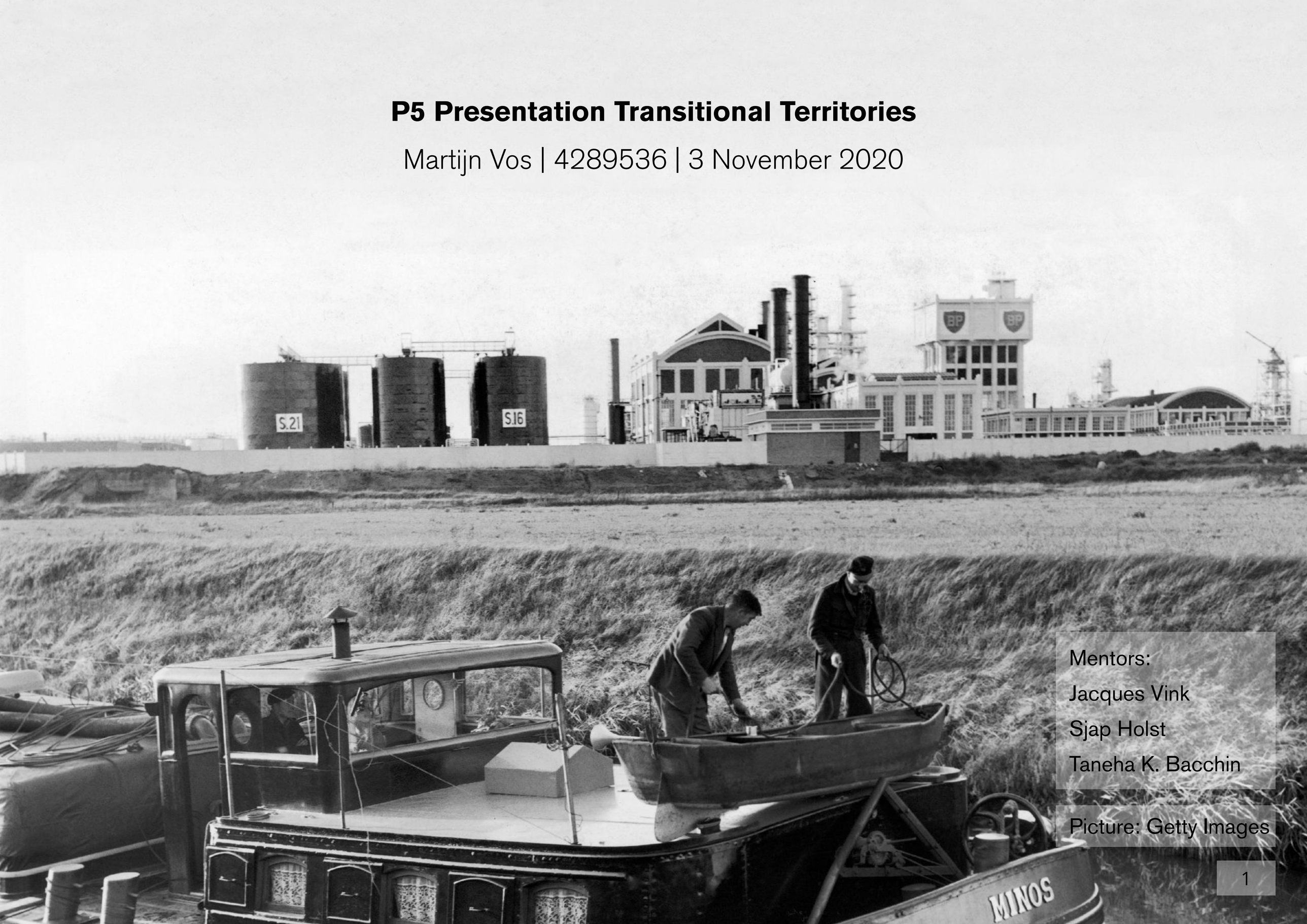
P5 Presentation Transitional Territories

Martijn Vos | 4289536 | 3 November 2020



Mentors:

Jacques Vink

Sjap Holst

Taneha K. Bacchin

Picture: Getty Images

Territorial level

How can fossil energy infrastructure be repurposed to facilitate a healthy port-city interface in transition?

Architectural level

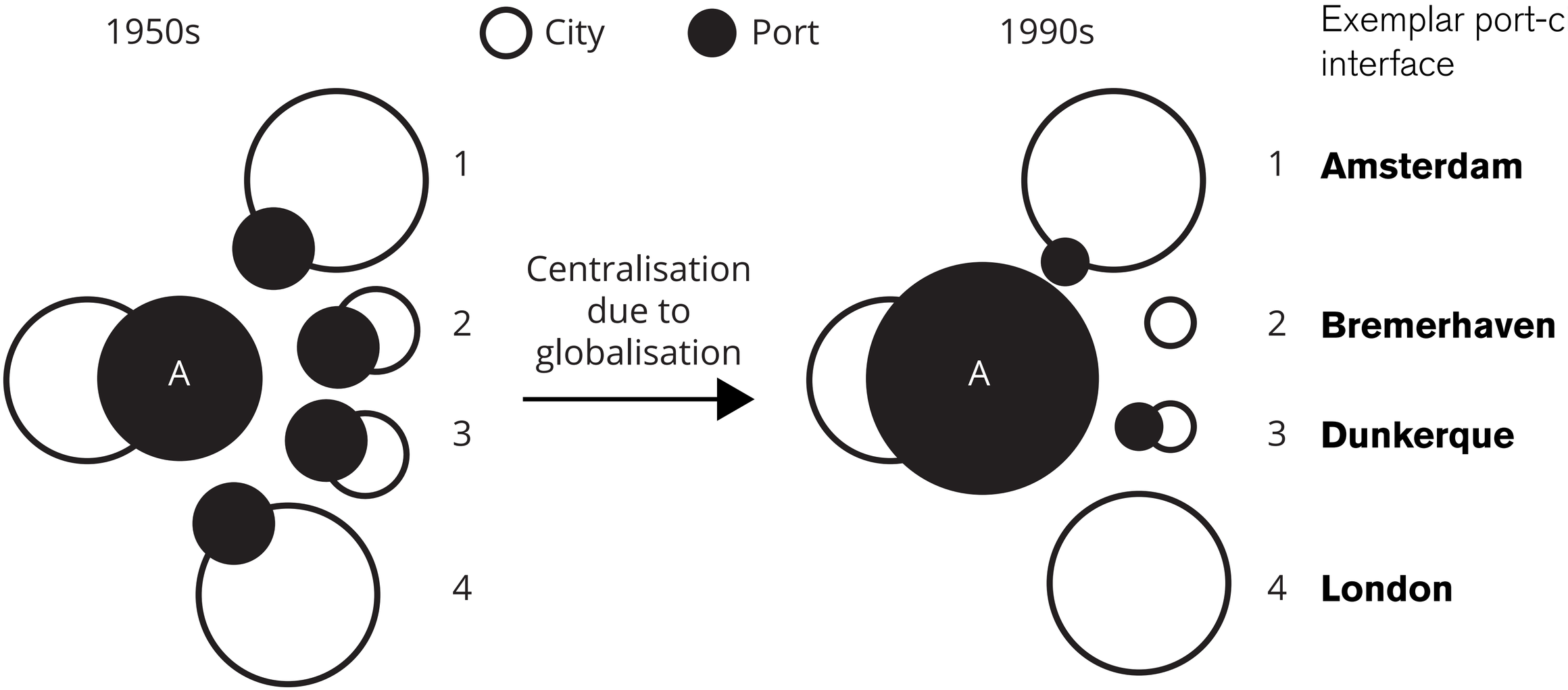
In what way can we gradually adapt obsolescent refinery infrastructure to reconnect them to urban ecological and social systems?

Disconnection between port and city

Stage	Symbol City Port	Period	Characteristics
I Primitive port/ city		Ancient/ medieval to 19th century	Close spatial and functional association between city and port
II Expanding port/ city		19th - early 20th century	Rapid commercial/ industrial growth forces port to develop beyond city confines, with linear quays and break-bulk industries
III Modern industrial port/ city		mid-20th century	Industrial growth (especially oil refining) and introduction of containers/ ro-ro require separation/ space
IV Retreat from the waterfront		1960s-1980s	Changes in maritime technology induce growth of separate maritime industrial development areas
V Redevelopment of the waterfront		1970s-1990s	Large-scale modern port consumes large areas of land/ water space, urban renewal of original core

Hoyle (1989)

Competition in a regional port system



Decommisioning

100 km

50°

Resilient refinery

Refinery exposed to economic factors

Offshore installation

Pipeline

Oil & gas infrastructure = Future waste?

Picture: Radio France

Decommisioning



Dunkerque oil refinery (SRD/BP) <2019

Picture: Colas

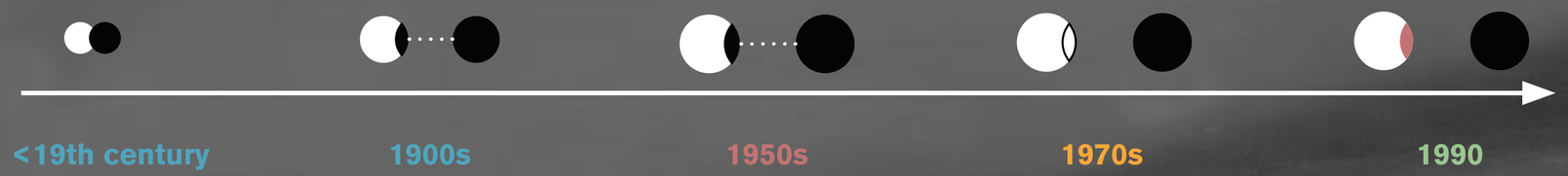
Decommisioning



Dunkerque oil refinery (SRD/BP) >2019

Picture: Colas

An overview of the port-city interface



Main lock

Old lock

Public beach front

Successful waterfront redevelopment

Channel derivation with sea barrier (1950s)

Old controlled waterlevel docks (~1900)

City centre

Nuclear power plant

Open sea container & bulk terminal

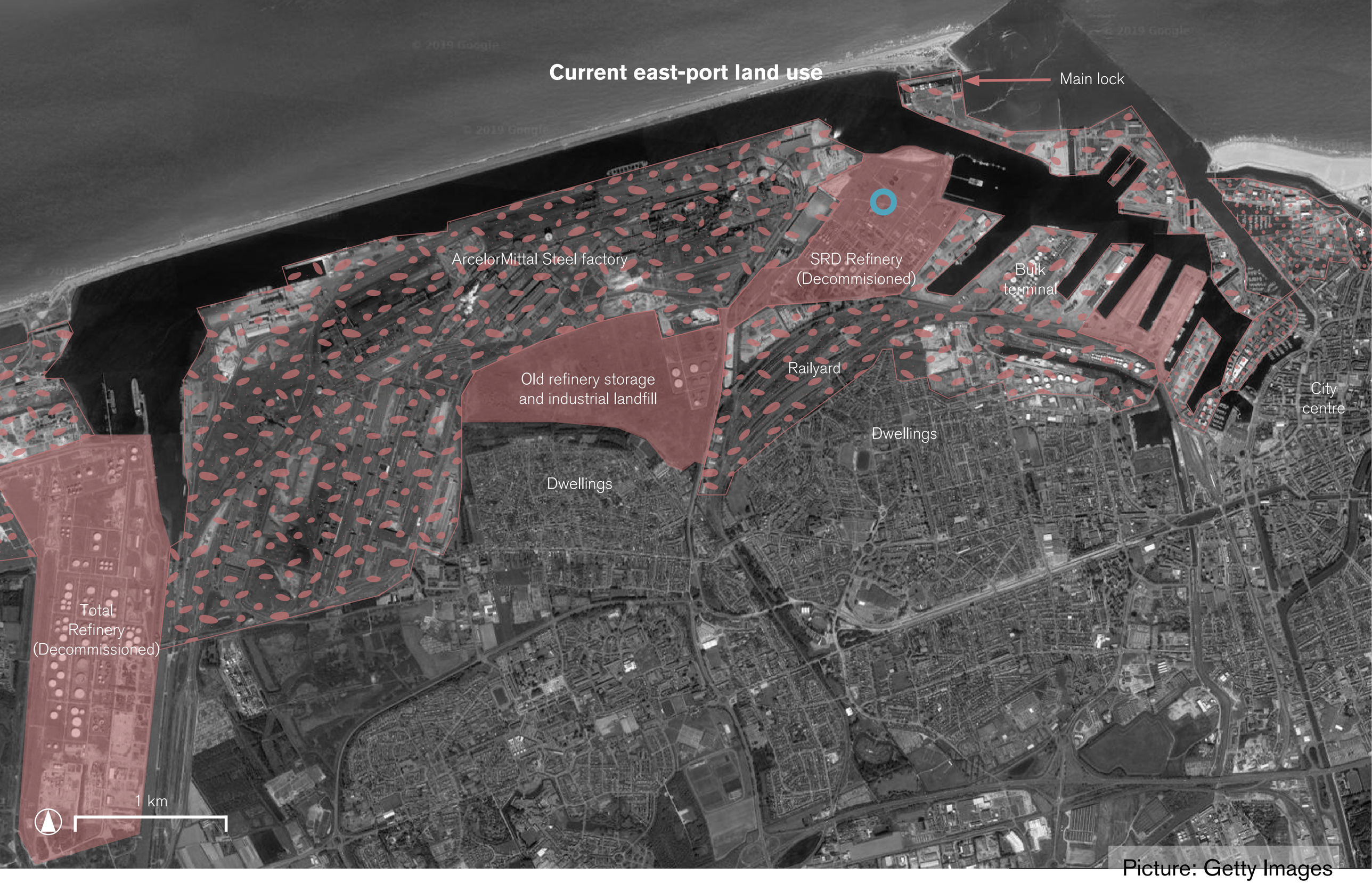
2 km

Overview of the Dunkerque Port-City interface Image: Google. Top diagram: Hoyle, 1989.

Dunkerque Port Authority

Former Hotel Le Reuze

Current east-port land use



Picture: Getty Images

Abandonded port zone

Productive port zone

Redeveloped port zone

Project site

Soil pollution areas in Dunkerque

- Aluminium
- Cadmium
- Chloride
- Cyanide
- Hydrocarbons
- Manganese
- Nickel
- Lead
- PDT
- Titanium
- Zinc

- Hydrocarbons
- Potentially some of the pollutants from the south west site (listed left)

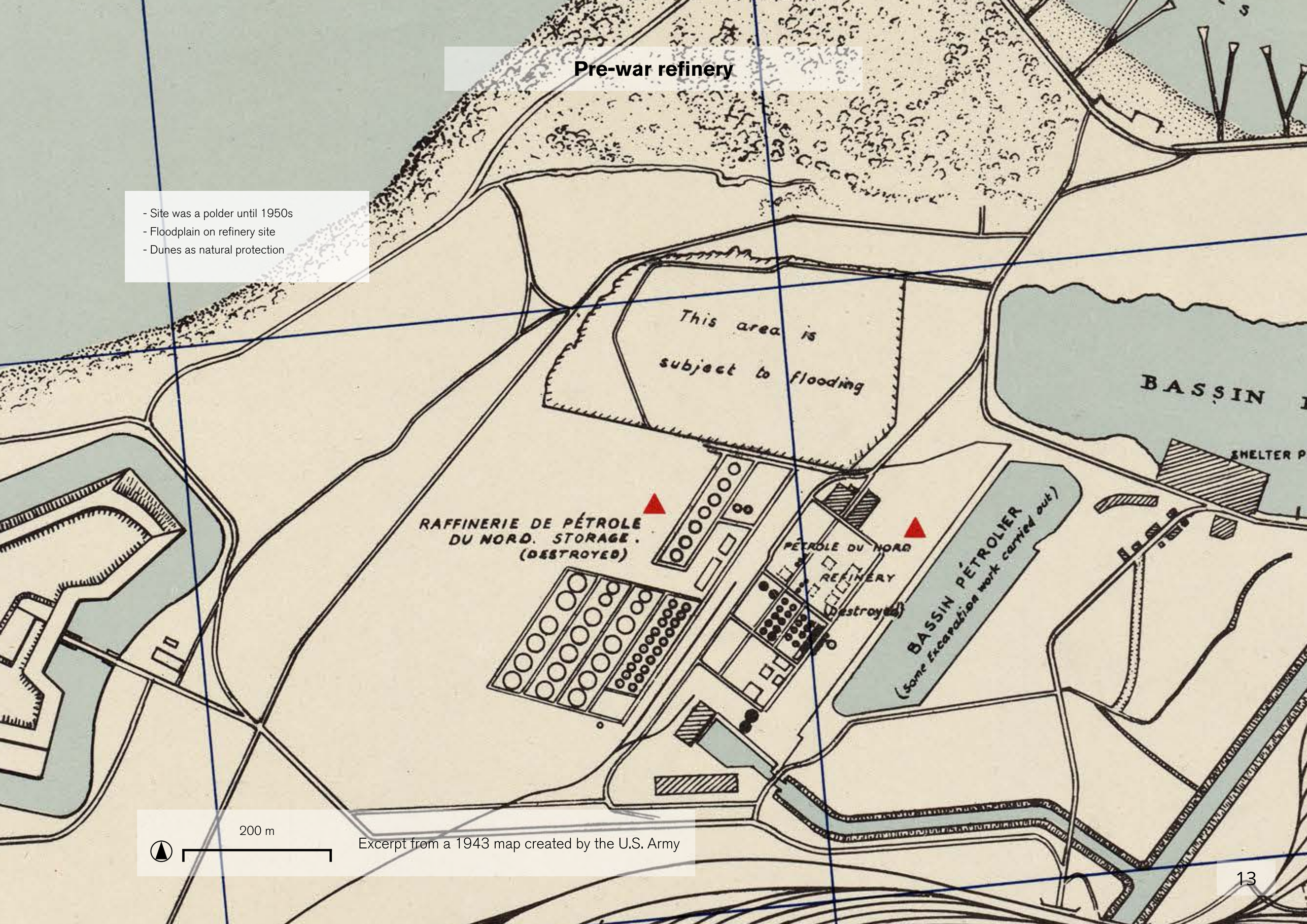
- Hydrocarbons
- Arsenic
- Chrome
- Copper
- Mercury
- Nickel
- Lead
- PCB-PCT

1 km

Railway | Car road | Small channel | Large channel/ ocean | Buildings | Site with soil pollution | Project site

Pre-war refinery

- Site was a polder until 1950s
- Floodplain on refinery site
- Dunes as natural protection



Excerpt from a 1943 map created by the U.S. Army

Overlay historic with current refinery

200 m

Excerpt from a 1943 map created by the U.S. Army

Soil contamination intensity

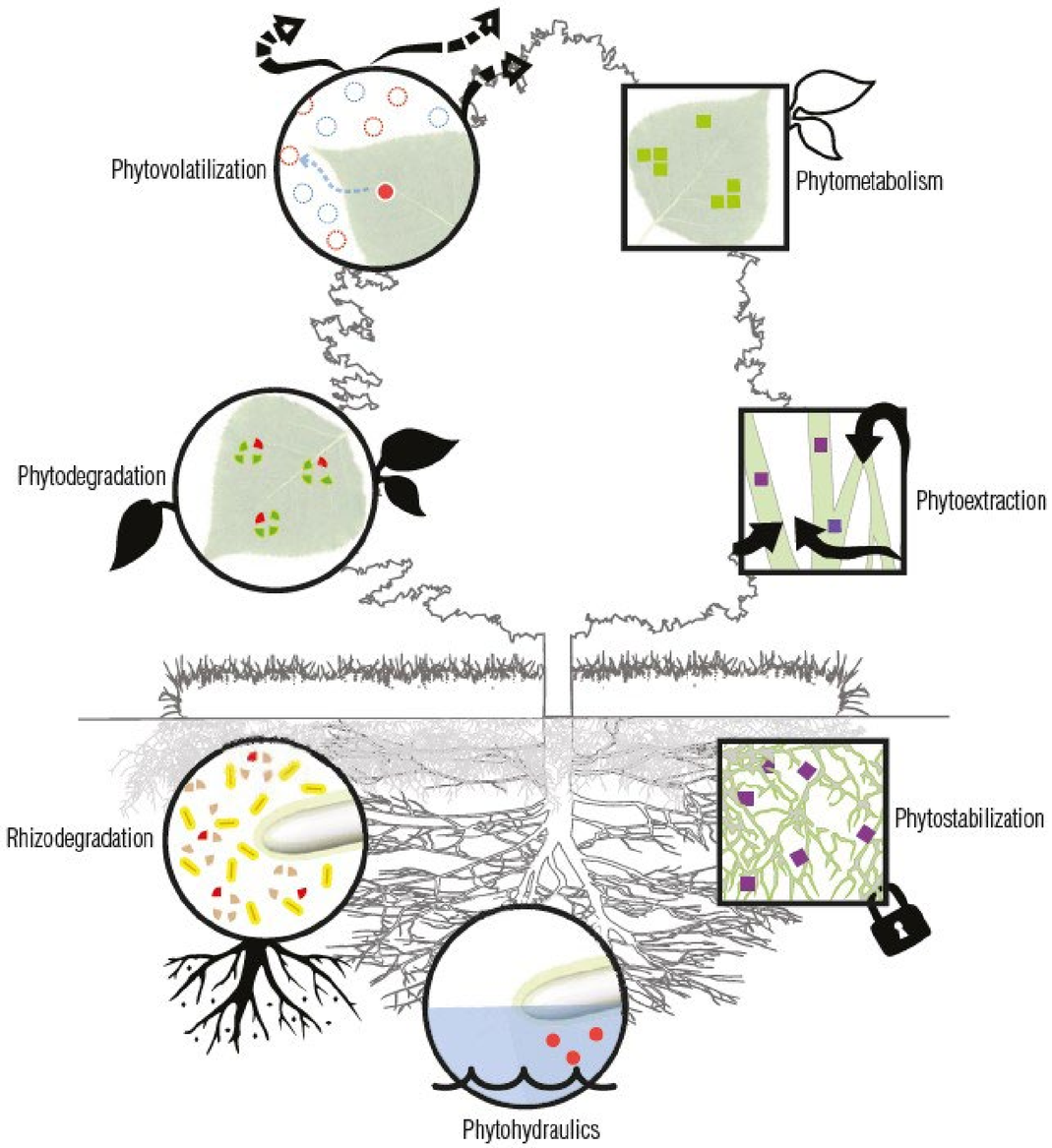
Legend

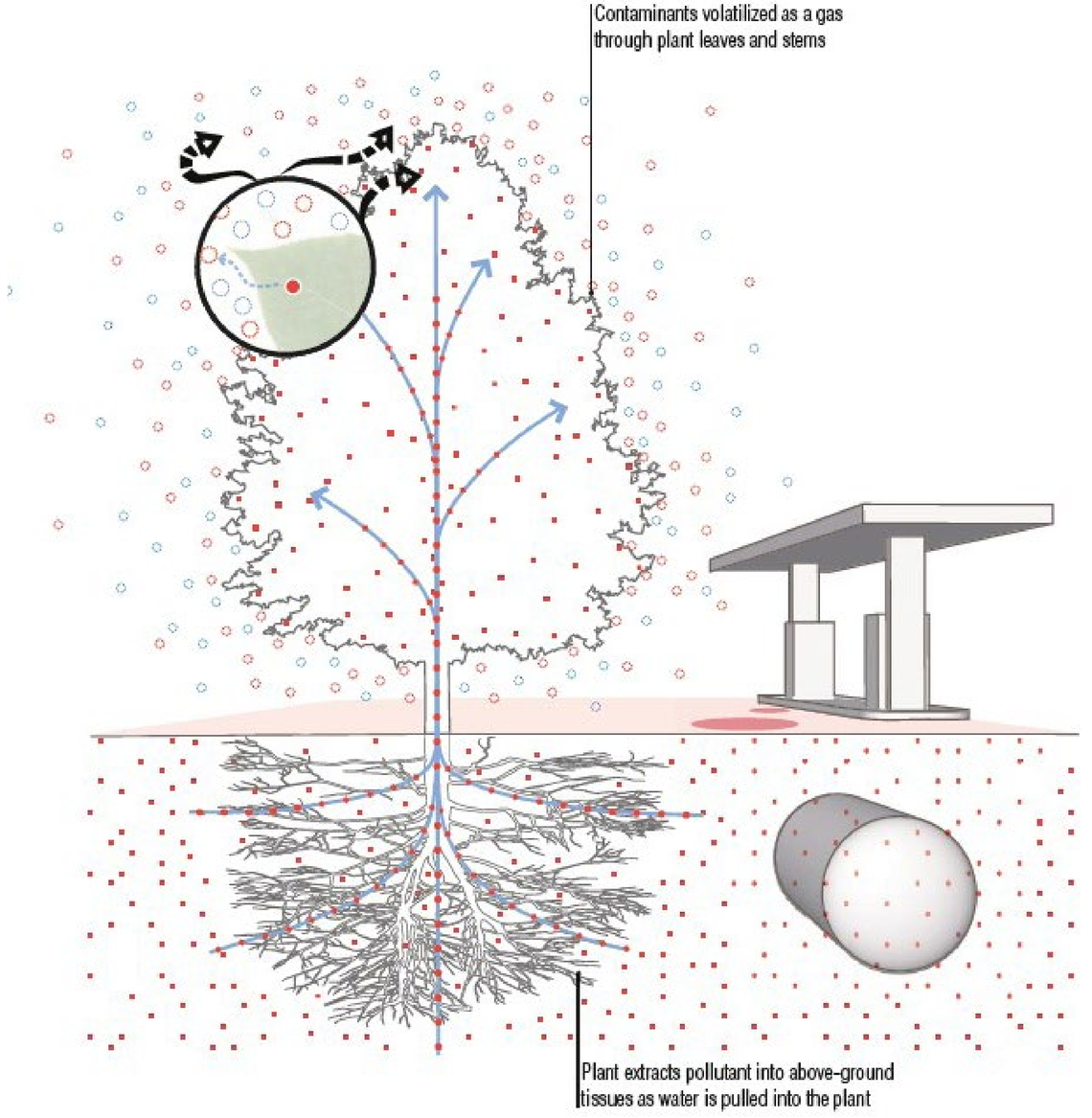
- No major soil contamination expected
- Some soil contamination expected
- Major soil contamination expected
- Surrounding buildings
- Water
- Plot outline

