VALUE OF WASTE: FROM YOUR PLATE TO COMMUNITY

Affordable Co-Housing through Zero-Energy Cooperative and Waste Management

June, 2023

Lena Gurkan Saul | 5616190

[this page is intentionally left blank]

ABSTRACT

The aim of this research paper is to redefine the current state of working and living developments that oftentimes result in gentrification and deindustrialization. It recognizes the importance of keeping these developments affordable, especially in the context of Merwe-Vierhavens, an old industrial port area in Rotterdam. The redevelopment plan that proposes to mix dwellings and production in this area lacks the ambition to create affordable housing or to keep low-tech industries on the site, and is at a high risk to become unaffordable over time. As a way of providing affordable housing, I proposed a combined model of cooperative co-housing and zero-energy housing. By incorporating waste management facilities into this development as the production space, I explored the synergies with dwellings. The findings from the site analysis, academic sources, interviews, and case studies showed that in addition to contributing to affordability, zero-energy housing, cooperative co-housing, and waste management systems all entail a social potential by co-existing in the same space.

Keywords: affordability, co-housing, cooperatives, Merwe Vierhavens, waste management facilities, zero-energy housing

Figure 0. Impression drawing - “living and working together”

VALUE OF WASTE: FROM YOUR PLATE TO COMMUNITY

Affordable Co-Housing through Zero-Energy Cooperative and Waste Management

| AR3AD100 Advanced Housing Design (2022/23 Q4)

Lena Gurkan Saul 5616190

tutors:
Ir. Olv Klijn
Dr. Anne Kockelkorn
Ruurd Kuijlenburg
Ir. Ferry Adema

CONTENTS

00/ INTRODUCTION

From the 16th century on, the relationship between the city and the port in Rotterdam depended on the role of its ports. For instance, in the late 1700s and early 1800s, the city functions fronted water as the harbors accommodated port-related industries and became desirable for shipowners and merchants. However, in the 19th Century, the close relationship between the port and the city was no longer needed since the ports were merely used to load and unload goods (Meyer, 1999).

The design assignment for the "Advanced Housing Design: Ecology of Inclusion" course takes place in the old industrial port area of Merwe-Vierhavens (M4H) in Rotterdam where the developers aim to introduce dwellings into the area in order to create a so-called "Maker's District" that brings working-living-learning functions together. In this area too, we see a shift in the relationship between the port and city the as the role of the port changed over time. In the late 1900s, with the automatization of the harbor, fewer workers were needed and the area became more and more vacant. As the area lost its attractiveness due to crime rates going up and prostitution, artists moved into the area because of the low rents. The artists were then followed by startup companies and small businesses that focus on creativity and innovation since the area provided them with cheaper and bigger workplaces (Pet and Metz, 2022). In 2019, the Municipality of Rotterdam and the Port of Rotterdam Authority started working on a new redevelopment plan to respond to the proximity of the port and the city, get the economy of the city and port together again, and contribute to the expansion and sustainability of both with the new and old maker's spaces (Ruimtelijk Raamwerk M4H, 2022).

Prior to presenting ideas about the design and the target groups, we should ask "Why the Maker's District?" or "Why combine work and living?". With these questions asked, the two articles, "Getting Back into the "Business of making things" by Johannes Novy and "The work home: an architecture of dual use" by Frances Hollis, become relevant. Both of these articles touch upon the idea of mixed-use where the working and living functions come together and suggest certain benefits of these mixed-use developments. These benefits include but are not limited to; reducing commuting to workplaces, creating urban spaces that function day and night, creating spaces for learning and interacting...etc.

Furthermore, it is also essential to address the current housing crisis in the Netherlands. In 2021, the housing shortage in the Netherlands was estimated to be around 331,000 houses and around 1 million houses should be built in order to meet the demand (Séveno, 2023). According to CBS, housing prices went up almost 86 percent for owner-occupied dwellings. In addition, according to CBS, in 2022, gas and electricity prices were calculated to be twice as expensive as in 2021. Without a doubt, both of these current issues affect low-income groups and make it much more difficult to own a house in The Netherlands.

Creating a good mix of residential and industrial functions in this area would not only provide new employment possibilities for the low-income groups but would also partly provide a solution to the housing crisis by being an example of how the often cast aside industrial areas can be redeveloped to supply affordable housing without losing the industrial functions.

On the other hand, in many post-industrial cities such as Brussels and London, we see that the rapid population growth puts the production areas in a vulnerable position as housing becomes prioritized (De Boeck & Ryckewaert, 2020). Concerning this, with the current housing crisis, we can identify many of the working-living developments in the Netherlands as projects of gentrification in two ways. Firstly, when the residential functions are introduced, the industrial functions get replaced by more desired functions such as shops and offices (De Boeck & Ryckewaert, 2020). Secondly, the area becomes more attractive with the new functions which provokes an increase in housing prices and thus drives the displacement of the former users that work in the area. Therefore, we must think of a new way of designing working and living developments in order to ensure that the M4H area does not become another project of gentrification.

0.1 Problem Statement

The redevelopment plan of the Merwe-Vierhavens (M4H) shows an ambition to provide spaces for innovative manufacturing, living, and education. Still, it does not indicate a desire or a framework to keep the location affordable nor for keeping the low-tech industrial production on site. In addition, an analysis of the housing prices per square meter surrounding the M4H area shows that the port areas and the areas closer to the city center tend to have higher prices per square meter compared to the rest of Rotterdam (figure 1). Therefore, this area is at a high risk of becoming a place that is no longer accessible to low-income people to live in, and that even drives away the artists and businesses that exist in the area.

Here, the situation of the Strijp-S area in Eindhoven becomes relevant. This old industrial site that was owned by Philips was bought in 2002 by VolkerWessels and Eindhoven Municipality to be developed into the creative center of Eindhoven (Strijp-S, n.d.). In the first phase of its redevelopment, the existing buildings provided creative individuals with affordable studios and workplaces that they could rent (Voetman, 2017). From 2012 until now more working spaces for entrepreneurs and residential buildings were introduced into the area, and more spaces for creative entrepreneurship and innovation spaces are planned (Strijp-S, n.d.). A current analysis of the housing prices per square meter shows a significant increase in housing prices in the Strijp-S area compared to its surroundings (figure 2).

As a result, we can see that although the redevelopment of Strijp-S has recreated Eindhoven from an industrial town to a place of innovation, technology, and design (Fernandez-Maldonado, n.d.), once the artists moved in, the area became more and more attractive and the housing prices went up, causing then the artists to be displaced (Voetman, 2017). Therefore, the workplaces offered in the area are not used by the same people who live there (Dane, Borgers, and Tilma, 2019).

The fact that the redevelopment plan for the M4H area lacks the ambition to create affordable housing or to keep low-tech industries on the site was regarded as the main problem as we can see a similar trend in the way the Strijp-s area was redeveloped. This area will not be successful in creating a mixed-use project if it excludes the often low-income workers lacking higher education who work on the site from this living and working environment. In return, it will not contribute to the reduction of transport or to a learning environment that could potentially be some of the benefits of such a development (Novy, 2022).

Figure 1. Housing Prices Per Square Meter In The Surrounding Areas of Merwe-Vierhavens (House Prices in Rotterdam, n.d.)

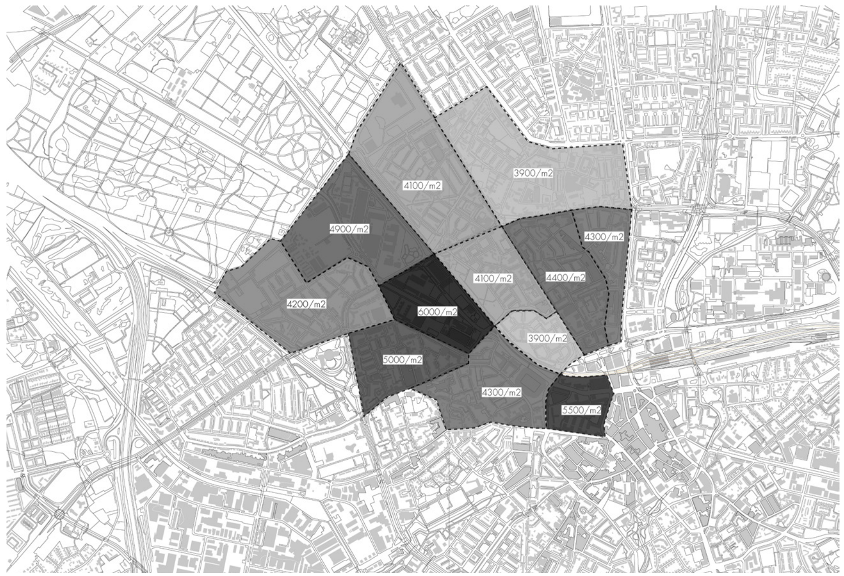


Figure 2. Housing Prices Per Square Meter In The Surrounding Areas of Strijp-S, Eindhoven (House Prices in Eindhoven, n.d.)

0.2 Research Goal and Questions

The design goal was to create a redevelopment plan that uses the full potential of such an industrial site to create an attractive development that is inclusive of low-income individuals. This meant that the site should have provided these groups with affordable housing and places to gather and work for them to learn from each other. My interest in cooperatives, co-housing, and nearly zero-emission buildings became a part of the solution while fulfilling this goal. I used cooperative co-housing to create ownership for low-income individuals through sharing and nearly zero-emission buildings to reduce energy costs. In addition, I focused on waste management for the production space as these facilities are very much dependent on dwellings but are still located in industrial zones. Therefore, the research goal was to mainly discover the role of architecture as the solution to creating an affordable working and living environment that provides the determined target groups with the spatial conditions to interact and learn from each other.

To achieve this research goal, I have formulated a research question and sub-questions to find an answer to the main question as such;

"How can a combined model of cooperative co-housing and zero-emission buildings contribute to creating a living, working, and learning environment for low to middle-income families and solo dwellers, including creative individuals?"

Sub-questions:

1. How does industrial activity create public space?
2. How does affordability resonate with practices of sharing and practices of thermal comfort?
3. What are the limits and social potentials of practices of sharing and thermal comfort?
4. What is the role of waste management systems in the urban fabric?
5. "What are the synergies between waste management facilities, co-housing, and zero-energy buildings?"

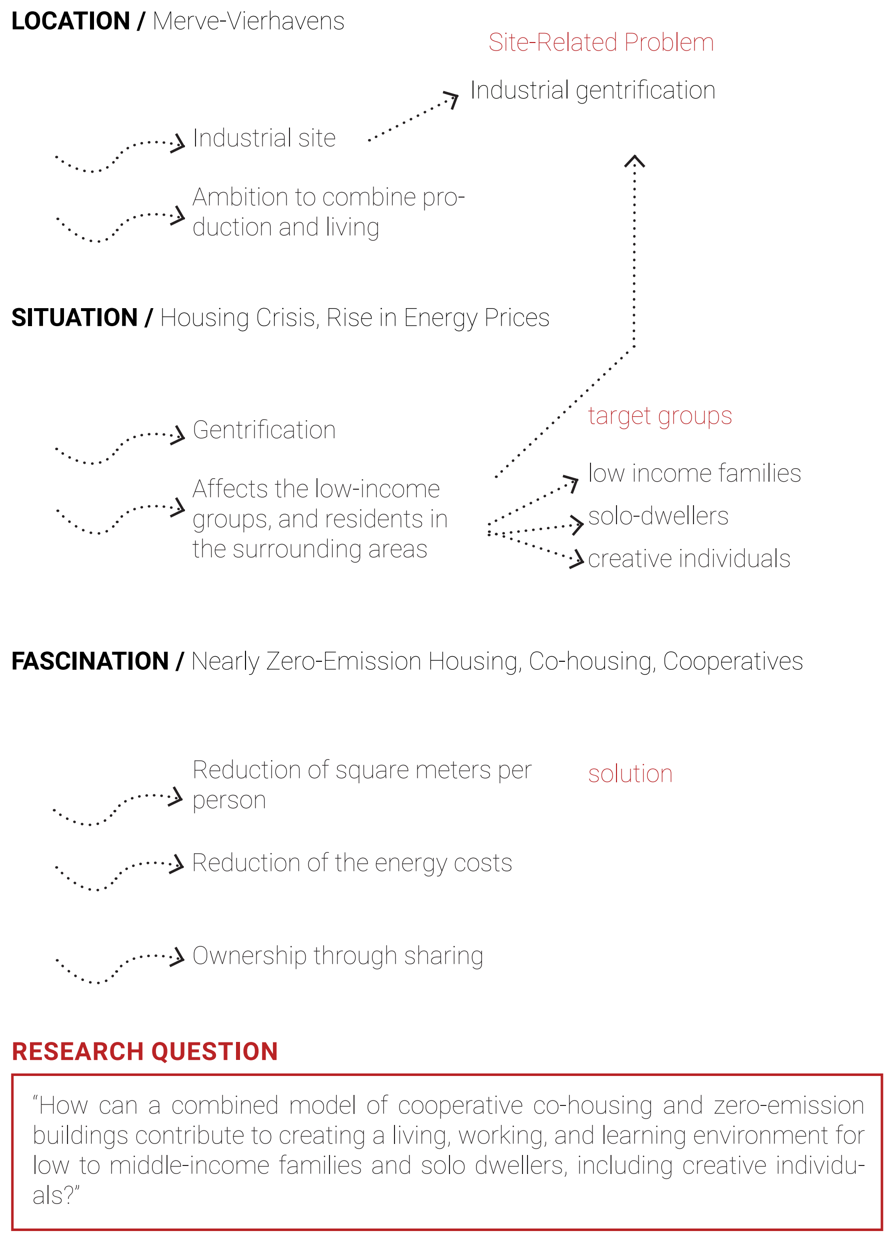


Figure 3. Diagram, thought process for the research question

0.3 Research Framework

In the process of rethinking working and living together, I identified the working-living projects that lack the ambition of creating affordable housing and workplaces and keeping the low-tech industries as gentrification projects. I then described the significance of keeping the industrial uses in these developments and of affordability in the quest for a new concept of living and working together. The theoretical framework includes a variety of concepts on which I based my research.

Productive City

In an article published in the European Journal of Spatial Development, Johannes Novy identifies various economic, environmental, and social benefits of introducing production spaces in the urban fabric. The author also emphasizes the importance of the less "trendy" but more vital functions in the functionality of the cities. In relation to this, he uses the concept "productive city" (Novy,2022).

Productive Frictions

Productive friction is a concept explained by John Hagel III and John Seely Brown in their article "Productive Friction: How Difficult Business Partnerships Can Accelerate Innovation" (2005) . In their book, they explain this concept as a possible productive outcome of a discussion between people with different backgrounds that typically creates friction (Brown & Hagel III, 2005).

Frank Van Klingeren states: "By deliberately allowing people to disturb one another a bit, you give them a sense of belonging together" (Ende, 1967). He believes that the frictions that arise between the different functions that coexist in the same context hold the potential to create social interactions between the different users of the area as they come together to find a solution to these frictions.

Cooperative Co-housing

Contrary to a for-profit development that generally requires higher rents from its residents, cooperatives provide middle-income and low-income citizens with affordable and stable rents. Cooperatives are a form of collaborative housing which combined with co-housing, offer communal spaces for the residents (Kockelkorn & Schindler, 2020).

Zero-Energy Buildings

Zero-energy buildings are characterized by their ability to produce, on-site, the same amount of energy as the users consume over the course of a year (Mlecnik et al., 2012). Concerning this, The article written by Andrea Chegut, Piet Eichholtz, and Rogier Holterman emphasizes the positive economic outcome of investing in energy efficiency in the affordable housing market (Chegut, Eichholtz, and Holtermans, 2016).

Hypothesis

In light of the theoretical framework and my problem statement, I hypothesized that affordability is the main determinant for the success of combining work and living functions in the M4H area and that nearly zero-emission buildings, cooperatives, and co-housing are all a part of the solution to achieve affordability.

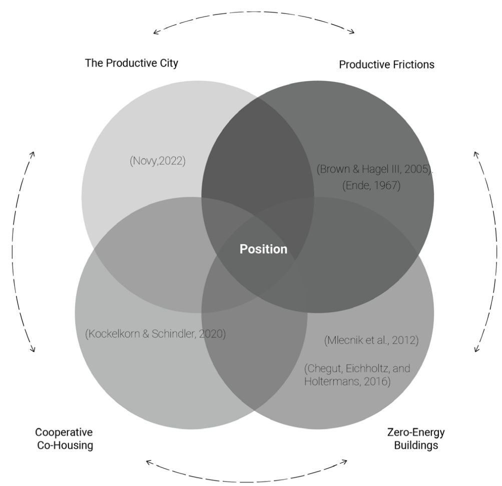


Figure 4. Diagram, theoretical framework

Relevant Terms

To communicate with the readers and have an accurate outcome from the research, I included a list of terms with explanations that may be relevant to this report ;

M4H: Merwe-Vierhavens. The location for the design assignment.

Industrial Gentrification: The displacement of the Industrial functions out of the urban fabric, deindustrialization.

Cooperative: A collectively owned building. The emphasis is on shared ownership rather than how the residents live in the building (Wedell, 2021).

Co-housing: Private housing with shared facilities. The emphasis is on the lifestyle rather than the ownership (Wedell, 2021).

Collaborative housing: This type of housing is characterized by the residents' participation in the building's management (Czischke, 2017).

Zero-energy buildings: Buildings that consume almost the same amount of energy over one year that is produced on-site (Mlecnik et al., 2012).

[this page is intentionally left blank]

0.4 Research Methods

I have previously formulated five sub-questions to find an answer to the main research question. With each chapter, I sought to find an answer to one or two questions with a variety of methods such as; observations during the site visit, interviews, literature review, and case studies.

The first sub-question was about understanding the characteristics of industrial areas and their conflicts with dwellings and the potential it holds to create public spaces. I started by analyzing different examples of working and living projects starting from Medieval English houses and ending with contemporary examples to discover the potential benefits and challenges of such a development that combines residential and industrial functions. In addition, I analyzed the historical evolution of Rotterdam's ports and their relation to the city. In relation to this, I looked into the existing situation of the Merwe-Vierhavens area and the future plans for it. Finally, due to the conflicting nature of production and dwellings, I depended on a literature review for the concept of "productive frictions".

The second and third questions are about determining in what ways cooperatives, co-housing, and zero-emission buildings can be a solution to housing unaffordability, and what it means for the users. I conducted a literature review and analyzed three different case studies; Soubeyran, a Swiss cooperation project as a low-energy co-housing (Tummers, 2017); San Riemo, a cooperative in Munich with various shared spaces; and Holunderhof, a cooperative in Zürich with shared spaces for families (Lengkeek and Kuenzli, 2022). In addition, I held an interview with a low-income family and a solo dweller to better understand their thermal practices and their limits for sharing.

Finally, the fourth and fifth sub-question was about finding out the role of waste management facilities in the urban fabric and understanding the synergies between waste management facilities and dwellings. I sought to find an answer to this sub-question with a re-evaluation of the case study Soubeyran and holding another interview with the target groups I defined by focusing on their waste routines.

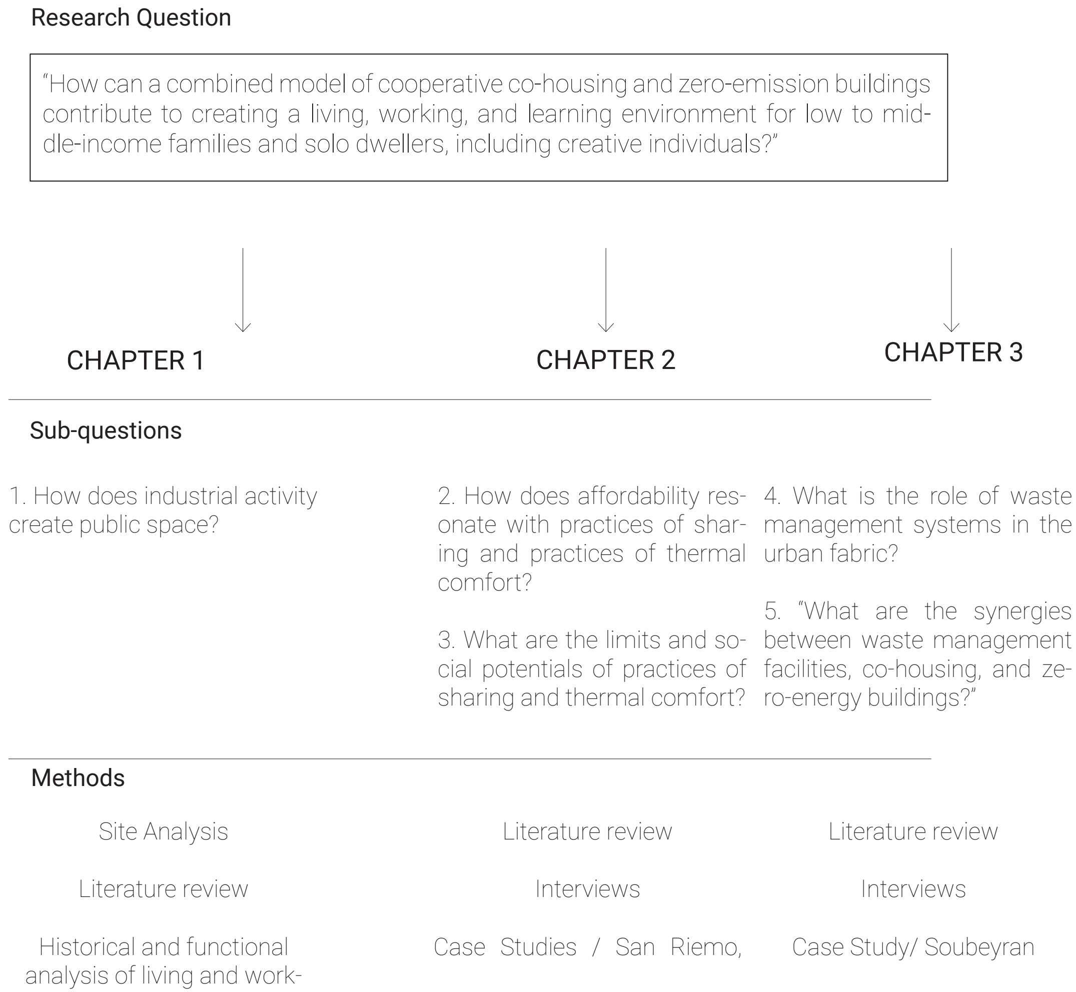


Figure 5. Diagram, research methods

Figure 6. De Boompjes, Rotterdam - August Willem van Voorden

/ 01 MERWE-VIERHAVENS: THE PRODUCTIVE CITY

1.1 The Productive City

According to the article by De Boeck and Ryckewaert, production spaces are described as "economically vulnerable" since in many post-industrial cities such as London and Brussels, we see a trend in industrial gentrification where dwellings replace functions such as manufacturing (De Boeck & Ryckewaert, 2020). As emphasized by Jane Jacobs in her book "The Death and Life of Great American Cities", basing city structures on a more flexible concept than rigid functional zoning is of great importance. This is primarily due to the fact that it is no longer feasible to establish the characterization of planning structure elements based solely on one of the prominent local activities. To support a better mix of functions inside city tissues, new urban concepts have to be established (J. Jacobs, 1961). However, as urban planners and city officials were not focused on keeping the existing manufacturing businesses and integrating the material production into the urban tissue, they followed the trend of industrial gentrification for decades (Novy, 2022).

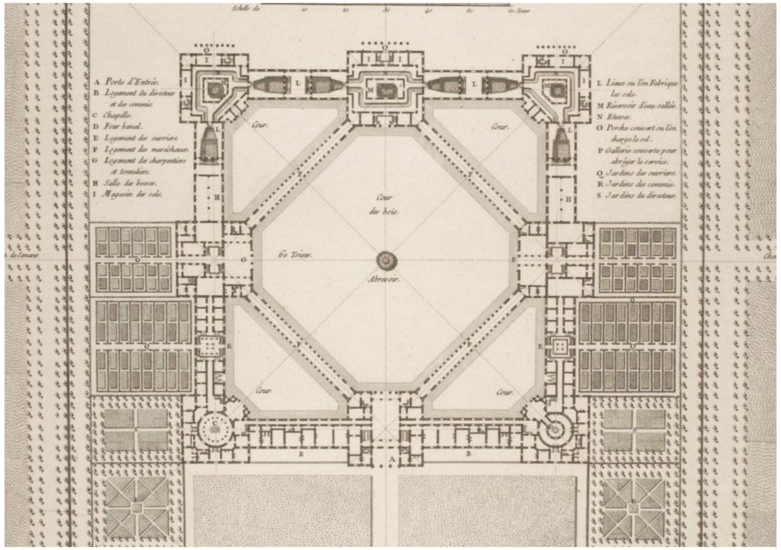
On the other hand, in recent years, urban manufacturing has become more frequently discussed in the academic realm. The term "productive city" began to be used as a new concept for developments that focus on integrating the production of material goods into the urban fabric. The productive city concept is characterized by many economic, environmental, and social benefits. For instance, it provides jobs for the often workers lacking higher education, reduce commuting to work and thus reduces CO2 emissions, and a learning environment (Novy, 2022).

Nonetheless, the idea of mixing manufacturing and living is a concept that has been introduced previously. In fact, one of the first examples of such a mix is seen in Medieval English houses (Holliss, 2015) and 17th Century Amsterdam Canal houses (O'Sullivan, 2020) where living and manufacturing, shops, or warehouses are combined under one roof. Later in history, as much as a clear distinction was established between work and living with the start of the industrial revolution, there was a peak in scale and objective in the mixed-use projects that existed. For instance, The Ideal City of Chaux, or Olivetti's Ivrea can be seen as an extension of the city that seeks to create the "ideal environment" for workers and improve production efficiency.

Worker's Village

The Ideal City of Chaux by Claude- Nicolas Ledoux, is a proposal for a new city that creates a healthier, happier, and more productive environment for employees. The design process consists of two plans; the first plan for this project emphasizes the living and manufacturing quarters (figure 7). Displaying a gateway at the southern side while keeping the residential buildings of the director on both sides. Furthermore, the plan's outskirts are occupied with a variety of functions, the chapel and the bakery towards the South and the salt production spaces towards the North. Eventually, worker's housing takes place in the middle sides of the proposal putting them in a clear sightline from the employer's view. The second proposal aims for the same productivity gains by employing a different strategic layout. In this plan, the director's house is situated in the middle of the plot provided with maximum control and observation over the production, highlighting the importance of efficiency (figure 8). Next to that, efforts were implied with the aim of improving the workers' living situation by adding orchards, kitchen gardens, daylight orientation, and buildings of common use. (Kaufmann, 1952).

A similar application of architecture to improve the living standards of workers for the broader aim of efficient productivity is visible in Ivrea. Ivrea is based on Adriano Olivetti's thoughts of how the factory could be the focus for the new ideal community which counteracts the fragmentation of modern society. As visible in figure 9, the project offers an extensive mix of functions including; living, working, and learning units while housing various service systems for the residents. Such as a nursery, social center, canteen, recreational center, and research center (Bonifazio and Scrivano, 2003).



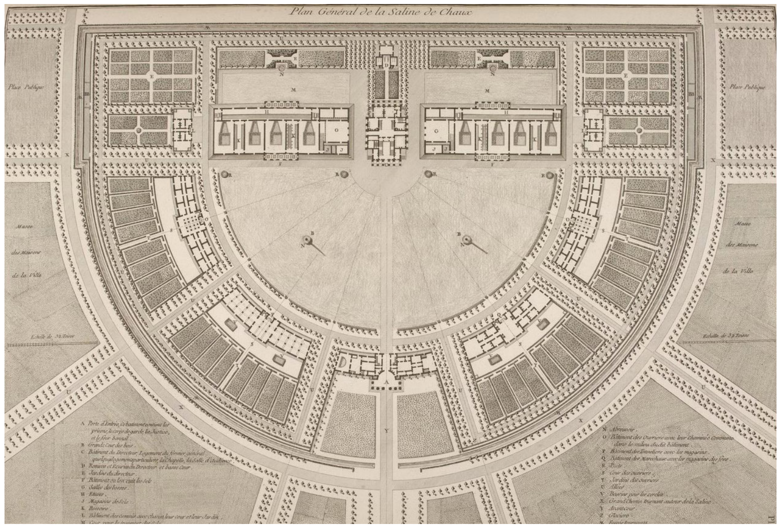


Figure 7. Saline de Chaux , First Plan (Ledoux, 1804)
Figure 8. Saline de Chaux, Second Plan (Ledoux, 1804)

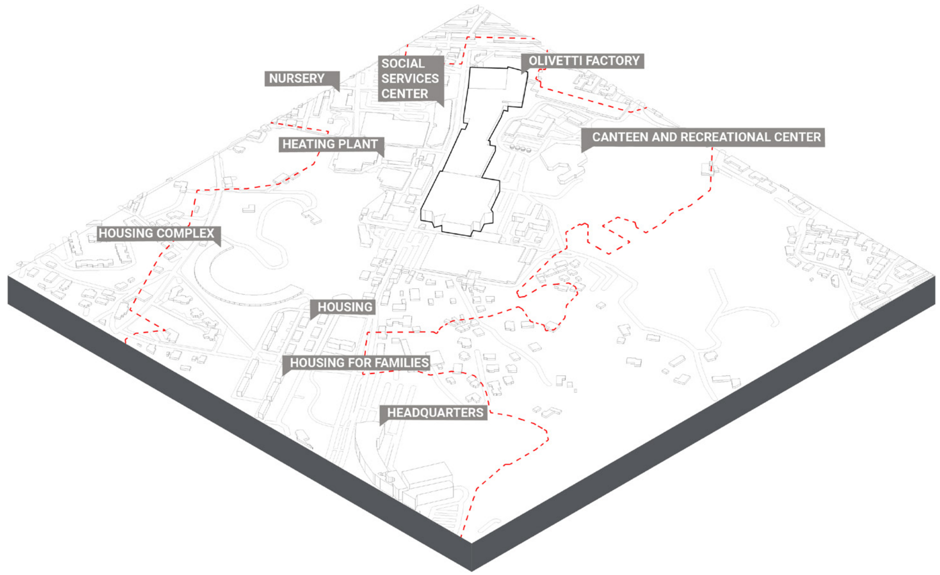


Figure 9. Functional Analysis of Ivrea

Contemporay Mixed-Use Projects

In contemporary mixed-use designs, we see a shift from a focus on social sustainability and production efficiency to a focus on present-day issues such as circularity and energy efficiency. For instance, projects like Buiksloterham are profoundly different from past examples of multi-functional projects, where we see an emphasis on circular systems with the ambitions of reducing the energy demand and supplying the rest of the energy demand with only renewable resources that are mainly produced on-site, creating a circular material flow, and recovering and managing rainwater (Metabolic, Studioninedots & DELVA Landscape Architects, 2014).

Other contemporary projects are seen in many post-industrial cities such as Paris, where mixed-use developments combine production and living under one complex. In addition, in port cities such as Rotterdam, Amsterdam, and London we now see a greater connection between the port which we associate with trade and production, and the city (Meyer, 1999

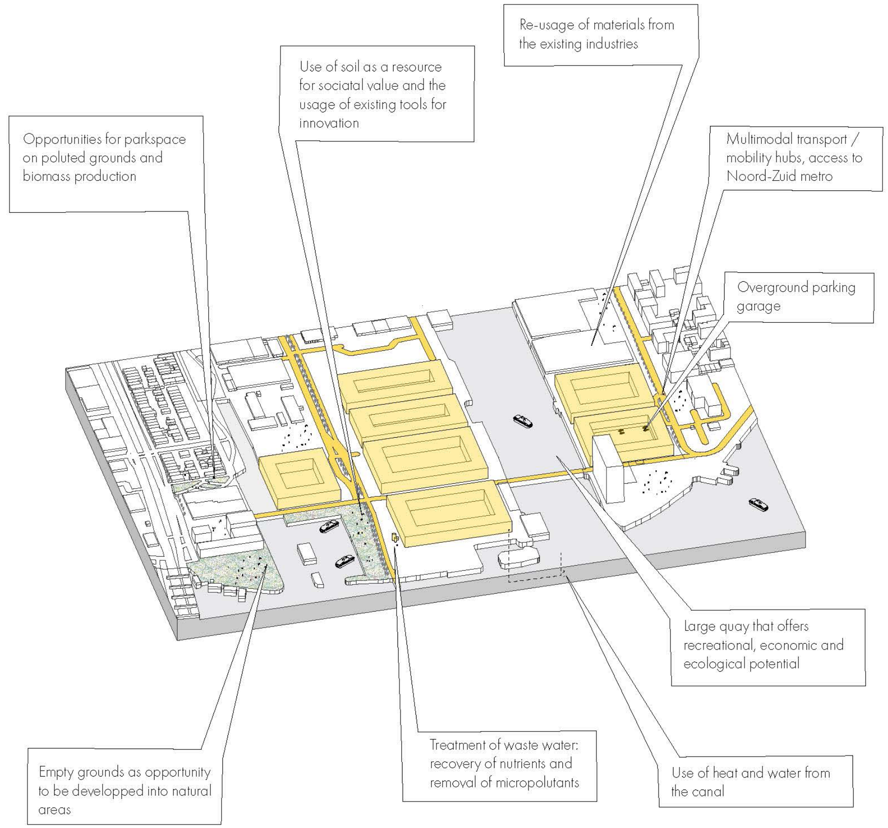


Figure 10. Urban Analysis, Buiksloterham/ Amsterdam

1.2 Merwe-Vierhavens

Merwe-Vierhavens is a port area in Rotterdam that is planned to become the "maker's district" where living and working functions are combined. This chapter starts by describing the historical evolution of Rotterdam's ports and follows with a site analysis of the Merwe-Vierhavens area.

The Boompjes

As in many port cities in The Netherlands, before the 17th century, Rotterdam was located within a system of dikes, and outside these dikes was the port. However, in the late 1700s and early 1800s, the economic activities of the city expanded beyond the dikes by raising sand flats outside the dikes. This new area created beyond the dikes was formed for future port-related functions and became even more significant than the old city behind the dikes. With this, a clear distinction between the city that remained behind the dikes and after the dikes were made. The city behind the dikes was called "Landstad" or "Polderstad", and the city outside the dikes was called "Waterstad". In Waterstad the loading, unloading, and storing of goods were made and the area also included other port-related industries such as shipyards, sailmaker's workshops, and ropewalks (Meyer, 1999).

As merchants and shipowners preferred the Waterstad area to build residences and offices over Landstad which was often crowded, a new relationship between the city and port was formed. This situation created a new concept of a public area called "Boompjes" (figure 11) where along the quays, a row of residential and office buildings fronted the water as in the rear the port-related functions were placed (Meyer, 1999).

However, as the role of the port started to change at the beginning of the 19th century, so did the spatial relationship between the port and the city. Ports gained more significance with their connection to developing industrial areas in England, North America, Germany, Northern France, and Wallonia. This meant that incoming goods had to be stored only for the short term, and transshipped as fast as possible. This change in the role of the port meant that the close relationship between the port and the city was no longer needed. Later, a more definitive separation between the port and city was created with the new railroads (Meyer, 1999).

Figure 11. The Boompjes, Painting by Carl Edward Ahrendts (1822-1898)

The Quest of Relinking Port and City

As Rotterdam's ports, which are often related to industrial uses, have a history of a close relationship with the city, which is often related to dwellings and offices, a similar vision of bringing industrial and residential functions together is visible in the new redevelopment plan of the Merwe-Vierhavens area. However, although the area has a history of a flow of goods through trains and ships, due to the changes in the industries that exist in the port and how they function, the area became slightly abandoned and the railways were disconnected. Currently, the existing situation of the area shows a clear distinction between the city (Landstad) and the port (Waterstad), where many of the city's amenities are separated from the industries in the port area with the dike and roadways (figures 12 and 13).

The disconnection between the M4H area and the rest of the city is not the only challenge of introducing the city functions into the area. An analysis of the existing buildings and how they relate to human proportions show that many of the existing urban ensembles on site consist of very big blocks of buildings with not enough public space (figure 14). For instance, the area exhibits many vacant warehouses that block access through the plot for pedestrians. This means that a new solution to keep the functions of the existing industries but also to provide through-block access to pedestrians is necessary. In relation to the lack of through-block access, in the early stages of the design, my team for the master plan design and I proposed an example building block with a courtyard above the plinth (figure 16). With this, we aimed to find a form of a building block that accommodates industrial uses by also keeping the site walkable for pedestrians.

