

DESIGN FOR CHANGE

An **adaptable housing complex** which deals
with the **impermanence of Architecture**



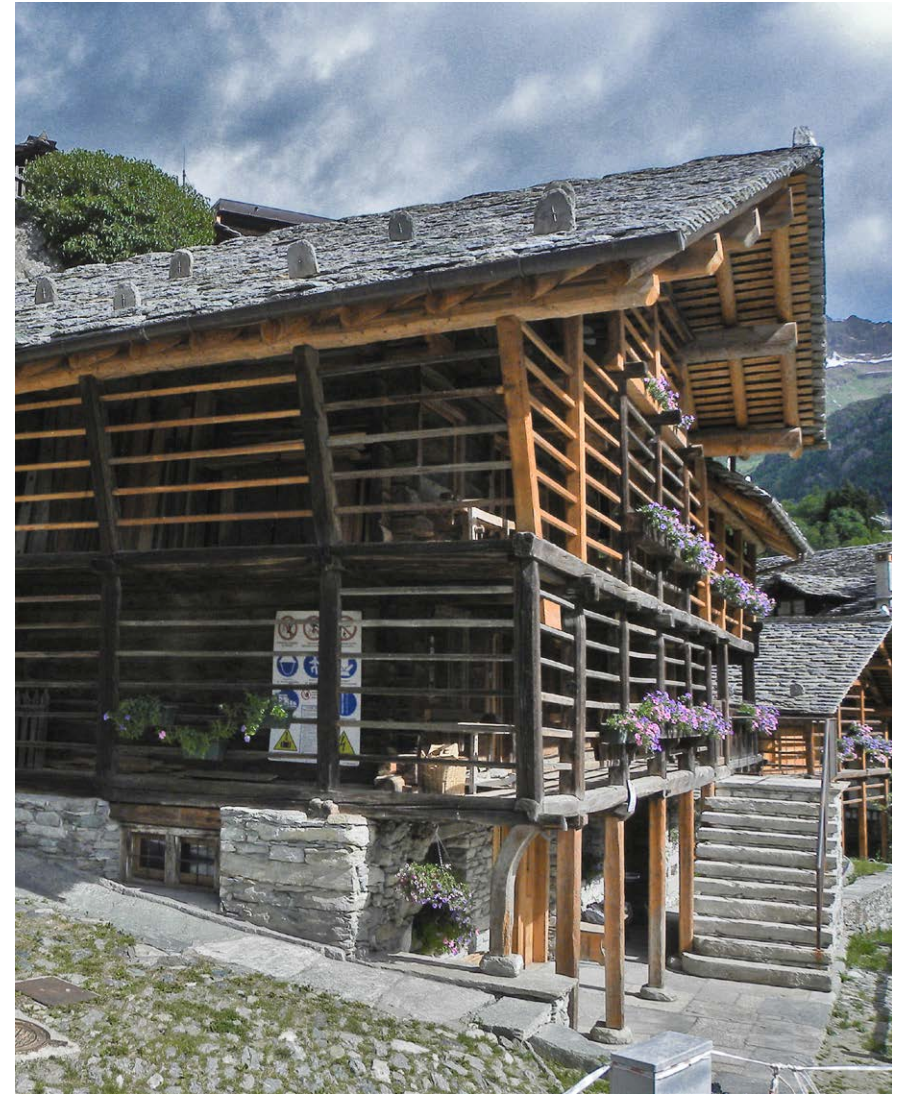
CONTEXT

- inspiration
- social context
- environmental context
- target group
- design objective
- urban context

DESIGN

- project vision
- building system
 - the building and the city
 - the communal spaces
 - organization of the building
 - the climate design
 - the clusters
 - the relation between research and design
 - the building system in detail
 - the adaptability of the system
 - conclusions

→ inspiration



→ social context



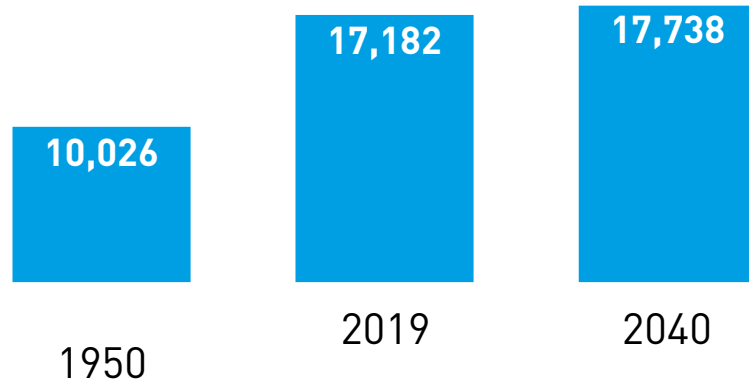
→ environmental context



→ social context

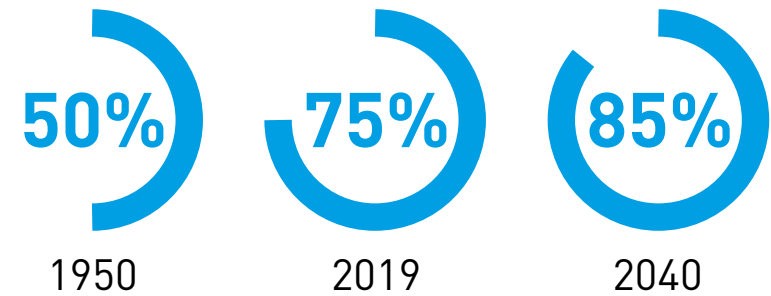
Dutch population (mil.)

Source: UN World Population Prospects



European population living in cities

Source: UN Urbanization Prospects



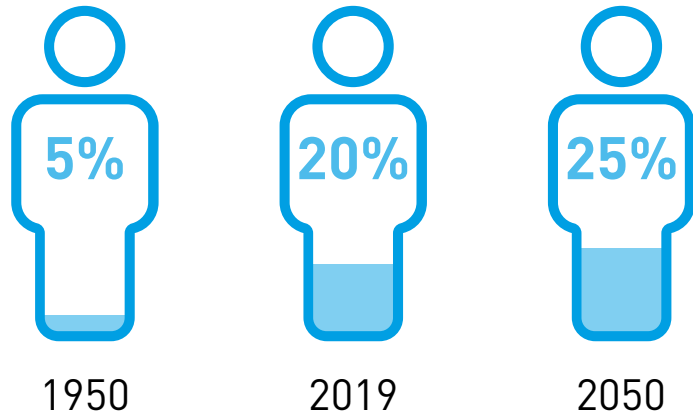
→ **+1 MILLION HOMES** ←
BY 2030

Source: Dutch Minister of Foreign Affairs

→ social context

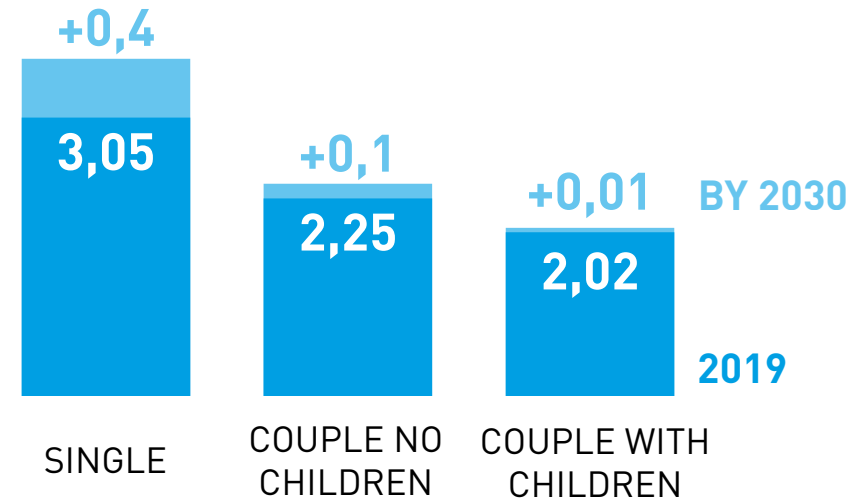
people living alone in the Netherlands

Source: Statistics Netherlands (CBS)



household types prospect (mil)

Source: Statistics Netherlands (CBS)



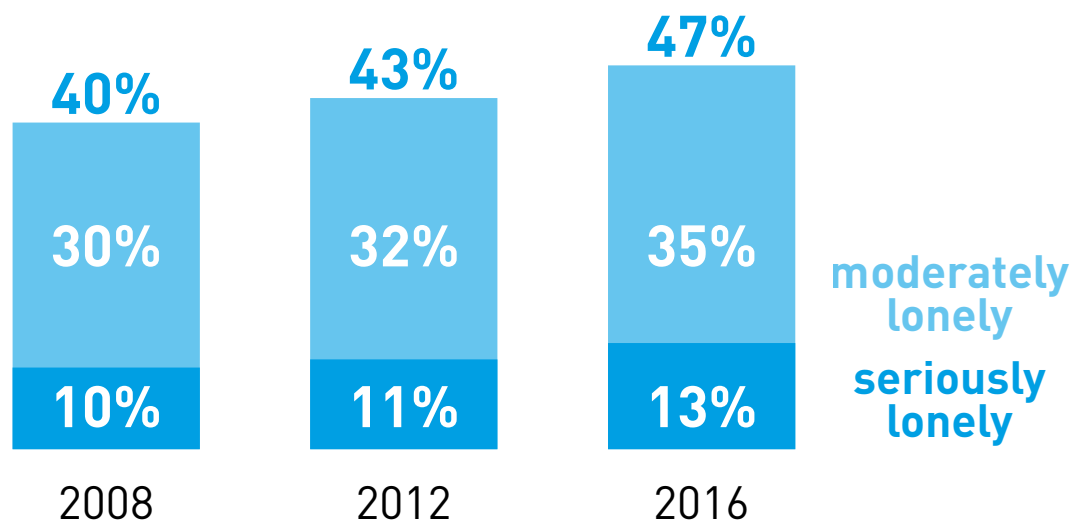
+400.000
INDIVIDUALS
BY 2030

Source: Statistics Netherlands (CBS)

→ social context

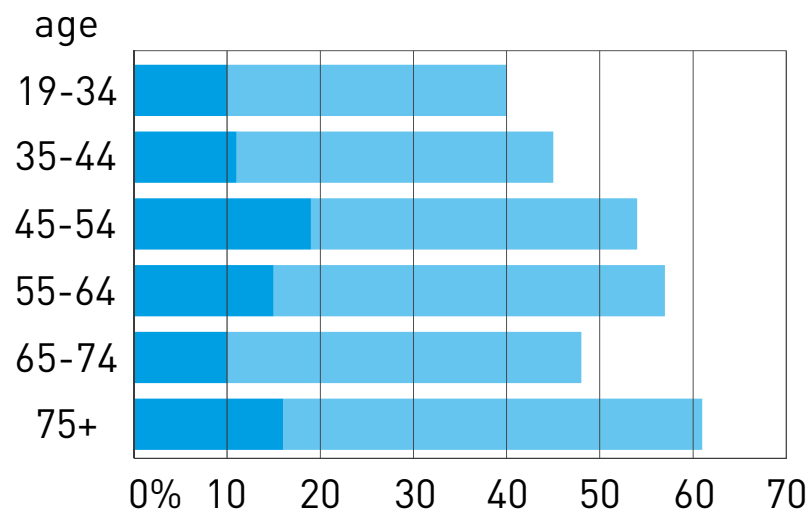
loneliness among Amsterdammers aged 19 and older

Source: Amsterdamse Gezondheidsmonitor 2016



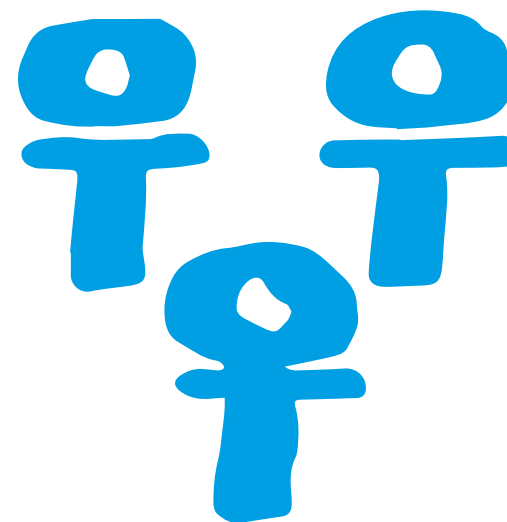
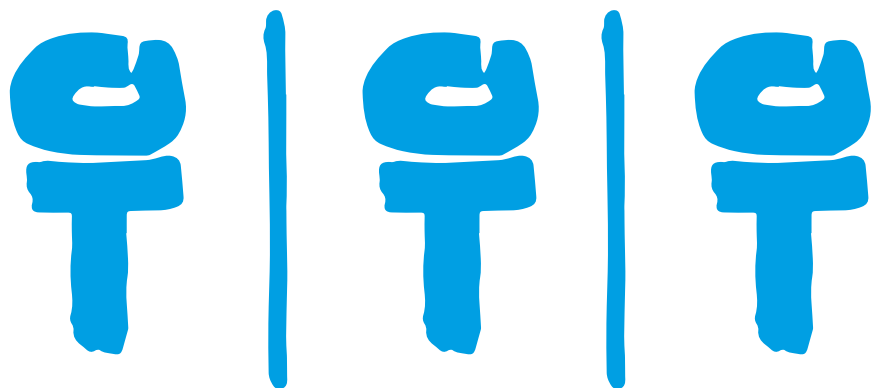
loneliness among Amsterdammers by age in 2016

Source: Amsterdamse Gezondheidsmonitor 2016



→ social context

+1 MILLION
HOMES



→ architectural context



P. Blom - Gesloten Staat - Amersfoort

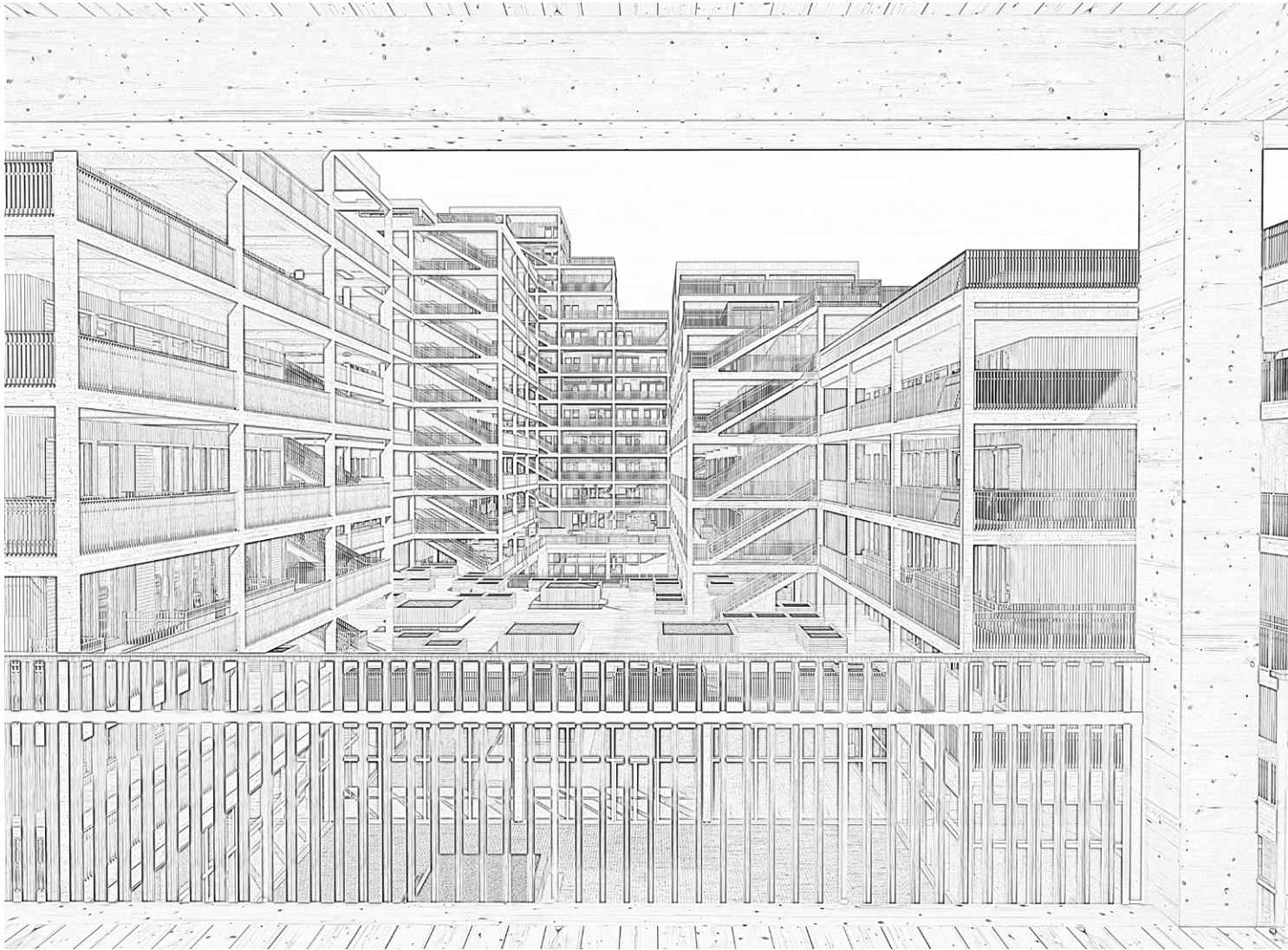
P. Blom - Cube Houses - Rotterdam

H. Hertzberger - Diagon house - Delft

→ architectural context

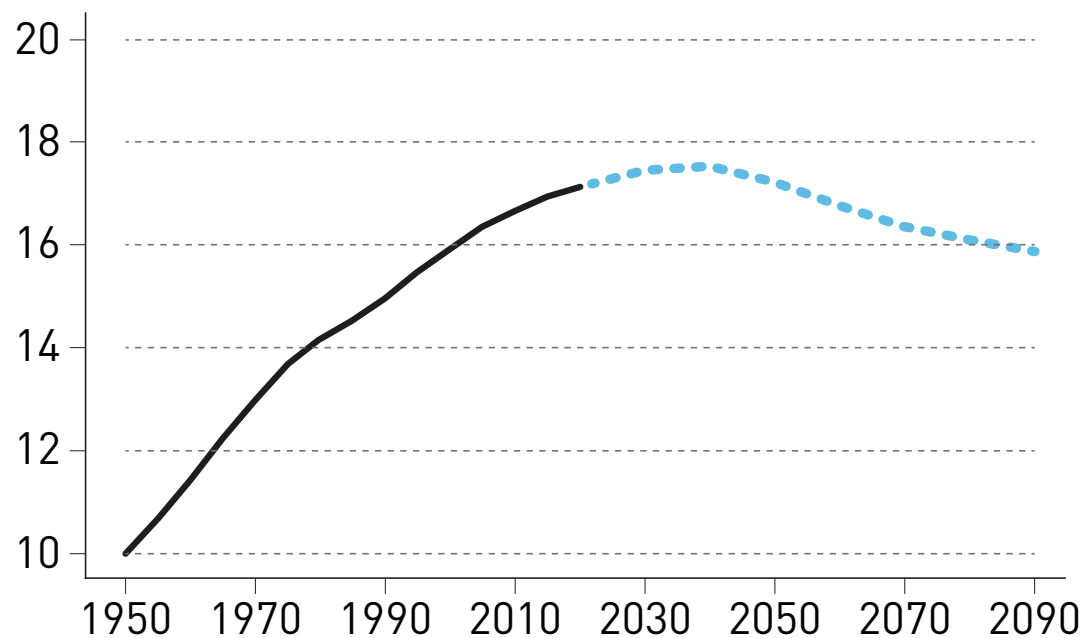
“...sought to **encourage encounter** and **communication**. Architectural features including **courtyards, open stairways**, visually connected **networks of paths**, and the **plastic articulation of building volumes and façades** were designed to produce **rich visual and spatial connections** between adjacent houses and flats, and provide areas that invited inhabitants to make **fuller use of exterior shared spaces.**”

Di Palma et al. - Intimate Metropolis - (2009)