200 m

Phytoremediation

A solution for cleanup





Images by Kennen and Kirkwood (2015)

Map of current situation
<2019-2020 demolition

Legend

- Structures to be demolished
- Structures to keep
- Surrounding buildings
- Water
- Plot outline

200 m

Pollution Treatment

Remediation Layers

- Trees
- Crops
- Funghi
- Perennials
- Wetland
- Deep water
- Plot outline

200 m

Implemented phytotechnologies
Interception Hedgerow

Types of organic material used:
- Trees

Species:
Douglas fir *(Pseudotsuga menziesii)*
Hybrid poplar *(Populus spp.)*

Goals:
Preventing Groundwater Migration
Filtering Air Pollution
Building future timber supply

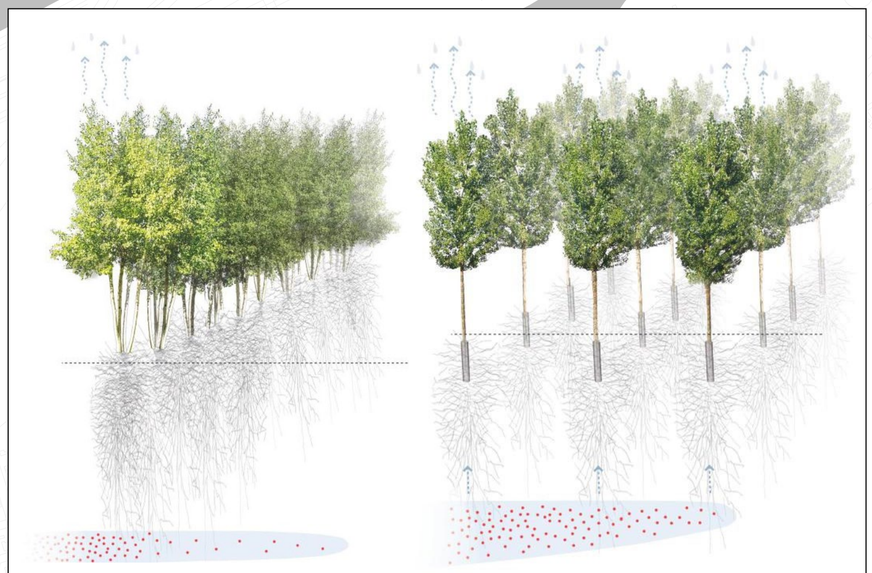


Image by Kennen and Kirkwood (2015)

200 m

Zone 4
Experimentation with Phytotechnologies

Zone 3
RL (Research Lab) for Cultivation & Biobased energy

Zone 2
RL for bio-based construction materials

Zone 1
RL for bio-based plastics

12

8 11 9

6 7

10

2 2

4

3 1

5

Site Facilities

1 Visitor centre
2 Conference centre
3 Restaurant
4 Sport facility
5 Hotel
6 Crop storage
7 Material storage
8 Biomass storage
9 Compost heaters
10 Visitor parking
11 Employee bike parking
12 Ferry boat departure

100 m

Zone 4
Experimentation with Phytotechnologies

Zone 3
RL (Research Lab) for Cultivation & Biobased energy

Zone 2
RL for bio-based construction materials

Zone 1
RL for bio-based plastics

Zone A
Manufacturing and energy production facilities

12

8 11 9

Zone B
Energy, Crop and Product-Storage

6 7

10

2 2

Zone C
Site Services

4

3 1

5

Site Facilities

1 Visitor centre
2 Conference centre
3 Restaurant
4 Sport facility
5 Hotel
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12 Ferry boat departure

100 m

Zone 4
Experimentation with Phytotechnologies

Zone 3
RL (Research Lab) for Cultivation & Biobased energy

Zone 2
RL for bio-based construction materials

Zone 1
RL for bio-based plastics

Zone A
Manufacturing and energy production facilities

12

Research and innovation

Logistics and Services

Zone B
Energy, Crop and Product-Storage

Zone C
Site Services

Site Facilities

1 Visitor centre
2 Conference centre
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12 Ferry boat departure

100 m

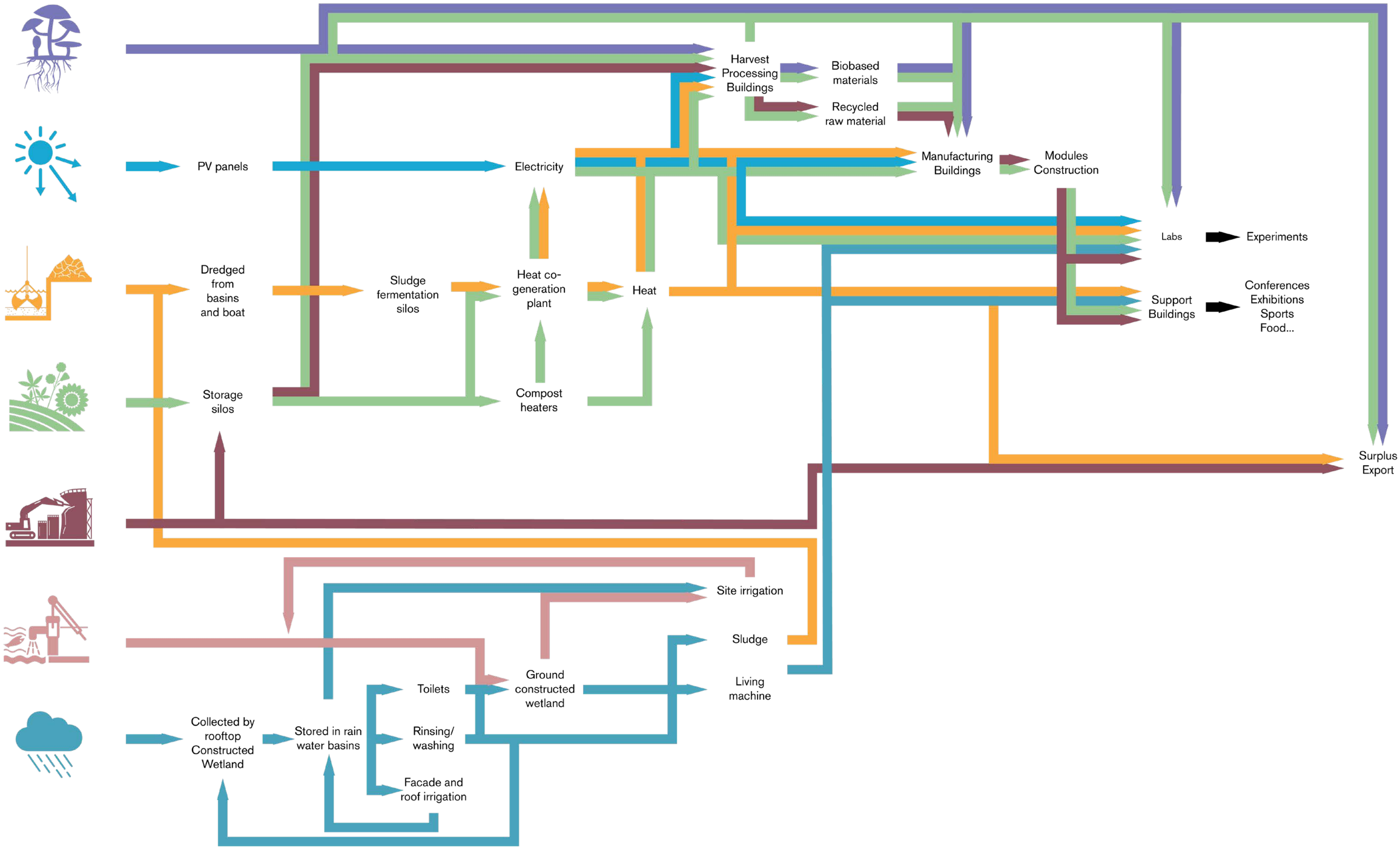
Petroleum refining factories

Stockage drums

Ancillary buildings

Pictures: SRD

Site Flows


Harvest
Processing
Buildings
Biobased
materials
Recycled
raw material
PV panels
Electricity
Manufacturing
Buildings
Modules
Construction
Labs
Experiments
Dredged
from
basins
and boat
Sludge
fermentation
silos
Heat co-
generation
plant
Heat
Support
Buildings
Conferences
Exhibitions
Sports
Food...
Storage
silos
Compost
heaters
Surplus
Export
Site irrigation
Sludge
Living
machine
Ground
constructed
wetland
Toilets
Rinsing/
washing
Facade and
roof irrigation
Collected by
rooftop
Constructed
Wetland
Stored in rain
water basins

A day in the life of...

Ole - Labourer

7:00 Shuttle boat from city centre
7:15 Arrival at site, gets coffee in small cafe
7:30 Takes tractor to plantation to harvest biomass
9:00 Brings harvested crops to storage tanks
9:30 Takes processed crops and old refinery materials (steel pipes etc.) from storage to zone A with tractor
10:00 Delivers materials and starts work in module factory
12:30 Has lunch in canteen
13:30 Arriving boat logistics (loading and unloading materials/ products)
15:00 Moves to zone 2 for meeting with scientist about change in crop cultivation
16:15 Stroll back from zone 2 to shuttle departure
16:30 Departure of ferry to city centre
16:45 Back in city centre, stroll home

7:00
13:30
16:30
12
7:30
7:15
12:30
15:00
10:00
9:30
9:00
8
11
9
6
7
10
2
2
4
1
3
5

Site Facilities

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2 Conference centre
3 Restaurant
4 Sport facility
5 Hotel
6 Crop storage
7 Material storage
8 Biomass storage
9 Compost heaters
10 Visitor parking
11 Employee bike parking
12 Ferry boat departure

100 m



Implemented phytotechnologies

Extraction Plot

Types of organic material used:

- Harvestable crops

Species:

- Industrial hemp *(Cannabis Sativa)*
- Flax *(Linum usitatissumum L.)*
- Sunflower *(Helianthus annuus)*

Goals:

- Remediating contaminated soil layers
- Providing biomass for:

Construction materials

Research experiments

Electricity and heat

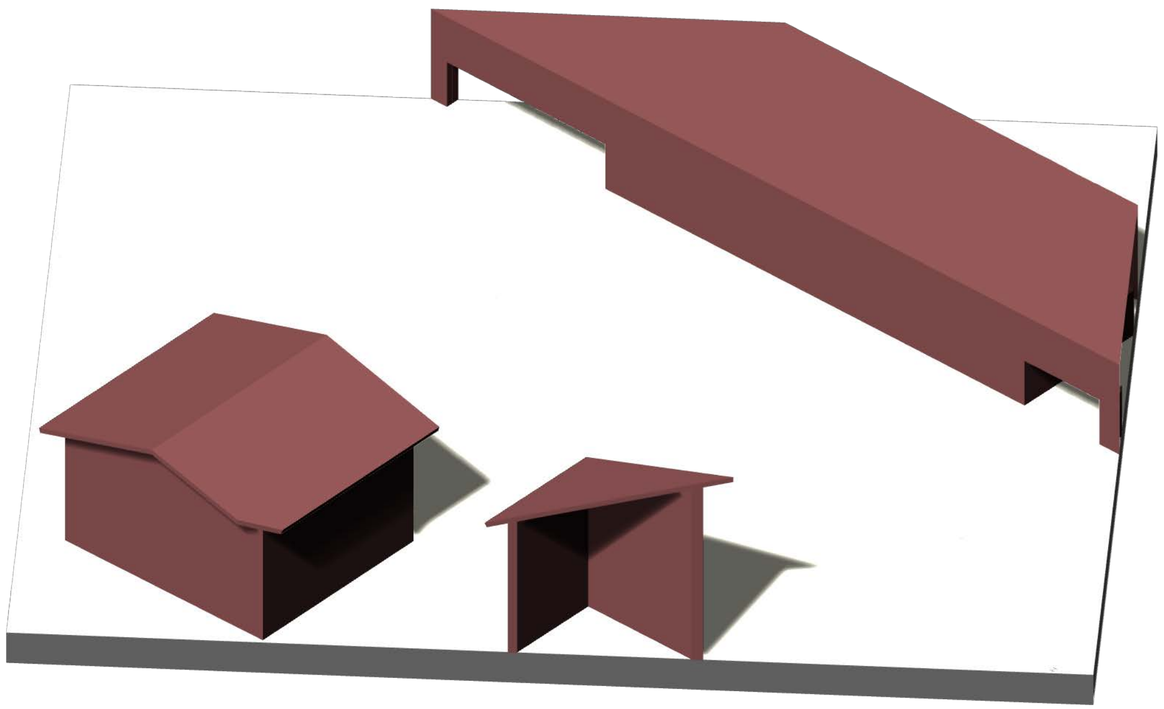


Image by Kennen and Kirkwood (2015)

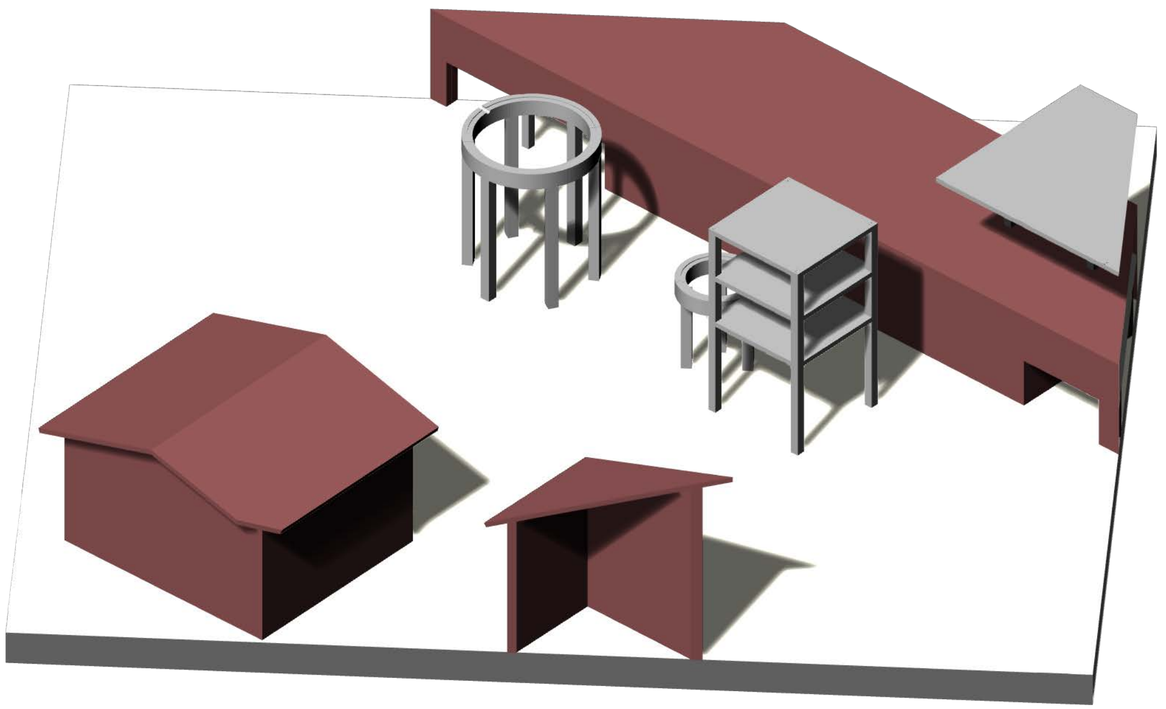
200 m

Extraction Plot landscape

Components of a refinery installation

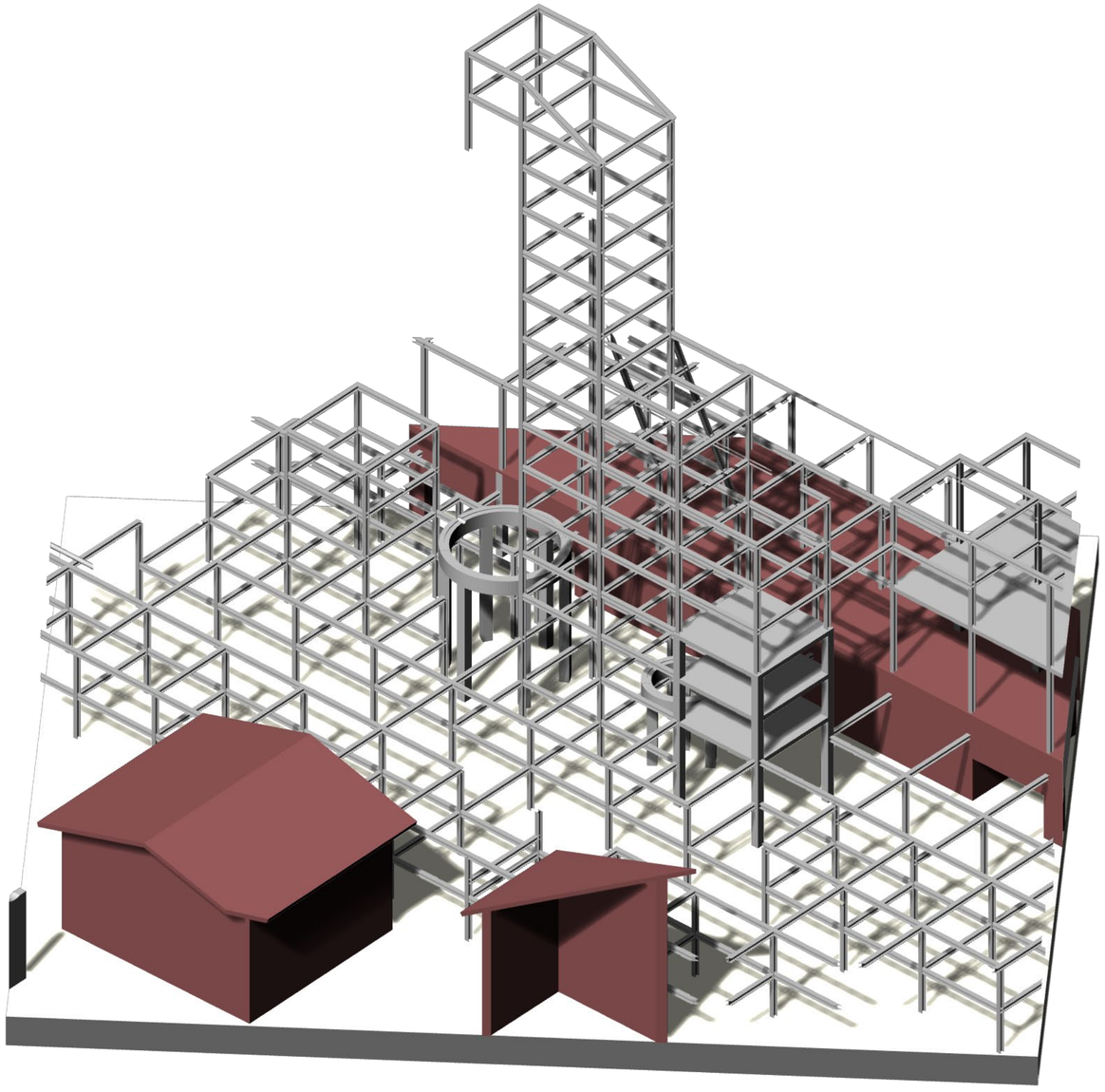


Pump / Monitoring buildings (brick / concrete)

