

# ENVIRONMENTAL FRIENDLY LIVING

A CONSCIOUS START FOR YOUNG PEOPLE IN THE CITY

Graduation project  
MSc Architecture  
Dutch Housing

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 **TU Delft**





# Content

- Research
- Design aspirations
- Concept
- Design
- Conclusion

## Research Main topics

- Housing for young starters
- Environmental friendly building

Young starters  
Motive



**Verloren generatie door  
tweedeling woningmarkt?**

Starter op woningmarkt hangt aan  
het infuus van zijn ouders

**De onzekere toekomst van  
starters: daar sta je dan, met  
je bul in de hand**

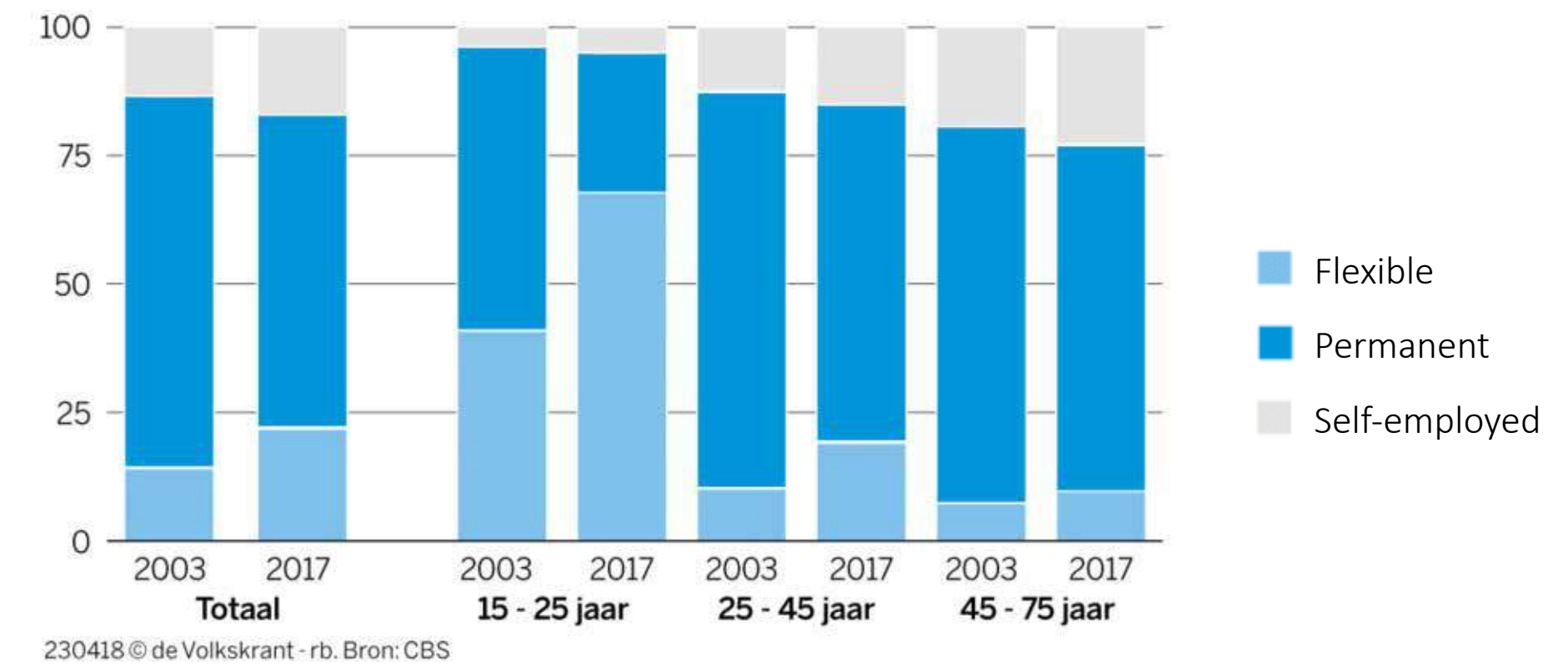
**'Starters op woningmarkt op  
dieptepunt'**



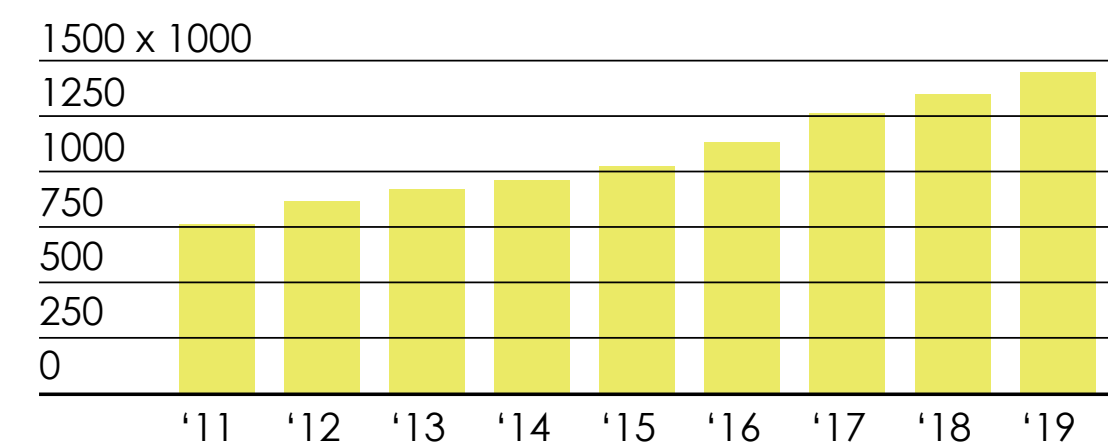
# Young starters

## Problem

- **Buying is impossible** because they don't get a mortgage
  - Flex contracts
  - Study debts
- **Social housing is unavailable** because either they earn too much or the waiting lists are endless
- **Public rental** sector, where the **supply does not suffice** and the **prices way too high**



Number of people with a study debt

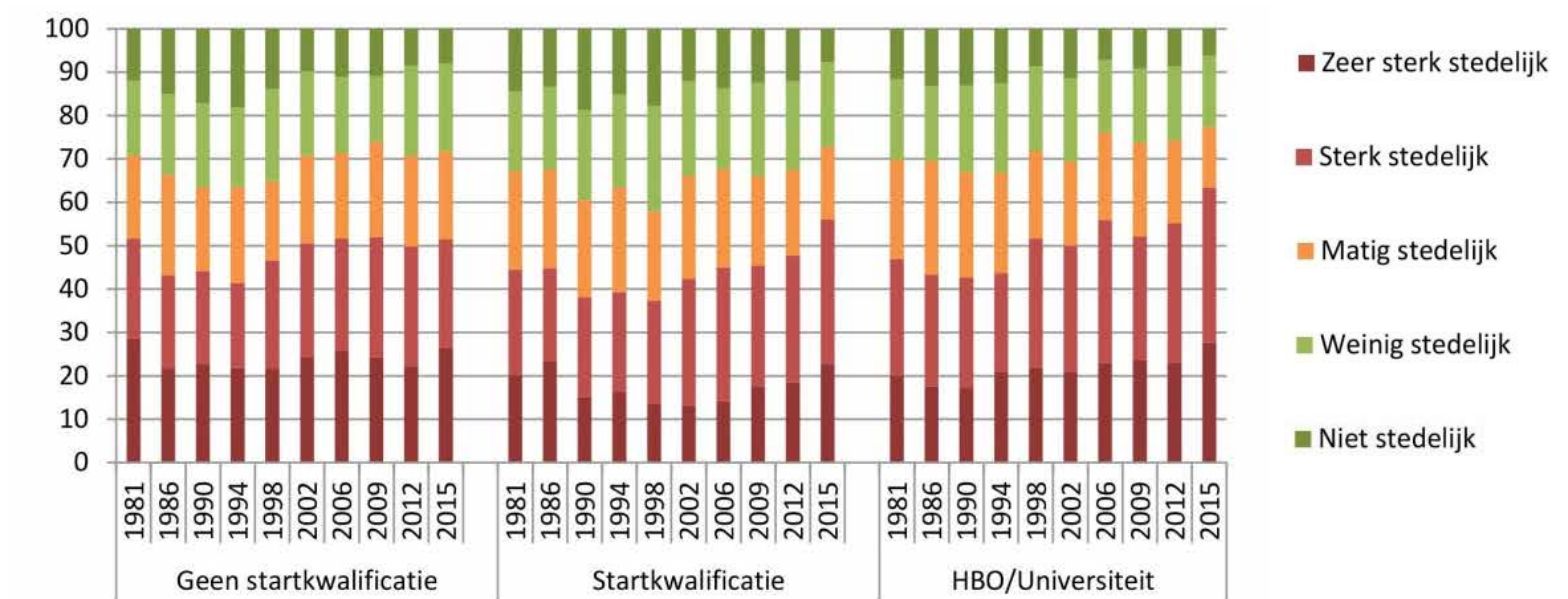
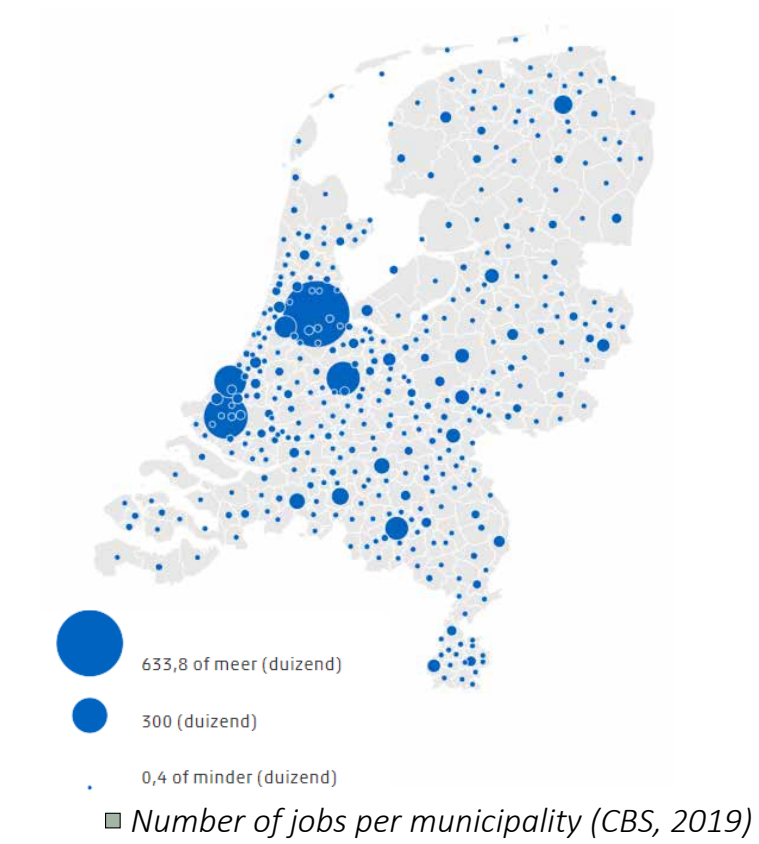


The past years, study debts have been rising. Especially since 2016, when the study compensation from the government was abolished.



## Young starters Characteristics

- Preference to live in the **city** because of **job opportunitie**
- Favour **liveliness** and the presence of **facilities**
- **Higher educated > dense urban environment**



■ Preferred living environment, according to education level (PBL, 2017)

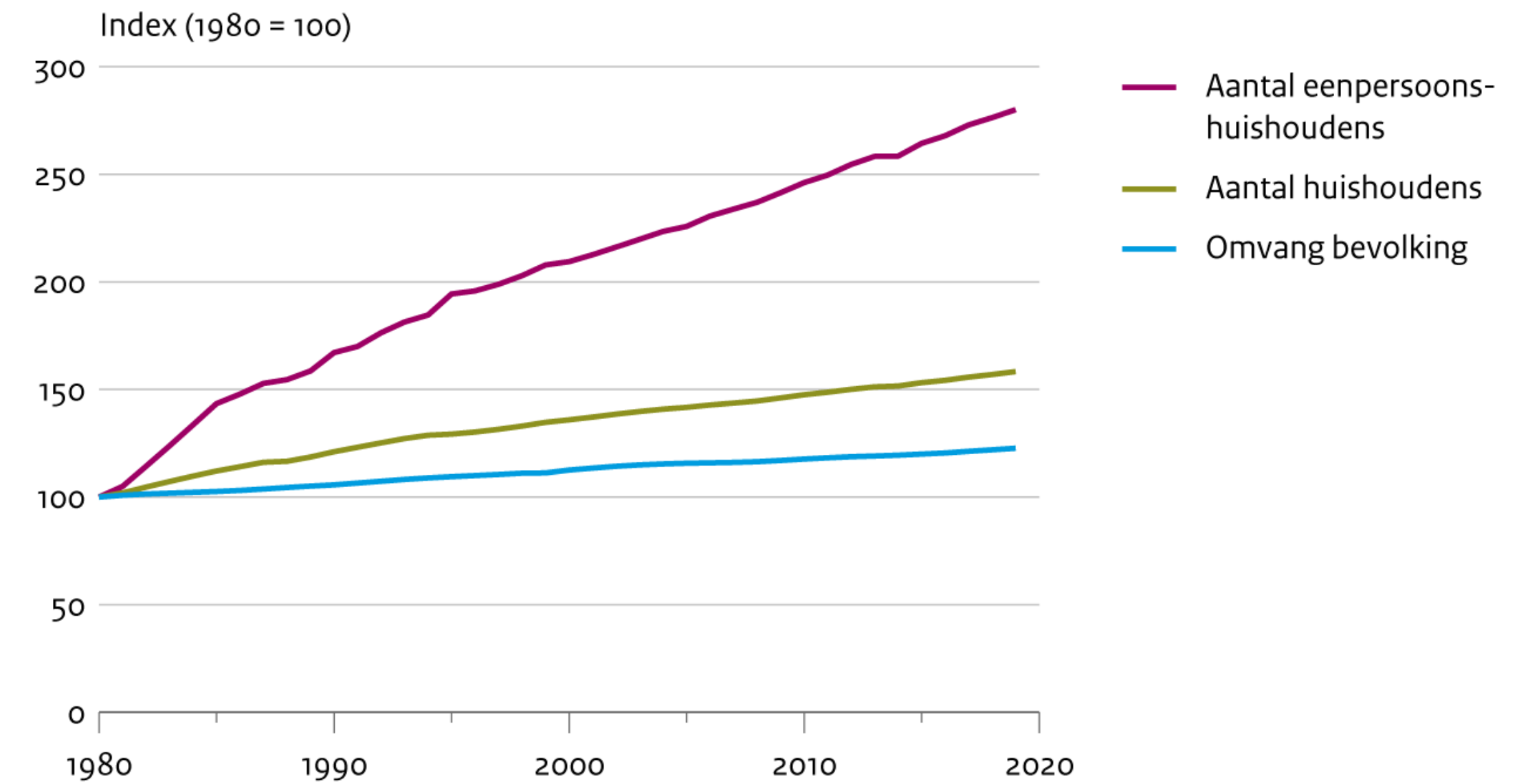


## Young starters

### Characteristics

- Young starters mostly live in a **small household**. This fits in the national trend of increasing number of small households

### Bevolkingsomvang en aantal huishoudens



Bron: CBS

CBS/mrt20  
[www.clo.nl/nl000120](http://www.clo.nl/nl000120)

### Small households



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



# Young starters

## Characteristics

- Lot of variety within the group
- Distinction on composition of household:

- Living alone



- Living together



- Young family





## Young starters

Housing characteristics

- **Survey:** inquiry of information about preferences
- **Case studies:** examples of projects in the Netherlands



# Young starters

## Housing characteristics

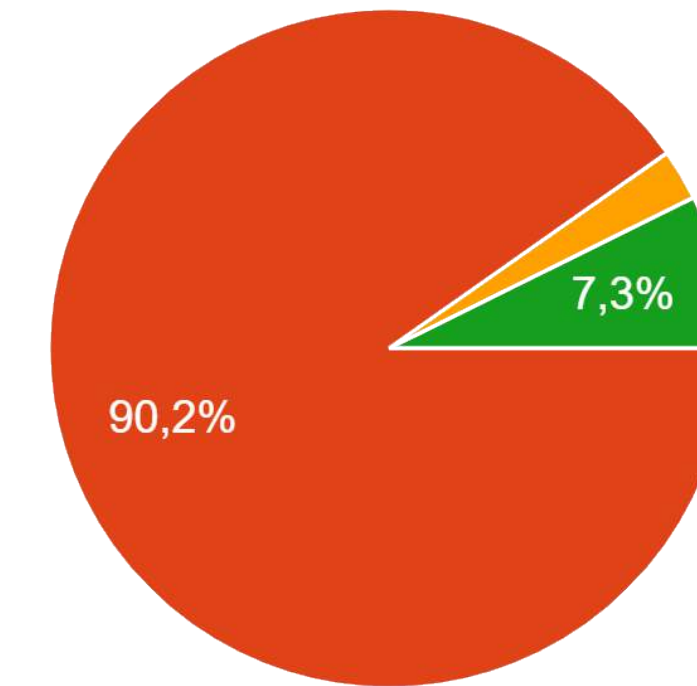
- Topics:

- Housing preferences
- Mixed living with families
- Layout and privacy
- Collective facilities

41

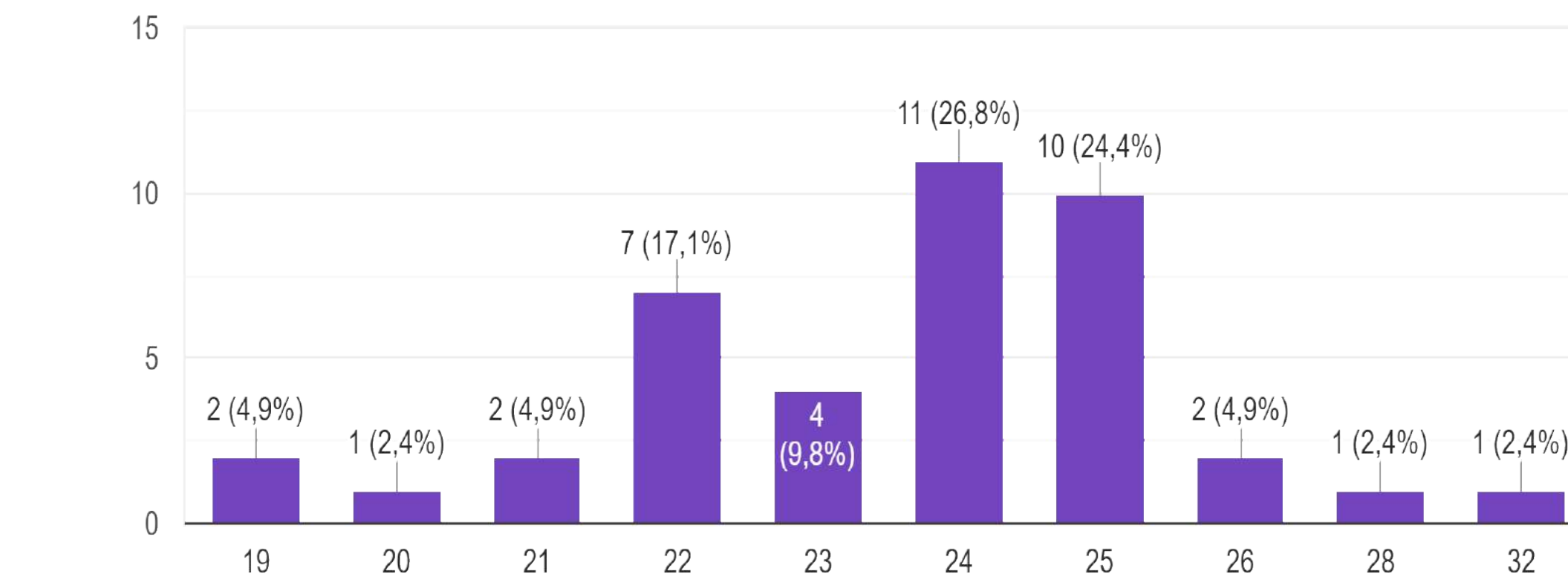
PARTICIPANTS

■ Number of participants



■ Phase in life

- University student
- Graduated unemployed
- Graduated employed



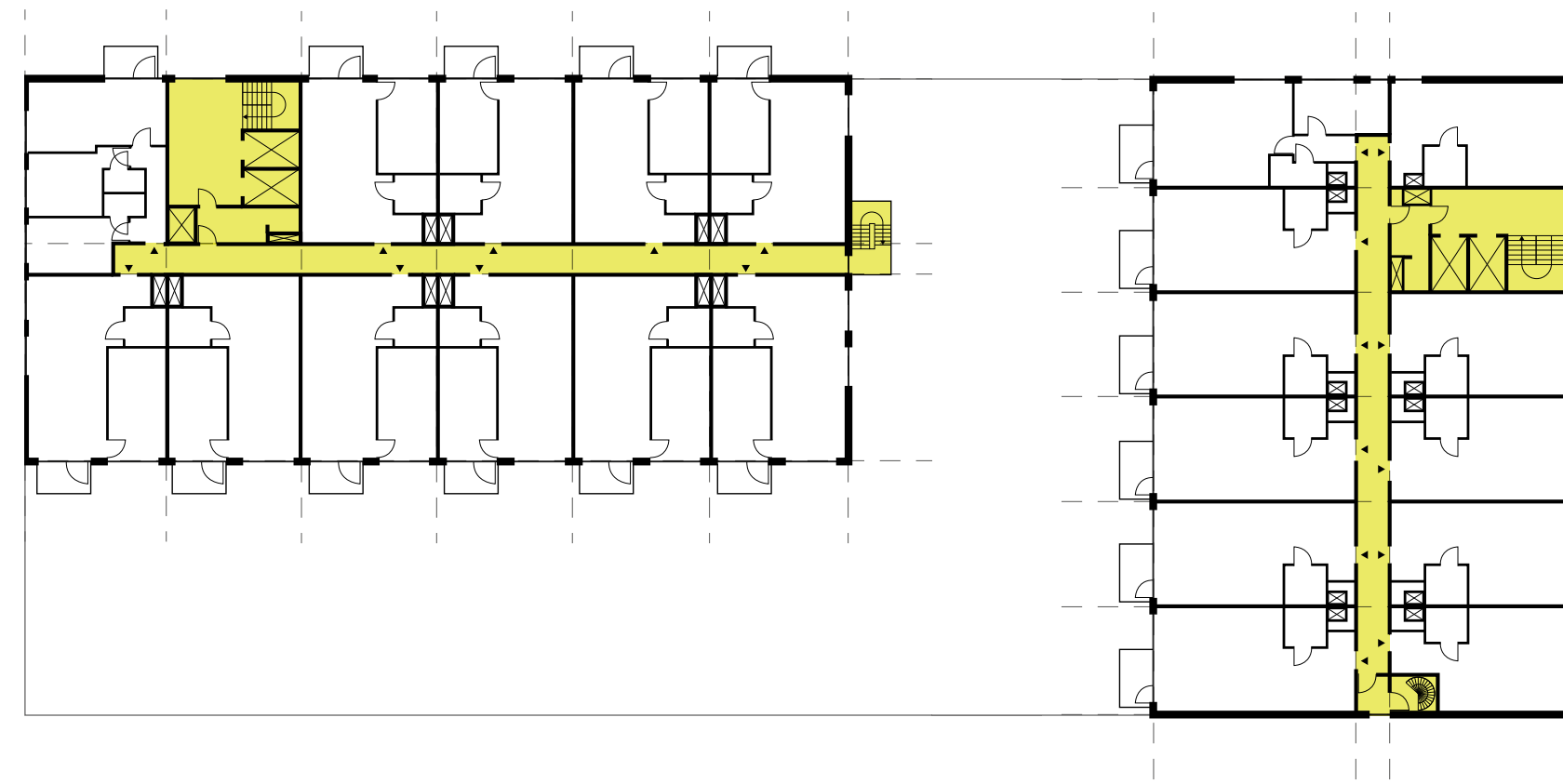
■ Age range of the participants



## Young starters Housing characteristics

- Topics:

- Dwelling types
- Bay widths
- Circulation and accessibility



# Young starters

## Housing characteristics

- Results:

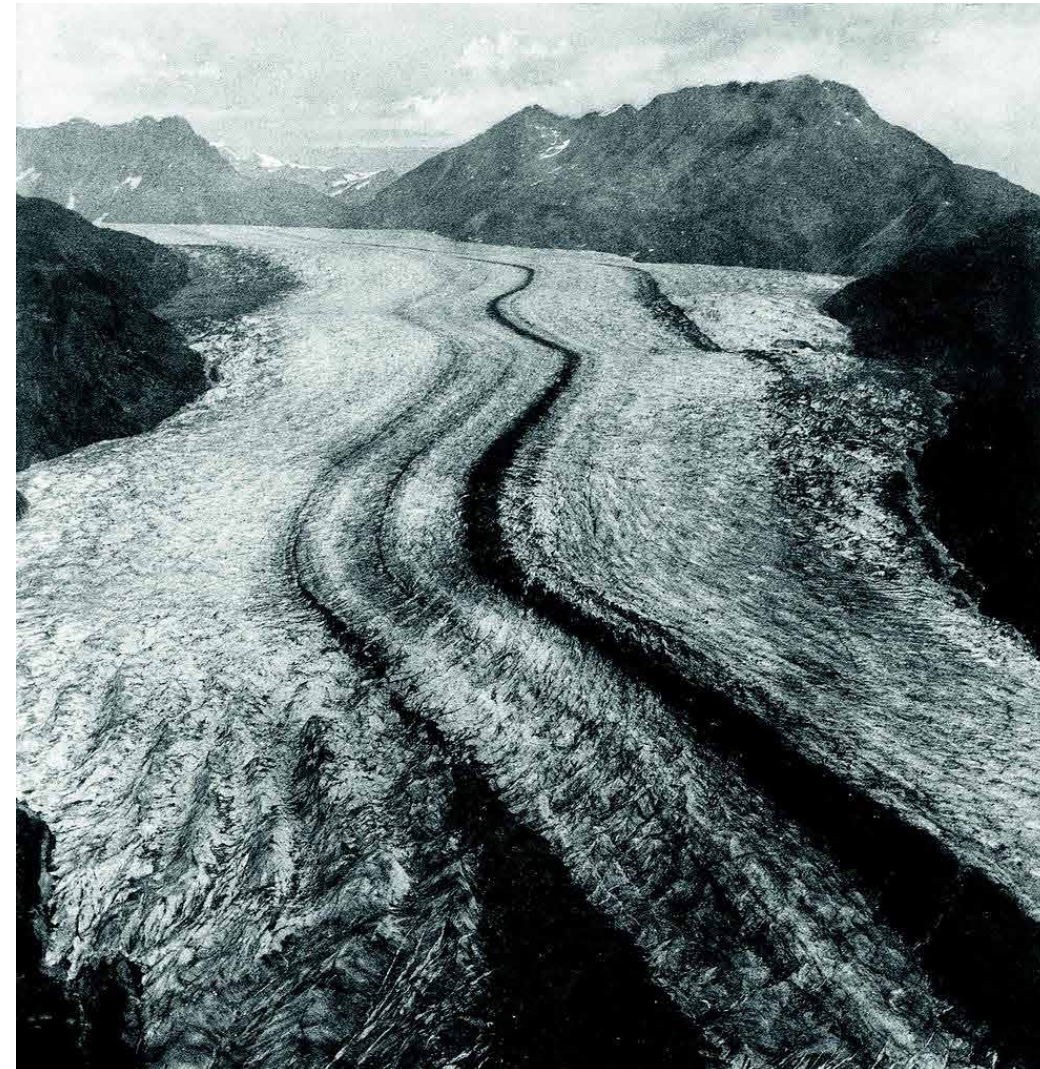
- independent dwellings very important
- collective facilities have added value
- dwellings may be compact
- privacy important when living together
- (green) outside space highly valued



# Environmental friendly building

Motivation

- Rising temperatures
- Rising sea-level
- More extreme wheather (longer dry periods and more heavy rainfall)
- Decreasing biodiversity
- Scarcity of materials



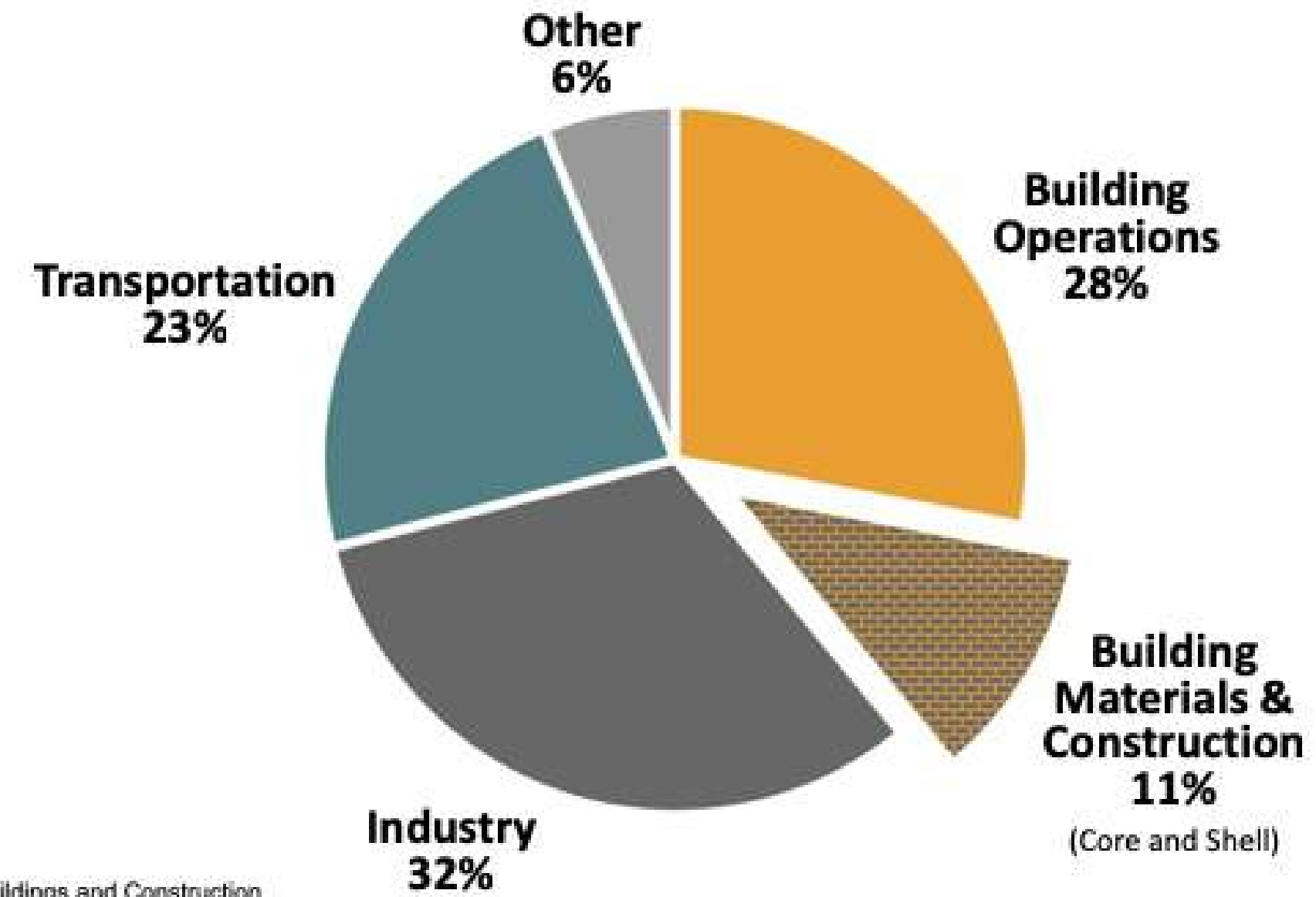


# Environmental friendly building

Relevance

- Large impact of the building sector
  - CO<sub>2</sub> emissions
  - Material use
  - Repression of nature

### Global CO<sub>2</sub> Emissions by Sector



Source:  
Global Alliance for Buildings and Construction.  
2018 GLOBAL STATUS REPORT.



