Biointegration of architecture and ecology system

AR3A010
Architectural Engineering

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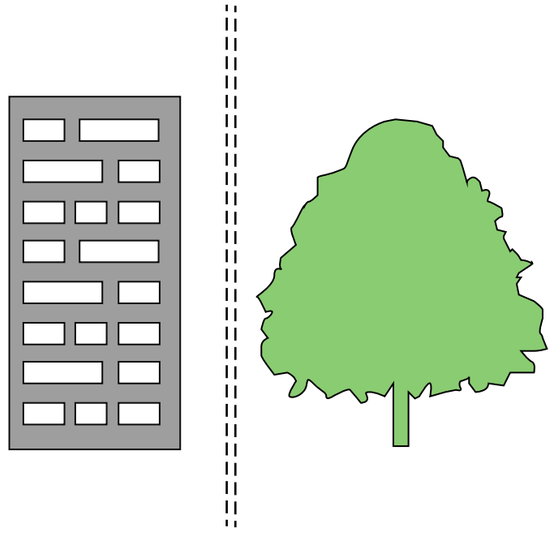
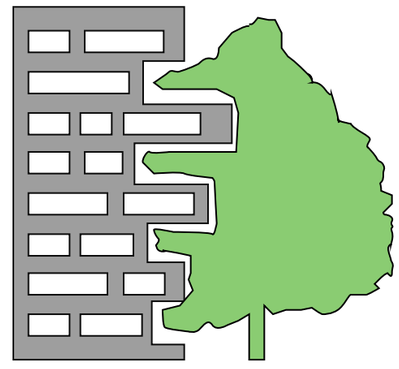
5550459

Problem statement

Design for the ecosystem



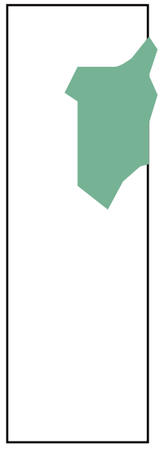
Architectural denaturalisation



Symbiotic bio-integration

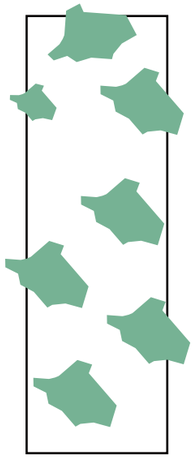
Problem statement

Three ways of designing plants and non-human biomass into built systems



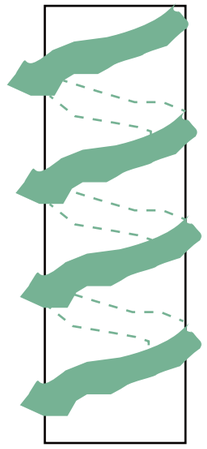
Juxtapositioning

Juxtapositioning is the concentrated placement of greening meterial at one or a few locations in the built form



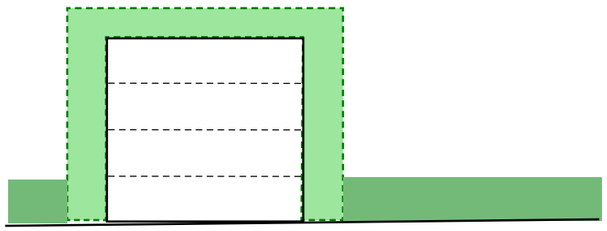
Intermixing

Intermixing is the distributed and patchy placement of green material



Integrating

Integrating consists of a woven blending of the greening material with tha built form

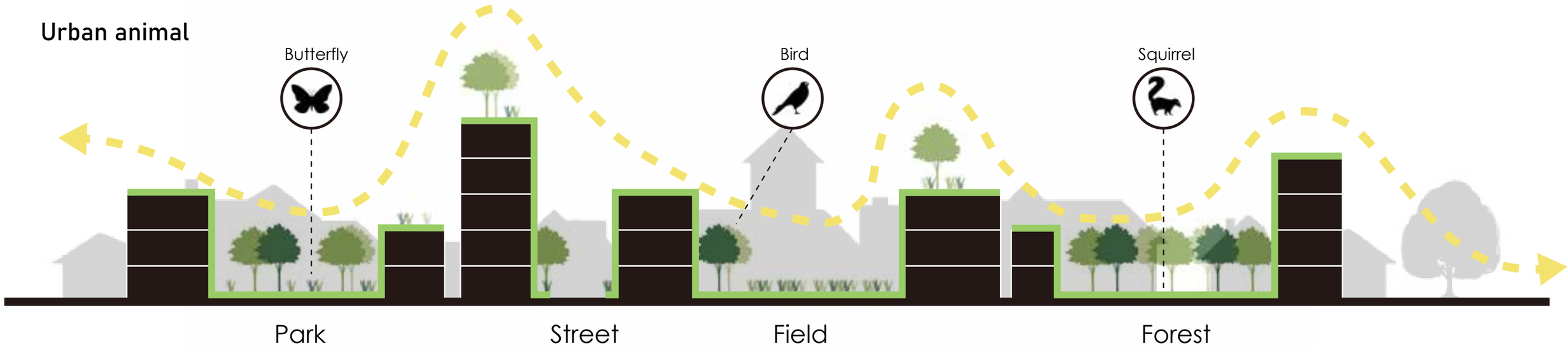


The greening material is linked to the existent vegetation at the ground plane and enables species interaction and migration , thereby engendering a more diverse and stable ecosystem

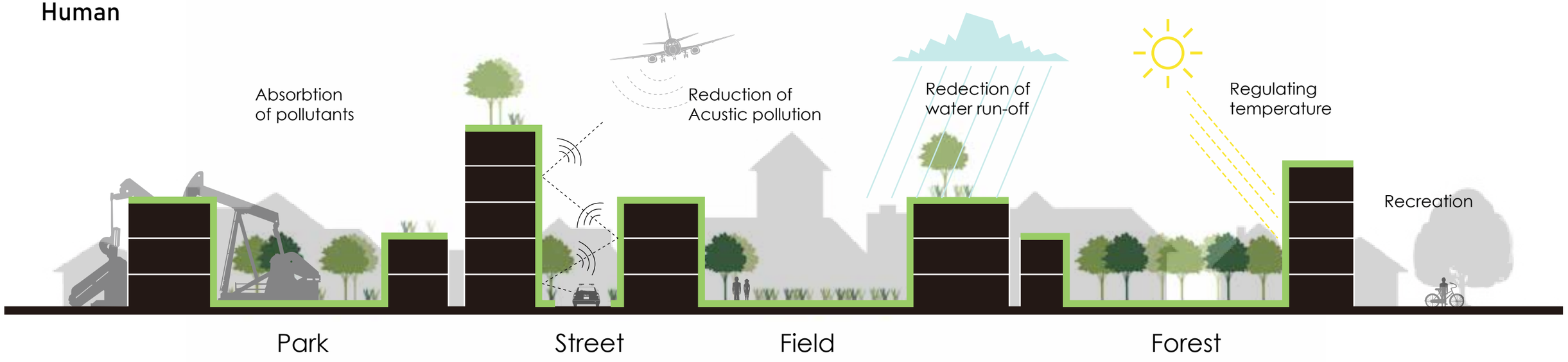
Problem statement

Green Connections

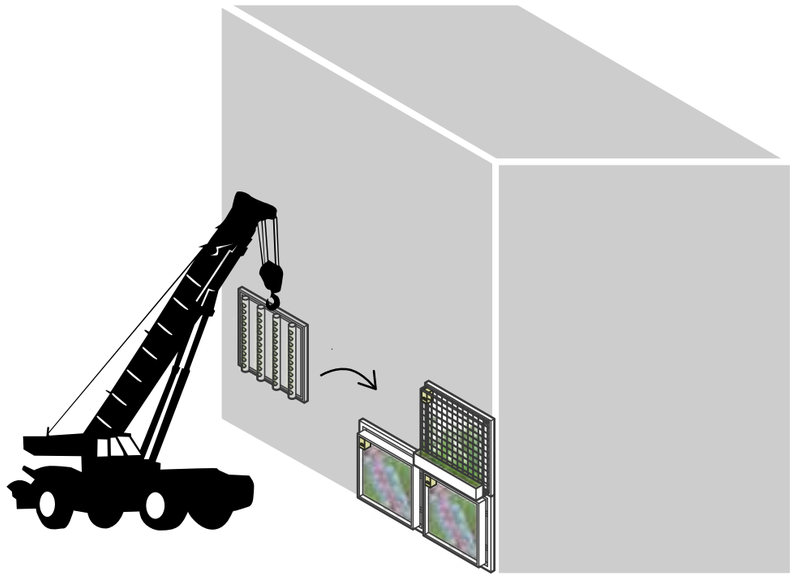
Urban animal



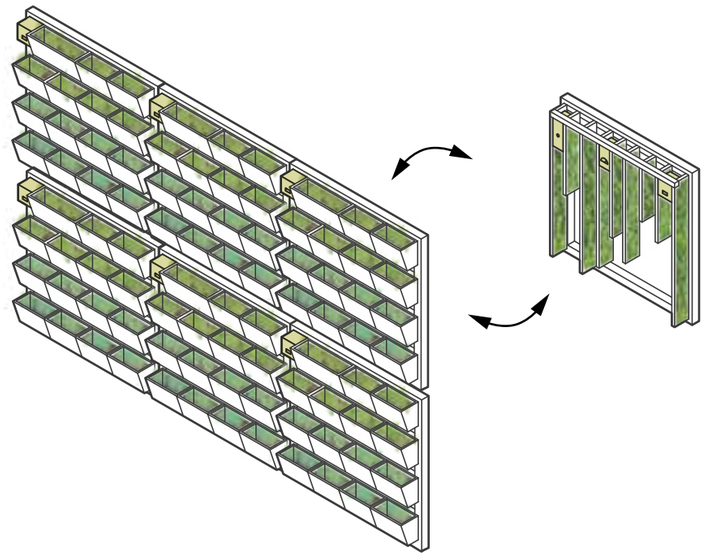
Human



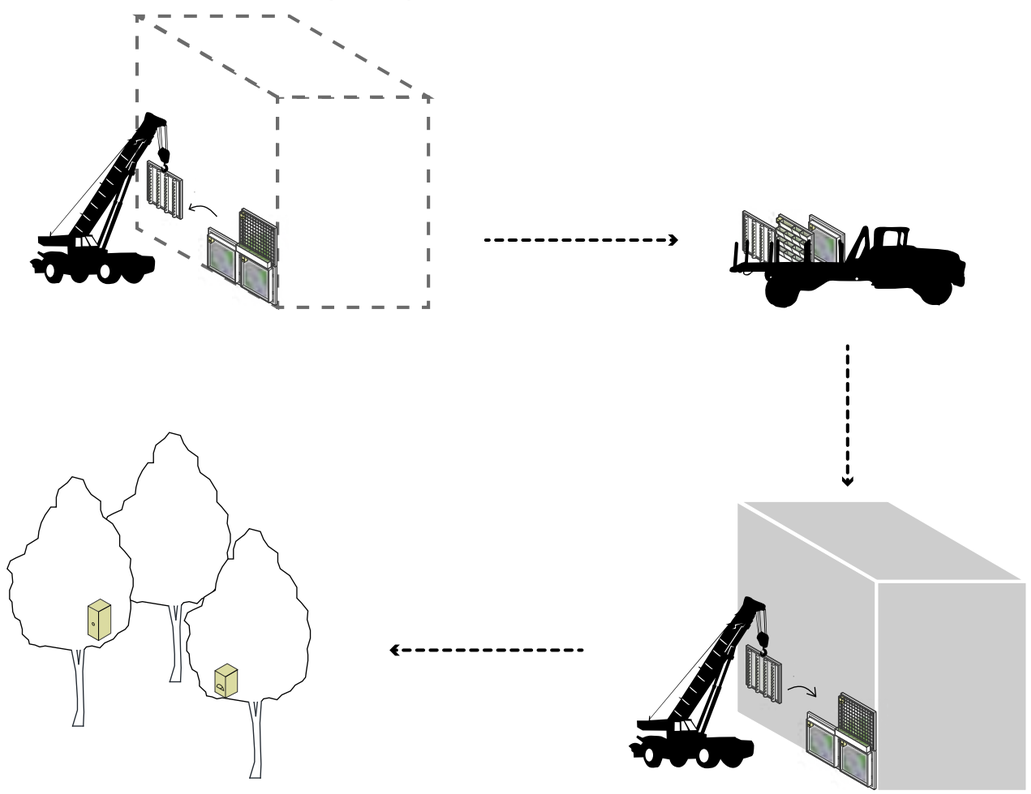
Why Modularity



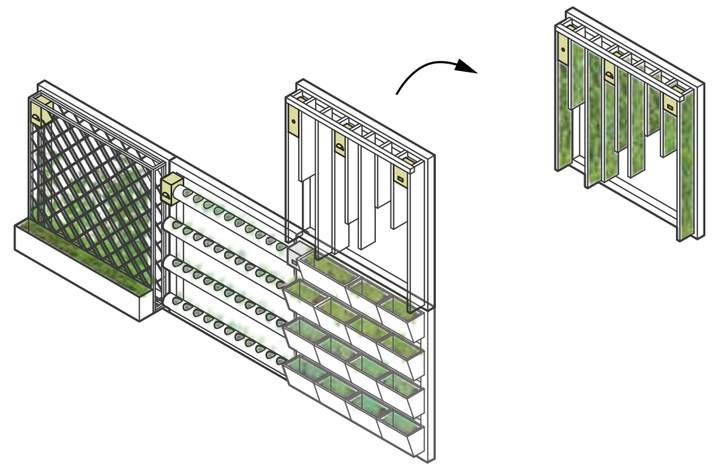
Quick installation without disturbing surrounding people and animals



Flexbility(to respond to changes in animal needs)



Recoverable and recyclable

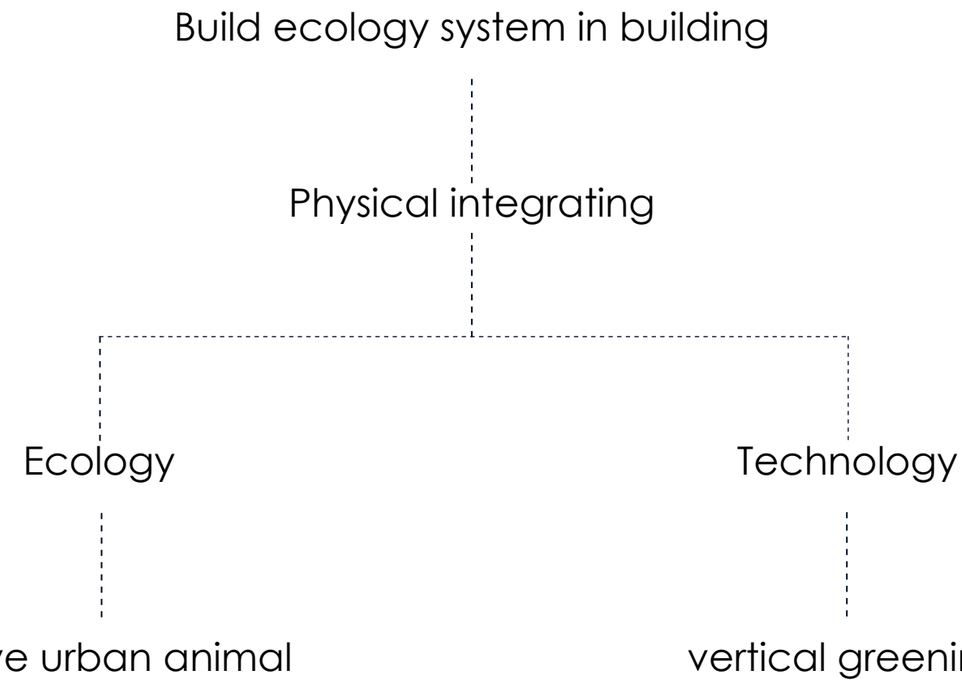


Easy to maintain

Research

Research question: How to use flexible modular vertical greening system to enhance the biodiversity of the city and build an ecological system on the building scale?

Sub question:
1.What is local biodiversity?
2.What is modular vertical greening?
3.How to combine the needs of urban animals with modular vertical greening system?



Research

Target species

Birds:

House sparrow

Black redstarts

Common swift

Oystercatcher

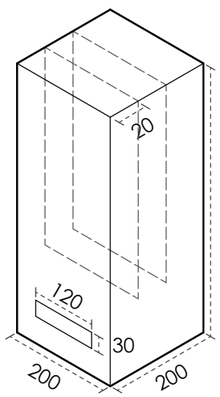
Bats:

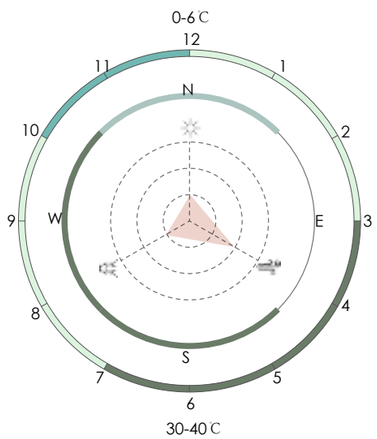
Common pipistrelle

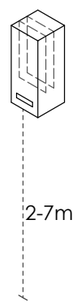
Insects: Wild bees

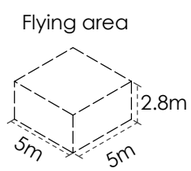
Plants: Native plant species

Result1





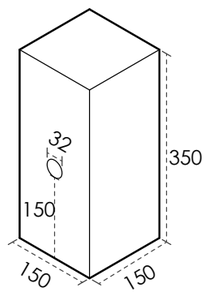


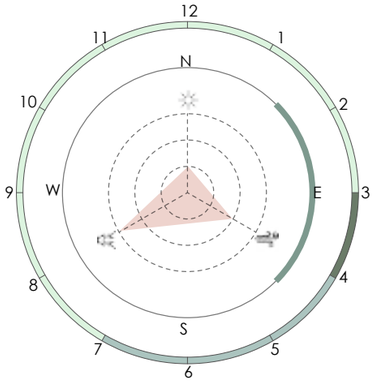


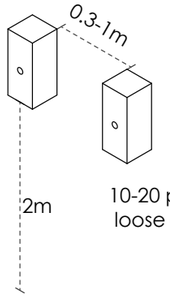
Material:
Rough (for grip)

Breeding
Nursing
Active
Hibernate
Migrate

HS

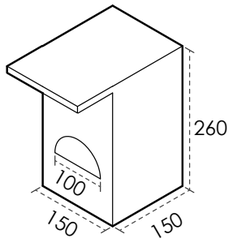


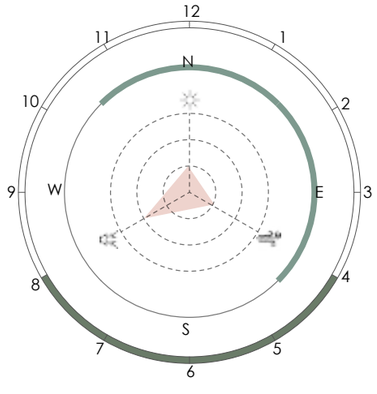




10-20 pairs
loose colony

BR

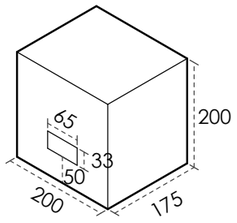


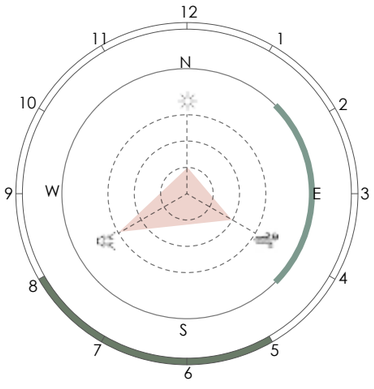


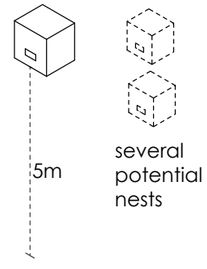
Attracted to
brown roofs or
ecoroofs

tbd
(sheltered
ledges)

