Open Building for everybody

A proposal for inclusive housing

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a proposal for an inclusive building

Graduation studio: Circularity: In-between now and unknown futures

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“...she took her hand and raised her brush. For a moment it stayed trembling in a painful but exciting ecstacy in the air. Where to begin?--that was the question at what point to make the first mark? One line placed on the canvas committed her to innumerable risks, to frequent and irrevocable decisions. All that in idea seemed simple became in practice immediately complex; as the waves shape themselves symmetrically from the cliff top, but to the swimmer among them are divided by steep gulfs, and foaming crests. Still the risk must run; the mark made.”

Virginia Woolf, To the Lighthouse

Acknowledgements

This report is the representation of my graduation research and design. It was a long process of group research, additional individual research and design. I would like to thank everybody in the Graduation studio for their input in my process, not only my fellow students, but especially my supervisors. Thank you, Jacob Voorthuis, for pushing me to understand, define and clarify what core of the matter and for giving me the tip of the wonderful novel by George Perec: 'La vie: mode d'emploi', which has been an inspiration for my design. Thank you Torsten Schröder and Barbara Kuit for your never-ending willingness to help me ahead with the research and design and for convincing me that I would succeed.

Most of all, I want to thank my family: my husband and children. Thank you for your confidence, support and help. Thank you for listening to my passionate pleas and elaborate explanations, it has helped me to focus and arrange my thoughts. Thank you for putting up with me when I was very busy and not always sociable. And thank you for stepping on the brakes every now and then. Your love has been a true inspiration for me!

Abstract

This thesis focuses on the differences in Open Buildings in the Netherlands between the 1980's and the current situation and investigates the possibility of designing an inclusive open building: an open building that houses a variety of residents. Open Building is a strategy for a flexible design: in an open building the support and infill are separated, giving freedom of infill to the resident and prolonging the life span of the building. Research was conducted by comparing projects from both periods through case studies, followed by a design proposal. The design was executed in an investigative manner.

Analysis of the case studies was done on six aspects: structure, skin, scenery, access and services. It shows that differences occur in each of these aspects. Differences are caused by changes in finances and organization, changes in society, fashion and the spirit of the time, and innovations. The different way of organizing and financing the housing market proofs to be of great influence on how an open building is made and for whom it is built. Open Building in the 1980's consisted mostly of large projects and small dwellings, nowadays projects are much smaller and the dwellings much larger. Not only the appearance of Open Building has changed, Open Building itself has also changed. The role of the architect changed from a mere designer of the support to a designer as well as a project developer. Furthermore, Open Building in the current situation faces the challenges of climate change and aims to respond to that by using sustainable materials, methods and techniques.

The design process shows that it is possible to make an inclusive open building, but that there are a lot of aspects that influence the success of the design.

Table of contents

Introduction

Introduction

The topic of the graduation studio was design for flexibility. Primarily there are two reasons to design for flexibility, the first one is adapting a building to its user, the second: being able to respond to change. Both reasons are a response to human behaviour. People are different, and behave in different ways, which means they do not all have the same wishes and desires for their built environment. Change is an integral part of human behaviour, we do not always want the same things, we grow older, we learn things, we may marry or have children: our situation in life constantly changes. The circular economy, however, strives to prolong the life span of a building since this diminishes the need for resources. Therefore, design for flexibility is one of the strategies used in circular building. As the first chapter in this report shows circular building involves many strategies, which do not stand alone but are always applied in a combination. Similar to circular design, design for flexibility can also be executed in various ways or methods, leading to a wide range of manifestations.

One of the methods to design for flexibility discussed in the group research is the concept of Open Building. In 1961 N. John Habraken published the book 'De dragers en de mensen', in which he states that at that time the method of building mass housing was on one hand limiting the choices of occupants and on the other hand limiting flexibility. Residents had no influence on their dwelling and the dwelling could not respond to change. According to him 'mass housing reduces the dwelling to a consumer article and the resident to a consumer' (Habraken, 1961, p. 61).

From the nineteen seventies on several open building projects have been realized in the Netherlands. Recent years show an increasing interest in Open Building. A group of architects and engineers have come together and launched the website openbuilding.co, and several new projects have been realized. (website openbuilding.co, 2022). Their goal is to make the built environment more sustainable, while simultaneously giving users more influence on their home. A quick look at the projects reveals that there are differences between the older Open Building projects and the recent ones. One distinct difference seems to be the appearance of Open Building: older projects were mostly large-scale housing with average sized dwellings and new projects appear to be small scale with spacious, luxurious homes. Older projects were mostly built as social housing and the new ones are privately owned. Open building seems to have changed from building for the masses into building for those who can afford it. This raises the first research question:

What are the differences between open building then and open building now?

In order to investigate this, four case studies were chosen, two from the 1980's and two from recent years. These were analyzed on several themes. The results of the analysis will hopefully also explain why differences occur and may give an insight into which strategies can best be applied to a new design.

Because this graduation project is not only a research exercise it will include a design proposal for a new design. The idea for this design is to make it more like Open Building was originally intended, so not only for a small, privileged group of people, but for everybody, including social housing. Which leads to the second research question:

Is it possible to make an Open Building design that offers living space for a wide range of users from different social classes?

The location chosen for the design is the area called Kop van 't Zand in Den Bosch, an area that was part of the first planned expansion of the city, situated near the inner city and next to the river and fortifications that played an important role in the city's history. The design will be made in an investigative manner. The goal will not only be to create the best possible solution to the design brief but also to learn from the issues that are encountered while doing so.

1. The english translation is called 'Supports: an alternative to mass housing' and was published in 1972

This report will first briefly introduce the range of the graduation studio with part of the group booklet, followed by the individual research: a short overview of open building and the analysis of the four case studies. The second part of the report involves the design: an introduction of the site, the design of the urban layout followed by the architectural design. The last chapter of the report is formed by the reflection on the design and conclusions regarding the research questions.

Flexibility as a strategy for circular building

Introduction to the group research

Before we, the students in the graduation studio, started with our individual part, group research was conducted. It resulted in the report 'Circularity in between now and unknown futures' (Broersma, Cooijmans, Fokkens, Hop, Szczepara and Verberne, 2022). The report has four main chapters: definition, history, culture & geography and types & program. It gives an overview of history and contains many interesting case studies. As an introduction to my own research, I include the first chapter of this report. It gives an overview of important key thinkers and organisations in the fields of circularity and flexibility and describes how they see circularity and flexibility and adaptability. It explains that most definitions on circularity introduce the so-called R-ladder, which may have different R's but often start with refuse or retain. In particular David Cheshire describes flexibility as a strategy of circularity, his diagram starts with Retain and Refit (Cheshire, 2019). These key thinkers also explain that there is a clear relation between circularity and flexibility.

Key thinkers that have been a particular inspiration for me are Ronald Rovers, Micheal & Joyce Huesemann, and Kate Raworth who all stress the need for a paradigm shift, David Cheshire for his practical approach to flexibility, John Habraken for giving power to residents, Stewart Brand for advocating to build in layers and Bernard Leupen whose method of analysis I found to be very useful.

Introduction to definitions on circularity and flexibility

The first thing noticed when reading literature regarding adaptability, flexibility, circular economy and circular building is the variation in definitions. Where one author speaks of flexibility another may call the same thing adaptability and vice versa. There appear to be as many definitions as there are books or articles on these topics, which leads to confusion.

The goal of this chapter is to unravel these definitions and to find out what the terms flexibility adaptability circular economy and circular building mean and what issues are at stake. This will answer the questions of what these concepts are, why we need them, how they work and for whom. We will look at the positions taken by different authors/thinkers. Our aim is not to come to our own specific definition for these concepts, but instead try to explain the existing ones.

The method used for this analysis is a literature review of some key thinkers in the field, followed by a comparison of their definitions and positions, and a conclusion about the main findings.

The chapter is divided in two parts, the first part is about the concepts circular economy and circular building, the second about adaptability and flexibility.

Definitions on circularity

Ellen MacArthur Foundation

The Ellen MacArthur Foundation is a leading organisation in the field of promoting the transition to a circular economy. It was founded in 2010 by former solo long-distance sailor Ellen MacArthur.

Definition Circular Economy

"A circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse and return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems and business models"(Ellen MacArthur Foundation, 2014, p.12)

According to the Ellen MacArthur foundation the Circular economy is based on three principles (see figure 1.2.1):

1. design out waste
2. differentiation between consumable (biological) and durable (technical) components of a product
3. energy for this cycle should be renewable

Definition Circular Design

The Ellen MacArthur Foundation does not offer a definition for circular building, however, they do mention what a circular design should entail: 'Circular design, i.e. improvements in materials selection and product design (standardisation/ modularisation of components, purer materials flows, and design for easier disassembly), lie at the heart of a circular economy.'(Ellen MacArthur Foundation, 2014)

In another article they mention three circular strategies that "directly address emissions from the built environment:

1. Making better use of existing buildings through sharing and reuse so fewer new buildings need to be created
2. Designing new buildings for flexible use and eliminating waste in construction
3. Reusing and recycling building materials so that they don't end up in landfill or incinerators"(Ellen MacArthur Foundation, 2021)

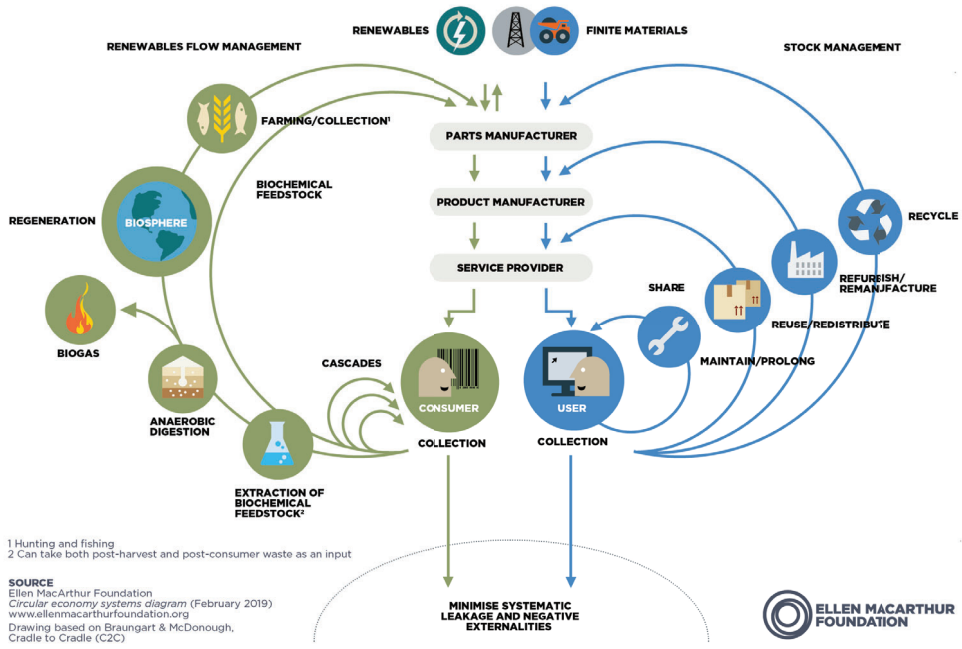
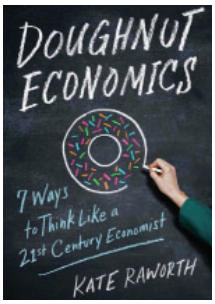


Fig 1.2.1 diagram of Circular Economy

Kate Raworth

Kate Raworth is an English economist, she is a Senior Associate at Oxford University's Environmental Change Institute and is also Professor of Practice at Amsterdam University of Applied Sciences.



Model

Kate Raworth does not use the term circular economy. She developed a model called 'doughnut economics'. She states that the current economic system, based on never ending growth of the GDP(Gross Domestic Product), is no longer sustainable, since it not only leads to depletion of the earth's resources, but is also damaging the living world and human wellbeing. The doughnut model (see figure 1.2.2) links worldwide social and environmental problems. The middle of her model shows the shortfall on life's essentials and the outer ring shows the overshoot on the earth's critical life supporting systems. In order to preserve the earth we should stay within the boundaries.

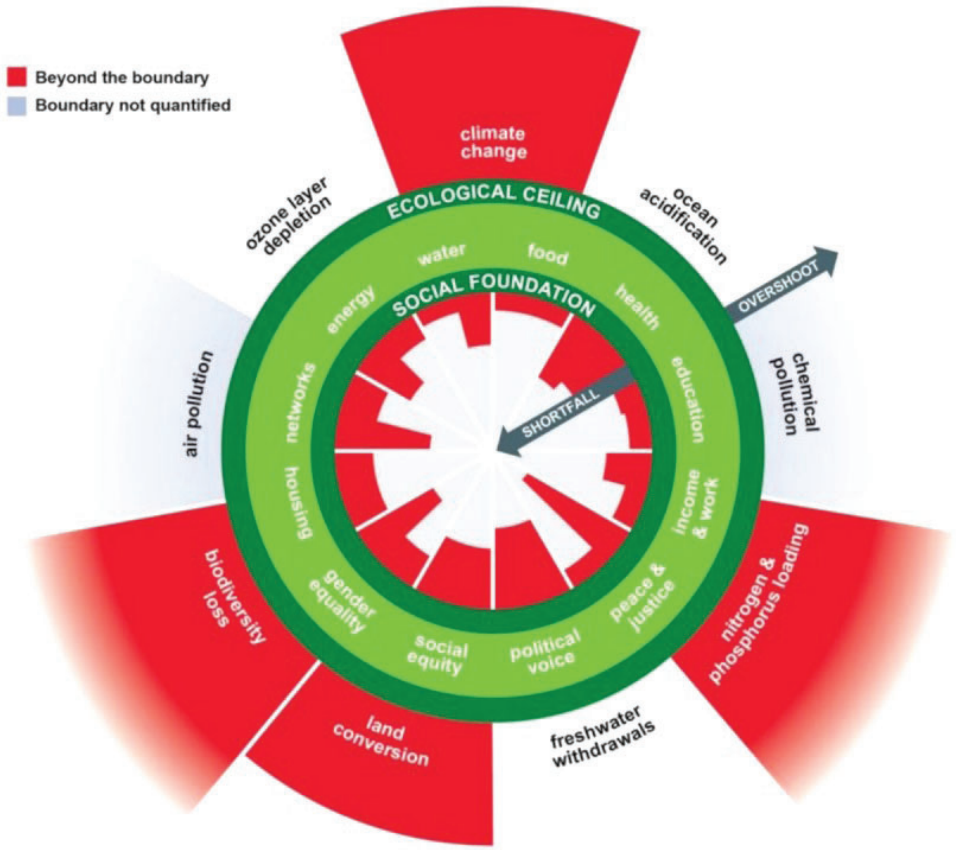
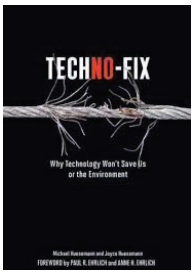


Fig 1.2.2. model of Doughnut Economics

Micheal Huesemann & Joyce Huesemann

Micheal Huesemann, PhD is a research scientist with more than 25 years of experience in environmental biotechnology. He has a special interest in environmental science and sustainability. Joyce Huesemann, PhD is and a activist and academic who has taught at several universities.




Definition

The authors of this book do not give a definition of circular economy, but three clear conditions for a 'circular flow economy':

1. All energy comes from renewable sources at or below renewable rates.
2. All materials come from renewable sources at or below renewable rates.
3. Waste(CO_2 is also 'waste') can only be released at or below assimilation rate, without negative impacts for the ecosystem or biodiversity. (Huesemann & Heusemann, 2011, p. 124)

In this book the authors dispute the idea that technical solutions will fix the urgent and expanding social, environmental, and economic problems. Instead technology has led to consumerism and materialism, which cannot be sustained. They argue that a paradigm shift in the way we organize our society and economy is necessary.

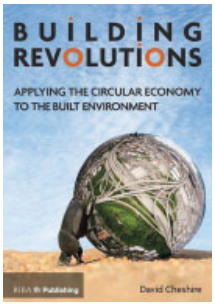
Although in theory meeting these conditions is possible, there are serious challenges, such as:

- Fulfilling these conditions is costly may face public opposition.
- Using solar energy for industrial processes means it cannot be used for ecosystems, biodiversity and other systems in nature that require sunlight. If this is done on a large scale, it will have an environmental impact.
- If the economy keeps growing at the current rate, there will not be enough agricultural land in the future to supply sufficient raw materials for biomass energy. This may lead to conflicts.
- When limited raw materials are replaced by a renewable plant based alternative, this also needs land. The risk is a depletion of renewable natural resources.
- Complete recycling of non-renewables is practically impossible, especially chemicals such as paint, pesticides, detergents etc.

Huesemann & Huiesemann conclude that these challenges and the problems as described can only be solved through a paradigm shift. They describe the common worldview based on the perspective that we are isolated individuals, which leads to conflicts (humans vs animals, rich vs poor etc.). This worldview should be replaced by one based on connection of people and nature, and a shared future.

David Cheshire

David Cheshire is sustainability director at Aecom, an American multinational engineering firm, that strives to do their work in the most sustainable manner.



Definitions

David Cheshire follows the definition for Circular Economy given by the Ellen MacArthur Foundation and explains what it means when this is applied to the building practice.

Principles Circular Building

The principles for circular building are summarized in a diagram (see figure 1.2.3)
The diagram shows nested circles, that have a clear hierarchy. The three inner circles are the most desirable. If it is impossible for the building to be retained, refitted or refurbished the three outer circles come into action: firstly the reclaiming of components, followed by remanufacturing of components and lastly the disassembly of the building. On the right the diagram shows the five design principles that are used to achieve this. These strategies are:

- Building in layers. Various layers have a different life-span. By disconnecting these layers one can be replaced or refurbished without the other layers being damaged.
- Designing out waste through building with reclaimed materials, making leaner designs and using modern construction techniques.
- Design for adaptability in order to prolong the lifespan of the building
- Design for disassembly makes it easier for components, modules or even complete buildings to be reused.
- Selecting materials in such a way that the lifespan of the component matches the lifespan of the material. Materials should be divided into technical and biological in order to keep them in the industrial loop or return them to the biosphere.

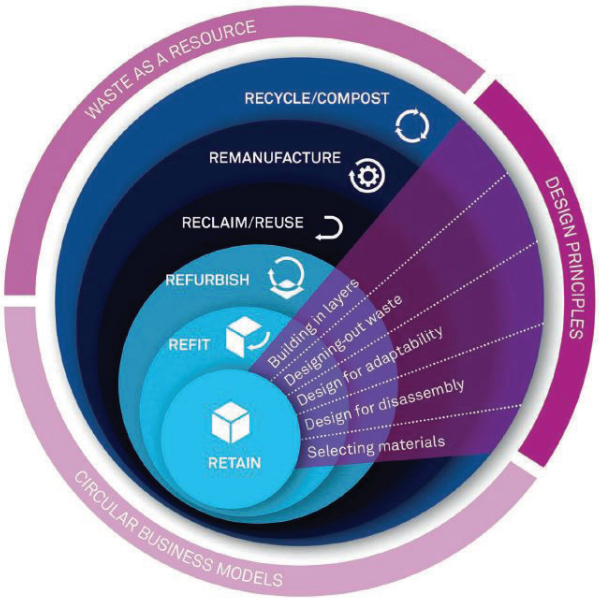
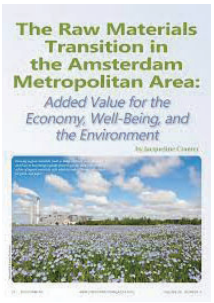


Fig 1.2.3 diagram for circular building

Jacqueline Cramer

Jacqueline Cramer is a strategic advisor and professor at the Copernicus Institute of Sustainable Development at Utrecht University. She is also ambassador for 'Circular Economy' and a member of the Economic Board Amsterdam.



Definitions

Cramer uses the definition provided by T. Bastein, E. Roelofs, E. Rietveld and A. Hoogendoorn in their report 'Kansen voor de Circulaire Economie in Nederland' (Opportunities for the Circular Economy in the Netherlands) (2013) which states that circular enonomy is "an economic system based on the reuse of products and raw materials and the restorative capacity of natural resources. It also attempts to minimize value destruction in the overall system and to maximize value creation in each link in the system. The goal is to counteract the depletion of natural resources, phase out waste, greenhouse gas emissions and the use of hazardous substance; and make a complete transition to renewable and sustainable energy supplies."

Principles of the 10R model

Cramer did research into the use of raw materials. The principle of the 10R model is that we should try to minimize the use of raw materials and thus prevent waste, while at the same time creating more value. To achieve this the model shows a list of priorities. These are all strategies to diminish the use of raw material, but there is a clear hierarchy, the top one is the most favourable: refuse and prevent the use of raw material. By adding the priority to the strategies the use of raw materials can best be limited.

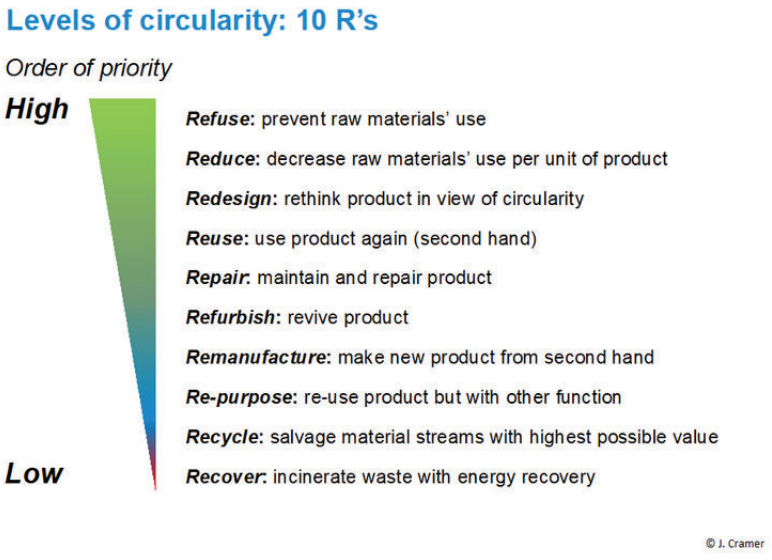


Fig 1.2.4 10R ladder

Ronald Rovers

Ronald Rovers is a researcher, advisor and lecturer in the area of sustainable building. He was a distinguished Fellow at the TUE and organiser of the first World conference Sustainable Building (2000, Maastricht)

Definition

"Circular building (or renovating) is using resources (and the energy for this) with a speed that assures that flows remain flowing. Or can be regenerated, and will be regenerated. This is first and for all a matter of space and time: how much resources per time period (volume speed, energy, restore capacity) are available, and how to optimize their use."(Rovers, 2021)

Rovers speaks of cycle for each material(resource). A cycle can be closed or open, depending on whether or not the material is regenerated within the period of its use. If material is regenerated, the cycle is closed. However, some materials, such as minerals and metals, cannot be regenerated.

Rovers also demonstrates that what is usually called 'circular', i.e. keeping products and/or resources in a cycle, is merely 'linear delaying', since the renewing of resources does not take place. He states that 'a building in itself can't be circular or not, it's the resource flow that counts.' He explains that the building should be considered as a storage of resources for a certain time. Managing these resources (materials and energy) should be done in such a way that it does not lead to the depletion of sources. In order to keep cycles closed and regenerate resources three things are important: land, labour and the sun. Rovers claims that land is the 'real capital', since it is needed to regenerate energy, food, water and materials. Labour can be regarded as a source of energy that is more or less freely available as people exist and need food anyway. The sun is important as it is the only inexhaustible source of energy.

Like Kate Raworth, Rovers also stresses the aspect of the division of resources, they should be distributed fairly so that 'maximum needs can be met for everyone' (Rovers, 2018, p. 154). He denounces the profit principle of the PPP model, as in practice the profit ends up with a small part of the population and thus leads to inequality.

Transitieteam Circulaire Bouweconomie

The Transitieteam Circulaire Bouweconomie (Transition team circular building economy) was founded by the Dutch government to plan the transition to a circular building economy.

Definition Circular Building

"Circular building is the construction, use and reuse of buildings, areas and infrastructure, without unnecessary depletion of natural resources, pollution of the living environment and harm to ecosystems; in a way that is economically sound and contributes to the wellbeing of humans and animals; here and there, now and later."(Transitieteam Circulaire Bouweconomie, 2017)

The Dutch government wants to have a circular economy by 2050, the construction sector is one of the key transition industries. The Transitieteam circulaire bouweconomie (Transition team circular building economy) was founded to implement the transition to a circular building economy. The report of the Transitieteam explains the steps that will be taken to reach this goal. There are three main transition steps:

1. Forming a 'base camp', this involves a. developing/stimulating the market for circular building, b. developing measuring methods and instruments, c. creating policy, legislation and regulations for circular building, and d. accumulating and increasing knowledge and stimulating awareness about circular building
2. 50 % of the building industry is circular
3. 100 % circular building economy

The report also mentions a number of challenges and opportunities:

- Cooperation of different sectors in construction industry offers opportunities to learn from each other.
- In 2050 houses not only need to be built in a circular way, but also need to be energy-neutral, which requires making homes more sustainable. By linking this to circular building, including the one million new homes to be built, a major contribution can be made to making the Netherlands more circular.

The transition creates a high demand on human capital in the building industry. Challenges are the shortage of personnel and the amount of workers that are no longer sufficiently qualified, due to changing energy and circularity goals, new and innovated products and the increasing influence of digitization. Craftsmanship needs to be updated and investments in education are necessary.

Platform CB ‘23

Platform CB’23 designs supports the realisation of part of the goals of the implementation program Circular Building Economy. This is done by acquiring and sharing knowledge, making an inventory and putting obstacles on the agenda and by drawing up agreements for the whole of the construction sector. One of their publications is the Leidraad Circulair ontwerpen (Guidelines for Circular Design)

Definition Circular Building

CB ‘23 uses the definition by the Transitieteam circulaire bouweconomie. “Circular building is the construction, use and reuse of buildings, areas and infrastructure, without unnecessary depletion of natural resources, pollution of the living environment and harm to ecosystems; in a way that is economically sound and contributes to the wellbeing of humans and animals; here and there, now and later.”(Transitieteam Circulaire Bouweconomie, 2017)

Circular Design Strategy

Platform CB ‘23 also defines a circular design strategy: A “strategy that describes which circular design choices must be made when and which resources are used to implement a circular strategy.”(Platform CB‘ 23, 2021, p.17)

This guideline distinguishes six design strategies for circular building:

1. Designing for prevention (not building)
2. Designing for the reduction of life cycle (choosing the solution that causes the lowest environmental impact)
3. Designing for future-proofing (design for adaptability)
4. Designing with reused objects (reusing objects, components or elements)
5. Designing with secondary raw materials (raw materials that have been used before or with residual flows from another product system)
6. Designing with renewable raw materials (building materials from renewable sources)

Regarding these design strategies and the design process a number of challenges are formulated.

- Circular building requires knowledge of design strategies and the condition under which you can apply them. This includes knowledge about process steps, preconditions, agreements and scale that belong to a certain strategy and knowledge about the combination of strategies.
- Circular design revolves around collaboration and the use of knowledge and experience from the entire chain, where the current design and construction chain is organized in a sequential and fragmented way. How can this be ensured?
- It is important to determine what preconditions are required. In the preliminary phase, as well as in later stages (realisation, use) the right points need to be brought to attention, in order to secure circularity.

Joanna Williams

Joanna Williams has a broad experience in the field of environmental sustainability. She is director of the Circular Cities Hub.

Williams argues that the model designed by the Ellen MacArthur Foundation (the RESOLVE conceptualisation, see figure 1.1.1) is not suitable for a city. She states that it is designed for circularity in business or industrial sectors, an economic system where actors are dealing with a single sector, rather than the complex urban system that the city is. She developed a special circular model for resource management in cities.

Definition Circular Cities

"The circular approach has three principal aims: to reduce resource consumption and waste; preserve natural capital and ecosystem services; and design out negative externalities (economic, social and environmental) associated with resource wastage, degradation of natural capital and ecosystem services in the city. This must be achieved within the context of continually changing demands, consumption patterns and systems of provision in cities. Thus the urban ecosystem undergoes a constant process of renewal, whilst minimising the consumption of resources and production of waste."(Williams, 2019)

Julian Kirchherr, Denise Reike & Marko Hekkert

The authors are part of the Innovation Studies Group of the Copernicus Institute of Sustainable Development, Utrecht University, The Copernicus Institute is a leading research centre for sustainability research and teaching.



Definition Circular Economy

"We defined CE within our iteratively developed coding framework as an economic system that replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes. It operates at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, thus simultaneously creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations. It is enabled by novel business models and responsible consumers."(Kirchherr, Reike, Hekkert, 2017)

Kirchherr, Reike & Hekkert published the research paper 'Conceptualizing the circular economy: An analysis of 114 definitions'. (2017) The goal of their research was to clarify the perception of the term Circular Economy. This was done through an analysis of definitions, by using a coding framework to count how often certain terms were used to define and describe Circular Economy. This resulted in the definition given above.

Kirchherr et al (2017) found that there are large variations in literature about the perception of the term circular economy and that the circular economy is most frequently depicted as a combination of reduce, reuse and recycle activities, notably "without necessitating a systemic shift ". Circular economy is often considered to promote "economic prosperity, followed by environmental quality". They found that aspects of social equity were often missing in the definitions. (Kirchherr et al, 2017)

Comparison and conclusions circularity

comparison of definitions

As Kirchherr et al. concluded there is a large variation in the definitions on Circular Economy. The main issues are:

- What is Circular economy, is it just a combination of reduce, reuse and recycle, or does it involve more than that?
- Is a systematic shift required?
- What is the aim of the circular economy: prosperity, environmental quality or social equity?

All definitions we found seem to more or less agree on what circularity is: replacing the linear flow of energy, materials and waste by a circular one. The reviewed literature also shows an agreement on the systemic shift that is required to achieve the transition from the linear to the circular economy. This systemic shift involves not only the change of the economic model, but also the social model. Raworth stresses that we should keep within the boundaries with regards to environmental impact as well as social shortfall. Huesemann & Huesemann argue that we cannot solve the world's problems without social cohesion. The main issue in the definitions seems to be the level of circularity that should be aimed for and/or that can be achieved. In a fully circular model all energy and materials are regenerated within the period of use. Some definitions already seem to assume that this is unachievable. This becomes clear when comparing the definition by the Transitieteam who speak of 'unnecessary depletion of natural resources, pollution of the living environment and harm to ecosystems; in a way that is economically sound' and other thinkers, such as Ronald Rovers and Huesemann & Huesemann in whose description the who 'unnecessary' is replaced with 'no'. Where in the first definition seems to have built in preconditions (economically sound) for circular building, the latter say that we cannot allow such preconditions. Nevertheless, they also indicate the challenges that are connected with the transition to a circular economy.

The definition by Kirchherr et al. is the most complete one. It shows that Circular Economy entails more than how it is usually described and that it requires a systemic shift. Furthermore the aim, the participants, the levels on which it operates and the means by which it can be achieved.

The model by the Ellen MacArthur Foundation is commonly used to explain circular economy, although Williams argues that is not suitable for the complex system of a city.

With regards to circular building Ronald Rovers explains that a building cannot be circular, only the building process can be done in a circular way. This means managing the resources, so that it does not lead to depletion of materials or energy. Some of the literature has a more practical point of view and focusses on strategies and steps that need to be taken to achieve circular building. David Cheshire, as well as the platform CB '23 mention strategies, these have a clear hierarchy, as does the 10R model. The most preferable strategies aim to slow down cycles by retaining buildings and increasing their life span, for instance the strategy of building for adaptability. Other strategies focus on keeping the cycles closed, by reclaiming and recycling components and materials. The report by the Transitieteam Circulaire Bouweconomie focusses on the implementation of circular building in the Netherlands.

Conclusions

The definition by Kirchherr et al. encompasses all aspects of the Circular Economy and is the most complete definition.

The most urgent aim of the circular economy is solving environmental problems, the depletion of materials, energy, clean water. This should be done in a fair way that benefits all people. Most thinkers agree that achieving a circular economy requires a systemic shift: in order to make it happen the economic model should change, profit and growth can no longer be the only driving force of the economy. A social shift is necessary to prevent a shortfall on the socials foundation including aspects like health, education, housing and social equity. The systemic shift should also go hand in hand with a change of relations between man and man, and man and nature.

Circular building is about managing resources and regeneration of materials. Several strategies can be employed to achieve this, preferably by increasing the life span of a building and thus slowing down the building cycle, which will allow more time for regeneration of resources.

Main challenges CB'23

- CB23 has created a set of design strategies that seek to design and produce buildings more circularly.
- A key challenge for the construction industry is to put these strategies into practice
- The results of these strategies should be reported back, allowing results to contribute to a more specified design strategy.
- Another challenge regarding the theme of circularity is to get all stakeholders to work together. This means good pre-conditions, agreements, and feedback that all parties could benefit from (Transitieteam Circulaire Bouweconomie, 2017).

CB'23 Platform describe the guide for measuring circulatiry in the construction sector (Guide Measuring circularity. Working agreements for circular construction. Version 2.0 – 02 July 2020).

Three key goals of circular construction are highlighted. These are:
- To protect stock of materials
- Environmental protection
- Value retention

For each of these points, several bullet points are made.

To protect stocks of materials (Transitieteam Circulaire Bouweconomie, 2017).:
1. The quantity of materials used (input)
1.1 The quantity of primary materials (non-renewable, renewable, sustainably produced and renewable, and unsustainably produced and renewable)
1.2 The quantity of secondary materials (from reuse and from recycling)
1.3 The quantity of physically scarce materials
1.4.1 The quantity of socio-economically scarce raw materials
1.4.2 The quantity of socio-economically abundant raw materials

2. The quantity of materials available for the next cycle (output)
2.1 The quantity of end-of-life materials available for reuse
2.2 The quantity of end-of-life materials available for recycling

3. The quantity of materials lost (output)
3.1 The quantity of end-of-life materials used for energy production
3.2 The quantity of end-of-life materials sent to landfill

Core indicators for protecting the environment (Transitieteam Circulaire Bouweconomie, 2017):
4. Impact on the environment
4.1 Climate change – overall
4.2 Climate change – fossil
4.3 Climate change – biogenic
4.4 Climate change – use of land and change in use of land
4.5 Ozone depletion
4.6 Acidification
4.7 Eutrophication - freshwater
4.8 Eutrophication - seawater
4.9 Over-fertilisation - soil
4.10 Occurrence of smog
4.11 Depletion of abiotic raw materials – minerals and metals
4.12 Depletion of abiotic raw materials – fossil energy carriers
4.13 Use of water
4.14 Emission of particulate matter
4.15 Ionising radiation
4.16 Ecotoxicity (freshwater)
4.17 Human toxicity, carcinogenic
4.18 Human toxicity, non-carcinogenic
4.19 Impact/Soil quality related to the use of land

Core indicators for value retention (Transitieteam Circulaire Bouweconomie, 2017):
Since no existing methods are available for measuring the indicators for value retention, the action team has started to create its own indicators. They break value down into techno-functional value and economic value.

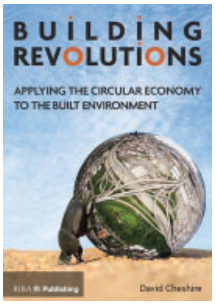
5. The quantity of initial value (input)
5.1 Techno-functional value
5.2 Economic value

6. The quantity of value available for the next cycle (output)
6.1 Techno-functional value
6.2 Economic value

7. The quantity of existing value lost (output)
7.1 Techno-functional

Definitions flexibility and adaptability

David Cheshire



David Cheshire is sustainability director at Aecom, an American multinational engineering firm, that strives to do their work in the most sustainable manner.

Definitions

by Addis & Schouten:

"Flexible building -
a building that has been designed to allow easy rearrangement of its internal fit-out and arrangement to suit the changing needs of occupants.

Adaptable building -
a building that has been designed with thought of how it might be easily altered to prolong its life, for instance by addition or contraction, to suit new uses or patterns of use."(Addis & Schouten, 2004)

The definitions were quoted in the chapter 'design for adaptability' where Cheshire describes methods, concepts and case studies, among which are the Open Building concept, Stewart Brand, and IFD, to explain how design for adaptability can be achieved. The chapter ends with a summary of factors that enhance adaptability in a building:

- over engineering structure and foundations
- structural solutions that provide clear floorplates and options to add or remove parts of the floorplate
- using a simple plan form
- positioning of cores and generous size of risers
- scenario modelling
- generous floor-to-ceiling heights with abundant levels of daylight
- applying the principles of design for disassembly

N. John Habraken Open Building

John Habraken was a professor and first chairperson of the Department of Architecture of the TUE and later head of the Department of Architecture at MIT, Cambridge. He was also director of the SAR (Foundation for Architects Research) from 1965 to 1975.

Definition

Habraken does not define flexibility and/or adaptability. He uses the terms support (which is the permanent part of a building) and infill (the changeable). "Supports are part of the public domain and are permanent, while the infill belongs to the individual and is changeable. Participation and freedom of choice for the user is the key objective."(Habraken, 1961)

In 1961 Habraken the manifest 'De dragers en de mensen' ('The supports and the people') was published, wherein Habraken proposed for a shift in mass housing, stating that at that time it offered residents insufficient possibilities for their individual way of life. The open building concept distinguished between different scales and different design levels. (see figure 1.3.1) The design of the structural system(support) and the components is the task of the architect, the design of individual home (infill) should be done by the architect in consultation with the user. Nowadays OpenBuilding has evolved into an organization that is 'dedicated to extending the lifespan of buildings, significantly lowering the ecological footprint and creating healthy communities'.

(Open Building, 2021) Future users have a say about the infill, thus a sense of belonging is encouraged.

Habraken also points out architectural challenges and opportunities of design for flexibility:

- (How) can it lead to a compelling new architecture? Habraken endorses the idea that 'without the love and pride of its users, a building is not assured of a long life even when the requirement of flexibility is met.'(Habraken, 2008)
- Design for flexibility is about the distribution of control (the architect passes over control to the user).
- It raises the question: where is the dividing line between the flexible building and the inhabitant's territory?

