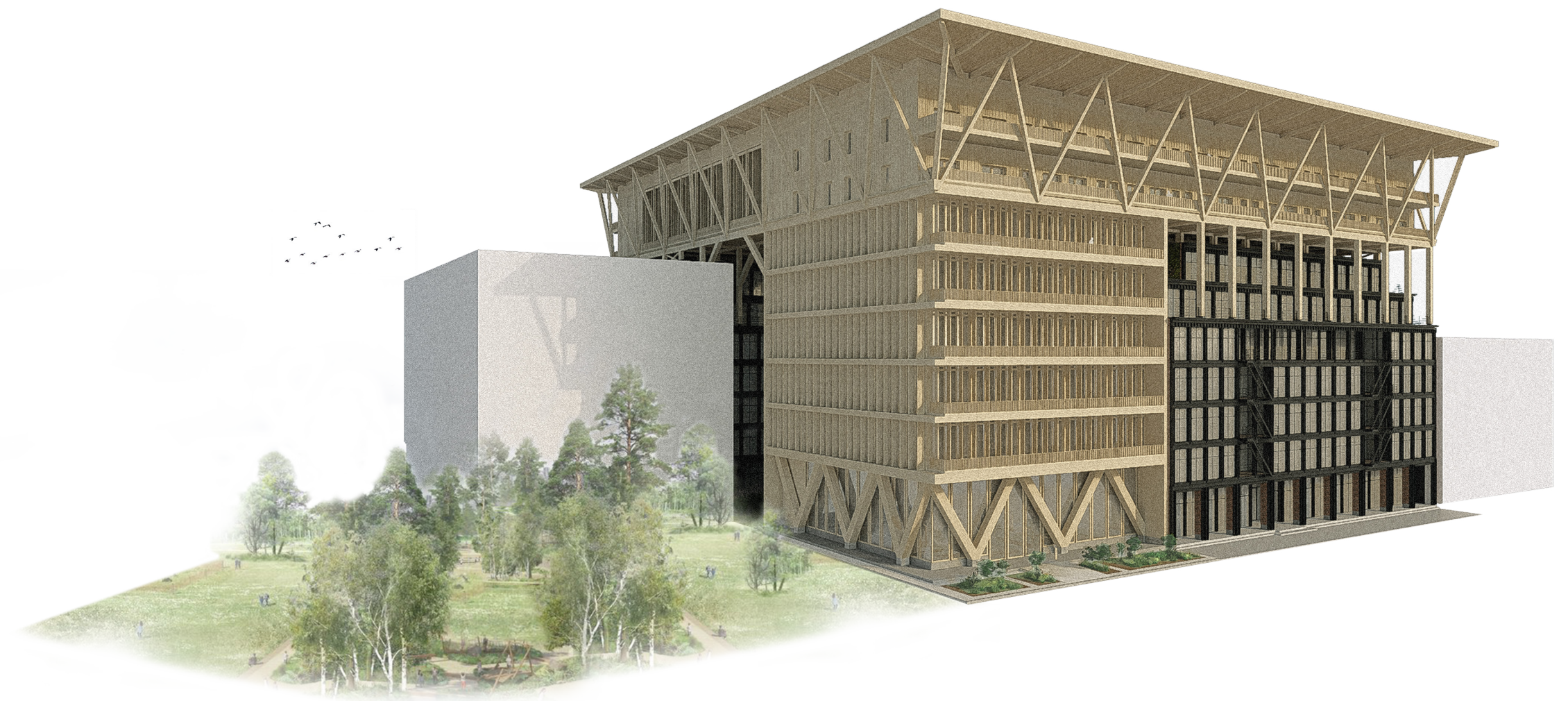


CARBON AND TIME

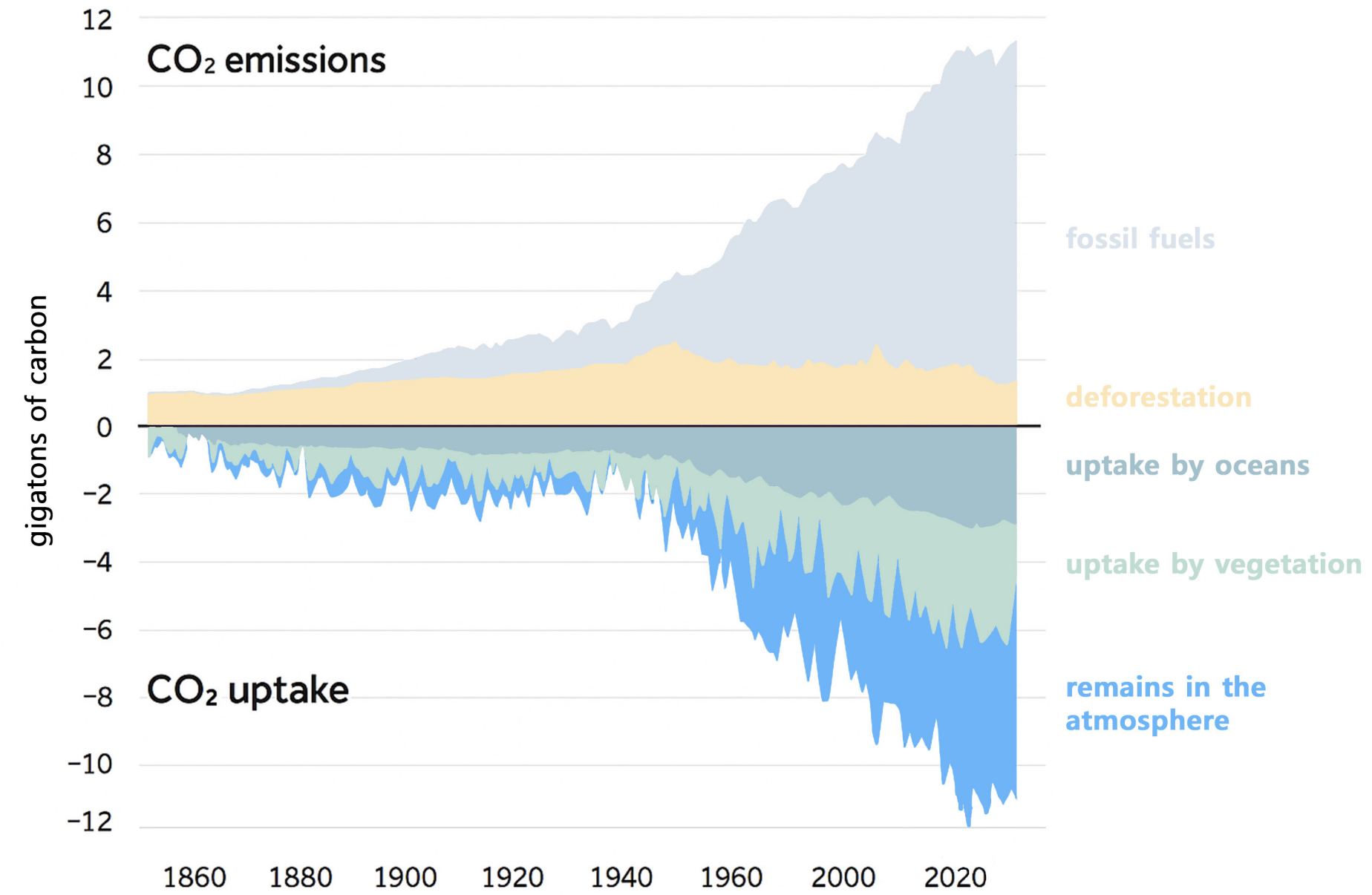
Designing for 500 years of carbon storage

Architectural Wood Studio



Stan van Etten 5668387
25 June 2025

Negative CO₂ balance



bron: Global Carbon Project

NOS Nieuws, Saturday 17 May 2025

Guido van der Werf (WUR)

*"Trees are struggling because of humans and climate change. People cut down forests, use land intensively, and fragment the natural environment. As a result, forests are becoming less resilient. As the climate becomes warmer and drier, trees lose more water and **grow less**."*



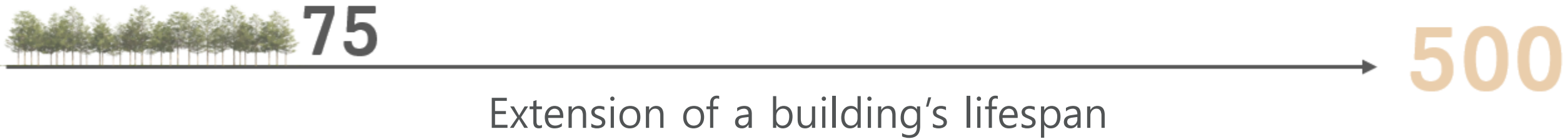
01 RESEARCH FINDINGS

01 RESEARCH TOPIC

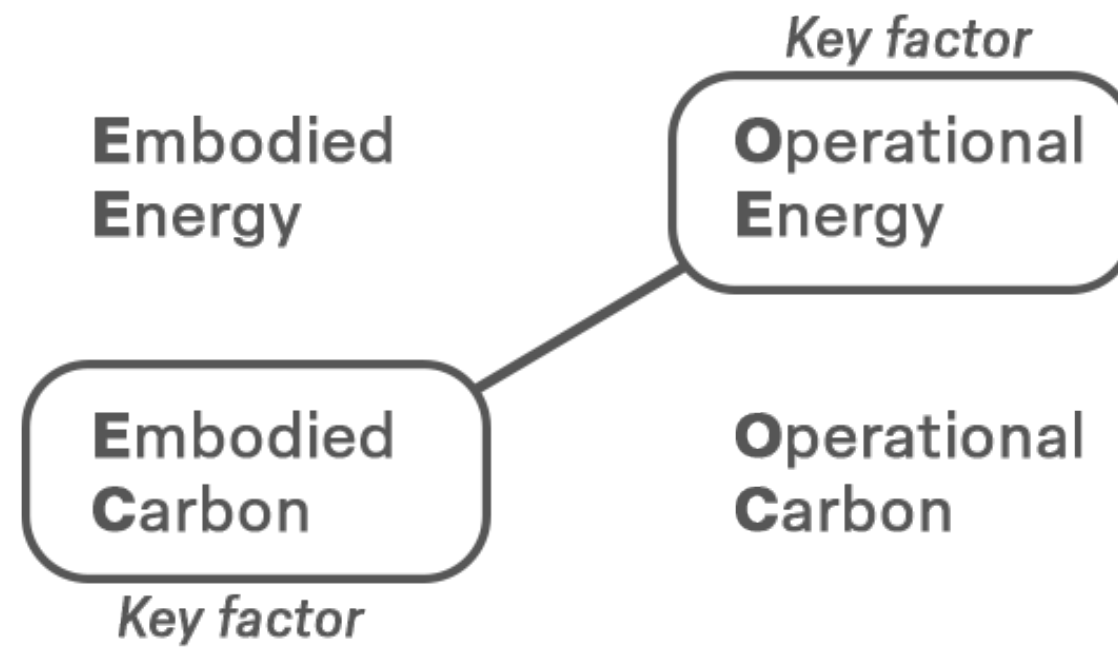
Main question

"How can design decisions for timber construction in the Netherlands be optimised into a guide for maximum carbon uptake and minimum embodied energy?"

01 FINDINGS



01 FINDINGS

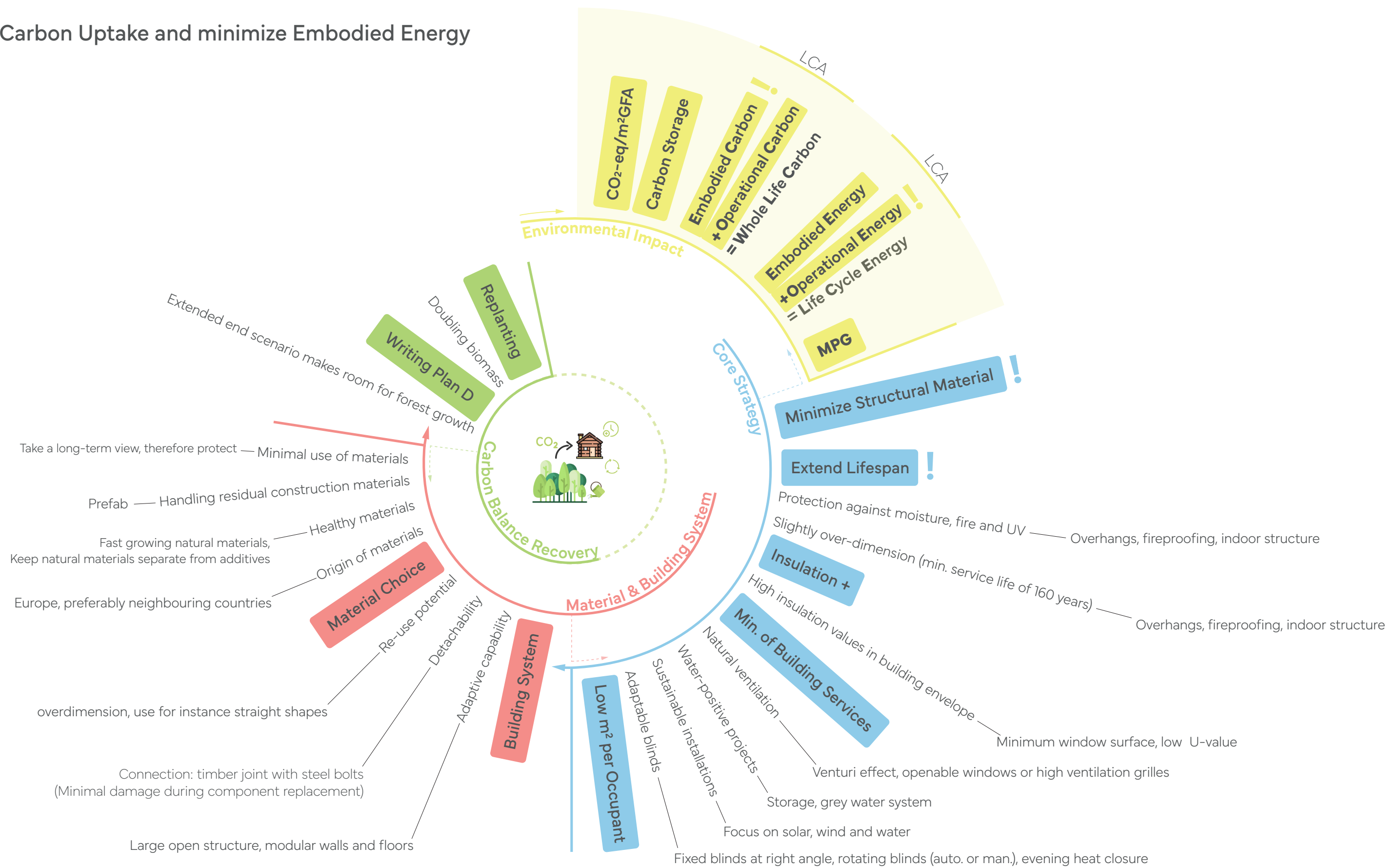


01 HYPOTHESIS

By extensively protecting a building with a large overhanging roof — thereby significantly increasing the roof surface area — the lifespan of a timber structure can be extended by several hundred years, while simultaneously reducing operational energy demand for heating and cooling.

01 MODEL

Guide to maximize Carbon Uptake and minimize Embodied Energy



02 CONTEXT

02 SITE PLAN



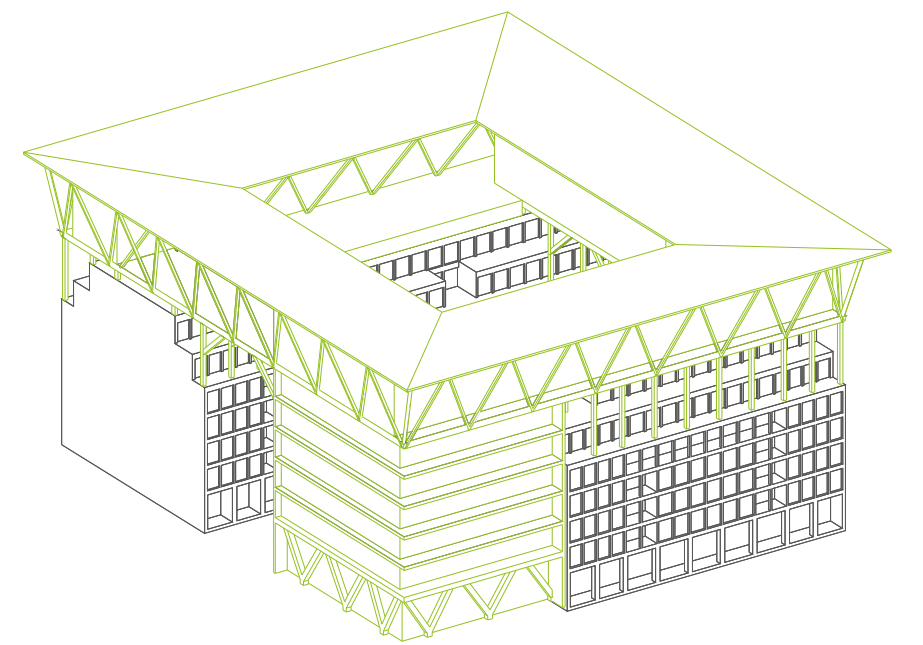
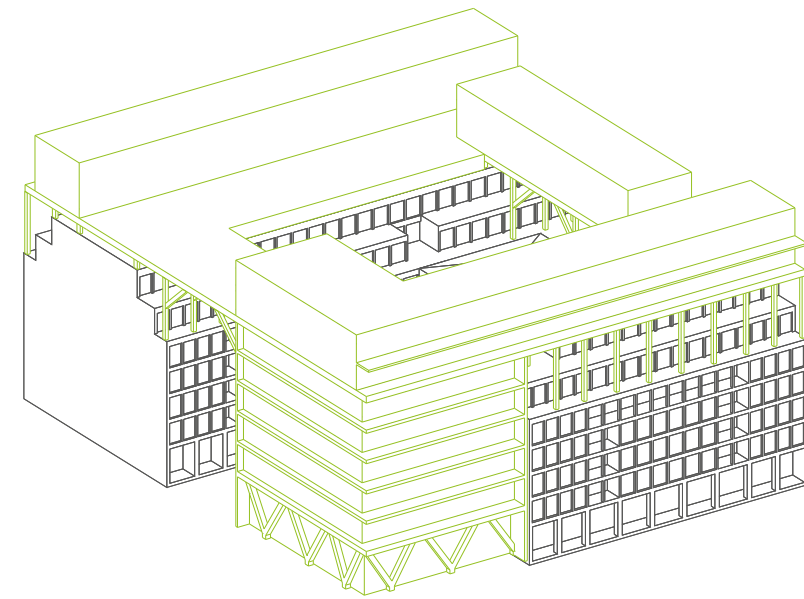
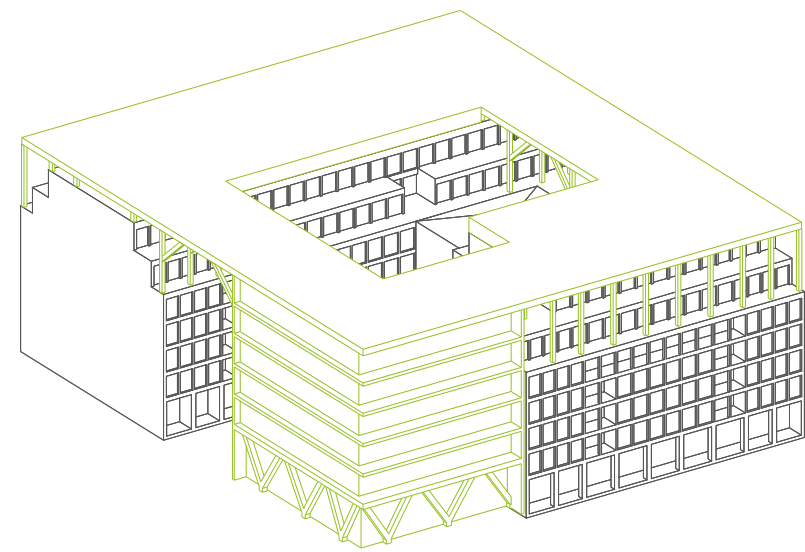
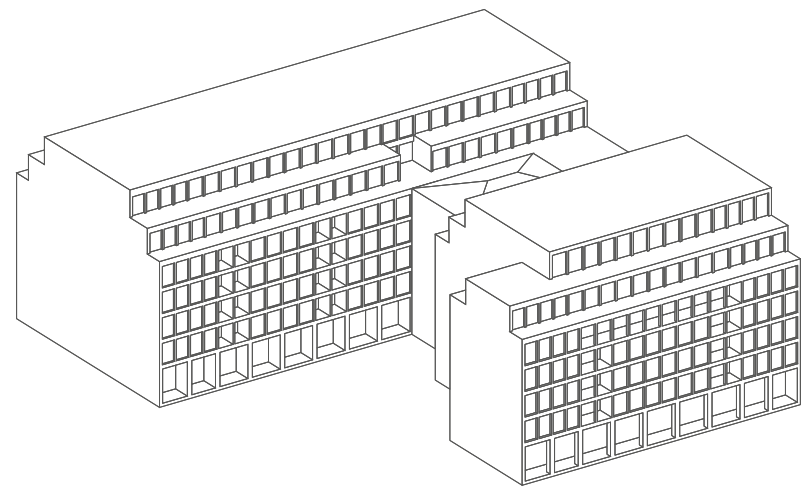
1 : 2500



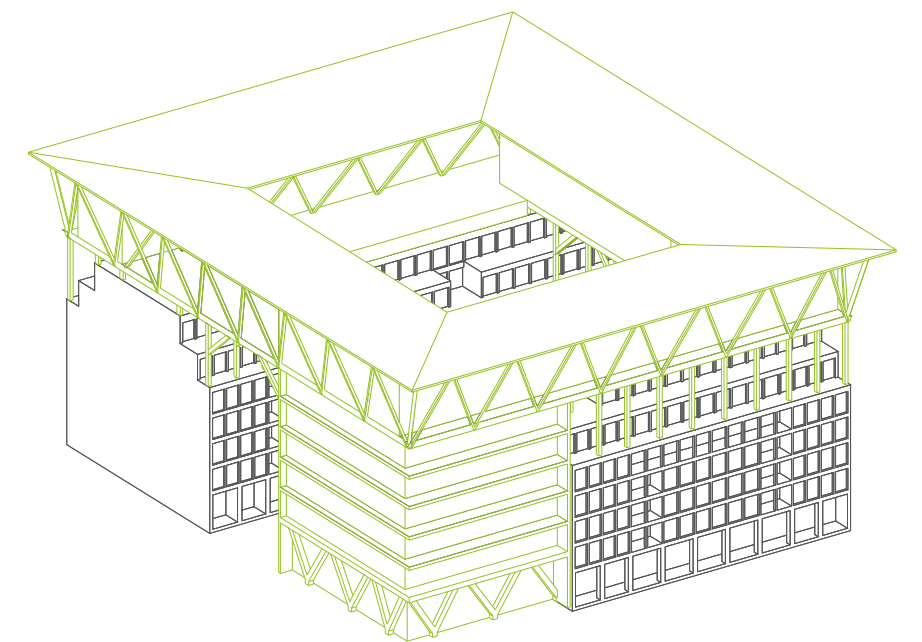
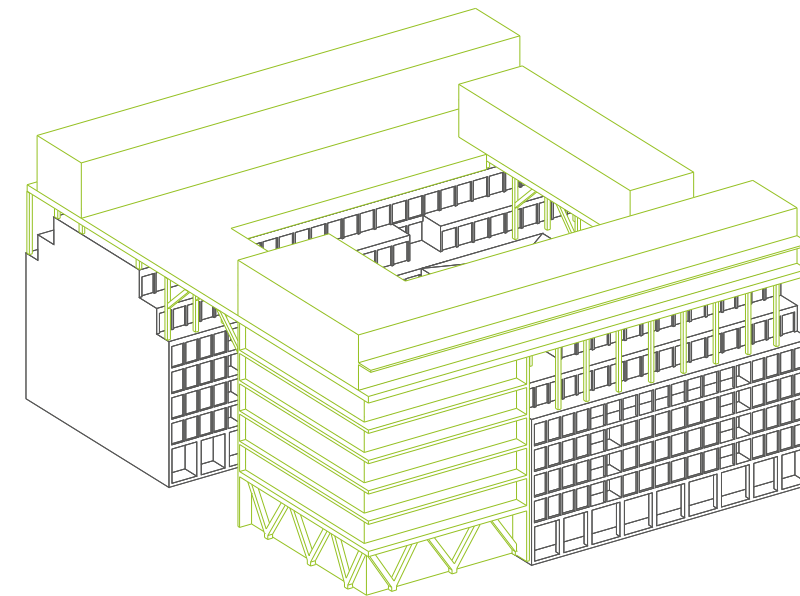
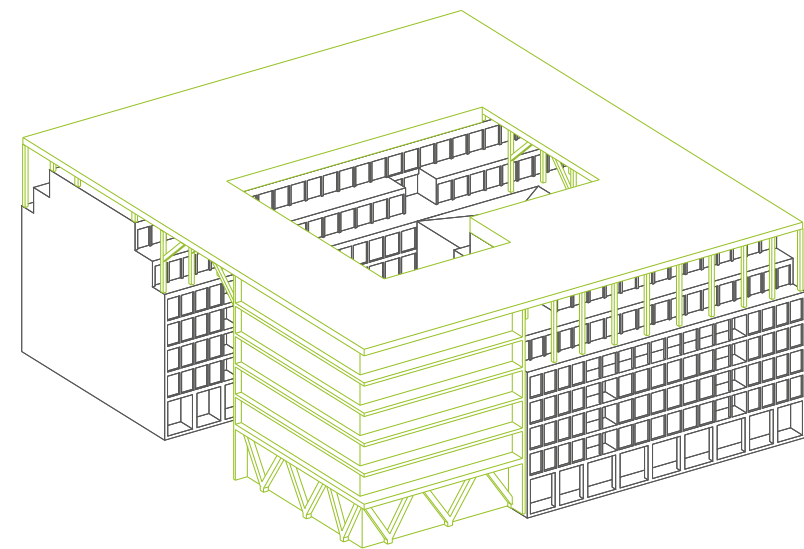
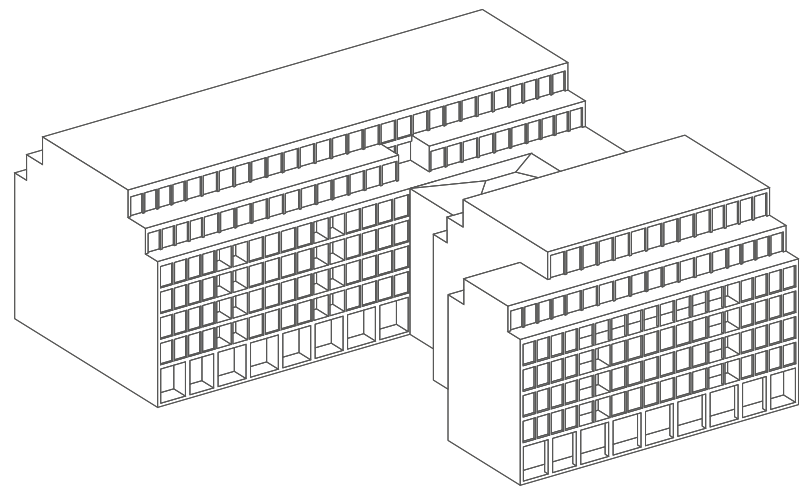
02 EXISTING BUILDING



02 OPTOPPING



02 OPTOPPING



Vertical building	5 floors
Heated floor area	2650 m ²
Covered outdoor area	980 m ²

Horizontal building	2 floors
Apartments	64
Heated floor area	4190 m ²
Outdoor area	3200 m ²
Green space	332m ²