# Environmental friendly building

Relevance

- Adapting built environment
  - Using sustainable materials
  - Water retention
  - Decreasing temperature in the city
  - Increasing biodiversity



# Environmental friendly building

Awareness

- Awareness increases attention and motivation
- Young people
  - Are affected the most by consequences
  - Have the most influence on the environment



# Design aspirations



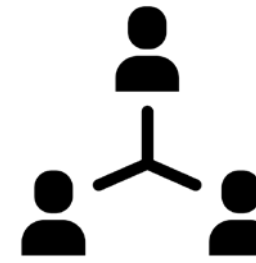
ENVIRONMENTAL-FRIENDLY BUILDING



VARIETY OF DWELLINGS



INDEPENDANT DWELLINGS



CASUAL COLLECTIVITY

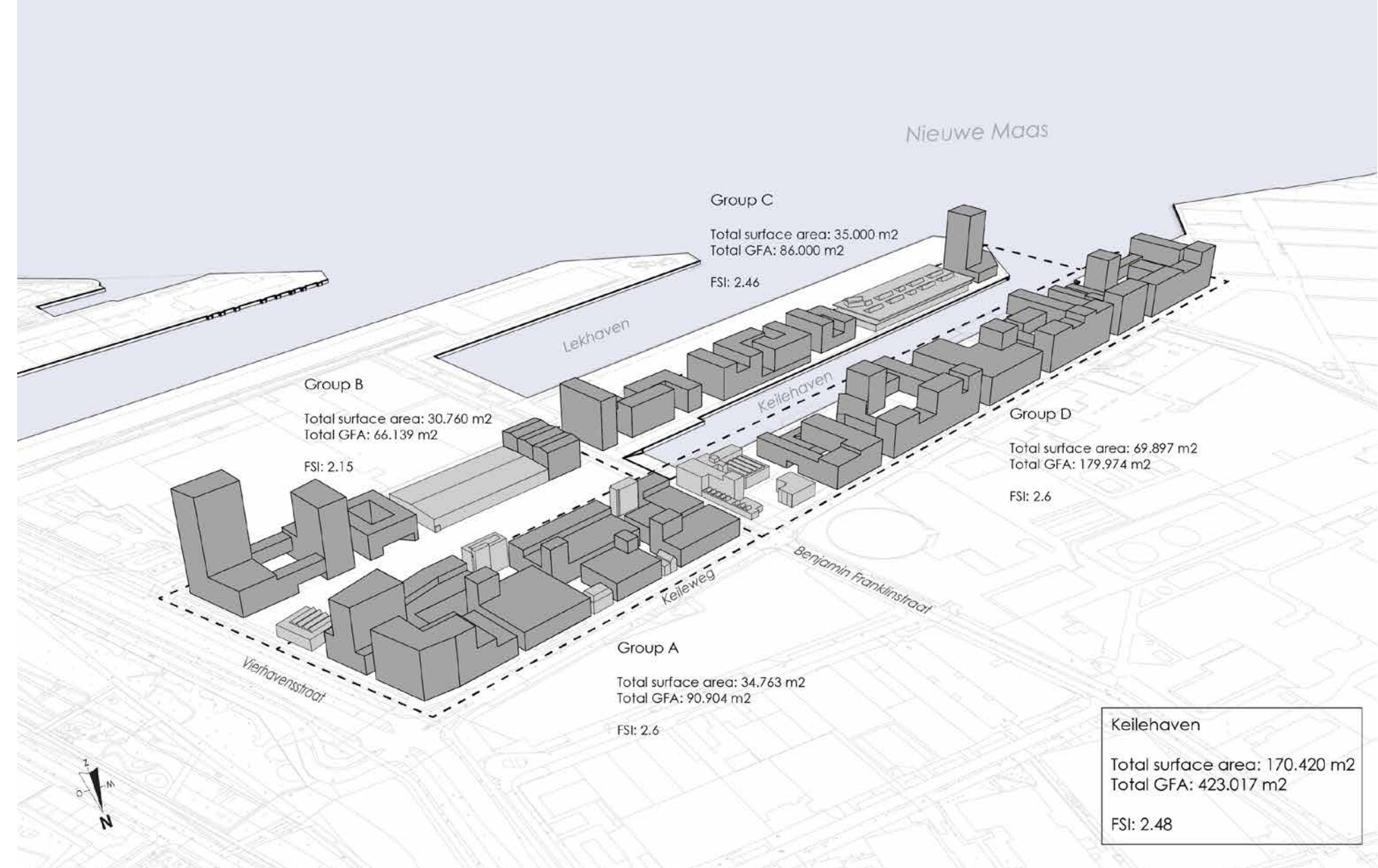


AFFORDABLE



# Location

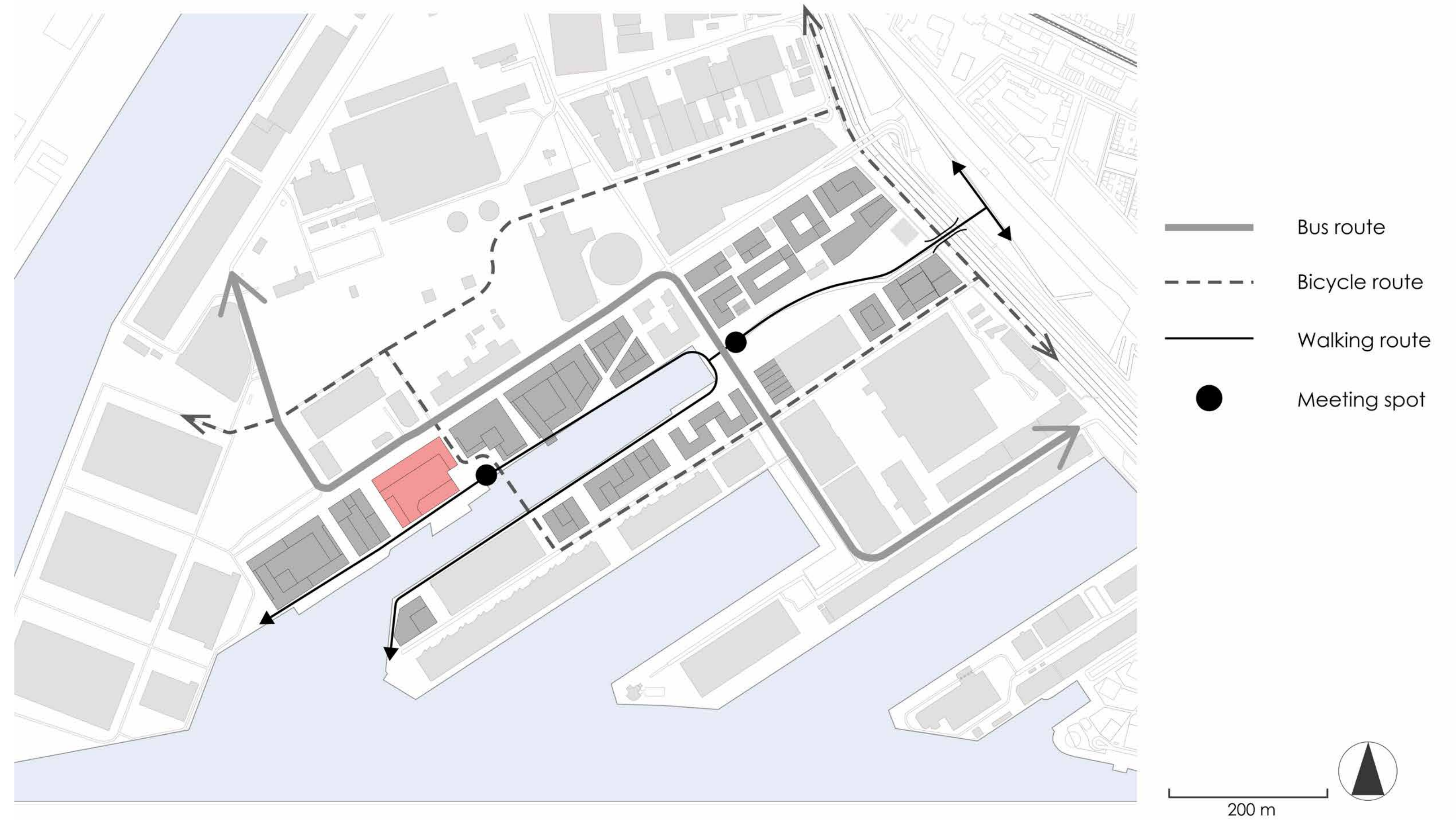
- Merwe-Vierhavens, Rotterdam
- Harbour harbour area that in the coming decades will be transformed into mixed housing and working area
- Urban plan designed with the graduation studio
  - High density
  - Large building blocks





# Building plot

- Located in western part
- Large plot in urban plan
- Located at a node in the area





## Building plot

- Vivid location
- Next to public square
- Bicycle route
- Keilehaven

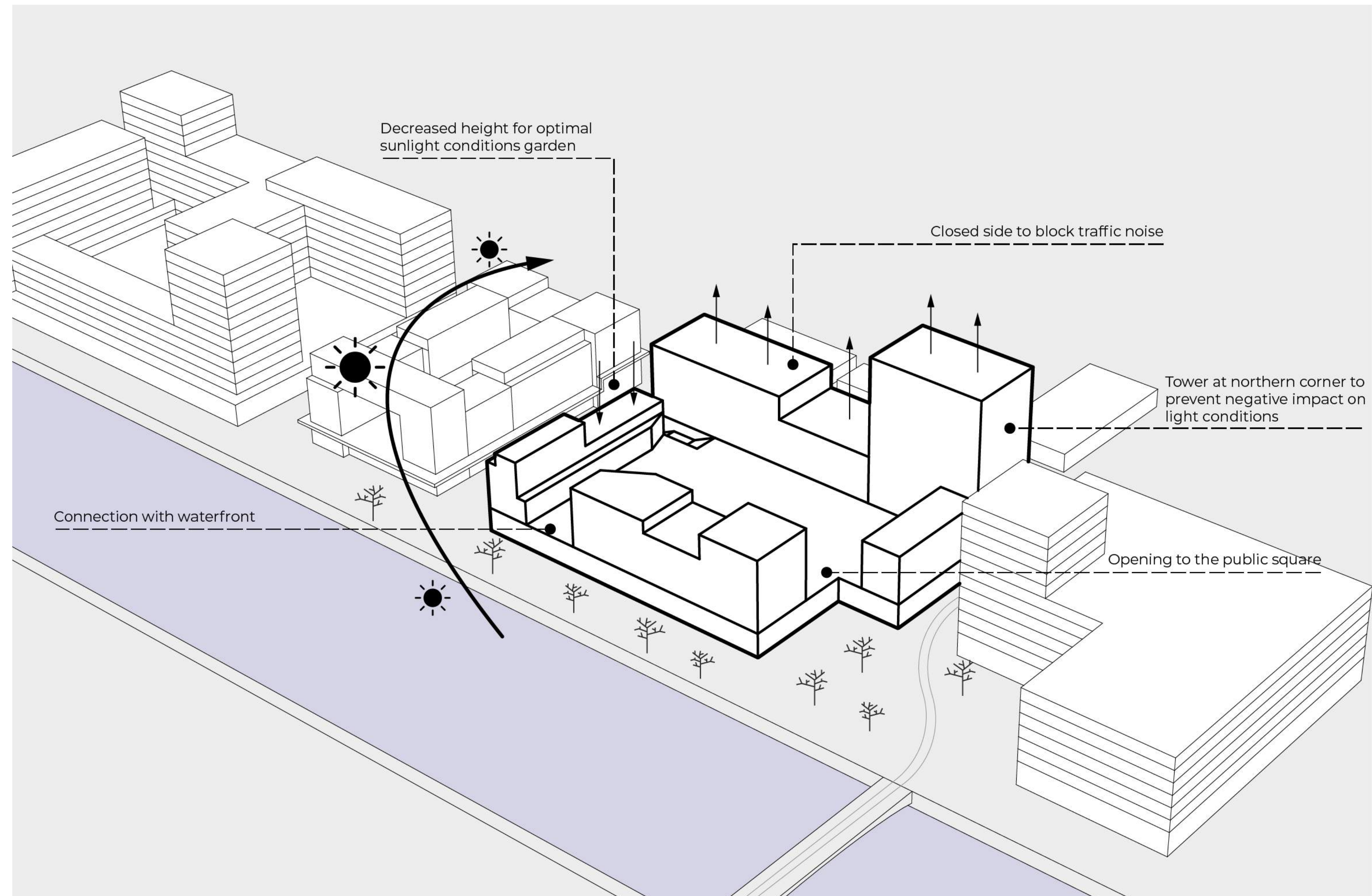




# Building mass

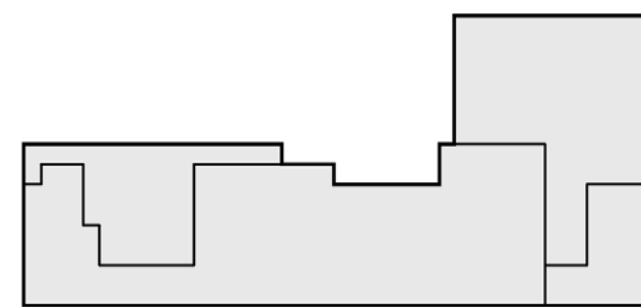
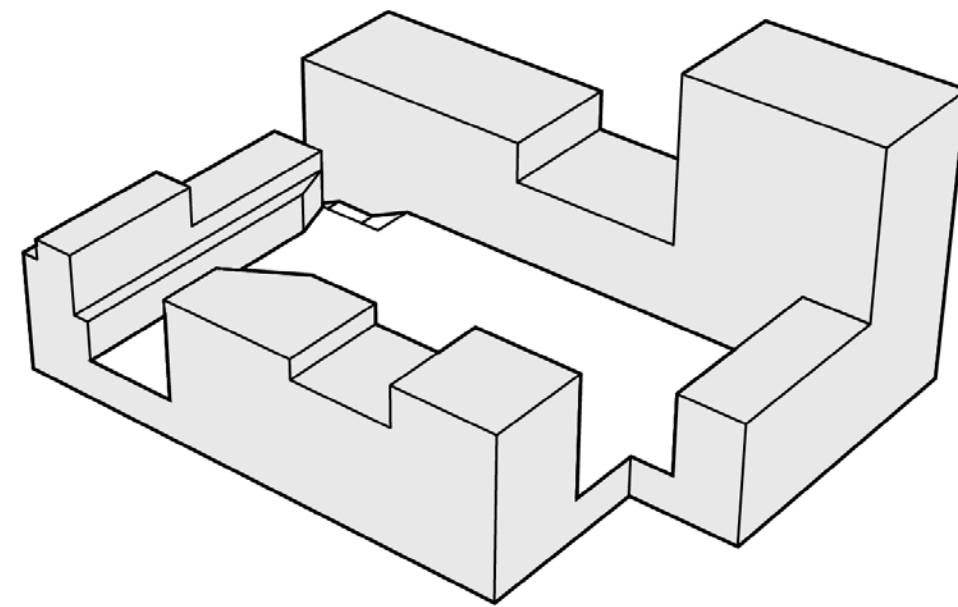
Reaction on context

- Plinth with blocks on top
- Openings in between the blocks for daylight and a connection with the context
- Closed side north-west to prevent nuisance Keileweg
- Lower on south-west for sunlight afternoon in the inner courtyard, high tower at northern corner

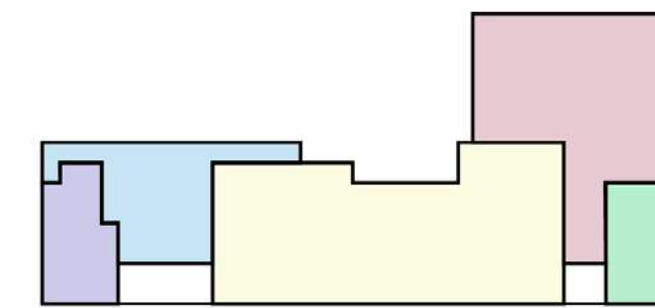
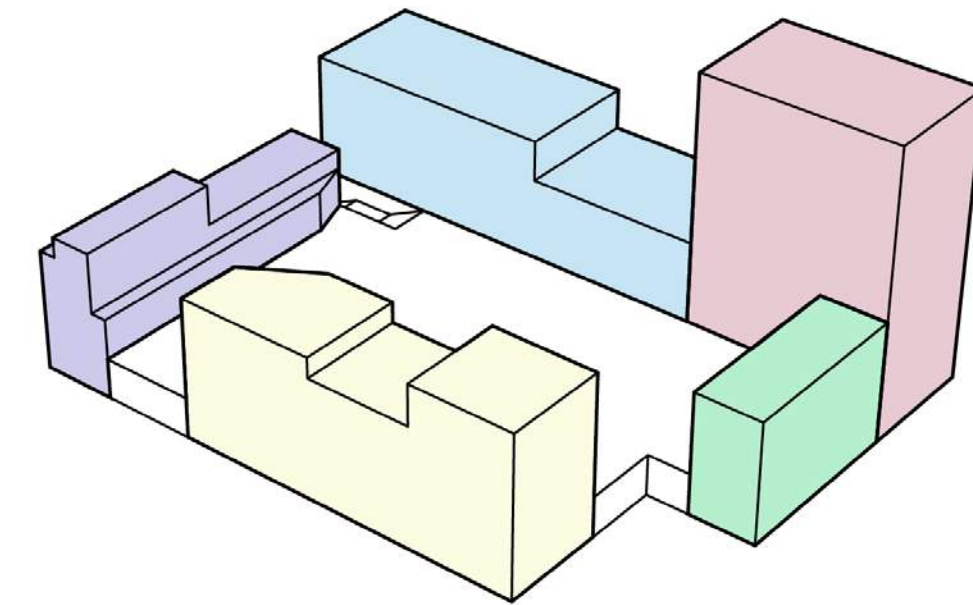


# Building mass

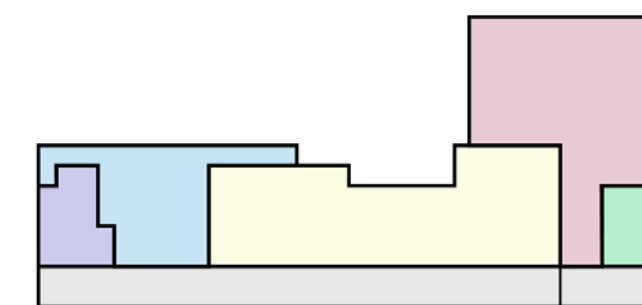
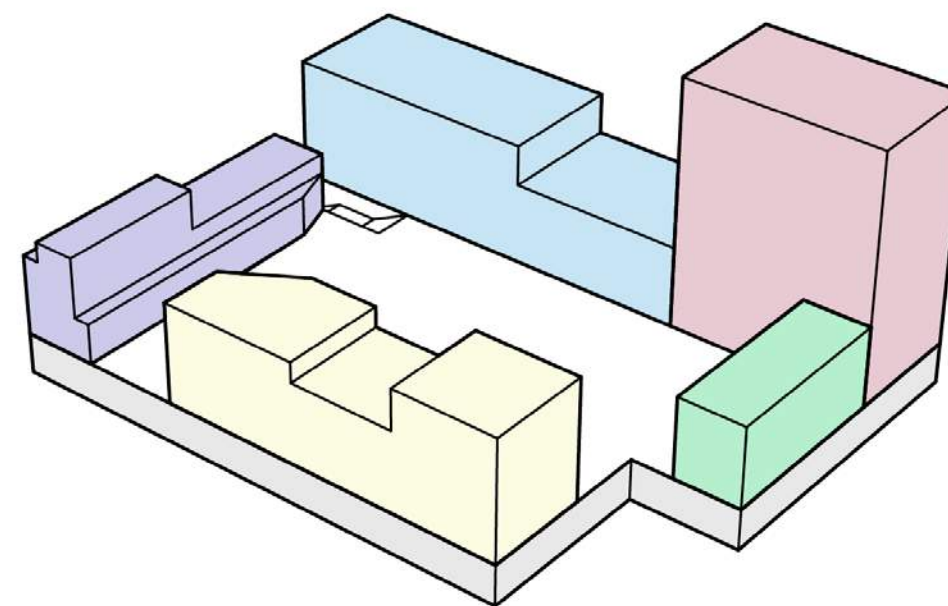
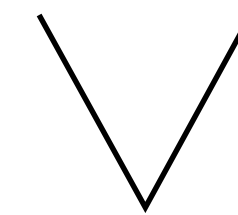
Architectural composition



■ *Monolith*



■ *Seperate volumes*

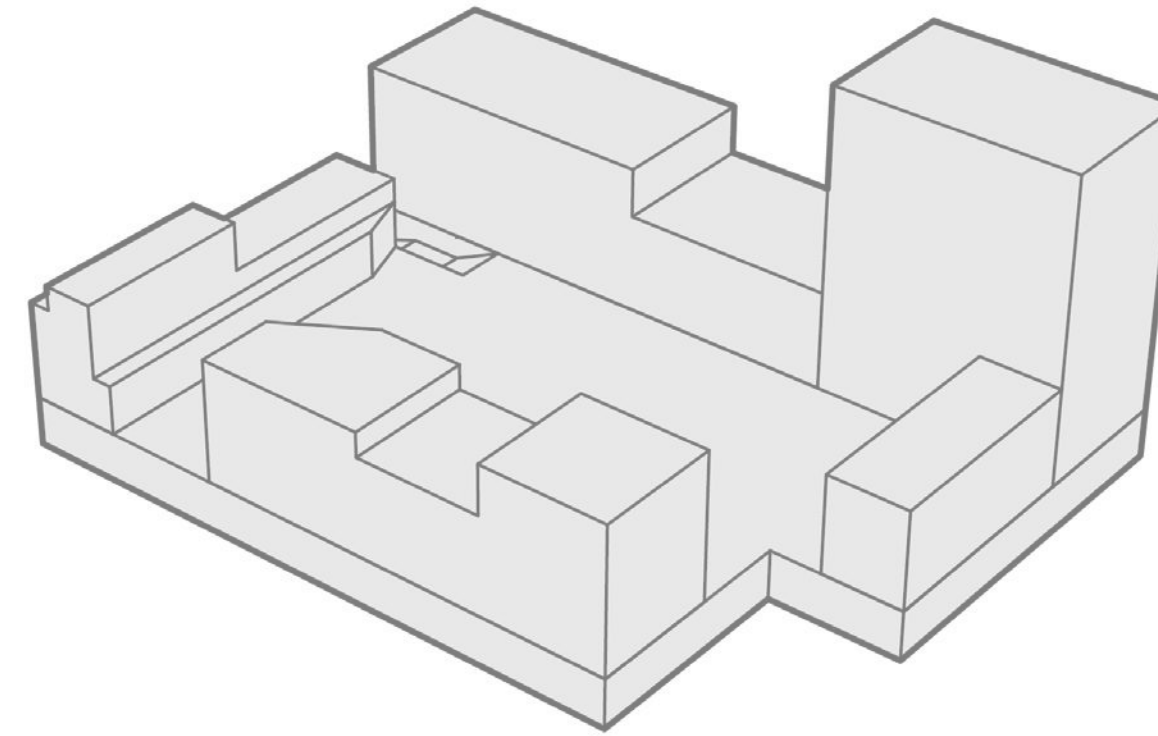
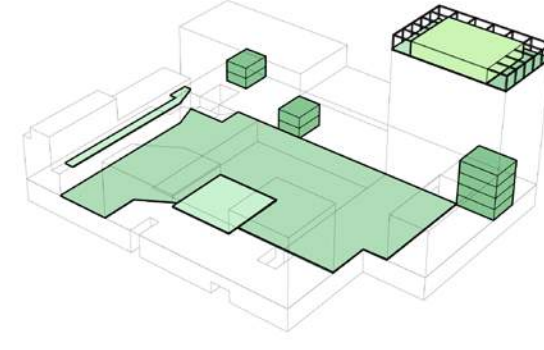
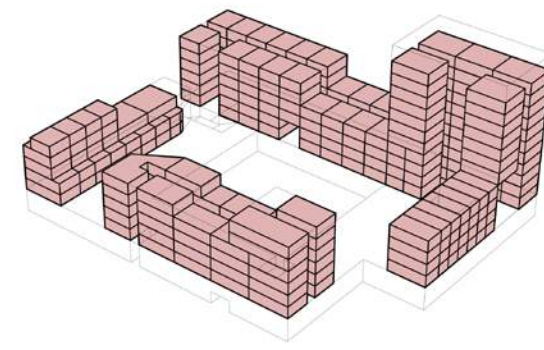
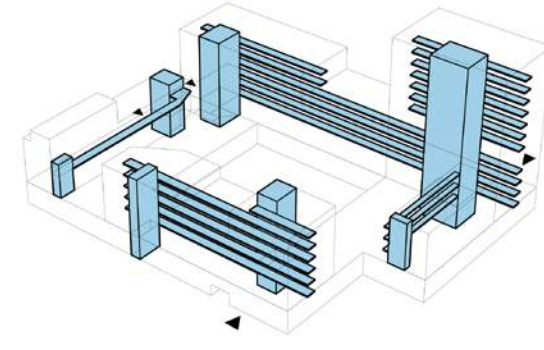
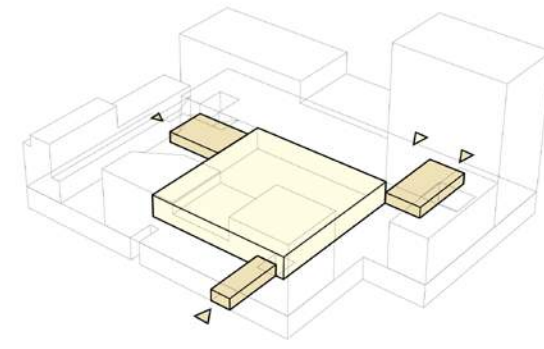
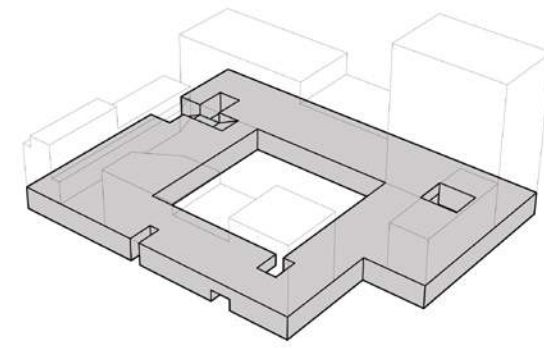


