INCREMENTAL HIGH-RISE

Housing project for the Hawkers Market in Sylhet, Bangladesh

Colophon

University of Technology Delft, TU Delft. Faculty of Architecture, Urbanism and the Build environment. Department Of Architecture, Group Global Housing. MSc3/4 Graduation Studio (AR3AD105) Architecture of Transition in the Bangladesh Delta (2024/2025).

Author: Julian Wijnen

Main mentor: Prof. Dick van Gameren

Second mentor: Ir. Rocio Conesa Sánchez

Research mentor: Ir. Frederique van Andel

Other supervisors: Prof. Marina Tabassum
Dr. Nelson Mota
Ir. Rohan Varma
Ir. Antonio Paoletti

Cover: Design synthesis illustration, by Julian Wijnen

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Figure 1: Madhabpur Lake. Picture by Julian Wijnen

Foreword

This booklet is a written and visual record of the graduation year of architecture masters student Julian Wijnen. After the Bachelors and the masters 1 and 2 semesters at the faculty of Architecture, Urbanism and the Built Environment at the University of Technology Delft (TU Delft) Julian embarks on this one year long project within the scope of the Global Housing Studio finalizing his studies in Delft.

Global housing studio

For the final year of the architecture masters a studio is to be chosen under which direction in architecture the student likes to graduate. In this case the Global Housing studio was chosen. This studio focuses on housing in relation to challenges relating to topics like density, urbanism or environmental influences; mainly looking at the situations of countries part of the global South. One such country is Bangladesh, therefore the bigger part of the graduation - the graduation project itself - is set in the city of Sylhet, Bangladesh.

Figure 2: Picture by Danai Makri

Figure 3: Laldighirpar Rd. Sylhet. Picture by Julian Wijnen

Bangladesh

Bordering the Sea of Bengal to the South, Myanmar to the East and being almost enclosed by India on all other sides Bangladesh is a relatively small country in Asia with one of the highest population densities in the world. Its citizens are mostly Islamic. Bangladesh faces multiple nationwide challenges, having to deal with high population growth rates, rapid urbanisation and regular nationwide floodings, while a significant part of its citizens are among the poorest in the world. Next to the capital city of Dhaka there are few other metropolis in the country like Chittagong, Kulna, Rangpur or Sylhet, of which the latter in particular is facing the challenges named before. This makes the city of Sylhet an interesting case study for the Global Housing graduation track.

Figure 4: Painting of the Barbican Estate by Liam O'Farrell

01 START-UP ASSIGNMENTS

September 2nd 2024 - November 25th 2024

At the start of the studio a series of assignments were given to the students to get a better understanding of the definitions and methods that are used in the Global Housing studio. The first being a case study of a well-known housing project from around the world: the Barbican Estate (see figure 4). The second being a case study analysis of a housing project in Bangladesh: the Joypurhat housing for mining workers. The third one: an exercise on density where cases from the first two phases needed to be combined to reach a certain floor space index (FSI).

Phase 1: Barbican case study analysis

After bombings during World War II left parts of London in ruin, the City of London brought in Chamberlin, Powell and Bon to come up with a design for the redevelopment of a 13 ha plot of land in the North of London surrounding St Giles Church after their earlier success with designing the nearby Golden Lane Estate. A Corbusian vision for a city within a city, complete with schools, shops, lush open spaces and its own cultural center was presented in 1959 after which construction started seven years later and finished in 1976. The complex, designed with a brutalist architectural appearance, became known as the Barbican Estate or the Barbican in short.

Figures 5 to 9 depicts the drawings made for the analysis of Andrewes House, a part of the Barbican Estate project. Figures 8 and 9 are the posters that were the end result of this first phase assignment.

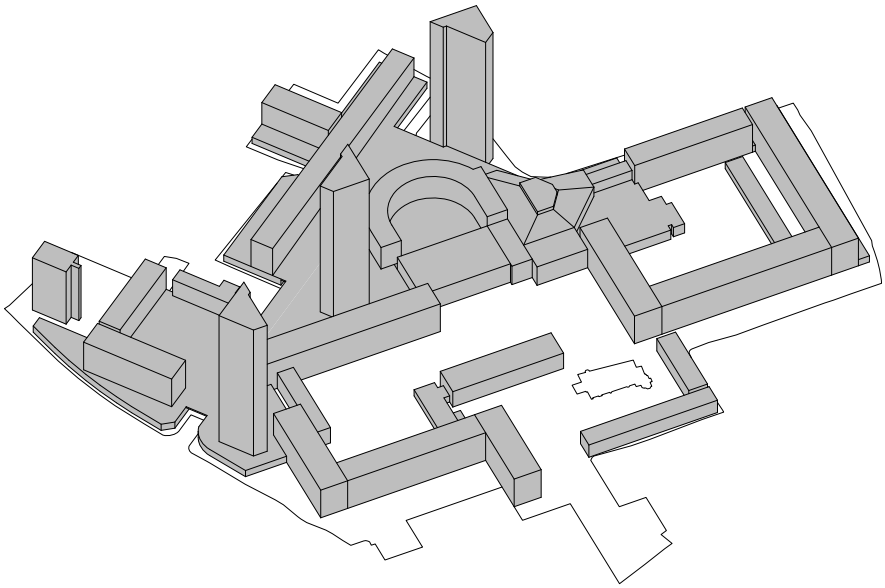


Figure 5: Barbican building volumes, isometric projection

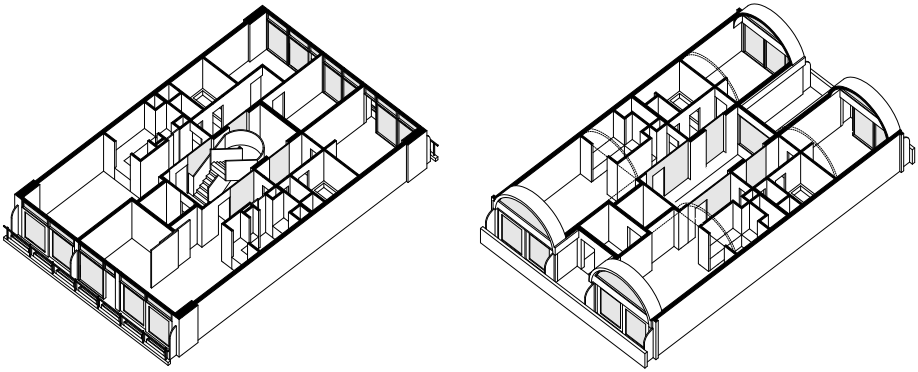


Figure 6: Barbican dwelling types 20/21 (left) and 23 (right), axonometric projection

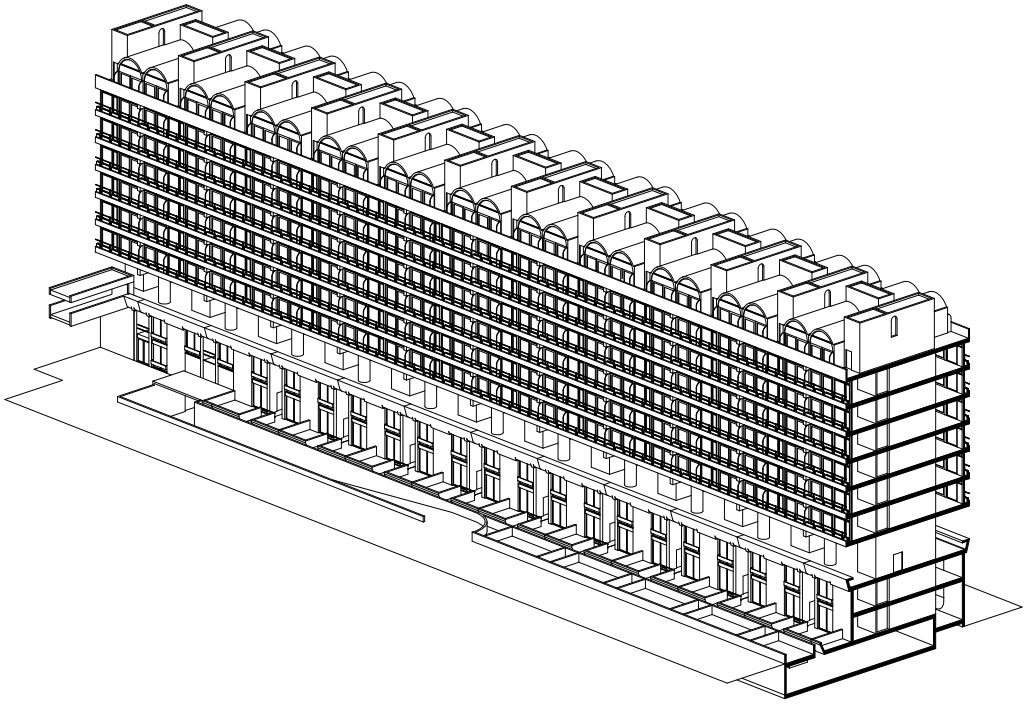
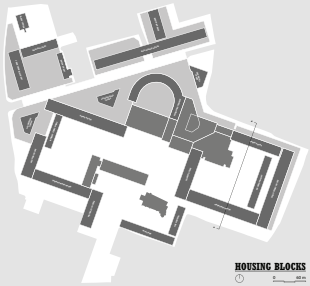
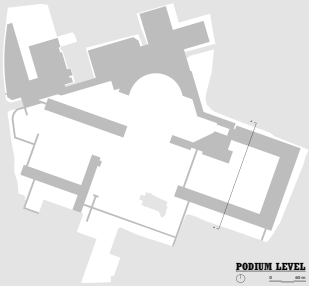


Figure 7: Barbican block: Andrewes House, isometric projection

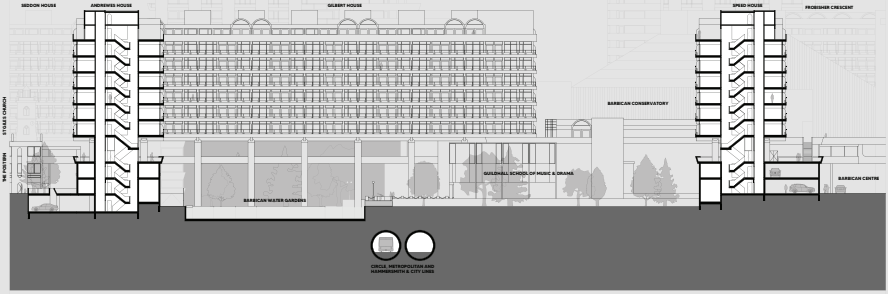
Blocks	Dwellings	Floors	Circulation
Terrace blocks:			
Andrewes House	192	11	Multiple cores
Ben Jonson House	204	11	Split-level corridor
Breton House	111	11	Split-level corridor
Bryer Court	56	11	Internal gallery
Bunyan Court	69	11	Split-level corridor
Defoe House	178	11	Multiple cores
Frobisher Crescent	69	10	External gallery
Gilbert House	88	7	Corridor
John Trundle Court	133	11	Split-level corridor
Mountjoy House	64	7	Corridor
Seddon House	75	7	Corridor
Speed House	114	11	Multiple cores
Thomas More House	163	11	Multiple cores
Willoughby House	148	11	Split-level corridor
Towers:			
Blake Tower	74	20	Central core
Cromwell Tower	111	44	Central core
Lauderdale Tower	117	44	Central core
Shakespeare Tower	116	44	Central core
Mews:			
Brandon Mews	26	3	Podium level access
Lambert Jones Mews	8	3	Podium level access
Townhouses:			
The Postern	9	4	Street/podium level access
Wallside	14	4	Street/podium level access
	2139		



HOUSING BLOCKS



PODIUM LEVEL



SECTION AA'

Barbican

London, Chamberlin, Powell & Bon, 1976

After bombings during World War II left parts of London in ruin, the City of London brought in Chamberlin, Powell and Bon to come up with a design for the redevelopment of a 13 ha plot of land in the North of London surrounding St Giles Church after their earlier success with designing the nearby Golden Lane Estate. A Corbusian vision for a city within a city, complete with schools, shops, lush open spaces and its own cultural center was presented in 1959 after which construction started seven years later and finished in 1976. The complex, designed with a brutalist architectural appearance, became known as the Barbican Estate or the Barbican in short.

Design Research: Global Housing

Global Housing Graduation Studio
Architecture of Transition in the Bangladesh Delta:
Autumn Semester 2024/25 [AR3AD105]

Tutors:

Prof. Marina Tabassum
Prof. Dick van Gameren
Ir. Rohan Varma
Ir. Frederique van Andel
Ir. Antonio Paoletti

Student:

Julian Wijnen

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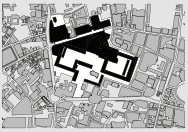
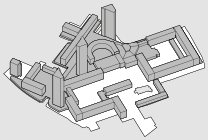
Figure 8: Barbican analysis synthesis poster

Neighbourhood



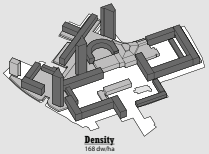
Plot
Area: 12,76 ha
Dwelling Units: 2139

Program
Residential= 147.978 m2 + Educational= 1.750 m2 +
Cultural centre= 18.015 m2 + Parking/shops/other= 41.500 m2



FSI/FAR
2.30

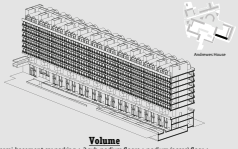
GSI
0.50



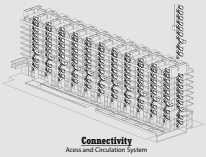
Density
168 dw/ha

Block

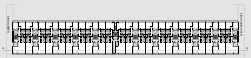
Andrewes House



Volume
semi-basement car parking + 2 sub-podium floors + podium (acces) floor +
6 flat apartments floors + 1 penthouse floor



Connectivity
Acess and Circulation System



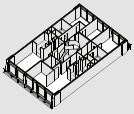
Typical Floor Plan
Dwelling Types 19(H), 20, 21, 57, 58

Podium Level Floor Plan
Access Points

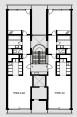
Section BB'
Locating Dwelling Types

Unit

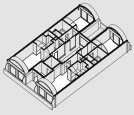
Flat Type 20 & 21
Area: 63,9 m2 & 65,4 m2



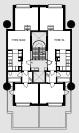
Flat Type 20 & 21
Area: 63,9 m2 & 65,4 m2



Penthouse Type 28(H)
Area: 55,4 m2



Penthouse Type 28(H)
Area: 55,4 m2



Sub-podium flat Type 76(H)
Area: 57,7 m2

Barbican

London, Chamberlin Powell & Bon, 1976

Plot Area: 12,76 ha
Number of Dwellings: 2139
Density: 168 dw/ha
FSI: 2.30
Unit Sizes: 45 m2; 260 m2 (88 m2 average)
GSI: 0.50
Client: Greater London Council
Scheme: Mixed use residential
Design: Chamberlin Powell & Bon
Tenure: Home Ownership

After bombings during World War II left parts of London in ruin the City of London brought in Chamberlin, Powell and Bon to come up with a design for the redevelopment of a 13 ha plot of land in the North of London surrounding St Giles Church after their earlier success with designing the nearby Golden Lane Estate. A Corbusian vision for a city within a city, complete with schools, shops, lush open spaces and its own cultural center was presented in 1959 after which construction started seven years later and finished in 1976. The complex, made in a brutalist architectural appearance, became known as the Barbican Estate or the Barbican in short.

The plan existed out of a combination of 3 slender 44 storey towers, 18 terraced blocks of around 10 stories high, a grand cultural center and a hotel later to be transformed into housing. Every building within the estate is connected by a single podium terrace stretching the whole complex so as to even link up the northern and southern parts of the Barbican otherwise being divided by Beech street. The terraced blocks in the north of the estate were placed either parallel or perpendicular to Beech street, while the southern Blocks are placed in an orthogonal grid in line with the St Giles Church and a remaining part of the historic London Wall. Most of the southern blocks surround two linked sunken courtyards filled with terraces, greenery and the Barbican water gardens.
The Barbican now holds a total of 2139 dwellings housing around 4000 people. There are 140 different types of dwellings ranging from studios, maisonettes, penthouses, to 1 up to 5 bedroom flat apartments. The floors of the 3 towers are mostly identical in layout with each containing 3 flats units on each level except for 2 floors of penthouses at their tops. The terraced blocks are all accessed from the podium level with each having 7 or 8 residential floors stacked on top. Underneath the podium level (sub-podium) the blocks are either open space, held up by columns, or filled in with a 2 or 3 storey base filled with flats, parking and other amenities.

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Figure 9: Barbican analysis graphic abacus poster

Phase 2: Bangladesh housing case study analysis

The discovery of limestone deposits near the city of Joypurhat, located in the Rajshahi district in the North-West of Bangladesh, led the Oil and Mineral Exploration and Development Corporation to develop extensive housing and other facilities for mining workers. This walled complex has a campus layout and is situated on an open plain on the southern edge of the city. The project design follows Planning Commission guidelines for government housing, establishing distinct housing zones for different levels of officers and workers. The campus supports 2,000 employees and their families, with it including facilities such as a clinic and hospital, a school, playing fields, a bazaar, and a mosque.

Figures 10 and 11 depict the drawings made for the analysis of Andrewes House, a part of the Barbican Estate project. These drawings were bundled together with the analysis of other students into a booklet.

Figure 10: Joypurhat workers housing block volume, isometric projection

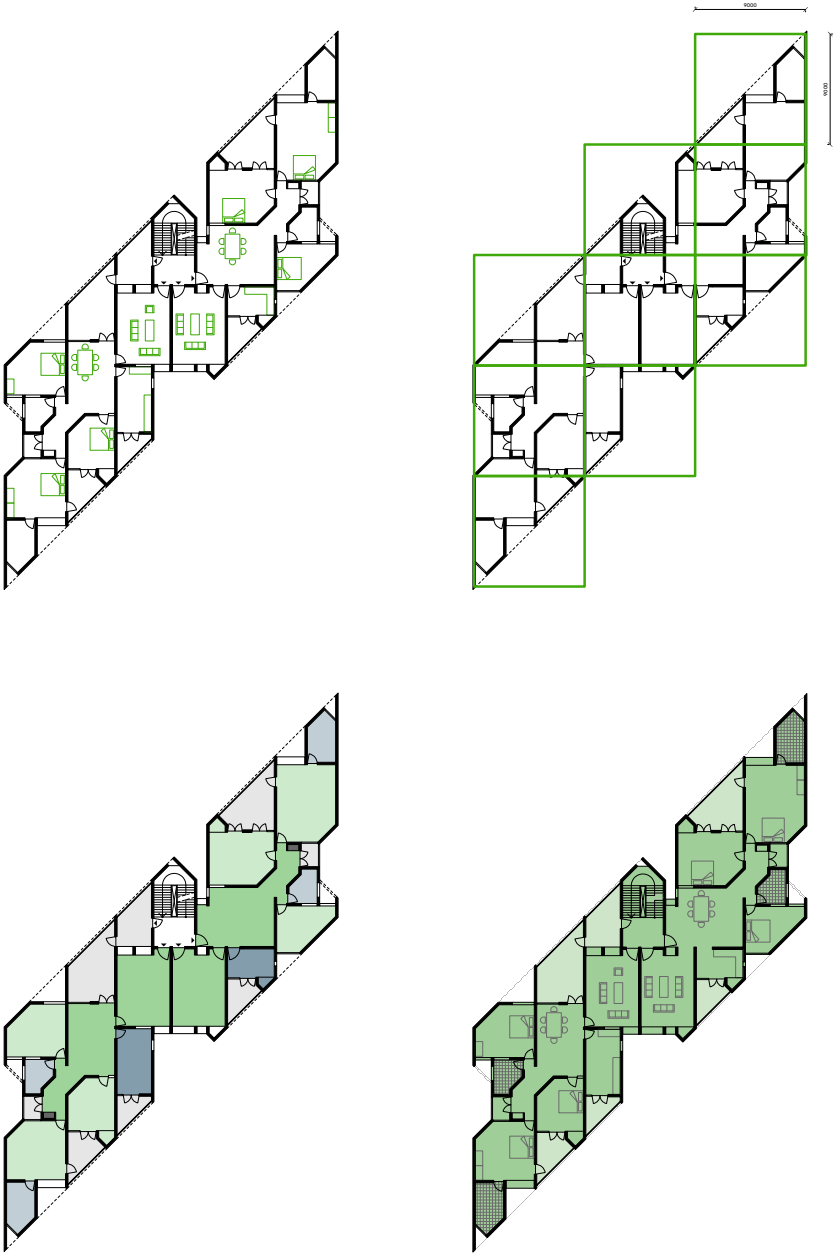


Figure 11: Joypurhat workers housing block floorplan breakdown

Phase 3: Density exersice

For the third and last phase of the studios start-up assignments a 1 hectare plot needed to be designed that combined 2 or more projects from phase 1 or from the booklet produced in phase 2 in a way that it would result in a certain floor space index (FSI). I chose to go with the highest FSI proposed by the assignment: a FSI of 5. This meant a floor space of 50.000 square meters had to be created on the 1 hectare plot. This was reached by combining the Barbican by Chamberlin, Powell and Bon and the Comfort Reverie by Marina Tabassum Architects projects and adding some extra floors.

Figure 12 to 15 show the results of this assignment.

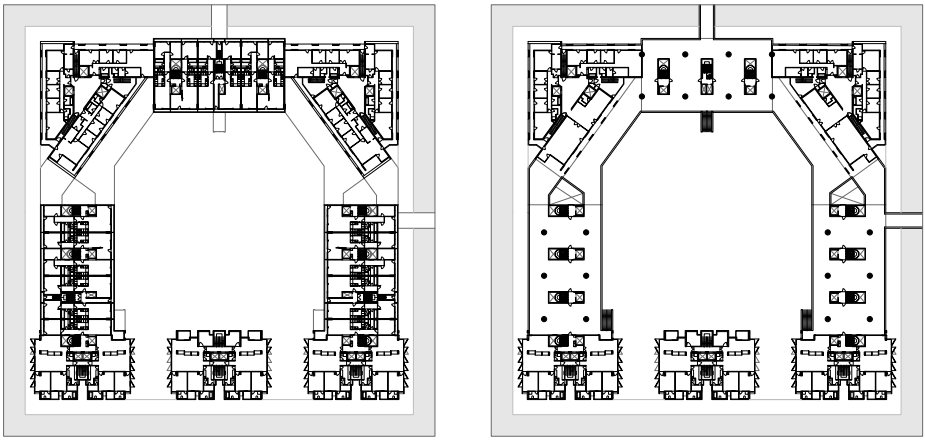


Figure 12: Ground floor and platform level floor plans

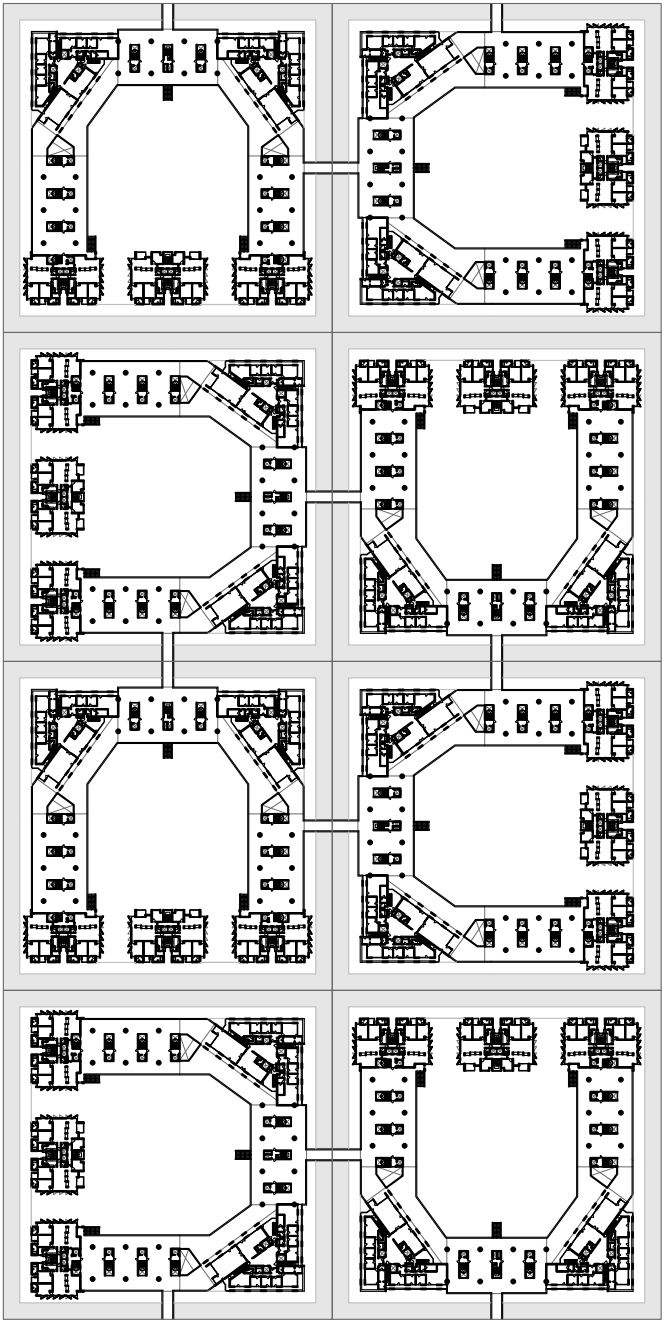


Figure 13: Interconnectivity of ha city blocks on platform level in plan

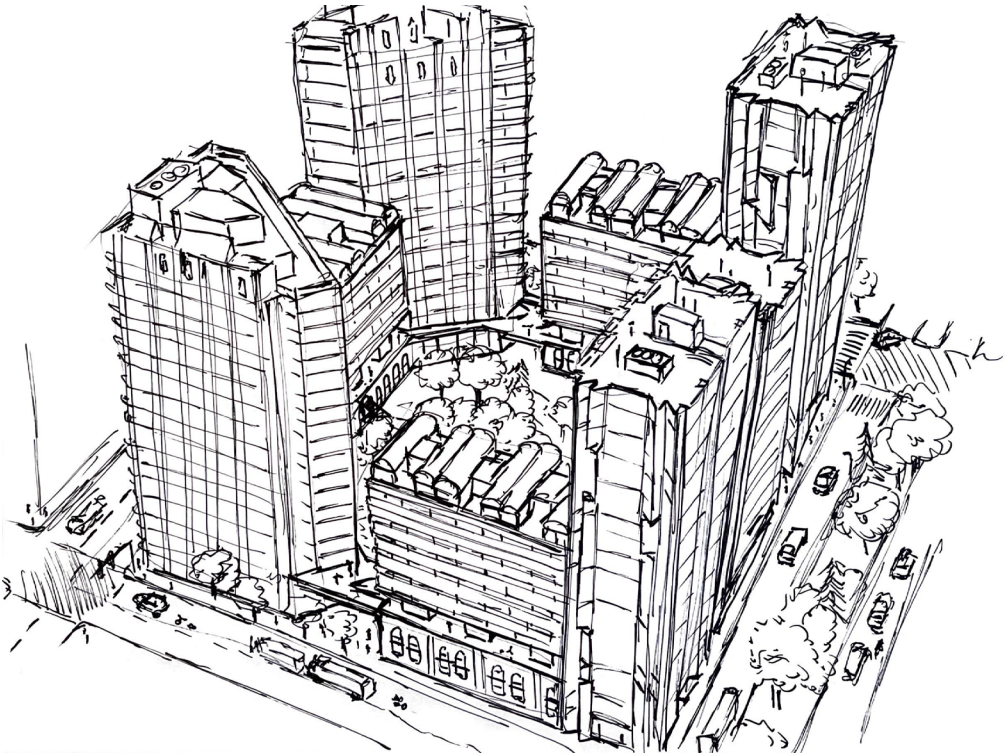


Figure 14: 1ha block impression

Figure 15: Picture of scale model 1:500

Figure 16: Highrise of Homes; For location in a major American city by SITE

02 Research

September 2nd 2024 - January 22nd 2025

This chapter goes into: the literature research phase that was done in the first semester of the graduation year that laid the groundwork for the design, the field trip and research and lastly the material research into Bangladesh' building materials.

Introduction

Bangladesh's capital city of Dhaka saw its already densely populated urban areas absorb a whopping 400.000 migrants over 2021 (Duque, 2024), culminating to an average daily influx of around 1100 people moving to the capital. Like Dhaka, other cities within Bangladesh and countries in the regions are experiencing the same growth rates (Alam & Mamun, 2022). Rapid urbanisation has become a problem to many of them, as the pressure on its cities and its services, infrastructure and housing capabilities has been steadily increasing over time (Tacoli et al., 2015).

In The New Landscape, urbanisation in the Third World, Charles Correa (1989) takes a good look at the upcoming third world's cities that are nothing like its western counterparts. These city's skylines are not marked by endless rows of sleek high-rises. Instead, informal settlements take up large swaths of the city's available space, which are mostly low-rise structures. Thus, densification of these cities happens mainly close to street level while a lot of space up in the air is left unused. Vertical growth could possibly be the answer to many of the problems that are consequential to urbanisation.

However, the inability of governments to keep up with rapid urbanisation has led to the exceeding numbers of informal settlements worldwide (Garland, 2013). These structures are mainly low-rise while simultaneously the living conditions in these areas are often of poor quality and unsafe. So how would you make high-rise available for these communities? One solution could be found in a relatively new form of architecture that is referred to as incremental housing. The intrinsic properties of incremental housing make for a housing scheme that is proven to be capable of giving low income home-seekers what they cannot provide themselves (Wainer et al., 2016).
Even though incremental housing has almost exclusively been realised in low-rise housing schemes, implementing incremental housing in a vertical way could be highly beneficial in the context of the rapid urbanisation plagued Bangladeshi cities.

This research will explore the properties and possibilities of a design that incorporates the use of incremental housing in a high-rise structure for a site within the dense urban fabric of the city of Sylhet. The research is hoped to contribute to solving some of the housing problems that arise from urbanisation.