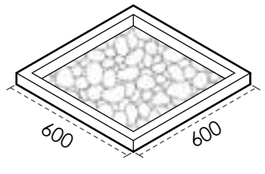
CS

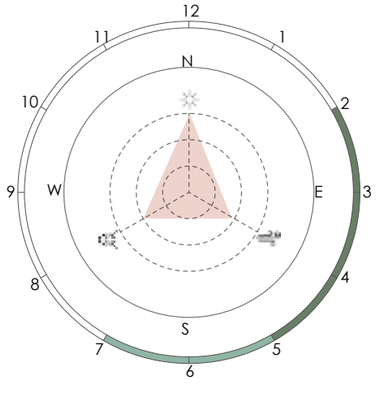


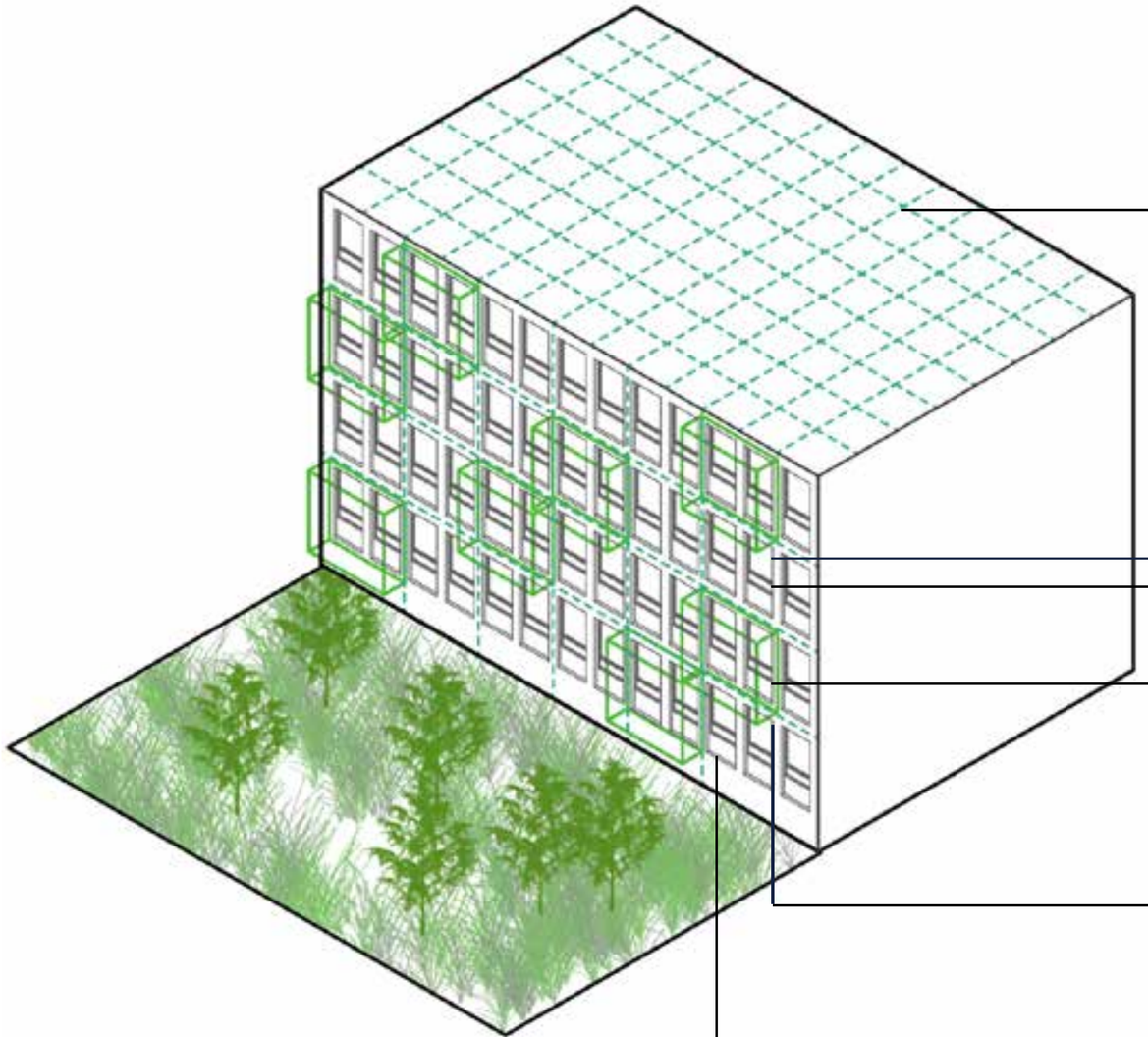




OC







E N W S

Oystercatcher

bat

bat

Black redstarts

Black redstarts

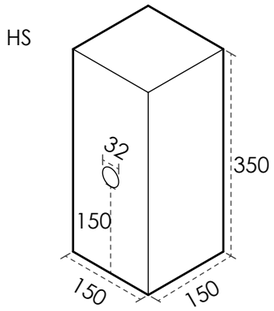
Common swift

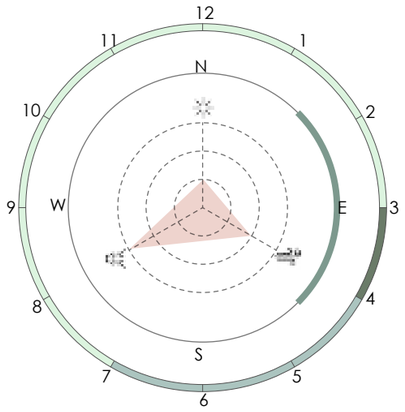
House sparrow

Butterfly

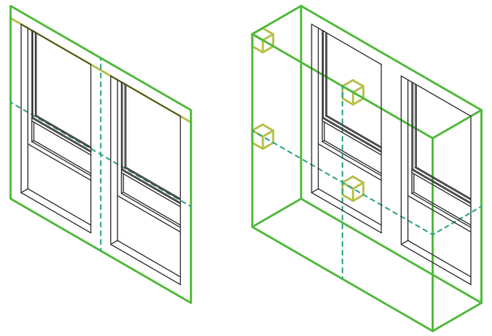
Wild bees

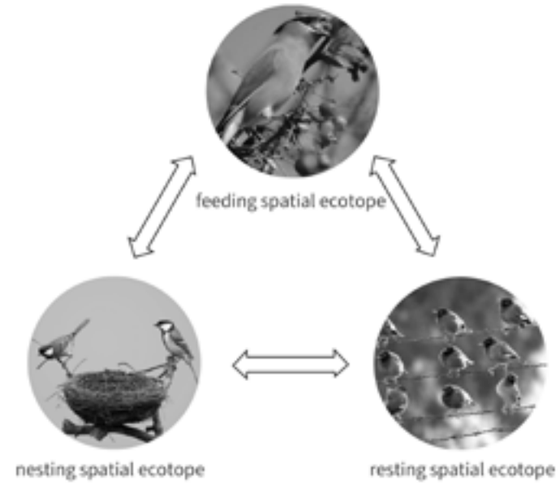
Design scale



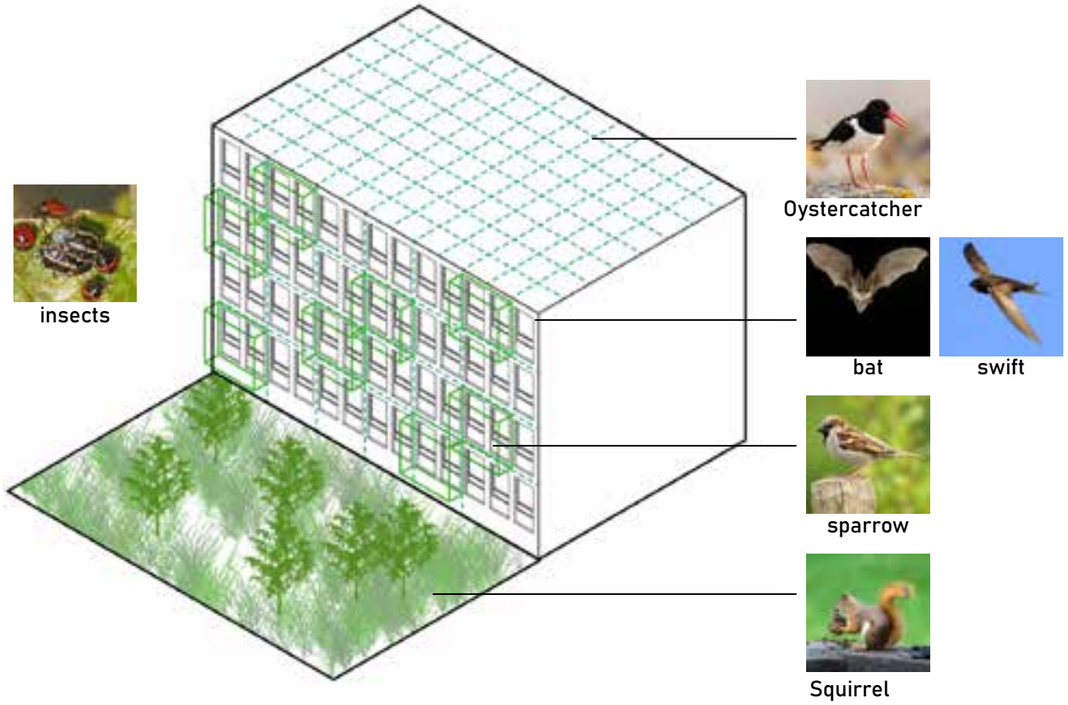


Element



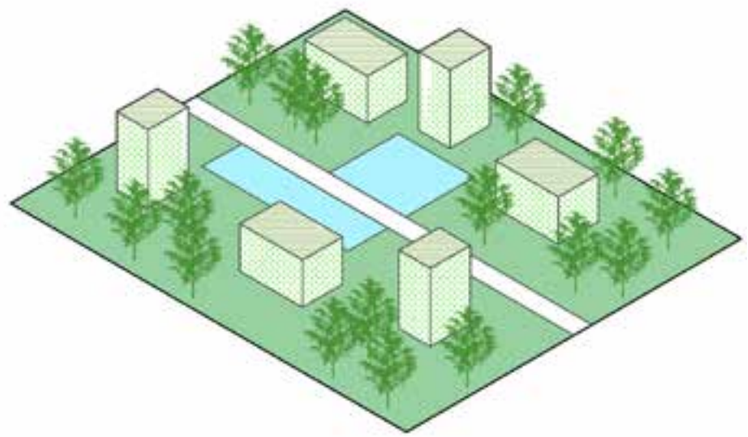


Unit



Building

Creating better habitats for building-dependent species



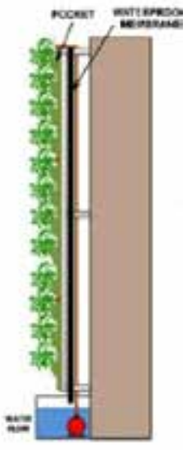
Neighbourhood

Result2

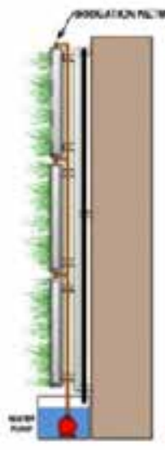
Green wall

Living wall system

Continuous Living wall
(Hydroponic Systems)

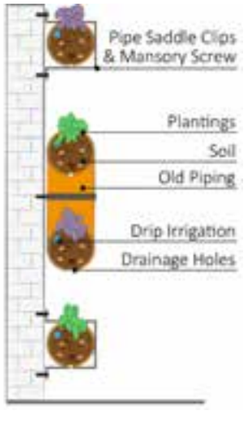


Modular Living wall

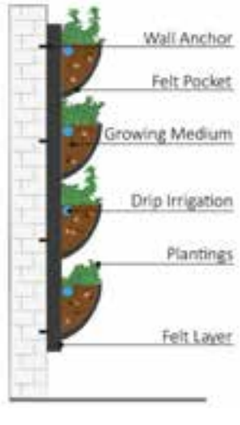


Inorganic /organic substrate

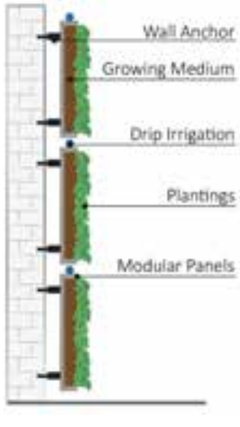
Planter/Pot



Textile bag

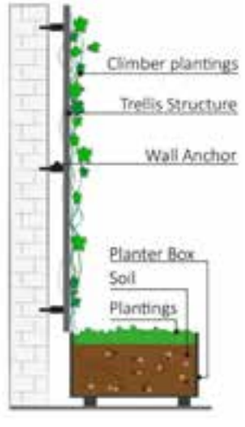


Panel

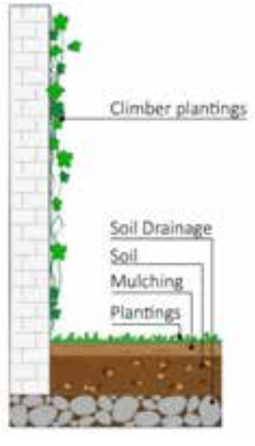


Green Facades

Indirect green wall



Direct green wall

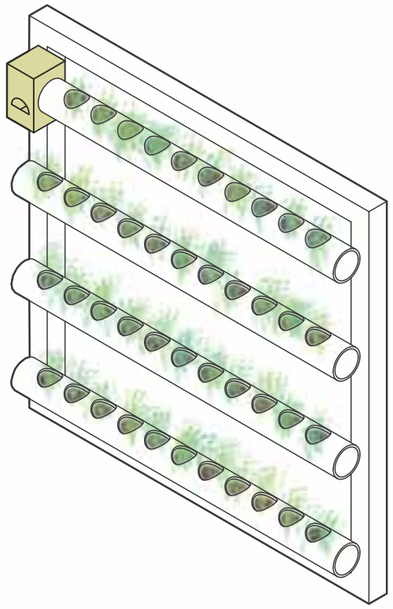


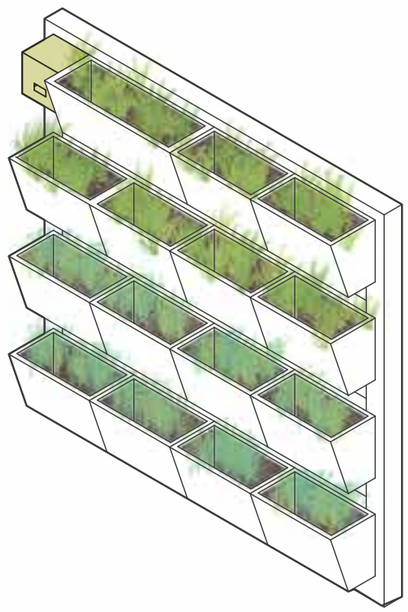
Other Typologies

New technology

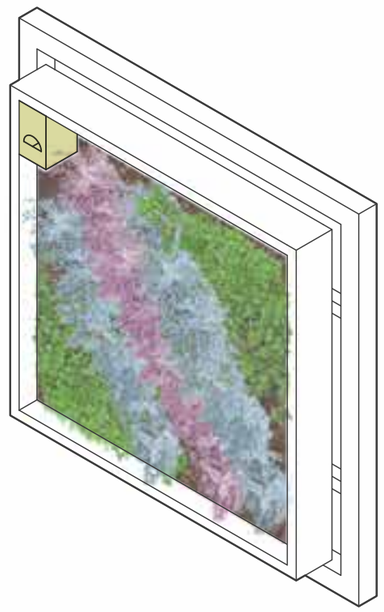
3D-Prints Living
Soil Walls

Planter/pipe



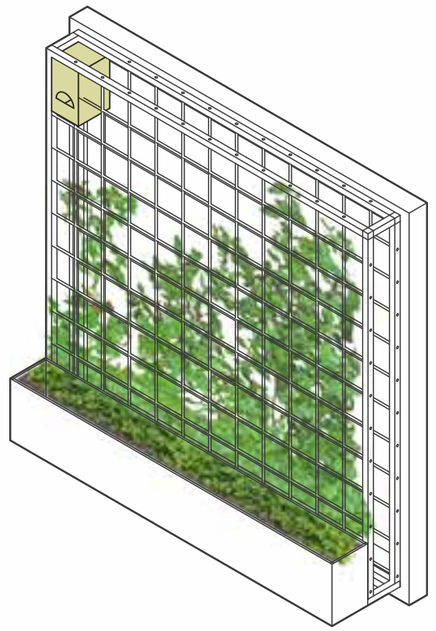


Panel

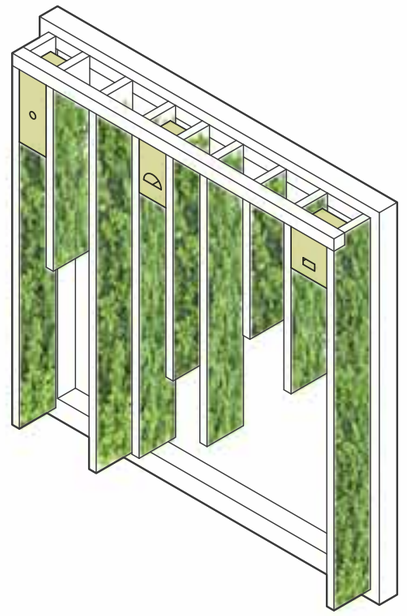


Indirect
green wall

mesh support



3D-prints living
soil wall



Build ecology system in building

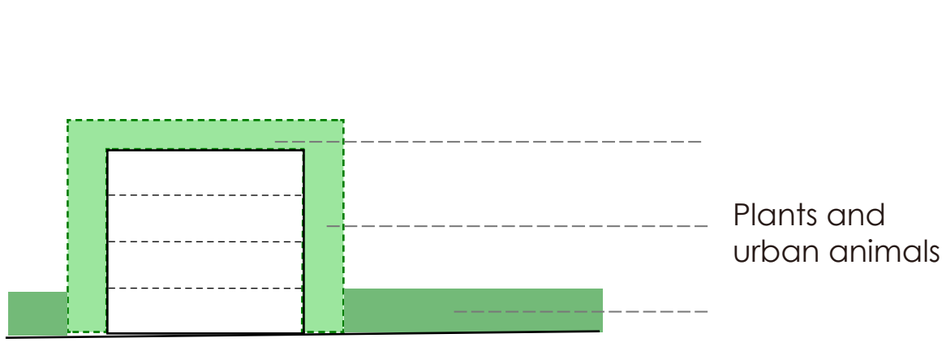
Biointegrating

Physical integrating

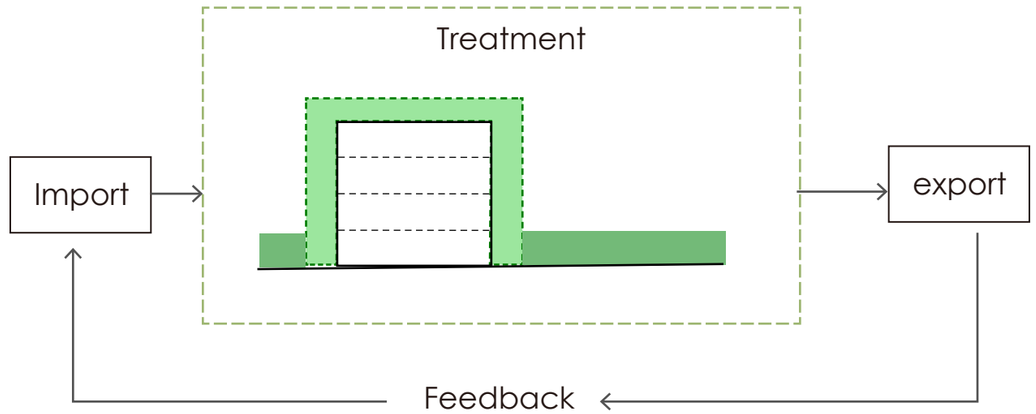
Integration of human habitat with plants and animals

system integrating

Architecture should make use of natural resources in a sustainable way, so that resource use coincides with natural recovery and renewal cycles.



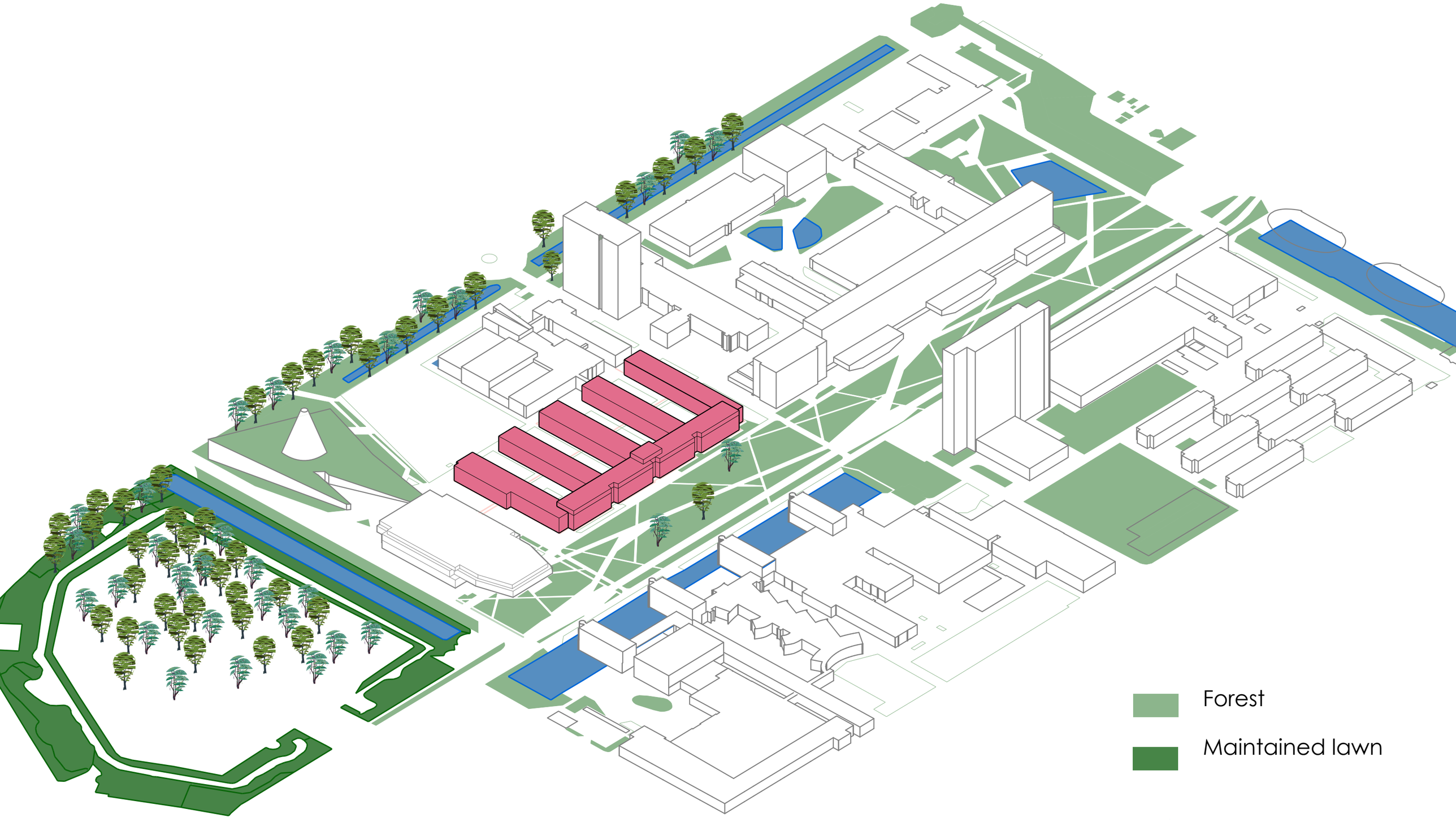
Modelling biological structures in ecosystems



Modelling energy cycles in ecosystems

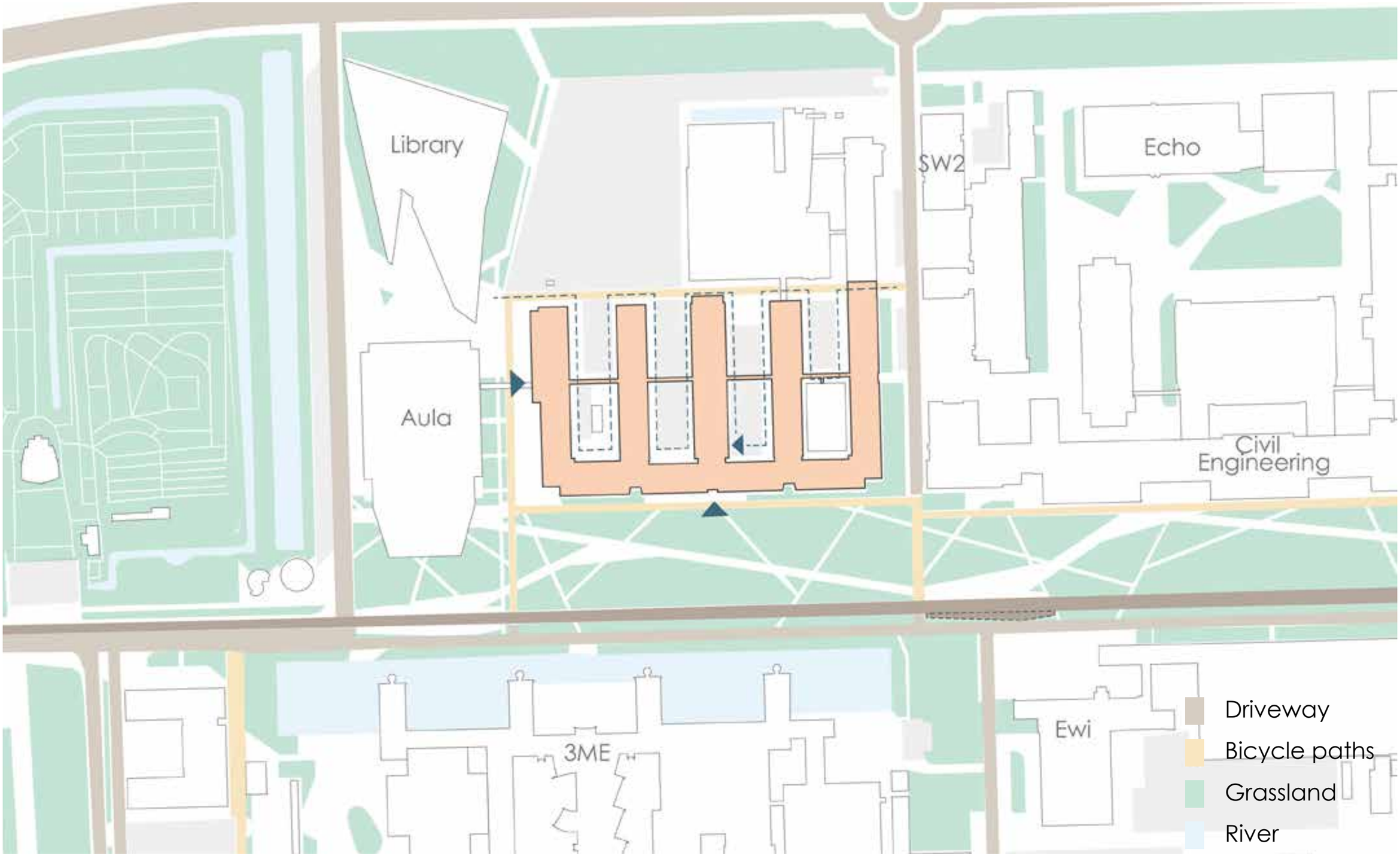
Context

Delft campus-Green types



Context

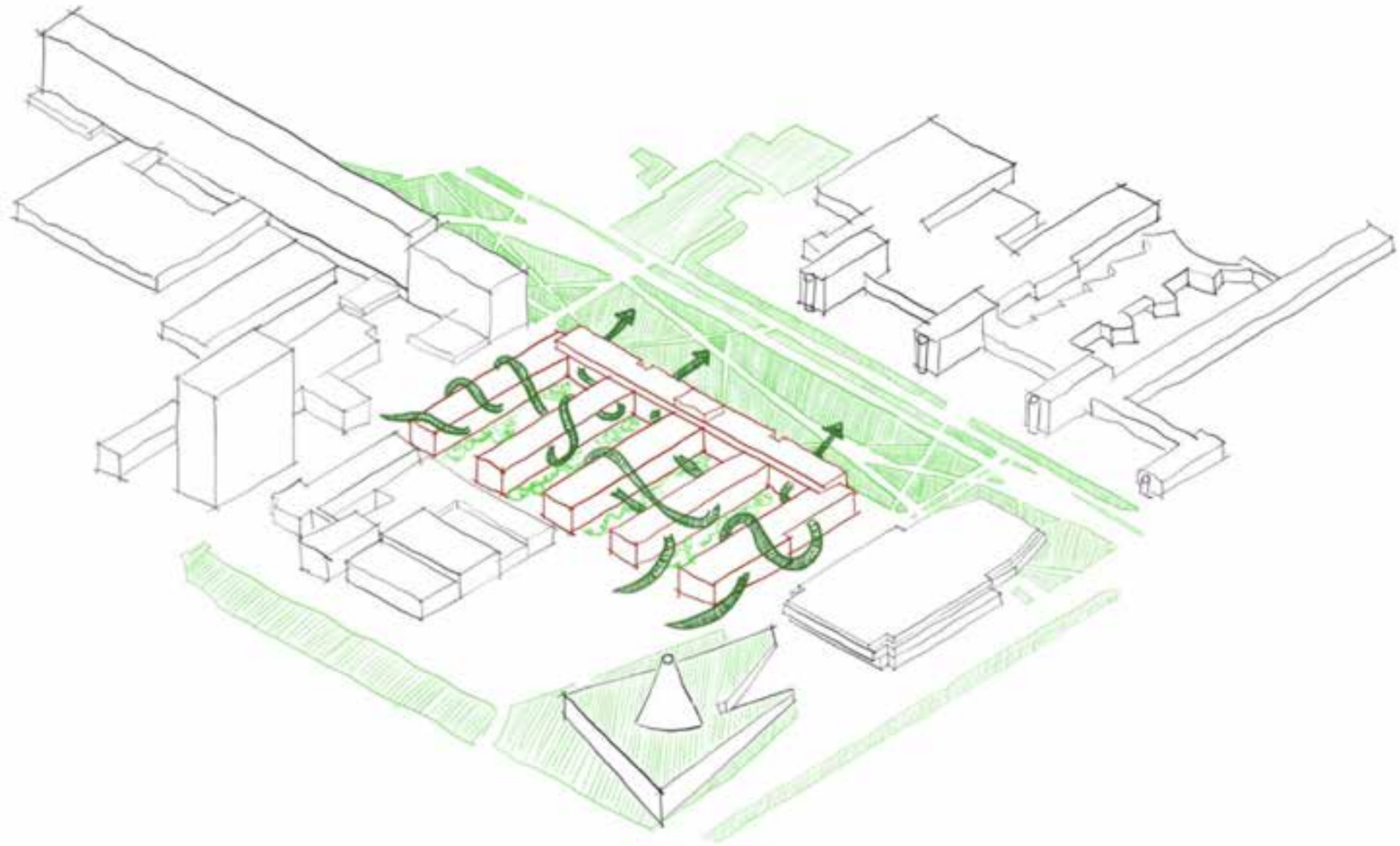
TNW


Library
Aula
SW2
Echo
Civil
Engineering
3ME
Ewi
Driveway
Bicycle paths
Grassland
River

