LOIT(H)ER

CREATING WOMEN'S PLACES OF LEISURE IN RESIDENTIAL NEIGHBOURHOODS

NAVI MUMBAI
OANA-CRISTINA CIOPLOIU
GLOBAL HOUSING GRADUATION STUDIO 2021-2022

CONTENTS

INTRODUCTION
STUDIO SCOPE

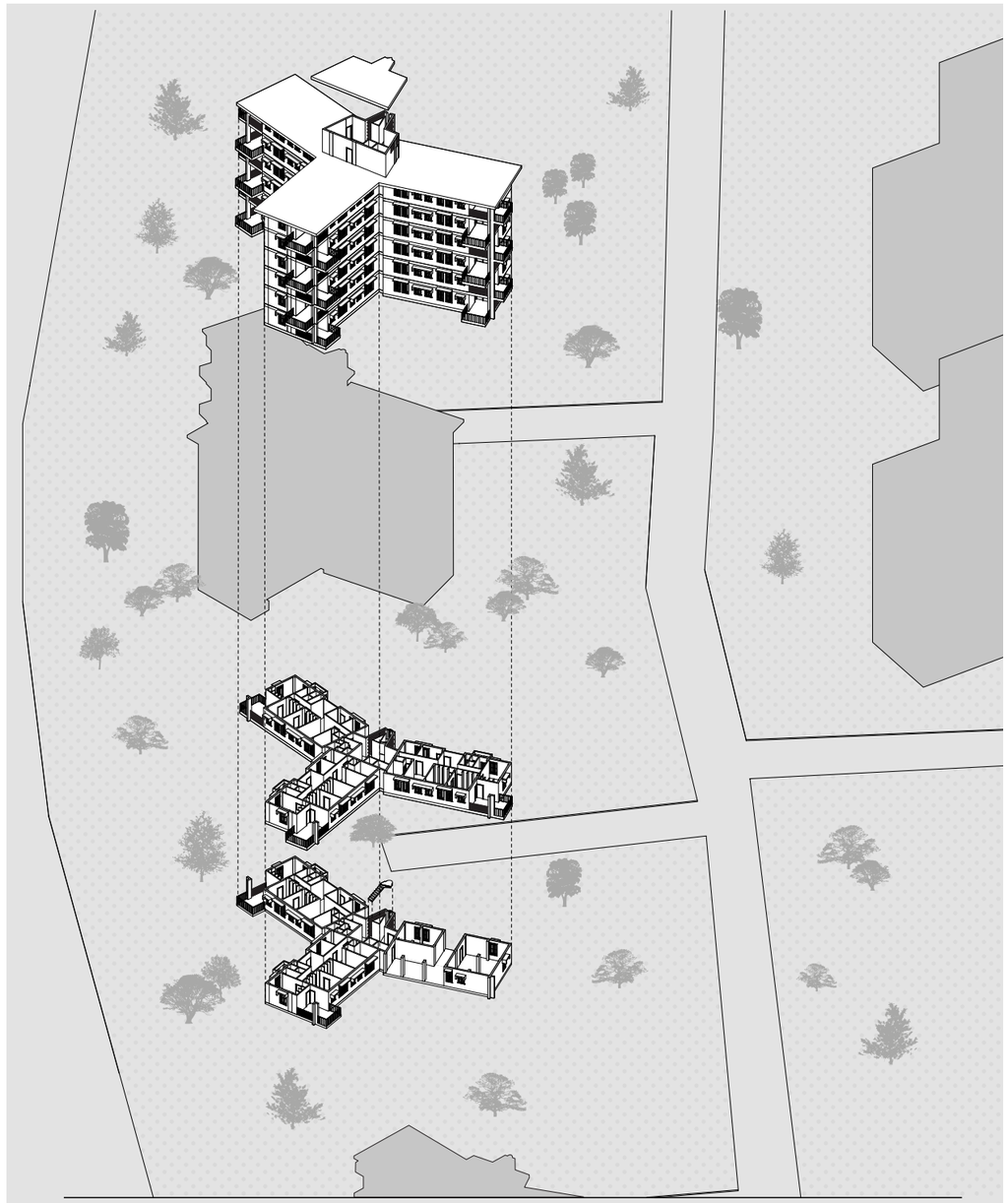
The graduation studio Global Housing 2021-2022 of the Dwelling department at TU Delft is Mixing Navi Mumbai, a studio focused on housing design in Navi Mumbai, India.

The studio's aim is to create affordable mass housing schemes which can be replicated in a different context.

The studio began with 2 initial assignments studying housing projects in India and more specifically in Navi Mumbai.

These assignments were followed by a joined group assignment with medicine students from Leiden University, a workshop entitled 'Housing as Healthcare'. During field work in the Hague and later, measurements of the dwelling environment were taken, as well as samples to determine air quality. The group conducted interviews with the residents to determine their daily behaviours. All the data collected was used to map out the residents' behaviours and understand how healthy their environment was.

During the first semester, research was done and helped shape the Research Plan, a document outlining the general direction of the graduation project, providing a better understanding of the problems to be tackled. This document provided the first understanding of the foreign context in which the project will take shape, and the research continued to evolve and change as the studio carried on.



Assignment 1 poster

INTRODUCTION
CONTEXT - NAVI MUMBAI

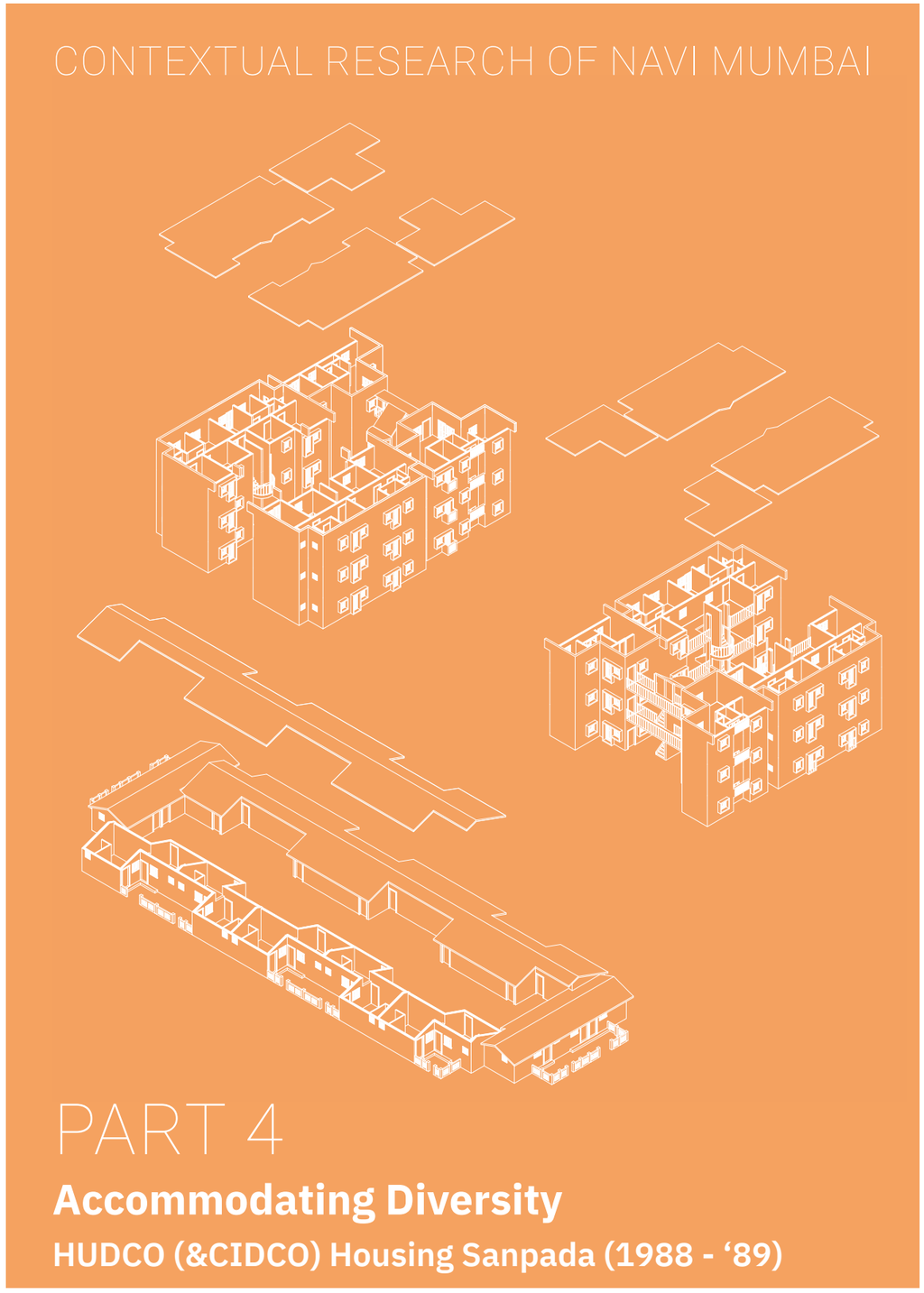
Navi Mumbai is the largest planned city. The brainchild of architect Charles Correa and civil engineer Adi Kanga, Navi Mumbai emerged in the 1970s as a planned satellite city, meant to ease the congestion of Mumbai and help with the housing crisis.

The city follows a nodal structure with public transport as the main backbone, with railways as the main connector to Mumbai. Navi Mumbai has a variety of residential options, and yet it has began to develop its own slum areas.

The second assignment of the studio allowed for a better understanding of this unique context, with the case study analysis of diverse housing projects, from the 80s to present-day developments.

The HUDCO and CIDCO Housing at Sanpada, by Hema Sankalia and Subodh Dhairyawan, shows a housing neighbourhood accommodating diversity, with dwelling options for all income groups.

The context of Navi Mumbai was studied mostly through literature research. Due to the global situation of the COVID-19 pandemic, a site visit was not possible. However, additional research methods and platforms became essential in understanding the context, such as Instagram, Youtube, and blogs.



Assignment 2 booklet cover
Oana-Cristina Cioploiu and Rianne Admiraal

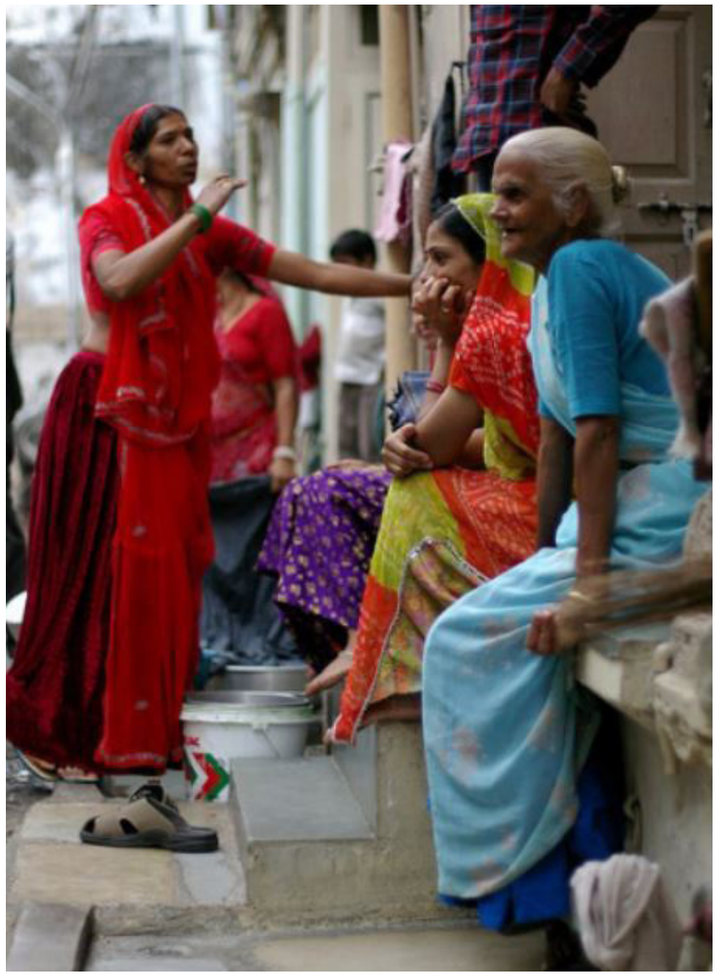
PROBLEM STATEMENT
RESEARCH PLAN

The following section is part of the course AR3A010 Research Plan, and is the Research Plan document highlighting the research course of action for the studio.

It has been added here in the state that it was submitted at the beginning months of the studio, in November 2021.

As the studio concept and design evolved and the research developed with them, the Research Plan may be outdated in certain areas.

CREATING WOMEN'S PLACES OF FUN IN RESIDENTIAL NEIGHBOURHOODS



Global Housing: Mixing Navi Mumbai

MSc3 Graduation Studio
Oana-Cristina Cioploiu

0. DEFINITIONS

To establish a base for the research to build on, a set of terms is defined as follows:

Body – The Cambridge Dictionary defines the body as “the whole physical structure that forms a person or animal” (Cambridge University Press n.d.). However, for this research, a wider definition is needed, in which the body is accommodated both physically and mentally. This would bring into focus problems such as safety, mental health and others.

Toolkit – A strategy with specific steps to determine what best methods and tools to be used to develop the project.

Fun – Shilpa Phadke, Sameera Khan and Shilpa Ranade describe fun in their book *Why Loiter? Women and Risk on Mumbai Streets* as “non-productive pleasure, taking risks and loitering,” (Phadke, Khan and Ranade 2011, 114) which is the definition that this research will also use.

Previous page: The use of *otla*, credit Madhavi Desai

1. INTRODUCTION

The house is the first environment we interact with, the first mould to shape us. But the idea of home expands beyond the front door, it spills out into the public space of the neighbourhood and creates thresholds, places of activity and places of loitering. Gender is being recognised as “the first instrument of abstraction” (UC Berkeley Events and Gayatri Chakravorty Spivak 2010), and is moulding behaviours in public and private spaces. With expected conduct influencing most of women’s interactions, what are the spaces that they use freely and safely? In other words, with a public environment designed mostly for men, what are the places of fun that women own in housing neighbourhoods?

Men in public space, Mumbai Fort Area, credit Sanjukta Basu

2. PROBLEM STATEMENT

The Indian context has a history of segregation on basis of gender, religion, caste and class. Neighbourhoods can encourage or challenge this segregation based on their social diversity. However, considering gender, most spaces are targeting male users, to the detriment of other minorities. “Mixed-use spaces allow women to access public space more easily so that they feel safe in them” (Phadke, Khan and Ranade 2011, 137), but in the more residential neighbourhoods, their position in the public and private space is subjected to expectations of behaviour (Phadke, Khan and Ranade 2011, 107-171). Spaces in which women feel free and safe to interact with the world are in short supply in housing neighbourhoods, which pushes them more towards the domestic space.

The *otla* represents a transitional space, a platform of interaction between the outside and inside, a threshold typically inhabited by women. It provides a break from the continuity of action and people from the street but is still a part of it. At the same time, it relates to the dwelling with the domestic activities that spill out onto the *otla*. Women engage in activities with others, do household chores or supervise children in this space. Madhavi Desai has illustrated the use of *otlas* by women of different religions (Hindu and Muslim), in her text *Traditional Domestic Architecture of Gujarat, India: Women, Space and Culture*, highlighting the importance of such a transitional space for both groups. “An essential component of the dwelling in the Indian context” (Desai 2014), the *otla* has a role in socio-economic relationships (Of the House, the City, the Earth and the Universe: the Otla as a Threshold Space 2011), and although it is a vernacular element traditional to the pol (walled neighbourhood structure with one street), it is used sparingly in modern developments such as B. Doshi’s Aranya (Kaza 2010), and is non-existent in mass housing apartment complexes, without providing alternatives.

The lack of proper water infrastructure for the poor communities emphasizes social inequalities in the Mumbai population and gender imbalances in the affected communities (Graham, Desai and McFarlane 2013). Toilet blocks developments in Mumbai establish the position of men above women in the public space. Getting to unsafe, unhygienic toilet blocks harms women’s health, all the while men are appropriating the public space by peeing in the streets. The situation of the public bathrooms is just the first example of the inadequate health infrastructure provided for women, who need privacy and security.

Both of the problems described show how spaces influence the behaviour of their users. By overlooking minorities such as women in design, their role in space is minimized. Both of these examples talk of public spaces in housing neighbourhoods and show how spaces of pleasure or necessity for women are overlooked. The research has as the main question *How can we create places of fun/pleasure for women in mass housing neighbourhoods?*

3. RESEARCH AIMS

To answer the previous question, it is important to understand what shapes the behaviour of women in their dwellings and neighbourhoods. This will be done by filtering their daily behaviour through lenses. When deciding on the lenses to be used, three characteristics stood out as main judges of the degree of success of a space: comfort, safety and health. Each of these can be expanded beyond the traditional definition of the physical body, referring also to mental comfort, safety and health. A place of fun/pleasure would encourage loitering daily, in a community or alone, and be comfortable, healthy and safe.

The benefit of filtering the information through lenses is that conclusions can be drawn from how people use or not their spaces. The lenses provide a uniform degree of analysis of precedents, as well as a basis for future design. For a concrete example, taking the space of the *otla*, for the Hindu woman, this is used as a comfortable space in contact with the community and safe space from the street activity, but not separated from it. Also, the *otla* remains “one of the most comfortable urban areas due to the high degree of shade on it throughout the day” (Agarwal 2009, 5). However, for Muslim communities, the safety concern uses the *otla* as a space of hard demarcation between the public and intimate dwelling.

The goal is to establish the relationships between spaces and the behaviours of those who use them. By using the mentioned approach of lenses through which the project will take shape, the design can evolve and become a toolkit. The lenses used for analysing precedents can also be used for developing the project, with particular attention to the female community. As mentioned in the problem statement, it is often that women are discriminated against in the public space, but also in their dwellings. An aim is to reinforce their place in the neighbourhoods and to provide spaces to feel comfortable, healthy and safe.

4. FIELD

The field of Navi Mumbai can be viewed as the first test-ground for the toolkit, both for its development and for its implementation as a mass-housing design. As such, the understanding of the context is projected based on a series of questions that could be replicated for future locations.

- Where is Navi Mumbai?
- Who are the residents of Navi Mumbai?
- What are the residents of Navi Mumbai doing? (More specifically, where are they working?)
- Specificities (Are there trends of the area being abandoned during the day, when most residents are at work? Are women left behind?)

For this research plan, a brief overlook of the site is as follows:

On one side of the creek, the over-saturated Mumbai, with contrasting expensive living conditions and slum and pavement dwellers; on the other side, Navi Mumbai, with a clear development strategy and diverse housing projects.

The planned city of Navi Mumbai is located on the West coast of India and relies on a development strategy of nodes, with public transport as the main backbone. Navi Mumbai was designed for a mixture of income groups, on the basis that higher-income housing and commercial properties would allow for the development of affordable housing for the low-income population (Shaw 2004, 162). Although these strategies are no longer reflected entirely in the evolution of the city, the prevalence of certain income groups in particular nodes of Navi Mumbai illustrates their social character (Shaw 2004, 166).

Map of Navi Mumbai, Figure by author

5. MAIN THEME

The theme of feminism lies at the foundation of the graduation project. Women in Indian society are still strongly linked to domesticity, which especially influences those from low-income groups. Taking care of the house and children are tasks that often go unrecognised, however, they are assigned to women without much consideration, limiting their involvement in other activities, such as income-generating ones.

With many spaces designed for leisure in the public sphere and the private one destined for men, women had to retreat to their homes. They were not encouraged or even allowed to "loiter the streets", or "claim the public realm". (N. Nair 2020) And yet, in their so-called 'safe space', expectations about their behaviour limit their freedom. "The female body is thought of only in places where socially-constructed roles need 'special' care: the kitchen, public restrooms… Other than these very specific sites, very few sites exist where the female body is taken into consideration while building private spaces" (Nakhal 2015). User-specific spaces, such as the women-only park (public space) presented by Madhavi Desai in her lecture *Gender and Architecture in India: Private and Public Spaces in Post-colonial Times*, or balconies as an intergenerational space for women (private space) (Kalia 2021), may be successful at empowering women to claim their space, but not sufficient.

The intersectionality framework in feminism theory brings back some categories previously used as segregation in the Indian context, going beyond gender, to race, sexuality, religion, disability and others. The individual is represented as overlapping identities, which influences the discrimination they are subjected to (Coaston 2019). Working at the intersection of the axis of individualities can help diversify the feminist movement in India. For example, by recognising the privilege of upper-income groups women, a tighter community and support system can be formed (R. Nair 2020), that would empower women no matter their social identities.

6.1 BEHAVIOUR

Women's behaviour is still seen as an influence on the honour of the family. In Mumbai, "women who demonstrate respectable purpose have socially acceptable access to public space" (Phadke, Khan and Ranade 2011, 108) However, the concept of using that space for fun is not as accepted. The absence of spaces of fun and leisure for women in their neighbourhoods create empty public spaces, and void thresholds between private and public. "The neighbourhood is not imagined as a social space for them (women)" (Sundararajan and @peopleplaceproject 2021). In describing the daily behaviours of women not only in their households but also in their neighbourhoods, the three lenses of comfort, health and safety would help identify the spaces women tend to linger in. The age of women influences their behaviour and perception of fun, and thus the spaces they would need for it.

Women's comfort can be influenced by several things, from climate to personal comfort. For example, shaded and well-ventilated spaces are preferred, to again reference the otla. A building with a shaded plinth would be a place for people to inhabit as a loiter space (Sundararajan and @peopleplaceproject 2021). The proximity to clean and safe toilets shows an impact on the health lens, which is going to determine whether a space is inhabited by women or not (Sundararajan and @ peopleplaceproject 2021). Furthermore, women's safety influences their willingness to use public space. The BPO industry, especially the introduction of the night shift with women labour force, has increased their mobility and access to public spaces, but at the same time also increased attacks towards women in these spaces (Nielsen and Waldrop 2014, 22).

Madhavi Desai gathers in her book *Women and the built environment* a collection of essays describing the condition of women in the house. The relation between the user and the space is highlighted, and how the status of the main user influences the maintenance of the space. This shows impact especially in spaces inhabited by women, which tend to be overlooked (for example kitchens). These nuances of household politics influence women's behaviour on a more domestic scale.

Women communities influence their behaviour by providing a rendition of safe space and support. For India, Mahila Mandals are informal communities for women to "come together in celebration, sorrow or crisis" (Das 2016) mostly encountered in rural areas. However, there is potential in their urban variants as places of empowerment.

6.2. INCOME-GENERATING ACTIVITIES

Patriarchal hierarchies have established men as having more important functions, both in the family and in the public sphere, since pre-colonial times (Patil 2013, 855). The breadwinners and decision-makers positions were typically occupied by men, with domestic labour in the care of women. However, “among the rural and urban poor, women have always had to earn a living” (Nielsen and Waldrop 2014, 6) most commonly in the “informal sector of the economy” (Nielsen and Waldrop 2014, 6).

The domesticity of the Indian women limited their literacy in economic matters, again under patriarchal influences: the men were in control of the money of the household. Mahila Milan is an Indian organisation that is providing a network for poor women to help them with credit and saving activities. It works with women slum and pavement dwellers, teaching them how to successfully maintain a dialogue with the officials. This has helped many families save their homes from destruction, and formed a community among vulnerable women (Demolitions to Dialogue: Mahila Milan - learning to talk to its city and municipality n.d.). The involvement of Mahila Milan shows that a community of women can impact the built environment around them, can learn how to earn and take care of money for their homes and families, and also how to make themselves be listened to by the officials.

Mahila Milan makes a clear impact as a step forward in the involvement of women in the public sphere. Research through the lenses of comfort, health and safety could point to spaces women could use to generate income from their neighbourhoods, strengthening the connection of their communities. “The idea that productive work happens in a sphere outside, in the city” (Sundararajan and @peopleplaceproject 2021) is challenged.

7. METHODOLOGY

The literature review for this research comprises of books, articles and online talks on topics such as feminist theory, intersectionality, behaviour patterns of women, places of fun for women, women in the public space, and what comfort, health and safety mean for women, all in the Indian context, if not a more specific Mumbai / Navi Mumbai context.

Shilpa Phadke, Sameera Khan and Shilpa Ranade offer in their book *Why Loiter? Women and Risk on Mumbai Streets* a detailed analysis of women in the Mumbai public space, and more specifically what places of fun they have, and how they interact with them. However, moving into Navi Mumbai as a context of research, social media would prove an invaluable analysis method, however with notable restrictions (for example, women from lower-income groups might have a smaller online presence).

Following theoretical research, preliminary conclusions can be drawn. A bigger part of the methodology will be research through design, based on a series of case studies of the Navi Mumbai area analysed through the lenses of comfort, health and safety. If the conditions allow a site visit in Navi Mumbai, the same lenses would shape ethnographic research on site. This will permit both an analysis of women’s behaviour in the area, but also a chance to interact with the female residents of previously selected case studies.

8. BIBLIOGRAPHY

n.d. ABOUT Mahila Milan. Accessed 09 29, 2021. https://www.sparcindia.org/aboutmm.php.

Afaina de Jong | TEDxAmsterdamWomen. 2021. Why feminism is essential to architecture. 01 13. Accessed 10 06, 2021. https://www.youtube.com/watch?v=C58myGKJGMA&ab_channel=TEDxTalks.

Agarwal, Kanika. 2009. “Residential Cluster, Ahmedabad: Housing based on the traditional Pols.” PLEA2009 - 26th Conference on Passive and Low Energy Architecture. Quebec City. 5.

Cambridge University Press. n.d. Definition of body from the Cambridge Academic Content Dictionary. Accessed 11 05, 2021. https://dictionary.cambridge.org/dictionary/english/body.

Chalana, Manish. 2010. “Slumdogs vs. Millionaires: Balancing Urban Informality and Global Modernity in Mumbai, India.” Journal of Architectural Education Vol. 63, No. 2 25-37.

Coaston, Jane. 2019. The intersectionality wars. 05 28. Accessed 11 10, 2021. https://www.vox.com/the-highlight/2019/5/20/18542843/intersectionality-conservatism-law-race-gender-discrimination.

Colomina, Beatriz. 2019. X-Ray Architecture. Lars Muller.

Das, Maitreyi. 2016. Mahila Mandals in Gender Politics. 09 13. Accessed 11 10, 2021. https://www.epw.in/journal/2000/50/commentary/mahila-mandals-gender-politics.html.

n.d. “Demolitions to Dialogue: Mahila Milan - learning to talk to its city and municipality.”
Desai, Madhavi. 2014. “Traditional Domestic Architecture of Gujarat, India: Women, Space and Culture.” 7th International Seminar on Vernacular Settlements on the theme ‘Reassessing Vernacular Architecture: Theory and Practice—traditions, identities and globalization. Istanbul: Istanbul Technical University Faculty of Architecture.

Japleen Pasricha | TEDxGurugramWomen. 2019. A 101 on the feminist movement in India. 03 11. Accessed 10 06, 2021. https://www.youtube.com/watch?v=auahIwy93So&ab_channel=TEDxTalks.

Kalia, Saumya. 2021. The Secret Lives Indian Women Lead on Balconies. 11 09. Accessed 11 10, 2021. https://theswaddle.com/the-secret-lives-indian-women-lead-on-balconies/?utm_campaign=later-linkinbio-theswaddle&utm_content=later-22115264&utm_medium=social&utm_source=linkin.bio.

Kaza, Krystina. 2010. “The Otla: A ‘Free Space’ in Balkrishna Doshi’s Aranya Settlement.” Unitec New Zealand School of Architecture.

Menon, Nivedita. 2015. “Is Feminism about ‘Women’? A Critical View on Intersectionality from India.” Economic and Political Weekly, Vol. 50, No. 17 (Economic and Political Weekly, Vol. 50, No. 17) 37-44.

Murti, Aditi. 2021. Tell Me More: Talking Urban Women’s Safety and Access With Dr Shilpa Phadke. 04 03. Accessed 11 10, 2021. https://theswaddle.com/tell-me-more-talking-urban-womens-safety-and-access-with-dr-shilpa-phadke/.

Nair, Nandini. 2020. The Woman on the Balcony. 08 13. Accessed 11 10, 2021. https://openthemagazine.com/cover-story/the-woman-on-the-balcony/.

Nair, Rashmi. 2020. Intersectionality Is Key For A Strong Feminist Movement. 10 30. Accessed 11 10, 2021. https://feminisminindia.com/2020/10/30/intersectionality-key-strong-feminist-movement/.

Nakhal, Jana. 2015. Women as Space/Women in Space: Relocating our Bodies and Rewriting Gender in Space. Accessed 11 10, 2021. https://kohljournal.press/women-in-space-women-as-space.

Nielsen, Kenneth Bo, and Anne Waldrop. 2014. Women, Gender and Everyday Social Transformation in India. Anthem Press.

2011. Of the House, the City, the Earth and the Universe: the Otla as a Threshold Space.
Patel, Sheela, and Diana Mitlin. 2001. The work of SPARC, the National Slum Dwellers Federation and Mahila Milan. Poverty Reduction in Urban Areas, London: Human Settlements Programme IIED.

Patel, Sheela, Jockin Arputham, and Sheridan Bartlett. 2016. “How the women of Mahila Milan in India learned to plan, design, finance and build housing.” Environment & Urbanization Vol 28(1) 223-240.

Patil, Vrushali. 2013. “From Patriarchy to Intersectionality: A Transnational Feminist Assessment of How Far We’ve Really Come.” Signs Vol. 38, No. 4, Intersectionality: Theorizing Power. The University of Chicago Press.

Phadke, Shilpa, Sameera Khan, and Shilpa Ranade. 2011. Why Loiter? Women and Risk on Mumbai Streets. Penguin Books India Pvt. Ltd.

Shah, Abhishek. n.d. Is ‘Intersectionality’ a Useful Analytical Framework for Feminists in India? Accessed 11 10, 2021. https://www.epw.in/engage/discussion/intersectionality-useful-analytical-framework.

Shaw, Annapurna. 2004. The Making of Navi Mumbai. Orient Blackswan.

Sundararajan, Sonal, and @peopleplaceproject. 2021. Conversation After Hours #5. 11 15. Accessed 11 15, 2021. https://www.instagram.com/p/CWTNZdXo6tu/.

UC Berkeley Events and Gayatri Chakravorty Spivak. 2010. BBRG PRESENTS: Gayatri Chakravorty Spivak on Situating Feminism. 04 02. Accessed 09 29, 2021. https://www.youtube.com/watch?v=garPdV7U3fQ&ab_channel=UCBerkeleyEvents.

PROBLEM STATEMENT
WOMEN AND PUBLIC SPACE

‘THE PROBLEM OF EVE TEASING IS QUITE FRANKLY VERY RAMPANT.’

Aditi Mittal, comedian and writer

OCCUPATION

The spaces are generally occupied by men, making them less comfortable for women?

PURPOSE

The use of public spaces by women in India is still subjected to their purpose, with leisure seen as not good enough to justify it.

‘WHY IS SHE HERE? THE QUESTION SILENTLY DEMANDED OF EVERY WOMEN IN A PUBLIC SPACE.’

Shreena Thakore, co-founder of No Country For Women (NCFW)

PROBLEM STATEMENT
WOMEN AND PUBLIC SPACE

‘OF THE 38 TOILET SEATS IN ANDHERI TRAIN STATION IN MUMBAI, 34 ARE FOR MEN. ONLY 4 TOILET SEATS FOR WOMEN’

Shreena Thakore

TOILET ACCESS

There is a lack of hygienic toilets in most public spaces, which impacts women more than men, who use spaces as open toilets freely.

LIGHT

The lack of proper lighting in public spaces and walkways create a safety issue for women.

‘THEY MAKE THE OUTDOORS HOSTILE TO WOMEN.’

Shreena Thakore

PROBLEM STATEMENT
PUBLIC SPACES TYPOLOGIES

Open spaces free and accessible to all should create a sense of belonging across age, income and social group.

An analysis of typologies present in the Indian context is provided here, emphasizing the use of most of these spaces for mostly religious purposes or leisure.

Some common typologies present in the Indian context are ghat, maidan, temple courtyard, chauraaha, aangan, bakda and katta.

Typologies:

GHAT
a series of steps leading down to a body of water, used for bathing or cremation, along a river

CHAIWALLA
a small roadside shop

CHAURAAHA
crossroad or intersection

GANPATI INSTALLATION
part of a Hindu festival which features cultural and economic activities, public celebrations include installing idols of Lord Ganesh in temporary shelters/stages

TEMPLE COURTYARD
open space for a religious building

PANCHVATI
religious space beside the river Godavari

1.

KATTA

ledge around a tree for seating in shade

2.

MAIDAN

emblem of openness, public gathering place for informal congregation, an open field, large public area, usually empty

3.

BAKDA

resting area with benches, under a tree

4.

AANGAN

courtyard, enclosed space adjoining a house

PROBLEM STATEMENT
PUBLIC SPACES TIMELINE

The daily life of all residents creates patterns of use for public spaces. These patterns are made using assumptions about daily Indian life in the city with information gathered from research made using blogs about the city life, social media research and contact with Indian residents.

While not fully accurate, the timeline analysis helps to understand the tendencies of certain groups of people to use a particular space in a moment of the day.

