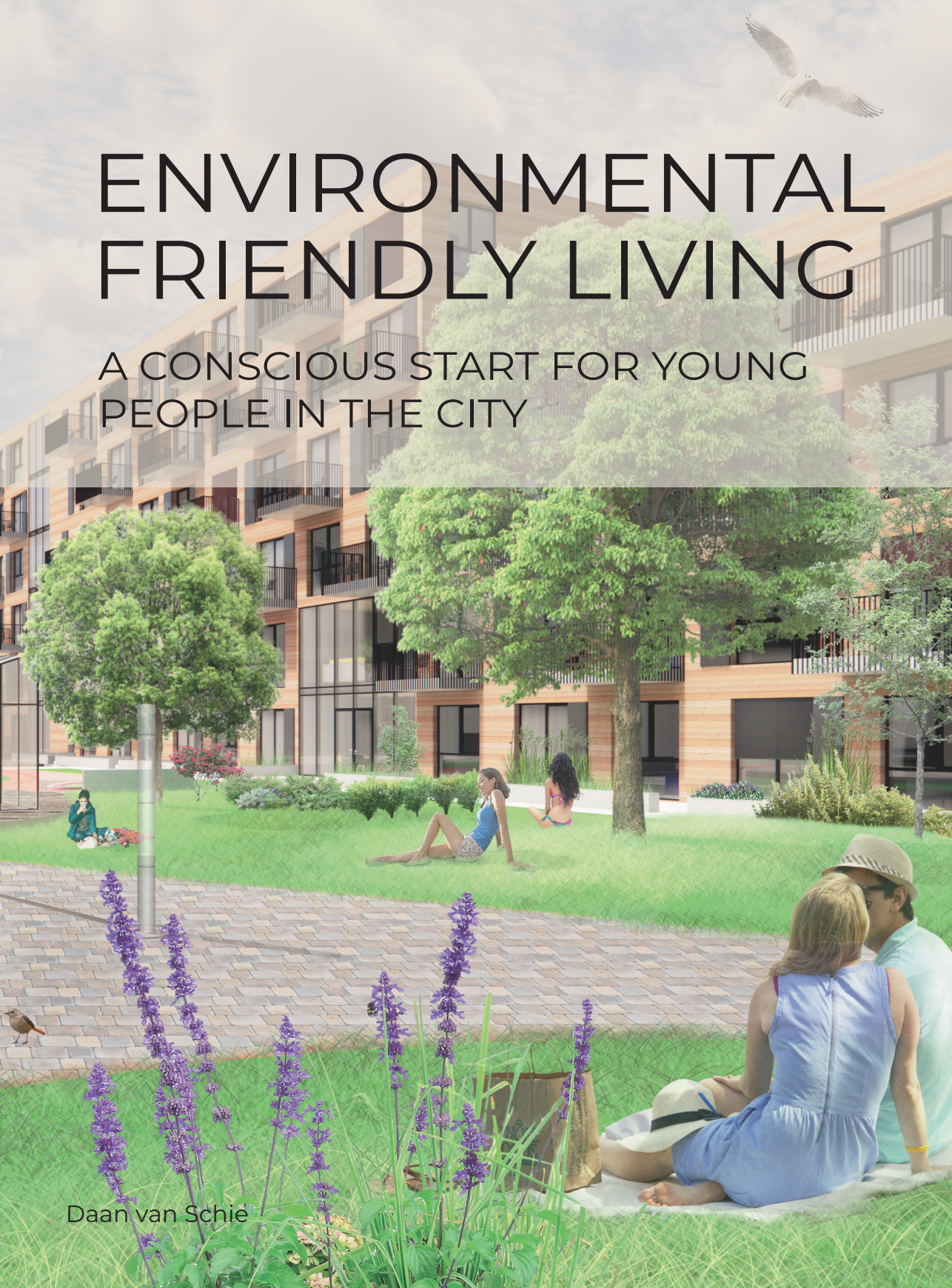
ENVIRONMENTAL FRIENDLY LIVING

A CONSCIOUS START FOR YOUNG PEOPLE IN THE CITY



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A CONSCIOUS START FOR YOUNG PEOPLE IN THE CITY

Graduation project
TU Delft
MSc Architecture

Dutch Housing
2020/21

Mentors:
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Foreword

Before you lies my graduation project within the Master Architecture at the Delft University of Technology. The project is done within the studio Dutch Housing and concerns the research-based design of dwellings within a soon to be transformed harbour area in Rotterdam. With the designs it is the goal to contribute to the larger debate about a better and more inclusive future. For this, the built environment and with that architecture is of serious importance. The current housing shortage in the Netherlands is one of the main concerns of the studio. To come to new solutions for these societal issues the project is about housing larger groups of people within a dense urban environment, such as the city of Rotterdam.

This booklet represents almost an entire year of hard work and is the final result of a tumultuous period. A year full of complex decision making, sketching, modelling and researching. For me personally the project was very instructive and I feel like I learned more in one year than in all 5 previous years of education. It also brought me genuine enthusiasm for new topics within the field of architecture. Topics such as constructing with wood and including nature in the built environment will become more and more important in the future and I am definitely planning to expand my knowledge on these topics in the coming years. With this said, the graduation project gave me a more clear vision for the future of architecture in general. Moreover it brought me ideas about what kind of architect I would like to become and which path I want to follow during the first phase of my career.

A graduation project is always a special one. It is the piece the resistance of your education and because of the length of the project and the importance of it, it can be stressful from time to time. But this past year it might have been even harder. Tutoring via Zoom, barely getting to know your fellow graduate students and not being able to relax with a cold beer in the Bouwpub, it was quite tough. COVID-19 controlled our lives almost every day and took away most regular ways to have fun and distraction. Because of this I, and with me a lot of other students, spend my time mostly behind my laptop at home. But despite all this the project remained interesting and enjoyable for most of the time. The tutoring of my mentors had something to do with this for sure. So for this and for all the guidance and knowledge they were able to bring me in the past year I would like to thank them. It was a pleasure to have you as my mentors Theo, Pierijn and Ferry! Last but not least I want to thank my friends and family for their support and helpful conversations about the project. This helped me finding new ideas and kept me sharp. A special thanks to my dad who, despite not being an architect, was always there for me when I was stuck. His locigal way of reasoning and knowledge gathered during his carreer was very unraveling at numerous moments in the past year.

Table of content

Introduction

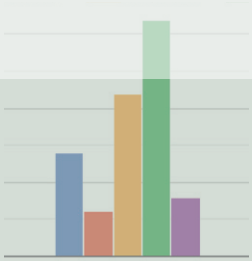
This booklet showcases my design project of the past year. It can be seen as a summary and will display all phases of the project.

First of all the initiative for the start of the project will be elaborated. This started with the decision to choose a specific target group to design for, in my case young starters. For the past few years it has been extremely difficult for them to find home. There are multiple factors that contribute to this problem. As a result one of the basic needs in life is insufficiently facilitated for this large group in society, which is a serious problem. Therefore I decided to search for a solution to this problem; by designing a housing complex that facilitates dwellings for young starters.

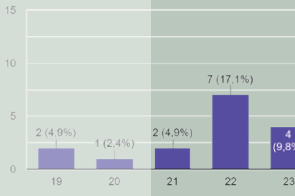
With this choice the project got more specific already and a starting point was present. The research done on the topic of the target group and the specificities concerning its relation to dwelling will be presented in the first part of this booklet. A second, more personal aspiration that arose during the project is the topic of an environmental friendly building. For the past years I started to worry about climate change and other environmental issues. This eventually convinced me that architects have to contribute to these issues as well. As a result the second objective in the project became the design of a building that took the environment into account. The research on these topics resulted in starting points for the design, which will be presented at the end of the research.

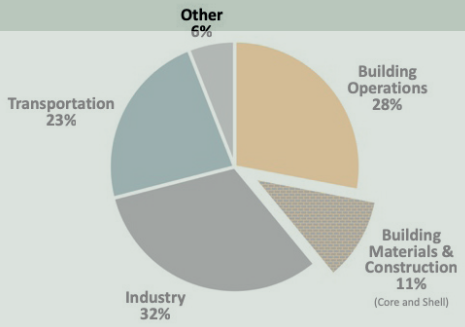
These starting points shaped the design of the actual building. This design is elaborated in the middle part of the booklet. Starting with the concept of the building the design will be showcased and all important elements of the building will be discussed. The final part of the booklet will include a reflection on the relation between the research within the graduation project and the final design. How did the research influence the design and what types of research have proven to be helpful at which decisive moments during the process. Also the relevance of the design project in relation to the broader societal context will be explained.

RESEARCH



The graduation project within the studio of Dutch Housing consists of both research and design. These two are in close relation with each other. The research is at the same time also the starting point of the graduation project. In this first part of the report the different types of research done during my graduation project will be elaborated. This research in the end results in a design brief, in which the aspirations for my design will be stated. Because research and design go hand in hand and are not performed in linear process, in practice they are intertwined and mingled. However, in this report research and design are addressed as two consecutive topics, to give a clear overview.

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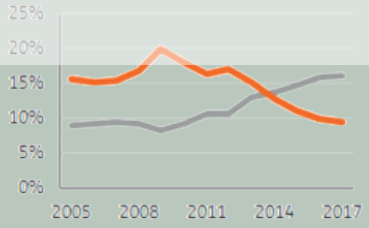
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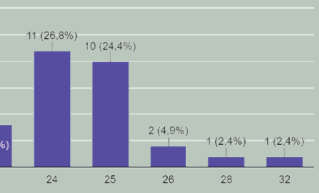
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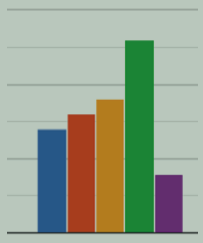


Young starters and their (hopeless) situation on the housing market

The last few years, the rising housing prices in the Netherlands are a hot topic. Everywhere on the news, items on this topic have been addressed. Especially in the cities of Amsterdam and Utrecht, the prices of houses have skyrocketed. But in other major cities in the Netherlands too, such as Rotterdam, this has been the case. Within the large amount of news items on this topic, one group of people that is highlighted many times is the young starter. News titles mentioned the difficult position this young people are in, and the dark perspectives they are facing on the housing market.

This topic grabbed my attention. Since I am now at the end of my studies, with this graduation project hopefully as my last project in the masters, this is a topic which affects me and my generation on a personal level. Within a year I have to leave my comfortable and above all cheap student house. Then I have to enter a housing market on which it is - so it sounds - almost impossible to find a house. Not a very pleasant prospect. Therefore I would like to contribute to the debate. In my graduation project I am doing research on the young starter and the preferences and characteristics of this group. Additionally, my graduation project is about translating these findings in a design, which will facilitate housing for young starters.

Problem statement

The accessibility of the market for young starters is currently one of the biggest issues on the Dutch housing market. These young people, who are in general in their early- or mid-twenties, threaten to fall into the cracks.[1] The fact that they are well educated makes that most of them earn too much money to have a chance at social housing. To buy a first house, however, they don't have the money either. With strict rules on mortgages it is harder to get a loan to buy a house.[2] Moreover, it is tough to save money for the purchase of a house, when the housing prices increase faster than you can save money.[3] What makes it even worse is that students nowadays have more depts after their studies, mostly caused by the abolishment of the study financing by the state ('studiefinanciering'). This average dept is likely to increase the coming years, unless the government decides to change this policy again. Therefore, buying a house is almost impossible at the moment.

When buying is almost impossible, and social housing is also not an option, people are forced to find a house in the private rental sector. To be more specific, this group mostly has to find a house in the middle- to high segment of the market. However, the supply in this rental market is insufficient. Prices are skyrocketing, especially in the larger cities. Therefore people with a middle high income, such as most young starters, are forced to leave the city.[4]

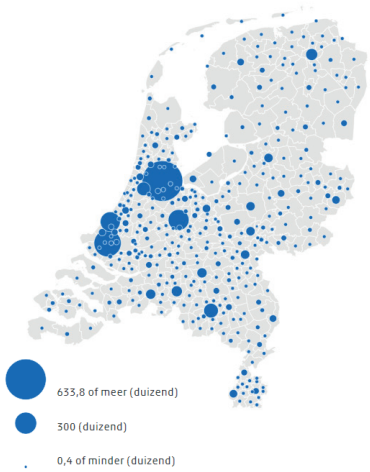
It all sounds very pessimistic. Some even speak of a lost generation on the housing market.[5] Something which would be dramatic, cause this would have a big influence of the lives of this generation too. It is thus of utmost importance to solve this problem. Partially this will be something that has to be done in politics and policy-making. But at the other side of the spectrum, architects and urban planners can also contribute to this topic by thinking of cities and buildings which facilitate housing for this section of the population. For my graduation project, it raises the question: what type of dwellings are suited for young starters and can preserve them for the city?

Definition of young starters

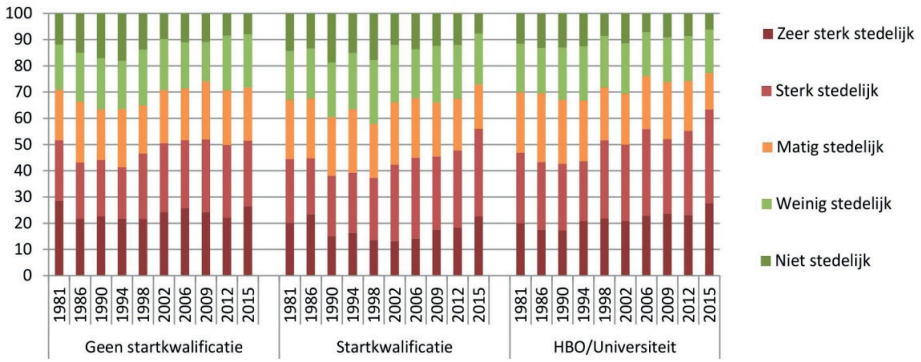
To do research on the users, it is first needed to make a clear definition of the target group. As mentioned before, young starters are mainly in their early-twenties or mid-twenties. Within my graduation project, young starters are therefore defined as young people under thirty years old. Exceptions, such as middle-ages people who are doing a second study after working for years, are excluded. These people have different financial opportunities and are in completely different places in their live and are therefore not representative. Furthermore, young starters are in this research defined as people who have obtained their diploma at the university of applied sciences (HBO) or the university (WO). The reason for this is that most of these people make too much money to get into social housing. Community college (MBO) students for example will, in general, earn less money and will therefore have a completely different perspective and starting point on the housing market.

The young starter needs the city...

As briefly mentioned in the problem statement, young starters are having trouble finding affordable housing in the city specifically. Prices are going up in a very fast pace since the last financial crisis, although it seems that at the moment of writing this report that this increase has stopped, partially by the corona-crisis. But why is it so important for the young starter to live in the city? The biggest reason is that there are more jobs opportunities in the city. In the G4 (Amsterdam, Rotterdam, Den Haag and Utrecht), the amount of jobs is substantially larger than in the rest of the country.[6] In the past, people who were thinking of starting a family moved out of the city. In this way, the children could have a safer, more calm environment to grow up. But in the last twenty years this has changed. Young families too want to live in larger cities. Nowadays, it has become quite ordinary that parents both have a job. In that case, it is convenient when your job is close by. The same for the day-care and the supermarket. Having everything within short range saves time, and makes it easier to combine a job and being a parent.[7] Besides the availability of jobs, the city attracts the young starter because it is vivid. There is a lot to do, cafés and restaurants are close by, and there are other young people. This all together makes the city very attractive for the young starter.



Number of jobs per municipality (CBS, 2019)



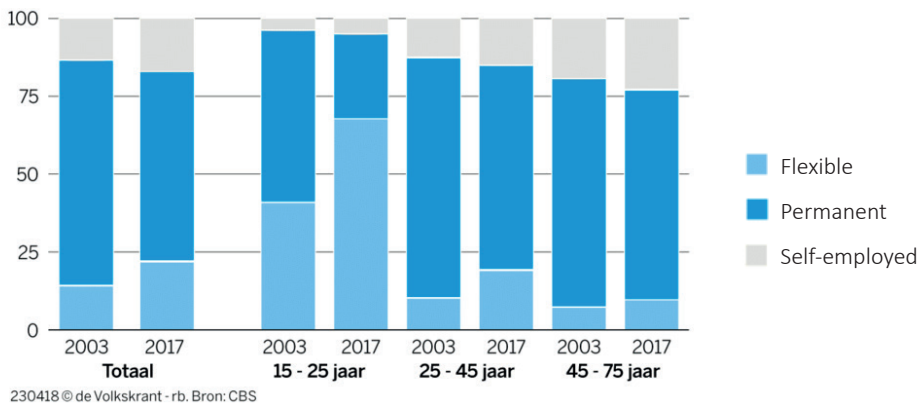
Prefered living environment, according to education level (PBL, 2017)

...but the city also needs the young starter

On the other hand, keeping the young starters in the city is important for the city too. Most important is their contribution to the economy. Young starters may not have a lot of money to spend right away, but because they have a higher education they most likely will within a few years. This means they are, in a slightly later phase, one of the groups which contribute to the economy in the city. The are also one of the largest spenders in the cultural and horeca sector, and therefore are part of the supporting foundation of this vital sector.[8] Finally, because they spend more than average, they influence the tax income in the city. This increase in tax income for the city will provide a larger budget of the municipality, from which eventually the whole population will benefit.[9] A sufficient supply in housing for young starters in the city is therefore crucial. It will contribute to an inclusive city. This makes it a topic which fits in this design studio ,as inclusiveness is one of the general aims in the Dutch Housing studio.

Flex contracts

As mentioned in the problem statement, young starters are forced to find a house on the private rental market most of the time. Living in a rental house in the beginning of their career is not necessarily a bad thing. It gives flexibility, which is convenient in these times with a lot of young starters having a non-permanent contract in their first job.[10] In 2015, Van der Werff en Berkhout stated that only around 25% of the young starters have a permanent contract within two years after graduating.[11] At the age of 28 there are more people with a permanent contract than those who have a temporary contract. This turning point was 10 years ago at the age of 24. This means a four years difference, which is quite a big shift in only ten year's time.[12] Therefore, adding rental houses to this market could be a solution to the problem. It could decrease the prices, something that would provide the young starters the chance to start saving money to buy a house in the next phase of their lives. It should be noted that having a temporary contract could be a big problem for rental houses as well. For a percentage of rental houses in the private sector you must have a permanent contract to be considered.[13]



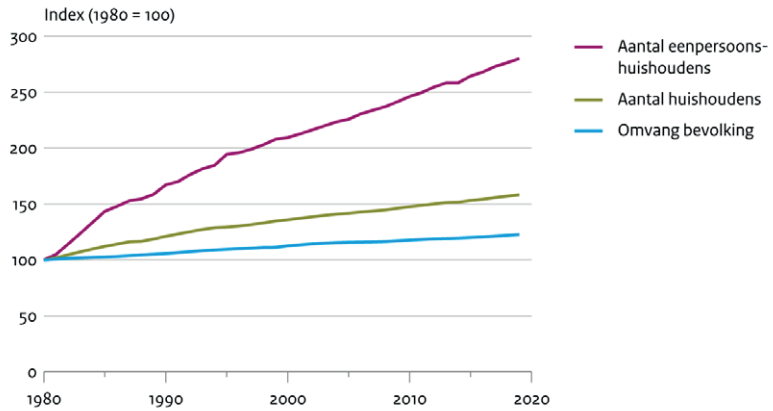
Type of employment of the working population, in relation to their age(CBS, 2018)

Smaller households

The last couple of years, the number of households is rising in The Netherlands. For example, in 2017 the number of households in the province of South-Holland raised with more than 16.000 to a total of almost 1.69 million households. The expectation is that this increase will continue, with about 189.500 additional households in 2030. This increase is in part caused by the rising amount of one-person households. In the city of Rotterdam is about 48% of the households a household of one-person. This will rise to about 50% in 2040, according to the CBS. Compared to the Dutch average, this is a high number. Urban areas and large cities in particular consist of a higher percentage of one-person households than of two-person households. In the more rural areas this is the other way around.[14]

Independent dwellings

We do not only need more dwellings, we also need more independent dwellings. Younger people nowadays prefer to have their own home with facilities such as a bathroom and kitchen. According to BPD, millennials do not want to share living spaces or facilities. According to their research, about 70% of the millennials between 17 and 27 years old want an independent home.[15] This number is just an indication for this research, as the millennial is a way bigger group of people than the young starter in this research. However, this indication is strengthened by Paul Schnabel from the SCP (Sociaal Cultureel Planbureau). He mentions the higher standard of living and the influence on the willingness to share facilities. Young starters have the desire for independent dwelling with its of facilities. Smaller studios with these independent facilities are a good solution to solve the shortage on the housing market, according to Schnabel.[16]



Population size and number of households in the Netherlands(CBS, 2020)

Different types of young starters

Within the group of young starters, there are many different types of people with many different preferences. To make research and design a bit easier, three 'groups' of young starters are defined. These three groups, which are also appointed by Paul Schnabel of the SCP,[17] are based on the composition of their household. This makes it immediately applicable on the type of dwelling they live in. In the remaining part of this report these three groups will be used when researching the preferences and the different types of dwellings.

Living alone

The first group is the young starter who is living on his/her own. This type has trouble buying a house, since he/she has only one income, which makes it even harder to get a mortgage. This makes that there are very little dwellings available for this person, especially within the city.[18] A small dwelling with independent facilities close to the city centre is desired by this type of household.

Living together

The second group is the young starter who is living together with his/her partner. This type has different preferences that someone living alone. They need a bit more space and might have a larger budget (depending on whether they both have an income or not). As with the young starter living alone, a problem is that currently there are not enough dwellings available for this type of household. And the ones who are available are too small.[19]

Young family

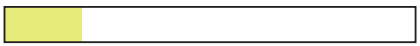
The last group are the young families. Some young starters may have children already or carry the wish to have children in the short-term. They have profoundly different preferences in terms of housing, given that children ask for a particular living environment. Which aspects are part of this living environment will be discussed later in this report. What is unmistakable is that these young families are the backbone of the economy of the city and therefore need to be bound to the city.[20]

Different types of dwellings

The previously mentioned groups of future users are the main categories. However, these households will not all have the same preferences. The 'perfect home for everyone' does not exist. Hence, a variation of housing types within the design project is desirable. This will increase the chance that the housing supply corresponds with the demand of the future users. Likely there will be the need for a variation in size of the dwellings. Some wish for a larger dwelling and are more willing to pay for it. Indubitably this is also very much depending on how much someone can spend. With this we enter a complex field of expertise, one that I am not familiar with. Still it is of importance to have some idea what type of dwelling is affordable for the aspired users. For this a research has been done on the income of the young starter and the expected prices of the dwellings which will be part of the design project. This research can be found in the appendix.

Facts an figures

Private rental section

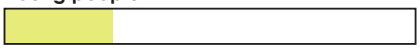


Around 19% of the Rotterdam housing market is private rental

Small households

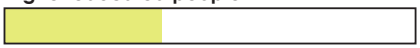
Around 85% of the group that is interested in rental houses in the middle- and high segment are one- or two person households

Young people



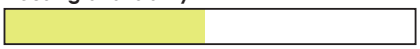
Rotterdam is a young city. Around one quarter of the population is between the age of 20 and 35.

Higher educated people



About 35% of the residents of Rotterdam is higher educated, with a HBO or University diploma.

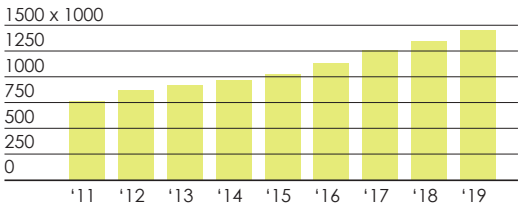
Housing availability



In the province of South-Holland, the supply in the rental sector is failing. Only 0.45 dwelling per household is available in this segment

Sources: CBS, Woonvisie Rotterdam 2030, Actieplan Middenhuur Rotterdam, Woonbarometer 2018. Personal adaptation

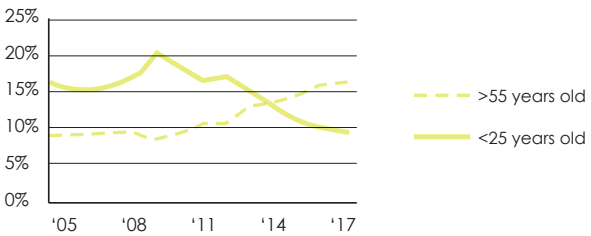
Number of people with a study debt



The past years, study debts have been rising. Especially since 2016, when the study compansation from the government was abolished.

Source: CBS, personal adaptation

Segment of purchases at the housing market, per age group



Young people buy less houses every year, while older people do more purchases. This can be seen as a reflection of the difficulty that younger people experience on the market

Source: ING economic bureau, personal adaptation

Young families in the city

Because the households with children are clearly different than the other two types of households, it is needed to adress some extra topics. This group has some specific preferences and needs when it comes to the dwelling itself, but also when it comes to the direct surroundings of the house.

Children need outside space to play (image: Dirk Verwoerds Fotoreizen)

Urban family typologies

Within the city there is less space. The traditional single family home, a type of dwelling lots of families live in, costs in the a fortune. If it is even available at all. Therefore, families and especially young families with a smaller budget should focus on different type of dwellings. One of those possible types is the family apartment. According to a study of BPD, a family apartment should be at least 90 m2 and three bedrooms.[21] Since there is enough willingness to live in such an apartment in the city,[22] this could be a good solution to house families in dense cities where ground level dwellings are simply impossible to build because of the ground prices. Other types of urban family dwellings are possible as well. The lifted single family home for example is designed by Heren5 architects and will be discussed in one of the case studies, further on in the report.

Outside space

An important aspect about dwellings for families is the available outside space. In the traditional single family home a backyard is almost always available. In an urban dwelling which is not on the ground level, this is not possible most of the time. According to the research of BDP,[23] independent outside space is the most missed aspect in a family dwelling in an urban setting. Therefore it is important to search for alternatives to the traditional backyard. A balcony is a solution, a roof terrace or garden in some way might be an even better one.

Children need to have safe space to play outside the house. A solution for this could well be combined with the previous topic of outside space. But a space for children to play could also be shared space. Having both an independent outside space and a shared space to play is even better. This has to do with the action-radius of children. Young children need a small and protected place to play, where the parents can watch. Older children want to play together with friends and neighbours and want to explore and wander. This space should have different qualities and a different size. A wide trottoir could be a solution where children can play together. On top of that, it facilitates interaction between the parents, without them having to violate the privacy of someone else's home.[24]

Dwelling lay-out

On the inside of the dwelling there are some important aspects when it comes to family homes. Some of these themes are mentioned in a document from the municipality of Rotterdam from 2016. In this summarizing document all entries from the design contest Open Oproep Gezinsappartementen are discussed. Different architects submitted their ideas and designs for a family apartment in the city. The outcome among others is a list of topics and elements which would be crucial to implement in urban family apartments, according to the participating architects. Some much mentioned elements are the presence of lots of storage space, a large entrance hall and flexible floor plans.

The presence of a large living room is also something mentioned in literature.[25] This has partially to do with space for children to play inside. Mainly younger children like to play in the living room because they enjoy the presence of other people in the room.[26] The parents on the other hand like to have the possibility to have a good conversation with friends, without the presence of the playing children.[27] Therefore a flexible lay-out, as mentioned before, could be a good solution. In the Kolenkithuis from Heren5 architects this is one of the key elements of the design, as will be shown later in the report.

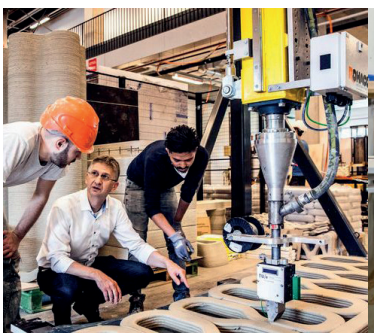
Furthermore, families in general prefer to have a guest room. This could of course also be a room that is flexible in use and could be used as guest room, play room or study. Split level dwellings or vides are not popular with families. This has mainly to do with sound, there this sort of design choices creates more open spaces in the house with multiple rooms that are in open connection with each other.[28]

Finally, architect Bas Liesker states the importance of the order in which the rooms are placed inside the dwelling.[29] One of the main reasons a lot of existing apartments in the Netherlands are not attractive to families is the fact that when entering the dwelling the bedrooms are passed by before one reaches the living room. His conclusion: there is a lack of separation between the private zones in the apartments (the bedrooms) and the zones were guests are welcome (the living room).

The makers

Because the design is part of the larger M4H area, which will be a makersdisrict in the future with both making an dwelling mixed together, the design project does also include a large programme for makers. Providing space for the makers industry within the city is imortant in multiple ways. It provides jobs, diverse and in large numbers. Moreover, it contributes to a sustainable future, because it decreases travel distance for both the employees and the products and materials.[30]
In my graduation project, I have chosen 'interior builders' as the makers industry. This is defined as all kinds of creative jobs, both knowledge-making and product-making. Some examples of these creative jobs are architecture firms which focus on interior design, furniture makers and interior builders who create kitchens and bathrooms for houses. These creative interior builders need each other. From personal experience I know that architecture firms who focus on interior design work together with furniture producers and suppliers a lot. Seeing, feeling and testing these products is essential. When these companies are locates in the same building, they can really work together. Co-production and an integrated design project is something which will be a lot easier. On top of this, these businesses could share equipment, such as 3d printers, laser cutters and machinery. This will save a lot of expenses, which will be effective for smaller firms and businesses in particular. The last couple of years furniture from smaller businesses is popular. A rising demand for customized furniture is visible. Moreover innovative and sustainable aspects are becoming more important in this sector as well.[31] This supports the choice to give this type of industry a place in the new and innovative Keilekwartier.

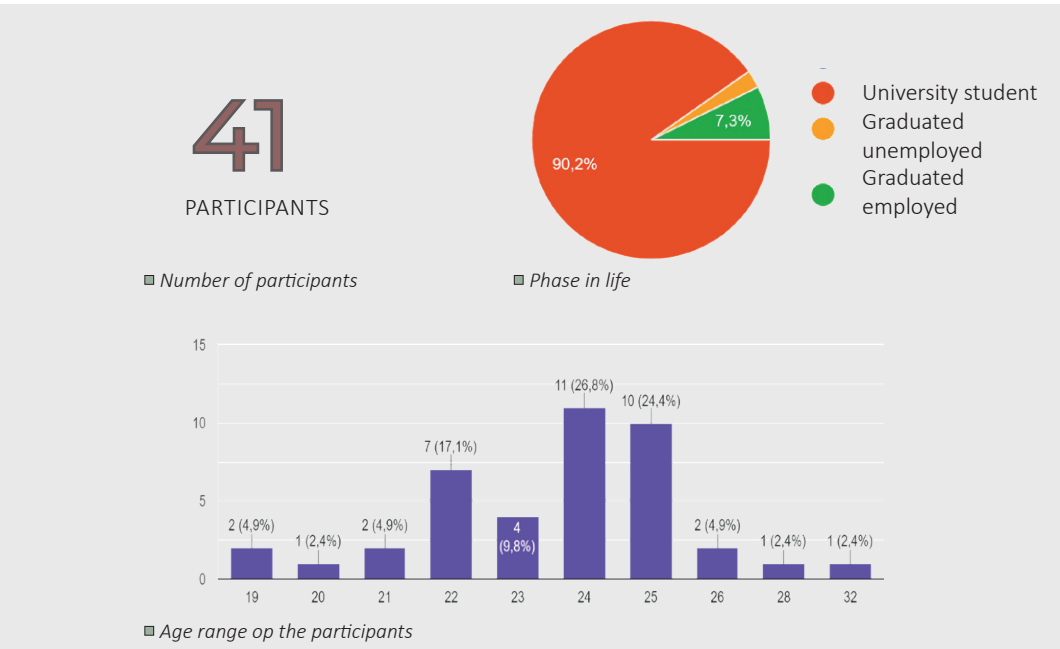
Interior builders will contribute to a vivid and creative atmosphere in and around the building. This liveliness is something which suits most young starters. They are still young and enjoy living in the city, partially because of all the activity that is going on. The objective is to design a building in which residents experience the vivid and creative atmosphere, but don't experience nuisance when they don't want do. Some people working in one of the businesses in the building might live in the same building, but the biggest part of the residents will work somewhere else, whether in the M4H area or further away. Thus, the connection between making and living is not a strict one. Besides the atmosphere, the makers will have another contribution to the area. The Keilekwartier and the whole M4H region will be the new home for thousands of households. They can use some new furniture and interior decoration tips. For this, they can now find local, personalized help within the area.



Survey

As a second research method to investigate the future users, a survey on the housing preferences of young starters is conducted. This method can complement the theoretical research presented in the previous section and may lead to different and more concrete answers. The survey, which is added in the attachment in full, was held under friends and acquaintances between the age of 19 and 32. A total of 41 people participated. Most of the respondents are students from the university. They will most likely be graduated within a couple of years and presumably have some thoughts about their first dwelling after their graduation.

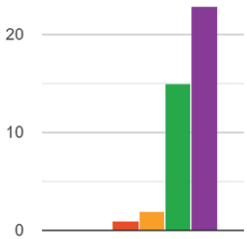
The survey is built up out of three sections. First of all, general information about the respondent in inquired. The second section is about the current living environment and characteristics of the house people live in at the moment. This set of questions is mainly added in the survey to understand the context people are answering in. The current conditions could influence the answers on the future preferences and are therefore needed to be known. The third and final section of the survey is a set of questions about the preferences of housing. For all questions in this section people were ask to reflect on their preferences for their first house after their graduation. If the respondent was already graduated, the preference had to relate to the first next house they would inhabit.



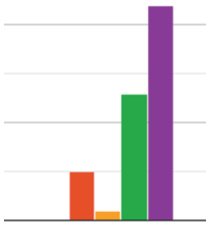
Independent dwelling

The most clear result of the questionnaire is that young starters want to have an independent dwelling. The respondents were not asked to explain why they value an independent dwelling as much as they do. But one reason might be the fact that these people have just finished a period in their lives in which they probably shared most of the facilities with multiple other students. After graduating, this could be a reason to have a fresh start with a clear upgrade in the dwelling. Not having to share the facilities anymore could be one of these important upgrades.

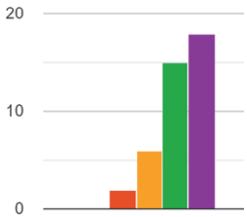
Almost all of the respondents point out that having a non-shared bathroom and toilet is important or even very important. Having a kitchen of their own is slightly less crucial, but still definitely an important factor for the respondents. The laundry space does not necessarily have to be individual within the dwelling.



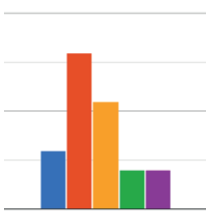
Importance of having an individual (non-shared) bathroom



Importance of having an individual (non-shared) toilet



Importance of having an individual (non-shared) kitchen

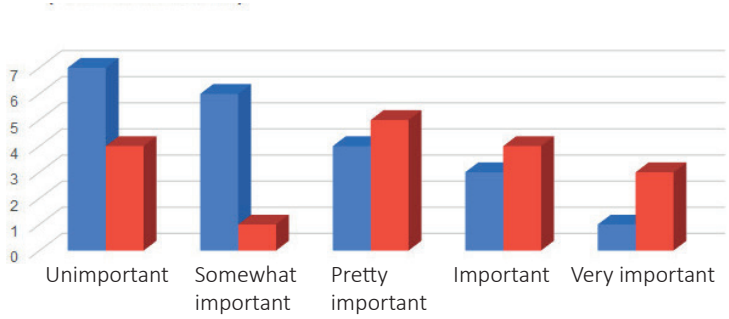


Importance of having an individual (non-shared) laundry space

Bathroom and toilet separated

For the dwellings itself, a few questions were included in the questionnaire as well. One of the topics was the presence of a separate toilet, outside of the bathroom. Although the result does not point out that having a separate toilet is crucial, there is a relation between the preference and the type of household. As shown in the figure on the left, people living together value a separate toilet more than people living alone. This could well have to do with the privacy, which is not an issue when someone is the only resident of the dwelling.

