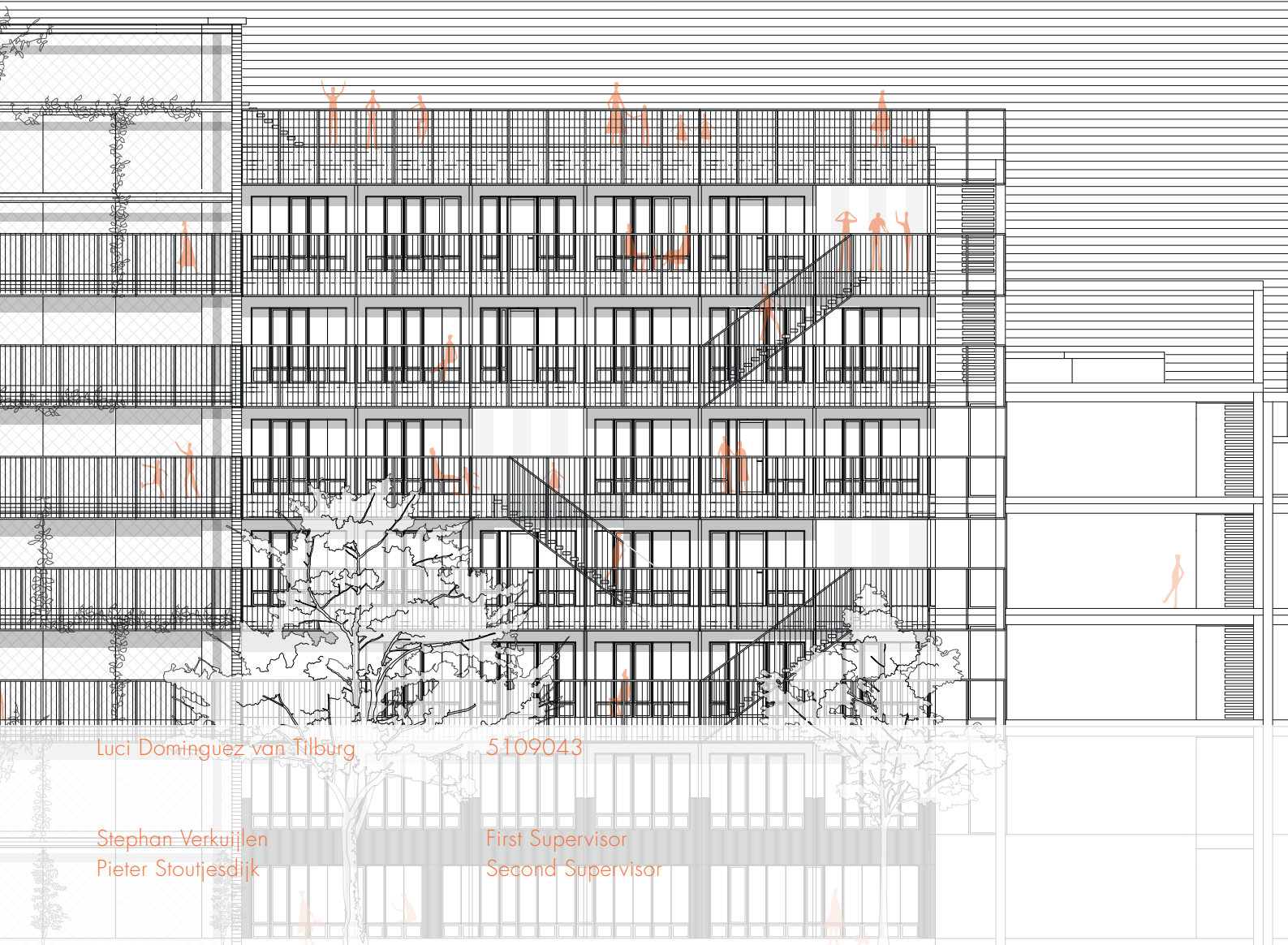


Spaces of Coexistence

Transforming Post-Office Buildings in Eindhoven into Circular Co-Living Environments for Diverse Communities

AR4AE020 Architectural Engineering Graduation Studio

November 2025 - June 2026



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Foreword

After six years of strolling around the faculty of architecture, the time has come to graduate and obtain my master’s degree. An exciting and intense period at the same time. As I am reaching the final phase of my life as a student, I find myself reflecting on the past few years, the many memories I have made and the challenges I have overcome. Through the years, I have gained knowledge from many different disciplines, worked with many students, and made many more memories in Delft than I could have ever imagined before starting my life here.

My time in Delft also came with many challenges. The COVID-19 pandemic, being one of the most obvious ones, as it cast over a large part of my life as a student. An abrupt change that asked everyone to drastically change their way of life. But overall, I feel very grateful and happy for everything that has happened in the past seven years, and I am looking forward to exploring what life as an architect will bring.

For the final phase of my educational career, I decided to join the Architectural Engineering graduation studio. Architectural Engineering brings together architecture and technology in a societal context. It is a studio that has a great emphasis on sustainability challenges such as circularity, building culture, biodiversity, climate adaptivity, and the search for renewal in architecture; themes that have always held my special interest. The graduation trajectory is divided into three phases: the research phase in the first quarter, the research by design in the second quarter and lastly the elaborated design phase.

Finally, I would like to thank my tutors Stephan Verkuijlen and Pieter Stoutjesdijk for the guidance, the endless conversations we had in the past eight months and the valuable input that you gave me that made this project possible. I also want to express my gratitude to all my friends and family who have supported me this last year. Spending time with all of you and balancing life throughout this year is what helped me stay positive, happy and motivated throughout the whole year.

Reading Guide

This graduation report contains all the steps that were undertaken from the start of the research proposal until the final architectural design. From November 2025 until June 2026 research was performed, many design iterations were developed, and finally, an integrated design proposal was presented. This process is compiled in this graduation report in four parts.

The first part discusses the problem statement, relevance and objective of this graduation project. Then, the main and sub design questions that will be answered in this report are formulated, and finally, a workable scope is presented. The second part highlights all the methodologies used to answer the design questions and presents the theoretical background. The third part shows the integrated architectural and technical design, and finally, a conclusion and discussion are presented in the fourth part.

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01

Introduction

what does this graduation report tackle and why is this relevant?



1.1 Problem Statement

Eindhoven is once again entering a historically familiar pattern of (dominant) company-driven urban development (Figure 1). Similar to the Philips era of the early twentieth century, the rapid growth of ASML and the broader chip industry is stressing the city’s housing supply, infrastructure, public facilities, and social fabric (ASML, 2024; Brainport Eindhoven, 2025; Kasteleijn, 2024; NOS, 2024a, NOS, 2025, and more). Urban development is increasingly shaped by short-term economic needs, resulting in a homogenous and linear spatial organisation that prioritises growth over long-term adaptability. This creates a city that remains structurally vulnerable to economic shocks, particularly in the event of industrial restructuring, relocation, or decline. An outcome Eindhoven has experienced before (Historie - Strijp-s., n.d. & Diederendirrix, 2025).

Today, this historical repetition manifests itself in social and spatial tensions. The projected arrival of approximately 70,000 new workers in the Brainport region, predominantly international knowledge workers, has intensified competition for housing and amenities. As a result, existing residents experience growing displacement and exclusion as new developments cater primarily to the demands of the high-tech sector (van den Eerenbeemt & Giebels, 2025).

The KnoopXL area, shown in Figure 2, is a good example of current urban development fueled primarily by the leading high-tech company ASML. As a former station area, it is planned to be transformed into an international innovation district: a dense, mixed-use neighbourhood that combines living, working, and green infrastructure (KCAP, n.d.). The project has set its goals to build a high-density district with 6,000 to 7,000 new homes. Yet, the contrast in density and building height between KnoopXL and the adjacent neighbourhood, Oud-Woensel, results in a greater disconnection between the two. These physical contrasts reflect and may further reinforce growing tensions between the existing and the future residents of Eindhoven.



Figure 3: Distribution of international inhabitants within the neighbourhoods of Eindhoven (Dominguez, 2025; AlleCijfers, 2025)

To further understand these social tensions, the cultural diversity through the neighbourhoods of Eindhoven is shown in Figure 3. Interestingly, the number of international inhabitants is highest in the Oud-Woensel and Centrum neighbourhoods, and with the proposed KnoopXL developments, this number will increase further.

Over the past two decades, the number of international inhabitants has increased from 21% to 45% (AlleCijfers.nl, 2026). In other words, almost half of the city’s residents now have an international background, while much of the built environment is shaped primarily to Dutch standards. Explaining why KnoopXL is promoted as a new ‘international hub’. KCAP states that the project aims to create a new social dynamic by “...inviting both long-standing residents and international talent” (KCAP, n.d.). However, the extent to which this translates into social inclusivity remains uncertain. The development risks becoming another example of Eindhoven responding to immediate economic demands rather than designing for long-term social change and future uncertainty.

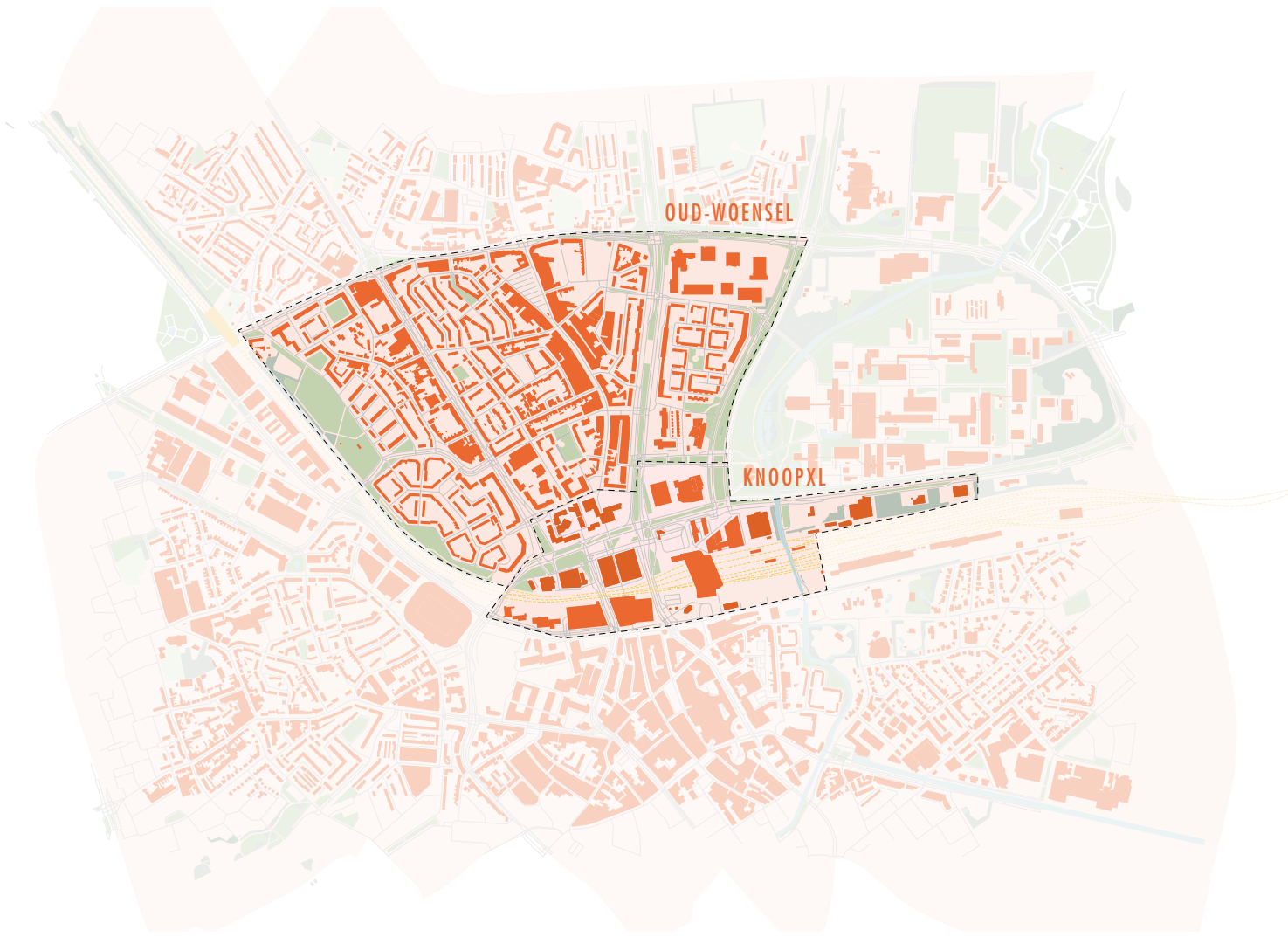


Figure 2: Context drawing, KnoopXL and surroundings (Dominguez, 2026)



Figure 1: A short timeline of Eindhoven’s repeating history, showing urban development as a result of the establishment of dominant industries (Dominguez, 2026; Brainport Eindhoven, n.d)

At the same time, urban growth is accompanied by linear material and waste flows, reinforcing unsustainable construction practices. According to Manon Grond, urban planner at the municipality of Eindhoven and involved in the KnoopXL transformation, the development will require the demolition of almost all existing buildings. This decision was made, according to Grond, because the high-density goals KCAP decided on together with the municipality of Eindhoven would otherwise not be achieved.

This decision meant high-rise buildings, and the existing buildings’ foundations are not structurally capable of supporting high top-ups. Besides, most of the buildings in the KnoopXL area are former office buildings built between 1960 and 1980, which means that transforming them to a different program poses many challenges. So, the core problem lies not in growth itself, but in the absence of a design framework that integrates social inclusivity and circular material systems, while enabling economic growth.

1.2 Relevance

The relevance of this project lies in both societal and technical grounds. From a societal perspective, this project addresses important Dutch political themes related to migration and housing affordability (EenVandaag, 2025). While high-skilled labour migration is often framed as economically indispensable, local communities increasingly question who the city is being built for. Statements warning of an “ASML city” and fears of displacement reveal these growing tensions even more. Furthermore, the ongoing threat of relocation, explicitly stated by ASML’s former CEO, Peter Wennink, raises urgent questions about the long-term consequences of spatial and economic dependency (van den Eerenbeemt & Giebels, 2025; NOS, 2024b).

Furthermore, housing research by Companen shows that single-person and two-person households mainly live in large homes. In 61% of cases, ‘spacious living’ applies, according to the Companens’ definition: in this segment of the housing stock, single people live in homes of at least 75 m² and couples in homes of at least 100 m². Of the total housing stock in Eindhoven, 40% is occupied by households that live in ‘spacious homes’. Furthermore, research has shown that a shift in housing culture is needed, whereby collective living becomes the norm. In the coming years, Eindhoven will see a significant increase in small, often single, young households: a group that fits well with the concept of shared housing. This research shows that people in Eindhoven are only willing to give up square metres or private facilities if there are sufficient amenities in the immediate surroundings (e.g., shops, restaurants, meeting places, a gym). These insights highlight co-living as a strategy to densify cities without losing the qualities of a dwelling, by offering qualitative, large communal spaces.

On a technical level, this graduation project addresses topics on resilience, circularity, and adaptability in rapidly growing cities. The building industry is the second-largest global contributor to CO2 emissions and produces 30% of global waste (Graham, 2024; Miller, 2022). In the Netherlands alone, 26 million tonnes of construction and demolition waste are produced annually, accounting for 40% of all waste (BRBS Recycling, 2025). Besides, building new housing at the current scale could cause Europe to miss its climate targets, making the adaptive reuse of schools, hospitals, and offices highly relevant. With office vacancy remaining 30% above pre-pandemic levels (McKinsey, 2023), these spaces offer significant housing potential while naturally evolving into important hubs for social gathering. At this moment, office vacancy in the Netherlands ranges between 8% and 9,2% of the total office stock (Maes, 2026).

1.3 Objective & Motivation

The objective of this graduation project is to develop an architectural typology capable of adapting to shifting ethnographic and demographic conditions, showing how Eindhoven can grow in a socially inclusive and materially circular way. The central design ambition is to create a mixed-use building that connects different cultures. By integrating living, working, and relaxing, the project aims to foster interaction between international newcomers and local communities, transforming difference into coexistence. This topic is of particular interest to me, as I have lived in the Caribbean for half my life and have experienced firsthand how cultures and architectural typologies can differ greatly between countries, making the transition from one to the other challenging.

Furthermore, it is also important to note that the aim of this design project is not to represent specific nationalities as fixed categories, but to identify relevant patterns in living arrangements, cultural practices, and domestic needs that influence spatial use, and to determine which engineering solutions meet these differing needs.

Finally, I am motivated by the challenge of transforming obsolete buildings, which are perceived as ‘old’ or ‘not useful anymore’ and bringing them back to life with more quality and character than before. Demolishing buildings is not necessarily the solution. The buildings scheduled for demolition in the KnoopXL region will serve as a starting point for this design challenge.

1.4 Research & Design Questions

To address the earlier-stated challenges and ambitions, this graduation project seeks to answer the main design question: “How can former office buildings (in the KnoopXL area) be transformed into mixed-use (co-living) environments that enable everyday coexistence between local communities and international newcomers, while remaining adaptable over time?” To answer this question, several sub-questions are formulated regarding the context, and architectural and technical design.

History

1. What can be learned from Eindhoven’s recurring history of company-driven urban development, particularly the spatial, social, and material transformations associated with dominant industries such as Philips? (research/case studies)

Context

2. Which 3–4 resident profiles are most prominent in Eindhoven, and what are their key differences in shared-space comfort, privacy gradients, cooking and ventilation, outdoor space use and threshold use? (research/research by design)

Architecture

3. Which architectural typologies and spatial strategies best support co-living across difference, while maximising interaction between users? (case studies/research by design/elaborated design)

Technology

4. Which structural interventions are needed to enable this transformation, and how can the extracted material be integrated into the new design? (research by design/elaborated design)

5. Which flexible system best enables culturally different household patterns across all scales, while still meeting building-physics, fire-safety, and construction constraints? (research/research by design)

1.5 Scope

The core design challenge is to develop an architectural framework that fosters interaction between the local and the future inhabitants of Eindhoven. For this reason, a typology of cooperative housing will be developed. This project focuses on the KnoopXL area, where a large number of buildings, mostly office buildings, are scheduled for demolition to make space for new development. To define a workable project boundary and identify a relevant site for this project, the buildings scheduled for demolition were mapped and grouped into four clusters (Figure 4, Appendix A1). A series of analyses was conducted (Appendix A2), and the former WTC office building was finally selected due to its strong spatial connection with Oud-Woensel, its interesting structural form, and the challenges that arise when transforming it into a mixed-use building.

The WTC building, designed by architect Leo de Bever, was built in 1977. A picture of the building under construction is shown in Figure 5. The building’s structure consists of two cast-in-place concrete stability shafts, prefabricated portals with TT-slabs on top, and concrete stability walls along the edges of the building. A prefabricated facade system is then suspended on the floors. Interestingly, the building was built mostly from prefabricated elements, allowing for example the facade from the building.



Figure 4: Buildings scheduled for demolition grouped into four clusters (Dominguez, 2026)



Figure 5: A picture of the WTC office building in construction (Eindhoven in Beeld, 2010)

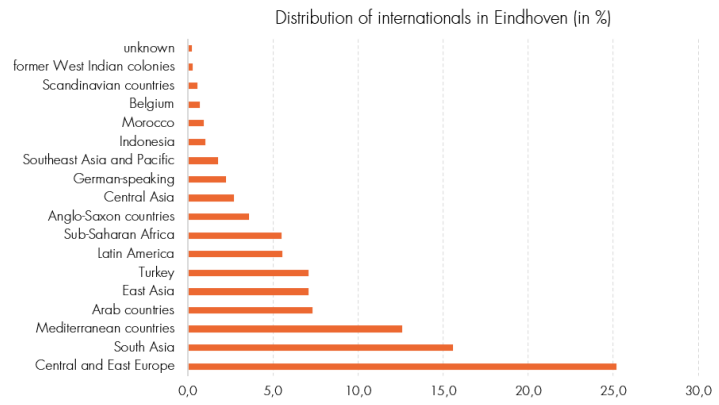
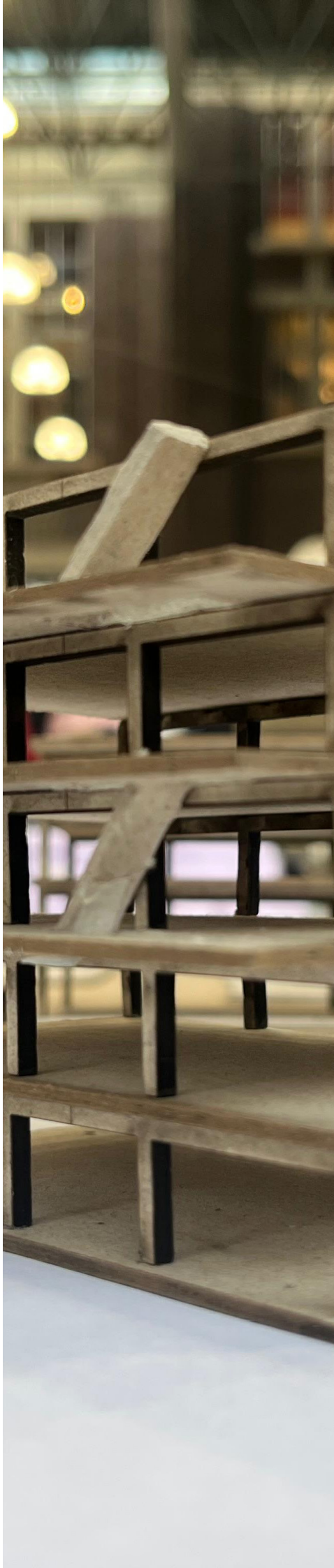


Figure 6: Region of origin of the international inhabitants of Eindhoven (CBS, 2025)

The TT-slabs have a span width of 13 meters, resulting in large open spaces within the building. This allows for considerable flexibility in future design interventions. However, transforming a former office building into a mixed-use building also comes with various challenges. Several aspects have to be taken into account, including differing safety standards, climatic conditions, such as daylight, insulation, acoustics, ventilation, and sustainability requirements.

In addition to the materiality aspects, the project also addresses social aspects. To establish an initial understanding of Eindhoven’s cultural diversity, data from CBS (Centraal Bureau voor de Statistiek, 2025b) were reviewed. Based on these insights, Figure 6 was created, showing that the international inhabitants of Eindhoven can be subdivided into 17 different regions of origin. This Figure provides an initial overview of the cultural distribution. Within these regions, more than forty countries can be distinguished. As the research phase is limited to approximately 10 weeks, it is not feasible to study all countries and their spatial preferences in equal depth. Thus, to define a workable project boundary, four resident profiles are defined to test the proposed co-living design. Demographic and ethnographic aspects were taken into account when selecting resident profiles. The selection of profiles is based on a combination of demographic and ethnographic research, which will be further discussed in the next chapter. Shared characteristics and key differences in their spatial preferences will be discussed. These insights serve as the basis for the cross-cultural design rules applied throughout the overall design.



Approach

how is the design project structured and what is the design framework?

02

2.1 Methods

To answer the main question, “How can former office buildings in the KnoopXL area be transformed into mixed-use co-living environments that enable everyday coexistence between local communities and international newcomers, while remaining adaptable over time?”, this project proposes several methodologies.

First, to understand the urban context of Eindhoven and its company-driven transformation history, two case studies are performed: Strijp-S and the former NRE terrain. Both are former industrial sites that have been redeveloped into lively mixed-use neighbourhoods. From these case studies, conceptual design principles will be derived that align with successful transformations, specifically in the context of Eindhoven.

As part of this contextual research, the project also maps Eindhoven’s demographic and cultural composition and identifies the most prominent residential profiles. For this matter, several methodologies are applied. Quantitative data derived from CBS (Centraal Bureau voor de Statistiek, 2025a,b), Onderzoek040 (n.d.) and a housing research by Companen (2024) serve as the basis framework for the demographic and cultural framework.

As introduced shortly in paragraph 1.5, four resident profiles will be defined. To define these profiles, four key criteria are formulated: the most prominent household compositions, the most prominent nationalities, differing spatial preferences, and differing expected durations of stay. These criteria are selected to define four profiles that reflect the most represented households in Eindhoven. Striving for differences in spatial preferences and expected time of stay, to develop a technical design that can accommodate different households and adapt over time. Subsequently, spatial needs and preferences are derived through research and then, through research by design, translated into spatial diagrams that form the foundation of integrated floor plans that support everyday coexistence among residents.

Moreover, three case studies on co-living design are presented: La Borda, San Riemo, and Gleis 21. These projects were selected because they present well-structured, socially successful plans. From these case studies, design rules will be derived for the integrated design. In addition to the contextual research, technical research will be conducted. The technical research focuses on the challenges and opportunities that occur when transforming former office buildings into mixed-use buildings. Prototyping studies of 1:200-scale models will map possible structural interventions for the former WTC building. Throughout the prototyping process, results will be documented through photo sequences

Another prototyping methodology is used to design a standard facade frame, “a universal facade panel”, that accepts replaceable infills, based on specific cultural needs. The system stays constant, but the infill changes. This idea is proposed in line with subquestion 5 and emerged from one of the main conclusions of the research presented in paragraph 2.2.2, which highlights that the transition from public to private space varies greatly across different resident profiles. Furthermore, if the system is to support long-term reuse, the connections must remain reversible after multiple assembly and disassembly cycles without a loss of structural or functional performance. The prototyping work is performed around three components: the base frame, the infill, and, when combined, the catalogue (Figure 7). The base frame will be developed through sketching and iterative digital design. For the infill, the goal is to test options aligned with the needs of the selected resident profiles to evaluate how the frame and connections perform with different infills. The expected outputs will be a design showing successful panel-to-panel connections and a panel catalogue with infill typologies linked to cultural preferences, while meeting the necessary technical and climatic performance requirements (e.g., water and vapour resistance, thermal performance, and design for disassembly).