EARLY MORNING (6:30-7:30)

people going to work
vendors offering tea, coffee and smoothies at their stalls under trees/shade

MORNING (8:00-11:00)

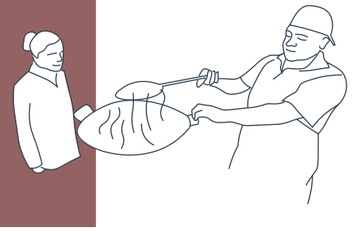
senior citizens gathering in open spaces, for religious purposes or others
vendors arriving at markets
people resting on bakda spaces

LUNCH (12:00-14:00)

more vendors doing business
school children coming from school, playing
high school students studying outdoors
people resting or sleeping on bakda spaces

EVENING (21:00-23:00)

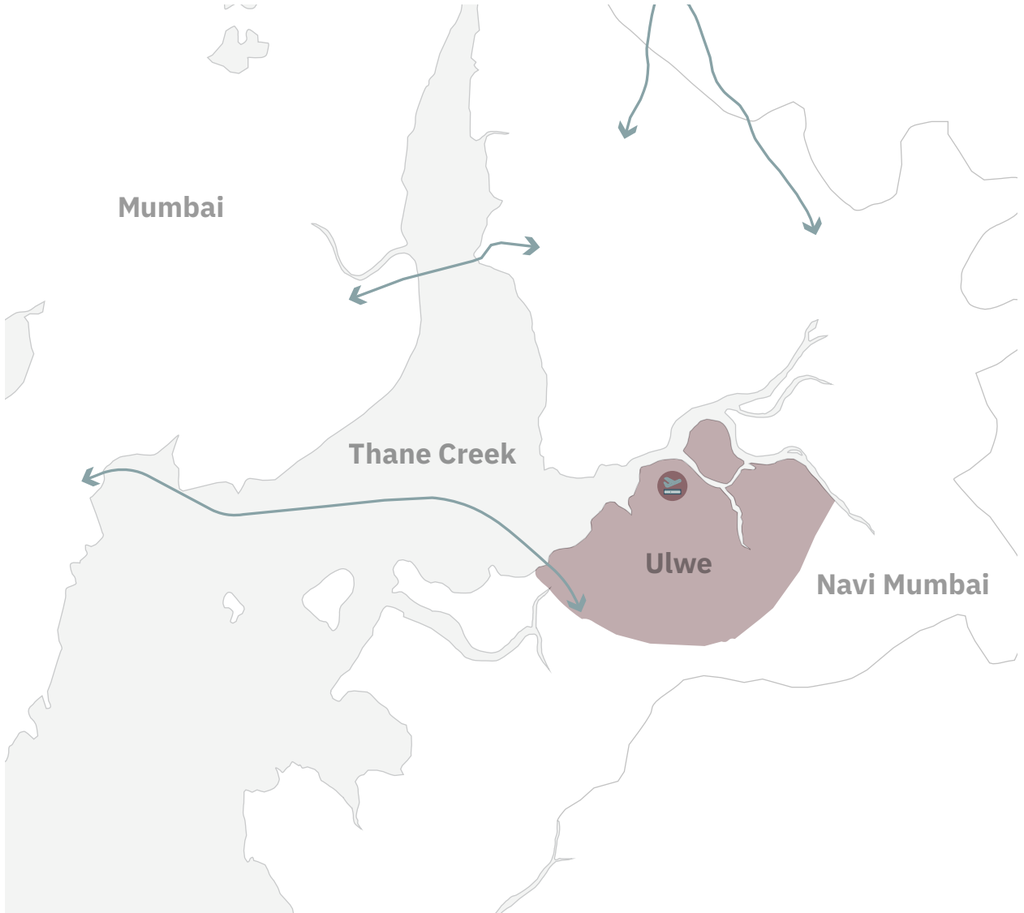
people having a walk
people relaxing on the bakda spaces
food stall activity increasing for dinner

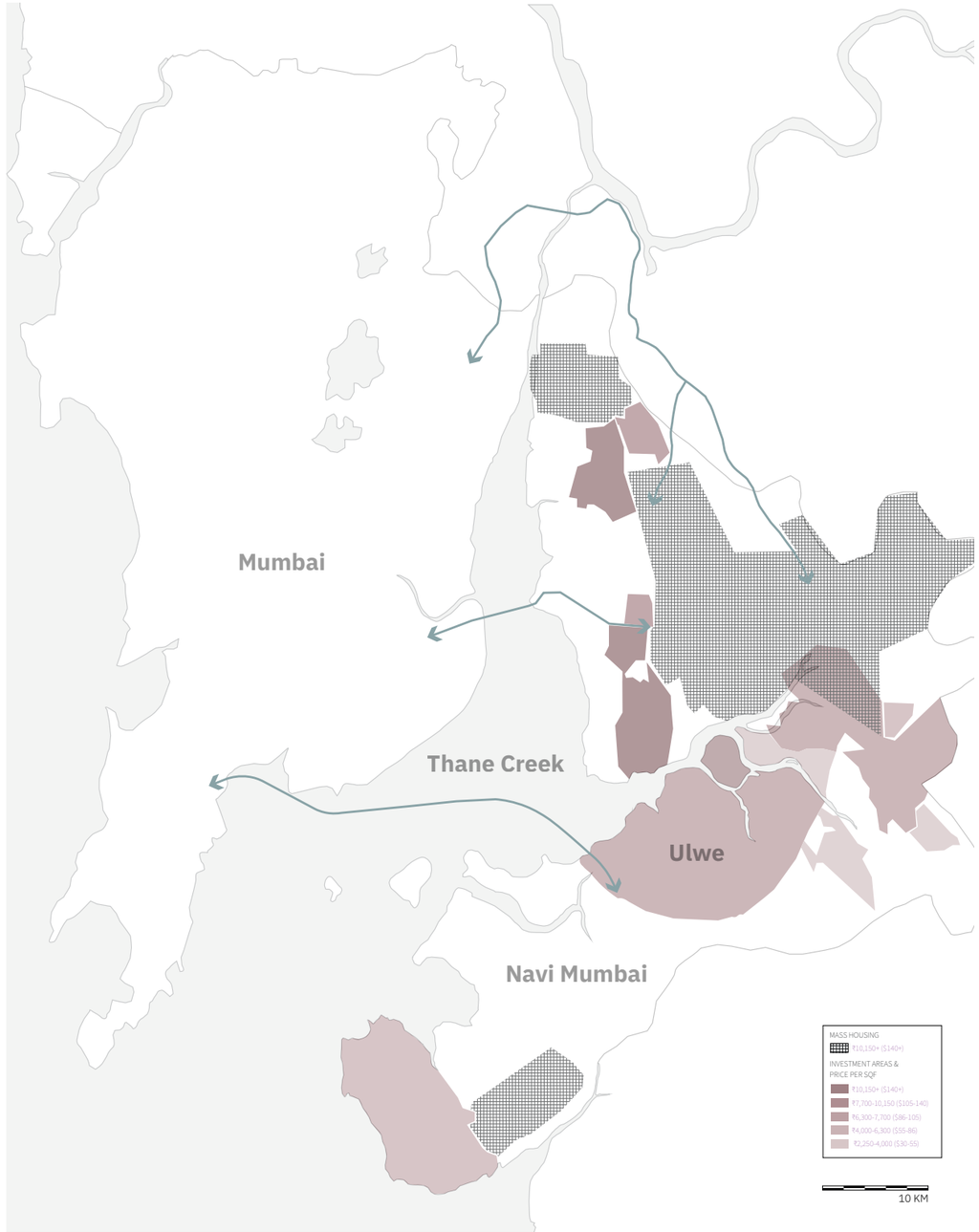


SITE SELECTION

Public transport connections were a major influence in the selection of the site. The new Interntional Airport and the Trans Harbour Link are currently under construction, both with a huge impact on the development of the Ulwe node.

These investments will create new job opportunities and provide easier transfer to Mumbai.





TRANSPORT

Public transport connections have a big impact on housing developments, especially for the lower-income groups, who depend on them to get around the city.

Even though Navi Mumbai is developing further and further, the ease of connections with Mumbai is still a selling point for projects there, as many jobs and opportunities are located across the creek.

Moreover, access to public transport is even more important to women residents, who in many cases experience harassment using or getting to buses or trains. Safe and pleasant routes to get to and from train stations are needed.

The highlighted bus routes have the most extensive coverage over the area, and an extension to these into the proposed design is taken into consideration.

Trains remain one of the easiest and most accessible way of moving between the two cities, Mumbai and Navi Mumbai. Proximity to railway stations was one of the main criteria for selecting a site.

Bamandongri Railway Station is the closest to the site, about 10 minutes by walking. Further South-West, Kharkopar Railway Station is located.

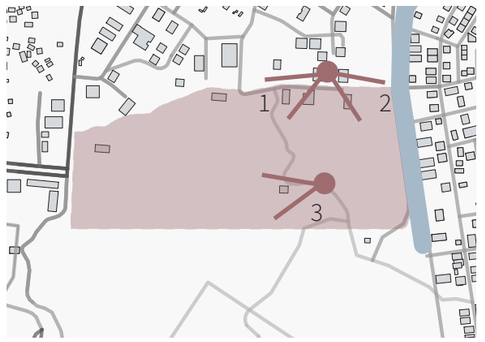
The future Navi Mumbai Trans Harbour Link is highlighted to the South-West of the site.

Transport links
Scale 1:5000 on A1

SITE ANALYSIS
EXISTING SITUATION

The site has an area of approximately 16 hectares. It is located in a zone that is experiencing new developments, but has poor infrastructure.

The existing buildings on site are 5 apartment buildings and a Hindu temple. The infrastructure around these is unpaved streets, that get easily muddy and flooded during the rain season, and pedestrian pathways leading to the temple. These are overgrown with vegetation, causing safety issues.



Location map

1.

2.

3.

SITE ANALYSIS
EXISTING SITUATION

To the South of the site, a condominium project is under development.

To the East, the site is bordered by a canal, separating it from a residential area.

To the North, the site is bordered by a residential area with apartment buildings, including the new constructions already mentioned on the site chosen.

To the West lies Bamandongari, a historic village of Navi Mumbai, and a node os the planned city. It is also known as sector 19B.

Site map
Scale 1:5000 on A1

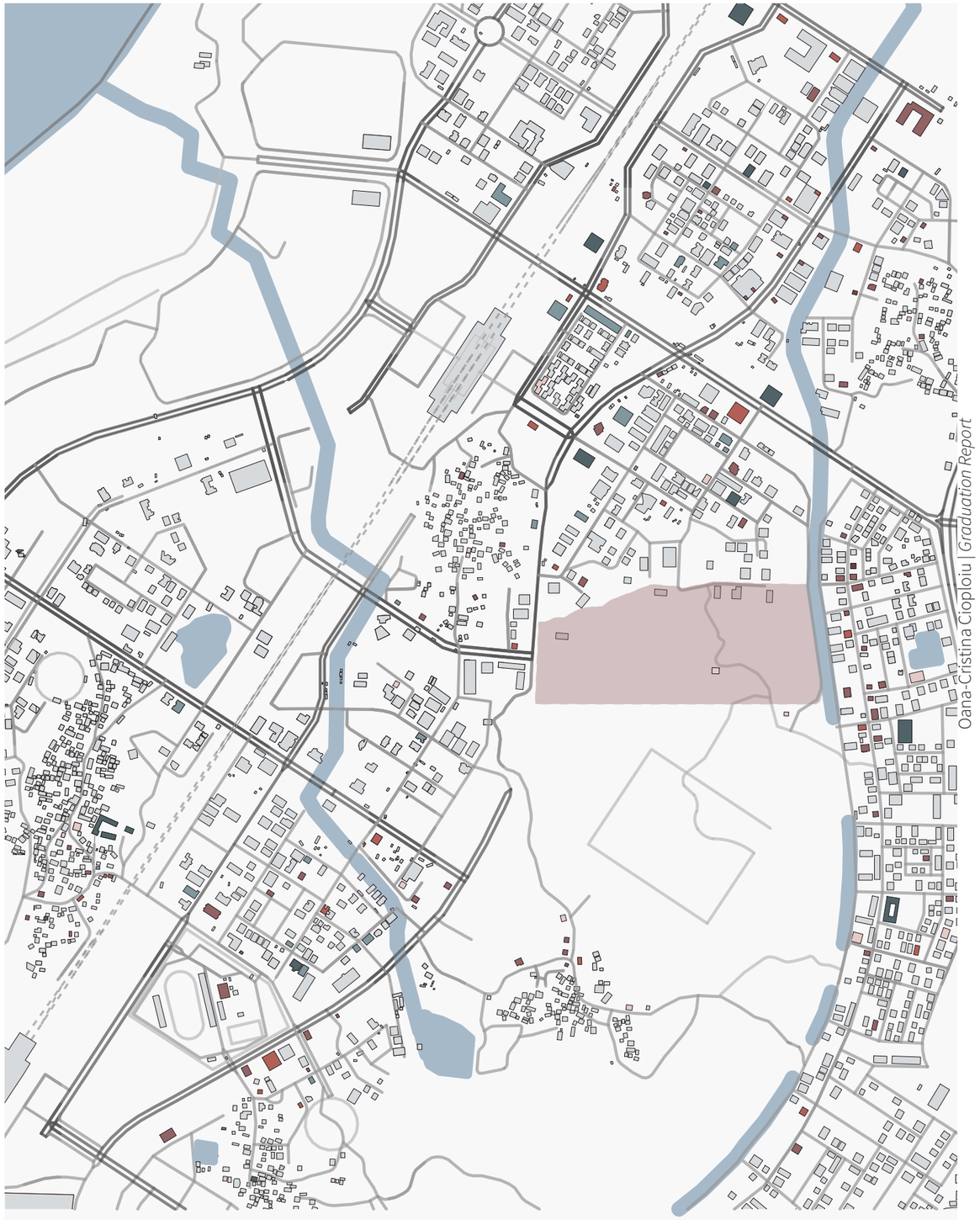
SITE ANALYSIS
NEIGHBOURHOOD AMENITIES

The site is predominantly surrounded by residential areas, with mixed amenities such as restaurants, shops and educational institutions in the proximity.

There are also a few hospital and other healthcare institutions, and even an art gallery.

There is only one public bathroom, in the proximity of a park and a residential area.

- Educational
- Commercial
- Restaurants
- Health
- Religious
- Cultural
- Public Bathroom

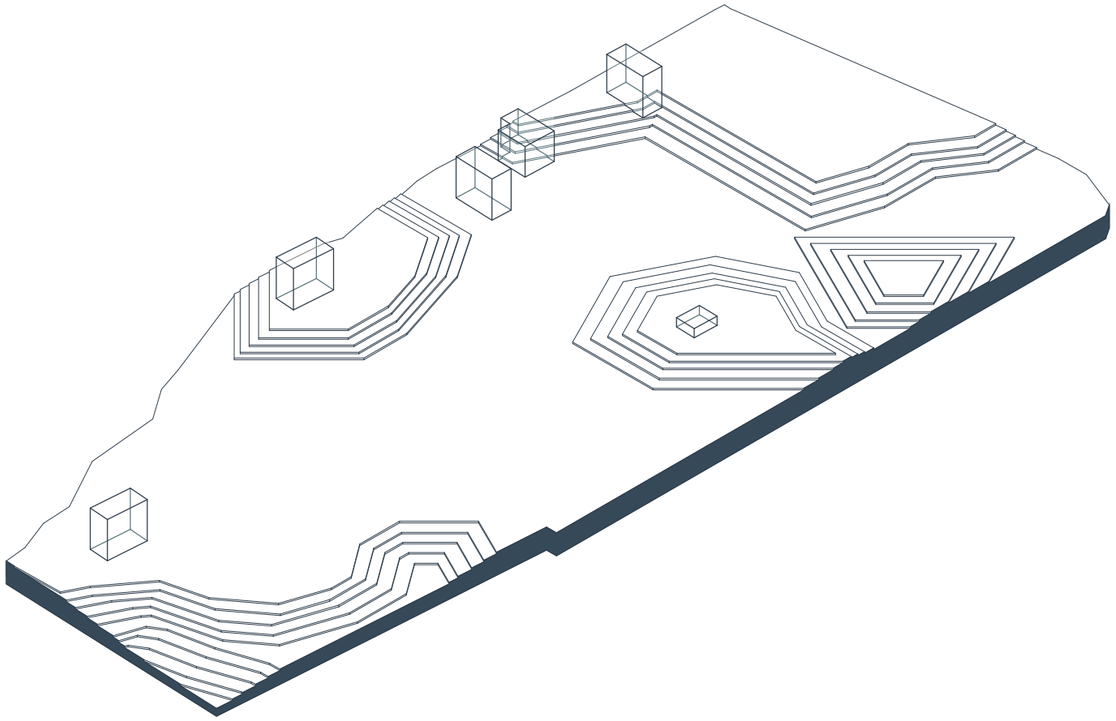


Amenities map
Scale 1:5000 on A1

TOPOGRAPHY

While the majority of the site is flat, there are sloped areas on site, mostly sloping 5 metres. The South-West corner of the site is the steepest, with a 10 metres slope.

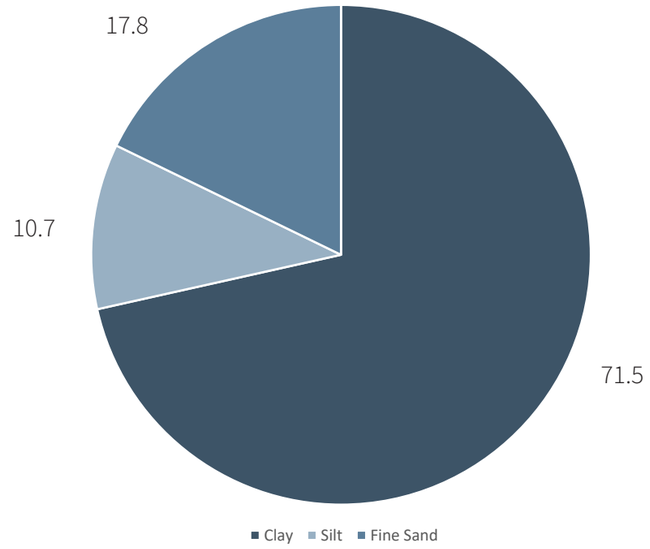
Some of the existing structures, the apartment building to the North and the Hindu temple also deal with the sloping topography.



Site axonometry, 1m levels, with existing buildings
NTS

SOIL

The area of Navi Mumbai has a soil consisting of 71.5% clay, 17.8% fine sand and 10.7% silt.



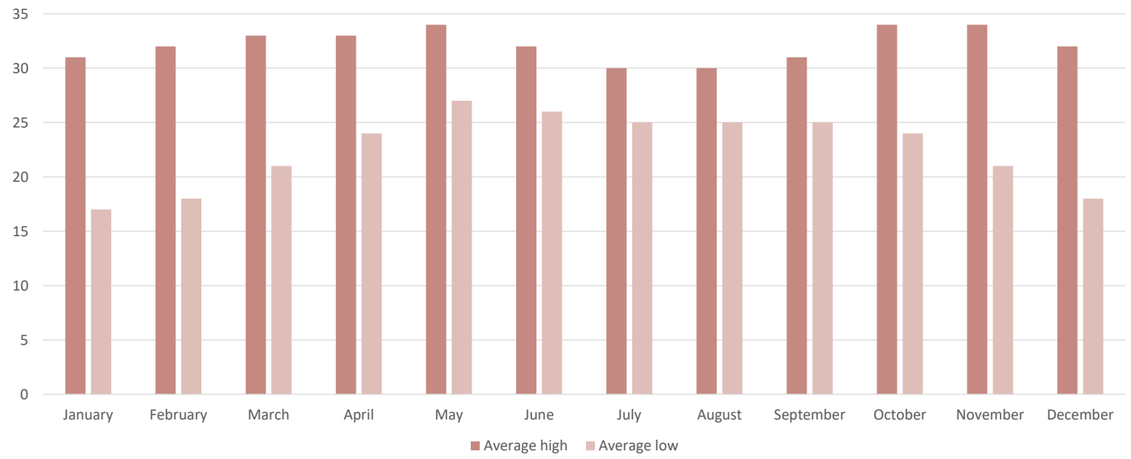
Soil texture analysis
Source: Environmental Compliance Monitoring Report Navi Mumbai International Airport (NMIA)

CLIMATE
TEMPERATURE

Mumbai and Navi Mumbai are located in an area of hot and humid climate.

Mumbai and Navi Mumbai have 2 seasons: wet and dry. During the wet season, conditions and oppressive, windy and overcast. During the dry season, the weather is muggy and mostly clear.

The monthly max temperatures stay above 30°C, while the average low vary between 18 and 28°C.

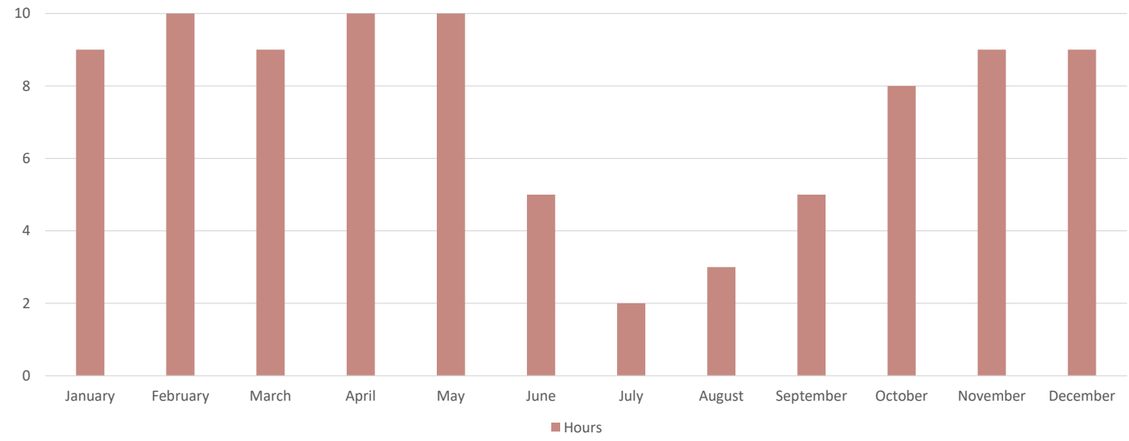


Average temperature graph
Source: NOAA

CLIMATE
SUNLIGHT

Located in the Northern and Eastern hemisphere, India lies about 2,5 km away from the Equator. Because of this proximity, the sun forms acute angles, with a 3° in summer and 30° in winter.

During the dry season, Navi Mumbai has an average of over 8 hours of daily sunlight.



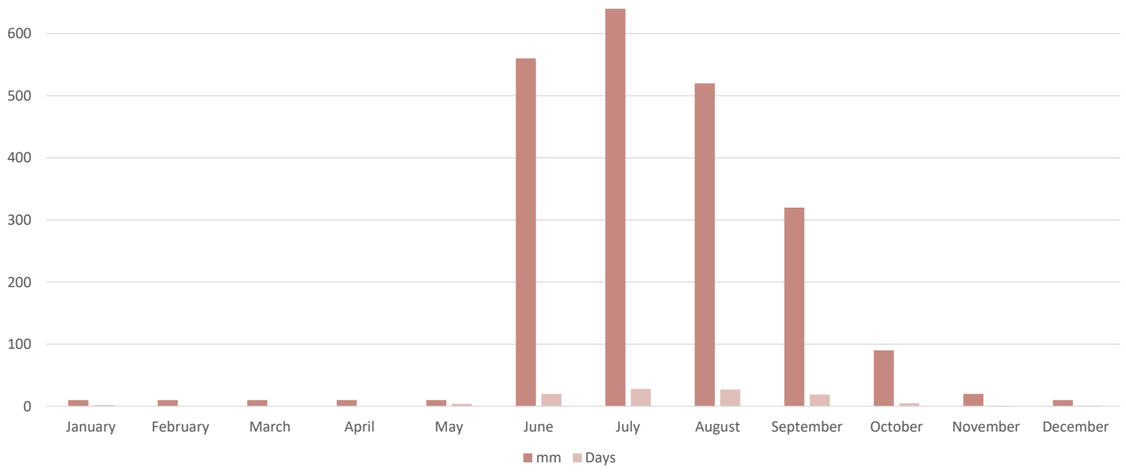
Average daily sunshine
Source: https://www.holiday-weather.com/mumbai/averages/

CLIMATE
RAINFALL

The wetter season lasts 4 months (June-October), and 8 months for the drier season (October-June). There are extreme seasonal variations in monthly rainfall. The rainy and rainless periods are roughly 6 months each, with the most rain in July and the least rain in January.

The monsoon usually hits the city in June.

The cloud coverage is mostly clear for about 7.5 months, from October to May.

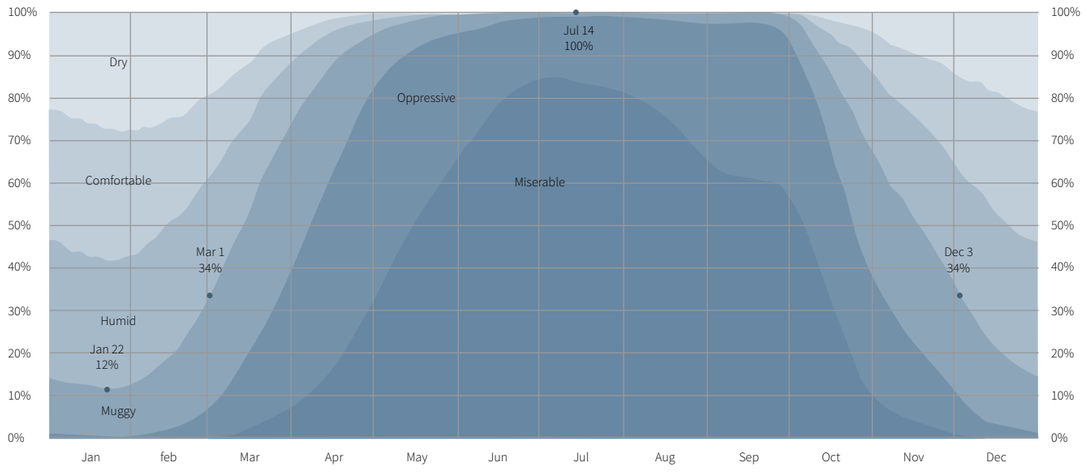


Average rainfall
Source: https://www.holiday-weather.com/mumbai/averages/

CLIMATE
HUMIDITY

Navi Mumbai has a monthly relative humidity above 55%.

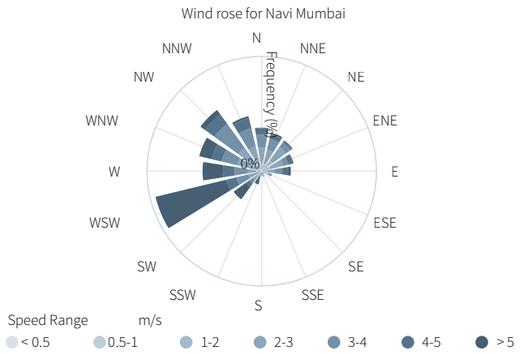
Together with the high temperatures, the humidity influences the comfort levels, with only a short period being comfortable.



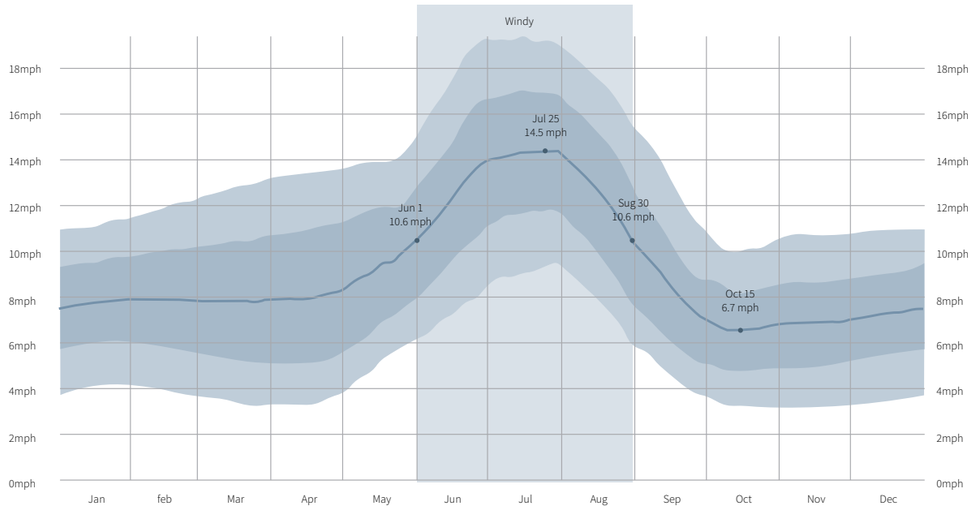
Humid comfort levels Mumbai
Source: WeatherSpark.com

CLIMATE
WIND

The wind in Navi Mumbai blows mainly from the South-West, from Thane Creek.



Wind Rose Navi Mumbai
Source: IndianClimate.com



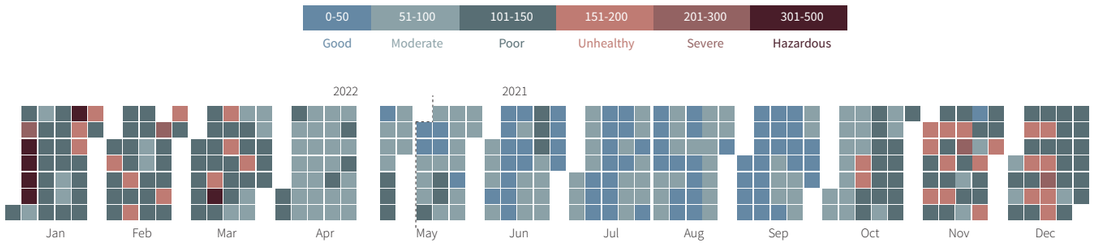
Average wind speed Mumbai
Source: WeatherSpark.com

CLIMATE
AIR QUALITY

Mumbai and Navi Mumbai suffer from air pollution, with most days having a general quality of Moderate/Poor AQI (Air Quality Index).

The AQI factor identifies few days in which the city is qualified as Unhealthy/Severe and even Hazardous, mostly in November/ December/January.

The city has plenty of days in which the air is qualified as Good (AQI between 0-50), mostly in May/June-September.



Mumbai AQI Calendar
Source: https://www.aqi.in/dashboard/india/maharashtra/mumbai

DESIGN GOALS

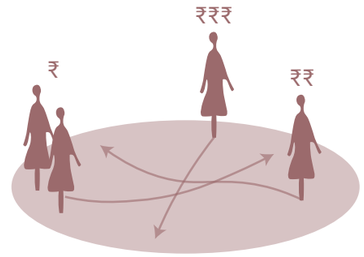
The project's initial goal was to offer dwellings for people spanning the three income groups. In doing so, a diverse community would be formed through social interaction in public spaces in the neighbourhood.

Secondly, particular attention was given to places where women could loiter for leisure and fun.

Lastly, the creation of more efficient thresholds in the neighbourhood, providing a semi-private space as an extension of the domestic space.

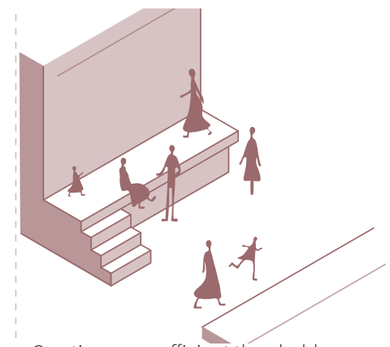
The three main goals can be summarized as such:

- Social interaction
- Places of leisure and fun for women
- Creating efficient thresholds



Social Interaction
Equal Provisions for all Income Group Residents

Places of leisure and fun for women



Creating more efficient thresholds

PRECEDENTS
HOUSING DIVERSITY
Hema Sankalia and Subodh Dhairyawan

- mixed-income project
- financially feasible
- different-income residents would intermingle and interact in a project with amenities, uniform quality along income groups housing
- collectively owned open spaces for easy maintenance
- **amenities** around a central green open space
- space for social interaction
- school, nursing home, shops, markets, religious centres, green spaces, and playgrounds
- original proposed **landscaping** not realised
- reduced the quality of the open spaces
- collective-owned open spaces for interaction and make their maintenance easier
- taken over as vehicle access grounds and refuse dumps
- better access to **public transport**
- proximity to railways

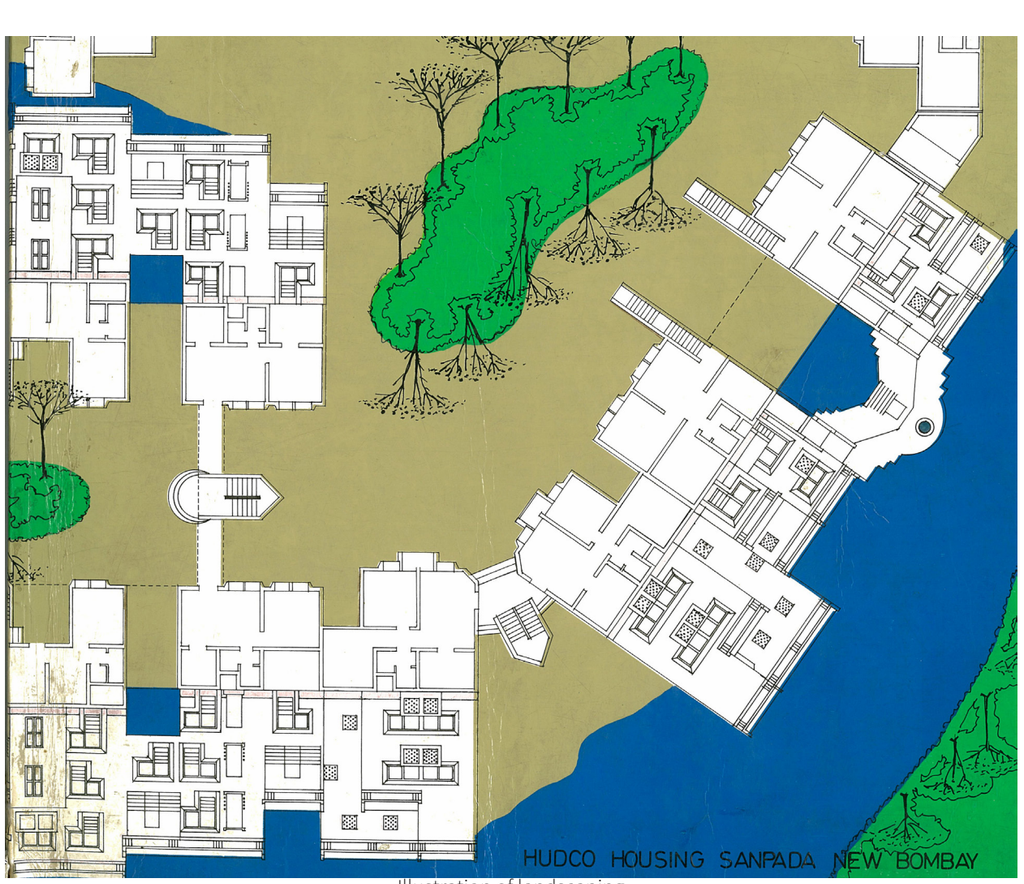


Illustration of landscaping
Not to scale

Masterplan
Not to scale

PRECEDENTS
HOUSING PROPOSAL
S+PS Architects

- **pedestrian community connected by nature**
- mixed-use, lower levels for public activities
- limit vehicular access
- low-rise without elevators

- **creating a sense of space with Indian spatial typologies**
- spaces spanning different social groups, age groups and usage typologies
- mixture of these Indian spatial typologies

- streets in the sky
- mediating the entry area with a threshold space, the ***otla***
- single sided circulation corridor for light, ventilation and views
- risen dwelling at the *otla* level providing privacy from circulation corridor level

- **loft** unit providing additional bedroom space

Proposed site plan
Not to scale

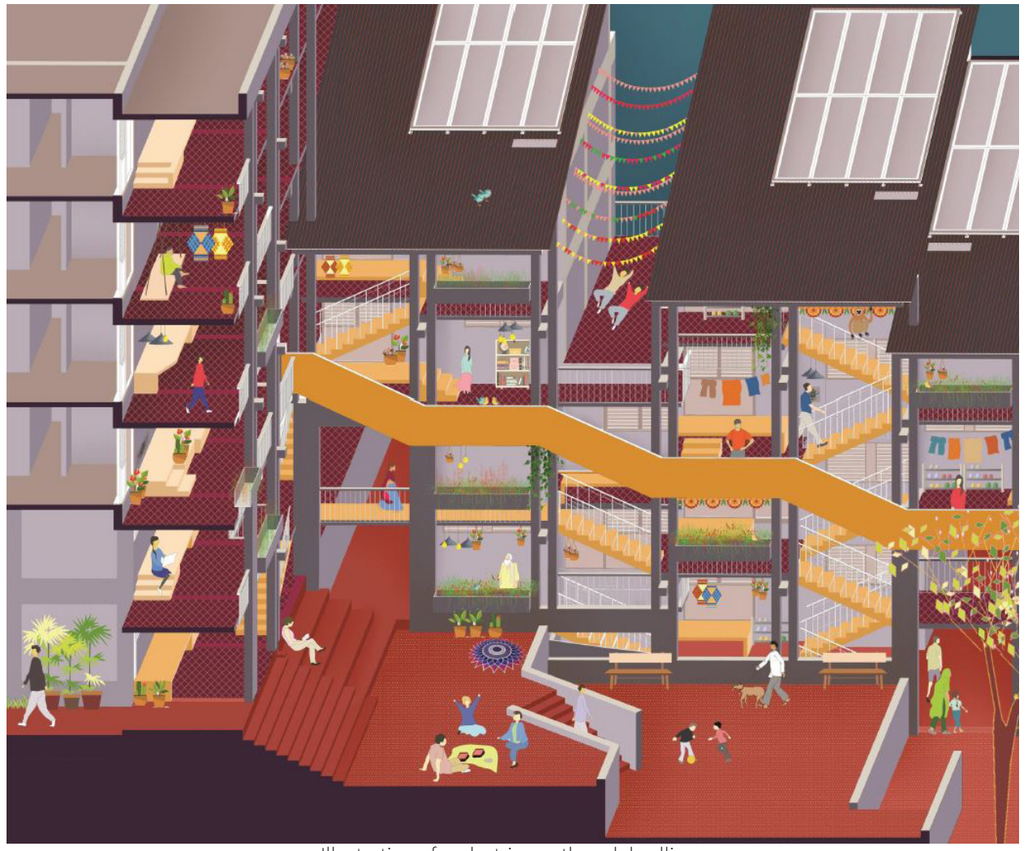


Illustration of pedestrian path and dwellings

PRECEDENTS
ATMARAM CHAWL
Chowgules

- community spaces
- common circulation ensuring privacy gradients
- reflection of community's living habits
- chawl typology

Circulation areas in use

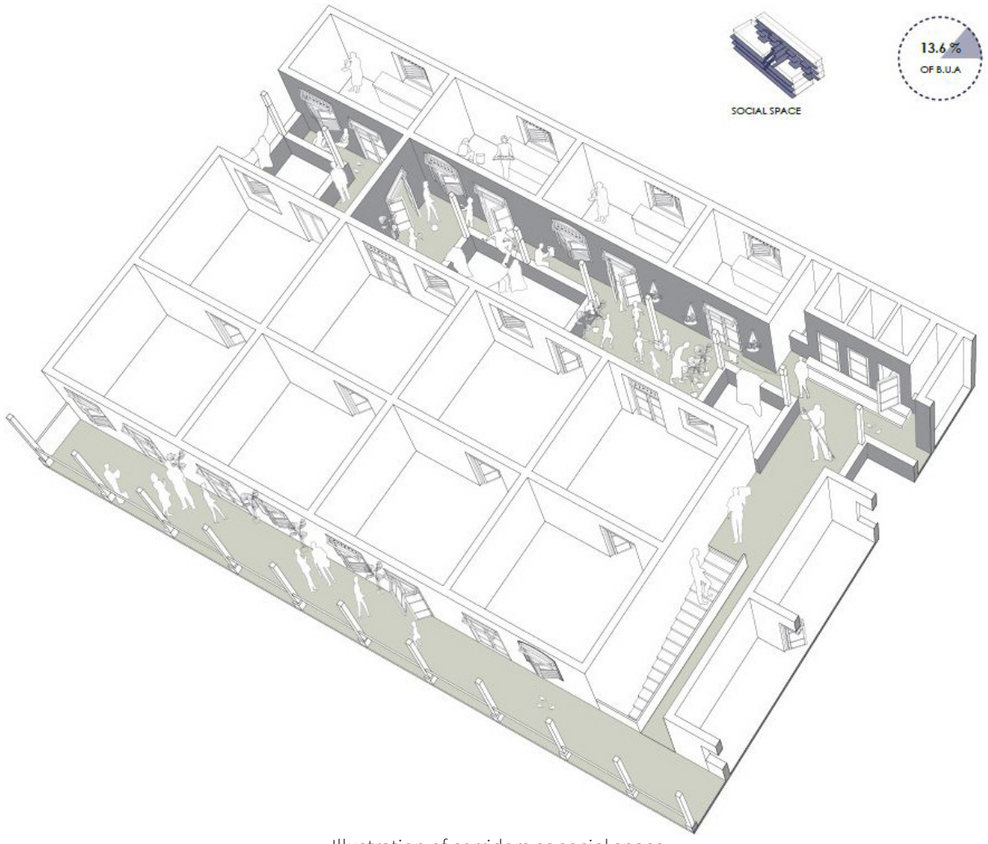
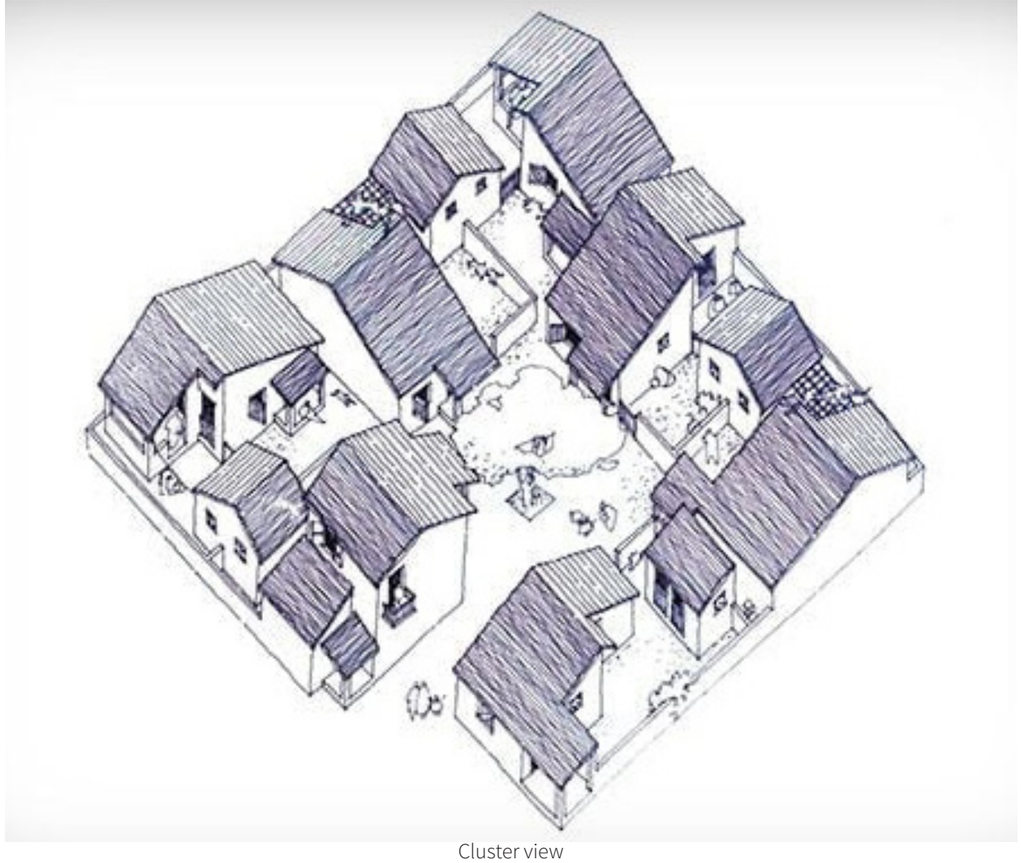


Illustration of corridors as social space

PRECEDENTS
BELAPUR HOUSING
Charles Correa

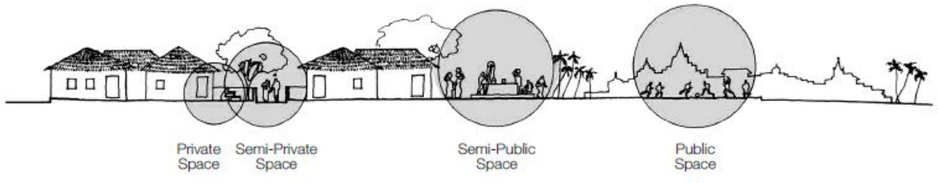
- sense of home and community
- levels of privacy from home to public
- use of courtyards of different sizes
- simple construction by local workforce



Cluster view

"There is much more to housing than just building houses. Urban living involves more than just the use of a small room of say, 10 sqm. The room, the cell, is only one element in a whole system of spaces that people need."

