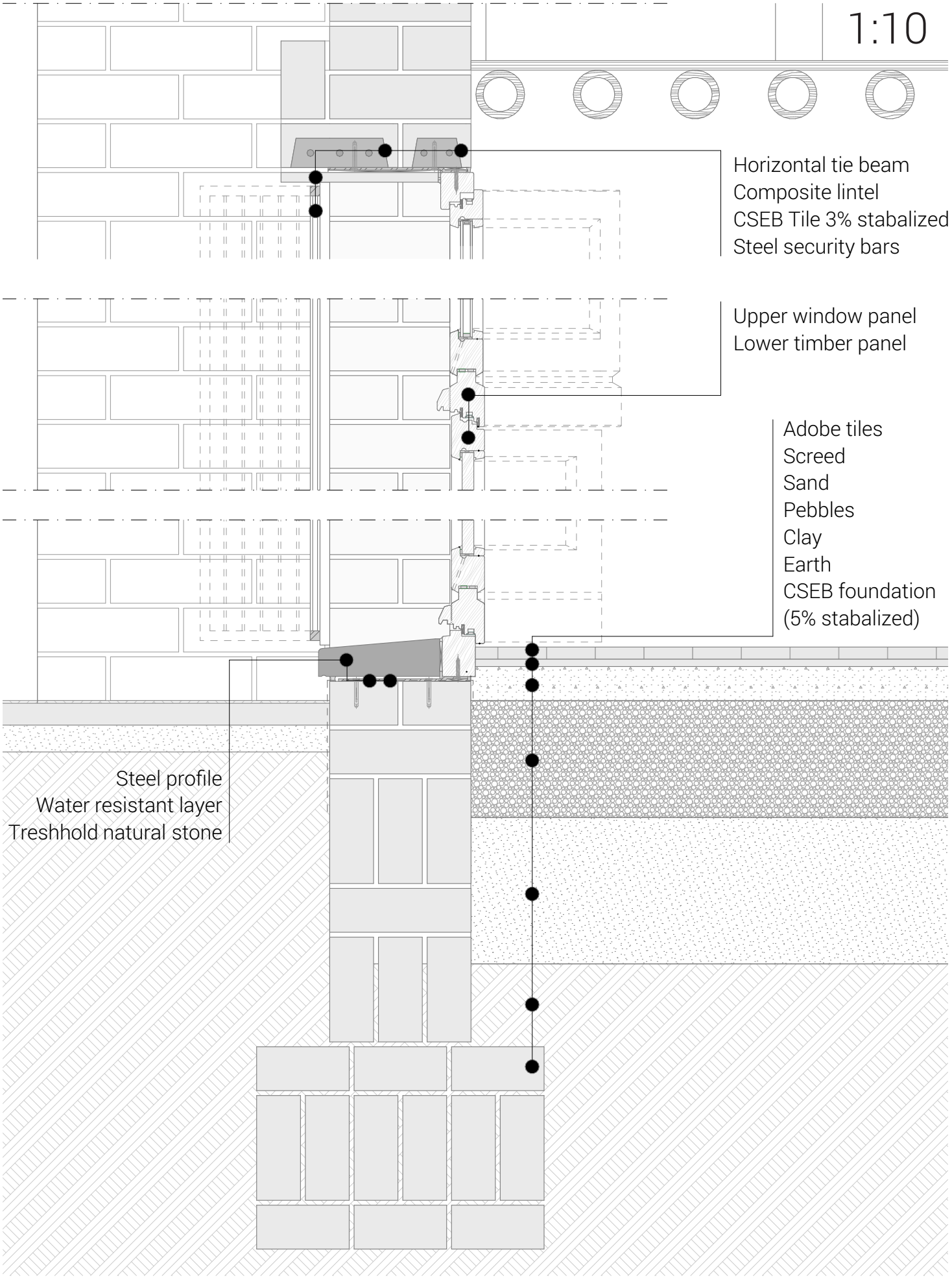
Figure 3.16
Cross section in relation with architectural expression facade.
Street side
1:100

Figure 3.17
Cross section in relation with architectural expression facade.
Inner courtyard side
1:100

