

BLENDING LIGHT EARTH AND TIMBER FRAME TECHNIQUES

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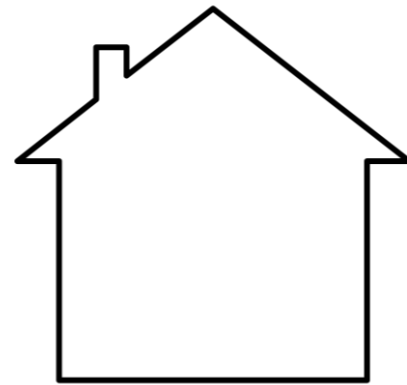
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PROBLEM
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RESEARCH
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CONTEXT
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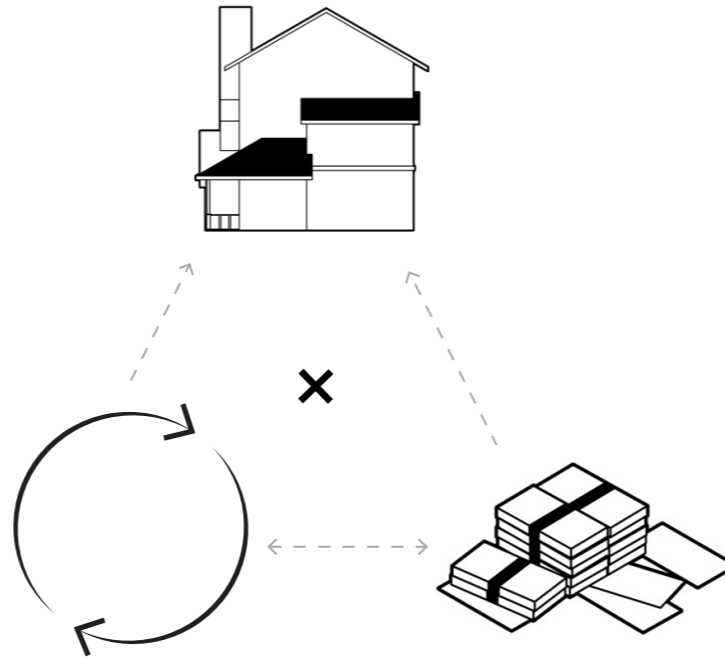
.....
DESIGN
.....

PROBLEM



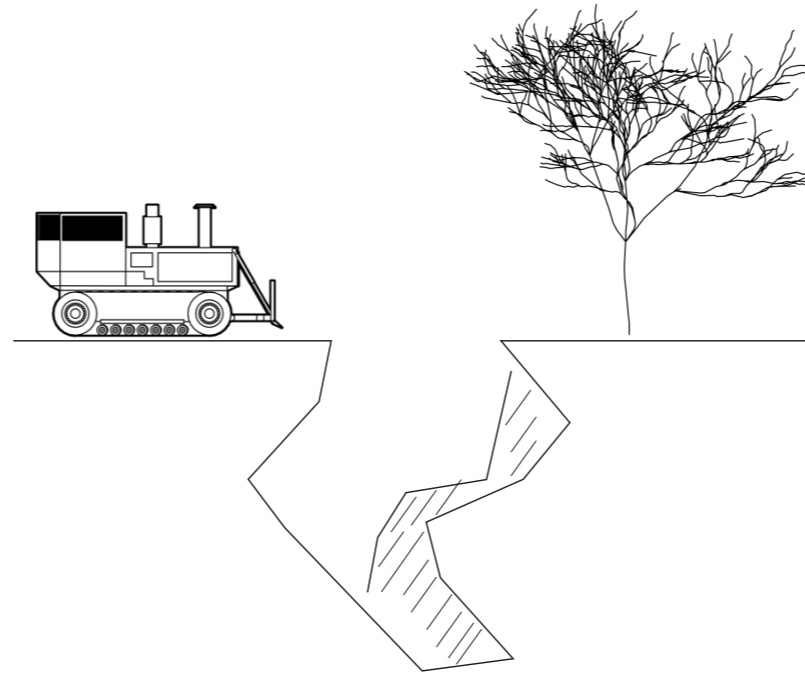
HOUSING SHORTAGE

900,000 houses to be built by 2030



STUBBORN BUILDING INDUSTRY

Little change in attitude towards sustainable methods



MATERIALS- & ENERGY TRANSITION

Integration of the sustainable aspects into the building is urgent:
Over-exploitation of ecosystems elsewhere

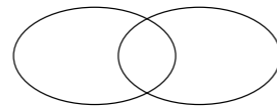


WHAT TO DO ABOUT IT?



NATURAL BUILDING METHOD

Traditionally, raw resources for building materials can be categorised as **earth**, **wood** and **fibres**. A building method that incorporates these materials is the **light earth method**.



EXISTING BUILDING METHOD

There is a great potential for regional materialisation and prefabrication of **timber frame building** elements.

LIGHT EARTH METHOD



LOW CARBON FOOTPRINT

With the material not having to be burned, little CO2 is emitted in the production.

UNLIMITED AVAILABILITY

Loam is an inexhaustible resource.
Straw is a agricultural by-product

TECHNICAL PROPERTIES

Thermal, acoustic, fire resistance, customazability...

TIMBER FRAME STRUCTURES



CARBON NEGATIVE

With trees absorbing CO₂ over their lifetime, timber buildings store carbon before it is again released.

STRUCTURAL PERFORMANCE

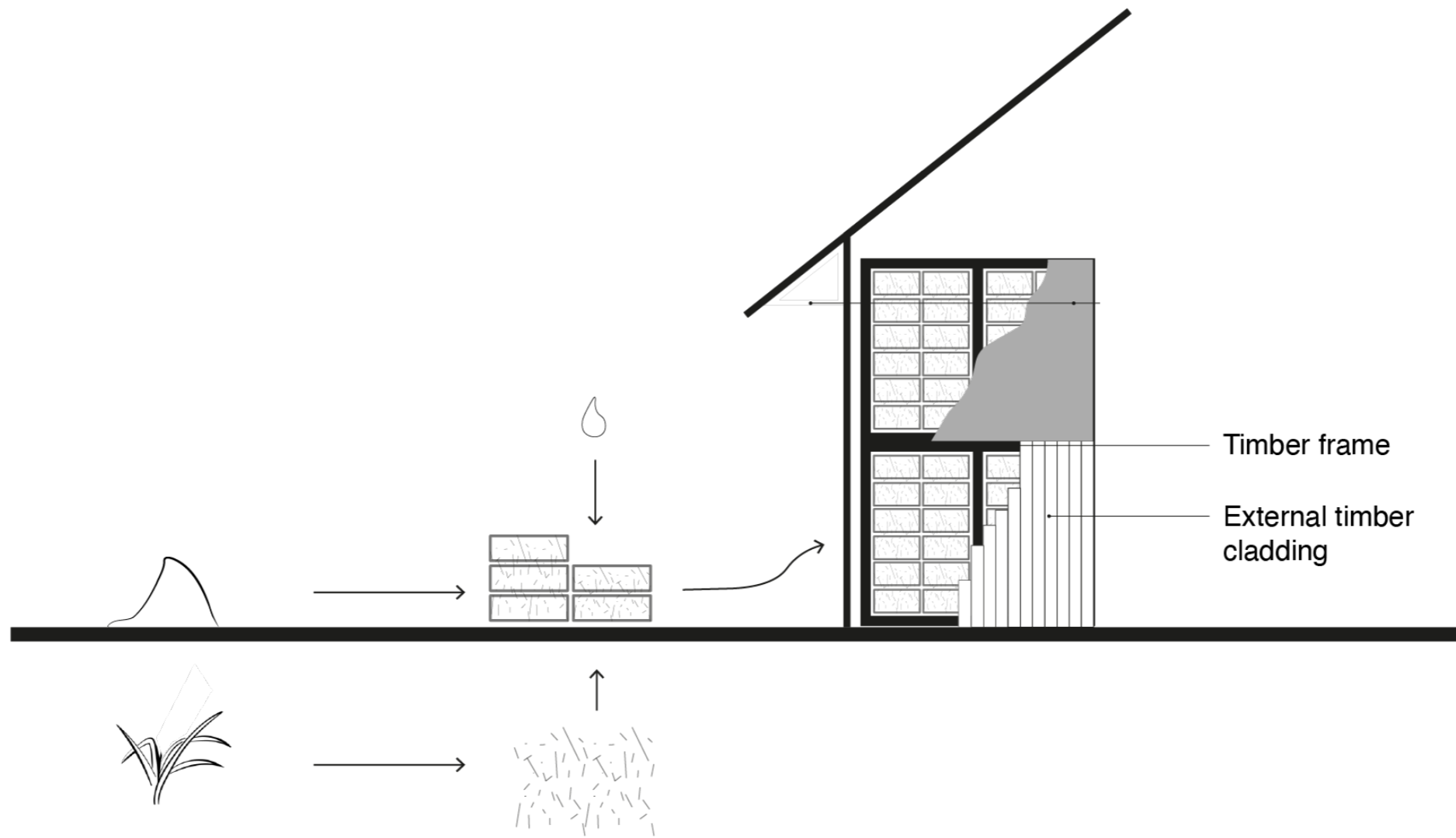
Timber acts under tension and compression, making it suitable for both horizontal and vertical building components.

PREFABRICATION-POTENTIAL

Prefabricated timber frames can be used in combination with other methods of timber construction, creating hybrid forms between mainly 1D and 2D systems.

RESEARCH QUESTION

In what ways can **light earth construction methods** be incorporated in **prefabricated timber frame housing construction methods**, using locally sourced materials (earth, wood, and fibres) from the Netherlands, addressing **contemporary residential requirements**?



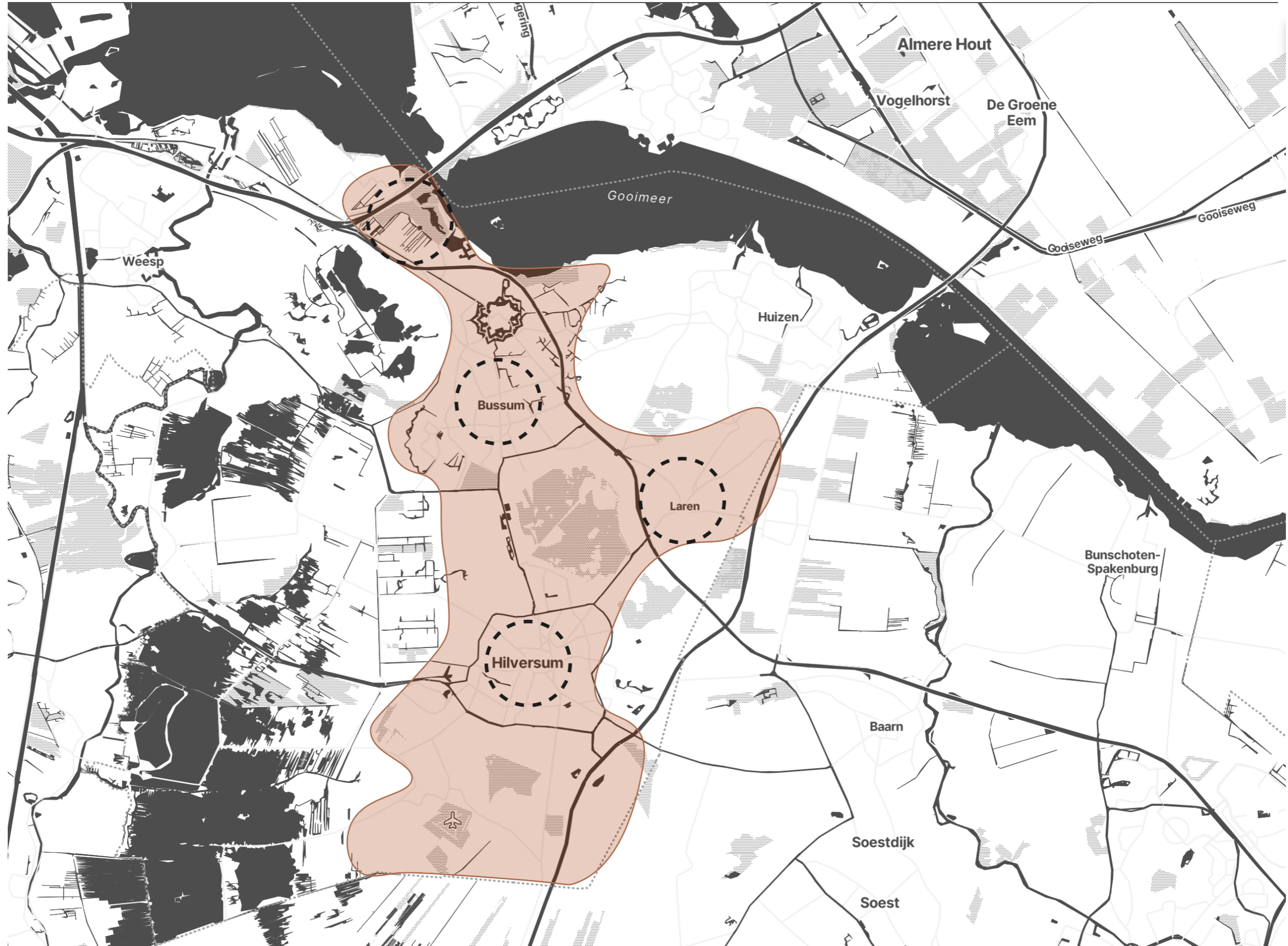
GOAL

Design a residential building integrally, through minimally adapting existing building methods while improving them by implementing a natural building method using only local materials.

CONTEXT

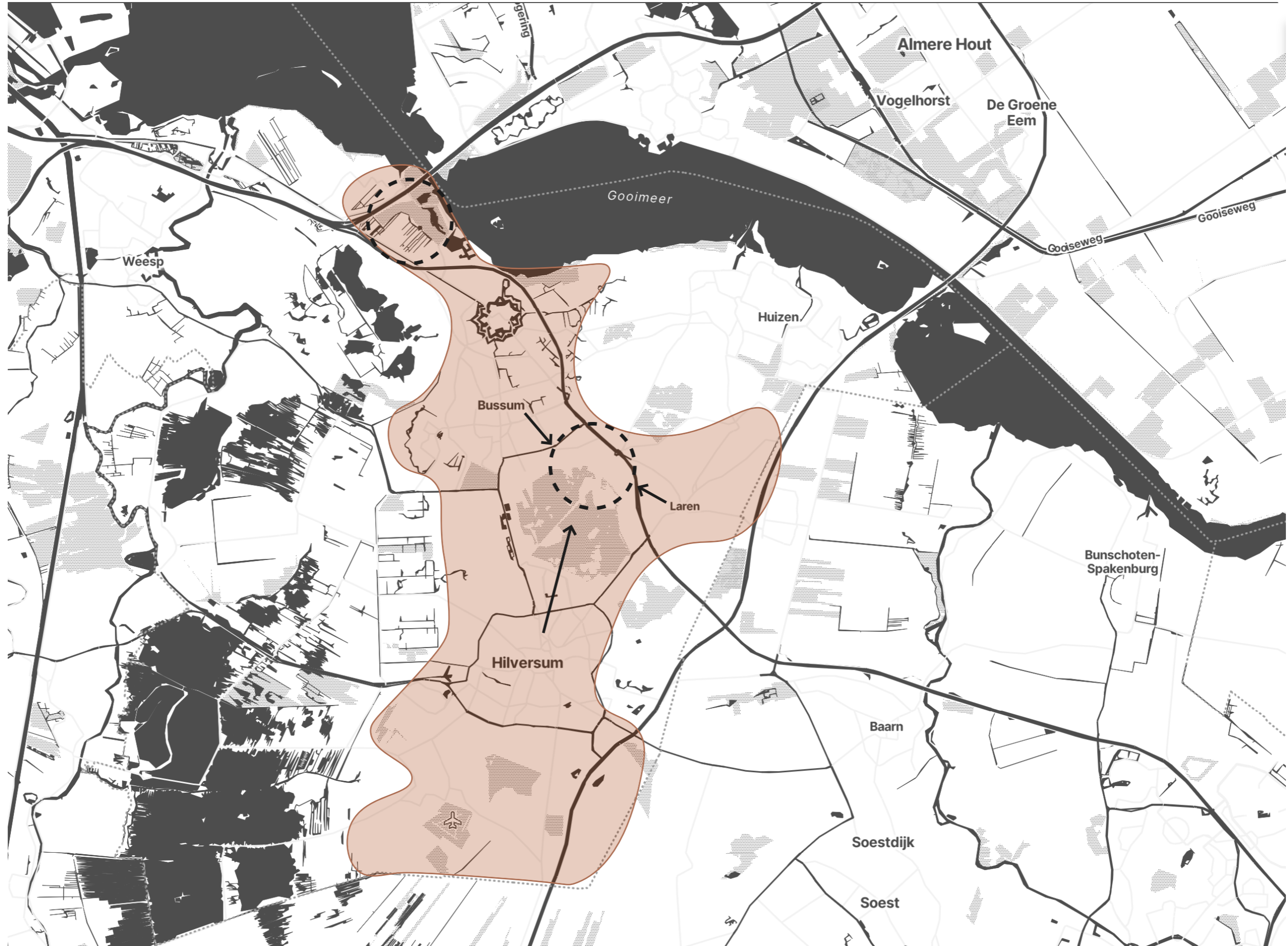
CONTEXT

Gooi & Vecht region: Gooise Meren, Laren and Hilversum



CONTEXT

Gooi & Vecht region: Gooise Meren, Laren and Hilversum



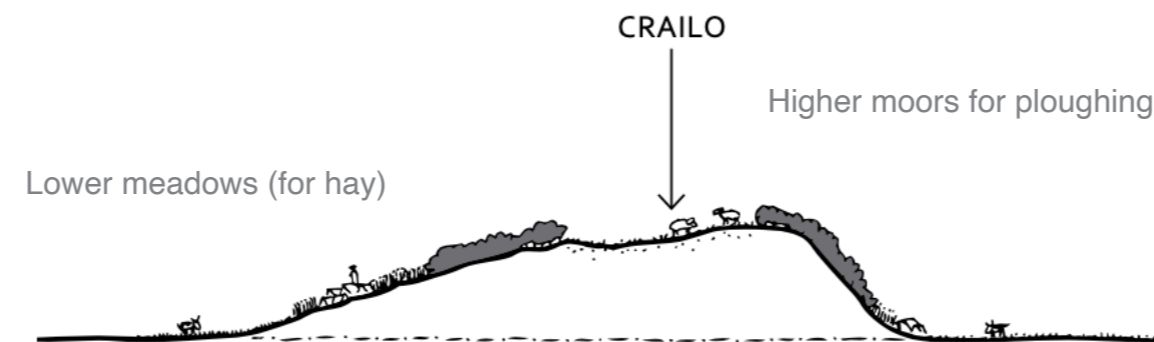
CONTEXT

Gooi & Vecht region: Gooise Meren, Laren and Hilversum



CONTEXT

Crailo



The site lies right on top of the Utrechtse Heuvelrug.
Crailo's landscape subsoil largely determines the spatial
layout of the area.