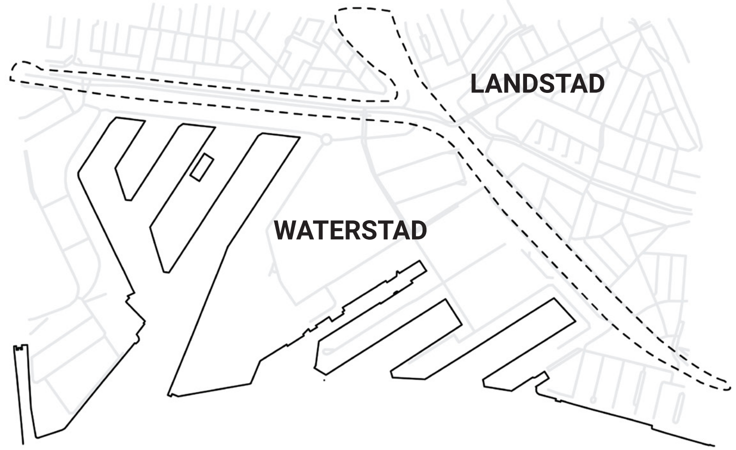


Figure 12. The separation between Landstad and Waterstad in the M4H area.

Figure 13. The disconnection between the city and Merwe-Vierhavens

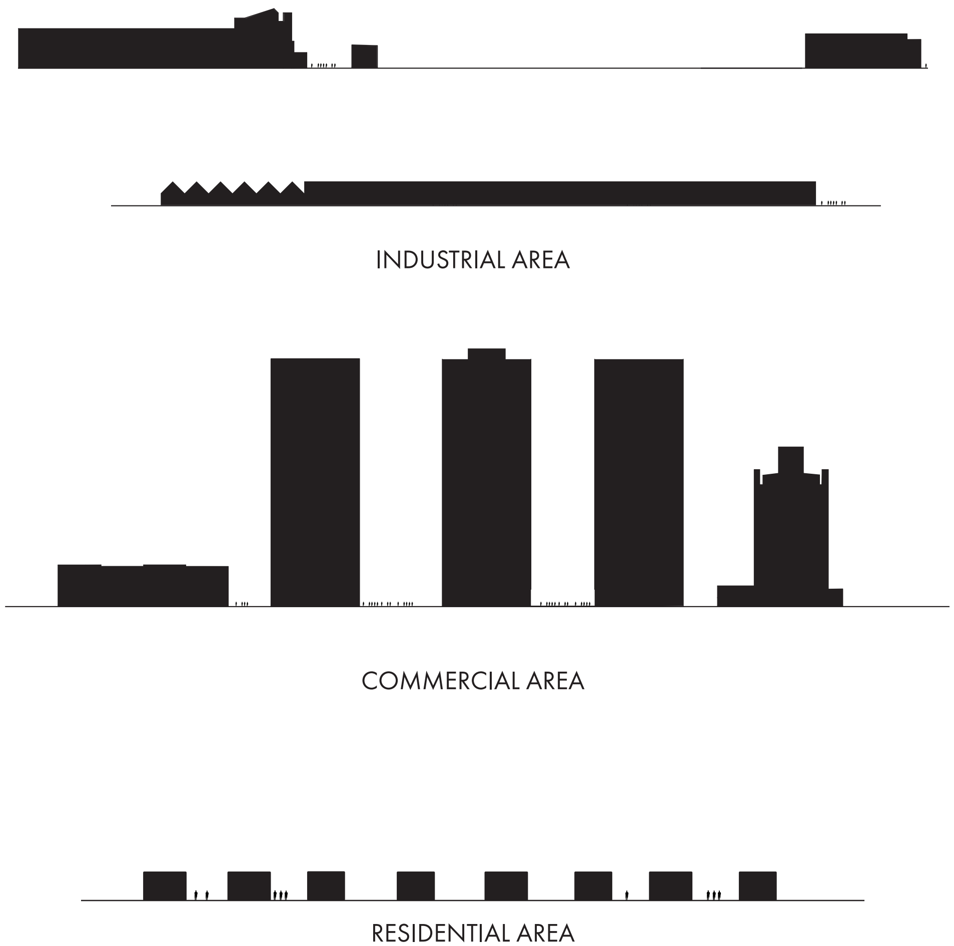


Figure 14. Analysis of the building proportions in the Merwe-Vierhavens area and its surroundings

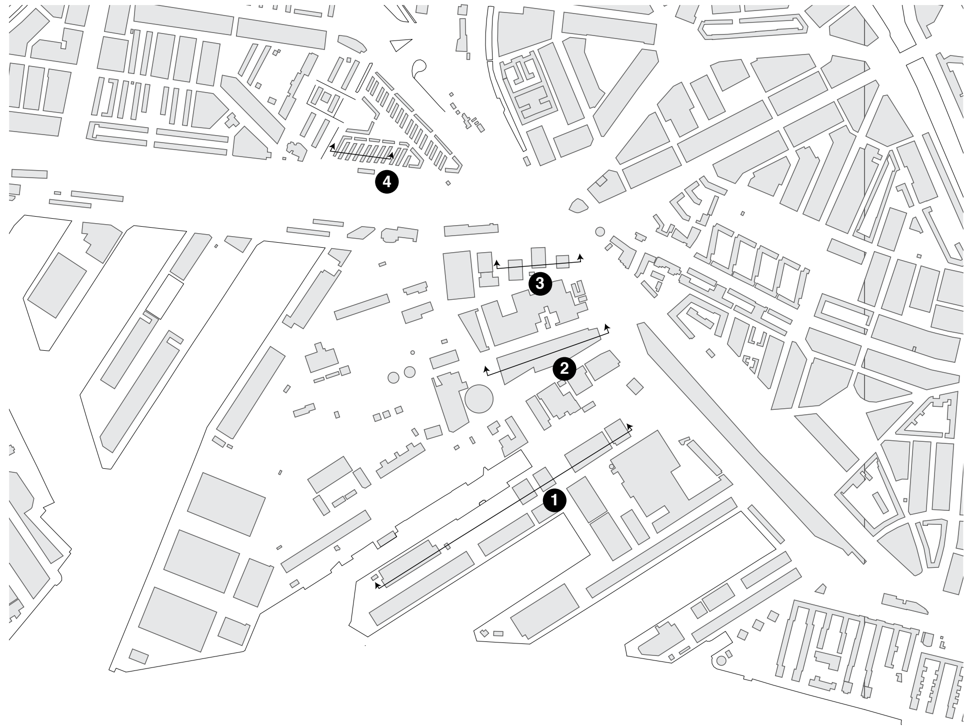


Figure 15. Keymap, Urban Ensembles

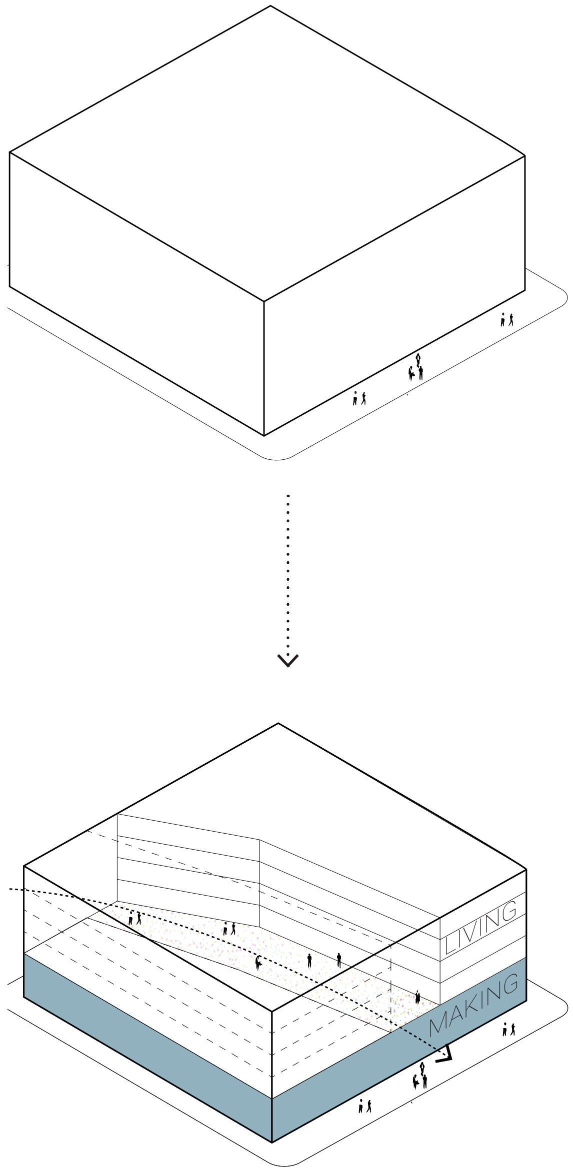


Figure 16. Mass propsal, through-block access

1.3 Conflicts and Public Spaces

As also demonstrated in the analysis of the Merwe-Vierhavens area, in the quest of relinking the port and city, we can expect many conflicts between residential and industrial functions as they require different block sizes and infrastructure.

Considering the conflicting nature of these functions, one might expect a clear separation between dwellings and production spaces in order to avoid any friction between the different users. In this case, the theories of Frank Van Klingeren become relevant. In his designs of multifunctional buildings, Van Klingeren includes a few partition walls between the different functions. Often, this design decision causes friction between the different users of these buildings. He argues that this decision of the lack of separation between the functions is essential to create a community. He sees a social potential in these frictions, according to him, these frictions initiate meetings and communication between the users in order to find a solution (Ende, 1967).

A common denominator in the mixed-use projects that were mentioned in this chapter is the presence of public spaces and facilities. Especially in the case of Rotterdam, The Boompjes played a very important role in creating quays that combined industrial activity and public spaces. Perhaps, the conflicting nature of the industrial activity and dwellings is the reason for the emergence of new public spaces such as the Boompjes.

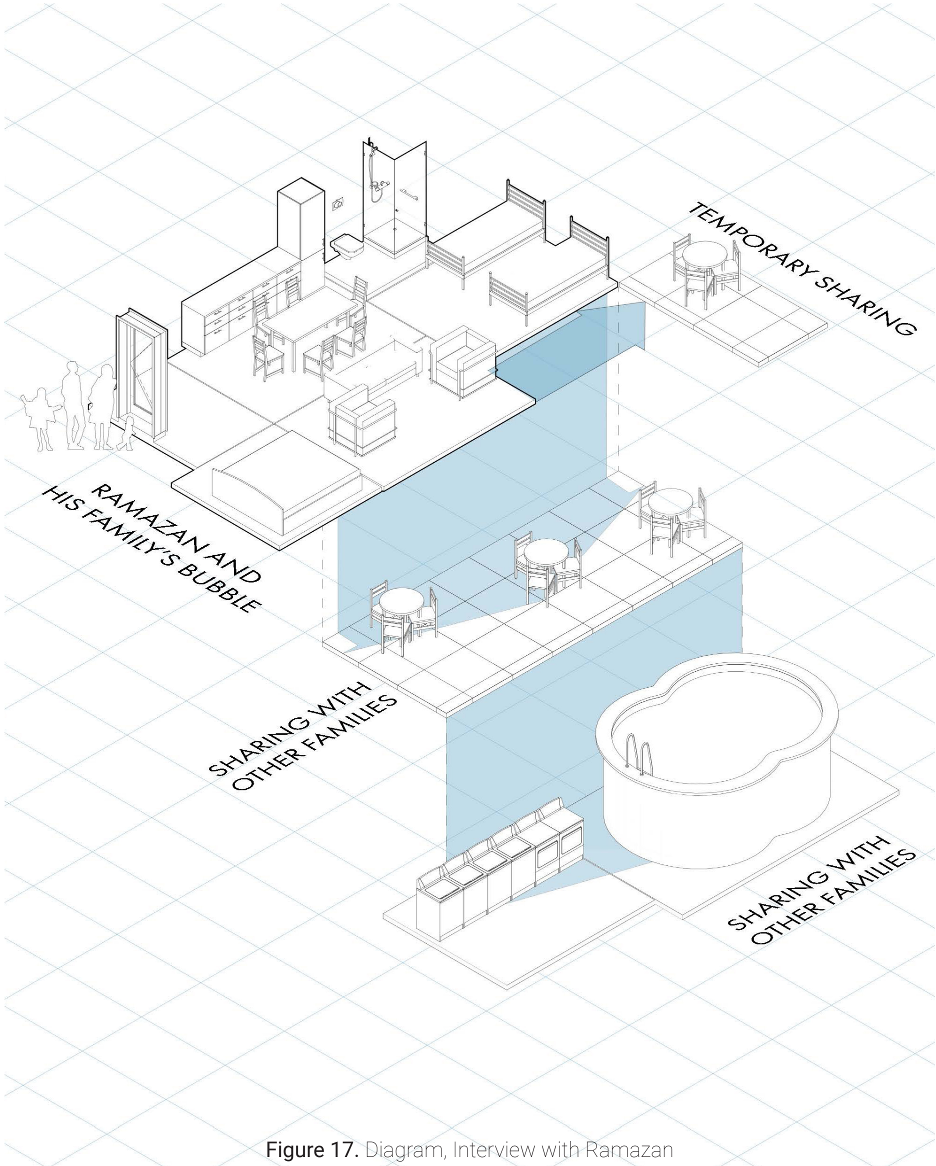


Figure 17. Diagram, Interview with Ramazan

/ 02 AFFORDABILITY AND USER BEHAVIOR

In this report, I proposed a combined model of cooperative co-housing and nearly zero-emission buildings as a solution to achieving affordability and thus contributing to the working and living development planned in Rotterdam. This chapter looks at how cooperative co-housing and nearly zero-emission buildings contribute to affordability and what the limits and social potentials of practices of sharing and thermal comfort are.

2.1 Affordability and Sharing

Sharing is at the very core of any kind of cooperation. The kind of shared property in the cooperatives can be explained as a blend of rental tenure and ownership. This means that each member owns a share of the cooperative which includes the land, building, and common areas. At the same time, each member of the cooperative pays a monthly fee to occupy a housing unit in the building (Kockelkorn & Schindler, 2020).

As well as sharing the property, the members of the cooperative also share labor and resources and co-govern the cooperative. These three different concepts of sharing influence the spatial composition of cooperative buildings. For instance, cooperatives often consist of large collective spaces and even the hallways are designed to contribute to the interaction of the users. In many of these examples, members of cooperatives gain access to more amenities through sharing. The provision of access for all members to certain amenities reduces the size of dwellings and flexibility in apartment arrangements that provide the members with apartment typologies that meet their housing needs (Kockelkorn & Schindler, 2020).

Often, it is possible to see atypical forms of living together within cooperative co-housing. This is due to the form of rent calculation called "cost-rent" that keeps the rents in the cooperatives below the market rents as it does not generate profit and calls for subsidies. Therefore, in the context of a dynamic housing market with less risk of vacancies, in contrast to developers who aim for profit, housing cooperatives have the ability to explore new and innovative ways of communal living (Kockelkorn & Schindler, 2020).

In this part of the report, the different possibilities of apartment arrangements that coincide with the needs of the users and their relation to communal spaces are explored through two case studies of cooperatives; San Riemo and Holunderhof.

Case Study/ San Riemo

Location: Munich
Program: Cooperative Housing
Year: 2017 - 2020
Architect: Arge Summacumfemmer, Büro Juliane Greb
Client: Cooperative Grossstadt eG

San Riemo is a residential cooperative project located in Munich. The building consists of seven floors including an underground parking space and an additional rooftop terrace. The ratio of public and private space and the sizes of the apartments and collective spaces differ on each floor (fig.18) (Lengkeek and Kuenzli, 2022).

As visible in figure 19, the ground floor consists only of public and collective spaces; rentable workshops open to the public, a cafeteria, a guest studio, and a space for an organization committed to supporting underprivileged young people. The ground floor also allows direct access to the building's cores through two different entrances.

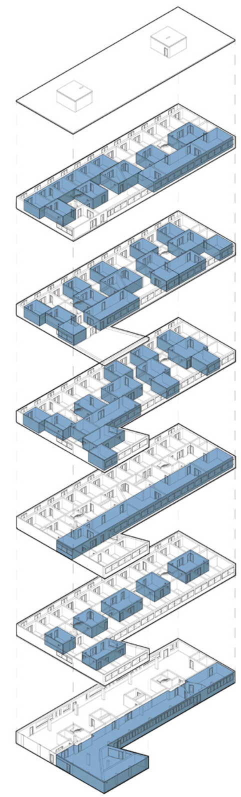


Figure 18. San Riemo, Communal Spaces

Communal spaces

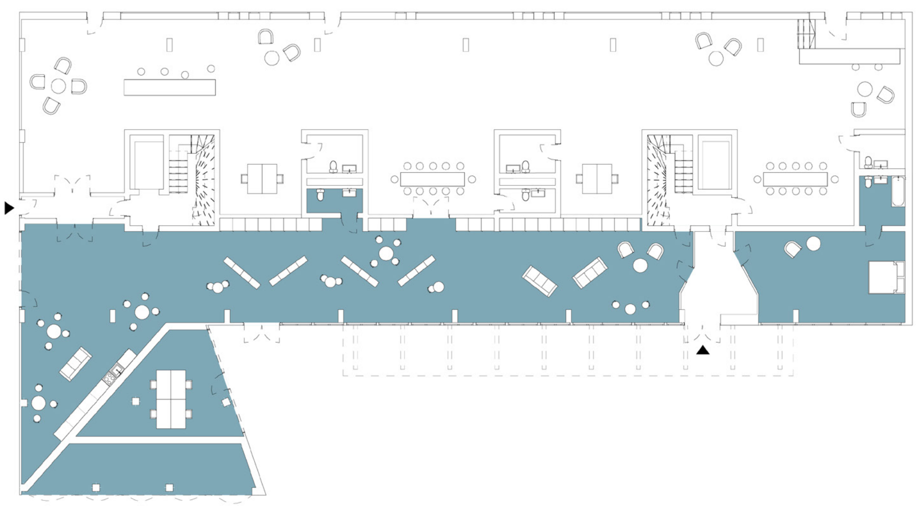


Figure 19.. Program, Ground Floor - San Riemo /Munich

Public Access

Collective Spaces

The first floor mainly consists of shared apartments (figure 20 and 21). On the south side of the building, two types of shared apartments are visible; one consisting of two bedrooms, a shared toilet, and a shared kitchen; and one consisting of four bedrooms, a collective living room, a kitchen, and two toilets. These two apartments can be accessed through the core on the south side. The middle part of the building, which can be accessed through both of the cores, consists of ten bedrooms, 4 toilets, one kitchen, and a living room. Finally, the apartment on the North side consists of six bedrooms, two toilets, a kitchen, and a living room. This apartment can be accessed through the core on the North side.

The second floor consists of family apartments and apartments that contain one bedroom, a kitchen, and a toilet within them (figure 23). All of these apartments are connected to each other with a living area placed linearly on the East facade (figure 22). At times, this living room acts like a hallway between the apartments as on this floor, some apartments can not be accessed directly from the cores. This is visible on the North side. While two of the apartments can be accessed through the core, the other one can only be accessed through the communal living room. Another example of such access through the living room is seen in the apartment with a single bedroom placed in the middle of the floor. Although this could be impractical at times, it may initiate an interaction between the different users.

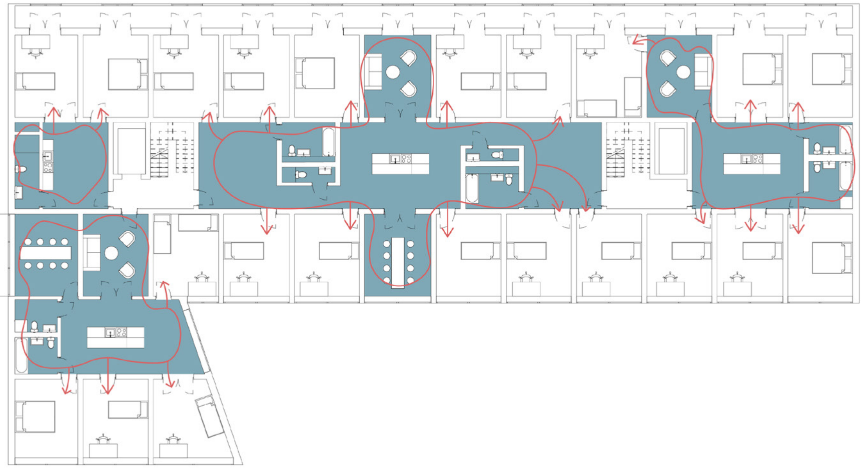


Figure 20. Shared Spaces, First Floor - San Riemo /Munich

Figure 21. Apartments, First Floor - San Riemo /Munich

Collective Spaces
Type 1
Type 2
Type 3
Type 4

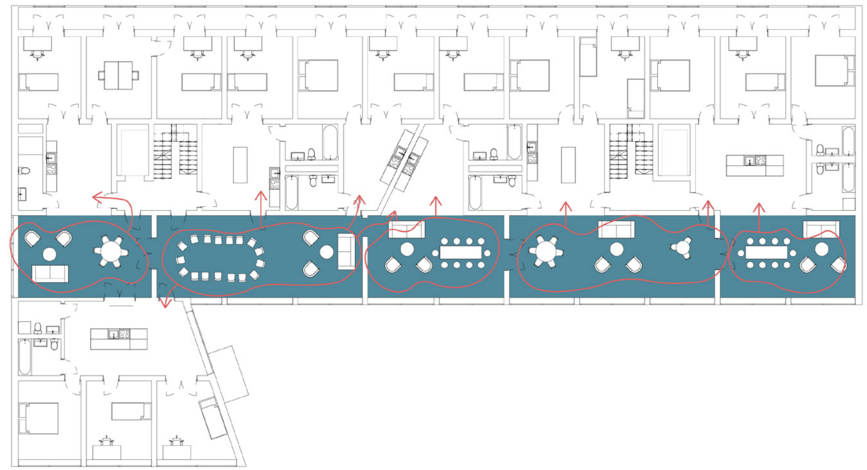


Figure 22. Shared Spaces, Second Floor - San Riemo /Munich

Figure 23. Apartments, Second Floor - San Riemo /Munich

"Staircase room"
Type 1
Type 2
Type 3
Type 4
Type 5

On the third, fourth, and fifth floors, a similar communal room of the family apartments, connects different cluster apartments to each other (figures 24, 25, and 26). Oftentimes, this communal room allows access to an apartment that doesn't have separate access. This room is described as a "staircase room" and the residents can decide how they want to use this room (Büro Juliane Greb, 2021).

I find the most distinctive quality of San Riemo to be its experimental nature that explores many different ways of living together. As seen in figure 27, typically, each of the floors is organized to fit the grid that divides the floor into three fragments; a row of rooms on both sides and kitchens and bathrooms in the middle. The non-load-bearing walls that separate each room allow for an adaptable ratio of communal spaces and private spaces according to the needs of the users. The flexibility of communal functions connected to the cores in various ways allows for a variety of communities to exist under one roof.

Figure 24. Shared Spaces, Third Floor - San Riemo /Munich

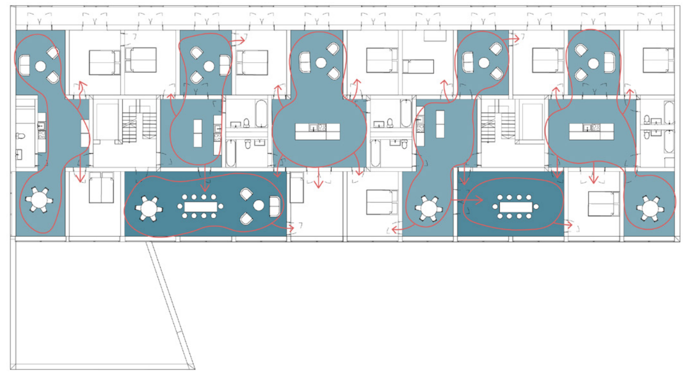


Figure 25. Shared Spaces, Fourth Floor - San Riemo /Munich

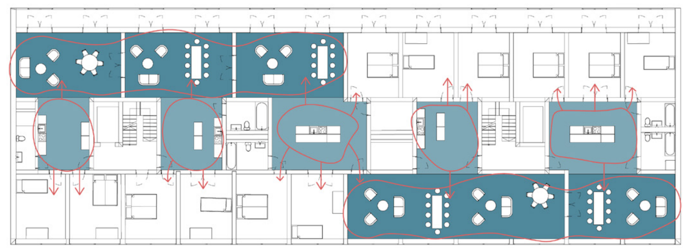


Figure 26. Shared Spaces, Fifth Floor - San Riemo /Munich

"Staircase room"
Collective Spaces

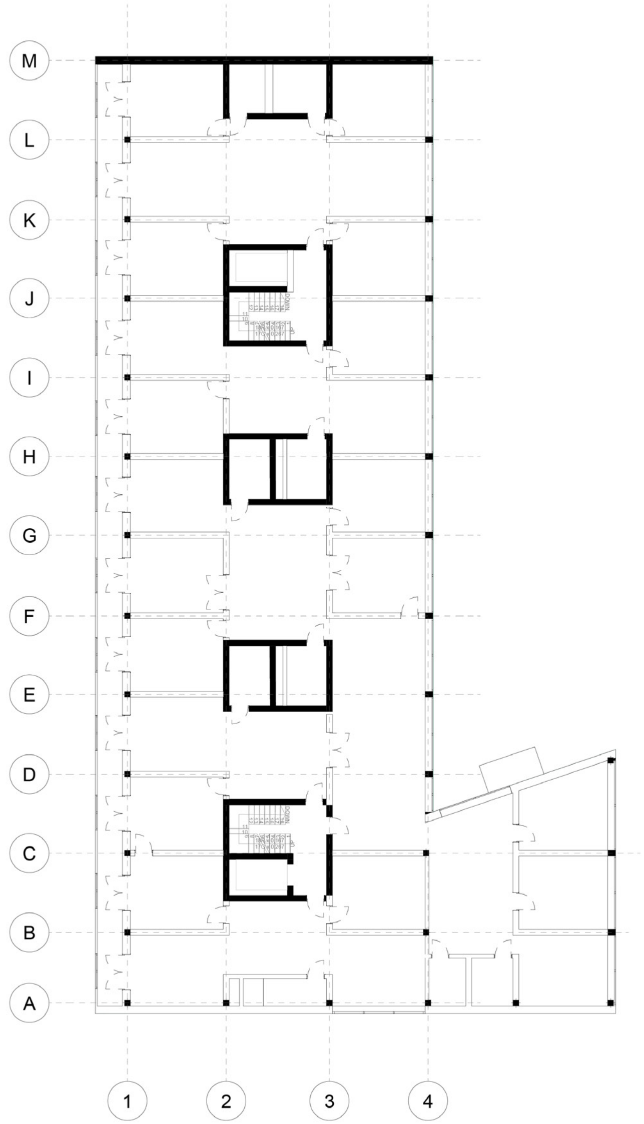
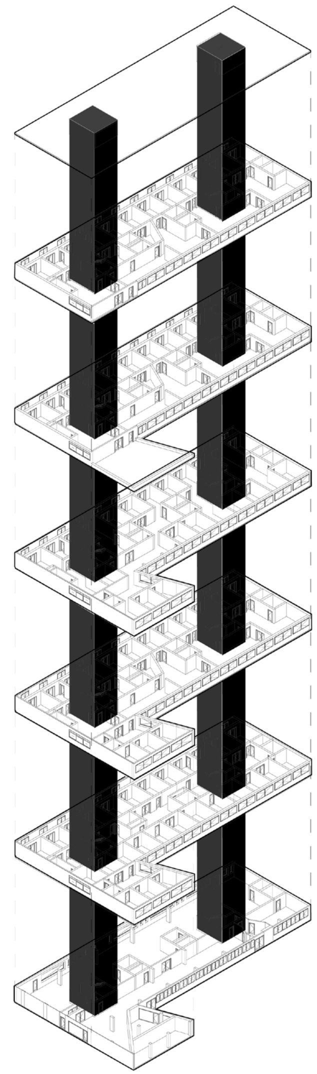


Figure 27. Structural Grid - San Riemo /Munich

Structural elements ■



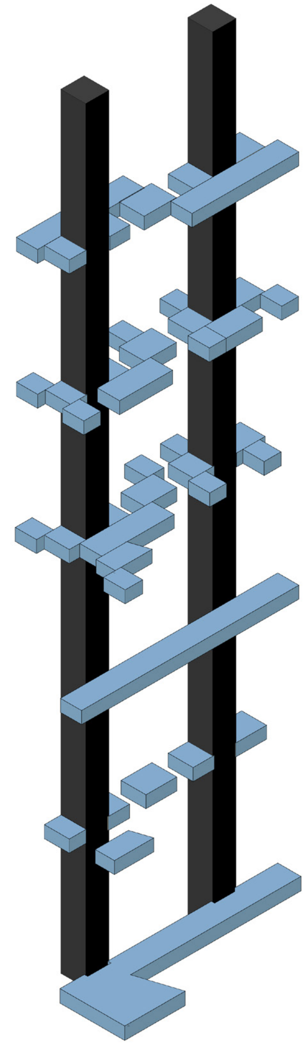


Figure 28. Vertical Access (Cores) - San Riemo /Munich

Figure 29. Vertical and Horizontal (Communal Spaces) Access- San Riemo /Munich

■ Vertical access (building cores)

■ Horizontal access (communal spaces)

Case Study/ Holunderhof

Location: Zurich
Program: Cooperative Housing
Year: 2016 - 2018
Architect: Schneider Studer Primas, Architekten GmbH-
Client: Non-profit building cooperative Röntgenhof Zurich (GBRZ)

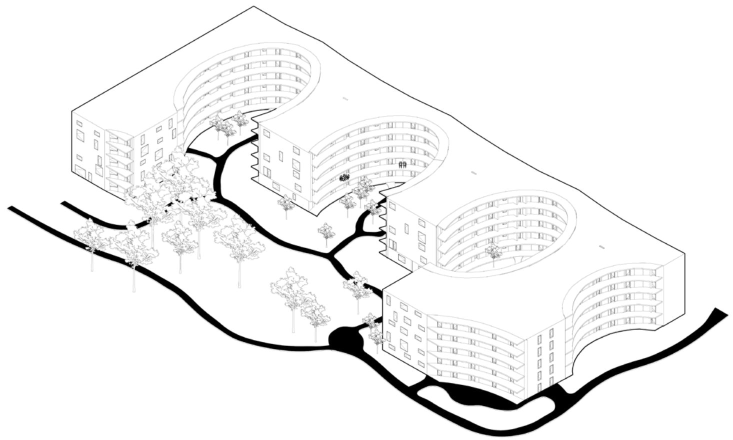


Figure 30. Public Space ,Holunderhof /Zürich

Public Access

Holunderhof is a residential cooperative project located in Zurich. The building has six floors including underground parking that is open to the public and each floor consists of four apartments and a communal terrace (Lengkeek and Kuenzli, 2022).

On the ground floor, the building provides a public daycare center for the public and is accessible through a big communal garden (figure 31). The building consists of seven entrances that allow direct access to six cores that lead to the apartments on the upper floors.

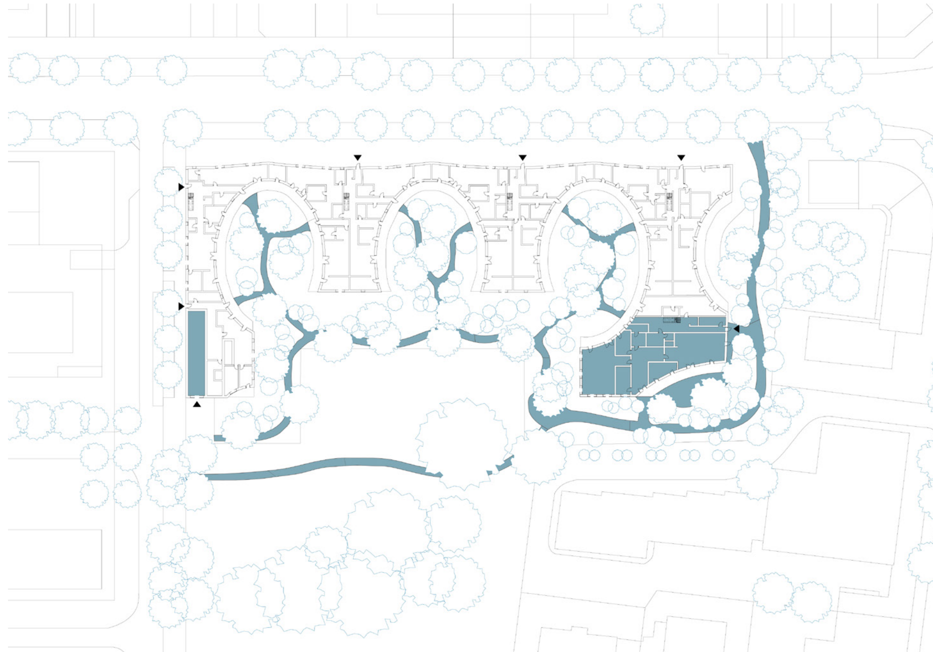


Figure 31. Collective Functions on The Ground Floor ,Holunderhof /Zürich

Collective Spaces

As visible in figure 32, a typical floor consists of four apartments with two to three bedrooms, an open kitchen, a living room, and a living room. Each of these apartments caters to families and allows access to a shared terrace. This shared terrace consists of four fragments that are separated from each other with a thin wall that prevents access from one to another.

When compared to San Riemo, Holunderhof provides fewer shared amenities to its users. In addition, the apartment configuration and the relationship between the private and public spaces are flexible on each floor in San Riemo, while Holunderhof has a very rigid and repetitive apartment configuration on each floor and a very clear distinction between the public and private spaces.

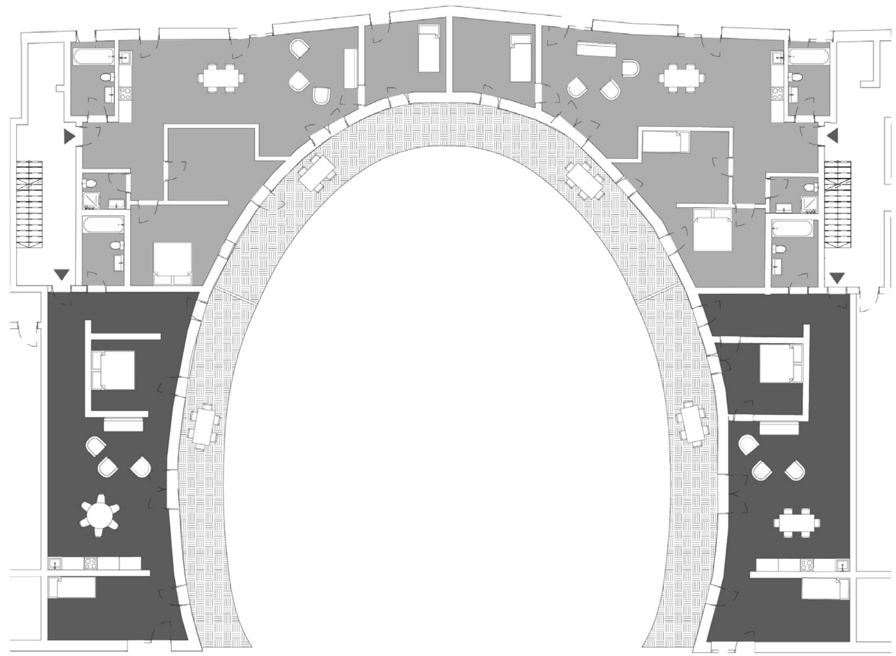


Figure 32. Apartments, Typical Floor - San Riemo /Munich

Holunderhof is not distinctive in the way the shared spaces benefit the residents but instead, with the focus on the quality of the outdoor space, demonstrates how a cooperative project can benefit the wider public. In addition, due to its orientation toward the sun and the shared outdoor space, we see a very open facade and balconies on the South side (figure 33). Although the building consists of family apartments with different orientations and sizes, each of these apartment types has access to an equal quality of daylight (figure 34).