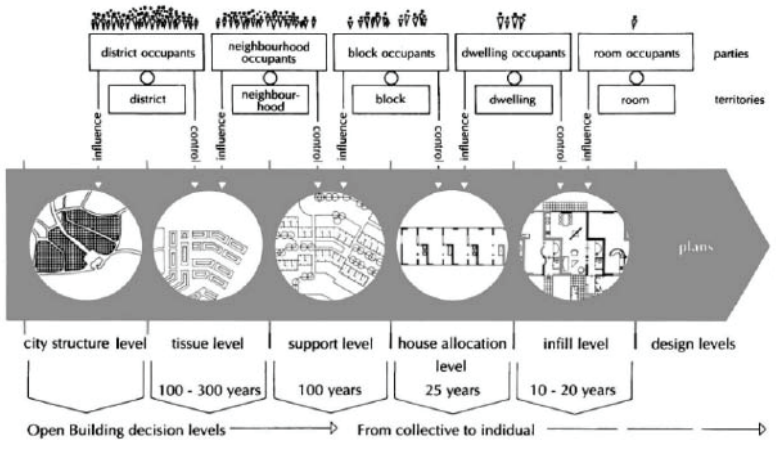
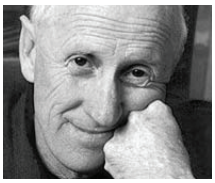
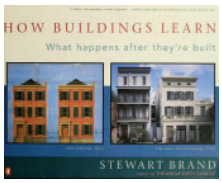


Fig 1.3.1 schedule for Open Building: parties, territories and design levels

Stewart Brand

Stewart Brand is an American writer, editor and entrepreneur. He published a number of books, among which 'The Whole Earth Catalog' (1968) and 'How buildings Learn' (1994). He is co-founder and president of The Long Now Foundation, a nonprofit organisation 'to foster long-term thinking' (The Long Now Foundation, 2022)





Definition

Brand does not give a definition of adaptability, but explains that adaptability is a relative concept. "Almost no buildings adapt well. They're designed not to adapt; also budgeted and financed not to, constructed not to, administrated not to, maintained not to, regulated and taxed not to, even remodeled not to. But all buildings (except monuments) adapt anyway, however poorly, because the usages in and around them are changing constantly."(Brand, 1995)

Concept

In his book How Buildings Learn Brand elaborates on the concept of shearing layers, first designed by Frank Duffy. All buildings can be regarded as a system of layers that each have a differrent life cycle. Connections between the layers should be in such a way that each layer can be maintained, refitted or changed without obstruction by other layers.

Brand defines six different layers:

- stuff (1 day-1 month) = furniture
- space plan (3-30 years) = internal layout
- services (7-15 years)
- skin (20 years)
- structure (30-300 years)
- site (eternal)

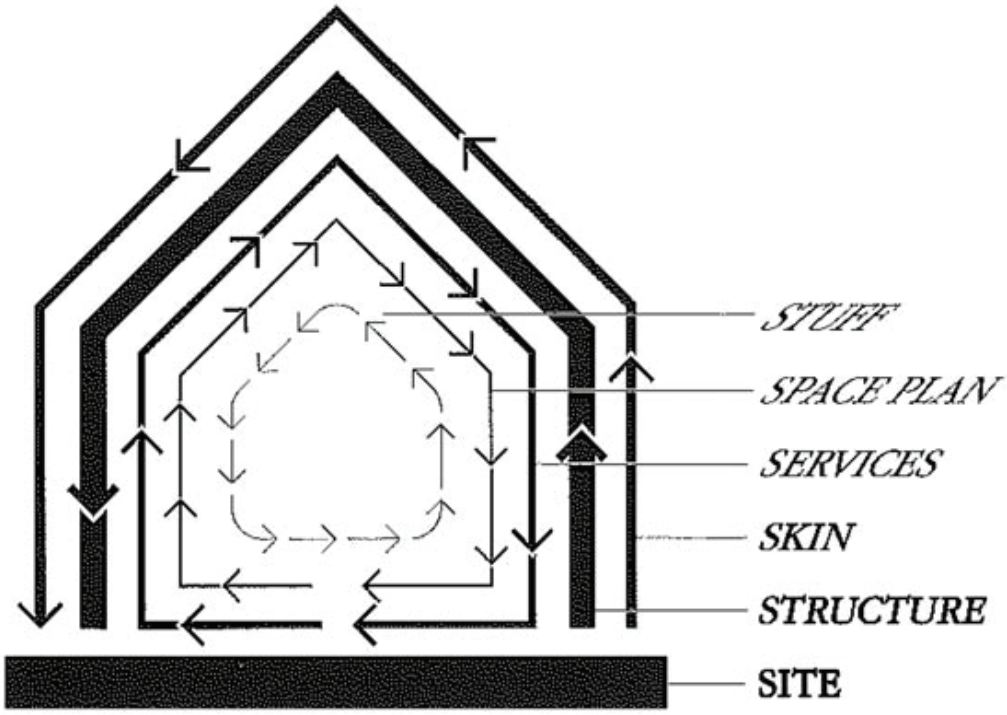
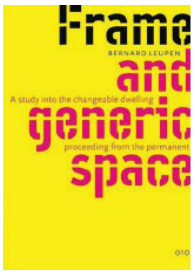


Fig 1.3.1 shearing layers of design

Bernard Leupen

Bernard Leupen is a photographer, writer and teacher at the TU Delft. He wrote a number of books on architecture, 'Frame and Generic Space' is his PhD thesis



Definition

Leupen does not give a a definition on adaptability or flexibility, instead speaks of changeable architecture, in specific about dwellings.

Concept

Each building consists of a fixed part, which cannot be changed easily, this is the frame. In addition, there is a generic space, the part that can be changed. Leupen argues that because the frame is fixed and permanent, this allows the generic space to have an unspecified purpose and be changeable.

To analyze frame and generic space he distinguishes 5 layers: construction, skin, scenery, services and access. Each of these layers or a combination of these can act as a frame. For example, in the Dom-Ino house the frame consists of construction + access and the generic space of skin + scenery. (see figure 1.3.3) The independence of the frame can be increased through articulation, thus making it more important and lasting. It is important that there is a disconnection between the frame and generic space. Because this is never perfect, the term excision is described as the intersection where frame and generic space meet and can be separated from each other.

A frame can consist of one layer, but also of several layers, this is called an integrated frame. For a frame where the layers can no longer be separated from each other he uses the term integrated frame (for example a load-bearing facade, where construction and skin are one). A third possibility for the frame is called the Matryoshka principle, which involves multiple frames on different levels in a building.

Categories

Leupen distinguishes between three categories of changeability:

- the alterable: the generic space contains a layer that can be changed
- the extendable: the generic space is not bordered on all sides
- the polyvalent: a polyvalent generic space contains no layers, but offers the possibility of different uses through its shape and size.

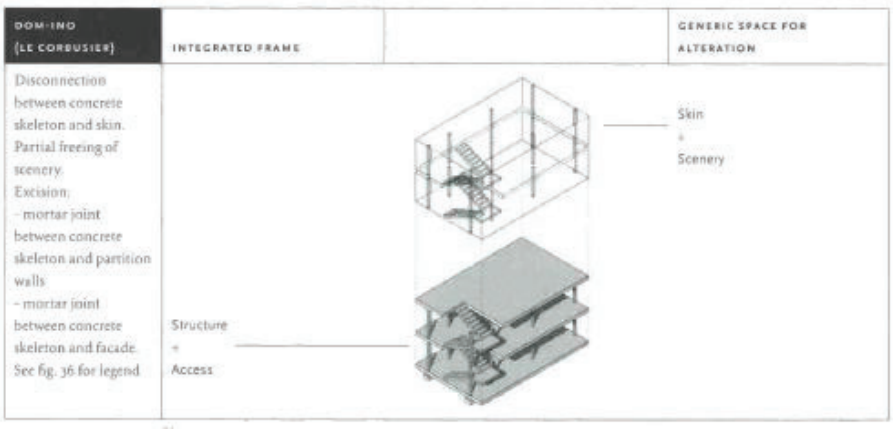


Fig 1.3.3 analysis of frame and generic space of the Dom-Ino house

Robert Schmidt III & Simon Austin

Robert Schmidt III is a senior lecturer in Architecture at Loughborough University, England with a special interest in designing for adaptability. Simon Austin is professor of Structural Engineering at Loughborough University,

Definition adaptability

"the capacity for a building to accomodate effectively the evolving demands of its context, thus maximizing its value through life"(Schmidt & Austin, 2016)

Categories

Schmidt and Austin define categories with regards to the type of change that occurs:

- Adjustable – change of task/user
- Versatile – change of space
- Refitable – change of performance
- Convertible – change of use
- Scalable – change of size
- Movable – change of location

Figure 1.3.4. shows these types of change and the design strategies that could be applied for each type. By adjustable they mean reconfiguration of 'stuff'(furniture or equipment) on a daily or weekly basis. Versatile means changing the spatial layout of a room. Refitable can include change of services, skin and/or space. Convertible means change of function on the building level, for instance from office to dwellings.

Schmidt and Austin argue that architecture should not be seen from the 'first use perspective' of the building as 'a finished product for a particular purpose, user and location'. Architecture should include time as a design variable, by which it becomes a process rather than a product. The designers role is then: intentionally designing the building so that adapting it for future uses is not impossible or cost-prohibitive, keeping in mind the kind of change that might happen.

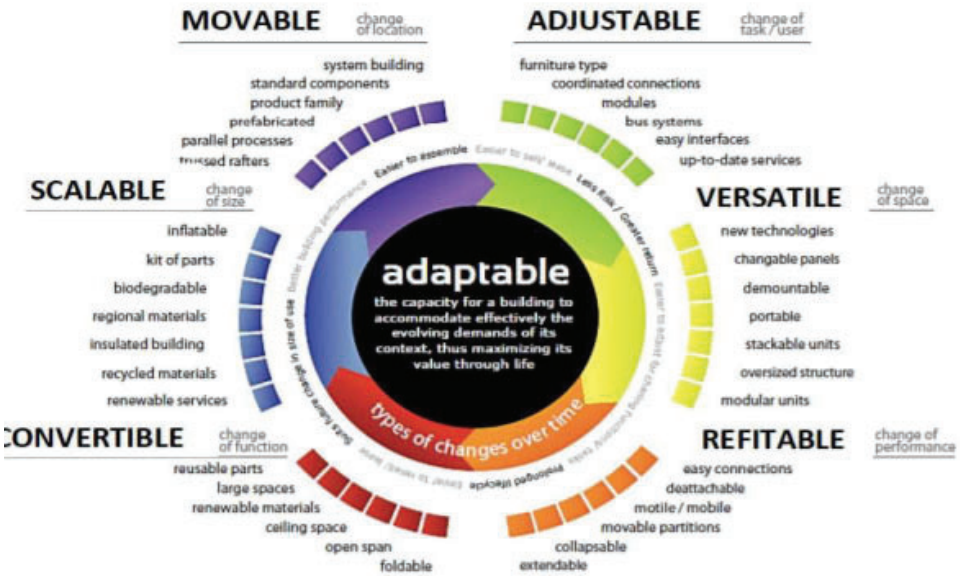


Fig 1.3.4. catagories and strategies for adaptable according to Schmidt and Austin

Tatjana Schneider & Jeremy Till

Tatjana Schneider is an architect, publicist and professor of History and Theory of Architecture and the City at the Techniscal University of Braunschweig, Germany. Her research focuses on case studies that promote the ground rules of socio spatial and ecological justice. Jeremy Till is an architect, writer, head of Central Saint Martins and Pro Vice-Chancellor of the University of the Arts, London

Definition

"flexible housing is housing that can adjust to changing needs and patterns, both social and technological. These changing needs may be personal (say an expanding family), practical (i.e. the onset of old age) or technological (i.e. the updating of old services). The changing patterns might be demographic (say the rise of the single person household), economic (i.e. the rise of the rental market) or environmental (i.e. the need to update housing to respond to climate change). "(Schneider & Till, 2007, p. 4)

Although in their book Schneider and Till only use the term 'flexible housing', they do distinguish a difference between flexibility and adaptability. To explain this difference they follow Steven Groák who defines adaptability as 'capable of different social uses' and flexibility as 'capable of different physical arrangements.' According to Groák adaptability means that through their form and size rooms and units offer a diversity in their use, normally achieved without physical alterations. Flexibility, however, involves physical changes, for instance through the use of folding walls or sliding doors, or by moving internal or external walls.

Categories

Schneider and till distinguish two categories:

- soft flexibility that "refers to tactics which allow a certain indeterminacy"(Schneider & Till, 2007, p. 7) This gives the user control of the room, allowing them to make changes as they want and need.
- hard flexibility. "refers to elements that more specifically determine the way that the design may be used."(Schneider & Till, 2007, p. 7) In this case the architect has designed elements to transform the room, such as sliding doors or moving walls.

Robert Kronenburg

Robert Kronenburg is a member of the Royal Institute of British Architects and holds the Roscoe Chair of Architecture (emeritus) at the Liverpool School of Architecture. He has a special interest in portable, flexible, adaptabile and mobile architecture.

Definition

"Flexible architecture consists of buildings that are designed to respond easily to change throughout their lifetime."(Kronenburg, 2007, p. 7)

Categories

Kronenberg distinguishes the following categories ('characteristics'):

- Adaptation = buildings that can change to different functions, users or a different climate.
- Transformation = 'buildings that change shape, space, form or appearance by physical alteration of structure, skin or internal surfaces'
- Mobility = buildings that relocate from one place to another to function better
- Interaction = 'buildings that respond to the user's requirements in automatic or intuitive ways' (smart buildings)

By transformation Kronenburg means buildings or rooms that change on a short time basis, such as in the naked house by Shigeru Ban, the Allianz Arena or the crate house by Allan Wexler (see figure 1.3.5.) For mobility three strategies are distinguished: portable, demountable and modular. Figure 1.3.6. shows example of demountable temporary paper office by Shigeru Ban.

Fig 1.3.5. Crate house by Allan Wexler

Fig 1.3.6. temporary office - Shigeru Ban

Comparison and conclusions

As the literature shows the words flexibility and adaptability are used interchangeably. Before dealing with the difference between these terms, we will look at similarities and variations to determine what, why, how and for whom flexibility/adaptability is.

Similarities and variations

The following similarities were found:

- All thinkers/writers speak about change or changeability.
- Adaptability/flexibility exists on different scales.
- The word use or user appears in almost every definition. Adaptability/flexibility exists for the benefit of the user.
- Most of these thinkers use the word ease or the word capacity to indicate the level of adaptability/flexibility. It is not a binary concept, but exists in a range between unable to change and easily changeable.
- Most of the literature emphasizes the disconnection of layers as a means to enhance adaptability/flexibility

Apart from the similarities there are also variations in definitions and categorizations:

- Some definitions include the words 'intentionally designed'. We argue to leave them out, since whether or not a building actually is adaptable and or flexible is more important than whether or not it was intentionally designed as such.
- Though all books and thinkers use the word change, this change can involve different things, on different scales, in a different time frame. Possible changes are:
    - change of user
    - change of function on room level
    - change of function on building level
    - change of size
    - change of performance (updating services/ users' needs and preferences)
    - seasonal change (summer/winter)
    - climate change (long term)
    - change of location
- There are two general reasons for adaptability/flexibility. The first is the desire to respond to change, thus increasing the lifespan of a building, the other reason stems from the wish to give the user more influence. Though the reasons are different, in the execution of adaptability/flexibility user influence and response to change often go hand in hand.
- There are different methods of analysis with regards to the layers, Habraken defines two layers: structure and infill, Brand defines 6 layers: site, skin, construction, services, space plan and stuff, and Leupen defines 5 layers: structure, skin, scenery, services and access.

Flexibility, adaptability and categories

The literature review shows there are numerous ways of defining adaptability and/or flexibility, which go along with different ways of categorizing. One type or category of flexibility/adaptability can have several denominations. This leads to the question: is there a difference between flexibility and adaptability and if so, how is the relation between these two concepts? Of the seven books/thinkers reviewed in this analysis only two define adaptability and flexibility as different concepts and both refer to definitions given by others. Schneider & Till refer to the definitions by Steven Groàk and David Cheshire uses the definitions by Addis & Schouten. Strangely enough Groak's definition adaptability is equal to polyvalency (as described by Leupen), achieved without physical alterations, where according to Addis & Schouten adaptability is achieved through physical alteration, such as addition or contraction. Their definitions for flexibility however, are more or less similar, involving rearrangement of fit-out or through folding walls and sliding doors. Two thinkers/authors define flexibility/adaptability as architecture that responds to changing demands, Schmidt and Austin use the word adaptability for this and Kronenburg calls it flexibility. Stewart Brand does not give definitions, but uses the verb adapt, and both Leupen and Habraken speak of changeable architecture, or changeable infill. Our own position in this discussion is divided, although the majority is inclined to agree with the description by Addis & Schouten, in the sense that flexibility seems to be more easily achieved (without physical alterations) than adaptability (achieved through physical alterations).

Another confusion is the category of movability, involving change of location. Kronenburg and Schmidt & Austin introduce it as a category of flexibility, where David Cheshire calls this 'design for disassembly'. This seems to be contradictory, however, a closer inspection reveals that design for disassembly uses some of the same strategies as design for adaptability/flexibility. Besides that, movability could

be regarded as adaptability/flexibility on a larger scale, for instance the city.

Although we do not want to make our own definitions for adaptability and flexibility we feel it is useful to give our own name to the different categories and types that were found in literature. This makes it easier to compare types and case studies in the following chapters.

Conclusions

Adaptability/flexibility deals with the capacity to respond to change. Change can occur through changing demands of users or to external causes (for instance climate change). It can occur on several scales. The general goal of adaptability/flexibility is to extend the lifespan of a building or the built environment, though this can go hand in hand with more freedom for the user to express himself. There are several strategies to achieve adaptability/flexibility, designing in layers is the most prominent of these strategies. Furthermore there are many different ways to define and categorize adaptability and or flexibility.

Open Building then and now

Overview of Open Building

Writings on Open Building often mention that Open Building started with the publication of John Habraken's book. However, in essence, Open Building is something that human beings have always done. Primitive shelters and dwellings were always Open Buildings because they were simple structures that could be adapted to changing activities, expanded, or inhibited by different people. A good example of this is the Ede long house as described in the group report (Broersma, Cooijmans, Fokkens, Hop, Szczepara and Verberne, 2022).

When residential buildings had become very complex and the need for extra dwellings very large, Habraken wrote his manifest. Habraken paints a very dark picture. He argued that the growing need for dwellings (activated by population growth) had led the method of mass housing to fulfill this need. Mass housing was fine as an emergency measure, but it did not end there. The result was standardization and uniformity. Dwellings were no longer adaptable to change, expansion and could not fulfill the wishes of the individual. They were designed for an average person but he/she does not exist. This way of building would eventually lead to dwellings that could no longer suit the occupants wishes, people would move out and buildings would become obsolete. This would not only lead to loss of investments but also effect social cohesion in a district. (Habraken, 1961)

So, he proposes a new method in order to repair the natural relation between the human being and his surroundings that dwelling is. He advocates a method of building that offers people the chance to do their daily activities in a way they want to, as well as providing the possibility of expressing themselves through their home and fulfilling their desire for variety. (Habraken, 1961) This method was later denominated as Open Building. It is based on separating the levels of decision making and responsibility, much like the shearing layers that Stewart Brand describes. Habraken distinguishes three main levels: the tissue level (the urban or district level with street pattern, greenery etc.), the support level (the base building) and the infill level. Each level has a different life span (Kendall, Teicher, 2000).

The support level is something that has often been misunderstood. This is partly caused by the abbreviation of the method. Support and Infill is often confused with Structure and Infill, or Skeleton and Infill. Although Habraken regarded the column and beam structure as very useful for a support, the concept of support is not identical to structure or skeleton. A support comprises all elements of the building that are shared by the occupants and that do not need to change. This includes the structure, the access, the provisions made for ducts and wiring, and usually also the façade, or part of the façade. The façade can also be part of the infill. (Bosma, van Hoogstraten, Vos, 2000) Supports must be designed in such a way that change and variety is ensured. Kendall and Teicher describe three types of change: in the layout of the dwellings, in the boundaries of the dwelling units (changing the distribution of the units) and change of function (Kendall, Teicher, 2000). Even though Open Building aims to restore the natural relation between human and environment it advocates modern industrial building methods, both for the support and the infill. Innovation is necessary for this new building task. A further matter that was advocated was research. In 1965 the SAR was founded, a foundation for Architectural Research. Research was mostly done on the methodology of architecture and urban design. Among other things it developed a method for designing residential supports, called SAR 65.

The role of the architect in Open Building is different from the traditional role of the architect. The architect is the designer of the support. Regarding the design of the infill there is transfer of control from the architect to the user. The exact boundary between the task and responsibility of both can vary. For instance, sometimes the architect designs the façade, and the user has no say in this, in other cases the façade belongs to the infill and the user may choose from different options.

Over time Open Building has slowly gained importance, not only in the Netherlands, but worldwide. Even though it is still not the most common method for residential buildings, it is widely applied to commercial buildings such as offices and stores.

Change is the key word in Open Building, but Open Building itself is also susceptible to change that arises from the changing society. Today's society has different challenges. In 2021 the manifest of Openbuilding.co was published. It incorporates many of Habraken's principles but there is one striking difference. Where Habraken starts with the view of the occupant and the negative consequences of mass housing, the mission statement of Openbuilding.co starts with the need for sustainability. The first part reeds:

'Open Building is a more than ever necessary instrument for city planning, building development and design processes. The building industry faces the task of drastically lowering its carbon and ecological footprint, by extending the lifespan of buildings, through adaptability. Open Building supports the transition to a society based on co-creation, participation, involvement and inclusion. The so-called supports or base-buildings form the 'infrastructure' for home-owners and users to inhabit and co-produce their environment.' (openbuilding.co, 2021)

Openbuilding.co mentions the relation to the theory of Stewart Brand (see the first chapter) and also advocate a disentanglement of layers.

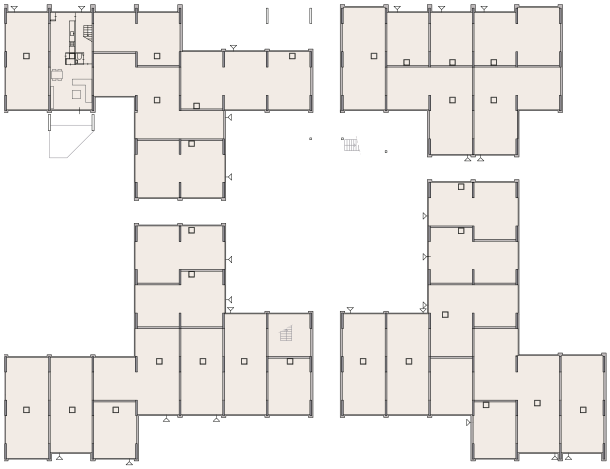
How these theories are practiced can be judged in the case studies.

Introduction to case studies

Four case studies were chosen, two from the past and two recent projects. I tried to choose projects that varied in structure, size and building process. For the older case studies this turned out to be very difficult and the availability of documentation was decisive in the choice of projects. The two projects from the past are both by Frans van der Werf and show a lot of similarities. The difference between them is that one of them underwent substantial changes. For the recent projects a choice was made for two types of structures: one with loadbearing walls and one with a column and beam structure.

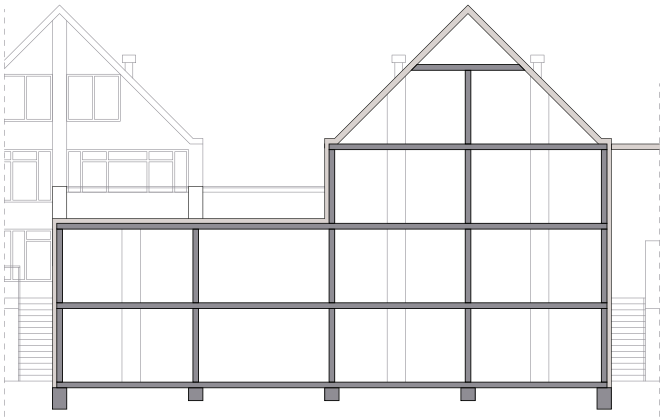
The case studies are:
Molenvliet Papendrecht by Frans van der Werf,
Keyenburg Rotterdam by Frans van der Werf,
Patch 22 by Frantzen et al.
And Superloft Houthavens 4 by Marc Koehler Architects

These case studies will be analysed on several aspects, following the categories Bernard Leupen distinguishes in his book Frame and Generic Space: structure, skin, scenery, access and services (Leupen, 2000).

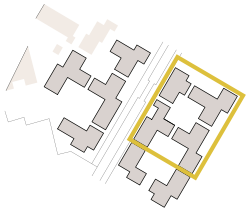


basic plan ground floor level

basic plan second floor level



basic section



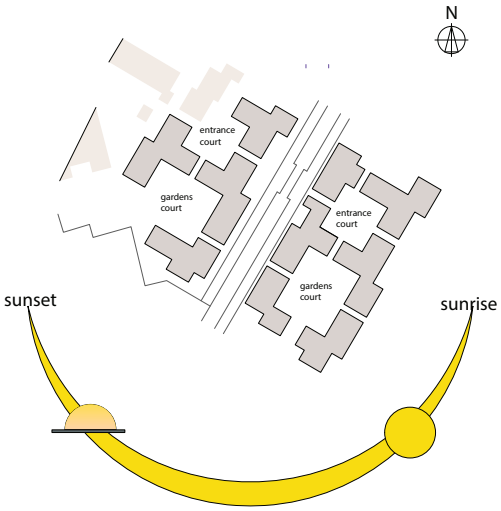
Case study Molenvliet

Location	Papendrecht Molenvliet
Architect(s)	Frans van der Werf
Year	1976

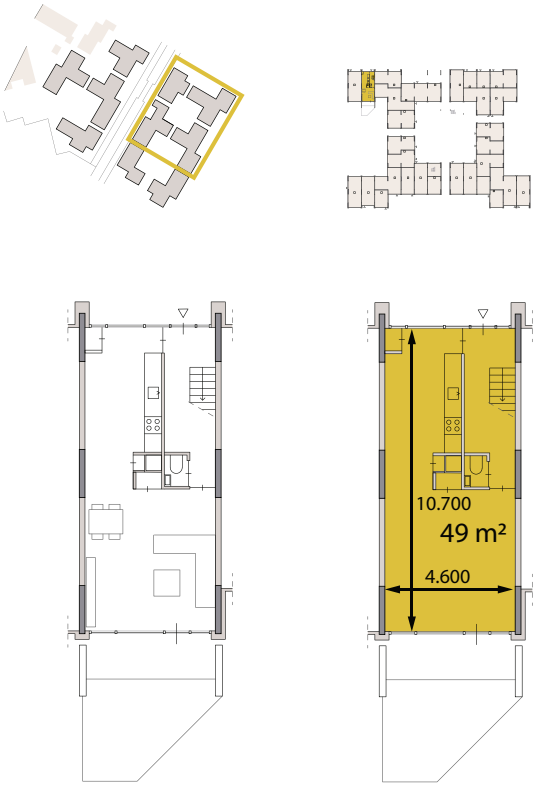
123 dwellings with 67 different types of layout, 200 m² office space

The project was initiated and commissioned by the housing association and was part of the program for experimental housing, which meant that it received extra finances from the government. Molenvliet is a large expansion district in Papendrecht, it was one of the first large scale Open Building project in the Netherlands. The architect was a pioneer of Open Building and was active in the SAR, a foundation that was concerned with the theory of architectural design.

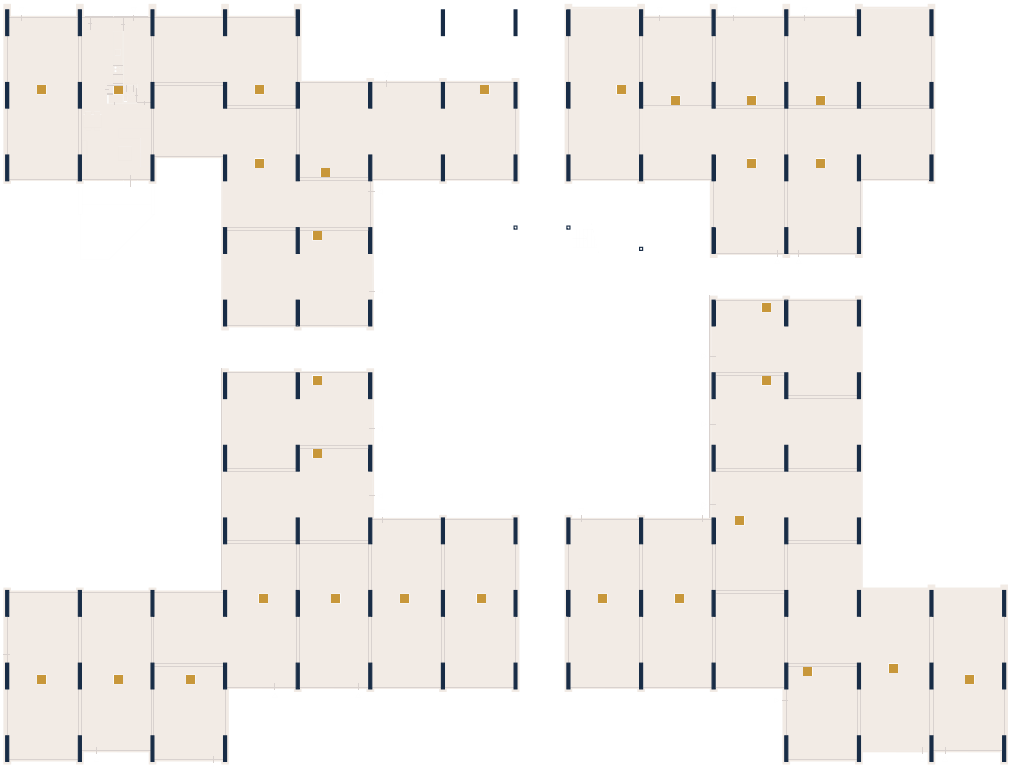
The original layout for Molenvliet was a checkerboard pattern of so-called entrance courtyards and garden courtyards. Courtyards are connected through allies. However, only part of it was realized so that now the courtyards are parallel with the main road in between. The dwellings are mostly maisonettes, though there are some other types as well. All blocks have a height of three layers and an attic, except the North facing garden court blocks that have a maximum height of three meters for reasons of sunlight. Each dwelling has a private outdoor space.



situation

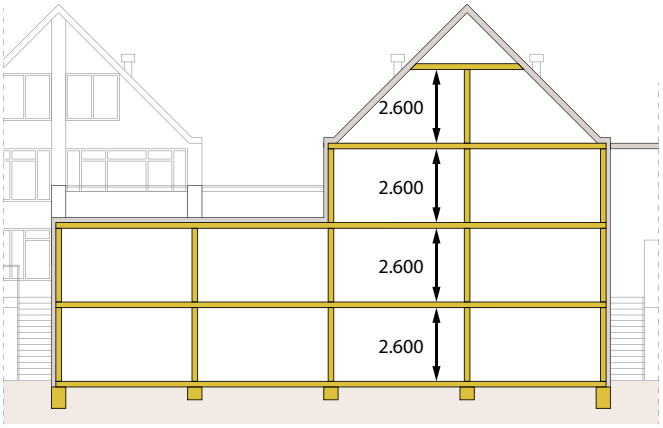


basic plan and measurements for one dwelling

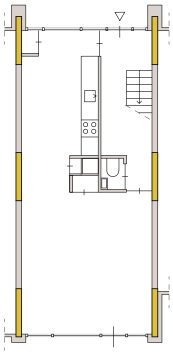


structure and shafts ground floor level

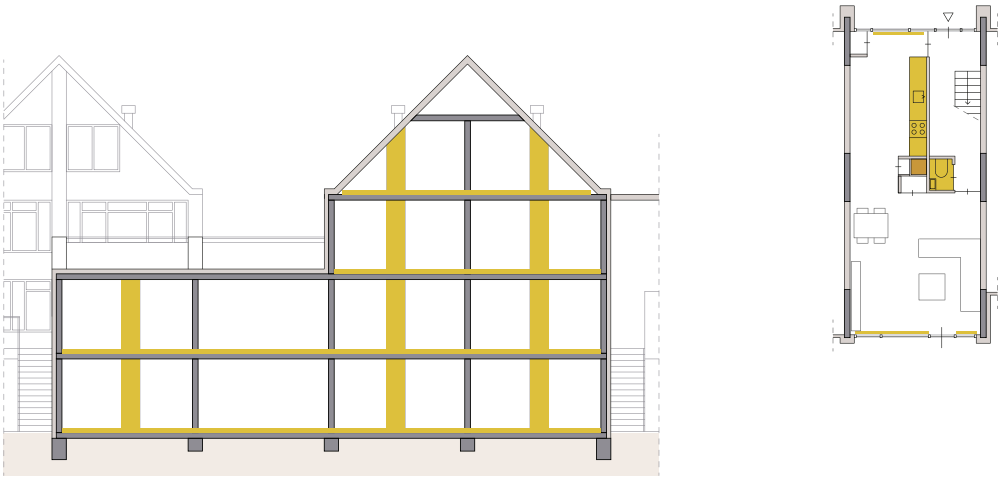
The structure is made with concrete loadbearing walls and so-called fontanelle walls. The fontanelle is the non-loadbearing part of the wall and does not have reinforcement. It can be removed in case a different division of units is desirable for instance when two dwellings are combined into one. The bay width is 4.8 m. Most dwellings have a depth of 11.8 m. All loadbearing walls have the same direction, which is the same as the pitched roofs. This was done for reasons of orientation. The plan is made up of courtyards and it is a known fact that people find it hard to orientate themselves in a courtyard, so if all roofs have the same direction, it is easier to define where you are and find your way.



structure section



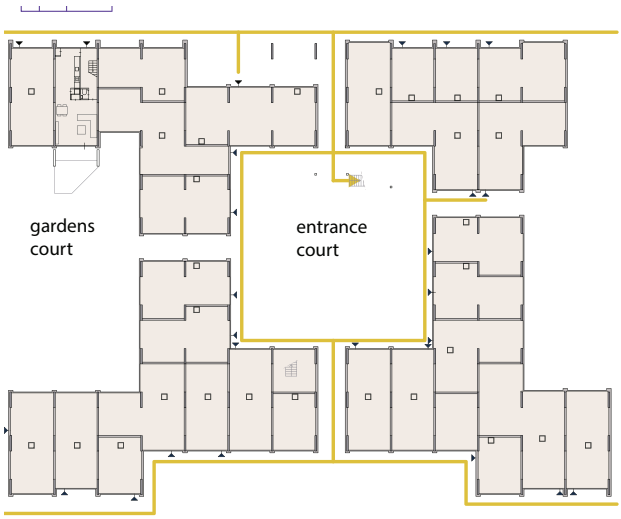
structure plan of one dwelling unit



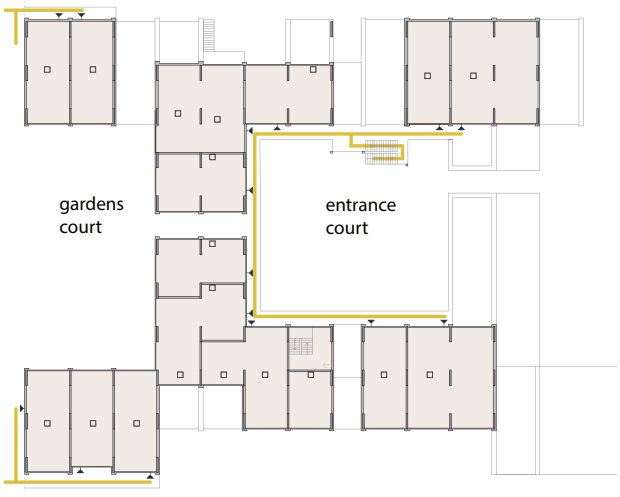
Services and ducts:section and plan of one dwelling.

Services and ducts:
Each dwelling has a central shaft for vertical transport of the pipes and wires. The meter cupboard was connected to this shaft. Bathroom, toilet and kitchen are in the vicinity of the shaft, as well as the central heating unit.

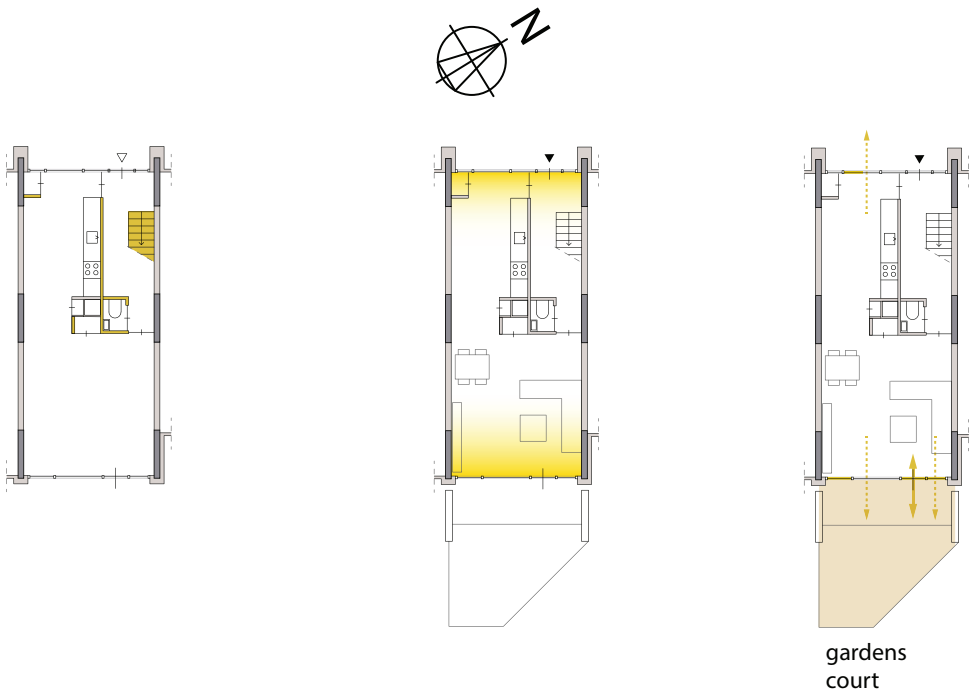
Access:
All dwellings are entered from the entrance courtyard. The maisonettes on the ground floor have a front door on the courtyard. In the courtyard there is a staircase that goes to the gallery on the second floor by which the second layer of maisonettes is entered. There are extra stairwells in the area where storage spaces are located.



access on ground floor level



galery access on second floor level



infill daylight relation inside outsice

Infill

In his book Open Designing van der Werf gives an insight in the process of finding a suitable and affordable system for the infill. This was preferably done before a contractor for the project was chosen otherwise that contractor would offer to do the infill as well, often not having the experience to do this, after which things turned out to become too expensive. In the case of Molenvliet three different parties were involved in the infill: one for the infill walls, one for electricity and a different party for the window frames (Van der Werf, 1993). For these window frames users could make a choice between several alternatives designed by the architect. Each opening could be filled with glass or a closed panel. Additionally, there was a choice of the colour scheme for the frames.

drawing made for the choice of window frame colours

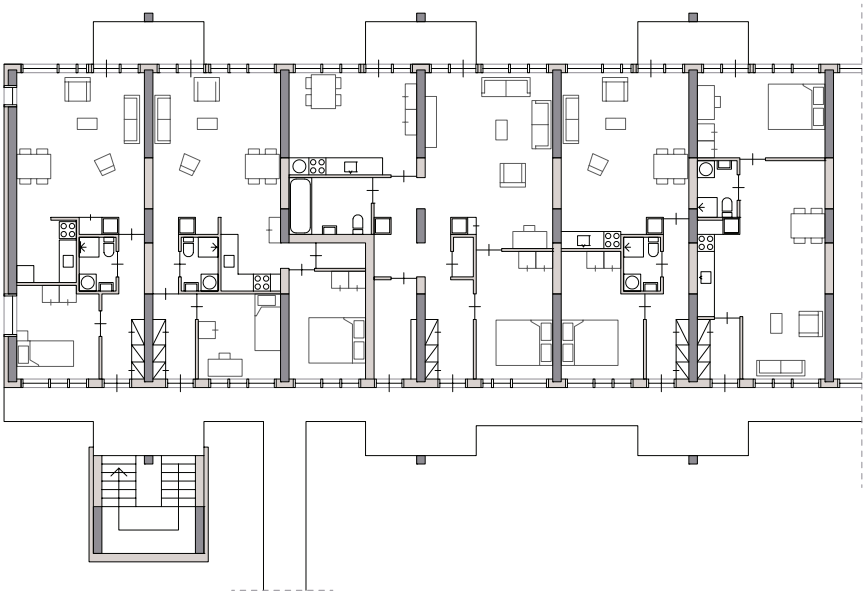
Case study Keyenburg

Location	Rotterdam Keyenburg
Architect(s)	Frans van der Werf
Year	1985

115 two persons HVAT dwellings, 32 single person dwellings and 5 MIVA dwellings (dwellings suitable for people with a handicap, on ground floor)

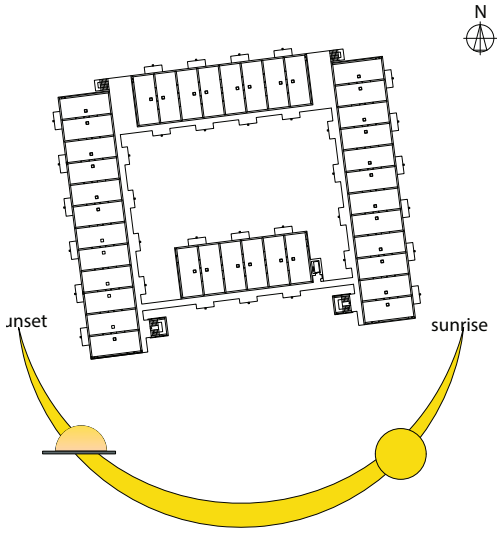
This project was initiated in 1982. Around that time the housing production in the Netherlands was regulated and subsidised by the central government to a large extent. Each city was allocated a housing quota, for Keyenburg the contingent consisted of so-called HVAT units: small dwellings for single and two-person households. These were usually meant for young people. However, in Keyenburg the housing demand was mainly for homes for the elderly. The housing cooperative therefor decided to execute it as an Open Building project so that the dwellings would not only be suitable for young people but also for the elderly and in the future units could be combined into larger houses.