Finally, the complete research-by-design phase is summarised in a Product Development Methodology (PDM). This matrix shows all relevant design aspects and the possible options for each design aspect. This served as a guiding principle for making decisions throughout the preliminary design phase. All findings are compiled into a theoretical framework and finally combined into an integrated design: a mixed-use co-living building that demonstrates how social coexistence and circular construction can be integrated, ideally in a way where the spatial and technical components reinforce each other.

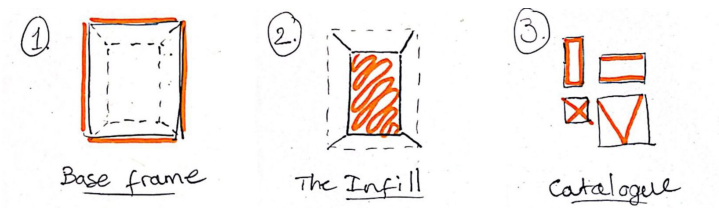


Figure 7: Prototyping methodology (Dominguez, 2026)

2.2 Planning

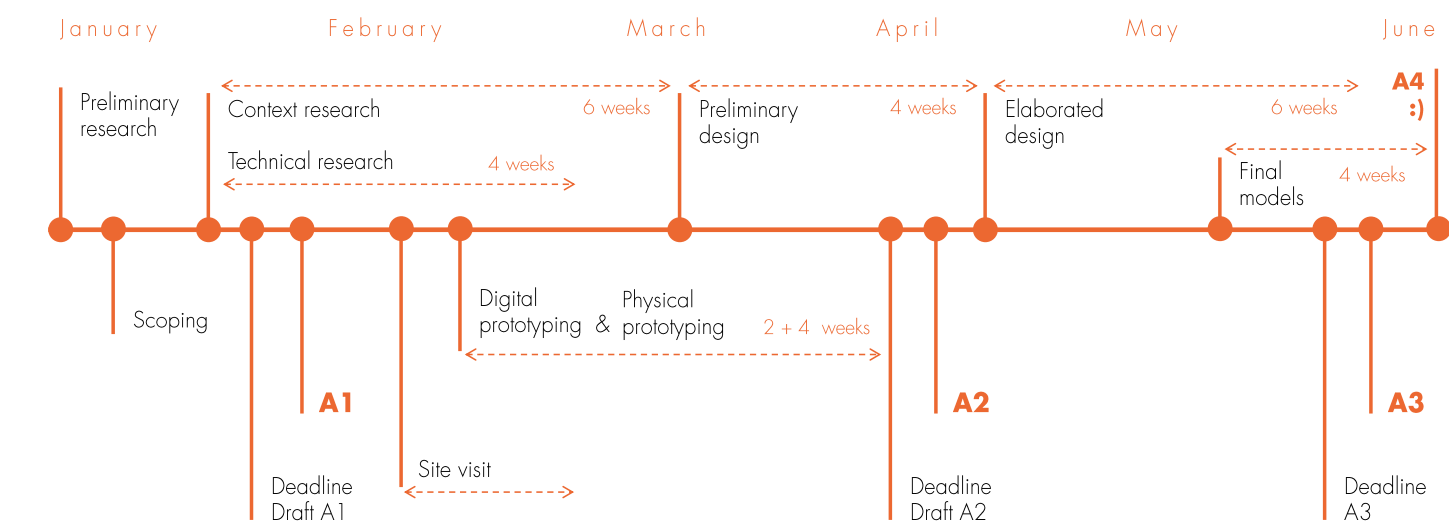


Figure 8: Planning of the 8 months in which the graduation project takes place (Dominguez, 2026)

2.3 Theoretical Framework

The theoretical framework is structured as follows: first, the urban context of Eindhoven is introduced and summarised into coherent conceptual design principles. Then, the four resident profiles are developed through demographic research. Following that, the three co-living case studies are presented, from which insights serve as the basis for the co-living floorplan iterations. And lastly, the possibilities for structural interventions of the former WTC building are analysed through scale 1:200 prototyping studies. To summarise the possibilities of the research-by-design phase, the Product Development Methodology is presented at the end of this paragraph.

2.3.1 The Urban Context

Eindhoven is a city shaped by recurring cycles of growth led by a single dominant tech actor: first Philips, and today ASML. Based on the two case studies of Strijp-S and the former NRE terrain, key insights on Eindhoven’s urban fabric and rehabilitation methods are compiled in Appendix D (Historie - Strijp-s, n.d.; West8, 2024; Calame, 2018; Diederendirrix, 2025).

Strijp-S demonstrates how industrial heritage can be activated rather than erased: a deliberate mix of old and new, temporary uses, and public-private collaboration helped turn crisis into opportunity and supported a diverse, culture-led urban environment. The NRE terrain reinforces several of these insights while adding specific principles: integrating valuable existing buildings, improving connections to surrounding areas, and enabling reconfiguration over time through a mix of large-scale development and small-scale initiatives. Both cases highlight the importance of breaking inward-facing “closedness,” co-creating with users, and designing for a live-work-life mix. These insights were used to develop design strategies for the elaborated design phase, shown in Figure 8.

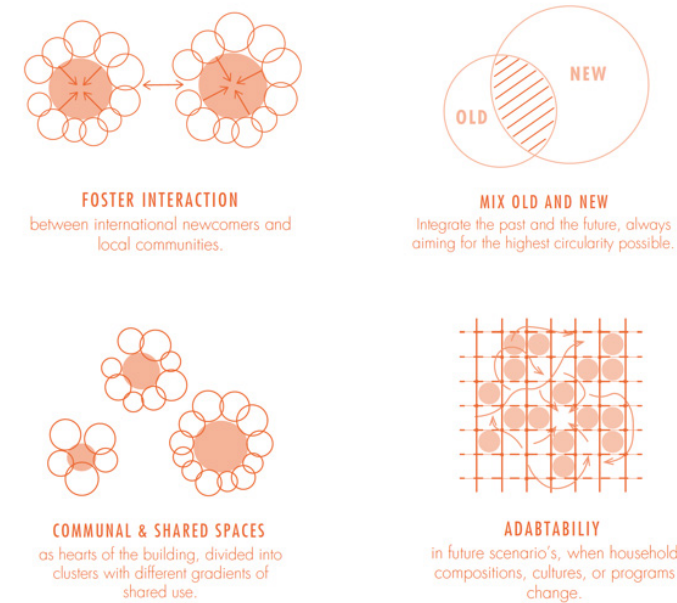


Figure 9: Conceptual design principles, based on Strijp-S and NRE terrain case studies (Dominguez, 2026)

2.3.2 Demography of Eindhoven

The most prominent household type in Eindhoven is single-person households. Numbers indicate that these households account for nearly half of all households, followed by families with children (26%) and households without children (24%) (Centraal Bureau voor de Statistiek, 2025a; Gemeente Eindhoven, n.d.; Companen BV, 2024). As for the most prominent nationalities in Eindhoven, India, Poland and Turkey are recognised as the largest international groups (Companen, 2024; Centraal Bureau voor de Statistiek, 2025b). These are considered alongside the local Dutch context to form representative resident profiles. As for the expected time of residence, the resident profiles will be composed to have a mix of ages and working classes. This translates into a mix of students, starters, couples (young and old), migrant workers, knowledge workers and retirees. A summary of all the retrieved data is available in Appendix E.

Finally, the spatial preferences of each resident profile should be considered. Therefore, extensive research was performed for Turkish, Polish, Indian and Dutch domestic preferences, such as floorplan layout, building traditions, materiality, and furniture design, which is compiled in Appendix F. This comparative analysis shows that differences in domestic culture do not require entirely different housing types, but rather a clear spatial framework that can accommodate varying degrees of sharing and privacy. Across all groups, the acceptance of shared space depends on clarity of spatial organisation and the possibility to choose when to engage and when to withdraw. This translates into the need for layered shared environments, where social, quiet and hosting functions are clearly distinguished. Additionally, a similar layout logic is identified across all groups. This simply means that wet areas, such as the kitchen and toilet, are often connected to one another for practical installation and drainage reasons. As well as the fact that the kitchen is often connected to the dining room for practical reasons. Bedrooms are often placed in the more private areas of the home, often enclosed by a hallway separating private and communal spaces. Differences become more explicit in relation to cooking, outdoor space use, and threshold space: higher-intensity cooking practices and more formal guest reception in Indian culture require a kitchen that can be closed off and well-ventilated, whilst in many Dutch, Polish, and Turkish homes, an open-plan kitchen is becoming increasingly common. In addition, outdoor spaces play a key role as mediating elements, supporting informal use, climatic control, and the transition between public and private life.

The transition from public to private space, the threshold, is different in every culture, due to differing privacy preferences, but is also influenced by personal taste. This threshold space serves as an interesting space for further deployment in the elaborated design and development of a technical framework that can accommodate these varying needs.

Taken together, these findings suggest that the design should not aim to propose a single way of living, but instead accommodate a clear spatial structure with adjustable degrees of openness, separation and use, enabling different resident profiles to coexist within the same architectural framework. The key insights of this demographic analysis are summarised in Figure 9.



Figure 10: Profile development summary (Dominguez, 2026)

2.3.3 Structural Interventions

Structural interventions are tested through several prototyping studies using 1:200-scale models. These studies were developed to identify interventions that would enable the transformation of the former WTC office building into a mixed-use building. Figure 10 shows three different interventions: removing entire floors to create double-height ceilings, removing parts of the floors to create inner courtyards and removing parts of the cantilever floors to create space for new external circulation galleries.

However, the interventions shown in prototyping studies A and B also reduce the structural stability of the existing building. Since large parts of the floor slabs have been removed, the structure's continuity and stiffness are weakened. As a result, new structural elements would need to be introduced to compensate for this loss of stability and to support the building after the intervention. Even though these interventions require more structural changes, they create spatial qualities that could be valuable for public and collective functions within the mixed-use building, such as large open spaces with greater incoming daylight.

Prototyping study C shows a different approach, where most of the existing structure can remain in place while still creating new spatial conditions. By removing parts of the cantilevered floor slabs to introduce external circulation galleries, the intervention makes use of the potential already present in the existing building and requires less structural modification compared to studies A and B. At the same time, the galleries create new shared spaces where residents can meet and interact, which directly connects to one of the project's main conceptual principles. In addition, the intervention changes the building's appearance by introducing a new layer to the facade, giving the former office building a new identity and character.

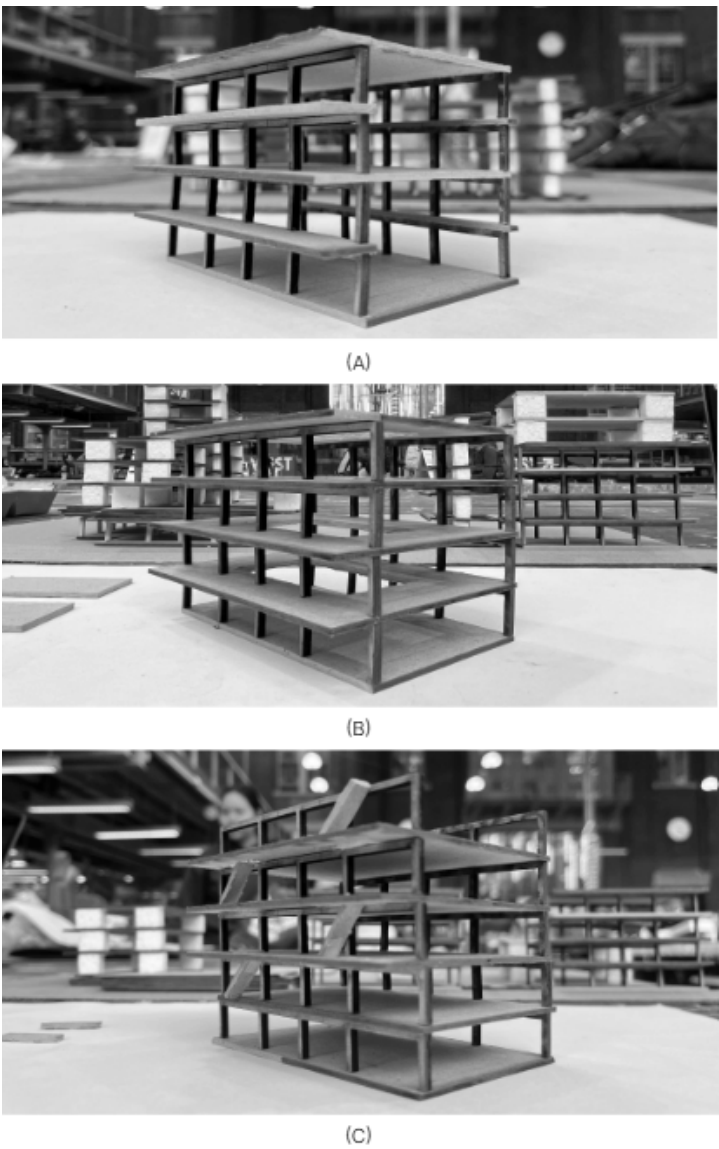


Figure 11: Prototypes of structural interventions (Dominguez, 2026)

03

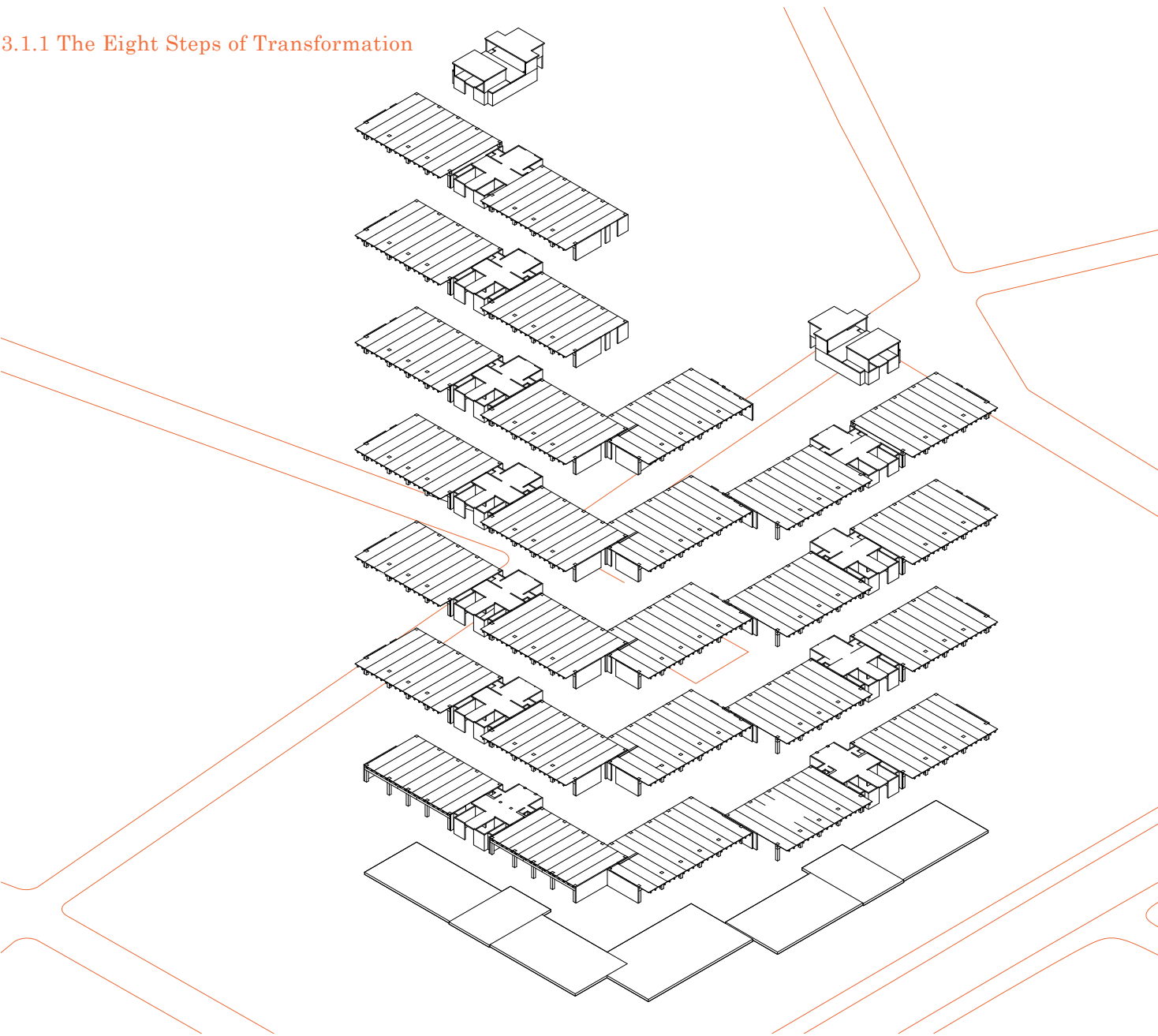
Results

how does the integrated design for co-housing across
difference work?



3.1 Integrated Architectural Design

3.1.1 The Eight Steps of Transformation



1. Analyse Current Situation: of the building's transformation possibilities.

2. Remove Existing Facade: as it does not meet the necessary requirements (daylight, thermal, and acoustic needs) for indoor environmental quality of the new program.

3. Extract Parts of Internal Structure: to create double-height spaces in the public and communal spaces, and creating vertical realtions within the building.

4. Extract Parts of Cantilevered Floors: to make space for new circulation routes, the gallery, and creating vertical connections in the building.

6. Place Shafts and Installations: to meet climatic requirements of dwellings and public functions (ventilation, water, sewerage, electronics, climate installations, solar panels, green roofs).

5. Place New External Structures: to support new staircases around the entire building, and placing extra floors on the south and west side of the existing shafts.

7. Place Adaptive Space Plan: to accomodate the different resident profiles and support future change in household composition and cultural diversity.

8. Place Modular Facade Panels: with different infills based on the cultural and personal needs of each resident. The joints allow future disassembly in case of demographic or programmatic change.

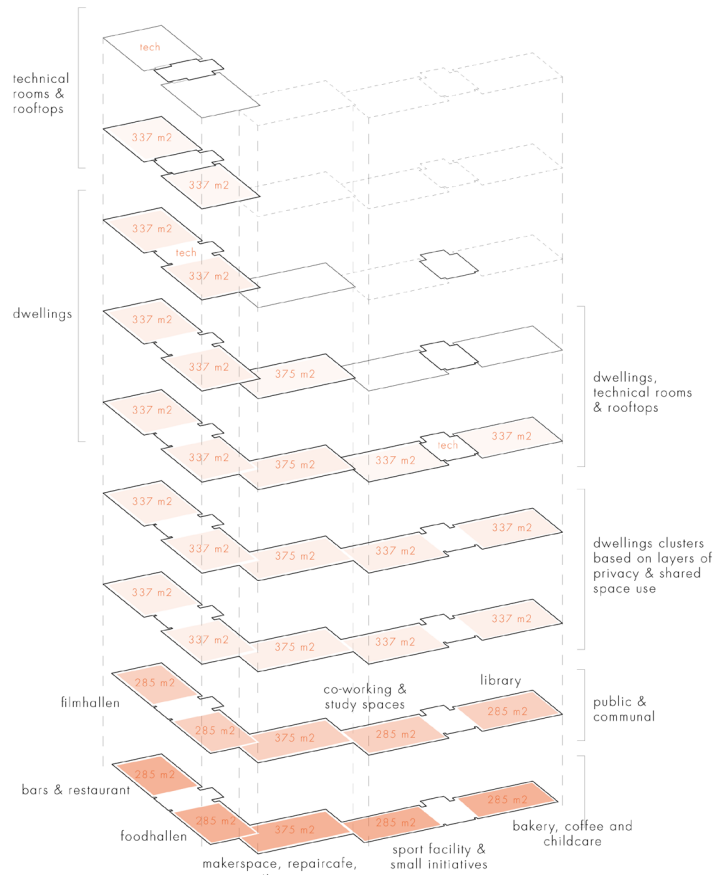
3.1.2 The General Layout

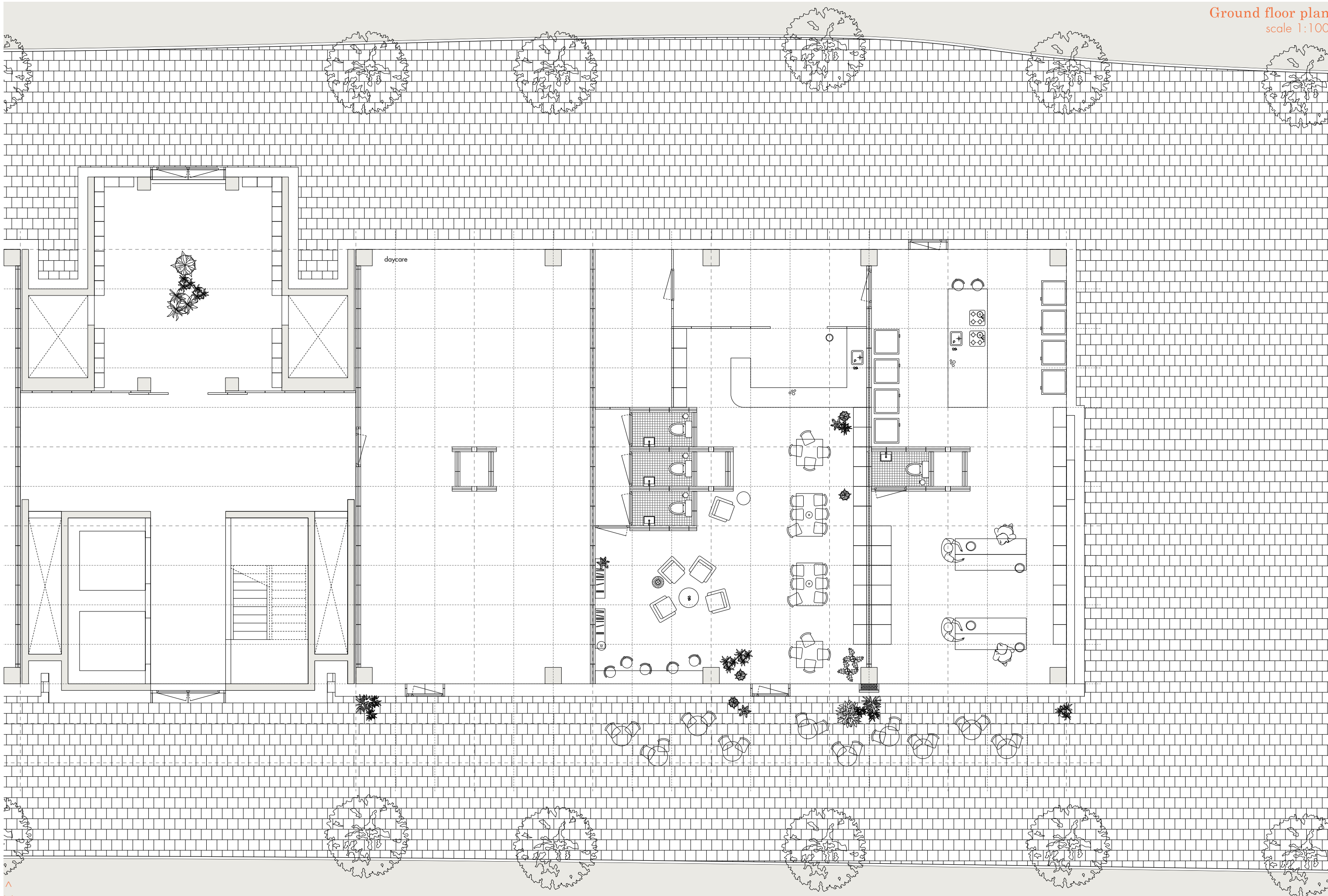
This schematic drawing shows the building's general layout. The final layout was developed based on the Product Development Methodology (Appendix G) and the conceptual design principles established earlier in the design process (Figure 9). Besides, three case studies on co-living design where performed, to develop a better understanding of this type of design. Insights from the three performed case studies: La Borda by Lacol Architects, Gleis 21 by Einszueins Architects, and San Riem by Summacumfemmer & Büro Juliane Greb, are bundled in Appendix I. Finally, several iterations of co-living floorplans where developed, to come up with the final design presented in this chapter.

The ground floor and parts of the first floor form the building's public plinth, as research showed that residents in Eindhoven are more willing to share facilities or reduce private living space when amenities are available nearby (Companen, n.d.). By opening these levels towards the surrounding context and introduce double-height spaces, a stronger connection between the building and its surroundings is created. In this way, the design aims to encourage interaction between the building and the surrounding neighbourhood. The layout of the public functions is based on orientation and the relation to the site. Functions primarily used during the day are located on the east side of the building, creating a connection to the future park and benefiting from the morning sun. Functions that are more active during the afternoon and evening are positioned on the west side, where they connect to the boulevard and receive evening sunlight.

Another important part of the design proposal is the communal spaces, which function as the social hearts of the building. These are the spaces where most interaction between residents takes place. Because the building is designed for different resident profiles, careful consideration was given to both the location and the infill of these communal areas. Creating opportunities for encounter and interaction between residents was one of the main principles guiding the positioning and design of these shared spaces throughout the building. But also offering places for relaxation and more quiet spaces to work, study and take a step back, was important. In this way, a diverse set of communal spaces is present throughout the building, offering spaces in which residents can choose when to engage and when to withdraw.

Finally, different types of clusters are implemented in the design. These clusters show the rich variety of floor plans that can be created based on the diverse needs of the different resident profiles introduced in the previous chapter. The building is subdivided roughly in 5 blocks. Each block was given a different character, to showcase how the different preferences and needs of the resident profiles can be compiled into an integrated design.







Second floor plan
scale 1:100 (on A0)

This floor plan shows how all the design elements come together as an integrated architectural design. The different layers of privacy are reflected in the design of the communal spaces. The galleries and rooftop terraces act as highly interactive communal spaces, as these are horizontally and vertically connected. The shared kitchen and laundry spaces are located in the building's existing shafts and are available to all residents on the same floor. These spaces are directly connected to the building's main circulation, emphasising spontaneous meetups among neighbours. Then, different types of semi-communal spaces are introduced, based on the needs of the dwellings in that cluster. Family-friendly clusters introduce playgrounds, while highly shared dependent dwellings share larger open kitchens and balconies. Each block has its own identity, shaped by the household and cultural mix of its residents. Each block will be shortly highlighted in the next part.

