The nurturing city

Graduation project

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The Nurturing City

Between standards and ideals: The future of housing in The Netherlands
2019–2020

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Table of contents

Topic research

Increasing ground prices are displacing the middle class families from Amsterdam. The available housing is either too expensive or simply unfit for families. They are therefore forced by the circumstances to move to the suburbs, away from their job, family and friends in the city. In the process, the city loses valuable middle class workers and the social cohesion that families ensure. This problem affects especially those families more in need of affordable housing and the support of their social circle: single parent families. Single parenthood has become widespread in the last decades; nowadays in Amsterdam one in four children (25,6%) live in a single parent household.

We need solutions to this lack of affordable urban housing that is suitable for families. Here we will explore one alternative form of housing that has the potential to meet that challenge: co-housing. The key in this kind of housing is the externalization of those functions that don't necessarily need to take place in the private realm. In that way, co-housing provides with private units that share common spaces, usually a large kitchen and dining room, as well as playing spaces for children. This, we will argue, brings down the housing costs and suits the needs of the urban middle class families, including single parents.

This chapter is divided into three parts. We first explore the problems that urban families face. What are the current trends at work that are displacing the urban middle families? What are the housing preferences of urban families? In the second part we introduce the concept of co-housing, explaining its characteristics and its raising

popularity. We finally conclude with the formulation of the design question, to be further answered in the form of a residential build-ing.

Urban families

The city is the ideal habitat for young households that want to build up their career and keep an active social life. It offers them an array of cultural services and like-minded people. Unlike previous generations, these young households don't want to move to the suburbs when starting a family. They prefer to stay in the city. This group forms what can be called the urban family (Hoekveld & de Jong, 2017).

Urban are usually formed by parents that have grown up in the city or have studied there. Geographer Lia Karsten (2014) explains this phenomenon as the result of the YUPs, the Young Urban Profession-als, moving into their next stage in life and forming a family—be-coming YUPP (Young Urban Professional Parents). They are used to the city, to its social and cultural life, and do not wish to leave it for a life in the suburbs. They might as well be single parents and need the proximity of their friends and relatives for the difficult task of bringing up a child alone (Keesom, 2013).

We might summarise the reasons why families decide to stay in the city into three categories (Boterman & Karsten, 2015). Firstly, shorter traveling times. Families with an urban preference value the fact that they can easily move between work, school and home. Because both parents usually work, living near their workplace is seen as essential. Ideally, at least one of the parents' work has to be at a bicycle-distance. Proximity to urban facilities services such as cafés and parks also rank high. Secondly, urban families value living near their friends and family. They have usually grown up or studied in the city, and would like to keep an active social life. And lastly, urban life gives them a sense of identity. The suburbs are seen by them as bland and unexciting. They identify with the diversity and multicul-turalism found in the city.

For these reasons, we have seen how in the last twenty years the percentage of families living in Amsterdam has raised. If the share

of families with children (and with both parents) was 14,8% in 1996, by 2019 it had raised to 15,9% (Boterman & Karsten, 2015; Gemeente Amsterdam, 2019). If we include single parents, one in four house-holds in Amsterdam is a family (Hoekveld & de Jong, 2017). And yet the city remains very unaccessible to families.

Lack of affordable housing for the urban middle class family
Despite the growth in the number of families, Amsterdam remains the municipality with the lowest percentage of families—the na-tional average is 33% (Hoekveld & de Jong, 2017). Moreover, Amster-dam has the highest migration rate among families. On a national scale, 14% of the families that got their first child in 2012 moved out of town within the next four years (see figure 1). In Amsterdam, the percentage of young families migrating within their first four years raises to forty percent (40%) (CBS, 2018).

The reason has been widely recognized: it is extremely difficult for these young families to find affordable housing. The most affected group are the middle income families (Moorman, 2016). Low income families have access to social housing. But the middle classes, usu-ally defined as earning too much for social rent (above 35.000 euro) but less than around 55.000 (Couzy, 2019b), don't have much room for manoeuvre. They cannot apply for social rental, but cannot afford the expensive free market prices either.

1.10 Verhuizingen naar andere gemeente na geboorte eerste kind

Vertrokken voor eind 2016 uit

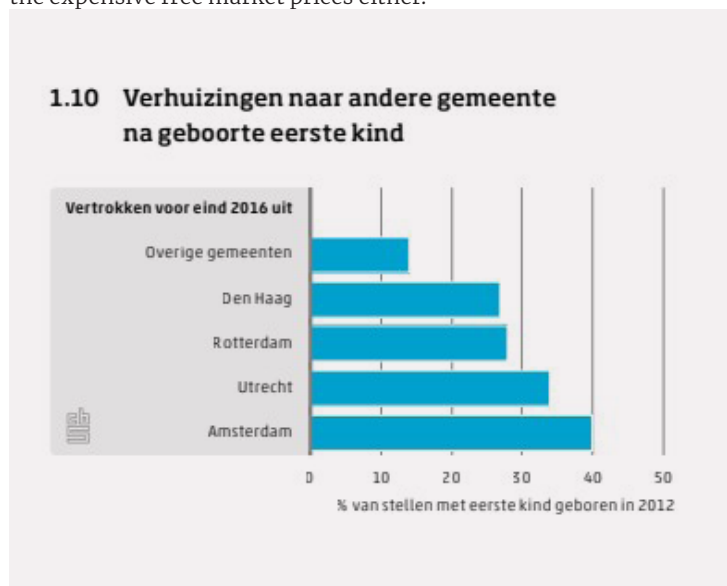|	
Overige gemeenten	
Den Haag	
Rotterdam	
Utrecht	
Amsterdam	

% van stellen met eerste kind geboren in 2012

Figure 1. Moving out to another municipality after the birth of the first child (CBS, 2018)

As the middle class is displaced, the city is becoming economically polarized. Data from the CBS reflect this situation. In figure 2 we see low and middle-class families decreasing both in absolute and relative terms in Amsterdam. At the same time, the share of high income families is increasing. If in 2007 41% of the families had high-incomes, ten years later the percentage raised to 51% (Gemeente Amsterdam, 2019). Since the relative number of low income households remains more or less stable, as they enjoy access to social housing, we can conclude that the urban middle class family is diminishing from the city (Moorman, 2016).

Living in the city becomes a thing for a select group of families, for the rich and those applicable for social rent. The rest leave the city more or less forced by the circumstances. Yet the city cannot dispose of the middle classes. It needs them for the work they perform and the social cohesion they ensure.

Why is this a problem?
On the economic side, by losing the middle class, the city loses valuable workers. As Couzy notes (2019), Amsterdam has already a shortage of personnel in the education, healthcare and catering

Figure 2. Number of families by income in Amsterdam (Gemeente Amsterdam, 2019)

Figuur 5 Gezinnen in Amsterdam, oudste kind < 12 jaar, naar inkomen, 2007-2019
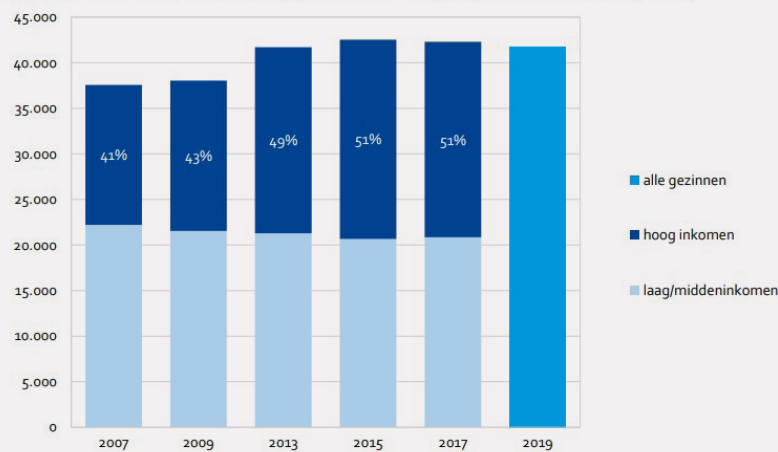
Hoog inkomen: 4^e inkomenskwartiel; laag/midden inkomen: 1^e-3^e inkomenskwartiel
Voor 2019 zijn nog geen inkomensgegevens beschikbaar.
bron: CBS/bewerking OIS

industry—jobs usually performed by middle-class workers. As middle class families leave, trained personnel becomes scarcer. Workers leaving the city might not choose to stay working there if they can find work in their new municipality. If they still decide to keep working in Amsterdam, the consequences are longer commuting times and larger traffic jams. Already 55% of the working force in Amsterdam resides outside the city (Couzy, 2019).

Coupled with this, Couzy (2019) points to the problem of an ageing population. While young middle class families leave, the population of those aged 65 and over increases. From a 13% of the population of Amsterdam in 2019, the older generation will reach a 17% in 2040. The results are greater risk of loneliness and more need of healthcare workers—which brings us back to the problem of the lack of personnel.

On the other hand, families contribute greatly to the economy by the sheer cost of bringing up a child. And not only retail profits—schools, sports clubs and other after-school activities also benefit from the presence of children in the city. Families care about the future of the schools, libraries, swimming pools, cinemas. Families are likewise involved in their environment, making sure that it remains safe and congenial. "With children, de city ensures its future", in Keesom's words (2013).

Social cohesion also becomes at risk with the migration of middle class families. Families are by nature great intergenerational links. They bring together the older and the younger generations. They bring different parents together to watch their children play or take them to school or after-school activities. Middle class families specifically form a link between the higher and the lower classes. Without them, the city becomes polarized between disconnected upper lower social strata (Moorman, 2016).

If the presence of families is important to the future of cities, we should put more effort into creating suitable housing for them. Yet for several decades, the construction of family houses in the cities has attracted little attention (Keesom, 2013).

Brief historical account

The lack of interest in urban family houses lays, according to Michel (2013) in Dutch housing history, which has given urban collective housing a bad reputation. Contrary to other European countries, The Netherlands has no tradition in apartments for families. Dutch urban housing has traditionally consisted in row houses, even in the biggest cities. A walk through the European capitals is enough to show this. While Paris or Madrid show centuries of collective housing tradition, Amsterdam has until very recently limited itself to single-family housing.

Some apartments were built during the interbellum period, targeted towards the urban well-to-do and the lower classes (the Amsterdamse School being a notable example). But apartments took root on a significant scale only during the post-war 'reconstruction'. As the country was facing a huge shortage of housing, the focus laid on quantity above quality. Large apartment complexes were built as social housing in a repetitive manner. Private units were carefully standardized and designed as compact as possible. Communal spaces such as the entrances, the galleries and the stairs were strictly functional—bland and unappealing (Michel, 2013).

The novelty of such apartment complexes quickly wore off, and a reaction against their scale and anonymity took over during the 70s and 80s. As the salaries began to rise and the housing shortage was stabilized, families left the apartments in the city for the new suburban neighbourhoods in the outskirts. Soon the apartment complexes gained a bad reputation. Living in one began to be seen as a measure of last resort, especially for families.

Only in the 90s did the apartment gain popularity again. With the liberalization of the construction sector, developers realized that they could make significant profits by targeting high-end apartments to the so called YUPs (Young Urban Professionals). Penthouses, lofts and studios brought status back to the apartment, with communal spaces as representative spaces signaling comfort and character. But these apartments were targeted for one or two-person households, not for children. Families, on the other hand, received their share of new housing as single-family dwellings in the
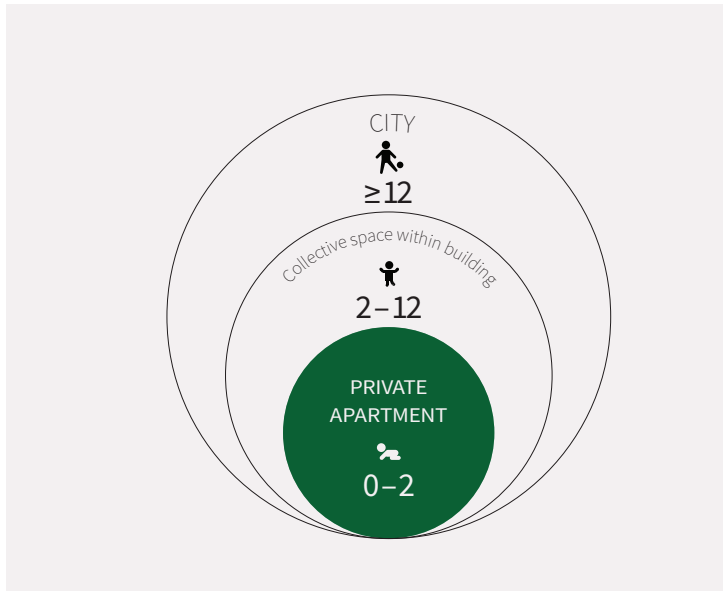
newly established Vinex locations. Only afterwards did it become apparent that many families did not want to move to the outskirts and preferred to live in the city—a realisation which, according to Keesom (2013), was taken as a "surprise" by the developers and the government, who couldn't foresee this trend.

As a result of these developments, cities lack affordable and suitable housing for middle-class families. Those families wanting to stay in the city have little option but to live under suboptimal conditions or to capitulate and move to the suburbs. If the city is to accomodate families, their preferences and expectations should be studied and taken into account. What are then those preferences?

What do urban families want?
As we have seen, urban families value most the possibility to combine a balanced work-family life. The location of the house is therefore crucial. To save time, proximity to work, school, and other urban facilities make it easier to combine work with child rearing and social life. Yet urban families don't usually want to live in the busy areas of the city. As Karsten (2013) has noted, urban families have a preference for quieter areas that are nonetheless near the activity of the city center. This provides the children with a relatively safe area to play outside.

It must be noted that children need to be able to play outside their home for their correct development. As children grow older, the area they should be able to roam and explore becomes larger. This is what the Dutch call the 'actieradius' (Karsten, 2013). Figure 3 represents this idea. During the first years, the child might play within his or her home building. As the child reaches four years old, when school starts, the 'actieradius' expands to include the child's neighbourhood. By the time the child is 12 years old, the whole city should be accessible for play (fig. X). Urban families have therefore a strong preference for a pedestrian area directly accessible from their front door (Hoekveld & de Jong, 2017).
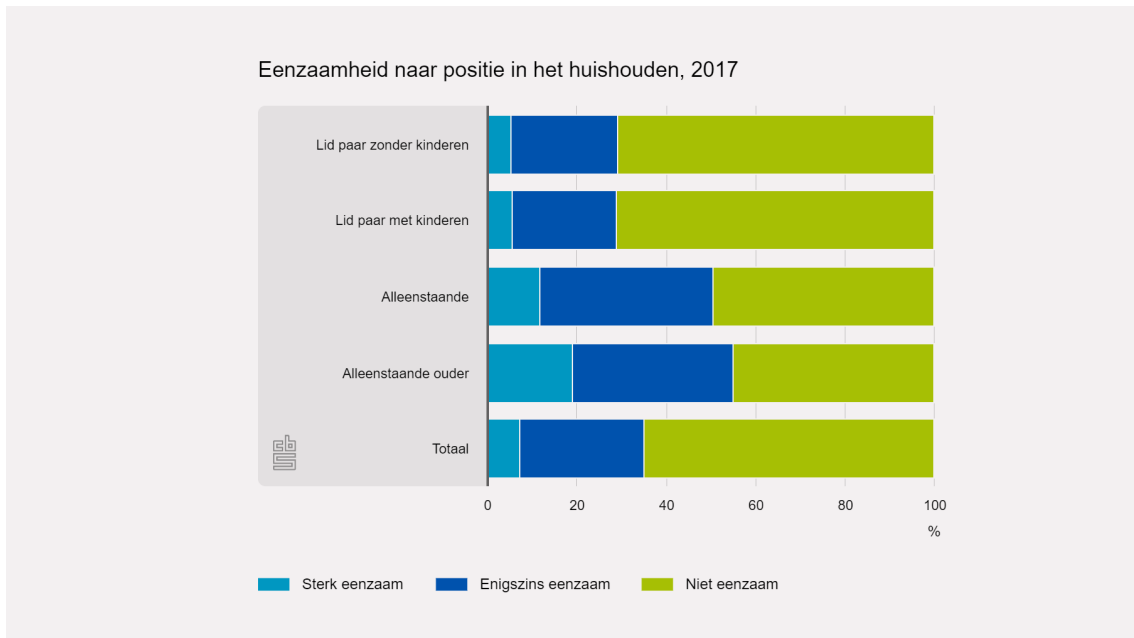
Despite their desire for a relatively quiet environment, urban families still place value on the bustling activity and diversity of the city. They place themselves against the homogeneity of the suburbs, and want their children to be exposed to the challenges of a diverse and multicultural environment (Hoekveld & de Jong, 2017).

Regarding the size of the dwelling, research shows that urban families are willing to sacrifice space and live in a smaller house if that allows them to live in a nice neighbourhood in the proximity of the city center. Families living in central areas do nevertheless complain over lack of space, both living and storage space. Taking advantage of the little space available is a must for urban family houses (Hoekveld & de Jong, 2017). Ingenious solutions such as a flexible plan and multifunctional rooms should be tested. For the rest, urban families have the same necessities as any other: storage room for baby carriages and children's bikes, a spacious hall where parents can clothe their children before going out, safe places for children to play without a need for the parents to keep an eye, etc.