The Open Building process caused several legal problems. Problems arose in the plan approval by the municipal Building Department, because not all infill plans were decided on at the time of approval. This was solved by making 'reference floorplans'. Another issue was caused by the Public Services Department that demanded the official requirements for the supply of electricity to be met.

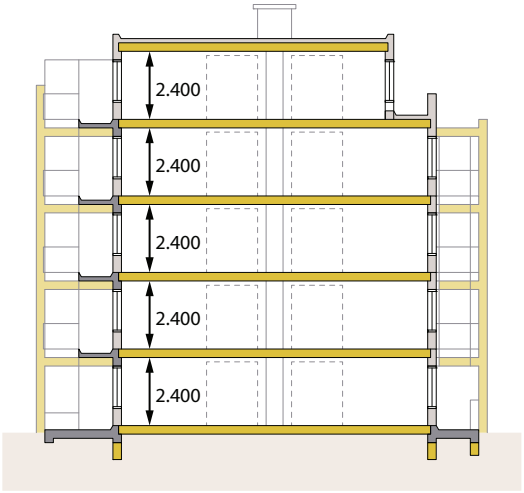


basic plan

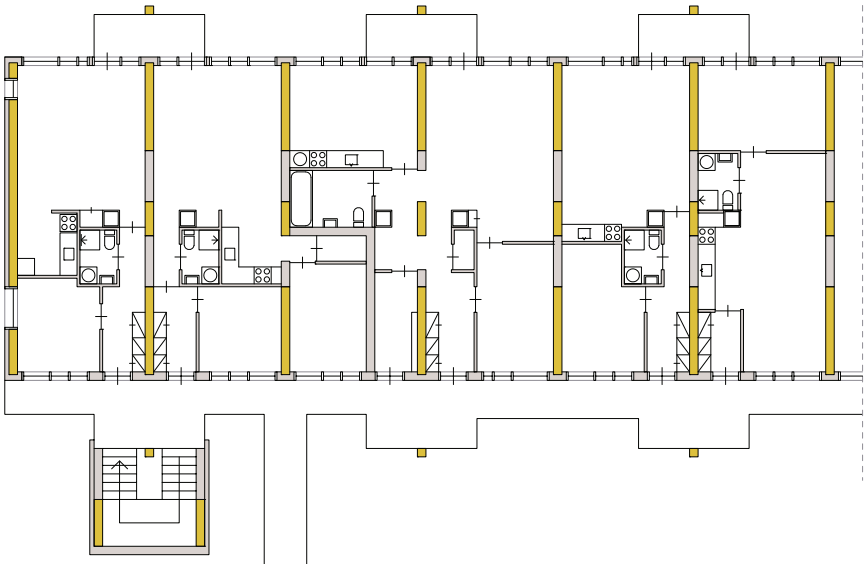
User participation was executed by the housing cooperative, each future resident had two individual consultations with with the architect or a representative. Within the boundaries concerning the placement of bathroom and kitchen they were free to determine their own floorplan and make choices regarding the quality of the infill. A full-scale model was used to evaluate the spatial qualities of the chosen layout. The costs of the choices made were passed on in the rent, calculations were made simultaneously. Some users who were only assigned their apartment at a late stage were unable to realize all their wishes. A few occupants were disappointed with the raised bathroom floor and the limitation the central shaft formed to the freedom of placing the kitchen to their desire. Other occupants were eventually disappointed by the choices they made, even though they had been part of the participation process. (Carp, 1985)



situation

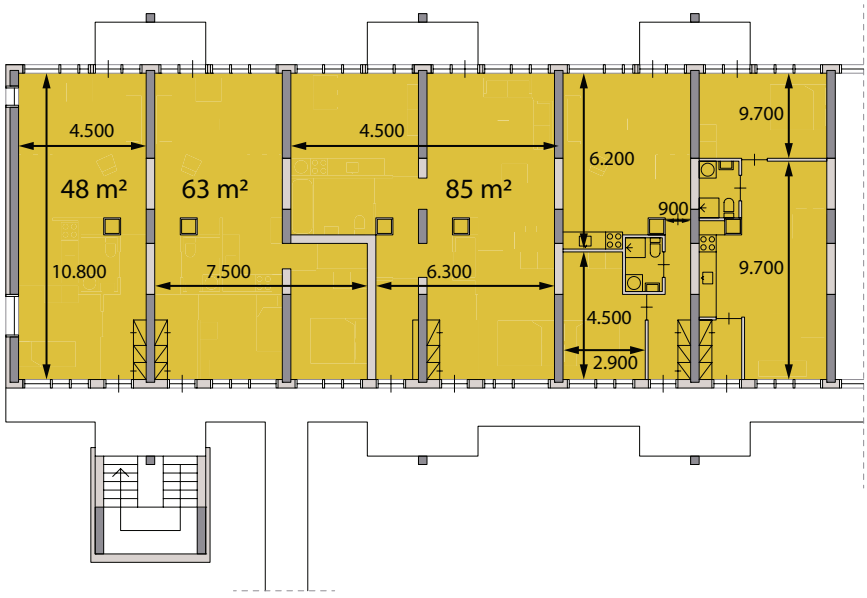


section: structure

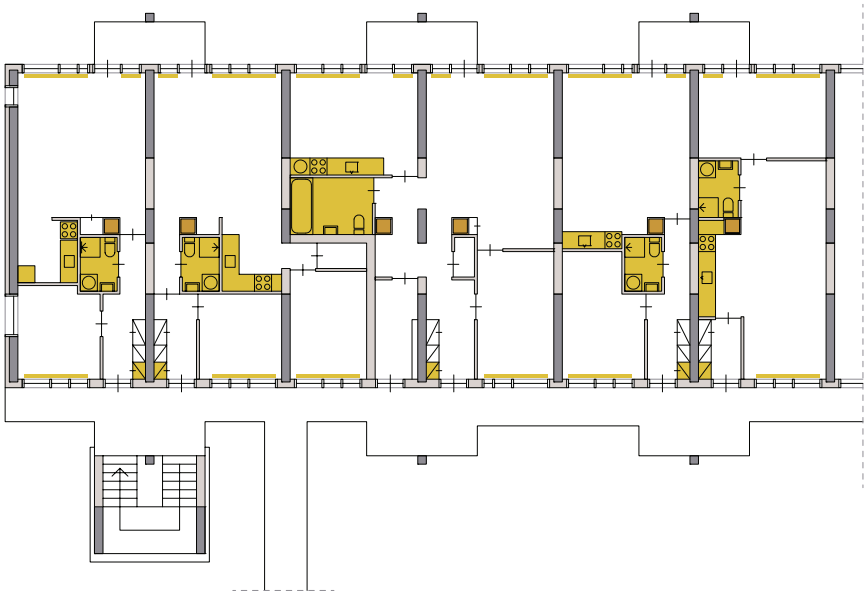


plan: structure

Structure:
The structure consists of concrete poured in situ with heated tunnel forms, the floor slabs have a width of 4.80 m. Prefab concrete was used for lintels, galleries, balconies, stairwells, and columns for the balconies. Loadbearing walls between two bays are so called 'fontanel walls'. The net size of the bays is 4.5 x 11.8 m (48.6 m2), which is suitable for a two person HVAT unit. On the top floor apartments are 1.5 m less deep, these are suitable for one person.

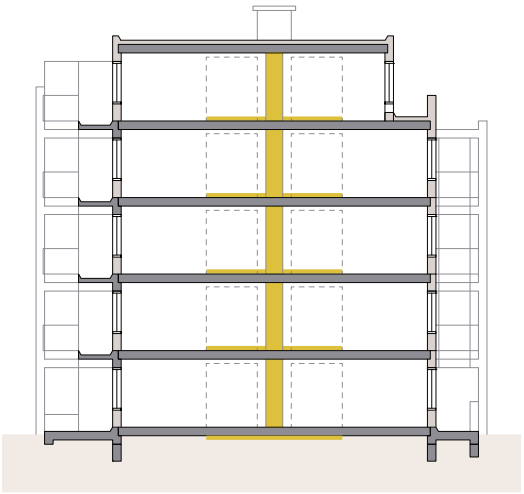


measurements

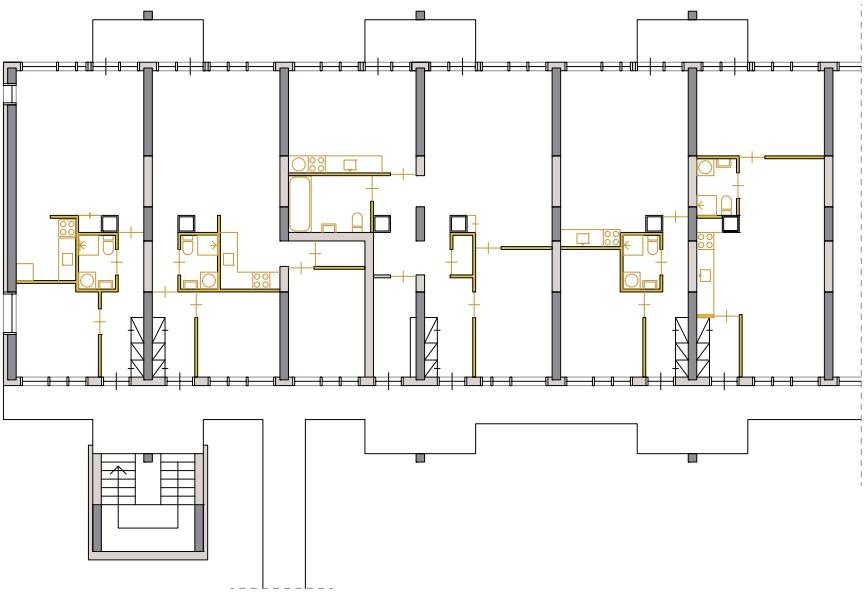


services and ducts: plan and section

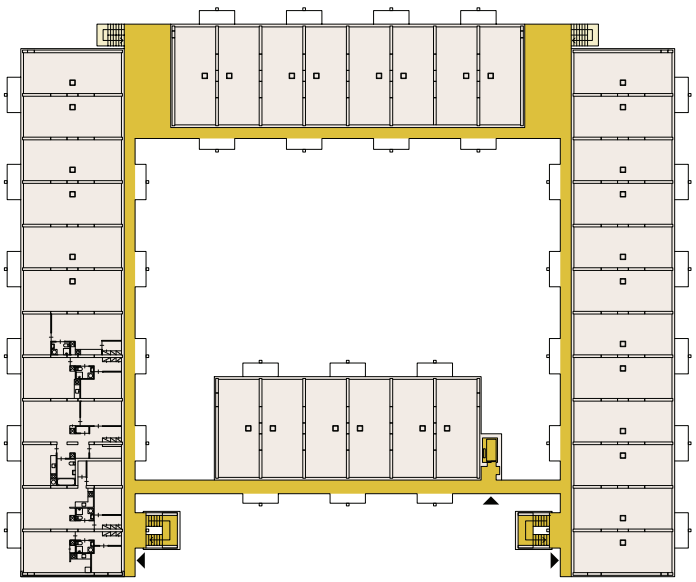
Toilet and bathroom need to be adjacent to a vertical shaft, kitchen adjacent to bathroom, toilet or shaft. Bathroom and toilet have a raised floor (relative to dwelling floor) because of sewage pipes. The freestanding vertical shaft for the ducts is in the middle of the apartments at about one meter distance from the loadbearing wall, so that a kitchen is possible on either side. The space between shaft and loadbearing wall is either corridor or bathroom (see floorplans). All piping and wiring were installed on walls and infill, a special plinth for electrical wiring was used. Each dwelling has an individual central heating with radiators at the façades, the horizontal piping for these is in the 60mm screed, as well as the gutters that connect the wires for the electricity with the meter. For the MIVA dwellings on the ground floor sewage pipes are underneath the floor.



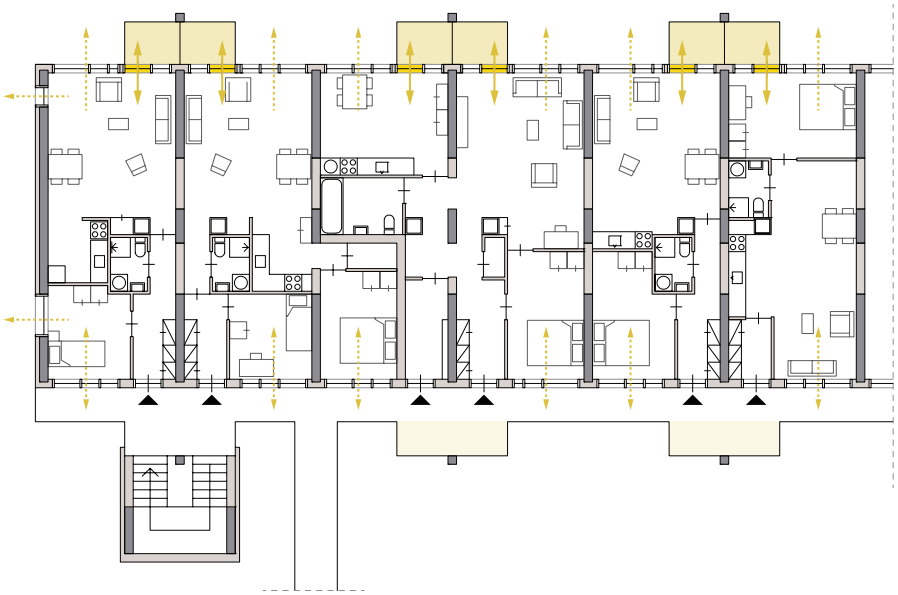
transport of the infill walls and making the bathroom with raised floor



Infill:
The infill packet consists of lightweight interior separation walls and doors, kitchen and bathroom equipment. It was installed after completion of the base structure, most elements could be carried by hand.



Acces:
Access to the apartments is via galleries, two main stairwells and two emergency stairwells and one elevator



Relation indoor-outdoor:

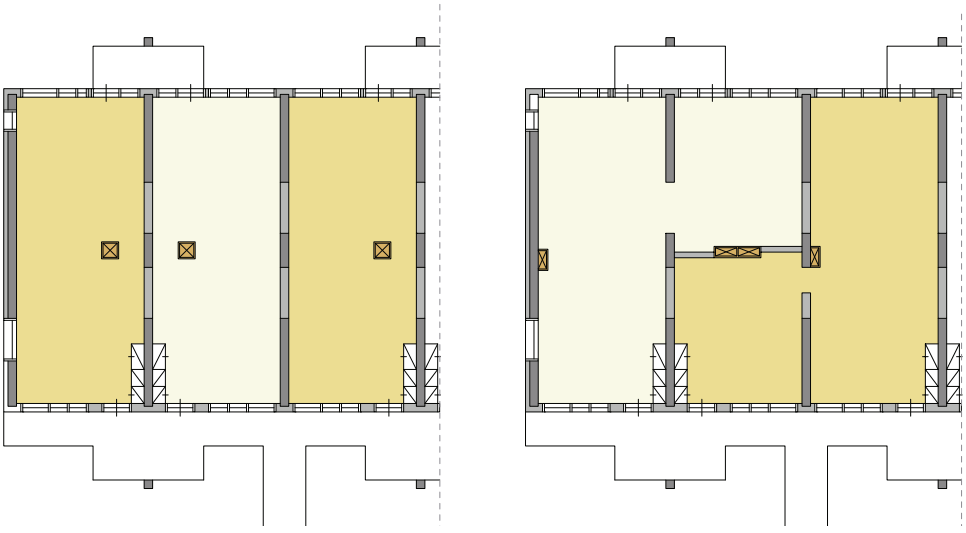
Each apartment has a balcony of 1.5 m deep on one side as well as an extra balcony bordering the gallery (1.2 m deep) so that it is always possible to sit outdoors in the sun.

daylight

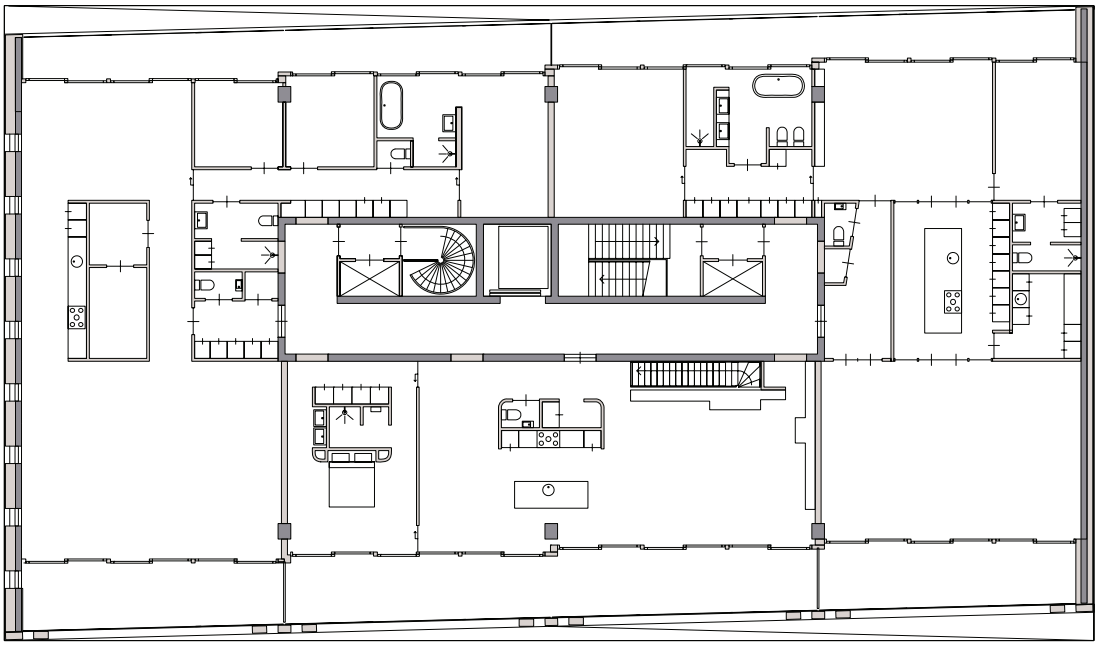
flexibility

The method of Open Building used in this case study is the same as was used in the Molenvliet project. There was user participation to a large extent: residents could even choose the color of their window frame, which led to a grey façade with very bright colored window frames. What is interesting about Keyenburg, and different from Molenvliet, is that here reparcellation did take place. In 2004 the complex was renovated. The small units were combined, from two to one or from three to two units. While this was done a loss of flexibility took place: shafts were replaced and repositioned and the flexible infill became a fixed one.

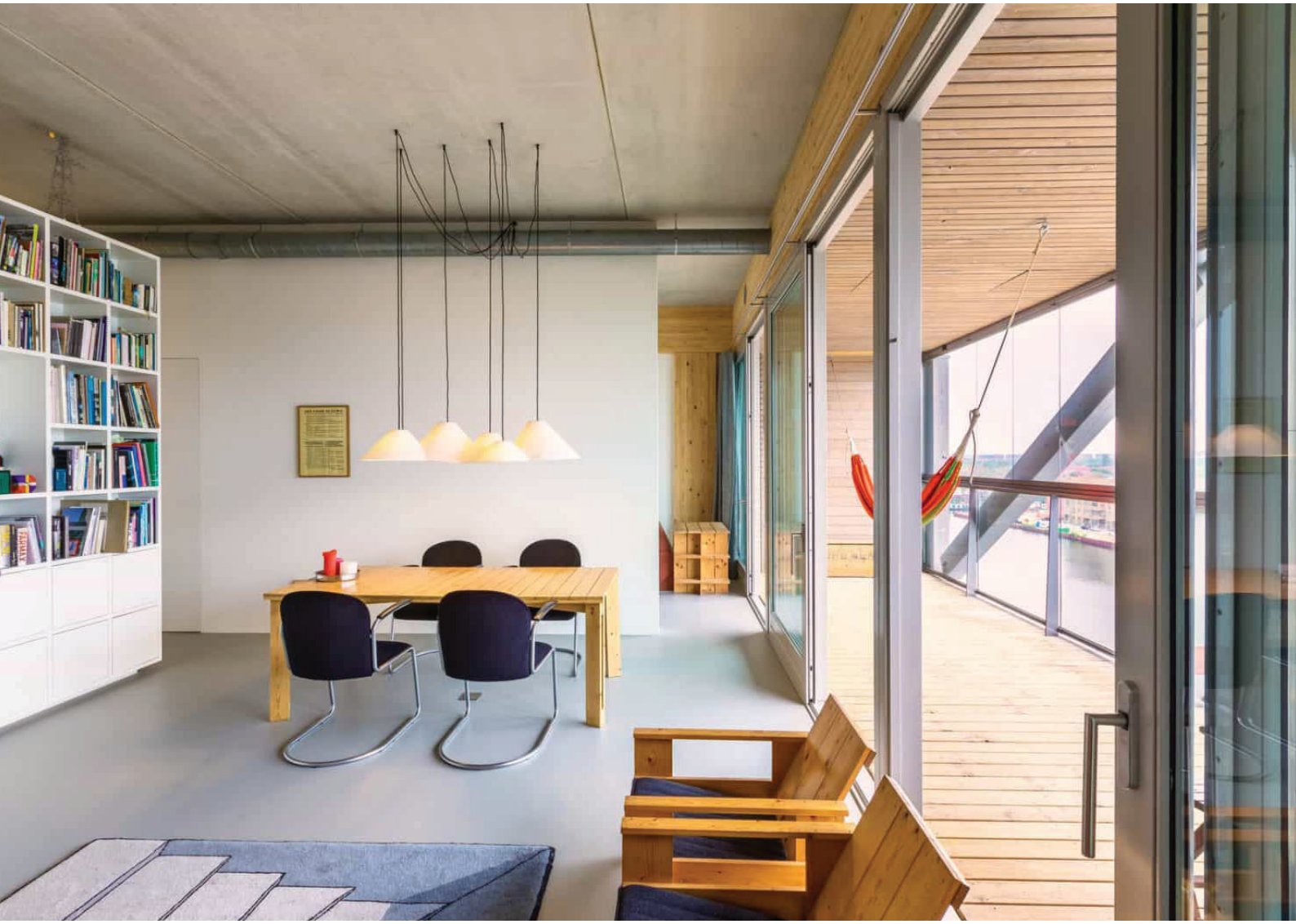
reparcellation from two units to one



reparcellation from three units to two



Patch 22 basic plan



Case study Patch 22

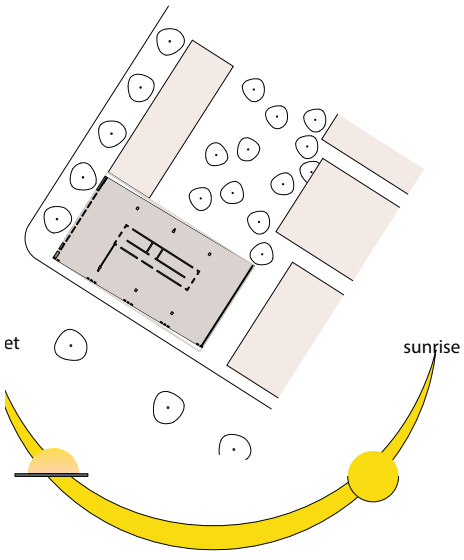
Location	Amsterdam Buiksloterham
Architect(s)	Tom Frantzen (Frantzen et al Architects)
Year	2016

33 living-working units(size varies) and 600 m2 of commercial space

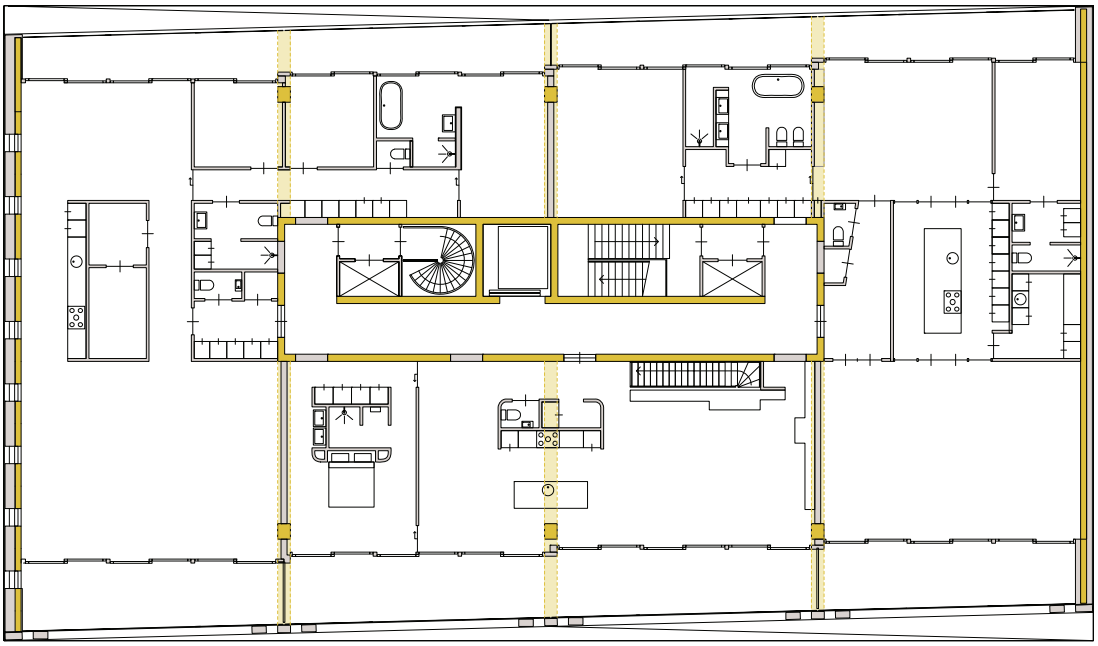
The project started as a tender organised by the municipality of Amsterdam. The plot was given to the developer with the most sustainable building. Frantzen and his partner Claus Oussoren founded Lemniskade Projects (a development company) and won the tender. Buiksloterham was a derelict harbour and industrial area. This project would be the first new built in the area. Frantzen compares the location to a pair of jeans with a hole in it: you can simply mend it with a sewing machine, but you can also patch up the trousers, creating something totally new and nice. In a similar way the whole area can be patched up, that is the idea of Patch 22 (lecture making architecture, 2021). It is one of the highest buildings in Holland with a wooden structure. The top 6 floors look like boxes that are slightly shifted relative to each other, as if the wind has moved them.

Since the building was built during the financial crisis Lemniskade was able to negotiate with the council on a new kind of land lease contract, which included that at least 10% of all apartments consists of office space. This makes the building more flexible, as it is now allowed to change an apartment into office space without further legal procedures. Frantzen states next to architectural and technical issues legal matters are also important when creating a flexible building (lecture making architecture, 2021).

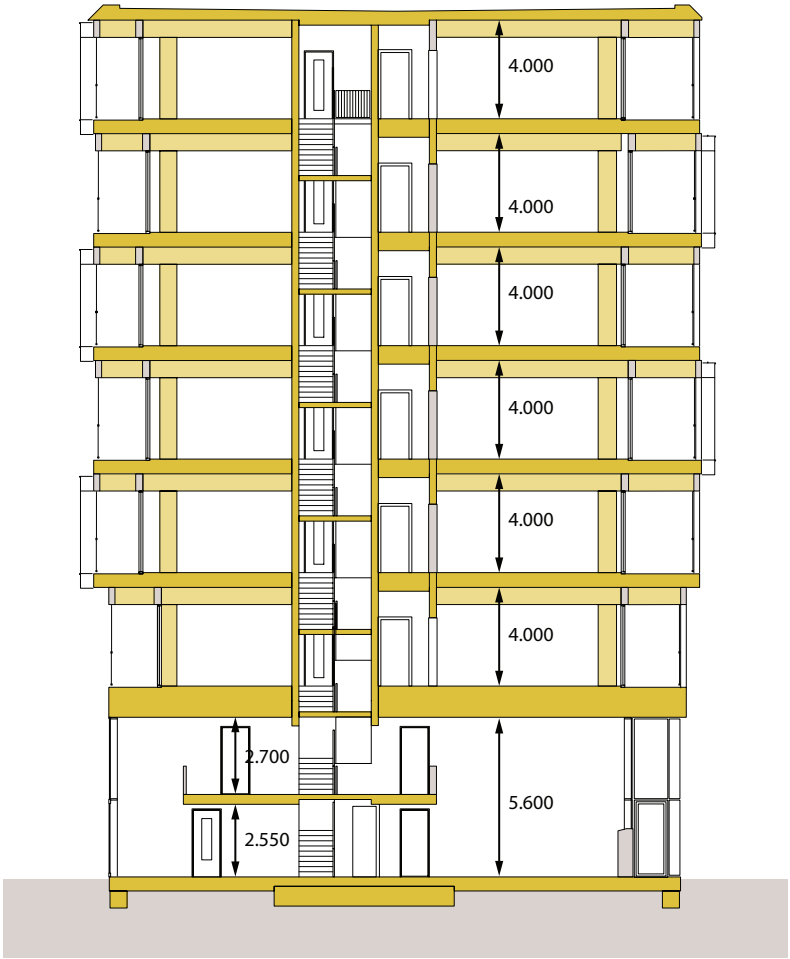
For the case study the 7th floor of the building was analyzed.

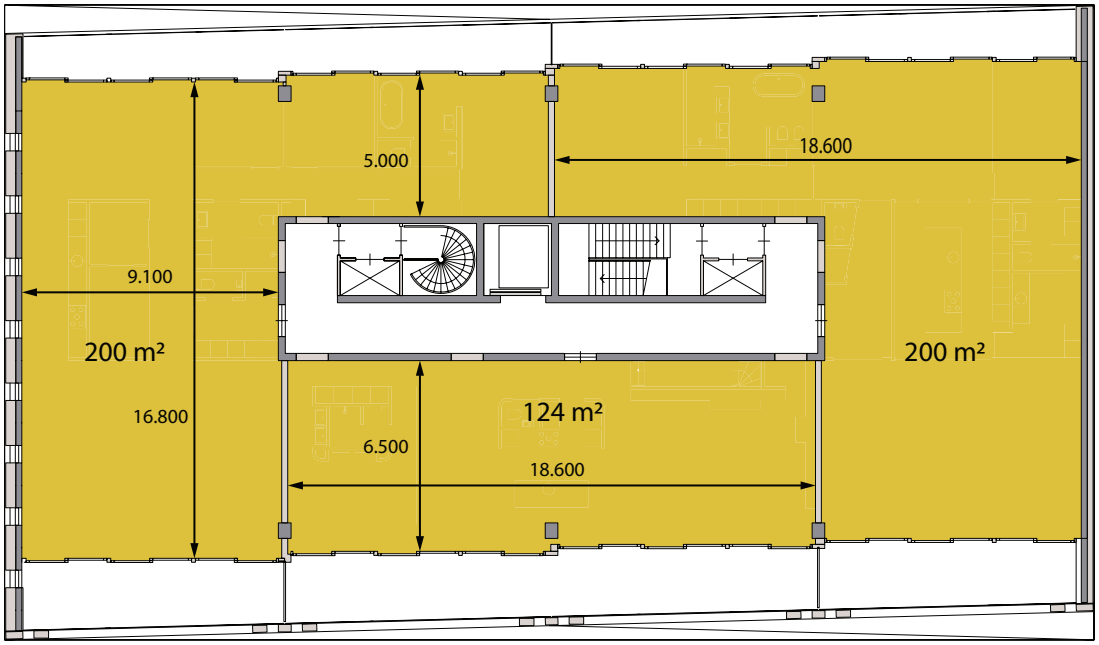


situation



Structure:
The structure consists of a concrete core, wooden columns and beams, combined with a SlimeLine floor: a hollow floor that consists of steel beams and a concrete ceiling. The span width is 9.4 meters.