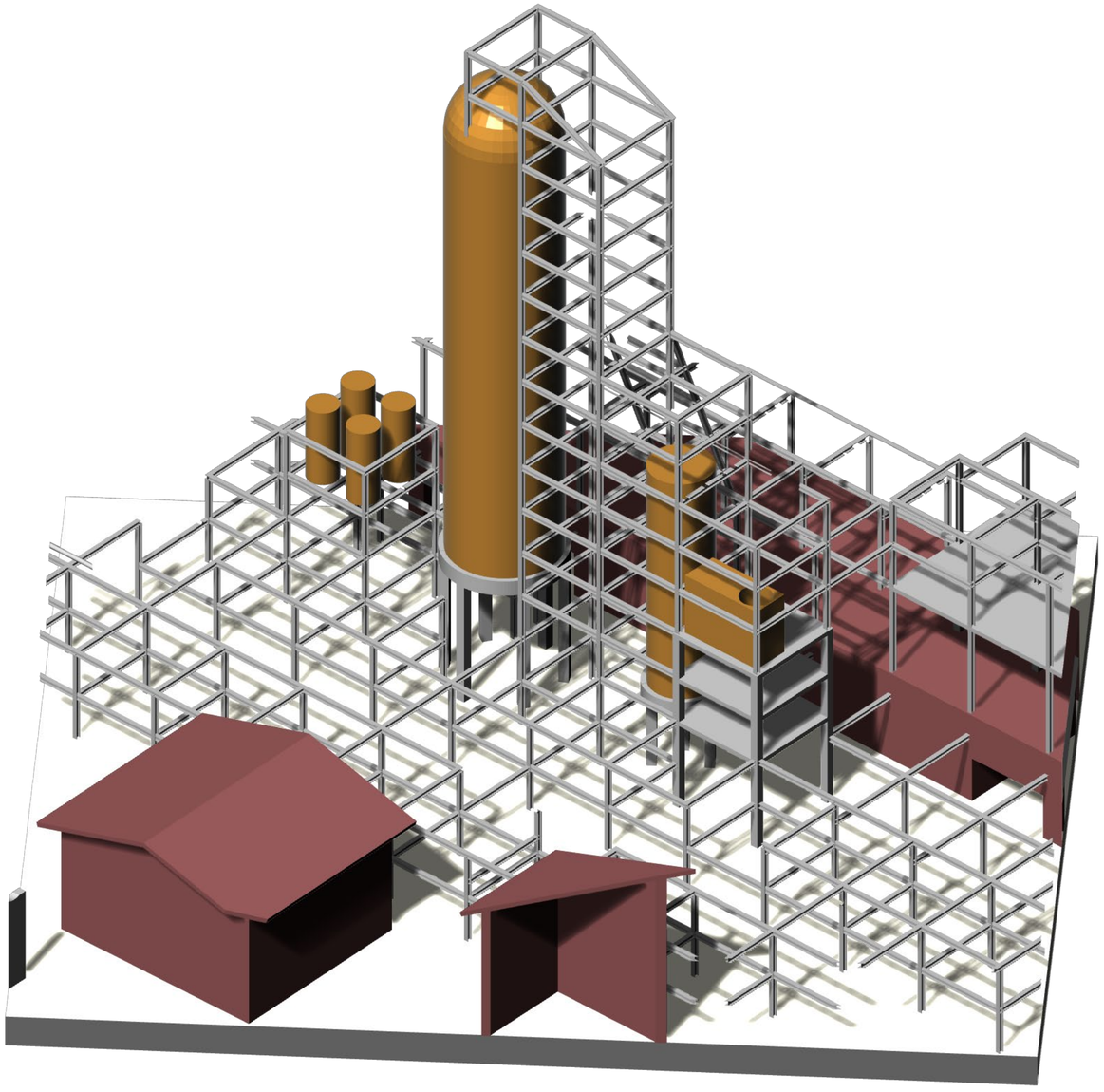


Concrete foundations for installation

Components of a refinery installation

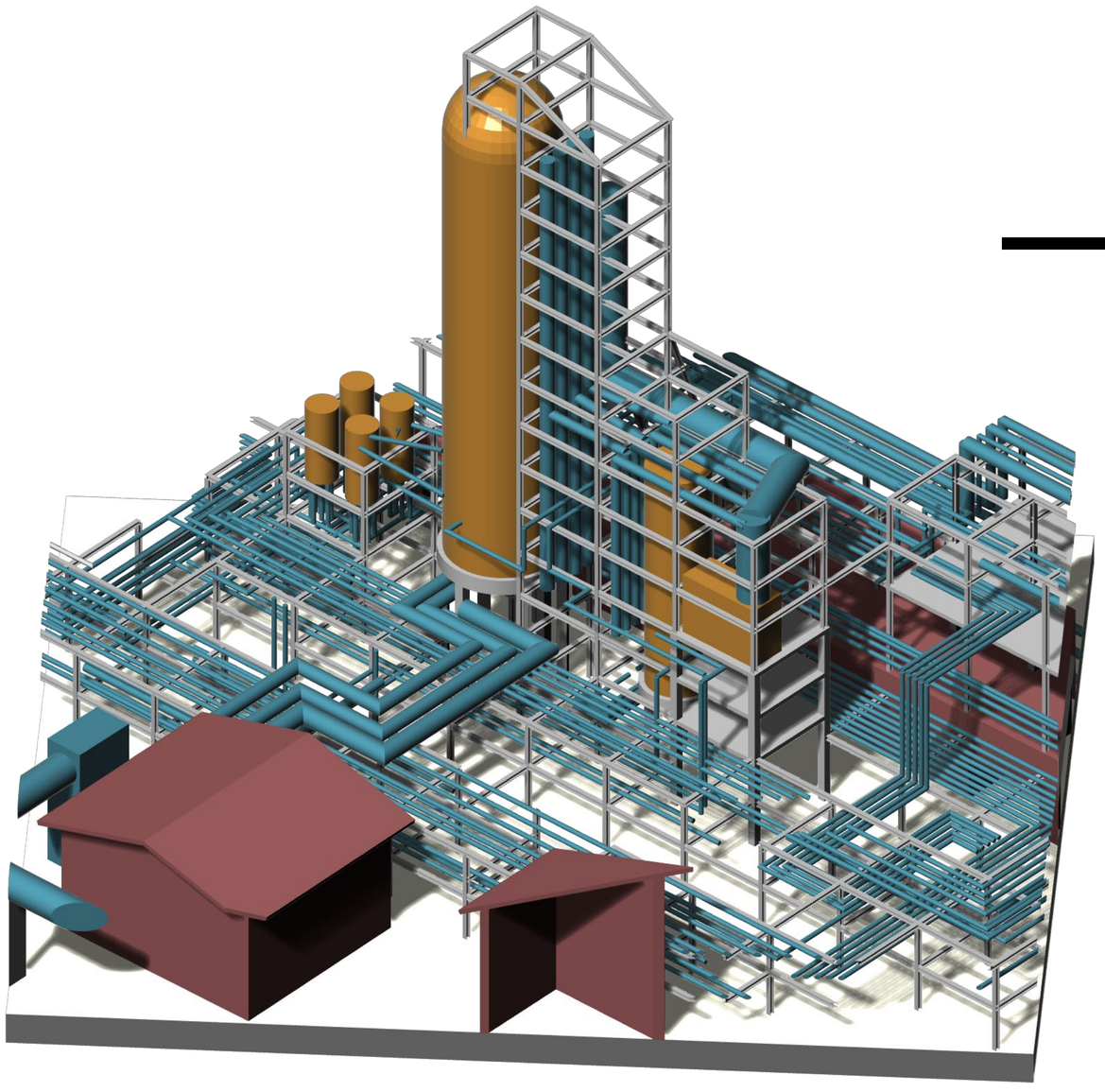


Steel H-beam skeleton

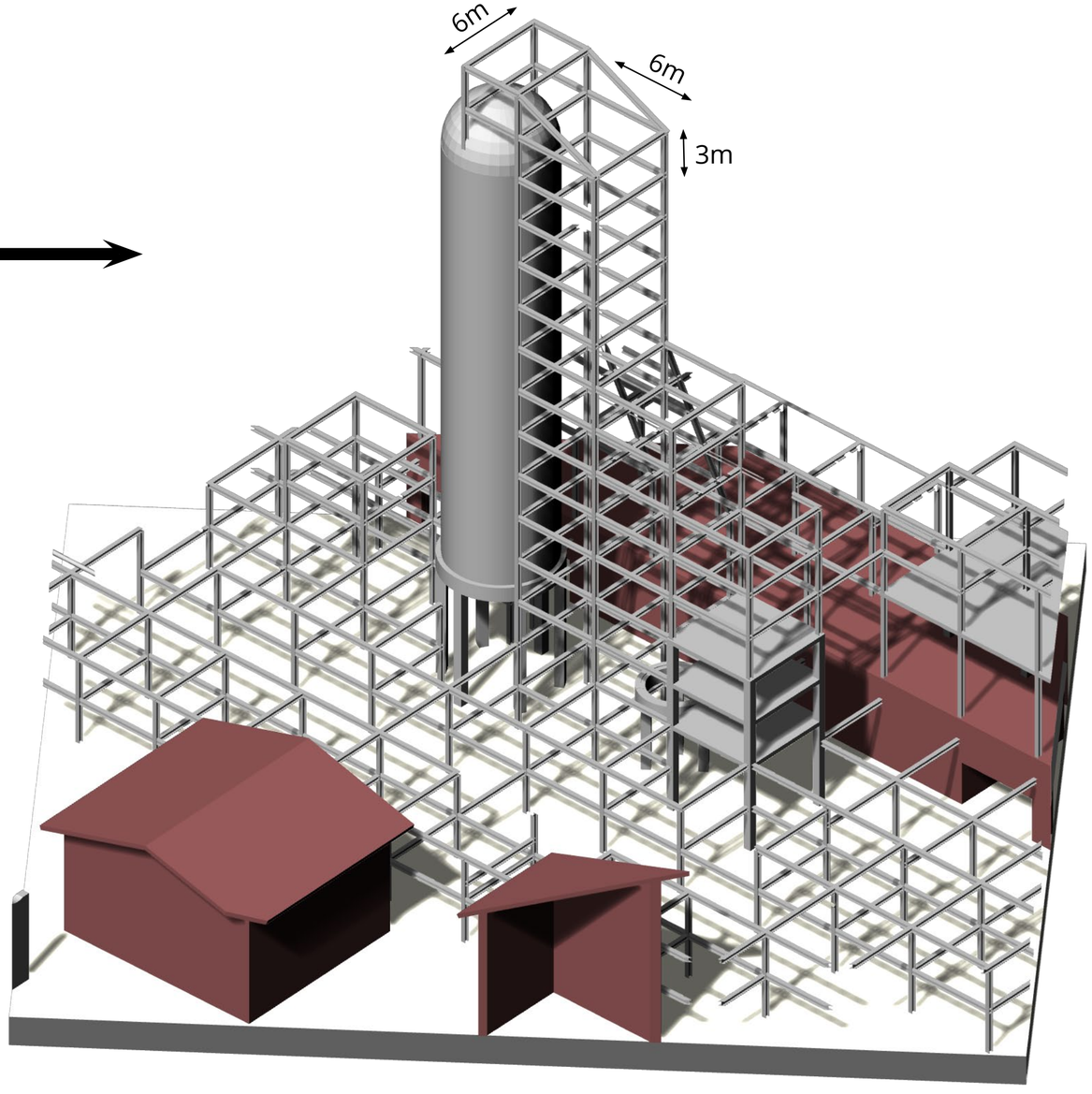


Furnaces, cracking / distallation drums

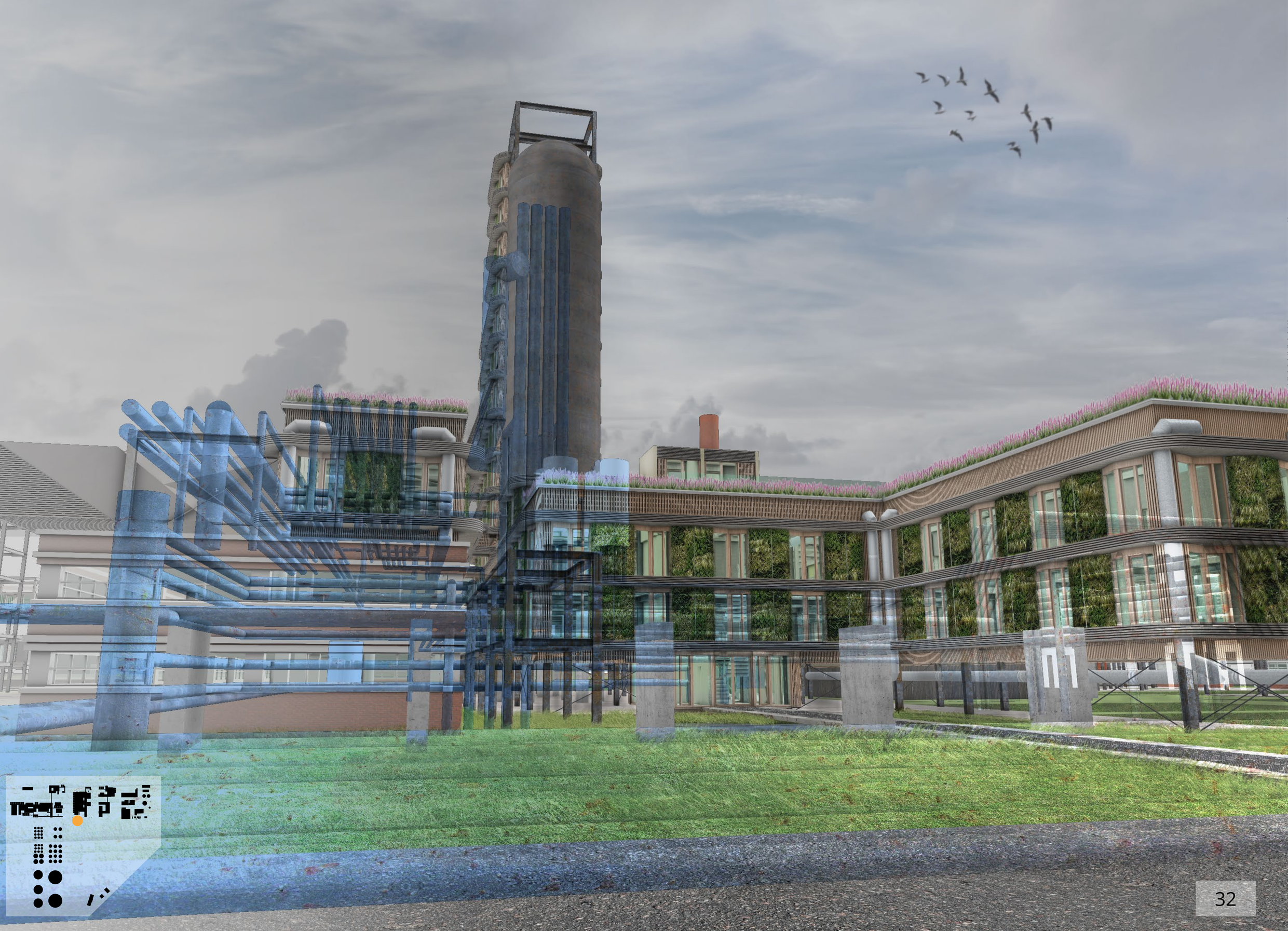
Components of a refinery installation



Steel piping for various purposes



Canvas for installation redesign



Structural Scheme

Primary structure

Legend

New timber skeleton

Existing steel structure

10 m

Structural Scheme

Stabilization

Legend

- New timber skeleton
- Existing steel structure
- Steel tension rod
- Stiff column-beam connection

10 m

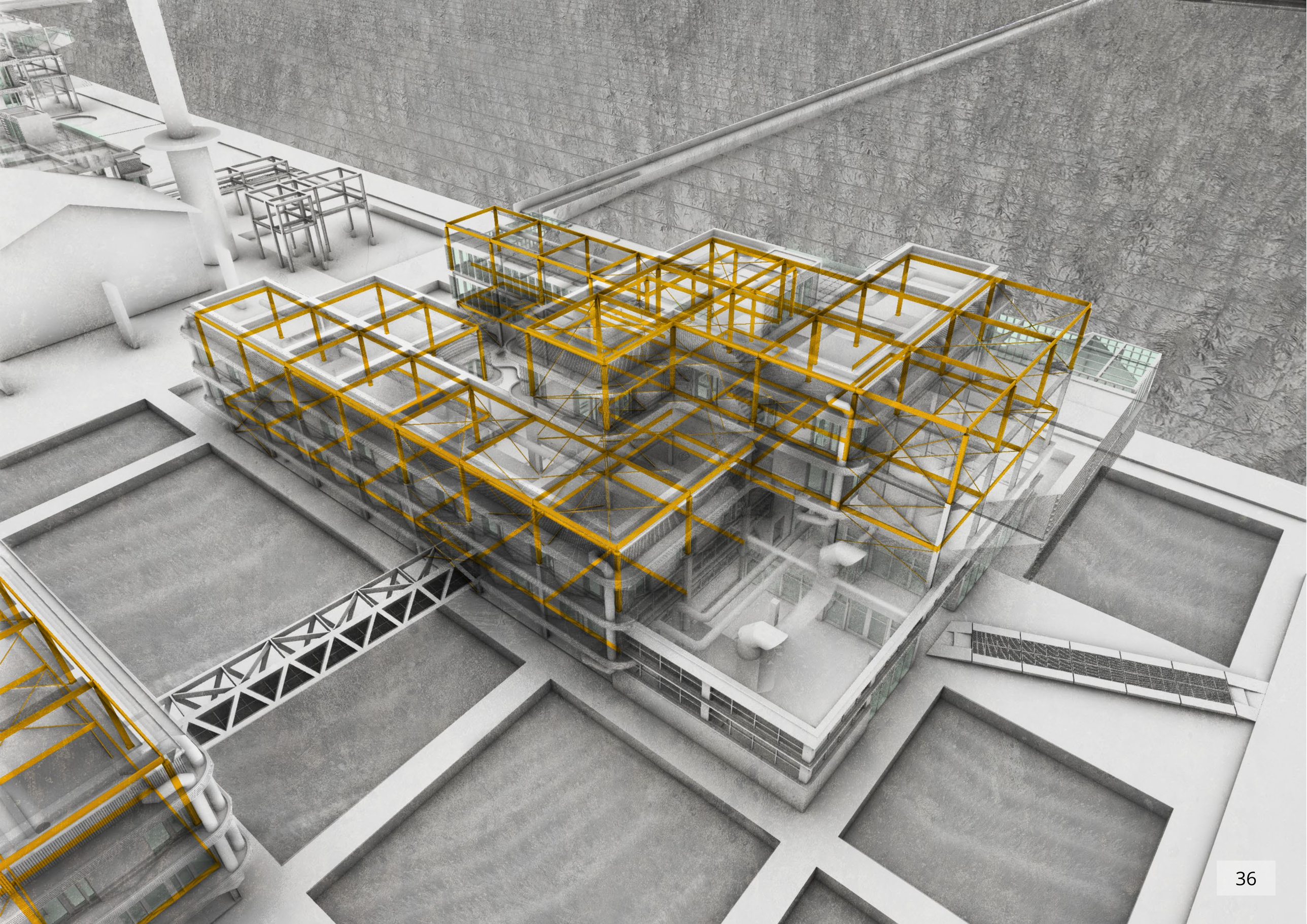
Structural Scheme

Secondary structure

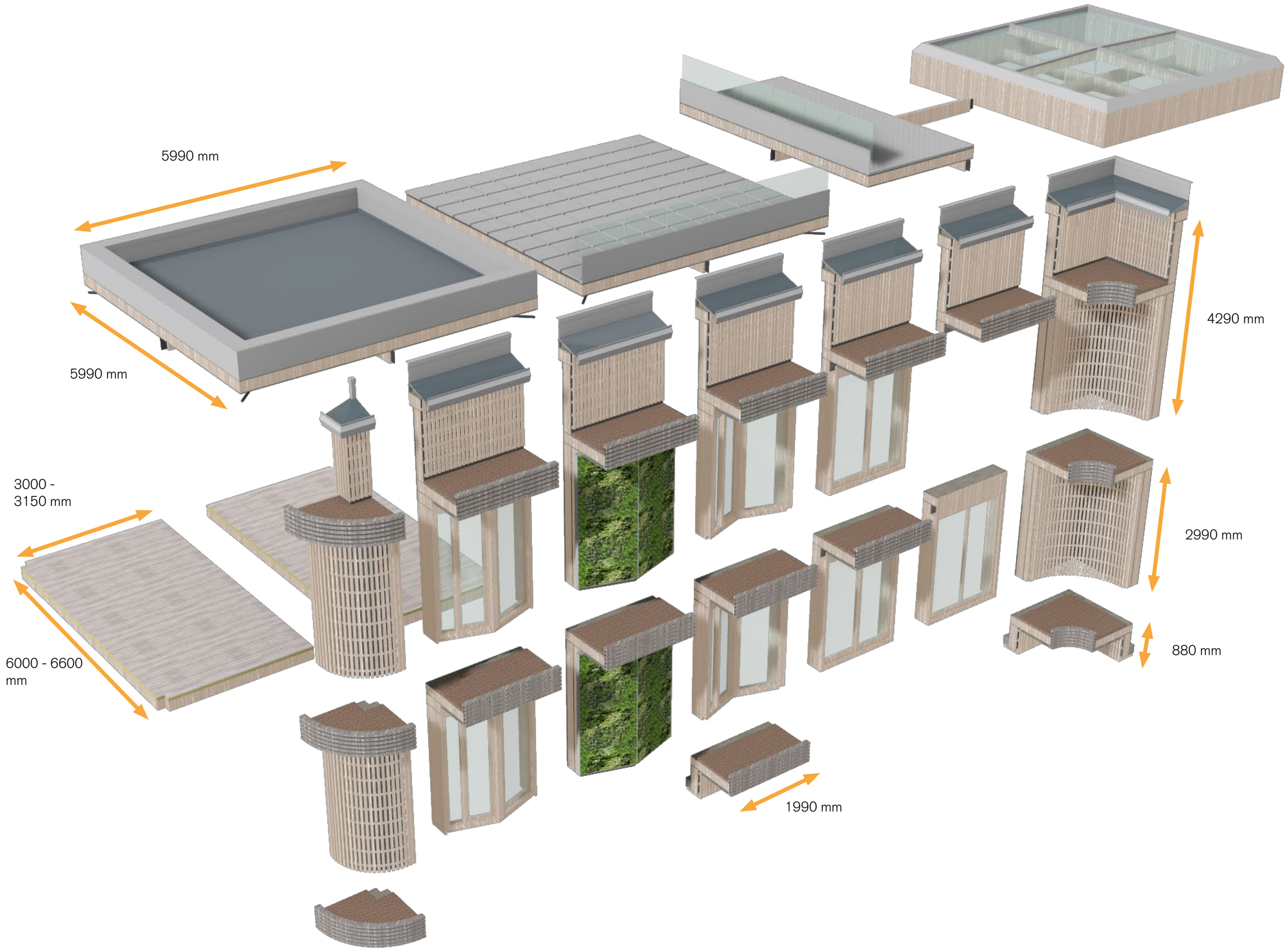
Legend

- New timber skeleton
- Existing steel structure
- Steel tension rod
- Stiff column-beam connection
- Secondary timber beam

10 m

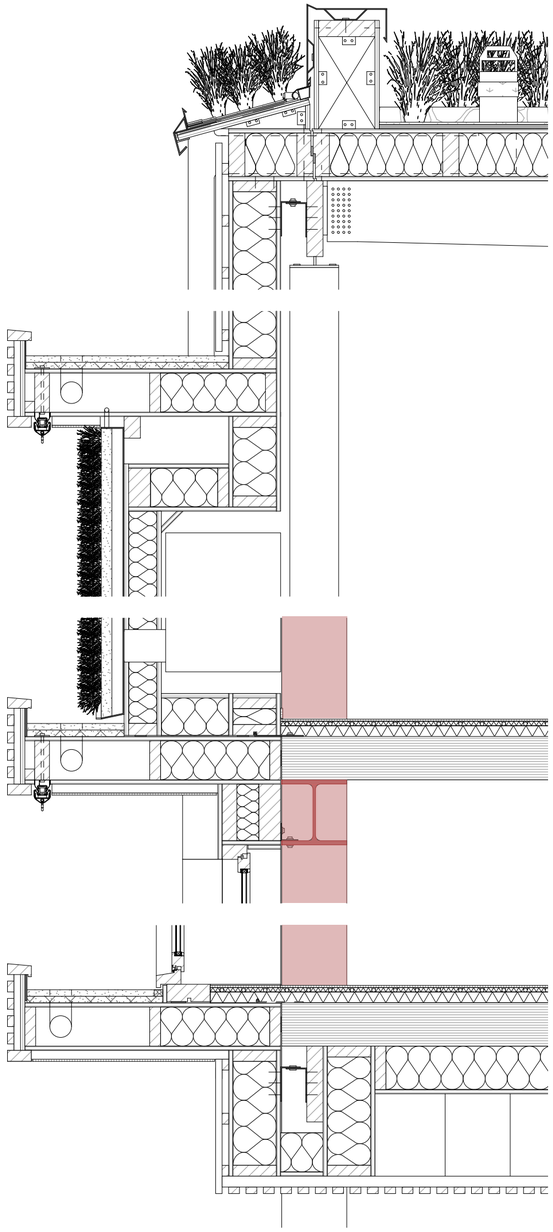


Module Catalogue



Building System

Existing Structure



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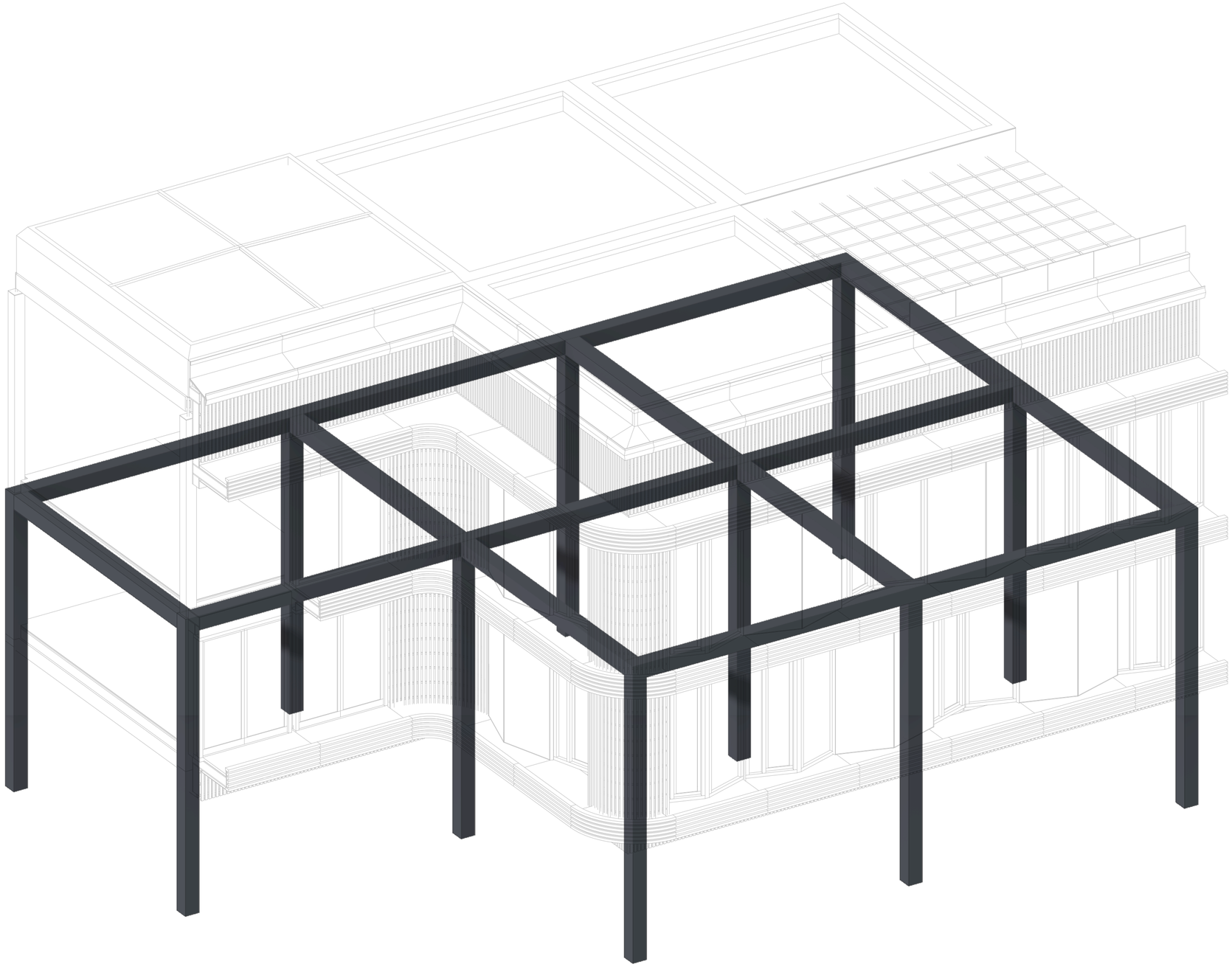
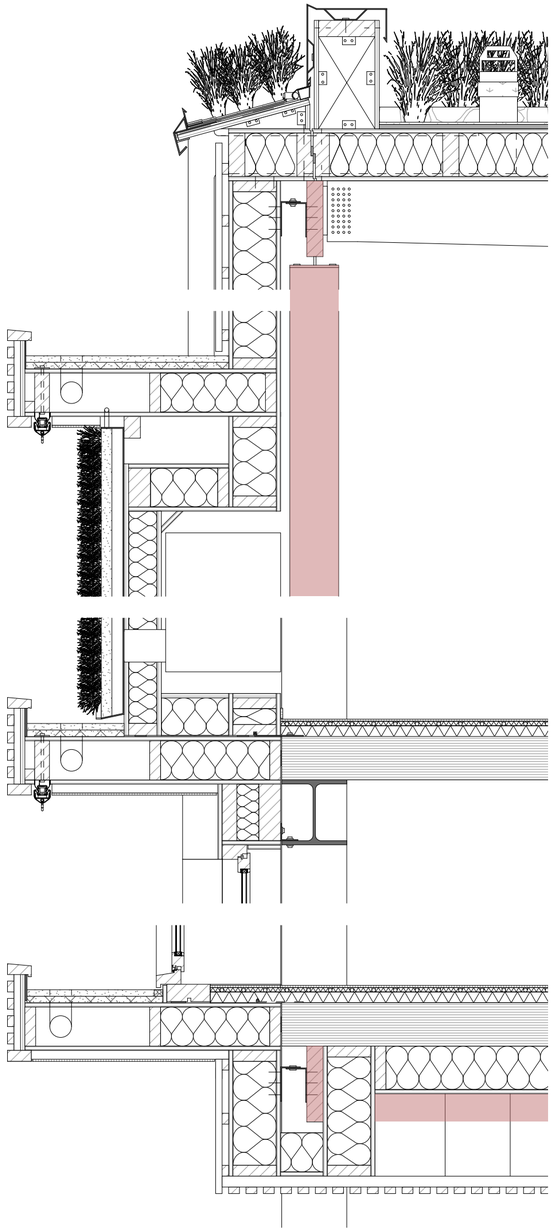