We have seen how an increasing number of families wish to stay in their city but cannot afford to do so. There is a lack of suitable housing for them. This problem is exacerbated in the case of single parent households, to which we now turn our attention.

What about single parent families?
Single parenthood has been steadily increasing in the last decades. In 2019 in Amsterdam, one in four children (25,6 %) lived with a

Eenzaamheid naar positie in het huishouden, 2017

	Sterk eenzaam	Enigszins eenzaam	Niet eenzaam
Lid paar zonder kinderen			
Lid paar met kinderen			
Alleenstaande			
Alleenstaande ouder			
Totaal			

single parent. A much higher percentage than the national average of 16%. In most cases (89%) the child resides with the mother (CBS, 2019). Many of these single parenthoods are a result of a divorce or a separation. But there is also a relatively high number of babies born into single parent households. While the national average is 9%, in Amsterdam the percentage of children born into single parent families raises to 15,9% (CBS, 2019).

Single parents benefit the most from the advantages of urban living, as it facilitates combining work-family life and keeping their family and friends at hand. Research shows that working single mothers have the most difficulty finding a balance between work and child-rearing. For example, single mothers usually work full time and have problems finding creches with full-time schedules or with service outside office hours (NJI, 2004).

While single parents can usually apply for social rent, the queue is long and the process takes time. Yet single parents that went through a divorce or a separation might see themselves suddenly without a home. Especially mothers can find themselves in that situation, as the house in which they lived is usually under the name of their male

partner. While applying for social rent, these people have to either find accommodation in suboptimal conditions or get into debt to pay for an unaffordable rent. We might add to that that most housing is designed for the "nuclear" family. We lack housing designed for the needs of single parents, especially their social needs (NJI, 2004).

As work and child rearing take up all their time, single parents are disproportionately at risk of suffering from loneliness. As figure 4 shows, almost one in five (19%) single parents feel very lonely. And they are the group most affected by this problem, which is now being recognized as a serious threat to their health. Loneliness increases an average of 29% the likelihood of mortality (Holt-Lunstad et al., 2015).

In conclusion, our age is witnessing the rise of young families that wish to raise their children in the city. Partly because of the imperatives of work—usually both parents work and proximity to work becomes crucial in achieving a work-family balance—, partly because they enjoy an active social life and identify with the culture and values of the city. Single parents also seek and benefit from living in the city, where they can more easily combine work with child rearing and find support in family and friends. Yet these families cannot find suitable housing. Specially the middle-classes are being affected, as they cannot apply for social rent nor afford the free market prices. Without these families, the city suffers from economic loss and lower social cohesion. We need therefore to find a way to provide affordable urban housing for families.

Co-housing

Cohousing is a living arrangement in which individual houses share common facilities. This arrangement offers two main benefits: it is more affordable than standard housing and it alleviates the burdens of domestic work.

Cohousing achieves its affordability by creating common spaces for those functions that don't need to happen in the private realm (Maak, 2015). These common spaces usually include a large kitchen, dining and living area, a playground for children and a laundry room. There the residents meet up, cook and eat together, and watch

their children play.

In order to afford those common spaces, the size of the individual houses is reduced. An average of 10-15% of the private space is "donated" towards the common facilities (Fromm, 1991). The largest reductions in the private home occur in the kitchen, the dining room and the living room; functions which can take place in the common areas. The private unit remains however big enough to perform independently. They include a small kitchen, a bath, a living room and a terrace or balcony. This allows the residents to retreat to their private sphere if they wish.

In the presence of autonomous private houses lies an essential difference between co-housing and other types of communal living. What we might call a 'comune', for example, consists in private rooms arranged around a communal setting (figure 5). These rooms are not autonomous units; they don't have a kitchen or bathroom, which have to be shared among all residents (Vestbro, 2012). This degree of communal sharing might be too much for families. By contrast, co-housing consists in autonomous apartments sharing some common facilities.

Figure 5. Commune from Zwicky Sud, Zurich, by Schneider Studer Primas. Retrieved from http://afasiaarchzine. com/2017/07/schneider-studer-primas/ schneider-studer-primas-zwicky-are- al-dubendorf-32/
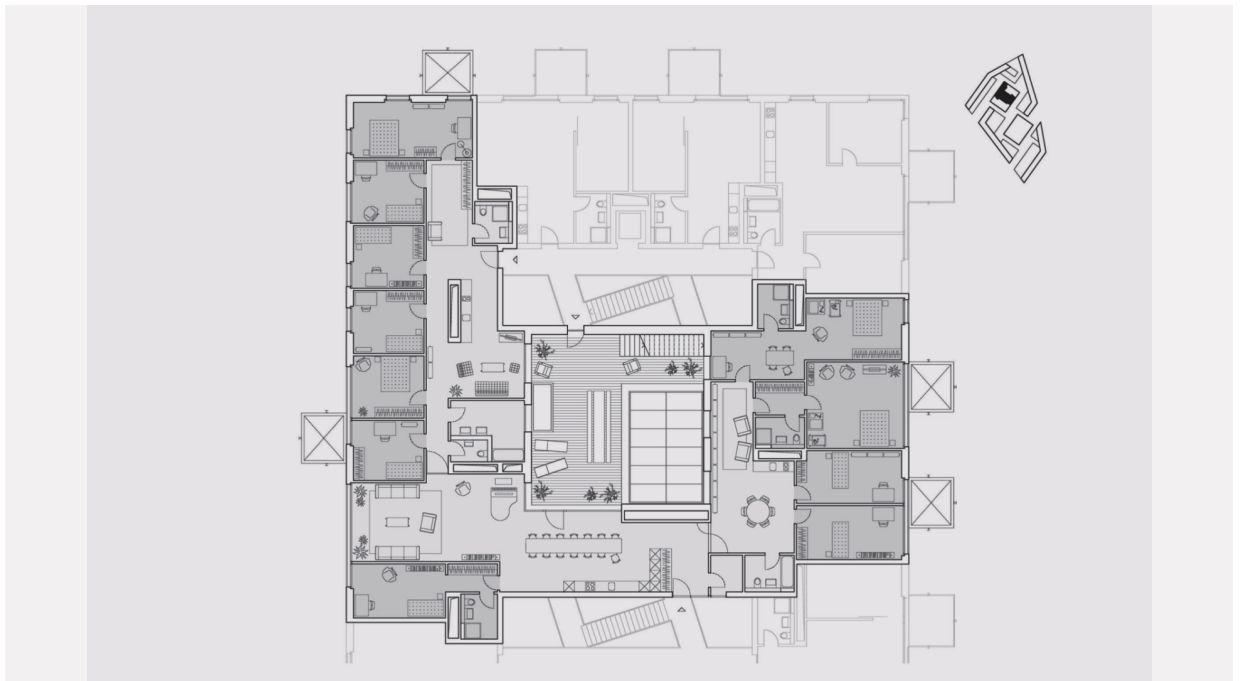
Likewise, co-housing does not depend on a shared religious belief or political ideology, unlike some idealist communities. Personal beliefs are considered to be each individual' private business. Co-housing offers a pragmatic solution, more than an idealist one; a new approach to housing, rather than a new way of life (Durrett, 2003).

At the heart of co-housing lies the will to pool resources, and this includes to share the time dedicated to domestic chores. The tasks of cooking, cleaning or looking after the children in the communal areas are usually done on turns by the neighbours. This not only saves time for the individual household, it also creates an opportunity for neighbours to develop relationships.

Trust among neighbours is therefore a central value in co-housing, and social contact among residents is encouraged by design. The private units are designed to encourage the flow towards the communal spaces by means of what Gehl (1986) calls 'soft edges'—gradual transitions between the private and the communal. This arrangement increases social opportunities. Common areas are placed at transited routes, so that they are easy to oversee and walk by (Fromm, 2011).

Beyond the criteria described above, co-housing can take many forms in type of ownership, organization of daily life, architectural form, etc.

In sum, the essence of co-housing lies in a balance between communal life and private life. This balance creates opportunities for reducing costs and sharing the burden of domestic work among neighbours. We will argue that these characteristics make co-housing a potential solution for the problems that urban families face, described in the previous section. But first, how did this building type develop and why is it becoming popular now?

The decline and rise of the communal
Living communally is as old as our species, but we have an innate preference to retreat to the private. That is the point made by Smith (2017): with increasing prosperity we have bought more and more

space, more privacy, to ourselves. That was not a problem, Smith argues, as long as technological limitations—especially regarding transportation—were putting a break to this innate preference. The city had to be walkable and streetlife was imperative. From the privacy of our homes we could instantly walk into the community that the city itself formed. This maintained a healthy balance between communality and privacy.

This balance became at risk with the advent of modern transportation, which let our privatizing instinct go unchecked. As suburbanization spread, the focus of our regulations were dedicated to the individual dwelling and its interior (minimal sizes, for example), but not to spaces for communal life (Smith, 2017)

Co-housing appeared as a reaction to this lost balance between communality and privacy. Durrett (2003) attributes its origin to a 1968 article, written by the Danish architect Jan Gudmand-Høyer: The missing link between Utopia and the dated one-family house. This fired the inspiration of several Danish families, who organized themselves to re-create the communities advocated by the article. The first cohousing community appeared in 1972 in Sættedammen, near Copenhagen. By 1982, Denmark counted with twenty-two co-housing communities (Fromm, 1991).

The Netherlands quickly followed, and the first Dutch co-housing community, Centraal Wonen Hilversum, was established in 1977 (Fromm, 1991). These early models set the precedents for the hundreds of developments that can now be found in Europe and North America (Fromm, 1991).

The proliferation of these communities has taken momentum since the early 2000s, and researchers are now speaking of a 'new wave' of co-housing (Lang et al. 2018). The growing interest in this form of housing responds not only to our concerns about the loss of the communal, but also to the global housing crisis and the ecological and other social consequences of our modern way of living. Against these challenges, co-housing is being lauded as an alternative, more sustainable approach to housing (Thörn et. al, 2019).

Werkende bevolking

tijd (uren)

48 ···························· scp.nl

36

24

12

0

20-64 jaar,
geen partner
of kind

20-64 jaar,
wel partner,
geen kind

20-64 jaar,
partner
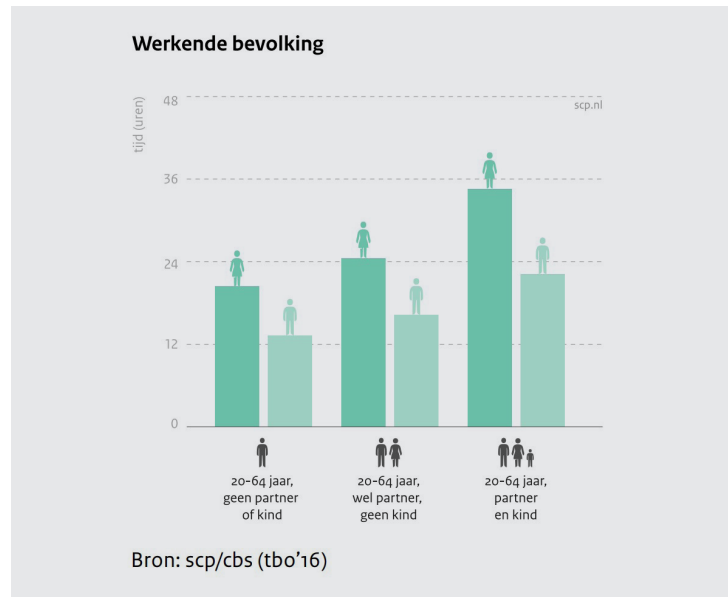en kind

Bron: scp/cbs (tbo'16)

Figure 6. Time dedicated to domestic chores in a week by sex and household type (Roeters, 2017)

We contend that co-housing can meet the problems and expectations of urban families. Affordability is of course one clear advantage that we have already discussed. In the next sections we will further explore two other benefits: the possibility to facilitate a work-family balance by sharing domestic chores, and the advantages of communal living for children.

Work-family balance
The burden of domestic work weighs heavy for families, more so in the case of single parents or if both parents need to work outside the home. As figure 6 shows, mothers with a partner spend almost 36 hours a week on domestic chores (Roeters, 2017). And one can imagine that single parents are confronted with even higher time spent doing domestic work. This amounts to roughly the same time as a part-time job, completely unpaid, that adds extra pressure on families.

What are exactly those domestic chores? A study from TBO has researched how much time Dutch adults spend on which domestic chores. These data cover all adults from 20 to 64 years, without distinguishing between families and households without children, but it gives us an idea on which domestic chores are the most time

Huishoudelijke taken naar sekse, bevolking 20-64 jaar, uren per week, 2005

Legend: koken | wassen en strijken | huis poetsen | boodschappen

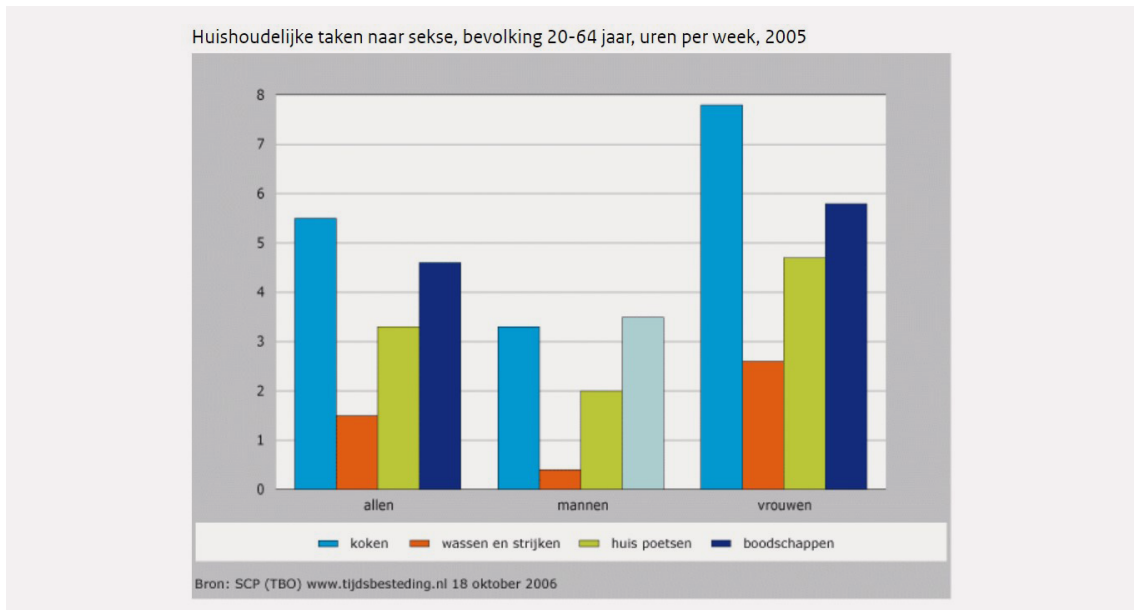Bron: SCP (TBO) www.tijdsbesteding.nl 18 oktober 2006

Figure 7. Time dedicated to different domestic chores in a week by sex (Breedveld. & van den Broek, 2017)

consuming. And those are, by far, the ones related to the kitchen, including cooking and doing groceries. According to the study, women spend almost six hours a week doing groceries, and almost eight hours preparing meals. We might infer that single parents of young children need to dedicate even more time to those chores.

To alleviate the time-consuming burden of preparing meals, co-housing usually involves collective cooking. These collective meals are prepared once or twice a week, or even five times a week, depending on the co-housing community. Usually the task is assigned on a rotational basis to all inhabitants: one day you cook, the next day another group of persons cooks. But that's not the only possibility. Some co-housing communities have established fixed committees of 'cookers', who of course get paid for their job.

Co-housing communities usually have dinner together. "We feel like a big italian family," said a resident a co-housing building in Hilversum about communal dining (Marcus, 2000). The act of eating together is usually considered by residents as cornerstones for the sense of collectivity (Wasshede, 2019). It helps to build relationships and trust among neighbours, creating a healthy social environment within the community. But while cooking is mandatory, communal

eating is not. Residents have the option to take their share of food and eat it in the privacy of their home.

The following quote from a resident of a co-housing community illustrates how this approach might look like.

> "These are my cooperative duties:
> Cleaning: two hours every ninth week.
> Cooking: four hours in November, February, and April.
> Meeting: three hours once a month
>
> In exchange, there is dinner for the family twice a week at the common house. There are facilities for laundry and child care, a library, and a sewing and TV room... Together things are purchased that cannot be afforded alone. Children can play with friends by just going out the door, and the neighbors here also become friends".
>
> —Mrs. Ziebell, Æblevangen cohousing, Denmark. (quoted from Fromm, 1991, p.5).