Green roof	5700 m ²
------------	---------------------

02 REFERENCE



Horyu-ji

Nara, Japan

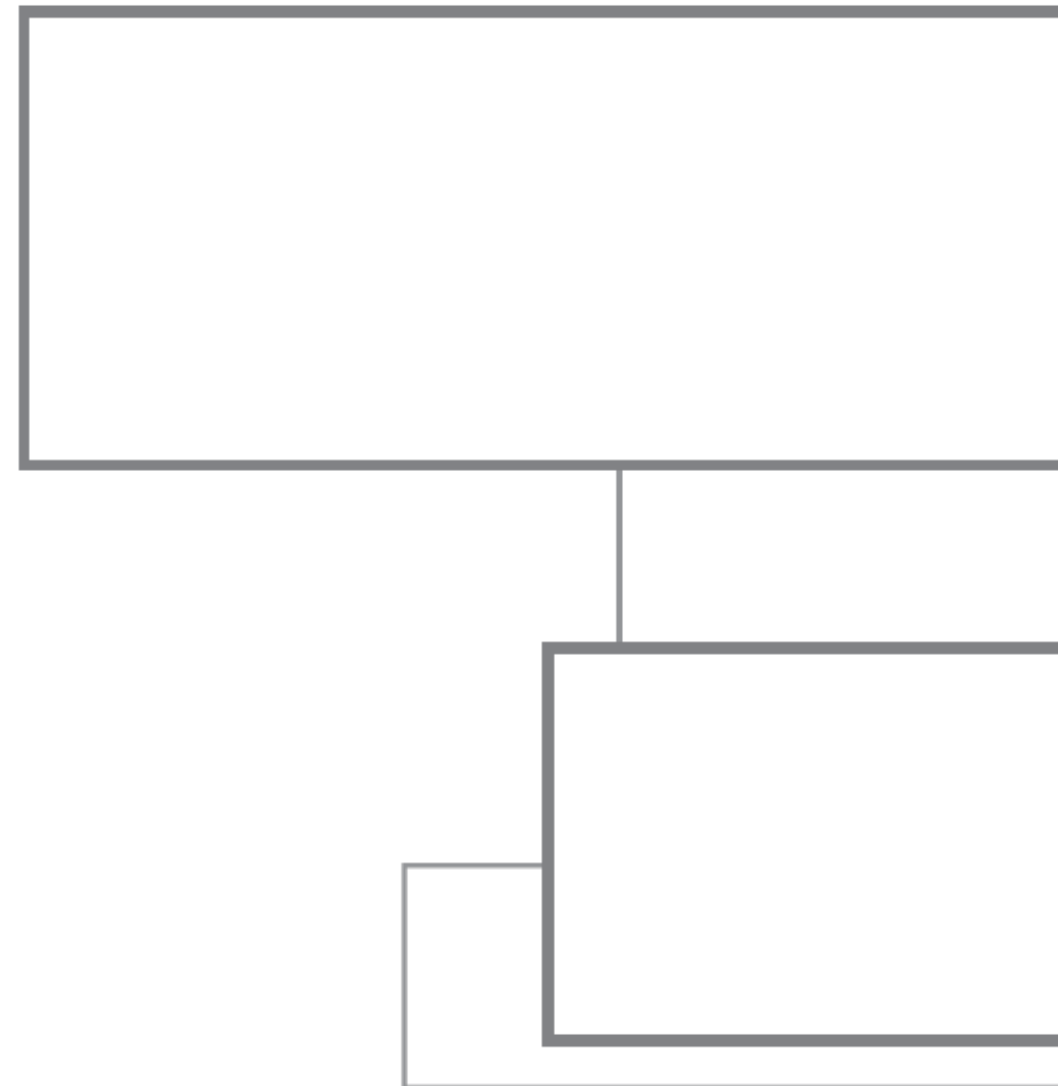
670 AD

1350 years old

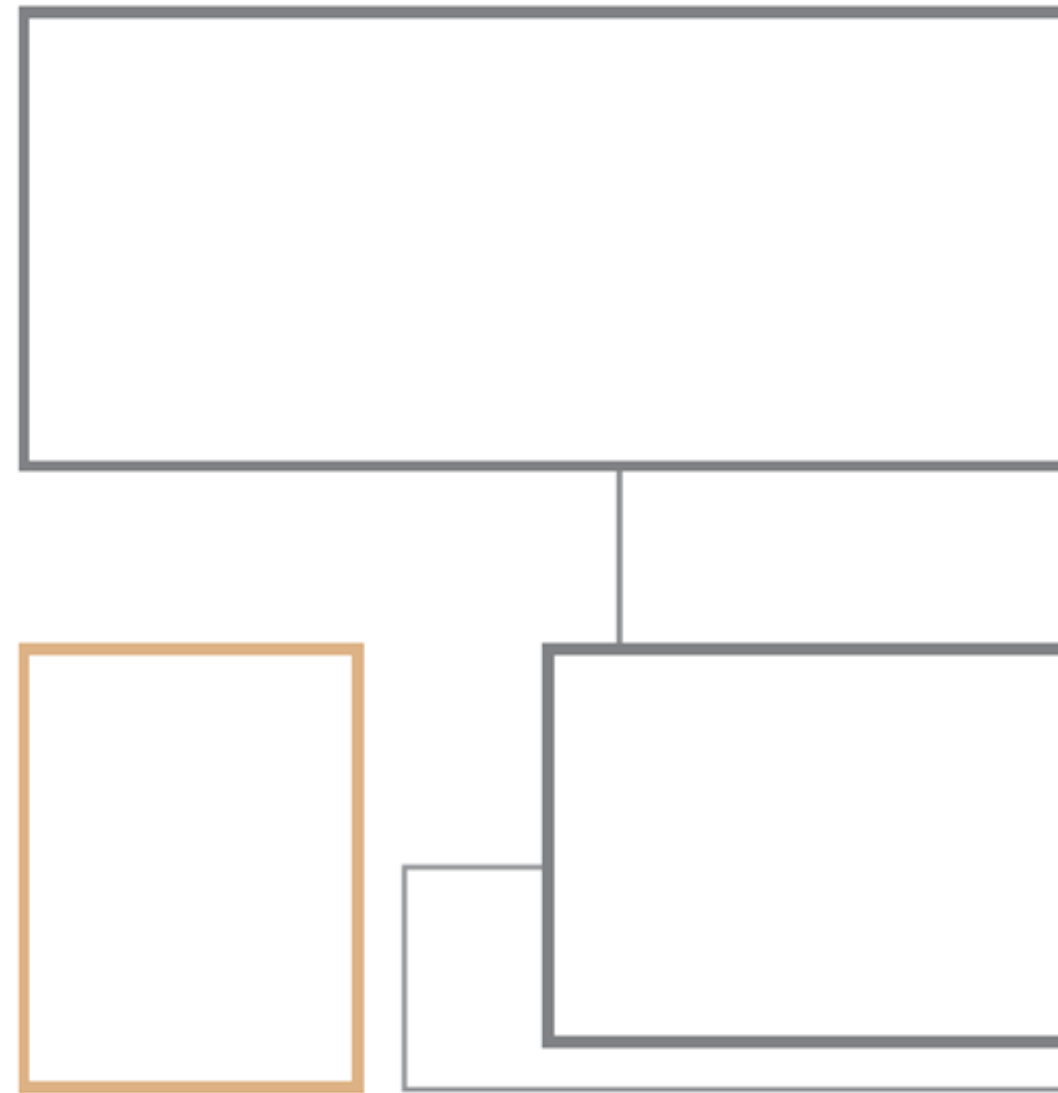


03 DESIGN

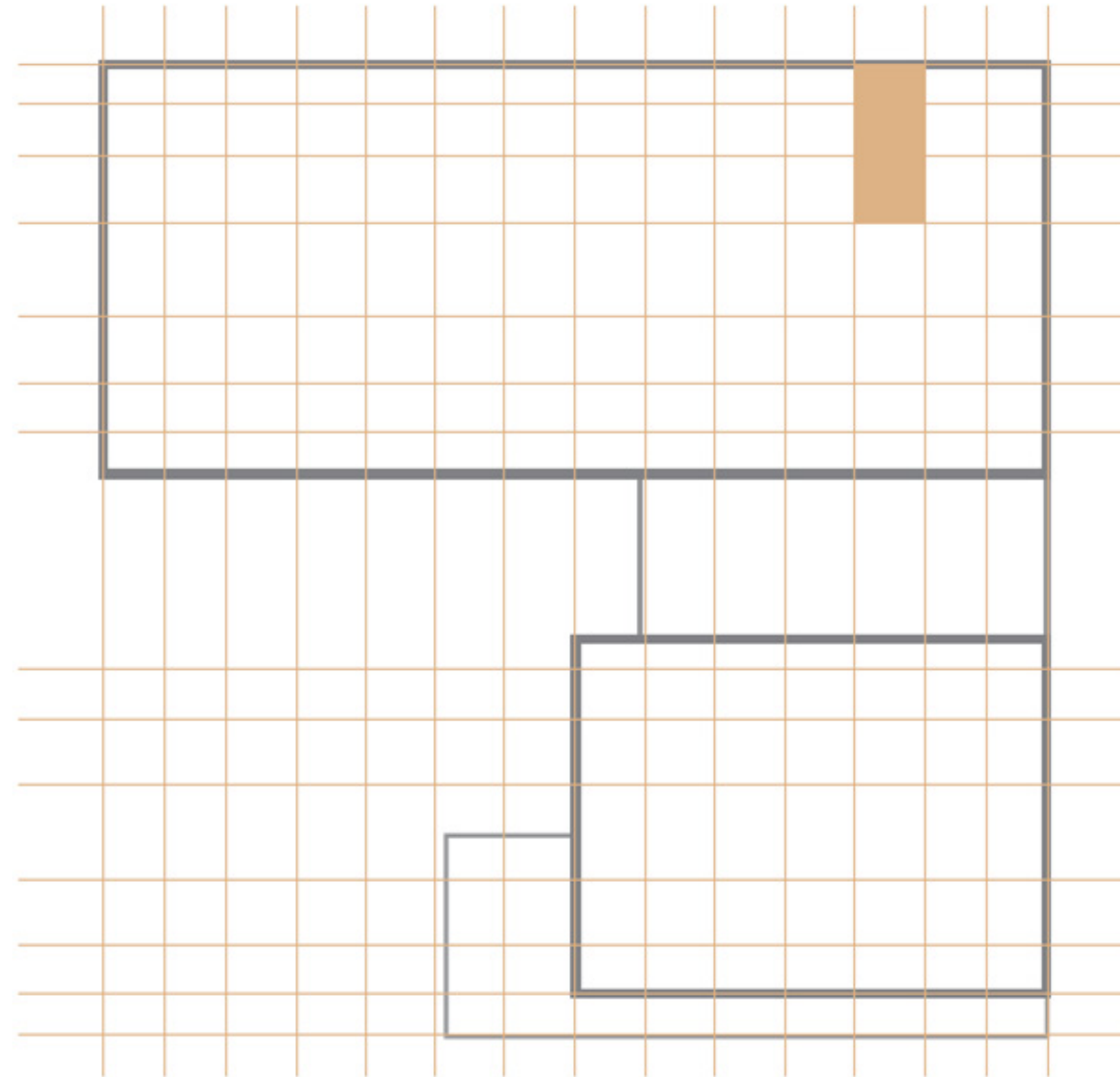
03 INITIAL DESIGN PROPOSAL



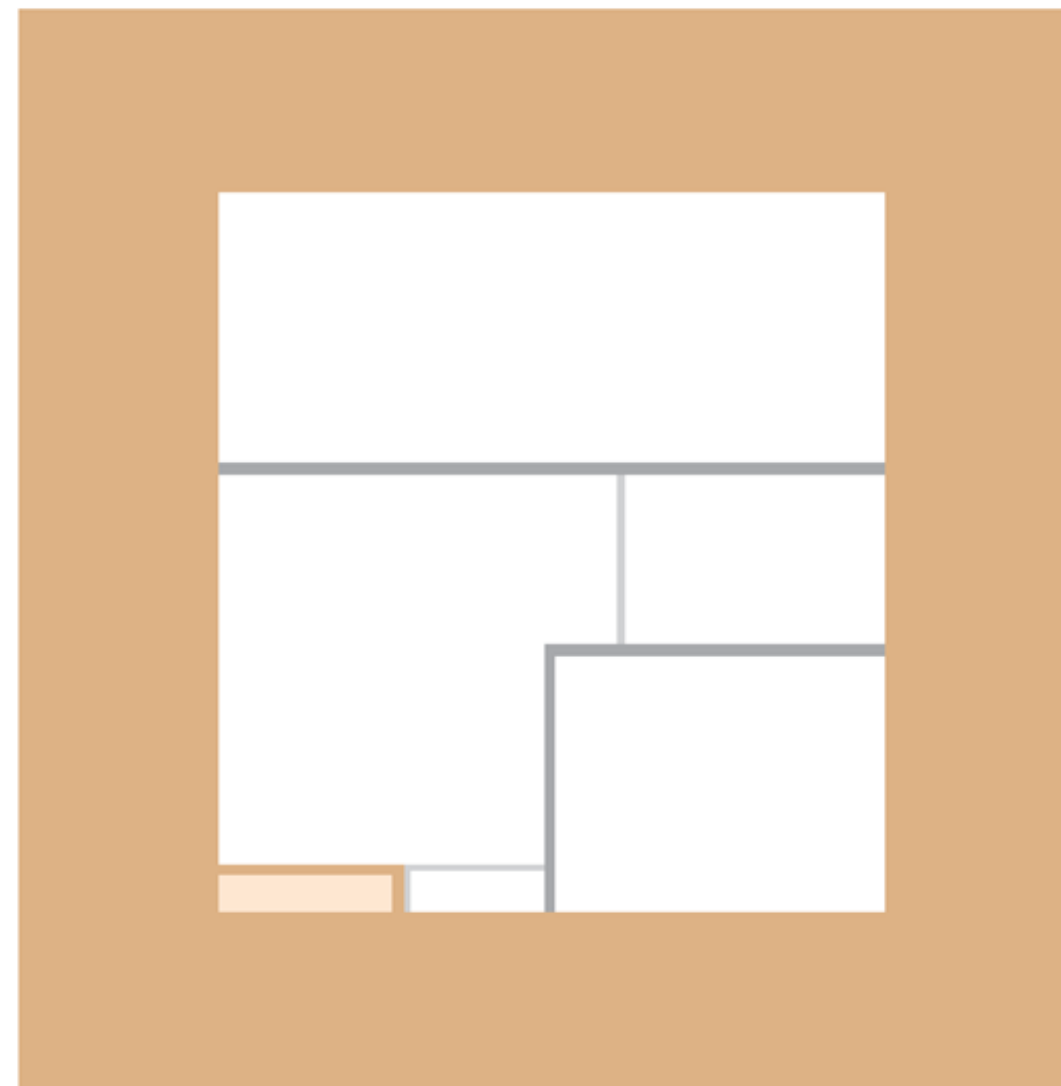
03 INITIAL DESIGN PROPOSAL



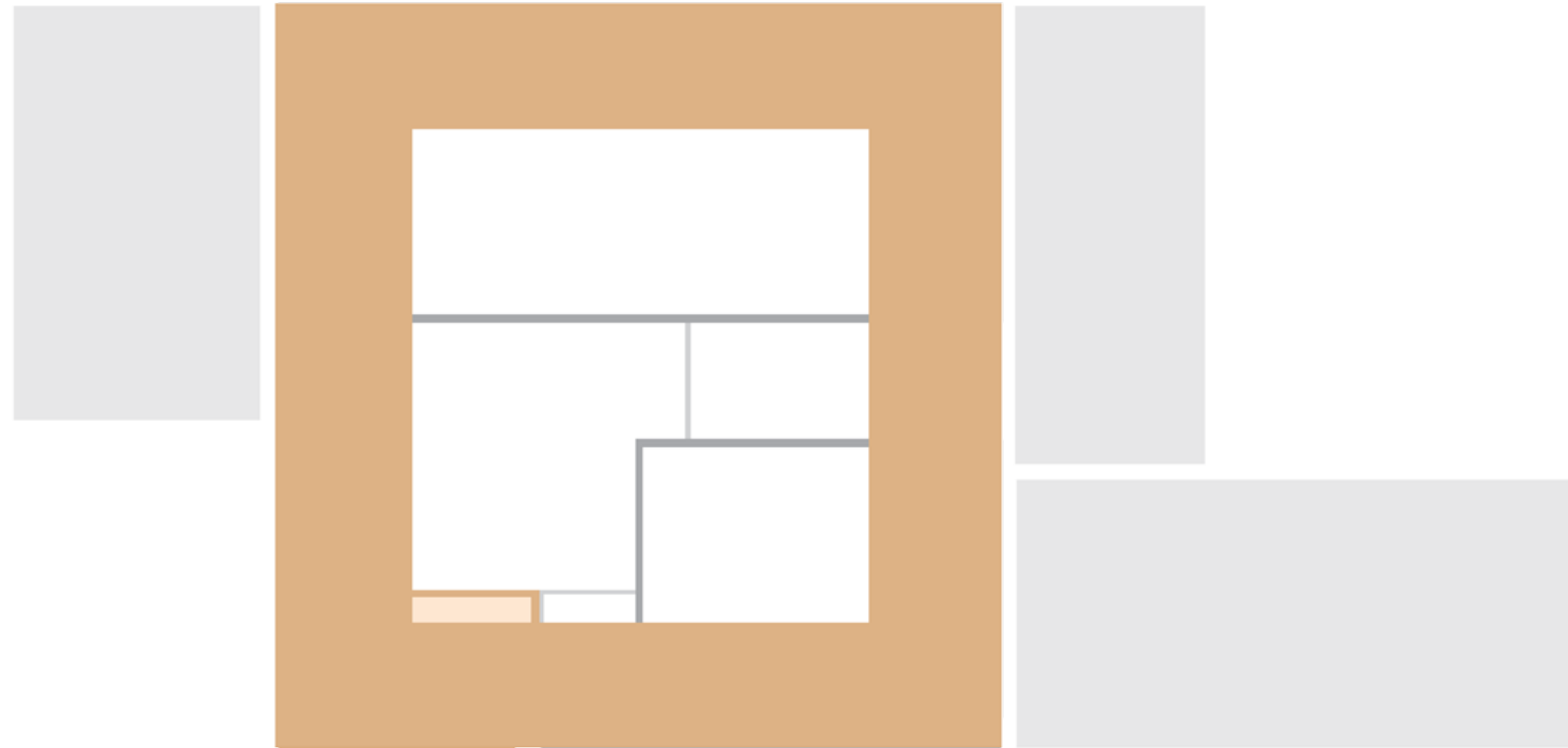
03 INITIAL DESIGN PROPOSAL



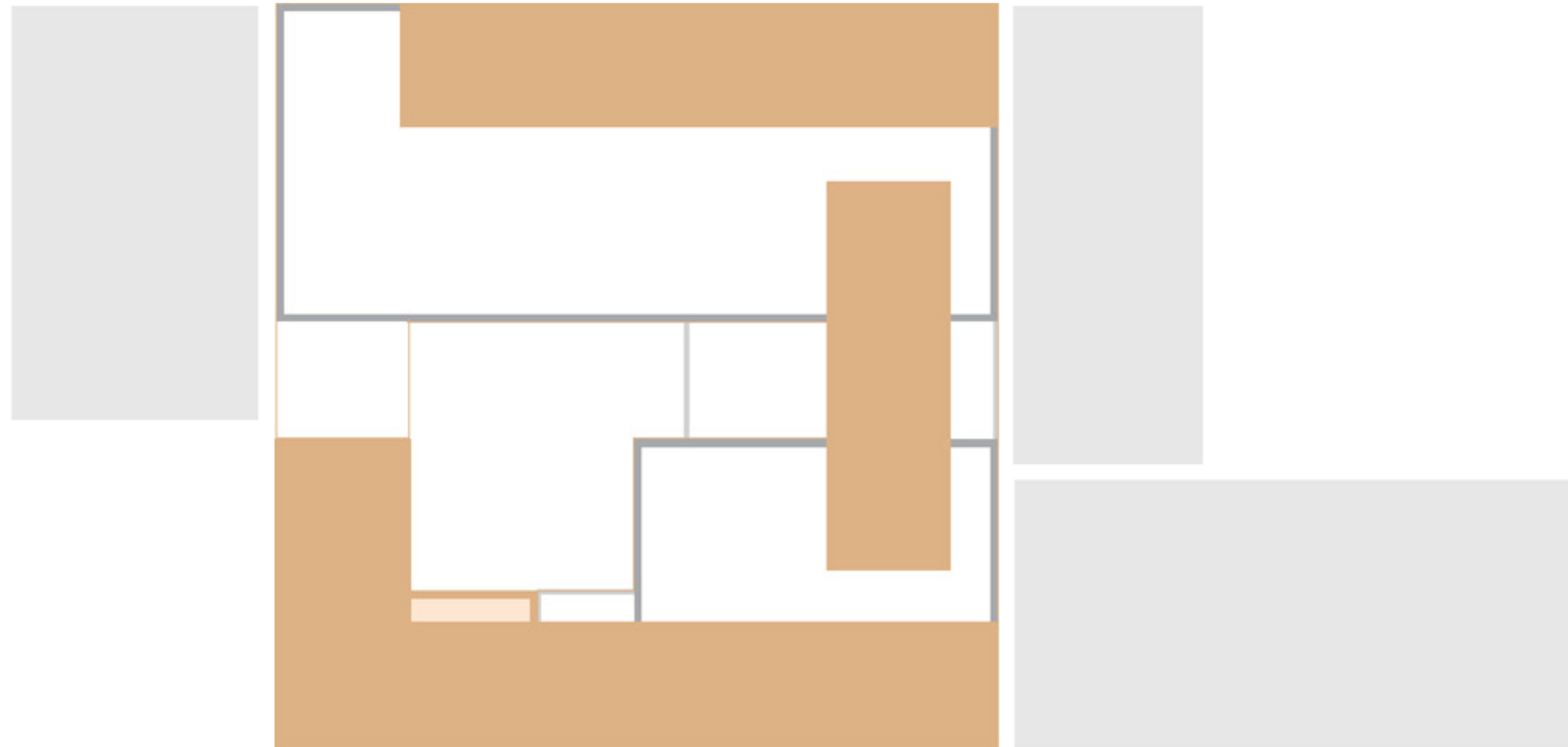
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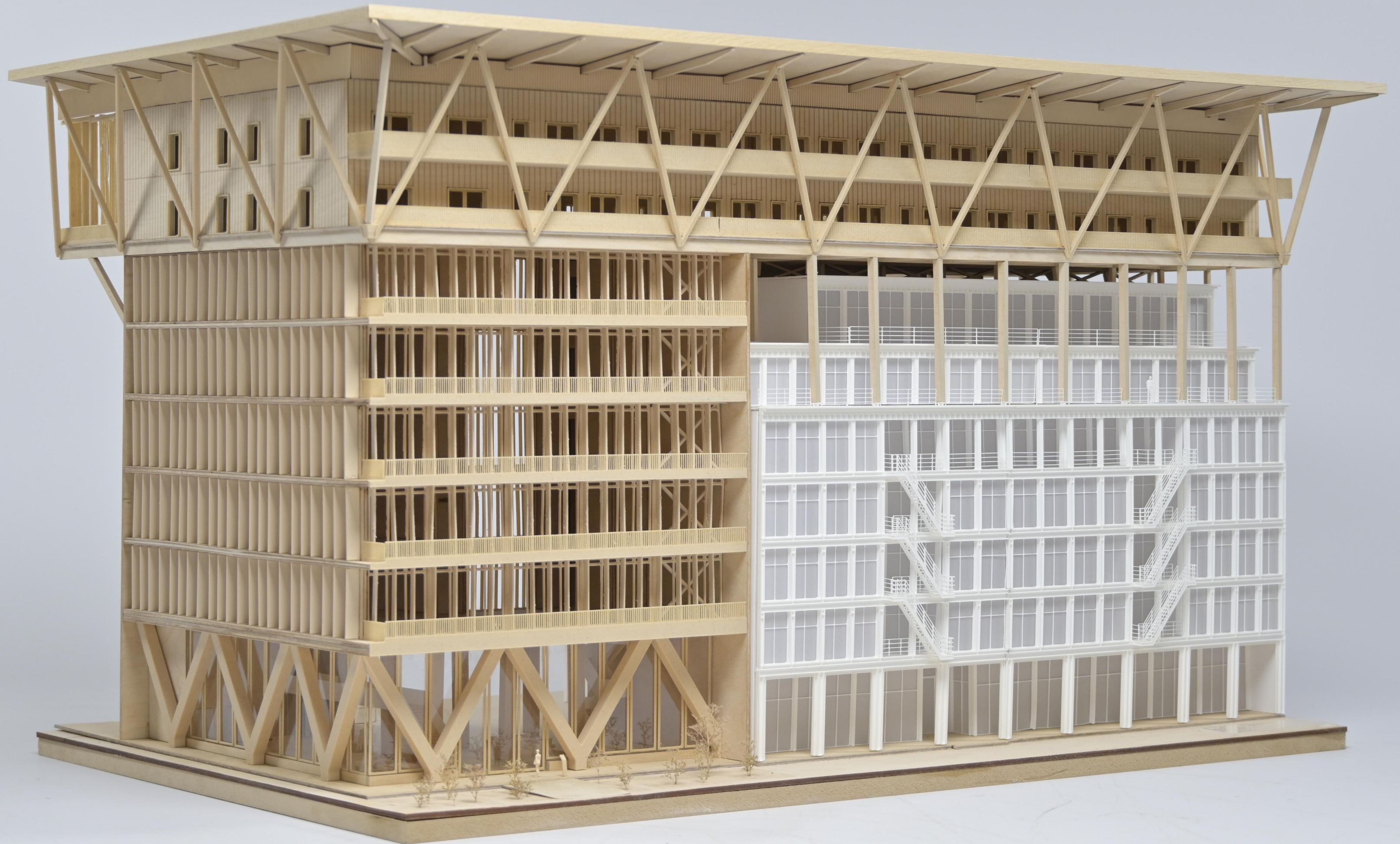