The Gallery

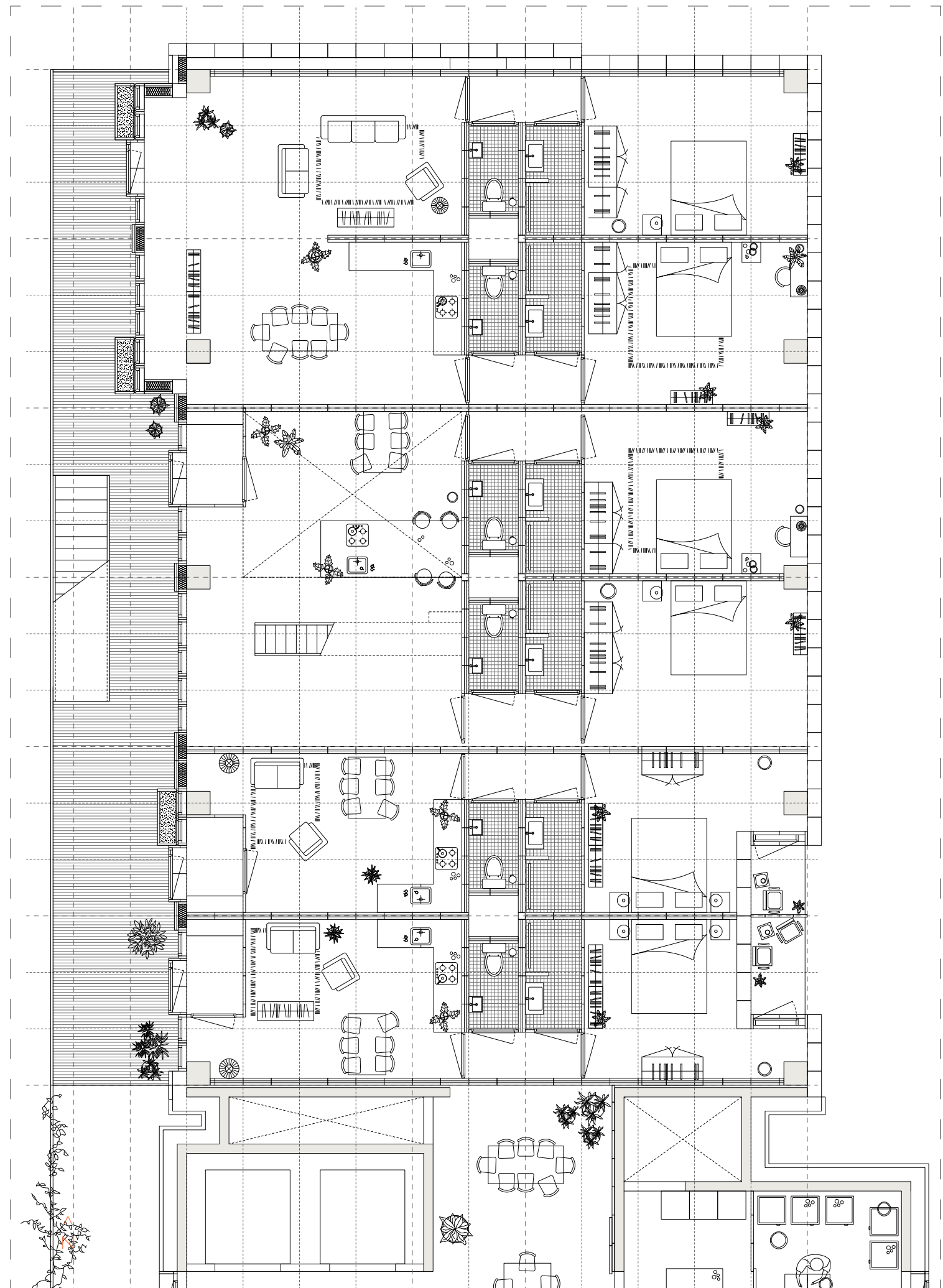


3d model, personal work, sketched together with gemini

'The Independent Shared One'

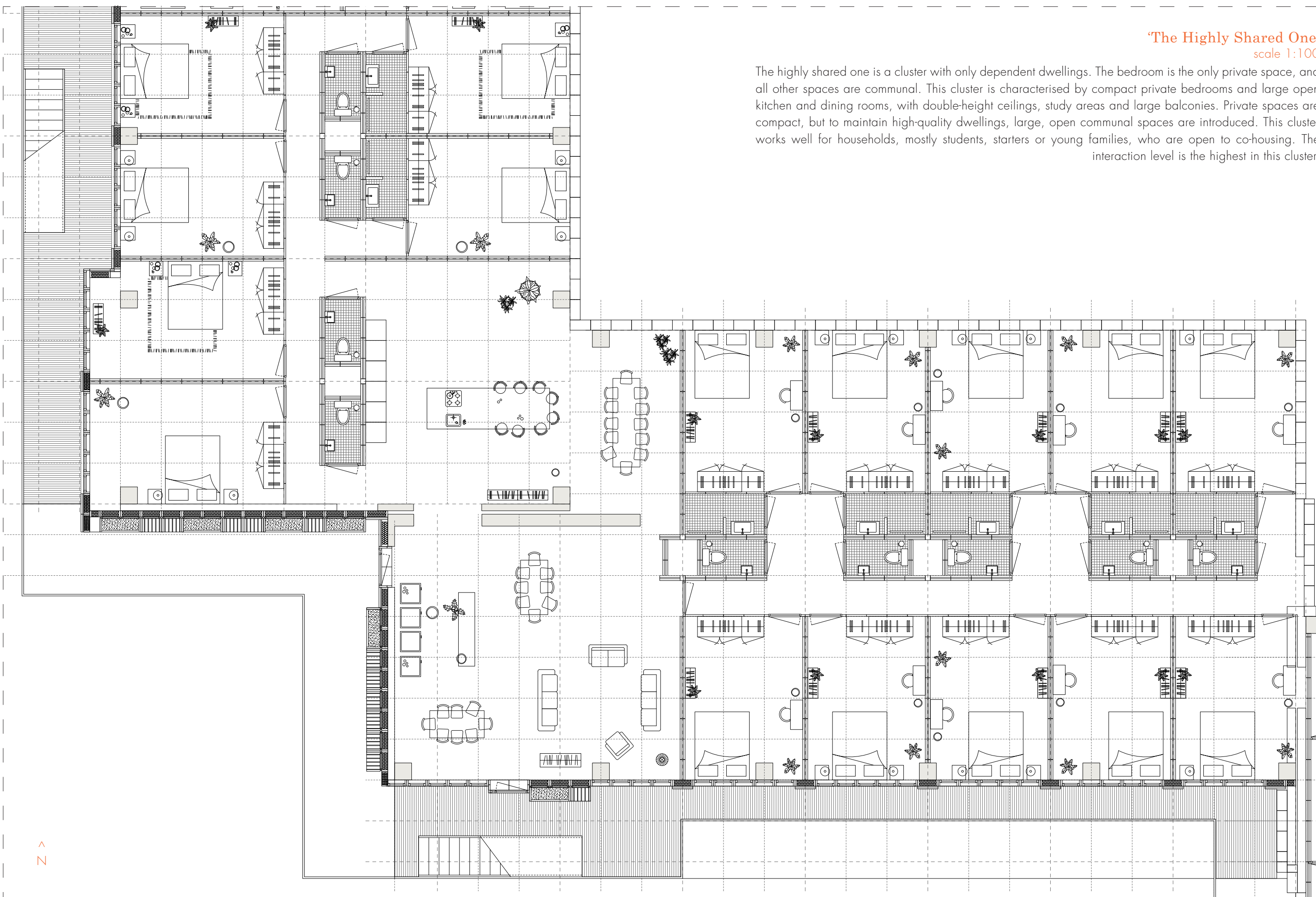
scale 1:100

The independent shared cluster includes dwellings with their own kitchens and sanitary facilities, sharing only galleries, larger kitchens for hosting, and rooftops. These dwellings accommodate more private households, an important prerequisite primarily for Turkish families, but also a type of dwelling that can accommodate every other household that prefers more privacy. The independent shared cluster mixed single-person households, pairs and families to stimulate interaction between diverse household types on the galleries.



'The Highly Shared One' scale 1:100

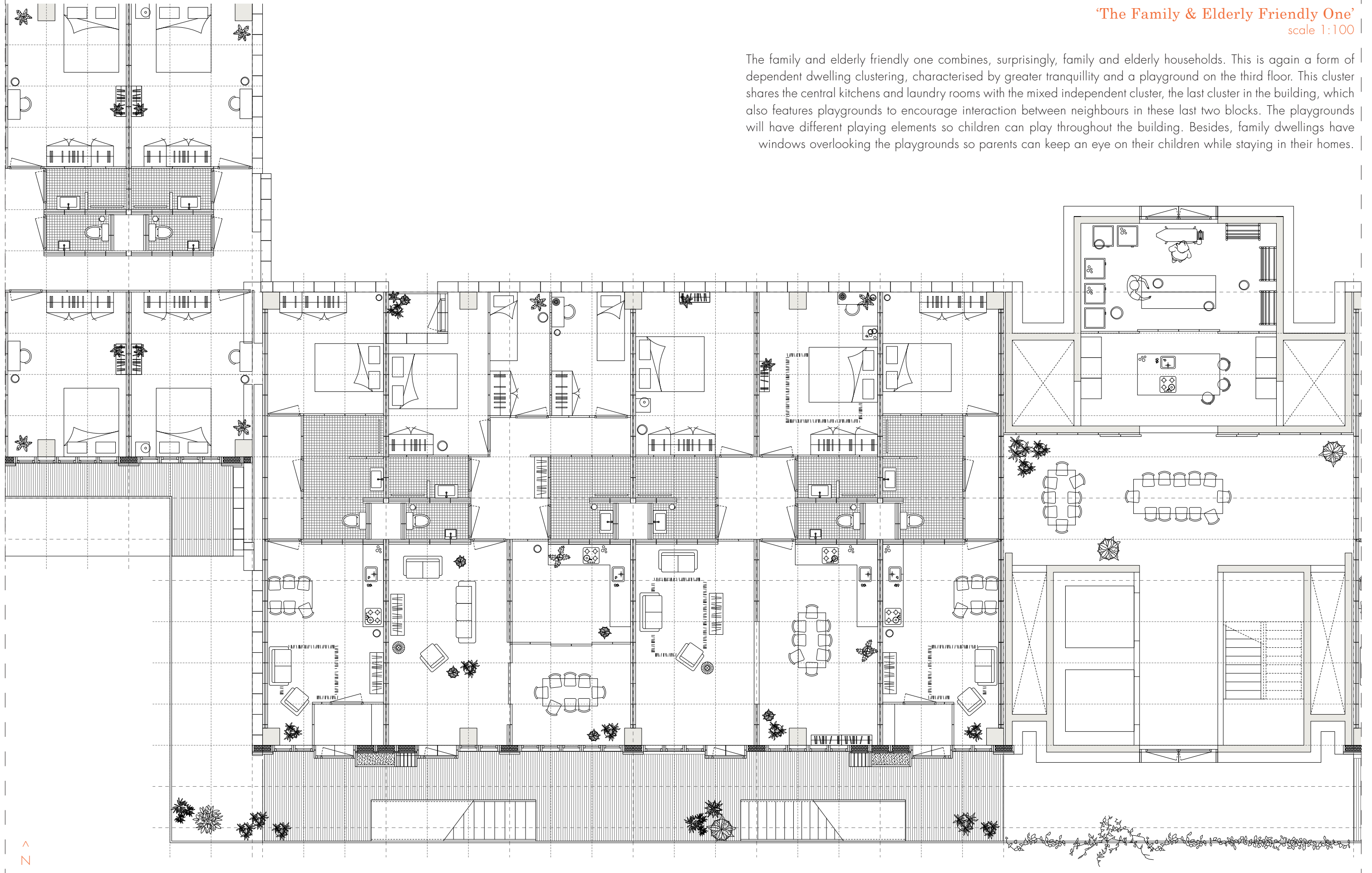
The highly shared one is a cluster with only dependent dwellings. The bedroom is the only private space, and all other spaces are communal. This cluster is characterised by compact private bedrooms and large open kitchen and dining rooms, with double-height ceilings, study areas and large balconies. Private spaces are compact, but to maintain high-quality dwellings, large, open communal spaces are introduced. This cluster works well for households, mostly students, starters or young families, who are open to co-housing. The interaction level is the highest in this cluster.



'The Family & Elderly Friendly One'

scale 1:100

The family and elderly friendly one combines, surprisingly, family and elderly households. This is again a form of dependent dwelling clustering, characterised by greater tranquillity and a playground on the third floor. This cluster shares the central kitchens and laundry rooms with the mixed independent cluster, the last cluster in the building, which also features playgrounds to encourage interaction between neighbours in these last two blocks. The playgrounds will have different playing elements so children can play throughout the building. Besides, family dwellings have windows overlooking the playgrounds so parents can keep an eye on their children while staying in their homes.



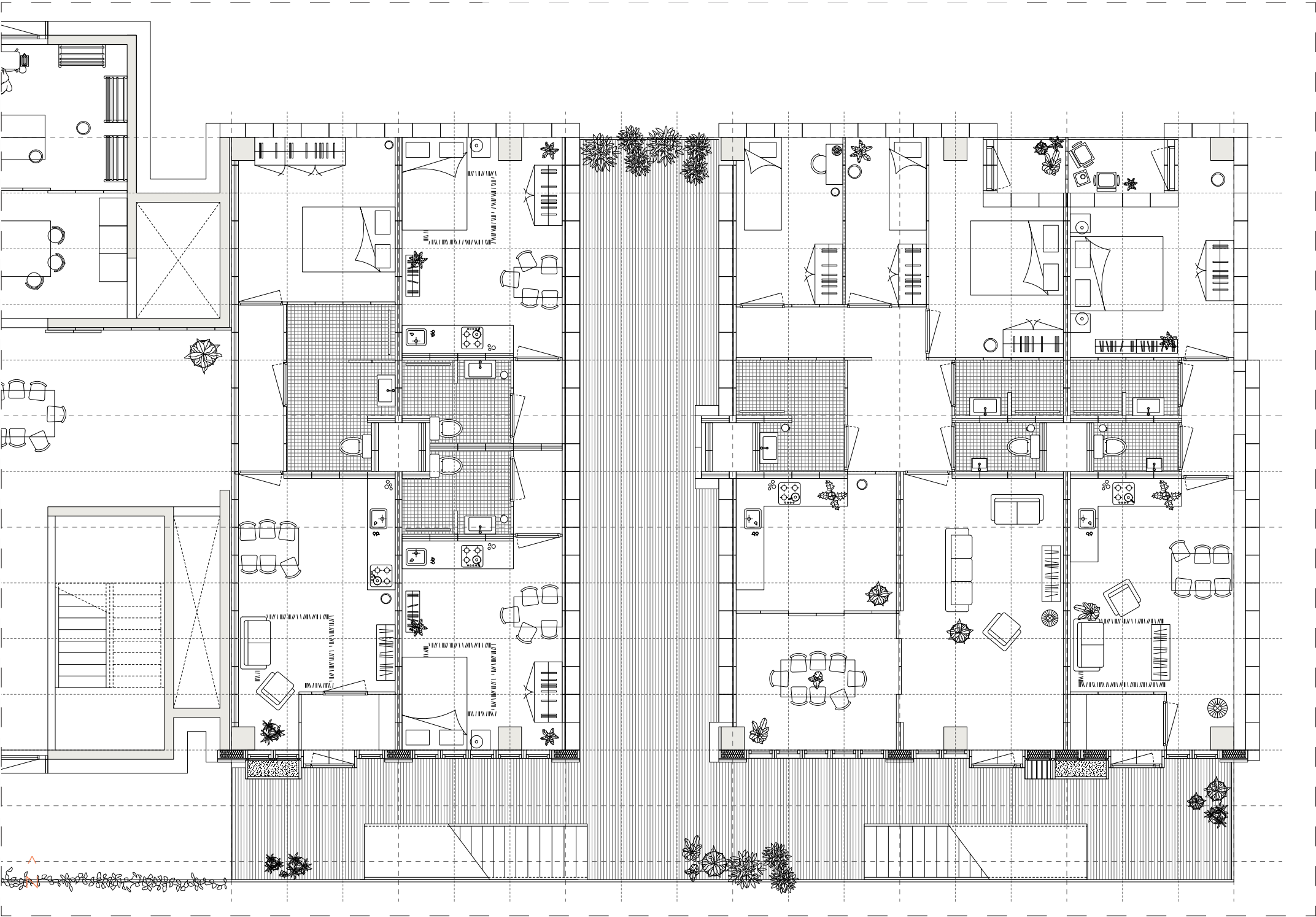
‘The Mixed Independent One’
scale 1:100

This last cluster has the greatest mix between resident profiles. More private dwellings, that can accommodate Polish and Turkish two-person households, are placed at the end of the gallery and include loggias to provide a private exterior space in the home. A family home where the kitchen, dining, and living areas can be separated, accommodating the needs of, for example, Indian families and residents who prefer more privacy within their home. And single-person households adjacent to one of the internal playgrounds. And finally, a home for an elderly person or couple that can accommodate persons in wheelchairs by providing larger bathrooms.

Shared Kitchens & Laundry

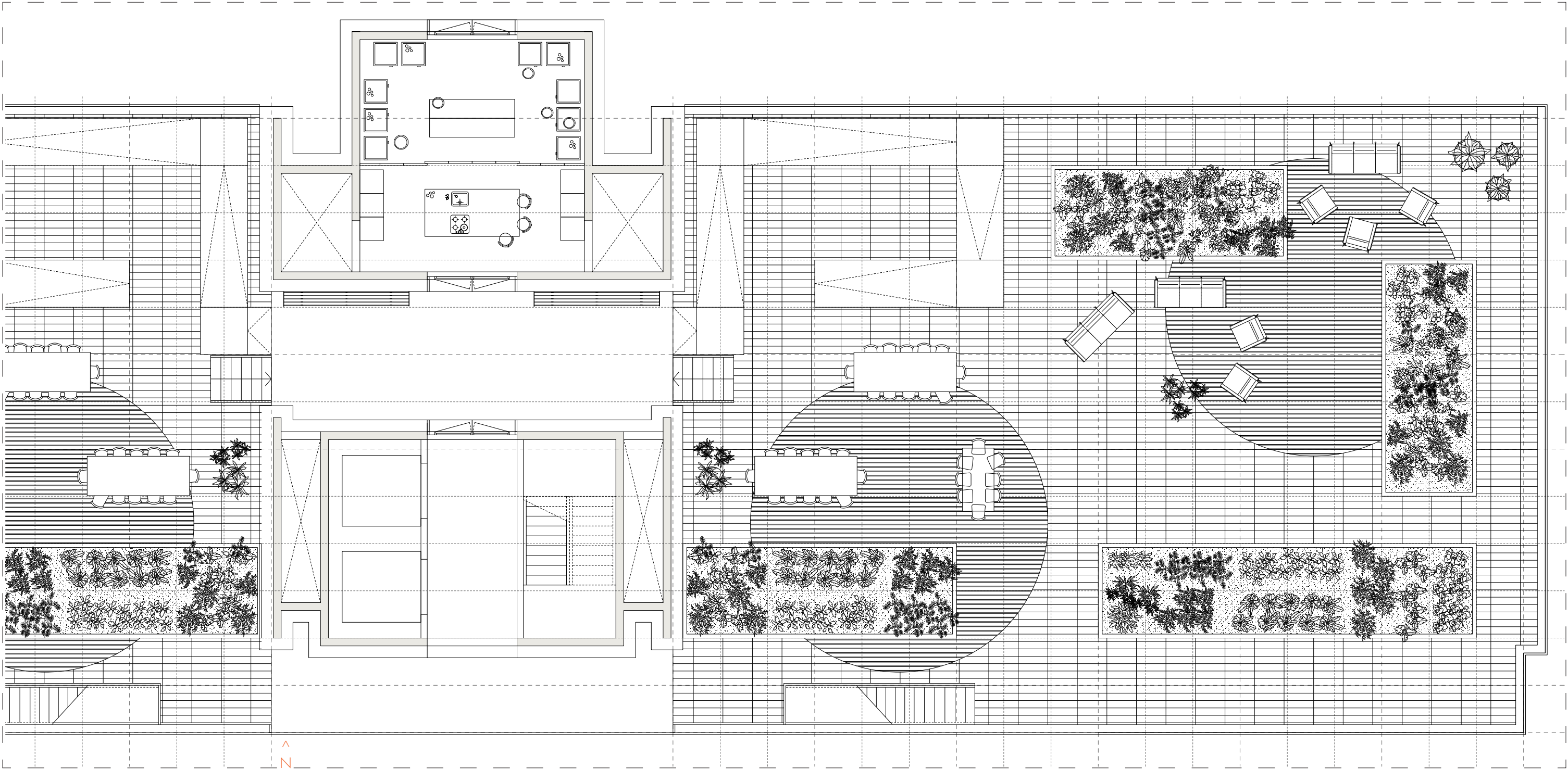


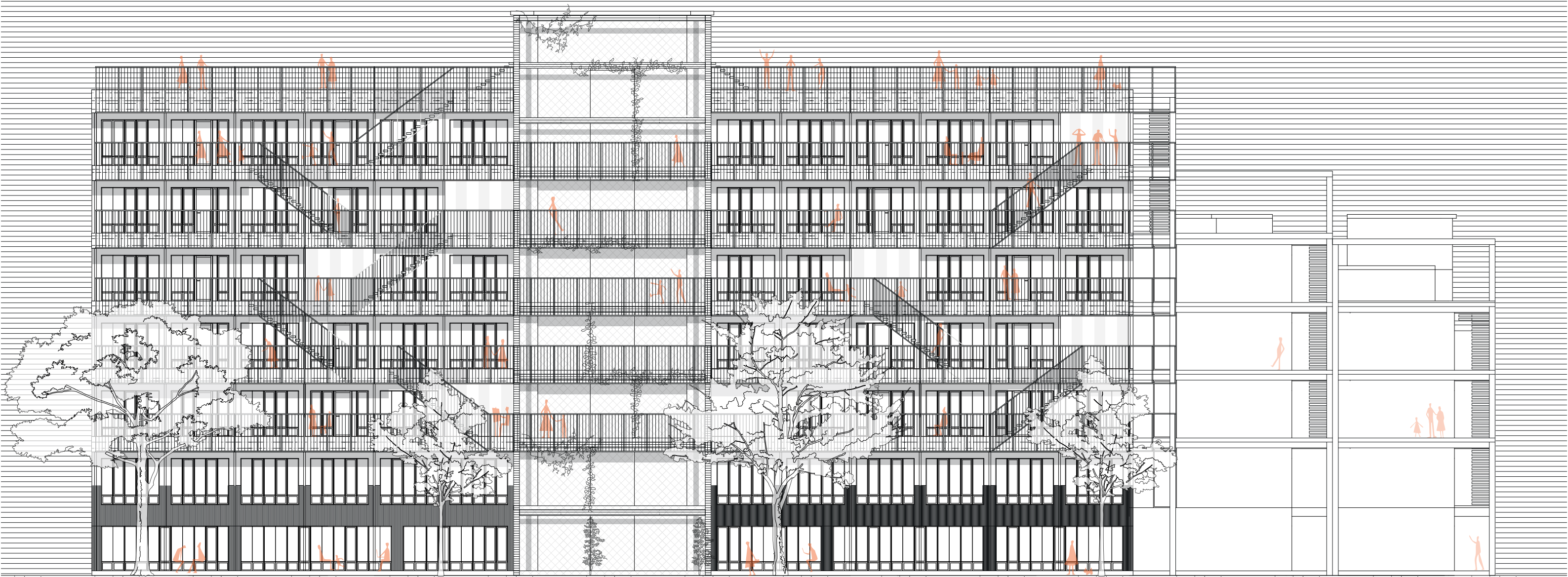
3d model, personal work, sketched together with gemini