Dutch population prospect

Source: UN World Population Prospects

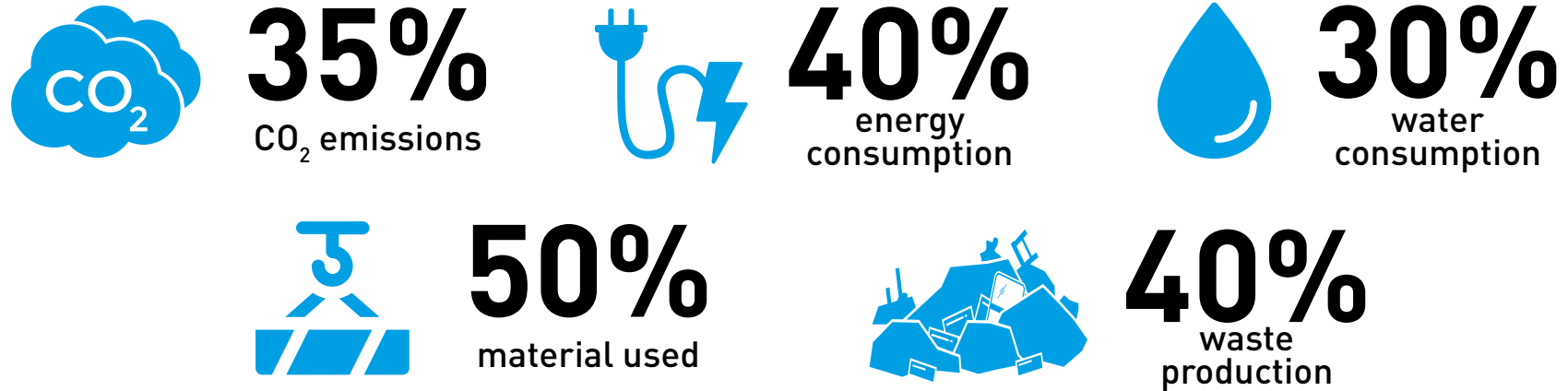


after 2040 the population of the Netherlands is expected **to decrease**

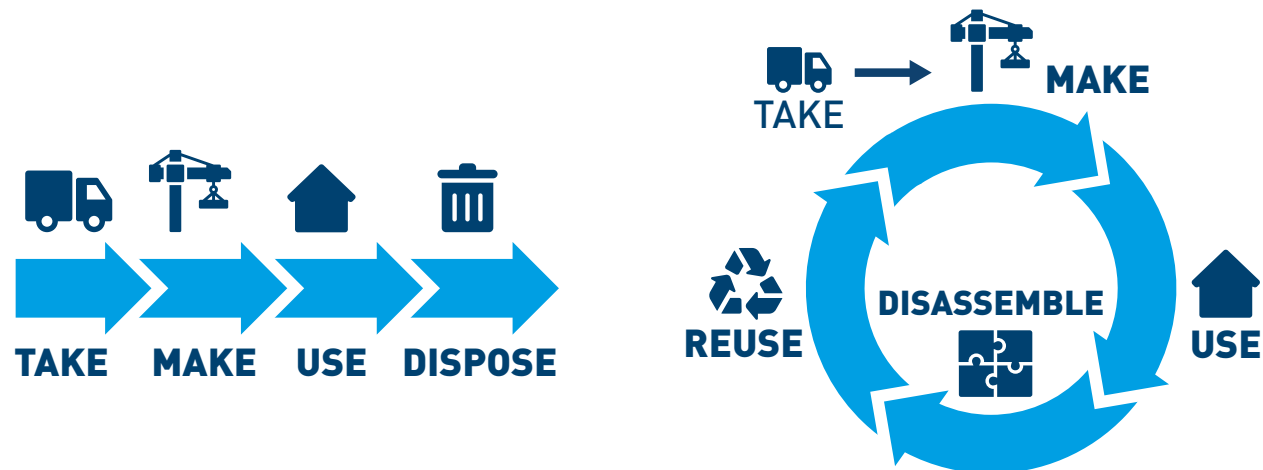
environmental context

The impact of the built environment

Source: Government of the Netherlands



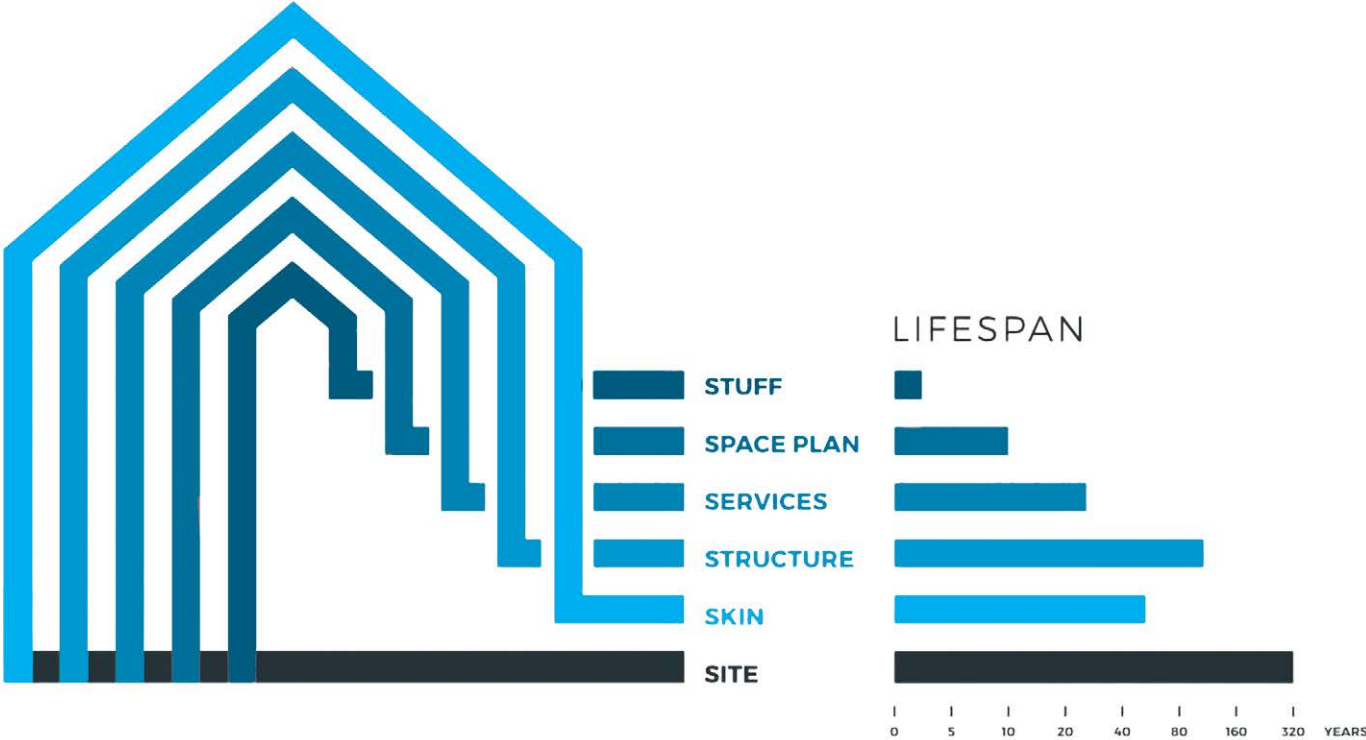
From linear to circular



→ environmental context

The building layers

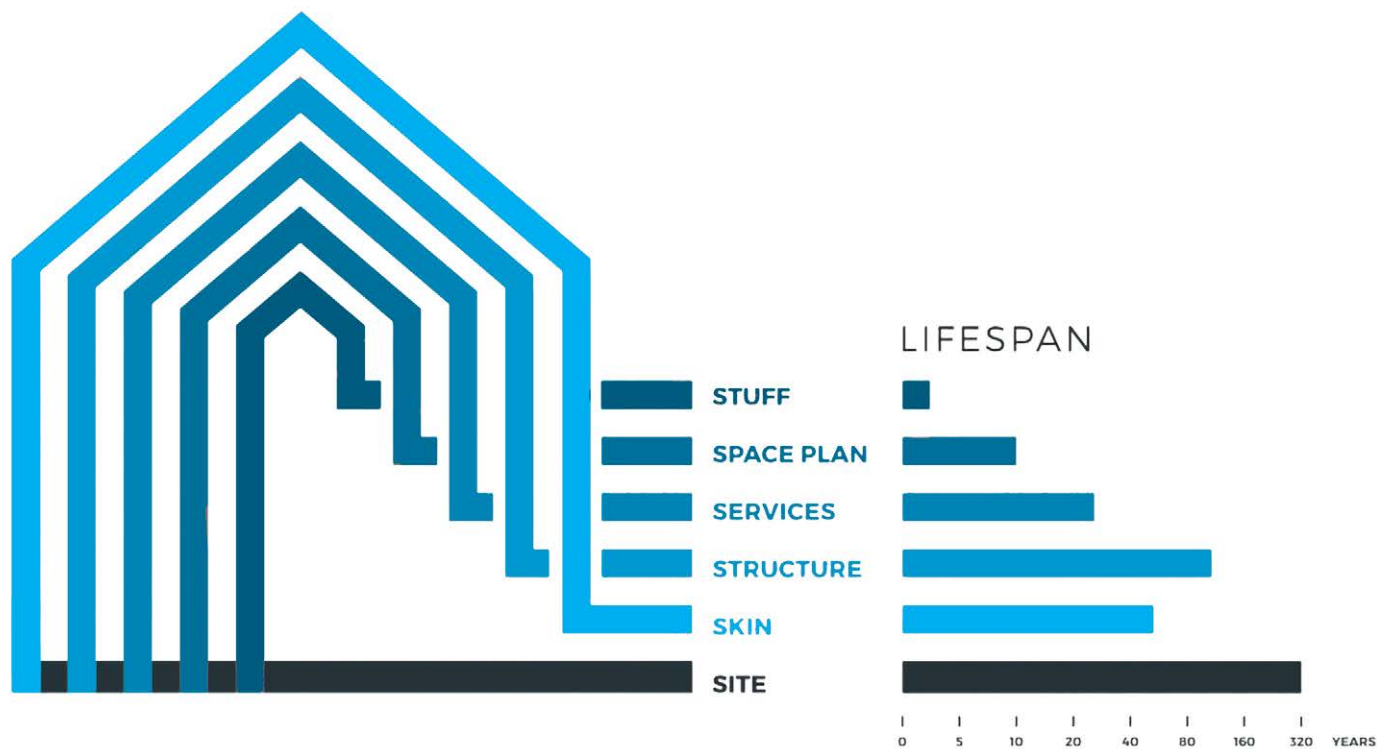
Source: Stewart Brand - How Buildings Learn (1994)



→ environmental context

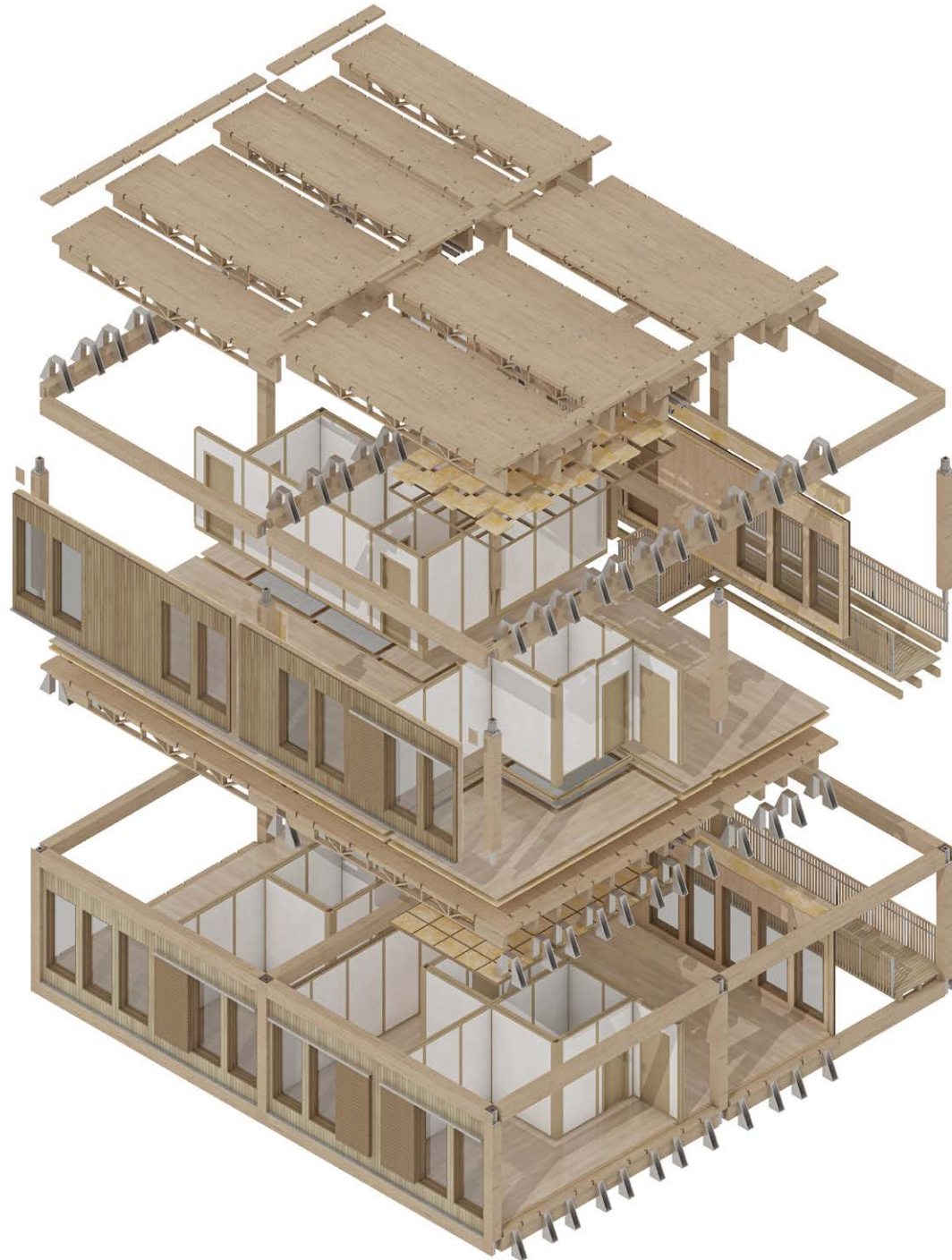
The building layers

Source: Stewart Brand - How Buildings Learn (1994)



the different **layers** need to be **separable** in systems which can be **demounted** and easily **accommodate the changes** of our society

- building system



- target group

The Sharing Economy



- target group

The ideal coliving for individuals

Source: One Shared House 2030 - SPACE 10

ONE SHARED

a playful research project by

- close to the city centre
- small community (4 - 10 people)
- willing to share
 - garden
 - common facilities
 - living space
 - kitchen
- not willing to share
 - bedroom
 - bathroom

HOUSE 2030

anton & irene + SPACE10

→ design objective

Design objective

The project aims to answer the current **need of HOUSING** creating **rich visual and spatial connections** that invited inhabitants to make full use of the shared spaces **fostering** the **interaction** and **reducing** the **sense of isolation**.

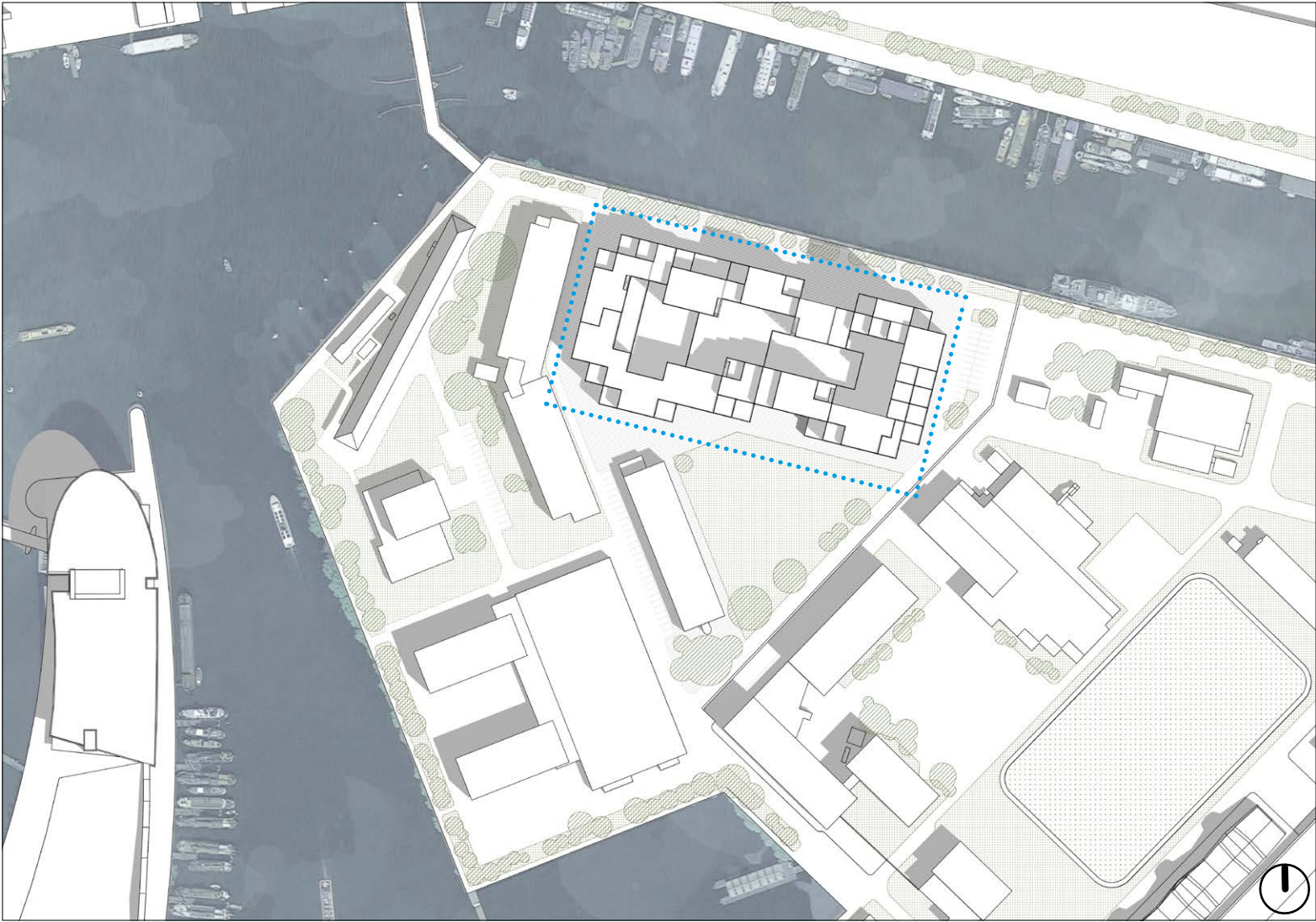
The building should be also able **to constantly ADAPT** to the **ever-changing needs** of the society, **avoiding wastefulness** of resources while fostering their **REUSE**

→ urban context

The Marineterrein - Amsterdam



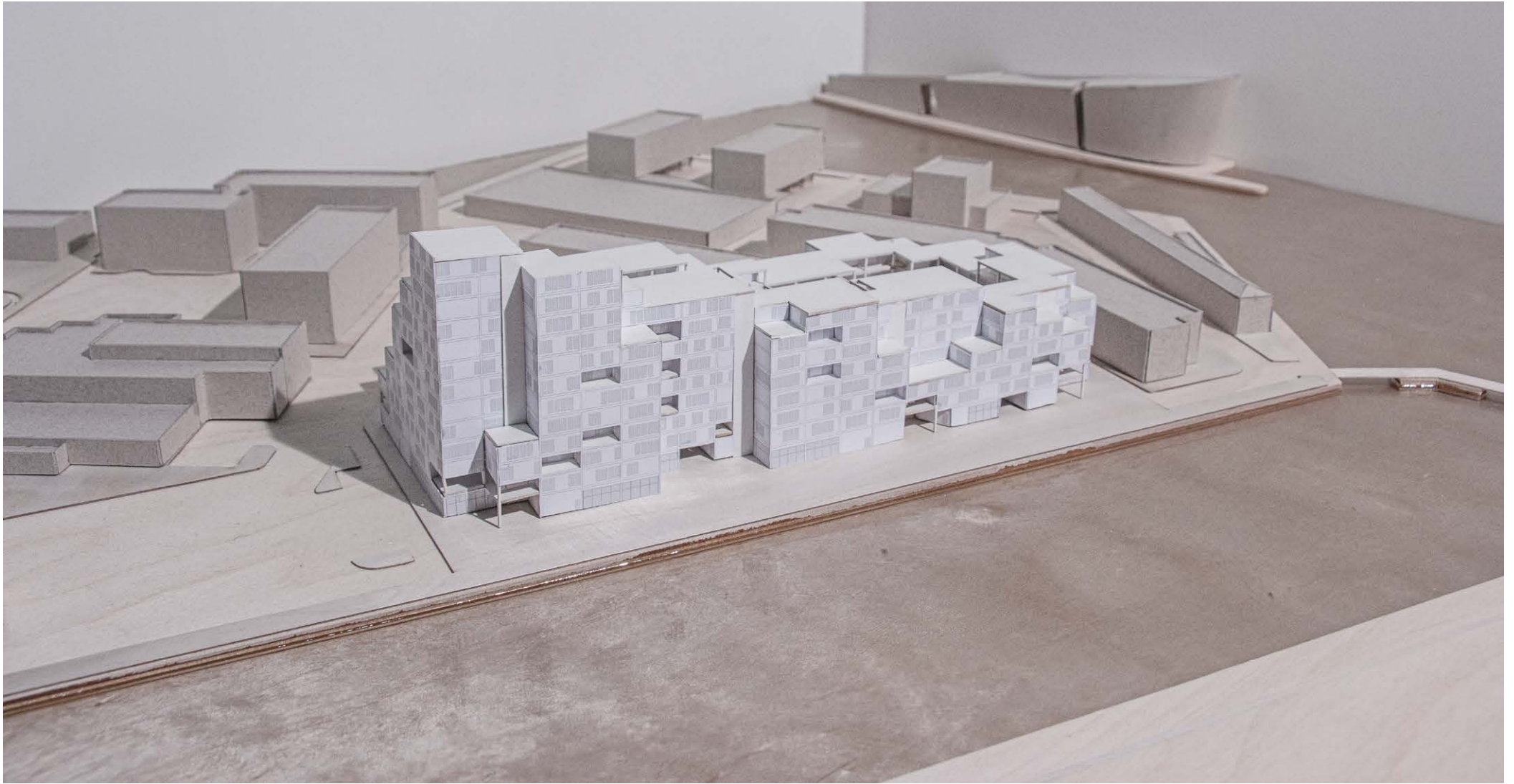
- urban context



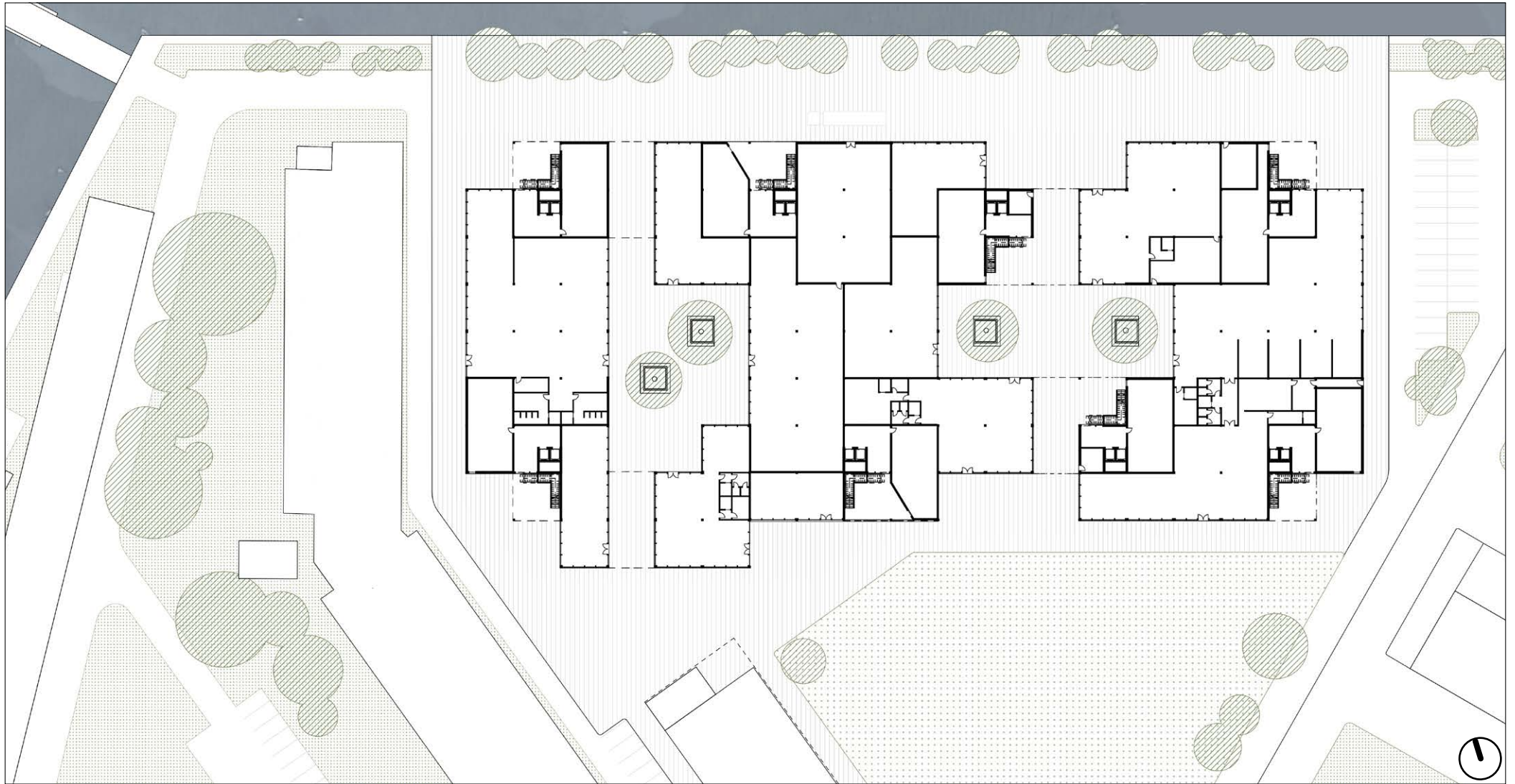
→ urban context



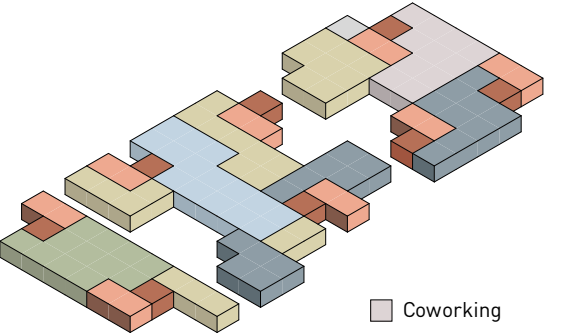
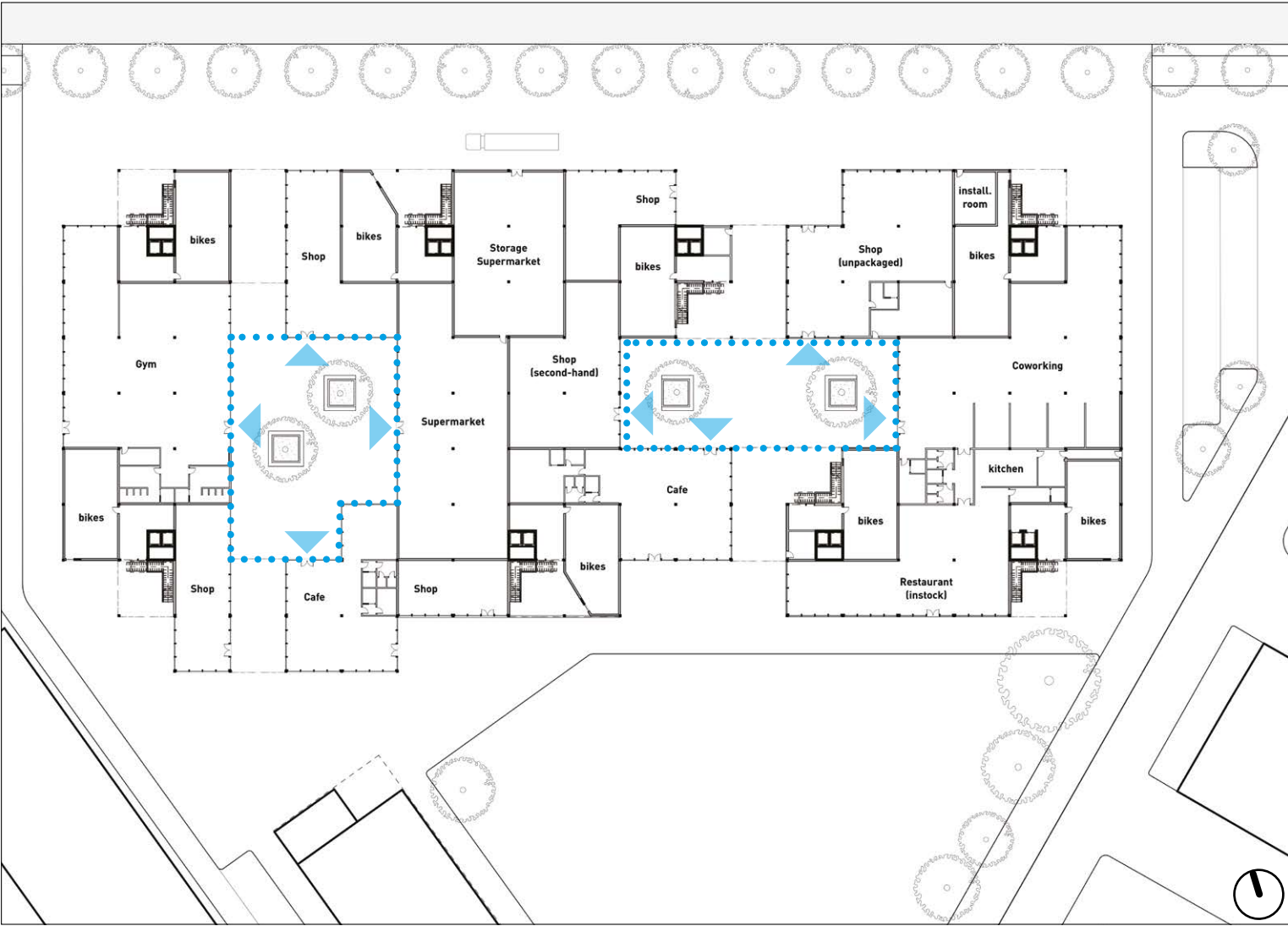
→ urban context