Design

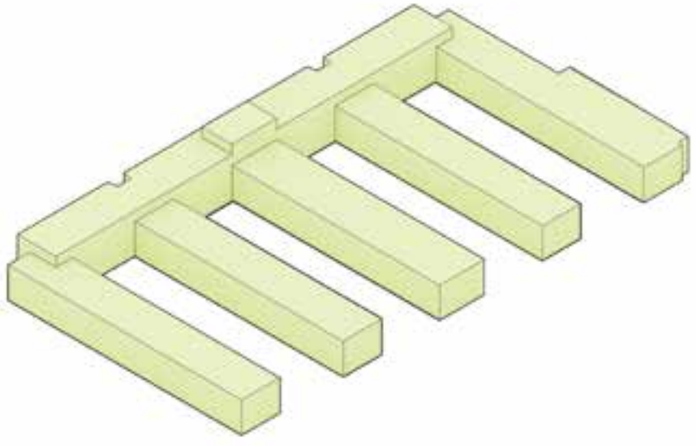
Concept

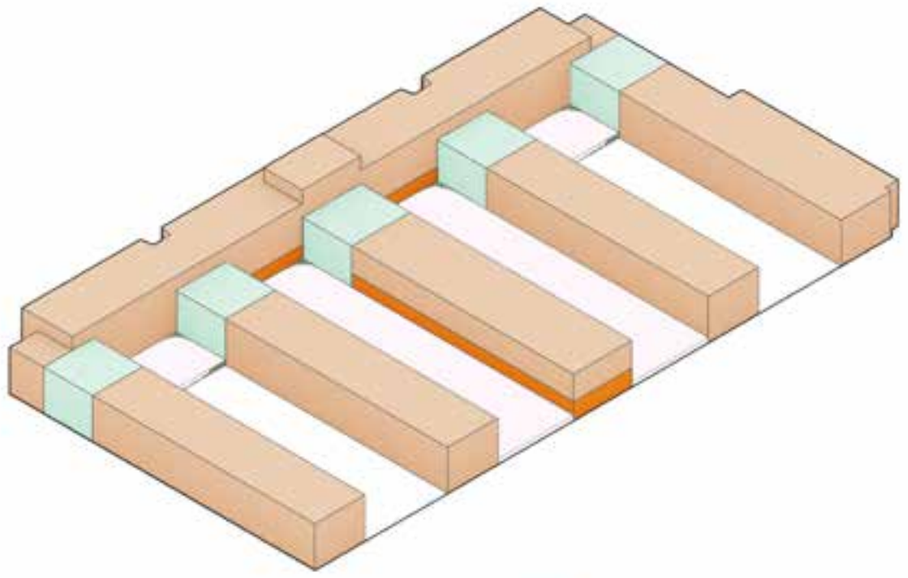
Make TNW building integrating with ecology system



Design

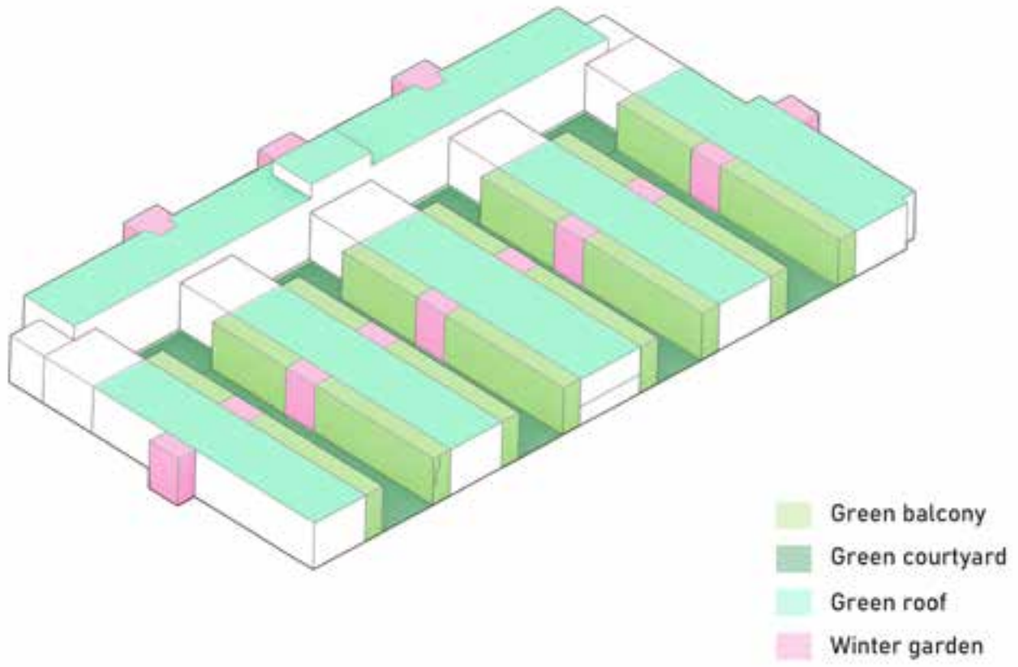
Program





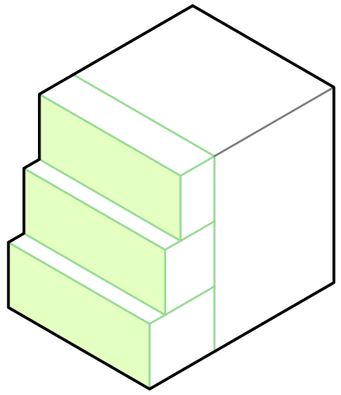
Educational

Collective housing+Urban gardening

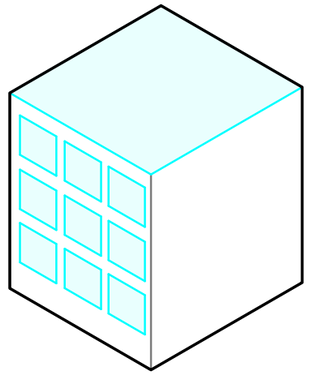


Design

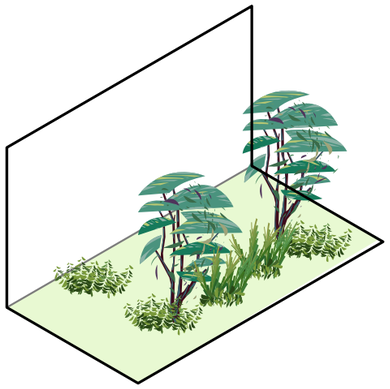
Three main intervention

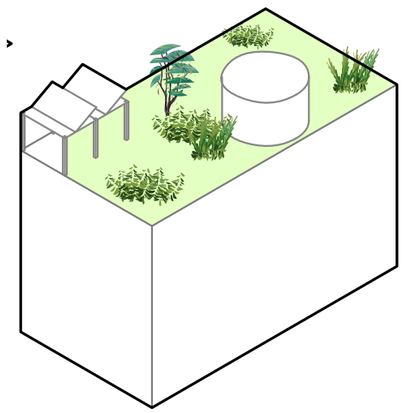


Modular green balcony



Green Atrium/Winter garden





Green roof/Green courtyard

Design

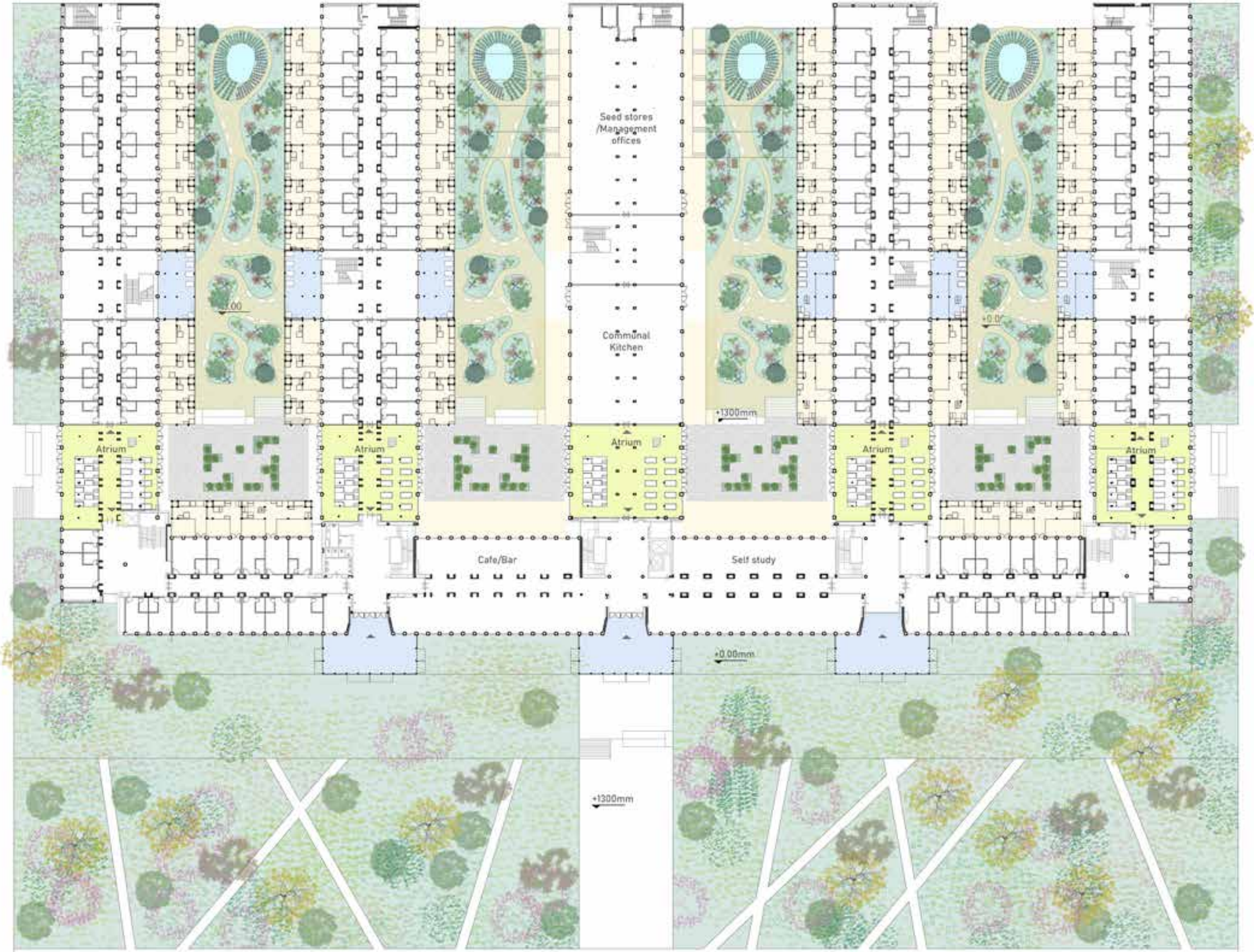
Site design

Driveway

Bicycle paths

Grassland

River

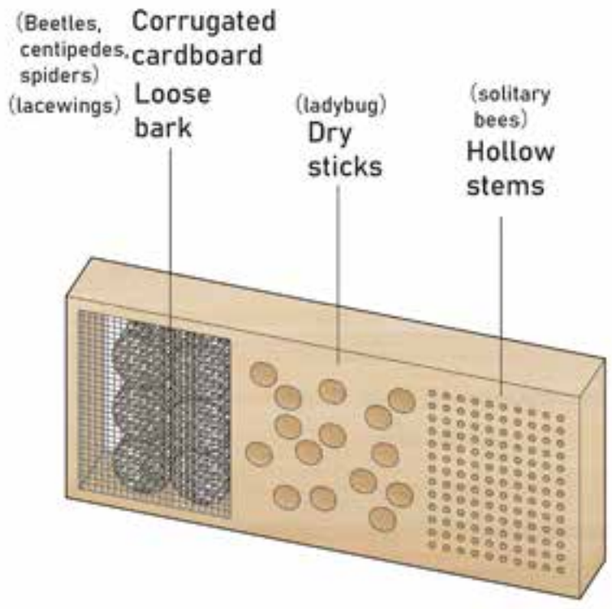

Seed stores
/Management
offices
Communal
Kitchen
Atrium
Atrium
Atrium
Atrium
Atrium
Cafe/Bar
Self study
+0.00
+0.0
+1300mm
+0.00mm
+1300mm

