



AMC



URBAN FARM

City Recovery Garden

- Integrate Urban Farm into the AMC Amsterdam

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28 May 2019, TU Delft

CONTENT



INTRO

Renovation of the AMC



PROBLEM

Future challenges for the AMC



OBJECTIVE

Changing position & identity



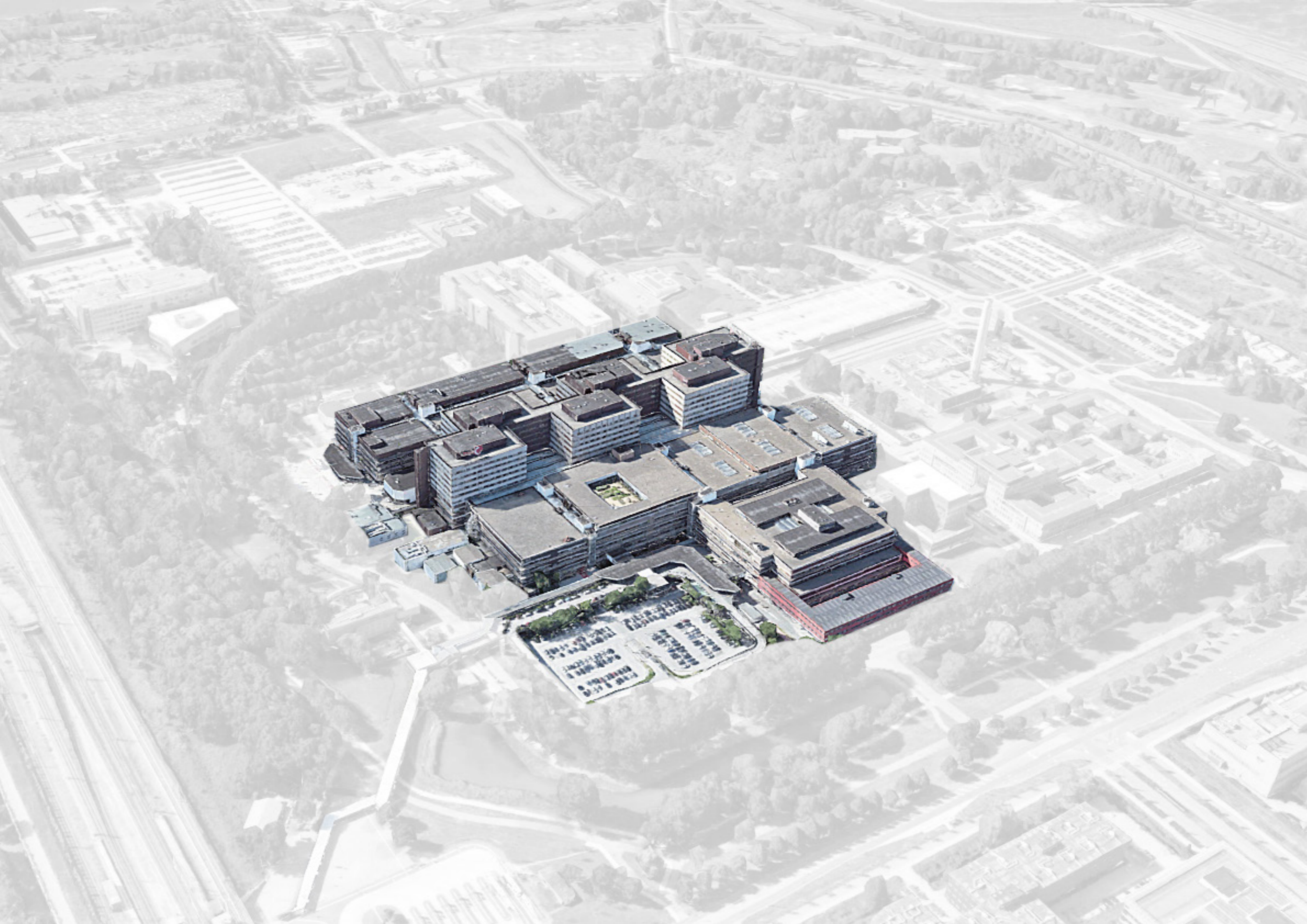
RESEARCH

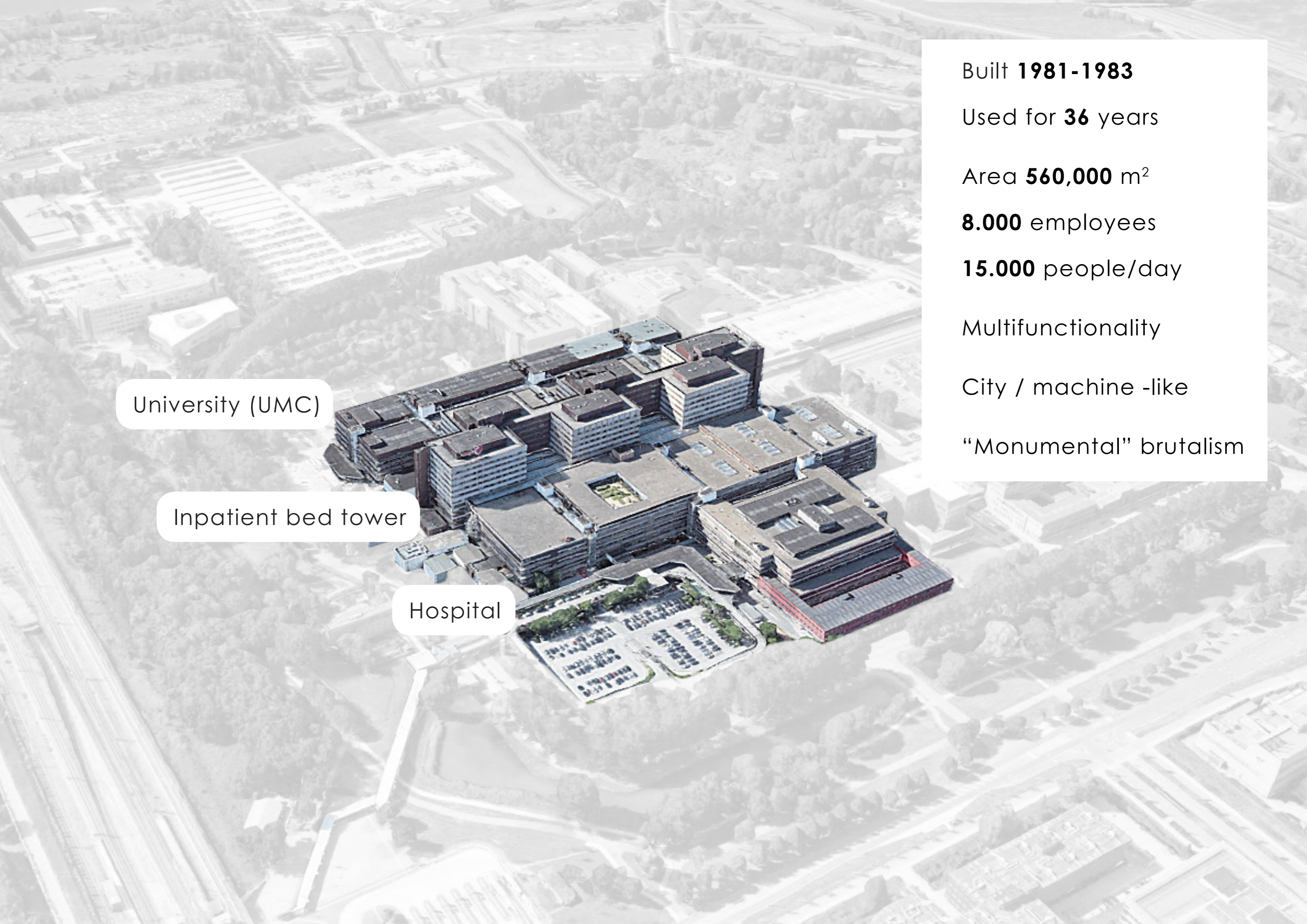
Flow & urban farming



DESIGN

Space, technique, climate





University (UMC)

Inpatient bed tower

Hospital

Built **1981-1983**

Used for **36** years

Area **560,000** m²

8.000 employees

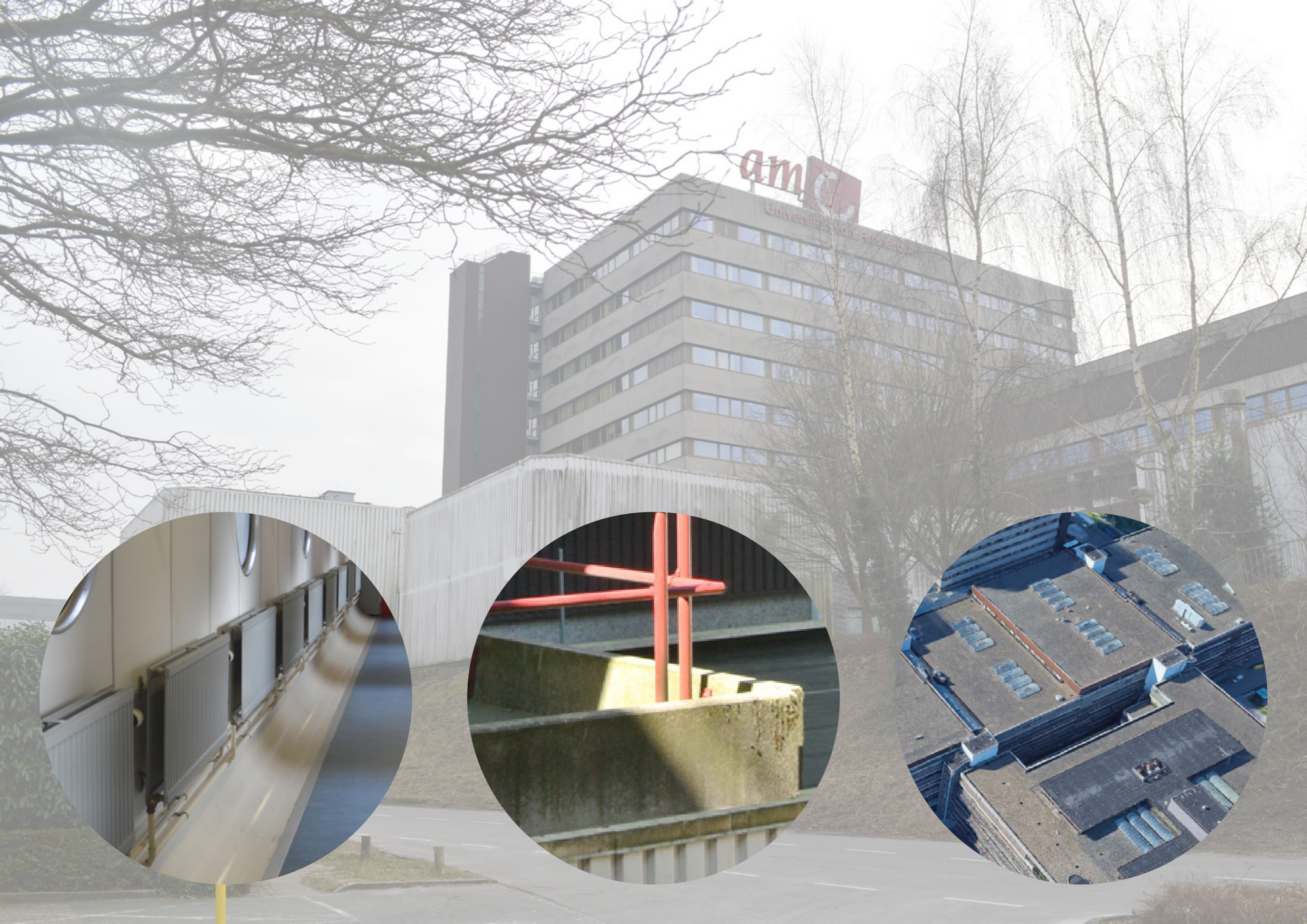
15.000 people/day

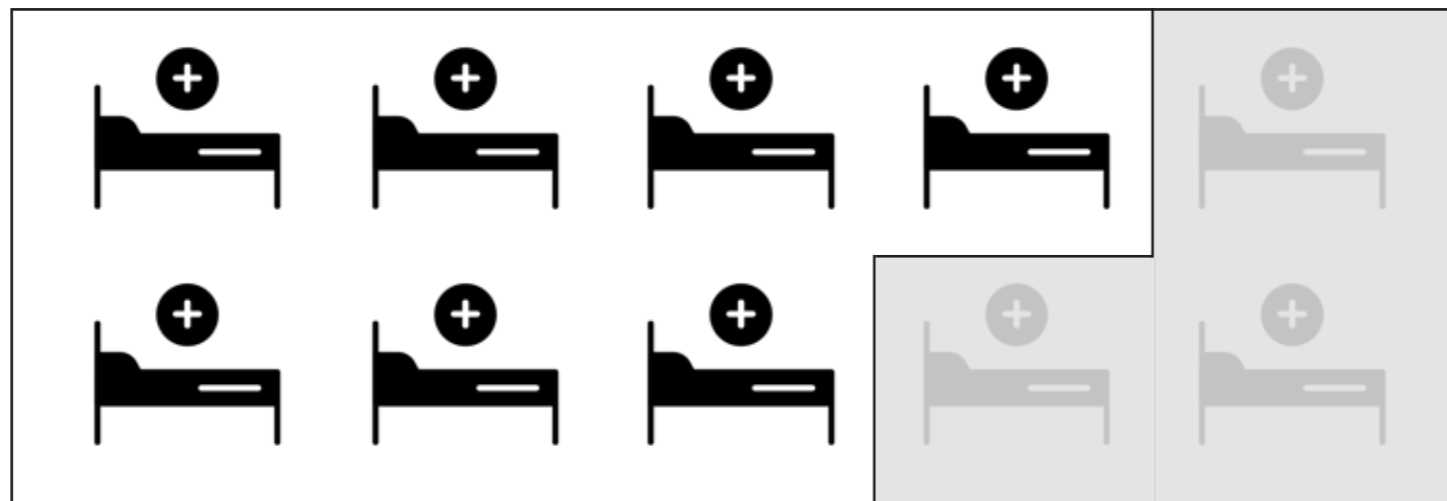
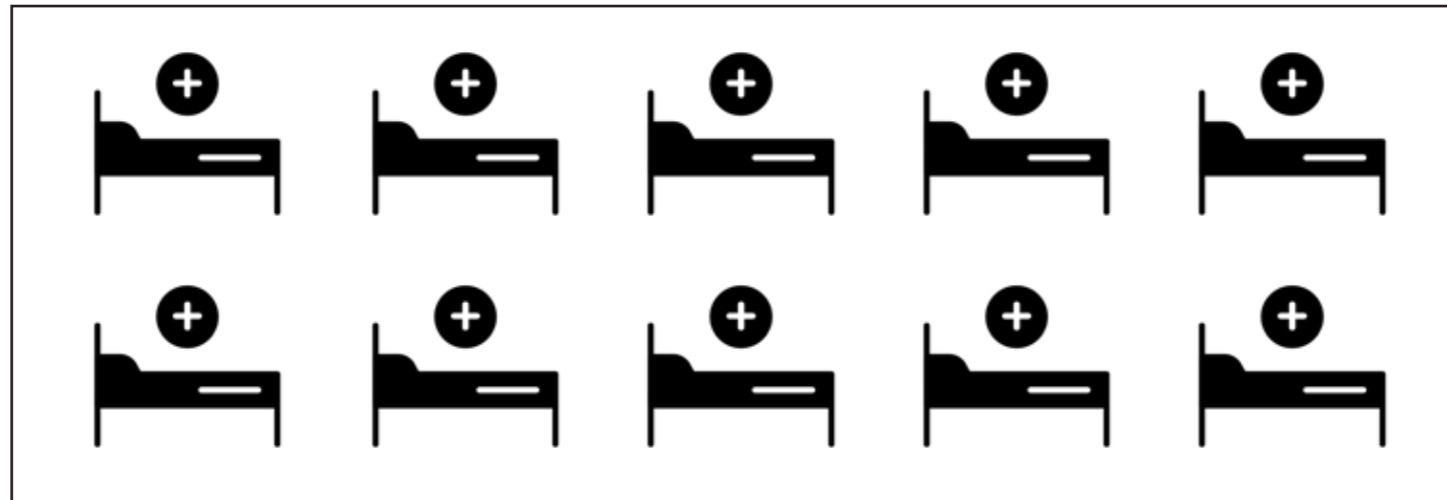
Multifunctionality