By alleviating the burdens of domestic work, co-housing can improve parent-child relationships. "When communities share child care and related tasks such as cooking, laundry, shopping and cleaning, parents ... can choose to interact with children more often when they want to rather than when they have to, thus reducing burnout and enhancing the overall quality of parent-child relationships" (Greenberg, 2003, p.680). But improved relations between children and parents are not the only benefits that co-housing can offer for children.

Nurturing environment
Children receive many benefits from communal life. Greenberg (2003) argues that growing up in a community provides children with a rich source of informal education. For once, they are exposed to a wider number of role models. In the standard, nuclear family housing, children have little contact with adults other than their own parents, close relatives, and teachers. In a co-housing scheme, by contrast, children spend much more time with a wider array of adults, and have the opportunity to interact with them during

communal dining or other activities. Moreover, by watching the adult organization of a community—consensus building, dispute resolution—children learn to navigate in the adult world quicker.

Greenberg (2003) also notes that co-housing provides children with a large area to roam and explore safely within the building. As we have seen in part 1, children need space to play outside their home for their optimal development ('actieradius'). Between the ages four to twelve, it is recommended for children to be able to play within their building. The communal spaces of a co-housing scheme allow the children enough space to play and roam freely while being protected from the outside and under the supervision of adults.

Sharing the responsibility for domestic chores and creating a nurturing environment meet the housing preferences urban families have, and that we have pointed out in the first part of the chapter. It gives the opportunity to combine work and family life, and it provides safe spaces for children to play.

Who builds co-housing?
The ambition to pool resources among neighbours is also used to finance and develop co-housing projects. Houses are usually created with a self-providing model, in which neighbours are involved early in the process and take the responsibility for the finances and design of the building. This contrasts to the standard, speculative model of real estate development, in which the end users have a passive role and are only involved at the final stage.

In the speculative model (fig. 8) a developer takes control and houses are designed, in last instance, as financial assets, not as houses to be lived in. A developer's job is to minimize building costs in order to maximize profit. From this perspective, values such as community, flexibility, high quality, etc. are seen as costs to be minimized. This model is moreover based on the over-indebtedness of the future residents via mortgages.

In order to make the communal spaces of the co-housing possible, this housing usually follows the self-providing model, in which neighbours form a co-operative that takes financial responsibility
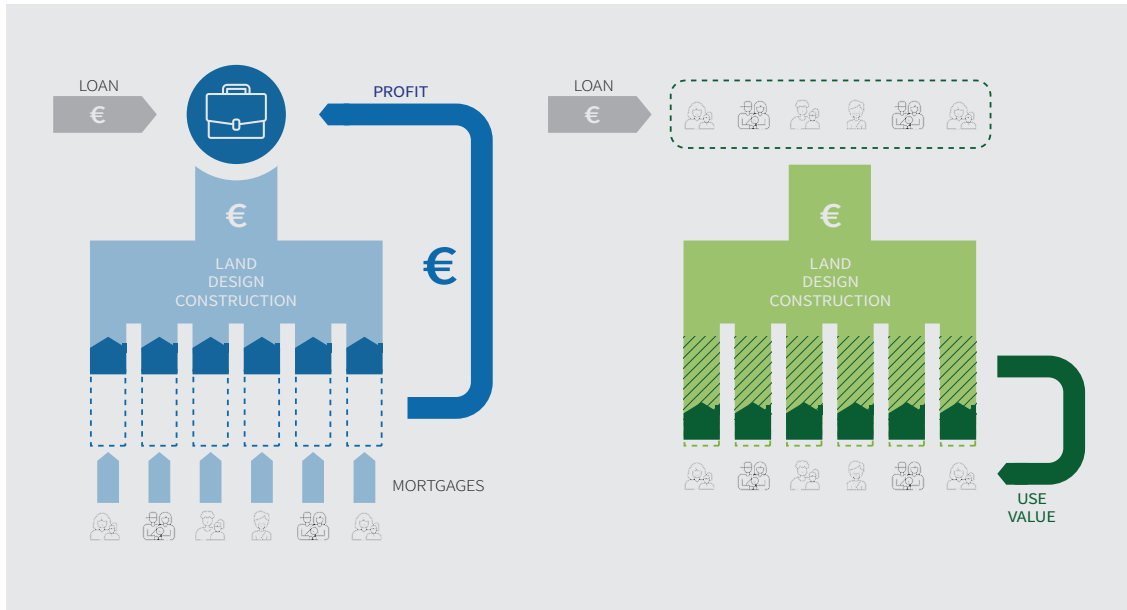
Figure 8. Financing models (adapted from Parvin, 2011)

and control over the design decisions. This creates a shift in value, away from financial gain and towards the long-term use value. This is also made possible by the fact that, by skipping the developer's profit and its related costs, the financial cost of the project can be reduced up to a third of its equivalent market price (Parvin, 2011).

We can illustrate this with the example of Wohnprojekt Wien, designed by einszueins architektur and completed in 2013 (see case studies bellow). The building, located in a central position in Vienna, and with 700m2 of communal facilities, forms a shared ownership among 39 apartments. To get the right of use of each apartment, residents need to provide an equity of 570 euros per square meter, and pay 9,96 euro per square meter per month for maintenance (BRON?). This means that, for an 80m2 apartment, residents would pay 45.600 euros of equity, and a 'rent' of 775 euros per month.

Design question

As the Netherlands faces the task of building a million new homes between now and 2030, co-housing schemes should be considered as an alternative especially attractive for urban middle class families and those groups more vulnerable to loneliness, among them single parents.

This leads to the design question my graduation project attempts to answer: How to provide affordable housing suitable for urban middle class families in Amsterdam that creates a strong support network for parents and their children?
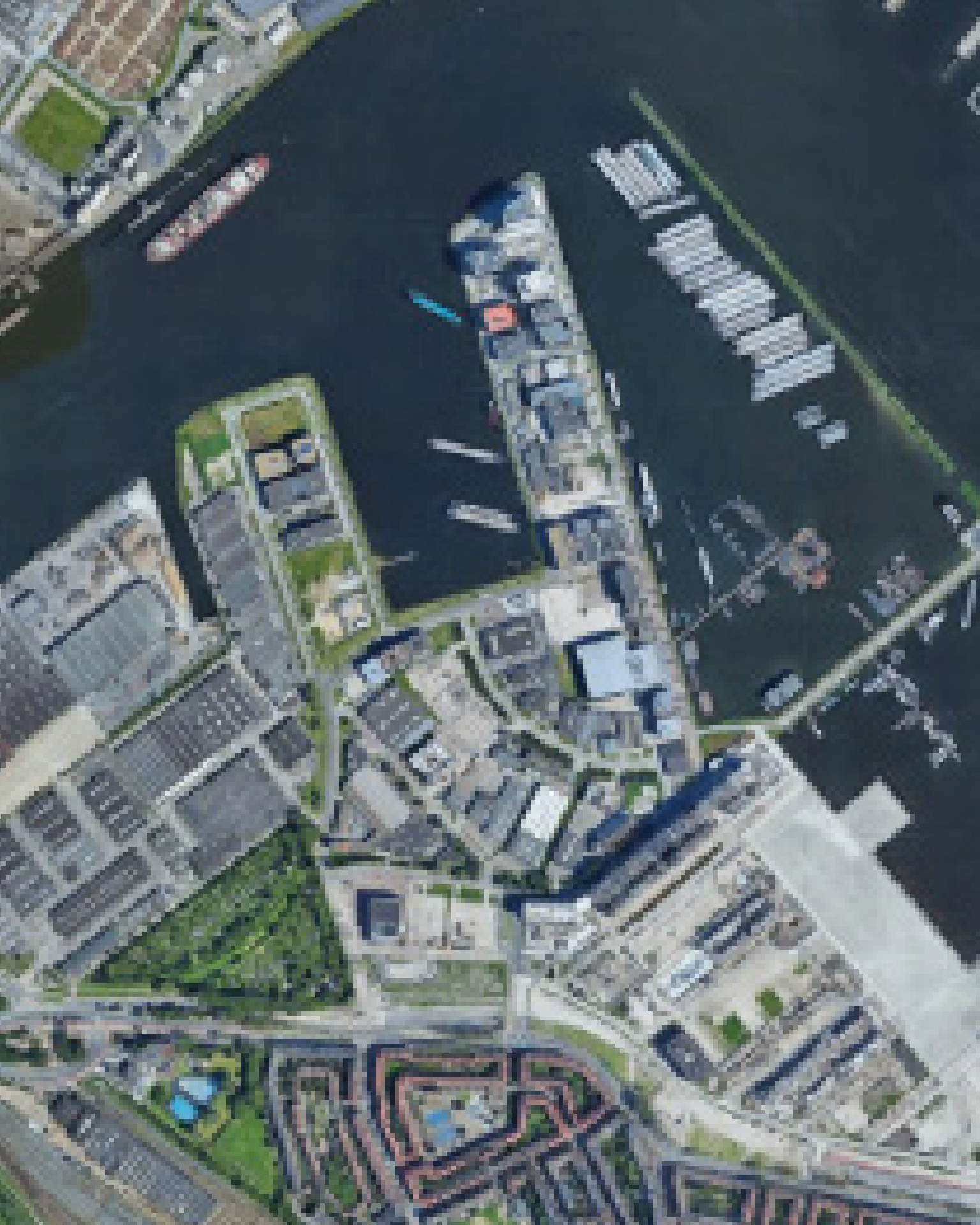
Design

The site for this assignment is predefined by the course and is located in the Minervahaven of the city Amsterdam in the Netherlands. The site of the Minervahaven is a unique location due to its close to the city centre of Amsterdam as well as the presence of water and harbour activities which are still very present at the site.

The masterplan is designed according to the main principles of a campus site. One of the starting points of a campus model is the ring road that diverts traffic to a parking nearby the desired destination. The site within the ring road brings together circulation, topography and a sequence of visual experiences. Also, the campus model remain a collection of buildings which may be more or less related to each other but still are essentially separate and distinctive from each other.
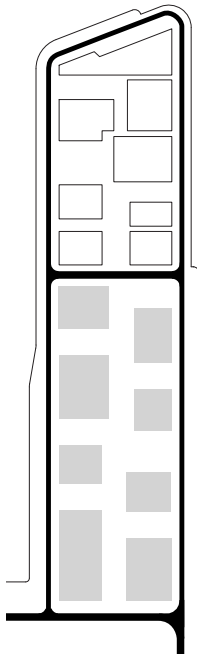
Car + bike access

Parking

private
public
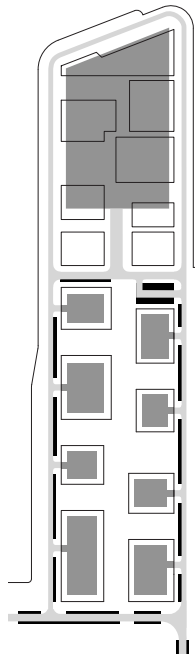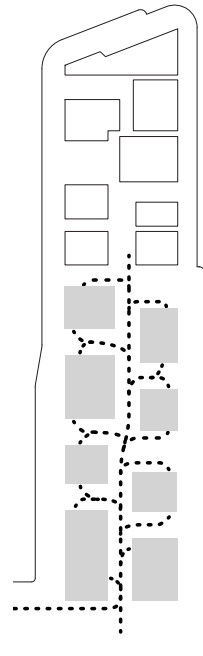
Main pedestrian access