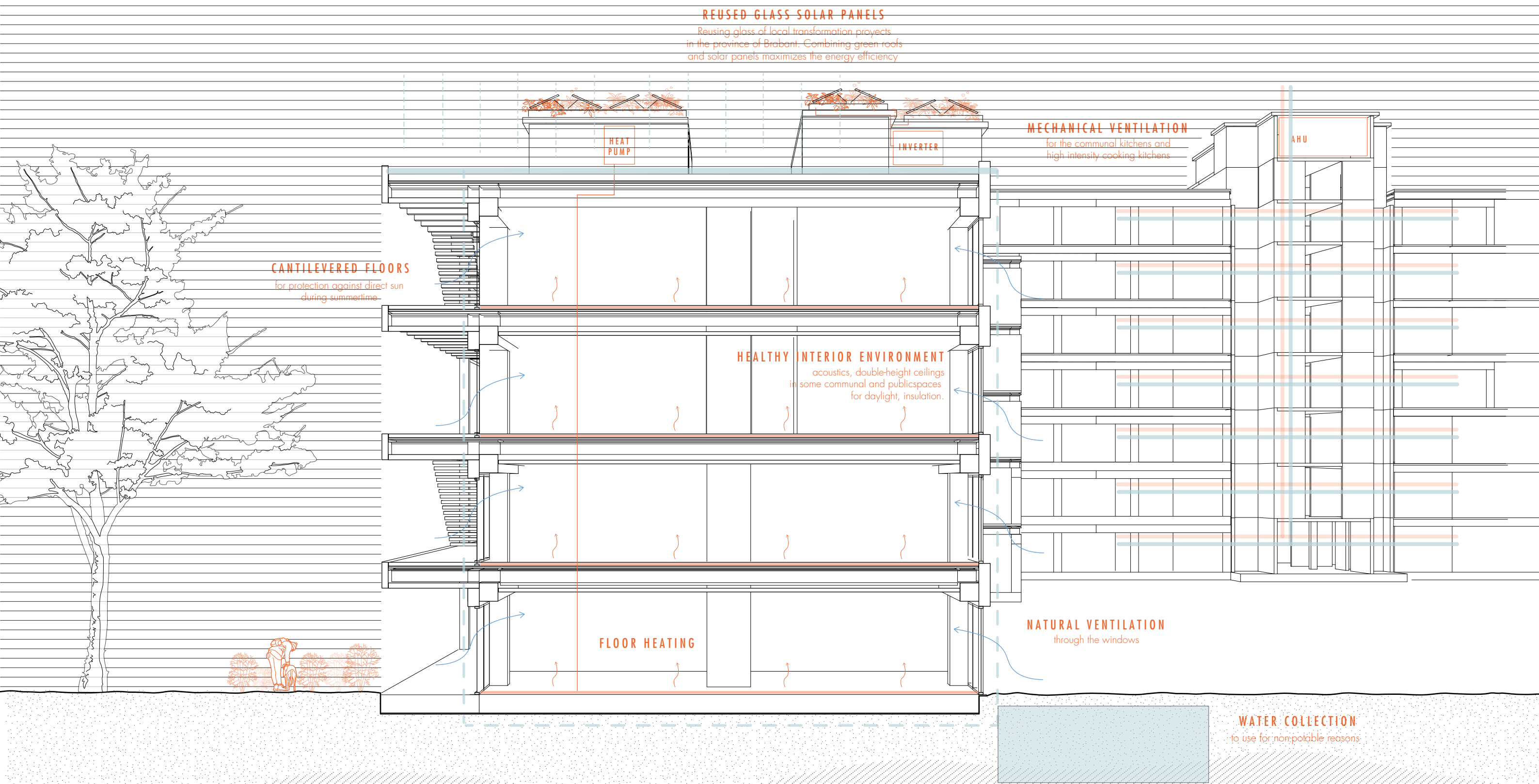


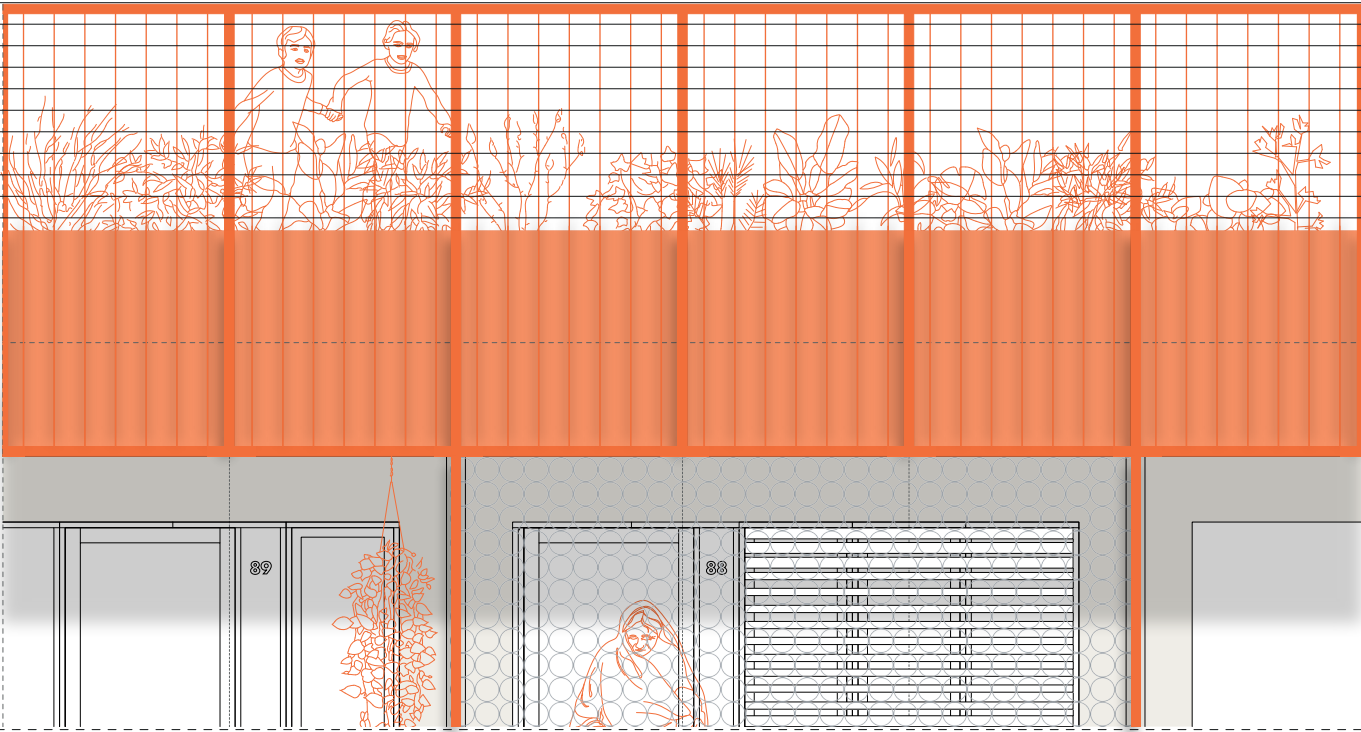
‘The Communal Rooftop Gardens’
scale 1:100

This last cluster has the greatest mix between resident profiles. More private dwellings, that can accommodate Polish and Turkish two-person households, are placed at the end of the gallery and include loggias to provide a private exterior space in the home. A family home where the kitchen, dining, and living areas can be separated, accommodating the needs of, for example, Indian families and residents who prefer more privacy within their home. And single-person households adjacent to one of the internal playgrounds. And finally, a home for an elderly person or couple that can accommodate persons in wheelchairs by providing larger bathrooms.

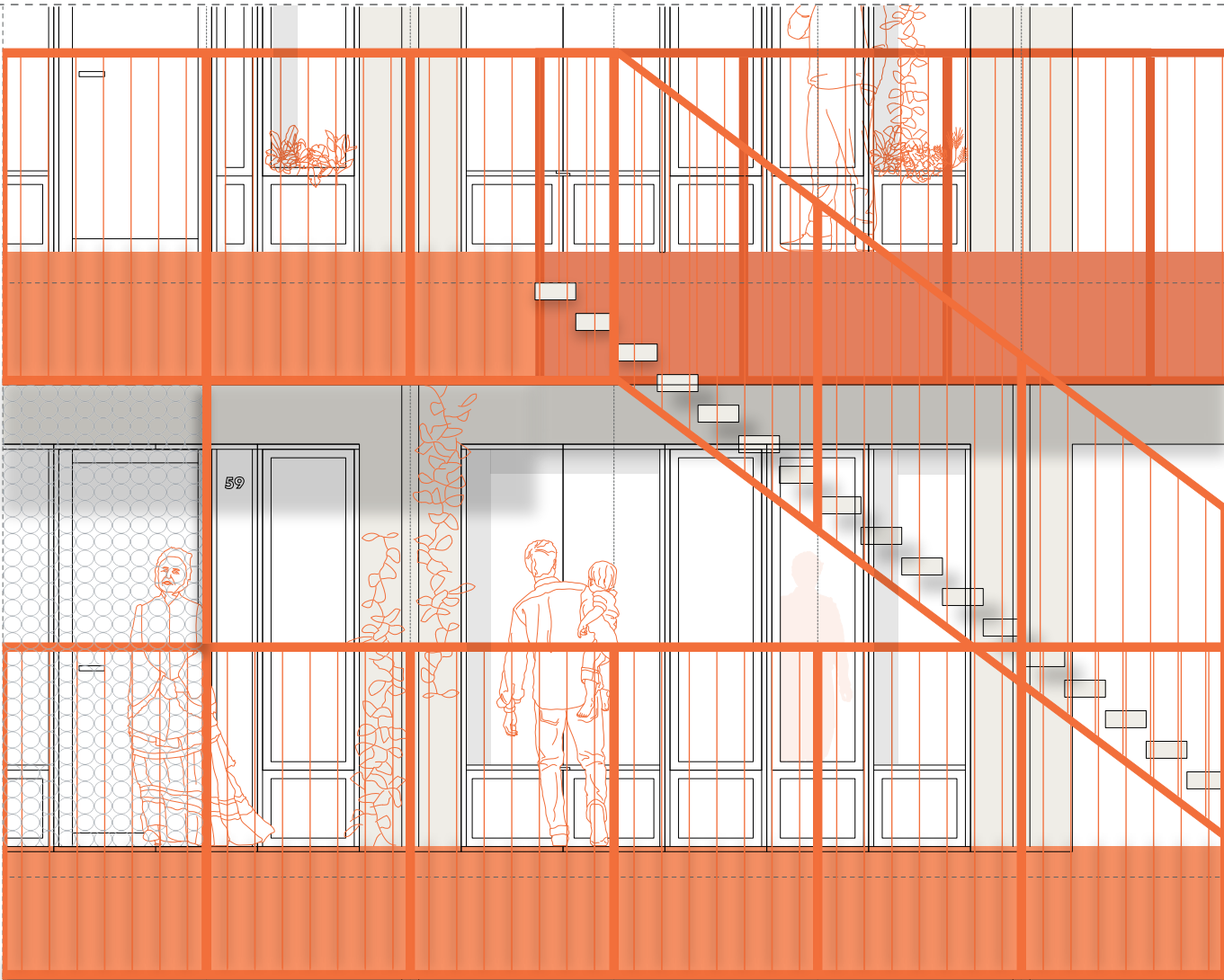
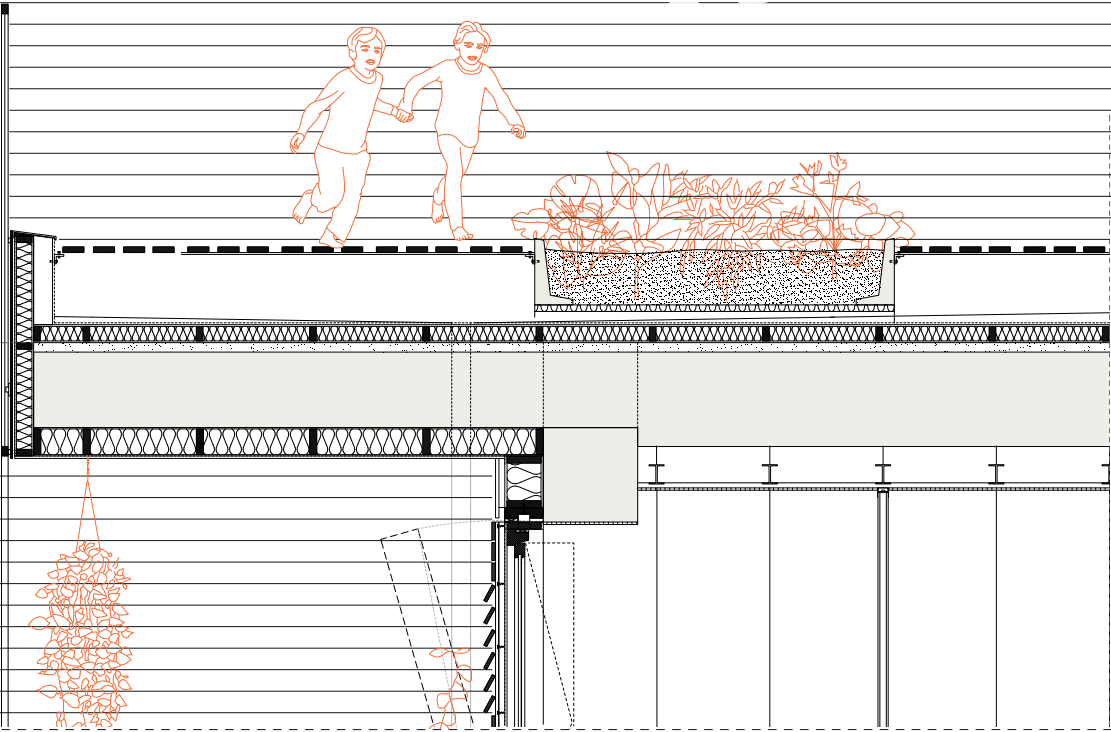




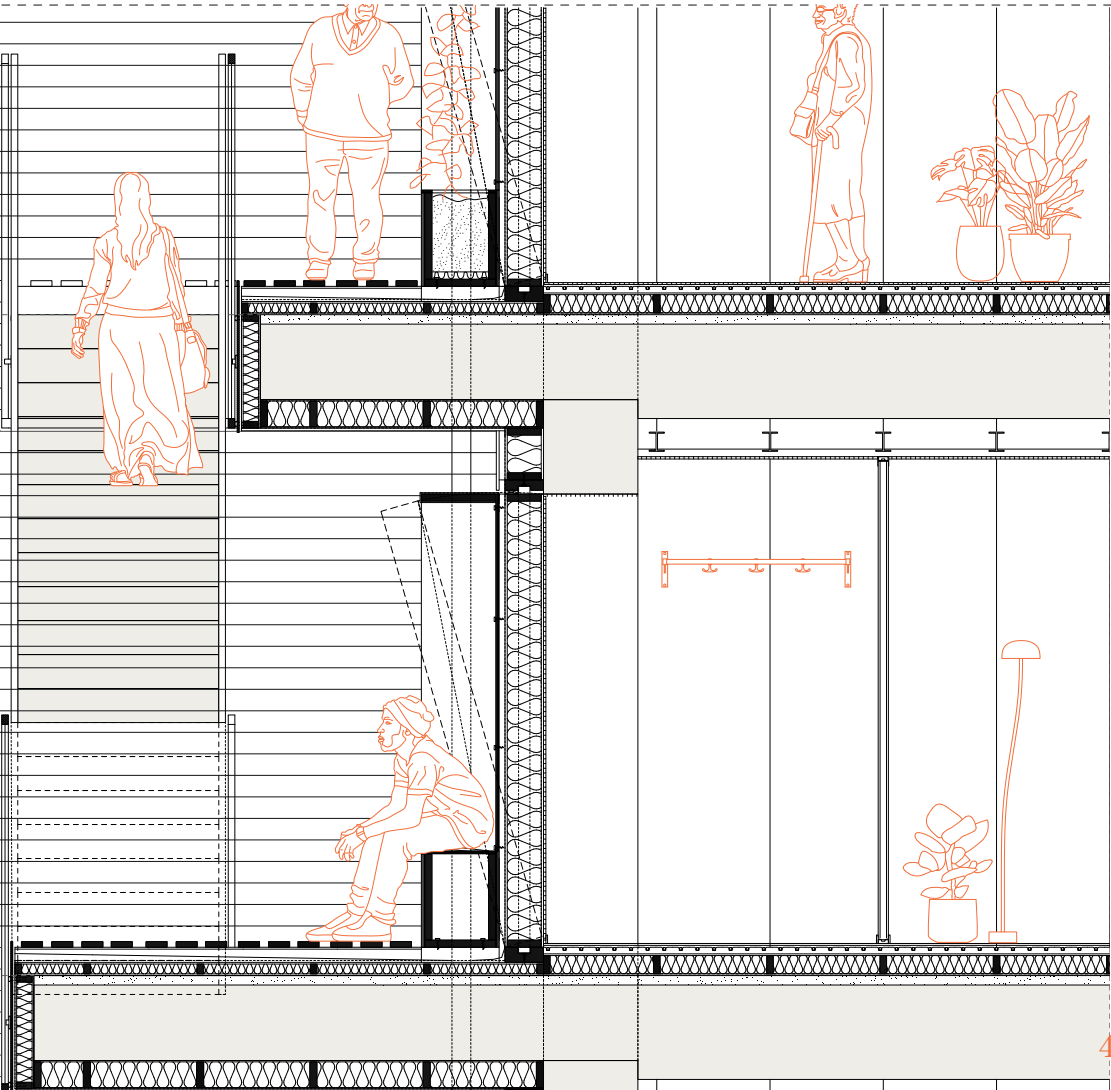




24460 + P



17460 + P



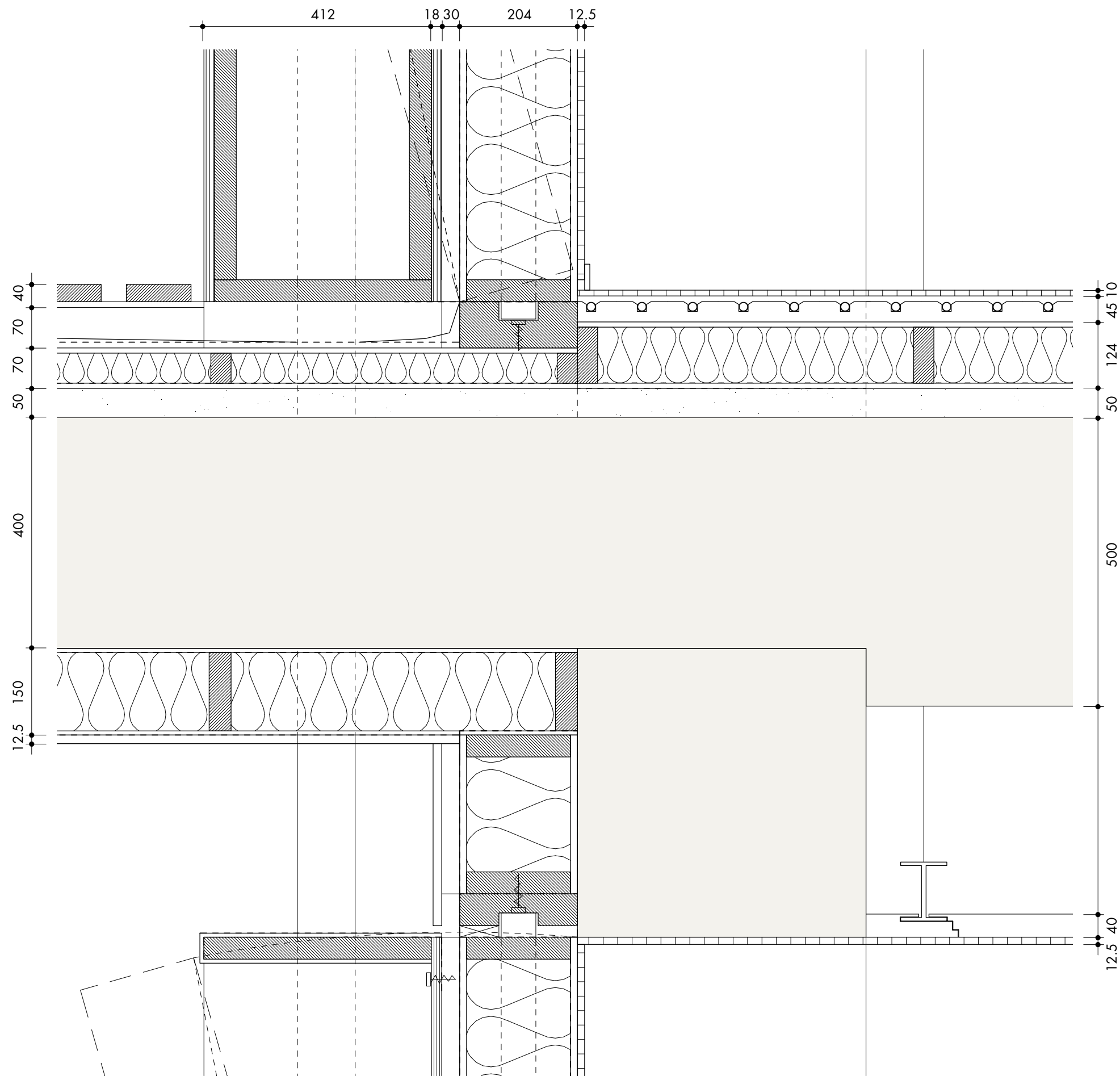
13960 + P

49

48

3460 + P

P



Vertical Section
scale 1:5

Exterior Floor Construction:

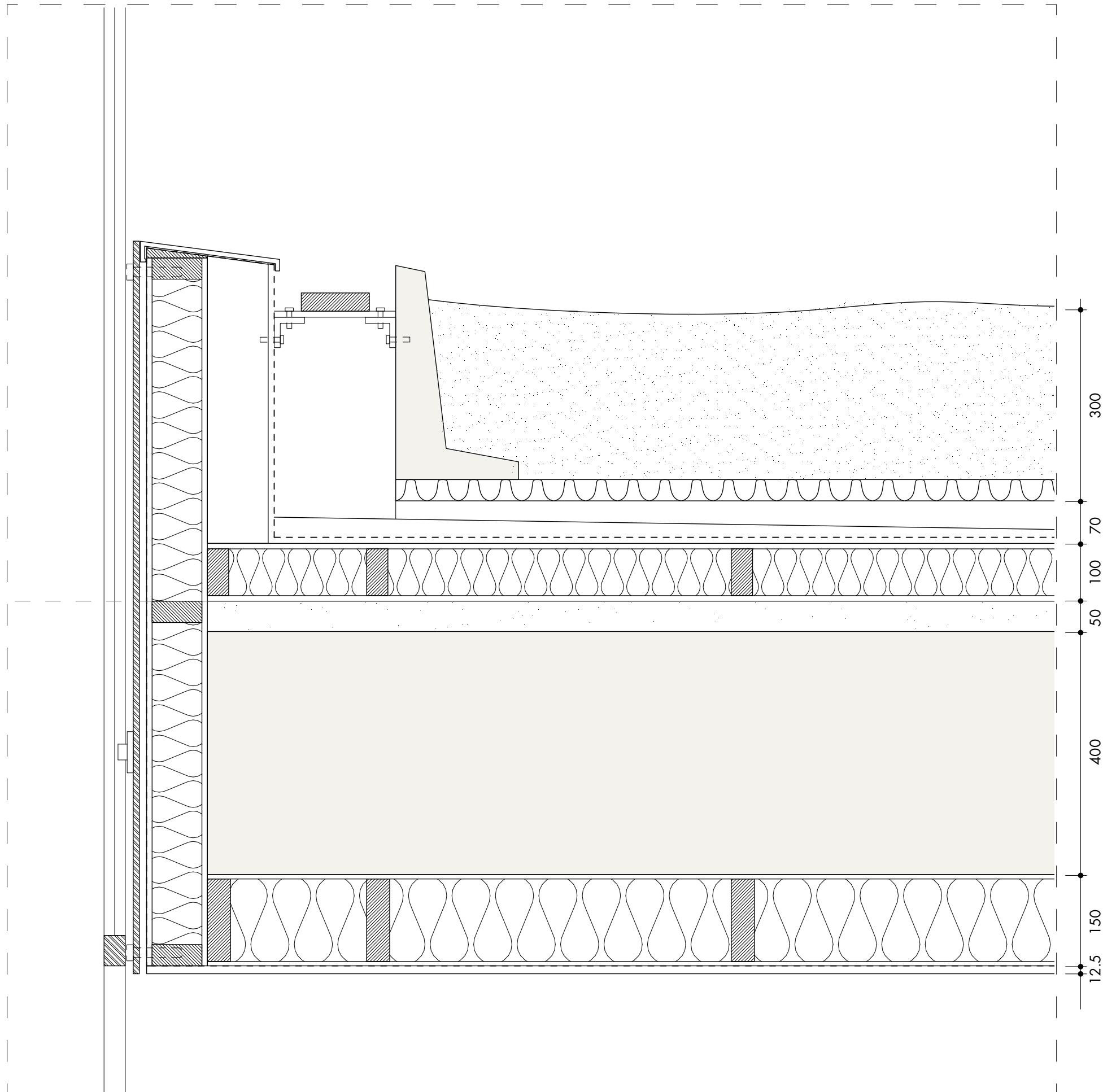
- 40 mm Wooden floors
- 70 mm Rainwater drainage
- 9 mm OSB board
- Watertight layer
- 52 mm Insulated timber frame construction, incl. 52x38 mm wooden beams
- Vapour barrier
- 9 mm OSB board
- 50 mm Screed
- 400 mm Precast concrete TT-floorslabs
- 9 mm OSB board
- Vapour barrier
- 132 mm Insulated timber frame construction, incl. 180x38 mm wooden beams
- Watertight layer
- 9 mm OSB board

Facade Construction:

- 412 mm Facade panel with built-in hardwood bench
- 30 mm Air cavity
- 12 mm OSB board
- Watertight layer
- 180 mm Insulated timber frame construction, incl. 180x38 mm wooden beams and 60x50 mm studs for (de)mountability
- Vapour barrier
- 12 mm OSB board
- 12.5 mm Plasterboard finish

Interior Floor Construction:

- 10 mm Wooden floor finish
- 45 mm Floor heating system
- 12 mm OSB board
- 100 mm Insulated timber frame construction, incl. 100x38 mm wooden beams
- 12 mm OSB board
- 50 mm Screed
- 500 mm Pre-cast concrete TT floor slabs
- 40 mm FAAY modular ceiling system
- 12.5 mm Plasterboard finish



Vertical Section

scale 1:5

- Roof Construction:
- 300 mm Soil for vegetable garden laid on waterproof system
 - 70 mm Rainwater drainage
 - 9 mm OSB board
 - Watertight layer
 - 82 mm Insulated timber frame construction, incl. 82x38 mm wooden beams
 - Vapour barrier
 - 9 mm OSB board
 - 50 mm Screed
 - 400 mm Precast concrete TT-floorslabs
 - 9 mm OSB board
 - Vapour barrier
 - 132 mm Insulated timber frame construction, incl. 132x38 mm wooden beams
 - Watertight layer
 - 9 mm OSB board
 - 12.5 mm Plasterboard finish

Conclusion

which conclusion-, discussion- and reflection points can be recognized?

04

4.1 Conclusion

This graduation project sought to answer the main question: “How can former office buildings in the KnoopXL area be transformed into mixed-use co-living environments that enable everyday coexistence between local communities and international newcomers, while remaining adaptable over time?” By combining historical analysis, cross-cultural demographic research, and structural prototyping, the project demonstrates how adaptive reuse can foster a socially inclusive, materially circular urban future.