the building and the city

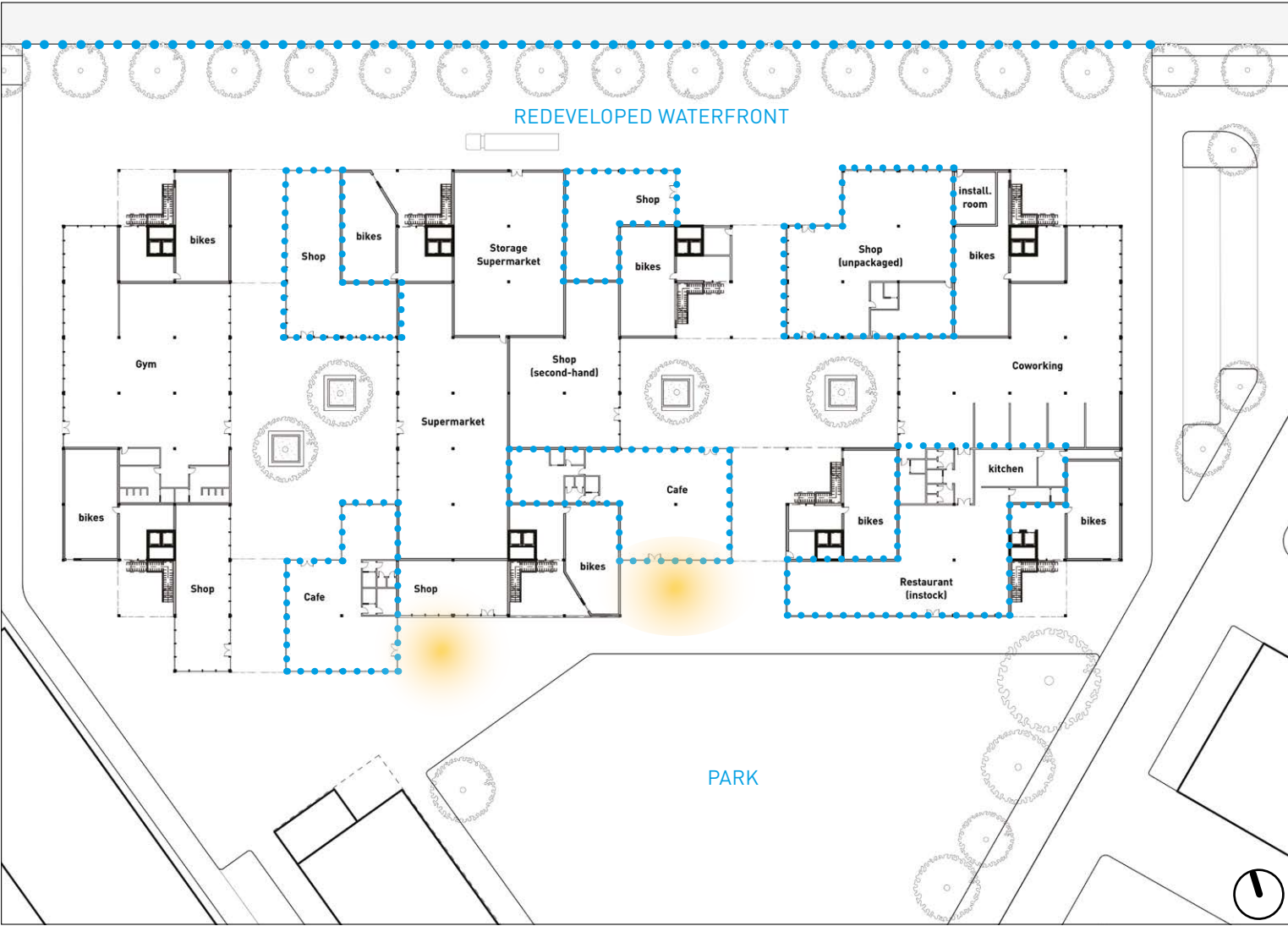
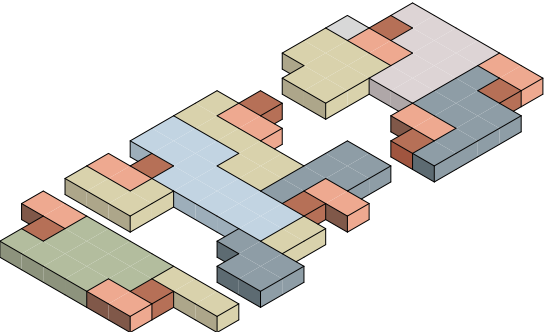


- the building and the city



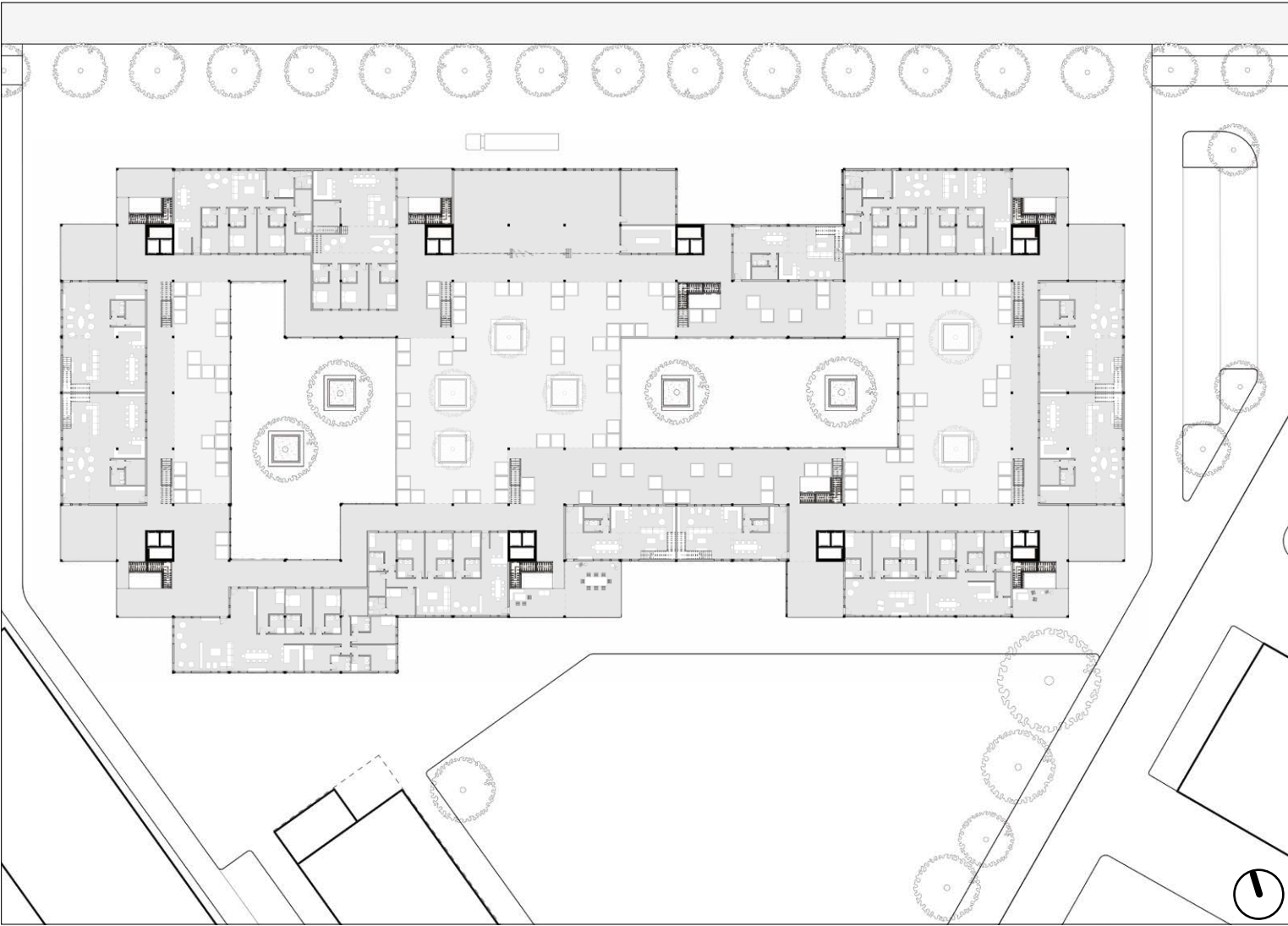
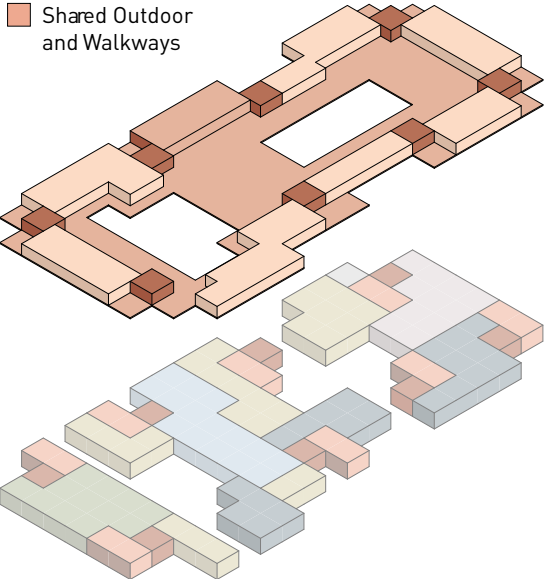
- Gym
- Shop
- Cafe - Restaurant
- Coworking
- Core
- Bike Parking
- Supermarket
- Installation Room

→ the building and the city



- the communal spaces

- Residential - Cluster
- Core
- Shared Outdoor and Walkways

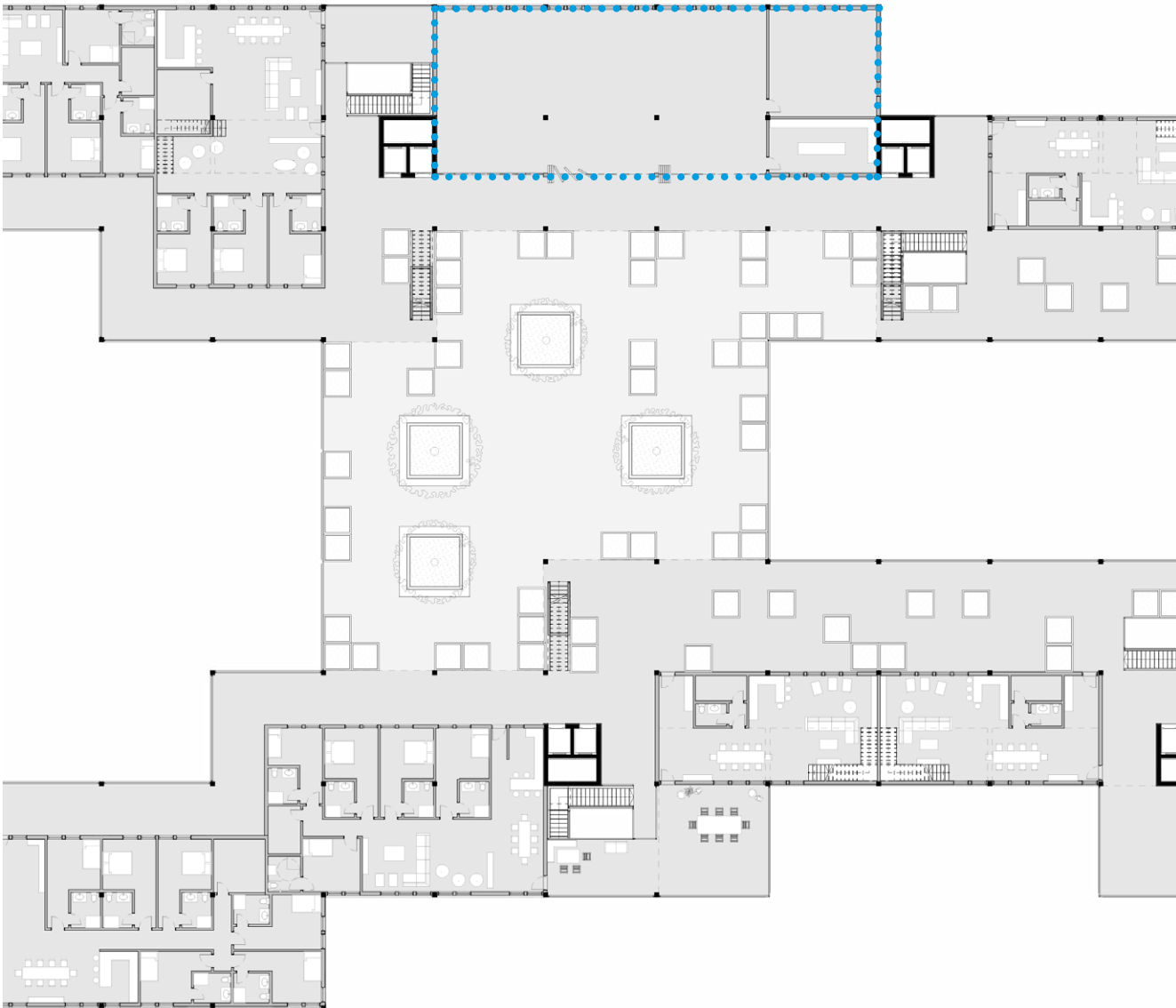
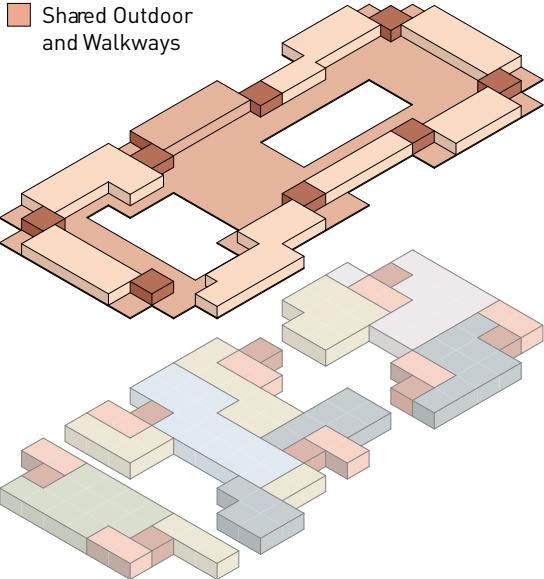


- the communal spaces



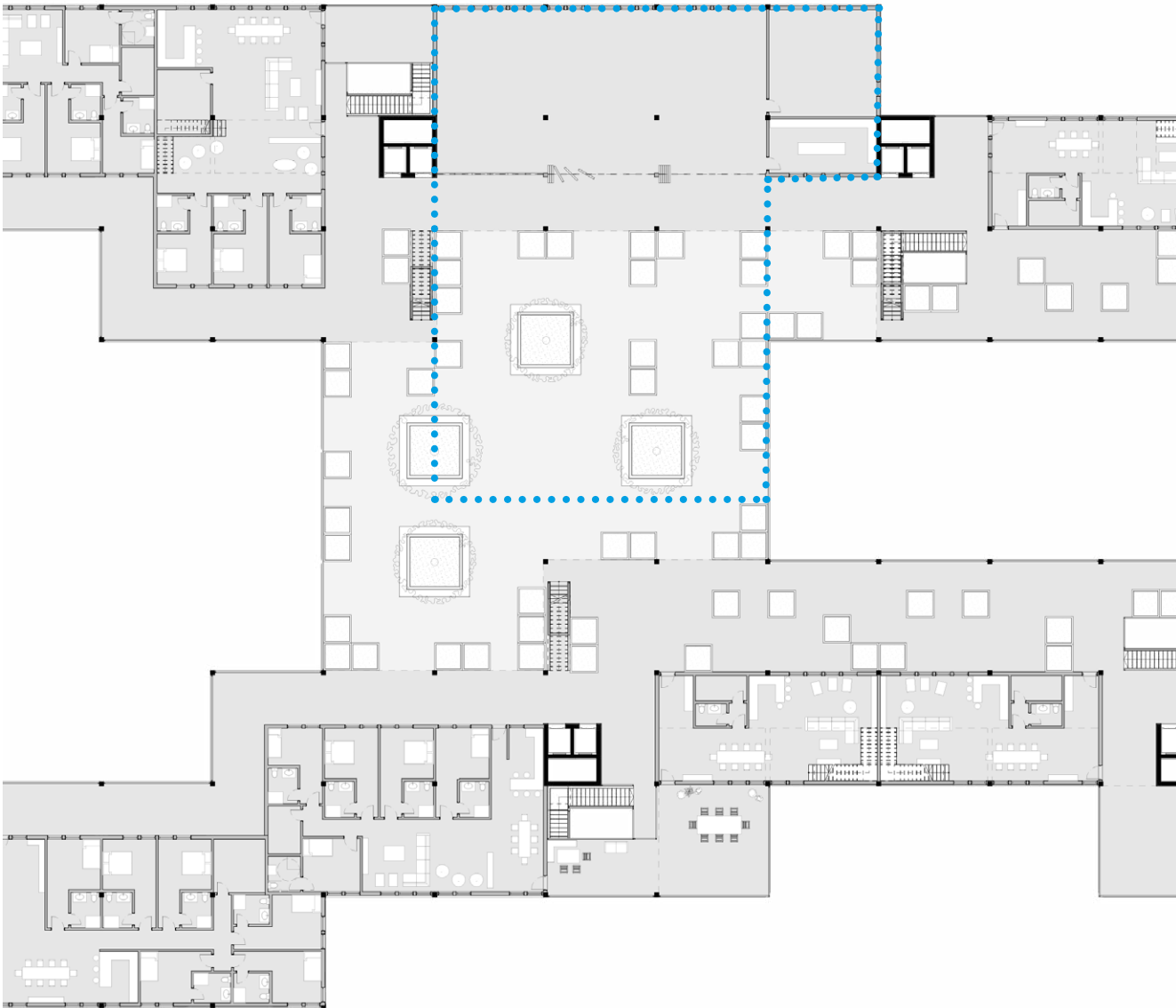
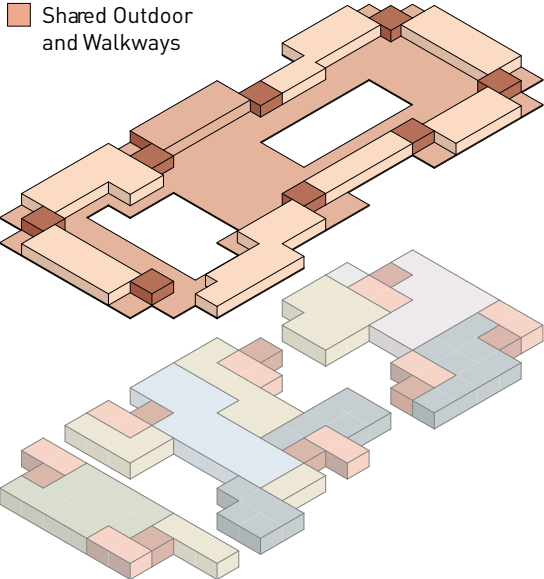
- the communal spaces

- Residential - Cluster
- Core
- Shared Outdoor and Walkways



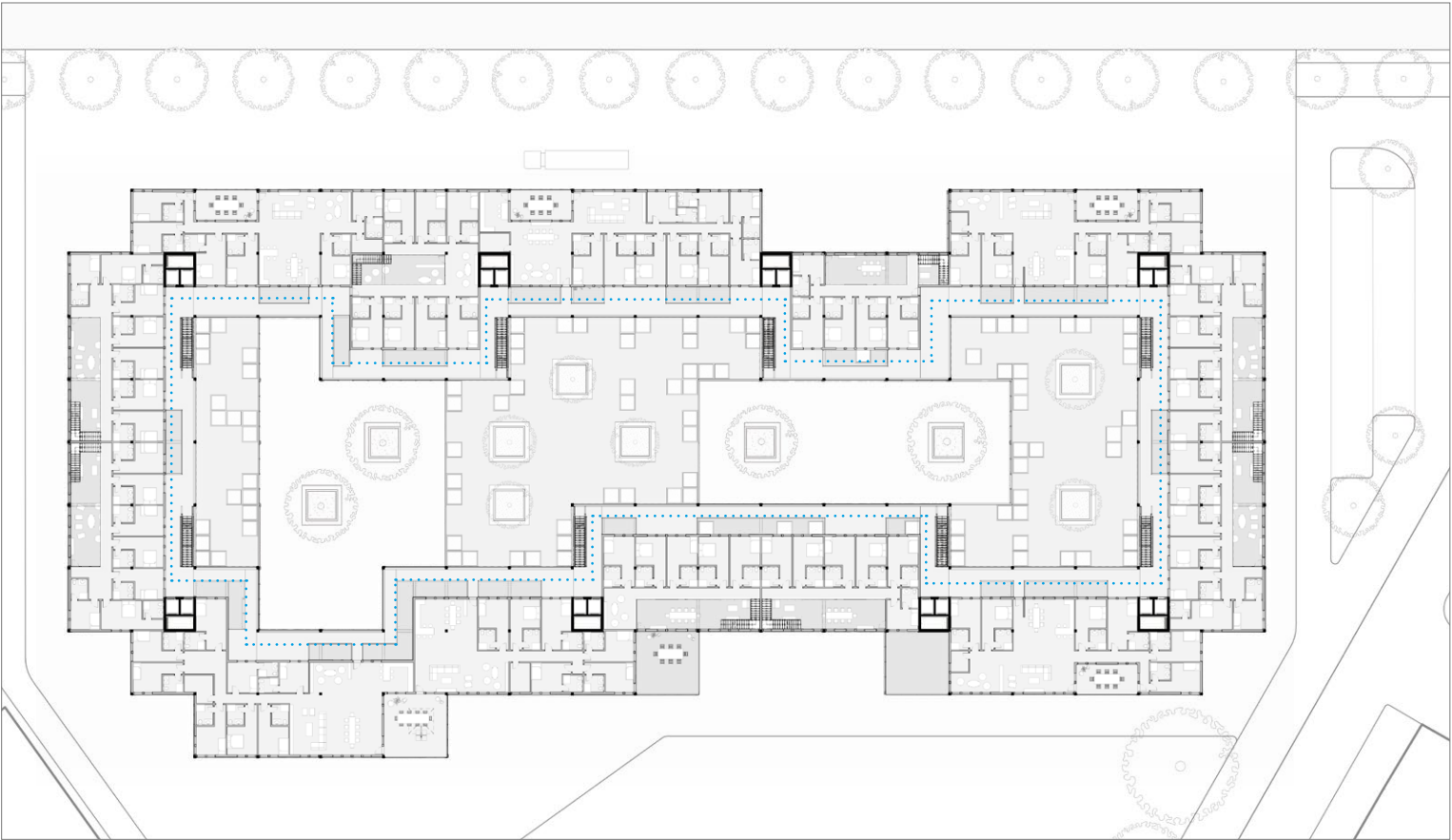
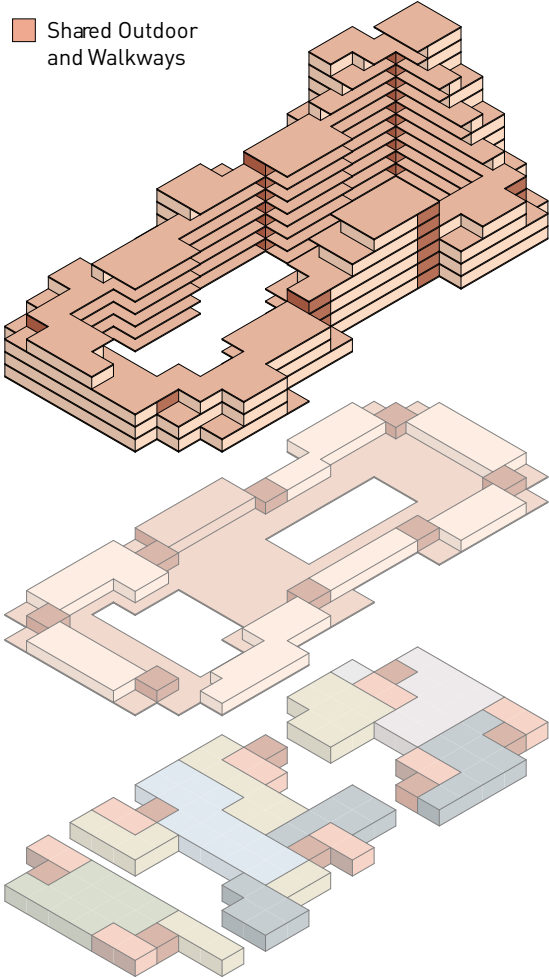
- the communal spaces

