Proteus

A new building typology for the changing society.

The usage of modular architecture and mixed buildings to aid the Dutch housing shortage

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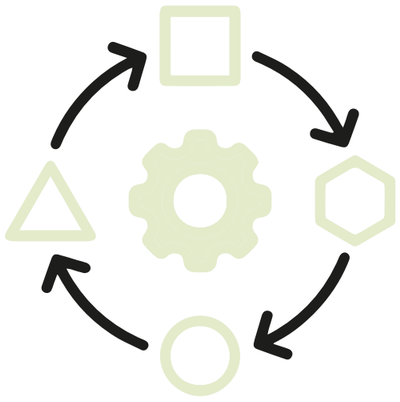
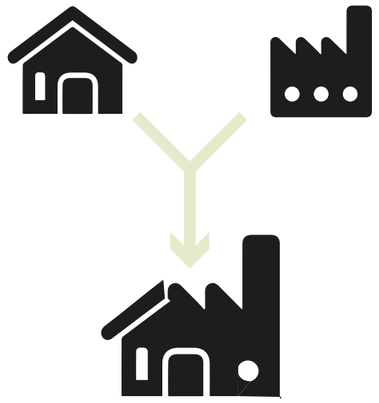
AR3AD100 Advanced Housing Design, Ecologies of Inclusion MSc3

Design Ambitions

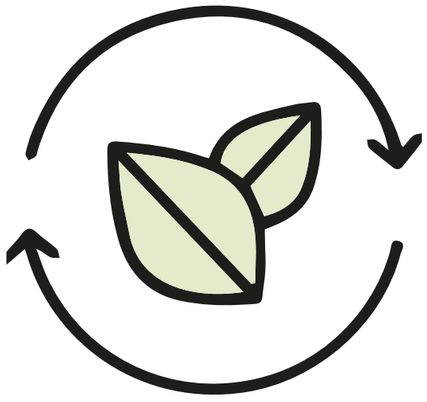


Adaptability

Affordable housing



Mixing production with living



Sustainability

Research question

Problem statement 1

Pushing production out of the city takes too much space.

What are the benefits of mixing production with living?

What are the constraints of mixing production with living

Problem statement 2

The housing market is under pressure as it has become unable for the majority of starters and single-person households to aquire a home.

How can we help solve the housing crisis as architects/developers?

Tools as an architect/developer

Choose the target groups
Choose the ownership type
Design adaptable building

Context and design

Location: Keileweg, Rotterdam

Design goal

Create a building that allows the mix of production and living while creating affordable housing for a wide array of target groups. This building is a prototype for an adaptable typology that could be helpfull in combatting the housing crisis.

Design brief

Site area: 9.298 m2

Plot area: 1.600m2

Production: 4600m2

Work spaces for approximately 308 people

Living: 4.400m2

80 Dwellings for approximately 150 people

Context analysis

Dutch housing market

Mixing Production + Living

Modular Architecture

Living needs

Literature review

Literature review

Literature review

Literature review

Manufacturing documentation

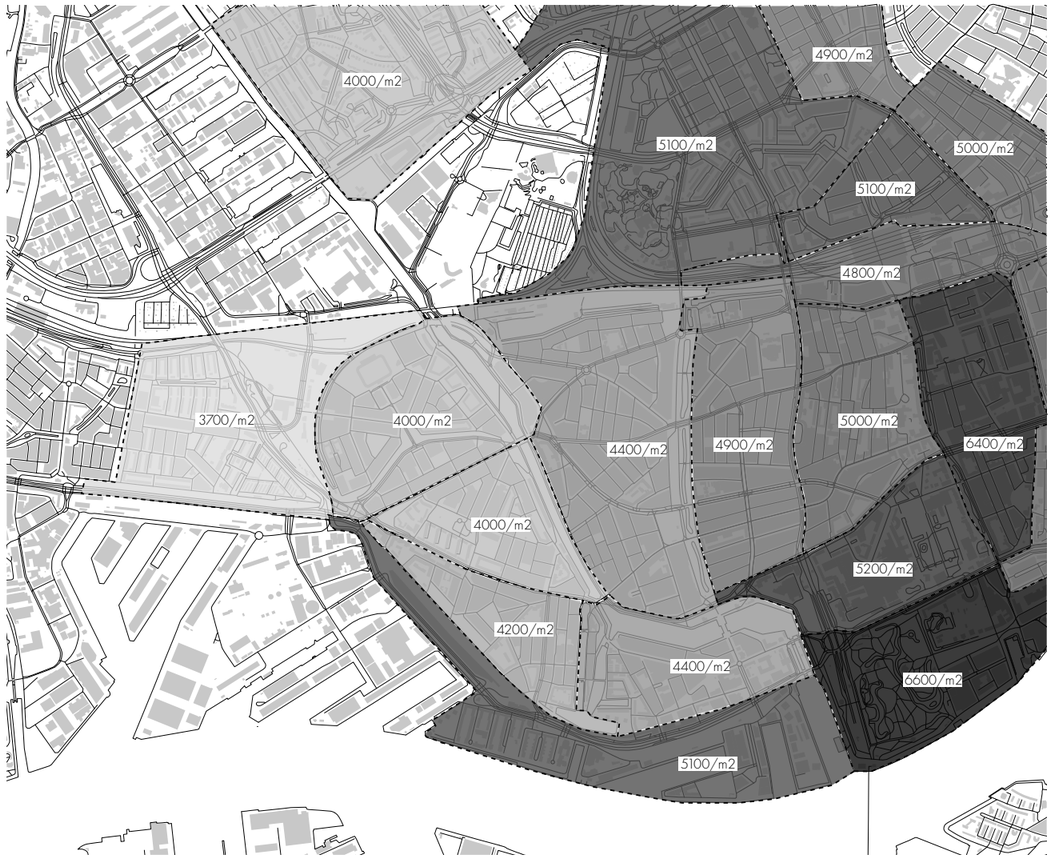
Habitat 67 and Nakagin capsule towers

L' hotel logistique

Bremer Punkt

Proteus

Key takeaways context analysis



Housing Prices Per Square Meter (Waterliving.com/nl)

Scale 1:5000

Housing Typology

Individual house	Multiple family house with an elevator	Multiple family house
5%	14%	81%

Ownership structure

Social rent	Private rent	Owned
50%	24%	26%

Housing Age

Built before 2000	Built after 2000
90%	10%

Income division

Lowest 40%	Middle 40%	Top 20%
60,6%	28,4%	11%

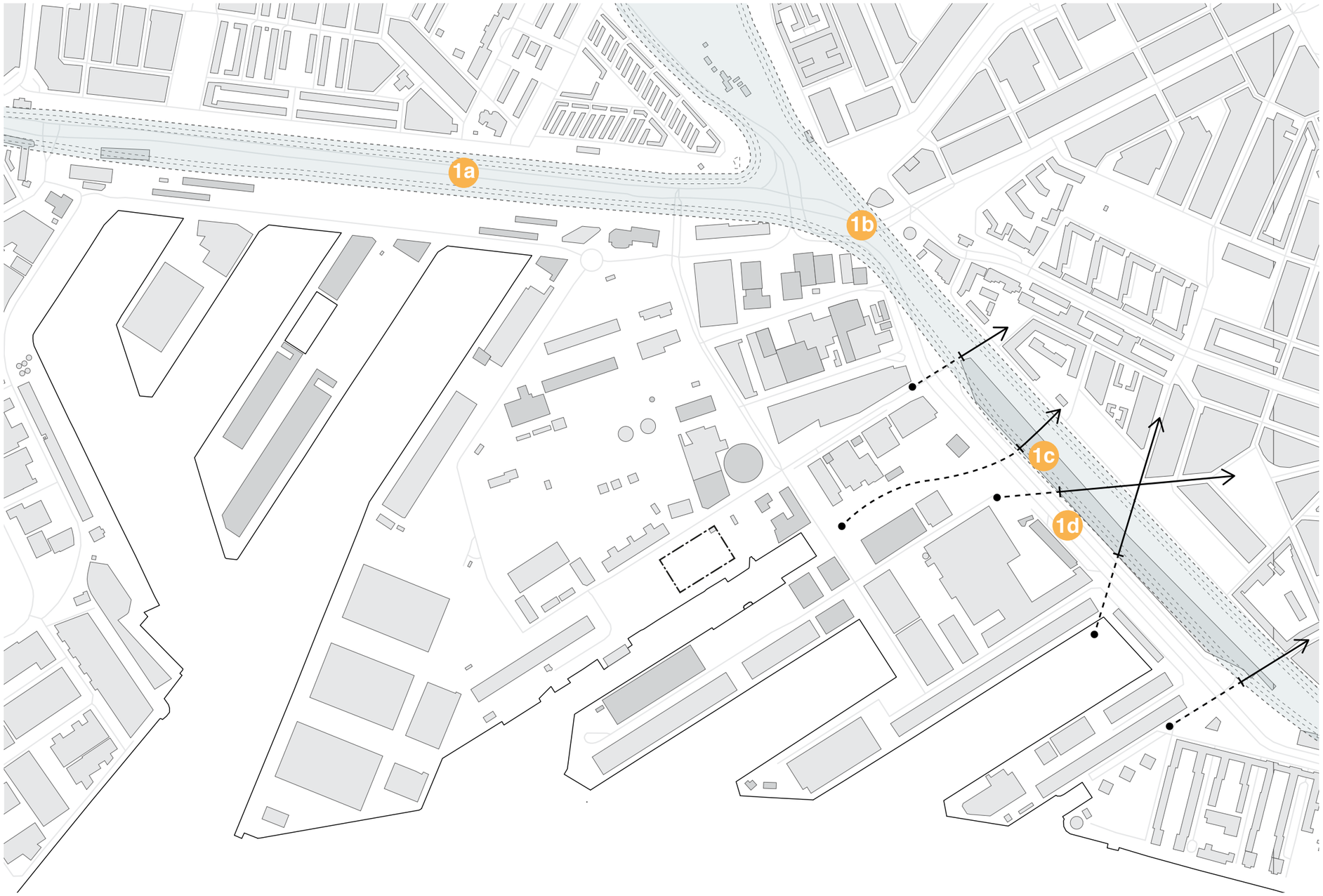
Household structure

1 Person household	2 Person household	Single parent household	Family household
54,5%	15,8%	12,3%	15,3%

Square meters per person in Rotterdam

1 Person	2 Person	Family
70 m²	48,25 m²	27,94 m²

Key takeaways context analysis



1 The lack of connection between the M4H area and the rest of the urban plan

1a Dike, road and rail infrastructure presents permanent physical barrier to existing residential area.

1b Multiple layers of transport infrastructure, primarily roadways, create physical barrier between M4H and Marconiplein.

1c Shopping centre and Dakpark along Vierhavensstraat creates strong, impermeable street wall, blocking access between existing residential areas and M4H. Possible future connections between the urban tissues are implied by existing landscape design.

1d Multi-lane road with very few crossings presents barrier between shopping centre and M4H. Opportunity to create a strong street wall along Vierhavensstrat to establish identity for M4H precinct.

Dutch housing market

Dutch housing market

Housing market colapsed

Households grew and market recovered

Not enough workers,companies and rules to help grow supply

Credit crisis 2008 → *Companies and workforce dissapeared* → *Shortage in housingmarket* → *Housingcrisis as we know it*

Needs to adres housing crisis

- *Build faster*
- *Adaptable housing stock*
- *Policy changes*

Contemporary Living needs

Students

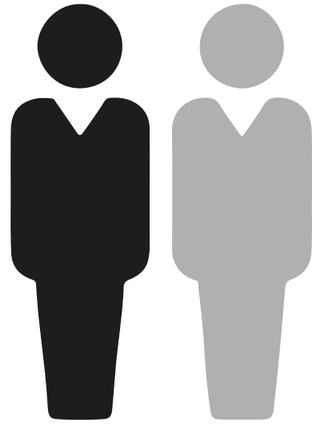
Goal

Close to school
Working space
Social interaction
Green spaces

Elderly

Goal

Enjoy Retirement
Social interaction
Safe space

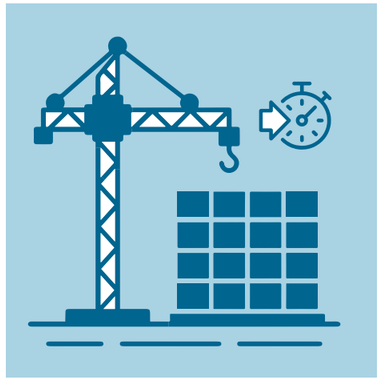


Starters

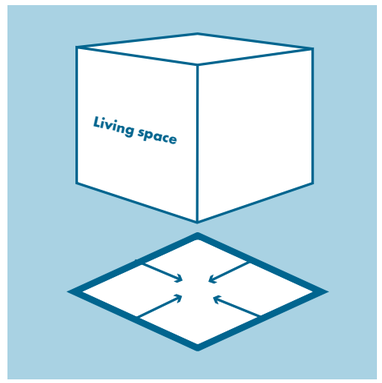
Goal

Build for the future
Mix used neighbourhood
Solid transportation network
Hybrid working space

Design



Speed up building process

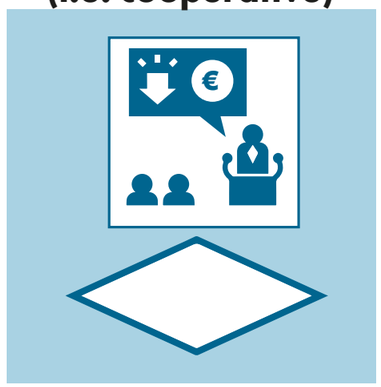


Minimize m2 per person

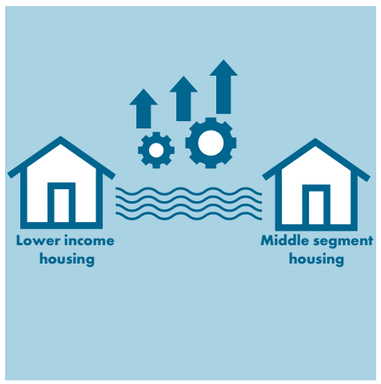
Use land efficiently

Create a flexible Housing market/ stock

Policy changes to accommodate a shared economy (i.e. cooperative)



Policy changes to reduce land costs for affordable housing



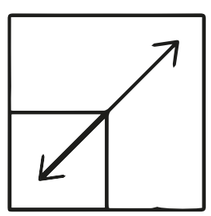
Improve flow from low income housing to mid income housing

Regulation

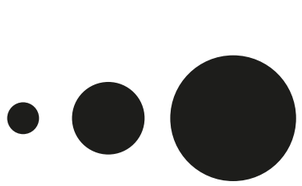
Mixing Production + Living

The need for a Hybrid factory

- Production was moved to urban borders due to health concerns and pollution
- Production needs clash with other function needs
- New innovation in manufacturing gives the opportunity to mix production and living



Scalable



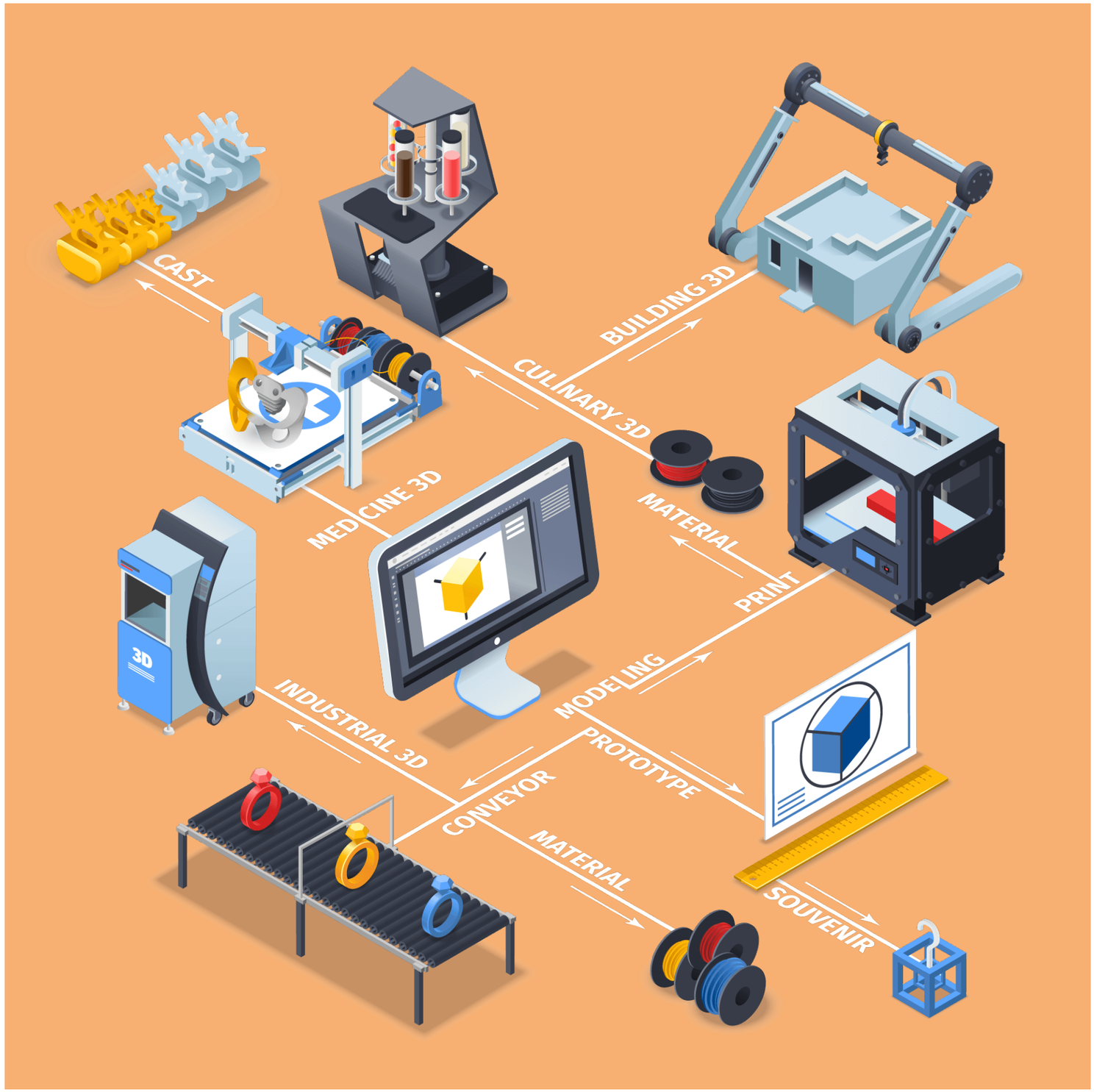
Variety

Controlled environment

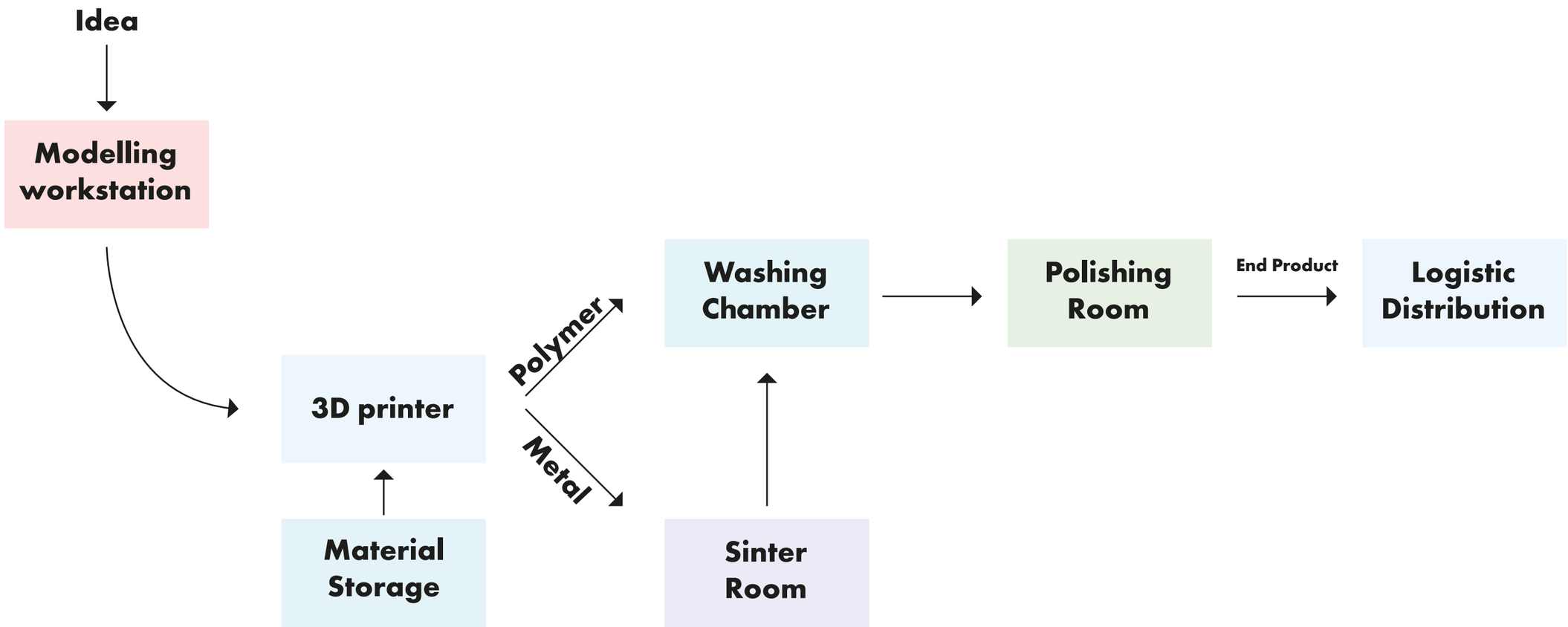
No sound pollution
No smell pollution

What is needed to facilitate 3D printing?

3D printing ECO-system



3D printing ECO-system



3D printing and actors

Residents

Ideas for products
Consuming product
Offering materials that can be reused

Help create a prototype
Waste reduction
Fullfill a need with print on demand
Education on new production methods

Create building materials by reusing materials
Provide building materials faster
ates interaction with residents and manufacturing

Material which can be reused(Lenas Building)
Port to connect with the rest of the world

Building

Creates a space where 3d printing can take place
ates transparancy and gives insight in production
lexible space that can be adjusted to other needs

3D Print Factory

City

A breeding space for entrepreneurship
Attract international bussines
Manufacturing sutainable (PoD and recycling)
Use land efficiently for manufacturing
Typology easy to integrate in urban fabric

L'Hotel Logistique

RAILWAY
The railway is important for the logistical hub. This hub wants to make the transition of goods between trains and streets easier by integrating it into the logistical hub

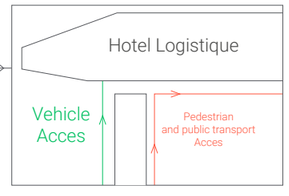
ROOF TERRACE
The roof terrace is used for public functions such as urban farming and sport fields. This is usefull to blend the living facilities with the logistical hub

MAIN STREET
A constant exchange between the hub and the resedential area, through the programmatic design of the hub.

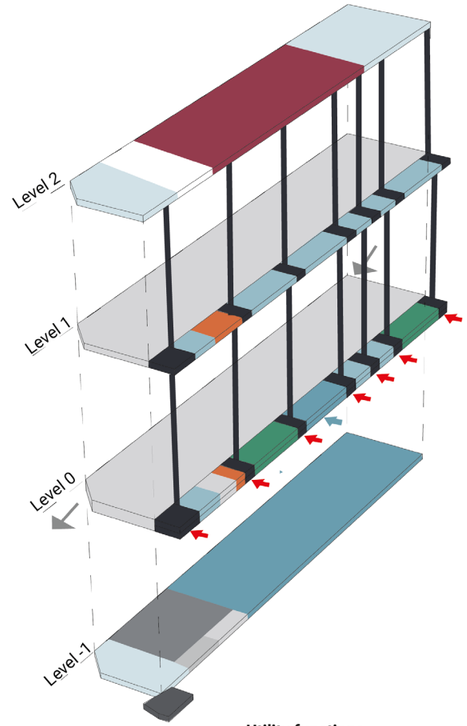
RESIDENTIAL AREA
The area next to the logistical hub is the residential area which accomodates all the living needs in total there are 1100 apartments

QUALITATIVE GREEN SPACES
The La Chapelle area introduces new qualitative green spaces. These public areas are connected with the Logistical hub through the streets

LOGISTICAL SYSTEM
Vehicles go in through this side they have an exchange with the logistical function and they are on their way again. The site connects from here with the streets into Paris, The highway into France and the Railway



PUBLIC FUNCTIONS
This side of the facade is filled by offices and public functions such as gyms and shops. This side facilitates the combination of living and a logistical hub

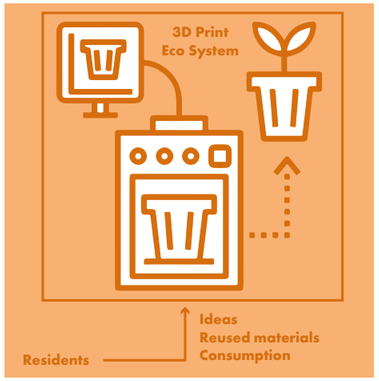


Utility functions
- Parking and Delivery
- Central Hearing
- Technical room
- Train Station
- Circulation

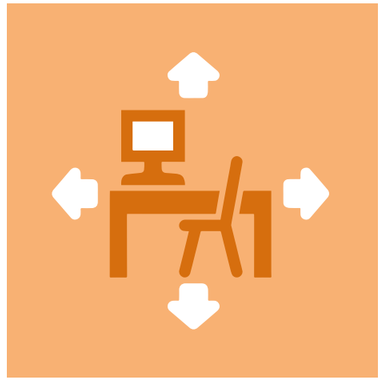
Work functions
- Warehouse
- Data Centre
- Offices

Public functions
- Urban Farm
- Fitness Area
- School of Commerce
- Sporting Functions

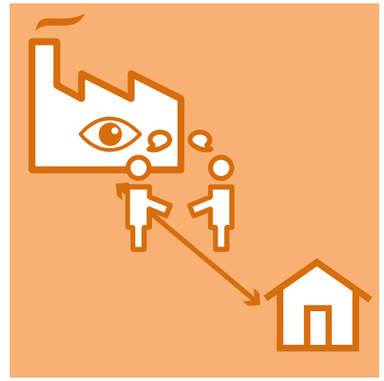
Car/Truck entrance
Train entrance and exit
Pedestrian entrance



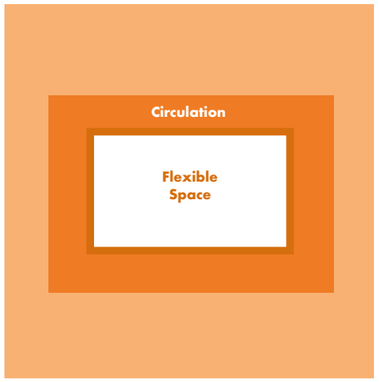
3D printing allows for a mix with interactive benefit



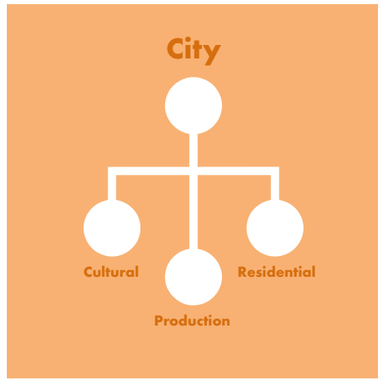
Create flexible production spaces that can fit different functions



Create a transparent production space and stimulate interaction



Place circulation around the flexible space to ensure its flexibility



Design an infrastructure that works for all functions

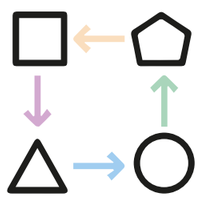
Modular Architecture

Modularity and flexibility

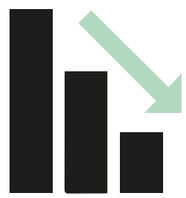
Definition

Modular architecture is an architecture that is built by using a modular building technique, this means that the building is composed of modules, components or elements which are built off-site.