■ *Volumes on top of a connecting base*



# Building scheme

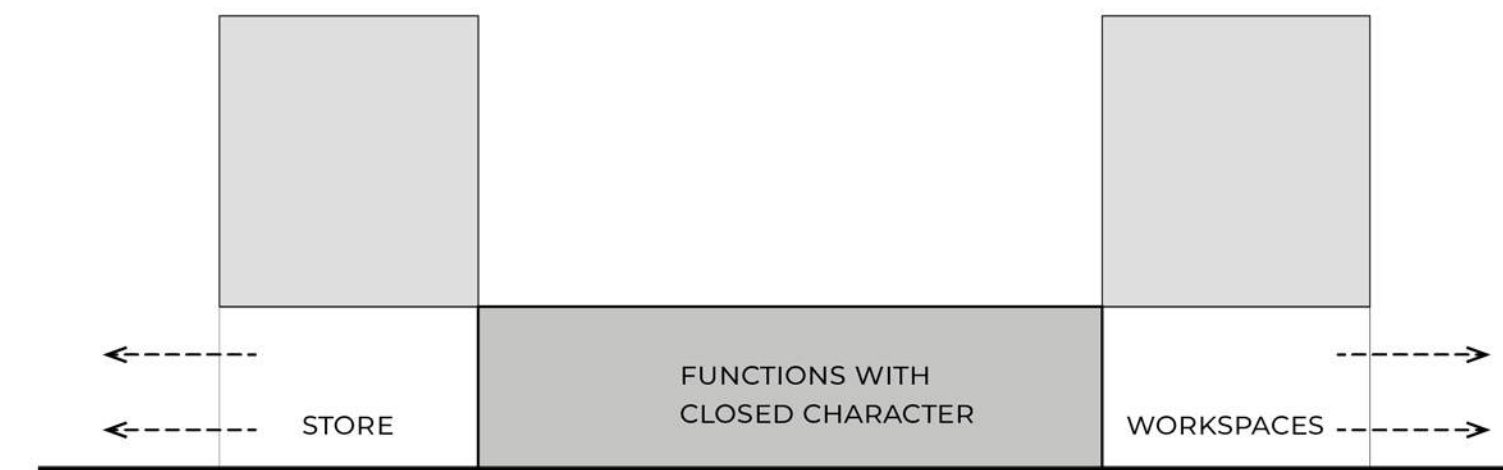
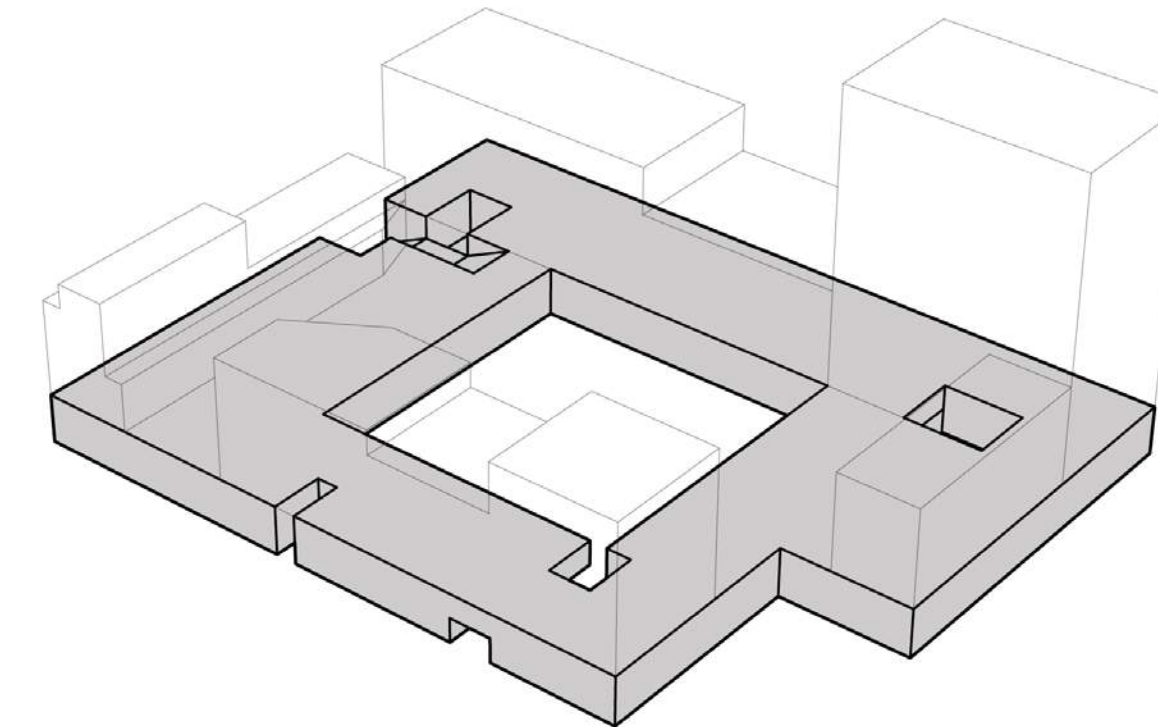
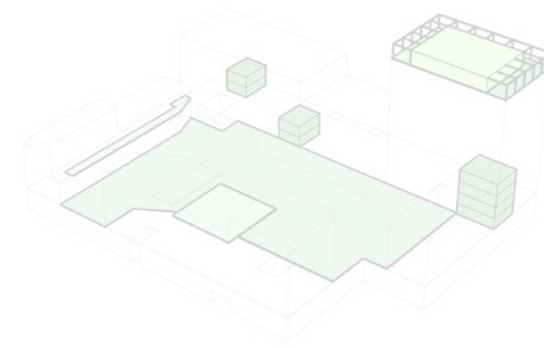
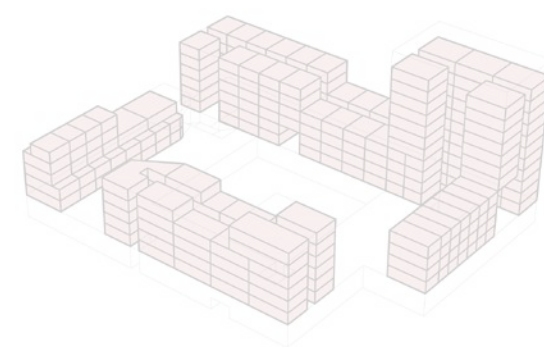
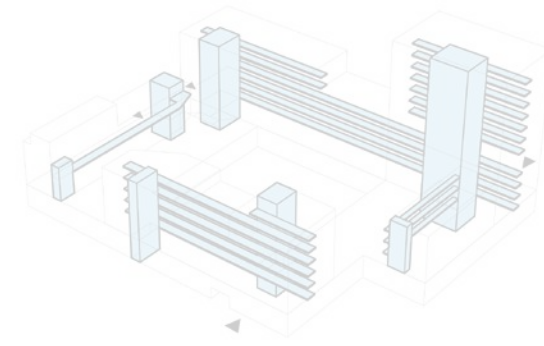
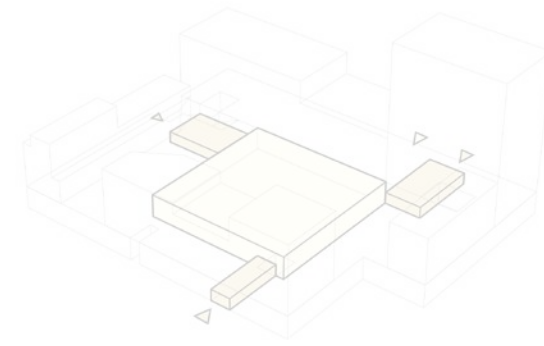
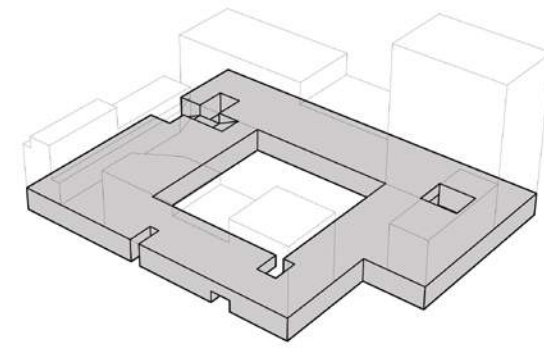
Overview



# Building scheme

Commercial plinth

- Contributes to vivid urban area
- Adds facilities to high density area on a prime location
- Transparant facade, interaction with surroundings and improvement of quality of the public space

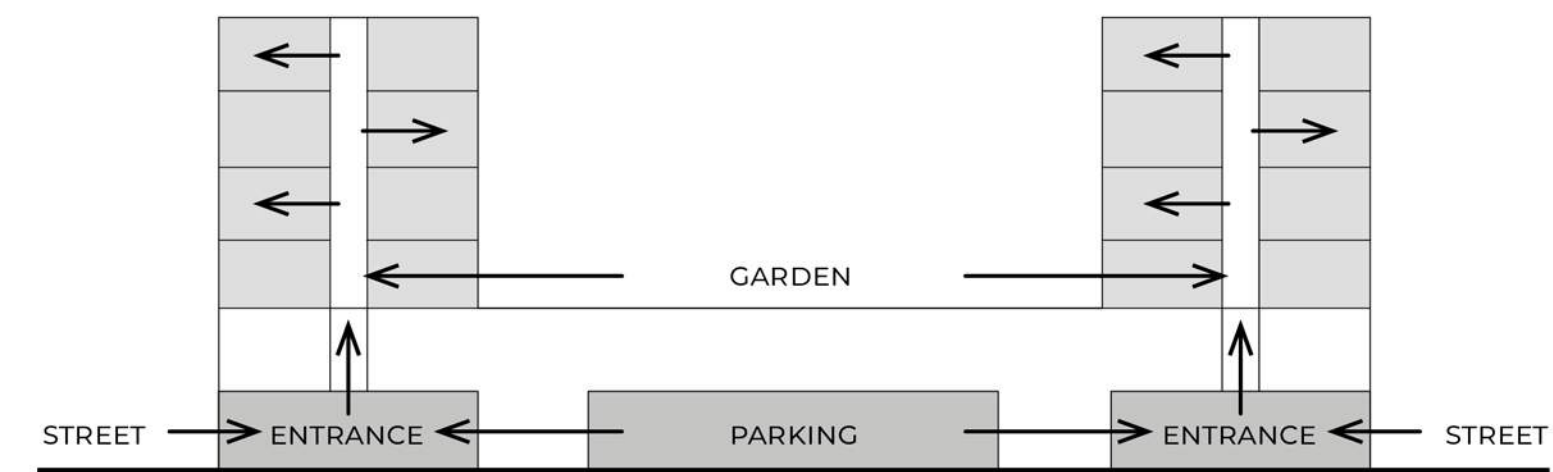
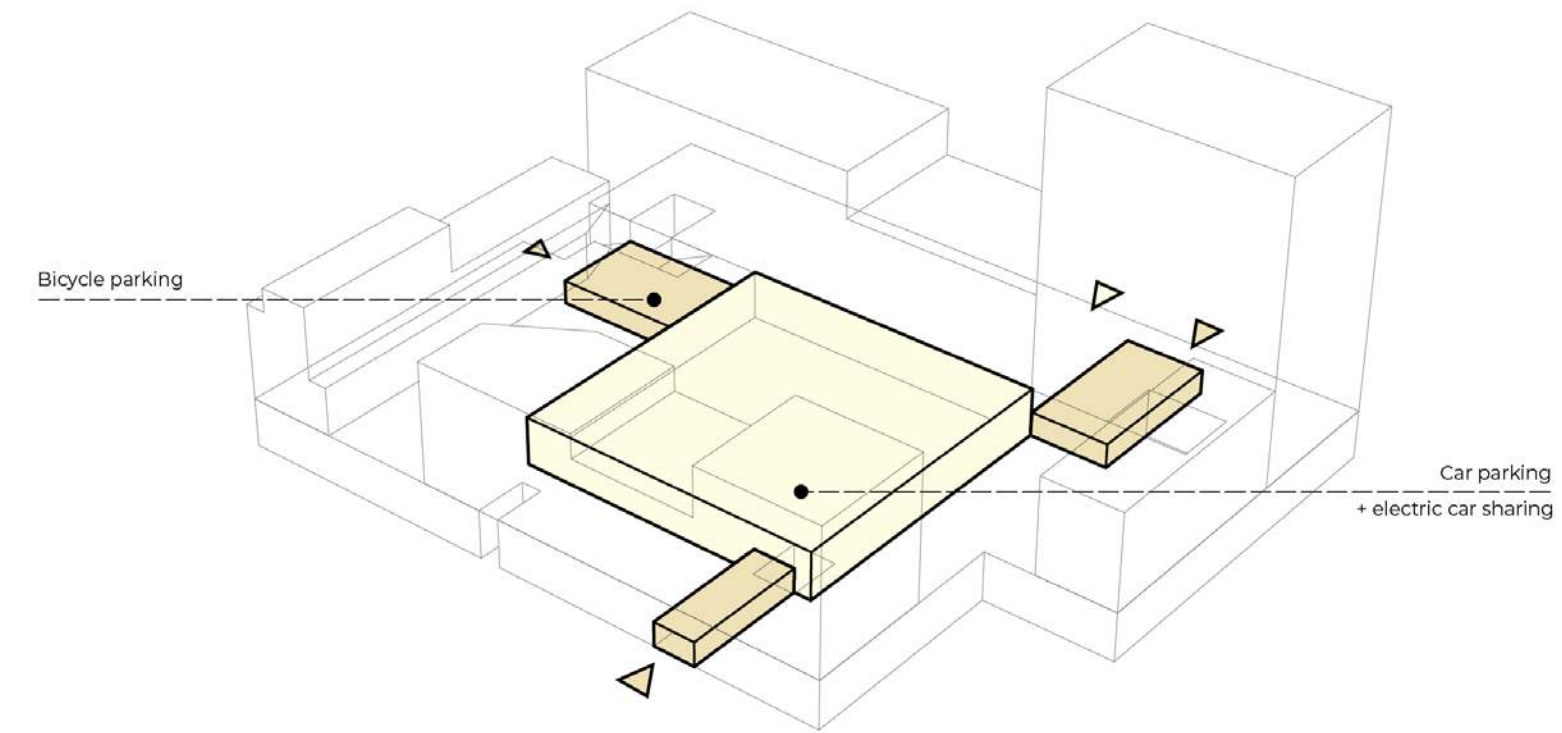
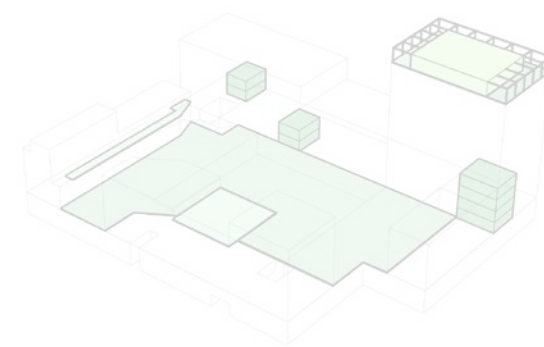
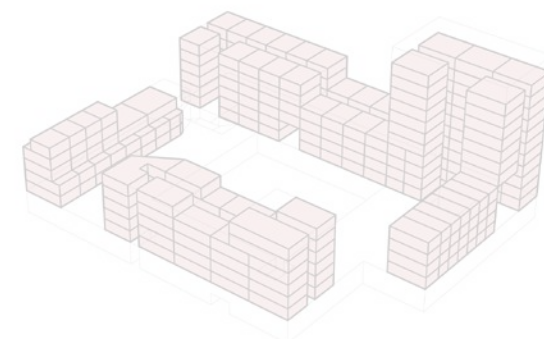
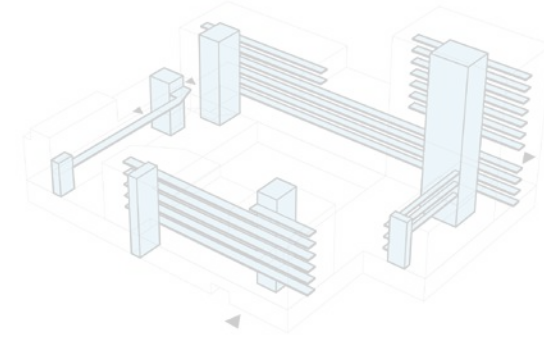
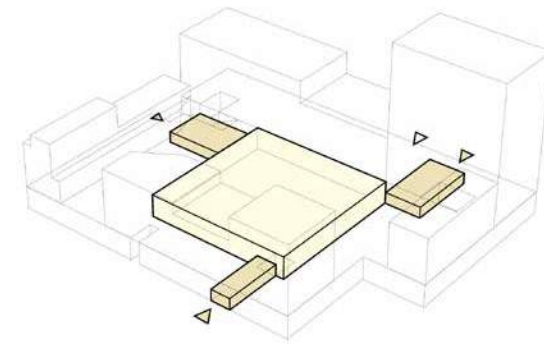
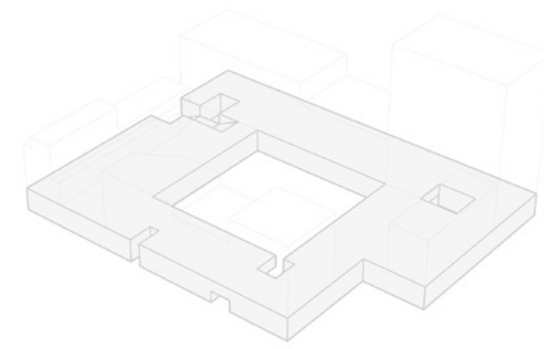




# Building scheme

## Parking

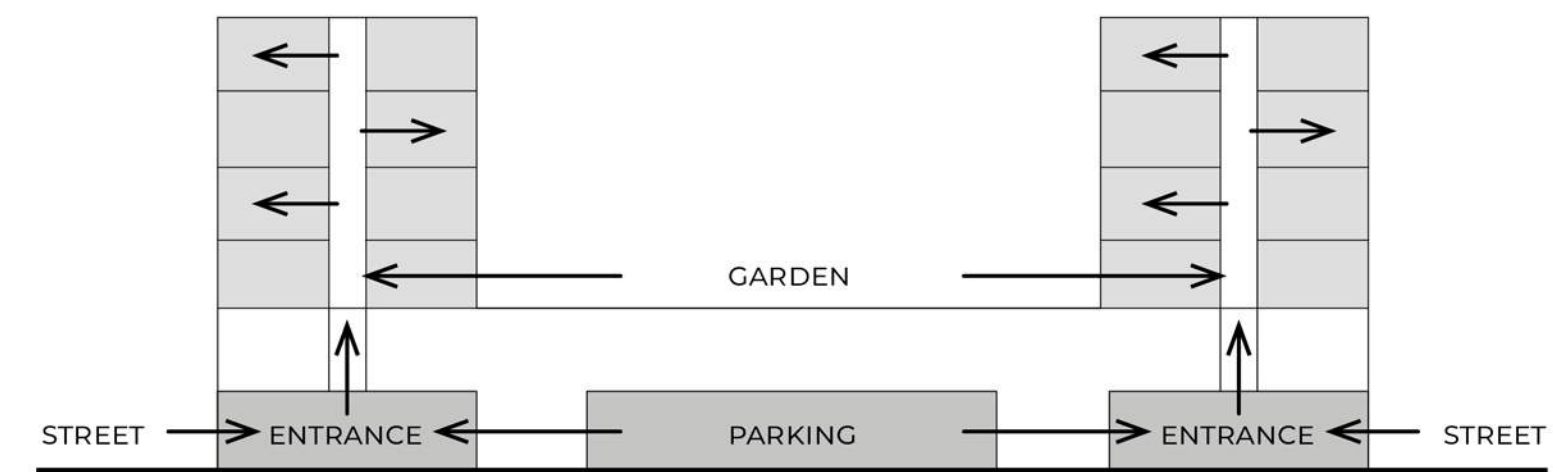
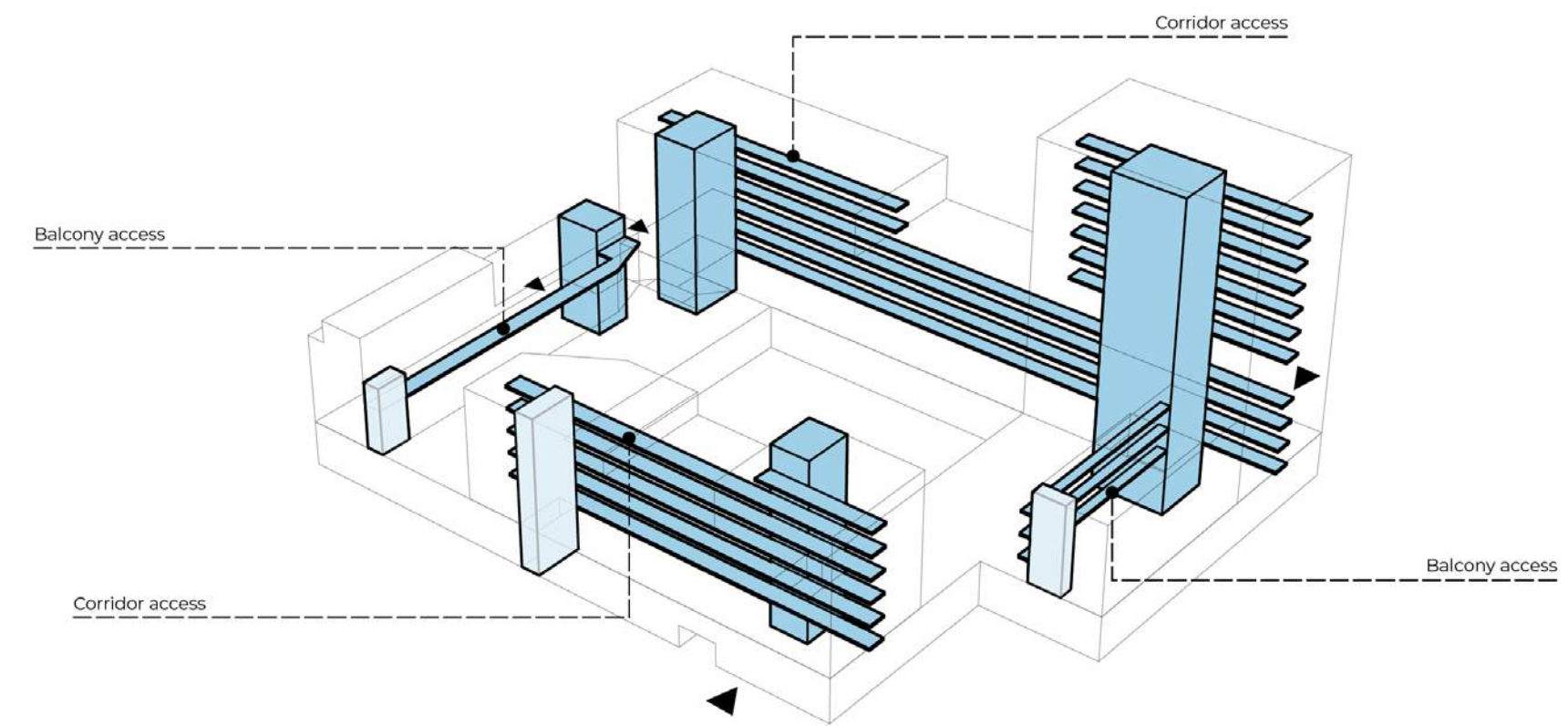
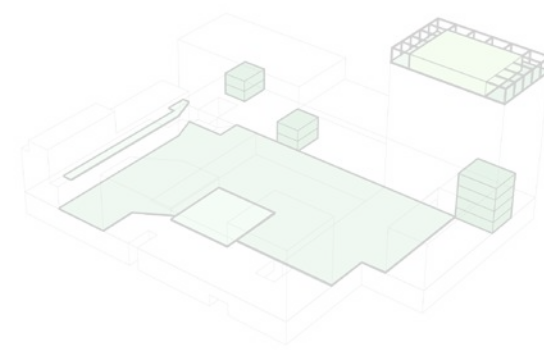
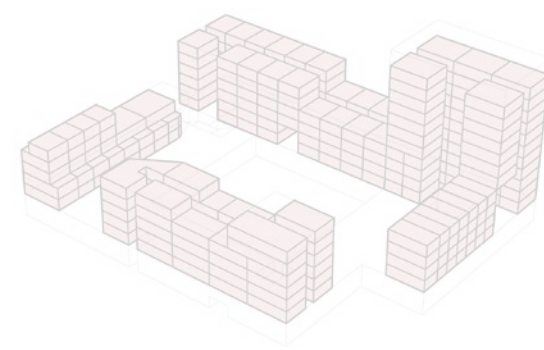
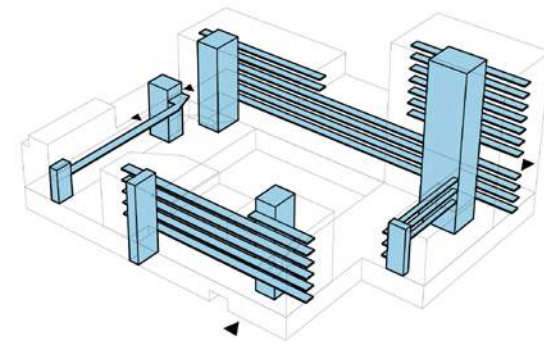
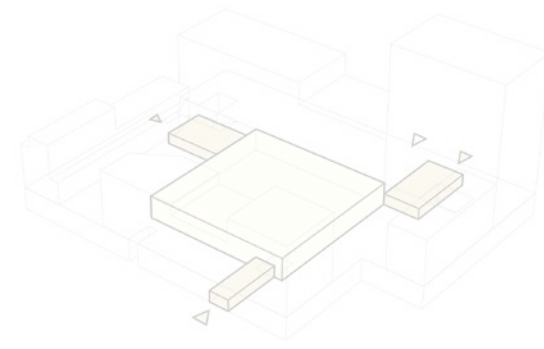
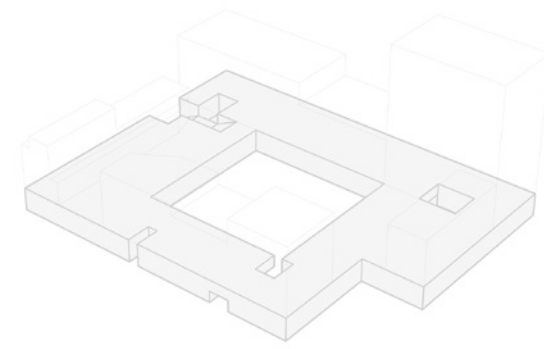
- Parking garage with private parking and shared electrical cars
- Bicycle parking for all residents, adjacent to the entrance to their home