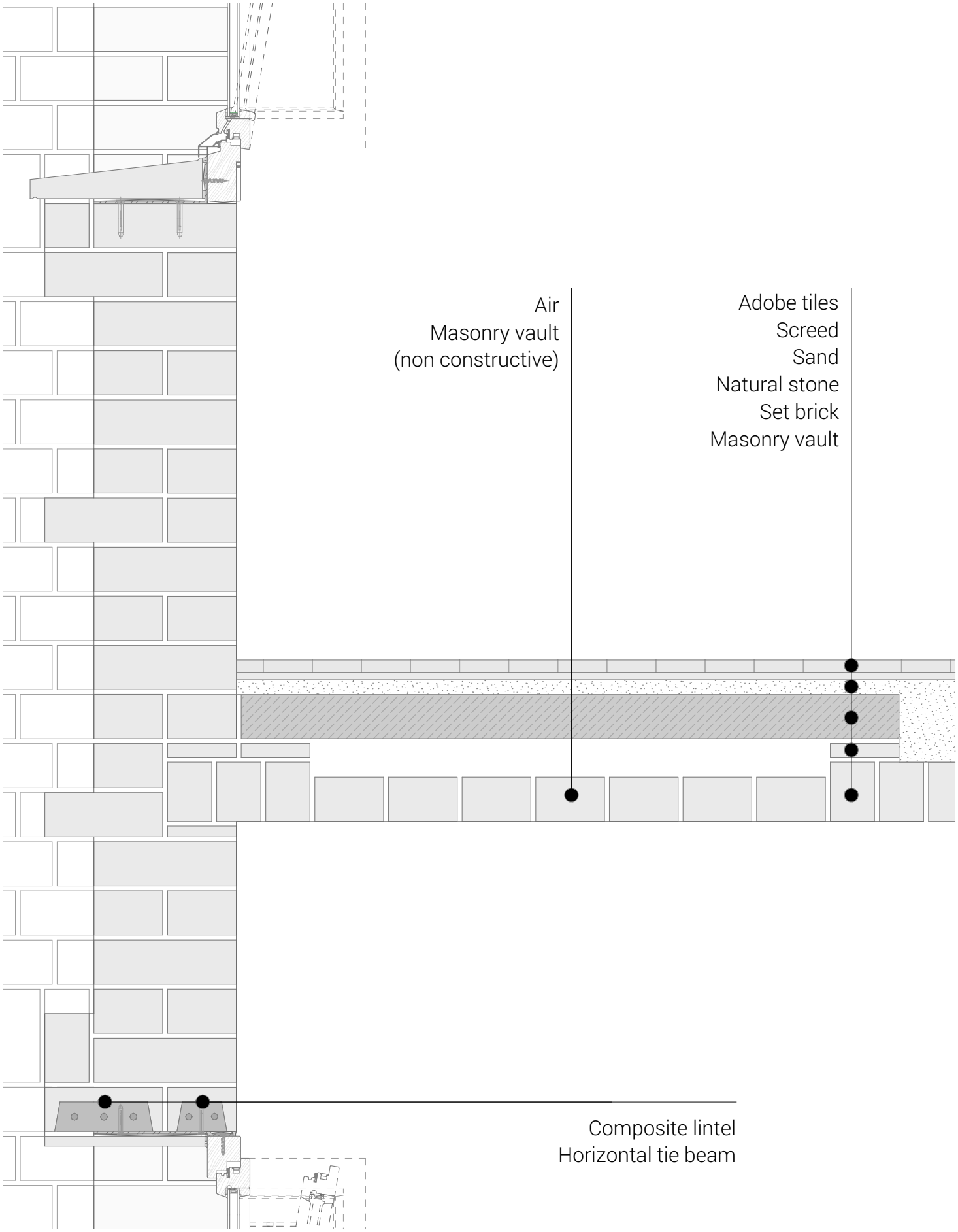
Detail eaves
1:10



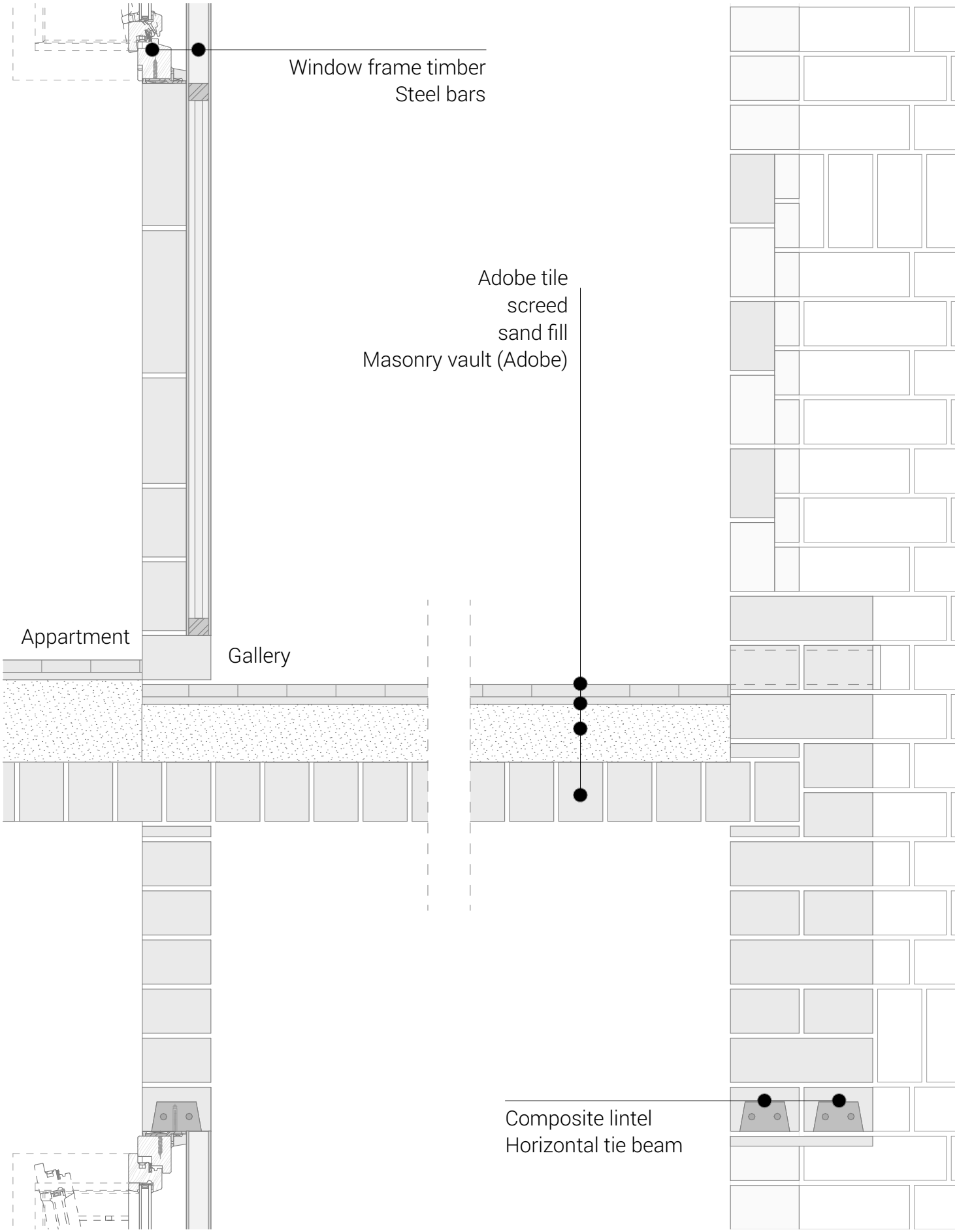
Detail dutch door
1:10



Detail exterior wall
1:10



Detail gallery
1:10



14 Conclusion

Conclusion

In my problem statement I came up with the following research question:

How can the dwelling landscape contribute to the development of a healthy 'river culture' in Addis Ababa and vice versa?