Rapid urbanisation

It is commonly believed that urbanisation is mainly driven by rural–urban migration through the promises of jobs in the city as described by Correa (1989). In contrast, the actual main cause of growth within a city nowadays typically originates from natural population growth (Tacoli et al., 2015). Thus, growth has mainly come from within the city itself. Policy makers in the cities facing rapid urbanisation are often neglecting the fact that this is the case, according to Tacoli et al. (2015). The policies they come up with are mostly meant to prevent rural-urban migration; the thing they believe to be the main problem of urbanisation. This has predominantly negatively influenced the poor, which is enforcing the concerns that scholars have about the ability of national and local governments to deal with rapid urbanisation.
These poor people especially will often forgo housing quality for the sake of a good location (Wainer et al., 2016). Thus, the parts of the cities that suffer most of the consequences of urbanisation are the highly congested central areas that become more and more dense through the need for living at a good location. The orderly densification of the city is therefore key in tackling the problems that arise from rapid urbanisation.
Different scholars (Marx et al., 2013; Gunter, 2024; Wainer et al., 2016; Napier, 2002, Bredenoord & Van Lindert, 2010; Garland, 2013) seem to agree on the big role of responsibility of the state in creating livable and sustainable city neighbourhoods, by overseeing the process of allocating the cities resources to the right places as well as being the facilitator of its densification processes. Woefully, many of these scholars seem to agree on the widespread governmental mismanagement that is taking place in many countries, specifically in the global south.

Urbanisation in Bangladesh

Even though the population growth of Bangladesh has been in a gradual decline ever since the mid 1980's and is expected to reach negative growth somewhere in the second half of the twenty-first century (United Nations Population Division, 2024), the major cities within the country are facing the exact opposite due to urbanisation (Alam & Mamun, 2022). The capital city of Dhaka absorbed a whopping 400.000 migrants over 2021 (Duque, 2024), while for that same year the ratio of people living in Bangladeshi cities grew with 3.14 percent, accumulating to 40.47 percent of the country's inhabitants living in urban environments (see figure 17).

The Bangladeshi are facing an additional driver for its cities' rapid urbanisation: climate migration. The country is repeatedly plagued with natural disasters as well as the consequences of climate change leading to climate driven migration, which is mostly internal (Duque, 2024). Bangladesh is seen as one of the most vulnerable countries to climate change (Anik & Arfin Khan, 2012).
Most notably are the floods that occur annually and cover large parts of land with water. The Bangladeshi are facing excessive water during the rainy season, causing floods as well as flash floods (Anik & Arfin Khan, 2012). The area in the north-east of Bangladesh surrounding the city of Sylhet is struck the most by these floods (see figure 18).

Climate driven migration is becoming a serious problem, while at the same time it seems to be ignored by policymakers. Rana & Ilina (2021) point out the unpreparedness and ignorance of authorities for the unexpected consequences of rural to urban migration. "The authorities are not prepared for and even deny the existence of migrants in the cities." (Rana & Ilina, 2021, pp. 6)

Informal settlements

Cities facing rapid urbanisation have historically always struggled to allocate adequate housing in time to its (new) inhabitants; as Mota (2021) describes the global housing status quo of being one in a permanent crisis since the

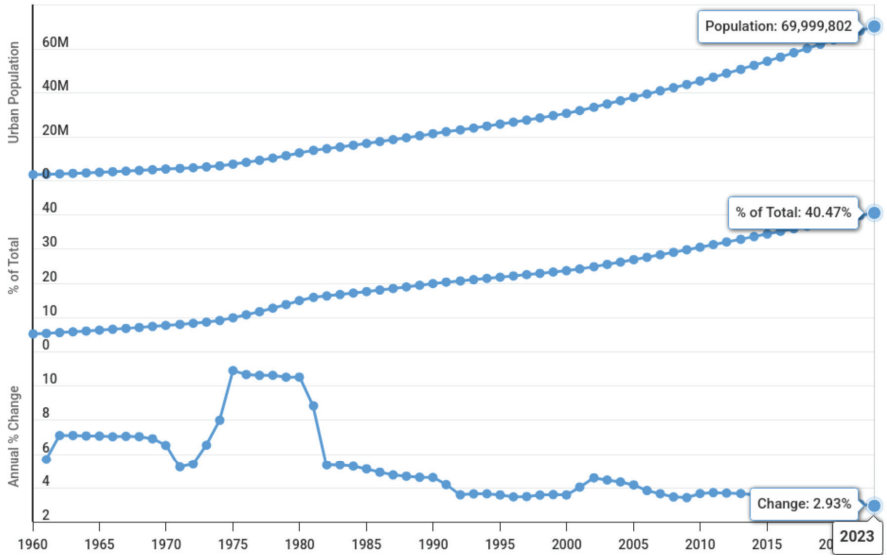


Figure 17: Bangladesh Urban Population 1960-2024.

Industrial Revolution (if not since forever). According to him the implications of urbanisation on the access to adequate housing is one of the critical challenges to be faced in the coming decades. With the government overwhelmed by the size of the housing shortages, the city's newcomers often have no other option than to resort to building informal forms of housing, with these areas of the city becoming known as informal settlements or slums (Marx et al., 2013).

Huchzermeyer (2003) provides evidence that housing ownership is out of reach for the poorest and newest arrivals in cities. This pushes them into manoeuvring themselves through the informal rental market. Gunter (2014) describes that through informal housing, the entry to the housing market in many cities in the global south is made. The families living in these neighbourhoods are often among the poorest with savings being small to none. She names a few factors such as high and rising costs of ownership, inability to apply for subsidised housing, irregular and low income to be among the causes of this.
The people living in these informal forms of housing are in many cases not eligible for loans, consequently they acquire their spaces on a brick-by-brick basis. Therefore, a form of self-help housing is taking root in many big cities around the globe. This form of housing can best be described by Jimenez (1982) as it: "implies a "progressive" step-by-step development which enables a household to phase in its capital and other resource investments in accordance with a variable income stream." (pp. 206)

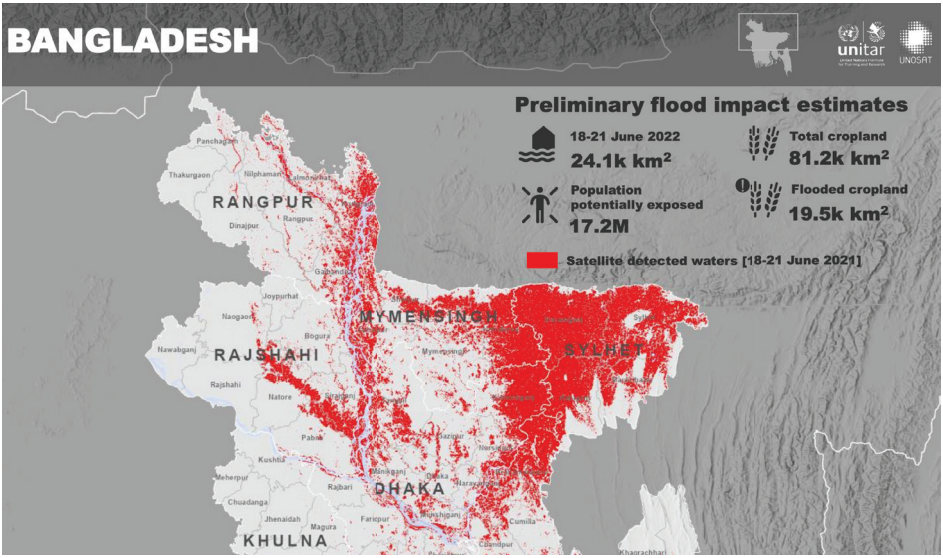


Figure 18: Preliminary satellite derived flood assessment in Bangladesh

Incremental Housing

In an attempt to battle global housing crises, a series of scholars (Wainer et al., 2016, Mota, 2021, Bredenoord & Van Lindert, 2010; Wakely & Riley, 2011) are calling upon incremental housing as a strategy to accomplish sustainable development goals when realisation of housing. This housing strategy can be considered a form of aided self help housing. Incremental housing can be described as a form of housing or the strategy of building housing that is deliberately designed to be incrementally expanded over time, often by the dwellers themselves.

The positive and negative

The benefits of incremental housing come in different forms as it enables structures and additional housing support to be tailored to existing buildings, respects people's housing preferences and creates buildings that are safe and cost-effective (Wainer et al., 2016). The latter, made possible through economies of scale. Economically the case for incremental housing is also very strong, as it is an opportunity for the poor to become homeowners without the need of putting in a large sum of money at the starting point, incrementally expanding their capital.
Furthermore, the fact that inhabitants help co-create their own living space results in a grown appreciation for the home itself, by virtue of the so-called Ikea-effect. Not only the appreciation, but the actual home value itself increases over time. It allows people to gradually appropriate the urban space for their own (D'Ottaviano & Bossuyt, 2024).
.
Of course as any other housing strategy, incremental housing likewise has its negative side. From an aesthetic point of view the informal expansions of community spaces could resolve into disorder and a sense of chaos (Silva, 2016). Silva mentions the fear some have that this might impact the values of adjacent properties.

From personal conversations, held at the Technical University Delft, the consensus among scholars such as Mota (2021) and others in the field of global housing was more optimistic. From their experience, these neighbourhoods end up looking more lively and interesting because of the informal expansions.

To sum up, incremental housing combines the brick-by-brick way of building with the benefits to be found in working of designs made by experts within the field of architecture and urban planning. Having only debatable negative effects, while being an economic opportunity for the poor.

Benefiting the poor

It is no coincidence that renting is the most common way for the poor to acquire their housing needs (Gunter, 2014). The money used for paying rent for the poor is often fueled by diminishing savings, borrowed money and cash assistance with increased numbers falling into debt (Goyes et al., 2016).
Next to this, slums are frequently cited as to be “poverty traps” (Marx et al., 2013) because of the state of perpetual poverty which is often present there. By injecting the incremental housing strategy into these areas the gradual accumulation of wealth could help set them free from this cycle.

Incremental housing is specifically useful in helping to solve the housing crisis felt at the economic bottom end of society. Wainer et al. (2016) point out the proven capabilities of incremental housing in giving low income home-seekers what they cannot provide themselves. It could also help the city by bringing forth some middle ground between the formal and informal neighbourhoods. The Un-Habitat Worldwide (2014) referred to the inhabitants of these neighbourhoods as “good” squatters as they reside in settlements that are semi-formal. According to Wakely & Riley (2011), between 20 percent and 70 percent of people living within the urban areas of developing cities already use an incremental way of building and/or expanding their house. The majority of them do this informally with little or no security of tenure (Wakely & Riley, 2011). Incremental housing can be instrumental in providing the security of tenure (Mota, 2021).

Policy

It is important to note that scholars like Bredenoord & Van Lindert (2010) and Marx et al. (2013) highlight the importance of the state aiding in the gradual formalisation of these neighbourhoods by offering guidance and giving out subsidies. Some of the most known and successful incremental housing projects, the ones designed by Chilean architecture firm Elemental, were surprisingly in most cases not expanded incrementally by the families themselves. Families managed to find subsidies from the government to pay for the expansion of the house before moving in (Vargas, 2014).

Through interviews and conversations with policymakers and other stakeholders held by Harper et al. (2012), they noticed a permeating opposition to incremental housing. Harper et al. (2012) concluded that this had mainly to do with the concern that it might lower the standards set for housing projects and that therefore they could ultimately be backing the creation of new informal settlements.

Vertical incremental housing

When investigating existing incremental housing projects and its many benefits they embody for the communities that dwell in them, you could only wonder what effect it could have on an even larger scale. A more dense typology of incremental housing that stacks dwellings into high-rise structures: vertical incremental housing. Some scholars (Goethert & Nohn, 2016; D'Ottaviano & Bossuyt, 2024) have tried to explore this topic as it is seen as a pragmatic strategy for addressing the pressures exerted by rapid urban growth. Their findings were optimistic as well as realistic about the complexity of introducing incremental housing, especially in denser urban areas.

"Vertical incremental housing may offer benefits by integrating resident involvement in already urbanised areas and providing low-income households with housing close to amenities and services. Unfortunately, high land costs, technical complexity and development risk undermine vertical incrementalism as a strategy." (D'Ottaviano & Bossuyt, 2024, pp.19).

Types of vertical incremental housing

Buildings that could be considered a type of vertical incremental housing are the ones being expanded by adding multiple additional floors, which is something that is already existent in many cities globally. Although, it is widely the case that the buildings were never intended to be modified (Goethert & Nohn, 2016). Leading in some cases to some unsafe situations. In cases where this type of vertical incremental housing is done in a formal way like Ecuador's Solanda Housing Project one could see up to three floors added over time (Vidal & Goyes, 2016). The incremental housing strategy here increased the neighbourhoods original population of 18,000 residents to a total of 80,000 people.
Other forms of existing vertical incremental housing include the sideways expansion of floor plans in already mid to high rise buildings (see figure 19).

The actual high-rise incremental housing projects -talking about buildings with ten stories and beyond- are after thorough literature review concluded to only be existing in the minds of architects. Featuring imaginary projects like "Highrise of Homes" by american firm SITE (see figure 16 and 20). These projects are in many occasions inspired by Le Corbusier's Dom-Ino (Goethert & Nohn, 2016).

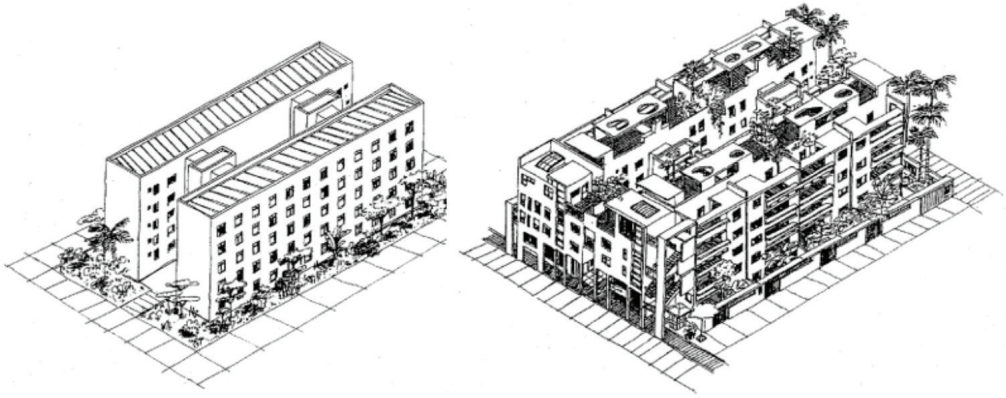


Figure 19: Horizontal incremental expansion in a high-rise housing complex

Figure 20: Highrise of Homes; For location in a major American city by SITE

Field research: Dhaka

Part of the research was a field trip to the country of Bangladesh itself to really get the experience of the situation on a first-hand basis.

The first days were spent in the capital city of Dhaka (see figure 21). The beating heart of the country with around 23 million people living in its greater metropolitan area. During these days several places within the city were explored with emphasis on housing conditions; visiting multiple houses ranging from high-income units to middle-income houses to slum housing.

Figures 22 to 40 show some of the pictures taken by Julian Wijnen throughout the visit to Dhaka, trying to visually convey the atmosphere of this intriguing city.

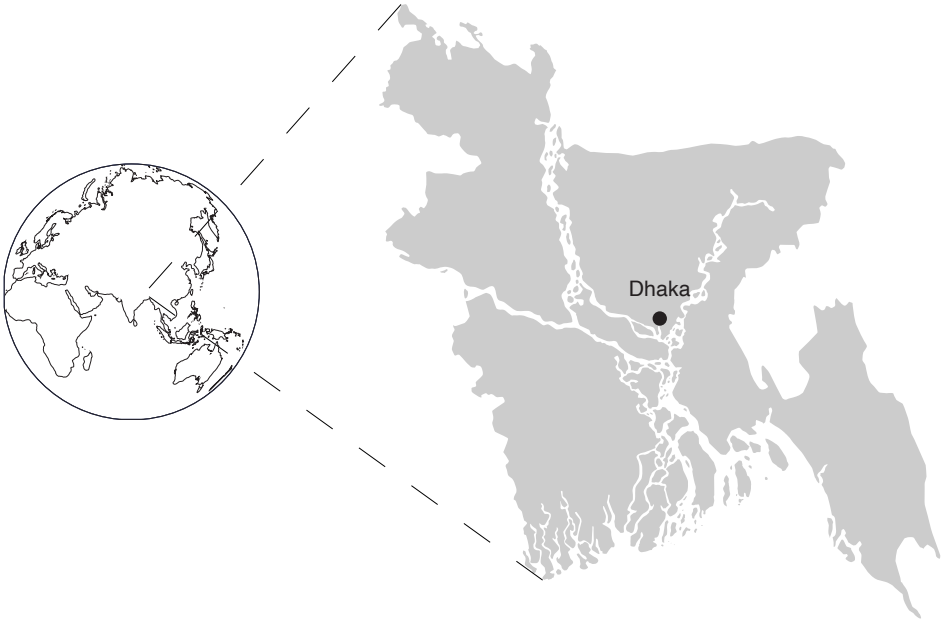


Figure 21: Location of Dhaka in Bangladesh and on the globe

Figure 22: Arrivel in Dhaka, Bangladesh. Picture by Julian Wijnen

Figure 23: Streets of Dhaka. Picture by Julian Wijnen

Figure 24: Man with a rickshaw. Picture by Julian Wijnen

Figure 25: Geneva Camp, Mohammadpur, Dhaka. Picture by Julian Wijnen

Figure 26: Geneva Camp, Mohammadpur, Dhaka. Picture by Julian Wijnen

Figure 27: Ayub National Hospital by Louis Kahn. Picture by Julian Wijnen

Figure 28: Bangladesh Parliament building by Louis Kahn. Picture by Julian Wijnen

Figure 29: Bait Ur Rouf Jame Mosque by Marina Tabassum Architects. Picture by Julian Wijnen

Figure 30: Bait Ur Rouf Jame Mosque by Marina Tabassum Architects. Picture by Julian Wijnen

Figure 31: Streetlife, Dhaka. Picture by Julian Wijnen

Figure 32: Streetlife, Dhaka. Picture by Julian Wijnen

Figure 33: High-income housing, Kalindi Appartments. Picture by Julian Wijnen

Figure 34: High-income housing, Kalindi Appartments. Picture by Julian Wijnen

Figure 35: Middle-income housing appartment buildings. Picture by Julian Wijnen

Figure 36: Middle-income housing appartment buildings. Picture by Julian Wijnen

Figure 37: Lower class housing, Korail informal settlement. Picture by Julian Wijnen

Figure 38: Lower class housing, Korail informal settlement. Picture by Julian Wijnen

Figure 39: Bangla Baton flat pack housing manufacturing site. Picture by Julian Wijnen

Figure 40: Bangla Baton flat pack housing manufacturing site group picture. Photographer unknown

Field research: Sylhet

The main part of the trip took place in Sylhet, one of the major cities of Bangladesh. During our stay several places within and around the city were explored, with emphasis on housing, while also visiting the sites that were selected as possible design locations for this graduation project.

Figures 41 to 57 show some of the pictures taken by Julian Wijnen throughout the visit to Sylhet and its surrounding region, trying to visually convey the atmosphere of this place.

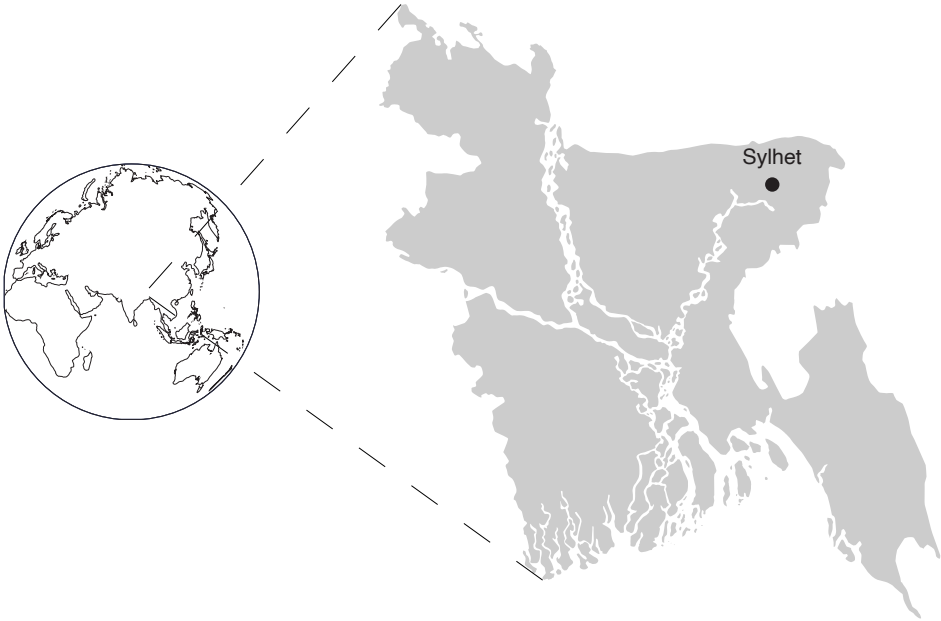


Figure 41: Location of Sylhet in Bangladesh and on the globe

Figure 42: Sylhet Skyline. Picture by Julian Wijnen

Figure 43: Keane Bridge over the Surma River. Picture by Julian Wijnen

Figure 44: Sweepers colony on the banks of the Surma River. Picture by Julian Wijnen

Figure 45: Streetlife, Sylhet. Picture by Julian Wijnen

Figure 46: Streetlife, Sylhet. Picture by Julian Wijnen

Figure 47: Streetlife, Sylhet. Picture by Julian Wijnen


হাজী কুদরত উল্লাহ মার্কে
রাফা ইমিটেশন

Figure 48: Hawkers Market street, Sylhet. Picture by Julian Wijnen

Figure 49: Hawkers Market bazar street, Sylhet. Picture by Julian Wijnen

Figure 50: Appartment building construction site. Picture by Julian Wijnen

Figure 51: Construction site near Laladighi pond. Picture by Julian Wijnen

Figure 52: Hakaluki Haor. Picture by Julian Wijnen

Figure 53: Fired brick manufacturing facility. Picture by Julian Wijnen

Figure 54: Rural housing. Picture by Julian Wijnen

Figure 55: School in rural village. Picture by Julian Wijnen

Figure 56: Rural Manipuri community courtyard. Picture by Julian Wijnen

Figure 57: Rural Manipuri community. Picture by Julian Wijnen

Shahjalal University of Science and Technology

During the field trip to Bangladesh a collaboration with the architecture department of the Shahjalal University of Science and Technology (SUST) was arranged. After getting a warm welcome and having introduced the Global Housing studio and its projects to the university, the students from SUST helped out with the field research by showing everyone around the city of Sylhet and the various proposed design sites, while also helping with translating conversations between the TU Delft students and locals.

For this project this field research resulted in a series of sketches mapping the Hawkers Market site, with a synthesis drawing (see figure 70) to conclude this phase. This synthesis drawing was presented (see figure 58) on the final day at SUST in a joint session.

Figure 58: Julian Wijnen presenting at SUST. Picture by Danai Makri

Figure 59: Shahjalal University of Science and Technology. Picture by Julian Wijnen

Material research

When back in Delft the material research was started. This assignment was there to map and study all materials that are being used in the built environment in Bangladesh. In groups of 4 or 5 students different chapters about different materials were created and later bundled into a booklet similar in style to the phase 2 booklet about exemplary housing case studies in Bangladesh.

For the purpose of the personal research project the material I chose to research was concrete and lime.

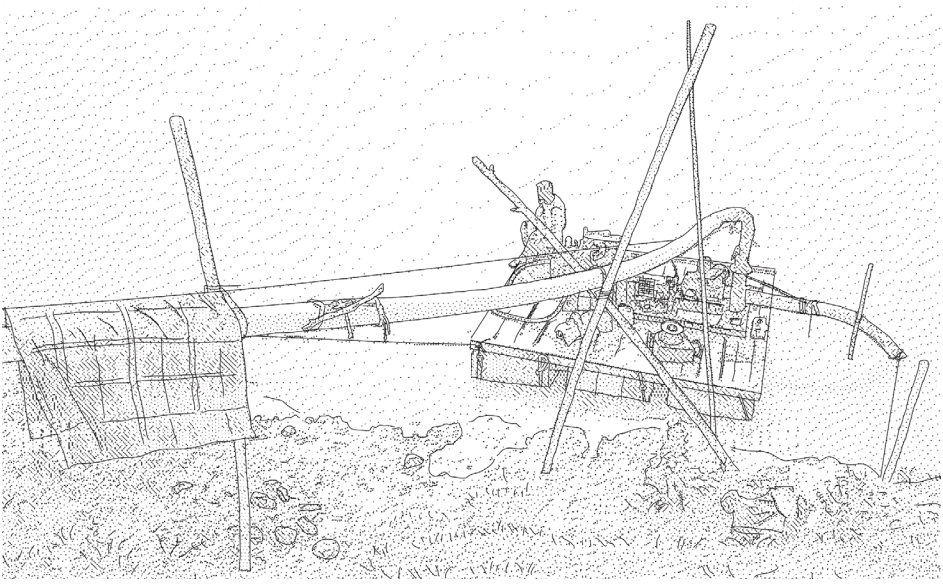


Figure 60: Illegal sand mining rig. Drawing by Kaspar ter Glane

Figure 61: Concrete facade construction of Dhaka University Library. Picture by Julian Wijnen