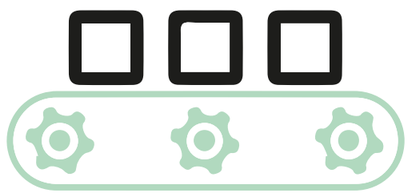
Why?



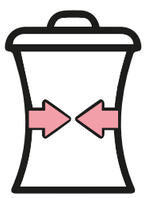
Adaptable



Reduces cost to build



Ability to automate



Reduce Waste

Reduce time to build

How do you design modular dwelling that allows for flexibility?

Modularity and flexibility

- LIN Architects
- Bremer Punkt
- 14 x 14 meters
- 11 Appartments
- 4 stories
- Standardization
- variety
- Flexibility

LIN

Giulia Andi

Finn Gleipel

Figure 4: LIN Architects (german-architects.com, n.d.)

Figure 5: Bremer Punkt 1 the first prototype (LIN Architect, n.d.)

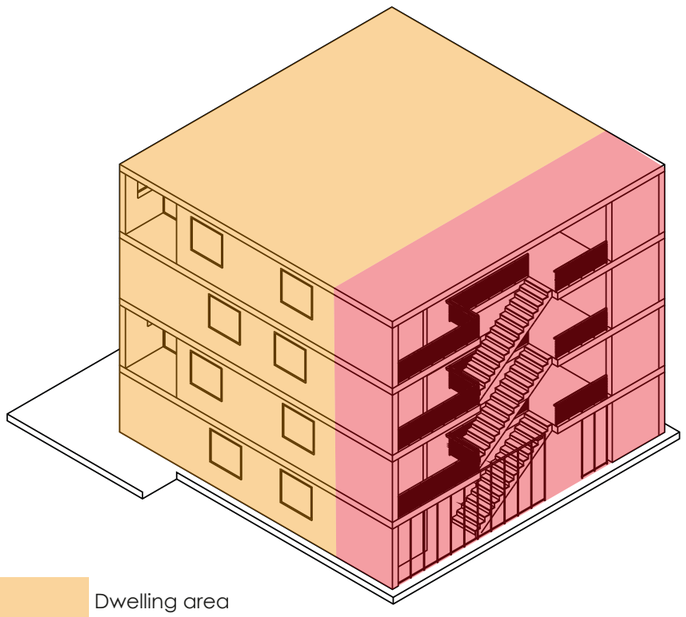
Modularity and flexibility

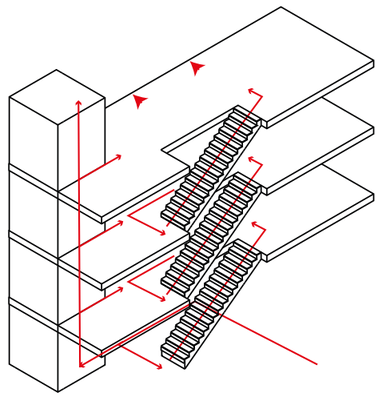
- Circulation system stairs and elevator

- 2 forms of circulation space

- Optimised circulation space means more living space
- Circulation space is fixed everything around is flexible

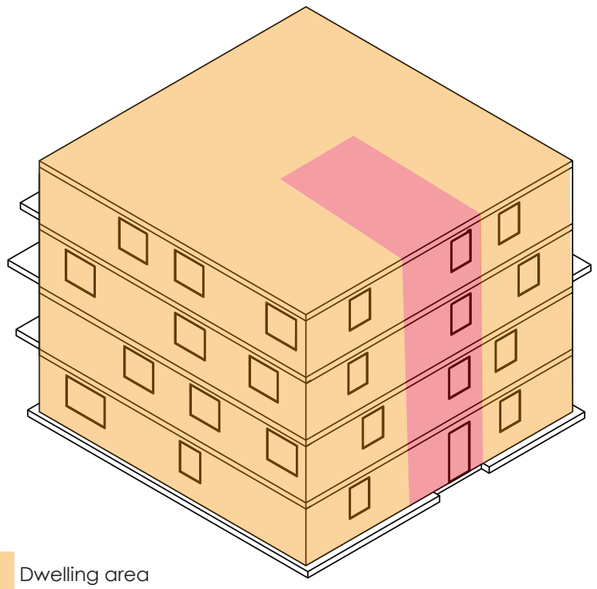
- Functions that dont need light designed towards the core and that do need light designed towards the outside

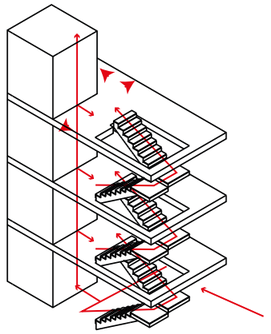




Dwelling area

Circulation area

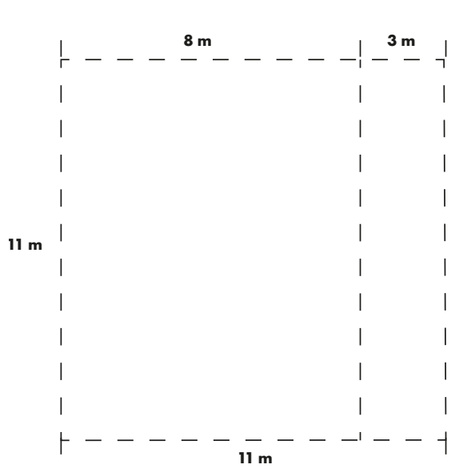


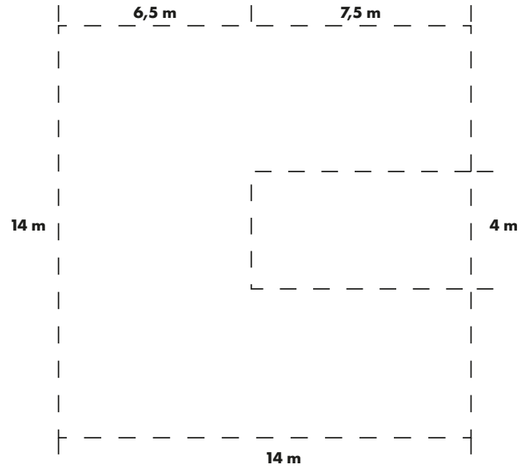


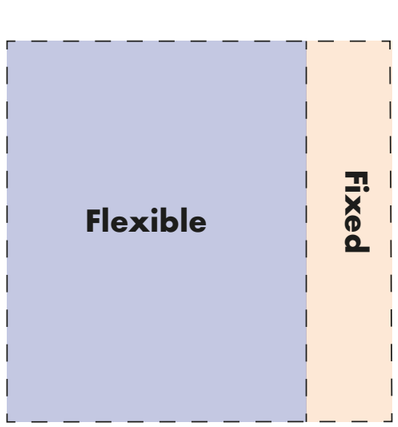
Dwelling area

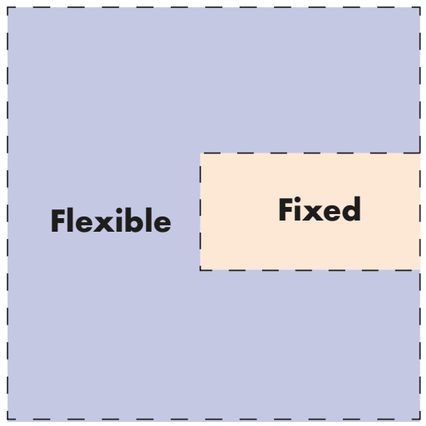
Circulation area

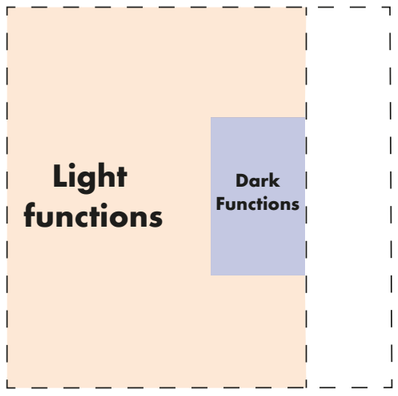
Modularity and flexibility

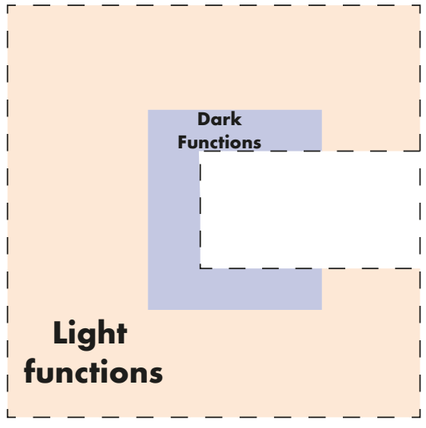




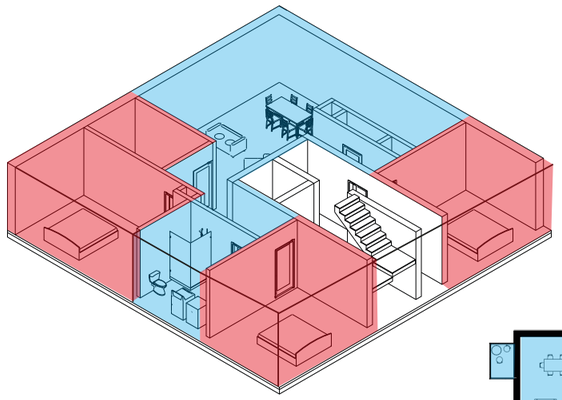






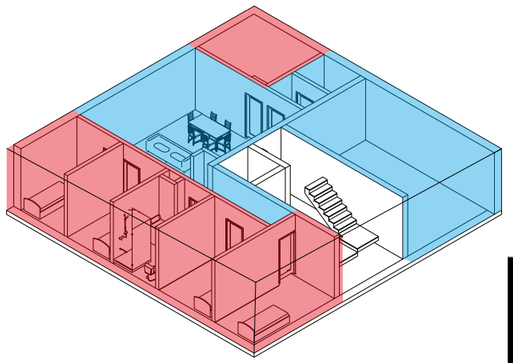


Modularity and flexibility



Private area

Collective area



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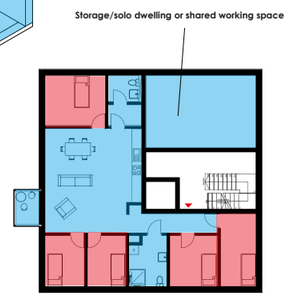
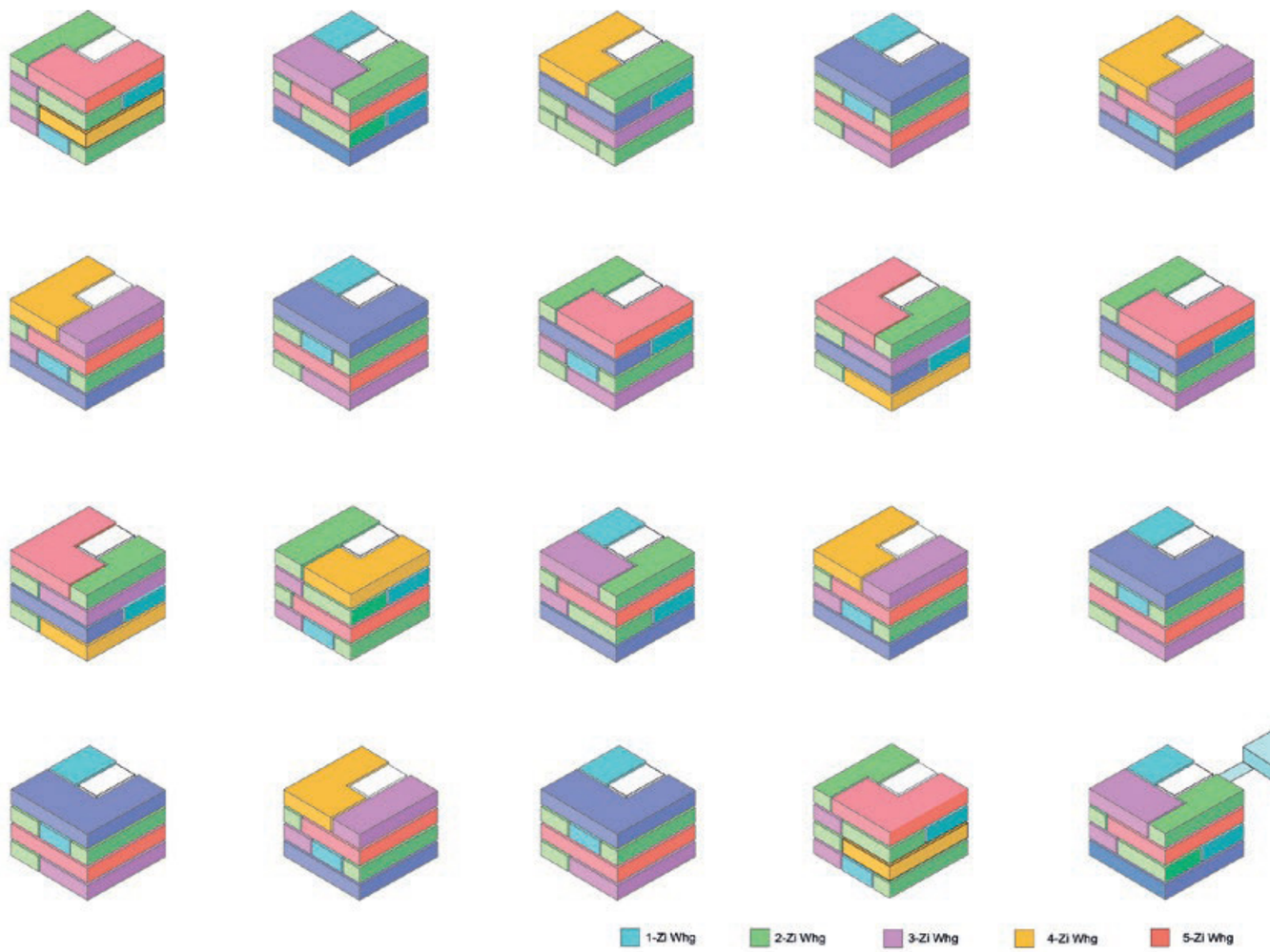
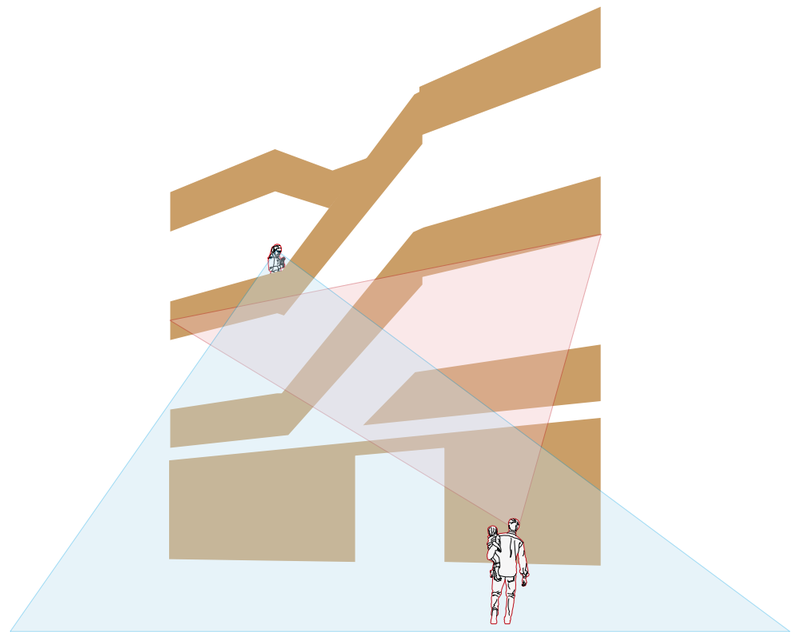
Collective area



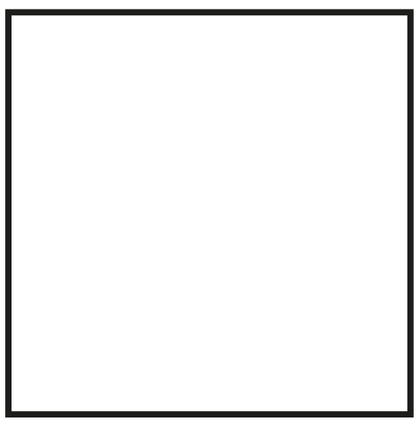


Modularity and flexibility



Modularity and flexibility

Main form



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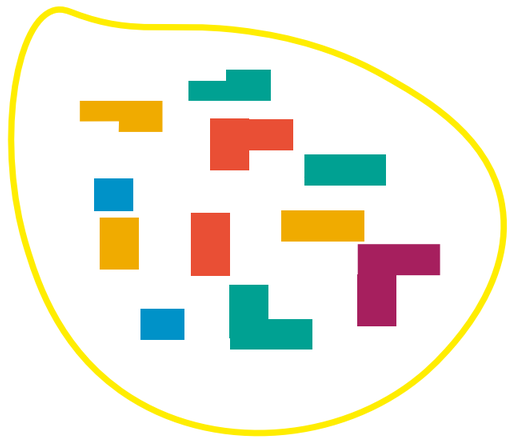
Range of typologies



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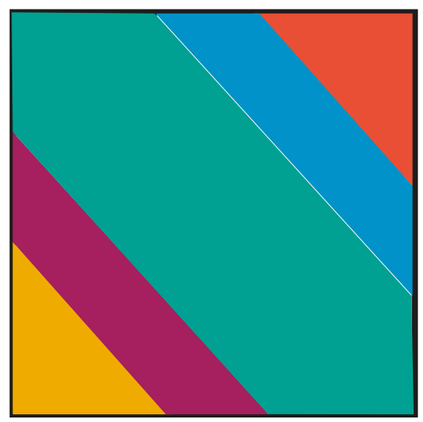
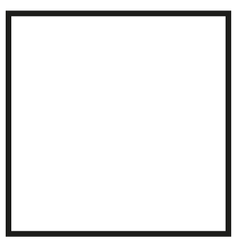
Adaptable and diverse Building



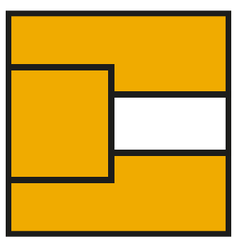
Benefit 1

Main Form



Different combinati-
ons to fill main form

First living need

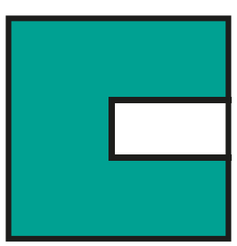


Societal change

New living need

Societal change

New living need



Using modules for
the facade

Standardization

Standardization

Benefit 2

Reduce cost to build

- Automation
- Controlled Environment

Benefit 3

Reduce time to build

- Automation
- Controlled Environment
- Building permit process is faster

Benefit 4

Reduce waste

- Easier to reuse
- Controlled Environment

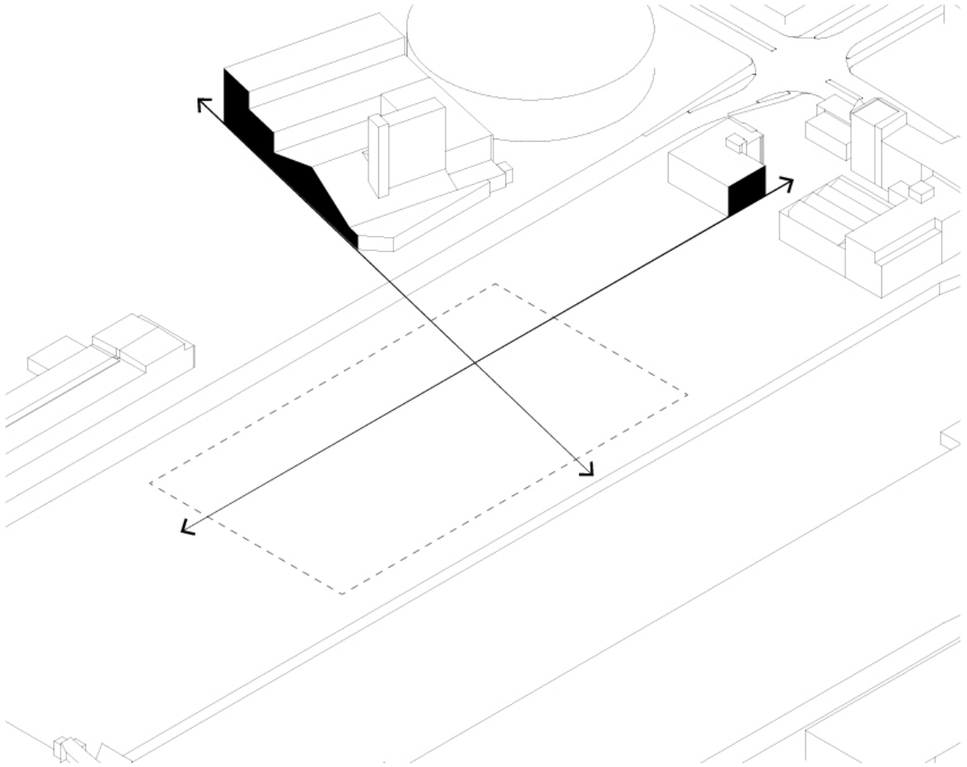
Benefit 5

Determine targetgroup at last moment

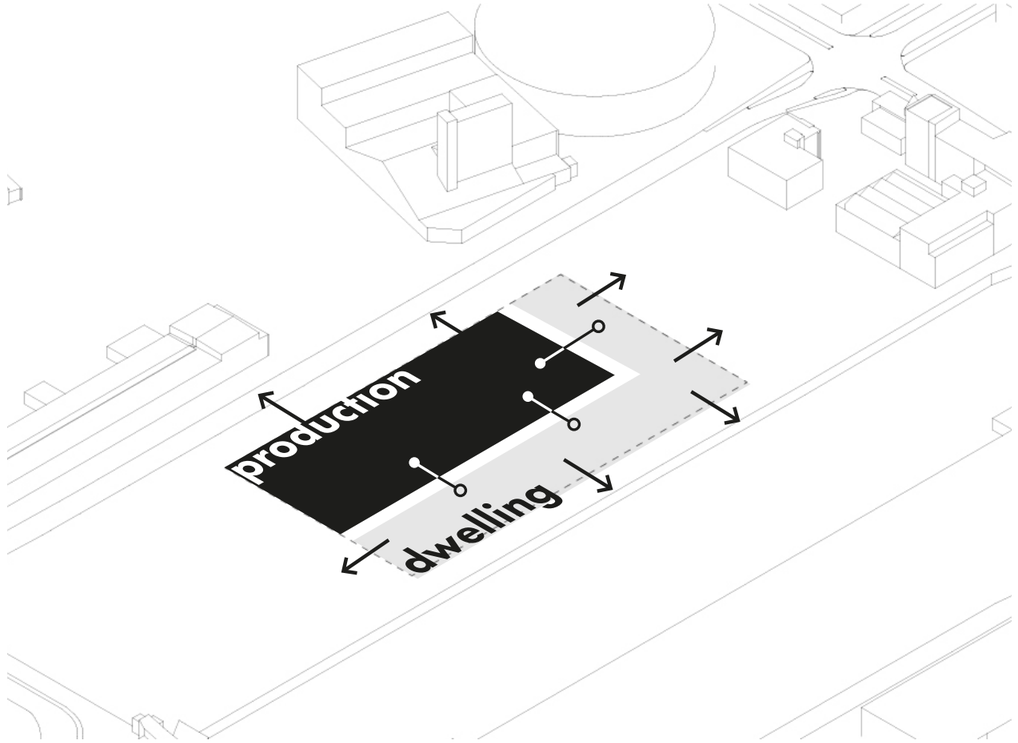
Urban Strategy

Aim		Strategy
- Reduce loneliness and isolation	→	Create spaces for interaction
- Create an inclusive neighbourhood	→	Design for a wide variety of residents
- Affordable housing	→	Standardization, cooperative ownership and large production companies.
- Future proof	→	Adaptable and modular design
- Low impact building	→	Passive design, Modular building techniques and natural materials

Urban Strategy

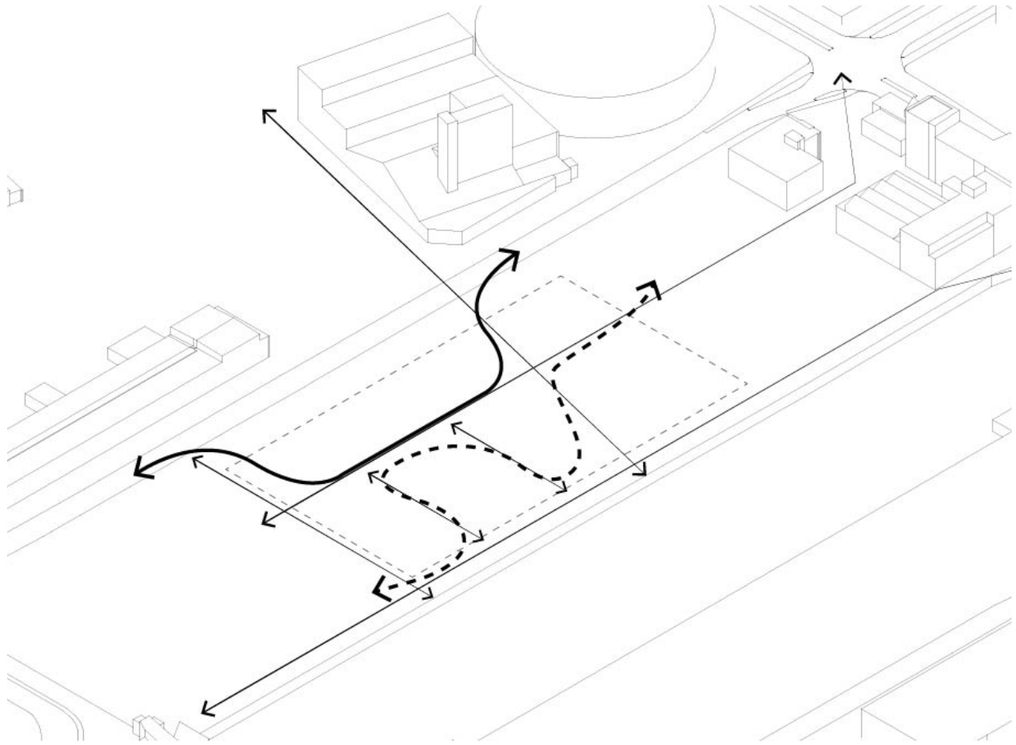


Relate urban fabric to existing significant built structures and streets.