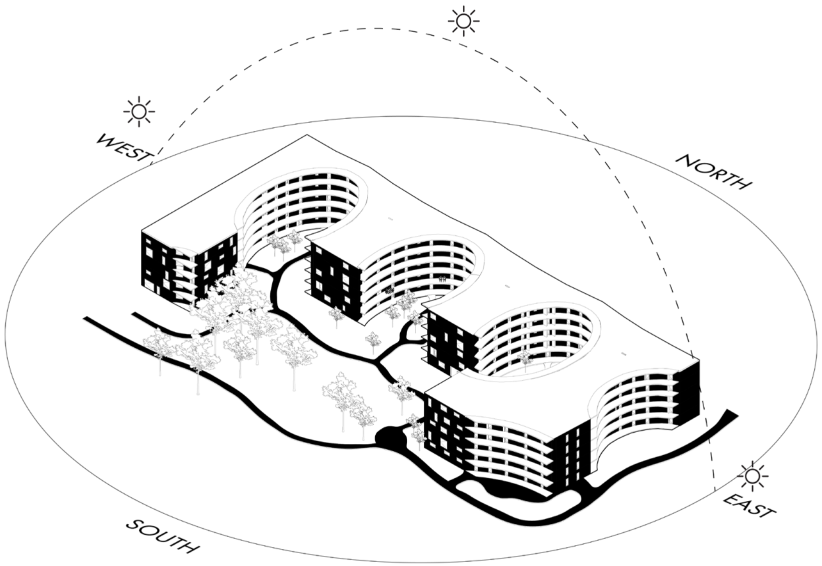


Figure 33. Orientation Toward the Sun - San Riemo /Munich

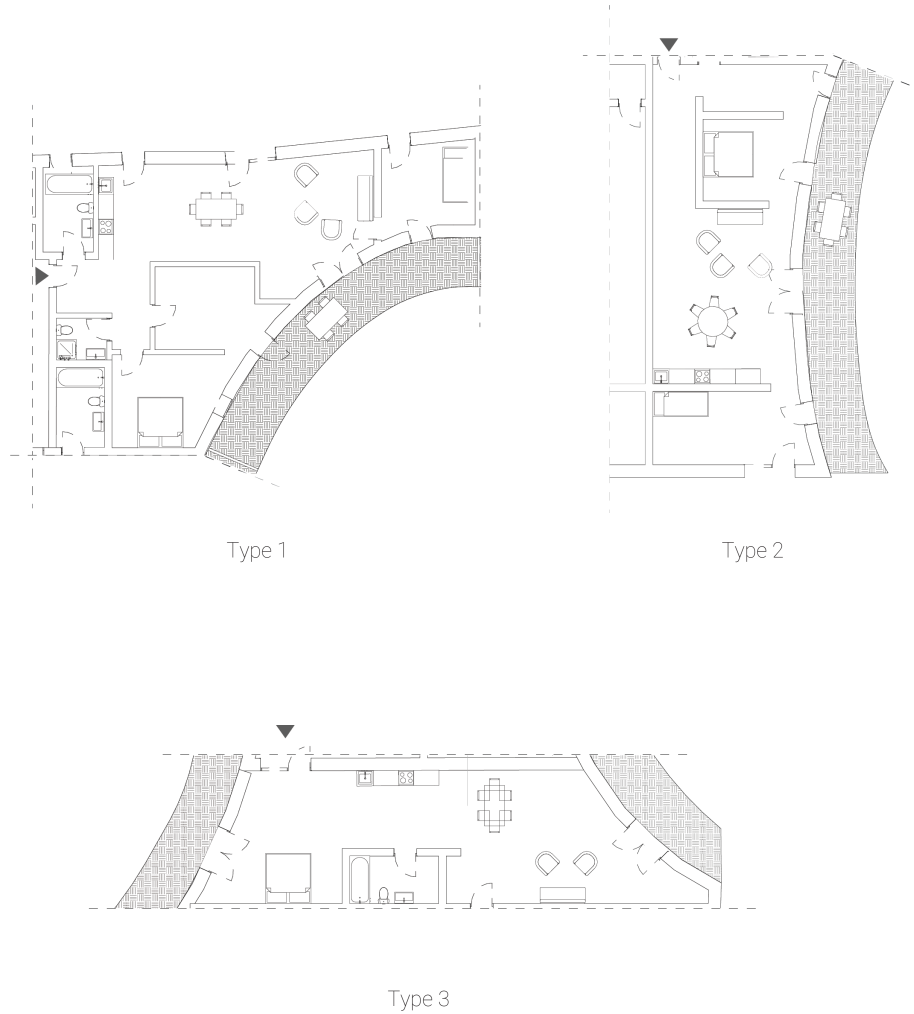


Figure 34. Apartment Types - San Riemo /Munich

2.2 Affordability and Energy Reduction

Nearly zero-emission buildings refer to buildings that are able to produce almost the amount of energy as the amount consumed over one year (Mlecnik et al., 2012). These buildings are also characterized by the integration of systems and insulation materials that reduce energy and heating demand. The energy demand is mostly covered by energy production from renewable resources through PV panels or solar thermal systems (Hernandez et al., 2019). Although there has been financial encouragement to make investments in order to integrate energy-efficient systems in households, such as income tax credits and tax-free loans in countries such as the US, low-income households remain less inclined to make these investments (Brown, Soni, Lapsa, and Southworth, 2020).

Project Soubeyran, a combined model of cooperation and nearly zero-emission building, is used as a case study in this report in order to explore how the systems that allow this energy production can be economically and architecturally integrated into the cooperative model.

Case Study/ Soubeyran

Location: Geneva
Program: Cooperative Housing
Year: 2016 - 2017
Architect: atba SA
Client: Cooperative Equilibre

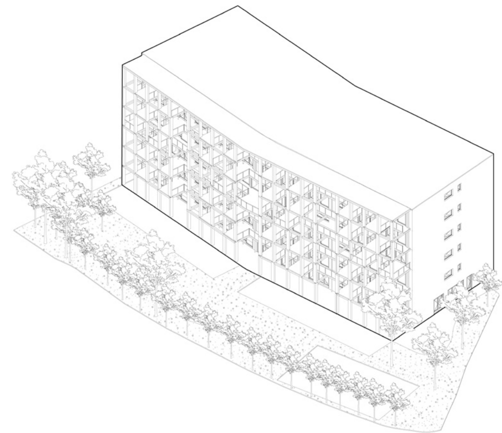


Figure 35. Open Space - Soubeyran /Geneva

In order to allow the energy produced on the roof through the PV panels to be directly consumed by the inhabitants of the cooperative, an energy production cooperative with the objective of creating a new form of legal status in Geneva was formed; la communauté d'autoconsommation (CA) (the self-consumption community). The electricity produced by the PV panels on the roof is primarily consumed by the residents, the rest is sold to Services Industriels de Genève (SIG), which sells it back to the community when the installation produces less electricity than required. The amount of money for the infrastructure of the PV panels was not included in the budget for the building construction but instead, a new participatory energy cooperative was created; EnerKo. The future inhabitants of the cooperative were asked to take part in the investment, and thus became members of two communities; CA and EnerKo (Coopérative equilibre, 2021).

The building consists of six floors and a rooftop terrace. While the rooftop terrace can only be accessed through the central stairway, the other floors can be accessed with three vertical cores connected to the communal spaces, entrances of the building, and the garden. In addition, the project provides its inhabitants with parking spaces for bikes and cars (figure 36).

Figure 36. Ground Floor - Soubeyran / Geneva

As visible in figures 37, 38, and 39, a typical floor consists of one-bedroom apartments and three types of shared apartments that can be accessed through one of the three cores. On these floors, vertical cores solely allow access to the different apartments. As visible in figure 40, different from a typical floor, a horizontal connection between the three vertical cores exists on the third floor. This corridor provides access to shared apartments, individual apartments, a common terrace, and a common laundry room. This horizontal corridor, with its connection to the communal areas, becomes a space for interaction rather than only a space for access. The configuration of the apartments also creates a visual and physical connection between the users as they face each other. This configuration also allows for the living rooms of most apartments to face South (figures 41 and 42).

Other than the configuration of the apartments, additional technical installations and architectural solutions are seen in figure 43 that reduce the energy demand of the building. One of these technical installations includes a heat recovery system that allows the usage of the extracted air for heating and providing hot water. The rest of the energy comes from the gas boiler. As for electricity, photovoltaic panels allow for a direct consummation of solar energy. In addition, the configuration of the balconies allows for them to block the sun during summer and allow it during winter. Still, the energy demand of the building is higher than the energy produced in order to provide good thermal comfort for the users (Coopérative equilibre, 2021).

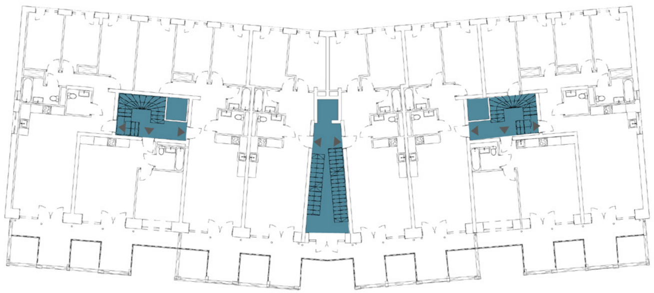


Figure 37. Horizontal Access, Typical Floor - Soubeyran / Geneva

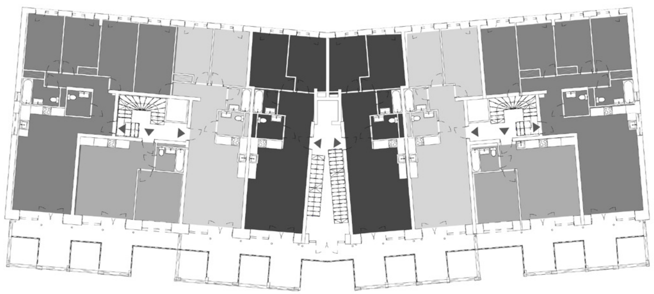


Figure 38. Apartments, Typical Floor - Soubeyran / Geneva

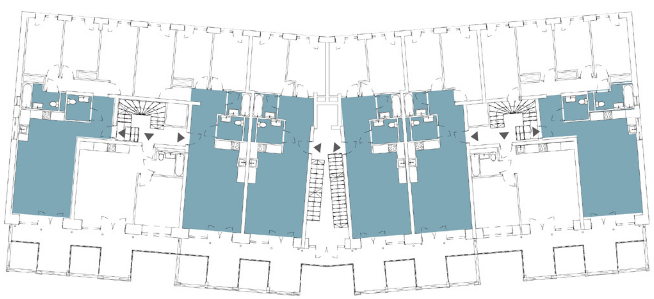


Figure 39. Shared Spaces, Typical Floor - Soubeyran / Geneva

Horizontal access
Collective spaces
Shared: Type 1
Shared: Type 2
Shared: Type 3
One Bedroom

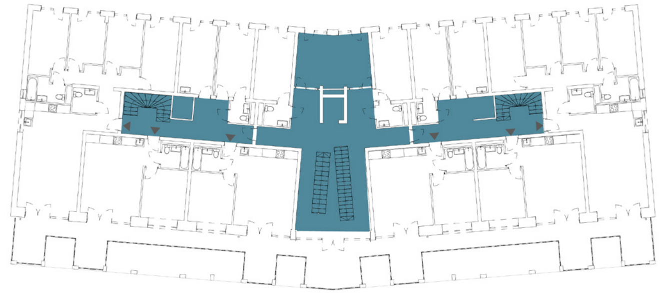


Figure 40. Horizontal Access, Third Floor - Soubeyran / Geneva

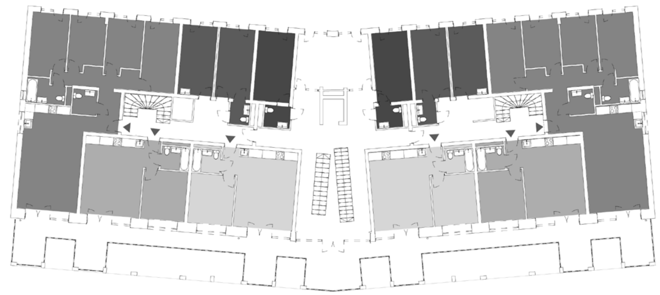


Figure 41. Apartments, Third Floor - Soubeyran / Geneva

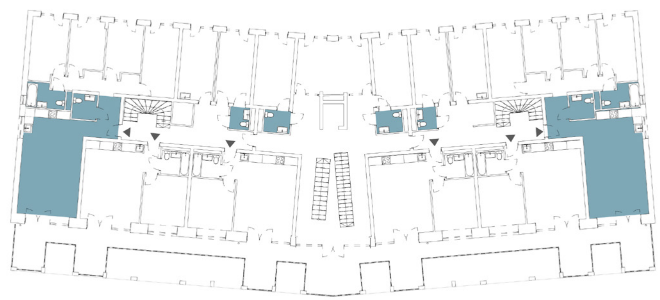


Figure 42. Shared Spaces, Third Floor - Soubeyran / Geneva

Horizontal access
Collective spaces
Individual
Shared: Type 1
Shared: Type 2
One Bedroom
One Bedroom

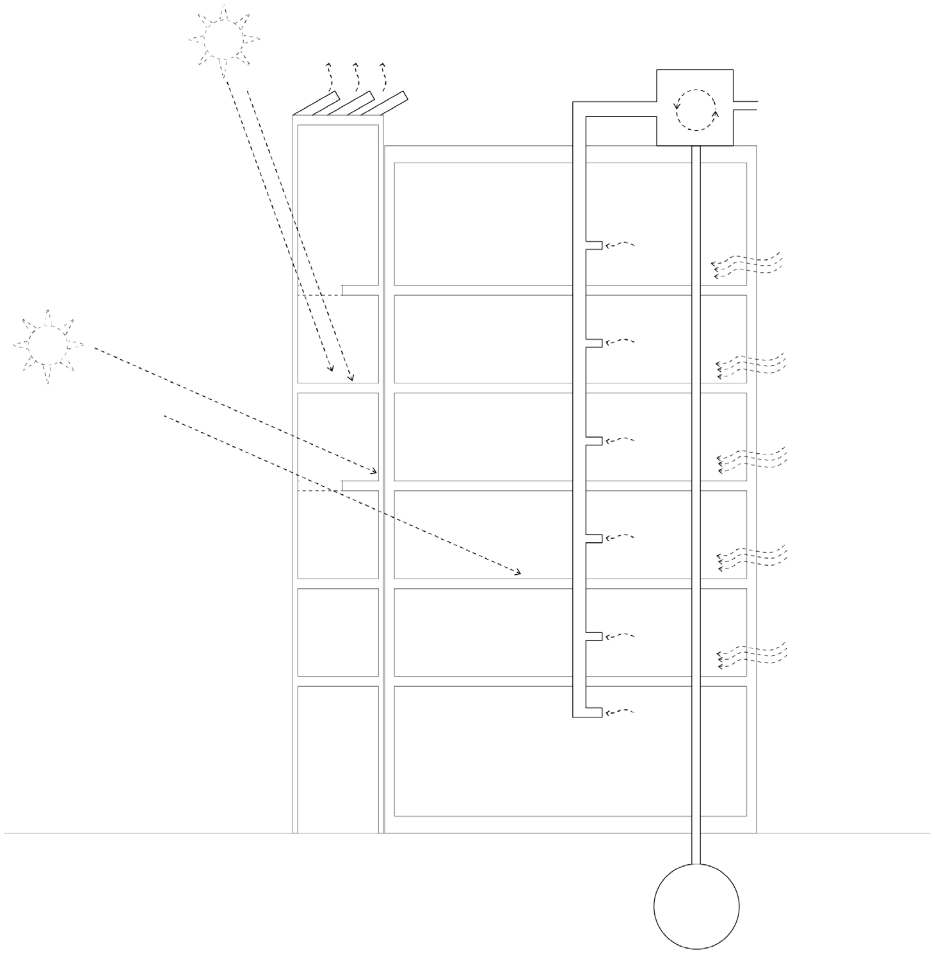


Figure 43. Climate Design, Soubeyran / Geneva

Social Potential and Practices of Thermal Comfort

The topic of thermal comfort is also important to mention as it is often mentioned for the evaluation of energy-efficient buildings. This is due to the fact that often, energy-efficient buildings allow less control over the temperature or the ventilation. In return, the thermal practices of the users, for instance, higher energy consumption, or opening windows during winter, could also result in the bad performance of these buildings. However, people are also willing to change their behavior when they are educated about the building operation (Thomsen et al., 2013). Therefore, rethinking the topic of thermal comfort and understanding the thermal practices of the users was important to improve the building design.

When reconsidering the topic of thermal practices and thermal comfort, the article of Sascha Roesler and Madlen Kobi with the title " Urban Climate Indoors: Rethinking Heating Infrastructure in China's Non-Heating Zone" becomes relevant. The article explores China's Great Heating Divide (GHD) where the country's thermal standards are evaluated based on the geographical situation and not the thermal situation. This means that in north China, where it's colder during winter, a heating network is present. However, south China lacks a thermal infrastructure which means that the users are responsible to find the means to heat their houses. This political decision based on the Huai River Heating Policy creates thermal inequality in southern China since it is difficult for low-income households to solve this problem without depending on the government (Roesler & Kobi, 2020).

The article also describes the thermal practices of a resident who lives in southern China, Wu Song, based on an ethnographic case study. For Song, cooking is the only time he finds thermal comfort; "[...] Around lunch, I am cooking, then I am eating. Only then do I feel really warm. After that, I usually go out or sit down again and then I start cooking again. Look, here in the kitchen is a mobile hotplate. I sometimes put it on the table and then I put the food on it. When the hotplate is on the table, it also warms me a bit. Food is an important warming source." The case study also shows the importance of certain objects used by Wu Song in order to stay warm such as; a blanket, an infrared heater, and a thermos with hot water. According to Song, he only uses the heater in the living room when he has visitors (Roesler & Kobi, 2020). This is also an example of how a space with a comfortable thermal quality can gain social potential.

2.3 Interviews

Considering that there is a lack of single-person households in the M4H area and the potential vulnerability of the low-income families that live around the area to the development of the area, I have identified them as my main target groups. In order to understand the needs and desires of the different users to provide housing and workplaces, I held interviews with these groups where I focused on their daily routines and thermal practices. I held these interviews with two people as representatives of these target groups; Ramazan and his family, a low-income family, and Romina, a solo dweller.

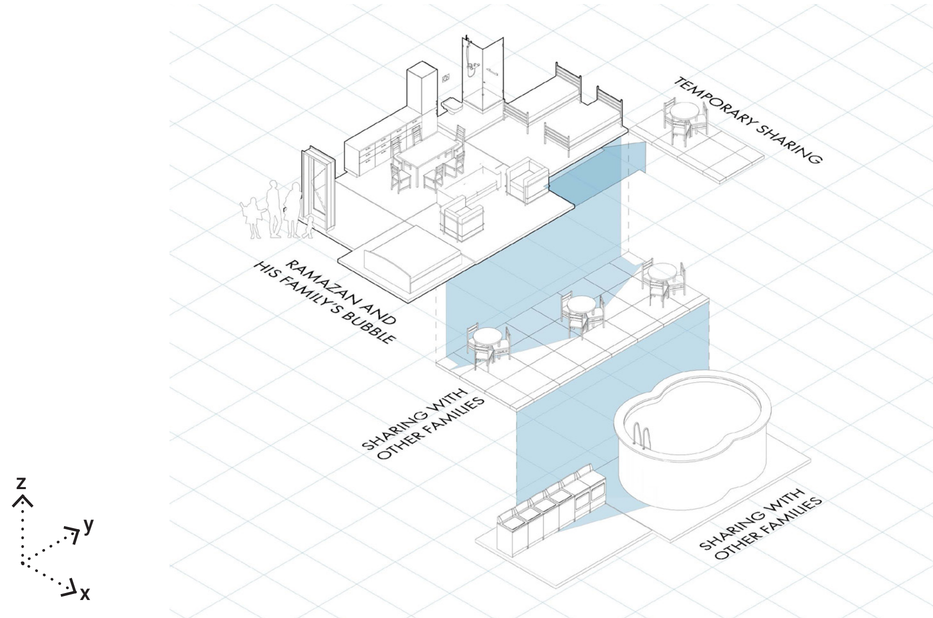
Ramazan and His Family

Upon visiting Ramazan and his family's apartment, I visualized my conclusions in figure 44 and 45. While one of these interviews focused on their needs and limits for communal spaces, the other interview focused on their thermal practices.

As visible in figure 44, Ramazan's house is a two-bedroom apartment with a kitchen and a living room. According to Ramazan, he spends most of his time with his family in his kitchen, where they eat together and talk about their day, and in the living room, where day sit together and watch TV. As he also described his child's bedrooms and the toilet as the most private part of his house, he identified the kitchen, living room, and bedrooms as his "bubble". The bubble refers to the functions in the house that he is not willing to share with other people. He emphasized the significance of keeping the living room a part of his bubble despite it being used for when they have guests saying: " I only have an hour or two with my daughters where we watch a tv show before they lock themselves in their room again".

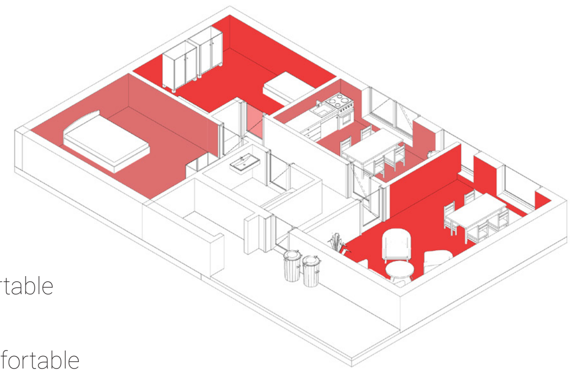
The arrows leading to the floors below refer to the amenities he is willing to share or have outside of his private apartment. He also doesn't mind moving vertically inside his building to use them. The shared amenities that he is inclined to share are; a communal terrace where he can smoke and interact with other people, a laundry room, and a pool. Although he thinks that the ratio of size and the number of people who use these spaces is important, he also mentioned that he would be willing to temporarily share smaller spaces such as a private terrace.

Figure 45, is based on the conclusions of the interview I held with Ramazan and his family about their thermal practices. According to Ramazan, they heat the living room, and his daughter's bedroom at all times. In order to reduce their electricity bills, they only heat their bedroom for a few hours before they go to sleep and they do not heat their kitchen as it usually stays warm after cooking.



Arrow, direction y: Access within the unit

Arrow, direction z: Vertical access (via the building core)



Thermally comfortable

Thermally uncomfortable

Figure 44. Conclusions, Interview With Ramazan and His Family - Sharing

Figure 45. Conclusions, Interview With Ramazan and His Family - Thermal Practices

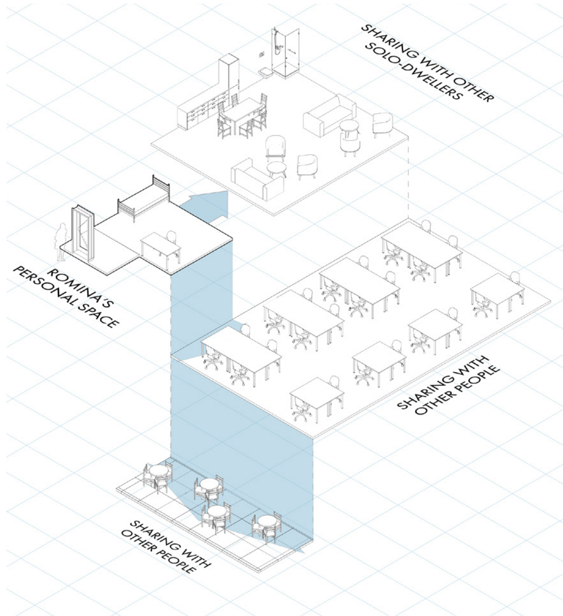
Romina Gurkan Saul

Upon talking to Romina and observing her daily routines while living with her, I visualized my conclusions in figure 46 and 47. While one of these interviews focused on their needs and limits for communal spaces, the other interview focused on their thermal practices.

According to Romina, she spends most of her time in her room when she needs her privacy to enjoy her free time, or to study. She is sharing the toilet, living room, kitchen, and a small terrace with me and our roommate. As she often finds it comfortable to also study in the living room or at her faculty, she says that she would be open to moving vertically inside her building for a shared study room. Furthermore, also believes that sharing a bigger communal terrace with other people could be useful as their household tends to neglect the plants on the terrace.

On the other hand, she believes that sharing some of the uses can be challenging at times and requires communication between the roommates. For instance, as we all wake up at a similar time, we oftentimes discuss the night before who gets to use the shower first. In addition, in times when one person needs more privacy, i.e parents are in town, boyfriend visiting from another city, informing the other roommate is also important. She believes that the living room being slightly oversized in our house helps her enjoy the space even in the times she needs more privacy.

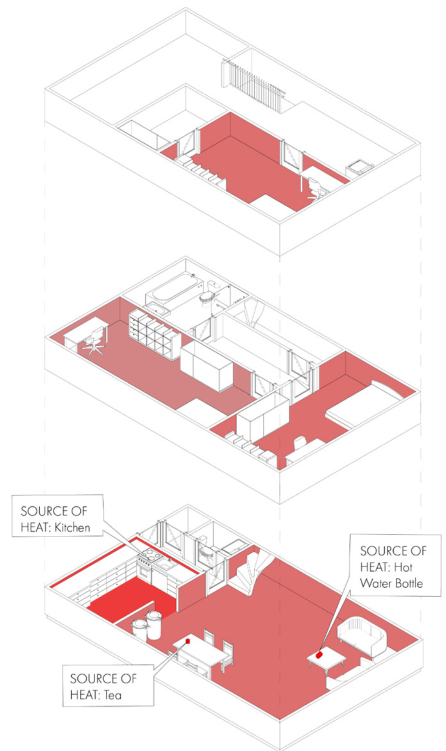
Figure 47, is based on the conclusions of the interview I held with Romina and our thermal practices in the house. As she was aware that I have been focusing on the social potentials of thermal practices, she also shared a brochure with me that she received from an organization called "Leger des Heils" in Delft. The brochure stated that the organization provides anyone who lives in Delft with "a warm living room" where they can drink coffee, study, or chat. She explained that she would be willing to use such a warm living room as she often engages in conversations with our roommate and me in the living room as it gets warmer after cooking. In addition, as her room receives less daylight than the rest of the rooms, she spends more time in the living room when it is sunny outside. I also observed that she often tends to use a hot water bottle and drink a lot of tea, two to three cups every night, to warm up. Only if it is really cold we turn the heater on for the rooms and the living room for a few hours.



Arrow, direction y: Access within the unit

Arrow, direction z: Vertical access (via the building core)

z y x



Thermally comfortable

Thermally uncomfortable

Figure 46. Conclusions, Interview With Romina - Thermal Practices

Figure 47. Conclusions, Interview With Romina - Thermal Practices

2.4 Findings

Co-living

As explored in this chapter, the fact that the members of a cooperative share property, labor, and resources, influence the spatial composition of cooperative buildings. These buildings often offer collective spaces that aim to create interactions between different users. The fact that cooperatives have less risk of vacancy allows experimental forms of co-housing as seen in San Riemo. On the other hand, as demonstrated by the case study on Holunderhof, we see an emphasis on the public benefit and equal access to daylight rather than shared spaces for the residents.

The analysis of the different case studies and the interviews also demonstrates the limits and social potentials of sharing for different target groups. While the analysis of Holunderhof shows fewer communal spaces for families, San Riemo explores the possible limits of sharing for families by providing them with a communal living room rather than a private one. However, according to the interview held with Ramazan, we find out that sharing a living room for some families is indispensable as they use the living room to socialize with each other. Here, the flexibility of San Riemo gains significance as the family apartments can be easily adapted by mixing shared apartments and family housing in such a way that families have their own private living rooms similar to the typical floor plans of Project Soubeyran.

For solo dwellers, the living room and kitchen initiate social interactions among the different users. For that reason, compared to families, solo residents require a bigger room for privacy. As demonstrated in San Riemo, these rooms are accessed through a shared multi-functional room. Oftentimes, although these spaces allow for social interactions, the residents have limited autonomy for these interactions as they might not have the option of avoiding their neighbors. Allowing the residents to decide on the use of these spaces could make it less challenging to live in such shared apartments. In addition, San Riemo demonstrates the dependence of the ratio between the size of the communal spaces and rooms on the number of rooms. As also exhibited in the interview with Romina, limiting the number of rooms and providing these rooms with enough communal areas allows the residents to find privacy, even in these communal spaces.

Thermal Practices

As there is less participation by low-income households in making investments for the integration of energy-efficient systems, the cooperative model was discovered to be relevant. As explored in this report, a combination of a cooperative and nearly zero-emission building, the project Soubeyran, allows its inhabitants to be a part of two other cooperatives. These two cooperatives, CA and Enerko, enable the inhabitants to use the energy produced by the PV panels and sell it back when they use less energy than produced.

As demonstrated in this chapter, most zero-energy buildings such as Soubeyran are designed to reduce the energy demand by means of additional technical installations and other architectural solutions such as maximizing the solar gains in the winter and shading the building during winter. However, poor thermal practices of the users in order to achieve a comfortable temperature could also lead to a bad thermal performance of these buildings. This shows that oftentimes, depending on the user, there is a conflict between a user's thermal comfort and co2 reduction.

Additionally, through the interviews, I discovered the inverse correlation between thermal comfort and affordability. Both interviewees demonstrated similar behavior in their thermal practices as they tried to avoid high energy bills such as heating specific rooms or using hot water bottles.

To highlight the positive, besides providing low-income groups with affordable housing by means of a reduction in their energy bills, zero-emission buildings hold social potential through the practices of thermal practices. For instance, as discovered in this chapter through the literature review and interviews, in less-than-ideal thermal situations, thermally comfortable spaces also create social interactions.

Figure 48. Impression of production and living on the urban plan

/ 03 PRODUCTIVE FRICTIONS

As I was searching for a way to create synergies between dwellings and production, I was once again inspired by Frank Van Klingeren's theory of how conflicting functions can create social interactions but this time, from a different perspective. I considered how the co-existence of these two functions on the same urban tissue improves their individual benefits. This thought process eventually led me to consider waste management facilities as my production space since they have a symbiotic relationship with dwellings; both depend on the existence of the other.

In relation to the first chapter, I looked into the place of waste in public spaces. Then, in relation to the second chapter, I explored potential synergies between co-living, energy reduction, and waste reduction and behavior towards waste.

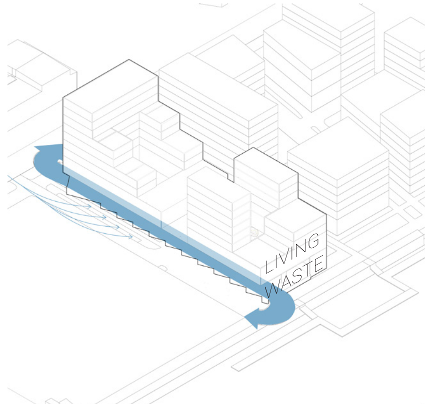
3.1 Waste and Public Space

The article by Goorhuis et al. (2012) marks an increase in waste generation in The Netherlands from 47Mton in 1985 to 63Mton in 2000 (Goorhuis et al., 2012). Due to this increase, in the late 1980s, there was a lack of landfill and treatment capacity in the Netherlands. This pushed for a shift in Dutch waste treatment policy from disposal to recovery. In 1993, the Dutch government made it mandatory to separate the collection and treatment of organic and garden waste and encouraged the separate collection of other recyclable waste flows with a separate collection of household waste. These flows include; organic waste, paper, glass, cardboard, and textiles (Goorhuis et al., 2012). The shift from disposal to recovery in waste treatment resulted in a decrease in the amount of waste landfilled from 35% to 2.1% between 1985 to 2016 (Rijkswaterstaat Environment, n.d.).

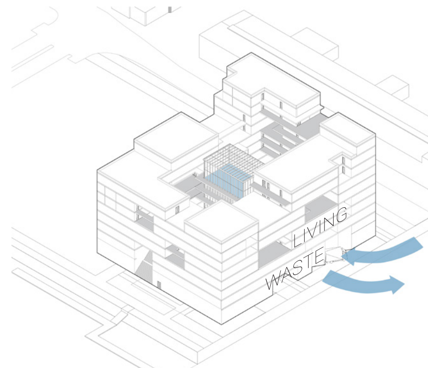
The policy of waste management in the Netherlands is based on the approach of "the order of preference" which aims to reduce the waste generation at the source, reuse if possible, recycle, and generate energy by incinerating residual waste. Landfilling is only allowed if none of the other methods are possible. Currently, 77% of the waste in the Netherlands is recycled and the residual waste is mostly used for energy production (Rijkswaterstaat Environment, n.d.).

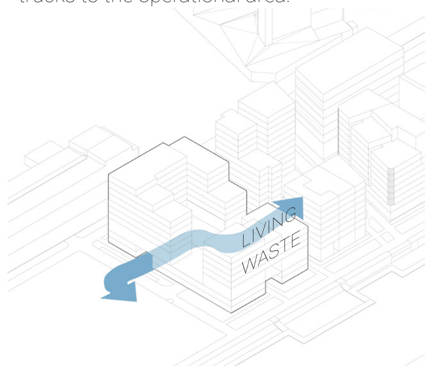
However, for the current waste management system to succeed, the participation of citizens is important as they are responsible for the treatment of waste in their homes. Increasing public understanding of the importance of recovery-based waste treatment can help governments in gaining the trust of the citizens and motivate them to separate and minimize their waste. For instance, schools in Kingston, Jamaica include waste management issues in their curriculum, including recycling, composting, gardening, and visiting recycling centers or landfills (Kaza et al., 2018).

On the other hand, waste management facilities are often located in industrial zones, removed from the public eye, perpetuating the societal tendency to dismiss waste (Muller, 2018). These facilities are often regarded as conflicting with dwellings as they generate noise and smell and require big building blocks that limit pedestrian movement. They also require truck access which might cause traffic and limit access in a residential area (figure 49). However, waste management, as a vital function in the urban fabric, can be introduced in public spaces to raise awareness and education about waste reduction. This can help people see waste as something valuable; for instance, as something that can be transformed into compost, reused, or converted into energy (Muller, 2018). For this reason, designers play a very important role in waste management, by rethinking waste as a resource and bringing it into public spaces, they have the ability to bridge the disconnect between the waste we generate and the infrastructure required to manage it. For instance, projects on the building level, such as Amager Bakke Waste to Energy Plant, which combines waste management with a public ski slope, demonstrate how waste management can be made visible and even desirable in the urban fabric (Muller, 2018).



First exploration: Slots for the vehicles are on the ground floor while the collection and separation area is elevated by 1,5 meters. Ramps are added to provide access for trucks to the operational area.





Second exploration (on the left): The trucks access the collection and separation area inside the building. The road runs inside the building.

Third exploration (above): The number of slots is kept minimal considering the number of people the collection center serves, Separate slots are reserved for the incoming and outgoing waste.

***Through a design-based research, I've explored different possibilities of truck access to the waste collection facility.

Figure 49. Access for Waste Collection Facility - Research-by-Design

3.2 Waste Routines

Designers should also consider waste management systems in the way they design dwellings as the participation of the citizens in the waste management system might also depend on the way their houses are designed. In this sub-chapter, the interviews held with a solo-dweller and low-income family, and the case study of Projet Soubeyran in Geneva are re-evaluated in order to understand the synergies between co-living and waste management and the waste routines of different users.

In their thesis, both Szaras and Andersson mention the positive impact of co-living on waste reduction. In many co-housing communities, the residents share a fridge and often cook together this results in the reduction of food waste as the residents share leftovers (Andersson, 2022). In addition, many examples of co-housing communities show concern about recycling and composting waste. For instance, residents of Æblevangen, a housing community in Denmark, bring their waste individually to a collection point and it is then collected and taken to a recycling facility. Organic waste is also collected and used by the municipality to provide heating in buildings. In other co-housing communities such as Ibsgården and Jernstøberiet, residents also use the waste for composting and use the compost as a fertilizer in their gardens (Száraz, 2015).