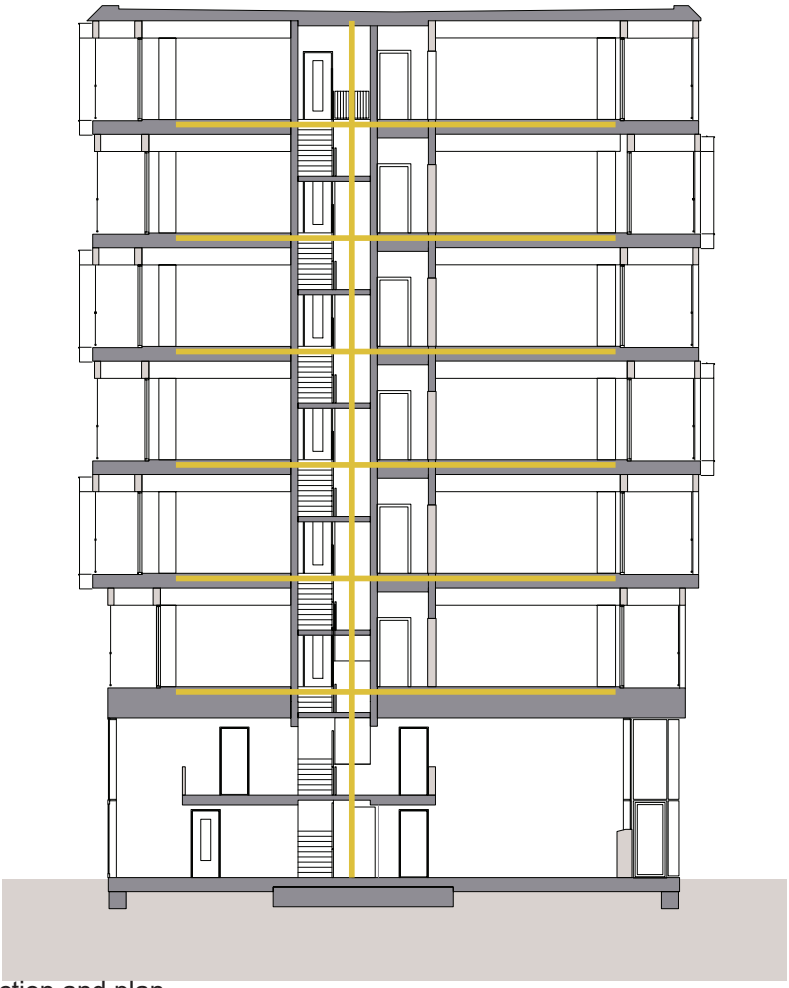




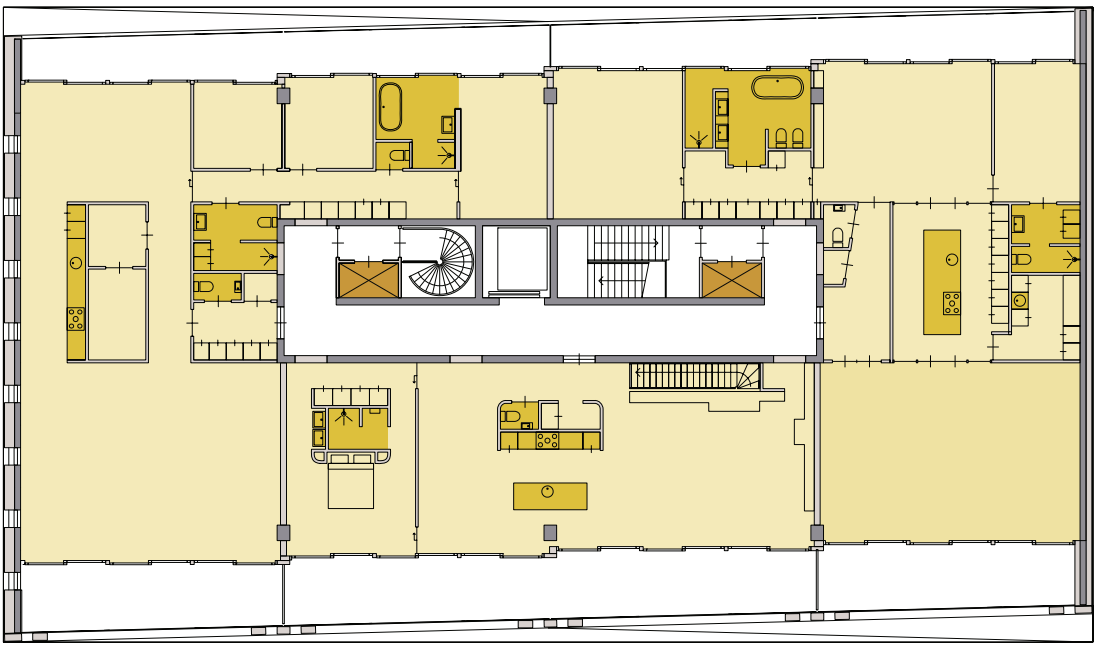
plan: measurements

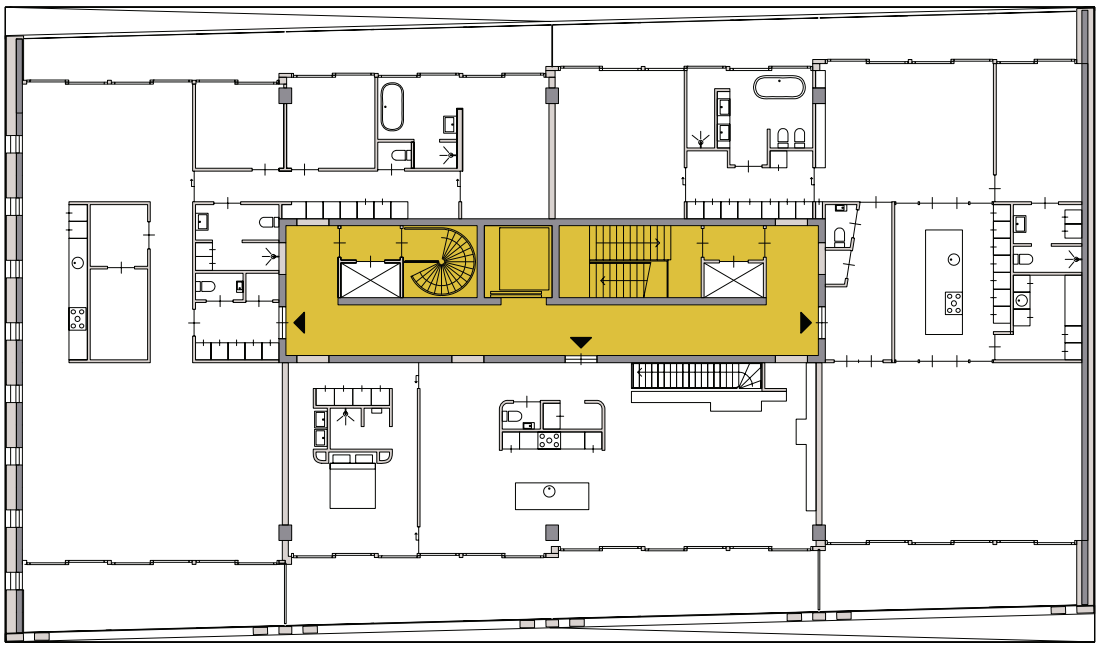
Services:
services such as bathroom, kitchen and toilet can be placed anywhere in the plan, horizontal transport is done underneath the raised floor, which is accessible. Vertical transport goes through two large shafts situated in the core. Floor heating is integrated in the raised floor.

pipes in the floor, before the raised floor is finished



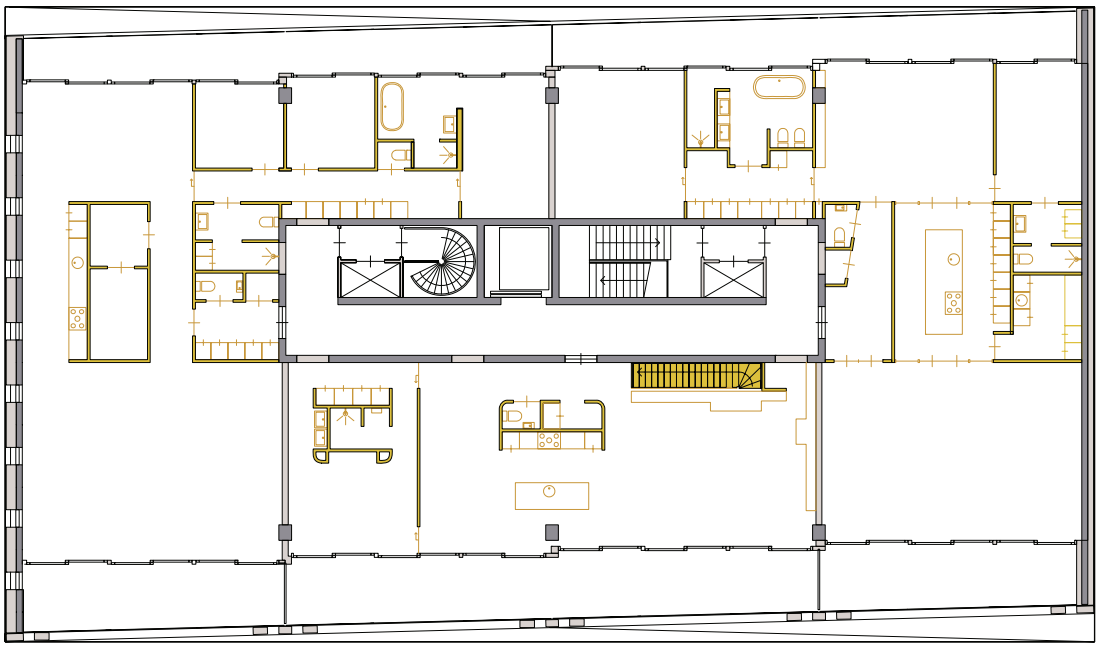
Servicies: section and plan



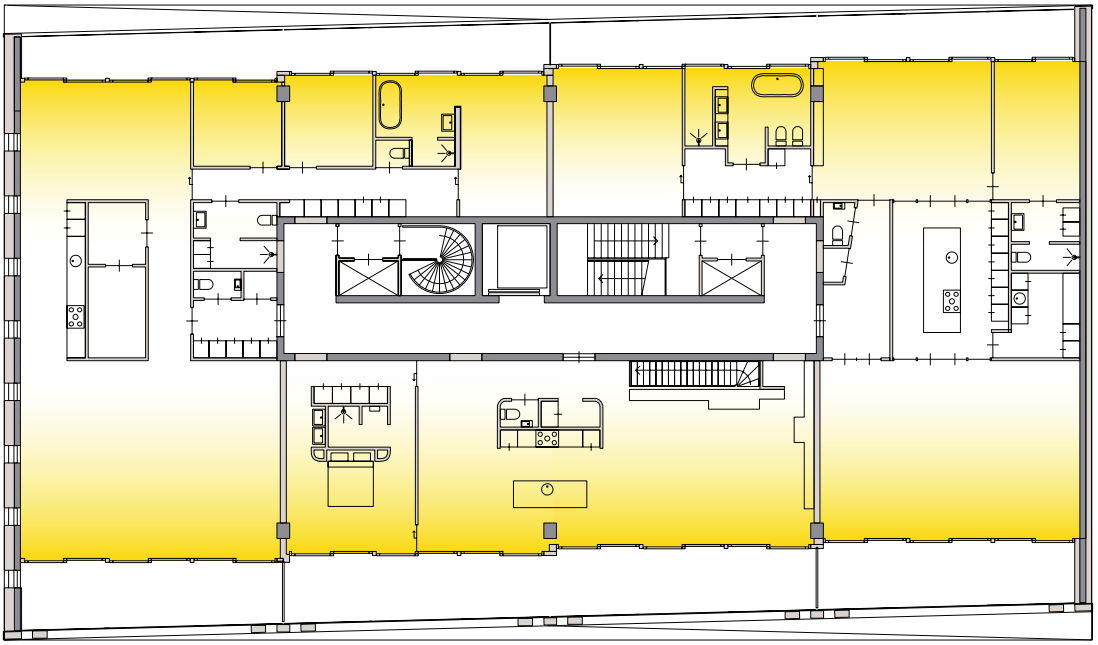


Acces through the central core

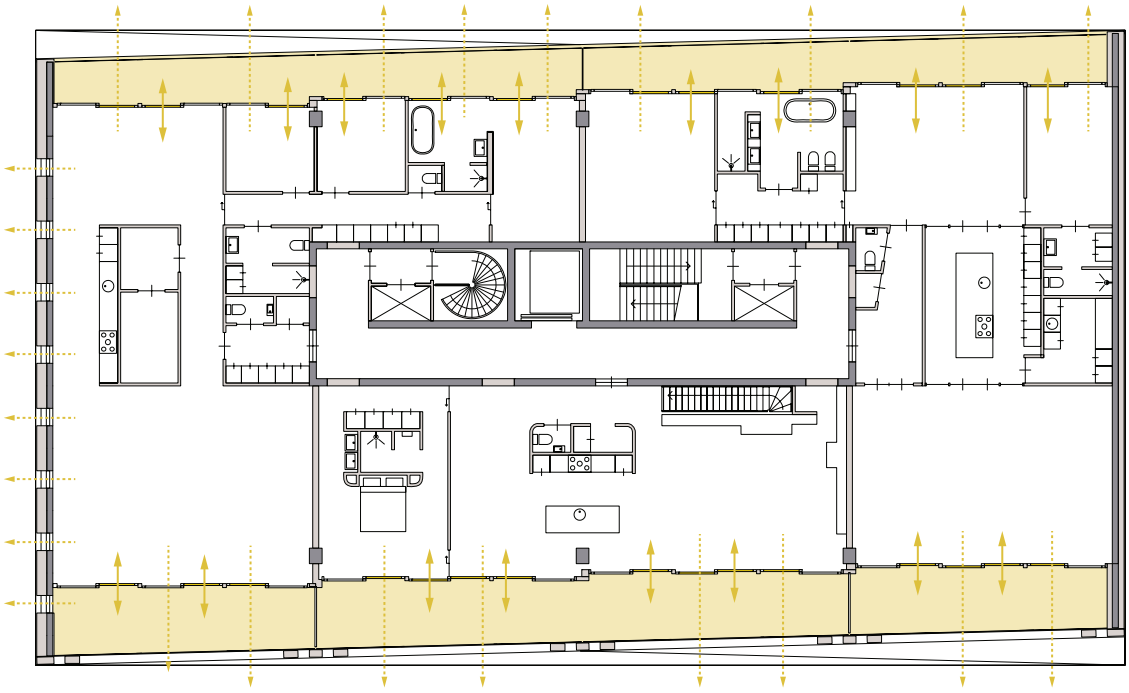
Scenery:
The method used for transport of ducts and pipes gives the residents maximum freedom to create a layout to his wishes and demands, bathrooms and kitchens can be placed anywhere, changes can be made at a later moment. Residents bought a casco apartment without any finishes. The raised floor also had to be installed by residents.



plan for infill



daylight

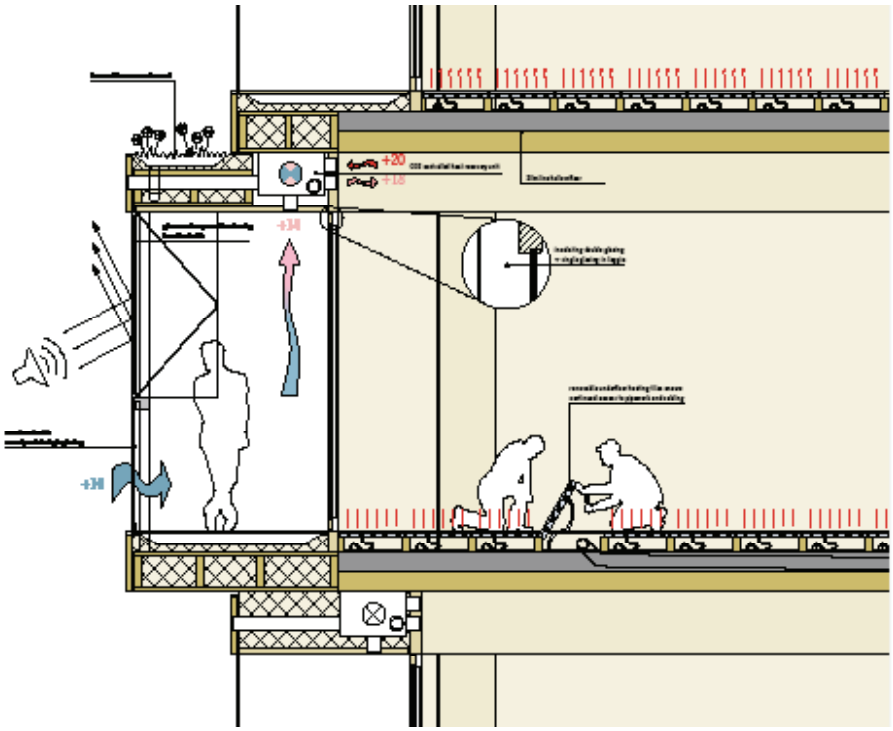


relation inside - outside, each apartment has a balcony with sliding glass that can protect from wind

sustainability and circularity and flexibility

The architect tried to use as much wood as possible in order to reach the goal of creating the most sustainable building. This resulted in a structure with wooden beams and columns. Furthermore the building has wooden cladding and a number of technical facilities that enhance sustainability such as solar panels, pellet heaters, heat exchangers and a rainwater basin.

The use of the SlimeLine floor allows for a flexible floorplan. It is even possible to place a bathtub on the balcony. Disadvantage of this concept is that a Slimline floor has a high percentage of steel and is a rather expensive solution. After the installation of all the ducts a top floor that includes floor heating is added. This allows for a flexible floorplan, bathroom and kitchens can be placed anywhere in the plan, the layout can be changed if needed. Each floor is divided into 8 legal units. Units can be combined into a larger apartment, one of the apartments is a combination of units on different floors. The wall dividing two apartments is not loadbearing, so two apartments can easily be combined at a later stage, for instance if one of the users wants to expand.



section explaining installations and the floor concept, drawing by the architect

Case study Superloft Houthavens

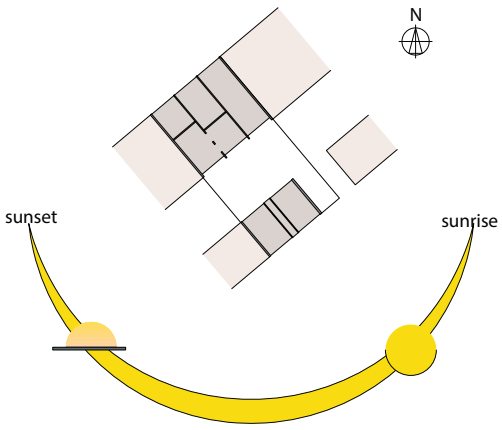
Location	Amsterdam Houthavens
Architect(s)	Marc Koehler Architects
Year	2016

19 residential units(size varies)

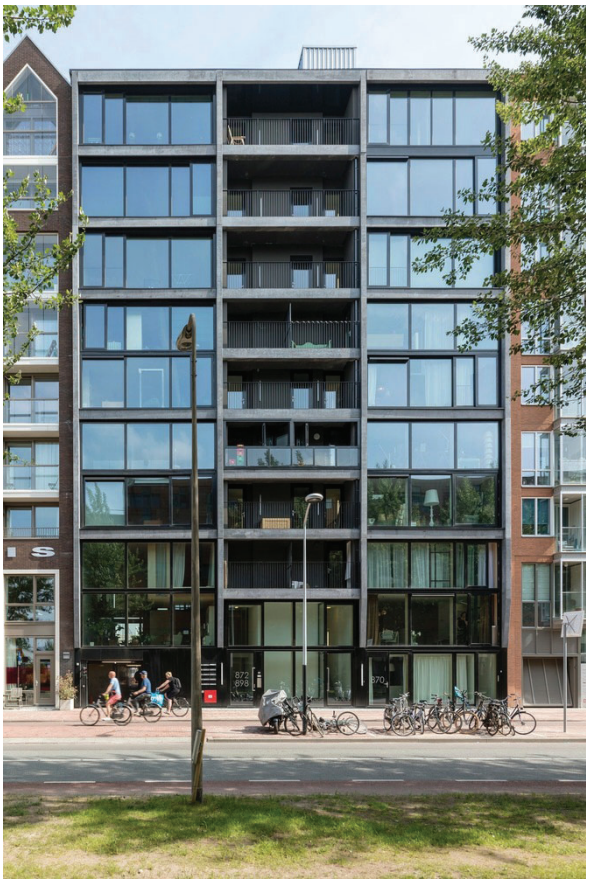
Superloft is a concept developed by architect Marc Koehler and has been realized in several places. Projects are developed together with future residents. A superloft is 6 meters high casco loft, residents have to take care of the infill. This gives them the opportunity to create their own atmosphere and the possibility to make changes if needed. In each project the concept is adapted to the situation, however the goal is always to design a sustainable and circular building.

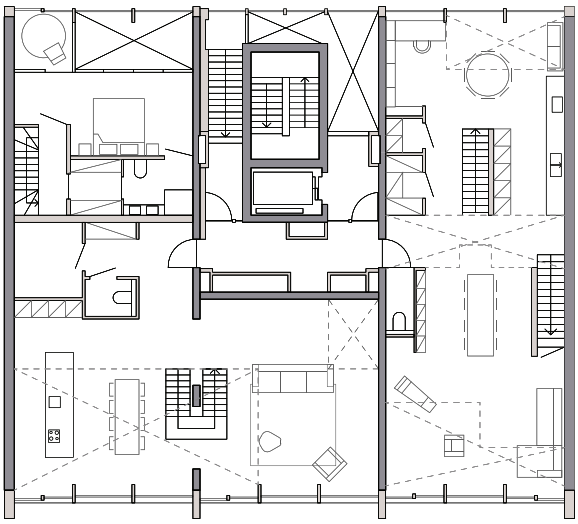
Superloft Houthavens comprises 14 lofts, they are privately owned, the project was realized as a so-called collective private ownership, which means that future owners form a collective that is the client of the contractor.

The project Houthavens plot 4 consists of three layers of superlofts with three layers of apartments on top. There is a central stairwell that gives access to the lofts and apartments. Each floor is divided into five legal units, units can be combined into a larger loft. The bathrooms of the lofts are situated next to the core, above the hallway that gives access to the lofts. Mezzanines can be added to the loft to increase floorspace (and reach the bathroom).

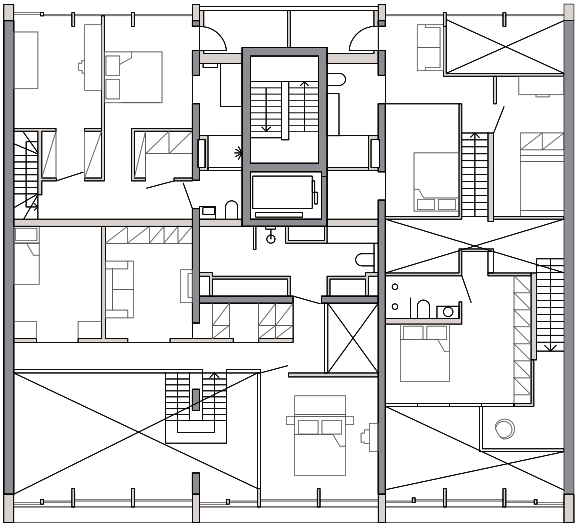


situation

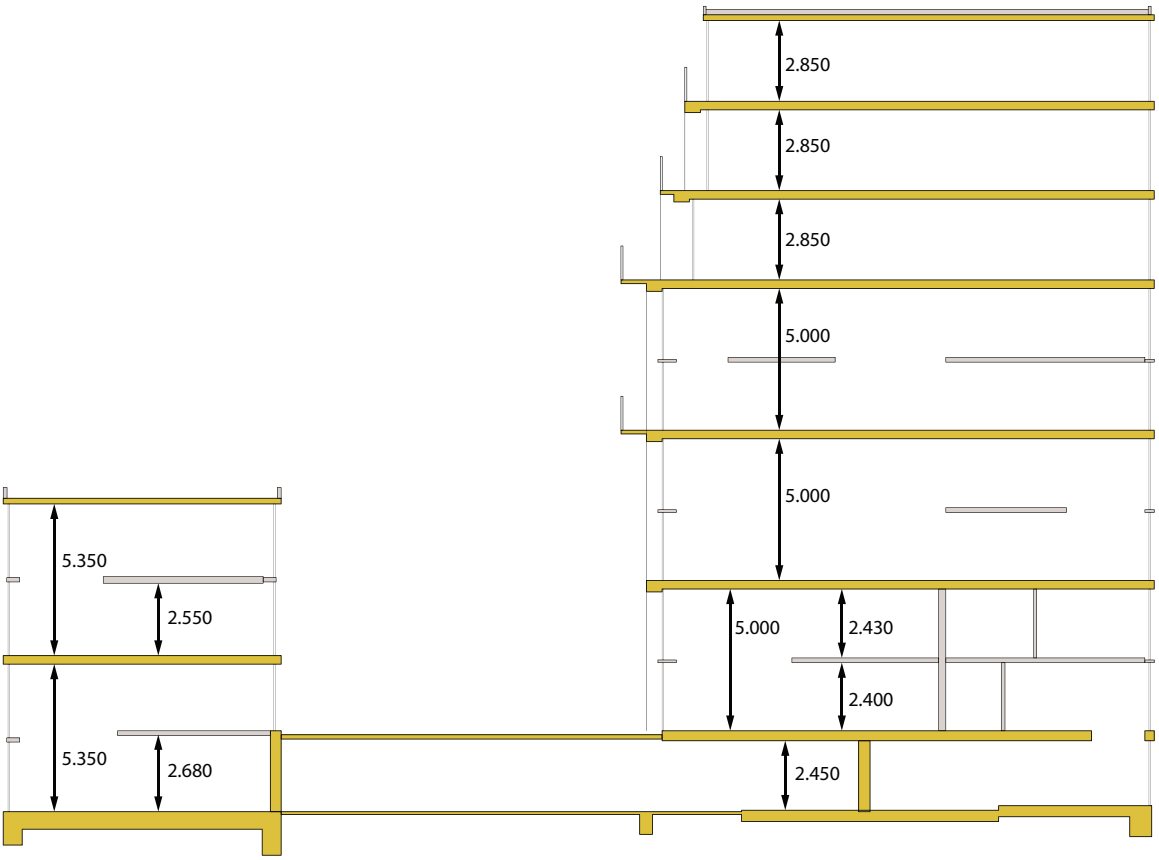




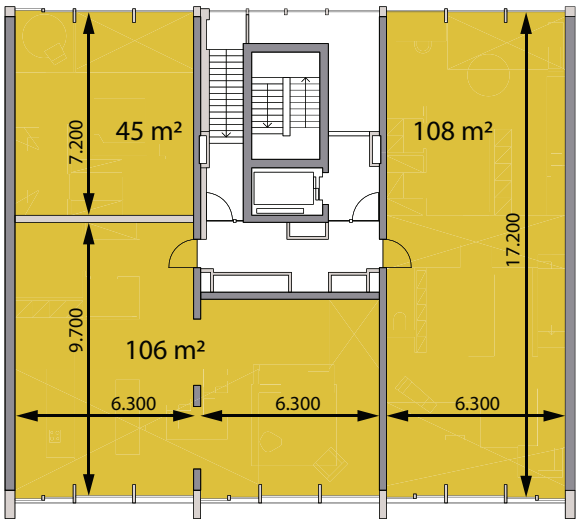
basic plan loft entrance level

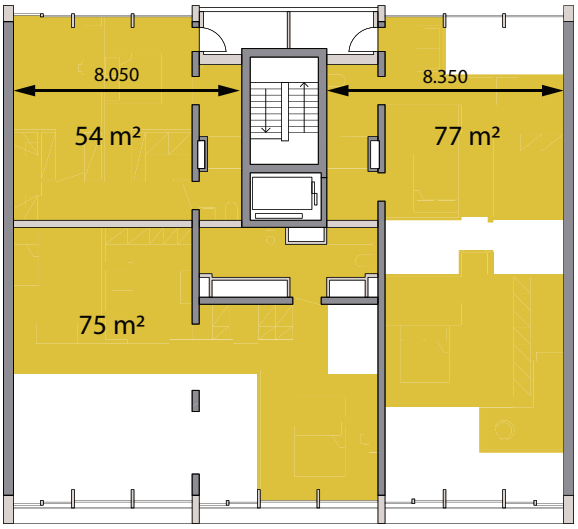


basic plan loft mezzanine level



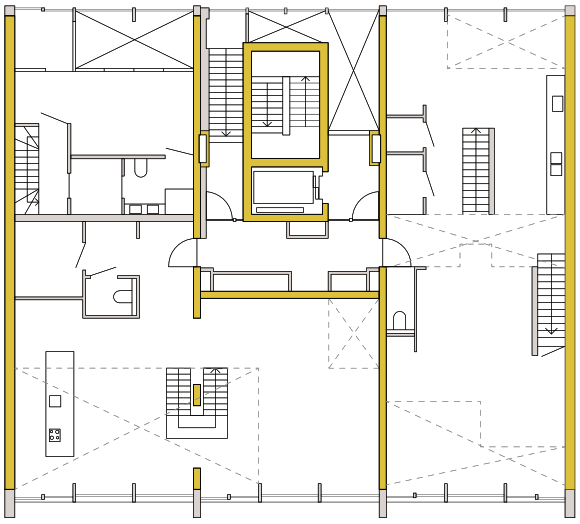
section: structure an measurements

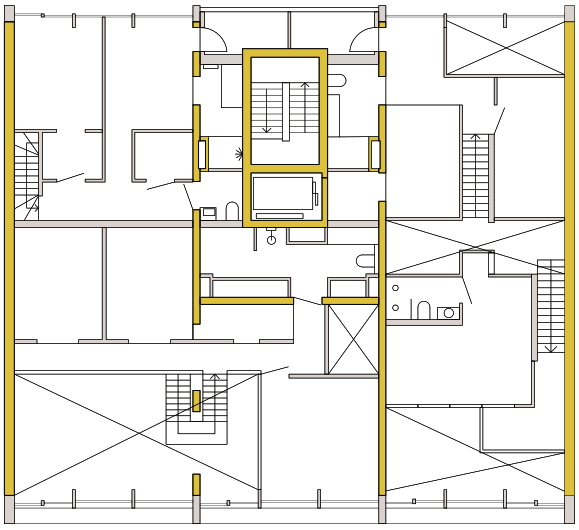




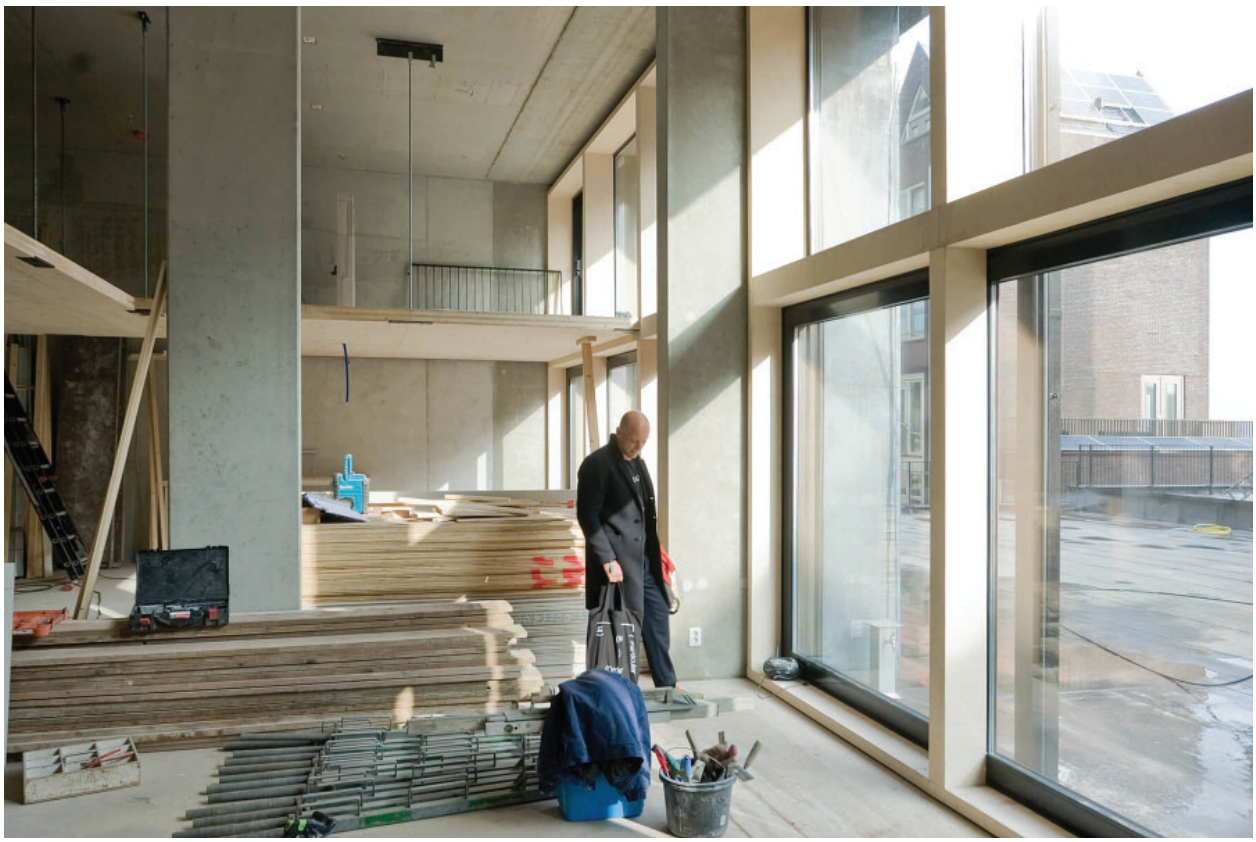
measurements

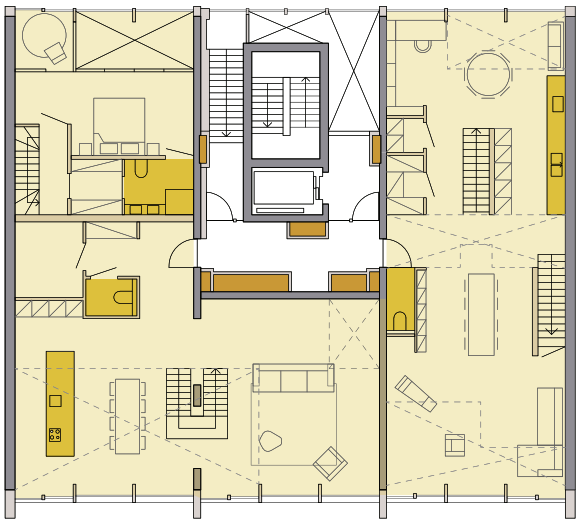
Structure: cast concrete, loadbearing walls and core, the span width is 6.6 meters, the depth of the block in total is 18 meters.

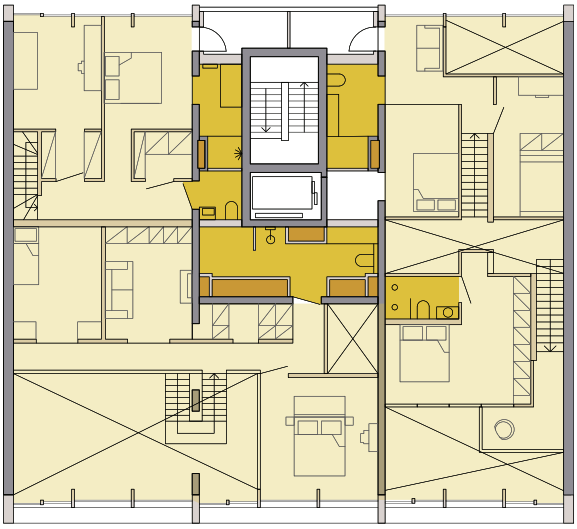




plan: structure

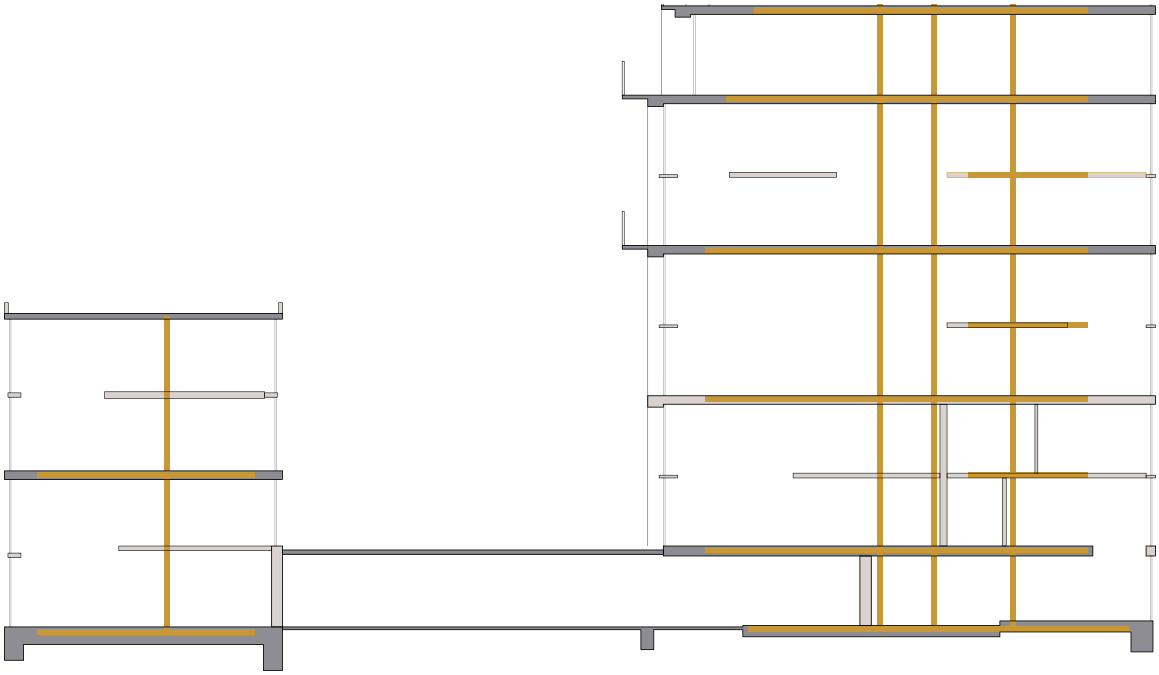




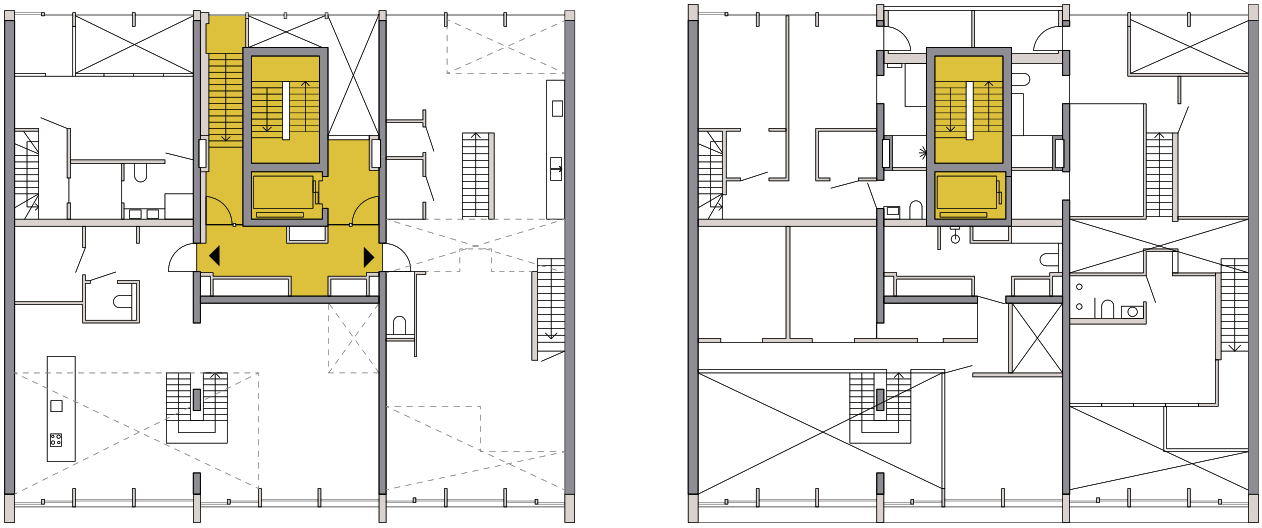


plan: services

Servicies:
bathrooms have a fixed place, vertical ducts are in the area of the bathrooms, near the core, horizontal transport of pipes is integrated in the floor

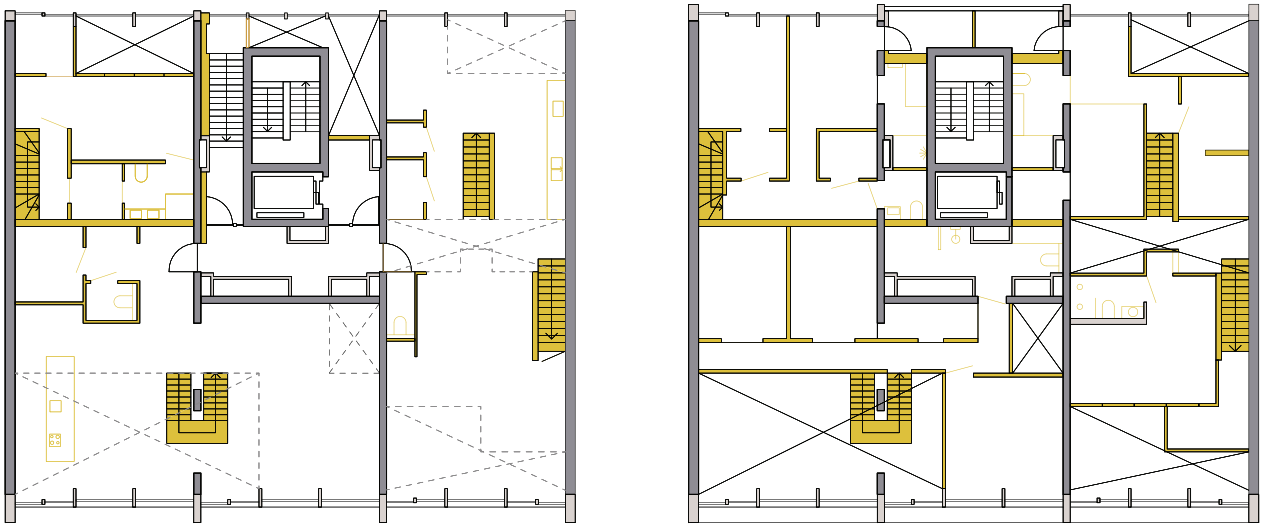


section: services

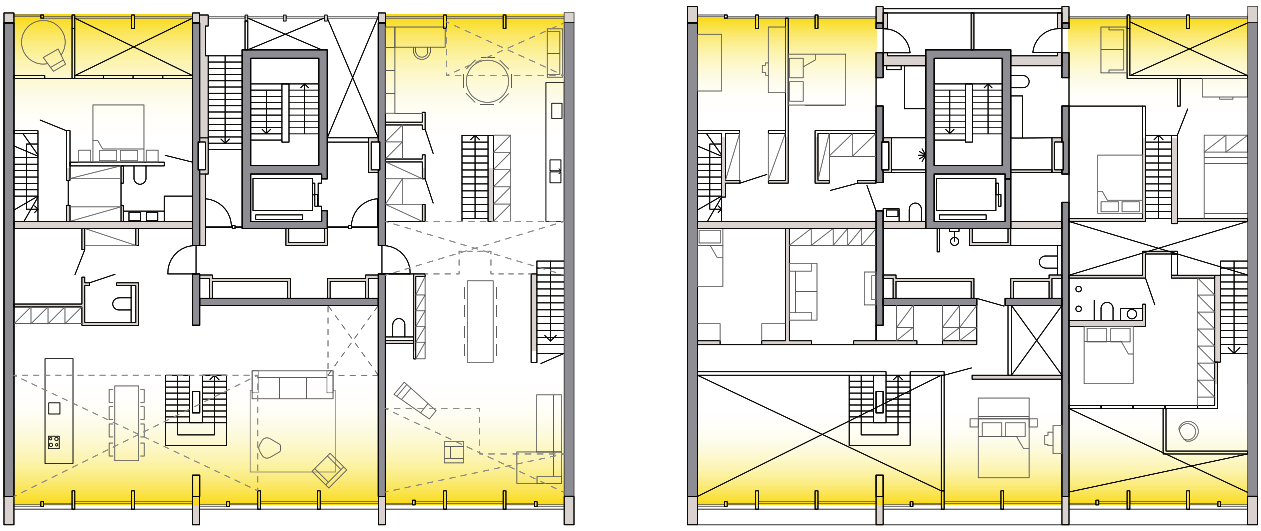


Access through central stairwell and hallway

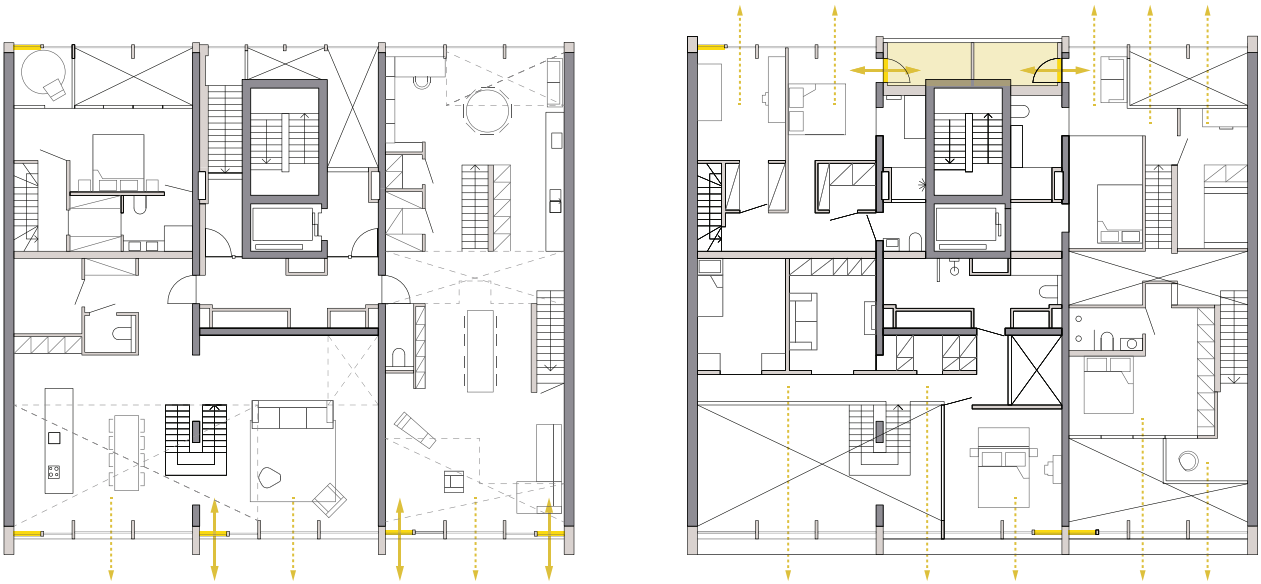
Scenery (infill):
Lofts are bought as casco apartment, infill is done by the residents, including the mezzanine



Infill



daylight



relation inside outside: outdoor space (balcony, top), entrance to garden (bottom) and visual relations

flexibility

Each floor of the building is divided into units, the building was not made with the idea of combining or dividing units after completion. Joining two apartments could be done but is difficult since it means breaking through a loadbearing wall. The flexibility of this project lies within the individual lofts. Residents can make their own layout and make changes if, for instance, their life situation changes. However, the horizontal pipes are in the floor, so relocating services is not very simple. Bathrooms are on a fixed place, near the vertical shafts. The height of the loft is only five meters, which means that in case of mezzanine there is only a floor to ceiling height of 2.40 m left.