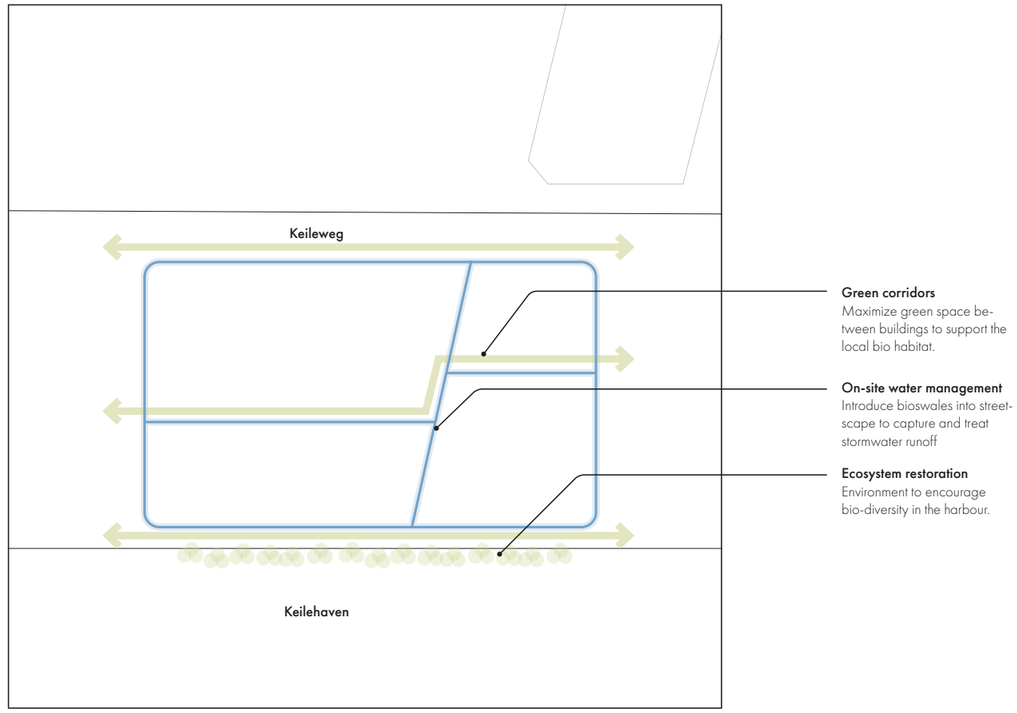


Production is more suited for the hard street and living for the waterfront.

Urban Strategy



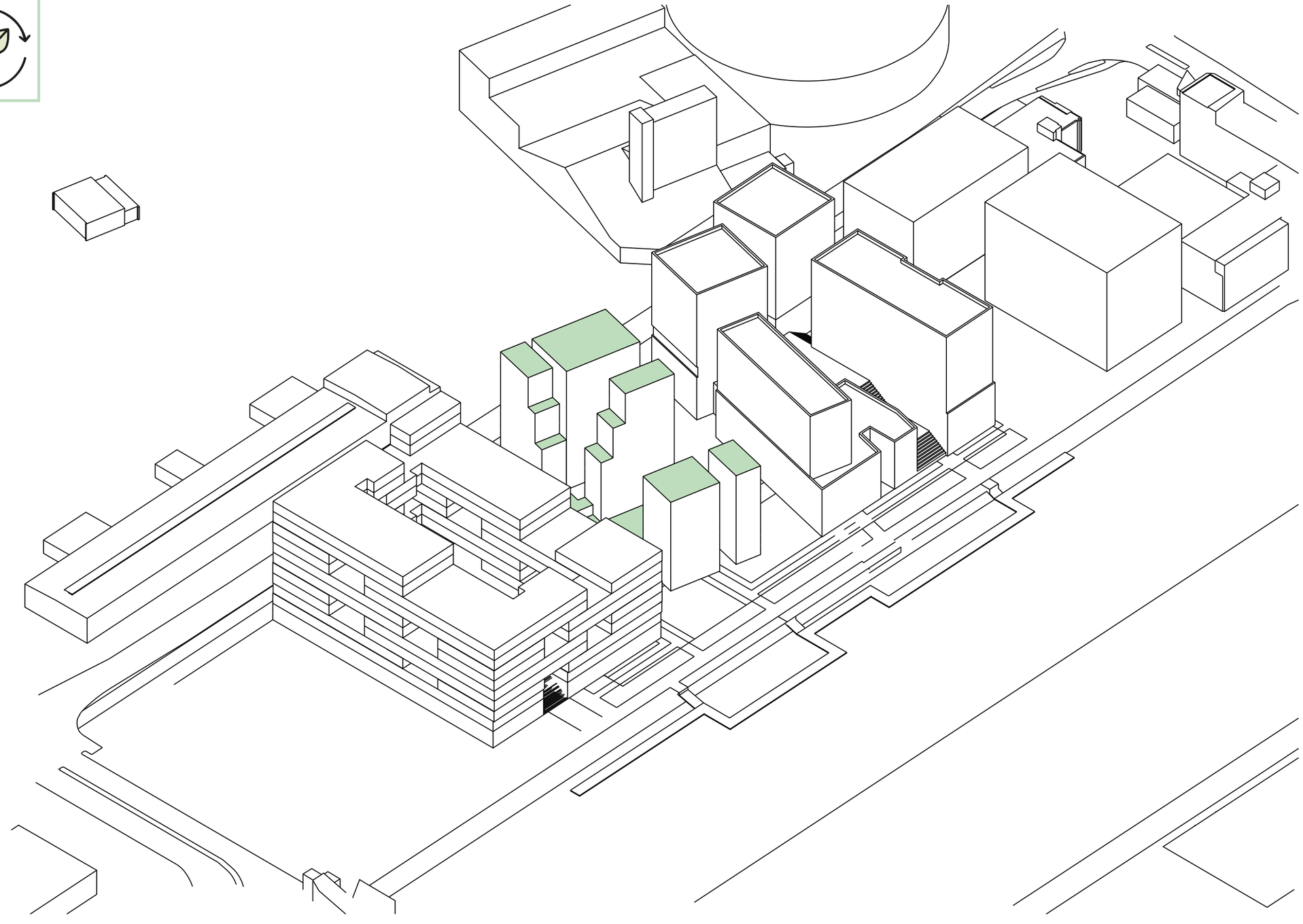
Infrastructure designed for production and living.



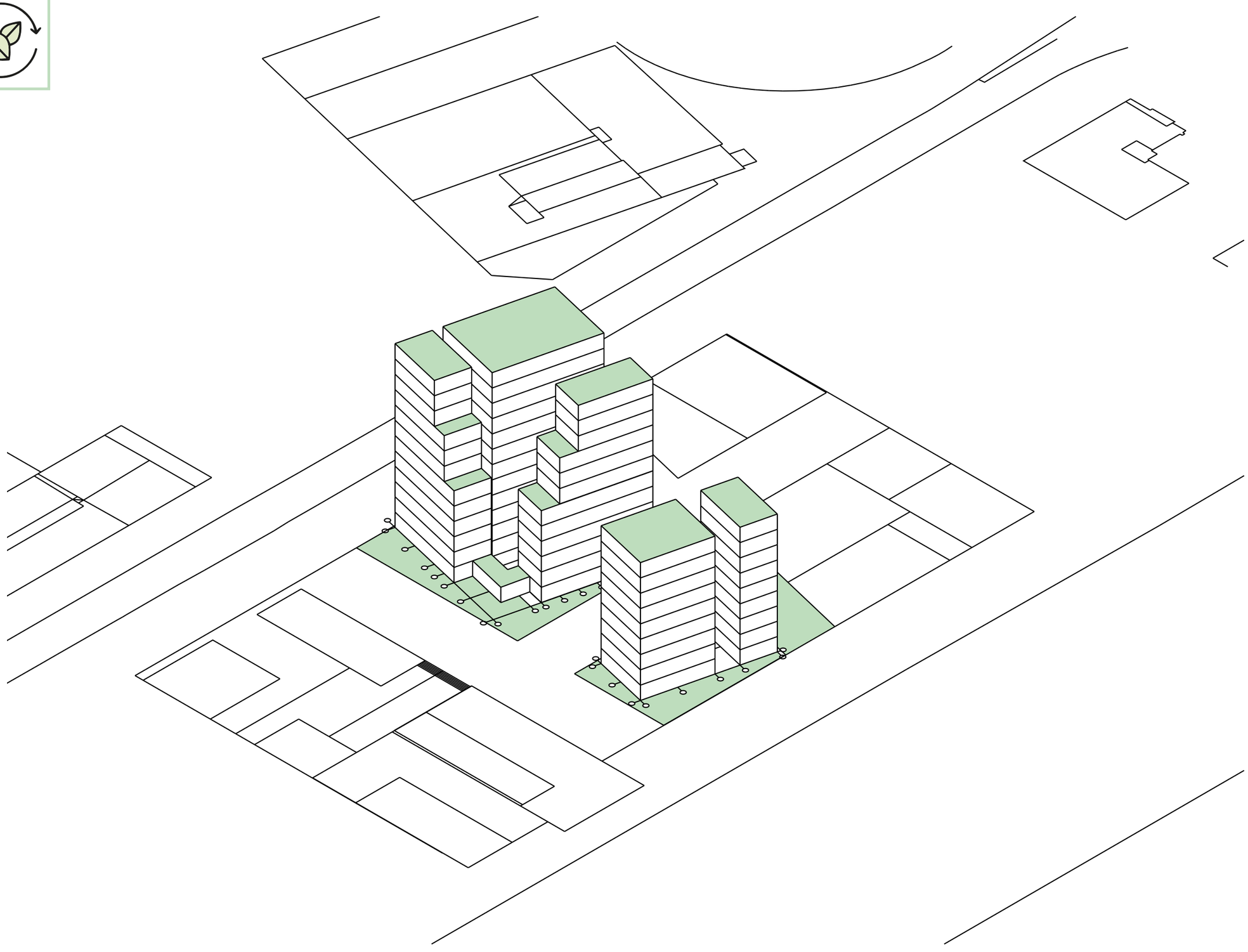
Green corridors that expand towards the water. Create an environment that encourages bio-diversity

Urban plan

Urban plan



Urban plan



Building concept

1 Establish plot

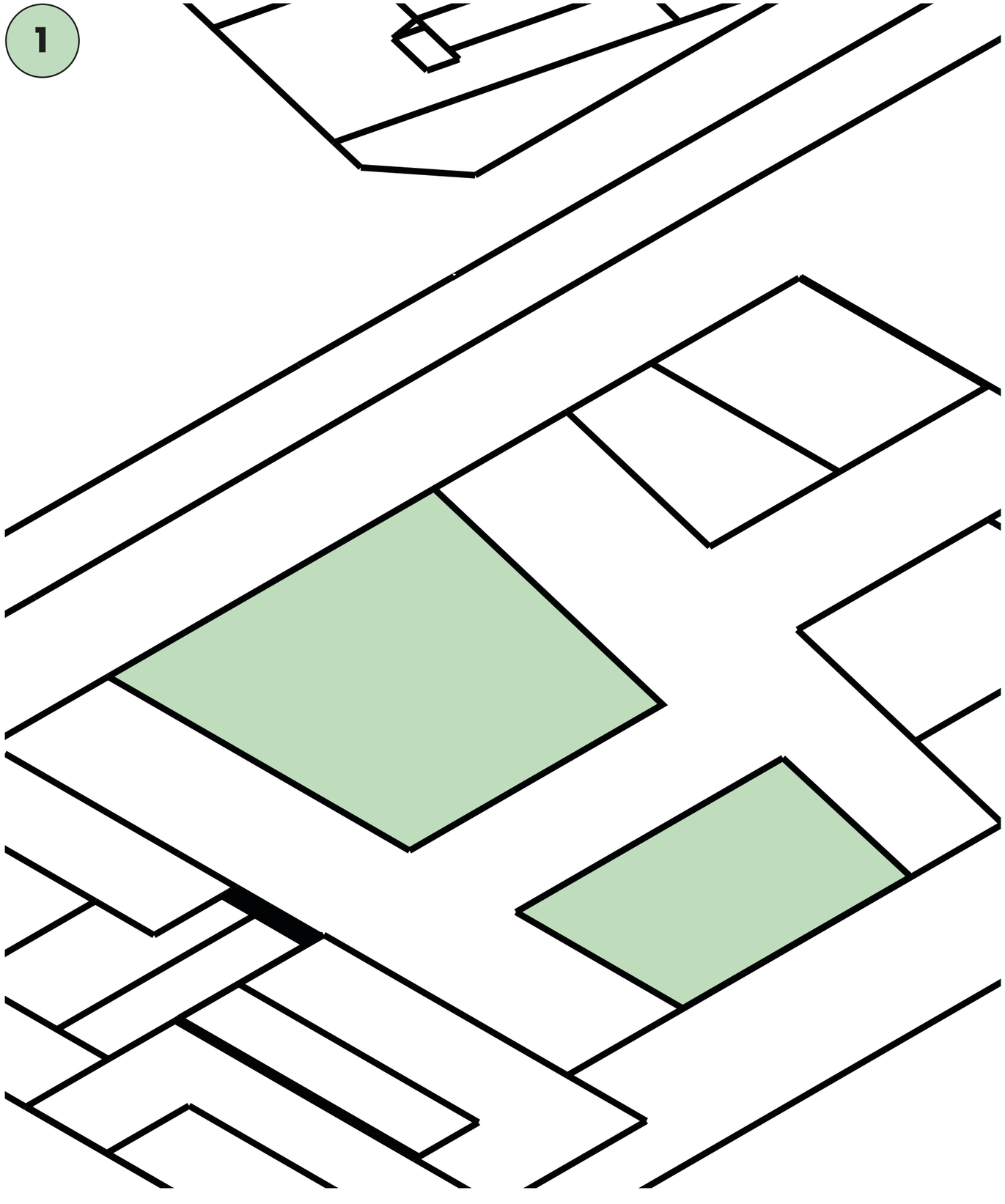
2 Create a grid for all functions

3 Determine programming based on orientation and logistics

4 Close plinth and create shared spaces

5 Build volume up and raise plinth

6 Adjust volume to solar orientation



Building concept

1. Establish plot
2. Create a grid for all functions
3. Determine programming based on orientation and logistics
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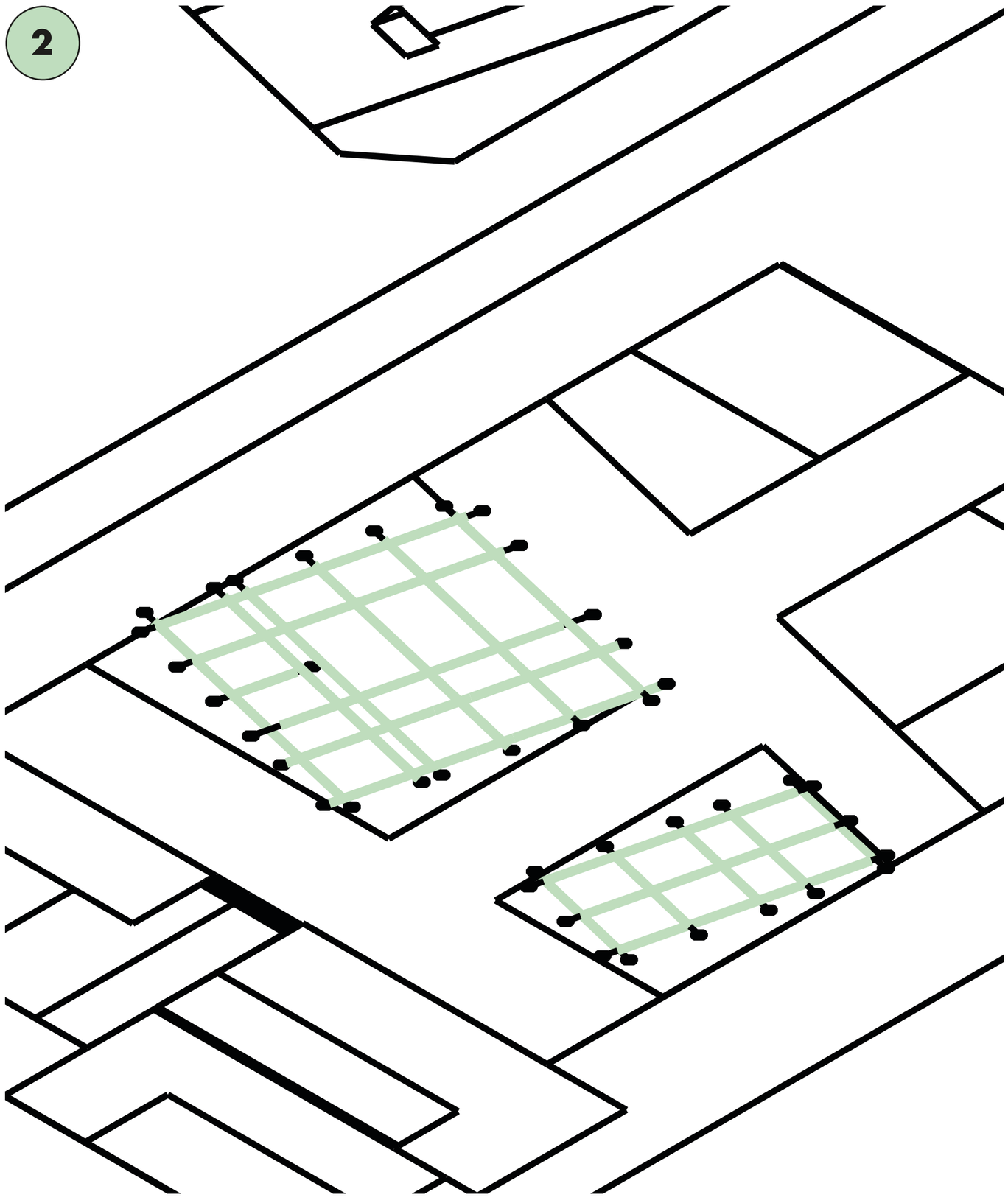
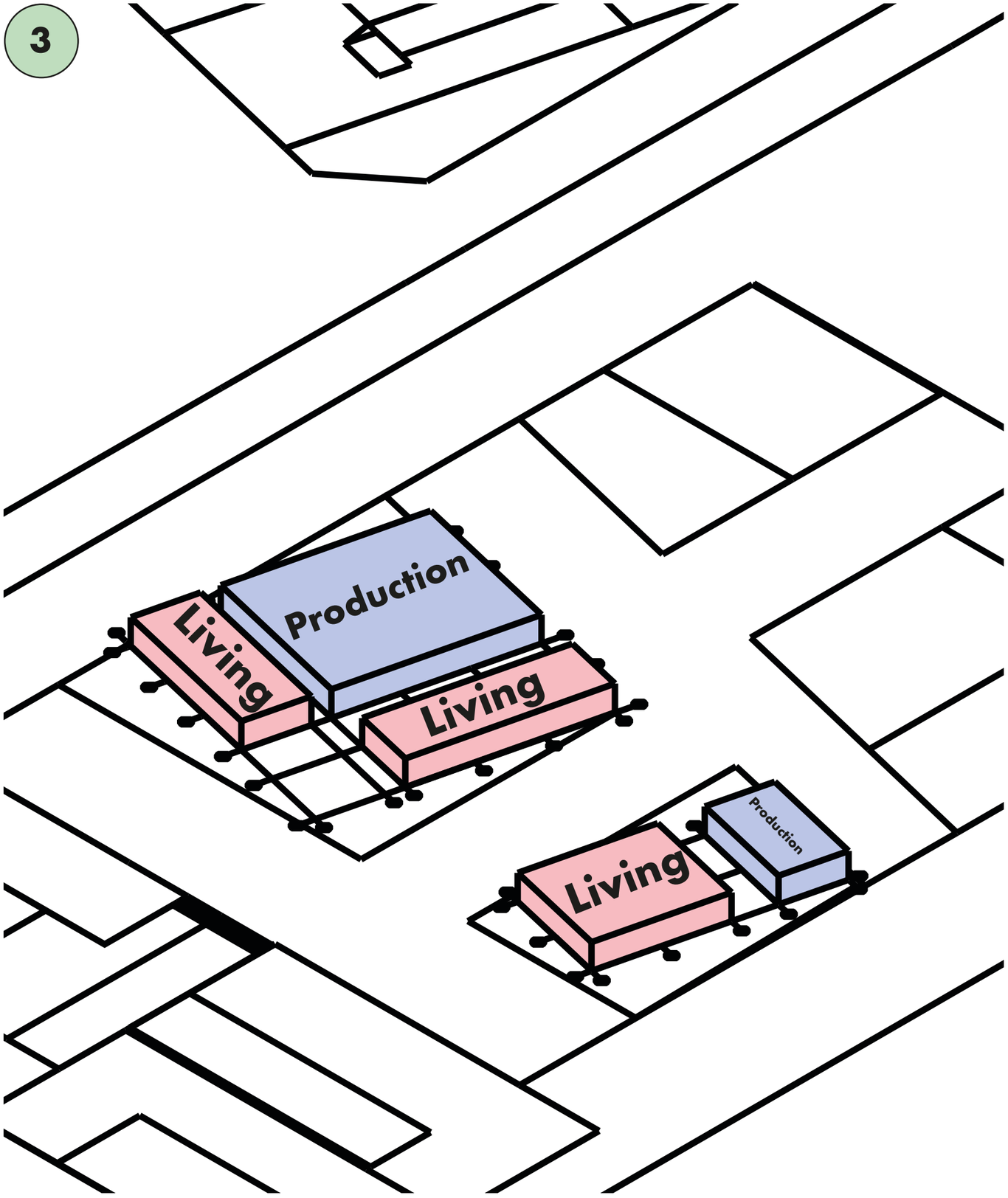
5. Build volume up and raise plinth
6. Adjust volume to solar orientation



Building concept

1. **Establish plot**
2. **Create a grid for all functions**
3. **Determine programming based on orientation and logistics**
4. **Close plinth and create shared spaces**
5. **Build volume up and raise plinth**
6. **Adjust volume to solar orientation**



Building concept

1. Establish plot
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3. Determine programming based on orientation and logistics
4. Close plinth and create shared spaces
5. Build volume up and raise plinth
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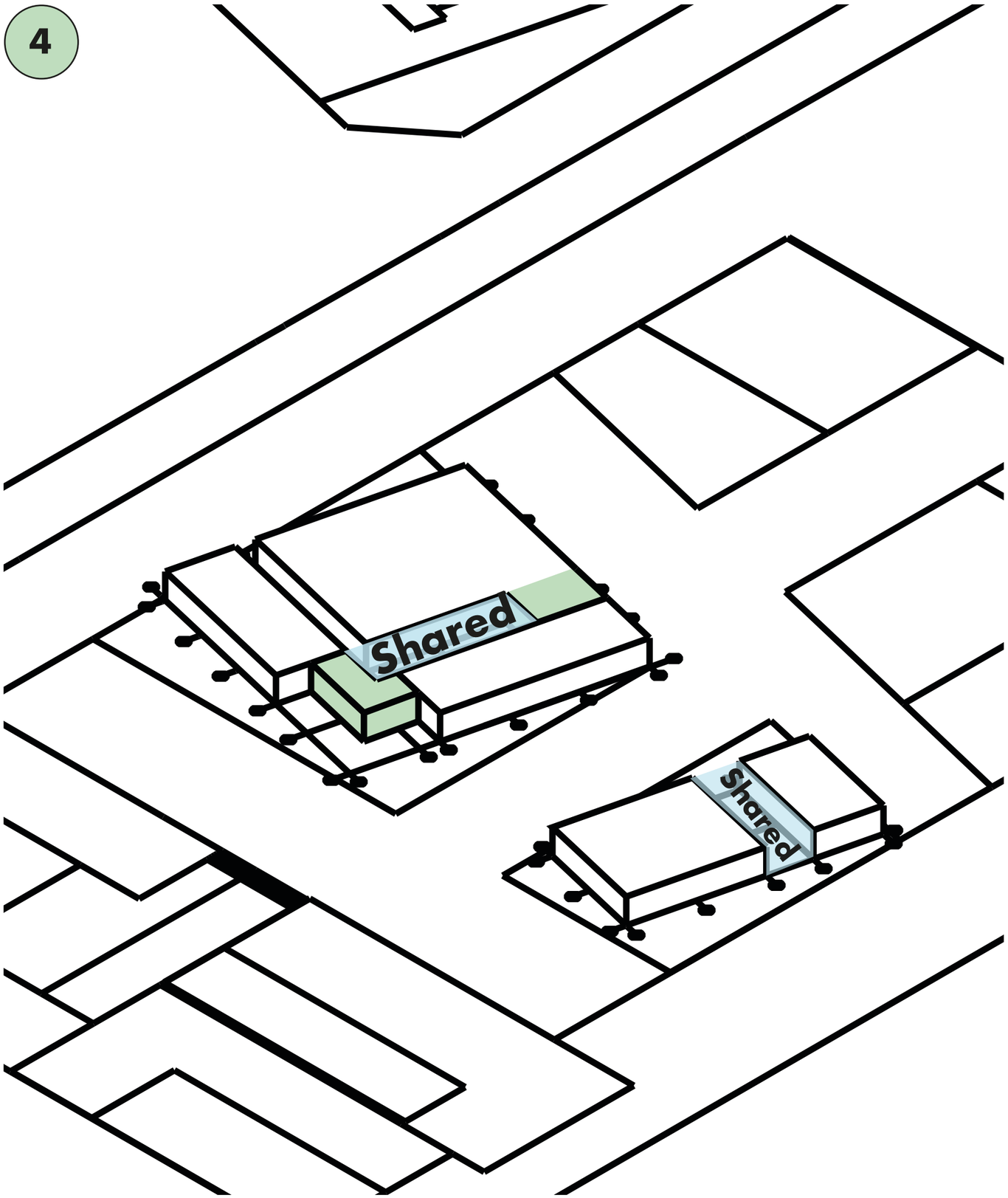