Soubeyran

The case study of Project Soubeyran shows the treatment of water and another type of waste; urines and feces, that can also be classified as organic waste. As seen in figure 50, there are three water flows that need to be treated: black water, which is the water from the toilet, grey water consisting of waste water from baths and kitchen, and finally rainwater collected on the roof. All these water flows require a different type of filtration technique and are used for watering the plants after the filtration. The treatment of black water is especially important to mention for this case study as the urine and feces in that black water are used to make compost with the help of a filter that consists of hay and earthworms (Coopérative equilibre, 2021).

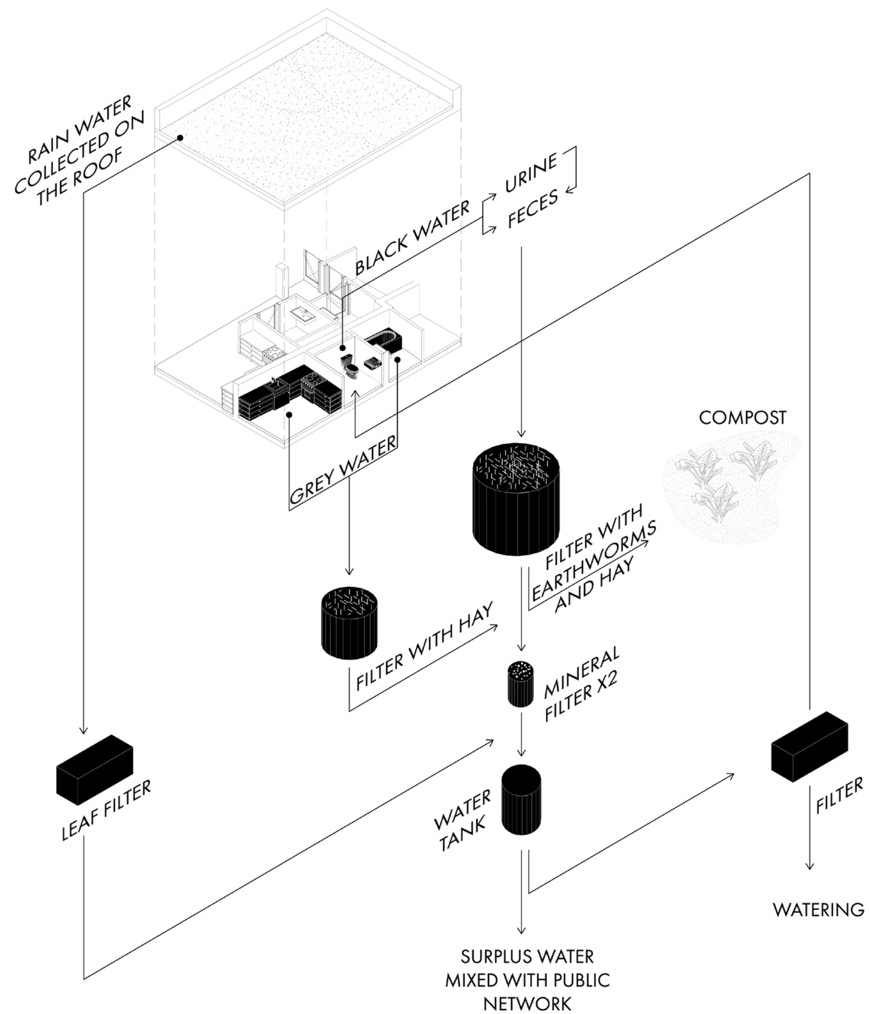


Figure 50. Water and Waste Management, Soubeyran / Geneva

In order to better understand the behavior towards waste and the waste routines of different residents that I aim to cater to in my building design, I held a second interview with my two target groups; solo dwellers and low-income families.

Romina

Upon interviewing Romina, and investigating the waste behavior in our house, I visualized my conclusions as seen in figure 51. As shown in the figure, the kitchen is the biggest source of waste generation in the house. The waste generated in the kitchen mainly consists of organic waste and plastic waste. This is then followed by the toilets which mainly consist of general waste and plastic. Finally, the bedrooms contribute to waste generation in the house with paper and cardboard. We separate our waste, throw organic waste and plastic waste, and general waste around twice a week, and paper and glass once a week or maybe once in two weeks. We have a cleaning schedule for the house and whoever is responsible for the kitchen usually takes the trash out. However, if it gets too full in the trash, then we also throw that away. We only have separate glass, plastic, and organic waste collection points but for general waste and paper/cardboard, we use the trash for a student housing nearby.

Ramazan and His Family

The interview with Ramazan and his family shows a much different waste routine. As seen in figure 52, Ramazan and his family don't separate waste. This is due to the fact that, in Ramazan's building, different containers for different recyclable materials are not provided, instead, there is one big blue container that is meant for all the recyclable materials (glass, paper, plastic…etc.). He also mentioned that even with this container provided, he doesn't think that it is collected separately. However, according to the building manager, all recyclable waste is collected once a week and is treated differently. This confirms that in the case of a lack of separate containers for different types of waste and trust in the government that the waste will be collected and treated separately, it is less likely that citizens will participate in recycling activities.

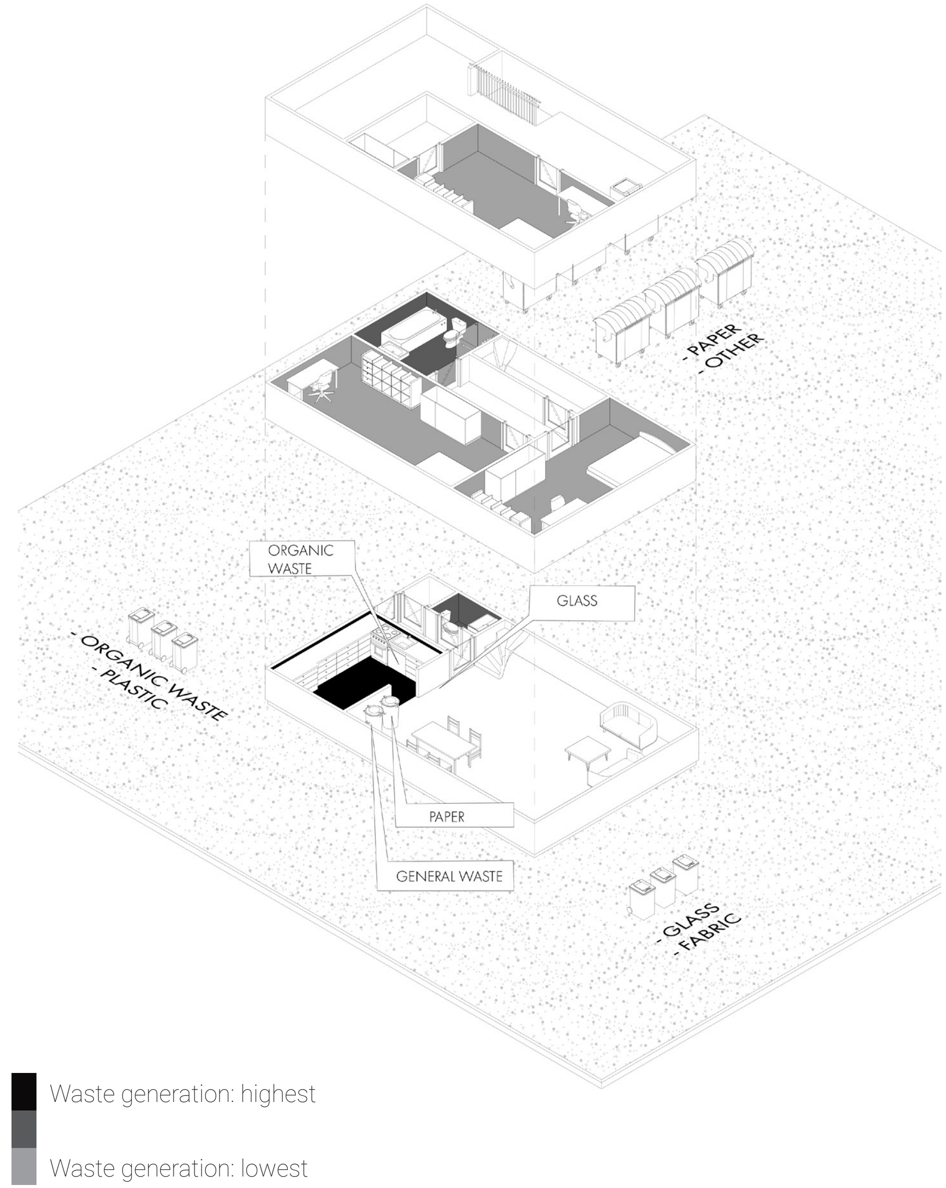


Figure 51. Conclusions, Interview With Ramazan and His Family - Waste Routines

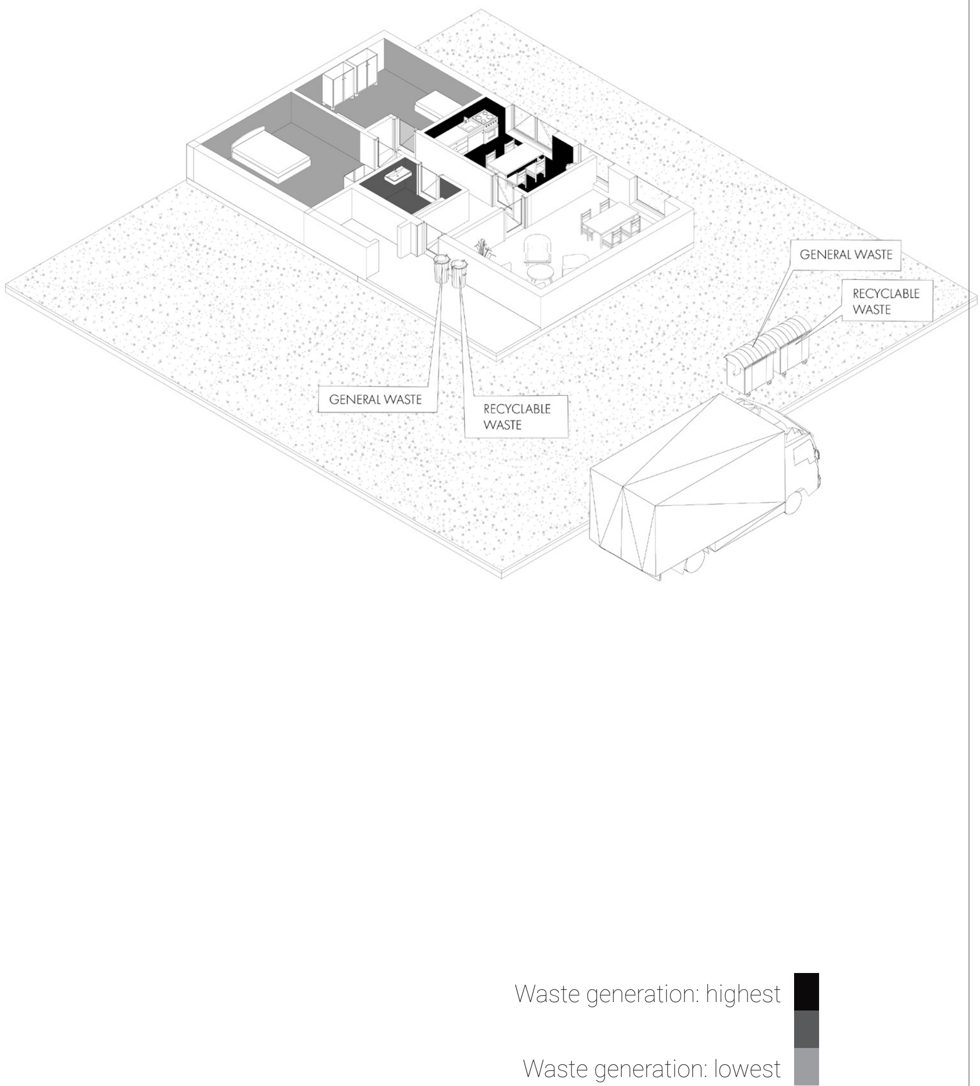


Figure 52. Conclusions, Interview With Romina - Waste Routines

3.3 Discussion

Taking the previous sub-chapters into account, we can conclude that designers play an important role in waste management. Firstly, designers have the ability to change the way people perceive waste from something that should be disposed of to a valuable resource by bringing waste management systems into public spaces despite the conflicting nature of waste management and dwellings. Projects such as Amager Bakke Waste to Energy Plant are examples of how these systems can become a part of the urban fabric. Secondly, waste should be considered in the design of dwellings as the waste routines of residents are often influenced by the availability of waste management infrastructure.

Furthermore, projects such as Soubeyran, Æblevangen, Ibsgården, and Jernstøberiet demonstrate the positive impact of co-living on waste treatment and waste reduction as members of these communities often participate in composting and recycling activities and most importantly reduce the waste generation at the source by sharing meals. This coincides with the waste policy of the Netherlands since, according to the approach of "the order of preference", the priority is to reduce waste at the source. In addition, adopting a better waste behavior for co-housing communities holds a social potential as it requires collective waste management.

If managed well, waste can be a source of electricity and fertilizer, thus contributing to achieving a zero-energy building, can be reused, and even in the example of Amager Bakke Waste to Energy Plant, create new types of public spaces in the urban tissue.

Considering the fact that the Netherlands is one of the five countries that generate the most amount of food waste in the European Union (Séveno, 2022), I decided to use organic waste as the main source of waste in my project. For that reason, through design-based research, and literature review, I chose to use Waste Transformers and a waste collection and recycling facility for my design assignment. As explained in figure 53, Waste Transformer is a small-scale anaerobic digester that can produce biogas or electricity and heat from biodegradable waste (Waste Transformers, 2022). I believe that by combining this small-scale waste-to-energy plant and a waste collection and recycling facility, I can create a better waste management system for the dwellings and stimulate better behavior towards waste.

Nevertheless, combining these two functions in this way contains a paradox; we rely on a system that produces energy from waste in order to provide energy for a co-housing, a form of living that typically generates less waste or manages it better. Therefore, for the design, the transparency and spatial accessibility of the production system are key elements. Waste Transformers and their synergy with co-housing should be visible to the public and the waste collection and recycling facility should be accessible for the surrounding dwellings in order to produce more energy.

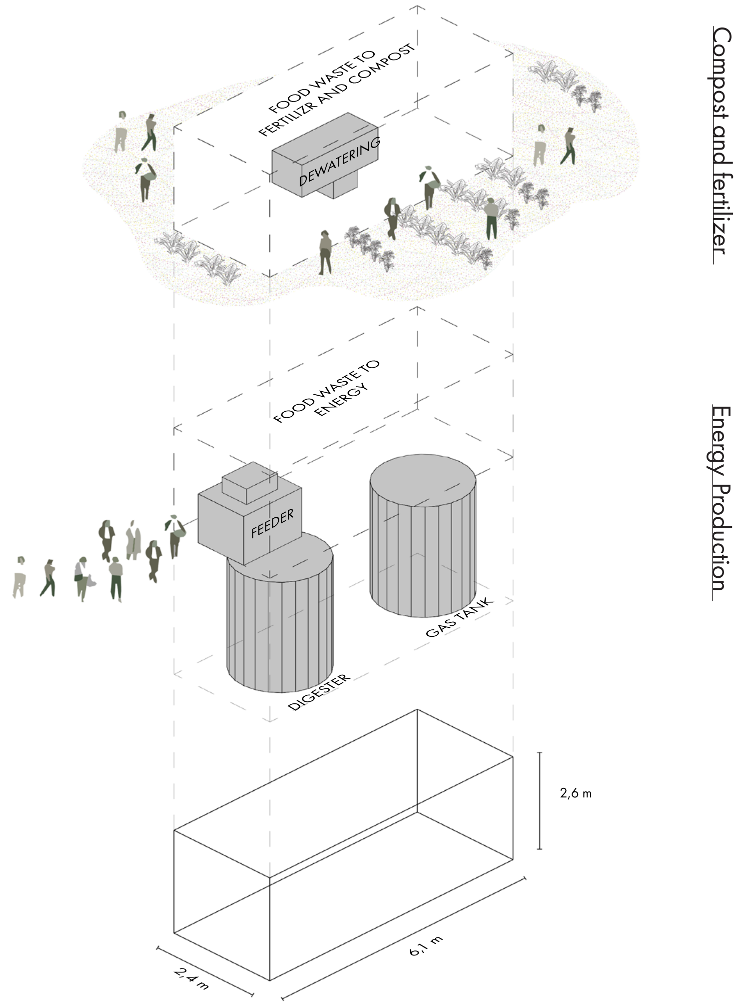


Figure 53. Waste Transformers

/ 04 CONCLUSION

In this research, I aspired to find a solution to the problem statement that describes working and living projects in post-industrial cities as gentrification projects. With regard to this, I hypothesized that a combined model of cooperative co-housing and zero-emission buildings would keep the project affordable and thus create a successful working and living project. I have formulated my research question as:

"How can a combined model of cooperative co-housing and zero-emission buildings contribute to creating a living, working, and learning environment for low to middle-income families and solo dwellers, including creative individuals?".

In order to find an answer to this question I have formulated three sub-questions. The first sub-question was conducted to determine the role of industrial activity in creating public spaces in the urban fabric. The second and third sub-questions were directed to determine in what ways cooperative co-housing and zero-emission buildings contribute to affordability and the limits and social potentials that these buildings entail for the users. Later, based on these sub-questions, and some of the findings, I chose to focus on waste management facilities for the production space of my design and formulated two more sub-questions. I formulated these questions to discover the current and potential role of waste management facilities in the urban fabric and the potential synergies with dwellings.

In the first chapter, I sought to find an answer to the sub-question **"How does industrial activity create public space?"** through a historical analysis of mixed-use projects, and port cities, site analysis of the M4H area, and literature on the theory of "productive frictions" and "productive city". As a result, I found the conflicting nature of dwellings and industrial activity to be a driver to create new forms of public spaces, it is only when dwellings emerge in the Waterstad that Boompjes appear, or it is only when we realized that industrial buildings limit access for pedestrians that we came up with new forms of building blocks that included public courtyards. Consequently, I believe that the challenge of ensuring **spatial accessibility** for production and living uses in the context of the M4H area is a good design ambition that will potentially lead to a new form of public space.

In the second chapter, I looked to find an answer to the sub-question **"How does affordability resonate with practices of sharing and practices of thermal comfort?"**. To do so, I depended on a variety of academic literature and sources, an analysis of the case study of Project Soubeyran, and the interviews I held with my target group. As a result, I discovered that cooperative co-housing and zero-energy buildings all individually contribute to **affordability.** The cooperative model provides the members the ability to own a share of the building in return for a below-market rent with the "cost-rent". Combined with co-housing, the users pay for a smaller unit but gain access to more with the shared facilities. As discovered through the Soubeyran case study, zero-energy buildings can be combined with a cooperative model in such a way that the residents become a member of two cooperatives that allows them to consume the electricity produced by the PV panels and sell it back when they use less energy than produced. As explored through the interviews, many users are willing to compromise their thermal comfort to pay less. Therefore, we can conclude that there is a correlation between the practices of thermal comfort and affordability. In relation to this, we can determine **energy reduction, energy production, and co-living,** as design principles for this sub-chapter.

In this chapter, I also sought an answer to the sub-question **"What are the limits and social potentials of practices of sharing and thermal comfort?",** by analyzing the case studies of Holunderhof and San Riemo and holding interviews. Through the interviews and literature, I found a potential for **facilitating social interactions** through sharing and practices of thermal comfort. This was a result of the interviews and literature on China's heat division that demonstrated the social potential of thermally comfortable spaces in less-than-ideal thermal situations. On the other hand, through my research, I discovered the discrepancy between how family apartments are designed in San Riemo and the interview held with Ramazan and his family. It demonstrated that the limits of sharing for certain target groups can differ. For instance, with the case study of San Riemo, we see that a few of the family apartments and shared clusters for solo dwellers are accessed through a multifunctional room described as a "staircase room". These rooms limit the autonomy of the residents for social engagements and their privacy. In relation to this, I determined the **adaptability and variety** of communal spaces as a way of granting the residents control over their autonomy for social engagements. This would potentially lead to more positive social interactions among the users.

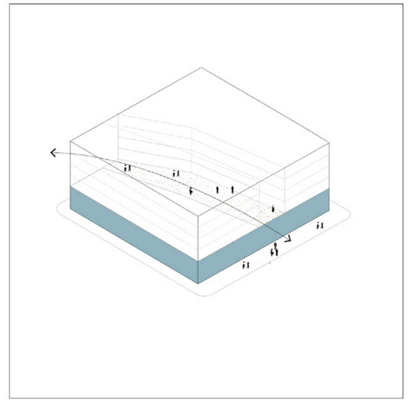
In the third, and last, chapter, I looked for an answer to the sub-question **"What is the role of waste management systems in the urban fabric?"** with the help of literature, reference projects, and design-based research, I discovered many possibilities for incorporating waste management facilities in the urban fabric and the educational potential of incorporating these facilities in the urban fabric to encourage a better understanding and behavior towards waste. As I searched for an answer to the second sub-question **"What are the synergies between waste management facilities, co-housing, and zero-energy buildings?"**, I discovered the potential of waste for **energy production and social interaction** and the potential of co-housing for **waste reduction** (through collective waste management). Nonetheless, I also recognize a conflict between co-housing, zero-energy buildings, and waste management facilities. In order to generate energy to design a zero-energy building, I use waste as a tool for energy production. But by combining these elements with co-housing, a form of living that typically produces less waste and better manages it, it is likely that less energy will be produced from the waste-to-energy system. Hence, I determined the **transparency** of waste management facilities in order to preserve the educational potential of waste and **hybrid infrastructure** to preserve its potential to provide energy for dwellings as design principles.

To conclude, I believe that these design ambitions and principles will help me produce a design that responds to the main question and that becomes a part of the solution to changing the way our cities are designed.

SPATIAL ACCESSIBILITY

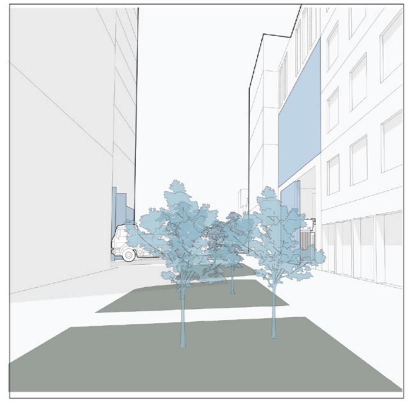
Hybrid Building Block

The building block should be able to fit industrial facilities while also allowing through-block access for pedestrians.



Hybrid Infrastructure

The urban design should facilitate the vehicular movement for production logistics and the movement of people who live in the area.



Anthropometric design

The building blocks on the urban plot should relate to human proportions.

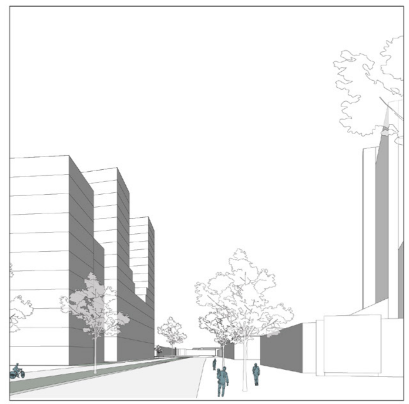
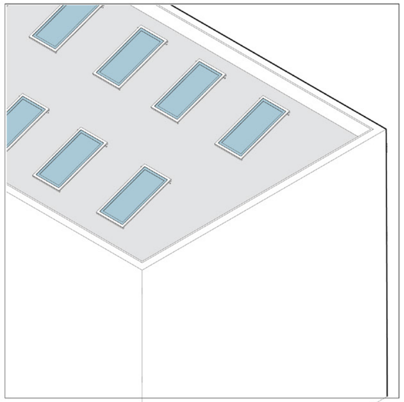


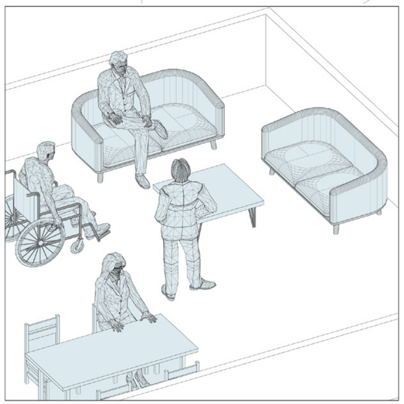
Figure 54. Design guidelines, spatial accessibility

AFFORDABILITY



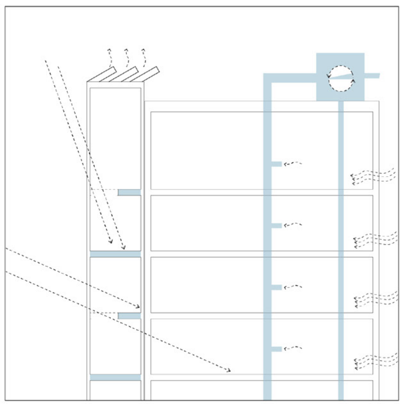
Energy Production

The building design should include systems that can generate energy from renewable resources.



Co-living

The building should include communal spaces that reduce the amount of square meters per person.



Reduction of Energy Demand

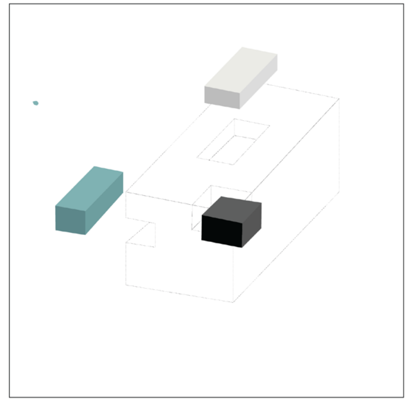
The building design should include architectural solutions and technical installations that reduce the energy demand.

Figure 55. Design guidelines, affordability

FACILITATING SOCIAL INTERACTIONS

Variety

The building should provide the users with a variety of communal spaces and apartment typologies in order to meet their demands.



Adaptability

The building design should be adaptable in oreder to meet the changing demands of the users over time.

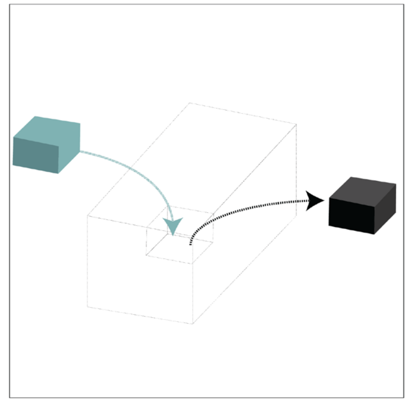
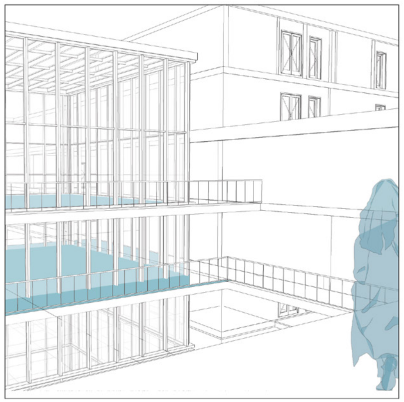


Figure 56. Design guidelines, facilitating social interactions

CREATE SYNERGIES

Collective Waste Management

The building design should facilitate a collective waste management among the inhabitants.



Transparency

Waste management facilities should be visible to inhabitants and the public in order to retain the educational potential of the waste management systems.

Figure 57. Design guidelines, creating synergies -

[this page is intentionally left blank]

[this page is intentionally left blank]

/ 05 APPENDIX

5.1 Bibliography

Case Studies:

1. Büro Juliane Greb. (2021). Summacumfemmer, Büro Juliane Greb · San Riemo. Divisare. Retrieved April 15, 2023, from https://divisare.com/projects/445152-summacumfemmer-buro-juliane-greb-san-riemo

2. Coopérative Equilibre. (2021). Coopérative equilibre. Retrieved January 17, 2023, from https://www.cooperative-equilibre.ch/wp/wp-content/uploads/2021/07/EQUILIBRE_Posters_Soubeyran_Basse-def.pdf

3. Tummers, L. (2017). View of Learning from co-housing initiatives — Between Passivhaus engineers and active inhabitants. https://journals.open.tudelft.nl/abe/article/view/1858/1978

Cooperative Housing & Co-living/ Sharing:

1. Andersson, J. (2022). (thesis). Coliving - Transition towards sustainability. Retrieved April 10, 2023, from https://www.diva-portal.org/smash/get/diva2:1711937/FULLTEXT02.

2. Balmer, I., & Gerber, J.-D. (2018). Why are housing cooperatives successful? Insights from Swiss affordable housing policy. Housing Studies, 33(3), 361-385. https://doi.org/10.1080/02673037.2017.1344958***

3. Czischke, D., (2017). Collaborative housing and housing providers: towards an analytical framework of multi-stakeholder collaboration in housing co-production.

4. Huron, A. (2018). Carving Out the Commons: Tenant Organizing and Housing Cooperatives in Washington, D.C. University of Minnesota Press. Retrieved from http://ebookcentral.proquest.com/lib/mit/detail.action?docID=5313074***

5. Kockelkorn, A., & Schindler, S. (2020). Cooperative Conditions: A Primer on Architecture, Finance and Regulation in Zurich. Cooperative Conditions | Home. Retrieved January 15, 2023, from https://www.cooperativeconditions.net/#

6. Lengkeek, A., & Kuenzli, P. (2022). Operatie wooncoöperatie. trancityxvaliz.

7. Morris, B. (2013). Making cohousing affordable: Strategies and successes. Communities, (158), 36-38,75. Retrieved from https://www.proquest.com/scholarly-journals/making-cohousing-affordable-strategies-successes/docview/1321077250/se-2

8. Száraz, L. R. (2015). Pro-environmental characteristics of urban cohousing communities (thesis). Retrieved April 10, 2023, from https://www.researchgate.net/profile/Luca-Szaraz/publication/287995133_Pro-environmental_characteristics_of_urban_co-housing_communities/

9. Winter, J., & Durrett, C. (2013). Achieving affordability with cohousing. Communities, (158), 34-35,74. Retrieved from https://www.proquest.com/scholarly-journals/achieving-affordability-with-cohousing/docview/1321077256/se-2

10. Wedell, D. (2021). [online] Available at: <https://criticalconcrete.com/co-ops-cohousing-co/> [Accessed 16 October 2022].

Productive Frictions:

1. Brown, J. S., & Hagel III, J. (2005, August 1). Productive friction: How difficult business partnerships can accelerate innovation. Harvard Business Review. Retrieved April 16, 2023, from https://hbr.org/2005/02/productive-friction-how-difficult-business-partnerships-can-accelerate-innovation

2. Ende, P. v. (1967, November 7). De magische doos van Van Klingeren. Het Parool.

Rotterdam /Merwe-Vierhavens:

1. Meyer, H. (1999). Chapter V – "The Northwestern European Port City: Rotterdam and the Dynamic of the Delta. In City and port: The transformation of port cities: London, Barcelona, New York and Rotterdam. essay, INTERNATIONAL Books.

2. M4H Rotterdam. (2022). Ruimtelijk Raamwerk M4H. [online] Available at: <https://m4hrotterdam.nl/ruimtelijk-raamwerk-m4h/> [Accessed 15 October 2022].

3. Pet, M. & Metz, T., (2022, February 20). Podcast De Architect, Merel en Tracy Praten Door [Herontwikkeling havengebied Rotterdam]. Spotify. Retrieved from https://open.spotify.com/show/5HtQaK7A4b5GCAf1tblRmW

Strijp-S:

1. Dane, G., Borgers, A. and Tilma, F., (2019). Lifestyles, new uses, and the redevelopment of industrial heritage sites.

2. Fernandez-Maldonado, A. (n.d). The Reinvention of Eindhoven: From Industrial Town in Decline to Capital City of a Technology and Design Region. Delft.

3. Strijp-S. (n.d.). History. Strijp-S. Retrieved January 15, 2023, from https://strijp-s.nl/en/history/

4. Voetman, L. (2017). Gentrification

[***: these sources are not cited]

[***: these sources are not cited]

- Aandacht voor Strijp-S - DURF! Aandacht. magazine.wijzijndurf.nl. Retrieved October 30, 2022, from https://magazine.wijzijndurf.nl/2846/gentrification-aandacht-voor-strijp-s

Waste Management:

1. Goorhuis, M., Reus, P., Nieuwenhuis, E., Spanbroek, N., Sol, M., & van Rijn, J. (2012). New developments in waste management in the Netherlands. Retrieved April 9, 2023, from https://journals.sagepub.com/doi/10.1177/0734242X12455089

2. Kaza, S., Yao, L., Bhada-Tata, P., Woerden, V. F., & Ionkova, K. (2018). What a waste 2.0: A global snapshot of Solid Waste Management to 2050. World Bank Group.

3. Muller, J. (2018). The Architecture of Waste Designing New Avenues for Public Engagement With Trash. Ricerche per La Progettazione Del Paesaggio.

4. Rijkswaterstaat Environment. (n.d.). Elements of dutch waste management. Rijkswaterstaat Environment. Retrieved April 9, 2023, from https://rwsenvironment.eu/subjects/from-waste-resources/elements-dutch-waste/

5. Séveno, V. (2022, December 23). The Netherlands one of the worst countries in the EU for food waste. IamExpat. Retrieved April 11, 2023, from https://www.iamexpat.nl/expat-info/dutch-expat-news/netherlands-one-worst-countries-eu-food-waste

6. Waste Transformers. (2022, November 23). Home turn Food waste into value on-site in our anaerobic digesters. The Waste Transformers | Food waste to value. Retrieved April 11, 2023, from https://www.thewastetransformers.com/

Working and living:

1. Bonifazio, P. and Scrivano, P., (2003). Olivetti Builds. Milano: Skira International Corporation.

2. Hatuka, T., & Ben-Joseph, E. (2022). New Industrial Urbanism: Designing Places for Production. Routledge.***

3. Holliss, F. (2015). The Workhome: An Architecture of Dual Use. https://doi.org/10.4324/9781315738048

4. Jacobs, J. (1964). The death and life of great american cities.

5. Kaufmann, E. (1968). Three revolutionary architects, Boullée, Ledoux, and Lequeu. American Philosophical Soc.

[***: these sources are not cited]

6. Ledoux, C.-N. (1804). L'architecture considerée sous le rapport de l'art des moeurs et de la législation

7. Metabolic, Studioninedots & DELVA Landscape Architects, (2014). Circular Buiksloterham: Transitioning Amsterdam to a Circular City

8. Novy, J., (2022). Getting back into the "business of making things". On the promise and perils of the "productive city".

9. O'Sullivan, F. (2020, January 15). The history of Amsterdam's Canal Houses. Bloomberg.com. Retrieved April 15, 2023, from https://www.bloomberg.com/news/articles/2020-01-15/the-history-of-amsterdam-s-canal-houses

Zero-Energy Buildings/ Practices of Thermal Comfort:

1. Chegut, A., Eichholtz, P. and Holtermans, R., (2016). Energy efficiency and economic value in affordable housing.

2. Hernandez, P., Oregi, X., Longo, S., & Cellura, M. (2019). Life-cycle assessment of Buildings. Handbook of Energy Efficiency in Buildings, 207–261. https://doi.org/10.1016/b978-0-12-812817-6.00010-3

3. Mlecnik, E., Schütze, T., Jansen, S. J. T., de Vries, G., Visscher, H. J., & van Hal, A. (2012). End-user experiences in nearly zero-energy houses. Energy and Buildings, 49, 471–478. https://doi.org/10.1016/j.enbuild.2012.02.045

4. Roesler, S., & Kobi, M. (2020). Urban climate indoors: Rethinking heating infrastructure in China's non-heating zone. ABE Journal, (17). https://doi.org/10.4000/abe.8061

5. Thomsen, J., Berker, T., Lappegard Hauge, Å., Denizou, K., Wågø, S., & Jerkø, S. (2013). The interaction between building and users in passive and zero-energy housing and Offices. Smart and Sustainable Built Environment, 2(1), 43–59. https://doi.org/10.1108/20466091311325845

Other:

1. Boelhouwer, P. (2002). Trends in Dutch Housing Policy and the Shifting Position of the Social Rented Sector. Urban Studies, 39(2), 219–235. https://doi.org/10.1080/00420980120102939

2. De Boeck, S., & Ryckewaert, M. (2020). The Preservation of Productive Activities in Brussels: The Interplay between Zoning and Industrial Gentrification. Urban Planning, 5(3), 351–363. https://doi.org/10.17645/up.v5i3.3092

3. Hansson, A. and Lundgren, B. (2018). Defining Social Housing: A Discussion

[***: these sources are not cited]

5.2 Illustration References

5.3 List of Reference Projects

Waste Management Facilities

1. Amager Bakke Waste to Energy Plant

2. BIG Designs Danish Recycling Center as Neighborhood Asset

3. Collection Center for Recyclable Materials / RUHM Architekten

4. Hong Kong Neighborhood Recyling Center

5. rban Solid Waste Collection Central / Vaillo + Irigaray

6. Smestad Recycling Centre / Longva arkitekter

[this page is intentionally left blank]

/ 06 REFLECTION

[this page is intentionally left blank]

1. What is the relation between your graduation project topic, your master track (Ar, Ur, BT, LA, MBE), and your master programme (MSc AUBS)?