Comparison and conclusions case studies

Similar to the description and analysis of the case studies the comparison follows the five aspects or categories that Leupen (Leupen, 2006) defined: structure, skin, scenery, access and services. As an extra the role of the user, the architect and the method of initializing and financing will be discussed.

structure

In these case studies three structural types were used:
1. concrete loadbearing walls with a concrete core for stability and concrete floors (Superlofts)
2. concrete loadbearing walls combined with fontanelle walls and concrete floors (Molenvliet/Keyenburg)
3. wooden skeleton structure, concrete core and slimline floors (Patch 22)

The choice for a structural type and the size of the span width has a large influence on how open building can be realised. All three types of structure offer freedom of infill for the users. The difference lies in whether, and how easily units can be combined or split. Here the column and beam structure of Patch 22 gives the most possibilities. In the Keyenburg and Molenvliet projects repartitioning is also possible through the fontanelle walls. In case of Superlofts combination or splitting of two units is still possible but requires more effort because of the loadbearing walls.
Bay width also influences the possible use of the building. The partitioning of the building or complex in units usually follows the structural system, so a larger bay width means larger the units, creating more room for flexibility on one hand but on the other hand making it more expensive and maybe unaffordable to groups of people. There is quite a large difference between the two case studies from the eighties that have a bay width of 4.8 meters and the more recent case studies who have a bay width of 6.6 meters (Superlofts) and 9.4 meters (Patch22). This goes hand in hand with the difference in size of the apartments.

skin

In most of the case studies the skin is not part of the structure, which offers flexibility because it could be modified or replaced. However, replacing a façade is a very costly exercise which will probably only be done in case of a large-scale renovation. In the Molenvliet project all loadbearing walls are in the same direction so it is likely (though no source was found) that some of the façade plays a role in the stability of the structure.
Even though the skin could be seen as part of the infill, user participation is uncommon regarding the façade. The image of the building is determined by the architect. There is, however, a difference between the older case studies, where users were allowed to choose from a series of colours or predefined window frames, and the recent case studies, where the whole of the façade is designed by the architect.

scenery

All case studies offer freedom of infill to the users, limitations in the freedom of infill concern the freedom of the placement of services, such as kitchen and bathroom. The loft concept offers extra freedom of infill because of the height of the space, offering the opportunity to make voids, which may create interesting interior views and a connection between levels. A difference between the older and newer case studies is the quality level of the infill, which may be explained by the fact that the older case studies concern social housing, and the newer ones are privately owned.

access

In his book Habraken writes about long winding ribbons of building blocks with freestanding vertical access towers. Horizontal access of dwellings takes place by way of galleries. Although they are not long window ribbons the gallery access is applied in both Molenvliet and Keyenburg. The nice thing of a gallery access is that it can be a meeting place, the disadvantage is people walking in front of your window. Nowadays gallery access is less popular, individuality is more important, and people are more attached to their privacy. The recent projects have access through a central core. This type of access is also more comfortable (warm/sheltered entrance). The consequence for Patch 22 and Superloft is that part of the apartments only has a façade on one side of the building, which limits view and sunlight.

services and ducts

The case studies show that the placement of ducts and shafts and the method of horizontal transport of sewage pipes has a huge influence on the freedom of placing services and the possibility of changing the layout. Three types of transport of pipes can be distinguished:

1. In Superlofts ducts and pipes are integrated in the concrete floor (as well as heating). The bathroom has a fixed position. The placement of the kitchen can be done at any place, but making changes means damaging and refixing the floor.
2. Patch 22 offers the most freedom of placing services and making changes to it by using the Slimline hollow floor. Ducts are accessible and changes can be made. The consequence is a large floor height because sewage pipes have large diameters and need a certain slope. In Patch 22 the maximum distance between an appliance and the central shaft is 14 meters. If one wants to use this method a clever positioning of the vertical ducts is handy. An extra advantage of the method used here is that the shaft is easily accessible.
3. Molenvliet and Keyenburg both have a partially raised floor, where the bathroom is located. This limits the position of the bathroom (next to the vertical shaft) and the kitchen (next to shaft or bathroom). An evaluation of the Keyenburg project showed that the raised floor was felt as a disadvantage by many of the residents (Carp, 1985). In this system the position of the shaft needs to be done carefully, it may limit changes in future. In the case of Keyenburg the shaft was repositioned when the complex was renovated, apparently the shaft was felt to be in the wrong place.

user, architect, initiator and finances

A striking difference between then and now is the involvement of the user and the way the building project is initiated. In the case of Molenvliet and Keyenburg the building project was initiated by the housing association that took care of commissioning an architect and a contractor. A design was made for the support and as soon as future residents were known a division of the available units was made. In the case of Patch 22 and Superlofts the initiator of the project is the architect/project developer who knows that there are groups of people who would like more personal input in realizing their own home and are willing to do an extra investment for this. He then goes in search of these future residents; they form a collective who commissions the architect/project developer to design the support. This way of working is called a Collective Private Ownership. In this case a division of the dwelling units is also made before building starts.

The difference in initiative goes hand in hand with a difference in financing the project. As was mentioned before, in the 1970's and 1980's 90% of the housing production was subsidized and a large part of it was social housing. Furthermore, in 1968 a special renewal program for housing was initiated by the minister responsible for housing, called the 'programma Experimentele Woningbouw' (experimental housing program). It was set up as a response to the monotonous expansion districts realized in the 1960's. Experimental building projects (all sorts of experiments,

not only open building) could receive a onetime subsidy for the extra investments. These are necessary because there is a price tag on flexible building: raised floor, accessible shafts, fontanelle walls are all things that are more expensive than traditional building methods with integrated pipes and ducts. Since nowadays building is hardly subsidized by the government and housing associations are pushed to build as economical as possible there is no room for extra investments here. These two things explain why Open Building then involved mostly social housing and is now only private ownership.

This difference in initiative and financing has a distinct influence on the resulting building. The first thing that can be observed is the scale difference. Molenvliet and Keyenburg are both projects for mass housing. The concept of Open Building was originally conceived for mass housing. Patch 22 and Superloft are privately initiated projects with for a smaller group of residents. Secondly the average size of the dwellings is considerably larger in the case of private ownership. Clients who are willing to make an extra investment usually want larger dwellings. A sidenote here is that the Keyenburg apartments are naturally smaller since they were only intended for one and two person households. Furthermore, there is a distinction in the way the infill is realized. In Molenvliet and Keyenburg future residents had two consultations with the architect or infill coordinator to discuss his wishes, after which a plan for the infill is made, which is then executed by the contractor or a third party. Residents all have the same infill system, which has been chosen by the building team (Van der Werf, 1993). In the PCO projects the infill for the dwellings is entirely left up to the residents; they can commission the architect who designed the support, do it themselves or find another party to finish the dwelling. This can result in a large variation of interiors which is visible in two interiors from Patch 22.

Recent projects are not only initiated in a different manner, the role of the architect in these cases is different as well. In both cases the architect is also a project developer, which means he not only designs but also has a financial interest in the project. Tom Frantzen stated that being an architect is merely a hobby, he makes his money by being a project developer (lecture Frantzen, 2021). Although this entanglement of architect and project developer is the case in these two case studies there are also projects with collective private ownership where that is not the case, for example the Shetsblok project in Amsterdam that was initialized by a foundation of future buyers (Kendall et al., 2022).

conclusions

An overall conclusion that can be drawn from the case studies is that the appearance and method of Open Building have changed. The differences between open building then and now can be explained as a result of changes in society as well as technical changes. The modern user has a different way dwelling, with different preferences, in the case studies this is for instance visible in the different types of access. The loft concept is a concept that is nowadays very fashionable but was hardly ever applied fifty years ago. User demands have also increased: where users in the seventies and eighties were not happy with a level difference between the bathroom floor and the rest of the dwelling, we see that nowadays this is no longer accepted.

Technical innovations such as the Slimline floor can also improve the transport of horizontal pipes; at the time of building Keyenburg and Molenvliet this type of floor was not available. Innovations are also visible in modern infill systems which can provide a higher level of quality.

The comparison of case studies shows that all aspects of the analysis (structure, skin, scenery, services and access) influence the flexibility of the building and that in each of these aspects there is a difference between open building in the past and recent projects. Of these five aspects the difference is most apparent when it comes to services and ducts. The vertical shaft positioned in the floorplan is something that is not seen in recent projects and was removed in the Keyenburg project.

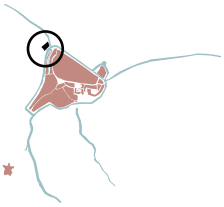
Changes in society also led to changes in the initiative, finances and the building process of an open building, leading eventually to projects that have a smaller scale, but on average with larger dwellings. From this we may conclude that the purpose of Open Building has changed. The concept of Open Building conceived by John Habraken was intended for mass housing. The idea was to give everybody the possibility to have an influence on their own home. In recent Open Building project that is not the case. There is no mass housing, and it is unlikely that it is reachable for people with a small income. This is not intentionally done; it is the consequence of the way building is organized and financed nowadays. The assumption made in the introduction to the research that Open Building changed from mass housing into something for the more privileged proved to be correct.

strategies to use for the design

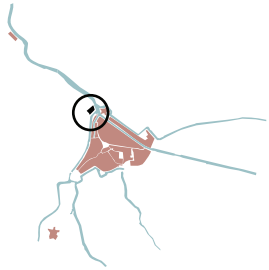
The case studies show that the main reason for the lack of social housing in recent Open Building projects does not lie within the scope of architecture, the architect or building in itself. This sort of frustrates the research question. It may be possible to make an Open Building design, it is unlikely such a design will be realized. The financial issue is always a difficult one for an architecture student. We lack knowledge of the cost aspects and do not have the possibility to discuss the financial consequences of choices we make. There is no building team with experts and contractors to give feedback on these matters. Therefore, although I am aware of these financing and cost aspects, I choose not to include these in my choices for the design of the building. Choices will be based on the best possible solution, knowing that these may be different in a real case.

For the structure of the design, I choose to use a column and beam structure like the Patch 22 structure. The reason for this is that it offers more possibilities to distribute units between future users and gives the possibility of changing this distribution at a later moment. For the transport of ducts, pipes and wiring I also choose the Patch 22 concept of a raised floor. I assume this will be a Slimline floor, but it may also be a different system of a raised floor as long as it offers enough room for the transport and the slope of pipes. This concept offers a maximum of freedom of infill. Where the distribution of units is concerned I would like to make a design which can include small, as well as larger units, in order to accommodate the widest possible range of residents.

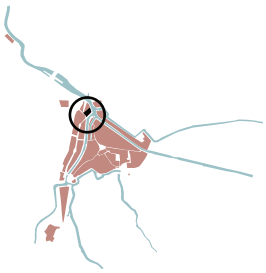
Design Urban Layout



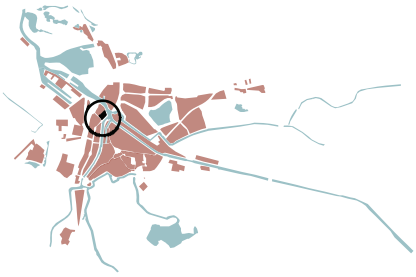
1588



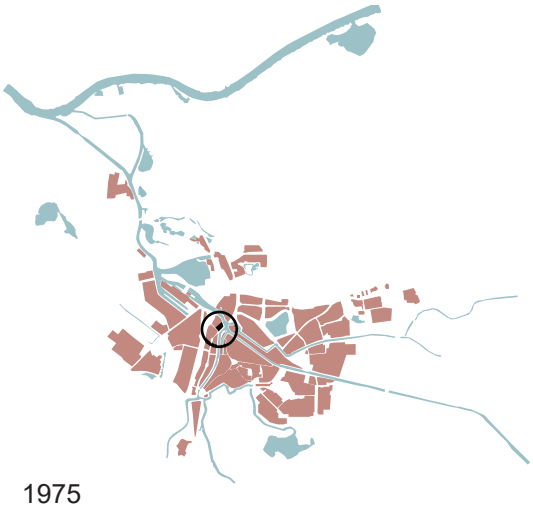
1861



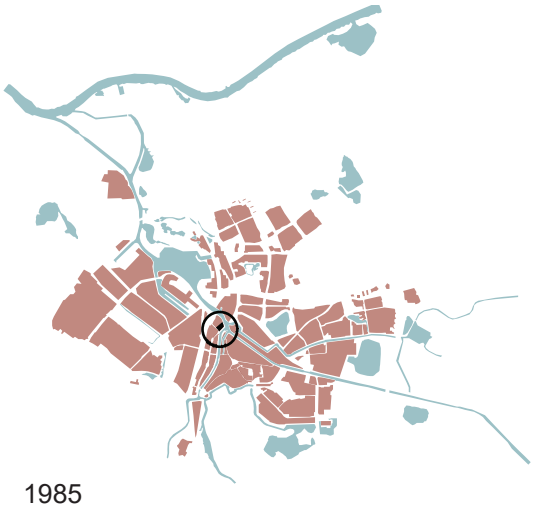
1935



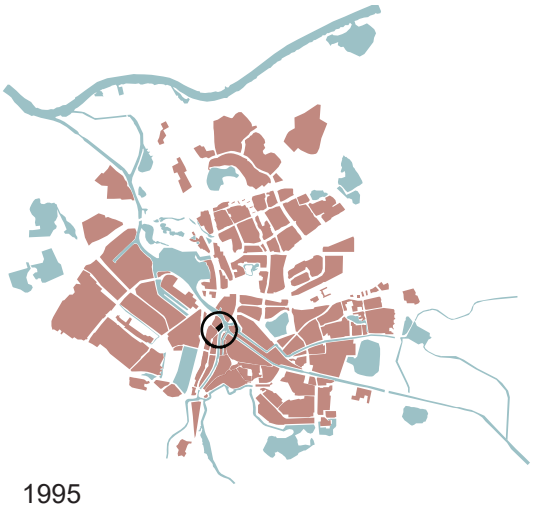
1960



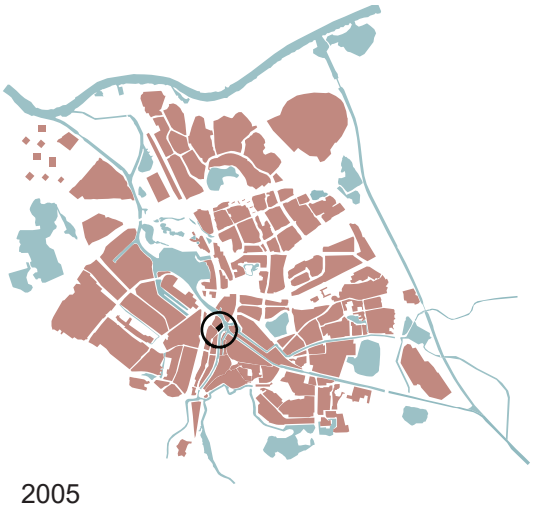
1975



1985



1995



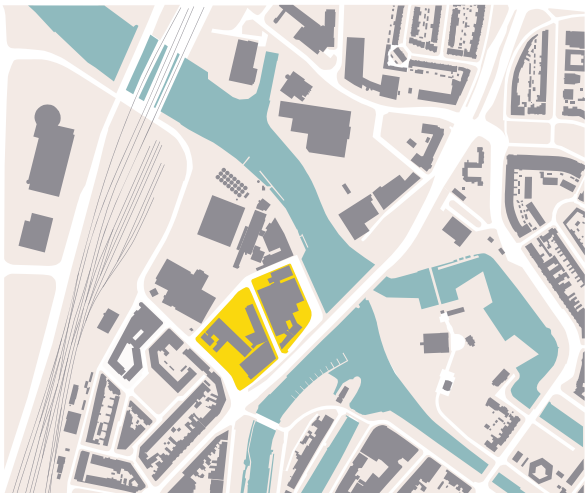
2005

historical development of the city

History and site analysis

The site chosen for the design is the 'Kop van 't Zand' area, located in Den Bosch. It is an area close to the inner city, that needs to be redeveloped.

The site in the city



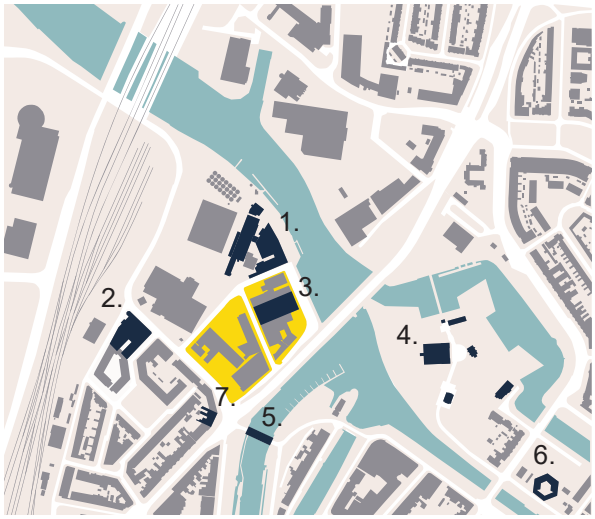
Current situation of the site

Den Bosch was founded in 1185 by prince Hendrik I of Brabant who owned an estate called Orthen (now the name of the north part of Den Bosch). The city was built on sandbanks near the meeting of the rivers Aa and Dommel. Ramparts were built to keep the water of the swampy surroundings outside the city. The name of the city, 's Hertogenbosch, means: the duke's wood. When the city started to thrive the city walls were moved outward, this was done three times. In the 14th and 15th century Den Bosch was one of the largest cities of Holland. It was also important for its cultural role. In the 13th century a Latin school was founded, and culture was also promoted through the many monasteries.

Water plays an important role in the city's history. Because the surrounding landscape was so wet inundation was used as a defence strategy. In 1629 however Frederik Hendrik succeeded in occupying the city through the reclamation of the area, after which trenches could be dug and the city could be besieged. In 1637 he built the fort Willem Maria. Frederik Hendrik was a protestant and oppressed the Roman Catholic religion, which was most common in this area. In 1794 the French invaded Den Bosch and this was felt as a liberation, since now there was again freedom of religion. The city started to thrive once more and in 1800 the canal of the Zuid-Willemsvaart was dug. It was only in 1874 when the fortress status of the city was lifted, and it became possible to build outside of the city walls.

sand is poured for the new district

the Mill building in former times



Monuments:

1. former Koudijs/de Heus factory
2. former Willem II cigar factory, now music venues and studios
3. former iron foundry Dufay and Son
4. fort Willem Maria, built in 1637, also known as the citadel, now houses the provinces historical information centre
5. bridge near Brugplein, connection to the inner city
6. powder house
7. a number of houses at the Brugplein

the iron foundry of Dufay, date and author are unknown

Kop van ‘t Zand, the first extension of the city

The city needed extra land and the first expansion of the was done between 1885-1893. The location Kop van ’t Zand was the most northern part of this extension. The name stems from the sand that was used because of the marshy ground. The city council ordered architect F.M.L. Kerkhoff to make a street layout for the new district. Connection to the inner city was made through a bridge near the new built train station, and in the north through a bridge near the Brugplein. The most representative part of the plan is situated near the station. Due to the revival of trade, there was also a need for industrial estate, thus a mixture of residential and commercial buildings is created in the ‘Kop van ‘t Zand’. Here the residential buildings are mostly social housing.

Later developments of the city

After the first expansion there followed a second one in the north of Den Bosch, but soon after that economic recess and the second world war put a stop to the expansions. It was not until after 1960 that city started growing again, this time it was a rapid expansion. Neighbouring villages were swallowed up by the city, water in the area was managed by creating several large pools. The excavated sand is used for building. On the location Kop van ‘t Zand the harbour is filled up and one by one large industrial companies move to the outskirts of the city. What is left are small businesses and derelict houses.

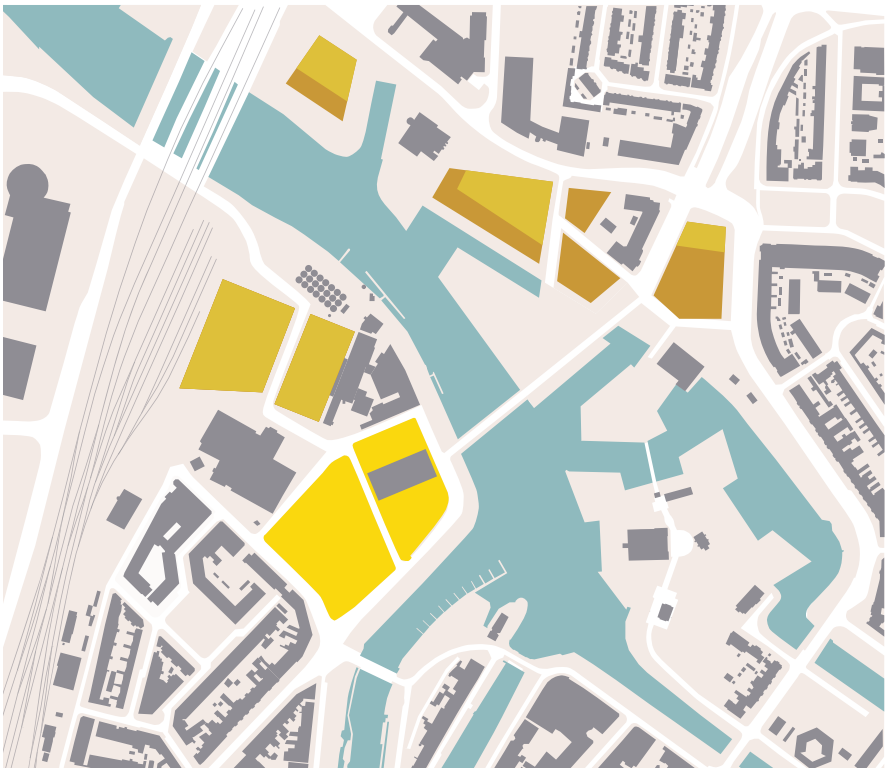
monuments

There are a number of monuments in the planning area (see map):

1. Former Koudijs/de Heus factory, a factory that produced animal feed, the so-called Molengebouw (Mill building) is part of this complex and the main landmark in the area. Since the firm moved out in 2013 it has a temporary destination as a collective building for all kinds of small-scale activities (startups) and also hosts a café.
2. Former Willem II cigar factory, now music venues and studios.
3. Former Iron Foundry of the firm George Dufay and Son, later Screw Foundry M. Lips. It was built in 1902, the date of construction of second part is unknown. The buildings of the former Iron Foundry are part of the plan. Until recently there was a skating rink here. The building is in a poor state but is being renovated at this moment. A new destination for this building could be that it houses small businesses, small scale retail: a small market or shop, or a gym. The development of the reuse of this factory is not part of the design, though it is likely that the building will also be some kind of support and infill.
4. The Fort Willem Maria built in 1637, also known as the citadel. It now houses the provinces historical information centre.
5. The bridge near the Brugplein, the connection to the inner city.
6. The powder house
7. A number of houses near the Brugplein

the scope of the city council’s plan, the darker yellow buildings are to be demolished

future situation: areas for new build and possible high rise



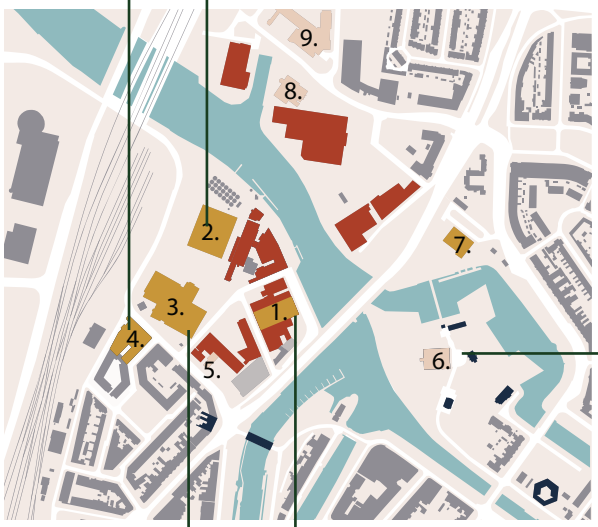
City Council plan

The city of Den Bosch has produced a so called 'perspective for the area'. This is still a draft plan, parties in the council are still divided about how it should be executed. The plan includes:

- Replacing the Diezerbrug with a lower bridge that runs opposite the former iron foundry. This will connect both sides of the river. The bridge will no longer be a barrier for pedestrians and will not block the view on and from the citadel/fort. The council has already approved this decision, the new bridge will be installed in 2024.
- Plenty of space for water and greenery, also in view of climate change.
- Demolition of part of the existing buildings and new development of residential areas, high rise buildings in some parts. New development consists of residential buildings and spaces for new ideas and experiments, these should be energy neutral, circular and have a healthy climate.
- Room for sports and culture on both banks: an events yard in the north and a culture square in the south bewteen Willem II and the Verkade factory.
- A pedestrian route going through the area, there should be a network of meeting places.
- Other keywords are innovation, hospitality, cultural heritage, continuous development, change, room for nature, experimental.

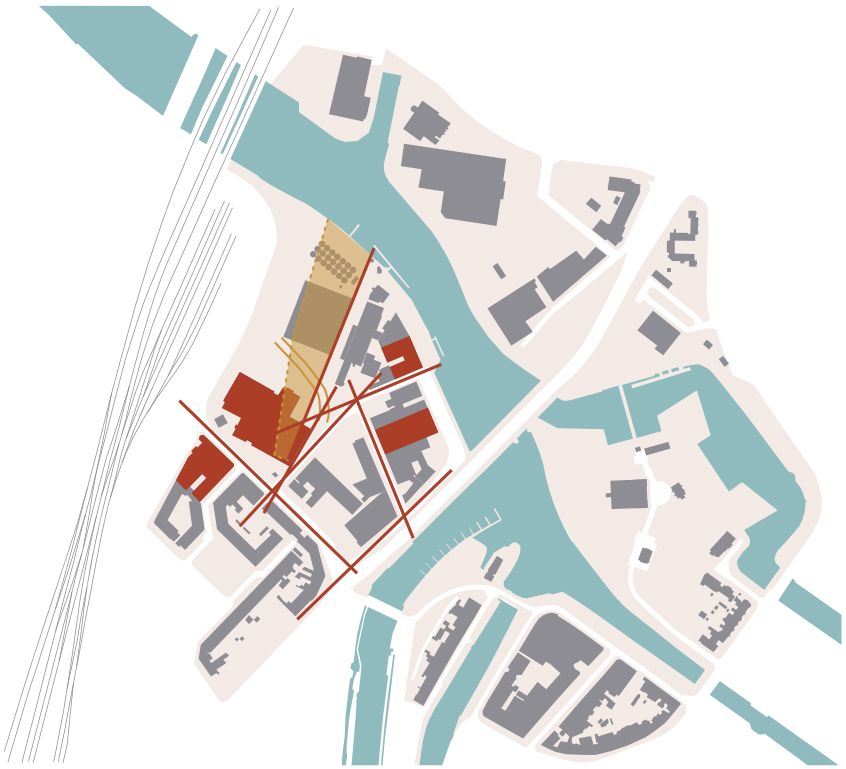
situation and images

functions

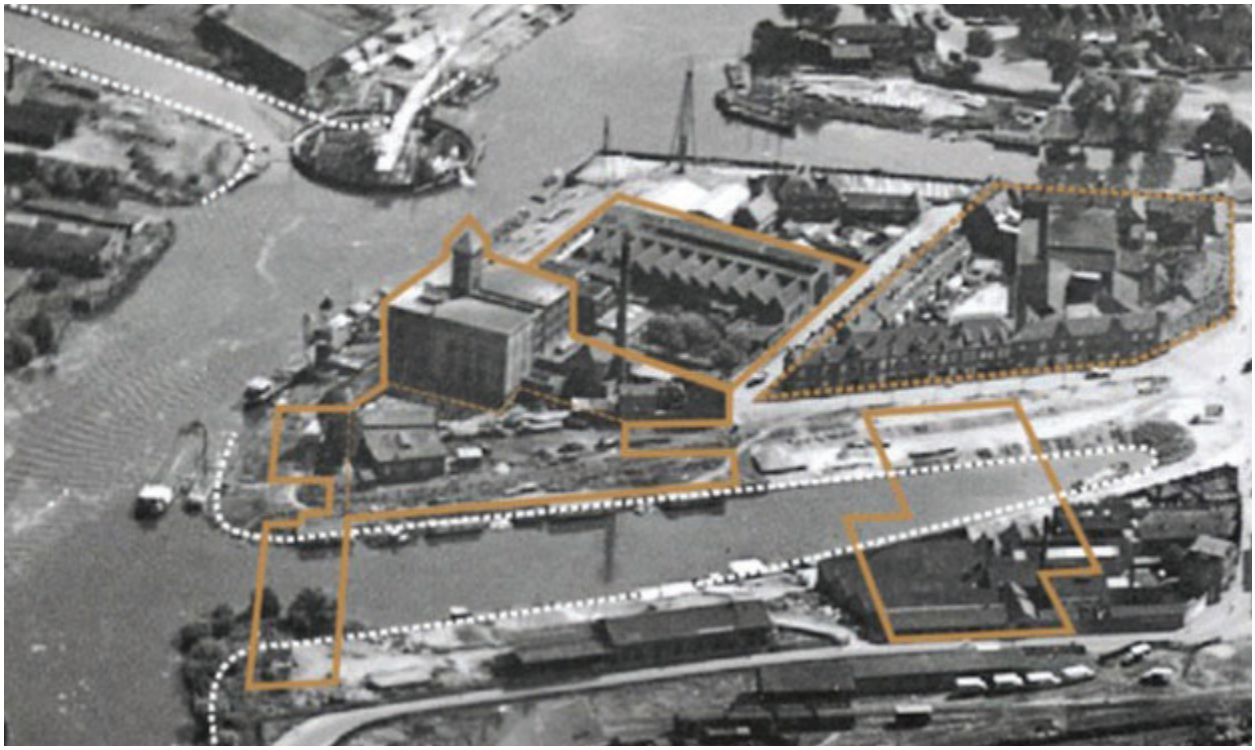


1. Former iron foundry
2. Former Koudijs/de Heus factory
3. Verkadefabriek
4. Willem II
5. hotel
6. rowing club
7. mosque
8. fire station

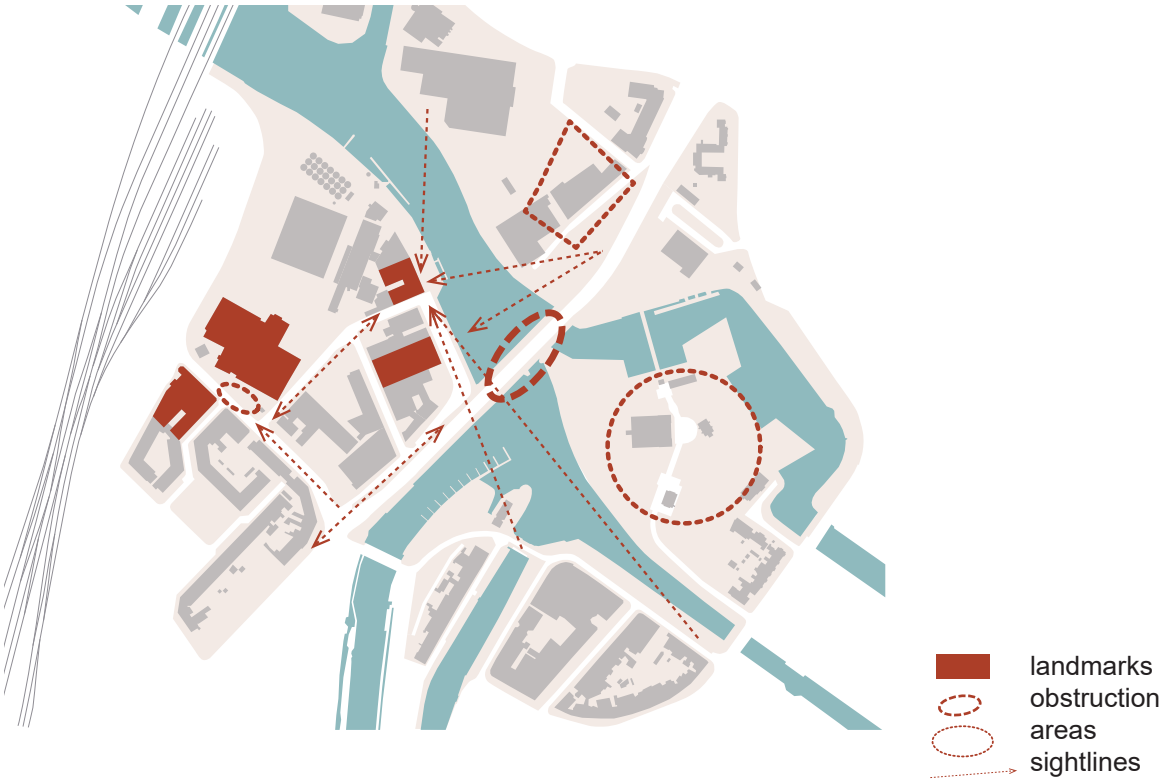
palimpsests and directions



There are a lot of different directions in the area. They are shaped by the street pattern, the waterfront and building lines. Some directions are a remnant of vanished elements, such as the harbour that used to be there(see image below). There are a lot of shifting directions, sometimes new buildings were built in a slightly shifted angle from the building that used to be there. For the design it may be interesting to follow (some of) these directions.



landmarks, sightlines, areas and obstruction



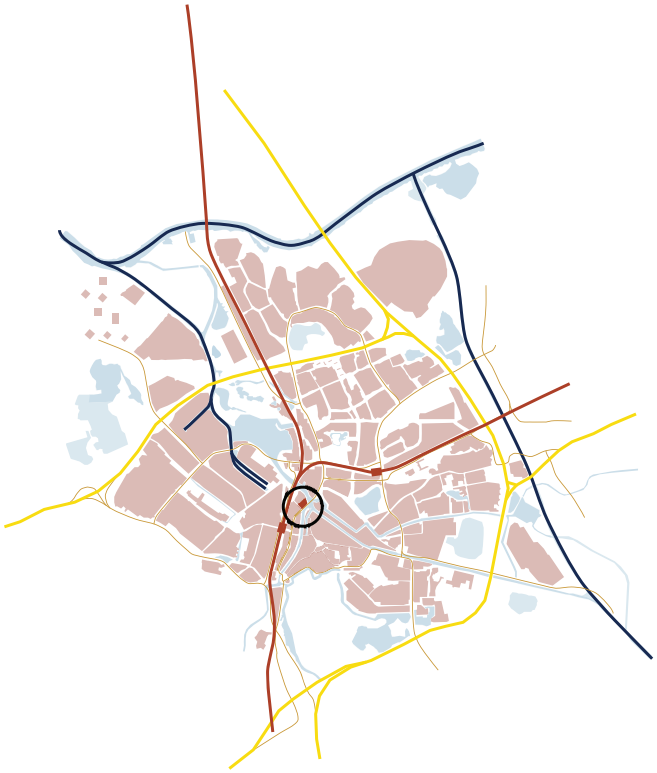
The current Dieze bridge is an obstruction for the view from and to the site and diminishes the experience of the fortification.