Importance of having an bathroom and toilet separated, according to type of household

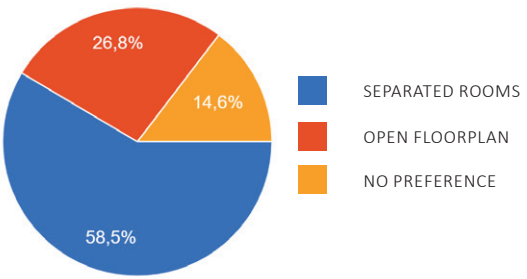


Collective facilities

When it comes to collective facilities within the building, there is a varying response. The respondents were given a statement, with which they could agree or disagree. The statement was: ‘ I am willing to sacrifice floor area of my dwelling, if in return I get access to a collective space in the form of...’ From this, it becomes clear that the majority of the respondents do not wish for a collective living room. However, there is a more positive response when it comes to more specified spaces. Spaces which facilitate sport, a reading room or a hobby space are desired by a part of the respondents. One explanation could be that these specific activities are harder to mix with daily life in the individual dwelling, whereas a communal living room does not offer additional activities which cannot be executed in the dwelling itself.

No open floorplans

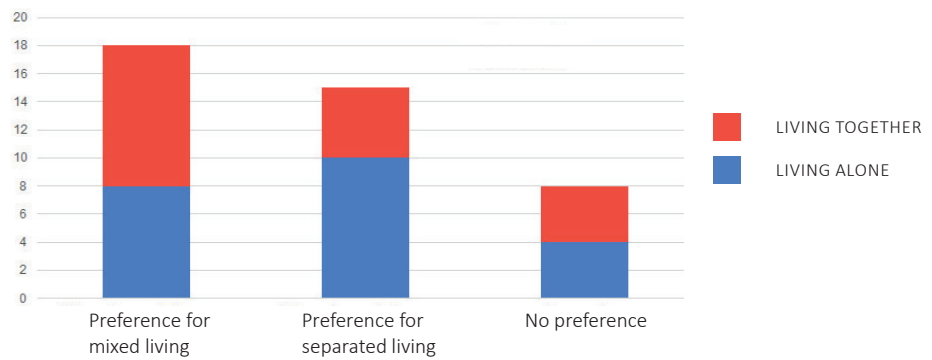
A second question on the dwelling lay-out was about the openness of the floorplan. The question was raised whether the respondent preferred an open floorplan of the more traditional smaller rooms. This last option was clearly the more preferred option. More than half of the respondents prefer separate rooms, which give more privacy and partially block the sounds within the dwelling. For people living alone this preference is slightly less obvious (see attachment).



Coherence with young families

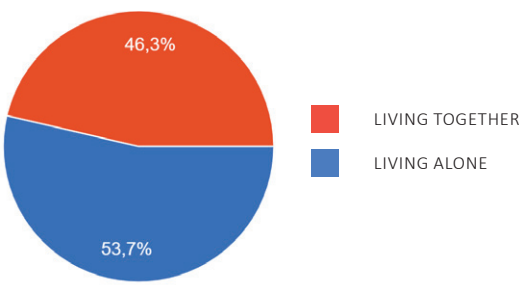
Because my graduation project is about housing for both single living, living together and young families, a question about this coherence was asked. The two proposed preferences were mixed living and separated living. Mixed living means a building where young families and the other households are mixed with each other and could be direct neighbours. Separated living means that the young families are living in a separated part of the building. The results show that in general there is no real preference for either mixed living or separated living. But looking a bit closer to the answers, the result shows that people living together prefer the mixed way of living more than the people living alone. One possible reason for this could be that people living together have a different way of living. People living alone might feel the need to party, have friends over and make a bit more noise. This possible conflict in the way they live compared to the way of living from young families might explain their choice for a separate way of living. Some elaborations from the respondents implicate this as well. Often mentioned motivations to live in a mixed building are the possibility to help each other, a more vivid and diverse environment and the possibility to stay in a dwelling for a longer time when your own household changes or expands. The main reason that people prefer to live separated is the fear of nuisance from both the young children (crying, waking up early) and the person without children (having friends over late).

Preference for mixed or separated living with young families, according to type of household



Types of households

A last outcome of the questionnaire is the ratio of people who are living alone and those who are living together with their partner. During the design this could be used as an indiation for the amount of dwellings. Almost half of the respondents expect to look for a next house in which he or she can live together with a partner.



Conclusion

This survey reveals some very specific preferences of students and young starters when it comes to their first home after graduation. For one, shared facilities are undesirable after graduating. With this outcome the survey supports the earlier findings about the need for independent dwellings. Also a shared living room is not wished for. Other collective spaces, such as sport facilites and a workshop are more populair and could be a good addition in the design project to contribute to the collectivity in the building. Furthermore, people living together value the separation of bathroom and toilet. They also prefer separate rooms over an open floor plan, presumably because of privacy and less nuisance.What is also an interesting outcome is the difference between people living alone and those living with a partner on the topic mixed living with young families. Most people living alone prefere a more separated living condition, whereas people living together prefer a mixed living condition way more often. Finally it is interesting to point out that the ratio of single living respondents and those living together complies with the numbers mentioned earlier in this report. Therefore this ratio will be used as a indication for the amount of dwellings that will be created in the housing complex.

Examples of dwelling types

Besides the research done on the future residents and their housing preferences as shown in the previous chapters, it is useful to analyse what kind of buildings have been designed in the past. To do this, I've analysed four different projects which are already built or are being built at the moment. The first three projects are (partially) designed for young starters and therefore provide useful information about the dwelling specifics, such as size, number of rooms and lay-out. The fourth project is somewhat different, cause it has been designed for families in the city. Since my project in focussed on all kind of young starters and a part of them might have a family of their own, it is of use to research a project especcially for families in the city as well. In all four projects, one or two representative floors have been analysed. The main focus of the analysis is on the dwellings them self, but also the accessibility and stacking of the dwellings have been researched.

Volt Delft, inner courtyard (image: Nieuw Delft)

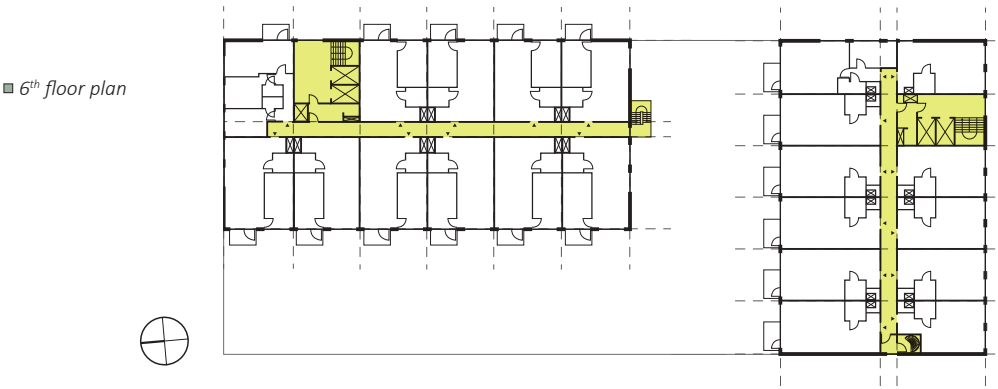
Cobana, Rotterdam

Architect: Rijnboutt

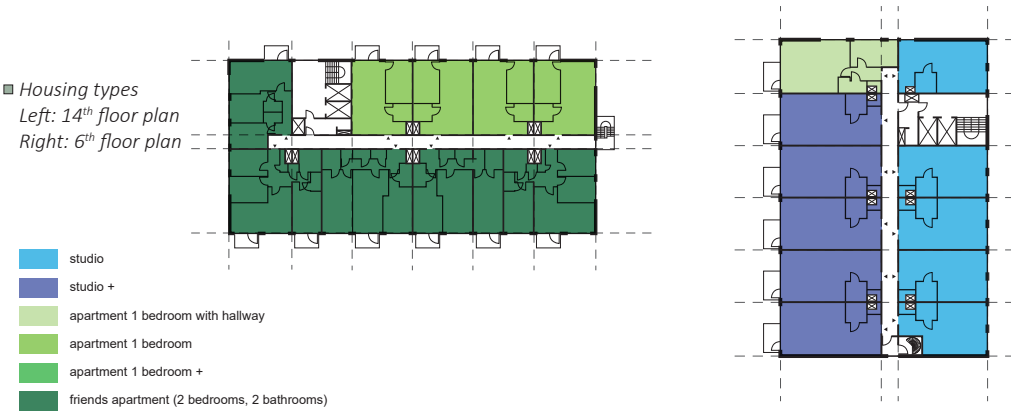
Cobana is a newly designed housing complex for higher educated graduates. The design is from Rijnboutt. The goal is to provide decent housing with a number collective facilities to this group of people, to make sure they won't leave the city after graduating. Cobana contains 375 rental apartments, in a variety of sizes. Studio's, 1 bedroom apartments and the 'friends-apartment' make up for the largest part of the houses and will therefore be discussed in this research.

Cobana (image from Rijnboutt)

The housing complex is composed of a large basement of three floors, on top of which two towers are placed. These towers house most of the dwellings, whereas the lower part contains the communal facilities and storage spaces. The towers have a corridor type of access. The grid size is 6.8m in the left tower and 5.8m in the right tower.



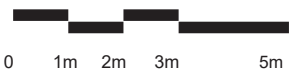
6th floor plan

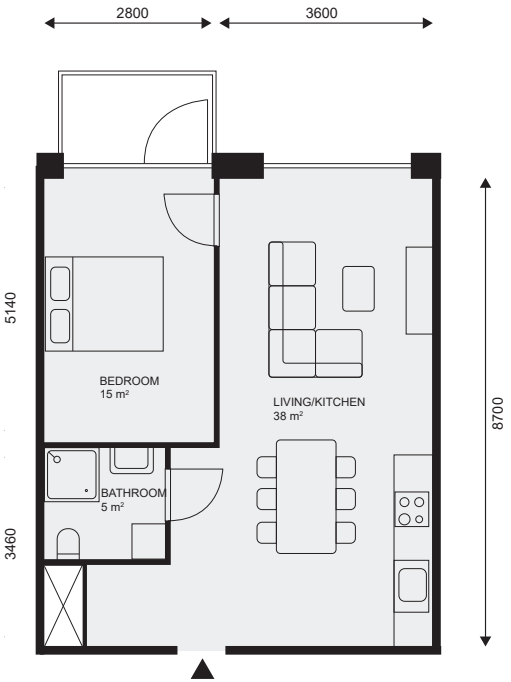


Housing types
Left: 14th floor plan
Right: 6th floor plan

One-bedroom apartment

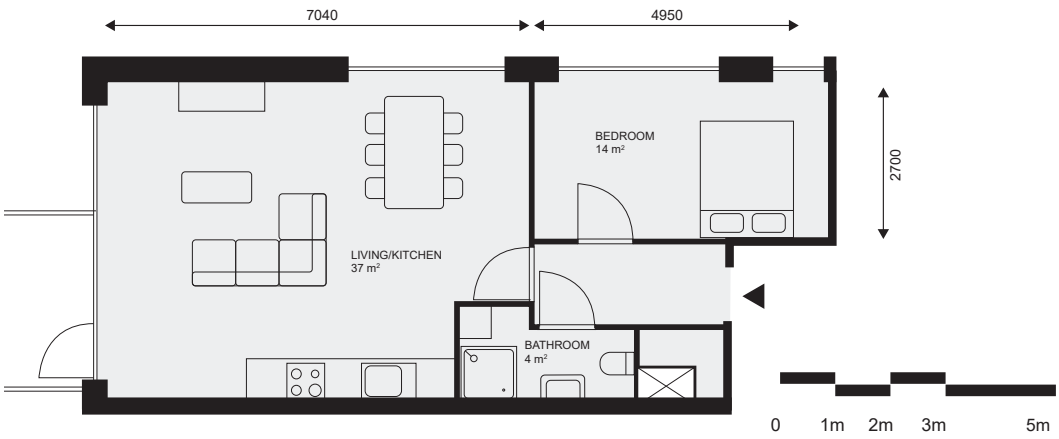
One of the apartments is the apartment with one separate bedroom and bathroom. It has a size of 58 m^2, and also has a balcony. Something that sticks out is the position of this balcony. Half of the apartments has this balcony attached to the bedroom, the other half has it attached to the living room. This has to do with the continues rhythm in the facade and the mirroring of the apartments. The toilet is located in the bathroom and the kitchen and living room are one open space, without partition wall or alternative interrupting element.





One-bedroom apartment with hallway

A slightly different apartment is located in the second tower. This 1 bedroom apartment is located in the corner of the tower, which makes the floorplan a bit different. The 59 m^2 apartment has a hallway, before entering the living room/kitchen. This means a completely different way of entering the dwelling and could give the apartment more quality. Entering the hallway first makes it feel larger and makes the transition between collective and private a bit more subtle.



Friends-apartment

The most outstanding apartment is probably the 97 m^2 friends-apartment. This dwelling is meant for two people, who have both their own private (bed)room and bathroom. They share a living room and kitchen, which saves space in the building and makes the apartment more compact. But it also means that you have to share and consider the presence of someone else. For people who like living together with someone else, this type could be a perfect solution. Having your own bathroom is, in my personal opinion, providing a lot of privacy. Because the bedrooms are almost as big as the living room, one can also stay in his/her own room when a bit more privacy is wanted.

Conclusion

With a clever design it is possible to create different types of dwellings within one grid size. The friends-apartment for one is 1.5 times the grid size and fits perfectly within this grid without having troubles with the load bearing walls. Moreover, the lay-out of the floor plan can make a huge difference in the experience of the dwelling. The hallway in the one bedroom apartment makes the dwelling feel way larger and it creates a smooth transition between public and private. This alteration to the standard studio may well prove to be worth the few extra square meters. Lastly, this project emphasises the relation between inside and outside. The location of the balconies is based on the exterior appearance, rather than on the functional connection to the lay-out of the floor plan. This is a choice, but does have consequences for the use of the dwelling.

Volt, Delft

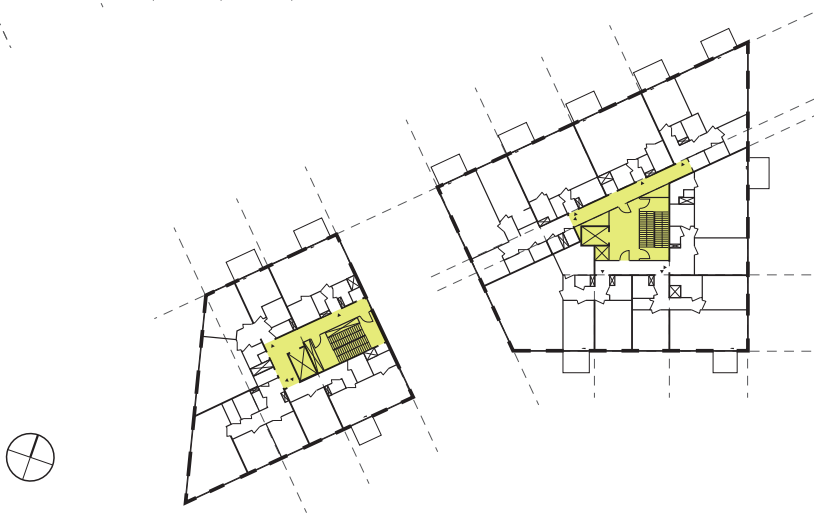
Architect: Barcode architects

This recently finished housing complex is located in Spoorzone Delft. It has a similar target group as Cobana: it is meant to house graduates from the TU Delft. The complex consists of tree different buildings, of which the largest one is analysed in this research. The positioning of the three buildings creates a small inner court, which is the communal core of the project. Multiple types of dwellings are situated in the building. The smallest ones are studios of approximately 50 m^2. The largest dwellings have 2 bedrooms and are about 75 m^2. Two cores provide access to the dwellings.

Exterior of Volt Delft (image: hureninvolt.nl)

Dwelling types, 4th floor plan

Accessibility, 4th floor plan

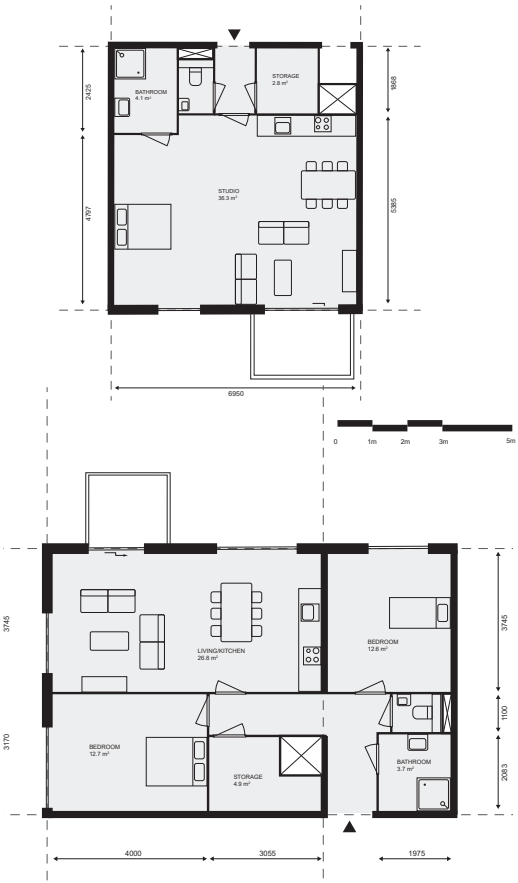


Studio

The smallest dwellings are studios. They have a separate bathroom and even a separate toilet. Storage space is also available. The living space, which thus includes a kitchen and the zone for sleeping, is rather square. This makes that the bed is relatively close to the kitchen and makes it harder to create a more private zone. However, the room is large enough and therefore the resident might have the possibility to create his or her own separation between the living zone and the sleeping zone. The presence of a small hallway before entering the living room provides the studio with extra space and make it immediately a more comfortable dwelling than the average student studio.

2 bedroom apartment

This 73 m^2 apartment has two bedrooms, a living room with open kitchen and a large storage space. Just as the small studios it has a balcony, accessible from the living room. The two bedrooms are almost equal in terms of size, so there is no master bedroom. Furthermore it is noticeable that the hallway, which does provide a smooth transition from collective to private space, leads past one of the bedrooms before entering the living room. According to Bas Liesker, architect at Heren5, this is not the perfect solution. When people visit, they shouldn't have to walk by the bedroom first. The bedroom is the most private area of the house and it would be logical to position it at the back of the house, far away from the front door.



Conclusion

When looking at the floorplan, the variety of dwellings is immediately visible. This is probably a result of the irregular building volume. It results in a wide range of dwelling size, but makes it almost impossible to optimize all dwellings. The dwellings them self all have independent facilities. The studio type even has a separate toilet, which is not very common in studio dwellings. The shape of the studio is also irregular. Most studios in the Netherlands are elongated, whereas this one is square. It results in a large living space. On the other hands the dimensions make it hard to get privacy in the sleeping area. A elongated space makes it easier to separate living and sleeping in a way, which might be preferred by some. The 2 bedroom apartment is situated in the corner of the building and can therefore have the current lay-out. If it was not situated in the corner, the two bedrooms would be located next to each other and the living room would be rotated by 90 degrees. In that case, it would still be a two bedroom apartment. This is only possible because of the ratio of the dwelling; its longest side is the facade and therefore admits a lot of daylight in the dwelling.

Lieven, Amsterdam

Kenk Architecten

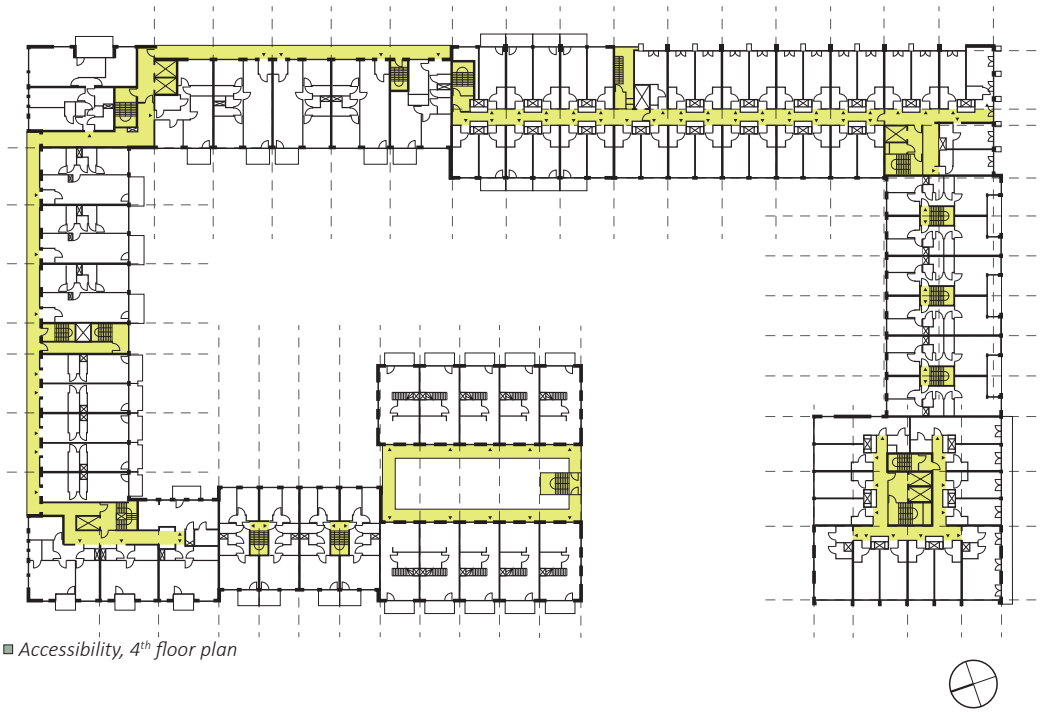
This project in Amsterdam is a large housing complex for both students and young starters. It includes a lot of different dwelling types. On top of this, it is also a combination of corridor access, deck-access (galerij ontsluiting) and staircase-access (portiekontsluiting). The dwellings are situated around a central courtyard and most of the dwellings have a balcony which is orientated towards this centralized courtyard. Around 1200 students and young starters will live in this housing complex after the construction will be finished.

Impression of the exterior (Kenk Architecten)

Housing types, 4th floor plan

Because of the complexity of the whole building, the accessibility is interesting to analyse. As shown in this image, not all parts of the building are connected to each other. According to the type of dwelling, the most suited access type was chosen. For example, the small studios are situated on a corridor. But the dwellings with a larger depth have daylight on both sides and are accessible via an internal collective staircase (portiek) or external deck-access.

The variety of dwellings makes that the building is suitable for more then just one type of resident. This makes the building sustainable in a way. It might be possible in the future to ajust it to a new type of resident if it is no longer needed to house (only) students and young people in the building.



Accessibility, 4th floor plan

Studio +

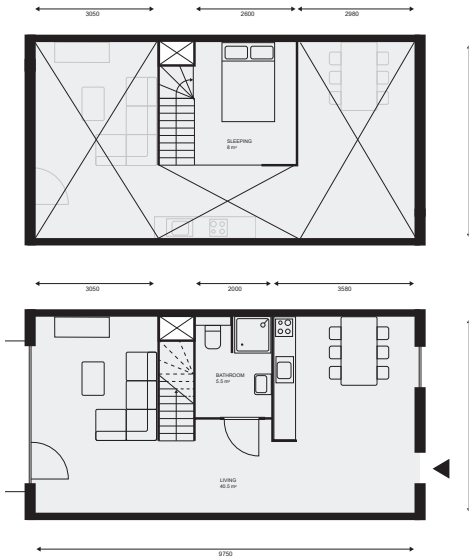
This studio, which is a deck-access flat, is with its 45 m^2 larger than the most common studio in this building. Because of its length, two separate zones are created by positioning the bathroom and storage (which don't need daylight) in the middle of the large open space. The larger space is used as living room and kitchen, and has a large balcony. The sleeping zone is positioned next to the entrance. This provides little privacy. The window next to the front door is providing the dwelling with daylight, but also decreases the privacy in the sleeping zone even more.

Studio with sleeping deck

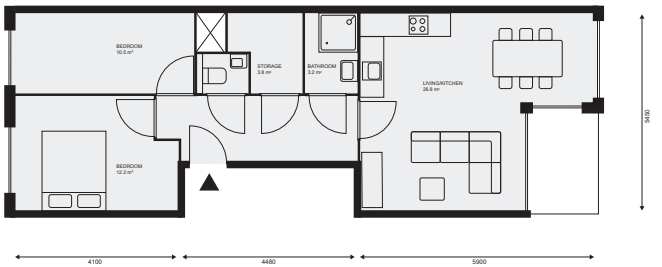
A second type of studio is this studio with a higher ceiling. The 46 m^2 dwelling is also split into two zones. One of the two is the kitchen, the other one is the living room. On top of the bathroom, there is space for a bed. In this way, the sleeping zone is still an open space, but because it is raised there is more privacy. The rest of the dwelling has a high ceiling, which improves the experience. But it also results to a smaller amount of floor levels.

Staircase-access flat

A completely different dwelling is this staircase-access flat of 65 m^2. It has a central entrance hall, from which all rooms can be accessed. The apartment has 2 bedrooms, a separate bathroom and toilet, and storage space. The open kitchen/living room are accompanied by a recessed balcony. This makes the inside living space a bit smaller. The bedrooms differ in size, therefore a clear master bedroom is present.



Floor plan of a studio with sleeping deck



Floor plan of a staircase-access flat

Conclusion

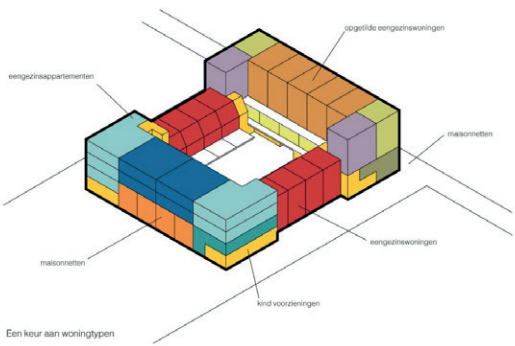
This project showcases a lot of different types of dwellings. This makes it a useful case-study about which a lot can be concluded. First of all, the grid size has been used in a smart way. Choosing a grid size in which one or two dwellings fit leaded to a mix of dwelling types. The studio+ for instance is 3.6m wide and fits in the grid size of 7.2m twice. The 2 bedroom apartment- which is not elaborated on in this analyses- fits perfectly in this 7.2m grid size. A second topic in this project is the relation between accessibility and depth of the dwellings. Using a corridor access is optimal when creating a compact volume with small studio dwellings. They don't need daylight on both sides as they are quite small thus don't have a large depth. The larger dwellings on the other hand can have a larger depth when daylight is entering on both sides. Therefore a deck-access type has been chosen in this part of the building. Eventually this large depth of these dwellings make it possible to fit a large number of dwellings in the volume, especially with the elongated studio+ type of dwelling.

Kolenkithuis, Amsterdam
Architect: Heren5

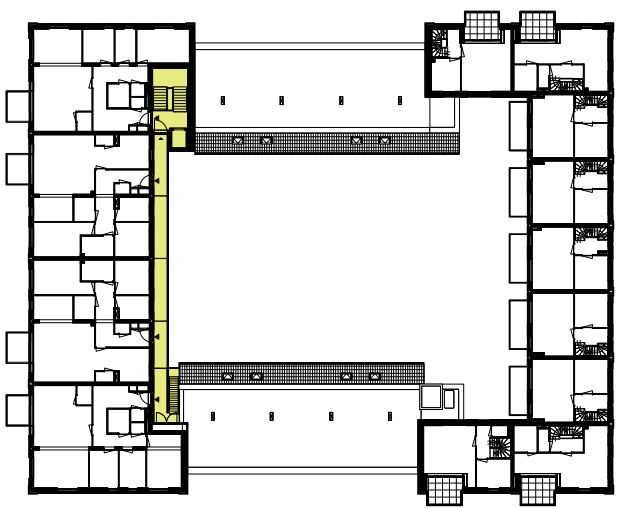
The last project which has been analysed is the Kolenkithuis in Amasterdam. This project is meant for urban families. The building is a smart and compact mix of 37 dwellings, which have a varying typology and differ in size. The foundation for the dwelling types is the outcome of research on the preferences of families, done by Heren5 architects and BNA research.

Some of the core aspects in the dwellings were the creation of a large number of rooms, the transition between public and private and large entrance spaces. Also interesting is the 'raised street' on the third floor. This deck provides not only access to the lifted family houses, it also is a safe space for the children to play. Therefore the deck is wider that a standard deck-acces.

Raised street on the third floor (image by Heren5 architecten)



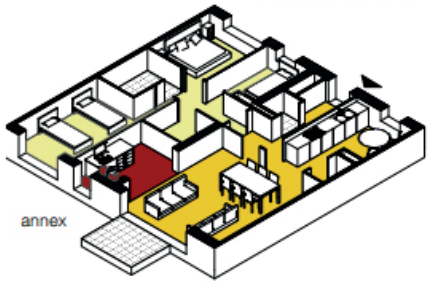
Housing types (image by Heren5 architecten)



Accessibility, 3rd floor plan (image from Heren5 architecten, personal adaptation)

Family apartment

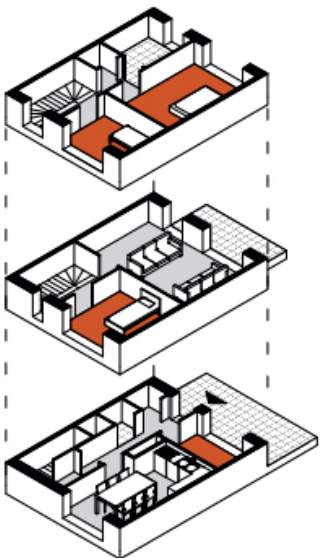
A one-level dwelling designed by Heren5 is the family apartment. This dwelling has three bedrooms, storage room, annex and living room with open kitchen. The open kitchen can be closed off. The annex can be in open connection with the living room or it can be a separate room. This possibility to make multiple small rooms or one larger open space makes the house flexible. It can adapt to the circumstances, something that is important when you have multiple children living in your house according to Heren5.



Family apartment
(image by Heren5 architecten)

Lifted single family home

The lifted single family home is the modern version of a traditional, very Dutch type of house. The single family home is one of the most built dwelling types in the Netherlands. Traditionally it has a backyard, sometimes also a front garden. This version of Heren5 is based on this popular type of house, but doesn't have a garden. Instead it has a large balcony on the second level (4th floor in the whole building). An interesting feature of this dwelling is the kitchen, which has been positioned on the 'ground floor'. The living room is positioned one floor higher, adjacent to the balcony. Furthermore the house has an annex on the ground floor, again for a flexible use of the house. On the first and second floor, a total of three bedrooms are present. The bathroom is at the top floor, which is also uncommon in Dutch housing.



Lifted single family home
(image by Heren5 architecten)

Conclusion

This project shows the possibilities in a compact volume. By optimizing the grid size multiple typologies fit on top of each other. Within the dwellings themselves the architect aims for a flexible home that suits all different kinds of families. One of the important aspects is the presence of lots of bedrooms. This gives the children an own room and privacy, something which will become more important when children age. Together with the flexible use and the annex this makes the dwellings suitable for young families, but also for older ones. Clearly visible in the floorplans is the preceding research on the family apartment. As mentioned in the first part of the report (p.12) Bas Liesker from Heren5 architects stated that the private part of the dwelling (the bedrooms among others) should not be exposed to visitors. By designing these dwellings, Heren5 architects translated this theory into something tangible.

Environmental considerations

Besides the problems that young starters are facing on the housing market, there is a second topic which I would like to adress in my graduation project: climate change. This world wide problem is a topic that is noticed for decades, but is very complex and therefor still not handled with. For a long time now, temperatures are rising on earth. Glaciers are disappearing, the poles are melting, forests are burning and whole parts of the world are slowly turning into deserts. On of the many consequences is that parts of our planet are becoming unhabitable. We face shortages of drinking water and it is becoming more difficult to grow enough food for a rising population. Moreover entire species are getting extinct.

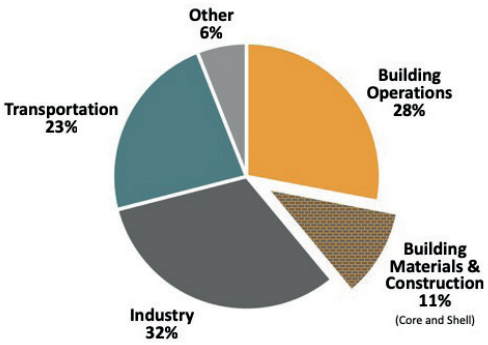
This dramatic image is for a large part caused by the CO_2 emmisions produced by mankind. CO_2 is emitted by all sorts of processes, which are vital for either our basic needs or our economy. This is what makes the problem so extremely complex. Most people nowadays finally understand that the need to change is high. So high in fact, that some say we are already to late. Thus we must do everything we can to contribute to a world in which we humans leave a smaller footprint. Architects can make a significant contribution as well, by designing buildings and cities that take these environmental changes into account and try to decrease the footprint of mankind at the same time.

Dry cracked earth during the worst draught ever in South Africa, October 2019 (Alaister Russell/The Sunday Times)

Environmental impact of the buiding sector

As mentioned before climate change is very complex and has multiple causes. Even though climate change is not the only environmental issue we are facing at the moment, it is the largest one. It is also one that I as a future architect can contribute to out of my profession. Even with its changing role the architect is still an important pawn in the building sector. I think that it is the duty of the architect to be involved in the debate about climate change and to find solutions within his profession that contribute to a permanent solution.

A sustainable built environment would really make a change, since the building sector plays a significant role in the emission of CO_2. About 11% of the global emission is comming from construction and 28% of all CO_2 emission is a result of energy usage in buildings. Furthermore the sector uses roughly 40% of all raw materials. This is also a problem, since we will run out of those in time, for some already in the comming decade. These consequences of the way we have been constructing for the past century are severe. Therefore we need to think about new ways of constructing. We need to use different materials, renewable and sustainable ones that have a smaller footprint and emit less $C0_2$ when producing them or constructing with them.



Global CO_2 emissions by sector (Global Alliance for Buildings and Construction, 2018)

Building for a changing climate

By designing sustainable buildings with a small footprint and with less CO_2 emission we can slow climate change down, maybe even bring it to a hold eventually. But the climate has already changed and is still changing. Therefore we need to adapt our design, to make them cope with these new conditions. Heavy rainfall, long periods of draught and hotter summers are a few concrete issues to which the built environment must be respond. Smart designed buildings can be a large part of the solution for these problems. Here lies a new challenge for the architect of the future.

Solar powered floating pavillion in Rotterdam as a sustainable building experiment (Ana Lisa, 2013)

The future of young people

The issues discussed are on itself important enough to address and to tackle during the design process. However, the target group of young starters makes it an even more important topic to include in my project. This large group of young people will face the extreme consequences of a changing environment in the future. For them it is most important to face the problem and to find solutions. At the same time young people can influence the process of climate change and other environmental issues the most as well, since they have a long life ahead of them. It is because of this that they need to be aware of the issue. Making them aware will seriously increase their motivation to contribute to a sustainable future, for them and for the planet.

Conclusion

During this research on the young starter and his housing preferences a lot of information has come up. First of all it has become clear that there is a tight relation between the young starters and the city. The young starters want to live in the city, because of job opportunities, a vibrant environment and lots of facilities. On the other hand the city needs this group because they contribute to the attractiveness and the economy of the city. Extra housing in the city is needed to make sure this symbiotic relation can be maintained. When it comes to housing preferences, one of the most important findings is that independent dwellings are desired. Both the literature and the survey show that sharing a kitchen or bathroom is not wished for by this group of residents. Some collective facilities in the building are desired however. A gym, reading room or workshop are some options that can embody this collectiveness in the complex, as the case study of the Hoge Heren shows. Within the dwelling itself the preferences are less universal. Here the division of the young starters in three categories is convenient. Resulting from literature, case studies and mainly the survey a reasonably concrete set of preferences is composed. The lay-out of the dwelling is one of them. People living together and families mainly prefer multiple different closed rooms, whereas people living alone might have the predilection to live in an open floorplan. Having a separate toilet is one of the more specific examples in this topic. A studio for one resident could have a toilet and bathroom combined, like the studios in the case study of Lieven. People who live together with others prefer more privacy and therefore desire more closed spaces. A dwelling with one bedroom, as presented in Cobana, provides this privacy and is for people living together a huge upgrade compared to a large open studio. Furthermore, larger households- especially young families- wish for outside space. For these families it is something that is missed the most in a lot of urban dwellings. This outside space is desirable for the young children of these households too. They need a space to play safely. Multiple design solutions are possible, such as a large balcony, roof terrace or a raised street like in the Kolenkithuis. Having children demands more specific qualities in a dwelling. An extra room is mandatory, but also a larger living room where children can play and enough storage space (either built-in or space for closets) can make a dwelling suitable for young families. What is absolutely clear is that there is a large variety within the group of young starters. And for all of them the troubles to find decent housing are existent. On these grounds it is compelling to design a large variety of dwellings that can house all of these types of households.