The proposed design integrates the water linked ecosystems within the urban fabric. The waterbodies play a crucial role within the environmental, social, economic and technical domains of the design proposal. They restore the ecosystems and thereby the historical identity of the waterbodies as it was before. The urban wetland creates a buffer for runoff water in order to prevent floods during peak falls of rain. Besides, the helophyte filter systems enables the natural purification of the river and the gross pollutant retention from the neighbourhood. Within the social and economic domain, the urban wetland and the green wedges play a vital role in the functioning of the productive urban open space system. With the urban agriculture facilities, recreational areas, food forests, household supportive amenities, playgrounds, social (shaded) gathering spaces and facilities that support fixed and flexible commerce, it serves the social and economical informal needs of the inhabitants. Moreover, technical interventions on a building scale buffer and harvest water for household purposes as much as possible.

Also regarding materiality, environmentally responsible choices, in line with the ideals of a river culture, have been made which support local economies as well. Earthen blocks and bamboo as main construction material minimizes the carbon oxide footprint and are locally available. Although a system with earthen loadbearing walls and masonry vaults is quite limiting, the efficient and responsive layout of the plans allows flexibility for future adaptations.

In addition the river culture is not at the expense of densification. the efficient and versatile modular building system of this design proposal is responsive to its environment and enables an urban scheme which increases the FSI of 24Kebele from 0,4 towards 2,7. Moreover, with this system a plot based development is possible which minimizes the eviction of local residents. The principle of the urban scheme could develop along the rivers of the city, and in this way, could alleviate the pressure on the housing stock in Addis Ababa on a big scale.

As discussed above, the qualities and properties that the river and the waterbodies possess, have been exploited to the utmost. To the point where it is beneficial for the environment itself and the dwelling landscape in a harmonious way. The dwelling landscape contributes to the development of a healthy river culture by creating space for waterbodies to properly exist. Besides, as a result of the evolvement of the productive urban open space system, the waterbodies have become a valuable asset interwoven in the daily patterns of life. This works vica versa as well; The river culture creates a framework in which people can participate in to sustain themselves. So I believe it means that the project blurred the boundaries between the dwelling landscape and a river culture, between people and nature, and contributes to a synergetic environment between the urban dwellers and the rivers of the city.

Figure 14.1
The green wedge

15 Reflection

Topic, research and design

Throughout my whole master program I have had a strong focus on sustainability and social aspects such as participation. Especially the relationship between people and nature is a topic which interests me deeply, as well as the low-tech interventions that go hand-in-hand with it. All this came together in this graduation project: Global Housing Graduation Studio: Addis Ababa Living Lab. This project has given me the opportunity to explore and work on these aspects extensively in each little detail.

During the fieldwork I noticed the distorted relationship between waterbodies and urban dwellers in the city of Addis Ababa. This also struck me during visits to other fast emerging cities where I have been before. It made me dig into water related issues in Addis Ababa and its many connections to dwelling. From these observations my problem statement emerged, resulting in the following research question: How can the dwelling landscape contribute to the development of a healthy 'river culture' in Addis Ababa and vice versa? Defining this research question was the start of creating a substantiated narrative for my graduation project. This became the guideline of the project and ensured the alignment between research and design. In this way I tried to follow a heuristic research process where research and design are in constant exchange. Based on my substantiated narrative, I took purposeful design decisions, especially in the beginning of the project when there was enough time and when the project was taking shape. However, as the project progressed, it became more complex and deadlines came closer and closer. Making it harder to proceed this intensive exchange between design and research. Nevertheless, I think I have always remained close to my projects' narrative. I believe that the extensive research I did for my problem statement formed a strong foundation and helped me enormously throughout the project, especially at those times.

Research methods

For this studio, three phases of research have been carried out. In the first phase a background study has been conducted to gain a better understanding of Addis Ababa and Ethiopia as a whole. This research formed a collective knowledge base on aspects such as climate, politics, urban growth, housing typologies, economy etc. This was supported by a selection of articles and books on low-income housing, dwelling in Addis Ababa and participatory planning and design. The first phase of the research formed the backbone for the second and third phase; the fieldtrip and the design assignment in general. I experienced that this knowledge base was essential to conduct a useful fieldwork research and to start the design process.