My graduation project topic resulted from the aim of the studio and my personal interests. The earlier research on the project location, Merwe-Vierhavens, showed the importance of keeping the area affordable and keeping the low-tech industries on the site in a development project that combines working and living. In the quest for affordability, my interests in co-housing cooperatives and zero-energy buildings became relevant. As for my production space, I considered waste facilities from the beginning. However, it was only when I realized the social and environmental potential that waste holds that I understood the synergy between co-housing cooperatives, zero-energy buildings, and waste management facilities. Sustainability and innovation have been a big part of my education at TU Delft during my master's. Therefore, my topic which aims to create a new type of urbanity that combines production and dwelling by also reducing the environmental impact of the building and facilitating social inclusion through waste shows the influence of the education I have received here at TU Delft.

2. How did your research influence your design/recommendations and how did the design/recommendations influence your research?

In my research report, I emphasized the risk of gentrification and deindustrialization in the redevelopment plan of Merwe-Vierhavens, a working and living project in Rotterdam's port area. These were based on the fact that the redevelopment plan lacked the ambition of providing affordable housing and keeping the low-tech industries on the site. To provide affordable housing, I proposed a combined model of cooperative co-housing and zero-energy housing. By incorporating waste management facilities into this research, I explored the potential synergies between waste management and dwellings. In the end, the design project was based on the findings of this research that aims to find an answer to the research question; "How can a combined model of cooperative co-housing and zero-emission buildings contribute to creating a living, working, and learning environment for low to middle-income families and solo dwellers, including creative individuals?"."

The beginning of this research was about gathering knowledge on the location and the mixed-use projects that combine production and dwellings. To do so, I examined the historical evolution of mixed-use projects and port cities, where industrial activity and dwellings exist side-by-side. From this analysis, I found the conflicting nature of dwellings and industrial activity to be a driver to create new forms of public spaces. In return, during the design of the master plan with my group, I also saw that the challenge of combining the two different building blocks for dwellings and production lead us to consider/create different forms of public spaces. As visible in Figure 1, it was only when we realized that industrial buildings require big building blocks that prevent through-block access for pedestrians that we sought for solutions to allow pedestrian movements. These initial steps of the design and research helped me determine design guidelines in relation to the spatial accessibility of the location.

Next, I looked into dwellings and how they can contribute to affordability. I discovered that cooperative co-housing and zero-energy buildings all individually contribute to affordability. Through the analysis of a zero-energy housing cooperative, Project Soubeyran, I examined how zero-energy buildings can be designed and combined with a cooperative co-housing model. Based on the findings of this research, I determined energy production, energy demand reduction, and co-living as design principles in relation to affordability.

I also looked into zero-energy buildings and cooperative co-housing from the user's perspective. To do so, I analyzed cooperative co-housing projects, conducted interviews, and used academic resources. Looking into the practices of sharing and practices of thermal comfort, I discovered the limits and social potential that they hold. For instance, the literature research and interviews showed that in thermally less-ideal situations, thermally comfortable places create social interactions. In relation to this, the interviews I held led me to consider the kitchen that can be regarded as a source of heating as a place of social interaction. In addition, by exploring the limits of practices of sharing and thermal comfort, I determined adaptability and variety of the communal spaces as design principles as they could give more autonomy to the users when it comes to sharing.

Finally, through a re-evaluation of the case study of Soubeyran, a second interview with the users I have determined, and literature research, I sought to find the role of waste management facilities in the urban fabric and the synergies with dwellings. With this research, I discovered the potential of waste to become a valuable source of energy production, compost, and fertilizer. I saw the potential of showing waste as a resource to the public and the residents to influence better behavior toward waste. In return, with the design, I searched for ways to combine the infrastructure needed to manage waste and make it visible to the public.

To conclude, the research directly influenced my design choices and recommendations for the design, and, in return, the design explorations also influenced the direction and focus of my research.

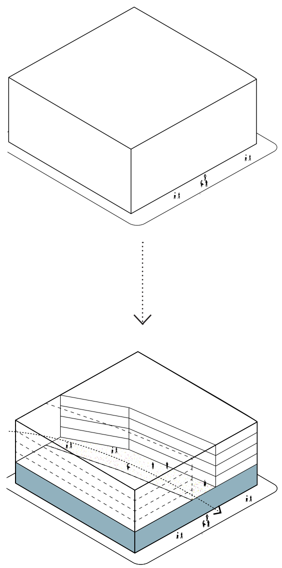
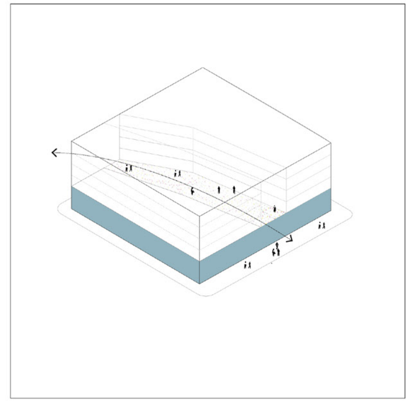


Figure 1. Mass propsal, through-block access

SPATIAL ACCESSIBILITY

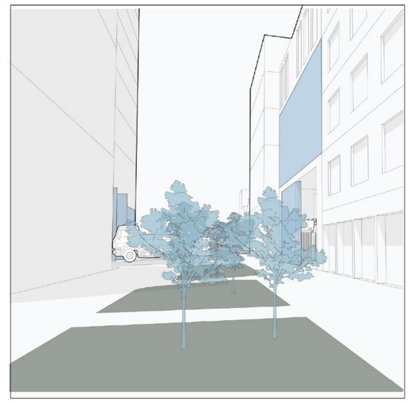
Hybrid Building Block

The building block should be able to fit industrial facilities while also allowing through-block access for pedestrians.



Hybrid Infrastructure

The urban design should facilitate the vehicular movement for production logistics and the movement of people who live in the area.



Anthropometric design

The building blocks on the urban plot should relate to human proportions.

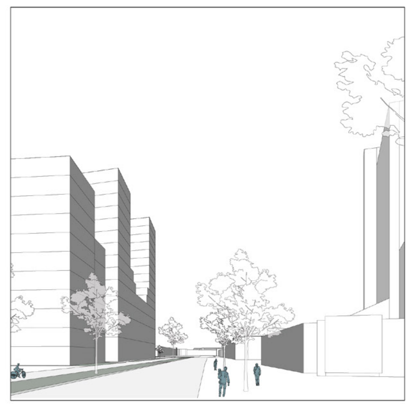
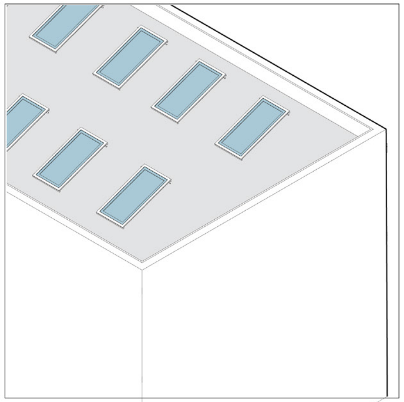


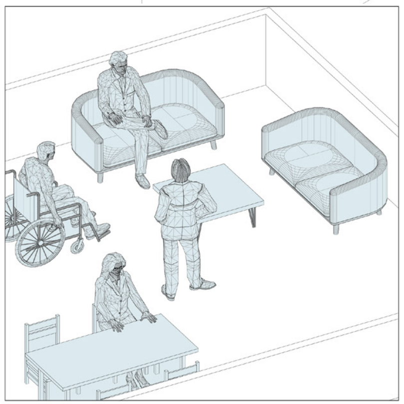
Figure 2. Design guidelines, spatial accessibility

AFFORDABILITY



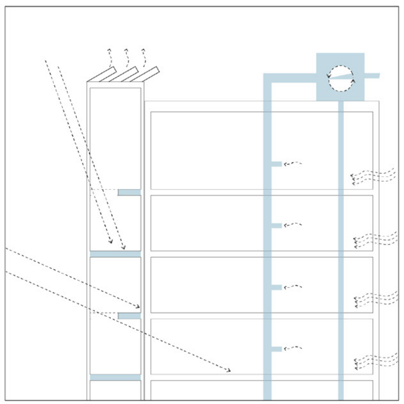
Energy Production

The building design should include systems that can generate energy from renewable resources.



Co-living

The building should include communal spaces that reduce the amount of square meters per person.



Reduction of Energy Demand

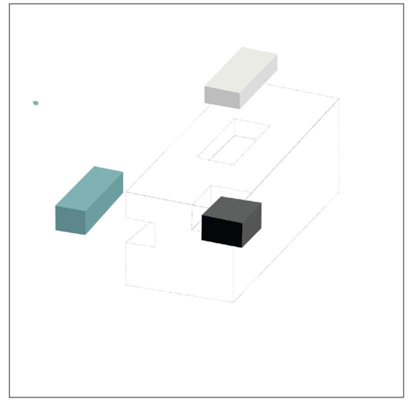
The building design should include architectural solutions and technical installations that reduce the energy demand.

Figure 3. Design guidelines, affordability

FACILITATING SOCIAL INTERACTIONS

Variety

The building should provide the users with a variety of communal spaces and apartment typologies in order to meet their demands.



Adaptability

The building design should be adaptable in oreder to meet the changing demands of the users over time.

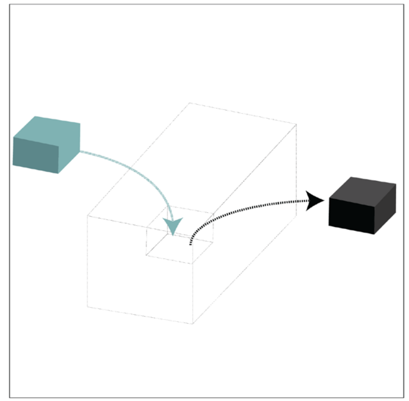
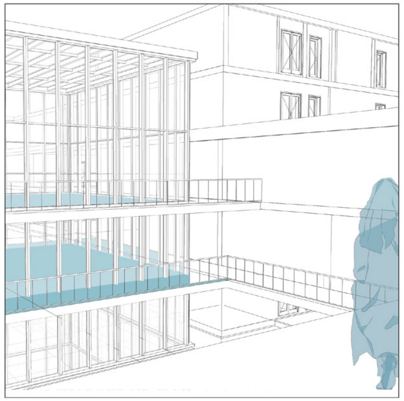


Figure 4. Design guidelines, facilitating social interactions

CREATE SYNERGIES

Collective Waste Management

The building design should facilitate a collective waste management among the inhabitants.



Transparency

Waste management facilities should be visible to inhabitants and the public in order to retain the educational potential of the waste management systems.

Figure 5. Design guidelines, creating synergies -

3. How do you assess the value of your way of working (your approach, your used methods, used methodology)?

The literature research on working and living projects demonstrated the evolution of mixed-use projects in relation to present-day issues. The historical study on Rotterdam's ports demonstrated ways of combining industries and dwellings in the port areas and new forms of public spaces that can emerge from this coexistence. While these methods of research provided me with theoretical knowledge, morphological analysis of Merwe-Vierhavens gave me a direction for the design.

Similarly, the literature research on cooperative co-housing and zero-energy buildings provided me with background knowledge of their economic and social advantages. Combining the literature research with the case studies of three different cooperative co-housing examples and interviews, I gained insight into practices of sharing and thermal comfort from a user perspective. Making drawings for the case studies and the interviews, I was able to use these insights to understand more clearly the spatial needs of the users. The mix of these different research methods helped me to determine design ambitions and design principles in relation to those ambitions.

Finally, the literature research on waste management facilities demonstrated the educational, environmental, and social benefits of introducing these facilities into the urban fabric. Through design-based research, I explored different spatial possibilities of combining these facilities with dwellings. While doing so, I considered the knowledge I gained at the beginning of the morphological analysis of Merwe-Vierhavens. Later, by revisiting one of my case studies and holding a second interview with my user groups, I explored people's waste routines. Representing these interviews and case studies, I could see how the building's design affects these waste routines. I later used the outcome of the literature research, case studies, and interviews to determine design principles and ambitions for the design phase.

In conclusion, by combining different research methods, I was able to gain insights, understand user needs, and determine design principles and ambitions.

4. How do you assess the academic and societal value, scope, and implication of your graduation project, including ethical aspects?

The concept of combining production and dwellings is not a new concept, we see many examples that combine working and living from medieval times to the present day. In contemporary mixed-use projects, we see that the introduction of dwellings in industrial areas provokes an increase in housing prices which causes the displacement of the often low-income groups that live in these areas or the surrounding areas. As these industrial areas become more attractive with dwellings, the industrial functions that keep our cities functioning also get displaced. Consequently, the people who work in these industrial buildings are faced with long commuting hours due to this displacement.

Therefore, the design assignment of combining working and living requires a different approach than the way we have been designing mixed-use developments. I believe that the aim of providing affordable housing with a combined model of cooperative co-housing and zero-energy housing in my graduation project is the first step in preventing a mixed-use project from becoming a project of gentrification. In the second phase of my graduation project, I combine these forms of dwellings with a waste management facility, a production space vital for our cities to function. I consider the co-existence of the two functions in a way that they benefit each other to be a very good way of initiating a change in the way we perceive industries in our cities.

5. How do you assess the value of the transferability of your project results?

The current housing crisis in The Netherlands, the increase in energy bills, and the way that post-industrial cities are expanding put low-income groups and industrial areas in a vulnerable position. The studio topic of combining production and living allowed me to consider all these issues and think of an alternative way of designing cities.

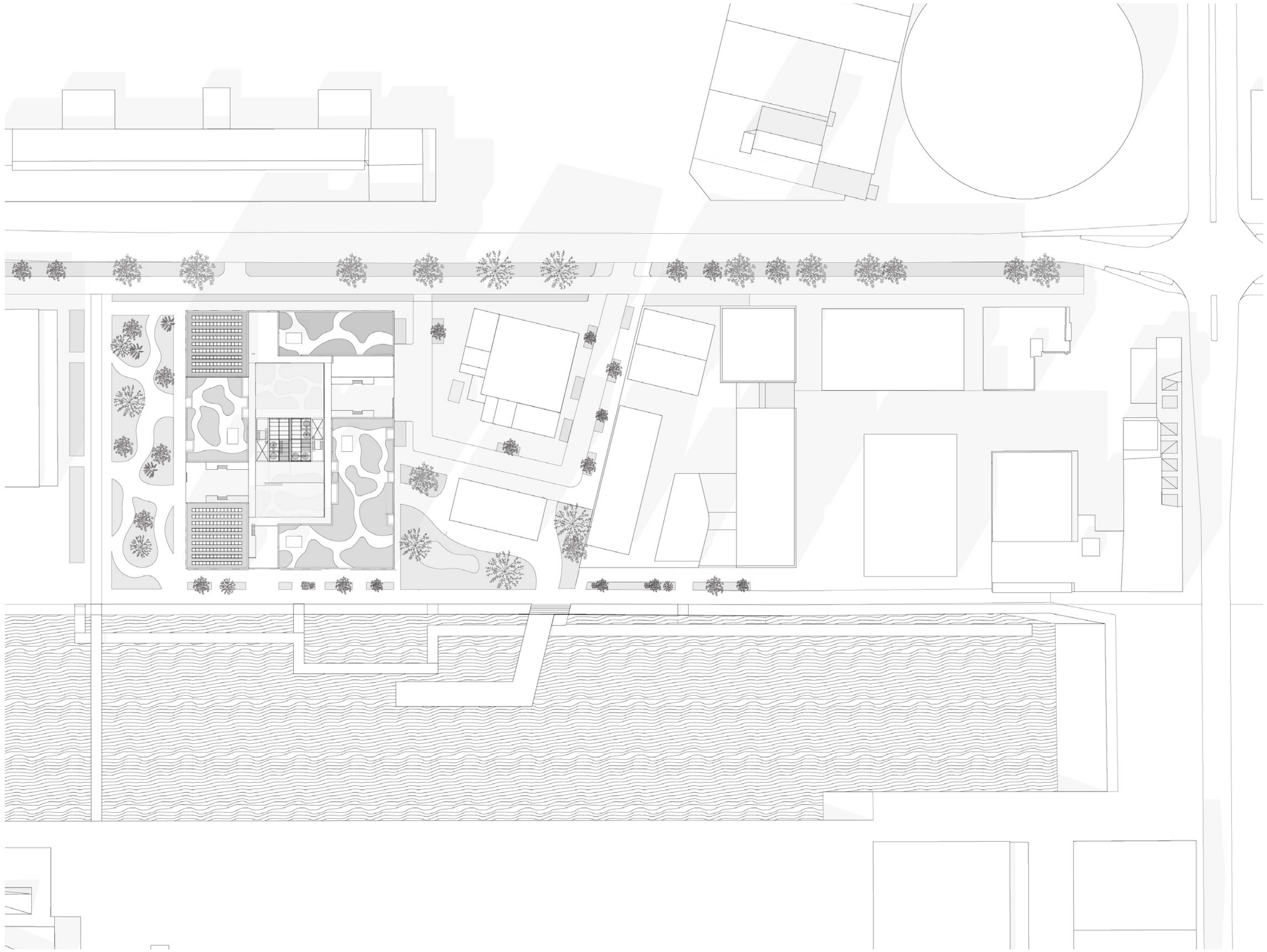
I used cooperative co-housing and zero-energy buildings as a means to provide affordable ownership of housing for low-income groups and reduce their energy bills. By choosing waste management facilities as my production space, I aspired to show the value of waste for dwellings and create better behavior towards it. Combining cooperative co-housing, zero-energy buildings, and waste management facilities in my graduation project, I sought to show an example of a building block that can be considered a step in designing a more sustainable city with regard to its environmental, economic, and social impact.

I believe that it would be favorable to implement such a building block in an urban environment of any post-industrial city. The building block consists of different waste management facilities including a waste collection center, recyclable material processing facility, and a small-scale waste-to-energy plant. These facilities enable the household waste of the dwellings in the building block and surrounding buildings to be used as a source that, in return, provides the dwellings with energy. Combining these facilities with co-housing, a form of housing that often better manages waste, and allowing public access to this building block, would educate the public about the value of their waste and would provoke better behavior toward it.

On the other hand, the scale of these waste management facilities depends on the amount of waste generated in its context. Therefore, placing such a building block in another context could require a change in the scale of these facilities.

/ 07 DESIGN

Urban Design | Urban Masterplan

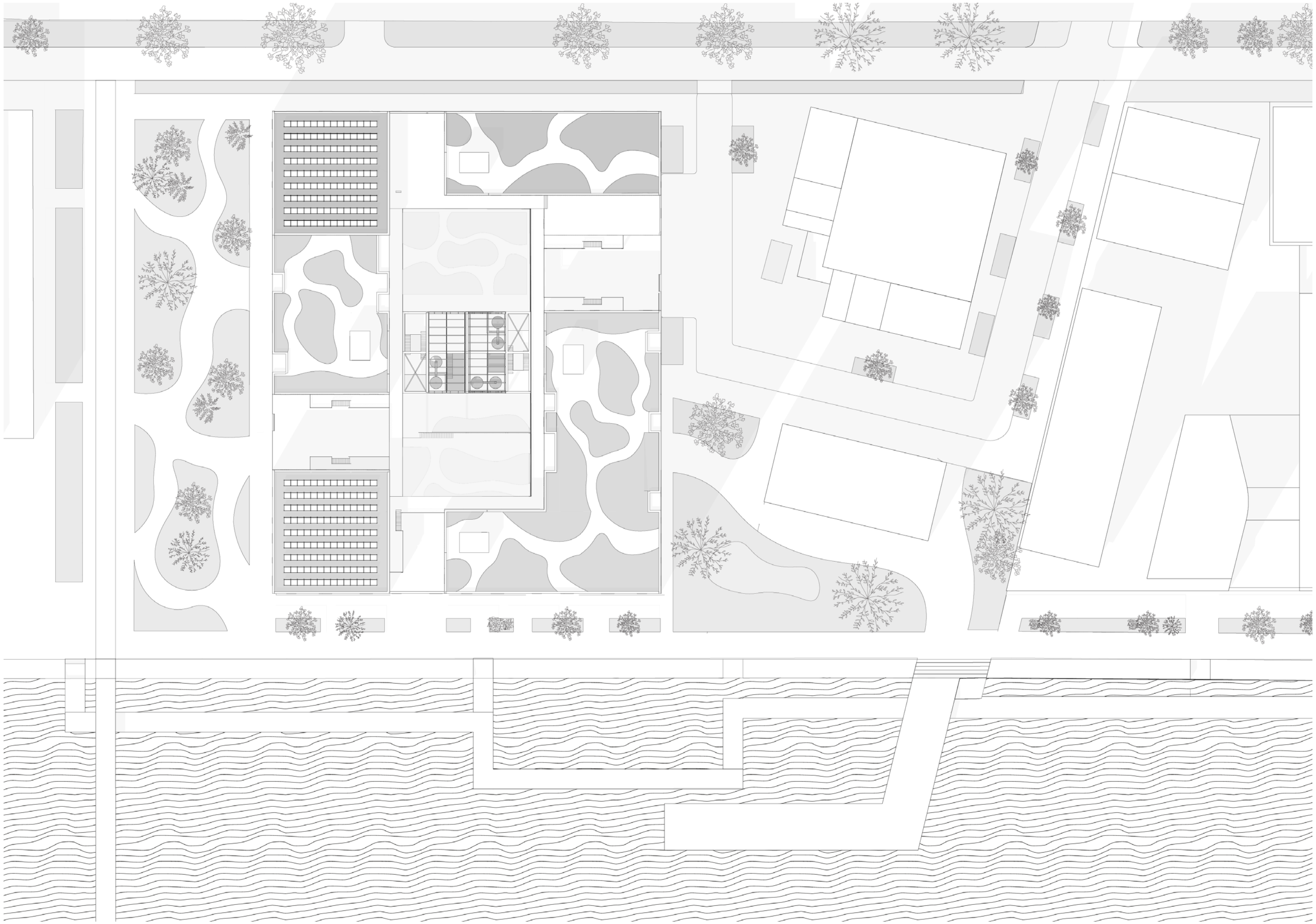


Scale 1:1000

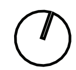
Urban Design | Urban Section

Scale 1:2000

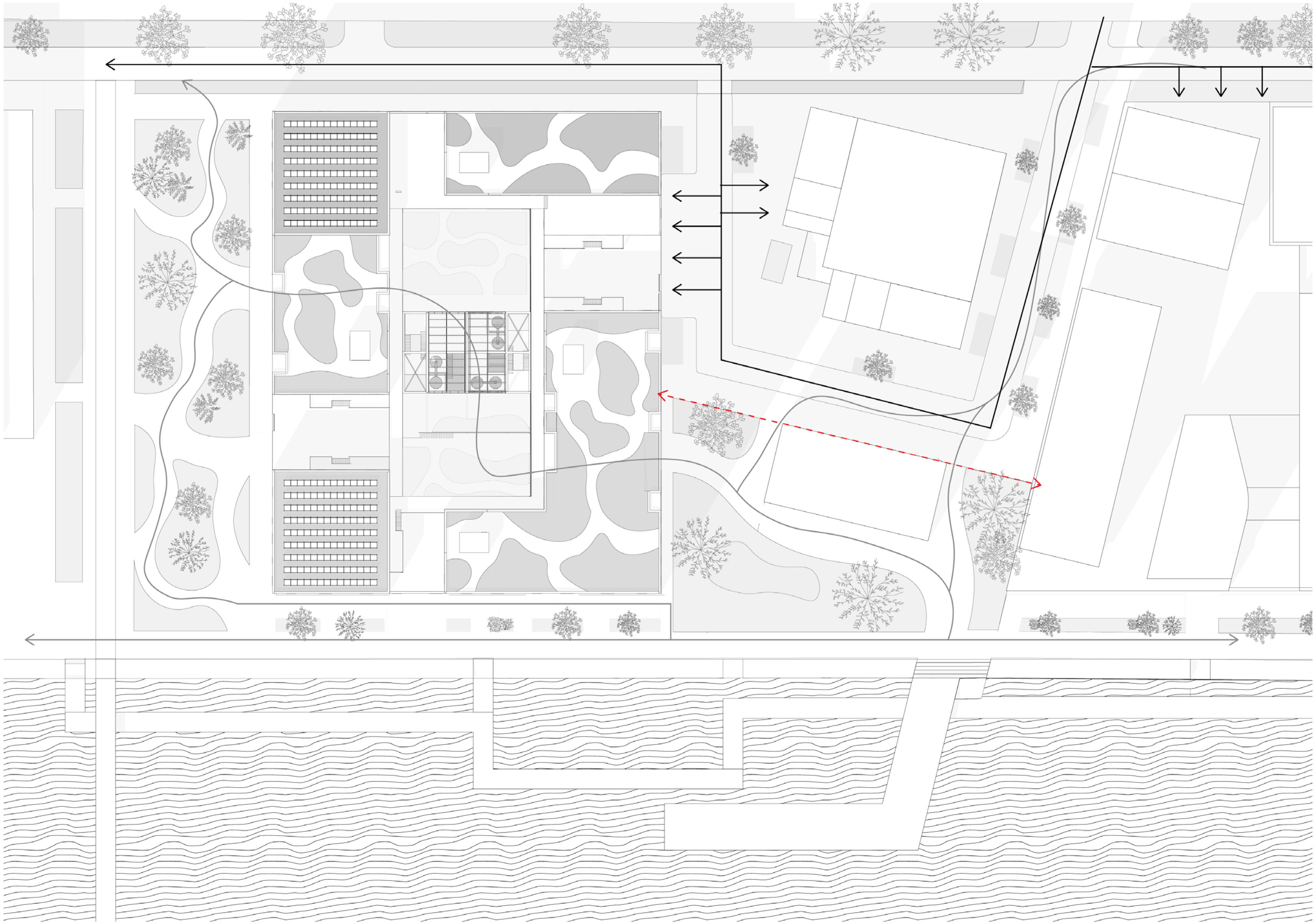
Urban Design | Site Plan



Scale 1:500

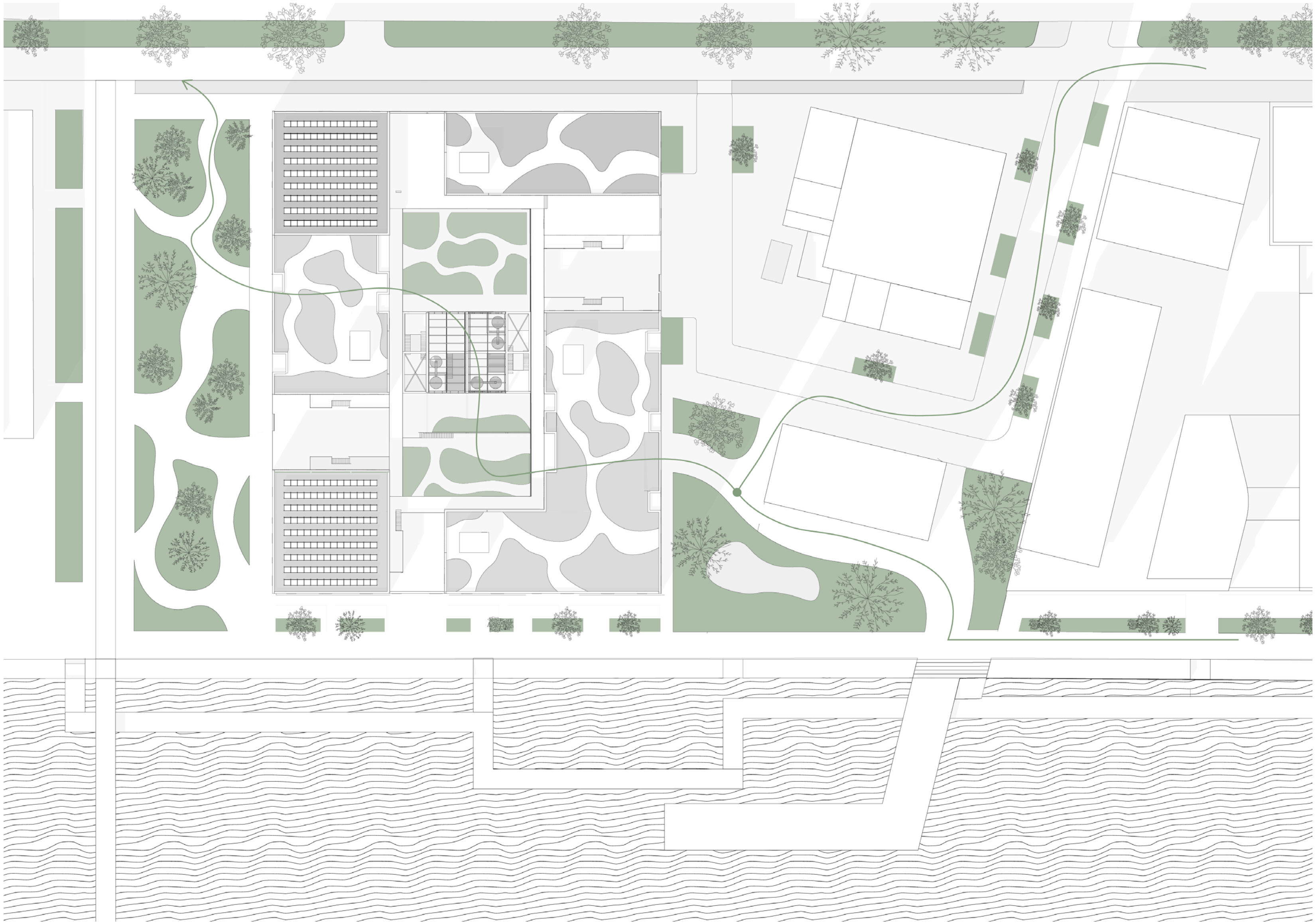


Urban Design | Site Plan



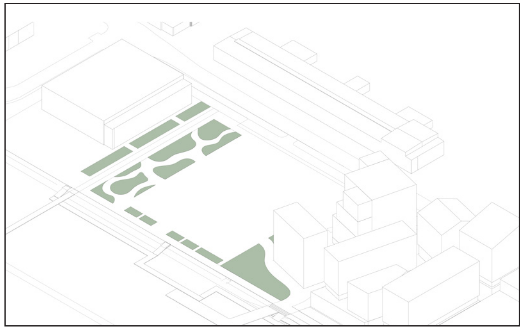
Scale 1:500

Urban Design | Site Plan

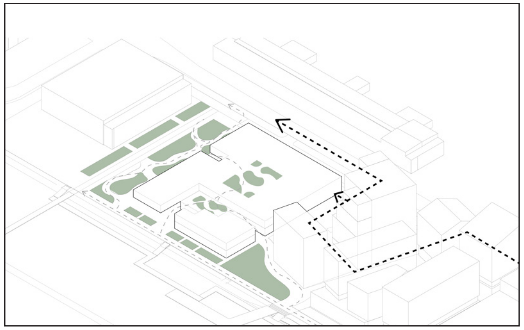


Scale 1:500

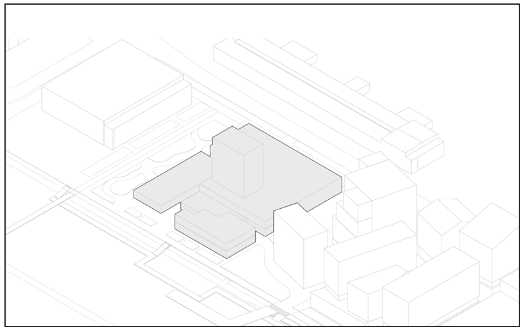
Building Design | In Relation to the Context