On top of this all the project should focus on the design of a building that takes the environment into account. This means emitting less carbon dioxide during construction, chosing materials that have a less negative impact on the environment. Furthermore the design should be adapted to the changing climate and be able to contribute to a built environment that is able to deal with these changing conditions. Using these aspects to improve the quality of the building and to give the building extra appeal is an additional ambition.

To conclude this research a design brief is formulated. The ratio of households is based on numbers from the municipality[32] and the results from the survey. This design brief will be used in the conceptual design as presented at the end of this report. Moreover, this list can be used during the rest of the design process as a guiding document.

Design brief

Building

Independant dwellings

Young starters prefer to have their own facilities. Sharing a bathroom or kitchen is something they are used to during their student time, but it is not something they want to continue with after graduating

Variety of dwellings

Since there is a large variety of young starters the design should incorporate different types of houses. This diversity will also improve the attractiveness of the place and will make the building more sustainable since other type of residents could move in tin the future when the market is changing

Affordable

Since one of the problems nowadays is that most houses are too expensive for young starters it is important that the design makes sure the dwellings are affordable. This can be done by designing compact dwellings. Choosing a construction type that saves money is also a way to reduce costs and therefore make the dwellings affordable

Casual collectivity

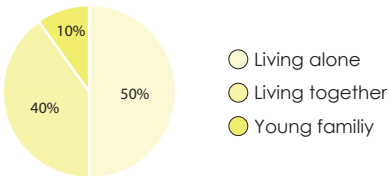
Within the building collective spaces are desired. These spaces facilitate acitivties that add to the comfort of the residents and can be arranged in ways that fit their specific wishes. On top of this they improve the connection between the residents.

Environmental-friendly building

The design considers environmental aspects and must contribute to a built environment that is resistant to the changing climate. On top of this these aspects should be made visible to make the residents and other people aware of the issues that are at hand.

Design brief

Dwellings

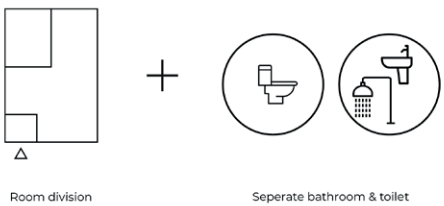


Living alone

- Compact studios
- Independant kitchen
- Private bathroom with toilet
- Separated (non mixed living) from young families
- Open floor plan is possible

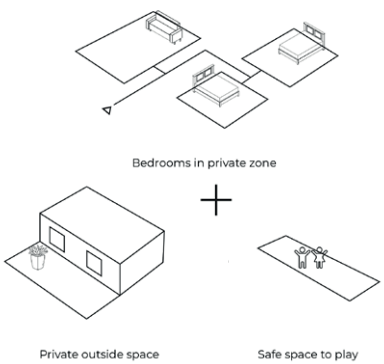
Living together

- Private outside space
- Functions separated in different rooms, no open floorplan
- One or two bedrooms
- Private bathroom
- Sepatare toilet, outside of bathroom



Young families

- Private outside space
- Safe collective outside space to play
- Large living room
- Wish for extra multifunctional room, which can function as guest room
- Plenty of storage space
- Bedrooms further away from the entrance than the living room



Design brief

Collective facilities

Sport facilities

Laundry room

Reading room

Outside space

Notes

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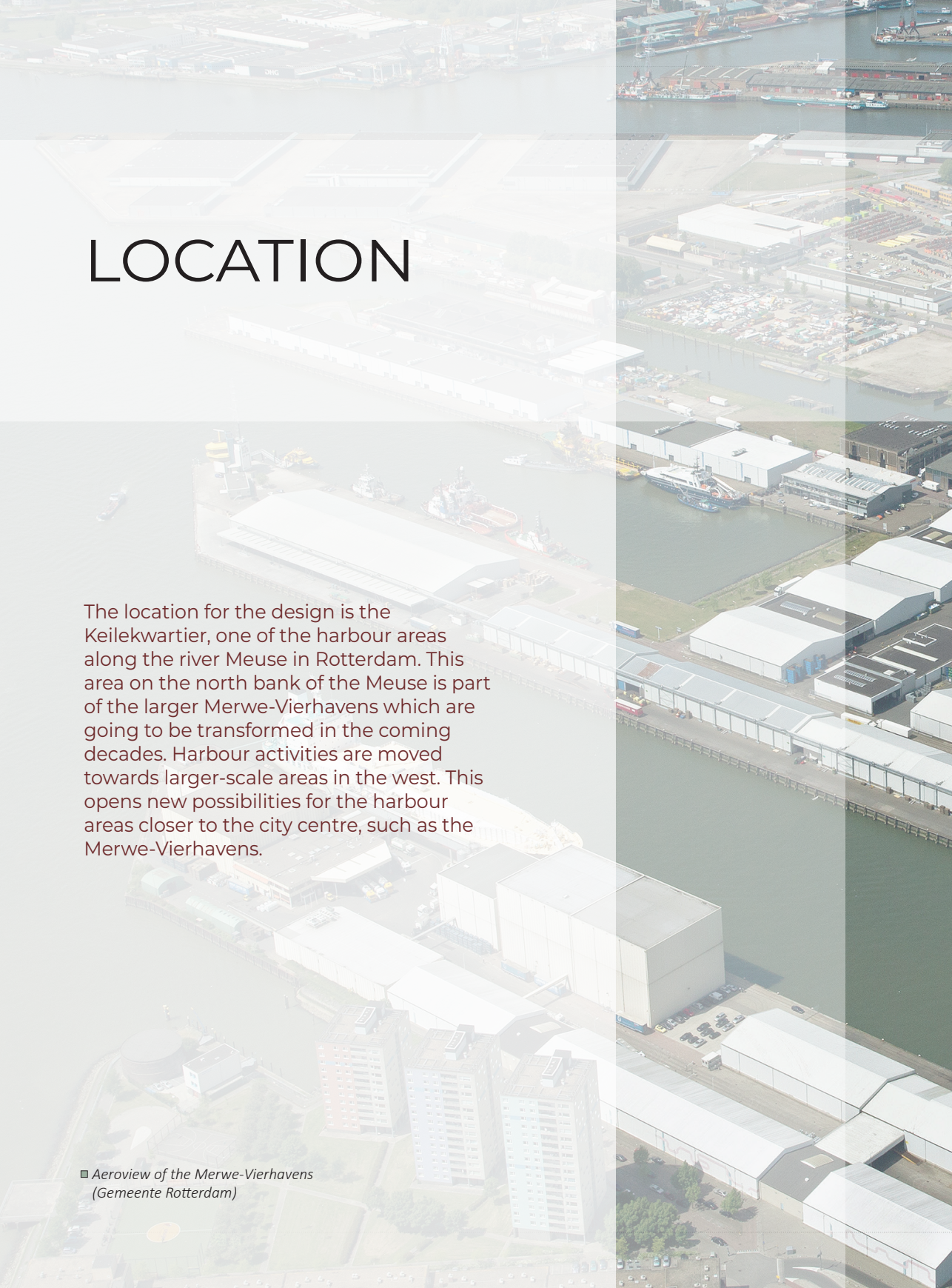
LOCATION

The location for the design is the Keilekwartier, one of the harbour areas along the river Meuse in Rotterdam. This area on the north bank of the Meuse is part of the larger Merwe-Vierhavens which are going to be transformed in the coming decades. Harbour activities are moved towards larger-scale areas in the west. This opens new possibilities for the harbour areas closer to the city centre, such as the Merwe-Vierhavens.



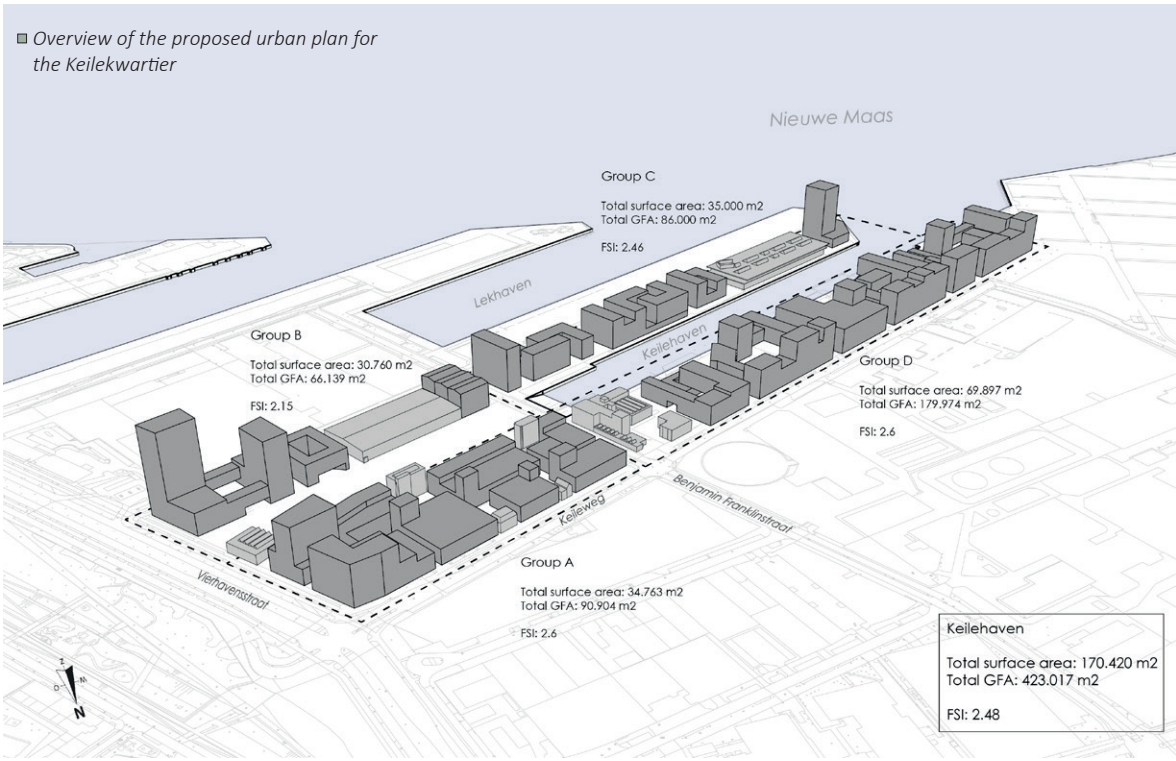
Aeroview of the Merwe-Vierhavens (Gemeente Rotterdam)

Transforming a former harbour area

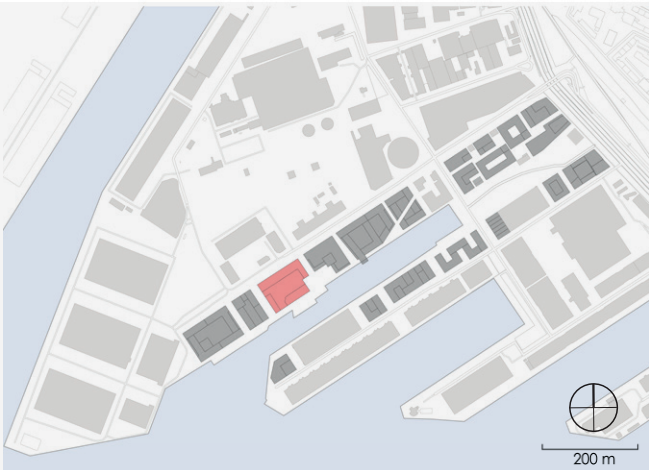
Within the graduation studio an urban plan is design with the group. This design is based on research and different studies during the first weeks of the project and carefully considers the ideas the municipality of Rotterdam has for this former harbour area. The plan proposes a high-density living environment situated around the Keilehaven. Monumental buildings are respected and will mostly be untouched. These existing buildings will maintain the old industrial vibe in the area. Traffic is mainly situated on the outer edge of the area. Quadrants C and D on the southwest side of the area are connected with a bicycle bridge (see next page). Two important meeting places are located in the area, one at the intersection of the Keilepark and the only road that crosses the area, one at the location where the bicycle bridge is connected to quadrant D at the north side of the Keilehaven. Here a city square is proposed.

The Merwe-Vierhavens area (M4H in short) together with RDM Rotterdam forms the new Rotterdam Makers District. The municipality and the Port Authority want to develop the M4H area into an innovative living-work environment, optimally equipped for the innovative manufacturing industry and with a mix of working, living, culture, catering, sports and education. An energetic district with an impact on both the city and the port.

(Municipality of Rotterdam, Ruimtelijk raamwerk 2019)



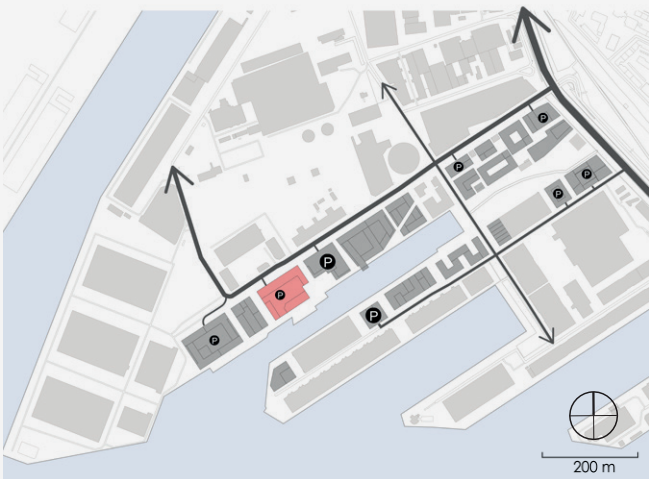
Overview of the proposed urban plan for the Keilekwartier



EXISTING BUILDINGS

NEW BUILDINGS

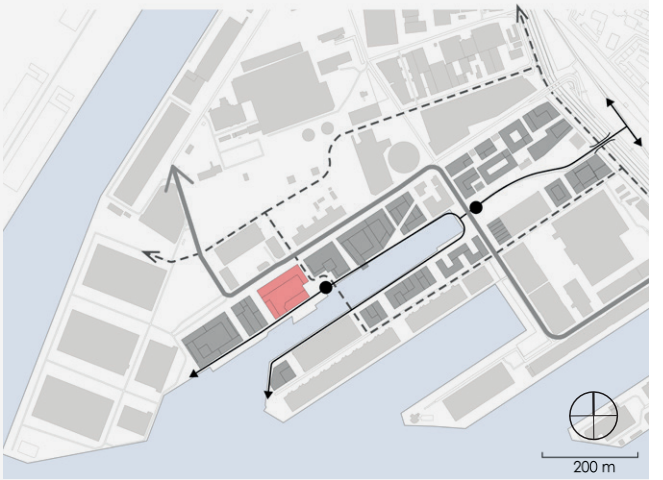
PROJECT PLOT



CAR ROUTES

PARKING SPACES

PARKING HUB



BUS ROUTE

BICYCLE ROUTE

WALKING ROUTE

MEETING SPOT

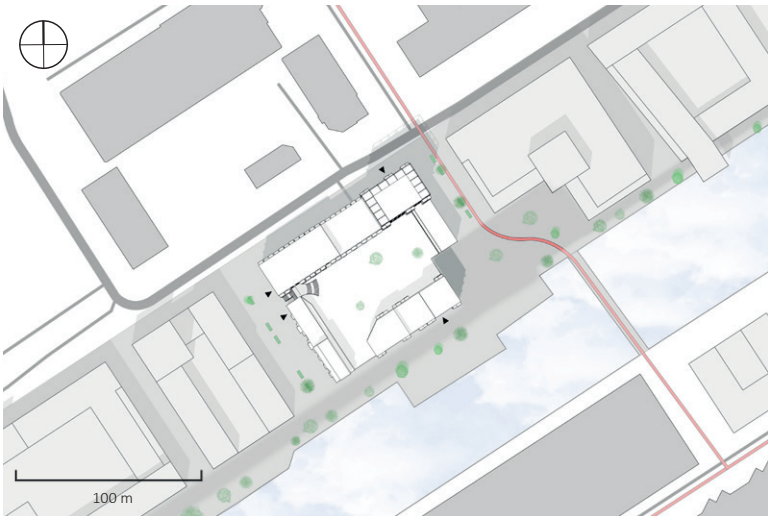
Building plot

The plot for my graduation project is located in the south-west of the Keilekwartier. This area consists of large plots which are situated in between the Keileweg on the north-west side and the water of the Keilehaven on the South.

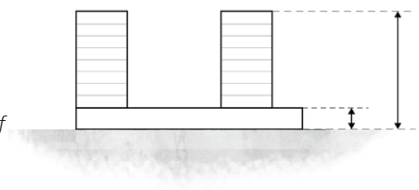
The measurements of the plot are 75x95 meter. It is located next to the city square, one of the two meeting spots in the urban proposal. On the east side of the plot a parking hub is located, on the west side a smaller plot on which a housing complex will be developed. Furthermore, the main bicycle route through the area is right next to the plot on the east side. All together, these elements make it a busy location, with a lot of liveliness. Gezellige stadsdrukte, I would call it in Dutch. This makes it a location which is well-suited for younger people. Moreover, situated along the main route and the city square pleads for public facilities, because it is a meeting place with high attraction in the area. The plot is also one of the largest plots in the urban plan. This provides opportunities to house a large amount of people.

Constraints

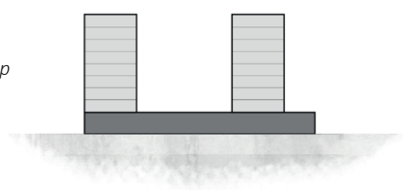
Following the urban plan some constraints are of importance for the building. The building must consist of a 6 meter high plinth and the total height may not exceed 45 meter. Furthermore the plinth must have a different character than the volume on top. Finally the building mass must include an excision on the east side. The depth is 28 meter, the width and shape are to be determined by the architect. This excision leaves space for the presence of a public square, which must function as one of the two important meeting spots in the area.



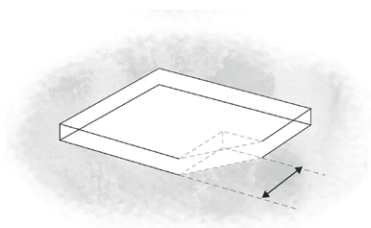
Overview of the proposed urban plan for the Keilekwartier



The building must have a plinth of 6m high and may not exceed height of 45m in total



Plinth and volume on top must have a distinctive character

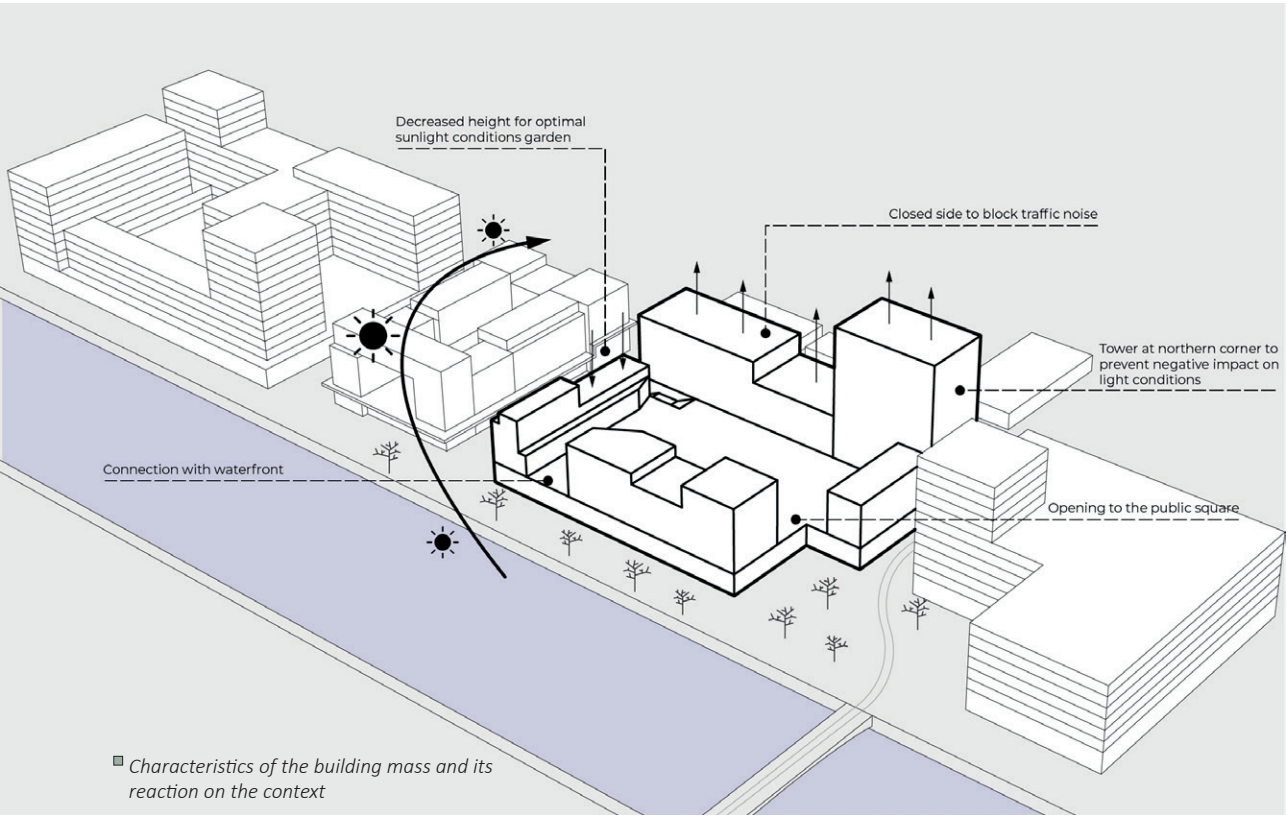


The mass should include an excision on the east side to create a public square

DESIGN

At the plot in the Keilekwartier a design has been made. This design for a large housing complex is largely influenced by the research as shown in the first part of the booklet. The design brief was the starting point for the design but during the process a lot of other studies have been done. In this chapter the design will be presented. At first the concept of the building is elaborated, followed by the actual design. Finally the technical aspects of the building are addressed.


Albert Heijn
BONUS



Characteristics of the building mass and its reaction on the context

Building mass

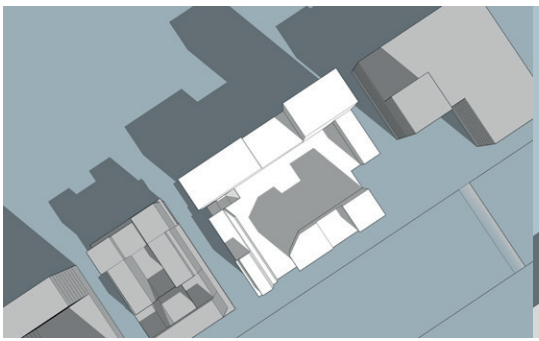
The first steps in giving shape to the building volume have been taken with the use of eye-height perspectives. This research has been done within the course Research Tutorial, with the help of Enscape, a handy render plug-in which made it possible to walk through the model with the presence of realistic daylight. The mass which had been designed in the urban plan was the starting point of this research. By moving along three different routes, the building volume was approached. Adaptations have been made on the basis of this visual research method. Building shape, relations of the volume with the surroundings, sightlines and daylight have been the main topics which were addressed in the research.

As a result a clear defined city square is shaped by creating a corner in the building volume. The open space on the inside of the volume receives lots of sunlight by lowering the mass on the south-west side. Connection with the surroundings is established by creating openings in between the clear volumes, while a closed mass on the north-west side protects the inner court from nuisance of the Keileweg. The high tower on the north corner marks the entrance into the area. In sum, a playful but coherent building volume is created. Each block on top of the plinth can have its optimalizations and character that fits the different types of users, while together they compose one large housing complex for young starters.

With this mass the building has about 34.000 m^2 and reaches an FSI of 5.06. This is conform the urban plan and helps create a high density area alongside the Keilehaven.

Solar conditions

The building mass is carefully designed and during the mass studies the solar conditions have been examined as well. The openings in between the blocks provide daylight in the core of the building mass, both for the dwellings on the inside and the open space in between the blocks. A lower volume on the southwest side makes sure that the open space in the centre of the blocks, which could function as a collective space, receives sunlight in the afternoon. By placing the tower on the northern corner of the building it does not have a negative effect on either the solar conditions of the dwellings or the open space in the core of the building.



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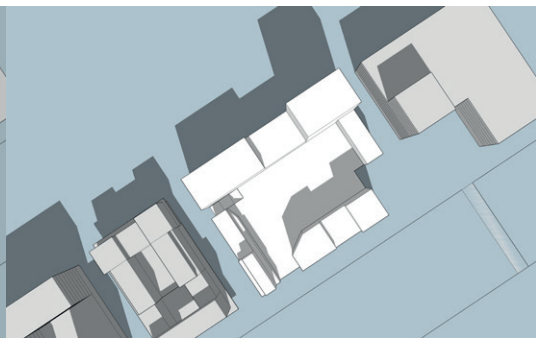

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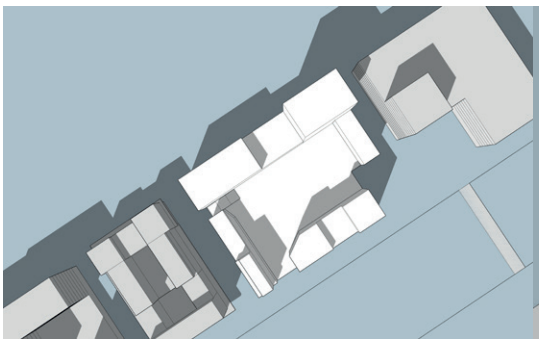

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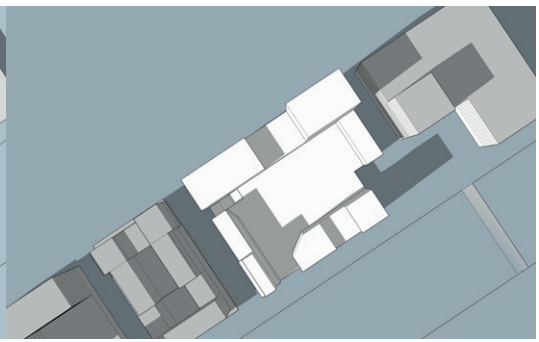

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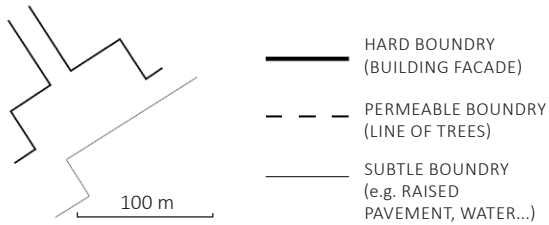
Character of the public square

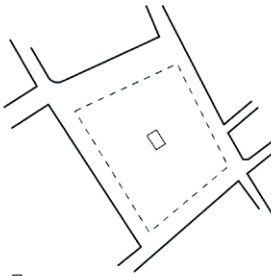
Alongside the research on the building volume, a small side study has been done to get a grip on the size of the public space around the building. The design of the public square is not in the main focus of the design assignment, but in a later phase of the project some statements on the design of the public space and its connection with the building have to be made.

Concluding this small research, the square at the design location is about the size of the Bastiaansplein in Delft. A size which is large enough to facilitate larger crowds of people, but not too large for this area with a high percentage of residential functions, not directly located in the city centre.

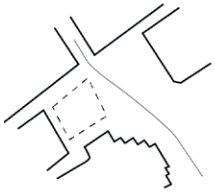


City square on the design location

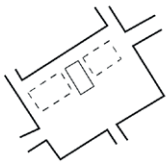
Grote Markt, The Hague



Plein, The Hague



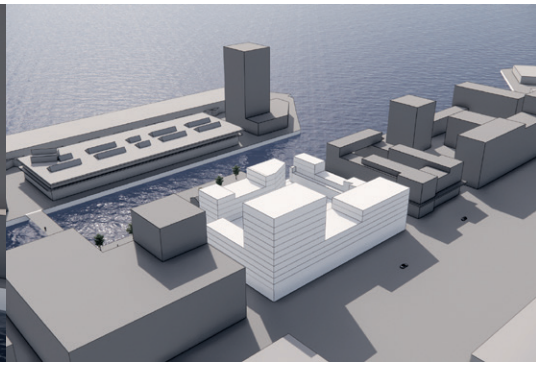
Leidseplein, Amsterdam



Bastiaansplein , Delft

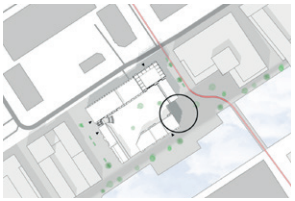
Preliminary building volume in its context
View over the Keilehaven

Preliminary building volume in its context
View towards the Keilehaven and the New Meuse

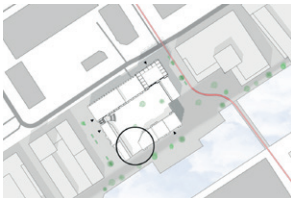


Reaction on the context

Entrance of the parking garage



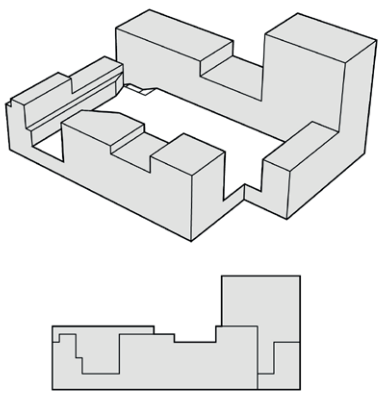
Public square with commercial functions



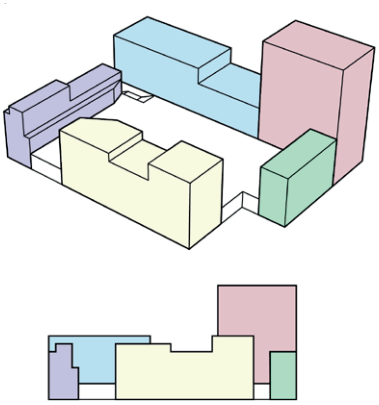
View over the Keilehaven and the monumental Katoenveem

Entrance to the inner courtyard

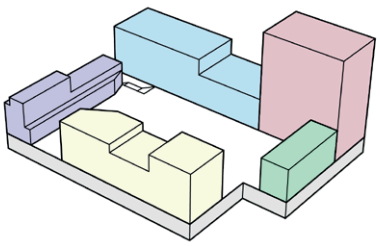
Architectural composition



Monolith

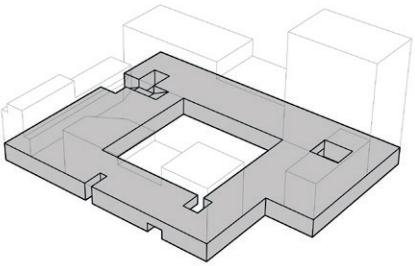


Seperate volumes

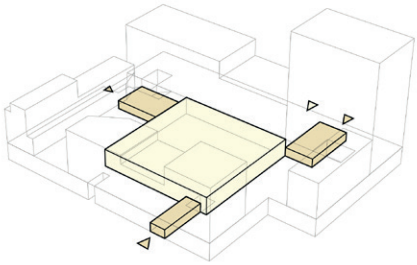


Volumes on top of a connecting base

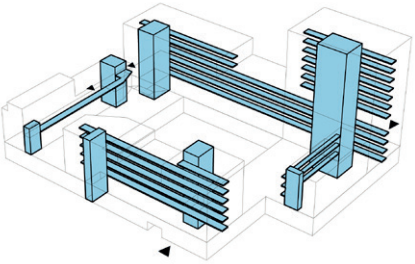
Organization



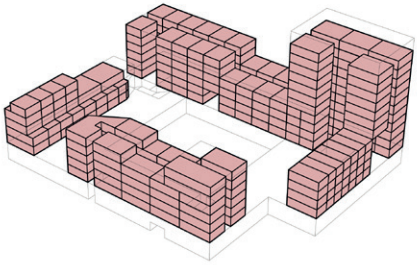
Commercial plinth



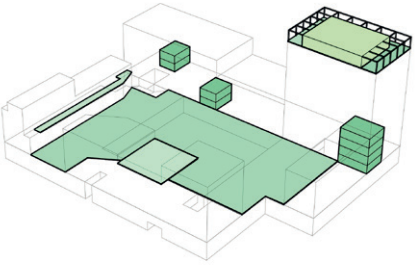
Parking



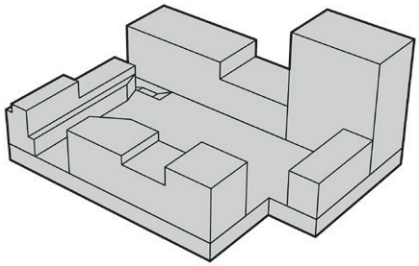
Circulation



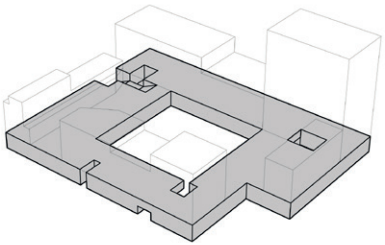
Dwellings



Collective space



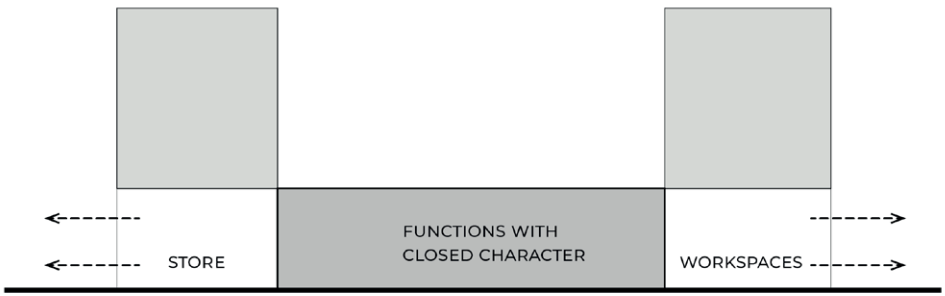
Total volume



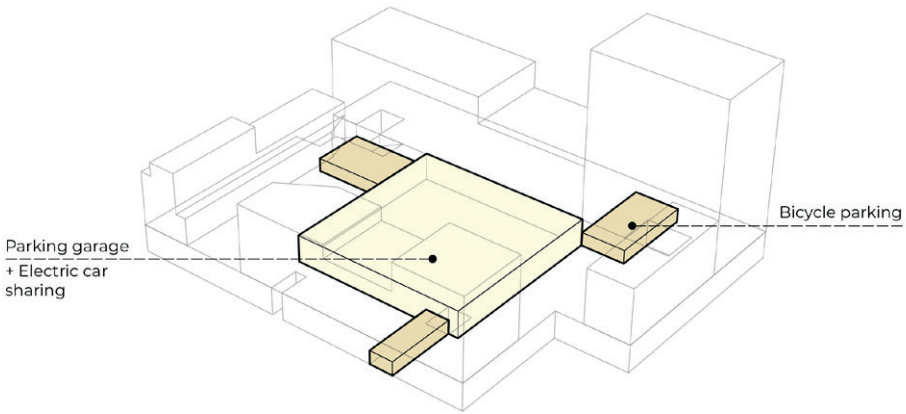
Commercial plinth

The plinth of the building incorporates public facilities and working space for the makers. These functions bring liveliness and connect the building to the character of the Keilekwartier as envisioned by the municipality. Furthermore it contributes to the outstanding character of the plinth, one of the constraints from the urban plan. In the architectural expression of the facade this will be accentuated even more.