6000 mm

Building System

Additional Primary Structure



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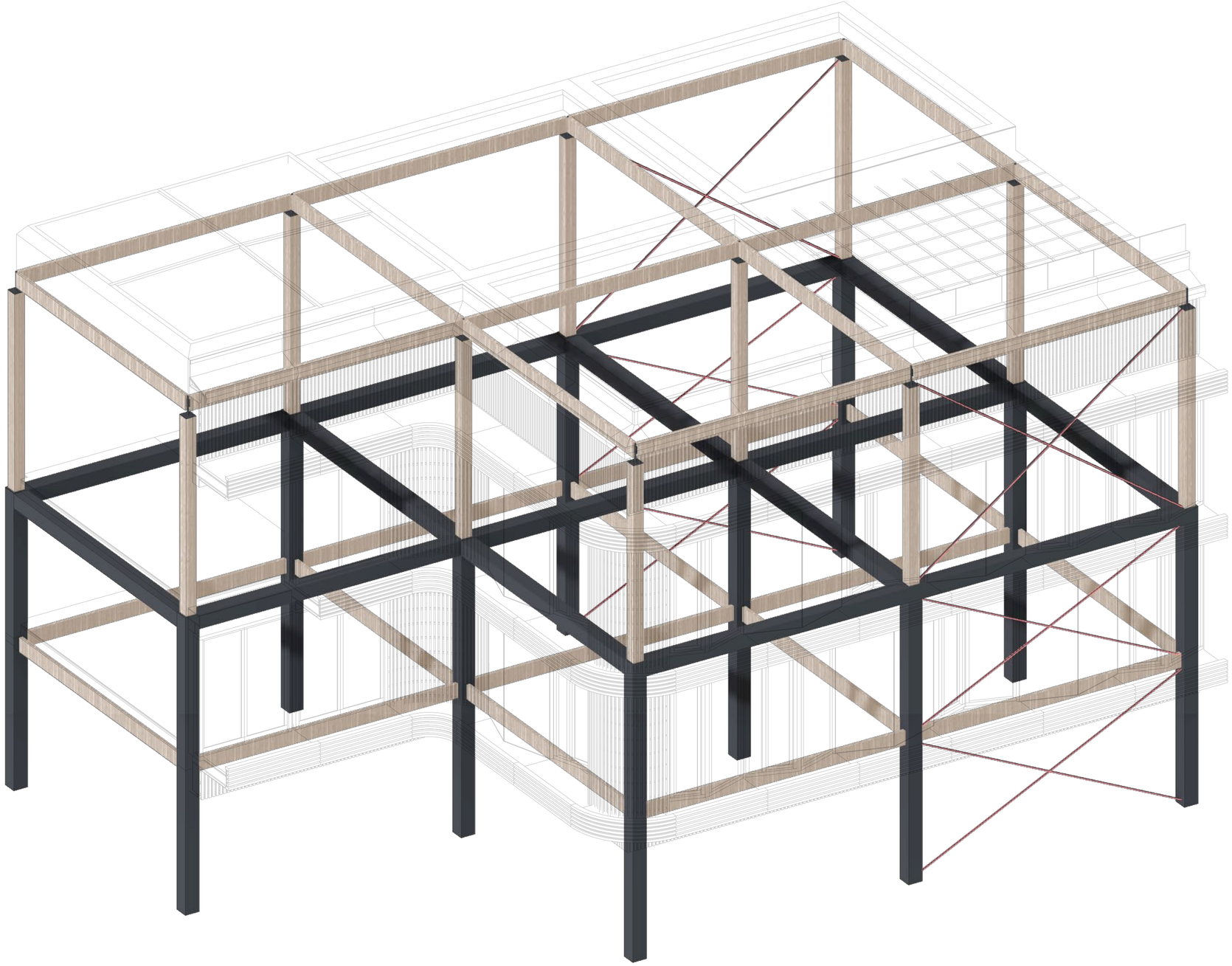

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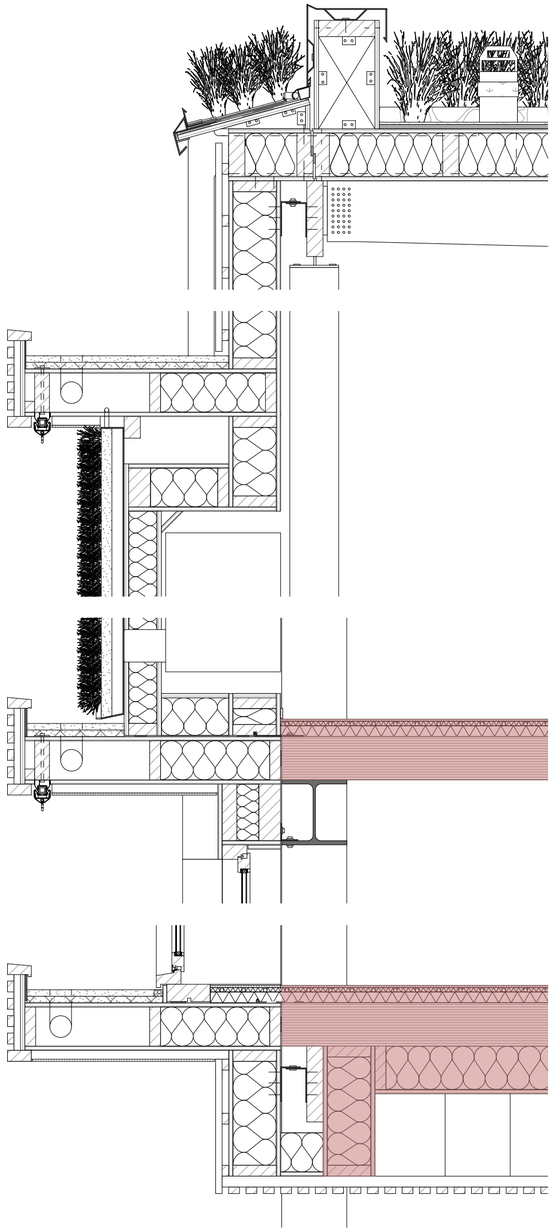
Building System

Floor Panels



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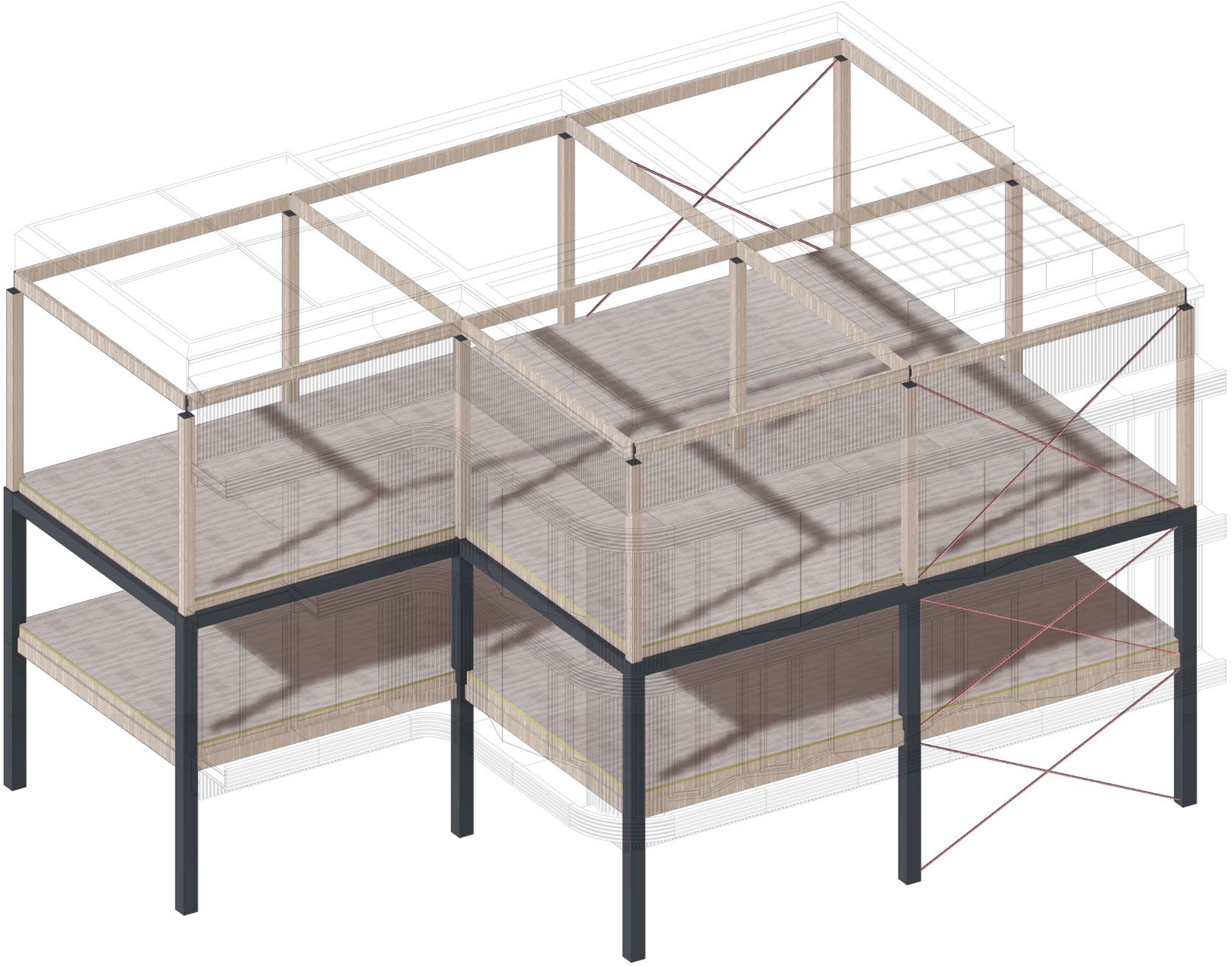

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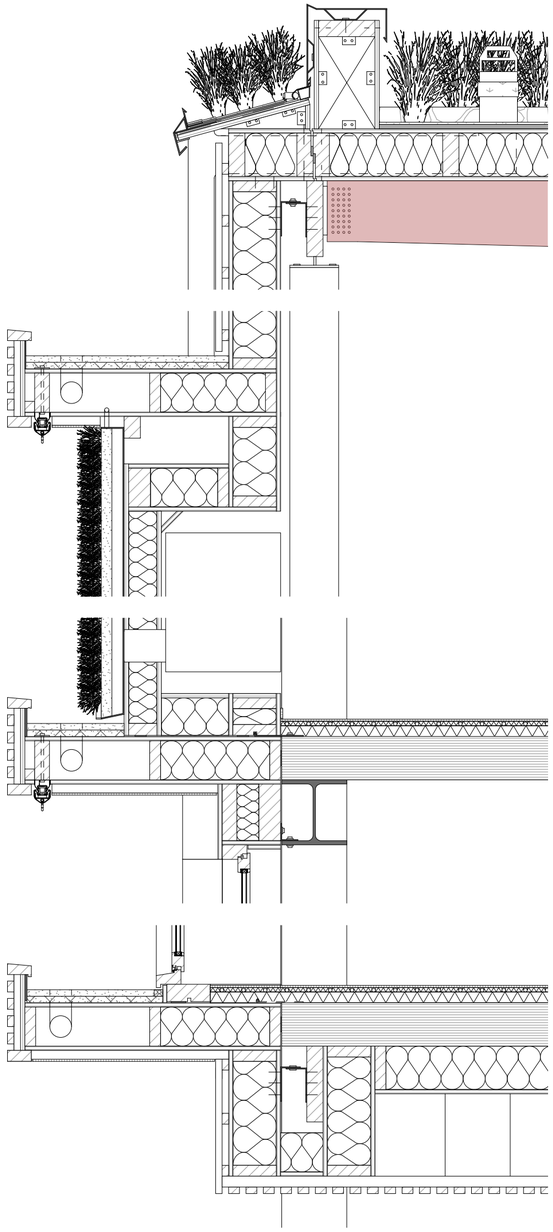
Building System

Secondary Structure & Bracing



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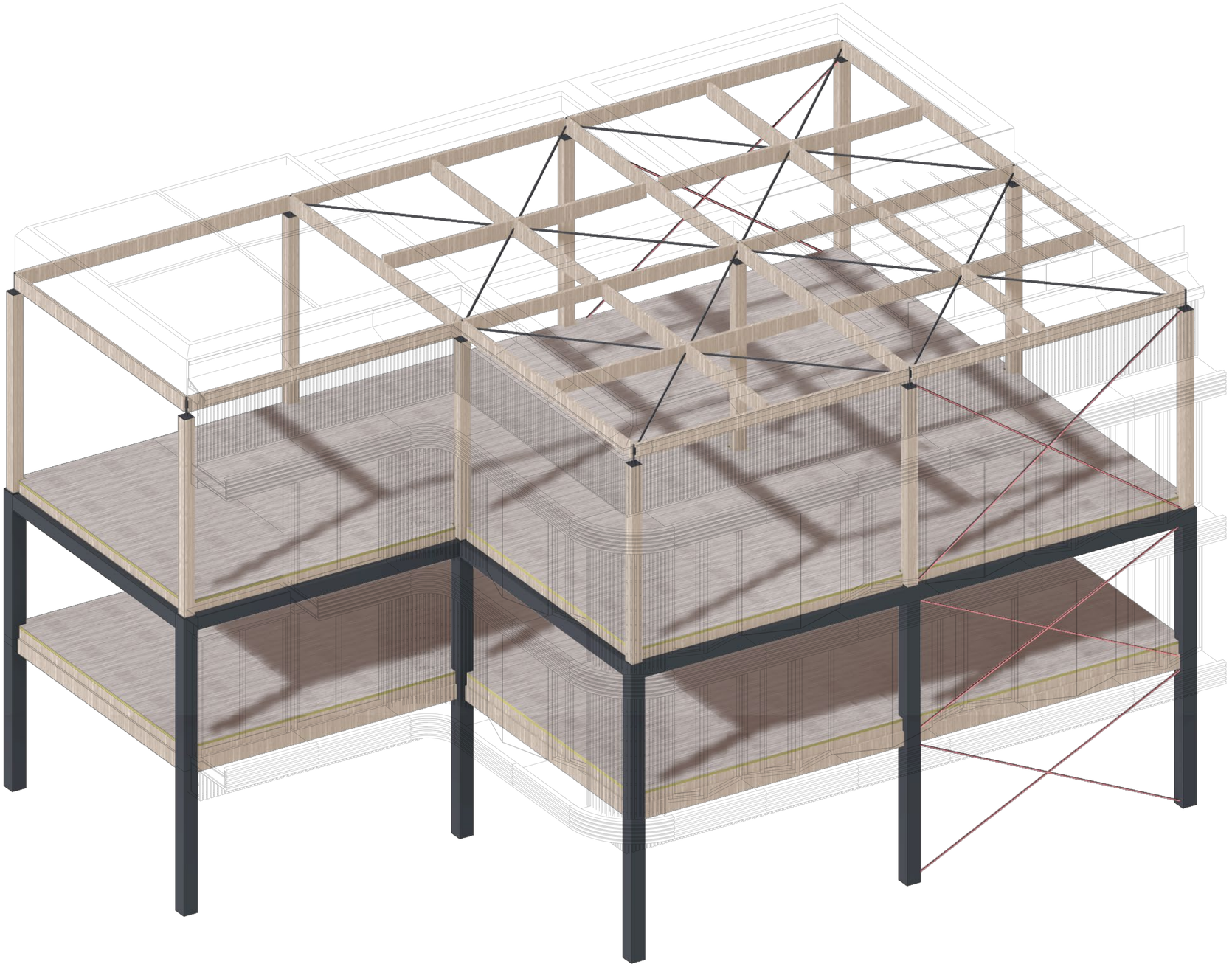

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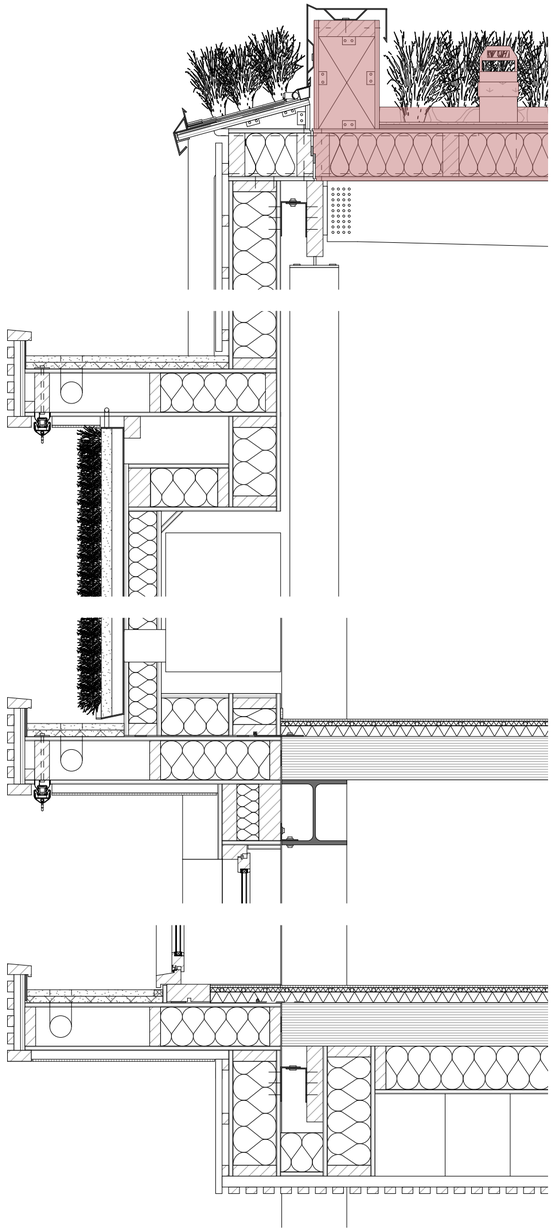
Building System

Roof Modules



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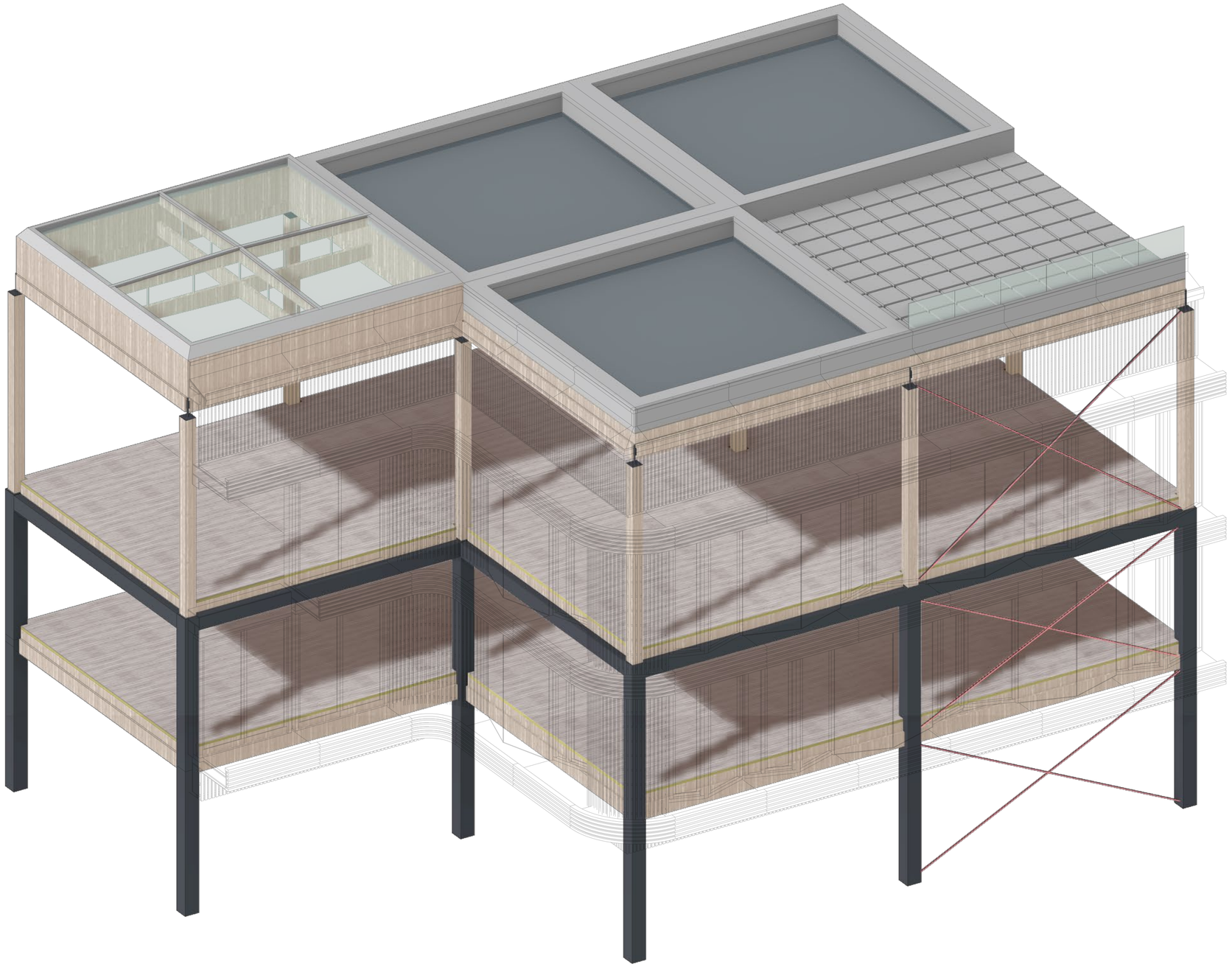
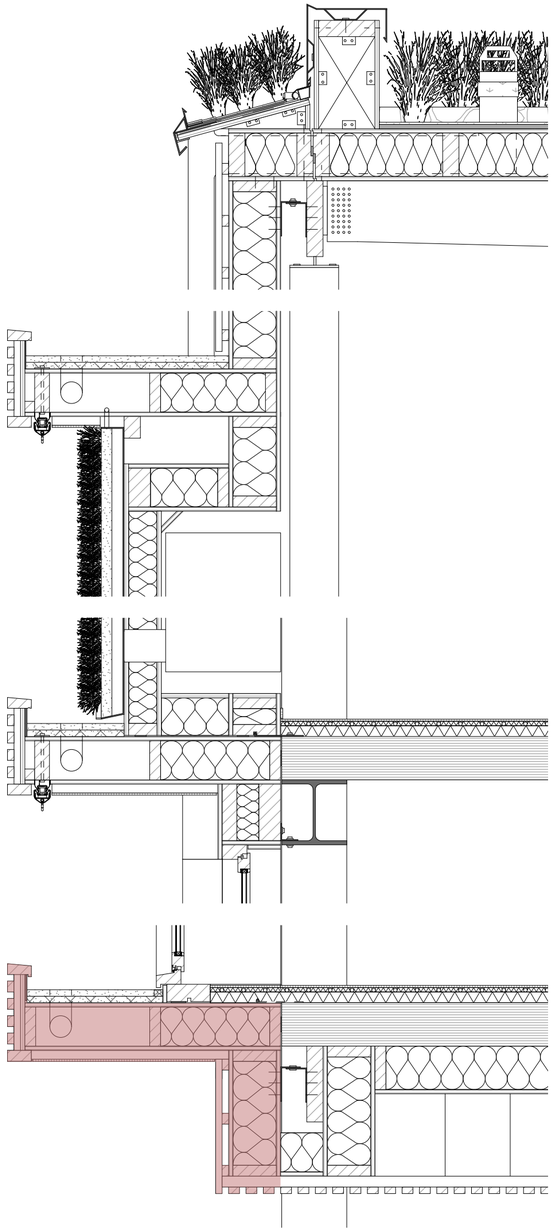