Charles Correa



Charles Correa (2010). "Space As a Resource". A Place in the Shade. pp. 23–24

Privacy sectional view

DESIGN RESIDENTS' GOALS

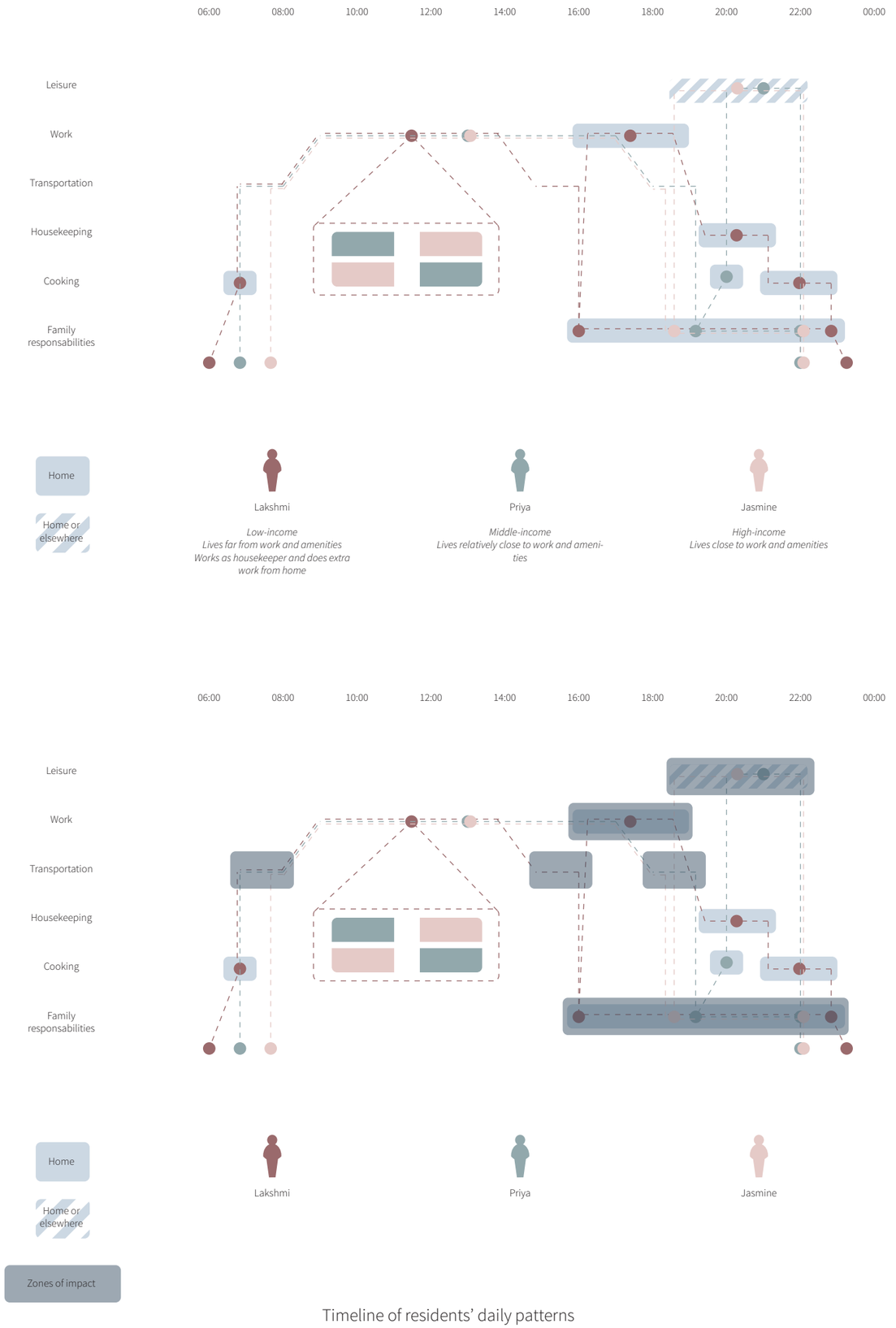
The project aims to provide housing and amenities for all income groups, and have a gender sensitive approach.

To better understand the daily life and behaviours of Indian residents, in particular women, a timeline of a usual day was done. The information used for this was gathered by talking to Indian residents and from research from blogs and social media.

This was used to determine additional areas of impact for the project, other than providing comfortable and safe housing conditions.

For a lot of women, being seen as the caretaker of the family and doing any other labour needs to leave place for overlap. This means that a lot of women would take care of the family or household (cooking, cleaning), while also supervising and caring for the children, sometimes even elder relatives. This activity, Family responsibilities, is shown as overlapping others, such as Work (working from home activities performed by low-income residents such as bead working, laundry or cooking; or by higher-income residents, a formal work-from-home office job).

The analysis uses the premise that the low-income woman taken as an example, Lakshmi, would provide services for higher-income as her main job, such as cleaning or cooking for these families.



Timeline of residents' daily patterns

RESIDENTS' GOALS

Low-income resident

Lakshmi

Transportation time

By providing better connections linking the new neighbourhood to public transport, Lakshmi can get to and from work faster. These connections can also be used for easier reach to parts of the city for other purposes.

Proximity to other residents from different income groups would improve Lakshmi's chances of getting hired by these, and would significantly decrease time spent on transport.

Family responsibilities

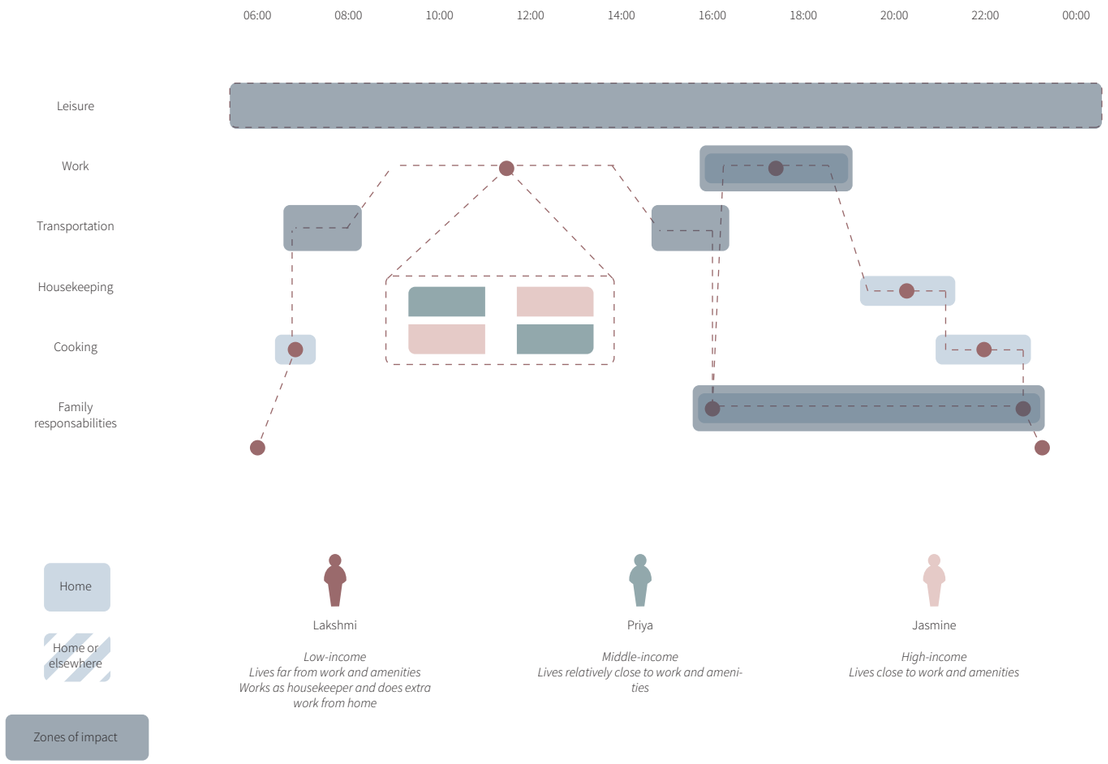
Child caring often ends up being the responsibility of the woman in the family. By offering places for children to play in, Lakshmi and her other neighbours can take turns in watching the children, while also taking care of other responsibilities.

Working from home

Lakshmi counts on other income-generating activities that she can do at home, such as laundry, bead working or others. Having a better environment to do these could improve her efficiency and products.

Leisure

Providing safe and comfortable leisure spaces in the proximity of Lakshmi's home could help her to spend time for herself.



Timeline of Lakshmi's daily patterns

RESIDENTS' GOALS
Middle-income resident

Priya

Transportation time

By providing better connections linking the new neighbourhood to public transport, Priya can get to and from work faster. These connections can also be used for easier reach to parts of the city for other purposes.

Family responsibilities

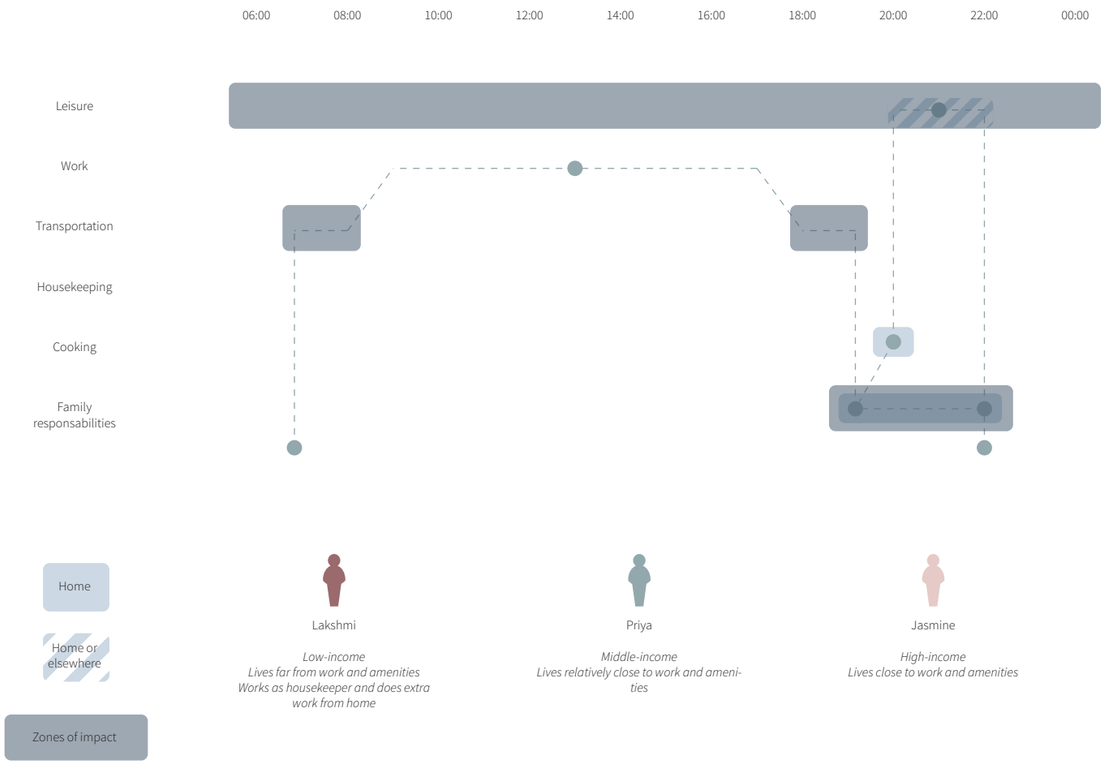
Child caring often ends up being the responsibility of the woman in the family. By offering places for children to play in, Priya and her other neighbours can take turns in watching the children, while also taking care of other responsibilities.

Taking care of the household

Proximity to other residents from different income groups would help Priya, who is now able to hire someone living close-by to help her with housekeeping.

Leisure

Providing safe and comfortable leisure spaces in the proximity of Priya's home would help her take time off when needed without the need to travel elsewhere for amenities.



Timeline of Priya's daily patterns

RESIDENTS' GOALS

High-income resident

Jasmine

Transportation time

By providing better connections linking the new neighbourhood to public transport, as well as good connections for private transport, Jasmine can get to and from work faster. These connections can also be used for easier reach to parts of the city for other purposes.

Family responsibilities

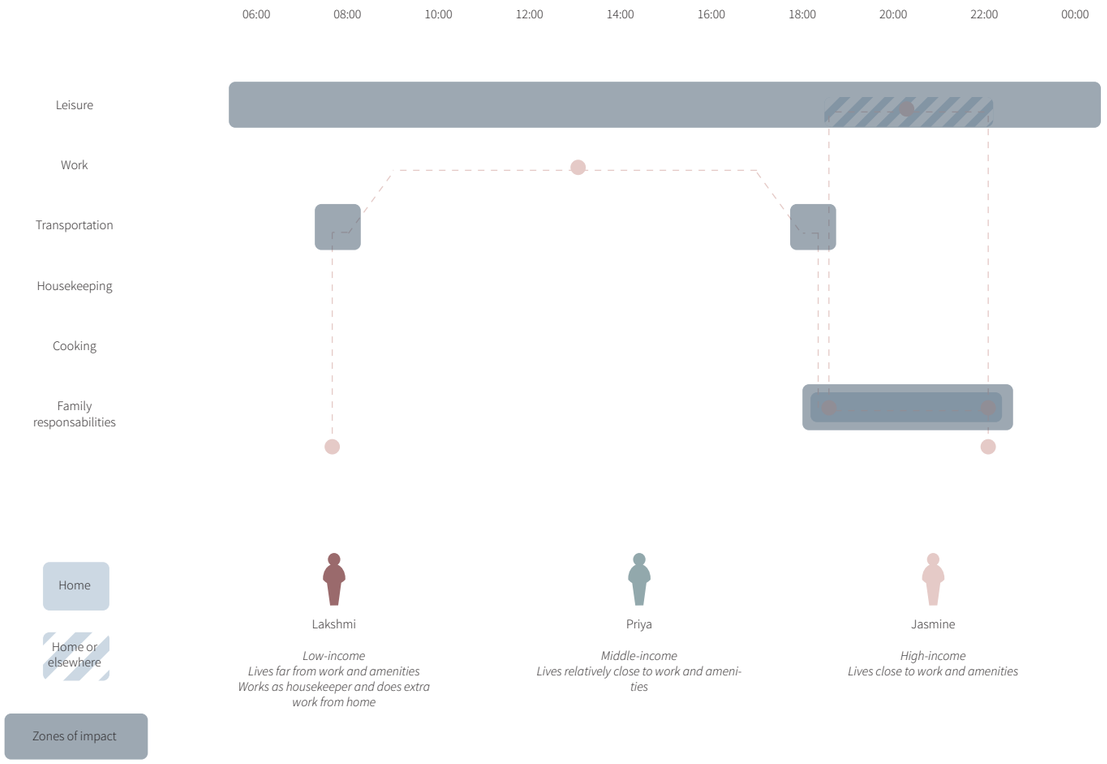
Child caring often ends up being the responsibility of the woman in the family. By offering places for children to play in, Jasmine and her other neighbours can take turns in watching the children, while also taking care of other responsibilities.

Taking care of the household

Proximity to other residents from different income groups would help Jasmine, who is now able to hire someone living close-by to help her with housekeeping and cooking.

Leisure

Providing safe and comfortable leisure spaces in the proximity of Jasmine's home could help her to spend time for herself. Diverse amenities close to her home would also improve her living conditions.



Timeline of Jasmine's daily patterns

COMMUNITY BOOSTER

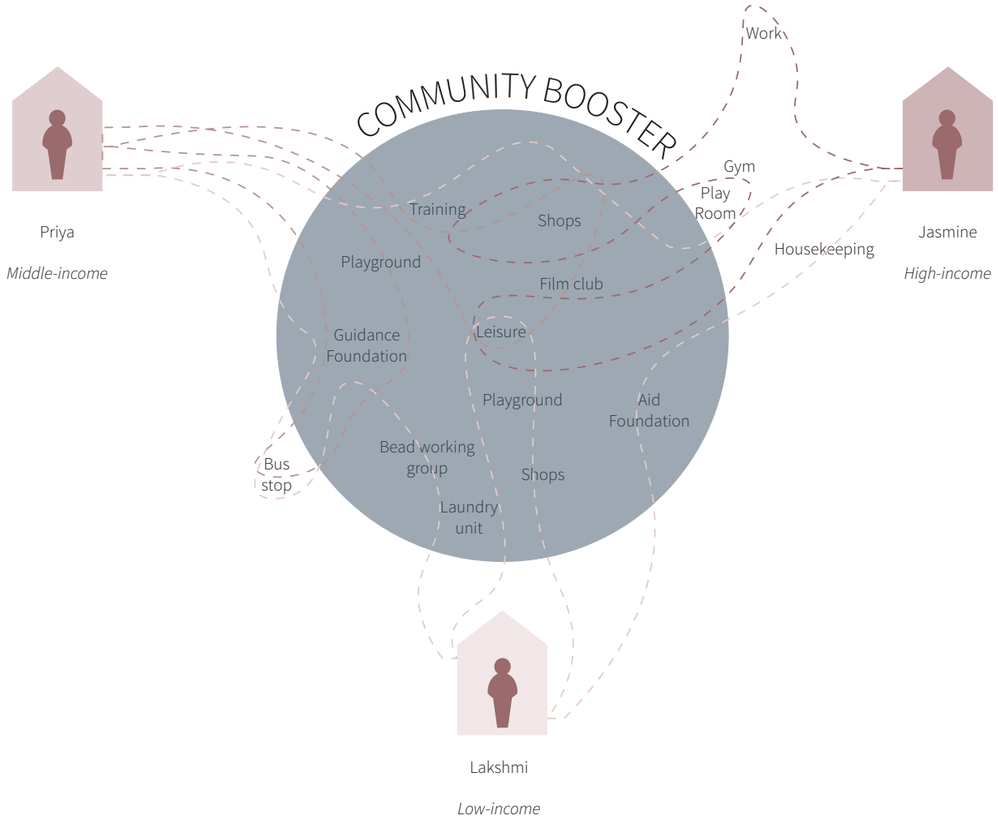
With the purpose of identifying common activities and places of interaction and overlap of the women from the different income groups, a map of a community booster was made.

This allows for the visual representation of activities happening outside of home, which could take place in a common area for all residents to meet.

Transportation is also taken into account, with routes for public transport by bus being available, but mostly the proximity of the income groups means that transport between these could be done by foot, transversing the place of interaction once again.

At the core of this area lies leisure. Providing safe and comfortable spaces in proximity to housing would increase their usability by women, who tend to not venture far from their dwellings for loitering.

These areas of interaction for activities, services, amenities or leisure are named community boosters for the design, as they promote interaction between the residents, no matter the income level or gender.



Amenities and income group residents connections

COMMUNITY BOOSTER AMENITIES

Flexibility within the community boosters is provided by employing multiple types of spaces.

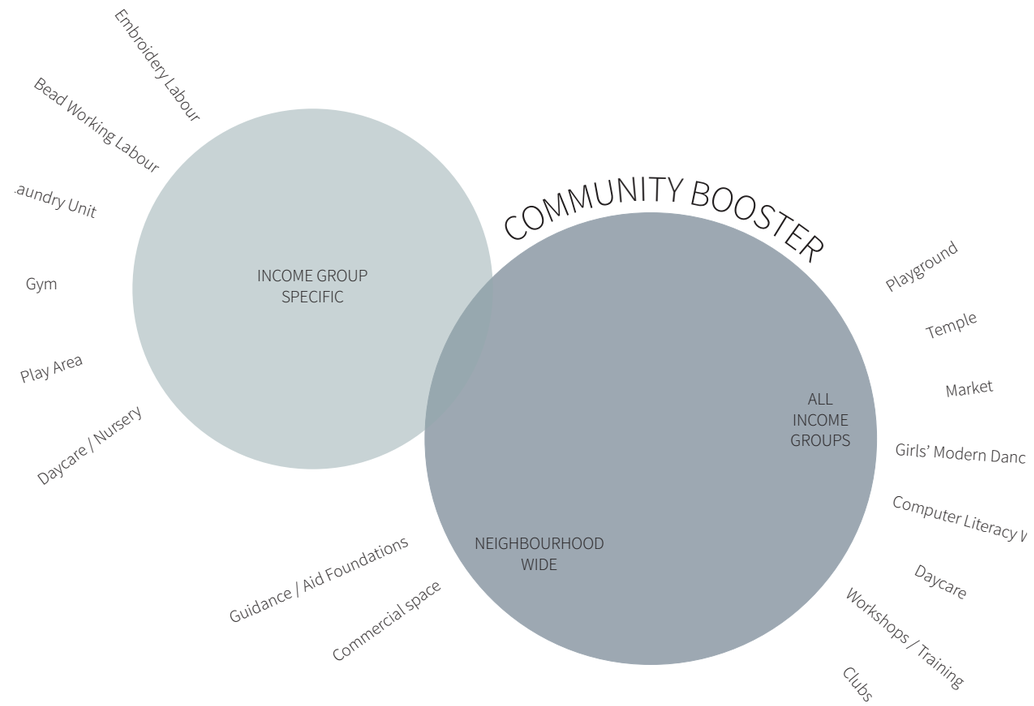
More formal spaces for commercial use are provided, along with a neighbourhood centre, market, and childcare facilities such as a nursery. In addition to these, pavilions would enhance the use of the areas, providing more flexible spaces for smaller scale activities or committees, or the possibility for foundations and associations to reach and improve the community.

Associations for aid and guidance

- *Mahila Milan (collective for women dealing with founding for housing)*
- *SNEHA Foundation (domestic violence and healthy development for women and children)*
- *Urja Trust Foundation (non-formal education course)*
- *Hothur Foundation (basic amenities such as quality education, medical aid, maternity guidance, counselling and matrimonial aid)*

Committees for collective activities

- *Beads working group*
- *Girls' Modern Dancing*
- *Computer literacy workshops*
- *Clubs (to be determined by residents)*



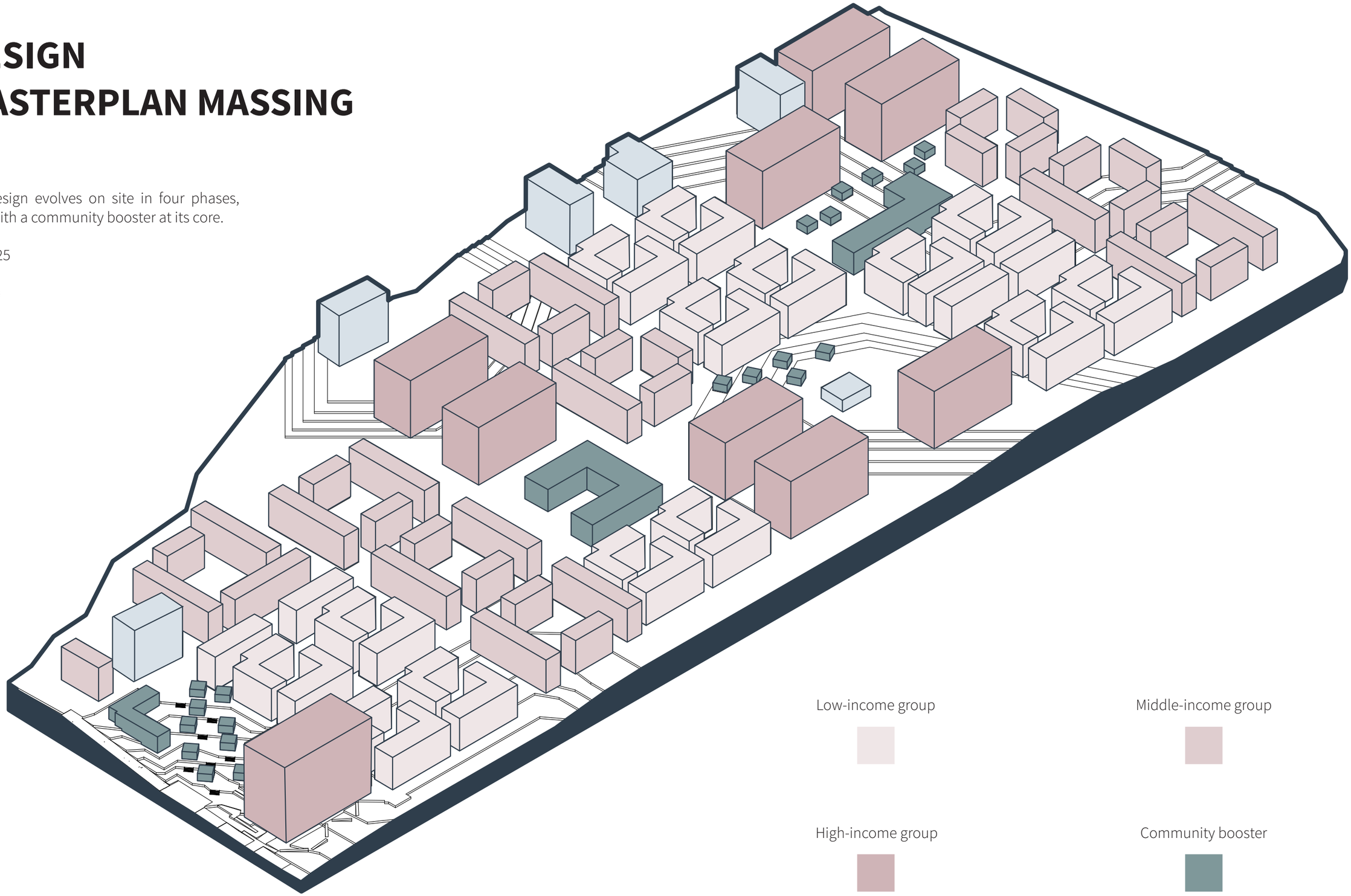
Amenities Division

DESIGN
MASTERPLAN MASSING

The design evolves on site in four phases, each with a community booster at its core.

GSI=0.25

FSI=1.5



Low-income group

Middle-income group

High-income group

Community booster

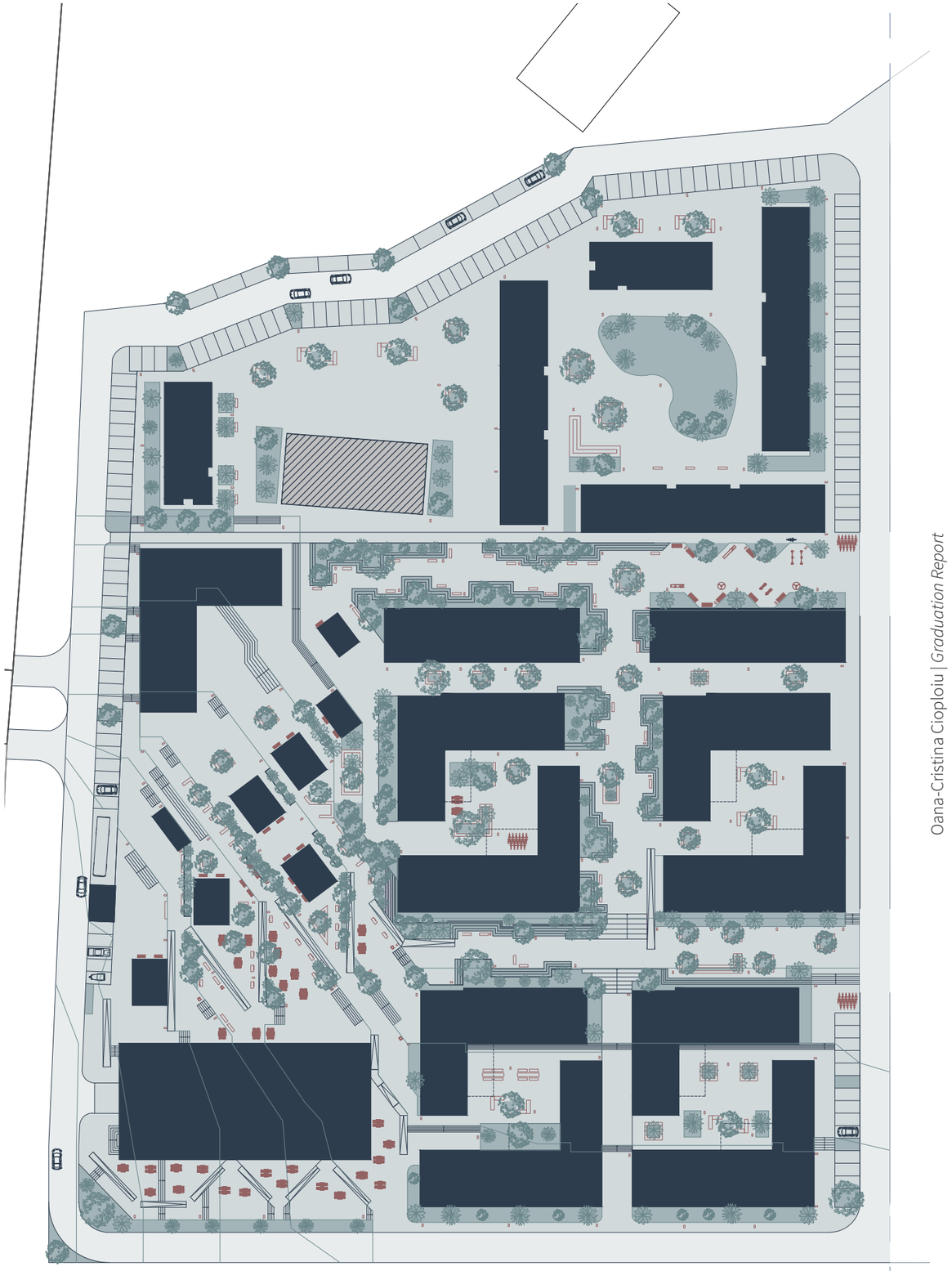
PHASE I

Residential space:
Low-income group 4 clusters
Middle income group 1 cluster and a half
High-income group 1 building