Public space

plaza
urban greenery
playground

Building height

< 15 floors
< 6 floors

6500
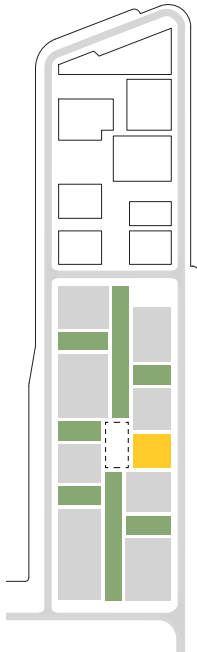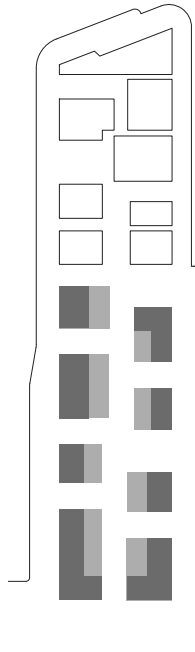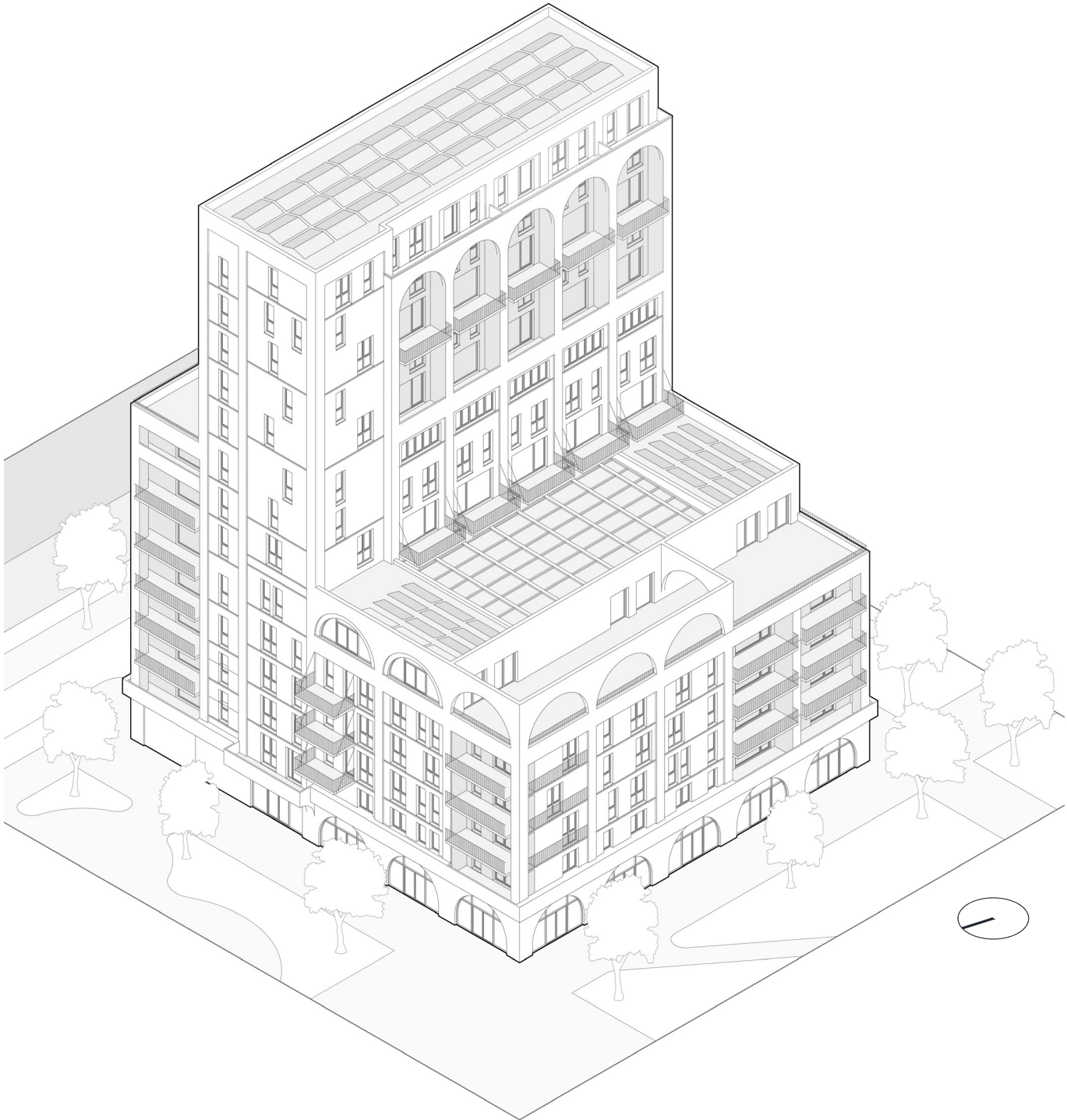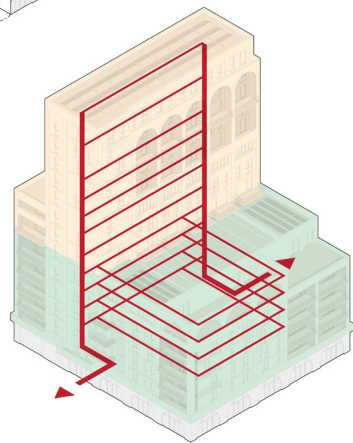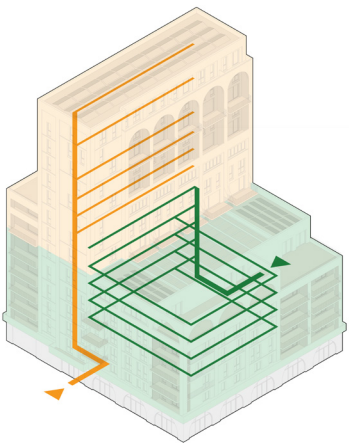