City / machine -like

“Monumental” brutalism







Number of beds
decreased
from 1000 to 700

AMC IS **SHRINKING**



Dr. Emile Comans

Lower

- 1) Average length of stay &
- 2) Bed occupancy rate

in

Acute care hospitals



OVERALL TREND OF SHRINKING

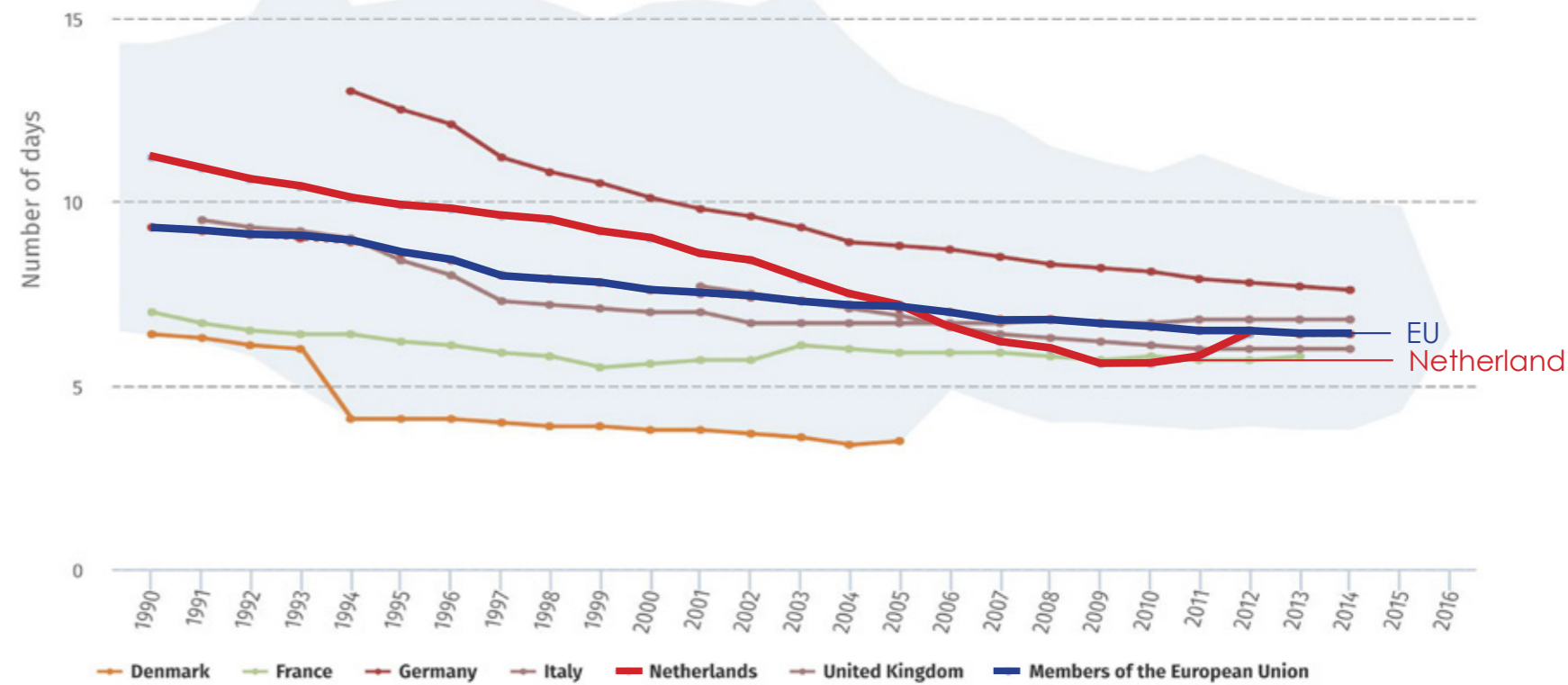


Figure 1. Average length of stay in acute care hospitals (WHO, 2018)

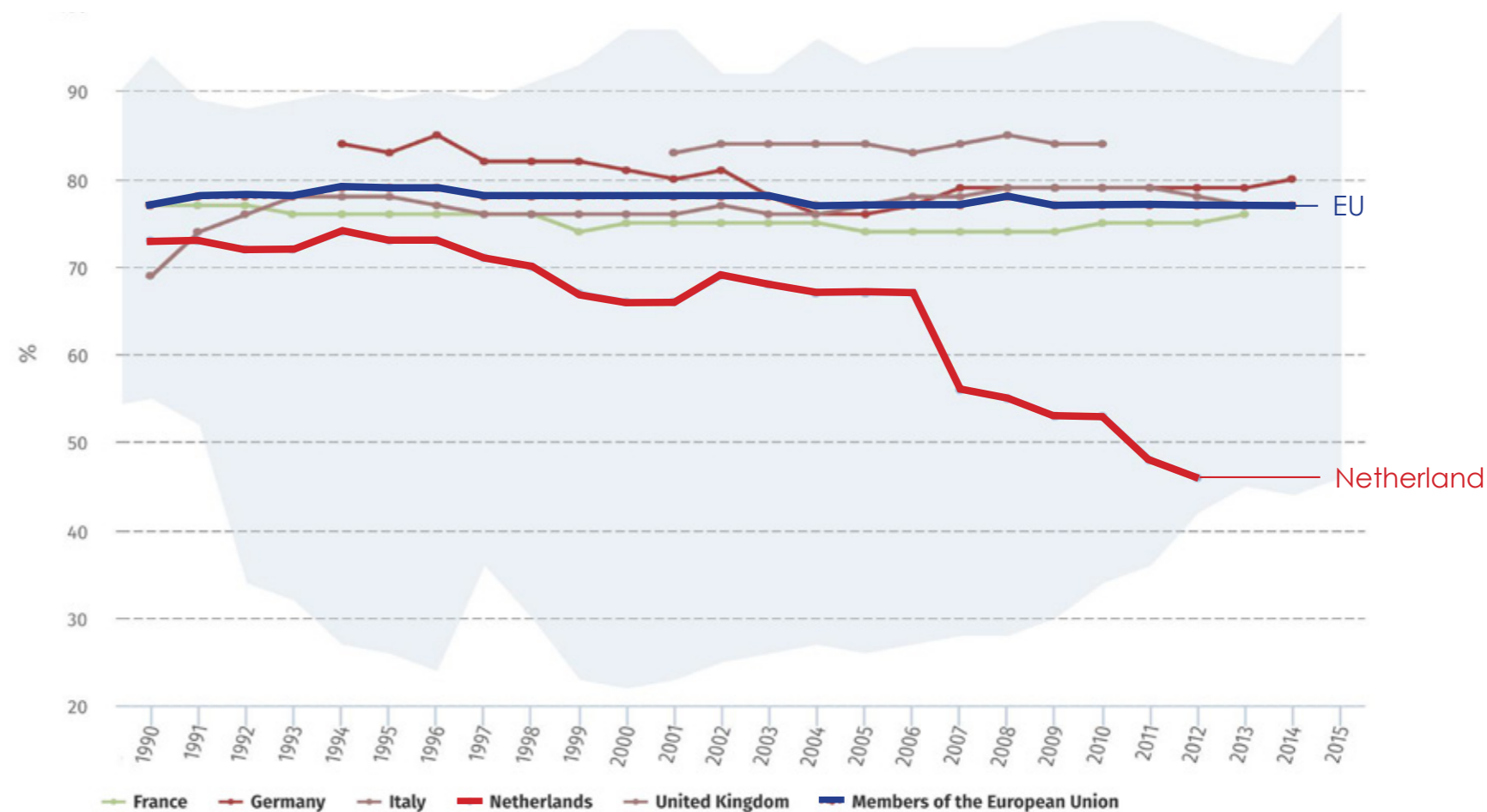


Figure 2. Bed occupancy rate in acute care hospitals (WHO, 2018)

CHANGING MEDICAL MODE



Traditional

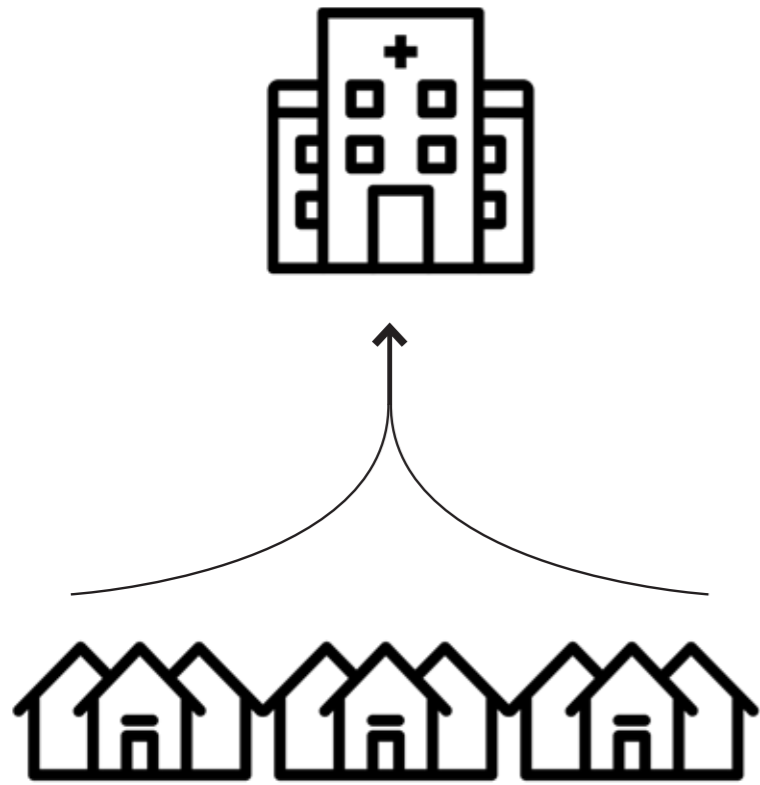


New

“Over **70%** consultations take place **online**” (Lambert, 2016)

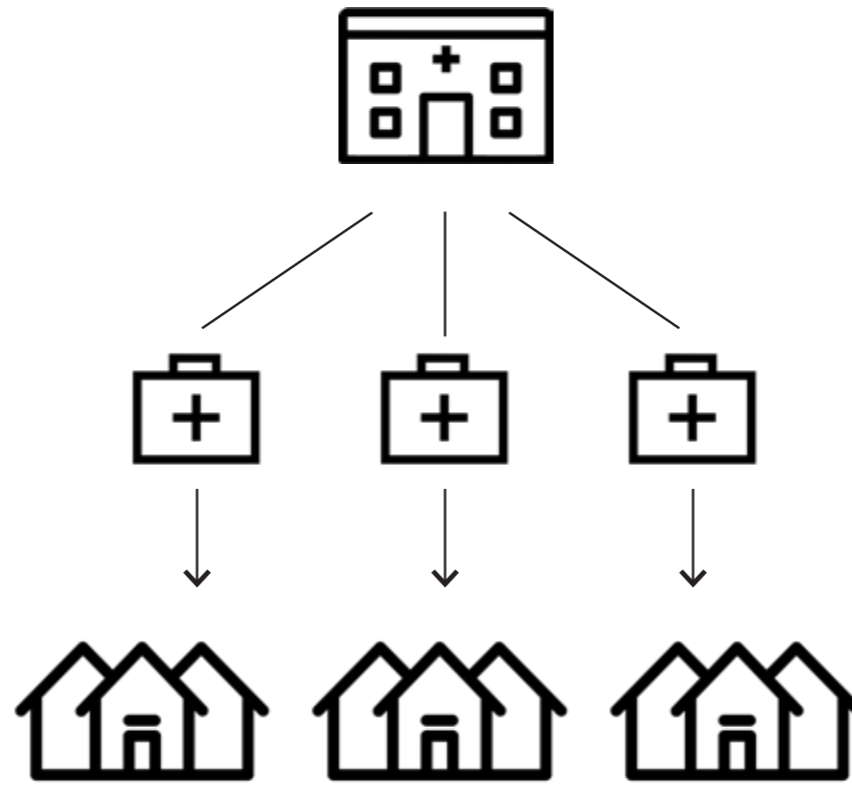
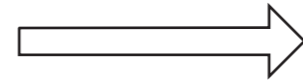


FUTURE OF HOSPITALS



Traditional

centralized, exclusive, territorial

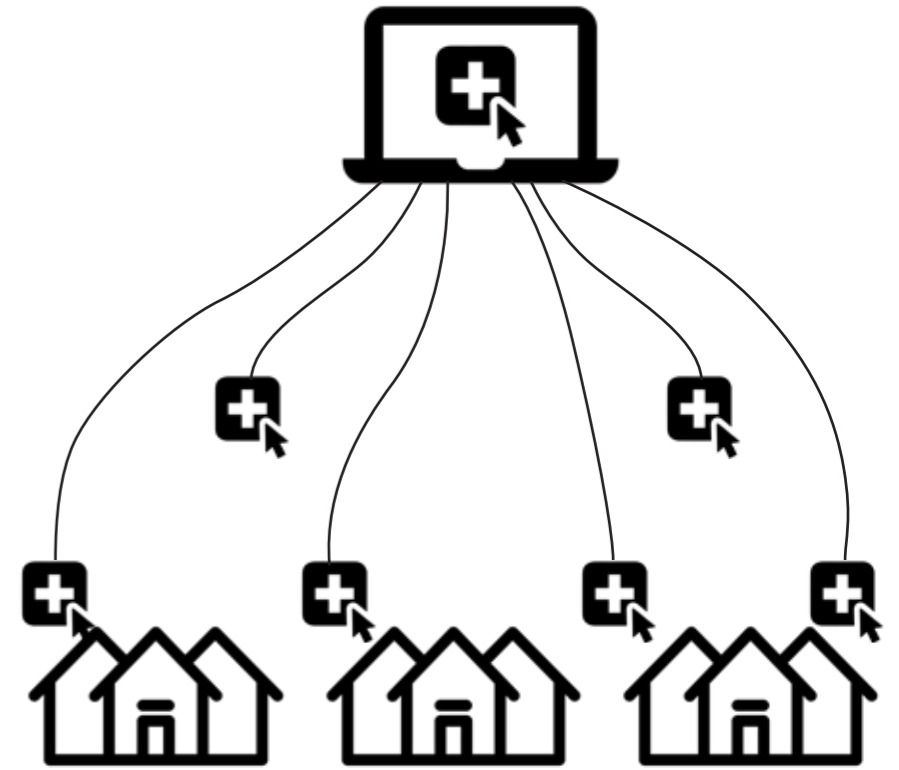


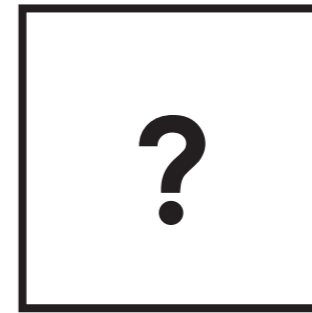
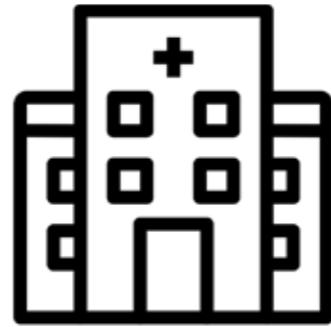
New

separated, shared, remote (E-health)



Hospitals: shrinking in size







“Medical care only account for **10%** of health outcome.”

