

# OP EN TOP WONEN



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**You once came into this world,  
like a gift from heaven.**

**We wanted you and needed you  
more than ever.**

**We grew up in you  
lived in you.**

**Celebrated, danced, argued, and slept in you.**

**We grew up.  
The world kept turning.**

**We have all changed.  
But you are still there,  
exactly as you were then.**

**Let us adapt you,  
paint you, grow you  
and shrink you and care for you.**

**So that you fit again,  
into tomorrow.**

*Ooit kwam in je deze wereld,  
als een geschenk uit de hemel.  
We wilden je en hadden je nodig,  
meer dan ooit.*

*We groeiden op in je  
leefden in je.  
Vierden, dansden, ruzieden en sliepen er.*

*We werden groot.  
De wereld draaide door.*

*We zijn allemaal veranderd.  
Maar jij bent daar nog,  
precies zo als toen.*

*Laat ons je aanpassen,  
je verven, je groeien  
en krimpen en verzorgen.*

*Zodat je ook weer past,  
in de dag van morgen.*

## Abstract

The architecture and construction sector is struggling with a number of major problems. These problems are linked to global crises concerning: ecology, social themes, economy, and the individual. This accumulation of problems can be summarized as the housing crisis, which is widely recognized nationally. This report provides an analysis of these problems and links them to available solutions. According to several experts, part of the solution to the housing crisis appears to lie in transforming existing homes by splitting them and, where necessary, expanding them.

This report specifically investigates how existing rowhouses in the Netherlands can be transformed through splitting and, where necessary, expansion. The aim is to explore the potential for this solution to the housing crisis. Through interviews with experts, the requirements and themes important for this type of project are examined at a practical level. Furthermore, design research into spatial possibilities is conducted through experimentation.

As a result, a design has been created based on a developed concept. This concept can be used as a tool to tackle a project in which existing rowhouses will be transformed. Advice and recommendations are also provided for future projects.

**Keywords:** Rowhousing, Transformation, Splitting, Expansion



# 01 THE PHILOS introduction

SPHY



# 1.1 PROBLEM STATEMENT

In December 2023, the Netherlands receives a failing grade from UN rapporteur Balakrishnan Rajagopal, who calls on the Netherlands to urgently get its housing in order and protect people's rights, namely: the basic right to a home. The warning stated that the Netherlands must

arrange healthy, structural housing while keeping climate change and energy transition goals in mind, and all of this without discrimination (UN, 2023).

Three years later, the situation does not appear to be much better. It is time to work on structural solutions.

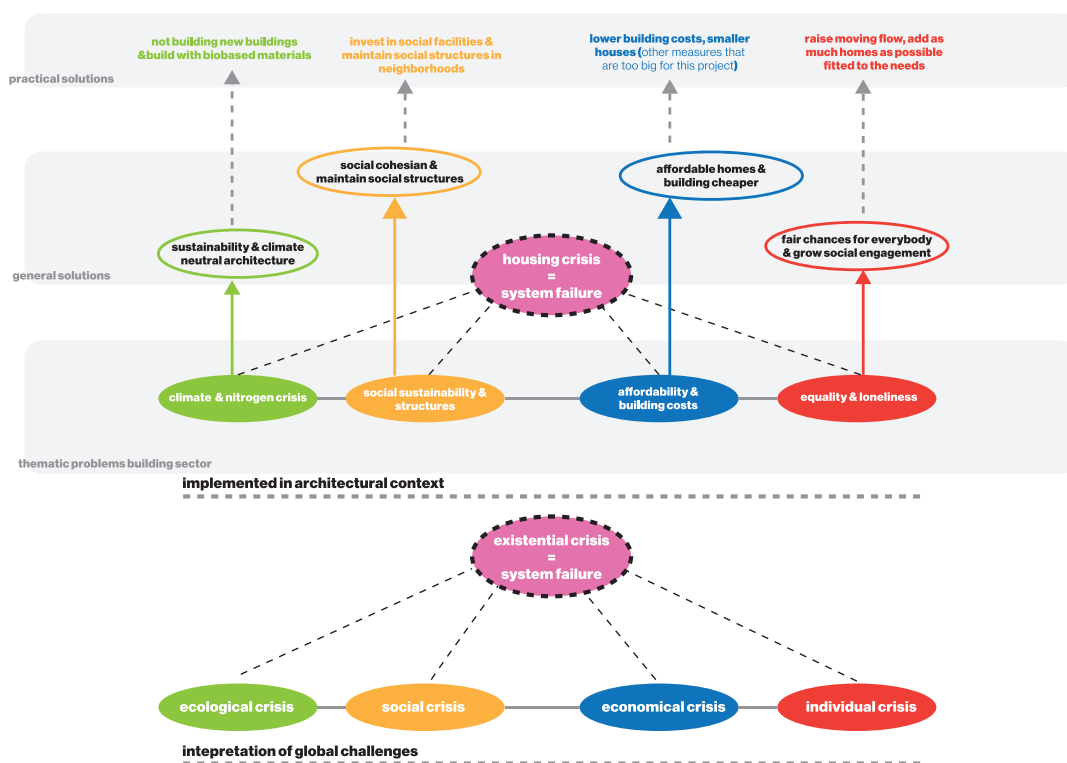


figure 1: own image. Diagram of problem statement

In 2022, the book *Betekenis Economie* (Economy of Meaning) by researcher and writer Kees Klomp is published. The book sketches a global situation in which the benefits of our prosperity economy and positive progress no longer outweigh the costs we incur. Four crises have emerged in society: *the ecological crisis, the social crisis, the economic crisis, and the individual crisis*. Together, these four crises form a larger, overarching crisis: *the existential crisis*. A so-called systemic crisis (Klomp, 2022).

The four crises cannot be understood separately from one another, but must be understood in relation to each other. Although it is

not a cheerful story, it is important to draw these connections in order to arrive at an integral solution. For this graduation project, this link is interpreted to the architecture and construction sector. The sector is experiencing a similar accumulation of problems and also appears to be failing as a system. Within architecture and construction, the four crises can be translated as the following:

- **Ecological crisis:** climate change and nitrogen issues, material scarcity, energy transition (Copper8, 2024)

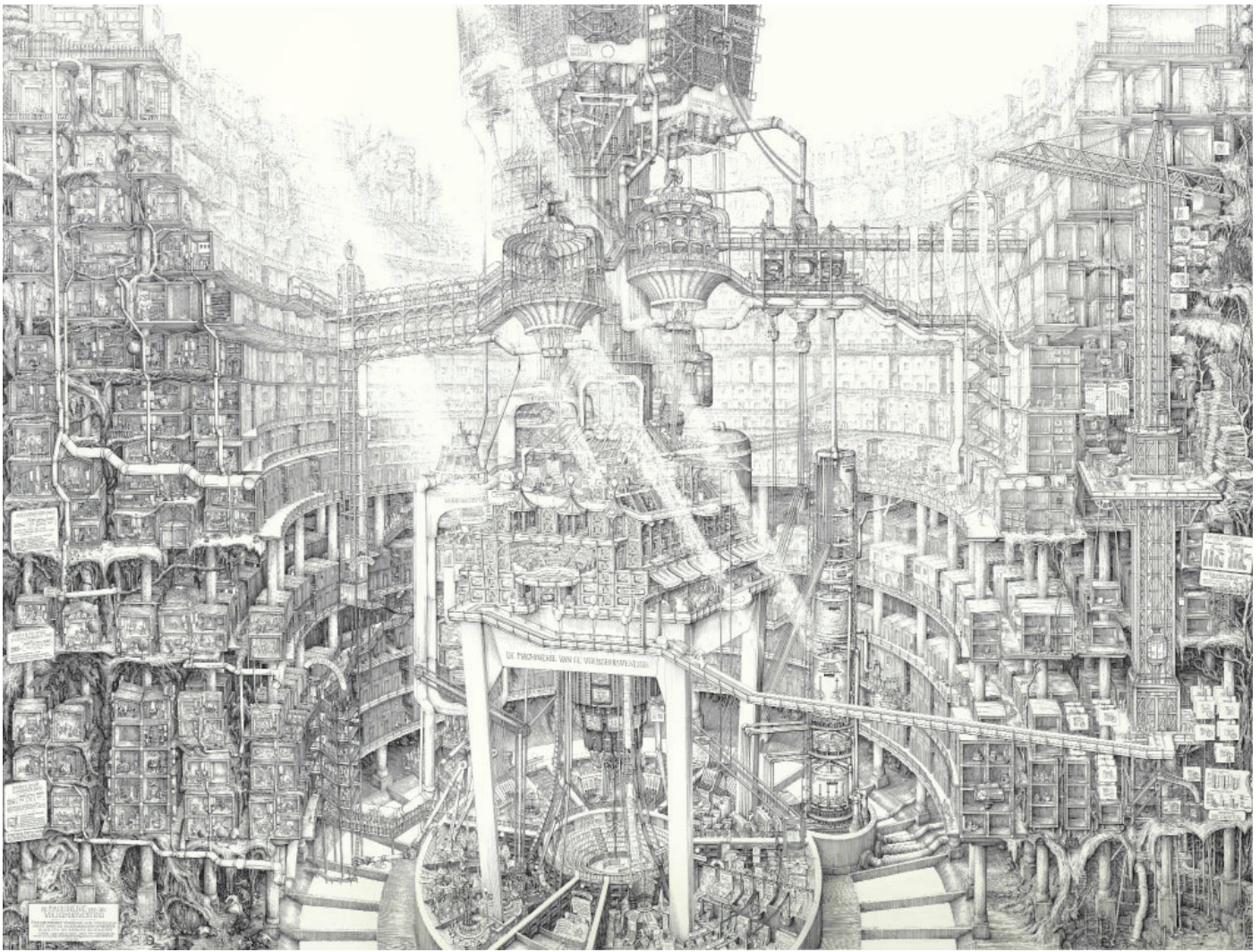


figure 2: Kingma (2025) *The Machinery of Public Housing*

- **Social crisis:** growing inequality, social unrest, rapidly changing demographics, polarisation through AI and Big Tech (Platform Woonopgave, 2025; Berger et al., 2023))
- **Economic crisis:** housing scarcity, unaffordable housing, high land prices (Bollen, 2025)
- **Individual crisis:** loneliness, inequality (Platform Woonopgave, 2025)

In diagram 1, practical answers to the problems are also provided through the four major themes. The combined answer of these solutions leads to the same conclusion: by transforming, splitting, and extending existing homes, one creates housing in a sustainable, affordable, fast, and social way.

Complex problems cannot be solved with simple solutions, especially not when the problems are intertwined with one another.

In a 13-minute video by Carlijn Kingma, the system is exposed and answers are provided through her illustration: *De Machinerie van de Volkshuisvesting* (The Machinery of Public Housing, 2025). Although most answers are solvable through policy, law, and economics, one solution is also mentioned that can be directly addressed through architecture. Kingma identifies the transformation, splitting, and where necessary the extension of existing homes as a practical solution to the housing shortage and general housing crisis.

## Housing Stock

A given that supports this research and its starting point are the current figures of the Dutch housing stock and the associated demographics.

To begin with the housing stock. In order to split and transform homes, there first need to be homes that are suitable for this purpose. When looking at the current housing stock, one particular housing type stands out: the rowhouse. Nearly half, 42% of all homes in the Netherlands are rowhouses (Platform Woonopgave, 2025). This amounts to over three million homes. These homes were designed as single-family dwellings, with an average usable floor area of 80m<sup>2</sup> - 120m<sup>2</sup> (CBS,2026).





bouwjaar woningtype	< 1945	1946 - 1964	1965 - 1984	1985 - 2005	2005 - 2024	totaal:
 Vrijstaand huis	288.100	143.300	231.800	253.000	139.000	1.055.200
 Twee-onder-één kap	172.200	139.100	163.900	148.700	87.900	711.800
 Rijtjeswoning	439.300	461.400	1.273.600	828.800	415.600	3.418.700
 Meergezinswoning	575.600	399.600	774.800	628.900	635.600	3.014.500
						<b>8.200.200</b>

figure 3: Platform Woonopgave (2025) Dutch Housing Stock

When looking at demographics, something equally noteworthy can be observed. The current average household size is 2.14 persons, lower than the average in 1970, which was 3.2 persons (Platform Woonopgave, 2025). A trend forecast also shows that in the coming years there will be a significant rise in elderly people living alone and a decline in births. In addition, there are more divorces and first-time home buyers are staying single for longer (Ministerie VRO, 2025).

Anyone who does the math will quickly come to the conclusion that there is an imbalance between the number of square metres in homes and how many people actually live in them (53m<sup>2</sup> per person, higher than in surrounding EU countries). This can, and must, change. Research by KAW (2020) shows, for example, that the ideal square footage for a home for two people lies between 50 and 70m<sup>2</sup>.

Personen in huishoudens, 2025

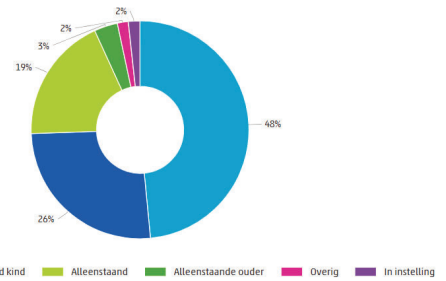


figure 3: CBS (2025) Numbers on Dutch Households

## What are we waiting for?

There is therefore a great deal of space to be found within the existing built environment. This provides a reason to investigate how we can make better use of this space. Large-scale research has yet to be conducted. Pilot projects and in-depth research have not yet taken place. This project is going to change that.

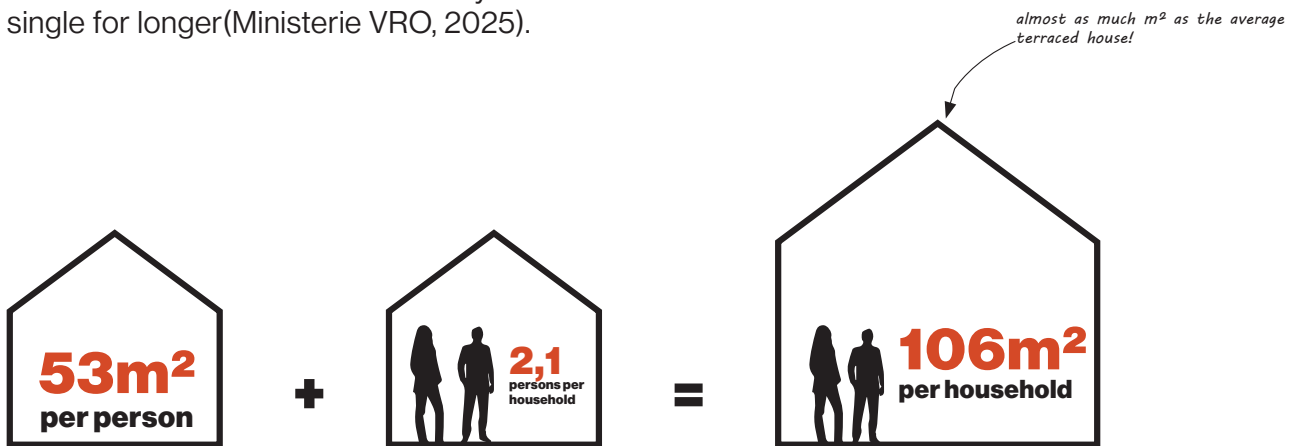


figure 4: own image. Equation of householdsize and m<sup>2</sup>

# 1.2 RELEVANCE

The relevance of this research lies in its direct potential to address the acute housing shortage in the Netherlands in a realistic, scalable, and environmentally responsible way. As previously mentioned, research indicates that with splitting just 5% of the existing Dutch terraced housing stock would already be sufficient to resolve the most urgent housing shortage (Platform Woonopgave, 2025). This finding alone highlights the enormous latent capacity within the current housing supply and underscores the urgency of exploring strategies that unlock this potential.

The importance of this approach is further confirmed by recent policy-driven research. Platform Woonopgave (2025), commissioned by the Dutch government, published the study *Beter Benutten Bestaande Rijtjeswoningen* (Better Use of Existing Terraced Houses), which explicitly identifies splitting of terraced homes as a key strategy for relieving housing pressure. This publication demonstrates that the topic is not only architecturally relevant but also socially, politically, and economically significant. Moreover, it signals a clear shift toward more sustainable forms of densification within the existing built environment.

The publication of this study has functioned as a starting signal for broader engagement with housing subdivision. Since its release, multiple architectural practices, municipalities, and housing authorities have begun investigating the

spatial, legal, and social implications of splitting existing homes (Volkshuisvesting Nederland, 2026). This growing interest reflects a wider recognition that the housing crisis cannot be solved through new construction alone and that the transformation of existing residential typologies is an essential part of the solution. Ever since, on a weekly basis, this topic is discussed in the news, books, newspapers, Linked-In, and even contests are set out, all to spread the message. For this project, noticing this trend, it has been an extra drive to enhance this project.

Within this context, the present graduation project positions itself as both adequate and necessary. By focusing on splitting and transformation of the terraced house and its housing block, the research contributes to an emerging field of examination that bridges architectural design, housing policy, and societal change. It aims to provide spatial insight and design-based knowledge that can support policymakers, designers, and municipalities in implementing subdivision strategies at scale, thereby reinforcing the broader relevance and impact of the project.



figure 5: own image. Experts on the theme



figure 6: own image. Relevance of theme

# 1.3 OBJECTIVES & MOTIVATION

This project aims to create a clear architectural precedent for how existing terraced housing can be transformed to respond to the demands of the current housing crisis.

By rethinking and reconfiguring what is already built, it demonstrates how spatial quality, affordability, and housing quantity can be improved without relying on new construction. Instead of adding more buildings, the project focuses on adapting the existing housing stock to contemporary living patterns and social needs. In doing so, it proposes a sustainable alternative to large-scale development, showing that healthy, affordable, and sufficient housing can be achieved through thoughtful transformation rather than expansion.

For this graduation project the following goals are defined:

**Goal 01.** Not build new buildings & when build, build with biobased materials

**Goal 02.** Adding the minimum amount of material and m<sup>2</sup>

**Goal 03.** Bring back the balance between m<sup>2</sup> and household size (aanjagen doorstroom)

**Goal 04.** Actively promote social cohesion

**Goal 05.** Actively protect and serve the basic human right of having shelter and tackle injustice

## **Bigger impact**

Another goal for this project is to try to create a systemic approach. The goal is to understand what is needed to create this type of project on a larger scale than just one block. The aim is to create an approach that could be used on a large scale throughout all of the Netherlands.

# 1.4 RESEARCH & DESIGN QUESTION

The main question in this graduation project is the following:

How can **existing rowhousing** be **split & extended** by using **timber construction**?

To answer this, two research questions are asked. One is technical and practical based, the other one is design based.

Question one is: **What are the rules and regulations** to split & extend existing rowhouses?

Subquestions to this question is:

- what are constructive, climate technical and building physical requirements?

Question two is: **How to design** to split & extend existing rowhouses?

Subquestions to this question is:

- how to deal with the existing situation?
- what are splitting & extending strategies?

# 1.5 SCOPE

## A broader approach

This graduation project attempts to look at the issue from two sides. On the one hand, it seeks answers through a specific project, but there is always a broader context present.

The overarching theme is the rowhouse in general. How can an answer be found on a large scale that can be applied on a small scale? To explore this, the project frequently zooms in and out. It is important to first briefly shed light on the bigger picture.

In the Netherlands, there are approximately 2,460 row house neighbourhoods (Platform Woonopgave, 2025). These neighbourhoods are often found in Vinex districts, but also outside city centres. They can essentially be found everywhere, as they appear in small villages and even in the middle of nowhere in formations of two. Below you can see a brief analysis of the types of terraced house neighbourhoods().

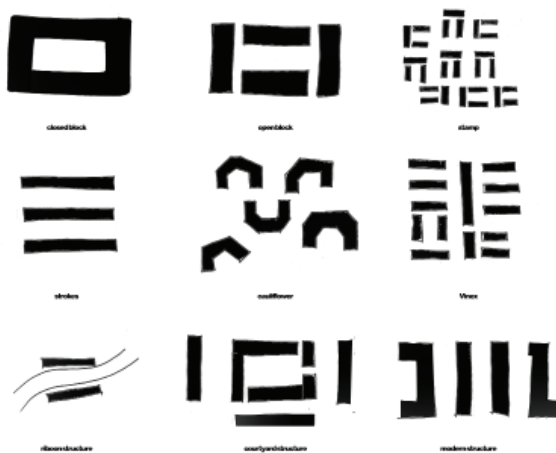


figure 7: own image. Urban typologies

The terraced house as a typology actually dates back to the Middle Ages. The Netherlands has a rich tradition of building terraced houses. It was not until after the Second World War that the construction of these homes was frequently used (Hulsman & Kramer, 2013). As a result, there is an enormous peak between of rowhouses build between 1965 and 1984(CBS,2026). The terraced house lends itself to fast, affordable construction that can be developed in series. Anyone who thinks that all terraced houses are the same is mistaken. In fact, hundreds of differences can be found between the various housing types.

A common typology is the *doorzonwoning*, which emerged after 1960(Hulsman & Kramer,2013). Light and a connection with nature were important. In 1980, terraced houses became more sober. There was an economic crisis, so materials were expensive.

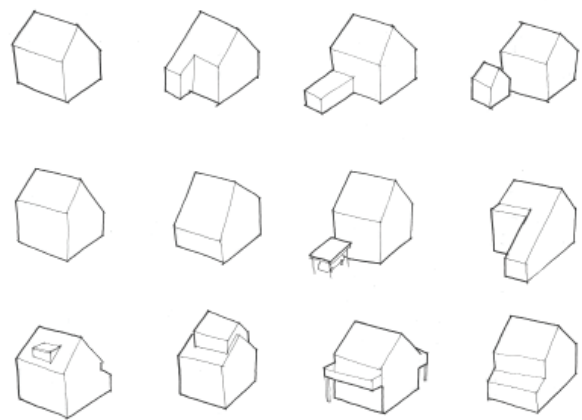


figure 8: own image. Rowhouse typologies

Important to this project is the function of the terraced house. After the war, there was a great need for better and larger homes. The rowhouse offered a way out and provided quality family housing. A true palace for the ordinary citizen(Hulsman & Kramer, 2013).

For a long time, the rowhouse was a sufficient design for a society in which the family was central. However, in today's society, the terraced house as a single-family home is no longer the most obvious type of housing. As described earlier, we now live with fewer people in one house. The families that once bought the terraced house are now left with just the two of them( Otten,2026).

Yet terraced houses are not meant to end up on the dumping ground. Terraced houses (especially those built between 1960 and 1990) lend themselves perfectly to large-scale transformation. The construction and structure of these homes provide a solid foundation for splitting, extending, and transformation. By transforming just 5 to 10% of these homes, the acute housing shortage could already be resolved (Financieel Dagblad,2026).



figure 9: images from Funda.nl

## Location Choice

For this project, the given location was the centre of Amsterdam. However, because my project involves a very specific typology, the centre of Amsterdam was deemed unsuitable due to the lack of this housing type.

Outside the centre of Amsterdam, however, there were plenty of neighbourhoods featuring rowhouses. From Amsterdam North to South, the homes can be found everywhere. The reason this particular housing block stood out was related to both the form of the block and its location. The year of construction and the type of row house were also reasons to choose this block.

The housing block is a independent block, which brings architecturally interesting challenges and possibilities. The block is also situated in isolation from other terraced houses, making it a perfect test location. The year of construction of this project is 1989, a good example, as the period between 1960 and 1990 saw the highest number of homes built that are now in need of renovation, and this period also saw the greatest number of terraced houses constructed. Finally, the homes are in their form the

most basic typologies, without any extensions. The sober appearance was also a reason to embrace the aesthetic challenge from an architectural perspective.

## The Block

The housing block consists of 29 identical row houses that are mirrored at regular intervals. The north and south rows each contain 10 homes, and the east side contains 9. The interior space of the block consists entirely of back gardens with storage sheds and is accessible via narrow alleyways.

## The Homes

The homes themselves have a usable floor area of 115m<sup>2</sup> and a garden of approximately 85m<sup>2</sup>. The floor plans are standard, with a living room, kitchen, and toilet on the ground floor, three bedrooms and a bathroom on the first floor, and a fourth bedroom in the attic. The windows of the homes are, unlike those of the *doorzonwoning* houses, fairly small. The facades are clad with yellow brick and a strip of red brick on the first floor.

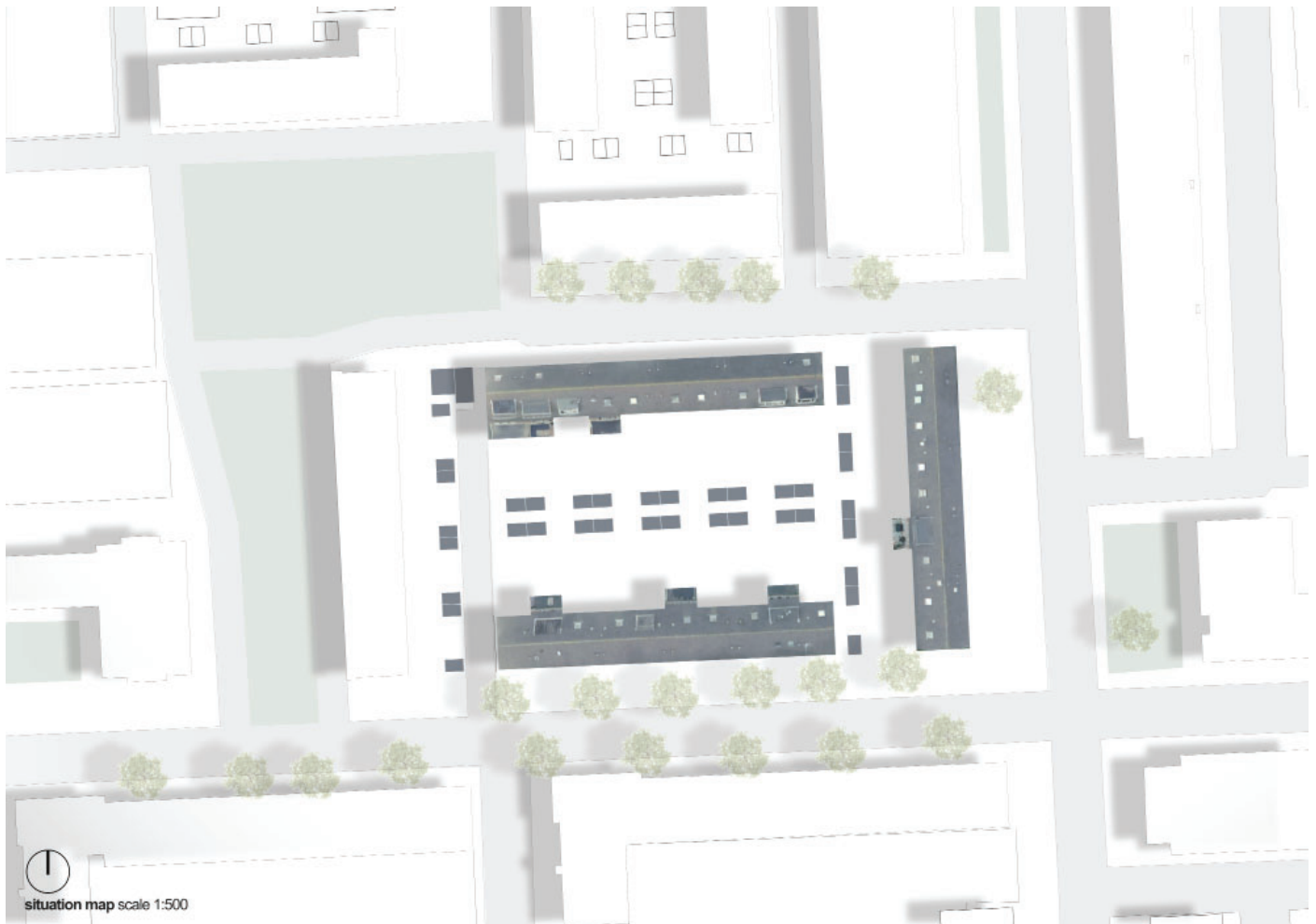
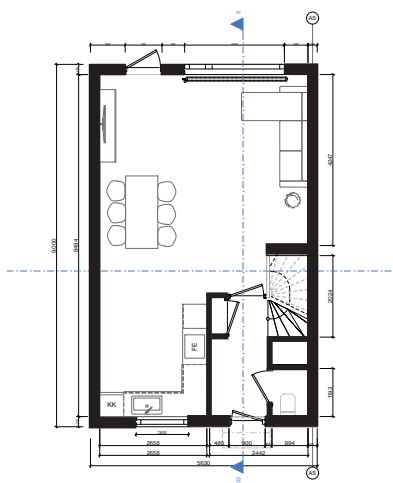
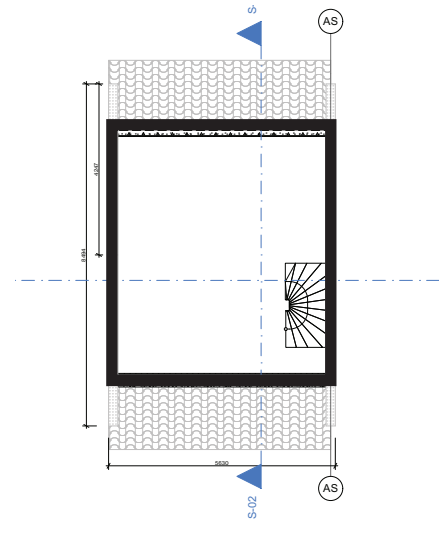
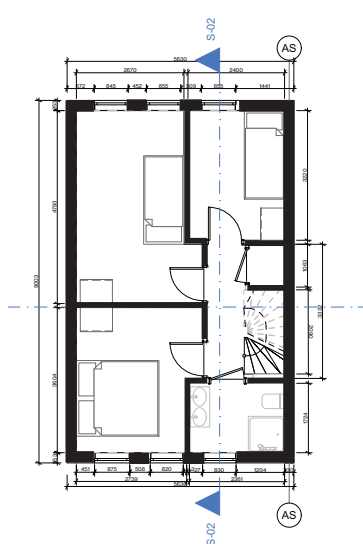




figure 10: own images

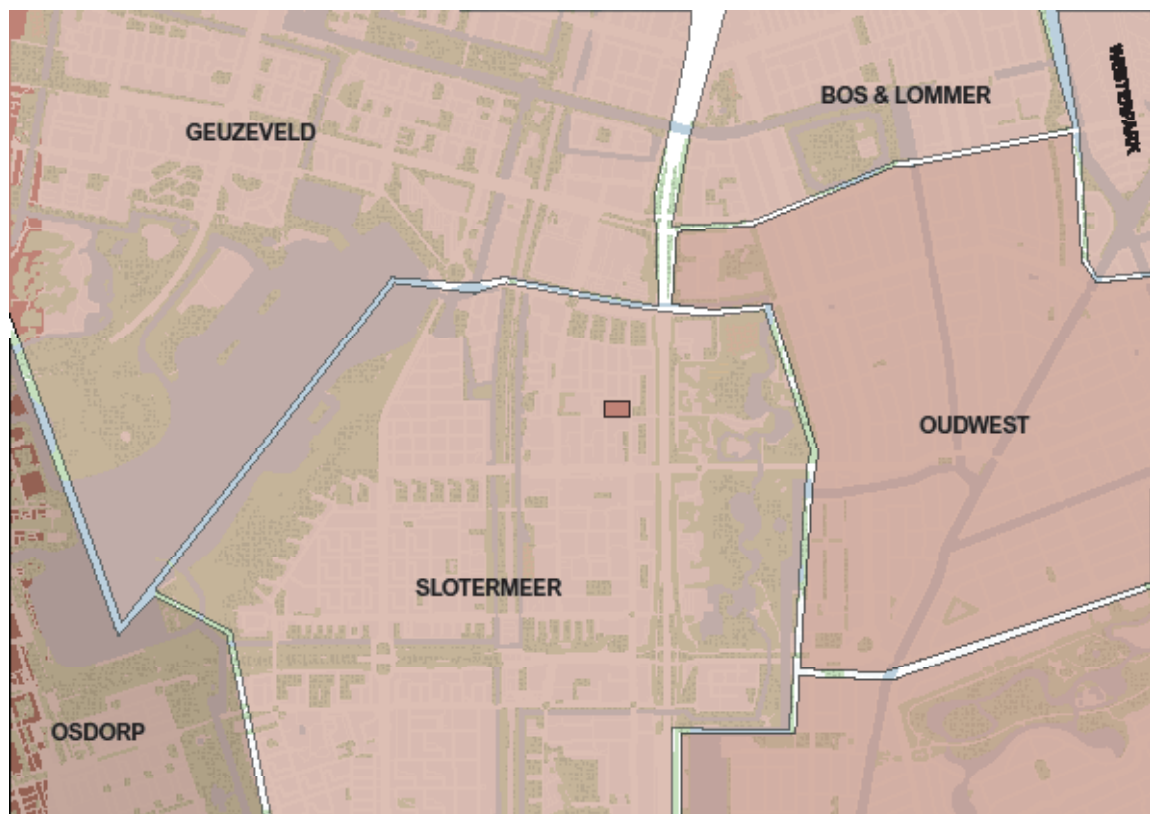


Floorplans existing rowhouse

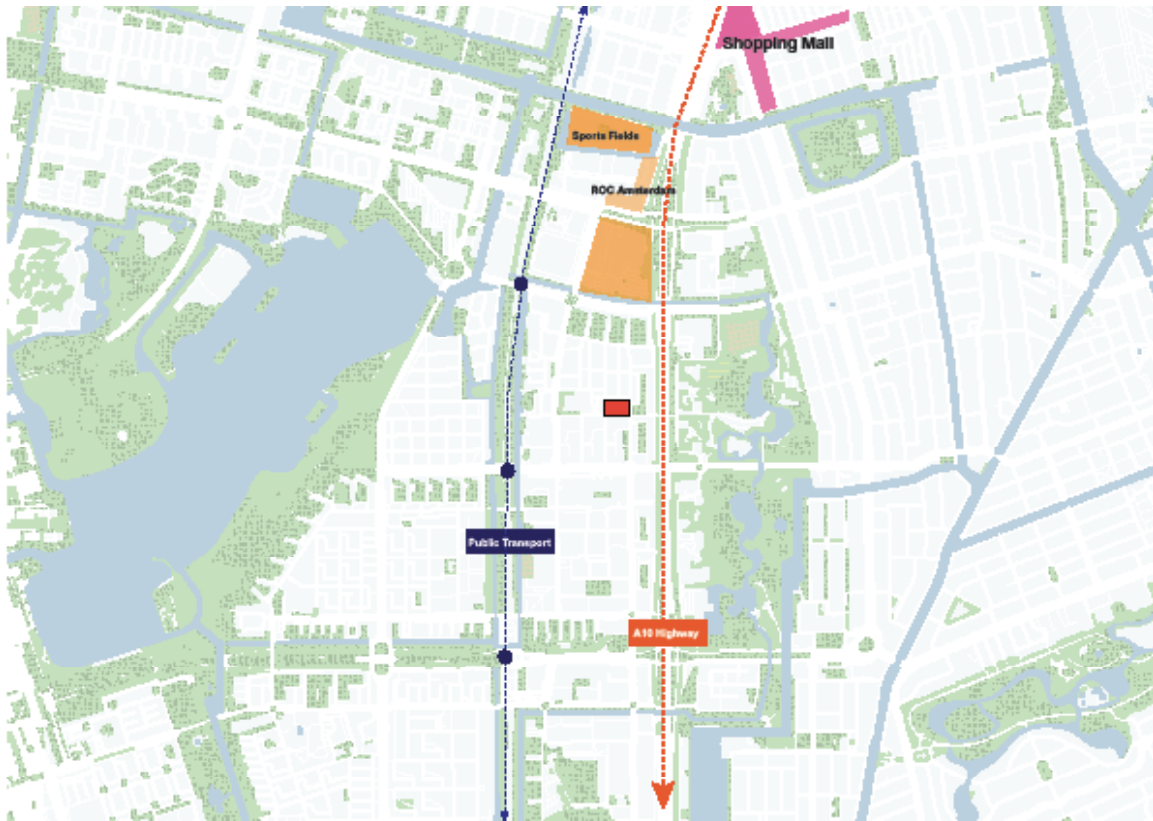




1:10 000 surrounding parks & greenery



1:10 000 districts of Amsterdam



1:10 000 facilities



1:10 000 distance to city centre

# **02 CONCEPT** methodology & re

research

# 2.1 METHODOLOGY & RESEARCH TECHNIQUES

To achieve a successful study, it is important to develop a good approach. Throughout the process of this project, many different types of research were used. As an elaborative instrument, the five generic elements were applied during the design process

(van Dooren, 2020), including experiment, laboratory, guiding theme, references and domain(s). Below, the different research techniques are briefly discussed.

## 2.1.1 Research Techniques

### Analysis (domain):

The technique of analysis was used for this research. This technique revolves around analysing and examining existing information. For this project, among other things, existing archival drawings were analysed. From these drawings, statements can be made regarding floor plan layout, climatic, building physics and structural elements. The immediate built environment was also analysed. This was used to inform design decisions. Finally, various timber construction methods were also analysed. These were subsequently mapped out using a mapping technique.

### Experiment (experiment/laboratory):

Experiment was used as a research technique at many stages throughout the process. Through experimentation, the spatial possibilities for the project were investigated. Experiments were conducted at the scale of the residential block, as well as at the scale of the individual dwelling. By conducting various experiments based on different strategies, a well-considered choice could subsequently be made in selecting the appropriate design approach.

### Interview (domain):

A substantial amount of knowledge was gathered for this project by conducting interviews with various experts. The experts were invited for a conversation based on their area of expertise. These conversations focused on the themes of: climate, construction and building technology. The experts were also asked for their advice on do's and don'ts. The input from the interviews was subsequently translated into a list of requirements and recommendations for the project.

### Literature review (references/guiding theme):

A literature review was also conducted for this research. Several important studies have contributed significantly to this project.

Beter Benutten Bestaande Rijtjeswoningen (2025): a highly relevant publication from the Dutch central government and Platform Woonopgave, in which research was conducted into the existing housing stock and the potential options for making better use of it.

### **Mapping (laboratory):**

Ruimte Zat in de Stad (2020): one of the most forward-looking studies into space in the city and the opportunities it presents.

Woningsplitsing voor woningcoöperaties in de praktijk (2025): this publication by Platform31 presents research into already completed subdivision and transformation projects of, among others, terraced houses. This publication contains a great deal of useful information on practical examples.

Mapping was one of the research techniques used to effectively document the outcomes of other techniques. At several points during the research process, a matrix or table was created containing relevant information for the project. For example, the characteristics of the various construction methods were mapped in this way, and the results of the design research were also captured in matrices. Mapping is a technique for documenting research in a clear and structured manner.

## 2.1.2 Research methodology

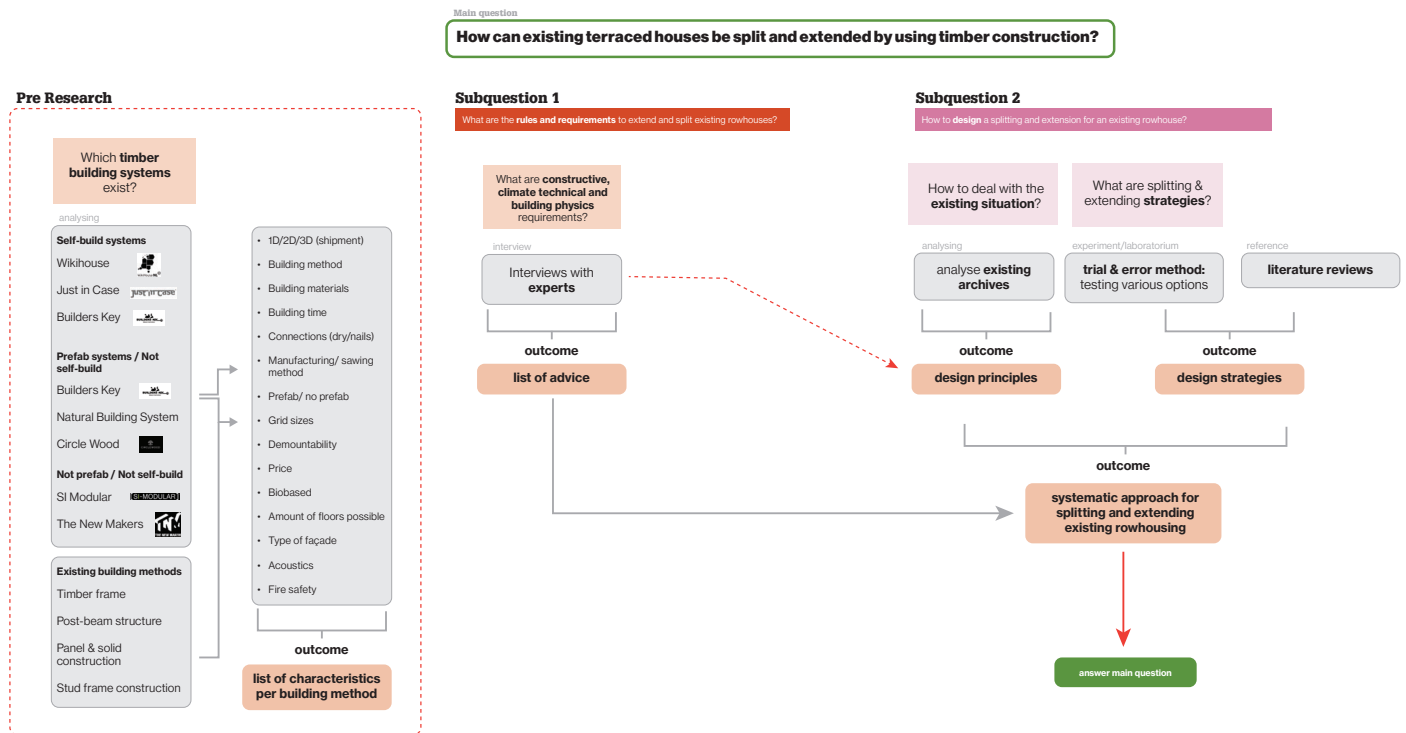


figure 11: own image. Methodology diagrams

The diagram above illustrates the research method. It shows how the technical component on the one hand, and the design component on the other, can together provide an answer to the main research question of this study. The method employs various research approaches and thereby attempts to find answers in multiple ways. The research is divided into two parts.

**1. Technical perspective:** this examines the research question from a structural, building physics and climate technology standpoint.

This part of the research primarily provides practical answers. The outcome of this section is a list of recommendations and guidelines that can be applied during the design process.

**2. Design strategy perspective:** this part focuses primarily on various strategies for approaching the design based on the research question. Literature review, experiment and analysis are central to this section. Based on these three methods, a systematic approach can be developed.

### Iterative process

It is important to note that the process is not linear. It is iterative (see figure on the right), as there is a constant alternation between research and design. The process was revisited multiple times and the research was continuously reframed.

This is also reflected in the methodology on the previous page. Outlined in red is a portion of the research conducted during the first few weeks. Later in the process, it became clear that this research was no longer relevant. However, this research retains its value, even if it is no longer actively used.

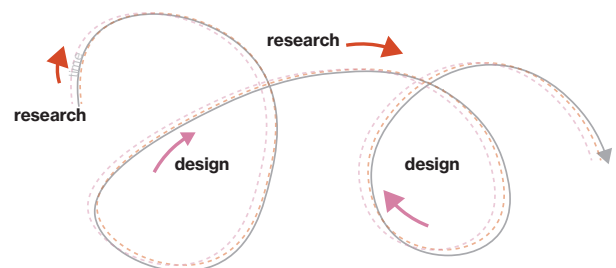


figure 12: own image. Iteration diagram

## Planning

The schedule (visible below) shows the various research phases. The first phase addresses the two sub-questions, which are subsequently subdivided into sub-sub-questions.

In **phase 1**, existing wooden building systems were examined and analyzed. Secondly, existing design strategies were investigated, and specific design requirements and regulations were examined.

In **phase 2**, a major translation was made. After the interviews and the iterative cycle, a new path was taken. Consequently, phase 2 addresses different

questions than initially envisioned. The outcome of phase two is a list of recommendations and a systematic approach to the design.

**Phase 3** involves implementing the recommendations and applying the systematic approach. The final design follows from this.

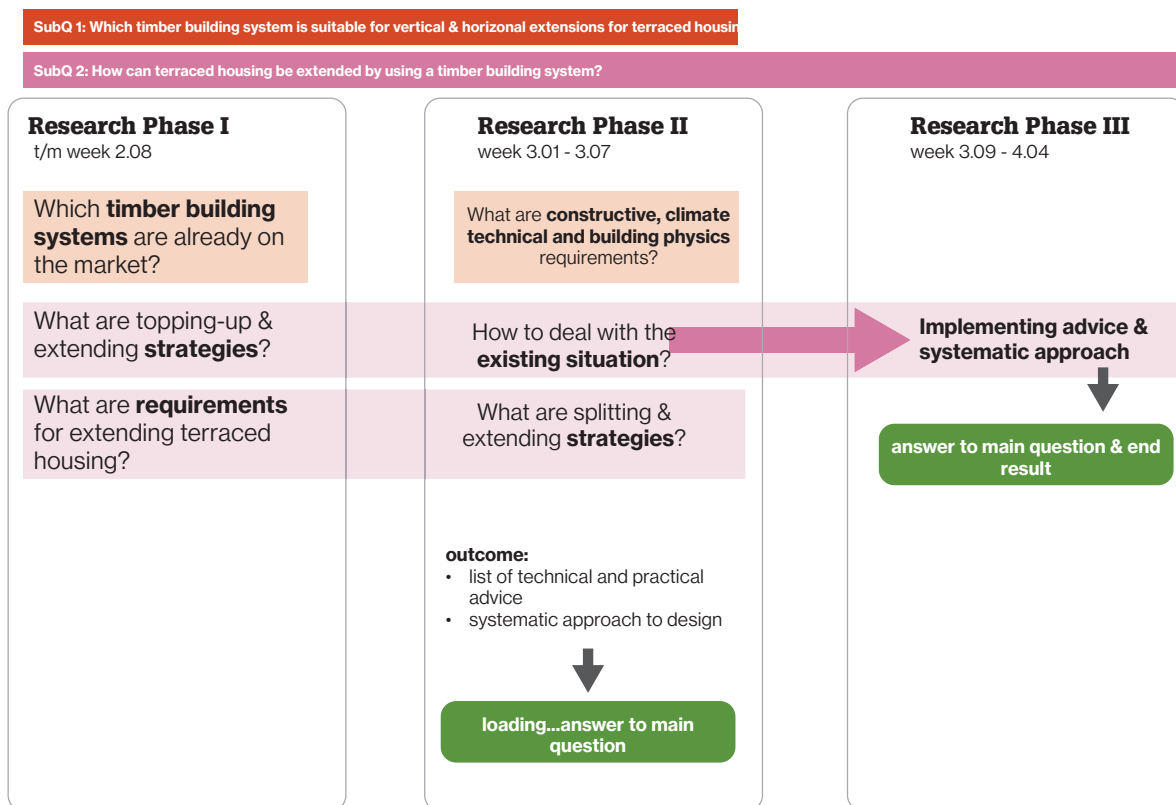


figure 13: own image. General planning

# 2.2 RULES & REQUIREMENTS

The first sub-question to answer the main question is: *what are the rules and requirements when splitting and extending (in timber)?*

To answer this question, interviews were conducted with experts. By questioning the experts about their knowledge of timber construction

and how to apply this to topping-up, extensions, and splitting, a list of recommendations could be made for this project. Prior to the interviews, a preliminary study into building systems was also conducted. However, the latter is not used in the rest of the research.