CONTEXT

Crailo

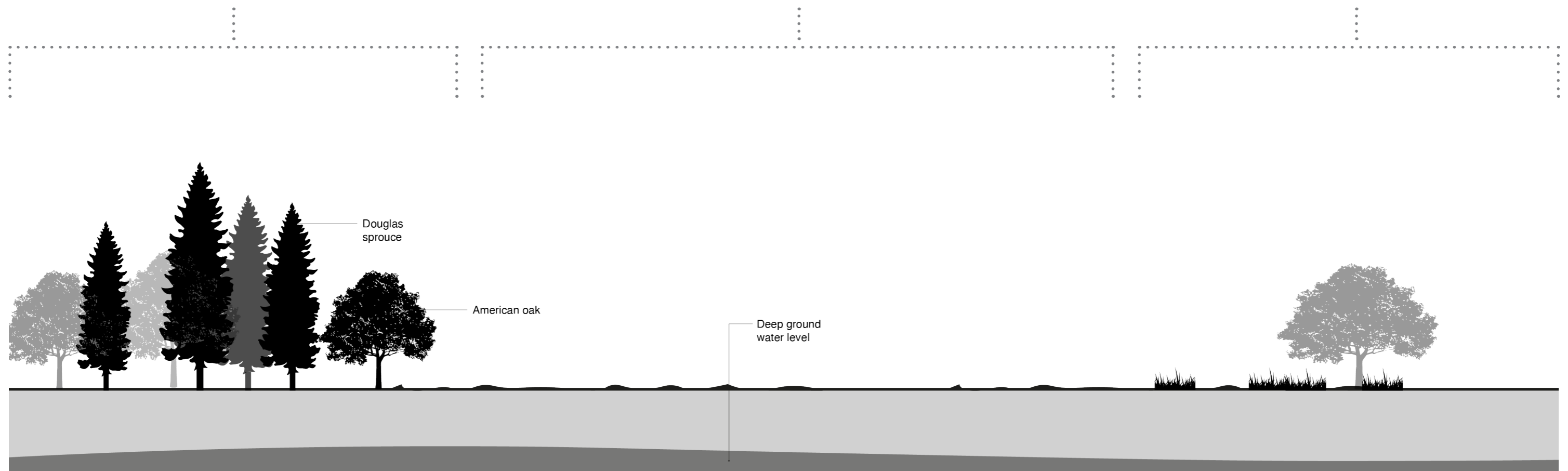
FORESTRY



DRY SANDY SOIL



MOORS



CONTEXT

Crailo



FORMER MILITARY TRAINING AREA

CONTEXT

Crailo



CONTEXT

Crailo



CONTEXT

Crailo



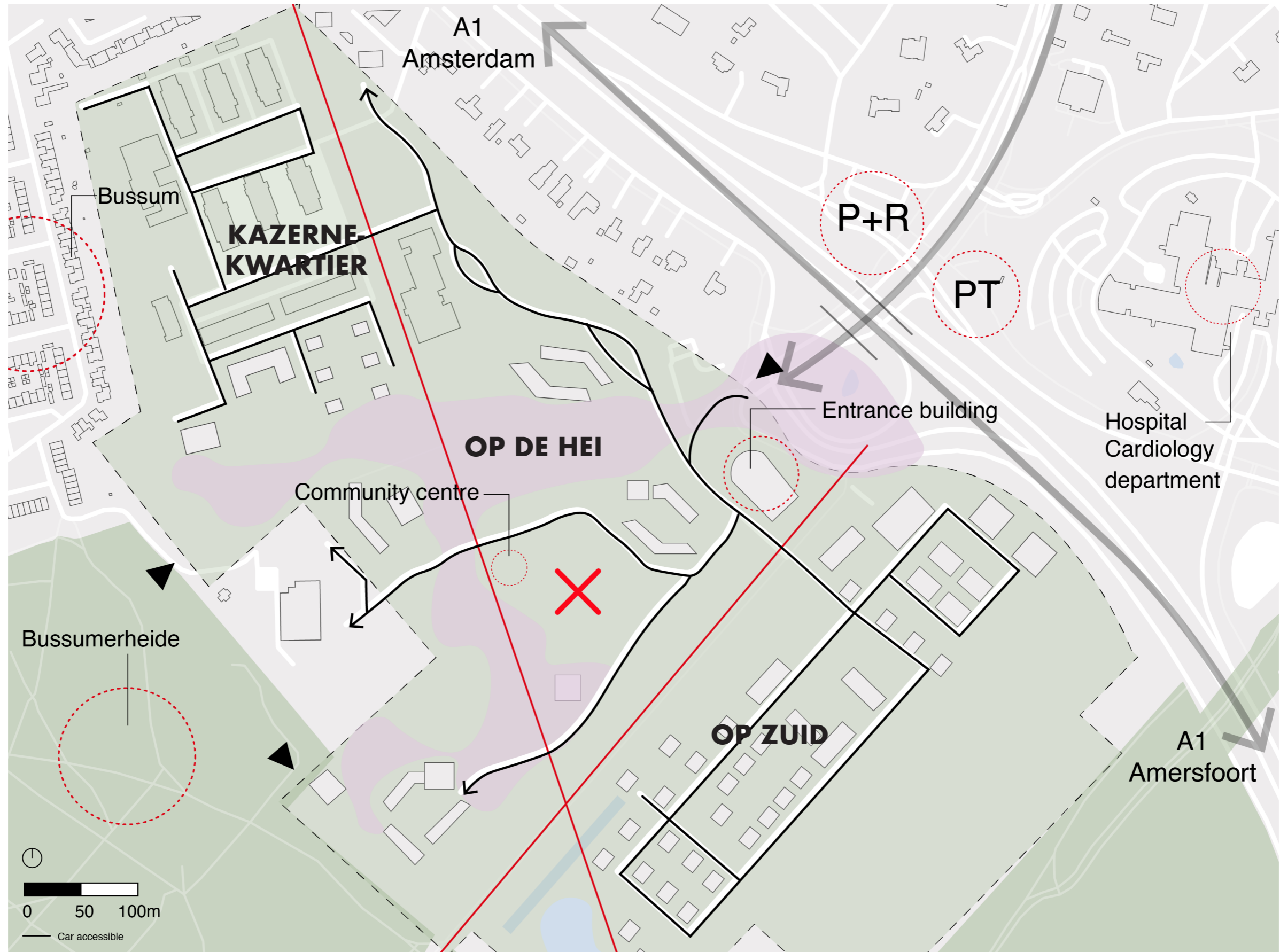
CONTEXT

Crailo



CONTEXT

Crailo



RESEARCH

RESEARCH

Local materials

AGRICULTURE | FIBRES

Flevoland

± 11.500 ha harvested wheat/year
1 ha wheat = 4000 kg straw
1 ha wheat = 200 bales of straw

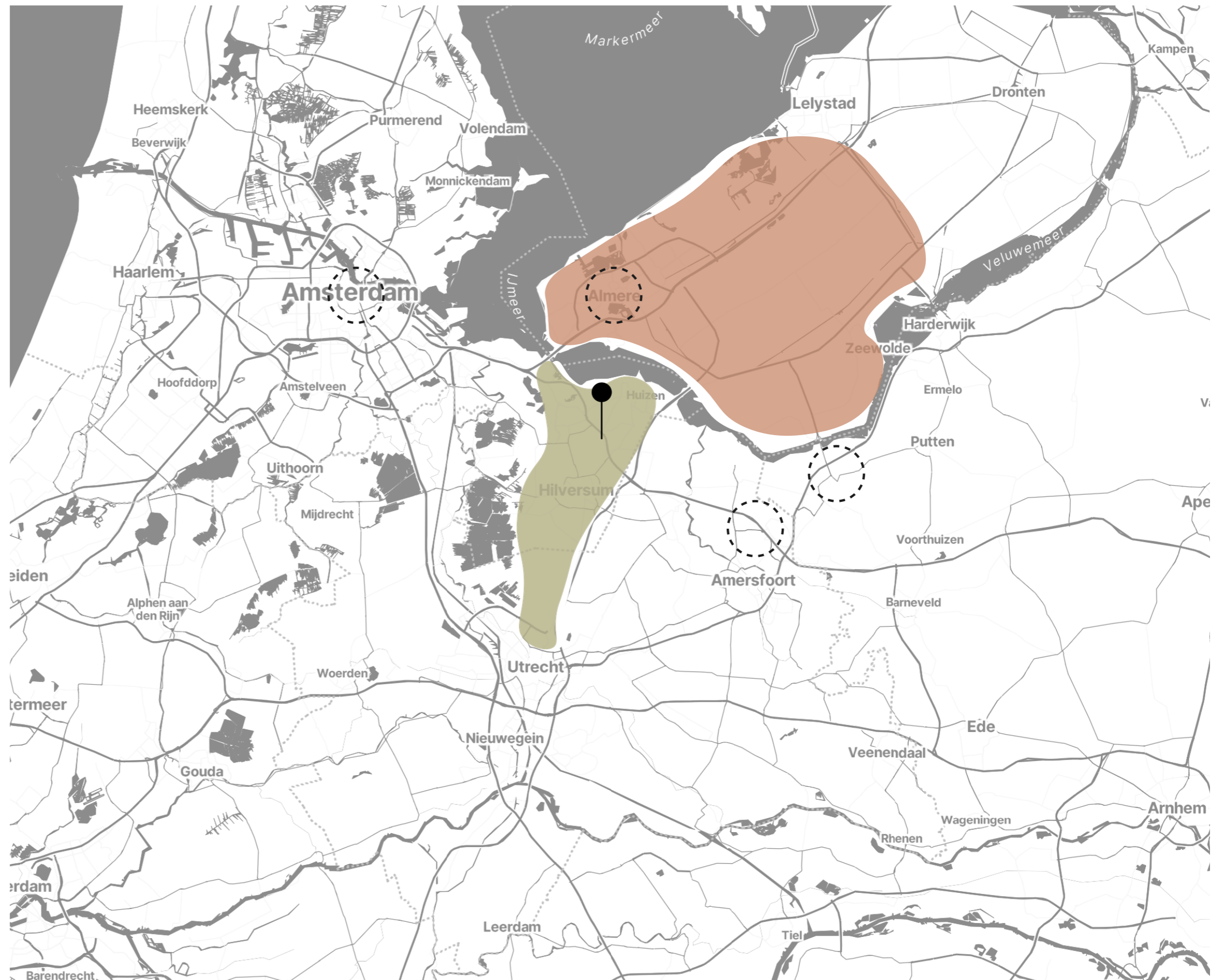
46*10*6 kg straw per year
2,3*10*6 bales per year

SOIL | EARTH

'Grondbank' Deposit

10 times a year
1000 tons of clay

10*10*6 kg clay per year



RESEARCH

Local materials

AGRICULTURE | FIBRES

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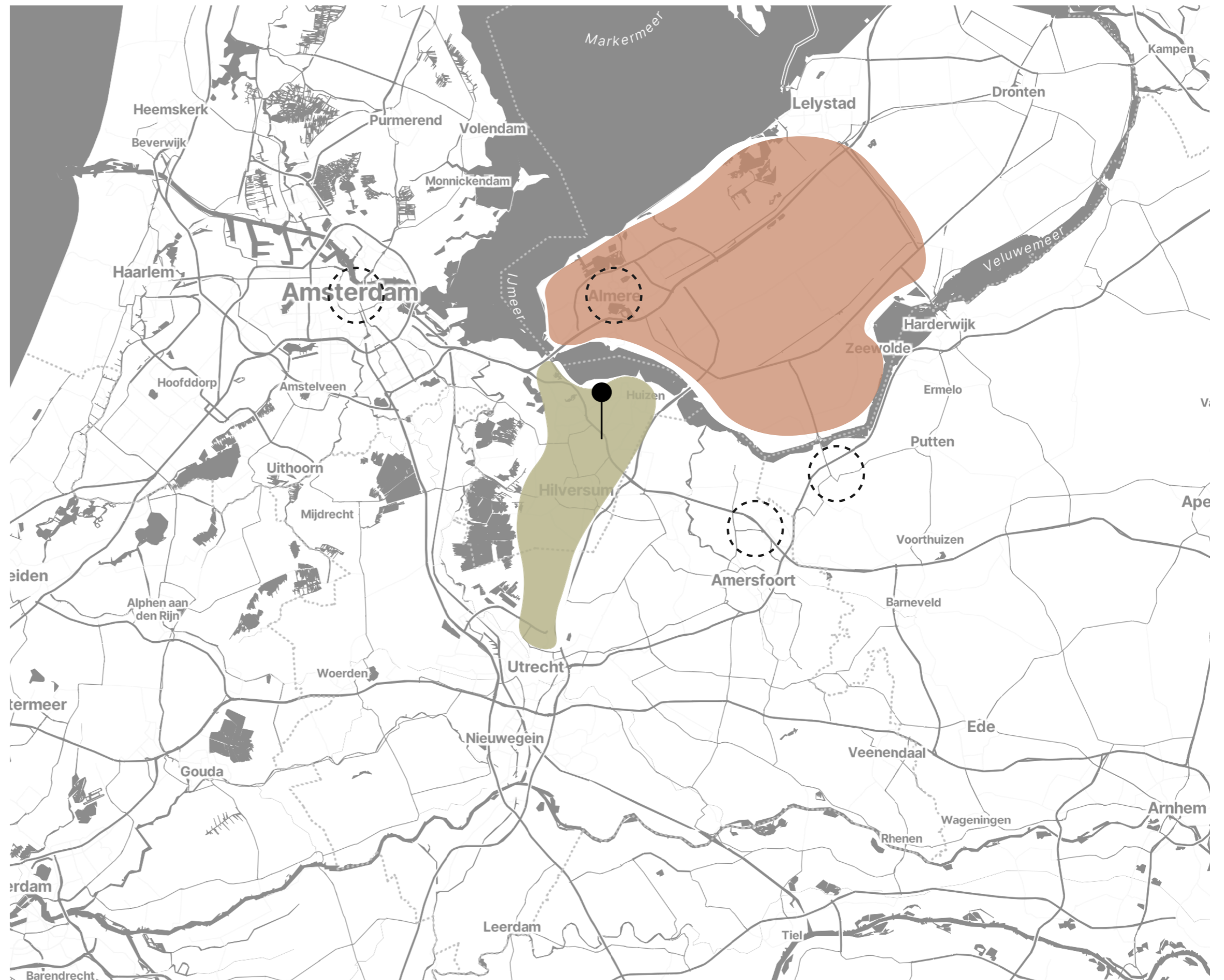
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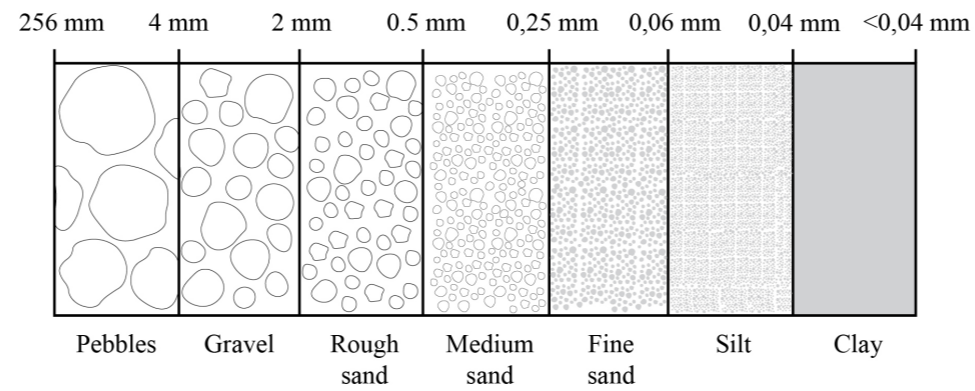
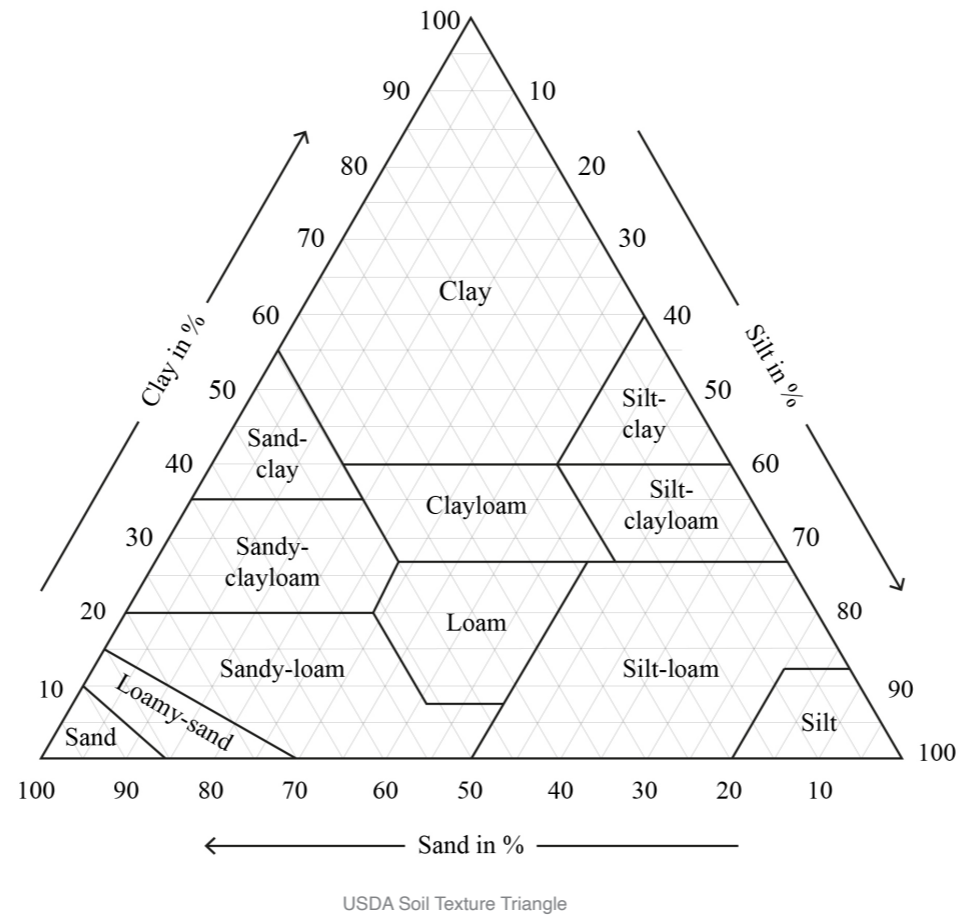
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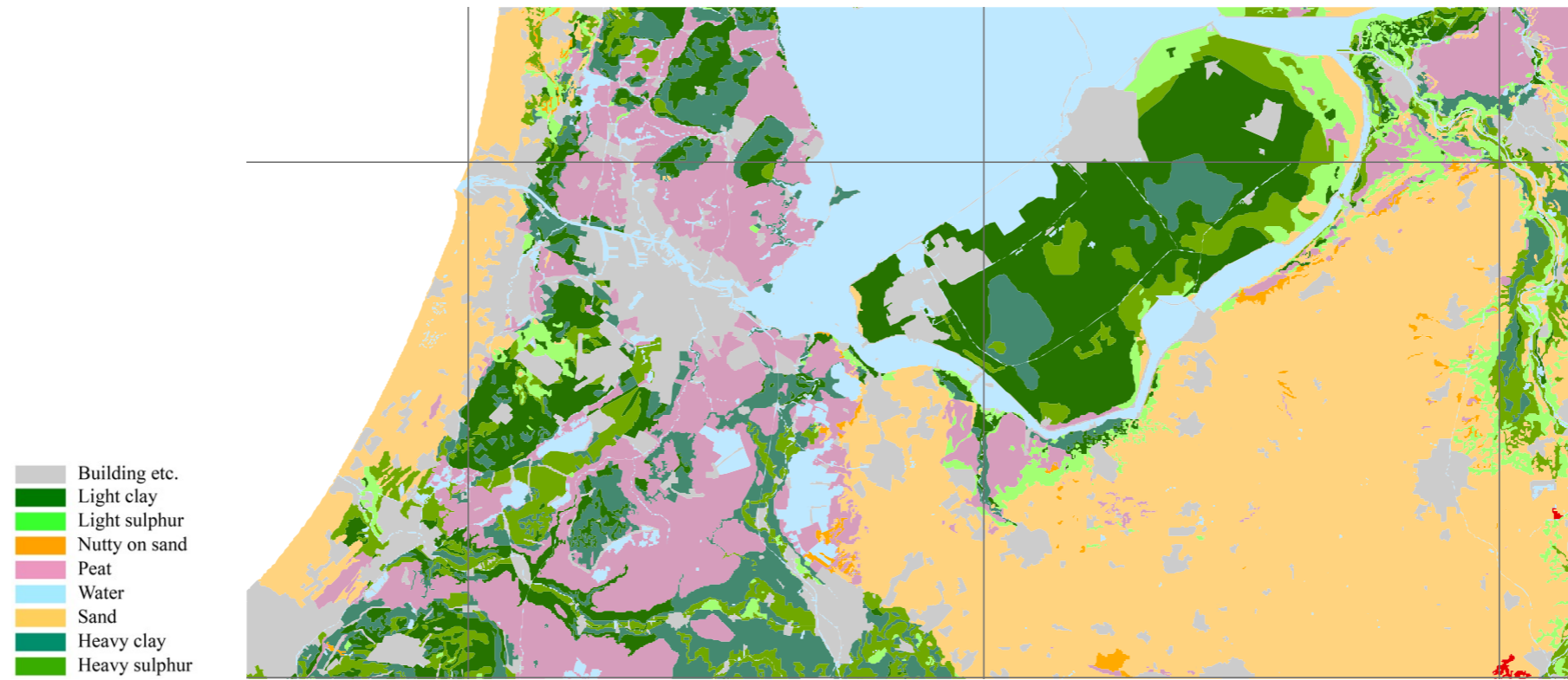
RESEARCH

Types of soil



RESEARCH

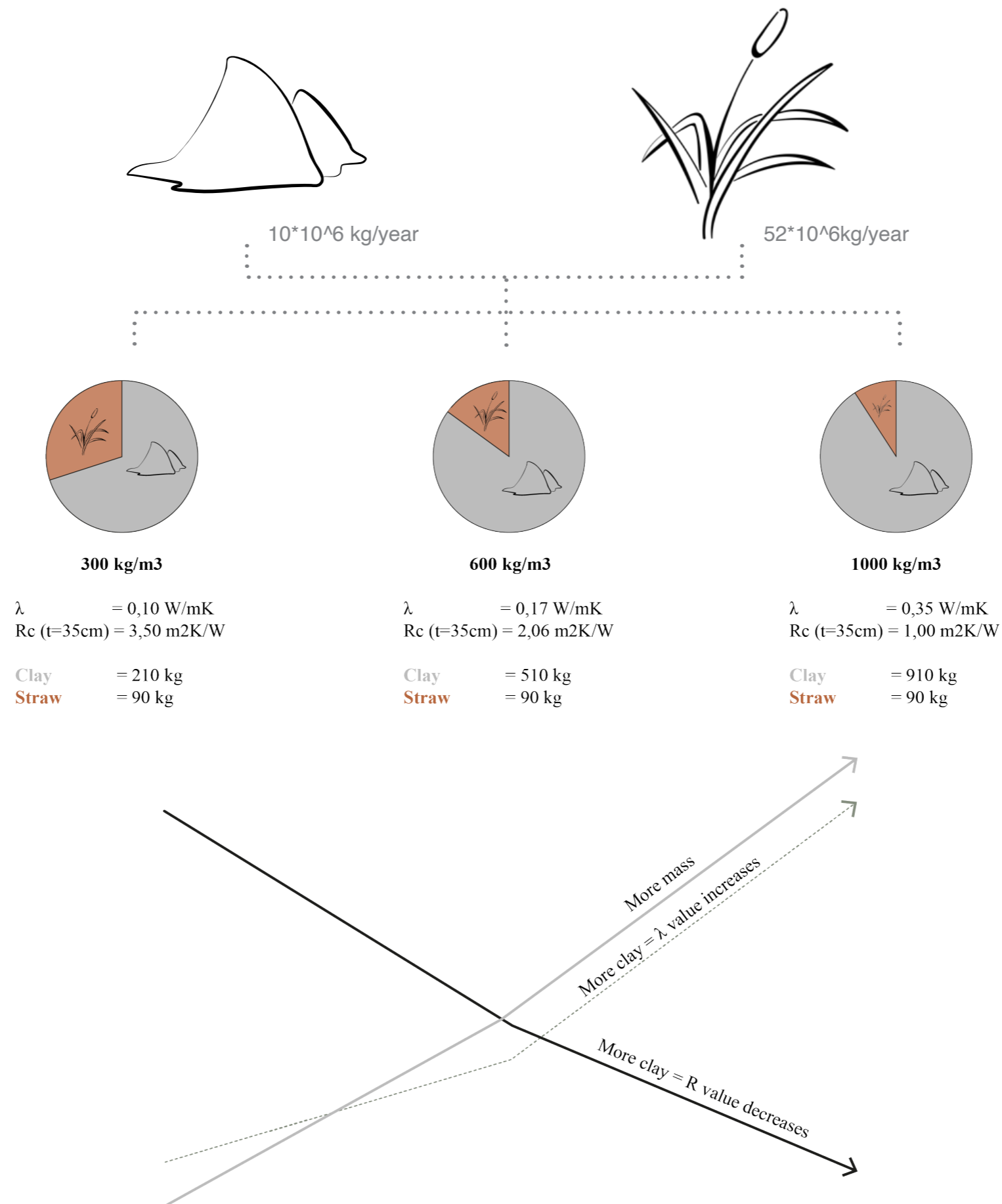
Types of soil



Map of soil types in the Netherlands (Wageningen University Research, n.d.)