03 INITIAL DESIGN PROPOSAL



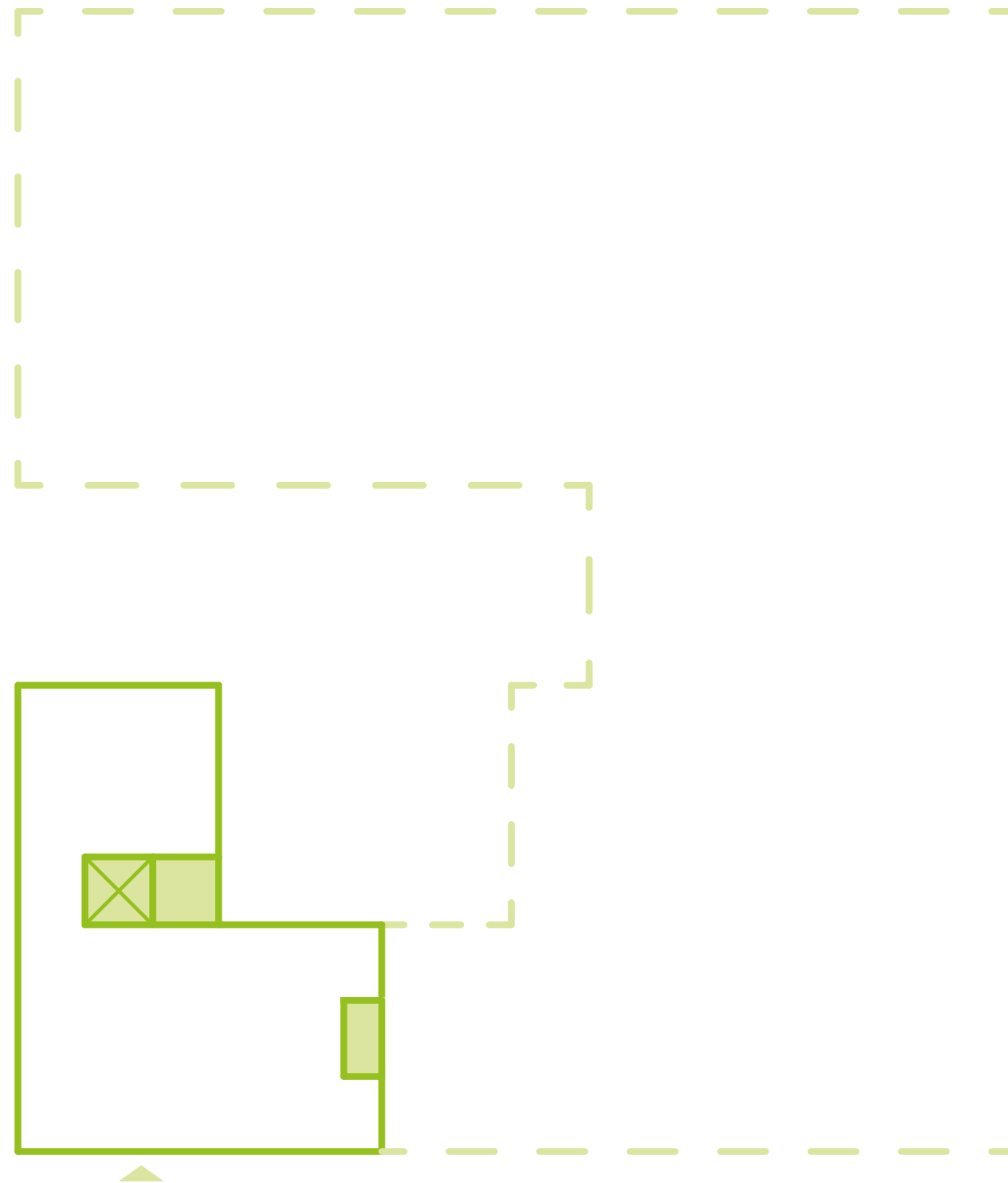
03 INITIAL DESIGN PROPOSAL





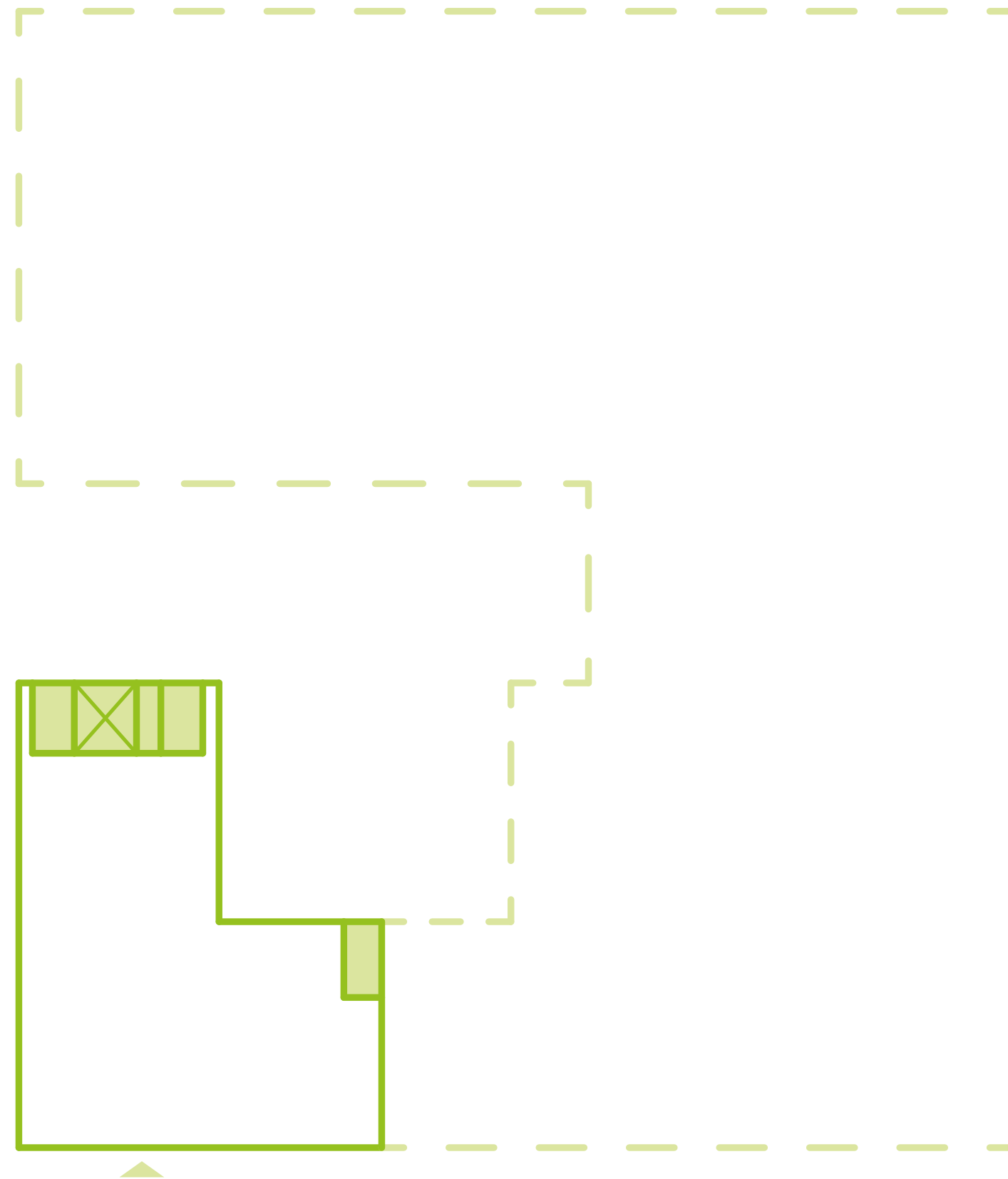
03 ENTRANCE
Initial Draft

Material quantity relative to
the current design
+ 28%



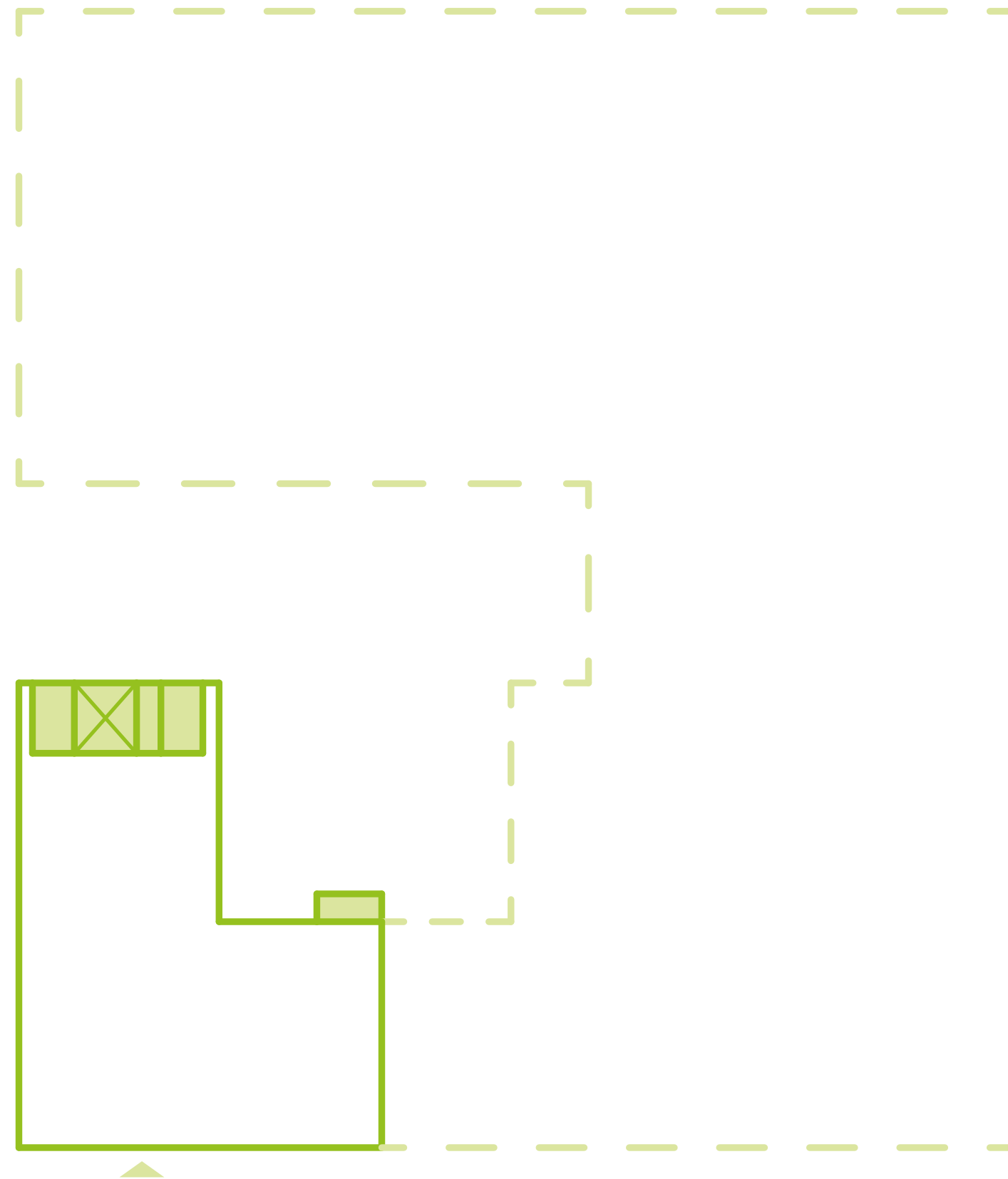
03 ENTRANCE
Current Design

Material quantity relative to
the current design
0%

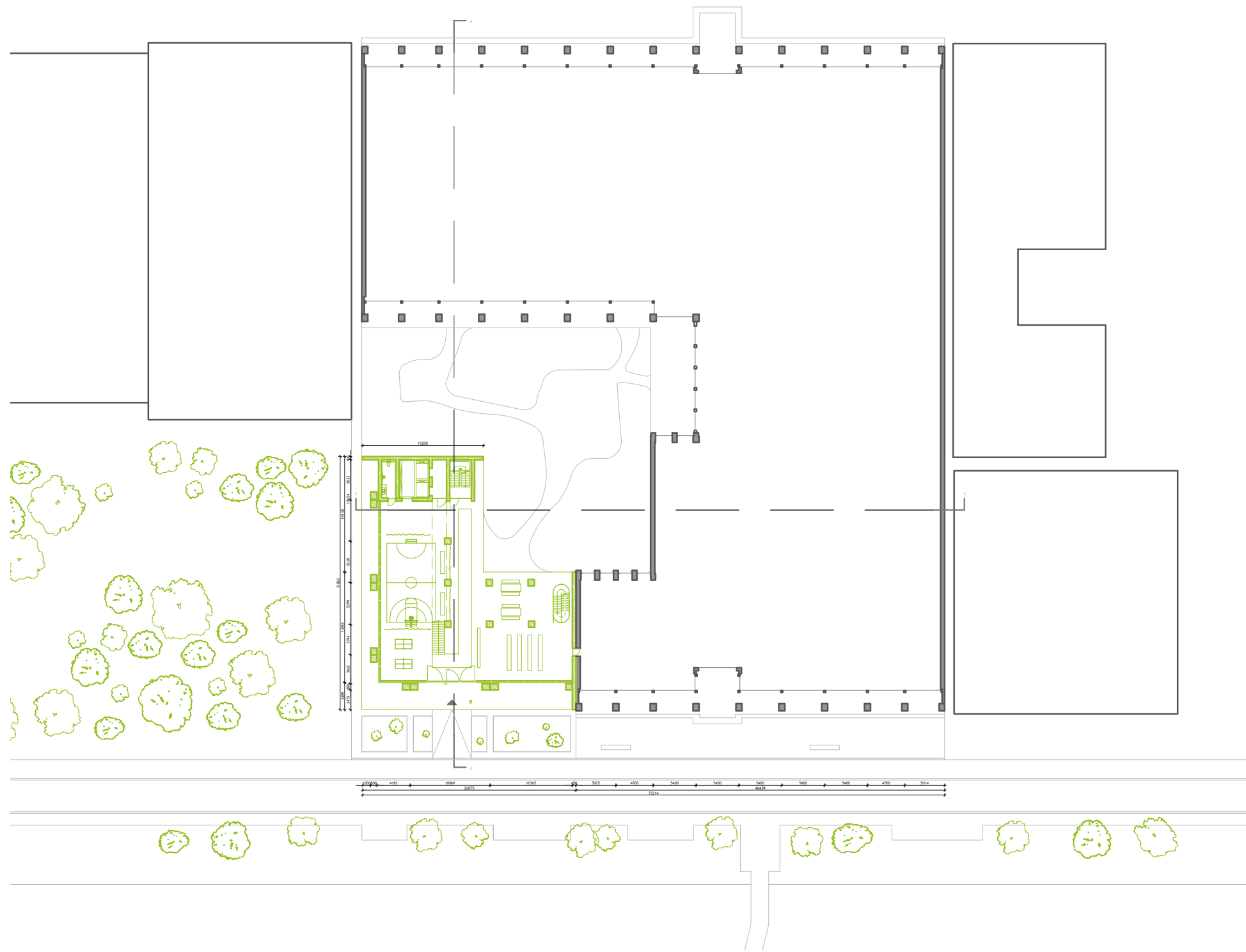


03 ENTRANCE Design Enhancement

Material quantity relative to
the current design
- 13%



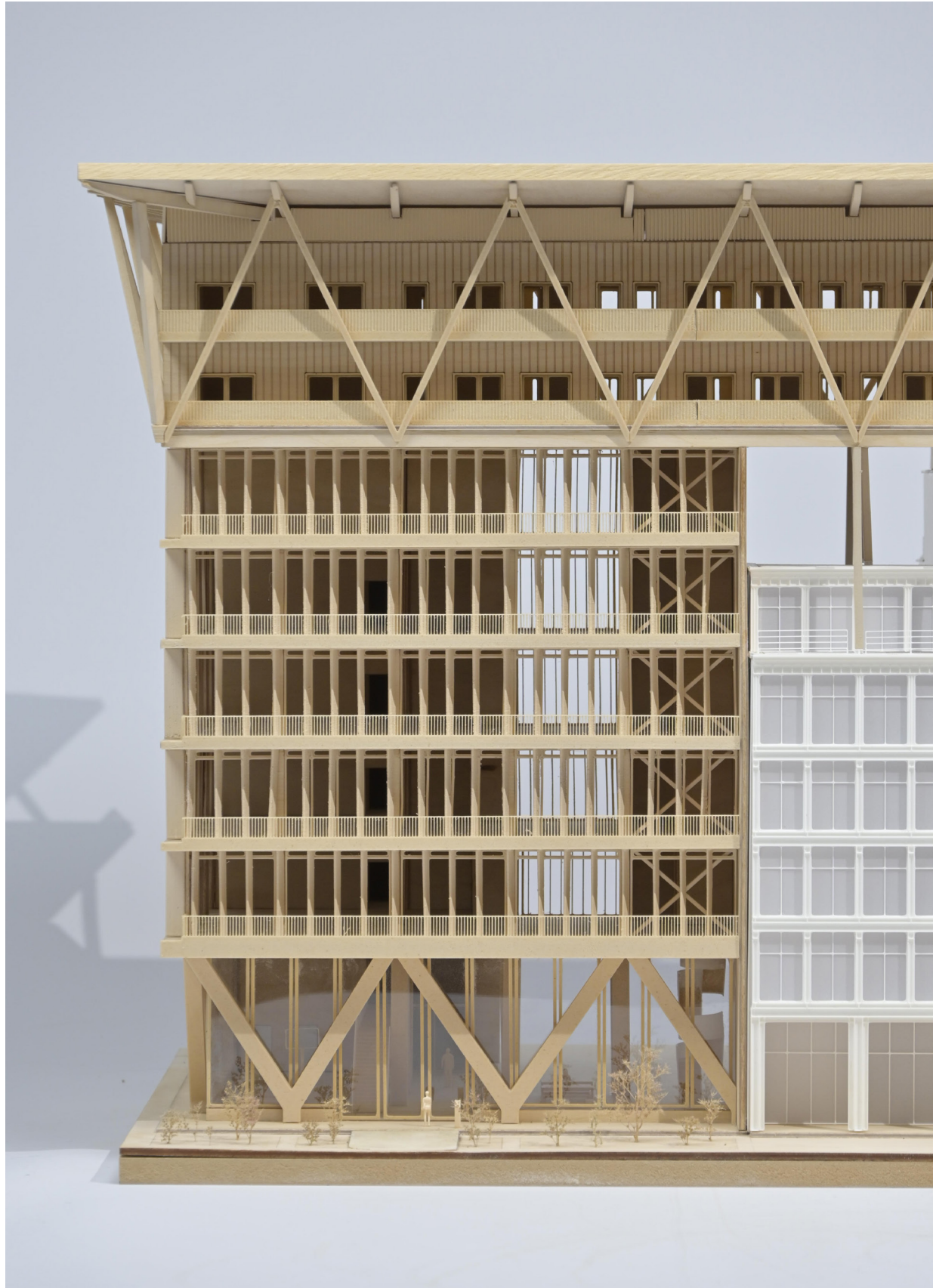
03 ENTRANCE



plan ground level - 1 : 500



plan ground level - 1 : 200



entrance ground floor



entrance ground floor - open-plan space



community driven

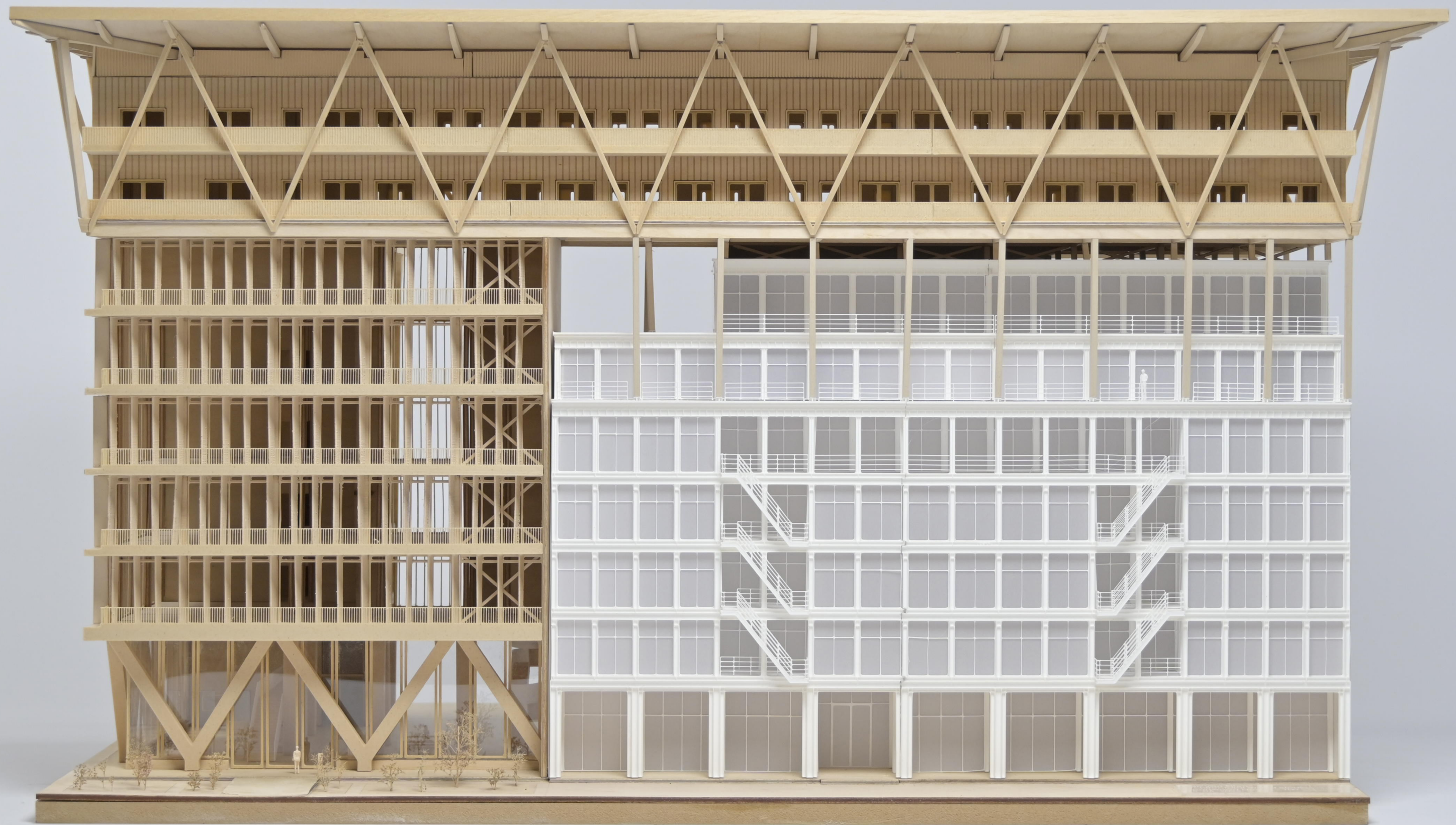
Building System

Minimal use of materials

03 TYPICAL FLOOR LAYOUT



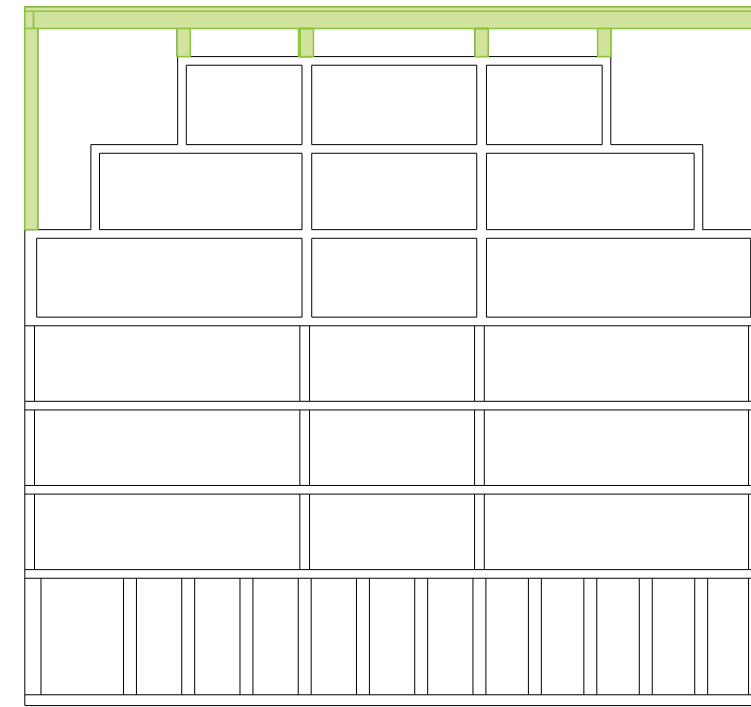
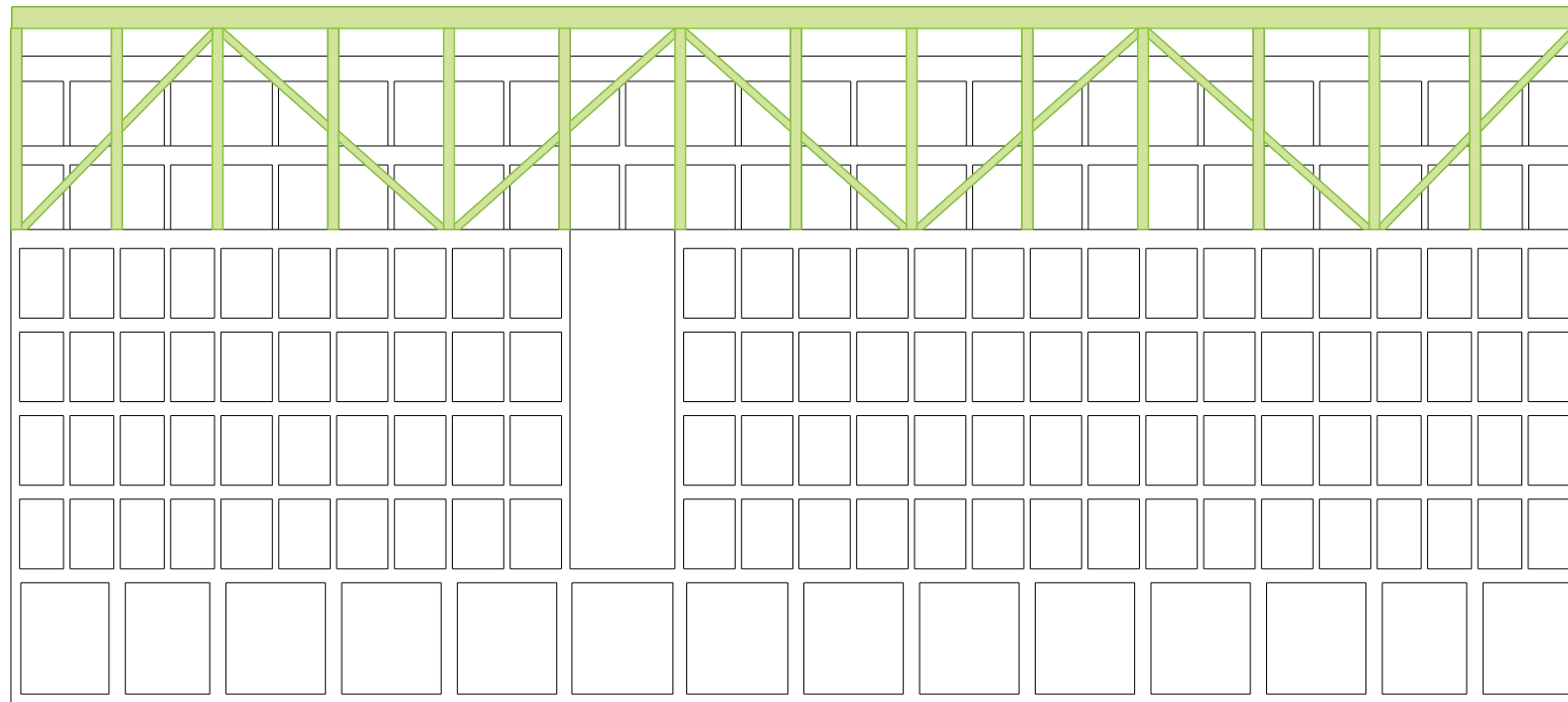
second to fifth floor - 1 : 200



03 PLATFORM

Initial Draft

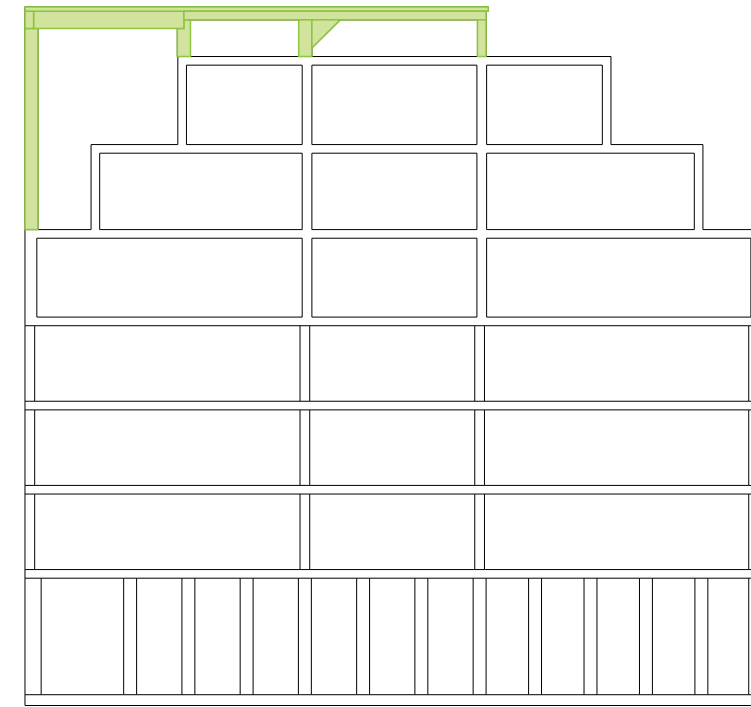
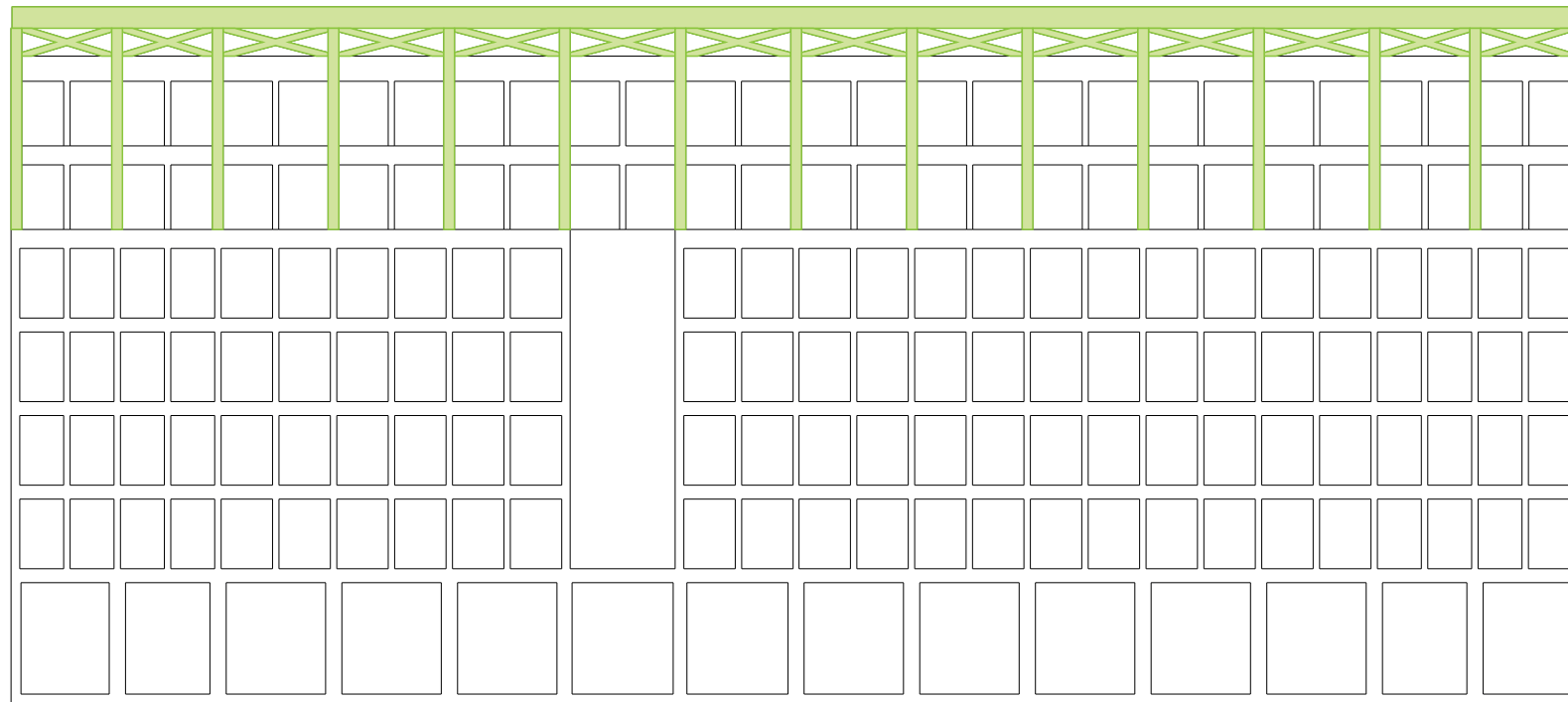
Material quantity relative to
the current design
+ 66%



03 PLATFORM

Current Design

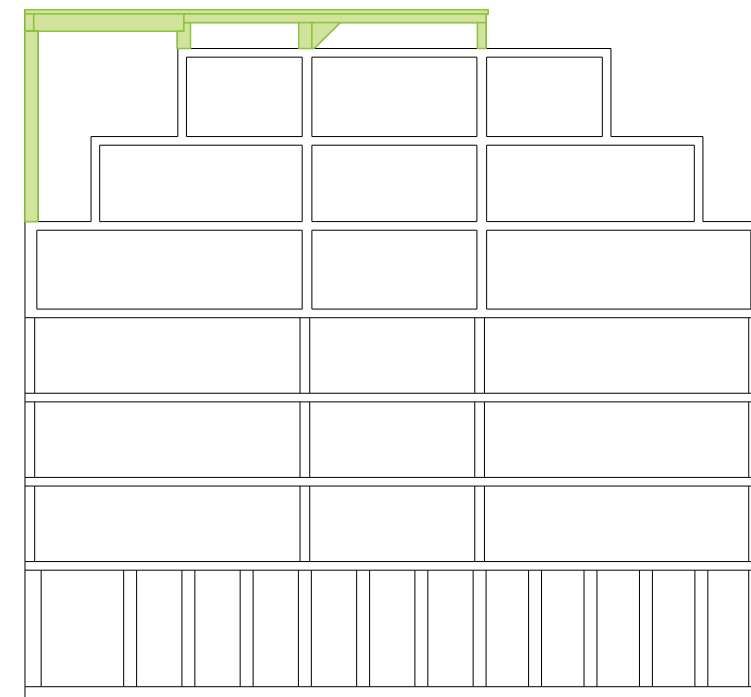
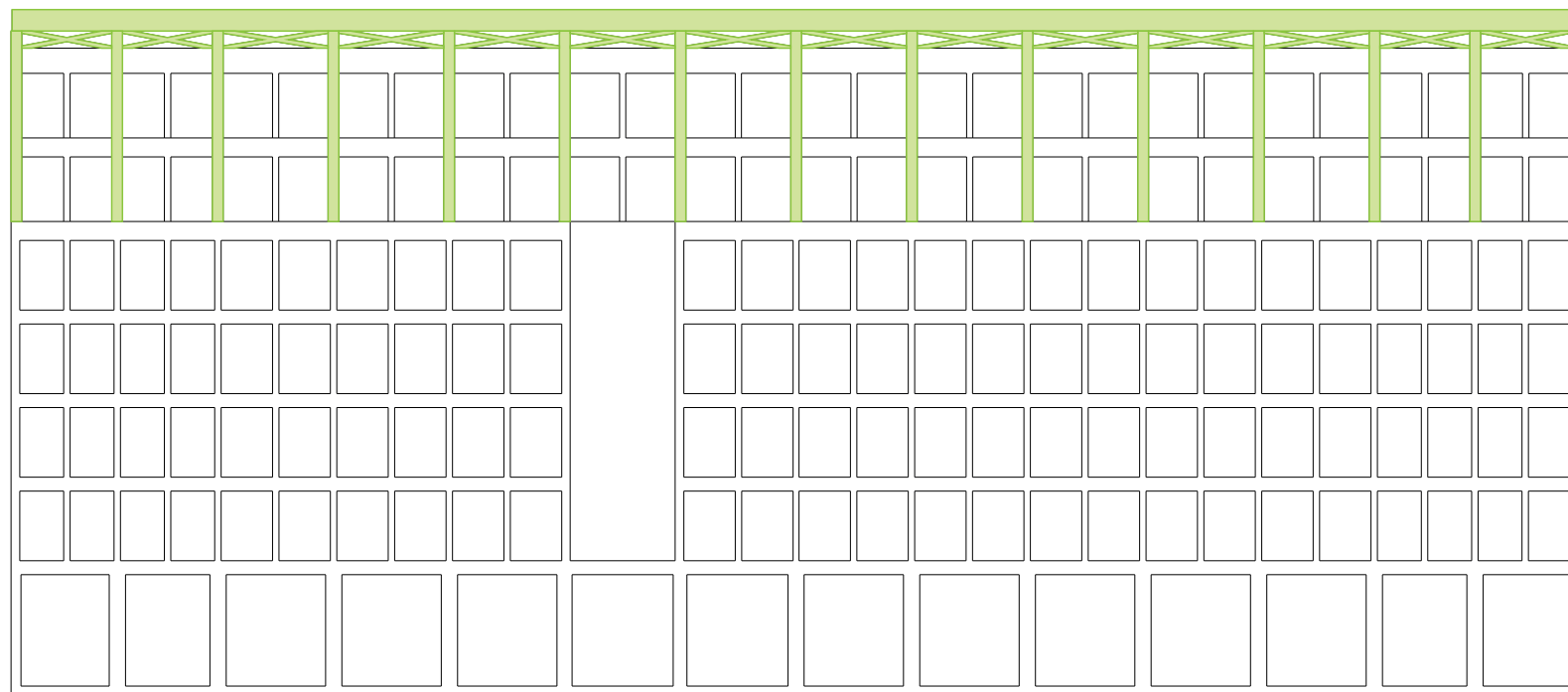
Material quantity relative to
the current design
0%