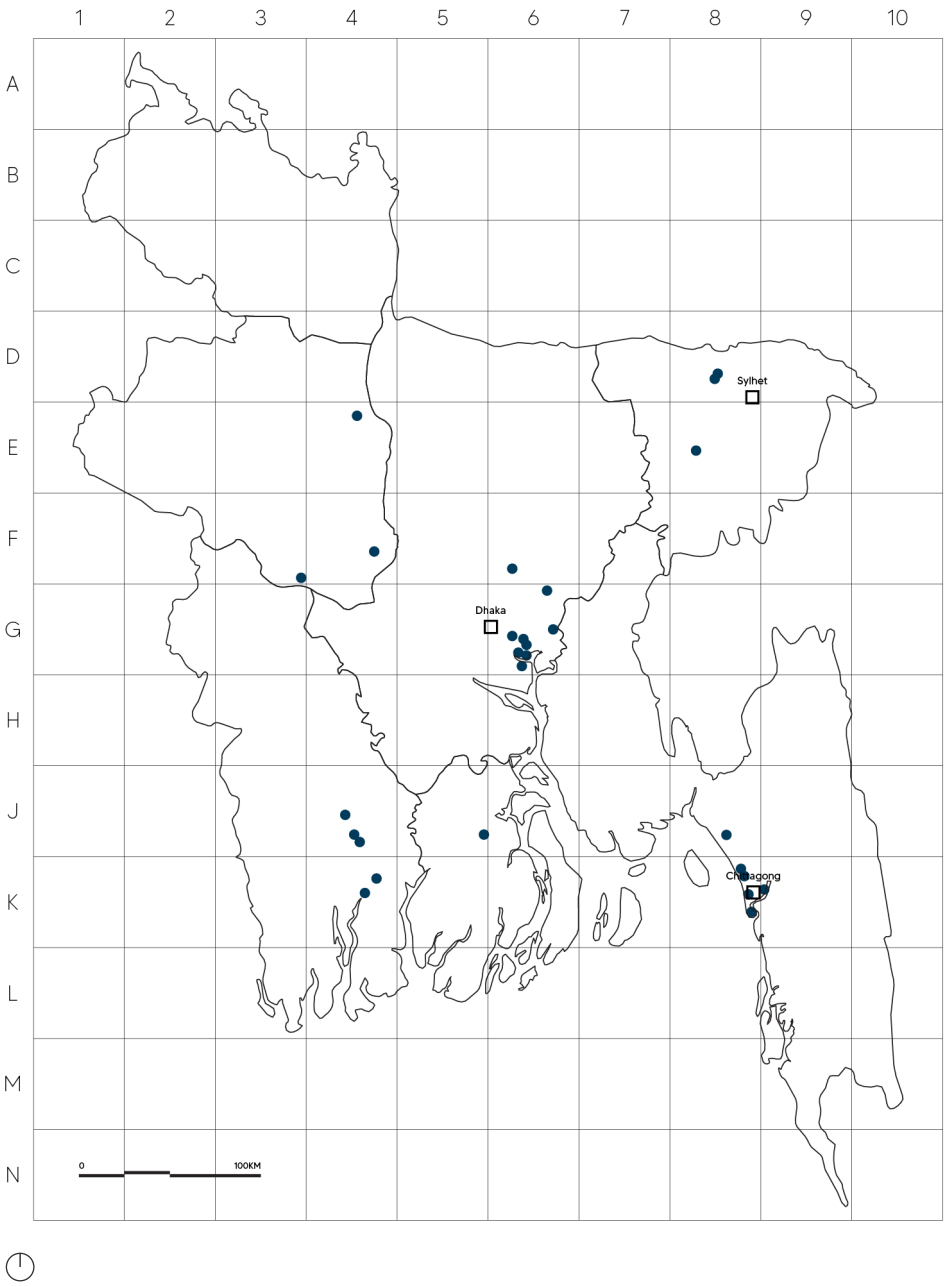


Figure 62: Bangladesh map showing cement factories. Map by Julian Wijnen

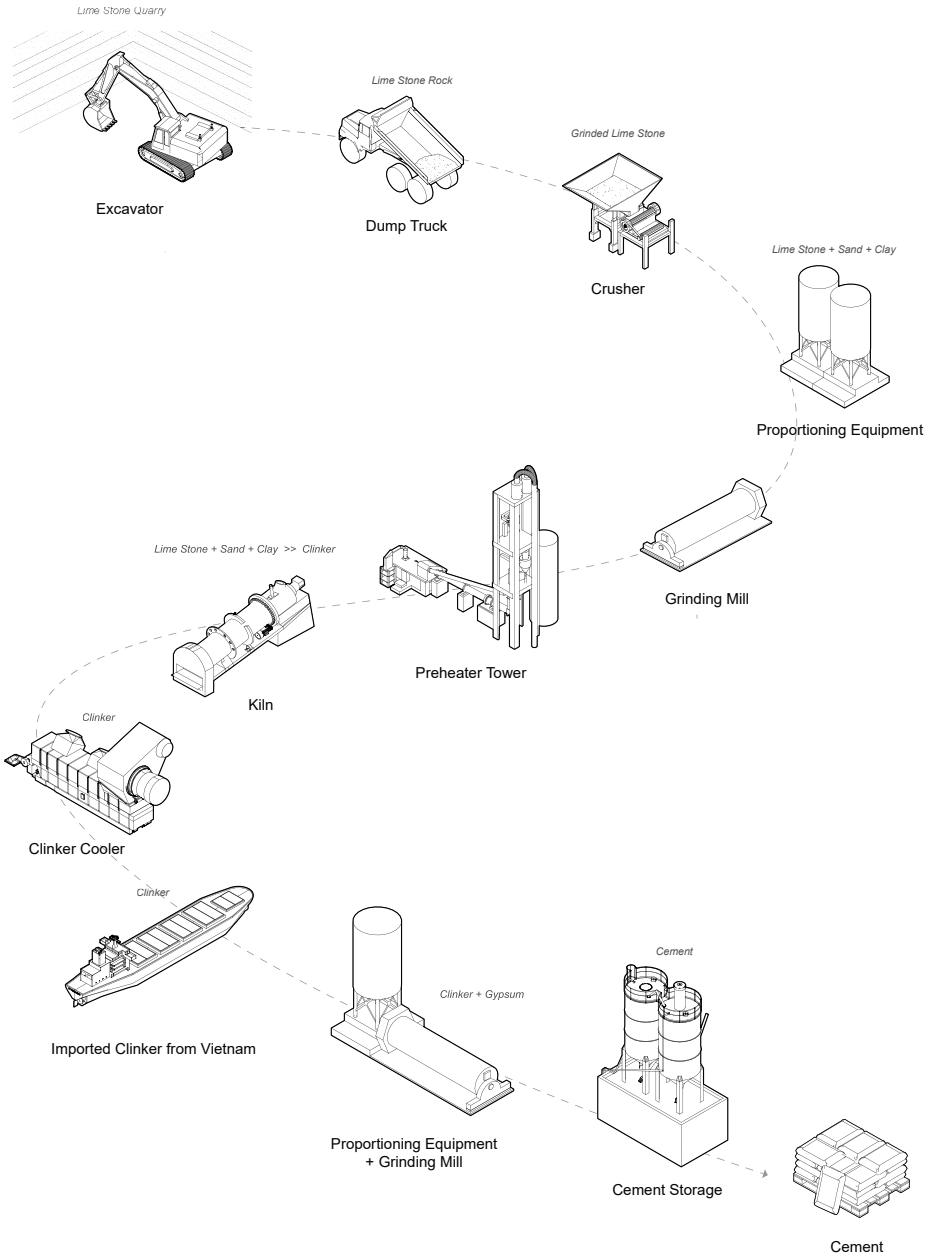


Figure 63: Cement production process. Image by Hyosik Kim

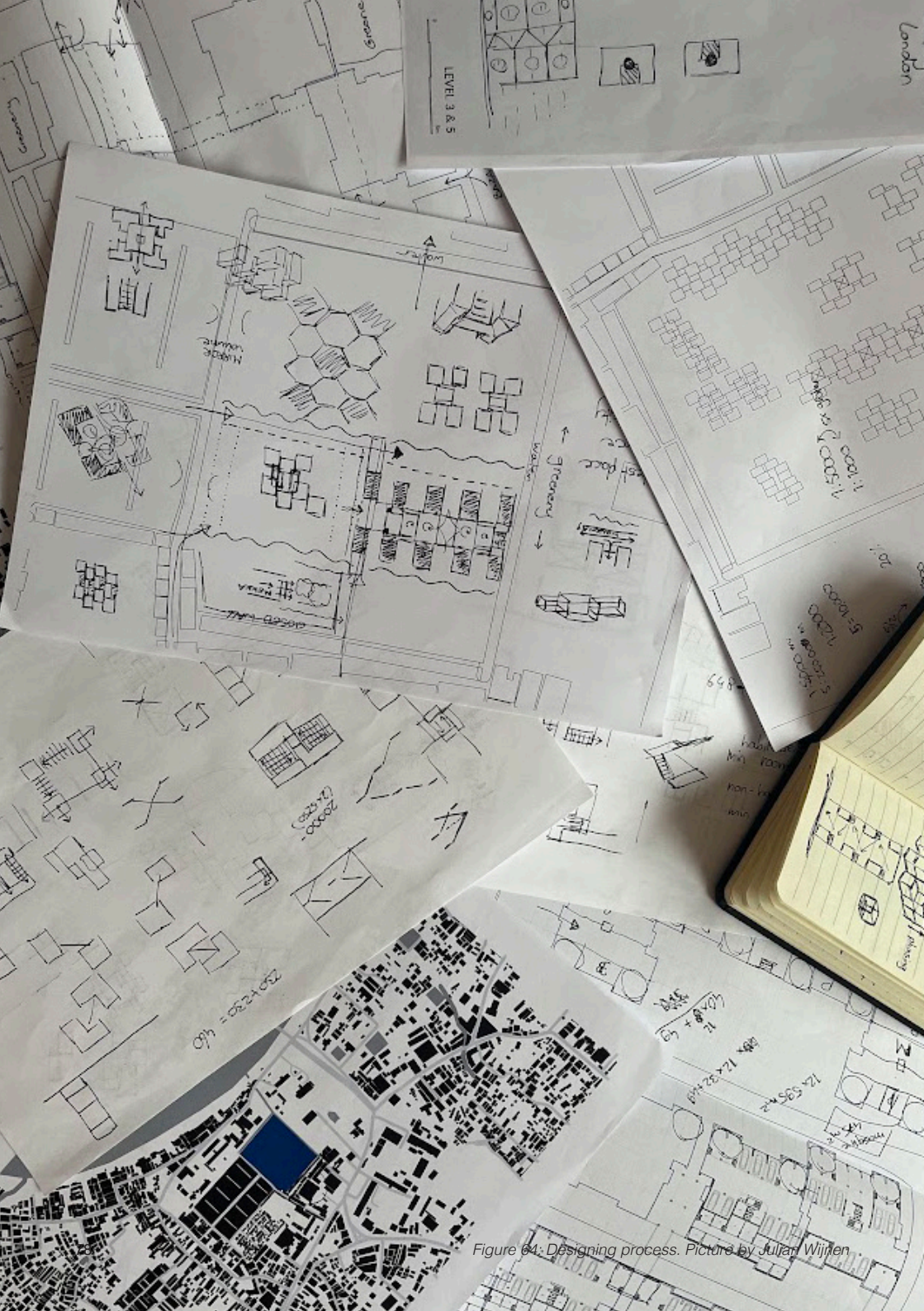


Figure 64: Designing process. Picture by Julian Wijnen

03 Design process

January 6th 2025 - June 19th 2025

This chapter goes into the design process that took place after being back from the field trip to Bangladesh. The design location was first analysed after which the first concept design could be developed for the second official asses moment of the graduation year, also known as “peil moment 2” or “P2” in short. Next this chapter follows the process towards an updated design following the feedback given at P2. This updated design was presented at P3.

The site chosen for the design is the Hawkers Market. The reason for choosing this site can be found in the site's location in the heart of Sylhet. Because of this the site has potential for a high-density housing complex. The graduation project goes into high-rise which often leads to high densities numbers, which would be a good match for this location.

The site itself (see figure 65) was a former bazar and now has a temporary market, but mainly lays bare waiting for its new purpose. The panoramas in figure 69 show the current situation of the site by the time of the field research in December 2024. Figures 66 to 68 show the lively markets surrounding the empty site. Figure 70 shows the synthesis drawing of the Hawkers Market.

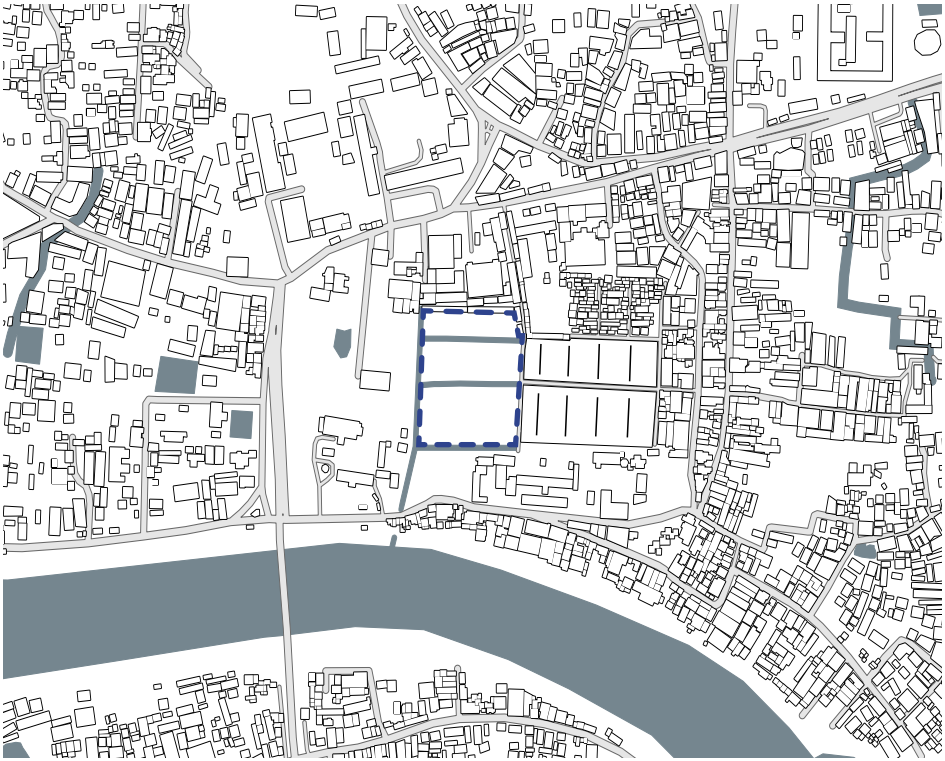


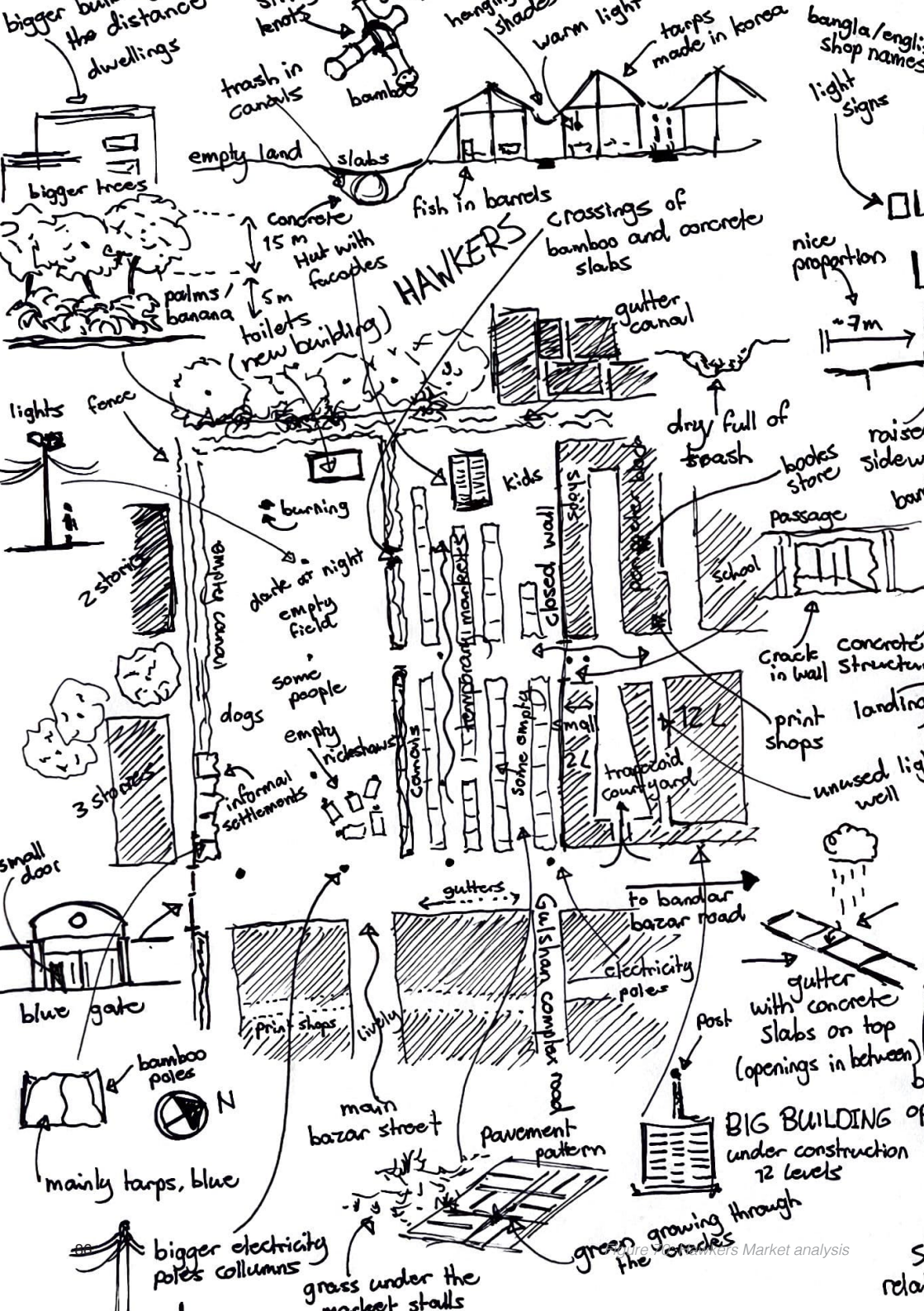
Figure 65: Hawkers Market and surroundings

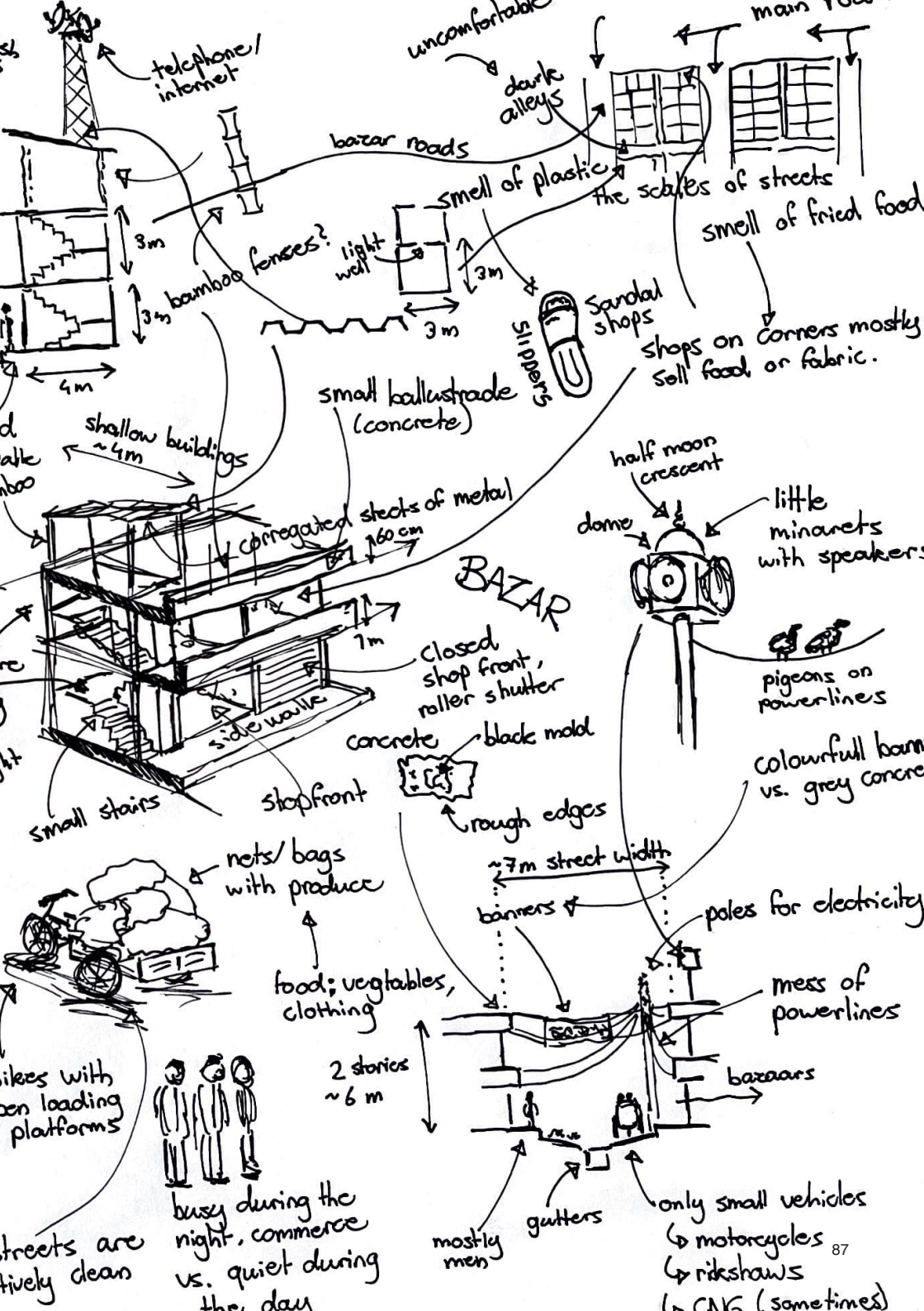
Figure 66: Hawkers Market bazar street. Picture by Julian Wijnen

Figure 67: Hawkers Market temporary market structures. Picture by Julian Wijnen

Figure 68: Hawkers Market bazar street. Picture by Julian Wijnen

Figure 69: Hawkers Market panoramics. Pictures by Julian Wijnen


bigger buildings the distance dwellings
trash in canals
bamboo
hanging shades
warm light
tarps made in korea
bangla/engli shop names
light signs
bigger trees
empty land
slabs
fish in barrels
concrete
15 m
Hut with facades
HAWKERS
crossings of bamboo and concrete slabs
palms/ banana
5m
toilets (new building)
gutter canal
nice proportion
~7m
lights
fence
dry full of trash
burning
Kids
bodies store
passage
2 stories
dark at night
empty field
some people
dogs
empty rickshaws
3 stories
informal settlements
smoky canal
temporary markets
closed wall
print shops
school
Crack in wall
concrete structu
landing
unused li
well
trapezoid courtyard
small door
blue gate
gutters
to bandar bazar road
Gulshan complex road
electricity poles
gutter with concrete slabs on top (openings in between)
bamboo poles
N
mainly tarps, blue
main bazar street
pavement pattern
Post
BIG BUILDING
under construction
72 levels
bigger electricity poles columns
grass under the
green growing through the cracks
Source: Hawkers Market analysis


telephone/ internet
bazar roads
uncomfortable
dark alleys
main road
the scales of streets
smell of plastic
smell of fried food
3m
3m
bamboo fences?
light well
3m
3m
4m
slippers
sandal shops
shops on corners mostly sell food or fabric.
small ballustrade (concrete)
shallow buildings ~4m
half moon crescent
dome
little minarets with speakers
corriegated sheets of metal
160 cm
BAZAR
7m
closed shop front, roller shutter
pigeons on powerlines
concrete
black mold
side walls
small stairs
shopfront
rough edges
colourfull boards vs. grey concrete
~7m street width
nets/ bags with produce
banners
poles for electricity
food; vegtables, clothing
mess of powerlines
2 stories ~6 m
bazaars
bikes with open loading platforms
busy during the night, commerce vs. quiet during the day
mostly men
gutters
only small vehicles
motorcycles
rickshaws
CNG (sometimes)
streets are relatively clean

P2 design

For the first assessment moment of the design process - the p2 - it was crucial to prove the concept of high-rise incrementalism. Therefore the design set out to show the practical possibilities of having incremental housing within a high-rise structure.

The design makes use of a cross-subsidisation of middle to high income dwellings combined with incremental housing units that cater to the lower income classes in society. Both parts of the building use the same circulation systems, structural elements and other services like plumbing pipes and electricity lines. Therefore the low income incremental part of the building becomes economically viable, tackling the problem of high costs relating to making high-rise housing for lower income classes, specifically when building high-rise incremental housing.

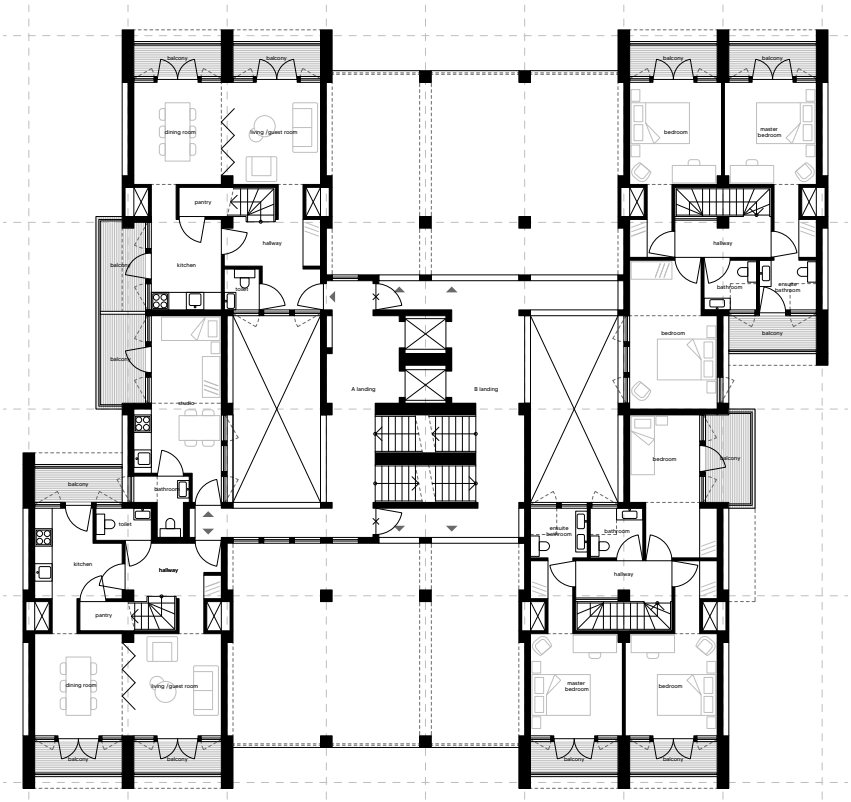


Figure 71: P2 design, typical floor plan

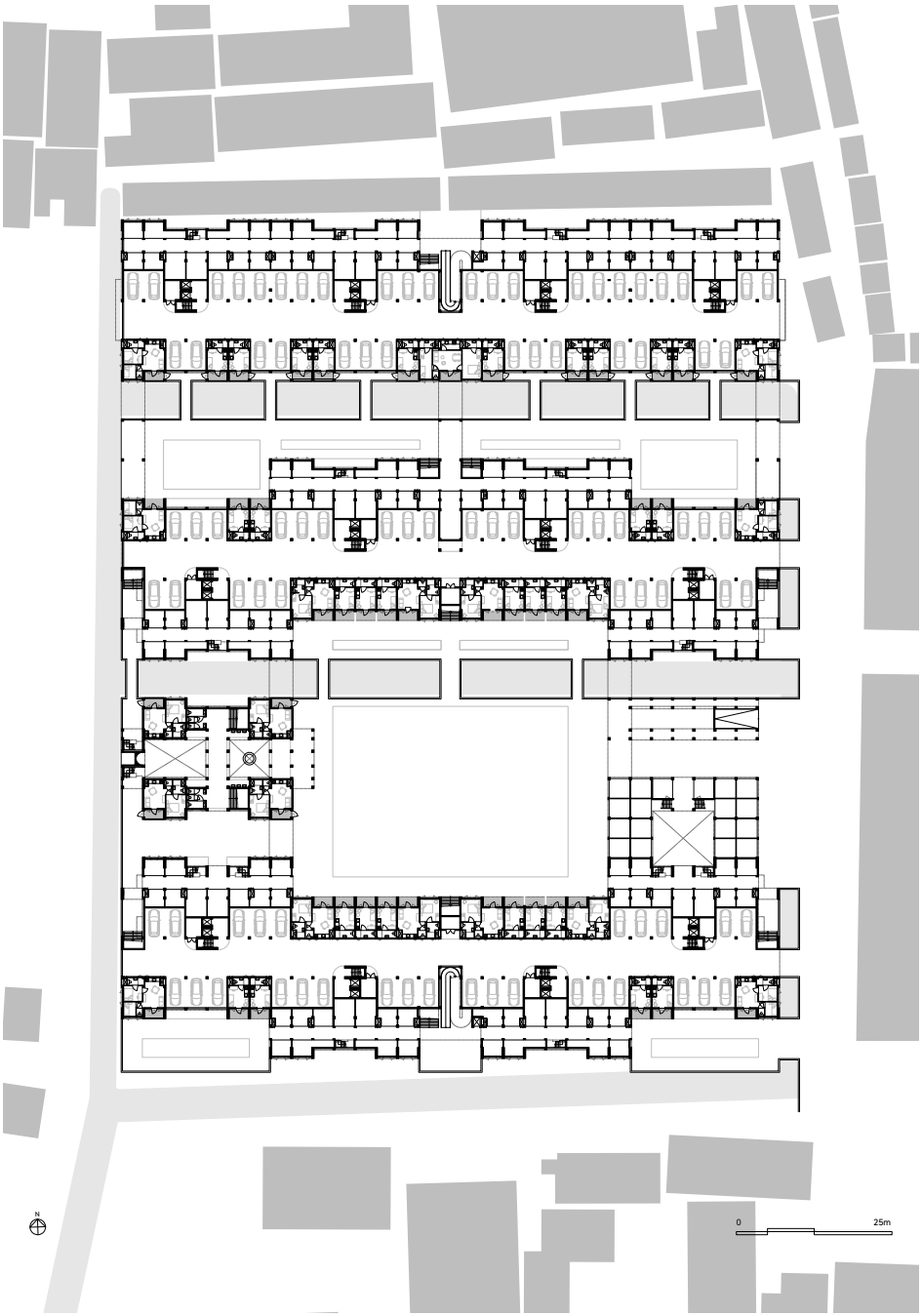


Figure 72: P2 design, masterplan

Figure 73: P2 design, type A1 dwelling

Figure 74: P2 design, type A2 dwelling

This P2 concept design was working, thus proving that high-rise incrementalism was feasible. Yet seeing the masterplan and the complexity of the buildings that were now created, multiple things needed to be addressed before the design was functioning properly and was fitting to the site and in its surroundings.

Figures 75 and 76 show the impressions of the design. Looking at it the density and poor quality of the open spaces in between became apparent. Thus working towards P3 a new design was developed, leaning on the principles of this design.

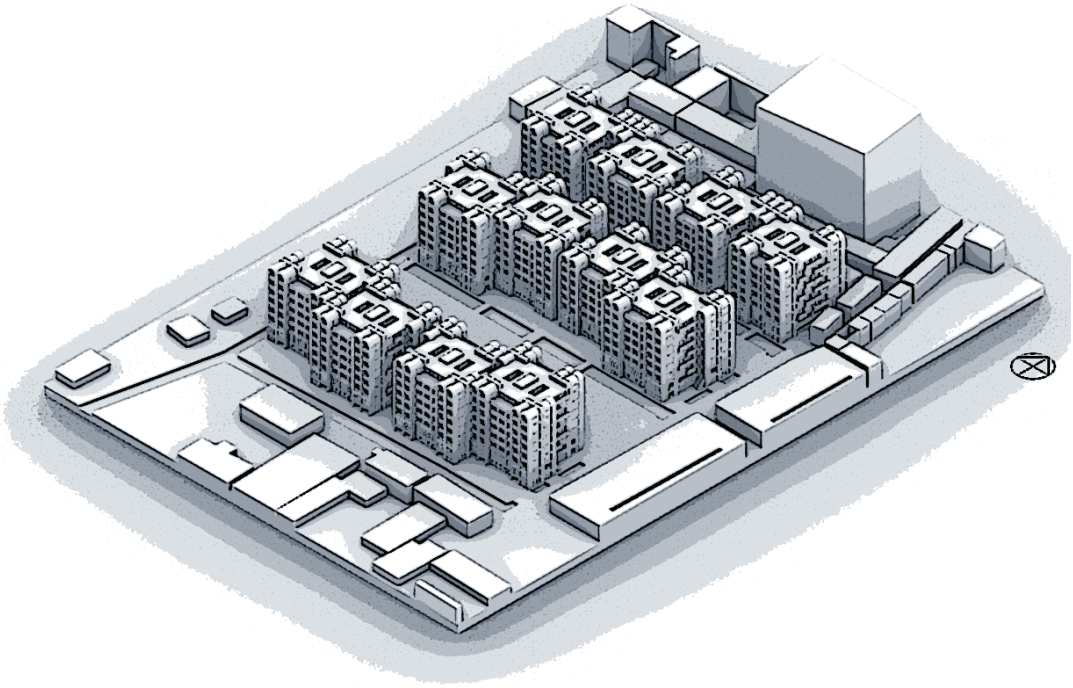


Figure 75: P2 design, masterplan isometric impression

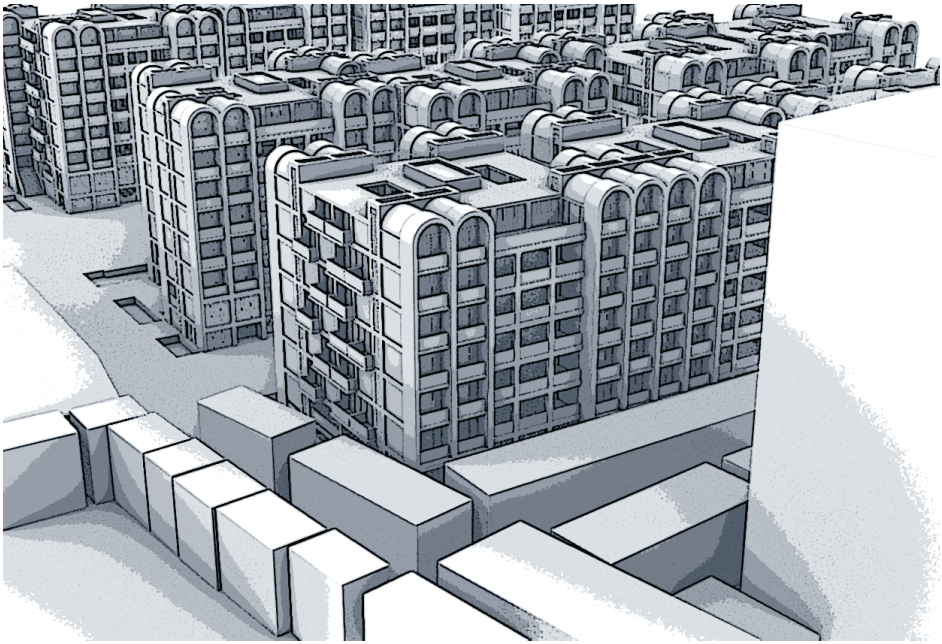


Figure 76: P2 design, impressions

P3 design

The updated design for P3 was more focussed on the modularity and connectivity between units, making it possible to produce buildings that could take on different shapes and sizes (see figure 81) without having to change the individual dwellings. Next to this the design was simplified by making courtyard buildings with central galleries that cater to the low income incremental housing units and giving the middle to high income units their own core. The added benefit to this configuration is the direct connection between the galleries used by the lower income people to the kitchens of the middle to high income housing units. This was done deliberately so that people working for the middle to high income households - something that's commonly seen in Bangladesh - can have direct access to these homes while being able to live in the same building in the incremental housing units.