RESEARCH

Technical properties



RESEARCH

Local materials

FORESTRY | WOOD

Goois Natuurreservaat (GNR)

2956 ha total

1666 ha forest

725 ha forestry with timber harvest

914 m³/year lumber

320 m³ Douglas wood per year

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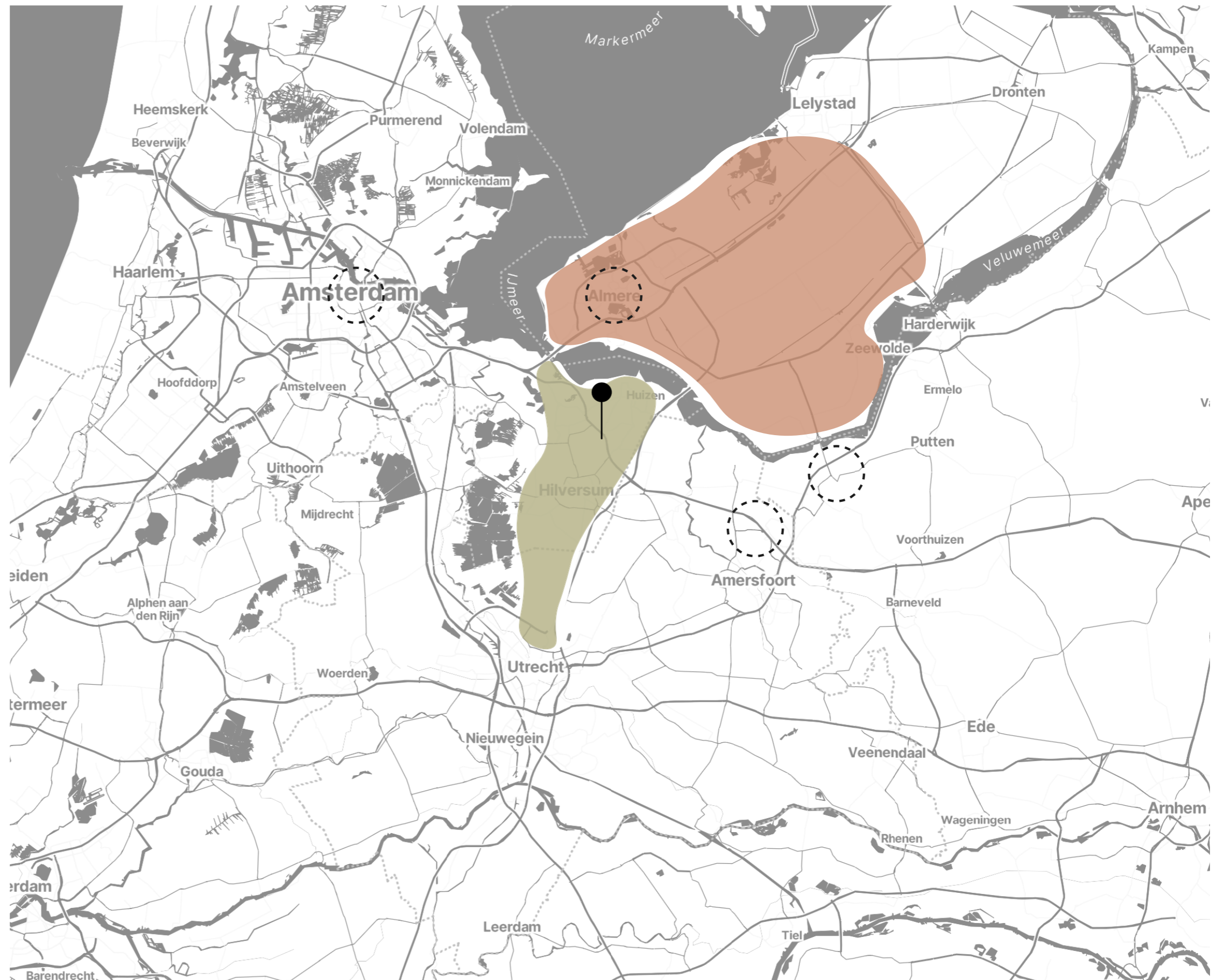
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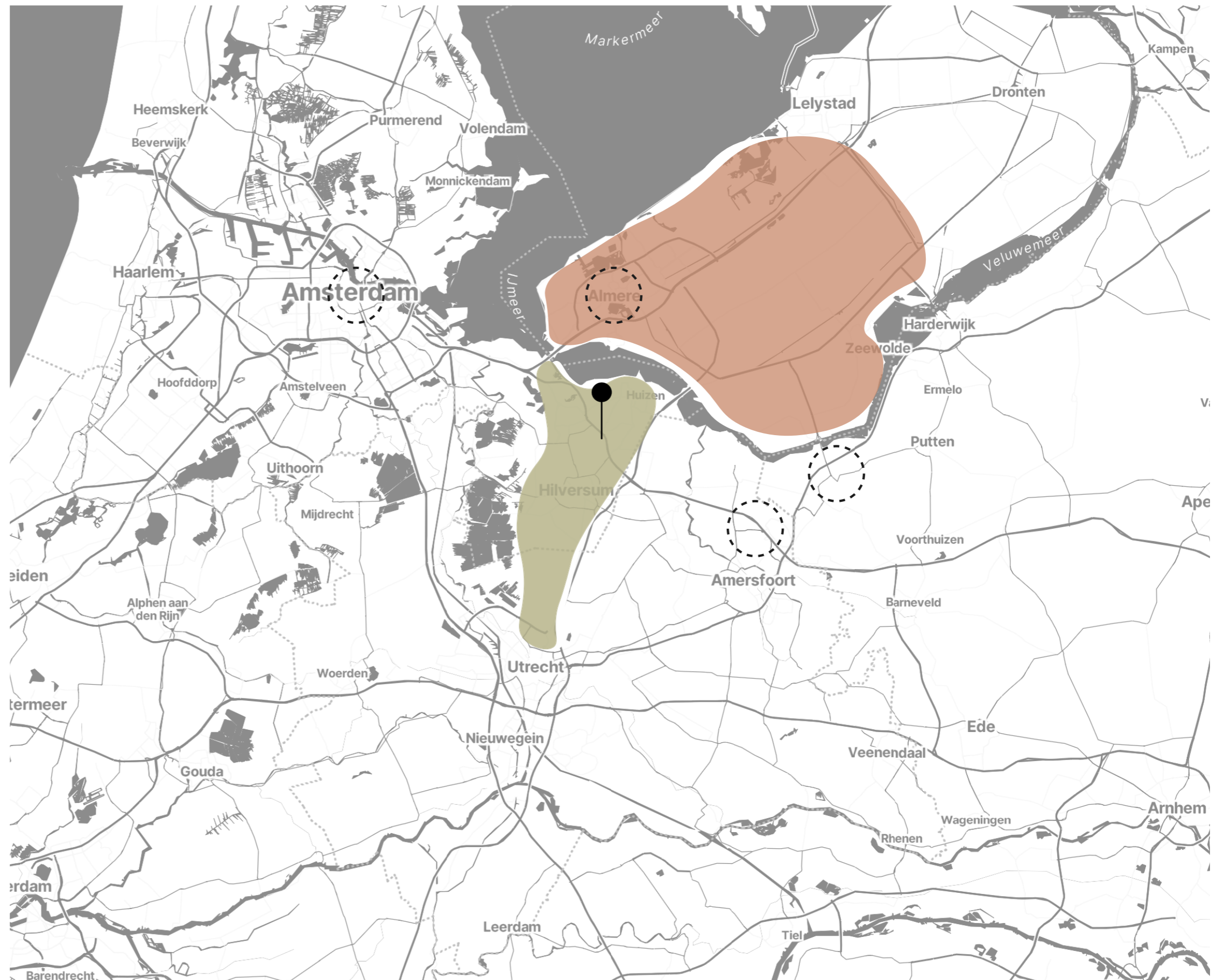
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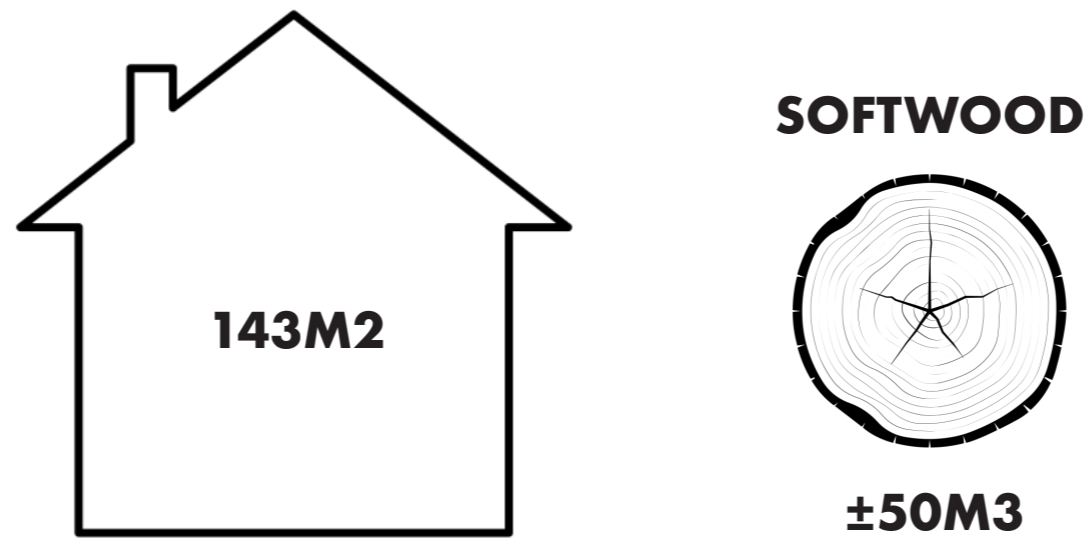
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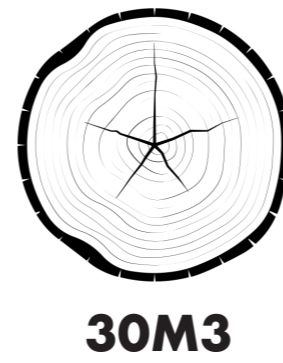
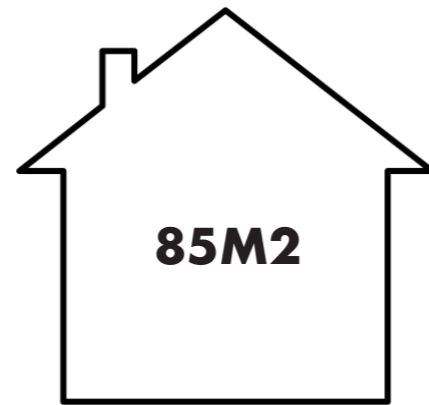
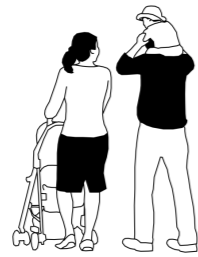




The average house in the Netherlands is 143m² (CBS, 2024).
Made out of timber, a house consists of about 50m³ of (soft)wood (Lerink, 2023).

RESEARCH

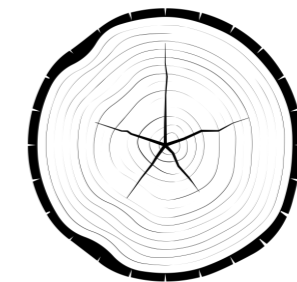
Possibility



GNR



DOUGLAS

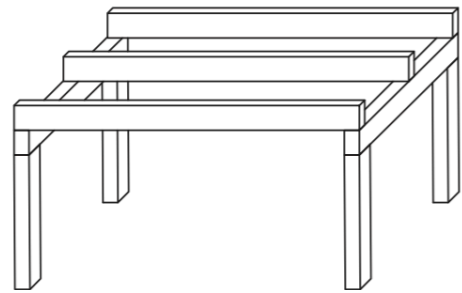
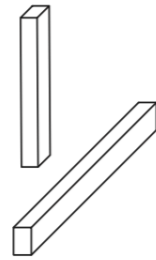


320M3/YEAR

RESEARCH

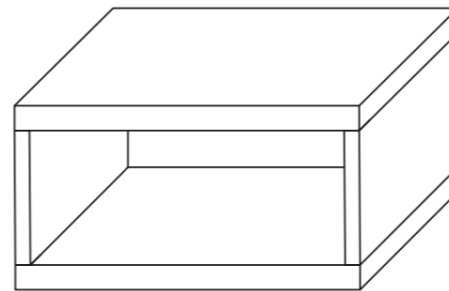
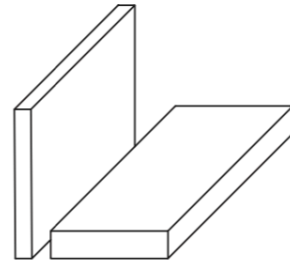
Prefabrication potential

1D



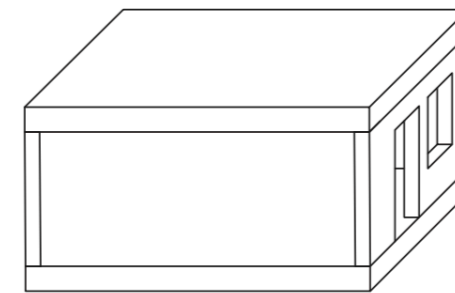
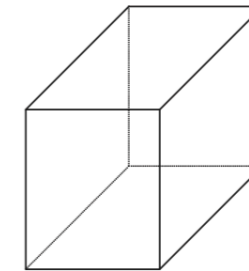
The Natural Pavillion, 2022

2D



Ligno Trend Roof

3D

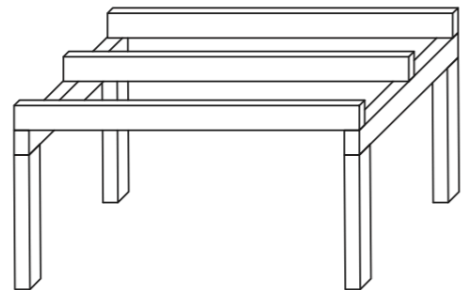
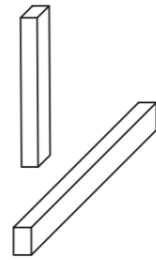


Metric Modular

RESEARCH

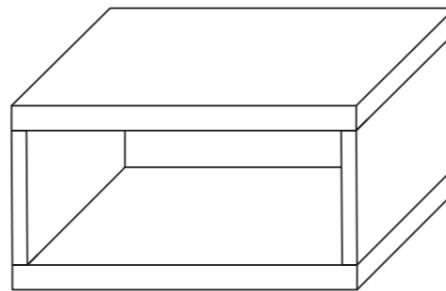
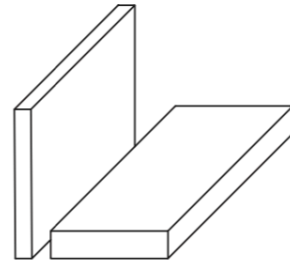
Prefabrication potential

1D



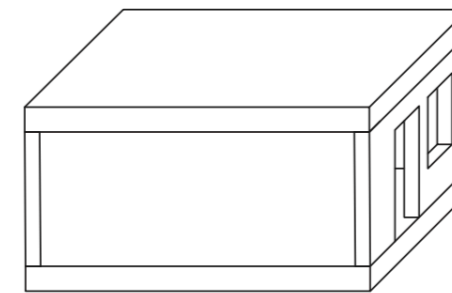
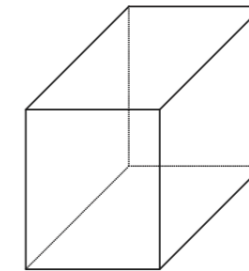
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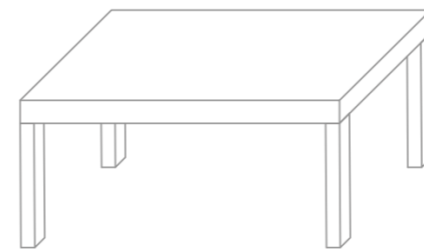
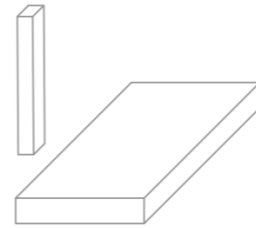