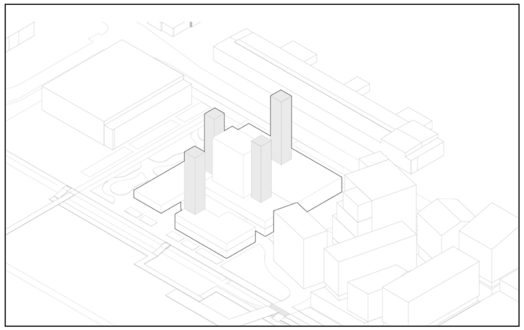
Step 1



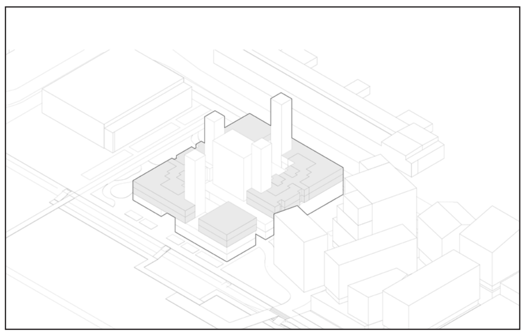
Step 2



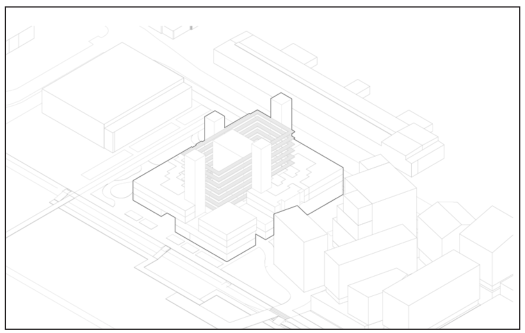
Step 3



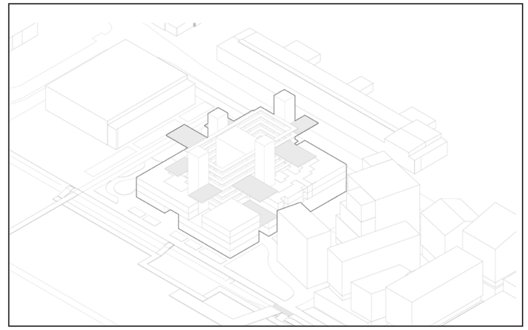
Step 4



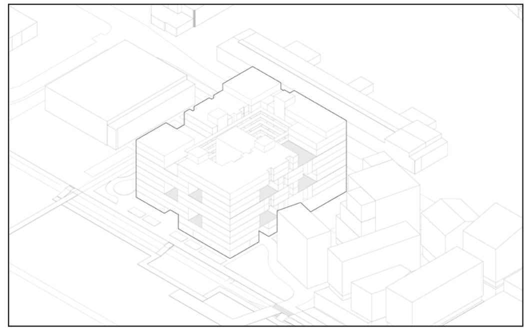
Step 5



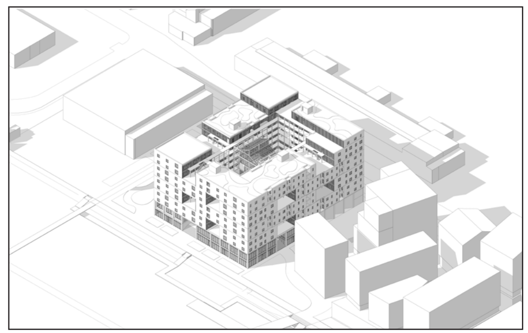
Step 6



Step 7



Step 8



Step 9

Facade | Materiality

Scale 1:200

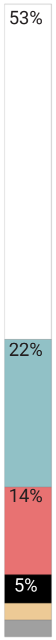
Facade | Materiality

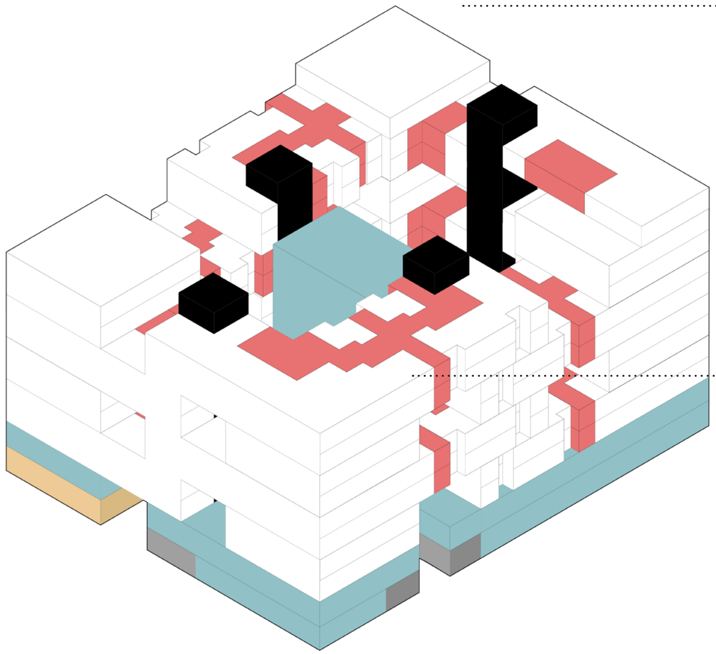
Scale 1:200

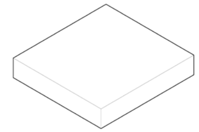
Facade | Materiality

Scale 1:200

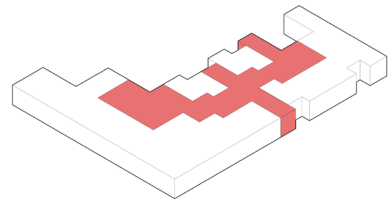
Building Design| Building Program







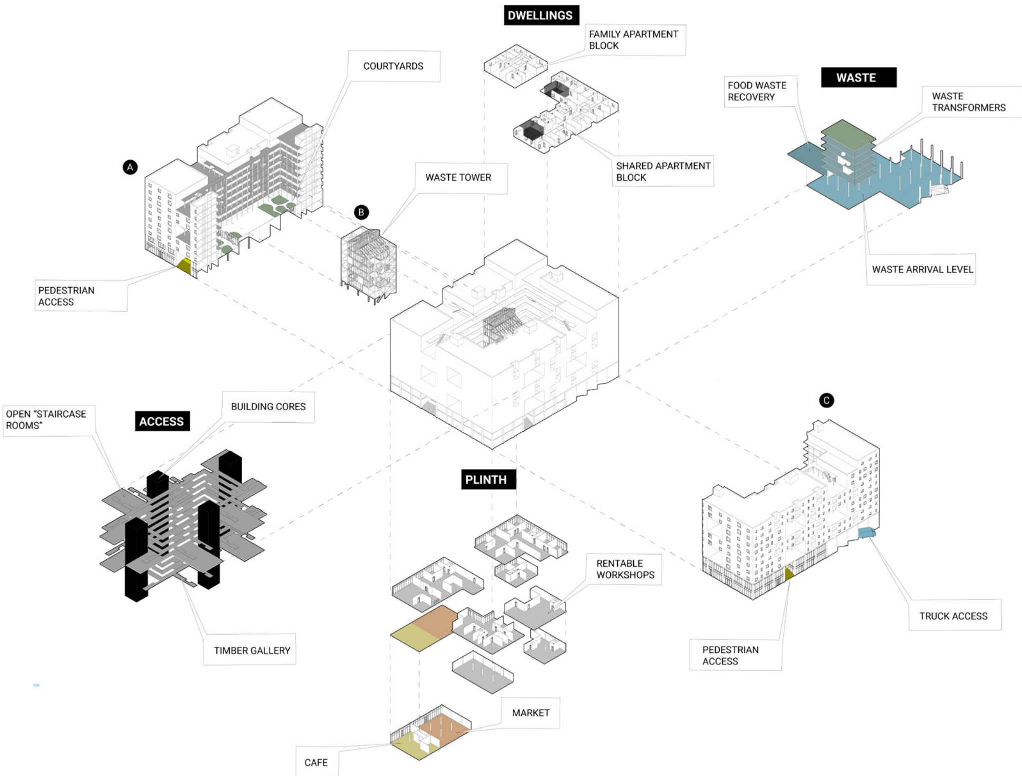
Family Block -
3 family apartments



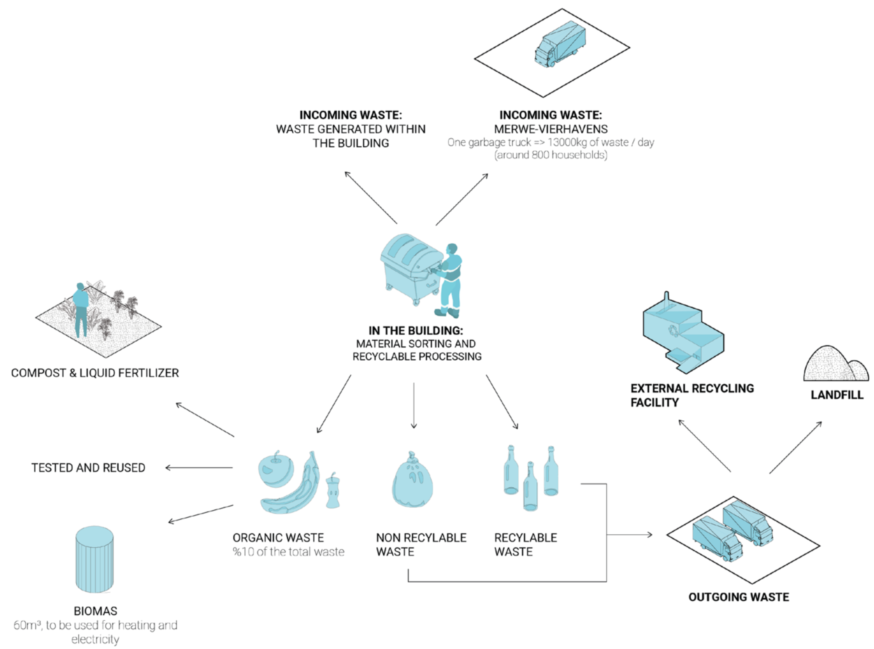
Cluster Block -
3 shared clusters

- Cooperative Housing
- Work (Waste management facilities, workshops)
- Communal Spaces (Within the shared apartments)
- Building Cores
- Commercial
- Entrances (Bike park + Dwelling core access)

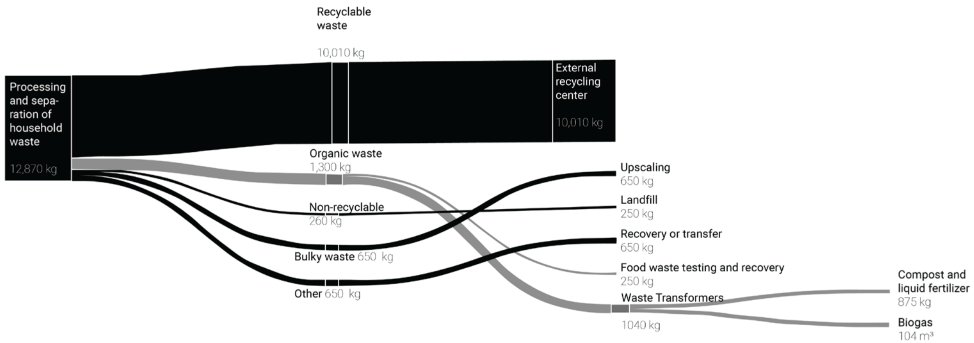
Building Design| Building Program



Building Design | Waste Journey

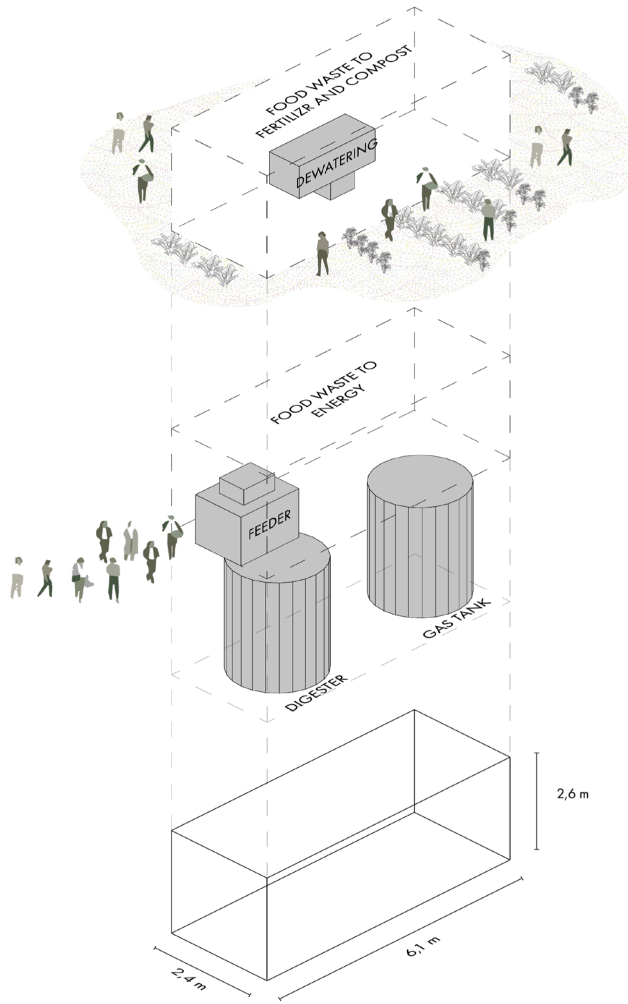


Building Design| Waste - Sankey Diagram



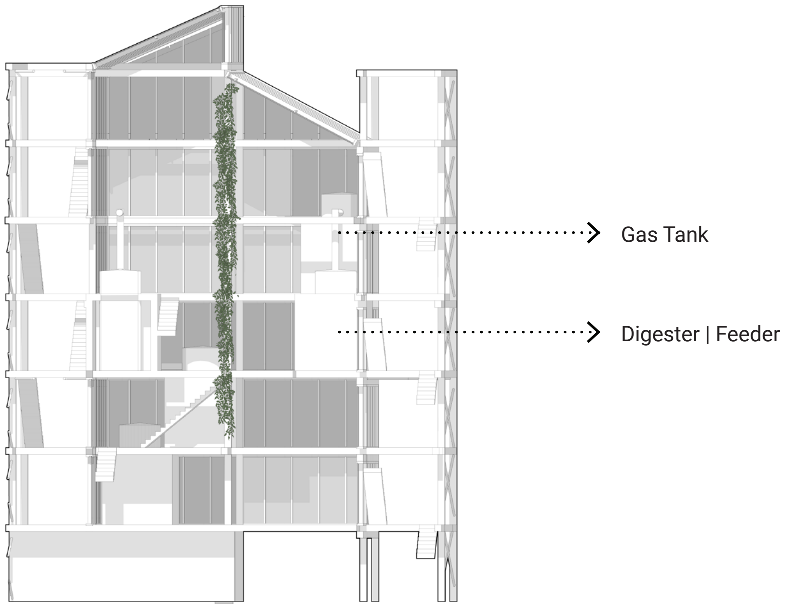
Building Design | Waste Management Facilities

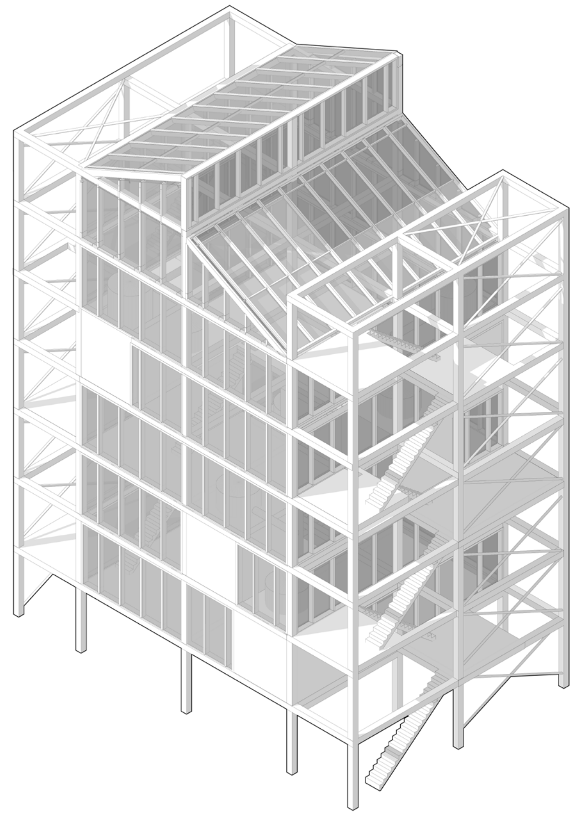
Diagram - Waste Tower



Building Design | Waste Management Facilities

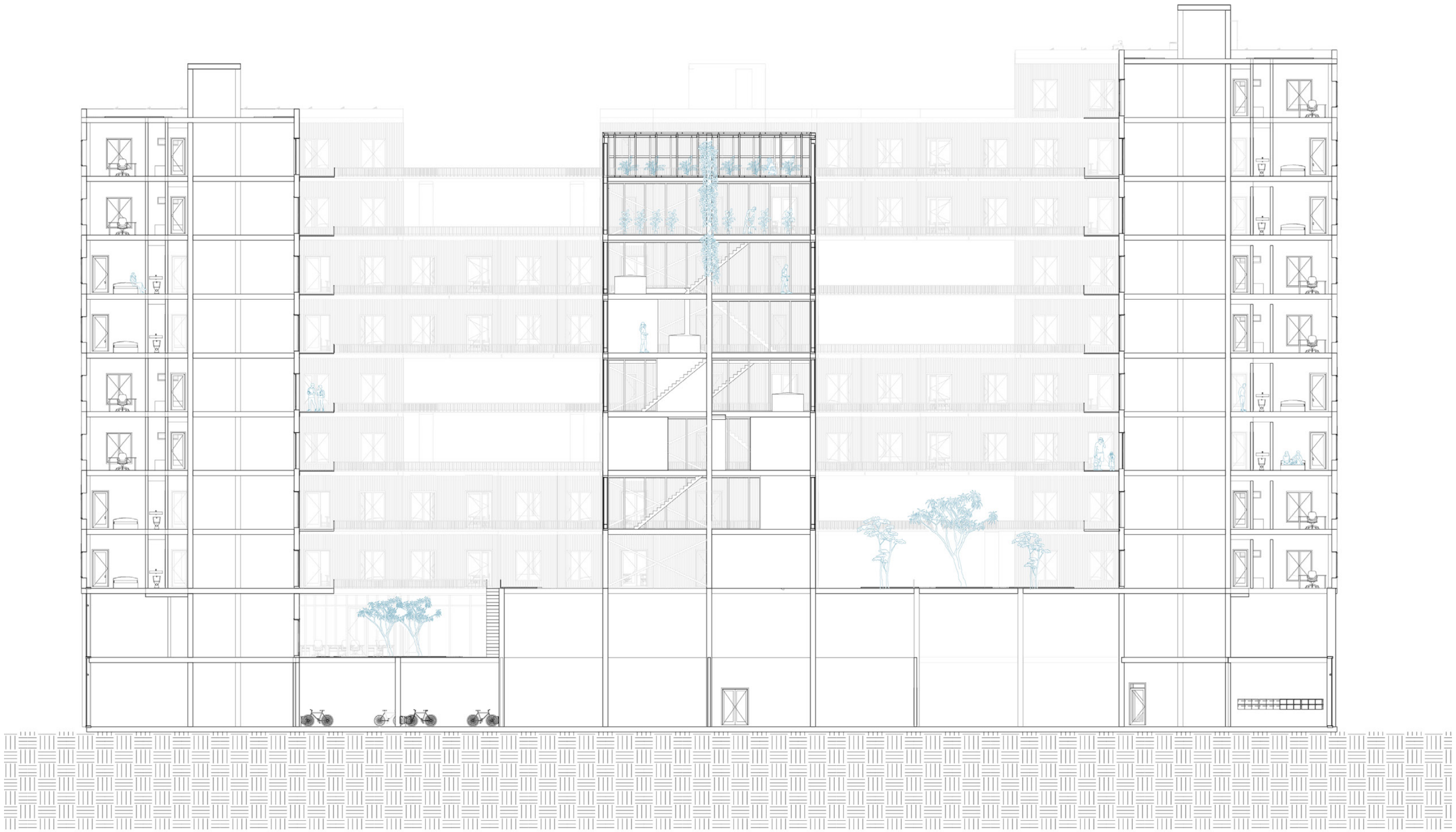
Diagram - Waste Tower



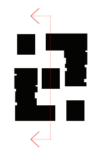


Building Design| Building Program

Building Section

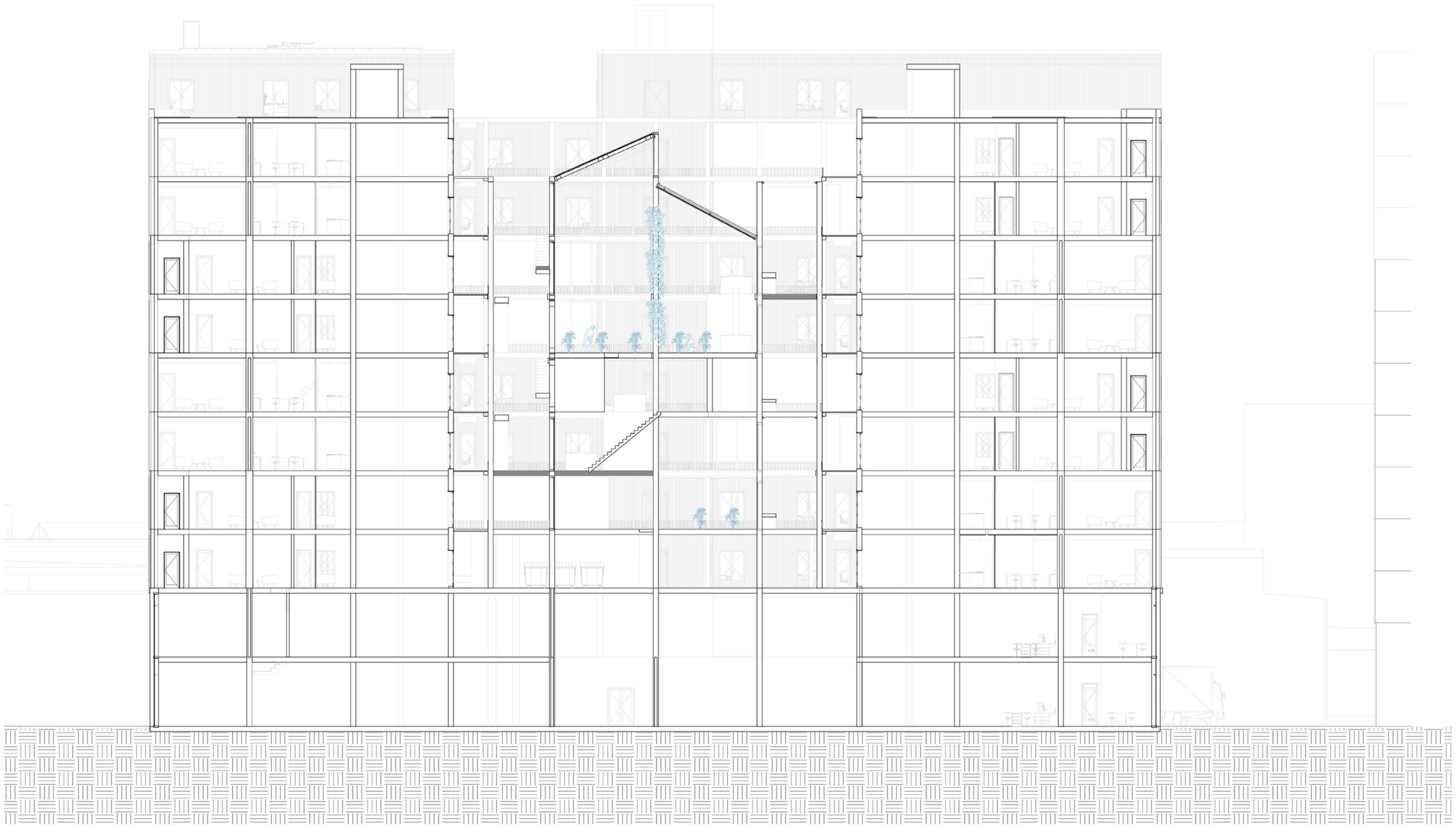


Scale 1:200

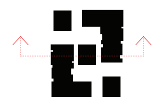


Building Design| Building Program

Building Section

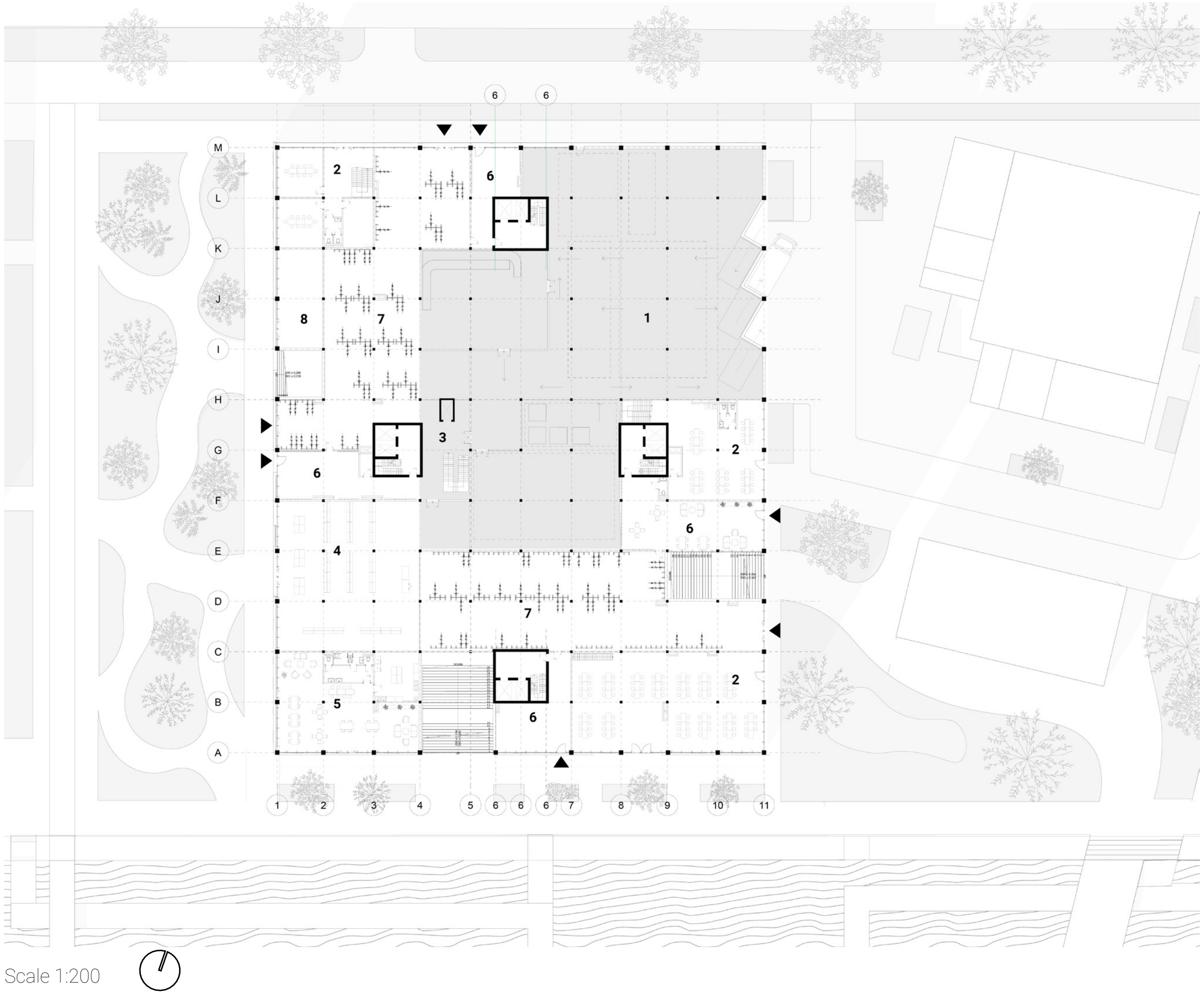


Scale 1:200



Building Design | Floor Plans

Ground Floor



Scale 1:200

1 Waste Transfer Station
2 Co-working Spaces, Workshops
3 Food Transport
4 Market | Recovered Food, Products
5 Restaurant
6 Entrance Dwellings
7 Bike Parking
8 Bike Repair
9 Food Waste Testing and Recovery
10 Courtyard
11 Waste Tower

Building Design | Floor Plans

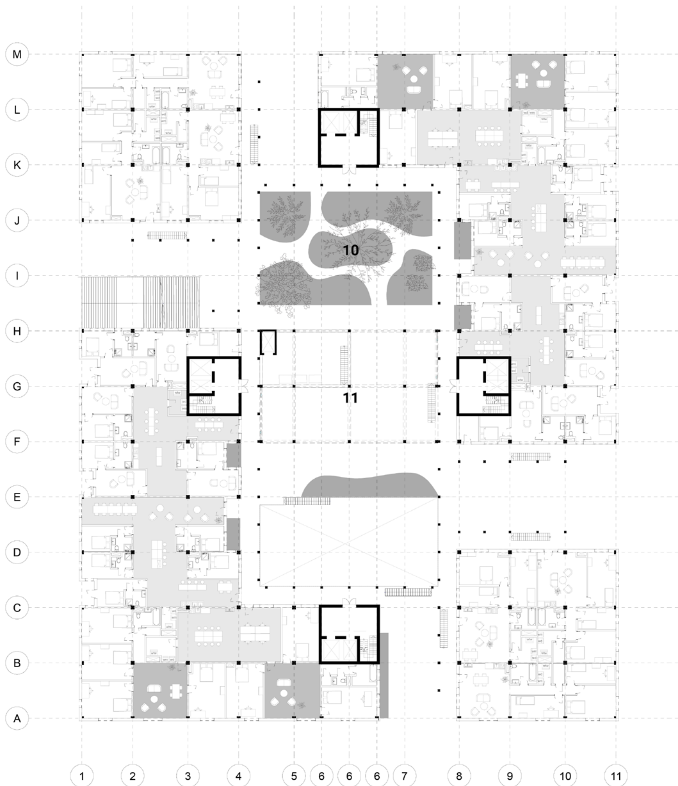
First Floor

Scale 1:200

1 Waste Transfer Station
2 Co-working Spaces, Workshops
3 Food Transport
4 Market | Recovered Food, Products
5 Restaurant
6 Entrance Dwellings
7 Bike Parking
8 Bike Repair
9 Food Waste Testing and Recovery
10 Courtyard
11 Waste Tower

Building Design | Floor Plans

Second Floor

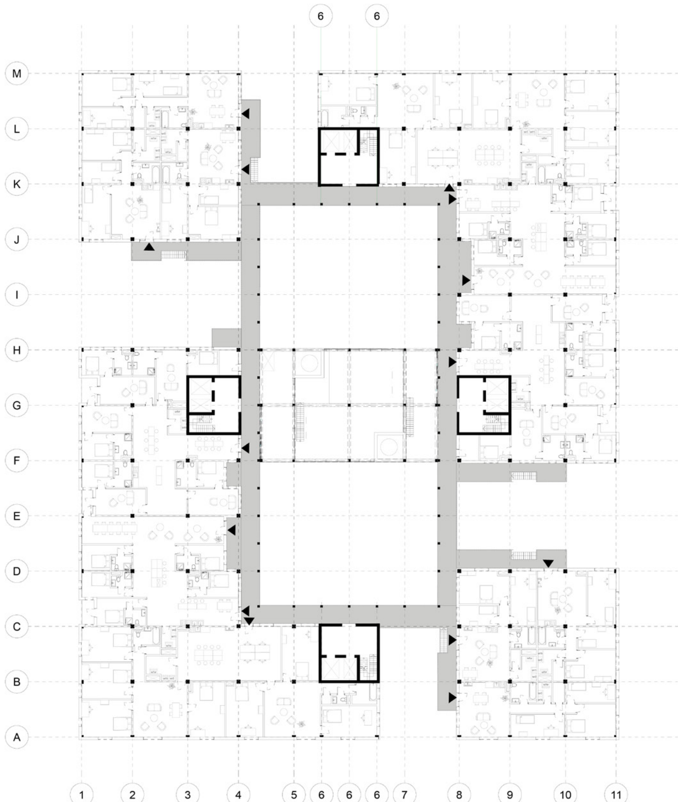


Scale 1:200

- **1** Waste Transfer Station
- **2** Co-working Spaces, Workshops
- **3** Food Transport
- **4** Market | Recovered Food, Products
- **5** Restaurant
- **6** Entrance Dwellings
- **7** Bike Parking
- **8** Bike Repair
- **9** Food Waste Testing and Recovery
- **10** Courtyard
- **11** Waste Tower