## 2.2.1 Research: Building Systems

At the start of the process, it was important to write down a research objective and to arrive at a preliminary research question.

The main goals of my project included, among other things, '*creating the greatest possible impact with the fewest possible resources*', and secondly, to develop a design that would be '*universal*' for all terraced houses, making '**modularity**' the research theme.

The main question became: '*Which timber construction system is most suitable for extending and splitting existing terraced houses?*' The intention was to evaluate existing modular timber construction systems against this question.

For the research, 7 different existing modular timber construction systems were identified. Using a table, the properties of these construction systems were compared with one another. The properties were based on the starting points that formed the foundation of this project, where **sustainability, low cost, speed, and demountable construction** were the design objectives.

A second research method was interviews with experts. They were selected based on their area of expertise: climate engineering, building technology, or structural engineering. Documents and questions were prepared for the interviews. The main objective of the interviews was the question: '*What are the rules and requirements when extending and splitting terraced houses?*

During the interviews, it became clear that existing modular timber construction systems are not particularly well suited for splitting and extending terraced houses (source). The experts gave the following reasons:

- Most timber construction systems have not been developed for adding storeys to or extending existing homes, but are typically intended for new construction. The way these systems are developed is therefore often not suitable for this purpose (Tinholt, 2026).

- Using these systems would be costly, as they are often CNC-milled, which is a relatively expensive cutting method. Adapting the construction systems to connect with existing terraced houses would also be expensive, for instance because it requires custom work (Kompatscher, 2026).

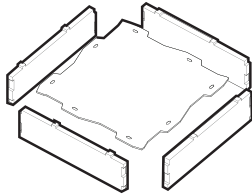
- Many timber construction systems fit together precisely. Many existing homes are not perfectly level. The construction systems often have little tolerance for variation, so this would not work well (Huibers, 2026).

Instead of recommending one of the listed timber construction systems, the experts unanimously stated that a simple prefab timber frame construction (HSB) would be sufficient. This would offer greater flexibility, be more cost-effective, and be better suited to custom work. Following the interviews, it was decided to proceed with a new main research question, and the construction method was established: prefab HSB (timber frame construction).

	1D/2D/3D (shipment)	Building materials	Building time	Connections (dry/nails)	Manufacturing/ sawing method
<b>COMPANIES</b>					
<b>Self-build systems</b>					
Wikihouse	2D	18mm multiplex	fast	bolts & dry connections	CNC-milled
Just in Case	2D	Underlayment, LVL beam	fast	bolt & dry connection	CNC milled
<b>Prefab/ not self-build</b>					
Builders Key	2D	100% timber (3s wood panel) underlayment flooring	±5 weeks	dry connections	CNC-milled
Natural Building System	2D or 3D	multiplex, I-beam	fast (?)	T & G cones % pegs	
Circle Wood	1D or 2D	CLT, LVL, steel connection	N.P. 6 months, fast	HKB method (steel nodes)	CNC & digital production
<b>Not prefab / not self-build</b>					
SI Modular	1D, 2D	I-beam (Metsä Wood), Kerto-Q, OSB	fast	interlocking connections	CNC-milled
Finch Buildings	3D	CLT, Glulam	3x faster	bolt & dry connections	CNC-milled

Prefab/ no prefab	Grid sizes	Demountability	Price	Biobased	Amount of floors possible
self-build	300,600,1200mm	100%	-25%	yes	1
flat-pack/self build	cassets 1100x1100mm	100%		yes, hybrid (steel beams)	
prefab	no (ideally 600mm)	100%	-10% (on timber frame)	100%	+3
yes(prefab 3D or flatpack	multiply 600mm	100%	competative with standard	100%	
prefab	3m tot 5,5m	100%	competative with standard	80% + (better than Paris Proof)	
partially, assembly on-site	5 or 6m, 1m grid, roof 45 or 1£ 100%		cost-effective	yes	
prefab	5 variations (3500x 7100, 8850, 9800, 11000, 11800)	100%		yes, mostly	

figure 14: own image. Building Systems table

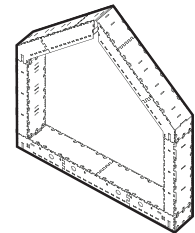


**Just in Case**

**Just in Case**  
Jeroen van Mechelen  
2025

**Building material:** Underlayment, LVL  
**Manufacturing:** CNC-milling

Just in Case	2D	Underlayment, LVL beam	fast	bolt & dry connection	CNC-milled
flat-pack/self build	cassets 1100x1100mm	100%		yes, hybrid (steel beams)	

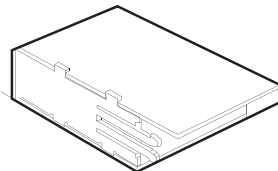


**Wikihouse**

**WikiHouse NL**  
Vincent Muller  
2014

**Building material:** 18mm Multiplex  
**Manufacturing:** CNC-milling

Wikihouse	2D	18mm multiplex	fast	bolts & dry connections	CNC-milled
self-build	300,600,1200mm	100%	-25%	yes	1

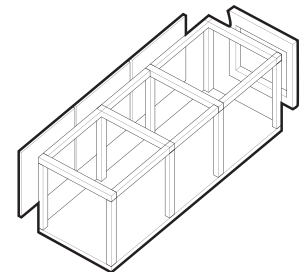


**Builders Key**

**Builders Key**  
Jan Gunneweg  
2023

**Building material:** 3S Wood Panel  
**Manufacturing:** CNC-milling  
100% dry connections due to interlocking system

Builders Key	2D	100% timber (3s wood panel) underlayment flooring	+5 weeks	dry connections	CNC-milled
prefab	no (ideally 600mm)	100%	-10% (on timber frame)	100%	+3



**Finch Buildings**

**Finch Buildings**  
Jurrian Knijtizer  
2014

**Building material:** CLT & Glulam  
**Manufacturing:** prefabricated

Finch Buildings	3D	CLT, Glulam	3x faster	bolt & dry connections	CNC-milled
prefab	5 variations (3500, 7100, 8850, 9800, 11000, 11800)	100%		yes, mostly	

figure 15: own image. Building Systems

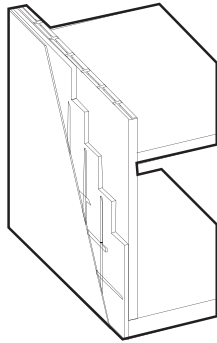


**Natural Building Systems**

**Natural Building System**

Chloe Donovan  
2019

**Building material:** Plywood, wood fibre  
**Manufacturing:** CNC-milling, prefab

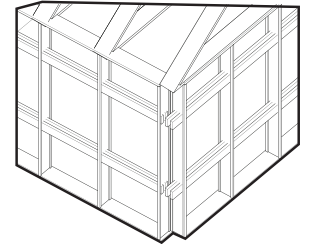


**SI Modular**

**SI-Modular**

Hans-Ludwig Stell  
2011

**Building material:** I-beam, LVL, Kerto®  
**Manufacturing:** CNC-milling



Natural Building System	2D or 3D	multiplex, I-beam	fast (?)	T & G cones % pegs
yes (prefab 3D or flatpack)	multiply 600mm	100%	competitive with standard	100%

SI Modular	1D, 2D	I-beam (Metsä Wood), Kerto-Q, OSB	fast	interlocking connections	CNC-milled
partially, assembly on-site	5 or 6m, 1m grid, roof 45 or 1:100%		cost-effective	yes	

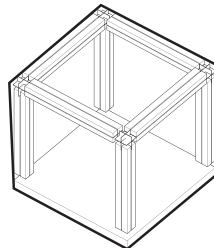


**Circle Wood**

**Circle Wood**

Noordereng Groep en Oosterhoff ABT  
2022

**Building material:** CLT, LVL,  
**Manufacturing:** CNC-milling, prefab



Circle Wood	1D or 2D	CLT, LVL, steel connection	N.P. 6 months, fast	HKB method (steel nodes)	CNC & digital production
prefab	3m tot 5,5m	100%	competitive with standard	80%+ (better than Paris Proof)	

## 2.2.2 Interviews with experts

For the research of this project, interviews were used as a research method. A total of four interviews were conducted with experts from different backgrounds. The aim was to find out what the requirements and regulations are when a terraced house would be split and extended using timber construction. The appendix of this report contains the transcripts of the interviews, as well as the documents that were present during the interviews, such as the questionnaire.

To keep the elaboration concise, it was chosen to present the interviews with the experts through the images and explanatory text below. In addition, a list of recommendations and requirements derived from the interviews has been compiled.

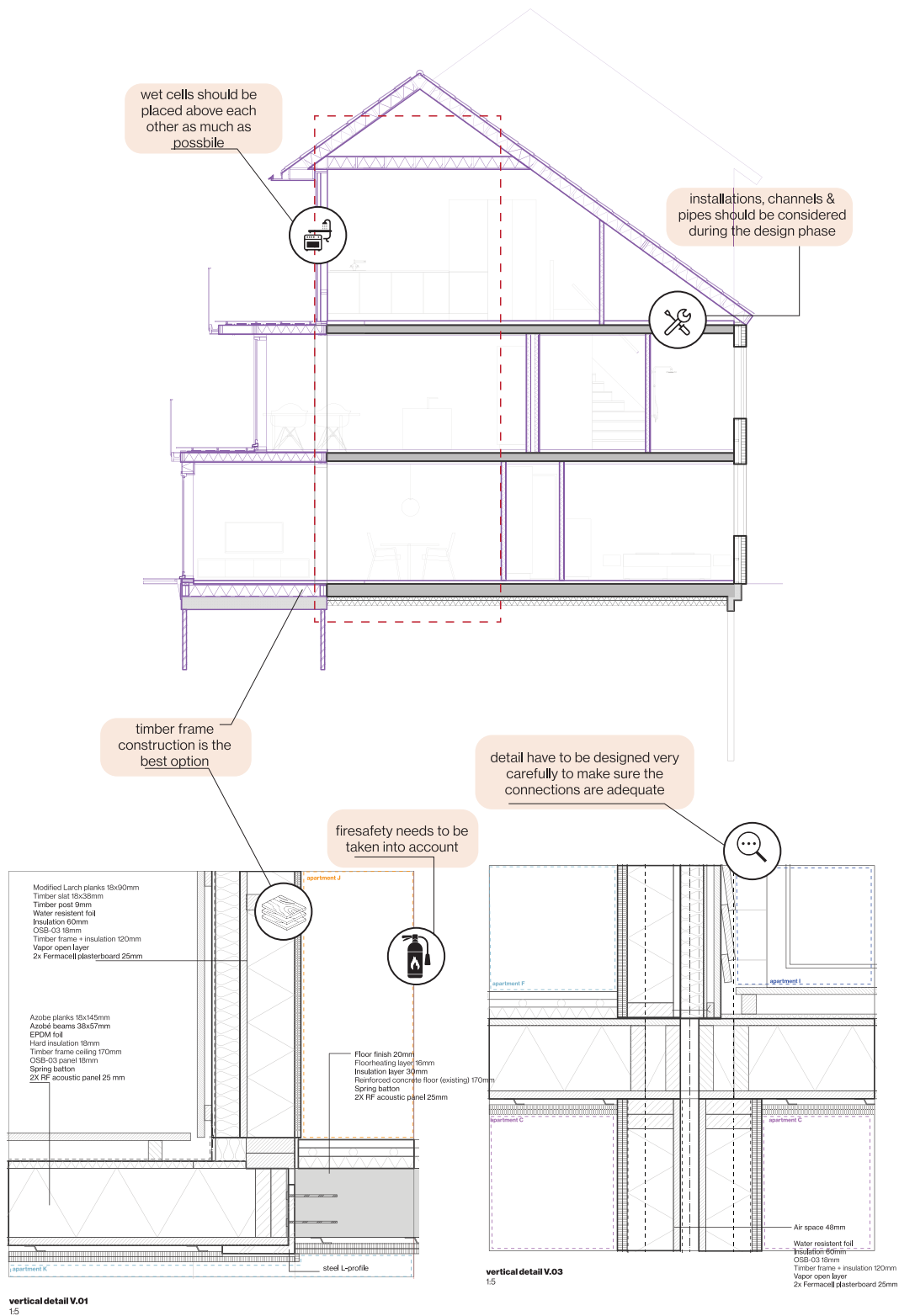
### De experts

**Jan van der Schaaf** - BIM Projects (building physics)

**Karin Kompatscher** - TNO (building physics / climate engineering)

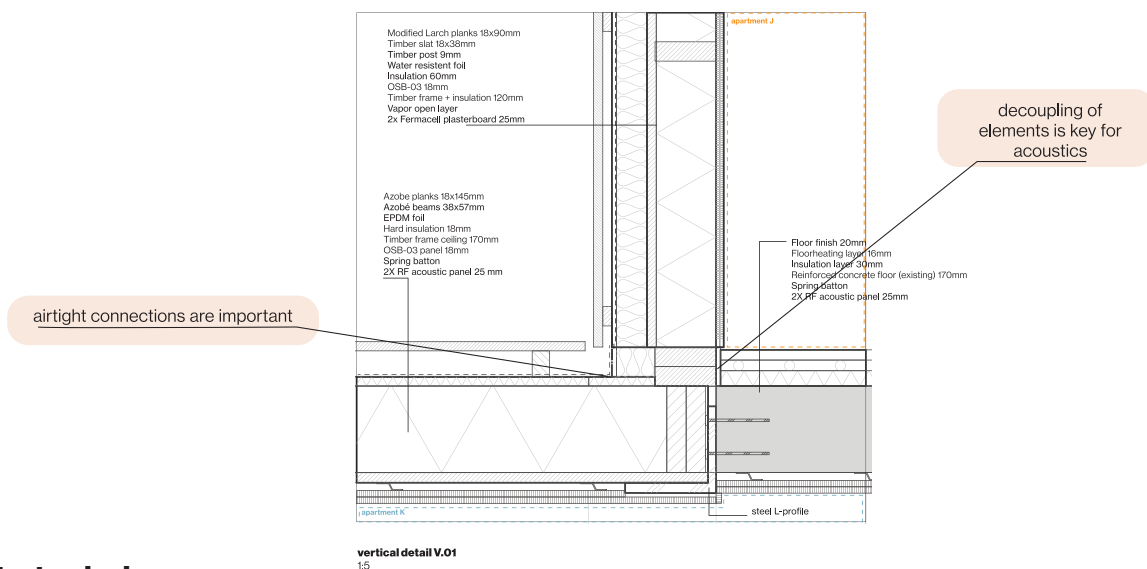
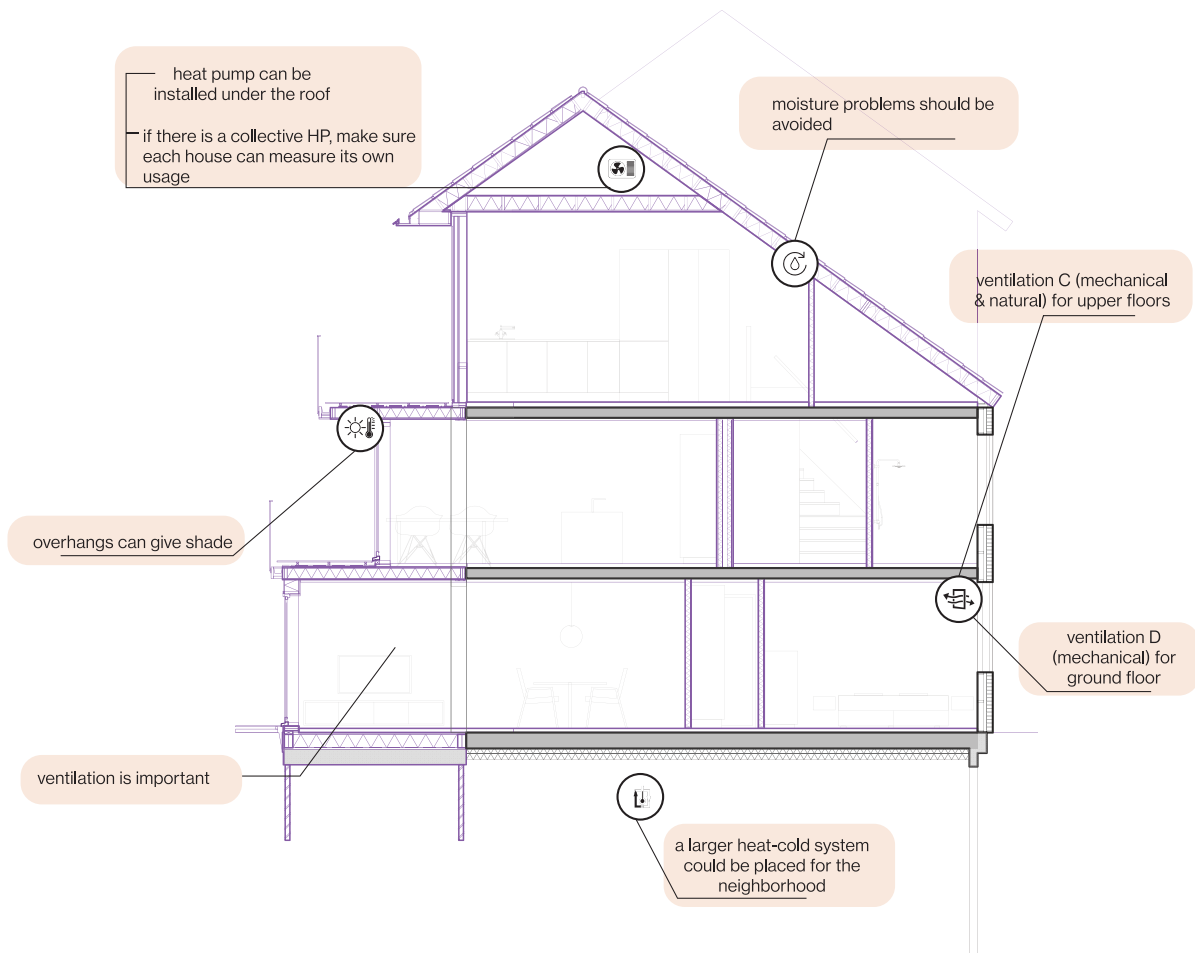
**Leonard Tinholt** - Pieters Bouwtechniek (construction engineering)

**Kitty Huijbers** - ABT (climate engineering)



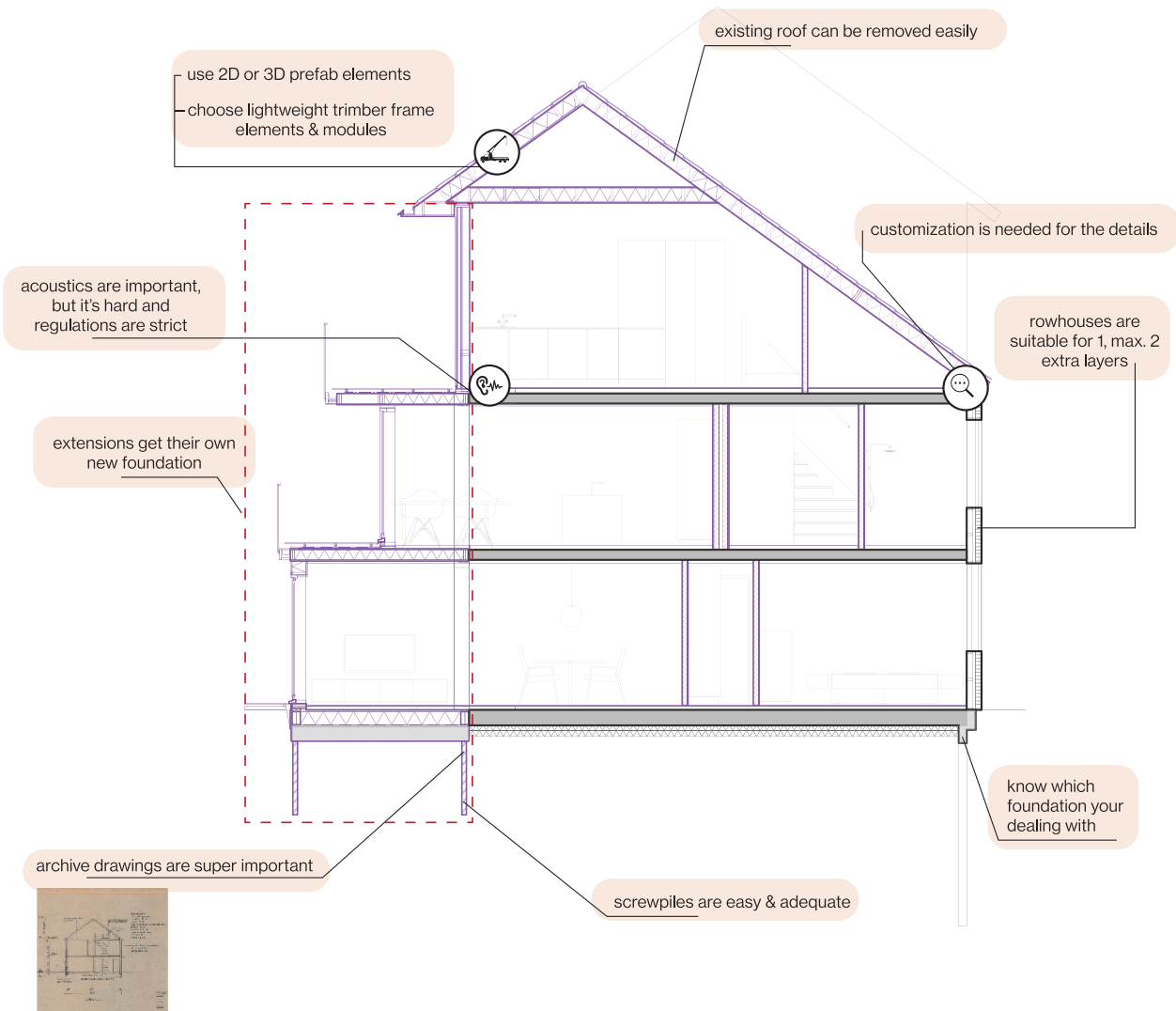
## Building Physics

- Timber frame constructions are the most suitable for lightweight, cheap and adaptable extensions and top-ups
- For extending and adding to an existing construction the connections are really important
- The connections should be carefully designed with focus on heatloss, moist control and decoupling of elements
- Taking care of fire safety, acoustics and installations are very important for this project
- During the design, thinking about channels and pipes for sewage and climate installations is very needed. In terms of placement of rooms, make sure the wet cells are placed on top of each other as much as possible



## Climate technique

- not building new buildings, but transforming them, is always more sustainable
- moist and water are very important themes when it comes to assembly and comfort. Make sure the elements are not wet during assembly, otherwise moisture and mold problems will occur
- make sure the connection between old and new are super airtight. This is a matter of using the right and enough materials like bands and tapes
- decouple the floors and ceilings as much as possible for noise. Timber is a material that is lightweight and it transfers sounds easily. There has to be a certain acceptance for this material, because you can not hold all the noise. It is part of the building materials characteristics
- Use different climate systems for the different target groups. Older people are in need of a more stable climate (type D) and younger people of a more adaptive climate (type C)
- There are multiple options for shared energy generations like the heatpump, pv-panels and a collective heat-cold-storage system. The heatpump could be stored under the roof, but make sure it is decoupled for the noise.



## Construction technique

- make sure that from the start you have the existing drawings, including the foundation drawings. The more information you have on the existing, the better
- rowhouses are not designed to be topped-up with many layers. An average rowhouse can be topped-up with one or max. two layers without the need to extra foundate your foundations
- depending on the weight of your top-up and the existing construction you can calculate the maximum layers
- having to extra foundate your foundations is a very expensive exersice, try to avoid that
- Extensions that are added can be build on a seperate foundation. Screw piles are a good example, because they don't need heavy drilling to be placed

# 2.3 DESIGN STRATEGIES & CONCEPT DEVELOPING

The second sub-question is: how do you design for the splitting and expansion of row houses, and what strategies are at hand?

To answer this two-part sub-question, existing examples addressing this theme were examined, and in addition, a great deal of design research was

conducted through the technique of trial and error (experimentation).

As an outcome, a systematic approach was developed in order to select the appropriate design strategy for the project.

## 2.3.1 Examples reviewed

During, and prior to the process of this project, there were a couple of examples that proved to be inspiring. They were not only signs that this theme was relevant, but the examples also provided highly relevant information and inspiration on how to approach this subject.

### Beter Benutten Bestaande Rijtjeswoningen Platform Woonopgave (2025)

At the start of this graduation project in late 2025, this publication was also shared. The research is an analysis of the current housing problems and presents a comprehensive package in which solutions are offered. The analysis reveals that in the Netherlands there is a potential to create well over half a million homes if splitting were to be applied. Their publication is followed by an extensive catalogue, in which the possibilities are shown at both neighbourhood and housing level. Further into the publication, legal, financial, and administrative matters are also addressed. In general, it gives a clear picture of the advantages and what there is to be gained collectively.

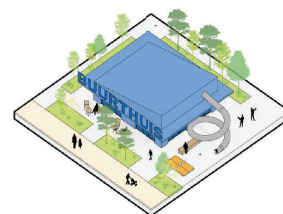
This publication has been a major source of inspiration, particularly for the underlying ideas and for demonstrating the potential that lies within our built environment. What differs between this publication and this graduation project is that this project takes a different angle than the publication by Platform Woonopgave.

#### Buurtvoorzieningen

Buurtvoorzieningen zijn er voor de hele buurt en bedoeld om de sociale samenhang tussen bewoners te versterken. Deze pagina toont een aantal opties, maar uiteraard is er nog veel meer mogelijk. Ook de voorzieningen op de volgende pagina's, die zich richten op klimaatadaptatie en ouderen, zijn in feite buurtvoorzieningen.

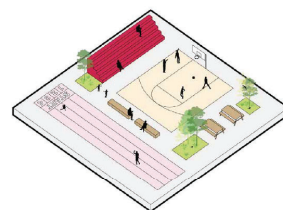
#### BUURTHUIS

Een buurthuis is de belangrijkste voorziening. Het is de centrale plek in de buurt waar mensen samenkomen.



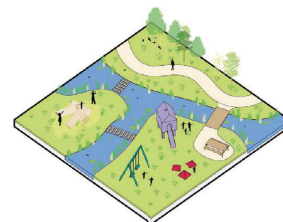
#### SPORT

Voor sport zijn er vele mogelijkheden. Sport is niet alleen goed voor de gezondheid, maar brengt ook mensen samen. Vaak zitten de bankjes om sportvelden op warme dagen vol met mensen. We adviseren daarom om altijd zitgelegenheid rondom sportfaciliteiten aan te brengen.



#### NATUURSPEELTUIN

In de natuur spelen is fijn voor kinderen en heeft gelijktijdig een positief effect op hittestress en de biodiversiteit. Ook voor de ouders is een natuurspeeltuin een fijne groene plek in de buurt.



#### KINDERDAGVERBLIJF

In veel buurten zijn de kinderdagverblijven verdwenen omdat het aantal kinderen is afgenomen. Door de komst van nieuwe jonge gezinnen is er weer behoefte aan kinderdagverblijven in de wijk.



figure 16: Platform Woonopgave (2025)

The angle this project takes is an deepdive into the question: what if one were to split and add storeys? What possibilities would then appear? And also, what does it mean from a structural and technical perspective? This project can be seen as a continuation of what Platform Woonopgave has started. It is an exploration of possibilities and potential.

it has also been able to provide inspiration for this graduation project.

The research initially yielded data that is important for this project. Secondly, it provides a broader foundation for this project, as this research too demonstrates that there is great potential in splitting and adding storeys to existing homes.

However, the research does not go further into technical elaborations and design strategies. Due to the lack of good examples and further research into how existing homes can be split and topped, this graduation research is considered to be a valuable contribution.

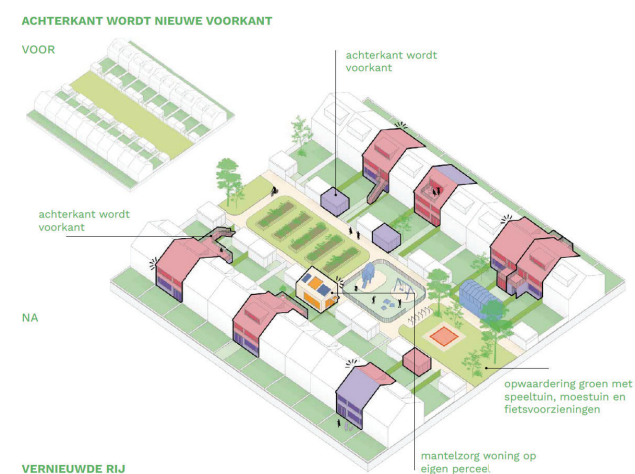


figure 17: Platform Woonopgave (2025)

### Ruimtelijke bovenwoning

De woningen uit de jaren '60, '70 en '80 kennen vaak een lage verdiepingshoogte. De vloer tussen de eerste verdieping en de zolder is meestal van hout. Dit geeft mogelijkheid om -in combinatie met een ruimtelijke dakkapel- een vide te maken. Zo wordt de bovenwoning een stuk ruimtelijker.

- 6 m<sup>2</sup> GO ●
- 78 m<sup>2</sup> GO ●
- 46 m<sup>2</sup> GO ●

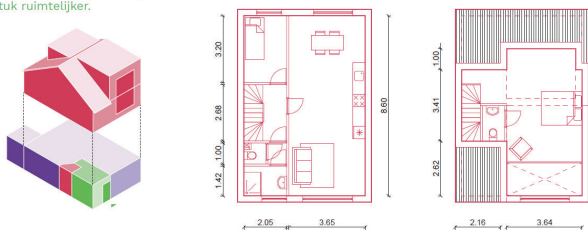


figure 18: Platform Woonopgave (2025)

## A Bestaande woningen



Juni 2020 | RUIMTE ZAT IN DE STAD

figure 19: KAW (2020)

### Ruimte Zat in de Stad KAW (2020)

This research by KAW, into the space that can be found within the existing city, has also been a source of inspiration for this project. Although the research demonstrates in a broader sense where space can be found (namely not only in existing row houses),



figure 20: KAW (2020)

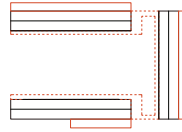
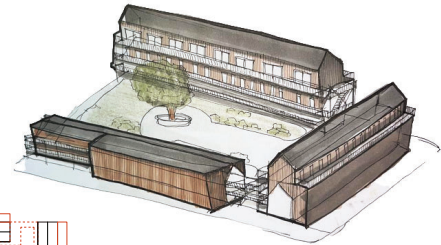
## 2.3.2 Trial & Error (experiment)

For this graduation project, research was conducted on two fronts. The first research addressed the question of how to split and extend using timber construction. This part focused on the technical, climate-related, and building physics aspects. The findings were incorporated into the process.

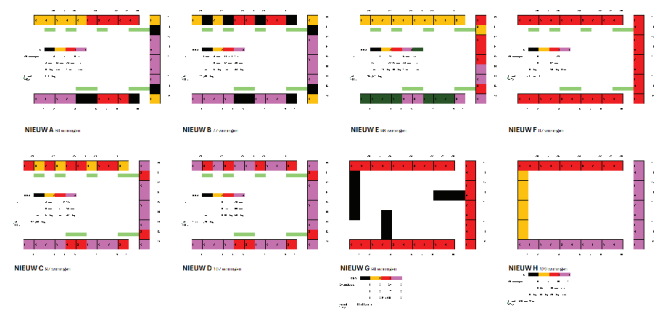
The second research of this project concerns the spatial question: how do you design for the splitting and expansion of row houses, and what strategies are available?

As described above, existing examples and approaches to tackling this were examined. Notably, very few examples could be found. This points to a still emerging field of research, and one in which there is still much to be discovered.

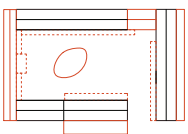
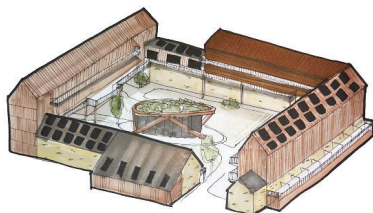
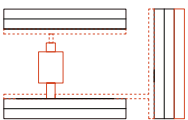
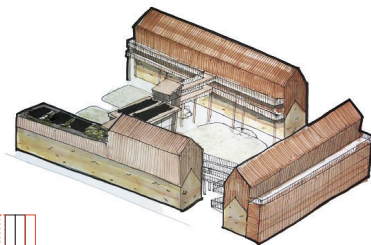
Partly because of this, the research method known as trial and error was chosen. It is based on experimentation, and through experimenting, reflecting, and experimenting again, knowledge is acquired. In the drawings below, for example, some of the first sketches can be seen. The goal was simply to start with a design. This resulted in a number of drawings.

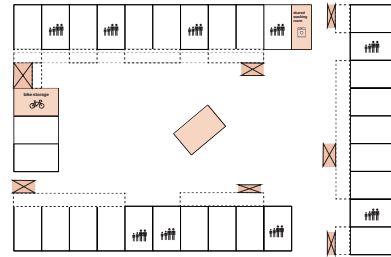
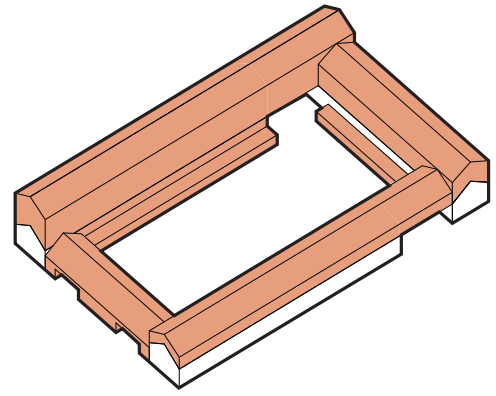
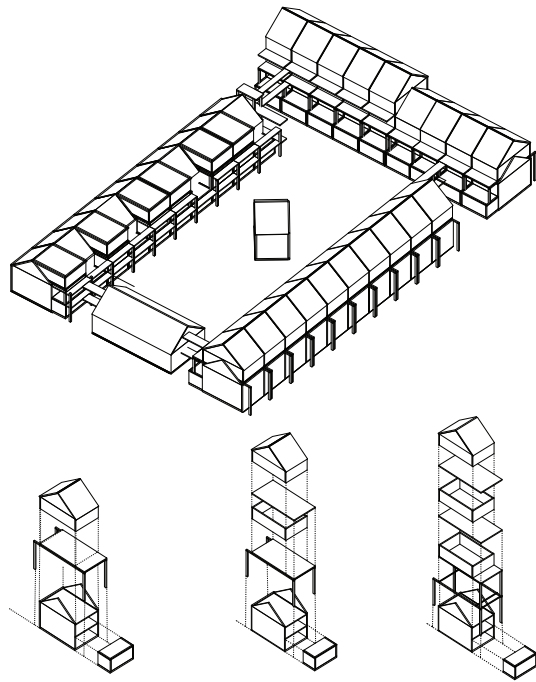


Shortly after these first sketches, the technical research began. At the same time, the design process continued. An analysis of the surroundings proved important for spatial awareness. How high should everything be? What types of housing are found in the area? What is the orientation of this block, and how much needs to be added?



The figures above show an approach in which numbers were examined. In order to create a design based on an existing situation, an assumption was made about the households in this block using current statistics from the CBS and demographic data about the neighbourhood. Since no figures are available on how many residents each home contains, it was decided to align the distribution proportionally with these statistics. The 29 homes were divided as follows: 6 single-person households, 9 families, and 14 couples.



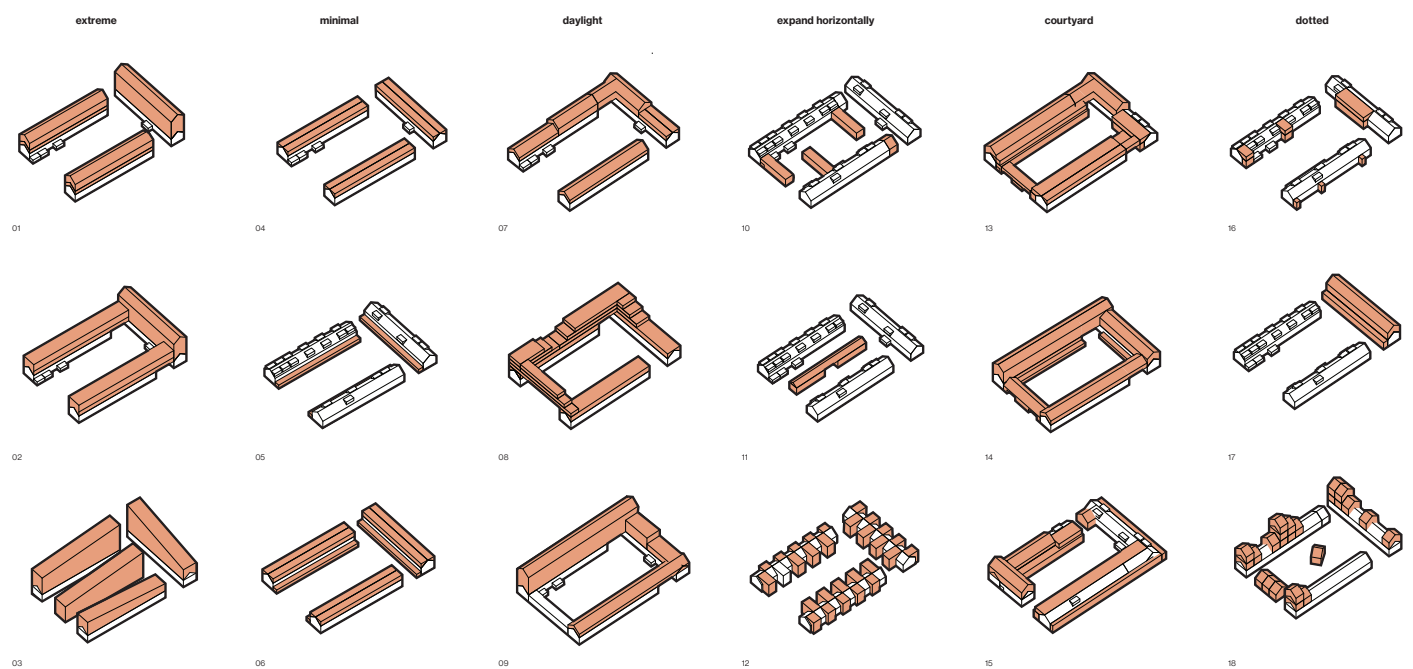


## Iterative process

The iterative process has a positive effect on the design process. By repeatedly creating a design, evaluating it, and then returning to the drawing board, a diverse range of results was produced.

Later in the process, when the findings from the technical research came back, a further deepening of the work was made possible. The trial and error method, combined with the technical research, led to an integral design. The alternation

between spatial design, strategy, and technical possibilities resulted in a gradual and iterative process.



## 2.3.3 Concept developing

During this project, a systemic approach was developed, that can be explained as The Concept.

As the project can be understood as an exploration of the possibilities that lie ahead when it comes to transforming the typical Dutch rowhousing neighborhoods, it became clear that this asked for a systemic approach.

### 01 Input

First of all, every rowhouse, every rowhouse neighborhood, is different. This is a very important observation, since there is not a one-size-fits-all solution. Therefore, it is important to start with an analysis of the context. Questions are: what is the existing situation? What is the typology of the neighborhood? What is the direct context of the rowhouses? What are the household sizes? Who lives here? What are the needs of the people? In other words, what are social and the physical characteristics of the project. And what is the goal?

### 02 Top-strategy

When the goals are clear, and the analysis is done, it is time to translate this into a so-called **Top-strategy**. This strategy is basically looking at the existing situation and the goal, and matching the right additions and splittings to that. A matrix was developed to showcase the possibilities. For this project a mix between *op-*, *tussen-*, *achter-* and *s-toppen* was chosen.

### 03 Module Matrix

After the strategy of 'toppen' has been chosen, the module matrix shows the possibilities of which modules could be used to create this. Similarly for the top-strategy matrix, this matrix can be developed over time.

For each type of 'toppen', different modules are suitable. However, the note has to be made, that these matrixes are guidelines, they are not the only solution.

The modules are all made out of timber frame 2D elements, which will be made prefab and installed on-site. There has been chosen for timber frames, since they are biobased, highly adaptable, lightweight and a highly trusted building method.

### 04 Facade Fair

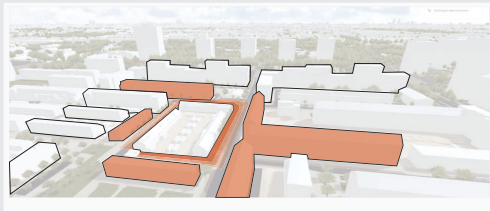
The last step in this concept is the Facade Fair. Besides choosing the modules and the strategy, choosing facades is also an important step in this type of project. The choice between individuality and collectivity is, for instance, an important decision in which homeowners can have a big say. On the other hand, the architect can play a key role in this decision too. Choosing the facade may effect the presence of the project and tilt it to a higher level. In the Facade Fair options are displayed like material, orientation of your wall, patterns and sun protection options.

After going through these four steps a design can be made. During these steps the architect is already involved. But, especially after these steps, the role of the architect is important by bringin everything together and developing a detailed plan. The 4-step plan can be seen as a tool to achieve the goals that this type of project aims to bring forward.

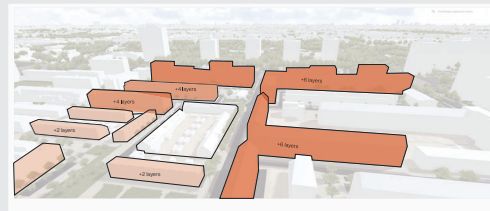


# 01 INPUT: ANALYSIS & GOALS

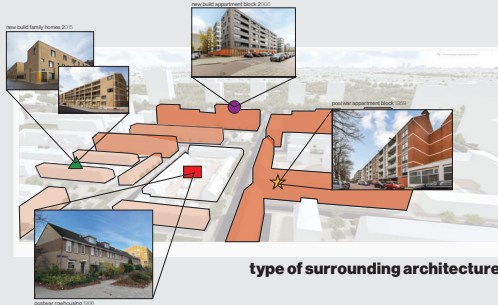
## 01 Analysis spatial context



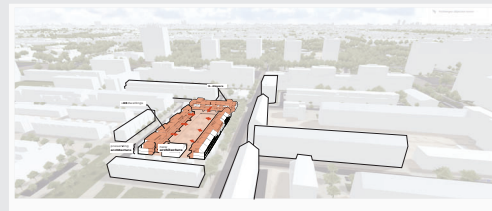
connection with direct surrounding



building heights

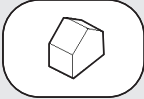


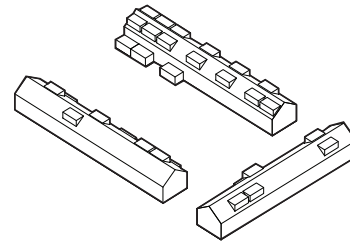
type of surrounding architecture



architectural possibilities

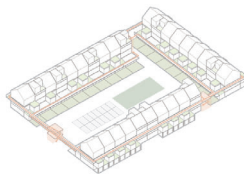
## 02 Project information

- **Urban setting:** urban / semi-urban / village / Vinex
- **Urban typology:** row / single / duo / block / area
- **Rowhouse typology:** 
- **Building year:** 1989
- **Location:** Amsterdam
- **Amount houses:** 29
- **Household demography:** 6x single person, 9x families, 14x couples

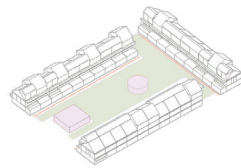


- **Orientation:** north/east/south/west
- **Soil quality:** sand
- **Energy supply:** district heating

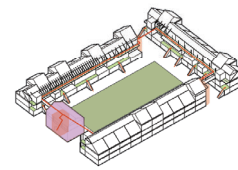
## 03 Project Goals



individual strategy



collective strategy



hybrid strategy

- **Collective spaces:** washing room, collective livingroom, study space, workshop
- **Special requests:** collective inner courtyard with swimming pond. Balance between collectivity and private space

## 04 Estimated houses to add

from 29 to **73**

**+ 44 houses**



## **01 Input: analysis & goals**

### **01 Analysis spatial context**

In this first step, it is important to analyse the spatial context. What is spatially possible, and what does the existing environment look like? Factors such as building heights, the degree of connection with the immediate surroundings, and architectural styles. The result is a quick scan of the spatial context.

### **02 Project Information**

The second step is gathering information about the project. Here it is important to consider not only the housing block typology, but also the year of construction, the location, the demographics of the project (age and number of households), and factors such as facade orientation and soil type. This information contributes to a more complete picture of the current project and its goals.

### **03 Project Goals**

The third step is establishing goals for the project. The degree of collectivity or individuality can be determined, as well as the desired number of additional residents and whether, for example, a communal space should be included.