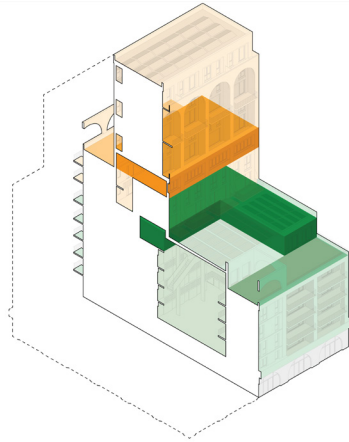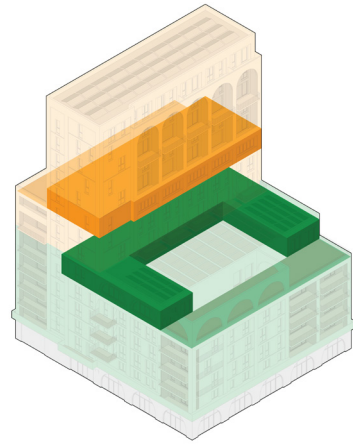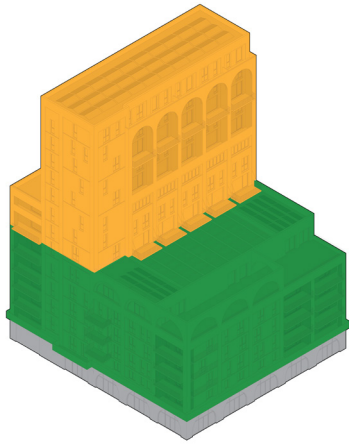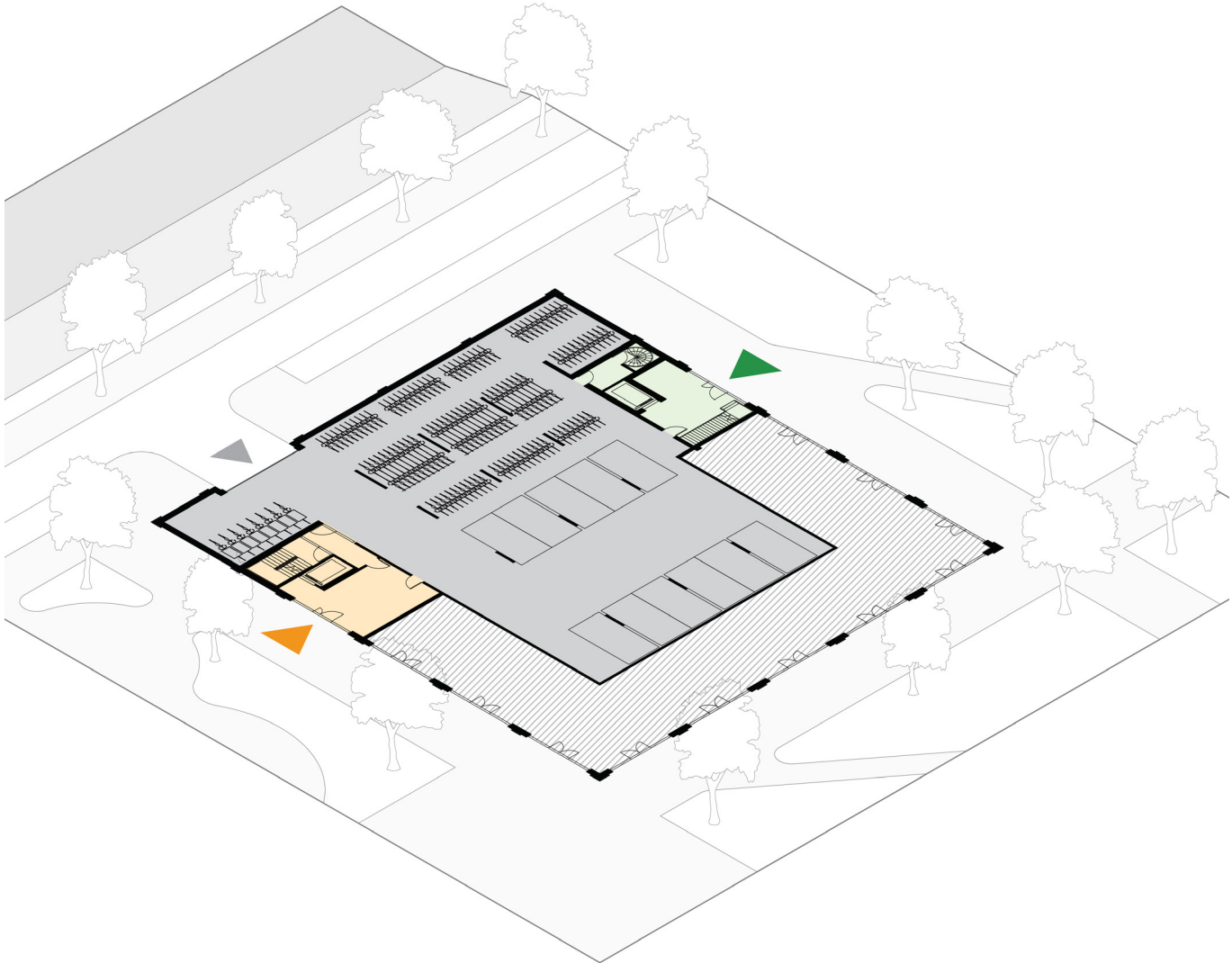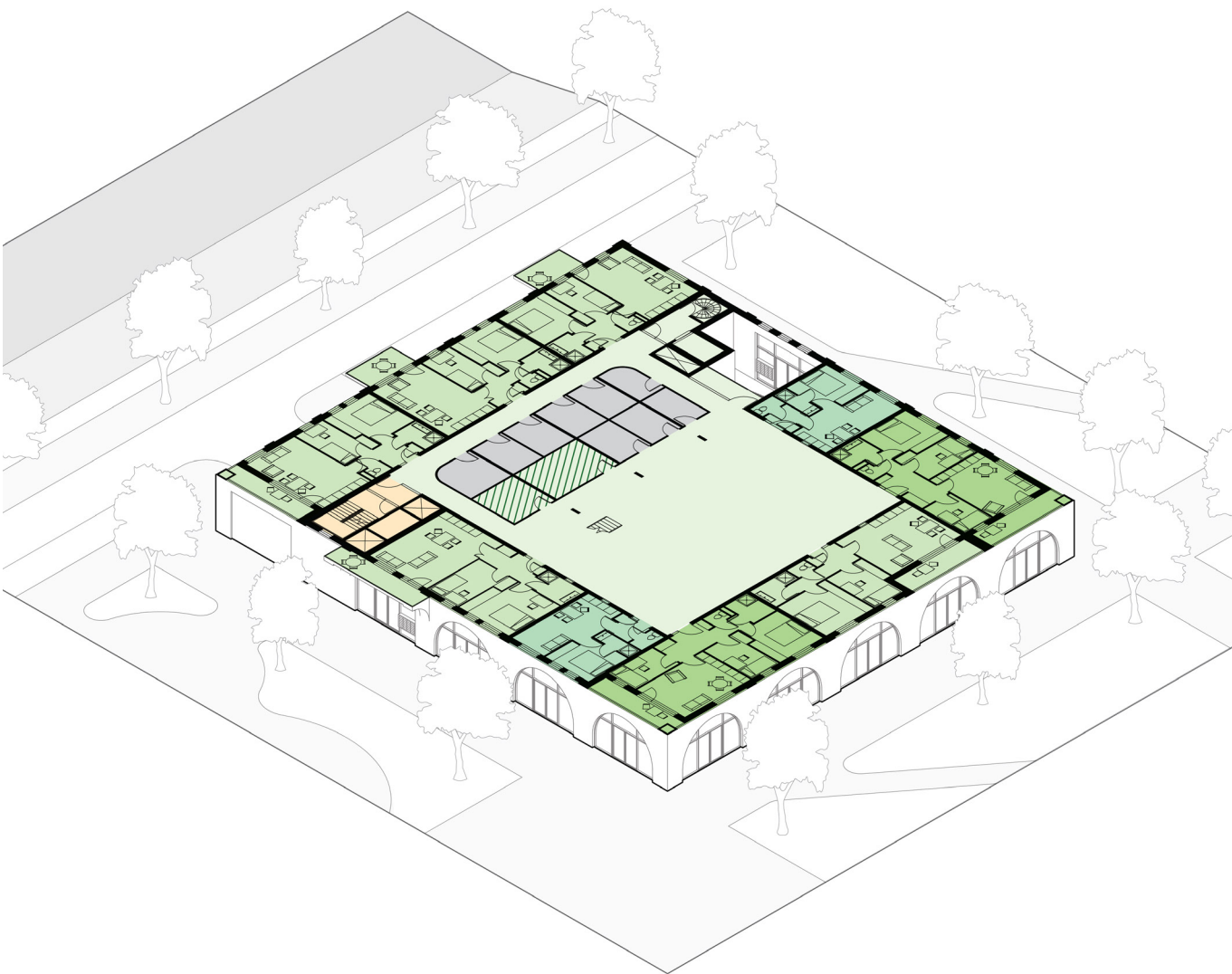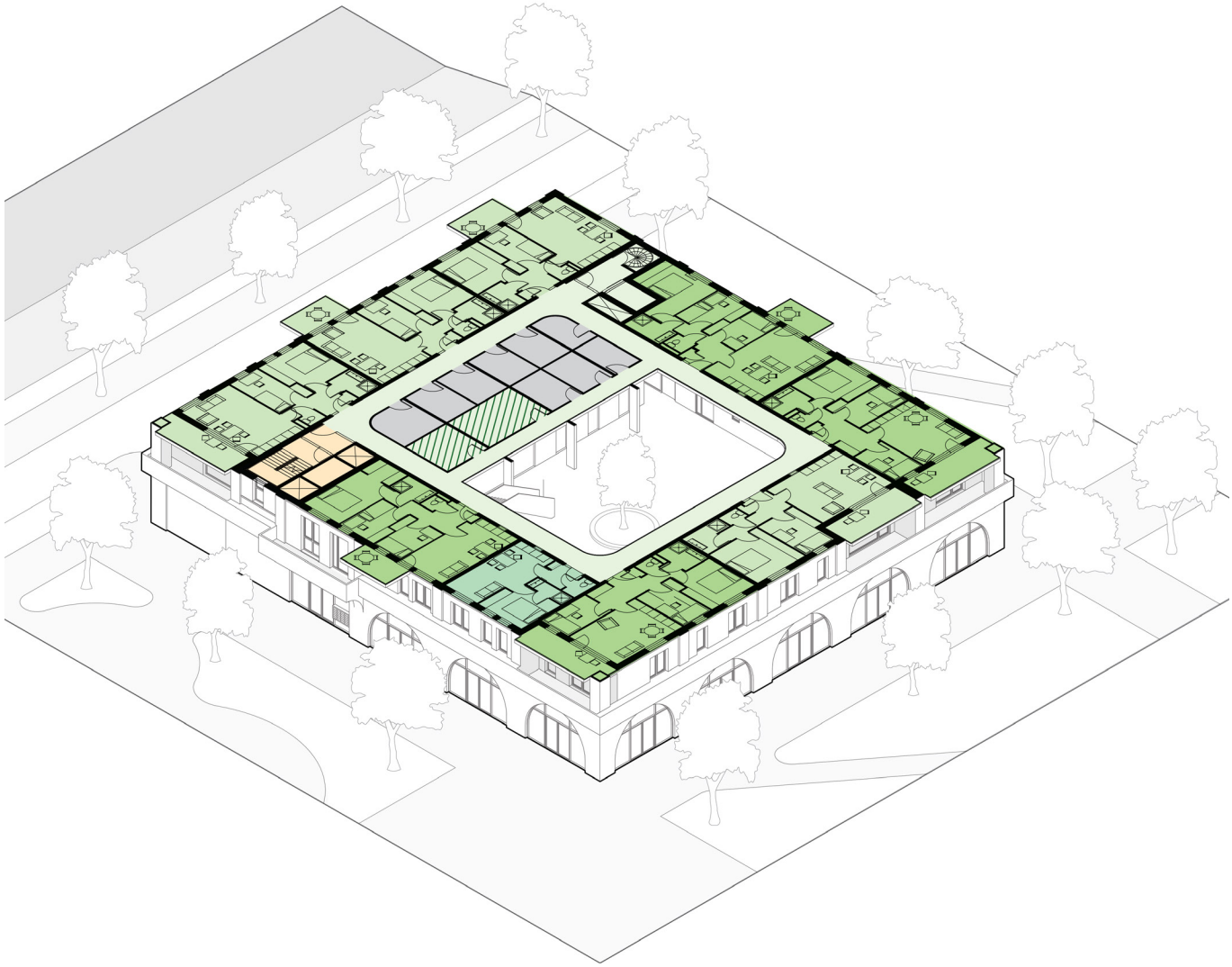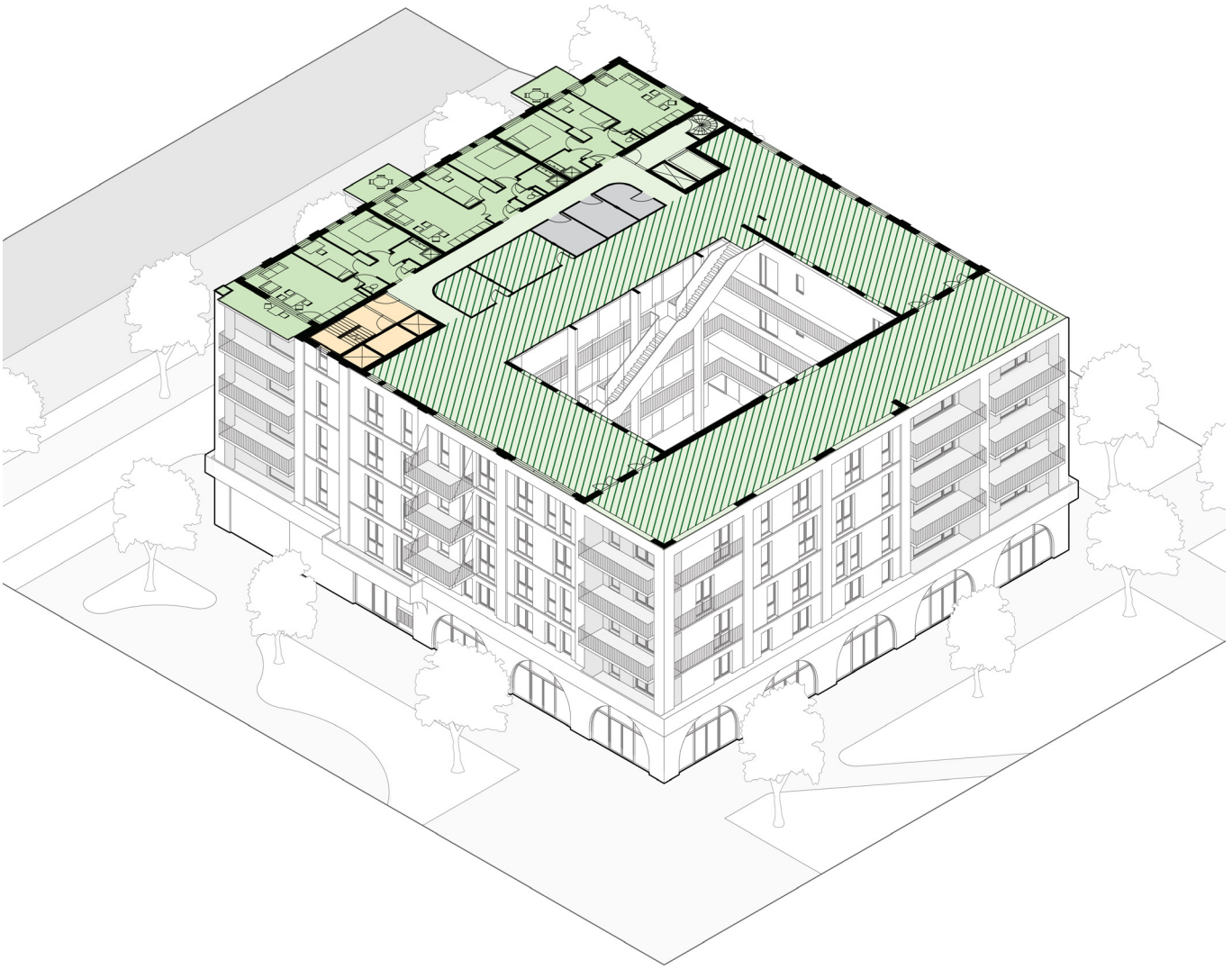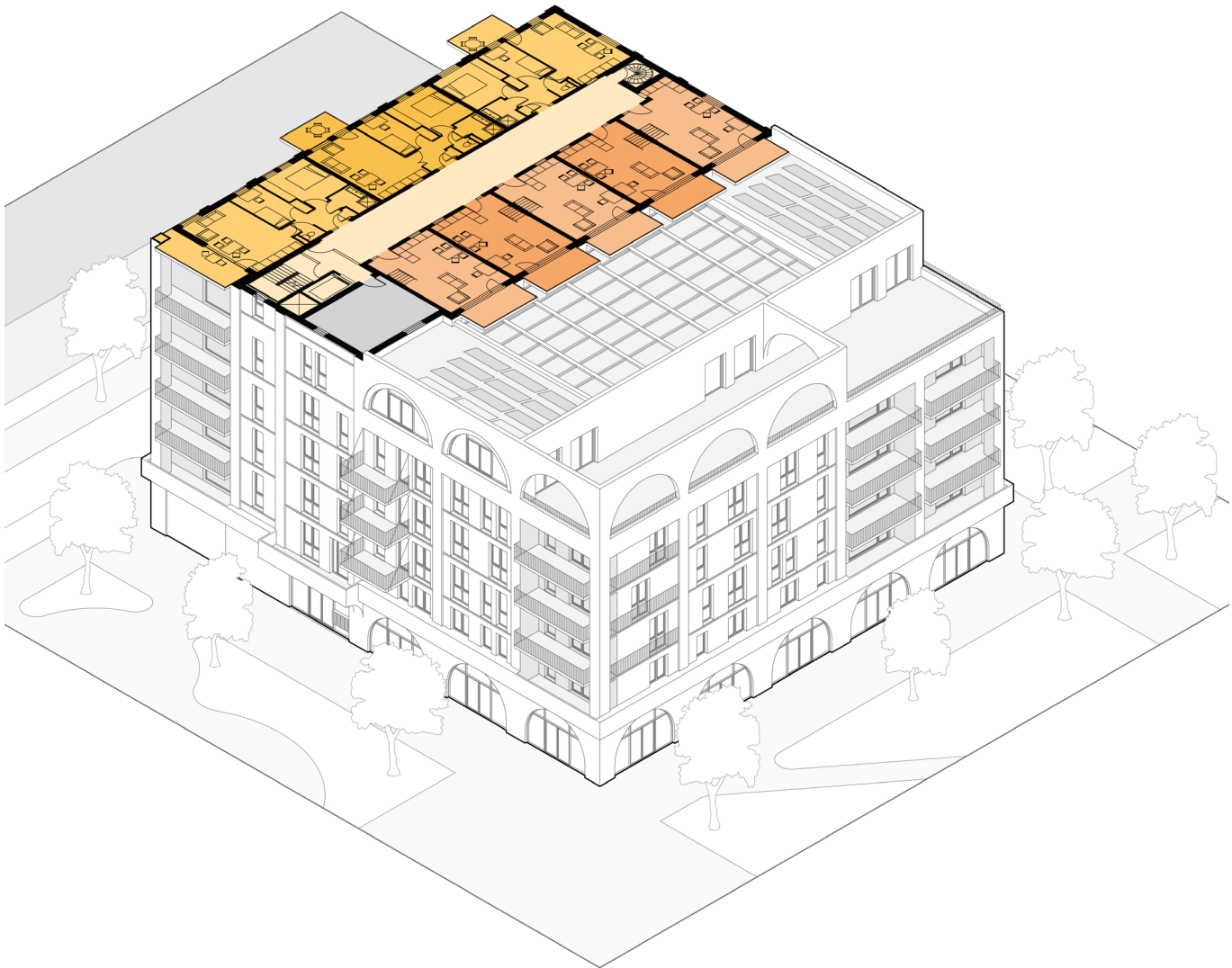