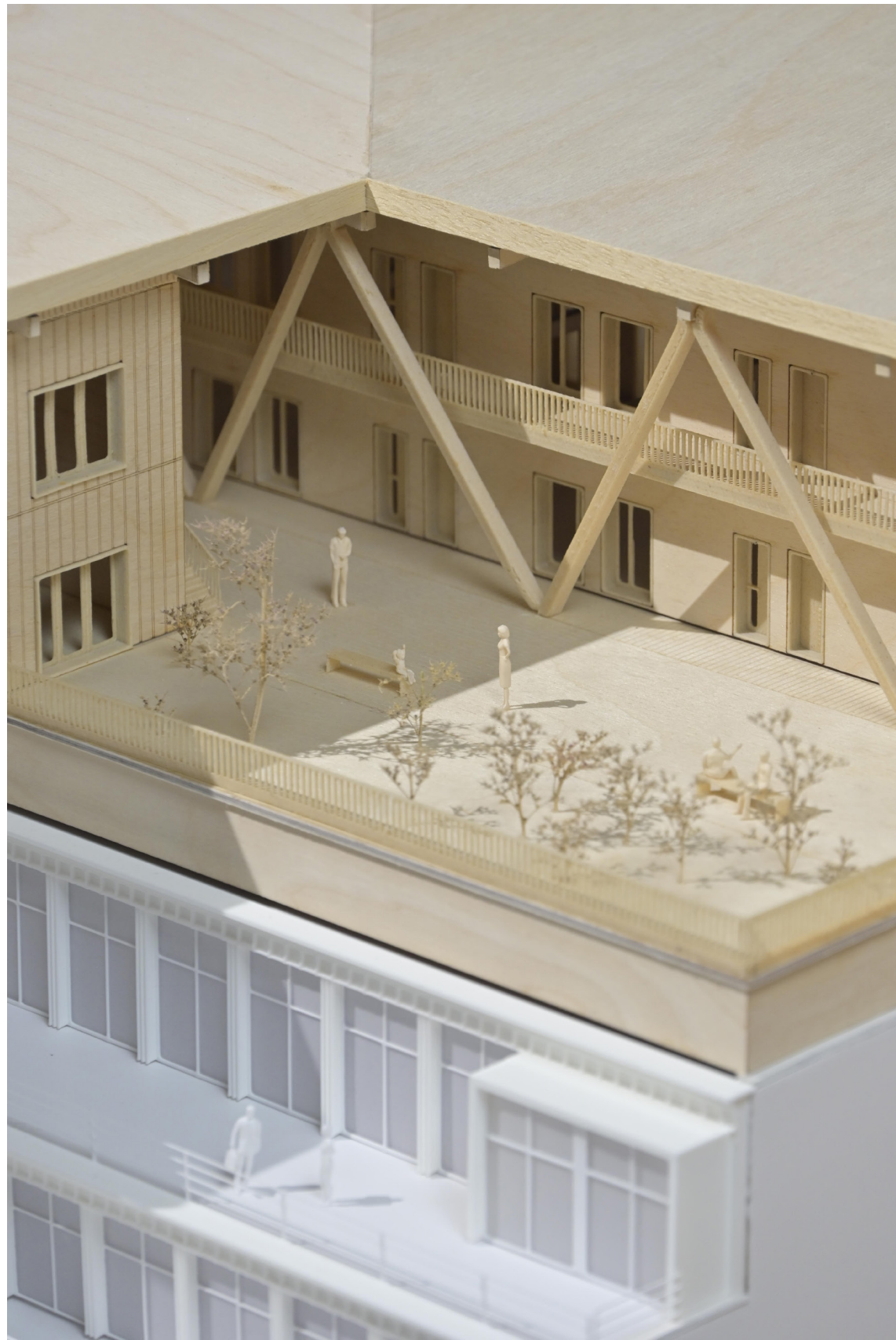


03 PLATFORM

Design Enhancement

Material quantity relative to
the current design
- 6%





courtyard - biophilic design

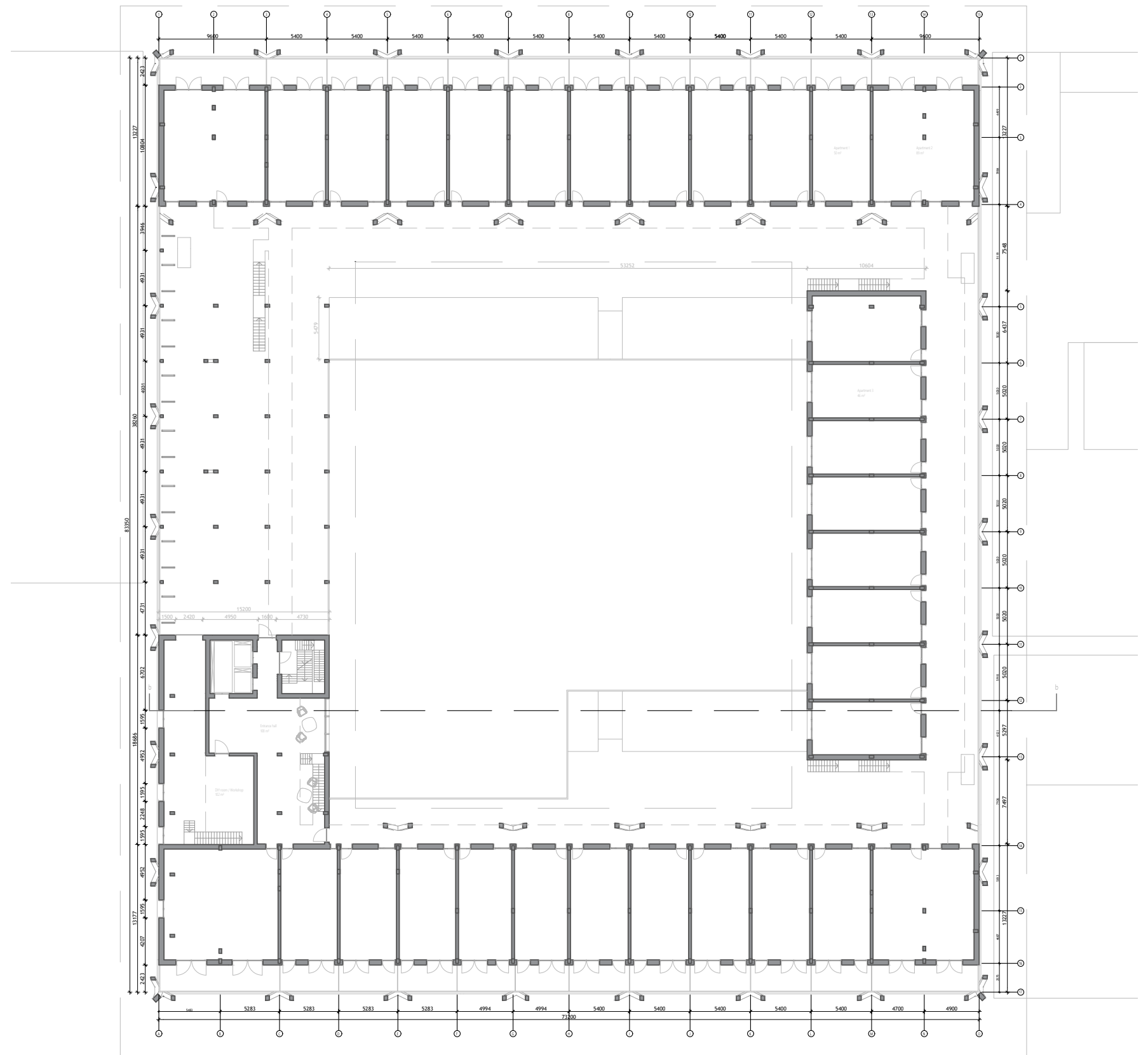


enclosed courtyard

Low m² per Occupant

Extend Lifespan

03 RESIDENTIAL FLOOR



sixth floor - 1 : 150

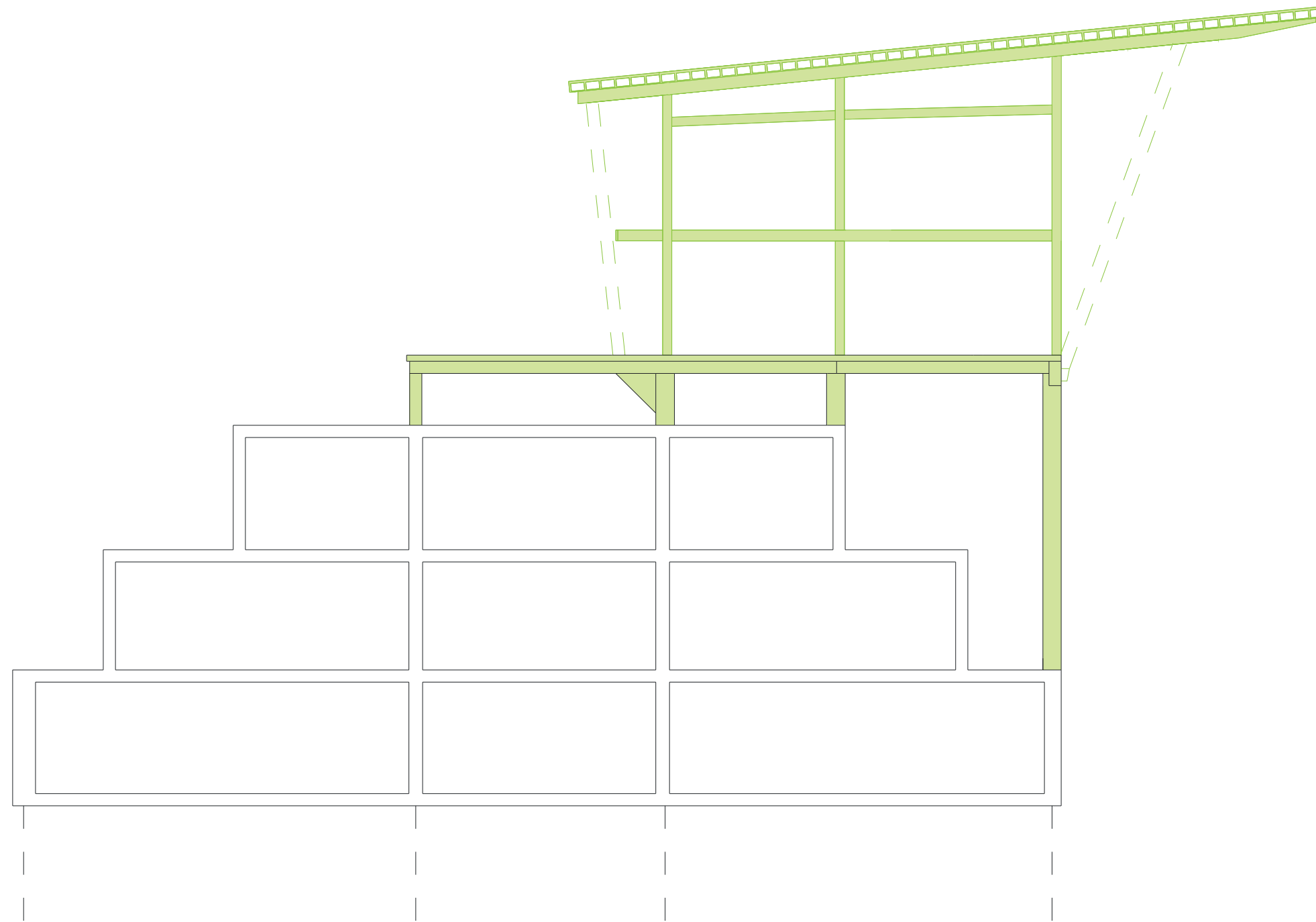


entrance to sixth floor

03 STRUCTURE

Initial Draft

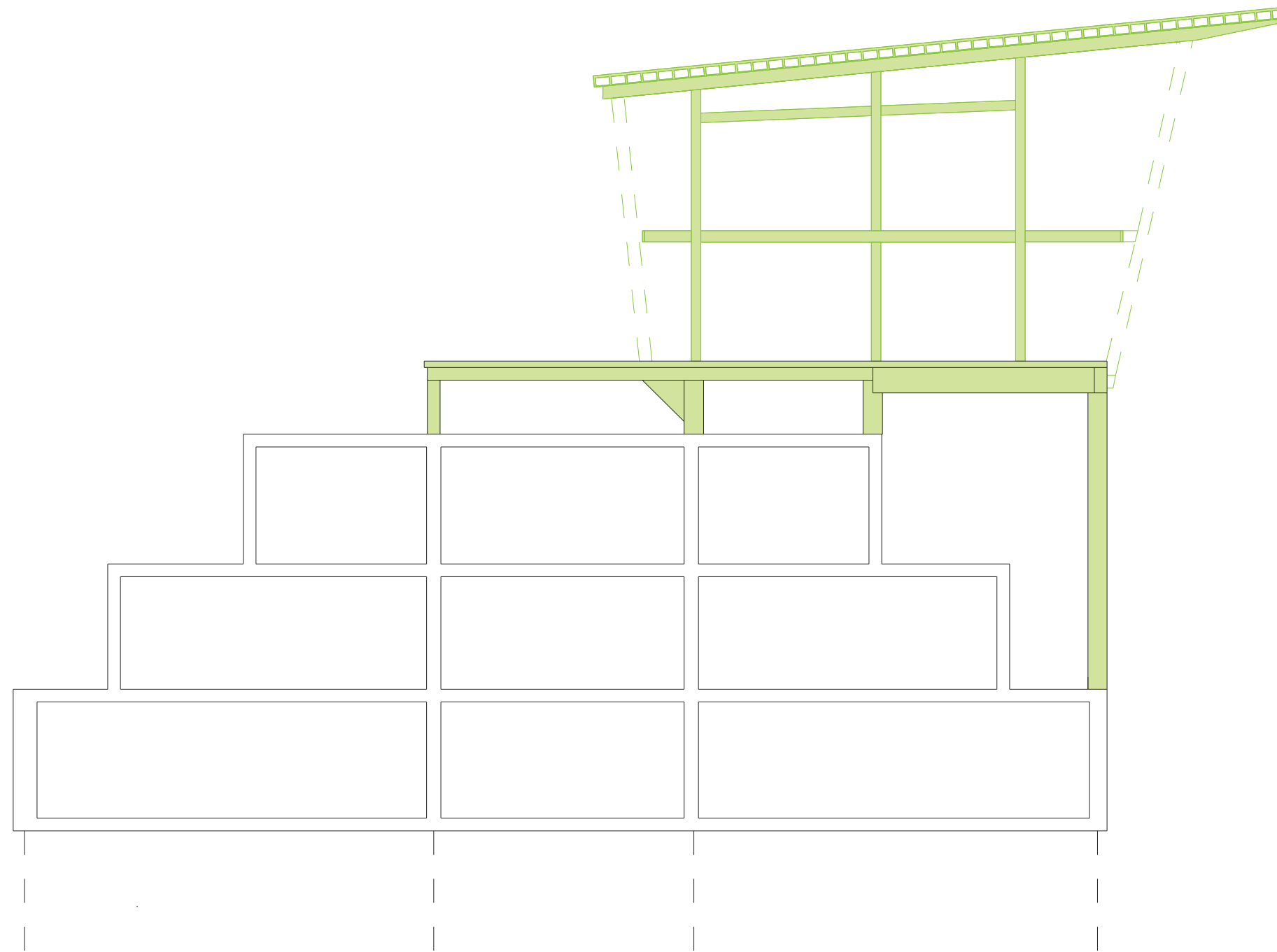
Material quantity relative to
the current design
+ 22%



03 STRUCTURE

Current Design

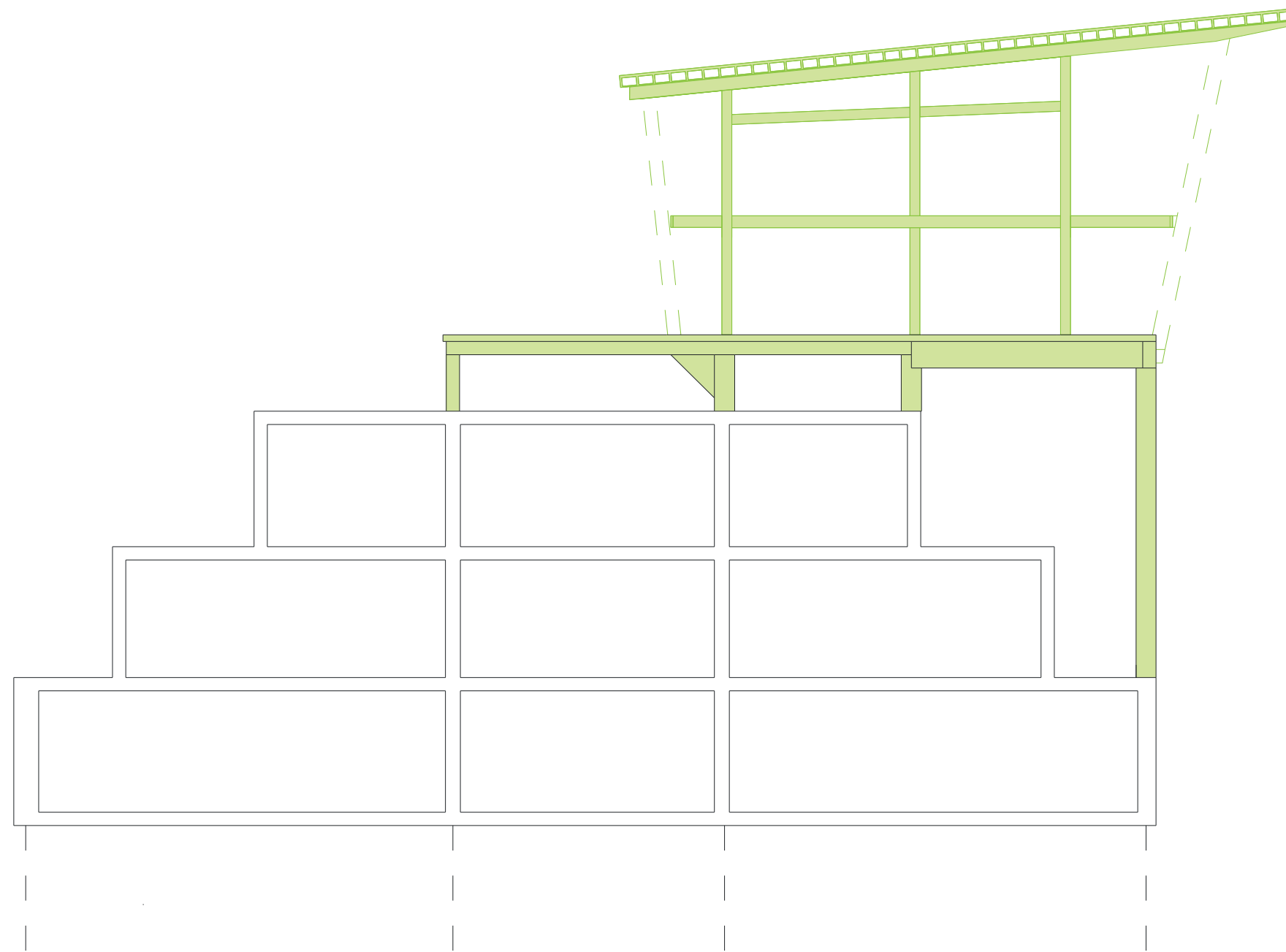
Material quantity relative to
the current design
0%



03 STRUCTURE

Design Enhancement

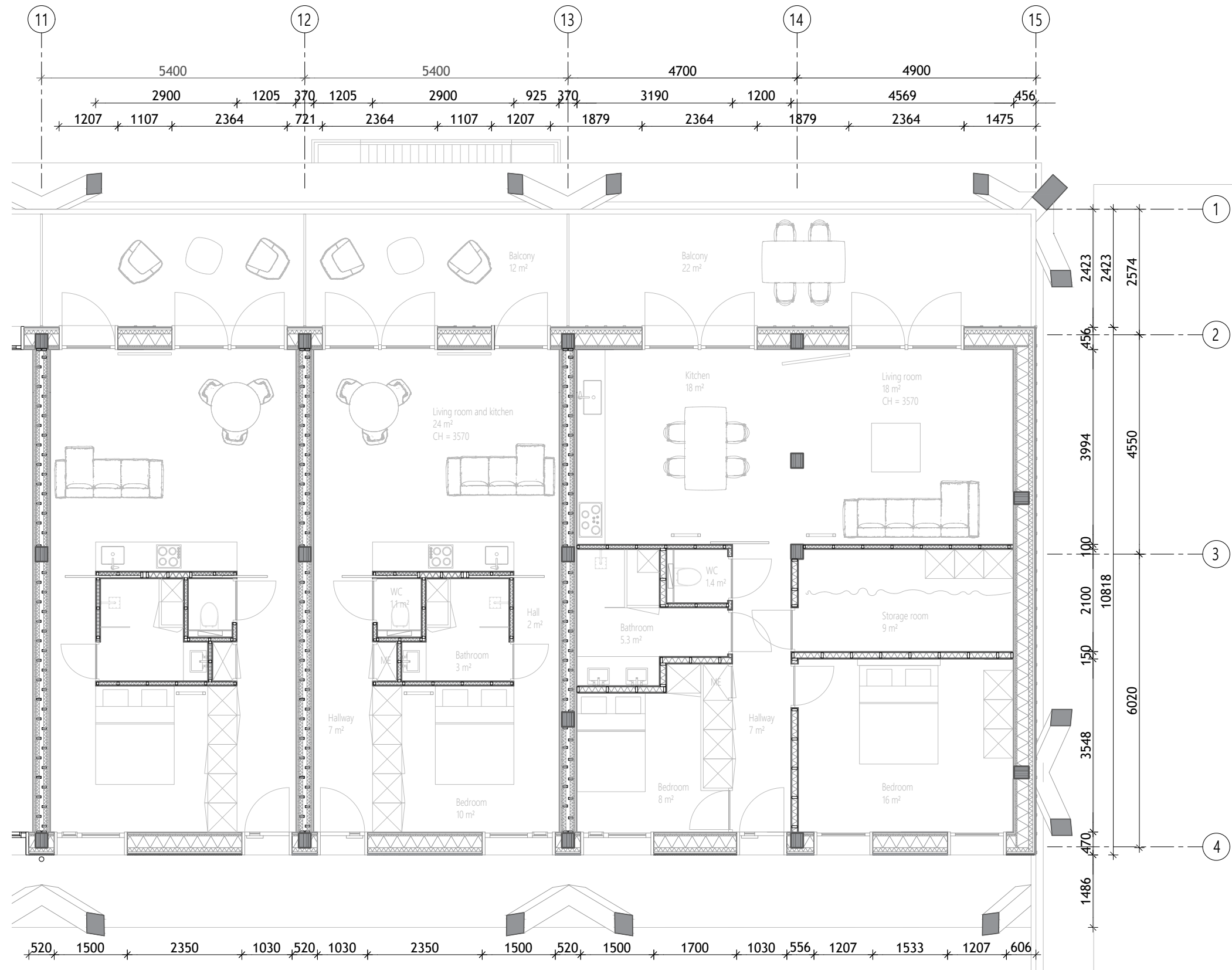
Material quantity relative to
the current design
- 18%



Low m² per Occupant

Extend Lifespan

03 APARTMENTS



typical apartment layout 1 : 50



interior - 45 m² gfa



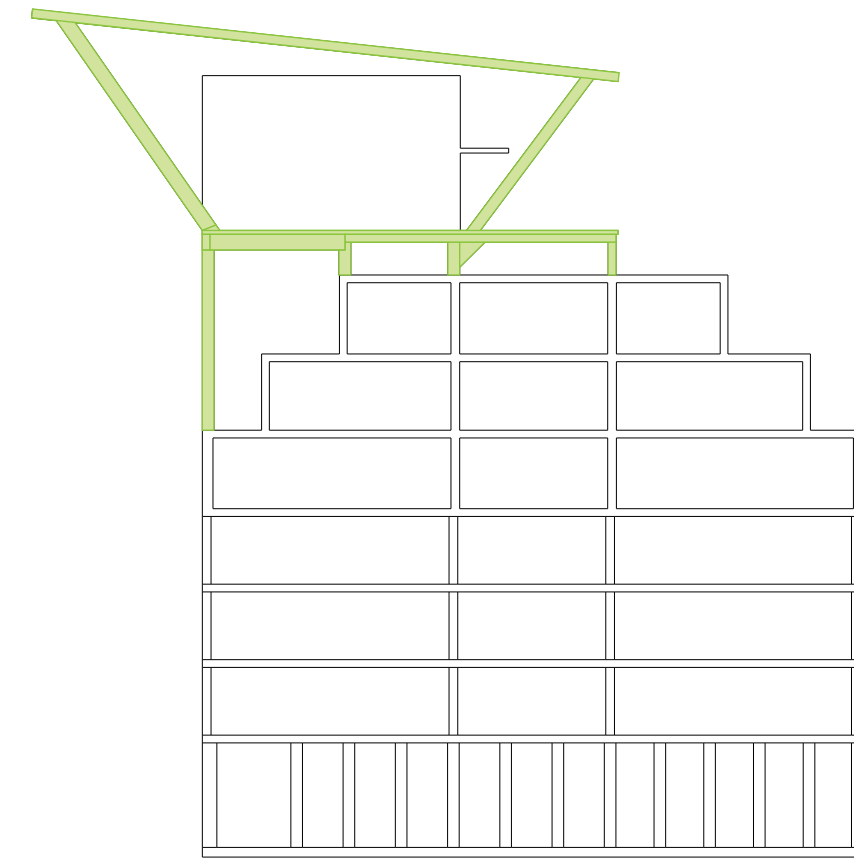
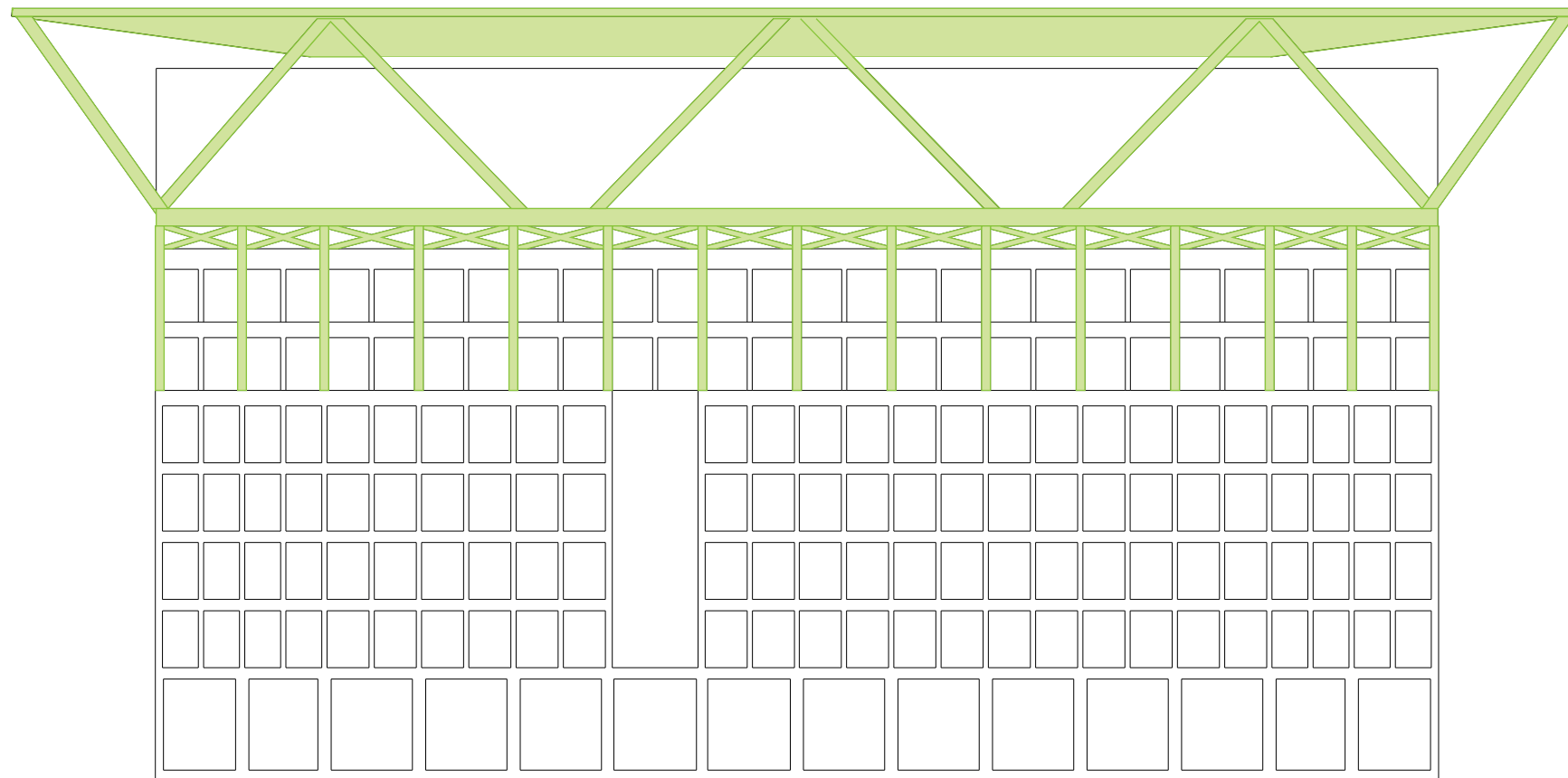
interior - 45 m² gfa



03 ROOF STRUCTURE

Initial Draft

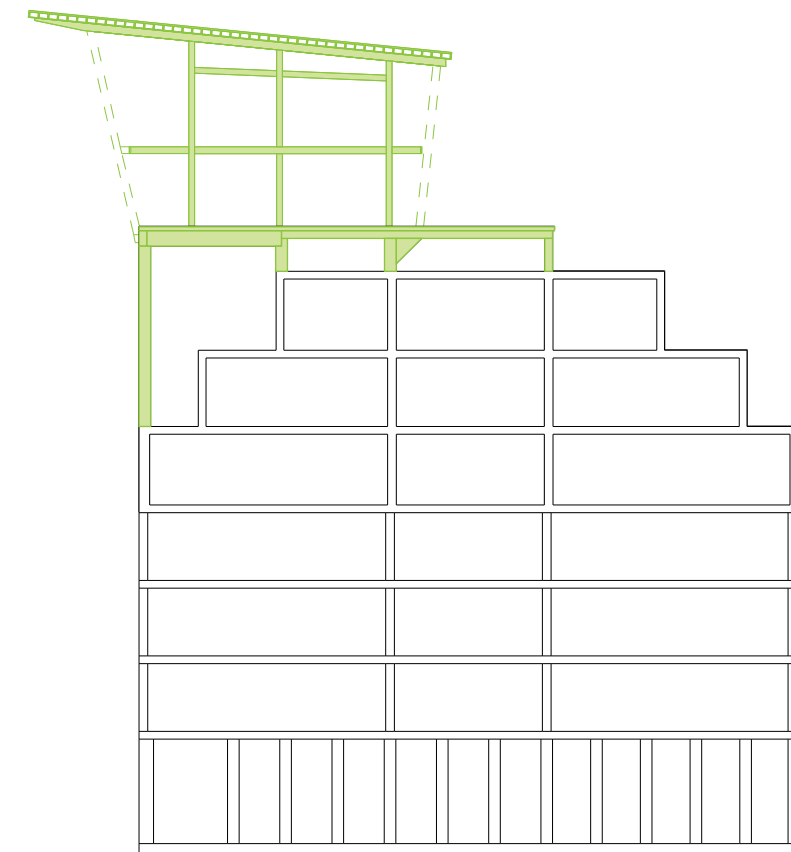
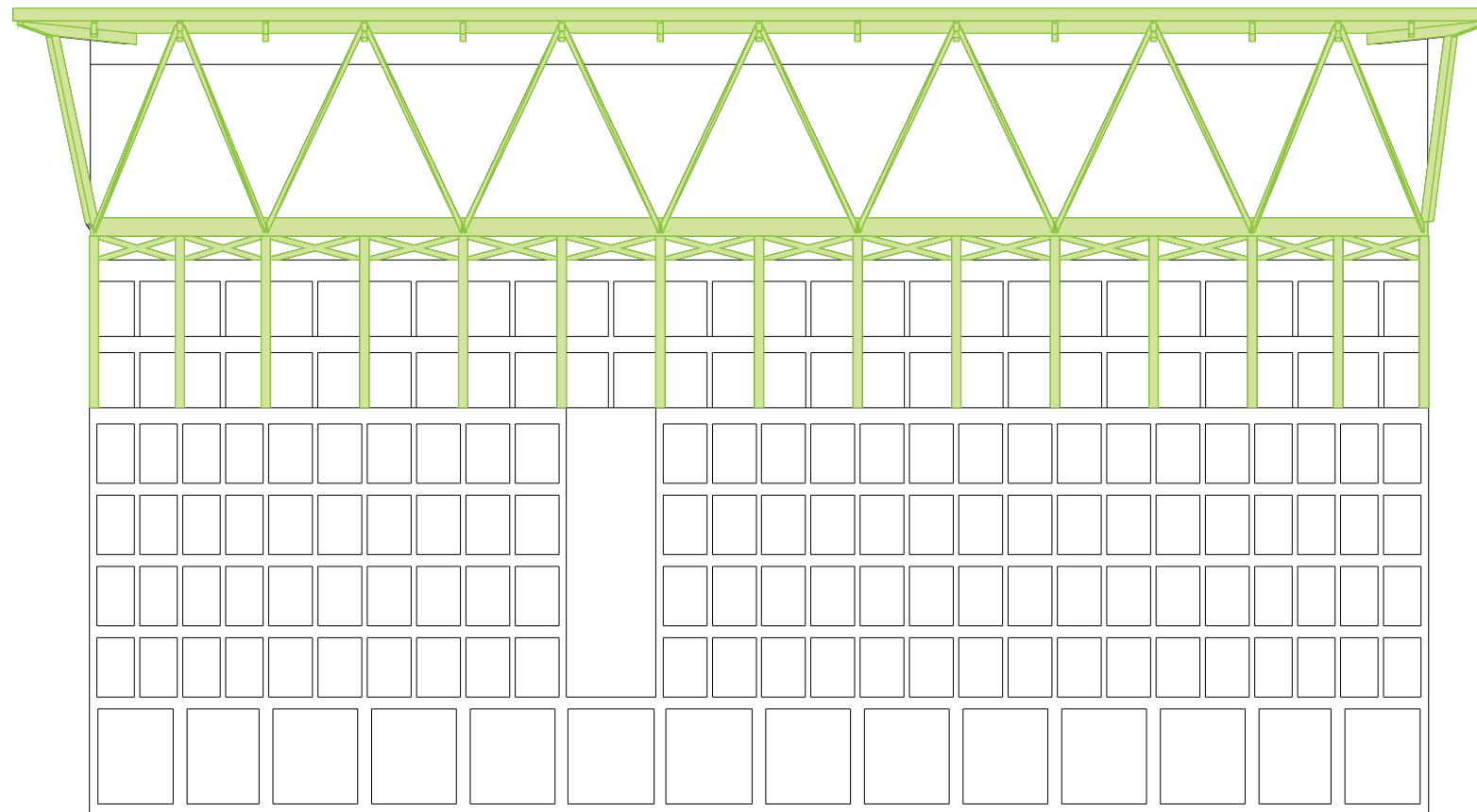
Material quantity relative to
the current design
+ 34%