WIDEN SCOPE OF HEALTH

Medical Treatment



Health awareness & Illness prevention



70% affected by Human behaviour, social environment & physical environment (food, etc.) (Stewart, 2016)



Pit

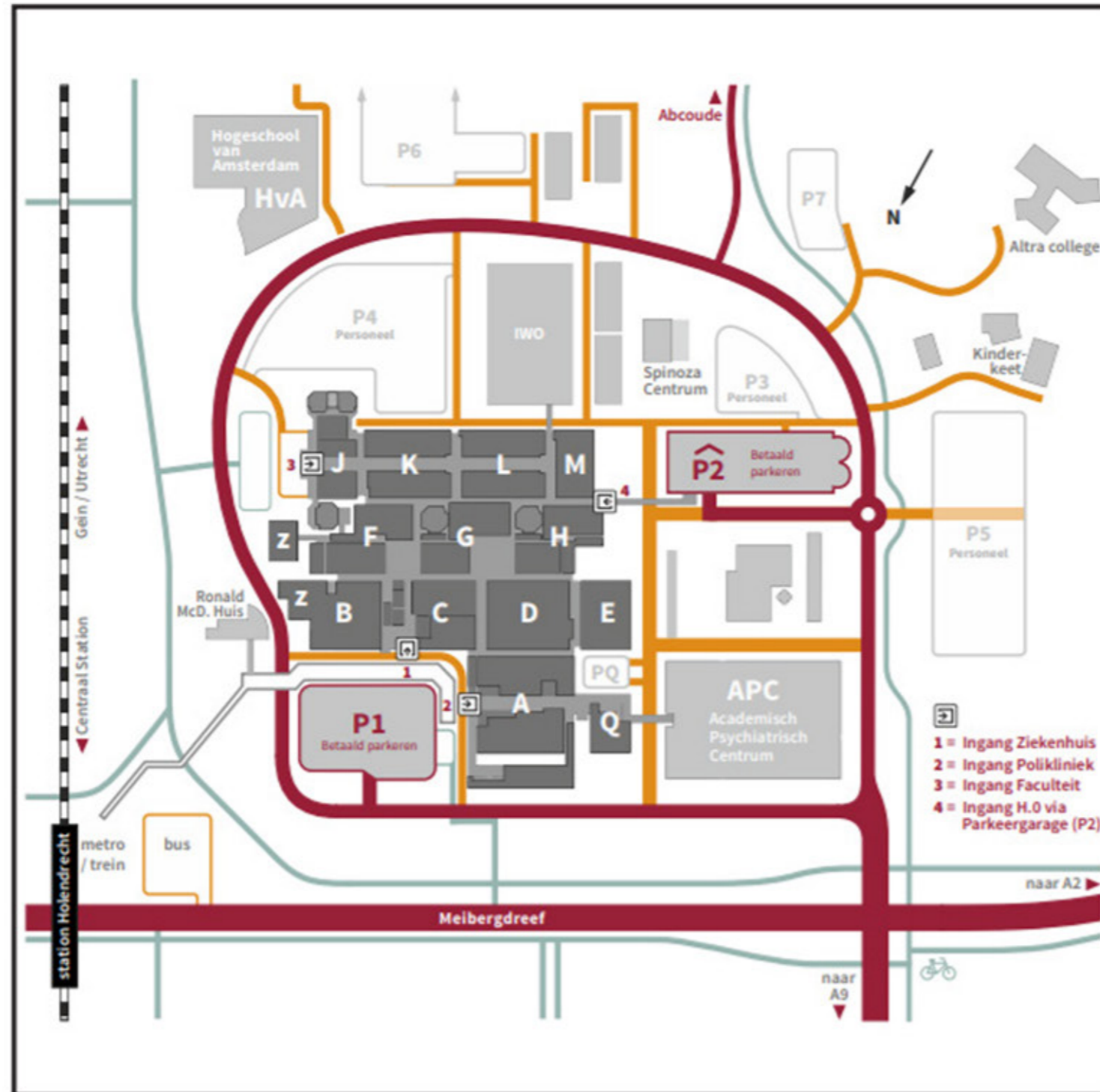
Food Co

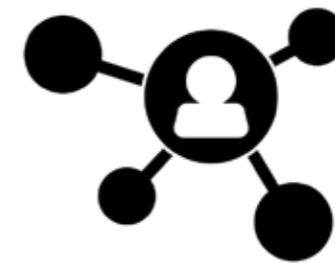
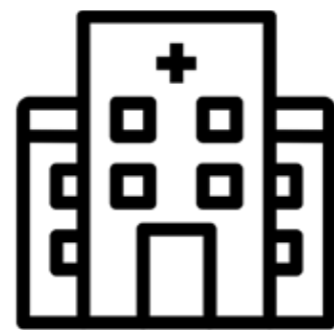
Deli

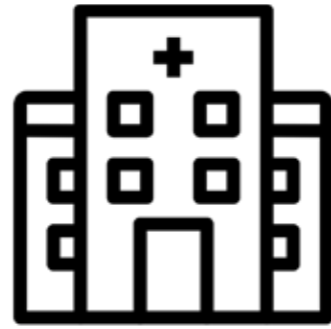
AH to go

Starbucks

Dominated by car







+



WHAT IS URBAN FARMING?

A cultivation practice in an urban environment, which involves growing or raising, processing and distribution of food and integrated into urban economy and ecology.

Urban farming = Farming in urban context



WHY URBAN FARMING IN HOSPITALS?

HEALTH



URBAN FARMING

HOSPITAL

“People involved in a community garden were **3.5 times** more likely to take enough vegetables and fruits daily as recommended.”

(Alaimo et al., 2008)

“A healthy dietary pattern is pivotal for prevention of **obesity** and **chronic diseases**

(van Rossum et al., 2011)

“Notion of “**care farming**”: farms could be utilized to promote mental and physical health”

(Dessein, 2008)

“Better meals contribute to **speedier recovery**”

(Cioci, Oilvan & Pinzauti, 2016)



Name	Location	Form	Production	Area	Mission
Lankenau Medical Center ¹	Wynnewood, PA, USA	Open-air organic farm on campus	> 4,000 pounds since 2015	1/2 acre	Meals; “Learning laboratory”
Cancer Treatment Center of America ²	Phoenix, AZ, USA	On-site conventional farmland	Cover 90% of its menu locally	43 acres	Feed patients; Open to visitors
St. Joseph Mercy Health System ²	Ypsilanti, MI, USA	Farmlands + 2 hoop houses	Not given	25 acres	Market; Meals; Events; Retreats; Education; Therapy
Henry Ford West Bloomfield Hospital ^{2,3}	Bloomfield Twsp, MI, USA	Hydroponic Greenhouse	Not given	1,500 ft ²	Patient meals; Cafe; Market; Education; Events; Public tours
Island Hospital ²	Anacortes, WA, USA	Weekly farm stand	0 (Provided by local farmers)	Not given	Produce; Recipes; Nutrition tips; “Fresh to Go” bags
University of Vermont Medical Center ²	Burlington, VT, USA	Rooftop garden (plots)	Not given 100% for menu	64 ft ² /plot	Education; Meals; Refuge from the hospital for long-term patients
Homestead Hospital ²	Homestead, FL, USA	Garden adjacent	30,000 pounds/year	10 acres	Meals; Education; Market
Boston Medical Center ⁴	Boston, MA, USA	Rooftop farm + 2 urban beehives	5,000 pounds / growing season	7,000 ft ²	Meals; Teaching kitchen
Mad River Community Hospital ⁵	Arcata, CA, USA	On-site vegetable garden + 2 greenhouses	Not given	Not given	Meals
Stony Brook University Hospital ⁶	Stony Brook, NY, USA	Rooftop garden shared by community gardens	> 550 pounds / season	2,200 ft ²	Meals; view

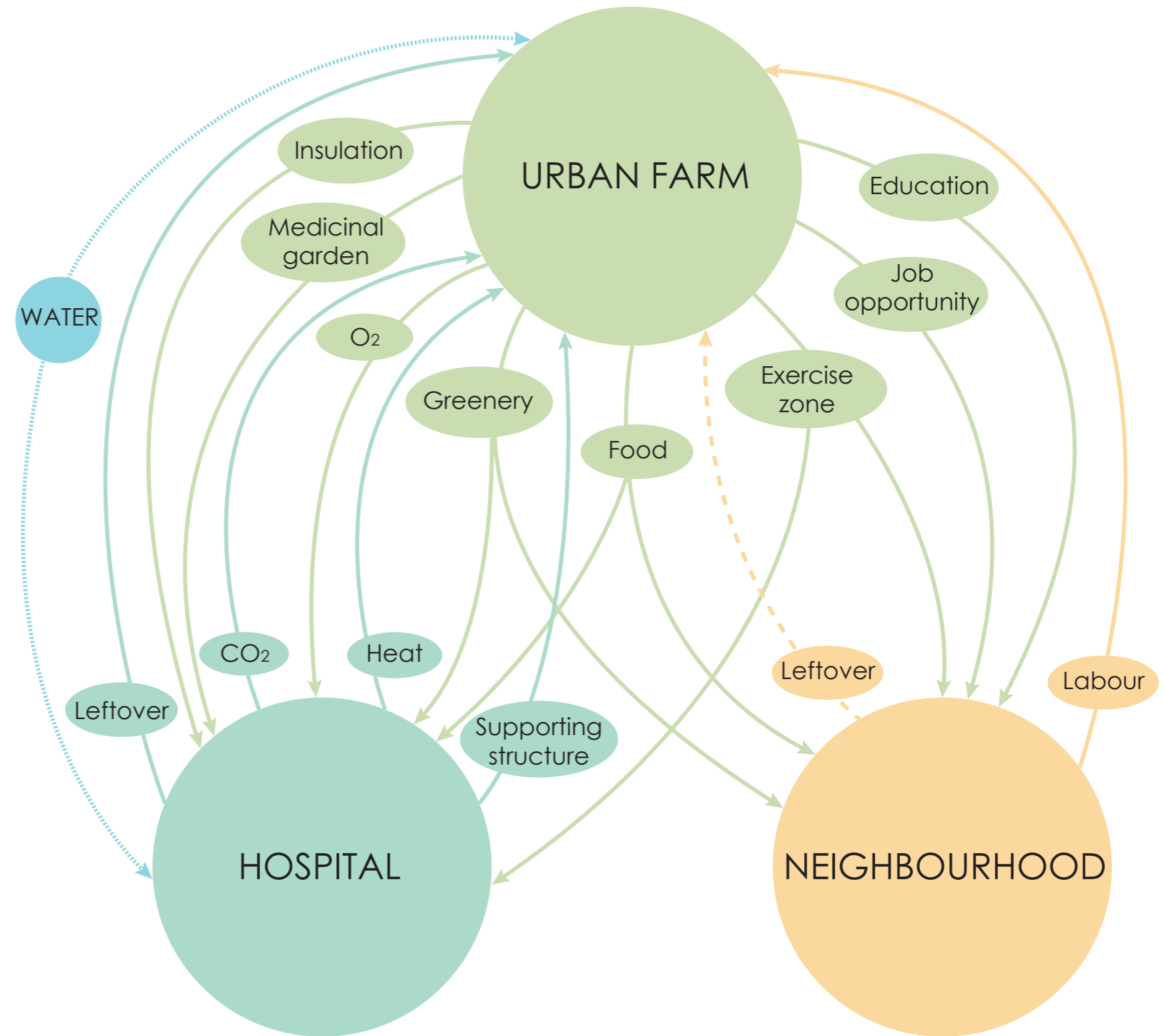


PROVIDE

- Healthy food
- Recreational space
- Green scenery
- Extra insulation
- Shading
- ...

PROMOTE

- Healthy diet pattern
- Healthy lifestyle
- Circulation
- Connection with public
- Neighbourhood involvement
- ...






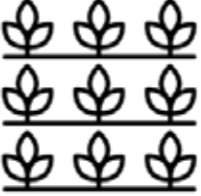
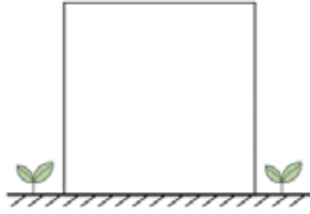
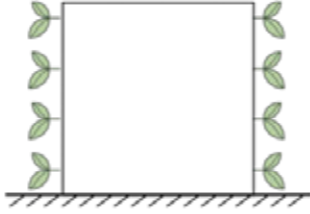
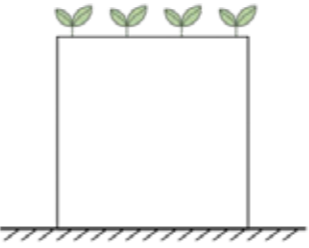








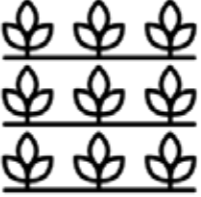


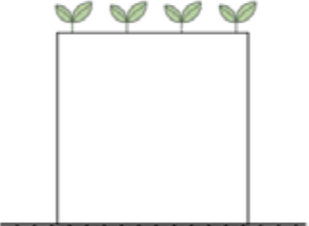

**HOW WILL URBAN FARMS PHYSICALLY
INFLUENCE HOSPITALS?**

RESOURCE FLOWS IN URBAN FARMING & HOSPITALS

Sub questions:

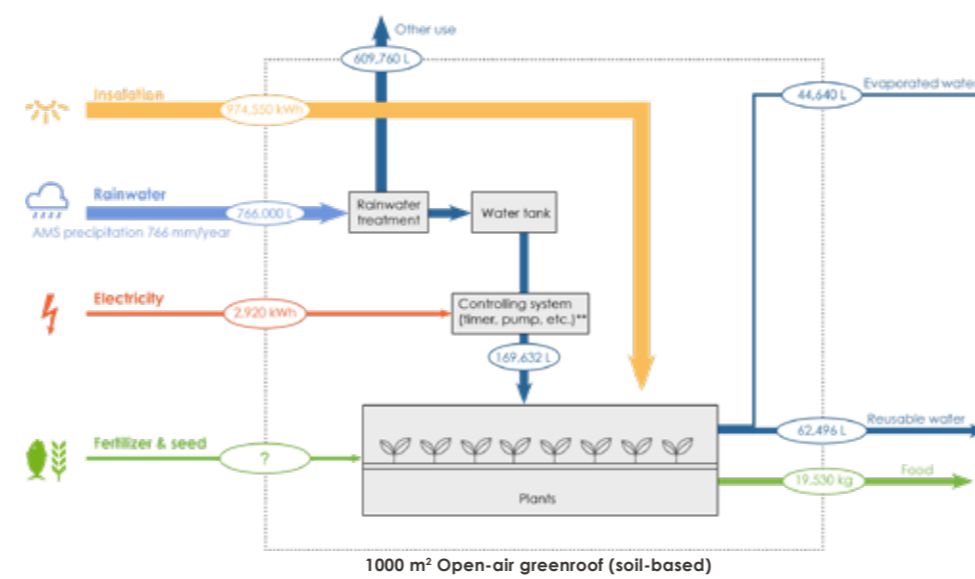
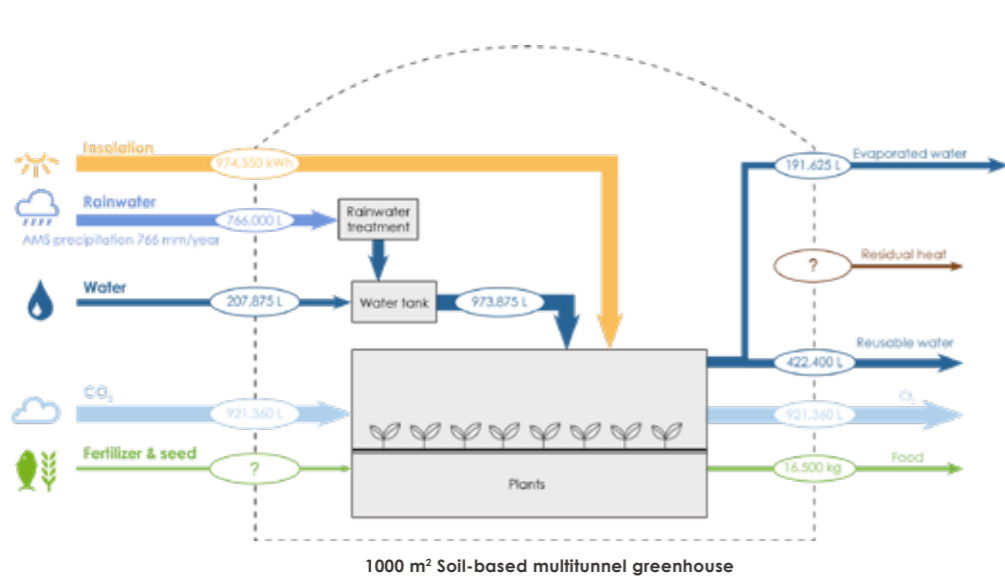
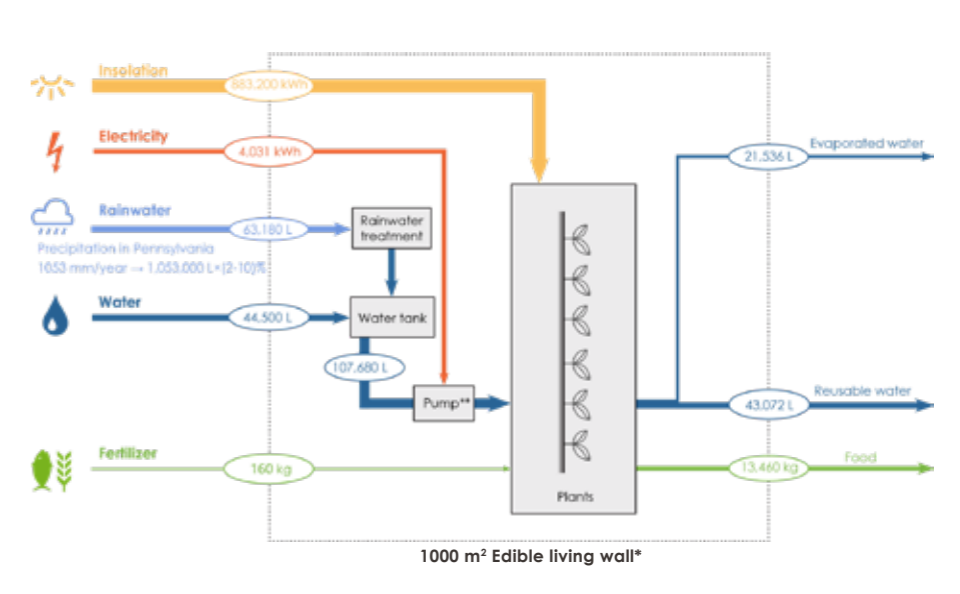
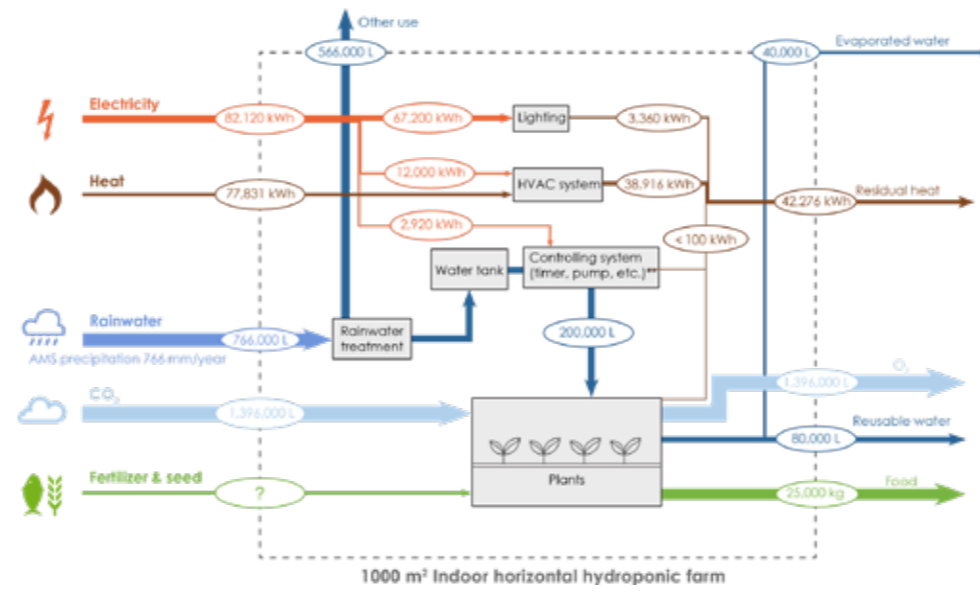
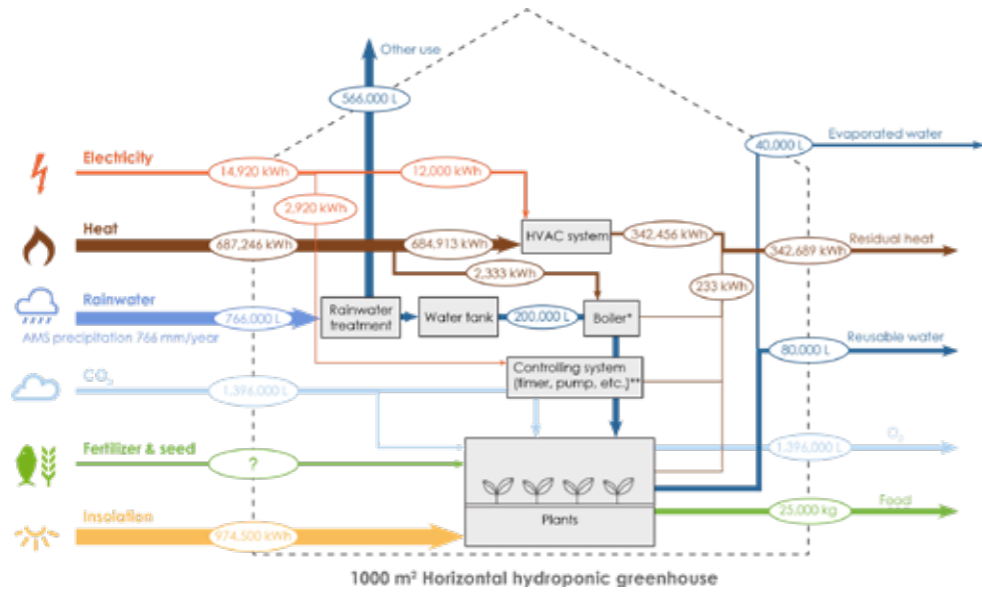
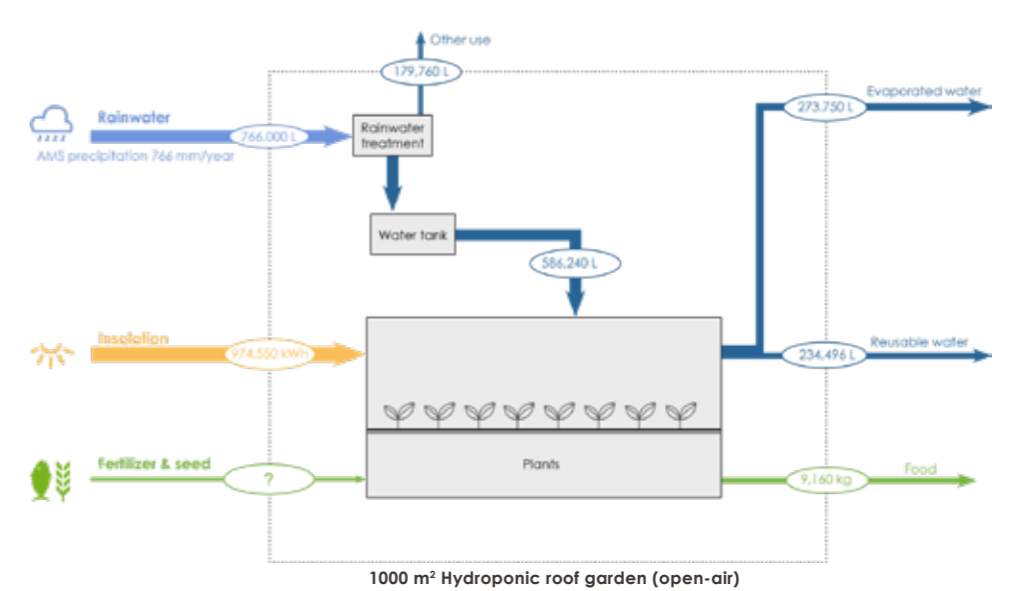
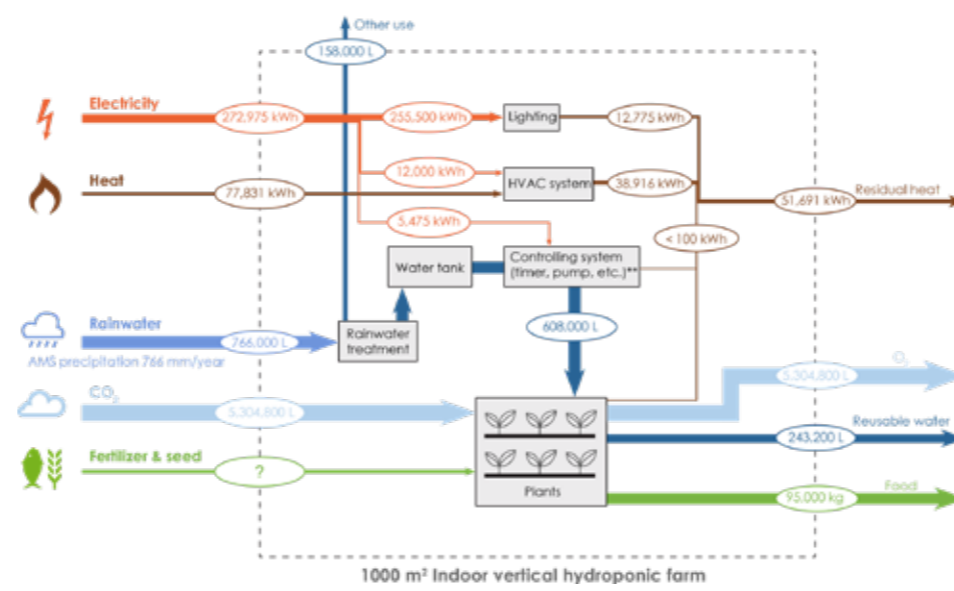
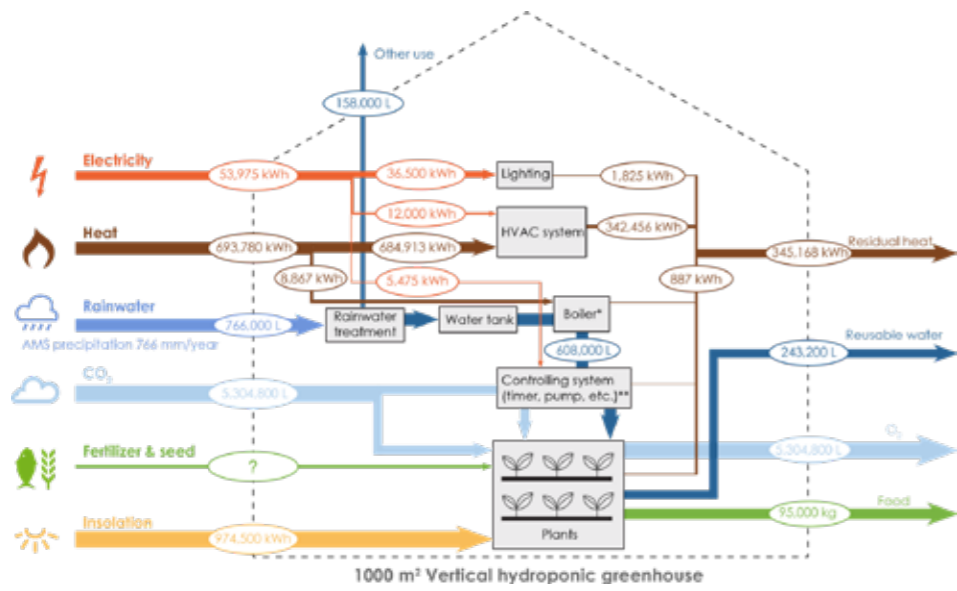
- 1) What are the available urban farming technologies at present?
- 2) What are the flows in these possible types of urban farm?
- 3) What are the flows in hospitals (case: current flows in the AMC)?
- 4) How can urban farming optimize the flows in hospitals?
- 5) What are the involved technologies?
- 6) Specifically in the AMC, what technologies are feasible and where to employ?