Community booster
Neighbourhood center
Pavilions
Bus stop

GSI=0.3

FSI=1.2



Phase I plan
Scale 1:5000 on A1

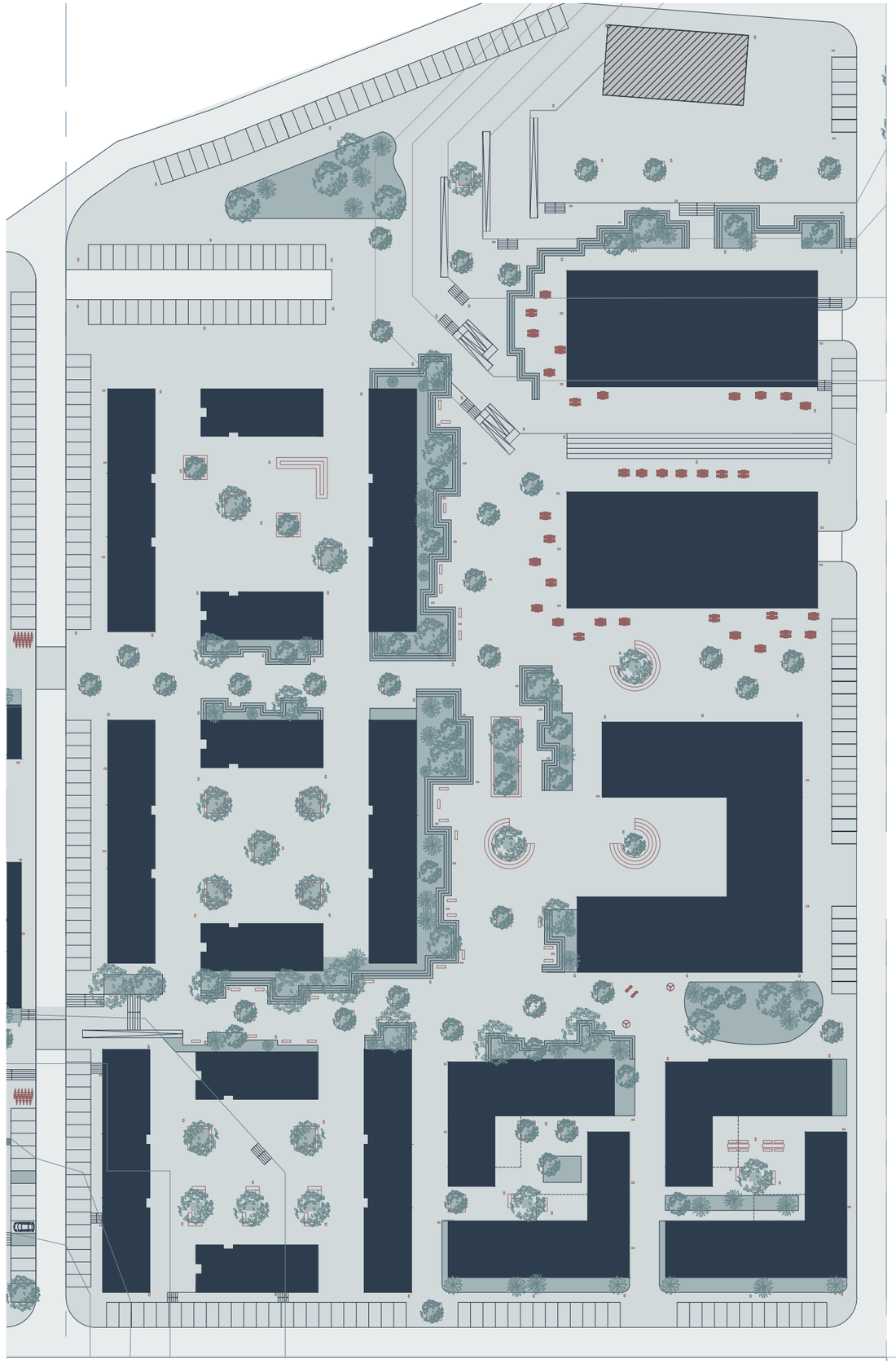
PHASE II

Residential space:
Low-income group 2 clusters
Middle income group 3 clusters
High-income group 2 buildings

Community booster
Commercial space
Library
Nursery/Daycare

GSI=0.3

FSI=1.4



Phase II plan
Scale 1:5000 on A1

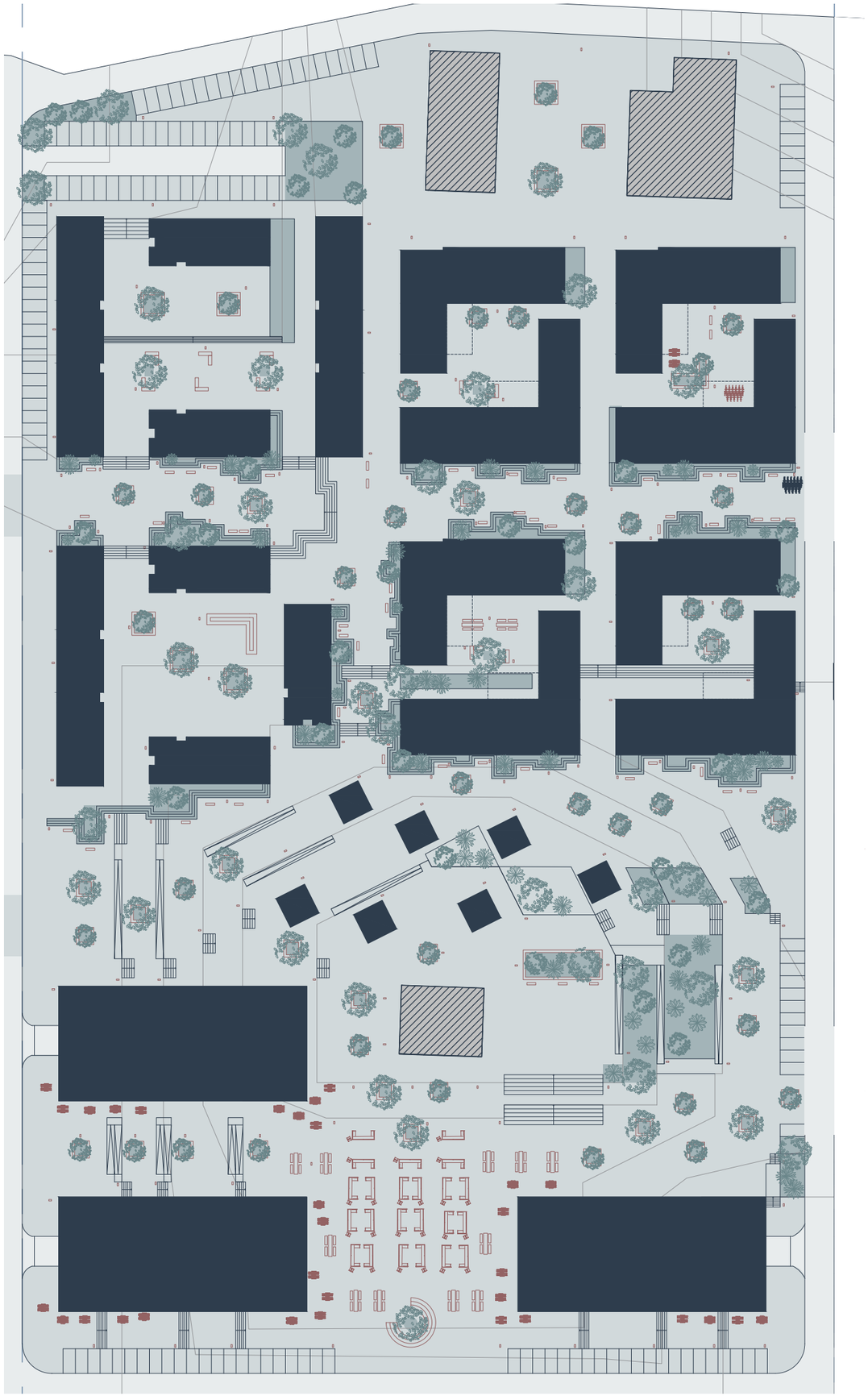
PHASE III

Residential space:
Low-income group 4 clusters
Middle income group 2 clusters
High-income group 3 buildings

Community booster
Hindu Temple
Market space
Pavilions

GSI=0.2

FSI=1.6



Phase III plan
Scale 1:5000 on A1

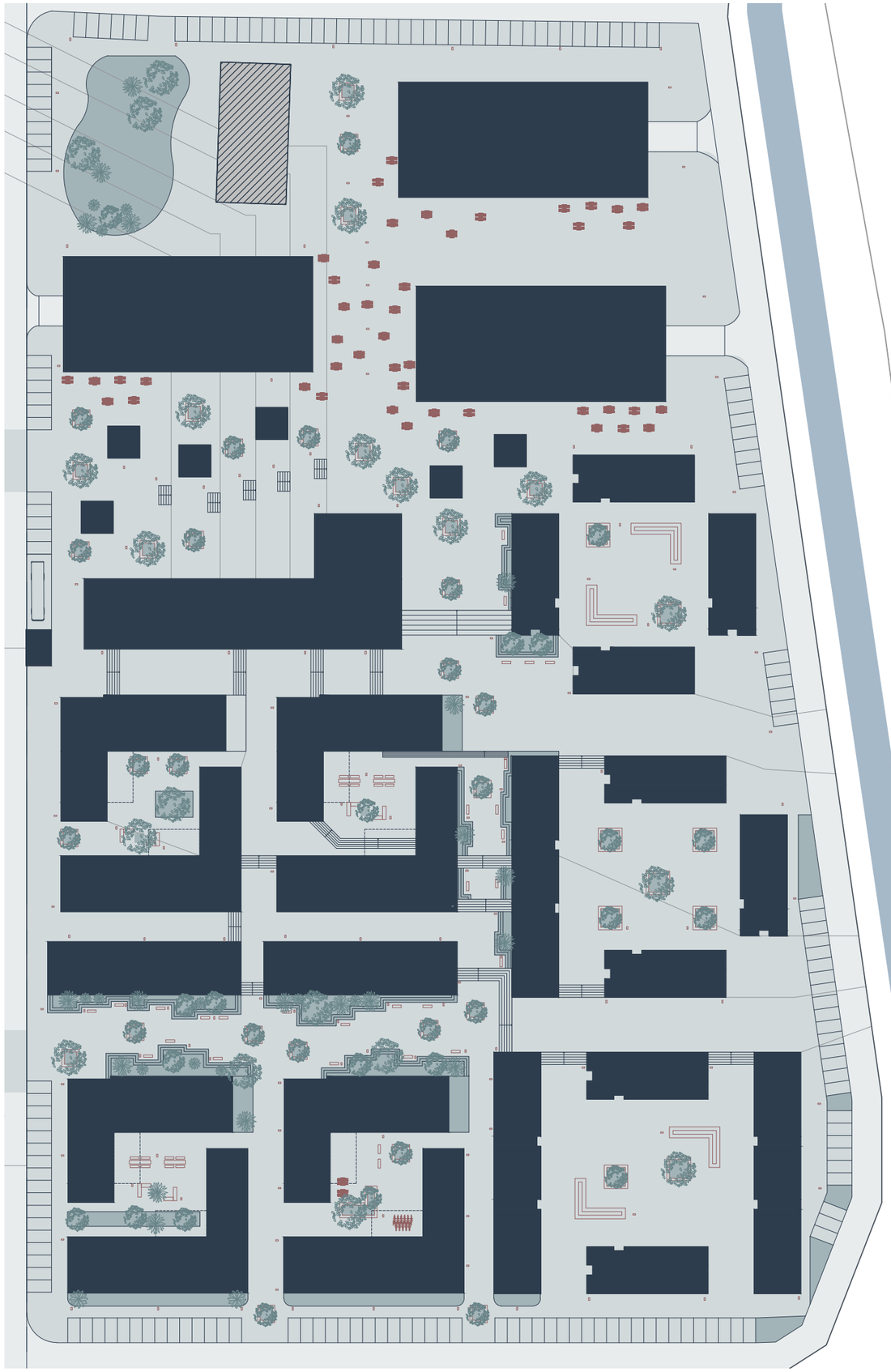
PHASE IV

Residential space:
Low-income group 4 clusters
Middle income group 3 clusters
High-income group 3 buildings

Community booster
Commercial space
Pavilions
Bus stop

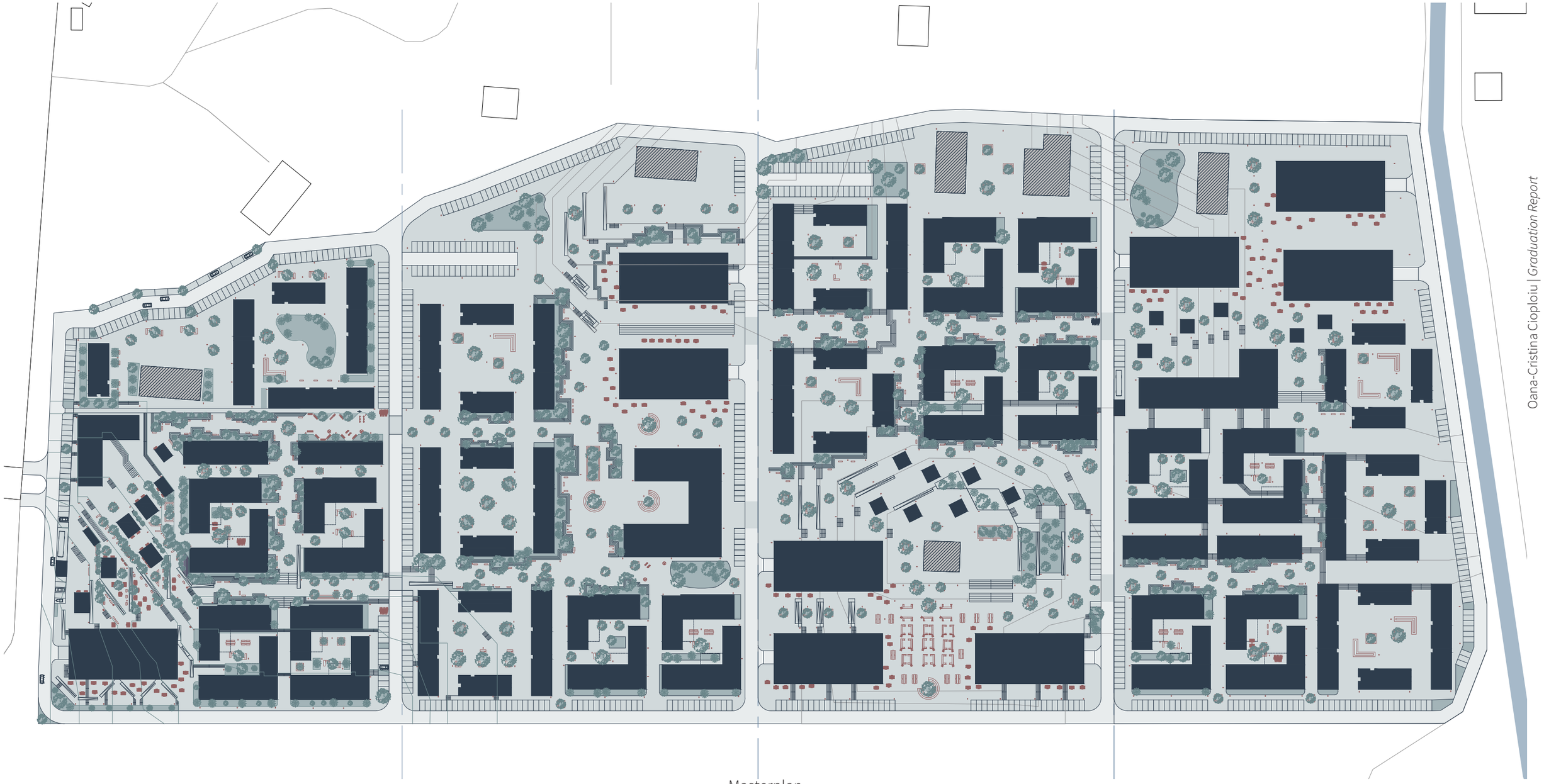
GSI=0.2

FSI=1.9



Phase Iv plan
Scale 1:5000 on A1

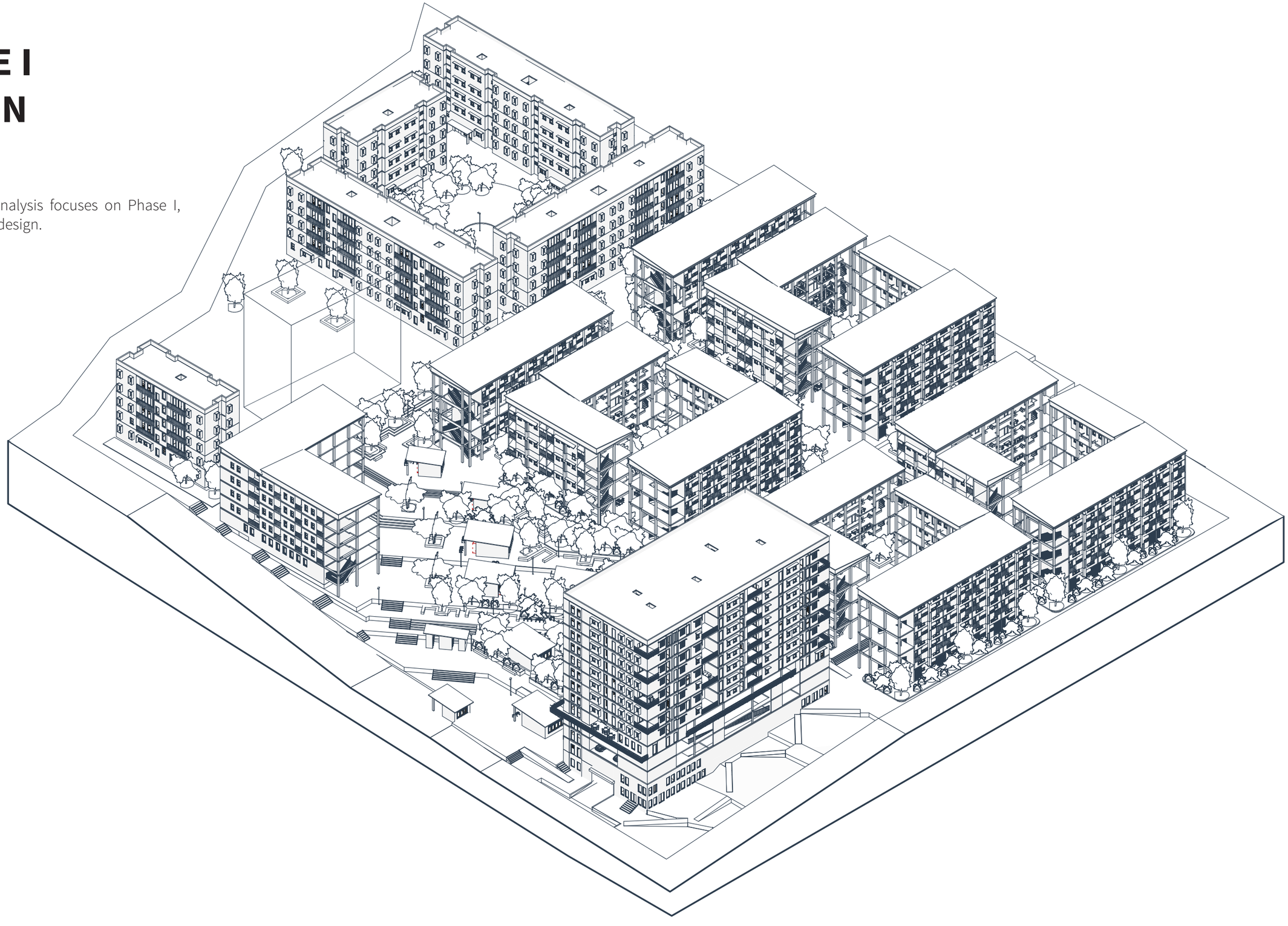
MASTERPLAN



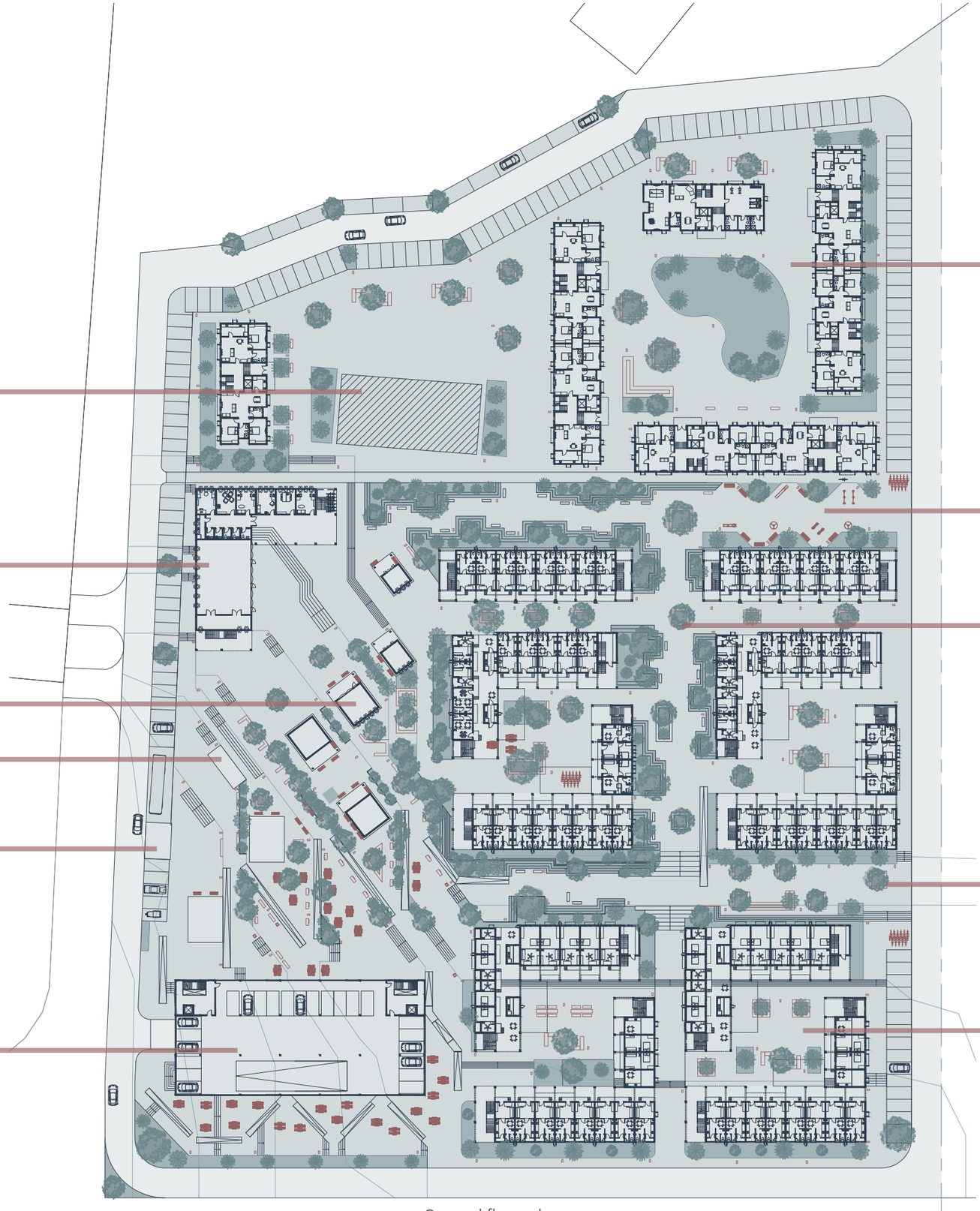
Masterplan
Scale 1:1000 on A1

PHASE I
DESIGN

The following analysis focuses on Phase I, elaborating the design.

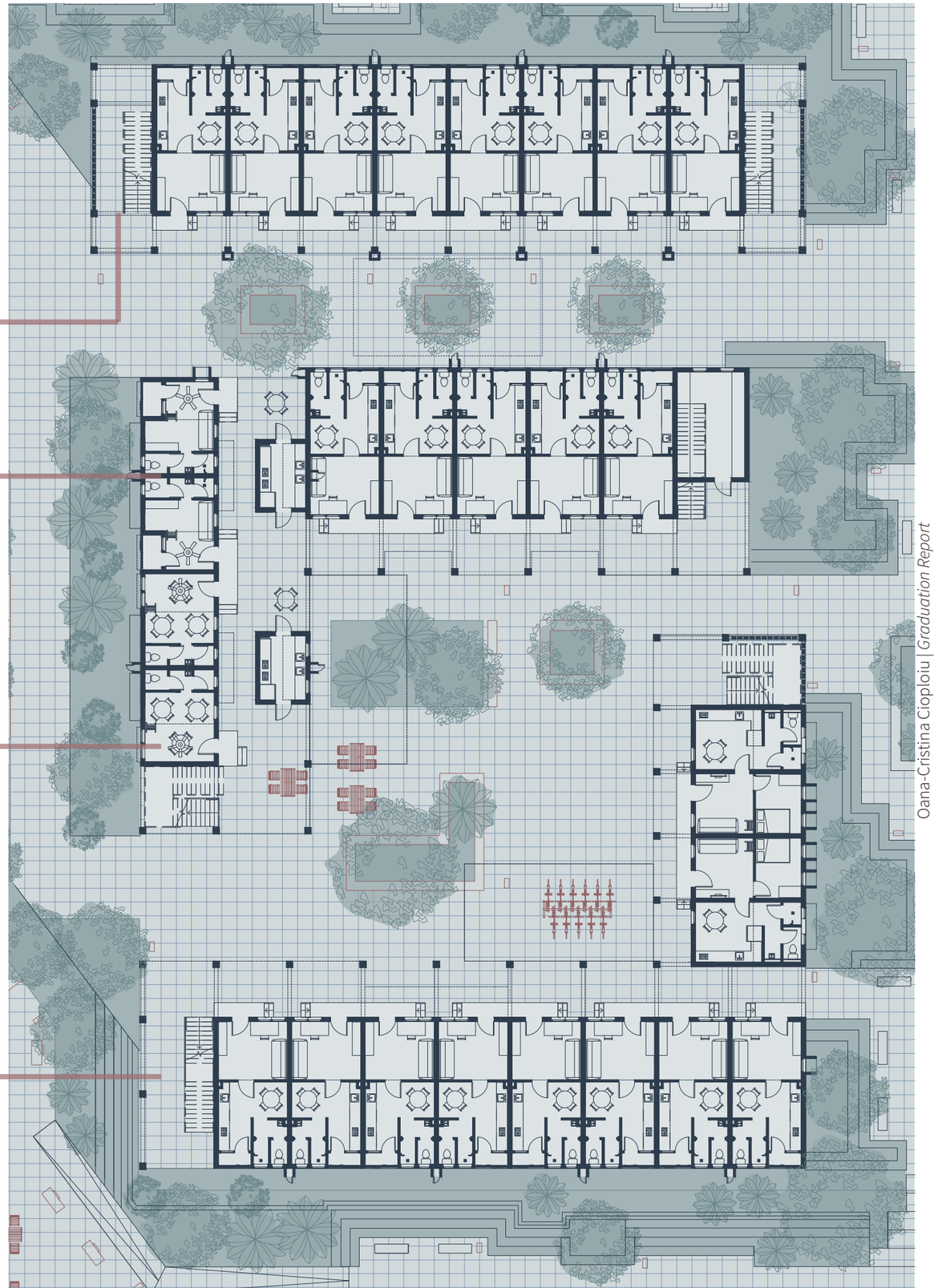


PHASE I
GROUND FLOOR



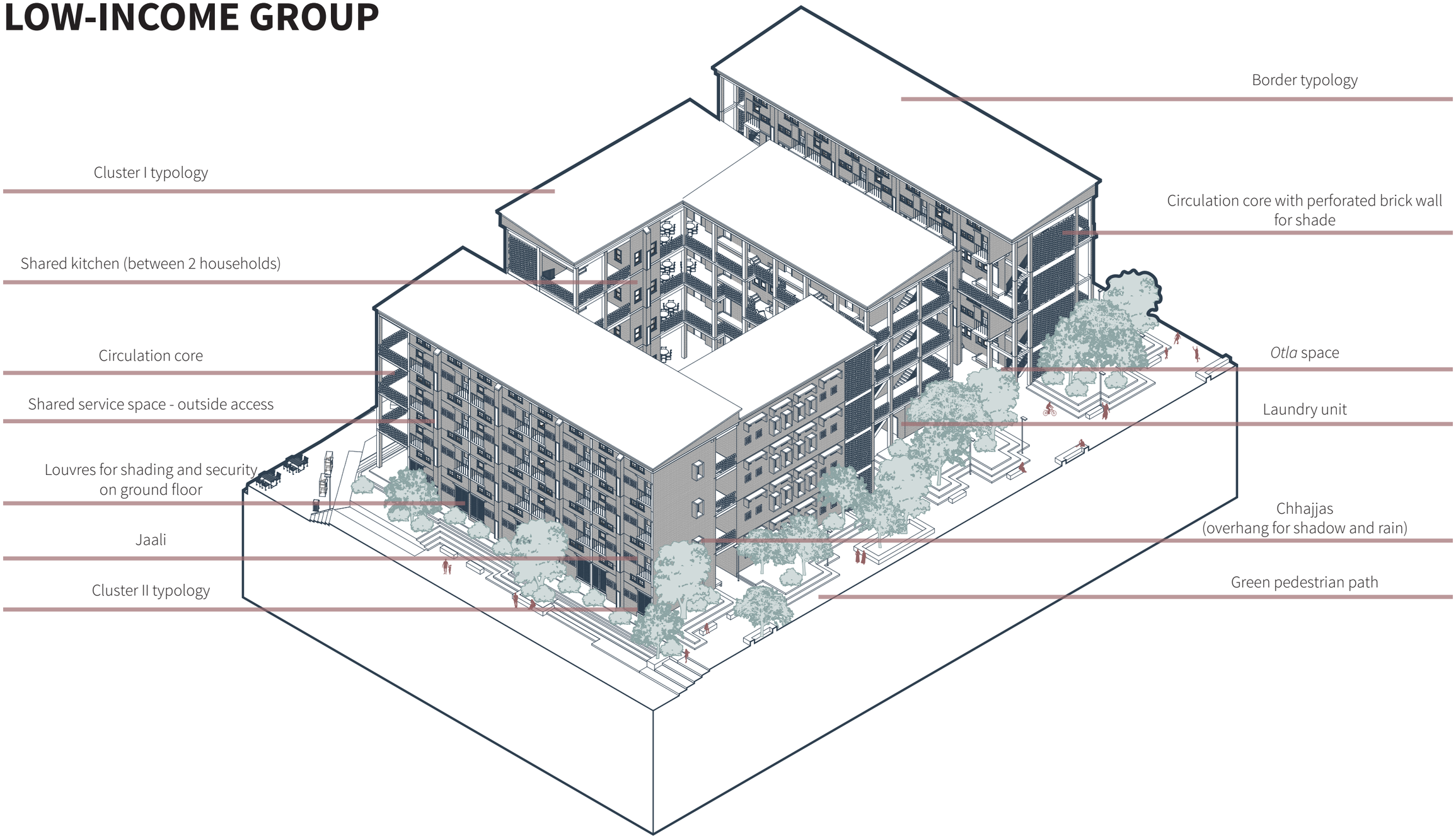
Ground floor plan
Scale 1:500 on A1

PHASE I
LOW-INCOME GROUP



Low-income group cluster plan - Ground floor
Scale 1:200 on A1

PHASE I
LOW-INCOME GROUP



Low-income group cluster axonometry
Not to scale

PHASE I
LOW-INCOME GROUP

GREEN PATH

PUBLIC

DOORSTEP
OTLA

SEMI-PRIVATE

COURTYARD

SEMI-PUBLIC

PEDESTRIAN ROUTE

SEMI-PUBLIC

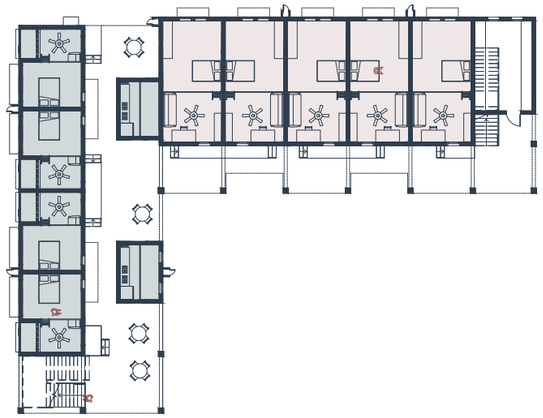
Low-income group cluster section
Scale 1:100 on A1

PHASE I
LOW-INCOME GROUP

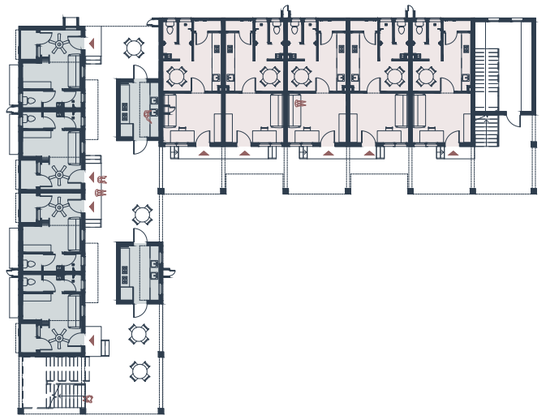
Low-income group courtyard view

PHASE I
LOW-INCOME GROUP

Cluster I typology

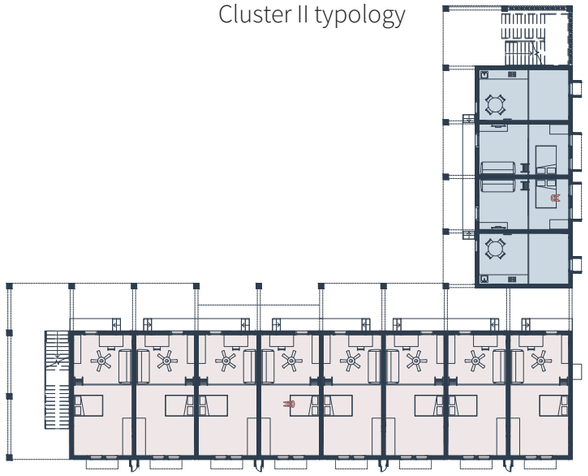


Mezzanine

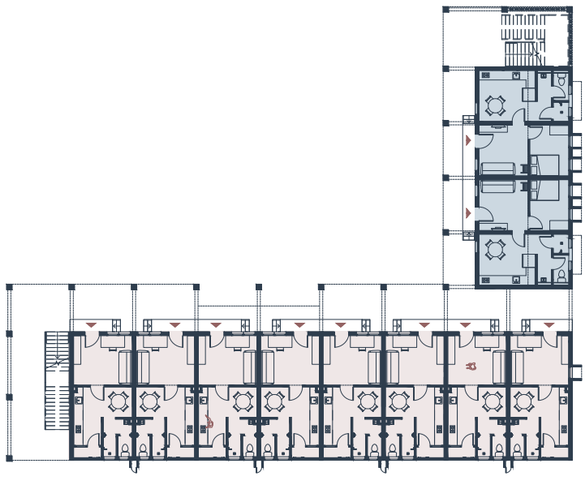


Ground floor

Cluster II typology

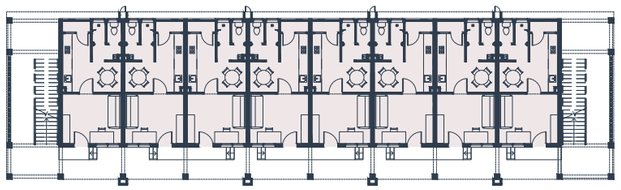


Mezzanine

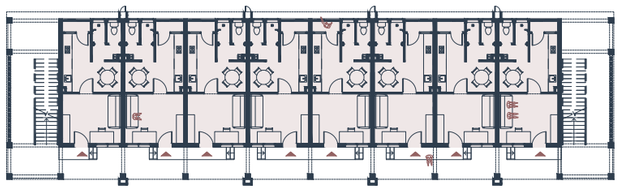


Ground floor

Border typology



Mezzanine

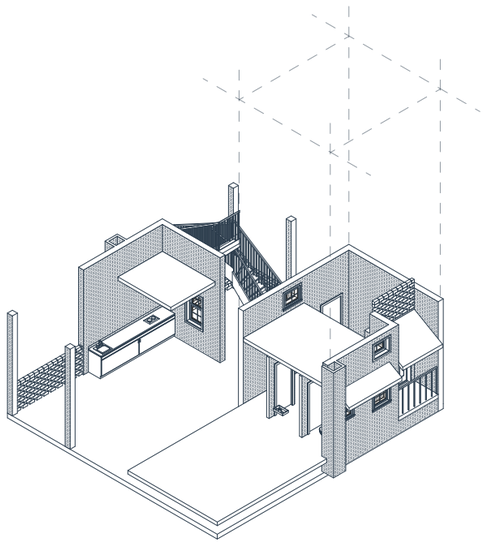


Ground floor

Building plans
Scale 1:200 on A1

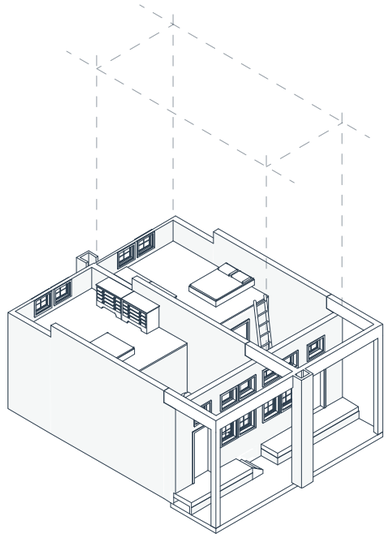
PHASE I
LOW-INCOME GROUP

Chawl typology



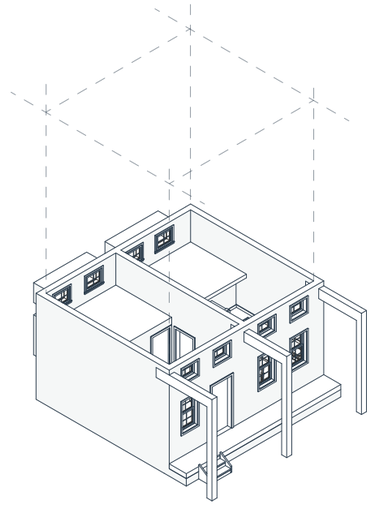
Unit size: 20 m²
Residents 1-3
Rooms: 1 + loft space
Common shared kitchen (2 households)
Budget Low

Border and Cluster typology I & II



Unit size: 30 m²
Residents 3-6
Rooms: 2 + loft space
Budget Middle

Cluster typology II

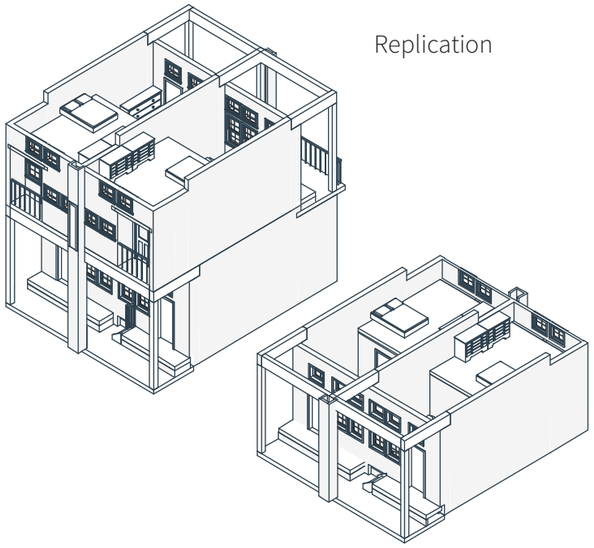


Unit size: 42 m²
Residents 4+
Rooms: 3 + 2 loft spaces
Budget High

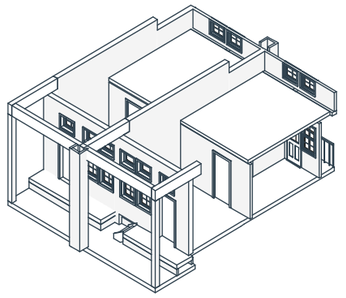
Unit typologies axonometry

PHASE I
LOW-INCOME GROUP

The short span in the buildings (4-5 m) allow for a load bearing structure. Concrete beams are utilised only where needed, to support the load above corridors.