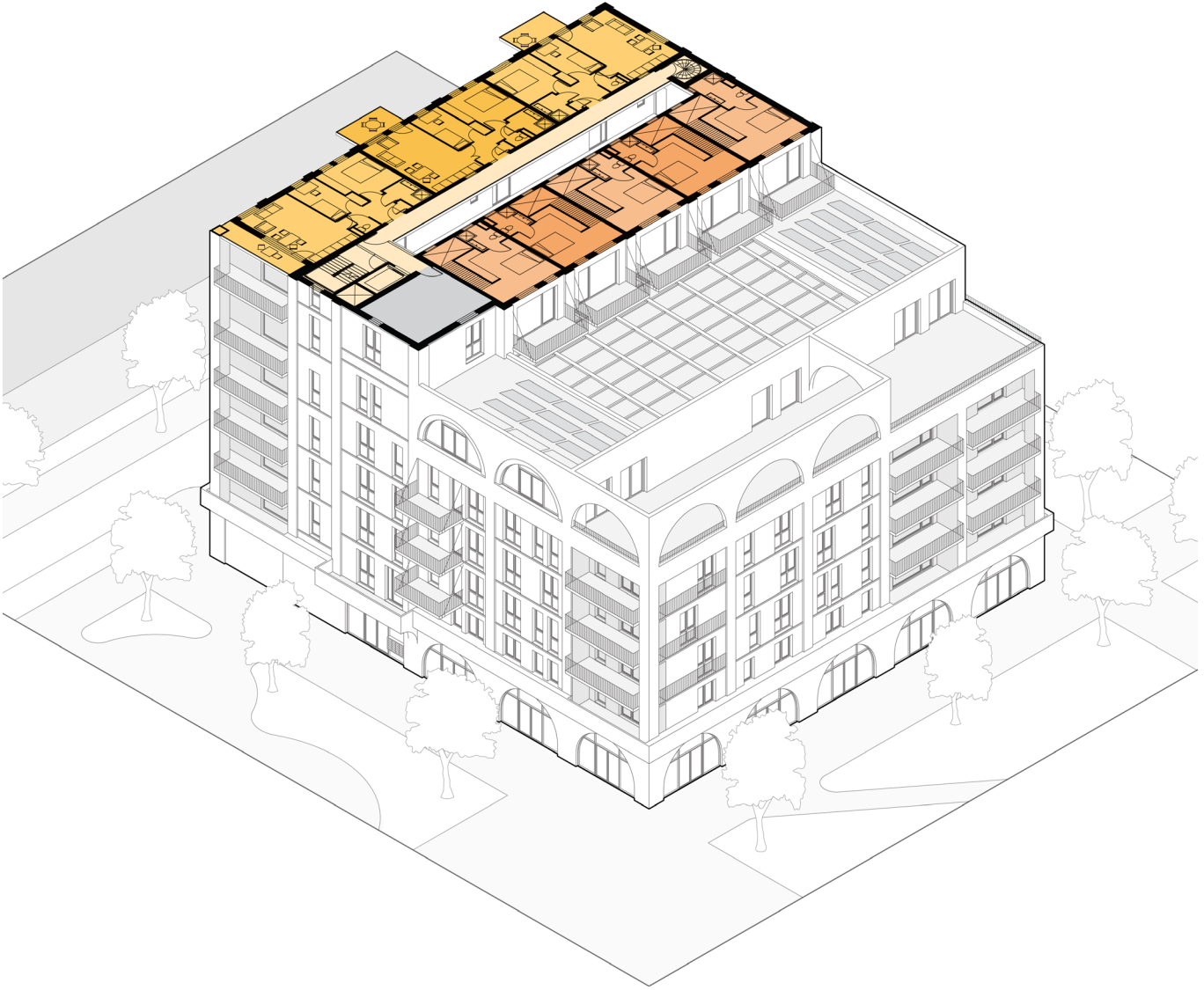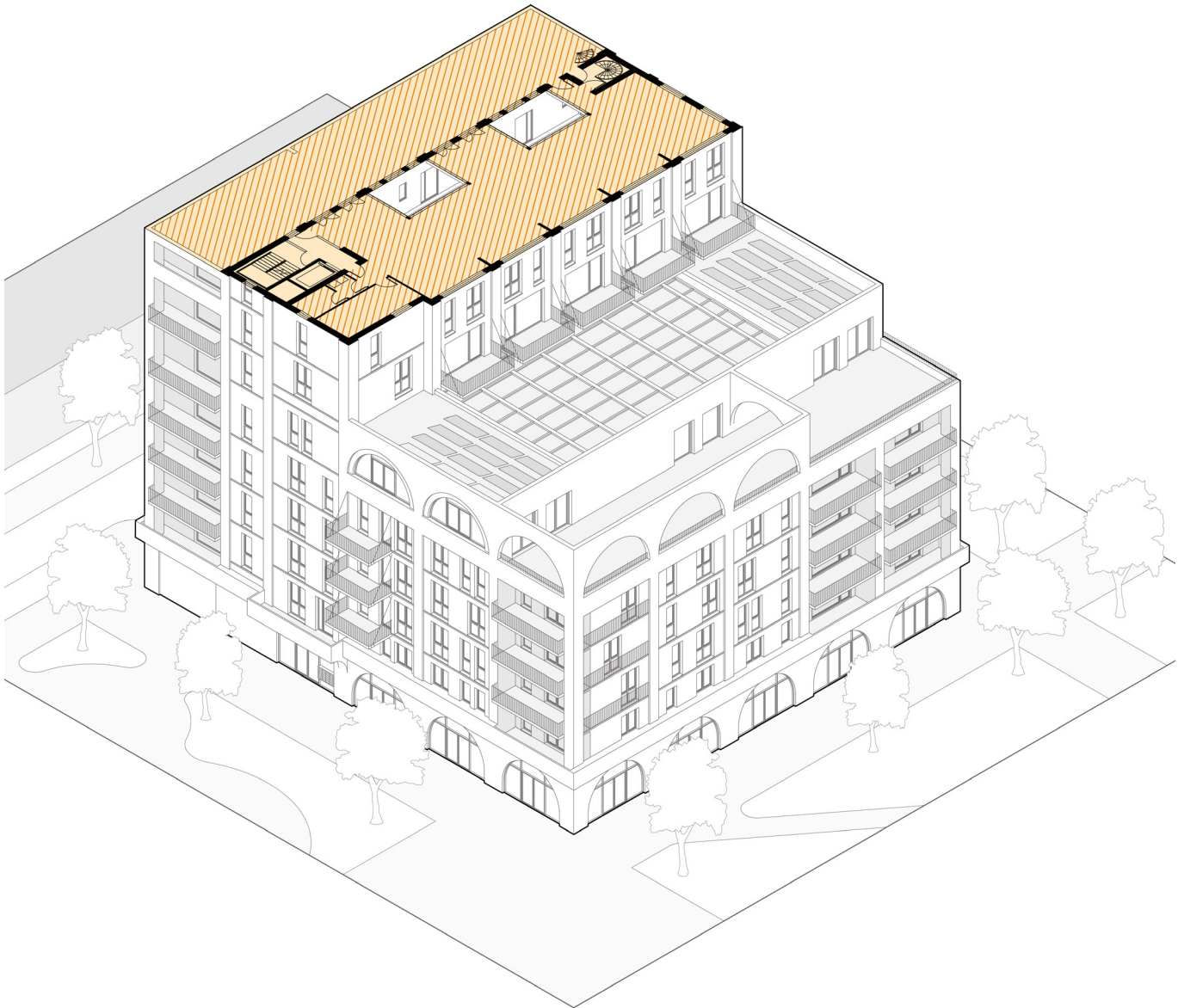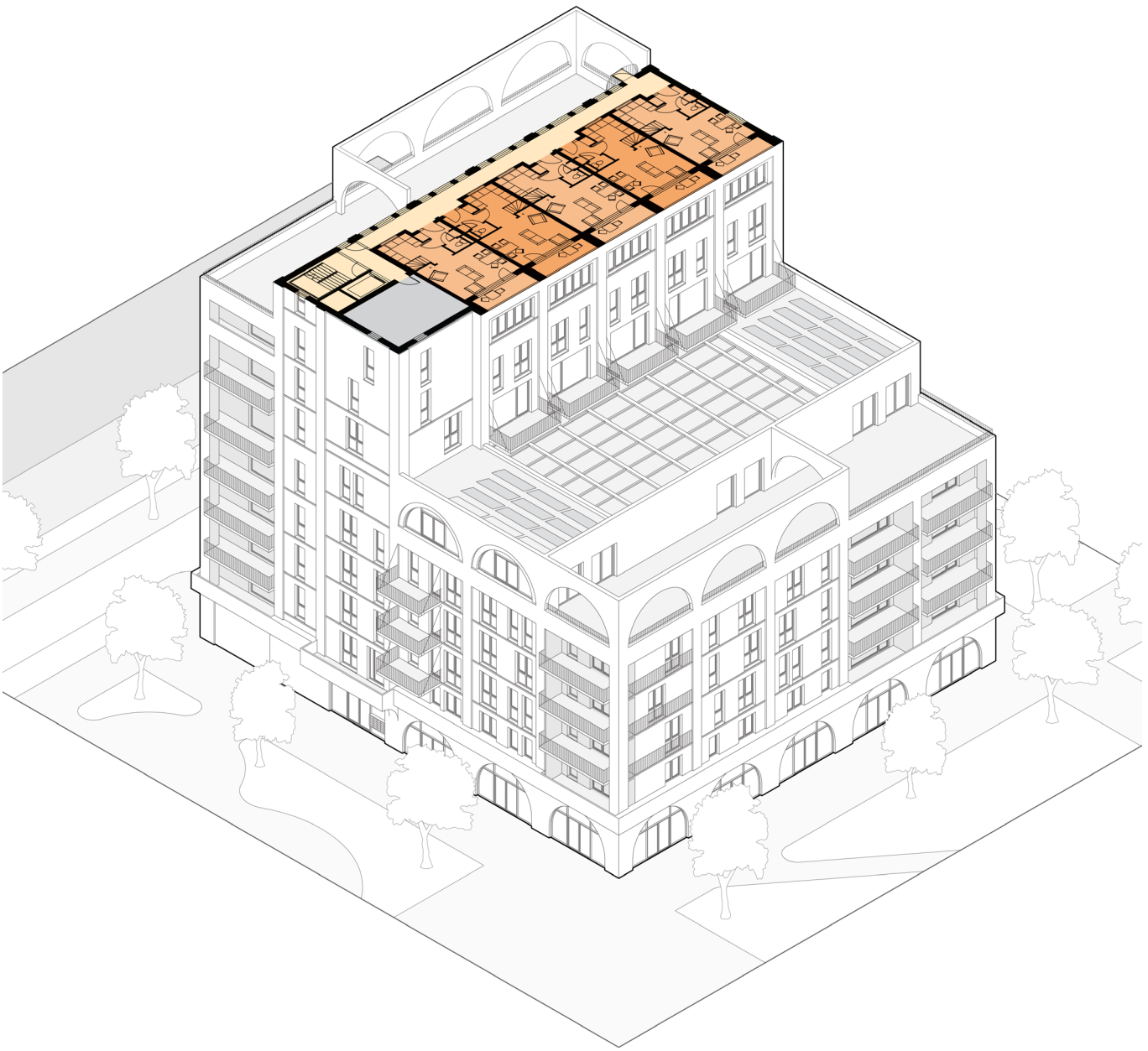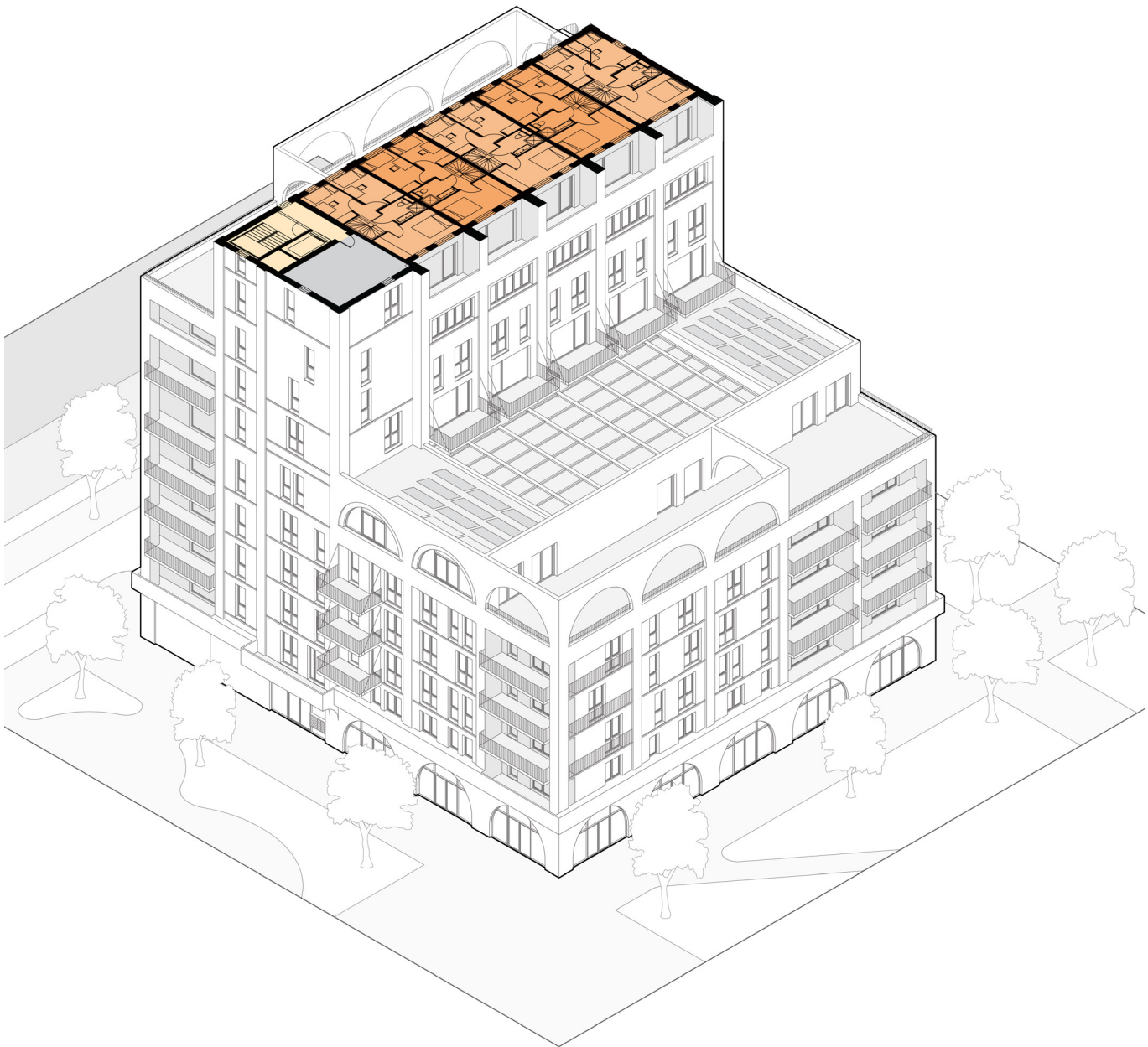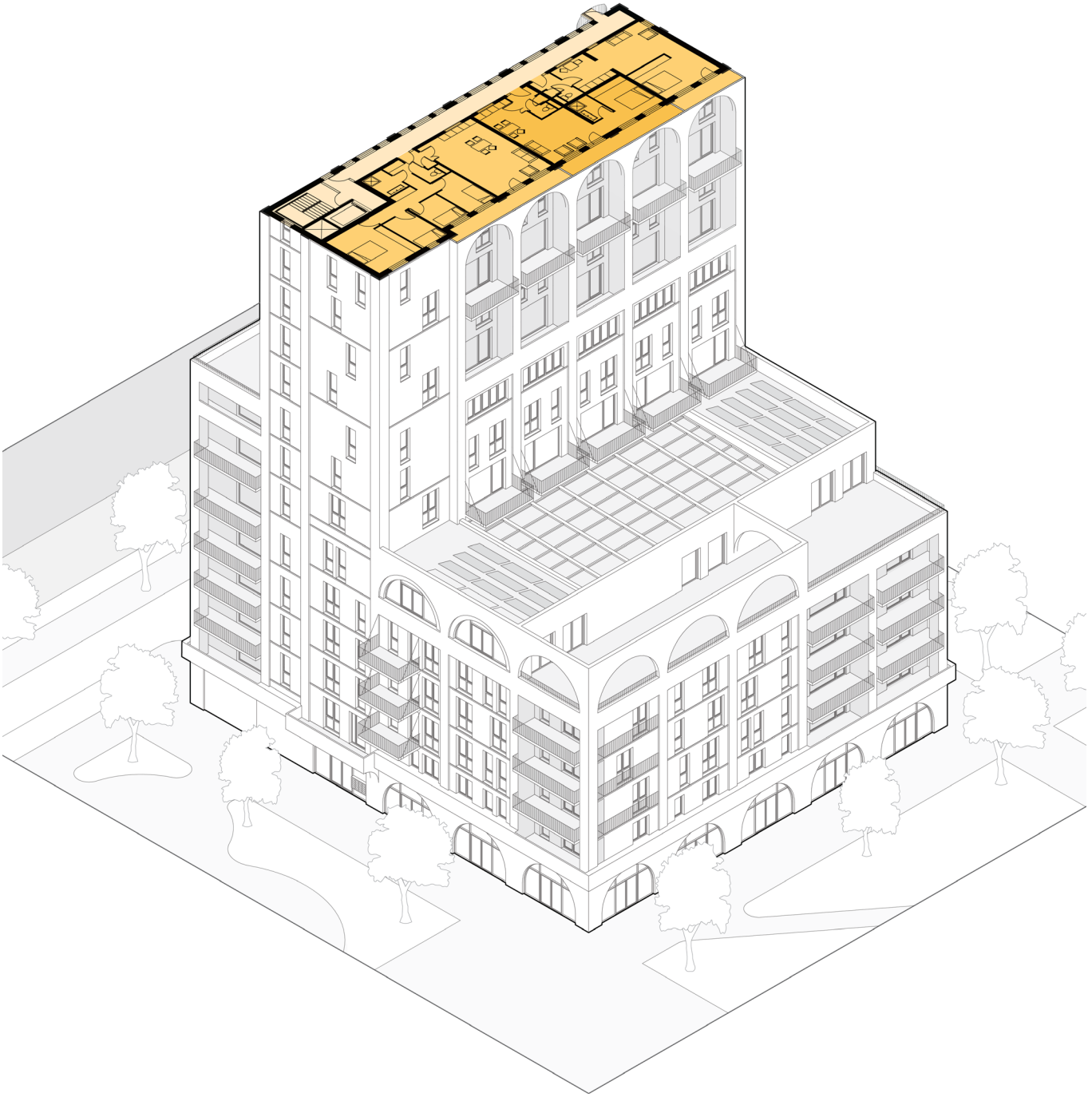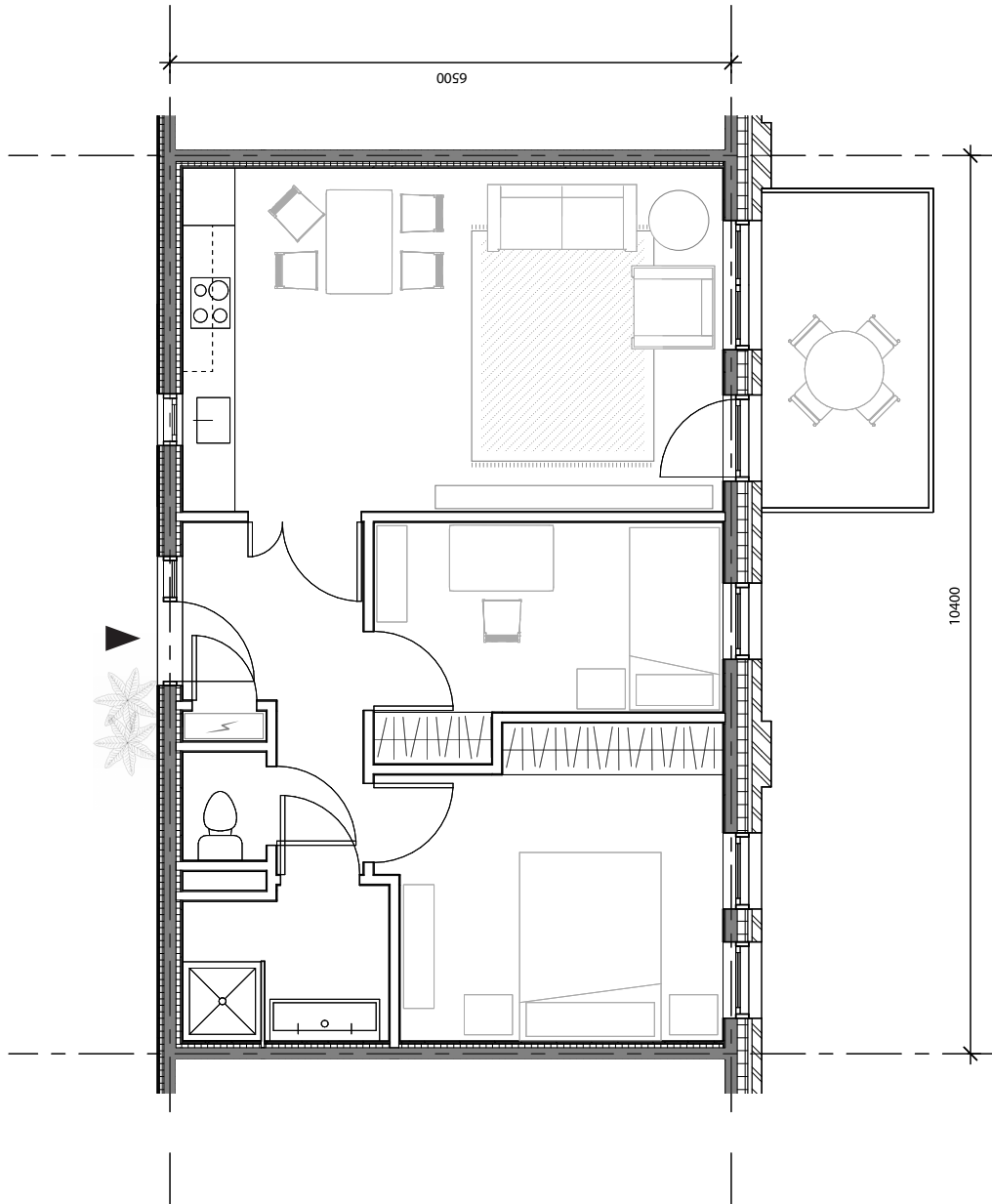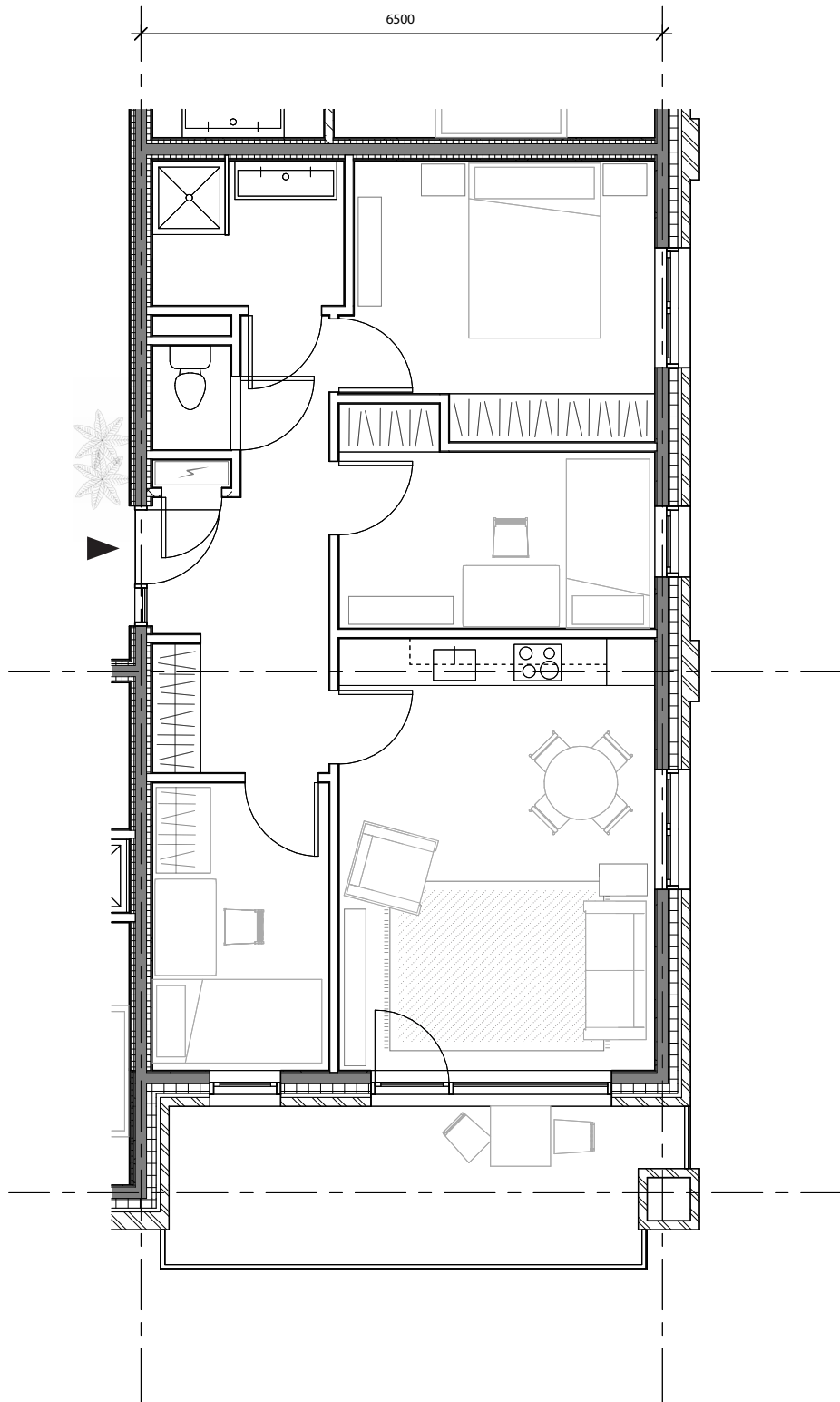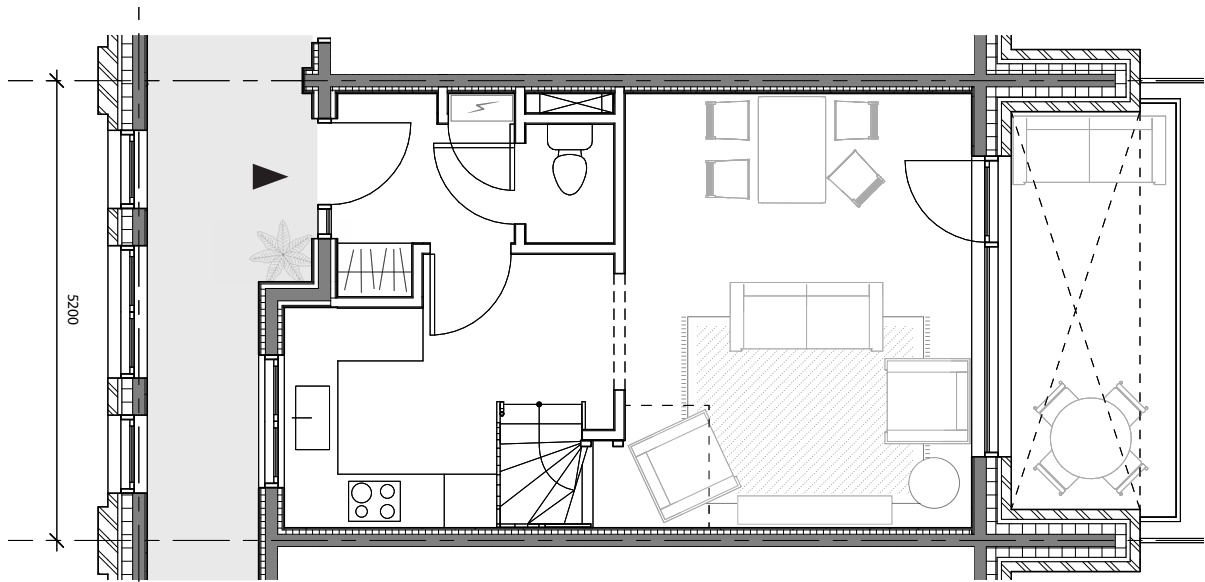
5200