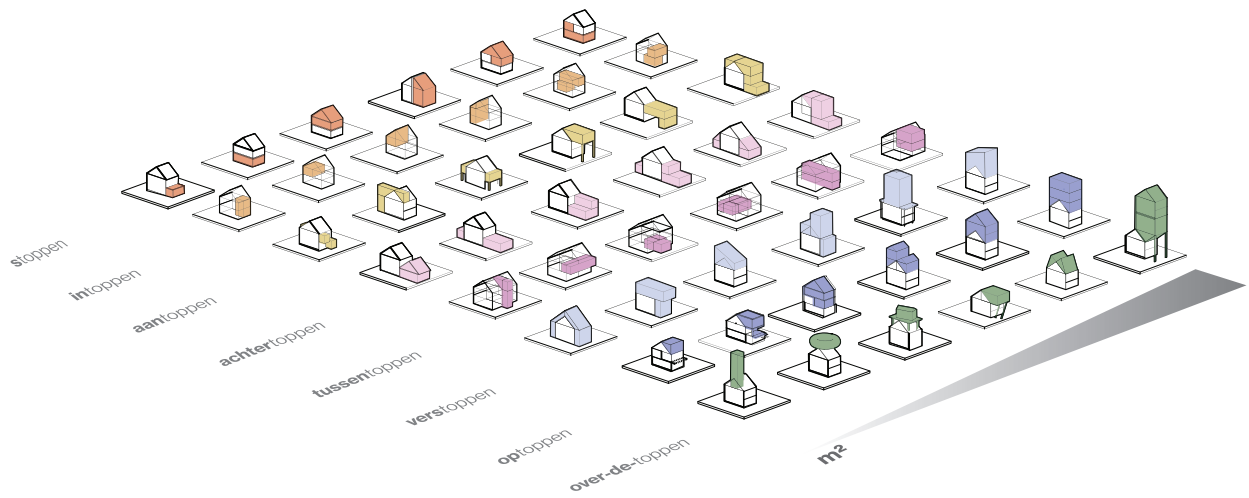
### **04 Estimated houses to add**

The fourth step is to make an estimate of the number of homes to be added and a rough estimate of the number of additional residents.

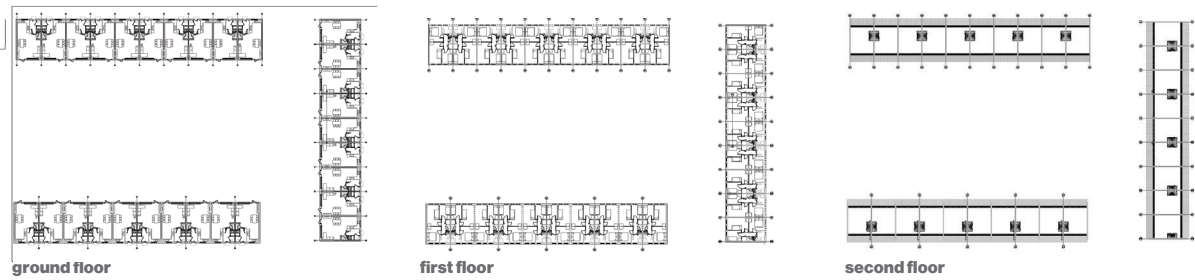
The first part of the process takes place primarily with the residents. It is important that their wishes and requirements are heard. For these moments with the residents, meetings are organised in which residents are informed as thoroughly as possible about the possibilities and are properly listened to.

# 02 TOP STRATEGY

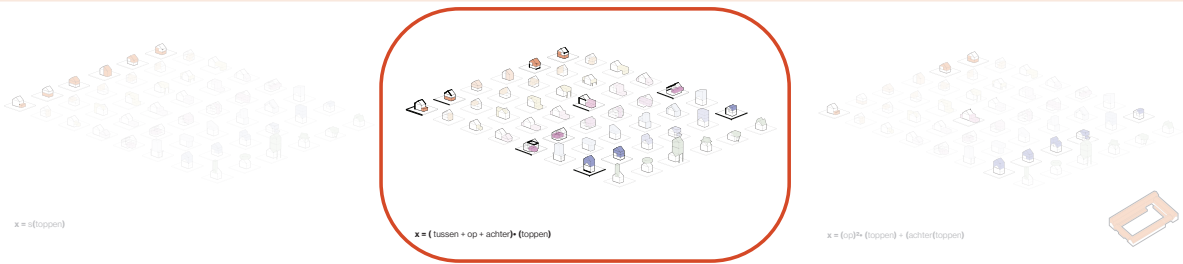
## 01 Top strategies matrix



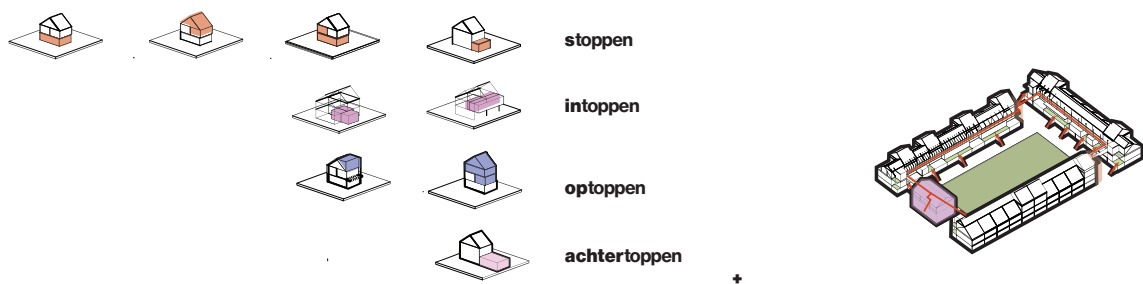
## 02 Compare floorplans with strategies



## 03 Mix & match strategies



## 04 Pick your combination



## 02 Top-strategy

### 01 Top-strategy matrix

In the first step, the matrix can be seen that displays all possible forms of 'toppen'. This matrix can be expanded in the future to include more forms of 'toppen'. Based on the results from step **01 Input**, the types of 'topping' can be examined. Depending on factors such as the size of the project, the financial resources, or the spatial context of the project, different options can be chosen.

### 02 Compare floorplans with strategies

It is important to study the current floor plans carefully. Where do opportunities lie? Based on the existing floor plans and the strategies to be chosen, it can be assessed whether the strategies fit within the already existing project.

### 03 Mix & Match strategies

Based on the previous step, there is a clear picture of what is and is not possible. Various combinations of *topping* strategies can be made. One option, for example, could be to use only roof additions. The main goal here might be to make as few changes as possible and to realise the project at the lowest possible cost. If you opt for a combination of *toppen* and *verstoppen*, the motivation may be to realise high-quality new apartments.

### 04 Pick your combination

In the fourth step, the combination has been chosen. There is now a clear picture of the project's goals and which types of *topping* belong to them. It is now possible to move on to the next step, in which the focus shifts to a practical level, examining how this can be carried out.

In the second part of the process, a great deal of designing takes place. The project is still in its early stages, but this phase is crucial for the remainder of the process. Here, the foundation is laid for the final result. The type of homes, the configuration, and the architecture are determined at this stage. At the end of this step, there is a list containing:

- the number of homes to be added
- the number of m<sup>2</sup> to be added
- the types of extensions that need to be carried out

## Types for 'toppen' explained

### stoppen stop

The existing home is only divided into multiple dwellings. In this case, the absolute limits of the floors are used. The home can be split into two dwellings.

### intoppen inside

Within the existing single-family home, a dwelling is created within the existing boundaries of the home. A small living space is created by separating a space from the existing home, either on one floor or across multiple floors.

### aantoppen adding on

One or more extensions are added to the existing home. This version of 'topping' can range from small extensions to larger added spaces.

### achtertoppen behind

Extra space is added behind the home on one or more living levels.

### tussentoppen in between

In this case, two existing homes are always involved. By adding a small connecting section, the homes can be linked, creating a new living space that partially extends into both adjacent dwellings

### verstoppen concealing

In this case, the new design wraps around the existing situation in such a way that the current situation is no longer recognizable.

### optoppen on

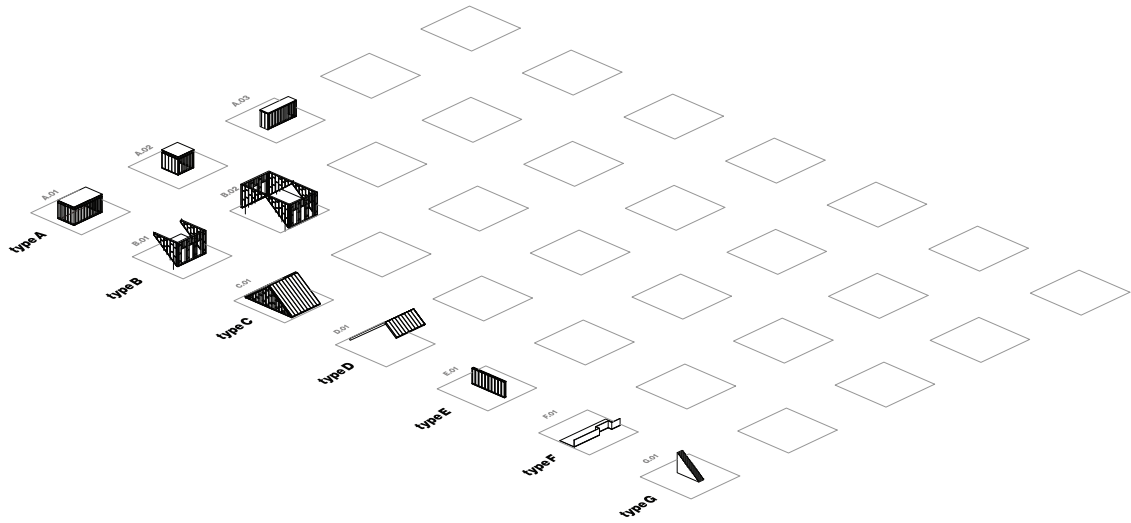
Living space is added on top of the roof of the existing situation.

### over-de-toppen over the top

In this case, living space is added to the existing situation in an excessive way. This may mean that a large amount of space is added, or that unusual forms are introduced.

# 03 MODULE MATRIX

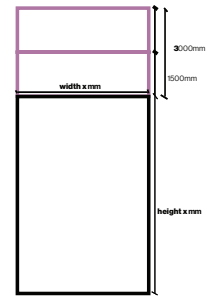
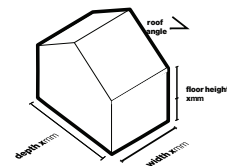
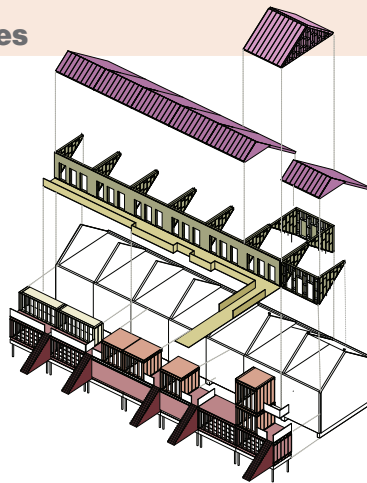
## 01 Module Matrix



type A	type B	type C	type D	type E	type F	type G
optoppen	optoppen	optoppen	optoppen	stoppen	optoppen	optoppen
tussentoppen					stoppen	stoppen
achtertoppen					tussentoppen	achtertoppen

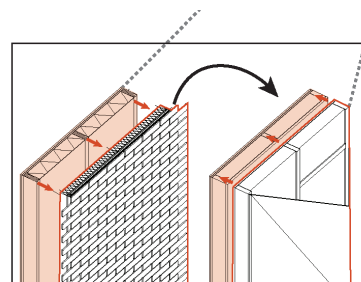
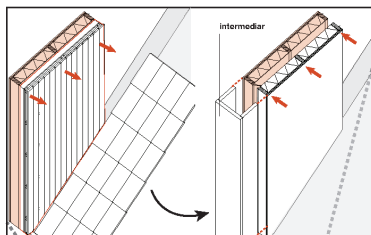
## 02 Chosen modules

- type G.01
- type A.01
- type A.02
- type A.03
- type F.01
- type B.01 & B.02
- type D.01
- type C.01



## 03 Important connections

1. removing the front-facade of the roof extension & removing roof of rowhouse
2. installing second timber frame element
3. installing intermedar to tie two modules together



1. removing the front-facade of extension
2. installing second timber frame element
3. the facade turns into a separating wall

## 02 Module Matrix

### 01 Module Matrix

With the results of the previous step, it is now possible to look at how the design can become a reality. The types of *topping* have been chosen, and in the module matrix, various standard modules are linked to these. This matrix will also be significantly expanded in the future. The matrix is primarily a useful tool for making decisions.

### 02 Chosen modules

Based on the preliminary design from the previous step, it is now possible to determine which modules best suit it. An important note is that in every project, the existing dimensions and grid must be taken into account. Each row house differs slightly in terms of depth, width, and ceiling heights. This must therefore be adjusted manually for each project.

### 03 Important connections

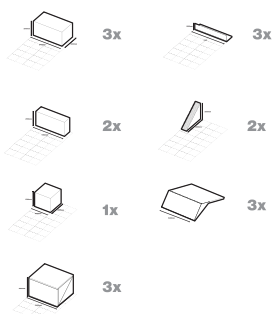
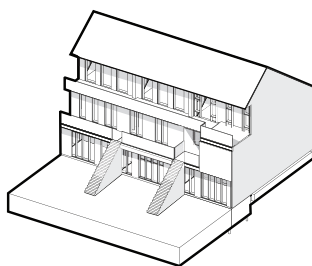
After selecting the modules, it is possible to look in detail at key challenges and complex junctions. Although these have already been taken into account during the development of the concept, it is also important to always examine these connections and junctions on a project-specific basis.

In the third phase, work is carried out towards a final design. The architect can consult together with a structural engineer and advisors regarding the execution.

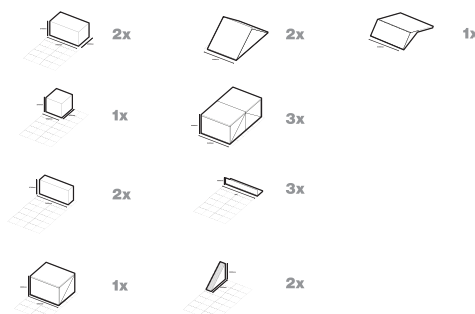
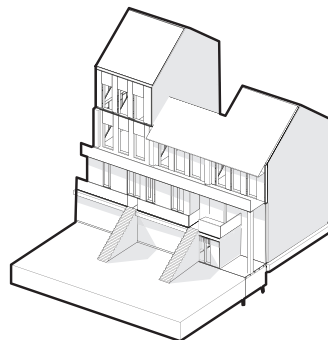
## Example of module combinations

Below an example of different combinations is visible. The three combinations are the same three existing rowhouses, but added by a different combinations of modules. Depending on the previous step (top-strategy) and on the design question a combination of different modules can be explored.

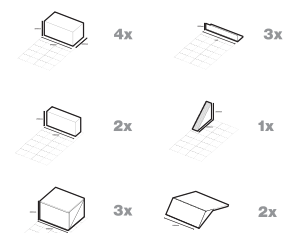
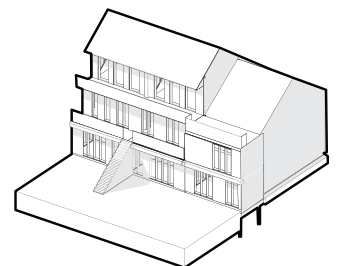
combination 01



combination 02

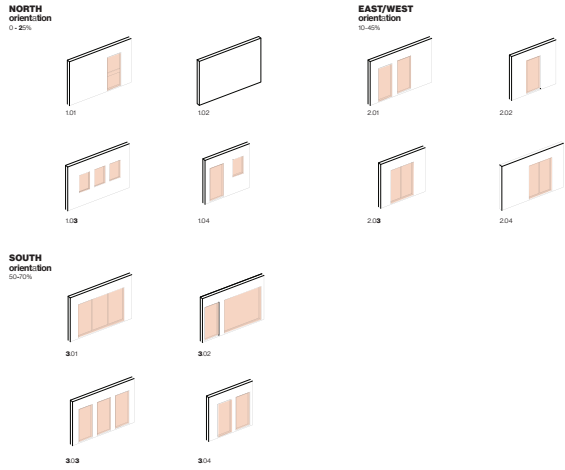


combination 03

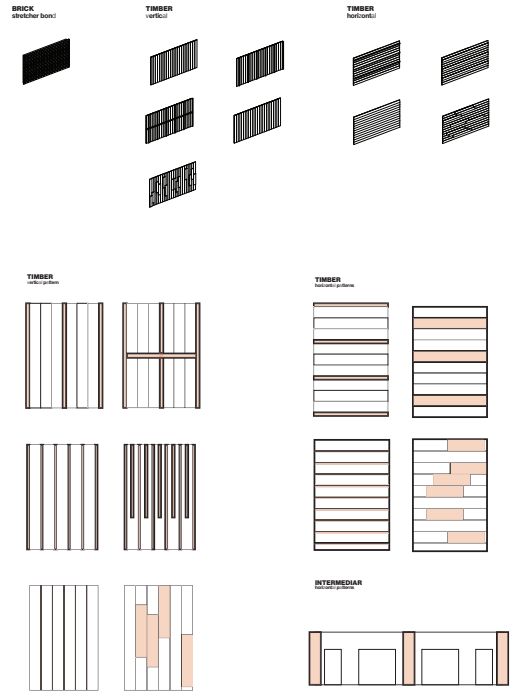


# 04 FAÇADE FAIR

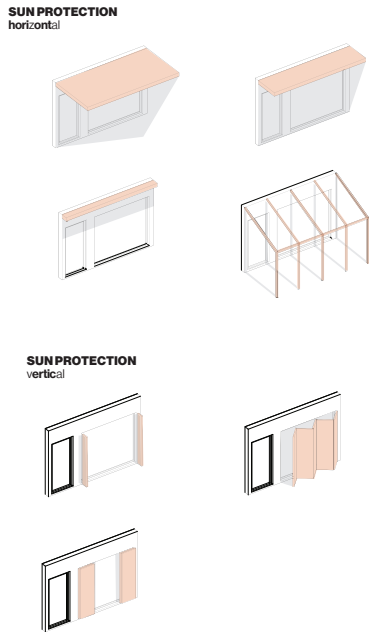
## 01 ORIENTATION FACADES



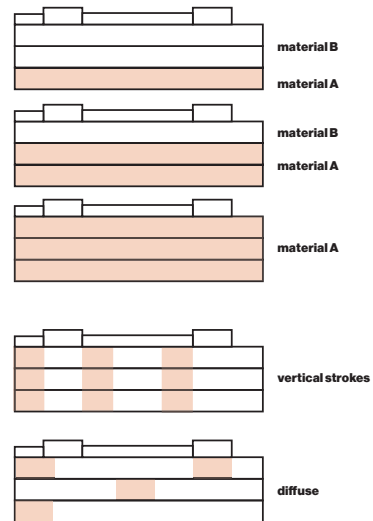
## 02 MATERIAL & PATTERNS



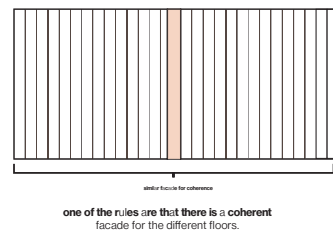
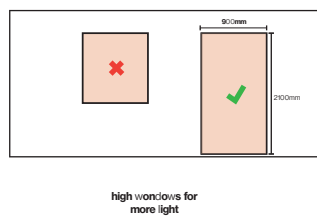
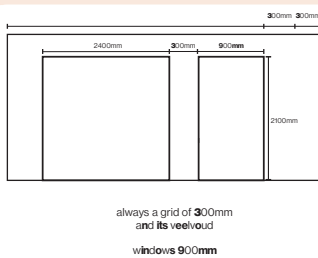
## 03 SUN PROTECTION



## 04 PICK A STRUCTURE



## 05 SET UP FACADE RULES



## **04 Facade fair**

### **01 Orientation Facades**

In this step of the concept, the design of the facade is examined. By going through these steps, a design is developed for the facade of the project. Step 1 for this is establishing the orientation of the homes and the desired openings.

### **02 Material & patterns**

In the second step, material choices and patterns are examined. These options too can be expanded upon in the future. What is important for the project is to make a particular choice for the design. These options are intended as guidance in making that choice.

### **03 Sun protection**

Based on the orientation of the facades, sun shading can also be considered. Depending on the orientation, a choice can be made between horizontal or vertical sun shading. This step too is project-dependent and is an important architectural decision.

### **04 Pick a structure**

After selecting the many facade options, there is also a design-supporting component that attempts to clarify the architectural structure of the facades. This too can serve as a helpful support for the architect.

### **05 Set up facade rules**

As a final part of the facade phase, a number of facade rules can be established by the architect. These rules apply to all homes that will participate in this project. In this way, the architect safeguards the architectural quality of the design. At the end of this step, an architectural proposal for the facade is in place..

## **Finished the steps?**

If all has gone well, a concept design should be ready at the end of this 4-step plan. The goals of the project and the possibilities have been analysed. A choice has been made regarding which *topping* strategy will be applied, and these have subsequently been implemented into the existing situation. Following this, a decision has been made on which modules can be used for the execution. Finally, a decision has been made regarding the facades of the homes. The architect can now continue at the drawing board and develop the project into a final design.

## 2.3.4 The Concept's Manifest

In this project, it was important to reflect on the role of the architect and the relation between the concept. On the one hand, a concept is being created in which it could be noted that the architect has less 'freedom' to design. On the other hand, the project is also quite context-specific. It is shown how the concept can provide a framework when a project such as this one is started. However, the complete project depends on many choices, in which architectural expertise is of great importance.

For this reason, it was chosen to emphasise that the project relies on a systematic approach up to a certain point, but that after completing the four steps, an architect is explicitly required.

The goal is therefore not for this concept to be a copy-paste formula. The architecture that emerges from this concept is always context-specific. The project architect will be able to bring their own style, but always in collaboration with the residents.

The concept does, however, come with a set of rules. These rules stem from the philosophy and objectives of this concept.

**1. A design that follows from this concept will always aim to be as sustainable as possible** (with regard to: building materials, construction methods, emissions during construction, disassembly, MPG scores, circularity, and biodiversity).

**2. A design that follows from this concept will always aim to add as little as possible, with liveability and impact in mind.** Taking into account the existing situation, the demands of society, and the available possibilities, a balance must always be sought with regard to the m<sup>2</sup> being added.

**3. A design that follows from this concept will always aim to keep the flow of residents in balance.** Elderly residents can continue to live in their neighbourhood, while young people and first-time buyers will be able to find housing in the remaining m<sup>2</sup> that become available.

**4. A design that follows from this concept will always seek to promote social cohesion.** The conversation is not held about, but with the residents, and the importance of social sustainability and liveability is a core value.

**5. A design that follows from this concept will always maintain one and the same architectural appearance.** The architect takes the lead in shaping a coherent final result.

The goal of this graduation project and the accompanying developed concept is also not to produce a new architectural style. The goal is much more about developing a new vision on architecture and living. If the focus shifts to how we can build new homes and living environments from what already exists, then this project has succeeded. The role of the architect in this is much more than spatial design alone. The architect is a bridge builder between society and the built environment. The architect becomes a master of the socio-spatial discipline.



## 2.3.5 Timeline

An enormously important question and factor in this project is the factor of **time**. In this project, there was a choice between two ways of working. One way is to approach the project as pure inspiration and to demonstrate its potential. In this case, the factor of time would matter less, and the question of what would happen if some of the residents did not wish to participate in the project would not be taken into account.

The other way is to include the factor of time and to think about the process over the years. This would not only be more realistic to consider, but it would also encourage reflection on the construction process and development over time.

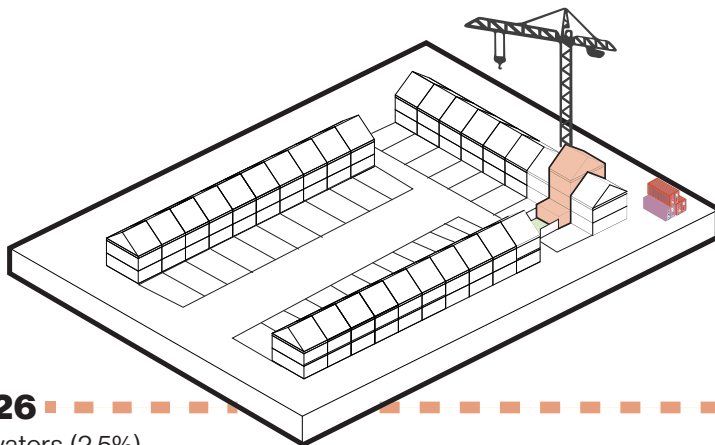
The decision was made to allow the factor of time to play a role. By doing so, it suddenly became important to ask what would happen if some of the residents did not wish to participate at all. And what happens if part of the project were to be built only a few years later? Below, a scenario is written about a possible timeline for this project.

### Theory of DOI

According to the *Diffusion of Innovation* (DOI) theory (by Everett M. Rogers in 1962) there are 5 types of behavior when it comes to change. This social scientific theory explains the types are: the innovators (2,5%), the early adopters (13,5%), the early majority (34%), the late majority (34%) and the laggards (16%) (García Avilés, 2020).

A translation of this theory was made, which resulted in a timeline where 1 of the 29 homes would start in year 2026. 7 years later, 89% of the whole block (25 homes) would have joined the project.

The timeline exposes a realistic approach where there is a big chance that the project grows over time. In this case adaptability of the construction is very important.



**2026**

innovators (2,5%)  
**1 house begins**

In early 2026, a meeting was held, organised by the municipality and the architect. During this meeting, the possibilities that this neighbourhood has in terms of splitting, topping, and transformation were presented.

The advantages for the neighbourhood were explained in detail, and many questions from residents were answered.

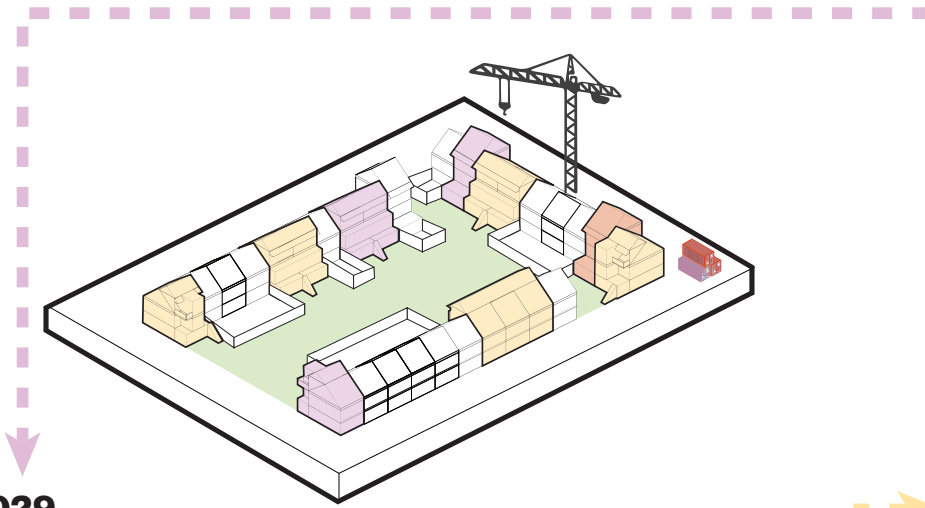
As a result of this meeting, one household came forward to register. This home belongs to a family of 4 people, who are willing to top-up their home. The architect sits down with the residents and

works through the step-by-step plan.

For now, the choice is made to add a storey. It suits the needs of the residents, and the current home lends itself well to the addition of one extra floor.

By mid-2026, the transformation has been completed. For this quick transformation using prefab elements, it was only necessary for the family to stay elsewhere for one week. A temporary container was hired for the storage of items that were in the way.





**2029**

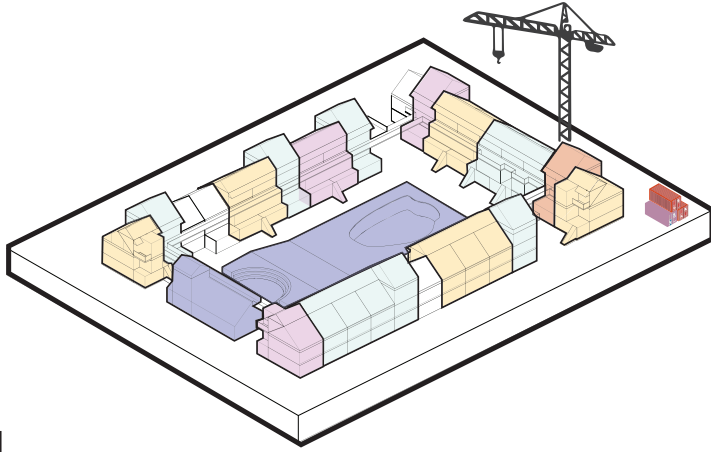
early majority (34%)

+10 houses join

It takes just under a year and a half before an even larger group comes around. Many people could see the advantages, but were not yet ready to take the step. However, after a year and a half, the early majority decided to join as well.

This step meant a great deal for the block. Another ten households decided to sign up. The enthusiasm was great. So many possibilities! A fourth variation was added. Three homes decided to form a sub-block together and to apply a combination of *tussen-*, *op-*, and *achter-* *toppen* here as well. In consultation with the

architect, the access between the homes, the sharing and opening up of the gardens, and the architecture are discussed.



## 2031

late majority (34%)  **89% has joined**

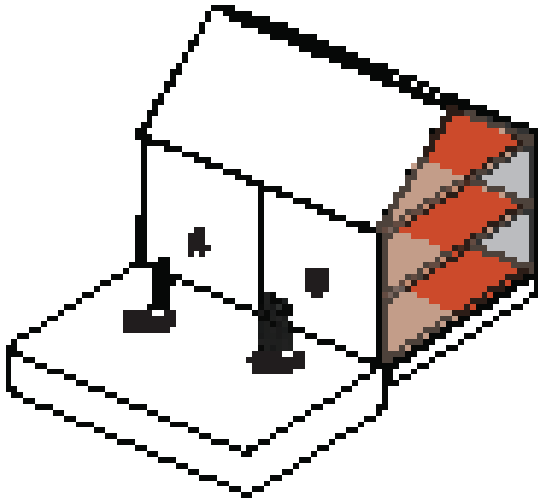
Another year and a half later, the last large group joins; the late majority. Over the past years, the households have witnessed the results of this project. The remaining households also came to see the advantages, and in conversations with the other residents, the idea of a shared neighbourhood room was also discussed.

Because most residents are 50+, they too recognise the benefits of the social aspect. In addition, it means they do not have to move. This ultimately makes it a logical choice for most of them. With nearly 90% of the block now participating, a large meeting is held. The participating homes are able to express their preference regarding the splitting of their home, and the neighbourhood room is also discussed. What should it contain? And can there finally be a shared inner courtyard?

The four remaining homes that are not participating are also welcome at this meeting. One is not interested, another has a personal reason for not participating. Nevertheless, a conversation is held with them about sharing their garden and joining a shared neighbourhood room. On the condition of retaining a small back garden, three of the four remaining households agree. One of the 29 households does not participate at all and also wishes to keep their garden.

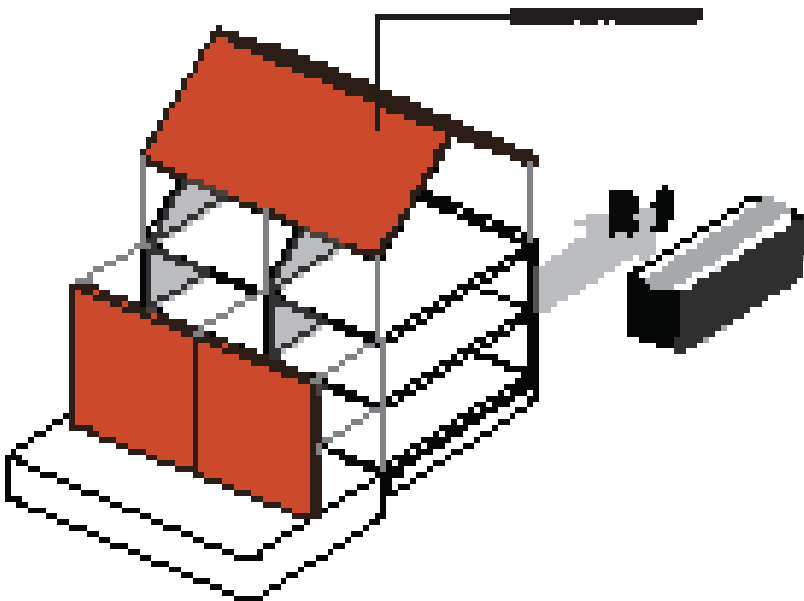
## 2.3.6 Assembly proces

**STEP 1**



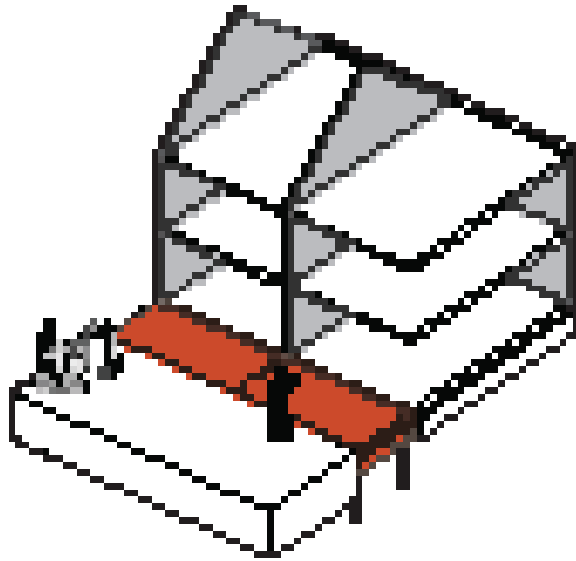
**STEP 2**

**STEP 3**



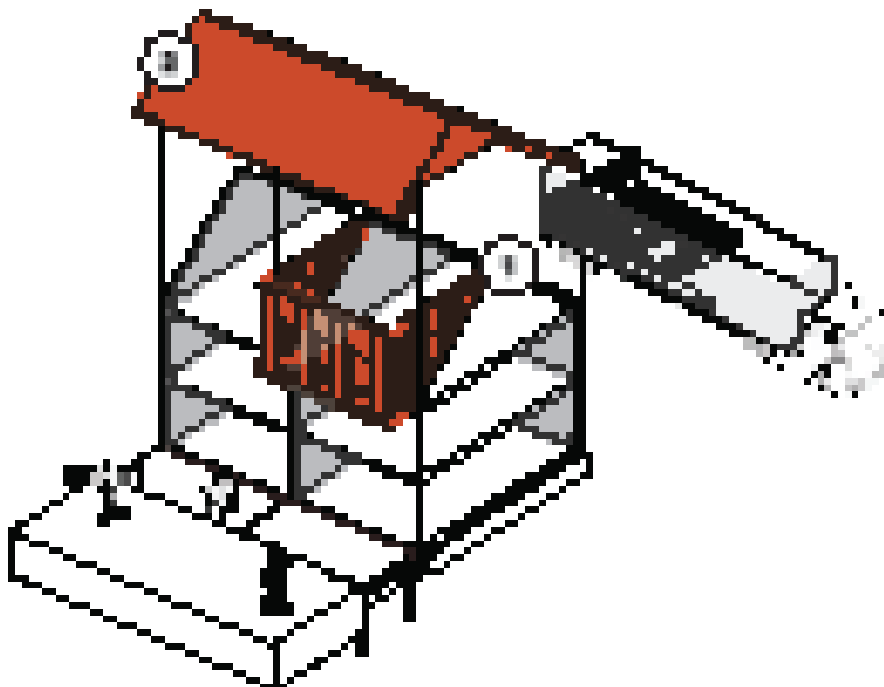
**STEP 4**

### STEP 3.1



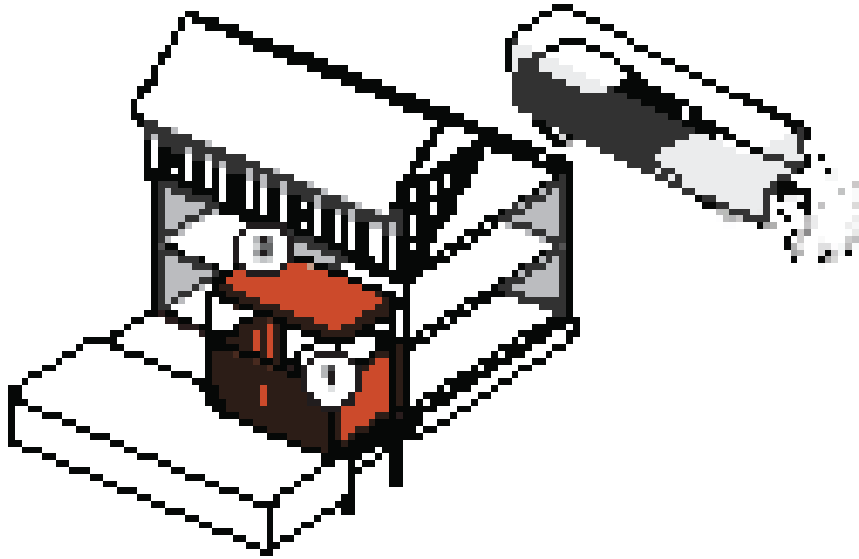
**Put the red Technic beam (part 1133) onto the grey Technic axle (part 28).**

### STEP 3.2

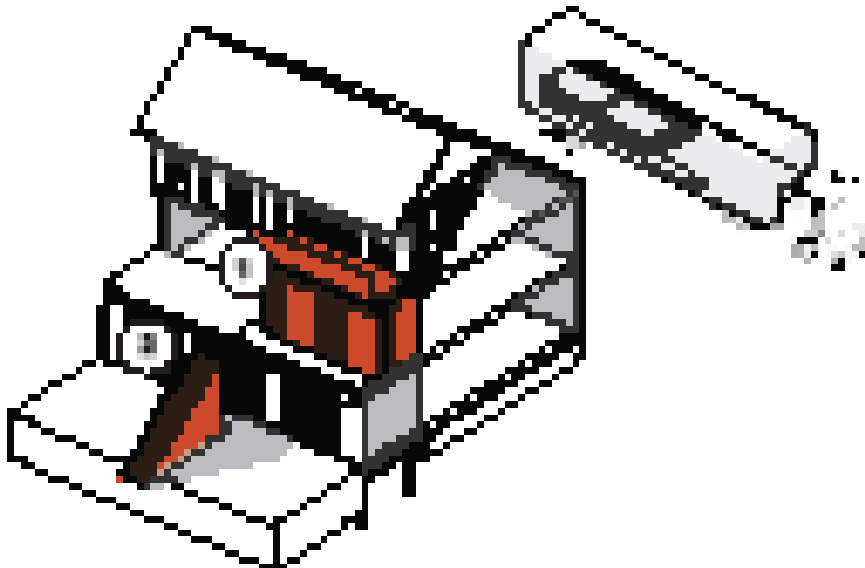


**Put the grey Technic axle connector (part 2) onto the grey Technic axle (part 28).**

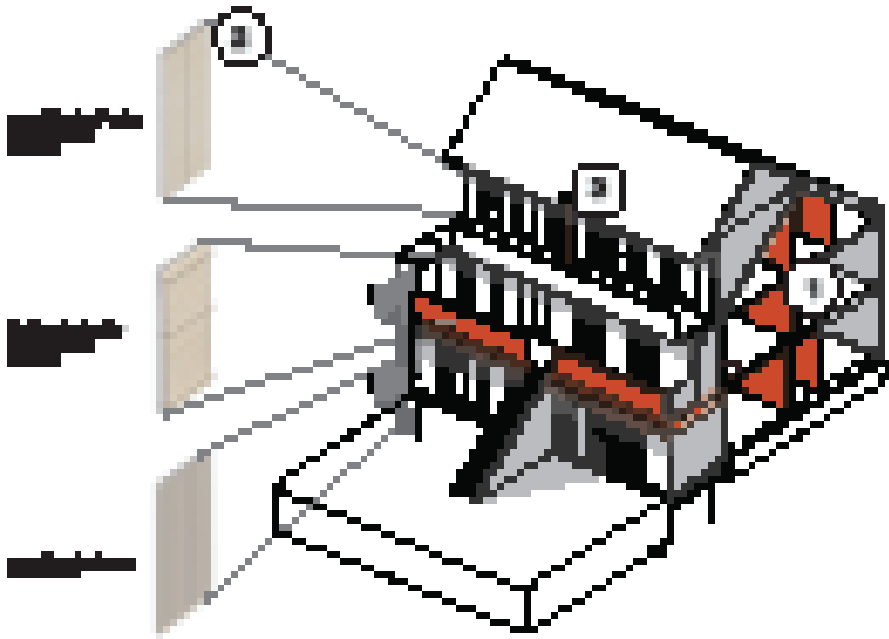
### STEP 3.3



### STEP 3.4

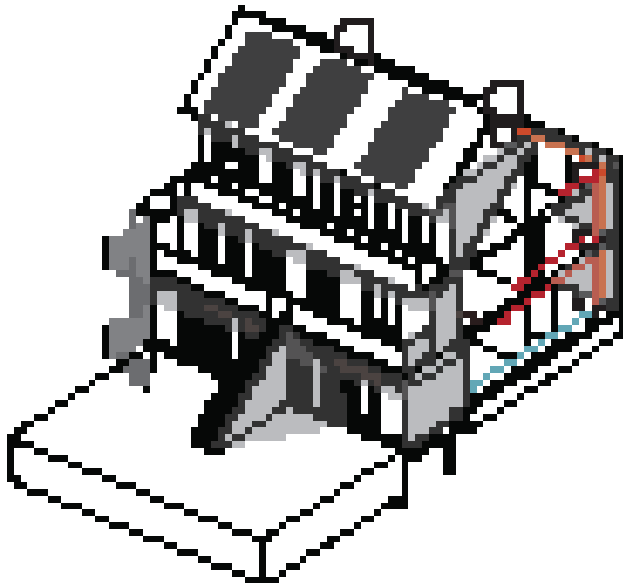


### STEP 3.5

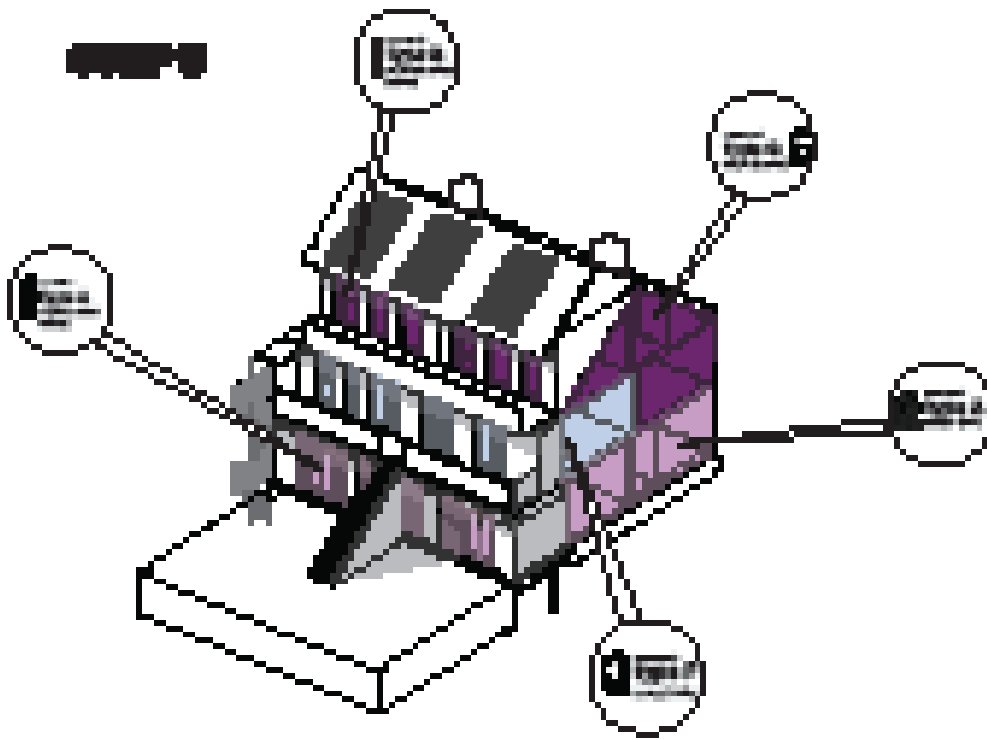


**Step 3.5: The structure is now almost finished. The roof is now in place.**

### STEP 3.6

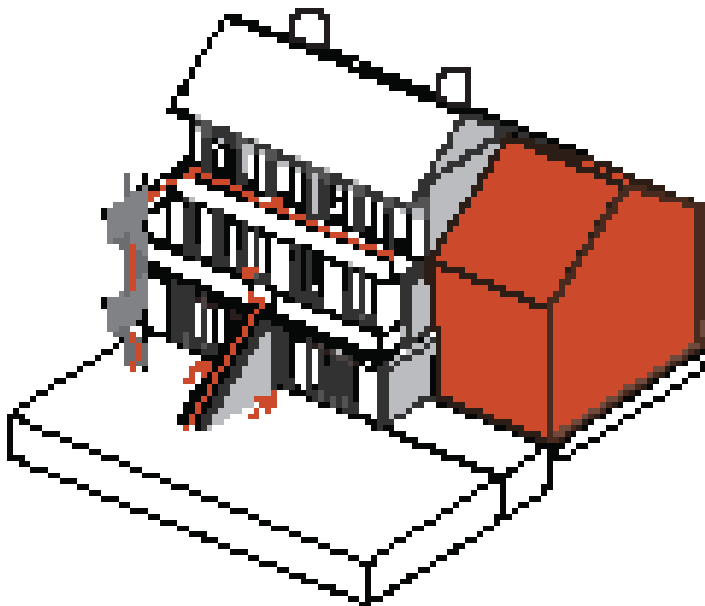


**Step 3.6: The structure is now almost finished. The roof is now in place.**

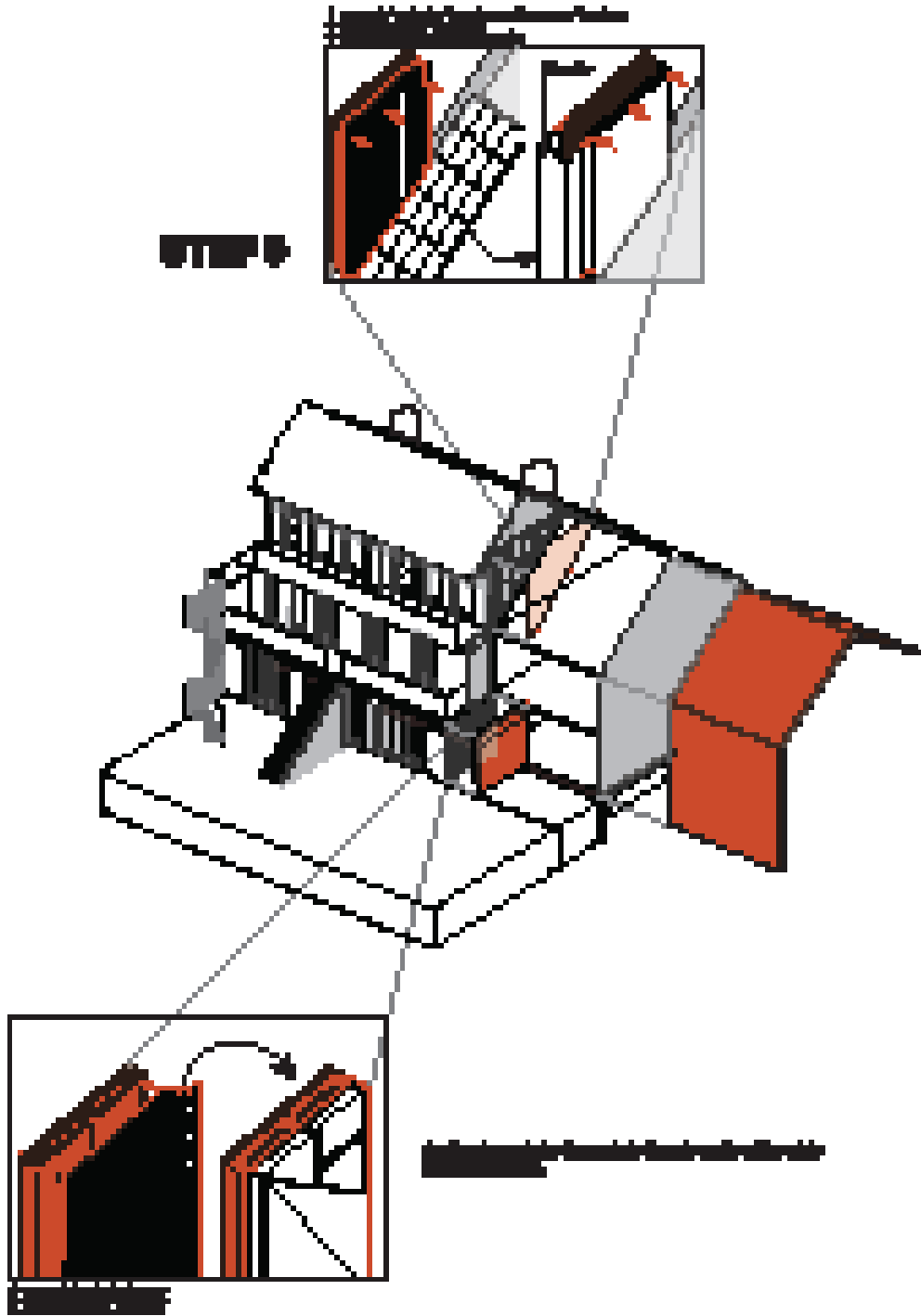


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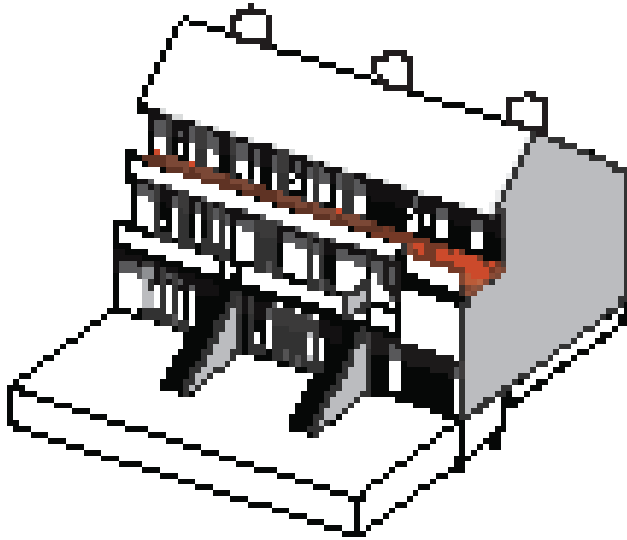
XXXXXX



XXXXXXXXXXXXXXXXXXXX



[REDACTED]



[REDACTED]

The steps above show how the process of assembly unfolds over time. As an example, one variation (variation 3) has been chosen to illustrate how it changes over time.