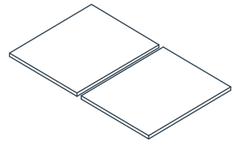


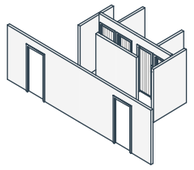
Replication



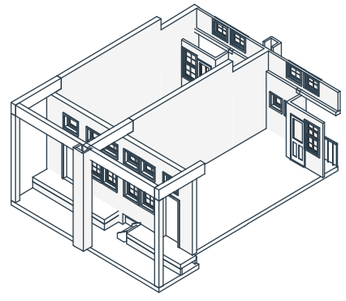
Minimised use of concrete beams
(to support the dwellings on top of corridors)

Bamboo loft flooring

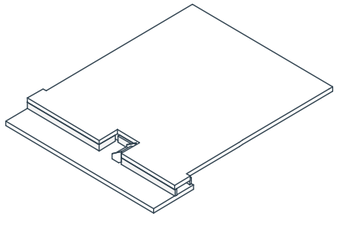




Stabilizing walls



Load bearing walls



Reinforced concrete slab

PHASE I
MIDDLE-INCOME GROUP

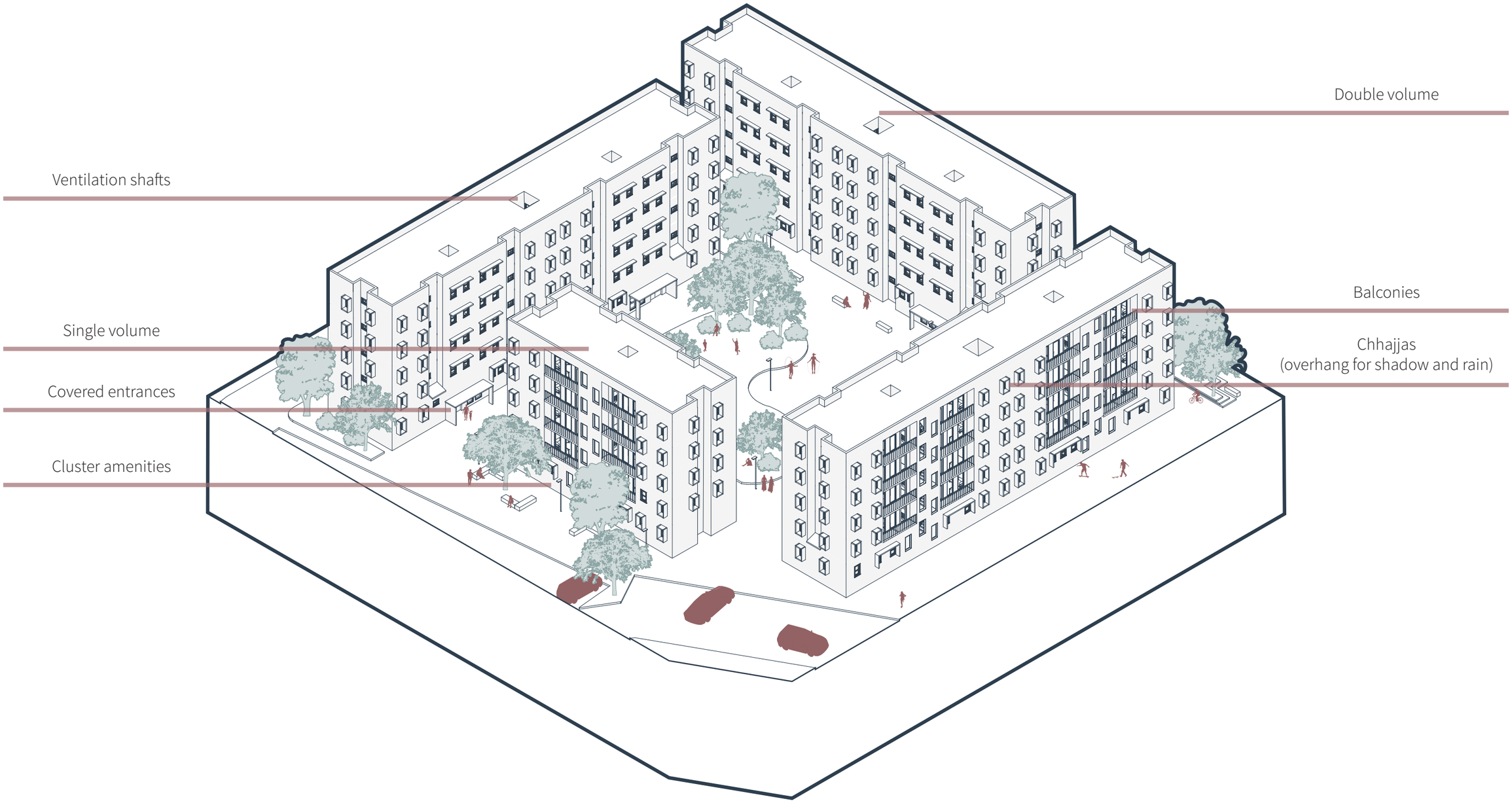
Middle-income dwellings are structured around a cluster, having a semi-public courtyard shared between 4 buildings. These buildings follow a single or double volume, with each volume containing a circulation core and apartments on either side if it.

Dwellings are prioritized, and as such they occupy the ground floor as well. For each cluster, amenities are provided at the ground floor of a building, offering gym space and play areas.

The courtyard is less intimate than the low-income one, with the absence of the *otla* as a transitional space. However, it utilities Indian typologies encountered in public space, such as the maidan, katta and bakda, to promote a sense of belonging and offer a pleasant environment.

Middle-income group cluster plan, ground floor
Scale 1:200 on A1

PHASE I
MIDDLE-INCOME GROUP



Middle-income group cluster axonometry
Not to scale

PHASE I
MIDDLE-INCOME GROUP

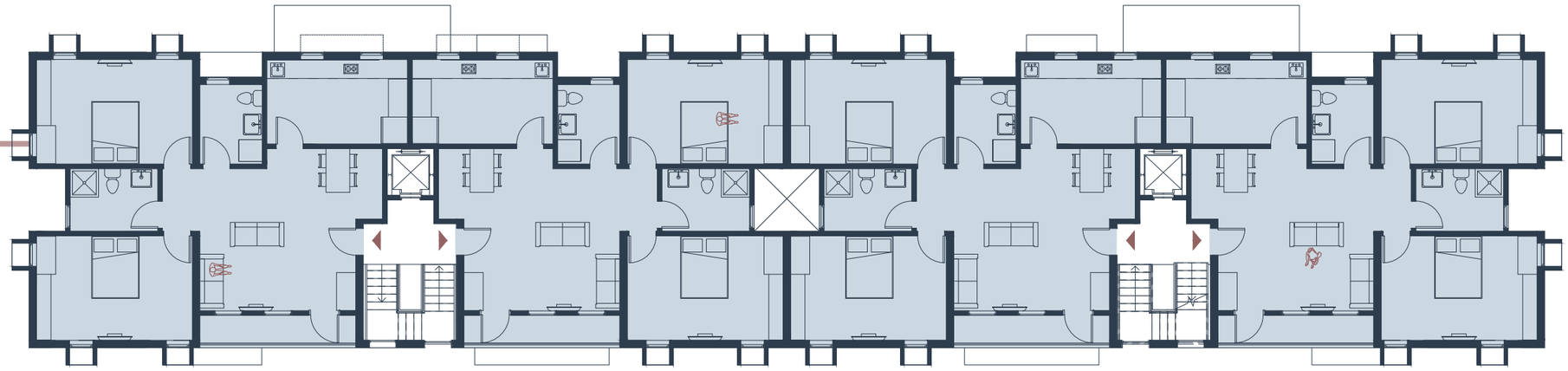
Middle-income group cluster section
Scale 1:100 on A1

PHASE I
MIDDLE-INCOME GROUP

Middle-income group courtyard view

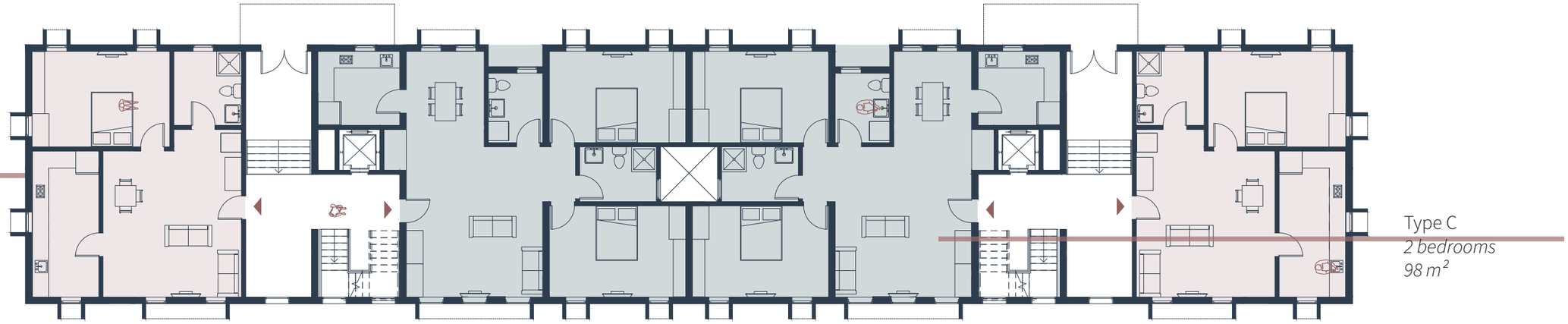
PHASE I
MIDDLE-INCOME GROUP

Type A
2 bedrooms
94 m²



Upper floors

Type B
1 bedroom
69 m²



Type C
2 bedrooms
98 m²

0 1 2 3 4 5 10

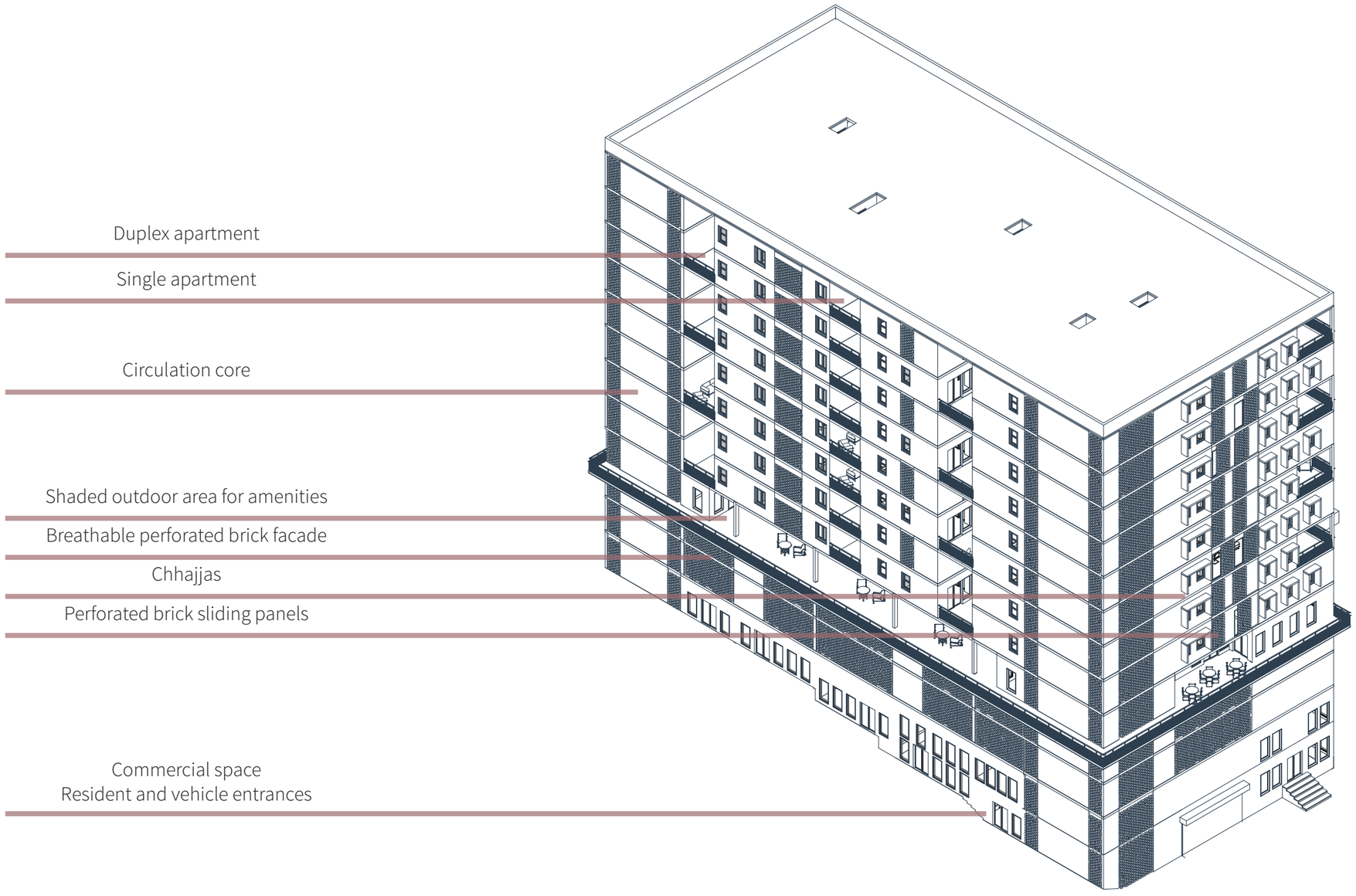
Ground floor

Building plans
Scale 1:100 on A1

PHASE I
HIGH-INCOME GROUP

The high-income group dwellings come in a typical configuration for the residents, the tower. This typology is comfortable and can provide multiple functions for the public and restricted ones for the residents at the same time.

The tower makes great use of perforated brick facades to ensure a comfortable shaded indoor environment, as well as chhajjas. The perforated bricks offer breathable facade areas for the parking levels, and are used in sliding panels for the dwellings' living areas.



Building axonometry
Not to scale

PHASE I
HIGH-INCOME GROUP

The 8 dwelling levels have 6 types of apartments, with 3 types spreading on double levels.

Each tower has a floor reserved for amenities for the residents, from gym area, to cinema room, play area, and even playground space for children.

The two levels beneath the amenities are dedicated to parking, providing a car space for each apartment. By raising the parking level above ground, it creates a safer space for women to navigate.

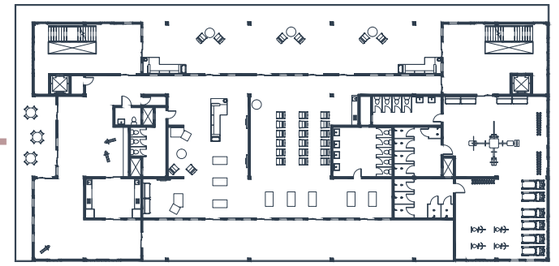
The HIG tower uses the ground floor as an interaction with the public, activating the street level. This level can house multiple commercial spaces, such as restaurants or shops, and is also the main entrance for the residents, with a lobby, and a car entrance from street level.

Apartments

Floors 5, 7, 9, 11
Floors 4, 6, 8, 10

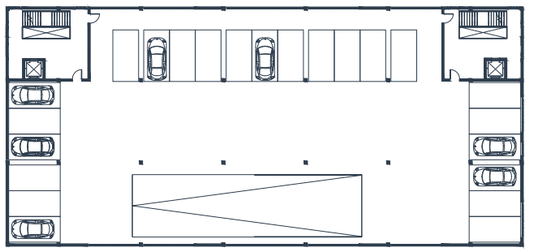
Resident amenities

Floor 3



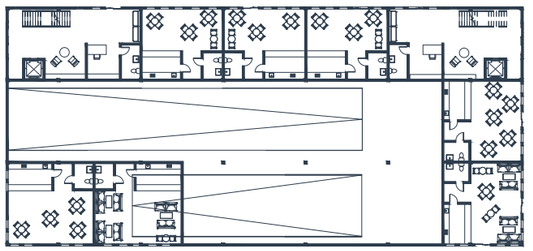
Resident parking

Floors 1&2



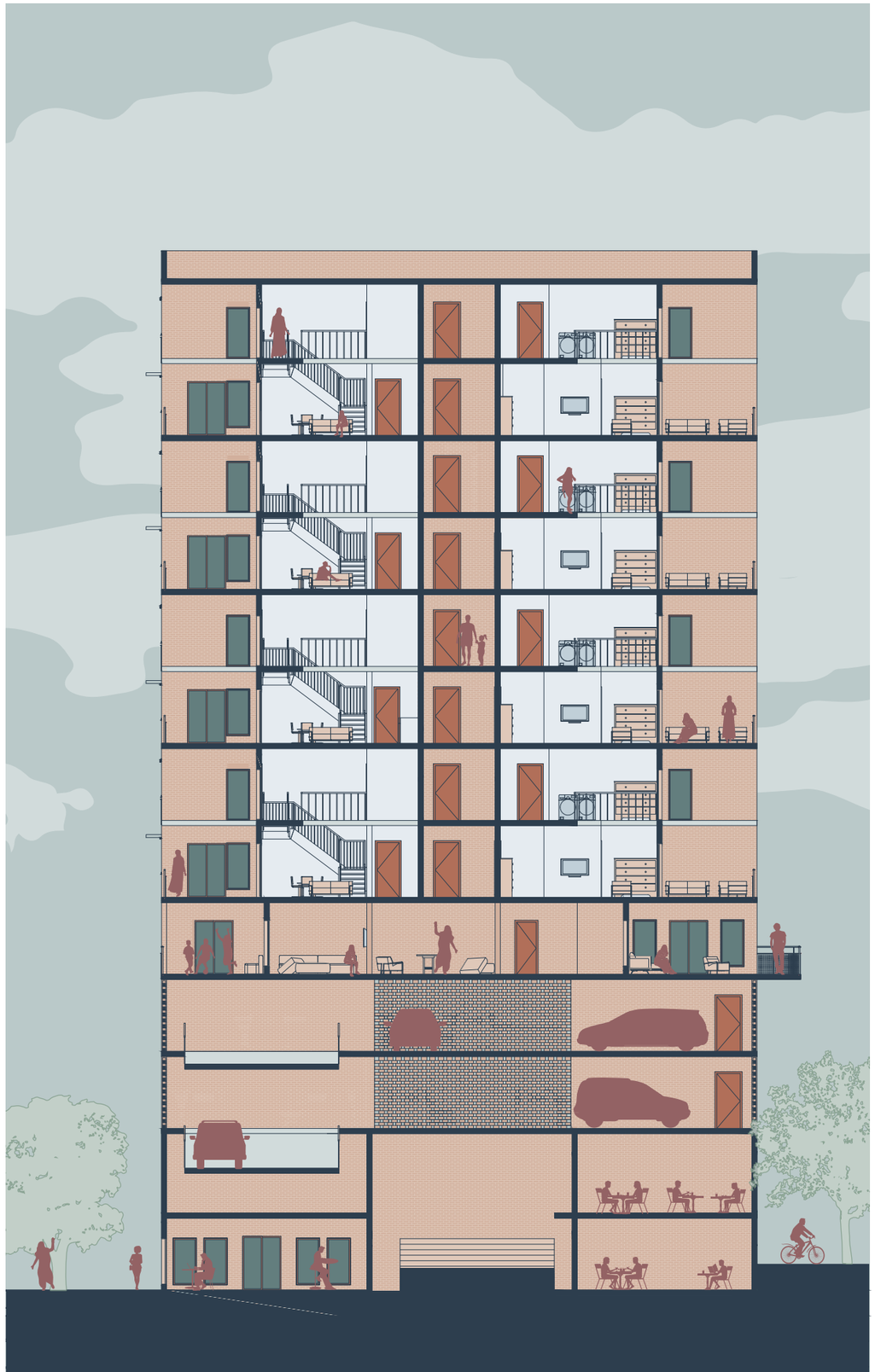
Commercial space
Resident and vehicle entrances

Ground floor



Building plans
Scale 1:300 on A1

PHASE I
HIGH-INCOME GROUP



Short section
Scale 1:100 on A1

PHASE I
HIGH-INCOME GROUP

High-income group view

PHASE I
HIGH-INCOME GROUP

Type A
Duplex apartment
3 bedrooms
222 m²

Type B
Single apartment
1 bedroom
105 m²

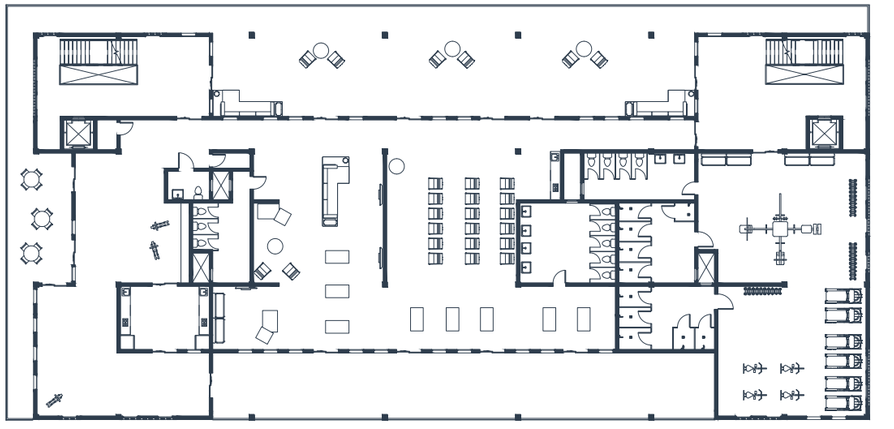
Type C
Duplex apartment
3 bedrooms
177 m²

Type D
Duplex apartment
3 bedrooms
176 m²

Type E
Corner apartment
2 bedrooms
125 m²

Type F
Single apartment
2 bedrooms
160 m²

Amenities
Gym
Daycare
Outdoor terrace space
Social space
Play area



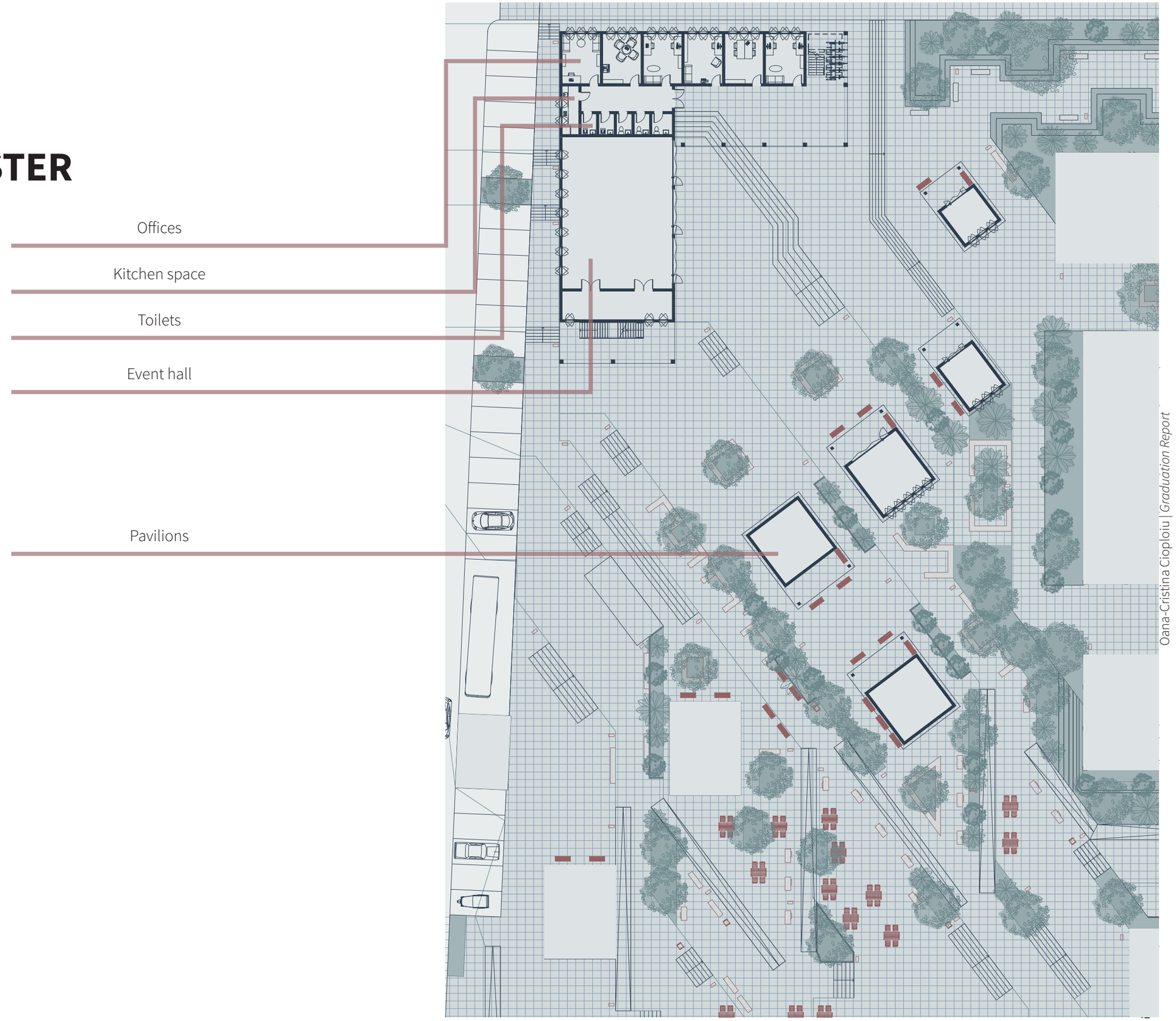
High-income group floor plans
Scale 1:200 on A1

PHASE I
COMMUNITY BOOSTER

Phase I has a community booster that strives to enforce the sense of community of the new residents. It is focusing mainly on the social aspect of interaction between different income groups, and offering spaces for activities that would strengthen these connections.

The main building is a neighbourhood center, which includes office spaces available for renting to organizations such as Mahila Milan. These could become important in spreading the reach of these organizations, many of which focus on improving the lives of women. The center also has space provided for an event hall, which could be used by the residents for gatherings or even celebrations.

Spread on the slope are pavilions, relatively small spaces that open up and spill on the area in front of them. These don't have a specific function, but are expected to change and adapt to accommodate the functions desired by the residents. The pavilions are used for small scale activities with people from all income groups, and become another area where they interact. These are part of the neighbourhood and are expected to be occupied by residents' clubs with a certain activity in mind, such as girls' dancing, women computer literacy workshops, and others as such.



Community booster ground floor plan
Scale 1:200 on A1

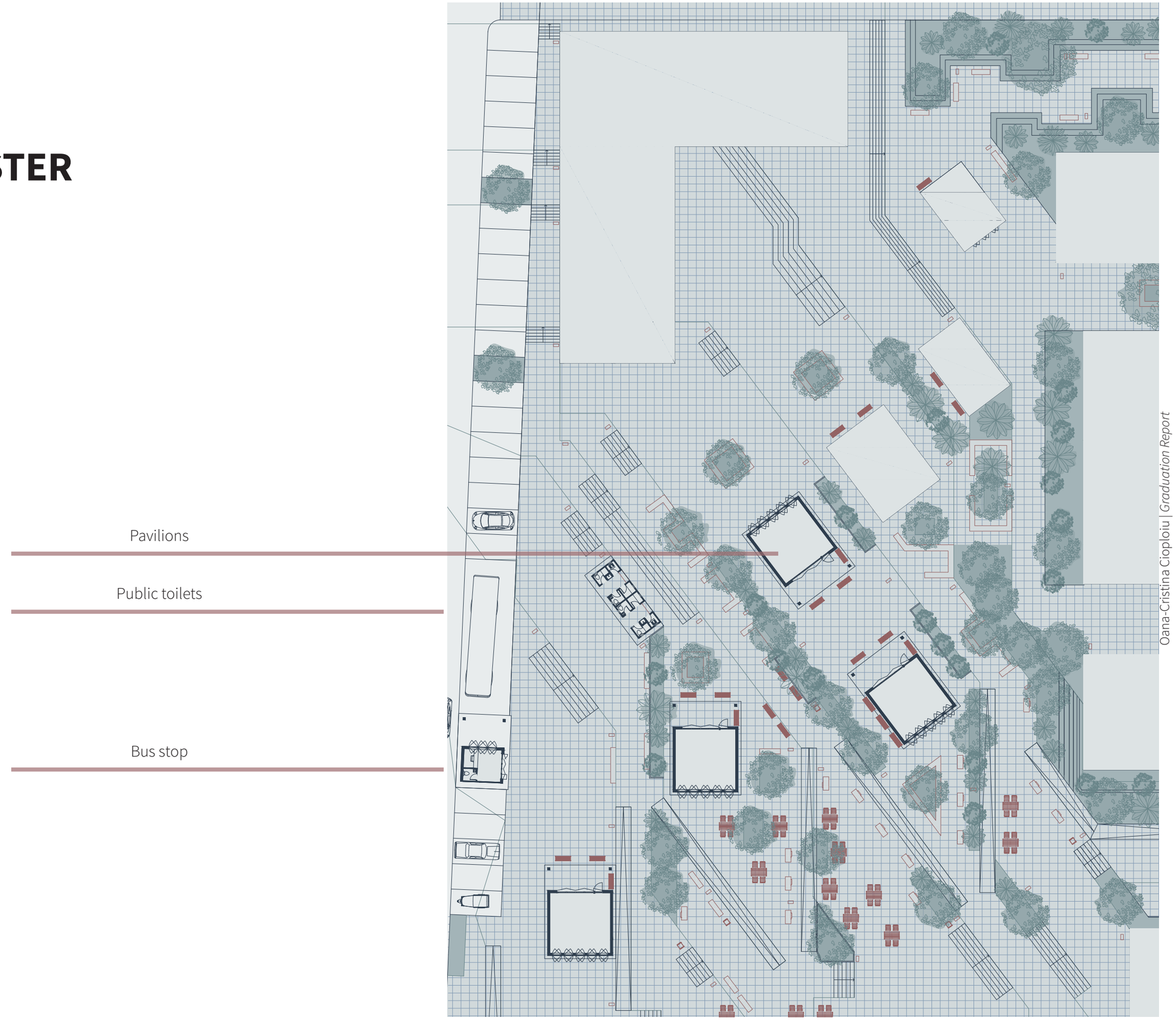
PHASE I
COMMUNITY BOOSTER

The community booster also offers public toilets in proximity to the new proposed bus stop. These offer equal provision between women and men, and also offer nursing area.

The first community booster serves as an entrance point to the neighbourhood, as well as a starting point to the green path. The green pedestrian path loops around the dwelling area, with two points of connection to the community booster.

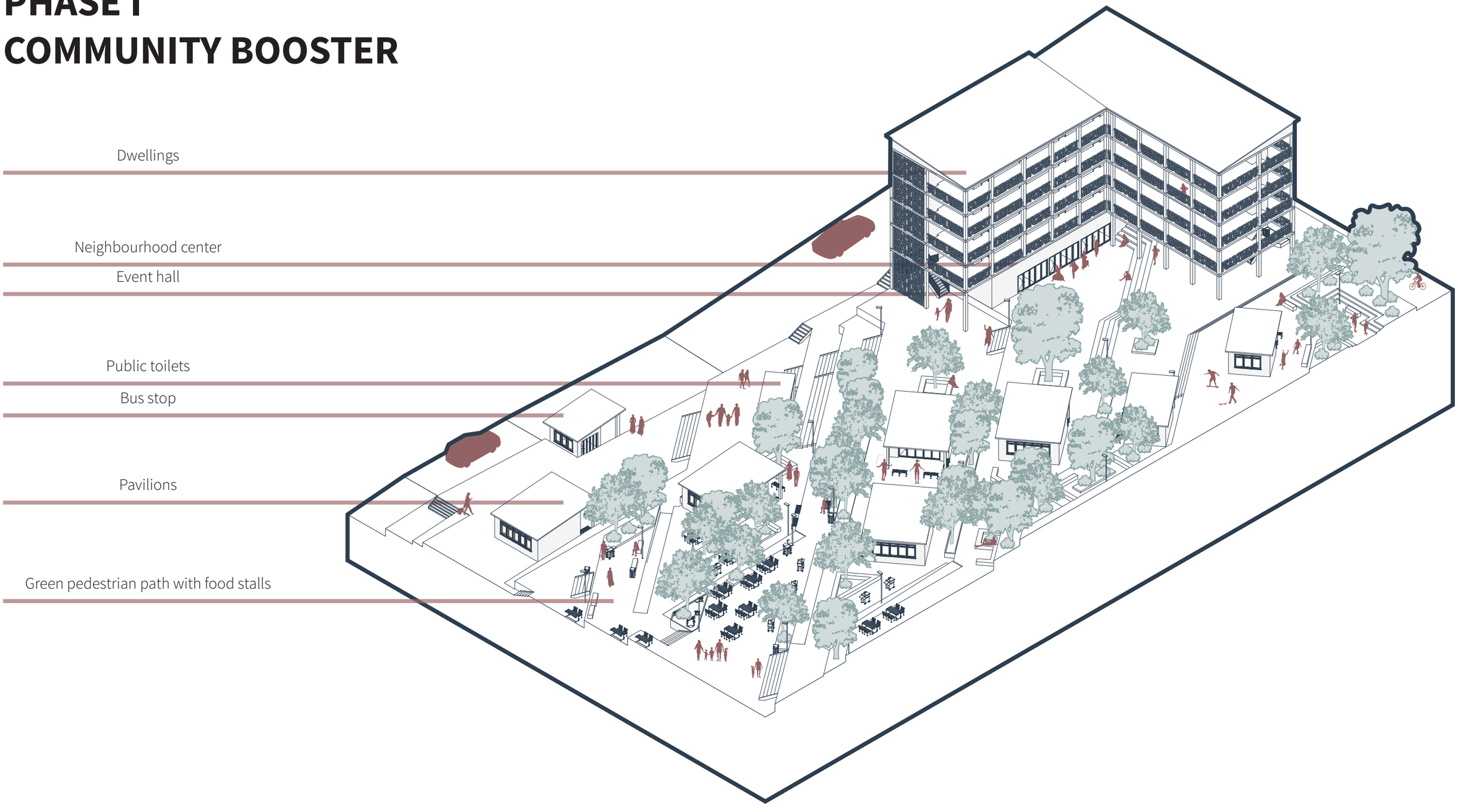
The first point of connection starts as an accessible route from the bus stop and navigates the slope with ramps between the High-income group tower and the pavilions. This area is populated by restaurants on the ground floor of the tower, and outdoor shaded areas are reserved for food and beverages stalls to be installed. Tables with chairs and bakdas (benches) are offered in the shade of the trees.