The Mill building is an imortant landmark, visible from many directions.

traffic and parking

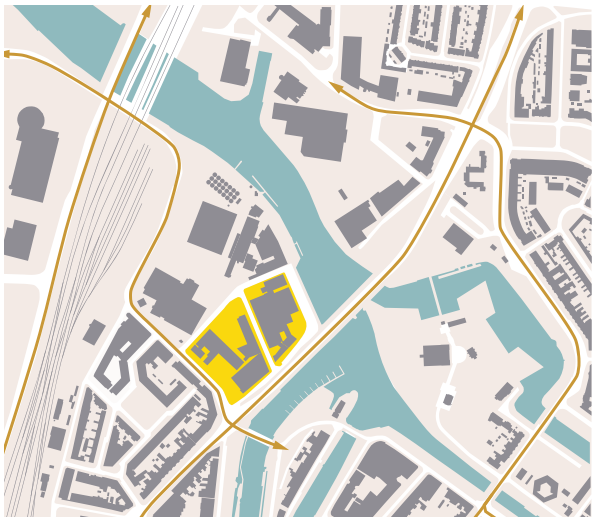
The council 's plan involves routes for pedestrians and meeting places. The waterfront on the Buitendijk will be accessible. The Dieze is now only used for recreational boats. The plan for pedestrian routes involves the redirection of car traffic. Some of the streets will no longer be accessible for cars, the road bordering on the southside of the location will become a 30 km road and can be slightly narrowed so that the footpath can be widened.

Even though according to the council's plan the area will attract visitors, the parking norm is only 0.1 or 0.2, which means that the need for extra parking space is limited. It is expected that in the future there will be more shared cars and use of public transport. The railway station is only 10 minutes on foot or 4 minutes by bike.

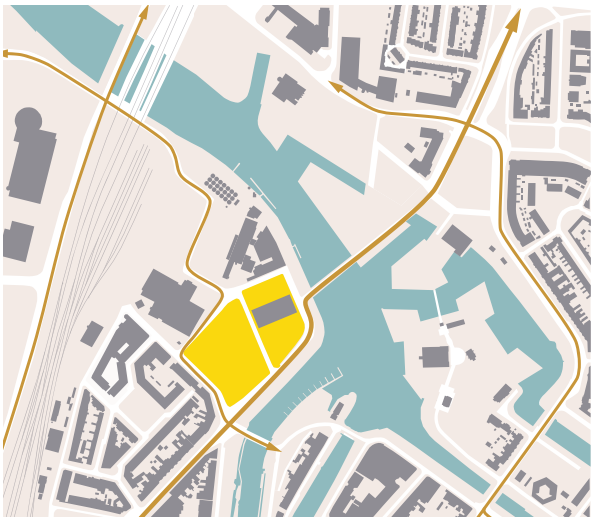


shipping routes
railway
highways
main acces roads

main traffic routes for cars current situation



main traffic routes for cars future situation



greenery, water and pedestrian routes

As was shown, water has played an important role in the history of the city and this area is part of that history. The experience of the water is currently hindered by the high bridge and the dilapidated state of a large part of the buildings. Still, there are interesting views. There is a lot of space for greenery along the water and this can be further enhanced in the new design.


DOKX

conclusions and starting point for the design

The council's plan for the area will serve as a starting point for the design even though it is still unsure which elements will be realized. The design is based the on finished situation of the plan, regarding the bridge, the traffic, the walking routes and the meeting areas. Certain elements in the council's plan will also play a role in my design. These are:

The walking routes are on the edges of the plot. The design of the urban layout should enhance the experience of the walking routes, the water, greenery and the fort. However, there should be enough space that is solely for the inhabitants of the plot. The Tramkade is the road between the Mill building and the plot is now a very narrow street. When the old buildings on the plot are demolished, this street can be widened, trees can be planted here, and this could really be a nice route. Apart from the ongoing routes for car traffic as indicated on the drawing there will be no cars allowed in the area and on the plot, only bicycles. The Havendwarsstraat, the street going through the plot will become part of the plan but will become a shared space for pedestrians and bicycles. The Boschdijkstraat on the south of the plot can be somewhat narrower, giving more space to pedestrians.

The building height should be limited to about five layers. A higher block or tower will not fit within the scale of the surroundings. Furthermore, the view on the landmark of the Mill building is very important, also in a historical sense. It can be regarded as a reminder of the industrial history of this part of the city. The latter is also the case for other buildings in the area.

The monument of the former iron foundry must be incorporated in the design, a full-scale plan for the reuse of the building is however not part of the design. The design for the new block(s) should fit the monumental status of this building and should not overpower it. It would be nice if the design can put the spotlight on this nice industrial building. Suggestions for the use: small retail (which is allowed here), a gym, small businesses or a café. Technically the realization of the infill here can be done in a similar method as the one used for the infill of the dwellings.

History shows that activities in this area have always been a combination of working and living/dwelling. Ideally the design should reflect elements of industrial buildings such as gates or shed roofs, or or an industrial building method, such as the juxtaposition of building elements that can be seen in the complex of the Koudijs factory. Here new buildings were positioned merely by practical and logistic considerations.

Finally, a healthy climate is important, and greenery is crucial in that aspect. The design has to give plenty of room for greenery, not only on the ground floor, but ideally also on the roof.

development of the building block

For the development of the building block five different scenarios were investigated. First, the layout of the case study blocks was positioned on the plot to get a sense of the size and shape and to see what it would look like. Other categories that were considered are strips, closed building block(s), the ribbon and a combination of a ribbon and a bridge.

case study blocks

variation Molenvliet

variation Superlofts several blocks

variation Patch 22 three towers

variation combination Superlofts and Pathc 22

strips variations

The case study blocks give insight in the scale, but are no inspiration for further development. The Molenvliet block does not fit and clashes with the Havendwarsstraat. Variation four is a combination of Superlofts and Patch 22, an island with a parking garage and small towers on top.

The strip is a standard shape of block that is often used in an East to West orientation. Strips are not so suitable for this plot. There is a lot of open space, you can 'see through' the project, there appears to be no private space for the people who live there. The space between the blocks looks ambiguous, there is no clear front or back-side. Furthermore, the blocks do not define or guide the public space of the street. In variation two and three there are short blocks that cause a strange kind of residue space.

strips variation 1

strips variation 2

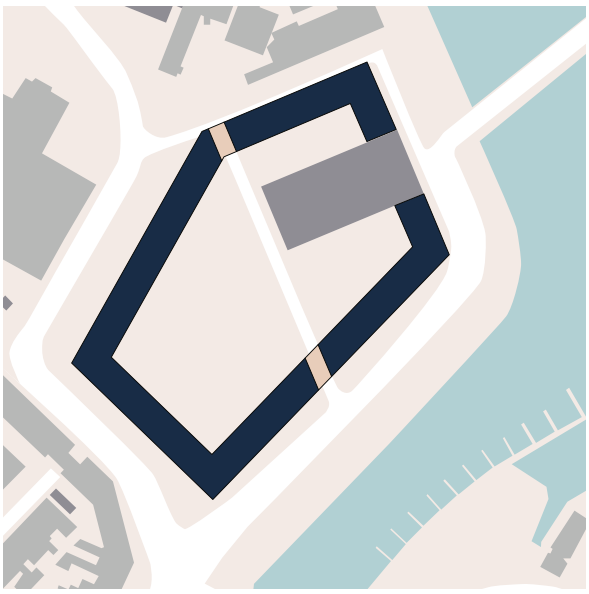
strips variation 3

strips variation 4

closed block variations

The closed blocks clearly define and guide the public space of the streets. Here a choice must be made about the distance between the blocks. Variation one has very small inner courts or gardens in the North-eastern part. In variation two the inner garden is far too large. Variation three tries to solve that with a block in the middle, but this block does not have a public side. Variation four is inspired by the Spaarndammerbuurt in Amsterdam. This is a nice pattern, but the plot is too small for it.

closed building block variation 1



closed building block variation 2

closed building block variation 3

closed building block variation 4

riibbon variations

The ribbon block is inspired by Habraken, who speaks in his book about long building blocks with separate access towers that meander through the (urban) landscape. It is also a combination of the closed block and the strips. The ribbon can be left open or closed at the ends. A third inspiration for the ribbon are the many directions in the area. The nice thing about the ribbon is that it guides the public space but also creates private space for inhabitants of the project. With these variations there is still the risk of a too small courtyard or garden. The ribbon is interrupted by the monument, but also forms a nice frame for it.

ribbon variation 1

ribbon variation 2

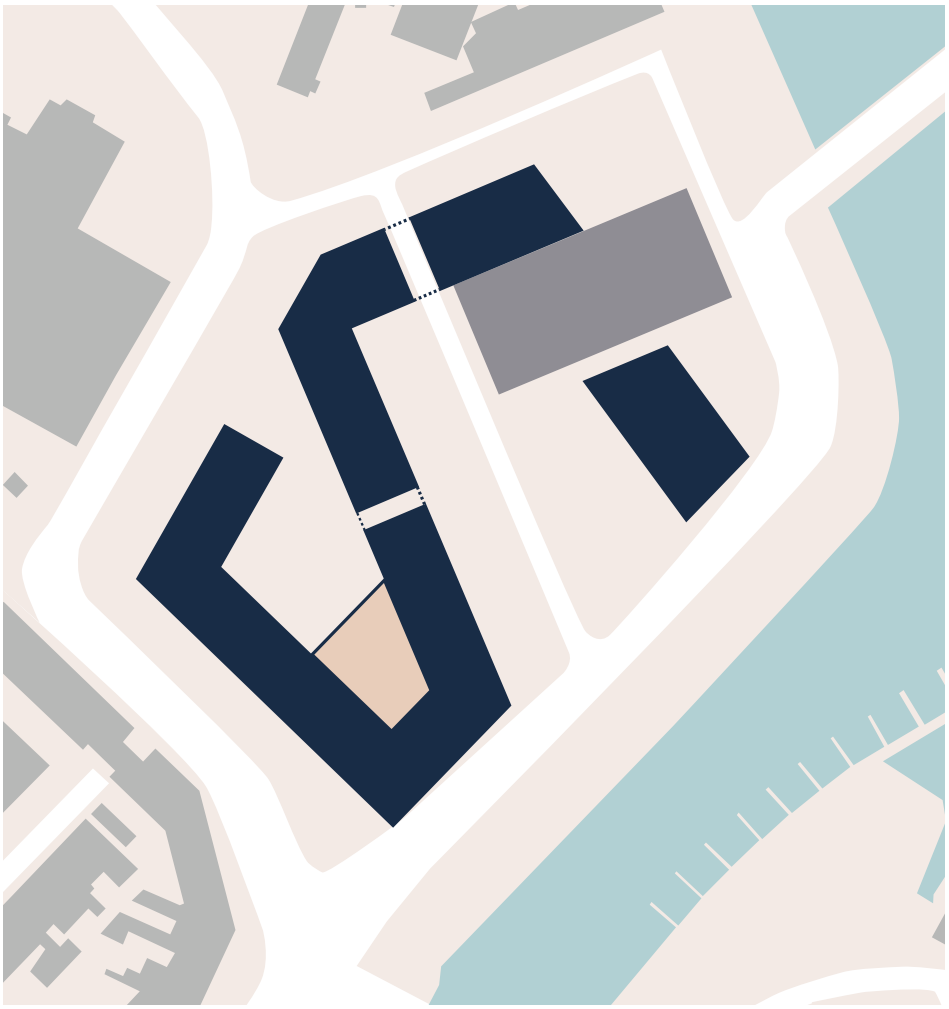
ribbon variation 3

ribbon variation 4

riibbon and bridge variations

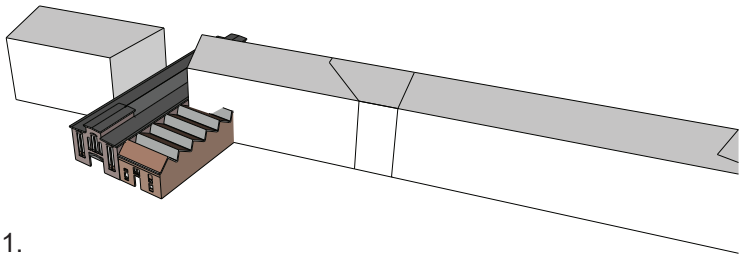
The bridge is an addition to the ribbon concept. This will increase the building volume and connect both sides of the ribbon at the interruption of the monument. Models were made to test the effect of the bridge. The concept of the bridge was dejected on account of the height of it. It would overpower the monument. Another issue is that the area underneath the bridge, that will receive little light and probably not be a nice place.

The chosen block



the chosen ribbon variation

The chosen block is a new ribbon variation. The ribbon is open at both ends so that there is no ambiguity, it is clearly a ribbon and not a closed block. In the North part of the plot the ribbon does not curl since that would create two very narrow spaces. The depth of building block here is about 20 meters, enough for a block with a central core and dwellings on both sides, the other blocks are 15 meters deep. They form two open courtyards or gardens, one is very open and public, the other is also accessible but only intended for the residents of the plan, it is more private in character and has private gardens. Part of the ground floor is used for a small parking garage for residents. There are two gates through the ribbon. The Havendwarsstraat will stay in its place and go through a gate to the Tramkade. The variation offers enough space for a nice walking route along the Tramkade.



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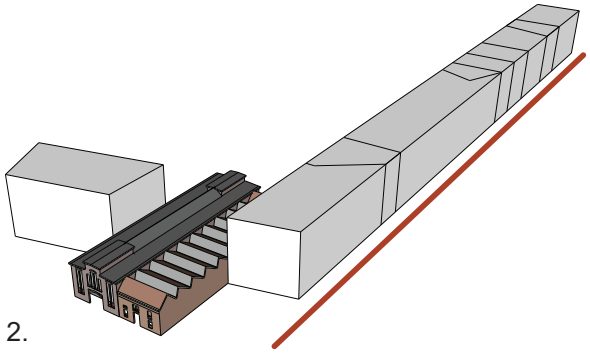

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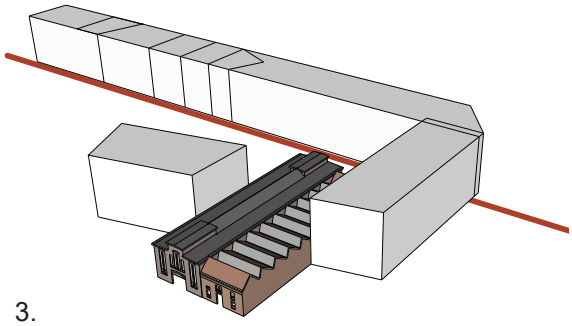

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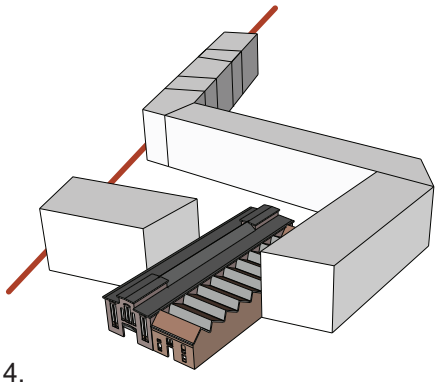

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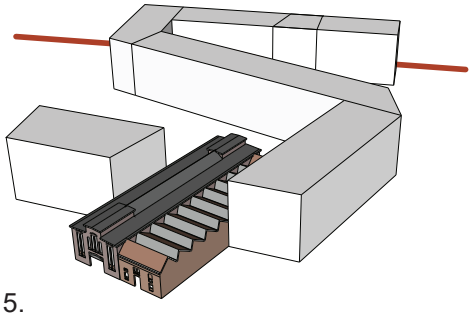

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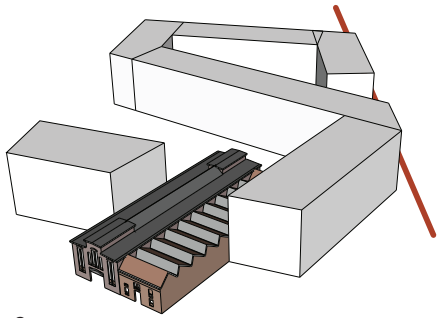
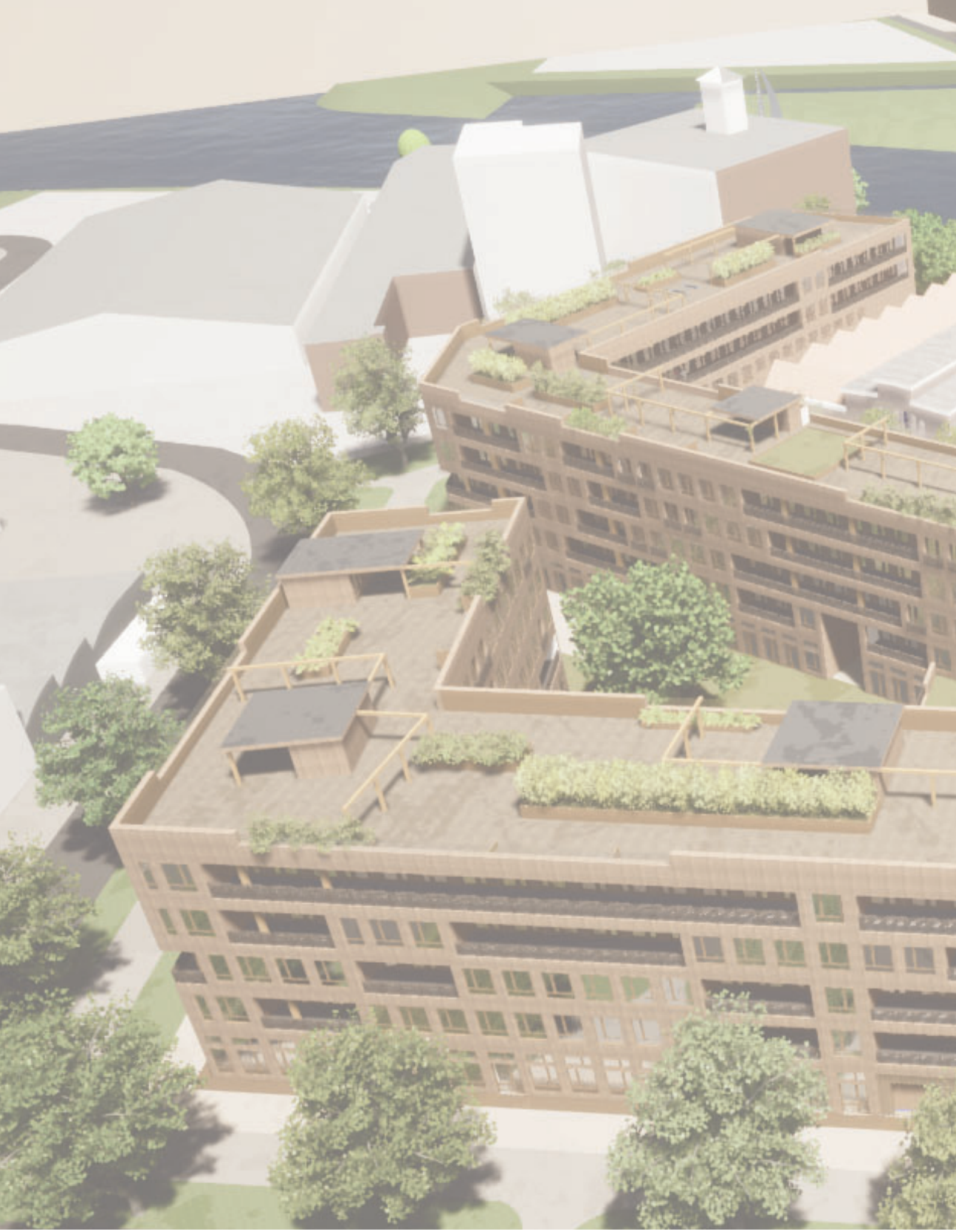
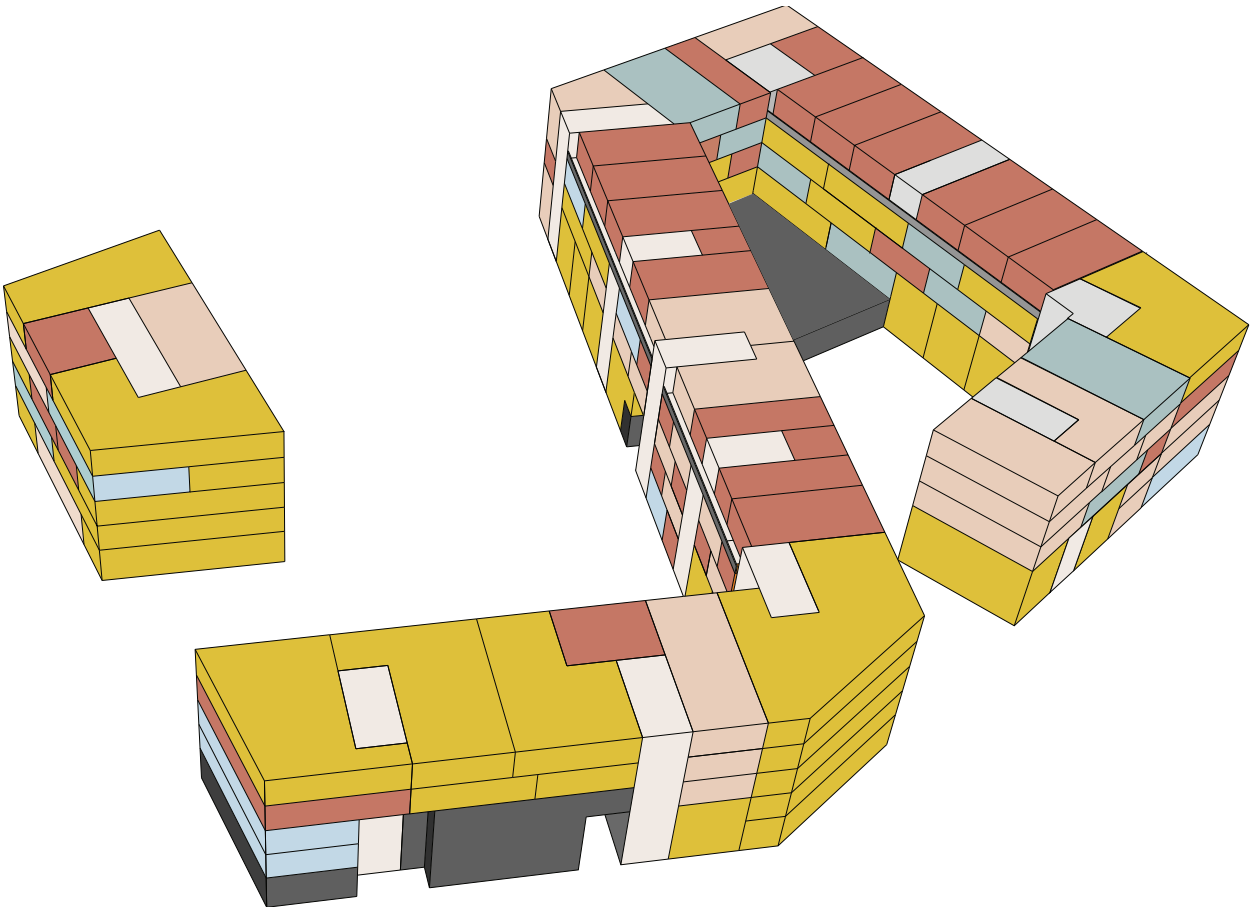


6.

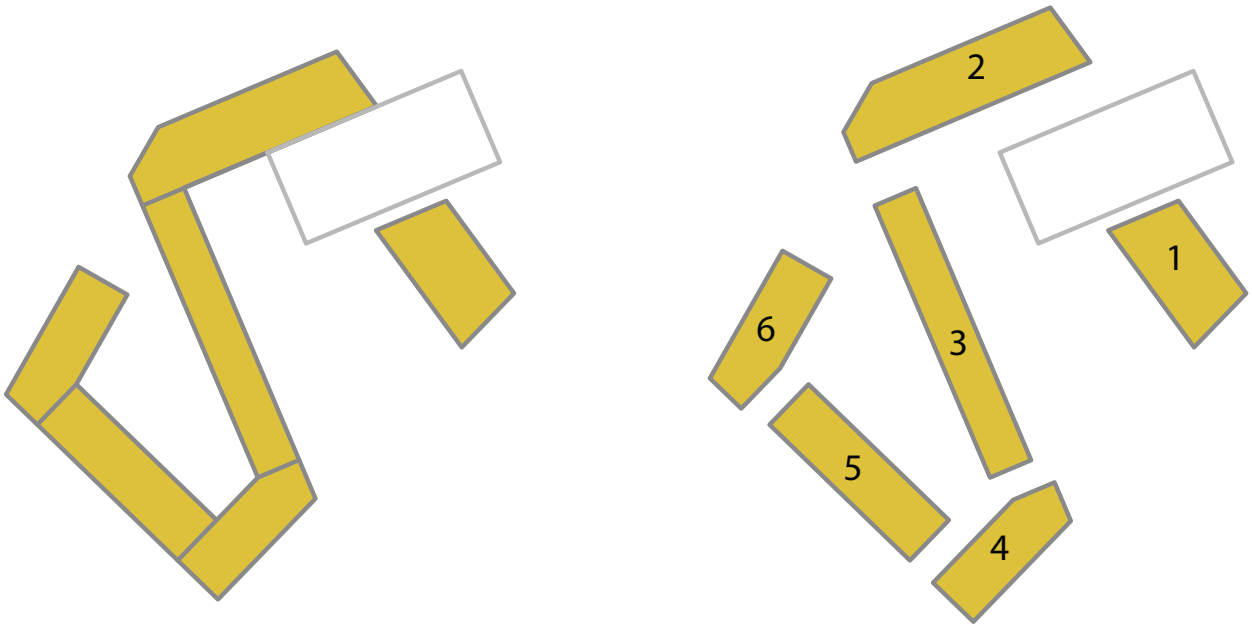
The ribbon responds to all the directions present in the area and thus conncets to its surroundings, but also tries to guide routes and define spaces. Each time the ribbon encounters a new direction it makes a turn. The monument protrudes the block, which makes space ro a public area neaar the waterfront. The new block formes a frame for the monument and does not interfere with the sightlines towards the Mill Building.



Design Open Building and Architecture



a proposal for the parcellation of the project, different colours reflect different size of apartments, yellow is largest, red the smallest, the dark grey area has a different function



seperation of the ribbon into clusters (or blocks)

Concept goals and themes

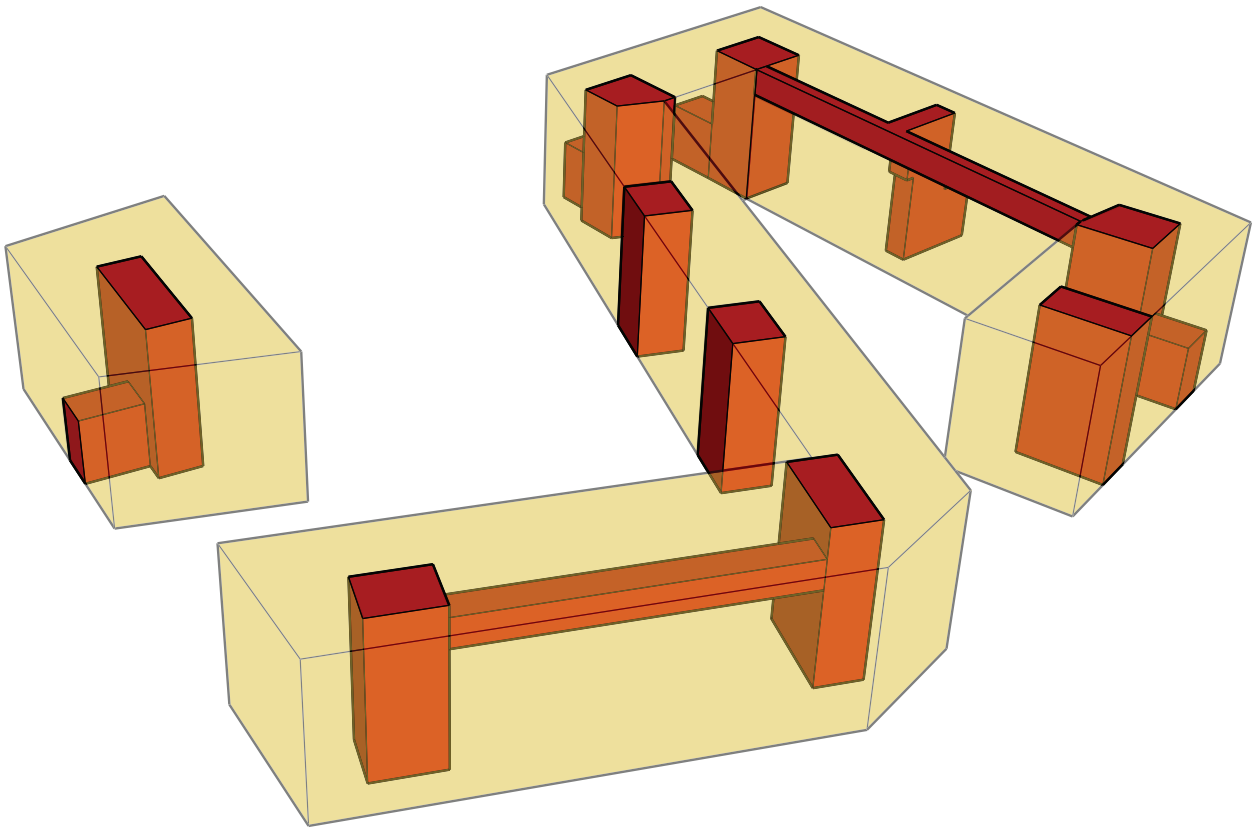
The concept for the design is to create a building that will give diverse groups of people the possibility to each create their own home. Diverse means that residents can have any cultural background, status, income, family size etc. etc. The only precondition is that they want to live in this kind of environment and that they want to create their own home. In order to create a sense of community and equality the idea is to mix these groups: one's 'plot' or parcel within the project should not depend on income or status or situation in life. So, young next to old, rich next to less rich, single next to married, etc. The ribbon is divided into 6 clusters, each cluster should be a mix of different sized apartments. Reparcellation or redistributing the available space/units over households was one the original goals of Open Building. In this design I would also like to keep that possibility open, even though experience has learnt that it is hardly ever done. It is likely that this strategy may also give a good result in housing a set of diverse residents. Apart from this concept of inclusion and ribbon, the design has other themes: rhythm, incisions, and industrial references. These will be discussed further on.

Open Building themes

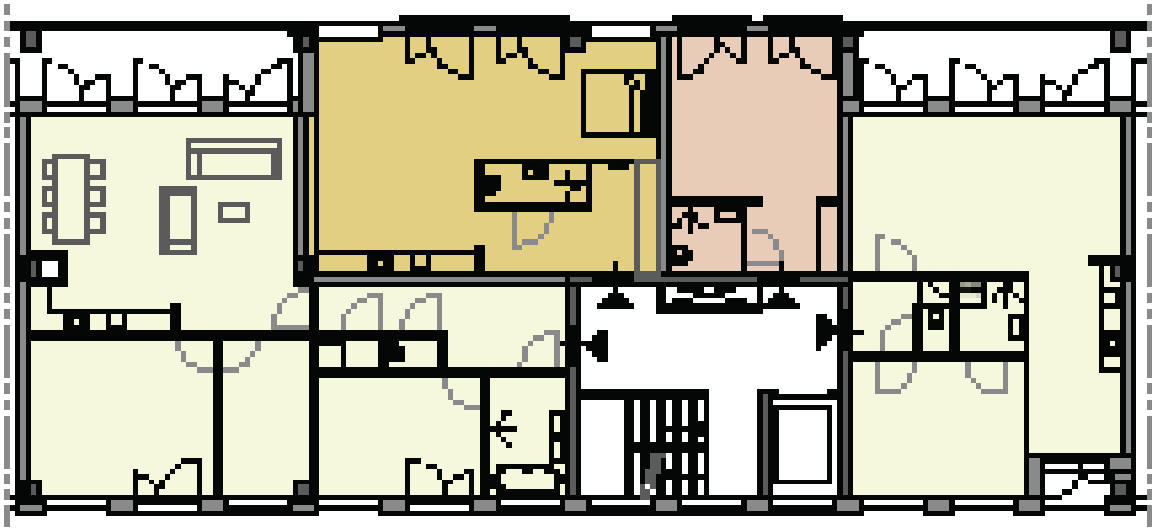
Parcellation and access

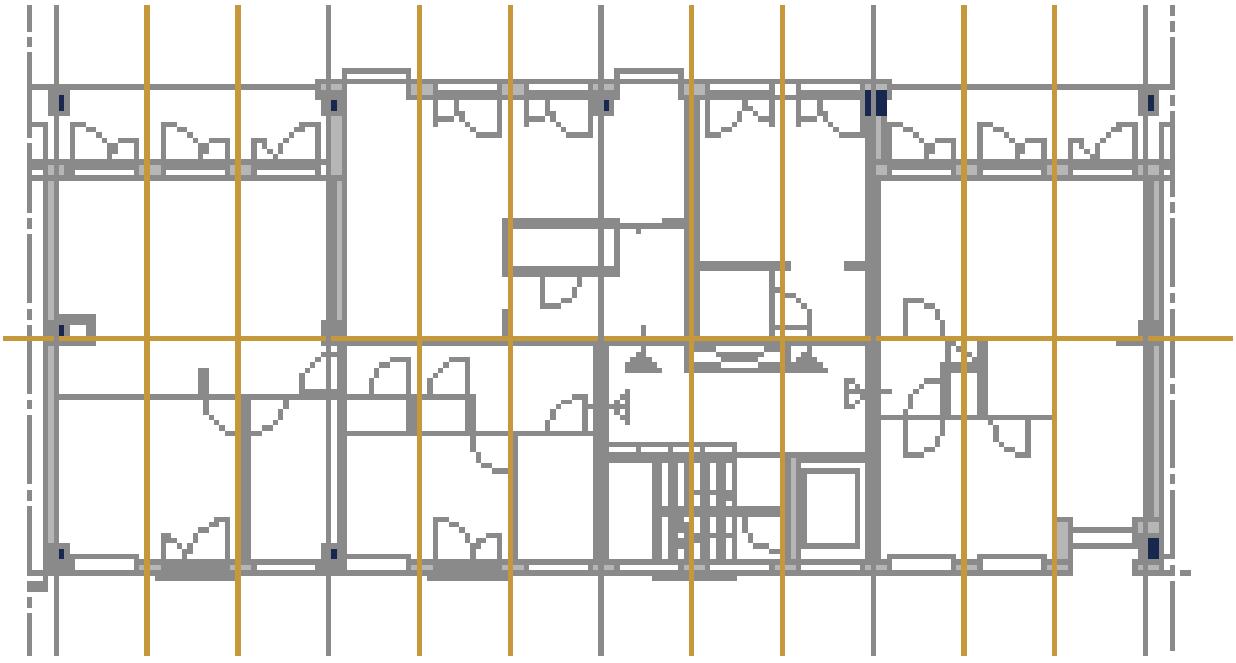
For the design some aspects were more or less fixed before the design started. The idea was to have a column and beam structure combined with a raised floor system. If possible vertical ducts should be combined with the vertical access. Because this was set, the design phase started with investigating how different sized dwellings could be divided over the project, this went hand in hand with the design of the access, since that also needed to be distributed over the blocks. In cluster 1 there would be a core and apartments around it. This was a relatively easy design solution. Cluster 2 is an extra deep block because it sits between the monument and the widened Tramkade. Daylight is an issue here, the first two layers next to the monument only receive light from one side and are not suitable for housing, as is the third layer, though this can have windows with a nice view over the shed roofs of the monument. These three layers have another function. On the fourth and fifth layer of this block are dwellings, accessed by a corridor. This was done to limit the number of stairwells. The corridor runs from the one stairwell to the end of the block where there is a window overlooking the water. For the other clusters there are two types of access: a stairwell on the façade or a stairwell in inner corner where two blocks meet. In cluster 5 the top layer has a gallery access, this saves one elevator and also allows for smaller apartments on this floor. The stairwells that are in the 'armpits' of the building have a two story high entrance on the façade.

The image showing the parcellation gives an impression on how apartments were distributed, in the final design this has slightly changed.



the system of access





the structural grid and the window grid and the parcellation for a part of cluster 3 (fourtgh floor) Dwelling dividing walls do not need to follow the structural grid

Structure grid size and pipes

Together with the design of the parcellation and access, the size of the structural grid and the window grid was determined. The structural grid is 7.20 m wide and 15 m deep. The 7.20 m can be divided in three reasonably sized rooms, or a large one and a smaller one. Windows are 1.75 m wide, leaving 65 cm to place the room dividing walls. Dwelling dividing walls can be placed anywhere on the grid of the windows. For practical reasons sometimes the bay width is 4.8 m. Stability of the structure is obtained by the loadbearing walls of the cores. These are made with Cross Laminated Timber. The column and beam are laminated timber.