- Residential - Cluster
- Core
- Shared Outdoor and Walkways



- the organisation of the building

- Residential - Cluster
- Core
- Shared Outdoor and Walkways

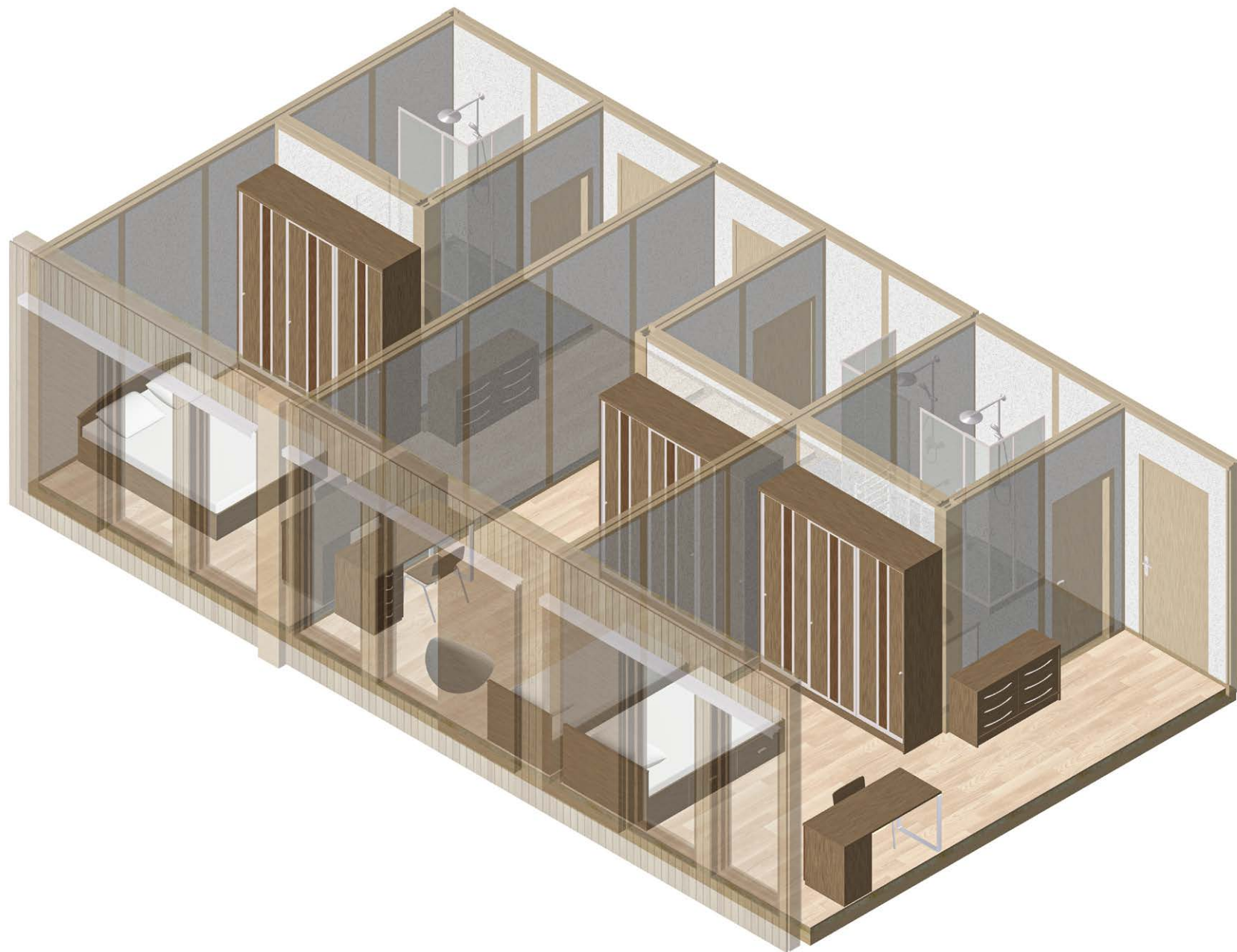


+910 m²
OUTDOOR SPACE

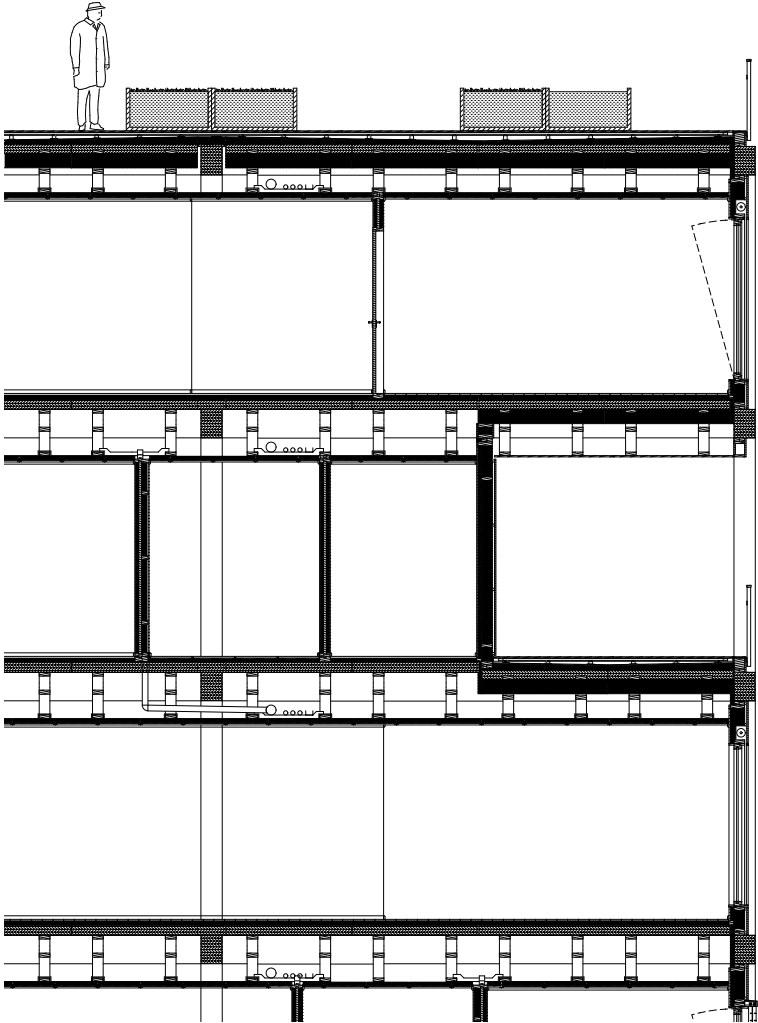
- the cluster



- the cluster



- the cluster

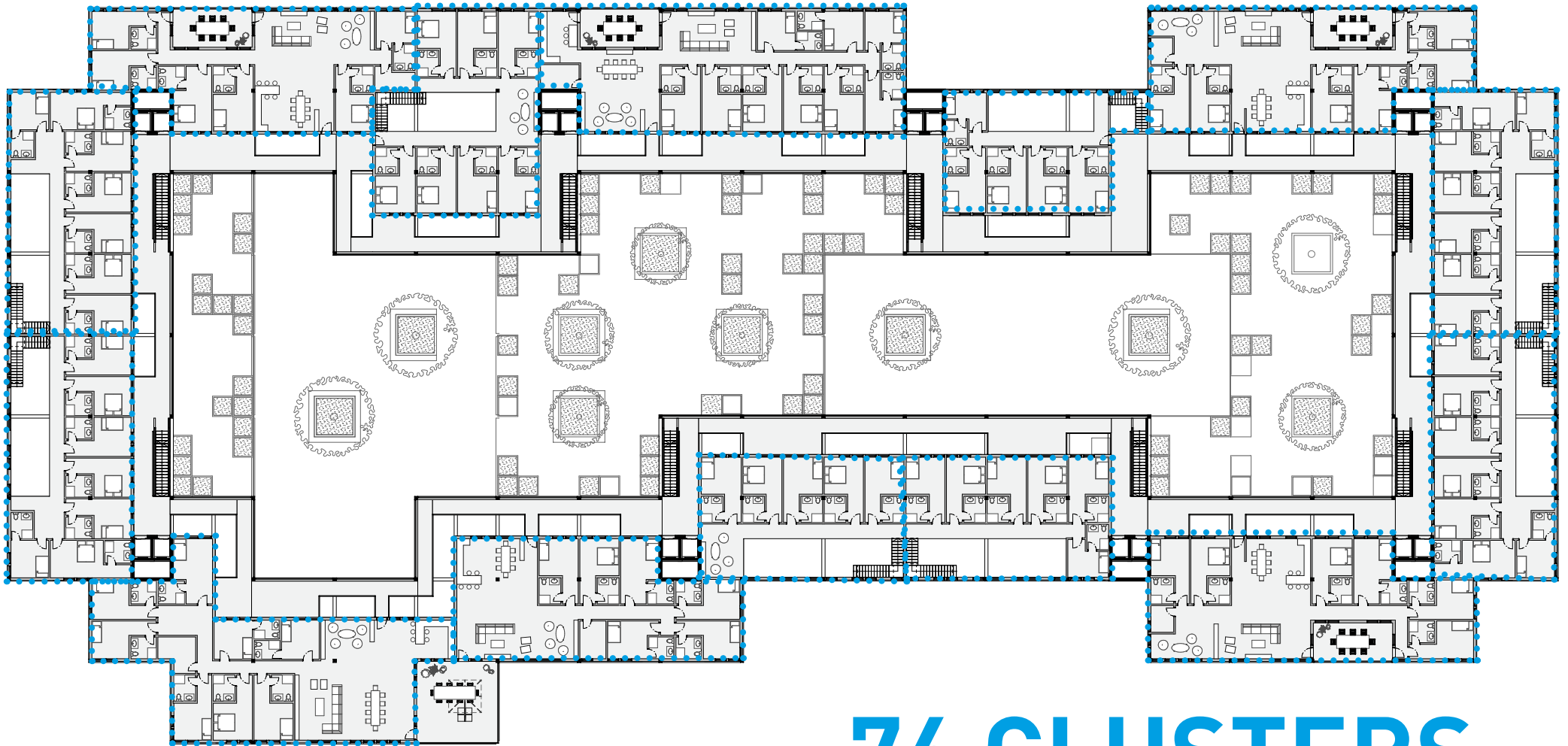


→ the cluster



WALKWAY
+910 m²
OUTDOOR SPACE

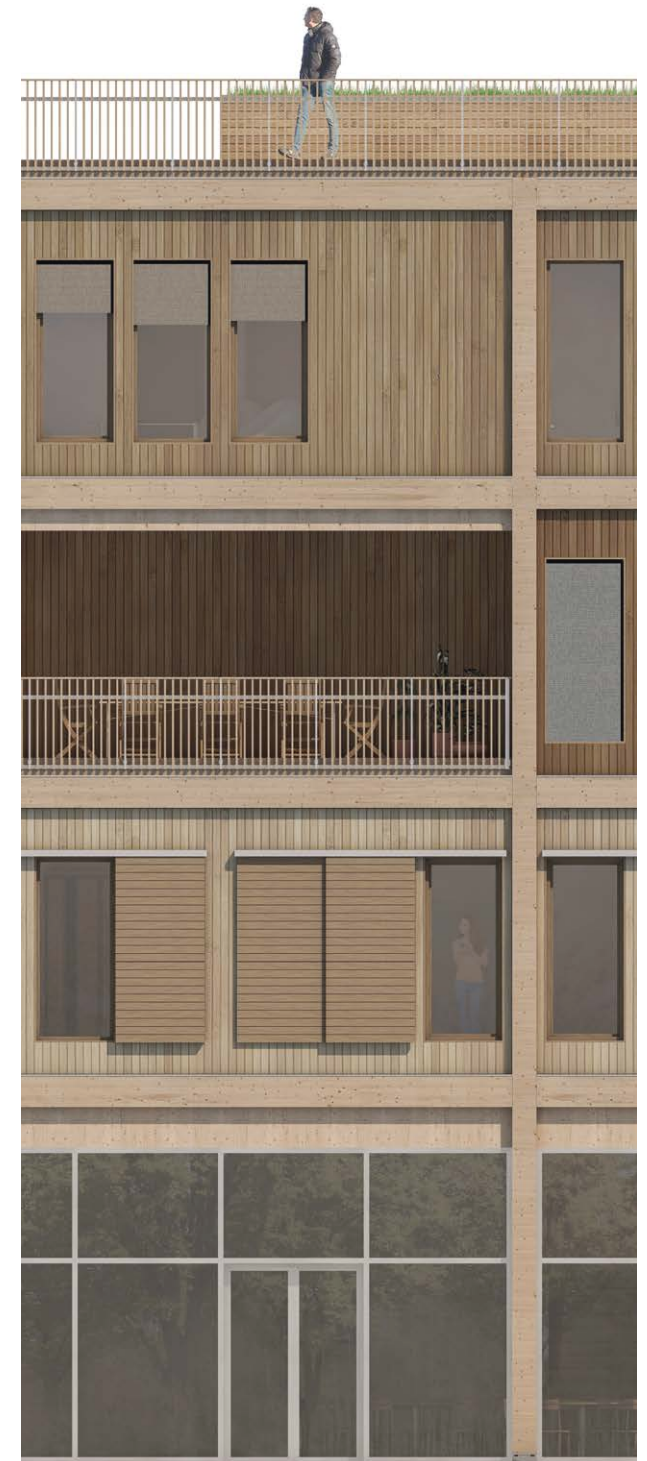
- the cluster



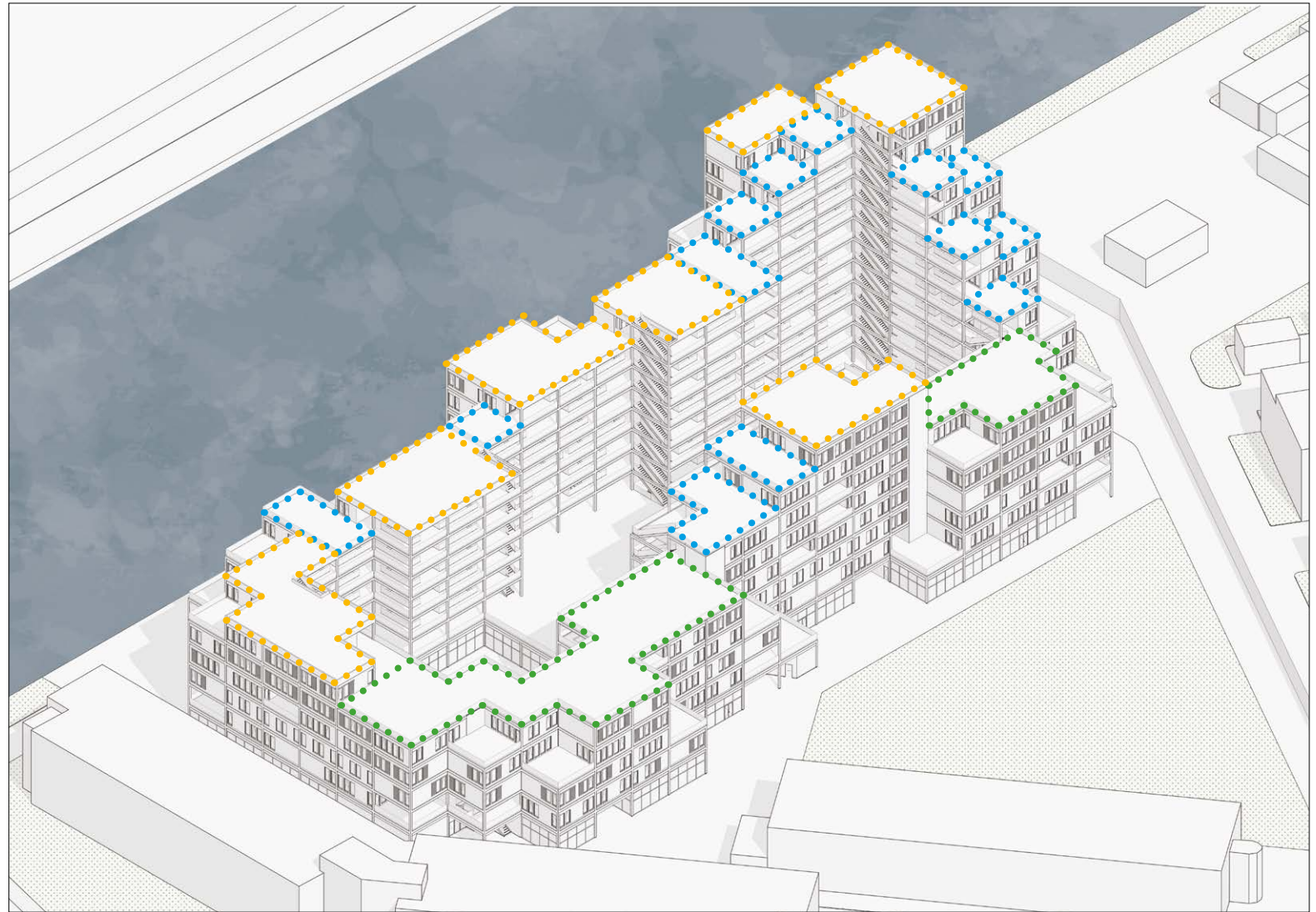
76 CLUSTERS
470 UNITS






→ the appearance of the building



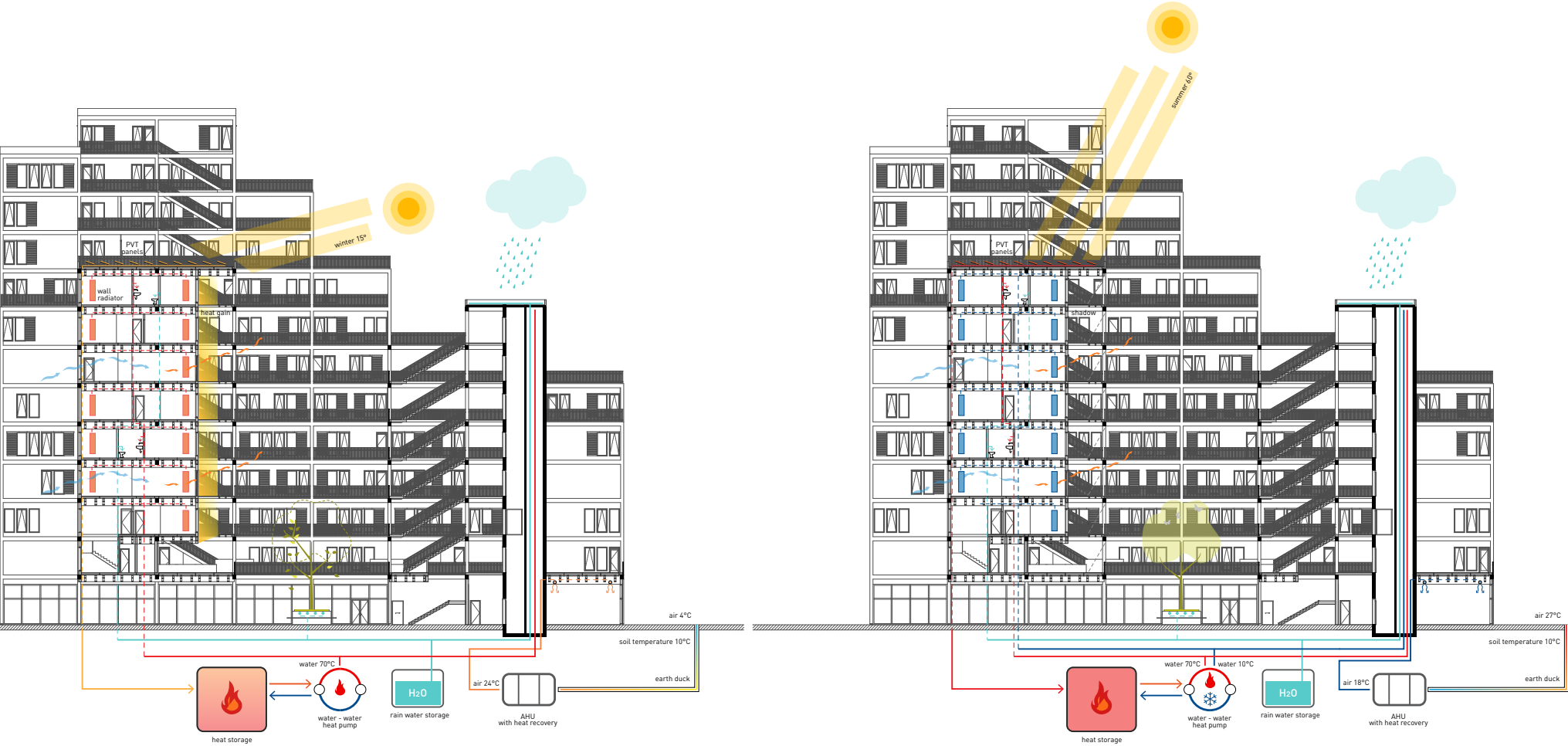
→ the organisation of the building



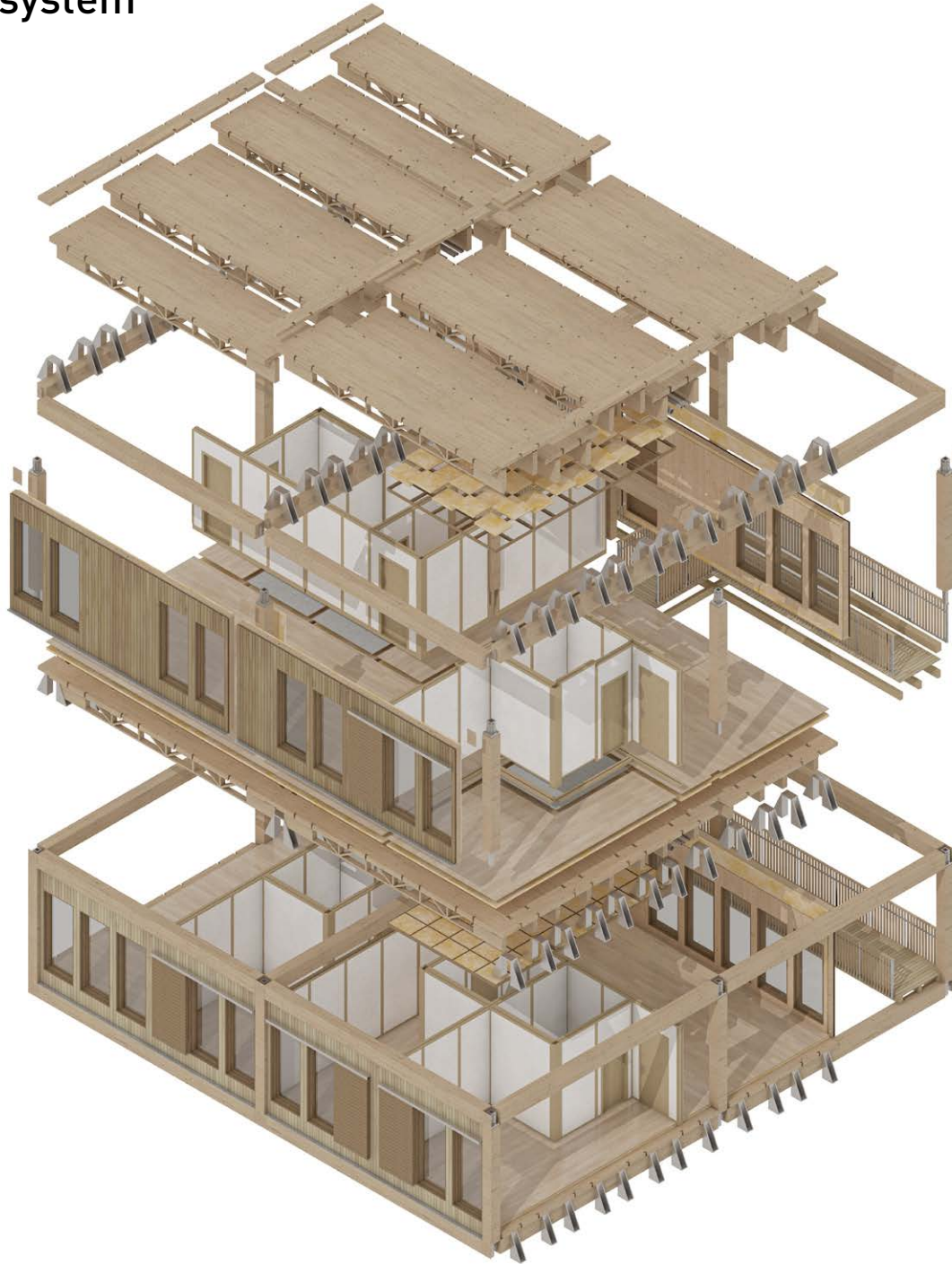
-  shared terraces 1000 m²
-  community garden 1150 m²
-  solar roof 1850 m²

SOLAR ENERGY
185 kWh

- the climate design



- the building system



- construction
- flexibility in time & space
- decision making

DESIGN FOR DISASSEMBLY WITH STRUCTURAL TIMBER CONNECTIONS

**Analysis and assessment of different connection systems used in
engineered timber building structures to maximise demountability
and reuse of the elements**

Leonardo Enzo Pozzi

Faculty of Architecture & the Built Environment, Delft University of Technology
Julianalaan 134, 2628BL Delft

enziopozzileonardo@gmail.com

07.06.2019

ABSTRACT

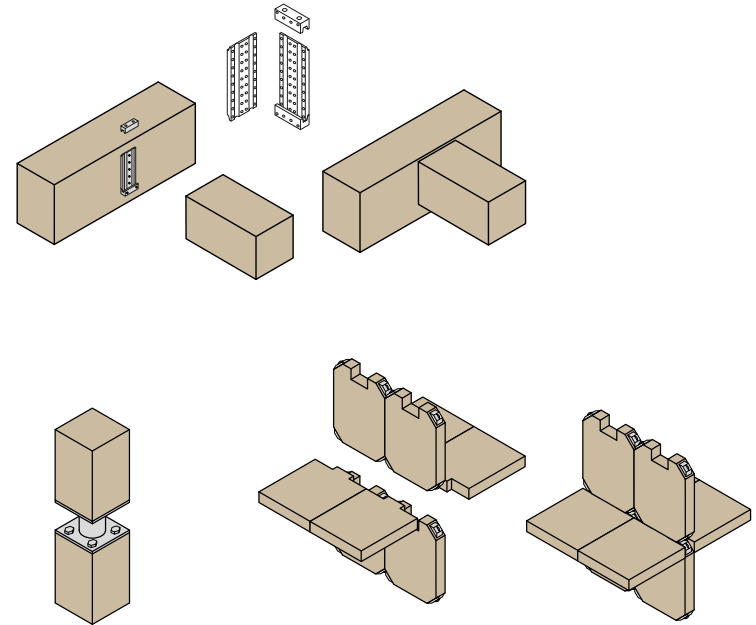
This paper illustrates how a decision-making process can be applied in the architecture field in order to find the most suitable solutions to design a modular and temporary mid-rise timber building structure that allows for disassembly and reuse of the elements. The paper explains the decision-making process adopted and different related weighting system to evaluate the importance of the criteria. It also illustrates and assesses the different connection systems, both carpentry (only wood) and mechanical (wood and steel), used in engineered timber structure, providing general information about the main characteristics of each connection system and giving sources to deepen the research. At the end conclusions are drawn, both in terms of validity of the different weighting systems adopted and in terms of which connection systems better fulfil the requirements of an engineered timber building structure that allows for disassembly and reuse of the elements, the main principles to consider when designing for disassembly in the building industry are also illustrated.