Metric Modular

RESEARCH

Prefabrication potential

HYBRID 1D/2D



KK Law

RESEARCH

Hybrid timber systems

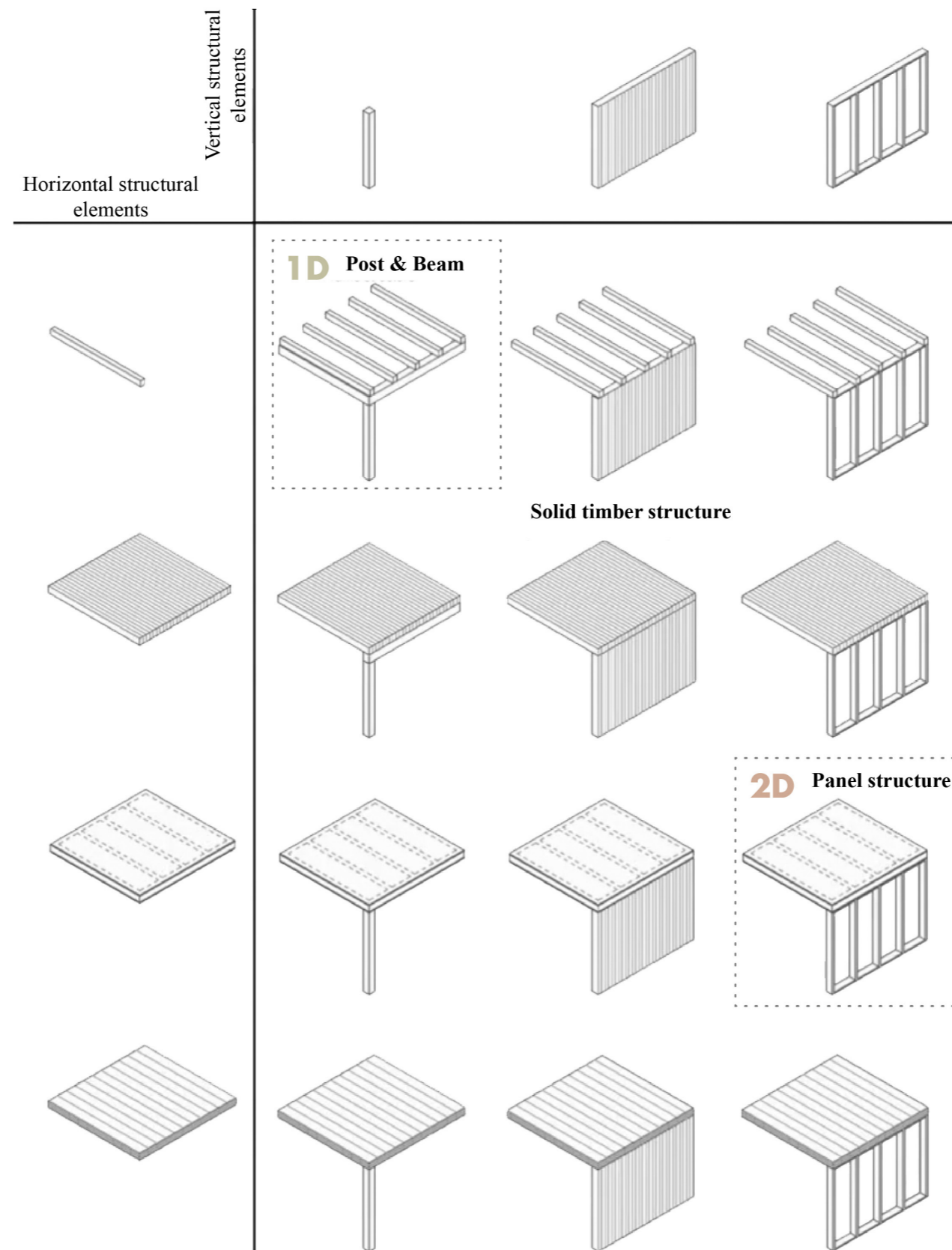


Diagram: Ssse OvO architects associates Amsterdam, 2023

RESEARCH

Hybrid timber systems

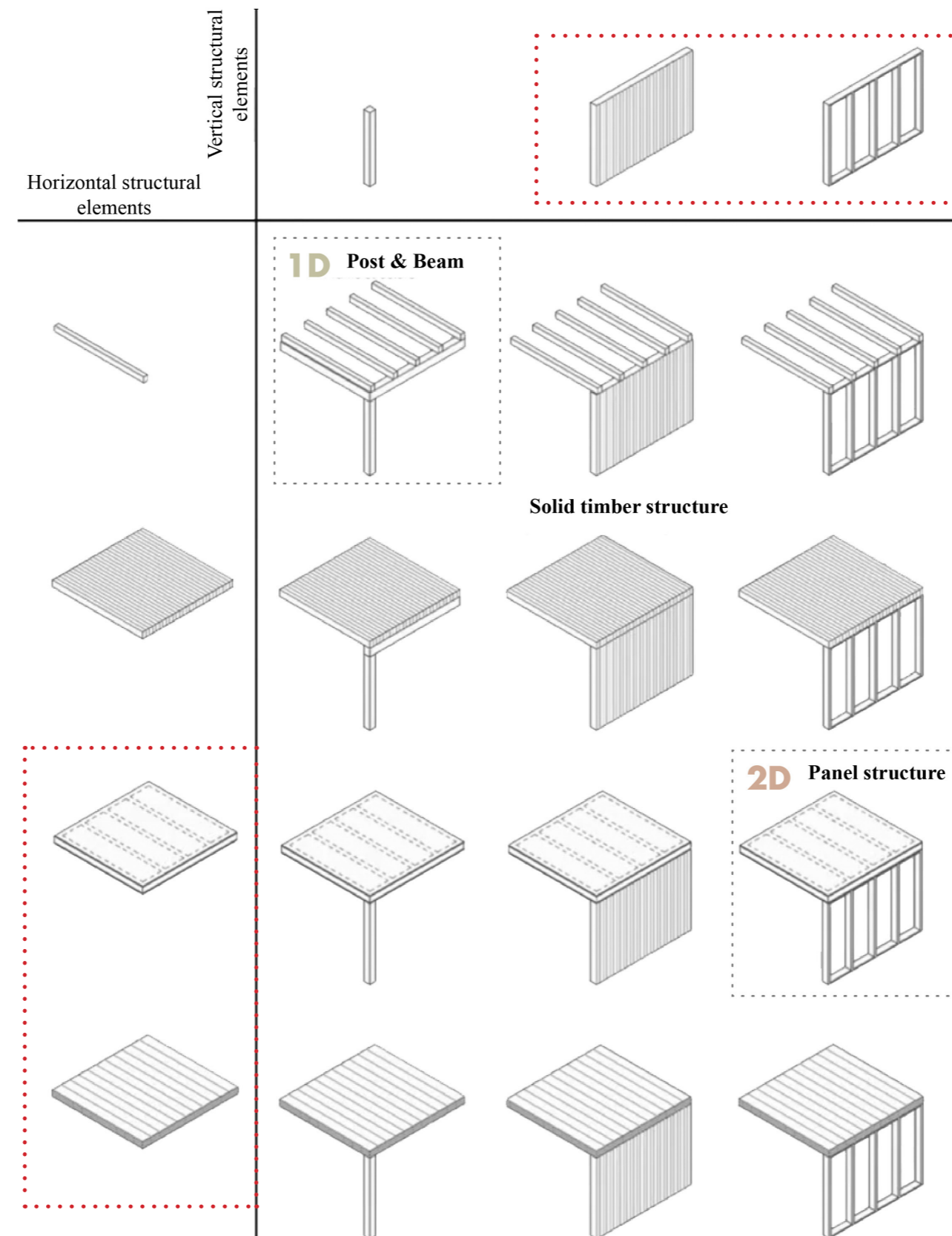
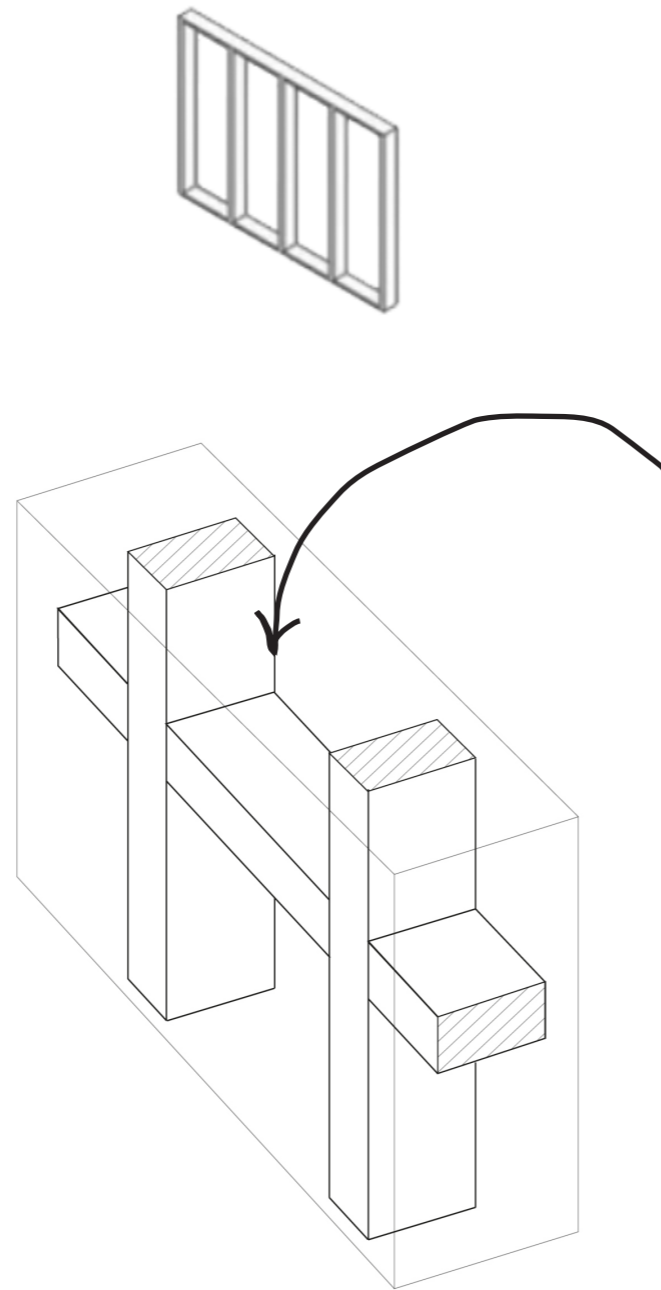
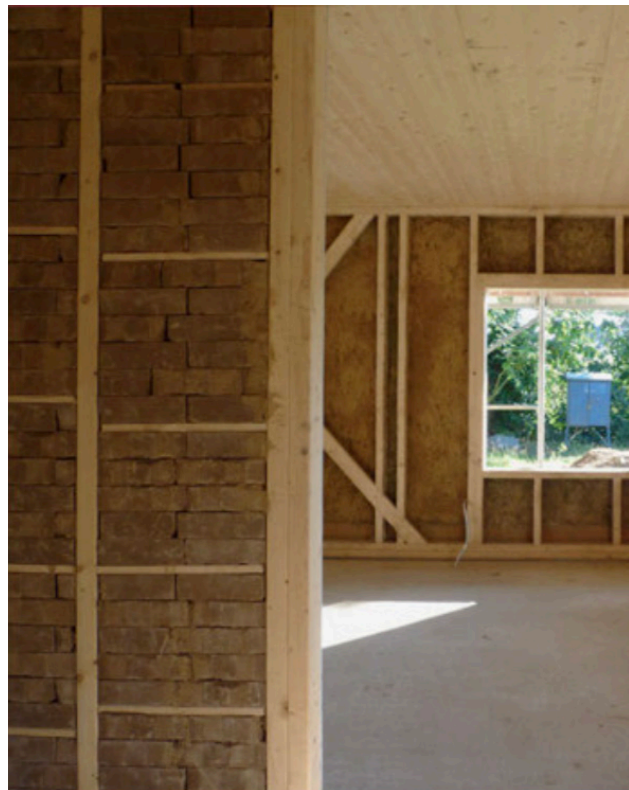


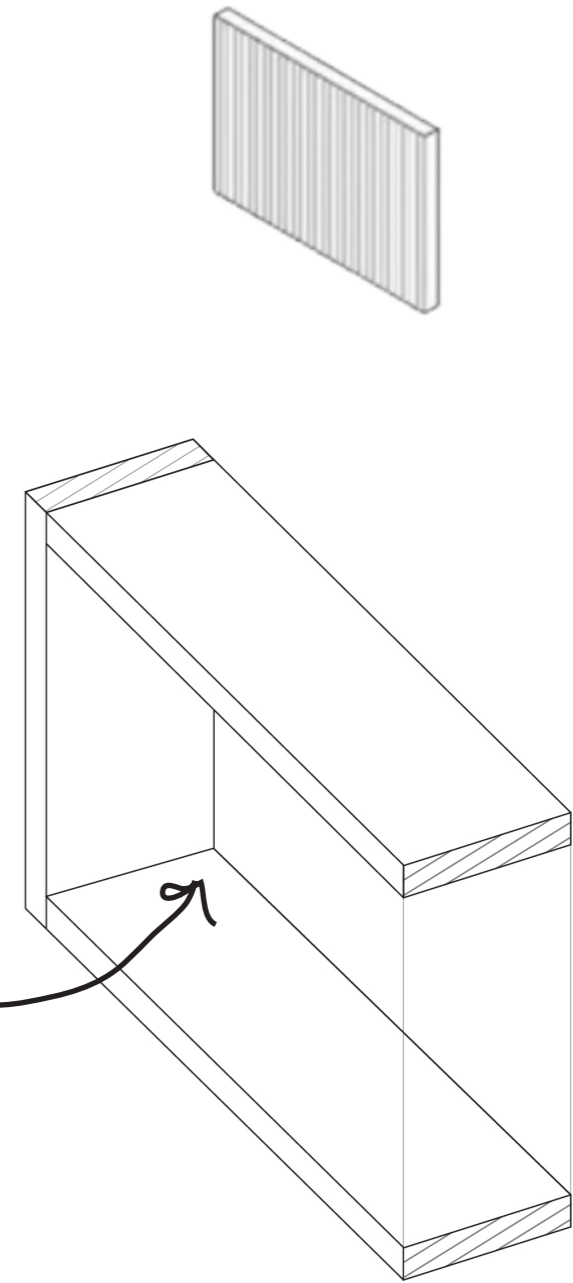
Diagram: Ssse OvO architects associates Amsterdam, 2023

RESEARCH

Implementation



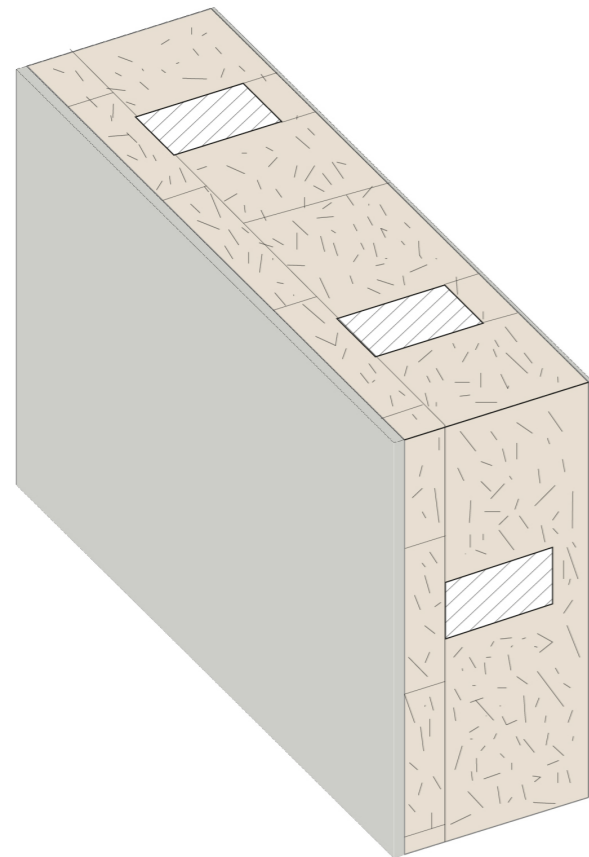
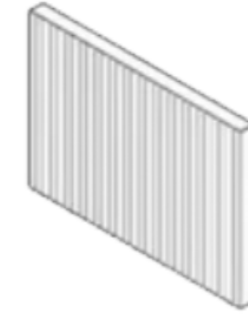
**TIMBER
FRAME**



**BOX/
PANEL**

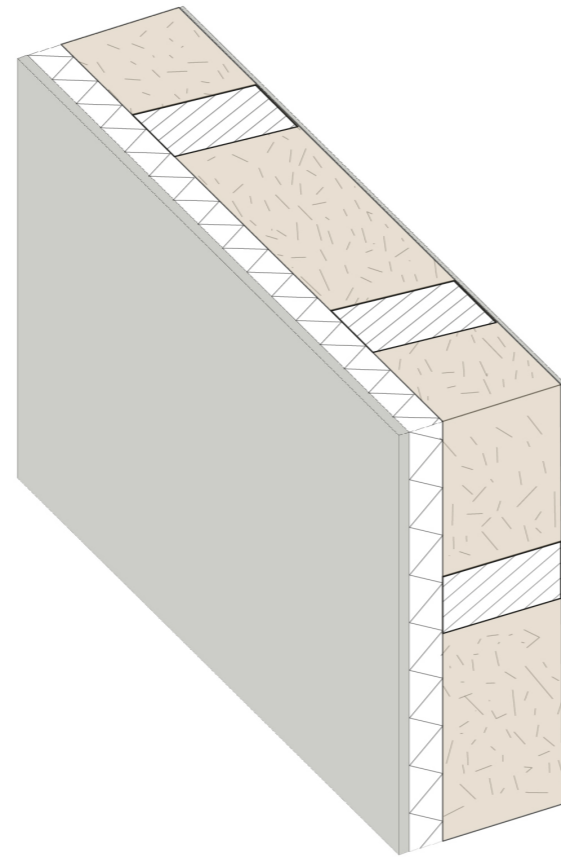
RESEARCH

Implementation | Facade examples



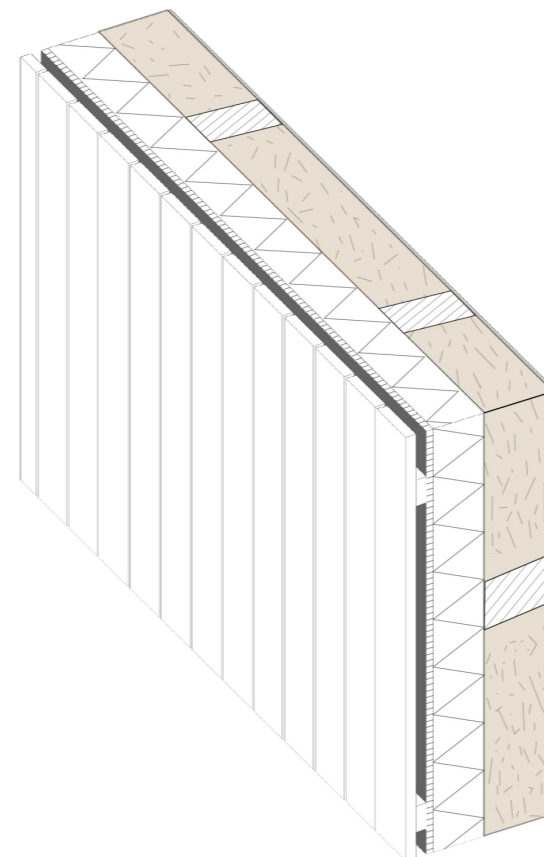
Wall 580mm thick
R = 5,55 m²K/W

external render
light earth 300 kg/m³
fibre-clay plaster



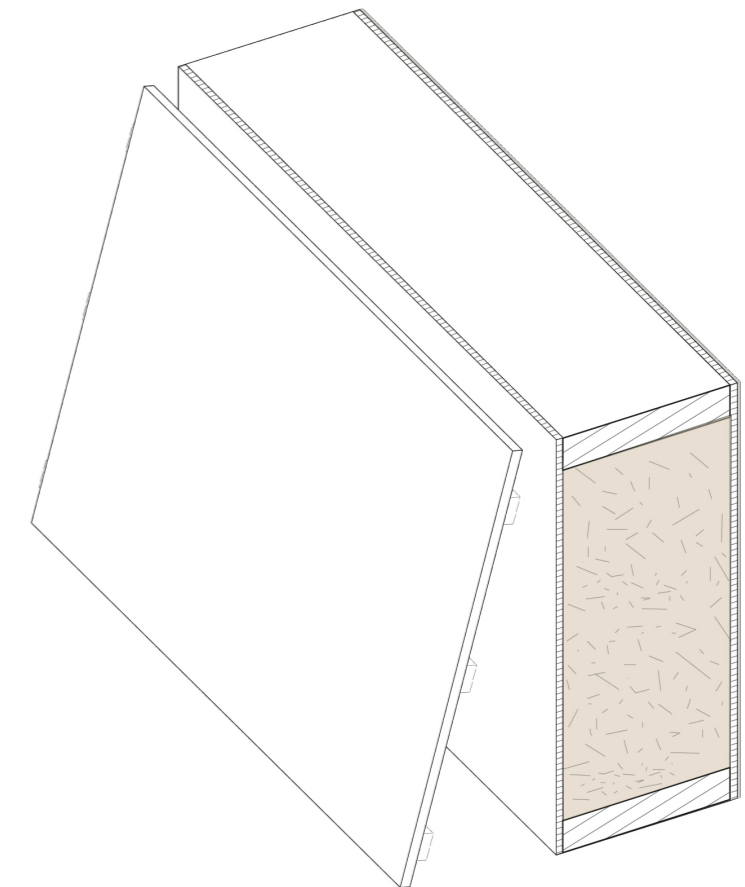
Wall 480mm thick
R = 6,20 m²K/W

external render
hemp insulation
light earth 300 kg/m³
fibre-clay plaster



Wall 440mm thick
R = 6,50 m²K/W

timber cladding
ventilation cavity
wind barrier
softwood fibreboard
hemp insulation
light earth 300 kg/m³
fibre-clay plaster

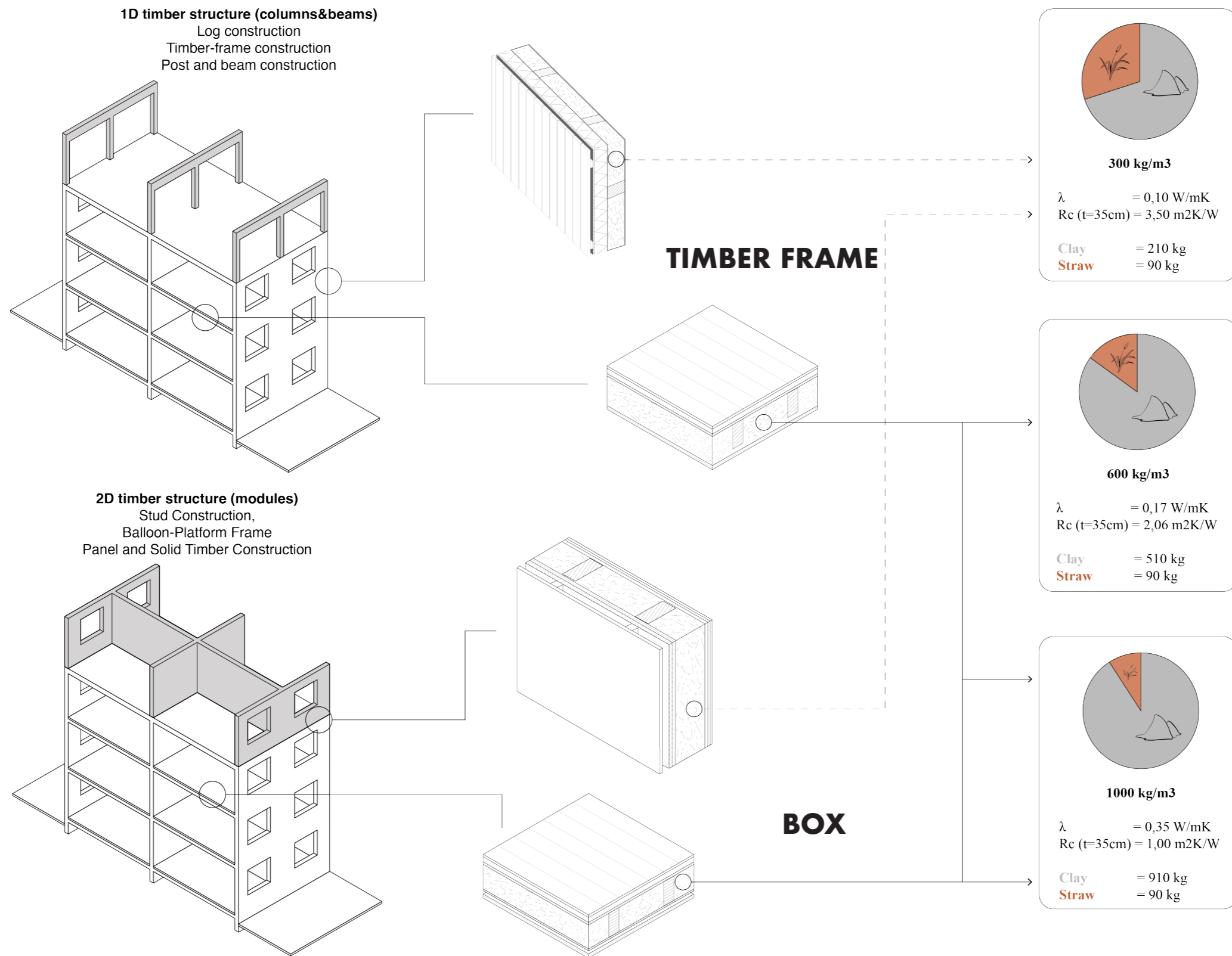


Wall ± 500mm thick
R = 5,50 m²K/W

optional cladding
timber panel (box)
light earth mixture
wind barrier
timber panel (box)
fibre-clay plaster