Building concept

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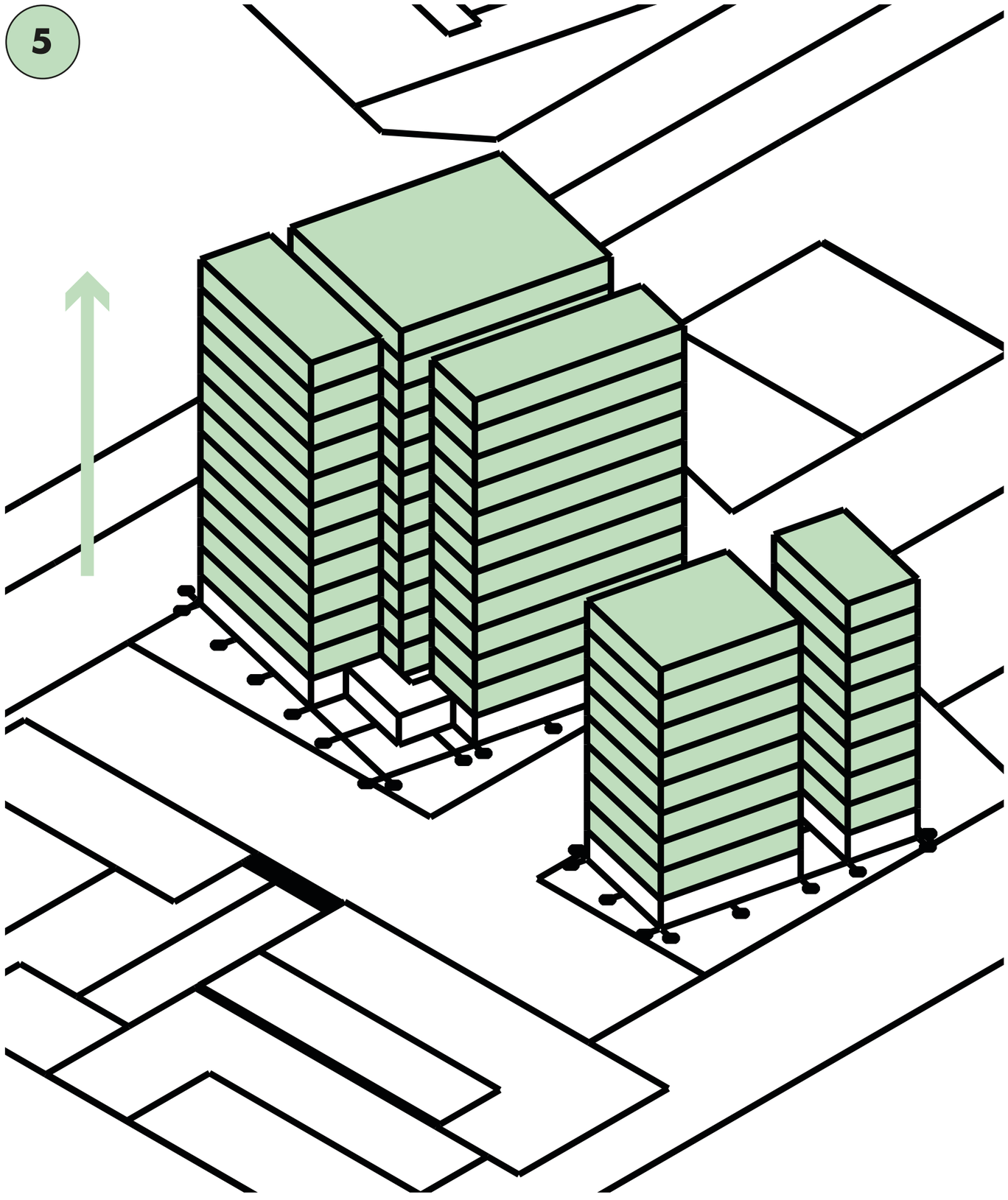

Building concept

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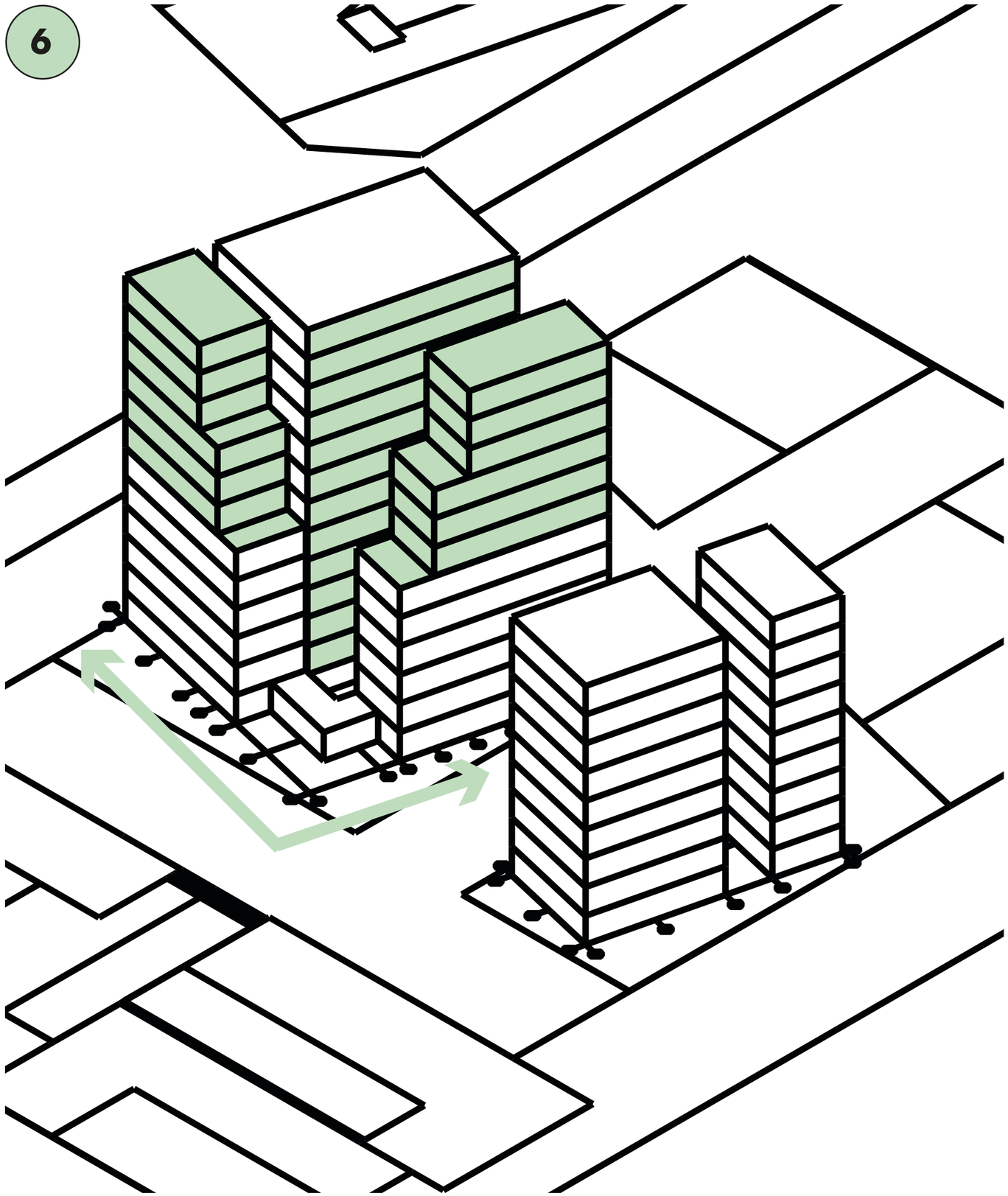

Building concept

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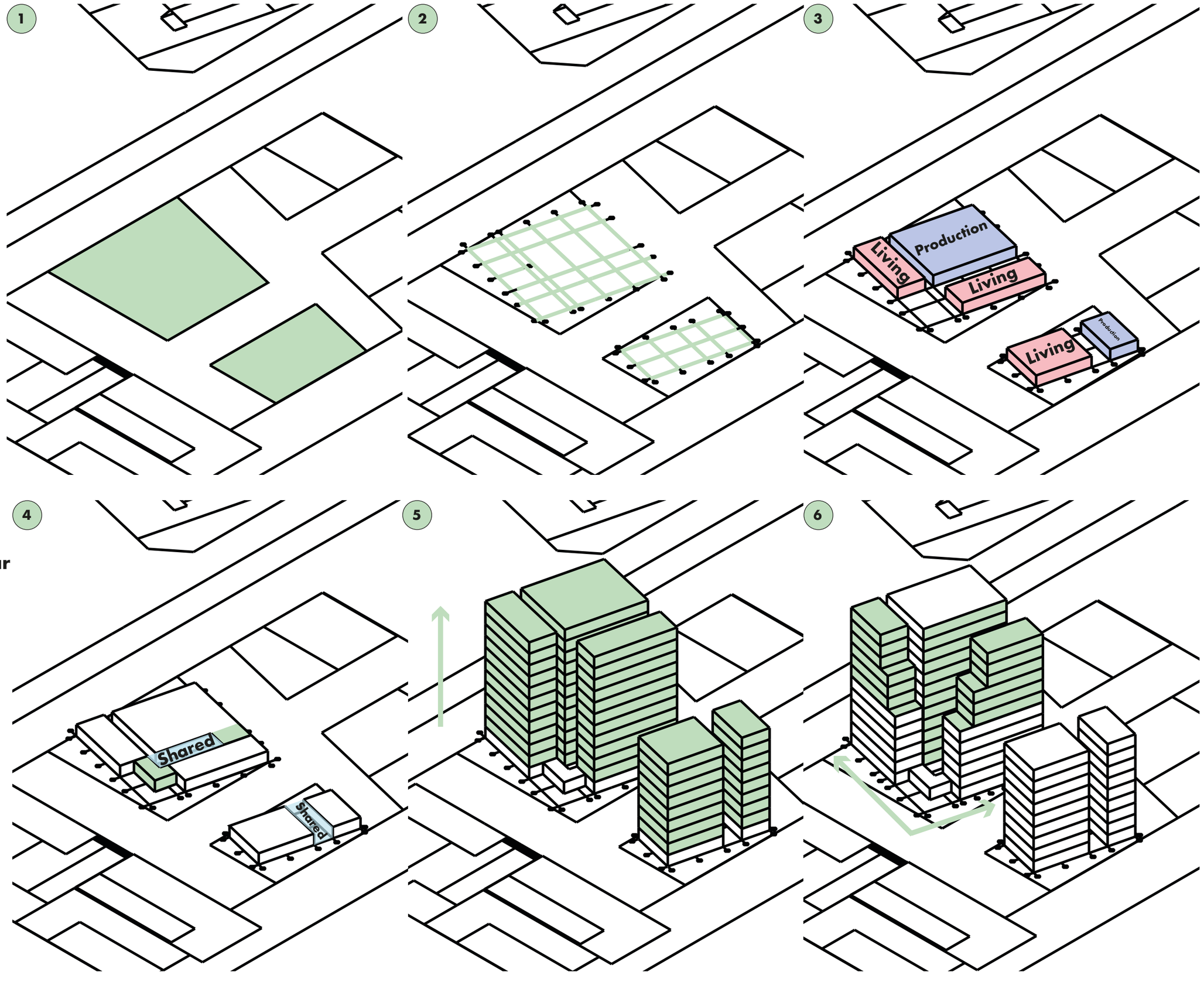
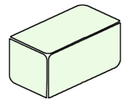
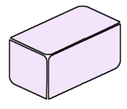
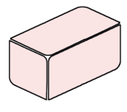
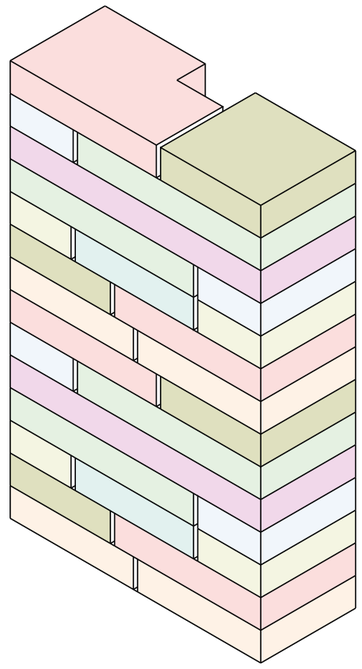


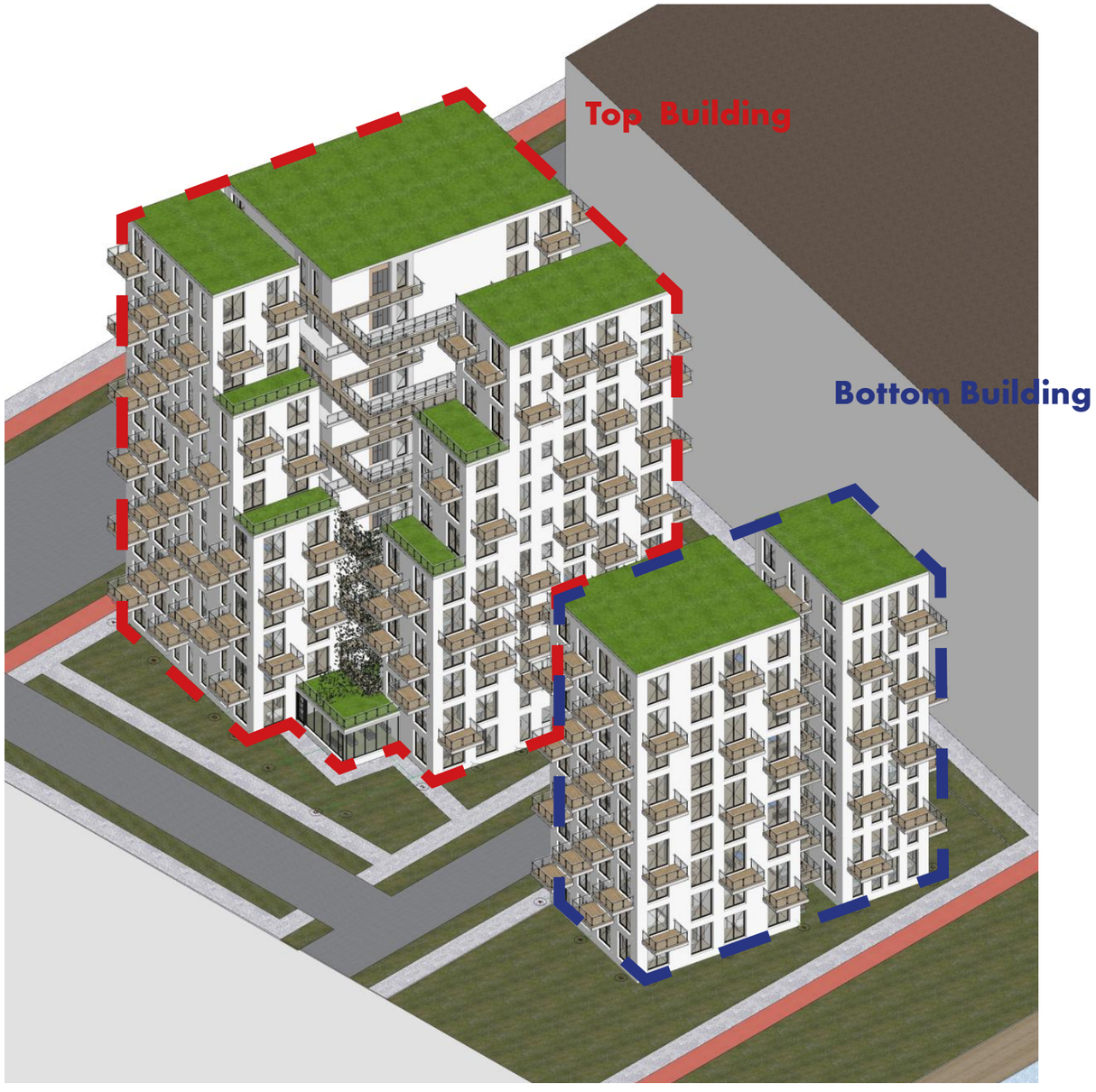
Target groups

Size	Type	
Solo Dwellers 30-50 m2		Students,Elderly,Starters
Familie dwelling 50-90 m2		Starters,Families
Communal living 100-130 m2		Students,Elderly,Starters
Industrial 3D Printing 200-400 m2		Medical companies Nautical companies Automotive companies
Small scale production/working space 10-70 m2		Arts and crafts Prototyping(3d Printing) Communal working space