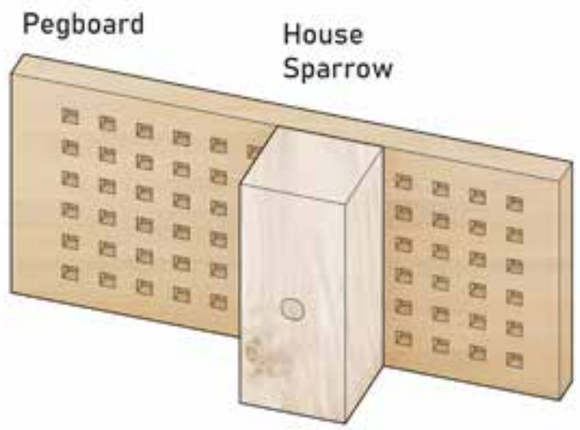
Design

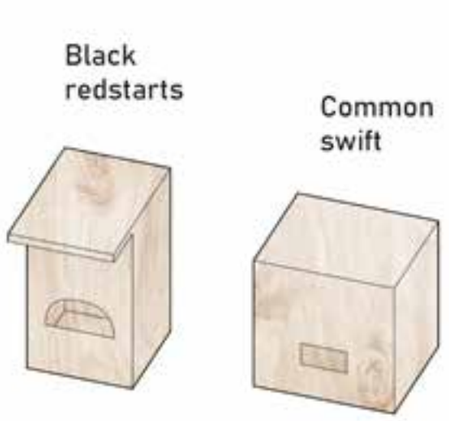
Modular green balcony

Design

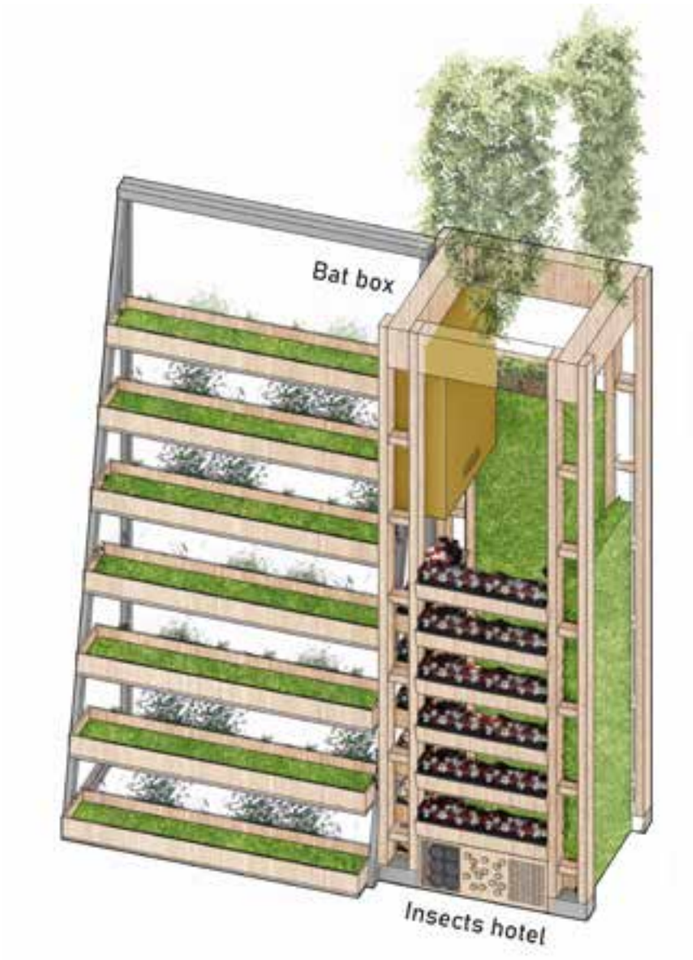
Modular green balcony



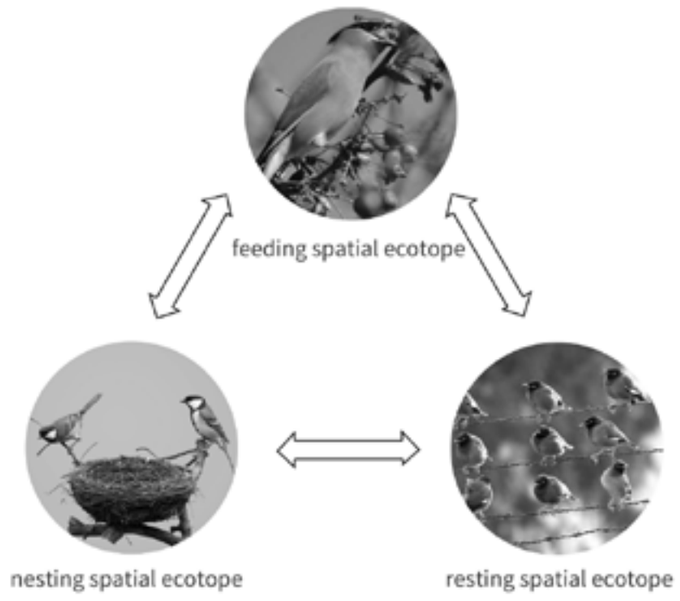


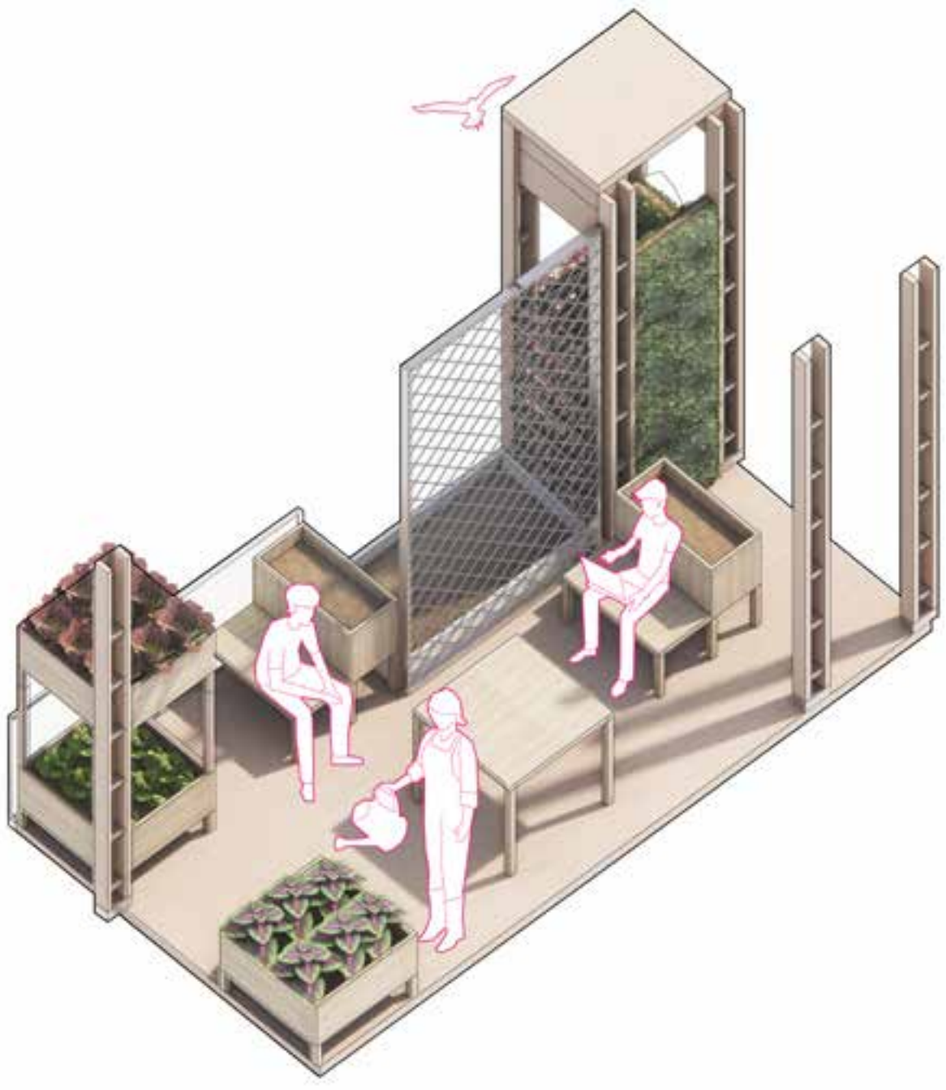


nesting spatial ecotope


Bat box
Insects hotel

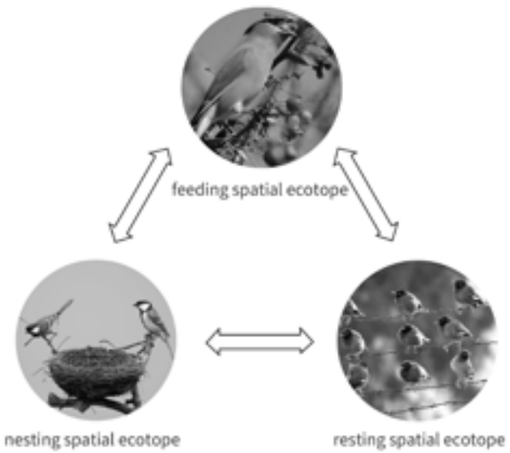

Bird nest
Insects hotel


feeding spatial ecotope
nesting spatial ecotope
resting spatial ecotope



HumanU

rban animal



Oystercatcher

Black redstarts

Bat

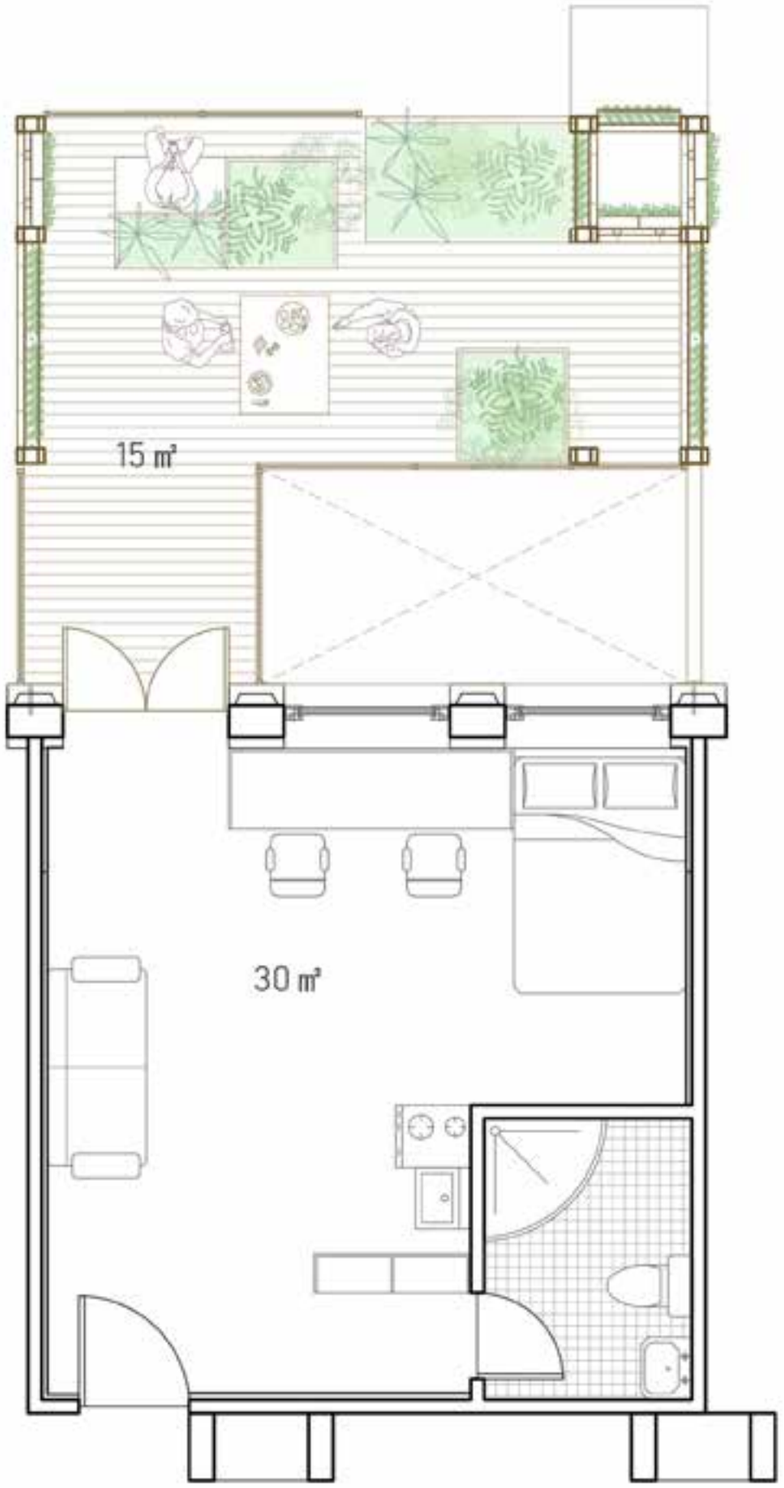
Common swift

House sparrow

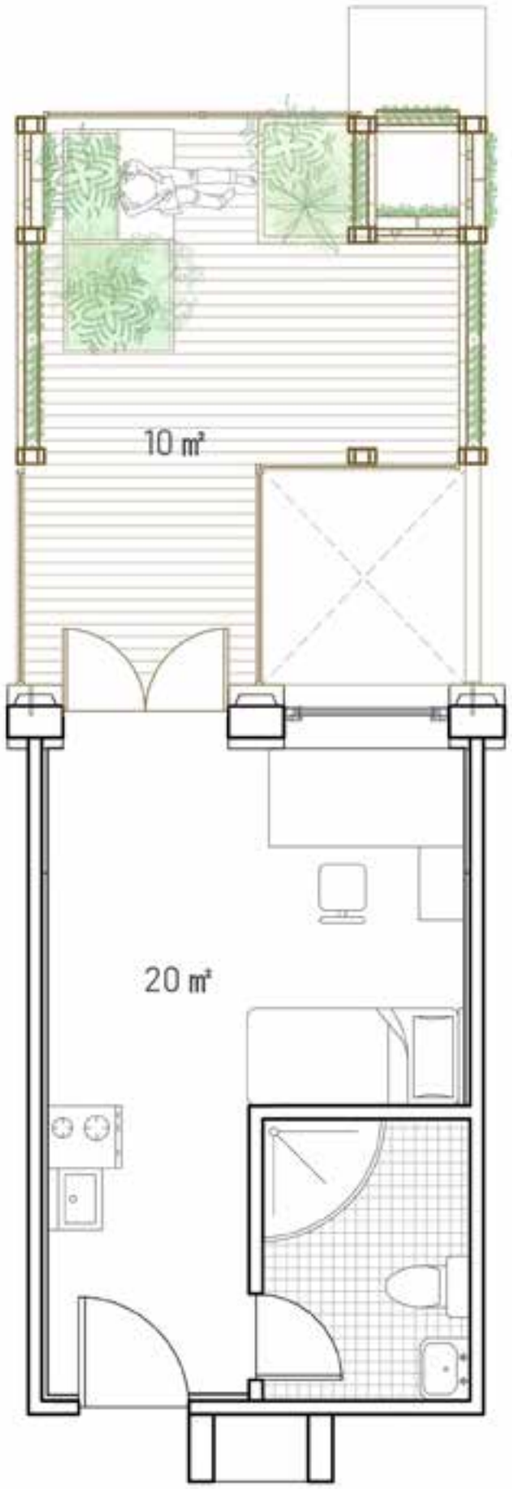
Butterfly

Wild bees

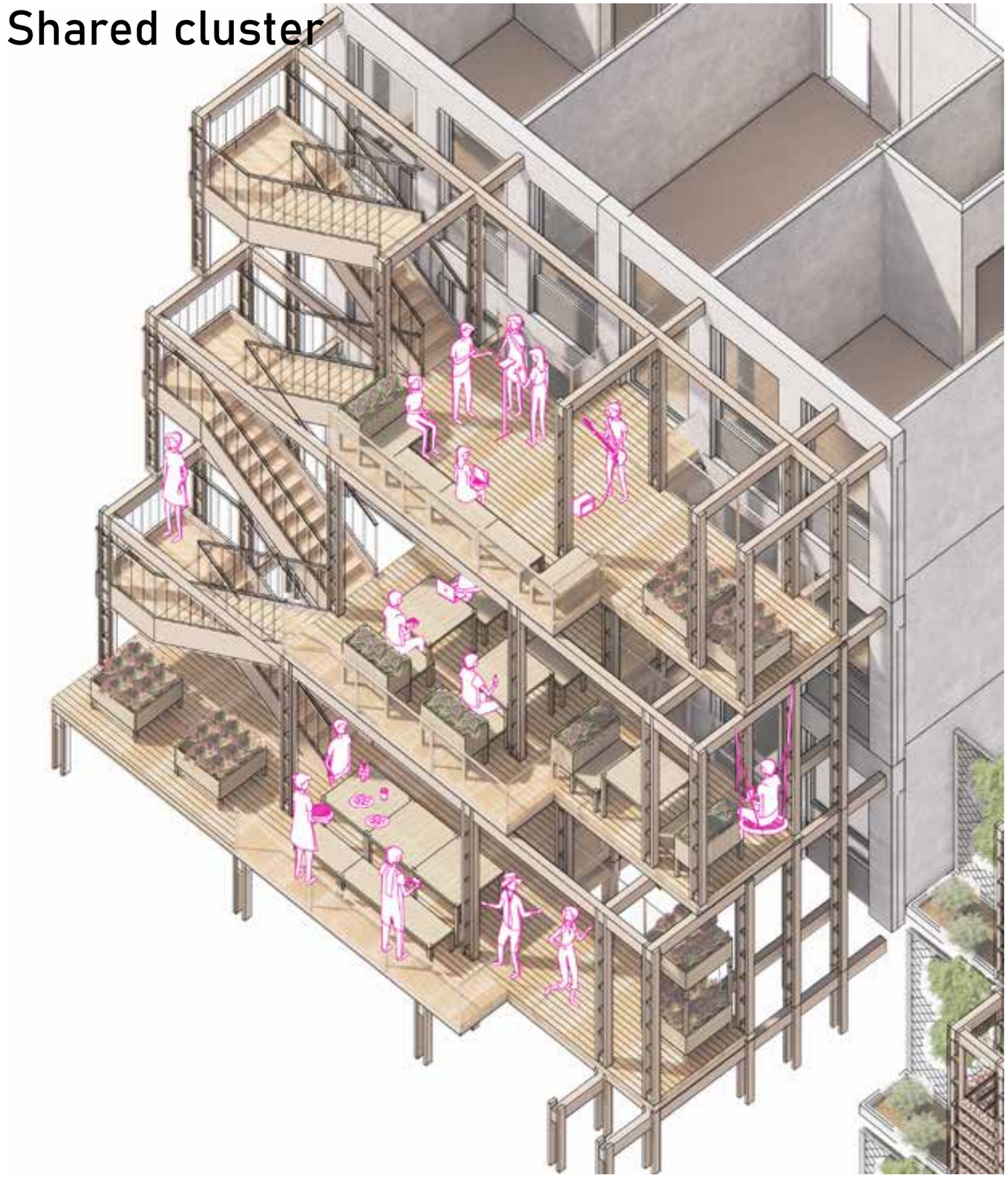
Studio A

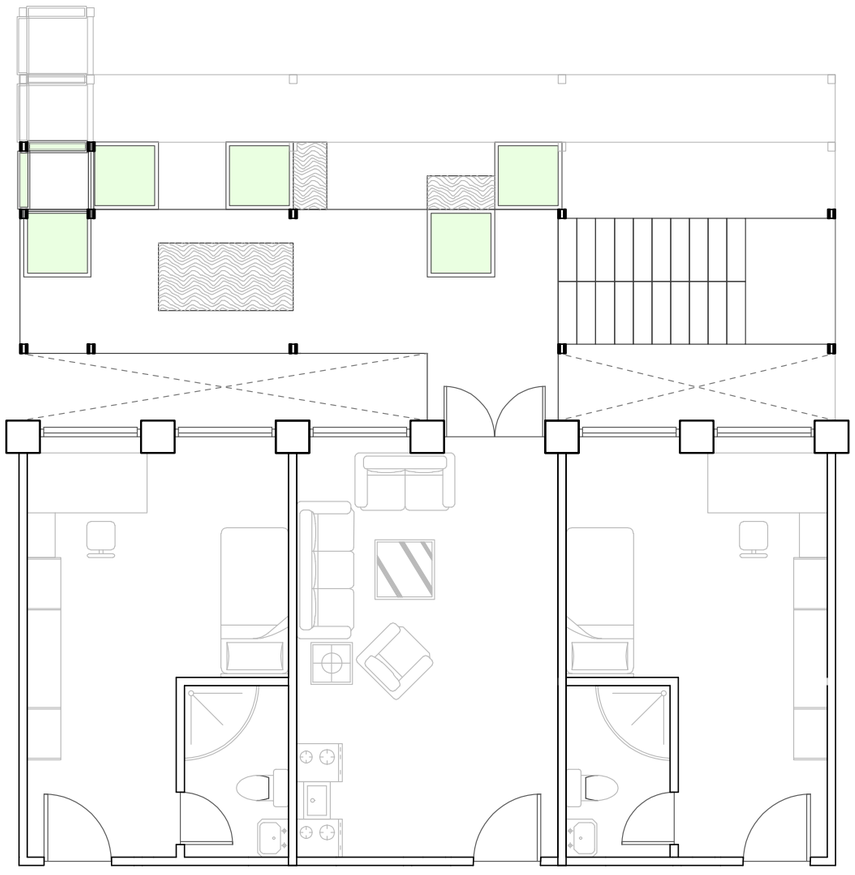


Studio B

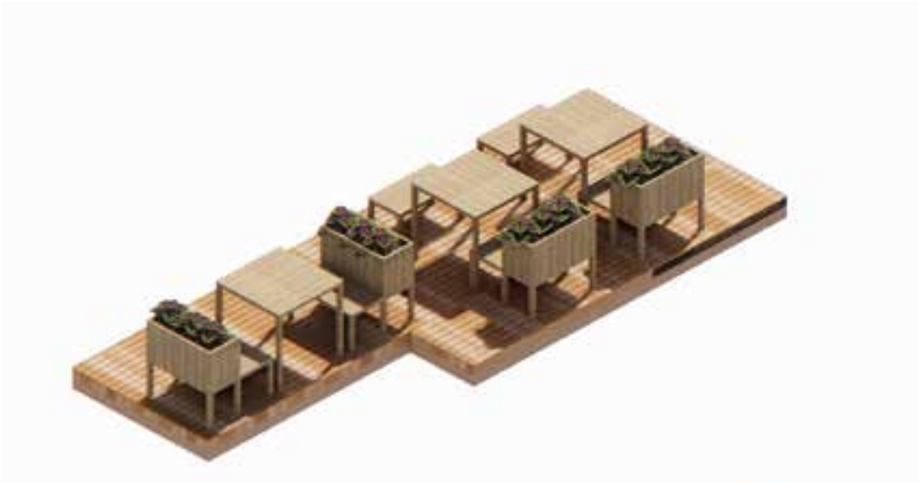


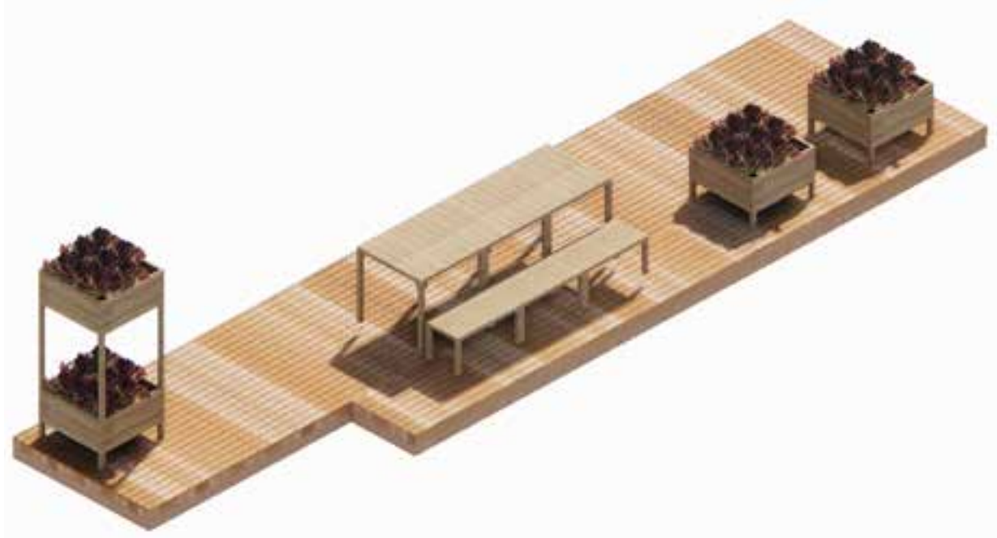
Shared cluster

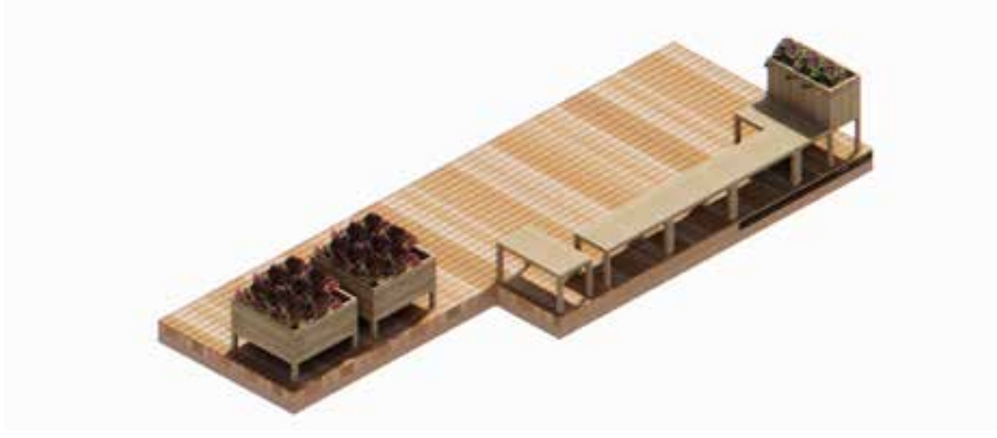




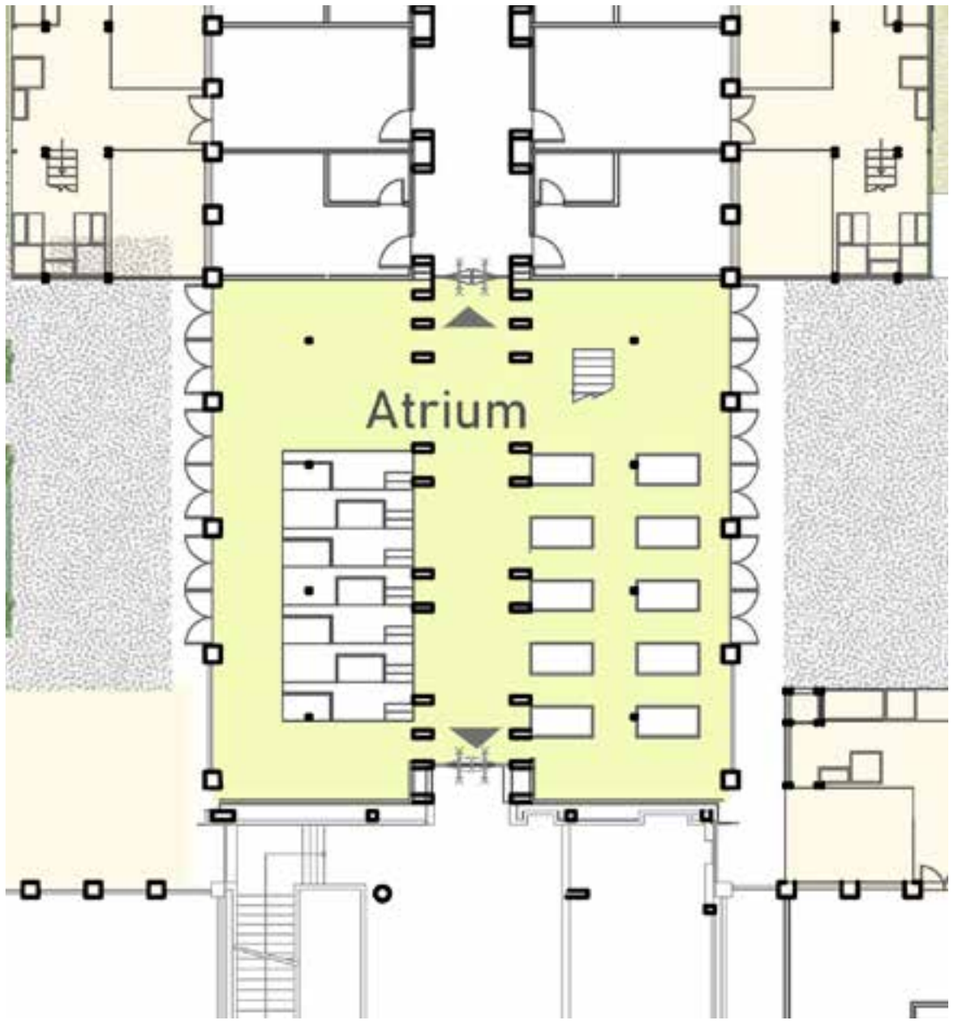
Modular unit for different space

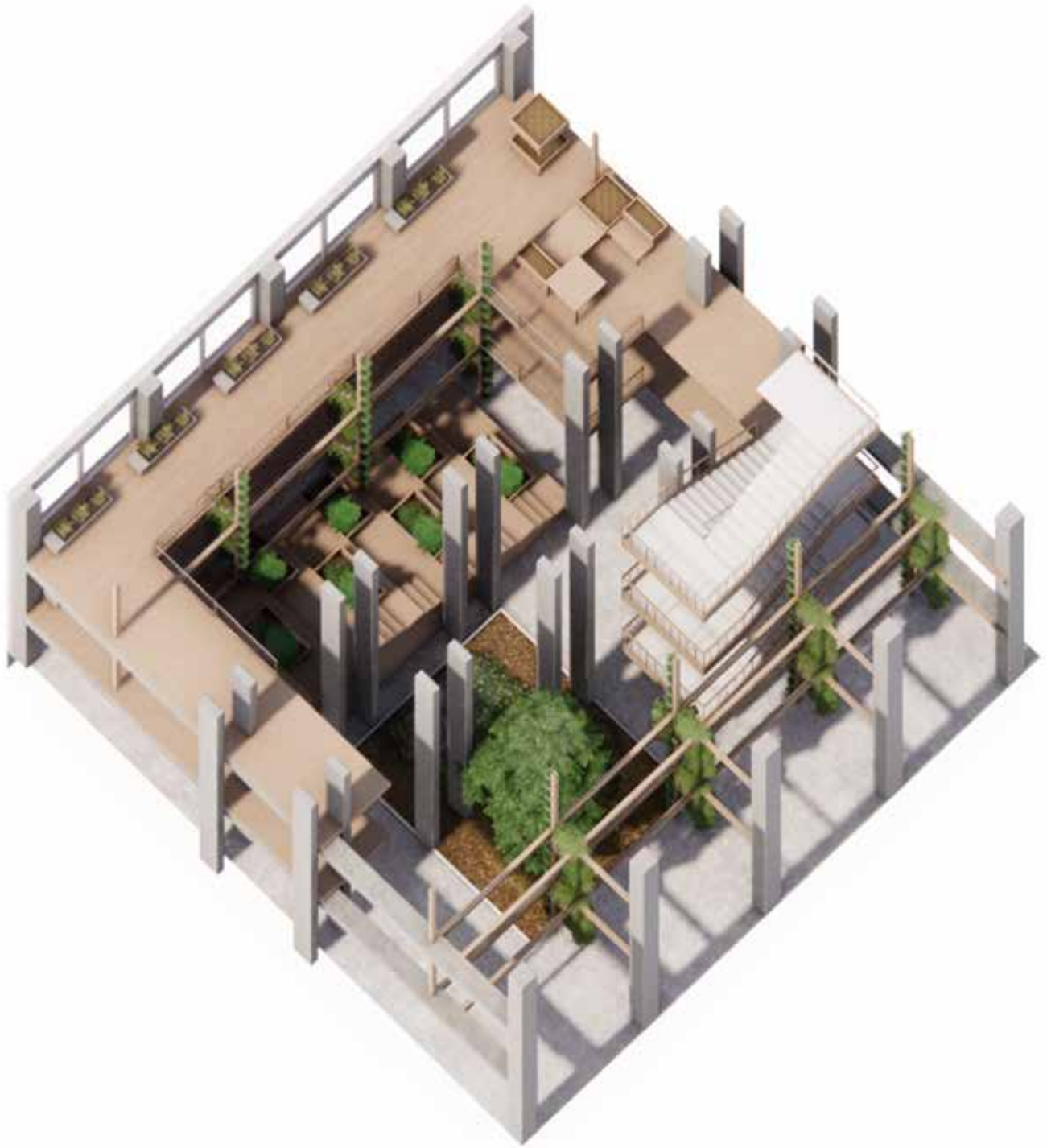