In the plinth 3150 m^2 rentable commercial space is present, all located on the outside of the building. This makes the plinth of the building open and transparent towards the environment. In this way interaction with the streets is possible and the quality of the public space is increased. The commercial space has a 5.4 m high ceiling, which makes it not only flexible in floor plan but also in height. The addition of an extra floor is possible and could increase the floor space significantly. Working spaces for the makers with a possibility for a small workshop is a desirable infill for part of the commercial space. Furthermore the location is suited to include a supermarket. A large amount of people will be housed in the area and this plot is at a node in this vibrant new area. The northeast side of the building, adjacent to the square and the bicycle route and with an entrance for the suppliers on the Keileweg, would be a logical spot in the building for a supermarket. The southern corner adjacent to the square would be a beautiful location for a cafe or bistro, with outside terrace on the square and with a view on the water of the harbour. These functions connect to the wishes of the young starters and will also attract a variety of people from the surrounding areas. With this the liveliness of the location will increase.



Relation between the plinth and the street

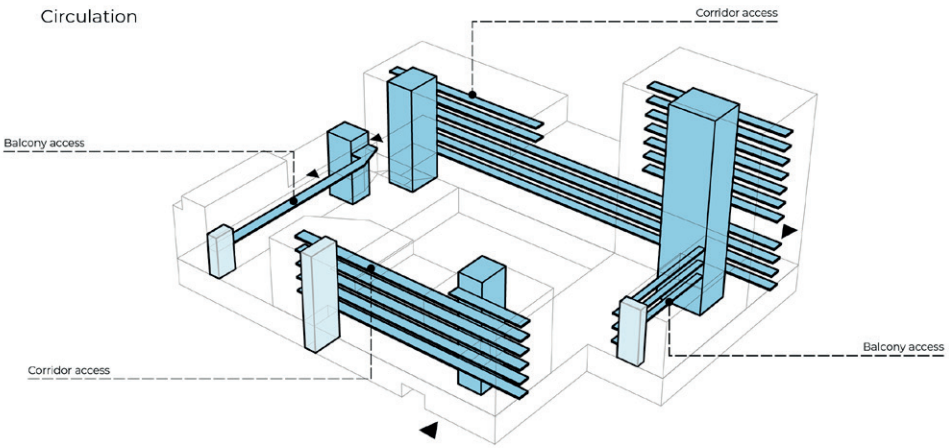


Parking

In the core of the plinth parking spaces are present. The car parking with 89 parking spaces for cars, including spots exclusively meant for electrical car sharing, is accessible from all entrances to the dwellings on top.

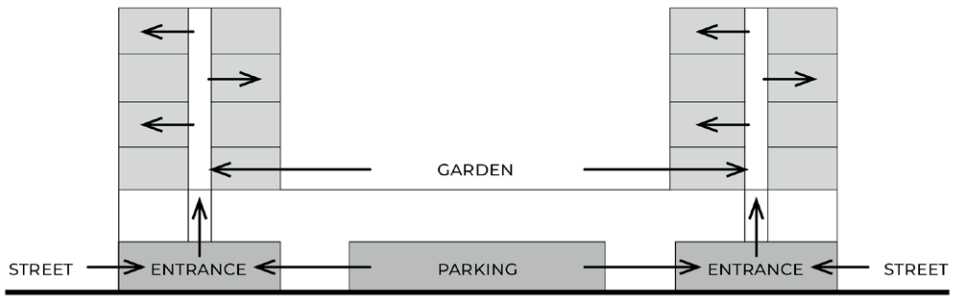
Furthermore the building has three collective bicycle parkings with a total of 510 parking spaces and additional parking areas for cargo bikes. This is more than enough space for all residents to store at least one bike. All three parkings are easily accessible from the street and directly located next to the stairwells. This accessibility and the large amount of parking facilities must stimulate the use of bicycles in the city. The area is well connected to the tram- and metro system of Rotterdam and therefore it is no longer needed for all households to own a car. In case of need they can always pick one of the shared electrical cars. In the future the ratio of shared cars will be increased and less private spaces for the residents will be available. But for this a larger transition in society and the mind of the people is needed.

Top: Sharing electrical cars is a sustainable solution and is a good solution for efficient use of space in a dense area (image: iStockphoto) Bottom: Cargo bikes are a convenient way of transportation in the city. To stimulate the use, parking spaces for these types of bikes are included in the design (image: SociBike)

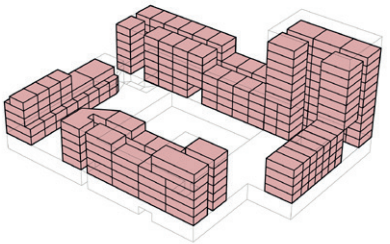


Circulation

The residential part of the building is accessible at four places. Entrances at street level provide access to a spacious entrance hall, which is also accessible from the parking spaces in the core of the building. From there the stairwells to the residential blocks grant access to the corridors and balcony-accesses. The access points are mainly located on the inner side of the blocks. All residential blocks have an entrance on the raised ground level as well, to establish a connection between the building and the inner court.



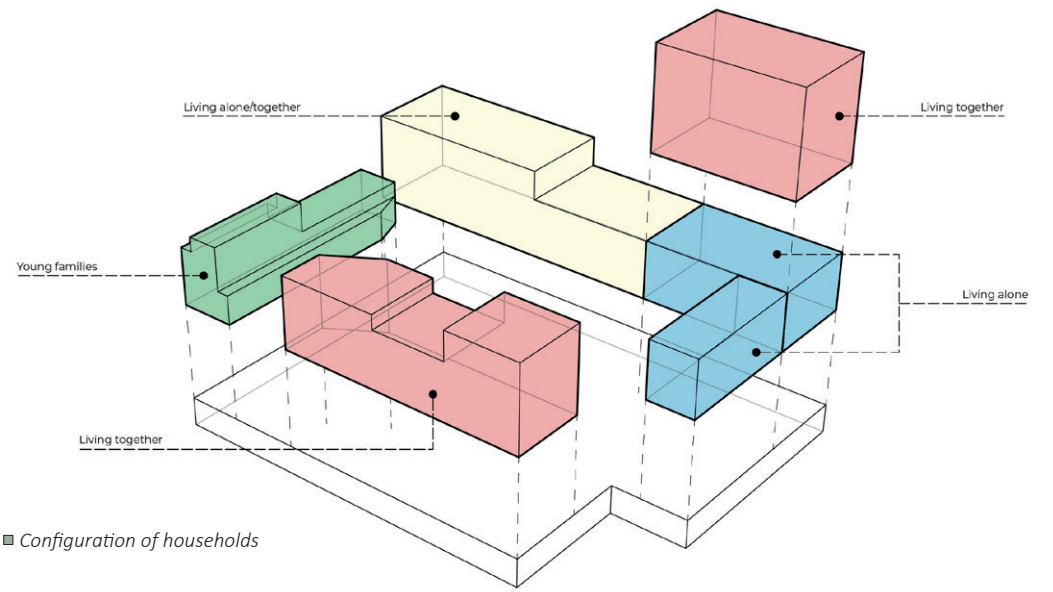
Movement through the building



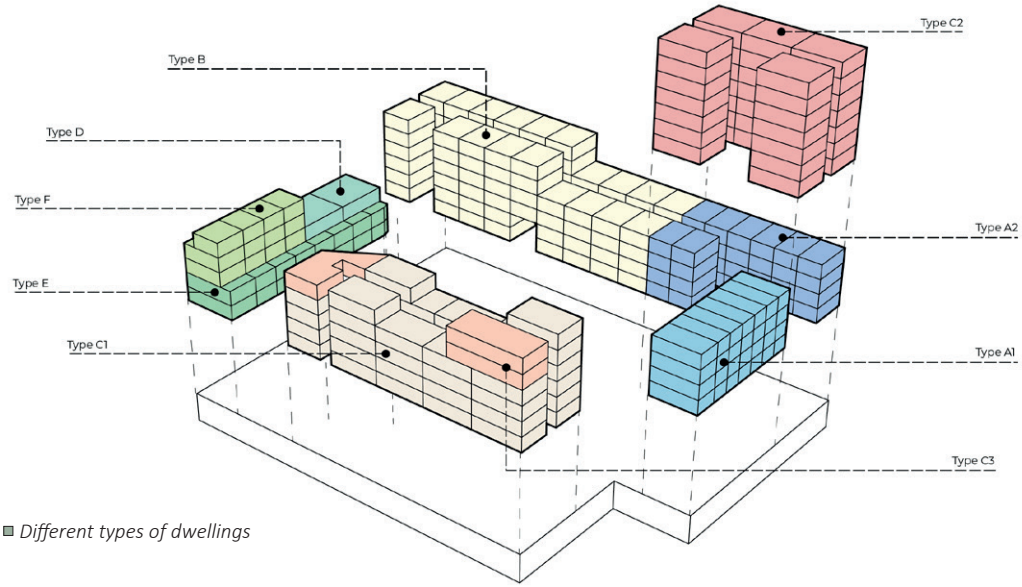
Dwellings

A large variety of dwellings are proposed to meet the wishes of the three groups of young starters; living alone, living together and young families. Smaller units for people living alone are situated in block 4 and 5 on the lower levels. These are situated together to have shared communal space and because they have a similar way of living. They tend to enjoy the occasional late-evening drink with friends or neighbours and do have an alternative lifestyle compared to the ones living together and those with young children. As resulted from the survey, they are less willing to live near young families. Consequently the larger dwellings, specifically designed for families, are located in a different part of the building; in block 2 on the west side of the building. In the higher part of the tower and in block 1 which is located at the side of the Keilehaven the apartments are present. These larger and more expensive dwellings have a better view and have more privacy then the smaller units.

The dwellings with a small bay width are located on the east and west side of the building. These units are long and more narrow and therefore benefit from daylight entering on two sides. Accompanying advantage is that they have a view towards both the inside and outside of the building. In this way the hinder from the buildings on the neighbouring plots is minimal.



Configuration of households

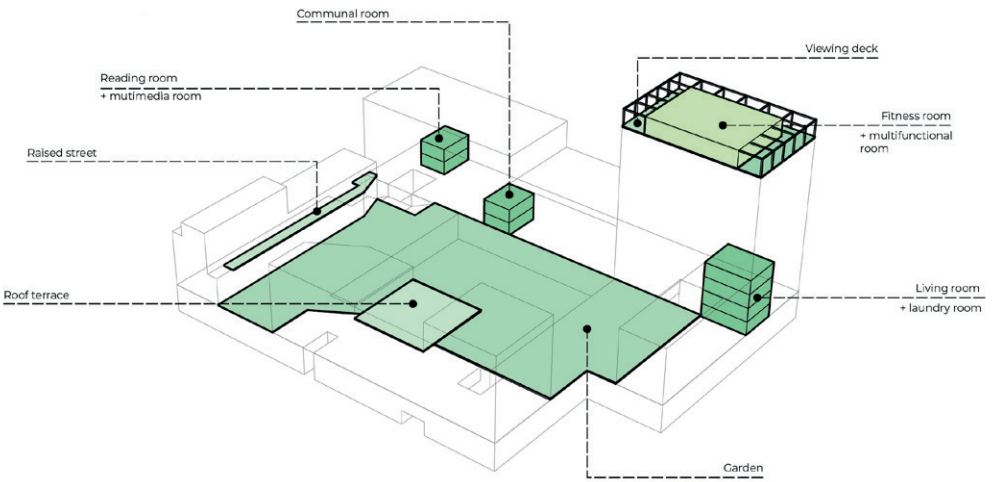


Different types of dwellings

Dwelling types

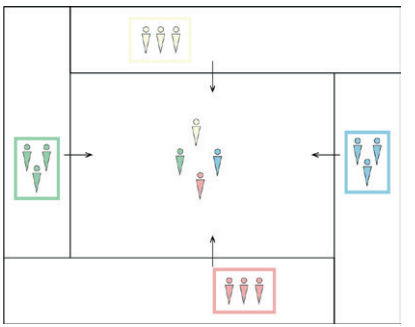
As the research has shown their is a large variety in the group of young starters. Therefore the building contains multiple types of dwellings. All of them are quite compact and independent dwellings. The variation in dwellings is not only helping to match with the needs of the young starters, it creates a diverse and therefore lively housing complex. Moreover is makes the building sustainable because the dwellings are attracktive for other types of residents as well. The diversity makes the building more adaptable to a fluctuating housing market.

TYPE A1:	28 X
TYPE A2:	32 X
TYPE B:	95 X
TYPE C1:	40 X
TYPE C2:	35 X
TYPE D:	2 X
TYPE E:	8 X
TYPE F:	4 X
TOTAL:	247 DWELLINGS



Collective spaces

As the research has demonstrated young starters wish for some shared facilities, depending on the type of household. To facilitate the desired collectivity in the building every building block contains collective space suiting the type of dwellings in that specific part of the building. The smaller dwellings can make use of a collective laundry room. To keep a decent group size in which residents can still personally relate to each other one laundry room is situated on the first four residential floors floor. Furthermore communal rooms are proposed for the residents of the studios, directly located next to the laundry rooms. These spaces function as communal living room and have a small kitchen, large dining table for meals with friends and neighbours, and a lounge. These spaces are free to use for all residents of the studios who want to organize something with more people than they can house in their compact studio

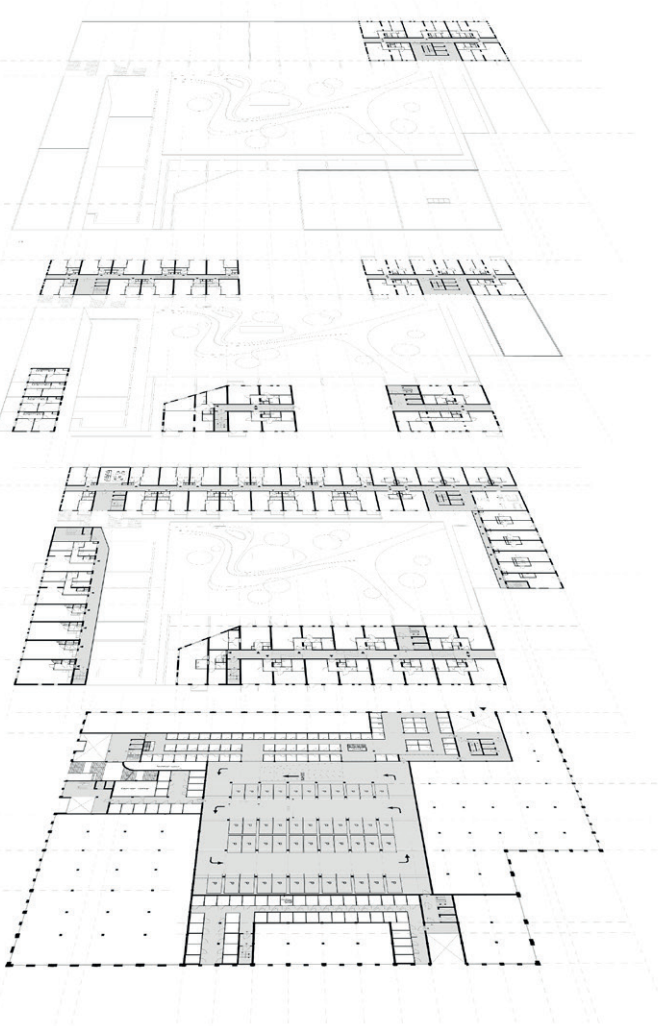


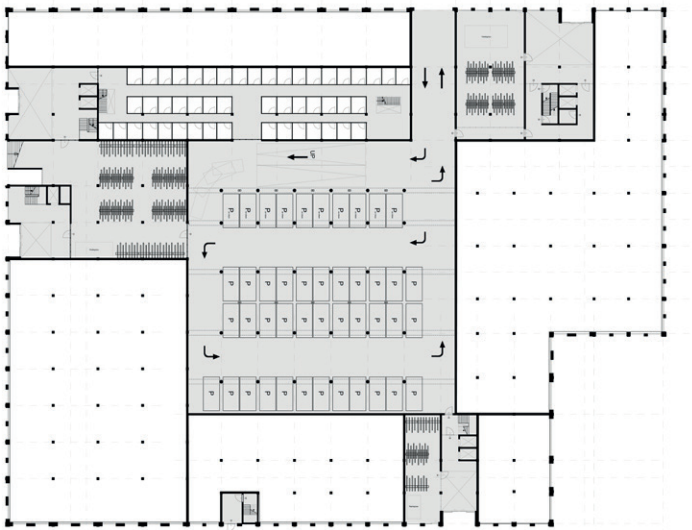
Configuration of households

For the residents of the smallest apartments (type B) a number of small communal spaces are present, located adjacent to the inner garden or the stairwell. In this way the spaces are accessible for residents from all floors. These spaces contain a reading room with small shared library, multimedia room, lounge and multifunctional space for meetings, large dinners and game nights. At the upper level of the tower larger collective spaces are present for all residents, including a fitness space, sky lounge with large roof terrace and multifunctional space for events, birthdays and receptions.

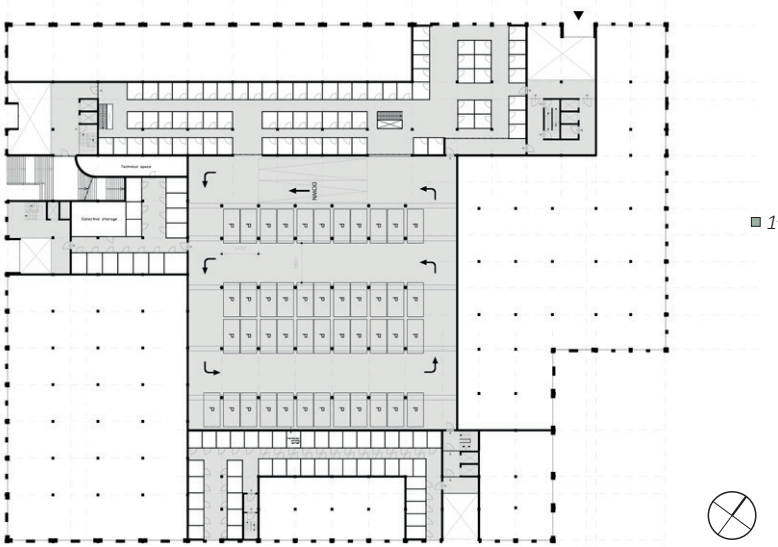
In the centre of the building a large green oasis offers calm and tranquillity for all residents. This large collective garden is accessible directly from all sides and is connected to the street via a stairs on the west side. The garden includes multiple functions for the residents and moreover contributes to the climatic ambitions of the building. This will be discussed later in the report.

Floor plans & sections

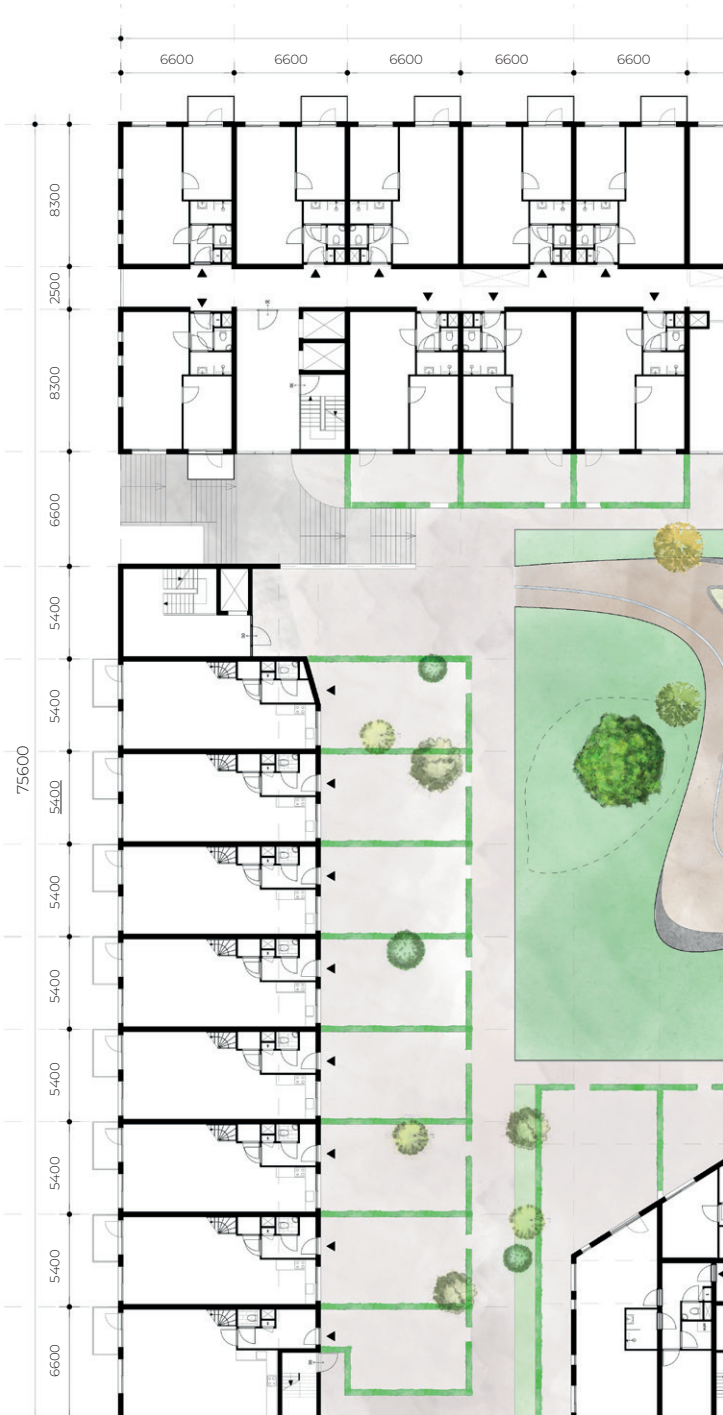




Ground floor plan - 1:1000



1st floor plan - 1:1000



2nd floor plan - 1:500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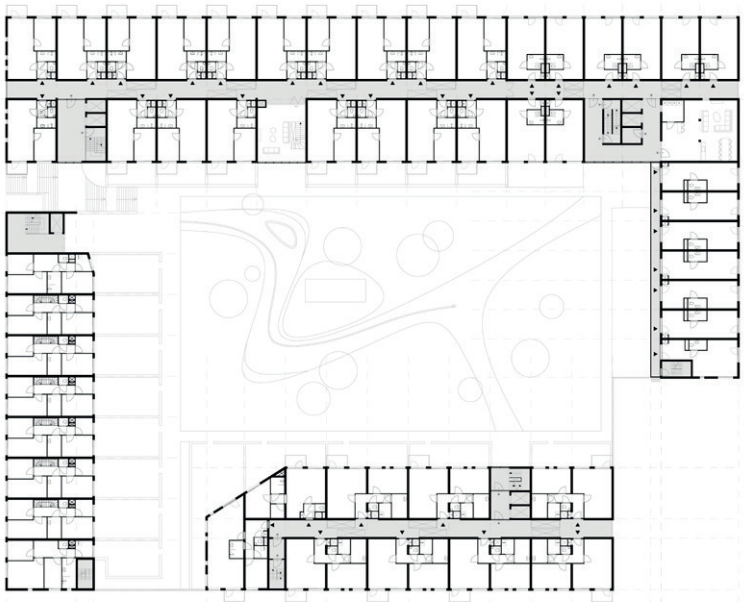
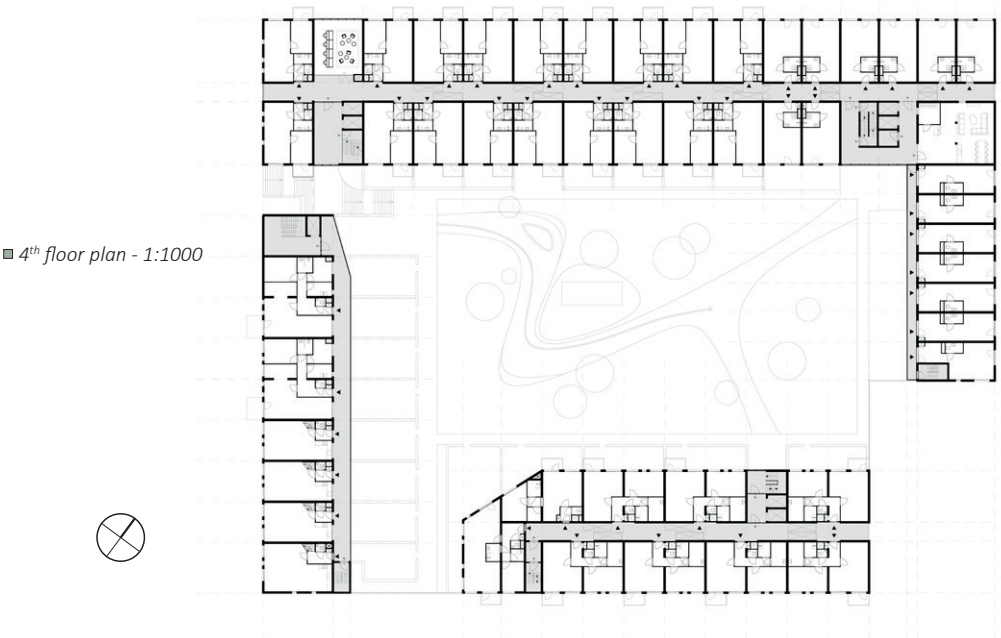
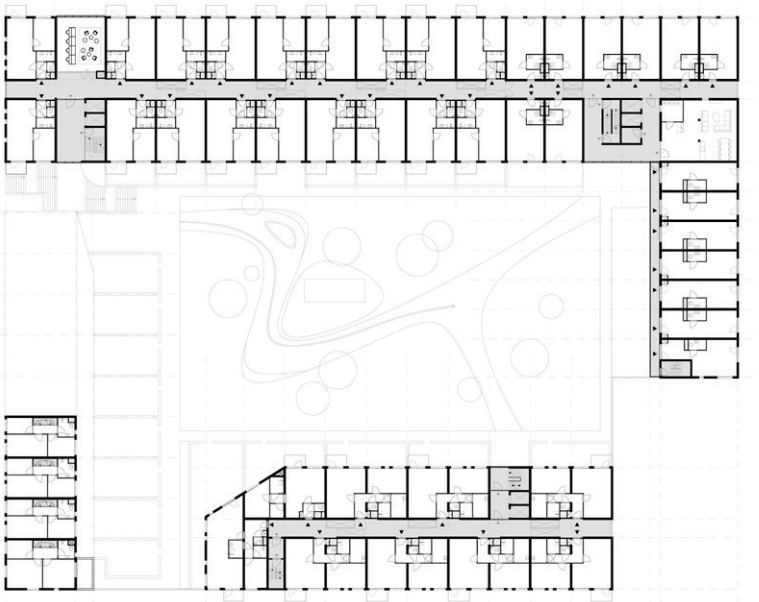


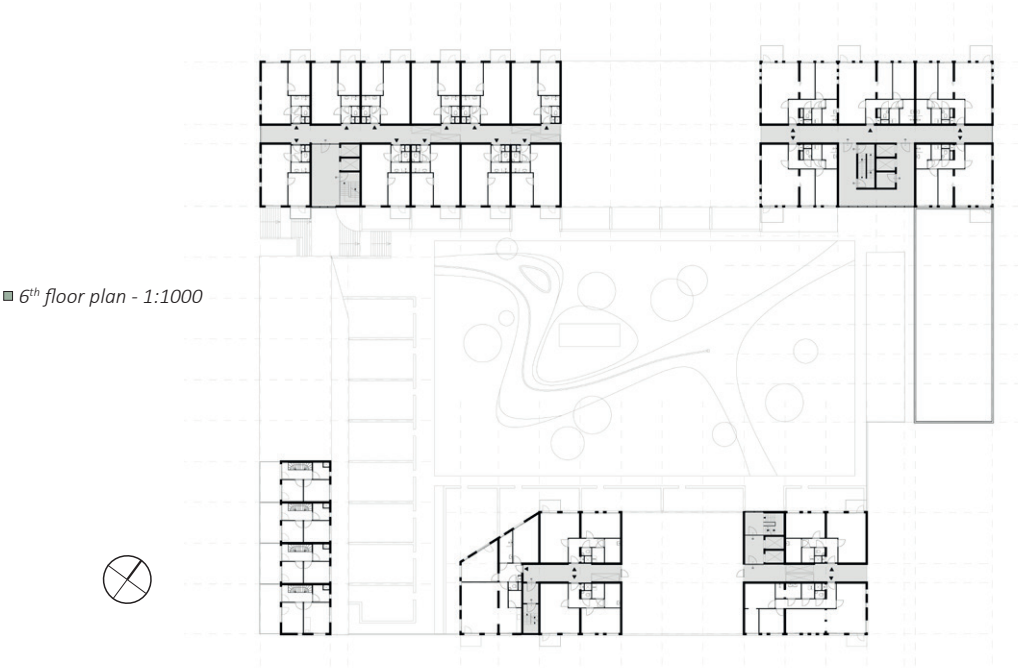
3rd floor plan - 1:1000



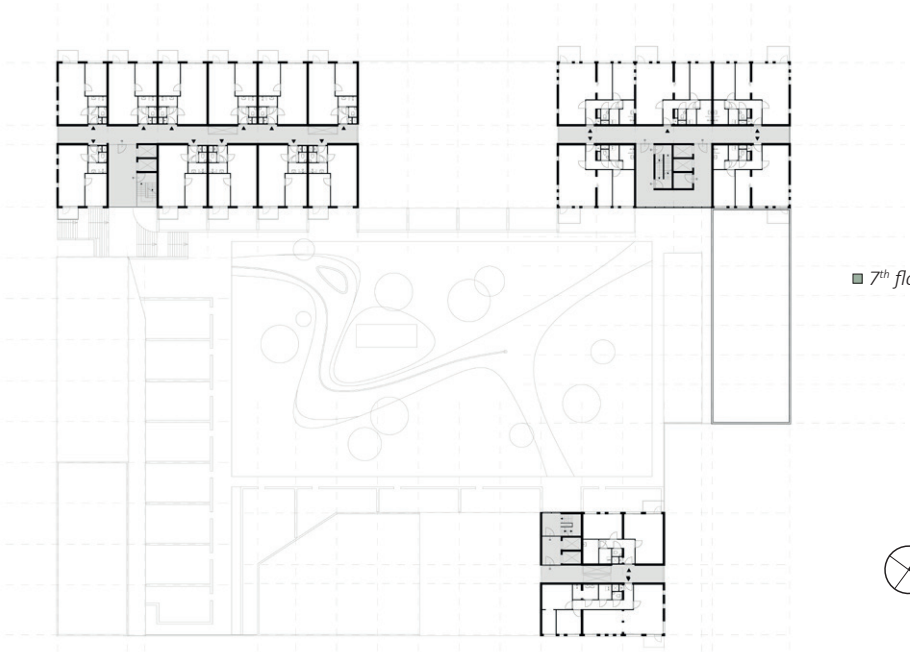
4th floor plan - 1:1000



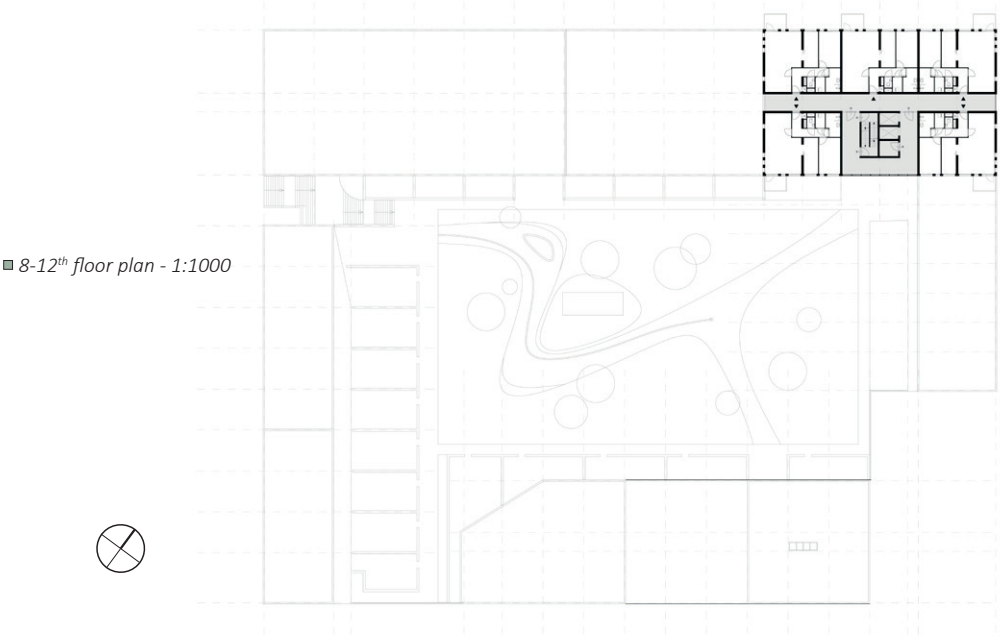
5th floor plan - 1:1000



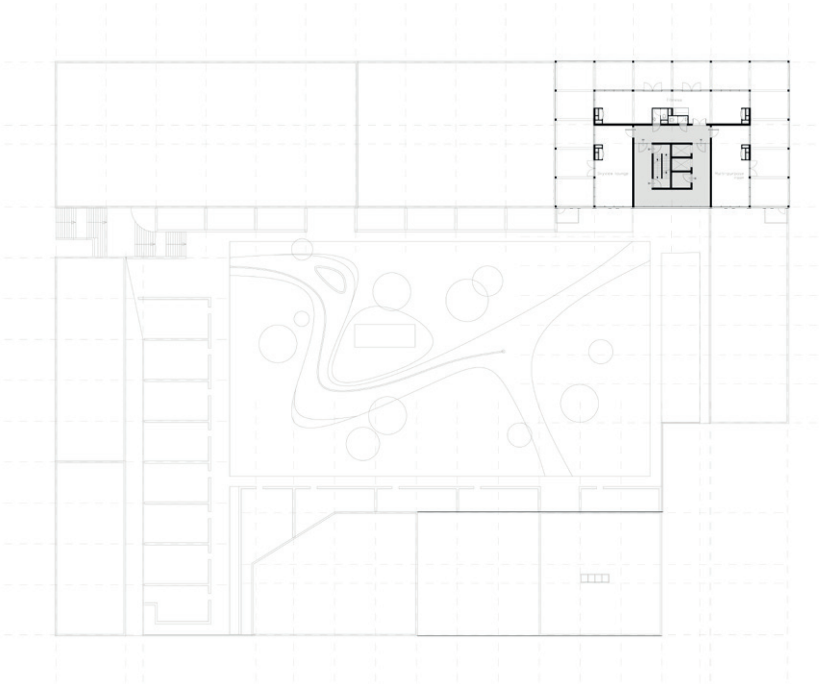
6th floor plan - 1:1000



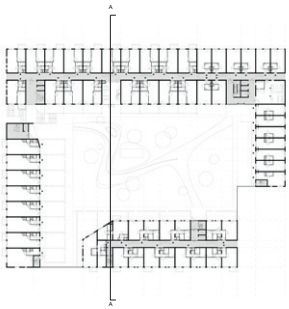
7th floor plan - 1:1000



8-12th floor plan - 1:1000

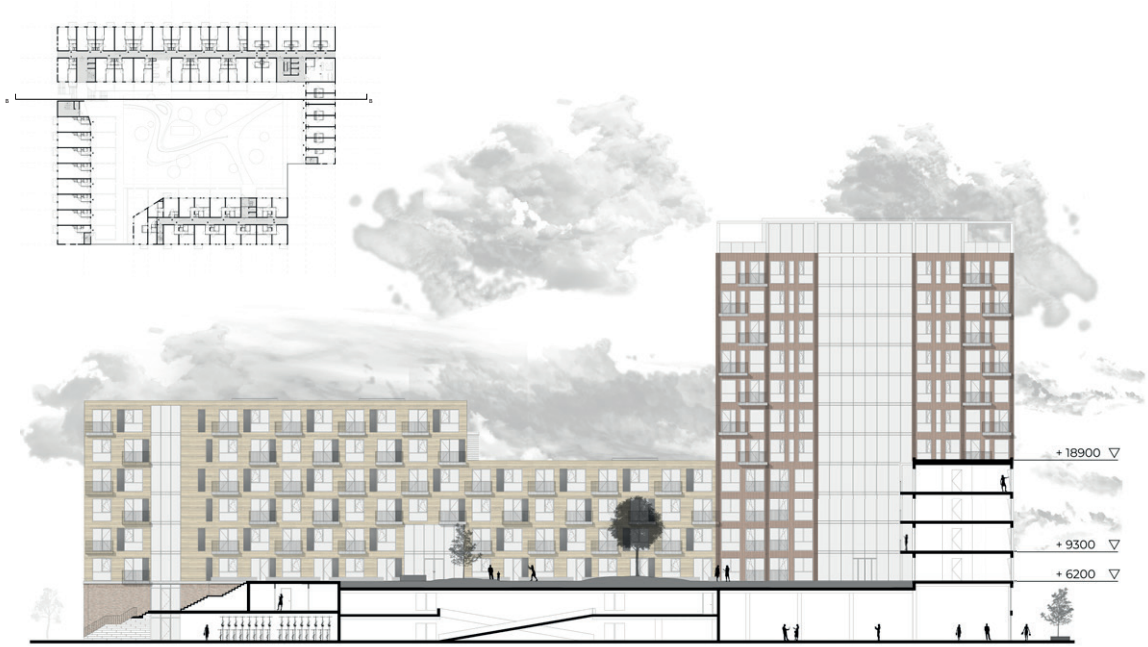


13th floor plan - 1:1000



Section A


+ 22000



Section B - 1:800

Section C - 1:800

Building appearance

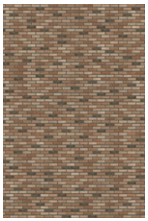
The building has a firm foundation with the plinth cladded in bricks. On top of this plinth the residential blocks have a timber cladding. This expresses the relation with the environment of the building and is also a representation of the wooden structure, which will be discussed later in the booklet. For the timber cladding multiple types of sustainable wood have been selected. With this all residential blocks have their own character.