Lessons from Eindhoven’s company-driven history, specifically the transformations of Strijp-S and the NRE terrain, reveal that urban resilience relies on activating, rather than erasing, industrial and commercial heritage. By introducing a live-work-relax mix and designing communal spaces that function as the social hearts, the project strives to maximise interaction between the inhabitants.

Demographic research established four distinct resident profiles. These profiles reflect the city’s high proportion of single-person households (nearly 50%) and integrate local residents with the city’s three largest international groups: India, Poland, and Turkey. A comparative spatial analysis of these groups revealed that cultural differences do not require entirely distinct housing typologies, but rather a clear architectural framework capable of accommodating varying preferences for privacy, cooking, and threshold spaces.

For example, Indian culture values having spaces for welcoming guests and high-intensity cooking, requiring kitchens that can be fully enclosed and well-ventilated, along with explicit privacy gradients to control social engagement. Dutch, Polish, and Turkish cultures favour open-plan kitchens, though Polish and Turkish domestic practices show a stronger preference for privacy within the family.

Architecturally and technically, these diverse needs were met through the development of an adaptable spatial framework. 1:200 scale structural prototyping studies evaluated different physical interventions. While large cuts, to create inner courtyards or double-height spaces, add a large amount of quality to a space by letting in daylight, they compromise the building’s structural stiffness and require reinforcements.

The final design focuses on external intervention: removing parts of the cantilevered floor slabs to introduce external circulation galleries. This strategy minimises structural interventions while creating an interactive facade layer that serves as a shared threshold space where local and international residents naturally encounter one another.

Long-term adaptability across multiple scales is achieved through two flexible, reversible systems, in the skin and the space plan. A “Universal Facade Panel” system is introduced as a standardised structural base frame that accepts replaceable infills based on specific cultural needs. Using reversible connections, residents can easily modify their panels to suit their preferences and needs. In this way, residents are able to add extra privacy layers, essential for the more inward-living Polish and Turkish profiles, or incorporate functional elements like benches and planters to activate the gallery. To provide internal flexibility, a 3.6-meter grid and a modular wall system, the FAAY wall system, are introduced. These dimensions can accommodate all types of resident profiles while maintaining flexibility, allowing the building to adapt as household compositions or cultural demographics change over time.

In conclusion, this project proves that transforming former office buildings into adaptable co-living environments allows Eindhoven to accommodate the city’s rapid international growth, without erasing its physical heritage, successfully turning difference into layered spaces of coexistence.

4.2 Implications and Recommendations

The strategies developed in this project demonstrate how Eindhoven can address rapid growth and material waste simultaneously. Instead of demolishing empty commercial buildings, the city can use them to bring diverse communities together. To turn these design strategies into reality, municipal planners, housing corporations, and developers should approach the city’s transformation from a different perspective. By preserving former office buildings and transforming them into new, mixed-use, lively environments, the city can meet its environmental goals while creating affordable spaces for social integration. The transition from one country to another can be challenging for international newcomers. Keeping and transforming these buildings provides inclusive spaces in the city, using the existing urban fabric to create a new environment.

Besides, housing corporations and researchers should focus on the use of these mixed-use co-living formats to bring together different groups. Currently, international workers, students, and local starters are treated as separate housing markets. Instead, they should be mixed within the same building. Using the spatial insights from this research, corporations can design shared housing that balances community spaces with clear boundaries for privacy. This ensures that mixing cultures results in a cooperative community rather than friction.

Finally, more research should be done on the spatial differences of the rich variety of culture the Netherlands has to offer. This research just focussed on four distinct nationalities, but it is not to forget that Eindhoven counts over forty nationalities. Therefore research on the spatial preferences of Eindhoven’s cultural diversity should be evaluated and taken more into account in future design.

4.3 Reflection

This project shows how the architectural profession can approach housing differently by putting cultural needs at the centre of the design from day one. Standard housing in the Netherlands often relies on fixed floor plans designed for a single, homogenised lifestyle. As cities like Eindhoven grow more international, this rigid approach does not fit in every case. This design proves that architecture can create a shared framework that still leaves room for individual cultural habits regarding cooking, socialising, and privacy.

Reflecting on the research phase, the theoretical framework could have been strengthened by revising the methods used to study the four cultural profiles. This research limited itself to literature reviews and case studies. While this provided a strong data foundation, validating the spatial analysis through personal interviews with people from India, Turkey, Poland and the Netherlands would have added great value. Literature can generalise cultural practices, but firsthand conversations could have revealed personal nuances, unexpected domestic habits, and/or direct feedback on the design. Engaging directly with the users would have grounded the theoretical framework with human perspectives.

The same goes for the co-living design development. The case studies showed that most successful co-living projects are done from a bottom-up approach, together with the ultimate residents of the building. In that way, their needs are directly reflected in the communal space, resulting in successful co-housing projects. Obviously, this is not a design that will be built tomorrow, but in hindsight, the fact that these co-living floor plans were developed from an academic point of view solely questions the real success of this project.

There was also a significant shift in the design tools and techniques used for prototyping. At the start of the graduation studio, the intention was to physically prototype the entire facade panel, the technical joints, and the full catalogue of options using detailed, large-scale physical models. However, due to the scale and time constraints of the project, physical prototyping remained limited to a few 1:200-scale models to test structural changes and its effects on the overall mass of the building. Instead of building large physical joints, a lot of the design work was done through iterative hand sketching. While hand sketching is a highly effective design tool that serves as rapid prototyping, it was a different experience from the hands-on physical making planned at the beginning.

In hindsight, this shift in tools was necessary. The 1:200 models helped address architectural questions about daylight and structural stability, while sketching enabled rapid adjustments to the flexible interior grid. However, actually fabricating a physical 1:1 joint or 1:10 panel would have provided a deeper technical understanding of how the reversible connections perform when taken apart and reassembled. For future research, combining these methodologies can bring both the cultural as the technical aspects to a deeper level.

05

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Appendix 06



KNOOP XL CLUSTERS



CLUSTER 3



CLUSTERS 1 & 2



CLUSTER 4

Appendix A2: Clusters KnoopXL Analysis

Bestemmingsplannen
(enkelbestemming)

Transparantie: 20%

Legenda:

- agrarisch
- agrarisch met waarden
- bedrijf
- bedrijventerrein
- bos
- centrum
- cultuur en ontspanning
- detailhandel
- dienstverlening
- gemengd
- groen
- horeca
- infrastructuur
- kantoor
- maatschappelijk
- natuur
- recreatie
- sport
- tuin
- verkeer
- ontspanning en vermaak
- water
- wonen
- woongebied
- overig



Energielabels van gebouwen

Transparantie: 0%

Legenda:

- Geen label
- Klasse A+++++
- Klasse A++++
- Klasse A+++
- Klasse A++
- Klasse A+
- Klasse A
- Klasse B
- Klasse C
- Klasse D
- Klasse E
- Klasse F
- Klasse G



Kwetsbare gebouwen

Transparantie: 0%

Legenda:

- Beperkt kwetsbaar
- Kwetsbaar
- Zeer kwetsbaar
- Te bevestigen



Functies van adressen

Transparantie: 0%

Legenda:

- Wonen
- Hotel/vakantiehuis
- Winkel
- Sport
- Onderwijs
- Gezondheidszorg
- Kantoor
- Industrie
- Bijeenkomsten
- Gevangenis
- Woonboot
- Woonwaggen/strandtent



Functies van gebouwen

Transparantie: 0%

Legenda:

- Wonen
- Hotel/vakantiehuis
- Winkel
- Sport
- Onderwijs
- Gezondheidszorg
- Kantoor
- Industrie
- Bijeenkomsten
- Gevangenis
- Overig
- Meerdere functies aanwezig



Bouwjaar gebouwen

Transparantie: 0%

Legenda:

- tot 1600
- 1600 - 1800
- 1800 - 1900
- 1900 - 1920
- 1920 - 1940
- 1940 - 1960
- 1960 - 1980
- 1980 - 1990
- 1990 - 2000
- 2000 - 2010
- 2010 - 2020
- 2020 en later
- Geen gegevens



**APARTMENT COMPLEX
CITY TOWER, HOLLAND2STAY**

architect: Leo de Bever?
year of construction: 1989, renovated ..?
construction material: concrete probably
facade materials:
tall front building: bricks masonry with aluminium frame windows
low-rise: glass curtain wall and grey metal cladding panels
white mid-rise: white coated aluminium cladding
other remarks: 160 studios and apartments, meeting rooms,
shared laundry room, rooftop terrace, gym, sauna, bike storage

CULTUUR & KUNST EINDHOVEN

architect:
year of construction: 1980
construction material: concrete
facade material: bricks, and second
facade with steel slats
other remarks: renovated by Studio
Groen+Schild in 2017, added stories
with extra classrooms

OFFICE BUILDING - FORMER WTC

architect: Leo de Bever
year of construction: 1977
construction material: concrete
facade materials:
main facade: precast concrete panels
(sand tone or darker tone on ground floor)
smooth finish, aluminium window frames
with dark tinted glass.
cylinder staircases: ribbed sheet, green
coated, aluminium/steel?
other remarks?

HORECA/BIJENKOMSTEN

architect: Leo de Bever?
year of construction: 1981
construction material: concrete
facade materials: brick masonry,
aluminium white frames and white
aluminium panels
other remarks?

HOLIDAY INN HOTEL

architect: Leo de Bever
year of construction: 1972
construction material: concrete
facade material: aggregate concrete
(precast or cast-in-place) with pebble finish
white metal cladding (likely aluminium sheets)
other remarks?

OFFICE BUILDING - FORMER WTC

architect: Leo de Bever
year of construction: 1977
construction material: concrete
facade materials:
main facade: precast concrete panels
(sand tone or darker tone on ground floor)
smooth finish, aluminium window frames
with dark tinted glass.
cylinder staircases: ribbed sheet, dark
coated, aluminium/steel?
other remarks?

OFFICE BUILDING - FORMER WTC

architect: Leo de Bever
year of construction: 1989
construction material: concrete
facade materials:
corner volume: glass curtain wall with
aluminium dark coated frames
silver facade: coated aluminium sheets or
aluminium composite panels
other remarks?

OFFICE BUILDING GRIFFIOEN

architect: Leo de Bever?
year of construction: 1989
construction material: concrete
facade materials:
main facade: precast concrete facade
elements with aluminium windows
top: red coated aluminium/steel panels
other remarks?

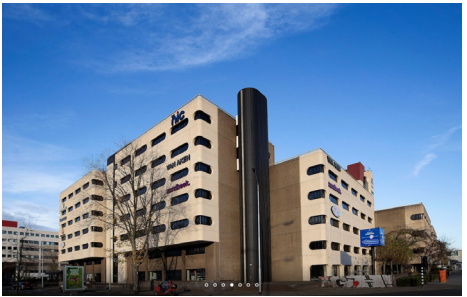
OFFICE BUILDING - FORMER WTC

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year of construction: 1989
construction material: concrete
facade materials:
main facade: precast concrete panels
(sand tone) smooth finish,
aluminium window frames with
dark tinted glass.
cylinder staircases: ribbed sheet, black
grey or white coated, aluminium/steel?
other remarks?



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facade materials:

tall front building: bricks masonry with aluminium frame windows

low-rise: glass curtain wall and grey metal cladding panels

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HORECA/BIJENKOMSTEN

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year of construction: 1981

construction material: concrete

facade materials: brick masonry, aluminium white frames and white aluminium panels

other remarks?



OFFICE BUILDING GRIFFIOEN

architect: Leo de Bever?

year of construction: 1989

construction material: concrete

facade materials:

main facade: precast concrete facade elements with aluminium windows

top: red coated aluminium/steel panels

other remarks?

HOLIDAY INN HOTEL

architect: Leo de Bever

year of construction: 1972

construction material: concrete

facade material: aggregate concrete (precast or cast-in-place) with pebble finish
white metal cladding (likely aluminium sheets)

other remarks?

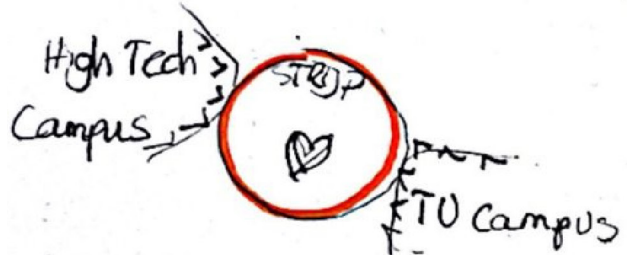




Karakter van het
erfgoed inzetten

CRISIS WAS EEN ZEGE

Een plek voor jonge
mensen om zich te
kunnen ontwikkelen



De ligging zorgde voor een
goede basis voor evenementen
en bedrijvigheid en cultuur

Engage
the
Community

KANSRIJK
DUURZAAM

MIX van
Nieuw en Oud

Groeien op een
organische &
gezonde manier.

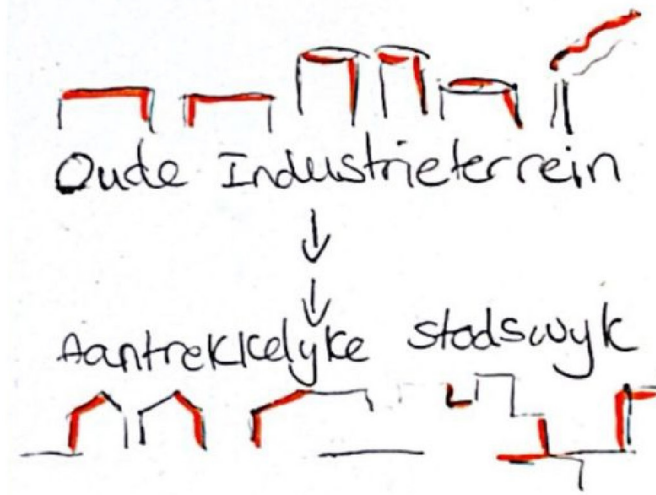
DIVERSITEIT

MIX van Creativiteit
en cultuur.

SAMENWERKING
publiek - Privaat.

NO DEMOLITION!
temporary uses meanwhile

9797979797979797
TORENALLEE
9200 99999999!



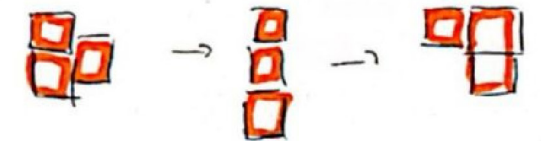
CONTRAST

INTEGRATIE
van waardevolle
gebouwen

Mogelijkheid tot
Herconfiguratie

ORGANISCHE AANPAK

MIX van
grootschalige projectontwikkeling
& kleinschalige initiatieven.



WOON +
WERK +
LEEF

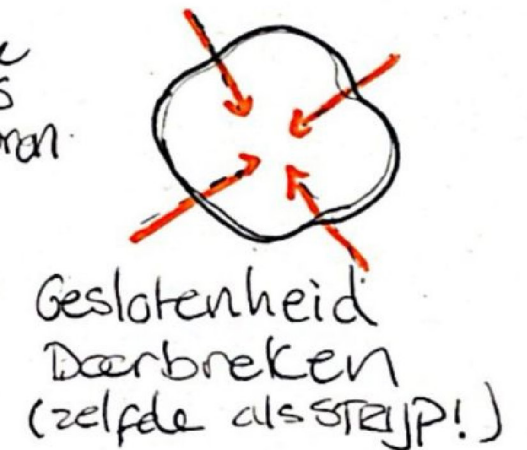
Transformatie
naar Wonen-werk
gebied

Industriële
verleden als
inspiratiebron

samen met de GEBRUIKERS
ontwikkeld



Nieuwe Routes Aanleggen
voor dooradering en betekenis
- volle straten



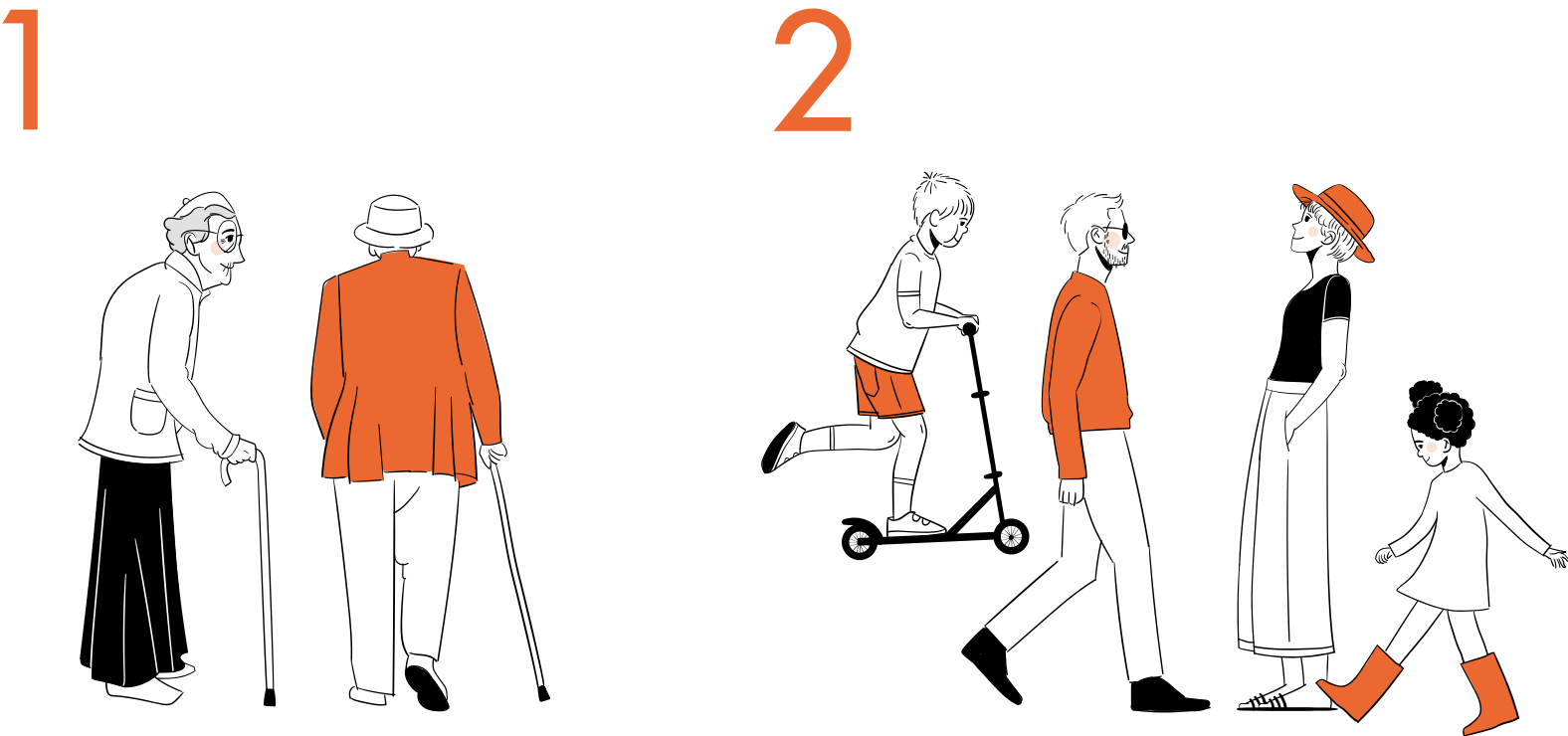
SUBQUESTION 2:

Which 3–4 resident profiles are most relevant in/around KnoopXL (e.g., long-term local households, international knowledge workers, starters, multi-generational family), and what are their key differences in daily routines, privacy gradients, cooking/ventilation, gender separation, work-at-home, and shared-space comfort?

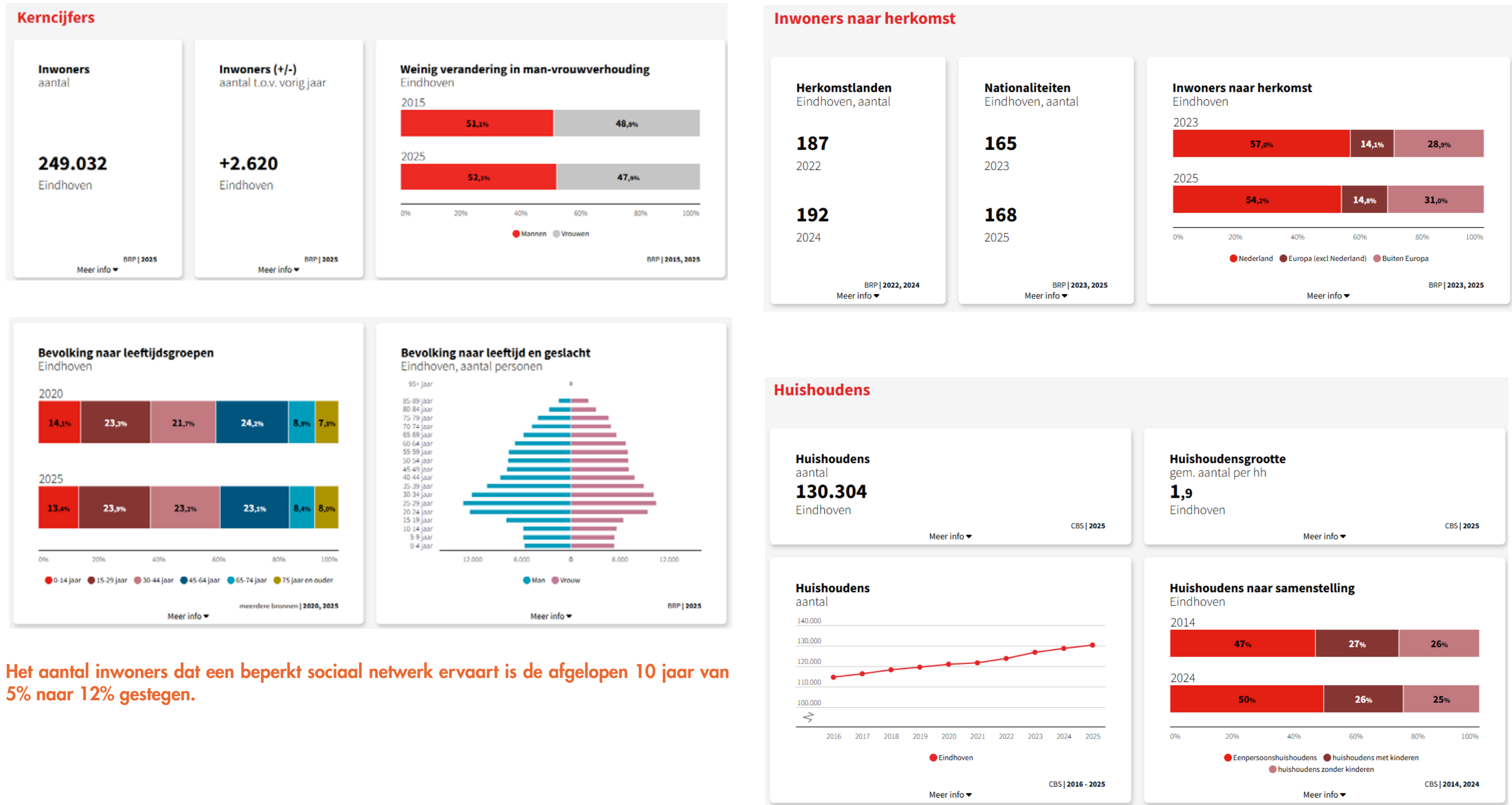
THE 4 ASPECTS THAT WILL GUIDE THIS DECISION:

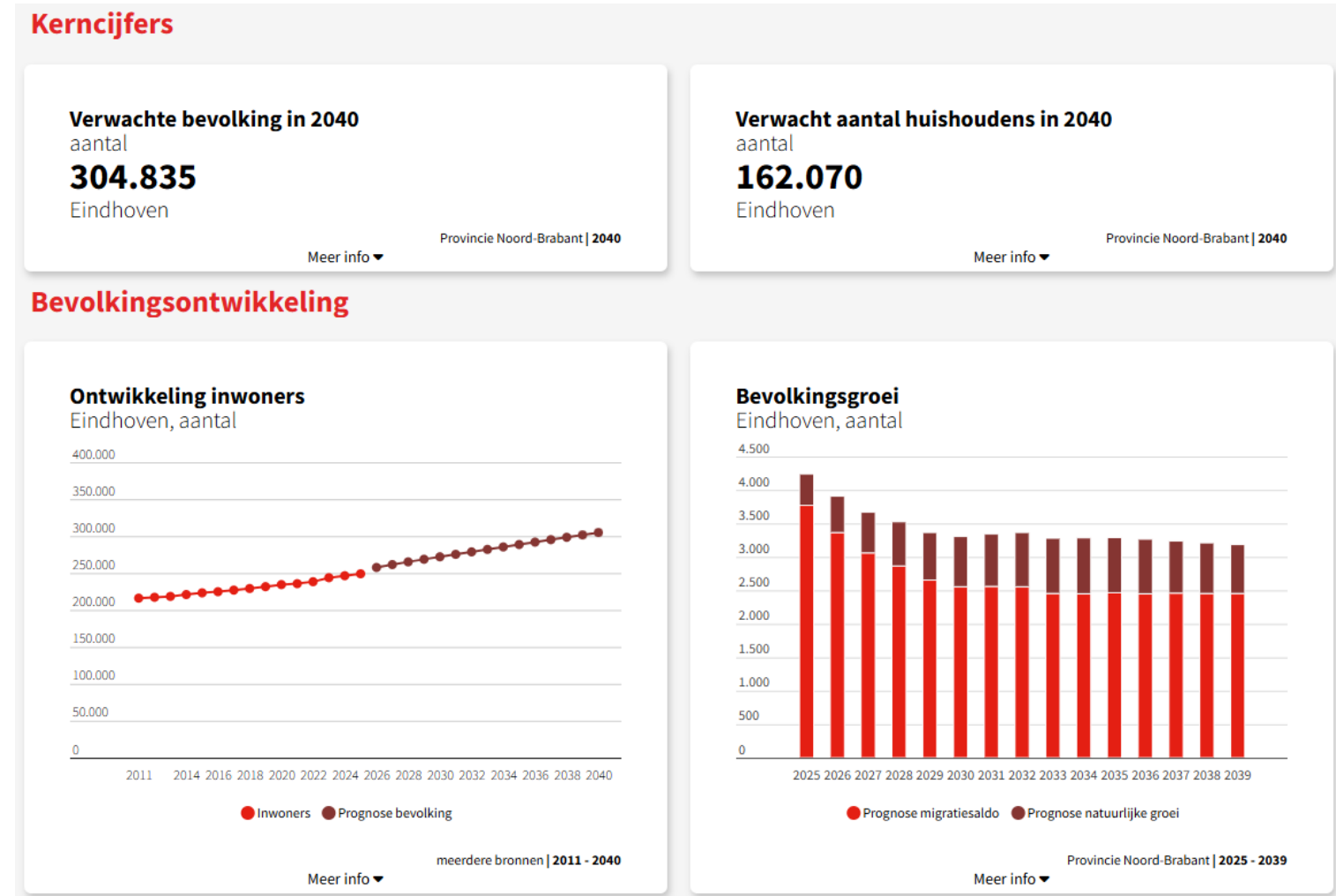
- 1 MOST PROMINENT HOUSEHOLD TYPES
- 2 MOST PROMINENT NATIONALITIES & CULTURES
- 3 DIFFERING SPATIAL PREFERENCES & REQUIREMENTS
- 4 DIFFERING EXPECTED TIMELINES