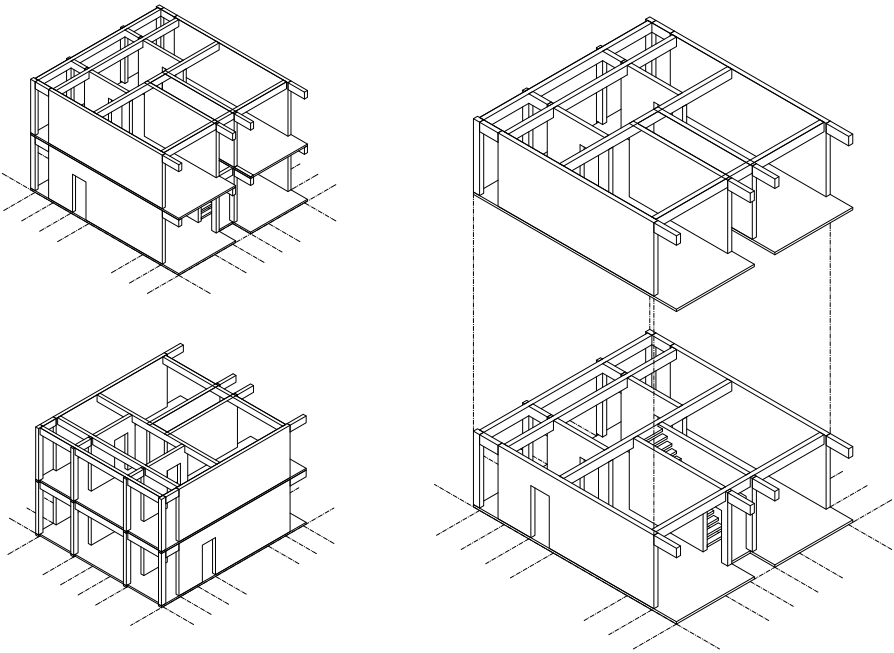


Figure 77: P3 design, (exploded) isometric

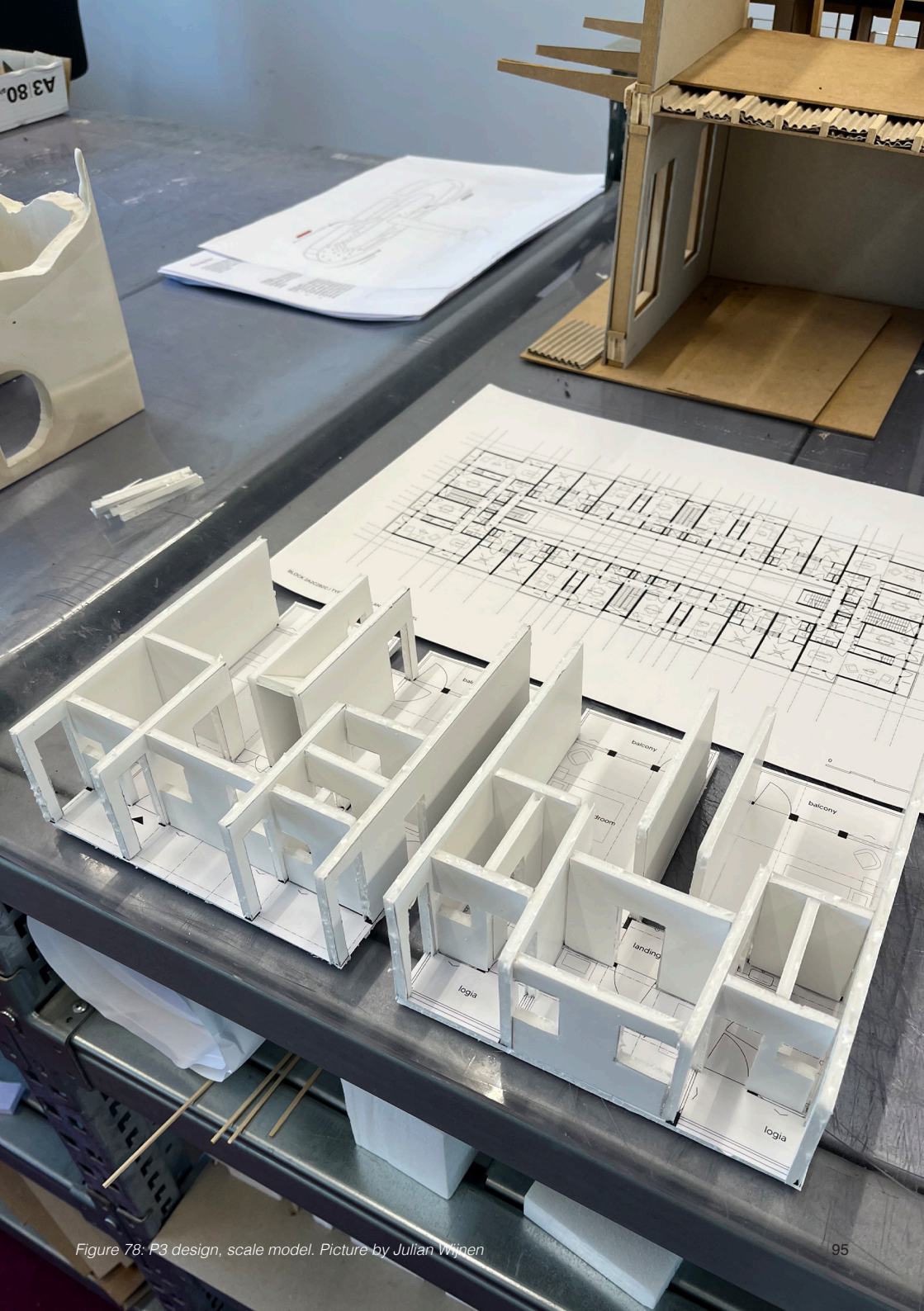
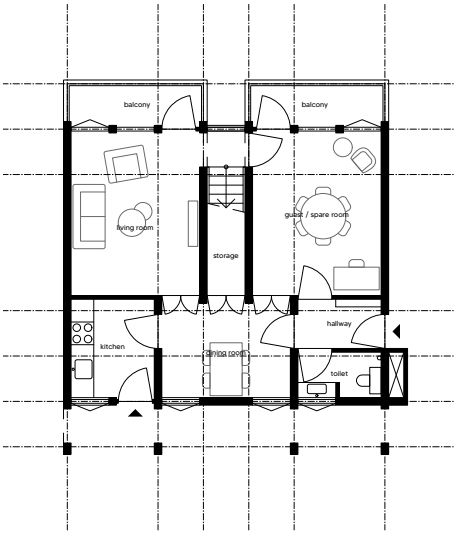
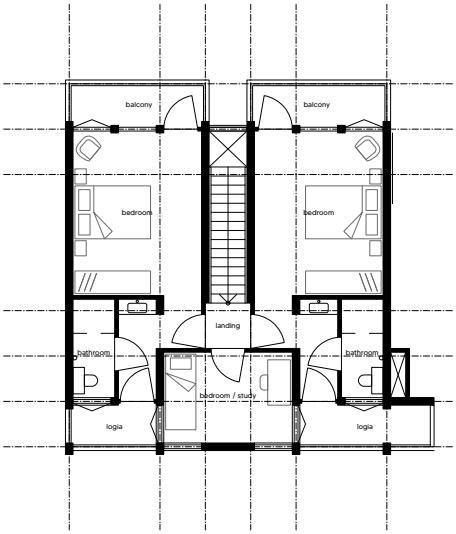


Figure 78: P3 design, scale model. Picture by Julian Wijnen

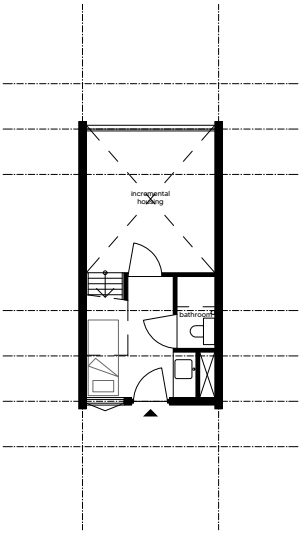


lower floor

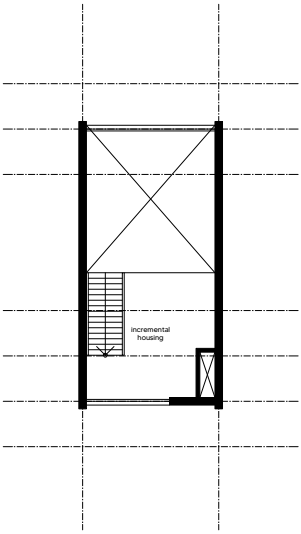


upper floor

Figure 79: P3 design, type A dwelling



lower floor



upper floor

Figure 80: P3 design, type C dwelling

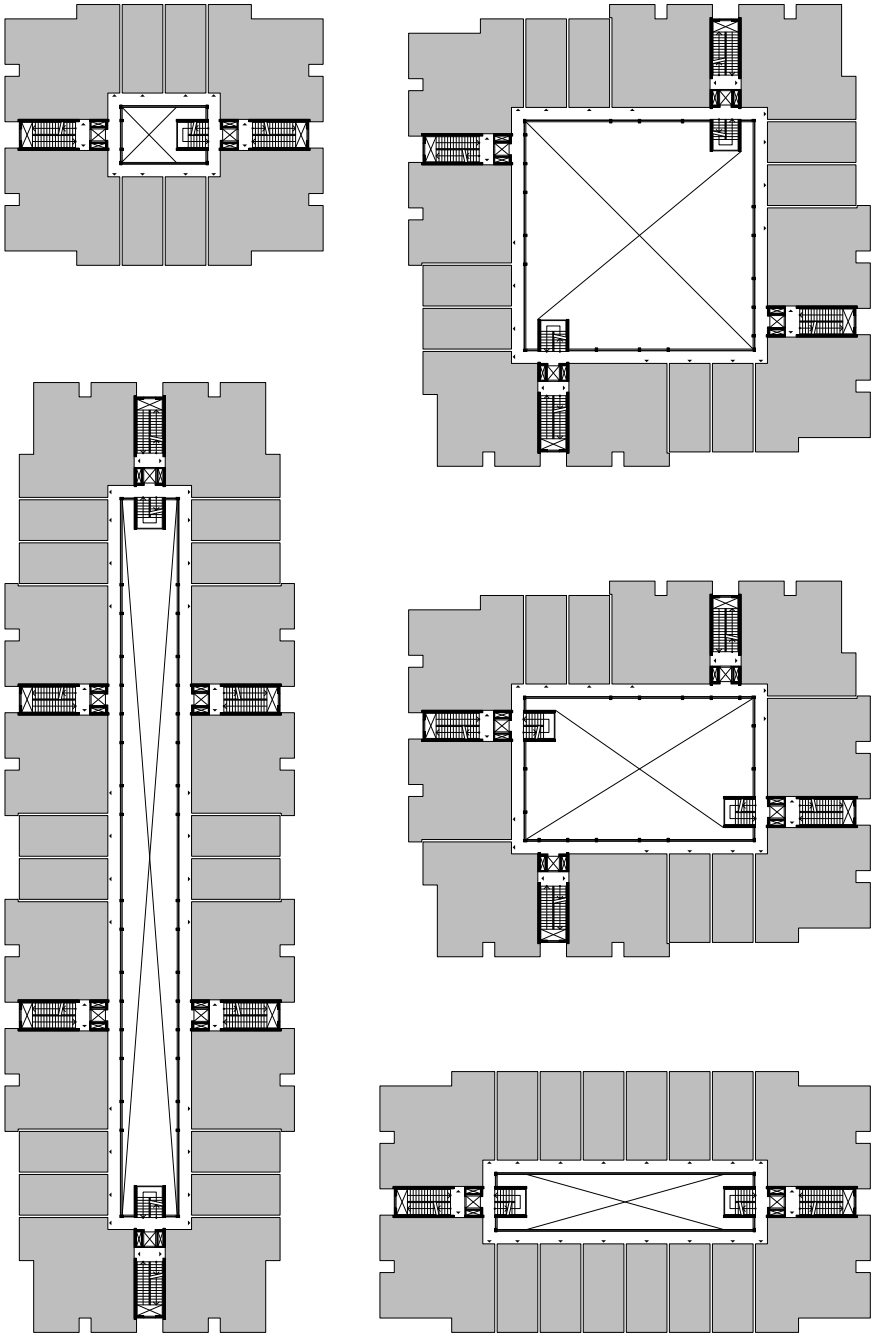


Figure 81: P3 design, block configurations through different combinations of dwelling types

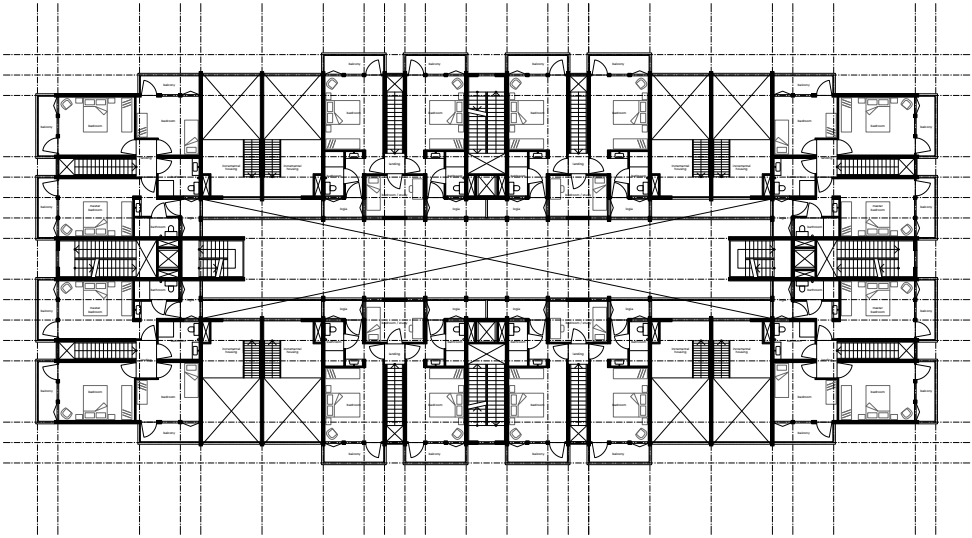


Figure 82: P3 design, typical upper floor plan

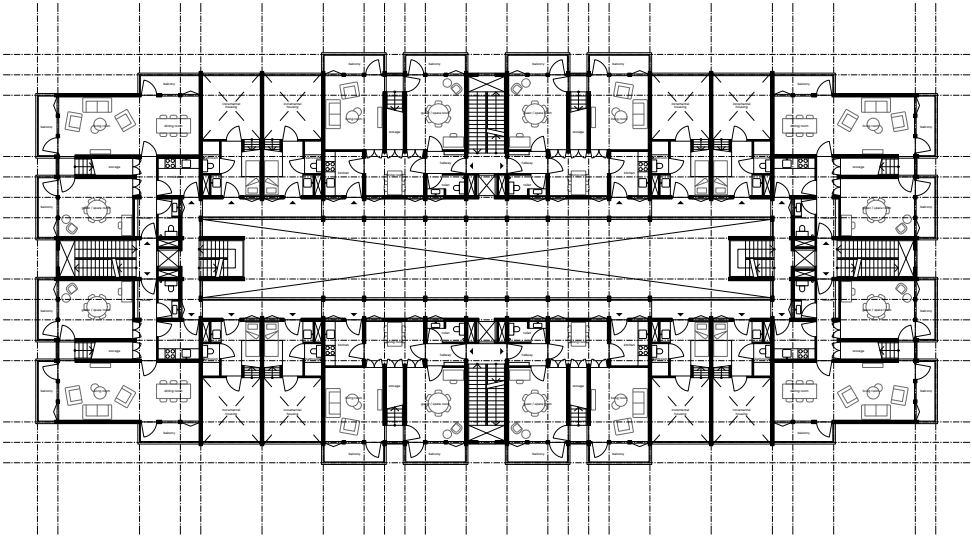


Figure 82: P3 design, typical lower floor plan

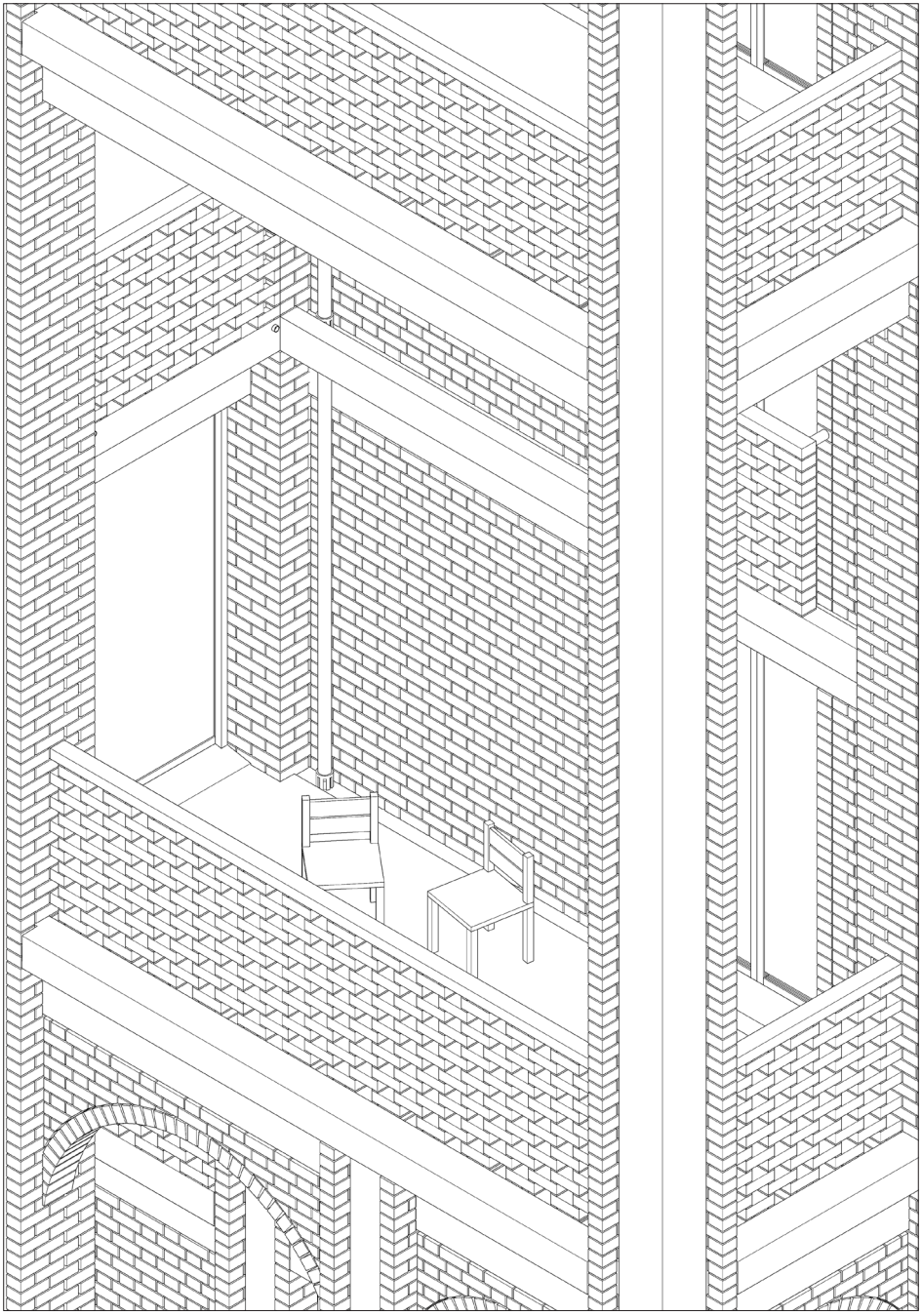


Figure 83: Facade fragment isometric

04 Final design

June 19th 2025 - July 3th 2025

After the P3 the design was altered once more to implement all the feedback and optimize the use of in and outdoor spaces, while also making it fitting to the site and its surroundings, culminating to a coherent masterplan. The final design and all the products that were made in accordance to the graduation requirements are shown in this chapter. The building shown here is the outcome of the final iteration of the design and research that was presented at P4 and worked out onwards to the P5 final graduation presentation.

Building volumes and impressions

The volumes of the buildings follow a zig-zagging path with the volumes mainly stretching out from east to west on the site. The volumes are all connected to one another by various corridors and bridges. The volumes leave open spaces in between that according to their size and accessibility can serve for different functions. The volumes are all set in an orthogonal grid with slabs of incremental housing duplex units (type B) sitting side by side that are accessed by external galleries wrapping around the semi open courtyards. On all corners and ends of these slabs, towers form the middle to high income housing clusters with one unit (type A) at each level per tower.

Figures 84 to 90 depict the site model and impressions of the design of the site and the buildings on it.

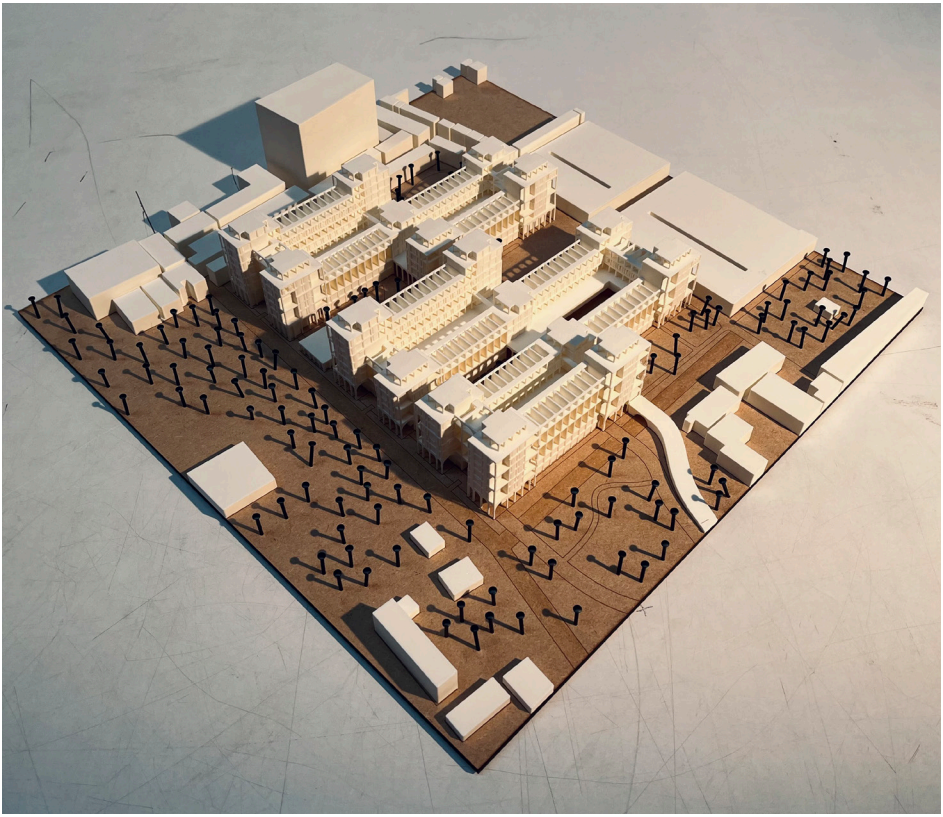


Figure 84: Site model. Picture by Julian Wijnen

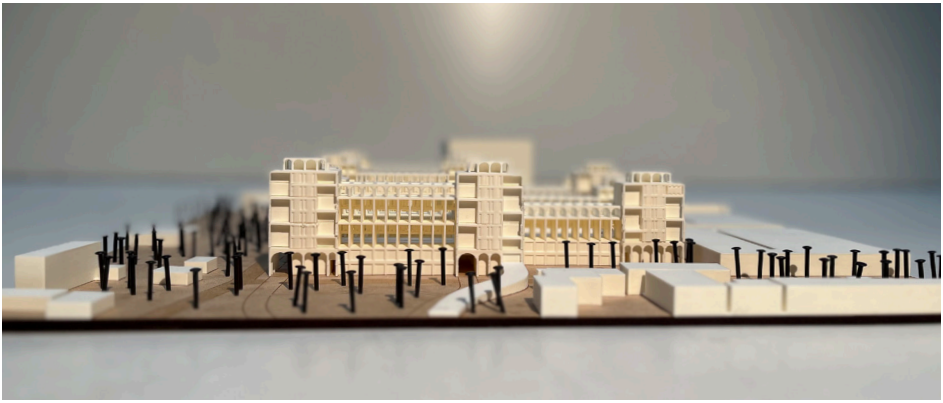


Figure 85: Site model. Pictures by Julian Wijnen

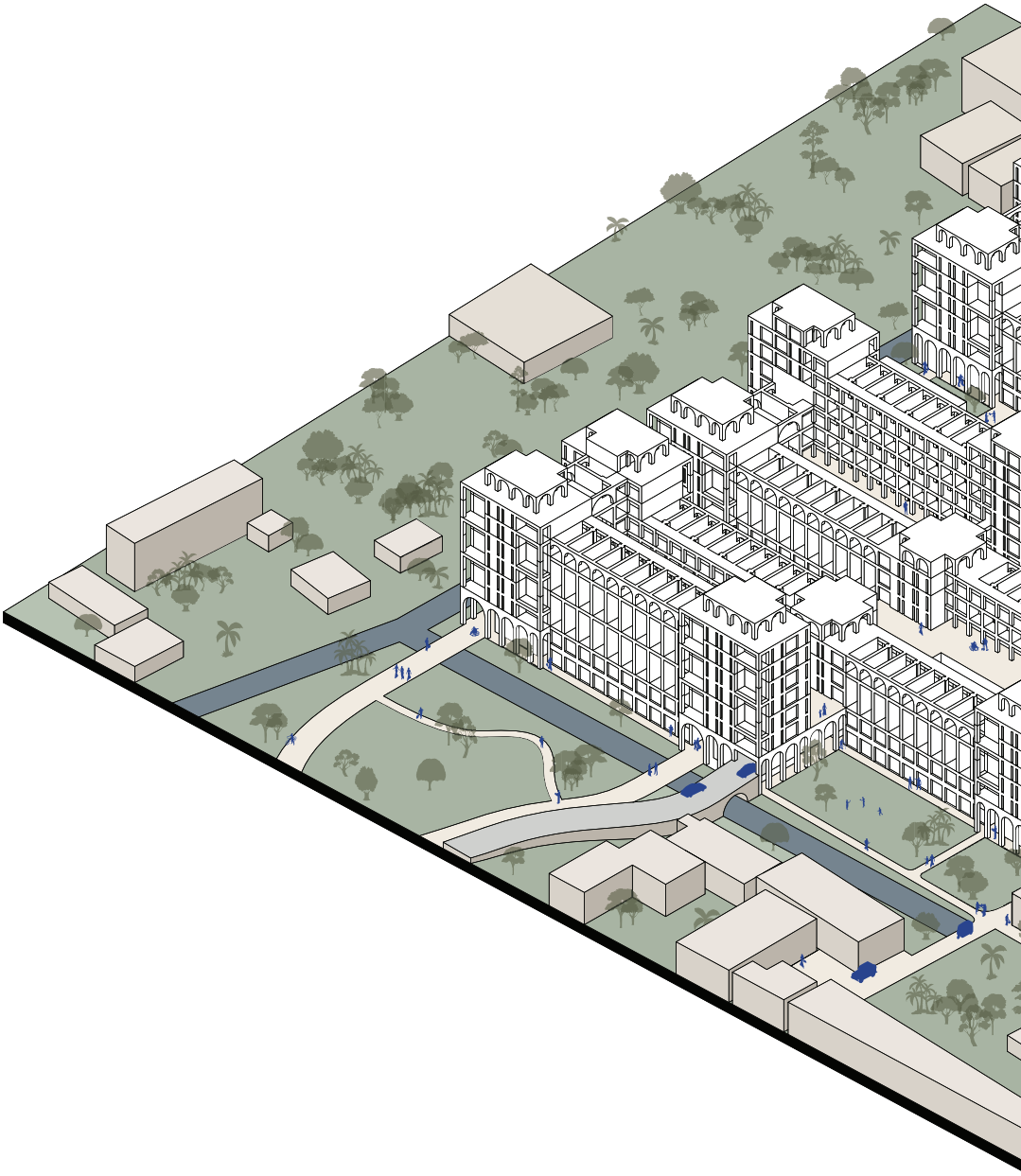
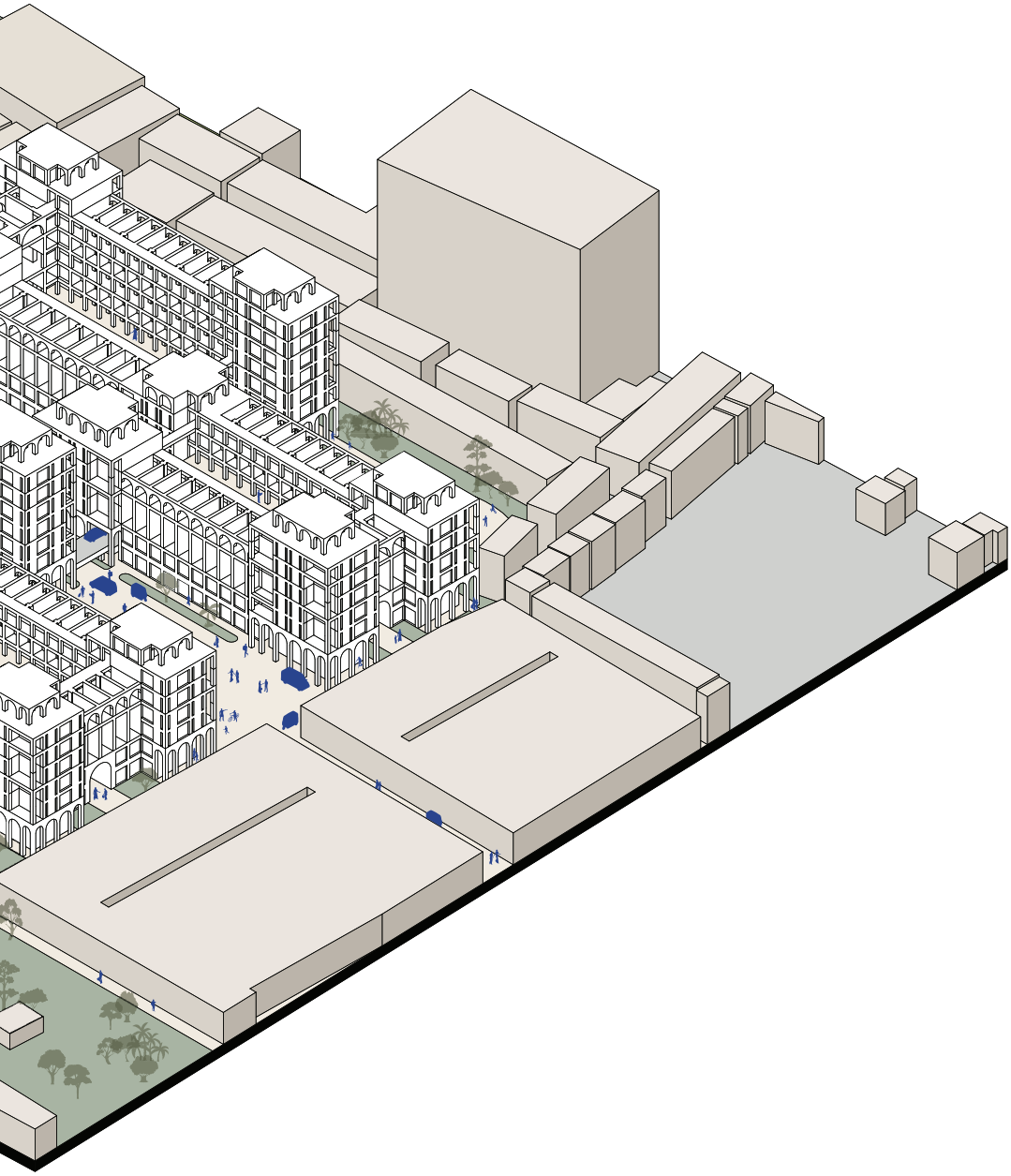