Control	 <p>Open-air</p>		 <p>Greenhouse (CEA)</p>	
Cultivation	 <p>Soil-based</p>		 <p>Hydroponics</p>	
Plant pattern	 <p>Horizontal</p>		 <p>Vertical</p>	
Location	 <p>Ground</p>	 <p>Facade</p>	 <p>Roof</p>	 <p>Interior</p>






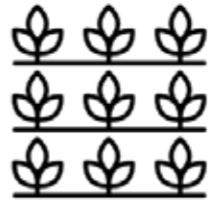
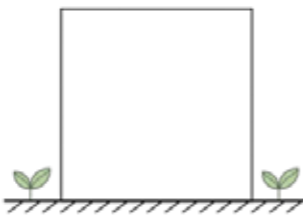
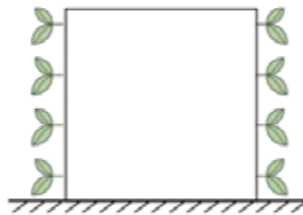
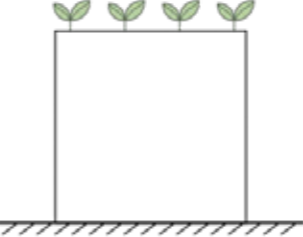

Control	 Open-air A1	 Greenhouse (CEA) A2		
Cultivation	 Soil-based B1	 Hydroponics B2		
Plant pattern	 Horizontal C1	 Vertical C2		
Location	 Ground D1	 Facade D2	 Roof D3	 Interior D4

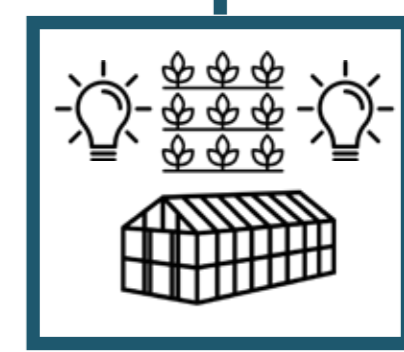
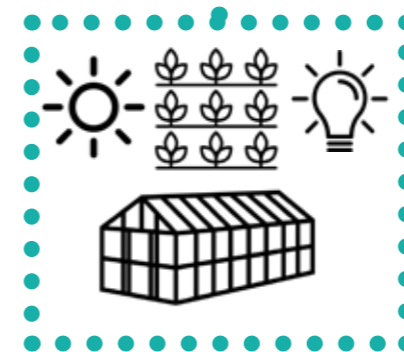
	CEA*	Non - CEA
Soil-based	- Multitunnel greenhouse A2 B1 C1 D1	- Open-air greenroof A1 B1 C1 D3
Soilless	- Vertical Greenhouse A2 B2 C2 D3	- Hydroponic roof garden A1 B2 C1 D3
	- Indoor vertical farm A2 B2 C2 D4	- Edible living wall A1 B2 C2 D2
	- Horizontal Greenhouse A2 B2 C1 D3	
	- Indoor horizontal farm A2 B2 C1 D4	

* Controlled Environment Agriculture technologies



Details in research paper

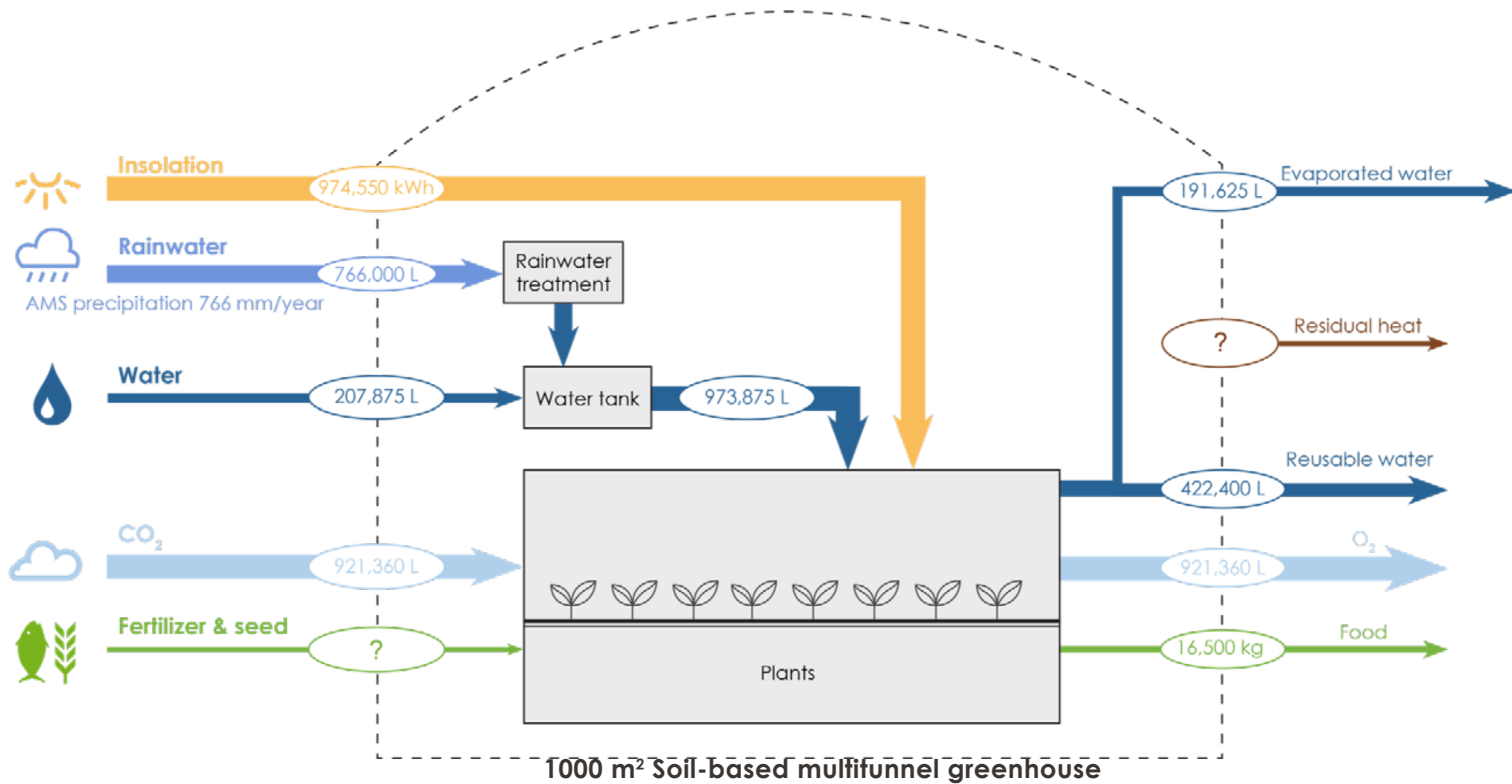
Control	 Open-air	 Greenhouse (CEA)		
Cultivation	 Soil-based	 Hydroponics		
Plant pattern	 Horizontal	 Vertical		
Location	 Ground	 Facade	 Roof	 Interior

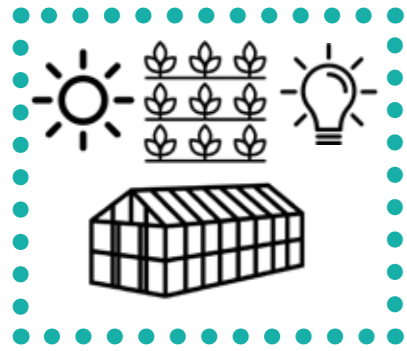




Traditional soil-based greenhouse

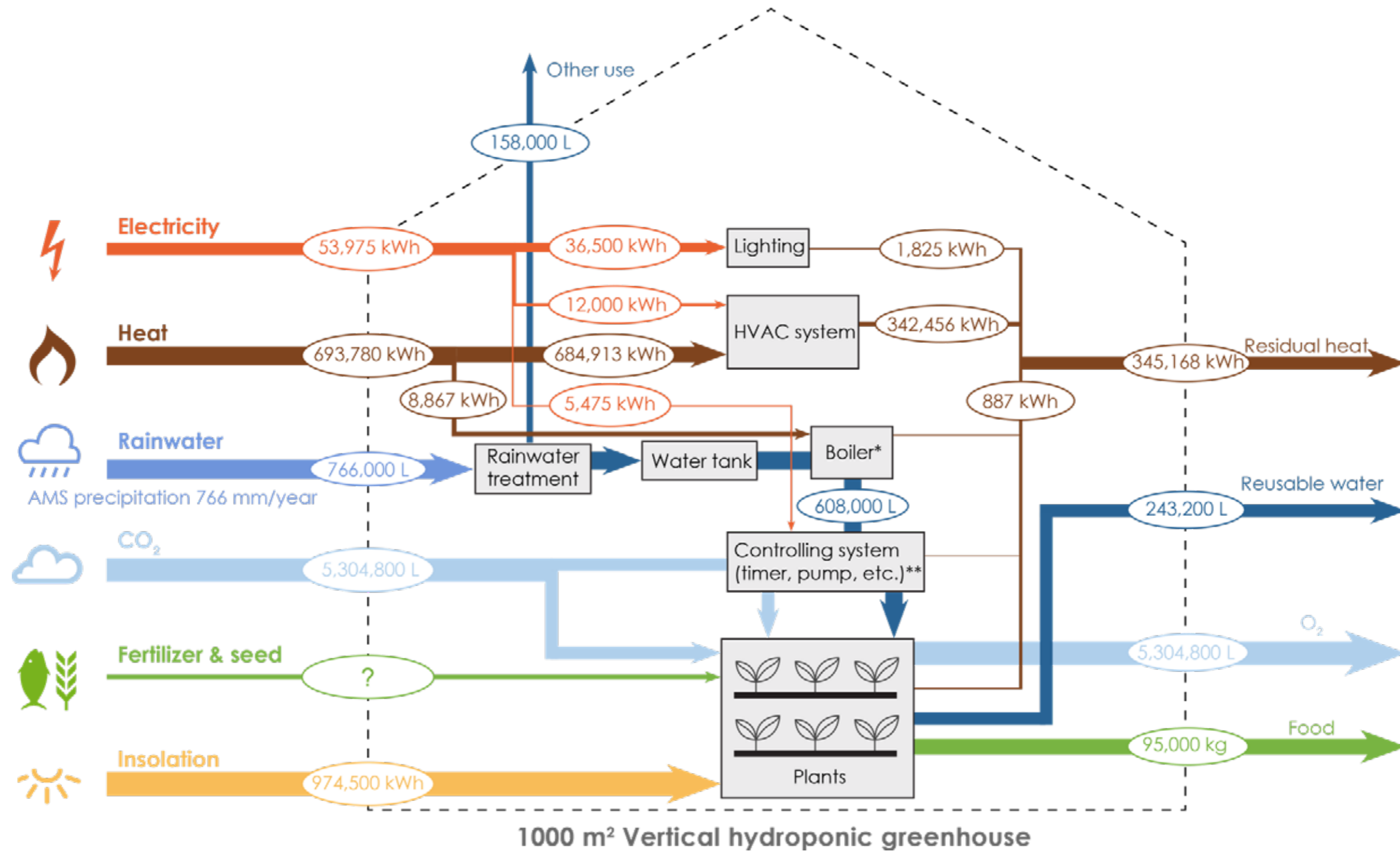
- Natural light
- Large water need
- Low-tech (suppose no electricity need)





Rooftop vertical hydroponic greenhouse

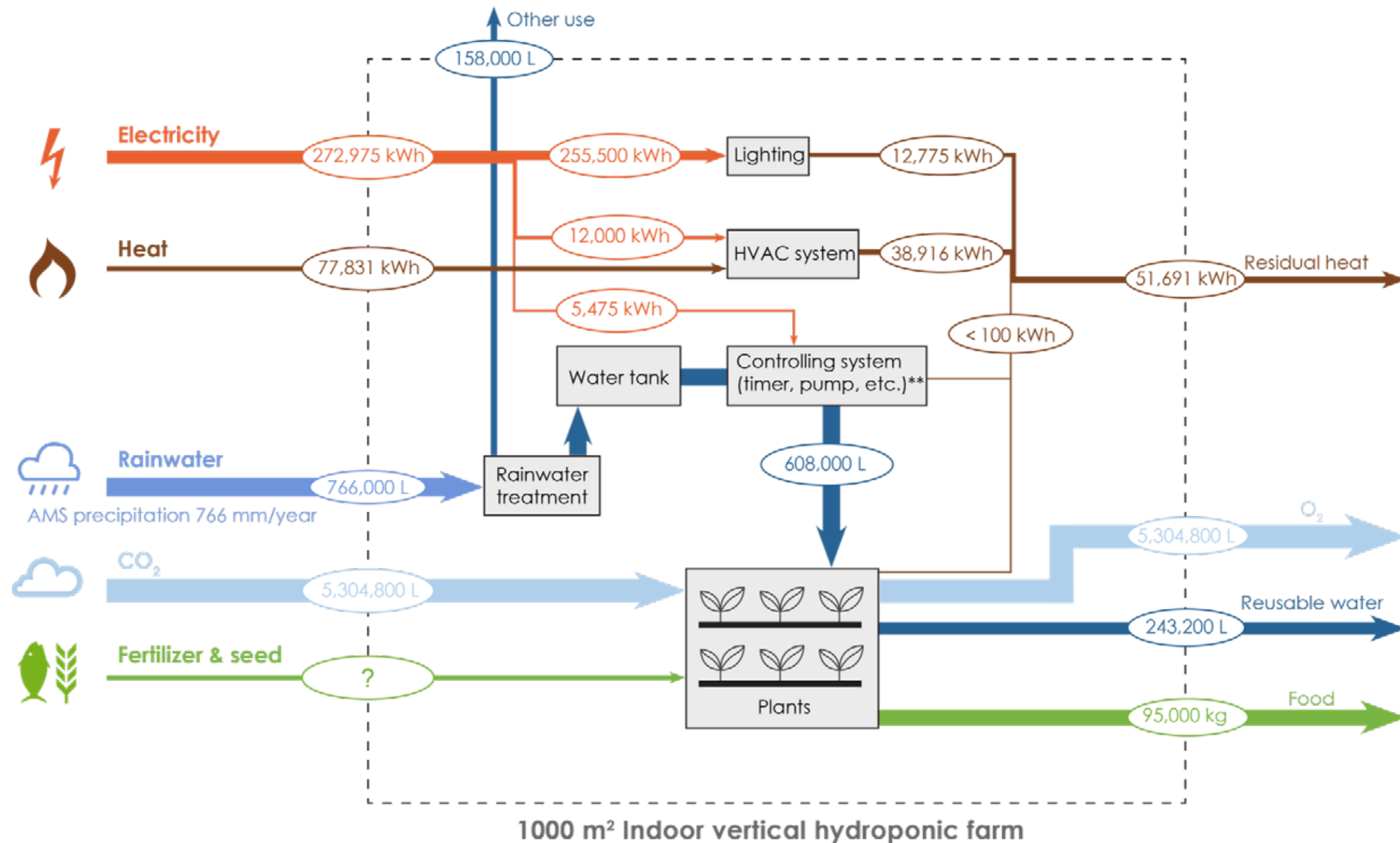
- Natural light + artificial light
- Large heat (& insulation) need
- High-tech (high productivity, high consumption)