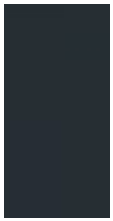
South-east elevation - 1:800

North-west elevation - 1:800

South-west elevation - 1:800

"Soft and natural, with a modern industrial touch"



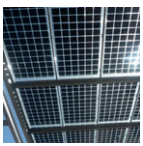



Thermo Ayous

Bamboo

Thermo Ash

Kebony character



North-east elevation - 1:800

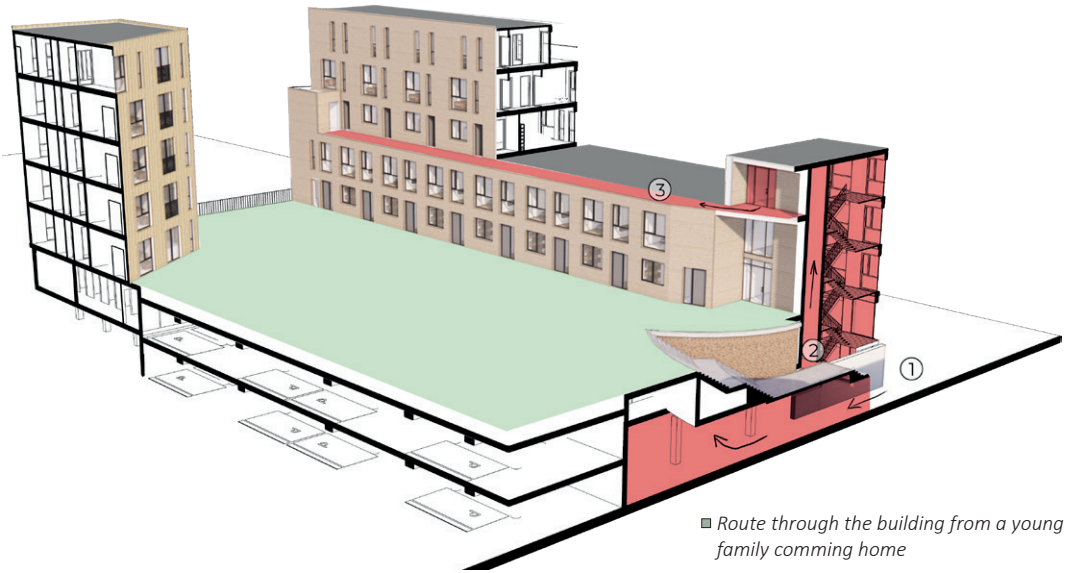
Impression of the exterior, seen from the south-west side of the building


't Keilecafé

Impression of the exterior, seen from the public square on the east side

Route architecturale

The young family - meeting with neighbours

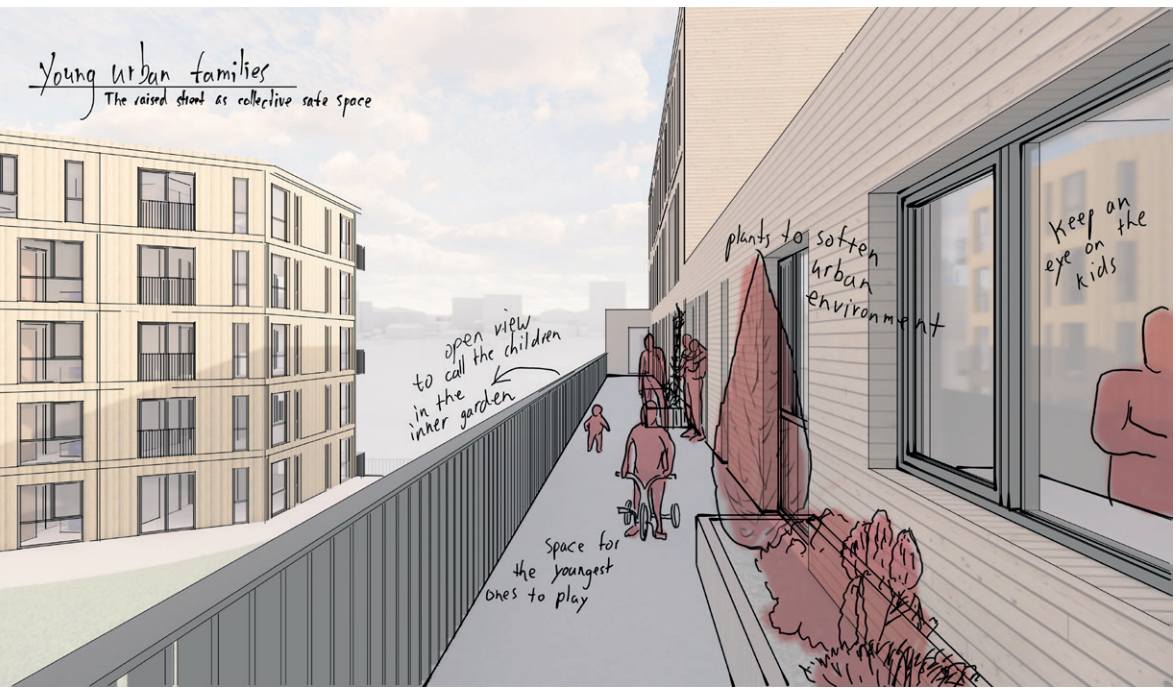


Route through the building from a young family comming home

1. In front of the building

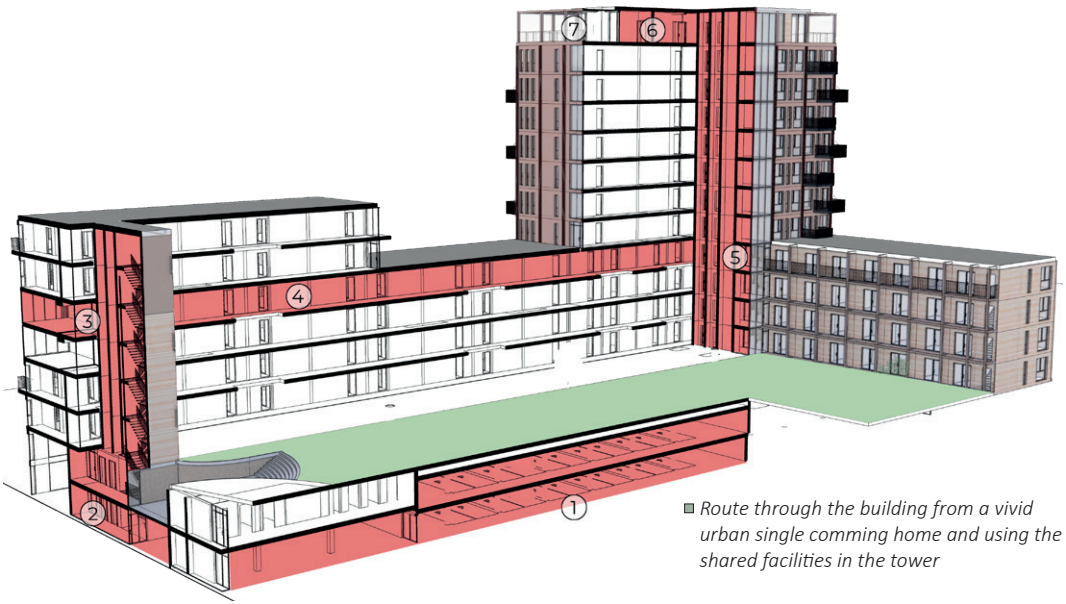
2. The entrance

2. The raised street



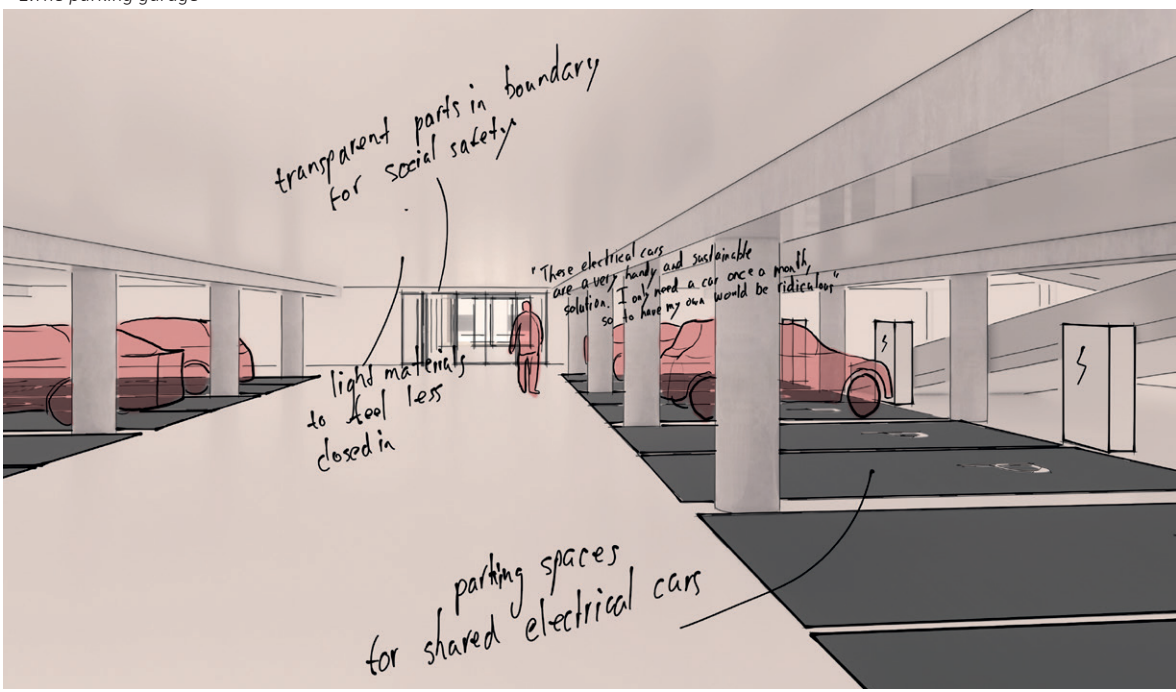
Route architecturale

The vivid urban single - sharing facilities and spaces



Route through the building from a vivid urban single comming home and using the shared facilities in the tower

1.The parking garage



2. The entrance

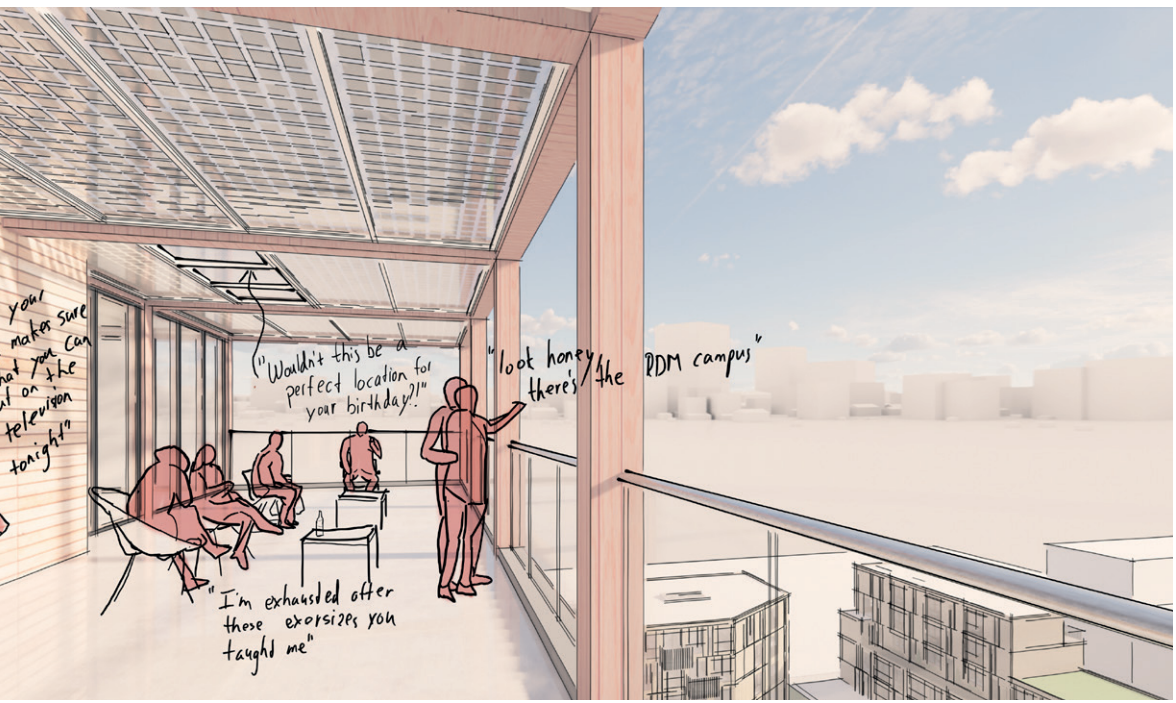
3. The stairwell with adjacent collective space

4. The corridor

5. The stairwell of the tower

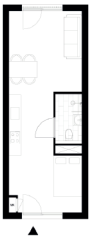
6. The fitness room

7. The roof terrace



Dwelling types

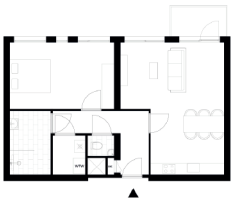
Type A1



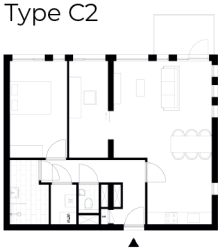
Type A2

Type B

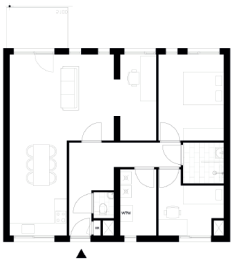
Type C1



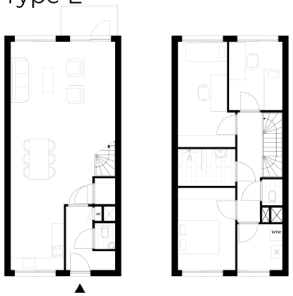
Type C2



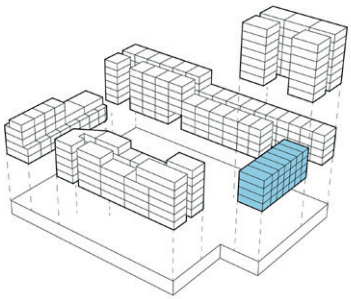
Type D



Type E



Type F

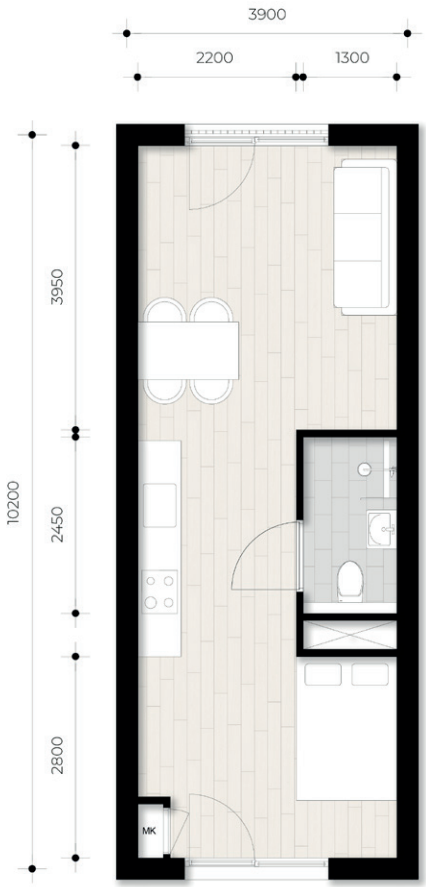


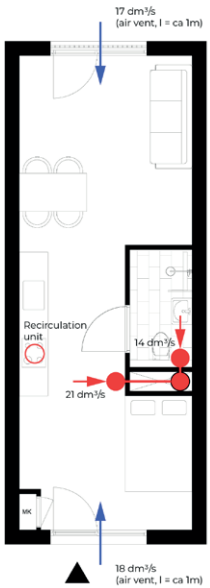
Studios

Two types of studios have been designed. These compact dwellings, meant for young people who are living alone, are fully independant and have all facilities needed. Two variants of the studio are present in the building: type A1 with two seperate zones and type A2 with one larger zone for both living and sleeping.

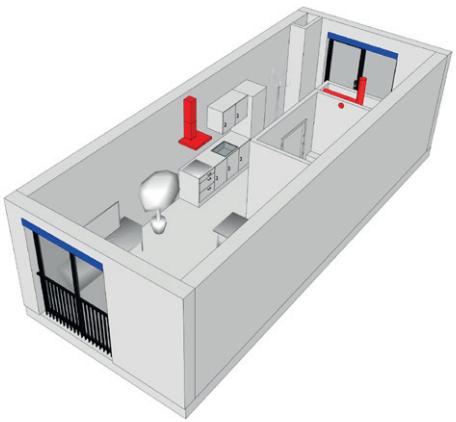
Type A1

- Studio
- 34 m²
- Sleeping area and living area
- Natural ventilation inlet, mechanical outlet

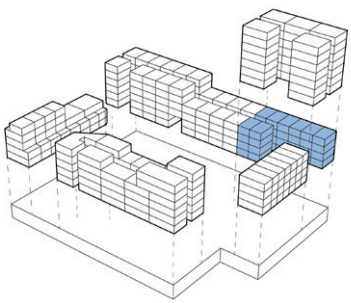




Left: floor plan of dwelling type A1 - 1:100
Top right: ventilation flows in floor plan
Bottom right: ventilation components

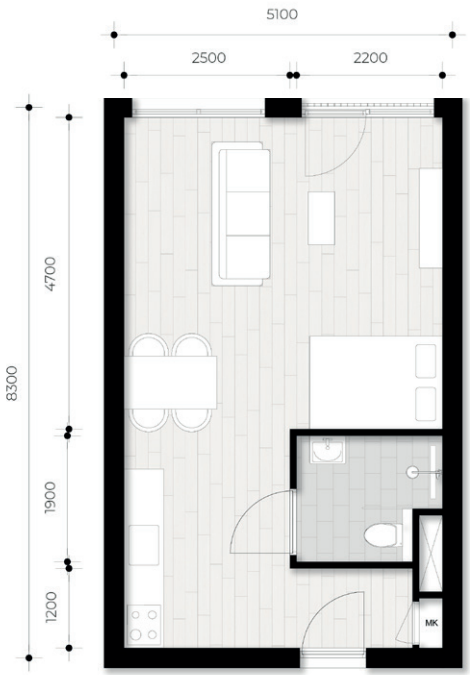


Living area of dwelling type A2

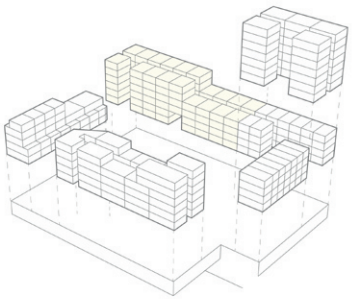


Type A2

- Studio
- 37 m²
- One large flexible zone
- Natural ventilation inlet, mechanical outlet



Floor plan of dwelling type A2 - 1:100

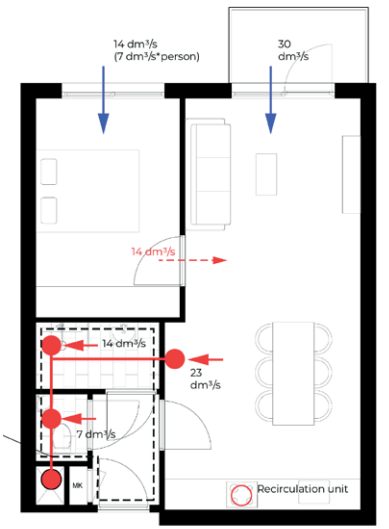


Type B

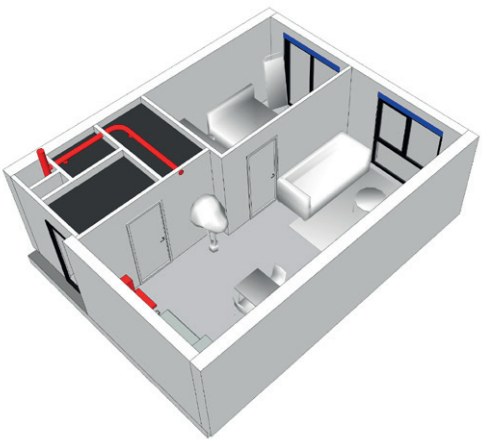
- Compact 2 room apartment
- 49 m²
- Private outside space
- Natural ventilation inlet, mechanical outlet

Floor plan of dwelling type B
1:100

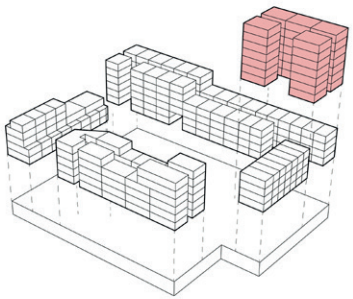
Living area of dwelling type B



Ventilation flows in dwelling type B

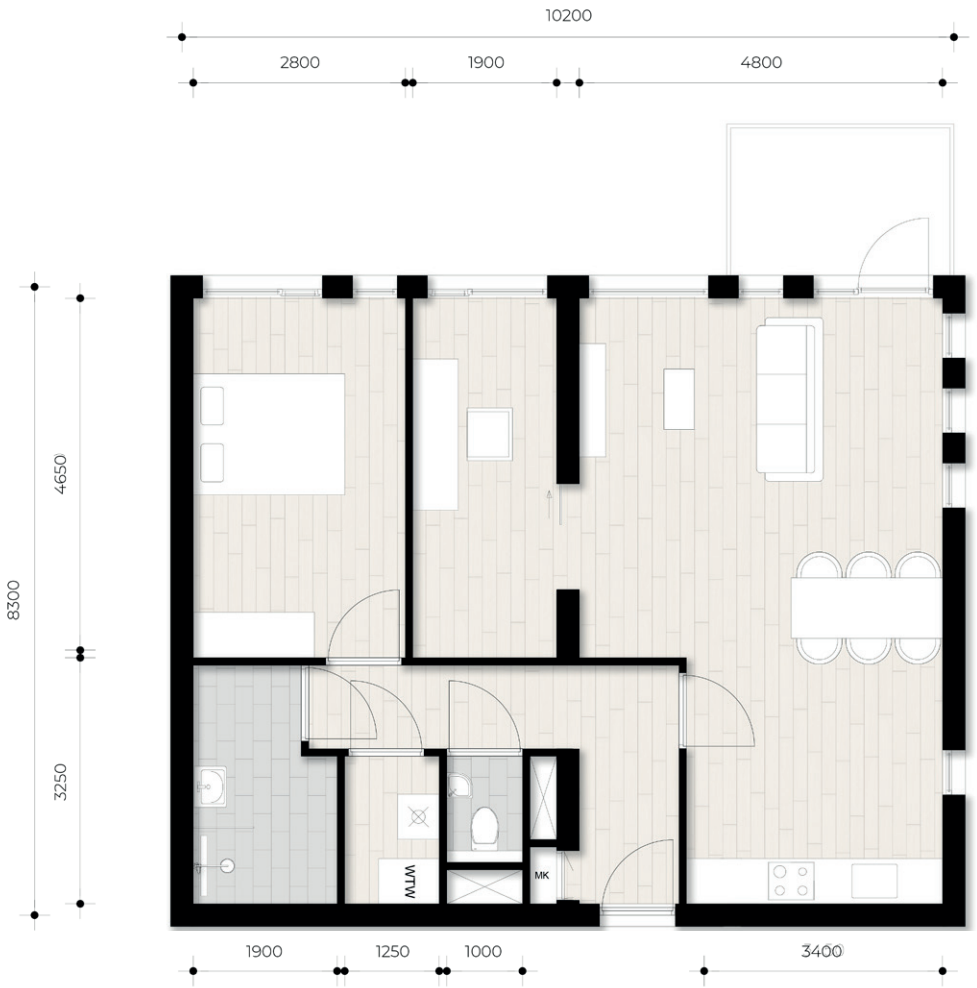


Ventilation system



Type C2

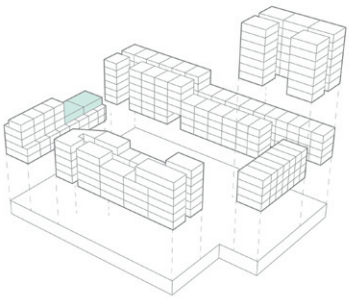
2 room apartment with annex
76 m²
Private balcony
Decentralized balanced
ventilation system



Floor plan of dwelling type C2 - 1:100

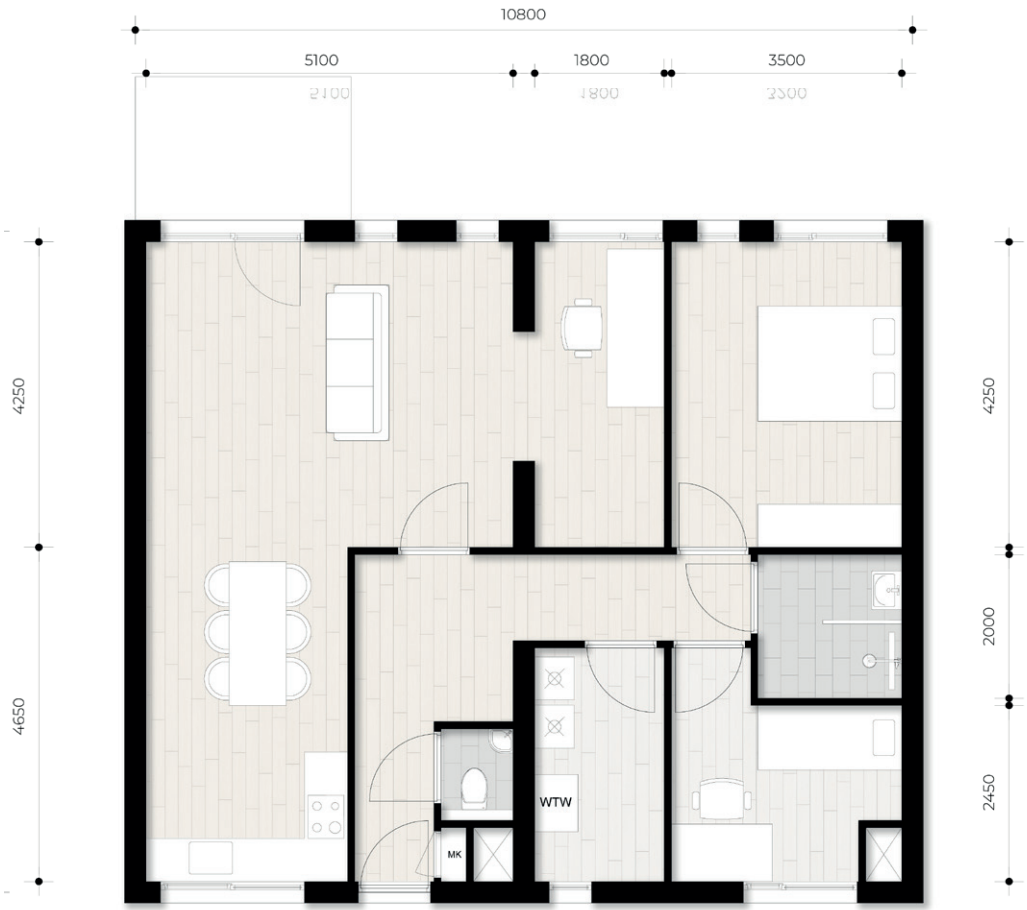
Living room with an exceptional view

View into the open kitchen



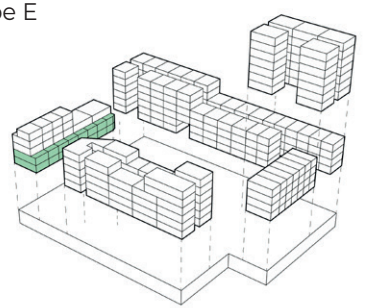
Type D

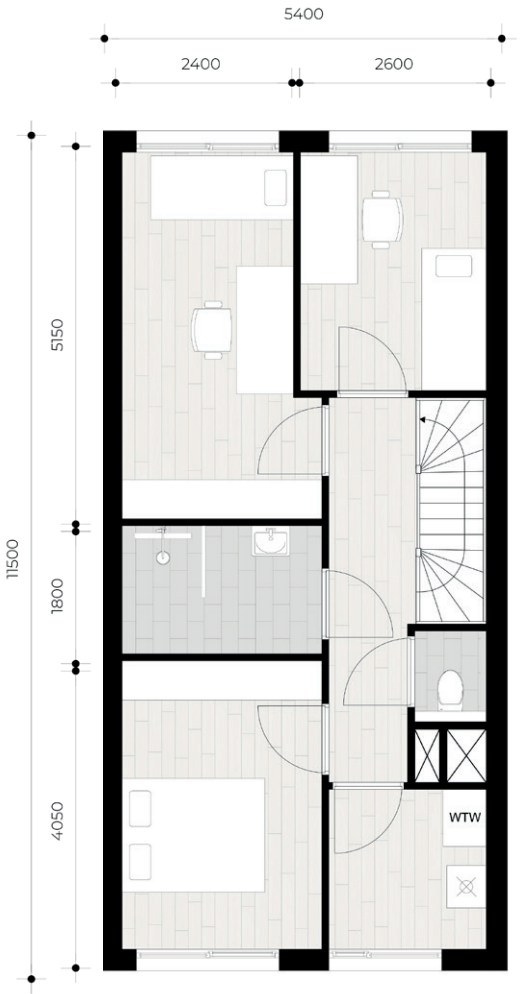
- Family apartment
- 90 m^2
- 2 bedrooms plus annex
- Private outside space
- Decentralized balanced ventilation

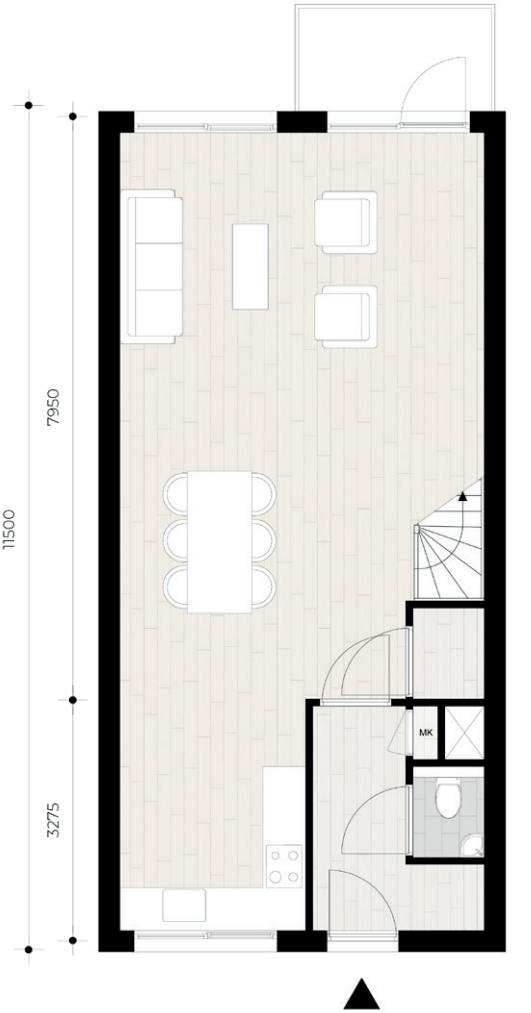


Floor plan - 1:100

Type E





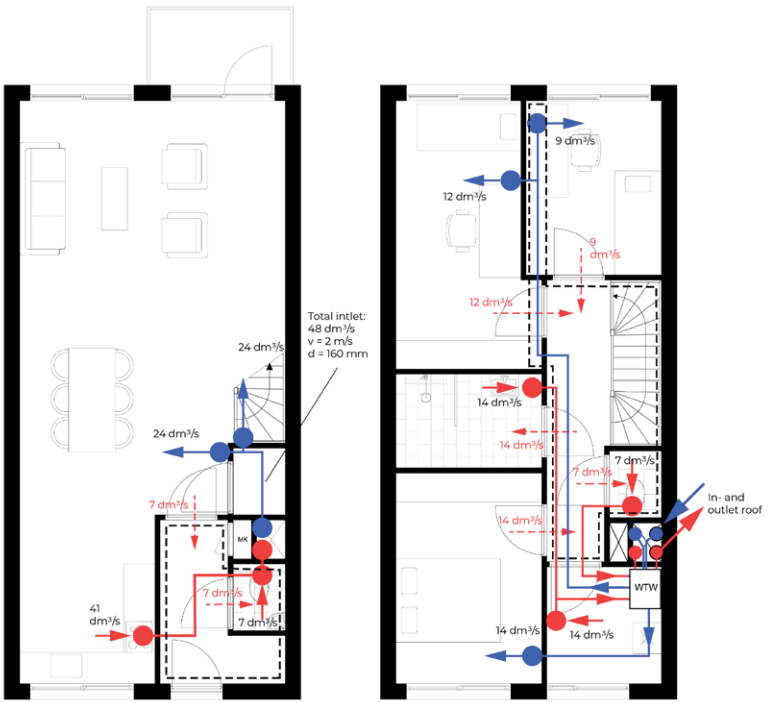


Top right: Ground floor plan - 1:100
Left: 1st floor plan - 1:100

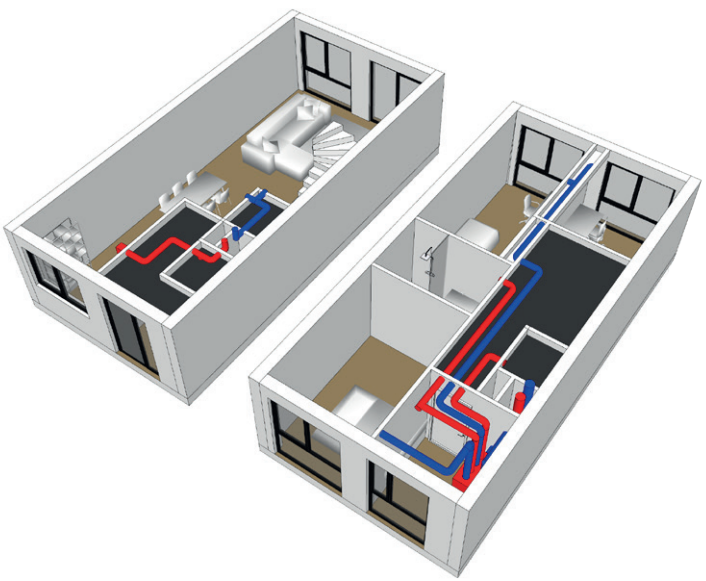
- Maisonette
- 107 m²
- 3 bedrooms
- Private outside space
- Decentralized balanced ventilation system

Living room of the maisonette

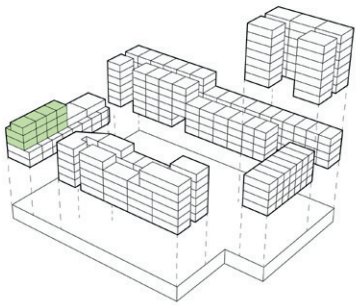
The maisonette is one of the dwellings that is designed especially for young families. It has a large open living room with enough space for young children to play in the presence of the parents. Furthermore this type has plenty of outside space. The dwelling is accessible through a private garden on the inside of the block. On the southwest side the dwelling has a balcony to enjoy the sun in the afternoon. Storage space is facilitated with a large built-in closet in the living room and with enough space in the bedrooms for large closets. A second, separate toilet on the first floor adds to the comfort of this maisonette.