Figure 86: Masterplan isometric



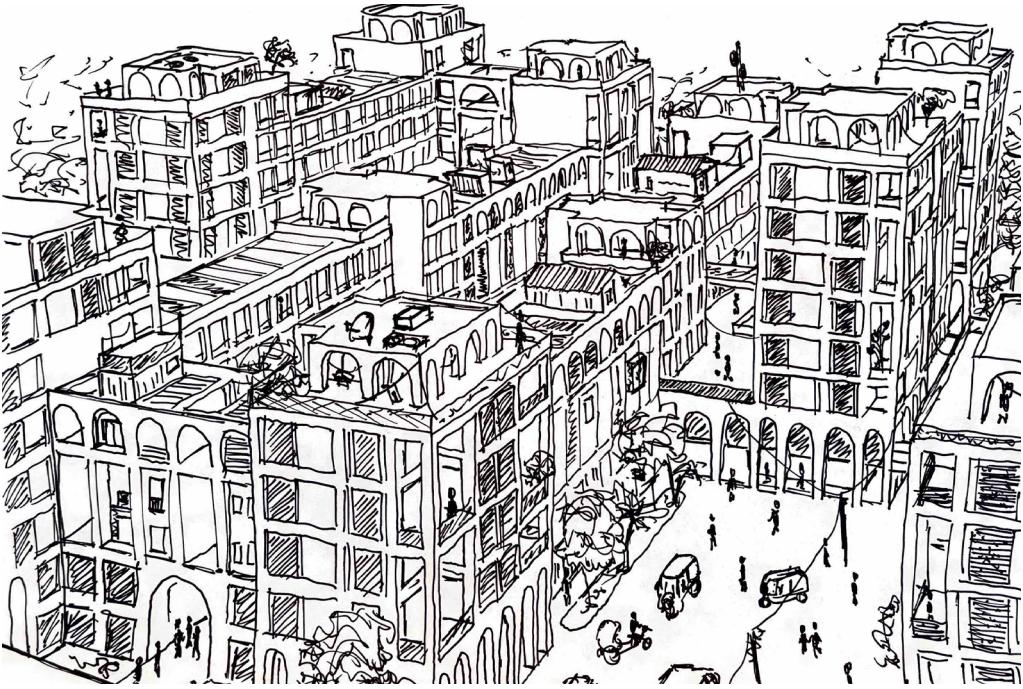


Figure 87: Site impression. Sketch by Julian Wijnen

Figure 88: Site impression. Sketch by Julian Wijnen

Figure 89: Streetview impression

Figure 90: Streetview impression

Plans, elevations and sections

This part of the chapter shows all of the plans, elevations and sections of the building (see figures 91 to 98). The final page shows the statistics for the overall plan: creating 43410 square meters of internal floorspace on this 1.52 ha plot, coming to a FSI of 2.78.

On the ground floor of the building stores and the entrance lobbies to the dwelling on the upper floors are located. The shops are all connected by a series of internal, outdoor or half covered streets, branching out from one main internal street running all the way north to south through the site. This collection of covered streets and stores makes the whole site into one big bazar bringing back the one that was once present on this site and making room for neighboring stores to relocate in anticipation of further development of the area.

The first floor of the building houses some storage for the shops below but is mainly allocated to parking for the middle to high income housing units. Most of these households would own one or two cars. Allowing space for 120 cars thus comfortably accommodates the needs of these dwellers. The parking floor can also be securely entered from the incremental housing part of the building so that possible chauffeurs living in the building could reach the car their driving directly. By having an internal street and a small bridge connecting the two main volumes of the plan, only a ramp is needed to bring cars up and down. This ramp is located on the south side of the plan connecting to the major road.

All the floors from the second floor and up are for housing with the roofs being accessible.

Figure 91: Masterplan ground floor

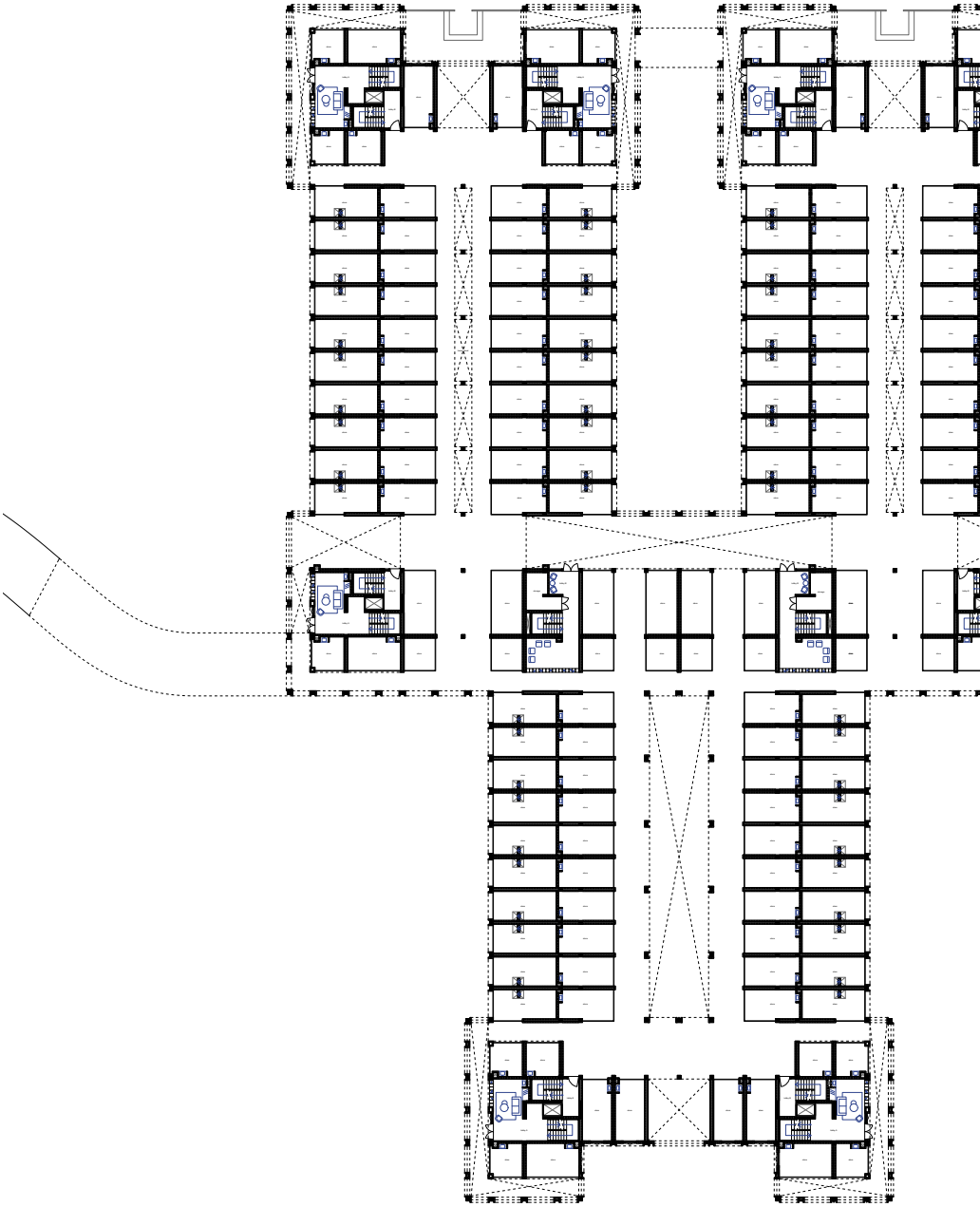
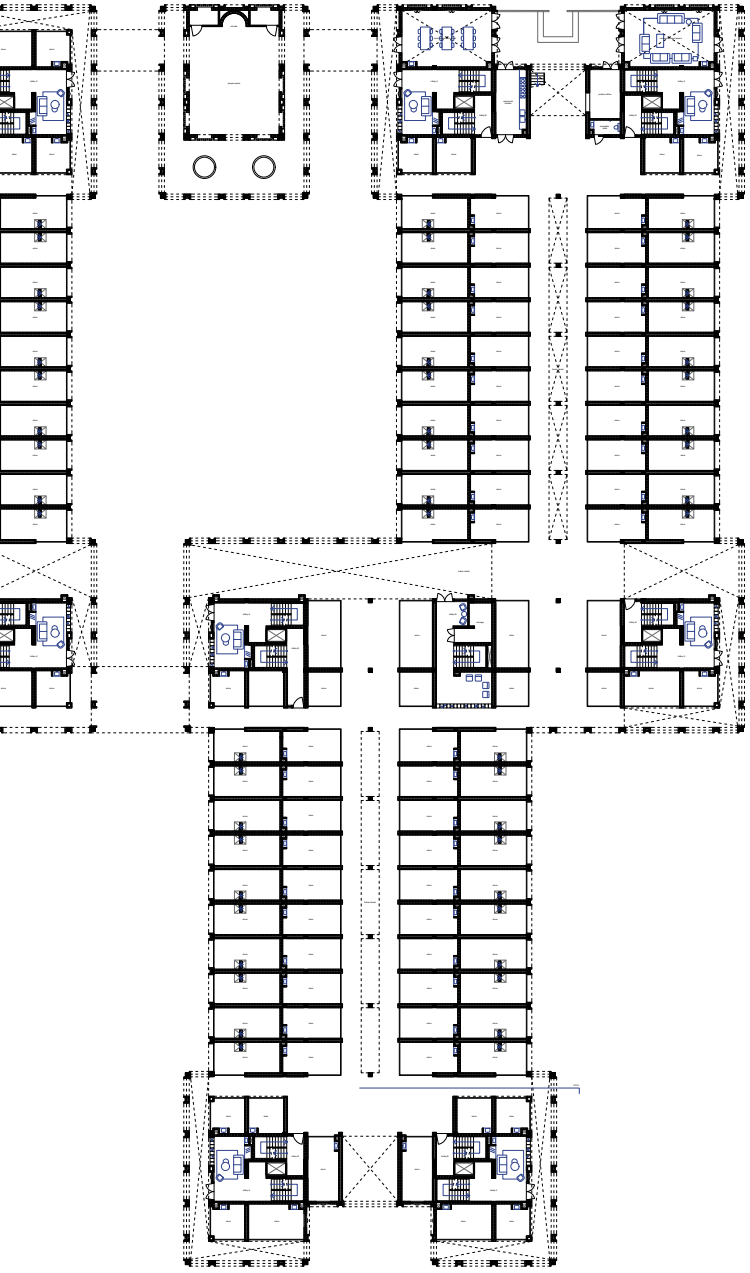


Figure 92: Ground floor plan



0 25m

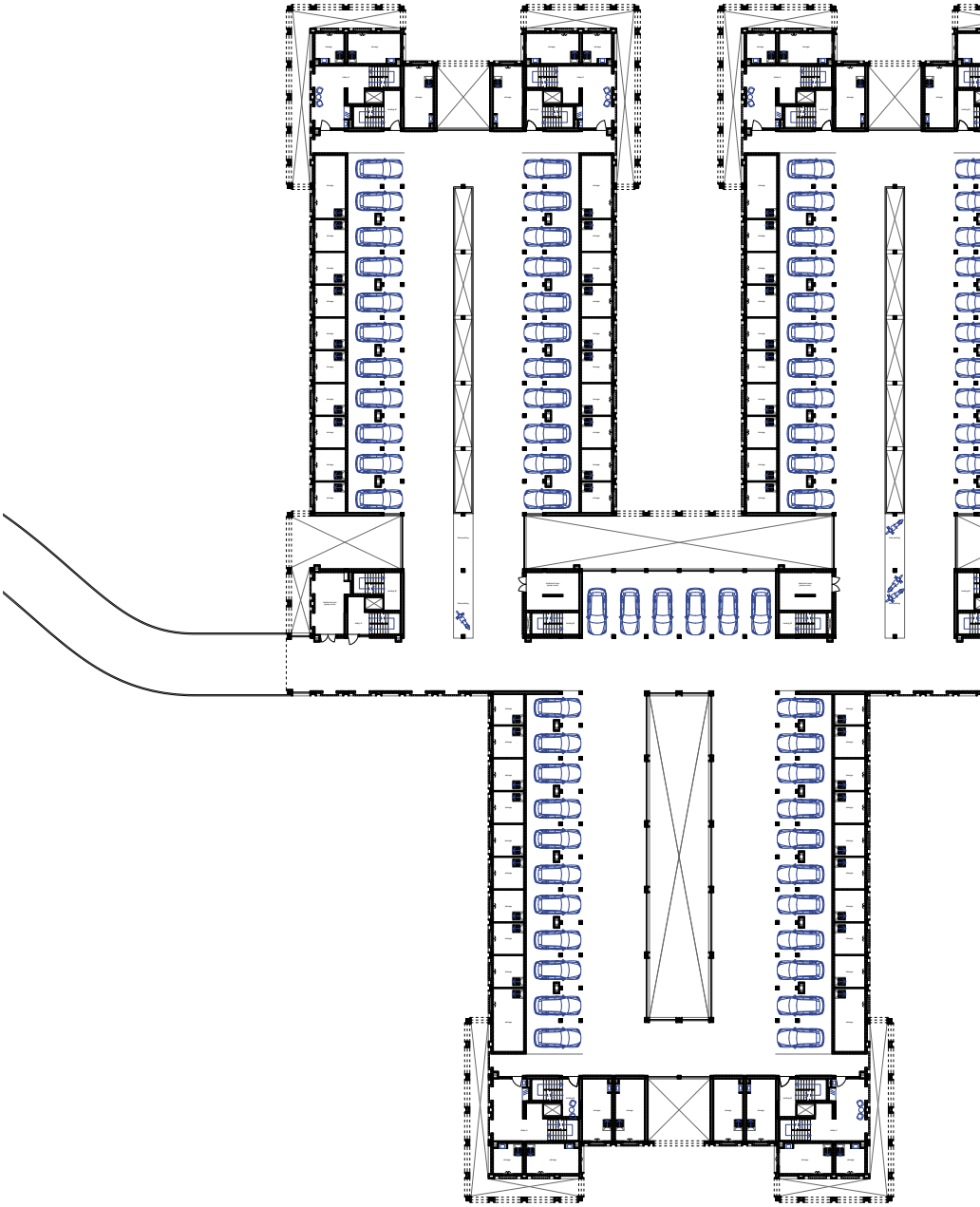


Figure 93: First floor plan

0 25m

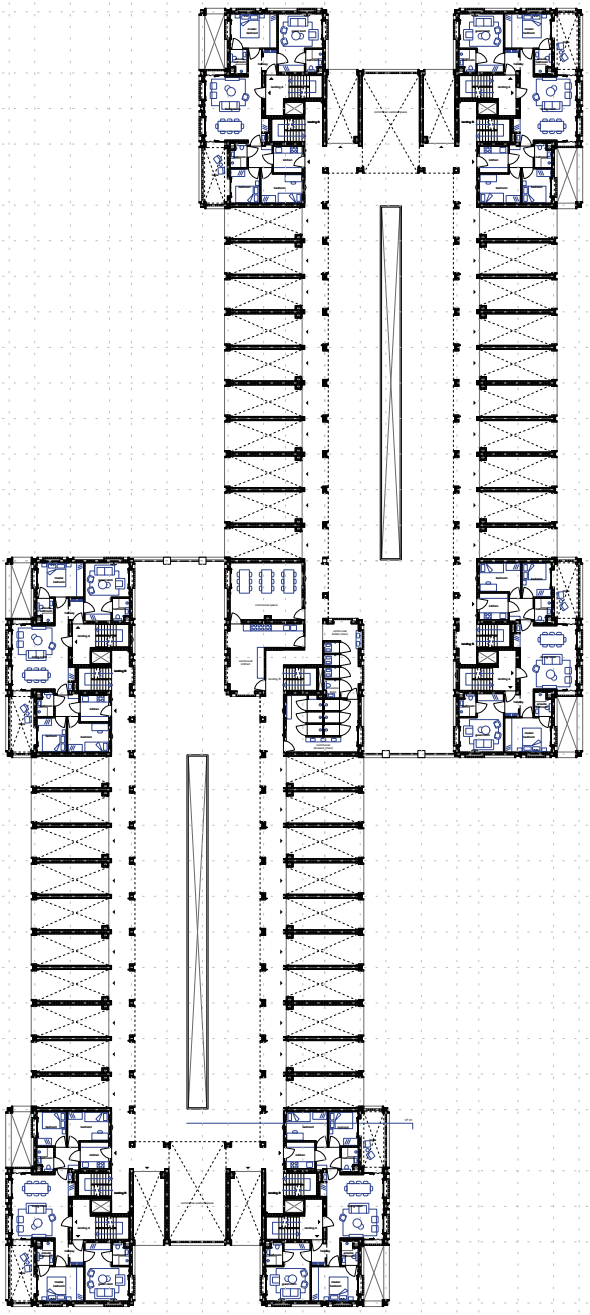


Figure 94: Typical lower dwelling floor plan

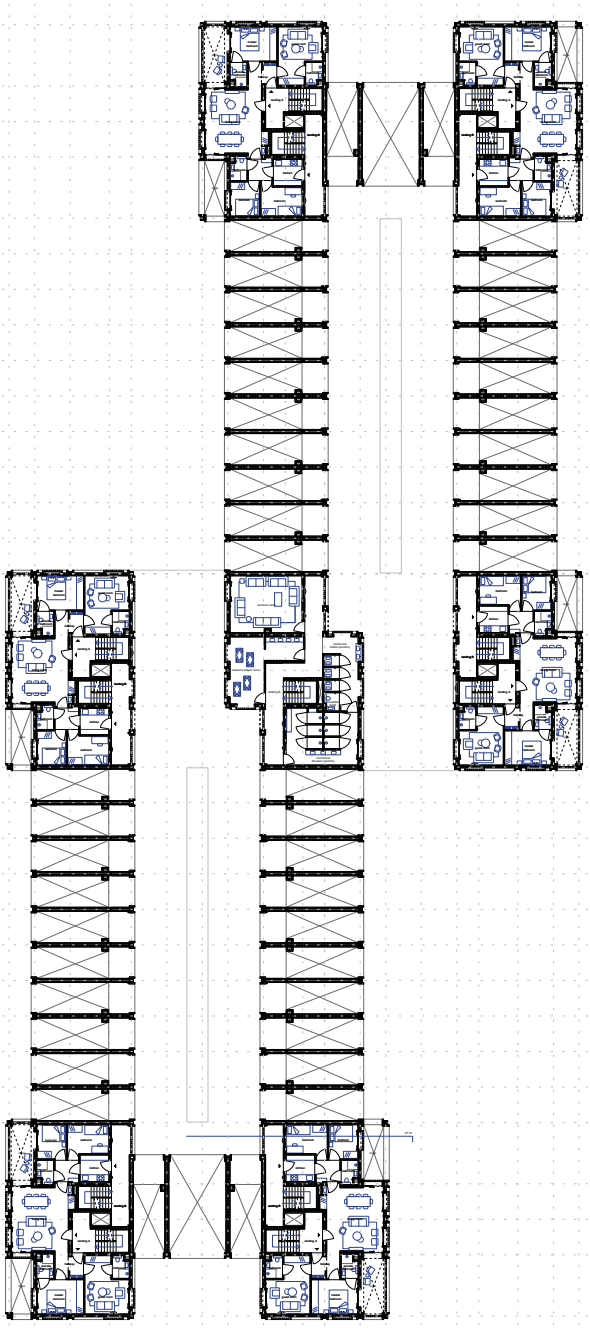
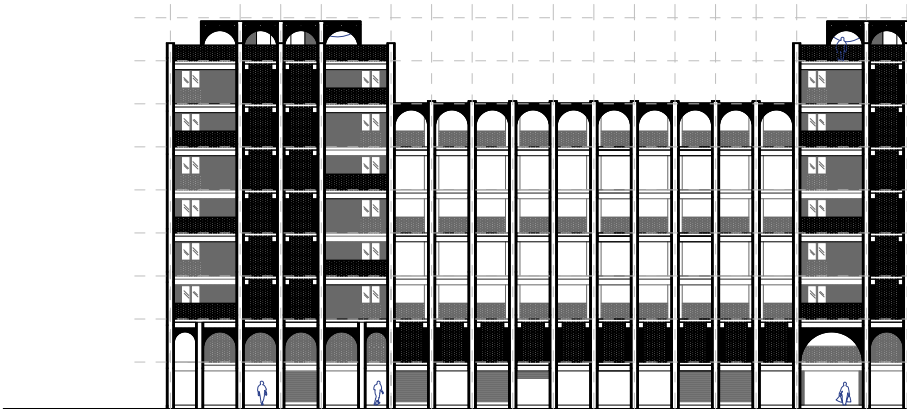


Figure 95: Typical upper dwelling floor plan

South facade



East facade

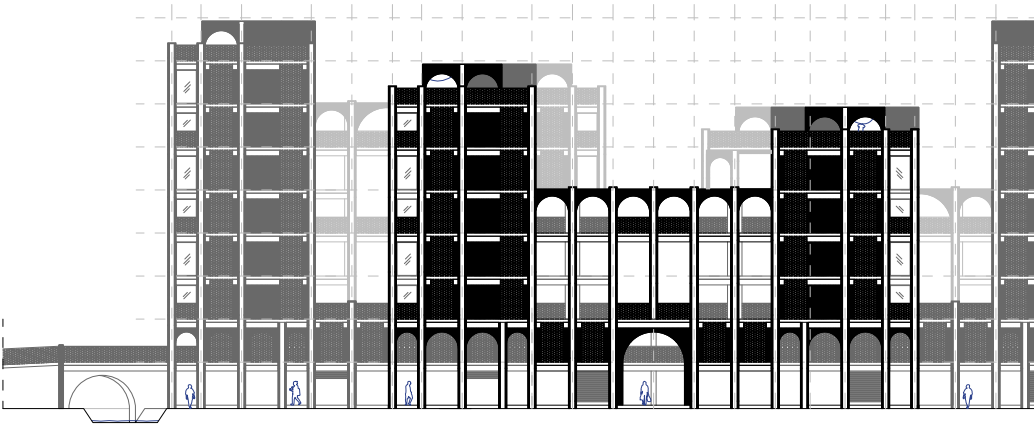
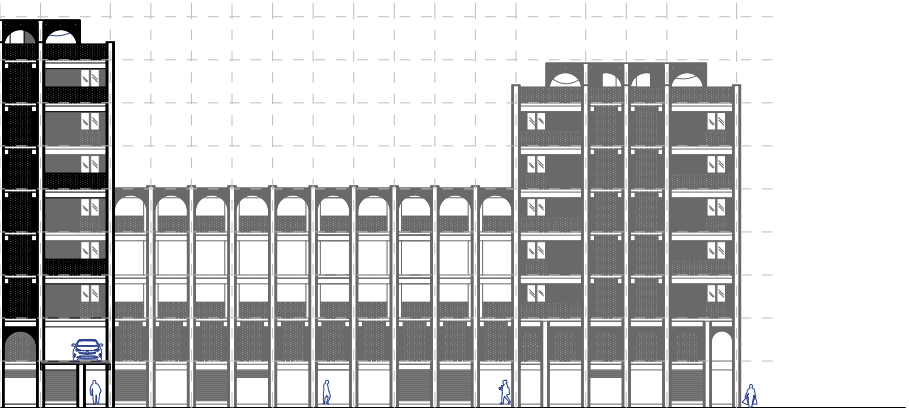
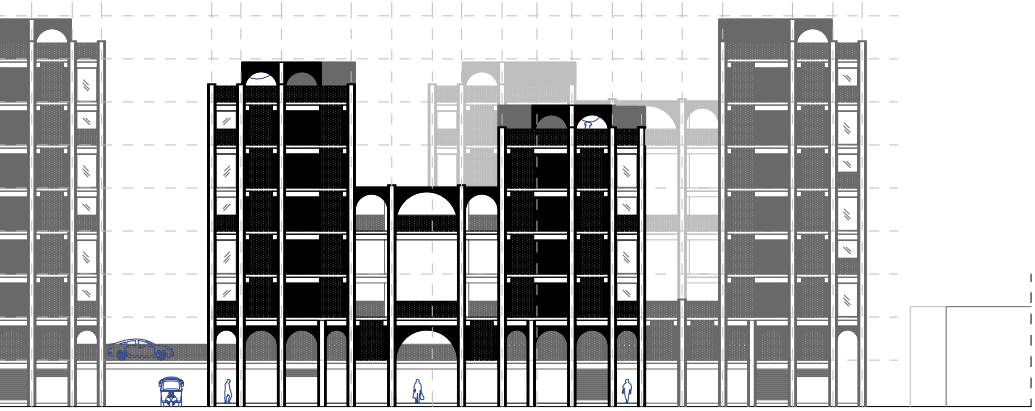