# Building scheme

## Circulation

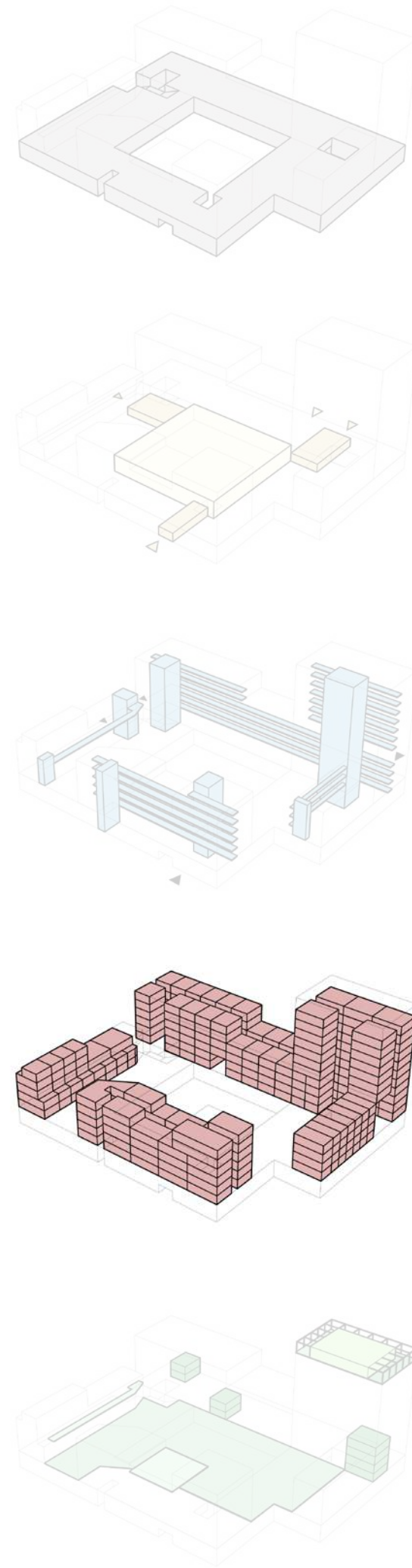
- Four entrances leading from the street to the residential blocks
- Combination of corridor access and balcony-access
- Access to all blocks on raised courtyard



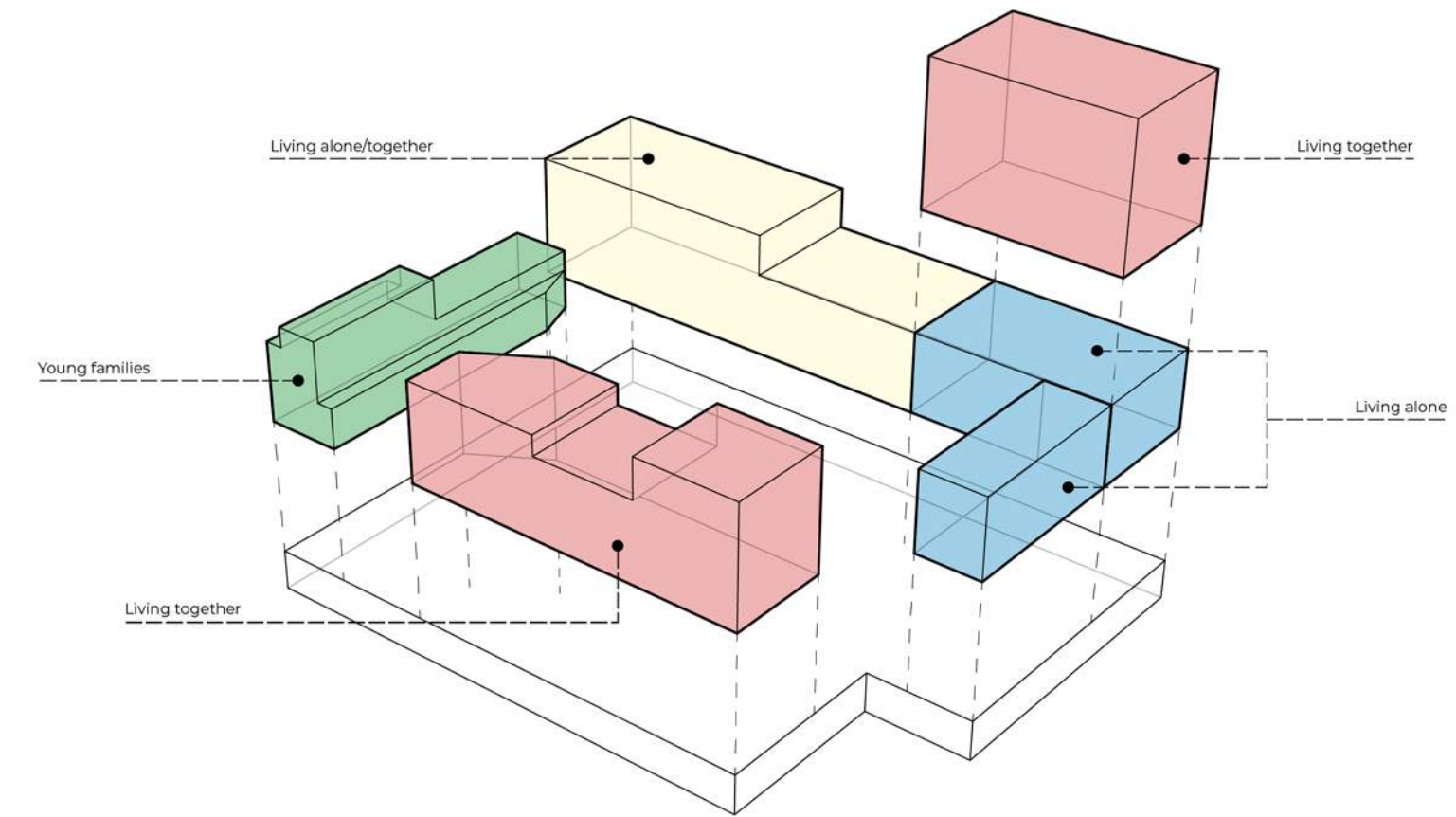


# Building scheme

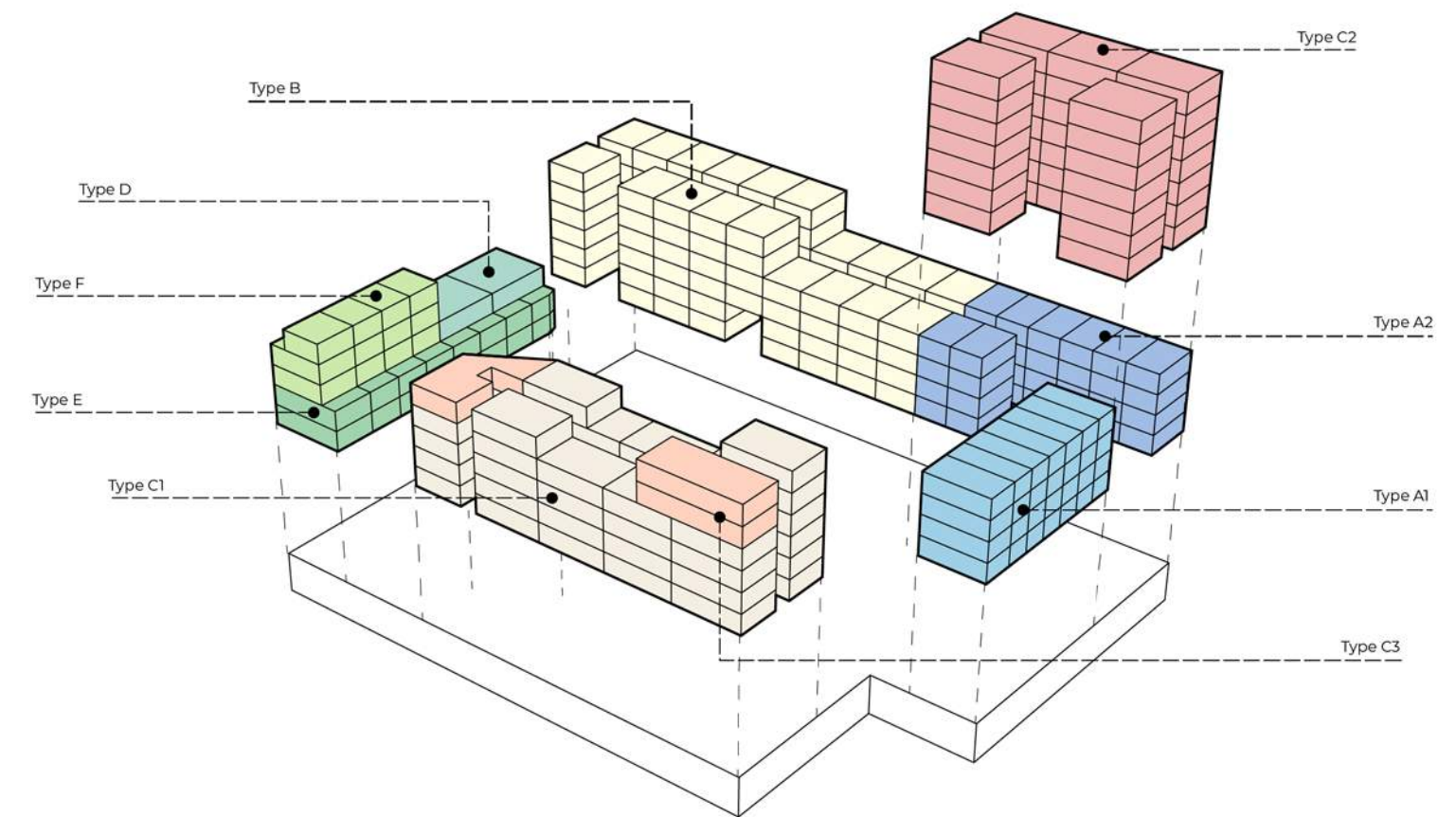
## Dwellings



General configuration



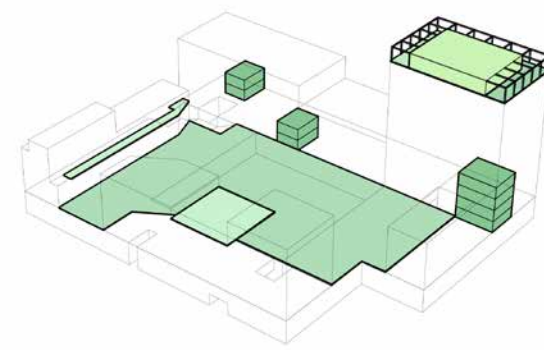
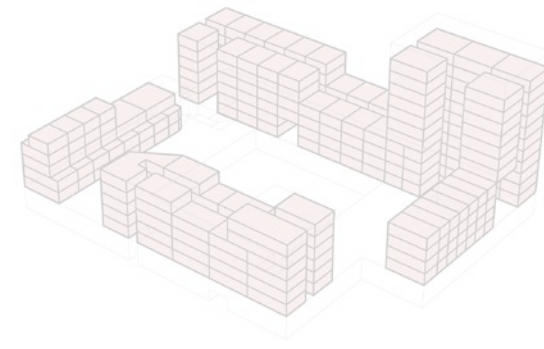
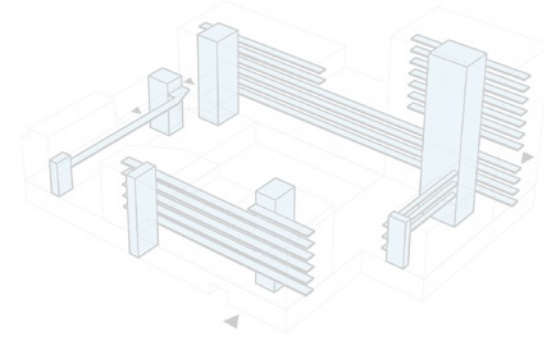
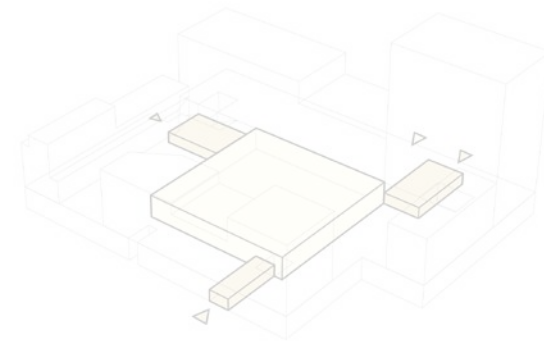
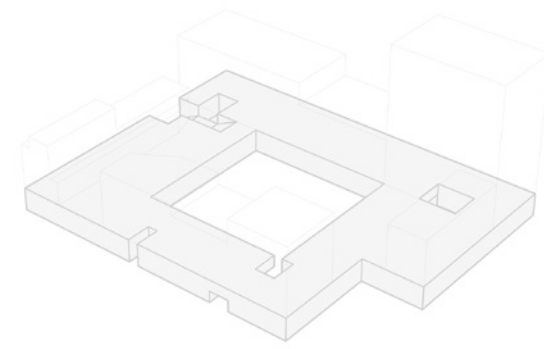
Detailed configuration



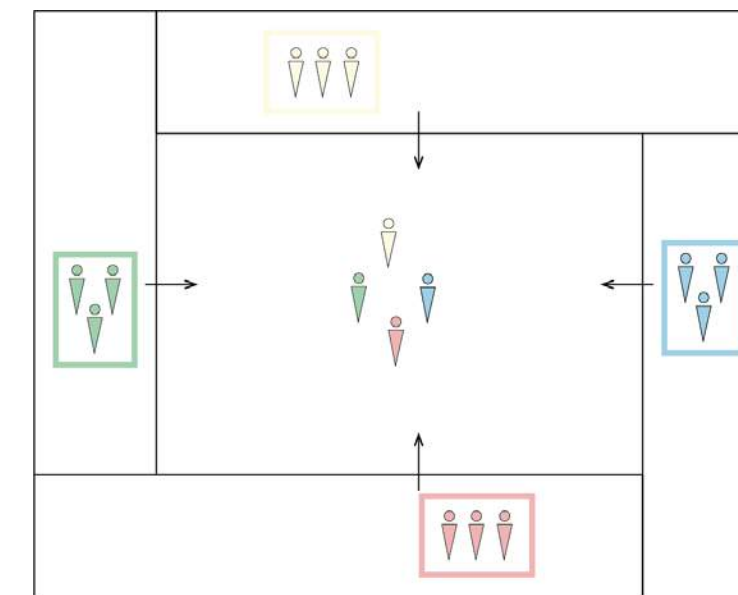
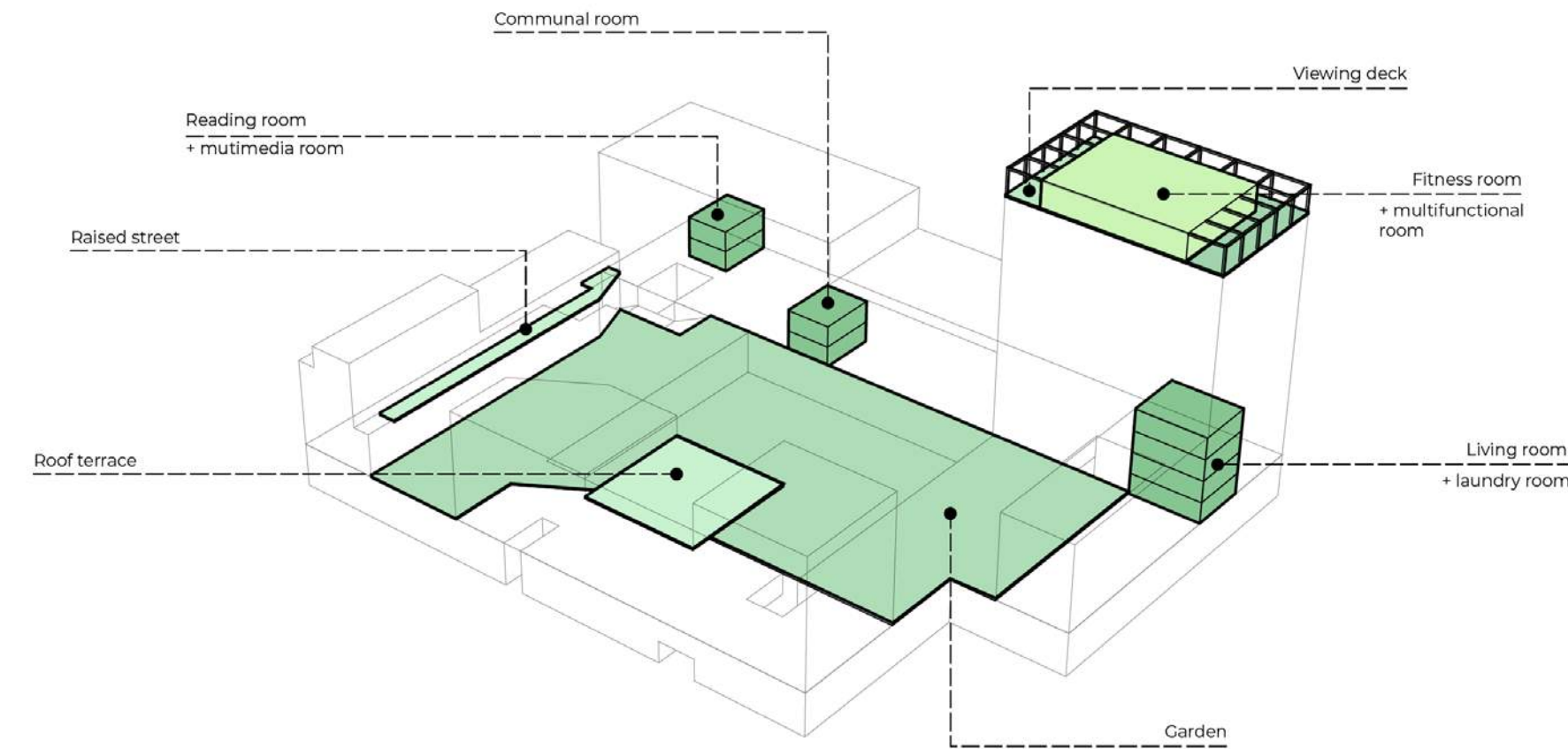
# Building scheme

## Collective spaces

- Collective space inside the block for the specific type of residents
- Smaller dwellings > more collective space
- Inner area: Garden as zone where all residents meet. Also important for environmental aspirations of the design



## Collective space





# Design

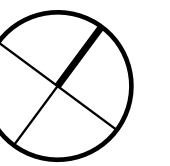
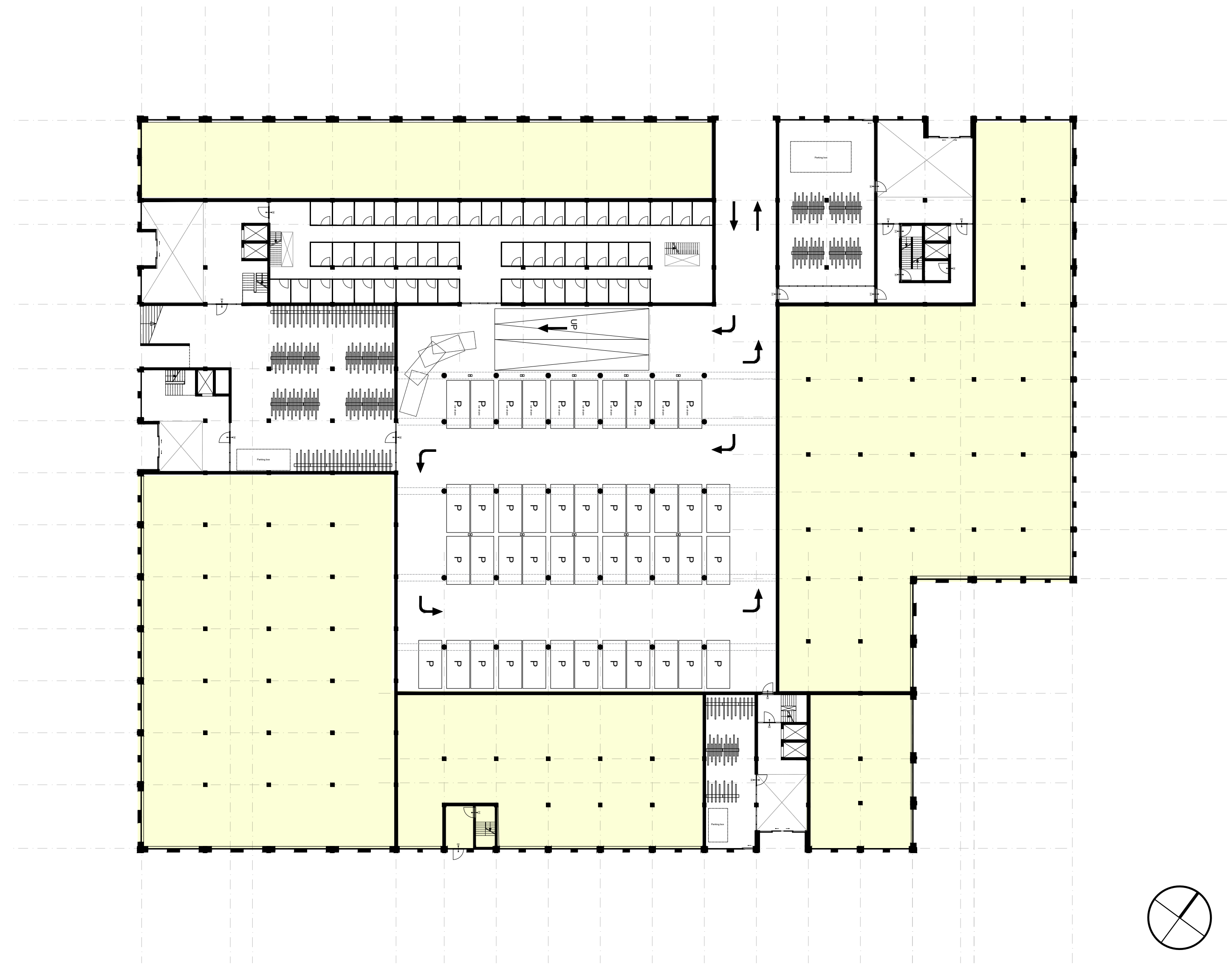




# Floor plan

Ground floor

- Commercial spaces

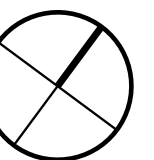
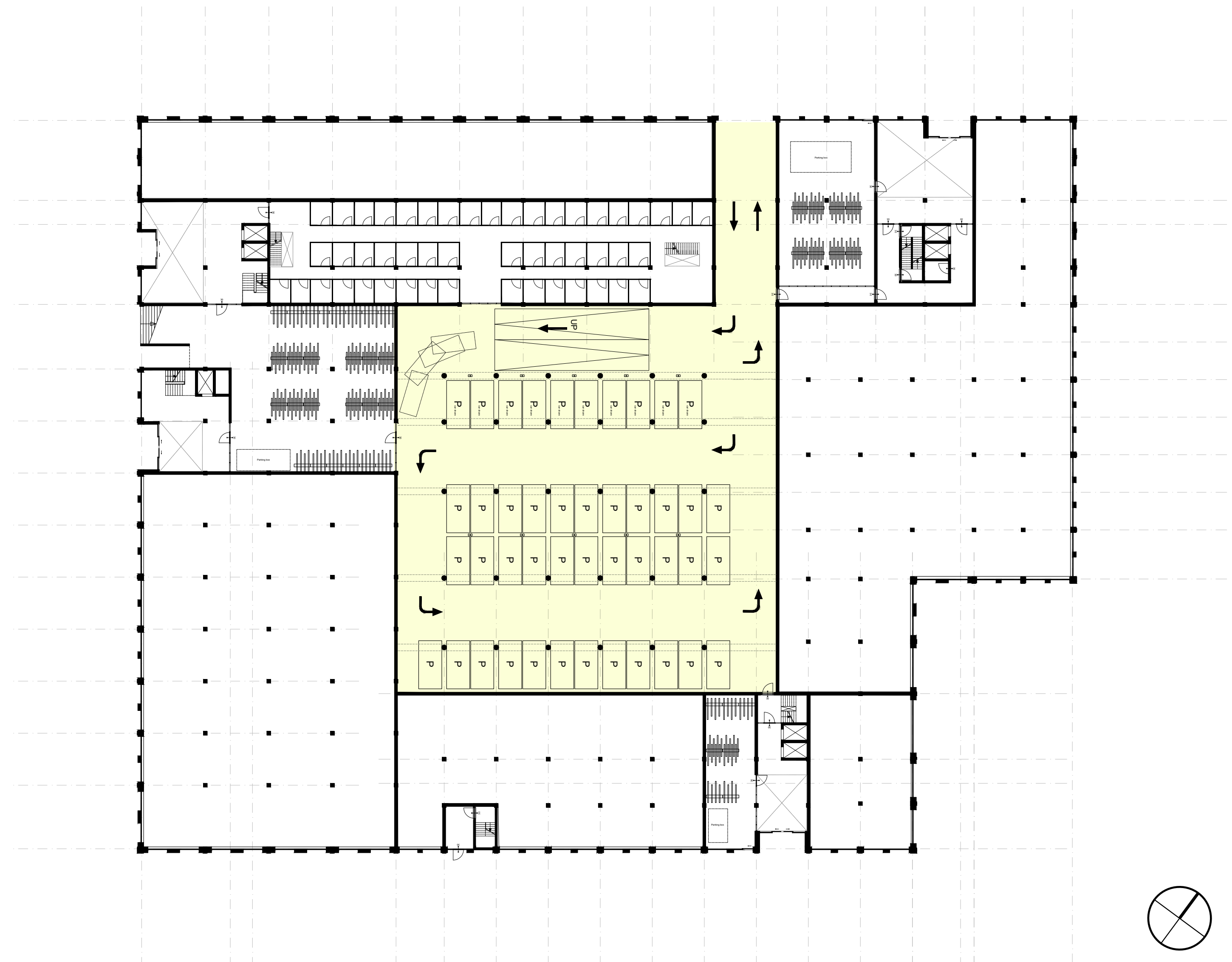