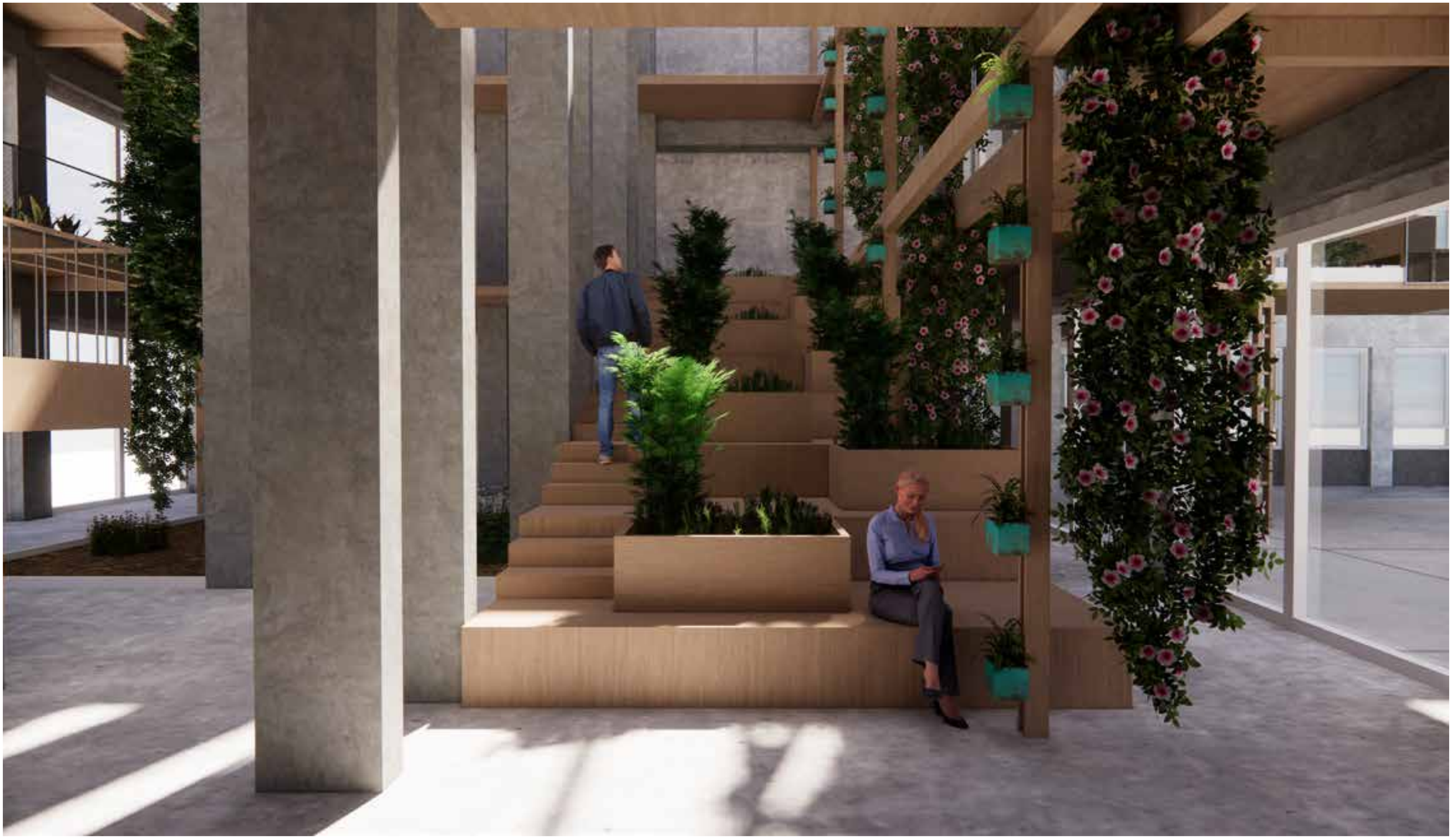




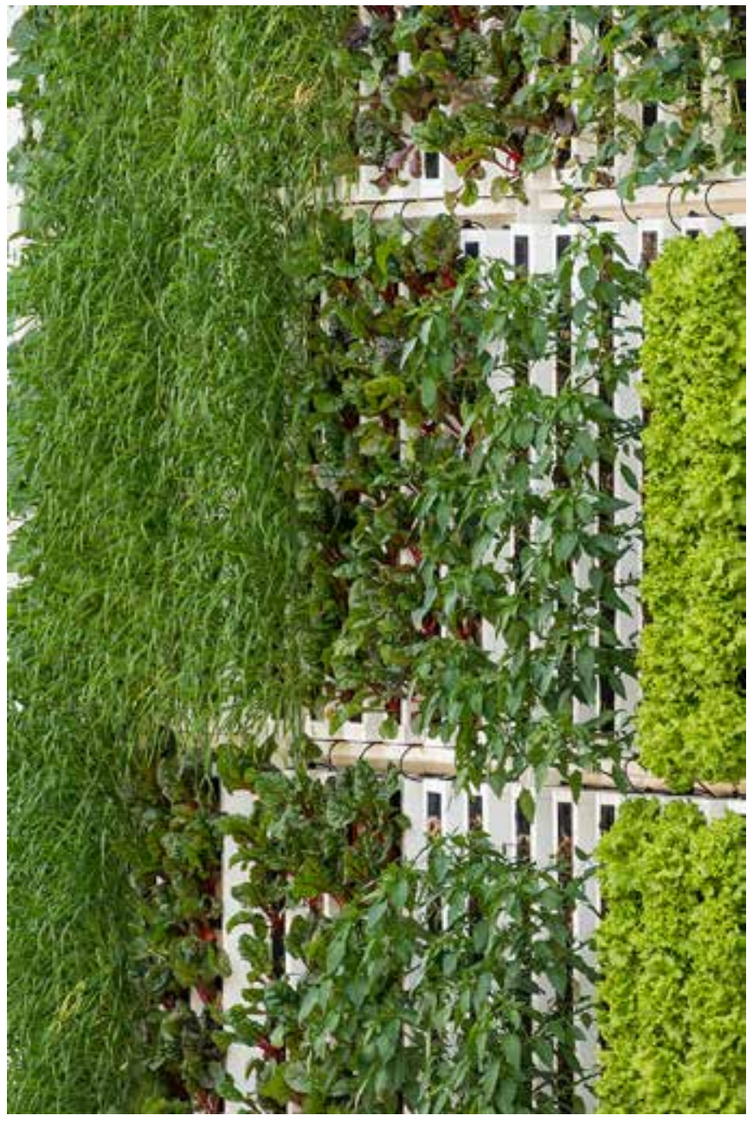
Green atrium



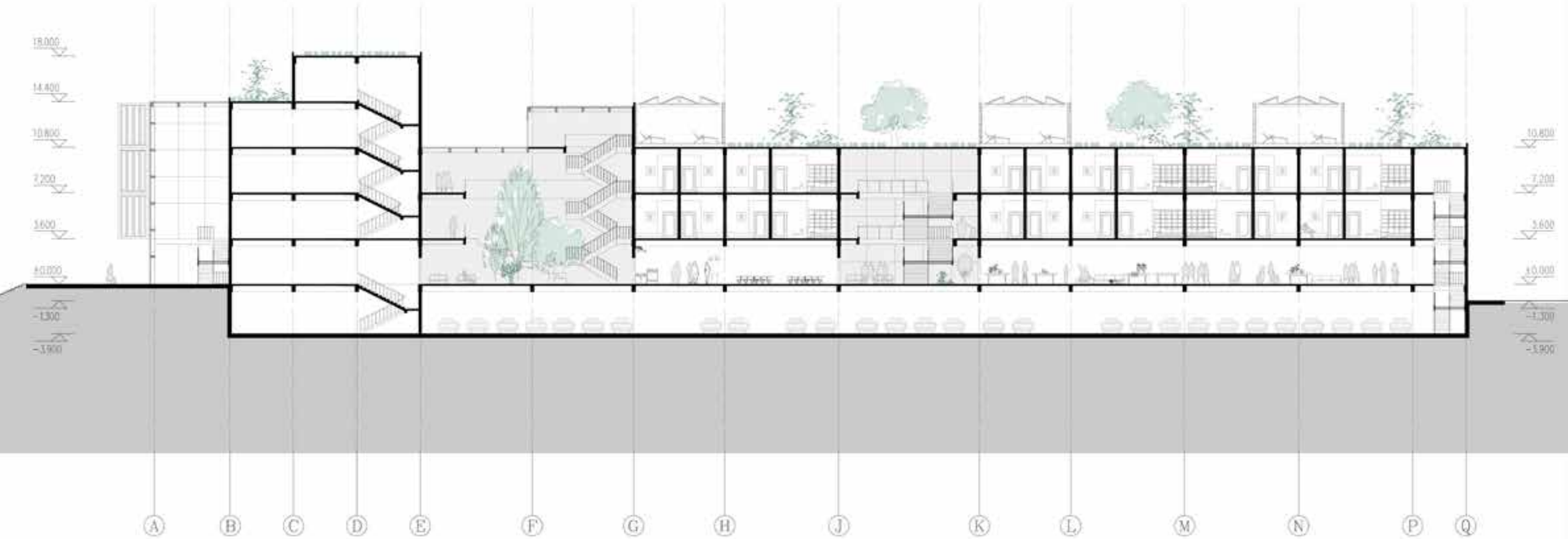




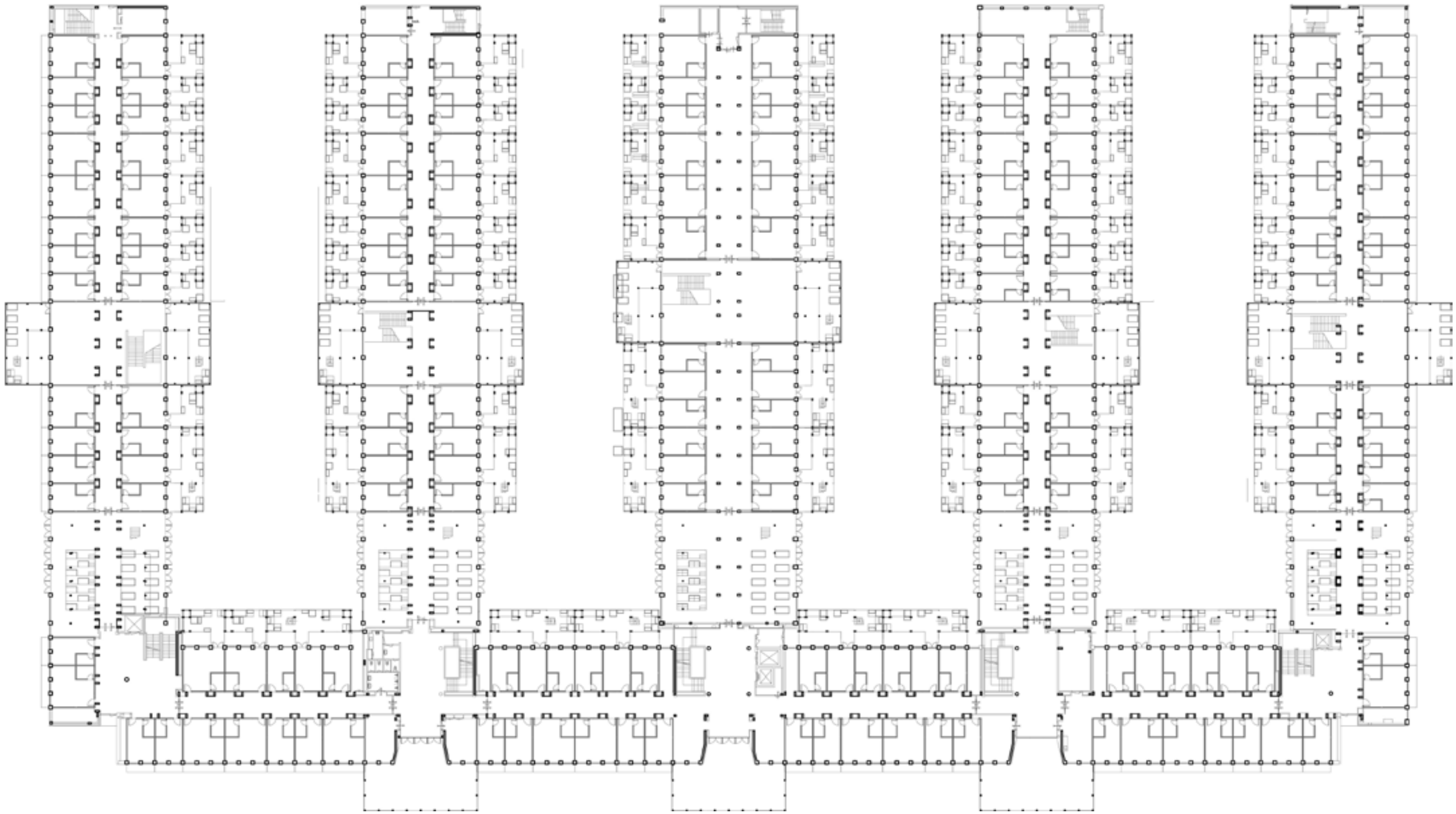
winter garden



Section


18.000
14.400
10.800
7.200
3.600
±0.000
-1.300
-3.900
A
B
C
D
E
F
G
H
J
K
L
M
N
P
Q

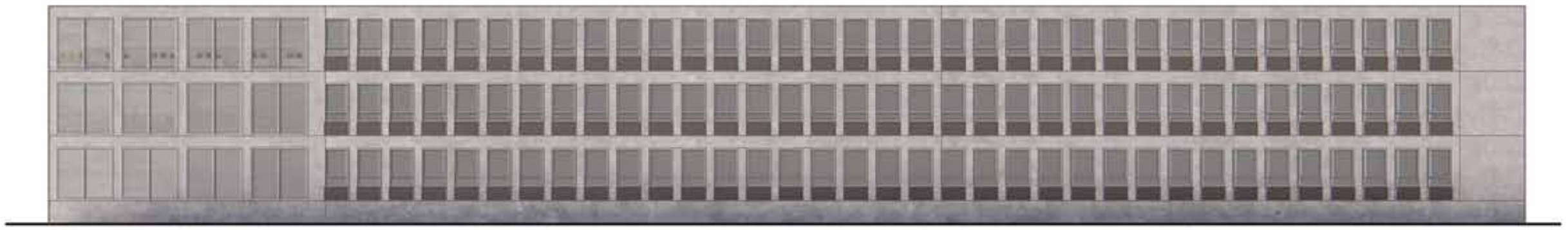
First floor plan




Building Unit
Main Entrance
Entrance
Existing staircases
New staircases

Elevation west

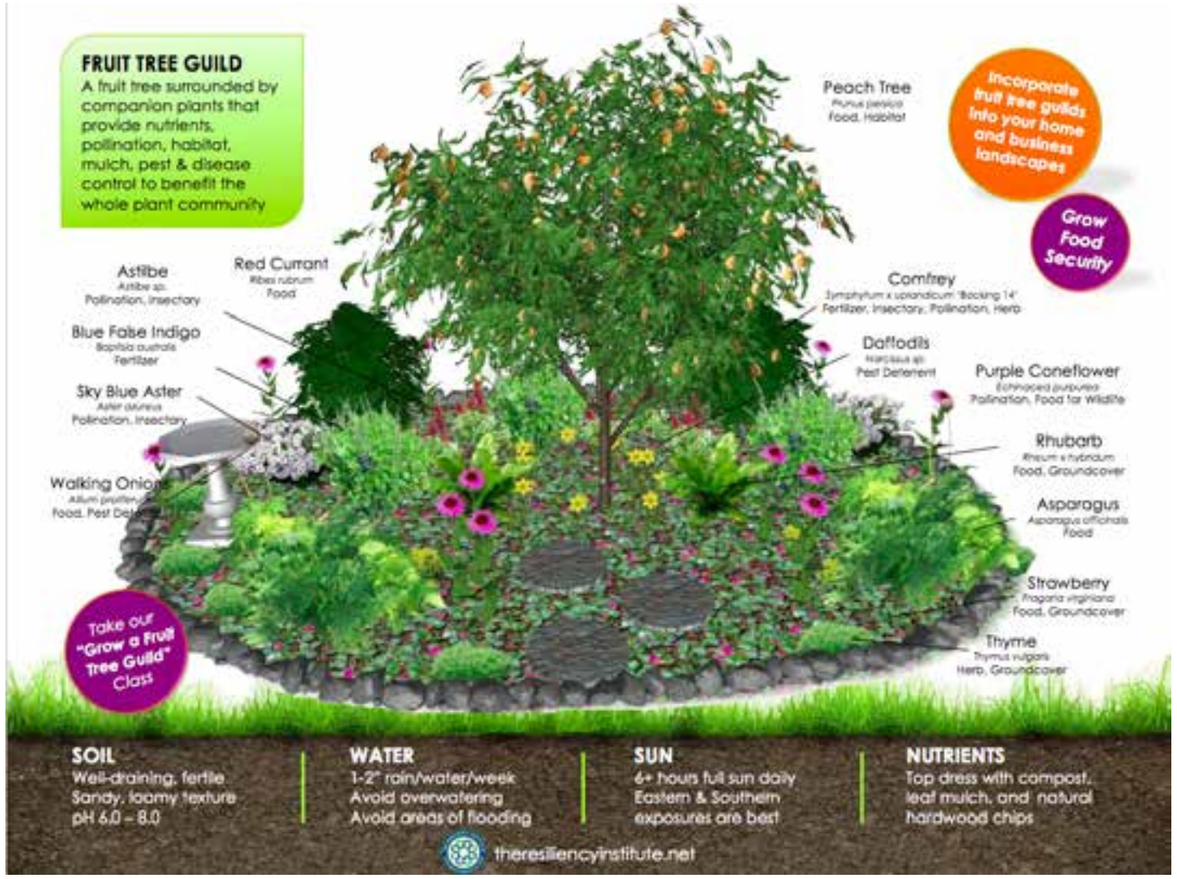
Elevation south



Green courtyard

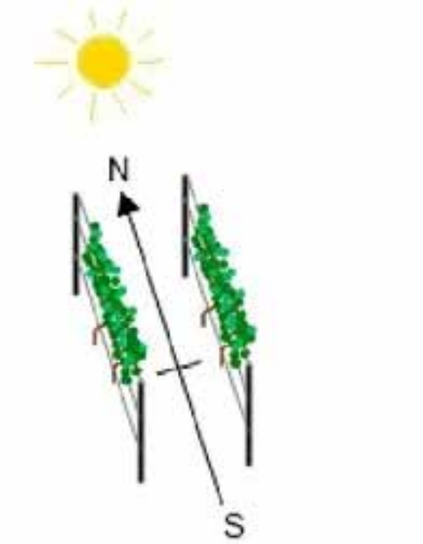
Design principles of permaculture

Fruit Tree Guild



Fertilizing plants, mulching plants, pest confusing plants, pollinator attracting plants, and - most importantly - food plants for you.One simple fruit tree guild can produce up to 200 pounds of food

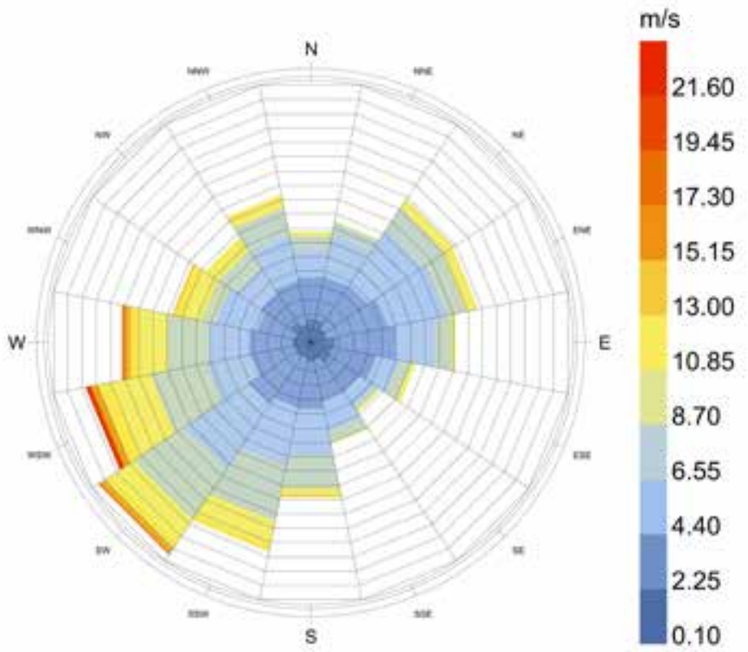
Site climate



North-South orientation of trellises so plants do not shade each other and sun shiles along full length of trellised plant