Figure 96: Elevations





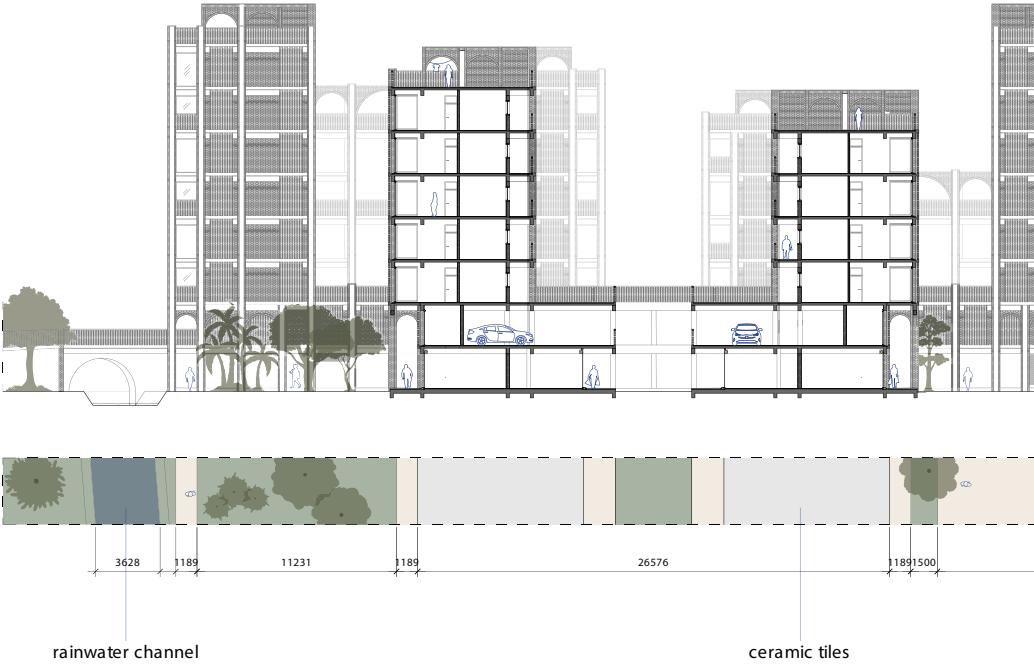
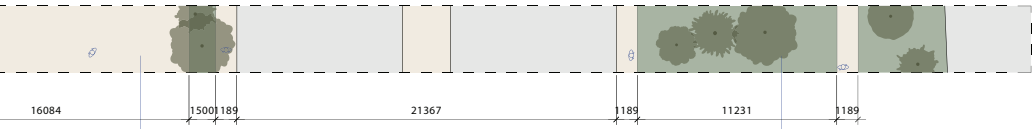


Figure 97: Streetscape section (North-South)



fine gravel

soil

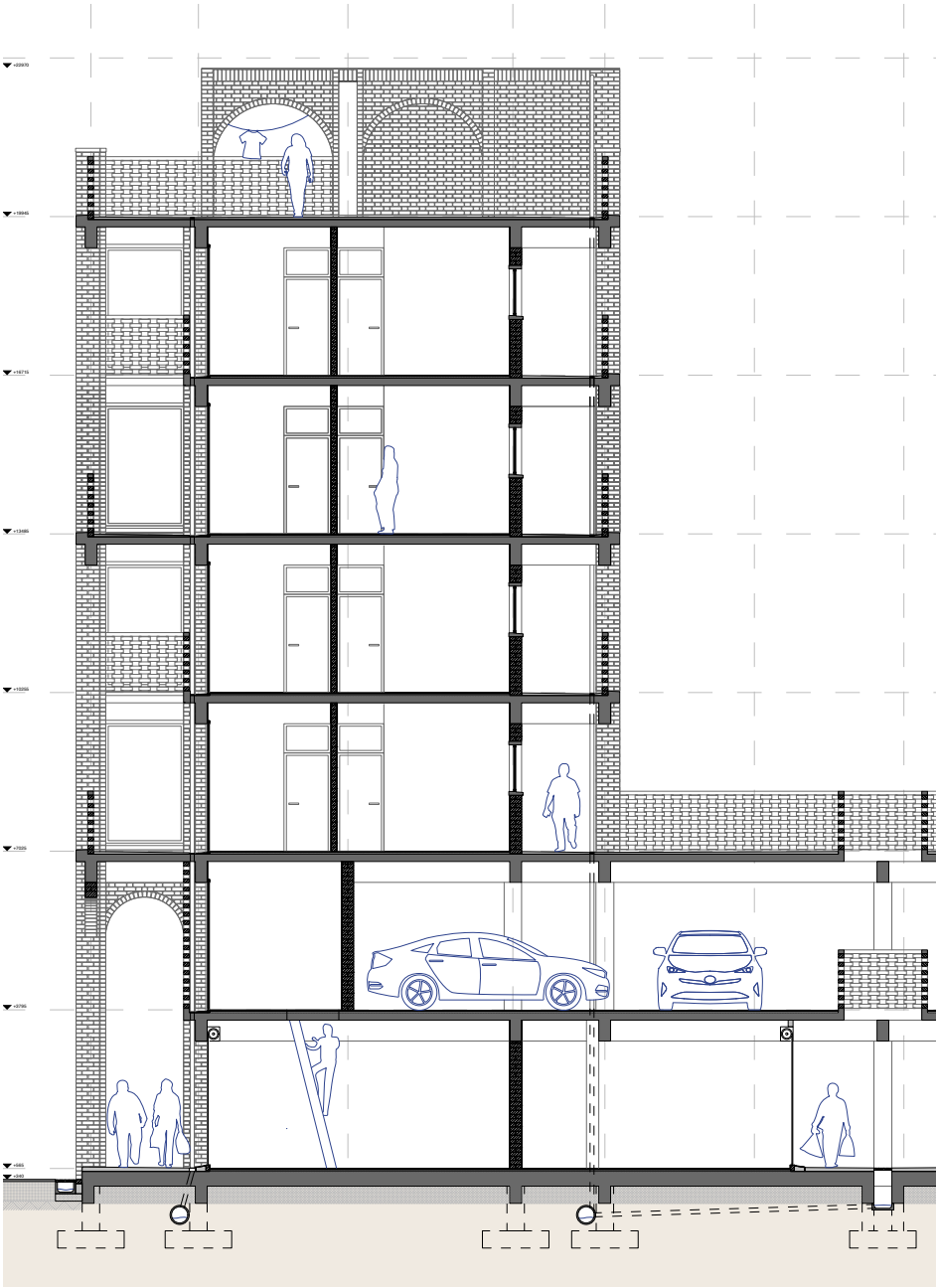


Figure 98: Fragment section

plot = 1.52 ha

total floor area = 43310 m^2

FSI = 2.78

GSI = 0.51

high-end dwellings = 72

low-end dwellibgs = 254

total dwellings = 326

density = 215 dw/ha

communal area = 2357 m^2

retail area = 4178 m^2

parking = 120 cars

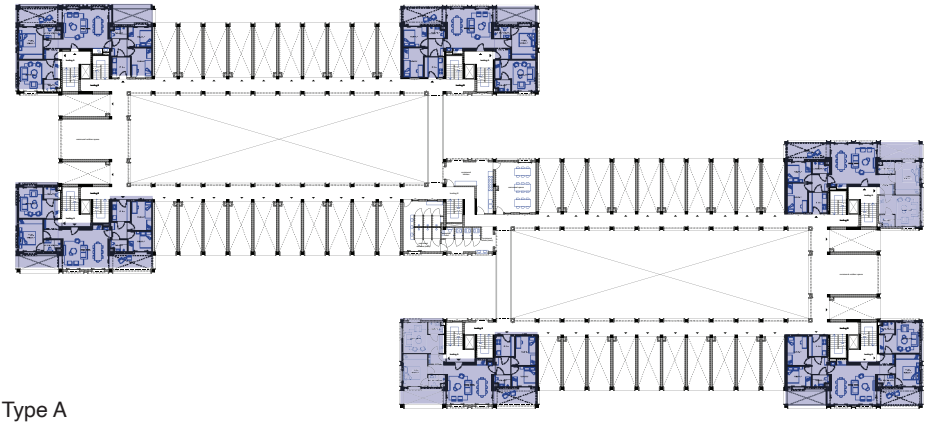
Dwellings

The whole design contains only the two different types of dwellings: 72 of type A and 254 of type B (see figure 99).

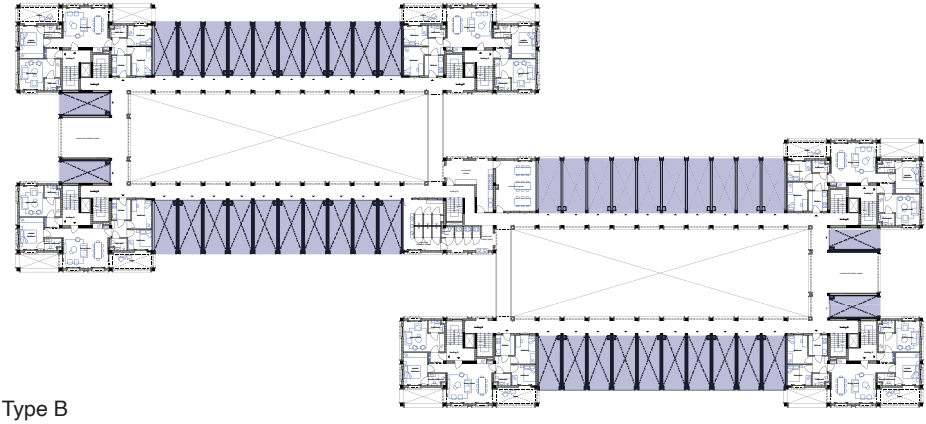
Type A is a 98 square meter 3 bedroom 3 bathroom private owned apartment with a guestroom / additional bedroom (see figure 100). This type of dwelling is located in the towers on every edge or end of the serpentine shaped blocks. From the private landing two doors lead into the house, one to the guestroom and one directly into the central living room that has on both sides bedrooms located as well as the kitchen that can also be accessed by the maid through a separate entrance. This separate entrance serves a dual purpose as this is also an emergency exit route.

Type B is a duplex apartment that can be incrementally filled in by the owner (see figure 101). The entrance is at the lower floor of the apartment with a total floor area of 35 square meters. An additional 6 square meters are on the upper floor of which the floorslab is the ceiling over the gallery serving the type B apartments. A shaft runs through the dwelling to which plumbing and other services can be connected. The concrete beams that run along the side walls of the unit stick out of the wall so that a level and sturdy floor or ceiling can be installed in a fairly quick manner.

Figure 102 shows the plan of the dwelling as its being sold: completely empty. The next three figures show optional layouts with different materialisations of facades and internal walls that one could use in filling in this dwelling.



Type A



Type B

Figure 99: Block floor plan and dwelling types

Type A:

interior floor area = 98 m^2

exterior floor area = 12 m^2

guest room / extra bedroom

bedrooms = 3 / 4

bathrooms = 3

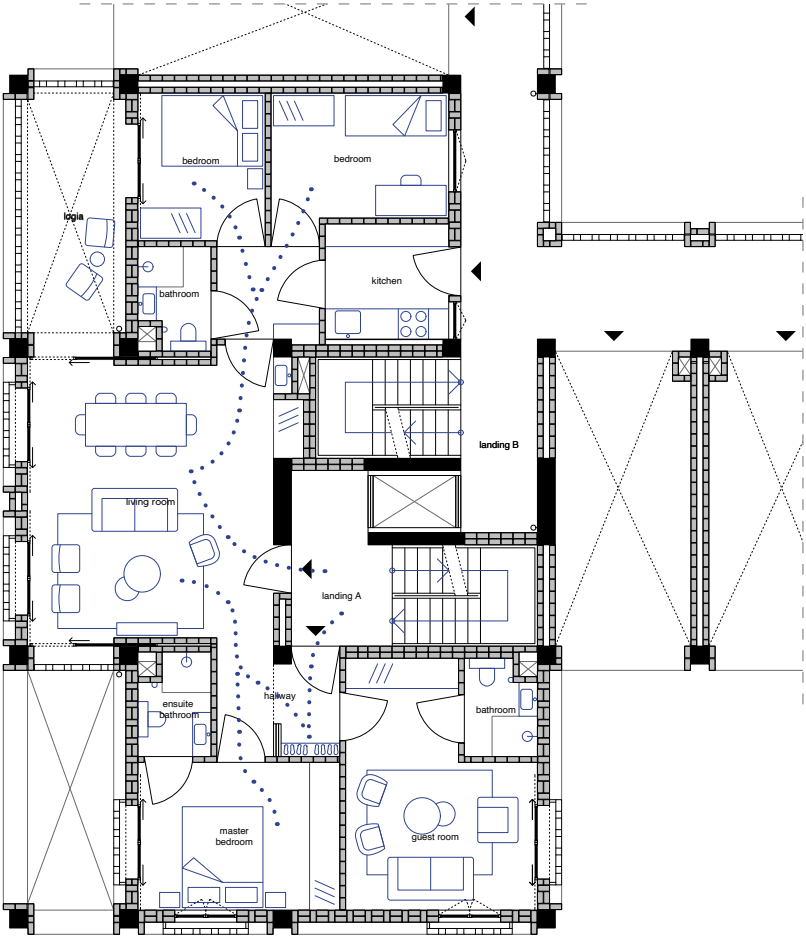


Figure 100: Type A dwelling floorplan

Type B:

floor area = 41 m^2

bedrooms = 2

bathrooms = 2

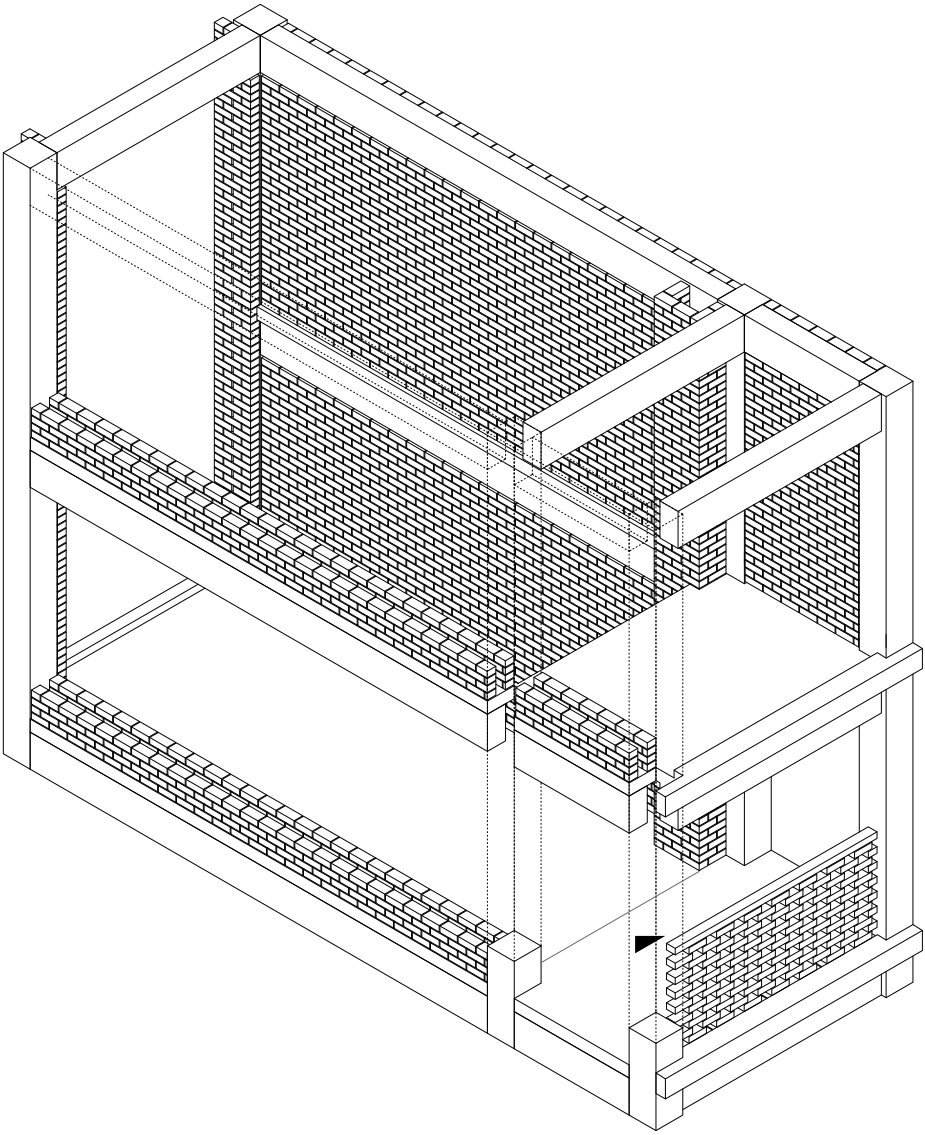
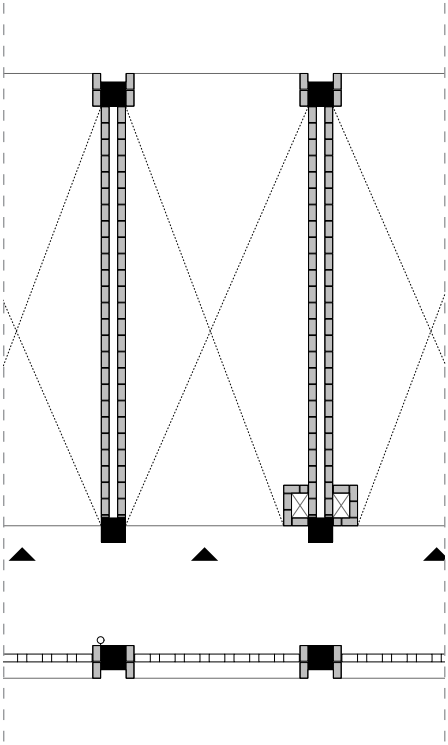
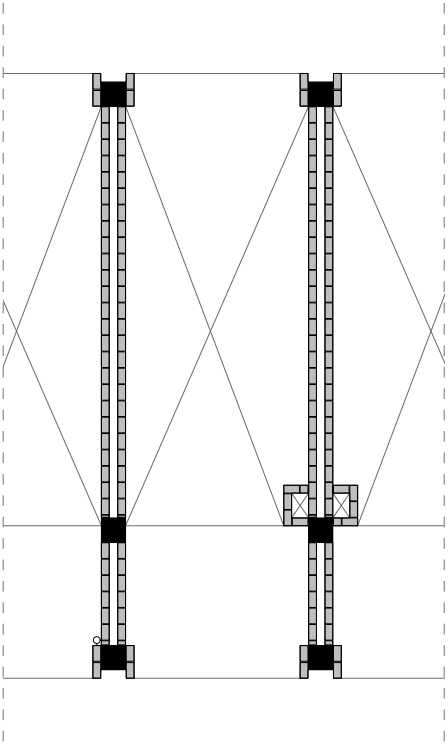


Figure 101: Type B dwelling isometric



lower floor



upper floor

Figure 102: Type B dwelling floorplan option

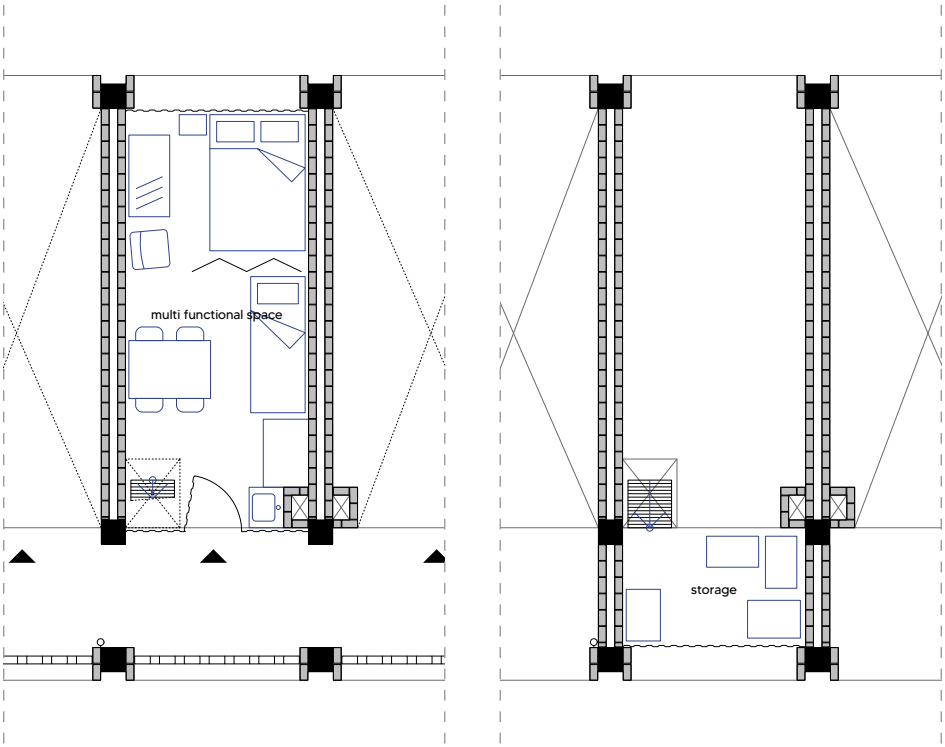


Figure 103: Type B dwelling floorplan option

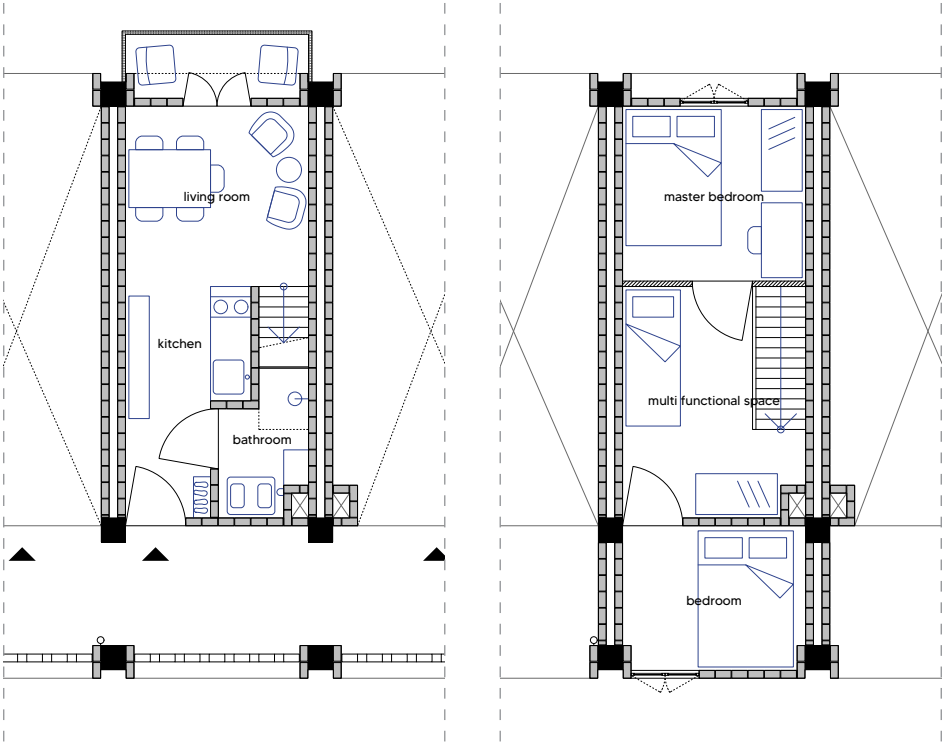


Figure 104: Type B dwelling floorplan option

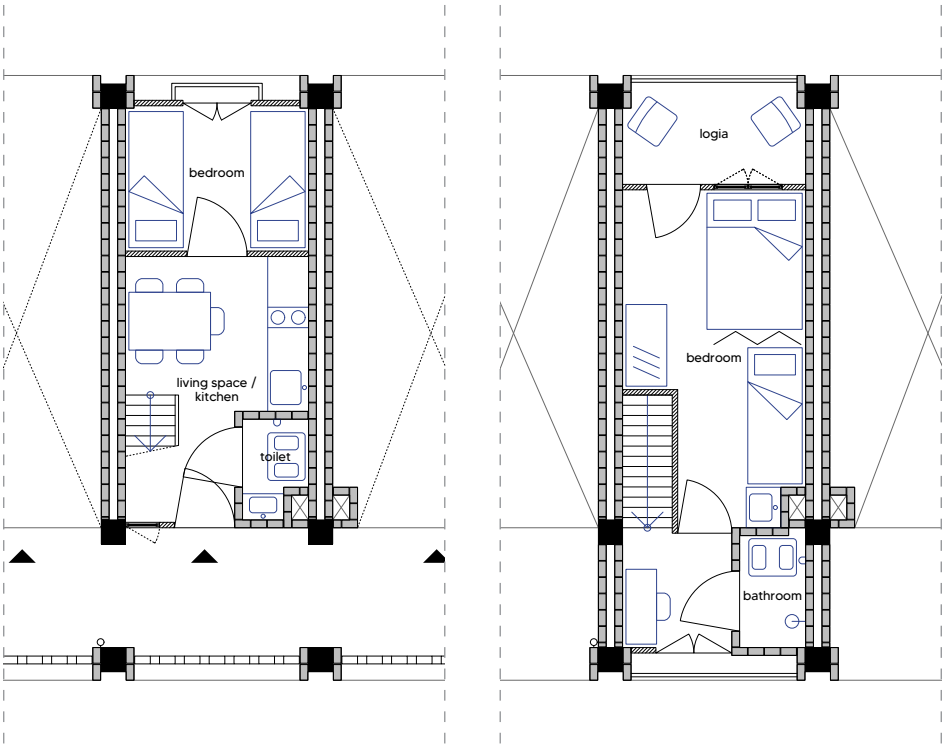


Figure 105: Type B dwelling floorplan option

Communal spaces and services

Within every tower that forms the knot between two U-shaped building volumes (see figure 106) communal spaces for washing, cooking, meeting and praying are located. The spaces provide services for all dwellings on that particular floor that because of their incremental nature might not (yet) have these services located within the house. Because of the incremental housing units being duplexes, these community spaces also span two floors before repeating. Hereby every second floor is exclusively for women, with a prayer space so that women have their own place for worship as they are not allowed to go to mosques.