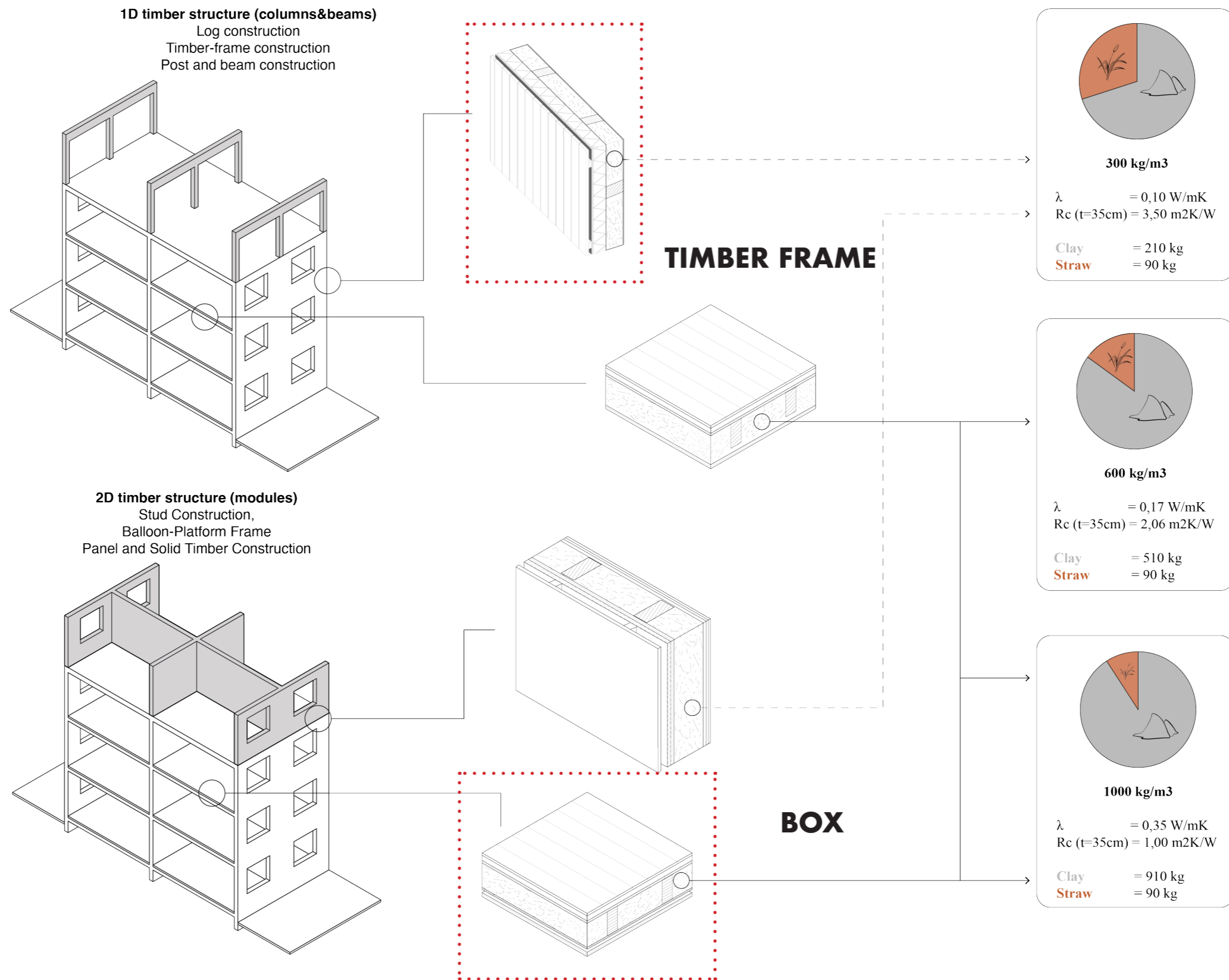
RESEARCH

Light earth method in hybrid timber systems



RESEARCH

Light earth method in hybrid timber systems

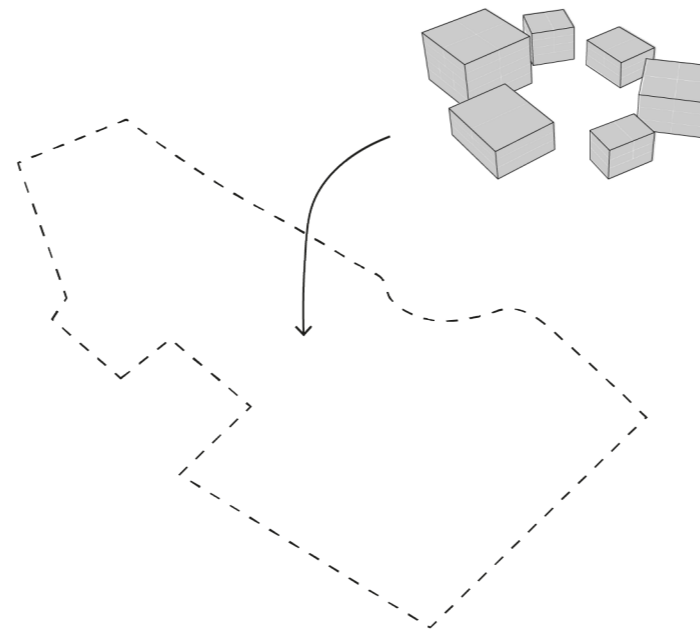


RESEARCH

Light earth method in hybrid timber systems

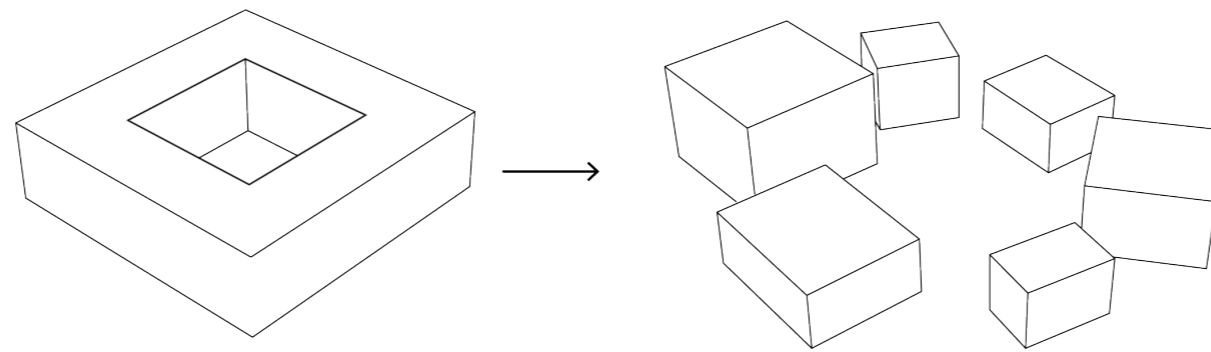


DESIGN



LOCATION

From an old military training area, to a future-proof green district

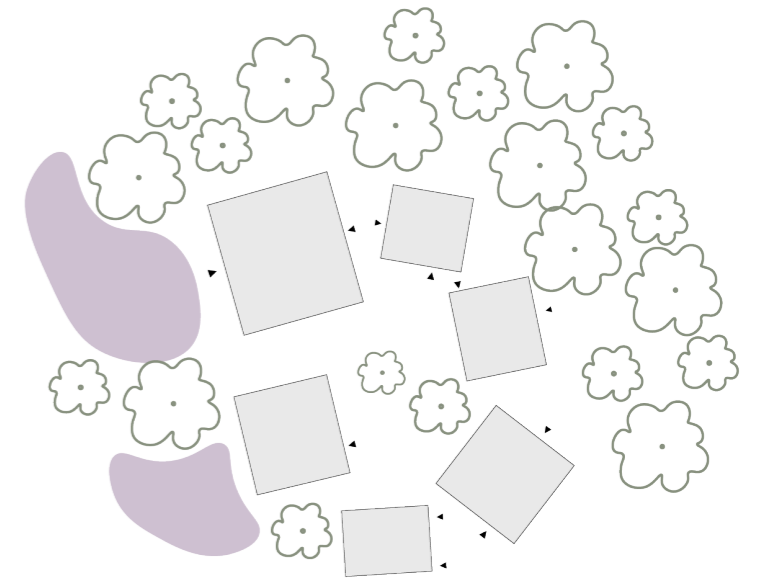
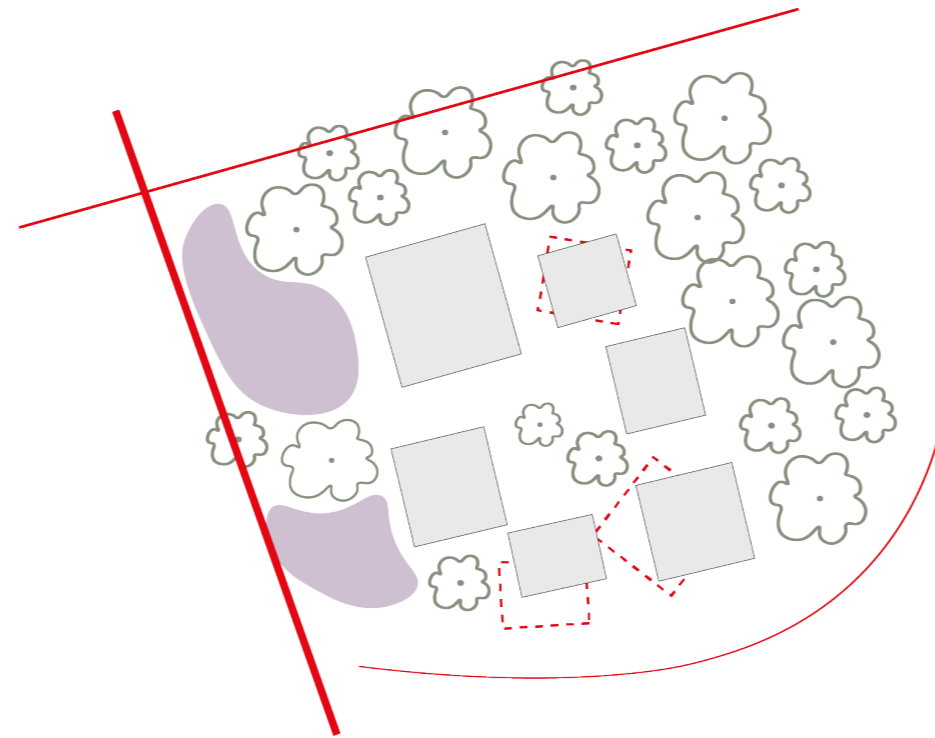
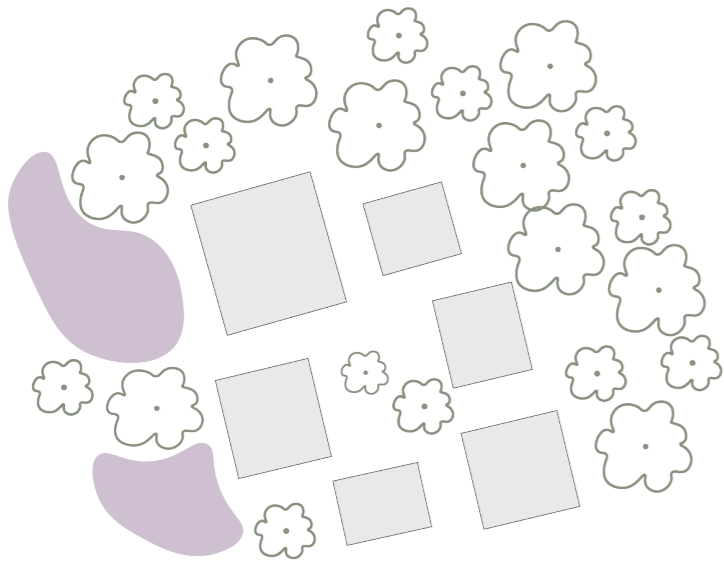


CLOSED VS OPEN

Just as a forest is formed, in different heights and freely oriented from each other

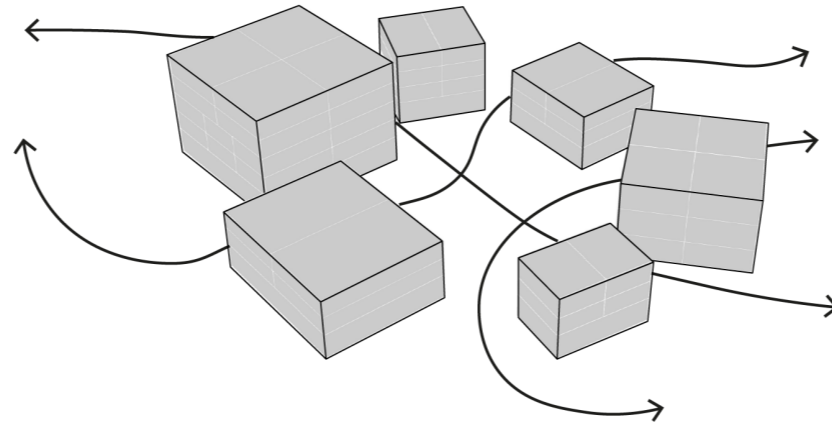
DESIGN

Design principles



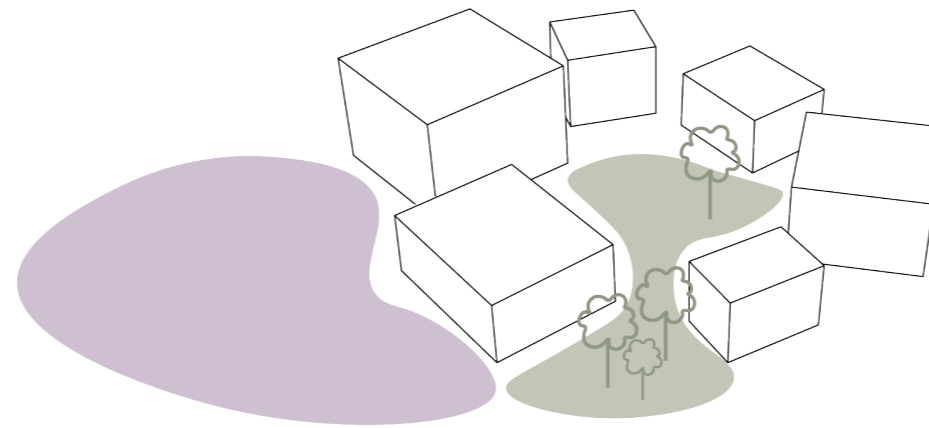
ORIENTATION

Buildings engage with the landscape and shape the space



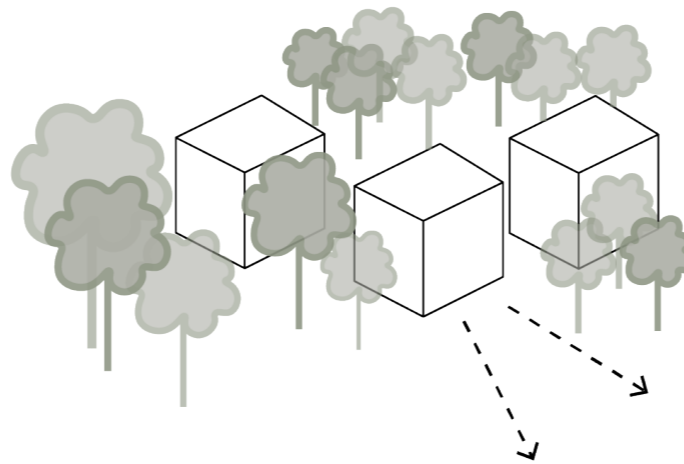
ROUTES

Nature-inclusive 'free-range routes' become part of a fordable landscape



LANDSCAPE

Buildings are guests in the landscape and are placed with respect for the greenery, but at the same time add a new layer.

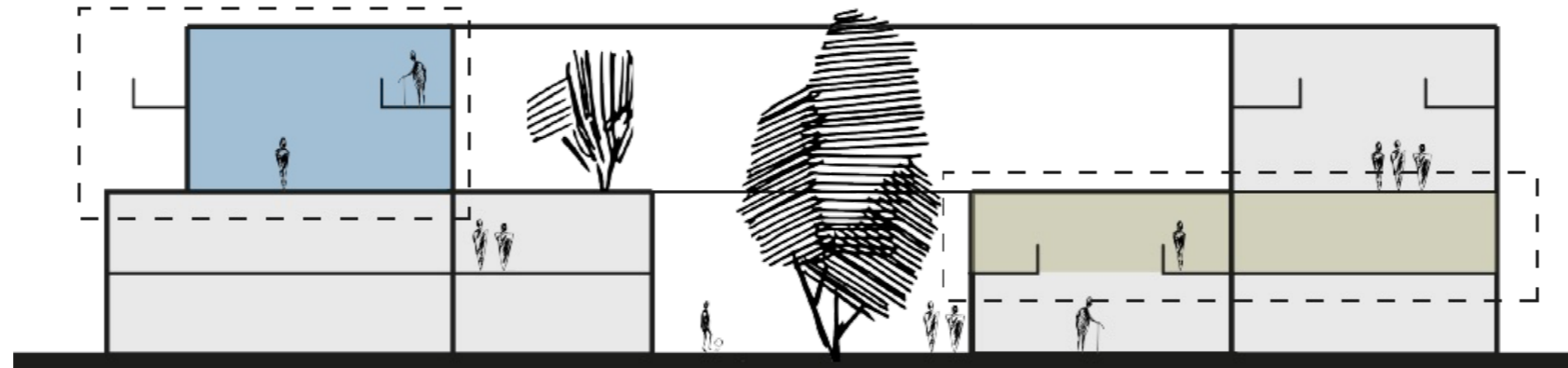


OPEN-HIDDEN

Buildings are half hidden in the forest with groups of trees
'softening'

DESIGN

Design principles



MIXED PROGRAM

The mix of dwellings provide the basis for an inclusive
multi-generational neighbourhood

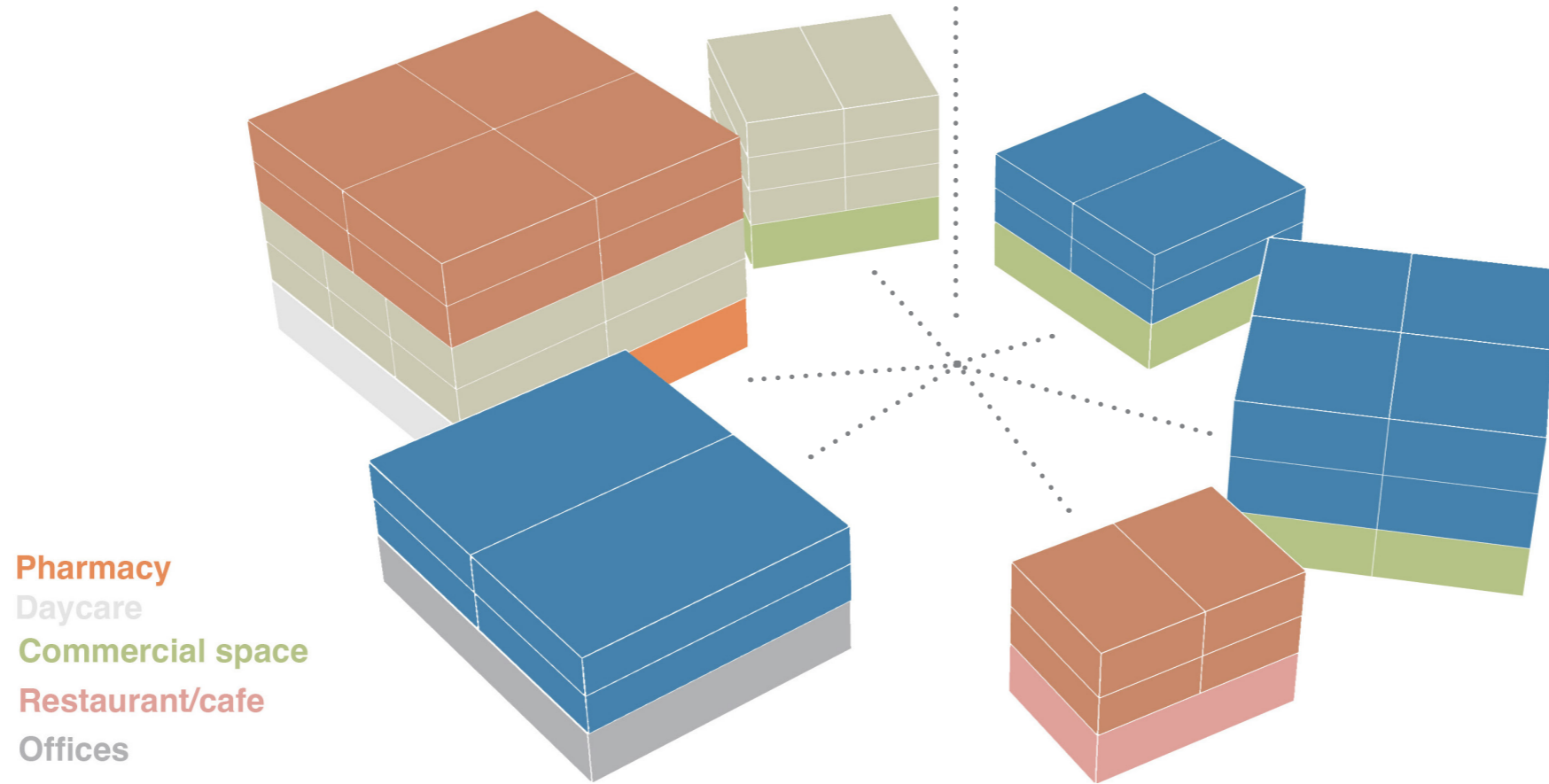


50 apartments

33% | Social housing

20% | Midsegment

47% | High segment



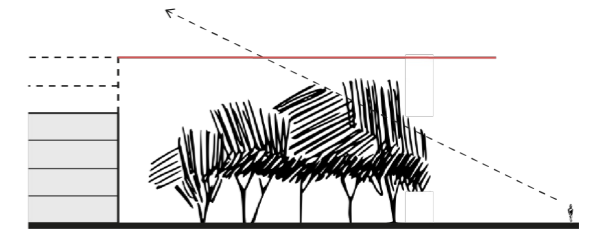
DESIGN

Program ground floor



DESIGN

Courtyard section



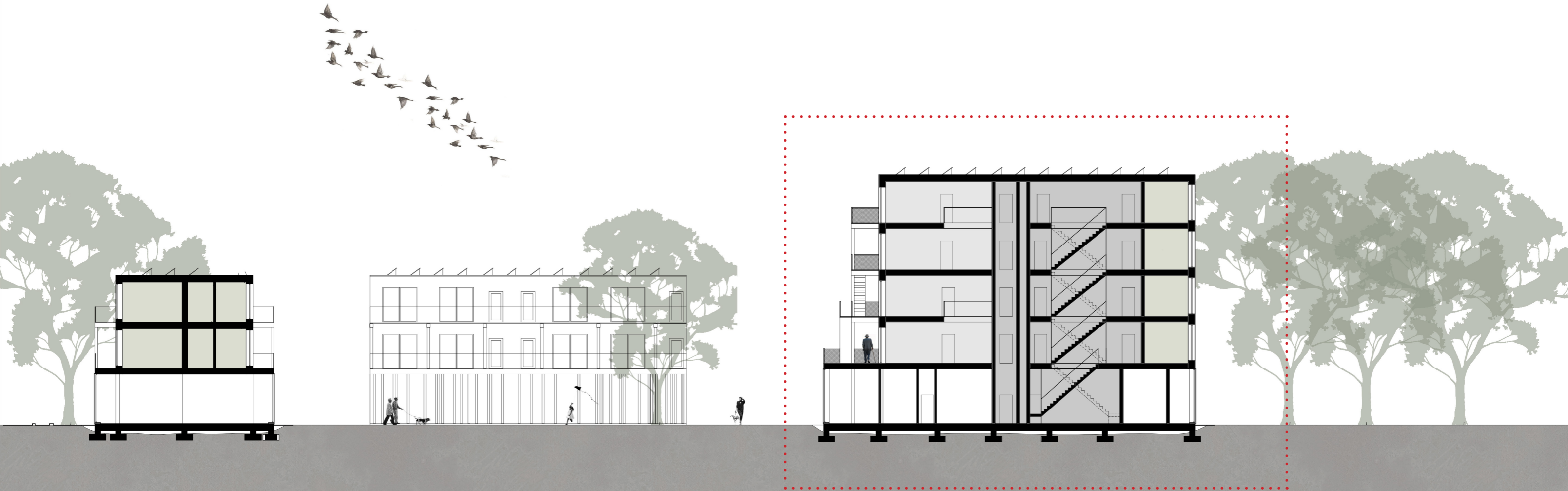
Tree boundary

Buildings are not visible from the main Bussum-heath, only from the internal spaces