EXAMPLES:

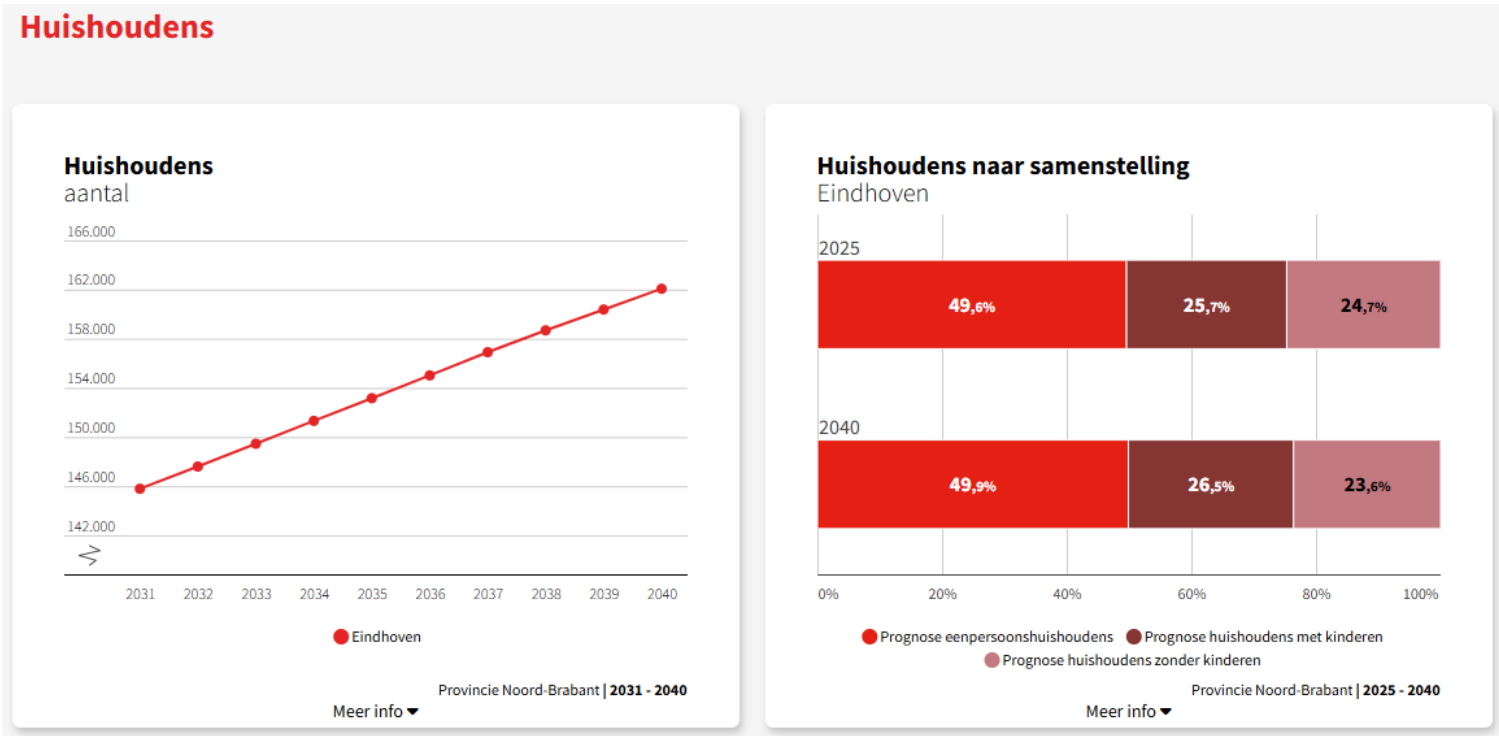


Current numbers

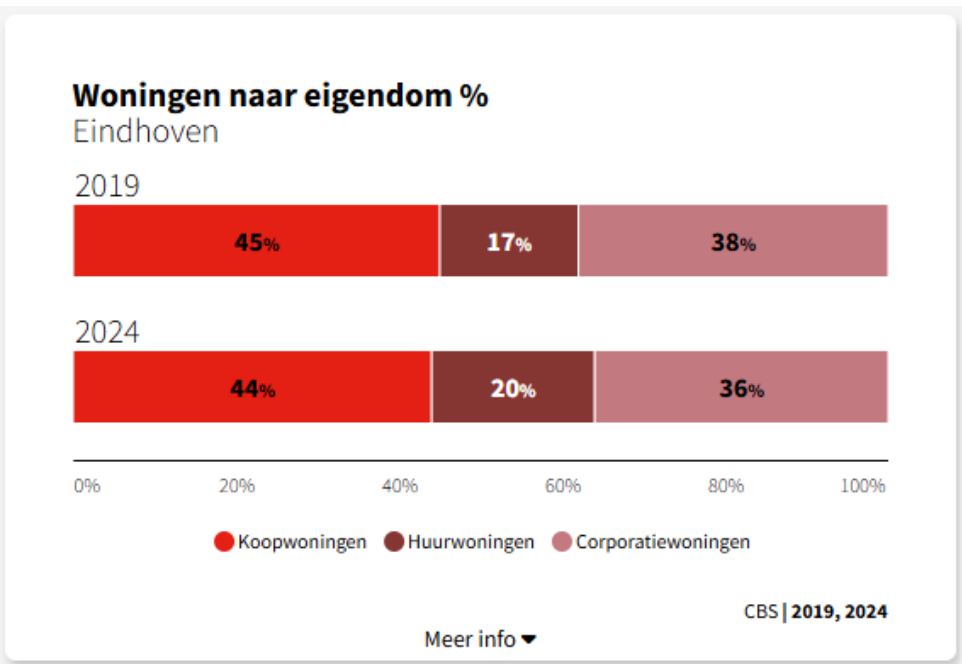
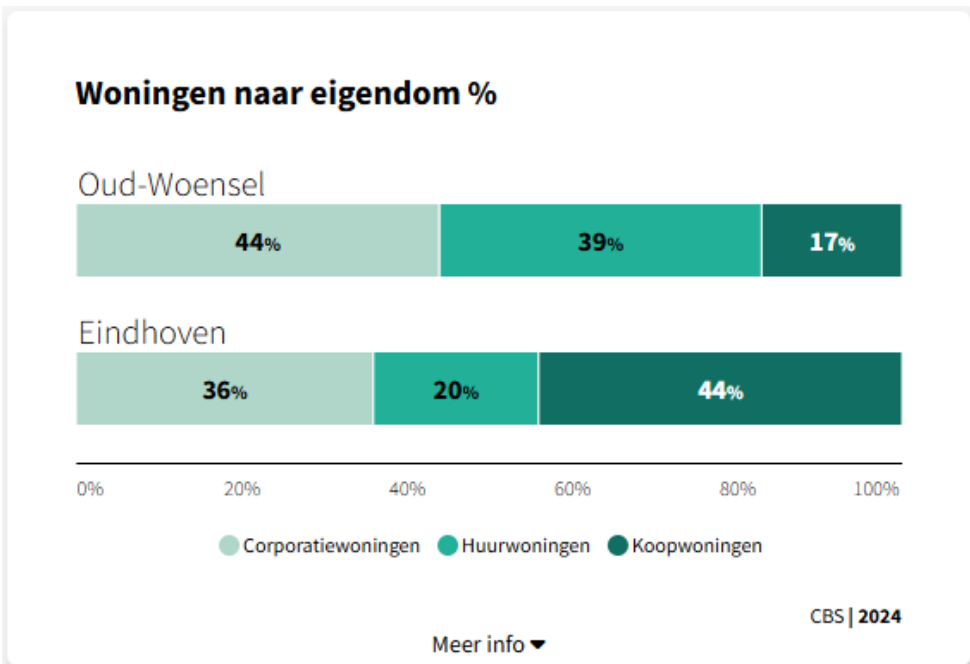
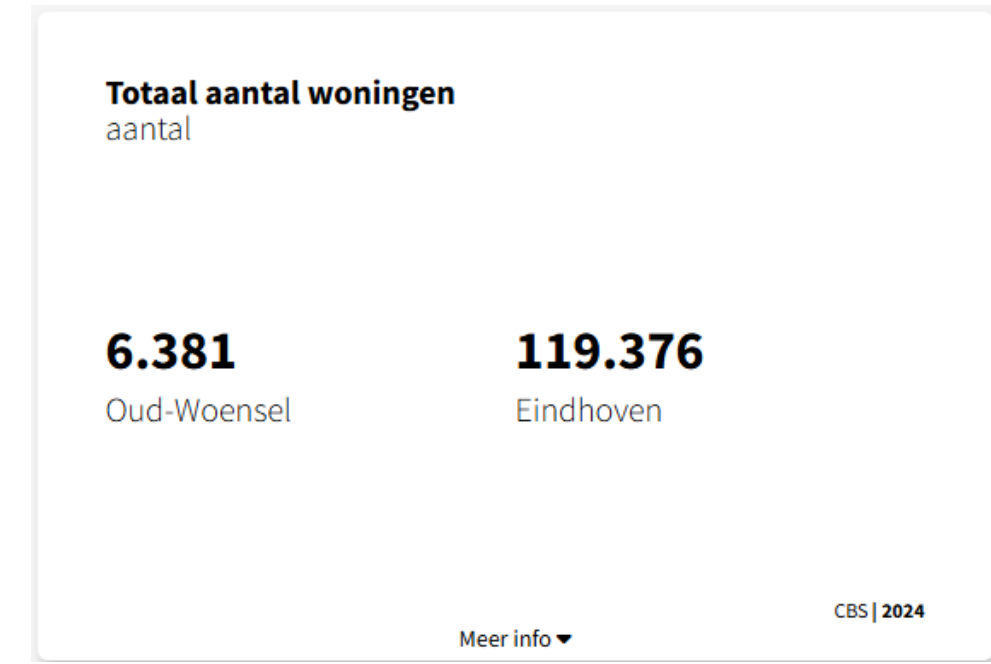




“Ook verwachten we dat er meer mensen naar Eindhoven komen met steeds meer diverse achtergronden.”



ONDERZOEK 040 WONINGEN



1 Netherlands

2 Central and East Europe

Austria, the Czech Republic, Germany, Hungary, Liechtenstein, Lithuania, Poland, Slovakia, Slovenia and Switzerland.

3 South Asia

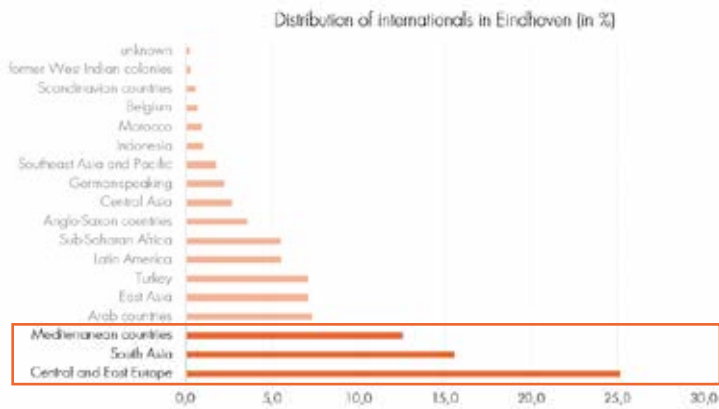
Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, and Sri Lanka, with Afghanistan also often included.

4 Mediterranean Countries

Southern European Coast:
Spain, Gibraltar (British Overseas Territory), France, Monaco, Italy, Malta, Slovenia, Croatia, Bosnia and Herzegovina, Montenegro, Albania, Greece, Turkey (East Thrace)

Western Asian Coast:
Turkey (Anatolia), Cyprus, Akrotiri and Dhekelia (British Overseas Territory), Syria, Lebanon, Israel, Palestine (Gaza Strip)

Northern African Coast:
Egypt, Libya, Tunisia, Algeria, Morocco

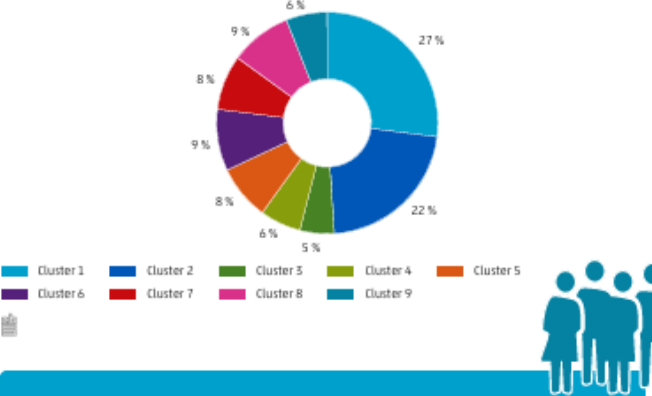


De Mensen van Eindhoven, 2023 (CBS)

De mensen van Eindhoven

- De volgende clusters zijn ontstaan omdat de mensen binnen die groepen veel op elkaar lijken, maar de verschillen tussen die groepen juist groot zijn:
 - Cluster 1 - 'Werkend, hbo- of wo-geschoold en koopwoning'
 - Cluster 2 - 'Jong, werkend en huurwoning'
 - Cluster 3 - 'Jong, studierend en thuiswonend'
 - Cluster 4 - 'Zelfstandigen'
 - Cluster 5 - 'Uitkering, huurwoning en alleenstaand'
 - Cluster 6 - 'Afhankelijk van partner/uitkering'
 - Cluster 7 - 'Gepensioneerd en corporatiewoning'
 - Cluster 8 - 'Gepensioneerd en koopwoning'
 - Cluster 9 - 'Jong, studierend en uitwonend'

De verdeling van de clusters, als percentage van de populatie in Eindhoven, 2023

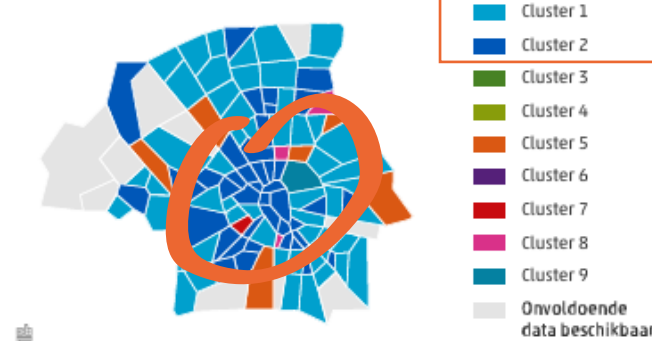


27% van de Eindhovenaren valt te scharen onder cluster 1.

De mensen op de kaart

- De mensen van Eindhoven zijn onder te verdelen in 9 negen verschillende clusters. Maar waar wonen deze mensen? Zijn de buurten en wijken van Eindhoven divers?
- Op de kaart zien we dat de grootste clusters het meeste voorkomen. We zien echter ook dat in sommige buurten mensen uit cluster 5 - 'Uitkering, huurwoning en alleenstaand' het vaakst voorkomen.

Meest voorkomende cluster in een buurt in Eindhoven, 2023



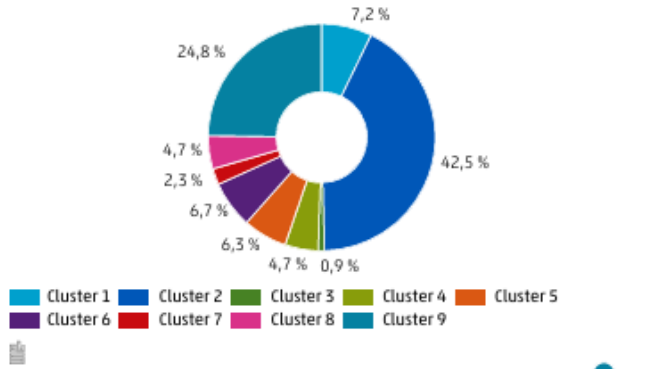
105 000 mensen vallen binnen cluster 1 of 2. Bijna 50 procent!

Alle onderzoeken van het CBS / Urban Data Center Eindhoven zijn te vinden op: www.cbs.nl/eindhoven en onderzoek.eindhoven.nl

Bewoners van de binnenstad

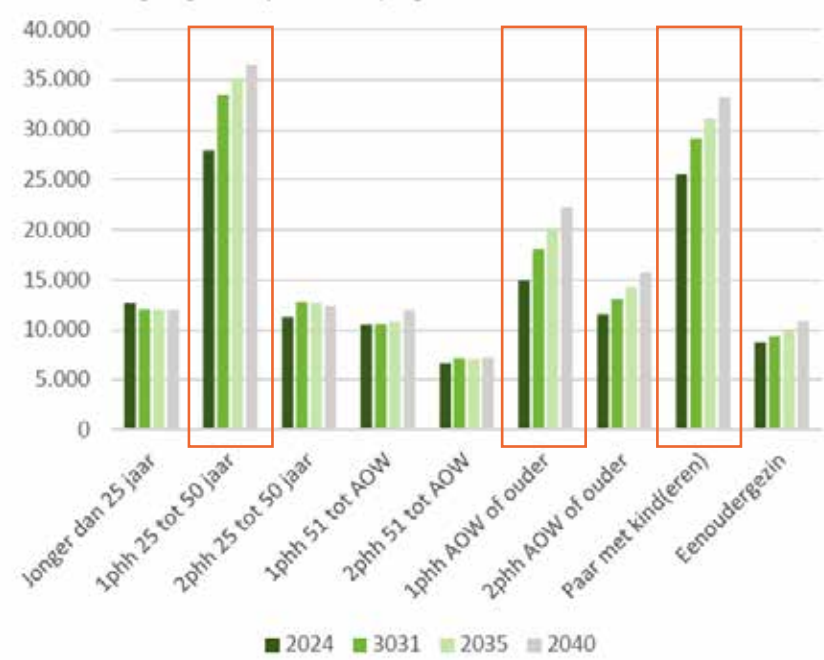
- Bij het inzoomen op de binnenstad blijkt dat hier vooral jonge Eindhovenaren wonen. Vooral cluster 2 - 'Jong, werkend en huurwoning' en cluster 9 - 'Jong, studierend en uitwonend' zijn in deze buurt vertegenwoordigd.
- De verschillende clusters zijn ook anders verdeeld over de wijken. Zo wonen mensen uit cluster 1, 3, 6 en 8 het vaakst in de wijken Achtse Molen of Aanshot. Mensen uit cluster 2 en 9 wonen daarentegen vaak 'binnen de ring'.

De verdeling van de clusters in Binnenstad, 2023



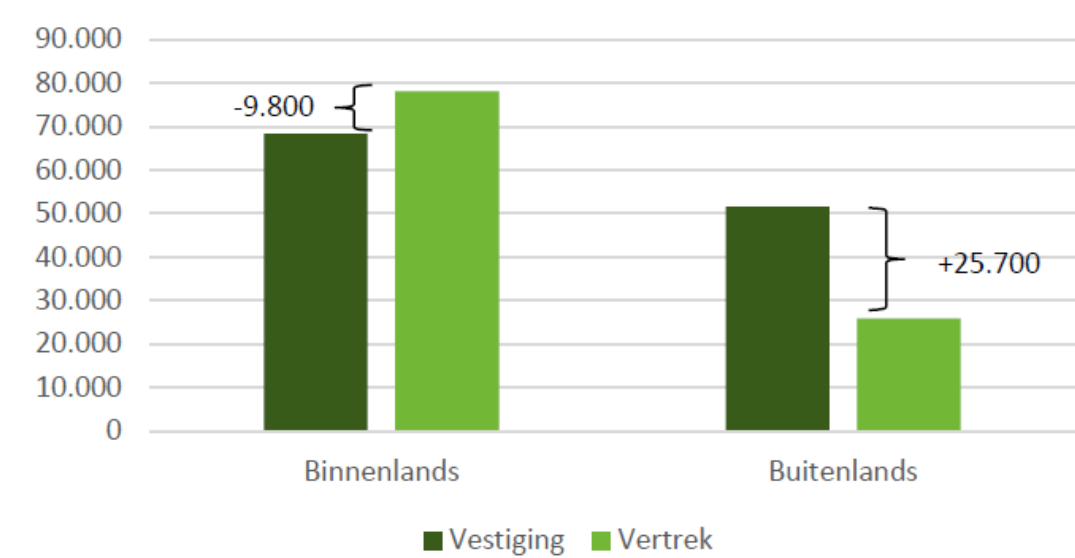
43% van de bewoners van de binnenstad behoren tot het cluster 'jong, studierend en uitwonend'

Figuur 4.1: Gemeente Eindhoven. Huishoudensontwikkeling naar leeftijd en samenstelling volgens de provinciale prognose, 2024 - 2040



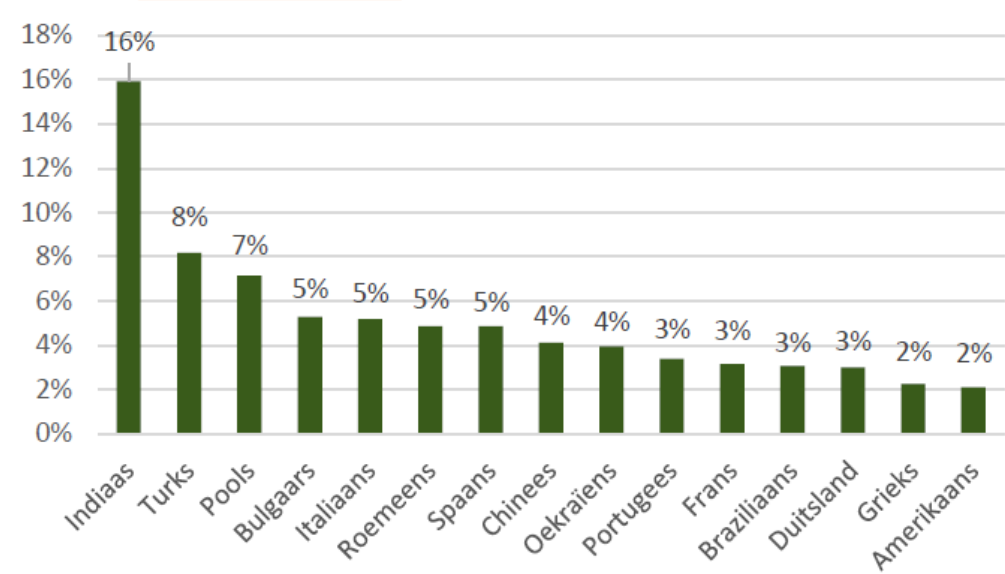
Bron: Provincie Noord-Brabant.

Figuur 3.8: Gemeente Eindhoven. Binnenlands en buitenlands migratiesaldo 2017 - 2022



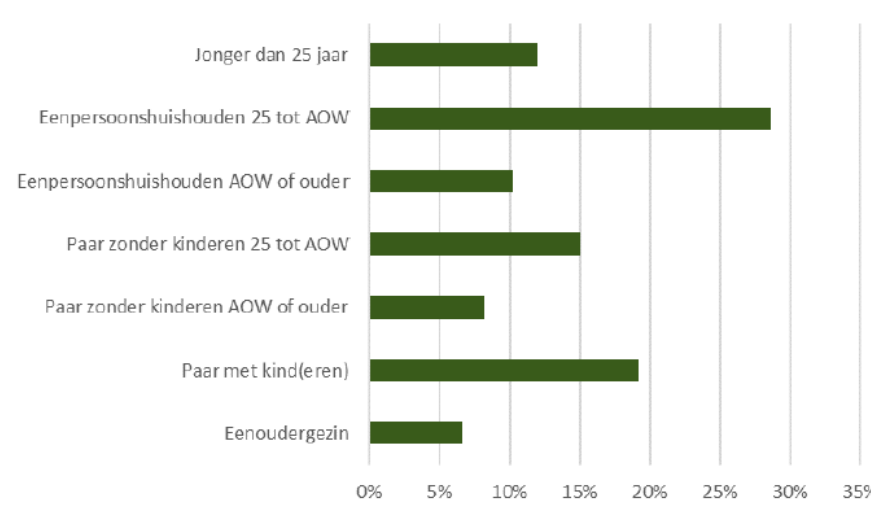
Bron: CBS.

Figuur 3.9: Gemeente Eindhoven. Nationaliteiten van driekwart van de buitenlandse vestigers, 2017 - 2022



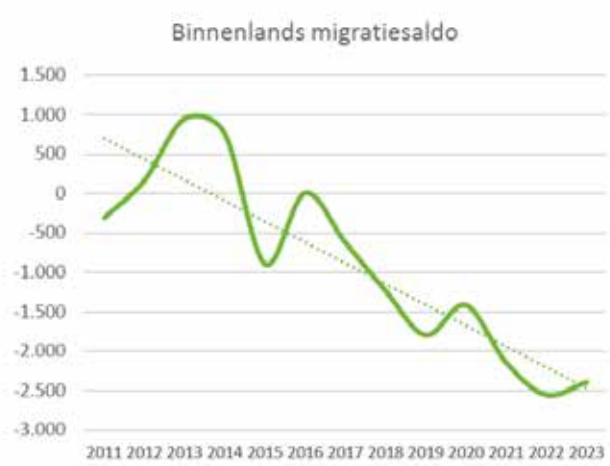
Bron: CBS.