Air flows of the balanced ventilation system in the maisonette

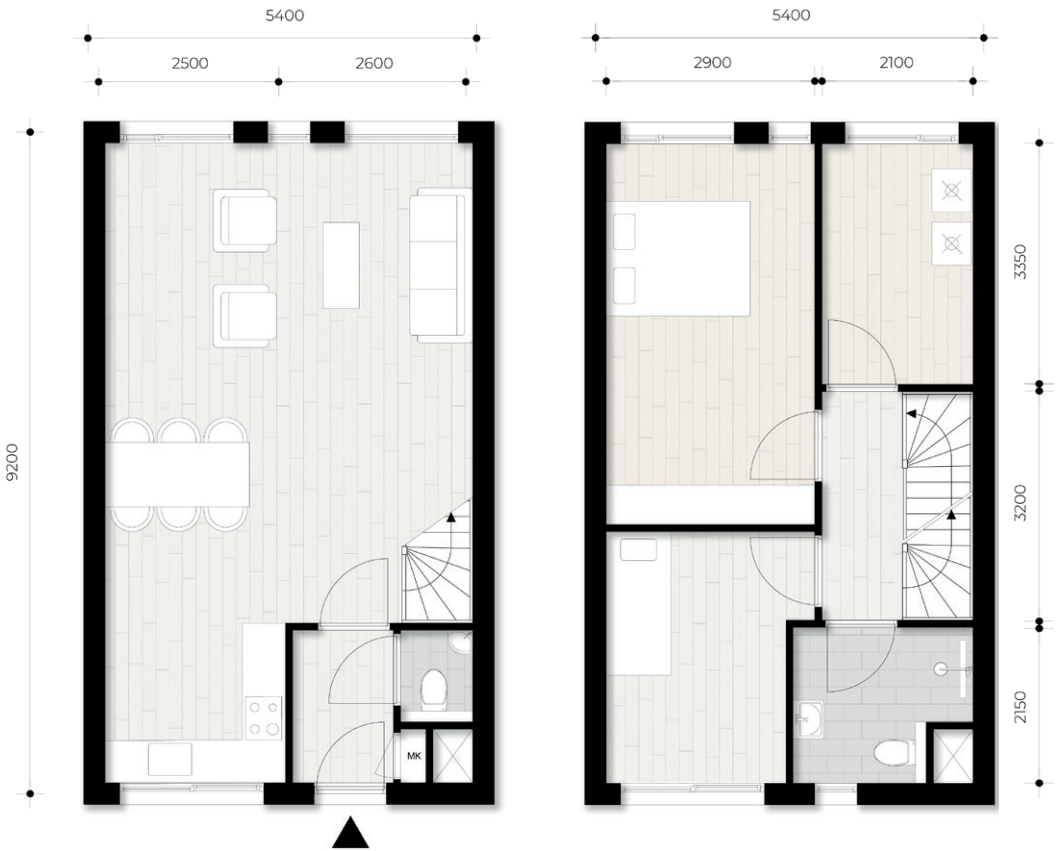


Balanced ventilation system in the maisonette



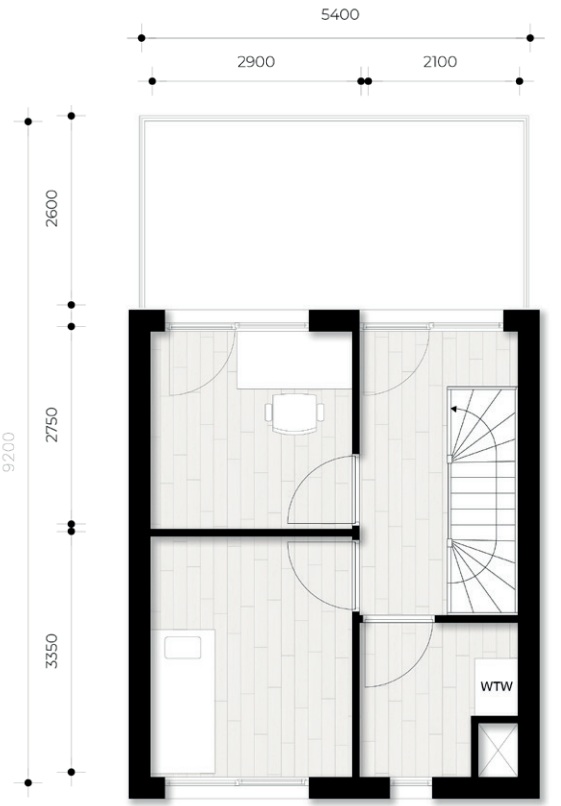
Type F

- Single family home
- 112 m²
- 4 bedrooms
- Large private roof terrace
- Decentralized balanced ventilation system



Left: Ground floor plan - 1:100
Right: 1st floor plan - 1:100

Section of dwelling type F - 1:200



2th floor plan - 1:100

Collective spaces

The communal reading room offers a place to read and work. The generous bookshelf can be used to exchange used books between the residents.

Above: impression of the garden room, a space to host game night, have a drink together and hold the occasional meeting
Below: Section of the communal garden room and lounge in the northern residential block

Impression of the garden, view from the west

WATER STORAGE

PLAYING

RELAXING

VEGETABLE GARDEN

BIODIVERSITY

HEAT REDUCING

INTERACTING

LEARNING ABOUT NATURE

Imporant themes within the garden

The garden

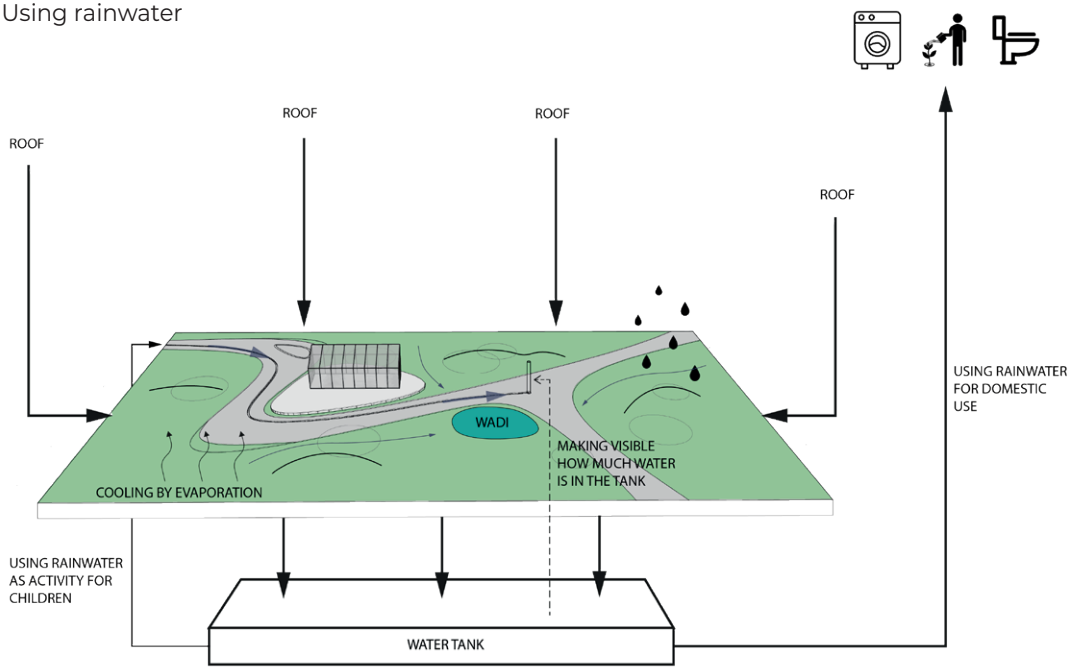
The area on the inside of the residential blocks contains a large communal garden. This garden is a place to relaxe for all residents. It brings nature back into the dense urban environment and has lots of positive influences, both on the social aspect as the environmental aspects. The garden is a place where all residents come to interact or to find a moment of quiet. Additionally this green oasis has multiple factors that contribute to the environmental and climatological side of the project. Water is retained in the soil and slowly carried off to a large water storage underneath the parking garage. By designing a landscape with height differences, the rainwater choses its path to the lowest point: the wadi. This design element makes visible what the weather conditions are and with this it helps increase awareness of the people. The garden also imporves the biodiversity of the city and decreases the heat within the city.

Functional elements of the garden

1. PLAYGROUND
2. SANDPIT
3. GREEN-HOUSE
4. WADI
5. WATER ART
6. RELAXING LAWN
7. SITTING DECK

Impression of the garden, view on the wadi and the water artwork

Using rainwater



Water flows in the building

Visibility and function

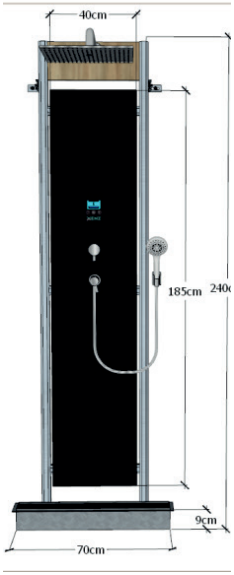
The rainwater is not just used in the building. The aspect of water is also made explicit in the design. The garden is a place where the water is retained. Here the rainwater is collected in the soil and slowly transferred to the water tank. The wadi makes the wheather conditions visible: with heavy rainfall the water cannot all be buffered in the soil and the lowest point of the garden is filled with water.

The water is also used as functional element in the garden. With one push on the button water is pumped up from the tank to the edge of the garden on the west side. Here it flows through a gutter in the middle of the pathway, towards the centre of the garden. In this way children can play with the water and are made aware of the waterflows. At the end of the gutter the water is flowing back into the soil.

Here an art piece is located, in the shape of a glass cylinder. This cylinder can be filled with water. The height of water present in the cylinder is depending on the water level of the tank underground. With this, the piece of art is also an element that contributes to the awareness of the residents. It shows the current water conditions and in this way tells something about the climate and the water usage of the residents themselves.

Decreasing the water usage

By using rainwater in the homes the amount of drinking water used in the building is decreased already. But since showering is the largest water consuming activity at home, it makes sense to find a solution for this water-consuming activity as well. More than 40% of the daily water usage at home comes from showering. With a 'water-recycling' shower such as the Upfall shower we can reduce this drastically. It uses 80% less water than a regular shower. The Upfall shower has a built-in filter that filters the used water that is pumped up from the drain. After this, the water is clean and can be used again in the shower. An additional advantage of this principle is that the used water is still warm. This means that there is way less hot water needed. Consequently the Upfall shower reduces the energy usage that is needed when taking a shower. Altogether this type of shower can contribute to the environmental friendly aspect of the building. I propose to use this shower in the larger dwelling types, since the shower takes some extra space due to the water reservoir .



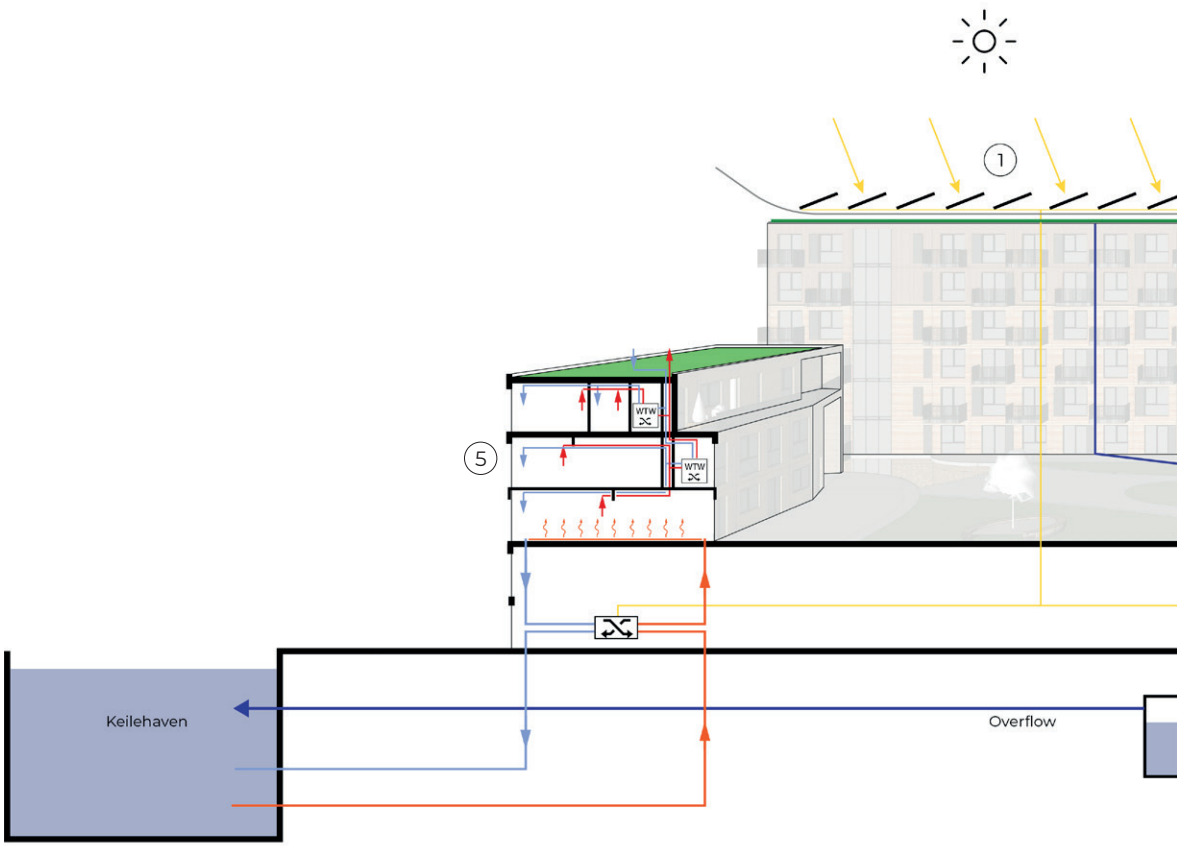
Upfall shower, a shower that recycles water and herewith saves water and energy (images: Upfall)

Total reduction

- Rainfall on the roof of the building is 502 m³ per month on average
- The estimated use of the dwellings is 547 m³ per month for toilet and washing machine. For this, rainwater can be used.
- On top of this the garden can be watered with rainwater as well.
- For this around 120 m³ per month is needed
- Based on this, I chose to have water storage with a capacity of 600 m³. This way the usage is slightly higher than the supply, but there is space to store the extra rain that is falling during winter

With the use of the rainwater from this amount of volume in the tanks and the additional use of recycled water in the shower, about 70% less water is needed in the building.

Type of water tank used (image: Postma pompsystemen)


1
5
WTW
WTW
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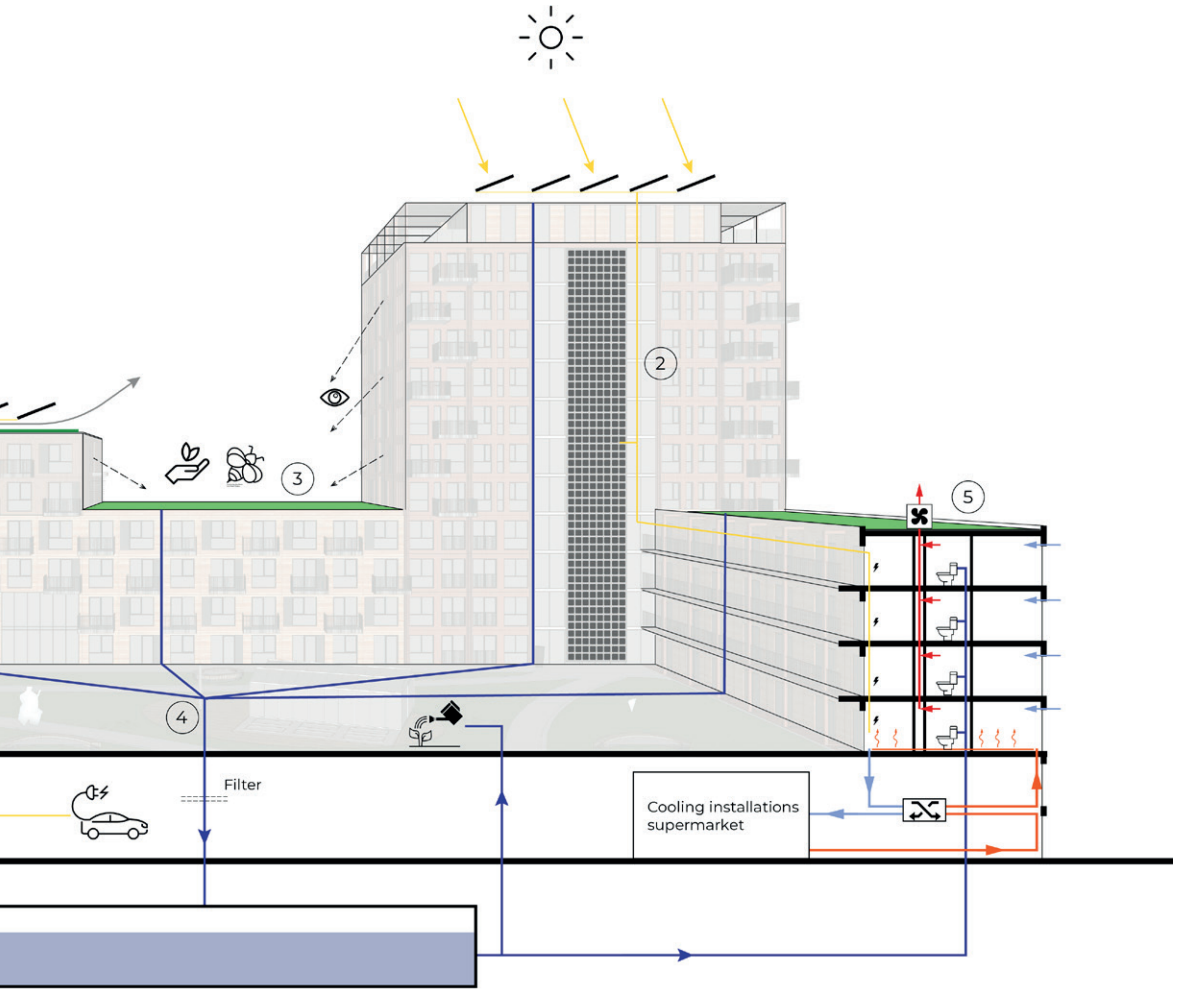
Overflow



Climate scheme with all integrated systems and flows

Optigrun solar roof system

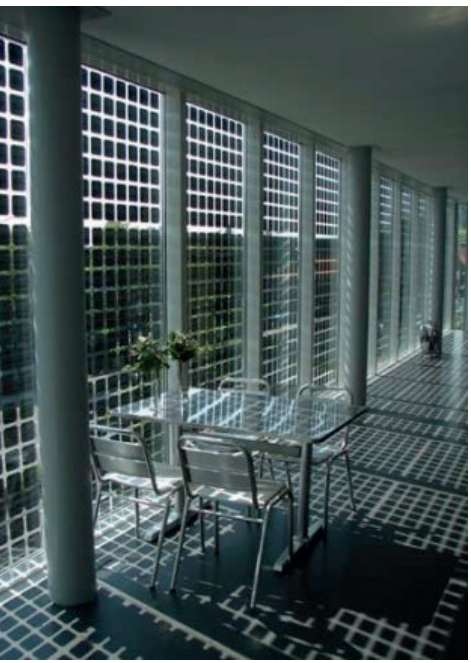
- Produces sustainable energy (± 255 kWh/ m^2*year)
- Green cools the air and increases efficiency of solar panels
- Green roof is a positive contribution to the bio-diversity
- No connection needed beween panels and roof structure, which makes it easy to take of the panels
- Rain water buffer

Extensive green roof

- Green cools the air and thereore contributes to counter the urban heat effect
- Green roof is a positive contribution to the bio-diversity
- Rain water buffer
- View on green out of the dwellings improves the quality of living and reduces stress

Solar roof system from Optigrun (images: Optigrun)

Example of integrated solar cells



Solar cells

- Making visible that energy is produced in the building
- Produces sustainable energy (± 50 kWh/ m2*year)
- Functions as sunshading
- Preserves the view outside
- Creates a vivid play of light inside the building

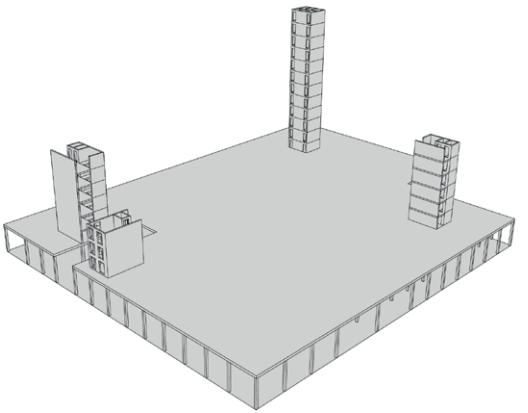
Energy overview

- 1900 m2 PV-panels on the roofs = ± 237.000 kWh/year
- 220 m2PV-panels in the facade = ± 23.100 kWh/ year
- 200 m2 PV-cells integrated in glass roof of tower = ± 9.600 kWh/year
- 180 m2 PV-cells integrated in the facade of the tower = ± 6.300 kWh/year

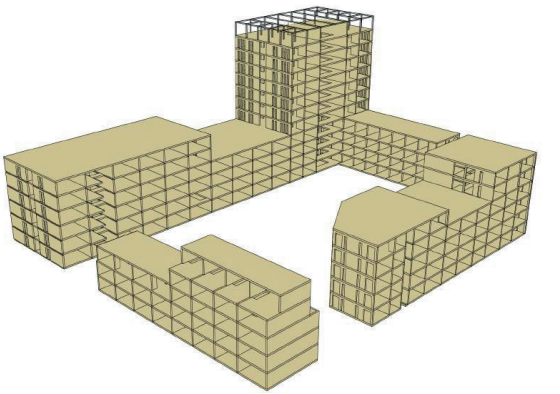
Total solar energy production in the building = ± 275.715 kWh/year
That means that 83% of the energy consumption is covered

Building structure

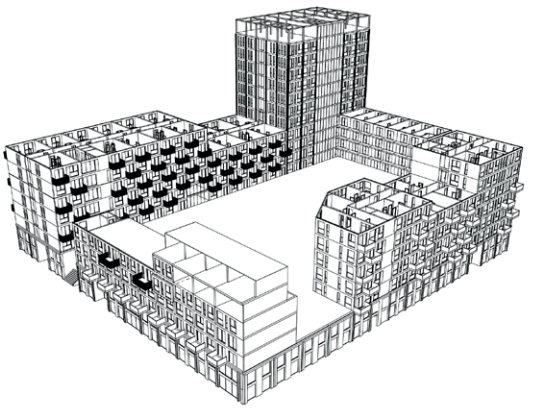
The type of structure and the materials used in the building are mainly chosen based on the aim to design a sustainable building that has a small footprint. The base of the building is constructed with concrete columns and floors. This makes it possible to design commercial space with a flexible lay-out and larger spans. Moreover the concrete can resist a possible flood, which is important since the building is located outside of the dykes. The cores are constructed in concrete as well, to provide stability in the building. On top of the concrete base the residential blocks are made of mass timber elements or so called Cross Laminated Timer (CLT). These lightweight structure is lightweight and is prefabricated. This makes that the foundations of the building can be reduced. In this way material and therefore money is saved. On top of these advantages of a CLT structure it has a positive impact on the footprint of the building. More on this on the next page.



Concrete base & cores, functioning as a durable foundation with a flexible lay-out due to the column sturcture



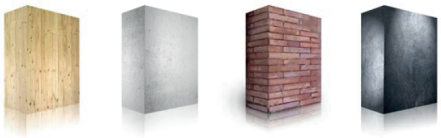
Cross laminated timber walls and floors, lightweight and sustainable material with a fast construction time

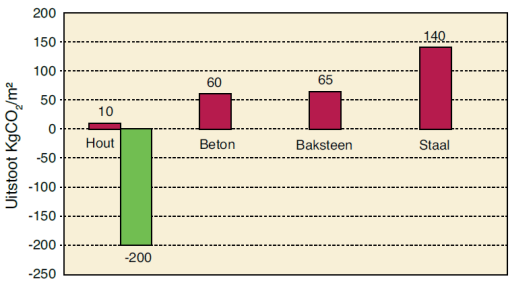


Prefabricated timber frame facade elements

Constructing in wood

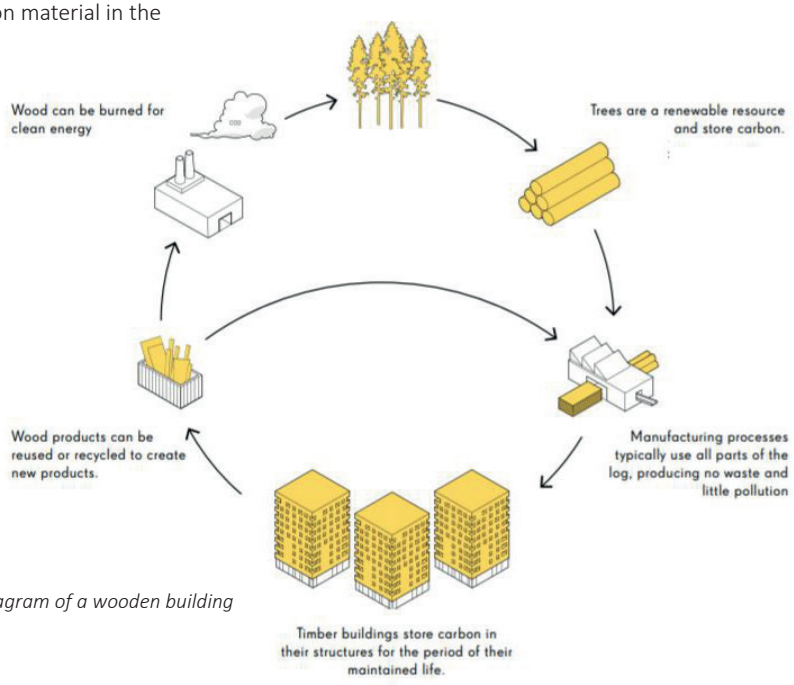
As introduced before my design is mainly constructed with CLT elements. This in the Netherlands relatively new construction type has multiple advantages. First and foremost it has a negative emission of CO_2. Since this gas is one of the largest causes of climate change, this is of huge importance. Whereas building with alternative materials such as brick and concrete causes excessive CO_2 emissions, building in wood reduces the amount of carbon dioxide in the air. This positive effect is present becasue of the fact that CO_2 is stored in wood. As long as the wood is not burned or decomposed this CO_2 will be retained.





Carbon dioxide emission of different building materials (image: Seminar 'A Revolution in Wood')

Here a second important aspect of constructing in wood is introduced. Since building with CLT is a dry method all elements can be taken apart at the end of the lifespan of the building. In this way the wood can be reused, either in buidings or in smaller products which require a lower quality of the wood. At the end of it's lifespan wood can be burned to produce energy, but an even better solution is to use the wood as insulation material in the form of wood fibreboard.



Building lifecycle diagram of a wooden building (image: CleanTech)

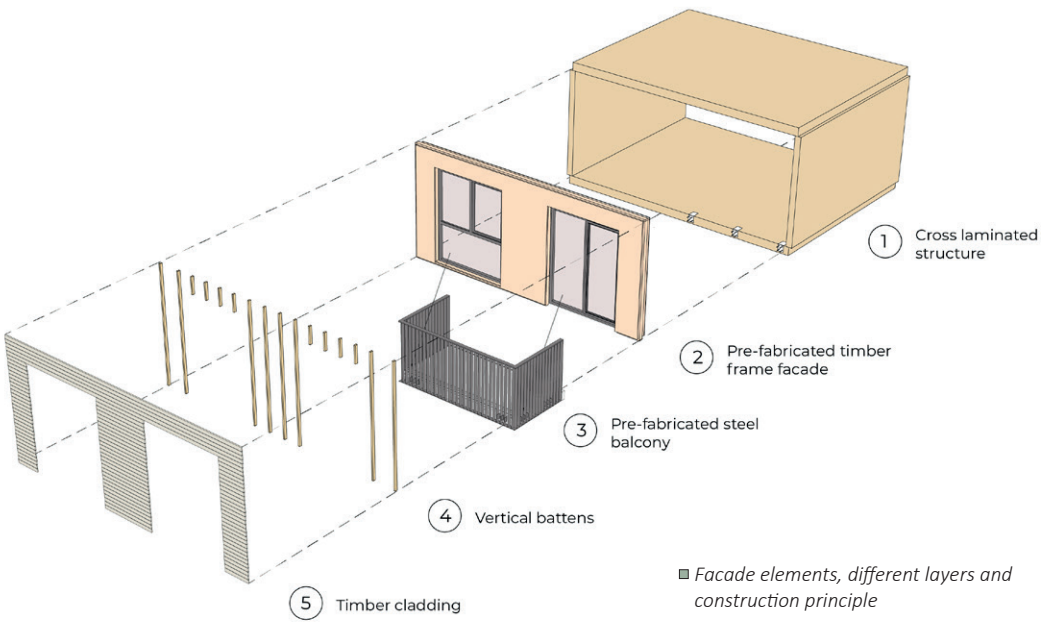
Environmental impact of building in wood

± **5000 m³ CLT** in the building
CO_2 reduction of 5560 tons by not using concrete
CO_2 reduction of 4550 tons by storing CO_2 in the trees
Total CO_2 reduction of 10.000 tons just by building in CLT

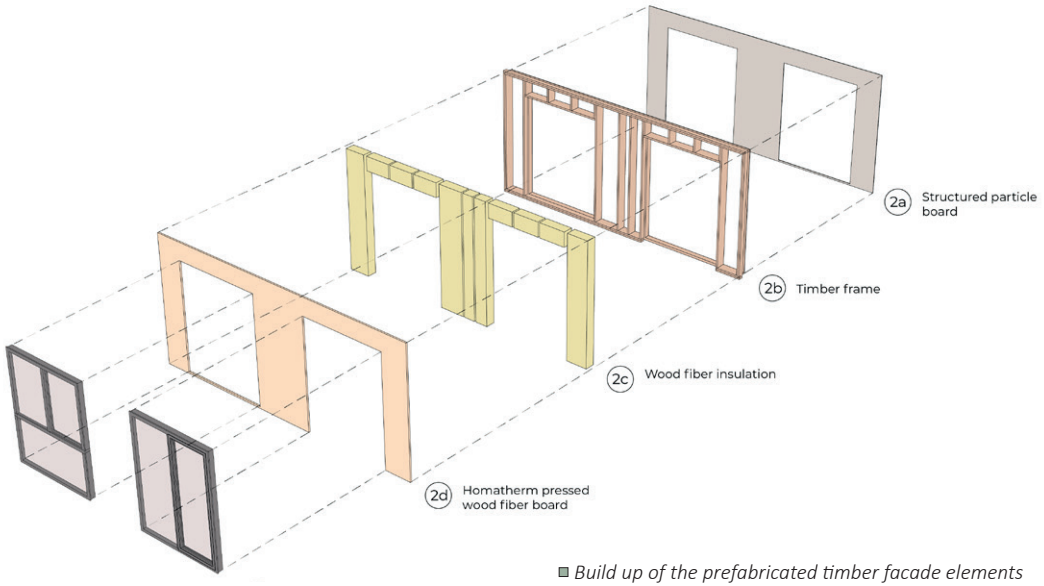
That is **10 million kg of CO_2!** That equals about 163 times a trip around the world in your car

Insulation from natural materials will bring an even higher reduction in CO_2 emission, as rockwool makes up for about 21% of all building material we use (in volume). In this design wood fiber is used as insulation material.