First floor
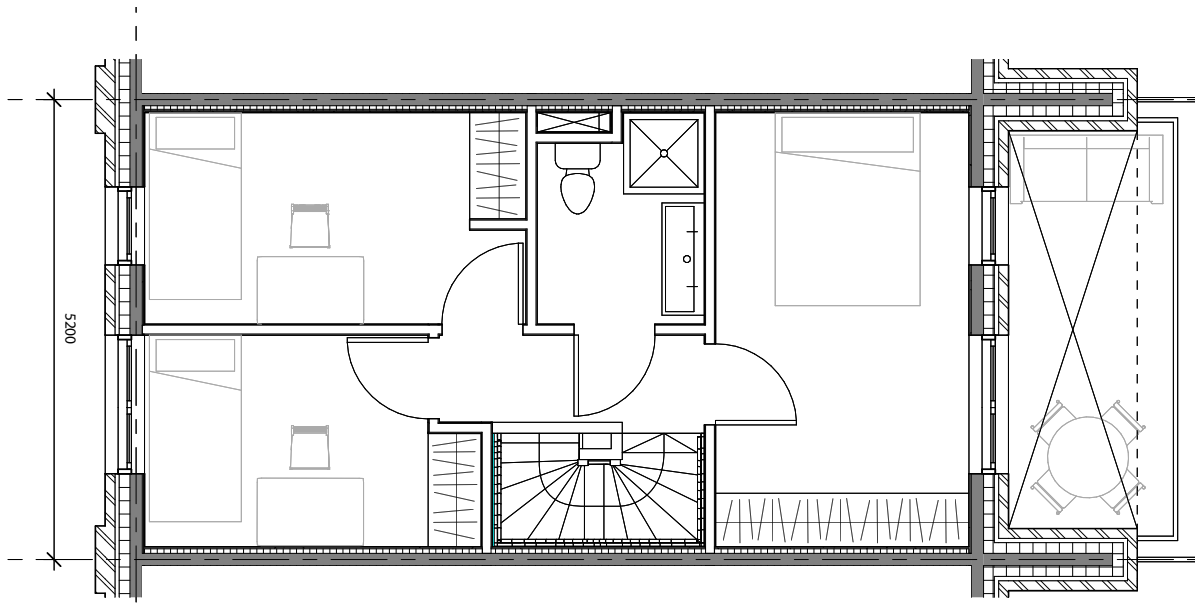
5200

Second floor

West elevation (inner street side)
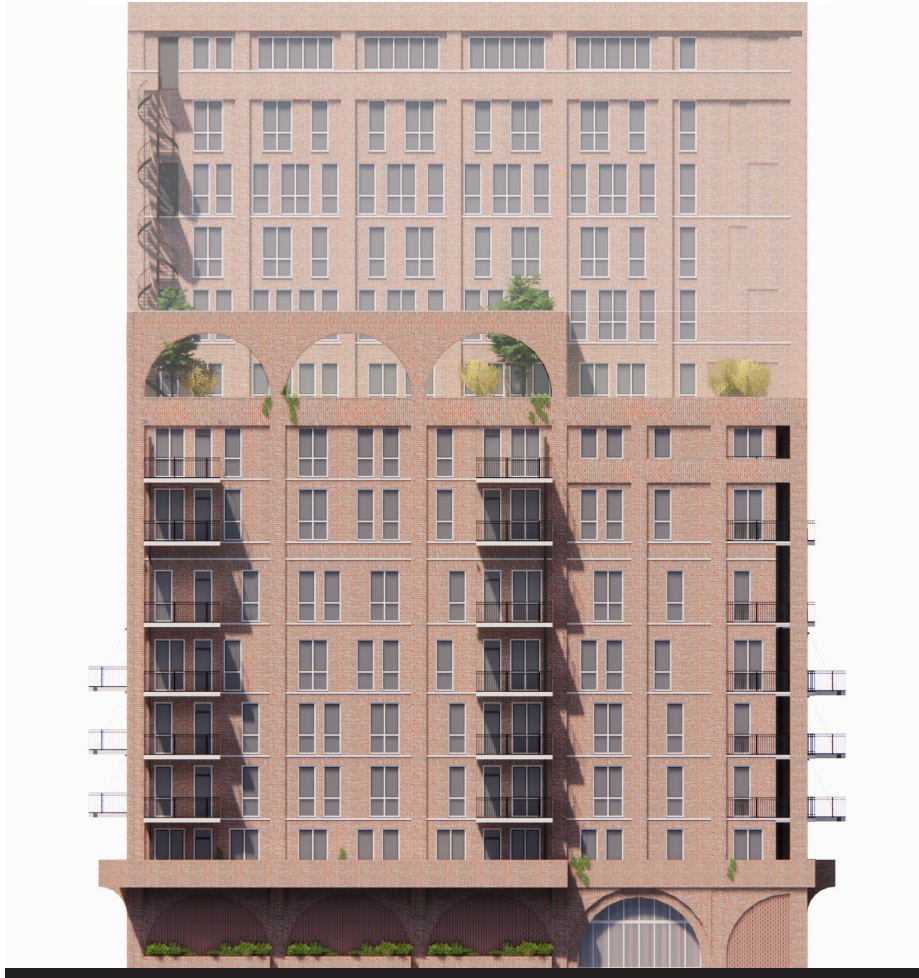
East elevation (waterfront side)

15 mm insulation

Aluminium waterslag *

Prefabricated concrete stringcourse

Waterwerende laag

Rigid insulation

Waterdichte laag

140 mm CLT

Duco ScreenFront150

Brick supporting construction

ClimaTop60AK+

Dichtingsbanden

Wooden profile window with
double glass

15 mm finish floor
55 mm concrete screed layer with radiant
heating
25 mm impact sound insulation
180 mm CLT
2 layers gypsum board
135 mm void
50 mm mineral wool (acoustic insulation)
1 layer gypsum board

Solar panels

Integral blinds
(Duco ScreenFront 150)

Shared electric cars

Exhaust air heat pump

Auxiliary exhaust air heat pump

Preheated natural air inlet
(Duco ClimaTop 60 AK+)

Floor heating

Atrium as buffer

Reflection on the design process

"It is expected from architectural engineers that the decisions they take in the professional practice are based, whenever possible, on the results of scientific research. Not merely on their own experiences, intuition and ideals and on the practice of 'trial and error'" (van der Voort, 1998)

By this graduation project I will be granted a Master of Science degree (MSc). It is expected from me to understand architecture as a body of knowledge to which I have access and I am able to contribute. The documentation of this project will be published in the TU Delft repository as any other scientific thesis. The question arises, does the design of my graduation project meet the scientific standards required? This reflection will focus on the role that research has played in the design process, and whether it can be considered scientific or not.

This graduation project belongs to the studio Dutch Dwelling of the Master of Architecture. Under the title "***Between standard and ideals: The future of housing in the Netherlands***", this studio aims to explore the potentials of residential architecture in the face of shifting values and current ecological and demographic changes. Against the inertia of the 'standards', the architect needs to discover new forms that respond to current ideals. The studio asks, in other words, "how do we want to live and what kind of buildings do we need to allow for that?"

As a quick summary of my project, the design focuses on the lack of suitable housing for families in the cities, particularly in Amsterdam. I propose as a solution a co-housing scheme, a way of organizing autonomous dwellings around shared spaces that include a communal kitchen and dining room. Co-housing has been gaining

traction in the last years, as it is seen not only as a way of providing affordable dwellings but also as a counterweight to the increasing atomization of society. I conclude, as explained in the P2 report, that co-housing suits the needs and desires of families who wish to live in the city, and this forms the basis of the proposed design.

Which research methods did I use to arrive at these conclusions and to elaborate the design of the building proposal? In other words, how did I obtain the knowledge to come to these conclusions and how scientific is the process and the result? In the following paragraphs I reflect on these questions, starting with an exploration of what research is and how it relates to science and design. Thereafter I will describe how my own design process looked like and how research has impacted it. Finally, I reflect on how this project can contribute to the body of knowledge of architecture.

What is scientific research?

Research, in its broadest sense, is simply the "gathering, arranging and analysis of information to gain knowledge" (van der Voort, 1998). Under this definition, to compare different health insurances to arrive at the most beneficial for your personal situation is research. But in order to qualify as *scientific*, research needs to fulfill several other criteria. Archer defines scientific research as "systematic enquiry whose goal is communicable knowledge" (Archer 1995:p.1). The goal of scientific research, in other words, is to create evidence, new knowledge that can be used by others to make informed decisions (AIA, 2013, p:911).

To further understand the difference between scientific and non-scientific research, we can categorize research according to their purpose into three types: exploratory, descriptive, and explanatory (van der Voort, 1998). Exploratory research has the goal of obtaining information on a topic or situation that is little understood. For example, during the first weeks of the graduation project, I had to explore what exactly is the problem I wanted to address. By studying the location and the current demographic trends, I could identify the lack of suitable housing for urban families. Descriptive research constitutes an extension of exploratory research. For example, having identified the topic of urban families, I delved deeper

into describing the housing needs and desires of this group. Both exploratory and descriptive research are based on methods such as observation, literature review, or simply asking experts. These types of research can be more or less rigorous and indeed help us gain knowledge, but they are not scientific. Scientific research propper usually corresponds to our third type: explanatory research. The goal here is to create new, original insights with explanatory power.

In order to achieve the goal of creating new knowledge, scientific research follows well established practices—the scientific method. It begins by stating a clear research question to be addressed, followed by a hypothesis and explicit research methods. A thorough knowledge on the existing literature on the subject is necessary to ensure that the research will provide new knowledge or challenge the existing one. Data is then collected and analyzed in order to draw a conclusion, which either validates or falsifies the hypothesis. The process needs to be systematically conducted and transparently recorded in such a way that a later investigator could replicate the research. Lastly, the research should be publisised and subjected to critical examination by others (AIA, 2013; van der Voort, 1998).

Scientific research is most easily understood regarding what we call the hard sciences, or disciplines in which the natural world is the object of study. Quantitative data can be gathered and experiments replicated in an straightforwardly objective manner. But it gets trickier when we ourselves, mankind, become the object of study. Can disciplines such as history, music, or architecture—in other words, the humanities—be researched scientifically? The answer is yes, with a caveat. In those disciplines, scientific propositions are evaluated not so much through empirical data, but through logical argument, example and citation (Archer, 1995). For the rest, research in the humanities must conform to the same requirements as in the natural sciences. It must have the production of new knowledge (not just information or exploration) as objective, with clearly stated research questions. It must be systematically conducted, with explicit data and sources and a transparently recorded process. And it must be published and subjected to peer review. Research, whether in the study of the physical world or mankind, is scientific as long as the aforementioned requirements are met.

Is the design process a form of scientific research?
Could the design of a building, such as the one carried out during this graduation project, be considered scientific research? I contend it could not; the design process cannot fit the mold of the scientific method. In order to explain this, I look first at the design process itself. What does the design process look like? Then I reflect on the consequences for architecture as a discipline.

Designing in architecture consists in exploring spatial possibilities and evaluating them in order to arrive at a well-thought solution for a problem. The issue is that in architecture, problems are 'wicked'; they are not defined and have to be 'discovered' in the process. For any given context and program, there are several possible solutions, none of which can be considered correct or false.

To confront an undefined problem, design uses, in academic terms, heuristic reasoning. This kind of reasoning involves the use of a priori devices, rules or processes—heuristics—that help define provisional solutions. The evaluation of these solutions provides with new knowledge on the problem that can be used to generate further solutions until a complete proposal is reached (Rowe, 1982). For example, it is known that Le Corbusier was inspired by the form of a crab shell to design the roof of Ronchamp Chapel (Rowe, 1982). Similarly, architects usually work with types, "tried and true" spatial principles that have proved to work successfully in buildings confronting similar problems. Both looking for inspiration in nature or using a type are heuristics, devices that provide a starting point for the solution of an undefined problem.

In practice, architects explore spatial solutions by sketching and making models—by representing form and space. These representations allow architects to evaluate the solutions at hand, revealing the unintended consequences, or the new opportunities, created by their choices. The process is thus not a linear one; sketches and models 'talk back' to the architect, in Schon (1983) words:

> In the designer's conversation with the materials of his design, he can never make a move which has only the effects intended for it. His materials are continually talking back to him, causing him to

apprehend unanticipated problems and potentials. As he appreci-
ates such new and unexpected phenomena, he also evaluates the
moves that have created them (pp. 100-101)

Design can thus be described as a 'web of moves' that architects
make, keeping several possibilities open and testing their conse-
quences, looking for unforeseen issues or hidden opportunities. In a
way, design consists in a complex array of '*what if...*' questions that
progressively lead to the understanding of the problem as well as a
suitable solution. Van Dooren et al. (2013) give an interesting exam-
ple to illustrate this point. They note how a design student and an
expert designer react differently to the task of creating a building
mass that fit its context. The student will usually start by analyzing
the surrounding buildings, comparing their height, inventorying its
materialization, extending their lines, etc. in the hope of logically
arriving at a solution. The expert, on the other hand, will jump
much quicker to simply drawing a more or less arbitrary mass in the
location and evaluating the consequences.

To complicate things further, design is a skill. With experience, the
architect can understand the implication of his moves unconscious-
ly. He becomes, in Schon words, like "a chess master who develops a
feeling for the constraints and potentials of certain configurations of
pieces on the board" (1983, p.104). Moreover, the architect's sketches
can be precise or extremely vague, open to interpretation, and
perhaps illegible to anyone but the author. The process involves, next
to objective and material requirements, also an important part of
artistry and intuition. For these reasons, "the design process never
becomes strictly methodical, systematic, repeatable or objective"
(Hauberg, 2011:50).

But what about evidence-based design (EBD)? Can design be used
to arrive at scientific evidence? EBD can be defined as "a design
process that leverages best practices and current knowledge as
well as primary, secondary, or tertiary evidence in order to solve a
particular problem or answer a specific question through a rigorous
process that resolves design issues with evidence" (AIA, 2013:937).
To qualify as scientific, this process needs to conform to the
requirements mentioned in the previous section, ie. there must be a

clearly formulated research question with an hypothesis to be either validated or falsified by transparently gathered data, usually by means of a post-occupancy evaluation. By its nature, EBD is limited to very specific topics within the design (the location of an entry, for example). One cannot expect to apply EBD on all, or even most aspects of a design. And caution should be taken in not using the rhetoric of EBD to justify a decision based on a more conventional design process. It is clear, however, that *all good design should be informed by scientific research*.

We can conclude that the design process, with its method of reflecting dialectically upon sketches and models, is hardly compatible with the requirements of scientific research. Yet this should not undermine design's value in creating knowledge. Science is, in the end, not the only way in which we can gain understanding of the world. Architecture deals with buildings and their context. Its main question is the material: "Architecture is in the most fundamental way about how ideas are embodied" (Hauberg, 2011:49). The way architects gain knowledge is by working with form and space, that is, drawing, modelling and studying existing buildings. The intention should not be to force a scientific methodology on architectural design, but to understand how the discipline works on its own terms—how knowledge can be gained and generalized from design.

The question of whether my graduation constitutes a contribution to the body of knowledge of the architectural discipline, in the sense that it can be accessed and used by others, will be dealt in the conclusion. We will firstly explore in the next sections how research has impacted my design process.

Preliminary research (P0-P2)

The first months of the graduation studio were dedicated to exploratory and descriptive research. The aim was to identify and understand the problem to be solved by the design. It concerned three main areas: the location, the 'target group', and the conceptual design

The location
The research on the location, Minervahaven in Amsterdam, began

with attending a lecture by Amsterdam's chief urban planner, Koos van Zanen, over the municipality's plans for the location, as well as reading the official literature by the municipality. What is the history of the location? What is the vision of the government? Which functions should take place there? What is the desired density? To that end, I consulted old maps of the location and the existing official literature.

Our second way of analyzing the location consisted in visiting and documenting it with photos and sketches, with the aim of experiencing in first person the dimensions, the existing sightlines, the character of the old and new buildings, the smell and the sound of it. In other words, to discover the location's character, its *genius loci,* to which our design should respond. The research concluded with the selection of a single picture that represents the character of the location, a pars pro toto, presented with an oral explanation to the group.

The potential of the location was further explored by designing an urban plan. To speed up the process, four existing plans were selected and superimposed on the location by four different groups of students. These were the Barcelona grid, the New York grid, the Borneo Sporenburg plan and the campus model. This research helped to explore not only the urban layout and street profiles, but also the consequences of applying different typologies—urban blocks, skyscrapers, high density, low rise—with regards to daylight, accessibility, shadows, etc.

By developing several proposals for the same location, the advantages and disadvantages of each proposal can be compared with regards to the 'target groups' that each student choses. Here we come to the crux of the question, the search for a problem regarding housing to which the graduation design project should provide an answer.

The 'target group'
To find a problem that could be resolved by an architectural proposal, I realized an exploratory research consisting in a literature review drawing from sources such as newspapers, scholarly books and governamental Dutch documents. The result of this literature

review research can be read in the P2 booklet; here we will sum-
marize it briefly. There is a lack of affordable and suitable housing
for families that wish to live in the city, or 'urban families'. These
households have to make a decision between living in suboptimal
conditions in the city or, more often, to move to smaller towns or
to the suburbs. As a result not only the families lose, but also the
city loses valuable workers and the quality that families bring as
social connectors. Given that the project location consists in a rather
central area in Amsterdam, I have therefore chosen 'urban families'
as the main target group to which my design proposal should offer a
housing solution.

Having identified the problem, the next step is to propose a possible
solution, or an hypothesis. In order to do that, we need a deeper un-
derstanding of the needs and wishes of urban families. Here we enter
the terrain of descriptive research. Further literature review showed
that urban families value a work-family balance in a situation in
which both parents usually work outside home. They also value the
services and activity that the city offers, but would like to live in
a relatively quiet environment in which children can play outside
without worries. They are furthermore willing to live in a rather
small house if this allows them to enjoy urban life. Based on these
needs and wishes, I concluded that a co-housing scheme can provide
a solution to the problem.

The conceptual design
With urban families as the target group, and a co-housing scheme
as a proposed solution, the basis was set for the start of the design
process. Which form should the building take? The design process
began by specifying a location in one of the four urban plans pro-
posed and choosing several buildings as case studies which could be
suitable for the location. In order to explore and arrive at innovative
typologies, students were asked to combine (superimpose, intersect,
etc.) the case studies. This design research consists, again, in asking
'what if...' questions, trying out possibilities with drawings and
models, and evaluating what happens in an iterative process.

The design of a conceptual building that could, in theory, answer to
the problem specified for the selected target groups, brings the pre-

liminary research phase to a conclusion. The results were presented before a committee of tutors, who evaluated whether the problem statement and the conceptual solution were feasible for obtaining the master diploma.