# Floor plan

Ground floor

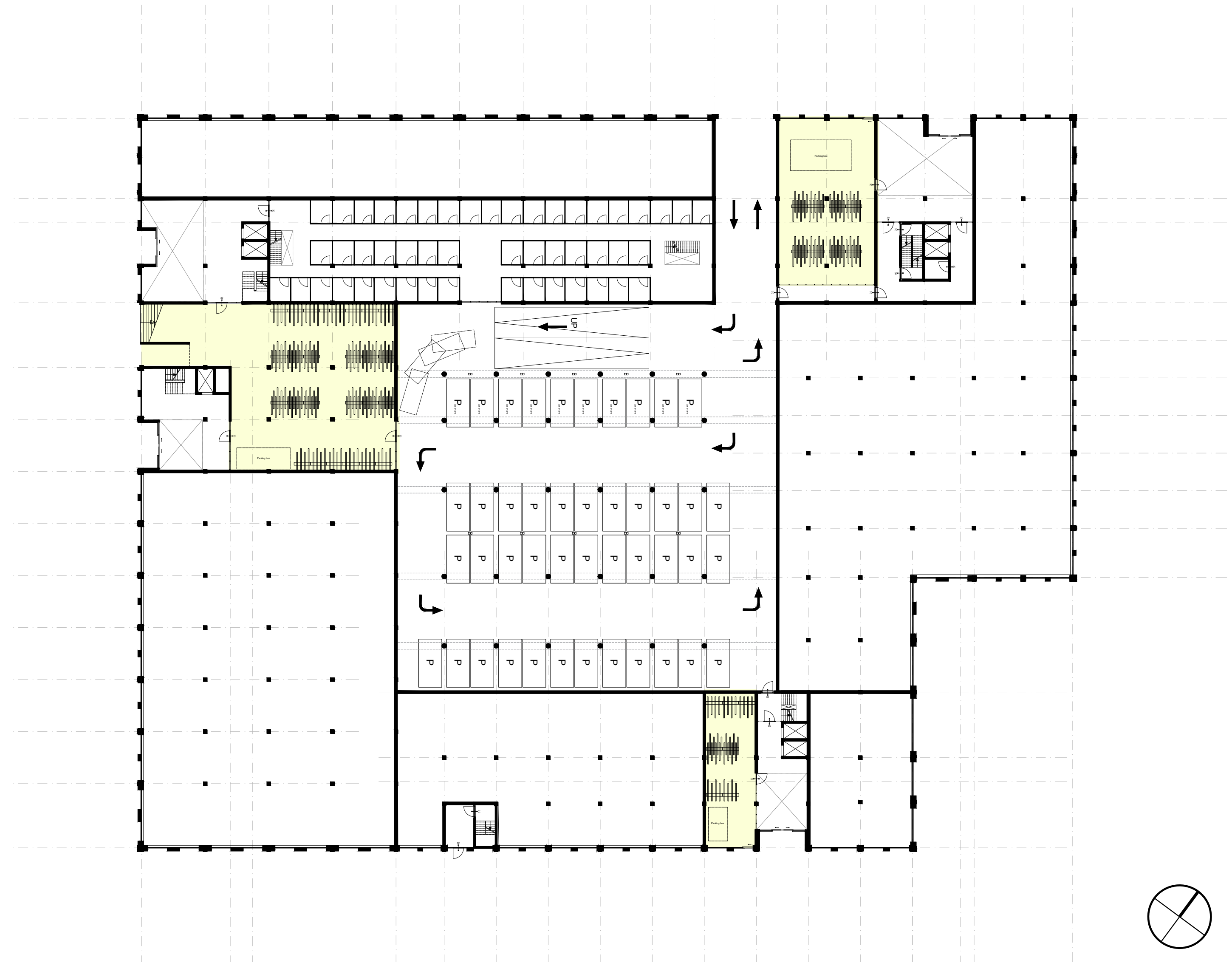
- Parking garage



# Floor plan

Ground floor

- Bicycle parkings

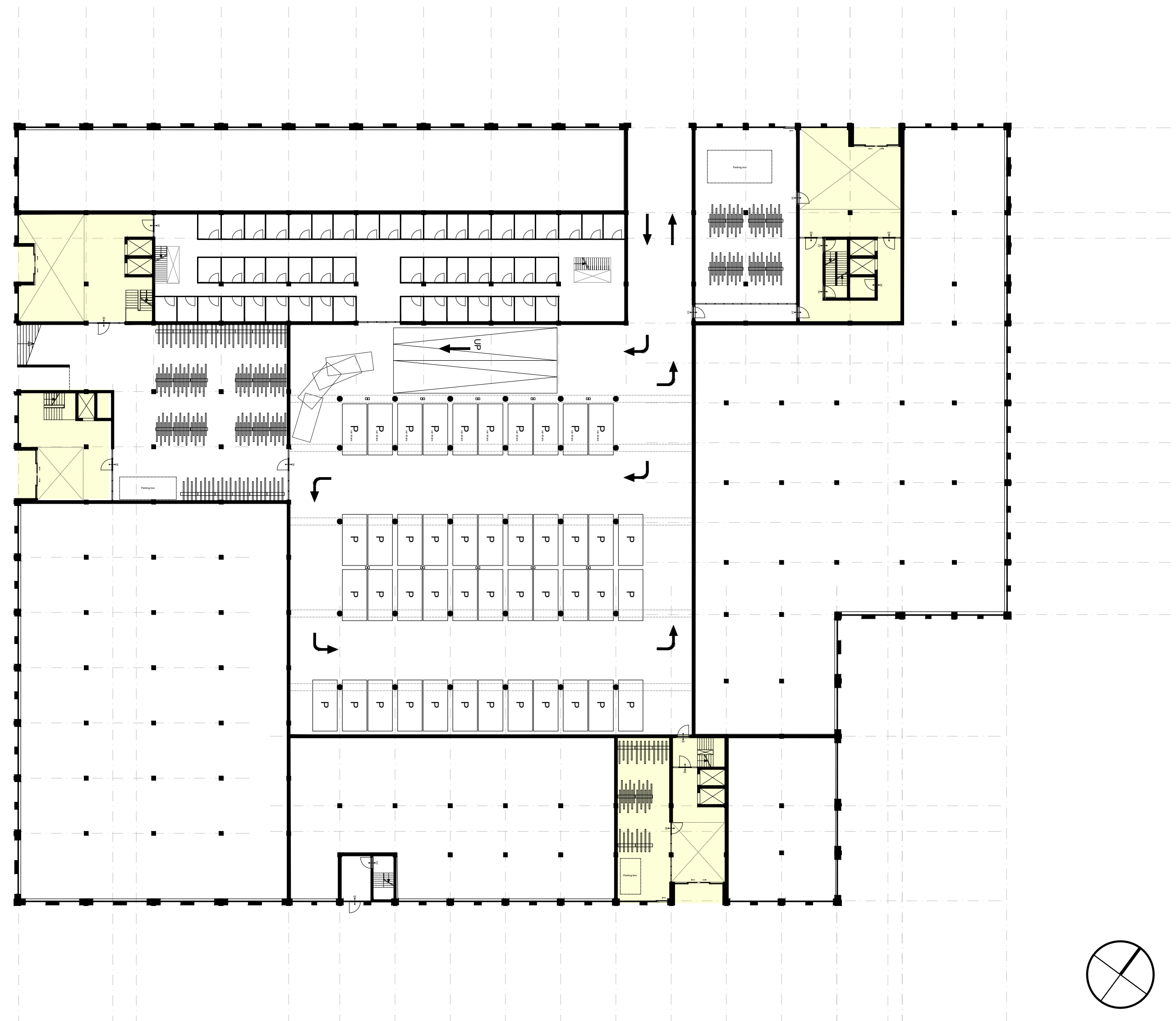




# Floor plan

Ground floor

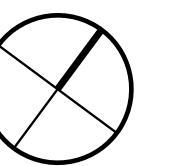
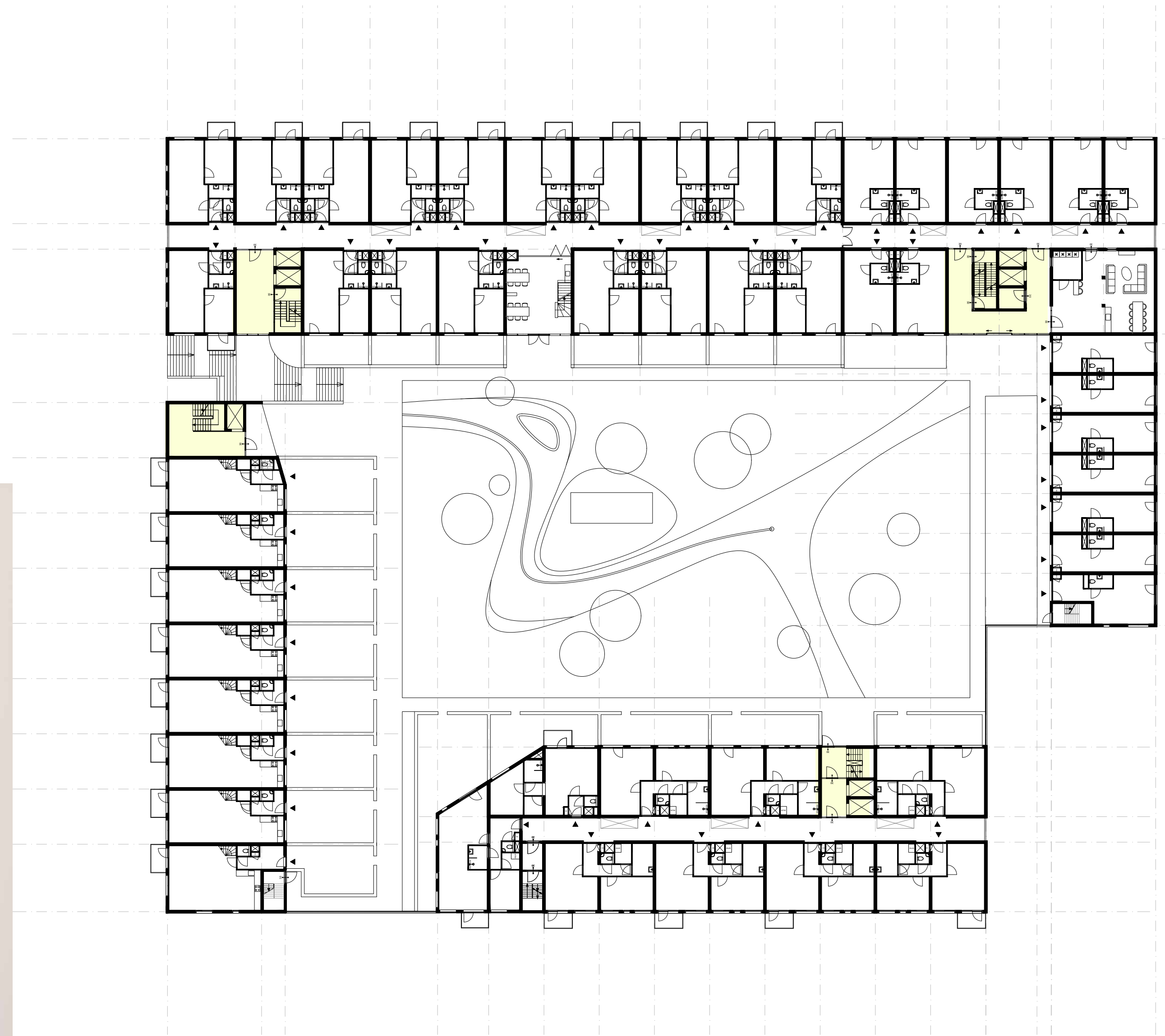
- Entrances to the dwellings



# Floor plan

2th floor

- Access to residential floor

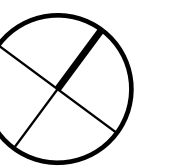
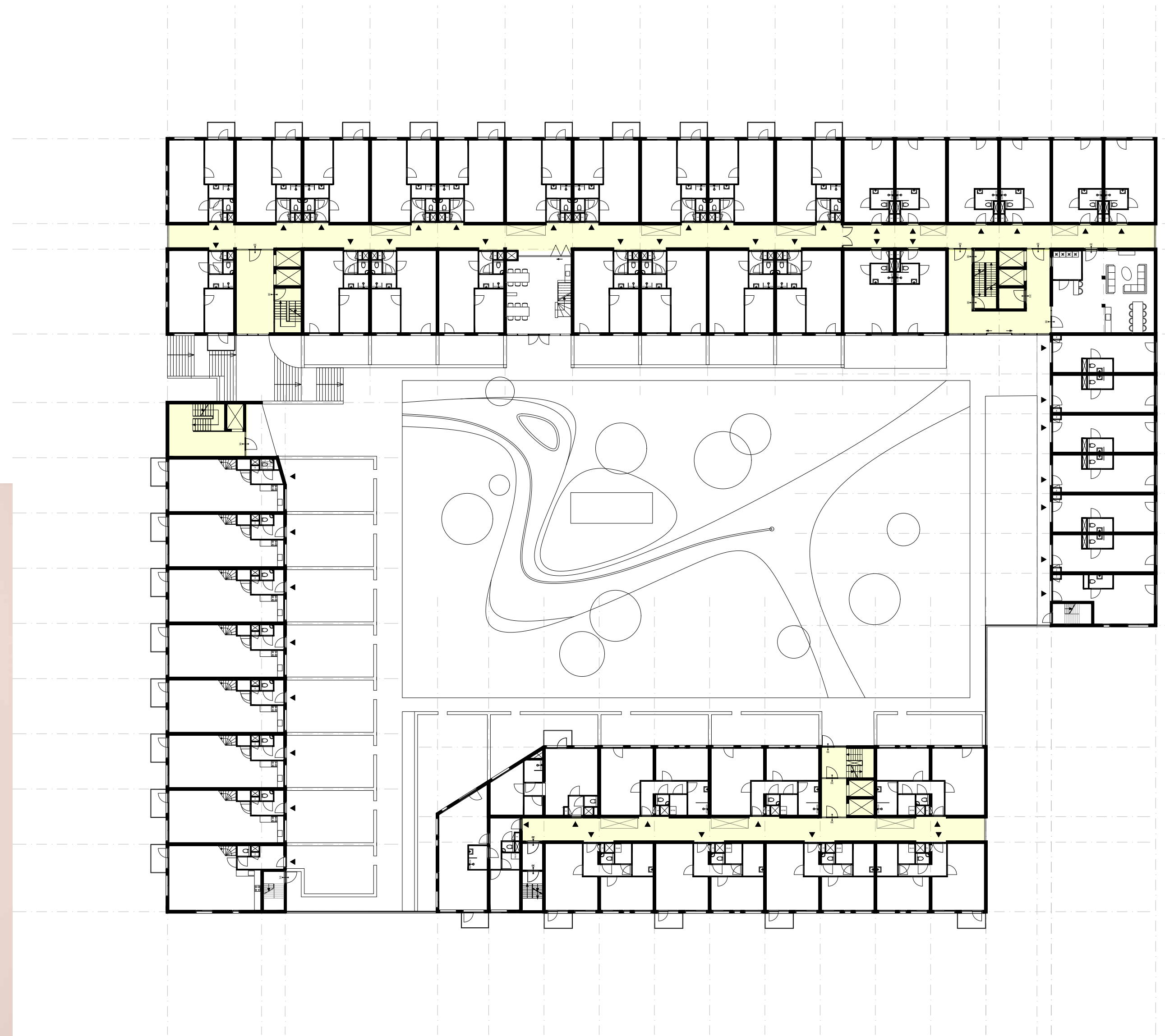
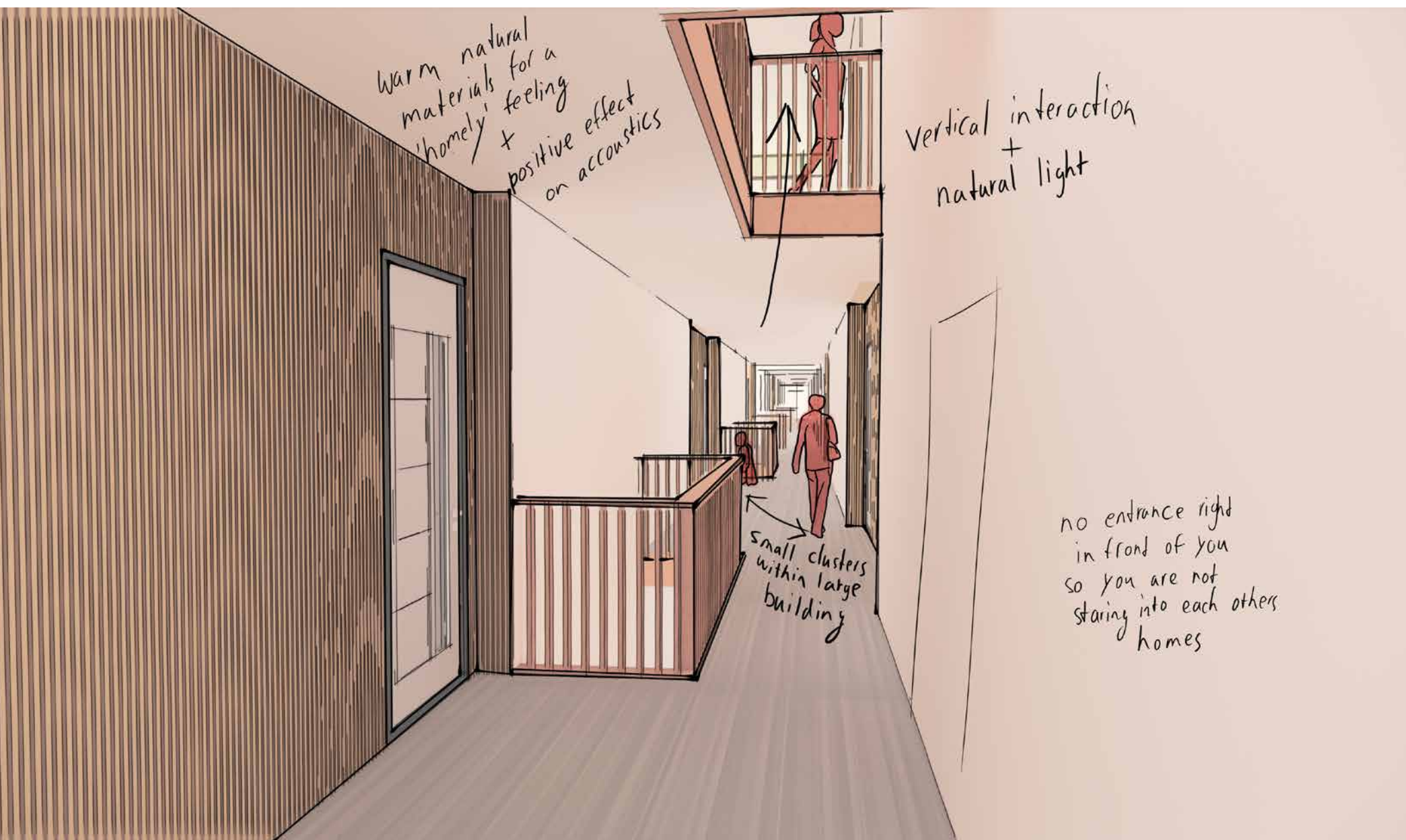




# Floor plan

2th floor

- Corridor access

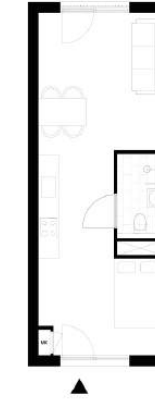


# Dwellings

## Overview

- Large variety of dwellings
- Suited for young starters and many other type of residents
- Total of 249 dwellings

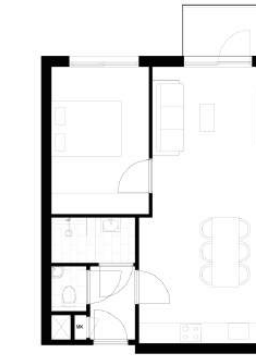
Type A1



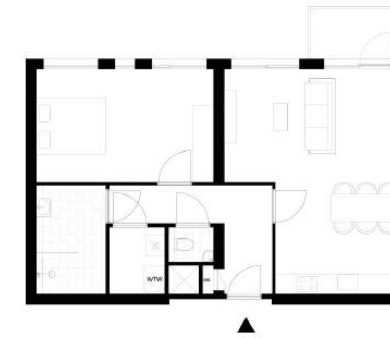
Type A2



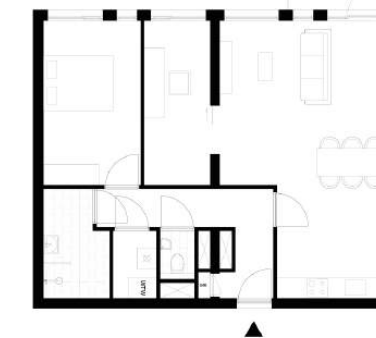
Type B



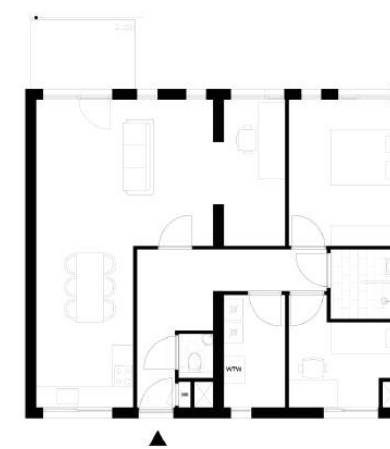
Type C1



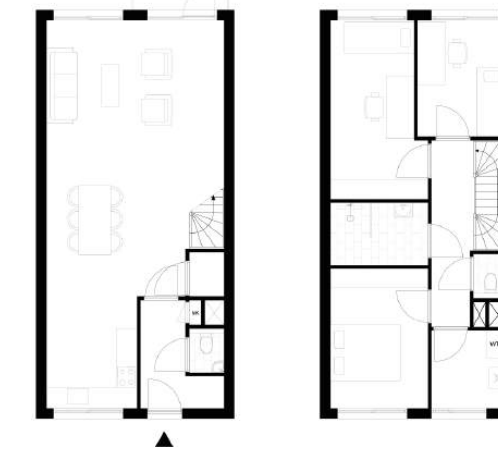
Type C2



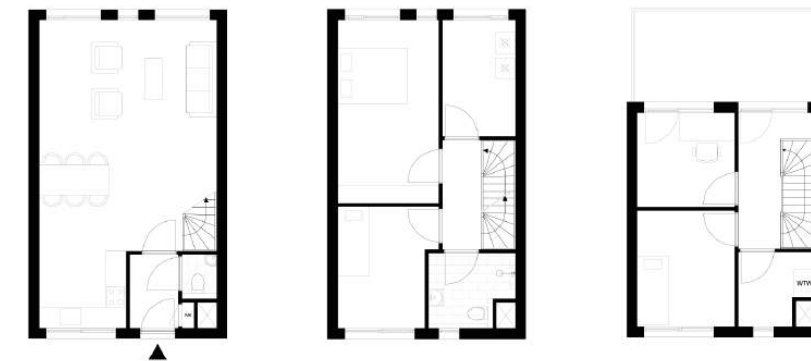
Type D



Type E



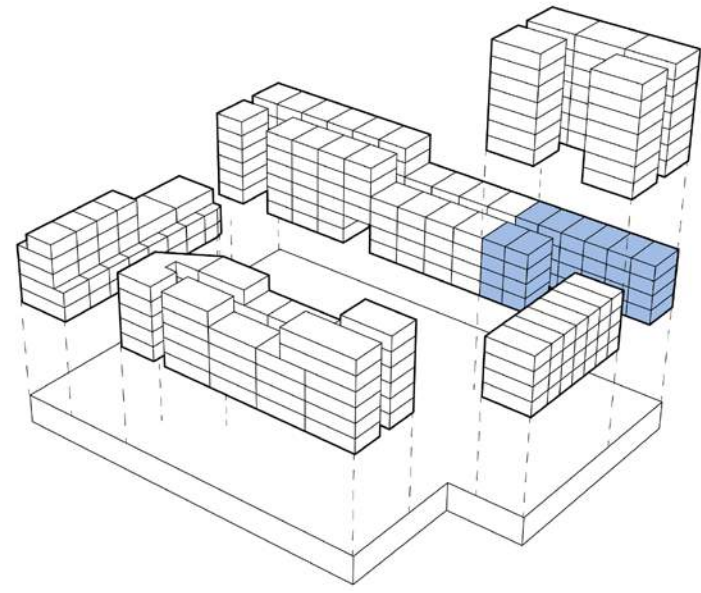
Type F



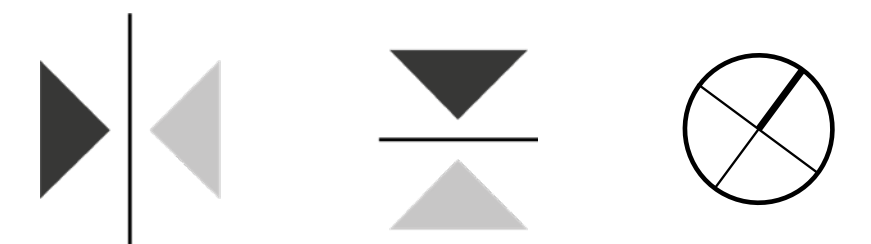
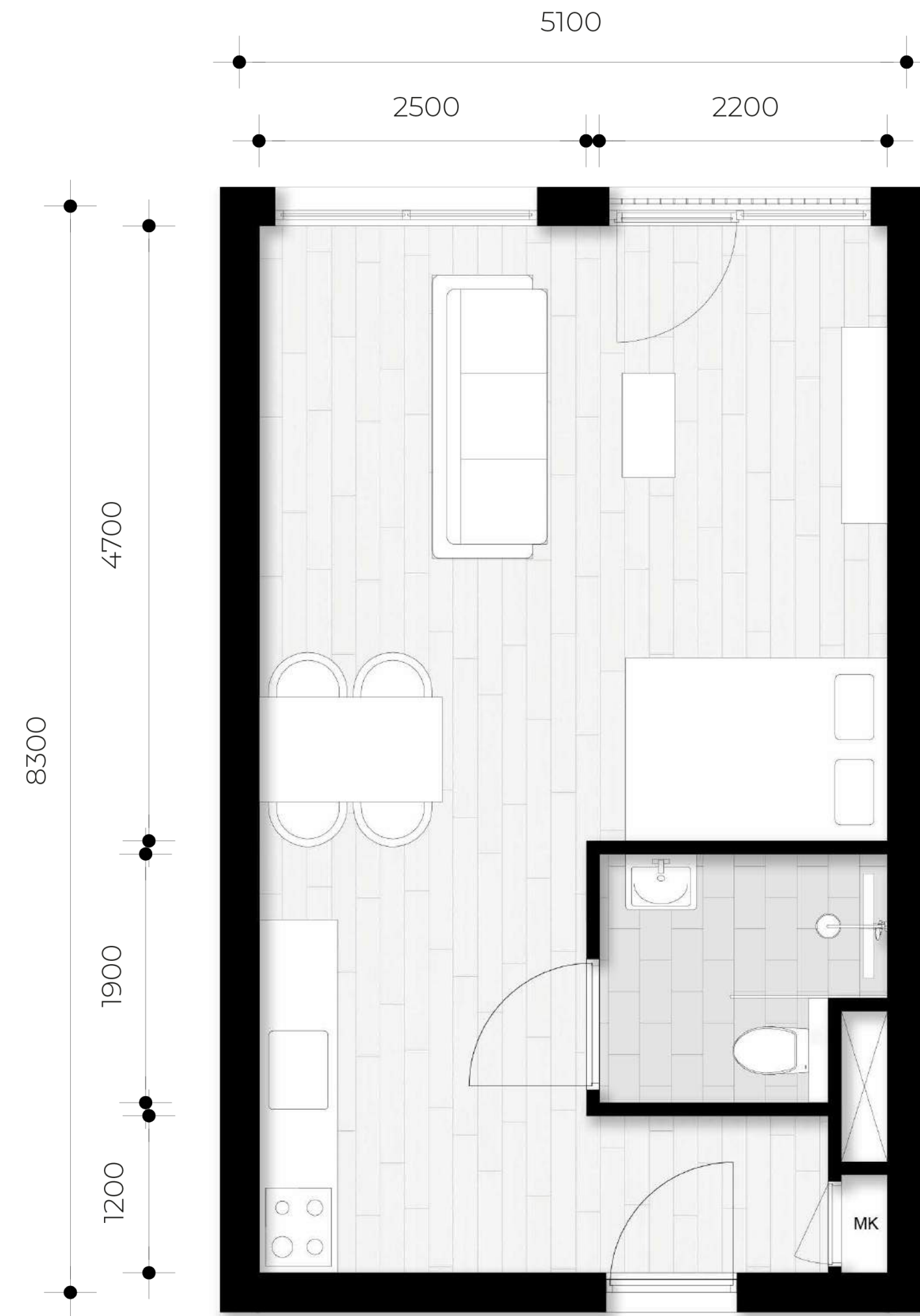


# Dwellings

Type A2

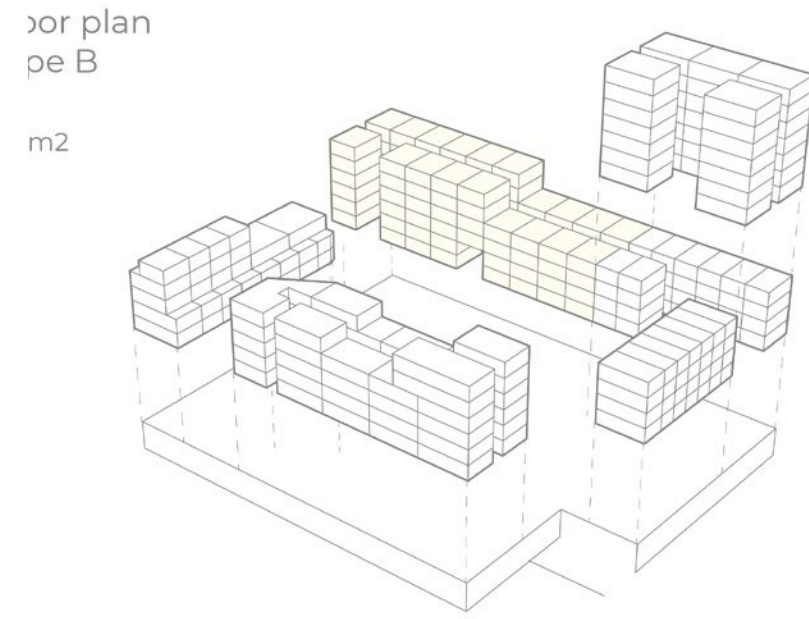


- 37 m2 studio
- Open floorplan with private kitchen en bathroom
- Very light because of large bay width