DESIGN

Courtyard section



DESIGN

First floor

G

F

E

D

C

B

A

1

2

3

4

5

6

7300

6100

7300

6500

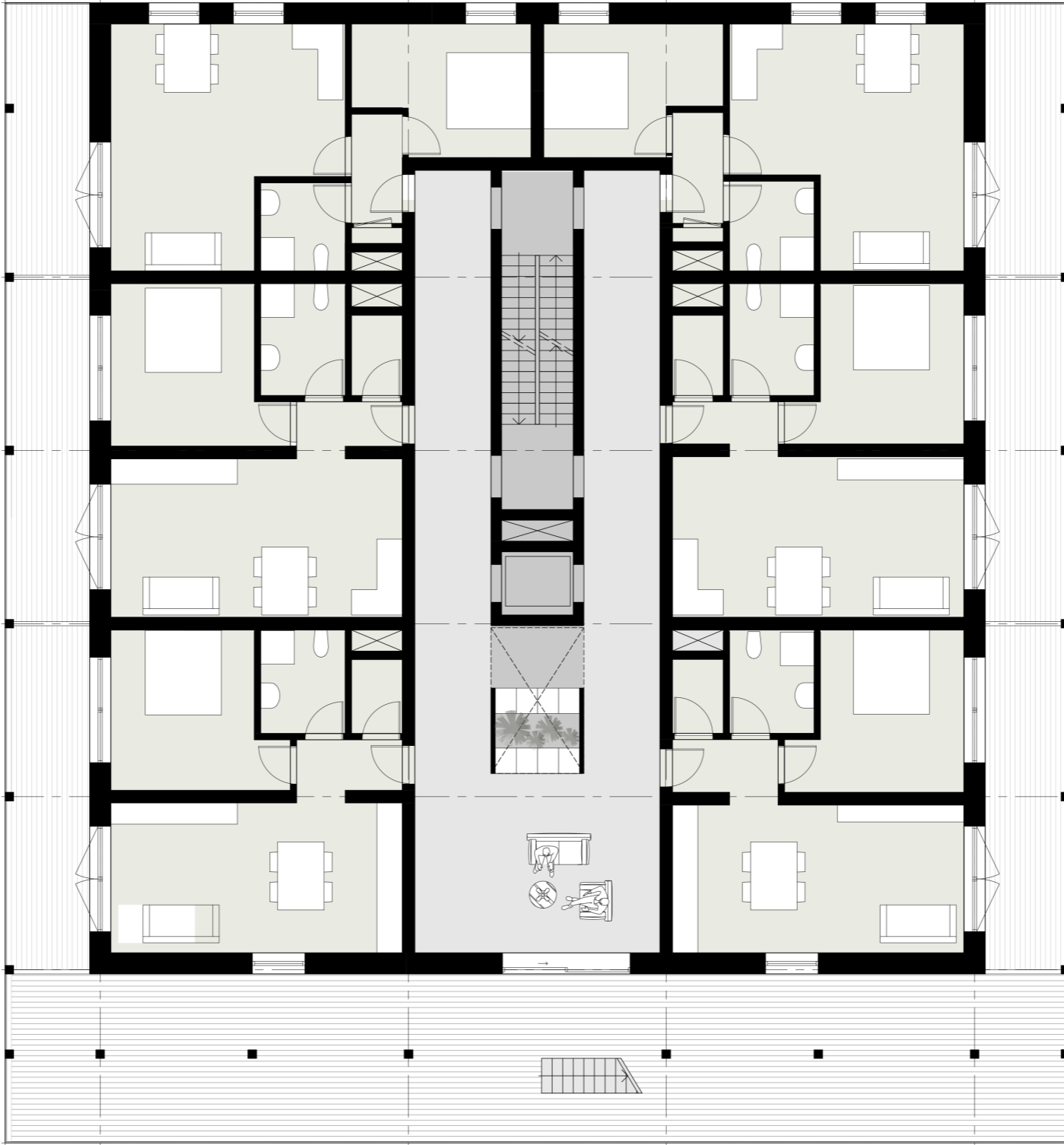
4100

4100

4100

4100

4100



DESIGN

First floor

G

F

E

D

C

B

A

1

2

3

4

5

6

7300

6100

7300

6500

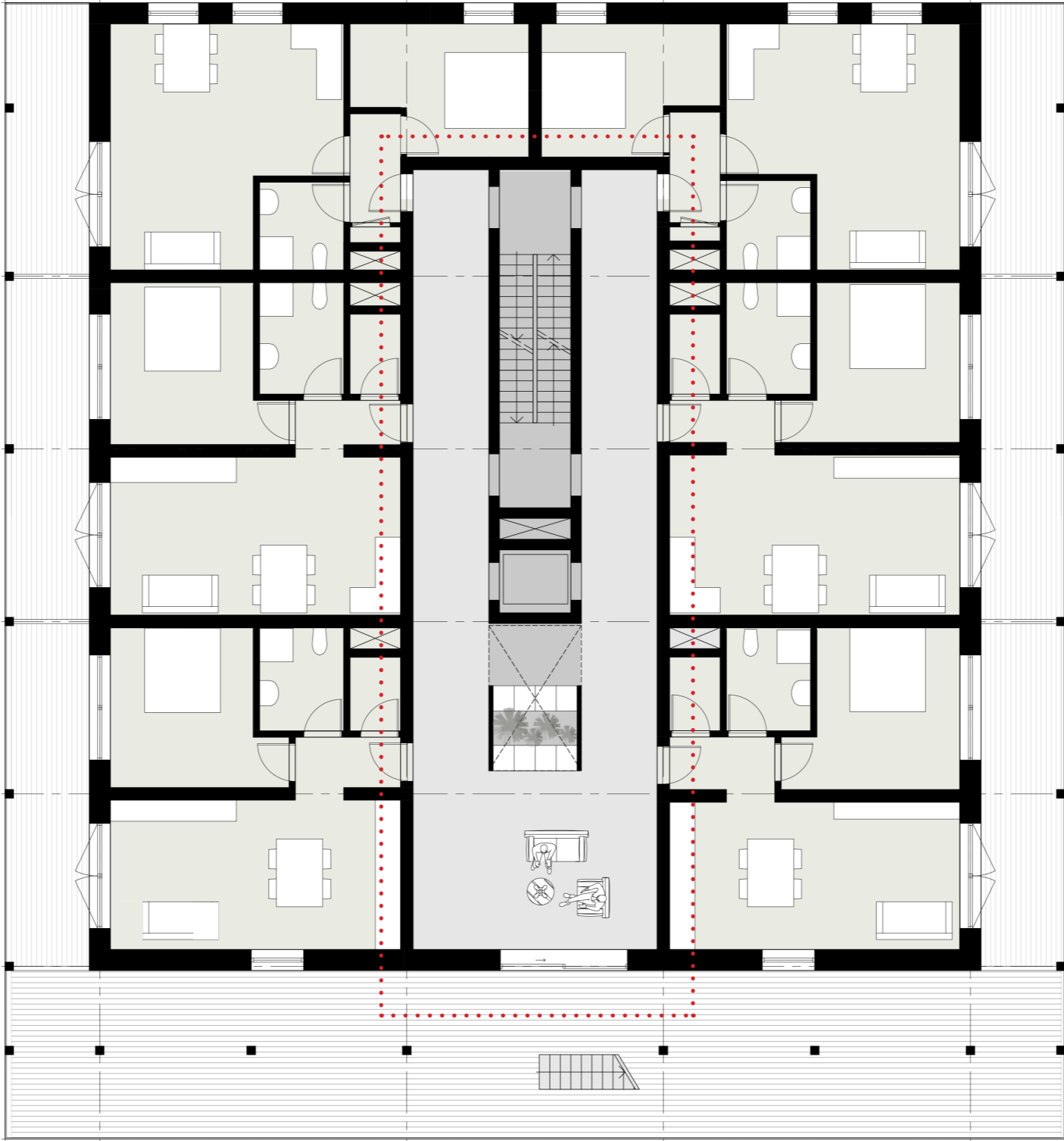
4100

4100

4100

4100

4100



DESIGN

First floor

G

F

E

D

C

B

A

7300

6100

7300

6500

4100

4100

4100

4100

4100

1

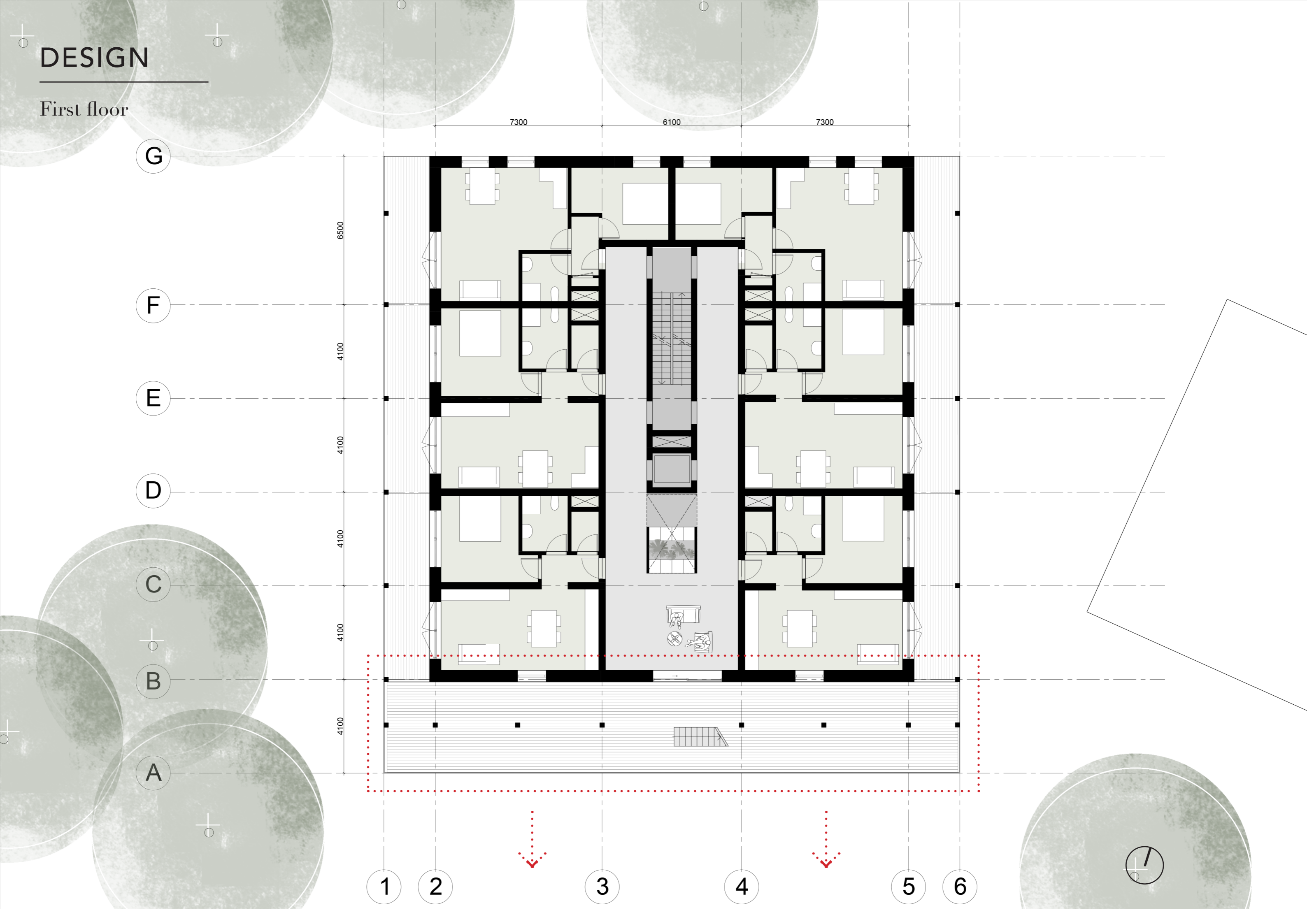
2

3

4

5

6



DESIGN

First floor

G

F

E

D

C

B

A

1

2

3

4

5

6

7300

6100

7300

6500

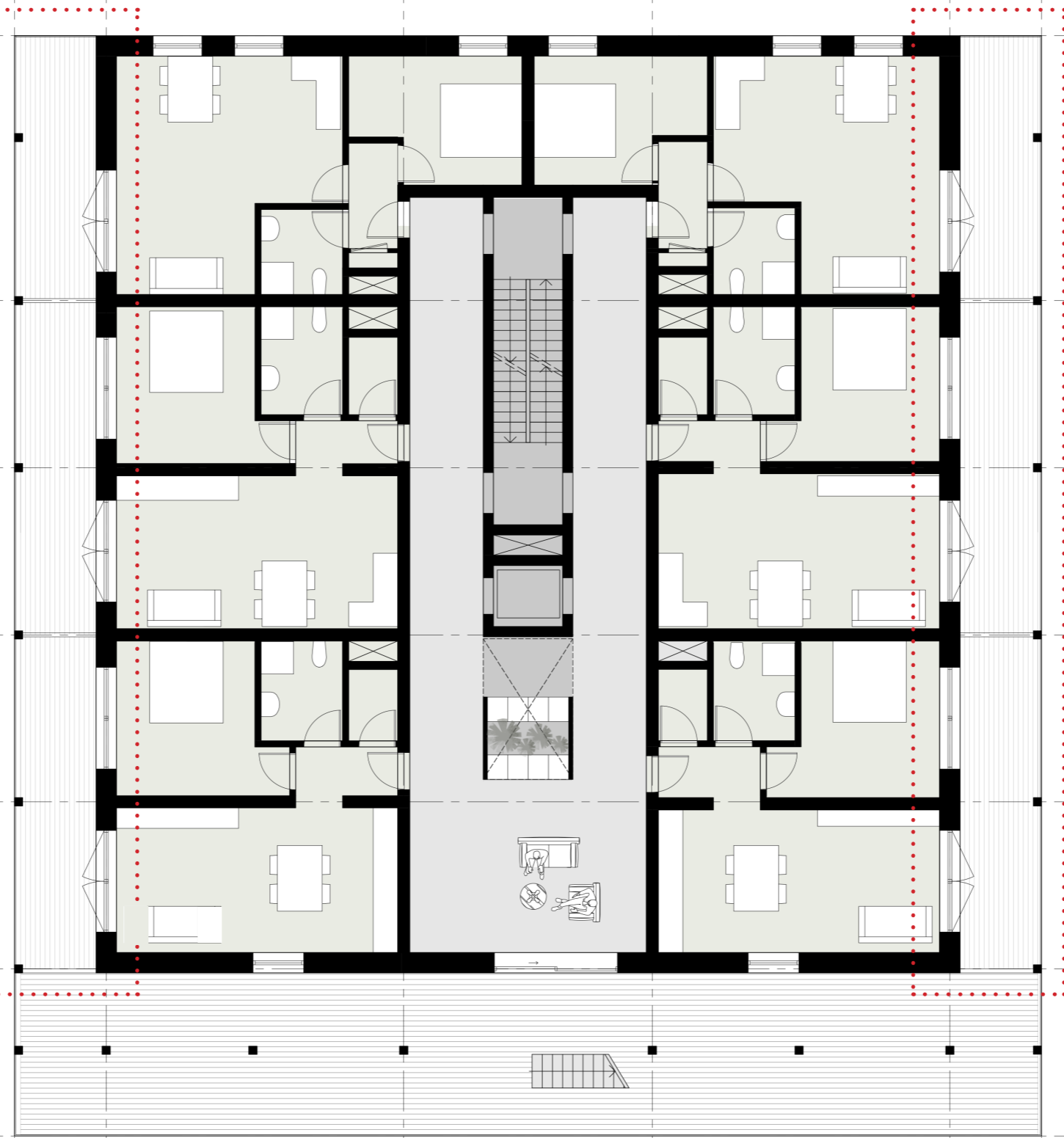
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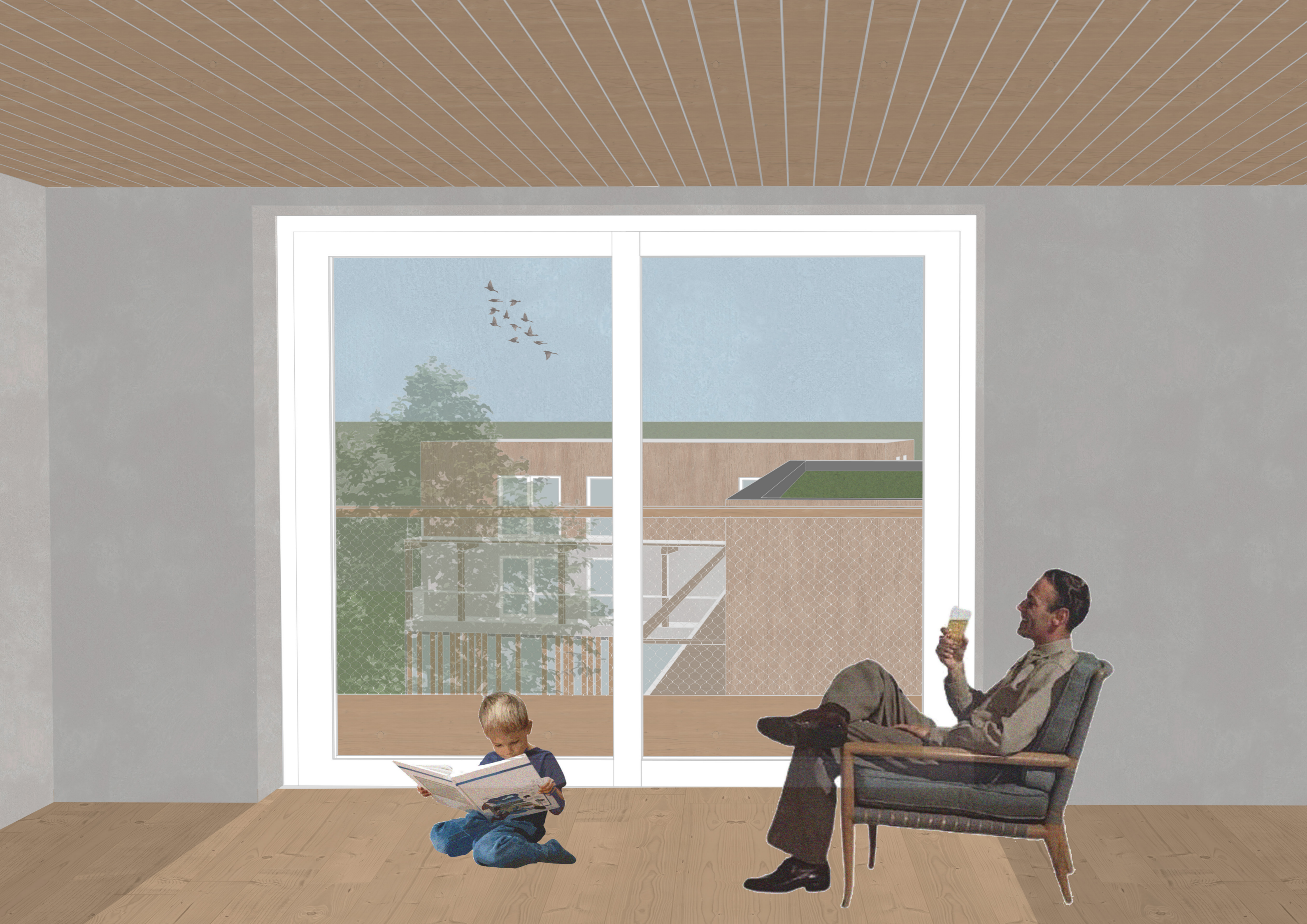
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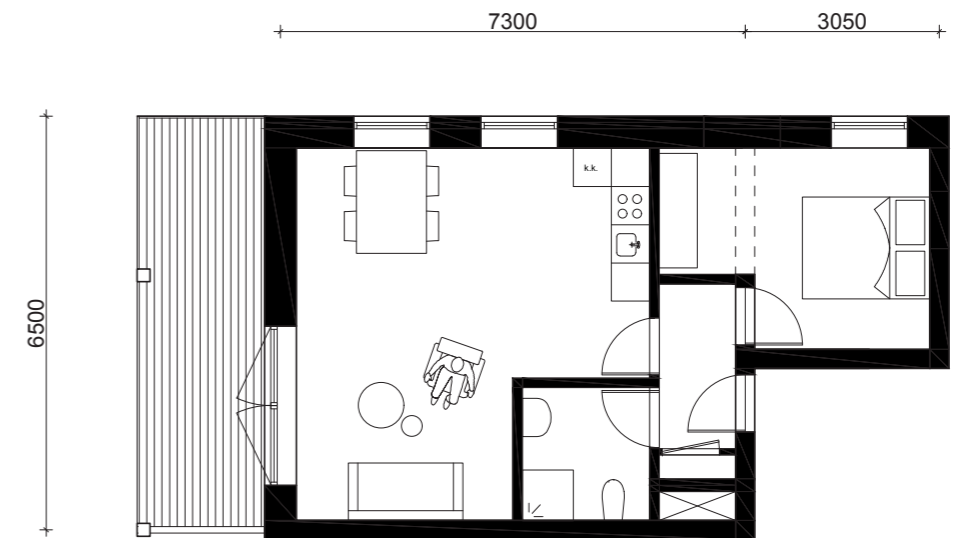
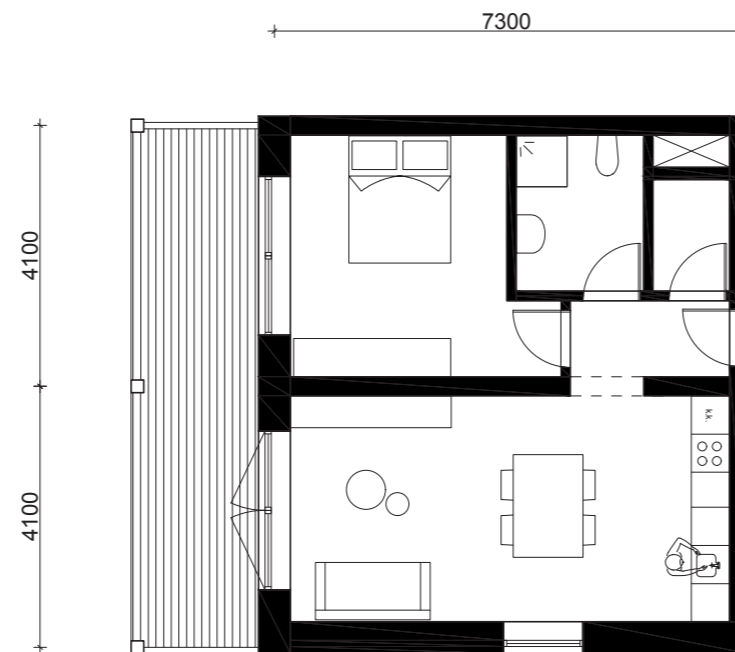
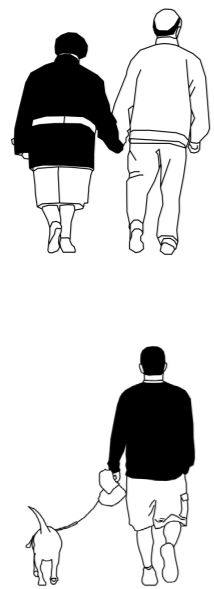