In the second phase, during the field trip, architectural ethnographic research has been used as a research method to get a better understanding of the everyday life and inhabitation patterns in Addis Ababa and more specifically in the neighbourhood 24 Kebele. It gave me an exceptional and valuable insight inside the gated communities in the neighbourhood. This form of research enabled me to design a built environment which resonates with local practices. Moreover, the ethnographic research I carried out in Mickey Leland site gave me insights in condominium living, from which I drew lessons on the qualities and shortcomings of Addis Ababa's current mass housing vision. By critically reflecting on this post-war housing scheme in an essay I concluded that mass housing is a logical response to extreme housing shortage. However, its narrow focus on apartments does not create a liveable dwelling environment. Therefore, in my thesis I argue that it is essential for residents to participate and have control, within a set framework/design, over
the majority of the outdoor spaces, making the neighbourhood socially activated and sustainable. This argument is central to my urban and managerial proposal for the project.
In the third phase, carrying out the actual design assignment, I continuously consulted literature at each design step I took. As the project got more complex and extensive, it was challenging to ensure the heuristic process of connecting design with research. However, with a strong foundation in the form of a clear vision and problem statement, I was able to narrow down my focus and carry out goal oriented research. In this way I made design steps fitting and strengthening the narrative of my project making my design propositions firmly grounded in ethnographic research and literature study, and provide a clear answer to the research question of the problem statement.

Ethical dilemmas and potential application of results in practice

In doing research, I had one major ethical dilemma. This concerned my position as researcher, and the sole agency on subject selection. As a researcher I can choose the literature, and I have the impression you can substantiate any possible standpoint based on the wealth of sources. Looking back at my design process, I might have had, as one would call, a 'tunnel vision', towards a 'goal' I wanted to aim for, which fits in the narrative of my project. I took design decisions considerately, but was I actually critical enough about particular choices? Did I search for all the downsides of the solution which fitted the narrative of my project best and had so many pros? Probably not. This is a dilemma and an issue which I feel with many projects and articles I see around me. And I believe it is not always wrong, maybe one becomes even indecisive by 'over consideration'.

However, this is something that kept 'gnawing at me' during the research process, but made me more and more considerate about my decisions.
Also in my design I had one specific ethical dilemma, that I have still not come to terms with completely. This concerns my 'modernist' top-down approach towards the project. In the beginning of the project I made the decision that for such a large scale landscape and dwelling project a top down approach is necessary to accommodate quality, harmony and the necessary big amount of dwelling units. Although, the introduced public spaces in my project form only a framework in which the residents participate and have control over, in the bigger scale, it still is a modernist urban super block approach. For me the question remains, is there another way, instead of this type of top-down approach, to accommodate so many residents on this small plot with space for nature as well? And in addition to this concern, am I in the right position, as a Dutchman with limited knowledge of Addis Ababa, to be the architect?

Therefore, it was easier for me to focus on an alternative perspective in connection with low-cost housing. In this way a vision on how to (re)connect people with waterbodies following water management schemes and technologies for dense low-cost housing could be from my perspective ethically a more appropriate consultation. And I think that specifically these applications could have a big impact for (fast emerging) cities such as Addis Ababa, where waterbodies are a problem instead of an asset. With this project I try to show how waterbodies can be of value for a water linked neighbourhood on a social and technical level in the context of Addis Ababa. Therefore, I believe that within these visions and 'water-perspectives' potential applications in practice are intertwined. Especially because I followed the motto 'preserve what works', which makes the actual application of ideas of the project Wmore accessible. This becomes prevalent in, for example, the proposed urban scheme by preserving the current urban structure and the managerial process by improving the current condominium system and introducing existing (informal) stakeholders such as the Iddir. Moreover, building with alternative building materials (earth and bamboo) and implementing low-tech water management technologies (such as helophyte filters, water buffers and fog catchers) may also be interesting within the professional and scientific framework. But also social aspects that are prevalent in the project may be relevant. The project shows how waterbodies can be accessible and be an added value for different classes in society. Besides, managerial wise it tries to create natural public spaces that can sustain itself, by nature and people. Through these insights, I have come to the belief that my project can contribute to the insights on how to implement (or not) projects focused on low-cost housing and creating harmony between urban dwellers and waterbodies.

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