03 ROOF STRUCTURE

Current Design

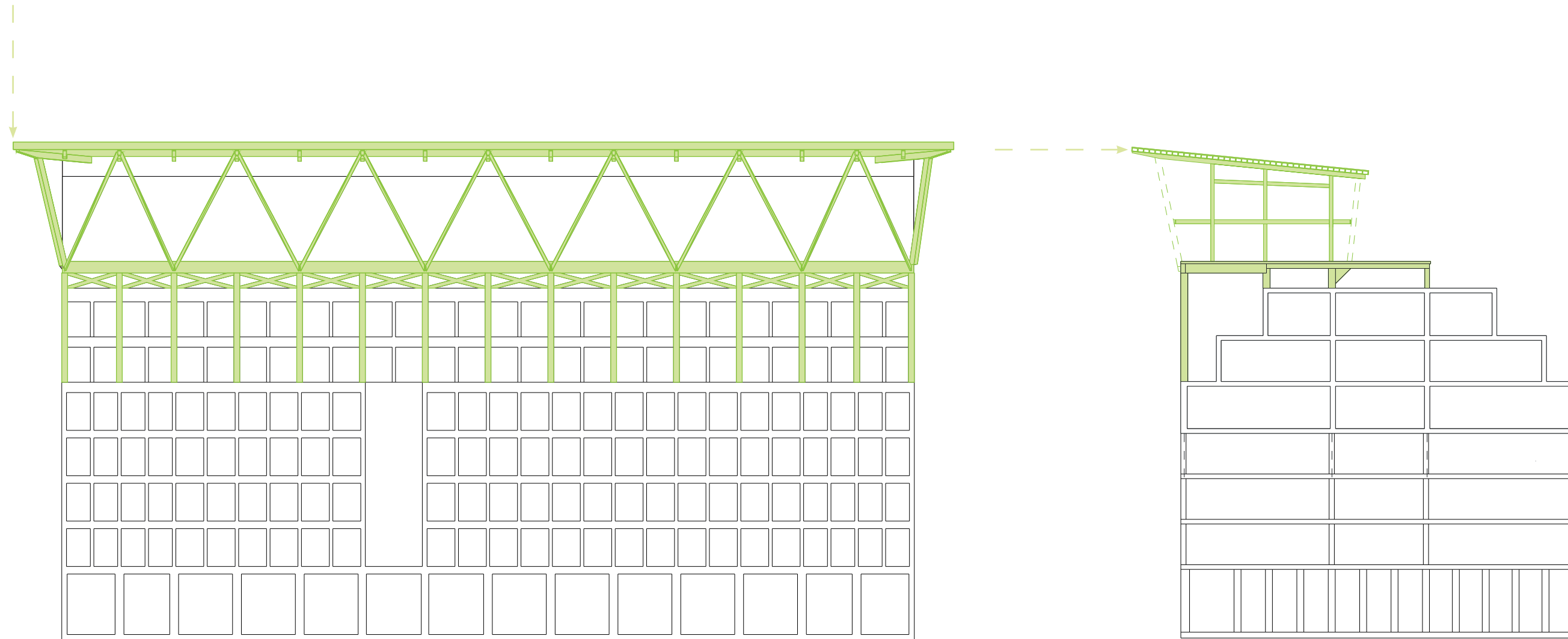
Material quantity relative to
the current design
0%



03 ROOF STRUCTURE

Design Enhancement

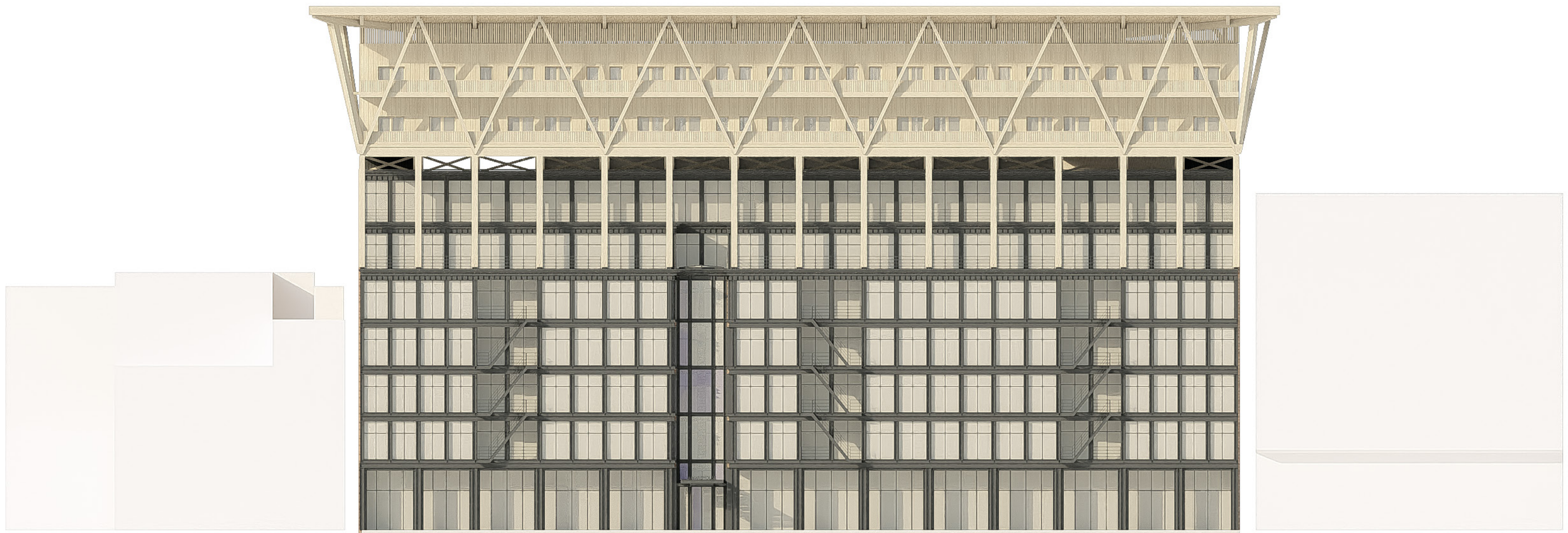
Material quantity relative to
the current design
- 7%



Minimize Structural Material

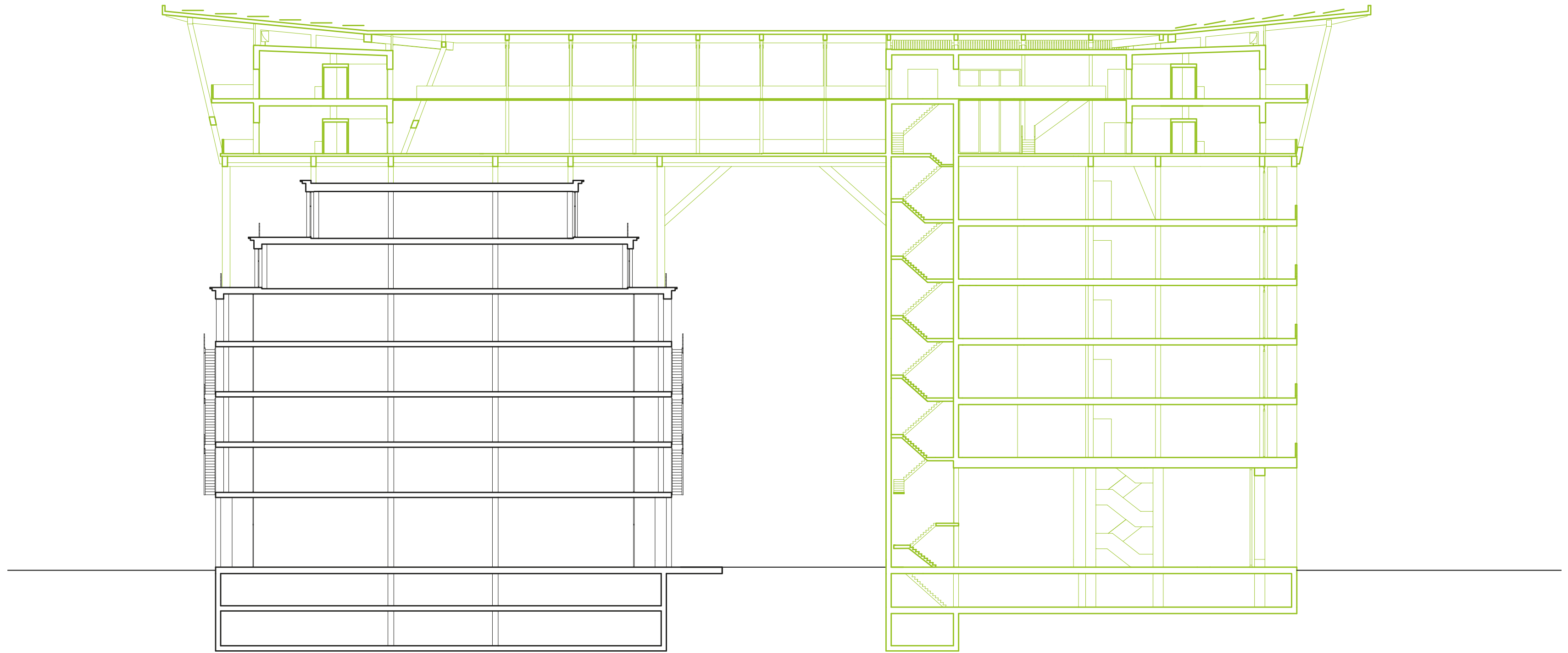
Following existing grid structure

03 ROOF STRUCTURE



rear view - north façade

04 CLIMATE



Min. of Building Services

Sustainable installations

WINDTURBINES

*20% (low factor) of 10KW peak capacity

total	161
-------	-----

energy delivery	2.820.000 kWh/year
-----------------	--------------------

SOLAR PANELS

*70% of 5700 m²

total m ²	3990
----------------------	------

energy delivery	2.750.000 kWh/year
-----------------	--------------------

TOTAL ENERGY DELIVERY

	5.570.000 kWh/year
--	--------------------

04 ENERGY DEMAND

Min. of Building Services

Sustainable installations

WINDTURBINES

*20% (low factor) of 10KW peak capacity

total	161
-------	-----

energy delivery	2.820.000 kWh/year
-----------------	--------------------

SOLAR PANELS

*70% of 5700 m²

total m ²	3990
----------------------	------

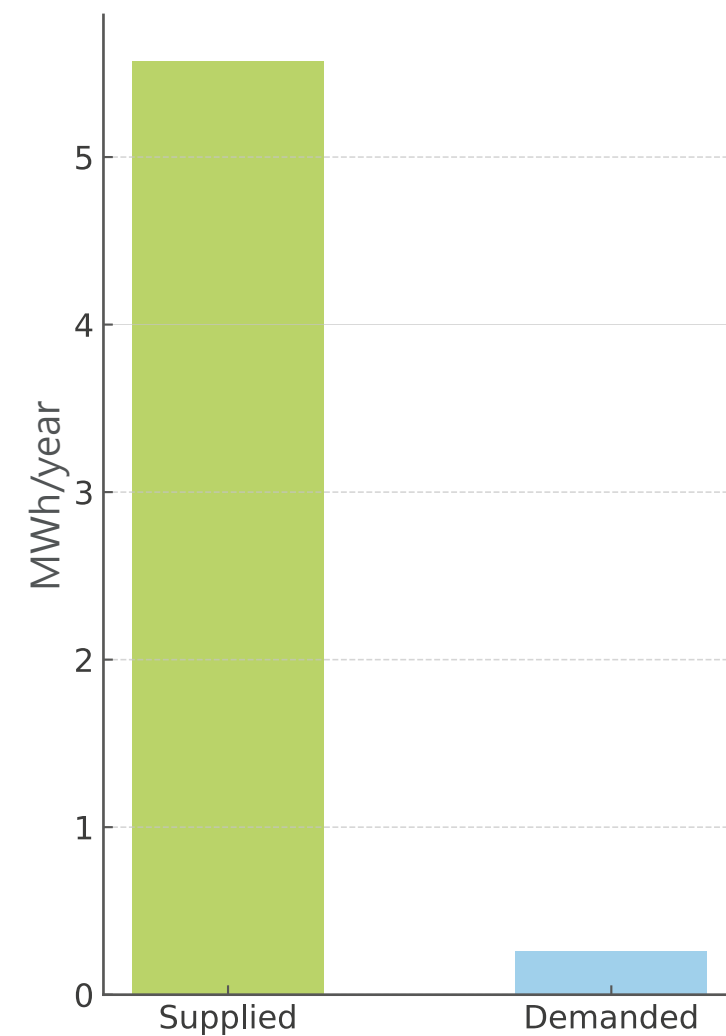
energy delivery	2.750.000 kWh/year
-----------------	--------------------

TOTAL ENERGY DELIVERY

5.570.000 kWh/year

04 ENERGY DEMAND

Energy Supplied vs. Demanded per Year



ENERGY DEMAND

*low 30 kWh/m² for apartments 4200 m²
low 50 kWh/m² for (flex)office spaces 2650 m²

apartments	125.000 kWh/year
(flex) office spaces	132.000 kWh/year

TOTAL ENERGY DEMAND

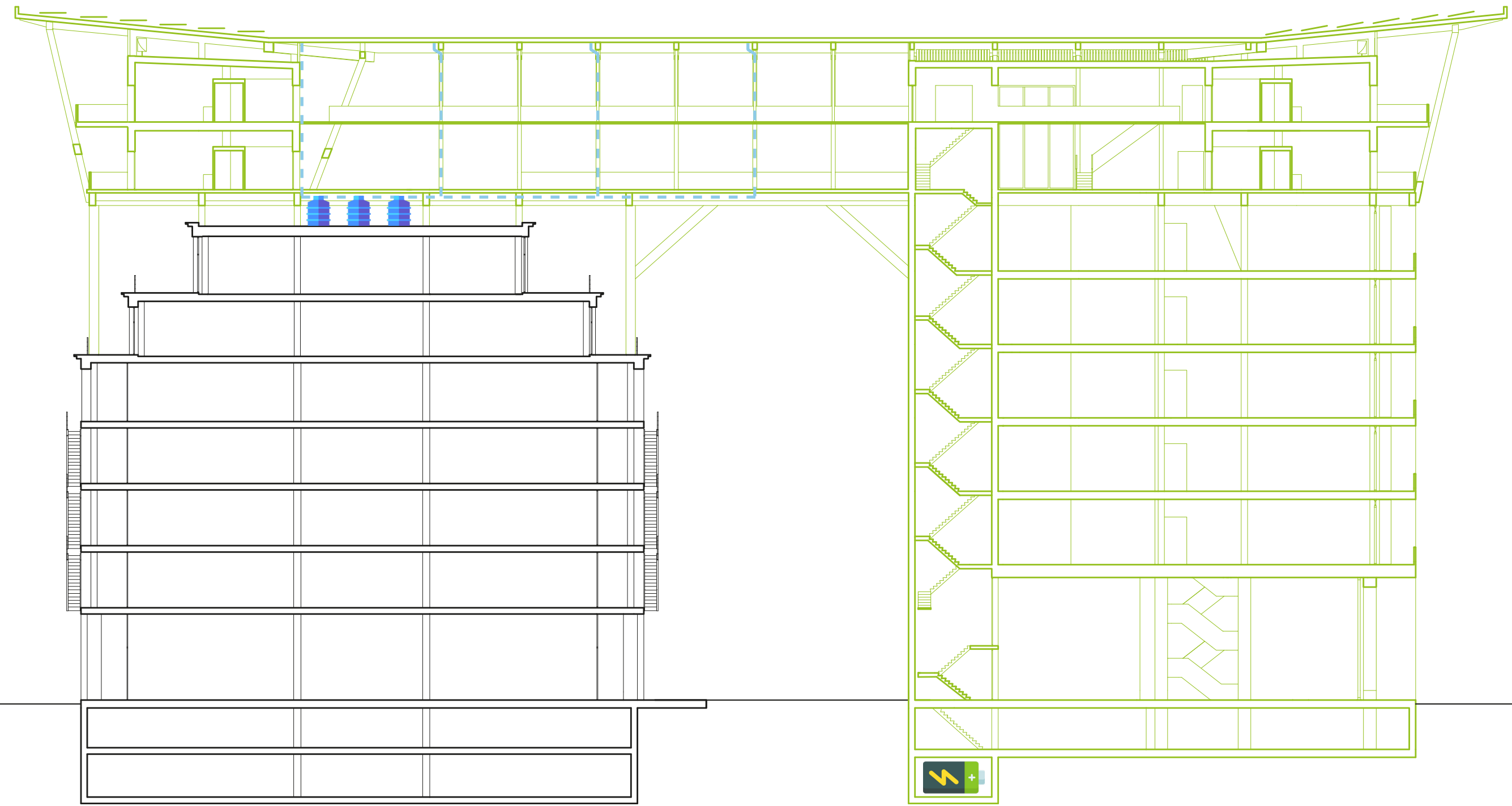
257.000 kWh/year

Min. of Building Services

Sustainable installations

Water-positive projects

04 BUILDING SERVICES



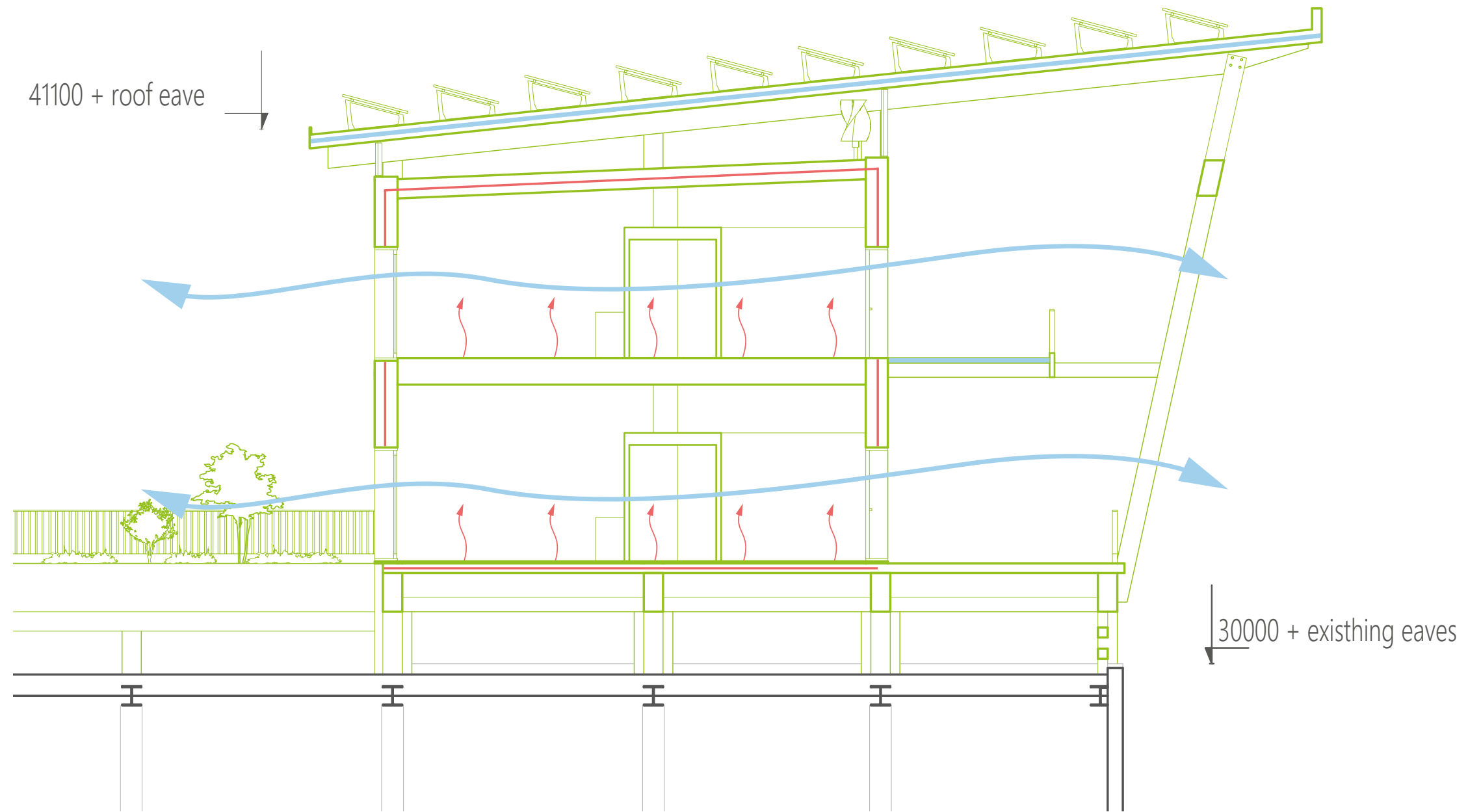
section aa

Min. of Building Services

Sustainable installations

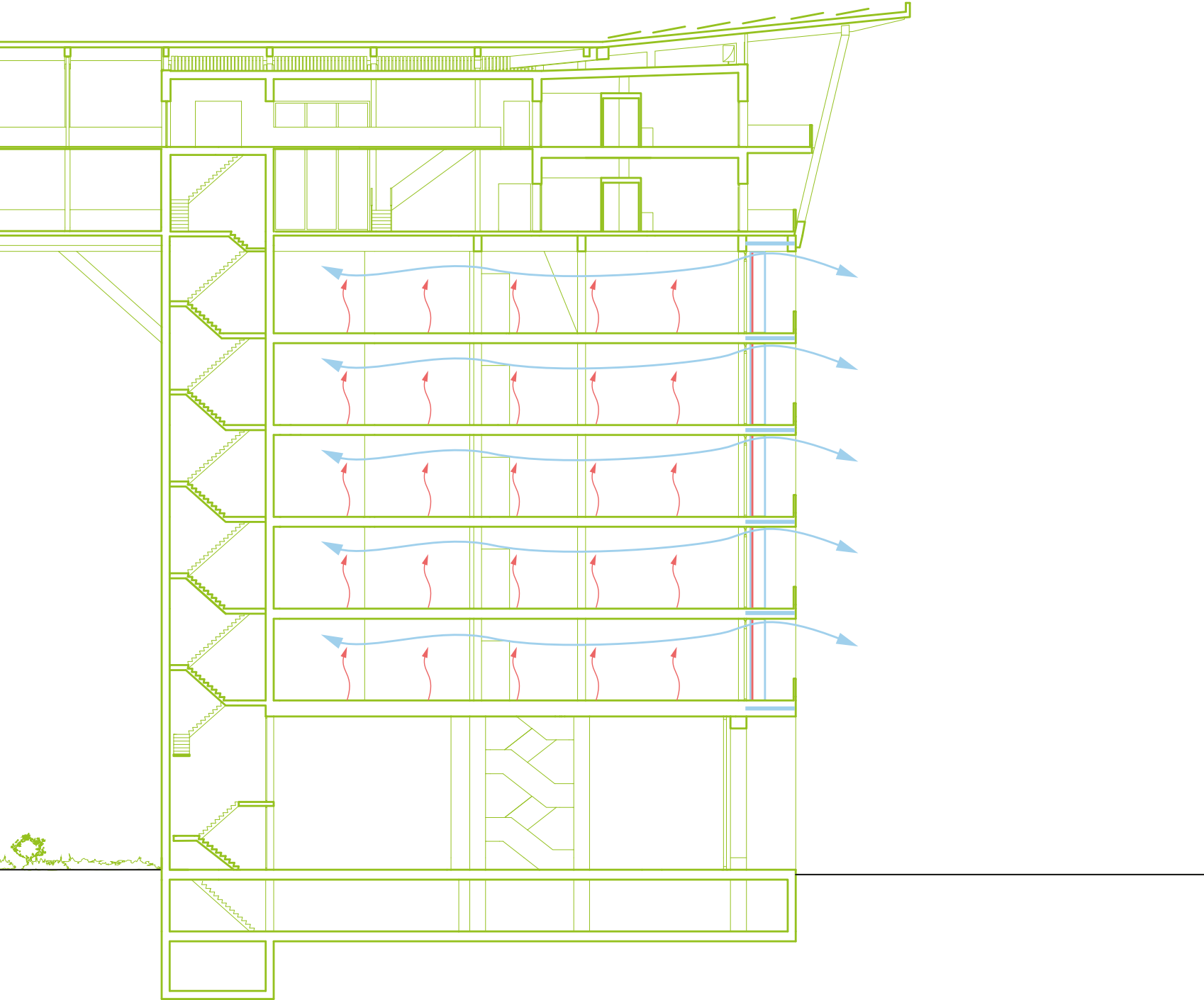
Water-positive projects

04 CLIMATE



section bb - heating and cooling - $R = 8.11 \text{ m}^2\text{K/W}$

04 CLIMATE



section aa - heating and cooling

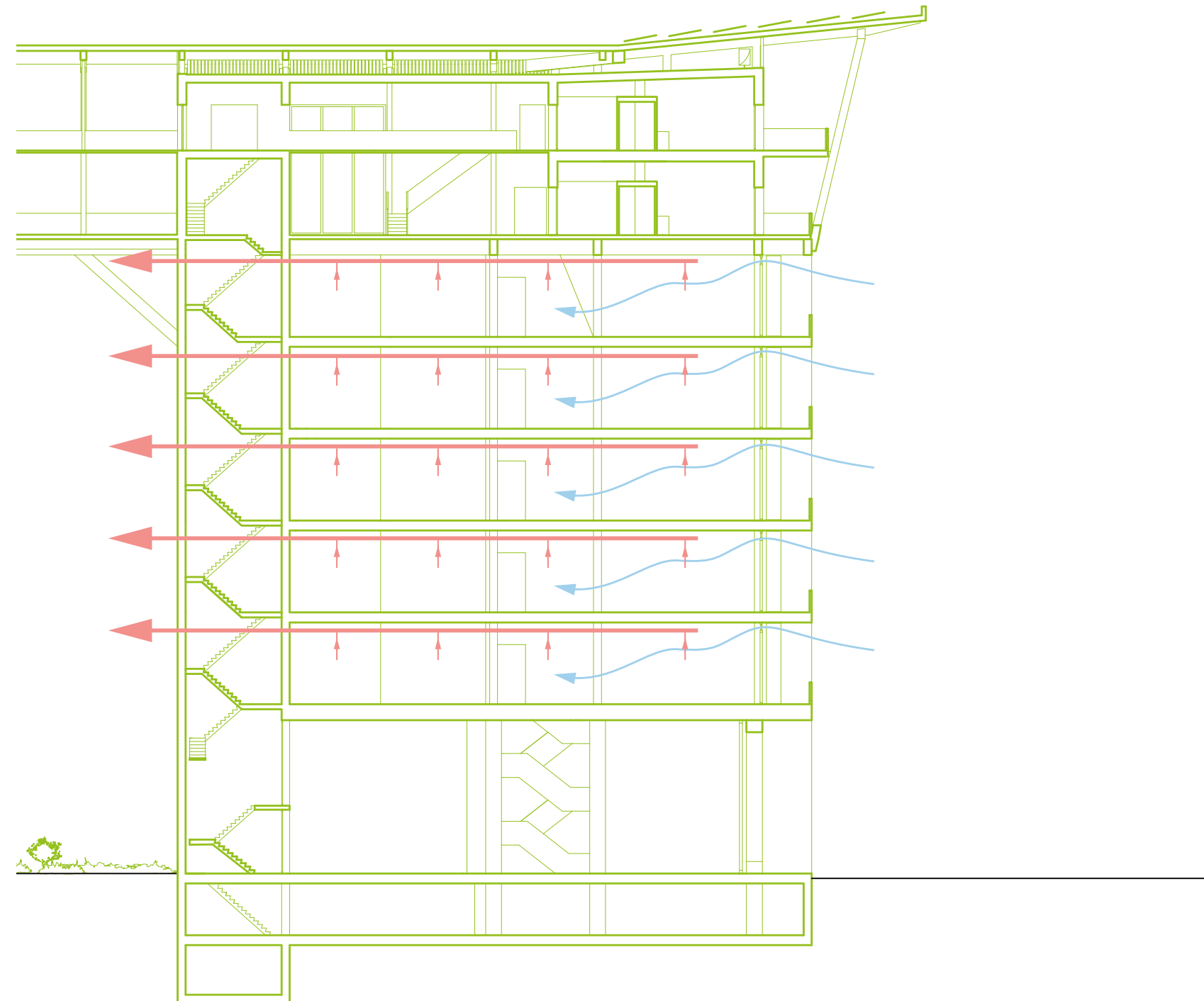


west façade - winter 14:50



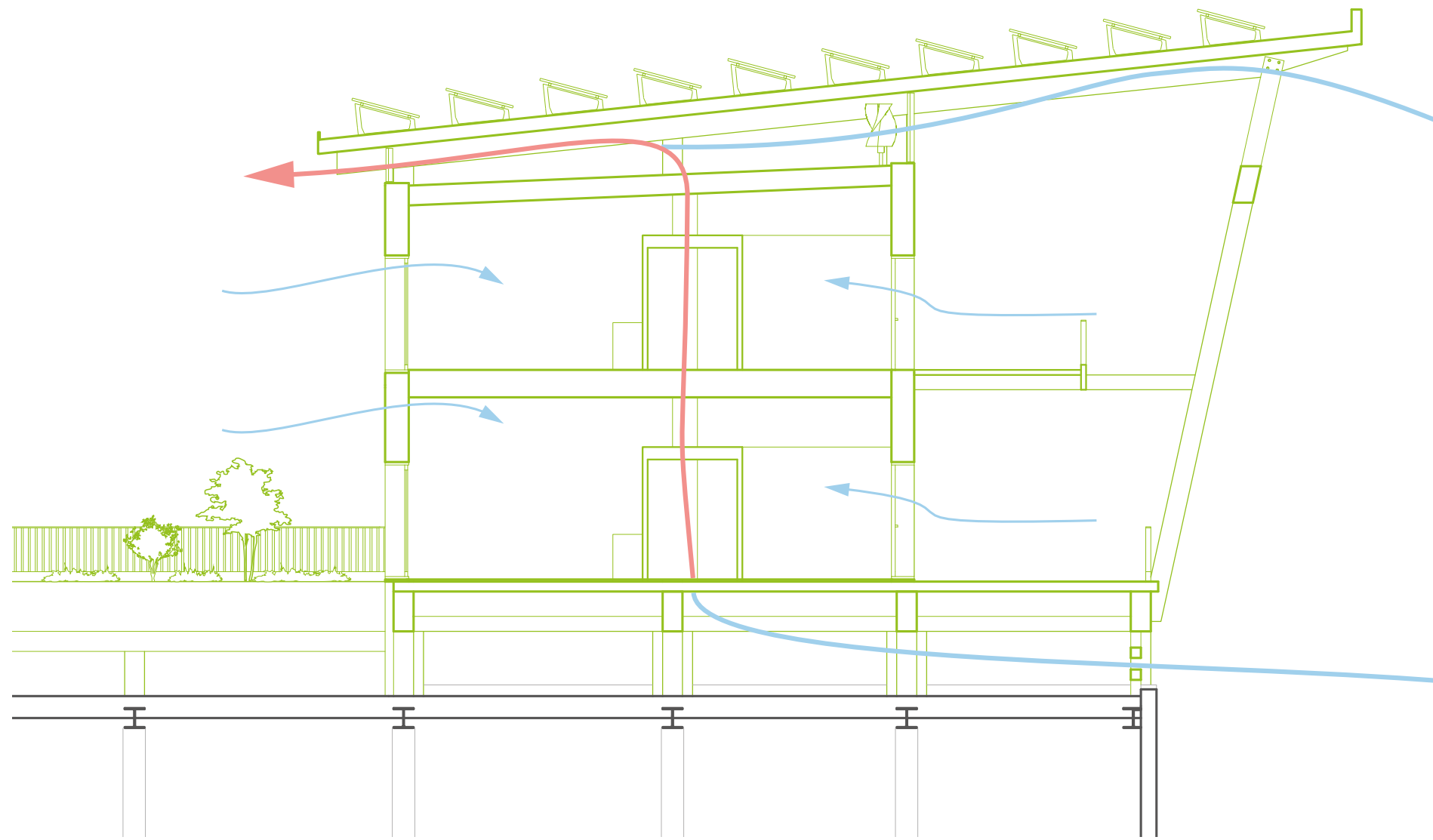
west façade - summer 15:30

04 VENTILATION

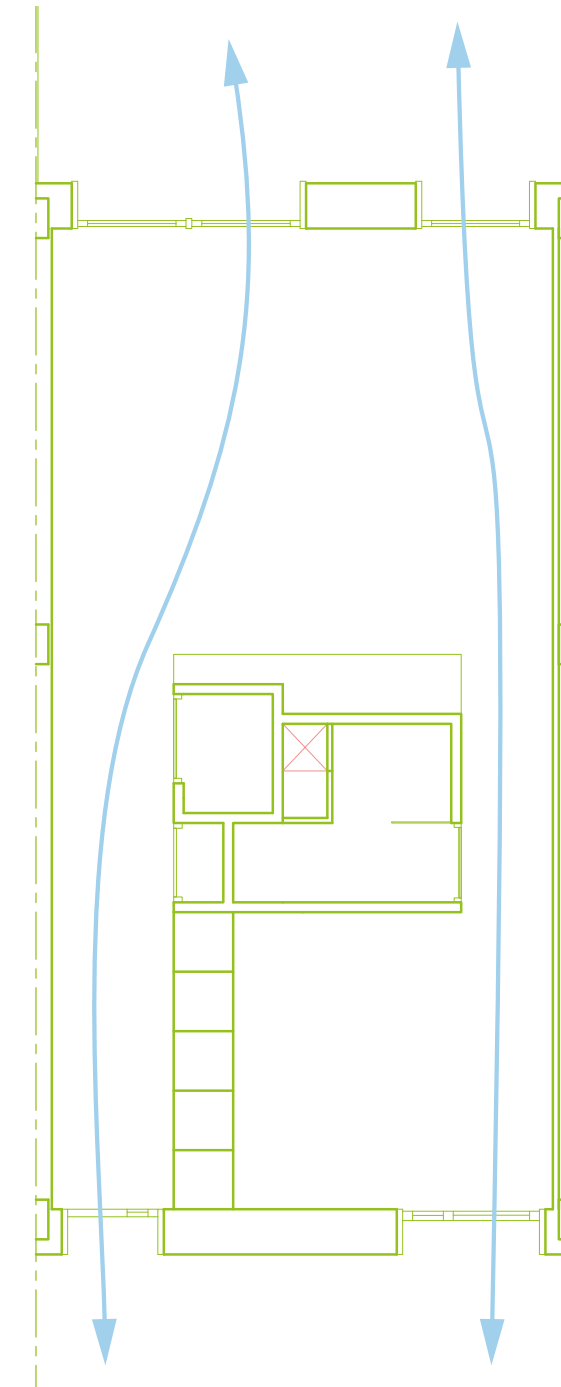


section aa - natural ventilation with mechanical extraction

04 VENTILATION



section bb - natural ventilation using the Venturi effect, high-level vents for winter ventilation