DESIGN

Overview dwelling types

ELDERLY/STARTER

50-60M2

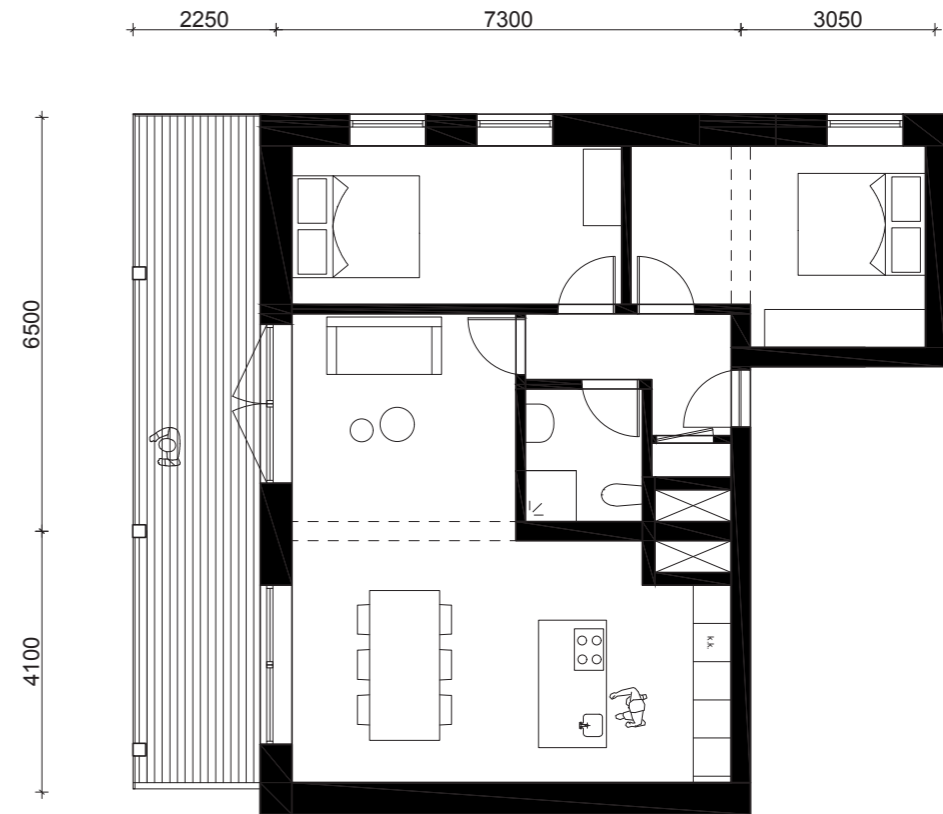
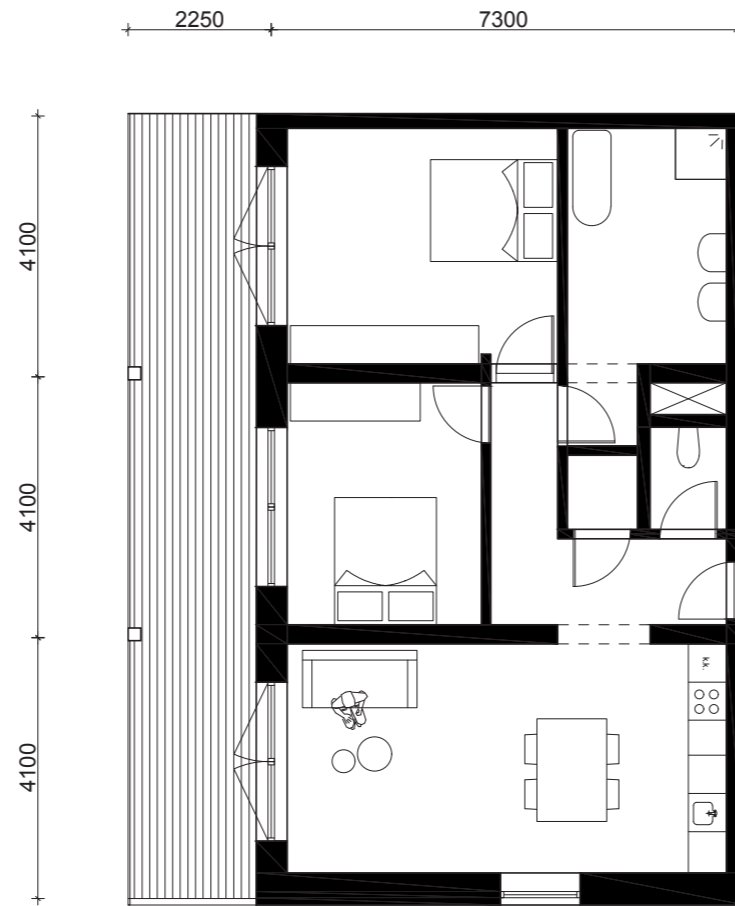
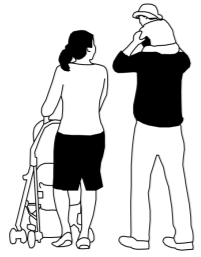