Building Design | Floor Plans

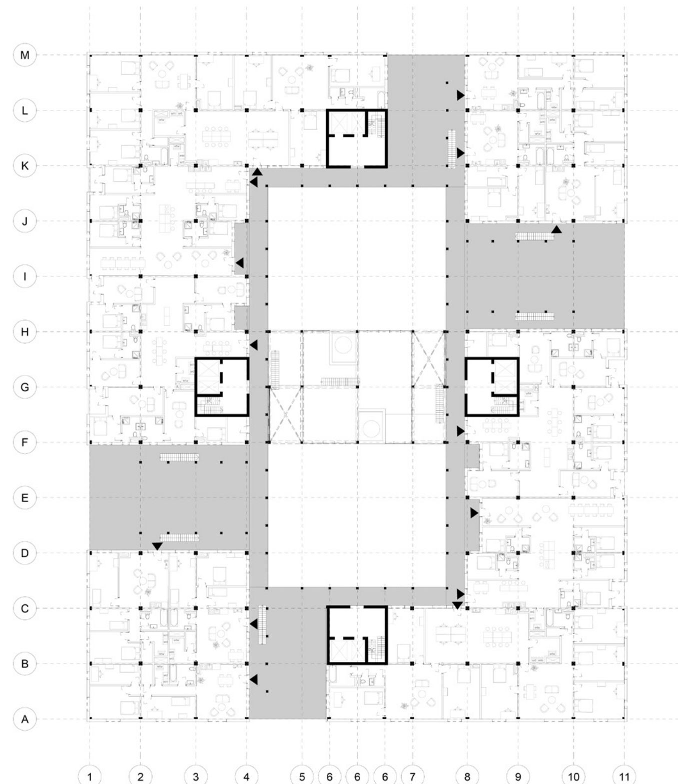
Third Floor



Scale 1:200

Building Design | Floor Plans

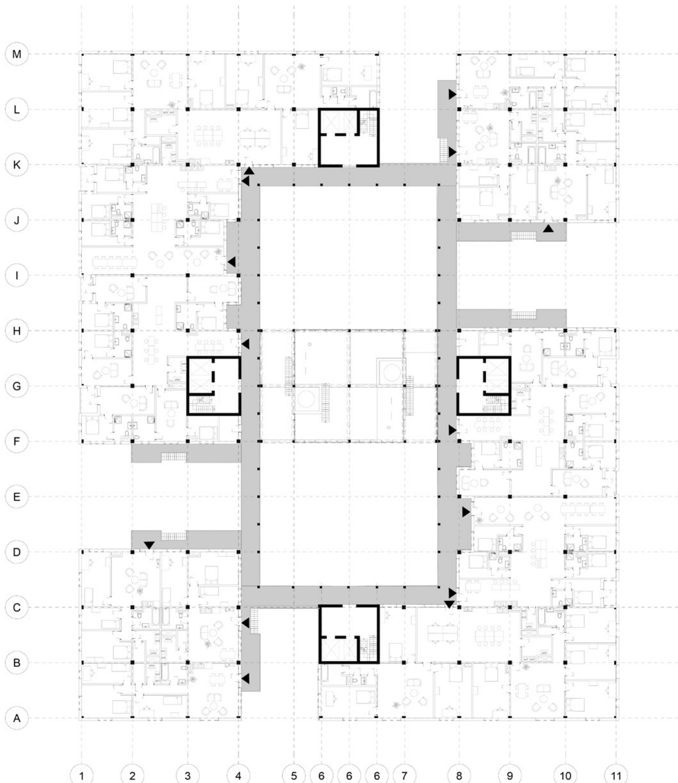
Fourth Floor



Scale 1:200

Building Design | Floor Plans

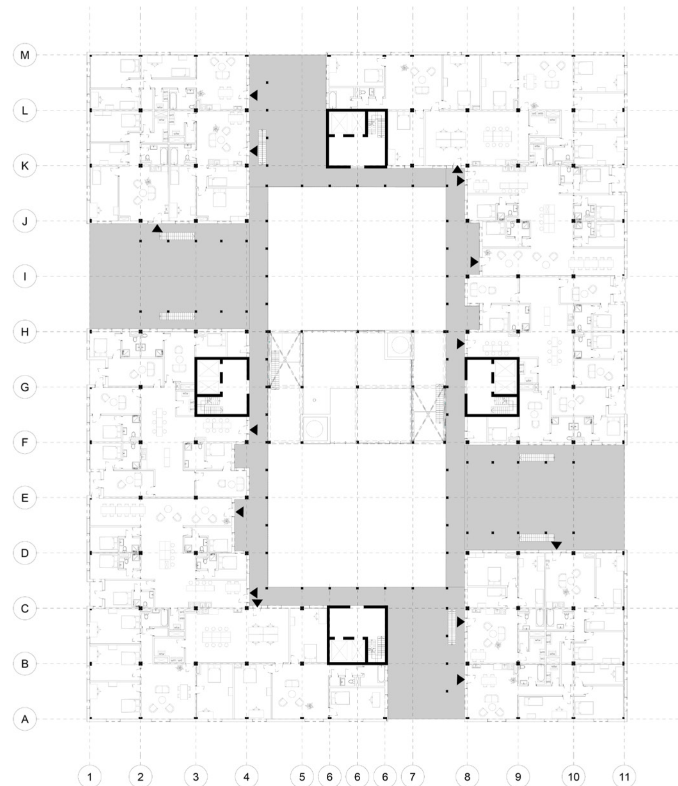
Fifth Floor



Scale 1:200

Building Design | Floor Plans

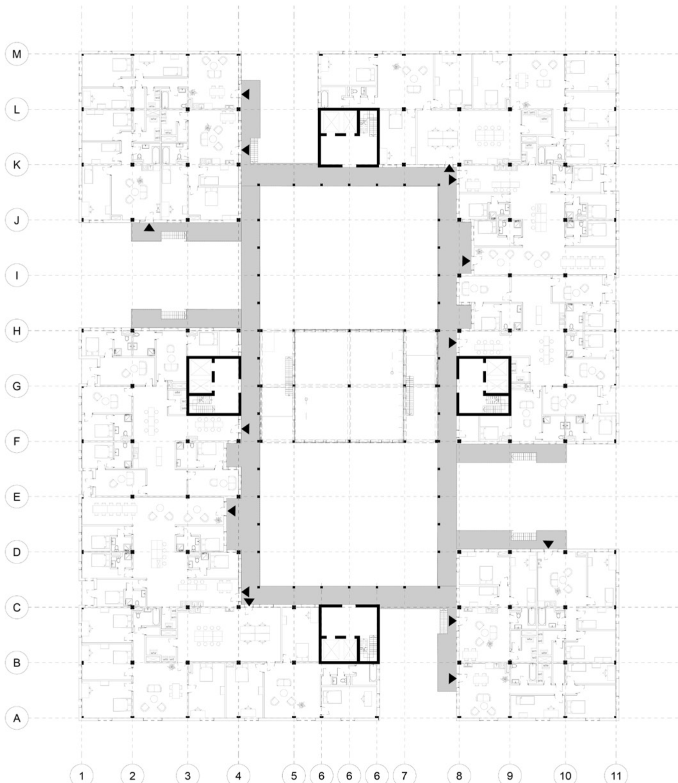
Sixth Floor



Scale 1:200

Building Design | Floor Plans

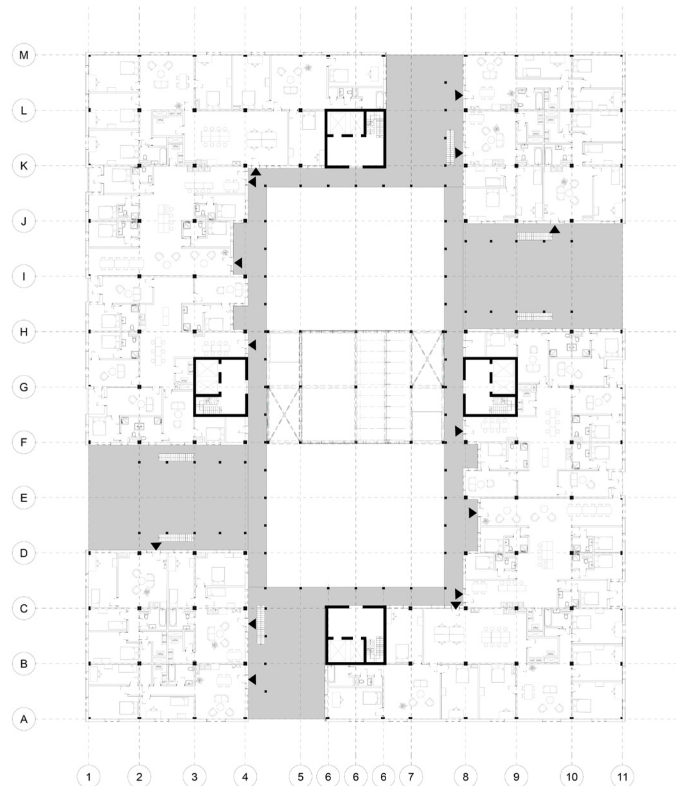
Seventh Floor



Scale 1:200

Building Design | Floor Plans

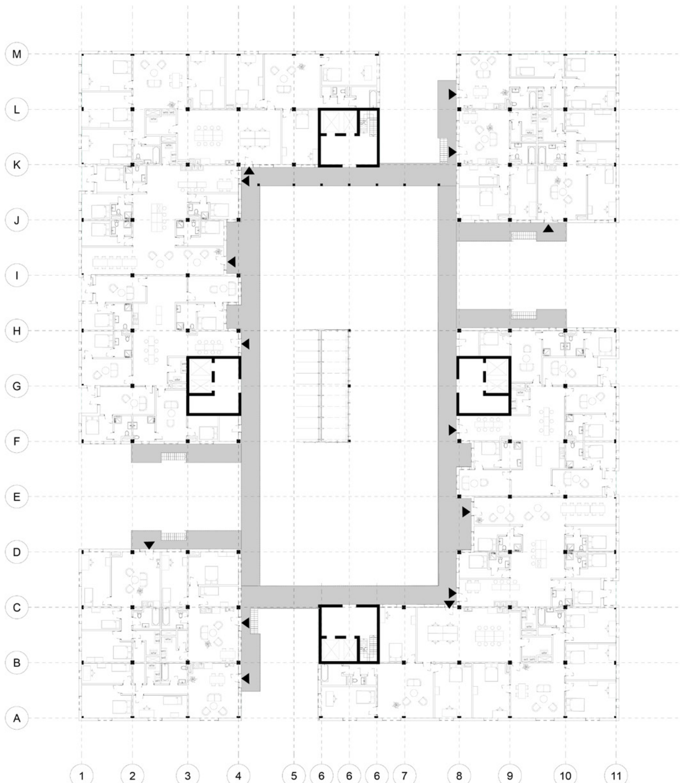
Eighth Floor



Scale 1:200

Building Design | Floor Plans

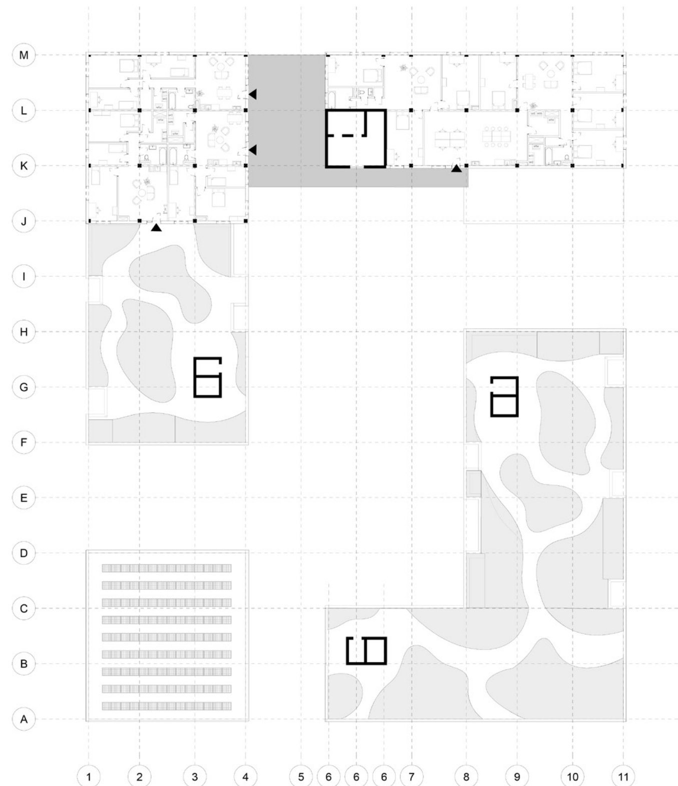
Ninth Floor



Scale 1:200

Building Design | Floor Plans

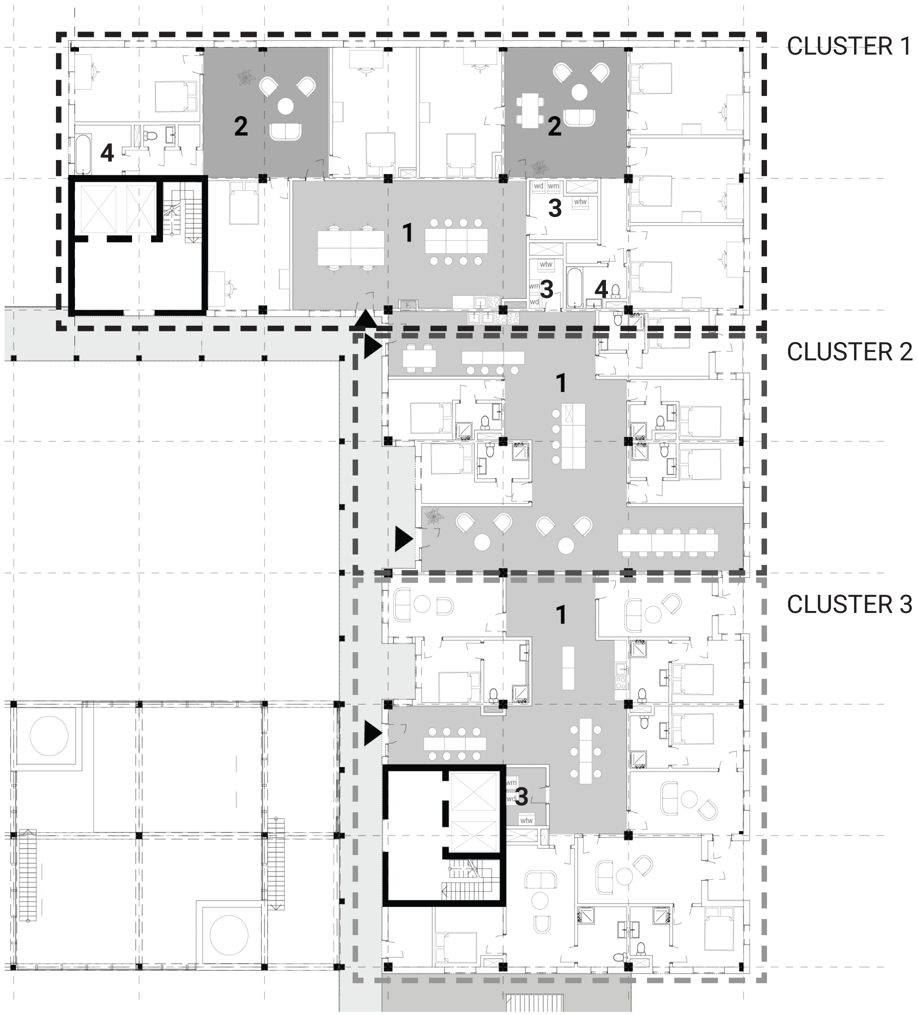
Tenth Floor

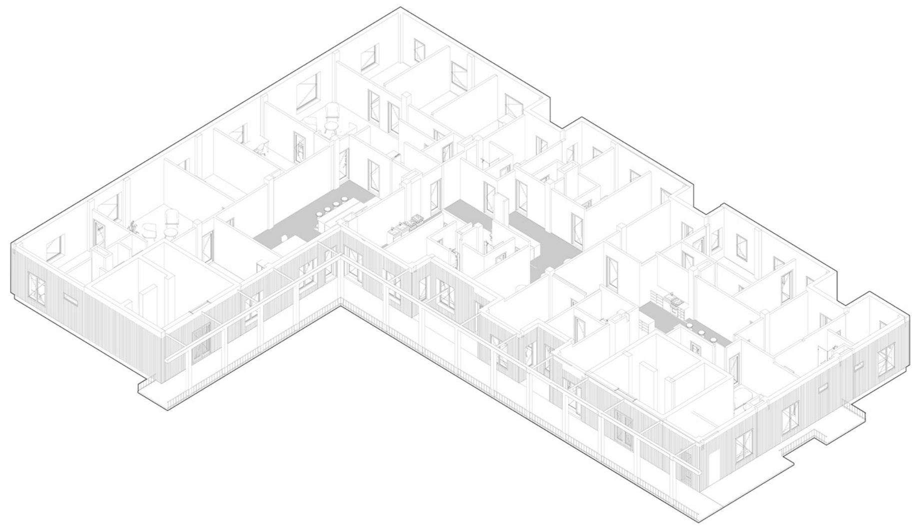


Scale 1:200

Building Design | Dwellings

Shared Apartment Block

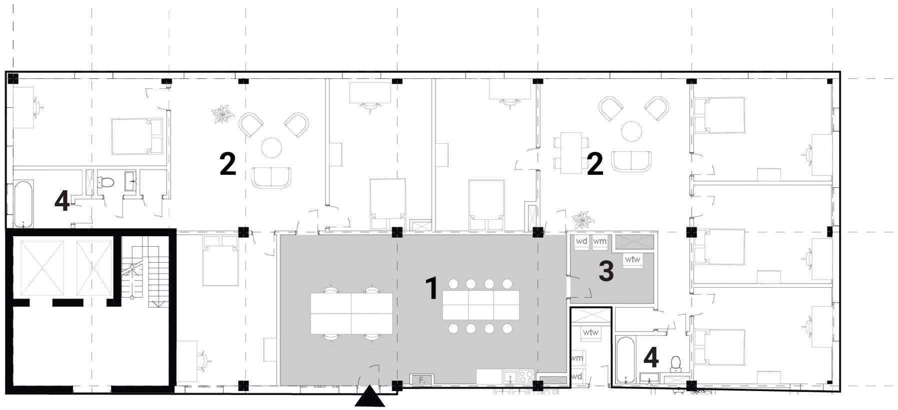




1 Collective Multifunctional Room
2 Shared Living Room
3 Technical Room
4 Shared Toilets

Building Design | Dwellings

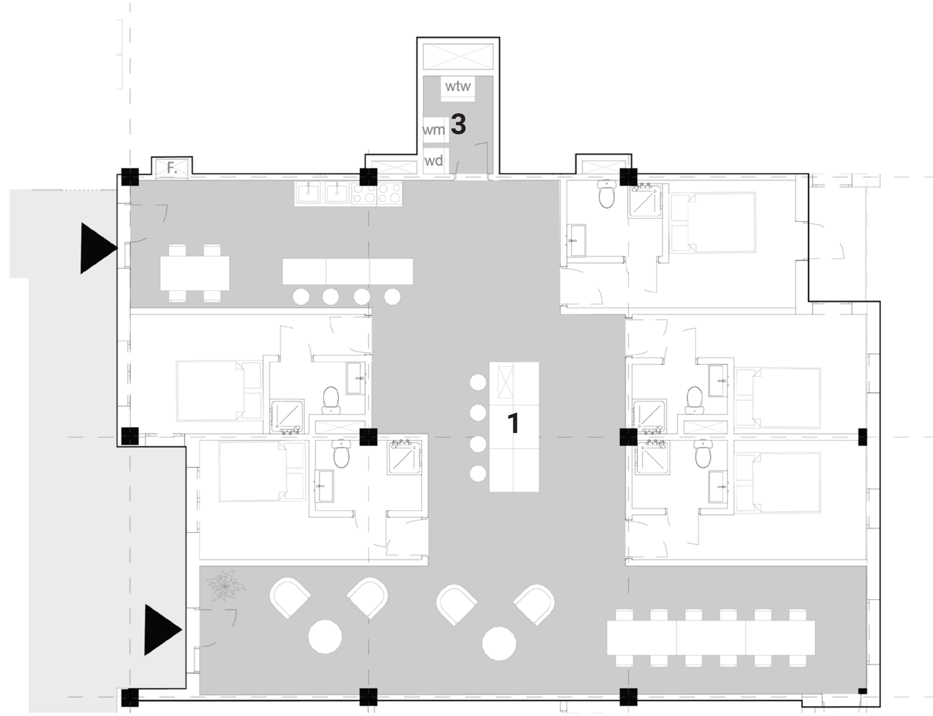
Cluster 1



1 Collective Multifunctional Room
2 Shared Living Room
3 Technical Room
4 Shared Toilets

Building Design | Dwellings

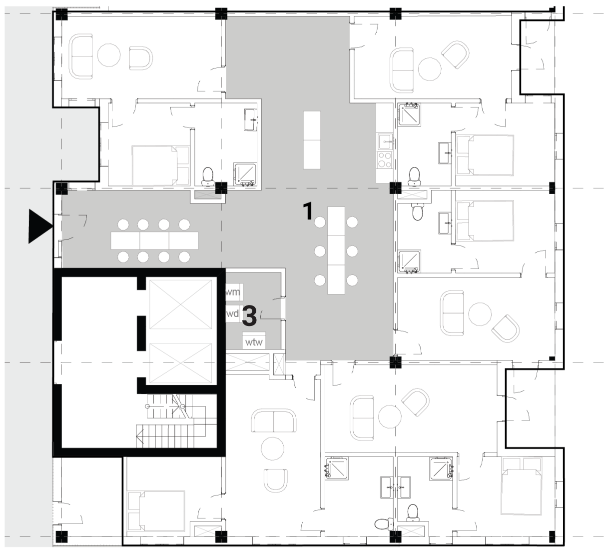
Cluster 2



1 Collective Multifunctional Room
2 Shared Living Room
3 Technical Room
4 Shared Toilets

Building Design | Dwellings

Cluster 3



1 Collective Multifunctional Room

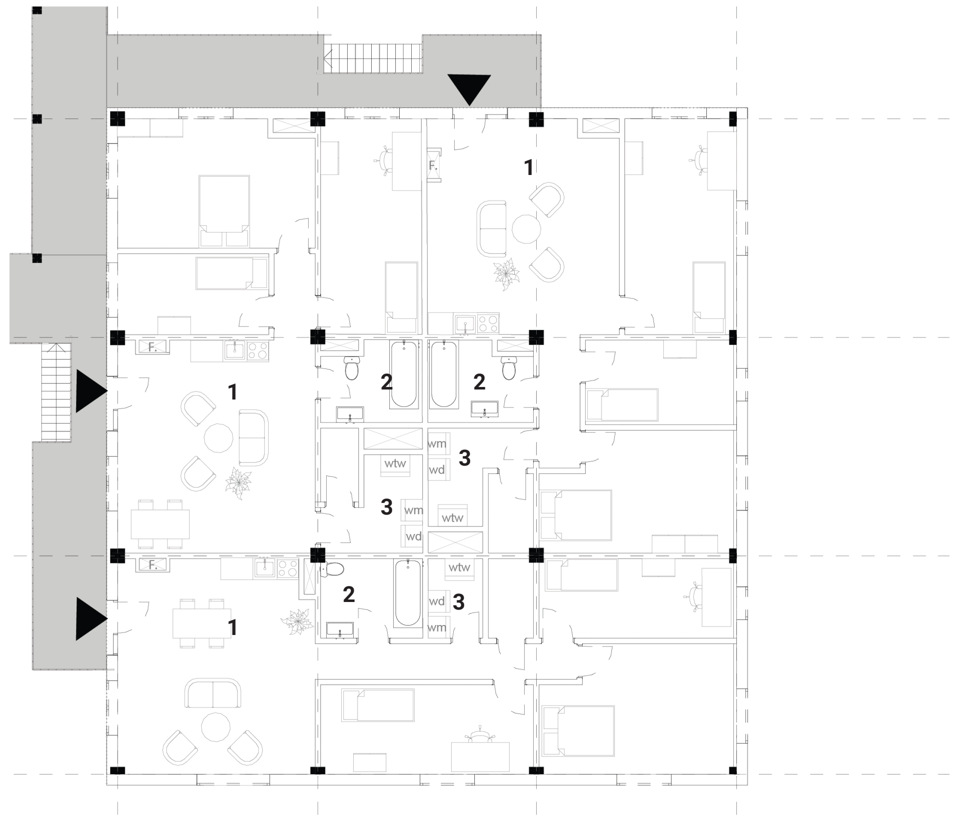
2 Shared Living Room

3 Technical Room

4 Shared Toilets

Building Design | Dwellings

Family Block



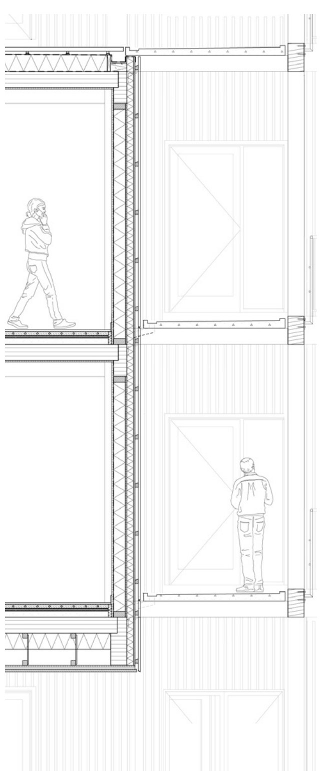
1 Kitchen / Living Room

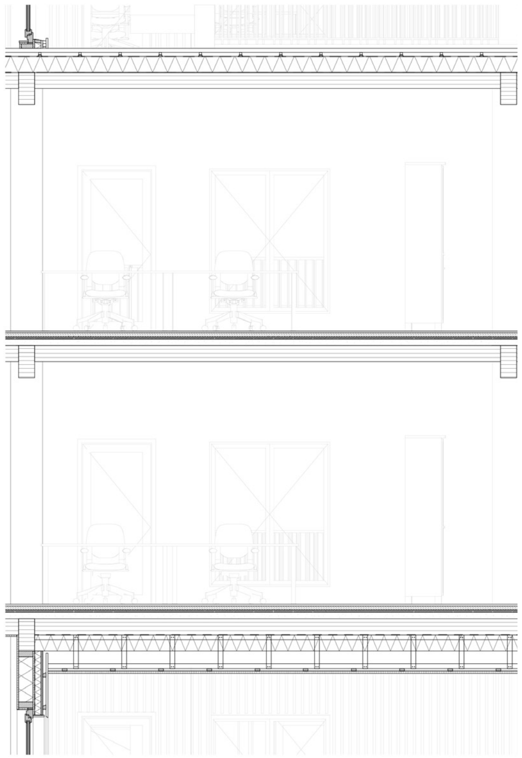
2 Toilet

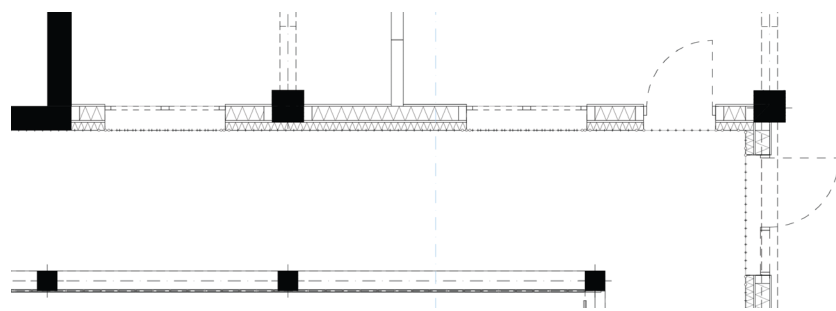
3 Technical Room

Building Technology | The Timber Gallery

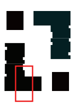
Fragment





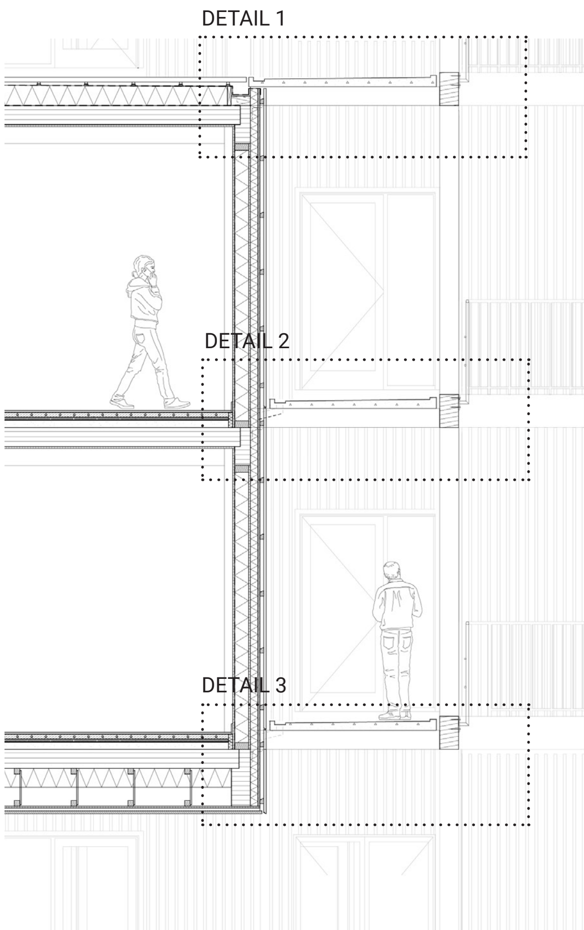


Scale 1:50



Building Technology | The Timber Gallery

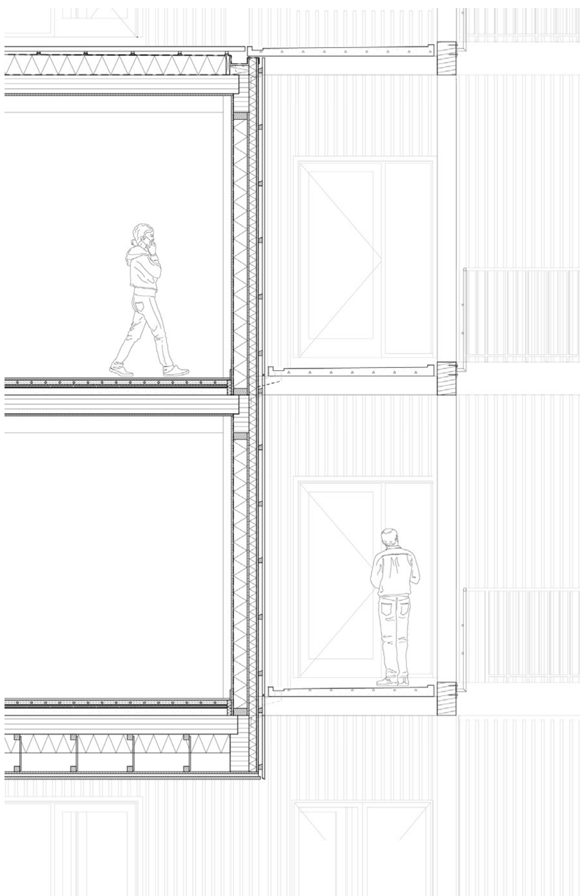
Fragment

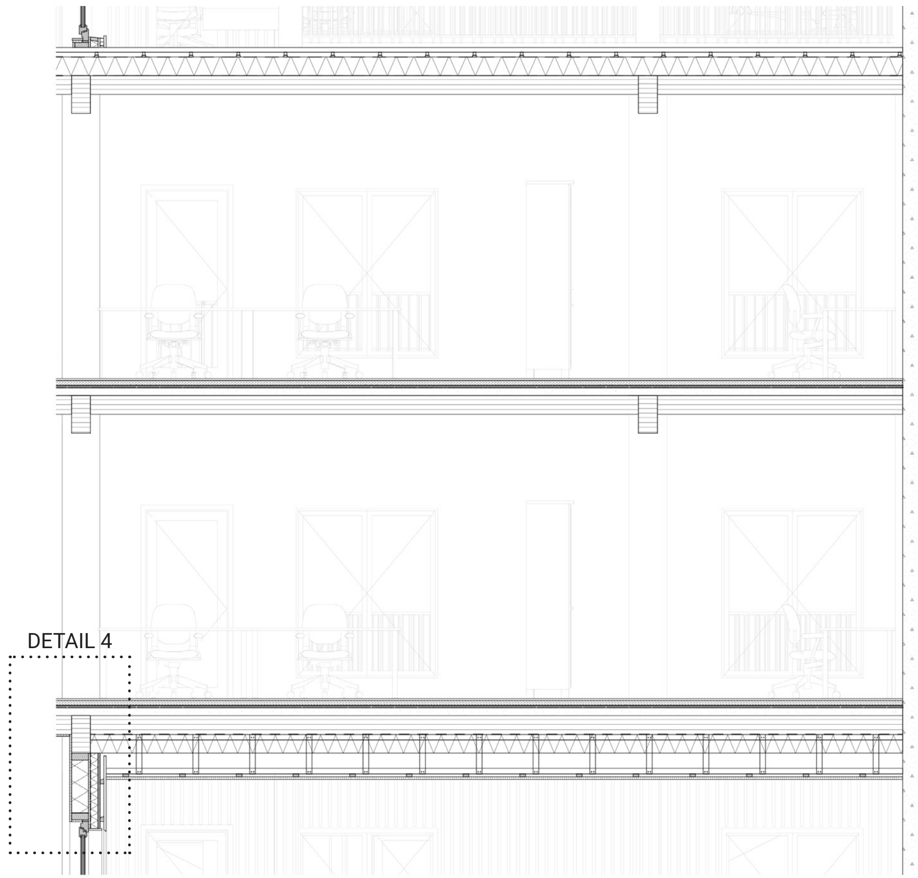


Scale 1:50

Building Technology | The Timber Gallery

Fragment

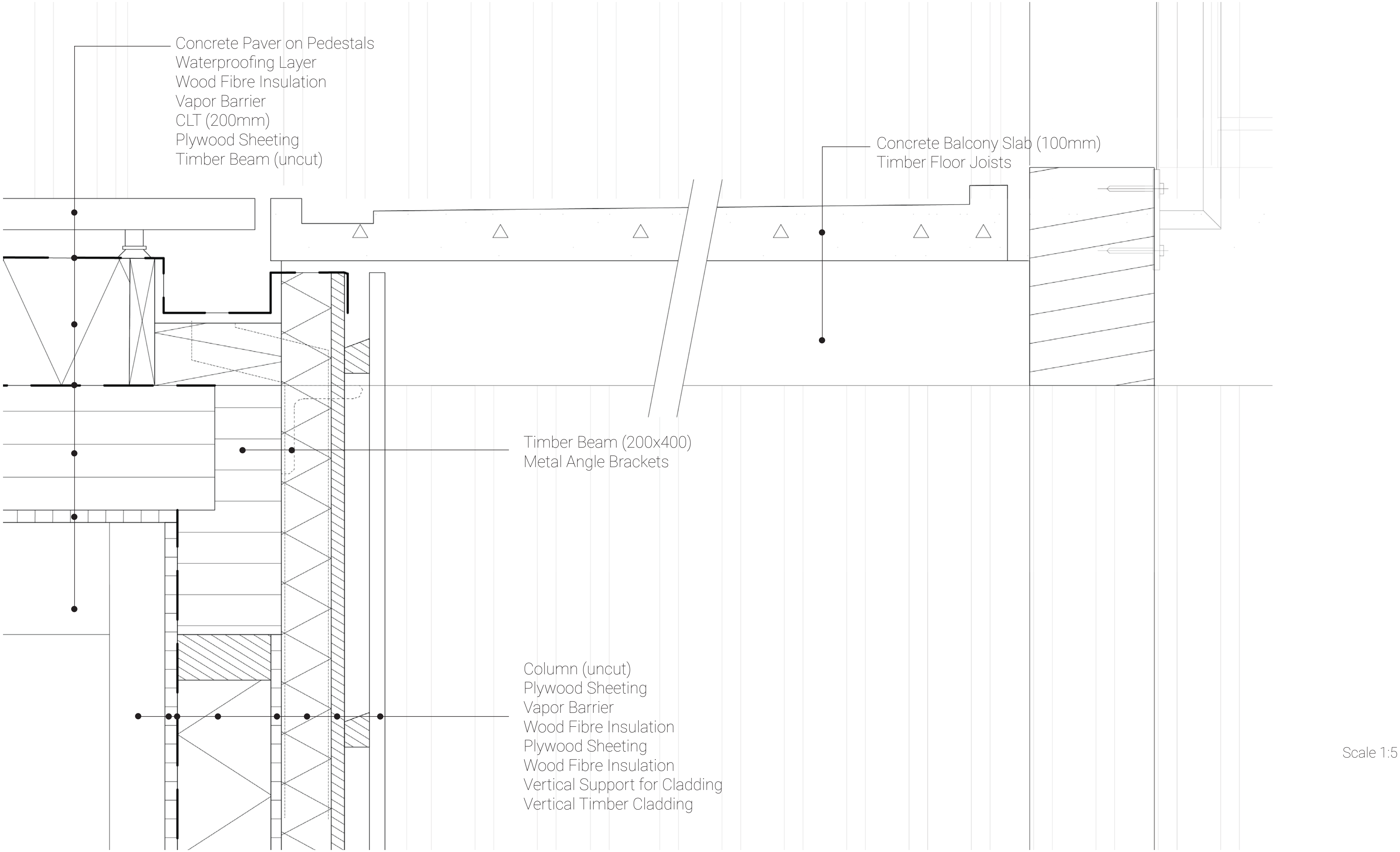




Scale 1:50

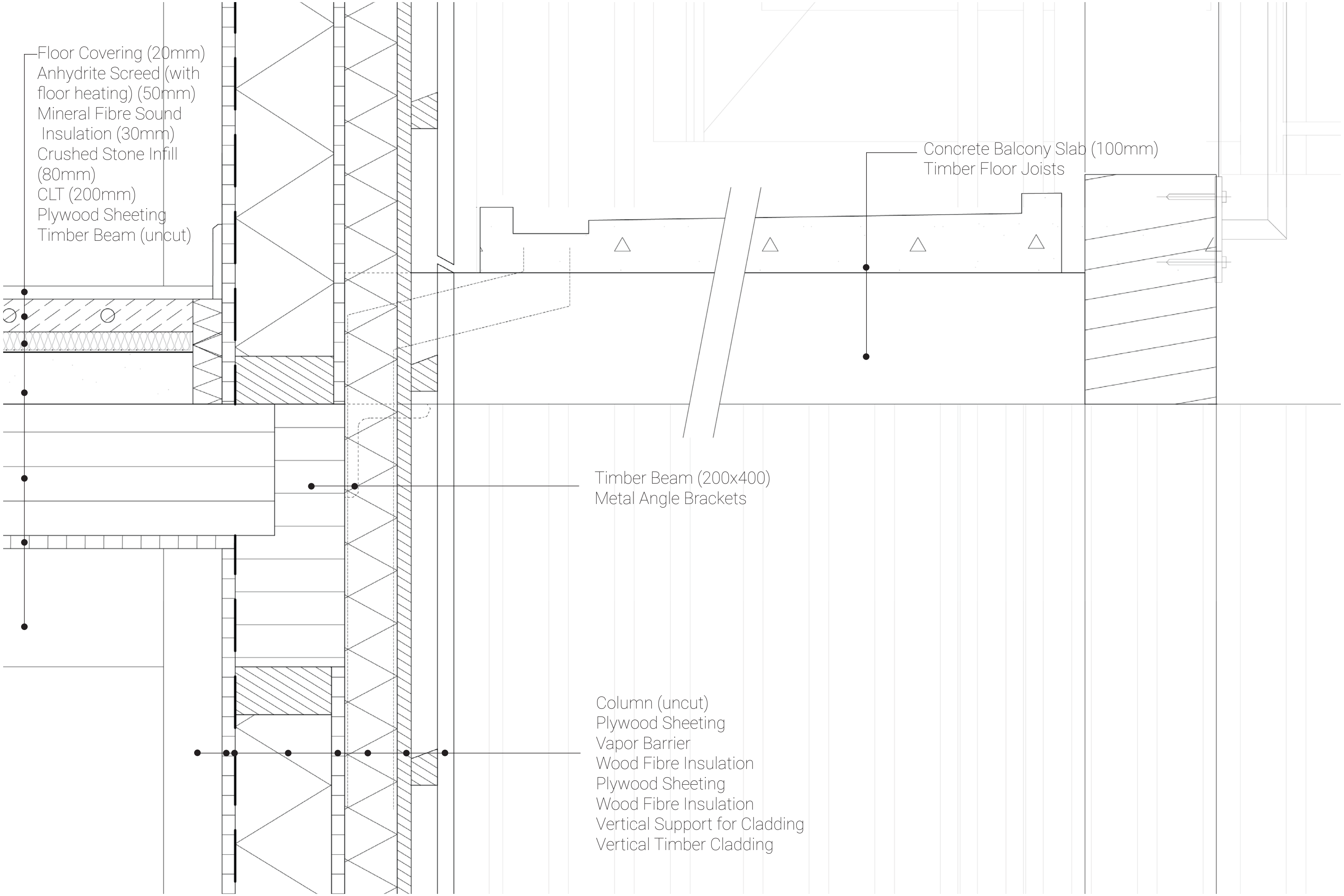
Building Technology | The Timber Gallery