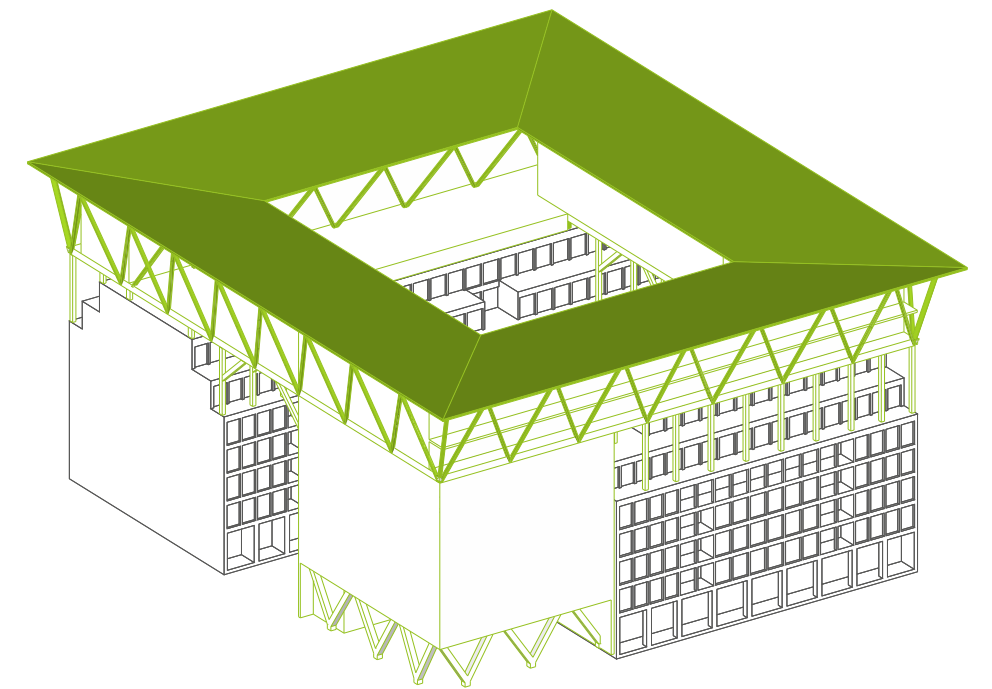
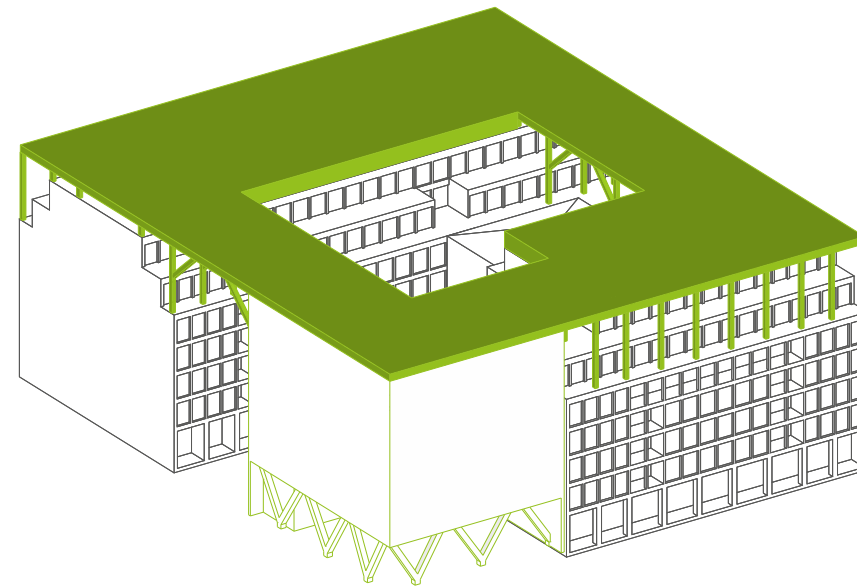
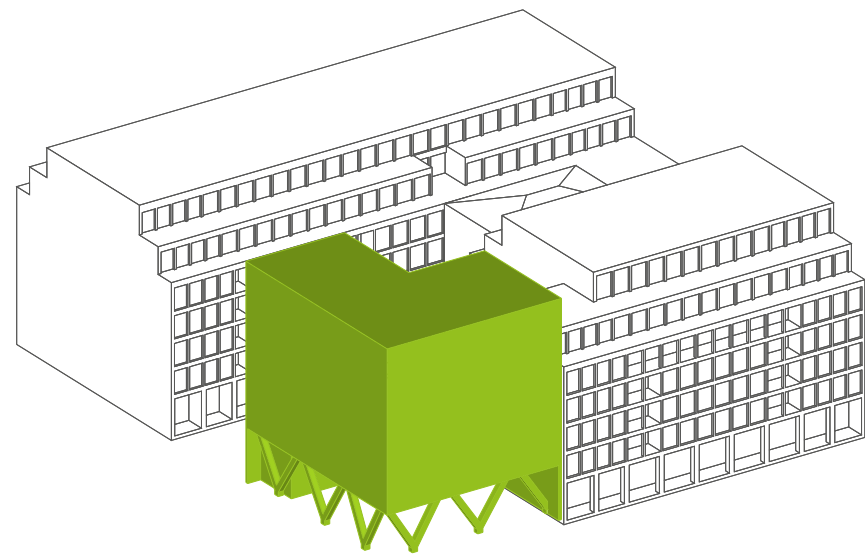


floorplan - cross-ventilation in summer

05 STRUCTURE

Minimize Structural Material

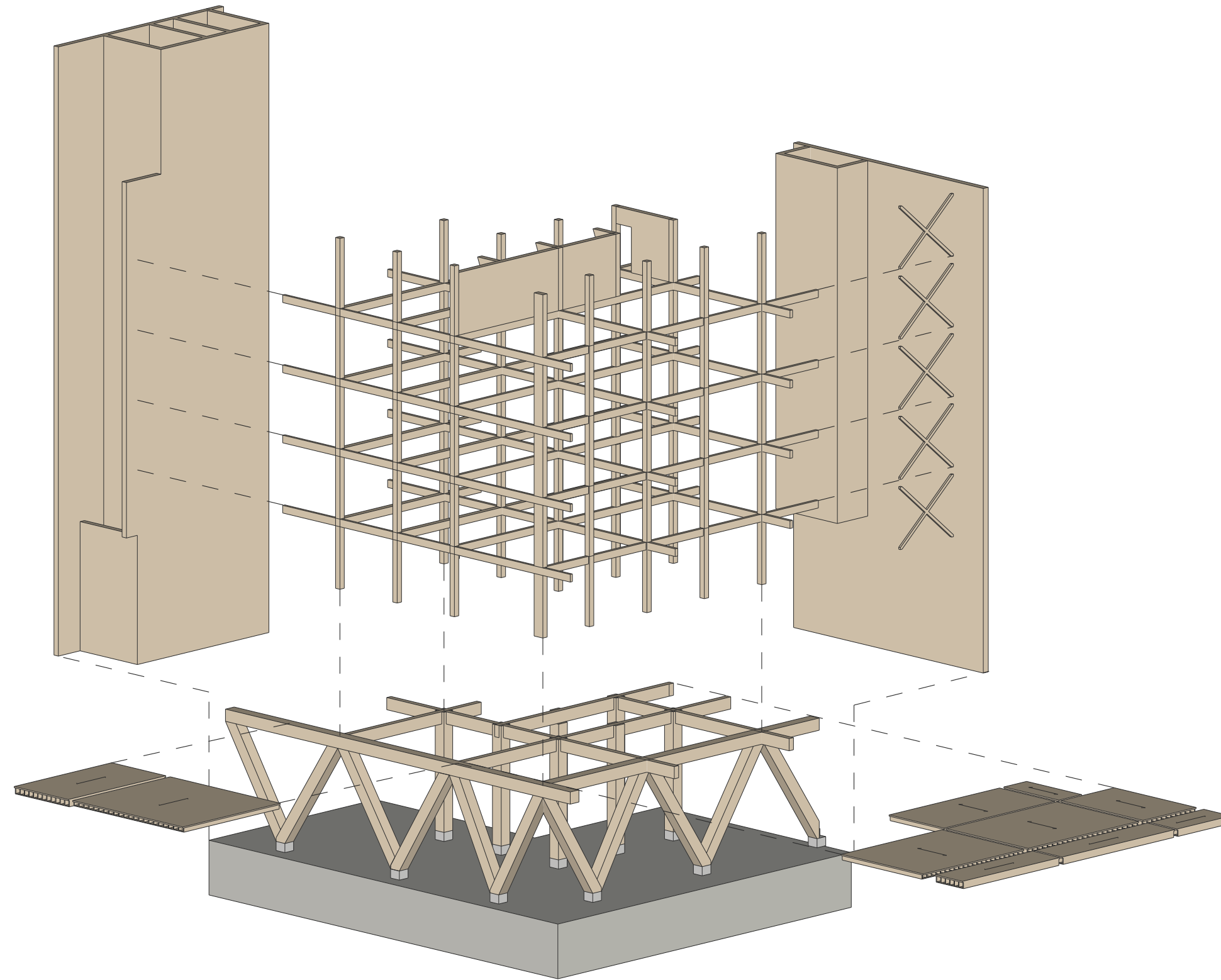
05 STRUCTURE



Minimize Structural Material

Thin flooring system

05 STRUCTURE



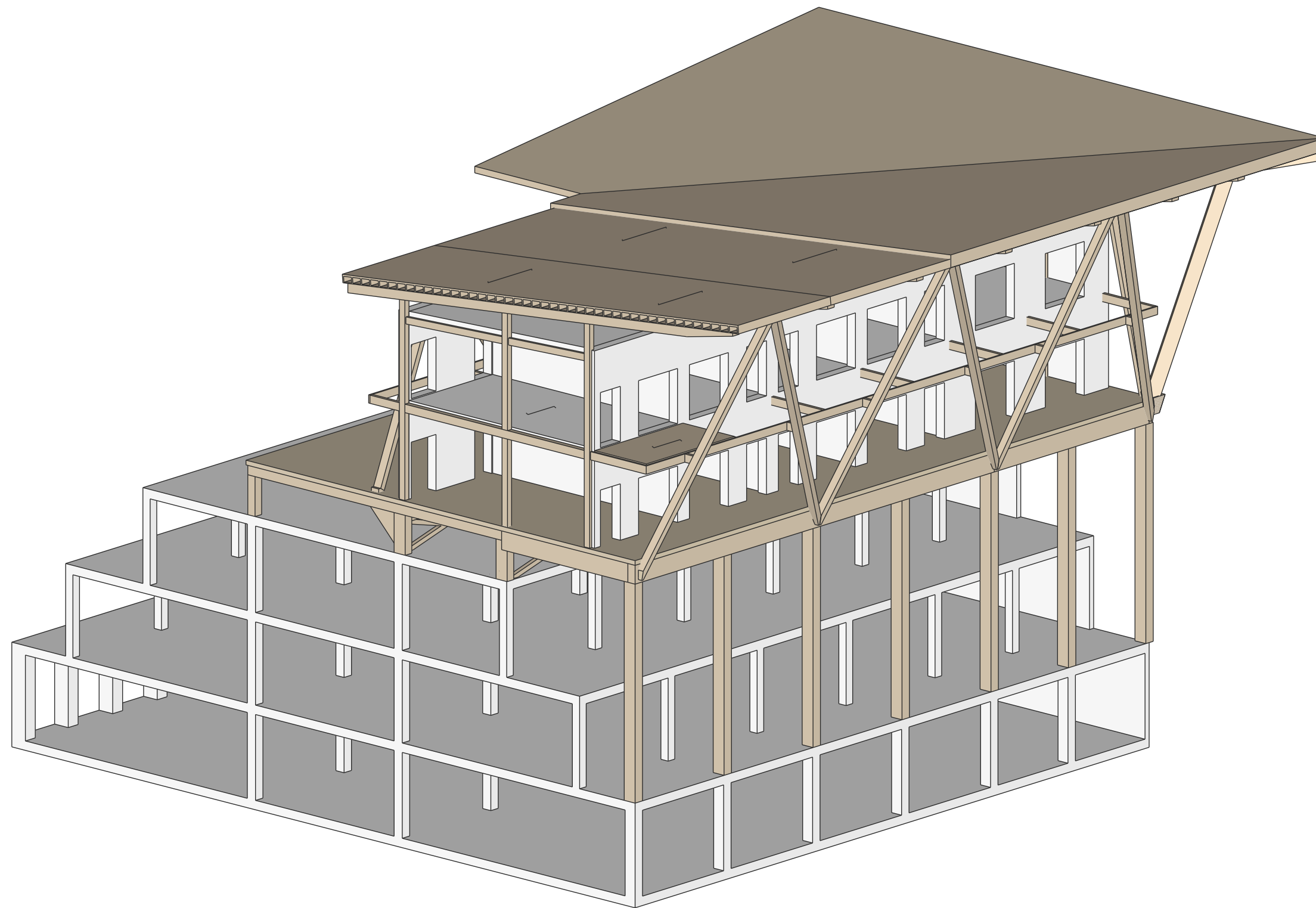
Minimize Structural Material

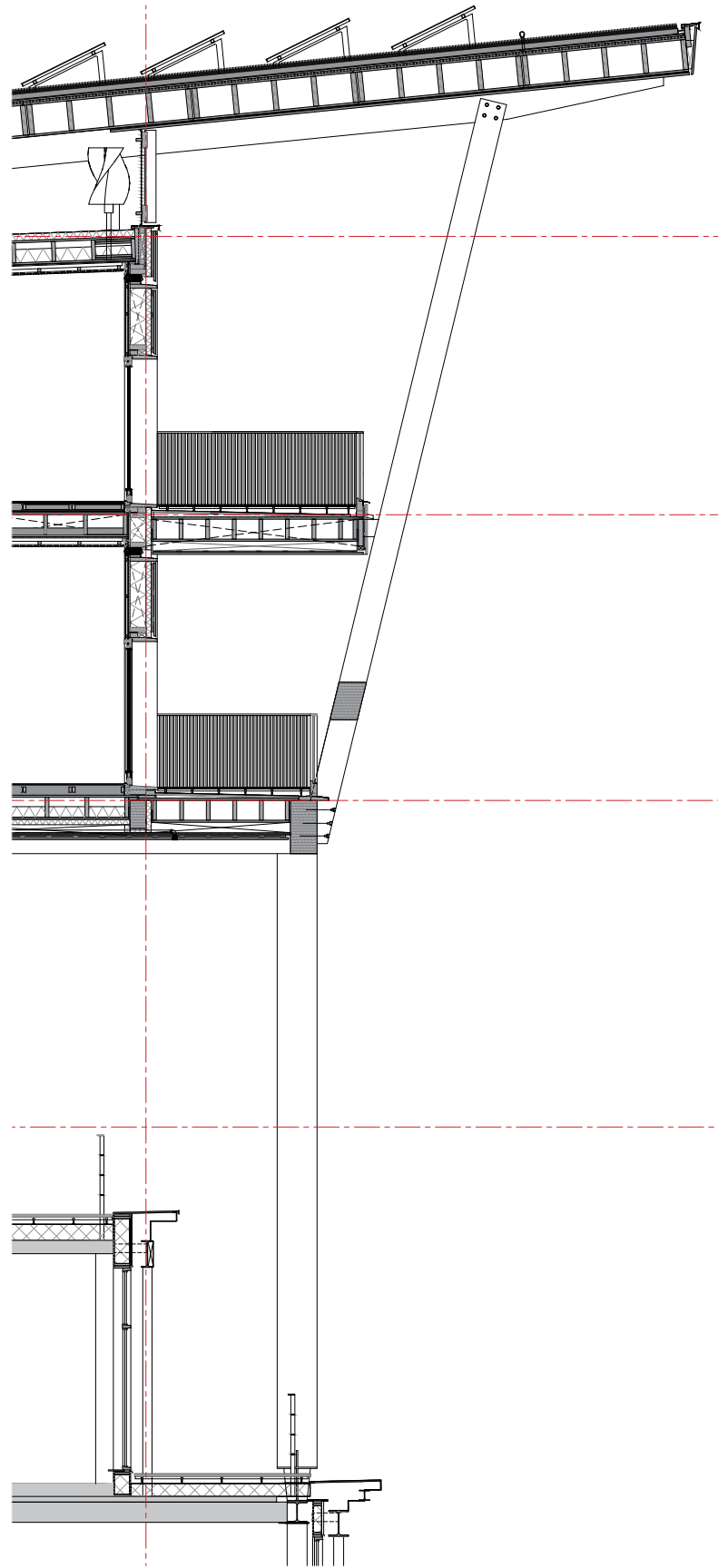
Protection against moisture, fire and UV