The raised floor allows people to have a free infill, ducts and pipes are transported horizontally in the cavity of this floor, which is large enough for the slope. The vertical transport is either in the stairwell, but, in some cases an extra shaft was needed. This shaft is positioned next to the column in the middle of the block so that two obstacles become one. It is not a very desirable scheme, but when some of the infill plans were drawn it turned out to be possible to include this in the layout.

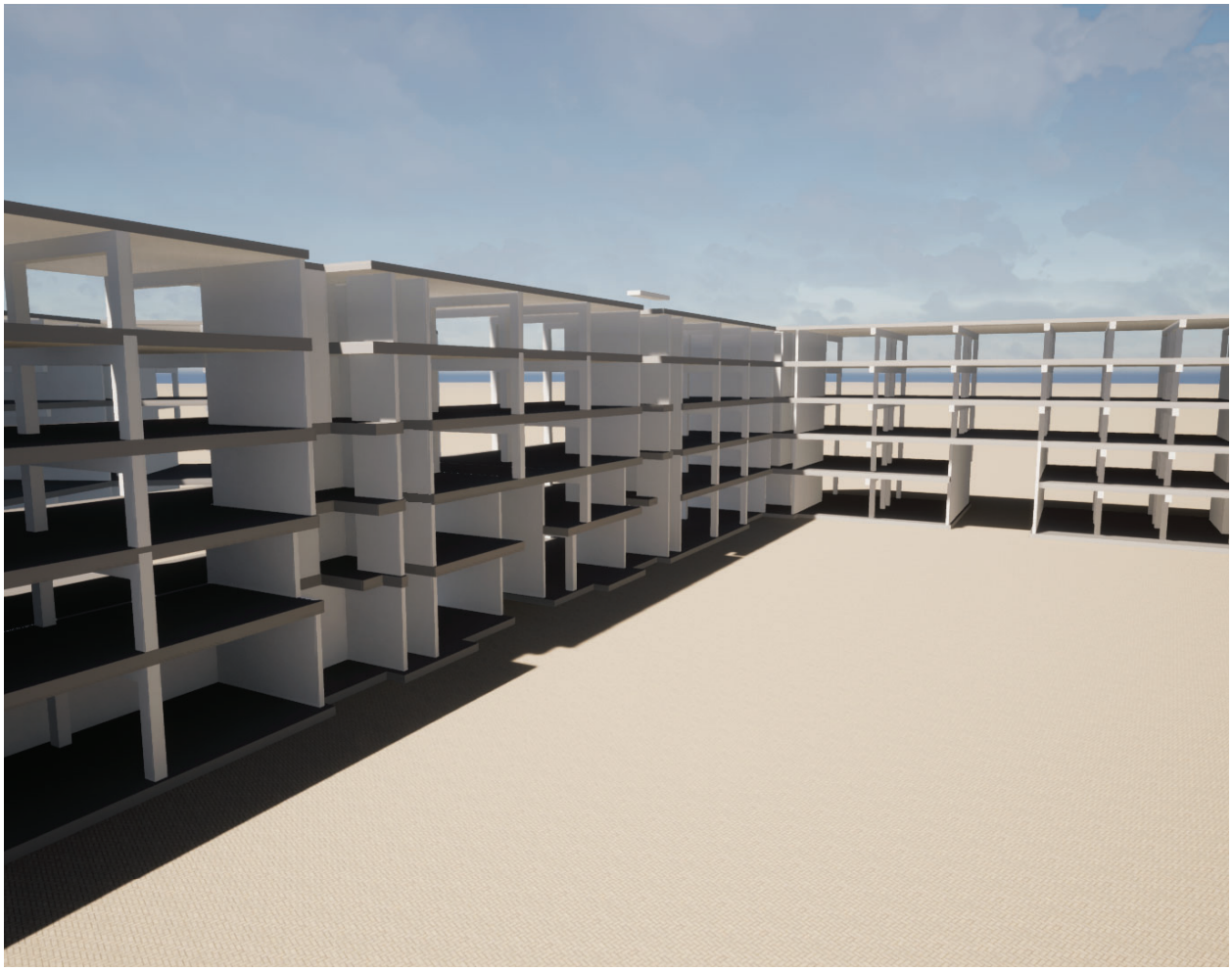


image of part of the structural system

Functions

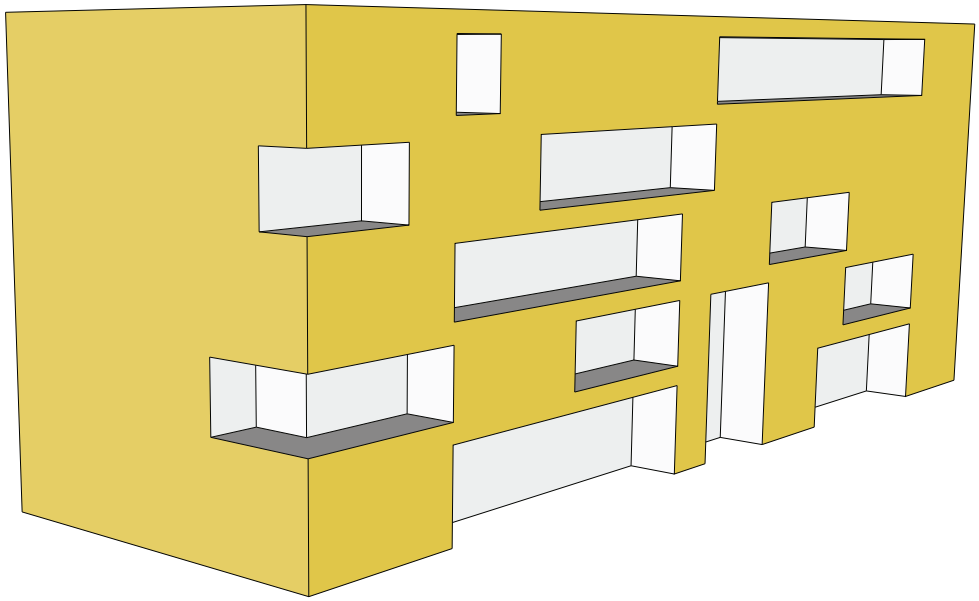
The former iron foundry will get a destination like the Mill building. After restoration there is room for small businesses, shops, recreation or a workshop for a craftsman. Part off cluster 2 has a non-residential function, as well as part of cluster 1, that lacks privacy on the ground floor.

Architectural themes

Rhythm: incisions and railings

For the façade the theme of inclusiveness was the start. If one lives in a block with a lot of apartments it would be nice if you could distinguish your own home. To achieve this a rhythm of incisions and railings is applied. The incisions are the balconies that are have an irregular pattern. The railings come from both the balconies and the French windows. French windows are mostly applied in the smaller apartments behind the stairwell. The pattern of railings and incisions is irregular but balanced, although on the North and East façade there are only a few balconies. The North façade of cluster 2 has a more monumental appearance in response to the to the former iron foundry. At later moment extra incisions were added near the entrances of the stairwells and on the part of the ground floor apartments that have an entrance on the footpath.

The windows are flush in the façade and the windowsills are 45 cm high, so they can be used to sit in. The French windows are positioned on the inside edge of the façade so the door can easily open and there is a very small outdoor space that can be used to cool your beer in winter of place a pot with herbs or flowers.

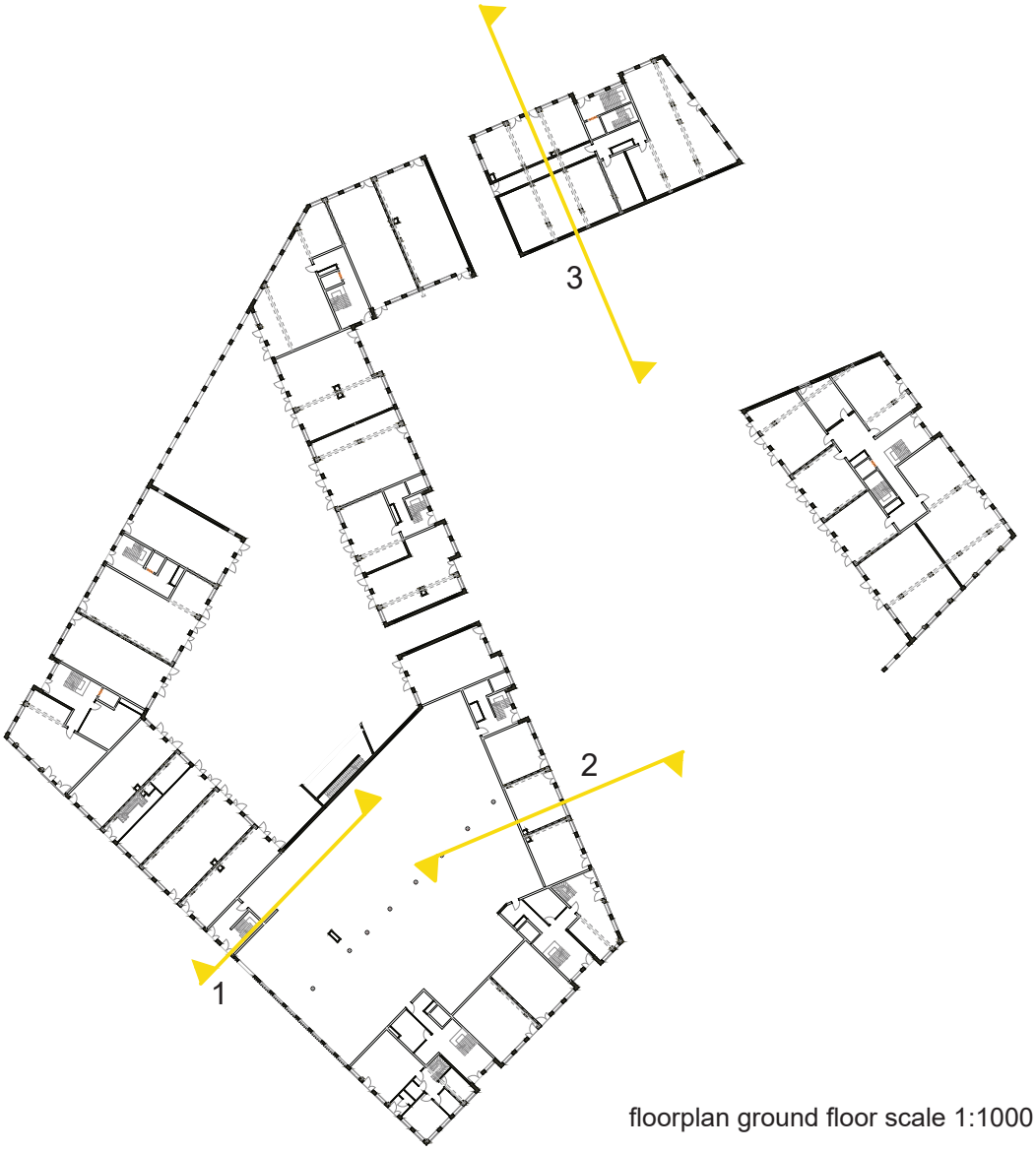


Industrial References

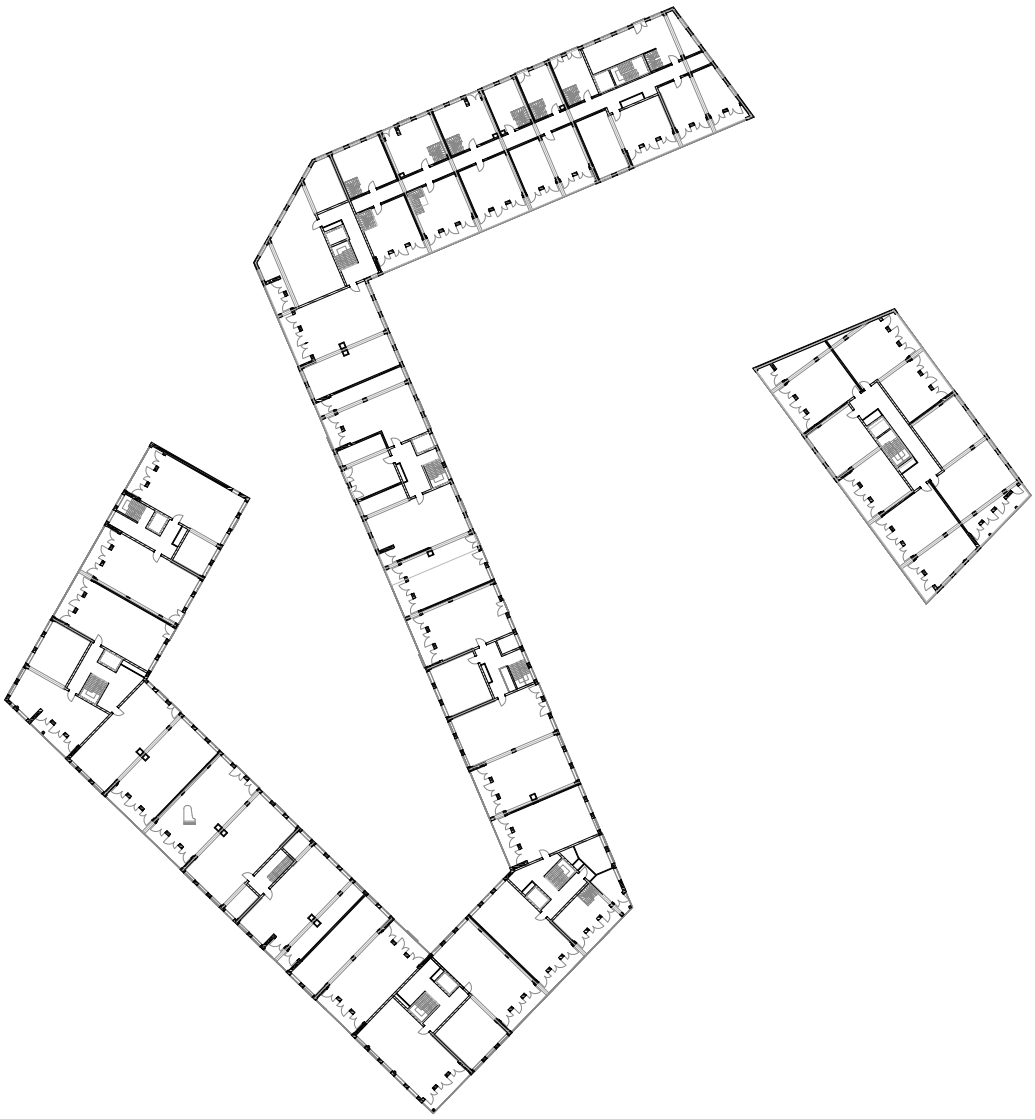
Although the ribbon is a residential building an effort was made to include some small references to the industrial buildings next to it. Looking at industrial buildings one can see that they are often built at the place where they are needed, resulting in ensembles with different directions. These directions were the immediate inspiration for the ribbon. Industrial ensembles are often walled ensembles with a yard and a gate. These elements can be seen in the design of the ribbon.

reminders of industrial elements: gates and wall

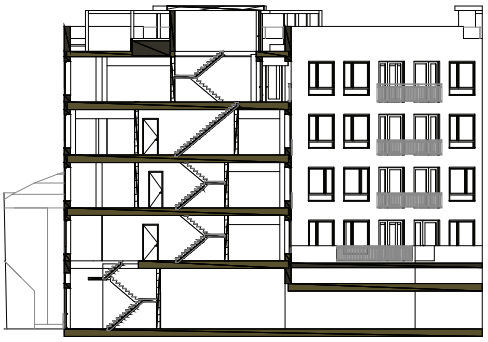
floorplans and sections



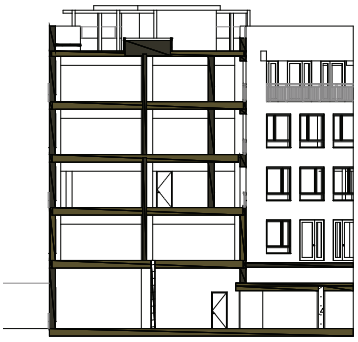
floorplan ground floor scale 1:1000



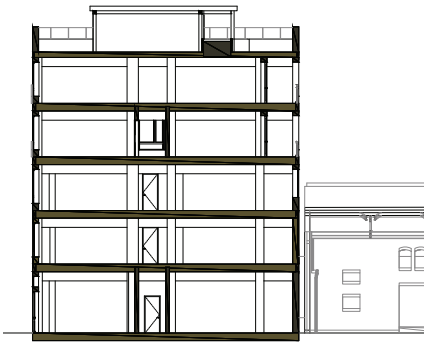
floorplan of third floor scale 1:1000



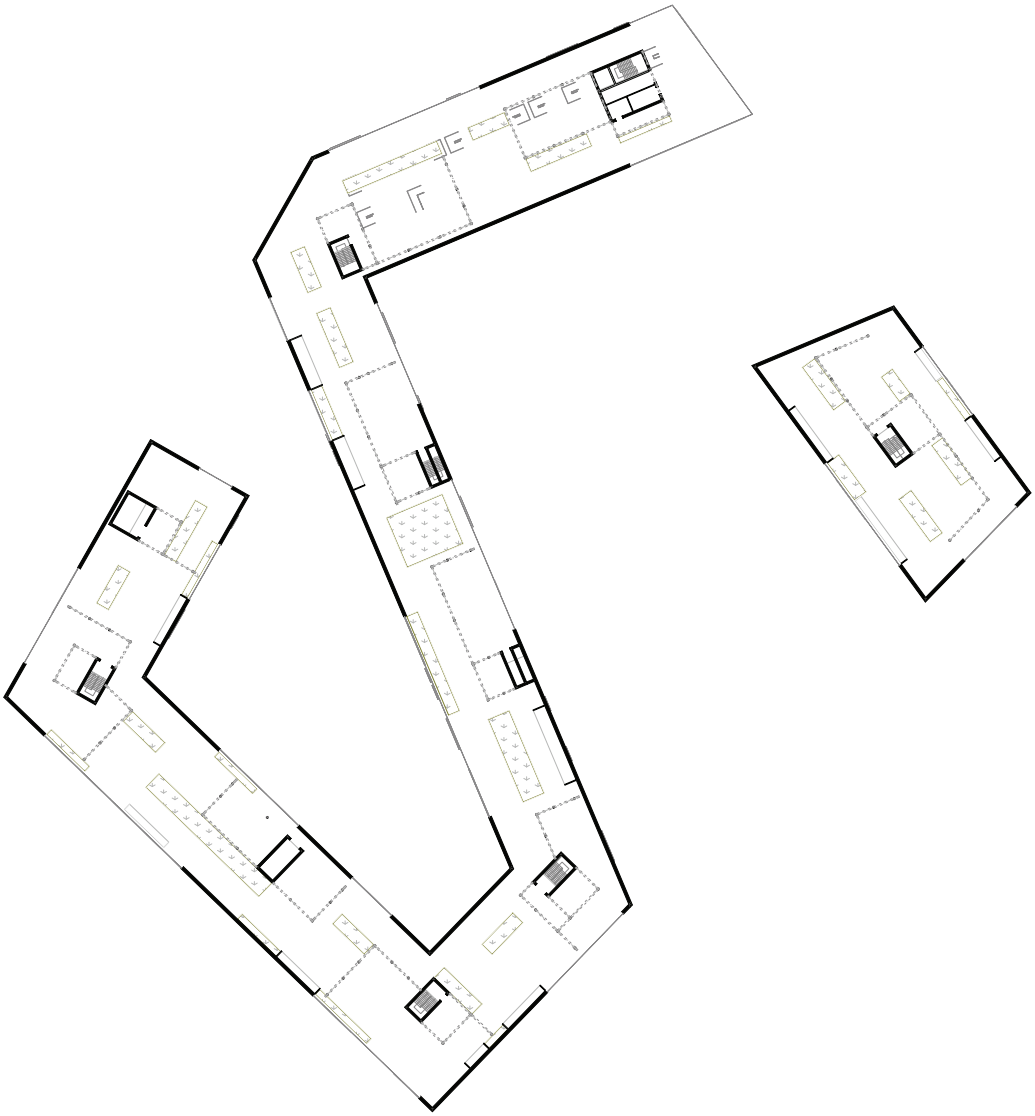
section 1 scale 1:500



section 2 scale 1:500



section 3 scale 1:500

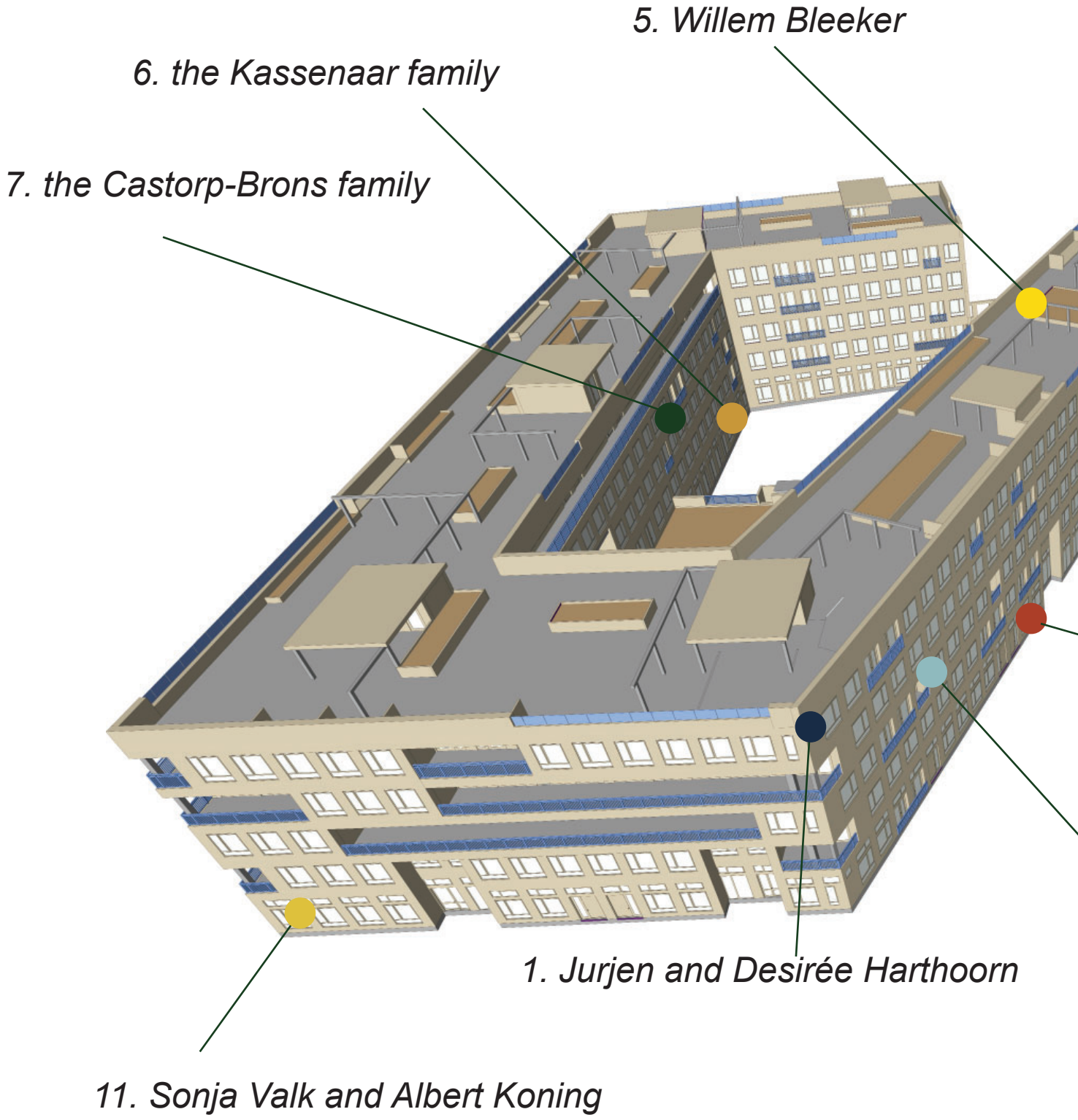


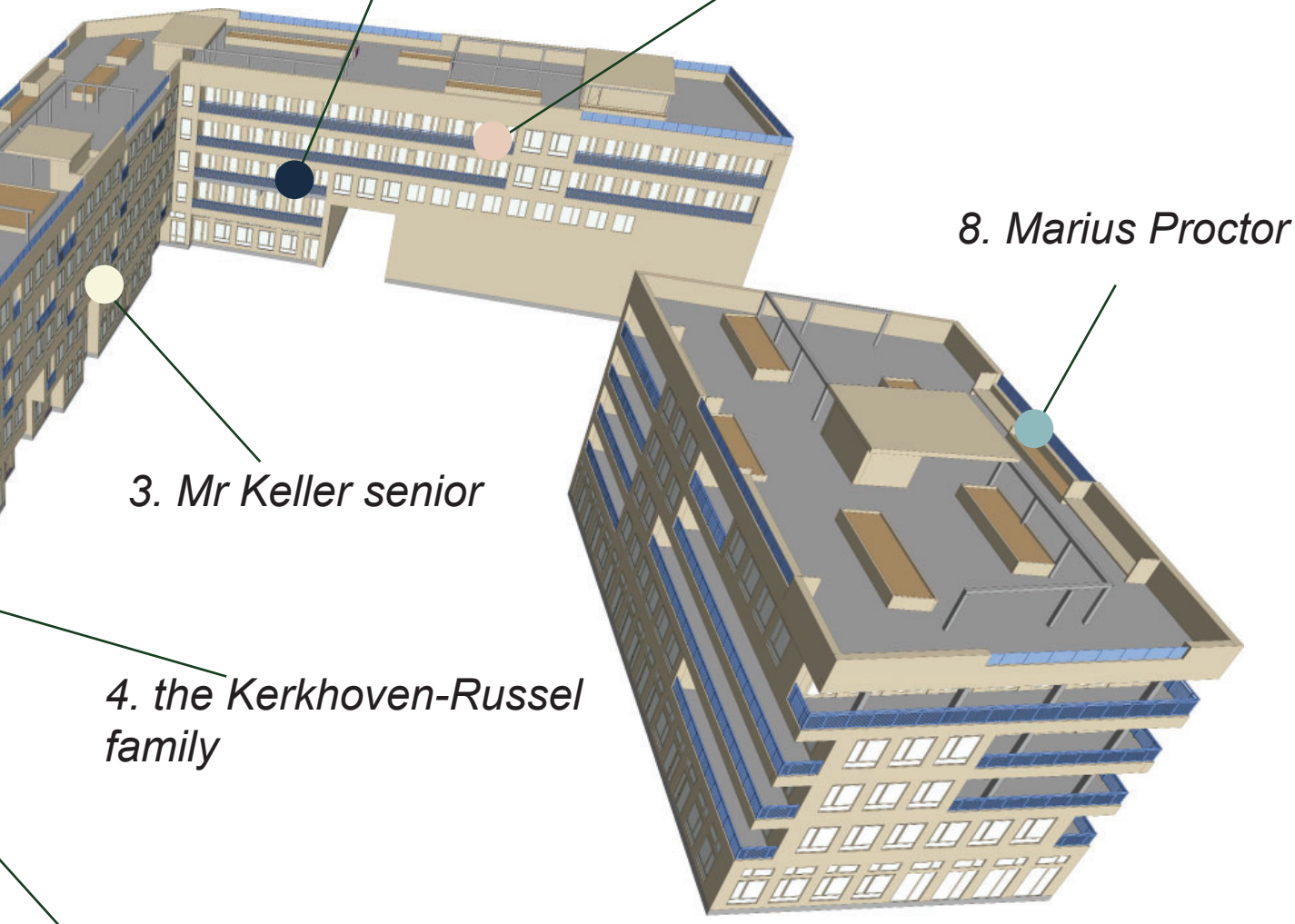
plan of the roof terrace scale 1:1000

The roof terrace

This does not need much explanation. The terrace is there for everyone for recreation, exercise but also for sheer practical things. A large part of it is green, it has solar panels on top of the stairwells that lead up to it.


Stories


5. Willem Bleeker
6. the Kassenaar family
7. the Castorp-Brons family
1. Jurjen and Desirée Harthoorn
11. Sonja Valk and Albert Koning


9 . the Hildebrandt family
10. Mr. and Mrs. Spier
8. Marius Proctor
3. Mr Keller senior
4. the Kerkhoven-Russel family
2. the Keller family

Stories of users

The key principle of Open Building is giving power to the occupants of a dwelling to shape it to their own requirements, wishes and preferences. This is done within the framework of the support. In order to investigate how this can be done a set of personas was made, after which each of these personas were given a suitable place in the project and a floorplan was developed according to their demands. The goal of this exercise is to investigate if and how user demands can be shaped into a home for them and if it is possible within the project to house different types and sizes of dwellings, including social housing. Another aspect that will be investigated is the repartitioning of the different blocks.

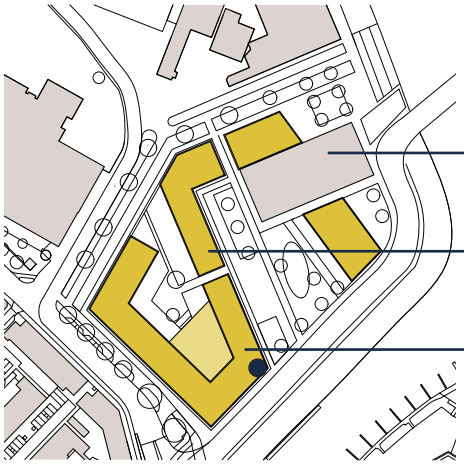
The personas chosen are a random set, it does not cover every possible way of dwelling. The personas are inspired by my own imagination and fascination for how people live, their habits, and how they use the space that is available to them. Although it is a random set, I did try to vary between traditional and more flexible occupants, old and young, higher and lower income and different lifestyles. Furthermore, an attempt was made to foresee possible changes in the way people dwell, such as an increase in the combination of workspace and home and non-traditional family composition. ways of living together. I chose to make the personas in the form of households, people sharing a house. For each of them there is a description of the composition of the household, relevant jobs, hobbies and habits, a short list of their wishes and the design that was made.

1. Jurjen and Desirée Harthoorn

A young architect couple of 28 and 30 years old who plan to work on their careers for about two years, after that they would like to have children. They regularly work from home and would each like to have a separate space for that purpose. Desirée would like to have a room reserved for herself. They are both vegetarian and would like to have an allotment garden. They try to live as sustainable as possible. They want:

- Extra bedroom for family to come, can serve as a guest room or study for now
- Allotment garden
- Separate study or workspace attached to living room
- Food market nearby
- Place where they can hang their laundry to dry outside

They have a corner maisonette on the third and fourth floor, it is 140 m^2

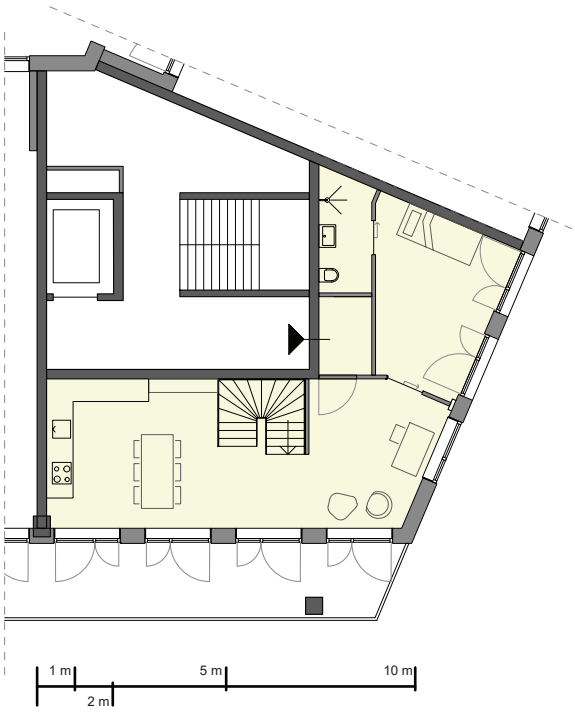


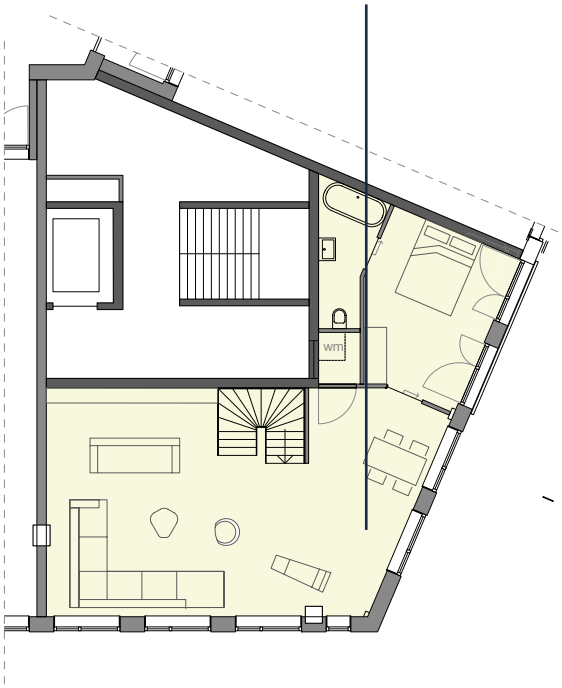
Space for small businesses and or shops

although there is no space for allotment garden, there is a small shared garden on the roof, which can be used for herbs and some vegetables

each stairwell has a seperate area on the roof that they can use to their own liking, can be used for drying laundry

Space for working playing (children) and reading on both floors





2. the Keller family

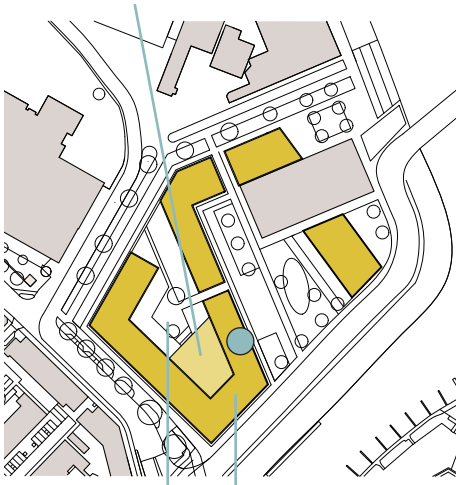
A family with two small children of three and six years old. Both parents work four days a week, they use daycare for their youngest and after school care for their eldest child. Mrs. Keller was born in Suriname and has an extensive family that often visit. She is a religious person and would like space to pray facing the east. Mr. Keller has a father of 70 years, who is also searching for a new place to live. They would like to live near him. The Kellers both use the bike as their main means of transport. They own a cargo bike to bring the children to school, daycare and do their shopping.

They would like:

- A large kitchen and a good size living room, with plenty of space for visitors
- Three bedrooms
- Bathroom with a tub
- A place where they can park their bicycles
- Quit place for prayer, facing east
- Vicinity of childcare

They have an appartment on the second floor of 135 m2 in the same block as Mr. Keller sr.

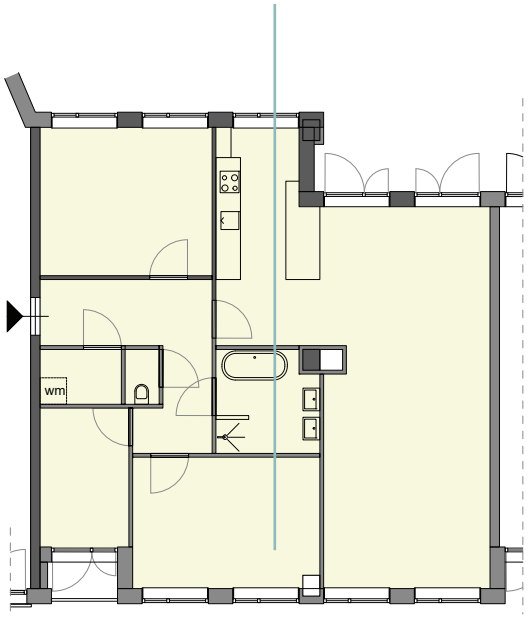
bicycle parking on ground floor

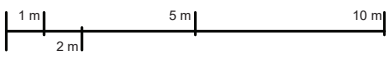


playground for small children in garden and on roof

daycare and school are nearby

Mrs. Keller can pray here if they make this their own bedroom or make a special spot in the living room





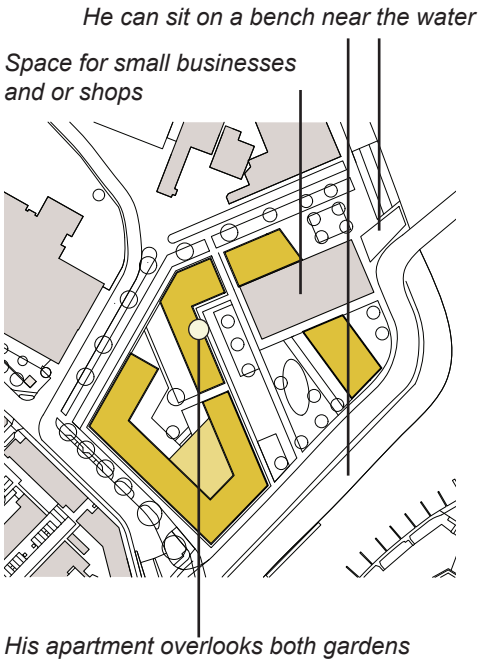
3. Mr Keller senior

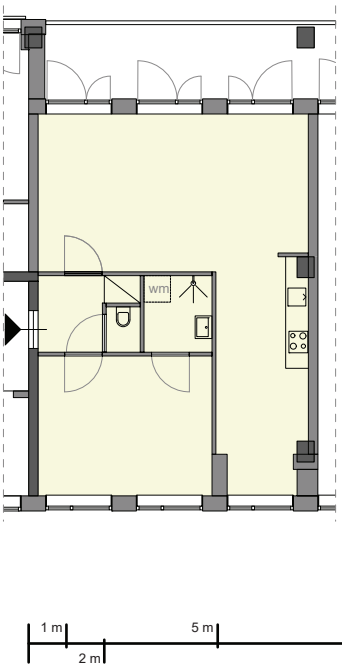
Mr. Keller was widowed a few years ago and since then he lives on his own. He is a pensioner, 75 years old and has two children, of whom one lives in the North of Holland. He still lives independently, and cooks his own dinner, but has some trouble walking long distances as his knees and back are worn from heavy work he used to do as a gardener. Sometimes he uses a walker. His son and daughter and law do the shopping for him once a week. He enjoys sitting on a bench with his mates, watching the boats on the canal. He is also a keen birdwatcher.