DESIGN

Overview dwelling types

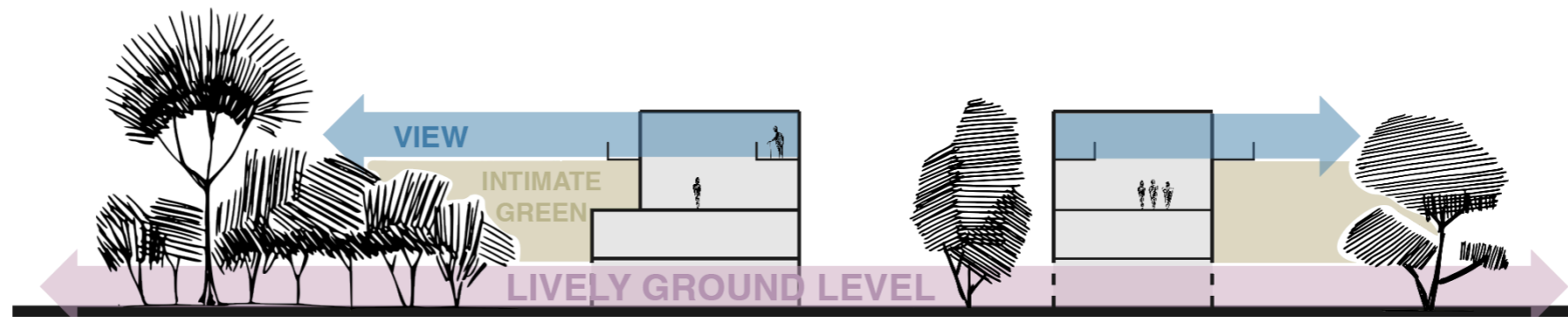
SMALL FAMILY

80-90M²



DESIGN

Design principles



FACADE

The 3-division of the facade is created by the scenery brought by the landscape

DESIGN

East facade



DESIGN

South facade



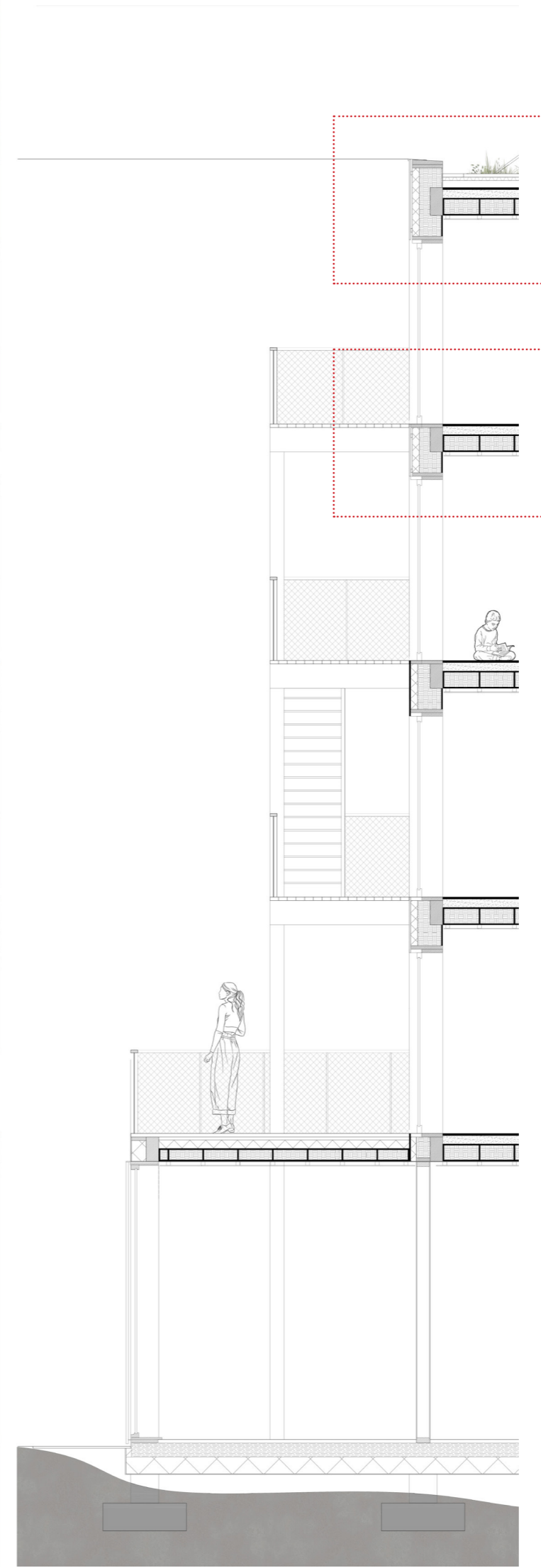
DESIGN

South facade



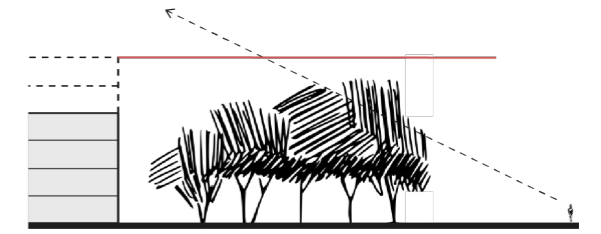
DESIGN

Fragment of the facade



DESIGN

Courtyard section



Tree boundary

Buildings are not visible from the main



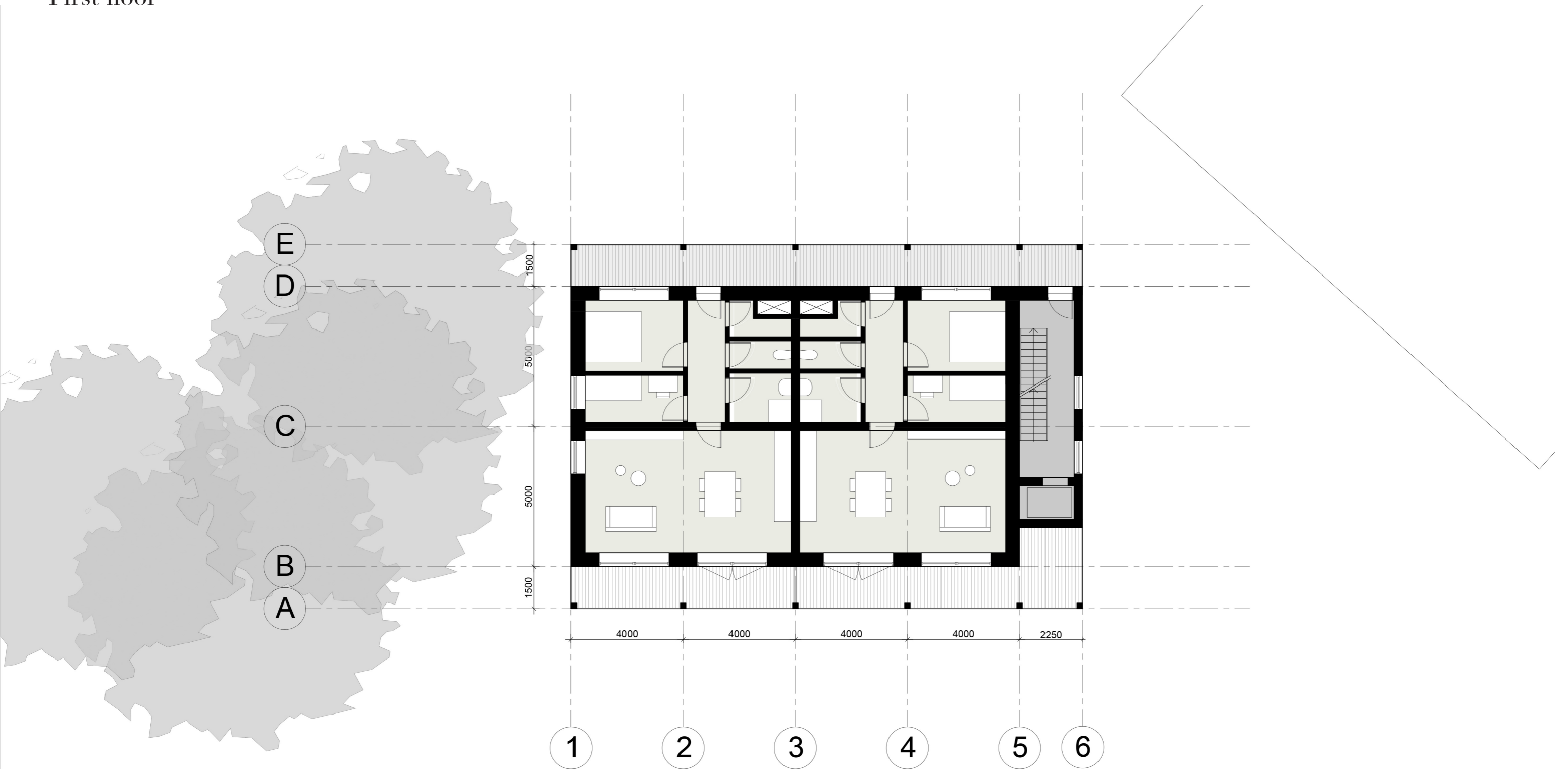
DESIGN

South facade



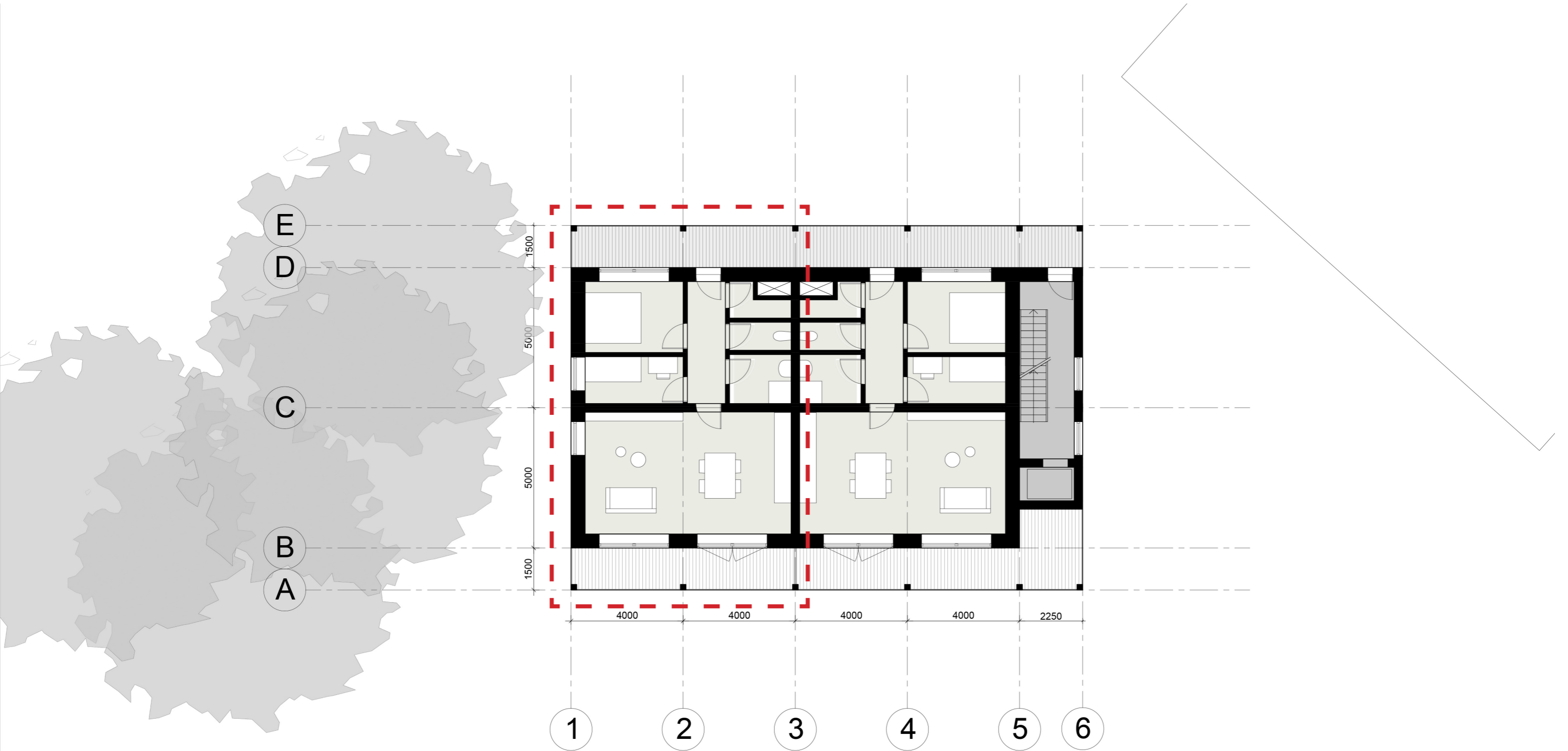
DESIGN

First floor



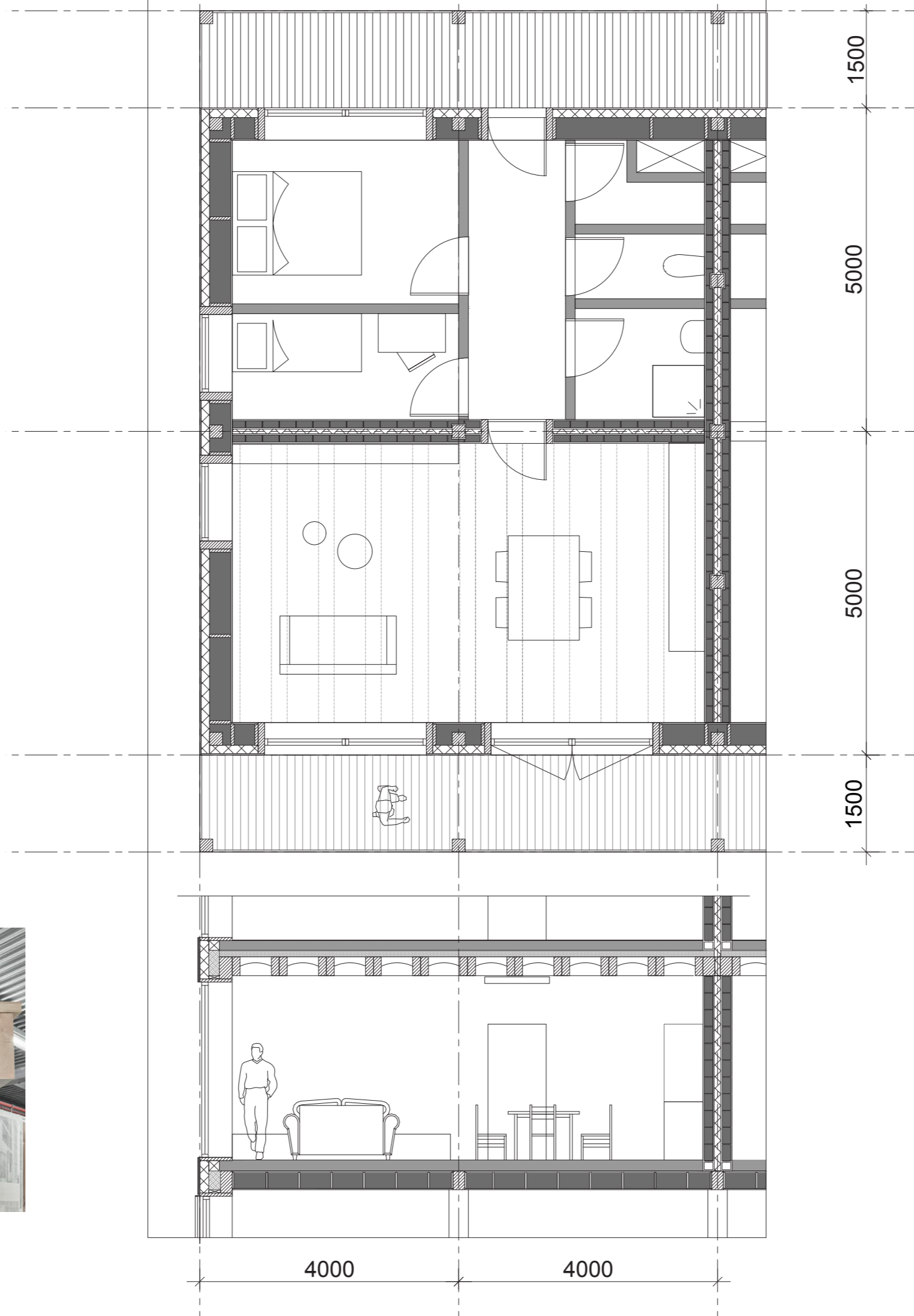
DESIGN

First floor

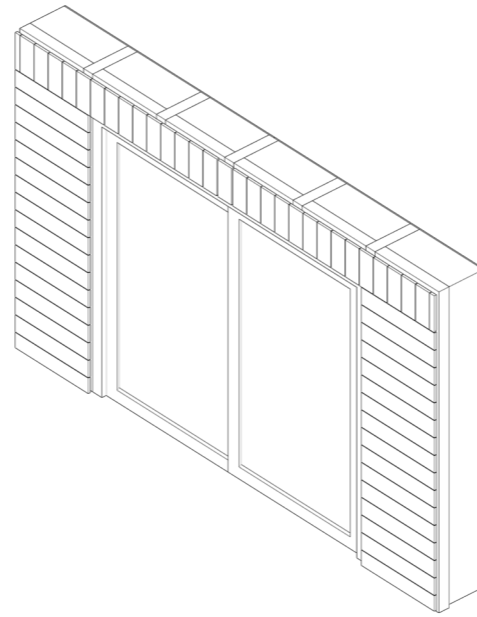


DESIGN

First floor

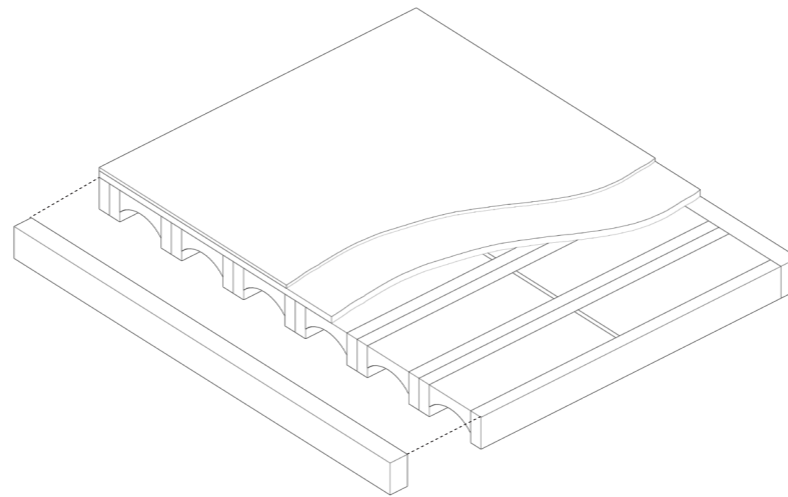






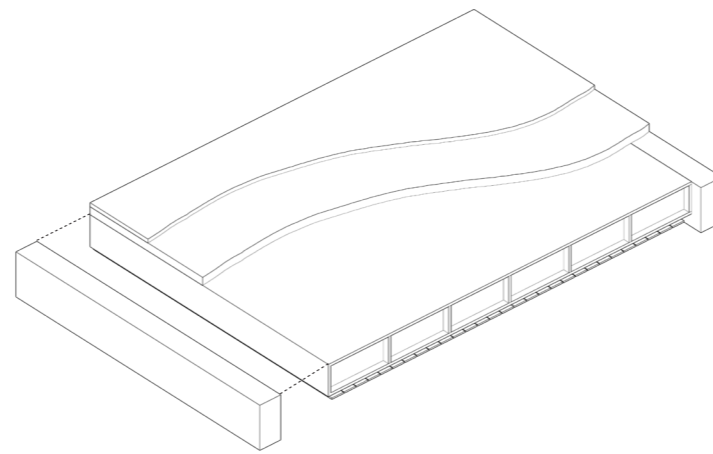
FACADE ELEMENTS

Window frames are already fixed to the timber frame walls with the light earth mixture in the factory. As a result, the houses are quickly wind- and watertight. This also ensures fast construction and a dry building site.



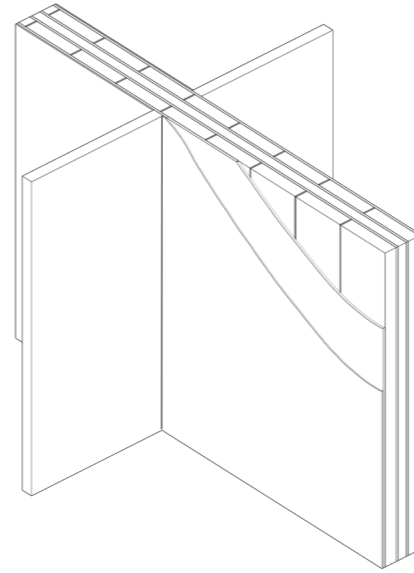
WOOD-LOAM FLOORS 1

Solid wood beams with stamped loam in between. As with light earth, the mass of the loam makes the floor similar to a concrete floor in terms of storing heat and releasing coolness. This contributes to a sustainable energy concept and the perception of the material in the home.



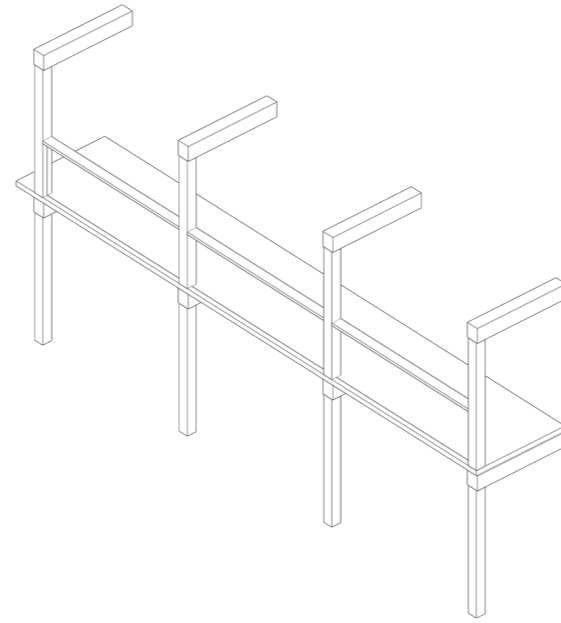
WOOD-LOAM FLOORS 2

Box construction: in the prefabrication process, the box ceiling is being filled with the light earth mixture. These floors are being placed in the public spaces and movement areas.



INSIDE WALLS

The dwelling partition walls consist of prefabricated panels with the light earth mix in them. For internal sound insulation, the cavity is filled with wood fibre insulation. The wall is thus completely biobased.

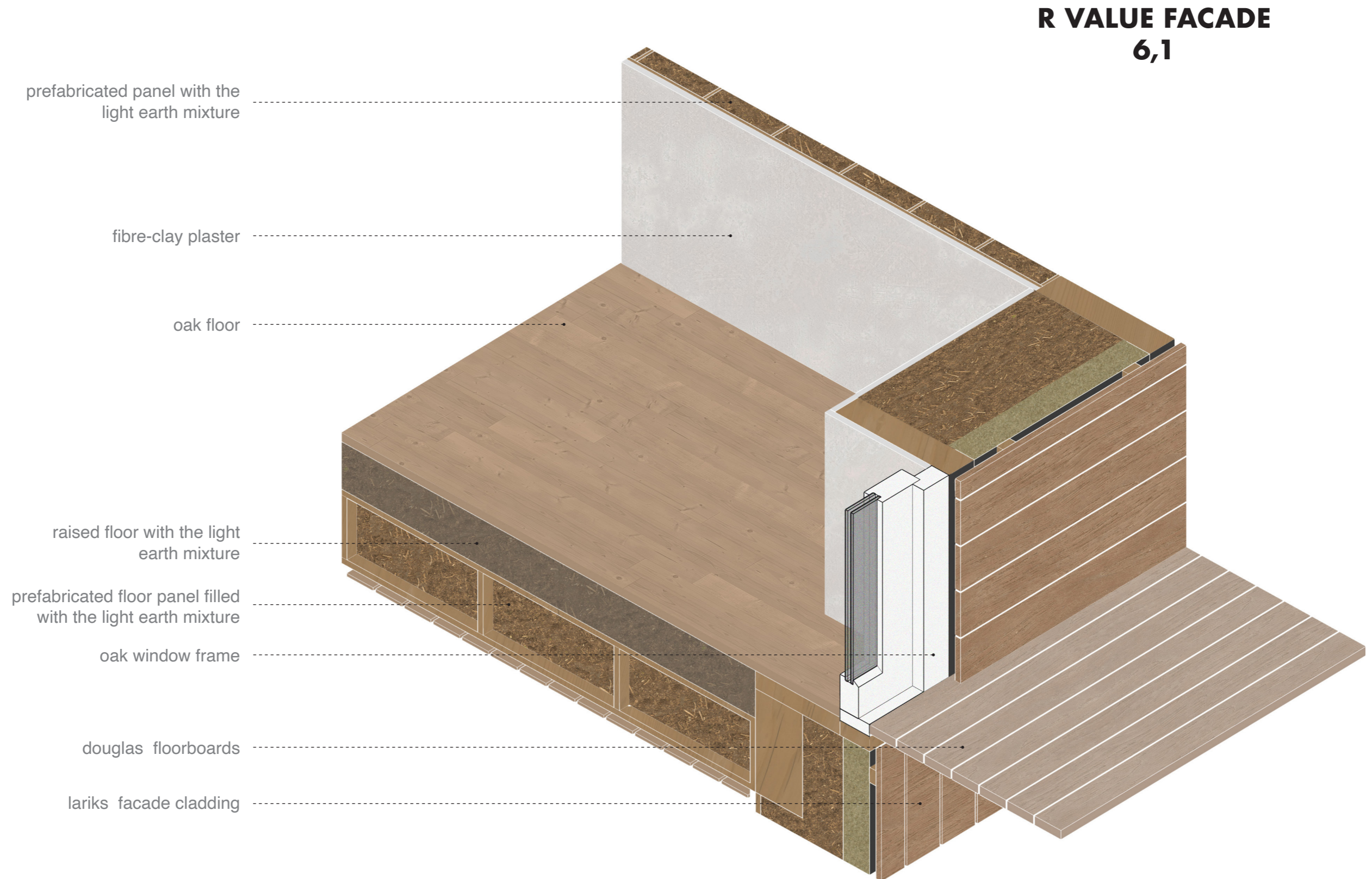


BALCONIES

Surrounding the buildings is a shell of balconies. On the sunny side (south), the balcony is a collective outdoor space. This creates contact and interaction between the residents. The balconies on the other sides act as private outdoor spaces of the houses.

DESIGN

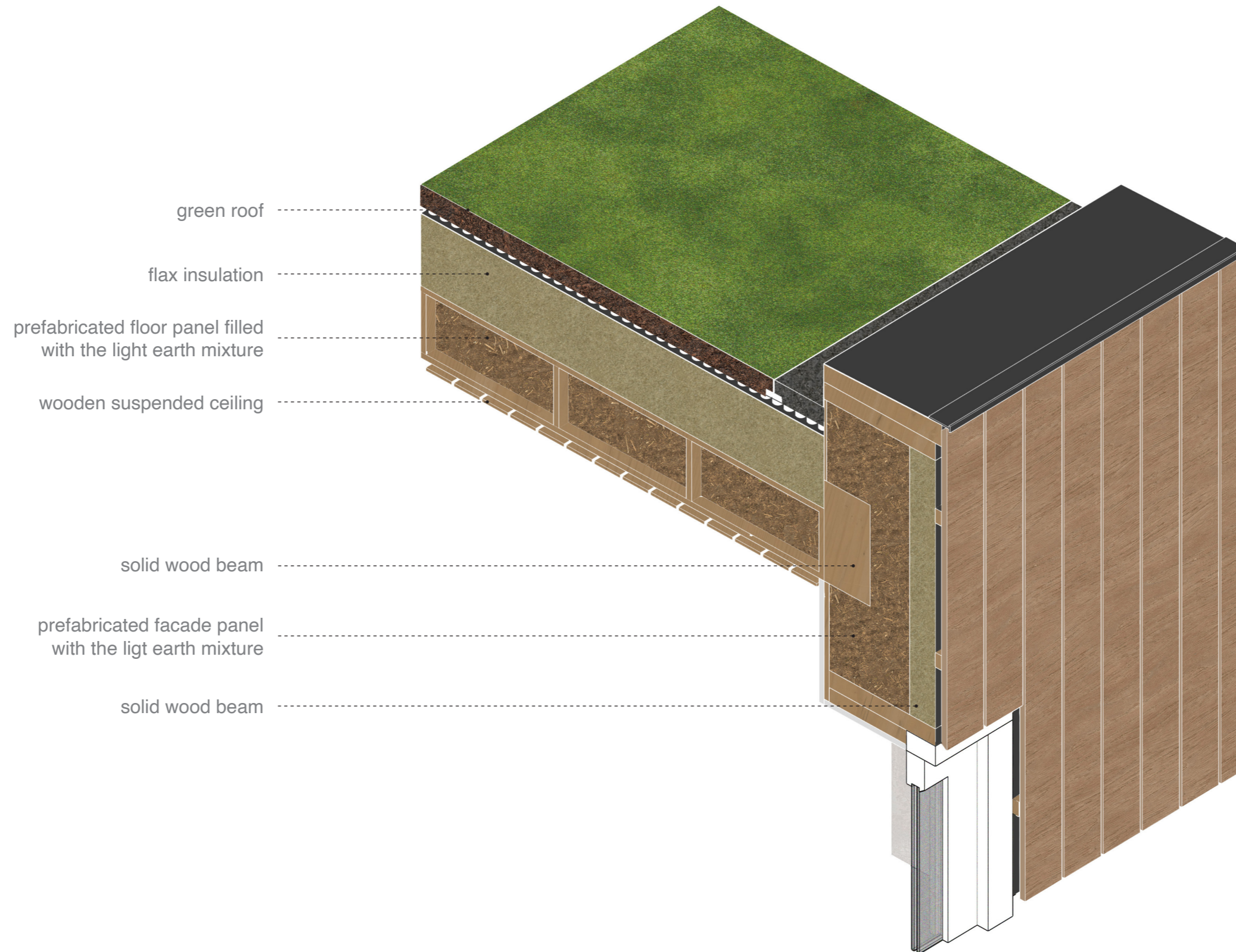
Corridor floor - collective terrace



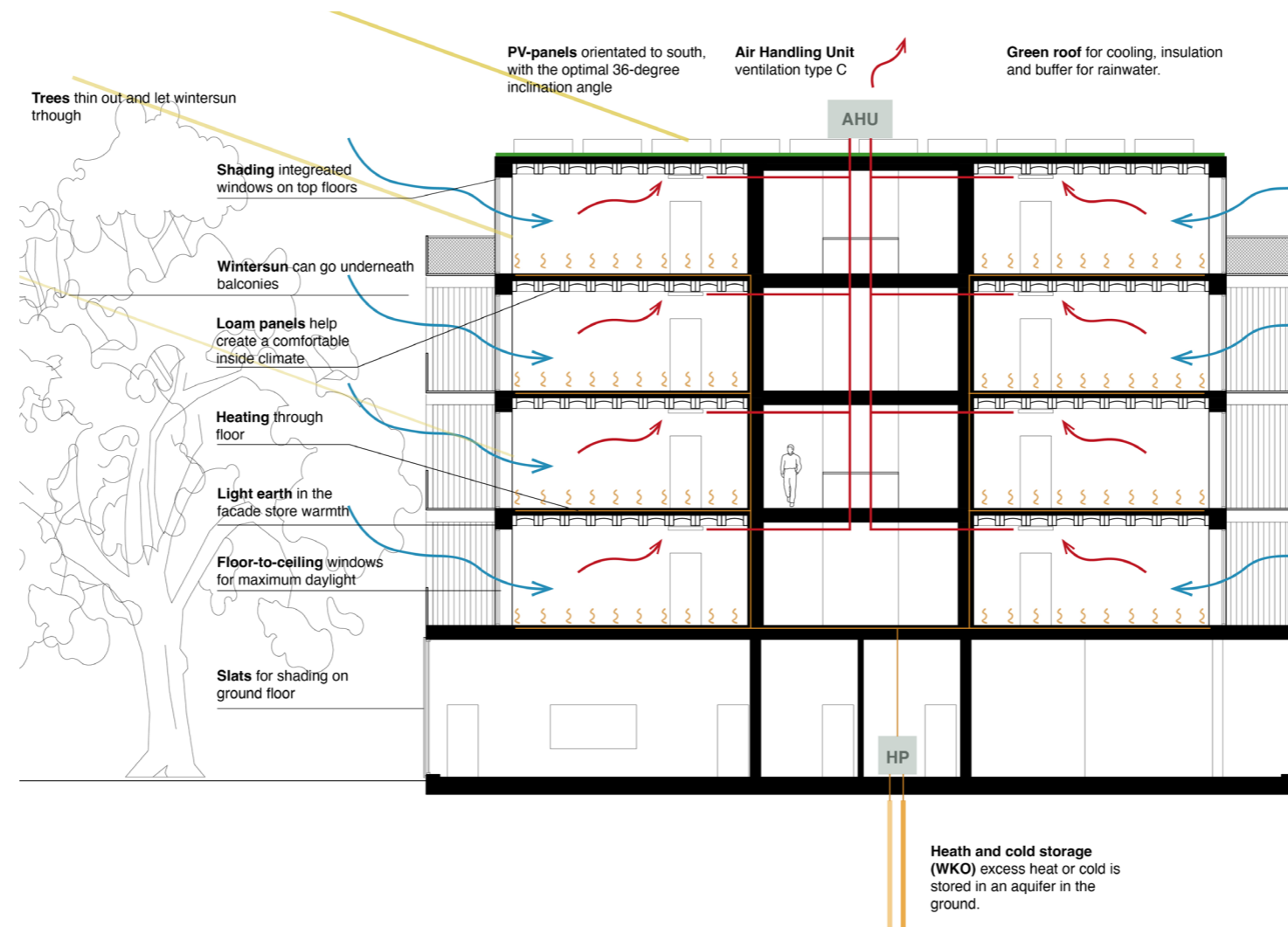
DESIGN

Roof

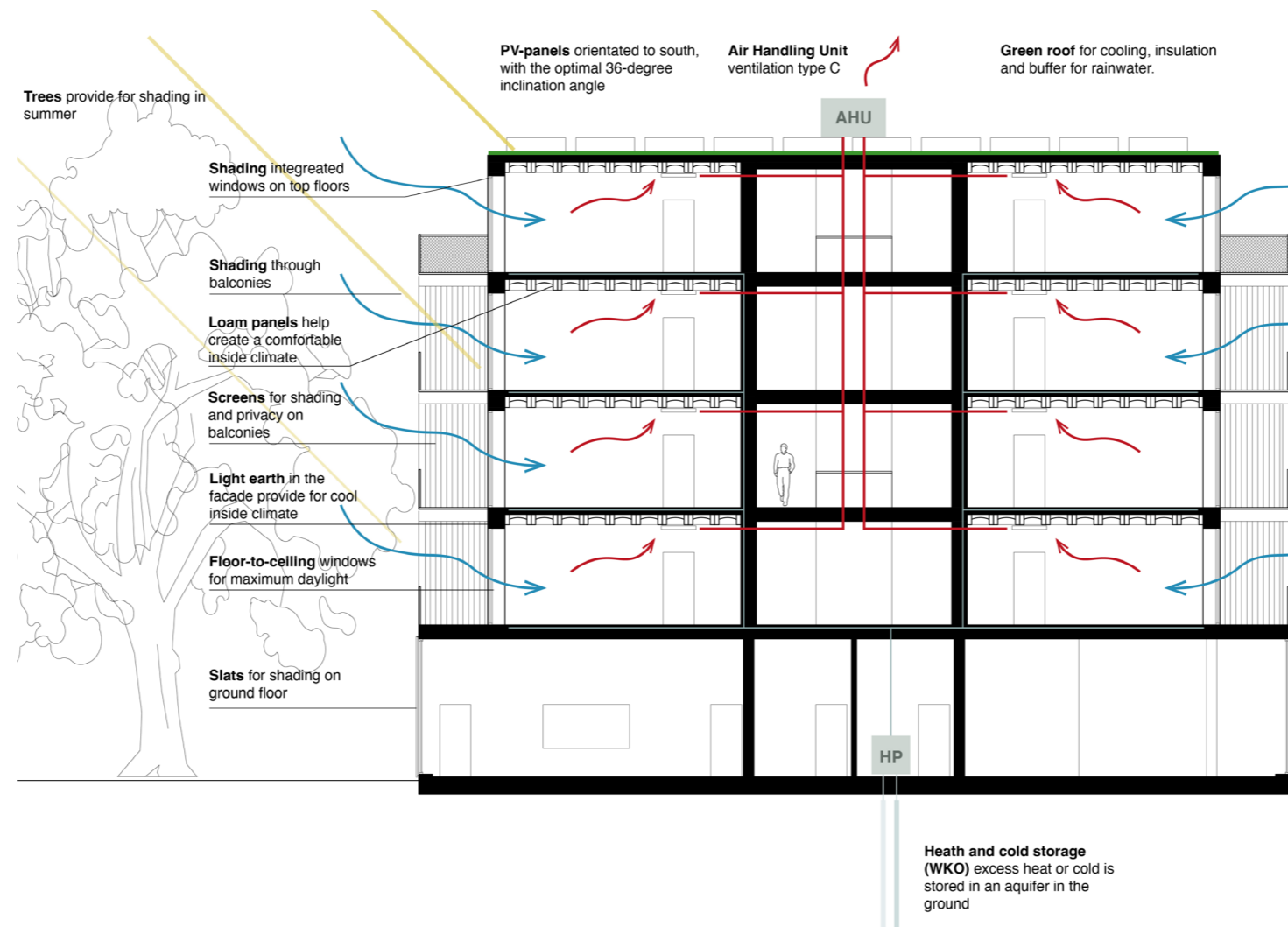
R VALUE ROOF
8,3



WINTER



SUMMER





THANK YOU.