Steps 1 through 3 show how two single-family rowhouses are transformed into 5 apartments. Where three people once lived, there are now 9. The first three steps are relatively quick and are completed within one week. In particular, the installation of the modules is a quick process, which can be finished within just 1 to 2 days.

Steps 4 through 6 show how, over the years, changes can occur in the number of participants in the project. It is demonstrated what would happen when one neighbour is already participating and the other is not yet. Step 5, for example, shows important

details about the assembly of a new module. In step 6, the gallery is discussed and how it only becomes collective at a later stage. Only when enough homes are participating in the project does the opportunity naturally arise to connect the galleries and create a collective access route.

The steps above show how this project can transform the housing block in a quick and straightforward manner. Without major interventions, a great deal of impact can still be made.





# 03 OUTPUT

## design & research



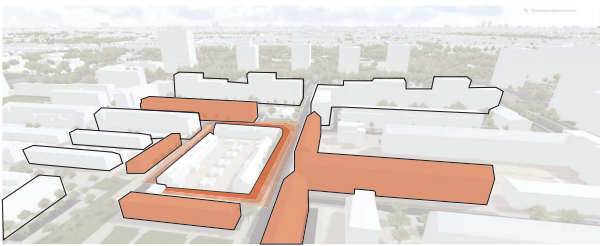


n results

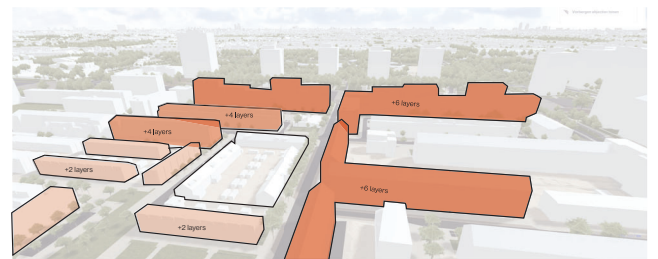
# 3.1 ANALYSIS & GOAL

In this first step of developing the project, it is important to thoroughly analyse the existing situation. From the immediate surroundings and building heights, to demographics and construction drawings. In addition, it is important to establish a goal for the project. How many homes need to be added? What

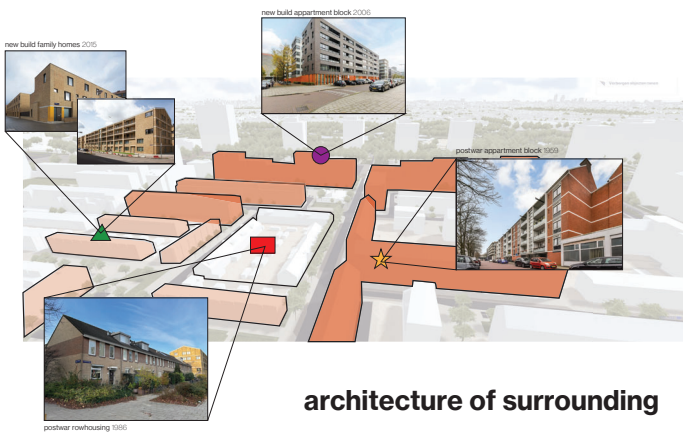
will the strategy be? What facilities does the neighbourhood lack?



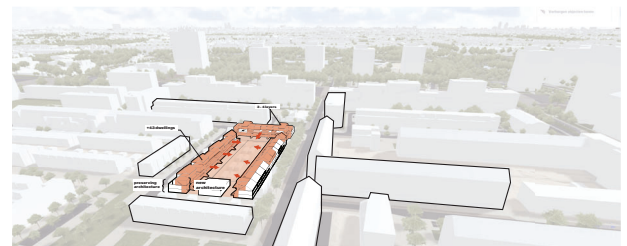
**connection to surroundings**



**building height of surrounding buildings**



**architecture of surrounding**



**opportunities in architecture**

## 01 Analysis spatial context

The immediate surroundings of the project can be described as a semi-urban context.

Amsterdam Overtoomse Veld Noord was originally built around 1950–1960 as a post-war reconstruction neighbourhood. Its function was primarily residential (Garden Cities, n.d.).

Later, between 2004 and 2019, urban renewal took place and new construction was built in various locations.

As a result, Overtoomse Veld has a very diverse range of housing. Although it lies outside the ring road and has a predominantly residential function, it has a semi-urban character due to its proximity to the city centre. The specific housing block that is central to this project is remarkable in its appearance. Within the immediate surroundings, it represents an

exceptional typology, embodying the typical Dutch post-war terraced house. It is surrounded by various typologies, and as a result, the block does not connect strongly with the surrounding architecture.

The building heights in the immediate surroundings range from 3 to 8 storeys. The opportunities for the housing block are:

- it can be topped by 1, maximum 2 storeys
  - the architecture does not need to directly align with the surrounding architecture
  - the existing architecture has historical value to a certain extent
- between 30 and 60 homes can be added



figure 22: own images

## 02 Project Information

The existing situation must be thoroughly analysed before developing a plan.

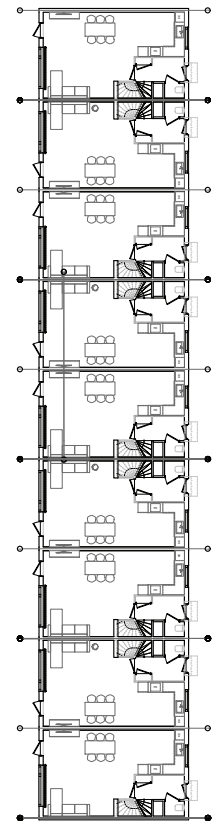
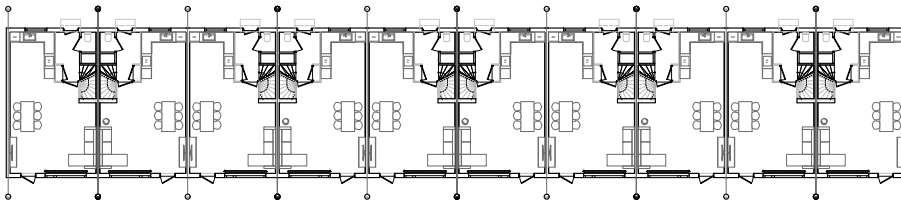
In a renovation or transformation project, archive drawings are of exceptional importance.

The existing load-bearing structure is of great significance here. The type of foundation reveals a great deal about the possibilities when it comes to adding storeys or extending.

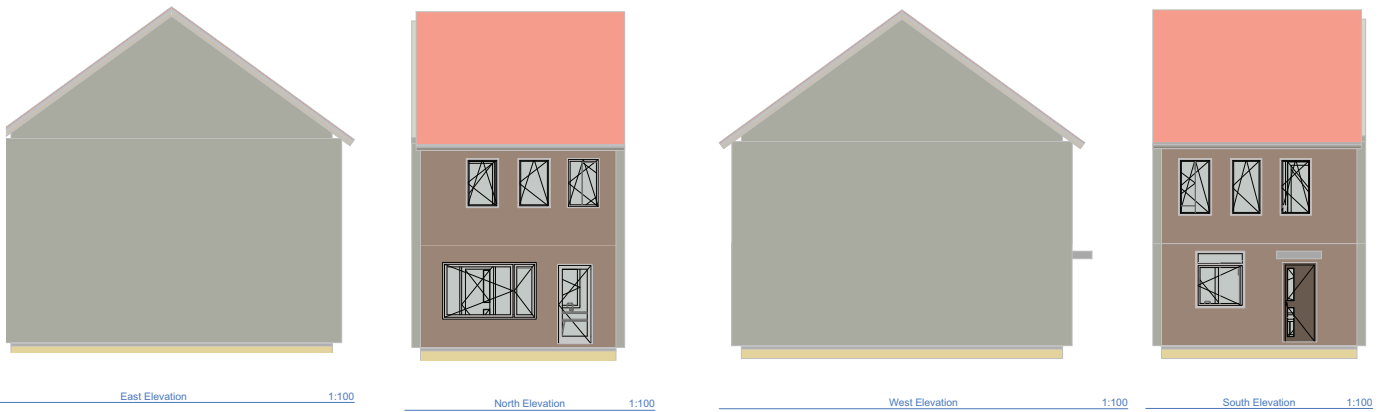
For this plan, archive drawings were available from the municipality. In the appendix (page ..), all archive drawings are displayed in full detail.

What can be read from the archive drawings and the information about the project is that these homes were most likely built on prefabricated concrete foundation piles. This gives the project somewhat more certainty that a topping of a maximum of two storeys is feasible.

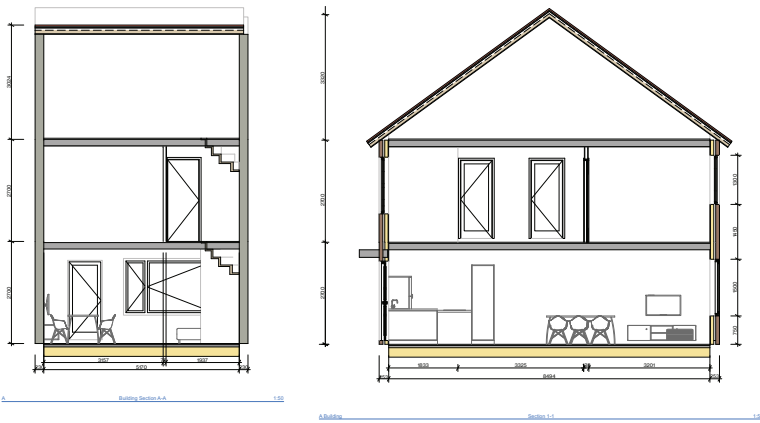
The homes are constructed from prefabricated concrete elements; the party walls and the floors, while the front and rear facades are timber frame (HSB) walls. The roof is a prefabricated rafter structure. Some homes in the block have recently been renovated.



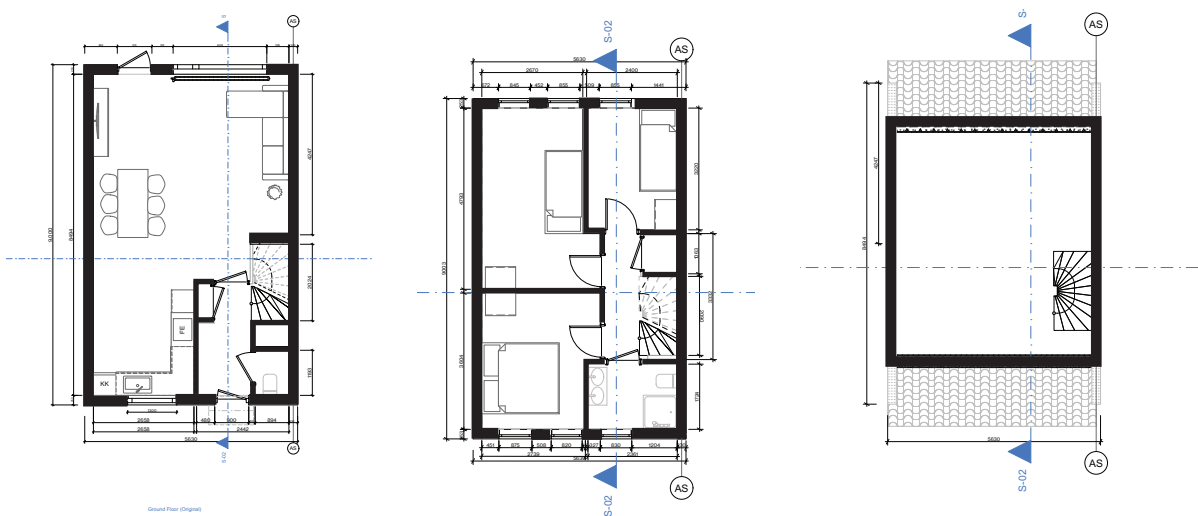
existing floorplan block (groundfloor)



**elevations of existing rowhouse**



**section of existing rowhouse**

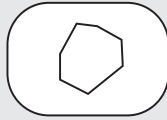


**floorplans existing rowhouse**

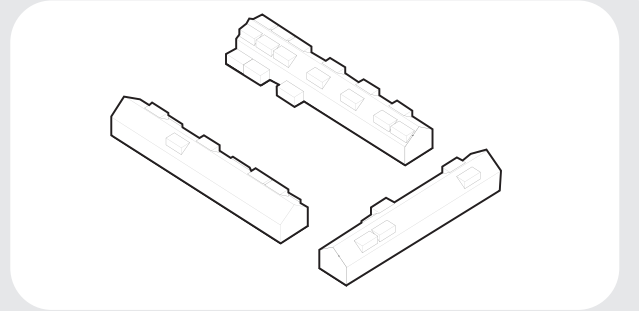
## 02 Project information

- **Urban setting:** urban / **semi-urban** / village / Vinex
- **Urban typology:** row / single / duo / **block** / area

- **Rowhouse typology:**



- **Building year:** 1989
- **Location:** Amsterdam
- **Amount houses:** 29
- **Household demography:** 6x single person, 9x families, 14x couples



- **Orientation:** north/east/south/west
- **Soil quality:** sand
- **Energy supply:** district heating

## 02 Project Information

In order to have the best possible foundation for the design, it was also necessary to establish who lives in the current block and how many people.

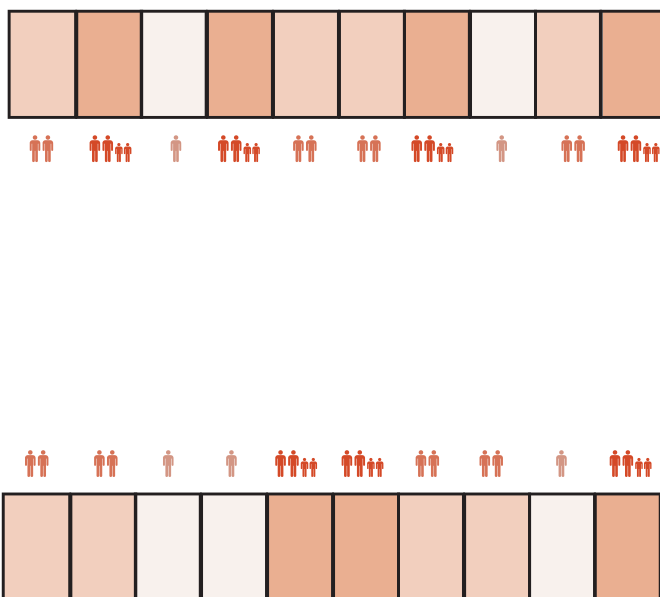
Since no accurate information is available about who lives there and what types of households are located where, an estimate was made based on current information about the demographics of Overtoomse Veld Noord (Allecijfers.nl, 2026) and the composition of Dutch households (CBS, 2026).

20% of households are single-person  
 30% of households are families  
 50% of households are couples

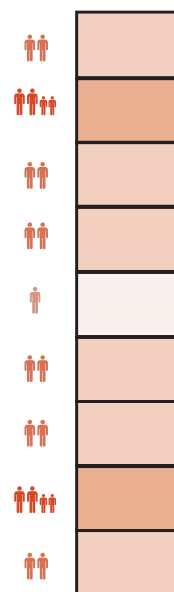
Based on this information, an estimate was made that:

- 6 homes contain single-person households
- 9 homes contain families
- 14 homes contain couples

The households were then randomly distributed across the 29 homes. For the project, this arrangement was taken as a given. No further adjustments were made to this formation.



existing household sizes



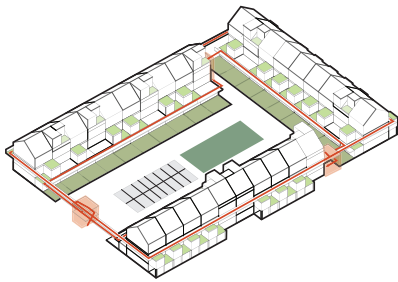
### 03 Project Goals

Next, the project goals were examined. Since this is a fictional assignment, I had to establish the goals myself. This came about as follows:

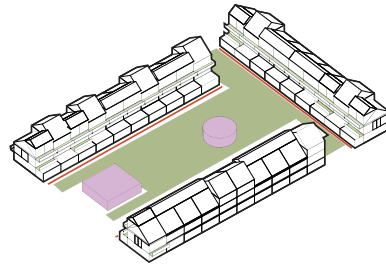
The demand from society and from the municipality of Amsterdam was examined. This revealed that there is a particular need for lifetime-proof homes for elderly residents and affordable homes for first-time buyers.

Subsequently, the goal emerged to find a balance between the number of homes to be added and the preservation of a relatively quiet and homely neighbourhood. In this regard, it was important to consider how far it was possible to go in

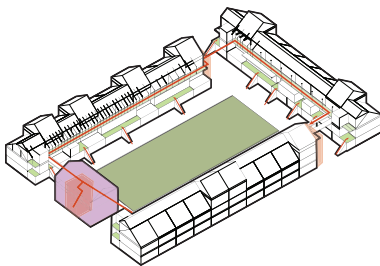
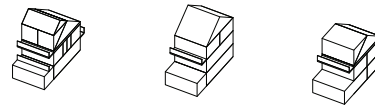
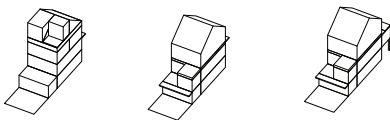
terms of numbers and adding storeys. Ultimately, a middle ground was reached. Since constructively speaking not a great deal of storeys could be added, the number of floors remained limited. Within the existing situation and with small additions, it became possible to turn 29 homes into approximately 73 homes. This meant an average multiplication of each home by 2.5. It also quickly became clear that a shared neighbourhood room would need to be added. This would include a laundry room, living room, study space, and workshop. The inner courtyard also needs to become collective.



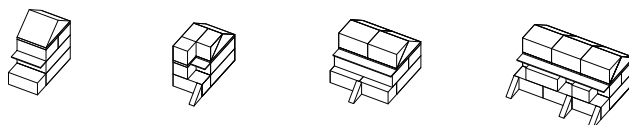
individual strategy



collective strategy



hybrid strategy

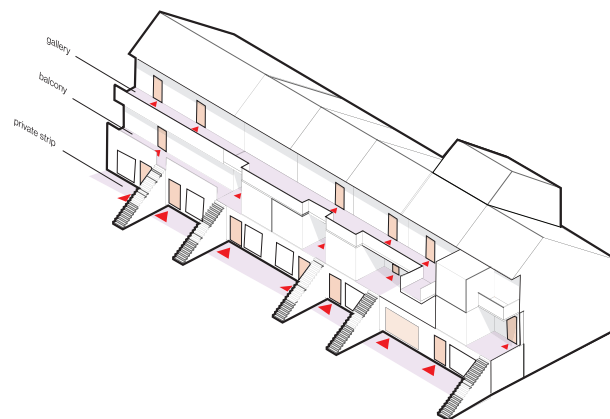


A hybrid solution was chosen as the strategy. Choosing a strategy such as this is important, as many design decisions can be based on it.

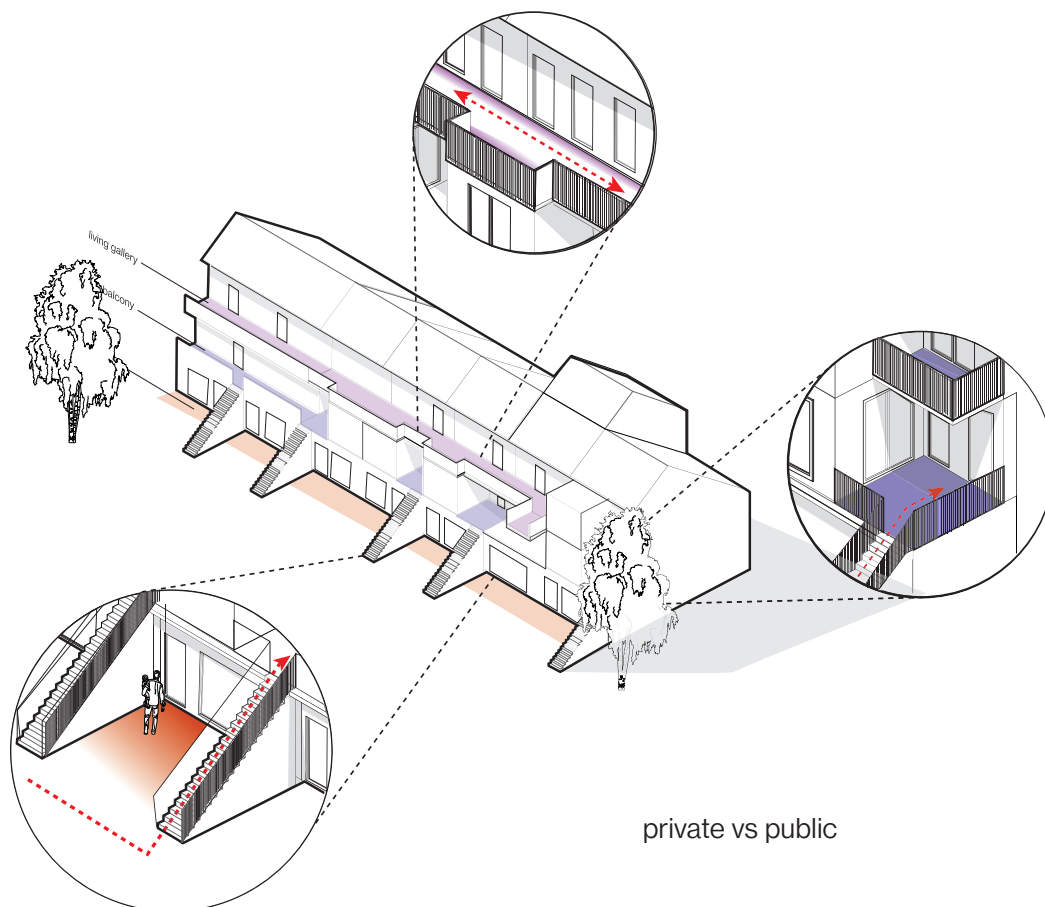
With a collective strategy, the focus will be more on sharing, while with an individual strategy, the focus will be on keeping elements such as outdoor spaces as private as possible.

With a hybrid approach, the aim is to encourage both collectivity and privacy. The image below shows how this can be achieved, for example through private balconies, a collective gallery with space to store personal belongings, and a small front garden.

It also quickly became clear that the decision would be made to activate the interior of the block by placing all entrances on the inside. Social interaction is thereby also considerably encouraged.



entrance strategy



private vs public

#### 04 Estimated houses to add

from 29 to **73**

**+ 44 houses**

 **x2,5**

The estimated number of homes goes from 29 single-family homes to 73 apartments. This means an addition of 44 extra homes, bringing the total number of homes to 2.5 times the original amount. The goal here, however, is to add as few m<sup>2</sup> as possible. This is because a large amount of m<sup>2</sup> is already present

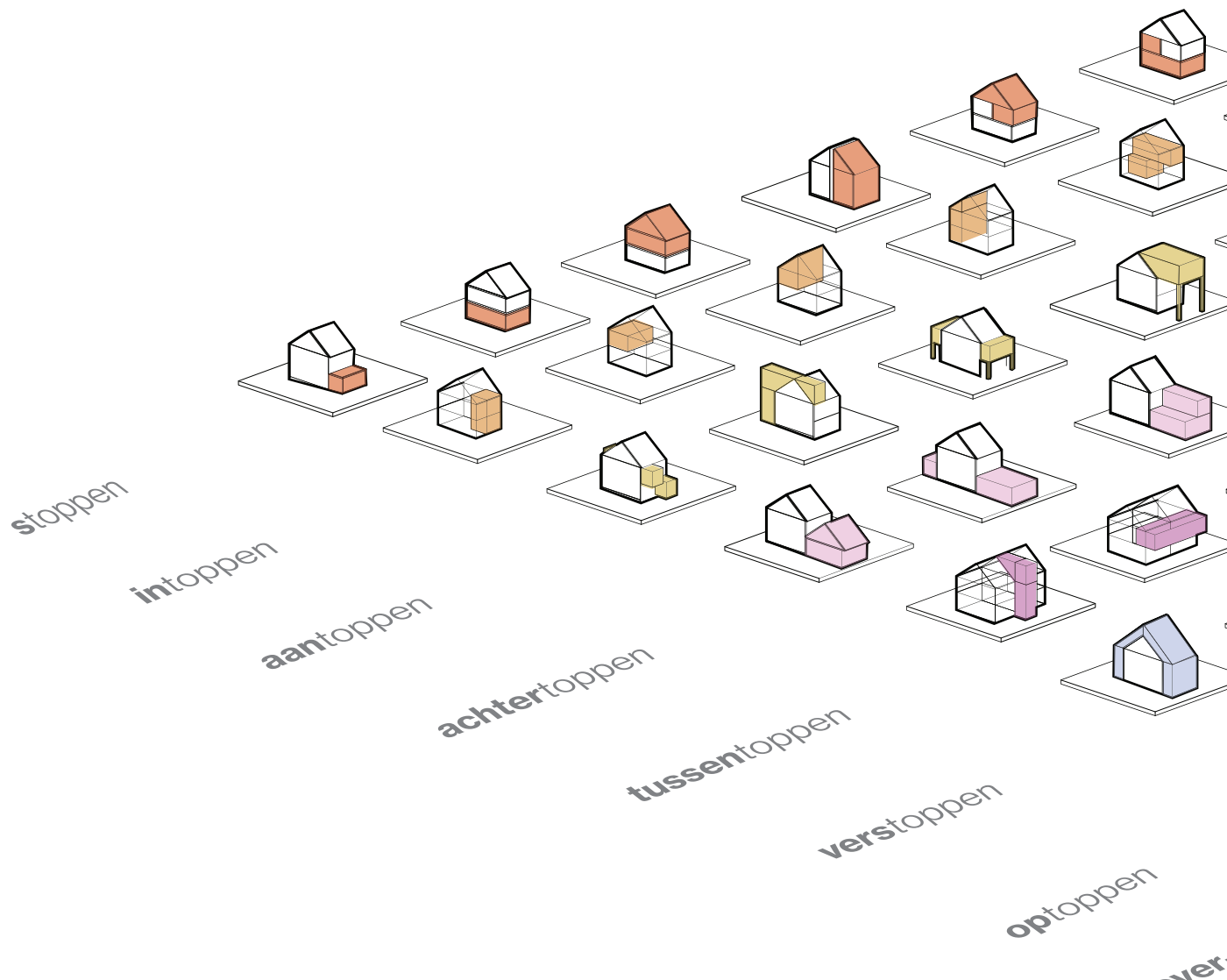
in the block that is currently not being fully utilised.

After completing this project, there will be an optimal balance between use and m<sup>2</sup>.

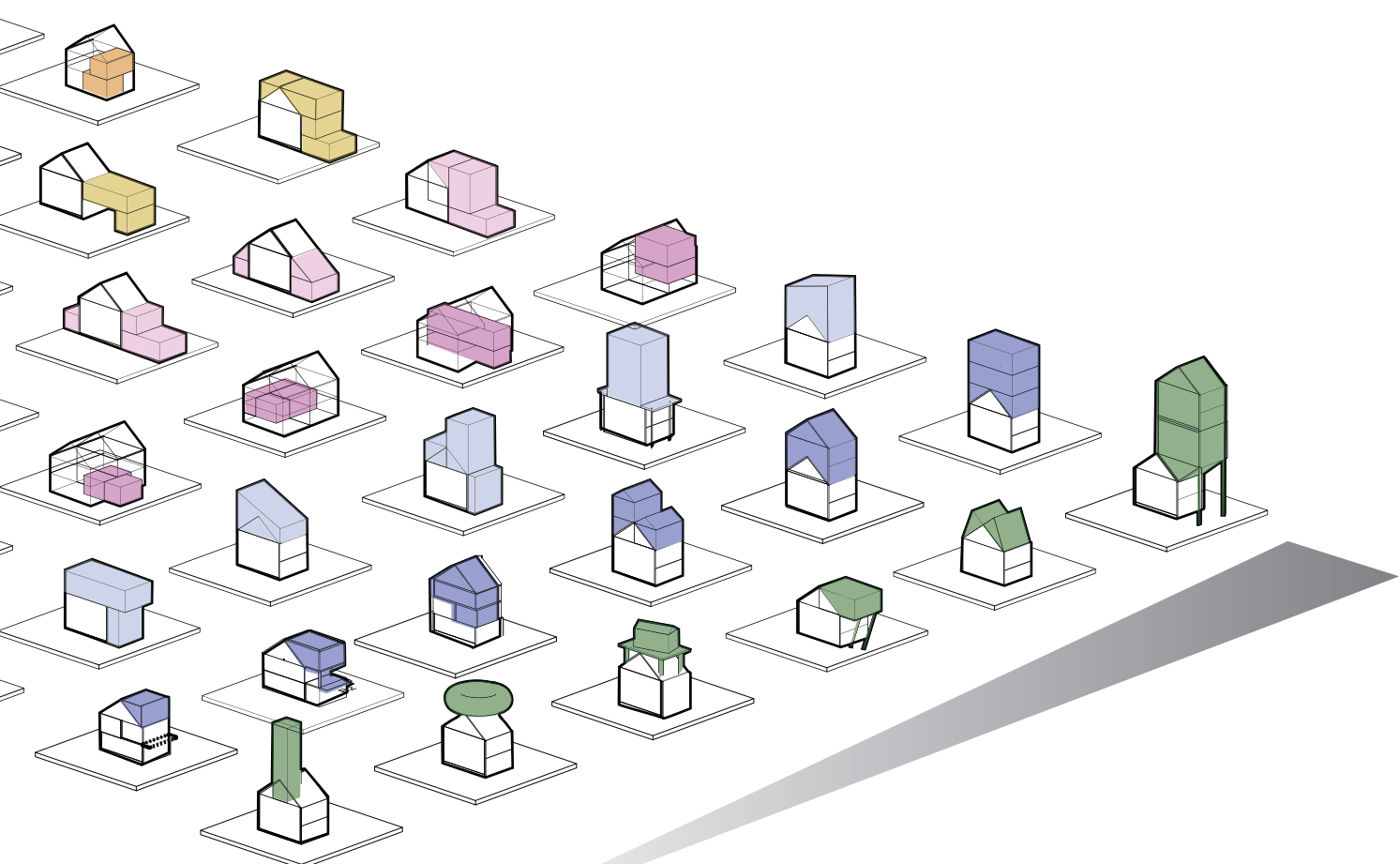
# 3.2 TOP-STRATEGY

The idea that a home can only be topped upward is a thing of the past. When transforming an existing home or building, many more options are available. By means of a topping matrix, a topping strategy can be developed that helps achieve the goals of the project.

One can *s-toppen*, *in-toppen*, *aan-toppen*, *achter-toppen*, *tussen-toppen*, *vers-toppen*, *op-toppen* en *over-de-toppen*\*.



*\*it is encouraged there are more types to be developed*



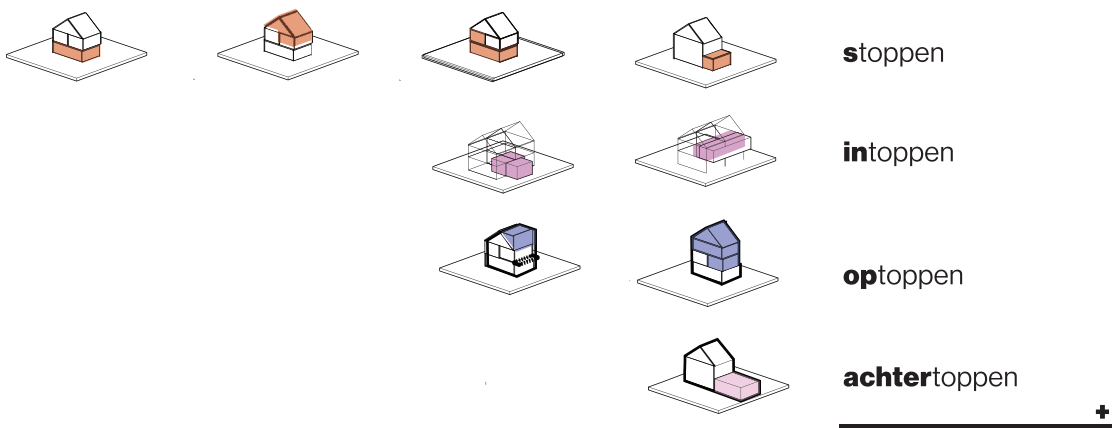
de-toppen

m<sup>2</sup>

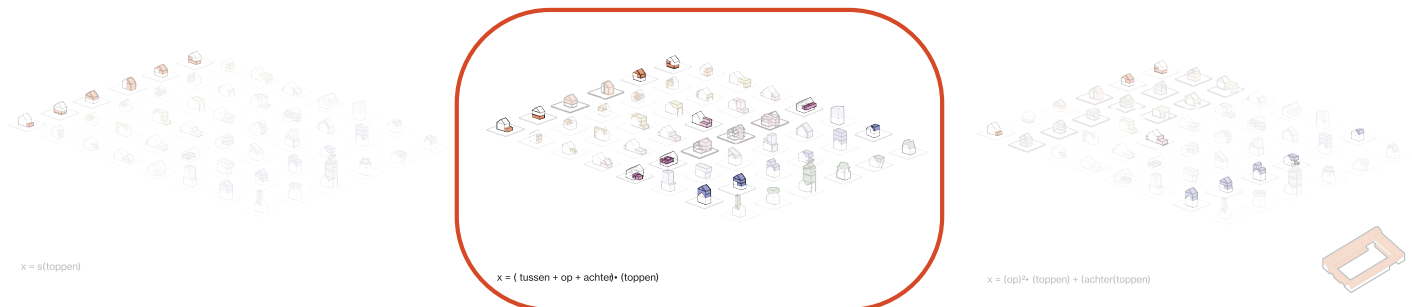
Choosing a topping strategy is a combination of analysing the existing floor plans, keeping the goals clearly in mind, and testing which options are feasible.

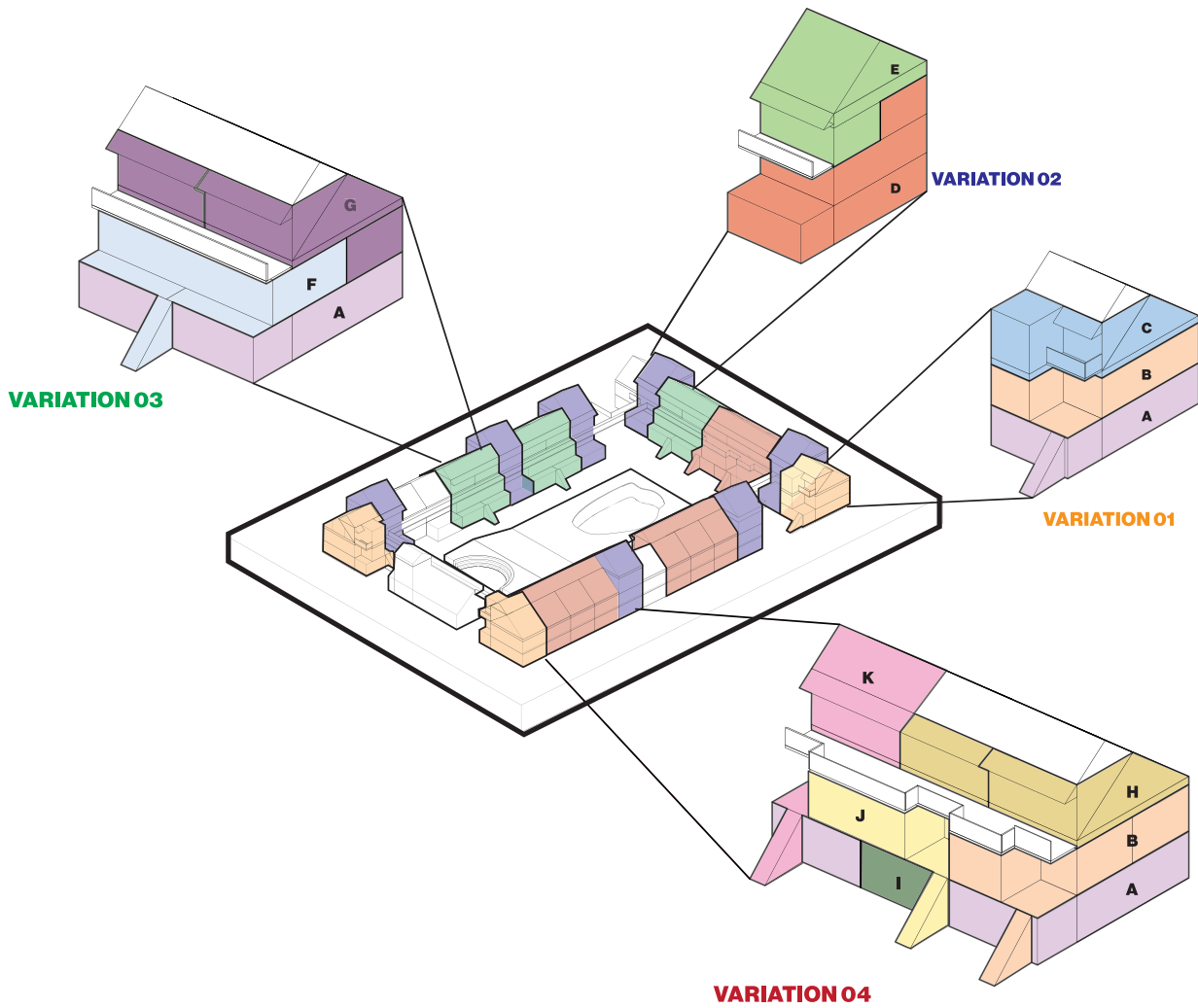
Many options were also tested for this project. The current block did fortunately provide a number of parameters, such as the interior of the block. As a result, the extensions could only be a certain number of metres in length. The number of storey additions was also limited to just 1 or 2 floors.

After a number of experiments, the following combination of *topping* types proved suitable:



### 03 Mix & match strategies





The added homes are divided into 11 types of floor plans. These are then arranged in 4 types of configurations. Within these configurations, the forms of *tussen-, op-, s-, en achtertoppen* are incorporated.

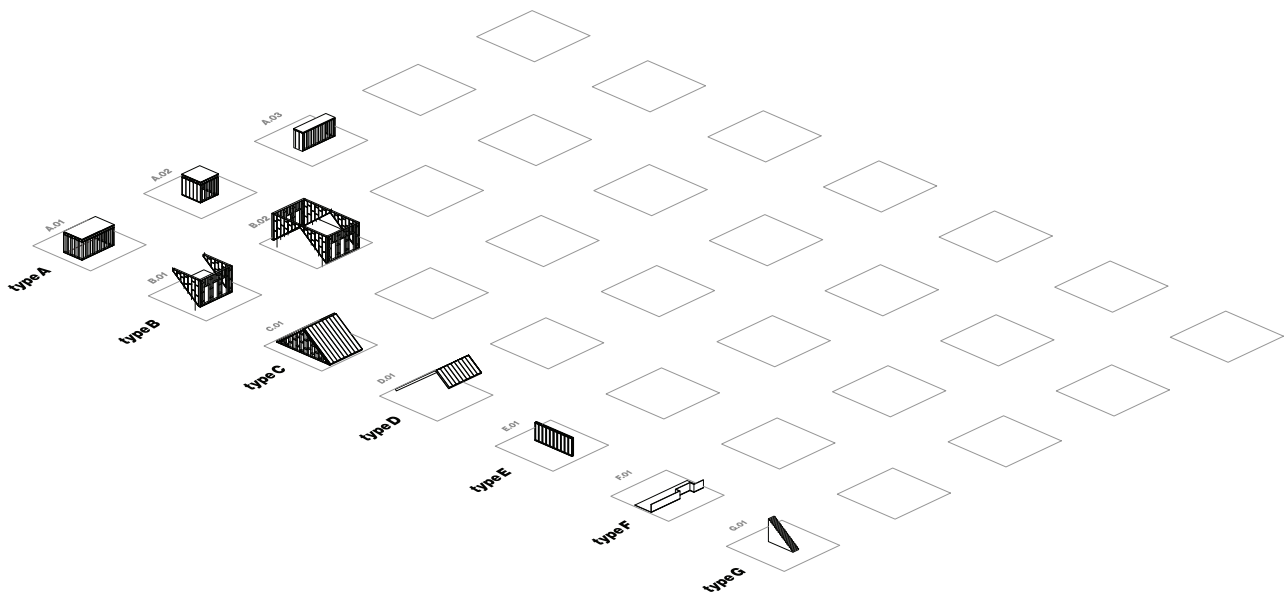
The homes range in size from 30 to 120m<sup>2</sup>. The apartments vary from studios of 30m<sup>2</sup> to lifetime-proof apartments of 60m<sup>2</sup>. Space has also been reserved for single-family homes that do not wish to give up any m<sup>2</sup>, but do wish to add a storey.