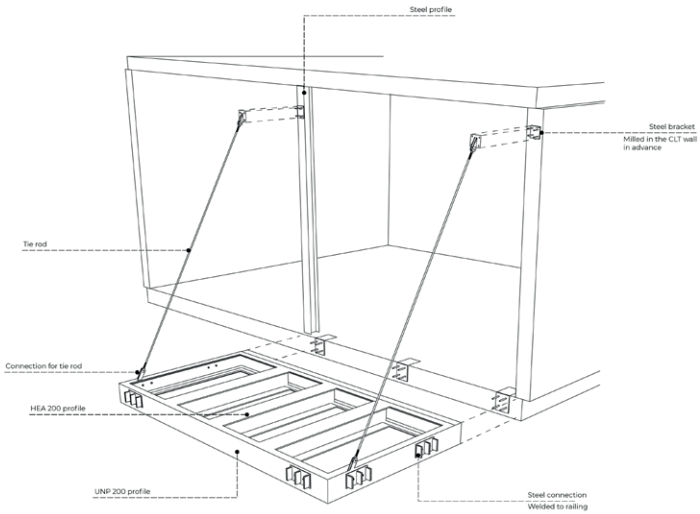
CLT walls and floors are prefabricated and therefore construction time is drastically decreased comparing to traditional building (image: Simpson Strong-Tie)



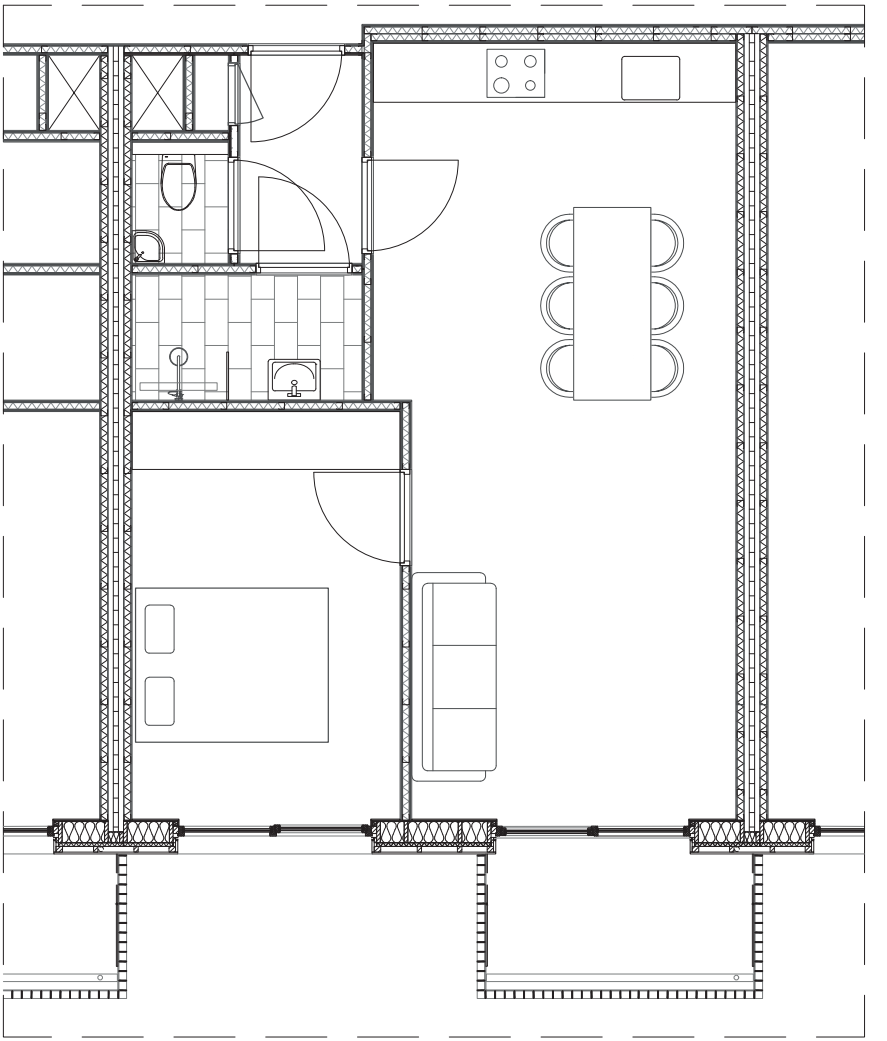
Facade elements, different layers and construction principle



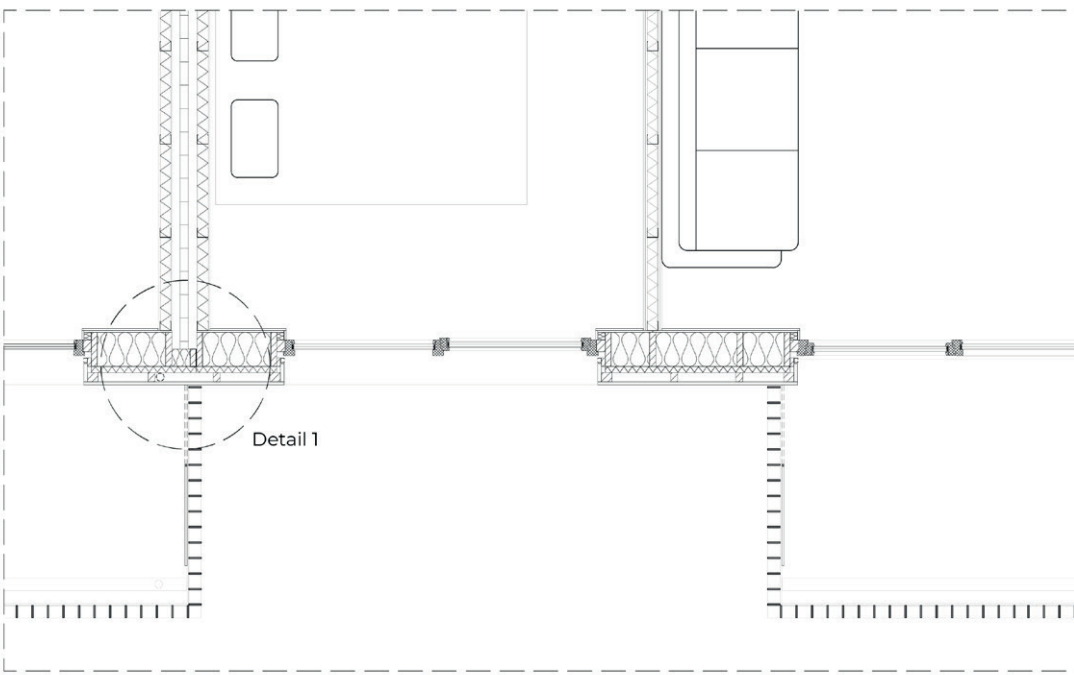
Build up of the prefabricated timber facade elements

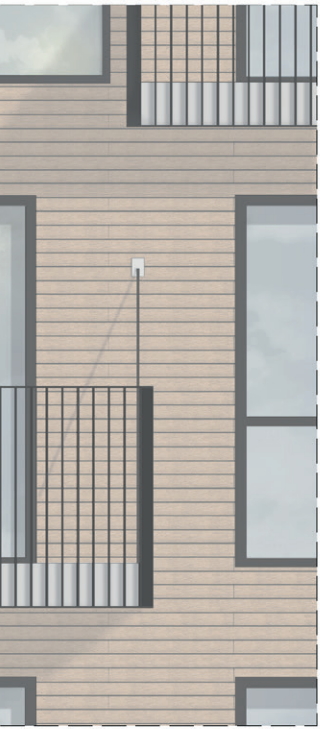


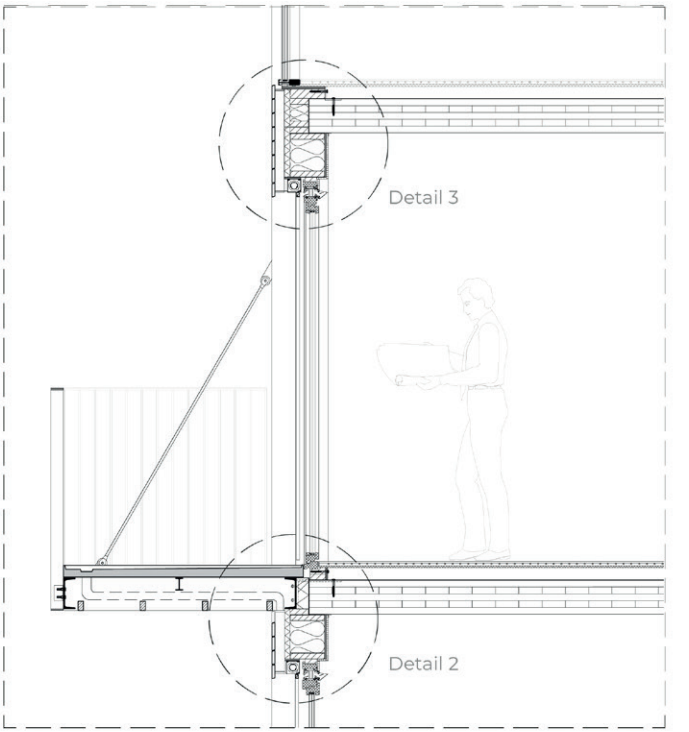
Construction method of the prefabricated balconies

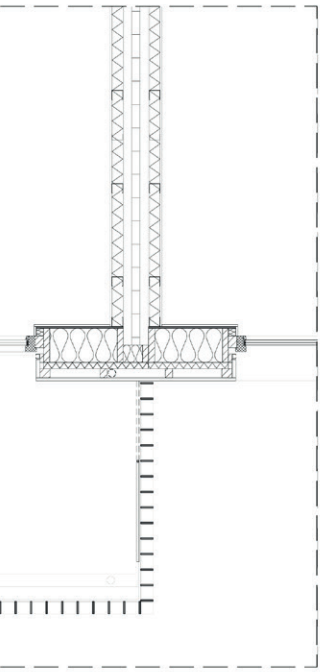


Technical floor plan of dwelling type B - 1:80

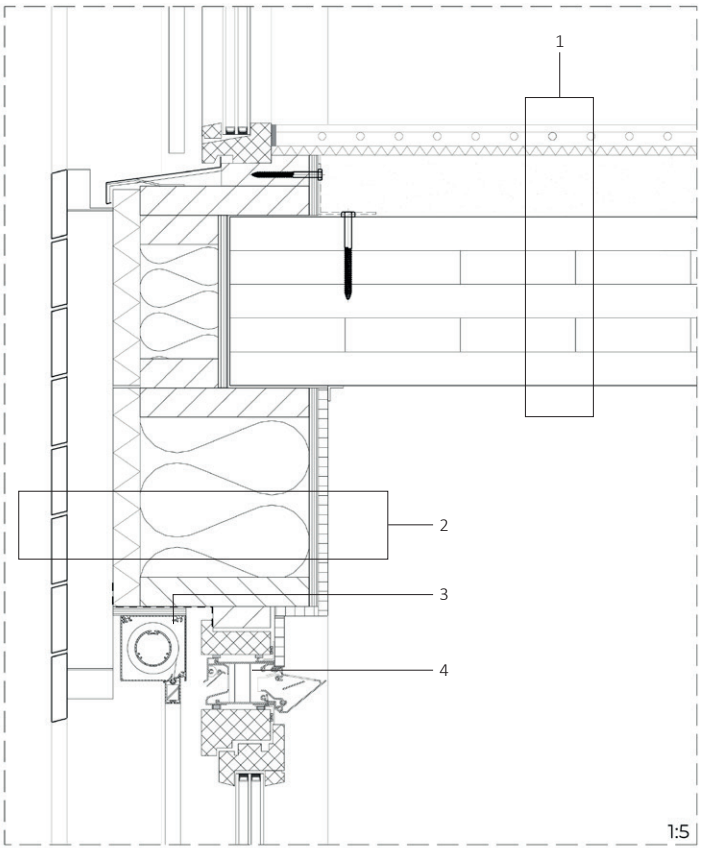

Detail 1





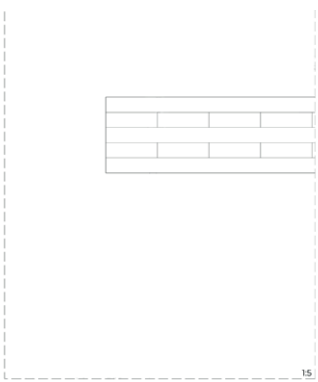


Facade fragment - 1:50

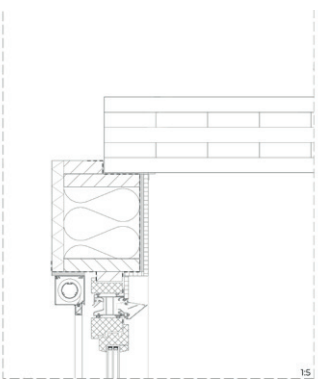


Vertical detail - 1:10
Facade/floor standard

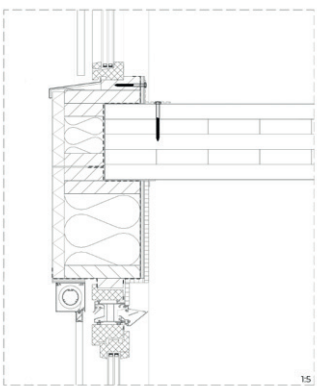
1. FLOOR COVERING, PLATE (NOPPENPLAAT) WITH FLOOR HEATING 18MM, XPS INSULATION 15MM, SAND LAYER 80MM, CLT FLOOR 220MM
2. PLASTERBOARD 12.5MM, STRUCTURED PARTICLE BOARD 12MM, TIMBER FRAME WITH SOFT WOOD FIBER INSULATION 220MM, HOMATHERM PROTECT, PRESSED WOOD FIBER INSULATION 35MM, VERTICAL BATTENS 60MM, BAMBOO HORIZONTAL CLADDING 20MM
3. SUN SCREEN
4. DUCO CLIMATOP AIR VENT WITH PRE-HEATING OF AIR



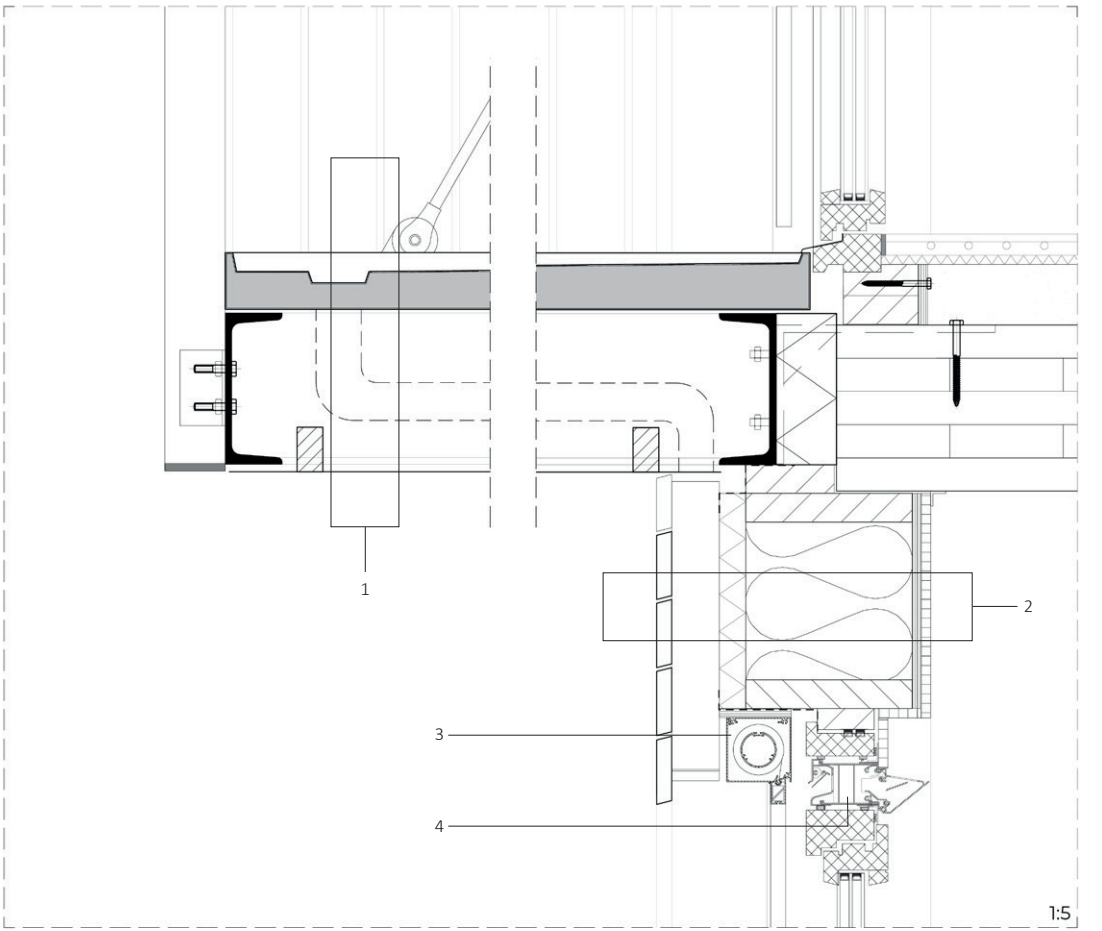
Step 1: CLT

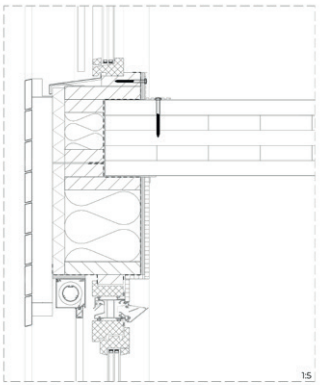


Step 2: Placing the prefab timber frame element

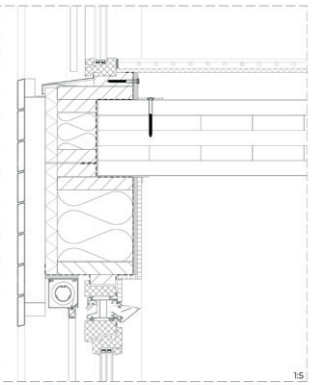


Step 3: Placing the next element on top, screwing to the floor and taping the outside



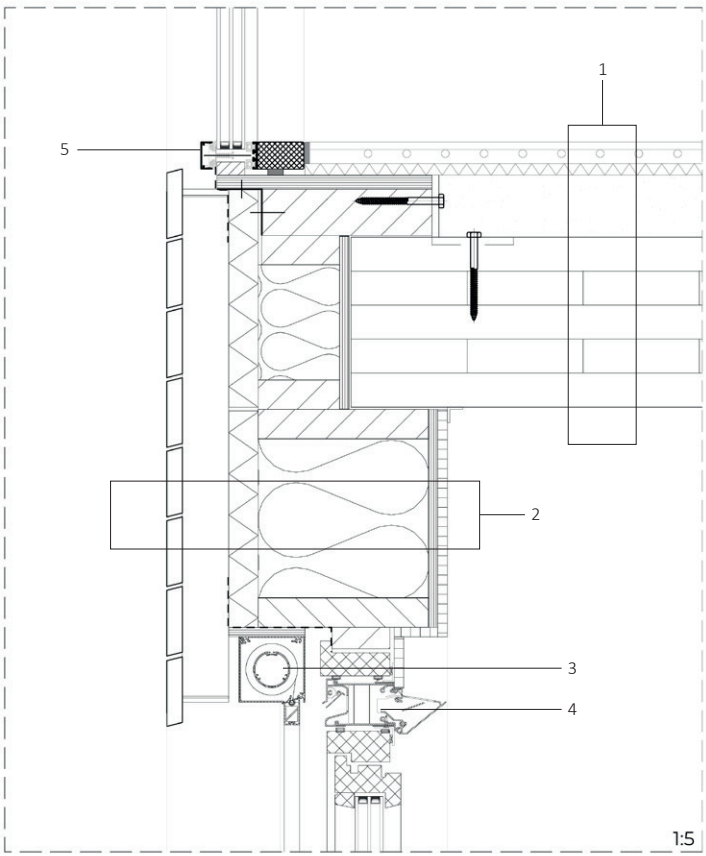


Step 4: Cladding the facade: connecting battens to the facade elements and covering them with horizontal rhombus cladding



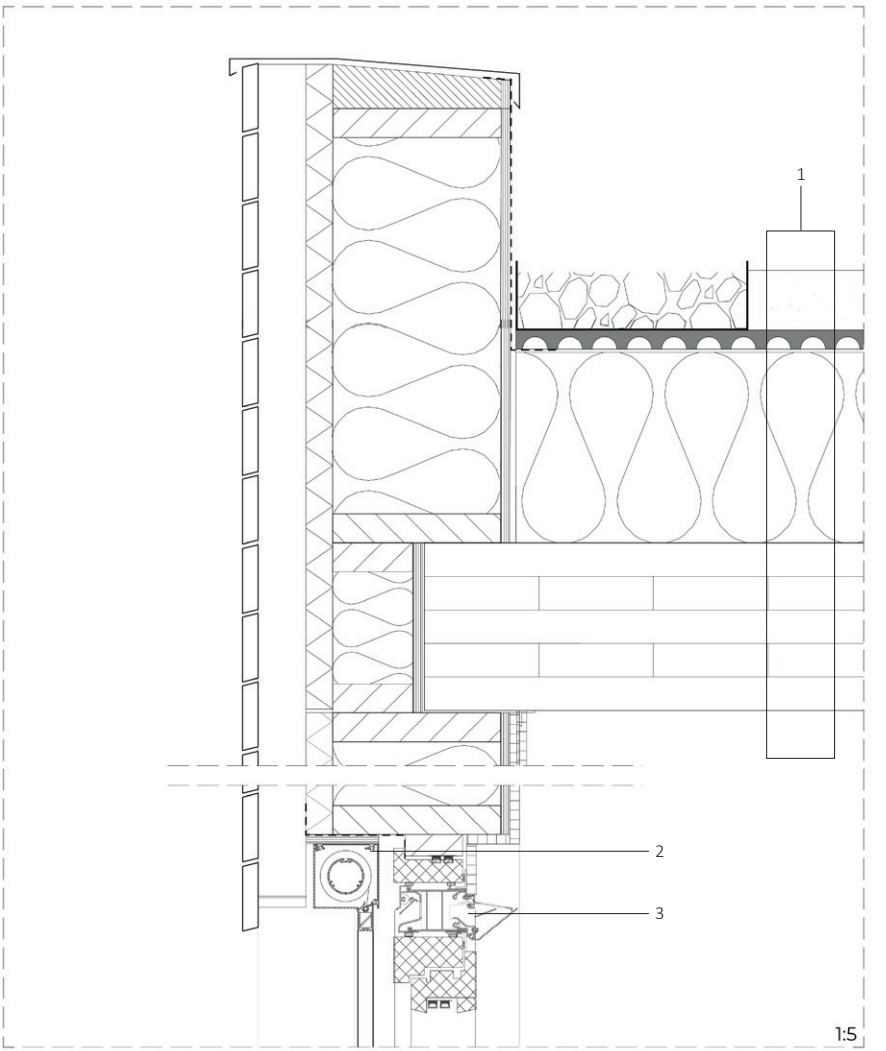
Step 5: Adding the dry screed on the floor, including piping and floor heating system

1. SOLID CORE PANEL 6MM, BATTENS 34X59MM, HEA STEEL PROFILE, PREFABRICATED FLOOR OF GLASSFIBER REINFORCED POLYESTER, STEEL RAILING BLACK POWDER COATING.
2. PLASTERBOARD 12.5MM, STRUCTURED PARTICLE BOARD 12MM, TIMBER FRAME WITH SOFT WOOD FIBER INSULATION 220MM, HOMATHERM PROTECT, PRESSED WOOD FIBER INSULATION 35MM, VERTICAL BATTENS 60MM, BAMBOO HORIZONTAL CLADDING 20MM.
3. SUN SCREEN
4. DUCO CLIMATOP AIR VENT WITH PRE-HEATING OF AIR

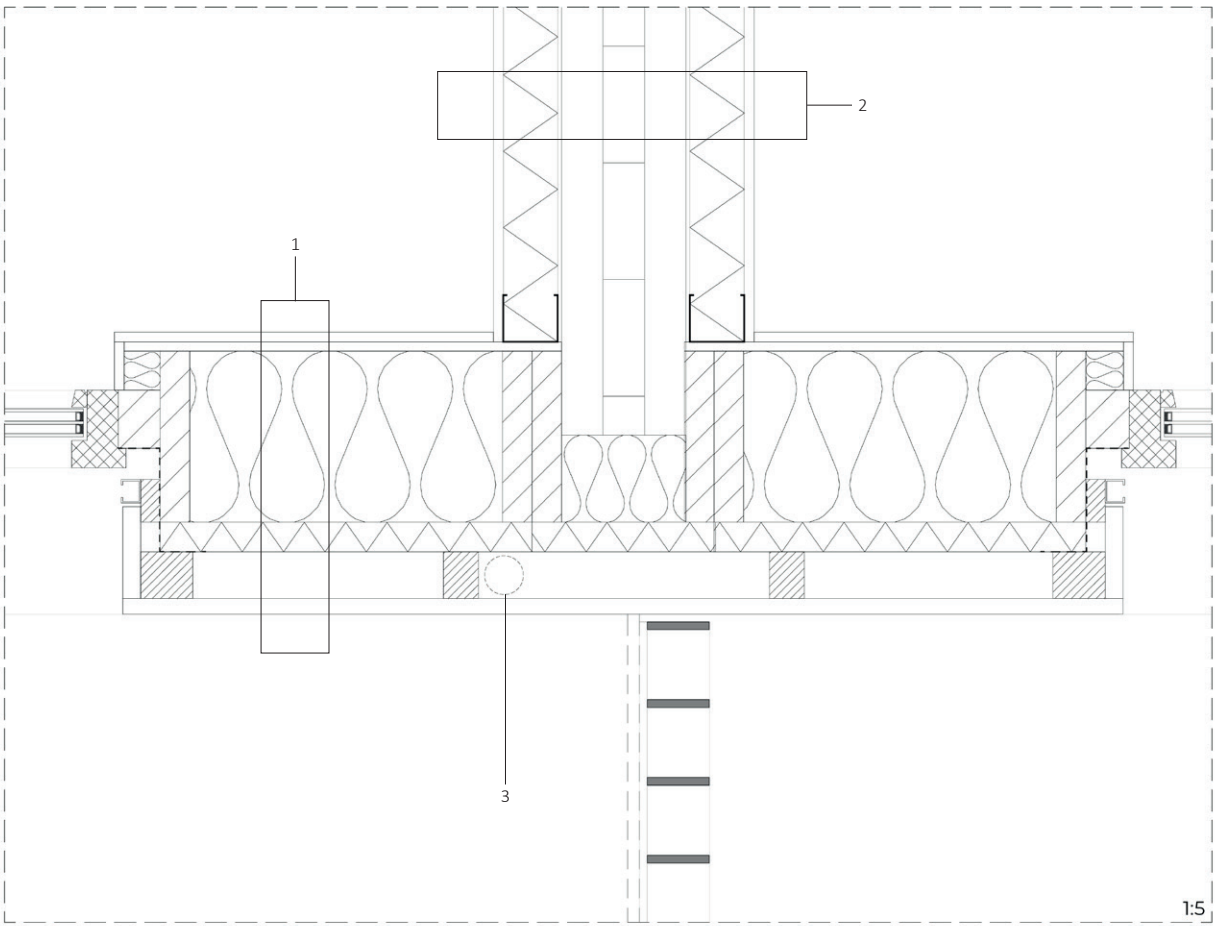


1. FLOOR COVERING, PLATE (NOPPENPLAAT) WITH FLOOR HEATING 18MM, XPS INSULATION 15MM, SAND LAYER 80MM, CLT FLOOR 220MM.
2. PLASTERBOARD 12.5MM, STRUCTURED PARTICLE BOARD 12MM, TIMBER FRAME WITH SOFT WOOD FIBER INSULATION 220MM, HOMATHERM PROTECT, PRESSED WOOD FIBER INSULATION 35MM, VERTICAL BATTENS 60MM, BAMBOO HORIZONTAL CLADDING 20MM.
3. SUN SCREEN
4. DUCO CLIMATOP AIR VENT WITH PRE-HEATING OF AIR
5. STABALUX WOODEN CURTAIN WALL SYSTEM WITH TRIPLE GLAZING

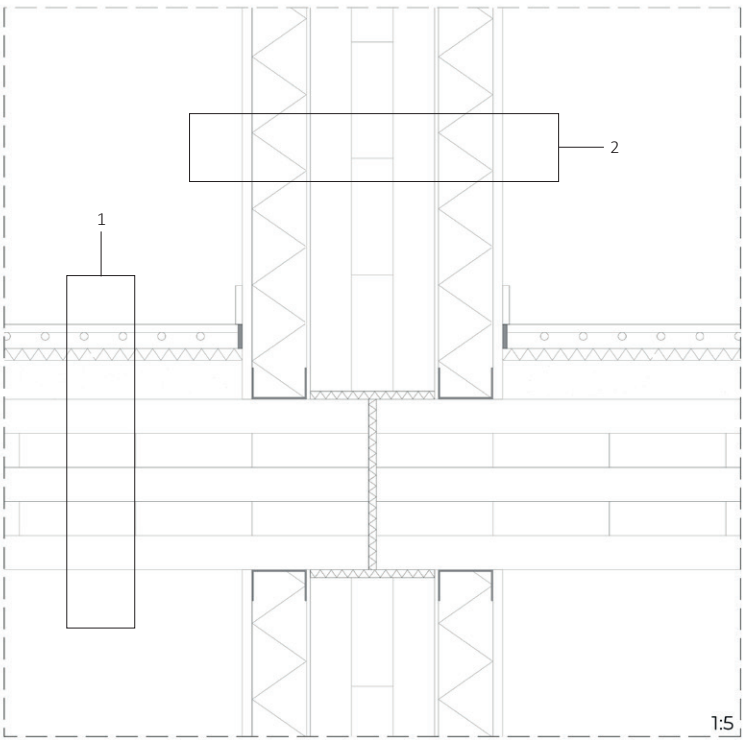
.



1. SOLARGRÜN ROOF (PV PANELS SYSTEM, SEDUM ROOF 50MM, DRAINAGE BUFFER 25MM), INSULATION
2. 250MM, CLT FLOOR 220MM.
3. SUN SCREEN
   DUCO CLIMATOP AIR VENT WITH PRE-HEATING OF AIR



1. PLASTERBOARD 12.5MM, STRUCTURED PARTICLE BOARD 12MM, TIMBER FRAME WITH SOFT WOOD FIBER INSULATION 220MM, HOMATHERM PROTECT, PRESSED WOOD FIBER INSULATION 35MM, VERTICAL BATTENS 60MM, BAMBOO HORIZONTAL CLADDING 20MM.
2. PLATERBOARD 12.5MM, METAL STUD FRAME WITH INSULATION 70MM, CLT WALL 160MM, METAL STUD FRAME WITH INSULATION 70MM, PLATERBOARD 12.5MM.
3. RAINWATER DRAINAGE OF BALCONIES Ø40MM

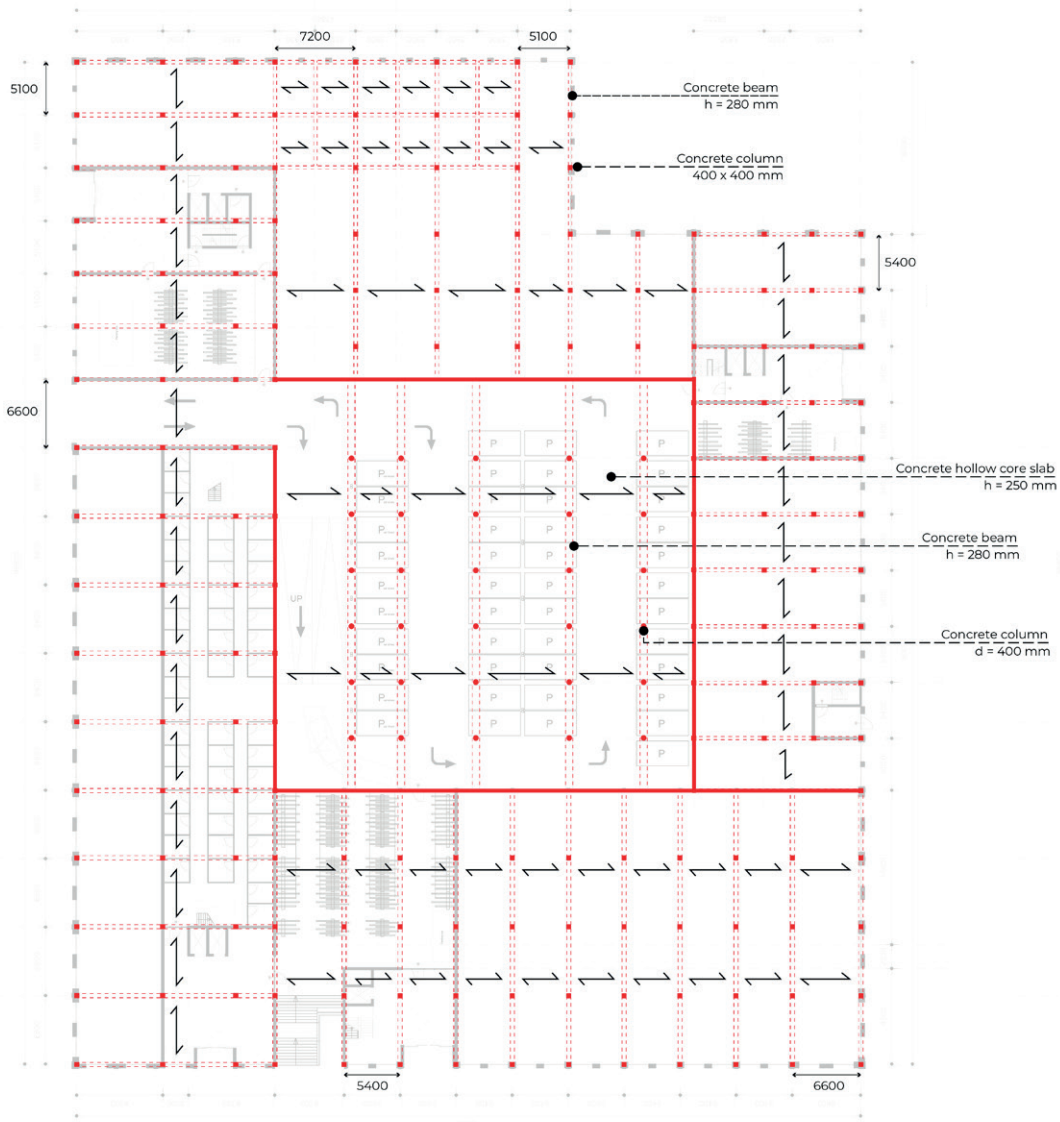


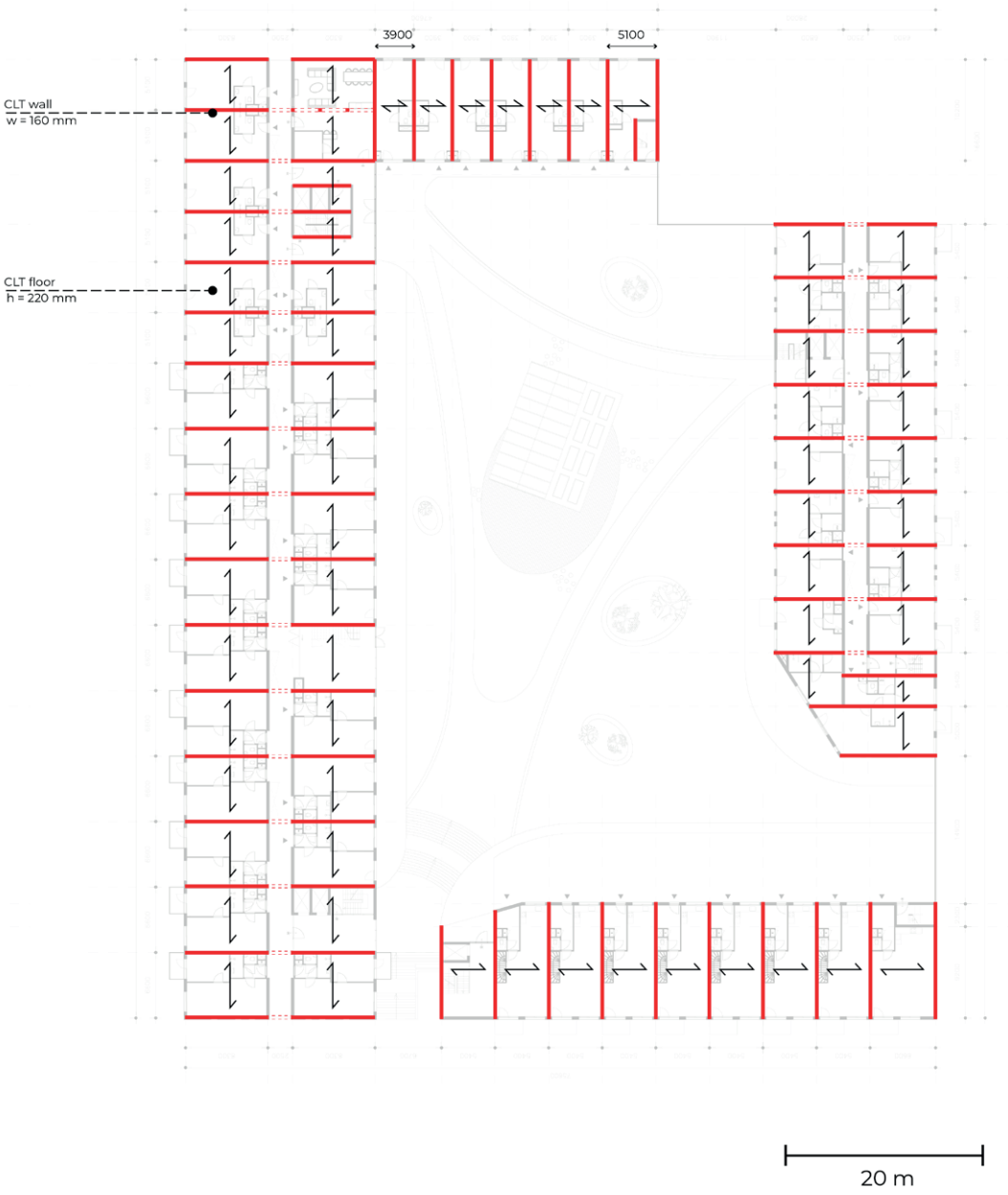
1. FLOOR COVERING, PLATE (NOPPENPLAAT) WITH FLOOR HEATING 18MM, XPS INSULATION 15MM, SAND LAYER 80MM, CLT FLOOR 220MM.
2. PLATERBOARD 12.5MM, METAL STUD FRAME WITH INSULATION 70MM, CLT WALL 160MM, METAL STUD

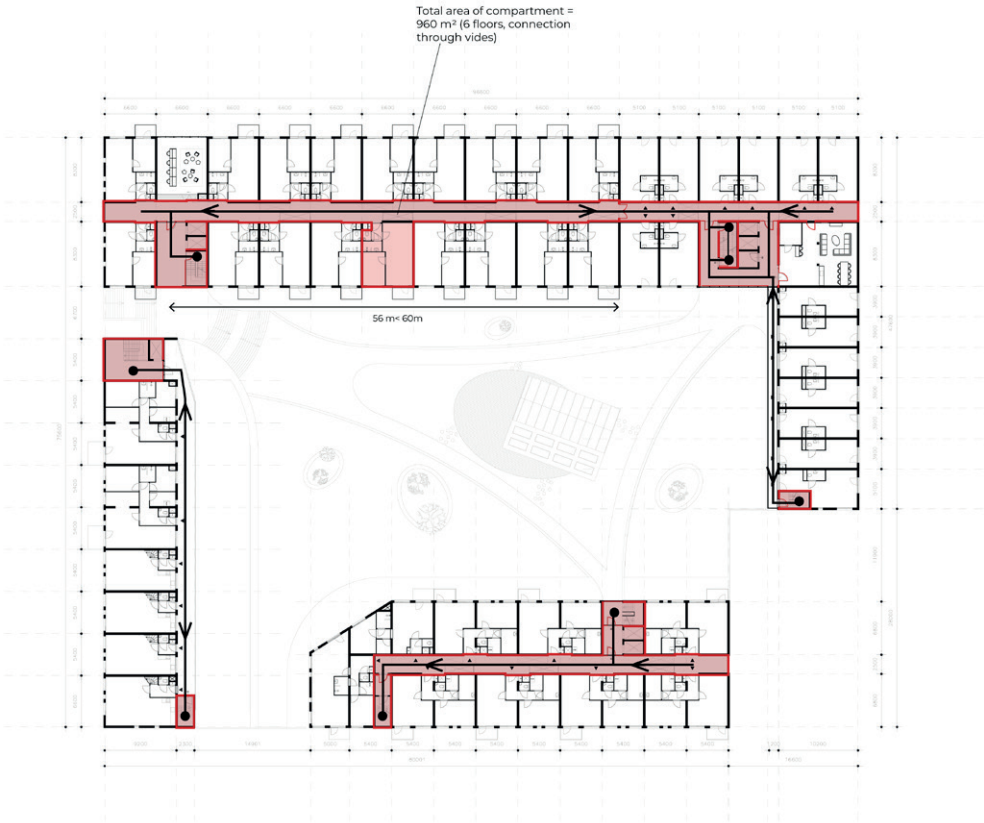
Acoustic performance

The floors have an acoustic performance of LnT,A=52 dB due to the seperated dry screed

The seperation walls have a performance of DnT,A,k=56 dB due to the metal stud facing fall on both sides of the CLT element.