The other point of connection is at the neighbourhood center, with steps that double as seats leading down to the event hall and continuing towards the bus stop.



Community booster level -1 plan
Scale 1:200 on A1

PHASE I
COMMUNITY BOOSTER



Community booster axonometry
Not to scale

PHASE I
COMMUNITY BOOSTER

Community booster view

MANAGERIAL STRATEGY

Establishing the players with the most power and interest for a housing project in Navi Mumbai is going to depend on the land owners and main developers, CIDCO. Responsible for the majority of the developments addressing low-income population and slum rehabilitation, their projects often prioritize housing the large numbers, creating projects with high FSIs, little to no landscaping, and even poor serviced buildings, with toilet blocks for a few buildings. These practices can create unsafe environments for the residents, in particular women.

Despite all this, CIDCO is seen as the main developer of the proposed scheme, with additional funding from organizations targeting women safety. This decision was made as an influence for future practice. Mahila Milan or SPARC could be the involved organization, pushing for a more gender-sensitive approach, while CIDCO would contribute with the land. Together, they would bring the project to a start by initializing phase I.

The phased approach of the project insures that enough funding can be collected for a small portion to be properly executed and inhabited, establishing the base for a community to expand.

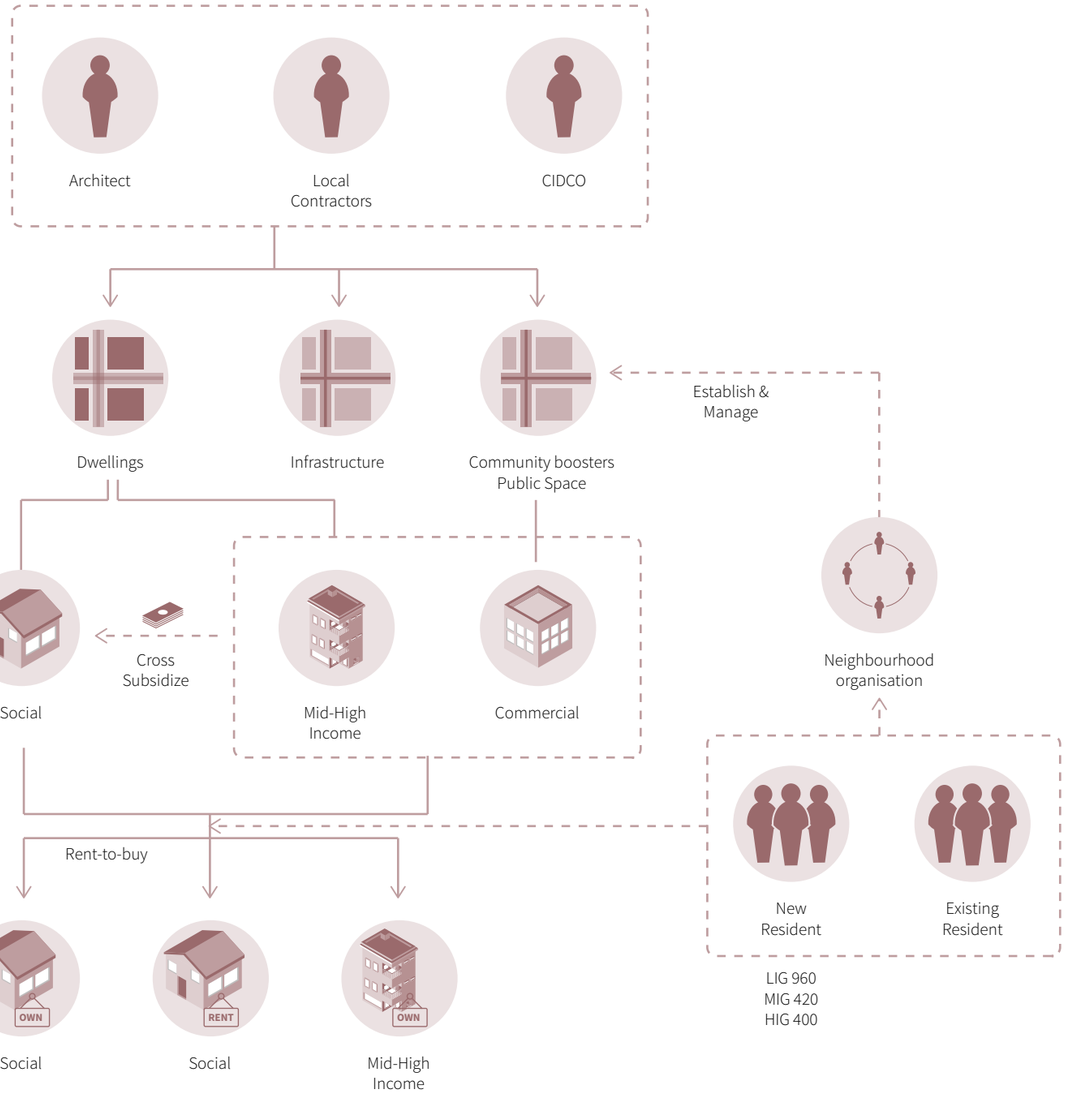
The existing residents from the four apartment buildings present on site are not directly impacted during the development and construction phase, but they are involved in the Neighbourhood Organisations formed to further develop and manage the neighbourhood.

Different construction methods were chosen for the components of the project. Low- and middle-income dwellings are housed in mid-rise buildings constructed with a load bearing method and locally produced materials. The tower typology for high-income residents uses concrete post and beam structure, allowing for the height and spacious rooms usually encountered.

As the construction methods differ, multiple local contractors can be employed to work at the same time for the project, having different timelines to completing their component of the project.

By using cross-subsidization, the social component (low-income dwellings) can be funded by the unit aquisition of middle- and high-income dwellings, as well as the commercial components included in the community boosters. The construction method of the high-income ensures a speedy delivery, to create the funding needed to complete the project.

The low-income dwellings can be rented or purchased through a rent-to-buy scheme. Middle- and high-income dwellings are to be purchased.



Managerial Structure Diagram

MANAGERIAL STRATEGY
PHASING

The managerial strategy is integrated with the design goal of social integration and interaction. The development aims to provide housing for all income groups and to encourage the creation of places where these inhabitants mix. The Phasing strategy is structured so that each phase has at the core a neighbourhood amenity. This will help fund some of the cheaper residencies being built in that phase. As such, each phase is growing from a nucleus, the community booster.

Each community booster is located at the intersection of the three income groups. They serve different purposes, evolving with the expansion of the neighbourhood, and by providing commercial spaces, they help to fund the low-income dwellings.

The first community booster of the development is a neighbourhood centre, which would serve as a headquarters for neighbourhood associations and would provide a gathering point for a community board.

Providing the flexibility for the community boosters was a main design decision. Their structures could be divided between multiple uses, and they would still be accessible to all income groups. For example, the Hindu temple already present on site is viewed as a way to bring a part of the community together, so it is used as a community booster. However, its land pocket can still be divided to include other uses, such as nursery, market or other shops.

Phase I

Neighbourhood centres
(main building and pavilions)
Associations Headquarters
Commercial spaces

Dwellings *(Low-, Middle-, and High-income)*

Phase II

Market
Commercial spaces

Dwellings *(Low-, Middle-, and High-income)*

Phase III

Hindu temple
Commercial spaces

Dwellings *(Low-, Middle-, and High-income)*

Phase IV

Educational *(nursery)*
Commercial spaces

Dwellings *(Low-, Middle-, and High-income)*

MANAGERIAL STRATEGY NEIGHBOURHOOD

Direct involvement of residents at all scales of the Neighbourhood Organisation allows them to have easy and direct impact on their surrounding environment.

50% women - 50% men division
The involvement of women in these organisational structures gives them power to influence the public environment, manage and care for their neighbourhood, and establish what activities take place and what amenities are included in the community boosters.

Neighbourhood Association
Formed of Neighbourhood Councils - representatives
Located in the Neighbourhood Centre
Decisions about infrastructure

Neighbourhood Council
All income groups
Located in the Neighbourhood Centre
Decisions and management of community booster and public space in the area

Neighbourhood Cluster
Small scale decisions and management of clusters
At least one for each income group (per phase)

Neighbourhood Committees
Located in the pavilions of the Neighbourhood Centre
Involved in training, providing services to the community
(such as Mahila Milan)

CONSTRUCTION

Sustainability is needed across the different levels of the project, from masterplan to cluster and building/ dwelling unit. This has been taken into account from the material choice, to the construction method, to the landscaping and buildings orientations.

The different income groups offer a wider variety of dwelling types and sizes, and thus the construction methods and materiality of these differ.

For the Low- and Middle-income groups, a load bearing strategy was used, being a cheap method of construction, while using local workforce. The materiality choice for these typologies lies on employing local workforce also at this level, in addition to choosing a main building material that is sustainable on its own.

For the High-income groups, considering the component of cross-subsidy and usual typology of tower, a post and beam construction is employed, using a concrete frame. This allows for these buildings to be finished quickly for each phase, providing the money flow needed to fund the social component.

CONSTRUCTION MATERIALITY

The material choice was informed from the desire to have the dwellings not plastered on the inside or outside for the low-income group. This quality is sought in Navi Mumbai, and one of the main reasons CIDCO chooses to develop its projects using a heavy concrete construction. For the proposed design, an alternative was sought that would allow the same outcome, un-plastered walls, but with a more sustainable material.

To improve the carbon footprint, minimize the environmental negative effects, involve more craftsmanship, and employ a cheap but durable material, bricks became the main material choice.

Compressed Earth Blocks (CEB) are made by compressing a mixture of soil of specific requirements using a hydraulic press, followed by a curing period to reach the full strength. For CEB, a soil containing Silt, Clay & Sand is used, mixed with water and if needed a stabilizer (cement, lime). The manufacturing process does not require burning, thus saving trees and not producing air pollution. CEB are affordable, durable and environmental friendly.

CEB will create a pleasant atmosphere in the dwellings and also allow for a cheap **load bearing** construction. The manufacturing process would use **local workforce** and create **job opportunities** in manufacturing and brick-laying. The soil type of Navi Mumbai is suitable for use in producing the compressed earth blocks, which allows for a local manufacturing process.

CEB can be stabilized or not, depending on the quality of the soil available and the height and spans of the final construction. The blocks can be shaped to provide interlocking edges, and thus reducing the quantity of mortar needed for bonding.

The height of 4-5 floors proposed implies the use of **Stabilized CEB**. These can be stabilized with cement or lime. The percentage of either needs to be determined after a careful analysis of the soil available as raw material. Typically, a percentage of 6-9 % Portland cement is employed. Once stabilization agents are added to the mixture, the blocks become water-resistant, eliminating the need for water-proofing.

1.

2.

School complex, Levs Architecten

CONSTRUCTION MATERIALITY

Several brick options were analyzed to determine a suitable choice for the project.

The main criteria for choosing SCEB was the aesthetic qualities it would bring to the project, left without plastering. As mentioned before, CIDCO often uses full concrete walls that are directly painted, in an effort to avoid plastering, while also providing a cheap material that performs well thermally and for sound-proofing.

Another criteria was employing a social component and creating job opportunities, both in creating the bricks and laying them.

Finally, the possibility of using soil from Navi Mumbai offered an additional layer of sustainability, by reducing cost and pollution from transport.

Advantages of CSEB:

Inexpensive
Energy efficient (Firing not needed)
Sound-proof
Locally-produced
Creating employment opportunities

Specifications

	Size:	*Compressive strength:*	*Water absorption:*
1.	*190 x 90 x 40 mm* *230 x 110 x 70 mm*	*100 kg/cm²*	*<15% by weight*
2.	*230 x 115 x 75 mm*	*75 - 150 kg/cm²*	*12-18%*
3.	*230 x 115 x 75 mm*	*93 kg/cm²*	*14%*
4.	*230 x 115 x 75 mm*	*80 - 150 kg/cm²*	*8-10% by weight*
5.	**220 x 115 x 115 mm** **235 x 235 x 140 mm**	**50 - 100 kg/cm²**	**5-7% by weight**
6.	*300 x 200 x 150 mm (solid)* *400 x 200 x 150 mm (hollow)*	*40 - 150 kg/cm²*	*<10% by weight*

1. Burnt Clay Bricks

Pros
- Good heat insulation
- Cost efficient material
- Low maintenance cost
- Reusable and durable
- Resistant to fire and pests

Cons
- Heavy construction material
-High construction cost
- Emissions from kilns

2. Clay Fly ash Burnt Bricks

Pros
- Un-burnt carbon present in fly ash helps reducing fuel consumption
- Less reduced emissions from kilns
- Reduction in weight
- Better thermal insulation

Cons
- Slow Strength Gain
- High-quality fly ash needed
- Longer Setting Times

3. Marble Slurry Bricks

Pros
- High volume utilization of waste
- Stronger than clay bricks
- High load bearing capacity
- Plastering can be avoided
- Good heat and sound insulation
- Less consumption of mortar

Cons
- Cement needed

4. Fly ash-Sand-Lime-Gypsum Bricks

Pros
- Reduced water absorption and shrinkage
- Reduction in mortar consumption
- Utilization of industrial wastes (ashes/sludges) and volcanic ash
- Absorb less heat than clay bricks
-Low cost material

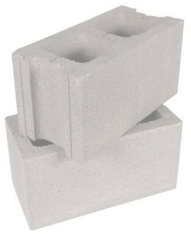
Cons
- High-quality fly ash needed
- Longer Setting Times
- Poor Air Content Control

5. Compressed Earth Blocks

Pros
- Energy efficient, environment friendly
- Manufacturing can be done on site or near the raw material source (lower transport cost)
- Minimum quantity of mortar needed for interlocking blocks
- Improved performance because of less number of joints
- Use of marble powder / stone dust possible

Cons
- Protection may be needed from rain/wind

6. Solid/Hollow Concrete Blocks



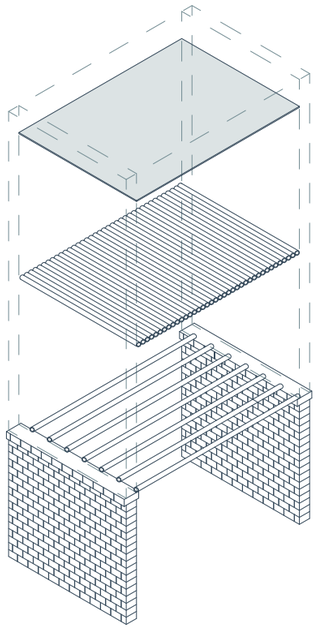
Pros
- Cost effective
- Simple manufacturing process
- Use of industrial waste (Fly Ash, Blast Furnace Slag)
- Less consumption of mortar

Cons
- Use of concrete

CONSTRUCTION MATERIALITY

The loft space of the low-income group dwellings has a light structure. Bamboo is used for this, with two pole layers under a bamboo mat.

The bottom pole layer sits on 5cm protruding CSEB on both sides. It is connected to the above pole layer using a square lashing technique.



Loft structure axonometry
Not to scale

1.

2.

Earthen School Tipu Sultan Merkez
Roswag Architekten

Corrugated Bamboo Roofing Sheets are used as roofing material, over a bamboo structure .

Woven bamboo mats are treated with an adhesive resin and passed through a hydraulic press. This shapes them as a wavy sheet, suitable for roofing.

Corrugated Bamboo Roofing Sheets are environmentally friendly, and because they are made of bamboo mats, they create labour opportunities. Compared to the conventional metal or plastic sheets, they are quieter in the rain and cooler in the sun.

1.

2.

Bamboo Farm Office
Ingvartsen Arkitekter

CONSTRUCTION MATERIALITY

For flooring finishes, quarry tiles and ceramic tiles are used.

Quarry tiles are suitable for indoor and outdoor use, durable (hence standing up well to high traffic), and non slip-able. It resists spills and moisture well, making them a good match especially for outdoor corridors, where rain is expected, and heavy traffic is involved. Being more expensive than ceramic tiles, they are proposed only for the outdoor corridors.

For the dwellings, ceramic tiles are used throughout the units.

1.

2.

Quarry tiles
Ceramic tiles

MATERIALITY *OTLA*

Originally used as a threshold, the *otla* is a transitional space between the public realm and the private environment, the dwelling. It is a space for social interaction.

For women, the *otla* space is more than just a threshold, it is an extension of their living spaces outdoors.

Few modern projects still employ the *otla*. Its lack can be seen especially in slum projects where women group to work or chat on makeshift steps outside their houses.

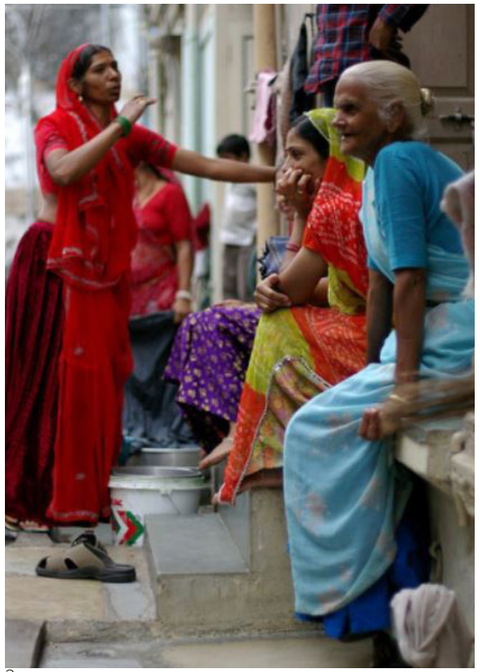
For the low-income group dwellings, the *otla* is seen as a semi-private area, a space in which the first social connections are made.

For its materiality, the *otla* was traditianally constructed with rendered bricks or masonry, and heavily embelished in old examples.

More recently, where the *otla* is used, it is laid bare of decorations, and uses mostly exposed concrete.

For the proposed project, the *otla* uses exposed compressed earth blocks and ceramic and quarry tiles, creating a warm atmosphere.

1.



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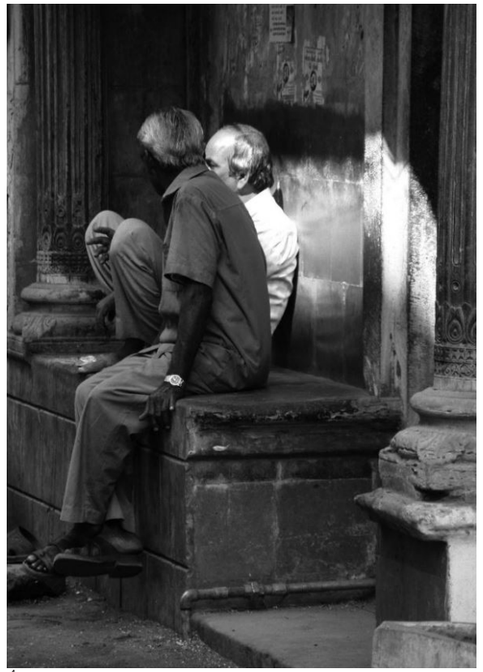

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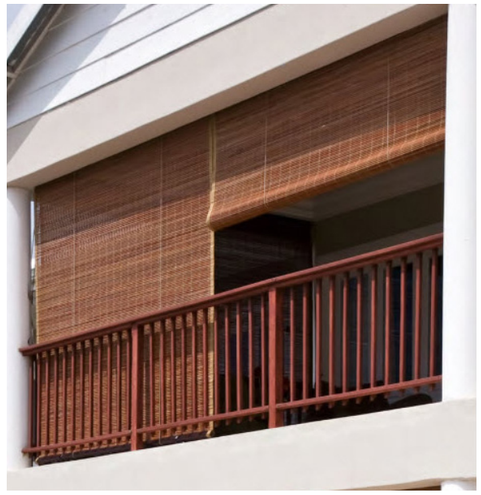
Traditional *otla* space
Typical materiality
Rendered bricks or masonry

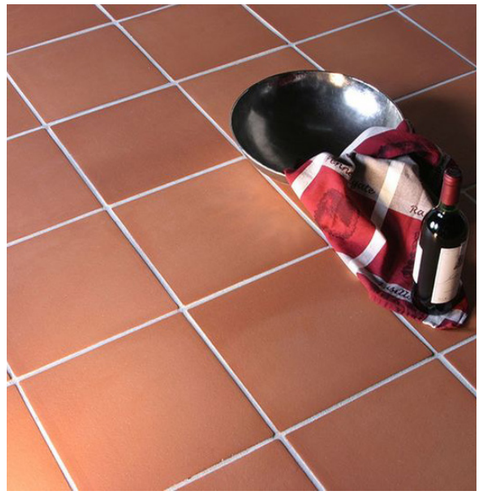
Modern *otla* space
Materiality
Exposed concrete

1 Compressed Earth Bricks

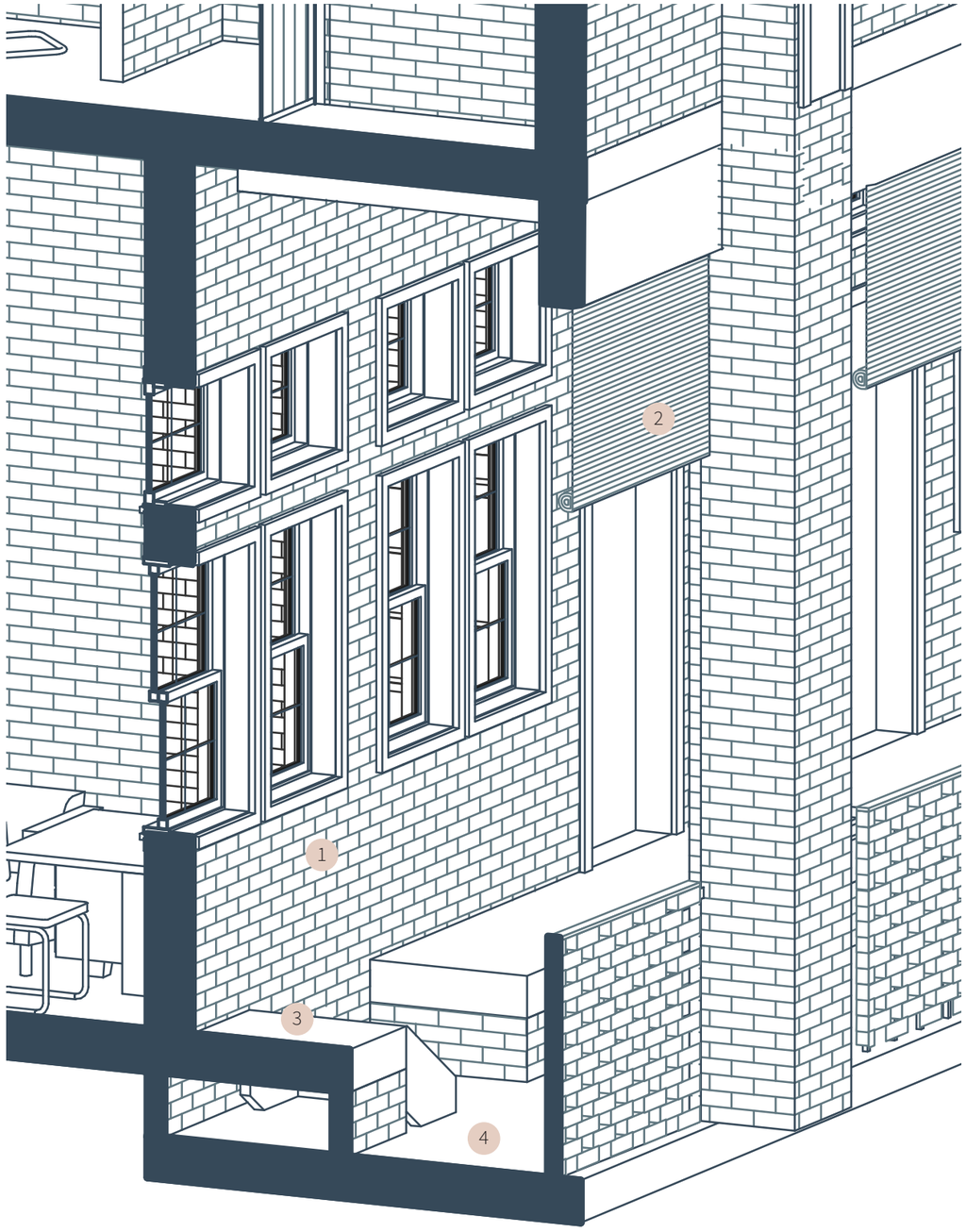


2 Bamboo shading

3 Ceramic tiles



4 Quarry tiles

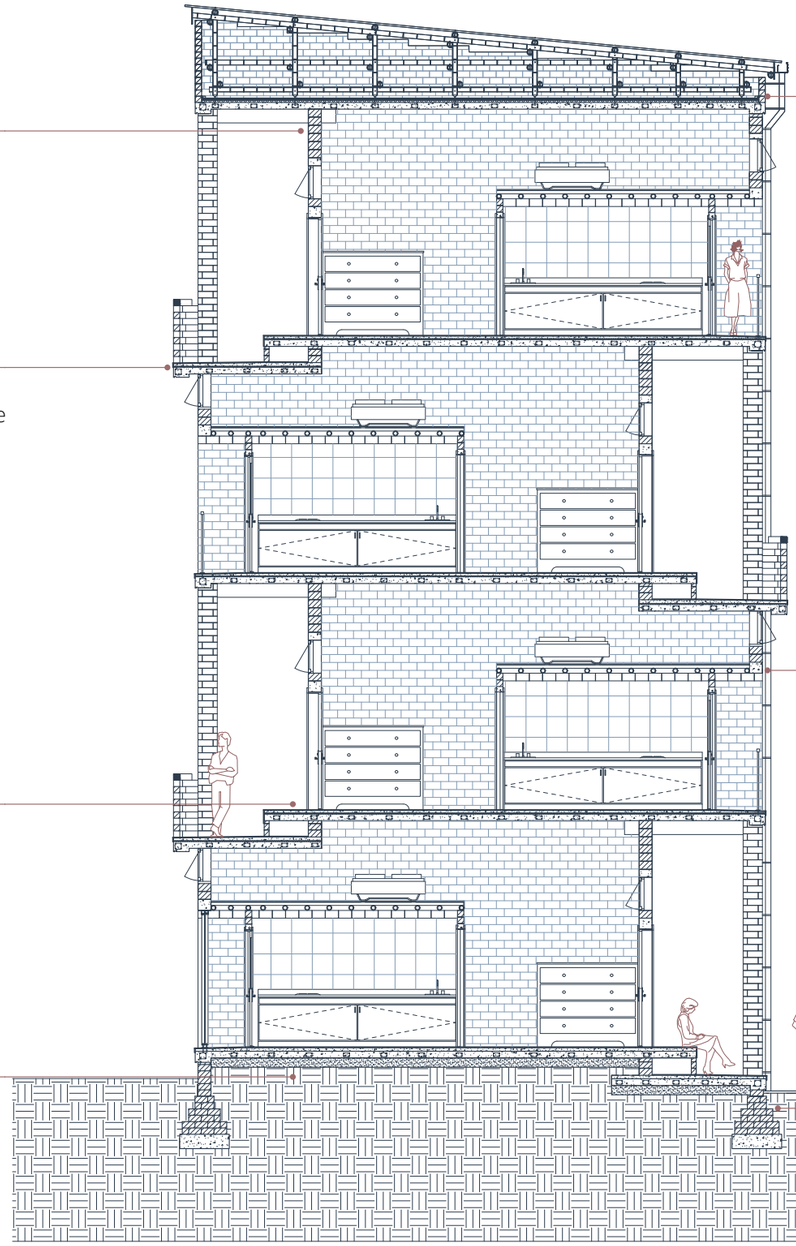


Proposed *otla* space

CONSTRUCTION SECTION

400x200x2300mm Concrete beam
235x140x140mm SCEB
140mm Lintel
600mm uPVC window
200mm Concrete lintel
uPVC Door

SCEB ballustrade with limestone top
200mm embeded beam with drip edge



Corrugated bamboo roofing sheets
100mm Bamboo posts, purlins and rafters
Metal gutter and drain
Fascia Board
Screed
Extruded Polystyrene Insulation
Damp-proof membrane
120mm Reinforced concrete slab

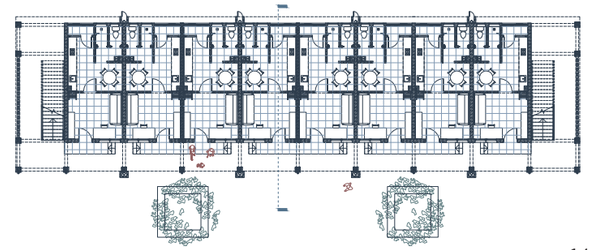
600mm uPVC window
235x140x140mm SCEB
200mm Concrete lintel
20mm Bamboo floor finish
60mm Bamboo
90mm Bamboo
115x230x115mm SCEB

120mm Reinforced concrete slab
Embedded beam w drip edge
Brick foundation
260mm Concrete footing

15mm Ceramic tiles finish
45mm Screed
20mm Extruded Polystyrene Insulation
120mm Reinforced concrete slab

15mm Ceramic tiles finish
45mm Screed
120mm Reinforced concrete slab
Waterproof membrane (plastic)
170mm Sand

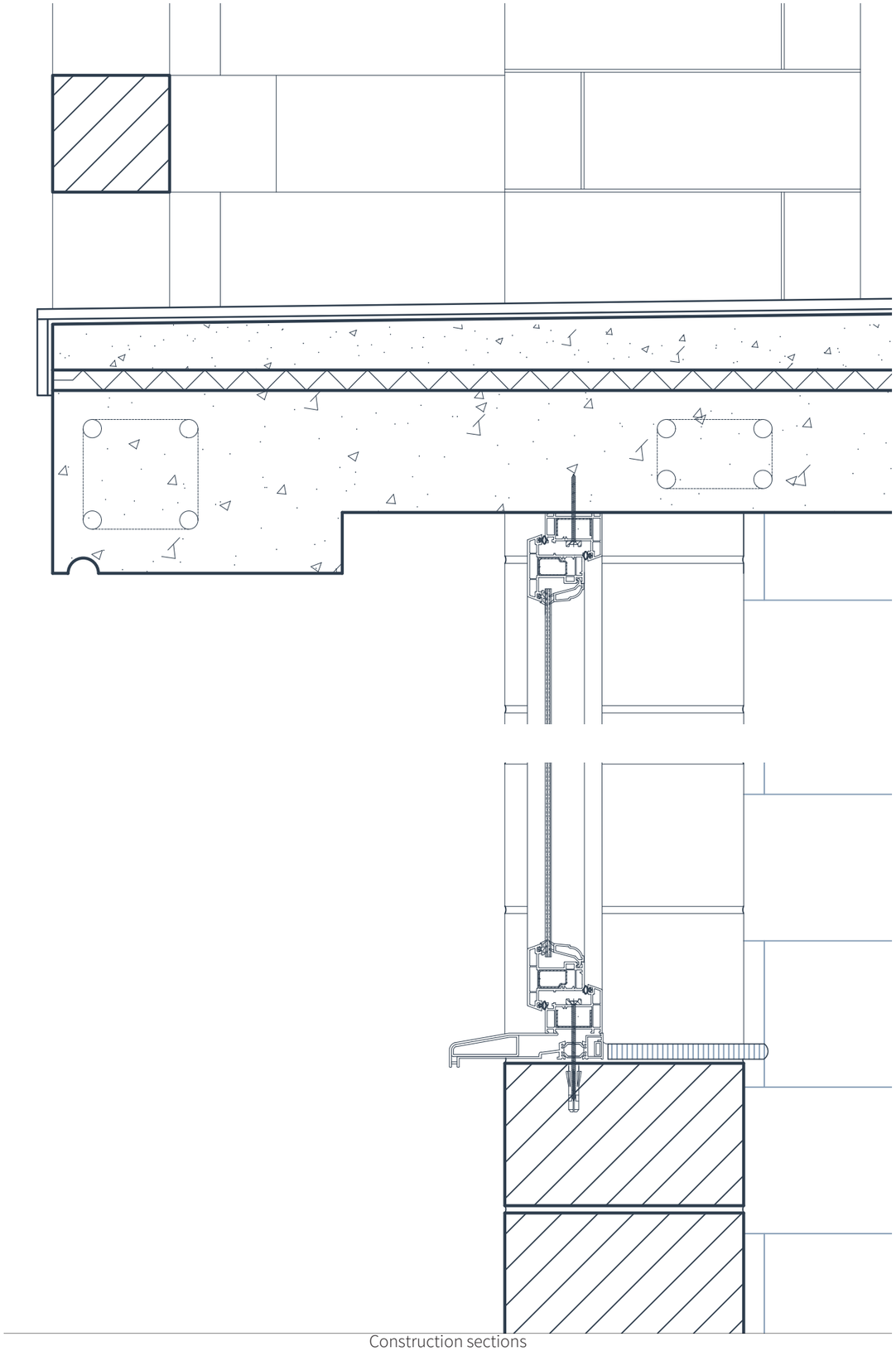
Border typology section
Scale 1:50 on A1



CONSTRUCTION DETAILS

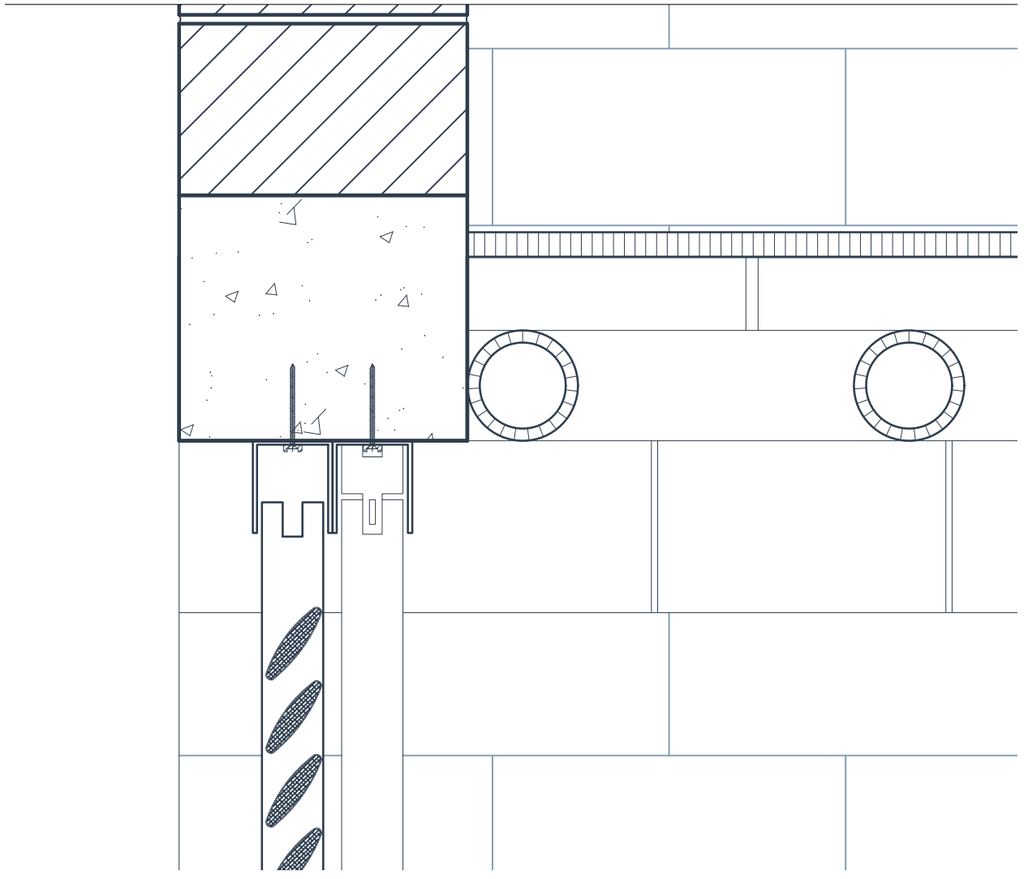
15mm Ceramic Tiles Finish
45mm Screed
20mm Insulation
120mm Reinforced Concrete Slab
200mm Embedded Beam with Drip Edge
uPVC Window Frame