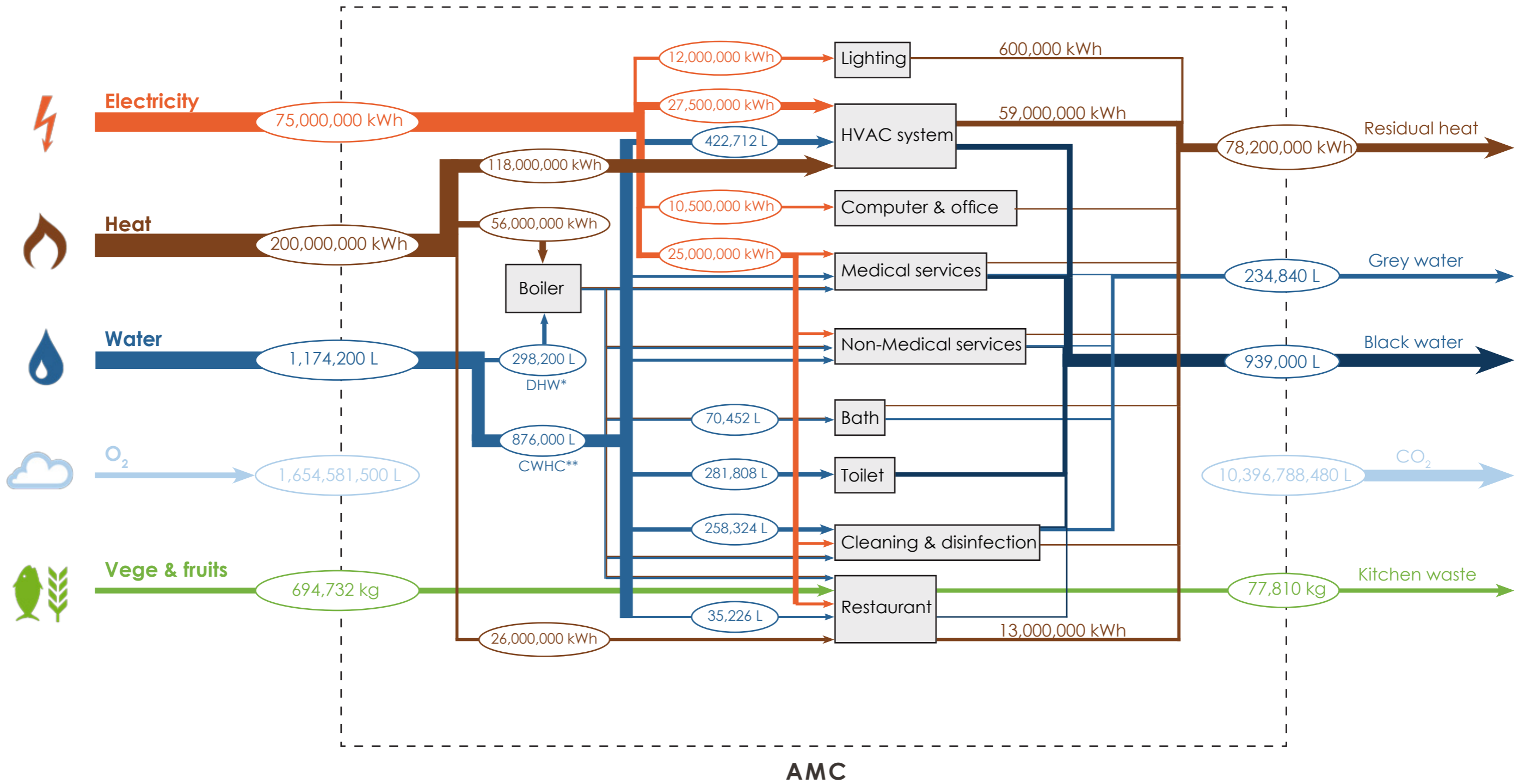




Indoor vertical hydroponic greenhouse

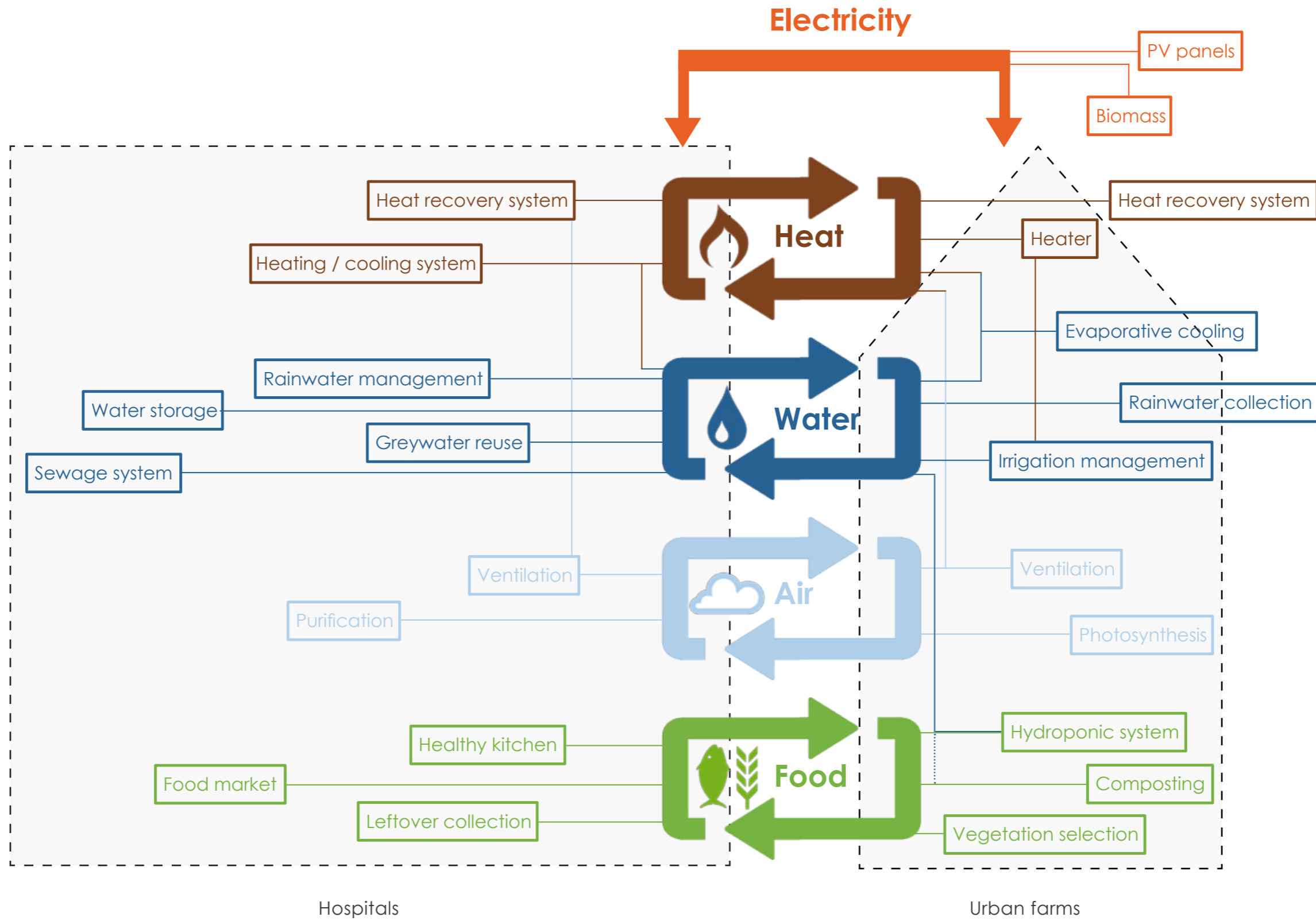
- Artificial light
- Insulated by building, heat from building users
- High-tech (high productivity, high consumption)

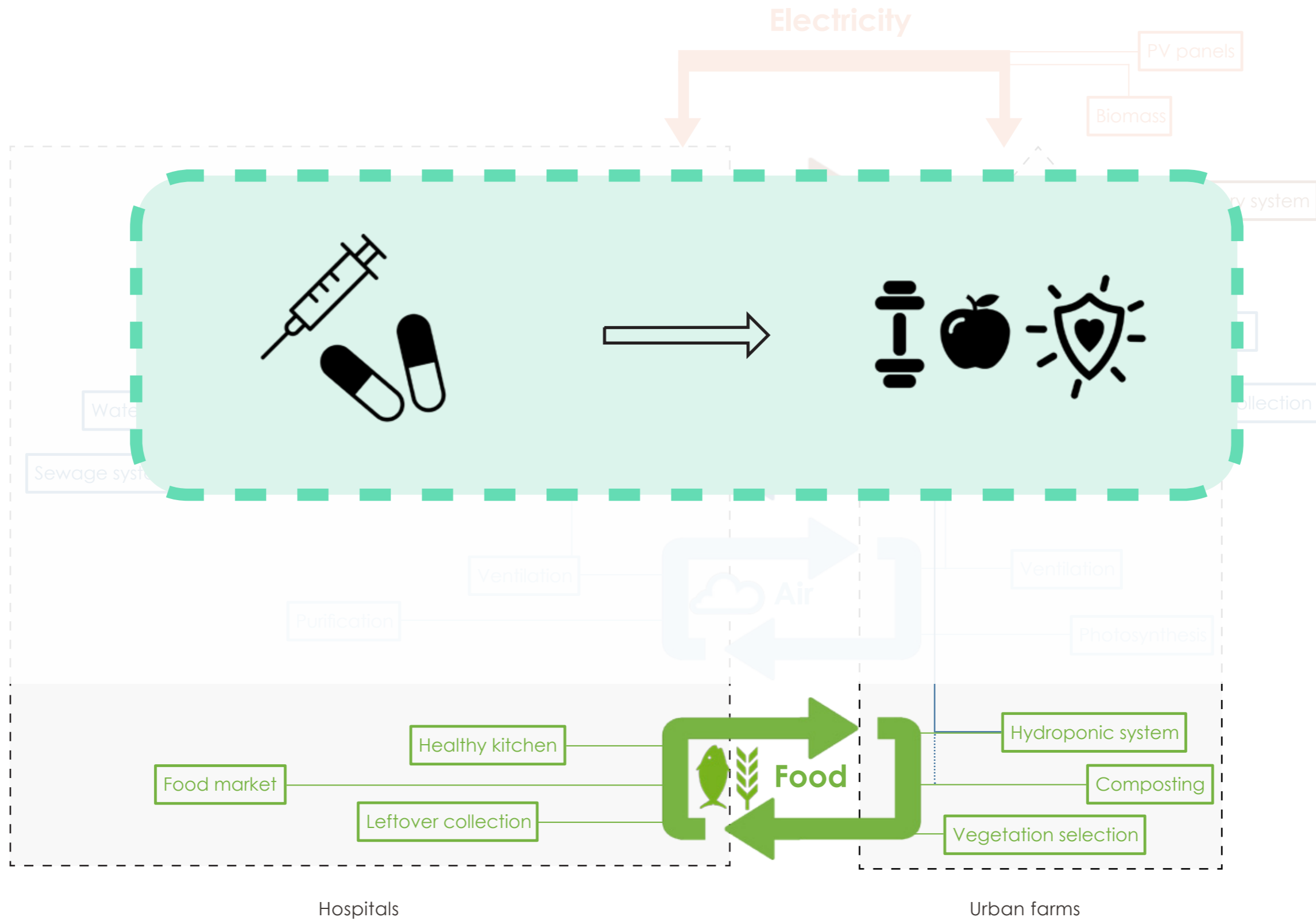




*DHW: domestic hot water

**CWHC: cold water for human consumption





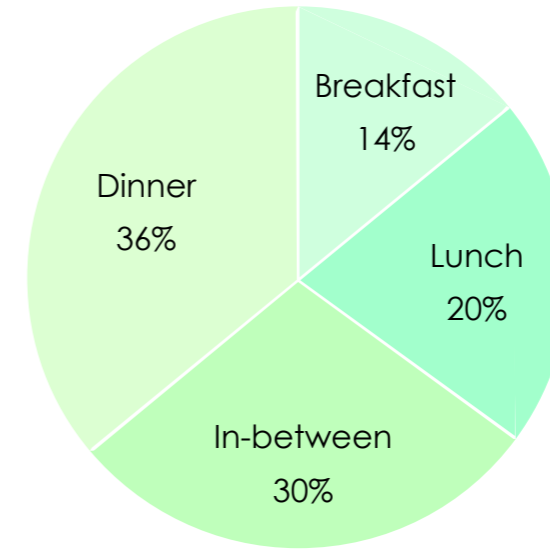


Vegetable
200g

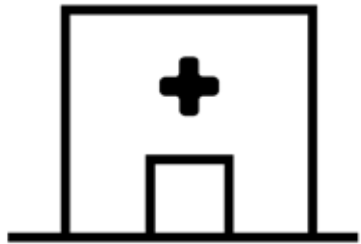


Fruit
200g

/person /day
suggested by Dutch Dietary Guidelines (2015)



MEAL
PROPORTION

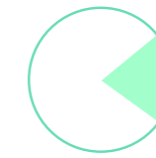
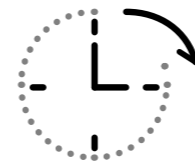


350,000 outpatient visit / year
open for 24h



Outpatient & visitor

< 4h



20%

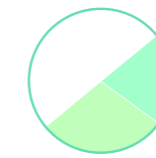
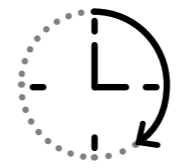


Over **7000** people work here
1,500 research staff
2,500 students
Weekday 9:00 a.m. - 17:00 p.m.



Staff & student

8h



50%

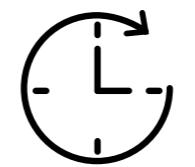


24 h wards
single; double; four-bed room
officially **1,002** beds
2,600 patients admitted / year