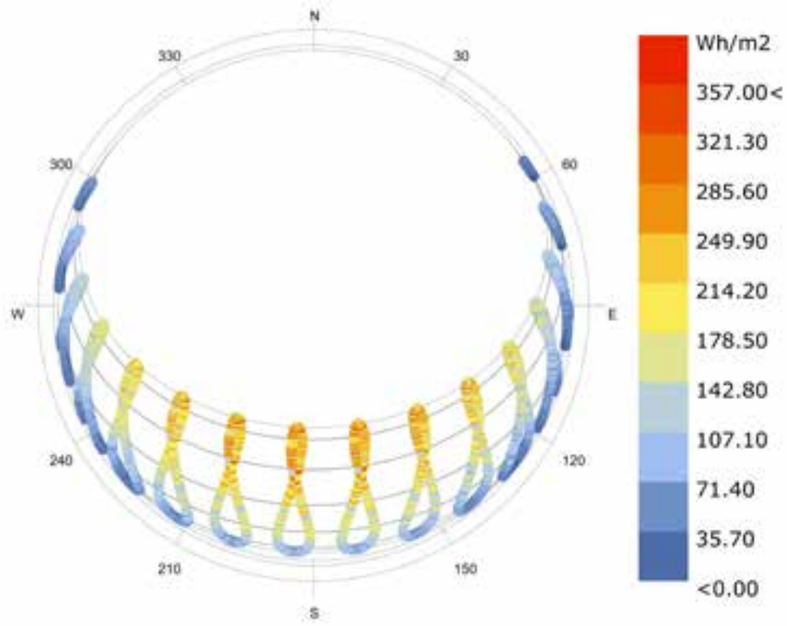
Scent of wormwood carried by wind over garden bed, masking scent from pests

wind

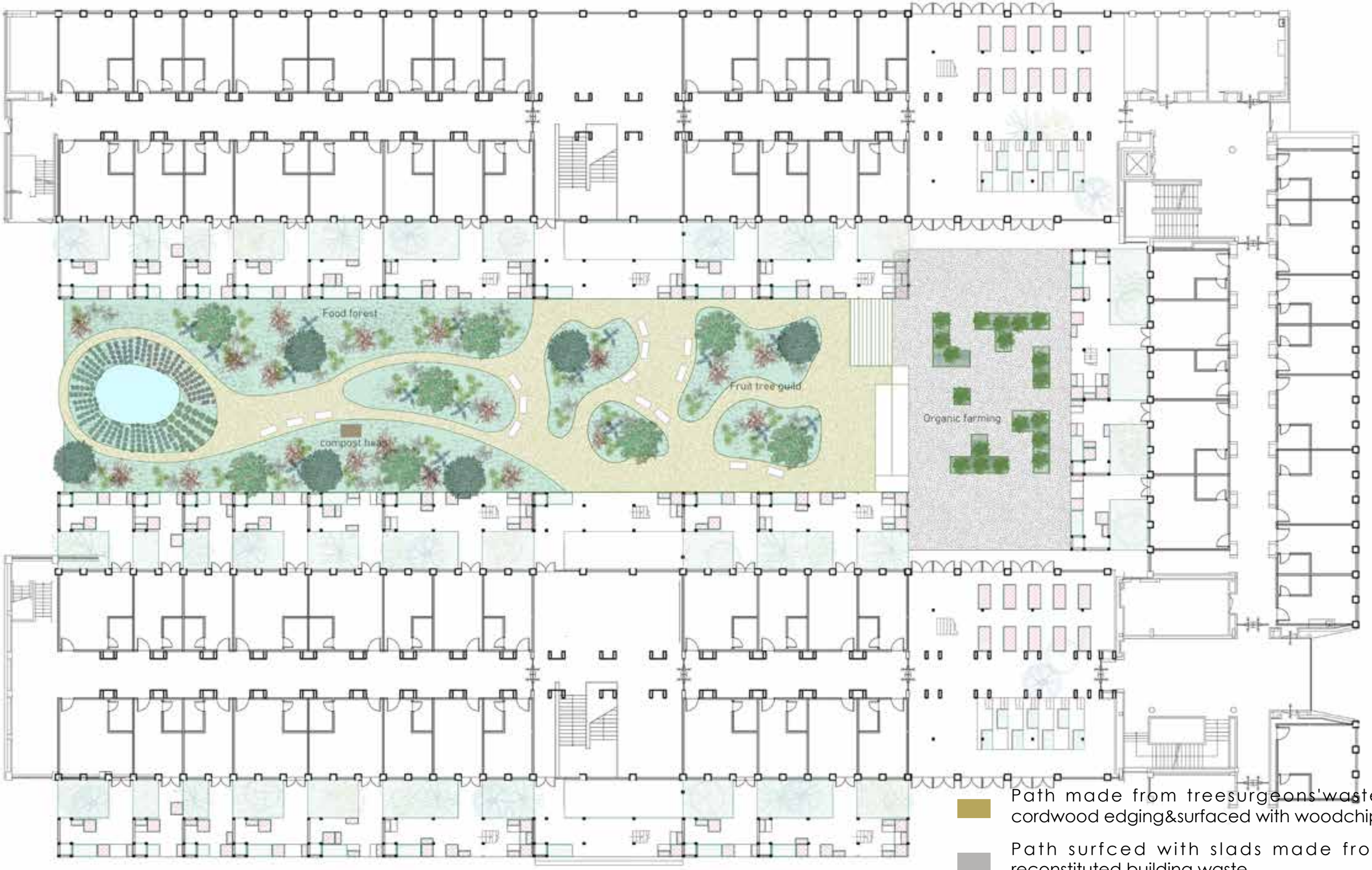


Wind Speed (m/s)
city: Ypenburg
country: NLD
time-zone: 1.0
source: SRC-TMYx
period: 1/1 to 12/31 between 0 and 23 @1
Calm for 2.51% of the time = 220 hours.
Each closed polyline shows frequency of 0.6% = 50 hours.

sun



Sun-Path Diagram - Latitude: 52.033000000000001
Hourly Data: Diffuse Horizontal Radiation (Wh/m2)
Ypenburg_ZH_NLD

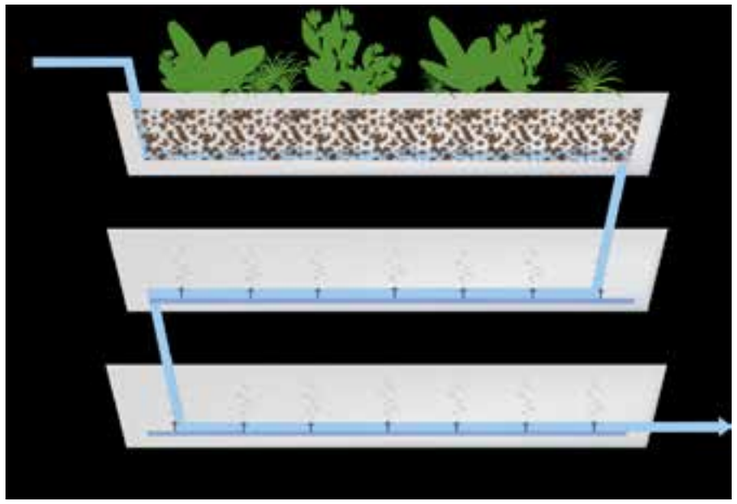


Path made from treesurgeons'waste-cordwood edging&surfaced with woodchip

Path surfced with slads made from reconstituted building waste

Watertreatment

VertECO technology treats waste/greywater within a vertically constructed plant-based wetland. The underlying principle is the employment of specific plant species in a special sequence to encourage the cleansing of polluted water through microbiological activity occurring in the root-zone.



Eleocharis Palustris

Juncus Effusus

Carex Pendula

Lysimachia Vulgaris

Lythrum Salicaria

Caltha Palustris

Grey water
&Collected rainwater

Grey water

Black water

Clean water

Rain water

Treated water

Rain

Rain

Rainwater
storage

Toilet Laundry

Clean water

Kitchen
Drinking

Shower

Electricity

Biogas
Digester

Rain

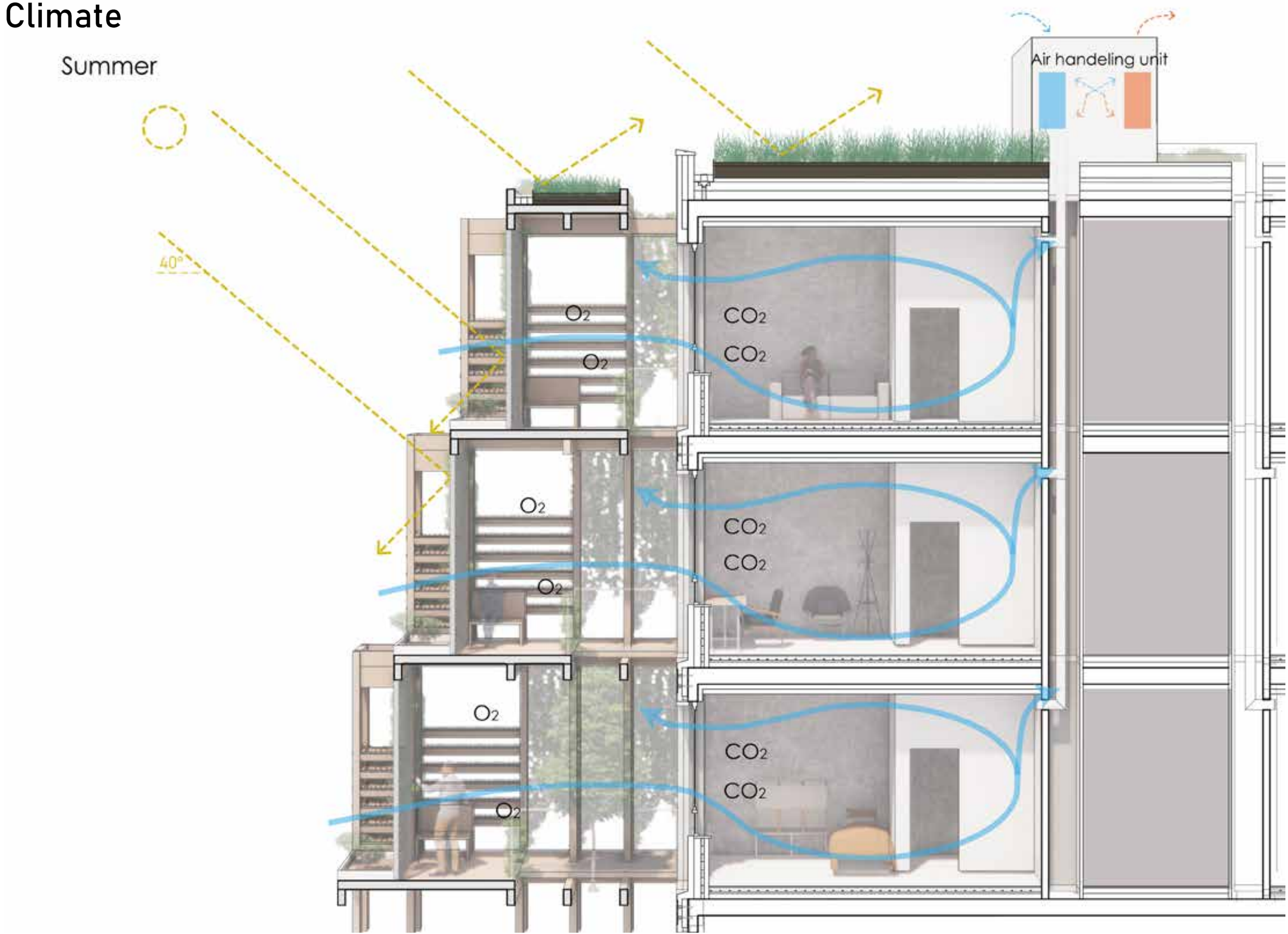
Water
lifting

filter

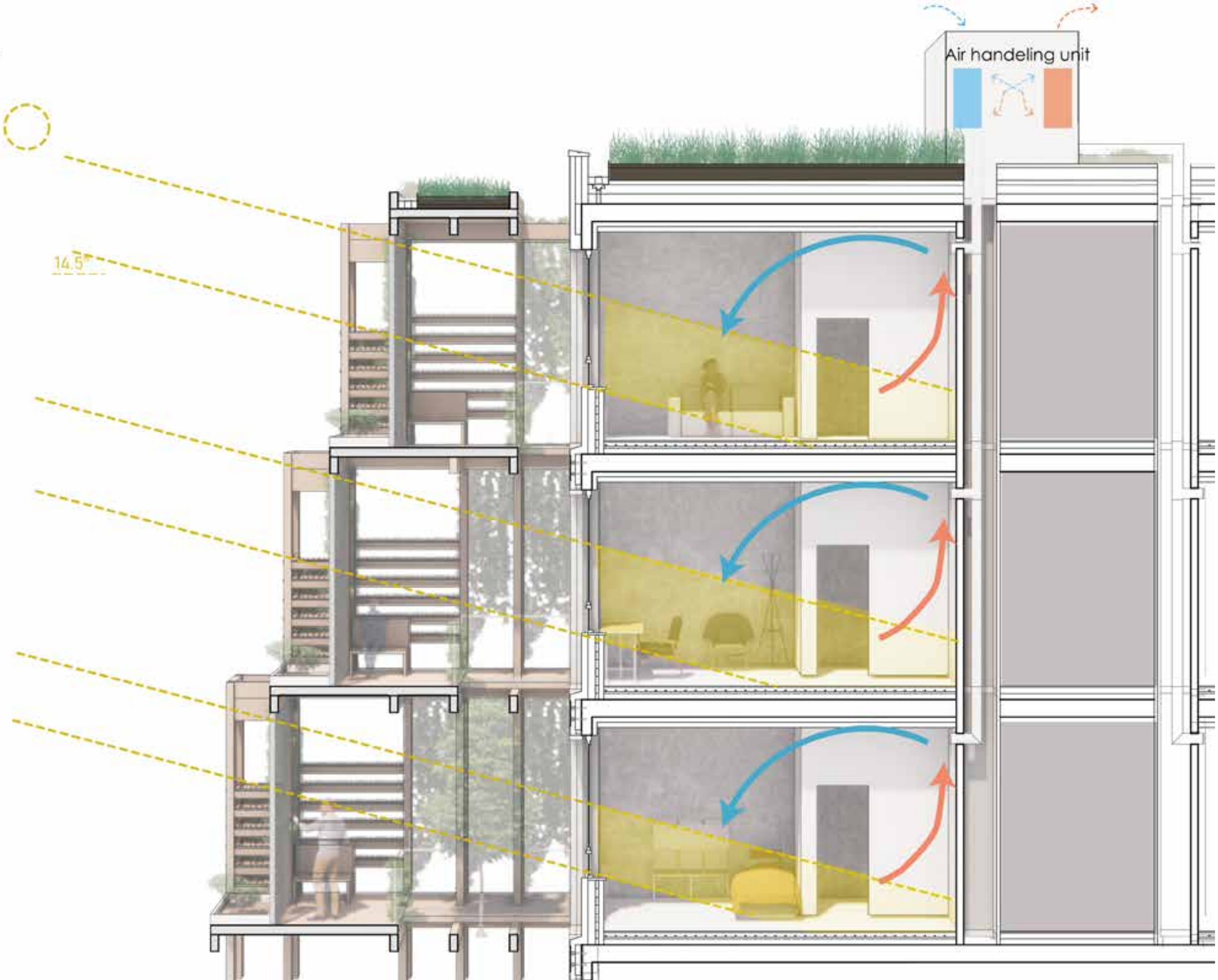
Treatedwater
storage

filter

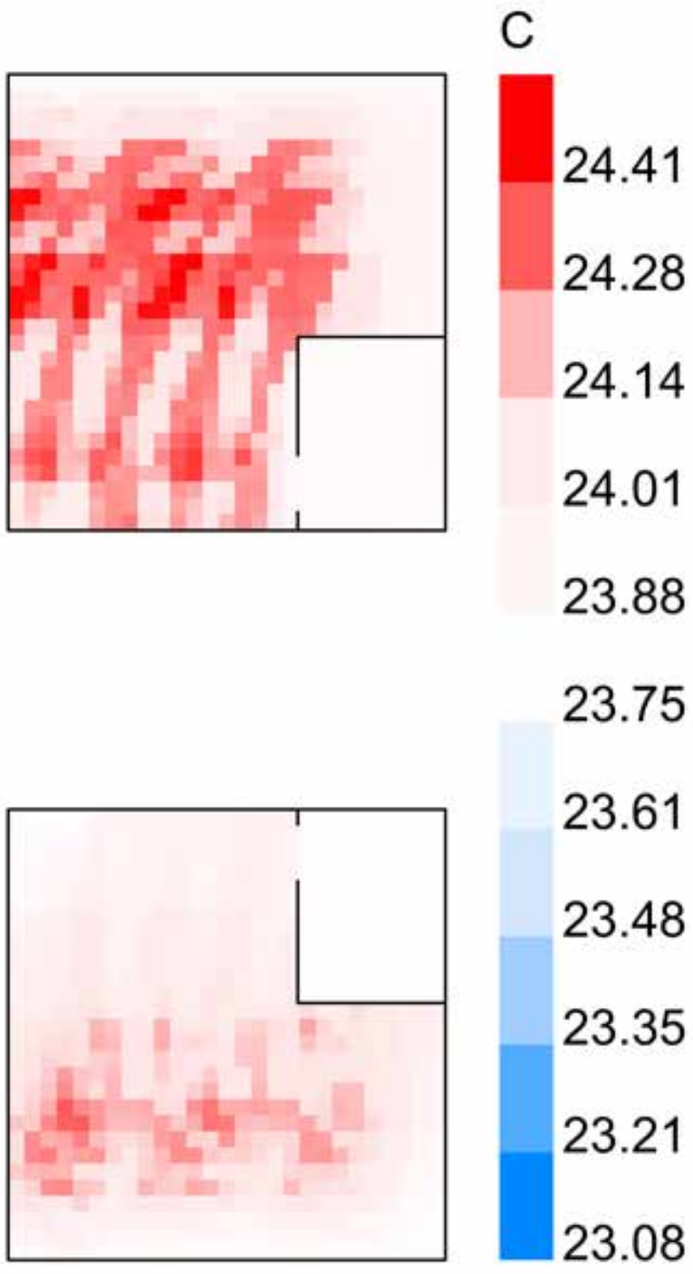
Climate


Summer
40°
Air handeling unit
O2
O2
O2
O2
O2
CO2
CO2
CO2
CO2
CO2
CO2

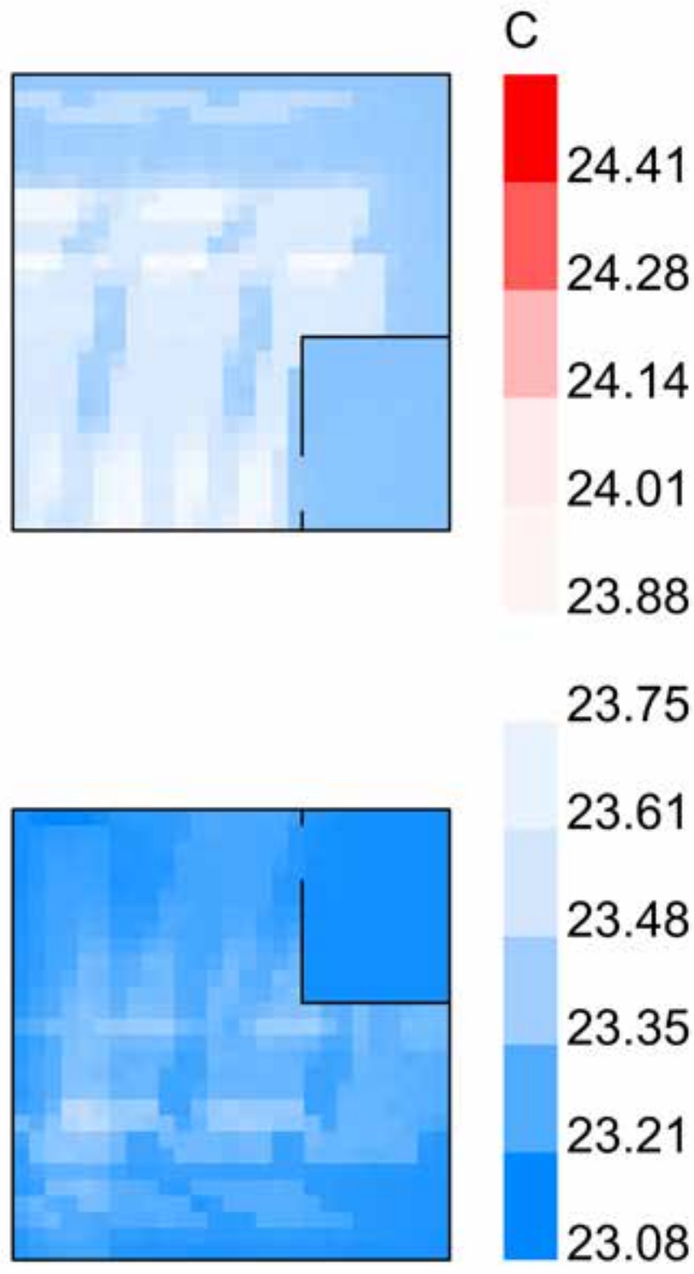
winter



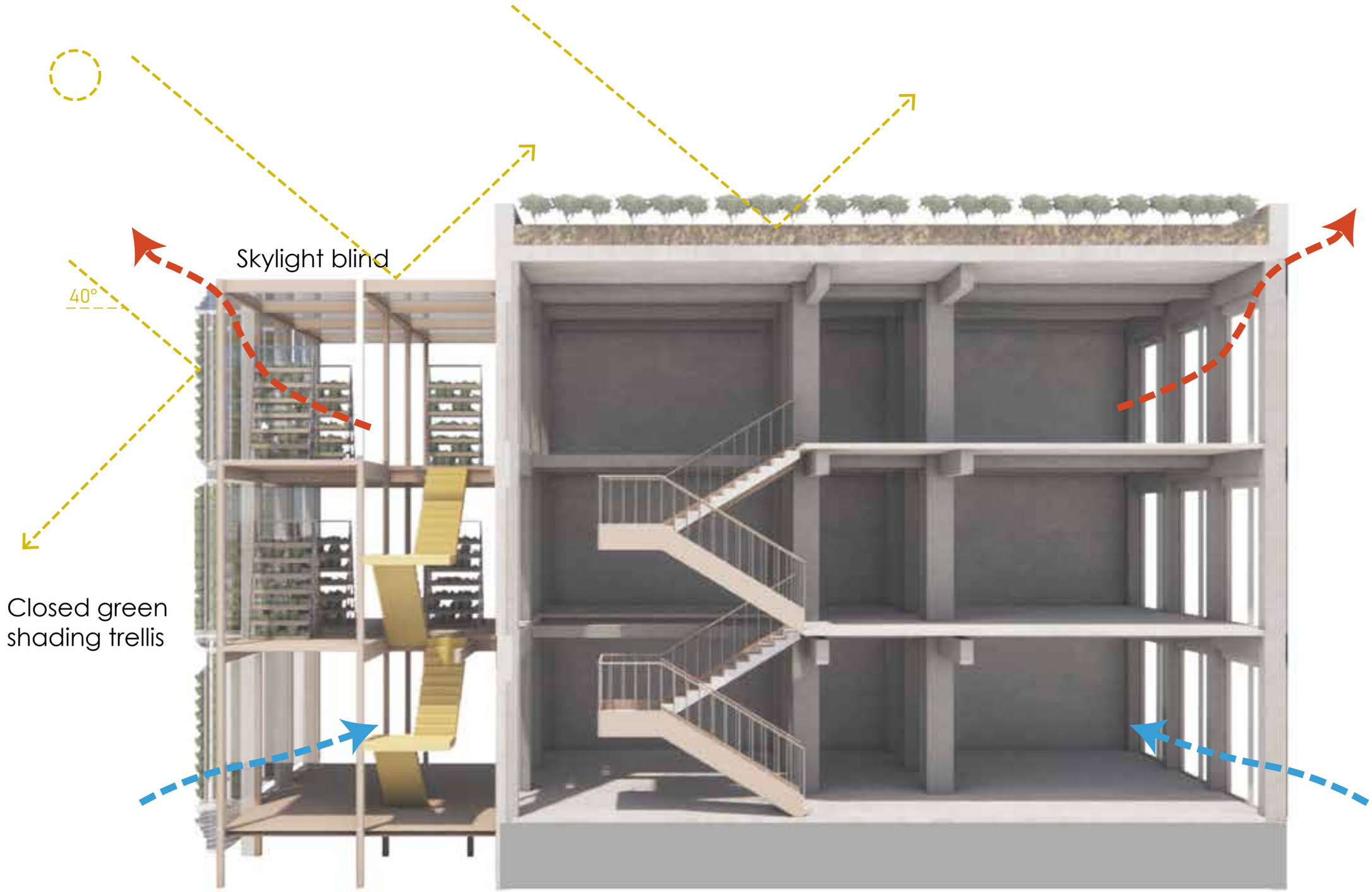
Indoor thermal comfort (UTCI) during extremely hot weeks
Before renovation