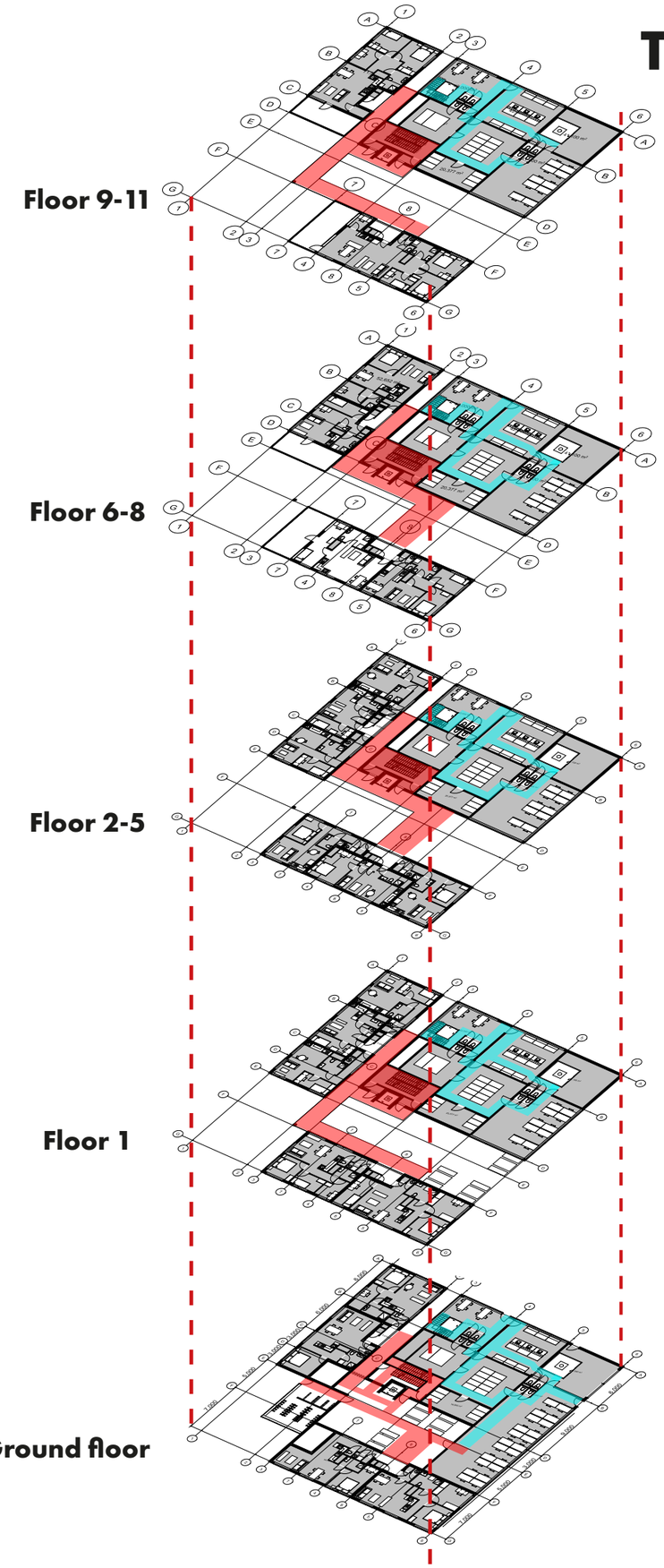
Building concept

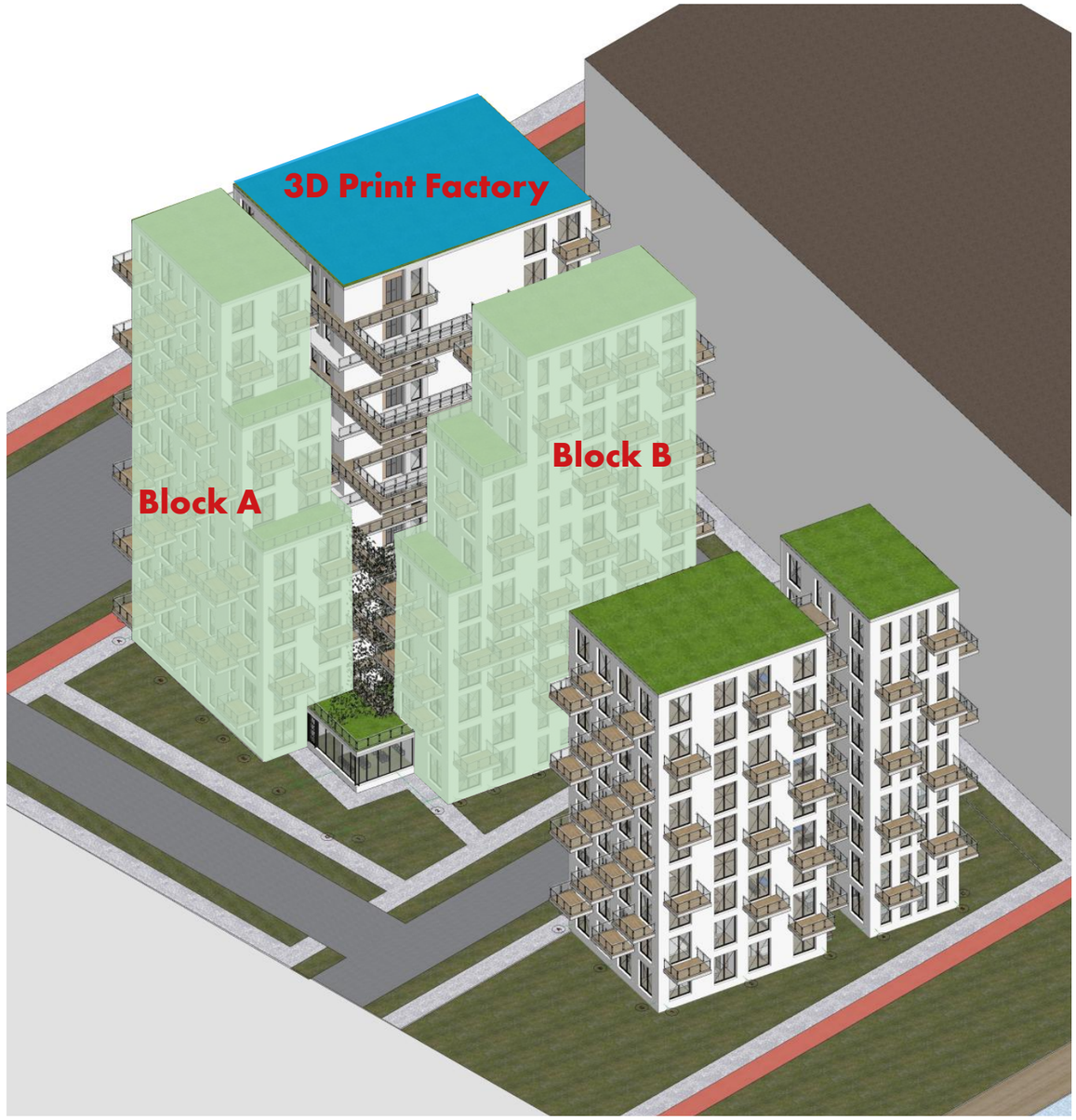


Key concept of adaptbility



Top building

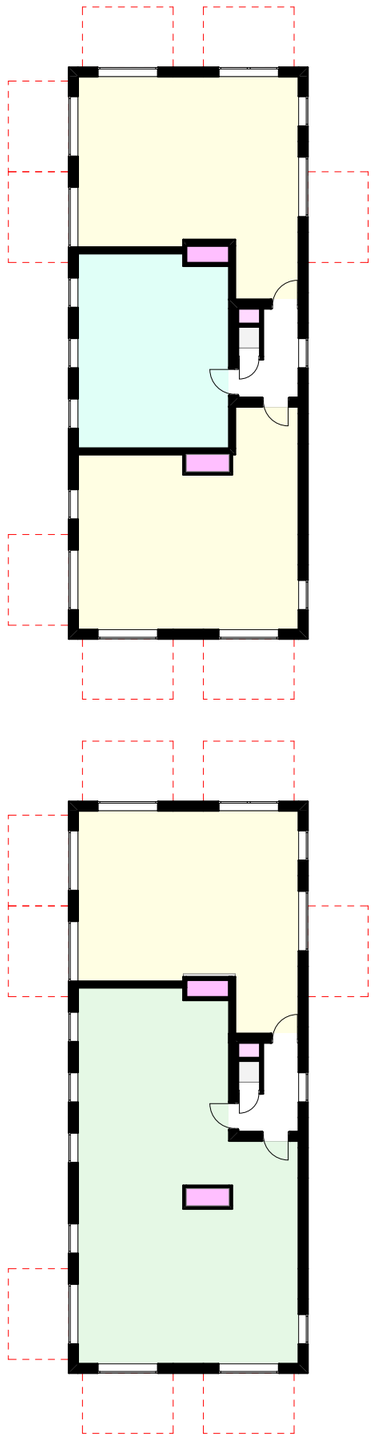


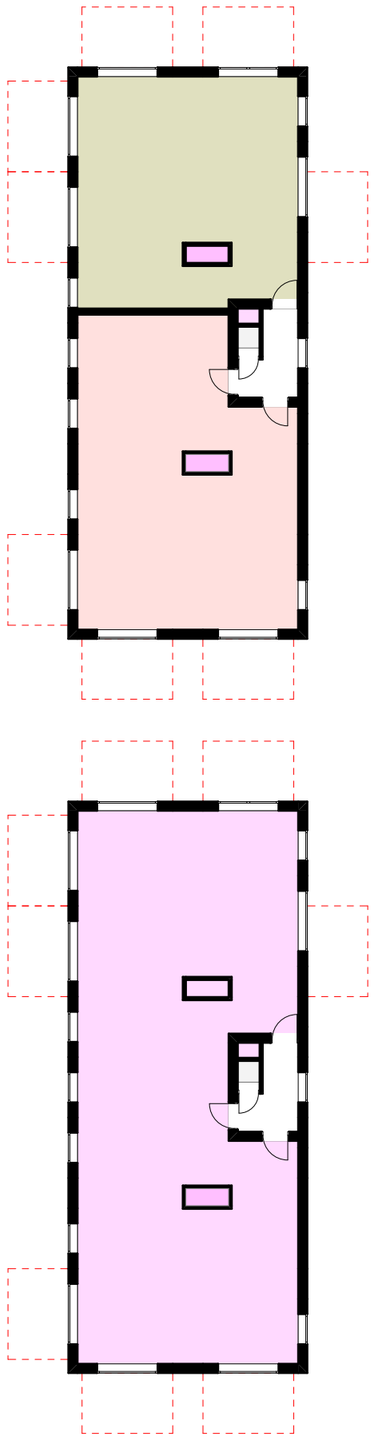


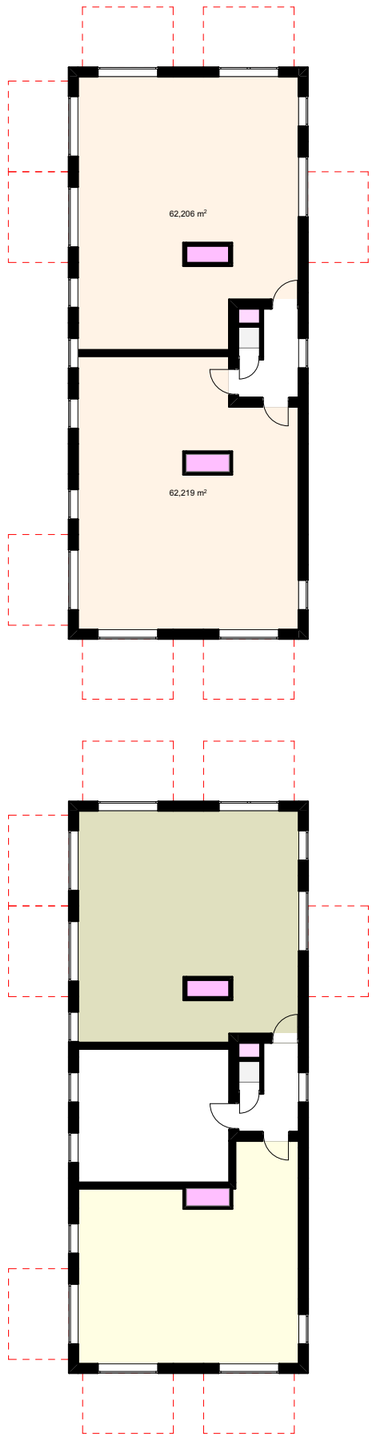
Living

Production

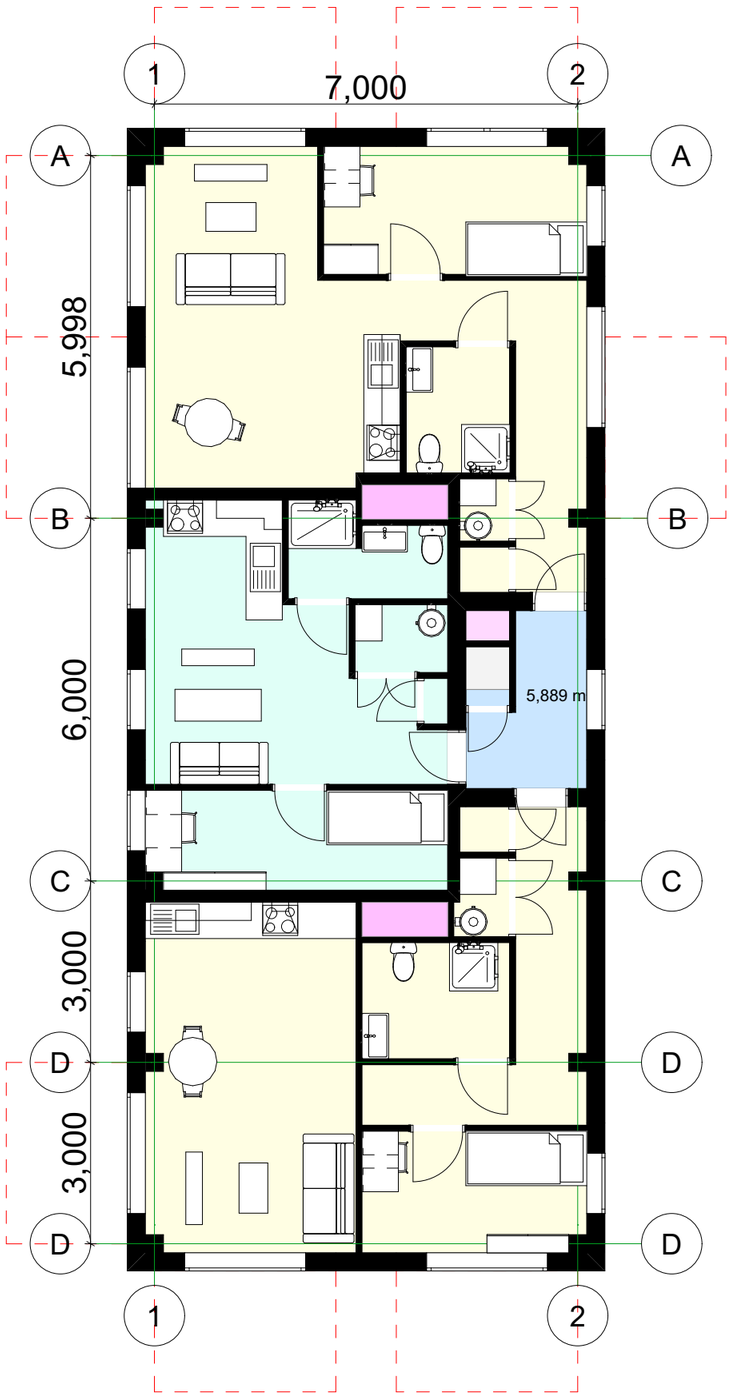
Living block A



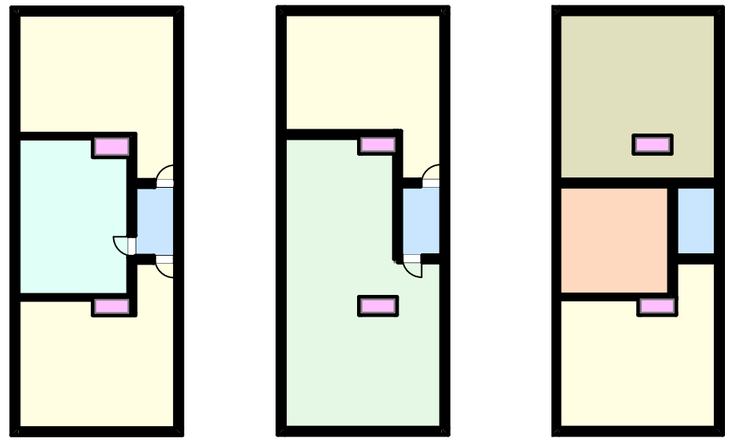




Type 1 Solo dwellers



Variants

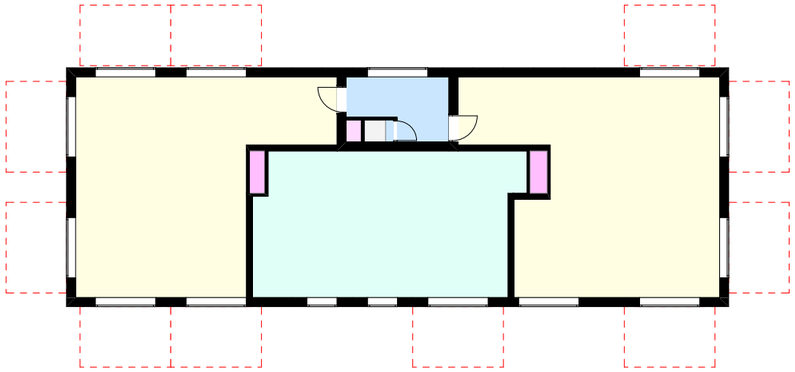


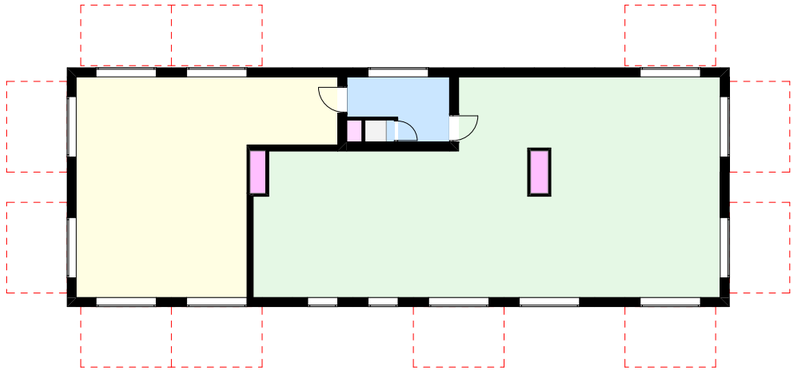
Target group:
Solo Dwellers(Starters, Elderly and students)

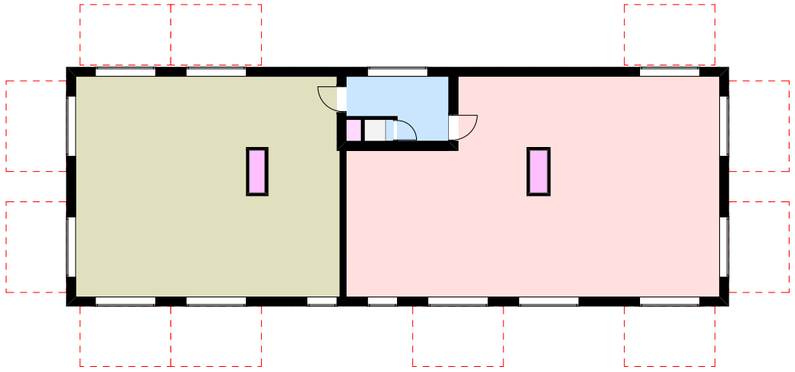
Size of appartment: 38 m2
M2 per person: 38m2

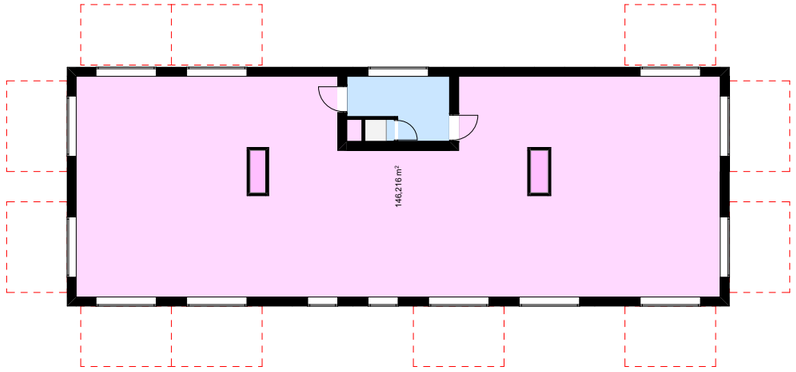
1 Bedroom
1 Living kitchen
1 Bathroom

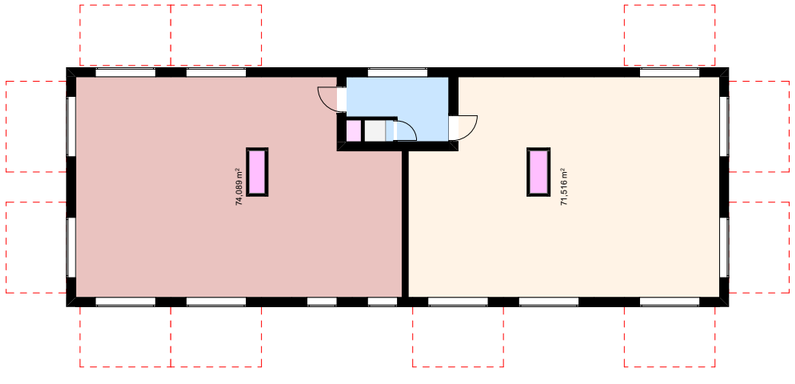
Living block B

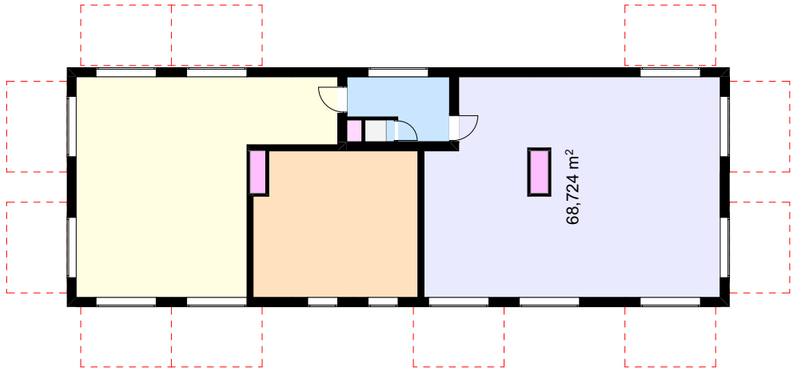




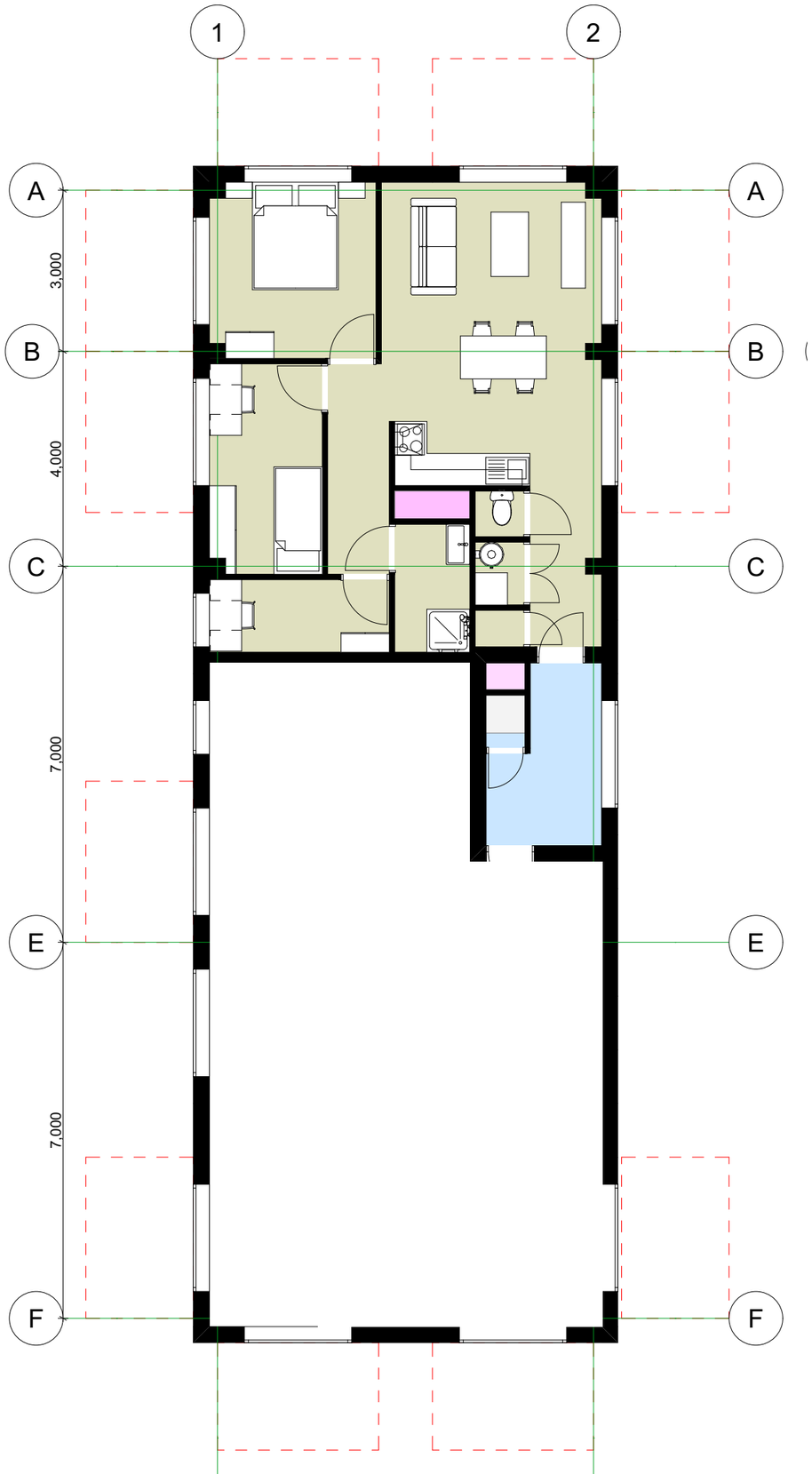




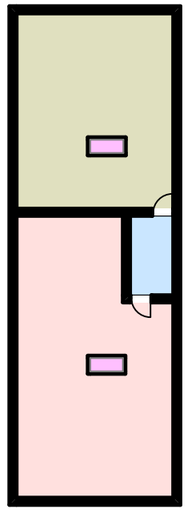




Type 2 Duo or Families



Variants

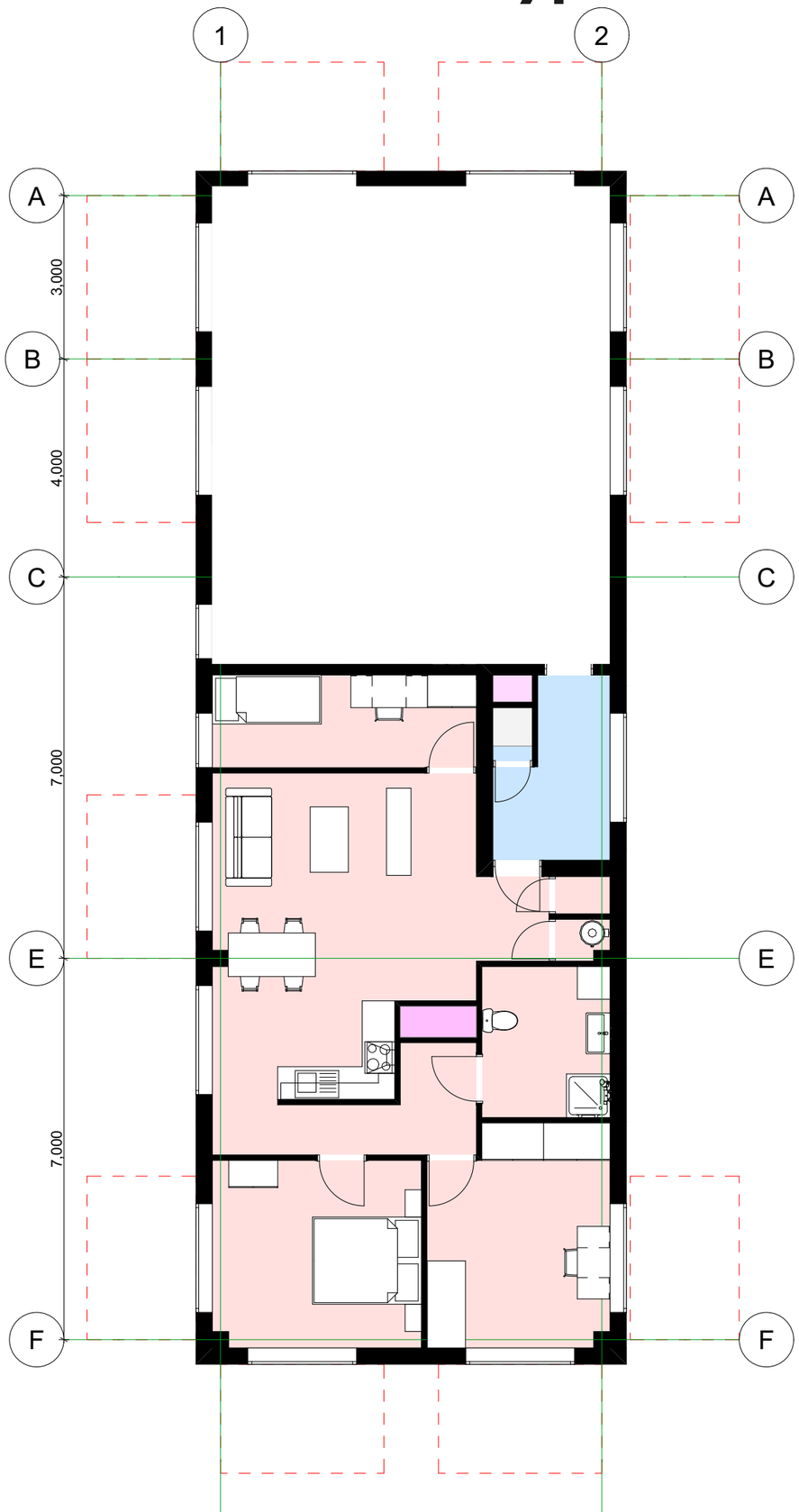


Target group:
2P households and families (Starters)

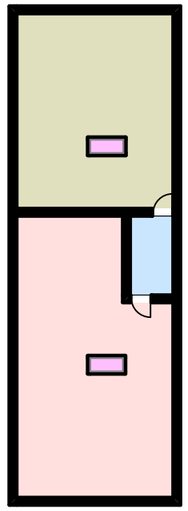
Size of appartment: 57 m2
M2 per person: 19 m2

1 Bedroom
1 Living kitchen
1 Workspace
1 Bathroom
1 Balcony

Type 3 Starter Families



Variants



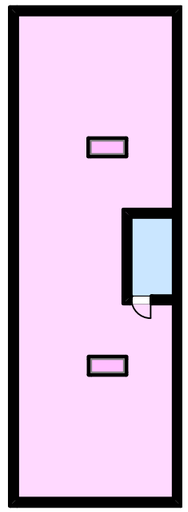
Target group:
Families (Starters)

Size of appartment: 72 m2
M2 per person: 24 m2

2 Bedrooms
1 Living kitchen
1 Workingspace
1 Bathroom
2 Balconies

Type 4 Communal living of solo dwellers

Variants

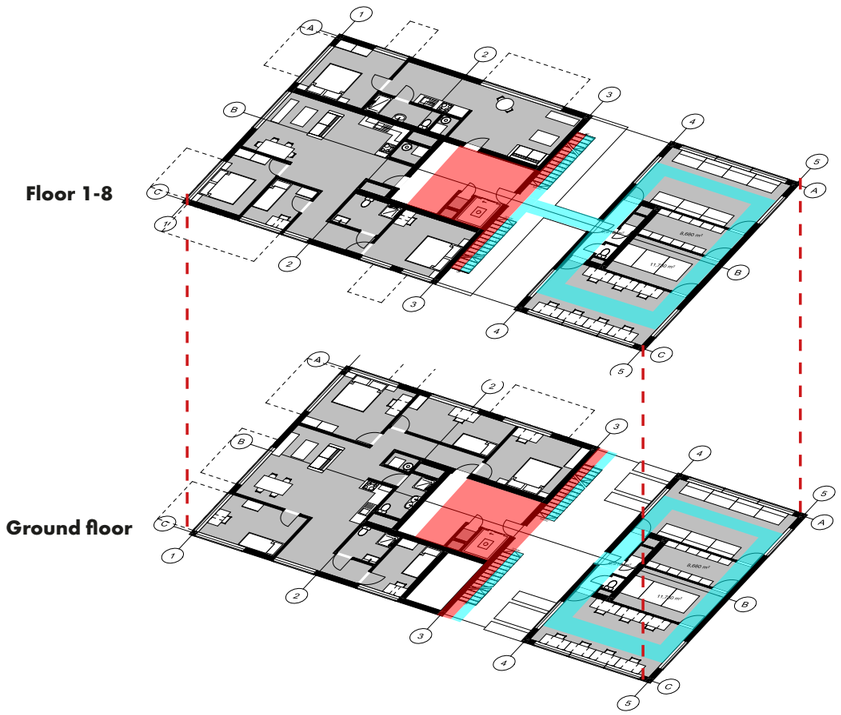


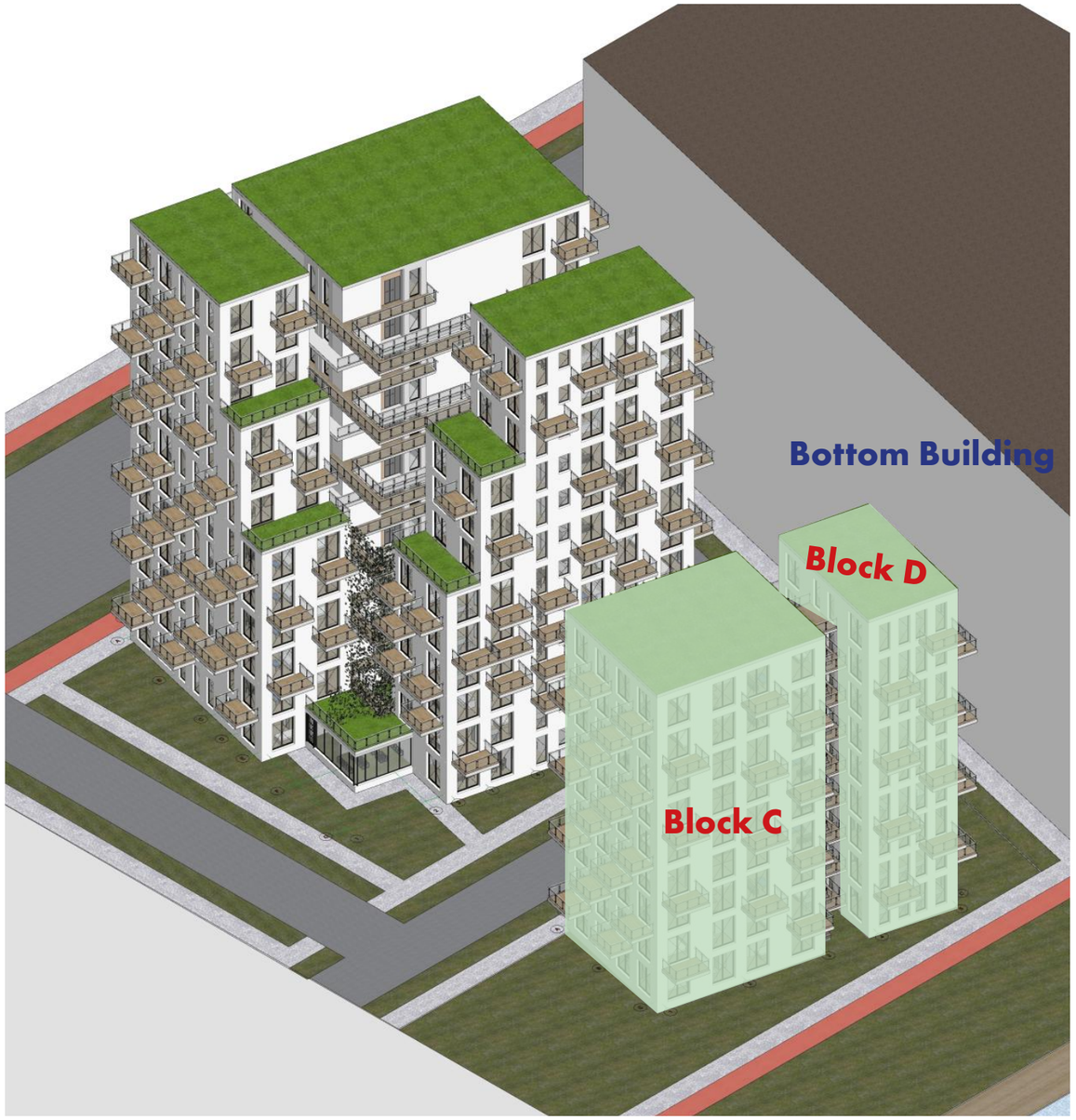
Target group:
Solo Dwellers (Students, Elderly, Starters)