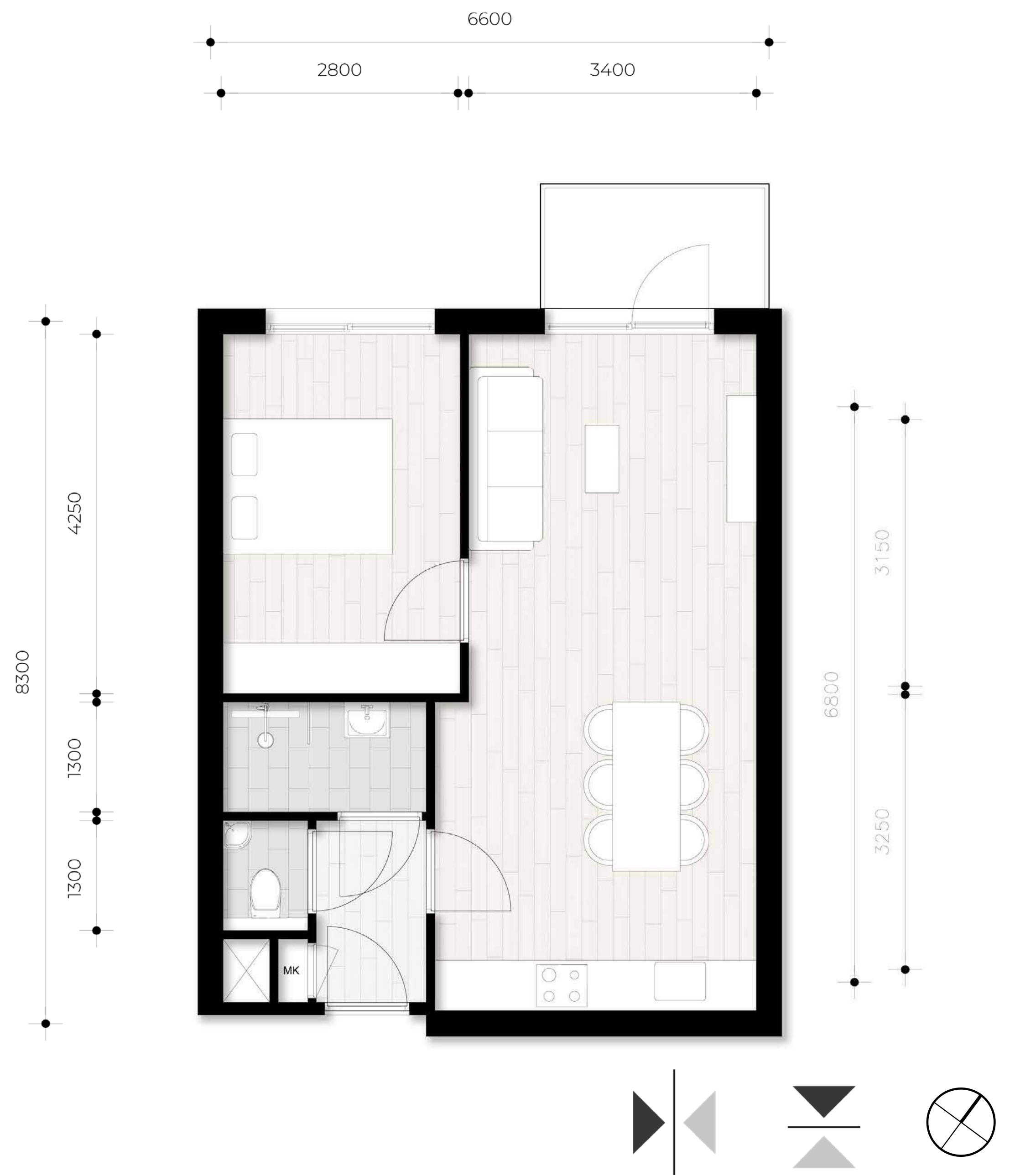




# Dwellings Type B



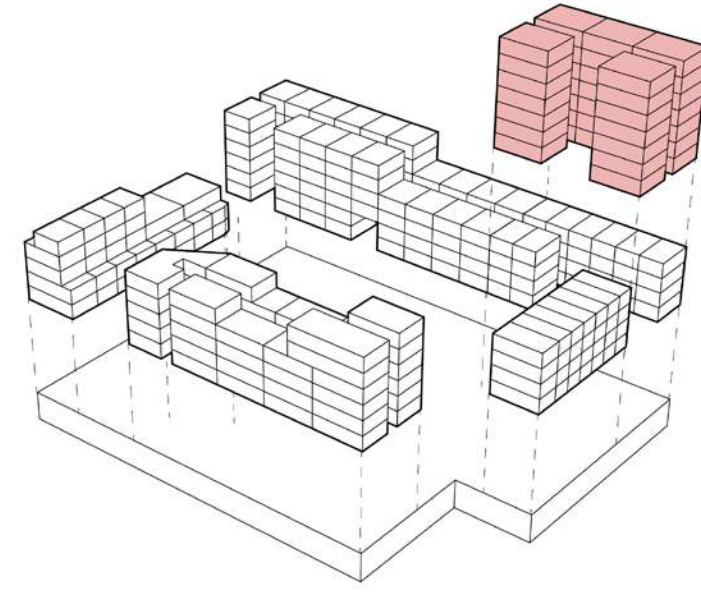
- 48 m2 compact apartment
- More privacy with hallway, bedroom and separate toilet
- Private balcony



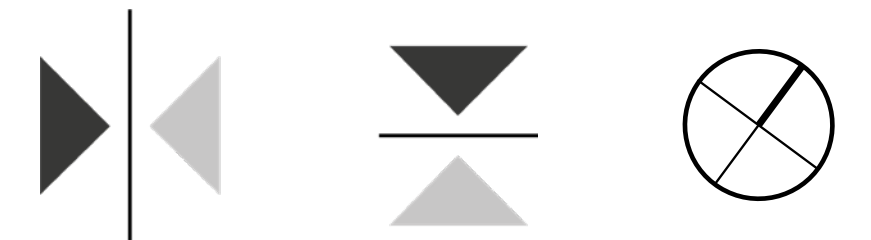
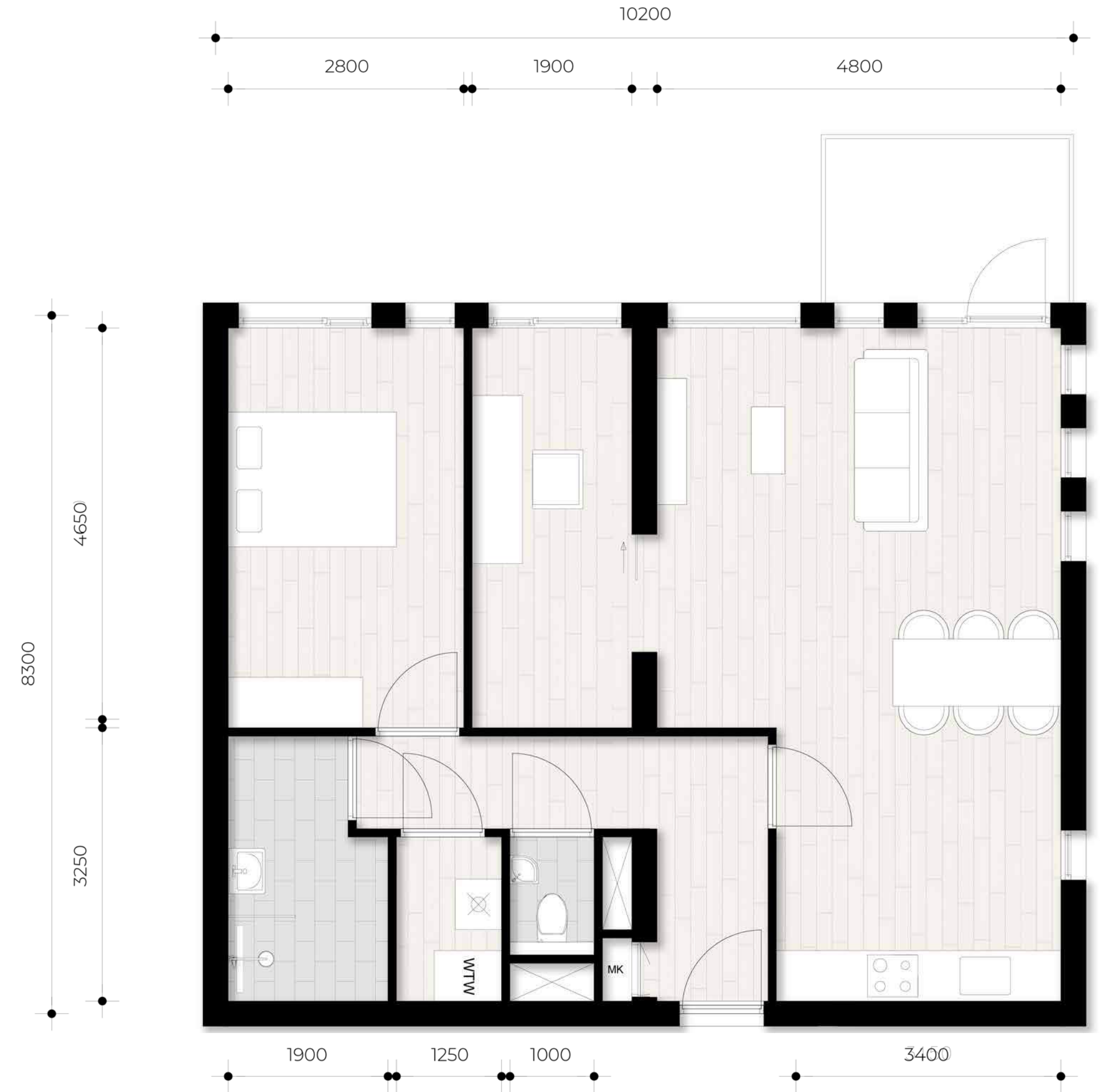


# Dwellings

Type C2



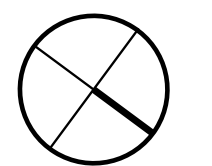
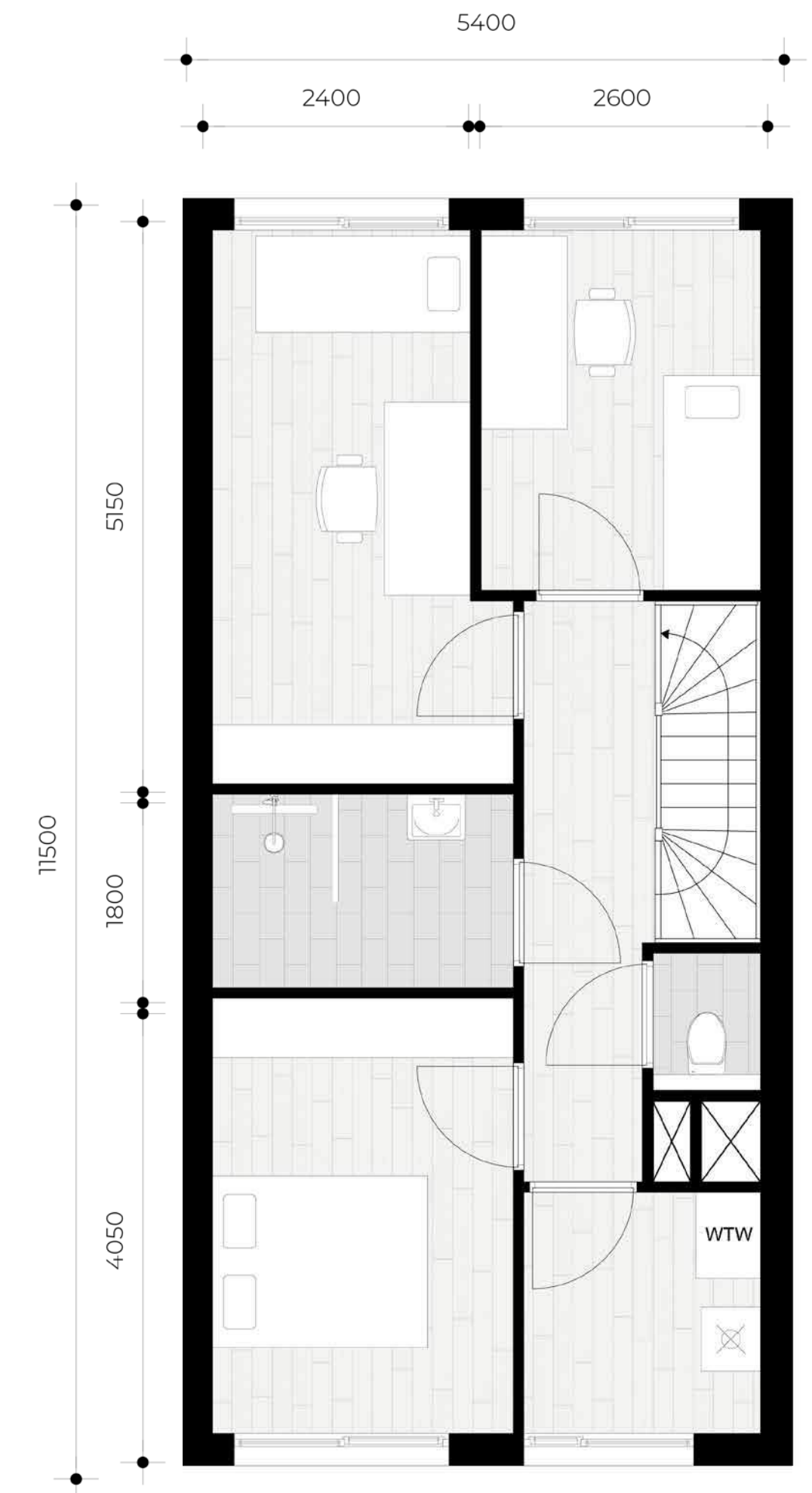
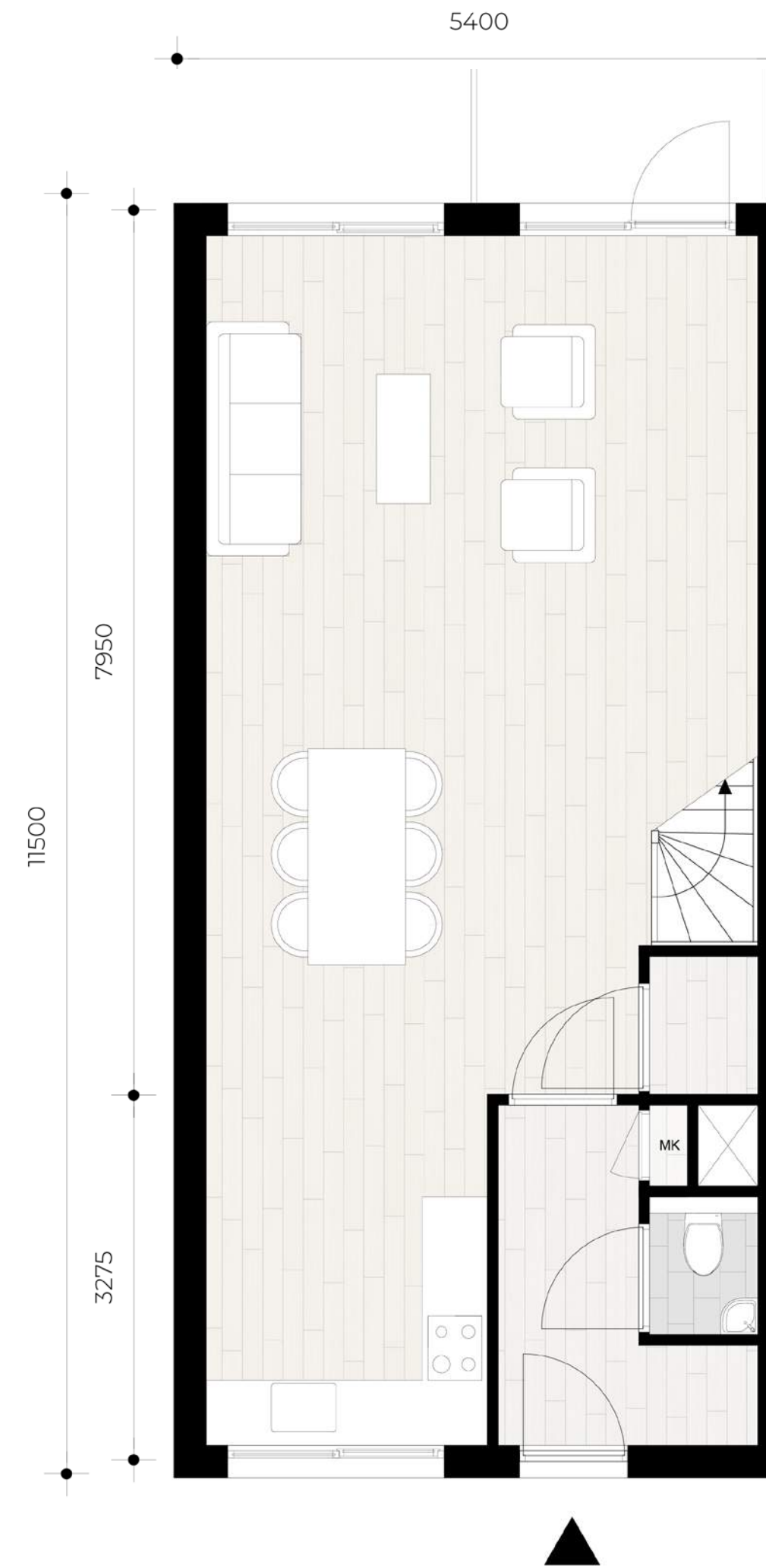
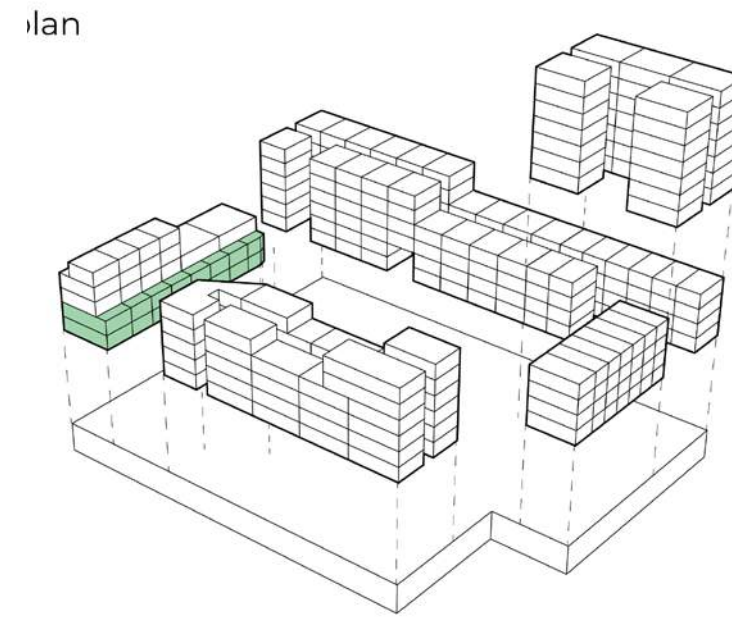
- 76 m2 apartment
- 2 room apartment with multifunctional annex and private balcony
- Decentralized balanced ventilation system





# Dwellings Type E

- 107 m<sup>2</sup> maisonette
- 3 bedrooms
- Private garden and balcony
- Lots of storage space
- Decentralized balanced ventilation system

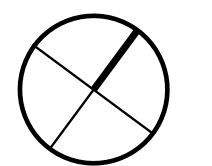
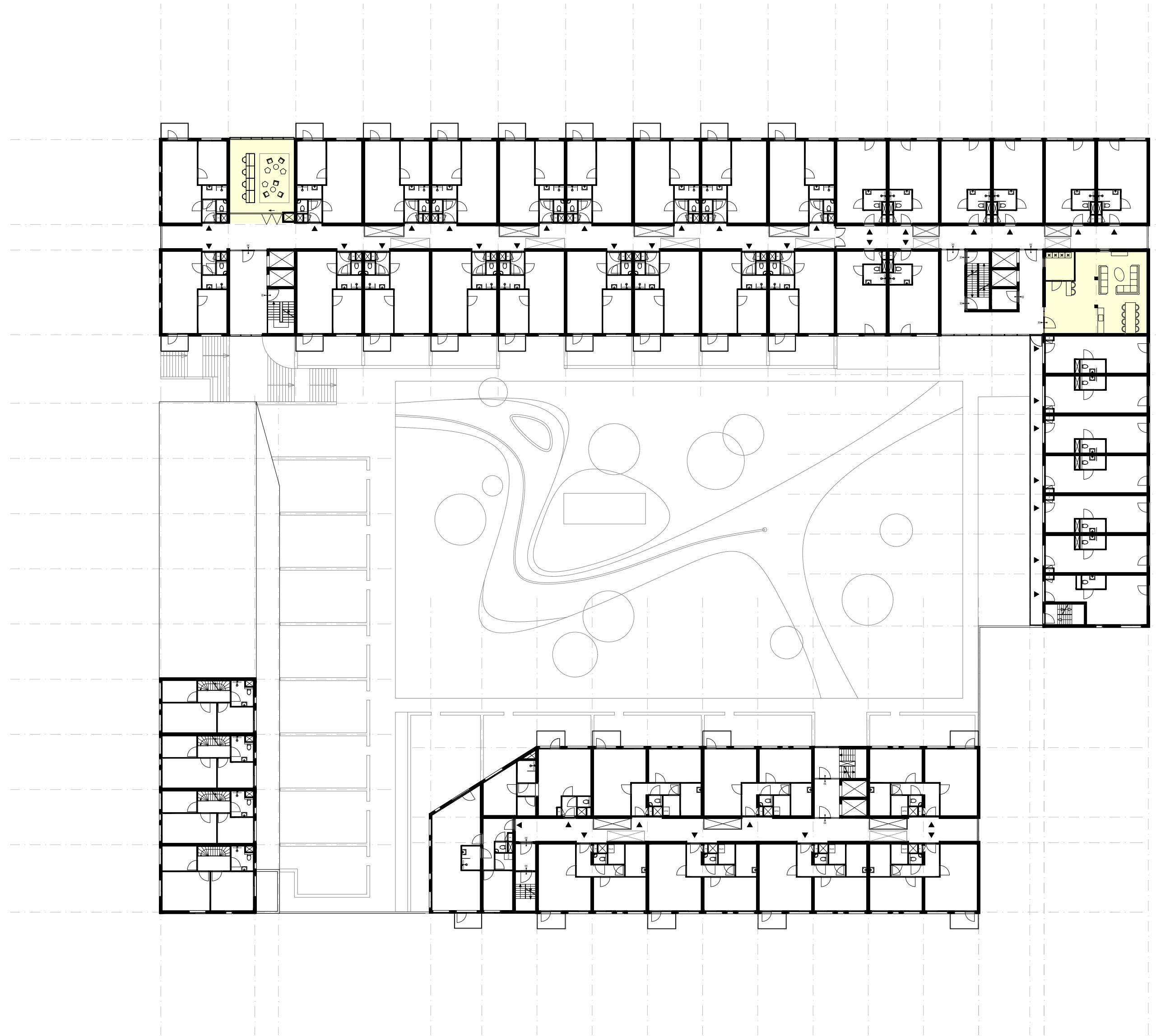




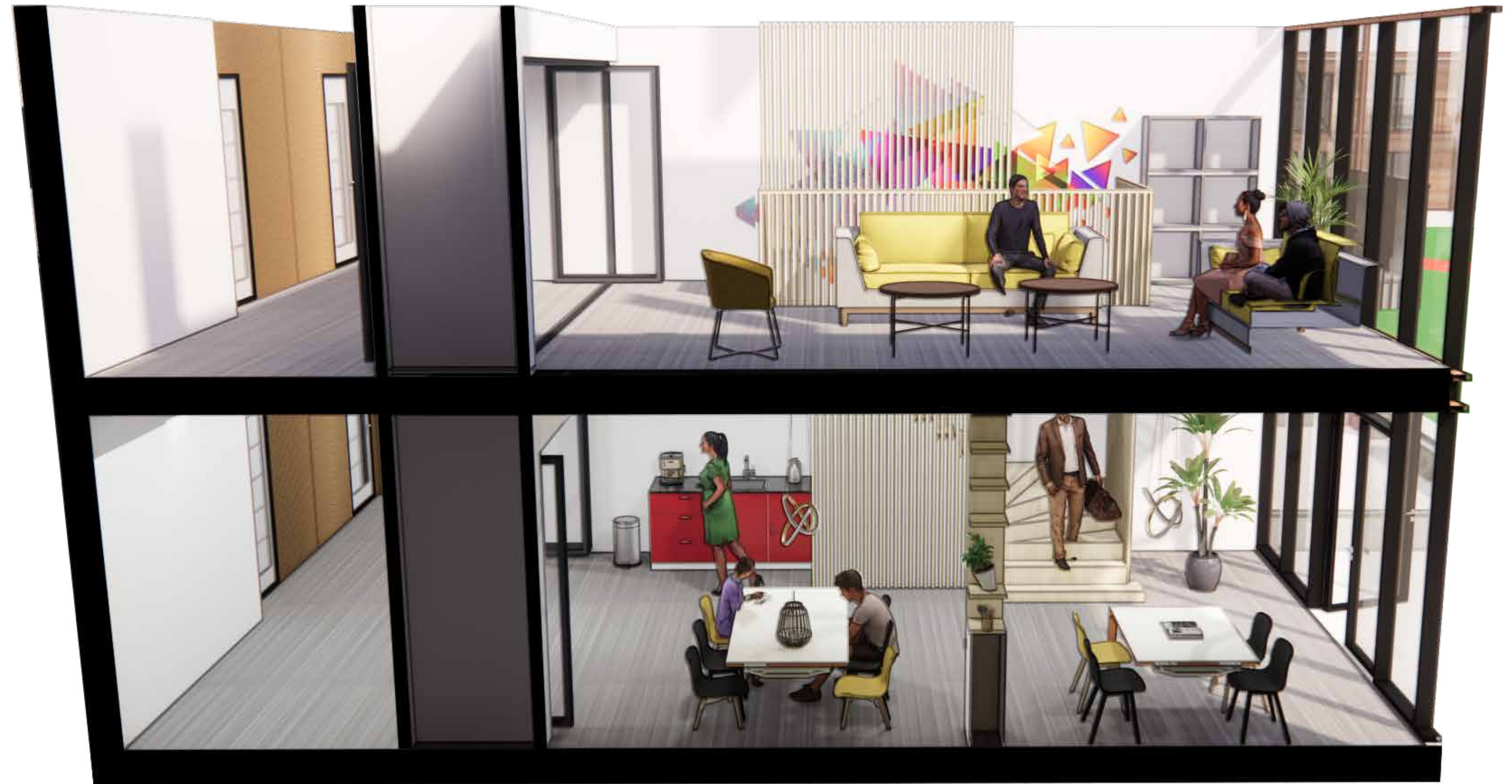
# Collective spaces

5th floor

- Located close to stairwells
- Functions that are desired by the young starters
- Increase interaction and comfort



# Collective spaces







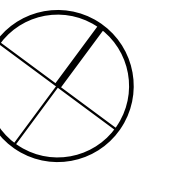
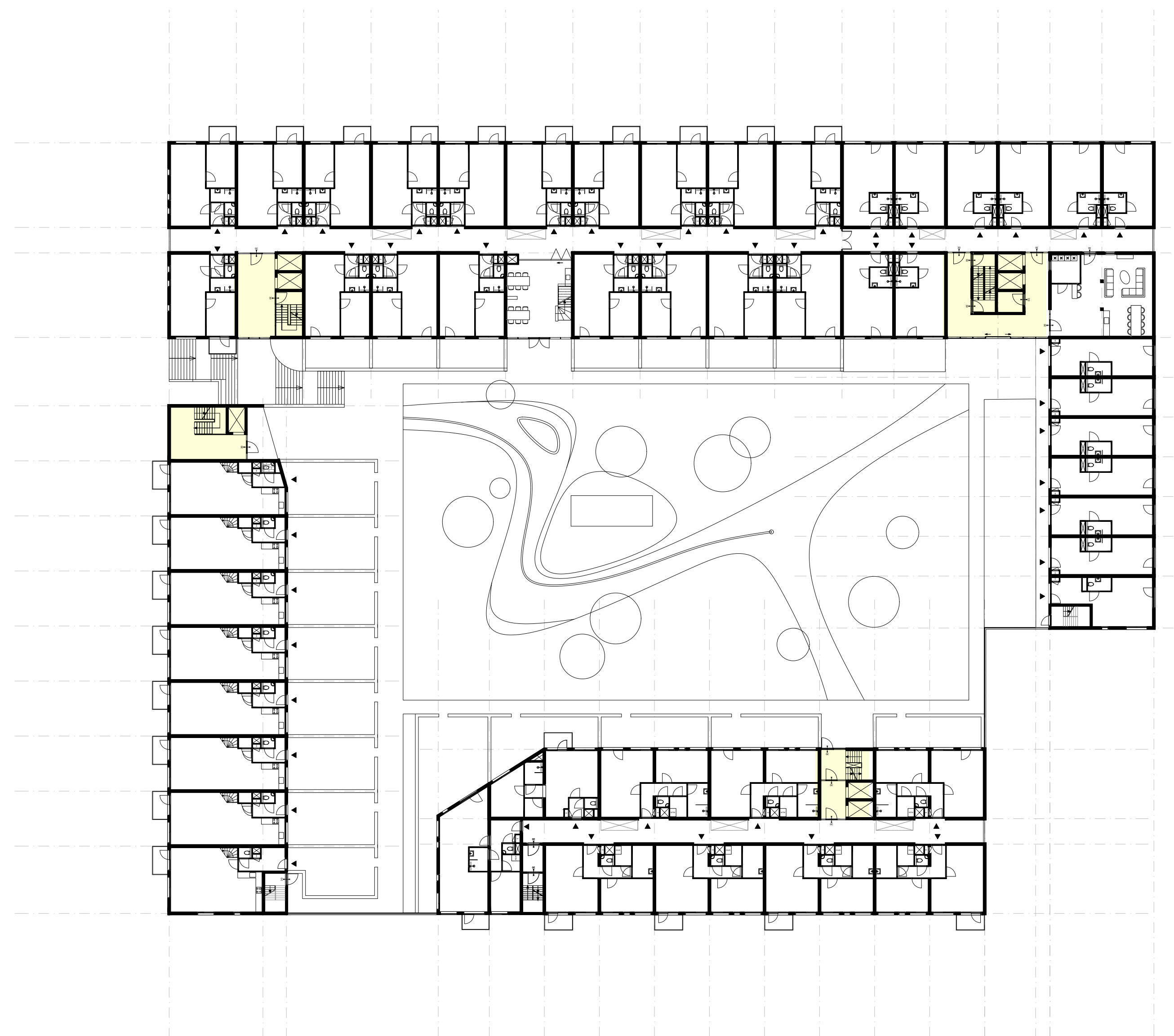