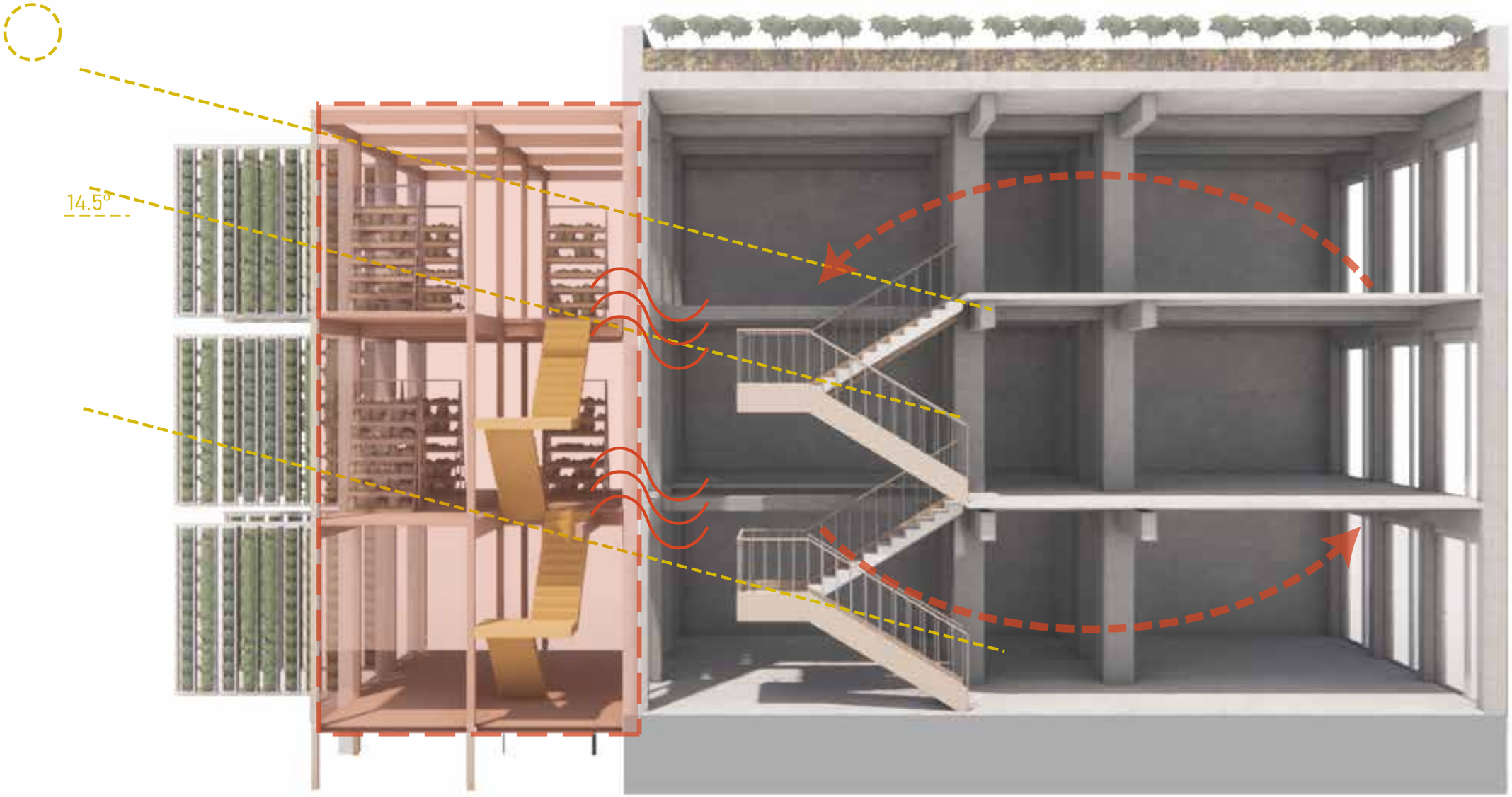
Indoor thermal comfort (UTCI) during extremely hot weeks
After renovation

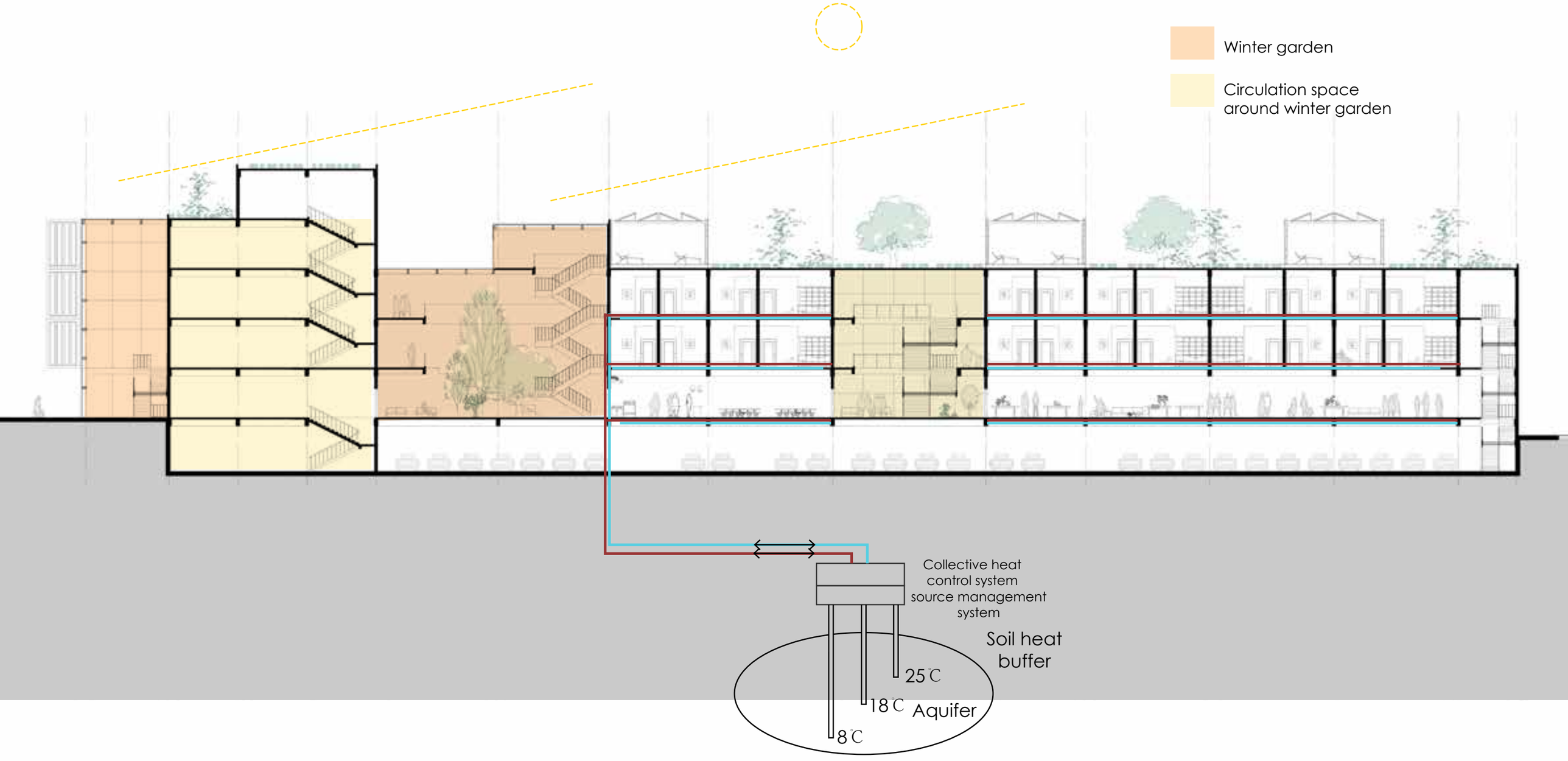


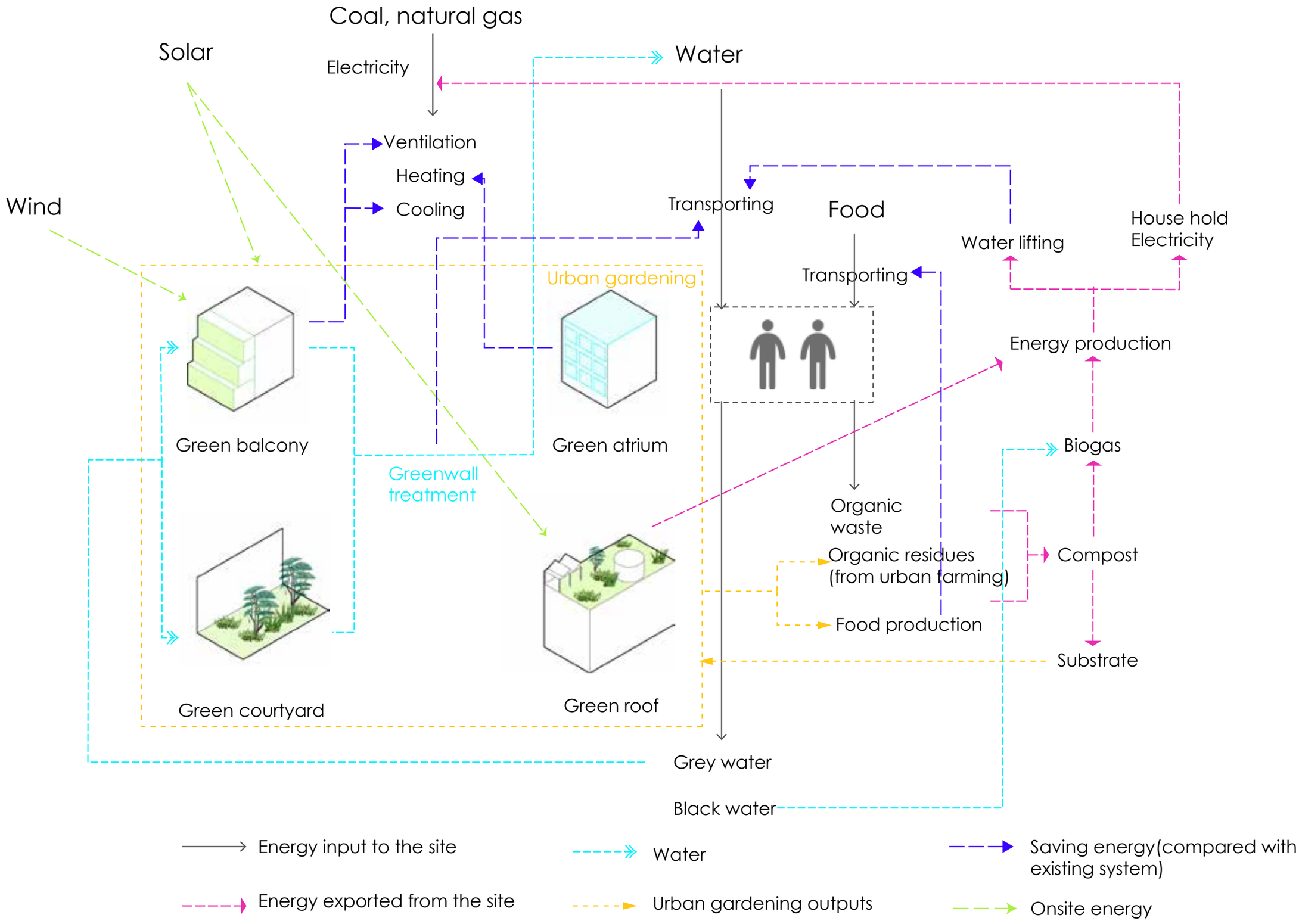
Summer



winter




Winter garden
Circulation space
around winter garden
Collective heat
control system
source management
system
Soil heat
buffer
25 ℃
18 ℃
Aquifer
8 ℃


Coal, natural gas
Solar
Electricity
Water
Ventilation
Heating
Cooling
Wind
Transporting
Food
House hold
Electricity
Water lifting
Urban gardening
Transporting
Energy production
Green balcony
Green atrium
Biogas
Greenwall
treatment
Organic
waste
Organic residues
(from urban farming)
Compost
Food production
Substrate
Green courtyard
Green roof
Grey water
Black water
Energy input to the site
Water
Saving energy(compared with
existing system)
Energy exported from the site
Urban gardening outputs
Onsite energy

Material

Existing material

Poriso stone

Path surfced with slads made from reconstituted building waste

Black glazed bricks

Natural stone

Polished concrete

New material

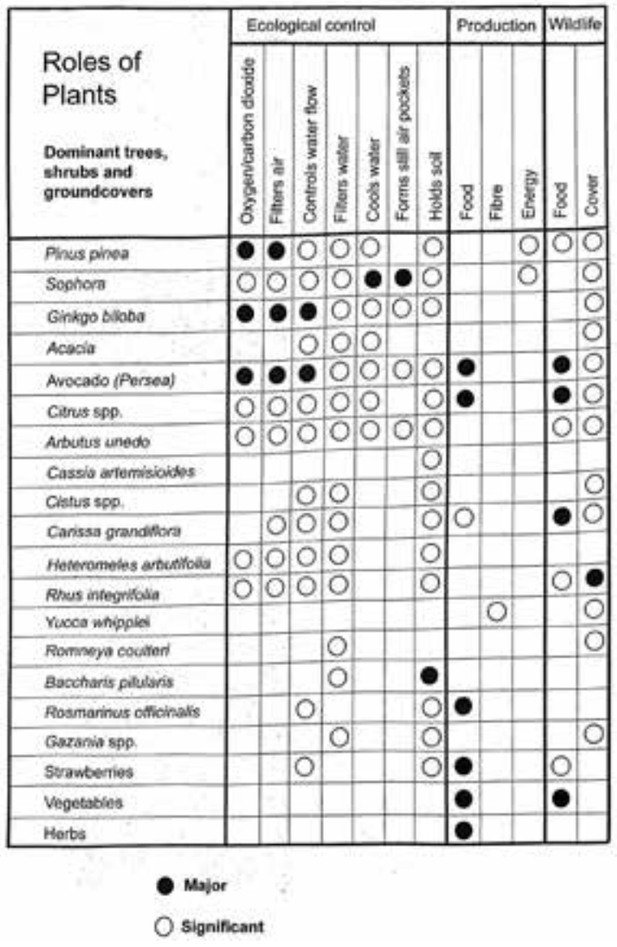
CLT panel

Wood decking

Reclaimed wood planter

Principles

Plants



Roles of Plants **Dominant trees, shrubs and groundcovers**	Ecological control							Production			Wildlife	
	Oxygen/carbon dioxide	Filters air	Controls water flow	Filters water	Cools water	Forms still air pockets	Holds soil	Food	Fibre	Energy	Food	Cover
Pinus pinea	●	●	○	○	○		○			○	○	○
Sophora	○	○	○	○	●	●	○			○		○
Ginkgo biloba	●	●	●	○	○	○	○					○
Acacia			○	○	○							○
Avocado (Persea)	●	●	●	○	○	○	○	●			●	○
Citrus spp.	○	○	○	○	○	○	○	●			●	○
Arbutus unedo	○	○	○	○	○	○	○				○	○
Cassia artemisioides							○					
Cistus spp.			○	○			○					○
Carissa grandiflora		○	○	○			○	○			●	○
Heteromeles arbutifolia	○	○	○	○			○					
Rhus integrifolia	○	○	○	○			○				○	●
Yucca whipplei									○			○
Romneya coulteri				○								○
Baccharis pilularis				○			●					
Rosmarinus officinalis			○				○	●				
Gazania spp.				○			○					○
Strawberries			○				○	●			○	
Vegetables								●			●	
Herbs								●				

● **Major**

○ **Significant**

Ecological Unit

1.Provide food for birds and insects
2.Provide cover for birds and insects
3. Native plants

Private Graden(modular planter)

1.Produce oxygen
2.Filters air
3.Profuce food

Winter Garden

1.Produce oxygen
2.Filters air
3.Profuce food
4.Able to grow in winter

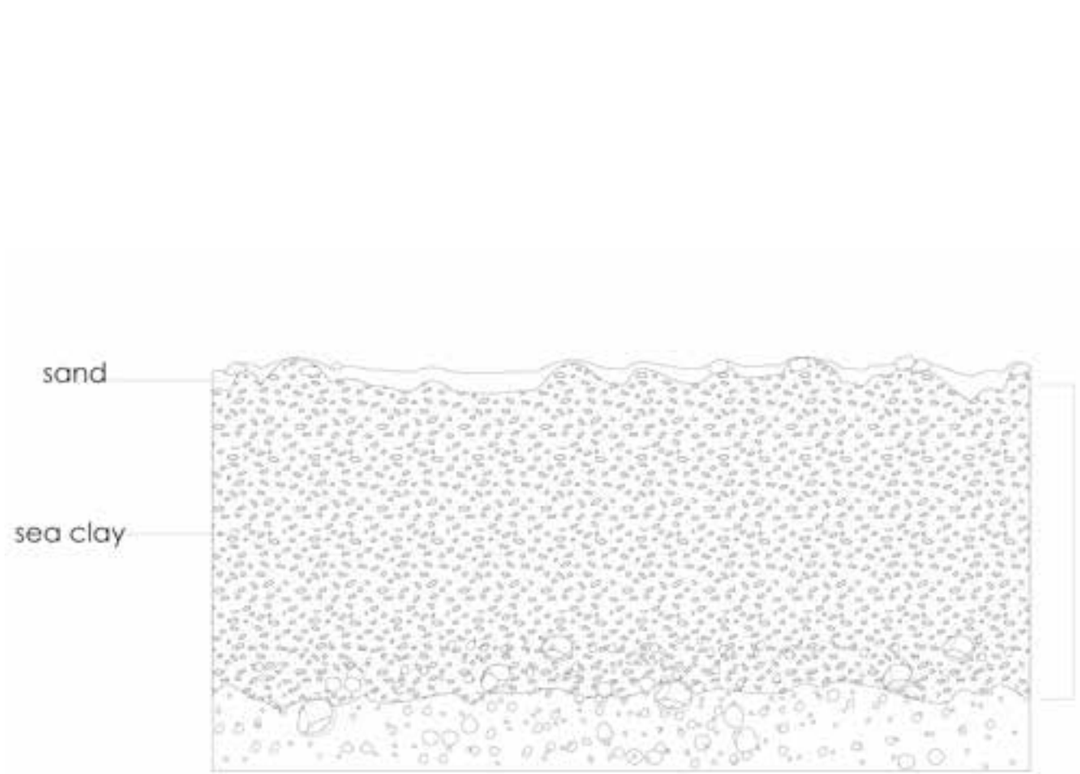
Watertreatment

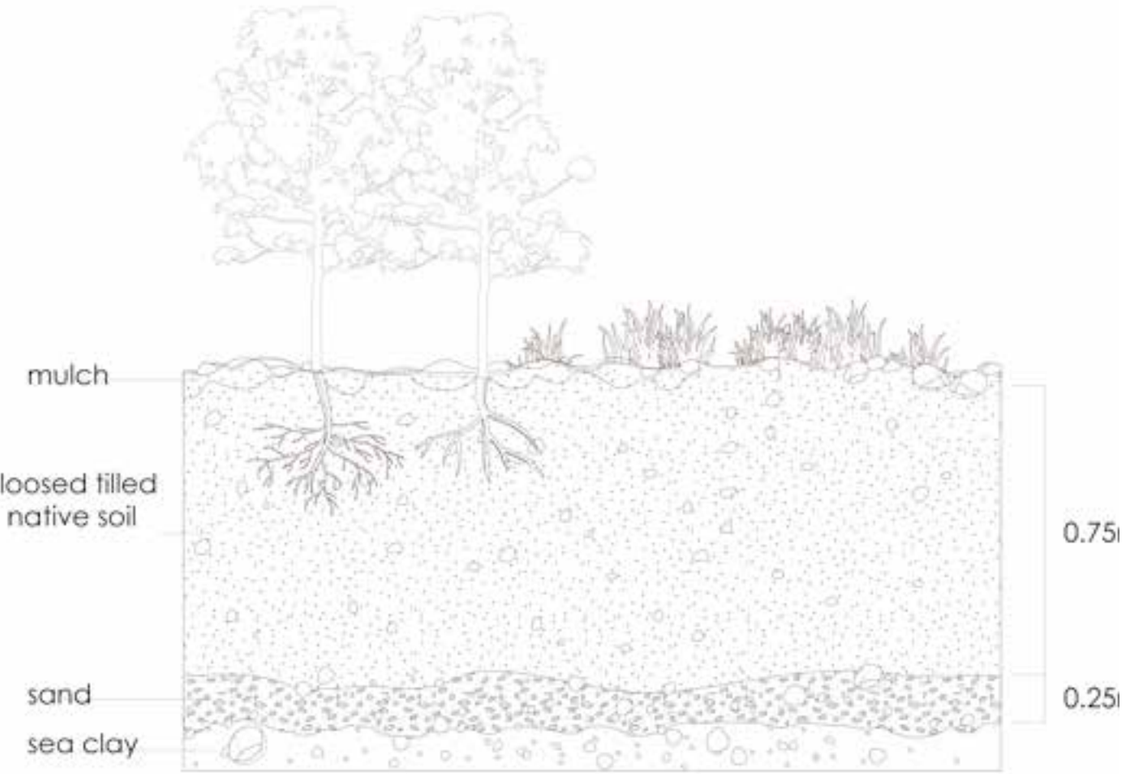
1.Filters water
2.Produce oxygen

Green courtyard and green roof

1.Holds soil
2.Controls water flow
3.Produce oxygen
4.Filters air
5.Food forrest

Soil


sand
sea clay
1m


mulch
loosed filled
native soil
sand
sea clay
0.75
0.25

Ecologica unit


Common Sage


Sheep Grass


Hyssop


Chives


Lavender


Flowering Rush


Hornwort


Willow


Bulrush


Yellow Loosestrife


Avocado(Persea)


Citrus app


Carissa grandiflora

Green roof and green courtyard


Red Currant


Comfrey

Astilbe


Blue False Indigo


Sky Blue Aster


Walking Onions


Daffodils


Purple Coneflower


Rhubarb


Peach Tree


Asparagus


Thyme


Strawberry

Winter garden

Pinus pinea

Arbutus unedo

Gazania spp

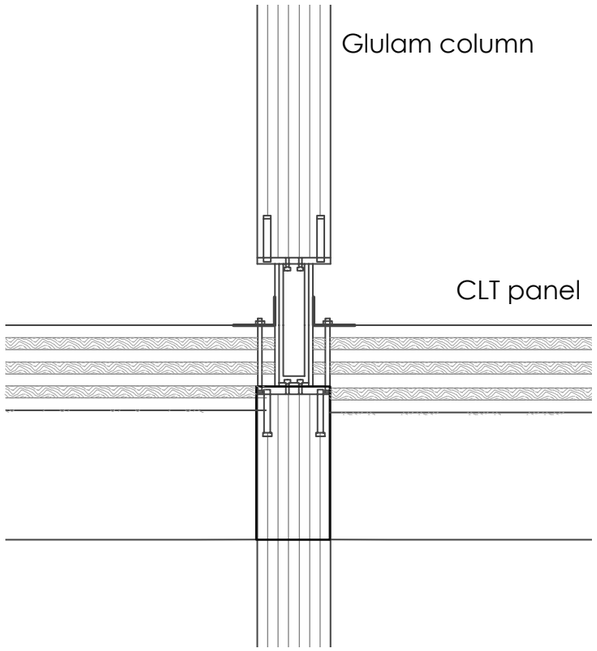
Avocado(Persea)