Figuur 3.1: Gemeente Eindhoven. Huishoudens naar leeftijd en samenstelling, 2023



Bron: CBS.

Figuur 3.6: Gemeente Eindhoven. Ontwikkeling binnenlands migratiesaldo, 2010 - 2023



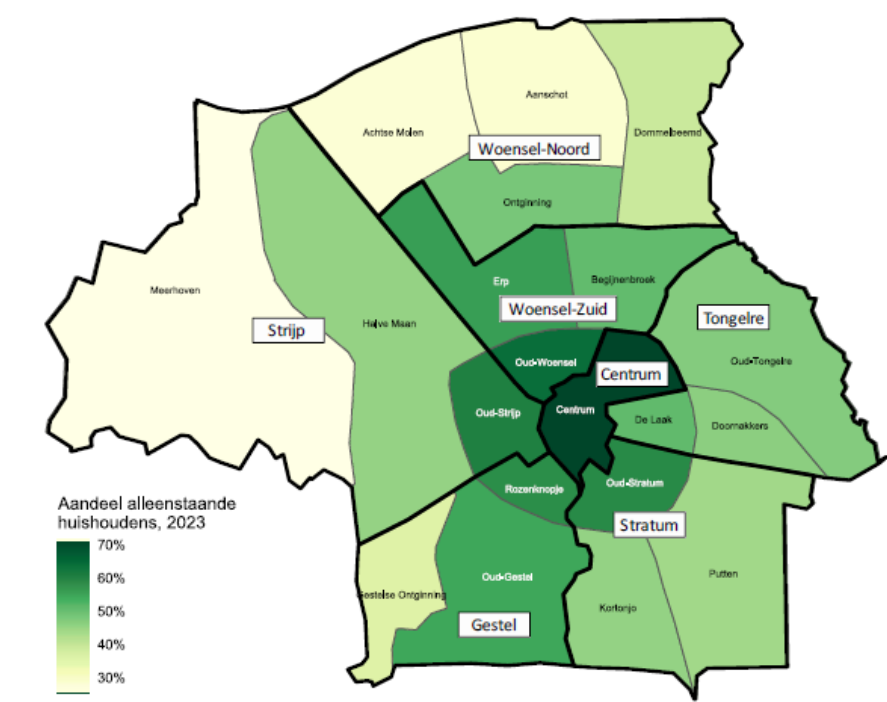
Bron: CBS.

Figuur 3.7: Gemeente Eindhoven. Ontwikkeling buitenlands migratiesaldo, 2010 - 2023



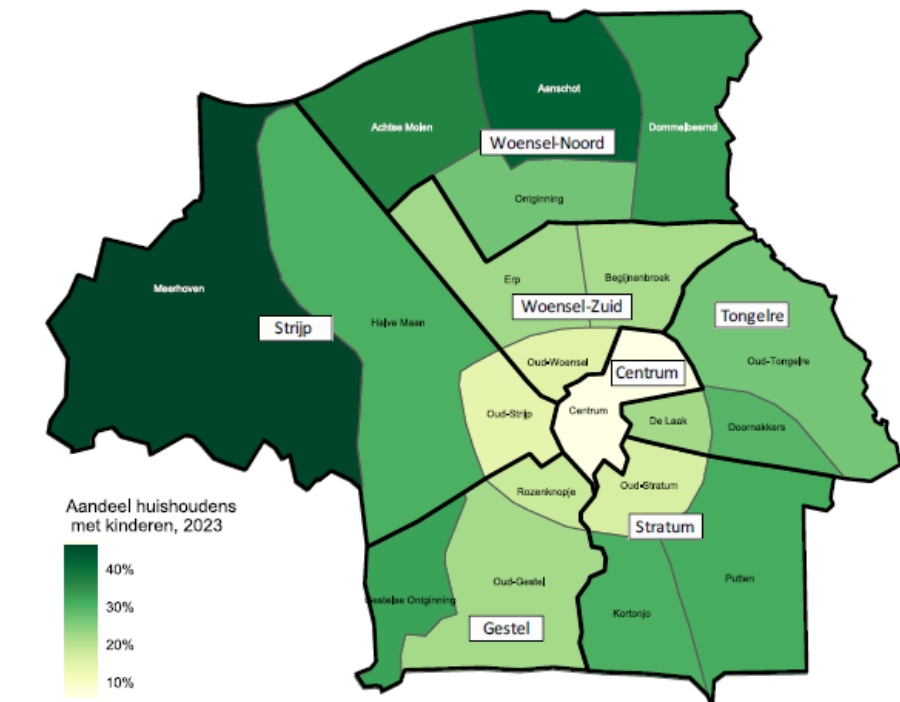
Bron: CBS.

Figuur 3.2: Gemeente Eindhoven. Aandeel alleenstaande huishoudens naar wijk en stadsdeel, 2023



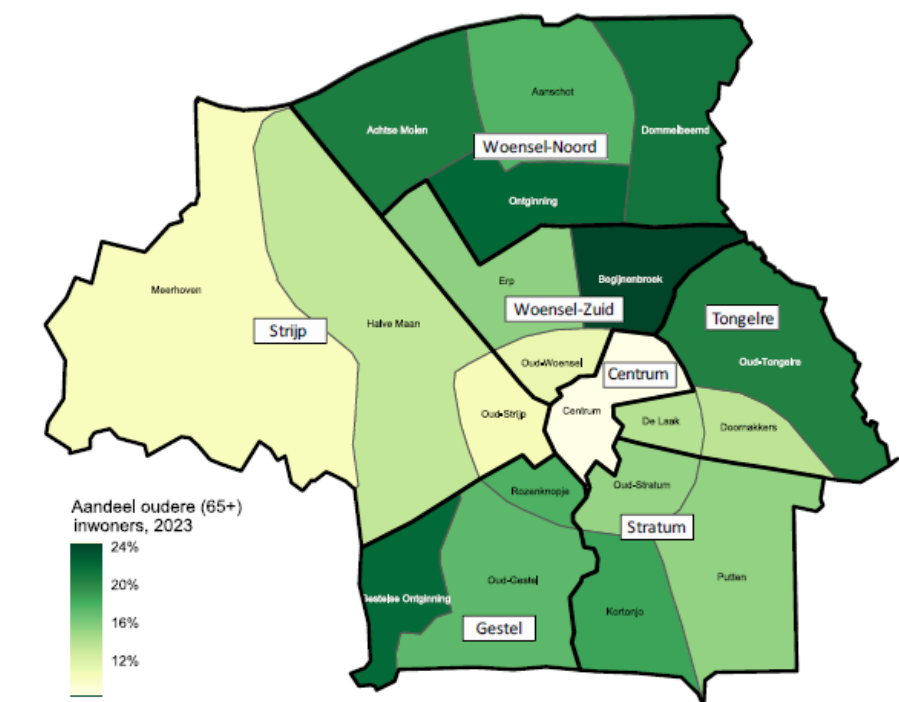
Bron: CBS.

Figuur 3.3: Gemeente Eindhoven. Aandeel huishoudens met kinderen naar wijk en stadsdeel, 2023



Bron: CBS.

Figuur 3.4: Gemeente Eindhoven. Aandeel oudere inwoners (65+) naar wijk en stadsdeel, 2023



Bron: CBS.

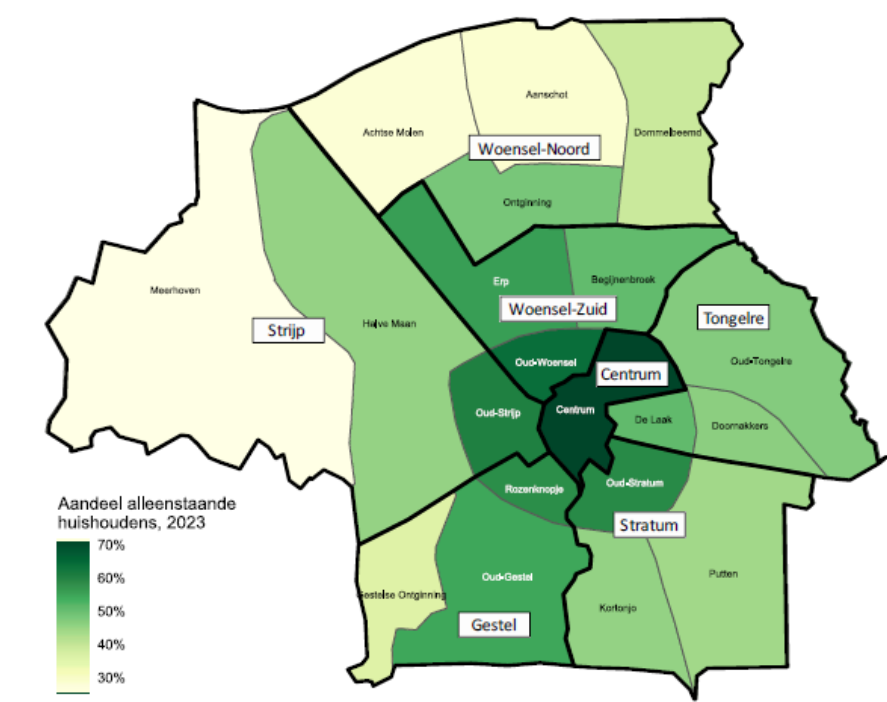
Tabel 3.5: Gemeente Eindhoven. Kleine huishoudens in grote woningen naar huishoudensgrootte en woonoppervlak, 2024

Huishoudensgrootte	75 tot 100 m ²	100 tot 150 m ²	150 tot 200 m ²	250 tot 500 m ²	500 tot 1.000 m ²	Totaal
Alleenstaand	17%	15%	3%	0%	0%	35%
Tweepersoons		19%	7%	1%	0%	26%
Totaal	17%	33%	9%	1%	0%	61%

Bron: WOZ-registratie en BRP, gemeente Eindhoven.

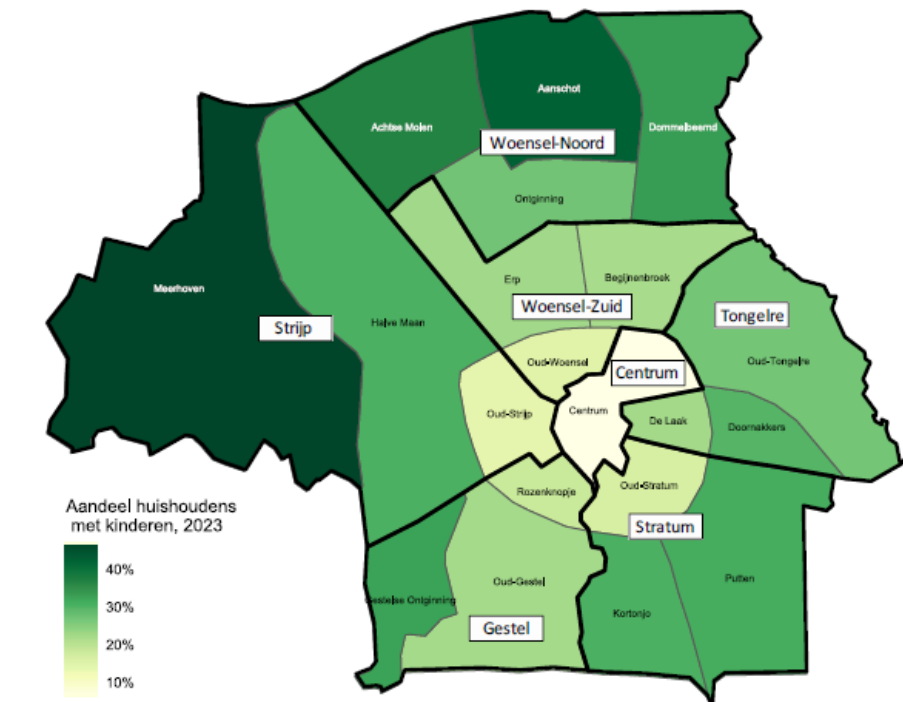
In 61% van deze gevallen is sprake van ‘groot wonen’ volgens bovenstaande definitie. In dit deel van de voorraad wonen alleenstaanden in een woning van minstens 75 m² en paren in een woning van minstens 100 m². Ruim een derde (35%) van de woningen van kleine huishoudens wordt bewoond door alleenstaanden die ‘groot wonen’. Ruim een kwart (26%) van de woningen van kleine

Figuur 3.2: Gemeente Eindhoven. Aandeel alleenstaande huishoudens naar wijk en stadsdeel, 2023



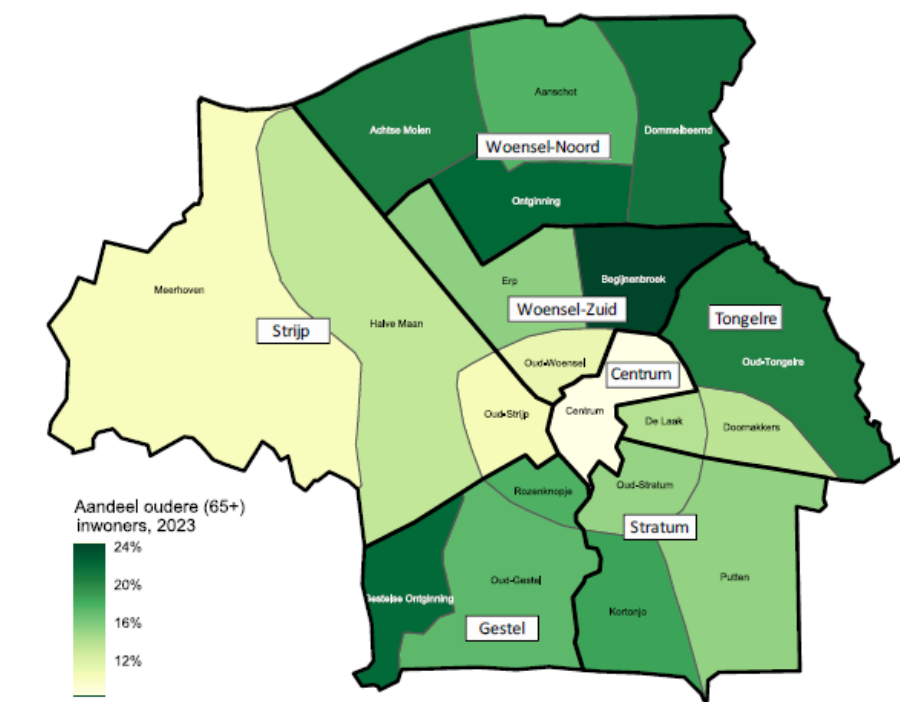
Bron: CBS.

Figuur 3.3: Gemeente Eindhoven. Aandeel huishoudens met kinderen naar wijk en stadsdeel, 2023



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1 MOST PROMINENT HOUSEHOLD TYPES

2025

49,6% Single-person households
25,7% Households with children
24,7% Households without children

2040

49,9% Single-person households
26,5% Households with children
23,6% Households without children

2x Single-Person Households
1x Household with children
1x Household without children



2 MOST PROMINENT NATIONALITIES

ONDERZOEK 040

	2023	2025
Netherlands	57,0%	54,2%
Europe (excl. NL)	14,1%	14,8%
Outside Europe	28,9%	31,0%

43% increase in Outside Europe

CBS - 2023 (internationals)

Central and East Europe	10,75%	25%
South Asia	6,88%	16%
Mediterranean Countries	5,59%	13%

2 MOST PROMINENT NATIONALITIES

Netherlands, Central and East Europe,
South Asia and Mediterranean Countries



3 DIFFERING SPATIAL PREFERENCES

NETHERLANDS

Characteristics:

CENTRAL AND EAST EUROPE

Postwar mass housing, small-unit efficiency, storage/threshold culture (utility room/shoe habits vary), household downsizing after migration

SOUTH ASIA

Multi-generational households, strong cooking intensity (spices/frying), prayer/ritual, guest hosting, and (in some contexts) gendered privacy gradients + courtyard logic.

MEDITERRANEAN COUNTRIES

Strong indoor-outdoor gradient (balconies/loggias/patios), extended family visits, seasonal living patterns, food-centered hosting.

3 DIFFERING SPATIAL PREFERENCES

Netherlands, Poland, India, Turkey



4 DIFFERING EXPECTED RESIDENCE TIME

PERMANENT STAY

Family
Migrant Worker
Knowledge Worker
Retired

TEMPORARY STAY

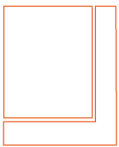
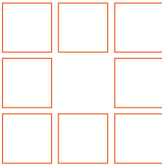
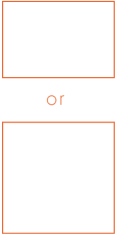
Student
Knowledge Worker
Migrant Worker

4 DIFFERING EXPECTED RESIDENCE TIME

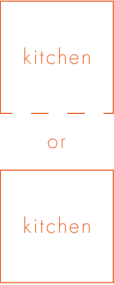
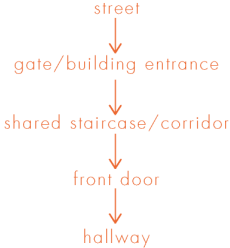
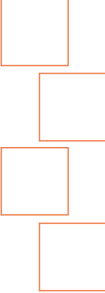
Permanent stay, 5-10 years, < 5 years



CO-LIVING DESIGN RULES INDIA

ENTRANCE / FRONT DOOR Main doors face east/north for positive energy, when following Vaastu Shastra principles (principles for functional and spiritual balance that guide spatial planning in some Indian regions)		KITCHEN + VENTILATION Often separated into dry and wet areas for food preparation and washing. Possibility to separate from other rooms.	
THRESHOLD Verandas as transition spaces between indoor and outdoor space. Space for social interaction. Carved pillars, railings, and arches. Serve as protective barrier against harsh weather conditions.		BATHROOM Seperate bathroom and toilet	
LIVING ROOM Adjacent to exteriors for enough natural light (applies for entire home). Long cushioned diwan (daybed) and attukattil jhula (swing).		INTERIORS / FACADES? Rich ornamented furniture. Materials like wood, marble, stones. Jaali patterns in walls and windows filters light and breezes. Opens to a courtyard, allowing air into the housing while shielding the interior from view. Play of light and shadow. Jhoola (swing) in outdoors and common spaces. Maintain balance between spaciousness and decor. Earthen and terracota shades. Terracota tiles. Brass as prominent material for lamps and accesories	
DINING ROOM Dining area near kitchen, typically centers around a low table or rug.		OUTDOOR SPACE USE Courtyards serve as heart of the home, providing a communal gathering space for families and hosting activities. Also allowing natural light, ventilation and rainwater harvesting. Also the site of traditional rituals and celebrations. Jharoka (skylight): small overhanging balcony.	
BEDROOM		SHARED SPACE COMFORT Strong community and neighborly bonds. Warm and welcoming culture, hospitality. Terraces used for social gatherings, drying clothes or small gardens.	

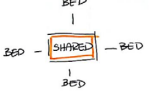
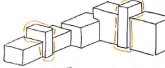
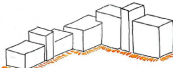
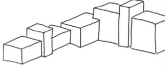
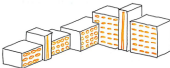
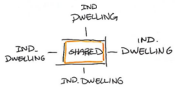
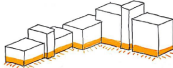
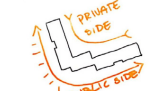
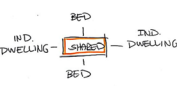
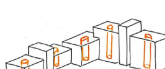
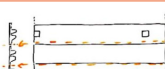
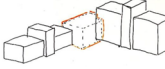
CO-LIVING DESIGN RULES POLAND

ENTRANCE / FRONT DOOR Entry hall as central distributor. A hallway with doormat, and guest slippers, no shoes indoors.		KITCHEN + VENTILATION Typical layout has seperate kitchen. Increasing shift toward open-plan living spaces.	
THRESHOLD value privacy, fences and good window coverage (blinds and curtains). Windows are decorative, lined up potted plants. Corridor as key organizing space.		BATHROOM compact, sometimes as prefabricated unit	
LIVING ROOM Living room as central social space. sofas covered with blankets for protection from dirt and damage. Living areas often have a fireplace.		OFFICE / WORK-AT-HOME CULTURE insert	
DINING ROOM Living + dining, multifunctional space		OUTDOOR SPACE USE Balconies used as mini garden, laundry dryer, smoker's corner, and bird feeder. Also often used for extra storage (bikes, sports gear, flower pots, cabinets, unwanted furniture). Balconies and corridors act as intermediate layer between public and private.	
BEDROOM bedrooms in private zones. Separated from the living area		SHARED SPACE COMFORT modern projects introduce shared gardens, playground and community courtyards. Common outdoor spaces foster social interaction. Spatial experience is collective and stacked	

CO-LIVING DESIGN RULES TURKEY

ENTRANCE / FRONT DOOR Generally shoes are not worn inside the house hallway ↑ kitchen	KITCHEN + VENTILATION Seperate kitchen
THRESHOLD Strong multi-layered threshold system. street ↓ gate/building entrance ↓ shared staircase/corridor ↓ front door ↓ hallway bath toilet	BATHROOM Seperate bathroom
LIVING ROOM Traditionally called the ‘sofa’ which means life among Turkish people. Rooms are arranged around the sofa. A room is a living unit whose shape, size and qualities vary little. Rooms allow multi-purpose and continuous use. Contemporary: ‘salon’ as social space and guest reception area. sofa interiors / facades insert	
DINING ROOM insert dining room kitchen	OUTDOOR SPACE USE Houses generally have open courtyards or gardens. Apartments often include balconies/loggias. Balconies used for daily life, drying laundry and storage.
BEDROOM Accessed via corridor. Clearly seperated from other rooms. corridor bed. bed.	SHARED SPACE COMFORT Social life remains mostly inside the apartment or outside in the city. Outdoor shared spaces like open green areas or informal gathering spaces on estate scale. Staircases and entrances act as informal meeting points and social interfaces, but minimal design emphasis.