235x 235x 140 SCEB (stabilized compressed earth block)
Bamboo sill (inside)
uPVC Window Frame with Aluminum sill (outside)



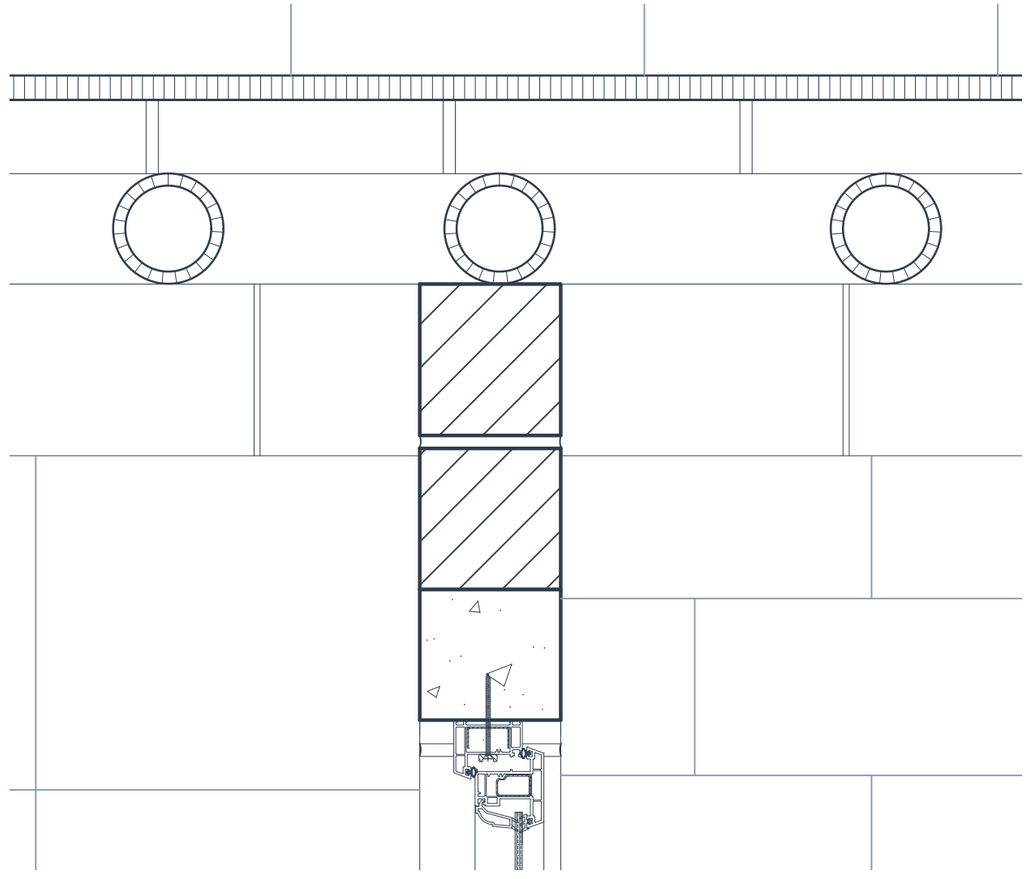
Construction sections
Scale 1:5 on A4

CONSTRUCTION DETAILS



200mm Concrete Lintel
Metal Louvres
20mm Bamboo Mat Finish
60mm Bamboo structure
90mm Bamboo structure

Construction section
Scale 1:5 on A4



20mm Bamboo Mat Finish
60mm Bamboo structure
90mm Bamboo structure
115x 230x 115mm SCEB
100mm Concrete Lintel
uPVC Door

Construction section
Scale 1:5 on A4

CONSTRUCTION DETAILS

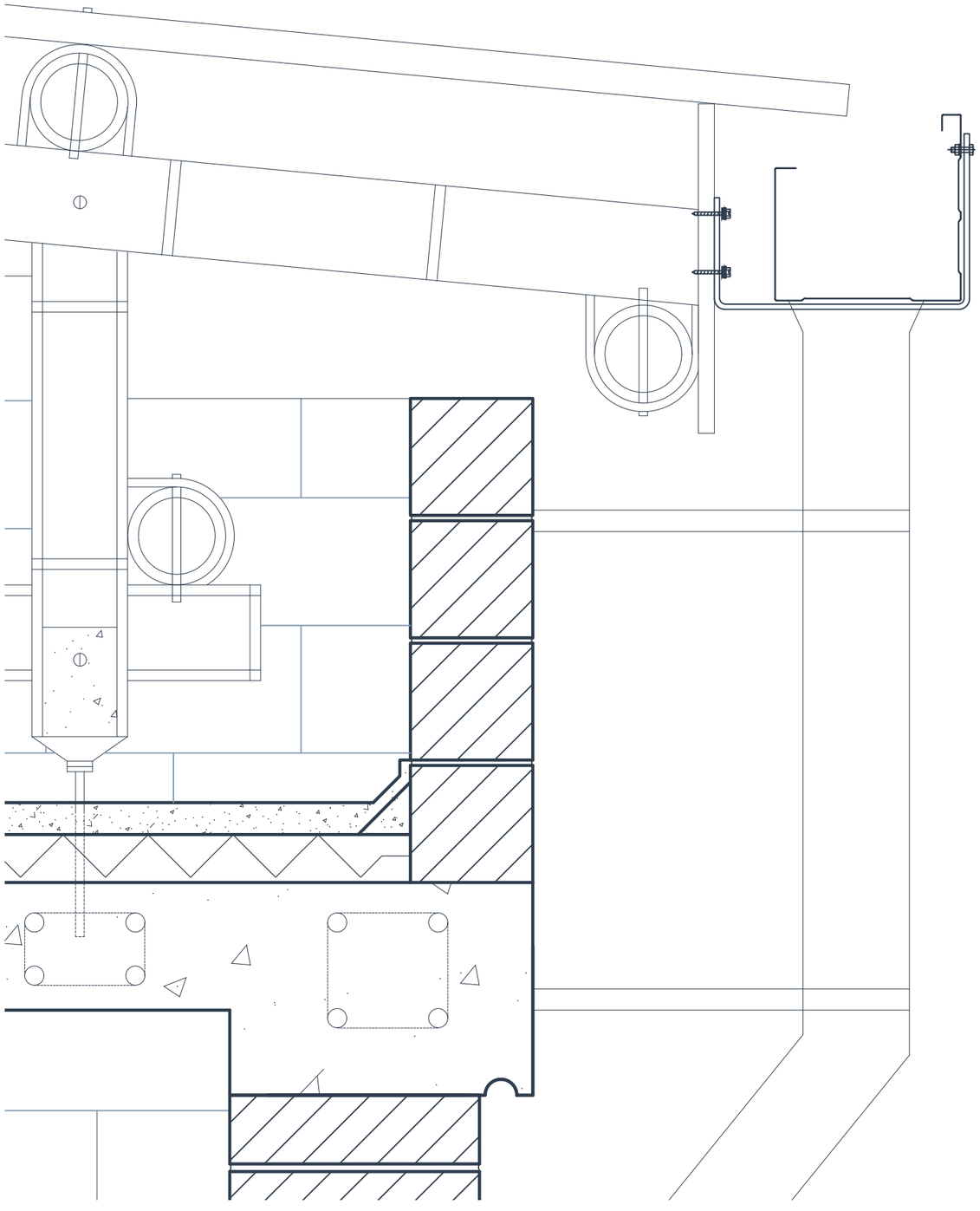
The connection between the bamboo roof structure and the reinforced concrete slab is made using steel bolts and steel anchors attached to the reinforcement of the slab.
The bamboo pole has cement mortar filling and threaded bars to provide secure connection to the steel elements.

Threading and lashing are used for creating a secure connection between the bamboo poles of the structure.

1.

Playa Man, Shade Shelter
The Scarcity And Creativity Studio (SCS)

Corrugated Bamboo Roofing Sheets
100mm Bamboo Posts, Purlins, Rafters secured with steel bolts with cement mortar filling
Metal Gutter and Rain Pipe
Fascia Board
115x 230x 115mm SCEB
30mm Screed
45mm Insulation
Damp-proof membrane
120mm Reinforced Concrete Slab

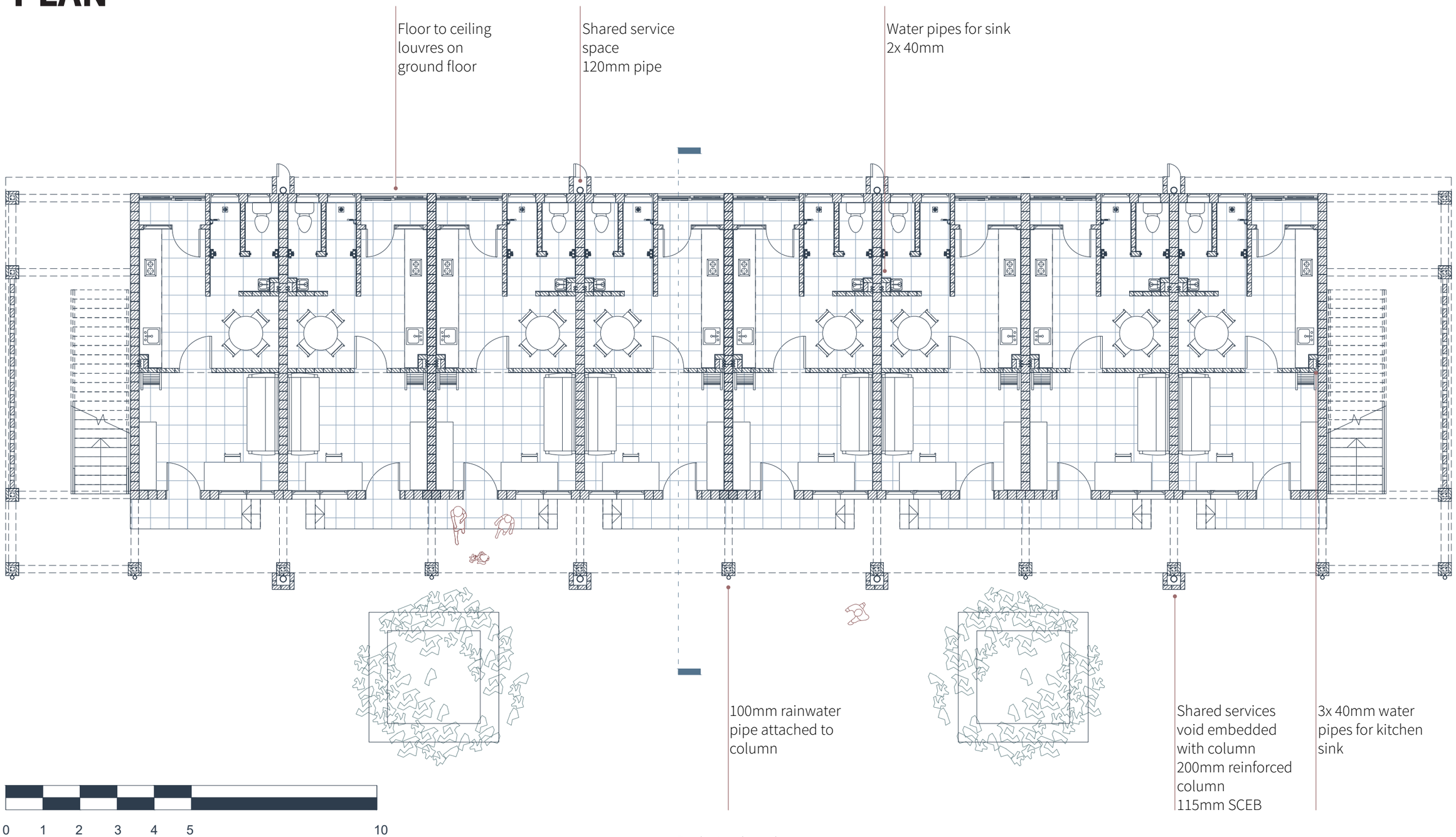


Construction section
Scale 1:5 on A4

CONSTRUCTION ELEVATION

Border typology elevation
Scale 1:50 on A1

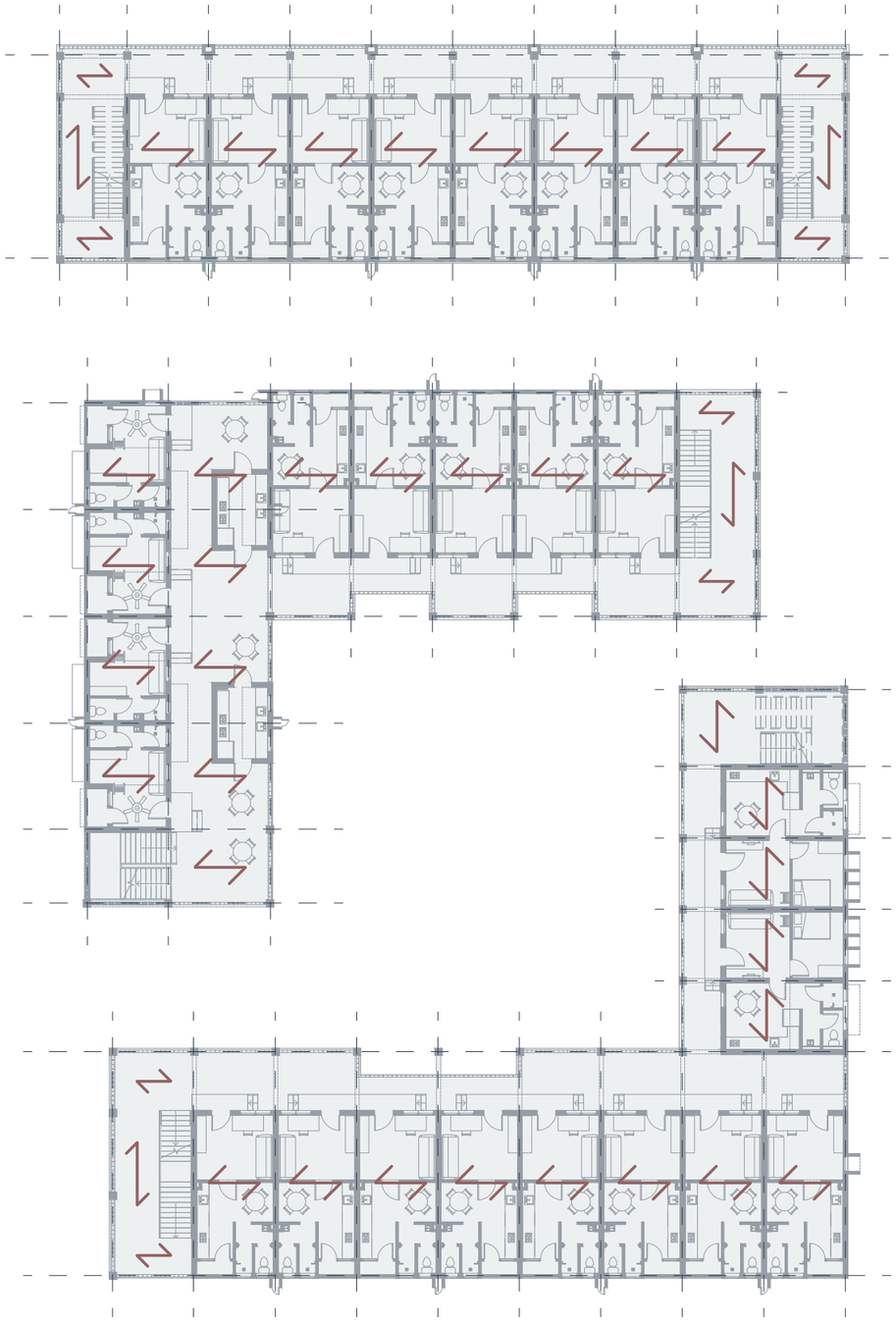
CONSTRUCTION PLAN



Border typology plan
Scale 1:50 on A1

CONSTRUCTION PLAN

The spans for the low-income group buildings are 4 or 5 metres.

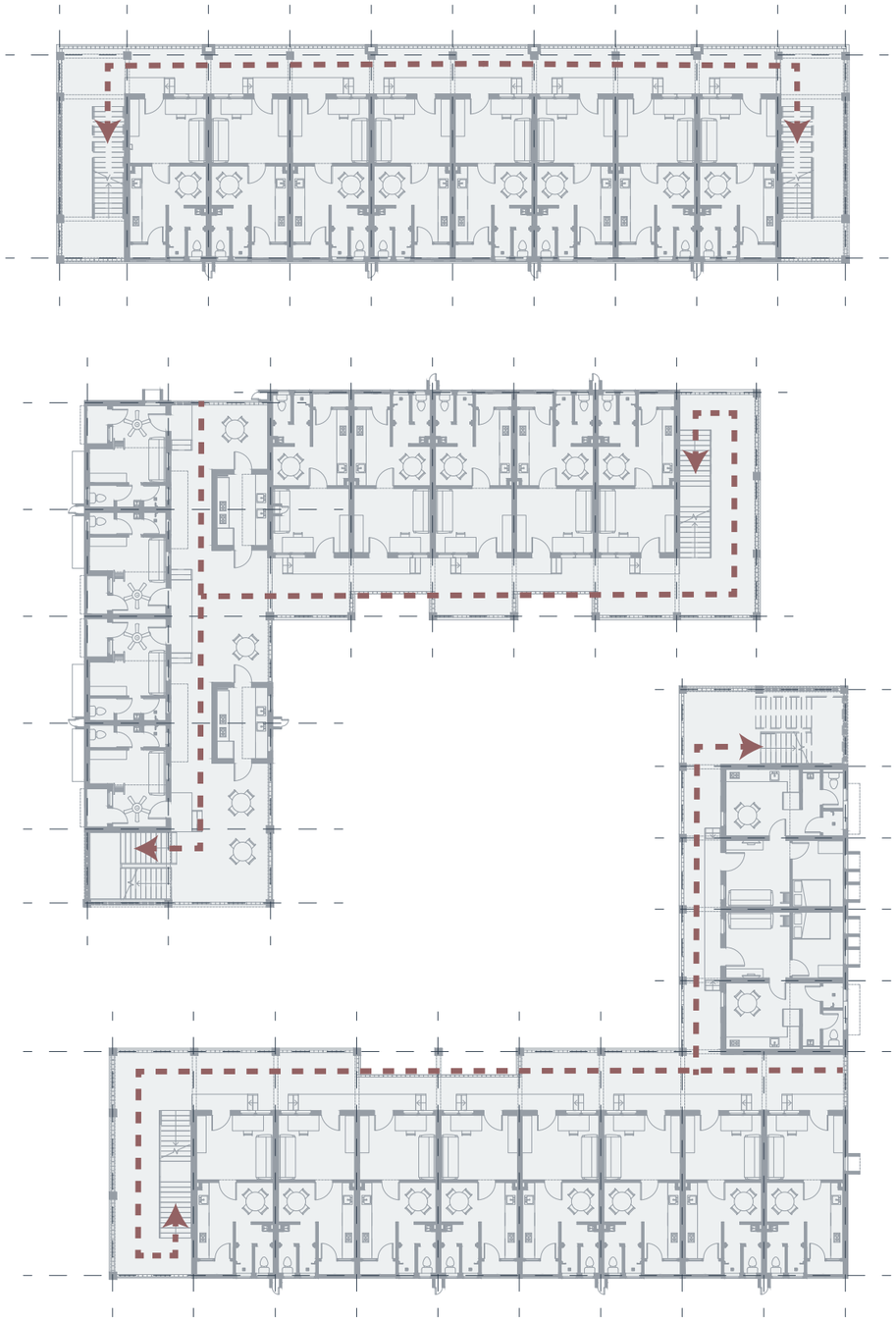


Low-income group cluster-Spanning plan, first floor
Scale 1:200 on A1

CONSTRUCTION ESCAPE PLAN

Each building has 2 escape routes, connected to outdoor corridors.

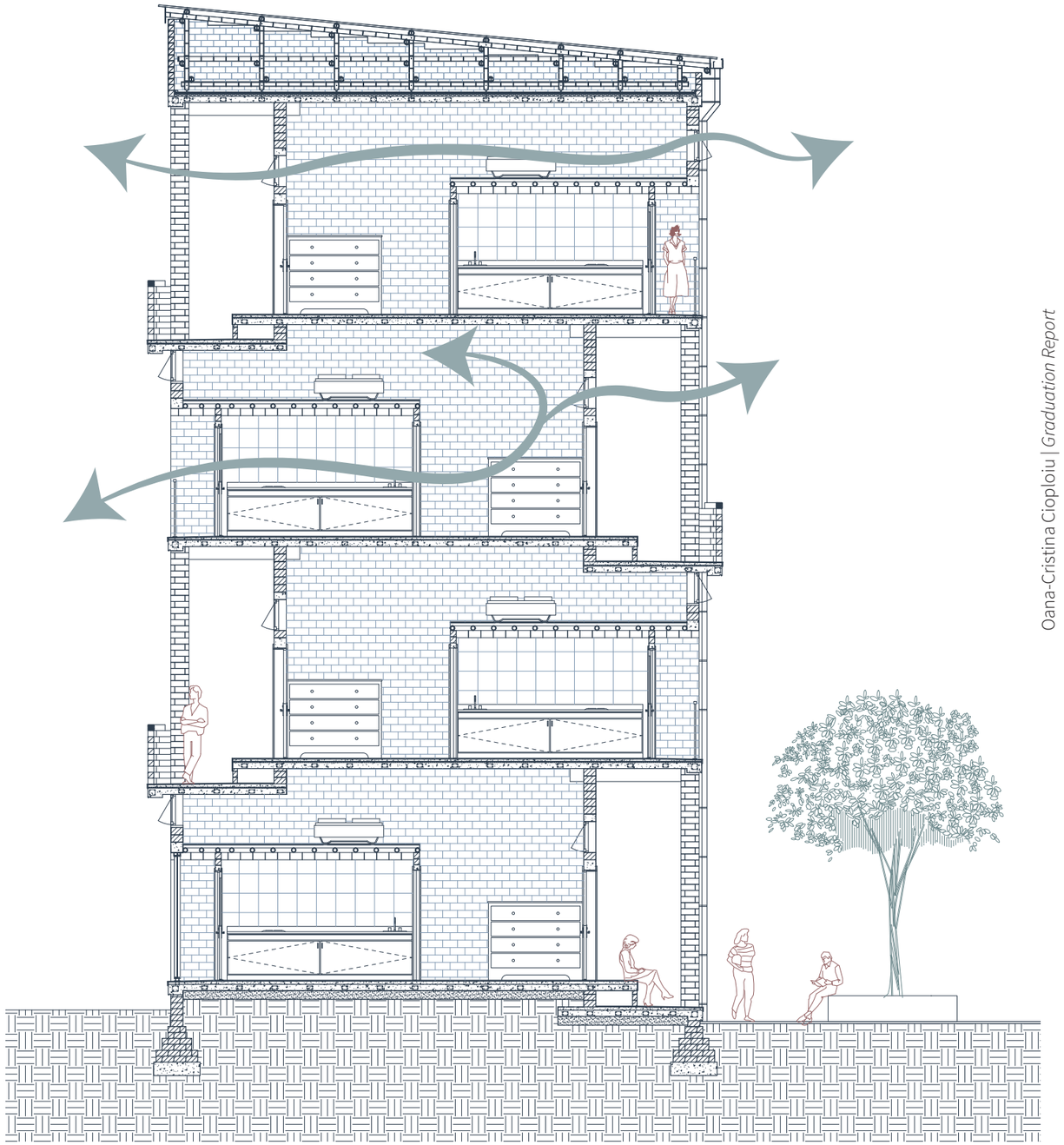
The width of the stairs is 1.5m, according to the Indian building regulations.



Low-income group cluster-Escape plan, first floor
Scale 1:200 on A1

CONSTRUCTION
CLIMATE | VENTILATION

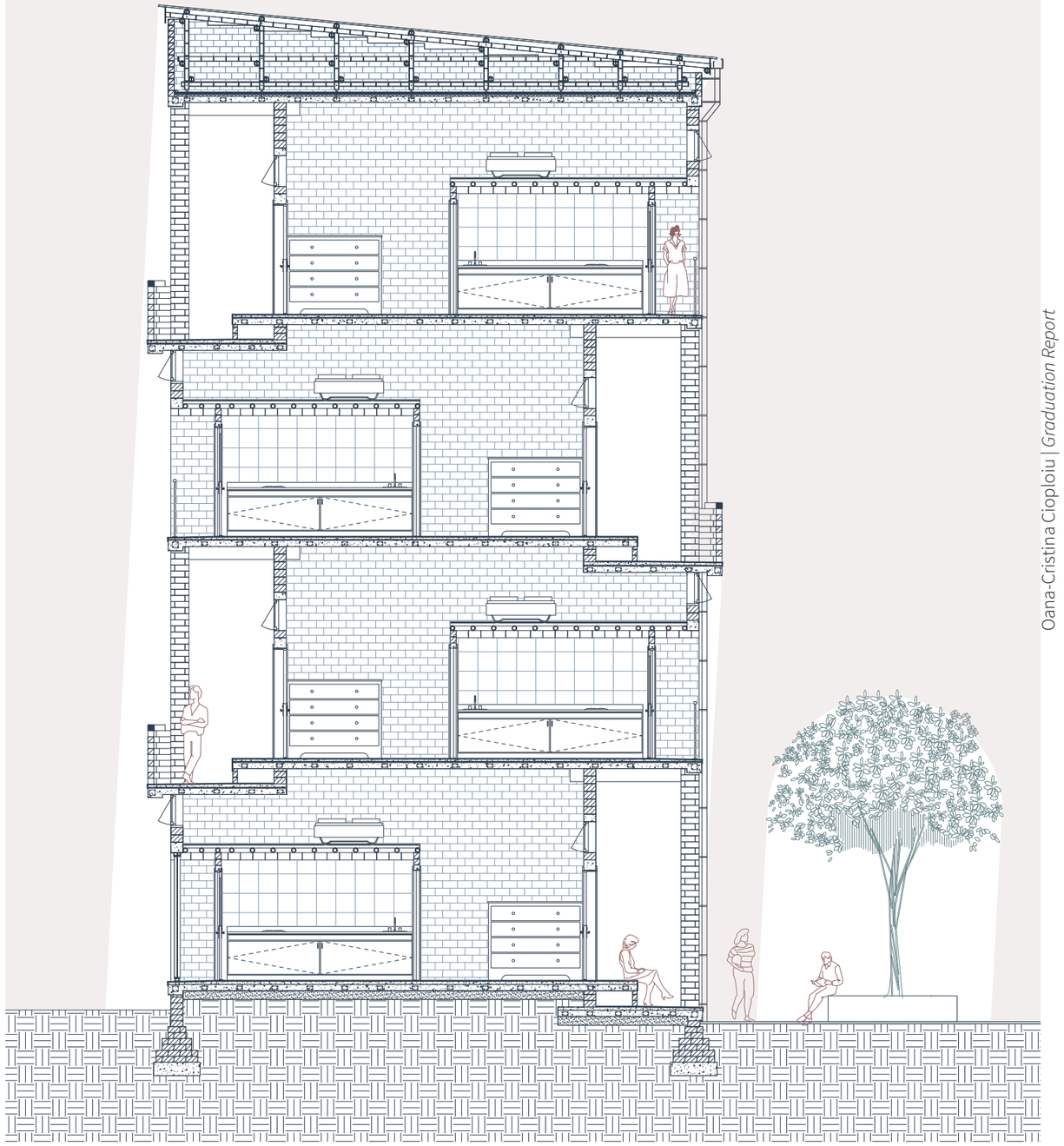
Cross ventilation is a priority in all dwellings. The low-income typologies have open facades on two sides,to promote ventilation. Moreover, these windows are doubles with windows higher in the wall, on the loft level. This will ensure a comfortable ventilation no matter the activities happening inside.



Border typology section, air cilrulation
Scale 1:50 on A1

CONSTRUCTION
CLIMATE | SUN

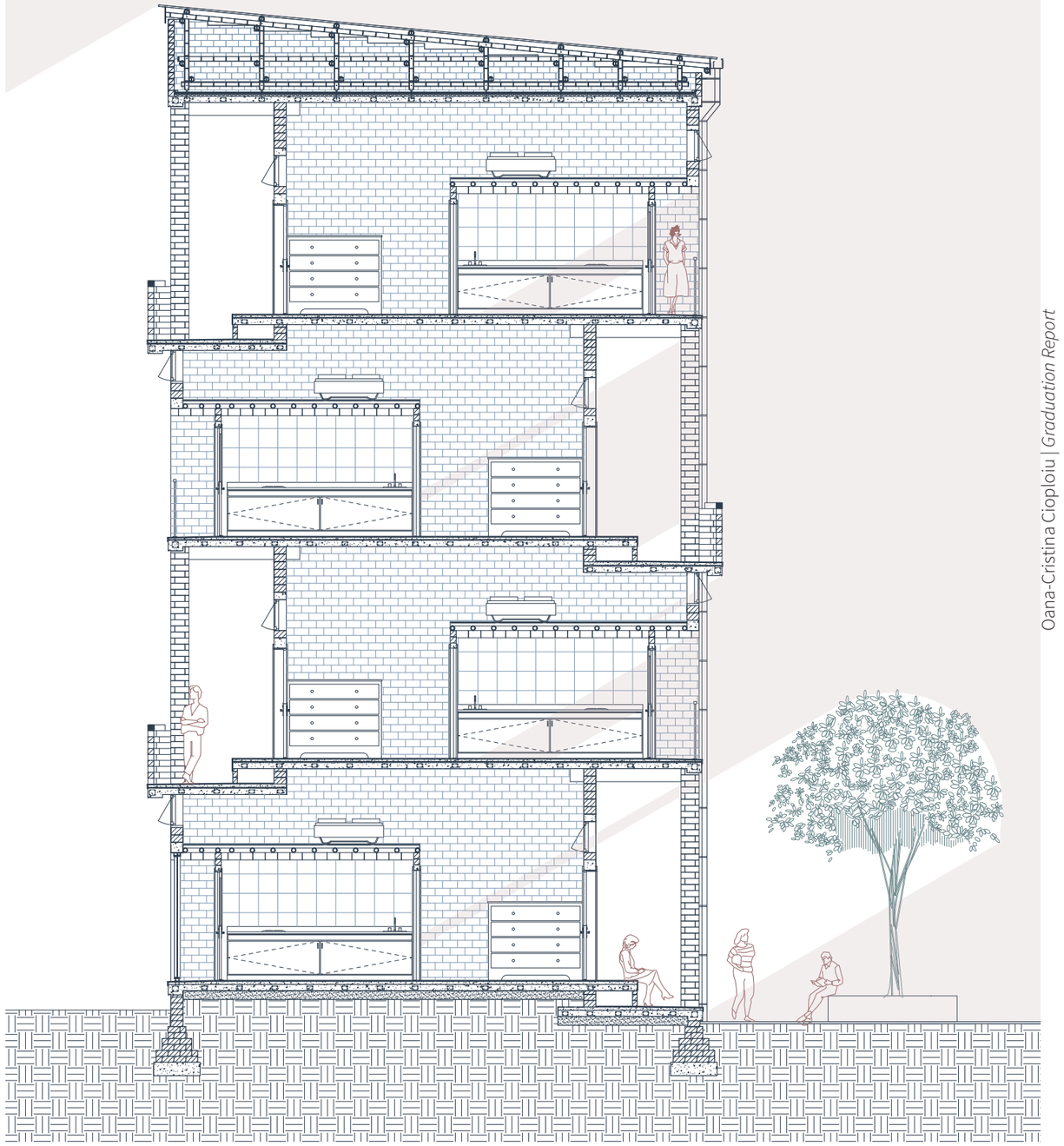
Summer sun exposure



Border typology section, sun exposure
Scale 1:50 on A1

CONSTRUCTION
CLIMATE | SUN

Winter sun exposure



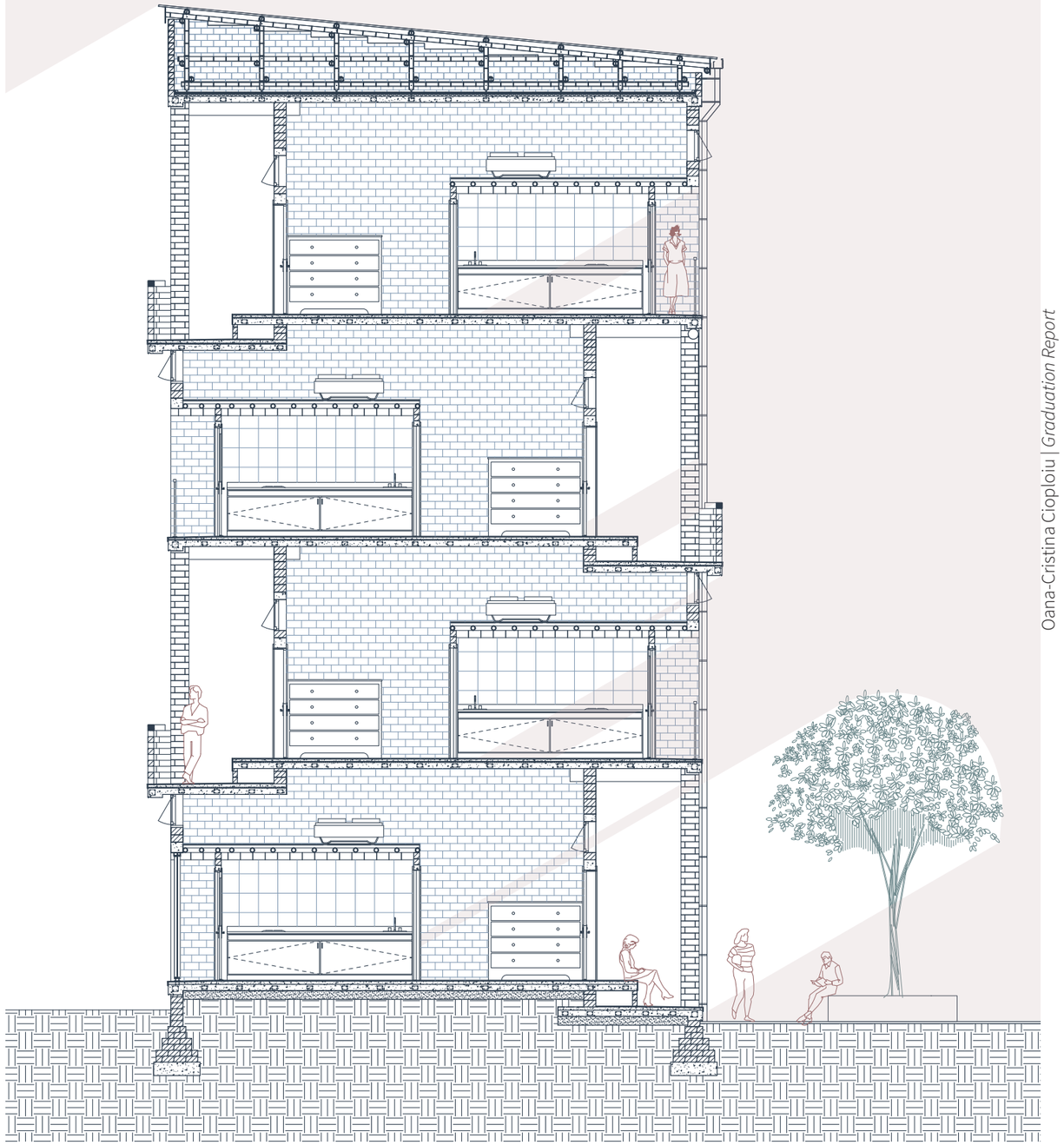
Border typology section, sun exposure
Scale 1:50 on A1

CONSTRUCTION
CLIMATE | SUN

Winter sun exposure

Additional shading is offered for better protection during the summer sun.

These bamboo roller blinds are user-operated, for a comfortable environment.