Slightly over-dimension

Thin flooring system

05 STRUCTURE





1 : 20



outward-facing façade



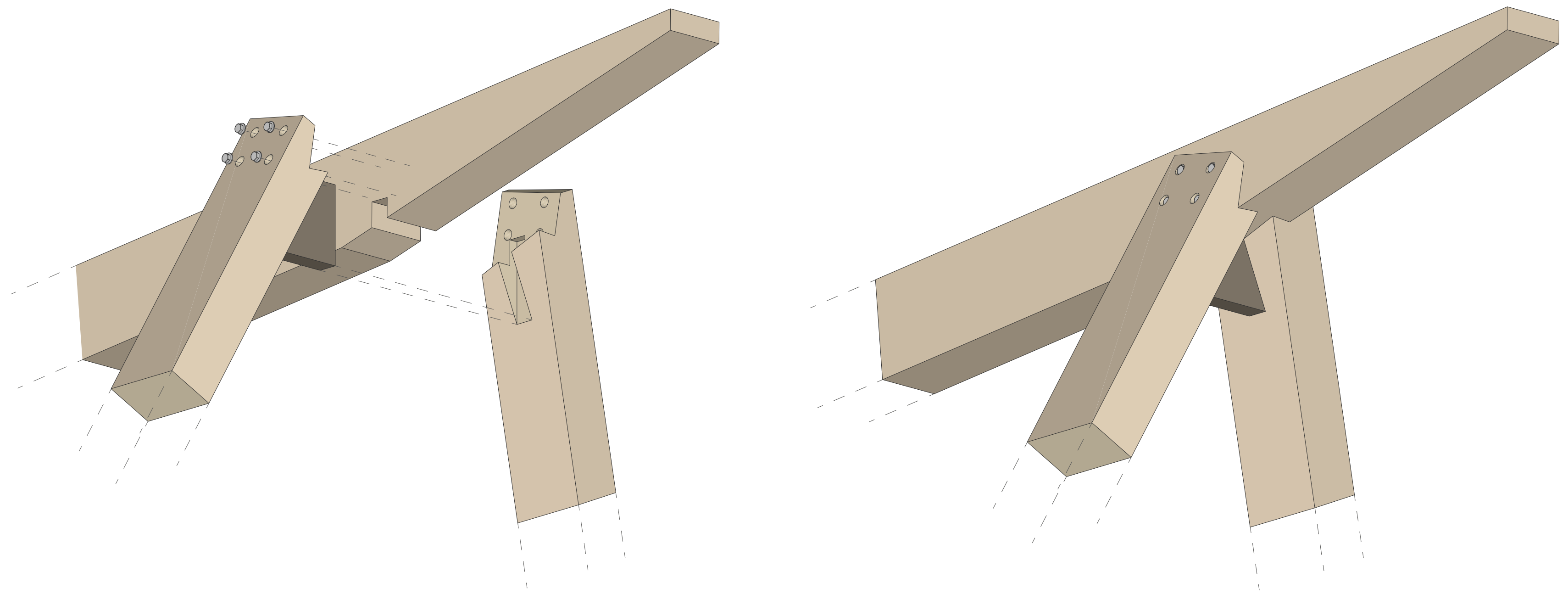
open structure

Building System

Detachability

Re-use potential

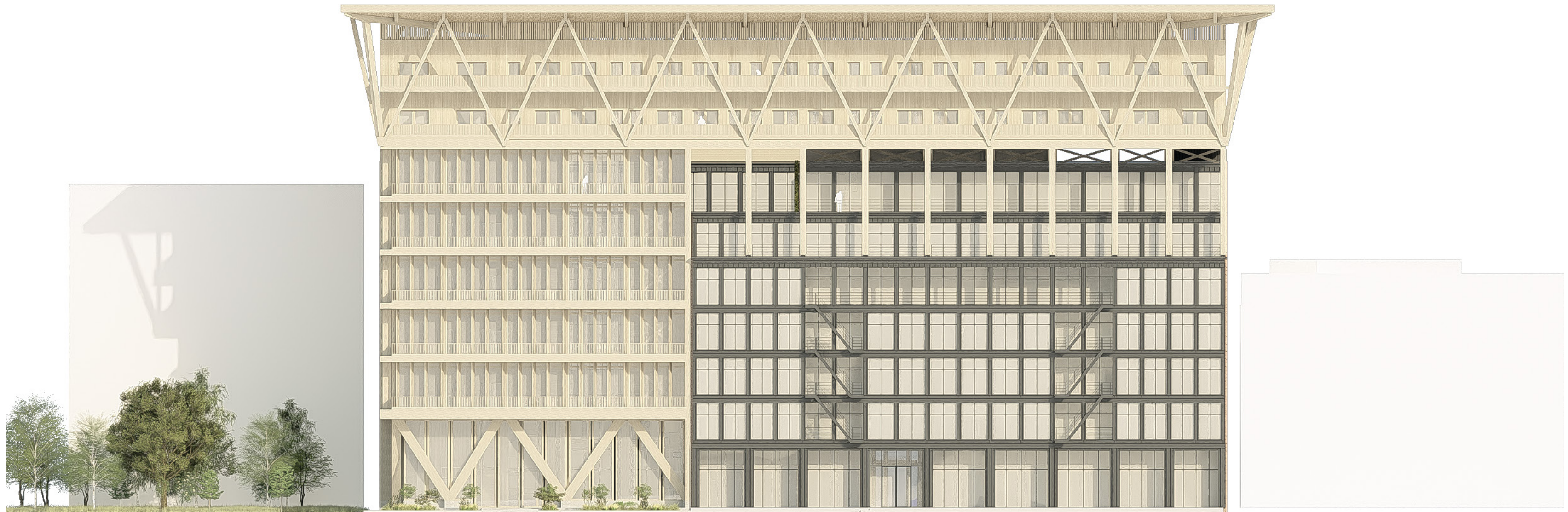
05 STRUCTURE



06 IN DETAIL

Minimize Structural Material

06 CONTRAST



front view - east façade

06 FAÇADE



Eldridge Anderson Architects
Jan Juc Studio



MasFernandez Arquitectura tops
Chilean home



courtyard facing façade

06 FAÇADE



Foyer Astural Chevrens Education Center
Lacroix Chessex



outward-facing façade

Building System

Detachability

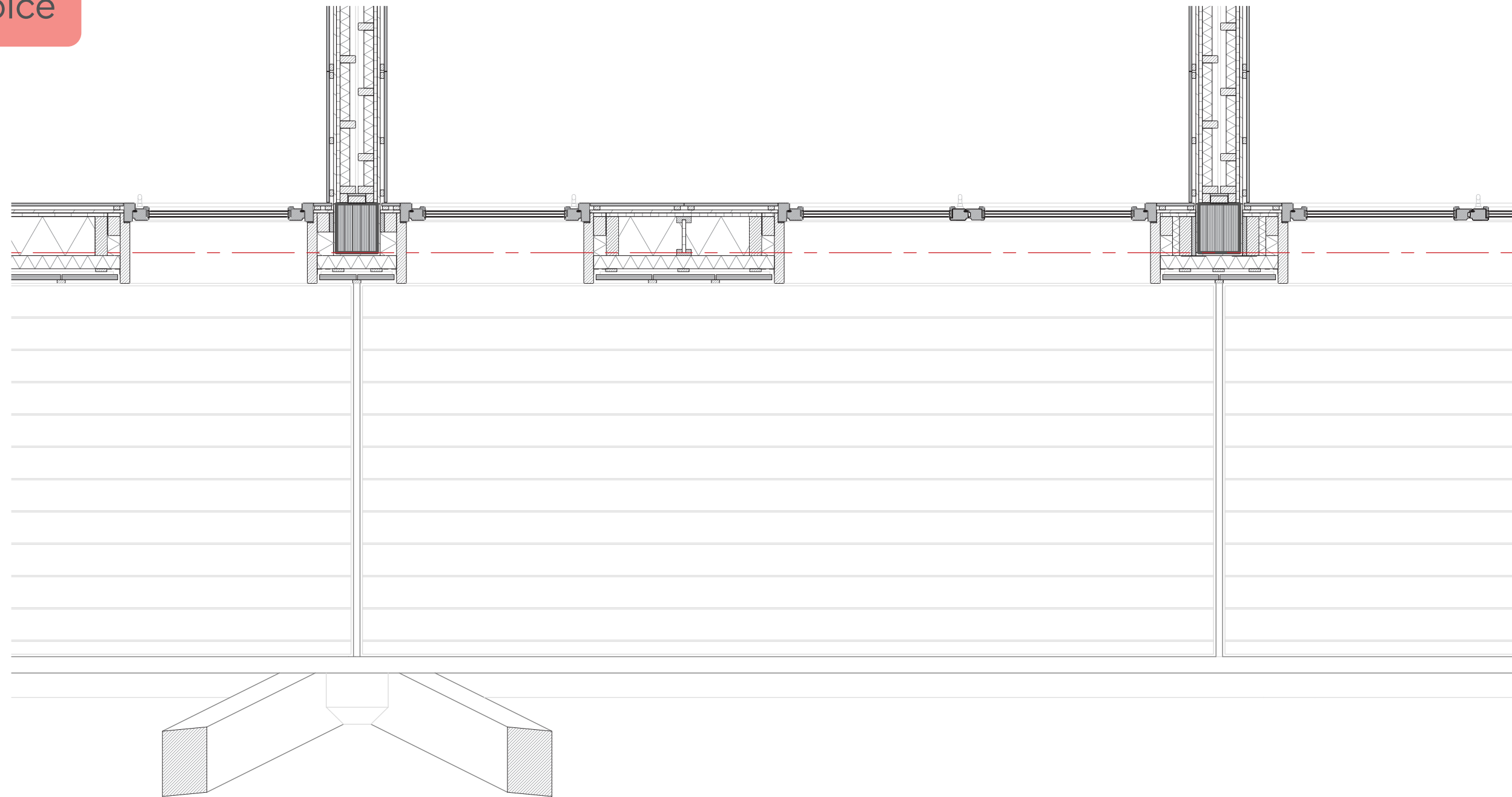
Re-use potential

Material Choice

Origin of materials

Healty materials

06 CONSTRUCTION SEQUENCE



1 : 20

Building System

Detachability

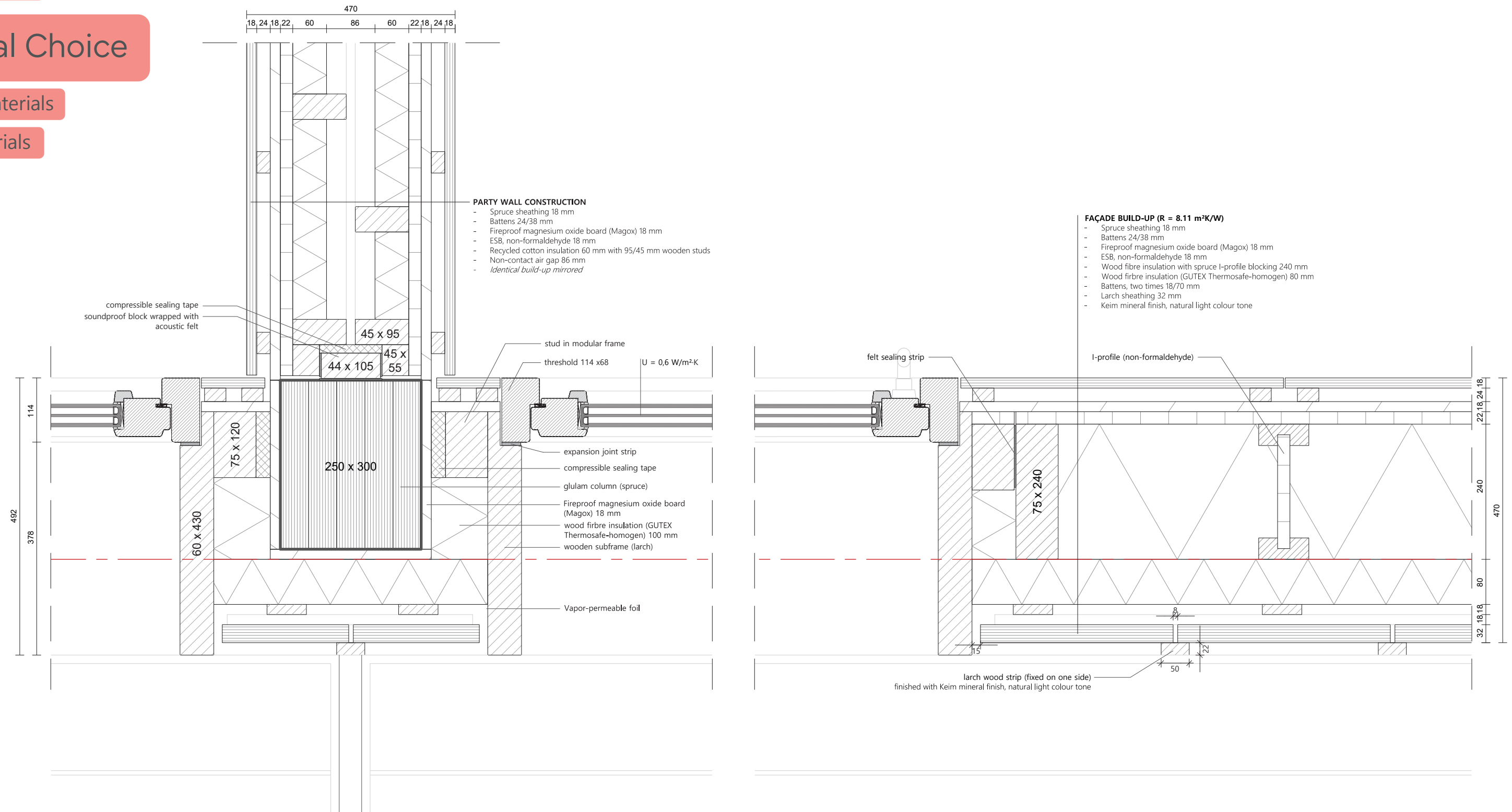
Re-use potential

Material Choice

Origin of materials

Healty materials

06 CONSTRUCTION SEQUENCE



party wall to facade connection detail 1 : 5

Building System

Detachability

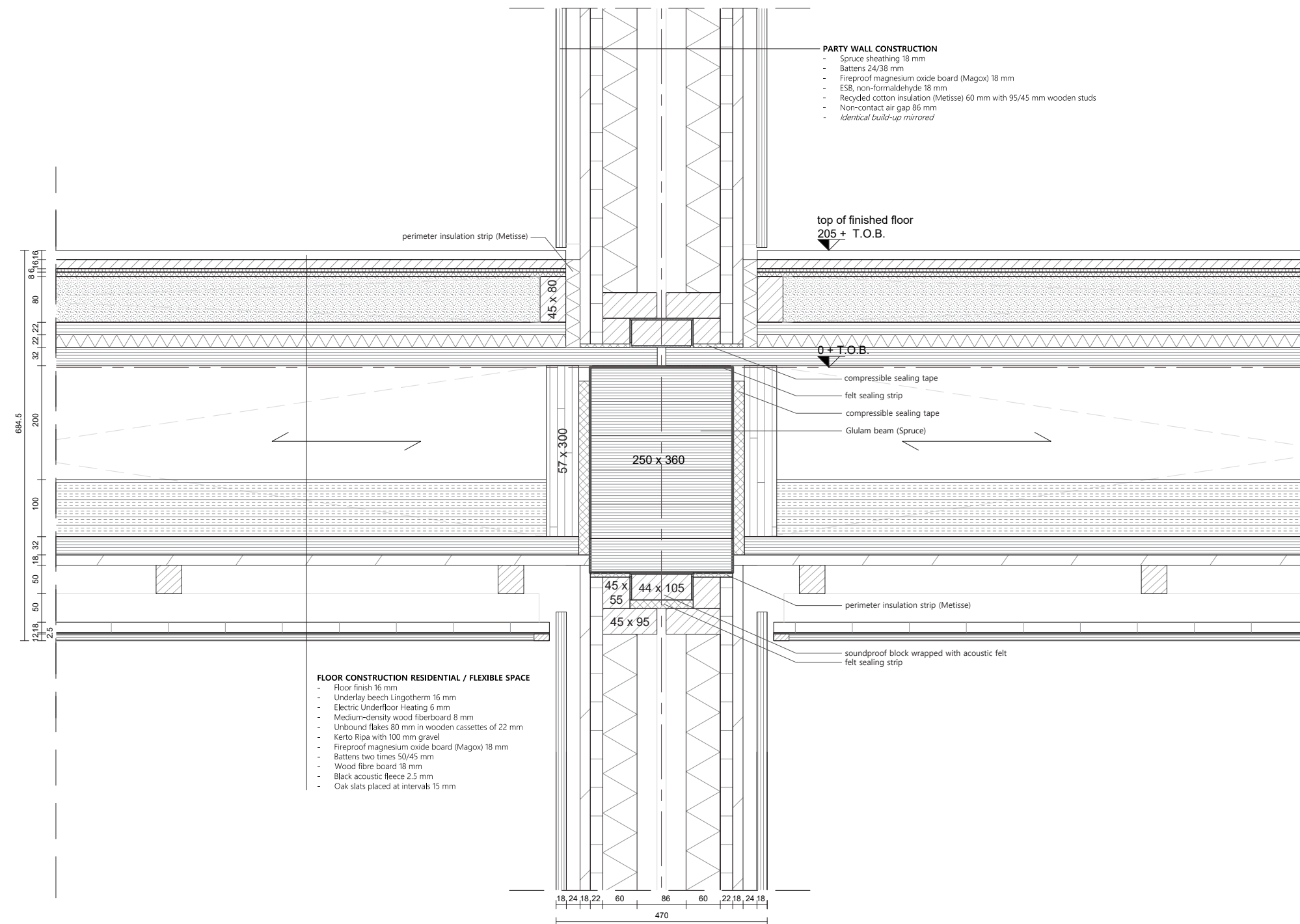
Re-use potential

Material Choice

Origin of materials

Healty materials

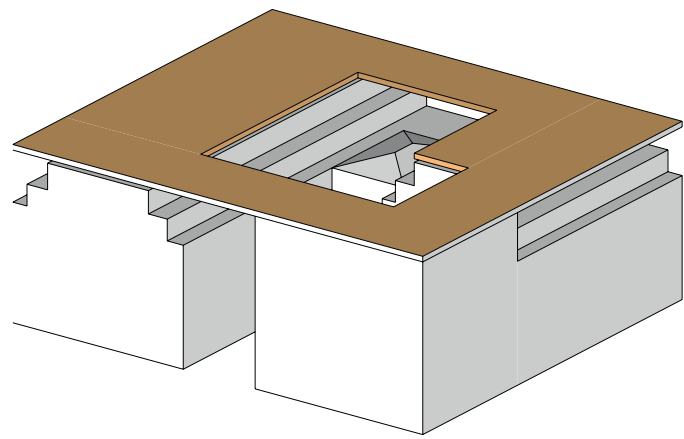
06 CONSTRUCTION SEQUENCE



party wall-floor connection detail 1 : 5

07 FROM HYPOTHESIS TO OUTCOME

07 CARBON STORAGE



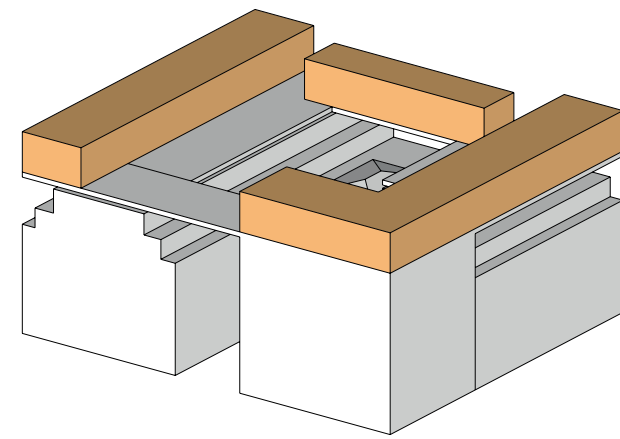
Floor area 3000 m²

Carbon Storage 503 ton CO₂e

Beams 203 ton CO₂e

Design Enhancement

Carbon Storage 497 ton CO₂e



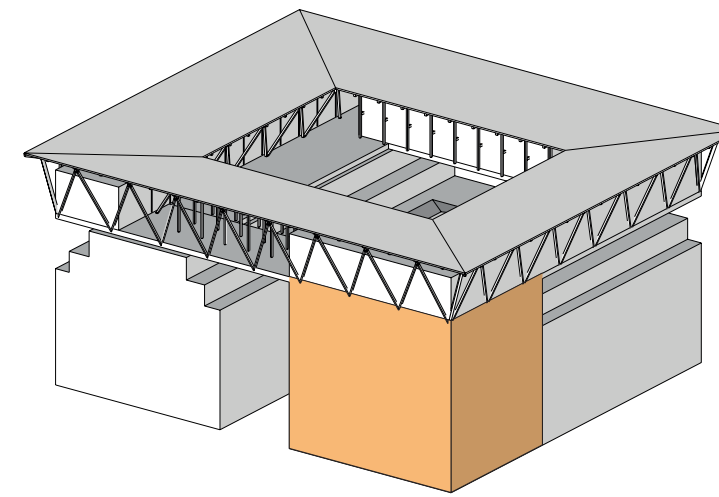
Heated floor area 4200 m²

Carbon Storage 566 ton CO₂e

Wood sheathing HIGH CO₂e

Design Enhancement

Carbon Storage 511 ton CO₂e



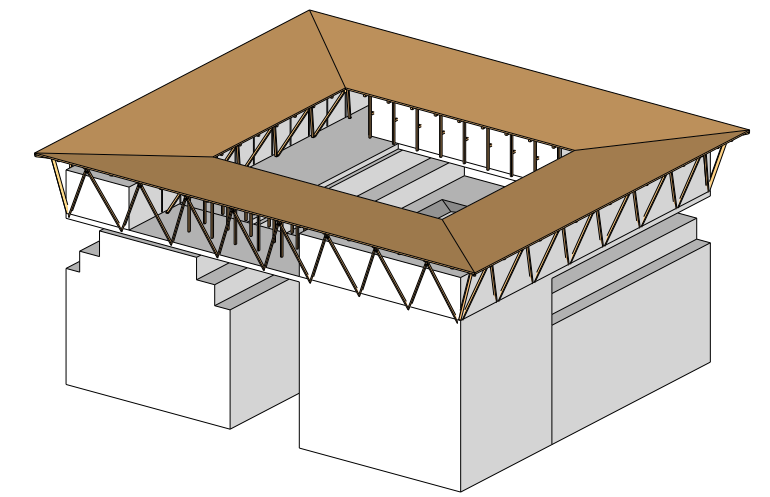
Floor area 3900 m²

Carbon Storage 800 ton CO₂e

CLT-walls 419 ton CO₂e

Design Enhancement

Carbon Storage 745 ton CO₂e



Roof area 5700 m²

Carbon Storage 771 ton CO₂e

Sheathing HIGH ton CO₂e

Design Enhancement

Carbon Storage 722 ton CO₂e

07 HARD TO COMPARE

Aeonwood Nest **with** Roof

Floor area 6715 m²

Carbon Storage 1840 ton CO₂e

274 kg CO₂-eq/m²



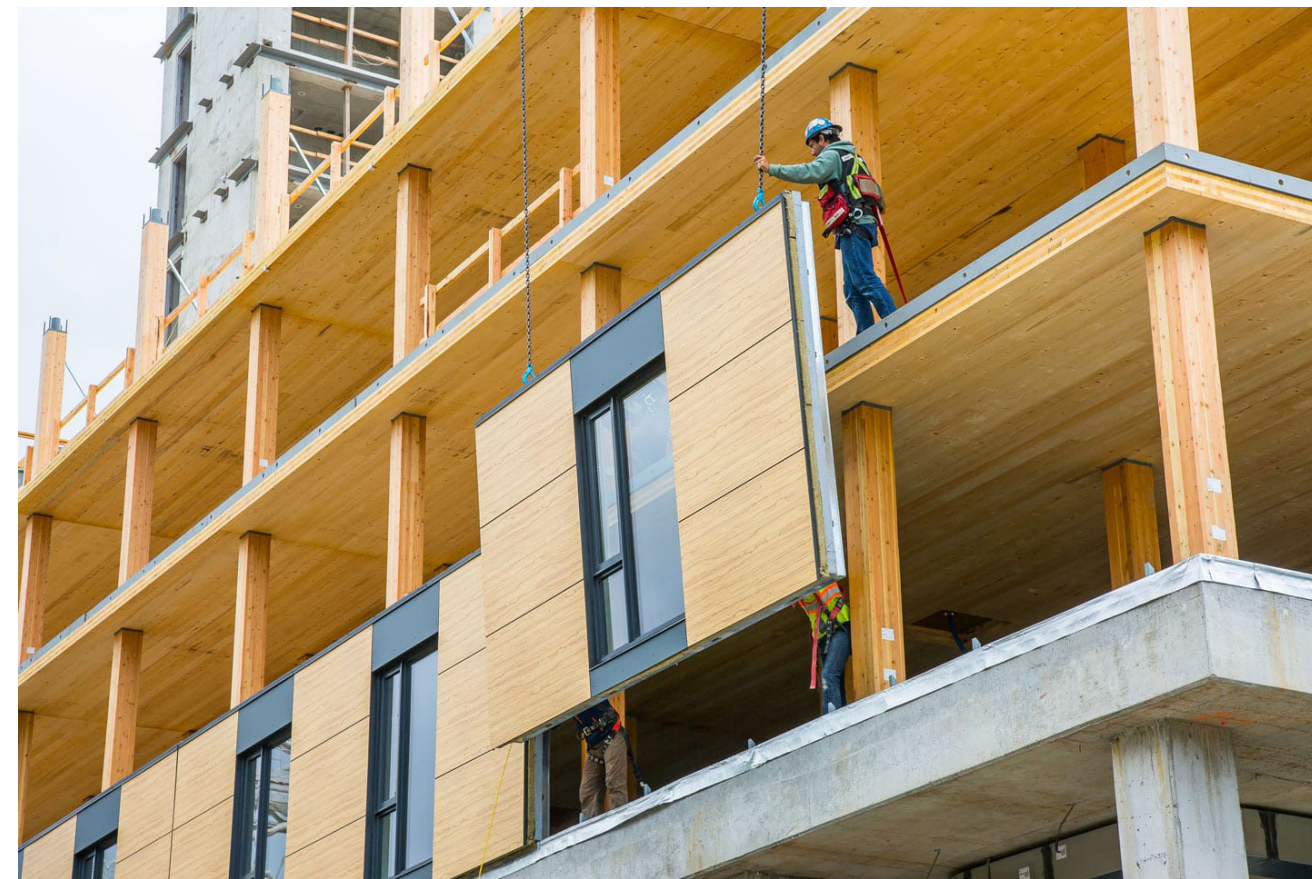
credits ArchDaily

Aeonwood Nest **without** Roof

Floor area 6715 m²

Carbon Storage 2726 ton CO₂e

159 kg CO₂-eq/m²



credits ThinkWood

BROCK COMMONS 2017

Floor area 14280 m²

Carbon Storage 1753 ton CO₂e

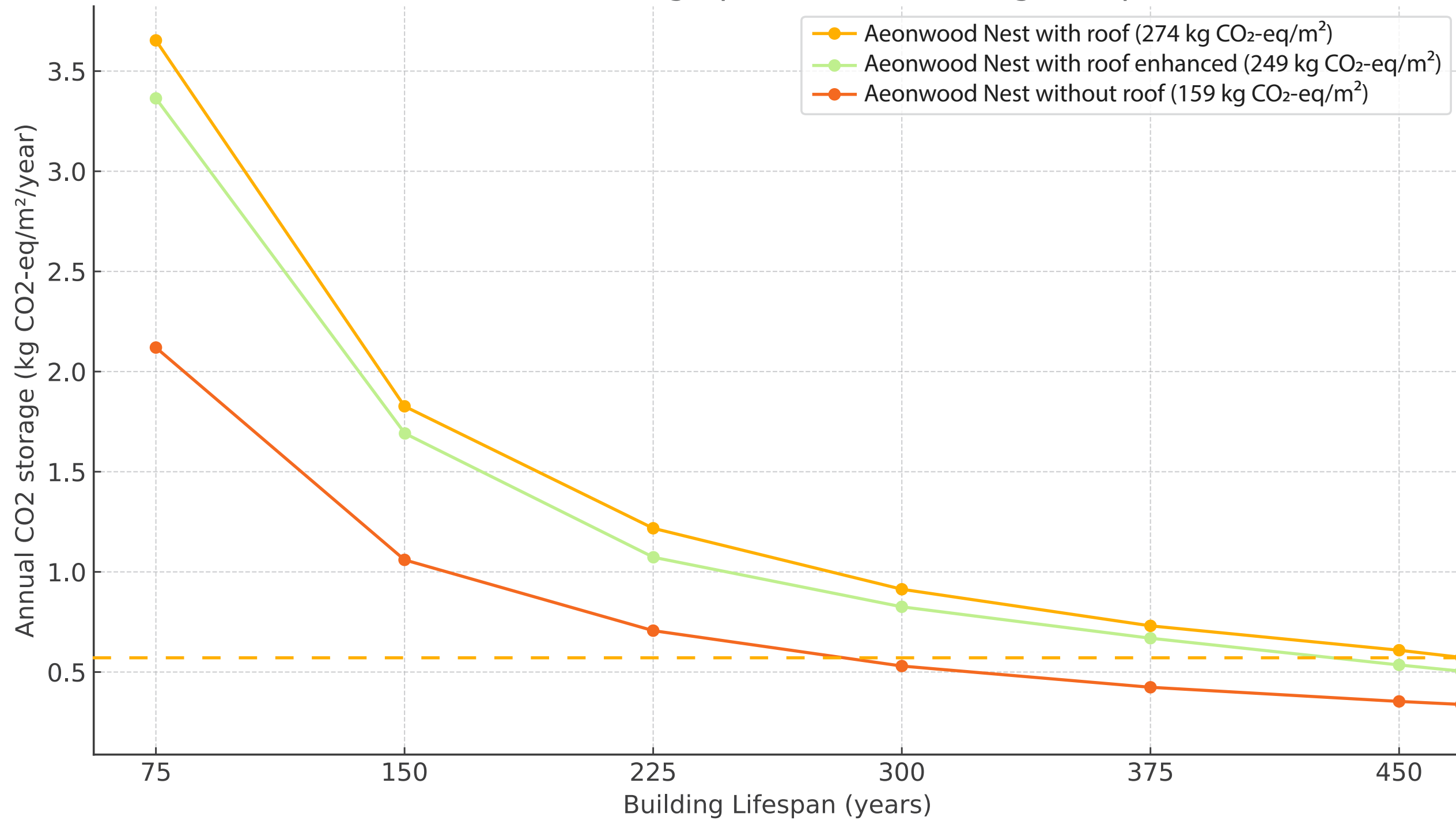
116 kg CO₂-eq/m²



credits HK Architekten

07 LIFE SPAN IN COMPARISON

Annual CO2 Storage per m² vs. Building Lifespan



07 CONCLUSION HYPOTHESIS

The Aeonwood Nest can reproduce itself up to **six** times during its lifetime.

3140 m³ of wood
1793 trees used

For **75** years, **24** trees to be planted

(Excluding all other advantages offered by the roof.)