His wishes are:

- An apartment with an elevator
- Vicinity of a small shop where he can do some of the daily shopping
- A balcony where he can have plants and
- A view with greenery and trees so he can watch birds
- A bench near the waterfront

He has an apartment of 70 m^2 near his son, on the first floor



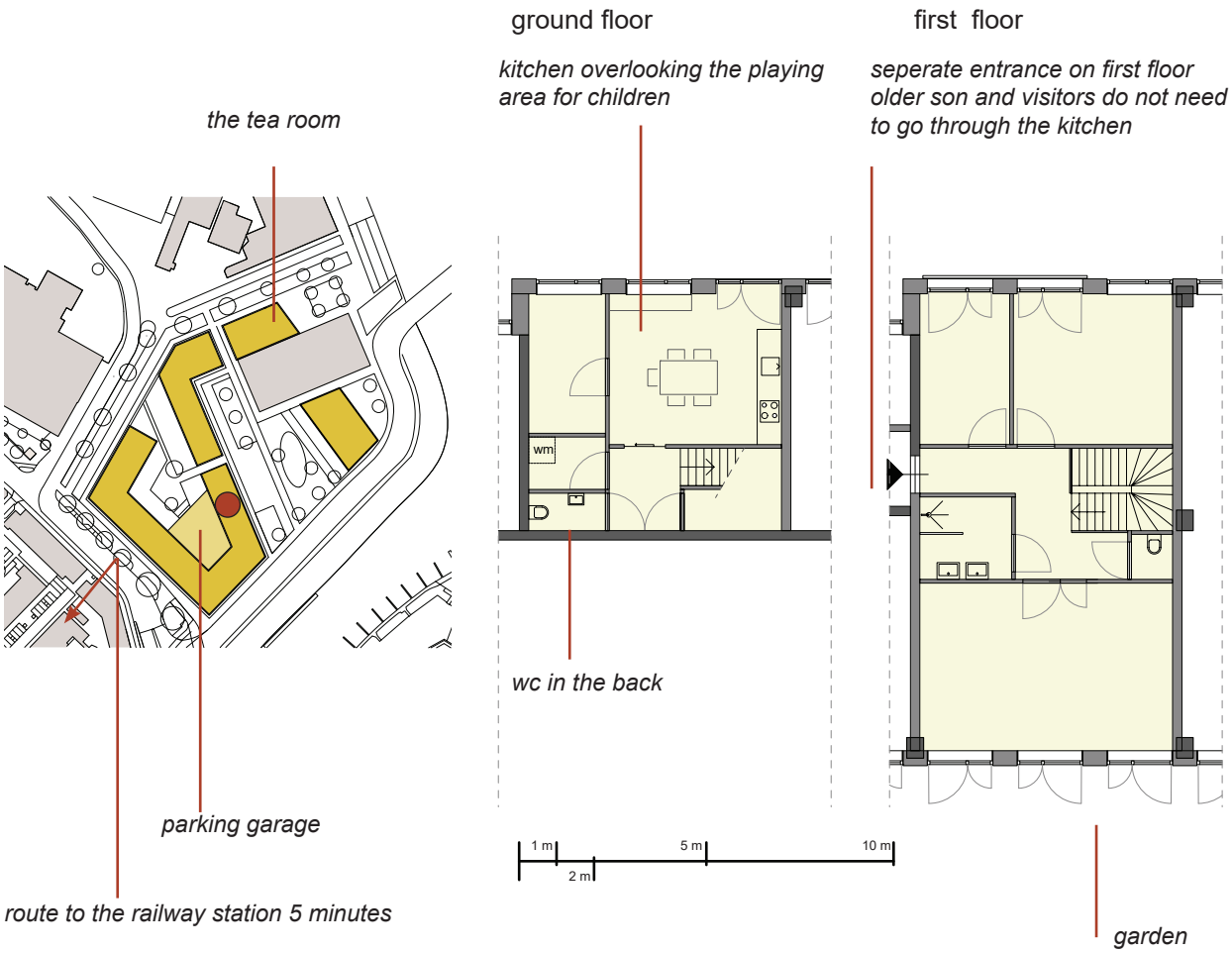


4. The Kerkhoven-Russel family

Rudolf Kerkhoven, 46 years old, married to Martha Russell (born in England). They have two sons, their eldest son lives on his own, their youngest plans to stay at home while he still studies. They take care of two foster children, twins of 6 years old. Martha likes baking and is planning to open her own bakery and tearoom. She practices a lot at home. Mr. Kerkhoven travels a lot for his work, for which he prefers to use public transport, but sometimes a car is very handy. The whole family enjoy company and like to throw barbeque parties. The foster children like playing outdoors, especially hide and seek and building huts. Rudolf Kerkhoven appreciates his privacy and would like a separate toilet where he can sit without being disturbed. They want:

- Parking space for their car or a shared car
- Garden for the barbeque parties
- Large kitchen
- Possibility for the children to play outdoors, preferably where their mother can keep an eye on them
- Separate bedroom for the son
- Accessibility to public transport
- Separate toilet, not adjacent to living room or kitchen
- Space to rent for the bakery and tearoom

They have a maisonette of 124 m² on ground floor and first floor



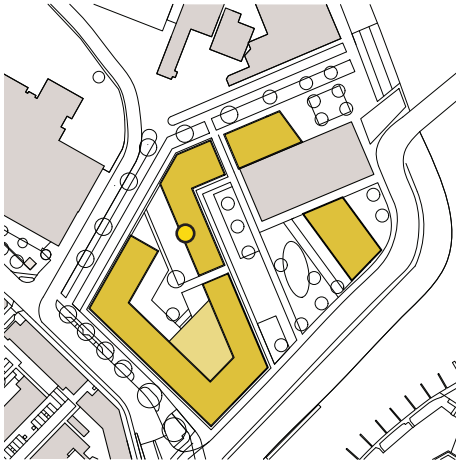
5. Willem Bleeker

A 22-year-old student who is a real sportsman. He plays volleyball and is a fervent cyclist. He is also a member of a student society and likes to go out on Thursday evenings.

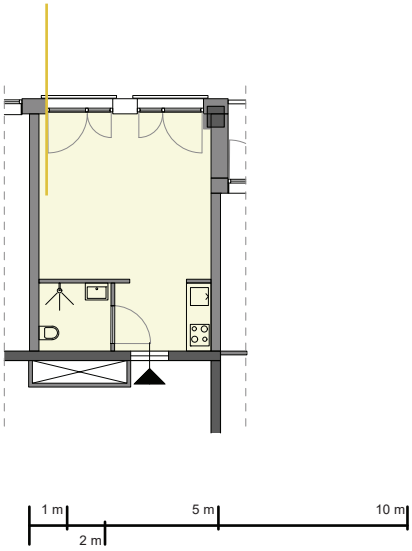
He would like:

- Small room with individual kitchenette and small bathroom
- Place to store his racing bike indoors
- Near the city centre

He has a room with a seperate bathroom and kitchenette (28 m^2) on the fourth floor



there is room for his racing bike to hang on the wall

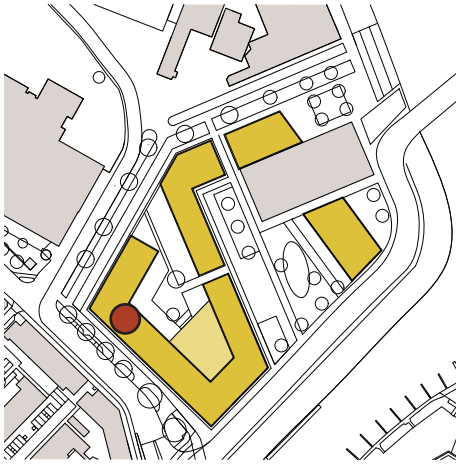


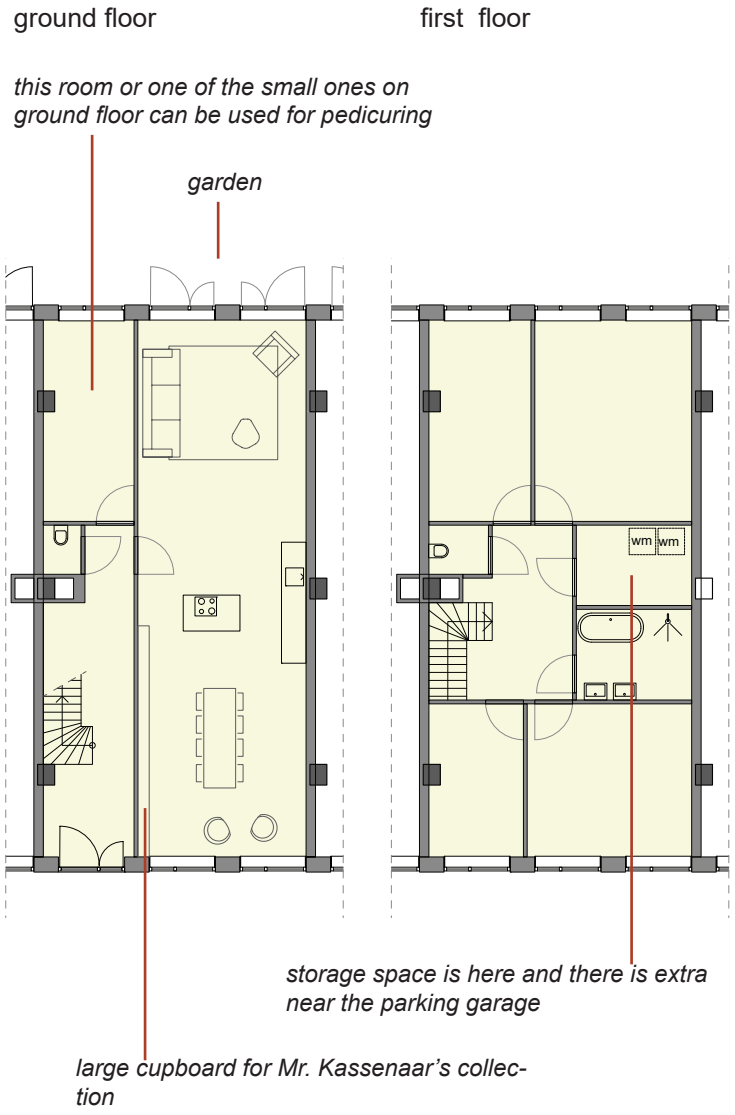
6. Koos and Tiny Kassenaar and their children

They have two older children still living at home. Their daughter Sophie is married and his two children of her own who frequently come and stay for the night when Koos and Tiny babysit. Tiny is a pedicure and works from home. Her hobby is needlework. Both like to sit outside in summer and cool down after a warm day. Koos and Tiny find it hard to throw things away, over the years they have collected too much stuff. One of the things Koos is proud of is his large collection of presse papiers. They need:

- Extra room for pedicuring
- At least three bedrooms and a spare room
- Outdoor space or garden
- No staircase in the living room
- Storage space
- A place to display the collection

They have a maisonette of 200 m^2 on the ground floor and first floor



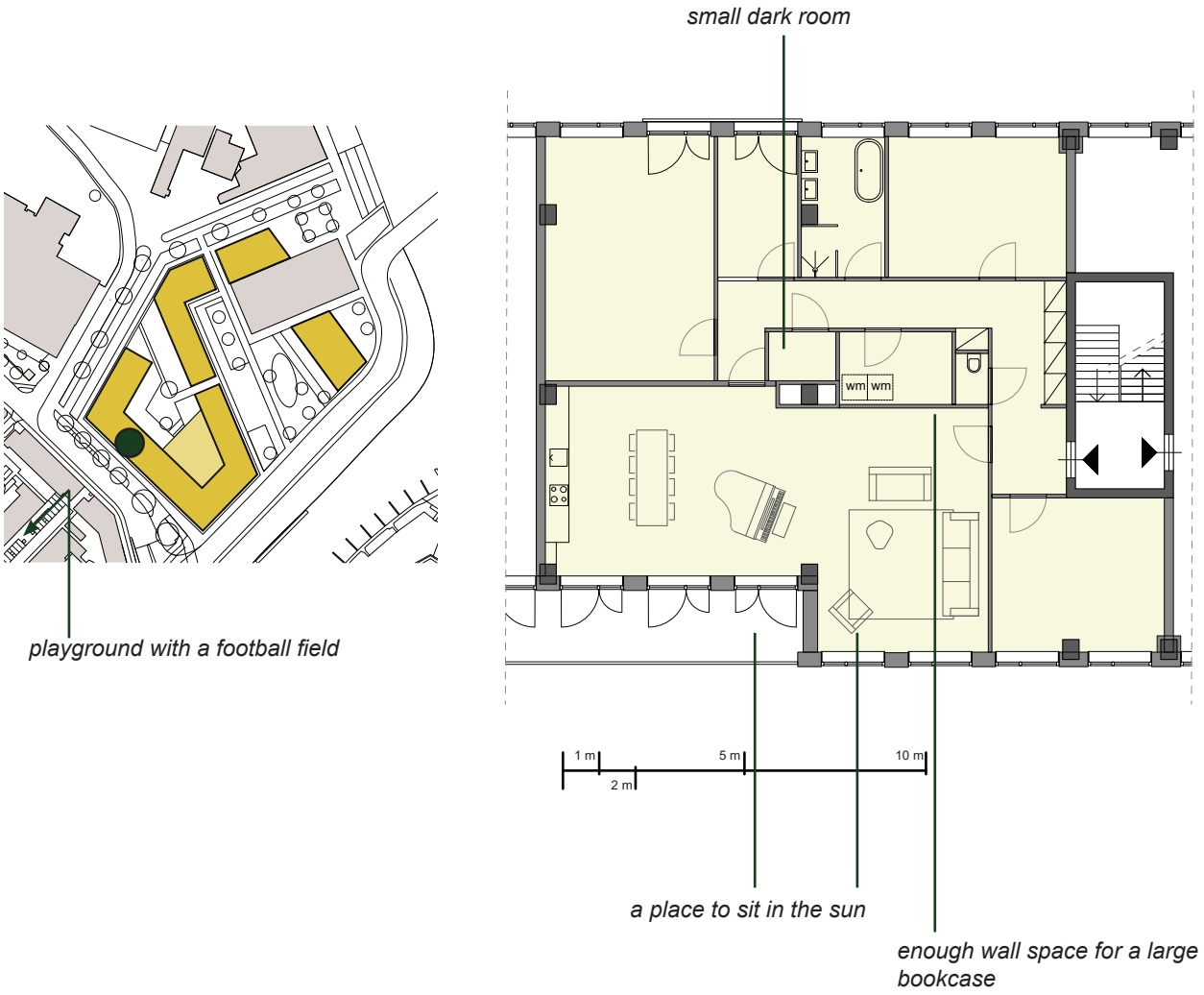


7. The Castorp-Brons family

Hans Castorp 42 and Ada Brons 40 have three children, aged between 10 and 15. They are a very musical family: they are both professional musicians. Ada and their daughter plays piano, one of their sons plays guitar and Hans is violinist. His hobby is photography, and he likes to develop his own photos in the old-fashioned way. They have a large library and Ada likes to sit in the sun to read. They both enjoy cooking and having friends over for dinner. Their son Max wants to become a footballer. Their wishes are:

- Large living room with enough space for a grand piano
- Room for a large dining table
- Ample kitchen space
- A place to sit in the sun, indoor or outdoor
- A small room that can serve as a dark room for developing photos

They have an apartment on the third floor of 200 m^2



8. Marius Proctor

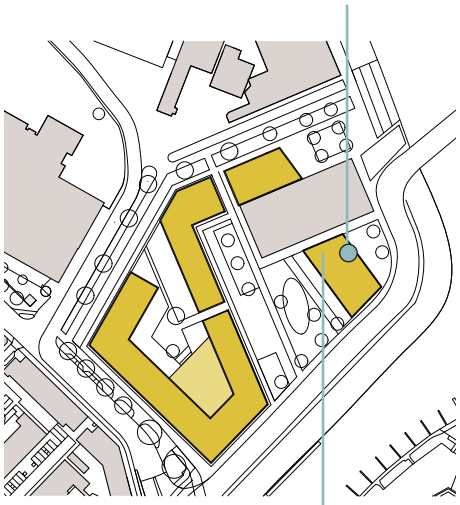
Marius Proctor is a writer, he is single and about 40 years old. He usually writes at home but has a part time teaching job in the afternoons at a secondary school. He likes to sit in front of the window and see what is going on without being too involved. It helps him to focus on the writing. He wants a simple apartment without luxury. He does not like cooking and usually only has bread, an orange and a vitamin pill for dinner. In the summer he likes to go camping on his own or with a friend. He has an extensive collection of novels.

He would like:

- A room with a view
- Primitive kitchen
- Not too noisy
- Large bookcase
- Storage space for his camping gear

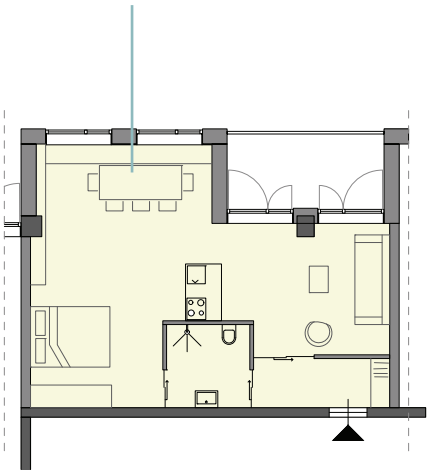
His 56m^2 apartment is near the waterfront on the fourth floor

apartment overlooking water and North of the city high enough to limit street noise



storage rooms on the ground floor of his block

large table overlooking the water

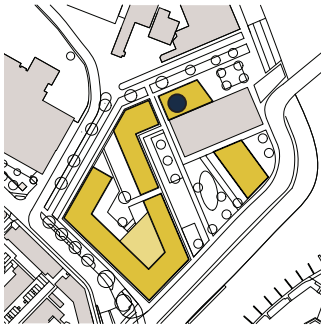


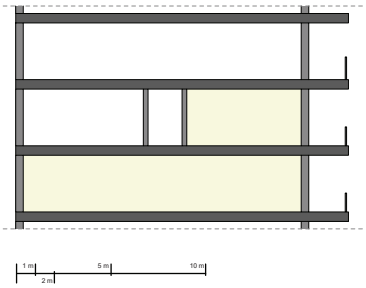
9. Russ and Marion Hildebrandt and their children

Want to have a very flexible space for them and their 3 children. They would like to have an apartment with partly an open floorplan where everybody can move around while they also have the possibility to separate themselves if needed. Their eldest child wants a seperate bedroom. They want:

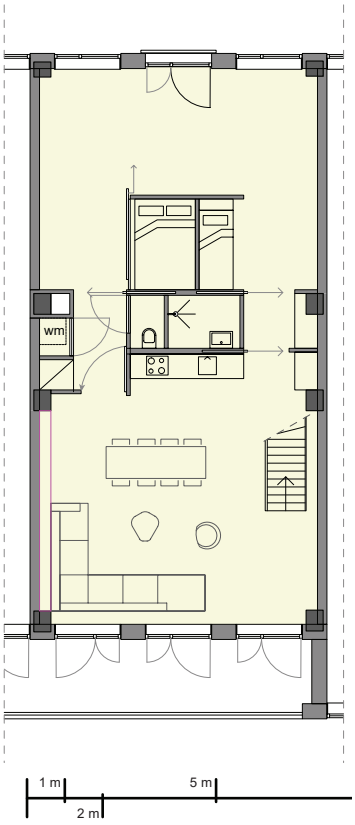
- Open floorplan for the largest part of their house
- Sliding walls or doors or elements
- The youngest children want to share a bunkbed

They have a 152 m^2 apartment on the second and third floor

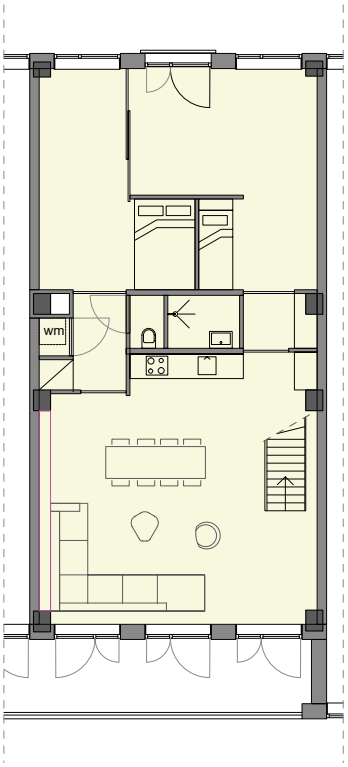




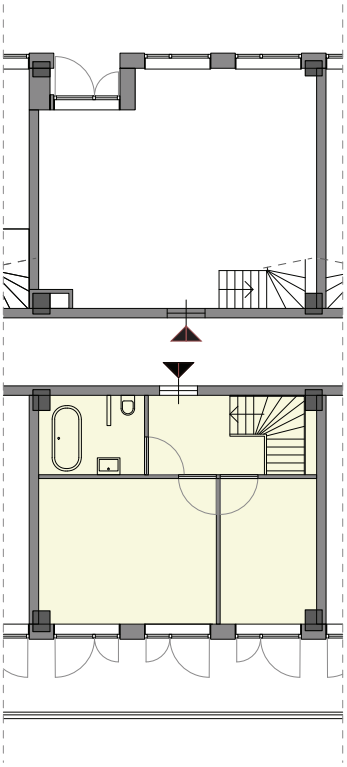
second floor open plan



sliding wall and doors are closed



the third floor does not have an open plan

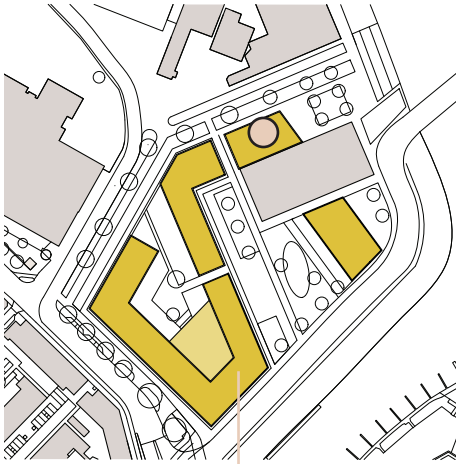


10. Mr. and Mrs. Spier

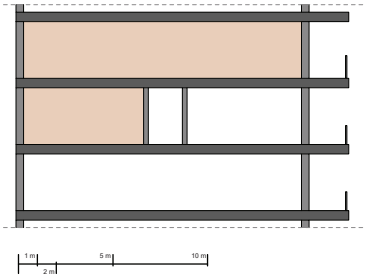
They are both in their 60's. Mr. Spier still works part time as a bookbinder. His hobby is his model railway. They have no children. Mrs. Spier is a few years away from her pension, she works as a sports teacher and likes to jog and do a workout daily. They have a dog, and both enjoy taking long walks. They want:

- Extra room for the model railway
- Outdoor space for jogging and/or workout
- Possibility to let the dog out

Their 95 m^2 apartment is on the third and fourth floor



Mrs. Spier can do her workout on the roof terrace and there are nice routes for jogging

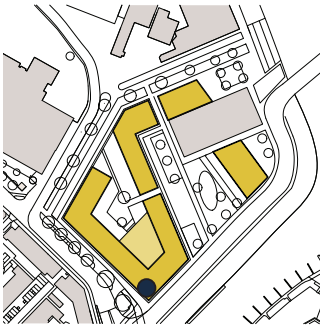


11. Sonja Valk and Albert Koning

A blended family. Sonja is divorced and has one child of 5 who is usually with her father, but comes to stay during weekends. Albert is also divorced and has two children that live with him part time and part time with their mother. They are in a relationship, but they value room for themselves as well. There is quite an age difference between Sonja and Albert's children. Albert is a very traditional man and wants a traditional living space. Sonja has a very different attitude. She likes to have a large open space where she can place elements as she pleases and change the layout if she feels like it. Kitchen and bathroom are of minor importance to her.Sonja is a photographer and wants a studio next to her apartment.

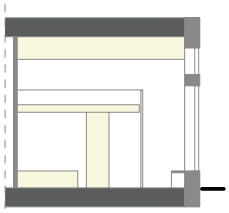
- Albert works night shifts would like a quiet place for bedroom
- Separate living spaces
- Possibility to come together
- Sonja: open space, possibility for change
- Sonja: room for her daughter to stay
- Sonja: space for her studio

They have two apartments connected by a staircase on the ground floor (65m2) and first floor (106m^2) So nja has a studio of 50 m^2

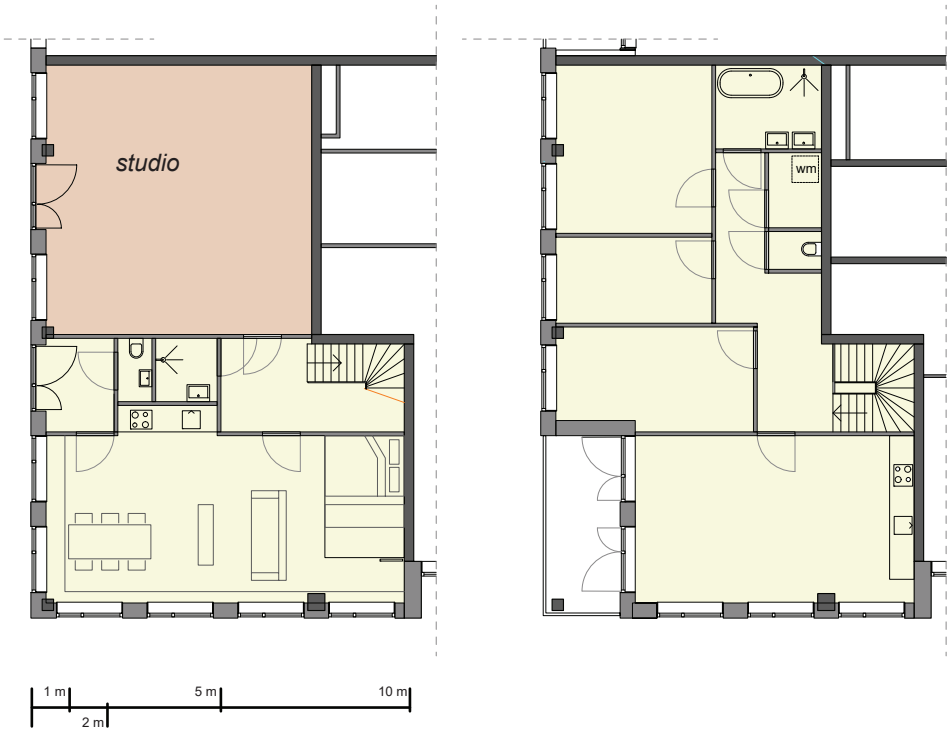


Sonja's apartment

Albert's apartment



a mezzanine for Sonja's daughter

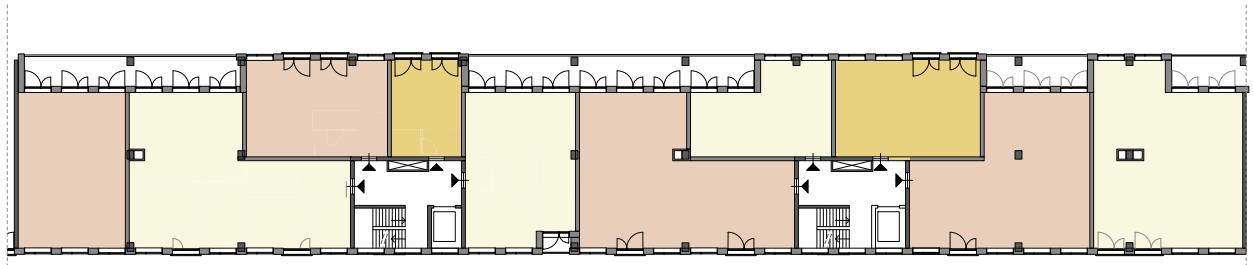


Reparcellation

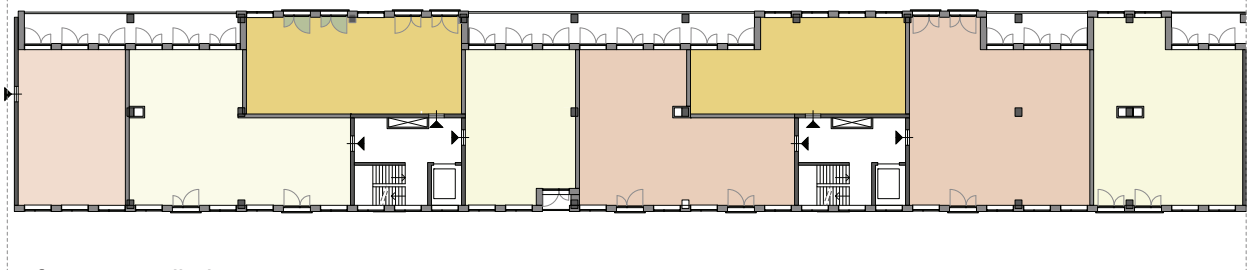
One of the reasons to choose a column and beam structure was having the possibility to make a different parcellation of the building blocks: a different distribution of the available space into apartments. This can include dividing a larger apartment in two or combining two apartments into one. Experience from the case studies showes that reparcellation can happen, though not very often. As long as the size of the apartments fits the market's demand there will be no need for redistributing space. In case of a need for a redistribution the technical and practical possibility to achieve this depend on different aspects of the building block.

For cluster one reparcellation is relatively easy. The floorplan is divided into eight units which each have a connection to the stairwell. If two adjacent apartments are available, it is simple to join them into one. Cluster two however has apartments that are accessed through a corridor. Joining two adjacent apartments is possible, but unlikely, since it would lead to very large apartments. Division of one apartment into two is difficult because there is only a corridor on the third floor. Change would probably mean adding a corridor on a different floor and closing opening in the floor for the stairwell. You may then repartition the block into smaller, one sided, units. However, half of the units will not have a balcony, be very small and entirely situated on the North.

For cluster three a proper attempt was made at reparcellation (see drawing below). Two one sided apartments can be joined into one and vice versa. Nevertheless, one must take care that after reparcellation the apartments each of the larger apartments still has access to a balcony.



before



after reparcellation

A possible way to make a different division of the apartments on one floor, in this case the fourth floor of cluster 3

A different method of reparcellation could be splitting up one two-sided apartment into two one-sided apartments. This means that either the stairwell should be large enough to give access to an extra apartment, or it can be done by adding a corridor through which extra apartments are accessed. In the last case the building block should be deep enough. The 15 meters of clusters 4 - 6 are not enough. Furthermore, there are still the problems of the orientation and the access to outdoor space. On top of this there is the problem of the vertical shafts. If more apartments next to each other are created more vertical shafts will be necessary. This provision should be made in advance, but that also means that in the apartments that are not split up there is an extra obstacle of a shaft.

A very thorough method of reparcellation could be changing the method of access. In cluster 5 an extra floor could be turned into apartments that have access through a gallery. Although this is possible, it can hardly be called reparcellation, since it would involve changing part of the floor and most of the façade.

A general conclusion that can be drawn from all this is that the possibility of redistributing units in a building block depends on access, balconies, depth and orientation of the building block. Reparcellation of a block that has a galery access (like in the case of Keyenburg) is easier than doing this for a block that has access throug stairwells. Reparcellation is also easier when there are balconies over the whole width of the block. When it is expected that that reparcellation may be necessary in the future, all these aspects have to be dealt with beforehand.

Reflection and Conclusions

Reflection on the design

The goal of the design was to create an open building that offers living space for a wide range of users from different social classes. The design should be able to respond to change. Change can include a change of the infill (layout) of a dwelling, a change in the distribution of available units among users (reparcellation), or technical changes in the services. In this section I would like to reflect on how far these goals were achieved. In addition, there will be a reflection on the graduation process and design process.

As was discussed the previous chapter, the redistribution of space turned out to be a very complex matter, depending on lots of factors.

structure

The choice for a column and beam structure gave the possibility to make a division of units (parcellation) with different sizes, which can also change(reparcellation). The dwelling dividing wall does not need to be on the structural grid and different sized dwellings can be placed on top of each other. This gives more freedom for residents to make a choice for a place where they want to live in the project. In the column and beam structure several things may be changed or redistributed. A disadvantage of this structure is that it can be an obstacle in the dwelling. This is the case when the dwelling is larger than one bay width and a column is in the middle of the apartment but also when the column is near the wall it will still stick out and it may complicate the making of the layout. In the infill layouts that were designed the position of the columns was never a real obstacle. Placing a large part of the columns near the facade turned out to be a good strategy. Another disadvantage of a wooden column and beam structure may can be the sound transmission in case the column is positioned in between two apartments. This led to the decision to make the dwelling dividing walls next to the structural gridline. Moreover, this way, the column only protrudes on one side of the wall.

A choice for the depth of the building block is also part of the choice for the structure. The choice for blocks of 13 and 15 deep, combined with a span width of 7.20 was, in hindsight, not beneficial for creating social housing. The floorspace of most dwellings has become too large. This also has to do with the effort to limit the number of stairwells in the building blocks, which was in its turn instigated by the wish to limit the number of elevators. The elevators are necessary because of the building height. Limiting the number of stairwells caused an increase in the number of bays between two stairwells, which led to larger dwellings.

skin

The ribbon can be regarded as a turning block from which parts are cut out at irregular intervals, where balconies are positioned. The choice was made in order to create a lively and varied façade image. The pattern of incisions makes the facade attractive. A disadvantage of this concept is that it is not so easy to redistribute (reparcellation) the building units, since every dwelling needs a balcony. Balconies over the entire width of the block would have made this redistribution much easier. The choice for the size of the window grid turned out to have a large influence on the design. The grid size for the windows is 2.4 m, that is a window of 1.75 m wide and 0.65 m between two windows. On one hand this size was good for the layout of the infill: a room of 2.4 m wide is still very usable, though maybe too large. On the other hand, the bay width of 7.2 m could not be divided into two equal parts of 3.6 m. A choice for a smaller window frame width would have made this easier.

scenery

No choice was made for a certain package of infill walls and facilities, though there are several systems on the market. The structure proved to be suitable to create dwellings for different people, with different wishes and demands. Vertical shafts and columns were sometimes in the middle of an apartment, but it was still possible to design a good infill layout for these dwellings.

services

I am happy with the choice made for the Slimline floor. It gave a lot of freedom in the placement and services and can respond to changing demands. Nevertheless, there is a slight disadvantage of the height of the floor and probably there is a very high price tag on this floor. The choice for the vertical shaft positioned in the middle of some of the apartments is something I am less happy with. It was necessary to give each dwelling access to services but complicates the infill design.

acces

Of all the puzzles that were made during the design the one of the access and the stairwells was the most complicated. The complexity of the ribbon shape, the scale of the blocks and the wish to optimize the ratio between access and dwelling space made the placement of stairwells very complicated. Sometimes the distance between two stairwells was too large but placing one extra would make the distance between them too small. Blocks of 15m deep are not suitable for making a corridor access. The stairwells in the corners of two blocks were the most difficult to design. All-in all, it was an exercise that taught me a lot. However, the conclusion that can best be drawn from this is that for designing access it is probably a good advice to keep your block as simple as possible.

Overall, I am content with the possibilities this building gives to occupants to 'make' their own home. The goal to create social housing was not as successful as I wished, a choice for a less deep building block would have been better for this. I think that in this phase the decisions were mostly influenced by the design of the urban layout and what was necessary for that. Maybe the choice for a simpler urban layout would have benefited the architectural design. This was a very educational experience as well.

process

Regarding the design process I must admit that it was conducted in a more or less familiar way. It was hard to make decisions, trying to make everything perfect. My head was filled with numerous aspects, all demanding attention. Some decisions were postponed, some extra research was done, eventually decisions had to be made, and then I was still not completely happy. As always, I would like to have done more and reach a higher quality of finish. On the other hand, I am proud of myself that I did make decisions and accepted the consequences and that I did finish it. I am happy that I was able to put so much of myself into this graduation process and into my design and research. I am happy that I did apply an investigative manner of designing, by having different block depths, different access types and infill layouts.

Conclusions

In the introduction an assumption was made that a difference between Open Building then and Open Building now was the size of the dwellings of Open Building as well as for whom these projects were realized. The comparison of the case studies showed that this assumption was right. It also explained why the difference occurs. Open Buildings now are all Collective Private Ownership, Open Building in the 70's and 80's was financed in a different through subsidies. Nevertheless, van der Werf describes that also at that time the architect was constantly pushed to make or keep things affordable (Van der Werf, 1993). The difference in finances leads to visible differences in the scale of projects, the average size of dwellings, but also in the quality and appearance of the infill. This, however, does not completely answer the first research question. There are more differences in appearance: different floor types, services (floor heating), different structural and non-structural material, a different shape of space (lofts) and a different way to handle the transport of ducts and pipes. Changes in Open Building projects are not only prompted by different financing but also by the changing society, fashion and innovation.

Besides that, there are changes that are not directly visible in the buildings: the role of the architect has changed, in modern projects he is often the initiator. Furthermore, the nature of Open Building has slightly changed. Its main focus is no longer creating mass housing, the attention has shifted towards sustainability. An overall conclusion is that Open Building, which is intended to respond to change, is also changing itself.

It may be so that in the practical sense Open Building has become something that is less affordable to people with a low income, but in the ideology that is not the case. The manifest of openbuilding.co still speaks of 'inclusion' and 'community development'. What has changed are the challenges we are facing and the threats of the current society. This change is reflected in the mission statement of Open Building. So, we see that each society responds to the threats and challenges of its time. In 1961 the threat was the monotony and uniformity, and the challenge was solving the housing shortage, in 2022 the threat is climate change and one of the challenges is still, or again, the need to house a lot of people.

Is it possible to make an Open Building design that offers living space for a wide range of users from different social classes?

This was the goal set for the design and even before the design started it became clear that financial aspects would probably frustrate this goal. The reflection on the design shows that this goal was not completely achieved. The amount of smaller dwellings in the project does not match the demand for them. The design does, however, show that it is possible to create a building with a mix of smaller and larger dwellings and very divergent floorplans. In principle it is possible to make an Open Building design that is sustainable and inclusive.

An advice for the future would be to keep promoting and developing the concept of Open Building and to create open buildings to gain more experience and thus create a constant flow of improvement, because I firmly believe this concept may help us to build in a truly sustainable way. A further recommendation would be for politics to revise the method of financing housing in such a way that there is not only an incentive to make money on a short-term, but also make sustainable investments that will pay themselves back in the long run.

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Fig. 1.3.3 Leupen, B. (2006) Analysis frame and generic space of the Dom-Ino house, Frame and Generic Space p. 72
Fig. 1.3.4 Schmidt, R. & Austin S. , (2016) Categories and strategies for adaptable image diagram Schmidt Austin retrieved October 26, 2021 from https://www.researchgate.net/figure/Design-strategies-for-adaptability-in-buildings-Source-Adaptable-Futures-2012_fig1_310081146
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