KEYWORDS: *Structural timber connections, Engineered timber structures, Design for disassembly, Design for reuse, Assessment method, Decision-making process, Weighting system.*

– the thematic research

	number of elements	elements complexity	prefabrication degree	ease of assembly	degree of freedom	structural strenght	finishing	ease of disassembly	end of cycle waste	reusability	costs	tot	weight
number of elements	1,00	0,50	0,33	1,00	0,33	3,00	0,33	2,00	0,33	3,00		11,82	∞
elements complexity	1,00		0,50	0,33	1,00	0,33	3,00	0,33	2,00	0,33	3,00	11,82	∞
prefabrication degree	2,00	2,00		0,50	2,00	1,00	3,00	0,50	2,00	0,50	3,00	16,50	∞
ease of assembly	3,00	3,00	2,00		3,00	2,00	3,00	1,00	3,00	2,00	3,00	25,00	∞∞
degree of freedom	1,00	1,00	0,50	0,00		0,33	2,00	0,33	2,00	0,33	2,00	9,49	∞
structural strenght	3,00	3,00	1,00	0,50	3,00		3,00	0,50	3,00	0,50	3,00	20,50	∞∞
finishing	0,33	0,33	0,33	0,33	0,50	0,33		0,33	0,50	0,33	0,50	3,81	∞
ease of disassembly	3,00	3,00	2,00	1,00	3,00	2,00	3,00		3,00	2,00	3,00	25,00	∞∞
end of cycle waste	0,50	0,50	0,50	0,33	0,50	0,33	2,00	0,33		0,33	1,00	6,32	∞
reusability	3,00	3,00	2,00	0,50	3,00	2,00	3,00	0,50	3,00		3,00	23,00	∞∞
costs	0,33	0,33	0,33	0,33	0,50	0,33	2,00	0,33	1,00	0,33		5,81	∞

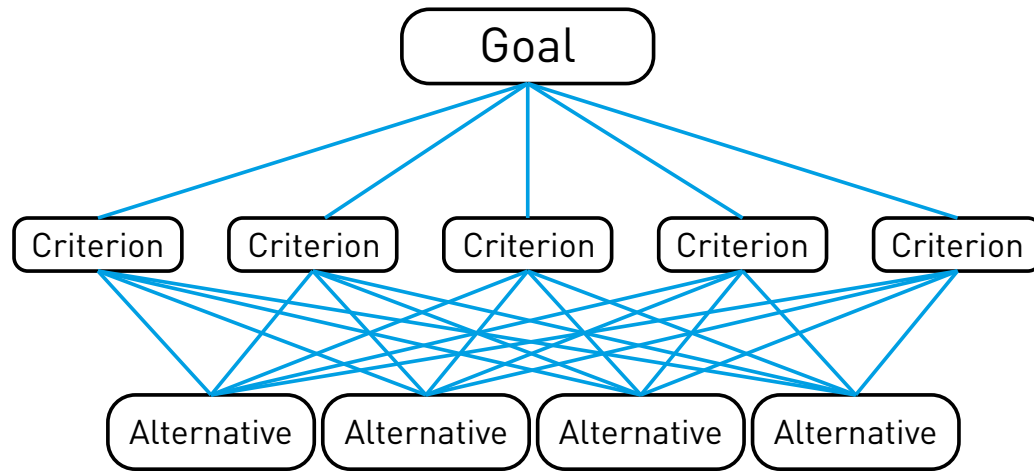
159,07 tot



THE ASSESSMENT METHOD

THE CONNECTION SYSTEMS

- the assessment method



Goal

Design a building which creates **rich visual and spatial connections** and is **able to adapt** in time to future requirements but also can be **demounted** in elements that can be **reused**.

Criteria

Important

- design freedom (2)
- space flexibility (3)
- ease of disassembly (2)

Contextual

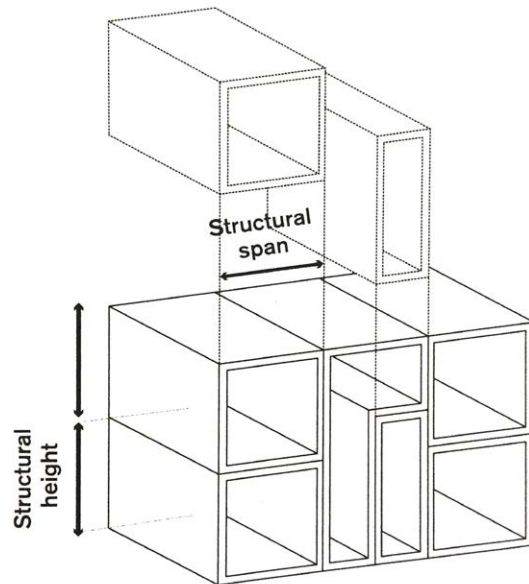
- automation (1)
- transportability (1)
- costs (1)

→ the assessment method

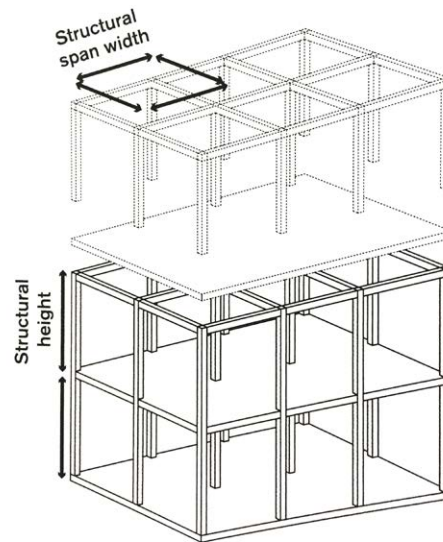
THE STRUCTURAL SYSTEM

Alternatives

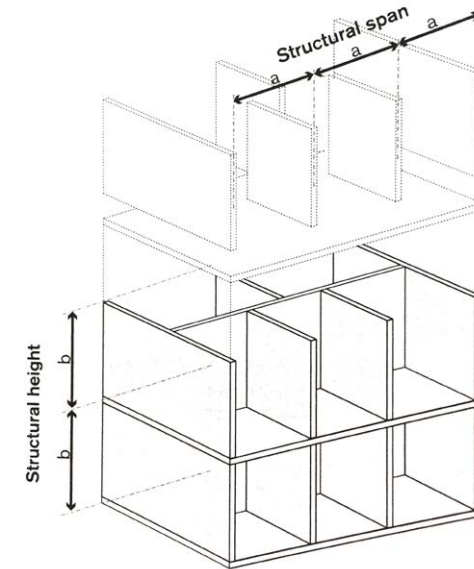
Modular Units



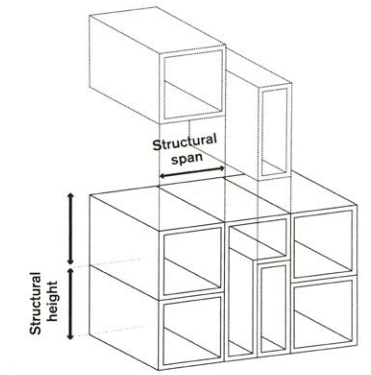
Frame Construction



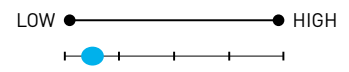
Load-Bearing Walls



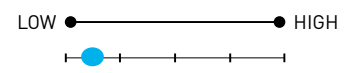
- the assessment method



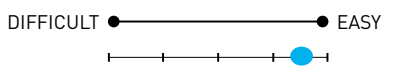
DESIGN FREEDOM (2)



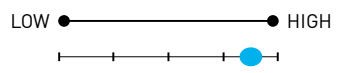
SPACE FLEXIBILITY (3)



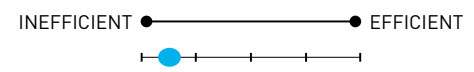
EASE OF DISASSEMBLY (2)



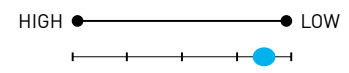
AUTOMATION (1)



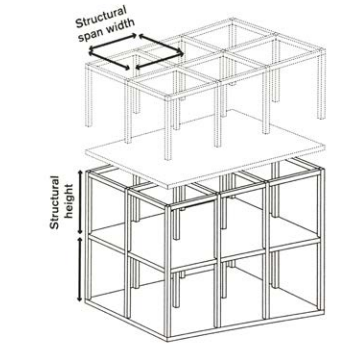
TRANSPORTABILITY (1)



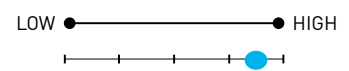
COSTS (1)



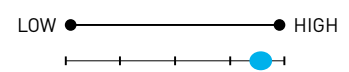
SCORE
22



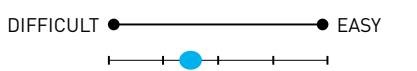
DESIGN FREEDOM (2)



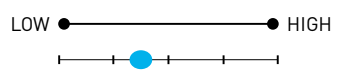
SPACE FLEXIBILITY (3)



EASE OF DISASSEMBLY (2)



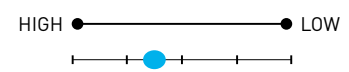
AUTOMATION (1)



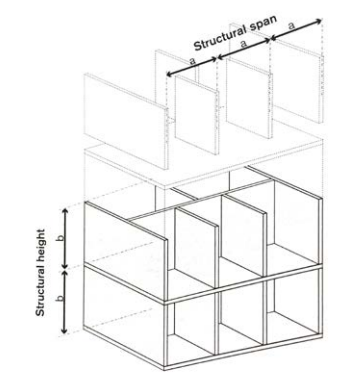
TRANSPORTABILITY (1)



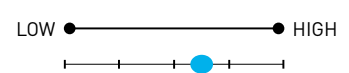
COSTS (1)



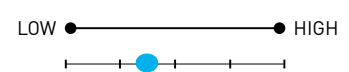
SCORE
28



DESIGN FREEDOM (2)



SPACE FLEXIBILITY (3)



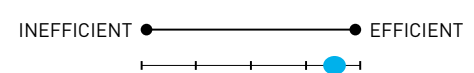
EASE OF DISASSEMBLY (2)



AUTOMATION (1)



TRANSPORTABILITY (1)

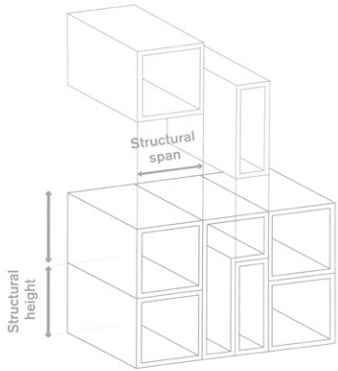


COSTS (1)



SCORE
26

- the assessment method



DESIGN FREEDOM (2)



SPACE FLEXIBILITY (3)



EASE OF DISASSEMBLY (2)



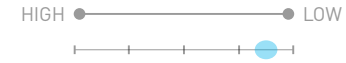
AUTOMATION (1)



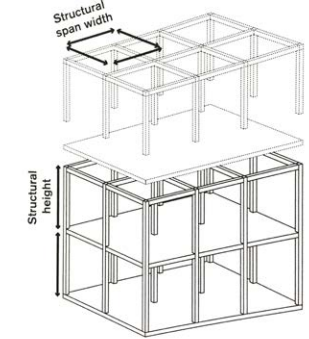
TRANSPORTABILITY (1)



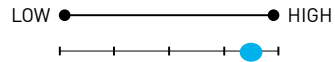
COSTS (1)



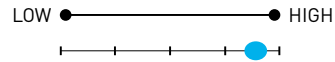
SCORE
22



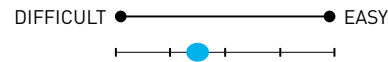
DESIGN FREEDOM (2)



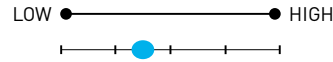
SPACE FLEXIBILITY (3)



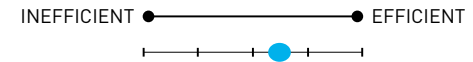
EASE OF DISASSEMBLY (2)



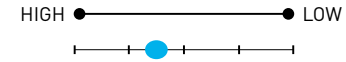
AUTOMATION (1)



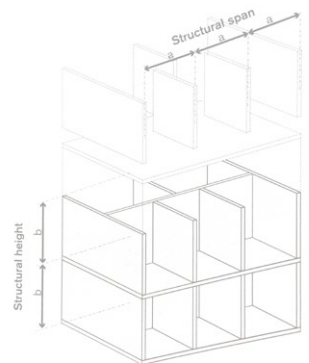
TRANSPORTABILITY (1)



COSTS (1)



SCORE
28



DESIGN FREEDOM (2)



SPACE FLEXIBILITY (3)



EASE OF DISASSEMBLY (2)



AUTOMATION (1)



TRANSPORTABILITY (1)



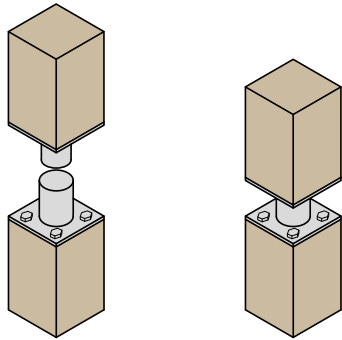
COSTS (1)



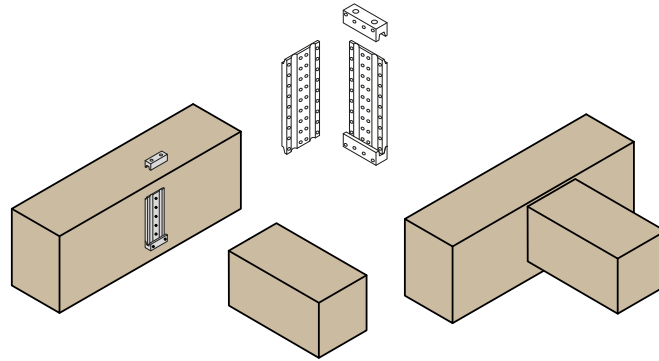
SCORE
26

→ the connection system

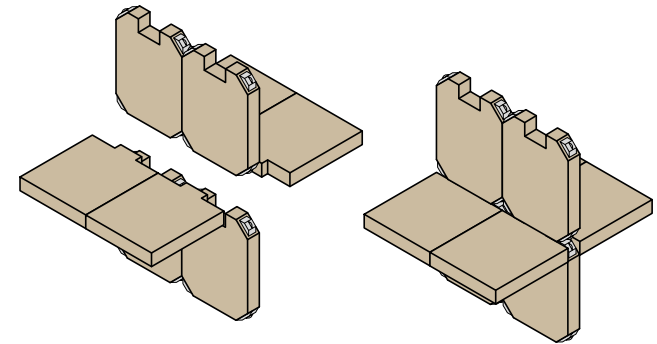
COLUMN TO COLUMN
CONNECTION



BEAM TO COLUMN-BEAM
CONNECTION

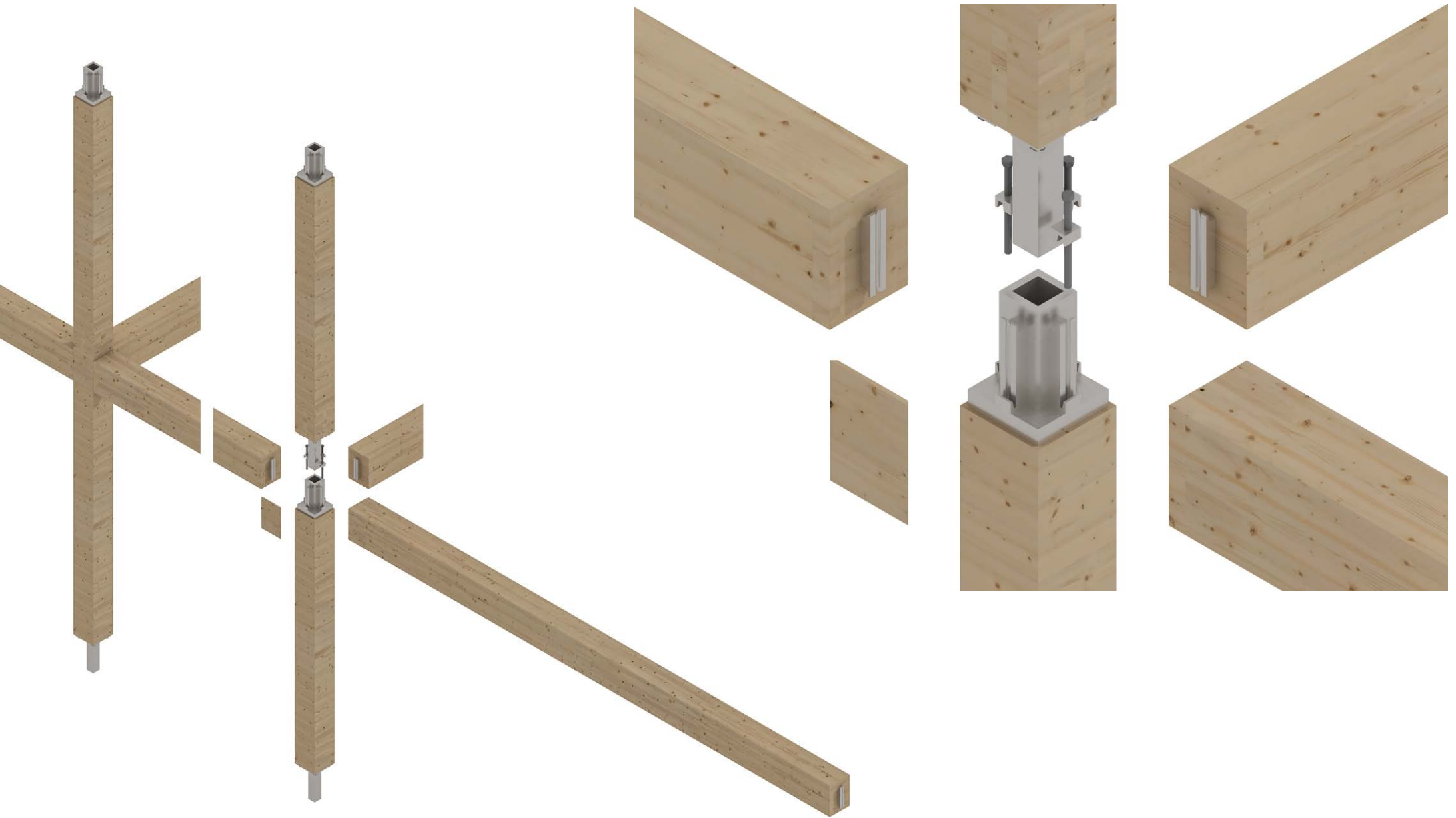


PANEL
CONNECTION

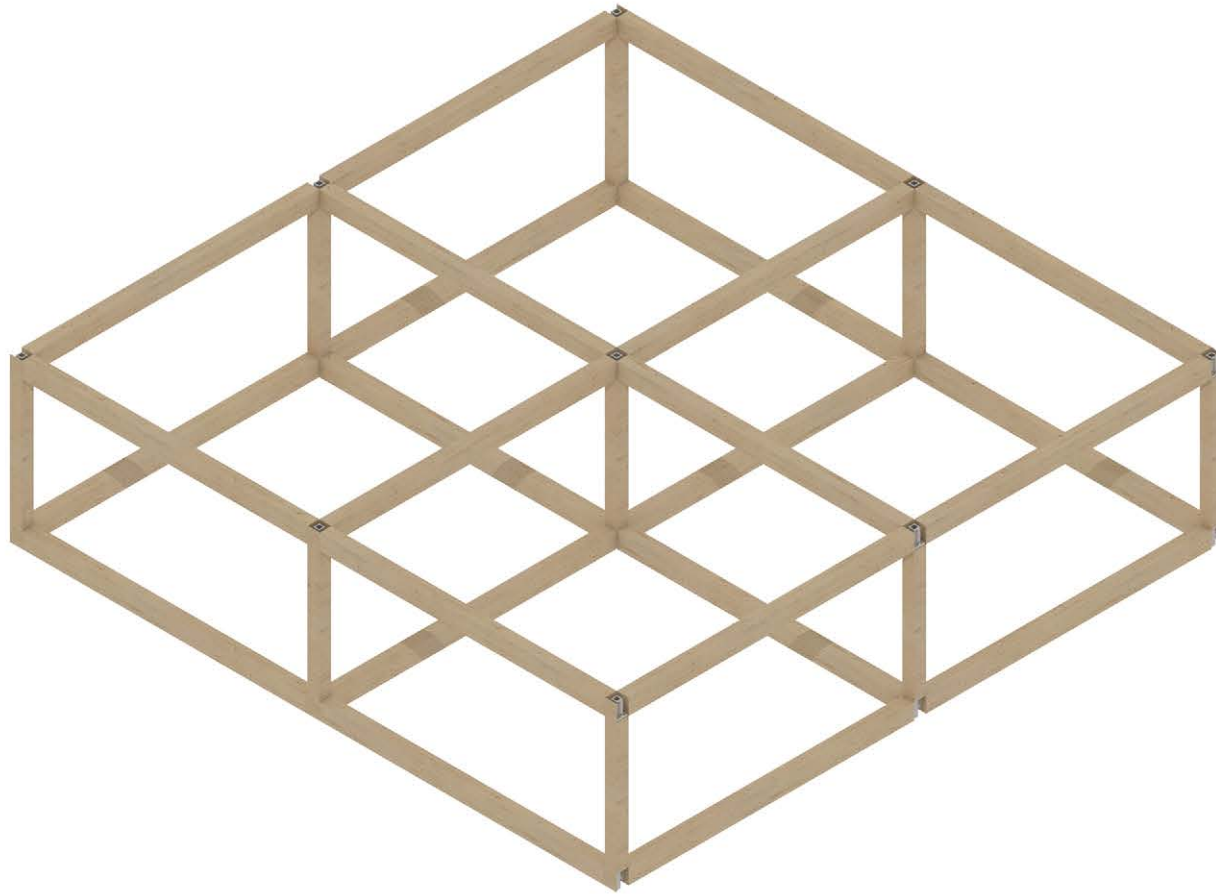


the connection of the elements should **not be direct** but instead should be done through an **intermediate connecting element** where the process can be repeated multiple times **without harming the main elements**