6000 mm

Building System

Bottom Gutter



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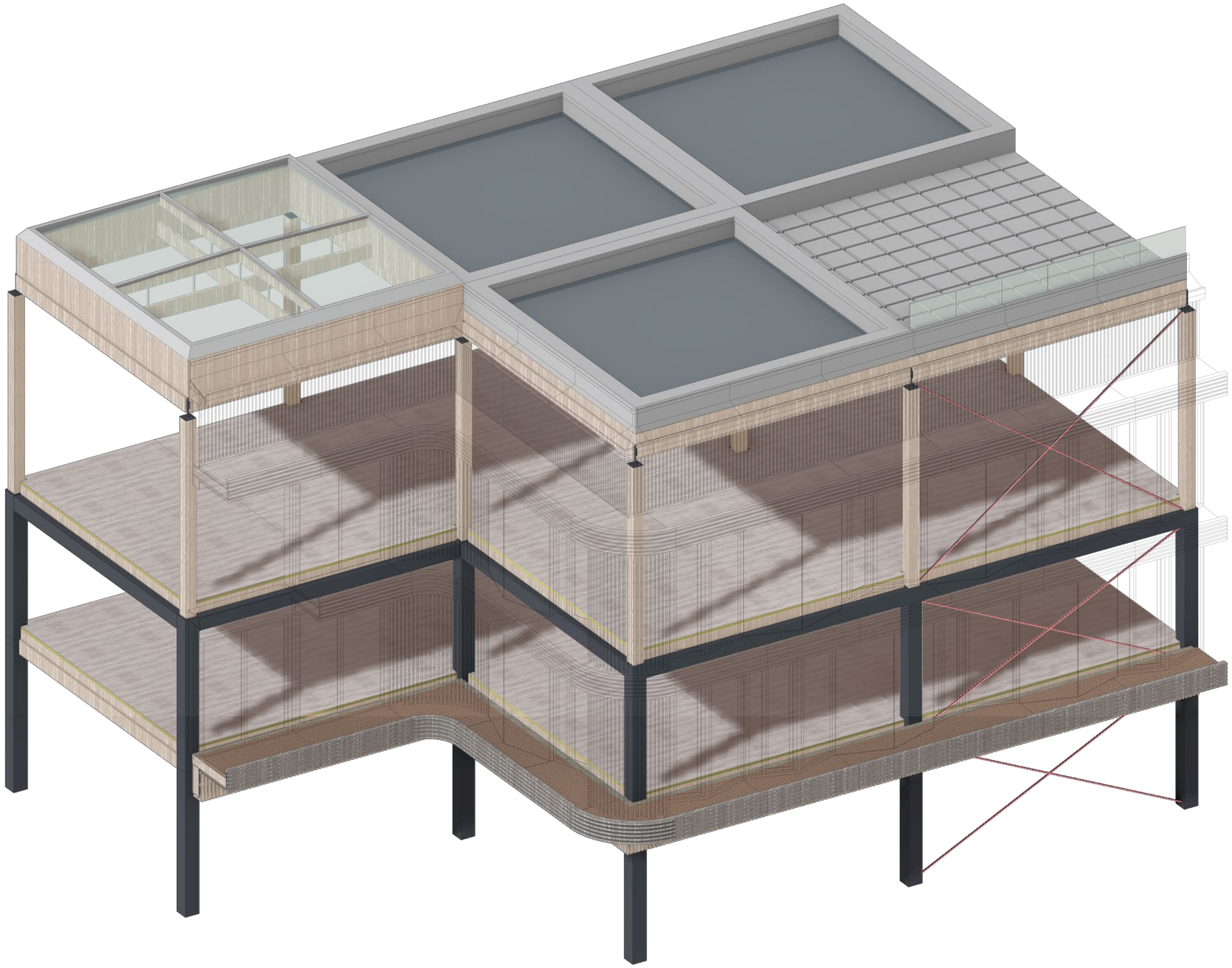
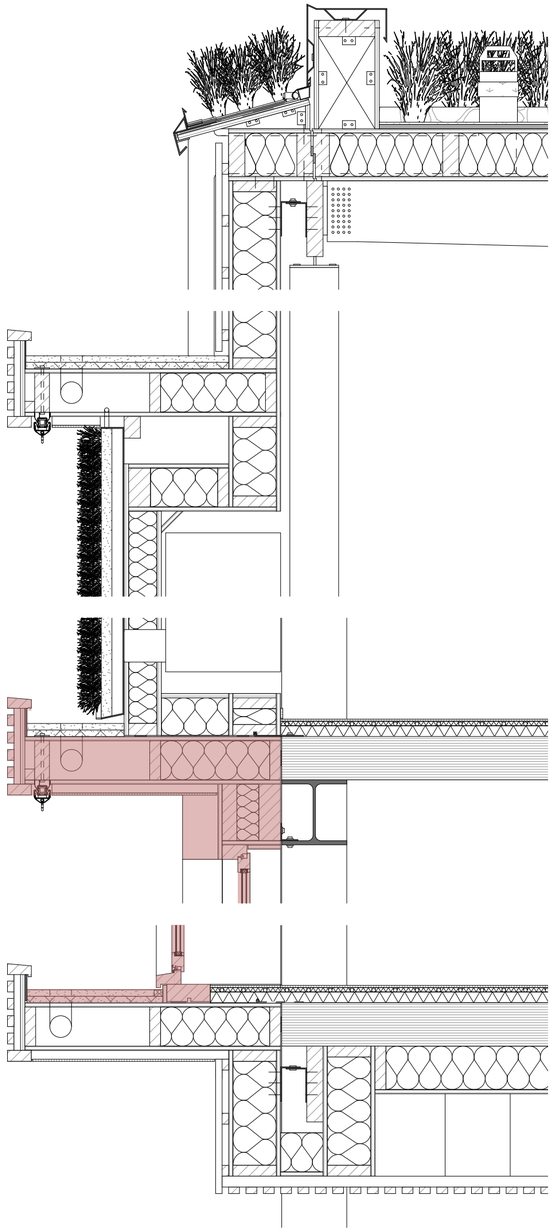


6000 mm

Building System

Window Modules



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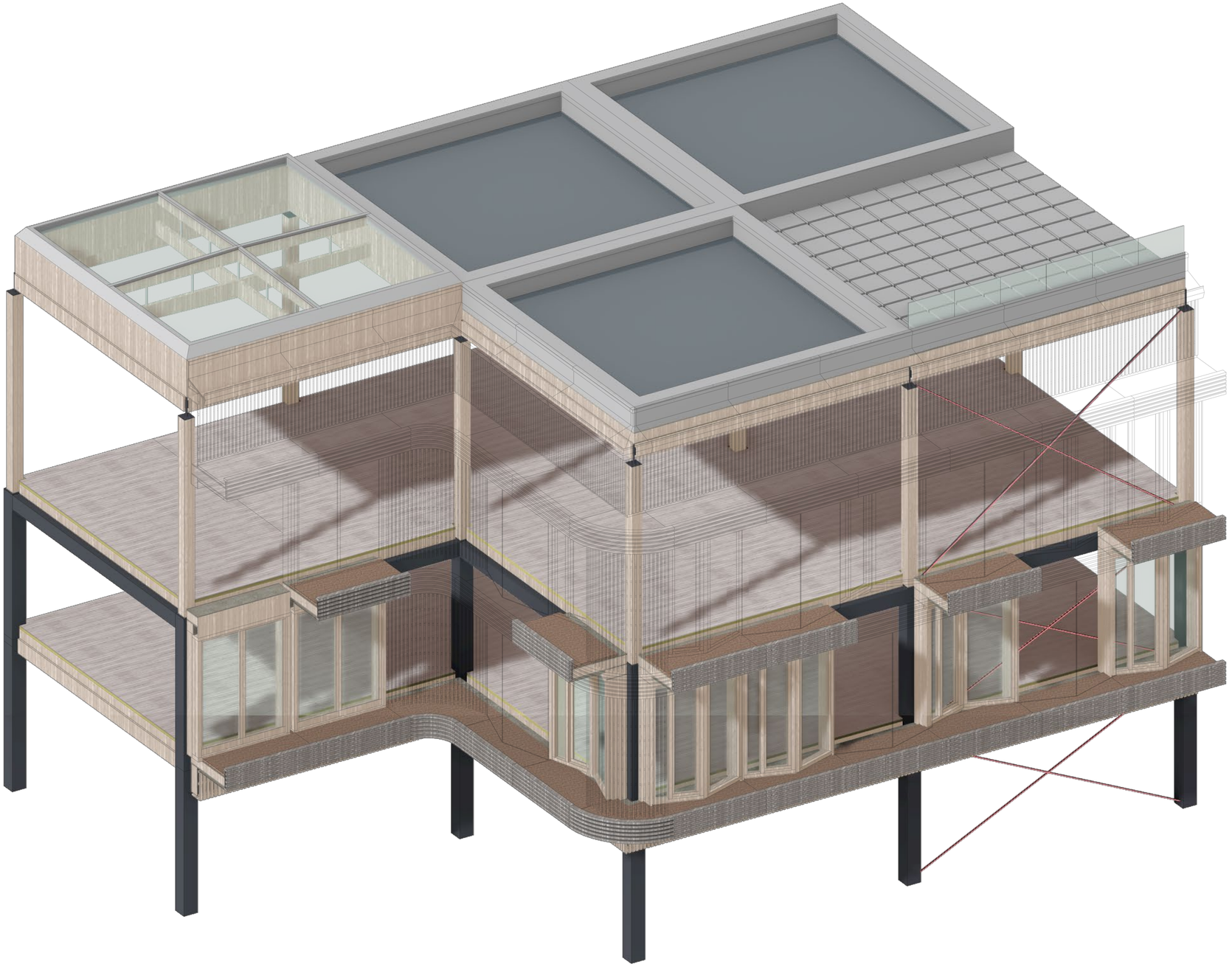

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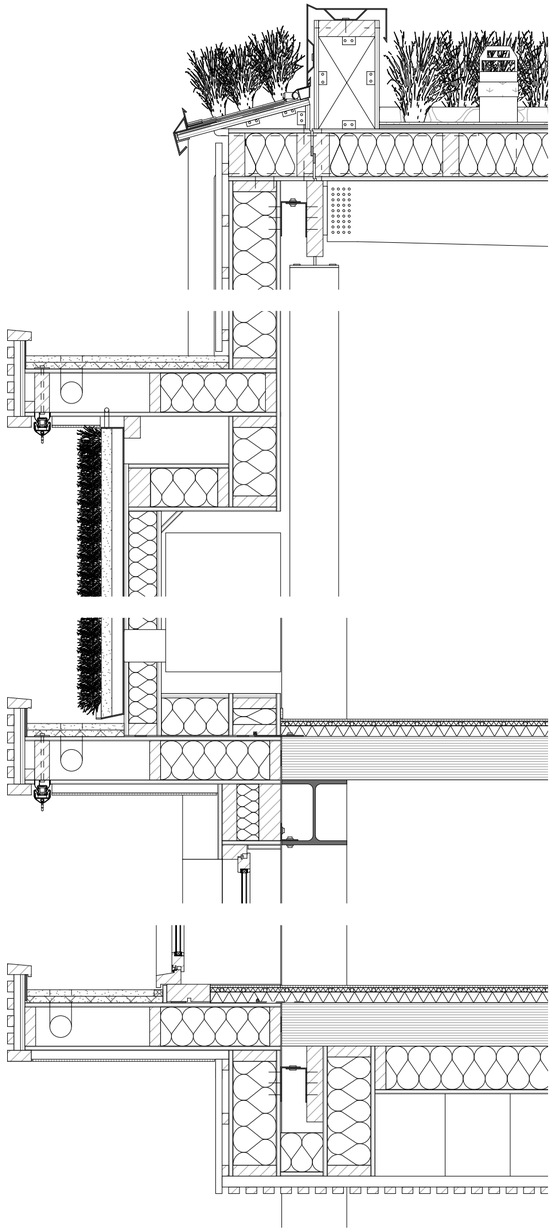
Building System

Vegetation Modules & Corners



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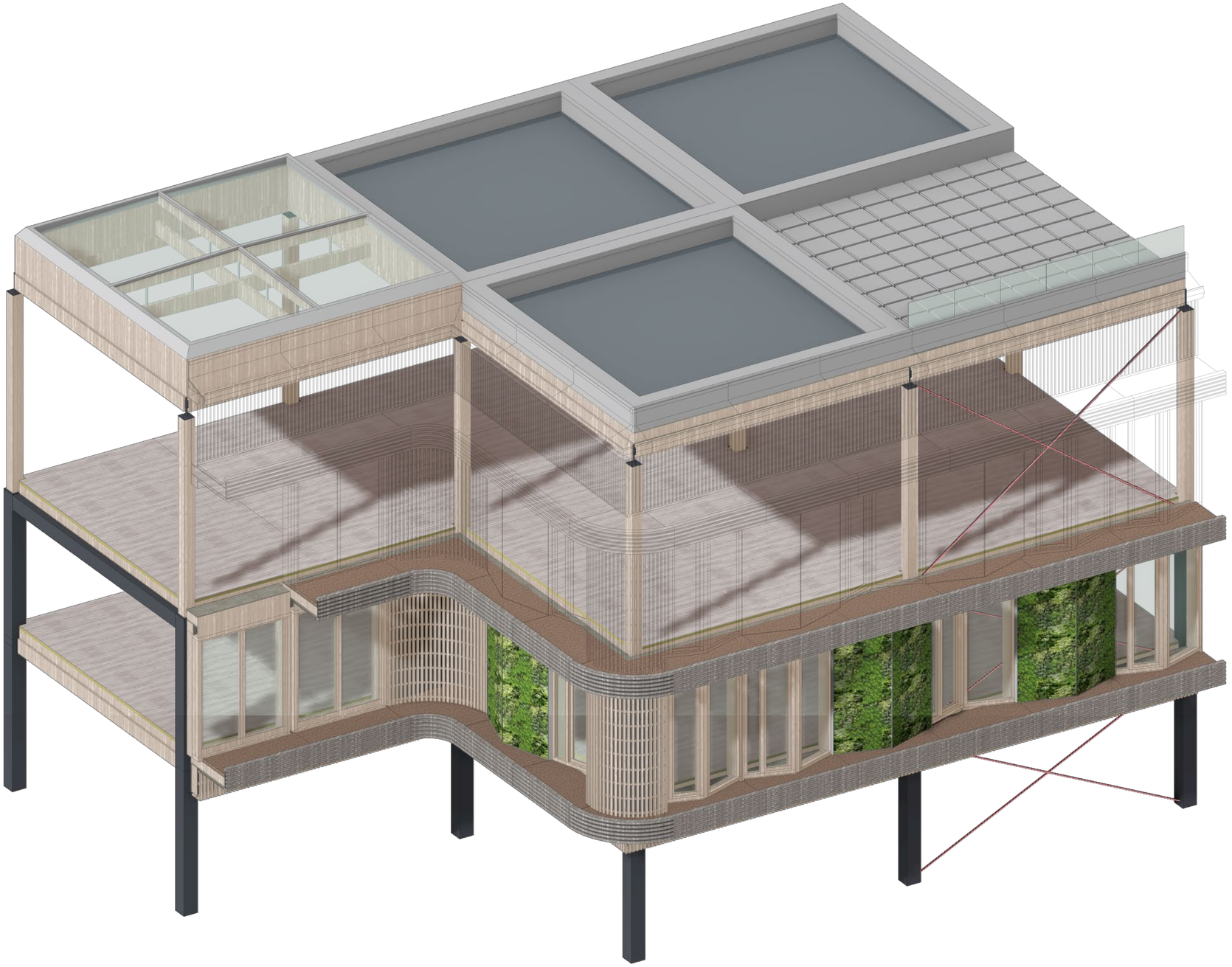
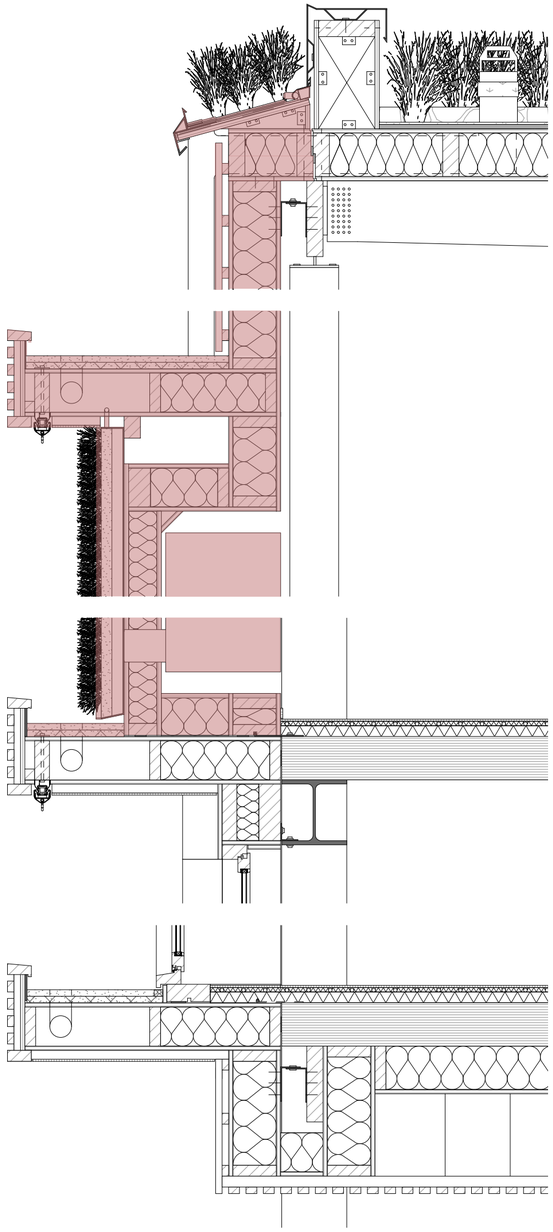


6000 mm

Building System

Repetition



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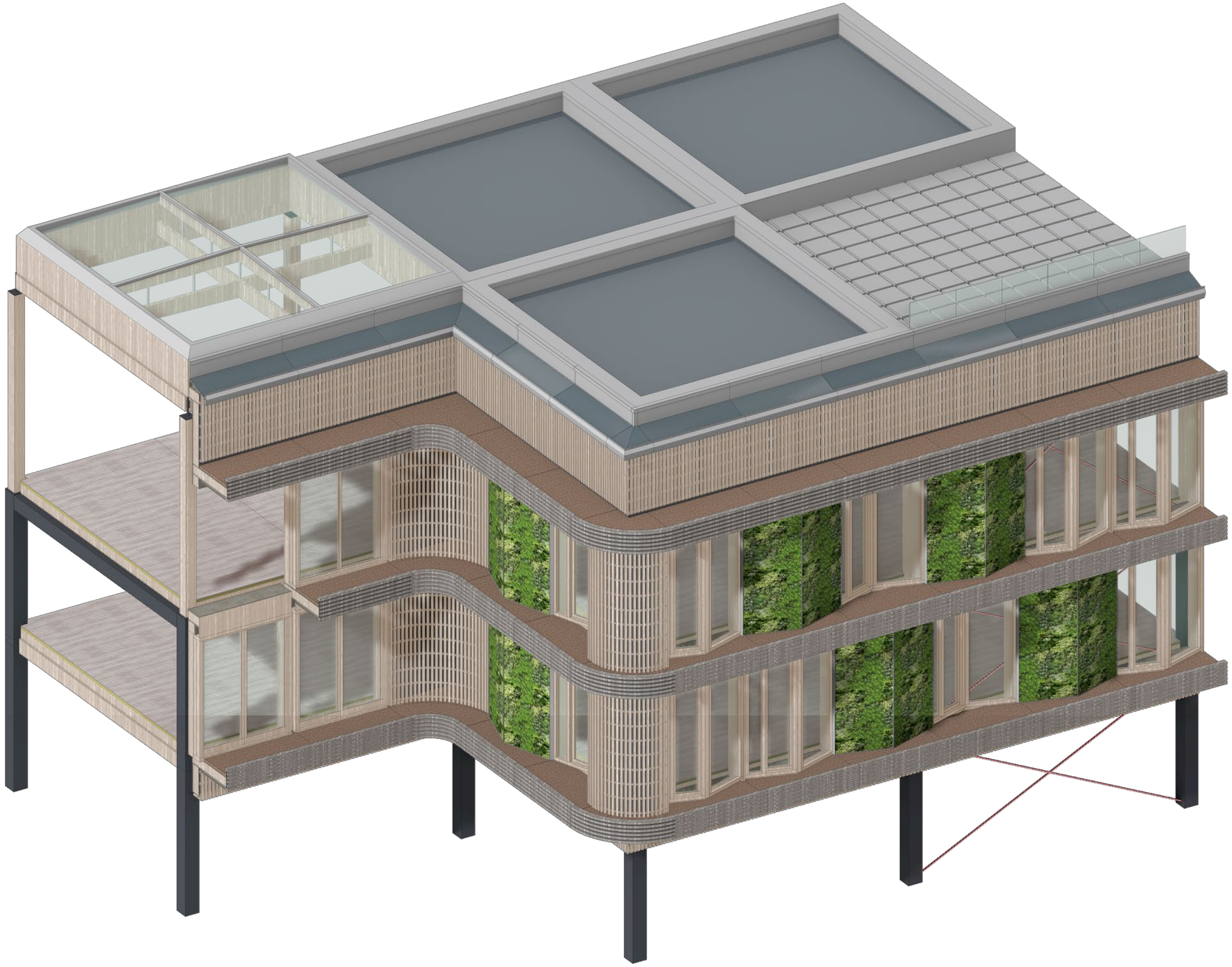


6000 mm

Implemented phytotechnologies
Degradation Bosque/ Production Forest

Types of organic material used:
- Trees

Species:
Scots pine for production *(Pinus sylvestris)*
European white birch *(Betula Pendula)*
Norway Maple *(Acer platanoides)*

Goals:
- Preventing Groundwater Migration
- Filtering Air Pollution
- Building future timber supply
- Research Experiments

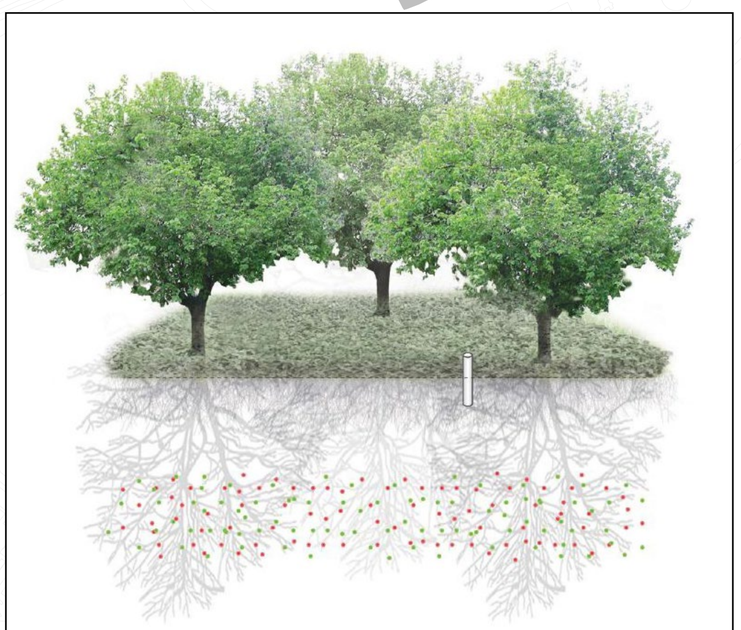


Image by Kennen and Kirkwood (2015)