Size of type: 130 m2
M2 per person: 16,25-21,6 m2

6 Bedroom
1 Shared Living kitchen
2 Bathroom
5 Balconies

Bottom Building

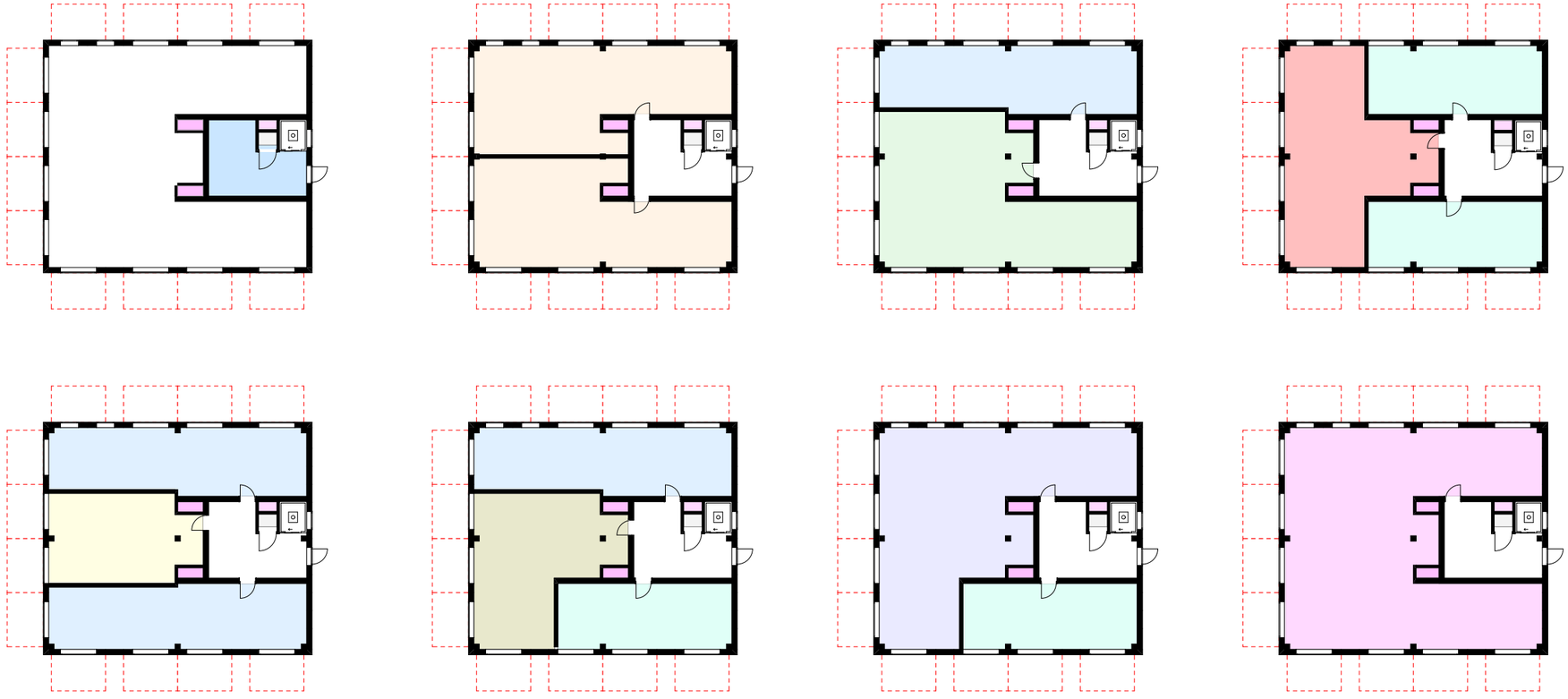




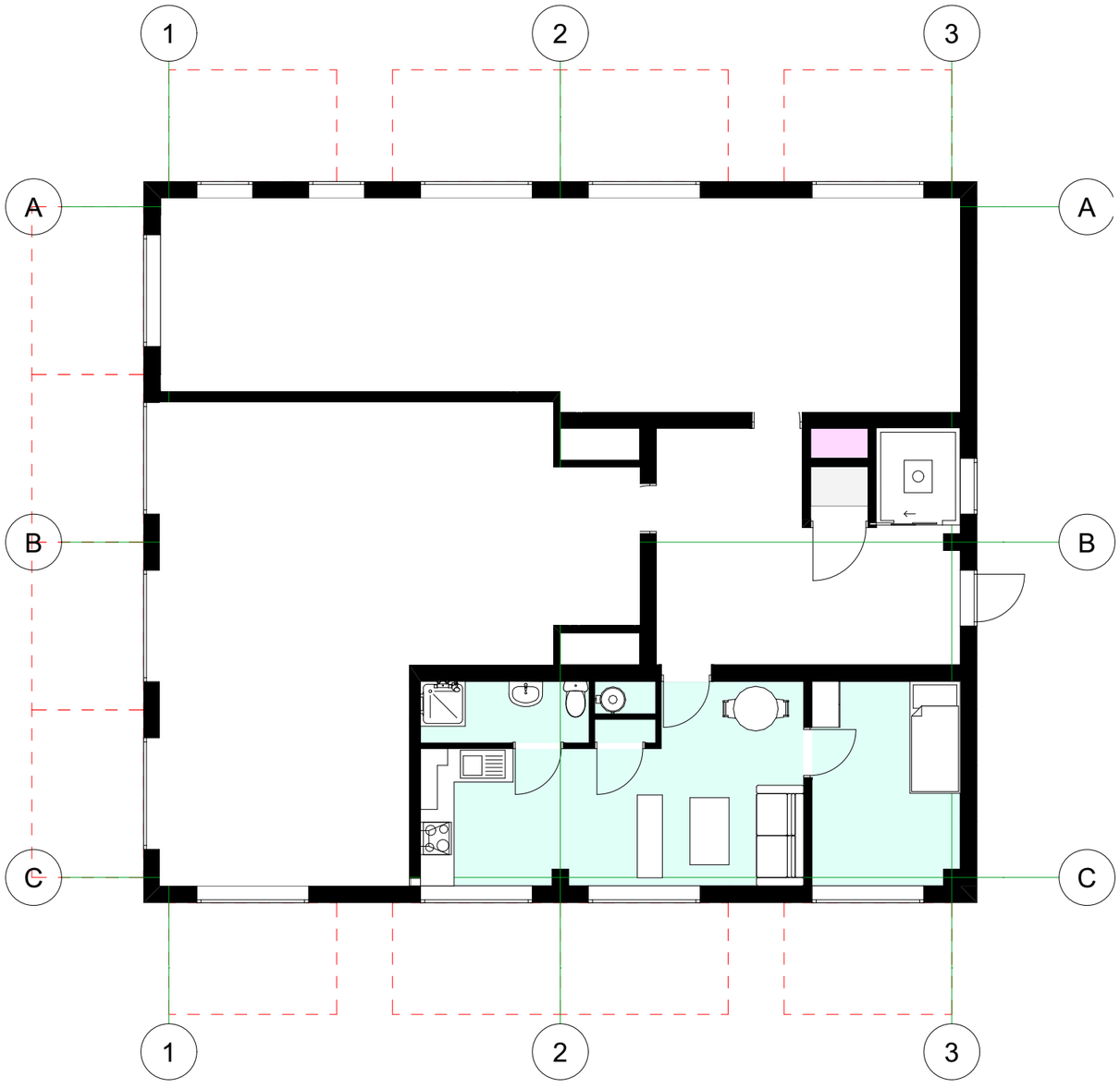
Living

Production

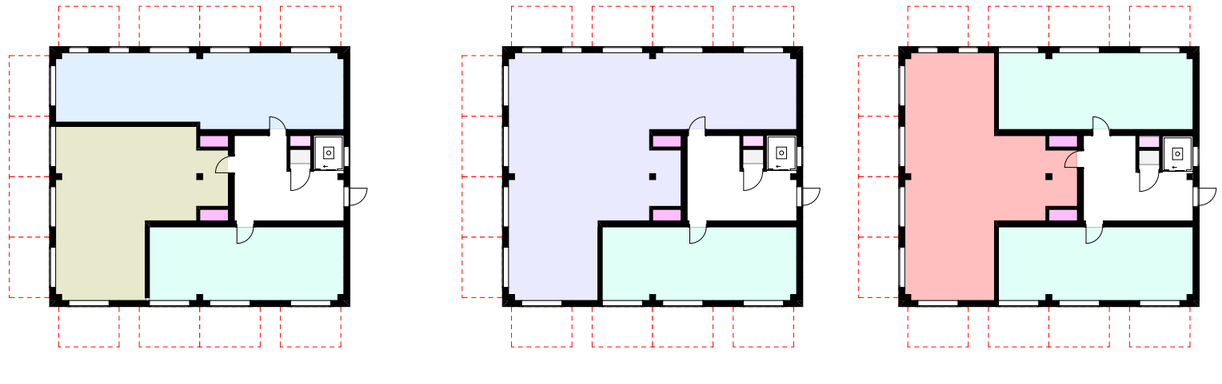
Living block C



Type 5 Solodwellers



Variants

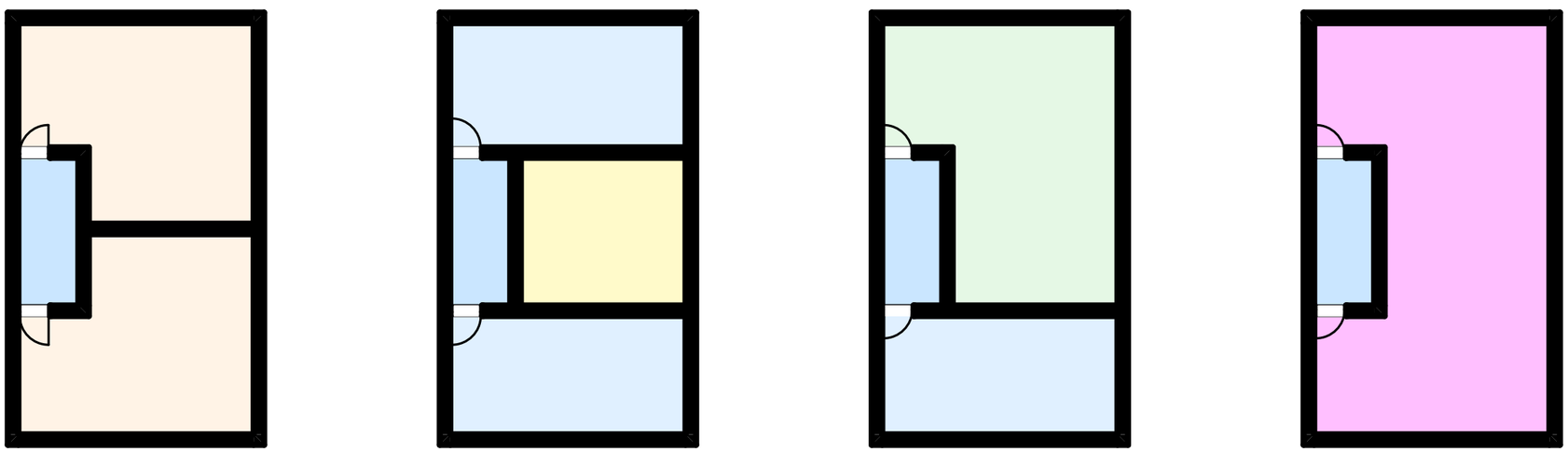


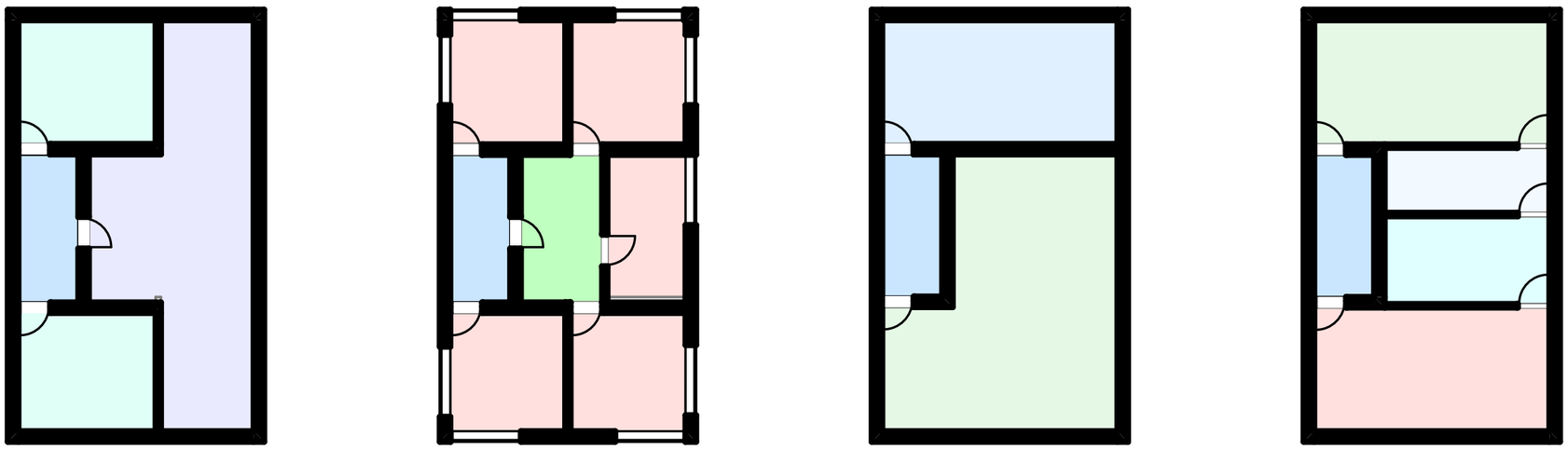
Target group:
Solo Dwellers (Students, Starters and Elderly)

Size of type: 35 m2
M2 per person: 35 m2

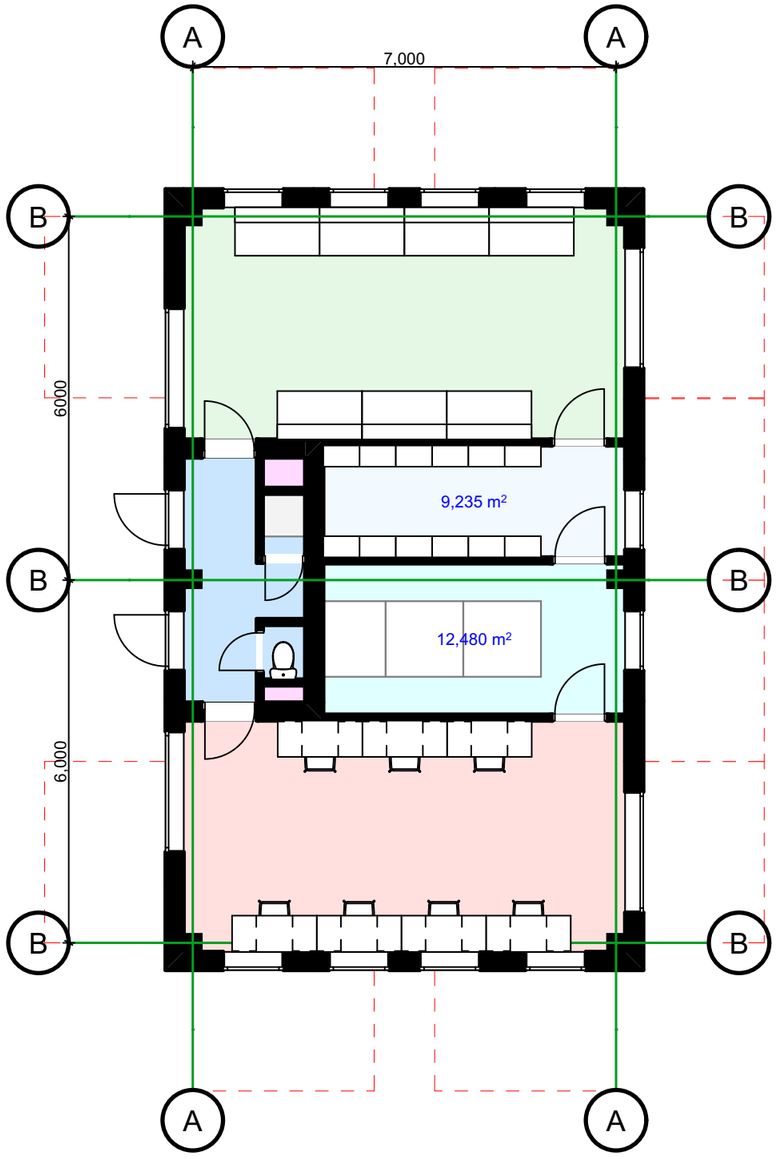
1 Bedroom
1 Living kitchen
1 Bathroom
1 Balcony

Production Block E





Type 1 SLS 3D printing factory



Target group:
Nautical, Automotive, Medical companies

Size of type: 70 m2

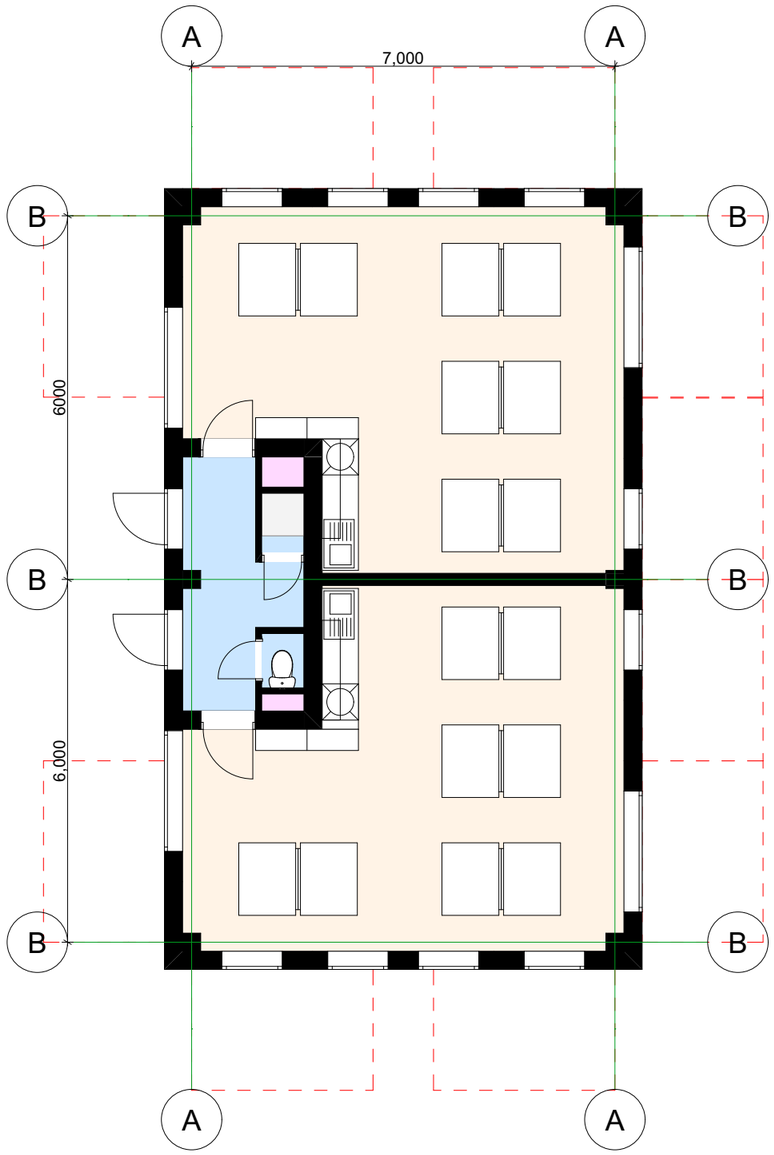
Modelling station

3D Printers

Storage

Polishing room

Type 2 Artist Workshop

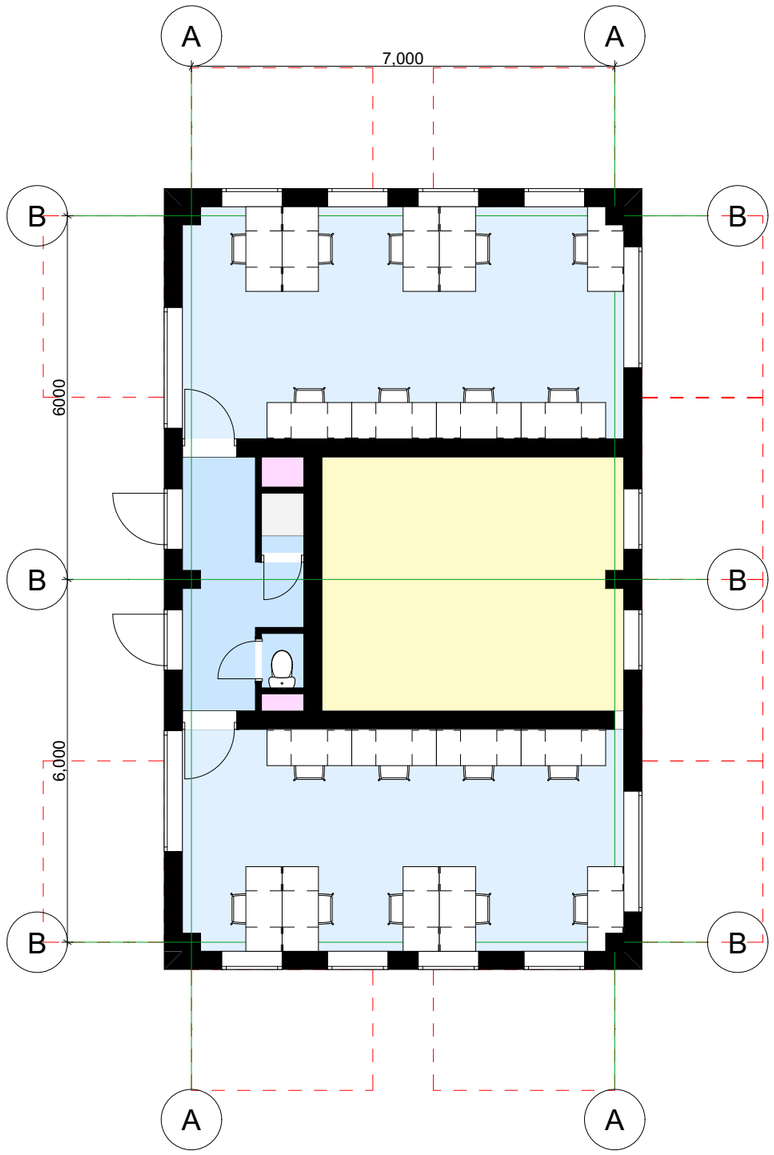


Target group:
Residents, Artists

Size of type: 35 m2

Workspace meant for artists and residents who want to learn art.