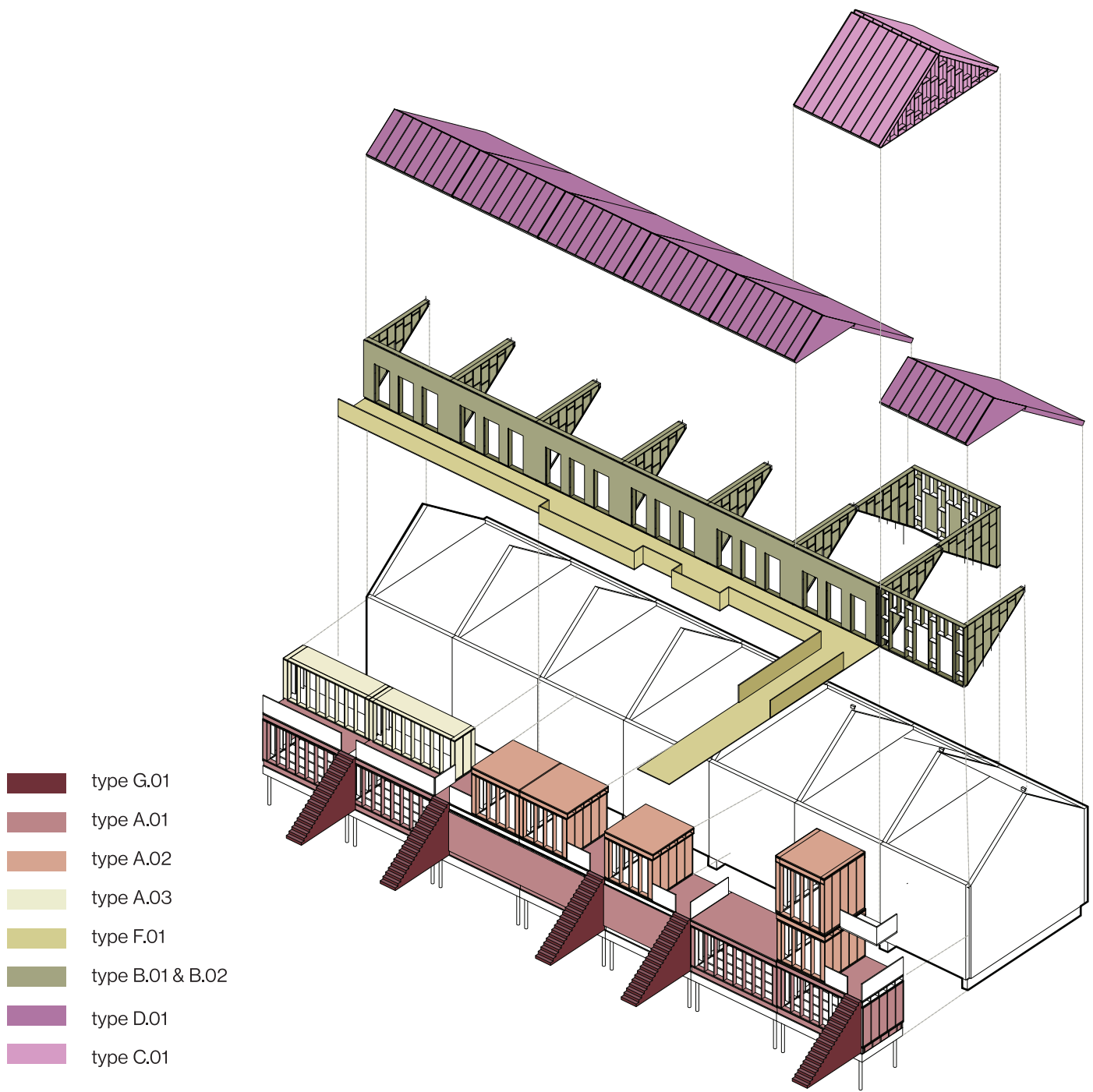
# 3.3 MODULE MATRIX

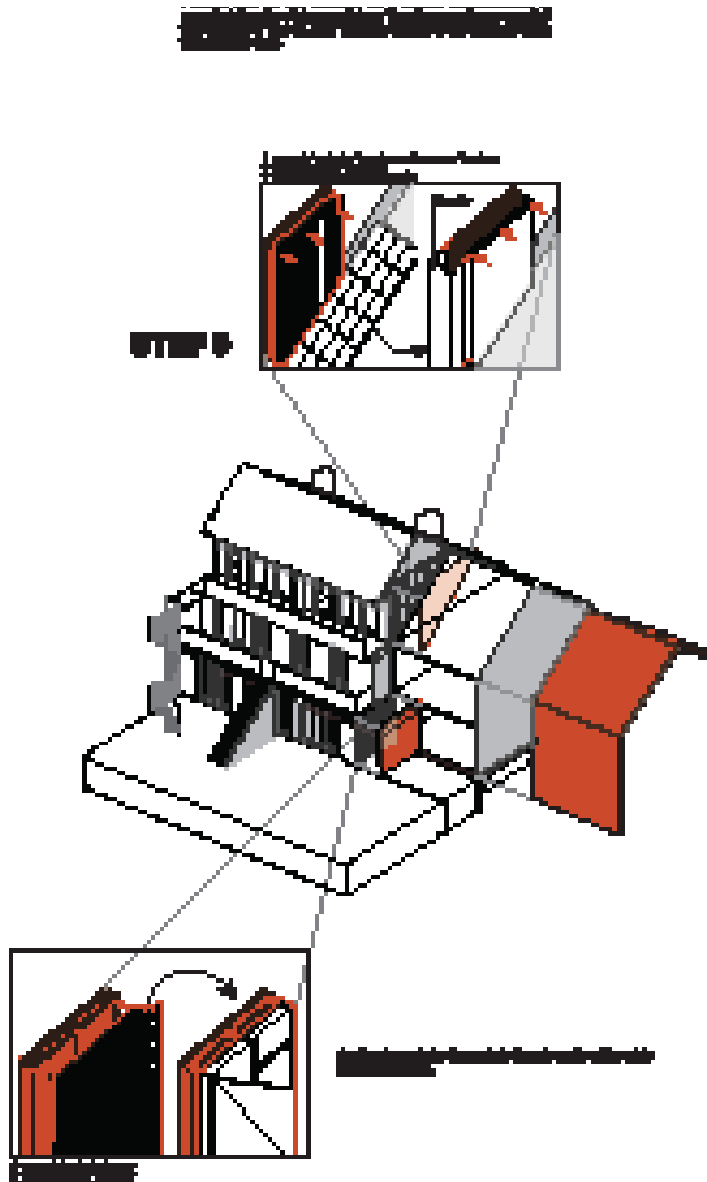
The modules for this project have been developed as cross-project modules. The intention of the matrix is to promote standardisation of the construction and to simplify the design process. Nevertheless, in every project, the modules and how they connect to the existing structure will need to be examined

in detail. In this section, the details and modules of this project are presented.



type A	type B	type C	type D	type E	type F	type G
optoppen	optoppen	optoppen	optoppen		optoppen	optoppen
				stoppen	stoppen	stoppen
tussentoppen					tussentoppen	
achtertoppen						achtertoppen





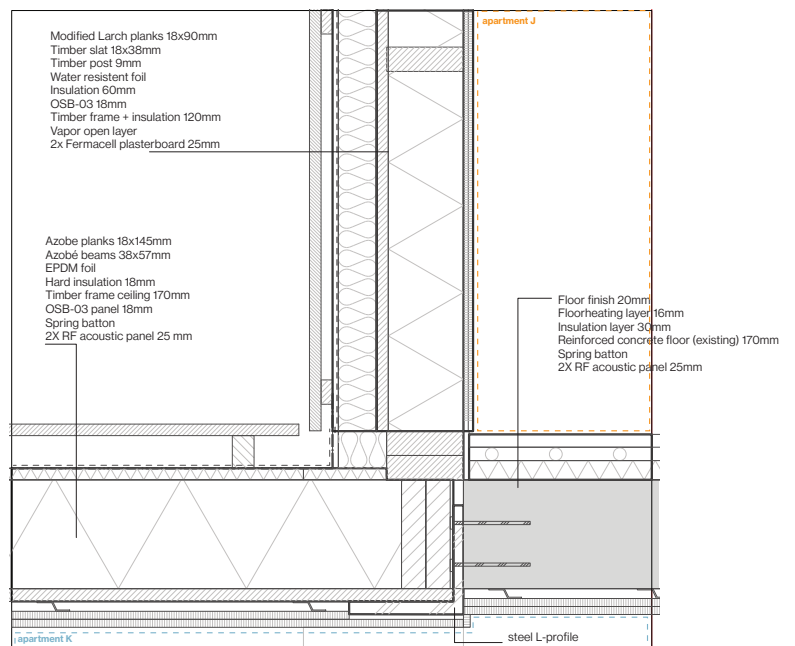
An important principle detail in this project is shown on the left. It illustrates that in some cases the exterior facades can, at a later stage, be transformed into a party wall.

This entails a change to the acoustic values, but also to fire safety and the RC values.

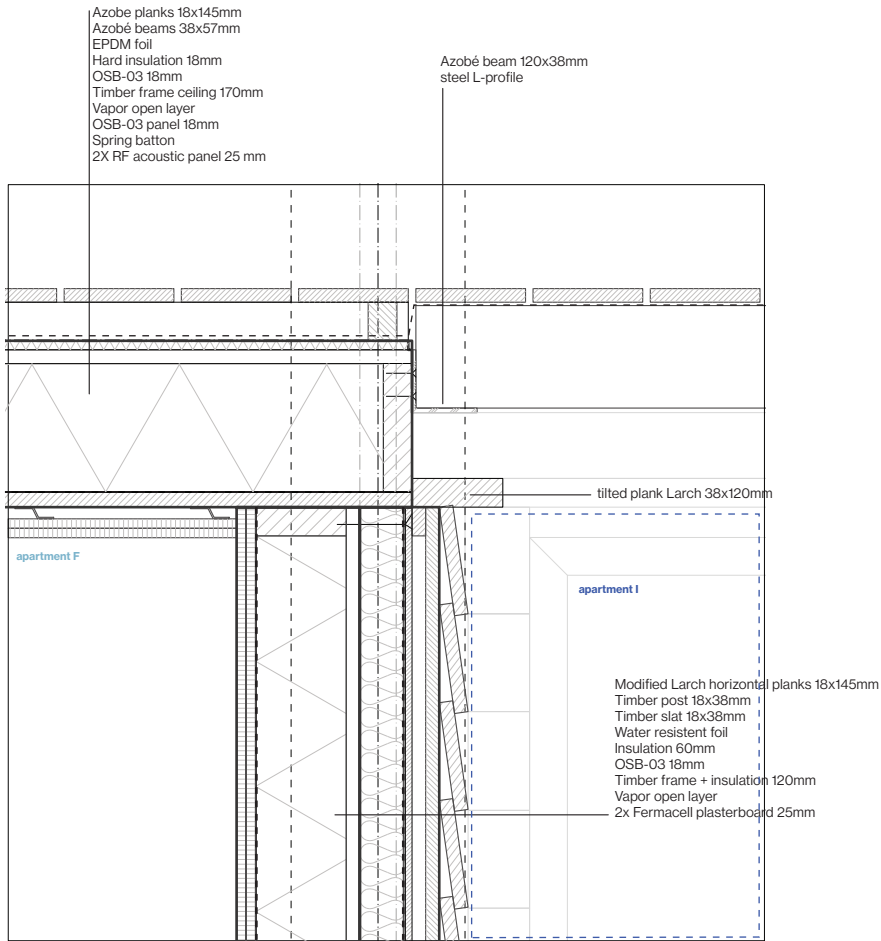
The principle detail shows that the walls are all divided into 2 parts. The timber frame (HSB) section, which primarily serves a load-bearing function. And the facade section, which can change over time and can be removed.

In the detail on the right, it can be seen how the modules are attached to the existing structure at floor level. The decision was made to make use of a steel angle profile fixed to the concrete floors. In this way, greater stability is created without the need for many columns.

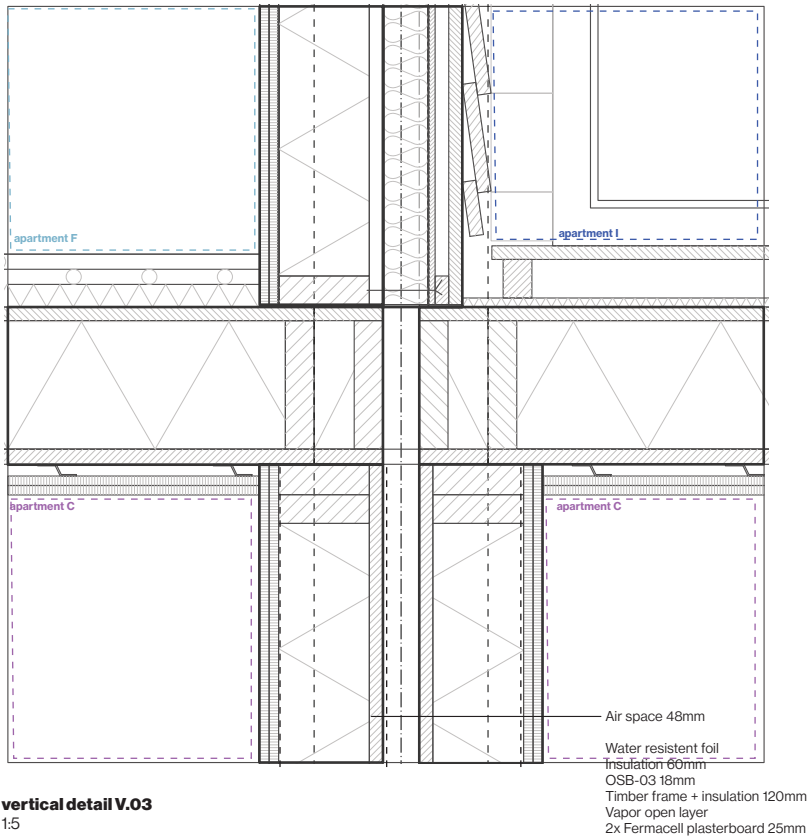
In addition to this connection, it is simply important to use proper draught sealing and waterproofing to prevent cold bridges and leaks.



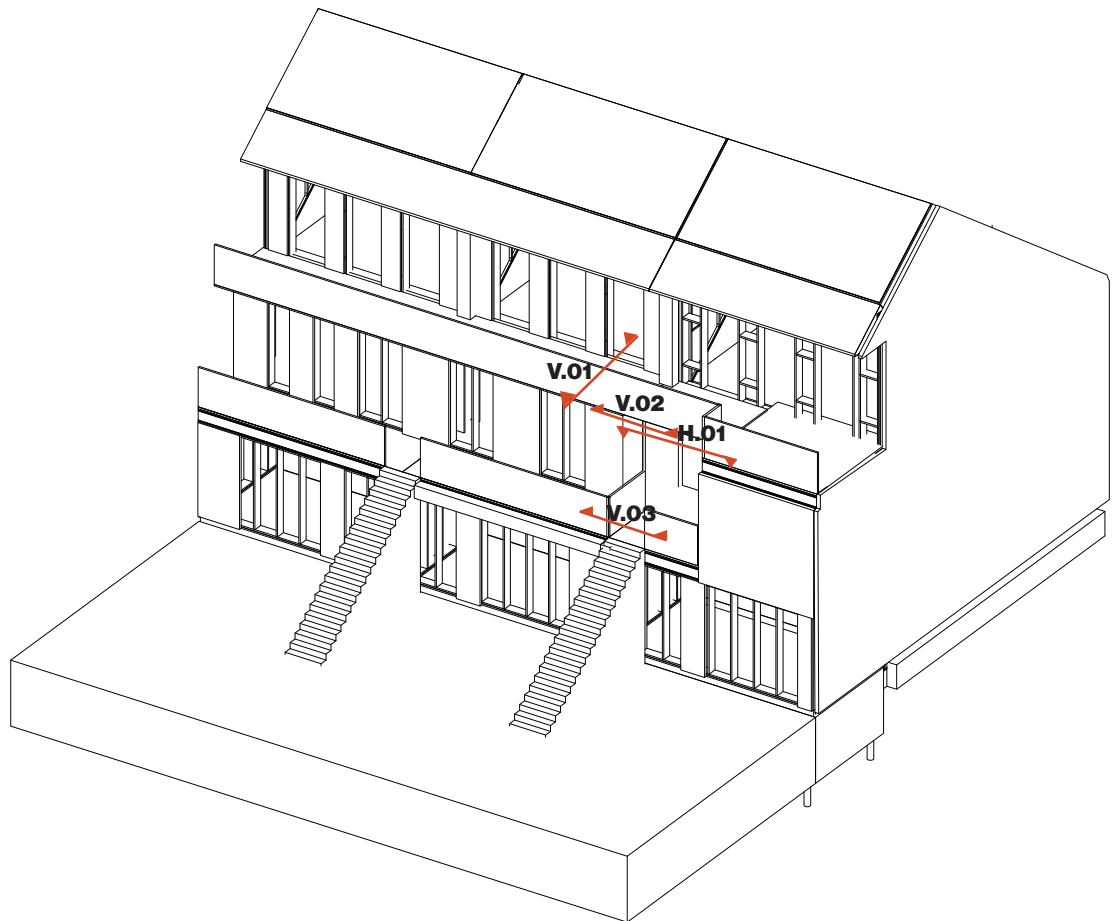
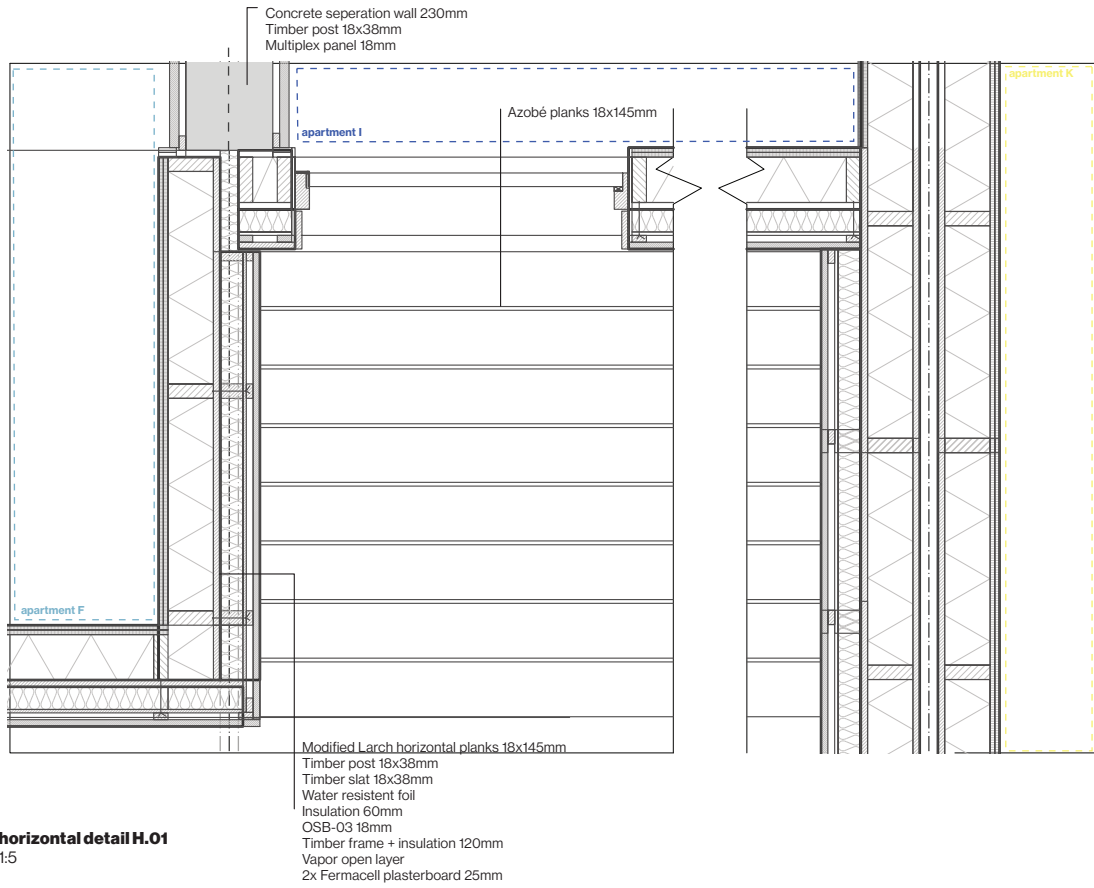
vertical detail V.01  
1:5



**vertical detail V.02**  
1:5



**vertical detail V.03**  
1:5



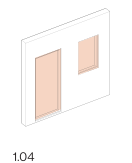
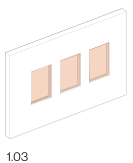
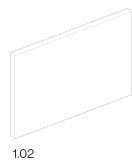
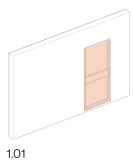
# 3.4 FACADE FAIR

The final step in the step-by-step plan of this concept is the Facade Fair. It is, like the other steps, a tool to arrive at a design and design choices. Here too, the intention is that the Fair expands over time. The current decision points in this step are based on this project. At a later stage, more options will be added for the facades. To begin with, it covers structure, patterns, materials, and sun shading..

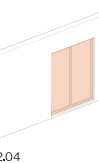
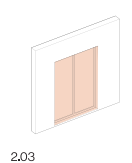
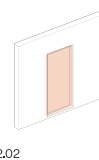
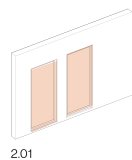
## 01 Orientation facades

Since this project concerns a housing block, it has windows facing all cardinal directions. The homes with their exterior facades facing west and south are somewhat more important to design carefully.

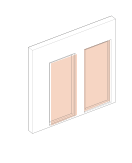
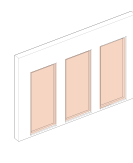
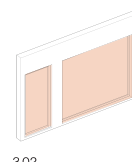
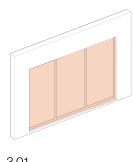
**NORTH**  
orientation  
0 - 25%



**EAST/WEST**  
orientation  
10 - 45%



**SOUTH**  
orientation  
50 - 70%

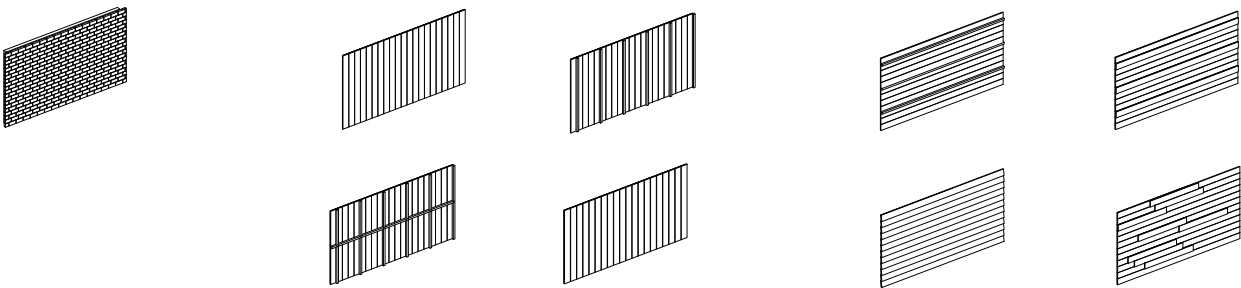


## 02 Material & patterns

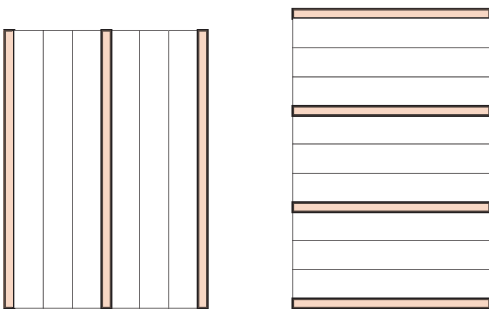
For this project, both brick slips and timber facade elements were chosen. On the ground floor, the extensions are clad with brick slips, while above that, everything is timber.

This was achieved by extending the brickwork, which originally covered the entire facade, to the rear (new front) of the residential block. The rest of the facades are made of timber.

During the design phase, a structure was chosen in which each floor is slightly different. This creates a horizontal unity and a vertical distinction between the floors. As a result, the block becomes more legible and gains more dynamics.

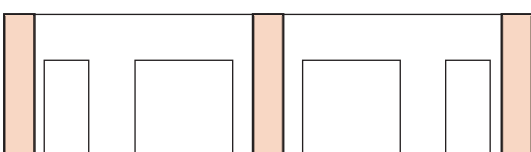


horizontal patterns



A distinction has been made between horizontal and vertical cladding. On the first floor, there is a horizontal grid consisting of 140mm planks. A protruding plank is added at the top, middle, and bottom of the facade. This is for aesthetic reasons and creates more dynamism in the facades.

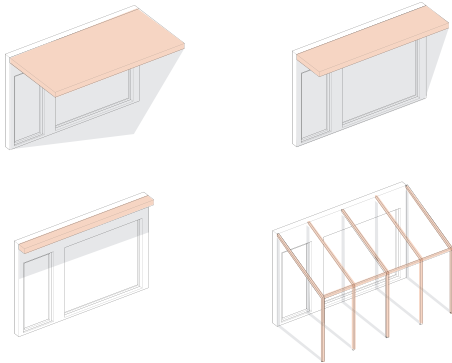
On the second floor, vertical planks have been chosen. These are 90mm wide. A protruding plank has also been chosen around the window frames on the second floor. This is also aesthetic in nature.



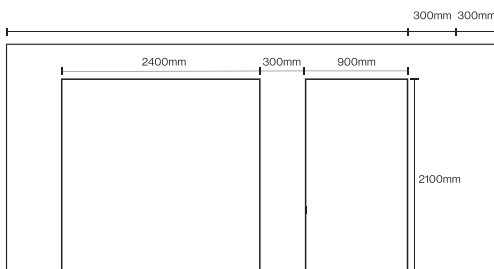
The intermediary is an option for when multiple modules are placed next to each other in the project. This intermediary ensures a sleeker appearance and gives the modules some adjustment space so they do not align perfectly. The intermediary also adds a rhythmic dynamic to the facade.



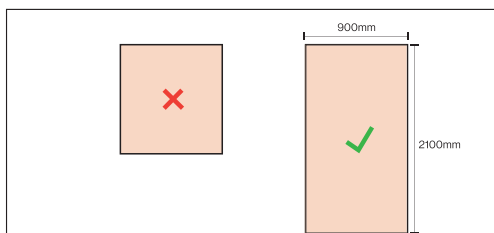
The chosen structure of the facades ensures that each floor has a different appearance. As described above, this creates dynamism, but also readability.



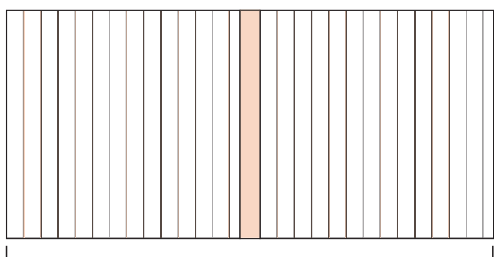
For sun protection a few options are added to the design. As the modules themselves already come with overhangs, they provide shade. On the groundfloor some extra wide aesthetical beams were added to create a small overhang had shade for this floor.



always a grid of 300mm and its veelvoud  
windows 900mm  
height 2100mm



high wondows fro more light



one of the rules are that there is a coherent facade for the different floors.

similar facade for coherence

On the left, three facade design rules are shown. These rules have been established and must be applied in this project.

1. A grid of 300mm is used. All windows and doors are 900mm wide and also multiples of 300mm.

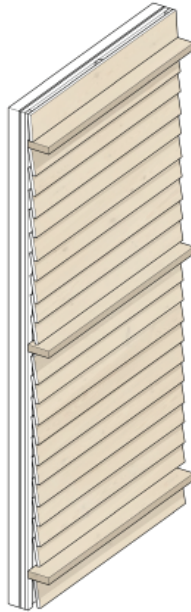
2. Windows and doors must start from the ground (with exceptions). The windows (also multiples of 300mm) are long to let in as much sunlight as possible.

3. There is rhythm and logic in the facades. Each floor has its own pattern.

**facade of groundfloor:**  
yellow brick waalformaat  
50x210x100mm



**facade of 1st floor:**  
Larch horizontal overlapping  
planks  
18x145mm



**facade of 2nd floor:**  
Larch vertical planks  
18x90mm





# 3.5 DESIGN RESULTS



figure 23. own image. 3D visualization



## Floorplans

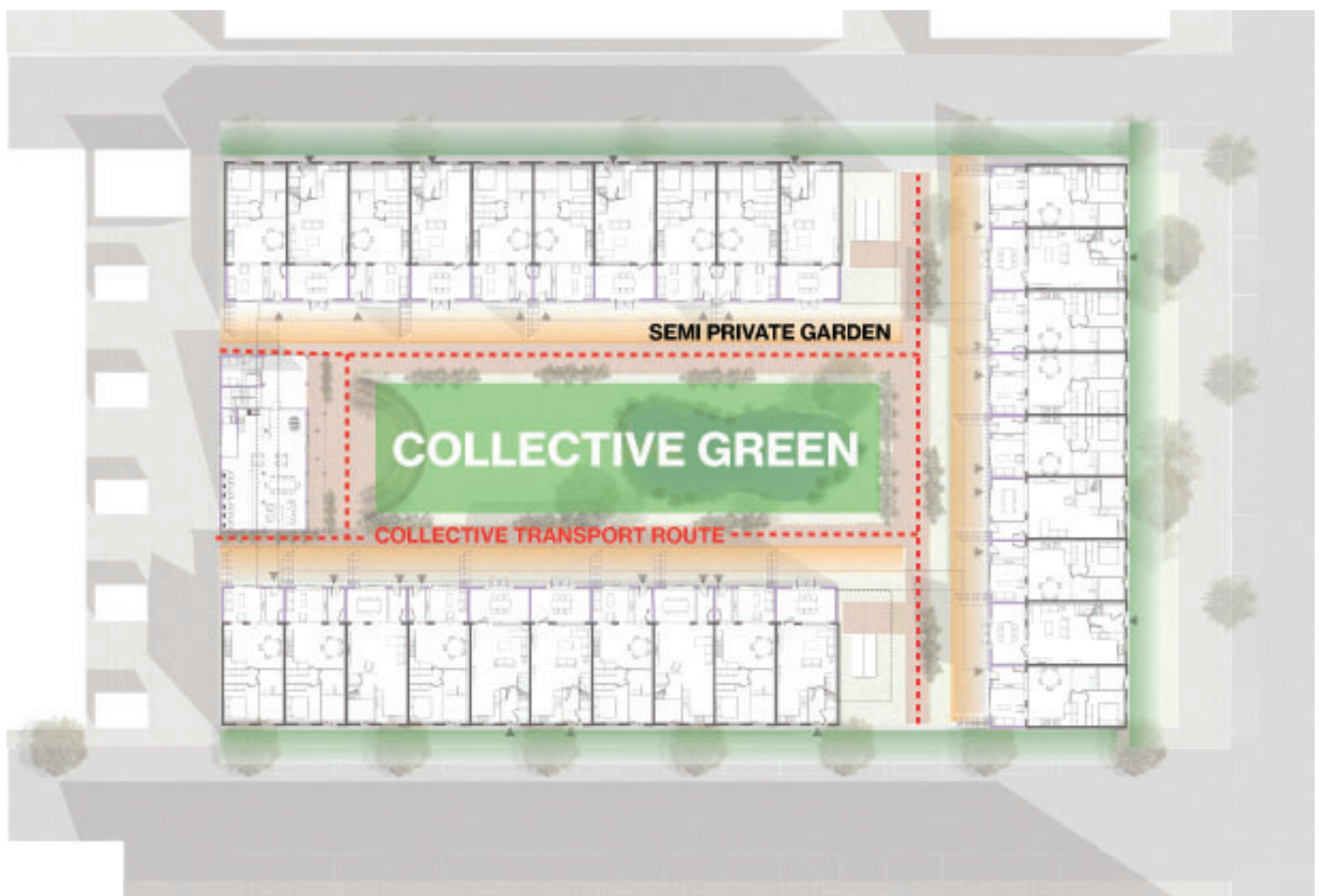
On the right, the floor plan of the ground floor is visible, including the current layout. The floor plan shows what the new situation looks like after the transformation.

The new communal living room is also visible in the floor plan. This is entirely new and effectively encloses the residential block, thereby facilitating the green inner courtyard. The shared living room is multifunctional. It connects the residential blocks, facilitates gatherings, and gives people the opportunity to use the study space, a workshop, or the laundry room.

The division of public and private spaces is shown in the diagram below. A strategy of an outer, obstructed, and inner ring has been adopted. The outer ring consists of the semi-private front gardens. These are relatively shallow front gardens

of the ground-floor residences. These residences have ownership and control over what they do there, and it is their private property. The red dotted line symbolizes the collective access road that runs around the block. This larger ring is not only a separation between private and public but also provides a continuous route within the block. This path also provides access to the green area and serves as a route to the communal living room. In the center sits the communal garden. It features a swimming pond, a lawn, and a small court with a grandstand. The garden is dedicated to greenery and nature. The garden is open to anyone who wishes to use it and is also suitable for parties and events.

The exterior of the block, where the entrances were previously located, is now suitable for bicycle parking and serves as a useful additional outdoor space with plenty of greenery.

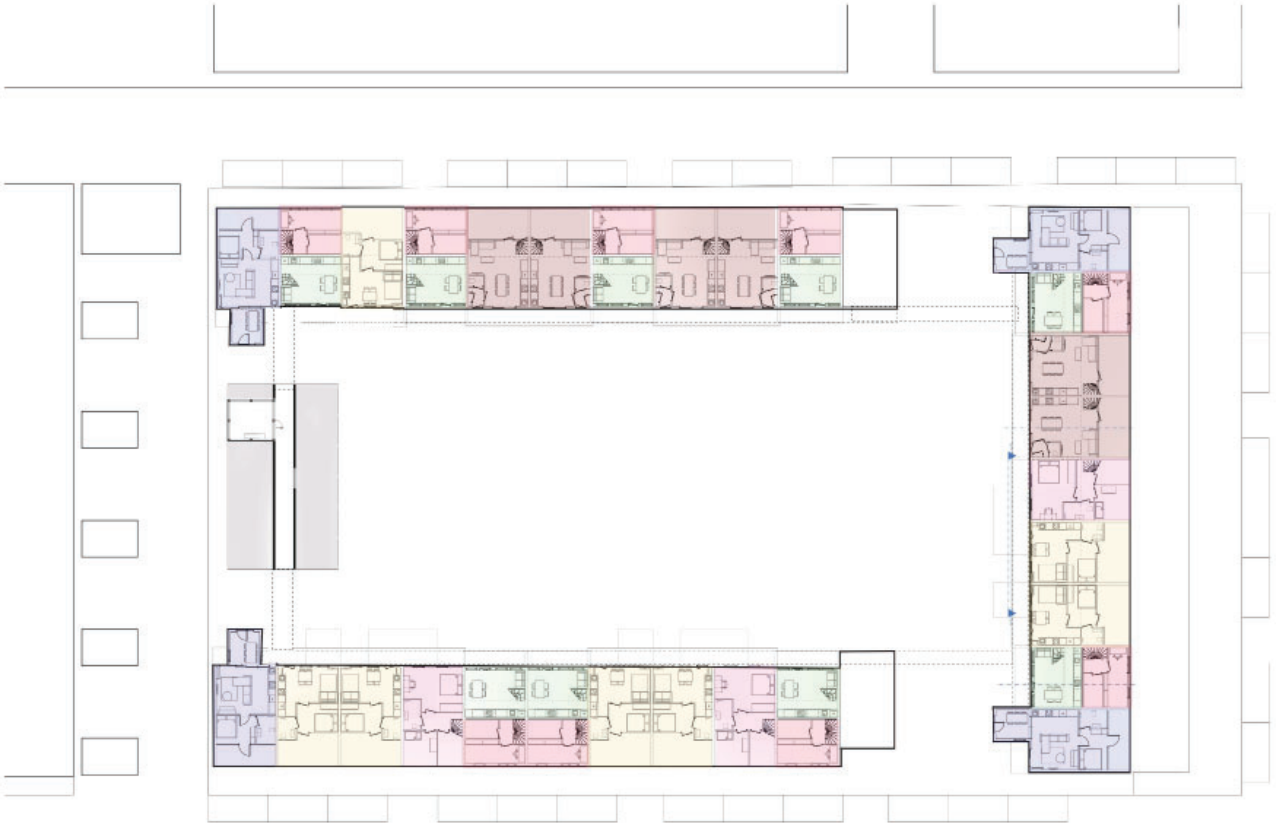




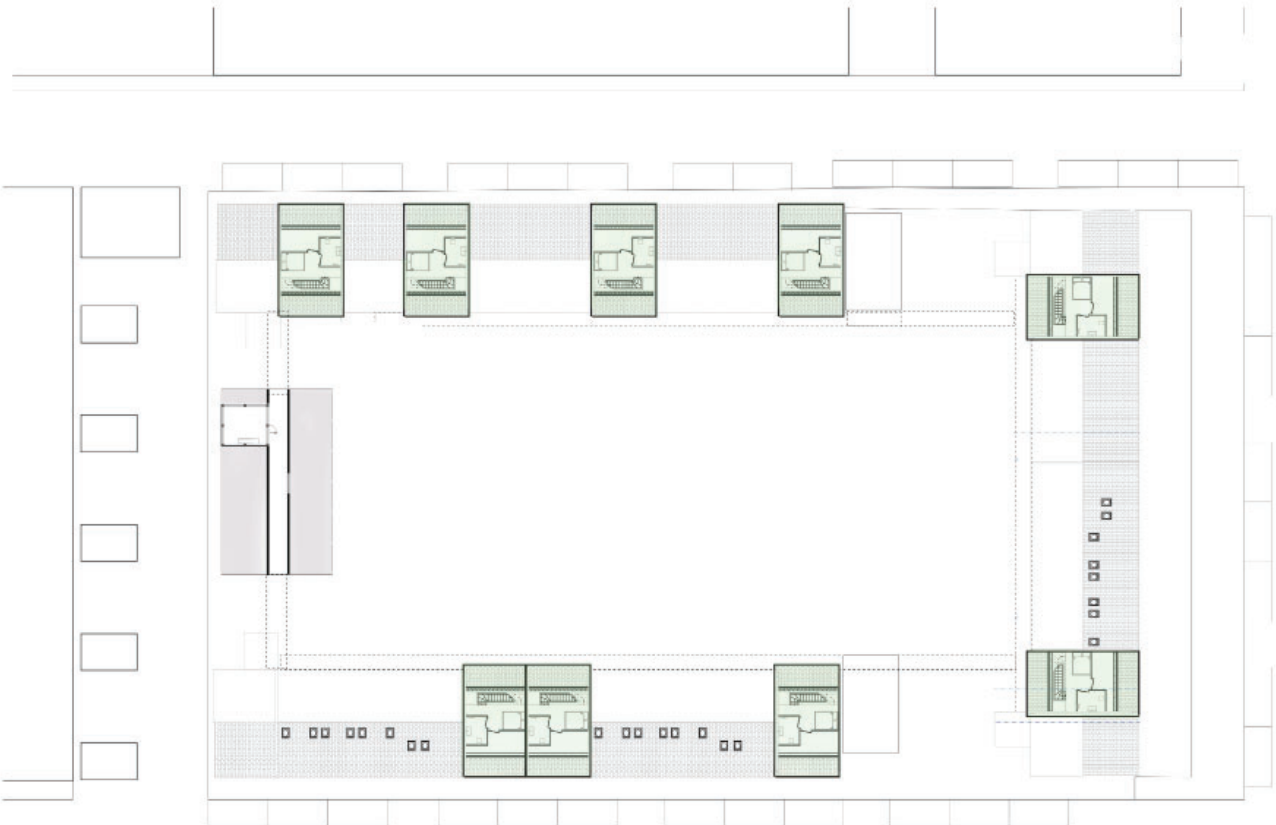
## More floorplans

On these pages, the other floors of the transformed block are visible. The homes are depicted in colors. It now becomes clear how the 11 different housing types interlock and together form a cohesive whole.





  
Second Floor  
1:200



  
Third Floor  
1:200



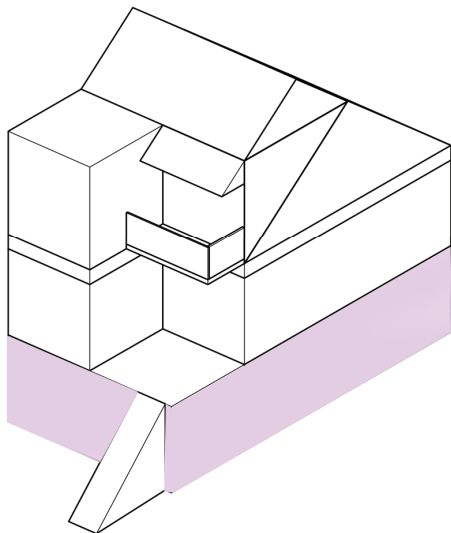
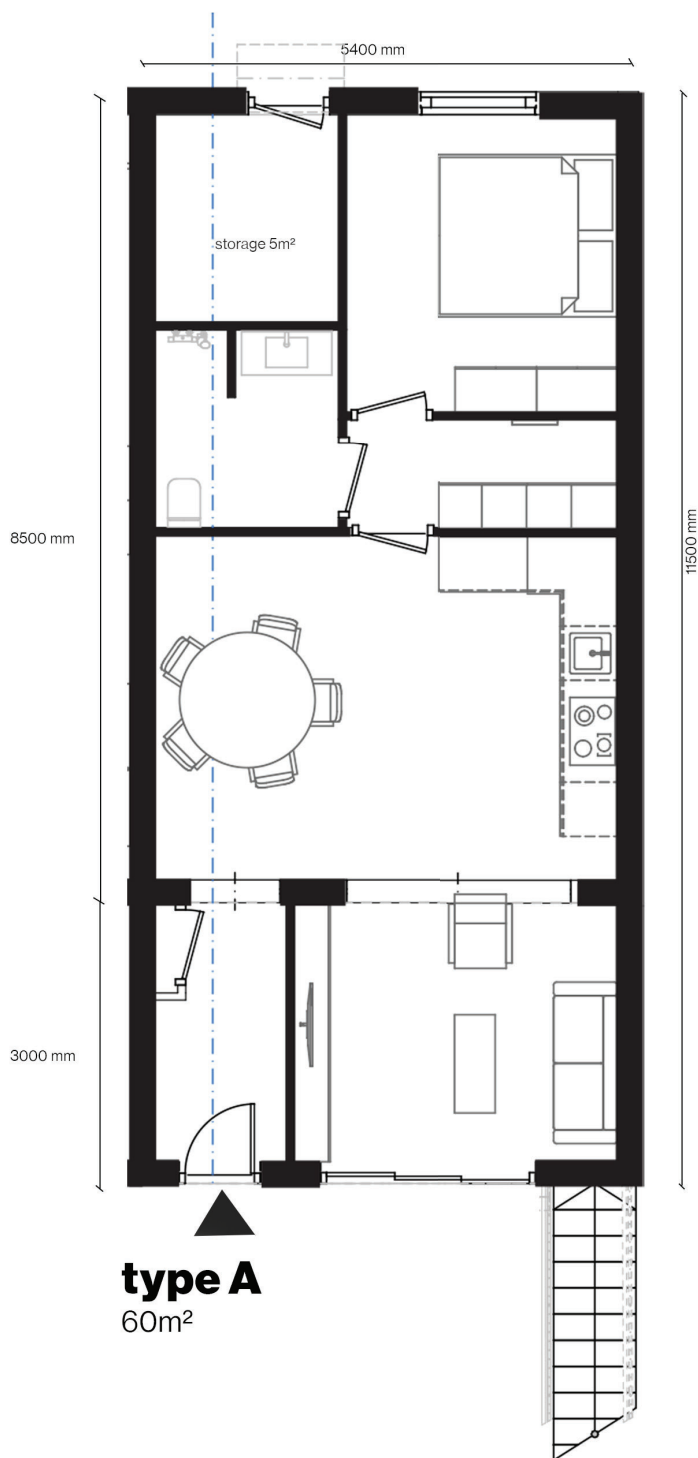
figure 24,25: own image. 3D visualization



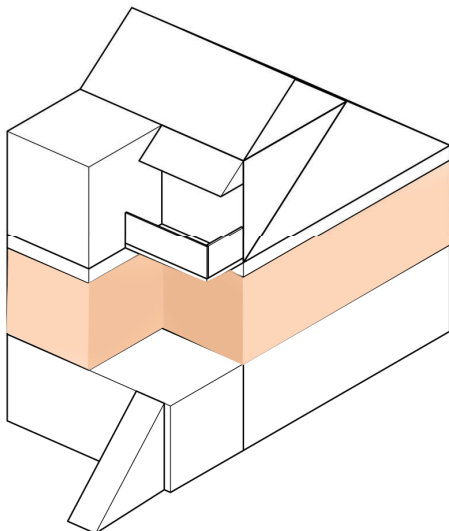
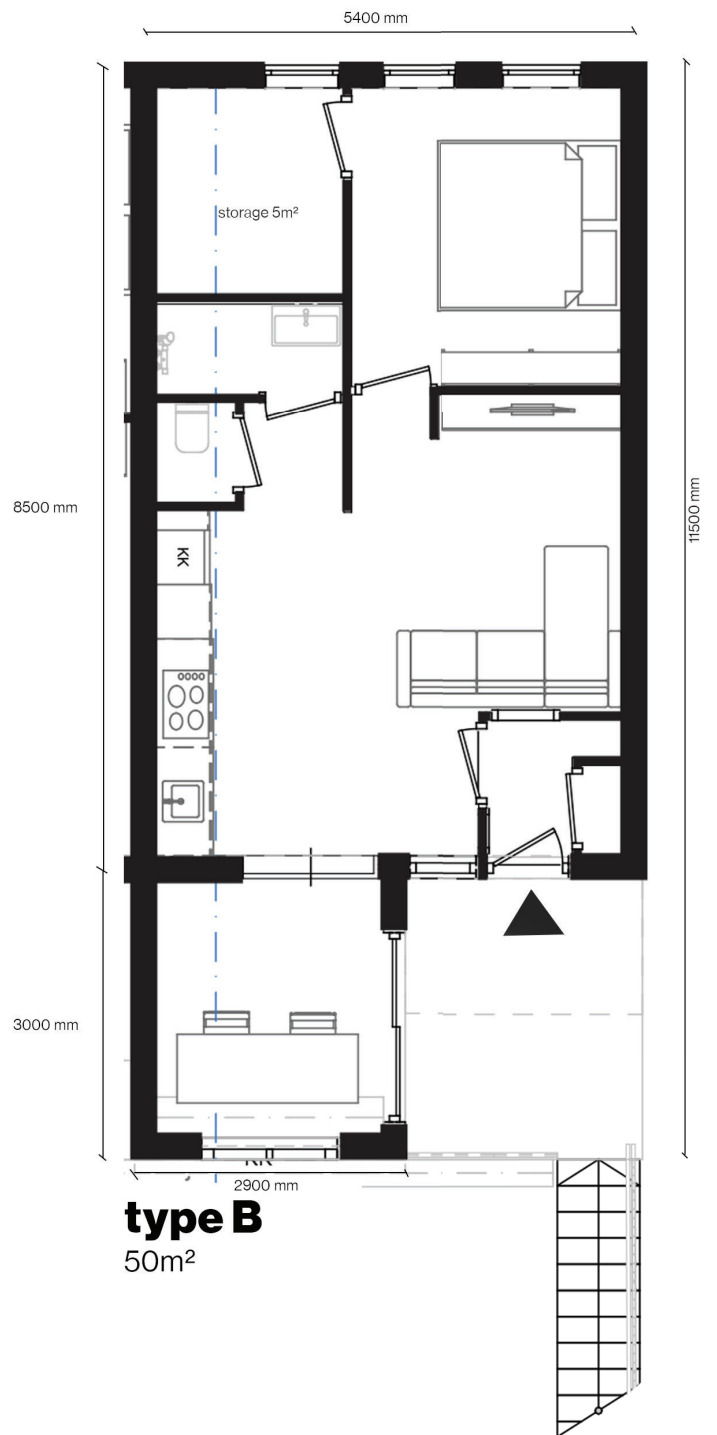
figure 26: own image. 3D visualization

# Variation 01

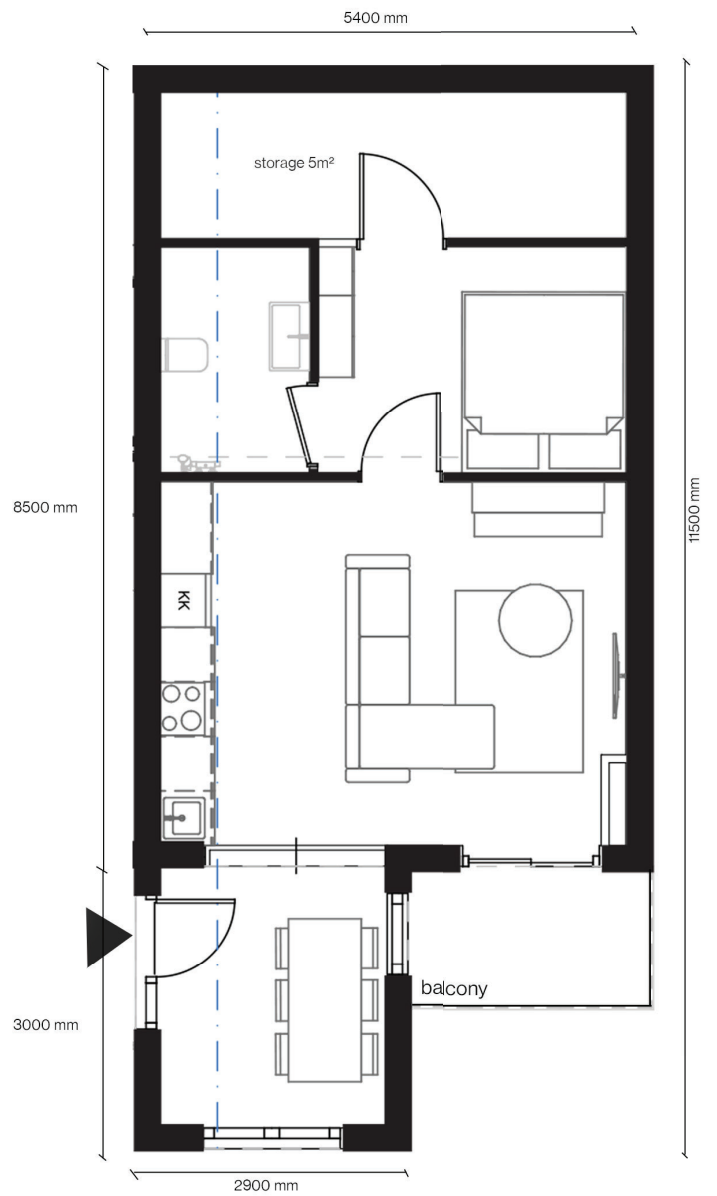
On the following pages, the homes are highlighted one by one. The floor plans show the layout in detail. Additionally, the position of each home within the variation is indicated in the bottom left corner.