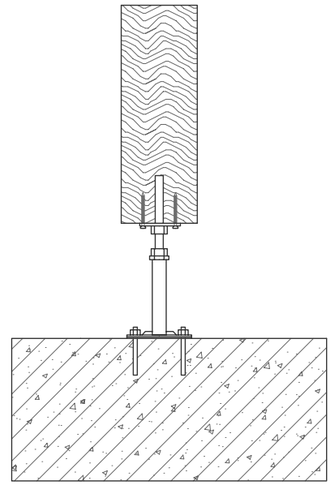
Cassia Artemisioides

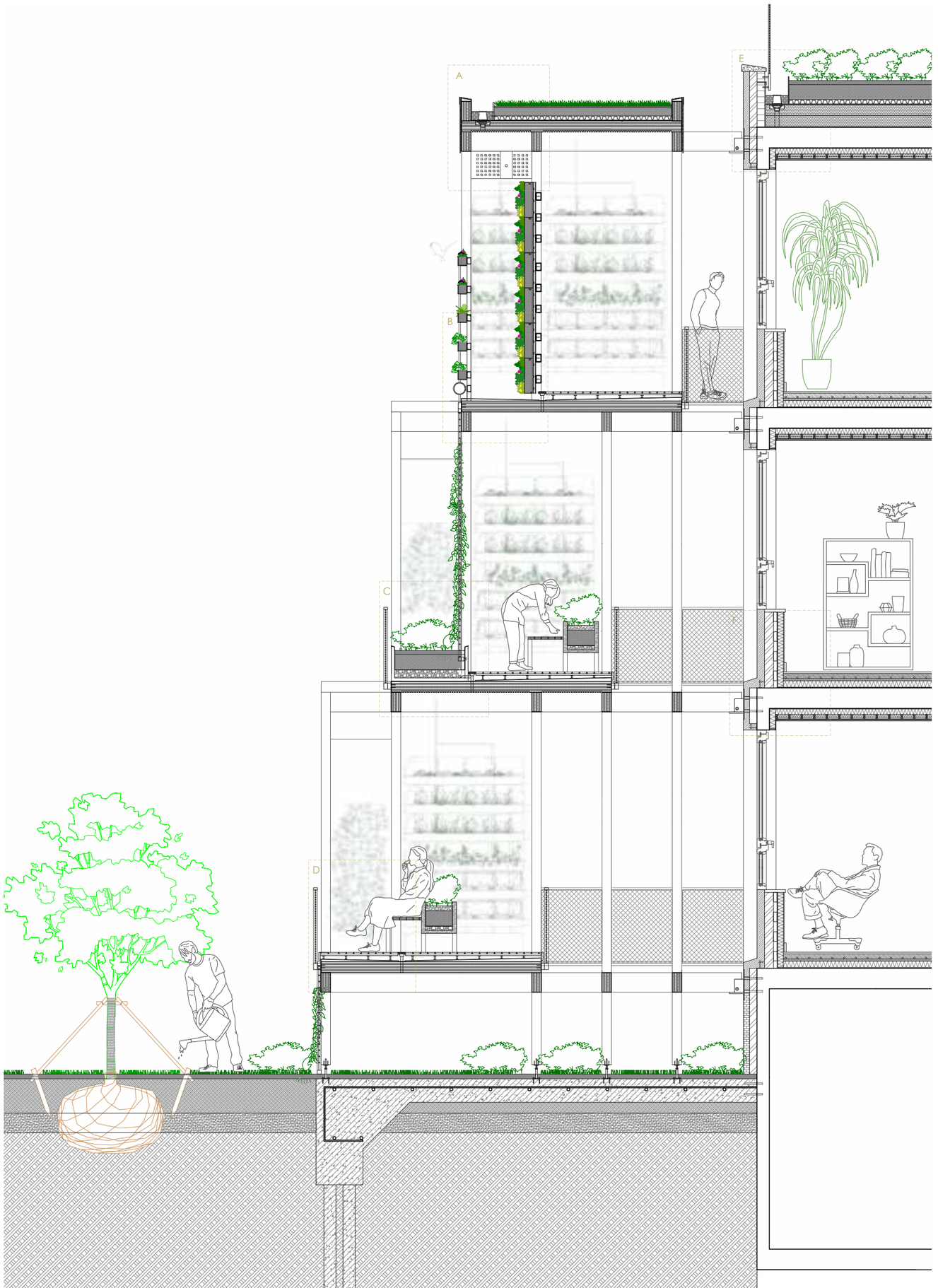
Cistus Spp

Carissa Grandiflora

Romneya Coutten

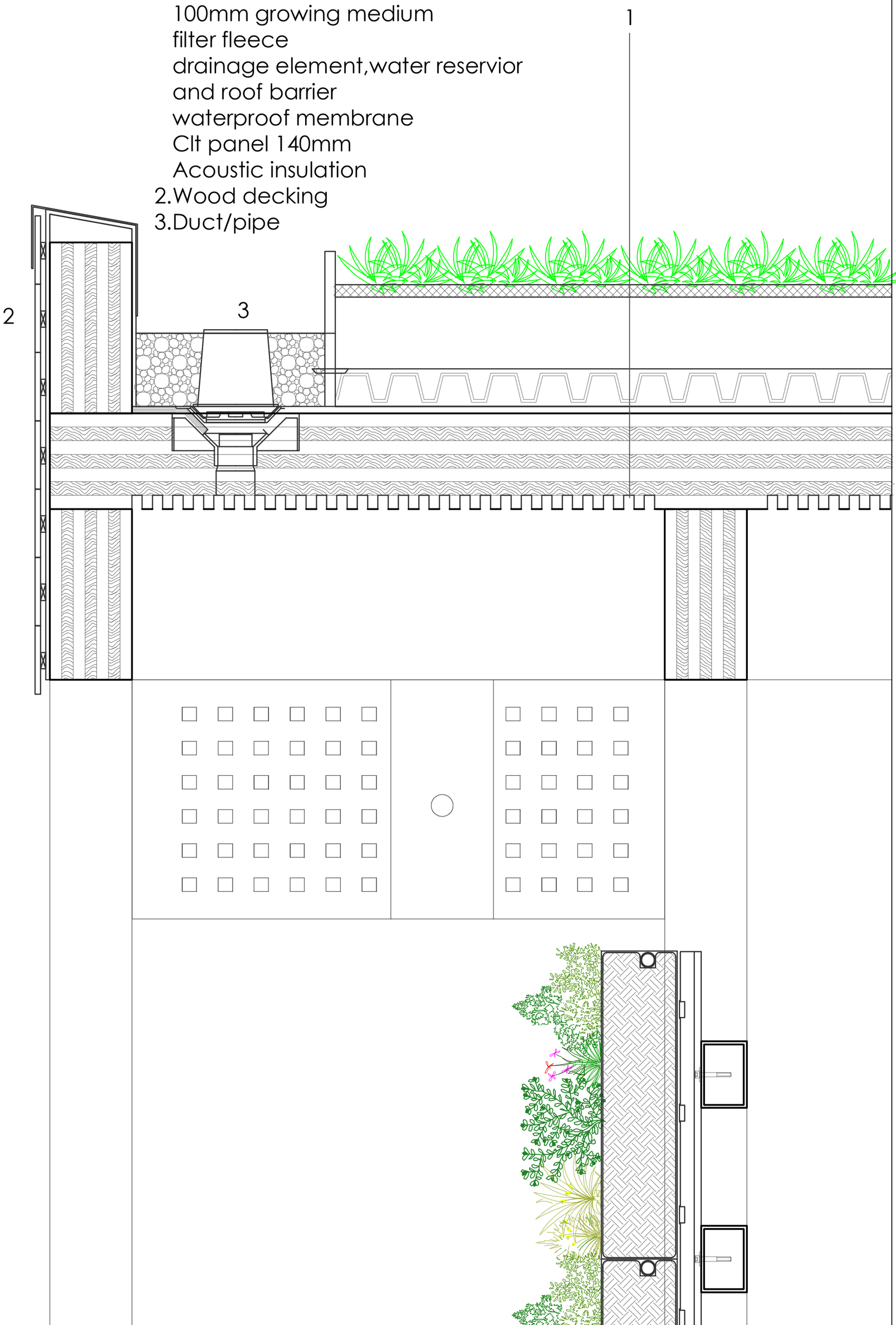

Glulam column
CLT panel




A
B
C
D
E
F

A

1.light vegetation
20mm mulch
100mm growing medium
filter fleece
drainage element,water reservior
and roof barrier
waterproof membrane
Clt panel 140mm
Acoustic insulation
2.Wood decking
3.Duct/pipe



B

1

2

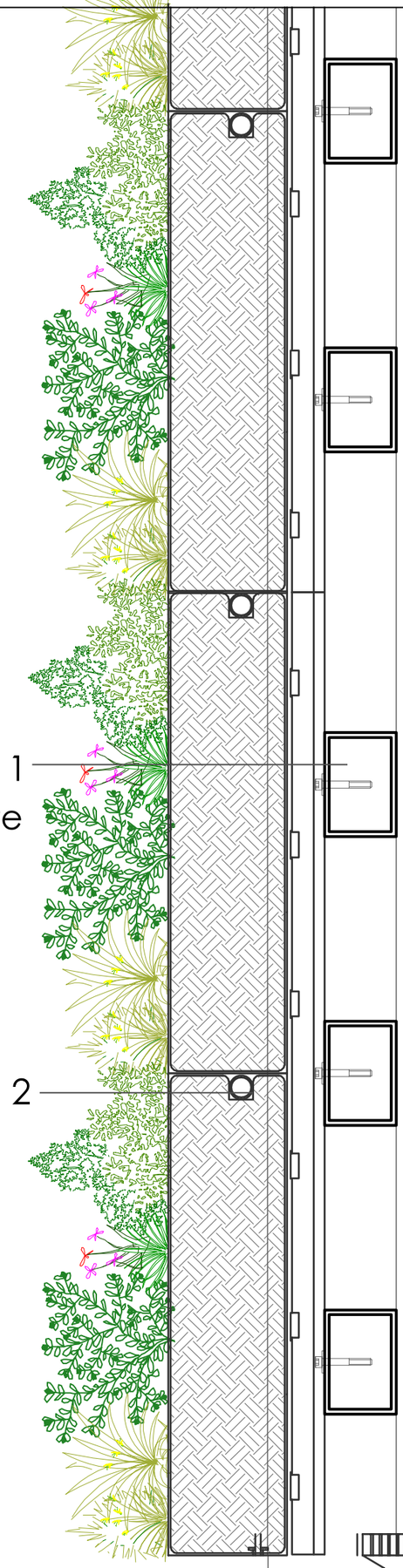
3

4

5

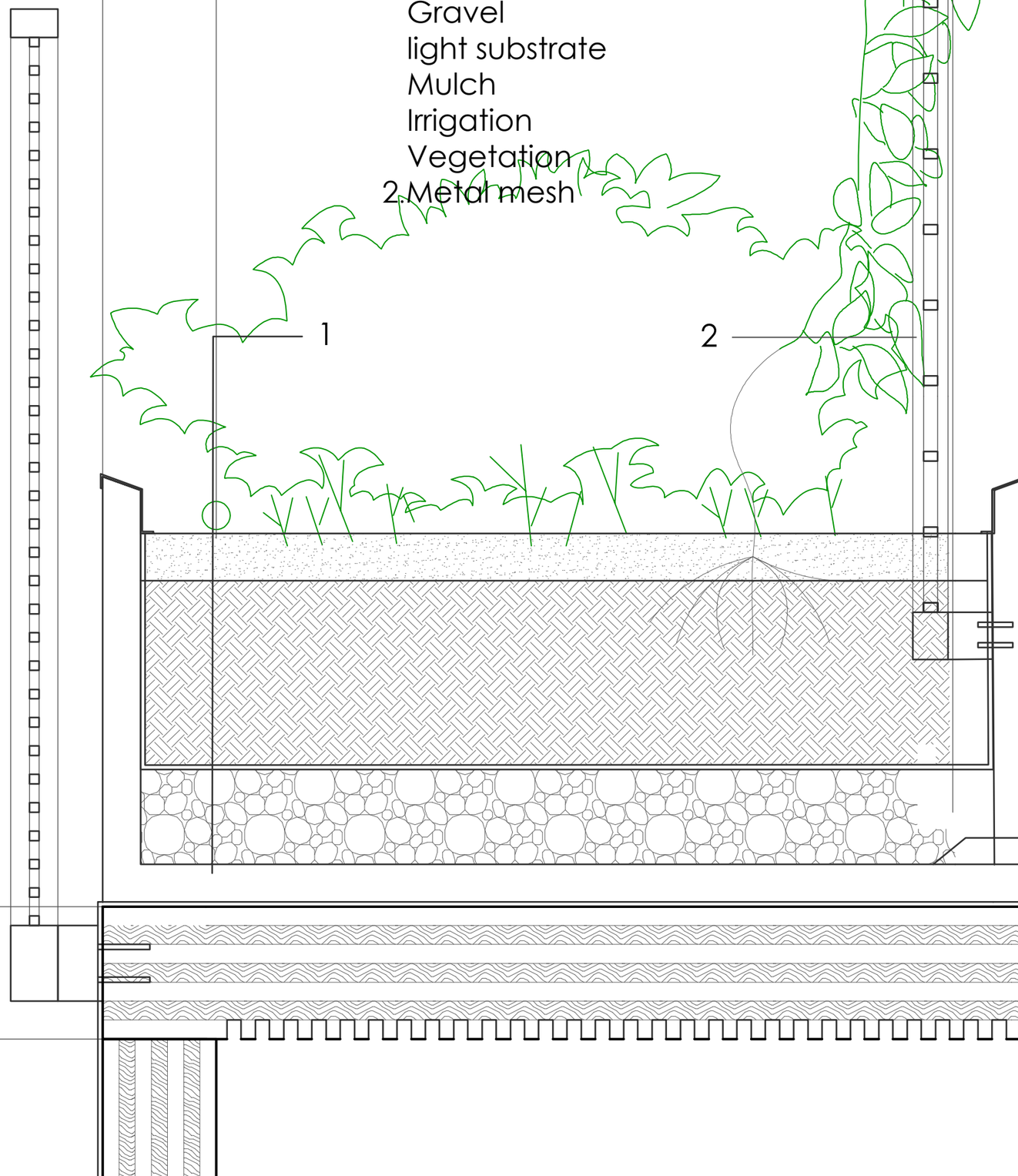
1.vegetation
Panel with light sub strate
Horizontal steel system
2.Irrigation

1.Plastics pot
Gravel
light substrate
Irrigation
Mulch
Vegetation
2.Horizontal steel system
3.Pot fastening system
4.water pipe
5.water tank



C

1.wooden pot
Gravel
light substrate
Mulch
Irrigation
Vegetation
2.Metal mesh



D

1.wood deck 25mm
wood decl substructure 60mm
pli-coating
water proof layer
CLT panel 140mm
2.duct/pipe

1

2

al grille

4

3.20 mm wooden floor
70 mm cement screed with
underfloor heating
30 mm impact-sound insulation
80 mm XPS thermal insulation
separating membrane, 2-ply

3

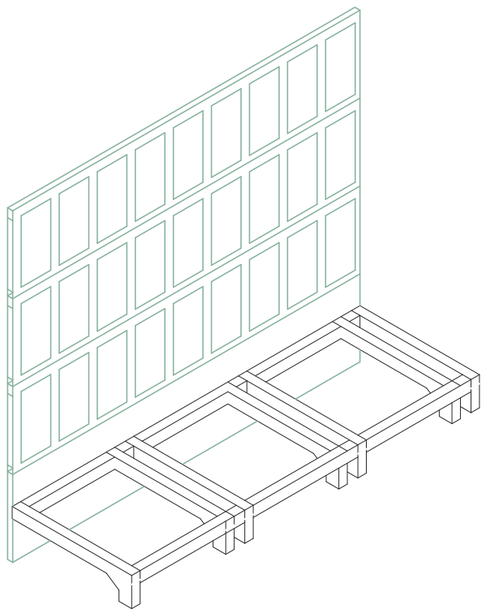
Fixing bolt

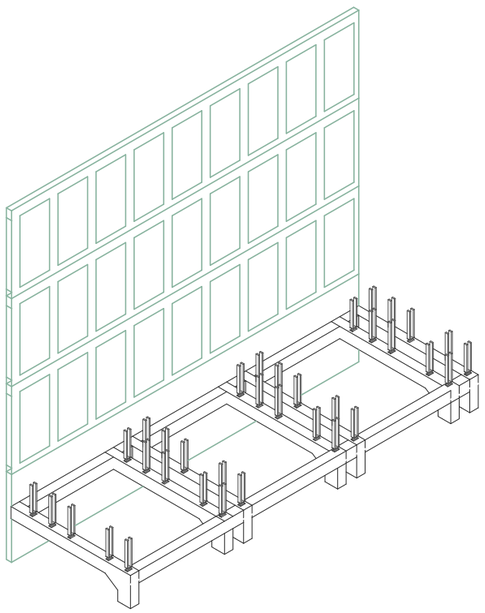
2

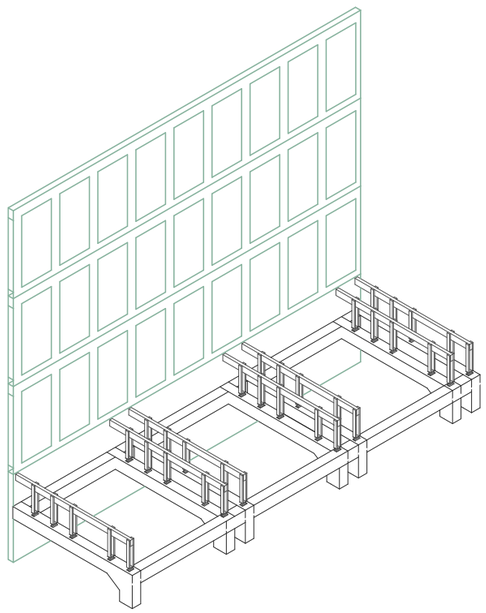
1

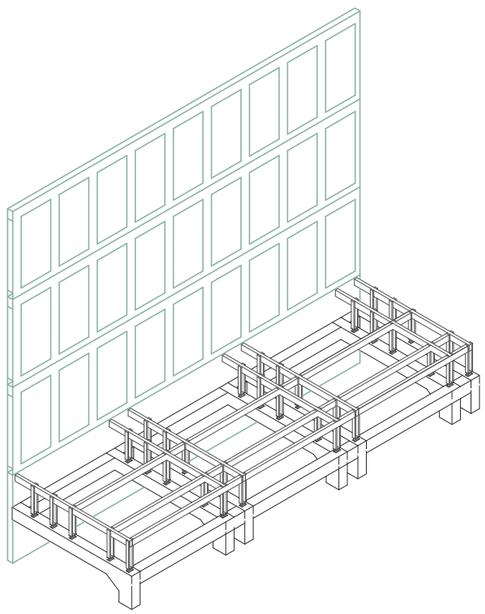
1.Separating membrane
70mm XPS thermal insulation
35mmAMW acoustic miner al wool
8mm Resilient bars
2 laywers Acoustic plasterboard
interspersed with
Soundblocker membrane
2.Acoustic sealant

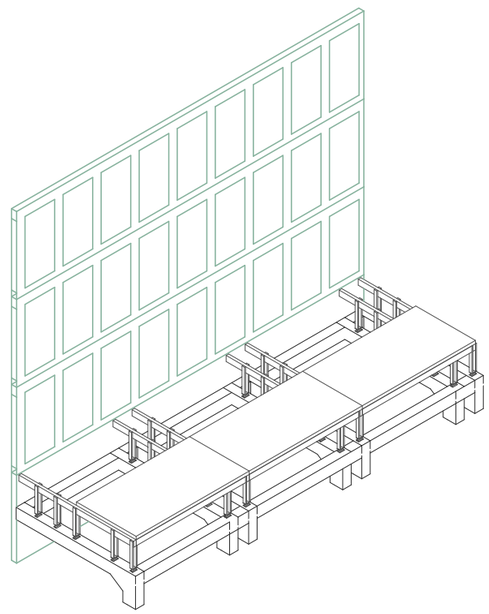
Structure

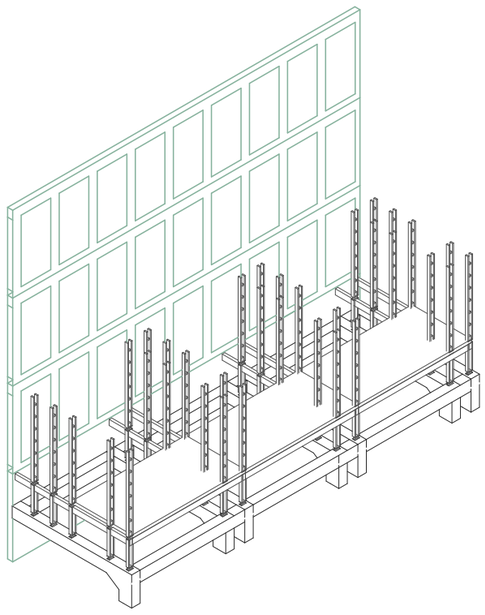


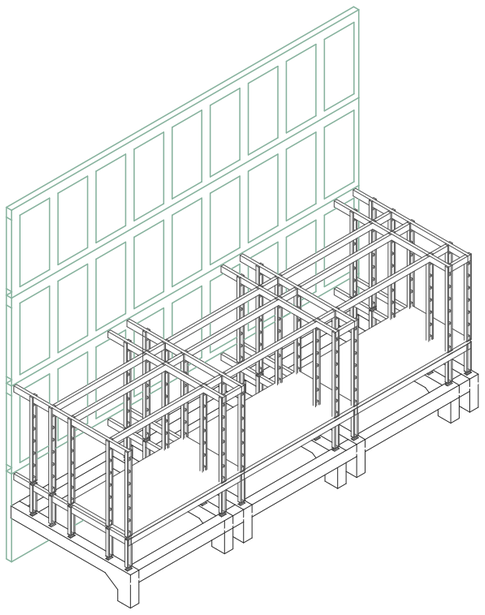


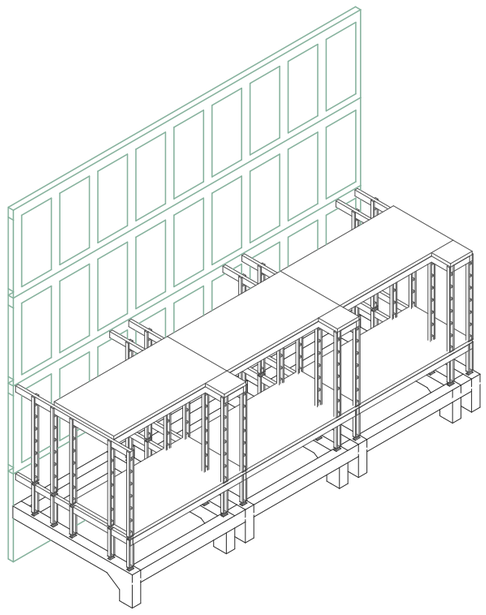


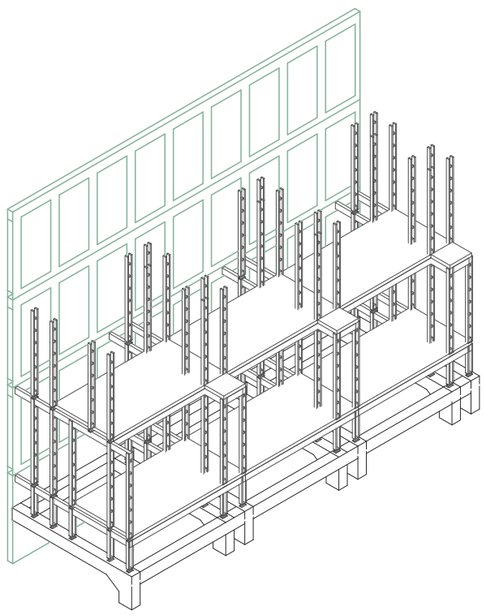


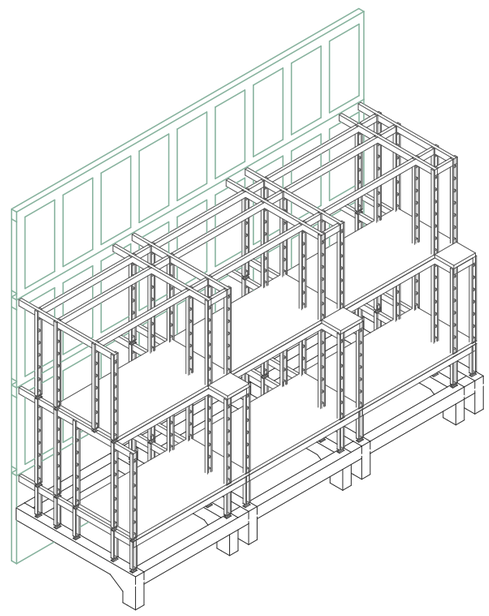


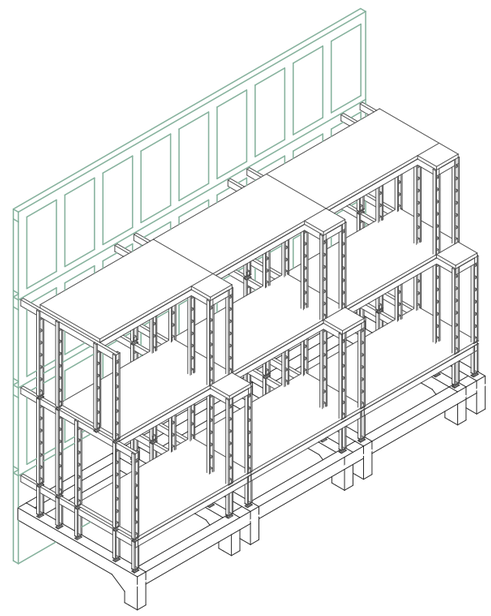












Thank you!