200 m

Catalogue

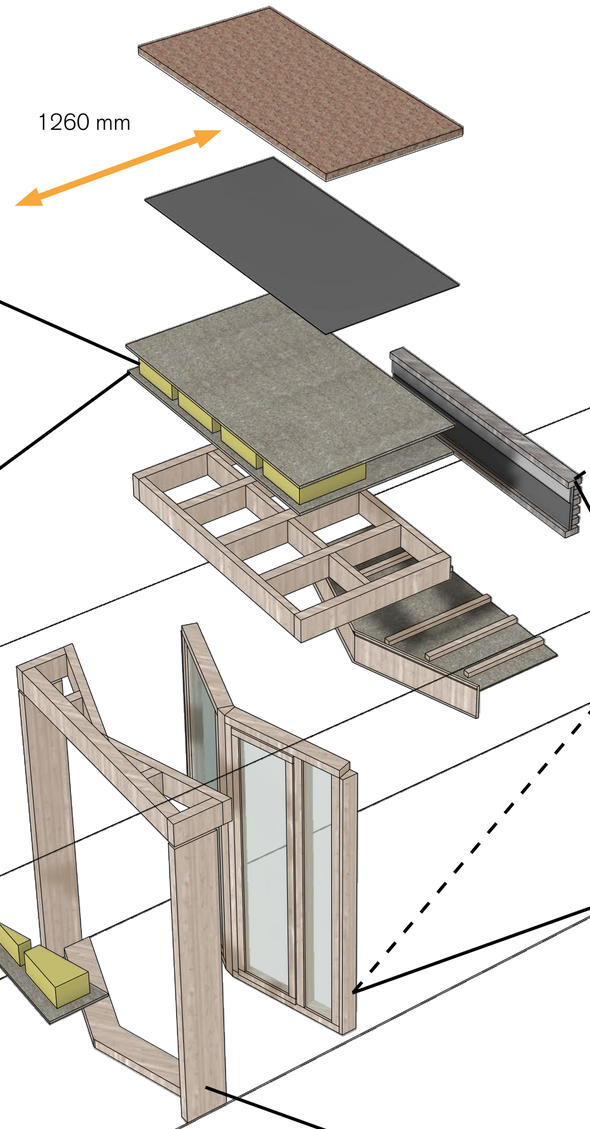
Window module



Hemp/ Flax insulation sheets



Hemp/ Flax particle board





Hempwood (in the future)



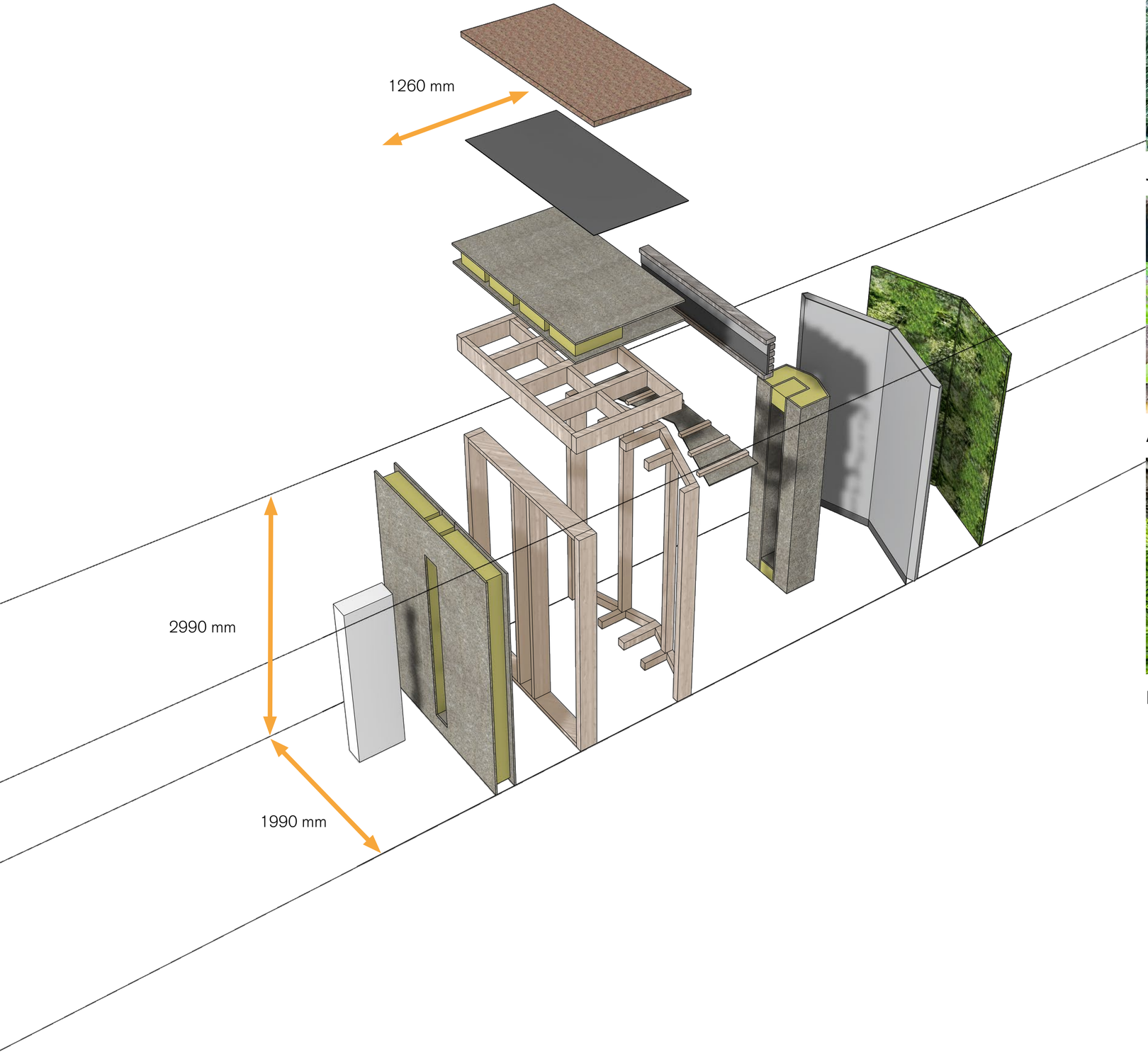
Platowood Limba Natural



PlatoWood Spruce Natural & grey

Catalogue

Vegetation Module





Japanese sedge Full sun



Common Polypody Full Sun



Asplenium Partial sun



Prairie spiderwort Partial Sun



Hakone grass Shade

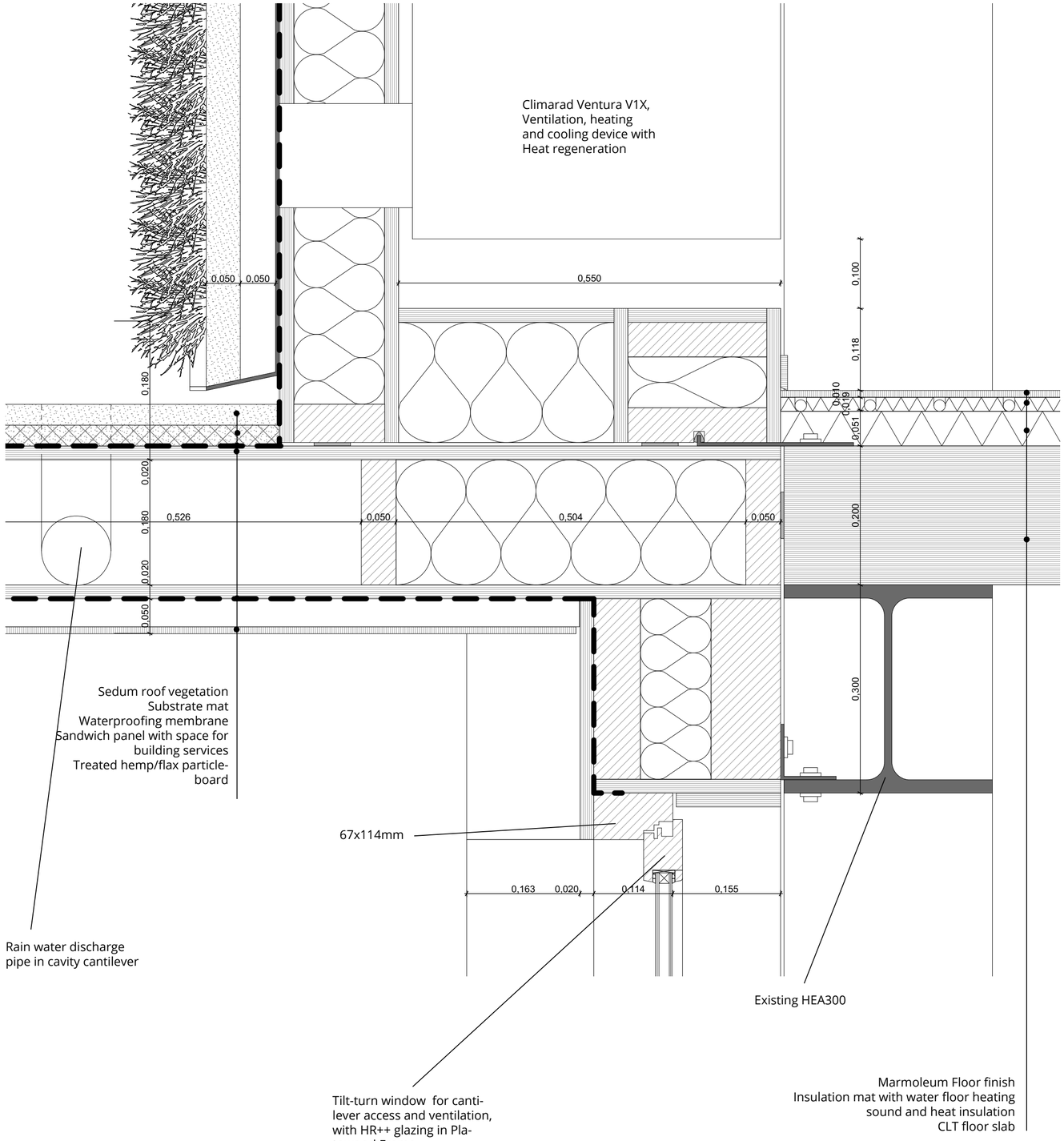


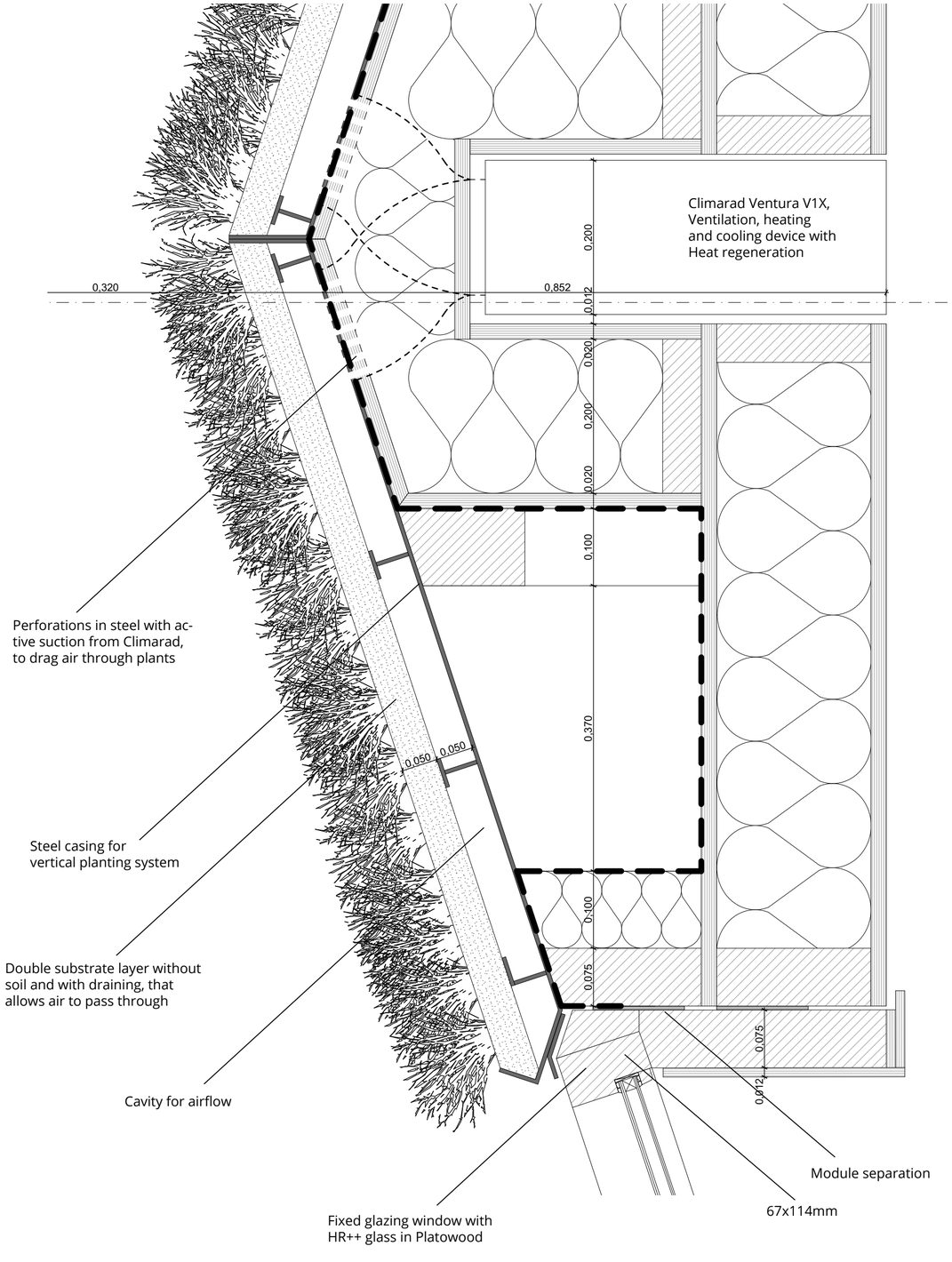
Pained fern Shade

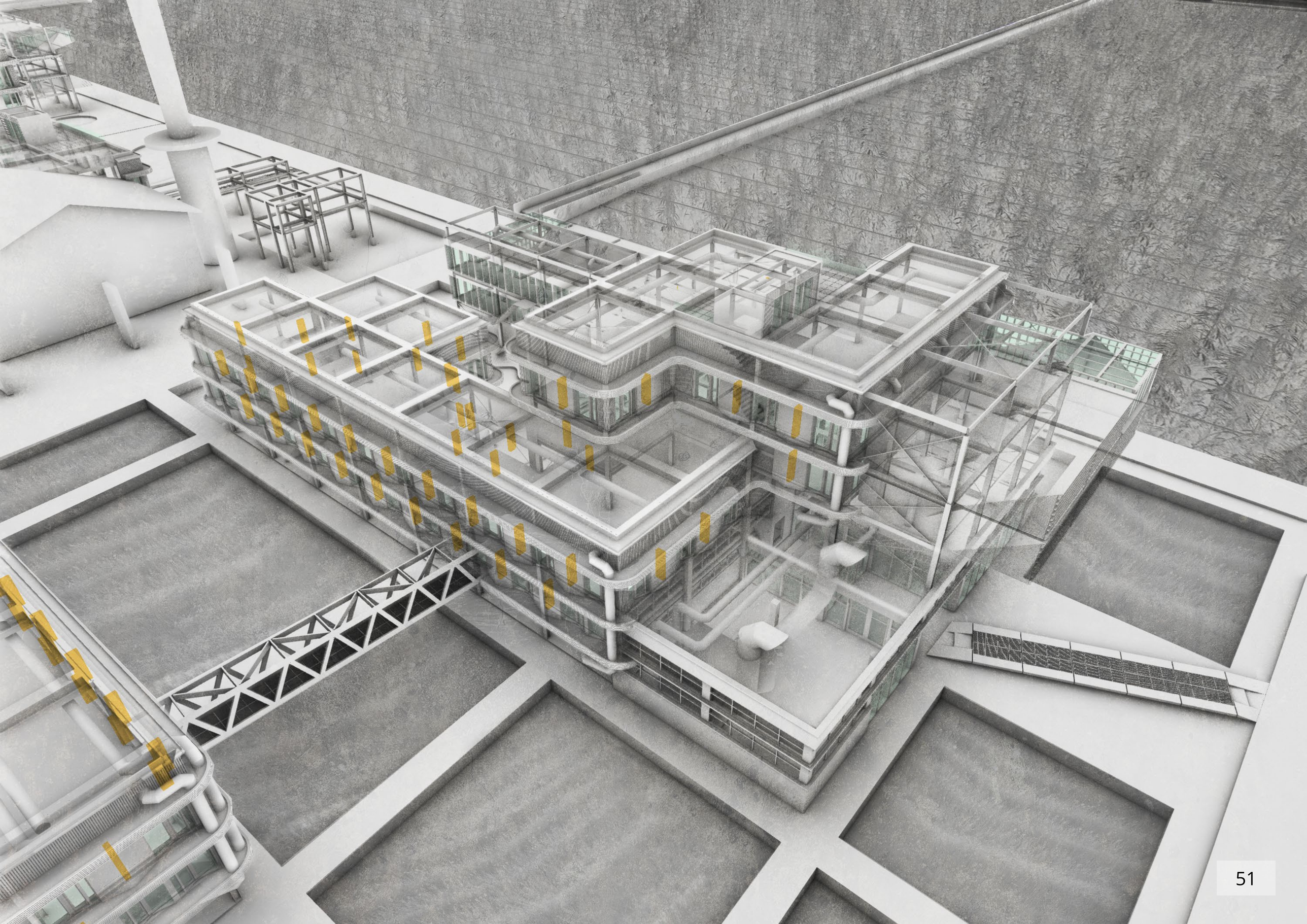


Sedum roof vegetation

Ventilation and heating system








BP
BP
BP
BP

Ferry to city centre

City centre

Central & East port

Saint-pol-sur-mer

Fort Mardyck

Harvesting, Maintenance & Logistics

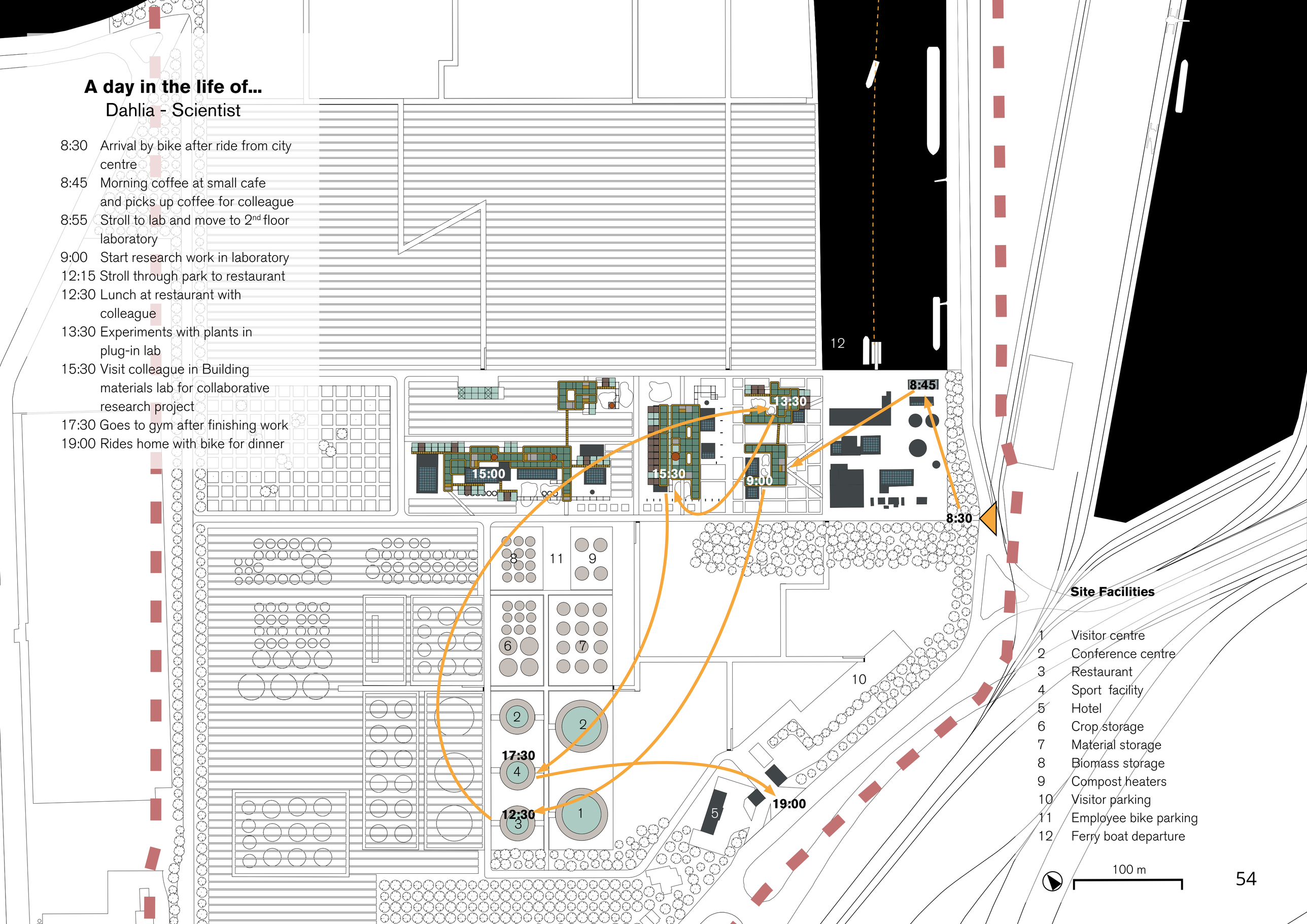
- Site access point
- Road outside plot
- Asphalted road
- Grassy road
- Harvesting zone
- Delivery route
- Plot outline

200 m

A day in the life of...