# Collective spaces

2th floor



# Collective spaces

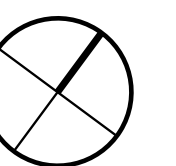
## The garden

- Green outside space for all residents
  - Social interaction
  - Decreasing stress
- Heat reduction
- Increasing biodiversity
- Water storage



1. PLAYGROUND
2. SANDPIT
3. GREEN-HOUSE
4. WADI

5. WATER ART
6. RELAXING LAWN
7. SITTING DECK









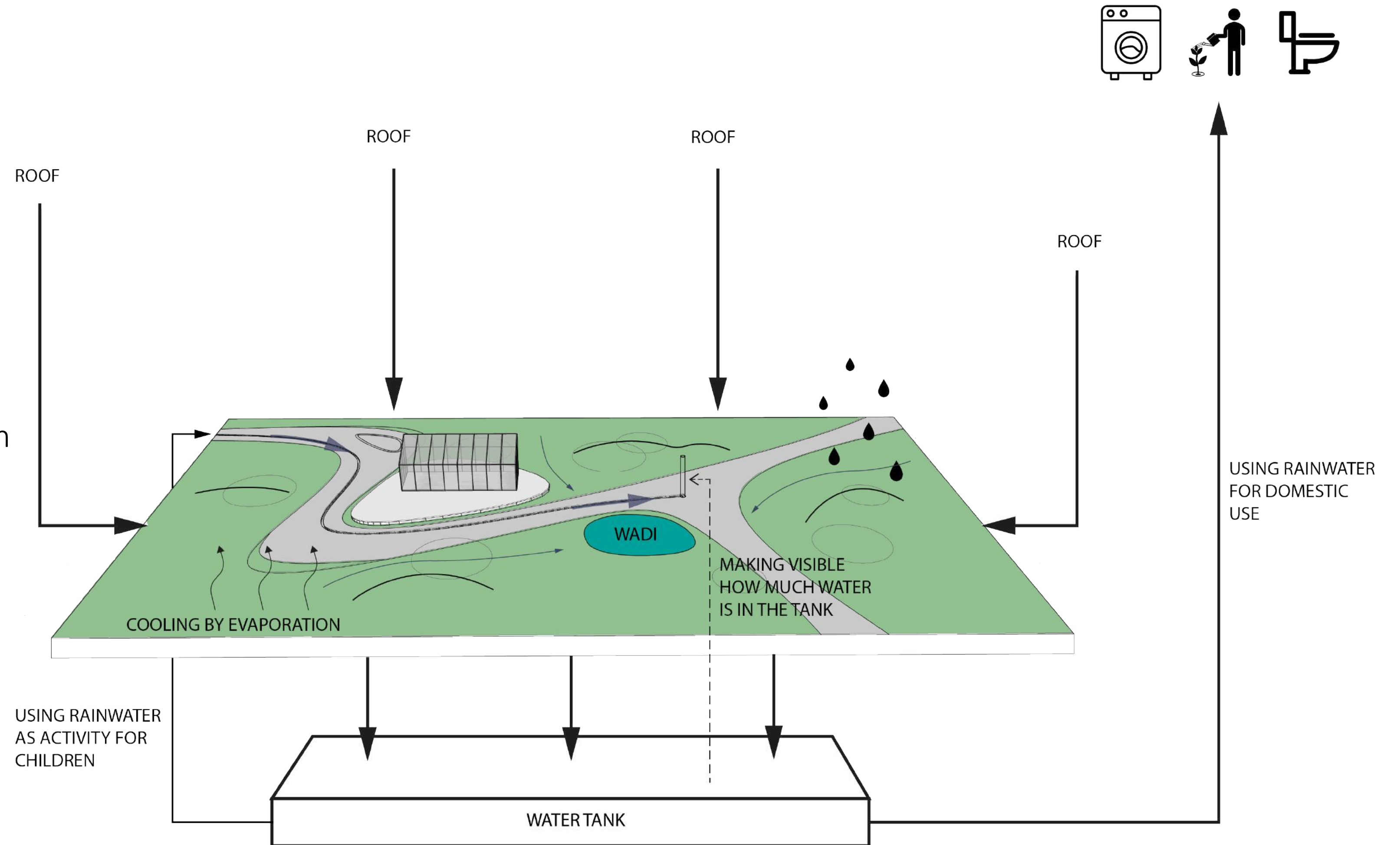




# The garden

Water schema

- Height differences create natural flow
- Rainwater stored and used for toilet, washing machine and watering garden
- Water from tank used for activity and awareness children













## Water Usage

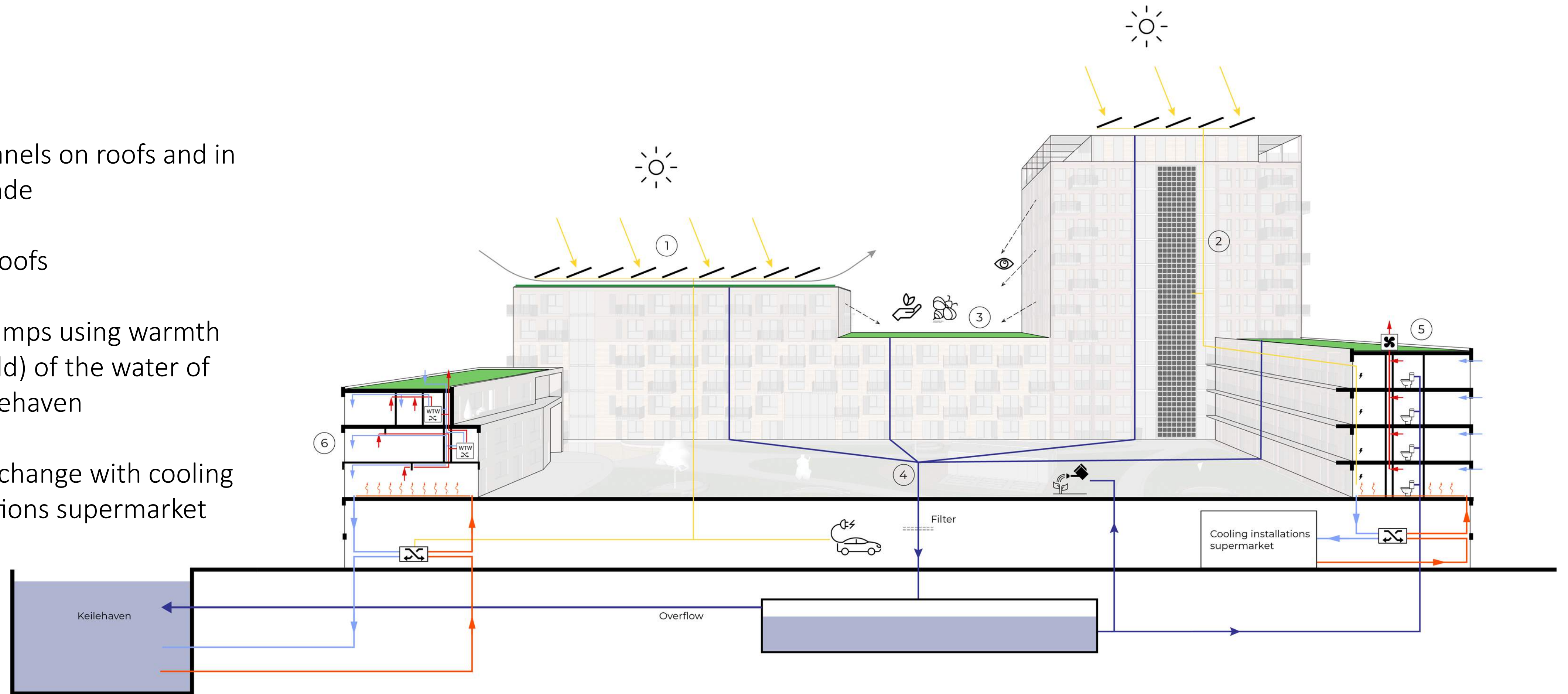
- More than 40% of water usage dwelling comes from shower
- Decreasing use with Upfall shower, uses 20% of regular shower
  - Water recycled + filtered
- Using rainwater + reducing water usage shower leads to a building that **uses about 70% less water**





# Climate scheme

- Solar panels on roofs and in the facade
- Green roofs
- Heat pumps using warmth (and cold) of the water of the Keilehaven
- Heat exchange with cooling installations supermarket

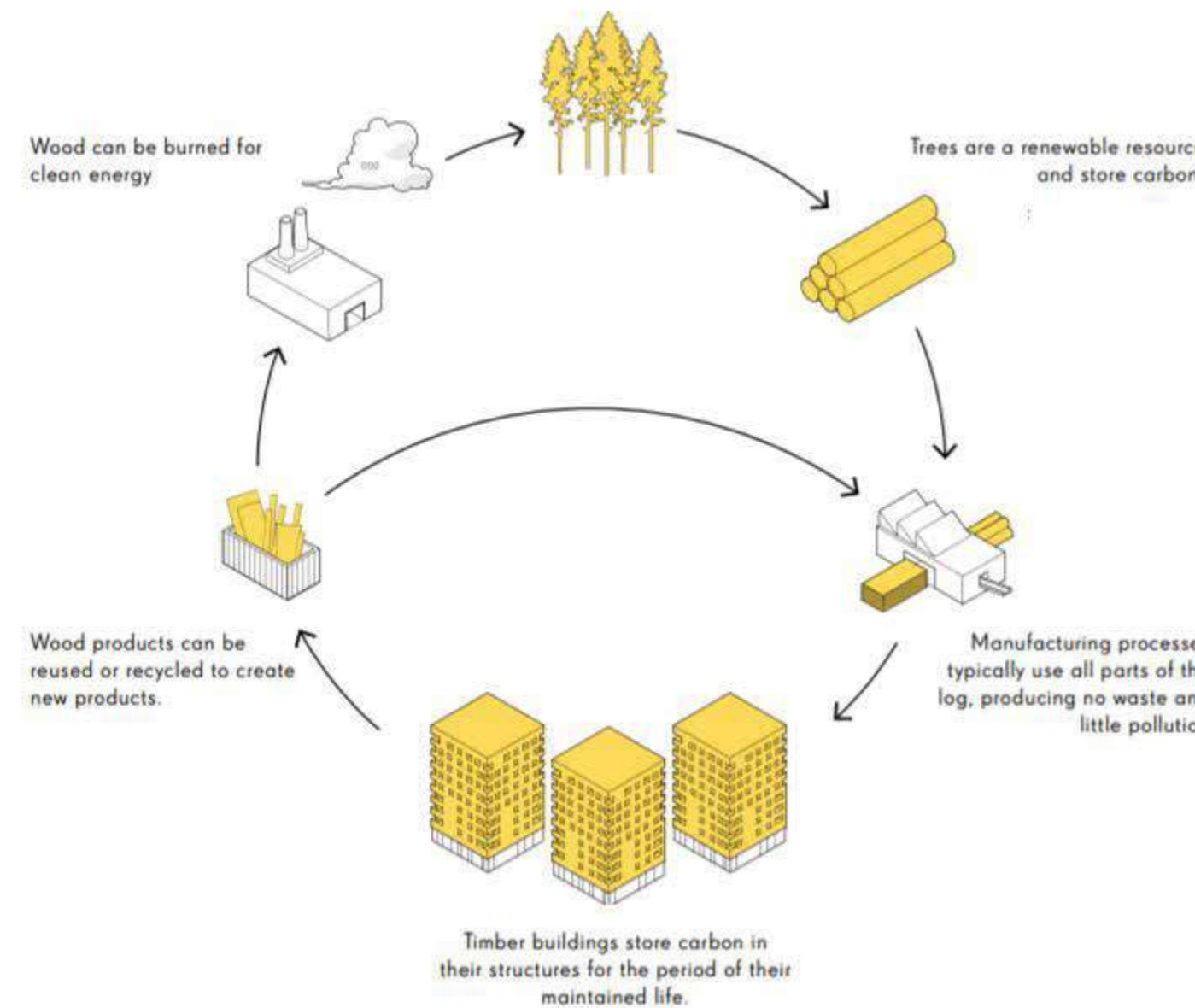
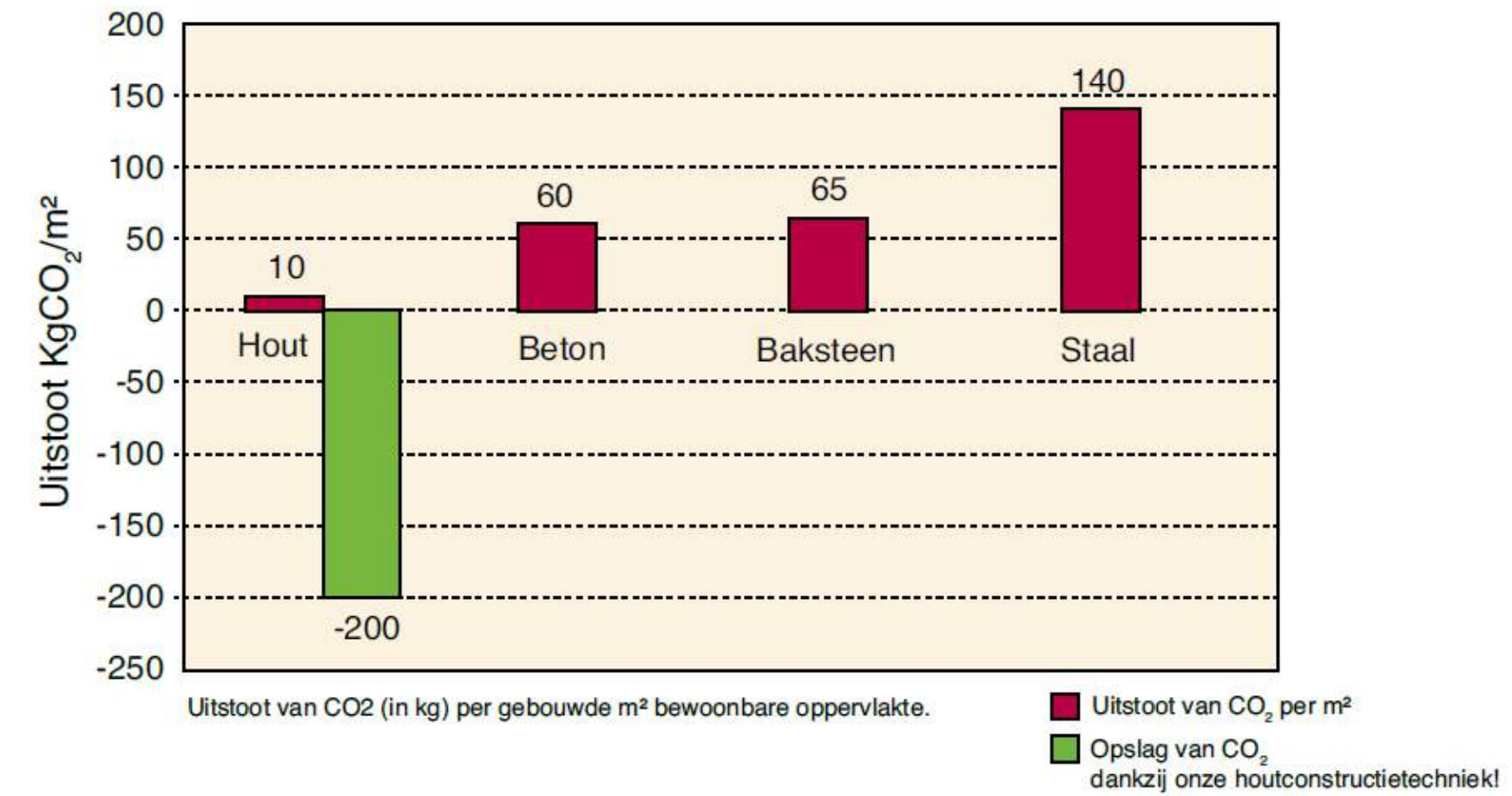
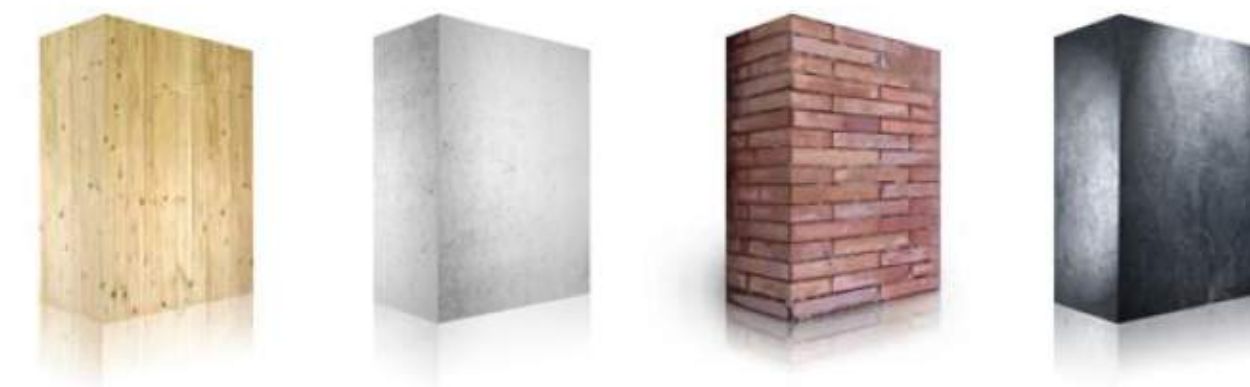




# Building structure

## Constructing in wood

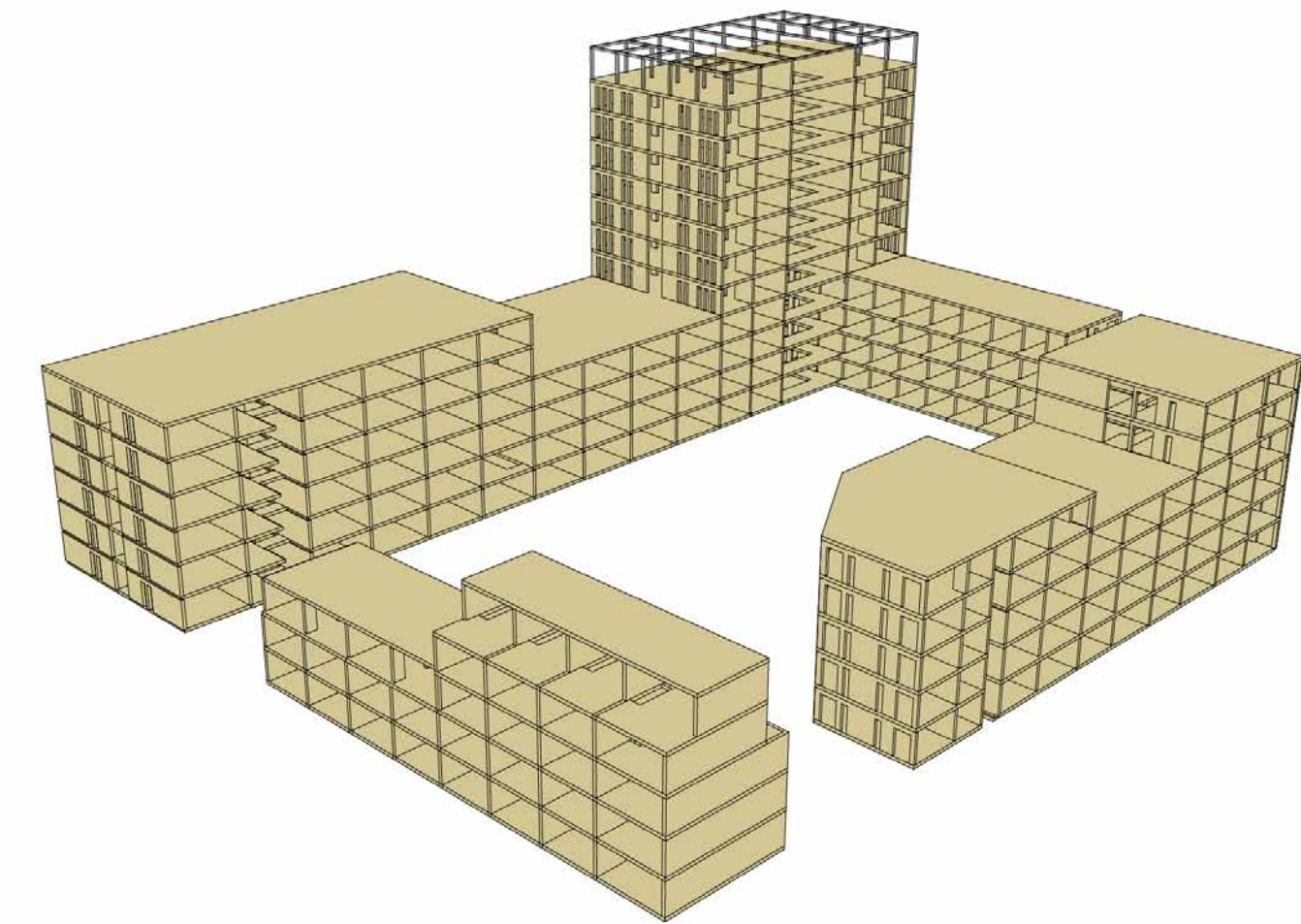
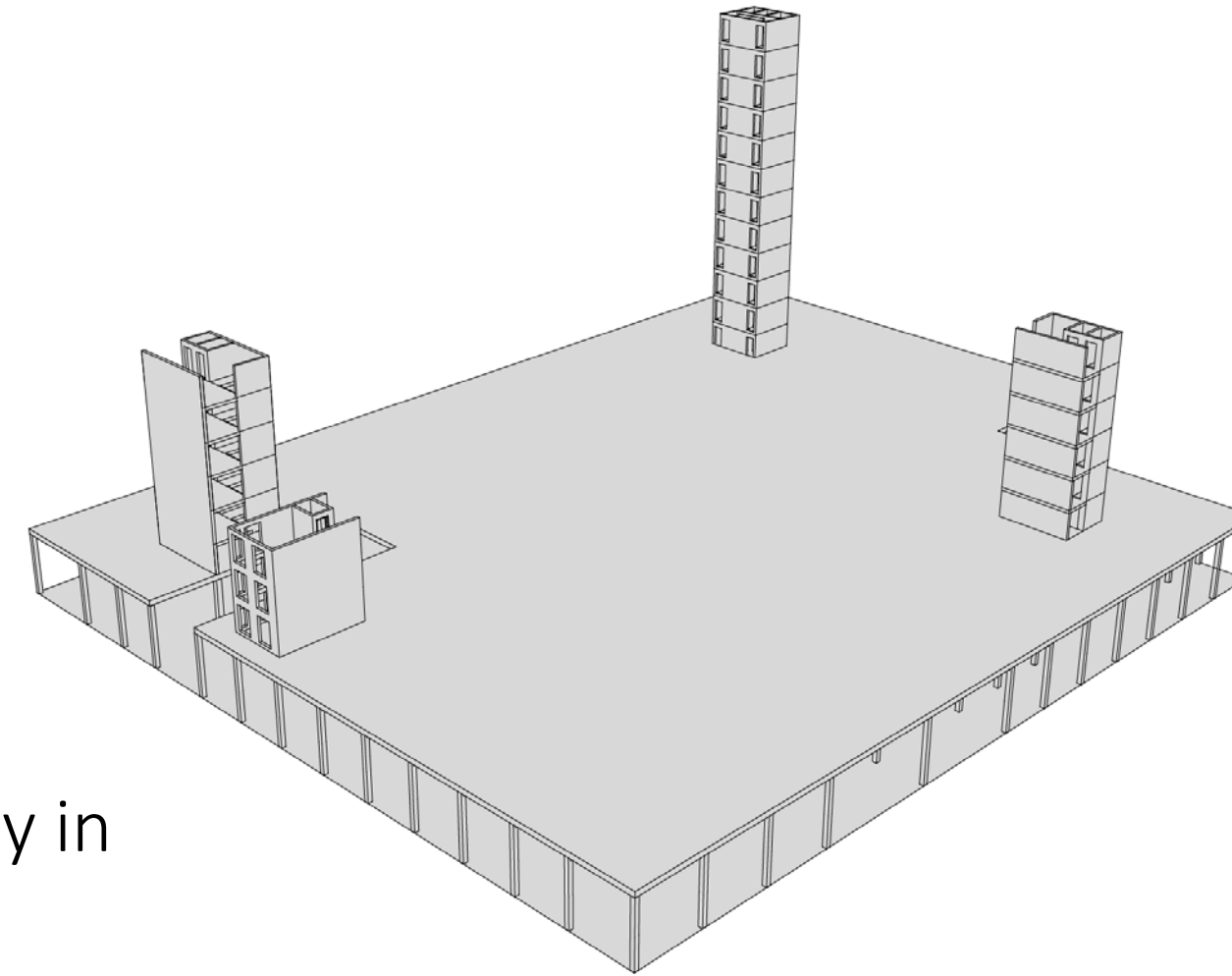
- Storing CO<sub>2</sub> instead of CO<sub>2</sub> emission
- Long lifespan because it can be reused multiple times
- Fast construction time
- Positive effect on comfort
- High esthetical value



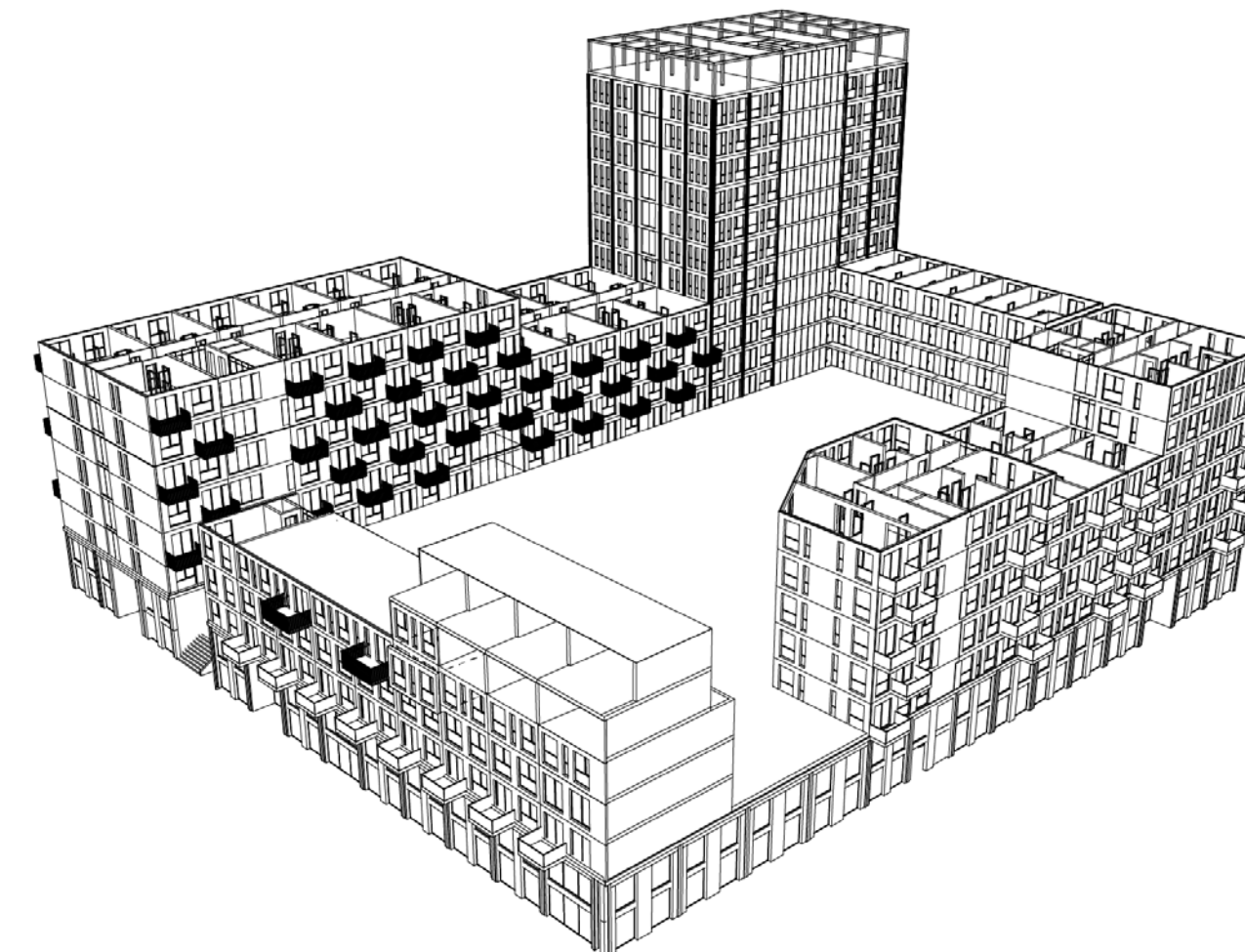


# Building structure

## Principles



- Firm concrete table structure
  - Larger spans bring flexibility in commercial spaces
  - Moisture proof (and flood proof)
- Concrete cores for stability
- Cross laminated timber (CLT) walls and floors on top
  - Sustainable material
  - Lightweight
  - Fast construction time
  - Demountable
- Prefabricated timber frame facade elements