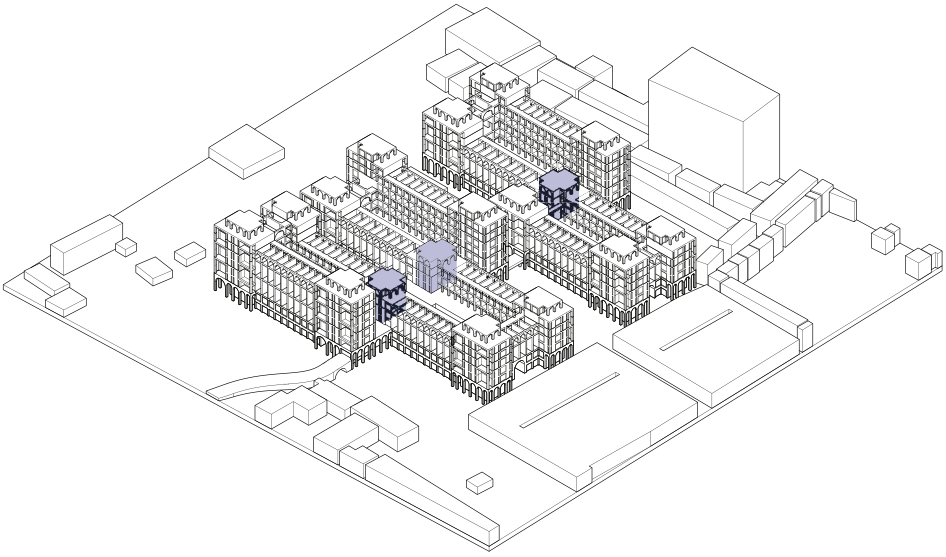


Figure 106: Communal spaces location in plan isometric

Figure 107: Public restroom at Sweepers colony, Sylhet. Picture by Julian Wijnen

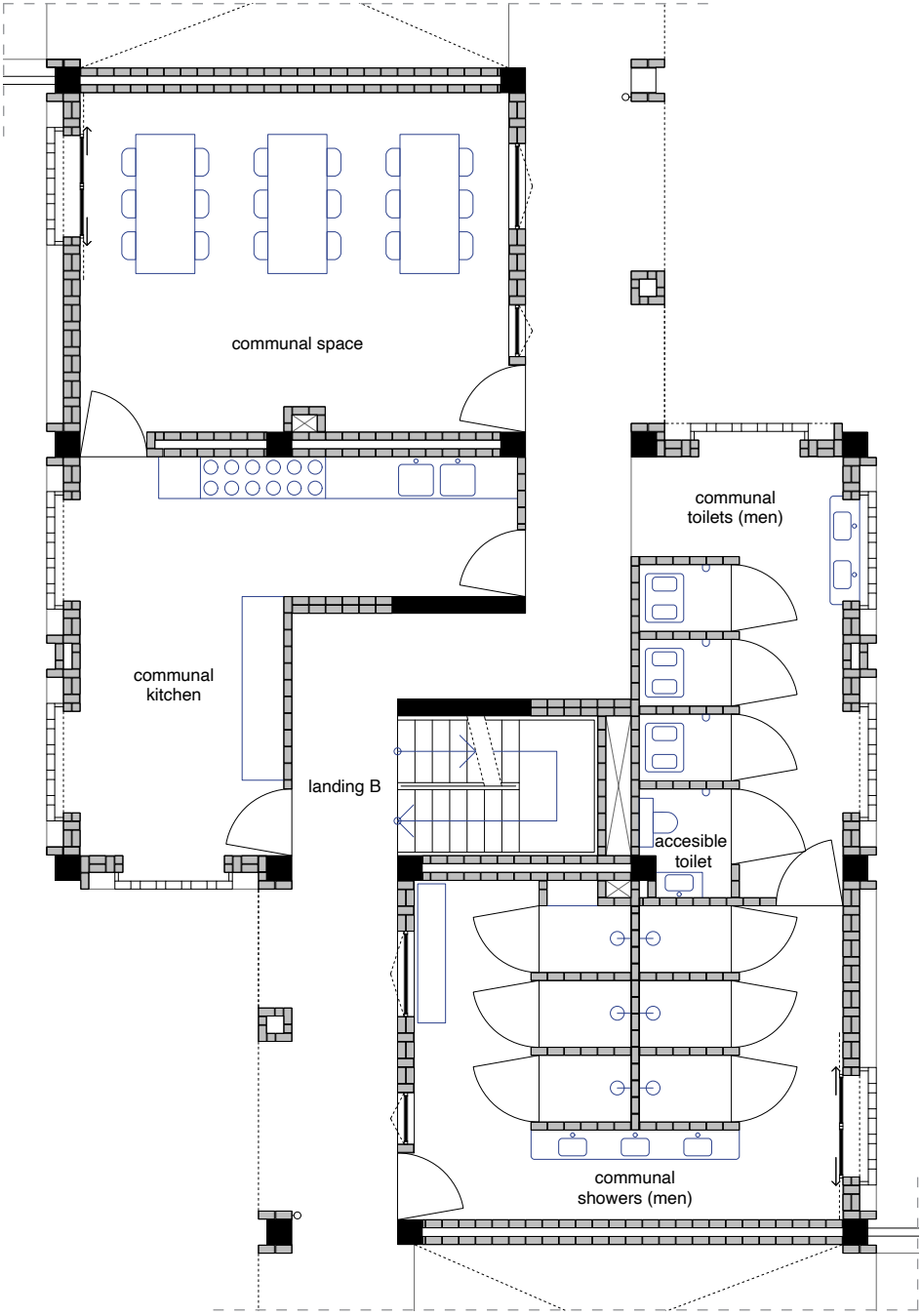


Figure 108: Communal spaces typical lower floor plan

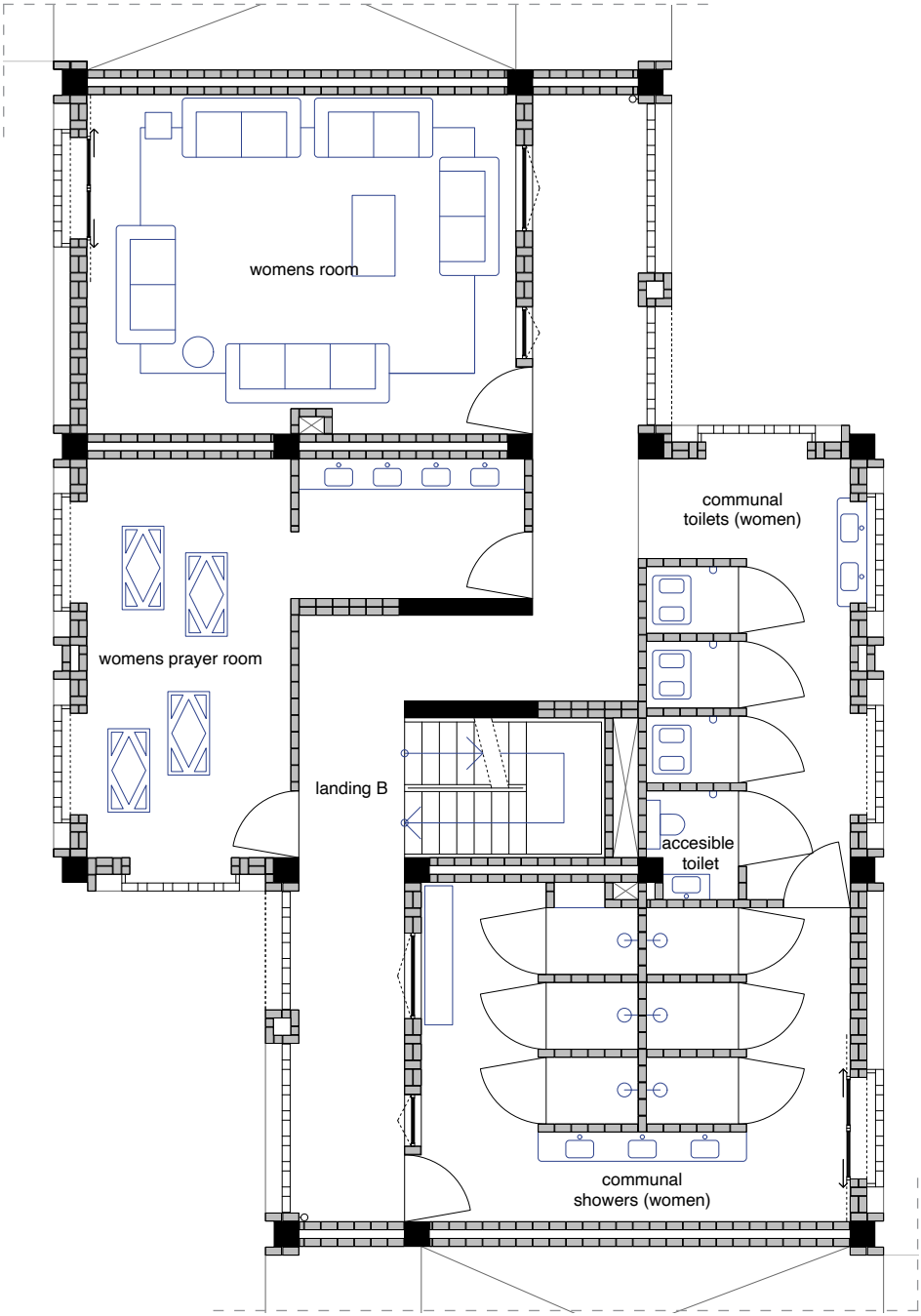


Figure 109: Communal spaces typical lower floor plan

Just like many of the buildings in Bangladesh (see figure 111) that have to cover multiple floors, this building will also be made out of a concrete column-beam structure (see figure 110). With on-site pouring being the norm there are some limitations regarding the span of the floors. Working with these limitations a grid of concrete footing is laid out on which the concrete structure can rise up (see figure 113).

The infill of the concrete frame consists of brick as this material is durable, widely available, widely used and understood in Bangladesh. Figures 114 to 117 show the impressions and detailing of the facades and how connections between different materials are made.

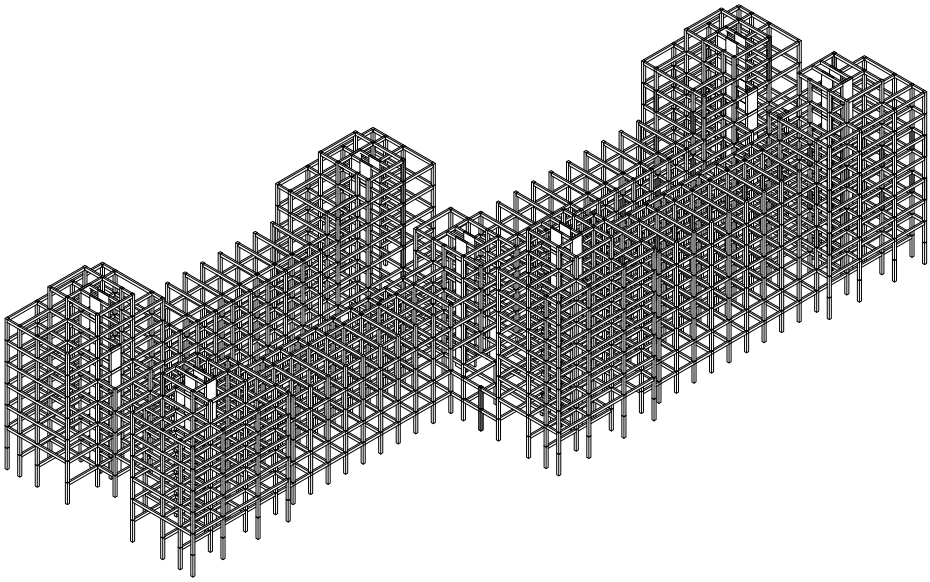


Figure 110: Concrete structure isometric

Figure 111: Concrete building skeleton at construction site in Dhaka

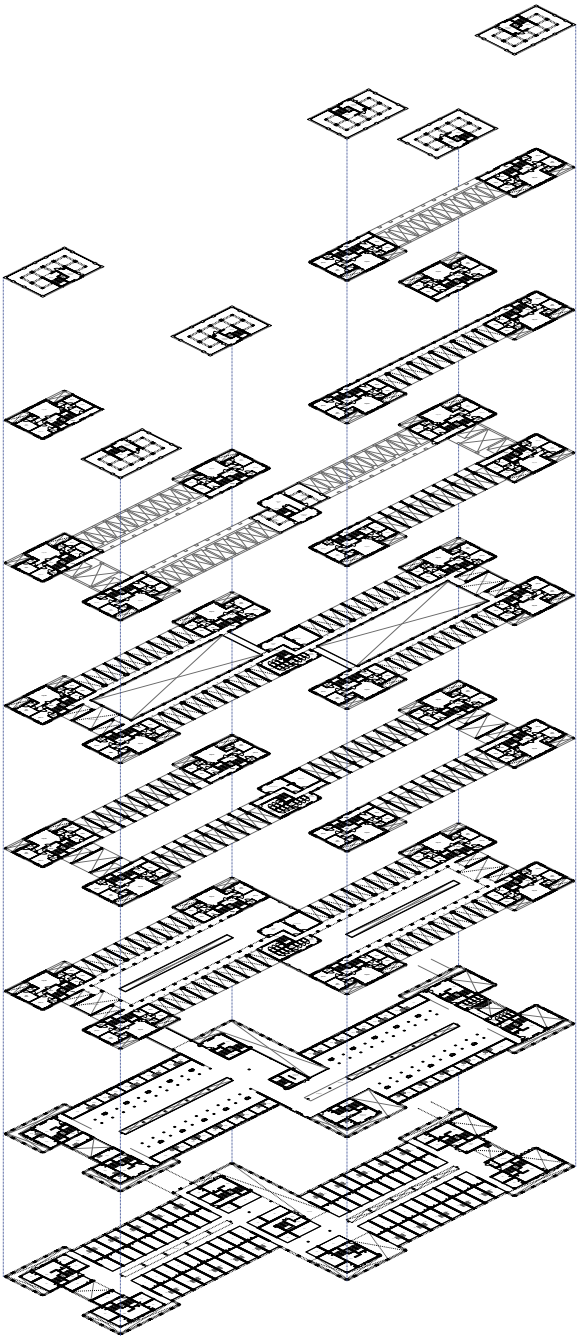


Figure 112: Floor plan exploded isometric

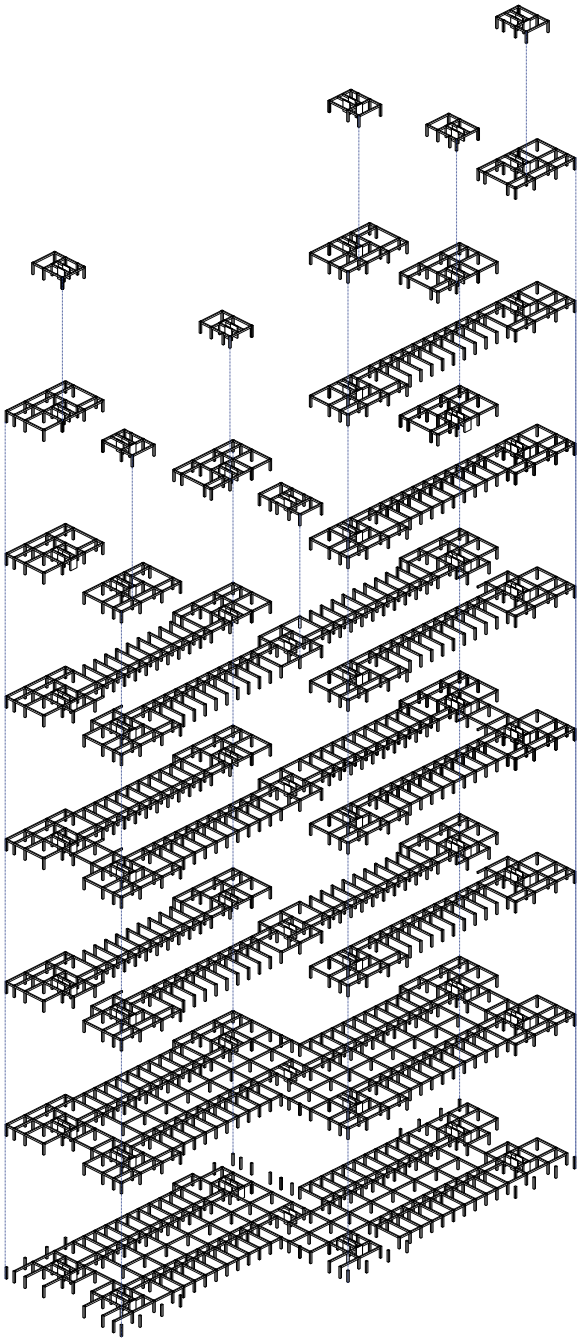


Figure 113: Concrete structure exploded isometric

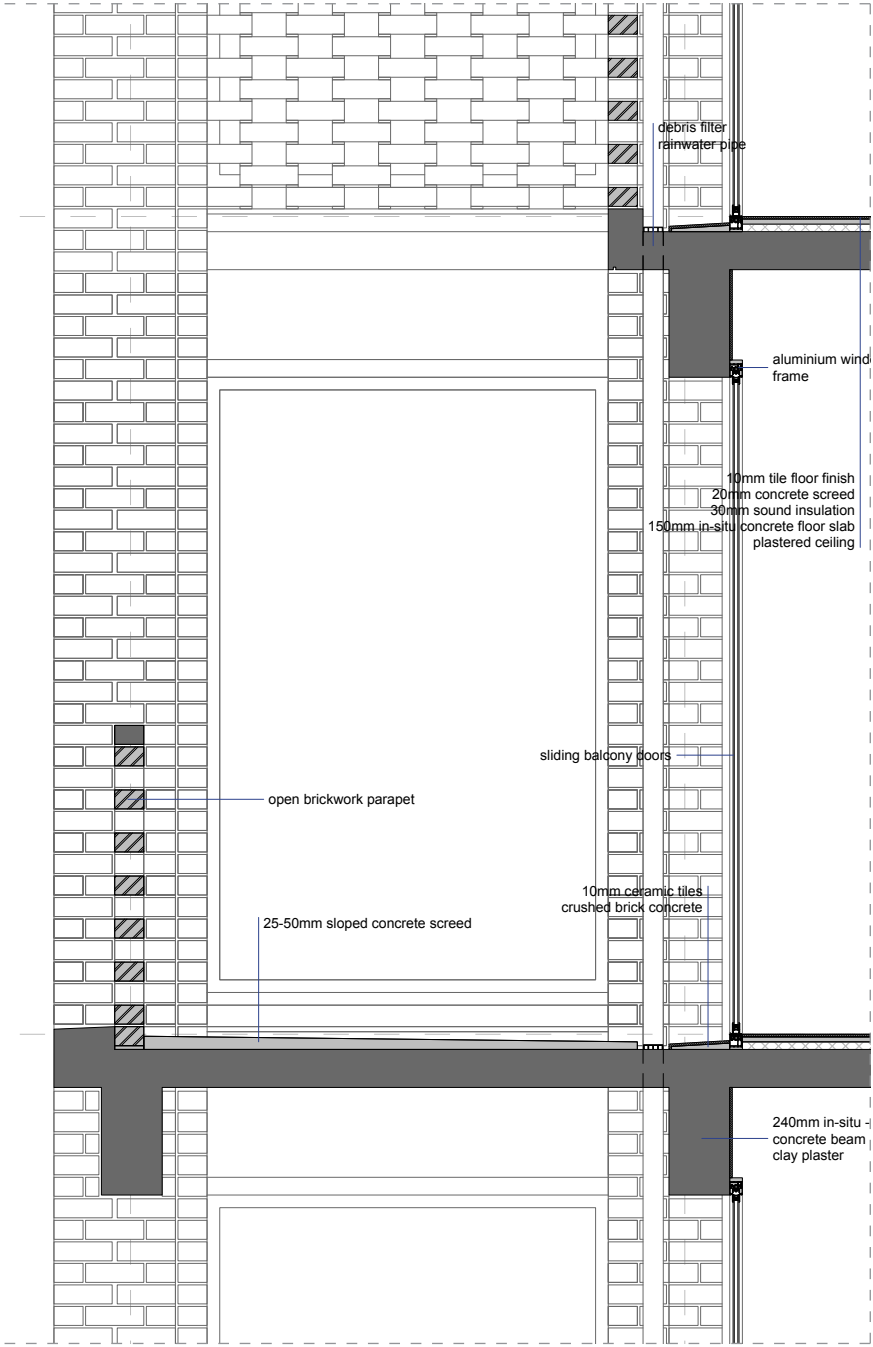


Figure 114: Vertical logia detial

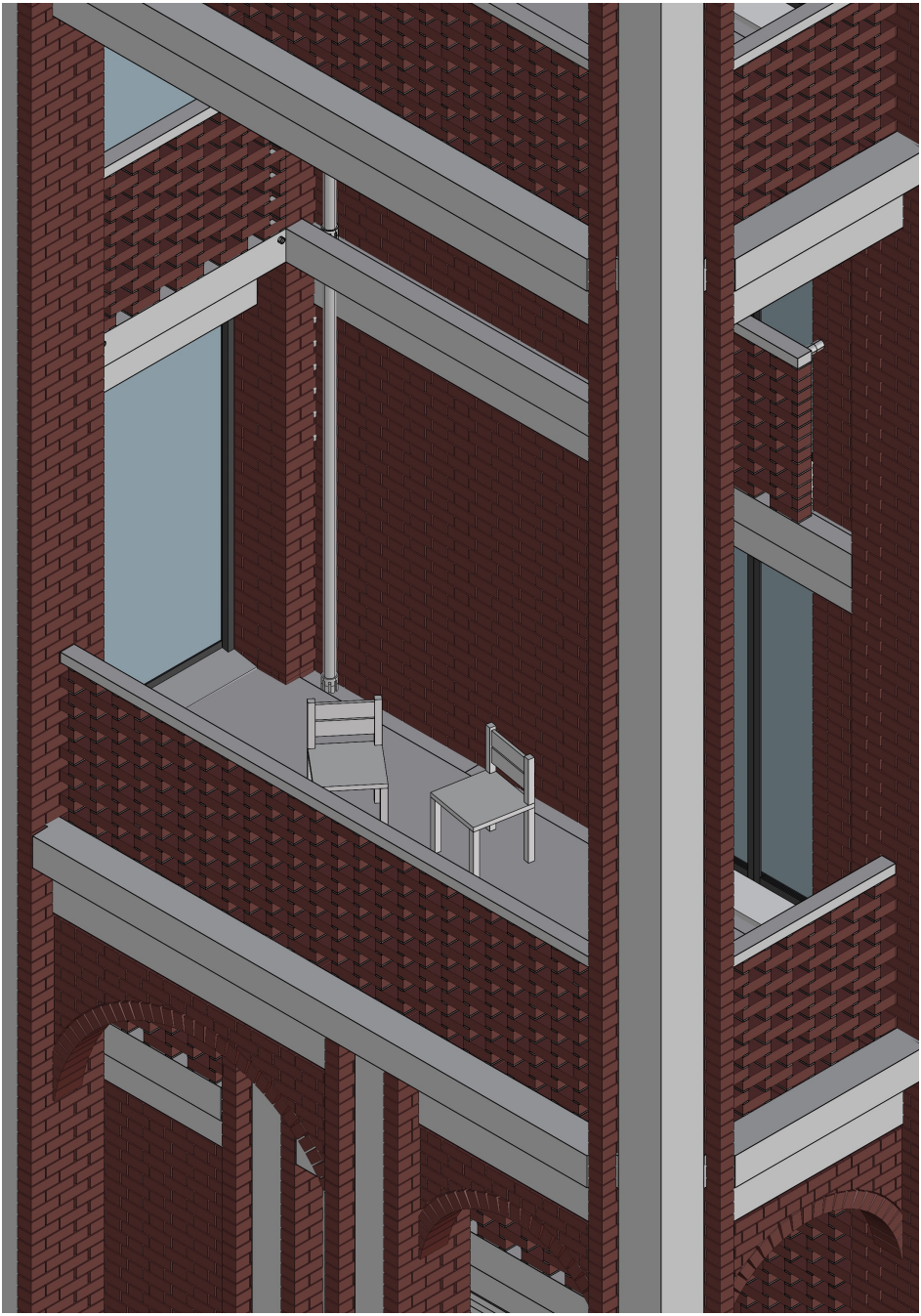


Figure 115: Logia isometric impression

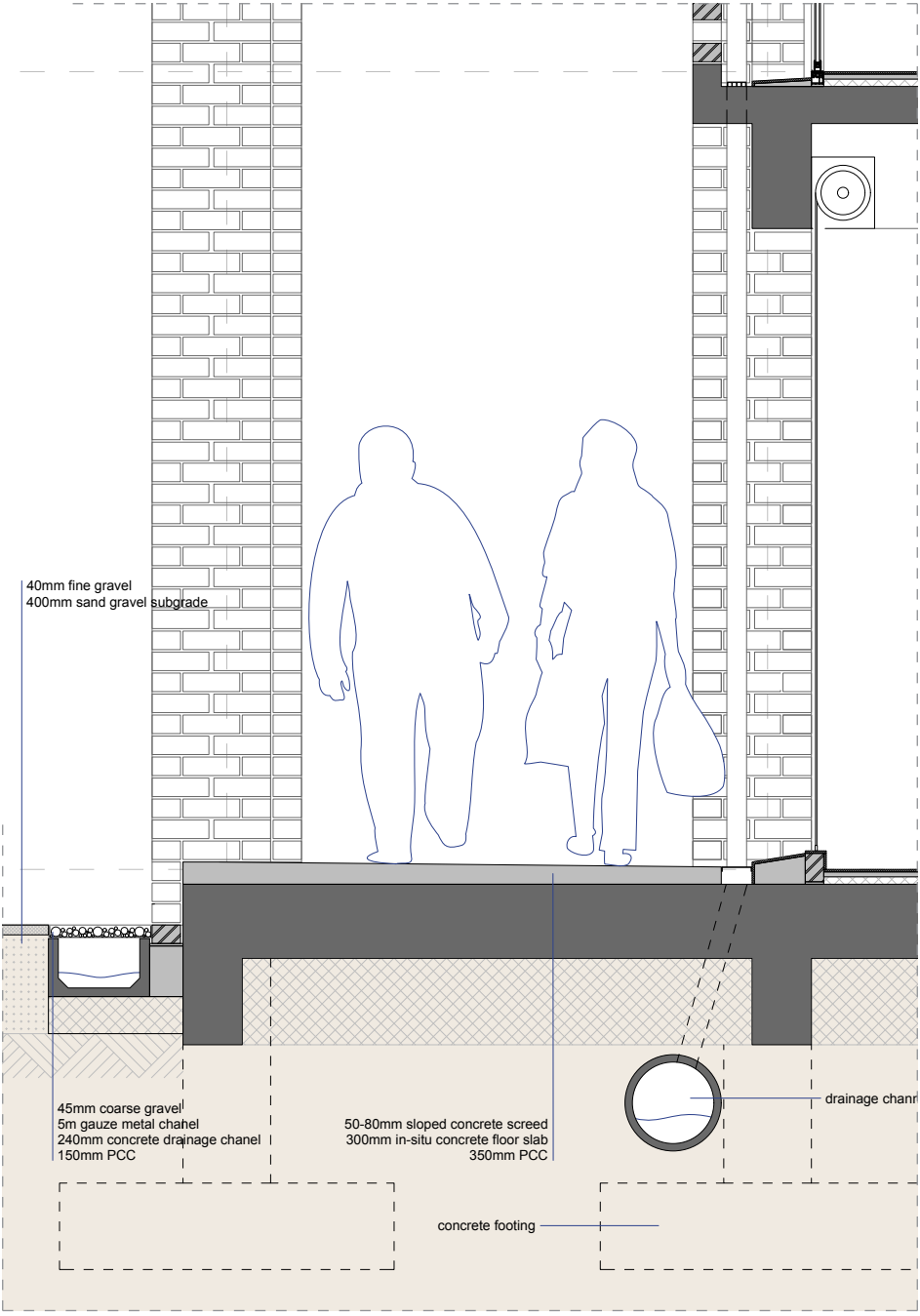


Figure 116: Ground level connection detial

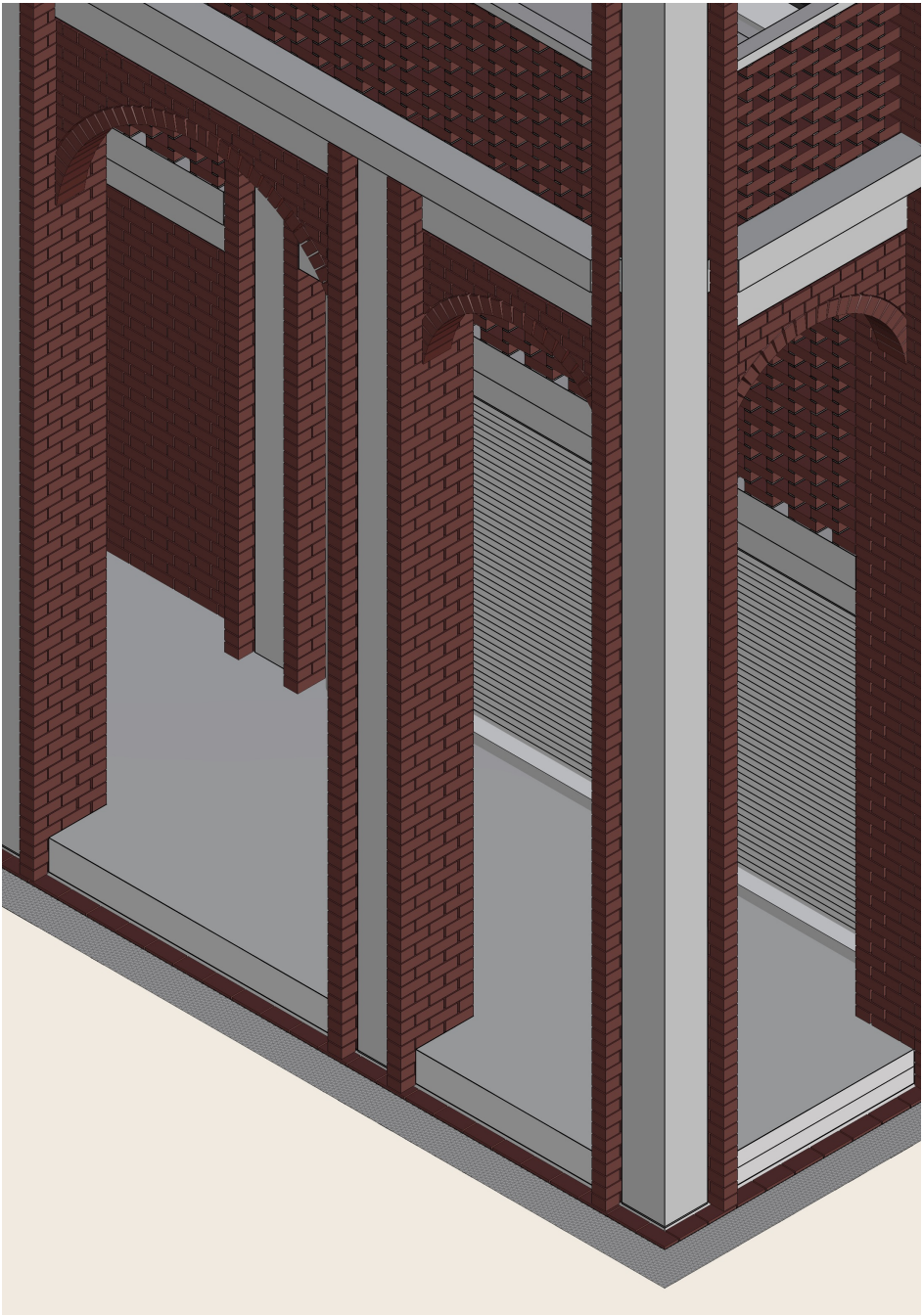


Figure 117: Ground level connection isometric impression

Bangladesh experiences heavy rainfall during summer months. The building uses this rainwater by collecting it at its roofs and balconies (see figure 119), then using gravity to let it flow to large underground tanks through which it ultimately is pumped up again into the towers of the building (see figure 118), where it is stored one last time before it can be used for flushing toilets and watering plants.

The roof structures that house these water tanks, the stairwells and the mechanical rooms for the elevators are also serving as a double roof that because of their open nature let a lot of wind through providing a shield against the intense sun's heat onto the apartments below.

Next figures 120 and 121 show the double facade that's created on multiple spots of the building. This extra porous brick wall provides shading (see figure 122) like a mashrabiya would in Arabic architecture. This same wall can also function as natural airconditioning, as the bricks when being wet by rain cool down the air that flows through it into the dwellings (see figure 123). Cooling the houses like this is sustainable and provides the dwellings with cool areas by using rain that's abundant during the rainy season which is at the same time the most hot period of the year.