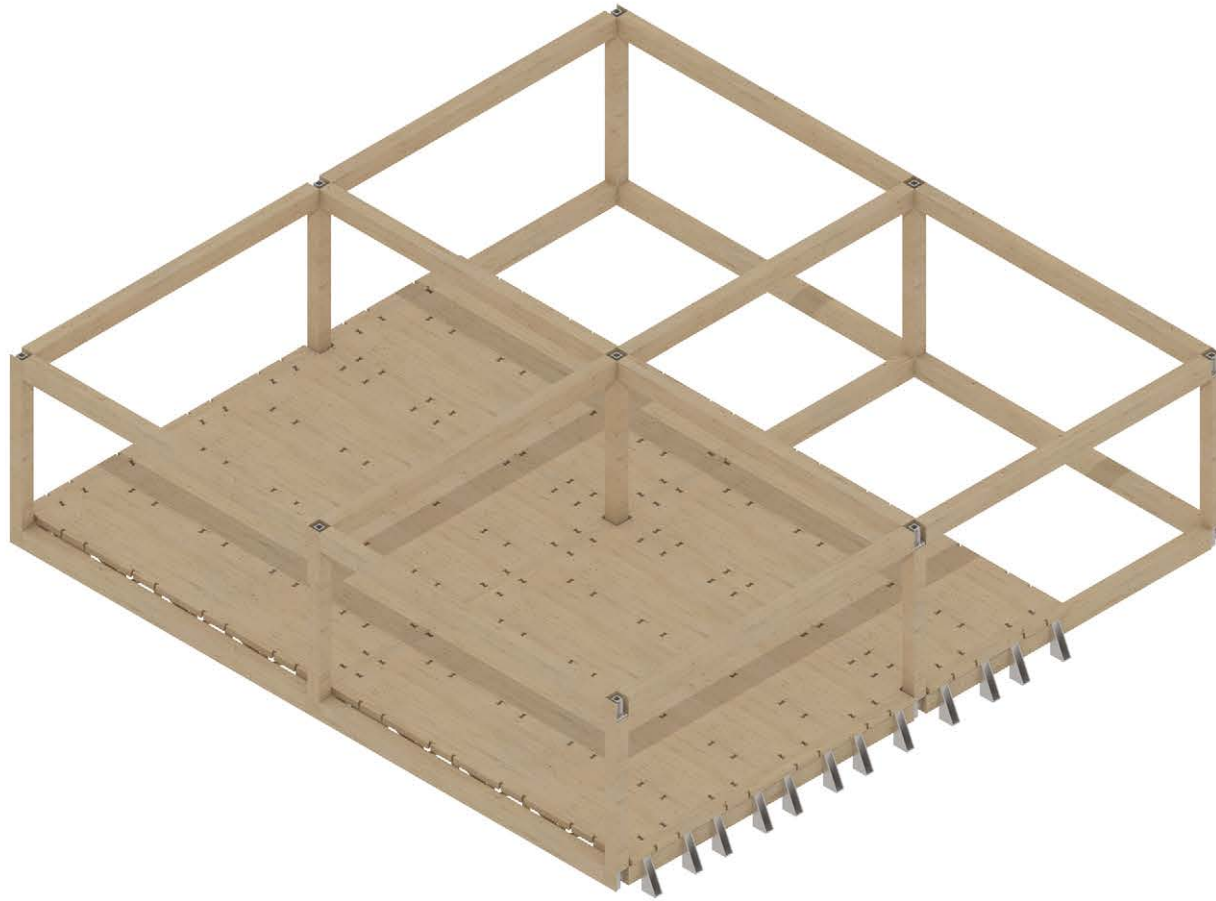
- the designed structural system



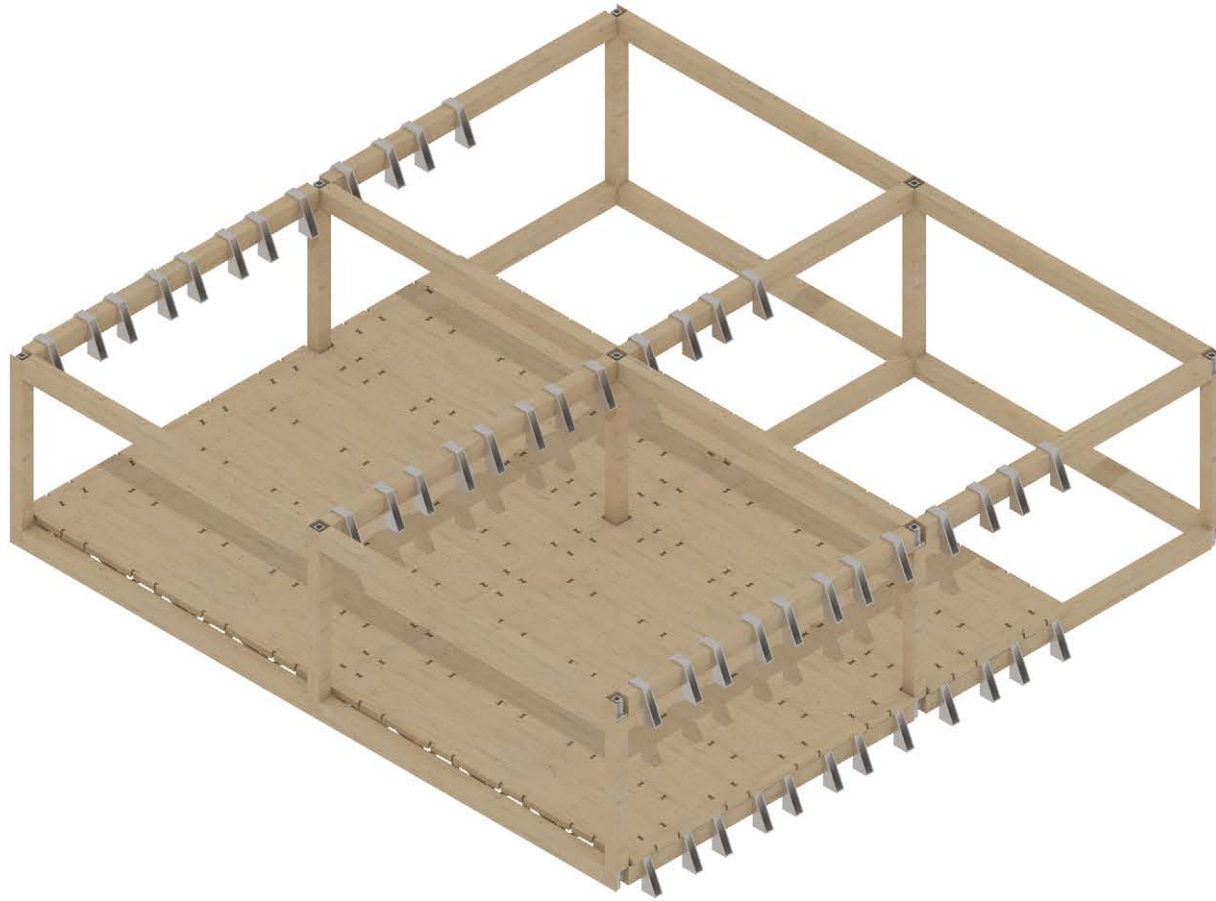
→ the building system



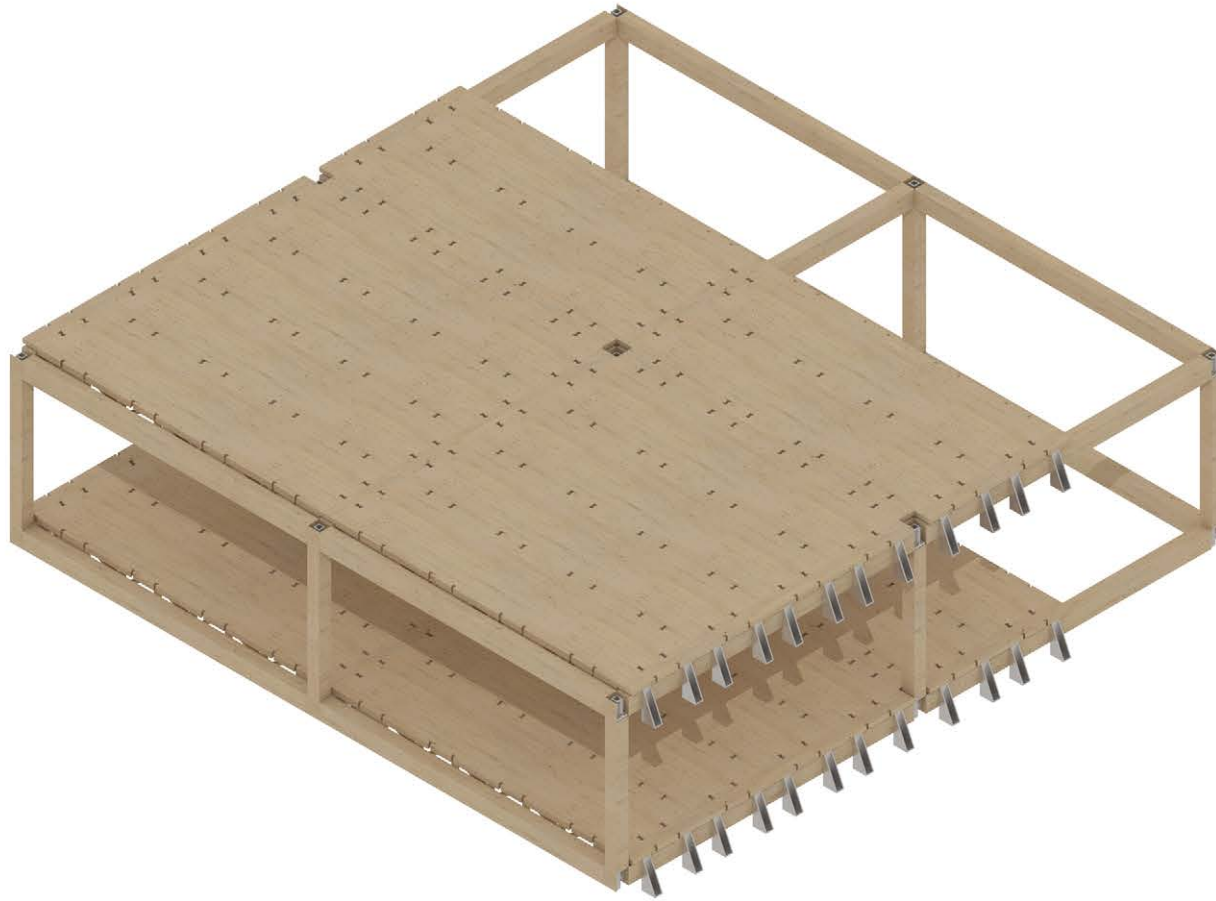
→ the building system



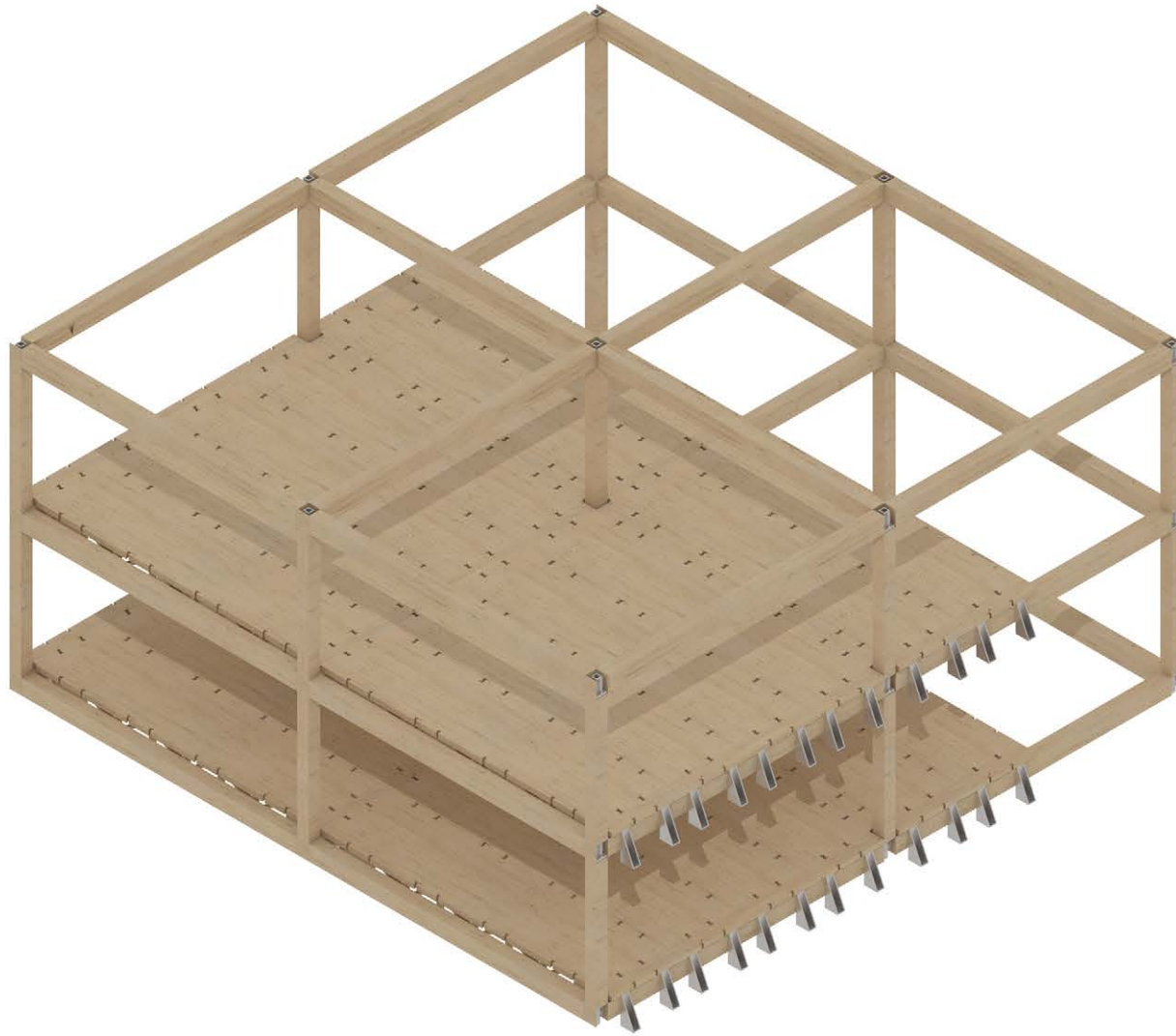
- the building system



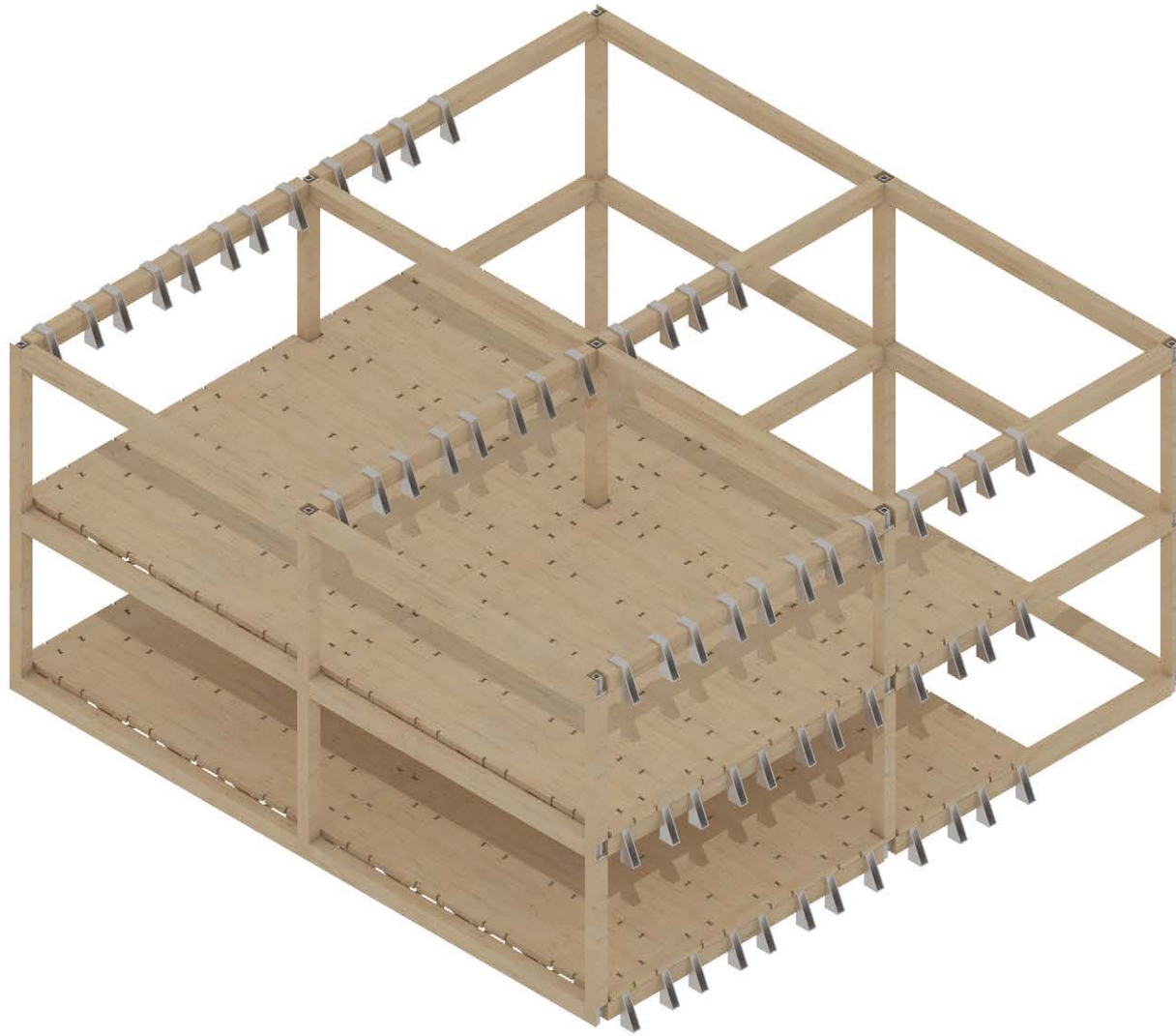
→ the building system



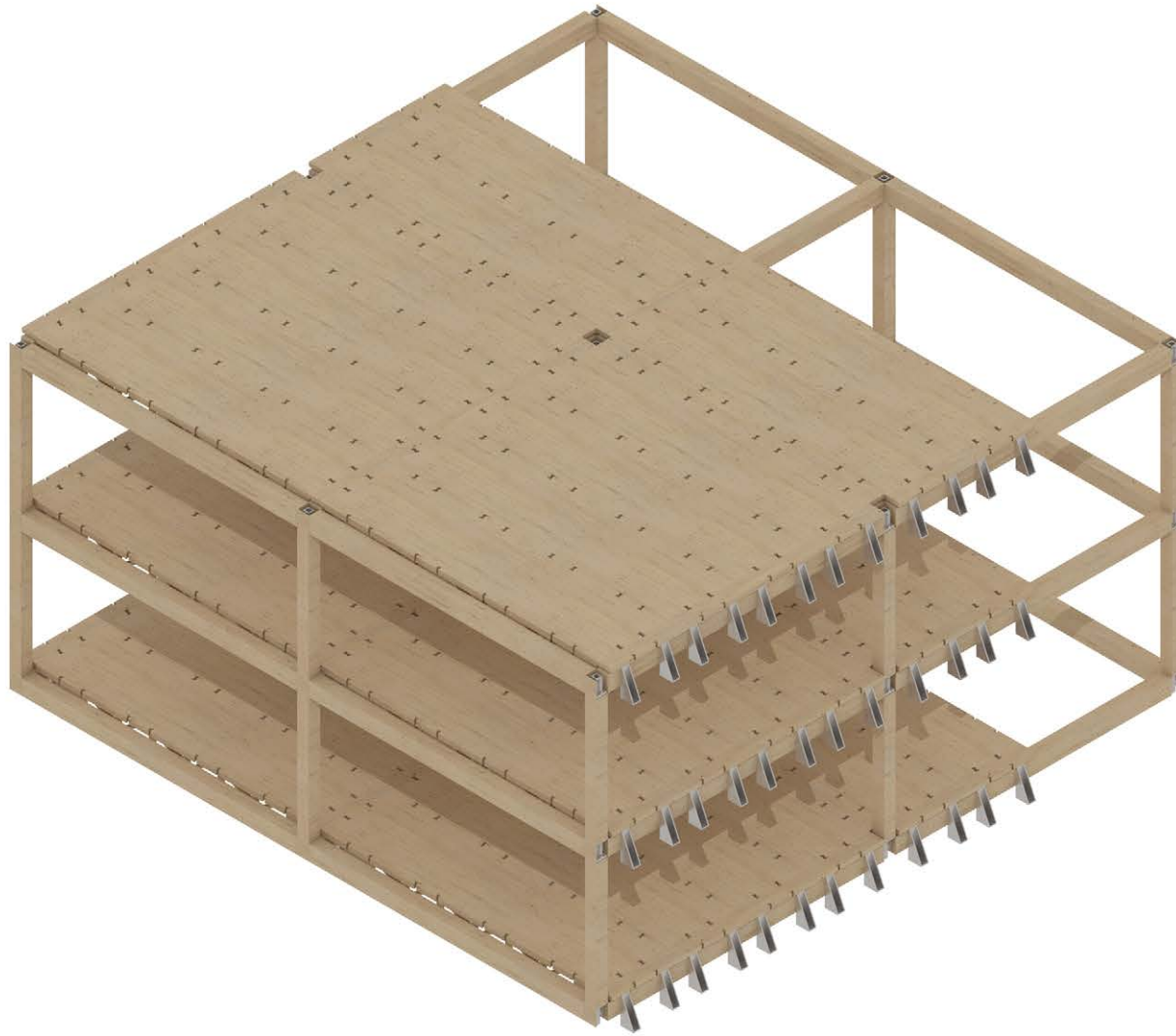
- the building system



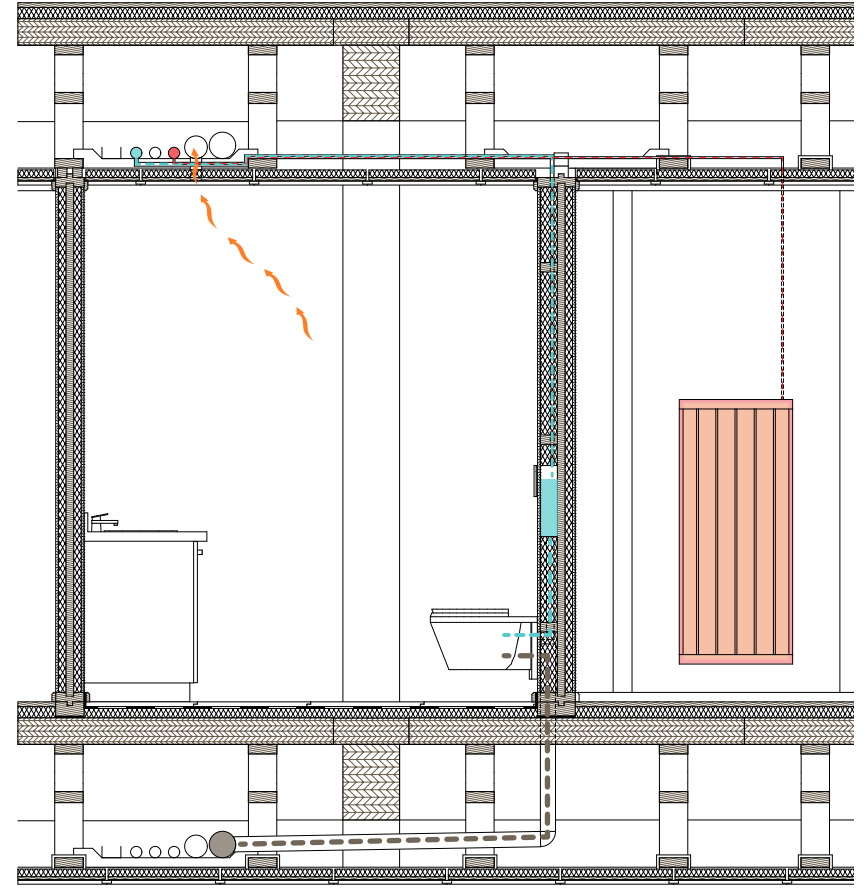
- the building system



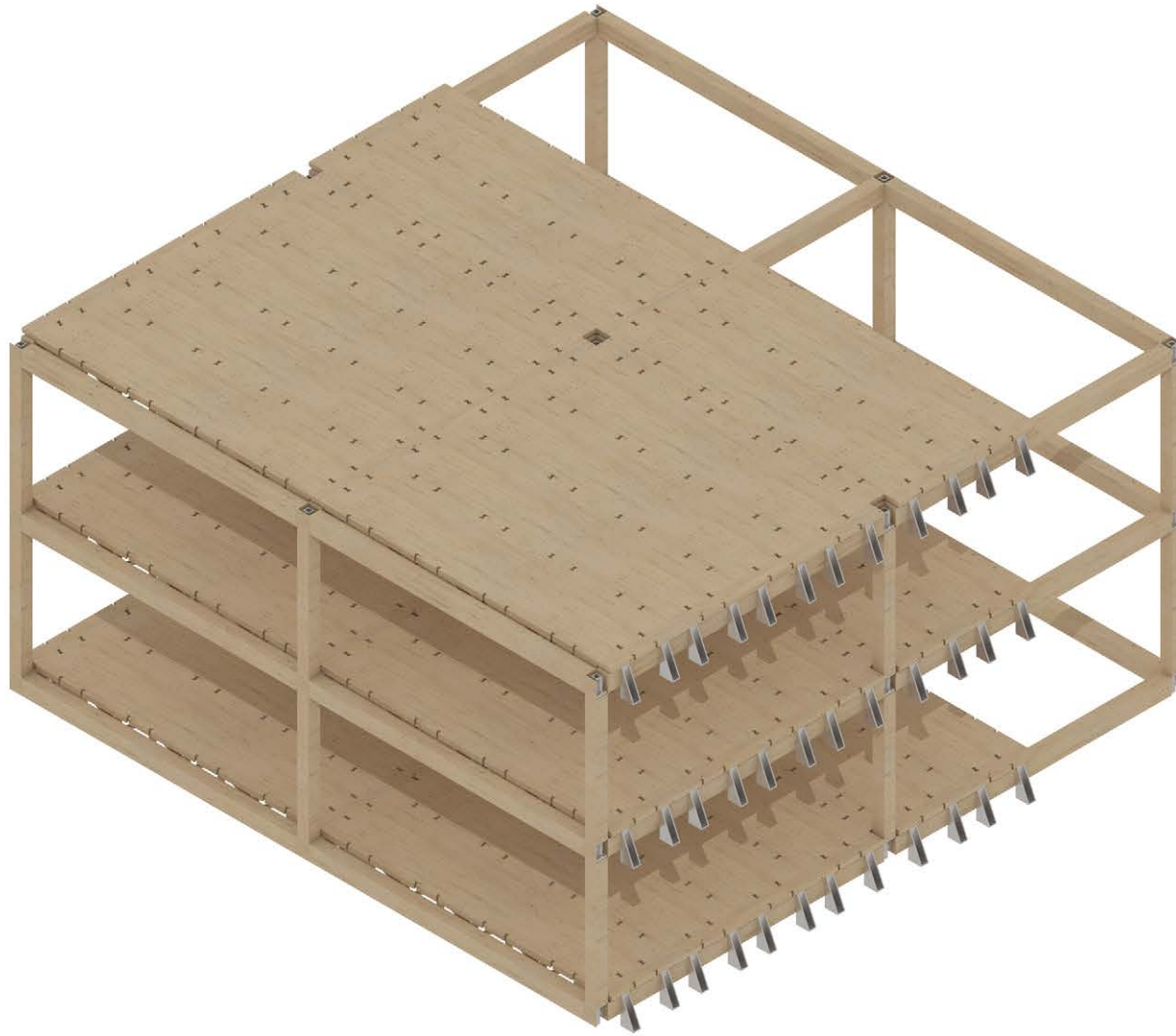
→ the building system



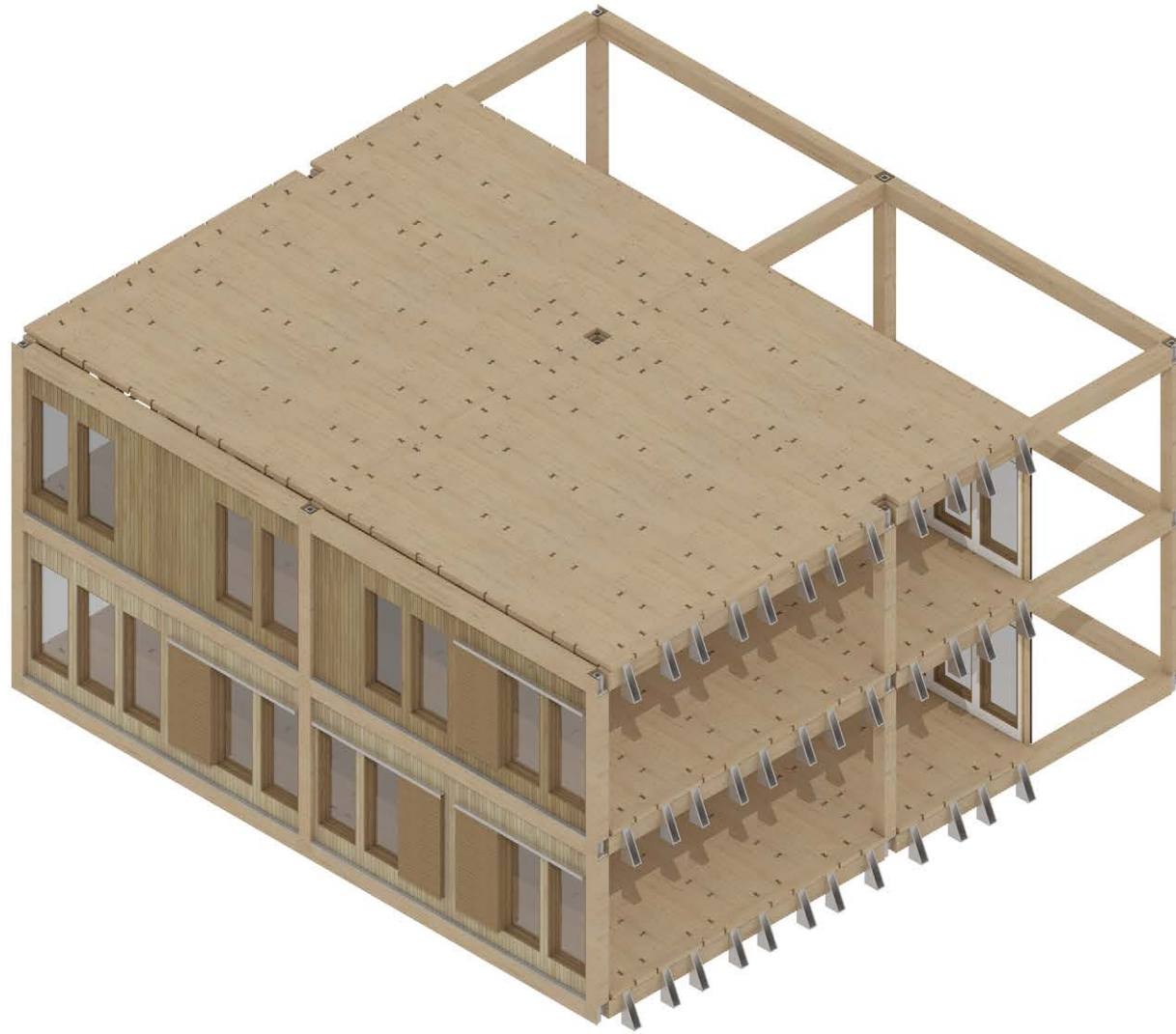
- the structural floor system



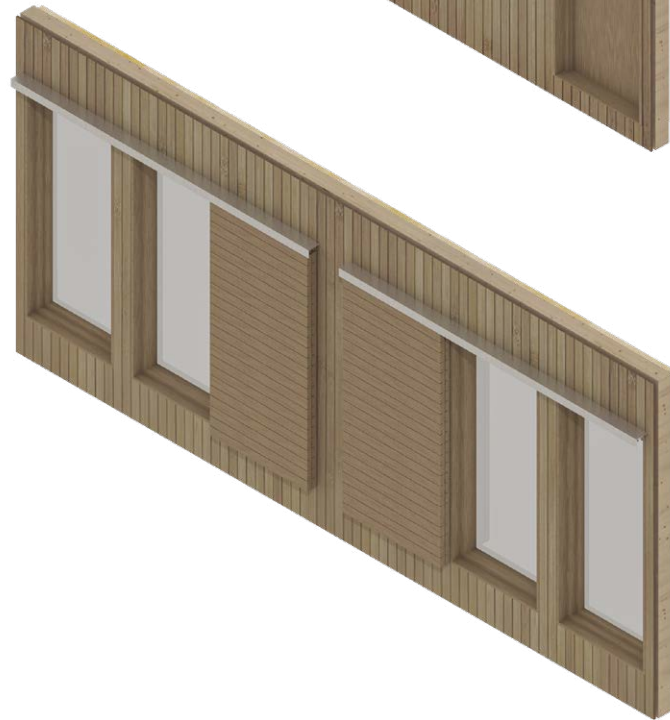
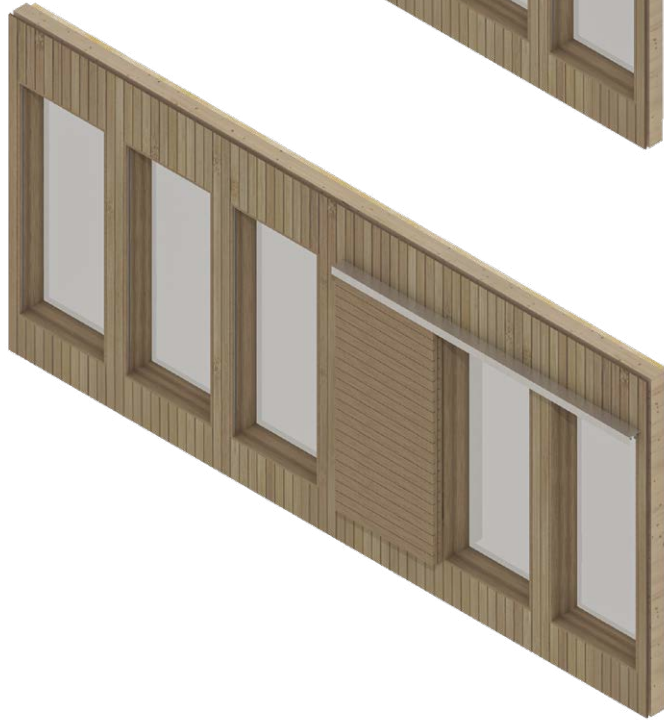
→ the building system