Type 3 shared working spaces

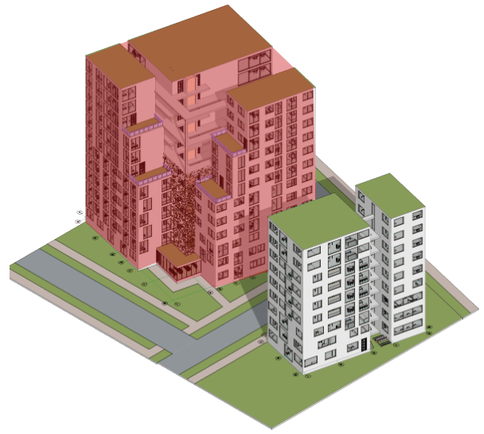


Target group:
Nautical, Automotive, Medical companies

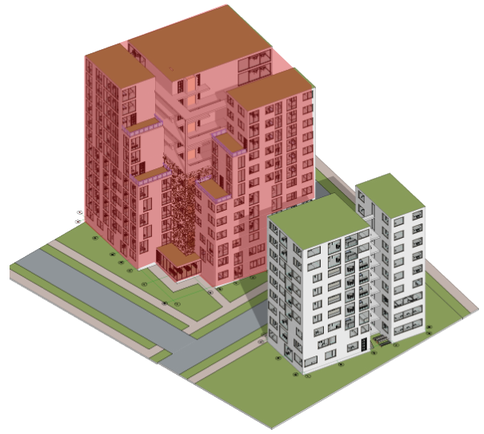
Size of type: 70 m2

Shared working spaces for the residents in the area.
In the middle a Space that can be used for multiple facilities (Joker room)