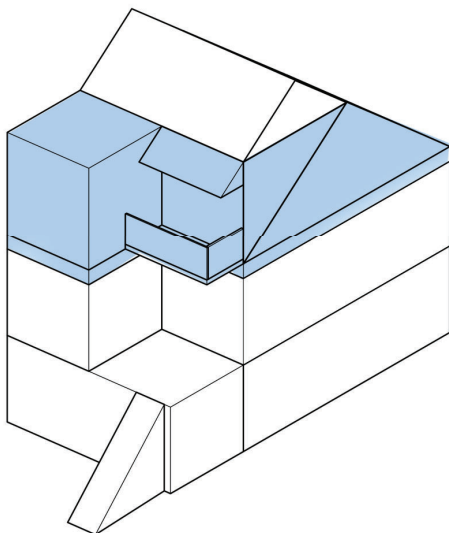
# Variation 01



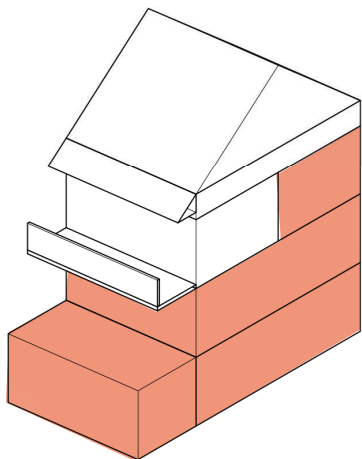
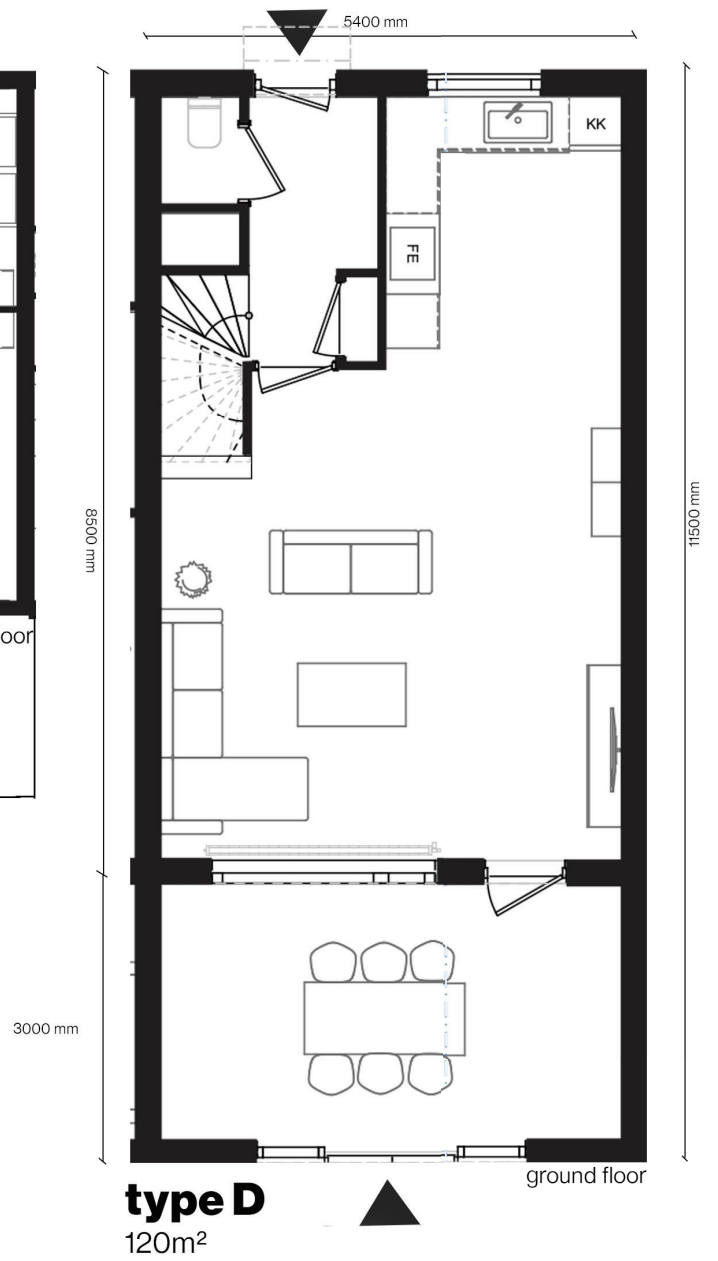
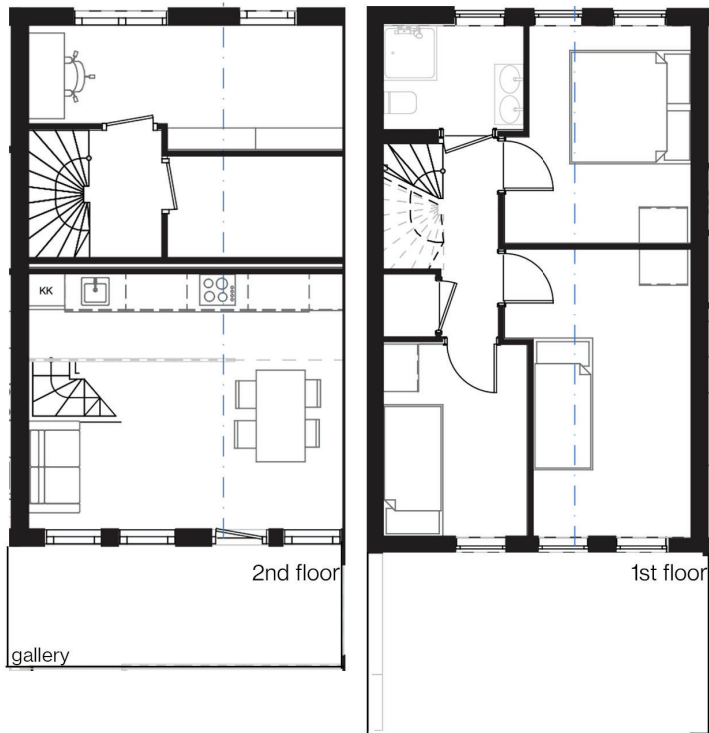
# Variation 01



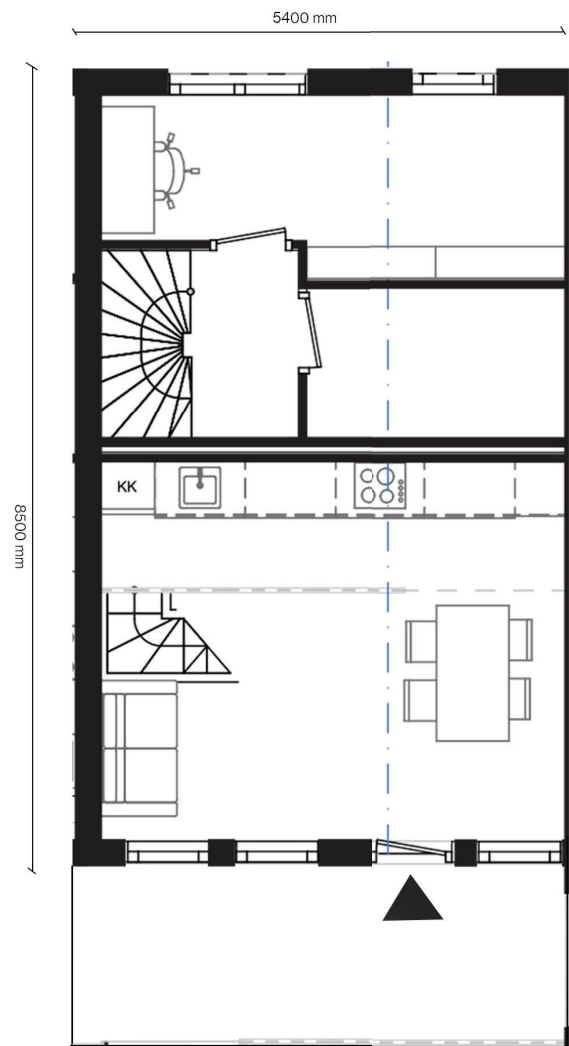
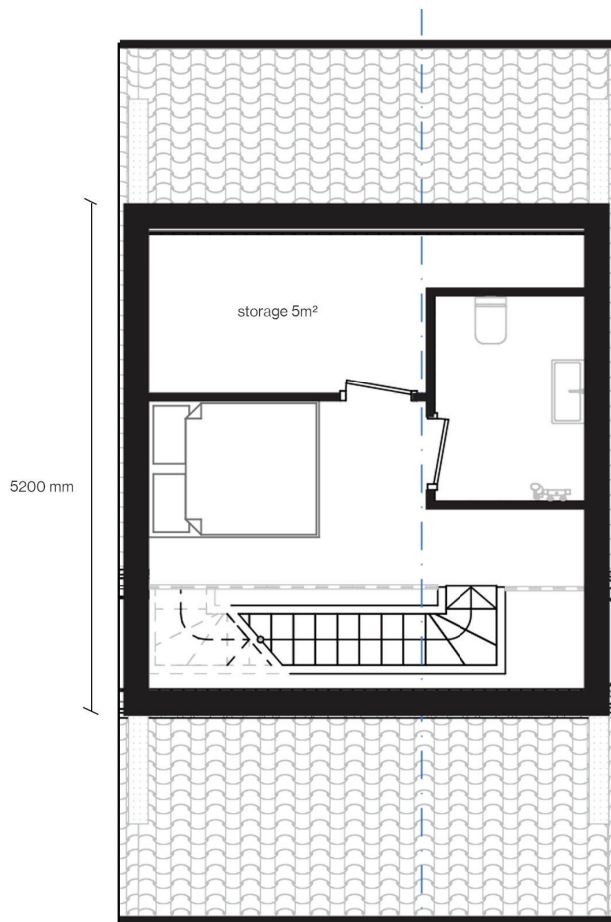
**type C**  
45m<sup>2</sup>



# Variation 02

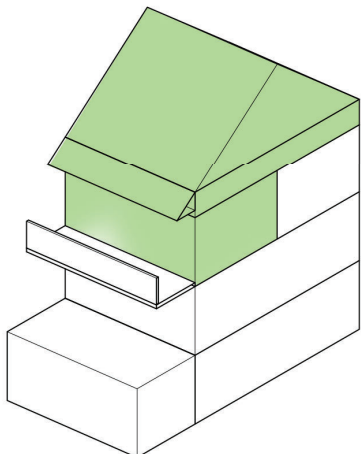


# Variation 02

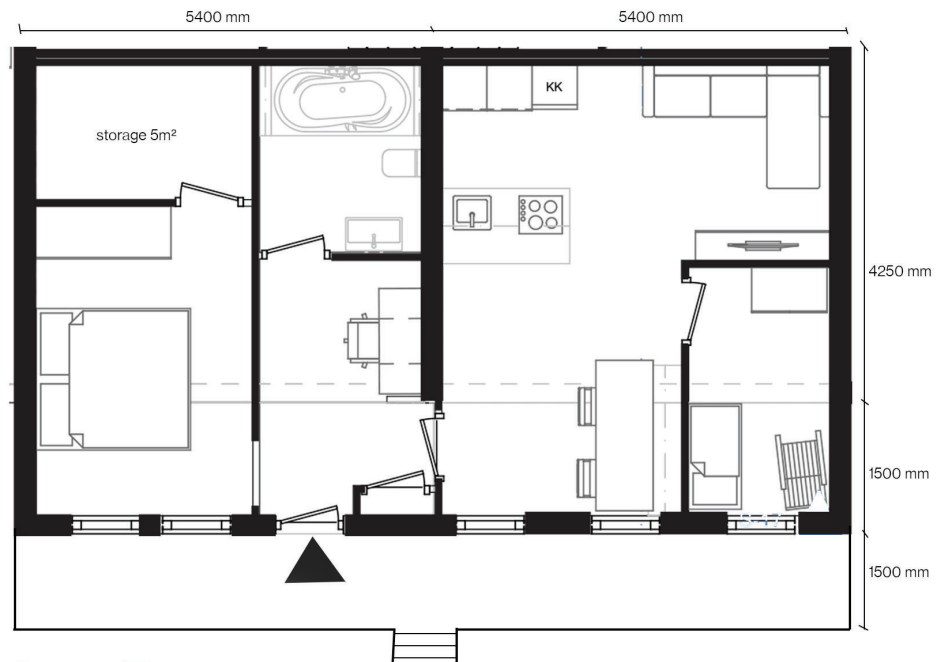


**type E**

40 m<sup>2</sup>

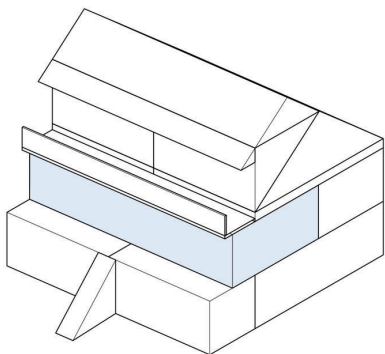


# Variation 03

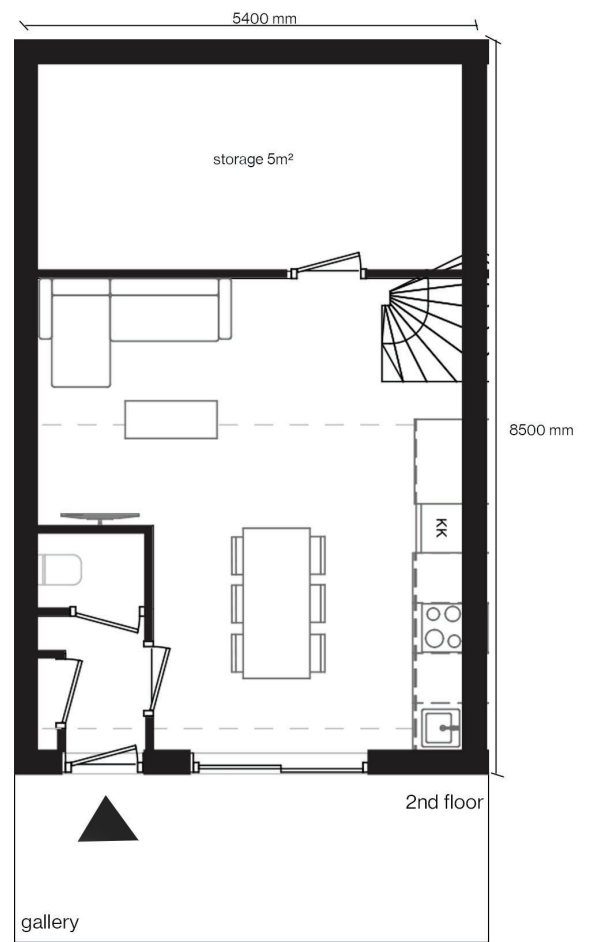
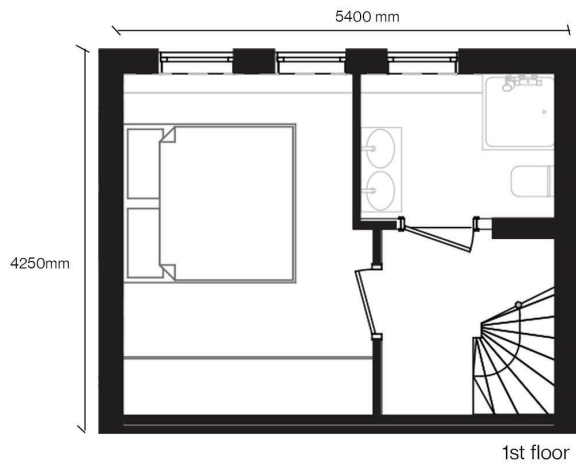


**type F**

60 m<sup>2</sup>

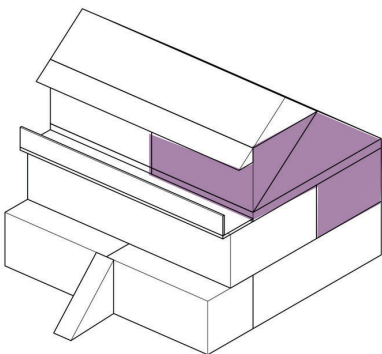


# Variation 03

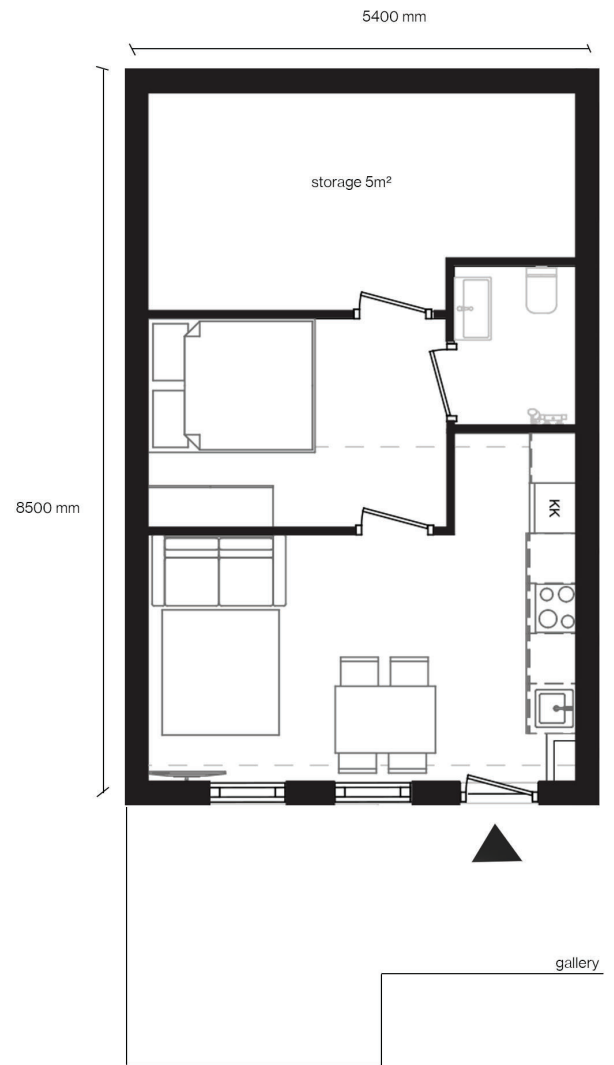


## type G

55 m<sup>2</sup>

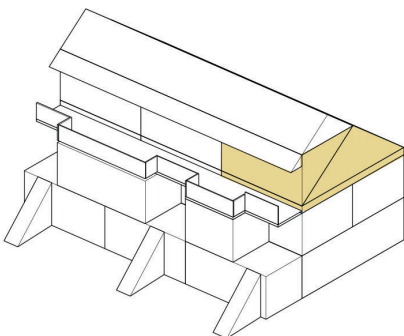


# Variation 04

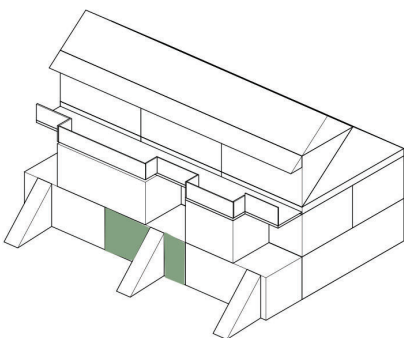
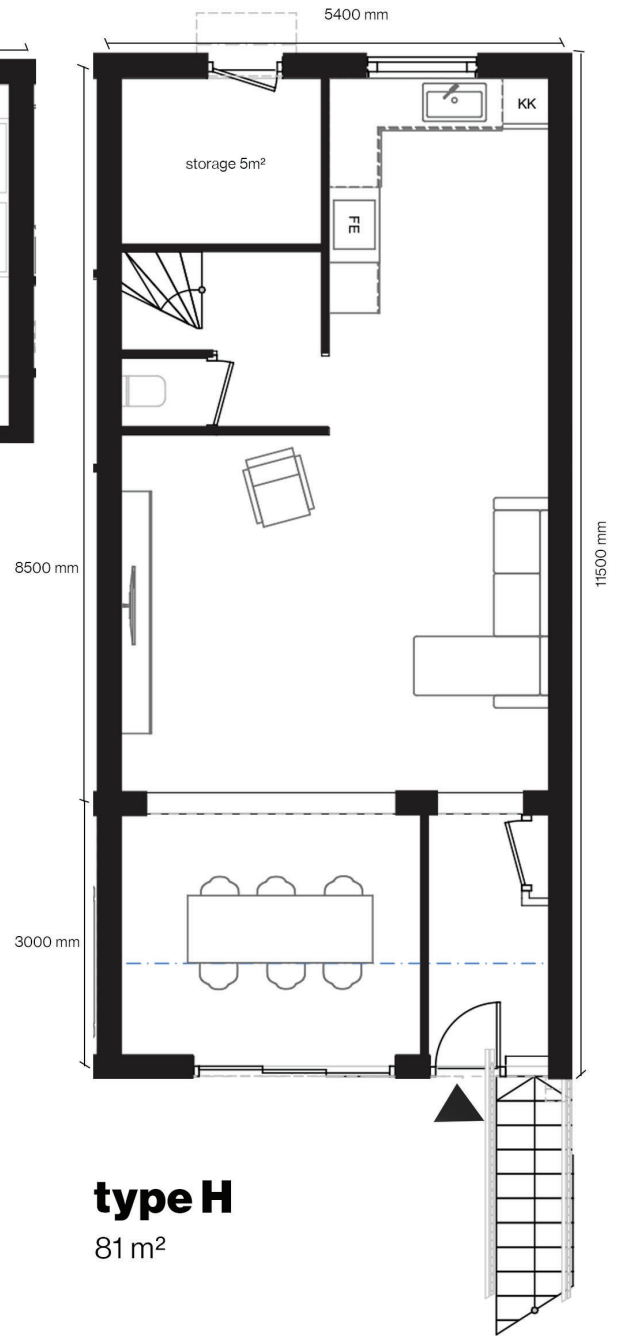
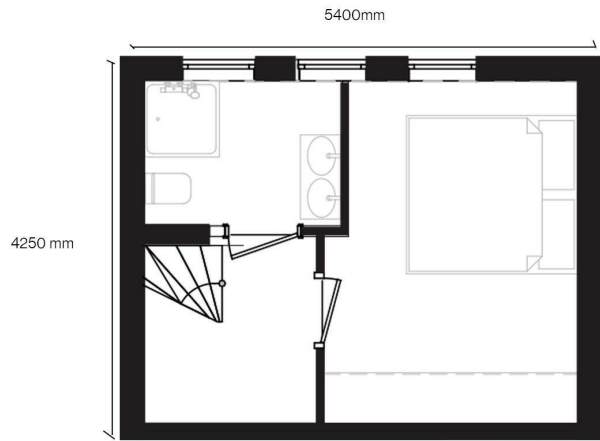


## type H

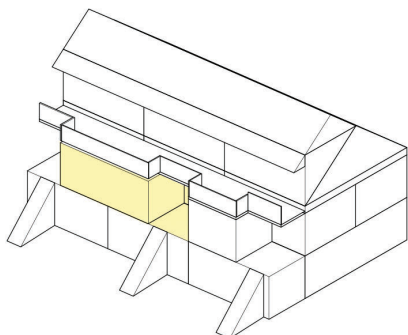
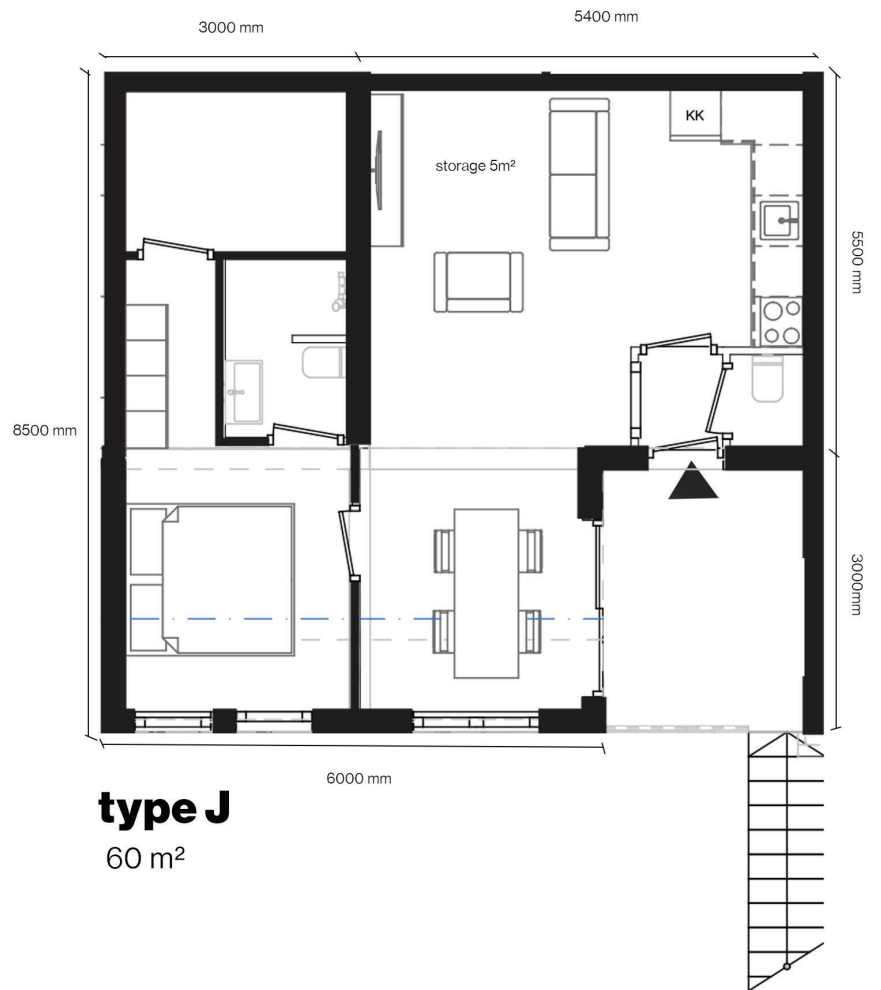
37 m<sup>2</sup>



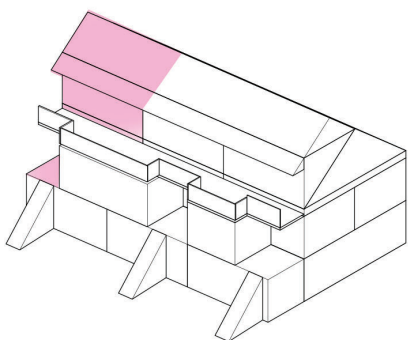
# Variation 04



# Variation 04



# Variation 04





## Collective Livingroom

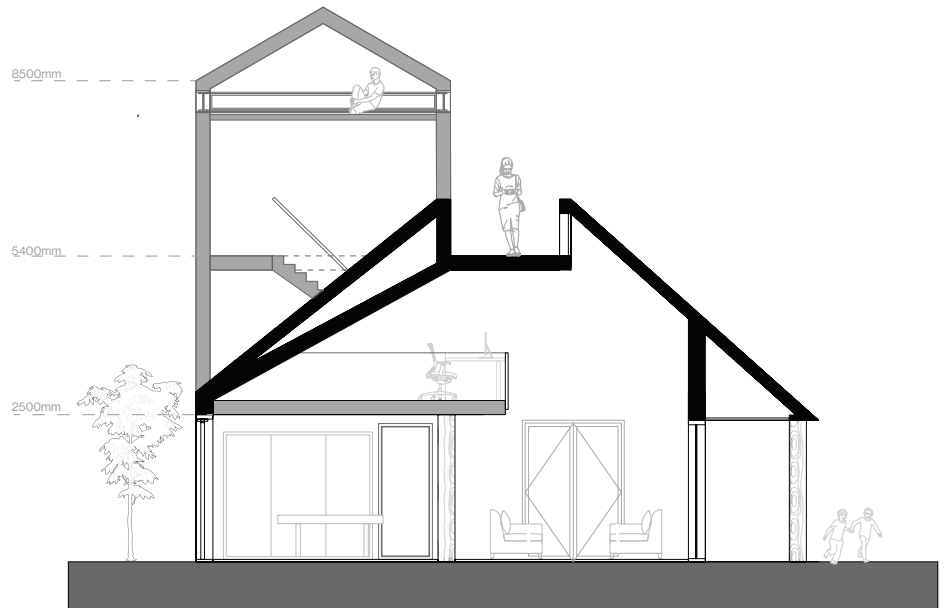
The communal living room is a space specifically designed for the block. The living room is situated in a strategic location, providing a visual framework for the residential block and fostering connection.

The small building literally connects the north and south sides of the residential block and houses an elevator and a stairwell.

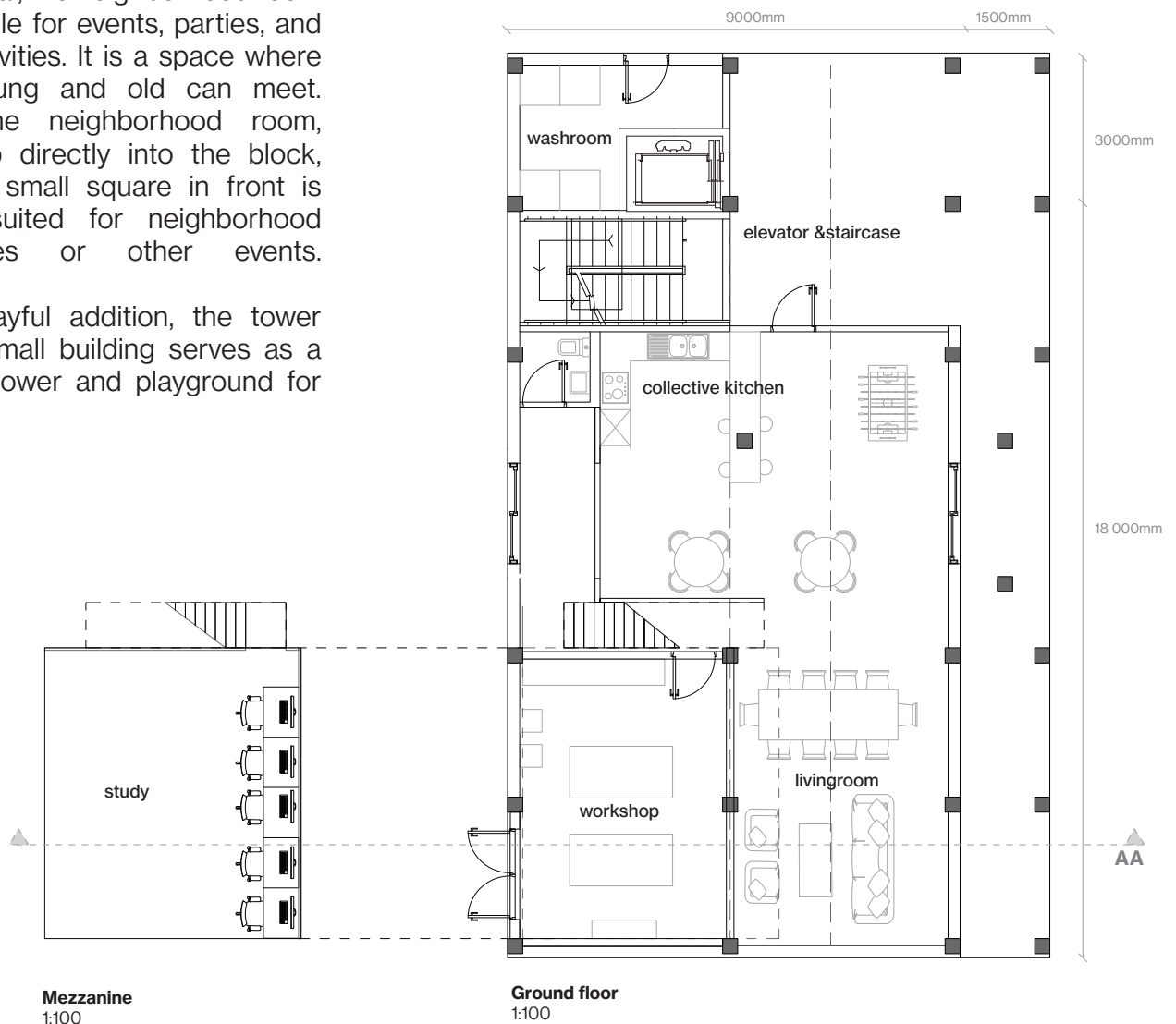
Additionally, the communal neighborhood room features a laundry room, a large kitchen, a living room, a studio space, and a study/workspace.

As is usual, the neighborhood room is available for events, parties, and daily activities. It is a space where both young and old can meet. From the neighborhood room, you step directly into the block, and the small square in front is ideally suited for neighborhood barbecues or other events.

As a playful addition, the tower of this small building serves as a lookout tower and playground for children.

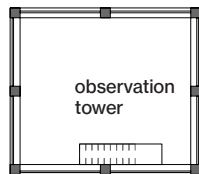
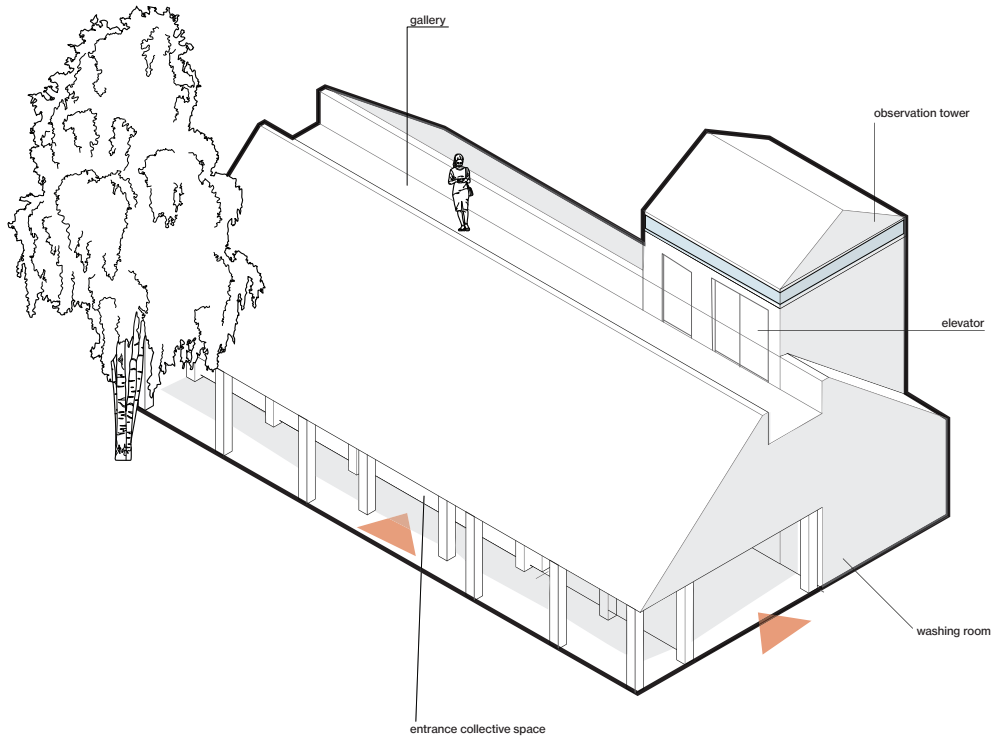


**Section AA**  
1:100

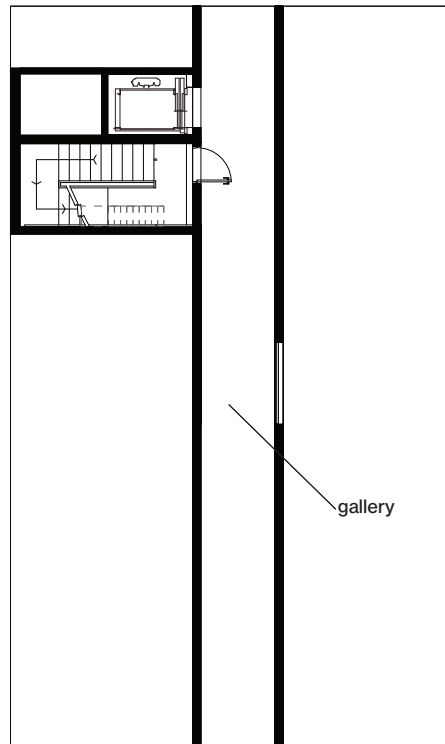


**Mezzanine**  
1:100

**Ground floor**  
1:100



**secret observation tower**  
1:100



**Rooftop gallery**  
1:100



figure 27: own image. 3D visualization





**1:100**  
elevation west facade

### Elevations

On these two pages, the elevations of the homes can be seen. These seven homes are illustrative of all the homes in the block. It shows how the design unifies all the interventions by choosing an overarching color for the window frames, stairs, and railings. It also shows how a choice was made for the facade cladding on each floor. By consistently introducing subtle differences, the whole appears coherent, yet a theme can be recognized across the different floors.

functional. For instance, they create an overlap between the different modules. Because these will never align perfectly, the intermediary ensures that the facade appears to flow seamlessly.

The intermediaries are sections of the facade that replicate throughout the main facade. These elements create a rhythm, but are also



**1:100**  
elevation east facade



**1:20**  
elevation west facade

## Climate Design

A climate design was also created for the design. This component focuses exclusively on climate-technical challenges within the building and how to solve them.

The drawing below provides an overview of these interventions. The adjacent page contains an isometric illustration of the installations, such as the heat pump and the ventilation types.

The drawing below shows how this home currently houses three apartments and how they relate to each other in terms of climate technology. This drawing is illustrative for all other homes.

A key issue in this project is how to manage the thermal balance of the three homes. This involves heating and cooling, as well as ventilation.

### Thermal comfort

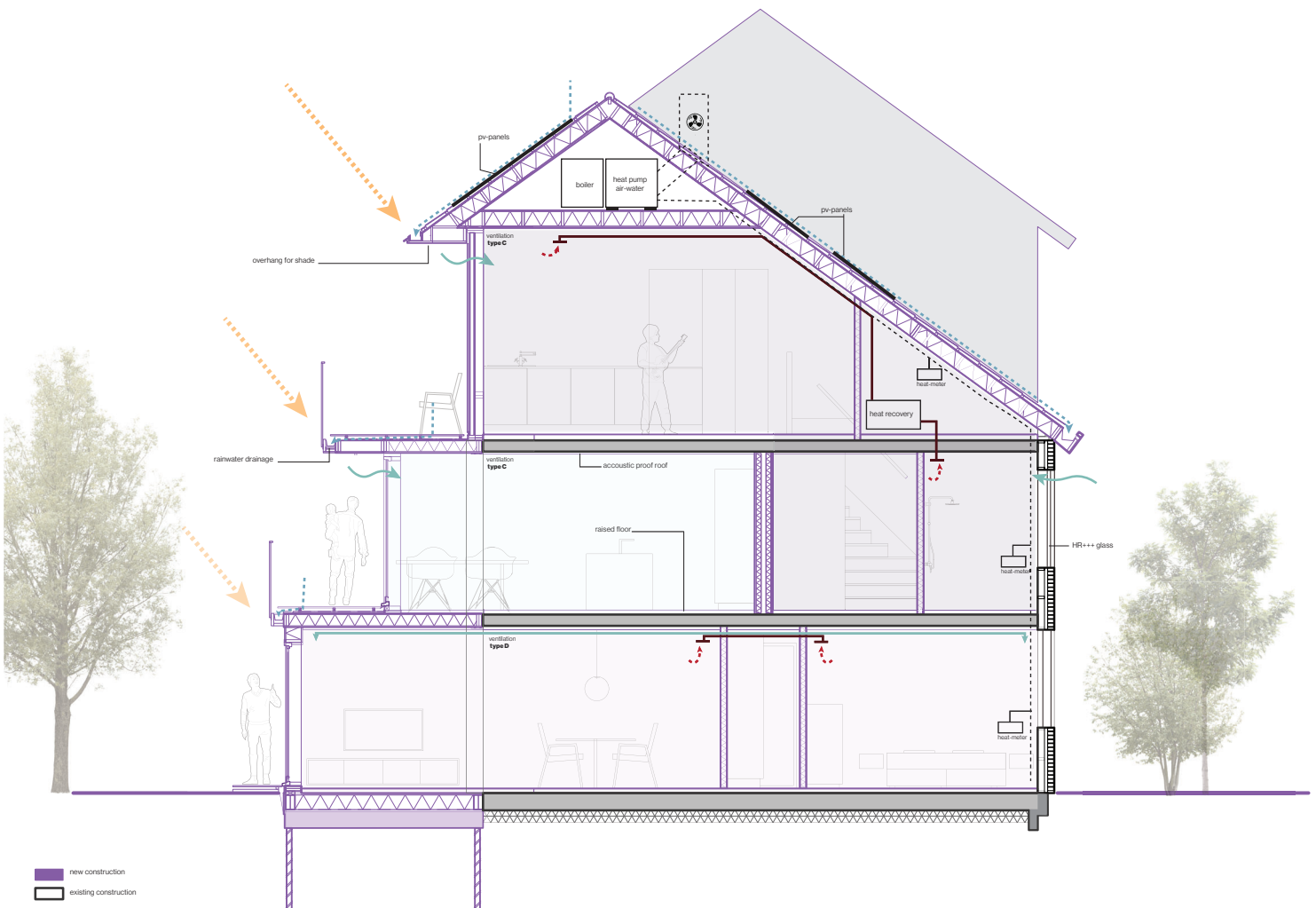
For thermal comfort, various ventilation types and heat sources were examined. Based on the

interviews, it was decided to equip the ground floor with ventilation type D and the two units above with type C (Huibers, 2026). This is because the ground floor will primarily be inhabited by elderly people who desire a more stable climate. Mechanical control is suitable for this purpose. Ventilation type C is more suitable for the two homes above. Not only because first-time buyers and young people often have a greater need for direct fresh outside air, but also because the new timber frame constructions make it easier to have fewer installations. This applies especially to the second floor.