Dahlia - Scientist

8:30 Arrival by bike after ride from city centre
8:45 Morning coffee at small cafe and picks up coffee for colleague
8:55 Stroll to lab and move to 2nd floor laboratory
9:00 Start research work in laboratory
12:15 Stroll through park to restaurant
12:30 Lunch at restaurant with colleague
13:30 Experiments with plants in plug-in lab
15:30 Visit colleague in Building materials lab for collaborative research project
17:30 Goes to gym after finishing work
19:00 Rides home with bike for dinner



Site Facilities

1 Visitor centre
2 Conference centre
3 Restaurant
4 Sport facility
5 Hotel
6 Crop storage
7 Material storage
8 Biomass storage
9 Compost heaters
10 Visitor parking
11 Employee bike parking
12 Ferry boat departure

100 m

Implemented phytotechnologies
Mycoremediation

Types of organic material used:
- Harvestable Funghi Mycelium

Goals:
- Remediating contaminated soil layers
- Providing biomass for:
Construction materials
Research experiments



Image: buildabroad.org

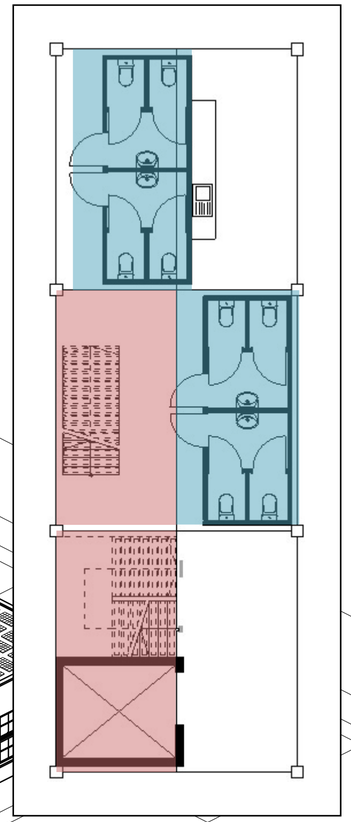
200 m



Pictures: SRD

Program

Entrance & Cores



Legend

- Building entrance
- First floor volume
- Circulation & emergency core
- Services core

10 m

Program

Subdivision of functions

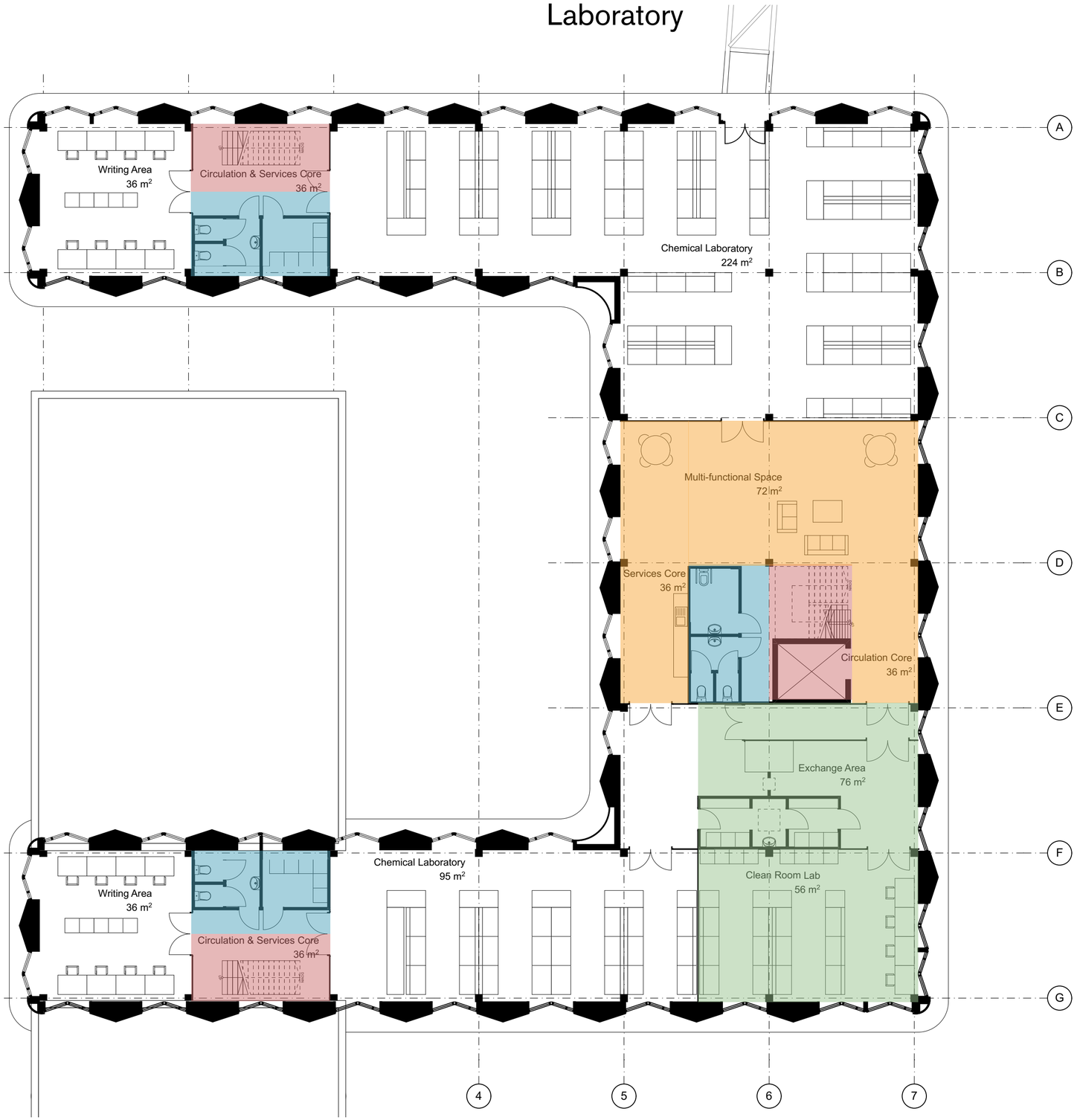
Legend

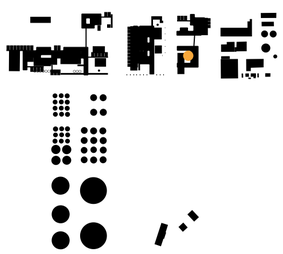
- Lobby
- Research Offices
- Laboratories
- Services core
- Circulation & emergency core

10 m

Program

Laboratory





2nd Floor Legend

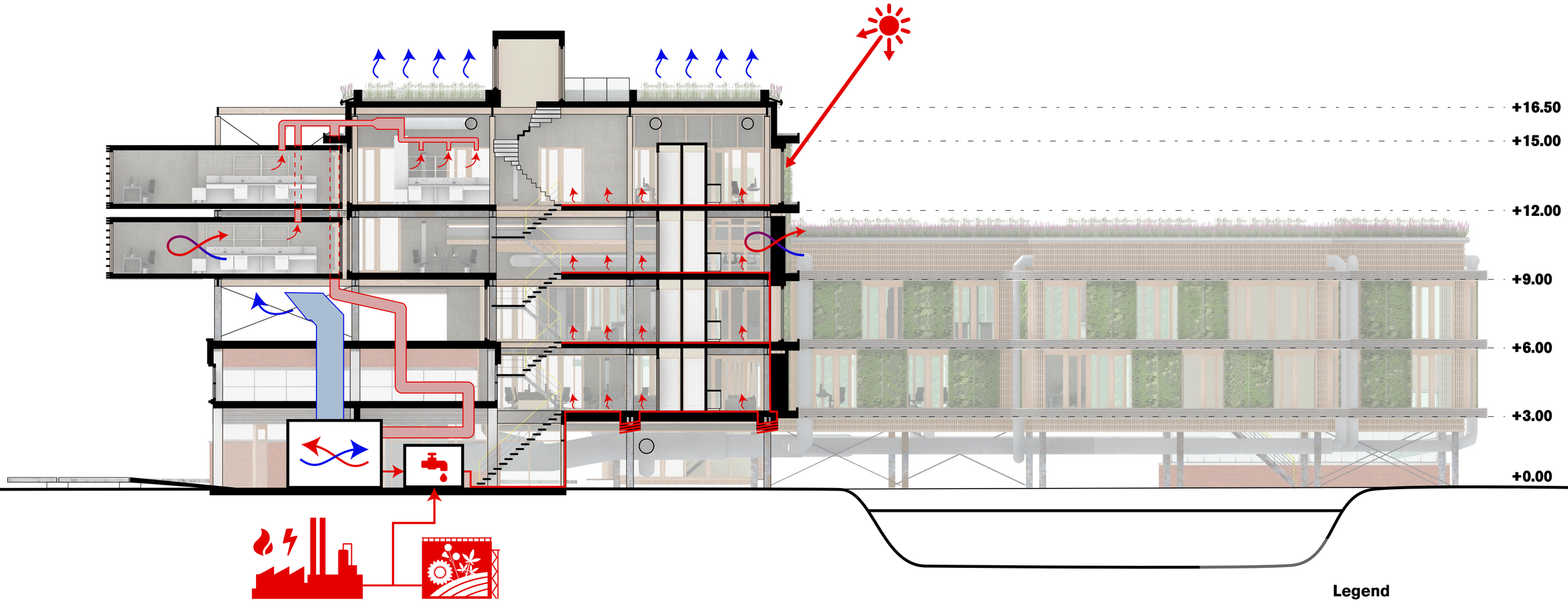
- Services core
- Circulation & emergency core
- Shared lobby
- Clean Room Lab (optional)

6 m



Program

Heating & Cooling

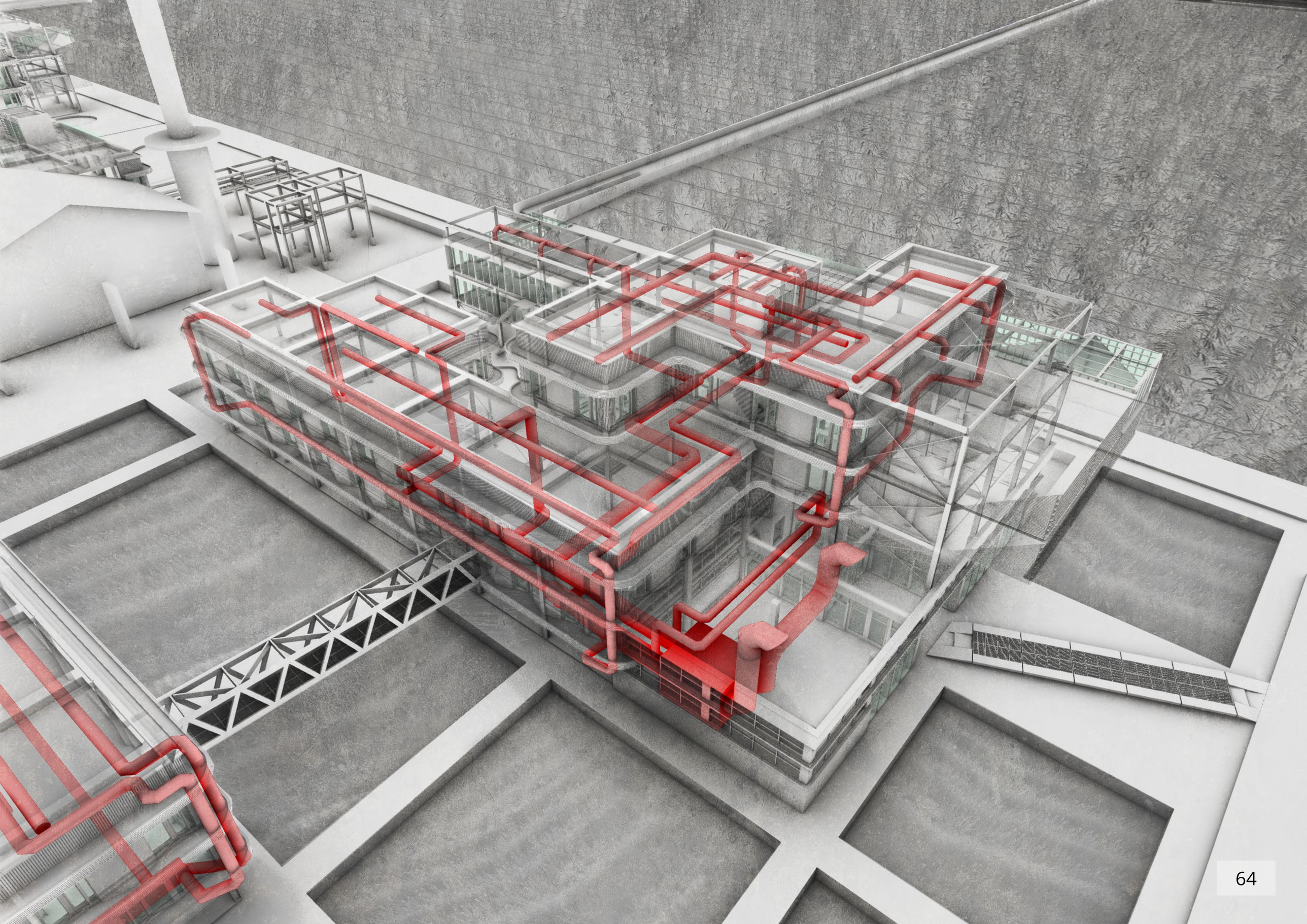


Legend

Warm Flow

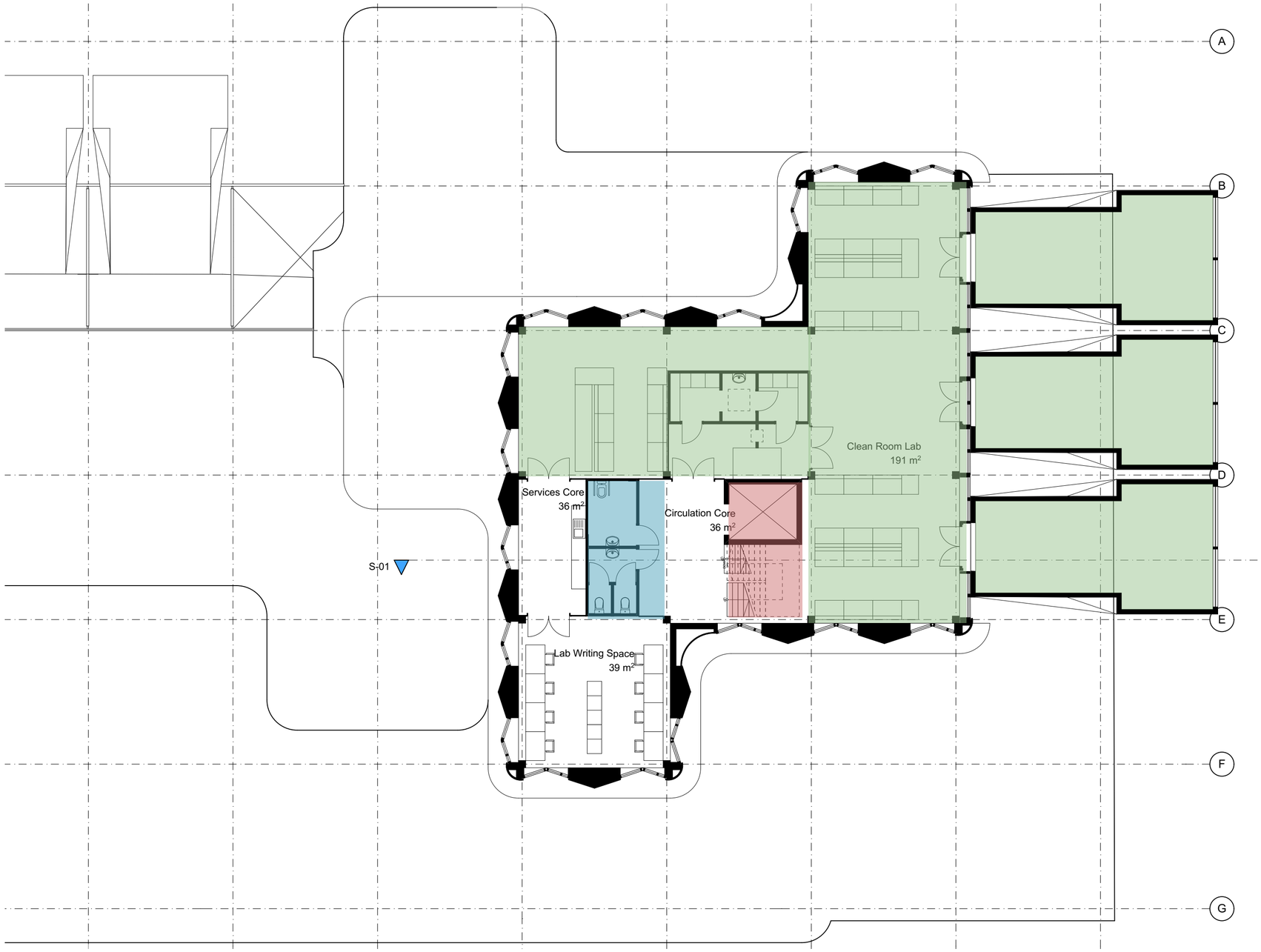
Cold Flow

6 m



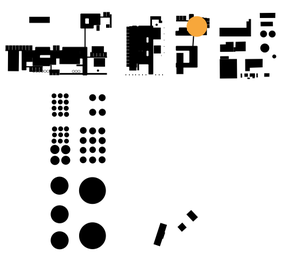
Program

Laboratory



4th Floor Legend

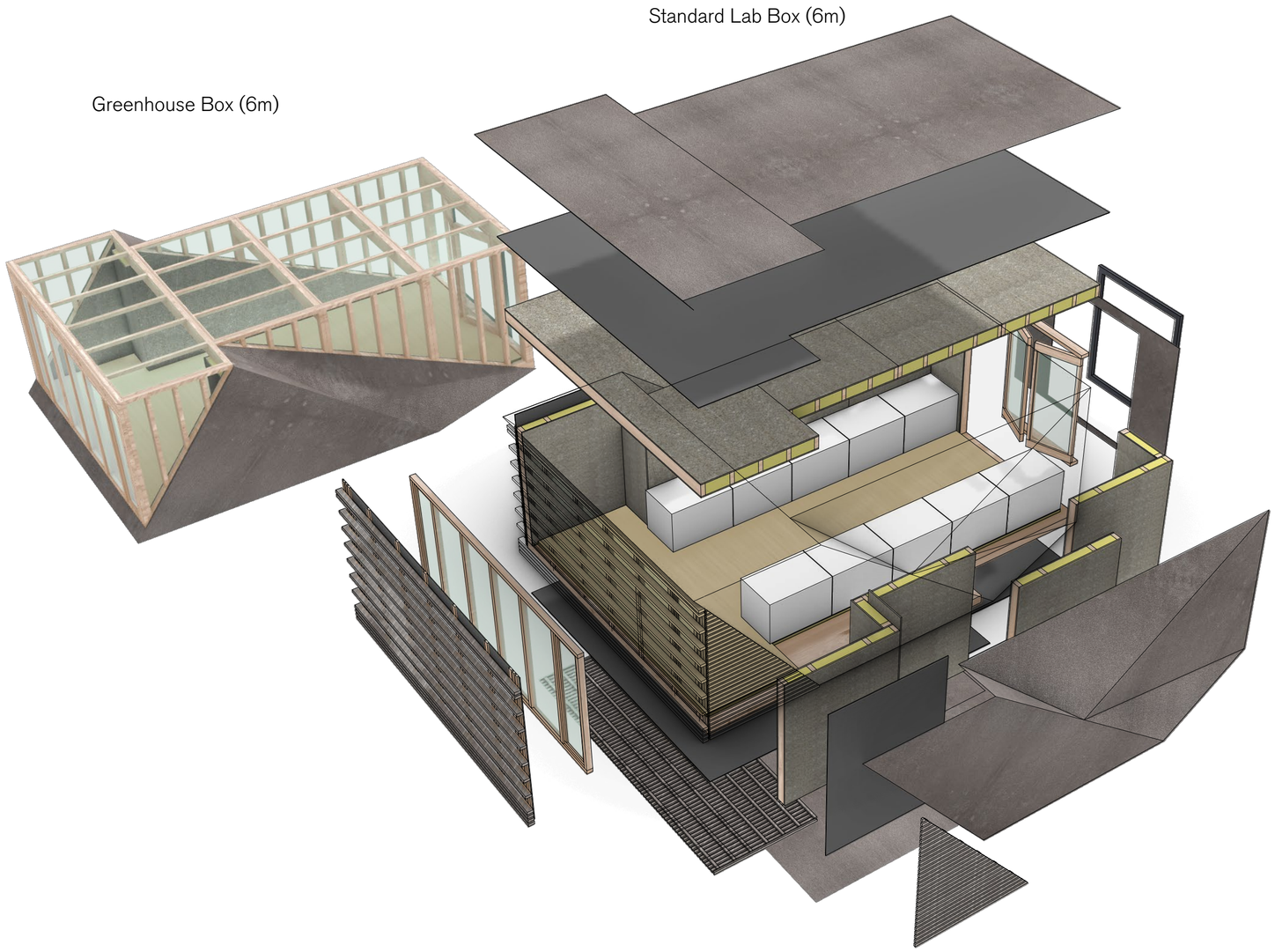
- Services core
- Circulation & emergency core
- Clean Room Lab (optional)

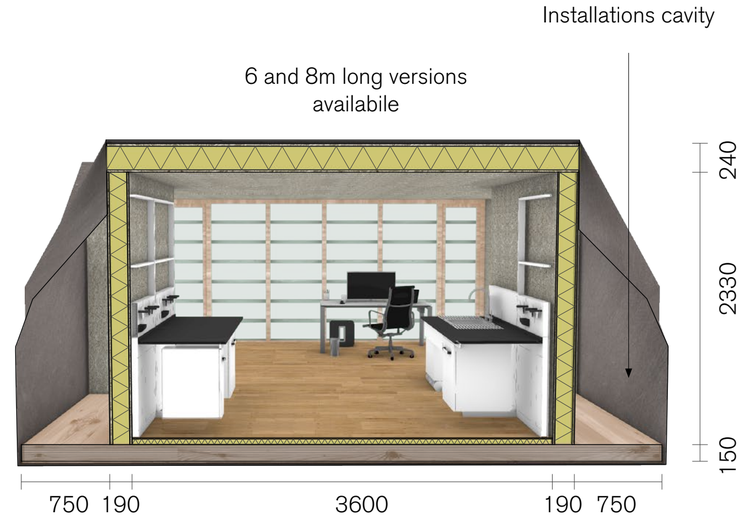


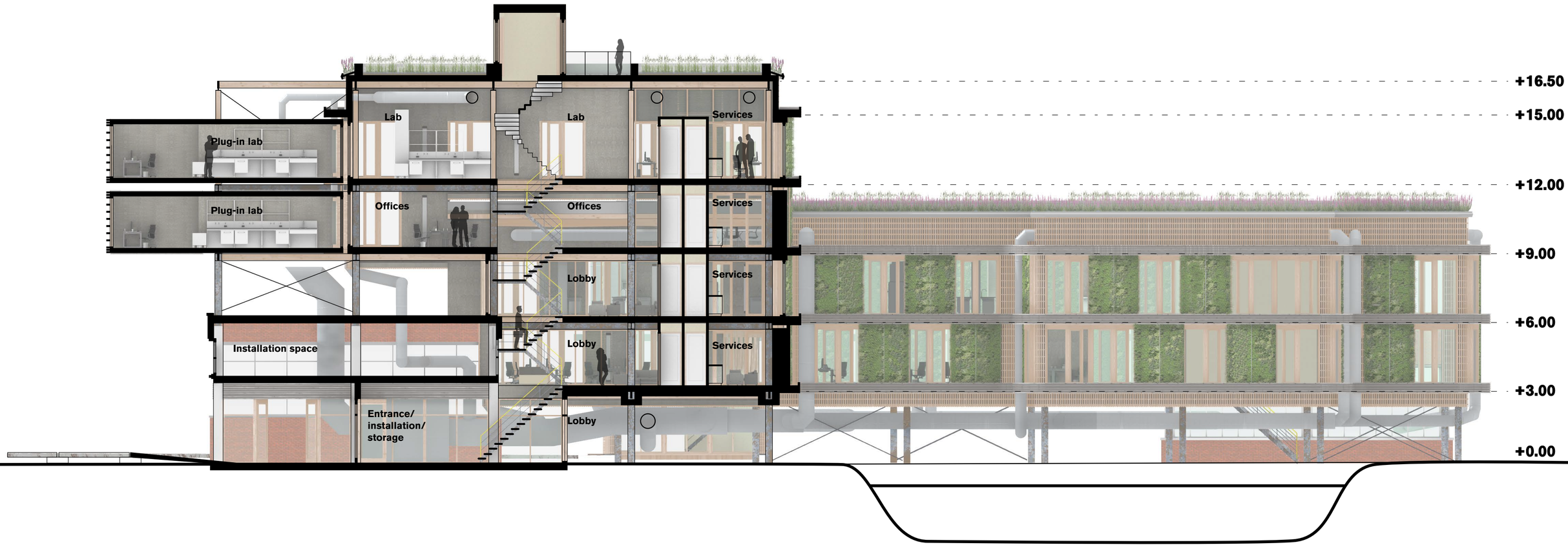
4th Floor

6 m

Catalogue
Plug-in Module






Plug-in lab
Lab
Lab
Services
Plug-in lab
Offices
Offices
Services
Lobby
Services
Installation space
Lobby
Services
Entrance/
installation/
storage
Lobby
+16.50
+15.00
+12.00
+9.00
+6.00
+3.00
+0.00

6 m

Ferry to city centre

City centre

Central & East port

Saint-pol-sur-mer

Fort Mardyck

Non-motorized traffic

- Site access point
- Boardwalk
- Asphalted road
- Semi-paved road
- Forest trail
- 360° Viewpoint
- Plot outline

200 m

Pictures: SRD



Implemented phytotechnologies
Degradation Cover

Types of organic material used:
- Herbaceous plants & shrubs

Species:
Grasses such as:
- Ryegrass
- Orchard grass
- Red fescue

Herbs such as:
- Sainfoin
- Birdsfoot trefoil
- Clovers

Goal:
Remediating moved soil for future reuse



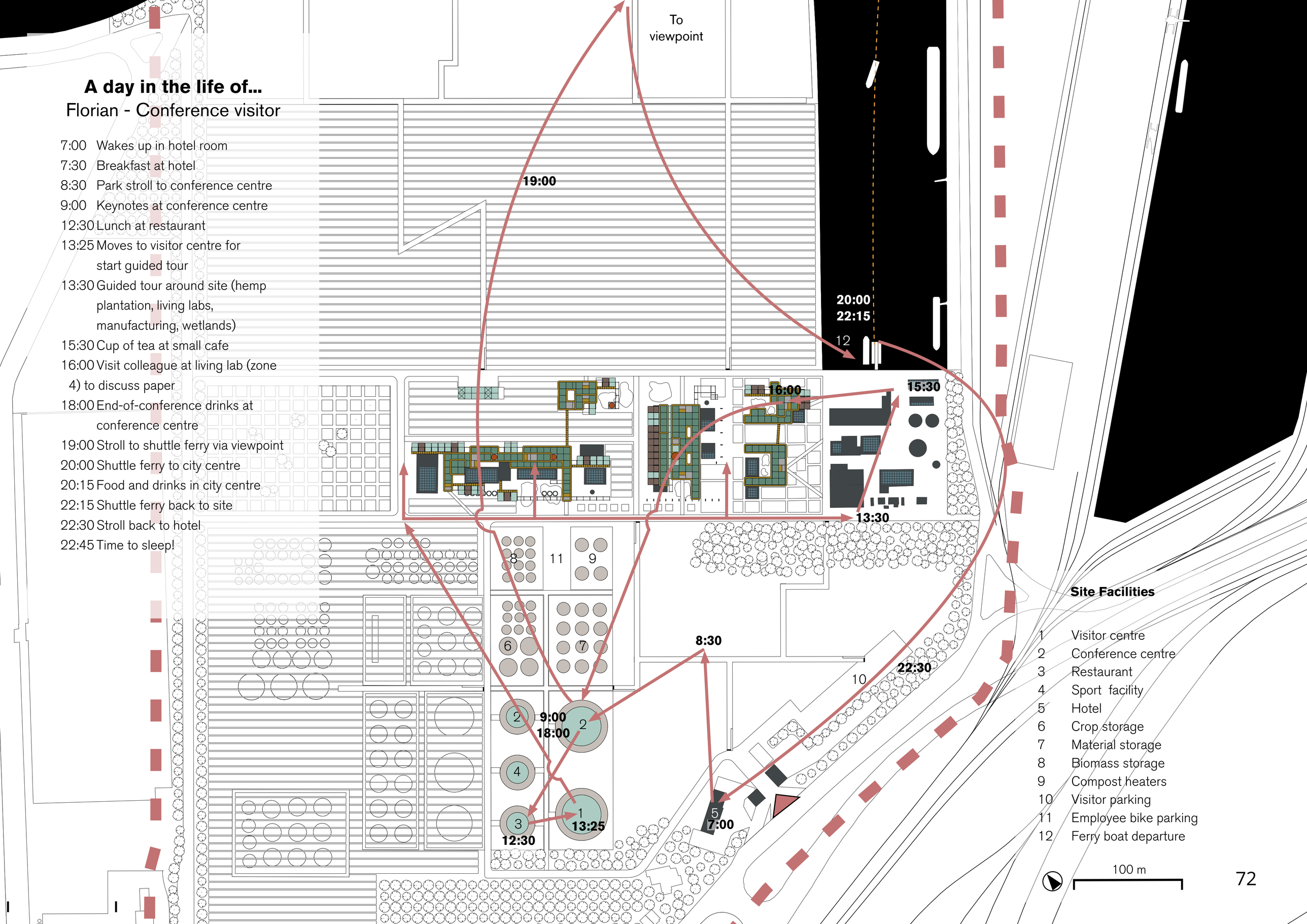
Image by Kennen and Kirkwood (2015)

200 m

A day in the life of...