Detail 1



Building Technology | The Timber Gallery

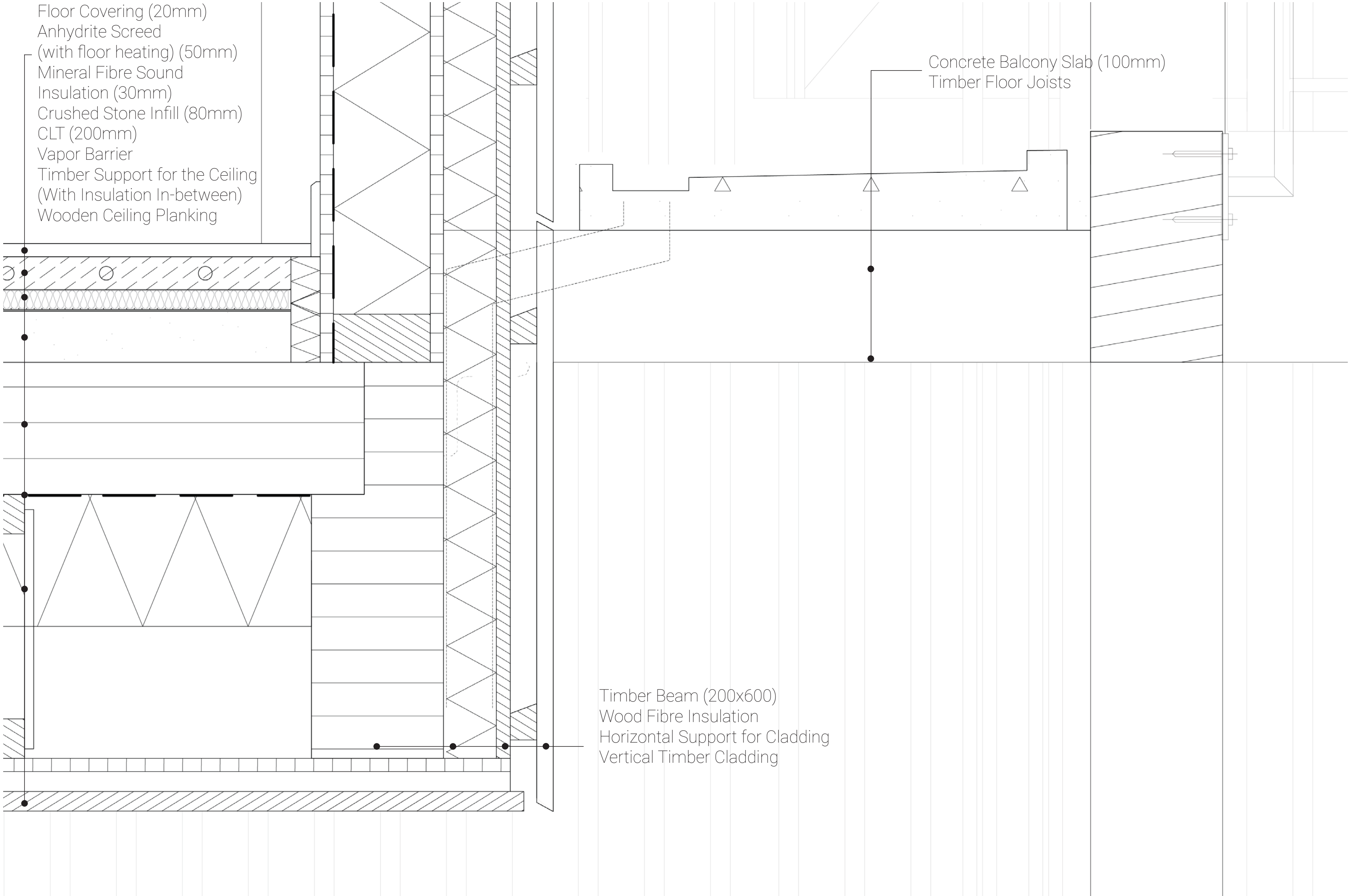
Detail 2



Scale 1:5

Building Technology | The Timber Gallery

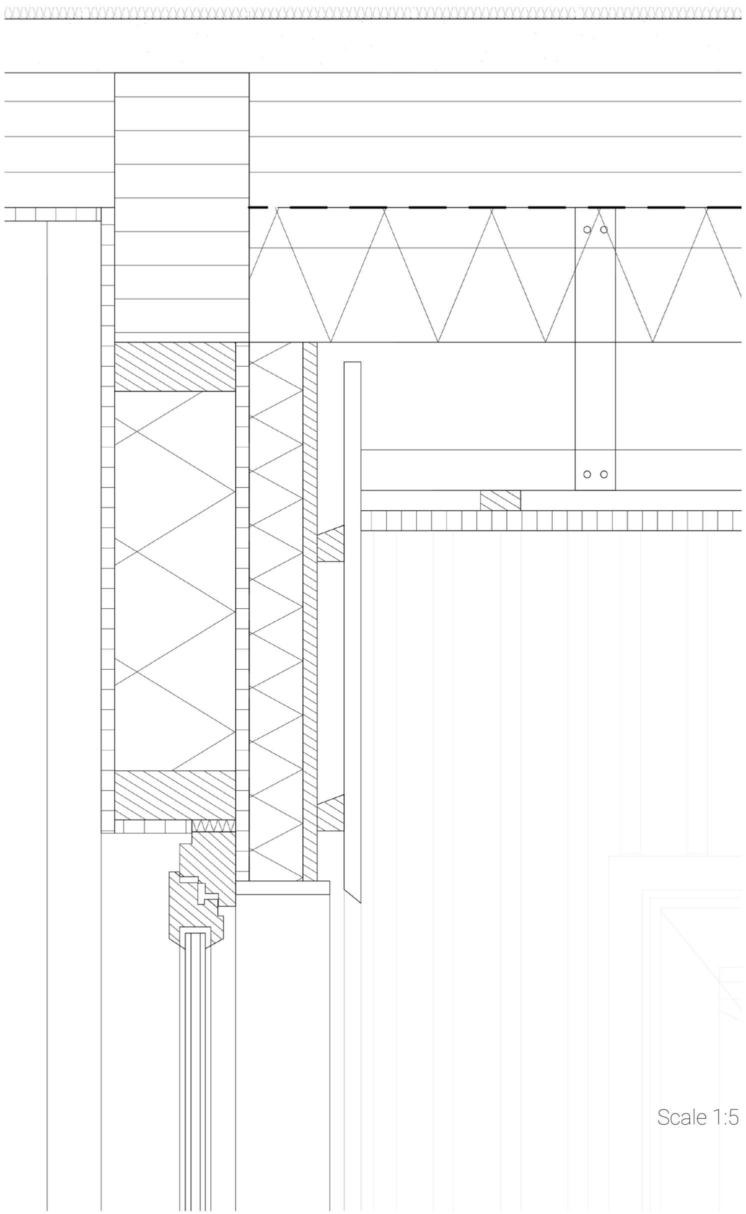
Detail 3



Scale 1:5

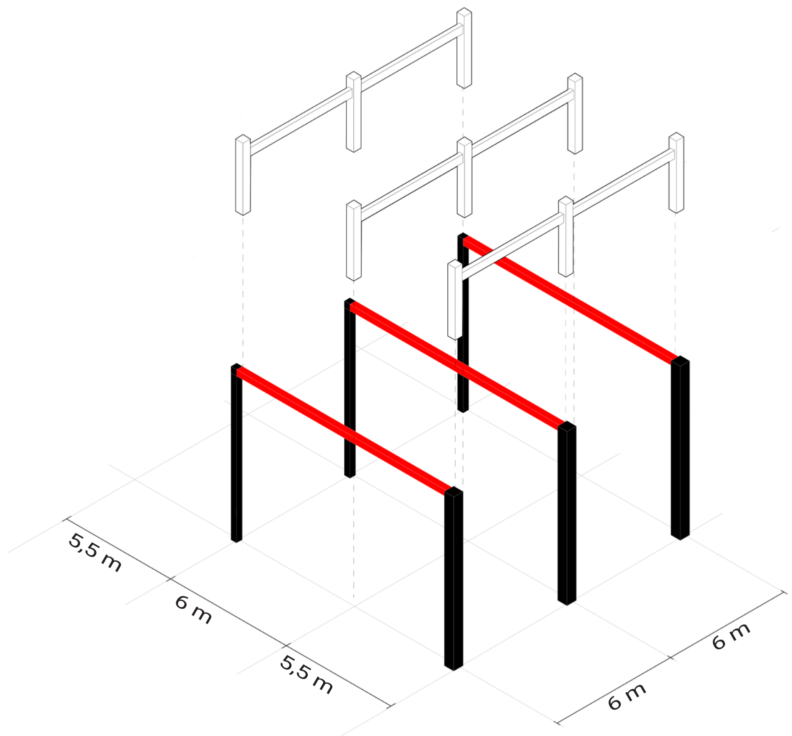
Building Technology | The Timber Gallery

Window Detail



Building Technology | Structural Diagram

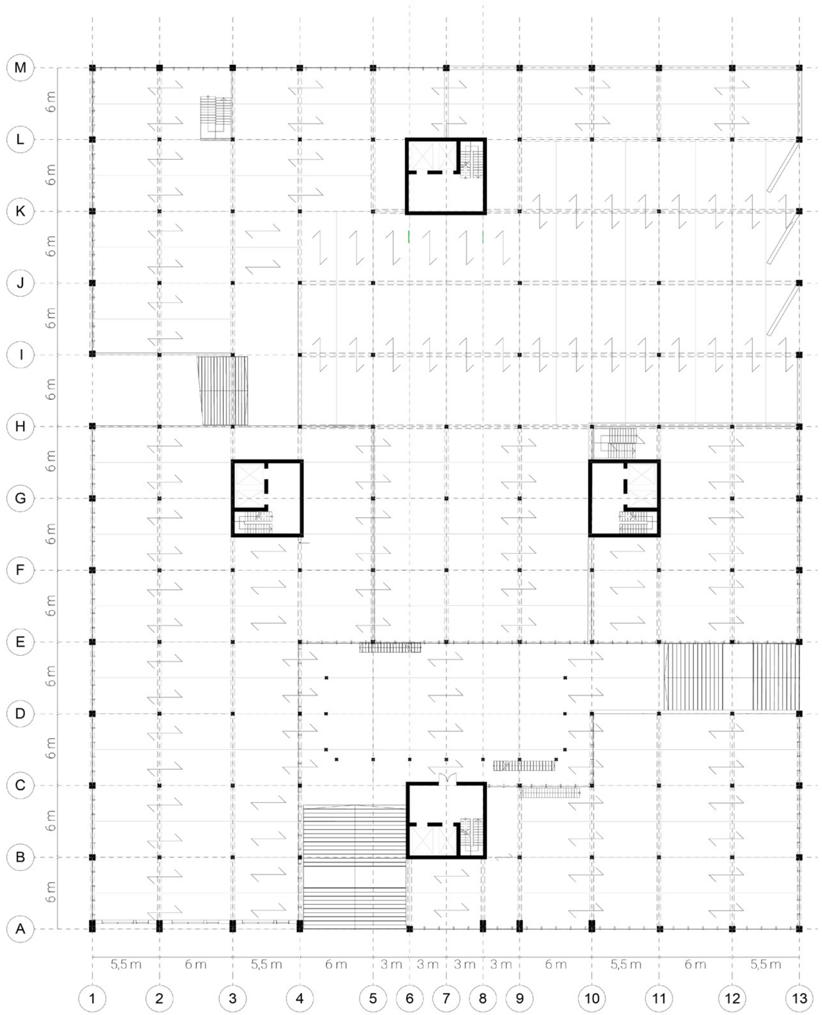
Axonometric Diagram



- Concrete Structure
- Timber Structure
- Transfer Beams

Building Technology | Structural Diagram

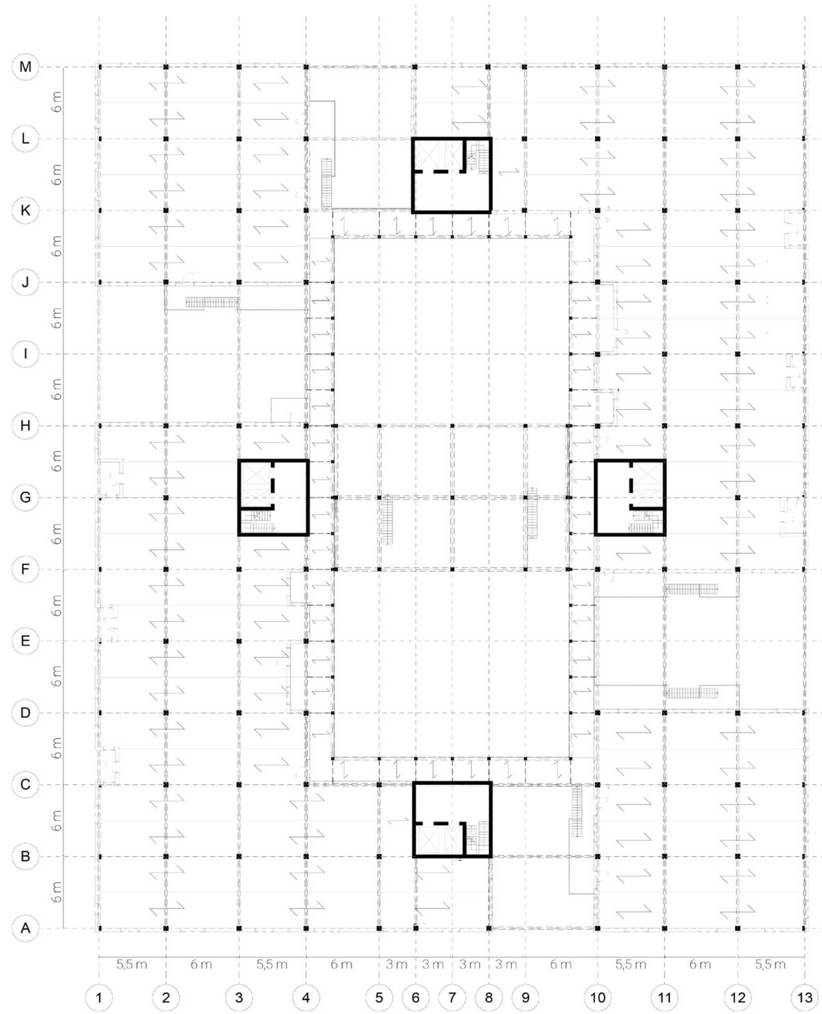
Floor Plan



First Floor

Building Technology | Structural Diagram

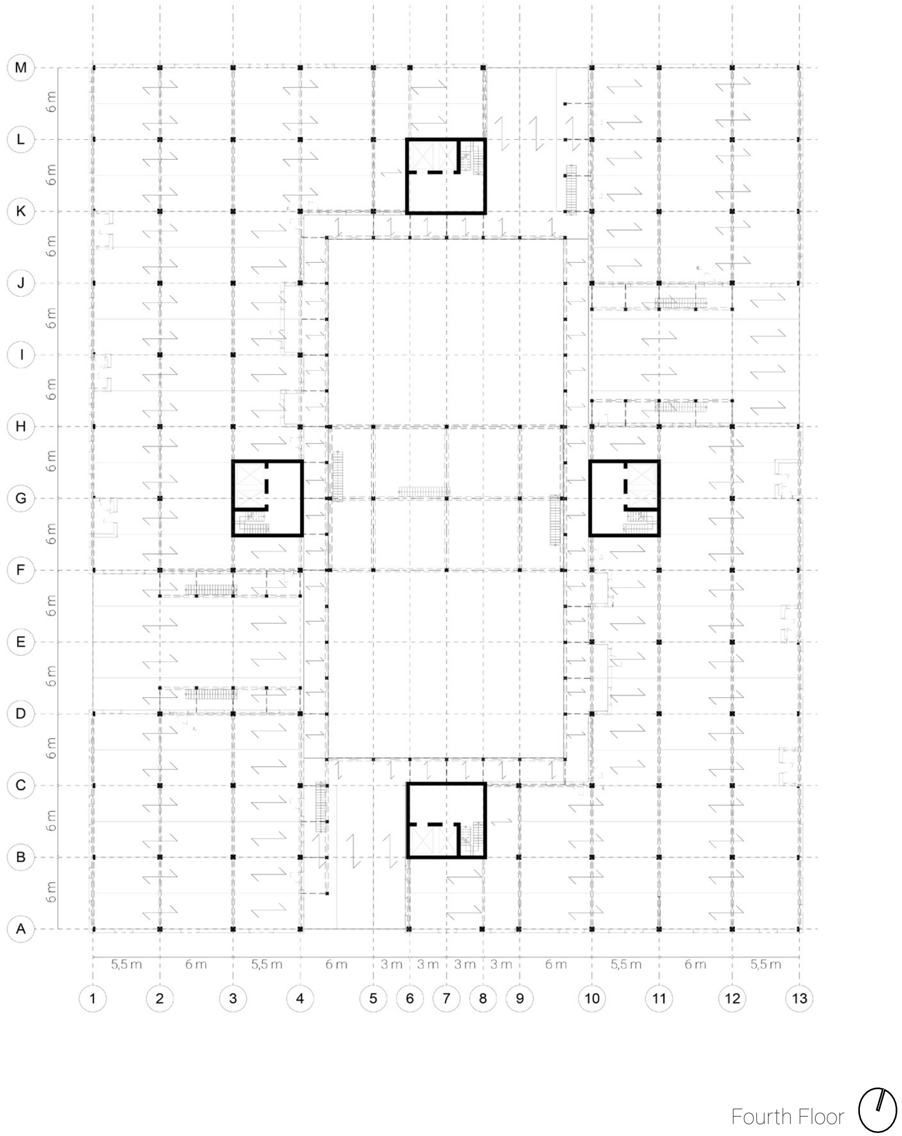
Floor Plan



Third Floor

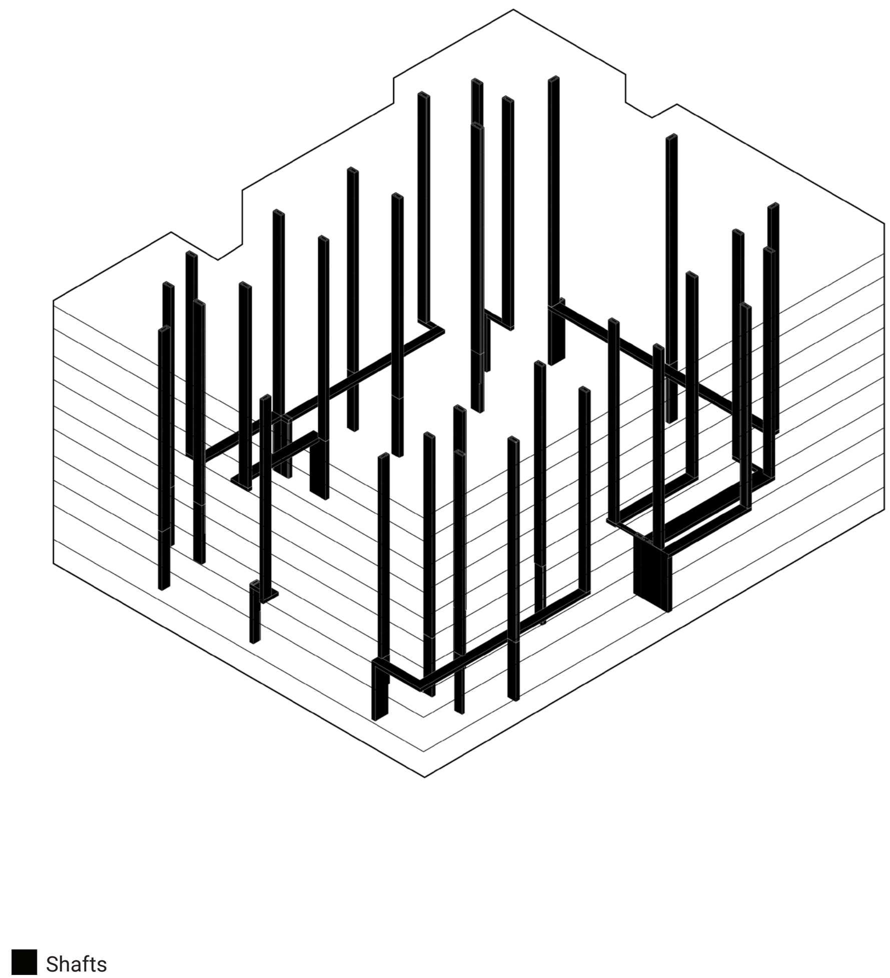
Building Technology | Structural Diagram

Floor Plan

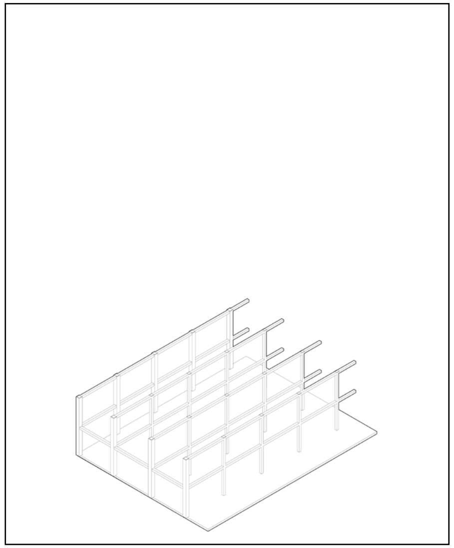


Building Technology | Structure

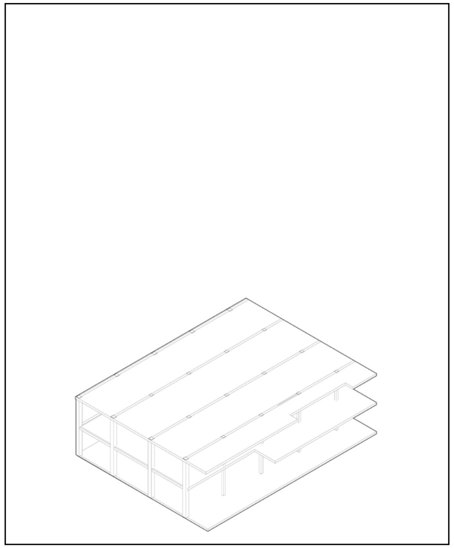
Shafts



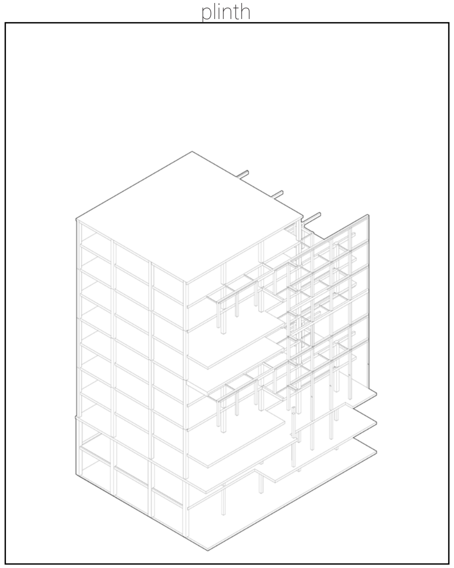
Building Technology | Sequence of Construction



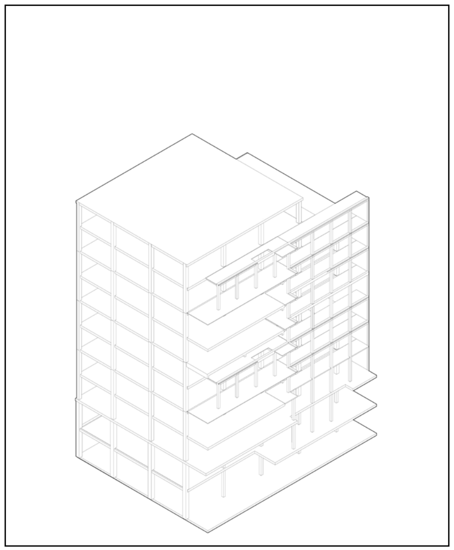
Step 1: Concrete columns and beams for the plinth



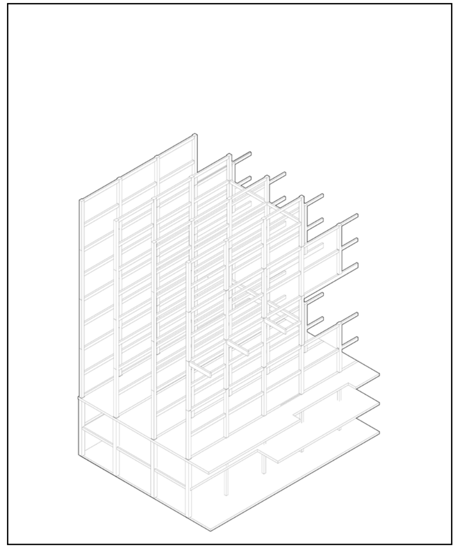
Step 2: Concrete floor slabs for the plinth



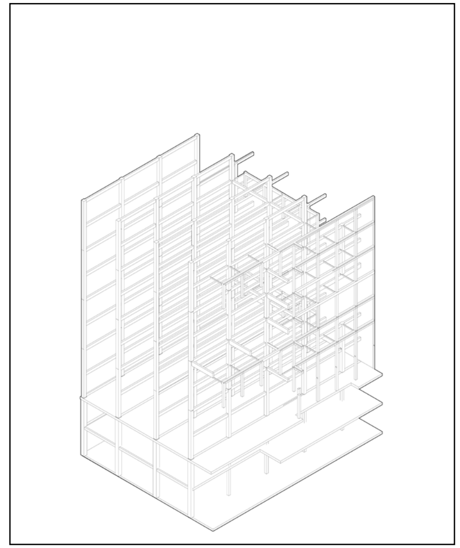
Step 5: CLT floor slabs for the main structure



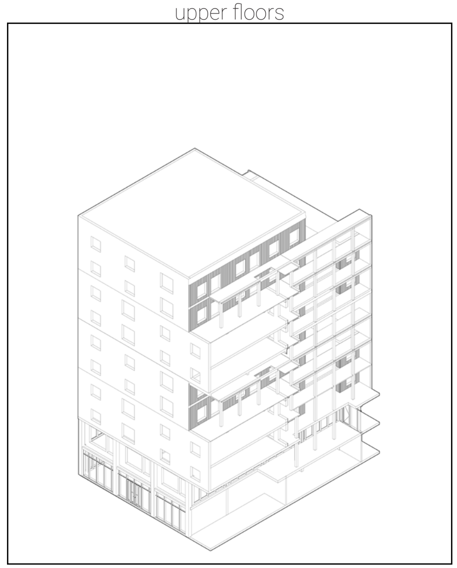
Step 6: Concrete slabs for the timber gallery



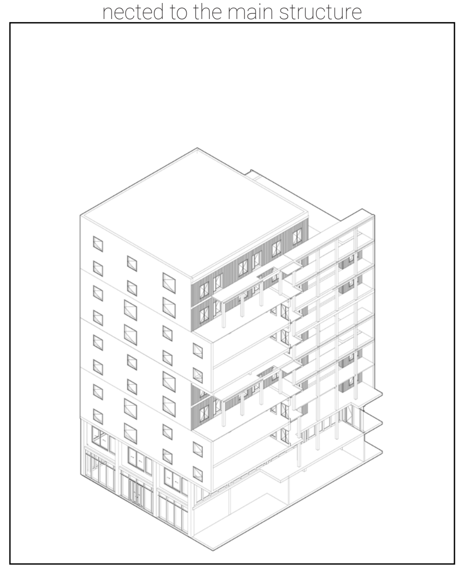
Step 3: Wooden columns and beams for the upper floors



Step 4: Structure of the timber gallery is connected to the main structure



Step 7: Facade



Step 8: Windows and doors

Building Technology | Sustainability

Climate Diagram

Greenery

1. Green roof
2. Greenery growth in the work tower with the fertilizer and compost generated from Heat Transformers
3. Greenery on the courtyard

Heating

4. PV panels
5. Heat Transformers: biogas generated from food waste is transformed into heat and electricity with a CHP (combined heat and power) unit
6. Boiler
7. The timber gallery allows daylight in winter and shades during summer

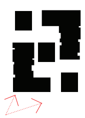
Ventilation

8. Heat recovery system

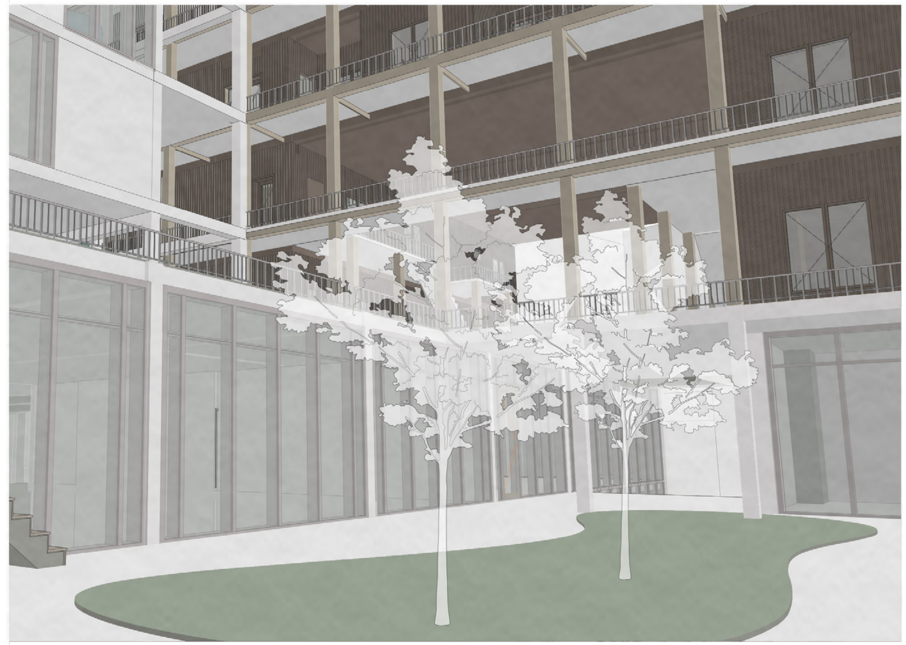
Water Management

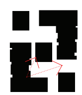
9. Water collected on the roof, courtyard and the timber gallery is stored in the water tank.
10. The water stored in the water tank is used to irrigate
11. Surplus water is mixed with public network

Final Design | Waterfront

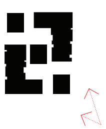


Final Design | Courtyard

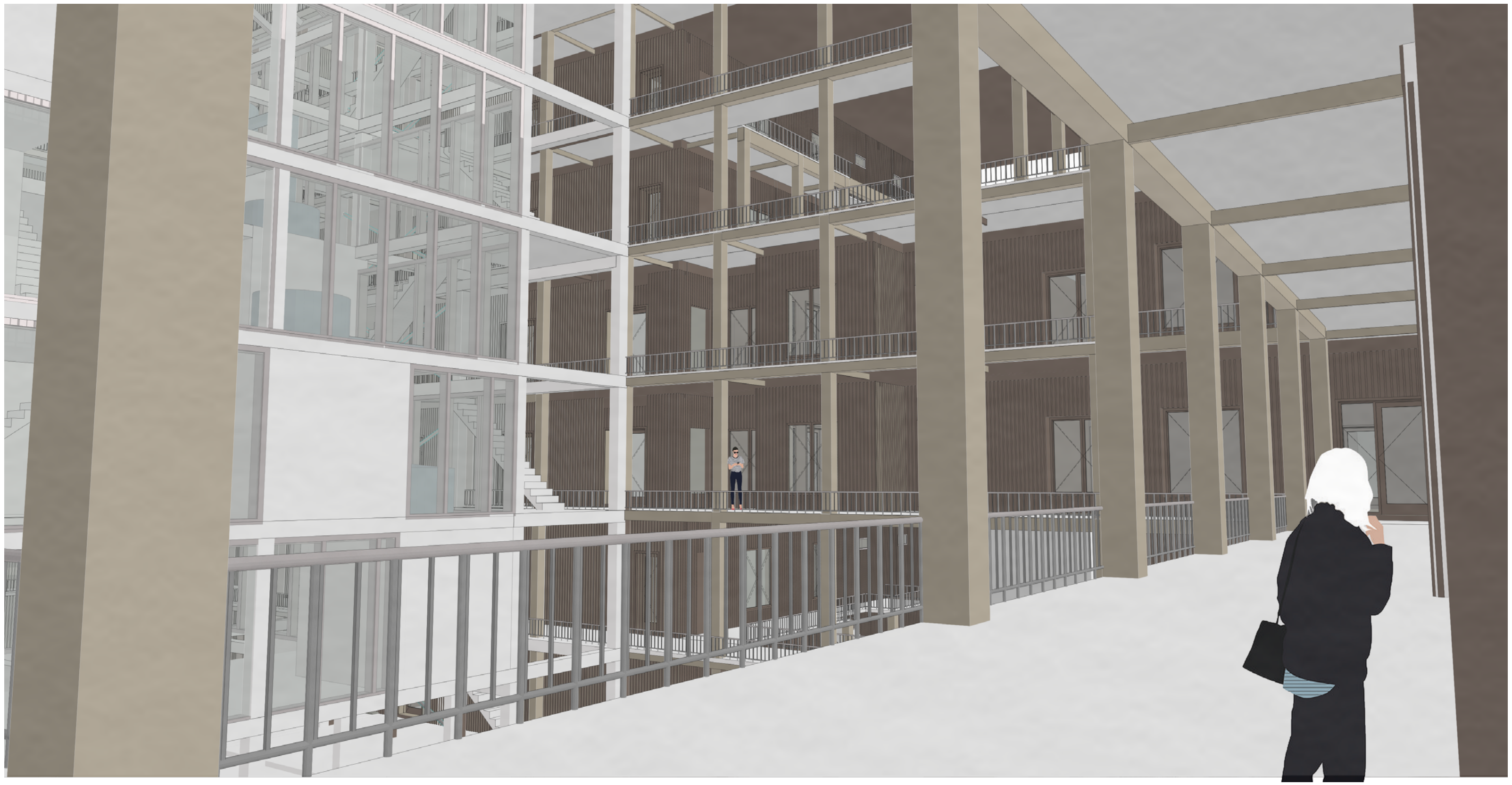


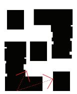


Final Design | Street



Final Design | Timber Gallery

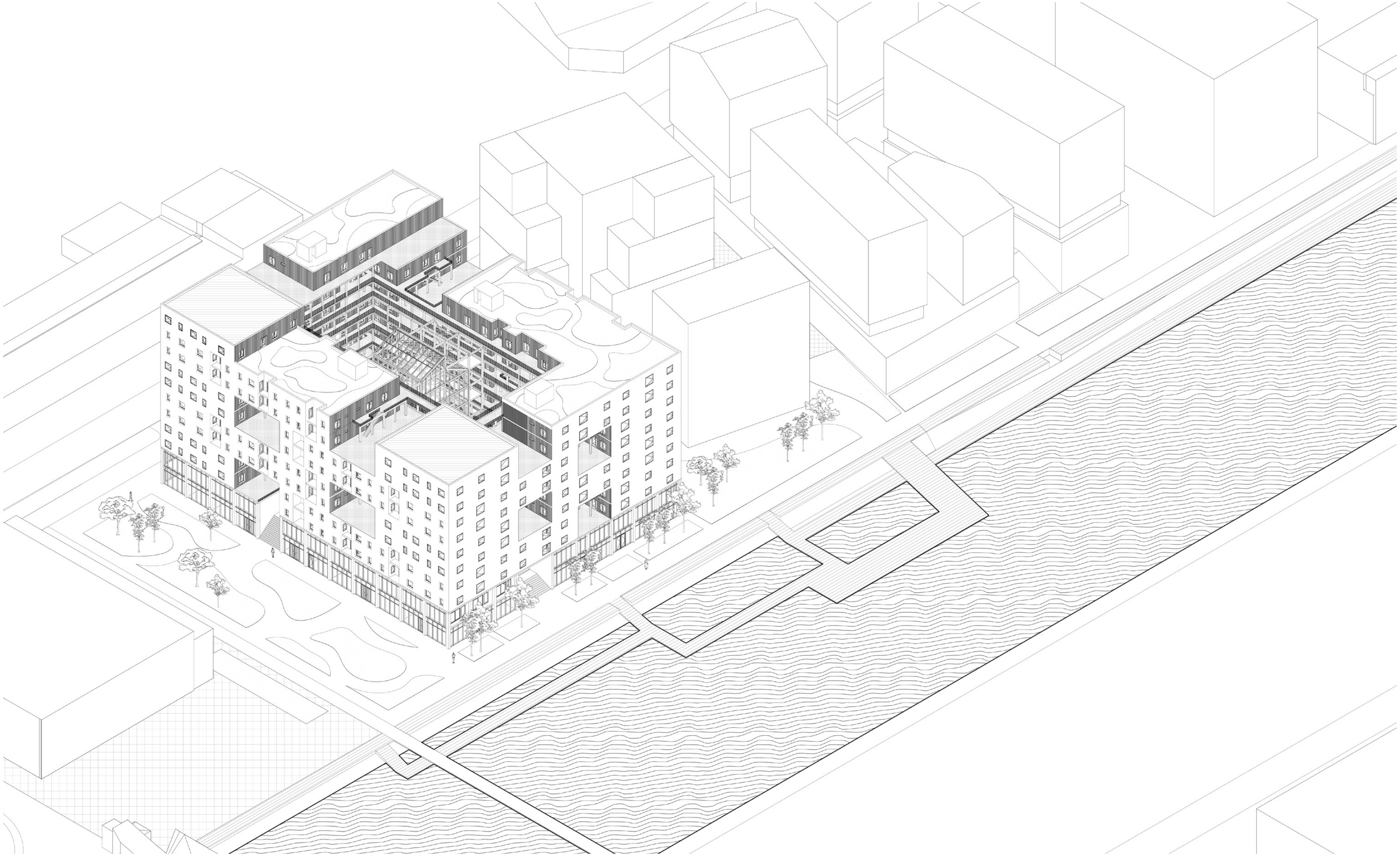




Final Design | Open "Staircase Room"

Final Design | Work Tower - Timber Gallery Connection

Final Design | Axonometric Mass



Final Design | Maquette

Final Design | Maquette

Final Design | Maquette