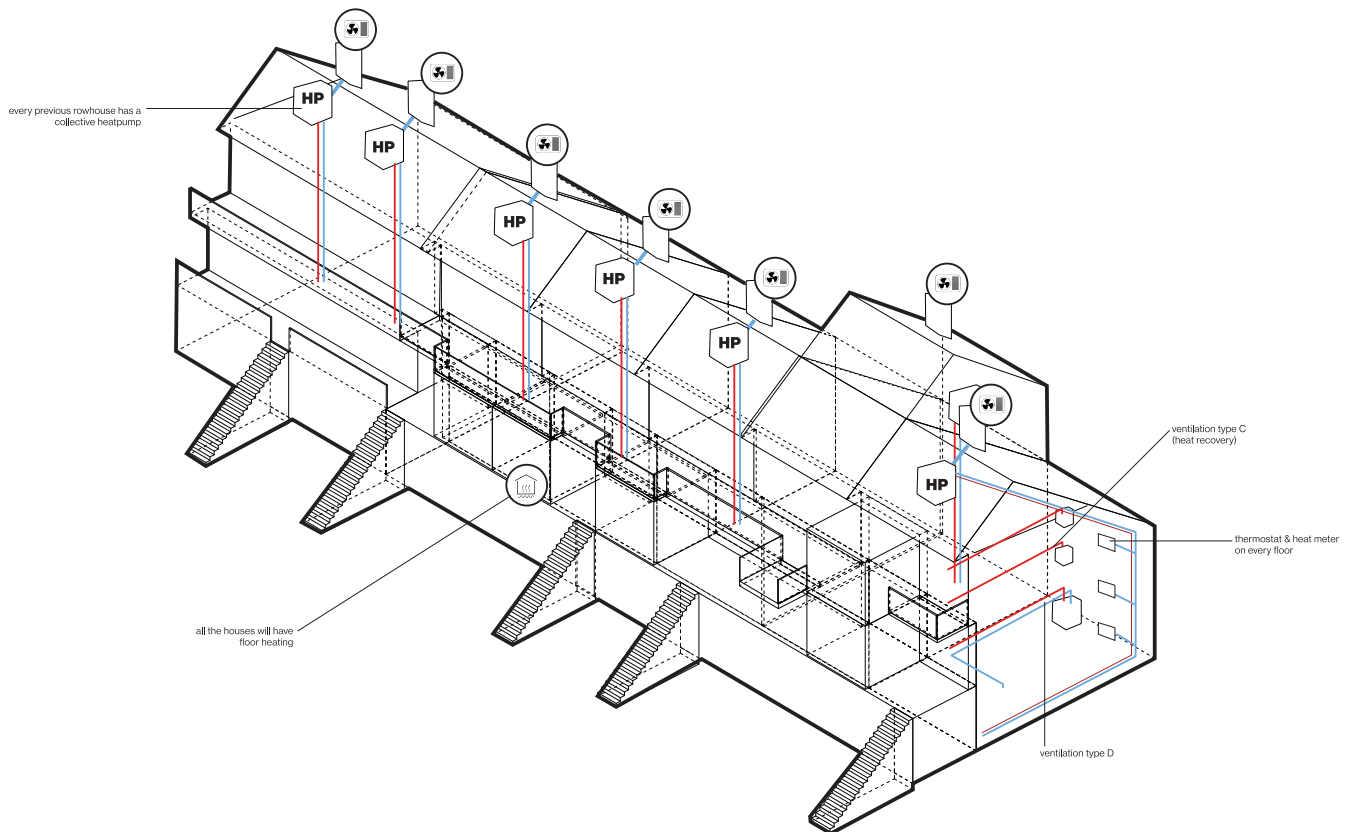
Underfloor heating has been chosen for heating and cooling. This is heated via channels in the floor, which are heated by the collective heat pump on the roof.

### Energy

The collective heat pump on the roof provides hot water and heating for the homes. The heat pump is located on the roofs, and the installations are situated in the added section under the roof.



**NORTH SECTION**  
1:50



The heat pump distributes the heat across the three homes, all of which have their own meter, boiler, and thermostat. A boiler and the solar panel installations are also located here.

The solar panels are situated on the roofs and are oriented towards the sun as much as possible.

### Acoustics

Acoustics is also an important theme, especially when splitting properties. The rule of thumb here is to decouple as much as possible (Kompachter, 2026). The floors, walls, and ceilings are decoupled as much as possible to prevent noise nuisance. In any case, it must be accepted that there is more noise nuisance with timber construction than with concrete.

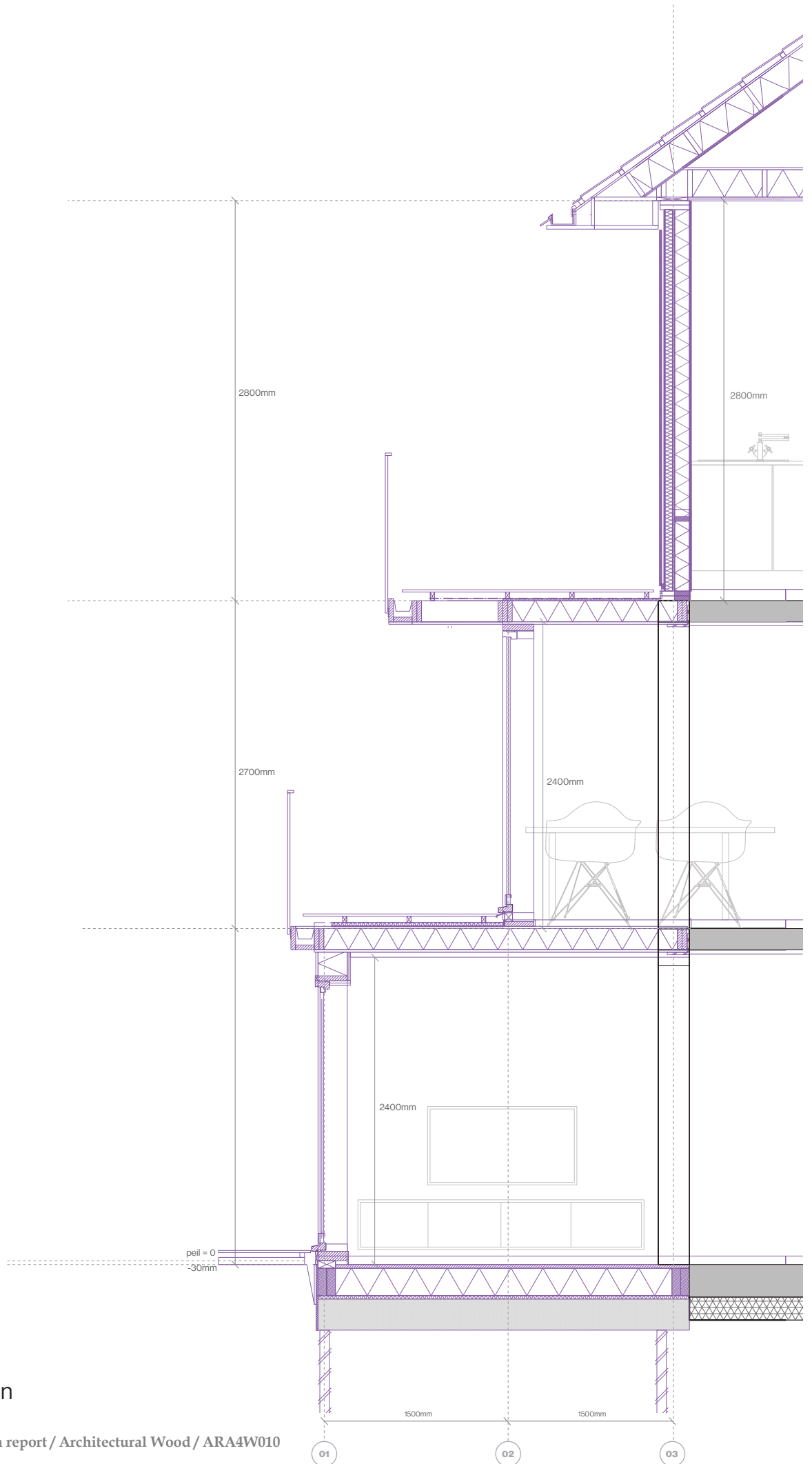
### Sun protection and daylight

Daylight and sun protection were also considered. For instance, overhangs were examined, particularly on the south and west sides. In most places,

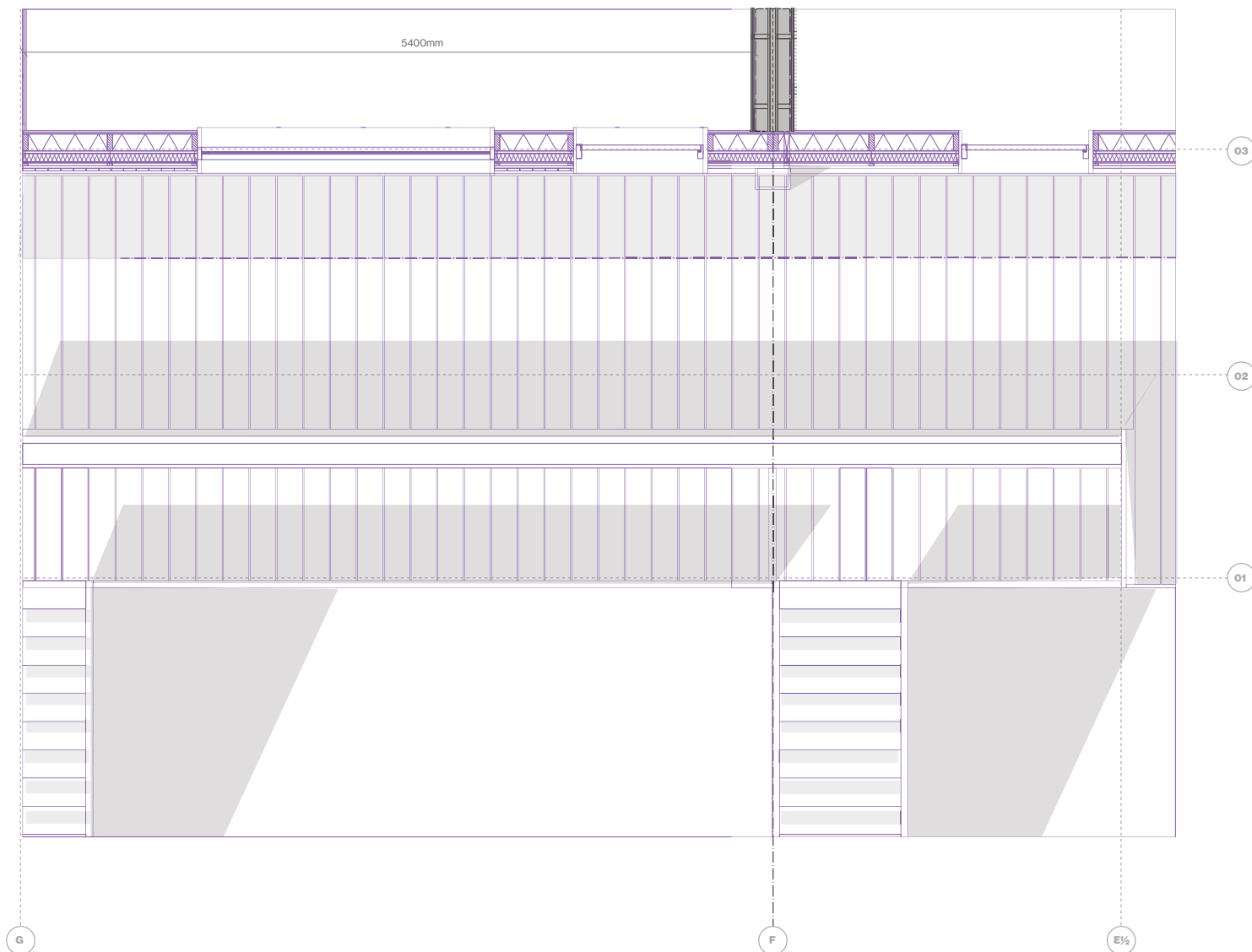
overhangs have been added to filter summer sunlight. However, because the homes can only receive daylight from two sides (front and back), a trade-off was made between window sections, overhangs, and the amount of daylight. After all, the indoor spaces must receive sufficient sunlight.

### Rainwater

Finally, rainwater harvesting was considered. There is regular rainwater drainage, but this water is collected in a communal rain barrel and used for watering the plants and, if necessary, for topping up the swimming pond.



**1:20**  
Vertical section



**1:20**  
Horizontal section

**1:20 Fragment**

On the left page and in the image above, the two 1:20 cross-sections associated with the facade fragment can be seen.

**Vertical cross-section**

This section shows a part of the project that is illustrative of all the homes. Although more relevant sections could be made, it clearly shows the major challenges of this project. For instance, an extra foundation must be laid for every extension. Furthermore, all modules must be connected to the existing structure. This involves a lot of airtight membranes and insulation. However, a piece of steel was also added, specifically where the modules connect to the existing home. This was done so that less material needed to be used to achieve the same strength. It can also be seen how the modules facilitate outdoor space.

The balconies and galleries are important elements in this design, because outdoor space is extremely important.

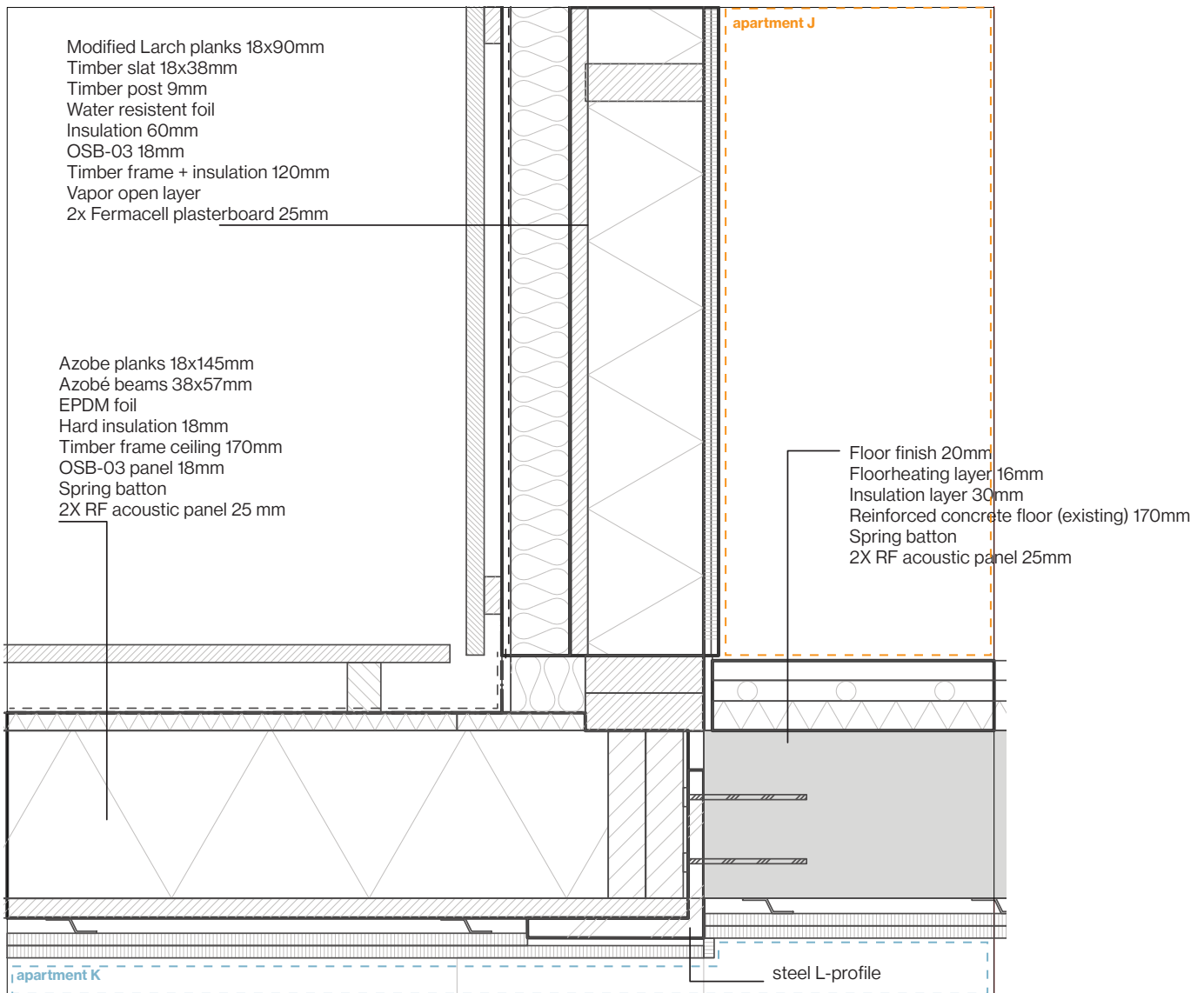
**Horizontal cross-section**

The horizontal cross-section was taken to show several things.

The first is the connection between two modules on the second floor. Visible on the left is a dwelling, a wall separating the dwellings, and a second dwelling to the right of it. Also visible is the intermediary connecting the two facades. The gallery is also closed off by a keystone.

Secondly, the deep gallery is visible, as well as the balcony of the dwelling below it. The staircase leading to the first floor is also visible.

# Detail V.01

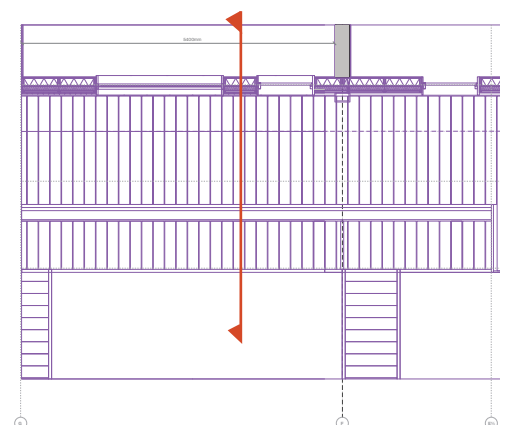


## vertical detail V.01

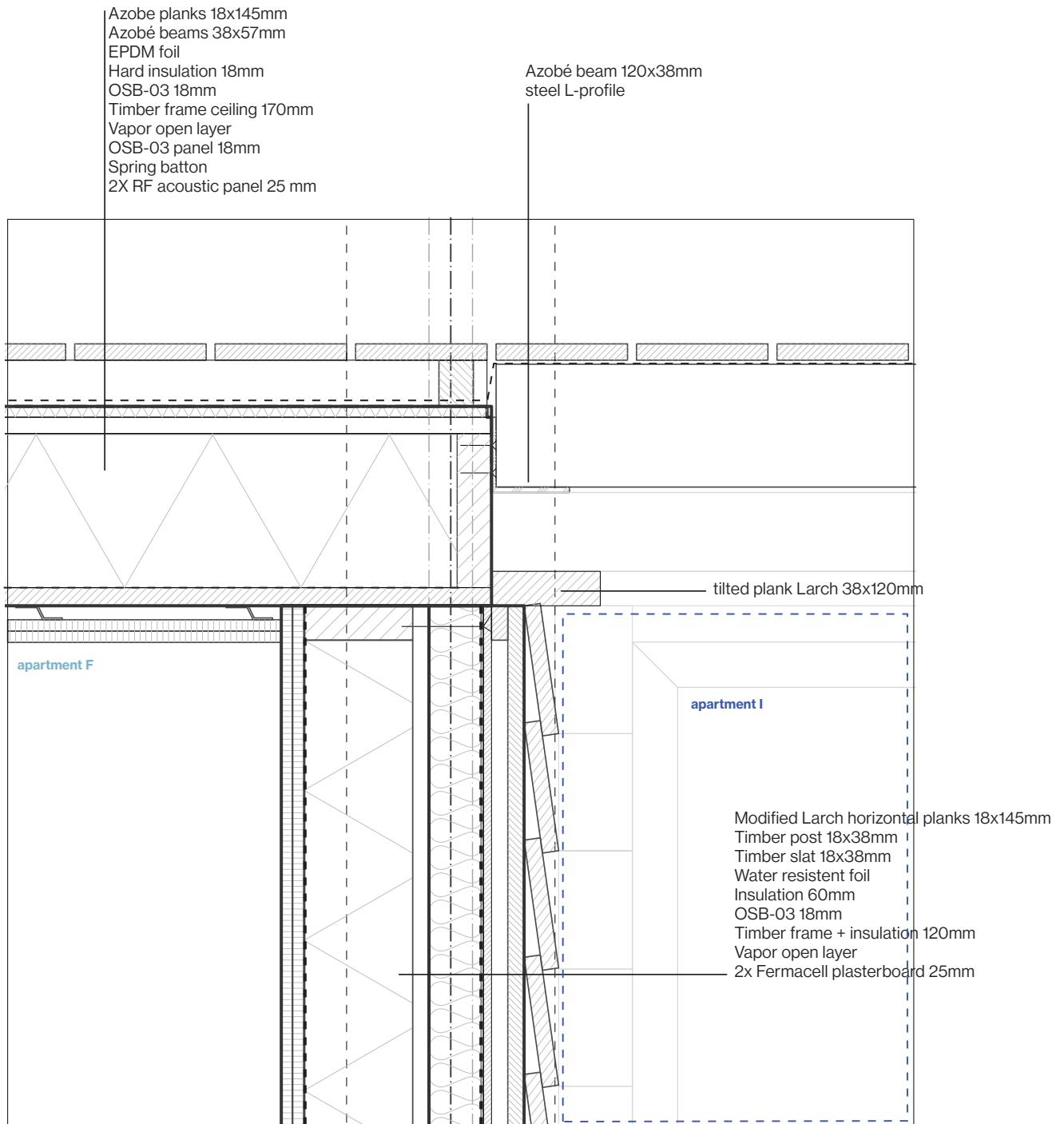
1:5

This detail shows the connection between the existing and the new. It demonstrates how the steel L-profile in the concrete floor ensures the stability of the new construction.

It also shows the connection between the interior and the exterior on the balcony. The acoustic ceiling and the floating screed are also visible.



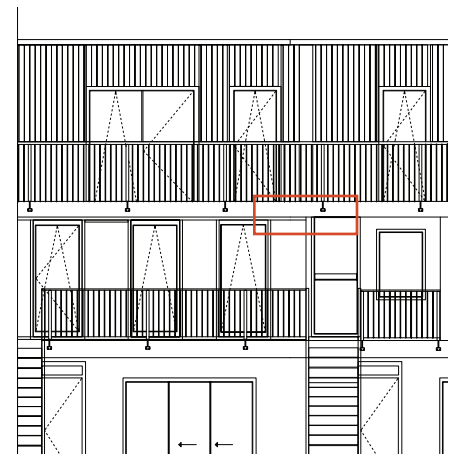
# Detail V.02



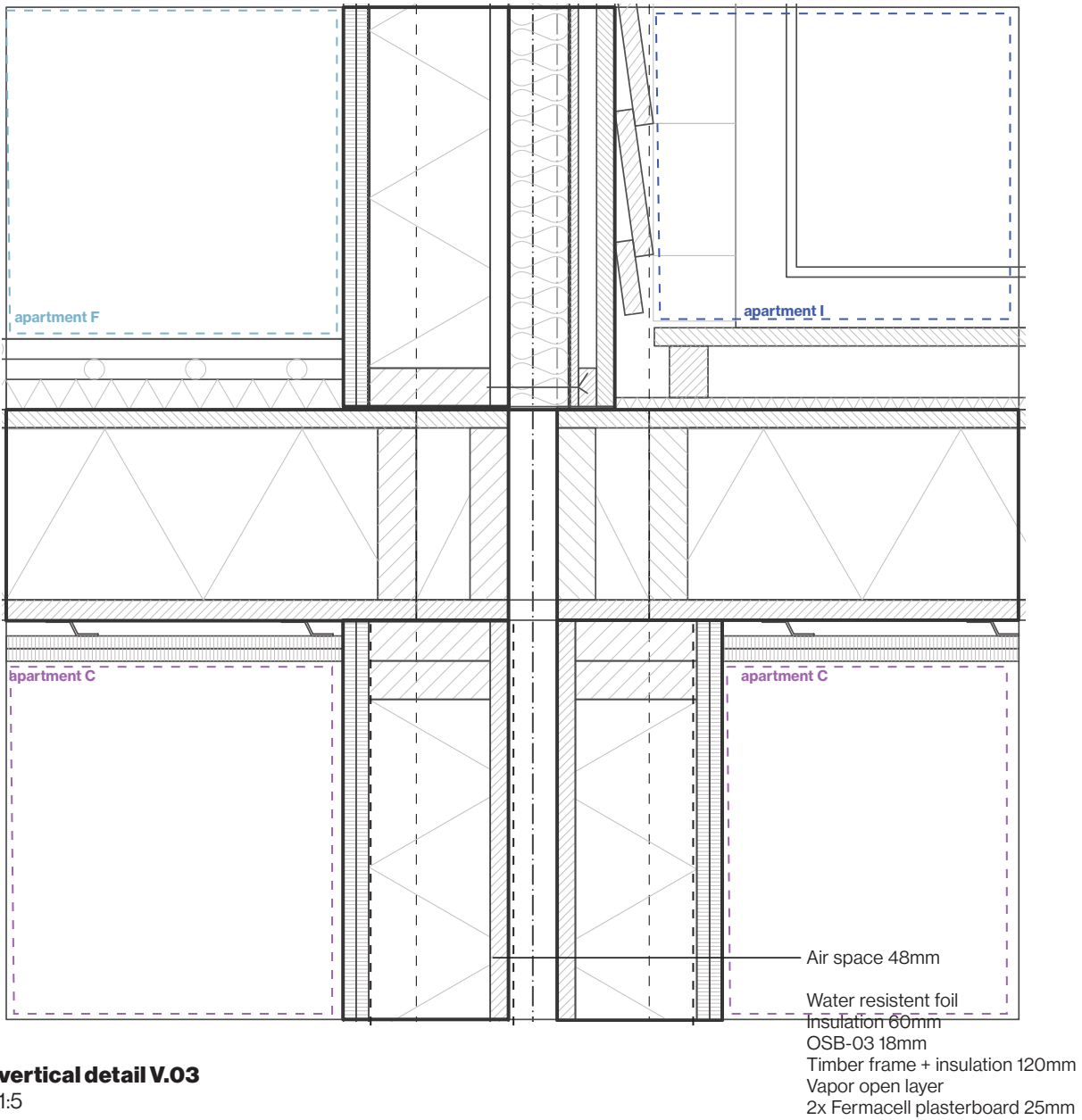
## vertical detail V.02

1:5

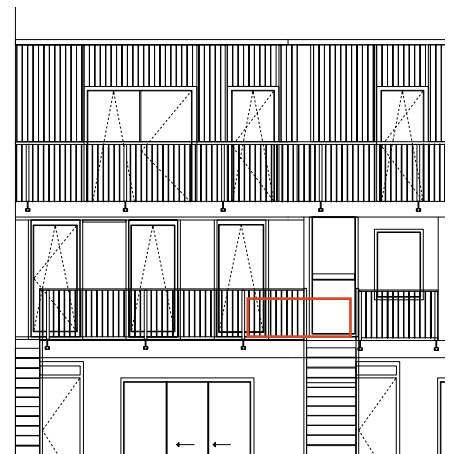
This detail shows an interesting connection between the gallery, an extension, and the balcony of apartment I. It shows how the wall structure (which is visible in every detail) is constructed and how the facade is positioned on the first floor. The covered section of the balcony of apartment I is covered by the gallery, which is supported by beams in this section. These beams are attached with steel angle profiles.



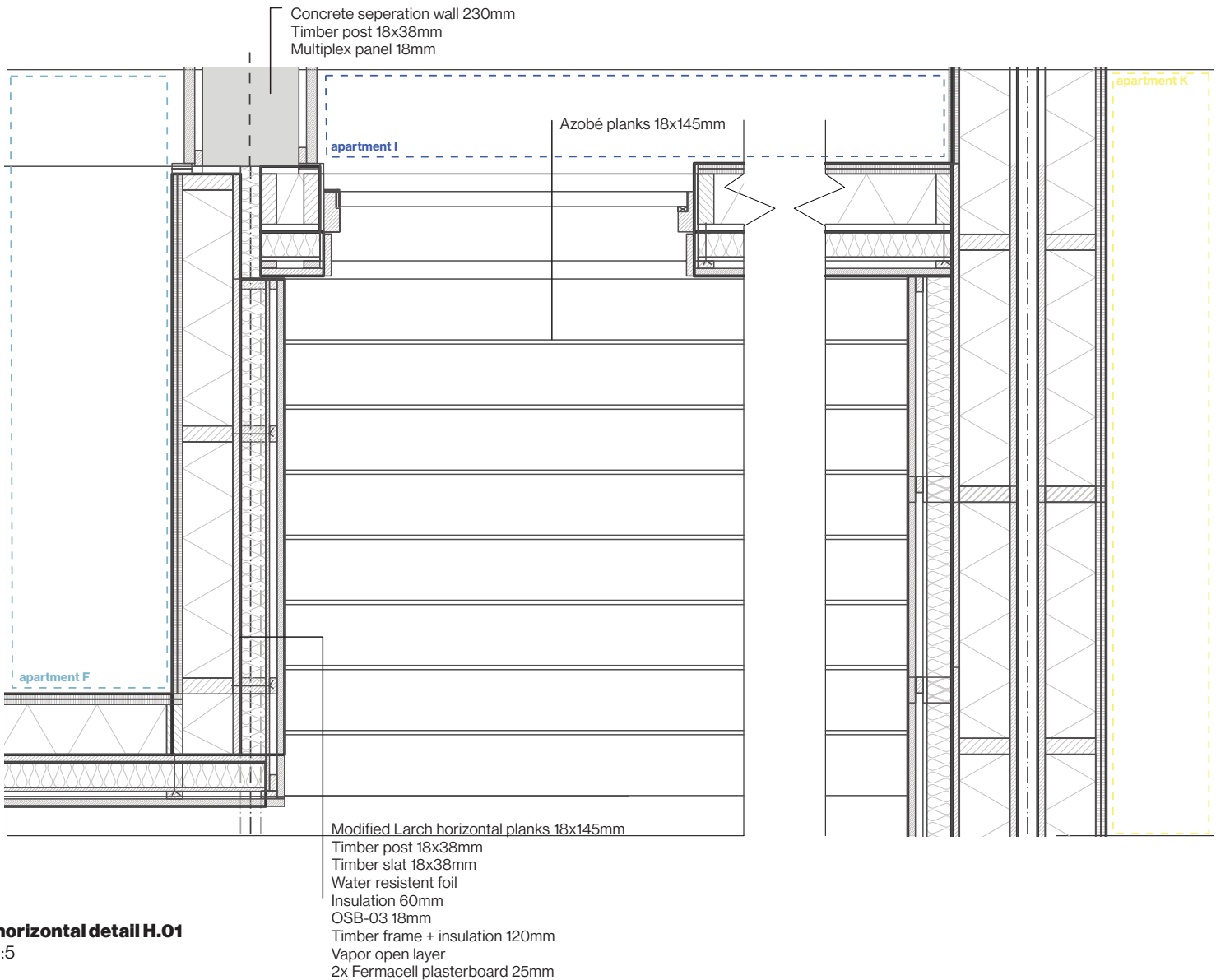
# Detail V.03



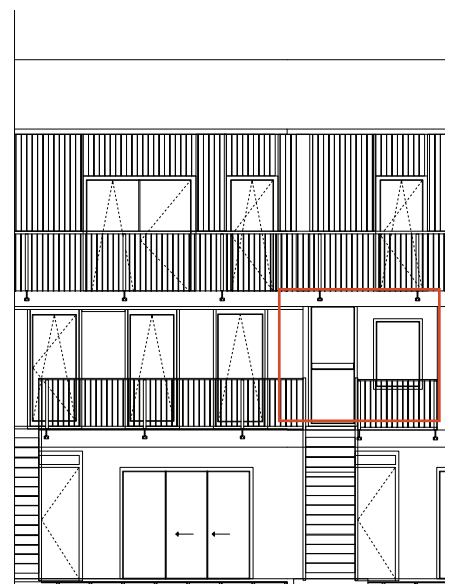
This detail shows how four apartments are connected. Visible are the timber frame wall and floor construction, the acoustic panels and floors, and the facade of the first floor again. The double plasterboard walls and ceilings meet both acoustic and fire safety standards.



# Detail H.01



This horizontal section once again clearly shows how the various modules and resulting dwellings are connected to one another. For all walls separating the dwellings, a future scenario has been taken into account in which certain elements or modules are removed or added. By consistently maintaining the same wall thickness and air gap, a grid and a standard wall thickness are preserved. This air gap is beneficial for acoustics, but also for the demountability of the modules.



# **04 IMPACT**

## conclusions & d

# iscussion

# 4.1 FINAL RECOMMENDATIONS

In this final chapter, the project and the process are reviewed. The final results and recommendations that can be made are discussed.

As a conclusion to this project and the associated process, it can be stated that both a design and a broader systematic concept have emerged.

Research was conducted into the main question: 'How can terraced houses be split and extended?'. This was done in two ways.

On the one hand, technical research was conducted into how this would be done in practice. This concerned the question: 'What are the requirements and regulations for splitting and extending terraced houses?'. For this part of the research, interviews were held with experts. Many answers emerged from these interviews that aided the research.

On the other hand, research was conducted into the spatial component of this project. The question here was: 'How do you design for the splitting and extension of a terraced house?' In this regard, design research was conducted through experimentation (trial and error). By investigating the possibilities and drawing on the first part of the research, a layered project could emerge.

The project demonstrates how construction can be carried out in a sustainable, social, and affordable manner. The goal of contributing as part of the solution to the major housing problem has hereby been achieved. The design is based on the aim of creating the greatest possible impact with the least amount of material. In this project, the number of homes has increased 2.5 times. The number of households grows from 29 to 73. This is achieved with an increase

in material of only 33% of the existing amount.

The home sizes range between 30 and 75 m<sup>2</sup>, with an average household size of 2 people.

Construction was carried out using prefabricated timber frame elements, which not only ensures a sustainable and bio-based project but also significantly accelerates the process. Timber frame structures are lightweight, easy to install, and affordable due to prefabrication.

The shared neighborhood room and inner courtyard contribute to increased social cohesion. Sharing the garden provides greenery and gives people the opportunity to enjoy a high-quality outdoor space together. The neighborhood room offers a space that people do not have at home. For instance, there is a study area, a workshop, a reception area for large groups, a large laundry room, and above all, it brings people together.

All in all, the impact on the existing residential block is significant. It has considerable potential, and this project shows where that potential lies and how it can be realized. The following page contains an overview of the advice and recommendations that can be made based on this project.

# RECOMMENDATIONS & ADVICE

## Technical research:

### Building technique:

- **Timber frame constructions** are the most suitable for lightweight, cheap and adaptable extensions and top-ups
- For extending and adding to an existing construction the **connections** are really important
- The connections should be **carefully designed** with focus on **heatloss, moist control and decoupling of elements**
- Taking care of **fire safety, acoustics and installations** are very important for this project
- During the design, thinking about **channels and pipes** for sewage and climate installations is very needed. In terms of placement of rooms, make sure the **wet cells** are placed on top of each other as much as possible

### Construction technique:

- make sure that from the start you have the **existing drawings** including the **foundation drawings**. The more information you have on the existing, the better
- rowhouses are not designed to be topped-up with many layers. An average rowhouse can be topped-up with **one or max. two layers** without the need to extra foundate your foundations
- depending on the **weight of your top-up** and the **existing construction** you can calculate the maximum layers
- having to **extra foundate** your foundations is a very **expensive** exercise, try to avoid that
- Extensions that are added can be build on a **seperate foundation. Screw piles** are a good example, because they don't need heavy drilling to be placed

### Climate technique:

- not building new buildings, but **transforming** them, is **always more sustainable**
- **moist and water** are very important themes when it comes to assembly and comfort. Make sure the elements are not wet during assembly, otherwise **moisture and mold problems** will accure
- make sure the **connection between old and new** are **super airtight**. This is a matter of using the right and enough materials like bands and tapes
- **decouple** the floors and ceilings as much as possible **for noise**. Timber is a material that is lightweight and it transfers sounds easily. There has to be a certain **acceptance** for this material, because you can not hold all the noise. **It is part of the building materials characteristics**
- **Use different climate systems for the different target groups**. Older people are in need of a more stable climate (type D) and younger people of a more adaptive climate (type C)
- There are multiple options for shared energy generations like the **heatpump, pv-panels and a collective heat-cold-storage system**. The heatpump could be stored under the roof, but make sure it is decoupled for the noise.

### Architectural:

- design smart by making use of **existing structures** like the staircase or existing channels and pipe systems
- **reuse spaces that are well designed** and design around these spaces, like the placing of a bathroom or kitchen
- **make smart use of extensions** and for example use the gallery as sunprotection
- decide on a few **design rules at the beginning of the project**, this will keep a coherence in the project
- start thinking about **routing and transportation as soon as possible** this will be a tough puzzle otherwise

# 4.2 IMPACT & AFTERMATH

What is the impact after the execution of this project? What potential has been achieved? And what can it become in the future? In this section, you will read about this impact and the future plans.

## 4.2.1 The Impact

**Goal 01. Not build new buildings & when build, build with biobased materials**

- An existing residential block has been transformed and, where necessary, extended with wooden elements.

**Goal 02. Adding the minimum**

By adhering to the goal of adding as little material as possible, space has been used very efficiently. Ultimately, only 33% of the existing structure was added to realize 2.5 times as many homes.

**Goal 03. Bring back the balance between m2 and household size (driving flow)**

- By splitting and, where necessary, extending, a balance has been found between the number of m2 and household sizes. Whereas there were previously 29 single-family homes, all 115 m2 and an average household of 2.1 people, there are now 73 apartments between 30-74 m2 with an average of 2 people per household.

**Goal 04. Actively promote social cohesion**

- By having social cohesion as a goal, much attention was paid during the process to how this could be promoted. A shared space has been added, the garden has been made communal, and design choices have also been made in the entrance and routing to promote interaction.

**Goal 05. Actively protect and serve the basic human right of having shelter and tackle injustice.**

- Because this project adds many homes in a fast, cheap, and sustainable way, the protection of the right to housing has been fulfilled. The idea behind this project on a large scale is to be able to do this in many more places and thus develop affordable, fast, and sustainable living space for young and old.

The goals for this project have been met as written above. By doing research and developing this project over the past 9 months, it can be concluded that this project has reached the impact that it wanted to reach. Looking forward, this project's theme might be continued in another program, due to its relevancy. What that exactly included is not clear yet, but maybe this project can lead to a further step in the future.





figure 28: own image. 3D visualization



## 4.2.2 Discussion

Although this report and the project present a relatively complete picture, there is still room for much discussion. Because little research has been done into this form of housing construction, there is also still much to talk about. In recent years, research has been conducted into the problem of the housing crisis, in which the solution of splitting properties and finding homes in existing buildings has often been mentioned. Nevertheless, little has been realized so far, and there are still many questions regarding feasibility and the financial side of the story.

In this project, too, not every aspect received equal attention. Due to the timeframe and origin of this project, the focus had to be primarily on the architecture and technical execution. This research and project therefore clearly demonstrate the possibilities for an existing residential block like this, both on an architectural and a technical level. Little research has been done to date, and there are few examples to be found of how it can be done at a technical level. It can be seen as the start of many other technical elaborations and architectural statements regarding this type of project. This project presents a complete picture, but is far from finished. We would therefore like to explore the possibilities and further depth at a later stage.

Themes that could still be addressed for a more comprehensive final result:

- affordability: what does the financial picture look like? What are the costs and benefits for a private

individual and for a cooperative? Will the private individual ultimately pay less monthly? What are the advantages and disadvantages associated with this?

- feasibility: How feasible is the project? Is it achievable in terms of costs, but also logistics? How do you ensure that this project enjoys broader societal support?

- legal: a difficult subject is how it is resolved legally. This is also discussed in the publication by Platform Woonpopgave. There are options for splitting plots, but that also proves to be a lengthy process. How can we ensure that these processes run faster and better? What is the impact of this on the project?

- participation: How do you ensure that residents go along with it? How do you convince owners to split their homes? Which meetings and processes are needed to ensure this runs smoothly?

The themes mentioned above are highly relevant to the project. They would elevate this project to a more realistic and higher level. Unfortunately, due to time constraints, it was not possible to delve deeper into this. However, interest in these themes remains significant. Hopefully, there will be room to reflect on this further and elaborate on it in the future.

# 4.3 REFLECTION

**In this reflection, I will look back on the past seven months of my graduation project. I will assess my own process and reflect on various key moments.**

## A1

From the very beginning, I was enormously driven and enthusiastic to get started. I was truly ready to begin and looked forward to developing a strong and interesting project. I had already settled on a theme that had captured my interest in the months before graduation started. This made choosing a subject and location relatively quick and straightforward. When it came to selecting a location, I knew early on that it had to be somewhere outside the city centre – and that is exactly what it became. My search ended at a residential block that I considered highly suitable, and after visiting it in person, that choice proved to be the right one.

From the outset, it was clear: we were under pressure from day one. We were the group with all presentation moments scheduled earlier than other studios, so the pressure would be considerable. On top of the regular curriculum, we were also given a case study assignment and asked to complete a MOOC. Educational on one hand, time-consuming on the other.

The A1 presentations were a first good test for everyone, and it was interesting to see how each person performed. There were many diverse projects and high ambitions. I felt confident about my A1 Go, though that moment is always nerve-wracking. Fortunately, everyone received a Go, and we were able to head off on our unforgettable excursion to Switzerland.

## A2

After our trip to Switzerland, the group dynamic was excellent. I was enormously glad to be graduating with this particular group, it truly felt like a gift. The pace had to increase and it was time to work towards a second, albeit informal, assessment moment. The stress that came with it was no less intense. The plan presented at A1 had to develop into something concrete, and the research phase also needed to be largely completed during this period.

I had decided to conduct interviews with experts, partly because relatively little had been written about my subject online or in books, it being a fairly specific and emerging development

within architecture. The experts were able to speak clearly about their field and provided valuable tips and advice. Since I had originally planned to focus on modular construction systems, I had oriented myself accordingly. However, the interviews made it clear that this direction was essentially a dead end.

A concrete outcome of my research was therefore, for example, the strong recommendation to build with prefabricated HSB (timber frame) elements. The A2 presentation also went smoothly, and I had made good progress. During this period, I also developed an increasingly clear vision of where I wanted to take the project.

## A3

After A2, the atmosphere within the group became somewhat more tense. Some people fell behind or became very stressed. The countdown to A3 had begun, meaning tight planning and consistent output. Our group had also scheduled a pre-A3 review, which turned out to be a double-edged sword: more pressure and less time in the short term, but better overall planning. And that proved to be true, because of the pre-A3, we had already completed a great deal, making these final two weeks somewhat less stressful, at least for me.

Over the past months, I often received reassurance from Max and Loes that things would work out. Over time, I developed a strong plan and concept that I am genuinely proud of. In general, I am pleased with the outcome, and the compliment from Loes, suggesting

I continue with this project after graduation, gave me an enormous boost. Still, you always remain uncertain about the qualities that are least developed in yourself. That never entirely goes away, but even in those areas I made a conscious effort to test and push myself further throughout this project.

I am glad to have been part of this studio and am grateful to all the tutors and fellow students. It was educational, enjoyable, and a wonderful way to bring my academic career to a close. Thank you!

# 4.4 MINISTERIE VAN SPLITSSEN EN TOPPEN



## OP EN TOP WONEN IN DE WIJK?



verduurzaamde &  
gerenoveerde woning



levensloopbestendige  
woningen



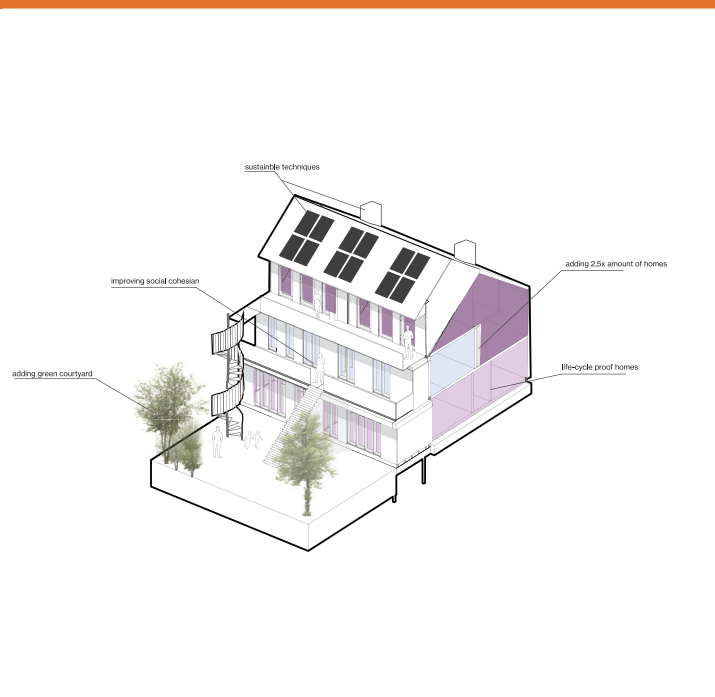
lagere woonlasten



gedeelde  
voorzieningen



sociale buurt



### MELDT NU OOK JOUW VVE AAN EN ONTDEK DE VOORDELEN VAN EEN OP-EN-TOP-WONEN-WIJK

Merkt u ook dat u de helft van uw woning nauwelijks lijkt te gebruiken? Lijkt het stil te zijn in uw buurt en mist u sociale cohesie?

Bekijk dan eens de voordelen van het Op-en-Top-Wonen concept!

Door uw woning te splitsen, renoveren en waar mogelijk uit te breiden kunt u niet alleen woningzoekenden aan een woning helpen, maar ook kunt u uw woning levensloopbestendig maken en verduurzamen. U hoeft uw geliefde buurt niet te verlaten en krijgt er sociale interactie voor terug. En een ander voordeel: lagere woonkosten.

**Enthousiast? Wordt samen met jouw buurt een Op-en-Top-Wonen Wijk en ontdek de voordelen!**

ga naar [www.op-en-top-wonen-wijk.nl/volkshuisvestingnederland](http://www.op-en-top-wonen-wijk.nl/volkshuisvestingnederland) en ontdek de mogelijkheden in uw buurt!