Inpatient

24h



100%

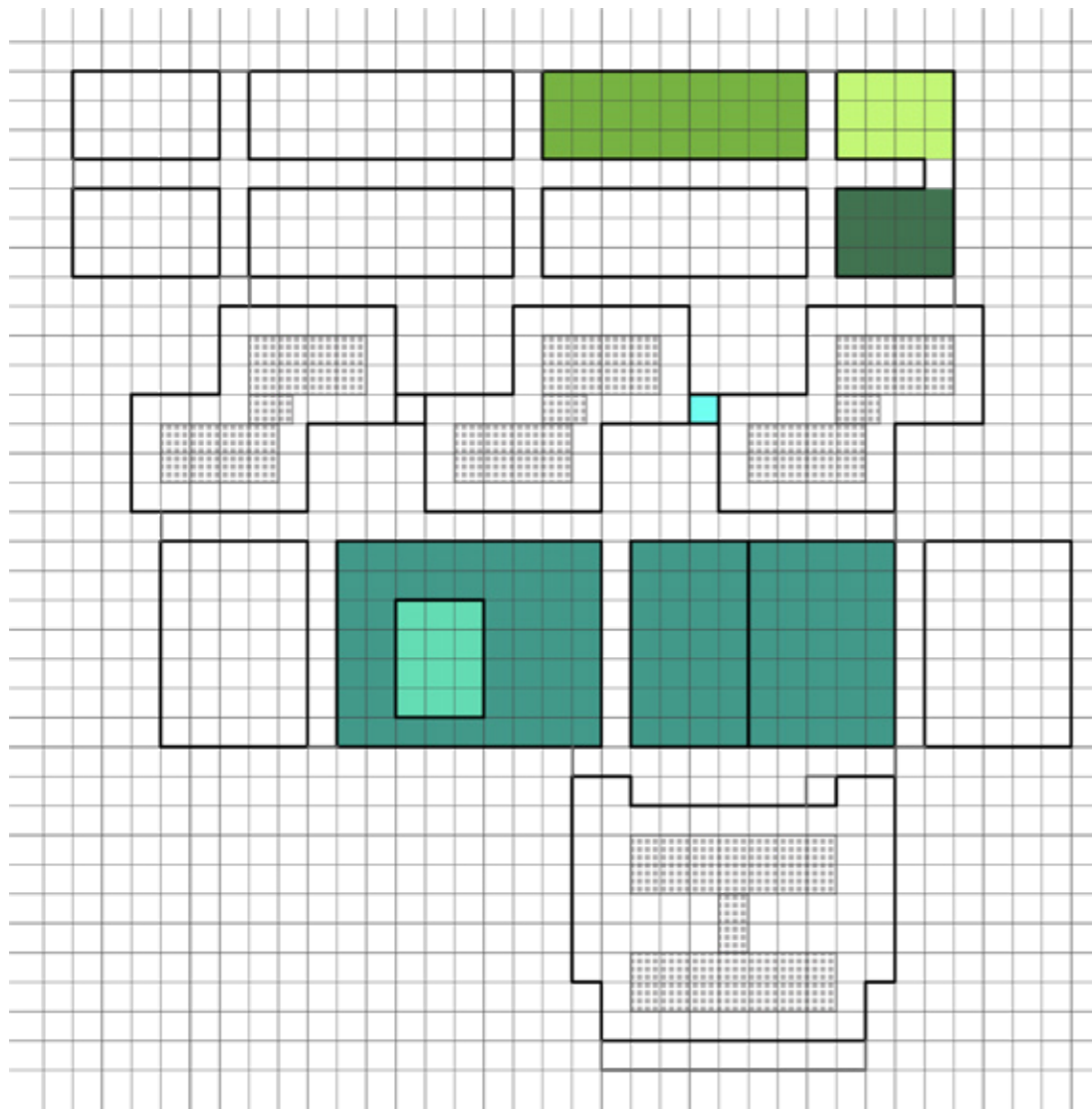
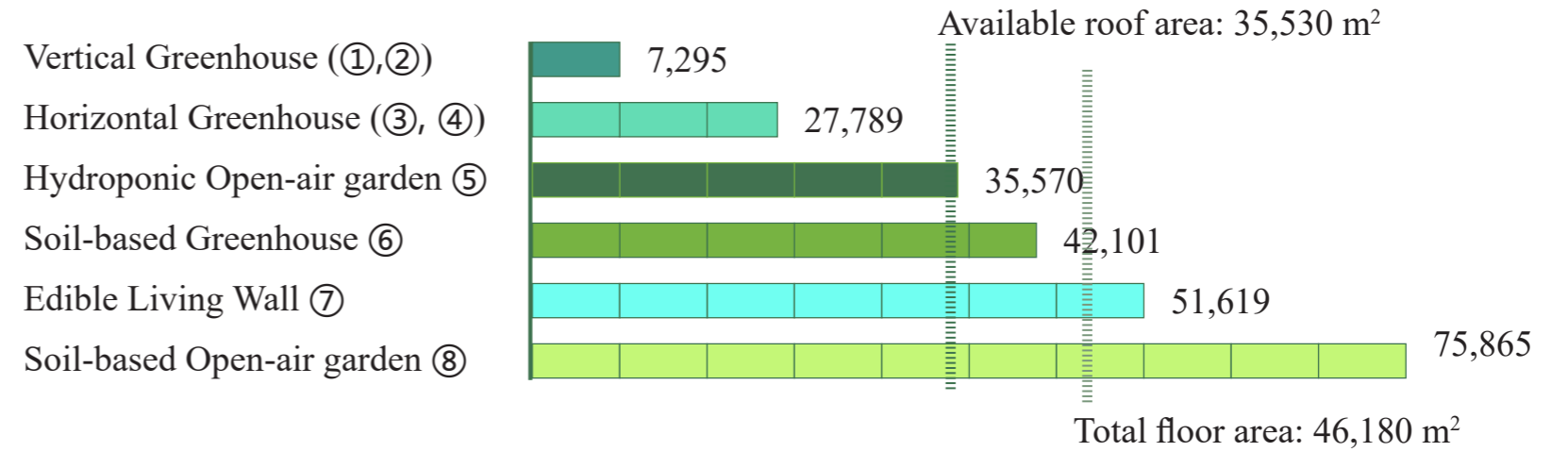


694,732 kg/year

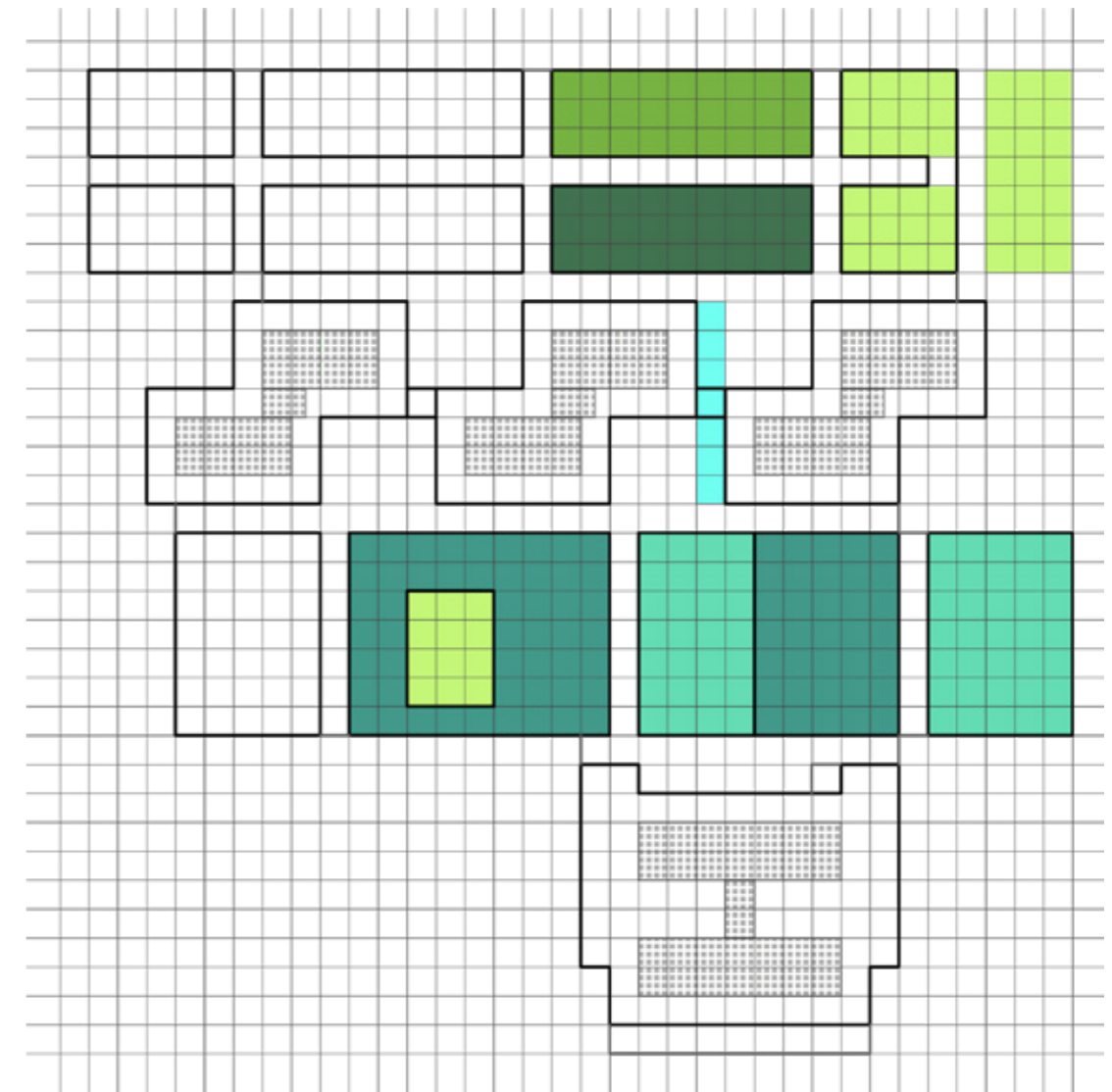
**FOOD DEMAND
IN THE AMC**

Yield	Hydroponic vertical greenhouse	95 kg/m ²	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5001193/
	Hydroponic horizontal greenhouse	25 kg/m ²	(Sanyé-Mengual et al., 2015)
	Soil-based multi-tunnel greenhouse	16.5 kg/m ²	
	Hydroponic rooftop open-air	19.53 kg/m ²	https://www.hb.edu/uploaded/Institute_for_21st_Century_Education/Sustainability/
	Soil-based (traditional)	9.16 kg/m ²	https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19920012131.pdf

Area need for food demand (694,732 kg) in the AMC (m²)



OPTIONS
for spatial
arrangement
of different
technologies



LOCATION

SITE

PROGRAM



SPACE




CONSTRUCTION

CLIMATE



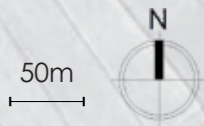
Amsterdam
Central Station

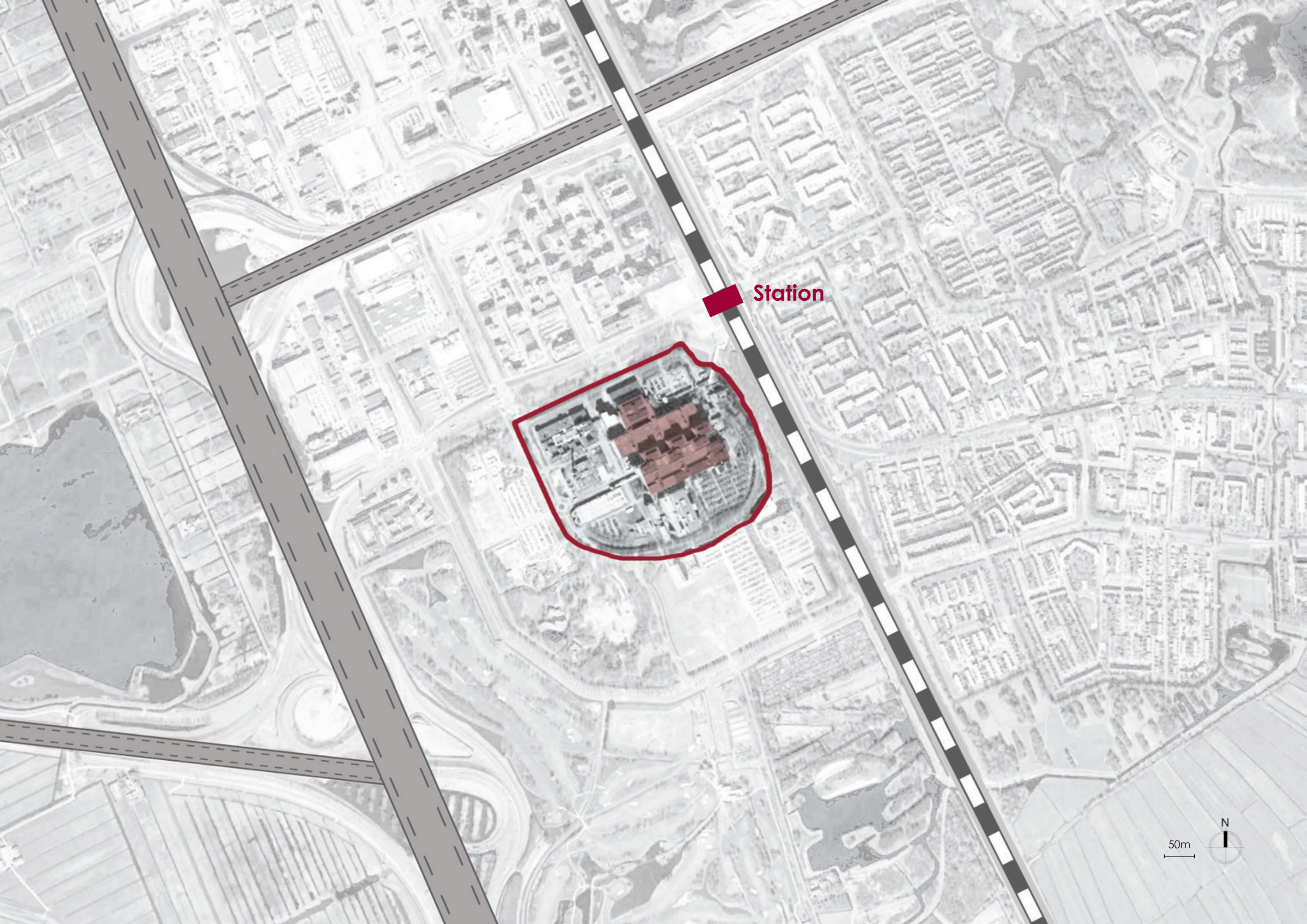
≈ 11.8 km

	40 min
	30 min
	25 min

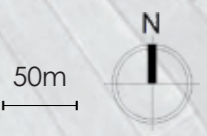

AMC







Station





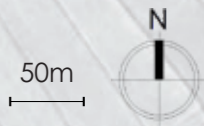
RESIDENCE + OFFICE



RESIDENCE



EDUCATION





No paved pedestrian



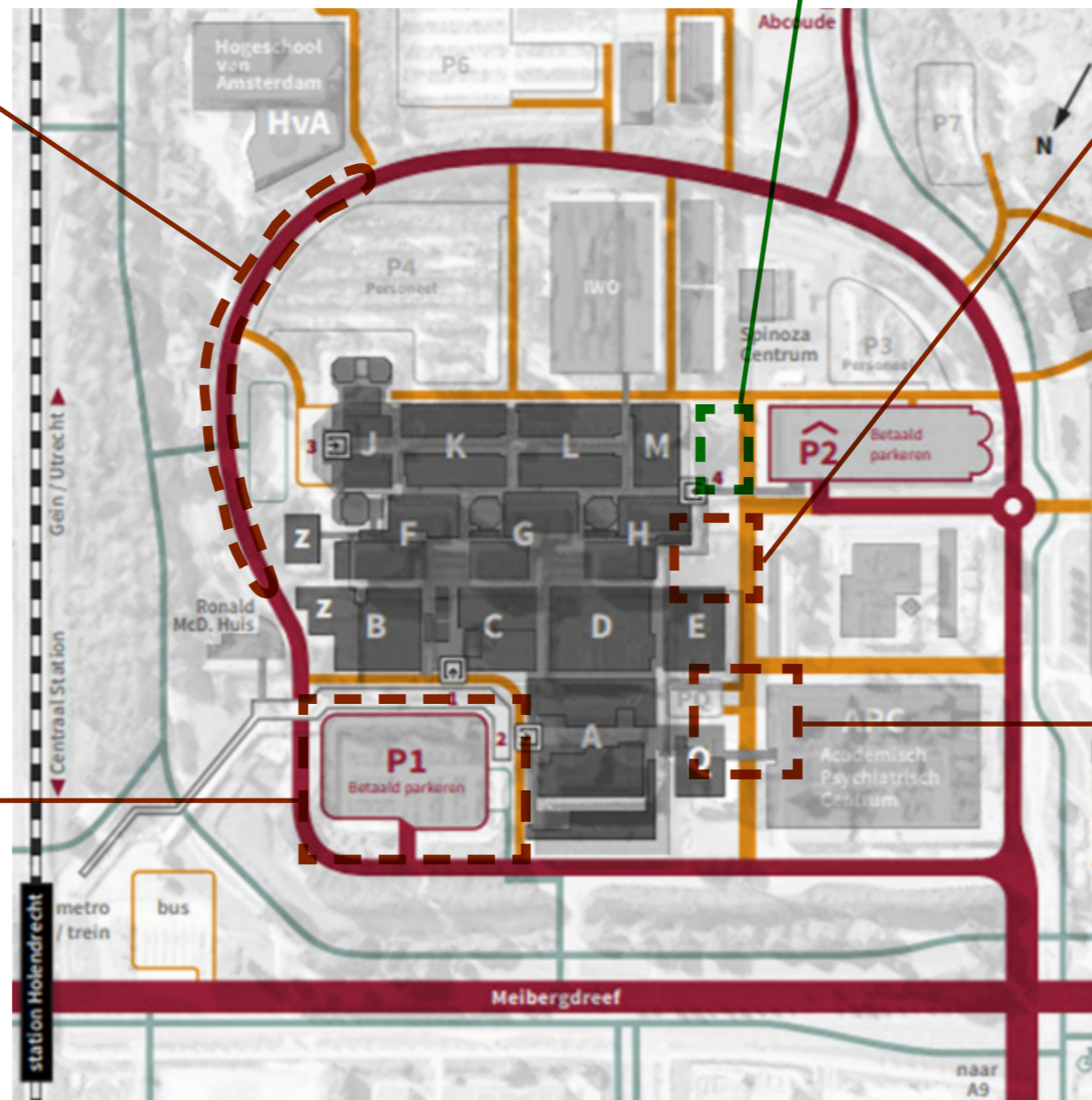
The only "lunch park"