Florian - Conference visitor

7:00 Wakes up in hotel room
7:30 Breakfast at hotel
8:30 Park stroll to conference centre
9:00 Keynotes at conference centre
12:30 Lunch at restaurant
13:25 Moves to visitor centre for start guided tour
13:30 Guided tour around site (hemp plantation, living labs, manufacturing, wetlands)
15:30 Cup of tea at small cafe
16:00 Visit colleague at living lab (zone 4) to discuss paper
18:00 End-of-conference drinks at conference centre
19:00 Stroll to shuttle ferry via viewpoint
20:00 Shuttle ferry to city centre
20:15 Food and drinks in city centre
22:15 Shuttle ferry back to site
22:30 Stroll back to hotel
22:45 Time to sleep!

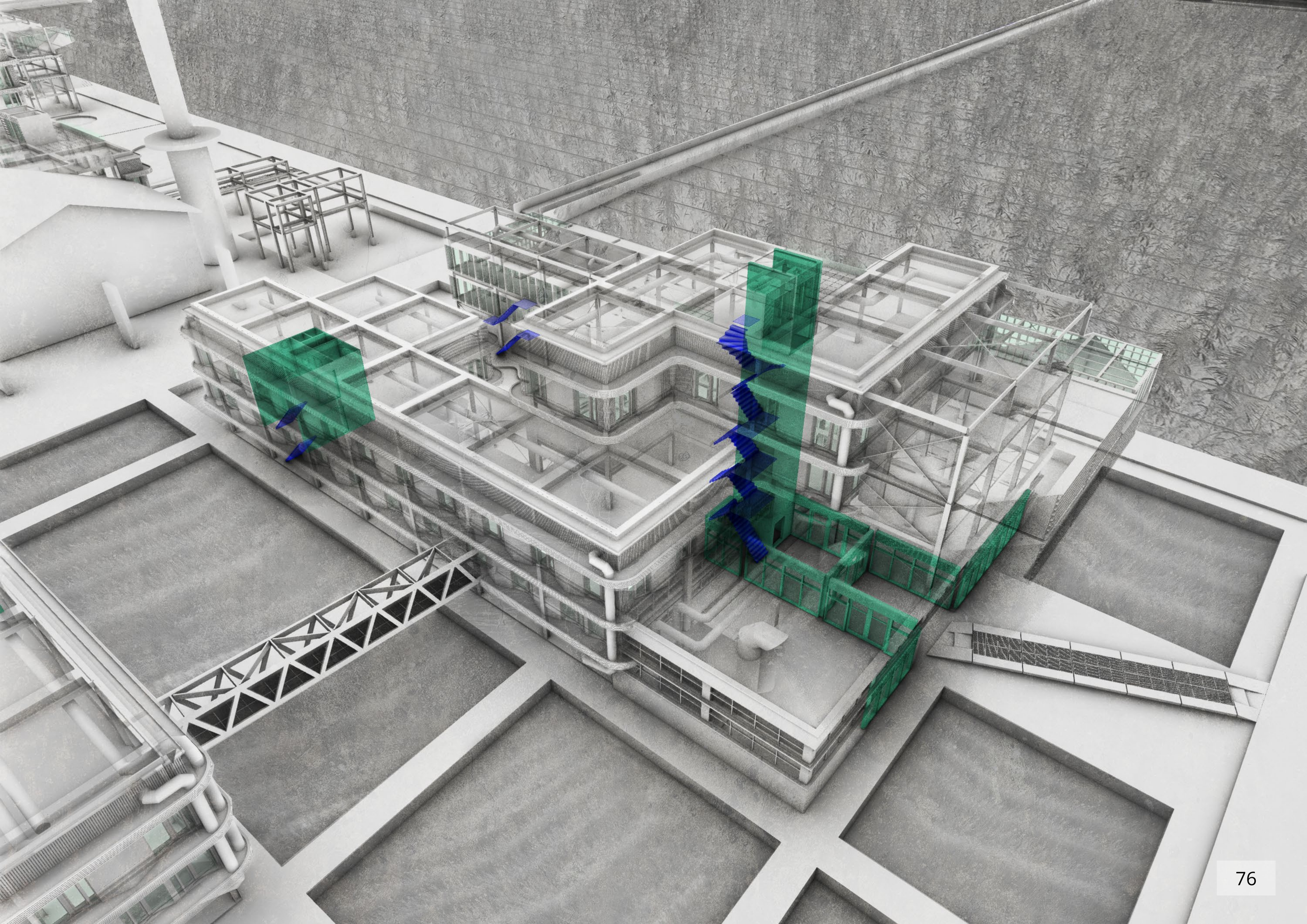


Site Facilities

1 Visitor centre
2 Conference centre
3 Restaurant
4 Sport facility
5 Hotel
6 Crop storage
7 Material storage
8 Biomass storage
9 Compost heaters
10 Visitor parking
11 Employee bike parking
12 Ferry boat departure



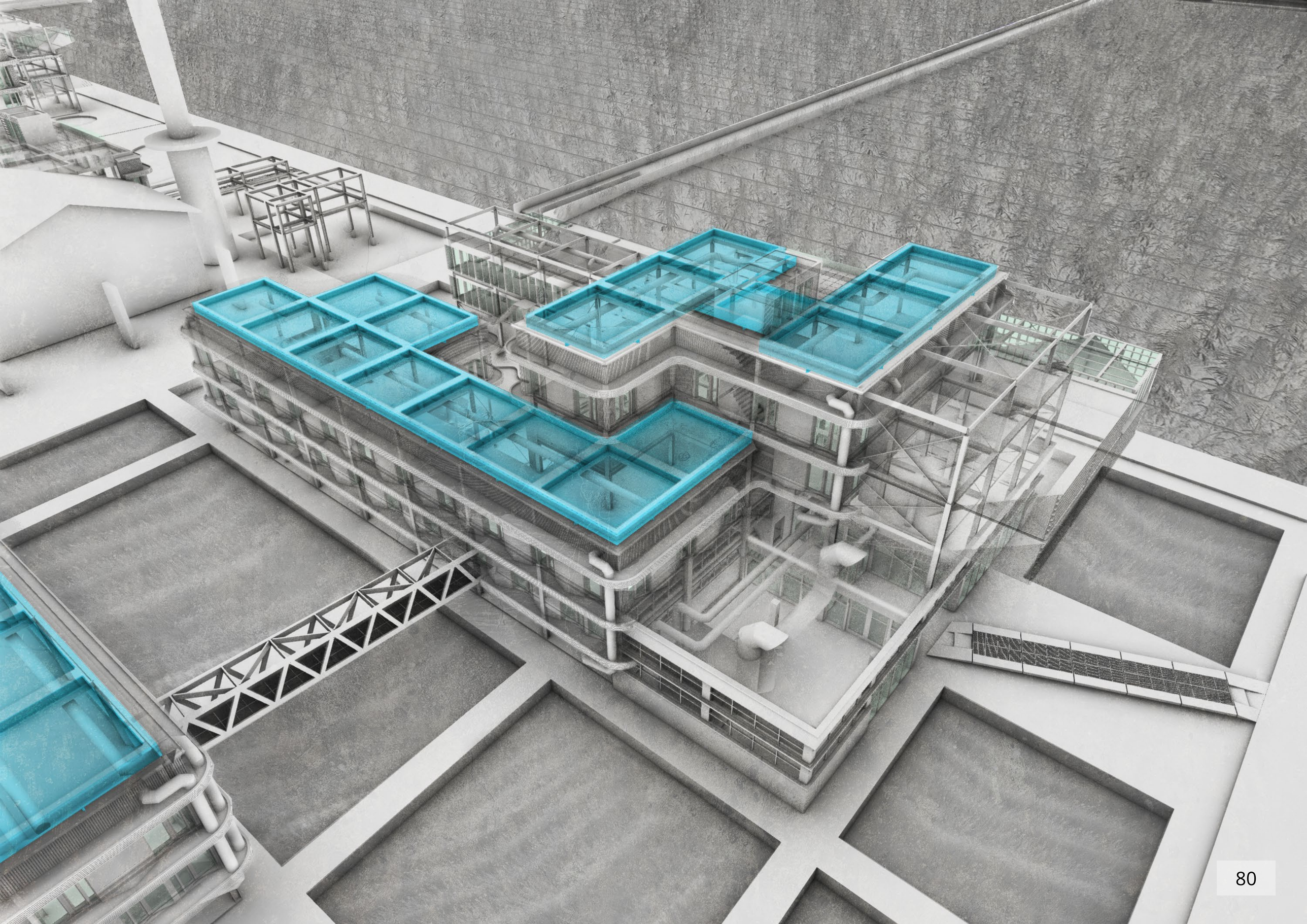





A
B
C
D
E
F
G
1
2
3
4
5
6
7
8
9
Meeting rooms
36 m²
Materials & product storage
149 m²
Office
217 m²
Services Core
36 m²
Circulation Core
36 m²
S-01
S-01
Lobby
72 m²
Installation Space
149 m²
Meeting rooms
36 m²
Circulation & Services Core
36 m²
Office
257 m²
1st Floor Legend
Services core
Circulation & emergency core
Shared lobby
Clean Room Lab (optional)
6 m

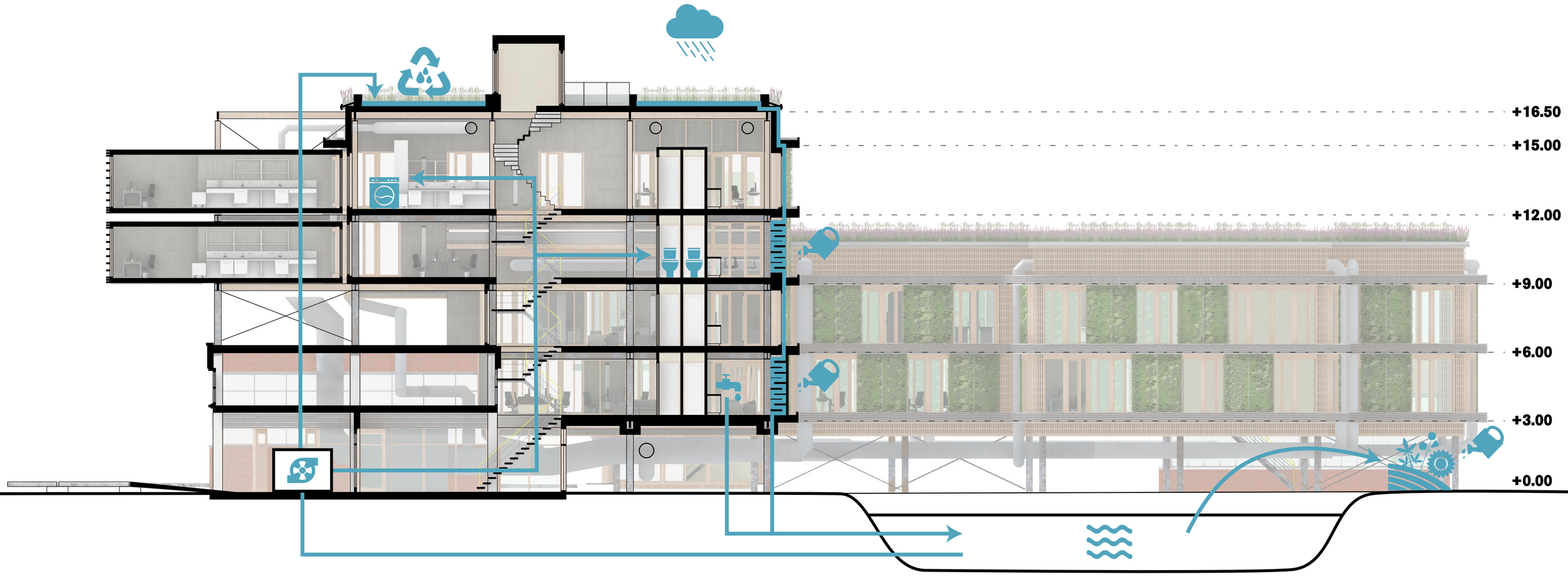






Water

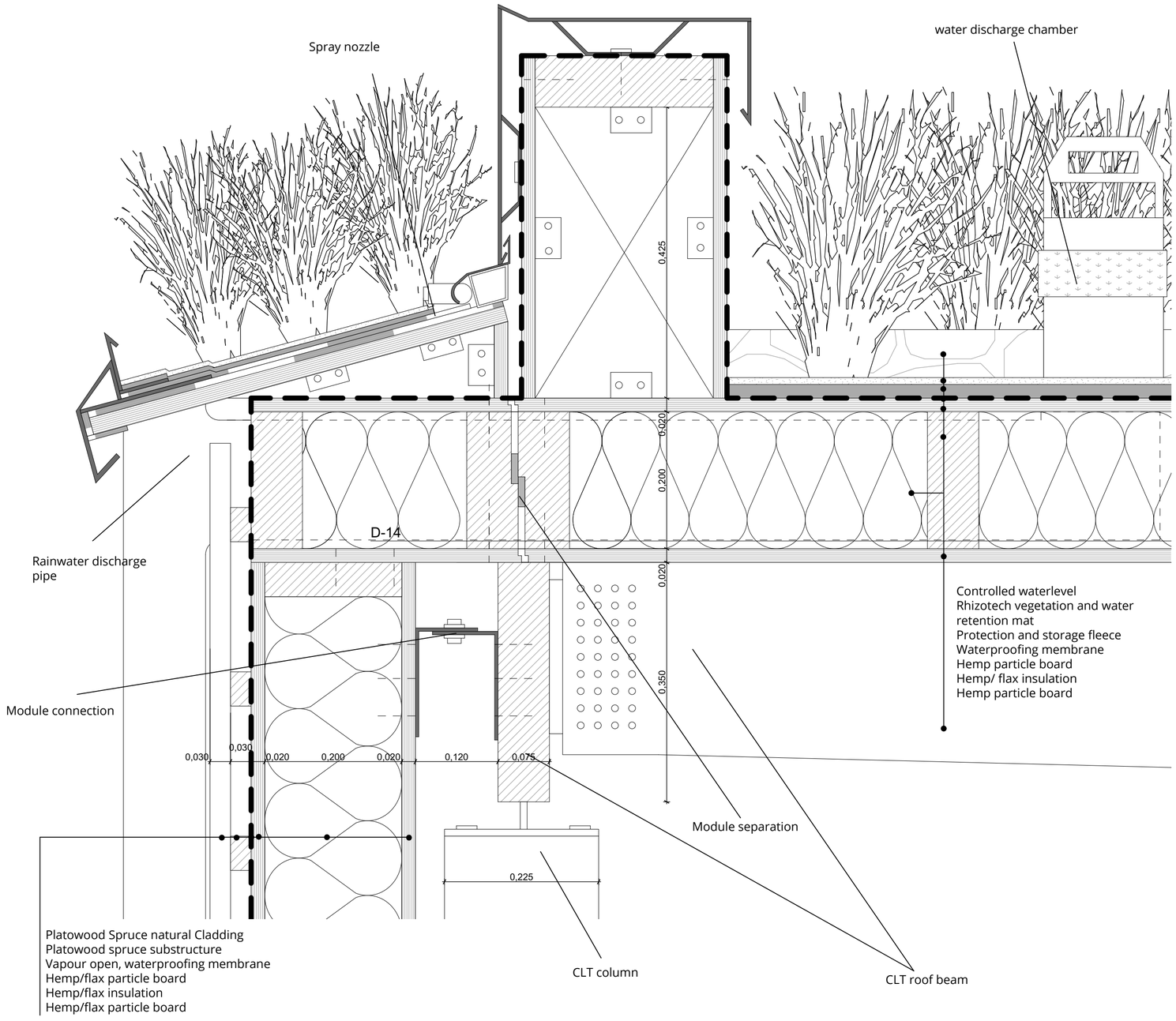
Reuse and wetlands system



6 m

Water

Reuse and wetlands treatment system



V3



Implemented phytotechnologies
Surface flow wetland

Types of organic material used:
- Harvestable & non-harvestable wetland plants
- Bacterial organisms

Species:
Phragmites australis *(Common reed)*
Cattail (*Typha spp.)*
Green bulrush *(Scirpus atrovirens)*
Common rush *(Juncus effusus)*

Goals:
- Remediating contaminated groundwater
- Cleaning water from buildings
- Providing biomass for:
Construction materials
Research experiments
Electricity and heat (sludge)

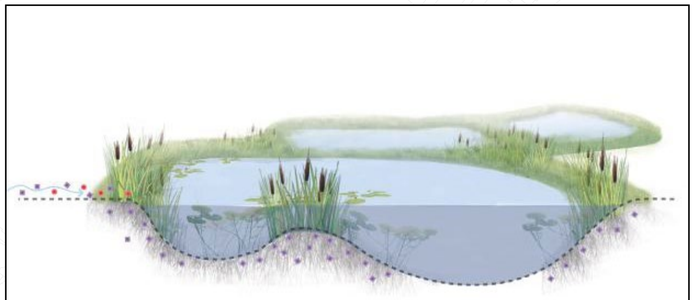


Image by Kennen and Kirkwood (2015)

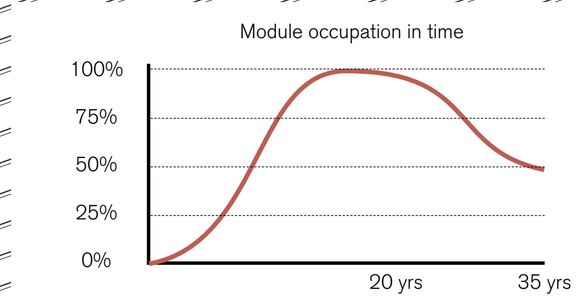
200 m

Surface Flow Wetlands



Growth model

Phase 1



Phase 1 Modules

Phase 2 Modules

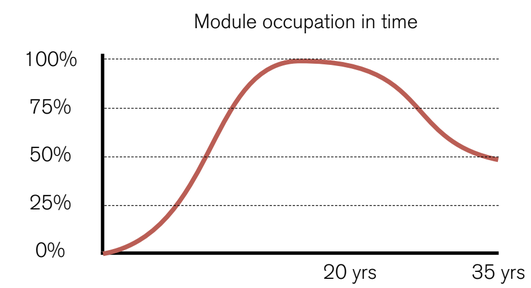
Phase 3 Modules

Phase 4 Modules

Extra circulation

Growth model

Phase 2



Phase 1 Modules

Phase 2 Modules

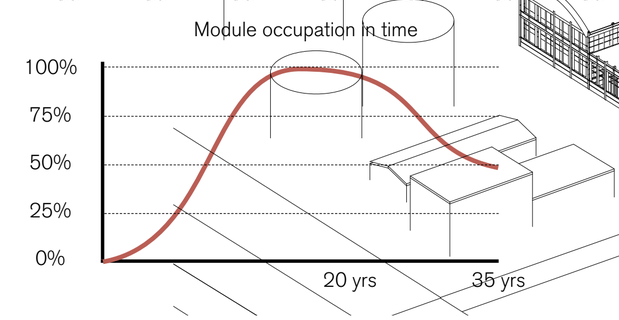
Phase 3 Modules

Phase 4 Modules

Extra circulation

Growth model

Phase 3



Phase 1 Modules

Phase 2 Modules

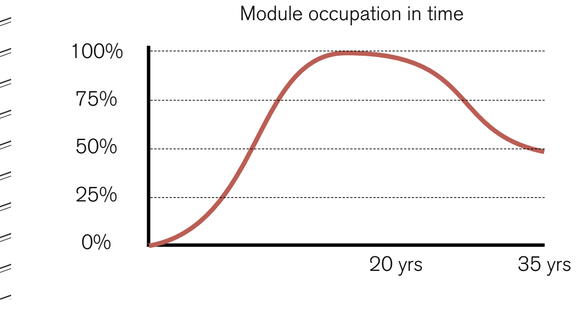
Phase 3 Modules

Phase 4 Modules

Extra circulation

Growth model

Phase 4



Phase 1 Modules

Phase 2 Modules

Phase 3 Modules

Phase 4 Modules

Extra circulation

Services & Logistics

Phase 1

Electricity

Production Space

Heat

Water

Services & Logistics

Phase 2

Electricity

Production Space

Heat

Water

Services & Logistics

Phase 3

Electricity

Production Space

Heat

Water

Conclusion

Some Quantifiable Results

~ 0,2 ha Solar Energy
~ 16 ha Surface Flow Wetland
~ 28 ha Remediated Extraction plot
~ 4 ha Remediated Experimentation plot
~ 15 ha of new trees
~ 1,8 of Research and laboratory space
~ 500-750 Workplaces in Research and laboratory Axis
~ 100-250 Workplaces in logistics & Services Axis

Remediation Layers

Trees
Crops
Funghi
Perennials
Wetland
Deep water
Plot outline

200 m

100 km

50°

Resilient refinery

Refinery exposed to economic factors

Offshore installation

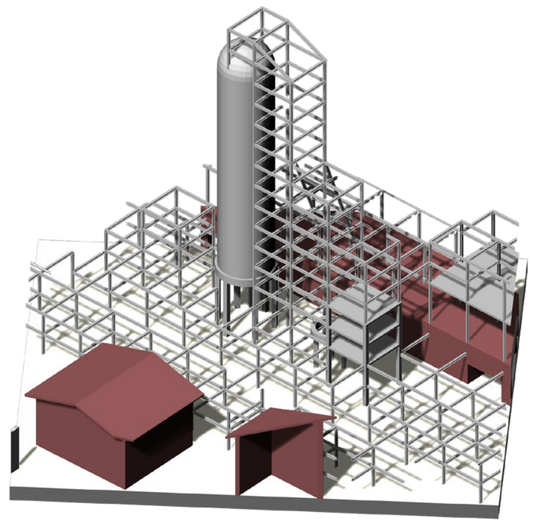
Pipeline

Reflection



Shell refinery Rotterdam, The Netherlands

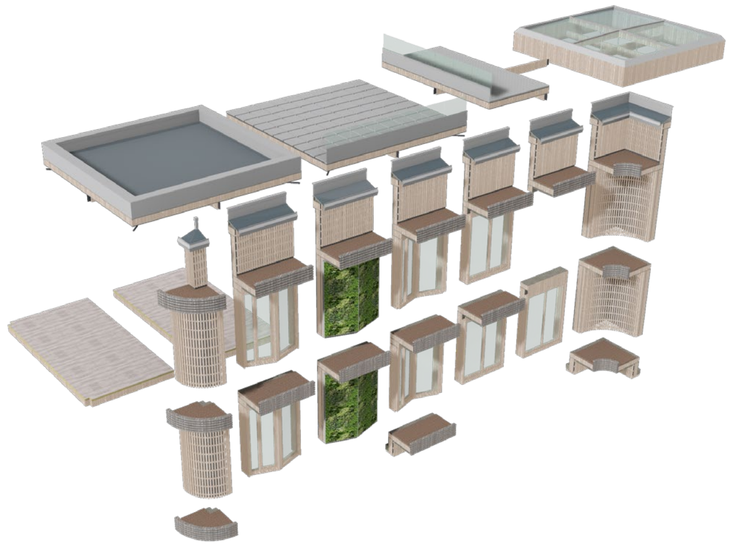
Picture: Shell





Mongstad refinery, Bergen, Norway

Picture: Helge Hansen



Adjust sizes to steel grid of other refinery

Thank you



Aquarel of Dunkerque refinery by SRD/ BP (1952)