After the proposal was accepted by the committee of tutors, the next phase began. In this phase, the conceptual design was further developed into a concrete, buildable design.

Designing a solution (P2 – P4)

The research methods used to inform and develop the design can be divided in two types: the application of scientific research to inform the design, and the research implicit in the design process itself.

Let's start by giving some examples of the scientific research that was used during the design phase, and how it has impacted the final result. The topic we will focus on is co-housing, which has been the object of recent academic study given its rising popularity. Some of the questions arising during the design phase of a co-housing scheme are, how big should the community be? How to ensure that people will make use of the communal spaces? How to preserve privacy while achieving density?

How big should the community be?
Part of the solution to achieve affordability is density. Higher density means that a certain economy of scale can be achieved, allowing for more shared services and driving down the costs per capita of construction and maintenance. But density brings with it the danger of anonymity, which would be counterproductive to the idea of creating a community where neighbours know and trust each other. How big should the community be in order to be sustainable? To answer this question I relied on a popular notion from anthropology known as the 'Dunbar number'.

The 'Dunbar number' was introduced in the early nineties by anthropologist Robin Dunbar, who maintains that there is a cognitive limit in the number of people an individual can maintain stable inter-personal connections with. This number was obtained from extrapolating group sizes in related primates, as well as in average

stable group sizes across human history. Dunbar came to the conclusion that we can maintain an average of 150 stable connections (Dunbar, 1992). Elsewhere, Dunbar explained this number as "the number of people you would not feel embarrassed about joining uninvited for a drink if you happened to bump into them in a bar" (Dunbar, 2004).

Further research into co-housing literature seemed to confirm this number. In their influential 1982 book 'The small collective house' (*Det lilla kollektivhuset*), the Swedish group BIG (bo I gemenskap) recommended a size of 20 to 50 households (Hagbert et al., 2020). Similarly, Fromm (1991) argues, based on precedents study, for a size between 18 and 35 households. Smaller communities lack privacy and are more vulnerable to social friction, while larger communities risk anonymity.

Based on this research, I arrived at the conclusion that, in order to stimulate interaction and trust among neighbours while maintaining the desired density, the building should be split into two different communities of around 25-35 households. Each community would share their own communal spaces, including a communal kitchen and a shared roof terrace. This strategy achieves both the benefits of community and of density. By superimposing both communities, the cost of the ground is shared by both, and other spaces such as the parking or the fire-escape routes can also be shared between both communities, driving costs down and thus achieving the affordability of the economy of scale.

How to design to increase social interaction?
Social interactions create the trust among neighbours required to form stable communities. While the built environment is not the only factor contributing to social interactions—social and personal factors also weigh—design does play a role in facilitating those interactions to take place. Williams (2005) has elaborated a literature review on the study of co-housing, focusing on how design in co-housing can enhance or obstruct social interaction. The literature she reviews is based on case studies, mostly ones in which the researcher has spent some time in co-housing communities studying them (ethnographic research). Based on this literature

review, Williams has distilled some 'principles of designing for social interaction'. These principles were very useful to guide my design. These are some examples:

Visibility
In order to ensure the use of the communal spaces, these need to be centrally positioned, easily accessible and visible, ideally from the dwelling itself. "Residents' ability to see and hear others using [communal] spaces outside their home greatly influences their sense of community and enables them to observe others with whom they would like to interact" (idem, p. 198).

The main challenge in achieving visibility of the communal spaces in an apartment building is that the visual connection is mostly vertical, which requires the use of voids. This has been a guiding theme during the design, and its impact can be seen in the layout of the circulation system. In the lower floors, the atrium itself directs the gaze upwards, towards the shared roof garden and the communal spaces on the 5th floor. The corridor on the 8th and 9th floor is visually connected to the communal space above by voids, and the maisonnettes are visually connected to the roof garden below.

An added benefit of using voids is that the circulation spaces gain quality, enjoying daylight and spaciousness. This provides the opportunity to use them as spaces for activity. For example, the 'patios' created by the atrium and the corridor can be used by children to play, or adults to socialize on their way home. Furthermore, the dwellings surrounding the atrium and the corridor have windows opening towards the interior of the space. This allows the inhabitants to have a look at the circulation space, fulfilling the principle named by Williams: "Opportunities for surveillance within the community are key to higher levels of social interaction" (idem, p.198)

Lastly, the fact that the circulation spaces are covered allows the residents to use them even with bad weather, a situation not uncommon in Amsterdam. This ensures that residents can spontaneously meet in them for a longer period of the year—an attribute of success identified by Marcus (2000)

Semi-private space
A second principle that aids social interaction is the presence of semi-private space, or buffer zone between the individual dwelling and the communal space. In William's words: "Semi-private space or buffer zones (gardens and verandas, etc.) are very important in terms of social interaction. They can create a protective barrier "providing a degree of privacy and territorial control with options for active contact into adjacent public space … These spaces also provide residents with an area in which to express themselves and their lifestyles" (Williams, p.198)

While this quote is written with ground bounded dwellings in mind (apartments cannot have front gardens or verandas) the principle applies as well to apartments. During the design, the aim has been to provide each dwelling with enough space at the front door to allow space for plants, shoe racks or baby pushchairs without obstructing circulation. By providing generous circulation spaces with daylight, I hope residents may extend their private domain into the communal space by personalizing their front door area and creating buffer zones that encourage interaction.

Less private space
While co-housing acknowledges the need for privacy and provides with autonomous dwellings to which residents can retire, Williams's research shows that small units can encourage the use of communal spaces. "If residents have less private space they are more inclined to spend time outside their unit" (idem, p. 199). Therefore, during the design process I've tried to limit the size of the individual units, keeping specially the living room and the kitchen rather small, as these functions can be performed in the communal spaces. Despite their limited size, dwellings are equipped with ample storage by, for example, including built-in closets in the bedrooms. Likewise, the external storage room of the dwellings has ample dimensions.

We have seen how anthropological research informed how big a community should be and how design can encourage social interaction. Both questions emerged during the design process and were partly resolved by consulting scientific sources from peer-reviewed academic journals. In this sense, this design can claim to be based

upon scientific research.

But while this scientific research can serve as a guiding theme in the design, it cannot establish what the design will finally look like. It is not a formula to be applied in order to get one design that logically follows. On the contrary, the design process itself is a form of open-ended exploration, a search for the most suitable translation of the guiding themes into spatial form. Moreover, while some aspects of the design can rely on scientific research, countless others are left to the intuition and tacit knowledge of the designer. These aspects are explored and evaluated during the design process. In the following section we will describe which methods were used during the design process to explore the problem and evaluate solutions.

During the design process, one source of invaluable knowledge are constructed buildings that faced related challenges to those I am dealing with. How have their architects confronted similar problems? Below are some examples on how I used research on precedents to guide the design.

The façades
The building's façades frame the public space and give character to the building and the city. They perform an essential role in creating a positive urban experience. Despite their importance, there is little contemporary literature, scientific or otherwise, on how to design successful façades. The task is left for the architect to find out by closely studying precedents to extract their implicit lessons. To that end, I realized some experiments by imitating the façade of several modern buildings which I considered fitting in character and materiality for the location. Using a 3D modelling program (SketchUp), I drew two different façades on the building volume, inspired by Casa de las Flores and Dalston Works (fig. 1). This quick experiment allowed me to discover some of the problems that the design will have to face. For example, how to integrate the balconies of the maisonettes in the façade in a way that provides for privacy for the dwelling as well as a pleasing façade? To answer the question I looked for a third precedent—200 Eleventh Avenue—that could solve the issue and applied its façade to the building volume (fig. 2).
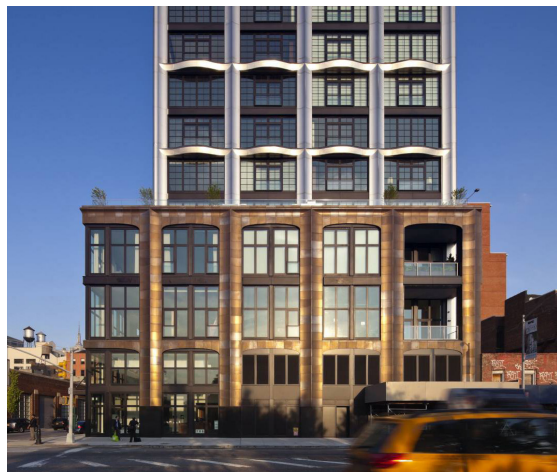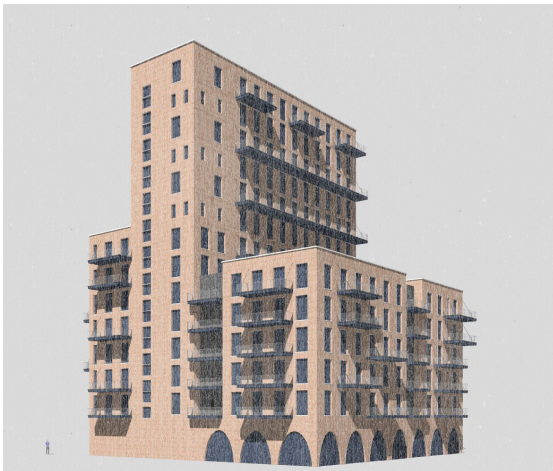
While none of the three sketched solutions were completely satisfactory, they allowed me to discover and evaluate different alternatives for materiality and form. Elements present in all of the three alternatives can be recognized in the final design: the arches in Casa de las Flores, the hanging balconies of Dalston Works and the double-height frames in 200 Eleventh Avenue.

Besides the aforementioned precedents, many others were used, implicitly or unconsciously, in guiding the façade design. Knowledge on how to articulate tall buildings was sought in early american skyscrapers; the materiality, colors and forms of pre-war Amsterdam architecture were studied to anchor the building in the city's traditions; and contemporary residential architecture provided with lessons on how to incorporate generous balconies and playfulness into the façade.

The common room
Having not ever visited any co-housing building, I was unsure on how to design the common spaces. How are those spaces used? In order to better understand this question, I investigated existing co-housing buildings in two ways, gathering both 'objective' information such as plans and more 'subjective' information such as interviews and photographs (fig. 3).

Plans allowed me to investigate questions regarding the general organization of the building. Where is the common room located? How is it accessed? How it is connected to the shared space outside? But also to look into more fine-tuned details, such as the exact dimensions of the rooms. For this project, I redraw the common rooms of two celebrated co-housing projects. By drawing them at the same scale and placing the same furniture in them, it was easier to compare their similarities and differences. This informed my decisions regarding the dimensions, location and accessibility of the common rooms in the design.

More 'subjective' information such as photographs and interviews provide invaluable information on how the communal spaces are actually used. Yet most photographs found in architectural magazines appear to be highly staged. Everything is brand new
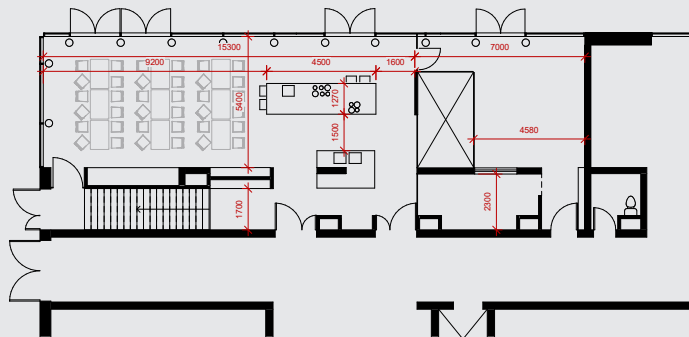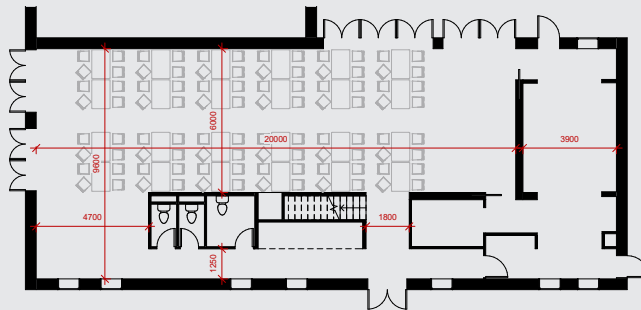
and barely used, hiding essential information for the designer. Fortunately I could find some photographs of how those spaces are used in the book Together! (Kries et al., 2017), as well as several interviews which helped me understand the experience of the residents.

Drawing / modelling
Experiments in the process of architectural design are carried out in the form of drawings and models, what van Doorne calls the 'laboratory' of the design process (van Doorne, 2013). By drawing or modelling ideas, the designer is able to visualize them and confront the unexpected consequences of those ideas in an iterative process. During the design process I used several means to visualize ideas, from hand drawing to computer drawing and modeling. Hand drawn sketches are quick and imprecise, leaving the drawing open to several interpretations. This method is useful for early stages in the design. For more detailed explorations I used two softwares: Revit for 2D plans and SketchUp for 3D impressions.

In the previous section, we have seen how SketchUp was used as a way of studying precedents in order to find a solution for the façade. Here we will describe how SketchUp was used to explore the architectural qualities of the atrium. This experiment was not directly based on explicit precedents, but on my own intuition, and serves as an example on how knowledge can be gained by the design process.

The experiment began by modeling one possible materialization of the atrium (fig. X). Technical aspects such as the structure, daylight or circulation were examined, but also more subjective qualities. Is the space and the materialization adequate for a residential building? Does it feel welcoming or too "institutional"? After analysing the model, I concluded that perhaps a more "domestic" character would be more fitting, and realized a second variant with warmer materials, more layering between the dwellings and the communal space, and a more enclosing top floor (fig. left). These alternatives are then compared in order to arrive at a satisfactory synthesis.

This exemplifies how knowledge on architectural qualities is gained by drawing and modeling. By creating variations on different characters for the space, I gain more knowledge on those subjective aspects. What makes this space feel "institutional" or "domestic"? Trying out my ideas on these qualities helped me better understand them, which in turn allowed me to make more informed decisions.

The research performed by the design process itself involves two main activities: distilling and applying the knowledge embedded in precedents—the "built literature"—and the exploration and evaluation of possible solutions by drawing or modeling them. Both activities overlap each other and are done more or less implicitly during the design process.

Ethical issues

I would like to touch upon some ethical issues that I have confronted in the design process that have to do with designing for a community. In the first place, how much should the architect decide? In practice, co-housing is usually designed with direct help from the future residents. This was not possible for this graduation project. This brings some dangers of 'utopianism'. For example, what should the relationship be between communal space and private space? It is a recurrent theme in utopian architecture that private space is usually neglected in favour of communal. In the design, attention has been given to ensure that each household can always retire to a private sphere.

Another ethical issue regarding building for a community is the danger of creating a "gated community". In other words, the idea of 'community' is often celebrated as integratory, but we should not forget that a community is also, by definition, exclusionary. A community depends on an idea of 'we' in opposition to 'them'. To counteract the potential negative effects, I have tried to ensure that the building contributes positively to the public realm, creating a public plinth. This issue has also been dealt with on the urban scale by providing high quality space for pedestrians separated from motorized traffic. This creates an attractive space for shops, cafés, and playgrounds, encouraging residents to make active use of the public realm. The isolation of the community is in this way prevented.

Conclusion

We started this reflection asking whether design can be considered science. As I have shown, science is first and foremost a method. This method is only applicable to design to a limited extend. Research in architectural design is mostly carried out through the means of sketches and the study of precedents. It is a subjective process in which there are no correct or false solutions. Can we still claim that this design project provides a meaningful contribution to knowledge?

My answer is yes. For one, I have used scientific evidence to guide the layout of the building, gathered from anthropological research on social interaction in co-housing communities. Perhaps more importantly, I contend that knowledge specific to architecture is embodied in the buildings themselves and their representation.

The guiding theme of the design has been the thesis that co-housing can provide suitable housing for families in a high-density urban context. The main solution involves stacking two different communities on top of each other to achieve the advantages of density while avoiding its dangers. This includes:

— How to divide an apartment building into smaller clusters that follow the optimal group size according to Dunbar (~150)
— How to integrate the communal spaces to make them visible from the dwellings and promote their use
— How to transform the usually 'dead' circulation space in apartment buildings into places of meeting with natural ventilation and daylight
— How to create a volume that keeps an intimate perception of the street by using three different circulation typologies: an atrium at the base, a corridor in the middle section, and a gallery on top.

My proposal therefore contains embodied knowledge that can be used by others when confronting similar problems.

Due to the peculiar characteristics of the discipline of architecture, the scientific method is not fully suited to produce new knowledge in an architectural context. It may nevertheless be considered that,

whilst providing the building blocks for new architectural knowledge, science does not define the design process as a whole.

During my research, scientific knowledge has been indispensable in making my design a coherent answer to the necessities of families in an urban environment. I can therefore say that design can be considered a parallel way of obtaining knowledge within the context of architecture. Plainly put, architectural design is not scientific, but exists next to science as a way to generate knowledge.

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