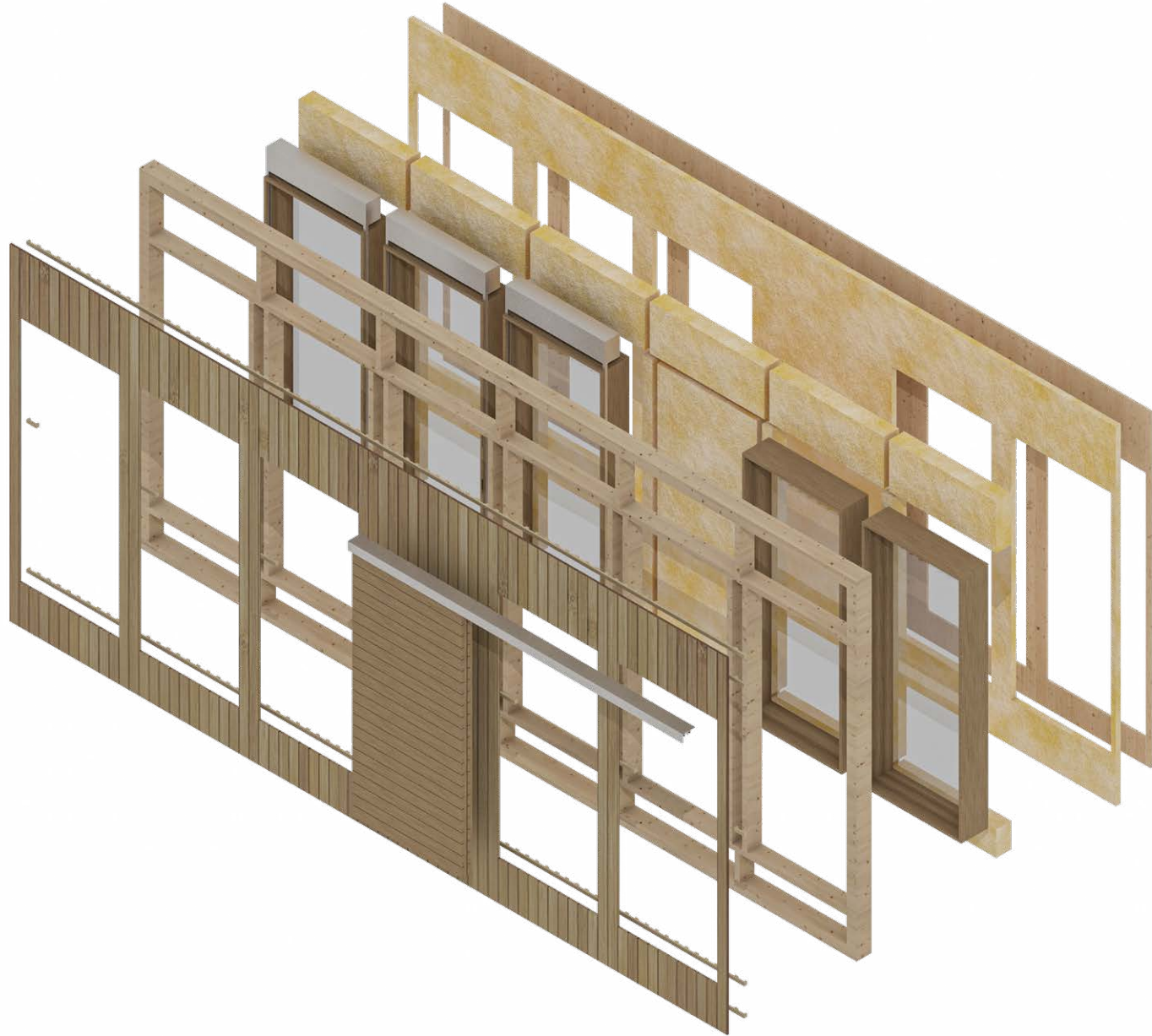
→ the building system



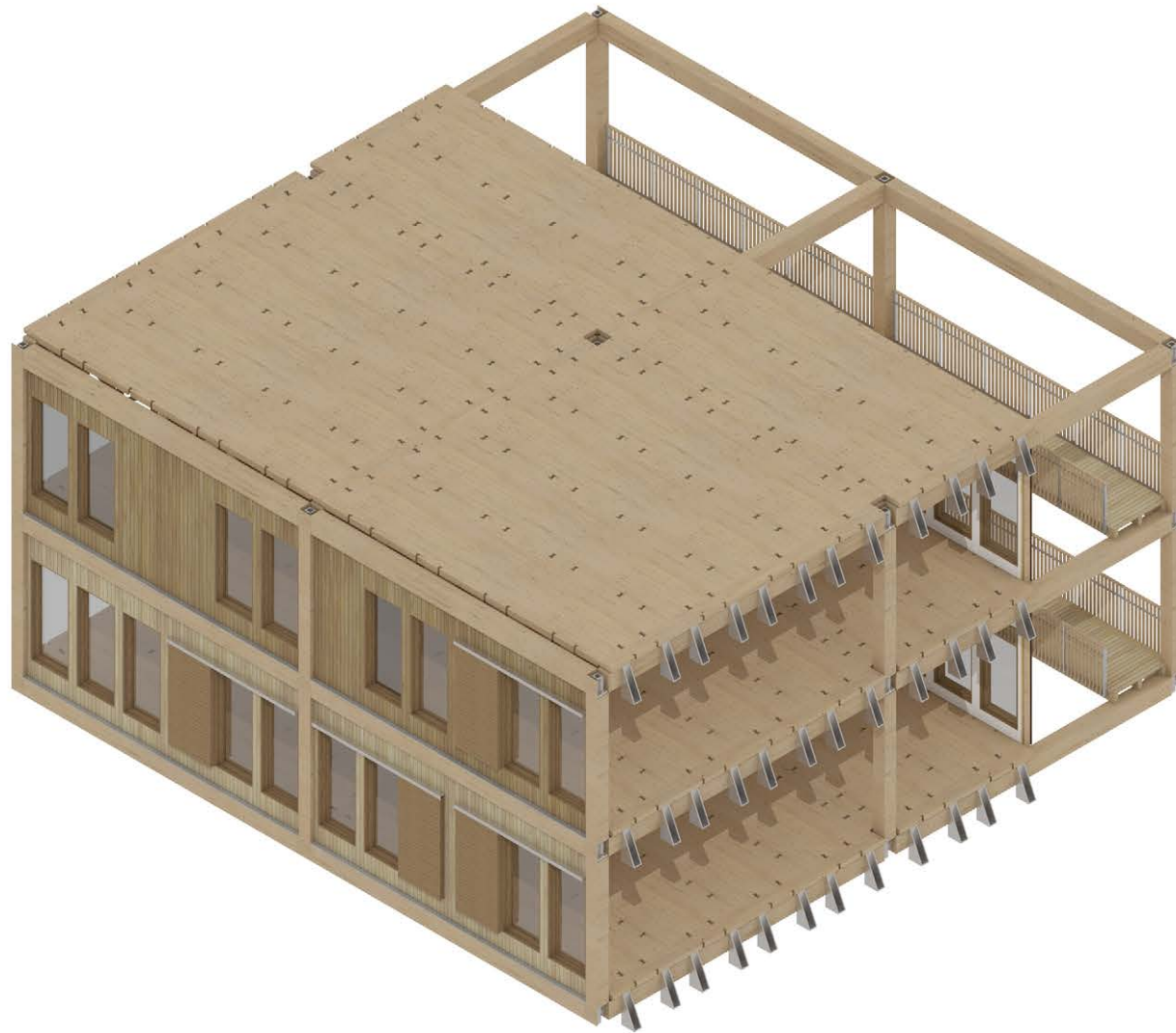
→ the facade element



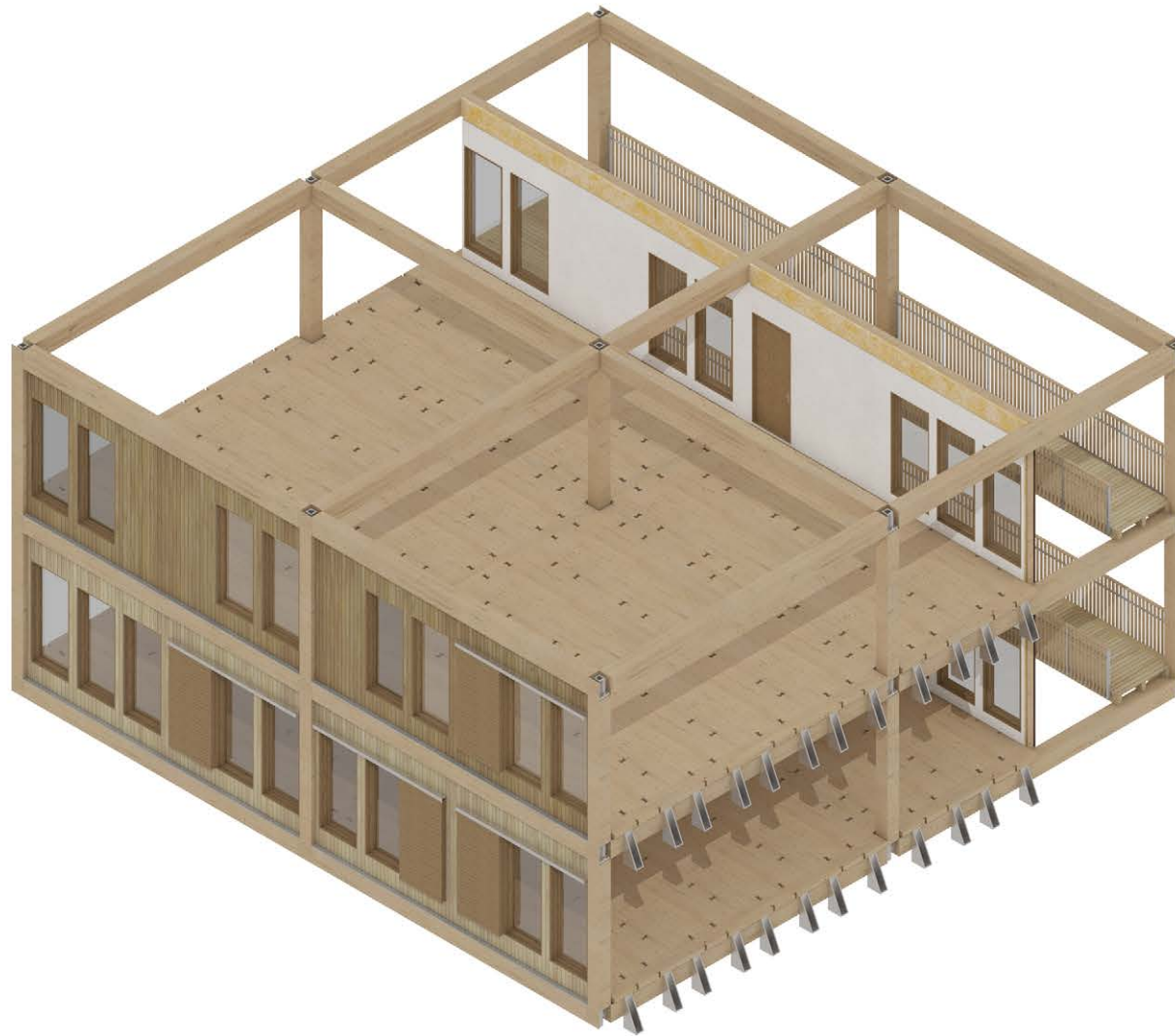
→ the facade element



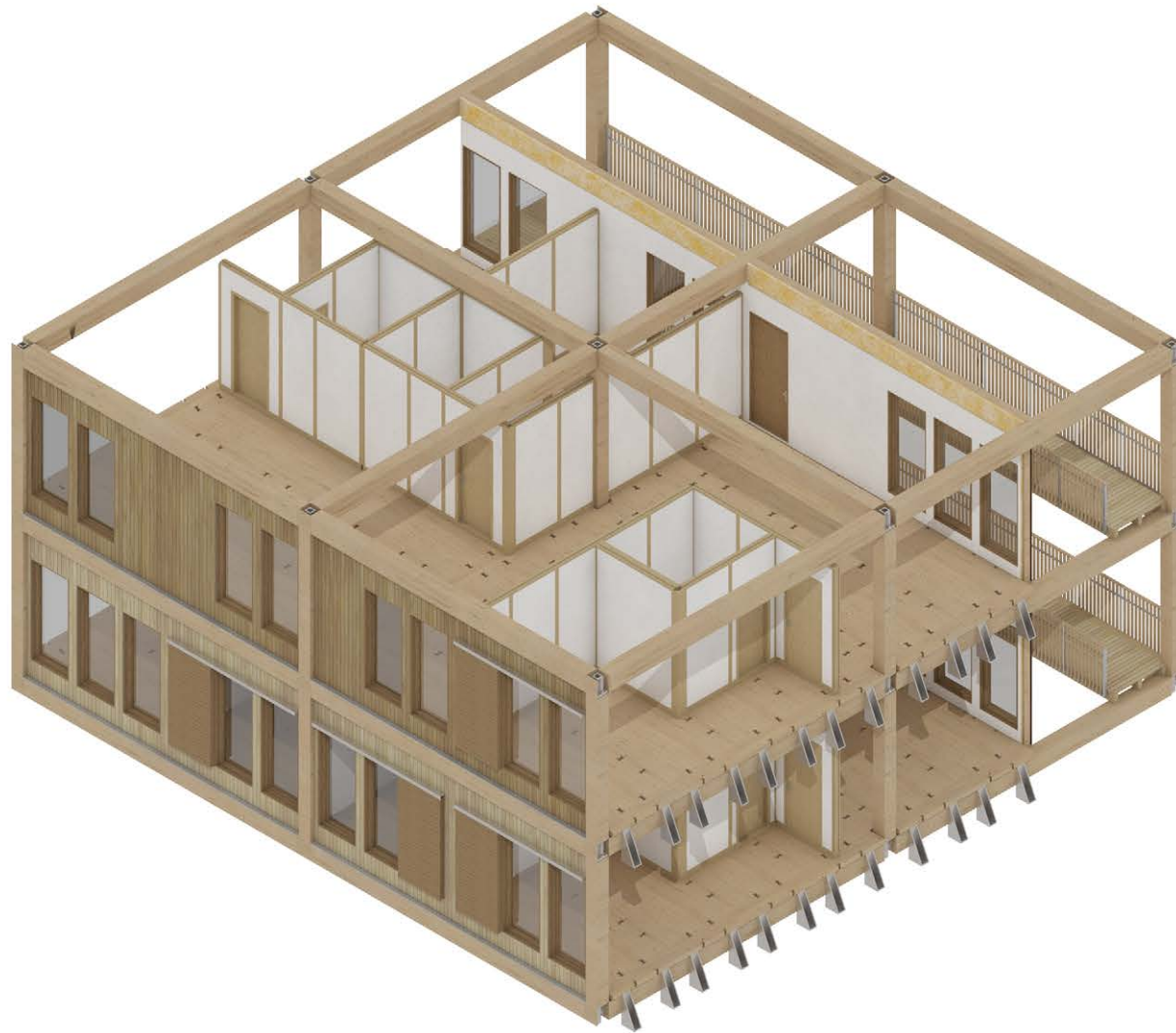
→ the building system



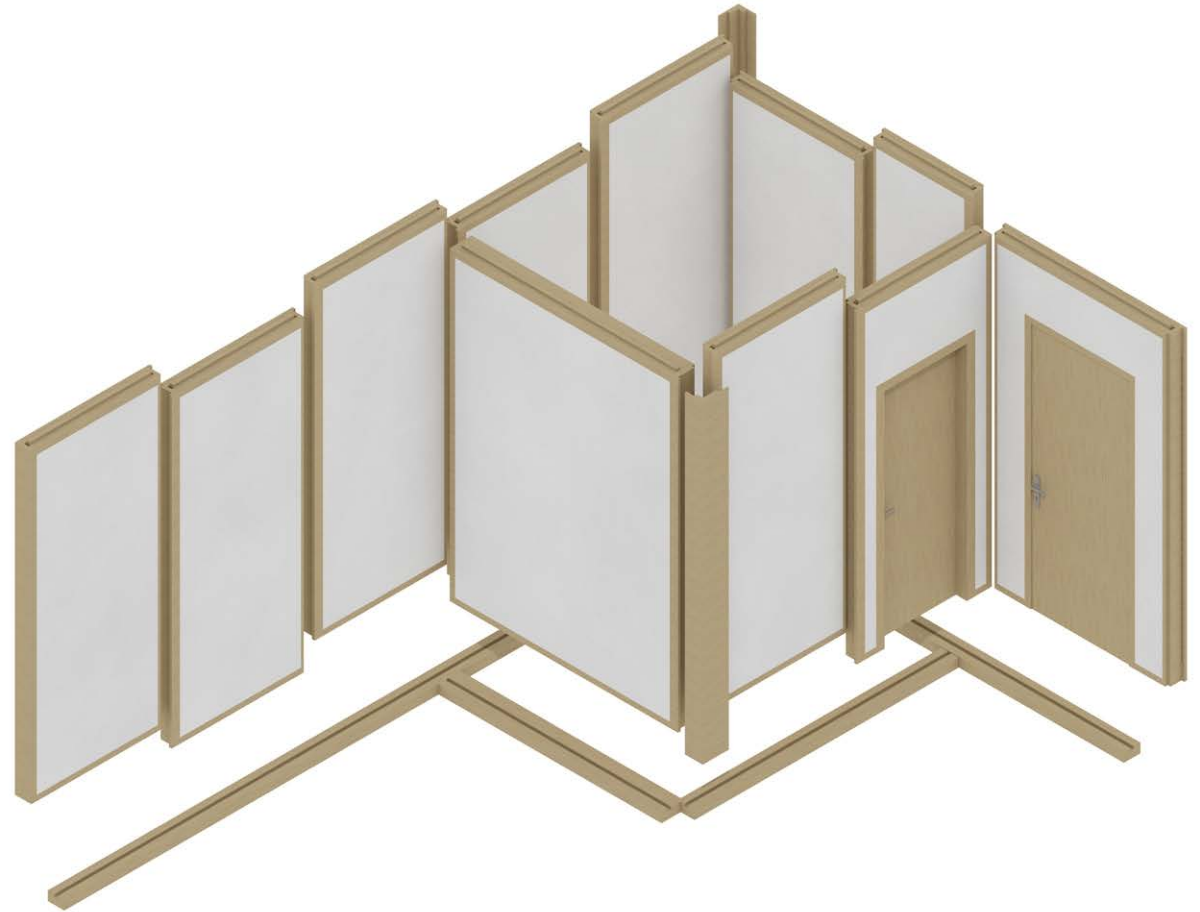
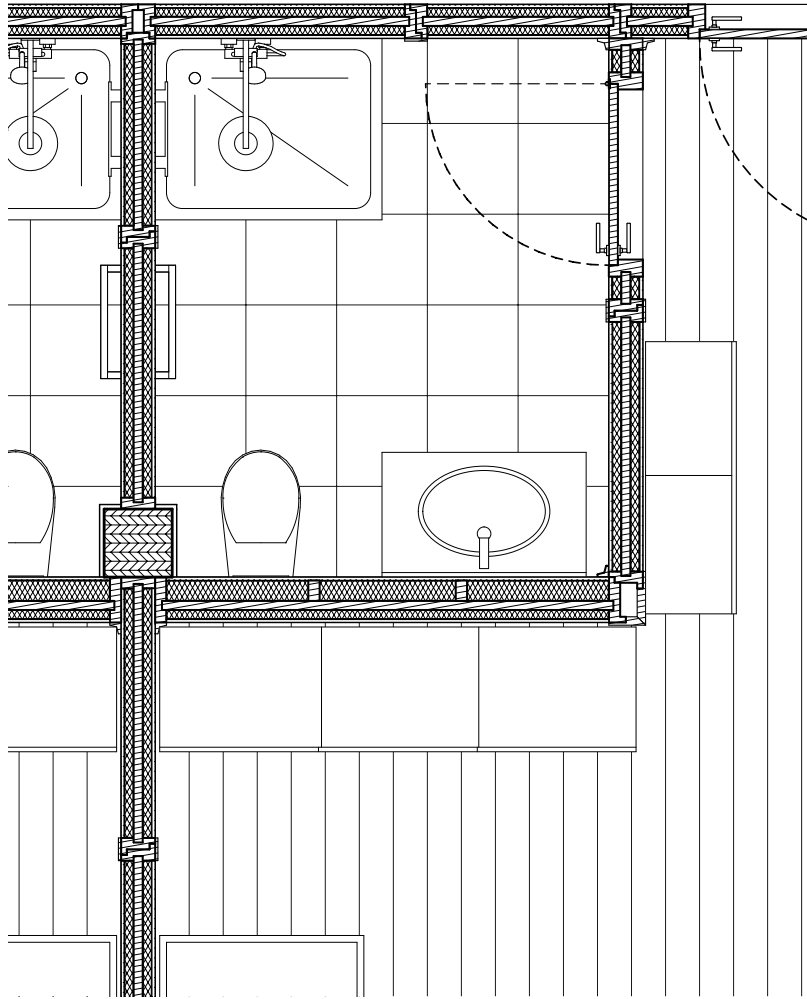
→ the building system



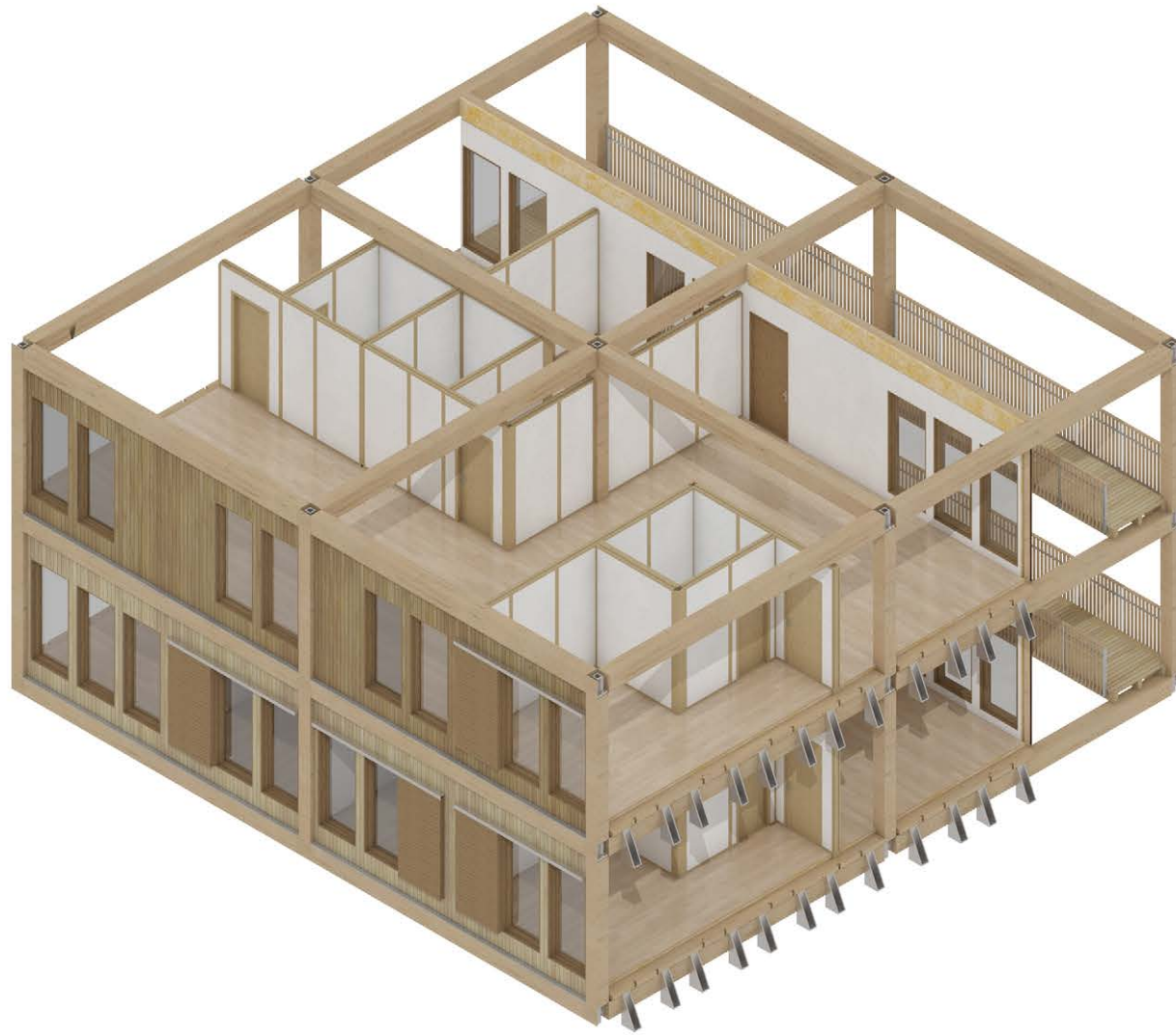