7200
5100
5100
Concrete beam
h = 280 mm
Concrete column
400 x 400 mm
5400
6600
Concrete hollow core slab
h = 250 mm
Concrete beam
h = 280 mm
Concrete column
d = 400 mm
5400
6600


3900
5100
CLT wall
w = 160 mm
CLT floor
h = 220 mm
20 m



Fire safety

The building is quite large, this has consequences for the fire safety of the building too. The main principle is that every residential block has a stairwell and exit on both ends. In this way a safe escape route is present. The main stairs reach down to the street level, whereas most fire escape stairways are connected to the raised garden.

The north-western part of the building has a length of almost 100 meters and because of the vides present in the corridors it has a very large compartment. Because safety regulations stated that a compartment may have a maximum of 1000 m3 a division between the lower part of the tower and the western part of the block has been made. There are fire doors present in the corridors that close automatically when there is smoke present in the building.

Result

The design comprises a large housing complex with a variety of dwellings. These dwellings, in the beginning designed as compact independent dwellings but due to its variation and layout also suited for many other people, are accompanied by multiple collective spaces. These spaces, both inside and outside space, add comfort to the way of dwelling and increases the interaction between the residents. Natural materials are used for both the structure and the facade. This combined with the construction method make the building largely demountable and result in a small footprint. The fast construction process and the compactness of the building saves money, that can be invested in extra climatologic and socially sustainable additions such as the large garden in the centre of the building. The vast amount of (integrated) solar panels and the way rainwater is used in the design make the building both beautiful and sustainable.
It is an environmental friendly home in the city for more than 400 young starters.

REFLECTION

At the end of the project you always look back at the results. In this project we look back at the process as well. During the last phase of the project a reflection has been made, focussing on the relation between the research and the design. In this last chapter of the booklet this reflection is included.

Reflection - Relation between research and design

Introduction

Architecture is a complex field of expertise. When one would ask me personally how I categorize this expertise, my answer would probably mention the aspects of design and technology. This in fact was the main reason for me to choose this education program in the first place. I always stated that I decided to study architecture because it would be the perfect combination between creativity (design) and science (including research). Now, in the final stage of my education at Delft University of Technology, I can look back at my six years at the faculty and reflect on this balance between design and research. For sure I can say that during my education in Delft I sometimes struggled with this balance. Trying to reach this balance I had projects in which I did a lot of designing without doing enough research to base the design on. At the same time I had moments where I was doing research without knowing why I was actually doing research. This struggle is, I think, a normal process that one must experience. It is a search for the right balance, which most likely will continue after graduating. Every architect in the field has his or her own process with its own way of researching. But for most it is an intrinsic part of the job.[1] During my graduation project research and design were more intertwined than in every other project in the Bachelor and Master, as is to be expected during a one year project which will be your piece the resistance of your education. To make this relation between research and design explicit, this reflection paper is written. On the one hand it is a way for myself to get more grip on this relation and the way I do research. This will help me in the future to be more aware of the different types of research and which are needed at what moment. On the other hand it shows the reader a glimpse of what is happening within my design process; on what grounds is a building shaped and why are certain decisions made. This can be interesting to know, but even more I think it can help increase the understanding of architects and therefore create a larger foundation of trust in the important role of the architect in general.

Structure of the report

Giving a clear insight in the decision making within the design project demands a variety of aspects. First and foremost the goal is to shine a light on the relation between research and design. For this it is needed to start at the basics: why is research done in general and what can it offer architects within the design project. To establish this, some written literature about architectural research will be briefly discussed. However, architectural research is still a broad term. To structure this I will introduce six main research methods that are stated by Theo Van der Voordt, who wrote a book on research techniques. For each of the methods a brief general description will be stated. This categorization will help to discuss different types of research done within my graduation project as well. This discussion about research that I have done will make the remaining part of this paper. I will elaborate on my personal process and the research I have done. To make explicit how this research influenced and in some cases directly shaped my design illustrations and images will be included in this final part of the paper. Altogether I try in this way to show how the research took place, which instruments were used and when. To place the type of research I did in a broader context and to state some of the characteristics of the types of research I will sometimes refer to literature about architectural research. These connections with the different categories of research as described by Van der Voordt, Groat and Wang[2] and Ray Lucas[3] can also

*1. RIBA, **How architects use research** (RIBA Architecture, 2014): 10*
2. Linda Groat, David Wang, Research methods (New Jersey: John Wiley & Sons, Inc., 2013)

help explain the choice for this type of research, or on the other hand illustrate weaknesses of certain types of research. Finally I will end the paper by trying to conclude what pattern I observe in my own research, and what useful conclusion I can draw after reflecting on my own research process.

What is research

Research is all about learning. Learning is something we do all the time. Since the moment you are born you learn. But research is not the same as learning. Research is more specific: it is a diligent and systematic inquiry (Gorny, lecture 13-2-2020) to collect information on a specific subject (Furthermore it is important that research is verifiable. (Ray Lucas, p8). If your research is transparent, to which structure will contribute most of the time, others can check it. This means they are able to understand what you are doing, how you are doing it and why you are doing it.

Doing research thus means that you are looking at a specific subject. This is done because there is a reason to look at this subject. You are consciously looking. This can be caused by a problem that needs a solution, or just because a certain topic grasped your attention and you are interested. In this last case, you are purely focussed on increasing your knowledge. To gather more information, you start looking. But does this immediately mean that you are doing research? Is it systematic what you are doing? Sometimes it is hard to distinguish on which side of the boundary you are working: are you really doing research. Especially within the field of architecture this is a blurred line, at least that is my experience. I would argue that looking for answers can still be very helpful, even if it is not structured at all. But it makes it hard for others to understand and therefore it will probably not contribute to the larger debate. On top of that it is difficult for yourself to understand what you are doing if you have no structure in your search for answers.

Why research is important to support your architectural design

As I mentioned in the introduction research is important to do research for multiple reasons. First and foremost you do research to come up with the best design. As an architect you have to understand the design brief, so you do research on the topics you will address with your design. Along the way a lot of questions will come in play. "How do I make my building fit into the context?". "What type of material will I use?". "What is the optimal span width for the floors?". All kinds of questions to which you do not have the answer immediately, because the questions are different in every project. You have to research these topics to get to an answer and to bring structure into your project. Because a lot of aspects have to be dealt with during a design process and it is all connected, sometimes it can be confusing and complex to order all the aspects in the process I experienced. This is another good reason to base your design aspects as much as possible on research: it makes sure it is documented and can be traced back. You can verify why you made certain decisions.

Not only the architect himself can verify the decisions. Also other people and parties such as the client, the municipality and your own colleagues can check why the decision making went the way it went. This makes it much easier to convince them that your design is the right design. I would say that research thus is not only important to base your design on, but also to base your communication on.

3. Ray Lucas, Research Methods for Architecture (London: Laurence King Publishing, 2016)
4. Gorny, lecture on Methods of architectural research, accessed 13-2-2020
5. "Research", definition according to Merriam Webster DIctionary. Accessed 15-11-2020. https://www.merriam-webster.com/dictionary/research

Different types of research

There are various types of research. A distinction between literature research and field research is widely known. The first of these two is focussed on using existing information found in literature. In the second research method new empirical information is gathered and used, sometimes in combination with already existing information.[6]

However, this is still a quite broad distinction and will therefore not proof to be sufficient to categorize the research I have conducted during my graduation project. Therefore I like to introduce the six main research methods which are further defined by Korteweg and Van Weesep (1983) and mentioned by Van der Voordt (1998). These six research methods are the following:

Literature research. This comprises systematic exploration, analysis and evaluation of different research results and interpretations of others (Van der Voordt). Thus, this is a research method which will purely be based on research of others. No personal data will be added.

Analysis of statistical material. This research method is mostly about the analysis- meaning a "detailed examination of a complex subject to understand the essential features"[8]- of facts and figures.

Surveys, which is a research on larger numbers of characteristics. It contains a lot of data which is gathered by the researcher himself and is a typical example of field research. For example questionnaires and interviews are ways to gather the data, in which a questionnaire is used to gain vast amounts of information while an interview is more used to gather more detailed information from a smaller group of people (Lucas, p83).

Content analysis involves researching written articles and manifests, lectures and visual material such as images. The goal of this research method could be to filter out trends and developments through time. Mostly data and reports from others are used, the researcher has to make connections between data and come to a solid conclusion.

Secondary analysis. With this method a renewed analysis of existing research material is done. Therefore a different method should be used than the first time the analysis was done, to come to new insight. It is also possible to conduct similar research with the same material, but from a different point of view or a different research question. This could lead to new results with the same material.

Experimenting is the sixth and final method mentioned by Korteweg and Van Weesep and is all about doing measurements repetitively with constant changing values. In this way the results of different values can be compared and a preferable result can be chosen.

In the next part of this paper I will mention these six categories from time to structure the research I have done during my graduation project. However, the research I did was not explicitly based on these six categories. Therefor it is likely that not all of the research I will mention in the coming chapter will fit perfectly within one of these six categories. Because of this I will use other literature as well, such as Groat and Wang and their seven research strategies they describe in 'Architectural research methods',[9] to elaborate on the type of research I did. These research strategies are not comparable with the six research methods of Korteweg and Van Weesep, because they can have overlap. Nonetheless these strategies can clarify the core elements of the research which I have done.

Furthermore there has been a second theme within my graduation project that has been a big influence on the design: climate change. For quite some time now my interest in and with this my worries about climate change has been increasing. The troubling

6. Theo van der Voordt, Methoden en technieken van onderzoek (Delft: Publikatiebureau bouwkunde, 1998): 12
7. P.J. Korteweg, J. van Weesep, Ruimtelijk onderzoek. (Bussum: Unieboek BV)
8. "Analysis", definition according to Merriam Webster DIctionary. Accessed 15-11-2020.. https://www.merriam-webster.com/dictionary/analysis)
9. Linda Groat, David Wang, Research methods (New Jersey: John Wiley & Sons, Inc., 2013)

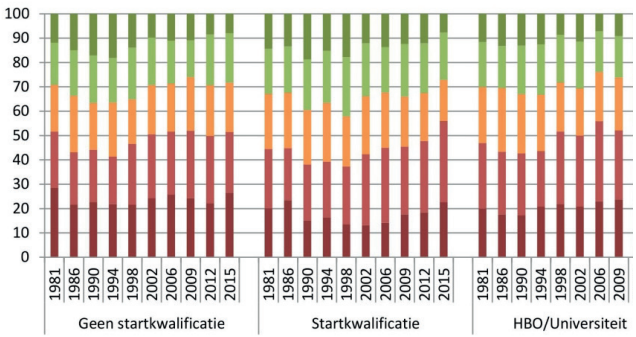
situations all over the world- with melting poles, long dry periods, short heavy rainfall and the decrease of biodiversity- grasped my attention. Unfortunately this theme is not as hot for the last couple of months because of the corona crisis, but I am sure it will be at the top of the agenda again in the coming years and probably decades. And even now with the presence of the pandemic a lot of thought is put into sustainability, in the building sector as well. With my building I want to contribute to this and to experiment on how to reduce the impact of a building on the environment. Not only by making it suffice to the BENG (the new 'almost energy neutral' regulation in the Netherlands which demands that new buildings have a very low energy demand), but also by taking the themes like water use and regulation, carbon footprint and biodiversity into account.

With this my graduation project is for a significant part shaped by research done on these two themes: the characteristics of the young residents and their demands when it comes to housing on the one hand, and the environmental aspects on the other.

Research in the graduation studio

The residents

One of the first things I did in the beginning of the project was an extensive research on the problems that young starters are facing on the housing market. The largest part of this research contains an analysis of statistical material as Van der Voordt categorizes it. I used a lot of statistical date and written texts from journalists and municipalities. For example, a text from the PBL [10] pointed out that the problems are mainly caused by the uncertainty younger people face nowadays. A large part of this group doesn't have a permanent contract, which makes it very hard for them to get a mortgage. This made me decide to focus on rental dwellings in my project.



Statistical analysis showed the increasing preference of especcialy higher educated people to live in an urban environment (WBO/WoON, 2015)

10. PBL, Wonen en gevoelens van onbehagen (Den Haag: PBL, 2020)

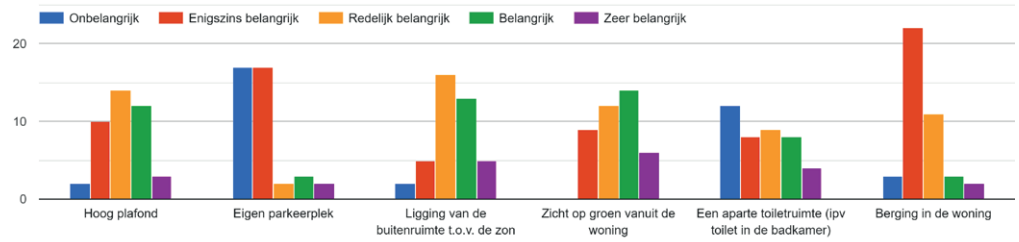
Other statistical infromation, such as the ratio of younger people (and especcially the higher educated ones, because they earn to much money to get into social housing) that wants to live in a urban environment such as Rotterdam contributed to my choice to focus on rental dwellings for young starters.

What type of dwellings was a next step, and a very important one. This decision is made based on a few different types of research. First of all I read about the variety of households within the large group of young starters. The largest part of this research is done doing content analysis: I read articles and reports about the target group. The documents Smaak voor de stad[11] and Waar jonge gezinnen willen wonen[12] where some of the sources i used for this. It lead to the insight that green and outside space is very important when living in a city.

Moreover I did research on the affordability. Figures from the PBL (figure X) served as one of the sources to determine how much my target group would be able to afford. I also used the guidelines from the Nibud for this.

This affordability is of course of influence on the size of the dwellings and was therefore usefull when making a choice on what type of dwellings I would design in my project. To get more information to base this choice on I made a survey. This survey consisted of about 20 questions about the wishes and preferences for a first dwelling after graduating and was held among 40+ friends and fellow students in the range of 18-32 years old. According to Ray Lucas[13] this type of survey is a structured questionnare-based interview. It is ideal to get a larger group of respondents, something I was looking for because I wanted to get an idea of the general preference, if there is one. What is very important for this type of interview according to Lucas is that all respondents get the same questions, which is very easy in the eare of Google Forms. Moreover Lucas states that it is hard to perform preference based questions, which is just what I did in my research. As he mentions as well it can be problematic when just asking "do you like this or this", because it establishes a false choise between two environments. When creating the questionnaire I was aware of this problem and therefore I tried to state the questions in a way that this problem would be minimal. For example, I did not ask "do you want a separate bedroom or do you want an individual bathroom.

Instead of this I phrased the question as follows: "how important is it for you to have..." This way, the respondent could rate the importance of certain aspects in and around a dwelling. This gave me space to make my own interpretation of it and to weigh and compare certain aspects.
In the end, the results of the survey lead to some very concrete design choises I made such as the presence of all individual facilities in the dwellings, bathroom and toilet seperated in the dwellings designed for more than one person, and the



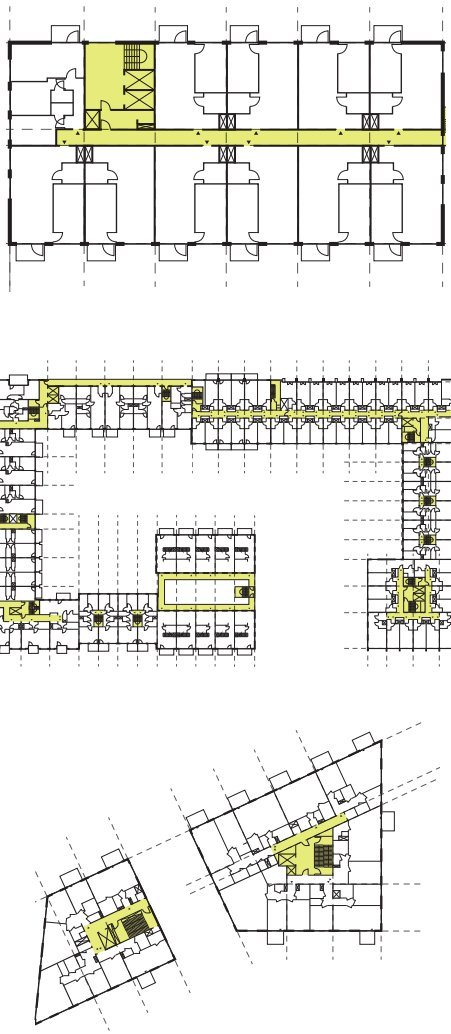
One of the results of the survey was that young people care about having some additional collective facilities in their housing complex and are even willing to sacrifice space of their own house for it

11. VROM, De Smaak voor de Stad, (Den Haag: VROM, 2006).
12. Koen Laarman, Frank van Dam, Waar jonge gzeinnen willen wonen, (Den Haag: PBL, 2018).
13. Ray Lucas, Research Methods for Architecture (London: Laurence King Publishing, 2016): 83

presence of a shared fitness room in the building. Although I am glad that I did conduct this survey and it helped me to ground my decisions, I have to admit that the survey was far from pefect. More in-depth questions would have prooved usefull to understand the argumentation of the respondents. For this, a different kind of survey would be more usefull. Perhaps personal interview, but certainly with a qualitative research stategy as this is more likely to lead to lead to a depth of understanding.[14] Finally I experienced that the way questions are formulated is very important. A next time I would put even more efford in this. Doing research on how to perform this type of research is neccecary I think.

Moreover I did a case study of three recently built projecs in the Randstad, which served as the precedents I analysed. Within this case study I focussed on two aspects: type and size of the dwellings and the type of access. Starting with the first aspect I learned a lot about sizes of rooms and the way they are configured in a clever way. Especcially in rather compact dwellings, as is neccesary when designing for young starters who can not afford very high rents, this way of configuring the rooms is important.

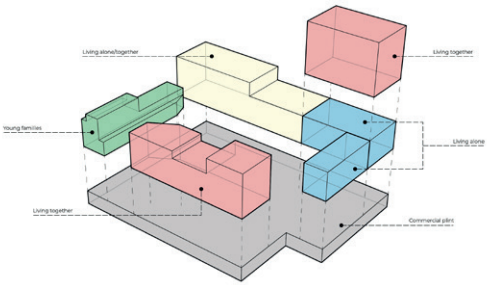
For the access type and internal circulation the case studies showed me that there is a strong relation between dwelling type and circulation type. Deep dwellings need to have daylight on two sides and can therefore not be situated at a corridor. Studios on the other hand are quite small and have an open floor plan, which let daylight reach deep into the dwelling. Therefore this type is suited for a compact placement on both tides of a corridor. By comparing the three projects and looking in a quite systematic way at a few aspects in all three projects in the same way I tried to make it possible to come to a generalizable conclusion. As Groat and Wang[15] describe this is a strength of this research method. It has the "capacity to generalize to theory". In this way I tried to generalize the relation between type of access and the dwelling.



Three of the reference projects used in the research phase
From top to bottom: Cobana, Rotterdam; Lieven, Amsterdam; Volt, Delft

14. Linda Groat, David Wang, Research methods (New Jersey: John Wiley & Sons, Inc., 2013): 280
15. Linda Groat, David Wang, Research methods (New Jersey: John Wiley & Sons, Inc., 2013): 429

The findings and results from the survey and the research on the users I combined with my case study. Based on this research I defined the basis of my design: a building with a commercial plint with multiple housing blocks on top. These blocks would function as one complex with a communal inner garden.



Distribution of different types of households

Every block contains a different type of dwelling, which fits the multiple types of housholds. In this case there is a supply in homes for people living alone, but also for the ones who are in a relationship and maybe even have a child. Based on my own experience (I live in a student flat where nuisance is not rare. Young people living alone have a very different way of living and a different rhytm than young families, so I can imagine it could cause some problems) and findings from the survey (would you like to live next to a young family?) these different 'profiles' are placed in different parts of the building. The book Building and Dwelling[16], where Richard Sennet states that people that are too different they are likely to hurt each when living together, was also a source of inspiration to think about this way of co-lliving. Nonetheless all residents meet each other in the communal spaces, the garden and the parking spaces. In this way I tried to find balance between mixing them and seperating them. In sum, there is a variety in types of residents and therefor in wellings. But this differentiation is not to big for them to live together. This is something which is represented in the expression of the buiding as well.

A discussion we once had in our graduation studio about group sizes also contributed to the building scheme I designed. I realised for example that my own building is very large and therefore a bit unpersonal. My though was that multiple smaller blocks would prove to be more inclusive, there the amount of residents you meet daily will be smaller and one woudd thus be more tend to speek to the fellow residents. I placed a small communal laundry room on every floor for the studios, instead of one large space in the bottom of the building as is more common in practice.

Vides in the long hallways in my design are also a result of my contemplation on group sizes. They tend to break up the length and with this create smaller clusters of dwellings. In this way I tried to increase the sense of having 'close neighbours. Especcialy the young families feel the need for a smaller community and social contact with the neighbours.[17] This is one of the reasons most highrise buildings in dense cities are not valued by families. A next aspect that contributes to the fact that families tend to avoid dense cities to live in is the lack of greenery. To resolve both of these problems I designed one of the building blocks as a block especcialy for young families. This block had a raised street as access type, which creates a small neighbourhood in the building and provides the young children with safe space to play. Green is present in pots in front of the dwelling, and of course in the adjacent communal garden. In this

Vides in the corridors provide natural light and vertical connections in the building

16. Richard Sennet, Building and Dwelling (New Jersey: Penguin, 2018): chapter 5

way, literature provided the starting point to think about this aspect. The Kolenkithuis from Heren5 arcitects in Amsterdam served as a concrete example of how this type of access can be designed.

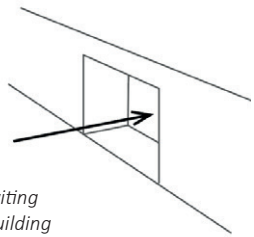
The mass of the blocks is defined by research done on the types of dwellings and the accompaniyng type of access, as I described earlier. But there are other factors which played a role in this decicion making. I did an extensive study on the experience in and around the building in Virtual Reality. For this I used Enscape, which is a real time rendering plugin. In the VR zone at the TU Delft library I spend a few days walking around in my model and changing it according to my findings in the VR experience. The height of the buildings was largely based on the sun- and daylight conditions, as well as on the feeling when walking in between the volumes. It has been a few days of experimenting in a virtual world. This word experimenting already points towards a direction of what type of reasearch this is. The experiment as one of the six main research methods mentioned by Korteweg en Van Weesep is about measuring, changing the conditions and then measuring the siuation again. In this case I would argue that this exactly what I have done these few days in VR. The measuring was the observations I made when waking through the model. When I was not satisfied, because there was to much shadow at a certain point or a façade was too high or to long, I changed the conditions (the building mass) and did the measurements again. This would go on until I was fairly content with the results. The difficult part again, as it is so many times in architecture, is that it is hard to verify why I was not content. It is quite subjective. To make this a more scientific experiment I would suggest making a verifiable set of documents which can be used to base the argumentations of the researcher on. This can be done with a set of images (as I did during my research), which shows different options for one specific aspect. For the amount of daylight for example it is easier to make it an objective study based.

One way to do this is by visualizing the shadows for every hour of the day and layering them on top of each other, as I did for the inner garden in my project. This study gave me extra insight in the amount of sunlight that can enter the garden, which helped me during the mass study of the building blocks. It also roughly determined the location of the green house in the garden.

The 'raised street' in the south-west part of the building serves as access to the dwellings and creates a smaller neighbourhood in the large bulding

Early mass study in Virtual Reality

Furthermore, the thoughts of Rasmussen in his book Experiencing Architecture are reflected in my building volume. His chapter on concave and convex shapes inspired me to experient with the shape of the entrances of the building. In the end I made an overhanging entrance for the parking garage and recessed entrances for the building blocks. This creates an inviting gesture (see image right).



Recessed entrances create inviting and visible entrances in the building

17. VROM, De Smaak voor de Stad, (Den Haag: VROM, 2006).

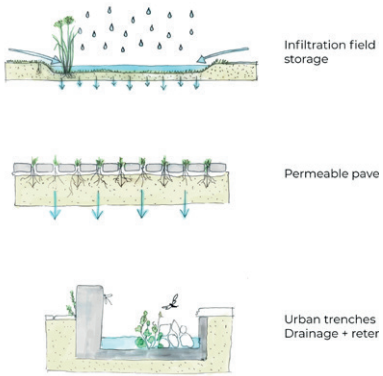
Climate-friendly building

A second theme in my graduation project is concerns the environment. As mentioned earlier in this paper I am more and more aware of the changing climate and all the effects this has on us humans but even more on the planet itself. I have to admit that during my education I have been quite indifferent about sustainability aspects in architecture. This had to do with the fact that all the themes and design solutions we were told about were shallow and too generic. At least that is how I experienced it for years. Maybe I am just more committed with what is going on in the world now that I am more mature, who knows. What also assisted my lack of interest was the short period of time I always had during a project. There was barely time to do research on new topics and thus the solar panel on the roof was the logical but very boring sustainable addition to the design.

This project changed all this. Although I still added solar panels to my building, there is way more. After a long summer after the p2 presentation with again a long dry period with high temperatures I decided I wanted to put more thought into sustainability and the environmental aspects of my building. After some thought I concluded that I should consider the impact my design has on the planet in multiple ways. I set my goals to design a building with a small footprint, but also one that would make the residents and even passer-by's more aware of environmental and climatic aspects. Because the intended residents of my building concerns young people this last theme of awareness is very important in my opinion. These young people will be the generation which face all the problems of climate change and material scarcity. But they are also the generation that can contribute the most to a better world and hence must be aware of the topics in play. The most important elements in my design regarding these topics will be elaborated.

The most remarkable part of the building is perhaps the large garden in the centre. This has a vast social role, but contributes to the sustainability of the building as well. For the design of the garden I got a lot of inspiration from the book Groenblauwe netwerken.[18] This book gives a wide overview of all environmental aspects in the build environment. Moreover it presents design solutions and measurements that can be applied in urban design and in architecture.

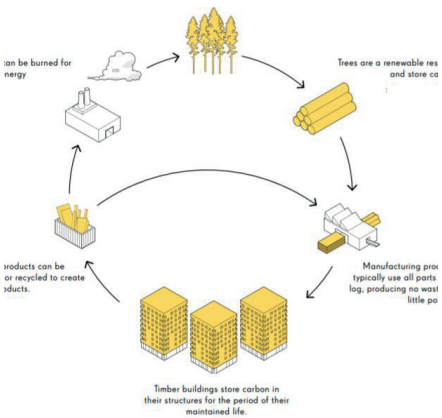
The garden is part of a water cycle in my building. In



this flow rainwater that comes from all surrounding roofs is leaded to the garden trough noticeable pipes (to make it visible). There the water flows through so called "stedelijke watergoten", open gutters with some plants in them as well. The water is guided towards the middle of the garden, where a large infiltration field is present. This area is swampy, filled with grasses and other plants that can withstand wet conditions as well as longer dry periods. In the infiltration field the water can penetrate the soil and from there it will flow towards a large water tank under the parking garage where it is stored. This water is used to flush the toilets in the building and to water the plants in the large garden. Altogether this system contributes to a decrease in water usage of all dwellings while at the same time making the residents aware of water flows and the climate conditions. An extra function of the garden is it's cooling character. In summers that will be hotter in the future the green has a cooling effect on the whole area. This will add to the living comfort and the health of the residents.

18. Hiltrud Pötz, Groenblauwe Netwerken, (Atelier Groenblauw, 2016).

The garden does not only have a climatic function. It also serves as a communal space in which the residents meet each other. When designed in the right way it could be, like Richard Sennett calls it, a synchronous space where multiple activities happen at the same time.[19] This active and engaging environment is strengthened by the porous boundary around the garden. The openings between the building blocks provide some kind of interaction with the outside world. Sounds from the urban surroundings penetrate the inner court. As Sennett quotes the acoustician R. Murray Schafer, "hearing is a way of touching at a distance".[20] In this way, the residents get in touch with the vivid urban life on the street.



Building lifecycle diagram (image: CleanTech)

Correspondingly to the implementation of sustainability into the design of the garden I took the environment into account when designing the whole construction method of the building. The building is build up out of a concrete plinth with a cross laminated structure on top. Concrete is of course not a sustainable material, because it is a fossil material with a very high CO_2 emission during the production. However it is a durable material and can therefore be used in a sustainable way when creating a building that will be used for a very long time. I designed the plinth with bigger spans and a double height, to create a flexible space which can be adjusted over time. According to Floriad Boer this can prove to be a wise design strategy to develop a sustainable building.[21]

The dwellings on top of the plinth have a CLT structure. As Pablo van der Lugt mentions in his book Tomorrow's Timber[22] we need to switch to a circular economy and the building industry is one of the largest consumers of materials. Using CLT as structural material can be one of the solutions for this. It is a renewable material, as trees (when the forests are managed right) grow back again. Moreover, using a CLT structure in stead of concrete reduces the CO_2 emission substantially. In my design the use of CLT reduces this emission with about 10.000 tons of CO_2. This makes a big difference to the footprint of my design, which is the reason I decided to go for this type material in the first place. The same counts for my decision to insulate my building with wood-fibre. As rockwool is the second largest material used in terms of volume[23] this will make that these material choices contribute to an even larger reduction of the footprint of my building compared to traditional construction methods. The choice for a CLT structure eventually shows in more parts of the design. Wooden window frames, visible CLT ceilings, timber cladding for the facades and a dry screed for the floors all contribute to the result: a climate-friendly building that has a small footprint and is for the largest part demountable.

Cross laminated timber ceilings give the dwellings character and comfort

19. Richard Sennett, Building and Dwelling: Ethics for the city (Milton Keynes: Penguin Books, 2019), 206-209
20. Richard Sennett, Building and Dwelling: Ethics for the city (Milton Keynes: Penguin Books, 2019), 224
21. Florian Boer, Seminar 'A Revolution in wood', (Delft, accessed 13-10-2020)
22. Pablo van der Lugt, Tomorrow's Timber, (Delft: Jeroen van Oostveen, 2020)
23. Florian Boer, Seminar 'A Revolution in wood', (Delft, accessed 13-10-2020)

To sum it up, it is rather difficult for me to precisely tell how the decision making process went with these topics. It started with an urge to make a design that takes the environment and human behaviour into account. Most ideas I got by reading literature on the topic and by watching lectures of more experienced people with a specialization in this direction of sustainable building. The precise integration of all aspects was mainly based on examples (such as recent projects with a CLT structure and the accompanying details and dimensions) and experimenting (where do the solar panels on the façade beautify the building expression while on the same time producing enough electricity). I tried to find the right balance between the technical aspects, the use-value and esthetical side.

Conclusion

Now that the project comes almost to an end and almost all research is wrapped up I should be able to reflect on the whole process as well. Of course for this it helped a lot to write this paper. I refreshed my memory and was able to look back on everything I have done. Doing this I identified some relations within my research process.
As Van der Voordt mentions[24] there are logical moments in the process to address certain research questions. Research on the program for example is logically done in the beginning of the process, research on what type of window frame more towards the end. With these questions and topics also a type of research comes into play. When reflecting on my own project I notice that most research is one in the beginning of the project. This is not a strange thing, but what is interesting is that the experimenting research Van der Voordt mentions is a type of research which continues until the end of the project. I think because this type of research is suited to do for all small details in the design. Or maybe it is because this is something that suits the nature of the architect: it contains a certain degree of freedom.
What I can say for sure is that most major choices in my design are based on a survey, analysis of statistical information and content analysis and not on experiments. But these experiments are, I think, mostly responsible for the implementation of the larger research in my design.
In general my design process is largely based on research. I have conducted many types of research, from literature research to questionnaires and from experimenting in VR to analysing case studies. This helped me a lot to come to a design of which I can say: I think it is a fairly good design. Of course there are always aspects which need more attention, but the core of the design and the story behind it is solid in my opinion. I am aware that it is not for me to say this, because I am the designer and therefore largely biased. But i think it is worth mentioning, because it is maybe the first time during my education I am satisfied with a design I made myself. And I can say with absolute certainty that the large amount of research I did is the reason for this. I know why I did it like this. For the first time, I did not struggle to find balance.

24. Theo van der Voordt, Methoden en technieken van onderzoek (Delft: Publikatiebureau bouwkunde, 1998): 4-6

“If you steal from one author it’s plagiarism; if you steal from many it’s research” - Wilson Mizner

Societal significance

Aiming at an inclusive society, in which every group has a place to live. This inclusivity is very important for our society, in which all should have a place to live their lives. Having a decent place to live is one of the basic needs of the man. This project is a reaction and an answer to the fact that lots of young starters are not able to find this place to live in the Netherlands. This large part of society faces uncertain times, with high study depts and little chance of getting permanent job contract. And above all they are facing a worrisome situation on the housing market. When they are done with their education they have to move out of their relatively cheap student house to a- in an optimal situation- larger home. But as the situation stand at this moment the connection to the market is miserable and it is almost impossible to get a decent place to live. This leads to more stress and can eventually have in influence on the rest of their lives. In such a way the project is contributing to an important societal issue.

Besides the social aspects my project aims to explore the field of compact and sustainable building. In my case this is done to house starters, but of course this can be done for most kind of groups in society. In my opinion this has to be done. To have as little impact on the environment as possible, but also to preserve nature and other 'non-urban' spaces in our dense country. Therefore I think my project can serve as inspiration for others as well. These themes will most likely be some of the key themes in architecture in the coming decades. I hope to contribute to this discussion with my project and to do so in my future career as well.

In my project I encountered two ethical dilemmas. I focus on the design of dwelling for starters. For me it is hard to accept that I 'have to' design dwellings which are quite small. The dwellings should be affordable and are therefore depending on the market value. This leads to dwellings which are smaller than I think one person should live in in the optimal situation. For me, this raises the question whether I have to give in to the market, or that I should design dwellings out of a more visionary perspective. A second aspect I have some ethical issues with is the use of CLT. I am very much convinced that this is the future for constructing. Therefore I am glad that I have now some experience with designing in CLT. But in practice there are still not enough sustainably managed forests in the world to construct all the buildings we need. Of course it is unethical- and also counterproductive- to cut down the whole Amazona and the forests in Siberia to construct 'sustainable' dwellings. Therefore we- the global community- should make sure that we find a balance between harvesting wood in a sustainable way and the preservation (actually we need a large expansion) of our forests and our biodiversity. The use of local forests is one aspect that could solve this dilemma for the largest part and is something that is suggested in the national debate during the last few months.

Constructing with timber is a very good solution to design buildings with a smaller footprint. However it is important that forests are managed in a sustainable way (image: private collection)

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