Appendix G: Product Development Methodology

Project Phase		RESEARCH			RESEARCH BY DESIGN							ELABORATED DESIGN	
Subquestion		sub-question 1		sub-question 2		sub-question 3			sub-question 4		sub-question 5		
Design Aspects		Urban Design Strategies	Reuse Strategies	Co-Living Design Rules	Clusters	Distribution Dwellings and Shared Space	Accessability	Public-Private Distribution	Structural Modifications	Facade Modifications	Levels of Flexibility	Facade Panel Orientation	
Criteria	Level of Interaction	 create new connections	reuse facade elements	privacy gradients	 blocks	 shared cluster dependent	 keep existing structure	 private building	 no modifications	 preserve existing facade	flexible space plan, within dwelling	Horizontal	
	Adaptability												
Criteria	Level of Interaction	 open for the public	reuse structural elements in the same function	layered shared environments	 horizontal alternating	 shared cluster independent	 external staircase	 public plinth	 extend floors	 remove existing facade	flexible space plan between dwellings	Vertical	
	Adaptability												
Criteria	Level of Interaction	 public vs private facades	repurpose structural elements in a new function	closed off, well ventilated kitchens	 horizontal centralized	 shared cluster mixed	 gallery	 public & private blocks	 top up	 reuse/repurpose existing facade	flexible program, enabling future program changes		
	Adaptability												
Criteria	Level of Interaction	 connect groundfloor to roofscape	transform to raw material and create new element	circulation routes that prevent guests from passing private zones	 horizontal 1-2-1	 communal cluster	 internal shafts	 public-private gradient	 cut concrete floor in span direction		flexible wet areas		
	Adaptability												
Criteria	Level of Interaction			acoustic separation	 vertical alternating	 public cluster	 mix	 public roofs	 cut concrete floor perpendicular to span direction				
	Adaptability												
Criteria	Level of Interaction				 vertical centralized				 remove entire building blocks and/or shafts				
	Adaptability												

AXONOMETRY OF THE BUILDING

Eighth Floor
usable area : 789 m2

Seventh Floor
usable area : 789 m2

Sixth Floor
usable area : 789 m2

Fifth Floor
usable area : 789 m2

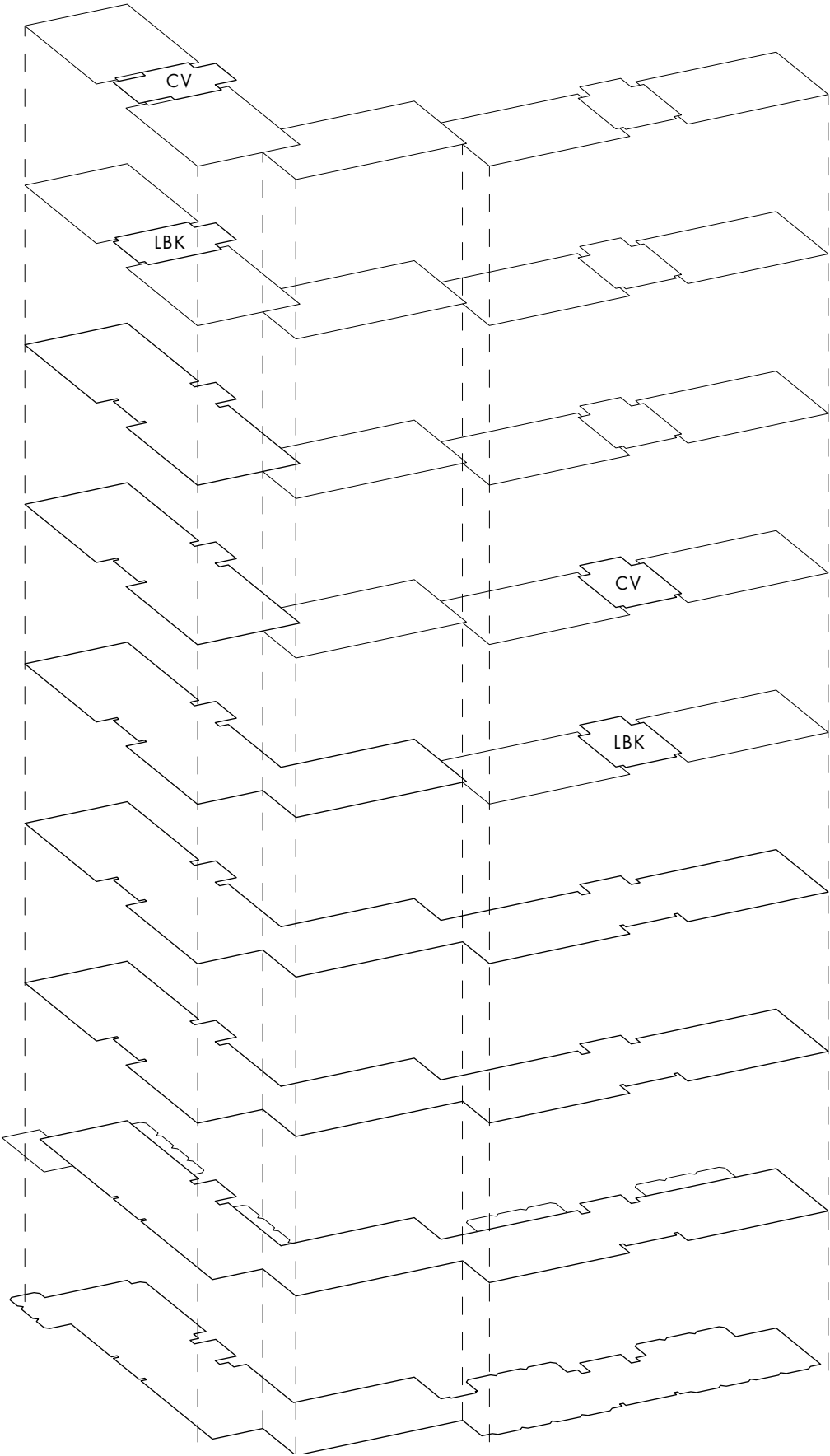
Fourth Floor
usable area : 1.159 m2

Third Floor
usable area : 1.945 m2

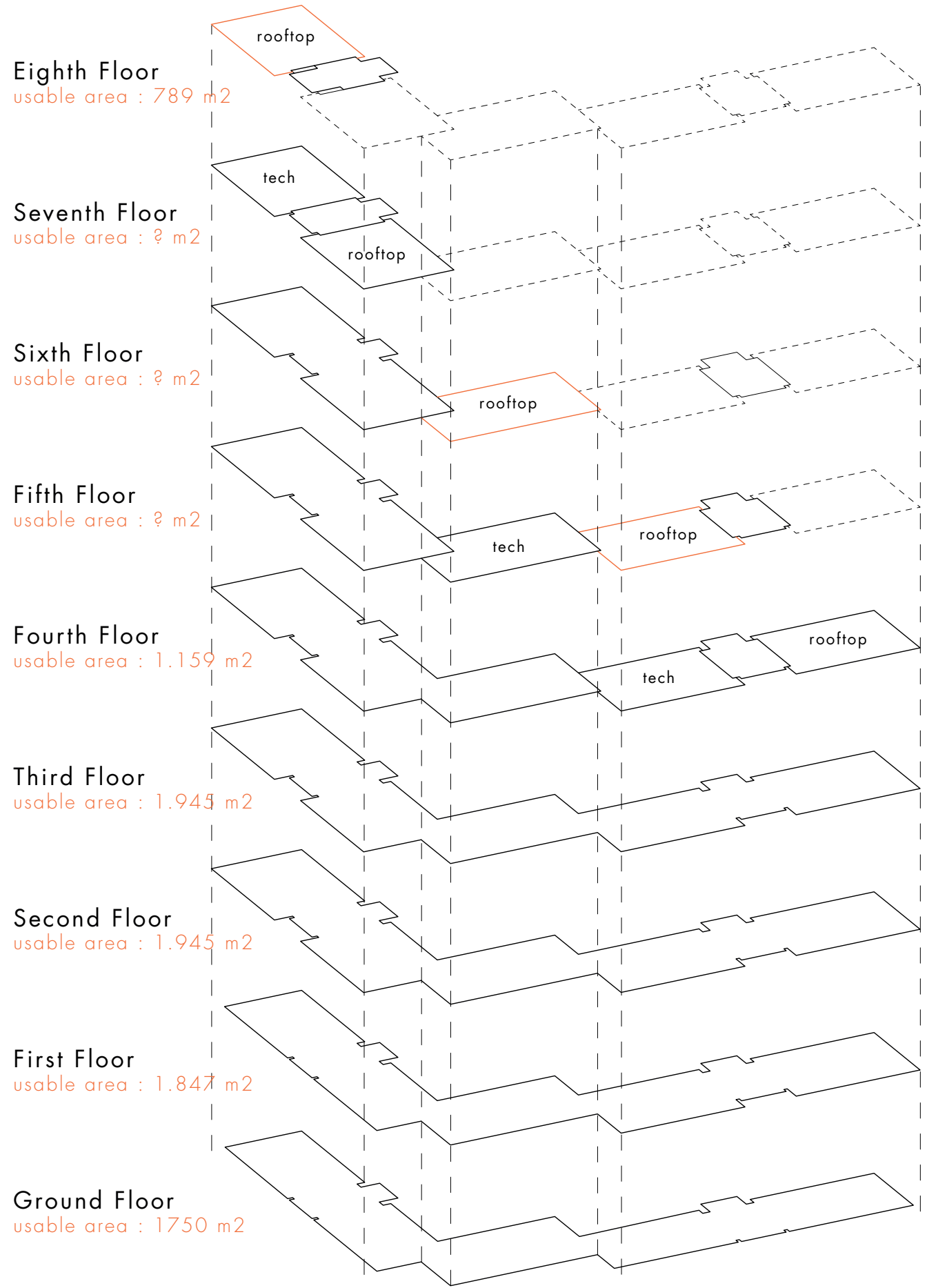
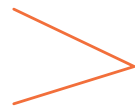
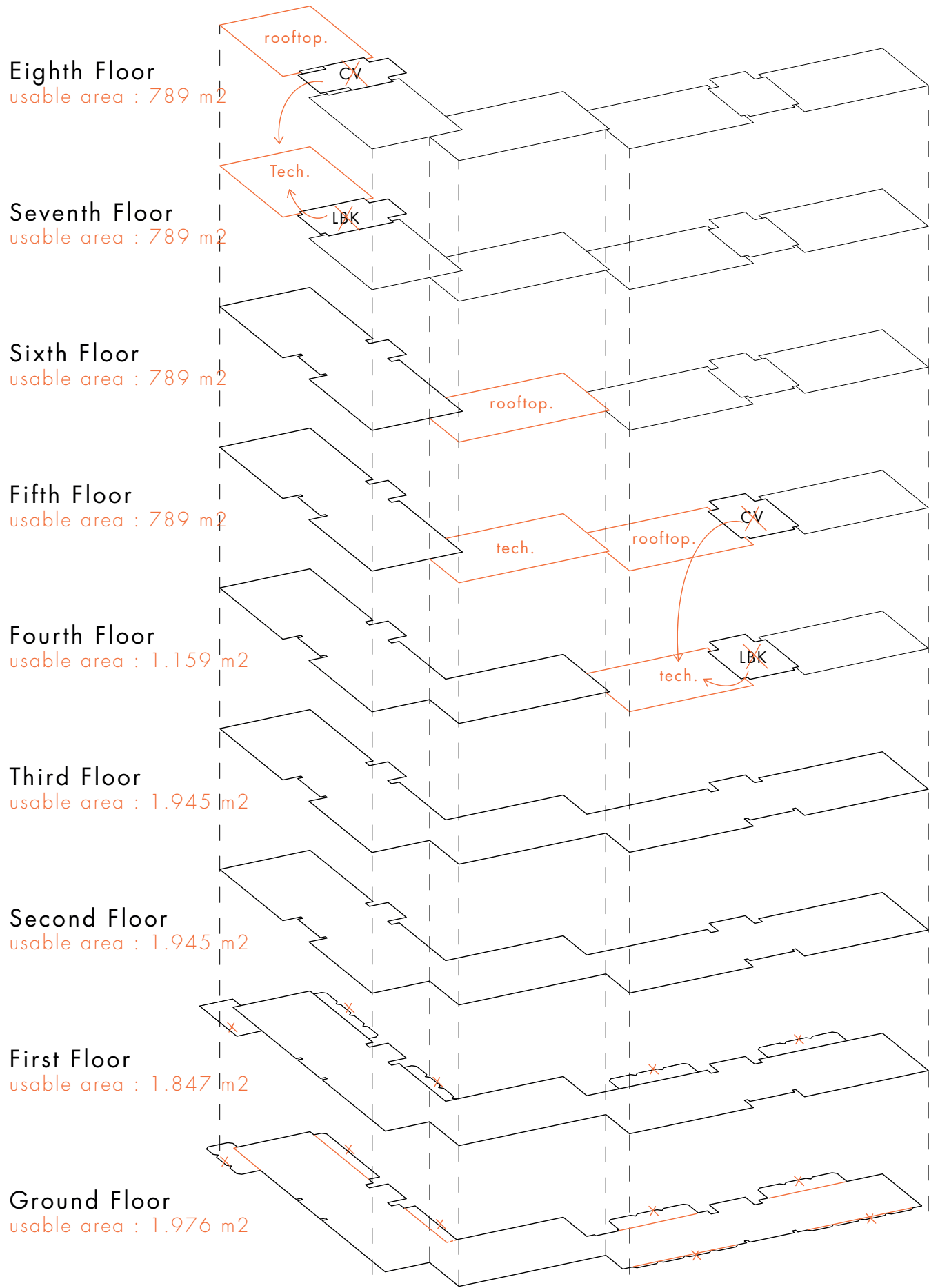
Second Floor
usable area : 1.945 m2

First Floor
usable area : 1.847 m2

Ground Floor
usable area : 1.976 m2



Appendix H: Program Development



Public Program

Ground floor: 1,230 m²
1st floor: 1,282 m²
Total public/semi-public space: 2,512 m²

Entrance/Reception/Mail area

Commercial
Pop up stores
Public Cafe/Restaurant

Workshop & Repair spaces
Makerspace / Bicycle repair / Repair cafe

Co-working/Office
Co-working cafe / study areas

Amneties
Daycare
Sport facilities

Logistics
Bicycle parking
Utilities

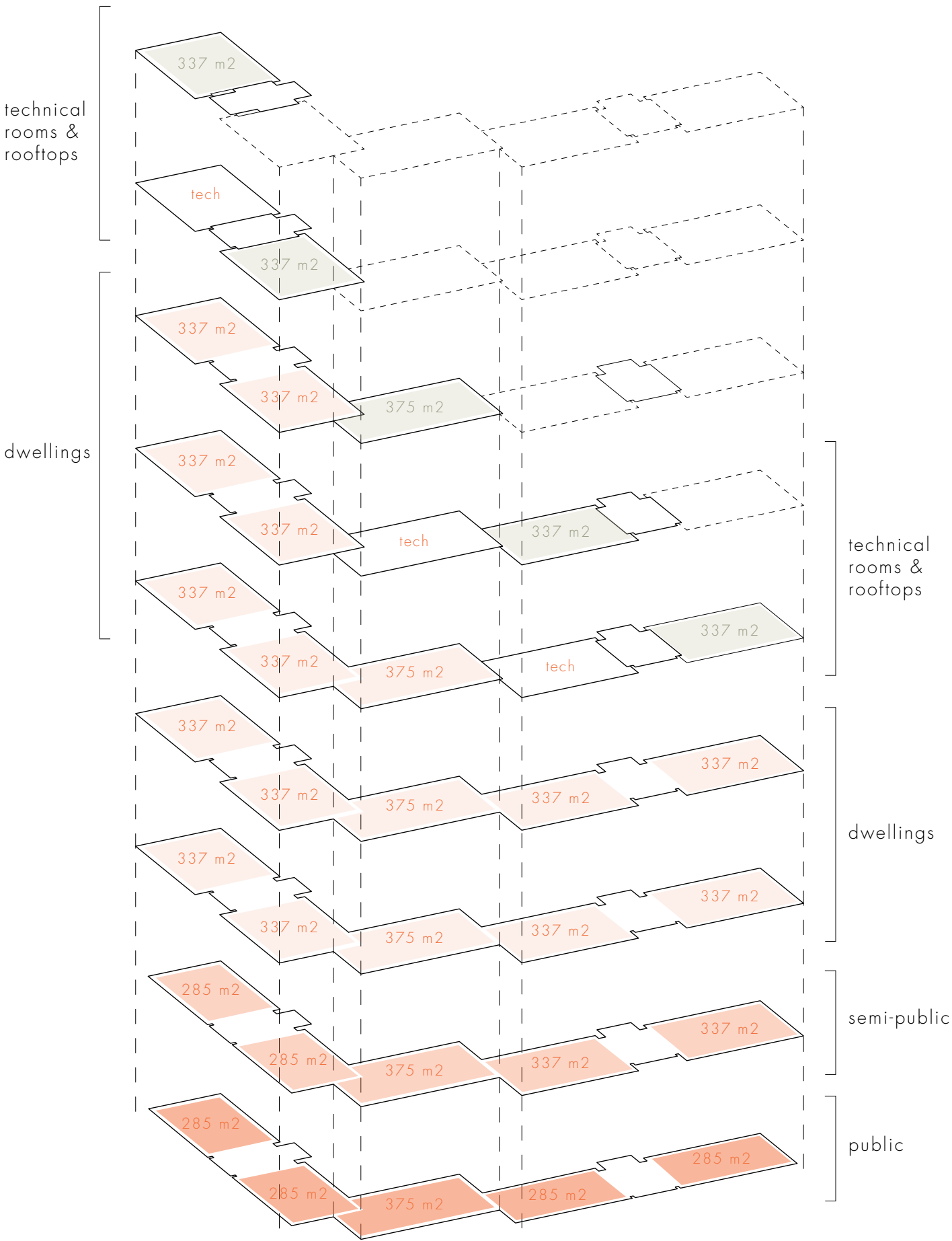
Other
Double-height atrium(s) as a public vertical interaction space

Residential Floors

2nd - 8th floors: 5,200 - 5,500 m²
Residential floors to be built in three cluster types, all with a mixed household composition:
50% single-person households
25% two-person households
25% family homes

Co-Living Starting Points

Conclusion from the Co-Living Design Rules Matrix: Organize “shared by choice,” with clear rules, quiet/social zones, varying levels of privacy, strong ventilation, bookable workspaces, and layered outdoor spaces.



Appendix I1: Co-Living Case Studies - La Borda, Gleis 21, San Riemo

La Borda, Barcelona (2018) - Lacol Arquitectura

La Borda, Barcelona (2018) - Lacol Arquitectura Cooperativa
La Borda is a pioneering example of the cessió d'ús (grant-of-use) housing model in Spain, developed through a resident-led cooperative process. The project accommodates 28 dwelling units organised around a central courtyard, with an architectural strategy that prioritises spatial flexibility and communal spaces over conventional private amenities.

The building's cross-laminated timber structure reflects the cooperative's commitment to ecological sustainability. Programmatically, La Borda redistributes domestic functions: individual units are deliberately compact, while generous shared spaces include a communal kitchen and dining hall, laundry facilities, a guest apartment, and multipurpose rooms. This spatial layout enables a reduction in individual living area without diminishing quality of life, as residents access collective amenities that would be unaffordable in conventional housing. The participatory design process, facilitated by Lacol over several years, established governance structures and spatial relationships simultaneously, making the architecture inseparable from its social framework.

Gleis 21, Vienna (2019) - Einszueins Architektur

Gleis 21 is an example of Vienna's Baugruppen (building group) model, in which future residents collectively commission and design their housing. Located adjacent to the city's new central railway station, the project comprises approximately 30 units organised around shared facilities including a rooftop terrace, community room, and workshop spaces.

The participatory process extended beyond programming to include construction-phase involvement, fostering a sense of collective ownership. Architecturally, Gleis 21 employs a flexible structural grid that accommodates diverse unit configurations, from single-person studios to multi-generational households. The project's urban strategy integrates ground-floor commercial and communal uses, activating the building's relationship with the surrounding neighbourhood.

San Riemo, Munich (2020)

San Riemo represents an experimental approach to co-living within the Kooperative Großstadt framework, a Munich-based housing cooperative. The project houses approximately 100 residents across varied unit typologies, including conventional apartments, cluster configurations, and a residential community for individuals with disabilities.

The architectural strategy emphasises spatial indeterminacy: generous room heights, operable partitions, and an intentional ambiguity between circulation and inhabitation allow residents to appropriate space as their needs evolve. Corridors function as extensions of domestic life rather than mere connective infrastructure. The building's materials, exposed concrete, timber, and coloured surfaces, reinforce a robust, adaptable aesthetic. San Riemò's significance lies in its demonstration that density and collectivity don't have to be at the expense of spatial generosity. The project challenges the typical distinctions between private dwelling and shared territory

These three projects all illustrate how co-living architecture can mediate between individual and collective life through spatial, programmatic, and procedural strategies. Each demonstrates that the design of shared housing is fundamentally a social project, requiring bottom-up approaches and architectural frameworks that remain open to appropriation, negotiation, and transformation over time.



Appendix J: Co-Living Iterations

One of the most crucial insights from the spatial variables analysis was the need for varying degrees of sharing and privacy in the spatial layout and the facade, and the ability to choose when to engage and when to withdraw. This significantly influences how co-living floor plans are designed, as each resident profile has different preferences for sharing spaces. Therefore, layered shared environments are developed, with a clear distinction between social, quiet, and hosting spaces. This approach was translated into three different clusters of dwelling and shared space configurations, to develop co-living floorplan iterations:

Cluster A: High level of interaction, with dependent dwellings and 35-40% shared space

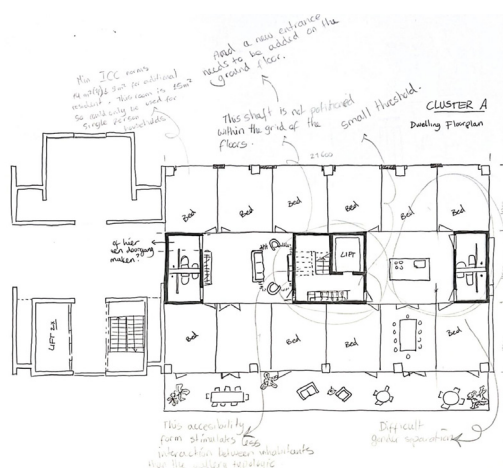
Cluster B: Moderate interaction, with hybrid independent/
dependent dwellings and 25-30% shared space

Cluster C: Some interaction, with independent dwellings and 20-25% shared space

The first iteration, A1, was inspired by the San Riemo project, introduced in paragraph 2.2.3 (Divisare, n.d.; Appendix I). This study revealed several challenges: the bedrooms do not meet ICC standards for two persons, the threshold area is small, the accessibility typology does not stimulate much interaction, the privacy gradient is weak, and the central core does not share the same grid as the floor elements, requiring significant structural interventions.

Iteration A2 shows an abstract ground-floor plan, using the existing shaft as the main entrance to the dwellings. Residents can access their floor via either stairs or the lift. Iterations A3 and A4 are based on prototype C (paragraph 3.2). This access typology promotes interaction by placing circulation externally, creating visual and physical connections between residents and the surroundings. It also functions as a transitional and outdoor space and aligns well with the existing cantilever structure, making it structurally feasible.

A1



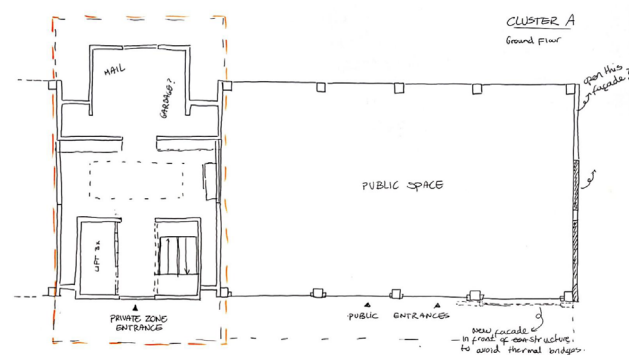
However, accessing these galleries requires additional floors to be attached to the existing cast-in-place shaft (shown in A3). Iteration A3 shows a mix of household types on one floor, aiming to foster interaction among different resident groups. A4 follows a more systematic approach, using a grid of 6 equal rooms, each 3.6 meters wide. This dimension supports efficient interior layouts and allows flexibility for future changes to the program, household composition, or user groups.

During the climate expert meeting, the gallery was approached as a potential buffer zone. However, daylight requirements, particularly for bedrooms, became the main constraint. When bedrooms are placed next to galleries, the cantilever depth cannot exceed 1.5 metres. This led to further exploration of the facade's placement. The development of Cluster B was more challenging than expected, so I shifted my focus to Cluster C, with the intention of later combining insights from Clusters A and C.

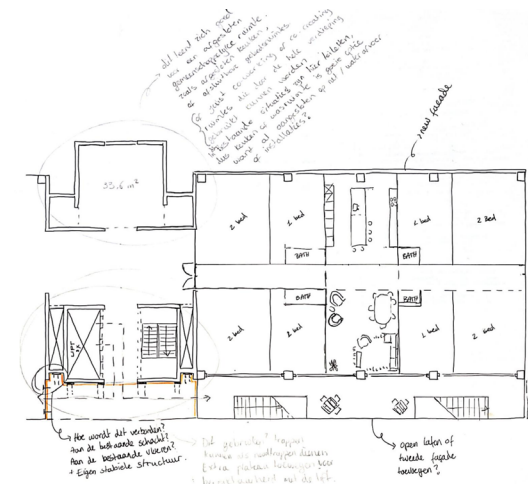
For cluster C, several iterations were tested, primarily comparing single-level and duplex dwellings. For duplex dwellings, the main challenge lies in the structural interventions required to create openings for staircases. Iterations C1-C3, explore different duplex dwelling layouts. C4 and C5 show single-level iterations. Among these, C4 shows strong potential, as it creates different layers of privacy, supports interaction, introduces semi-private spaces that act as social hotspots within the plan, and opens up opportunities for passive climate design.

Based on all these iterations, A4 and C4 are found to be the most promising. By combining the spatial qualities that emerge from C4 with the systemic approach of A4 to introduce a certain level of adaptability into the design, the final floor plans will be developed.

A2



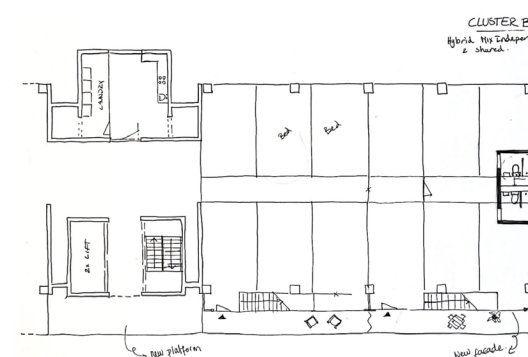
A3



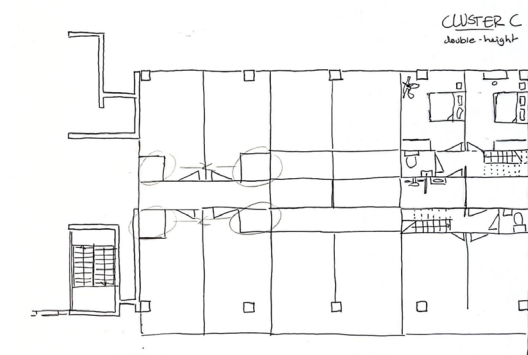
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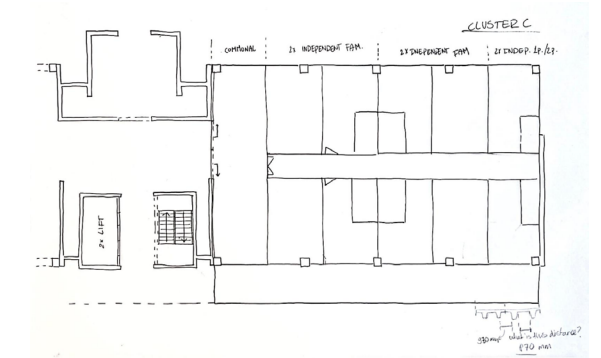
B1



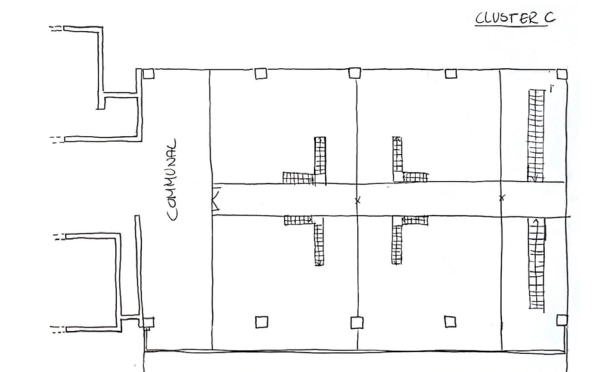
C1



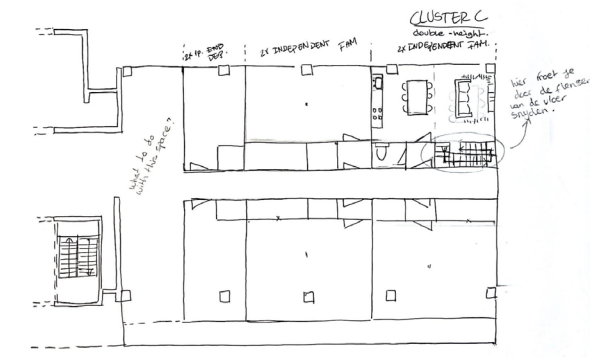
C2



C3



C4



C5