# Building structure

## Environmental impact

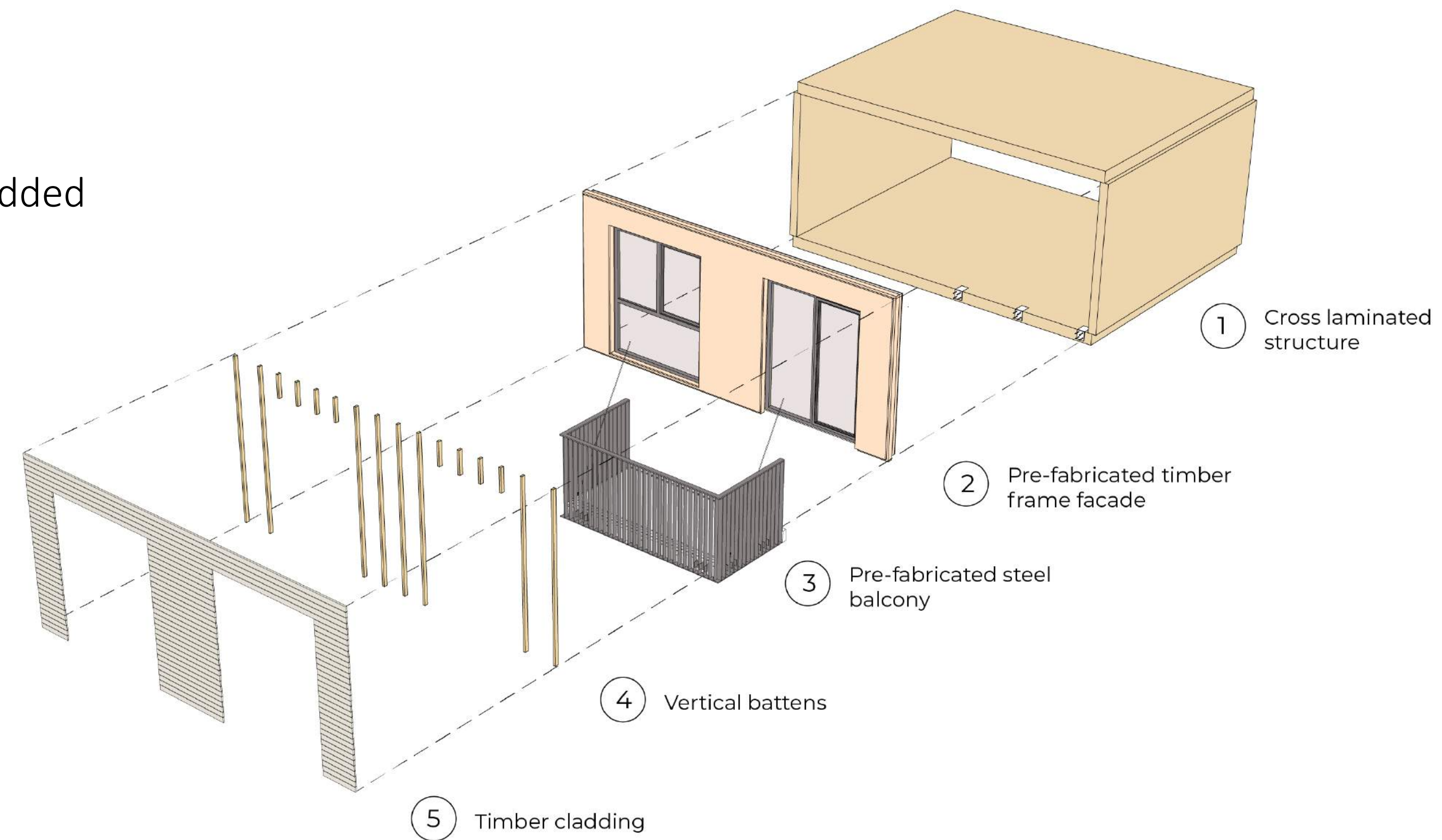
- $\pm 5000 \text{ m}^3$  CLT in the building
- Reduction of 10 million kg of  $\text{CO}_2$  compared to a concrete building
- That equals about 163 times a trip around the world in your car



# Facade

Build up

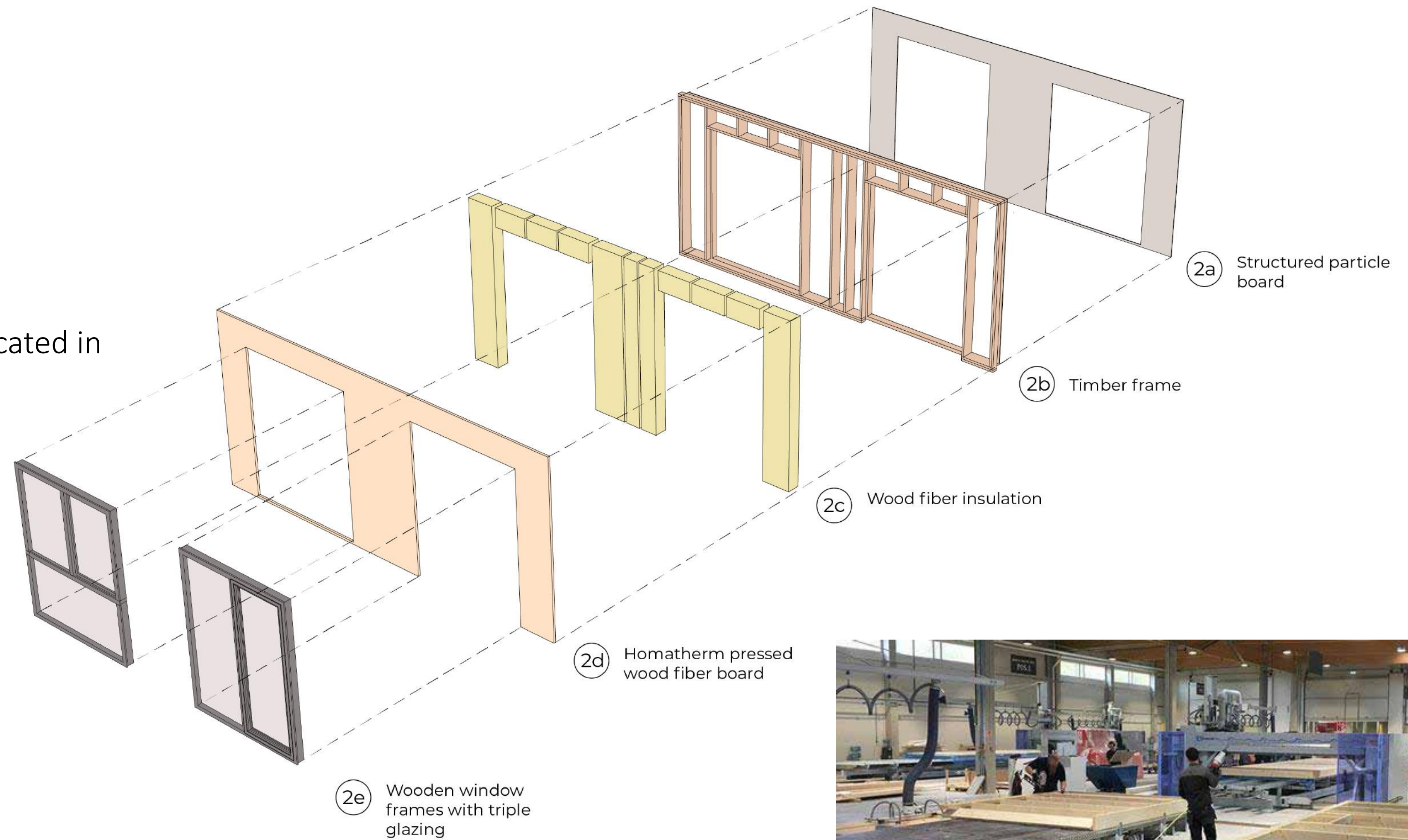
- Prefabricated timber elements
- Balconies and wooden cladding added later





# Facade Build up

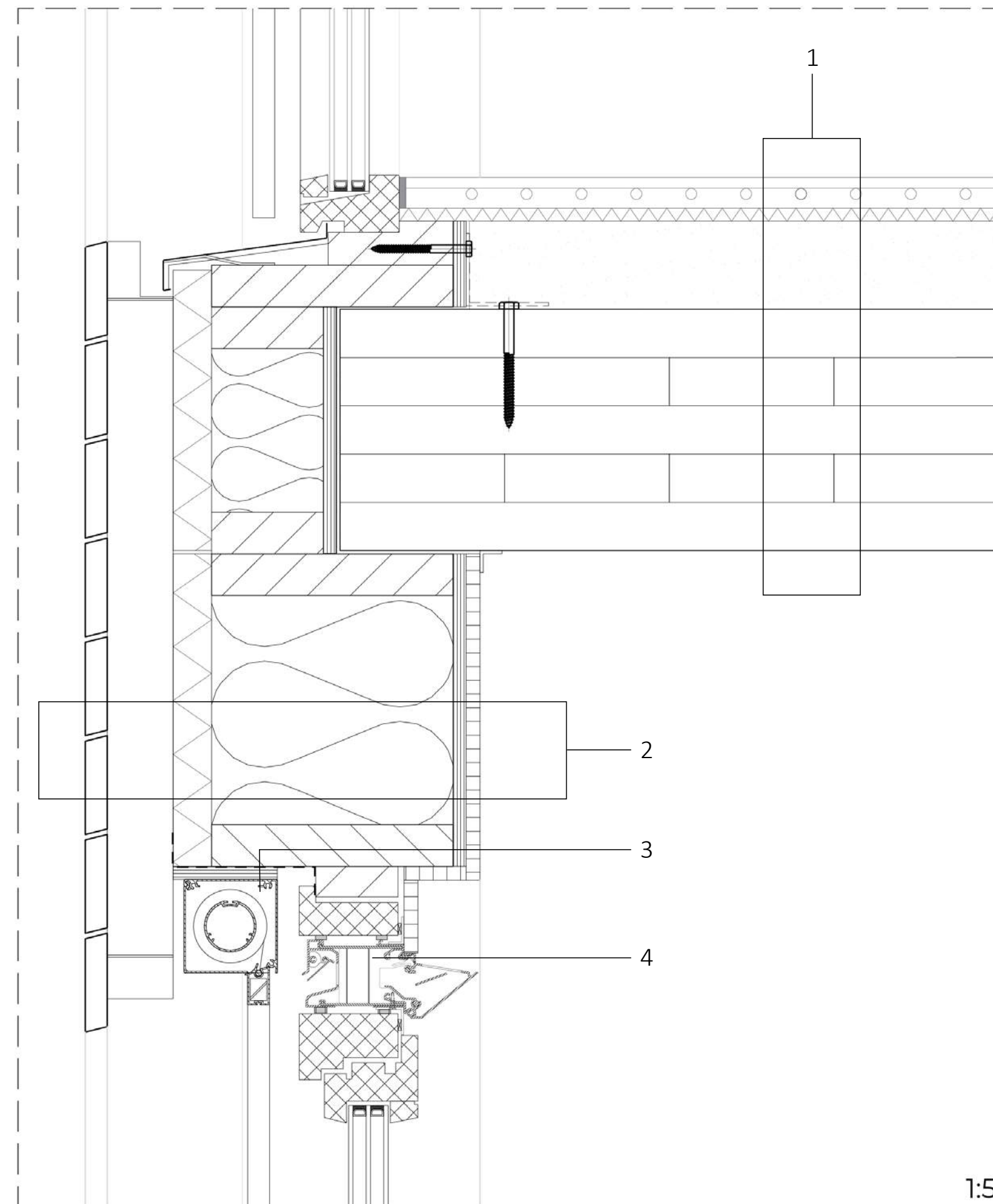
- Timber frame elements fabricated in factory
- Advantages:
  - fast construction
  - high precision
  - better insulation





# Facade Detail

- Standard detail of connection facade/floor



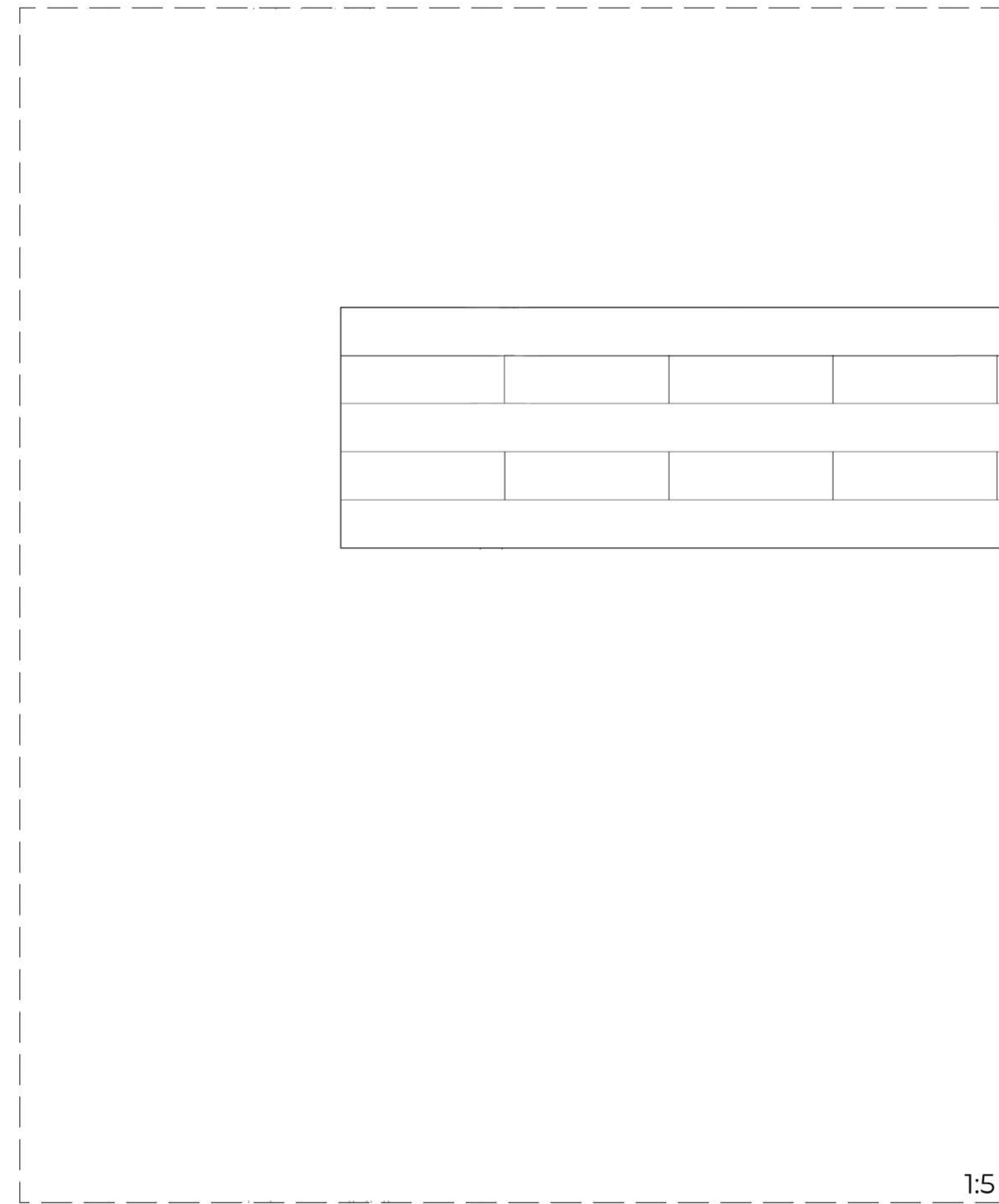
■ Vertical detail - 1:10  
Facade/floor standard

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



# Facade Detail

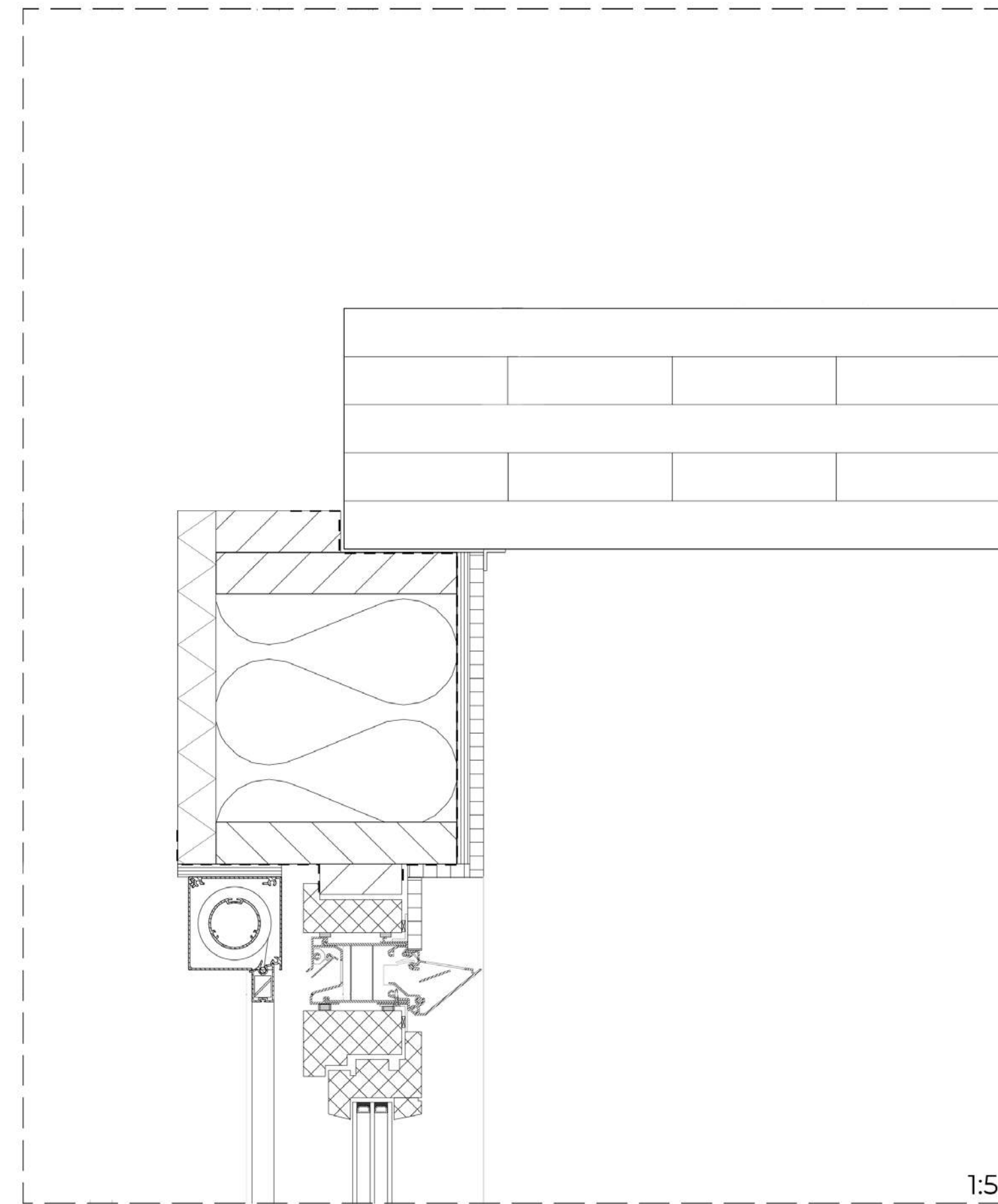
- Step 1: CLT load bearing structure





# Facade Detail

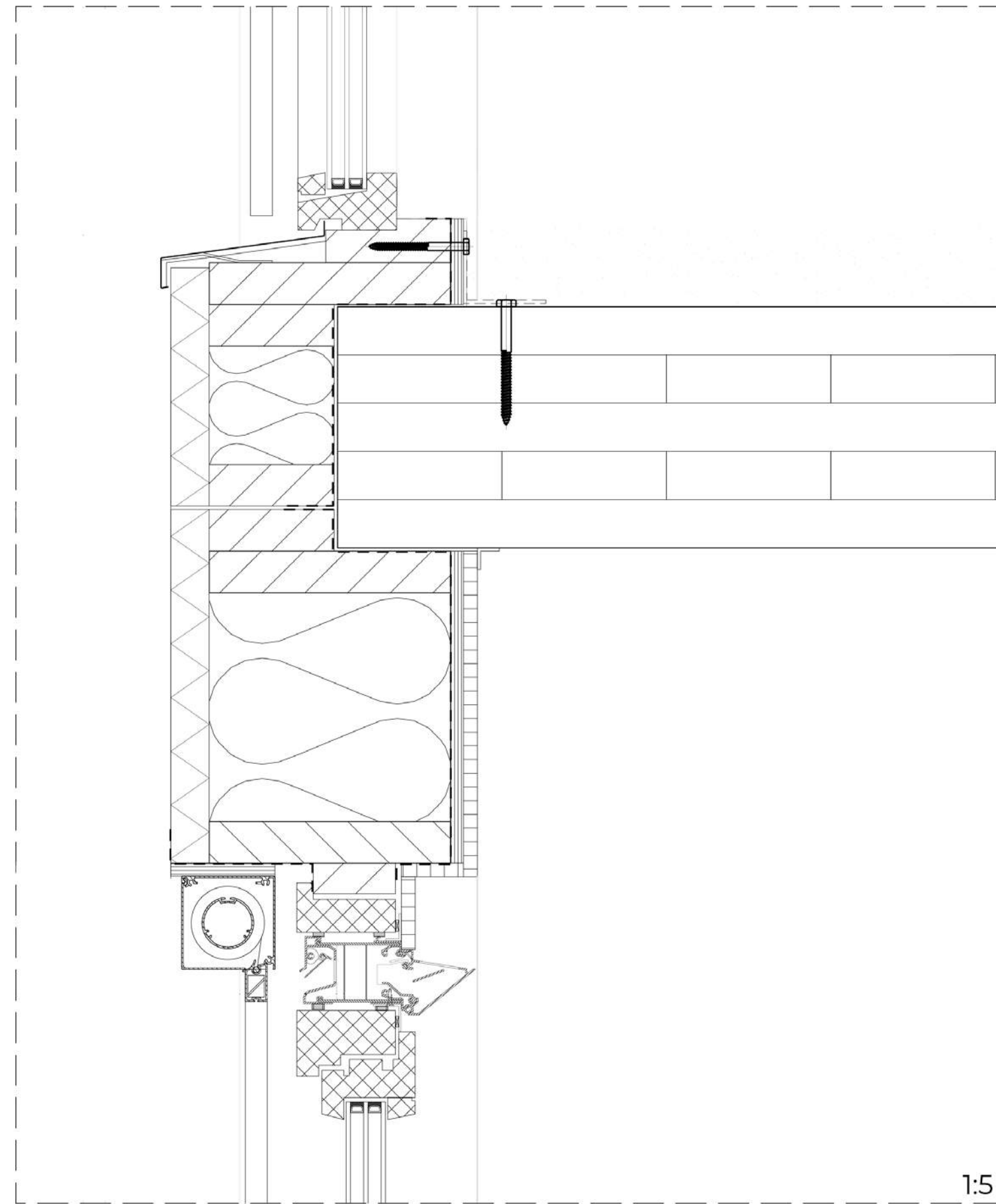
- Step 1: CLT load bearing structure
- Step 2: Placing first prefab element





# Facade Detail

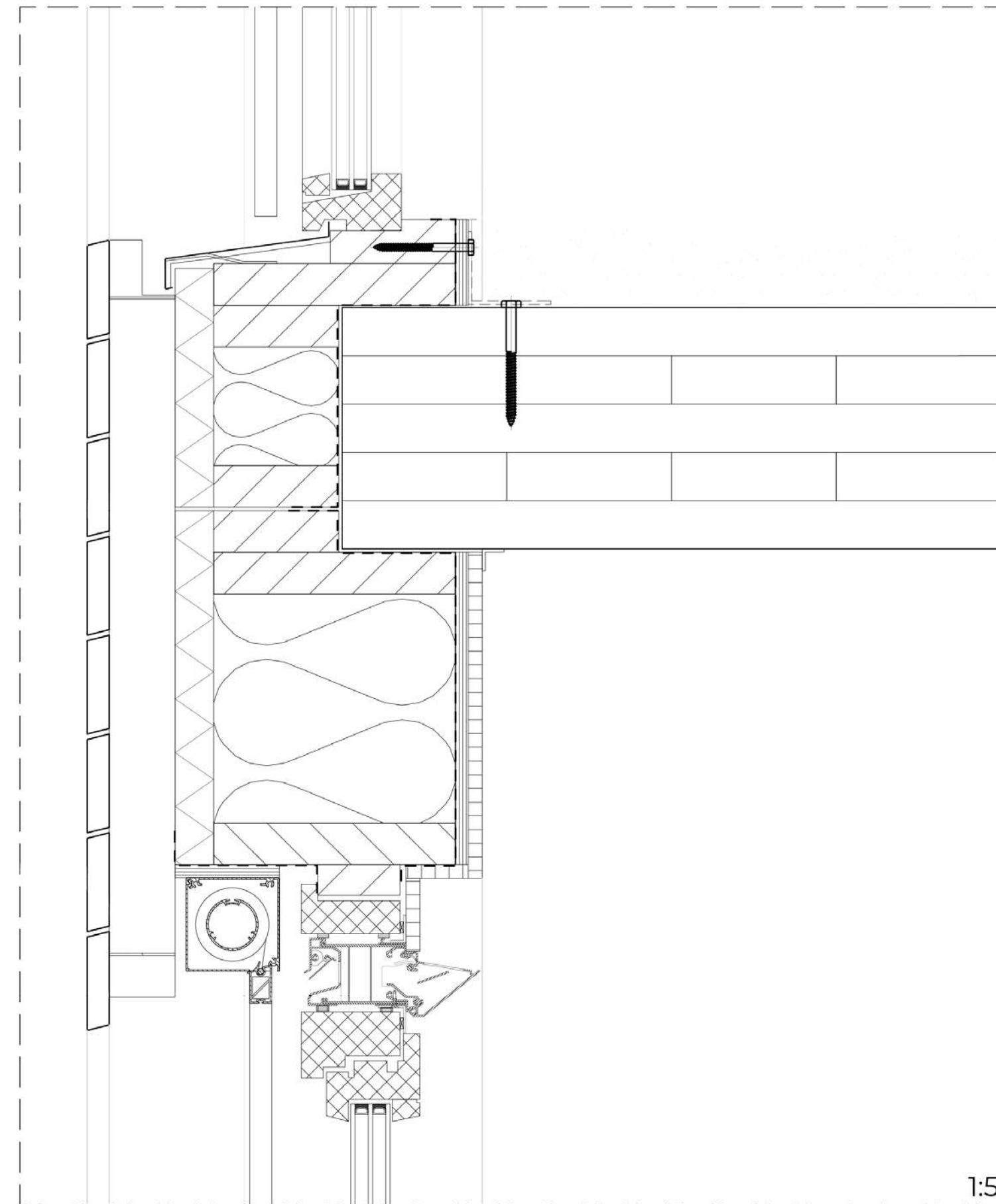
- Step 1: CLT load bearing structure
- Step 2: Placing first prefab element
- Step 3: Placing second prefab element





# Facade Detail

- Step 1: CLT load bearing structure
- Step 2: First prefab element
- Step 3: Second prefab element
- Step 4: Timber facade cladding





# Facade Detail

- Step 1: CLT load bearing structure
- Step 2: First prefab element
- Step 3: Second prefab element
- Step 4: Timber facade cladding
- Step 5: Interior finis