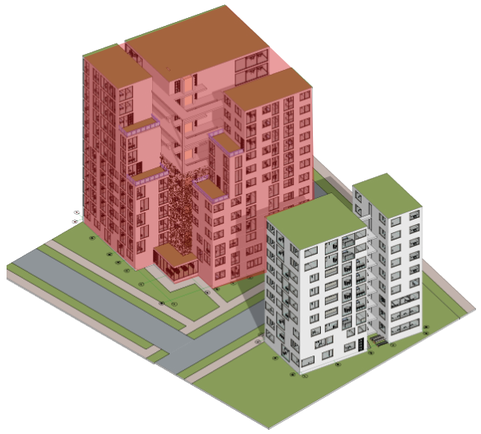
Groundfloor
1:200



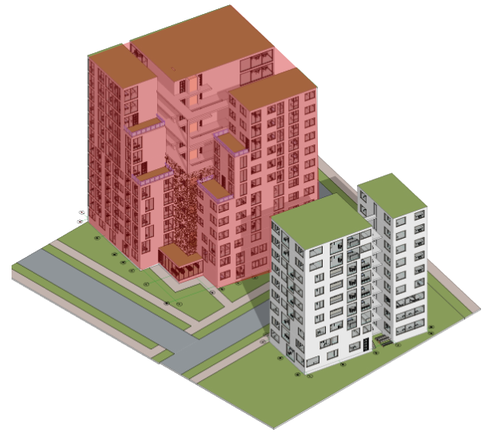
First Floor
1:200



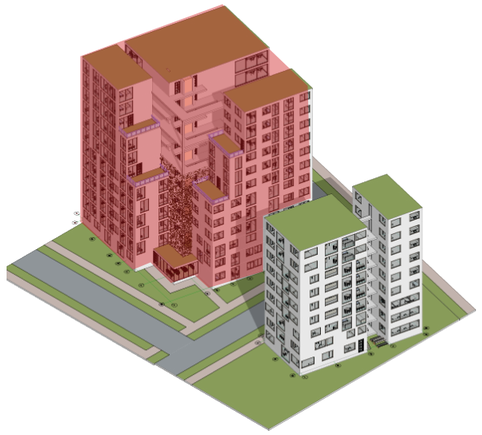
Second Floor
1:200



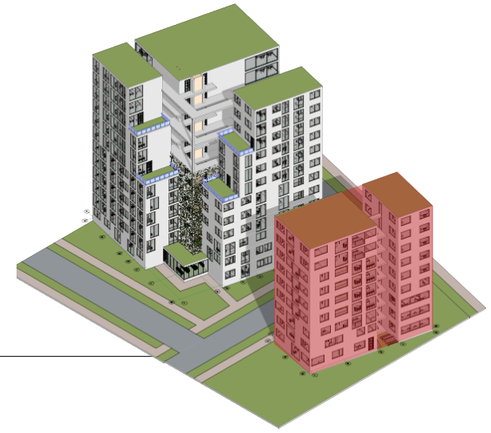
6th - 8th Floor
1:200



9th - 11th Floor
1:200



Ground Floor
1:100



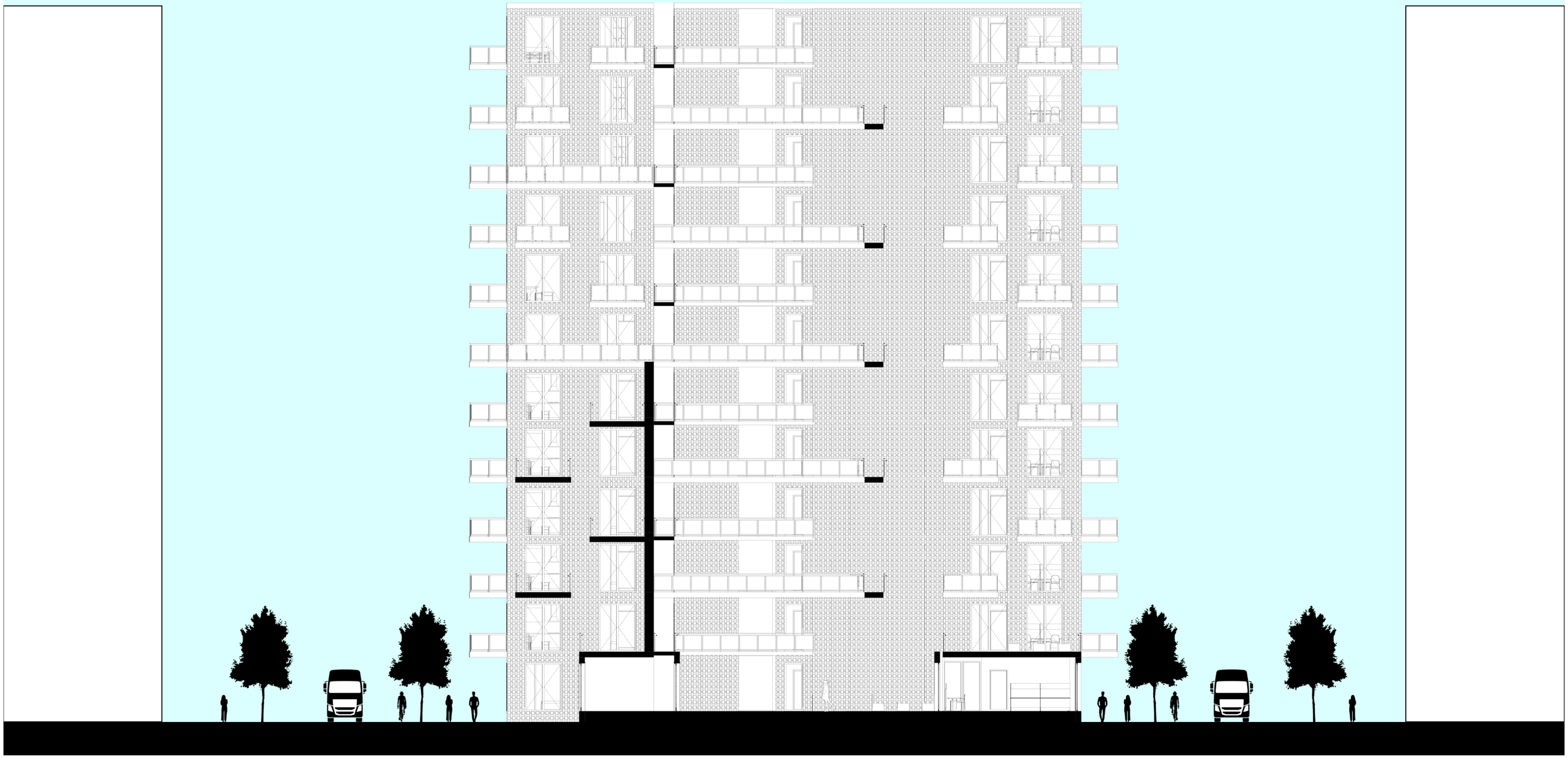
1st floor
1:100

2nd Floor

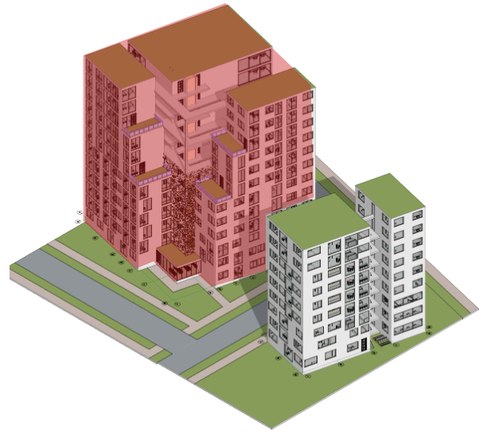
3th-6th Floor
1:100

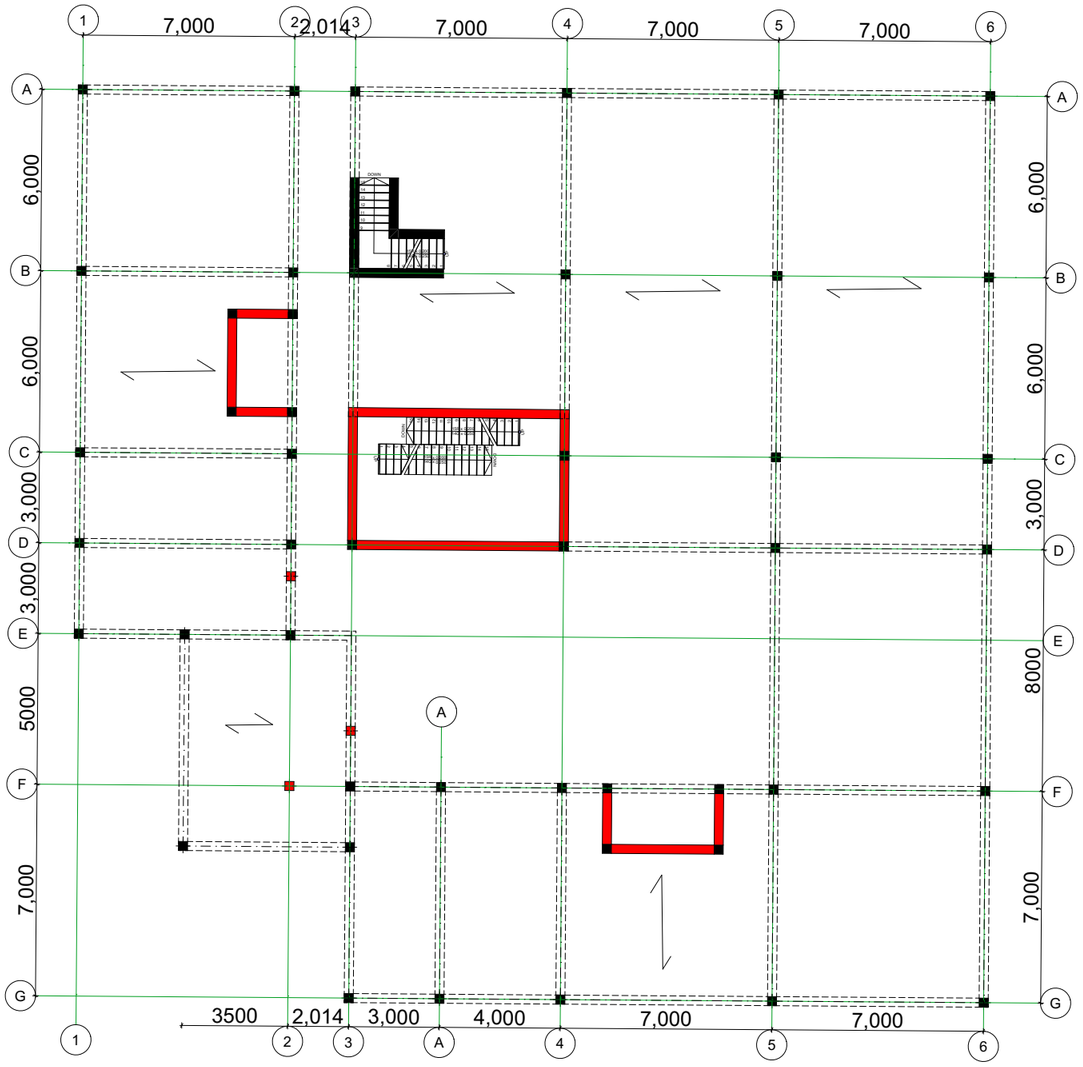
7th-8th floor

Section 1:200

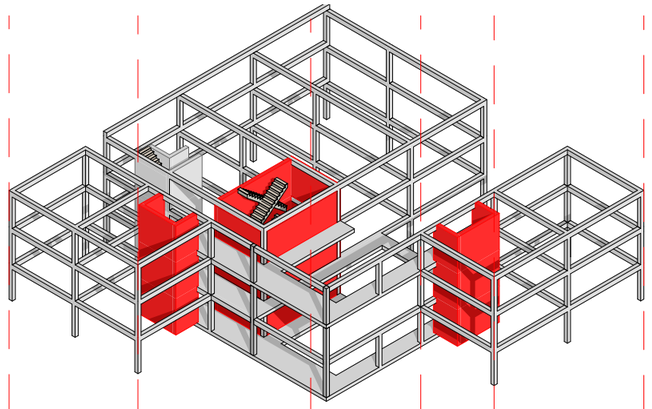


Loadbearing structure

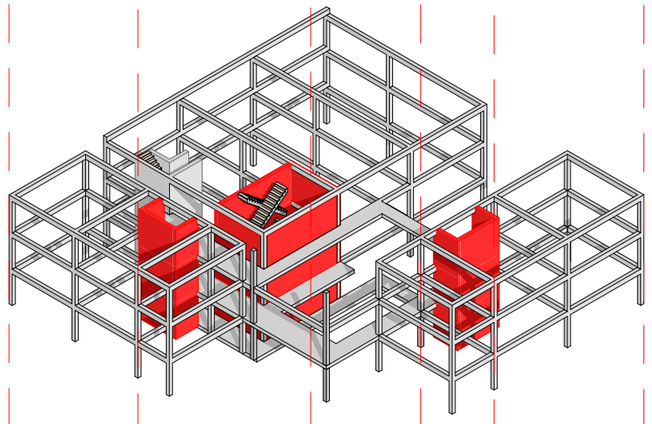




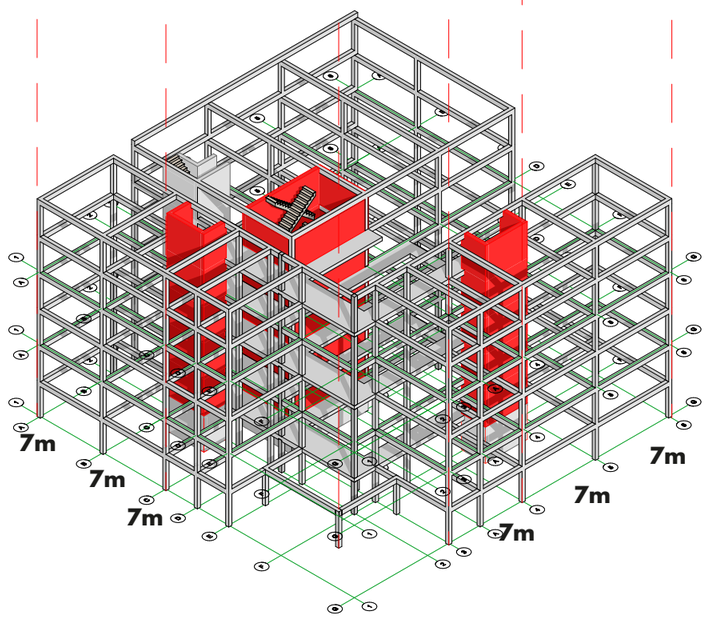
Floor 9-11



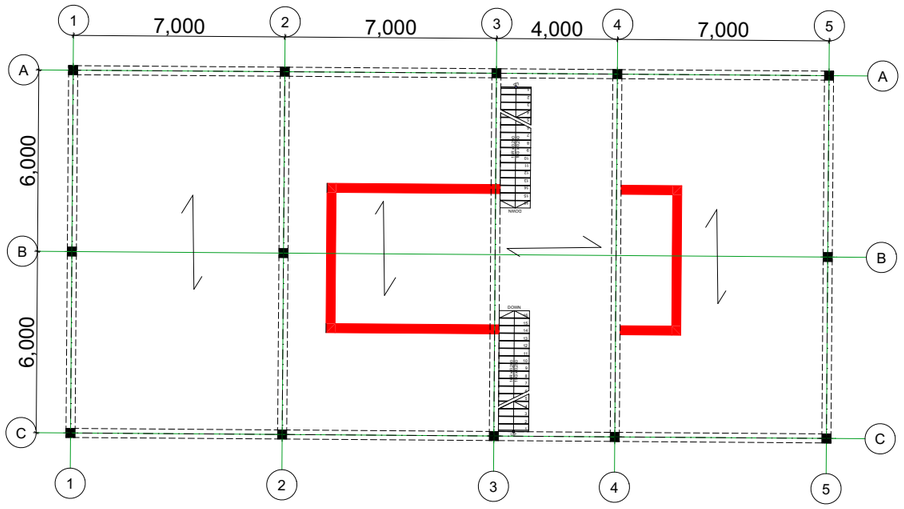
Floor 6-8

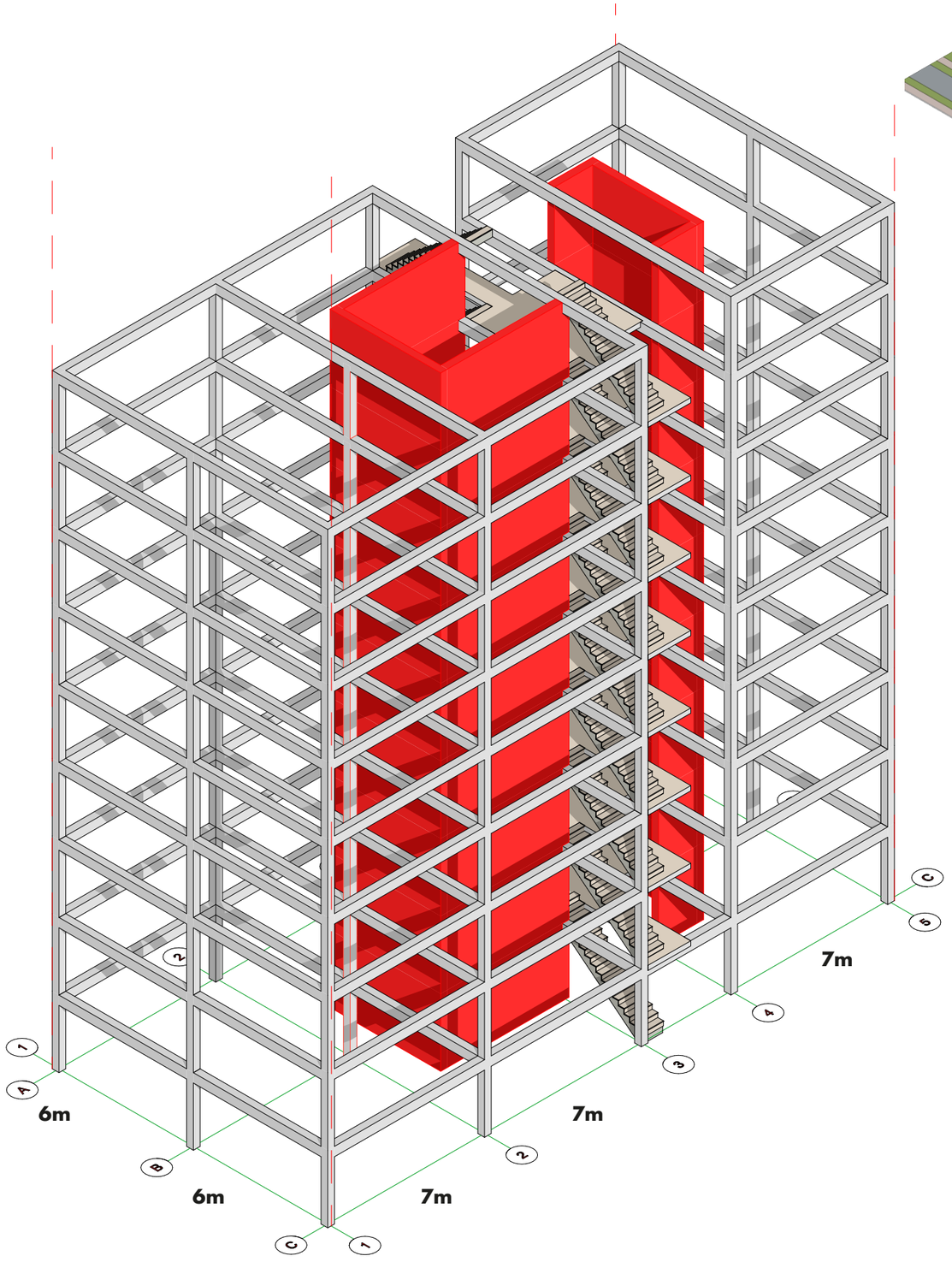


Floor 0-5

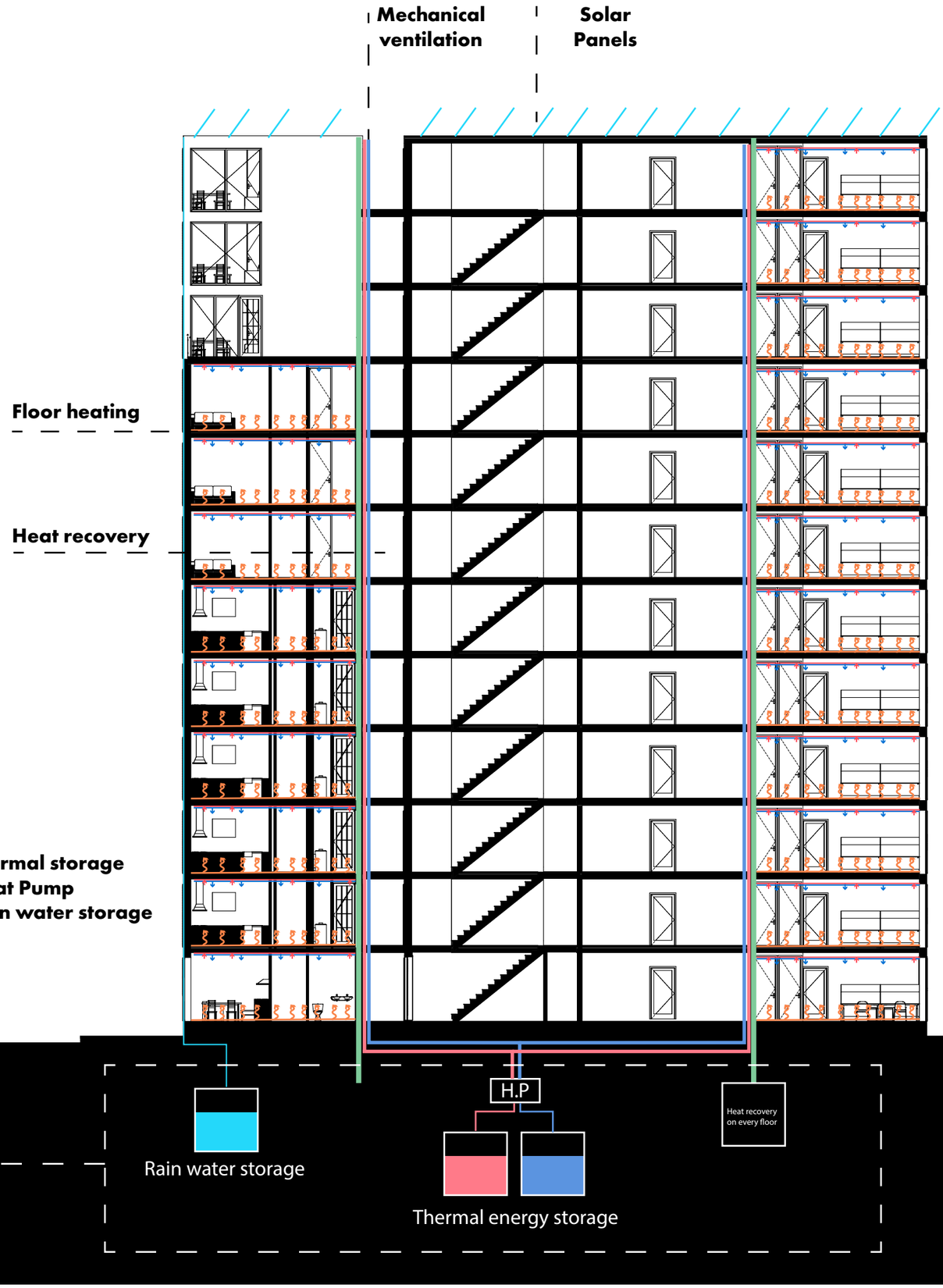


Loadbearing structure

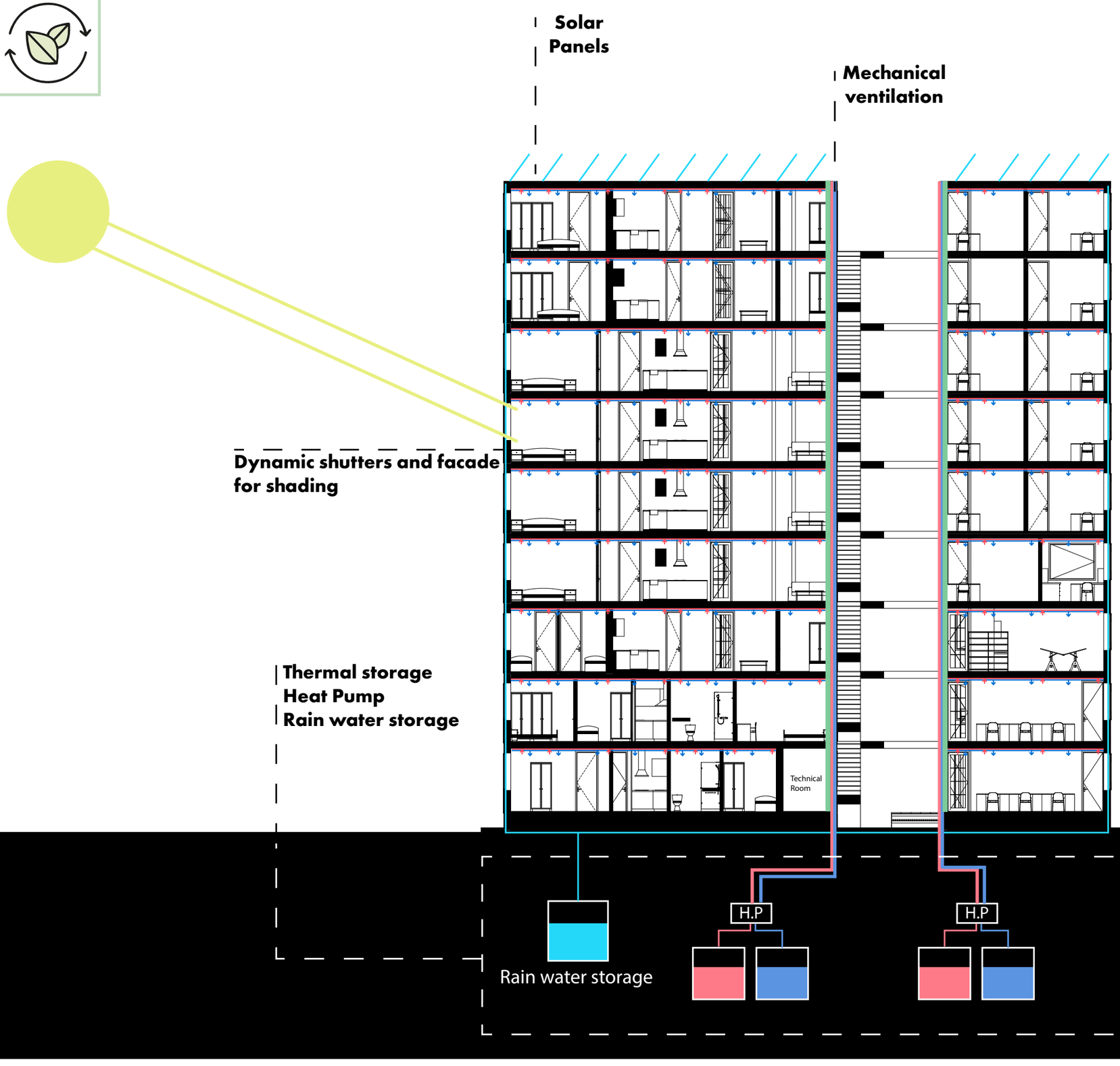




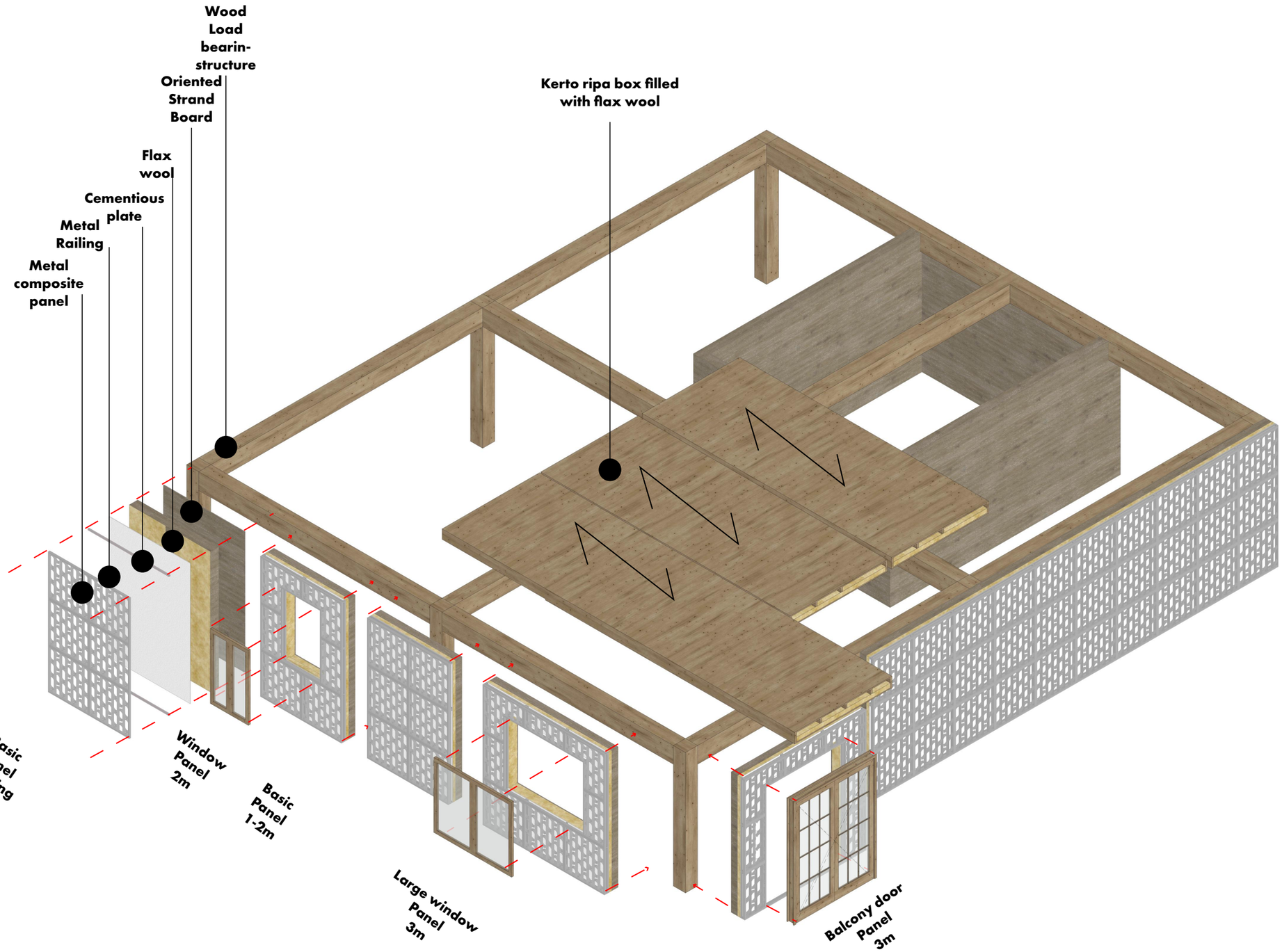
Climate principle

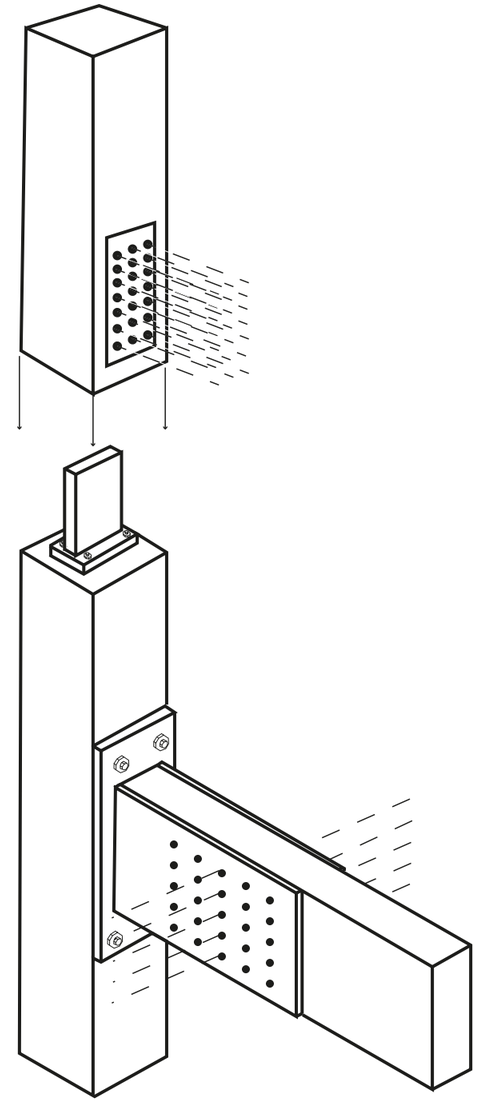


Climate principle

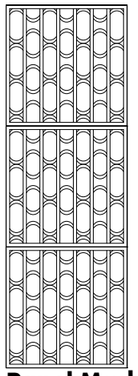


BT Principle

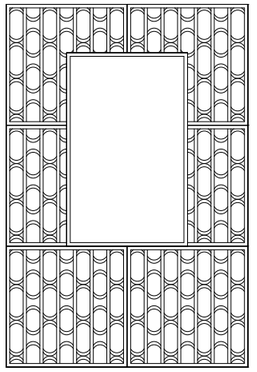




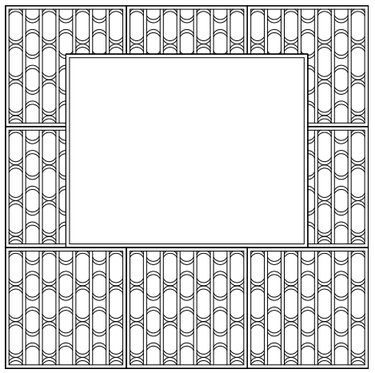
BT Principle



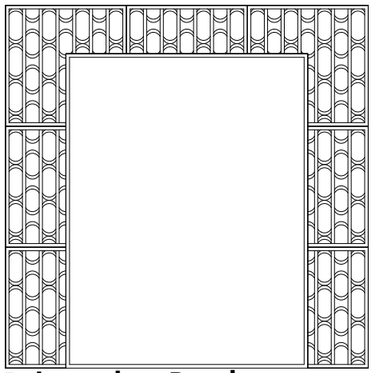
Panel Module
1m



Window Panel
2m

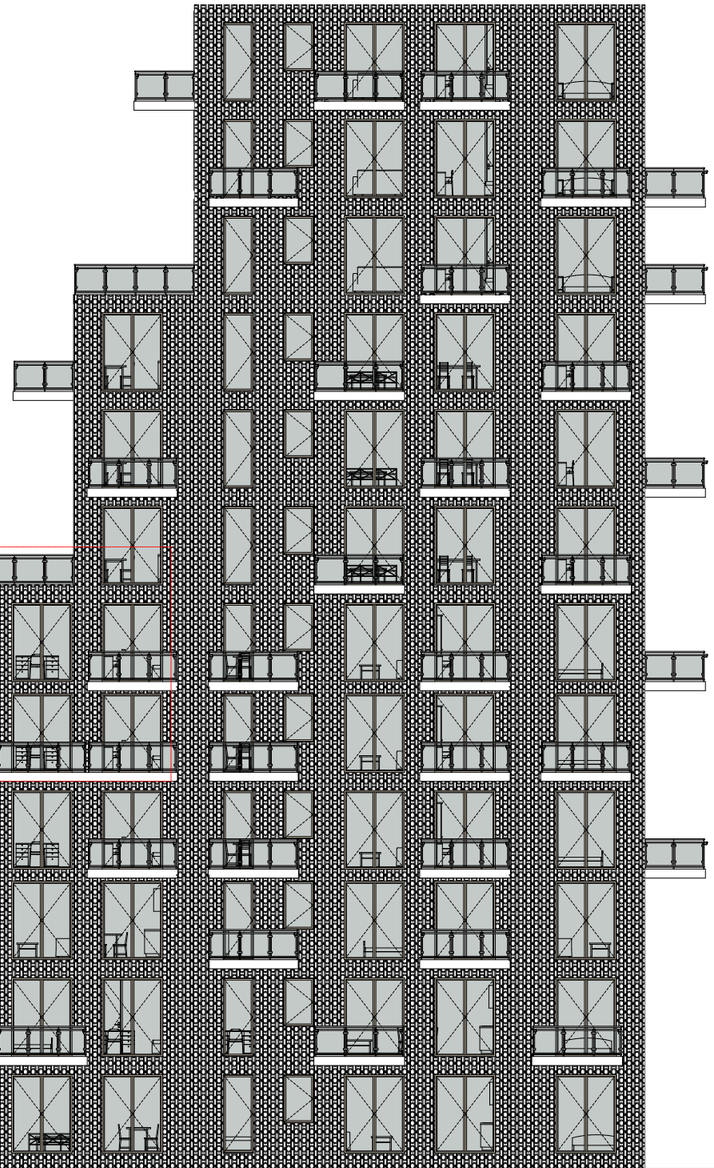


Large window Panel
3m

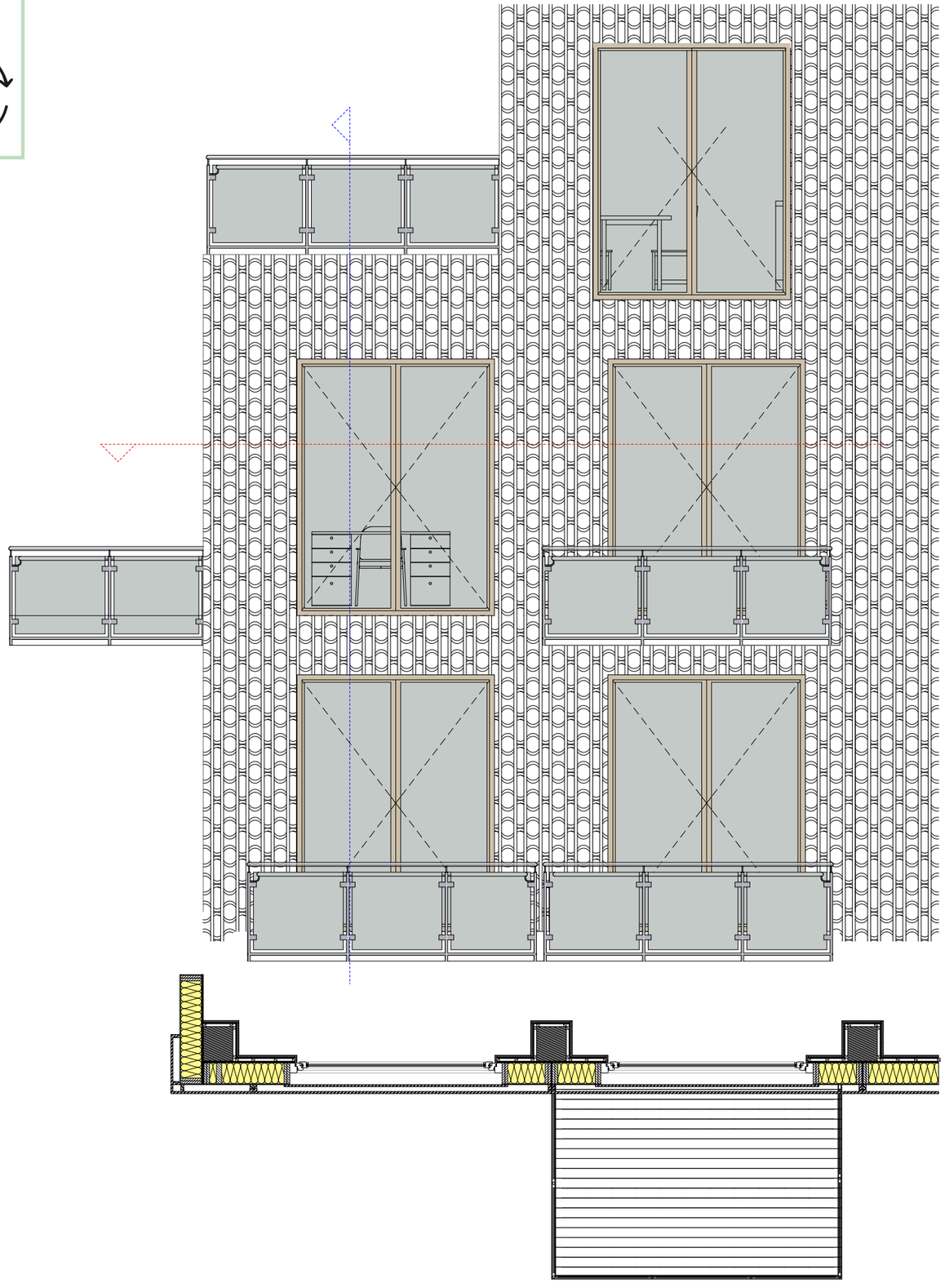


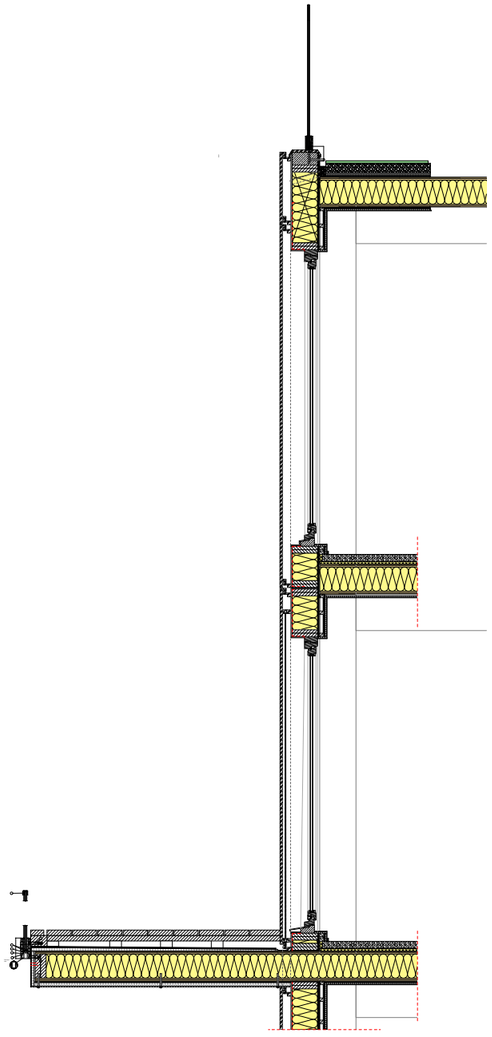
Balcony door Panel
3m

1: 20 Fragment

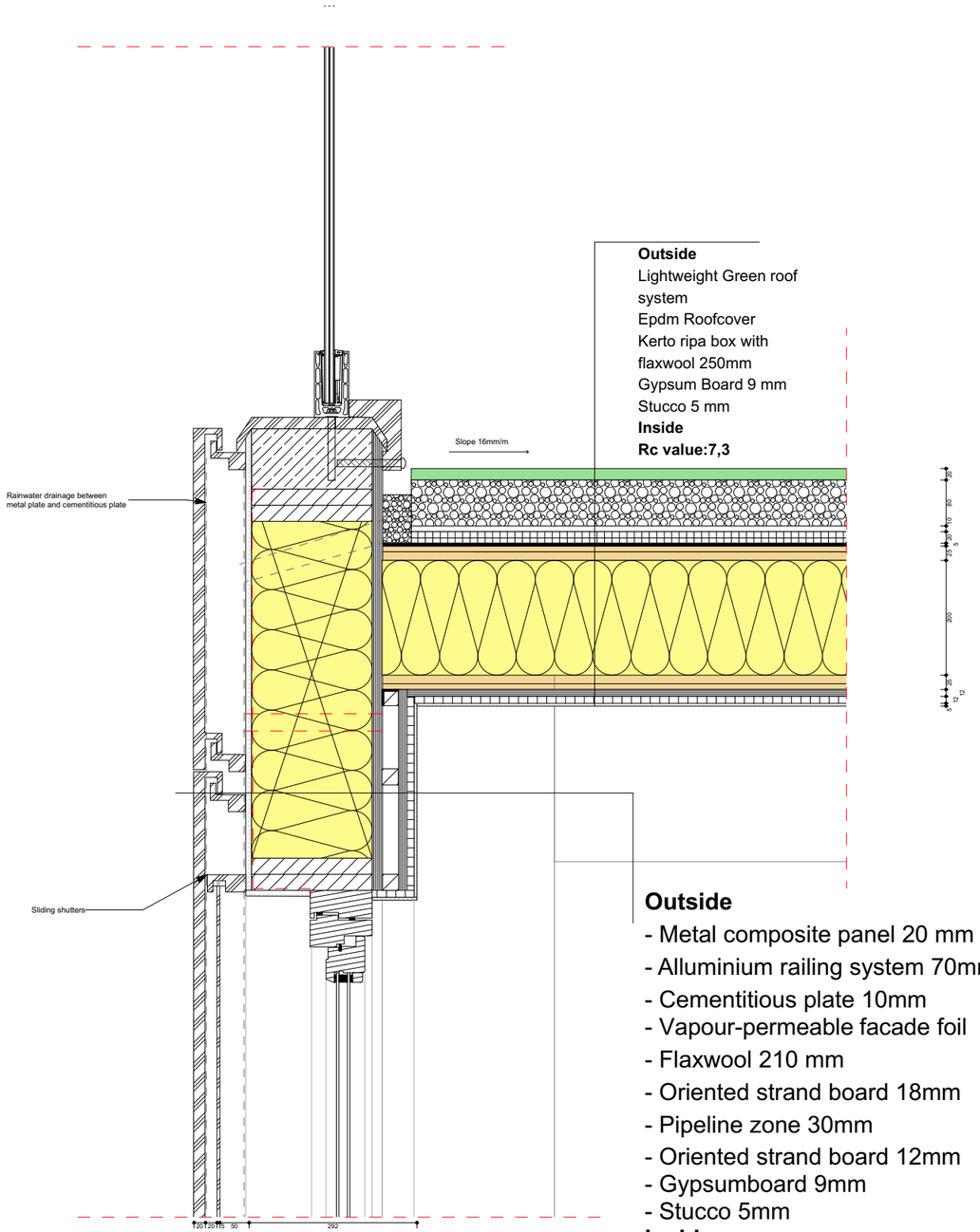


Facade Fragment





Details

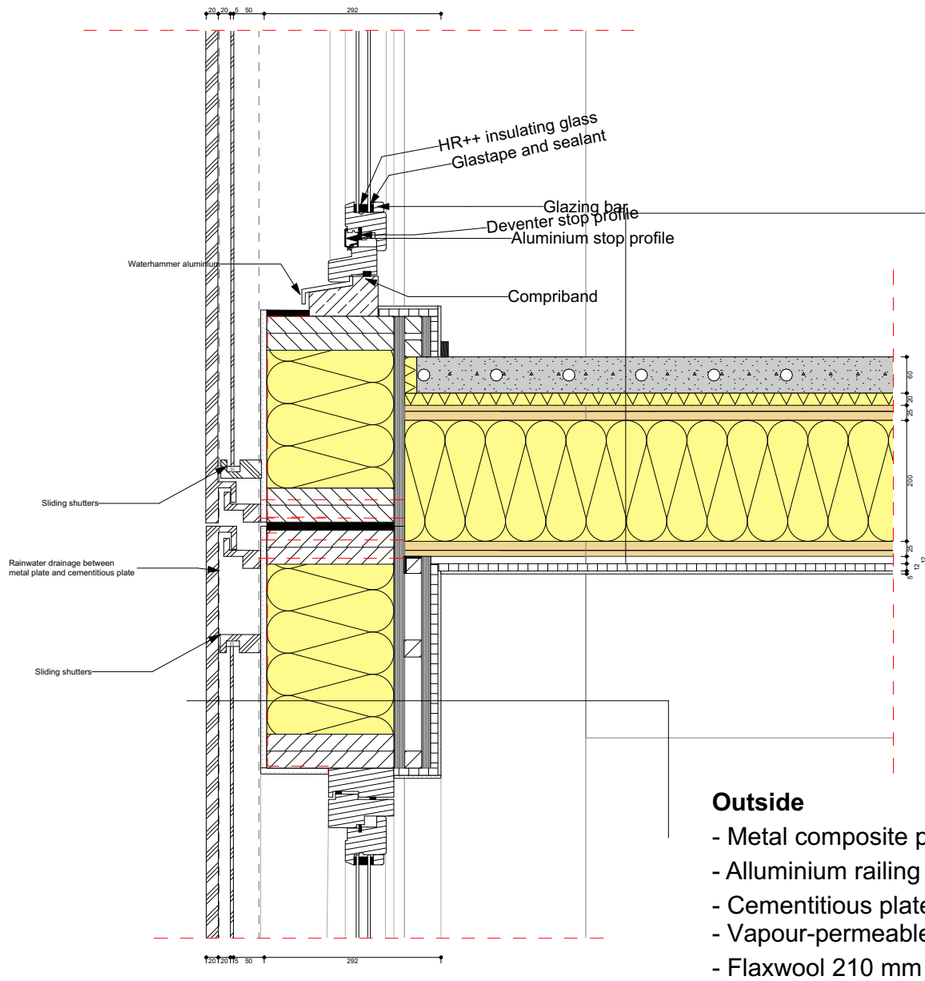


Outside
Lightweight Green roof system
Epdm Roofcover
Kerto ripa box with flaxwool 250mm
Gypsum Board 9 mm
Stucco 5 mm
Inside
Rc value:7,3

Outside
- Metal composite panel 20 mm
- Alluminium railing system 70mm
- Cementitious plate 10mm
- Vapour-permeable facade foil
- Flaxwool 210 mm
- Oriented strand board 18mm
- Pipeline zone 30mm
- Oriented strand board 12mm
- Gypsumboard 9mm
- Stucco 5mm

Inside
Rc Value: 6,9

Details

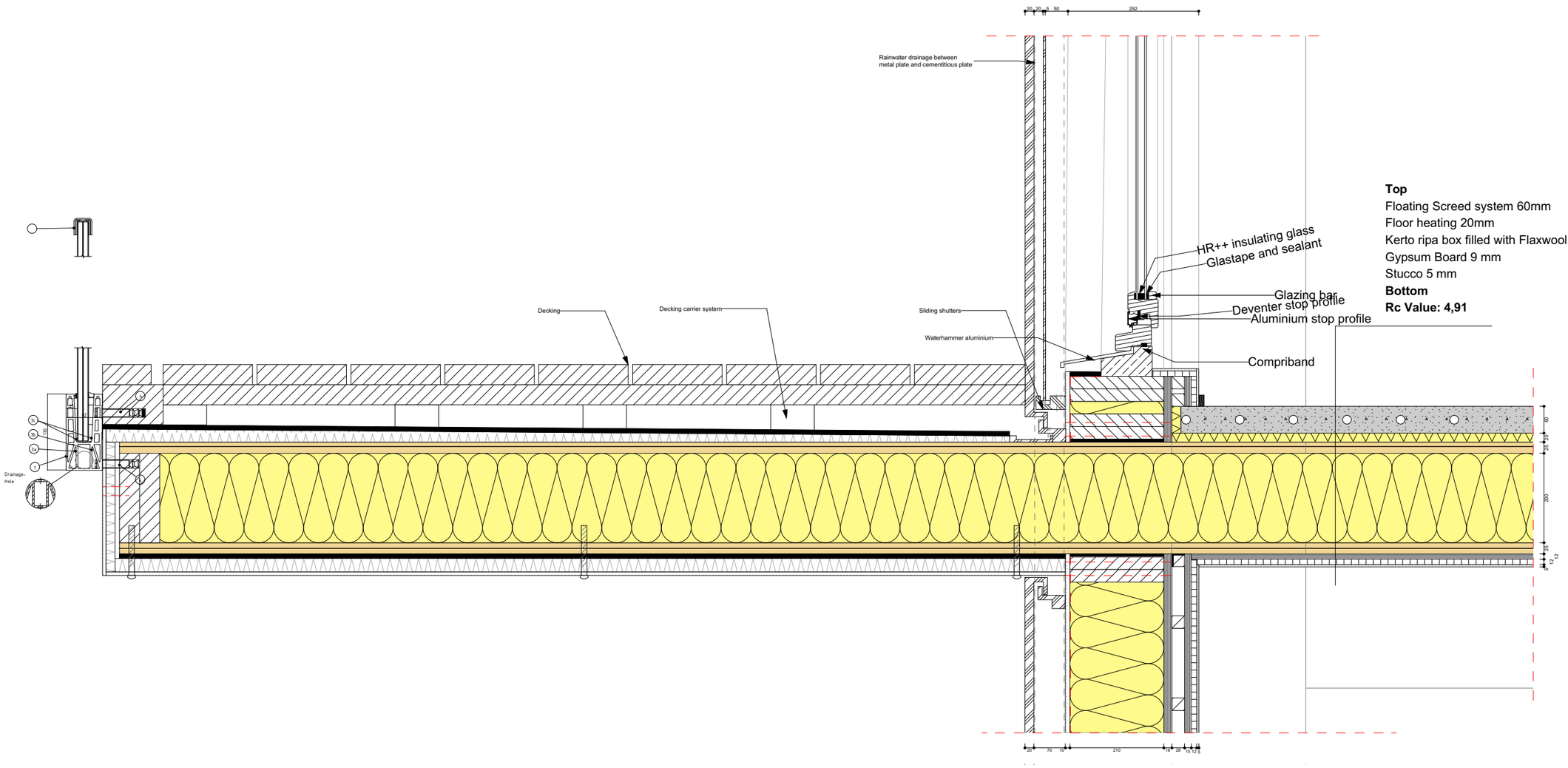


Top
Floating Screed system 60mm
Floor heating 20mm
Kerto ripa box filled with Flaxwool 250mm
Gypsum Board 9 mm
Stucco 5 mm
Bottom
Rc Value: 4,91

Outside
- Metal composite panel 20 mm
- Alluminium railing system 70mm
- Cementitious plate 10mm
- Vapour-permeable facade foil
- Flaxwool 210 mm
- Oriented strand board 18mm
- Pipeline zone 30mm
- Oriented strand board 12mm
- Gypsumboard 9mm
- Stucco 5mm

Inside
Rc Value: 6,9

Details



Top
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