→ the building system



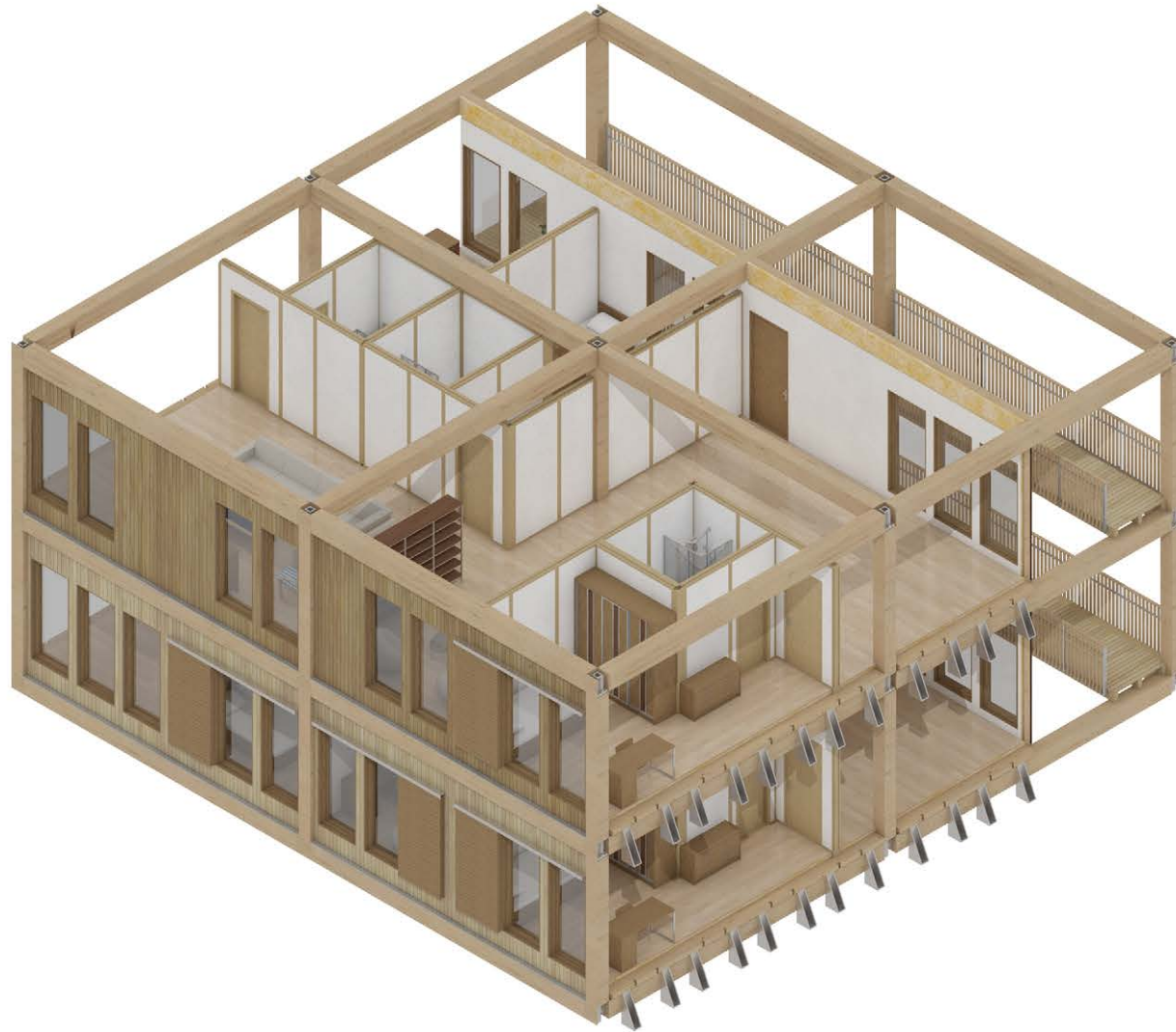
- the modular wall system



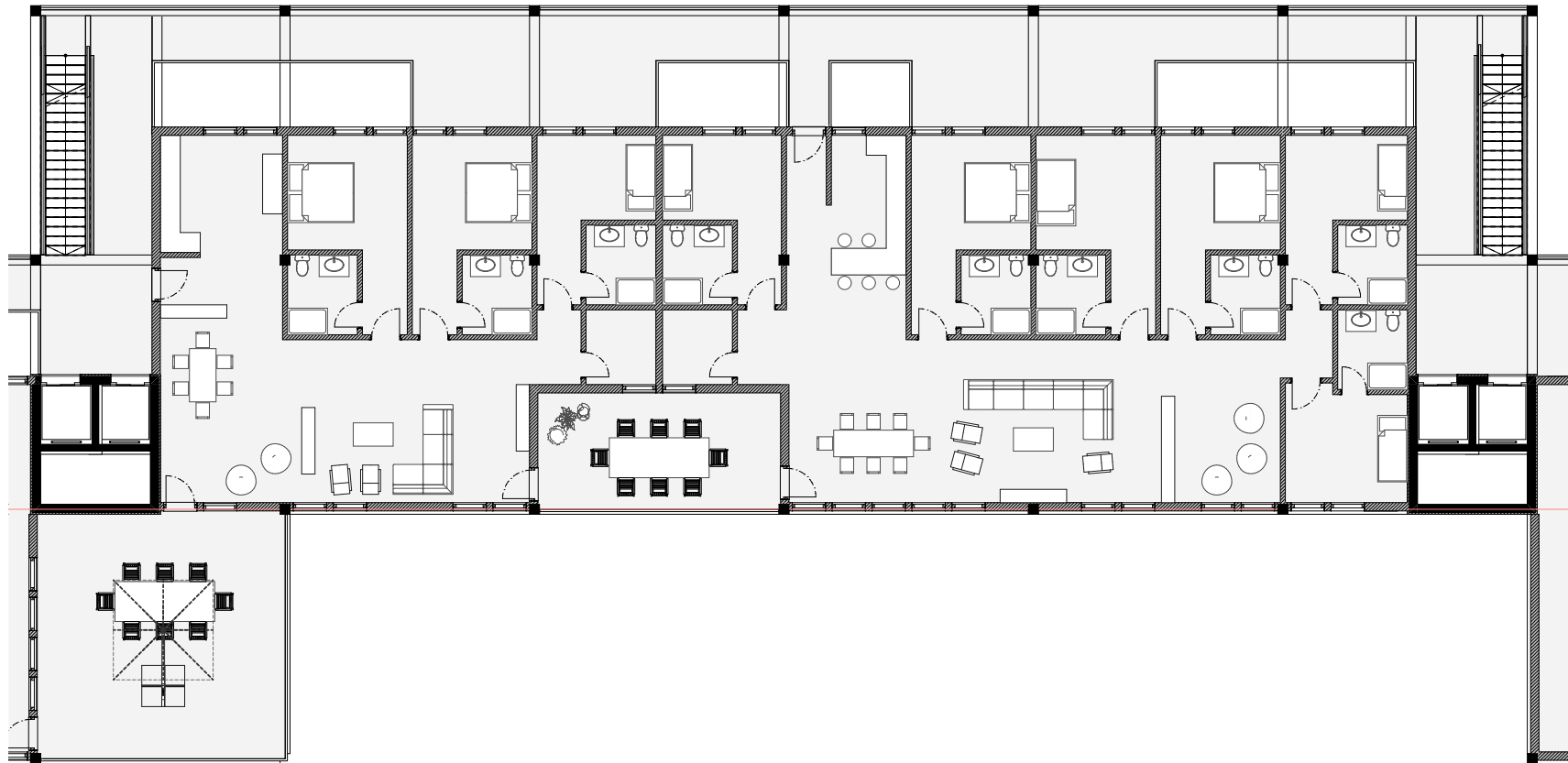
→ the building system



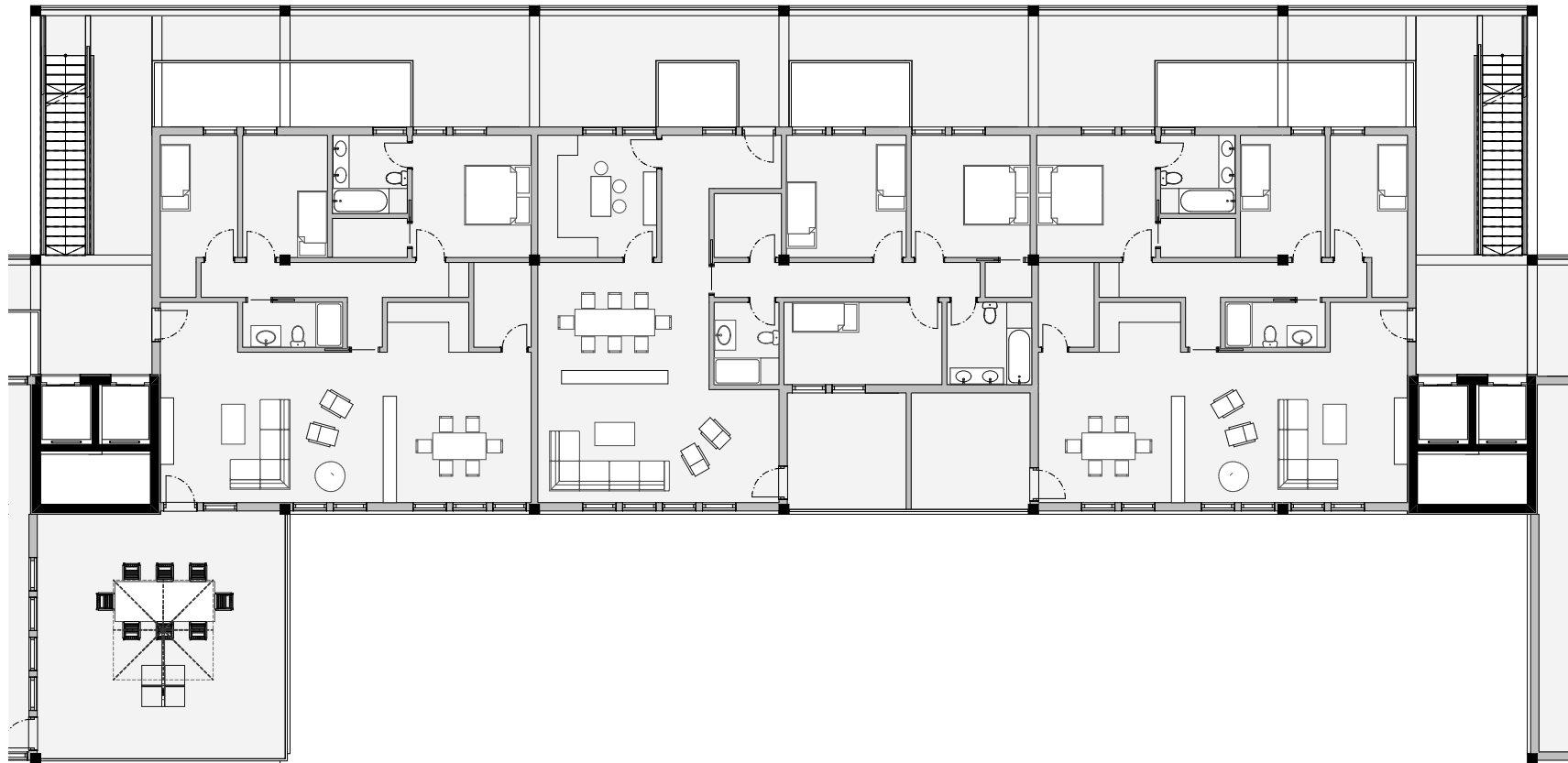
- the building system



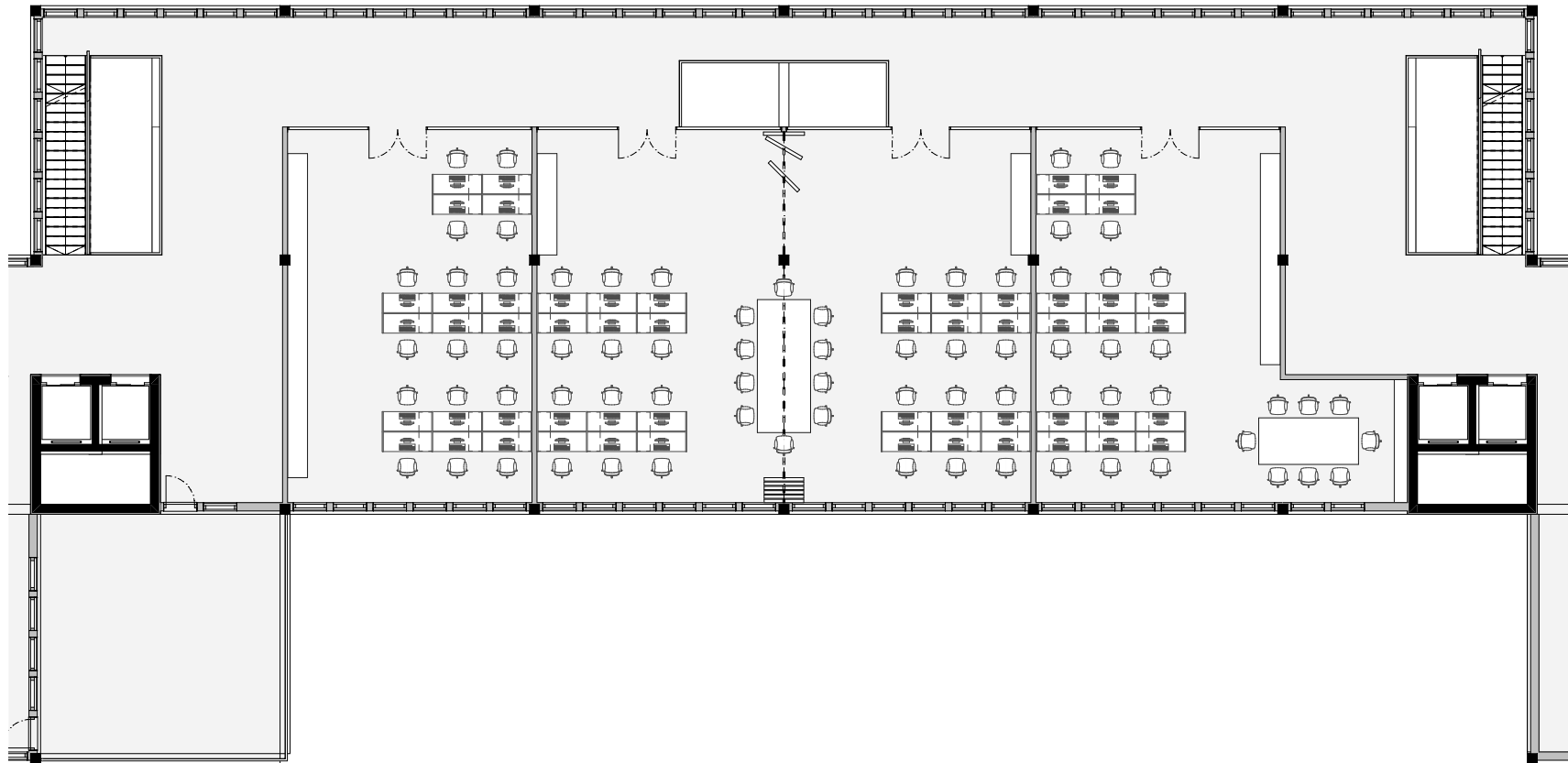
- the adaptability of the system



- the adaptability of the system



- the adaptability of the system



→ conclusion