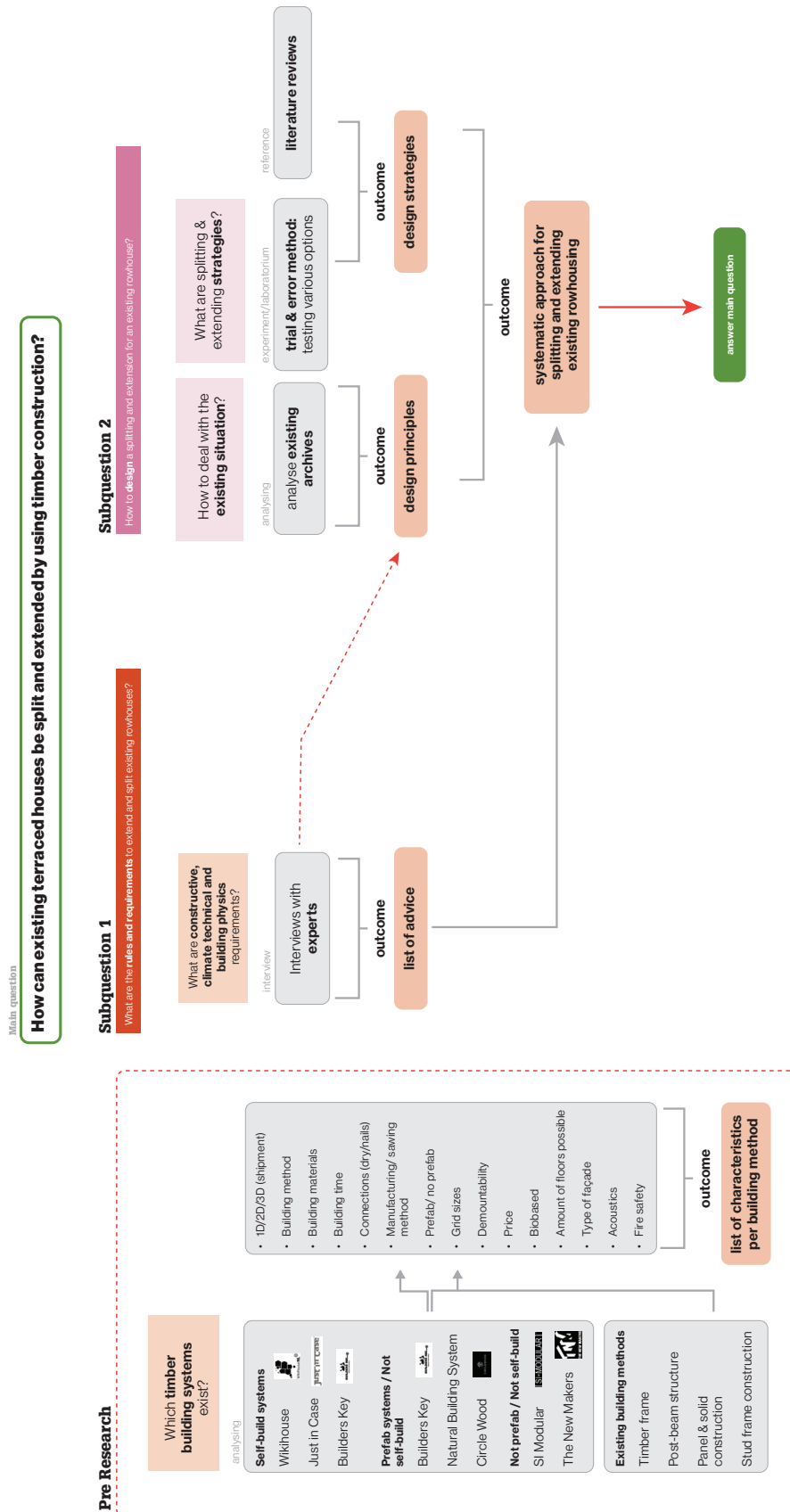






# 5.1 APPENDICES

## 5.1.1 Research methodology diagram



# Expert Interview Summary

BIM Projects & Structural Building Advice

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<b>Date of interview:</b>	24 February 2026
<b>Interviewer:</b>	Architecture Student (graduation phase)
<b>Expert / Interviewee:</b>	Jan van der Schaaf — Building Technician
<b>Subject:</b>	Rooftop extensions and subdivision of terraced houses in Amsterdam
<b>Context:</b>	Graduation research into sustainable housing construction

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## 1. Introduction and Context

This document presents a structured summary of an expert interview conducted as part of a graduation research project focused on the sustainable rooftop extension and subdivision of existing terraced houses. The interview was conducted online and took the form of a semi-structured conversation, supported by a presentation and digital drawings of the research project.

The research project concerns 29 terraced houses in Amsterdam. The central research question examines the potential for transforming existing dwellings — through rooftop extensions and subdivision using timber construction — as a sustainable contribution to addressing the housing shortage. The conversation was structured around five themes: structural connections, acoustics, fire safety, floor plans and building services, insulation and ventilation, and construction systems and methods.

## 2. Profiles of the Speakers

### *Interviewer — Architecture Student*

The interviewer is in the final graduation phase of an architecture degree programme. She has developed two design concepts for the rooftop extension and subdivision of the terraced houses: a courtyard concept, in which the central area between the housing blocks is enclosed to create a shared courtyard, and a copy-paste concept, in which the form of the existing dwelling is replicated and stacked at various locations across the block. The interviewer asked targeted questions about the technical aspects of her design and carefully documented the expert's advice throughout the session.

### *Interviewee / Expert — Jan van der Schaaf, Building Technician*

Jan van der Schaaf works as a building technician, integrating structural engineering, architectural design, and building physics in his professional practice. He has extensive experience assessing technical challenges in both existing and new-build residential construction. During the interview, he elaborated on technical requirements and key considerations by producing live digital sketches directly on the shared screen.

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## 3. Theme 1: Connecting New Construction to the Existing Structure

*Question from the interviewer:*

What are the key considerations when connecting a new timber construction to the existing concrete structure? Which factors are most critical in this process?

*Response and explanation from the expert:*

The expert identified two primary aspects of the connection: the structural joint and the building-physics seal. Structurally, it is essential that the existing skeleton can bear the load of the new rooftop extension. Because the concrete floors were cast in situ, the concrete ring beams offer a reliable anchoring point. For the front and rear facades, where no load-bearing structure is present, the expert advised installing steel profiles to transfer the forces to the concrete ring beams.

From a building-physics perspective, the expert emphasised the importance of maintaining an uninterrupted insulation line to prevent condensation and thermal bridging. Where timber frame facades are used, the insulation of the extension must connect seamlessly with that of the existing facade. Waterproofing via membranes and open perpendicular joints ensures adequate drainage of any water penetration. Where adjacent dwellings extend simultaneously or independently, separate connection details are required at the party wall junctions. The expert also recommended applying a joint sealant at the transition between old and new construction.

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## **4. Theme 2: Acoustics and Sound Insulation**

*Question from the interviewer:*

How can acoustic problems be addressed, given that multiple dwellings will now be stacked vertically within a structure that is partly concrete and partly timber?

*Response and explanation from the expert:*

The expert stated that a floating screed floor on top of the existing concrete floors is unavoidable. Although concrete floors of approximately 170 mm already provide a degree of sound insulation, this is generally insufficient on its own. Perimeter connections — where the floor meets the wall — require particular attention in order to prevent structure-borne sound transmission.

For party walls in timber construction, the expert recommended a double timber frame wall in which the two frames are kept entirely separate from one another (with an air gap between them), each finished with insulation and plasterboard. Plasterboard provides the necessary acoustic mass. The expert stressed that CLT panels are too heavy for non-load-bearing party walls and offer little acoustic benefit in this context. Metal stud walls — known as flexible or decoupled walls — were highlighted as a good alternative due to their acoustic performance. Circularly demountable systems, using sliding profiles and tape over the screws for easy disassembly, were also mentioned as a viable option in line with circular construction principles.

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## **5. Theme 3: Fire Safety and Escape Routes**

*Question from the interviewer:*

What are the key fire safety considerations in the design of the rooftop extensions, particularly with regard to access galleries and escape routes?

*Response and explanation from the expert:*

The expert highlighted the critical importance of escape routes along access galleries: where residents can only evacuate in one direction, the facades of the dwellings along that escape route must be fire-resistant. Stairwells must be designed as enclosed, fire-safe enclosures. Fire spread —

the transfer of flames via windows to upper floors or adjacent dwellings along a gallery — is a specific risk that must be considered in the facade layout.

The expert advised the interviewer to consult a reference document on facade fire resistance ratings in order to determine when timber cladding requires additional fire protection measures. He also pointed out that service shafts passing through multiple floors must incorporate fire-stopping provisions. For specific fire safety calculations and compliance assessments, the expert referred to a qualified fire safety consultant.

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## 6. Theme 4: Floor Plans and Building Services

### *Question from the interviewer:*

What is the most sensible approach for positioning wet rooms, kitchens, and meter cupboards in the new floor plans, and how should the service pipework and ducting be organised efficiently?

### *Response and explanation from the expert:*

The expert's fundamental principle was that meter cupboards should be located close to the entrance and must be stacked directly above one another across the vertically subdivided dwellings. Kitchens, bathrooms, and plant rooms should be positioned as close together as possible — both horizontally and vertically — in order to minimise pipe runs. A central service shaft is essential for this, accommodating water supply and drainage pipes as well as ventilation ducts.

For heating, the expert recommended a dedicated heat pump per dwelling in combination with a heat recovery ventilation (HRV) system. For ventilation, a mechanical system (system B or C) was advised, in which fresh air is supplied to living rooms and bedrooms while exhaust air is extracted from kitchens and bathrooms via dropped ceiling sections. The expert emphasised that future-proofing in accordance with current Building Regulations requirements should guide all services design decisions.

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## 7. Theme 5: Construction Systems and Methods

### *Question from the interviewer:*

Among the timber construction systems under consideration — including BuildersKey, Finch Buildings, timber frame (HSB), CLT, and GLULAM — which is most suitable for the rooftop extensions?

### *Response and explanation from the expert:*

The expert expressed particular interest in Finch Buildings as the most promising system for this project, as it has been specifically developed for dwellings placed side by side and stacked vertically. As a result, Finch Buildings already incorporates solutions for party walls and inter-module sound insulation, and applies an insulation layer and facade finish to the exterior of its modules. The other systems — such as timber frame (HSB), CLT, and GLULAM — are primarily designed for standalone residential construction and do not include built-in solutions for party wall detailing.

The expert explained that, structurally, a steel framework is required to transfer the loads of the rooftop extension to the existing concrete ring beams, as the front and rear facades of the existing dwellings have no load-bearing structure. A steel beam is installed across the width of the dwelling, on which the timber construction system is then placed. BuildersKey was also mentioned as an

interesting option due to its clear modular grid and structural logic.

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## 8. Conclusions and Recommendations

The interview yielded valuable insights into the technical requirements for the rooftop extension and subdivision of the Amsterdam terraced houses. The expert confirmed the feasibility of the project in timber construction, provided that the following key points are addressed:

1. Structural connection via steel profiles to the existing concrete ring beams, combined with an uninterrupted insulation layer.
2. Acoustic measures: floating screed floor on all concrete floors and a double, decoupled timber frame wall as the party wall.
3. Fire-safe stairwell enclosures and fire-resistant facades along escape routes; service shafts to be provided with fire-resistant enclosures.
4. Concentration of all service pipework in a central shaft; meter cupboards to be stacked vertically near the entrance.
5. Finch Buildings is the preferred construction system due to its integrated party wall detailing; a structural engineer is required for the connection to the existing structure.

The interviewer has indicated that the insights obtained will be incorporated into follow-up interviews with a structural engineer and a building services consultant, and that the design concepts will be further refined on the basis of the advice received.

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This document has been compiled on the basis of a recorded and transcribed conversation. All statements are presented in paraphrased form and are not intended as verbatim quotations.

# Expert Interview Summary

Climate Design, Building Physics & Timber Construction

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<b>Date of interview:</b>	February 2026
<b>Interviewer:</b>	Architecture Student (graduation phase)
<b>Expert / Interviewee:</b>	Building Physics & Timber Construction Specialist, ABT
<b>Subject:</b>	Climate design, moisture management, acoustics, fire safety and timber systems for rooftop extension
<b>Context:</b>	Graduation research — splitting and extending terraced houses in Amsterdam

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## 1. Introduction and Context

This document presents a structured summary of an expert interview conducted as part of a graduation research project on the sustainable rooftop extension and subdivision of existing terraced houses. The interview was held with a building physics and timber construction specialist at ABT, a structural and building engineering consultancy. The conversation followed a semi-structured format guided by the student's design themes, and took place online with reference to drawings and design variants developed in ArchiCAD.

The research project focuses on 29 standard terraced houses in Amsterdam. The student's central aim is to demonstrate the potential for splitting and vertically extending these dwellings using timber construction, thereby contributing to a sustainable response to the housing shortage. The interview covered six themes: passive and active climate strategies, moisture and airtightness, connection of old and new construction, acoustics, fire safety, and timber building systems.

## 2. Profiles of the Speakers

### *Interviewer — Architecture Student*

The interviewer is in the graduation phase of an architecture degree programme, working within the studio Architectural Wood. She has developed multiple design strategies for splitting and vertically extending the terraced houses, including variants with zero, one, two, and three additional storeys. Her key research question concerns which timber building system and construction method is best suited to rooftop extension, and what technical requirements must be met. Prior to this interview, she had already spoken with a structural engineer and a researcher at TNO.

### *Interviewee / Expert — Building Physics & Timber Specialist, ABT*

The expert works at ABT, an engineering consultancy involved in a wide range of timber construction projects including the CircleWood system (formerly known as Houtkern). She has practical knowledge of climate design, moisture behaviour in timber structures, acoustics in timber-framed buildings, and fire safety requirements. During the interview, she provided substantive technical advice across all themes and offered to share a publication on ten tips for biobased construction.

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## 3. Theme 1: Climate Design — Passive and Active Strategies

*Question from the interviewer:*

What approach to heating and cooling is recommended for this project, particularly given the transition from a single-family terraced house to stacked apartments housing different target groups including elderly residents and young starters?

*Response and explanation from the expert:*

The expert stated that in a well-designed Dutch dwelling, active cooling is not currently necessary. The design strategy should focus on maximising solar gain in winter while preventing overheating in summer. Key passive measures include carefully proportioned glazing (avoiding excessive south-facing openings), and ensuring cross-ventilation possibilities — front to back — so that residents can flush heat from the building at night. Since converting the house into apartments removes the natural through-ventilation of a single dwelling, the design should compensate for this through openings in the roof and facades.

For target group differentiation, the expert distinguished between elderly residents — who benefit from a stable indoor climate, low-temperature underfloor heating or radiators, and potentially heat-cold storage in the ground — and young starters, for whom a more compact, flexible system such as a climate unit (klimatraat) integrated into the facade may be more appropriate. This unit draws fresh air from outside behind a heating element, combining ventilation and heating in one compact device, and is particularly suitable for smaller units. The expert noted that the heavier concrete lower floors have more thermal mass and respond more slowly, making them better suited to low-temperature heating systems, while the lighter timber upper storeys could accommodate a more flexible air-based system.

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## 4. Theme 2: Moisture Management and Airtightness

*Question from the interviewer:*

How does timber construction perform in terms of airtightness and moisture in the Dutch climate, and what are the most important considerations when connecting a new timber rooftop extension to an existing concrete structure?

*Response and explanation from the expert:*

The expert advised working with a vapour-tight construction rather than an open, vapour-permeable one — particularly in residential buildings, where a single coat of standard paint can effectively eliminate the vapour openness of a wall assembly. A vapour retarder should be applied on the warm (interior) side of the construction, and it must run continuously across the junction between old and new. The expert warned that timber must never be allowed to become saturated during construction; unlike concrete, which can be left exposed over a weekend, wet timber can take months to dry out and will rot if sealed while damp.

On the thermal continuity at the junction between the existing concrete structure and the new timber extension, the expert emphasised that the insulation line must overlap without interruption. The timber frame panel (HSB) of the new construction should be positioned so that its insulation zone overlaps with the insulation already present in the existing facade. The ventilated cavity must remain unobstructed — it must never be blocked at the junction. Regarding airtightness, the expert advised against over-sealing the building with tapes and foam, as this undermines future disassembly. However, she acknowledged that timber requires a somewhat better baseline airtightness than concrete due to its greater vulnerability to moisture ingress.

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## 5. Theme 3: Acoustics in Timber Construction

### *Question from the interviewer:*

How should acoustic performance be approached in a building that combines existing concrete floors with new timber floors and party walls? Is there an inherent limitation to what timber construction can achieve acoustically?

### *Response and explanation from the expert:*

The expert confirmed that floor and ceiling assemblies in timber construction are inherently thicker than their concrete equivalents, requiring more reserved floor-to-floor height. Standard Building Regulation requirements for sound insulation can generally be met with current market systems, and the expert noted that this is no longer as challenging as it once was. However, the key issue is low-frequency sound — rumbling from heat pumps, washing machines, and tumble dryers — which current regulations do not address. Timber construction does not attenuate low-frequency noise as effectively as the mass of concrete.

The expert presented two design approaches: accepting low-frequency transmission as an inherent characteristic of timber construction (particularly suitable for younger residents with more active lifestyles), or adding secondary linings — extra plasterboard layers on both sides of party walls and external walls — to suppress low-frequency sound. The latter significantly increases wall thickness and eliminates exposed timber surfaces. For party walls, the expert recommended either double decoupled timber frame walls (two HSB frames completely separated by an air gap, with insulation and plasterboard on each) or CLT walls with single or double secondary linings depending on the desired acoustic performance. For the existing concrete floors, a thin dry floating screed incorporating underfloor heating can be added at relatively low build-up depth.

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## 6. Theme 4: Fire Safety

### *Question from the interviewer:*

How should fire safety be approached when designing with exposed timber, and how does the current regulatory framework address timber construction?

### *Response and explanation from the expert:*

The expert described fire safety in timber construction as a contested and rapidly evolving field. The simplest compliant solution is to encase all timber in plasterboard, but this negates the aesthetic and experiential value of building in wood. A new national technical guideline (NTA 6125) has recently been published, providing guidance on the percentage of timber surface that may be left exposed in residential buildings. The expert recommended using this guideline as a basis for design decisions.

She noted that the fire behaviour of timber is fundamentally different from that of concrete, and that current Dutch Building Regulations were developed with concrete and masonry construction in mind. In practice, compliance decisions are often the result of negotiation between the fire safety consultant and the fire brigade, rather than straightforward regulatory application. The expert suggested a pragmatic approach: leave timber exposed where architecturally desirable, apply secondary linings where required for acoustics (which simultaneously addresses fire safety), and install smoke detectors in every room — not only in hallways — to ensure early detection and safe evacuation. She viewed resident safety through early warning as more achievable and effective than relying solely on passive fire-resistant construction.

## 7. Theme 5: Timber Building Systems

### *Question from the interviewer:*

Among the timber building systems under consideration — including CircleWood (ABT), CLT, HSB, and CNC-prefabricated systems — which are most relevant for rooftop extension, and is CircleWood actively being used in construction projects?

### *Response and explanation from the expert:*

The expert confirmed that the CircleWood system (developed by ABT, formerly known as Houtkern) is in active use and not merely a concept. It has been applied in residential buildings, schools, and asylum seeker reception centres (COAs), the latter requiring very rapid construction timescales. She acknowledged that the system has undergone several name changes over the years, and that individual projects may appear on ABT's website under different names. A reference project she mentioned is the Tolzaal apartment blocks, which are shortly to be built entirely according to the CircleWood principle.

For party wall construction in timber buildings, the expert indicated that ABT typically uses CLT walls with single or double secondary linings (voorzetwanden), depending on the acoustic requirements. She also discussed a double decoupled HSB wall system as an alternative, in which two separate timber frame panels are kept physically disconnected to prevent sound transmission. Regarding the use of gravel or ballast (gint) as a mass element within floor assemblies — in place of wet concrete — she noted that this is increasingly being used in the market as a dry, removable alternative that achieves the acoustic mass needed without the incompatibility of wet concrete and timber.

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## 8. Conclusions and Recommendations

The interview provided detailed technical guidance across all six themes relevant to the graduation project. The expert confirmed the feasibility of timber rooftop extensions on existing terraced houses, while highlighting the following key points of attention:

1. Climate design should prioritise passive strategies (solar shading, cross-ventilation) and differentiate heating and v
2. Moisture management requires a vapour-tight construction with a continuous vapour retarder on the warm side; tir
3. The thermal insulation line and vapour retarder must run continuously across the transition from old to new, with de
4. Acoustic performance in timber construction can meet regulatory requirements for standard sound insulation; low-fi
5. Fire safety should combine NTA 6125 guidelines for exposed timber surfaces, acoustic secondary linings (which al
6. CircleWood (ABT) is a proven and actively deployed timber building system suitable for this typology; dry gravel-fill

The expert offered to share a publication on ten tips for biobased construction, which the interviewer will incorporate into her ongoing research alongside findings from interviews with a structural engineer and a TNO researcher.

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This document has been compiled on the basis of a recorded and transcribed conversation. All statements are presented in paraphrased form and are not intended as verbatim quotations.

# Expert Interview Summary

Structural Engineering & Construction Feasibility for Rooftop Extensions

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<b>Date of interview:</b>	27 February 2026
<b>Interviewer:</b>	Sharice van der Schaaf — Architecture Student (graduation phase)
<b>Expert / Interviewee:</b>	Leonard Tinholt — Structural Engineer / Construction Advisor
<b>Subject:</b>	Structural feasibility of rooftop extensions and subdivision of terraced houses
<b>Context:</b>	Graduation research — splitting and extending terraced houses in Amsterdam using timber cons

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## 1. Introduction and Context

This document presents a structured summary of an expert interview conducted as part of a graduation research project on the sustainable rooftop extension and subdivision of existing terraced houses. The interview was held with Leonard Tinholt, a structural engineer and construction advisor with practical experience in feasibility studies for housing densification and renovation projects.

The research project focuses on 29 standard terraced houses built around 1986 in Amsterdam West, just outside the ring road. The student's aim is to demonstrate the potential for splitting and vertically extending these dwellings using timber construction, thereby contributing to both the housing shortage and sustainable densification of existing urban fabric. The interview covered four main themes: foundation capacity and load-bearing limits, the existing structure and construction options, construction methods and timber building systems, and archival research.

## 2. Profiles of the Speakers

### *Interviewer — Sharice van der Schaaf, Architecture Student*

The interviewer is in her sixth and final year of an architecture degree programme, graduating within the studio Architectural Wood under the supervision of Loes Thijssen. Her project explores two design strategies for the terraced house block: a courtyard concept, in which the inner area is enclosed to create a shared garden court with new dwellings arranged around it, and a copy-paste concept, in which the typology of the existing house is replicated and stacked at various heights. She is investigating how many storeys can realistically be added, which timber building system is most suitable, and what technical requirements apply.

### *Interviewee / Expert — Leonard Tinholt, Structural Engineer*

Leonard Tinholt is a structural engineer and construction advisor who regularly conducts feasibility studies for rooftop extensions and housing renovation projects. He has direct experience with the practical constraints — particularly regarding foundations and archive data — that determine whether such projects proceed. He offered frank, practically grounded advice throughout the interview and encouraged the student not to be overly restricted by technical objections in her design process.

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## 3. Theme 1: Foundations — The Critical Bottleneck

*Question from the interviewer:*

What are the most important structural considerations when adding rooftop extensions to existing terraced houses, and how should the foundation be assessed?

*Response and explanation from the expert:*

The expert immediately identified the foundation as the single most critical factor in rooftop extension projects. In the western Netherlands — including Amsterdam — buildings are founded on timber or concrete piles rather than on sand, and those piles must be capable of carrying the additional load of any extension. The primary obstacle in practice is almost always the absence of reliable archival data about the foundation: pile type, depth, and load-bearing capacity are frequently unknown.

Without this data, engineers must work from assumptions. If the conclusion of a feasibility study is that the foundation needs to be reinforced, a project will almost never proceed — foundation reinforcement is extremely costly, highly disruptive, and requires the building to be vacated. Regarding the specific project, the expert noted that the drawings showed square pile indications, suggesting prefabricated concrete piles with a prefabricated foundation band, though this could not be confirmed without archival records.

On the question of residual capacity, the expert explained that two favourable factors apply to buildings of this age: older structures were designed using higher safety factors than current standards require, and a structure that has stood for 50 years without significant settlement or cracking is considered a proven construction, allowing reduced safety factors in recalculation. These two effects together create a margin that may accommodate a limited extension. However, for a simple terraced house with only two floors and a roof, this margin is small. The expert's practical assessment was that one additional storey is realistic, two storeys is doubtful, and three or more is not feasible without foundation reinforcement.

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## **4. Theme 2: The Existing Structure — Options and Decisions**

*Question from the interviewer:*

Can the existing pitched roof (sporenkap) simply be removed and reused? Does the existing concrete structure need reinforcement before adding timber storeys? And are intermediate transfer structures required?

*Response and explanation from the expert:*

The expert confirmed that removing the existing pitched timber roof is straightforward and requires little effort. Reuse is possible and desirable from a sustainability standpoint — where a new pitched roof is planned, the existing elements can be reincorporated. For dwellings receiving a flat roof or a different roof form, those elements that cannot be reused may be discarded.

For the existing concrete structure, the expert outlined two approaches. The first and most sustainable option is to leave the existing construction entirely in place and build directly on top of it, using a timber frame panel (HSB) or other lightweight system — this avoids demolition waste and embodied carbon. The second option is to remove heavy concrete elements (such as the gable walls) and replace them with lighter timber frame walls, thereby freeing up structural capacity within the foundation's residual load-bearing margin. The expert noted that the choice depends on the weight budget available once a structural calculation has been made.

A third option discussed was the installation of an entirely independent structural frame in front of the existing concrete casing — separately founded with new micro-piles — to which new facades, balconies, and galleries are attached. This approach maximises design flexibility and removes dependency on the capacity of the existing structure, but requires its own foundation and represents a more significant intervention.

On the question of a transfer structure (*tussenconstructie*): in cases where the existing roof is a lightweight timber structure, it cannot carry the loads of a new floor, and a steel or timber transfer structure is inserted at party wall level to span the existing roof and support the new storey above. In this project, the existing top floor is already a reinforced concrete slab of approximately 170 mm, which the expert considered a favourable starting point. When that existing floor becomes a party floor between two separate dwellings, however, more stringent acoustic requirements apply — which may necessitate added mass or a floating screed. On balconies and galleries, the expert was clear: attaching these to the existing masonry facade is not feasible for this building type. They must either be independently founded or, in the case of the new timber extension itself, short cantilever balconies of up to approximately 1.5 metres can be formed by extending floor beams beyond the facade.

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## 5. Theme 3: Timber Building Systems and Construction Methods

### *Question from the interviewer:*

Among the timber systems considered — including Buildersky, Wiki House, Finch Buildings, Justin Case, SI Modular, CircleWood, HSB, CLT, and GLULAM — which approach is most suitable for a scalable rooftop extension project?

### *Response and explanation from the expert:*

The expert framed his response around the twin realities of the Dutch construction sector: cost and labour scarcity. The most efficient solution for a scalable project is large prefabricated volumetric modules, produced in factory conditions where quality control is high and on-site labour is minimised. A crane positions the modules one by one, dramatically reducing construction time. For this building type, he noted that the pitched roof triangles must first be closed off with HSB panel elements before modules can be placed, which represents an unavoidable preparatory step.

The expert was dismissive of the click-and-connect self-build systems such as Buildersky, Wiki House, and Justin Case for use in a scalable professional context. While well-intentioned and suitable for individual self-builders, they are too expensive and operationally complex for large-scale contractors: on-site workers must understand and follow detailed assembly sequences, which adds risk and cost. He also raised concerns about scalability for Buildersky specifically, noting that it is the product of a single individual and would be difficult to replicate at volume.

For spans of approximately 5 metres — as in this project — conventional timber sections are sufficient. LVL (laminated veneer lumber) beams become necessary only for larger spans, typically above 6 to 7 metres. The expert noted that in current practice, small rooftop extension projects are still frequently built using traditional site carpentry rather than prefabricated systems, precisely because malfits with the existing structure are common and on-site adjustability is essential. For genuinely scalable, repetitive rooftop extensions across many houses of the same type, the preferred route is prefabricated HSB wall, floor, and roof elements — or full volumetric modules where logistics and crane access permit. He also mentioned the Amsterdam-based company HDO

in Beverwijk as a specialist in prefabricated HSB rooftop extension systems with considerable completed project experience.

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## 6. Theme 4: Archival Research

### *Observation from the expert:*

Throughout the interview, the expert repeatedly returned to the importance of archival research as the foundational step for any rooftop extension feasibility study. Structural drawings showing the concrete party walls and their reinforcement, foundation plans indicating pile positions and types, and original load calculations are all invaluable inputs that make feasibility assessments faster, cheaper, and more reliable.

The expert noted that the Netherlands has a poorly organised archival system for building documentation, and that relevant records are frequently missing or incomplete. He observed that the construction drawings the student had obtained — showing reinforced concrete party walls and floor slab reinforcement layouts — are already useful for assessing what the structural elements can carry, even if the foundation documentation remains unavailable. He suggested that the name of the original structural engineering firm, visible on one of the drawings, might be a route to obtaining further data, though he noted the firm may no longer exist.

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## 7. Conclusions and Recommendations

The interview provided clear and practically grounded guidance on the structural feasibility of rooftop extensions for this typology. The expert confirmed the technical possibility of limited extensions while identifying the following key points of attention:

1. Foundation capacity is the decisive factor: without reinforcement, a maximum of one additional storey is realistic for
2. Archival research into pile type, depth, and original load calculations must be treated as a priority — it is the single
3. The existing structure should ideally be left in place (most sustainable). Where weight savings are needed, concrete
4. The existing pitched roof can be removed with minimal effort and partially reused where a new pitched roof is planned
5. Balconies and galleries must be independently founded or cantilevered from the new timber extension structure; at
6. For a scalable project, prefabricated HSB elements or full volumetric modules are preferred over click-and-connect
7. The student should not allow technical constraints to overly restrict her design ambition — the housing challenge re

The expert offered to remain available for follow-up questions and expressed interest in receiving the final graduation project results. The student will also forward a consent form for the expert's signature.

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This document has been compiled on the basis of a recorded and transcribed conversation. All statements are presented in paraphrased form and are not intended as verbatim quotations.

# Interview Summary

Expert Consultation — Timber Construction & Vertical Extension

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<b>Interviewee:</b>	Karin (Senior Researcher / Expert Consultant)
<b>Subject:</b>	Timber-based vertical extension and renovation of existing row houses
<b>Date:</b>	May 27, 2026
<b>Prepared by:</b>	Project team

## Executive Summary

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This document summarises the key insights obtained during an expert consultation with Karin, a researcher with experience in sustainable timber construction and building renovation. The interview covered four main topics: vertical extension (topping-up) of existing structures using timber systems, acoustic and fire safety requirements, ventilation and heating strategies, and the suitability of various timber construction systems. The overarching conclusion is that the proposed project is technically challenging, with the critical success factors being the connection between existing concrete structures and new timber elements, and the structural capacity of the existing foundation.

## 1. Vertical Extension (Topping-Up) with Timber

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Based on collaborative research with another consultancy, Karin indicated that the majority of row houses built after 1995 are generally unsuitable for vertical extension. These dwellings were constructed to optimised structural standards, leaving little to no residual load-bearing capacity. For pre-1995 housing, a maximum of one to two additional storeys may be feasible, subject to a thorough foundation assessment.

Should foundation reinforcement be pursued, the cost investment would be substantial; however, it would unlock the possibility of adding two to three storeys, making the project financially attractive to property developers. The decision regarding the number of additional floors is therefore primarily an economic one.

### Key technical considerations:

- **Existing triangular concrete structure:** The concrete triangular element on the second floor should ideally be removed to create a flat base for the new construction. Removal does, however, incur additional costs. Alternatively, an engineered connection solution may be developed, though this requires dedicated structural design.
- **Moisture and airtightness:** The interface between existing concrete and new timber elements must be carefully detailed. Special attention is required to prevent moisture ingress, ensure airtightness, and manage the drying behaviour of the assembly. Material separation and infill detailing are recommended strategies.

## 2. Acoustics and Fire Safety

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Karin advised that fire safety requirements should be addressed in strict accordance with the Dutch Building Decree (Bouwbesluit, BBL). The specified systems and products are generally pre-assessed

against these regulations. Additionally, compartmentalisation principles must be clearly understood and correctly applied throughout the design.

With regard to acoustics, timber construction inherently performs less well than heavier masonry or concrete systems. The recommended approach is to decouple structural and non-structural elements wherever possible to reduce the transmission of impact noise. A distinction must be made between timber frame systems (HSB — Houtskeletbouw) and cross-laminated timber (CLT): CLT offers greater mass and, consequently, better acoustic performance. Accepting a degree of acoustic limitation in timber construction may be necessary and should be explicitly acknowledged in the project documentation.

### 3. Ventilation and Heating

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Two types of heat pump systems were discussed:

- **Air-to-air heat pumps (air conditioning units):** These systems heat and cool air directly and circulate it within the interior. They respond quickly but do not heat the building fabric, meaning thermal retention after switch-off is limited. They also consume relatively more energy and involve additional mechanical components.
- **Air-to-water heat pumps:** These systems connect to radiators or underfloor heating, transferring heat to the building structure and thereby achieving longer-lasting warmth after the system is turned off. This option is considered preferable from a building physics perspective.

Noise generated by heat pump units was identified as a relevant concern. The recommended mitigation is acoustic decoupling of the unit from the wall or roof structure, particularly in timber construction, to minimise vibration transmission.

For ventilation, Karin strongly recommended the exclusive use of Type D mechanical ventilation (balanced mechanical supply and extract). This system guarantees consistent indoor air quality and eliminates the need for passive ventilation grilles. Resident education on the correct use and maintenance of the system was highlighted as an important factor for long-term performance.

### 4. Timber Construction Systems

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Karin was familiar with Finch Buildings and was involved in the development of Circle Wood. The majority of the reviewed systems are based on timber frame (HSB) construction. Scalability was acknowledged as a consistent challenge across all prefabricated systems.

A flat substrate for the new construction is generally required for prefabricated systems to be applied correctly — reinforcing the recommendation to remove the existing triangular concrete element. Custom design using HSB or CLT offers greater flexibility and a potentially better fit with the specific conditions of the existing structure.

Regarding Builders Key specifically, Karin noted it as an interesting system, but emphasised the importance of carefully detailing the connection interface and managing moisture exposure during and after construction. Timber elements must be protected from precipitation throughout the building process to prevent moisture-related damage.

### Conclusions and Recommendations

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The expert consultation confirms that this is a technically demanding project. The principal challenges centre on the structural interface between existing construction and new timber elements, and on the load-bearing capacity of the existing foundation. The following strategic decisions require further deliberation:

- **Number of additional storeys:** One storey without foundation reinforcement versus two to three storeys with a full foundation upgrade — a decision driven primarily by budget and investment objectives.
- **Treatment of the existing triangular concrete structure:** Removal is recommended for constructive and economic reasons, though a bespoke engineering solution remains an option.
- **Construction system selection:** A custom HSB or CLT design may offer superior adaptability compared to proprietary prefabricated systems given the site-specific constraints.

Karin's closing advice was to clearly document any accepted risks — such as acoustic performance limitations or cost uncertainties — within the project report, and to approach the design with rigour regarding structural connections and moisture management.

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*This summary is based on informal interview notes and is intended for internal project use only.*

# DATA MANAGEMENT CHECKLIST

## Instruction

This checklist is relevant for all graduation projects of the Master AUBS. The form is intended to highlight common aspects of graduation projects that require particular attention with regard to planning the research and data management. Relevant information and supplementary sources regarding each question are provided below each question.

With this checklist, the faculty wants to avoid that students unexpectedly find themselves in complex and stressful situations, in which ethical or privacy matters and/or other laws and regulations become an issue. In projects involving humans, certain types of data processing increase the risks to the human participants: planning such projects requires additional evaluations and advice from university staff before ethical approval can be received and the project can begin. In the case of a graduation project, obtaining additional advice or permits may delay the project with an extra education period or semester. To avoid this, it is recommended that students set up a graduation project with a low level of risk. Therefore, all students have to check their risk, by completing this checklist before their A1.

The first section of the checklist (A) should be completed by all students, together with their supervisor, during the planning of the graduation project, before the A1. It does not need to be submitted to anyone for review or approval. Please consider questions 1 to 3 carefully in relation to the intended graduation project, and answer with 'yes' or 'no'.

The second section of the checklist (B) should only be completed if the graduation project involves working with data from human participants. In that case, the student and their supervisor must apply for and receive ethical approval from the [Human Research Ethics Committee](#) (HREC) before the project can begin (see the paragraph 'Explanation and follow-up' after the questions). The student can submit the application to the HREC, but the supervisor is responsible for making sure that the project is compliant with relevant privacy regulations and ethical policies.

Section A. General considerations	yes	no
<p>1. Is the graduation project conducted as part of an internship (at a company), or as part of a research project at TU Delft?</p> <p>If a student's graduation project is conducted at a company or as part of a research project at the university, questions of data ownership and intellectual property rights need to be addressed in a written <a href="#">graduation or internship agreement</a> before the project begins. Students and their supervisor should consult the <a href="#">Intellectual Property Rights of Students webpage</a>. Additional information can also be found in the <a href="#">Extended Personal Research Data Workflow</a>.</p>		✓
<p>2. Does the project involve conducting (part of) the research outside the Netherlands?</p> <p>Students who intend to travel abroad (even to other EU countries) for study, exchange, research, internship, or graduation project purposes need to follow the <a href="#">Travel Safety Protocol</a>. This includes attending a mandatory Travel Safety Training Session: see the <a href="#">Disclaimer</a>.</p>		✓
<p>3. Will the research involve processing data from humans, such as running a survey, conducting interviews or workshops, collecting data through social media or internet forums, or re-using existing datasets about humans provided by a third party? (If 'yes', see follow-up questions 4 to 13 in Checklist B.)</p> <p>Students who work with data from human participants must complete the next section and apply for and receive ethical approval from the <a href="#">Human Research Ethics Committee</a> (HREC) before conducting the research.</p>	✓	

<b>Section B. Extended risk factors</b> (only if question 3 has been answered with 'yes'.)	yes	no
<p>4. Will the project involve participants who may be considered vulnerable, such as the elderly, refugees or asylum seekers, ethnic minorities, patients, or people with disabilities?</p> <p>Participants who may suffer very adverse consequences (for instance, due to discrimination) if their personal data became publicly available can be considered vulnerable.</p>		✓
<p>5. Will the project involve participants who cannot themselves give informed consent for taking part in the project, but for whom consent must be obtained from a legal guardian?</p> <p>Participants who cannot give <a href="#">informed consent</a> can include, for instance, children or participants with intellectual disabilities, mental disorders, or dementia. Such participants are also considered vulnerable in the context of the <a href="#">General Data Protection Regulation</a> (GDPR).</p>		✓
<p>6. Will the project involve processing any of the special categories of personal data below?</p> <ul style="list-style-type: none"> <li>- Race</li> <li>- Ethnicity</li> <li>- Criminal offence data</li> <li>- Political opinion</li> <li>- Union membership</li> <li>- Religious or philosophical beliefs</li> <li>- Sex life and/or sexual orientation</li> <li>- Health data (including measurements such as heart rate)</li> <li>- Biometric or genetic data (including fingerprints, iris scanning, facial recognition)</li> </ul> <p>The <a href="#">General Data Protection Regulation</a> (GDPR) defines a stricter rules for processing <a href="#">special categories of personal data</a>. If it is necessary to process these data in a project, it is it is important to provide additional safeguards.</p>		✓
<p>7. Will the project involve processing personal data that could be considered sensitive, such as the ones listed below?</p> <ul style="list-style-type: none"> <li>- Information about a person's income, debts, or other payments</li> <li>- Information about a person's (un-)employment status</li> <li>- Information about a person's performance at school or work</li> <li>- Information about relationship problems or (gambling) addiction</li> <li>- Information about poverty, domestic violence, or youth welfare/social work involvement</li> </ul> <p>Some types of personal data are considered <a href="#">sensitive</a>, because they can have a high impact on the privacy of the data subject if other persons gain access to these data. Sensitive personal data should only be processed if necessary: in such cases, additional safeguards need to be put in place.</p>		✓
<p>8. Will the project involve processing video-recordings, or photographs of participants?</p> <p>TU Delft considers photographic and video-materials of research participants to be <a href="#">sensitive personal data</a>. If such data need to be processed, additional safeguards must be put in place.</p>		✓

<b>Section B. Extended risk factors</b> (only if question 3 has been answered with 'yes'.)	yes	no
<p>9. Will the project involve sharing or transferring personal data between multiple partners or collaborating organisations involved, such as between TU Delft and an internship company?</p> <p>According to privacy law, sharing personal data between organisations requires a <a href="#">privacy agreement</a> to be in place: setting this up takes time, and requires support from additional university staff. Furthermore, personal data sharing can potentially expose research participants to different types of risks: these risks must be considered in the ethical application.</p>		✓
<p>10. Will the project involve deception, or covert observation of participants?</p> <p>In some types of research, obtaining <a href="#">informed consent</a> for processing participants' personal data is not an option: for instance, if the research involves deception, or the research is covert (conducted without participants knowing about it). In such situations, the steps to mitigate risks to participants are important, and an alternative <a href="#">legal basis</a> for processing the participant's data needs to be established with the help of additional support staff.</p>		✓
<p>11. Will the project involve working with social media data?</p> <p>Social media data are personal data, but since it is usually not possible to ask for <a href="#">informed consent</a> for processing social media data, another <a href="#">legal basis</a> for processing the participant's data needs to be established. Processing of social media data also involves legal considerations related to terms of use of data from third-party platforms: therefore, research with social media data requires expert support on privacy, ethics, and legal matters.</p>		✓
<p>12. Will the project involve using learning algorithms or other AI to analyse, combine, or otherwise process data from participants?</p> <p>The use of AI in research involves many considerations in terms of data protection, ethics, security, and intellectual property: for more information, see TU Delft's <a href="#">Instructions for use of Generative AI</a>.</p>		✓
<p>13. Will the project involve participants who are based in a country or countries outside of the EU?</p> <p>Students affiliated with TU Delft must comply with Dutch and EU regulations of personal data processing (<a href="#">GDPR</a>). Furthermore, the student and their supervisor must make sure that the research complies with <a href="#">local (privacy) legislations</a> of any foreign destinations. Additional support from an external (local) expert may be required.</p>		✓

### Explanation and follow-up

If you have answered 'no' to all questions 4 to 13, your project is likely to be considered low or minimal-risk: see the paragraph 'Projects with minimal or low-risk' on the next page.

If you have answered 'yes' to one or more of the questions 4 to 13, your research likely involves extended or high risks to participants, according to the [General Data Protection Regulation](#) (GDPR) and TU Delft's privacy and ethical policies: for information regarding such projects, see the paragraph 'Projects with extended or high-risk' on the next pages.

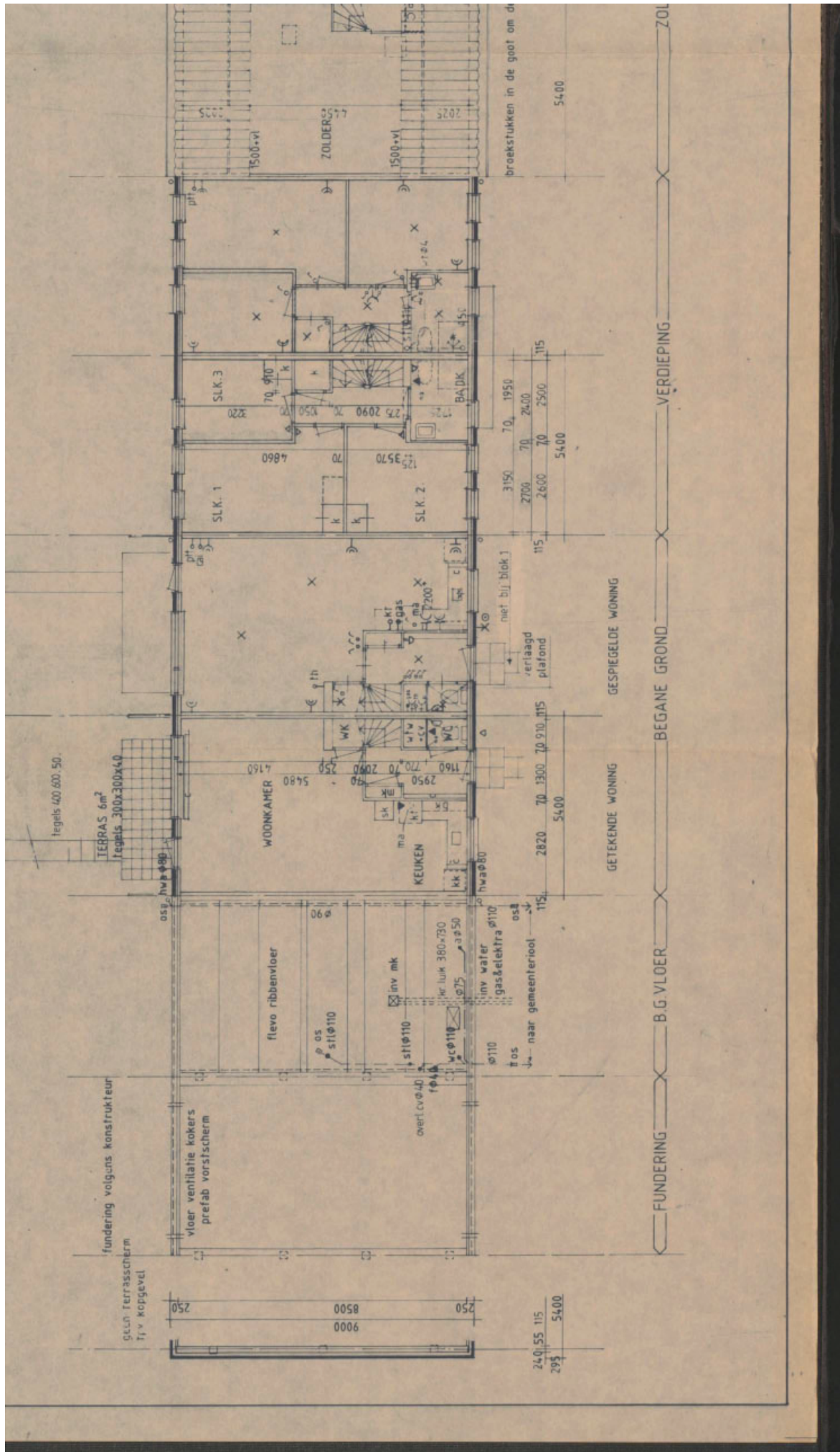




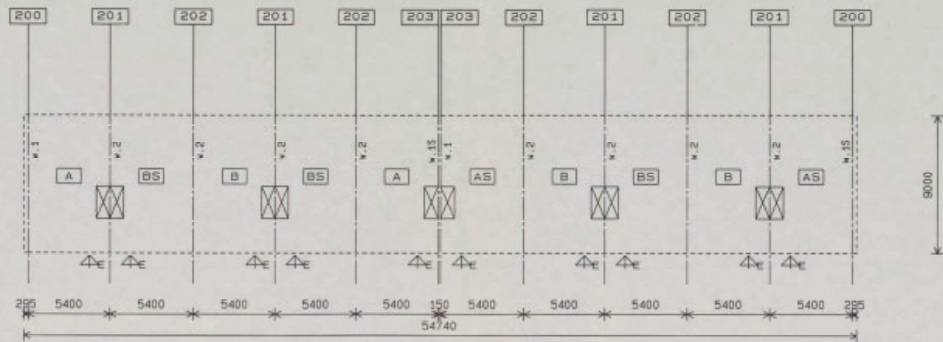












MATENPLAN 2e VERDIEPING BLOK 1

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