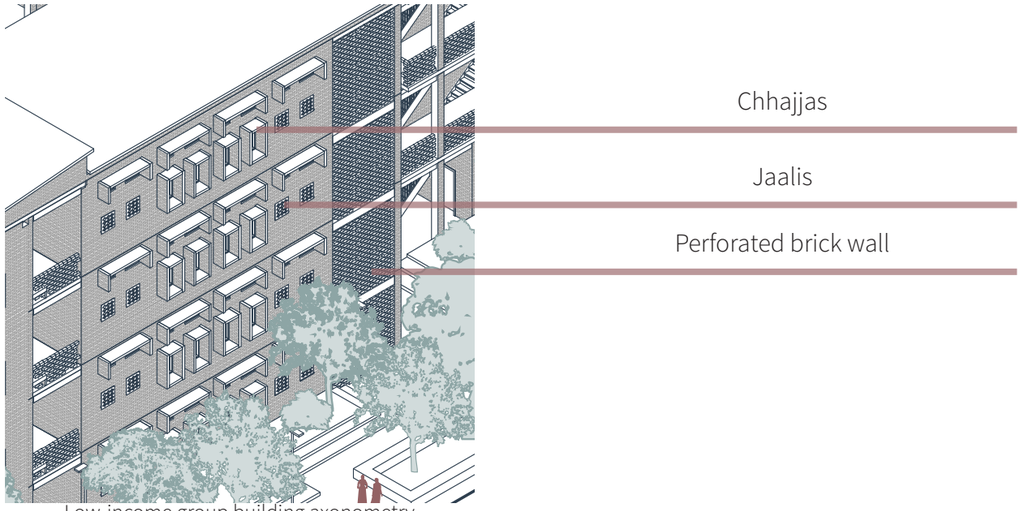


Border typology section, sun exposure
Scale 1:50 on A1

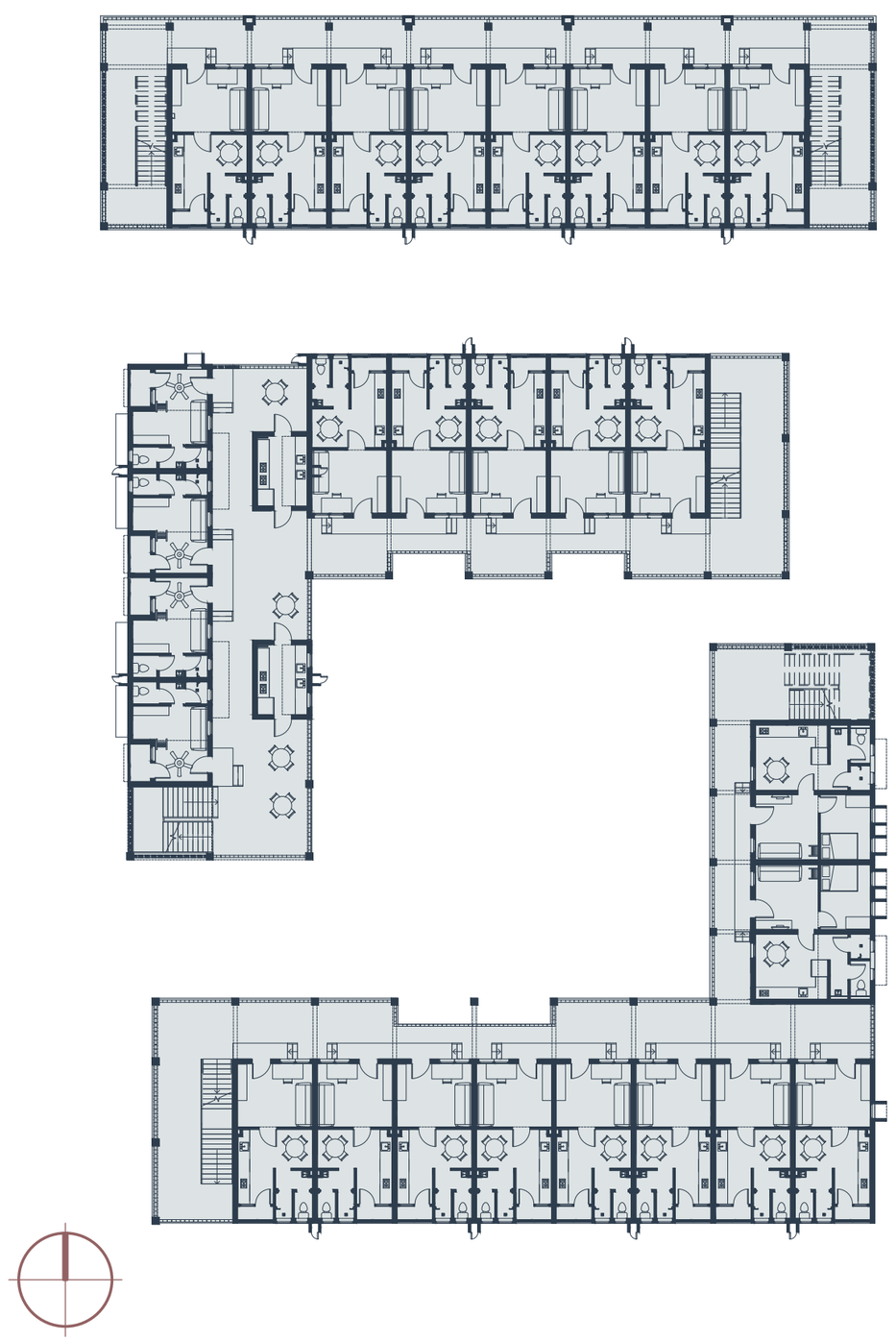
CONSTRUCTION
CLIMATE | SUN

Taking into account the position of the site, for better climate control within the buildings, an orientation of South-North is preferred. Most of the dwellings use this orientation, with just two short wings facing East-West.

Shading is provided accordingly to the cardinal point the facade is facing, with overhangs for the South and a combination of overhangs, vertical shading and perforated brick walls for the parts facing East and West. As previously mentioned, the project also uses traditional Indian shadings, such as chhajjas and jaalis for shade and privacy for the bathroom windows.



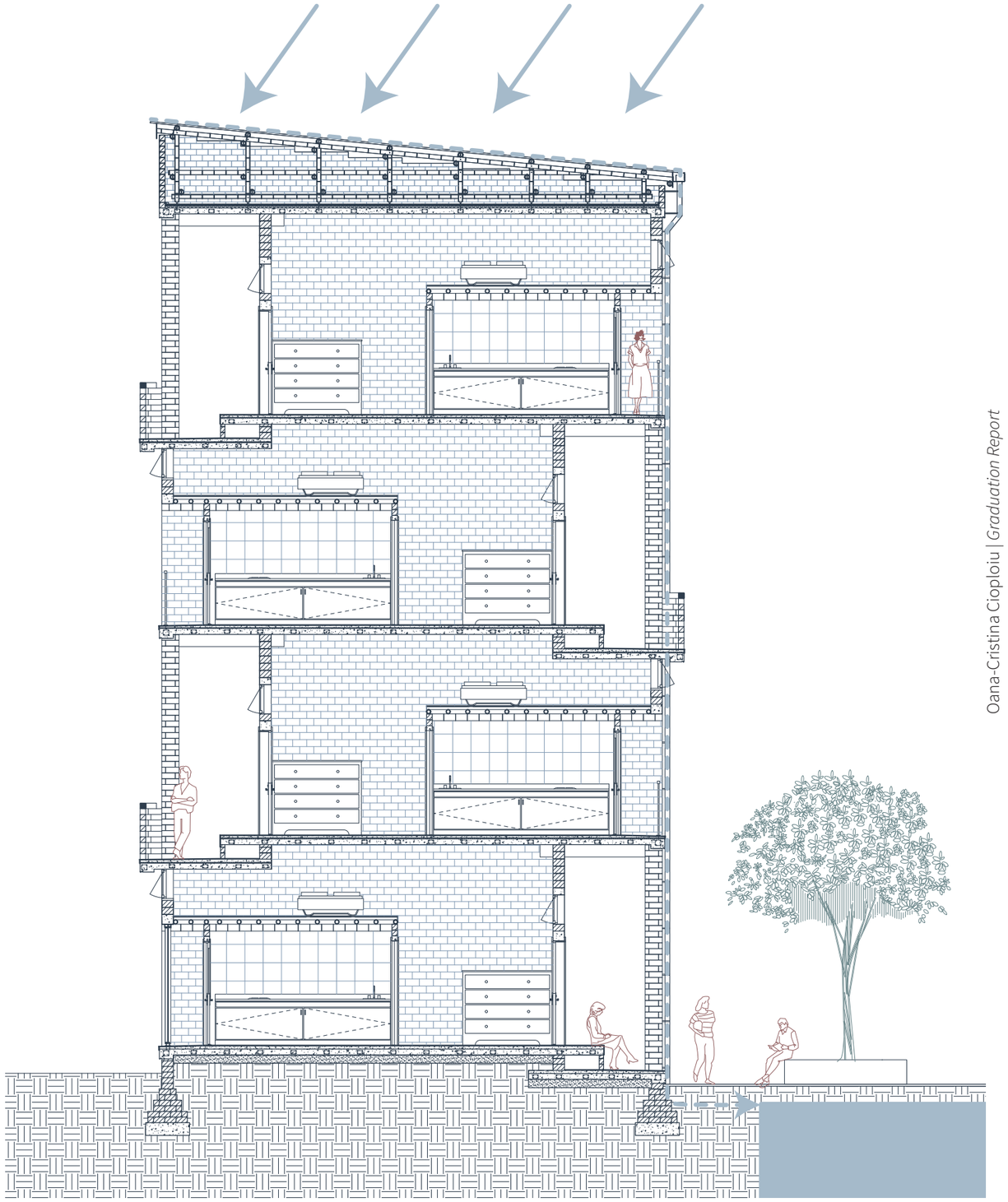
Low-income group building axonometry
Not to scale



Low-income group cluster-Orientation plan, first floor
Scale 1:200 on A1

CONSTRUCTION
CLIMATE | RAINWATER

The slanted roofs and rain pipes collect and deliver the rainwater to these storage tanks, to be used in the households later as gray water.

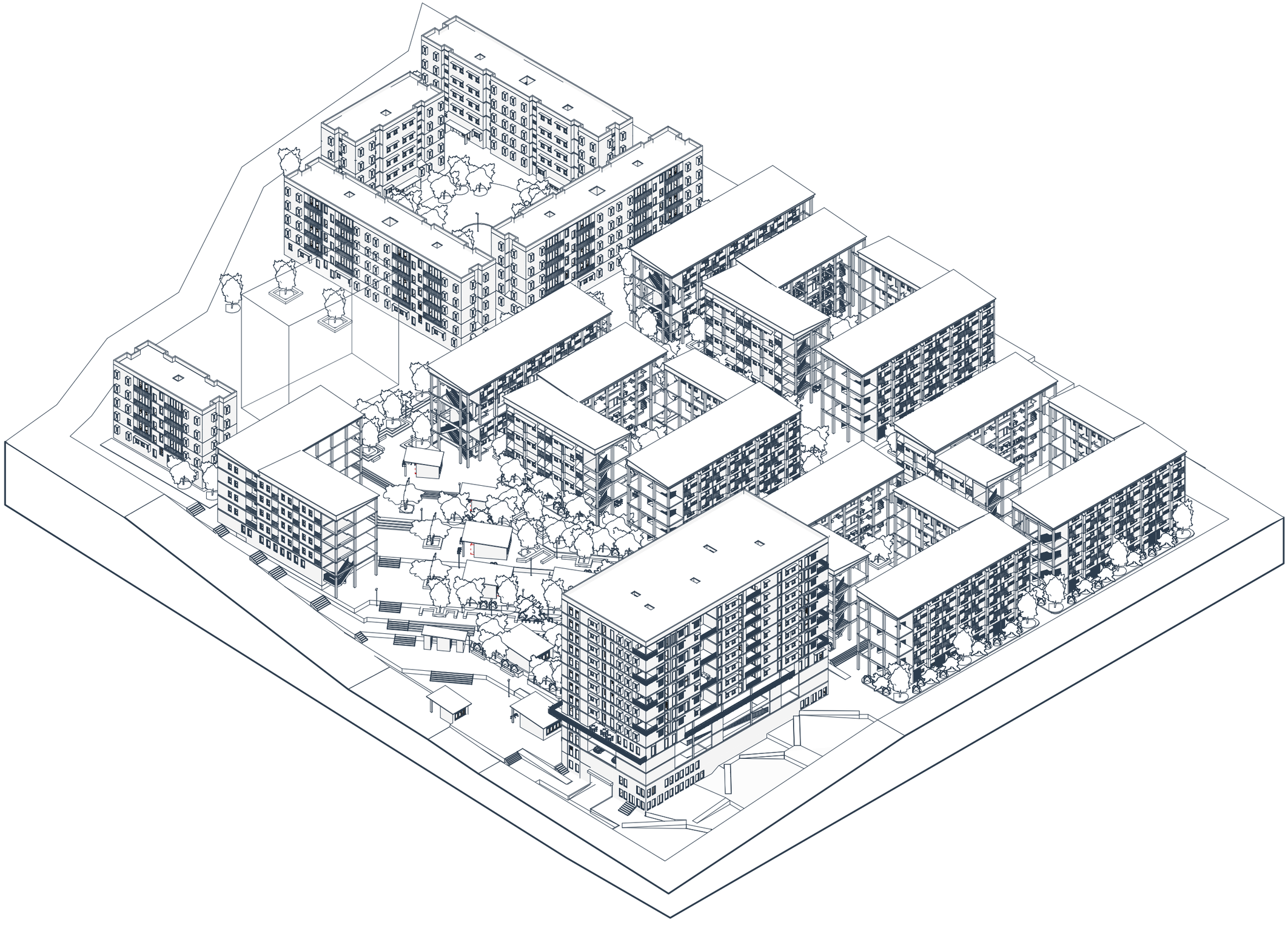


Border typology section, rainwater collection
Scale 1:50 on A1

CONSTRUCTION
CLIMATE | RAINWATER

Water storage tanks are provided underground in the courtyard space.

Low-income group cluster-rainwater tanks, ground floor
Scale 1:200 on A1



WIDER PROJECT INTEGRATION

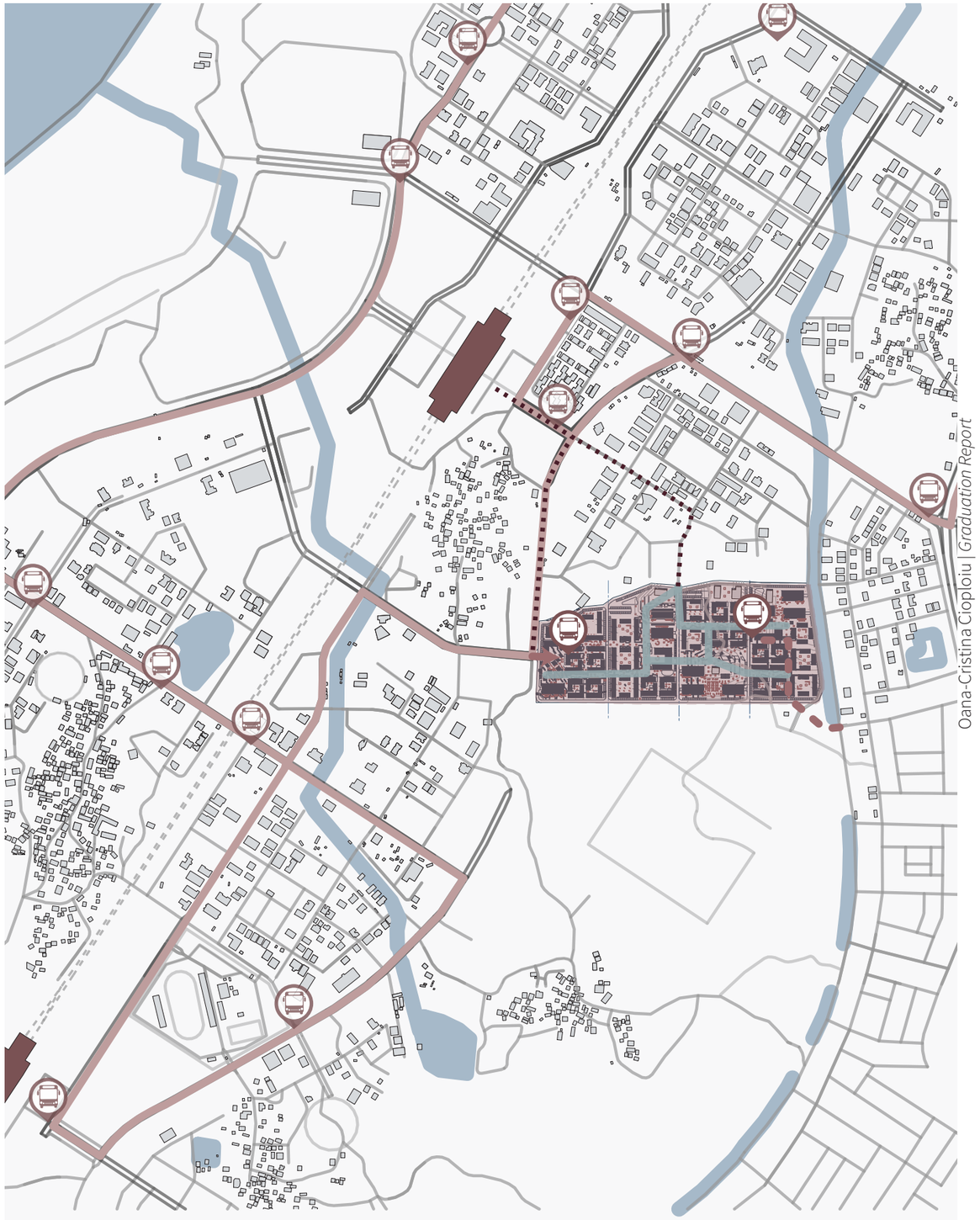
Transport

The project will help create a link between the residential area to the East, which was previously more isolated from the railway station.

With the integrated bus stops in the project, easier access is provided to the public transport system.

Upon completion, the resulting project would reinforce a community, allow women more freedom to occupy public space and create new connectivity routes.

The two new bus stops in the neighbourhood have the amenities necessary (such as commercial space and appropriate toilets). Their location serve as a step into the project (from first phase) and as a connection point with other residential areas (last phase).



Proposed transport links
Scale 1:5000 on A1

WIDER PROJECT INTEGRATION

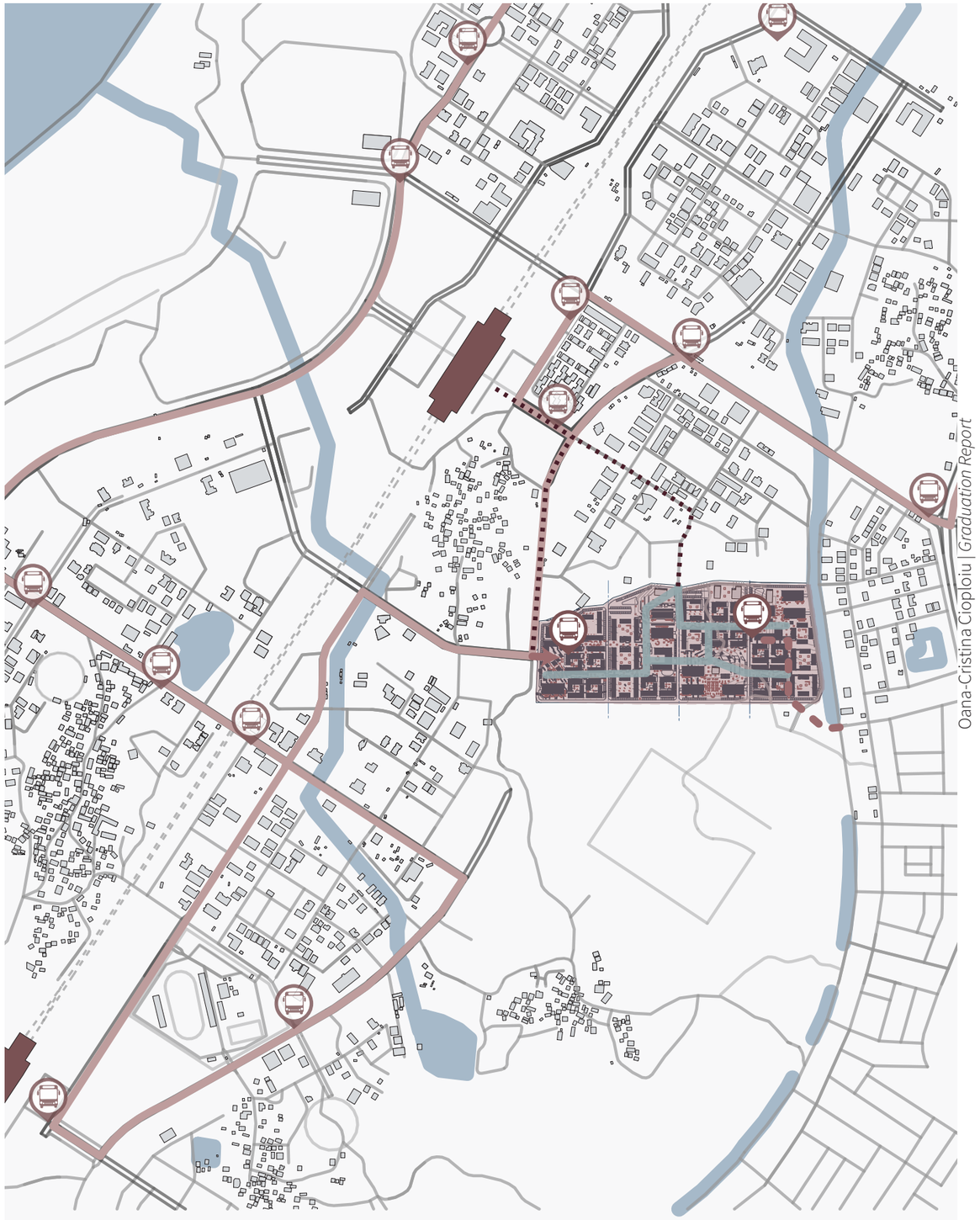
Green path extension

As previously mentioned, public transport connections were an important factor in the site selection. With the development of the project and an integrated extension of bus routes, an additional layer of accessibility is sought by extending the proposed green path as an accessible pedestrian route towards the railway station.

The new and extended green path would allow for easy, safe and comfortable circulation, serving as a connection for the residential area beyond the site, to the East.

Public bathrooms

An additional hub of public toilets is proposed adjacent to the railway station, providing equal services to men and women, and encouraging women to reclaim the public space.



Wider site integration
Scale 1:5000 on A1

REFLECTION

Project information

Creating places of fun and leisure for women in housing projects

From the initial stages of the studio, my design aspired to promote social integration and interaction in housing neighbourhoods, providing a safe environment in which women can loiter.

The project setting is Navi Mumbai, a foreign context for me. This allowed for a reinterpretation of a complete contextual analysis, delving into more than site and climate, but also lifestyles, customs, and even building techniques used in India.

In Navi Mumbai, new low-income developments by CIDCO create high-density projects that often overlook the in-between, the spaces between the towering apartment buildings. These become erratic empty spaces that are hard or unsafe to navigate by many residents, including children, the elderly, and women.

These spaces make it difficult for the residents to occupy them as public spaces. Meanwhile, mobility to other more pleasant public spaces poses multiple obstacles for women. Safety, comfort, and access to hygienic toilets are recurring topics when researching how Indian women use public spaces. On top of that, their purpose for using these spaces is brought into question, and loitering (especially far from home) is seen as a questionable practice. Low-income women are the most vulnerable regarding the issues previously described, as higher-income women afford to become consumers to justify using the public realm.

Providing a platform for social interaction between different income group residents was one of my first goals. These are defined as community boosters in my project, and are meant to provide services, amenities and public space open for all residents.

The importance of certain Indian elements was evident from the beginning, such as the *otla* space and the loft, providing a flexible threshold and sleeping or storage space respectively, while other elements came later in the design process following ongoing research and organising the principles employed. One such element was the green path, which allowed to create a pedestrian route through the project and serve as a public space at the same time, providing a structuring method for the elements already present in the design. This also reinforced additional Indian typologies of public spaces such as the *katta*, *bakda* etc.

The feedback received at P2 stage and further on helped to define the spaces and activities happening between the income group dwellings, and in the community boosters. Ongoing building and technology tutoring has ensured a practical attitude during the design process, and a feasible quality of the project.

Overall, the studio posed a challenging task and it was a rewarding journey to design a socially inclusive housing project in Navi Mumbai. The complexity of the project expanded beyond the general design challenges, into social, managerial, technological, and environmental aspects.

Relationship between research and design

At the start of the studio, context-led research was the focus, done through literature reviews and case study analysis for housing projects. This phase was a group effort, focusing on post-independence projects across India and it offered the first glimpse into the new context, providing an understanding of the customs and lifestyles of Indians.

Analysing projects from Navi Mumbai served as background research to better understand the development of the city. Social problems such as women's access to the public realm and water disparities between income groups were discussed as part of the lecture series held during the beginning of the studio. The lecture '*Gender and Architecture in India: Private and Public Spaces in Post-Colonial Times*' sparked a particular interest in me, setting a gender-sensitive approach to my design, and having women's needs in mind while developing the project on all scales.

The projects analysed at this point in the studio allowed me to identify modern trends and design decisions that are no longer relevant, as well as elements that I considered important to bring back, such as the *otla* space.

Delving deeper into the context of India brought to my attention the difficulties that women encounter when navigating the public realm, even in close proximity to their dwellings. Trying to understand their independence and daily patterns was challenging, being done only through literature review and online resources such as social media and blogs. However, the topic has pushed me towards the theme/concept of my project, creating places of fun and leisure for women.

A finding that surprised me while researching the context was the caste system, which provided further segregation between the population. Although not in use anymore, some cultural histories can be hard to erase from the modern mindset. This was one of the reasons I chose to develop a mixed residential neighbourhood that can fight the stereotypes still present in Indian society.

The research question that structured my design was '*How can we create places of fun/pleasure for women in mass housing neighbourhoods?*' Throughout the design process, research was present at each stage to formulate design approaches which would attempt to answer the question. Sociological aspects from the research are reflected in the decisions considering the design of certain elements of the project, such as the inclusion of the *otla* space for the low-income

residences. Precedents were consulted during the design period to question certain design intentions, or bring new elements into the project, such as the *katta* and *bakda*.

Relationship between graduation topic and studio topic

This year's studio, *Mixing Navi Mumbai*, has as its core focus affordable housing tackling the problems of social, spatial, and environmental inequality. At the same time, the quality of replicability is a main focus for the studio and a quality that the design projects should aim for. Navi Mumbai is taken as an example of urbanisation patterns present in many parts across the Global South. The goal is to produce affordable housing for an inclusive development of Navi Mumbai.

Housing lies at the core of architecture, being the environment most of us interact with. However, the global housing shortage poses challenges for keeping up with the urbanization needs while also developing humane solutions.

My project topic of gender-sensitive design enabling women to loiter for fun in public spaces was a direct result of the research done in the initial stages of the studio. The problems noticed during the first research phase allowed for an easy subject focus on women's places and their use of public spaces for fun and loitering.

Bridging the gap between the public and private, and creating new thresholds became an important theme while designing. This also allowed for the inclusion of public spaces within the neighbourhood, and they became platforms of social interaction between the income groups.

Research method and approach

Elaborating on the research methods employed, many strategies were used to gather information for a better understanding of housing in India.

A research method encouraged in the Global Housing Studio is visual ethnography. However, because of the pandemic situation, it was not possible to conduct this on-site in Navi Mumbai. The research method was instead used for the workshop *Housing as Healthcare*. Although performed in a Dutch context, which is very different from the Indian one, it allowed to better pick up details connecting the patterns of inhabitation of the residents and their dwellings. The practice made it easier to identify elements of importance for Indian residents from precedents by analysing their plans, sections, and occasionally photographs with inhabitants' appropriations.

Precedents studies were employed throughout the whole duration of the studio, from the initial group work at the beginning to independent research analysing more relevant projects for my particular topic.

Identifying the meaningfulness of certain design elements determined the integration of spaces open for women, from a more efficient threshold bridging the private and public space to the creation of semi-public spaces that they would be free to appropriate and use for domestic activities.

Extensive research was done through social media channels, including Instagram, blogs, and YouTube. This provided an essential component for completing the literature research to provide a picture of the Indian lifestyle and challenges faced.

Relationships in a wider social, professional, and scientific framework

The problem of urbanization is prominent, especially in developing countries in the Global South, where a constant migration from the rural to the urban is happening much faster than the city is able to accommodate. Mumbai is one city on the verge of becoming over-saturated and the housing disparity from low- to high-income is evident. Navi Mumbai offers a unique context as being a planned city, however, the reality is that it still evolves sporadically and chaotically, and it isn't immune to segregation patterns which lead to situations such as slums springing up next to expensive luxurious tower projects.

The nodal development of Navi Mumbai was meant to encourage a socially diverse urban environment. In reality, some nodes became more targeted to high-income residents, and patterns of imbalance present in Mumbai can again be found in Navi Mumbai.

Its connection and dependability to Mumbai is also an organising principle for these imbalances, with high-income projects occupying prime real estate plots, and low-income pushed farther away from transportation nodes. This in turn encourages the development of informal settlements in proximity to the transportation links.

My project tries to fight the segregation of income groups by providing an interaction platform where residents can become a community. Having this platform at the intersection of three areas of housing allows the residents to still have their own spaces that reflect their living styles and aspirations. The idea of the community booster to encourage social interaction was present in the initial stages of the design. Through ongoing research about activities in public spaces independent of a consumerism culture, an additional layer of contextual elements could be added to the project, such as the public spaces typologies rooted in the Indian context (*katta*, *bakda*, etc.)

The goals of social integration and interaction across income groups and genders are not limited to Navi Mumbai. The transferability of the project relies on using the masterplan strategies on different sites, not necessarily copying the buildings and pasting them on

a new site. Relating the project to the social framework, while rooted in some cultural Indian customs and using multiple Indian typologies of public spaces or thresholds (*otla*), the main strategy of community booster-green pedestrian path-dwellings can still be used to develop a housing neighbourhood on another site. The main goals of social interaction and integration are relevant in most contexts, and a gender-sensitive approach is needed as a modern way of developing housing neighbourhoods.

Ethical issues and potential applications of the results

Dealing with designing in a foreign context, in which previously I had no direct interaction was a challenge to overcome. Understanding the needs and aspirations of residents from the targeted income groups and determining patterns of inhabitations for women was difficult when working in a context not visited first-hand. However, it also pushed me to seek new methods of interaction with the context, from contacting friends who live in India to searching on Instagram relevant posts.

This is a research method that should be treated with a certain degree of incertitude. The limitations of certain topics or people online represent a gap in the research. For example, low-income residents have a smaller footprint on social media discussing topics such as women's safety and accessibility in public spaces, and even less focusing on their daily patterns.

Understanding the conditions and lifestyles of the urban poor in Navi Mumbai was a goal followed throughout the duration of the studio. Finding a balance between the lifestyles of the low and high-income people was an additional matter to be tackled during the design.

The issues of women's presence in the public space and social interaction and diversity in housing projects are too vast to be resolved with a single solution, however, I believe that the design intentions represent a step forward in raising awareness for them. Overall, my project aims to reinforce a new outlook on what an inclusive gender-sensitive housing neighbourhood can bring.

REFERENCES

Compressed Stabilised Earth Blocks:

Earthblocks.in. 2021. Earth Blocks India Pvt. Ltd.. [online] Available at: <https://www.earthblocks.in/FAQ.aspx> [Accessed 15 March 2022].

House Caravan. 2022. Compressed Earth Block Vs. Brick | House Caravan. [online] Available at: <https://housecaravan.com/compressed-earth-block-vs-brick/> [Accessed 15 March 2022].

Rigassi, V., 1995. Compressed earth blocks: Manual of production. [online] Nzdl.org. Available at: <http://www.nzdl.org/cgi-bin/library?e=d-00000-00---off-0hdl--00-0----0-10-0---0---0direct-10---4-------0-1l--11-en-50---20-about---00-0-1-00-0--4----0-0-11-10-0utfZz-8-10&cl=CL1.3&d=HASH01cf0835ed104fa479c5cc9b&gt=2> [Accessed 15 March 2022].

n.d. Environment Friendly Indian Building Material Technologies for Cost Effective Housing. Society for Excellence in Habitat Development, Environment Protection & Employment Generation (SHEE).

Bamboo:

2002. Construction with Bamboo - Bamboo Connections. [ebook] Available at: <https://bambus.rwth-aachen.de/eng/PDF-Files/Bamboo%20Connections.pdf> [Accessed 16 May 2022].

Schröder, S., n.d. Bamboo Lashing Manual. [online] Guadua Bamboo. Available at: <https://www.guaduabamboo.com/blog/bamboo-lashing-techniques#:~:text=Start%20the%20pegged%20lashing%20by,cross%2Dpole%20if%20you%20prefer.> [Accessed 16 June 2022].

Akram, W., 2017. Bamboo Roofing: Designs, techniques and materials. [online] Bamboooz.com. Available at: <http://www.bamboooz.com/bamboo-roofing-designs-techniques-materials/> [Accessed 16 March 2022].

Schröder, S., n.d. Corrugated Bamboo Roofing Sheets. [online] Guadua Bamboo. Available at: <https://www.guaduabamboo.com/blog/corrugated-bamboo-roofing-sheets> [Accessed 16 March 2022].

Quarry tiles:

Wallender, L., 2020. A Basic Primer on Quarry Tile. [online] The Spruce. Available at: <https://www.thespruce.com/uses-for-quarry-tile-1822628> [Accessed 16 May 2022].

IMAGE CREDITS

Page 27: (Indian public space typologies)
1. *https://smmcollege.in/college-katta/*
2. *https://commons.wikimedia.org/wiki/File:Kolkata_Maidan,_Kolkata,_India.jpg*
3. *https://www.bbc.com/news/science-environment-33288311*
4. *https://commons.wikimedia.org/wiki/File:Aangan_in_village_crafts_museum.jpg*

Page 35: (site snaps)
1, 2 & 3. *Google Maps*

Pages 50-51
1&2. *Credit: Hema Sankalia and CEPT Archives*

Pages 52-53
1&2. *Credit: S+PS Architects*

Pages 54-55
1&2. *Credit: How to build an Indian House-The Mumbai Example, Sameep Padora*

Pages 56-57
1&2. *https://theanamikapandey.com/charles-correa/*

Page 135: (Compressed earth blocks school)
1. *https://www.dezeen.com/2014/02/12/vaulted-brick-primary-school-mail-levs-architecten/*
2. *https://www.designboom.com/architecture/levs-architecten-gangouroubouro-primary-school-mali-11-13-2014/*

Page 137: (types of bricks)
1&2. *https://www.engineeringdiscoveries.net/2019/06/difference-between-red-bricks-and-fly.html*
3. *https://www.tradeindia.com/products/marble-slurry-bricks-c6239857.html*
4. *https://www.indiamart.com/proddetail/fly-ash-lime-gypsum-brick-23363169773.html*
5. *https://www.indiamart.com/proddetail/earth-brick-soil-bricks-side-walls-interlocking-clay-brick-22838574830.html*
6. *https://www.indiamart.com/saisuppliersmaharashtra/concrete-blocks.html*

Page 138: (bamboo loft structure)
1&2. *https://www.zrs.berlin/project/earthen-school-tipu-sultan-merkez/*

Page 139: (bamboo corrugated sheet)
1&2. *https://www.studiohannahwood.com/bamboofarmoffice*

Page 140: (Quarry tiles)
1. *https://www.wallsandfloors.co.uk/quarry-tiles?gclid=CJbb_5LGodECFYU-Gwodw7YB3Q*
2. *https://valor.studio/portfolio/cub-house*

Page 142: (otla spaces materiality)
1. *credit Madhavi Desai*
2. *Pallasma, Juhani. "The Thinking Hand", John Wiley and sons, 2009, http://www.berkeleyprize.org/endowment/the-reserve?id=15*
3. *credit: Vineeta Nair, https://www.researchbank.ac.nz/bitstream/handle/10652/1568/Kaza%20-%20Otla.pdf?sequence=1&isAllowed=y*
4. *http://magictoursblog.blogspot.com/2014/09/what-is-otla.html*

Page 143: (modern otla materiality)
1. *https://www.researchbank.ac.nz/bitstream/handle/10652/1568/Kaza%20-%20Otla.pdf?sequence=1&isAllowed=y*

Page 144: (proposed otla materiality)
1. *https://www.designboom.com/architecture/levs-architecten-gangouroubouro-primary-school-mali-11-13-2014/*
2. *https://www.blindsdirect.co.za/shop/outdoor-blinds-and-shades/outdoor-roller-blinds/outdoor-bamboo-roller-blinds*
3. *https://valor.studio/portfolio/cub-house*
4. *https://www.wallsandfloors.co.uk/quarry-tiles?gclid=CJbb_5LGodECFYU-Gwodw7YB3Q*

Page 152: (bamboo detail roof)
1. *https://www.designboom.com/architecture/the-scar-city-and-creativity-studio-bamboo-shade-shelter-gala-pagos-playa-man-01-17-2017/*

Page 168 (bamboo shading roll)
1. *https://www.blindsdirect.co.za/shop/outdoor-blinds-and-shades/outdoor-roller-blinds/outdoor-bamboo-roller-blinds*