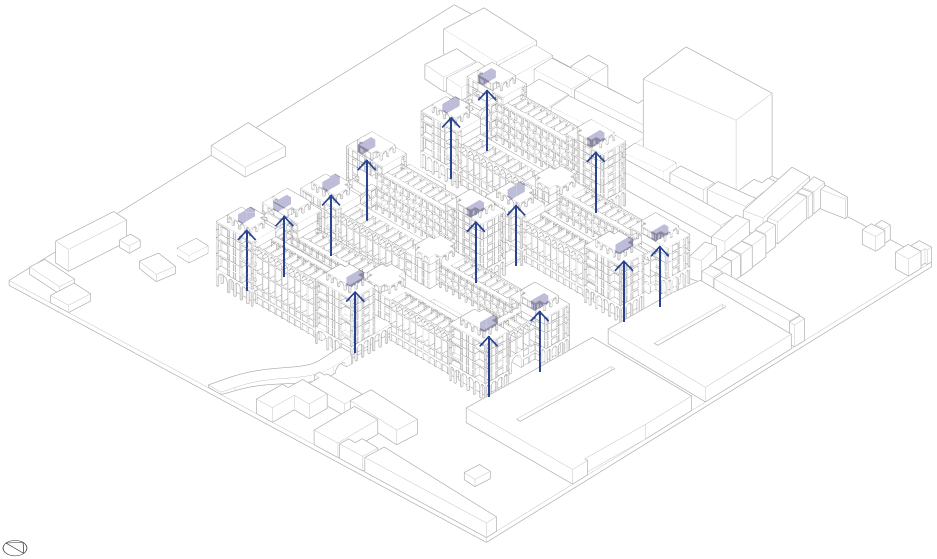


Figure 118: Tower watertanks location in plan isometric

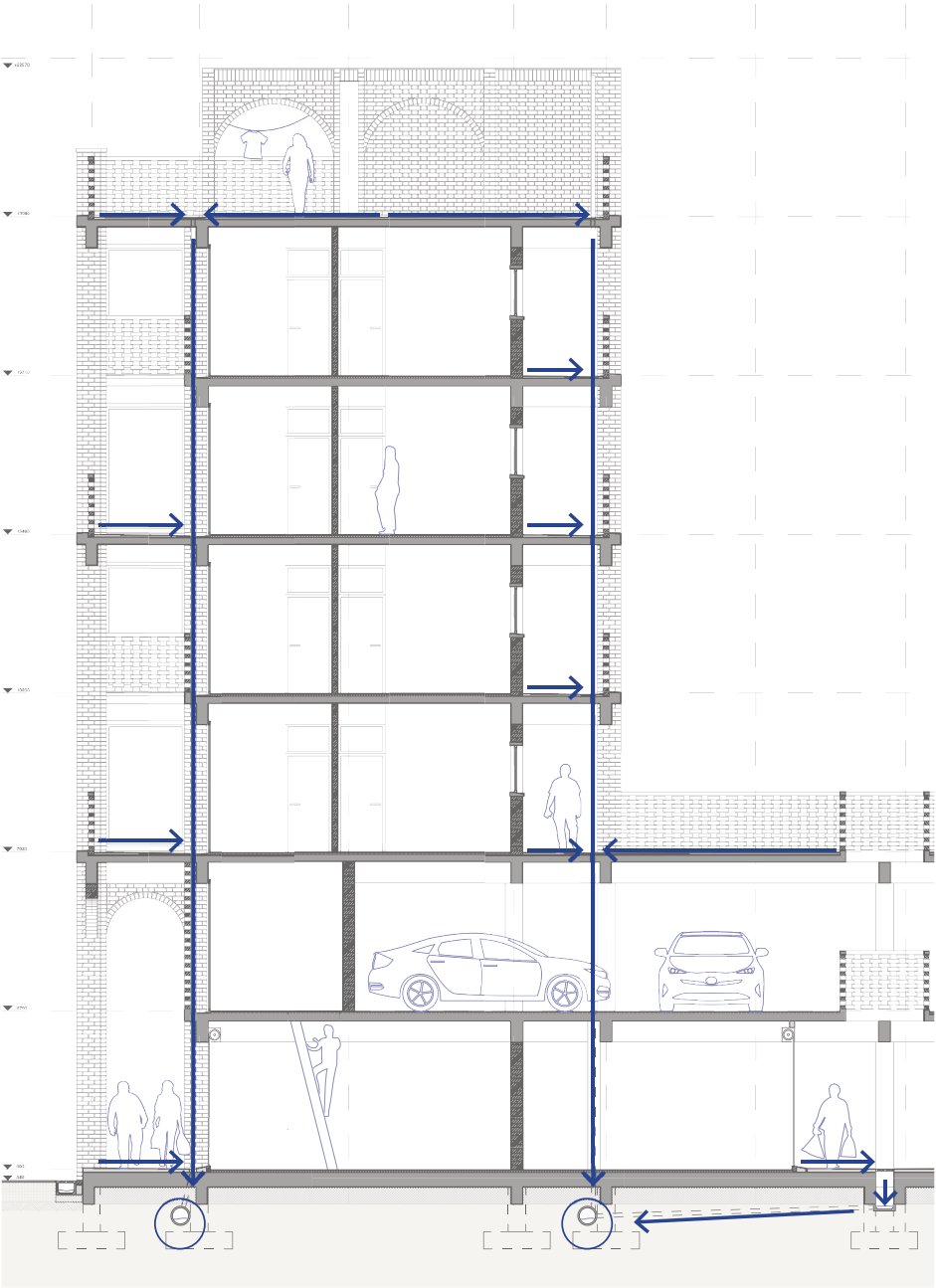


Figure 119: Rainwater collection in fragment section

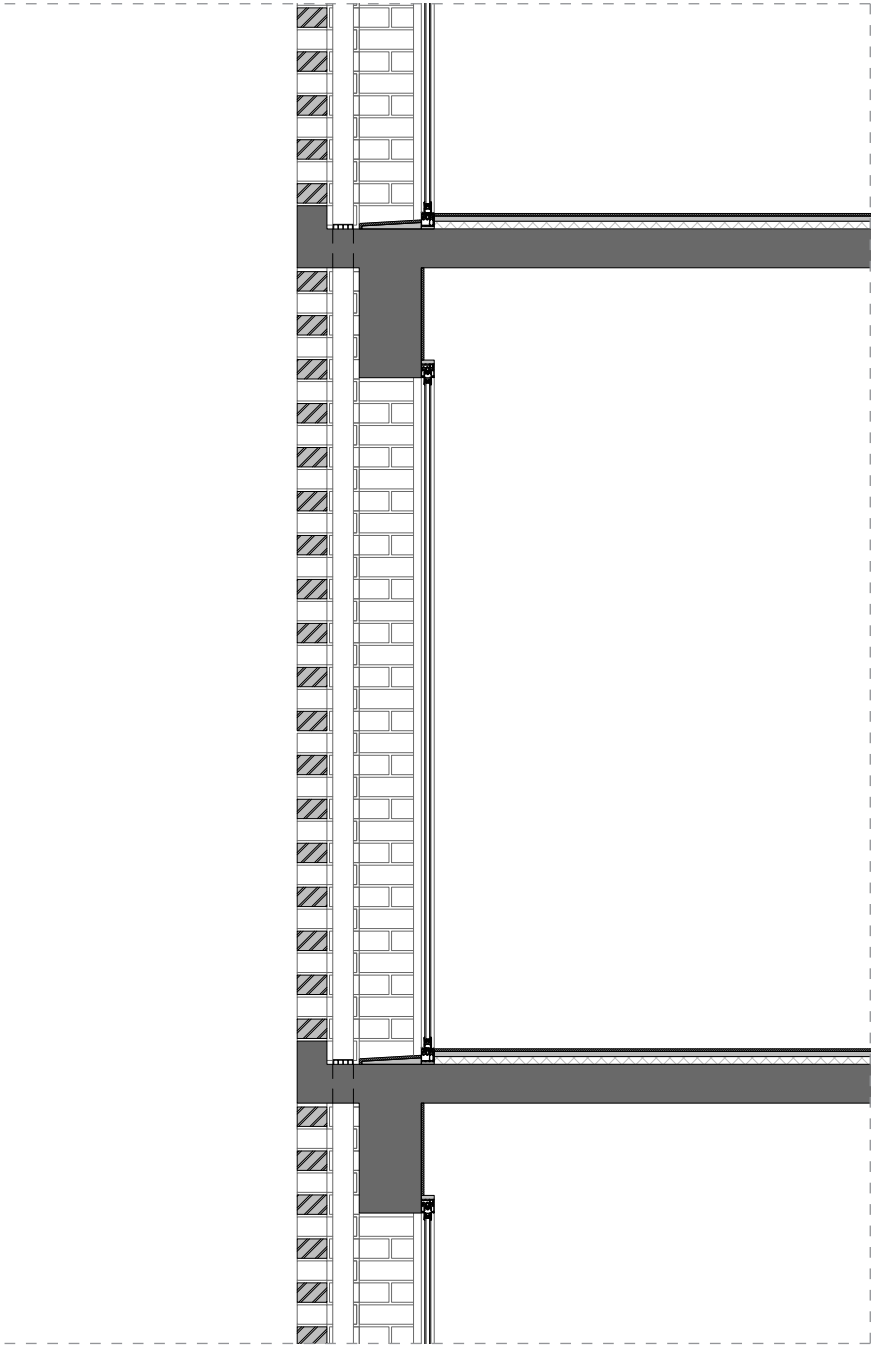


Figure 120: Vertical open brickwork (mashrabiya) facade detail

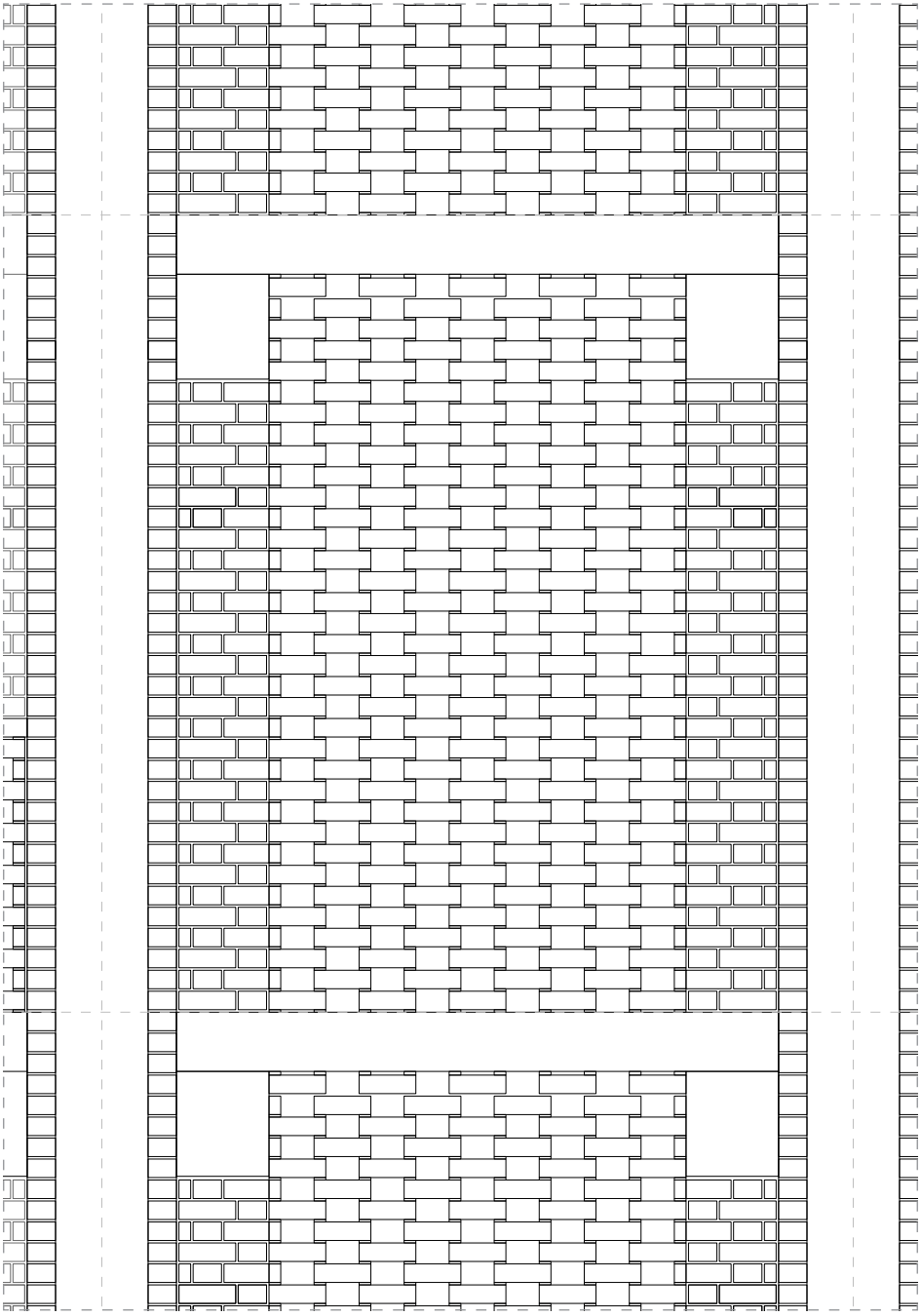


Figure 121: Elevation of open brickwork in facade

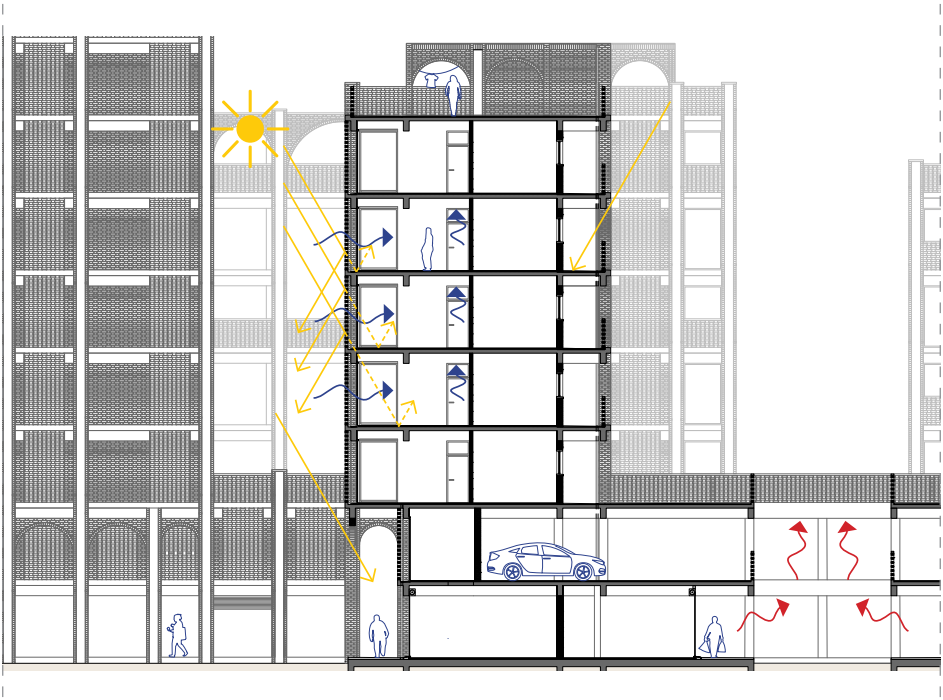


Figure 122: Facade fragment section on shading

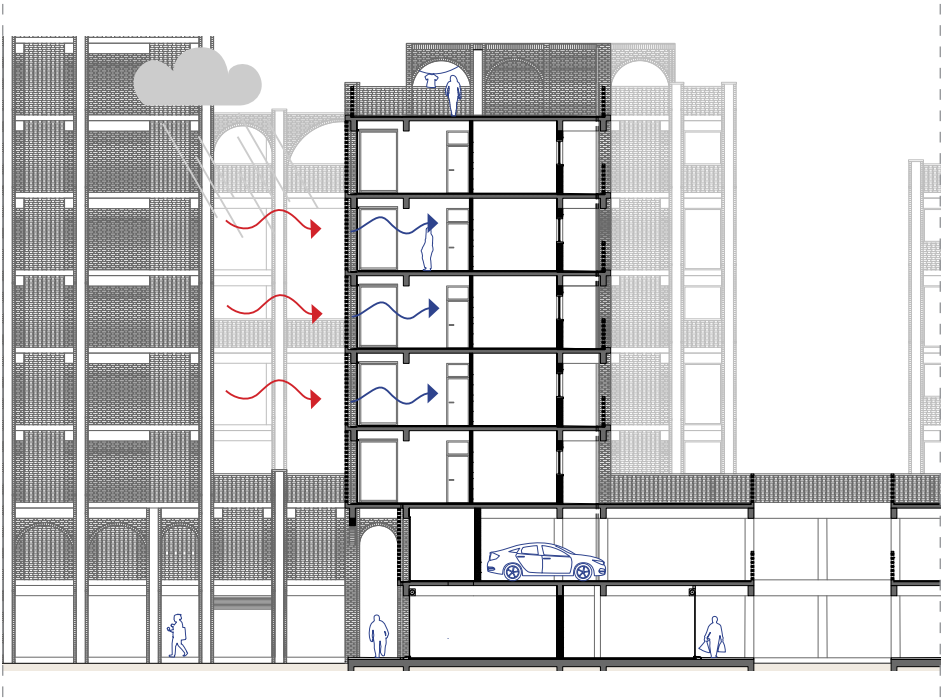


Figure 123: Facade fragment section on cooling

Project synthesis

The project's originality comes first from its cross-subsidisation of the different parts of the building, where the construction of middle to high income housing units make up for the embedded costs of building (high-rise) for the lower classes at such a prime location within the city of Sylhet. This then sets the stage for the incremental housing in this projects of which the dwellings can be stacked into a high-rise structure, not only benefitting the lower classes by creating adequate housing in the city center that can be expanded and invested in over time, but also to the wider population as it provides a sustainable way of densifying the urban fabric. These qualities of the project can best be seen in the synthesis drawing (figure 124 to 126) where the project, set out over time, portrays the gradual growth or incrementalism of the project.

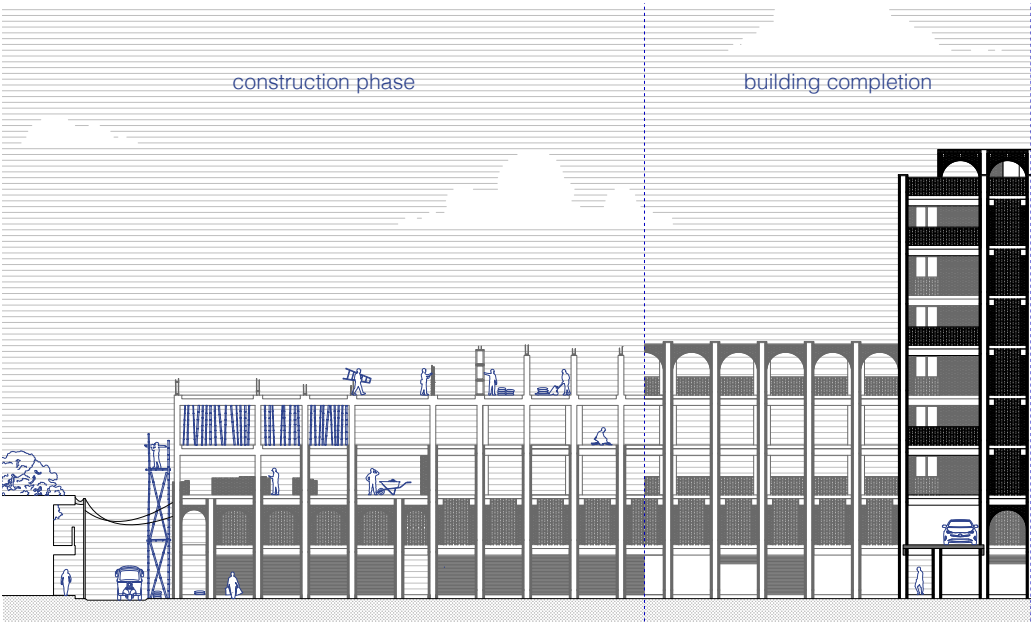
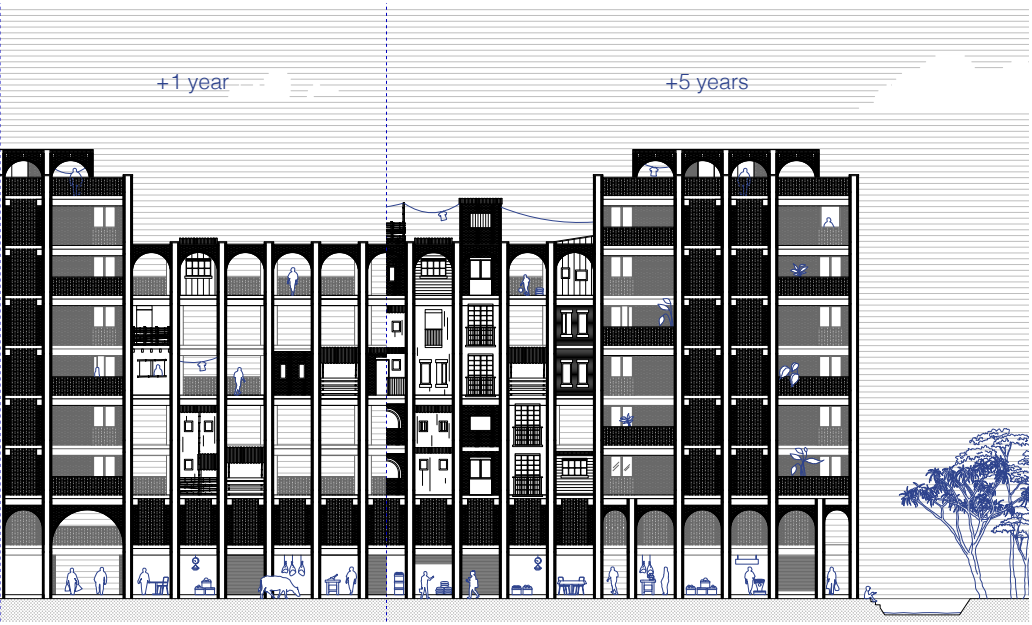


Figure 124: Project synthesis


+1 year
+5 years

construction phase

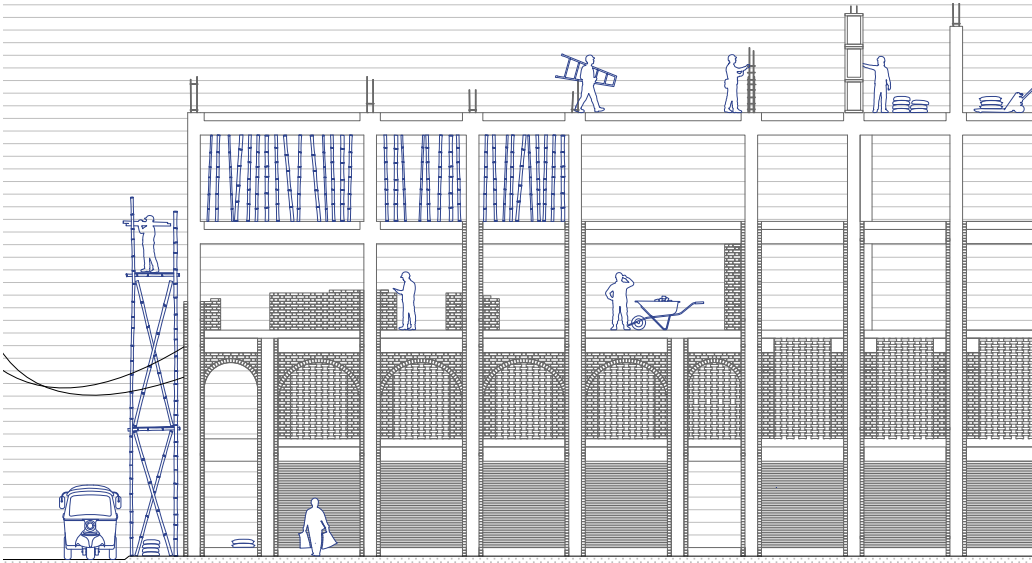
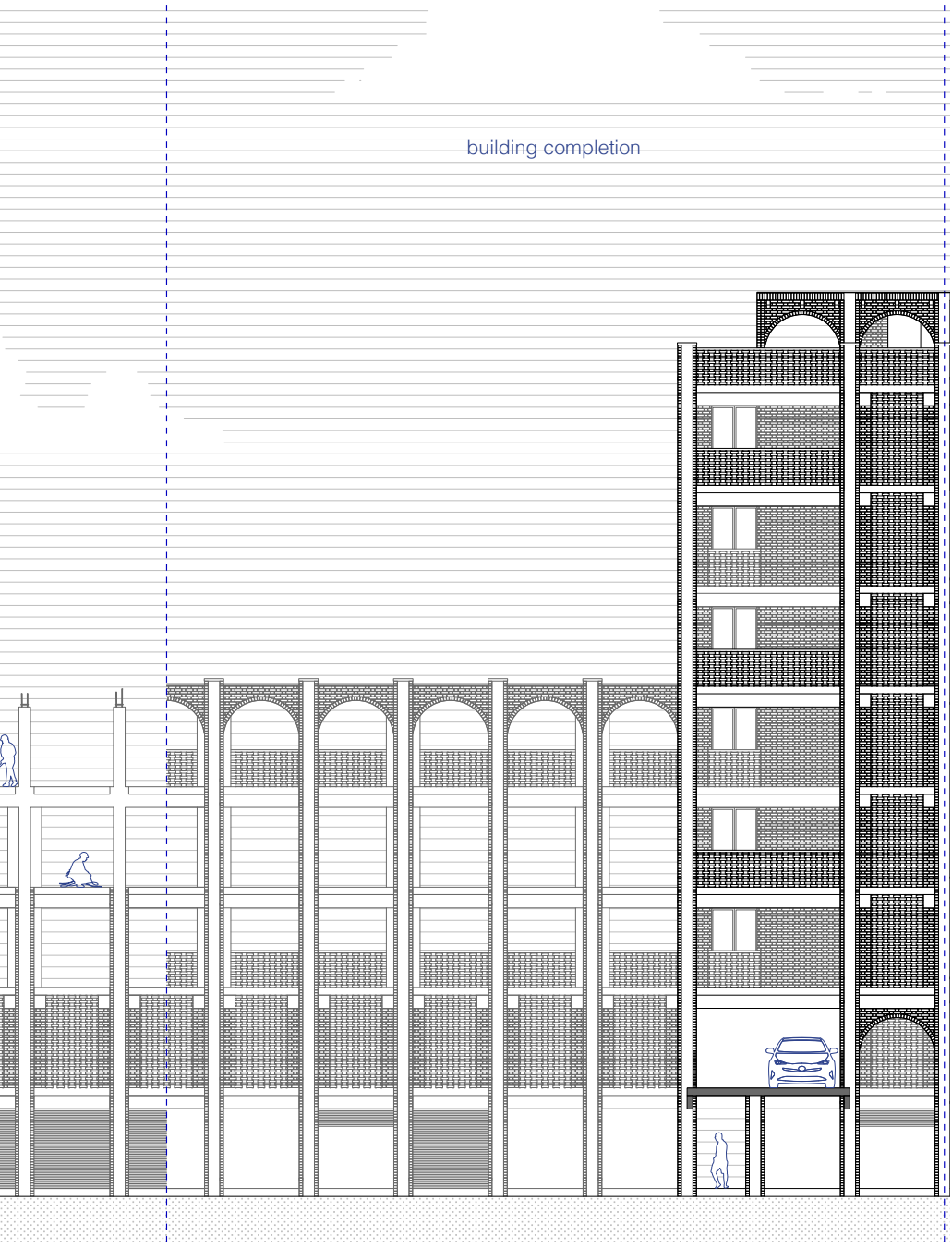


Figure 125: Project synthesis, zoomed in on construction phase and building completion


building completion

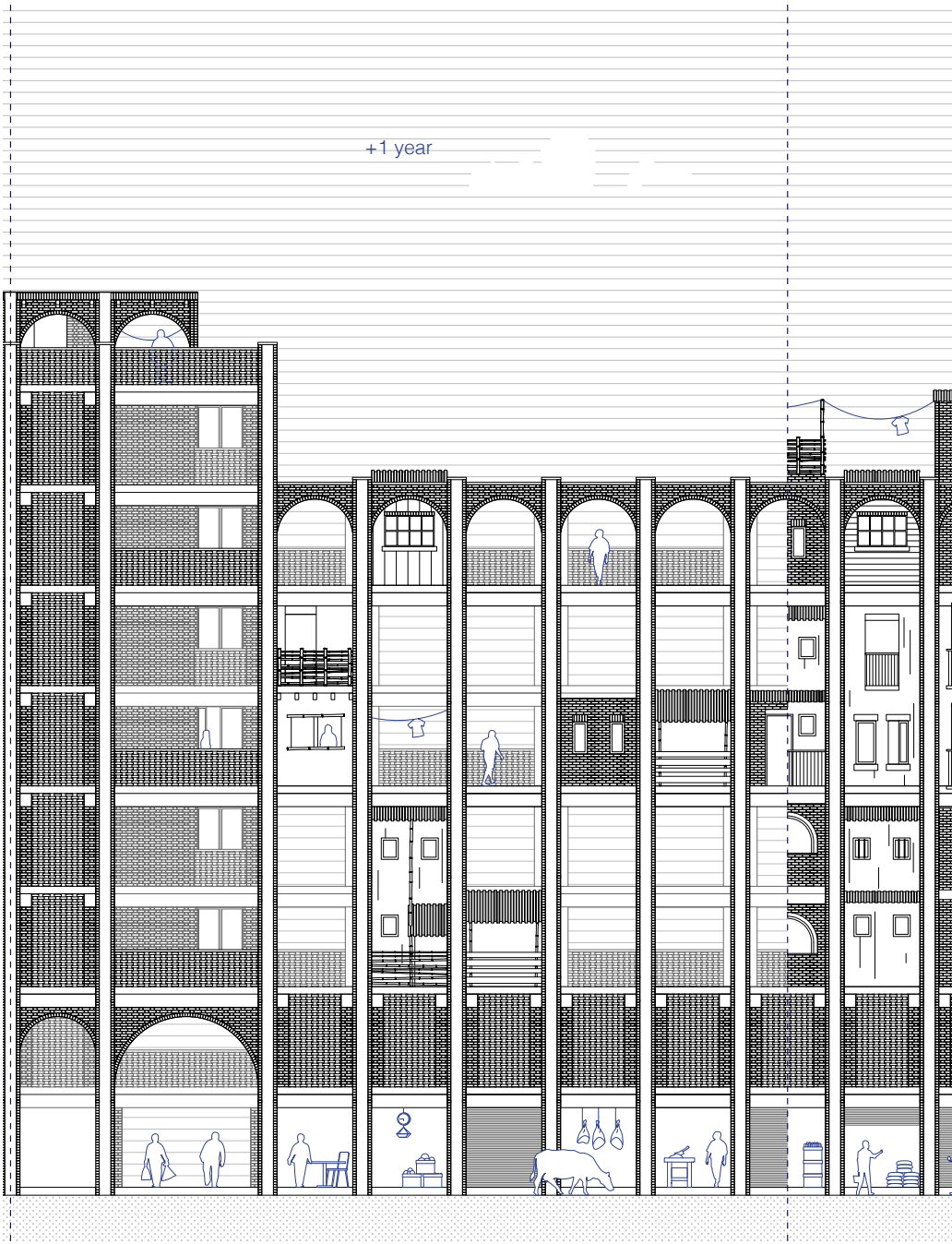


Figure 126: Project synthesis, zoomed in on +1 and +5 year(s)

+5 years

Figure 127: Dhaka University Central Jame Masjid mosque. Picture by Julian Wijnen

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September 2nd 2024 - July 3rd 2025

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Figure 128: Man crossing, rural Bangladesh. Picture by Julian Wijnen

Thank you