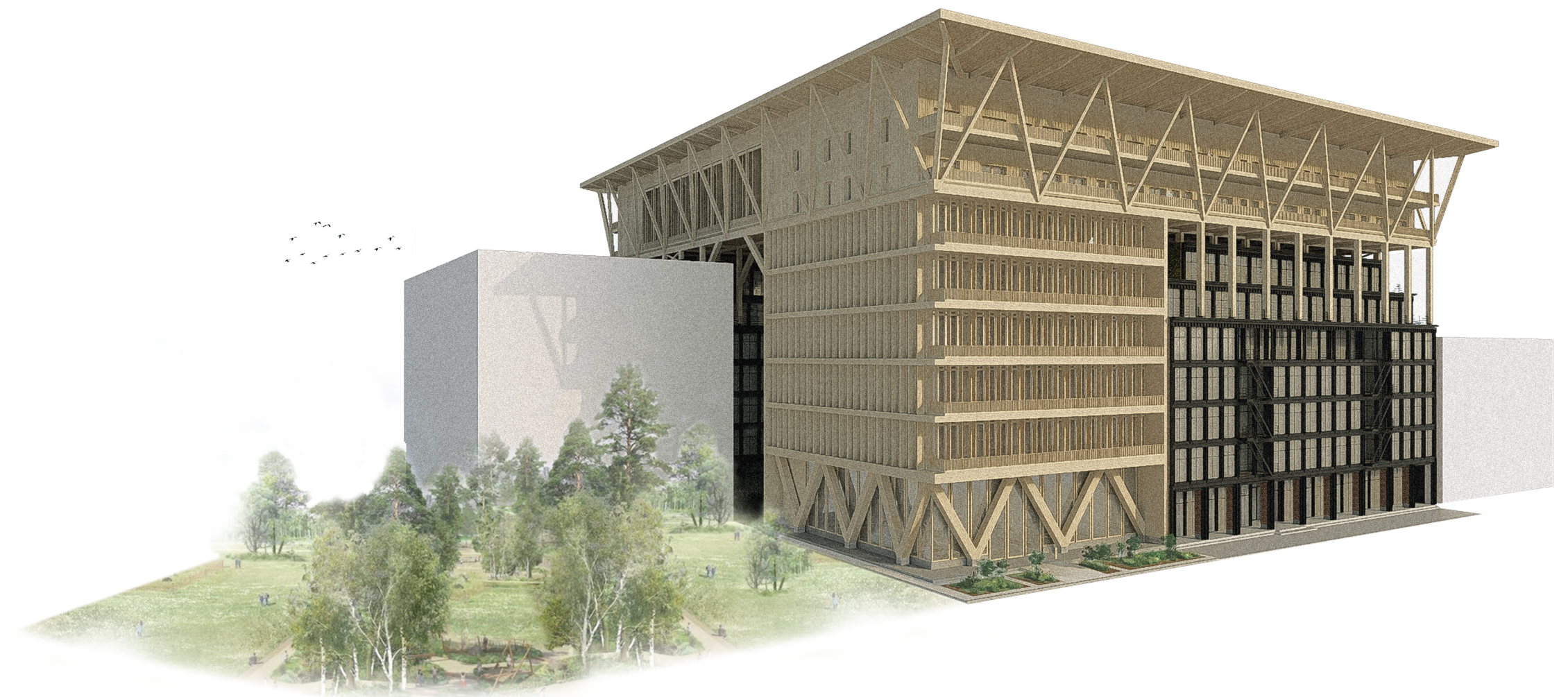
07 DESIGN CONCLUSION



CARBON AND TIME

Designing for 500 years of carbon storage

Architectural Wood Studio

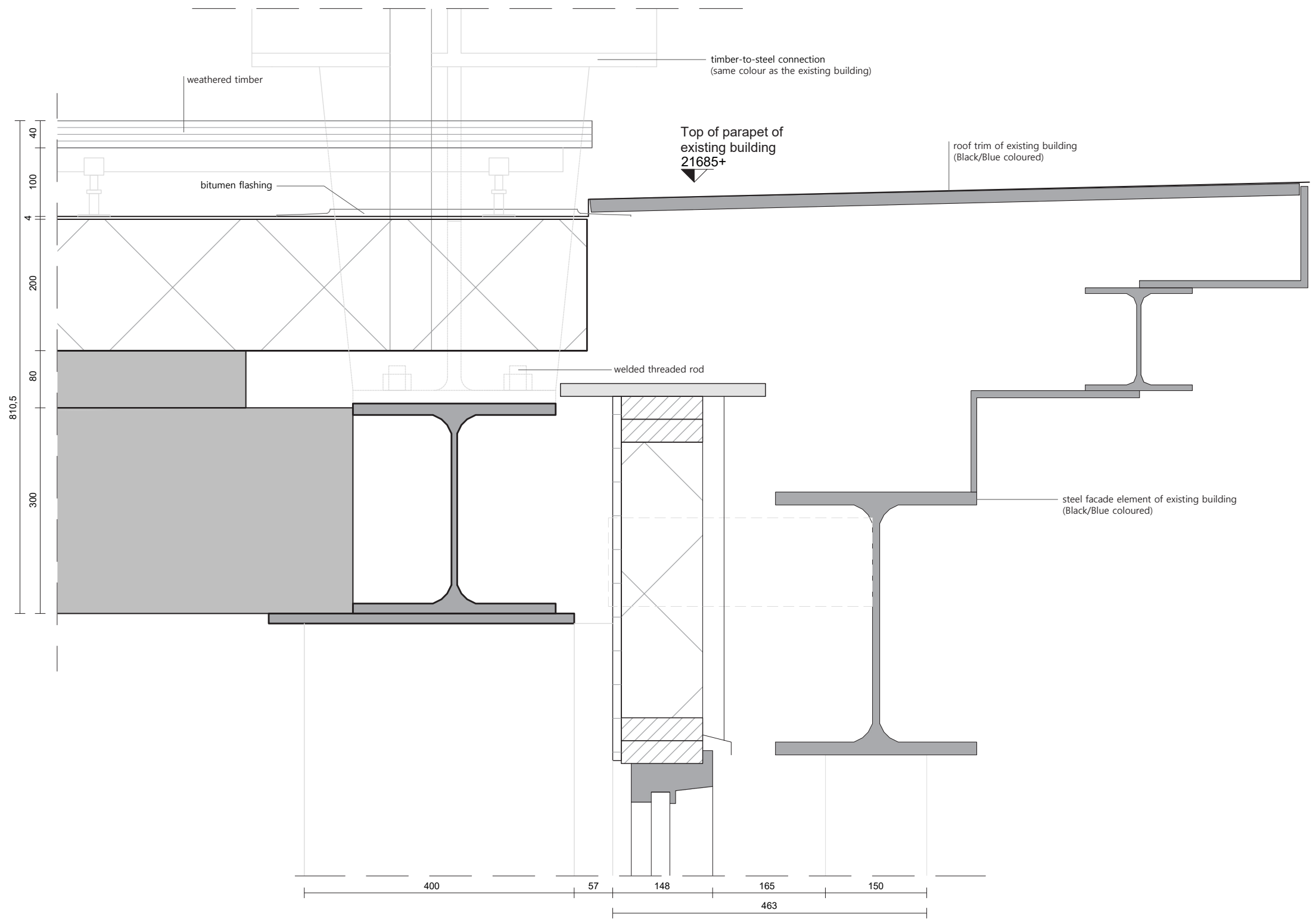


Stan van Etten
5668387

08 ADDED VALUE



05 STRUCTURE



connection between new and existing structure 1 : 5

Building System

Detachability

Re-use potential

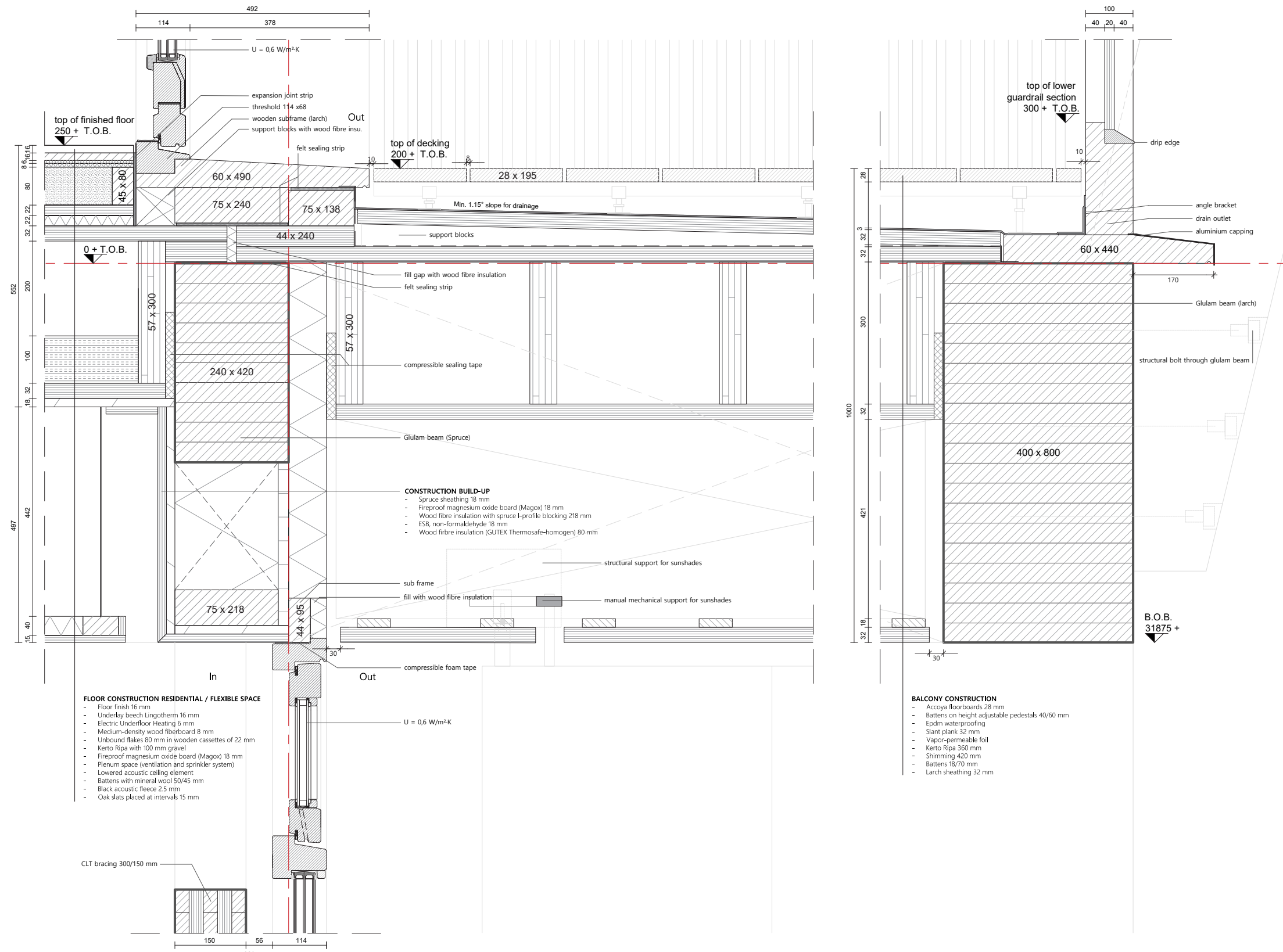
Material Choice

Origin of materials

Healty materials

Extend Lifespan

05 STRUCTURE



office-to-residential interface detail 1 : 5

Building System

Detachability

Re-use potential

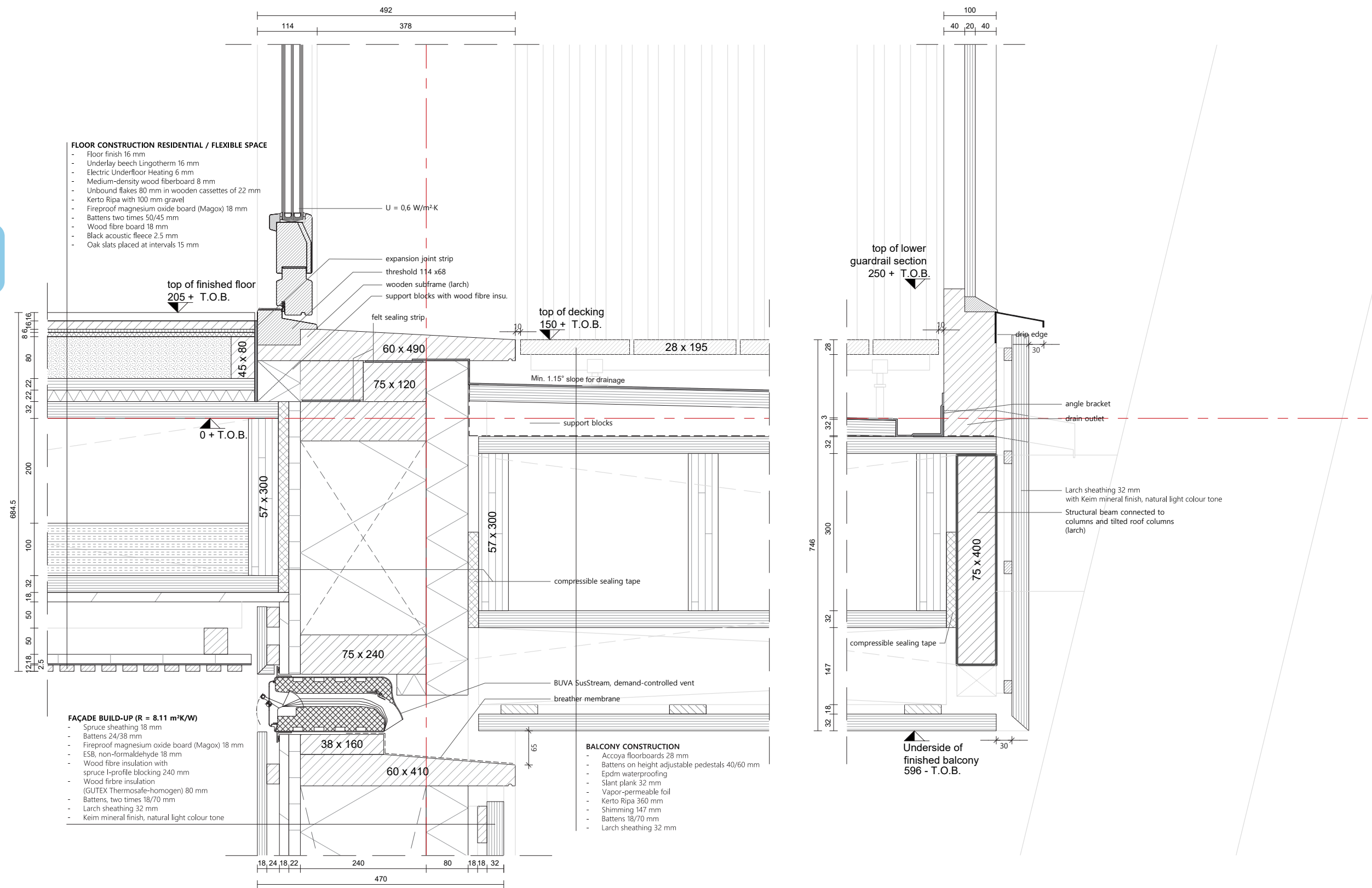
Material Choice

Origin of materials

Healty materials

Extend Lifespan

05 CONSTRUCTION SEQUENCE



externally supported balcony with façade and party floor detail 1 : 5

Building System

Detachability

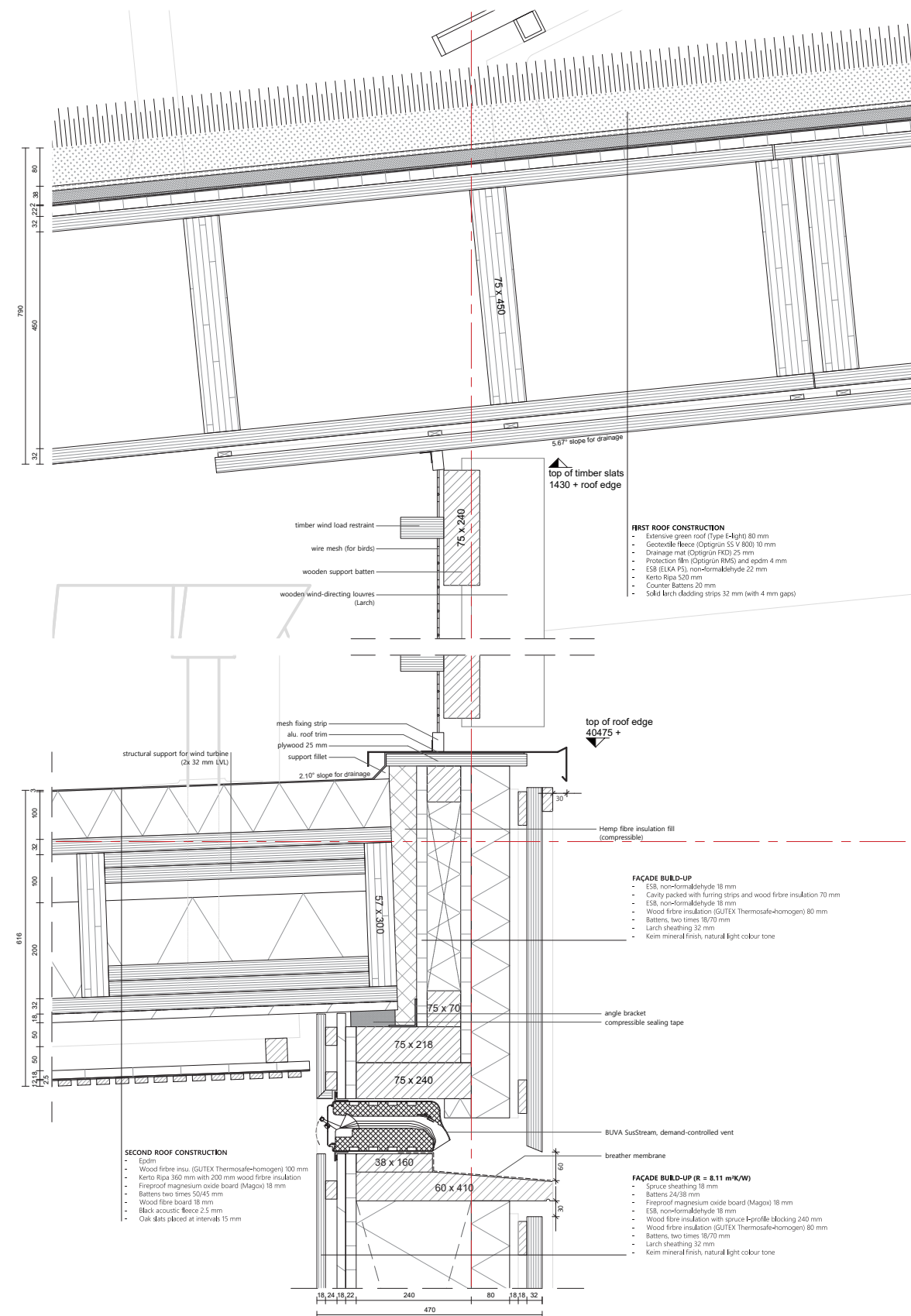
Re-use potential

Material Choice

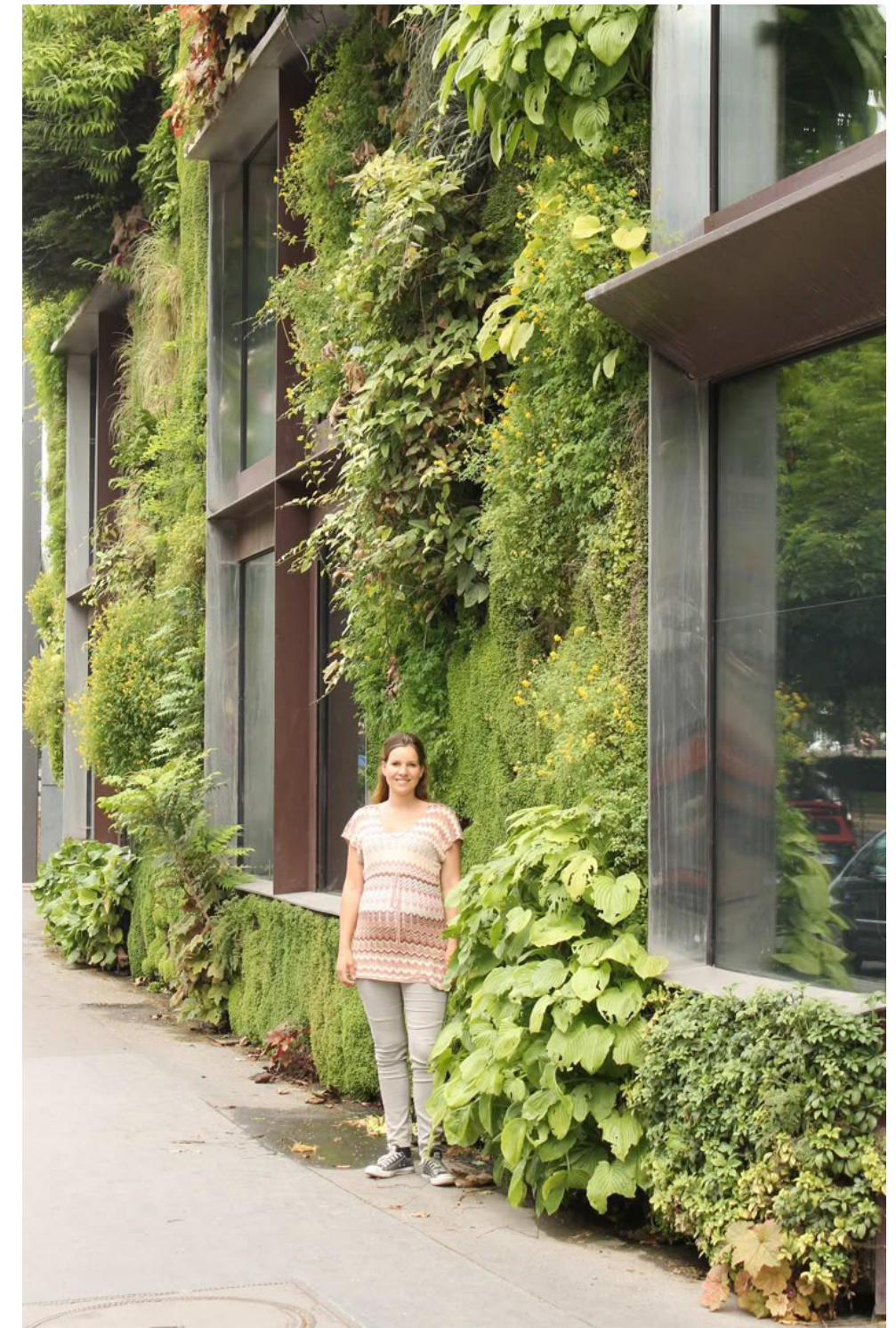
Origin of materials

Healty materials

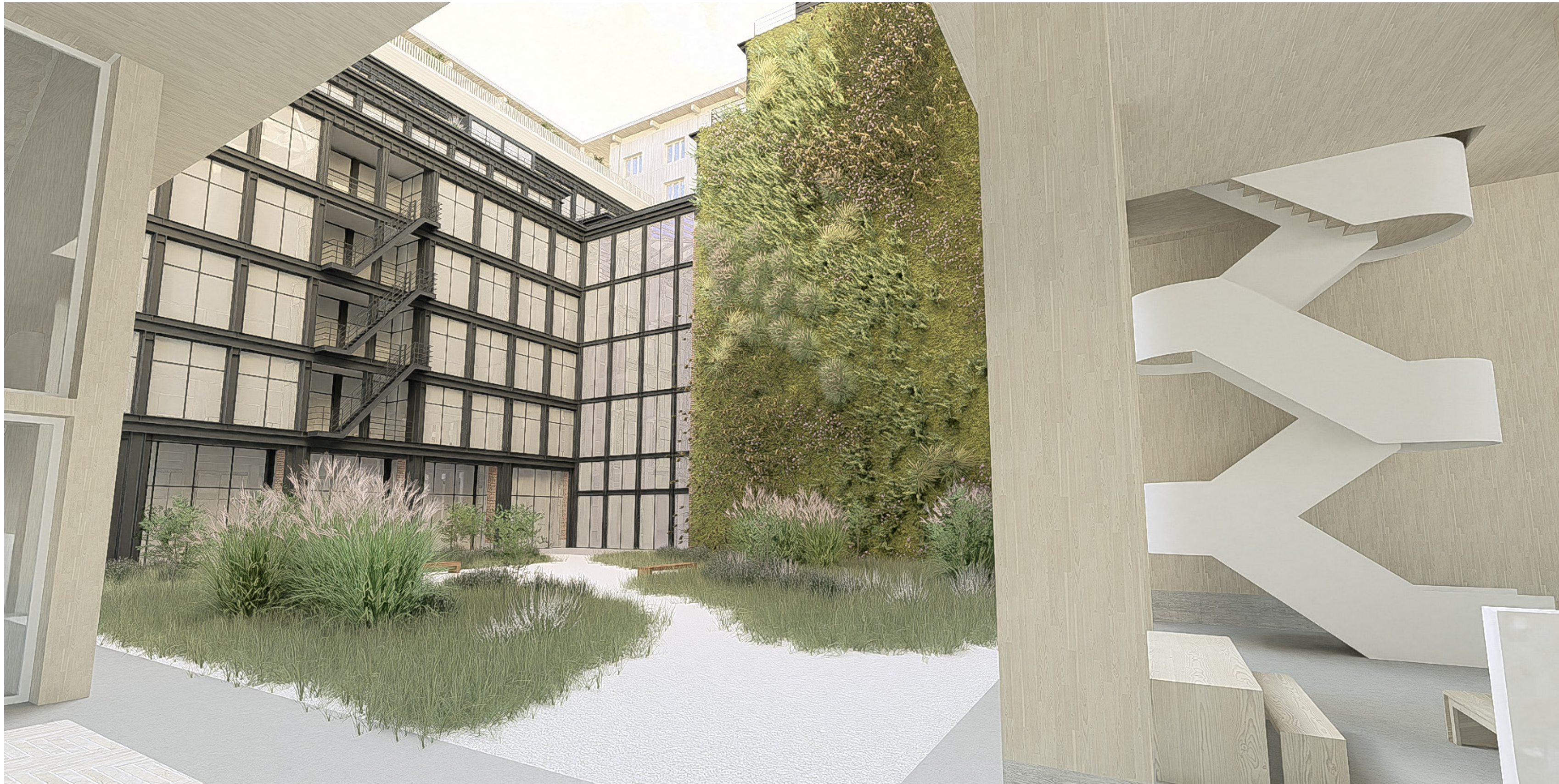
05 STRUCTURE



08 GARDEN



VTwonen



central garden - connection between office and new building



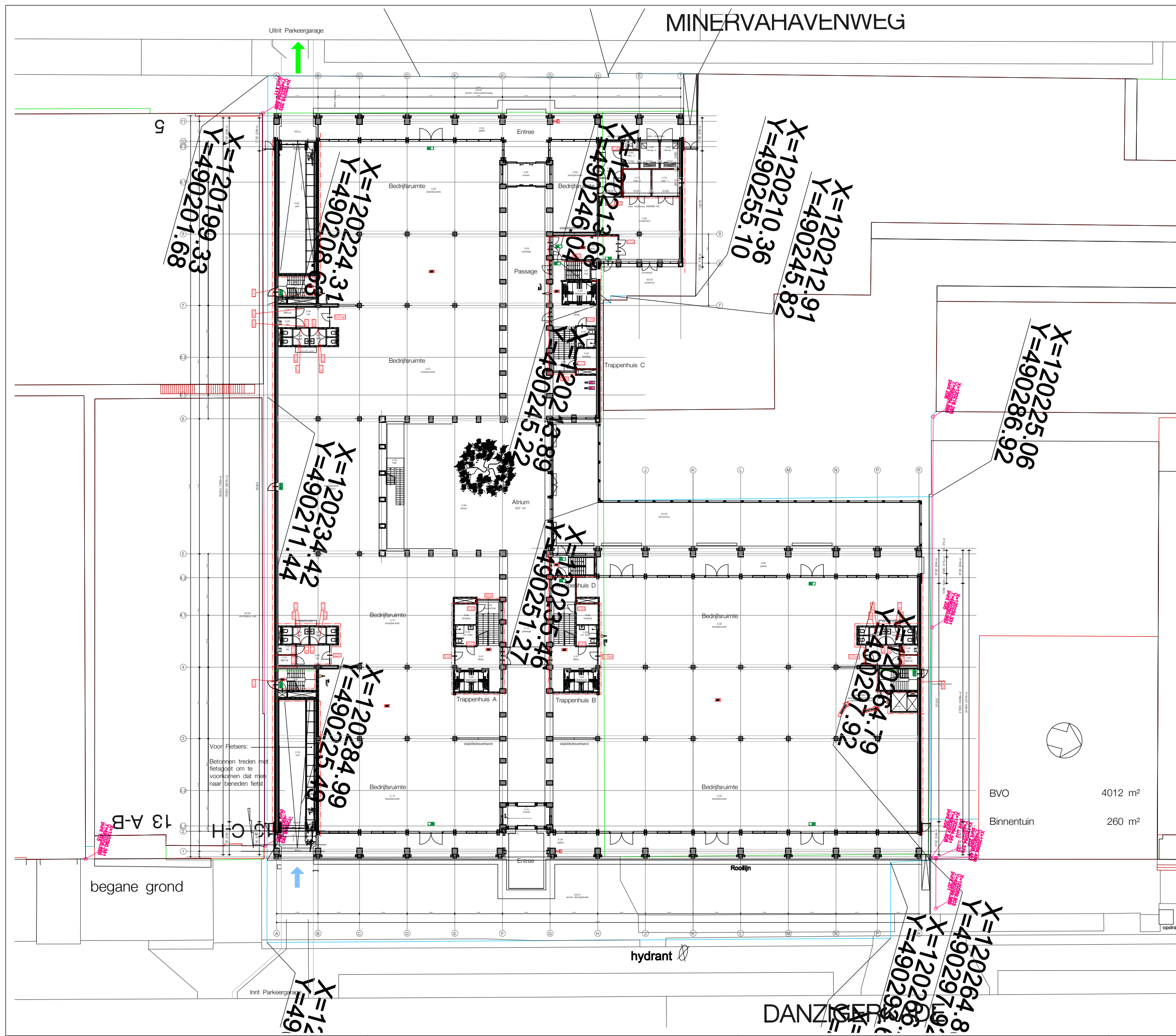








MINERVAHAVENWEG



X=120225.06
Y=490286.92

X=120212.91
Y=490245.82
X=120210.36
Y=490255.10

X=120199.33
Y=490201.68
X=120224.31
Y=490208.65

X=120218.89
Y=490245.22
X=120213.68
Y=490246.04

X=120234.42
Y=490211.44

X=120235.46
Y=490251.27

X=120264.79
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X=120284.99
Y=490225.49

X=120264.8
Y=490297.92
X=120265
Y=490298

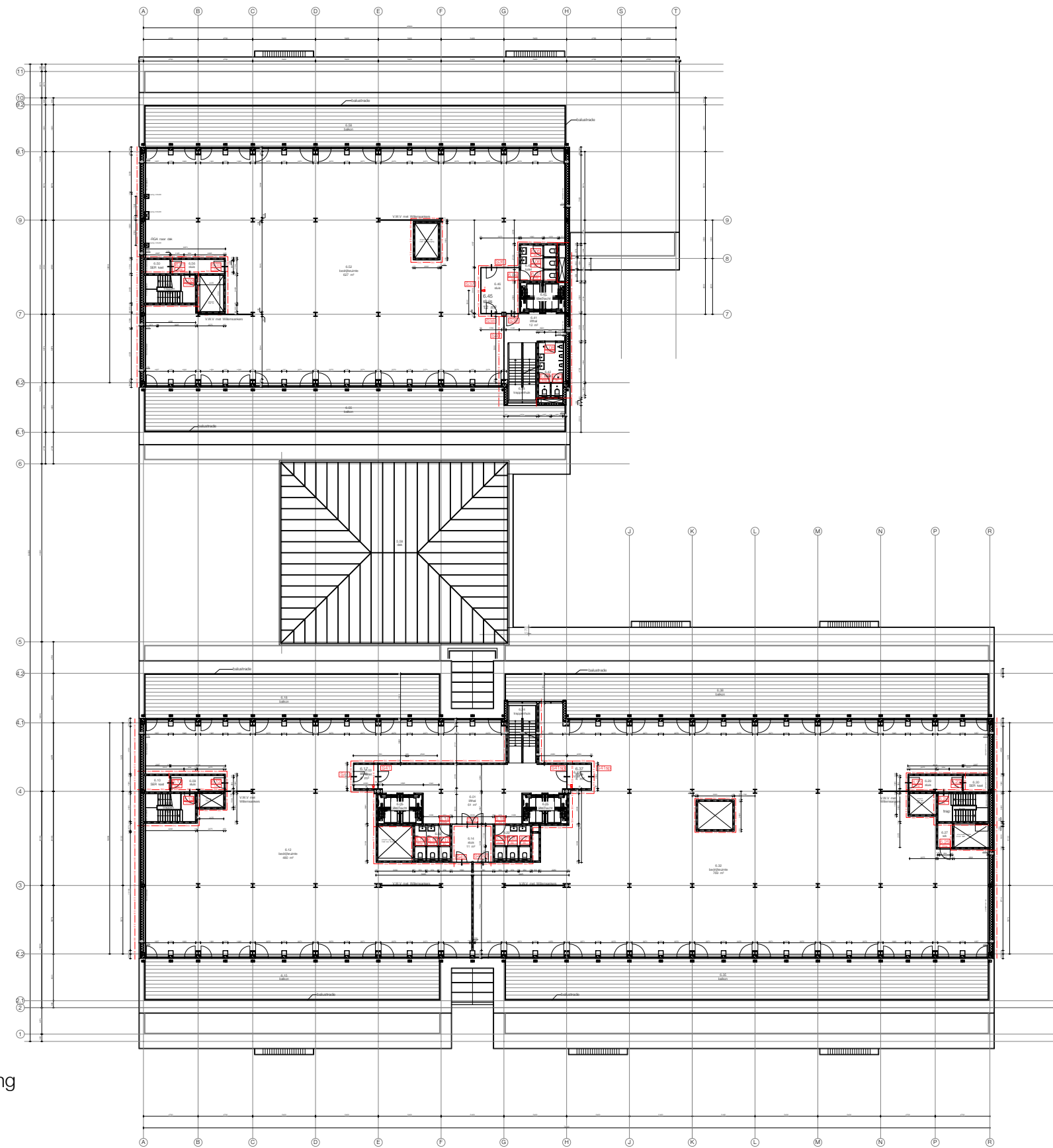
begane grond

hydrant

BVO 4012 m²
Binnentuin 260 m²

dd.

dedato ontwerpers en architecten design - retail - architecture		datum 20.12.2016	
Dedato Europe bv Danzigerkade 2C - 1013 AP Amsterdam Postbus 656 - 1000 AK Amsterdam T +31 (0)20 628 62 33 info@dedato.com - www.dedato.com		opdrachtgever	
Heren 2		1013 AP Amsterdam	
Danzigerkade		getekend MP	
1013 AP Amsterdam		projectnr. 375-1043	
project AWAREHOUSE DK 14-15		file	
Technisch Ontwerp Uitbreiding		schaal 1:200	
Begane Grond		formaat A1	
tekening nr.		tekening nr.	
01	24.02.2017	02	14.04.2017
02	14.04.2017	03	26.04.2017
03	26.04.2017	04	31.08.2017
04	31.08.2017	05	28.09.2017
05	28.09.2017	06	26.10.2017
06	26.10.2017	07	12.04.2019
07	12.04.2019	08	01.05.2019
08	01.05.2019	09	28.08.2019
09	28.08.2019	10	06.09.2019
10	06.09.2019	11	
W 003			
alle maten in het werk controleren			



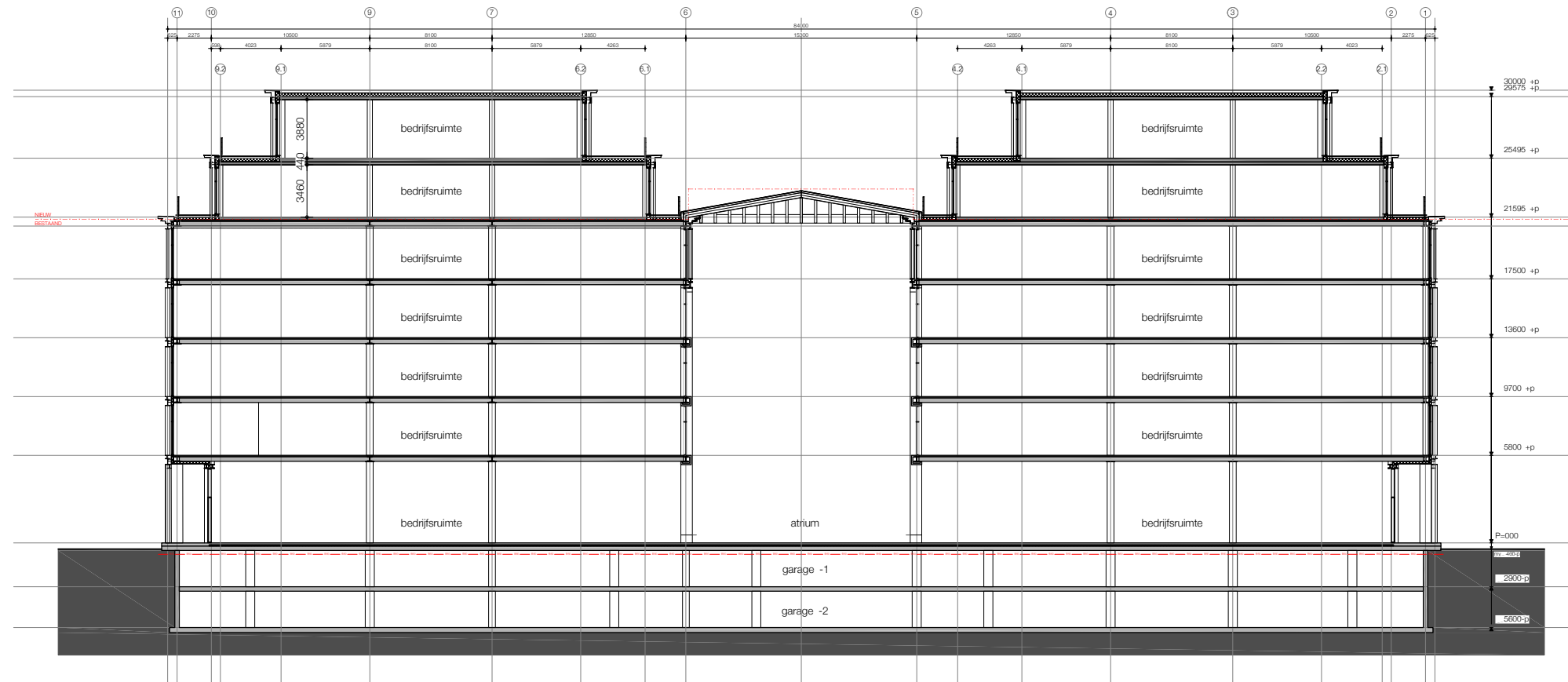
6e verdieping

dd.

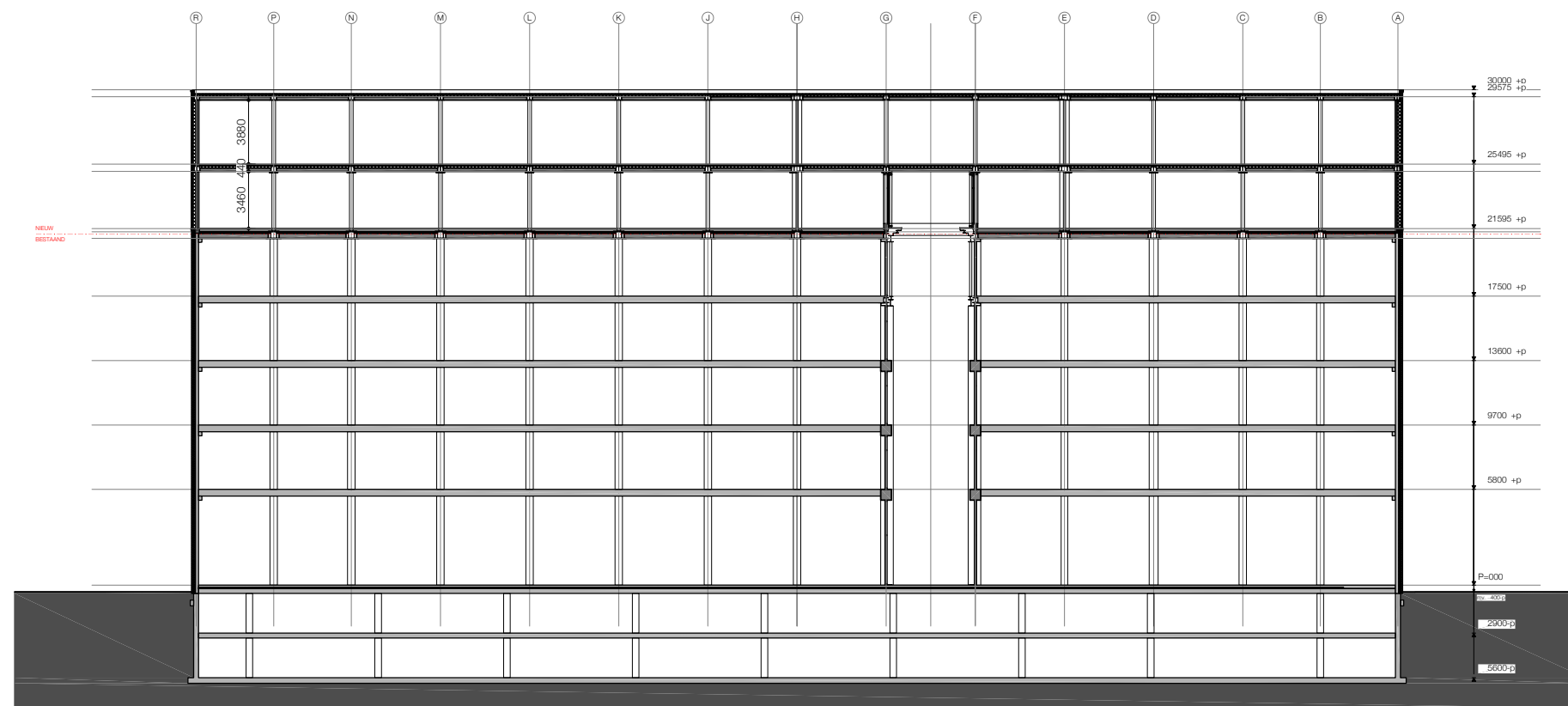
dedato ontwerpers en architecten design - retail - architectuur Dedato Europe bv Danzigerkade 2C - 1013 AP Amsterdam Postbus 436 - 1000 AK Amsterdam T +31 (0)20 628 62 33 info@dedato.com - www.dedato.com		datum 16.07.2018
opdrachtgever Heren 2	Danzigerkade	getekend MP
1013 AP Amsterdam	1013 AP Amsterdam	projectnr. 375-1043
project AWAREHOUSE DK 14-15 UITBREIDING	Technisch Ontwerp Uitbreiding	file
6e Verdieping	Bedrijfsruimte	schaal 1:200
tekening	11	formaat A1
gewijzigd	1 23.07.2018	2 14.09.2018
	4 14.11.2018	5 06.02.2019
	7 12.04.2019	8 01.05.2019
		9 28.08.2019
		10
		11
		12
		13

TOB 008

alle maten in het werk controleren



principe doorsnede A



principe doorsnede B

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 Postbus 435 · 1000 AK Amsterdam
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 info@dedato.com · www.dedato.com

dd.

opdrachtgever	Heren 2	datum	16.07.2018
	Danzigerkade	getekend	MP
	1013 AP Amsterdam	projectnr.	375-1043
project	AWAREHOUSE DK 14-15 UITBREIDING	file	
	Technisch Ontwerp Uitbreiding	schaal	1:200
tekening	Doorsnede Uitbreiding Bedrijfsruimte	formaat	A1
	Bedrijfsruimte	tekening nr.	
gewijzigd	1 23.07.2018	2 16.09.2018	3 01.10.2018
	4 12.04.2019	5	6
	7	8	9
	10	11	12

OVB 010

alle maten in het werk controleren