Parking-like bare plaza



Entrance, domain of car



Bare roads, ruled by car

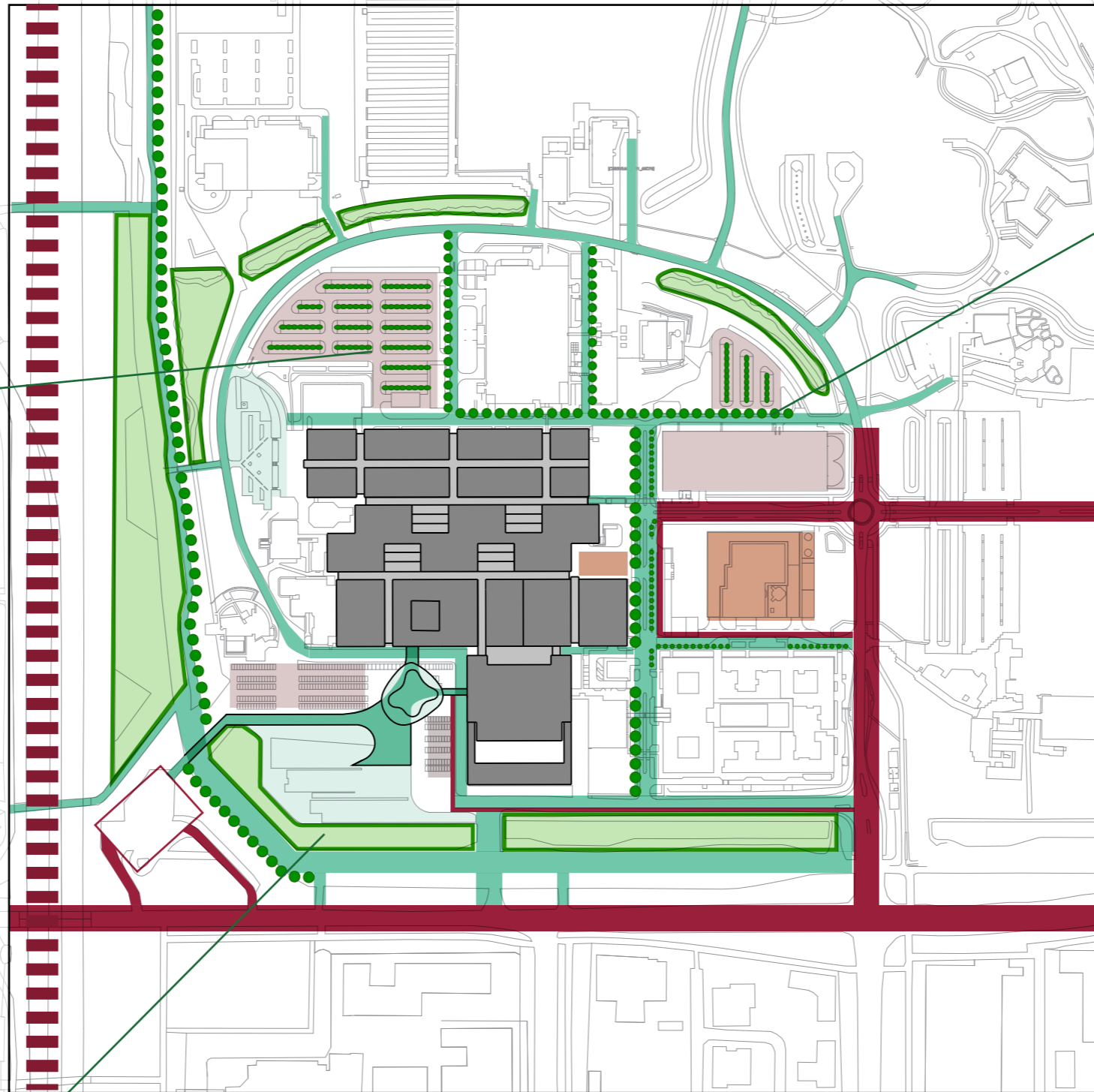
Car-dominant district



Espalier fruit tree for car park



Fruit tree near roads

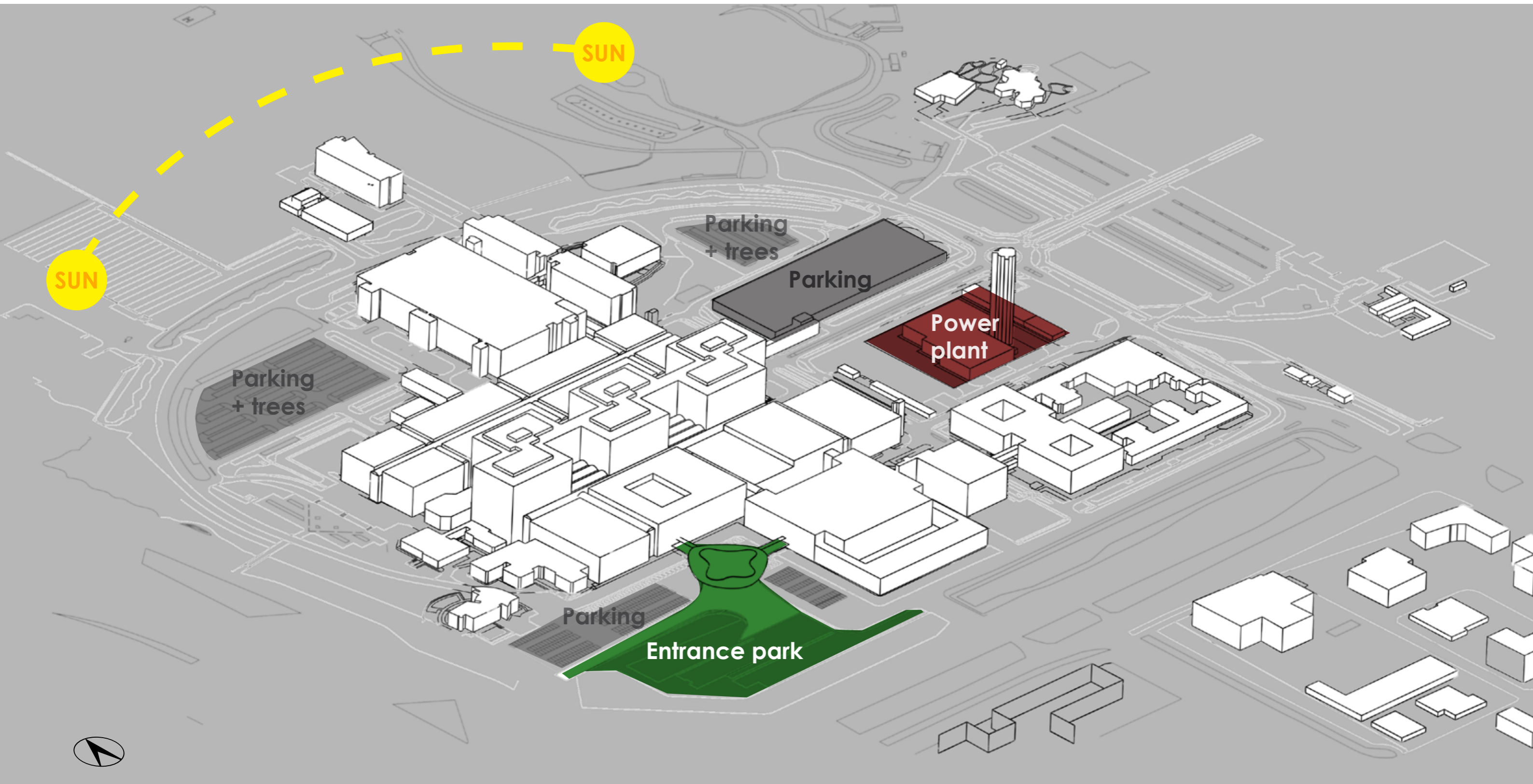


Fruit tree landscape



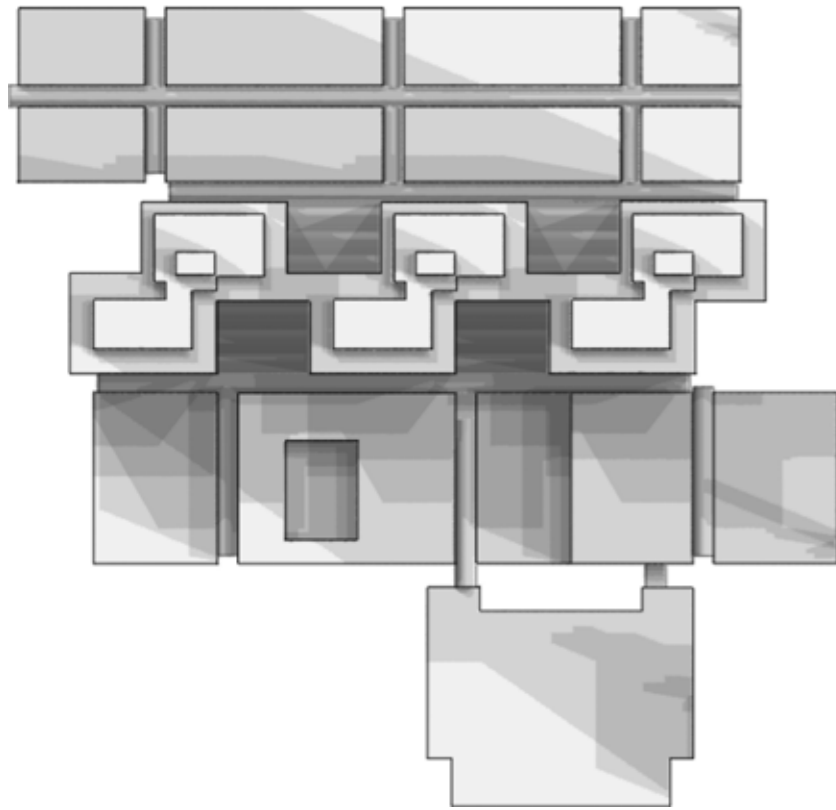
HEALTH PARK PROPOSAL



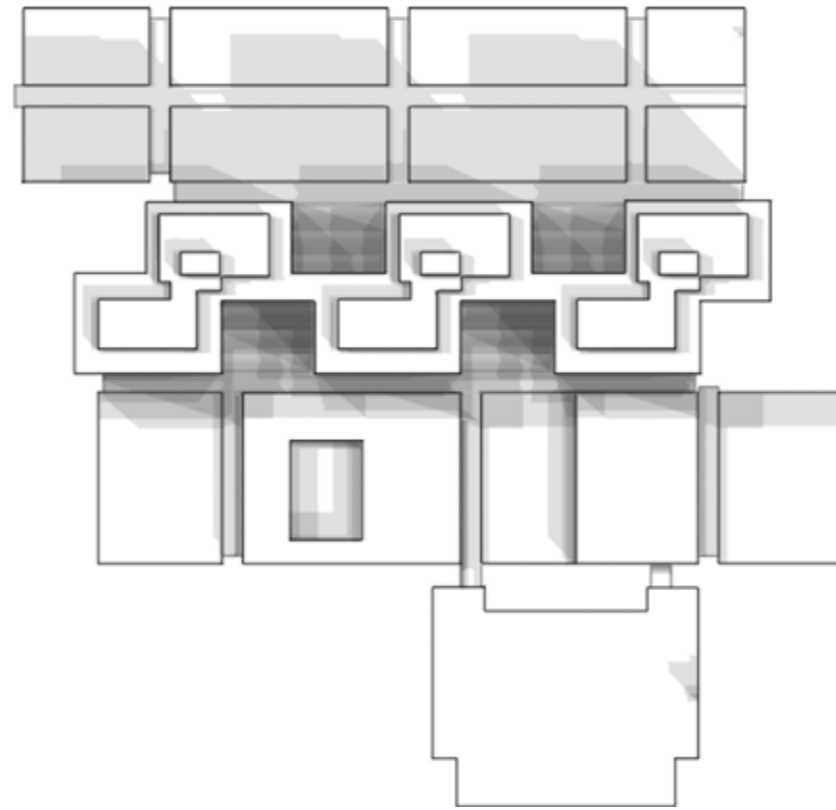


SUNLIGHT CONDITION

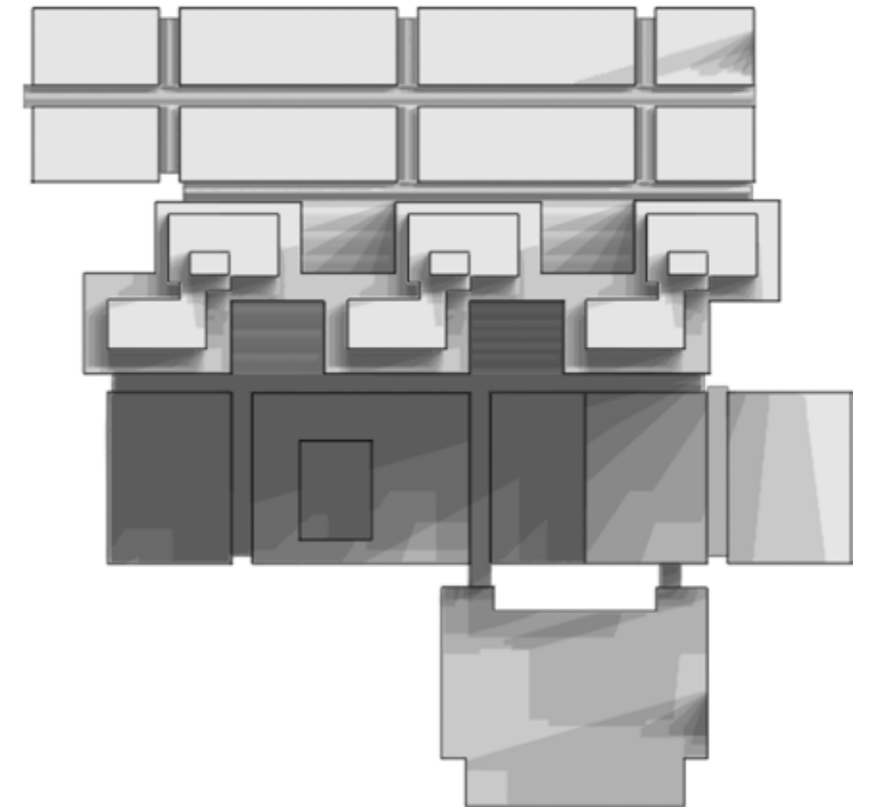
Spring



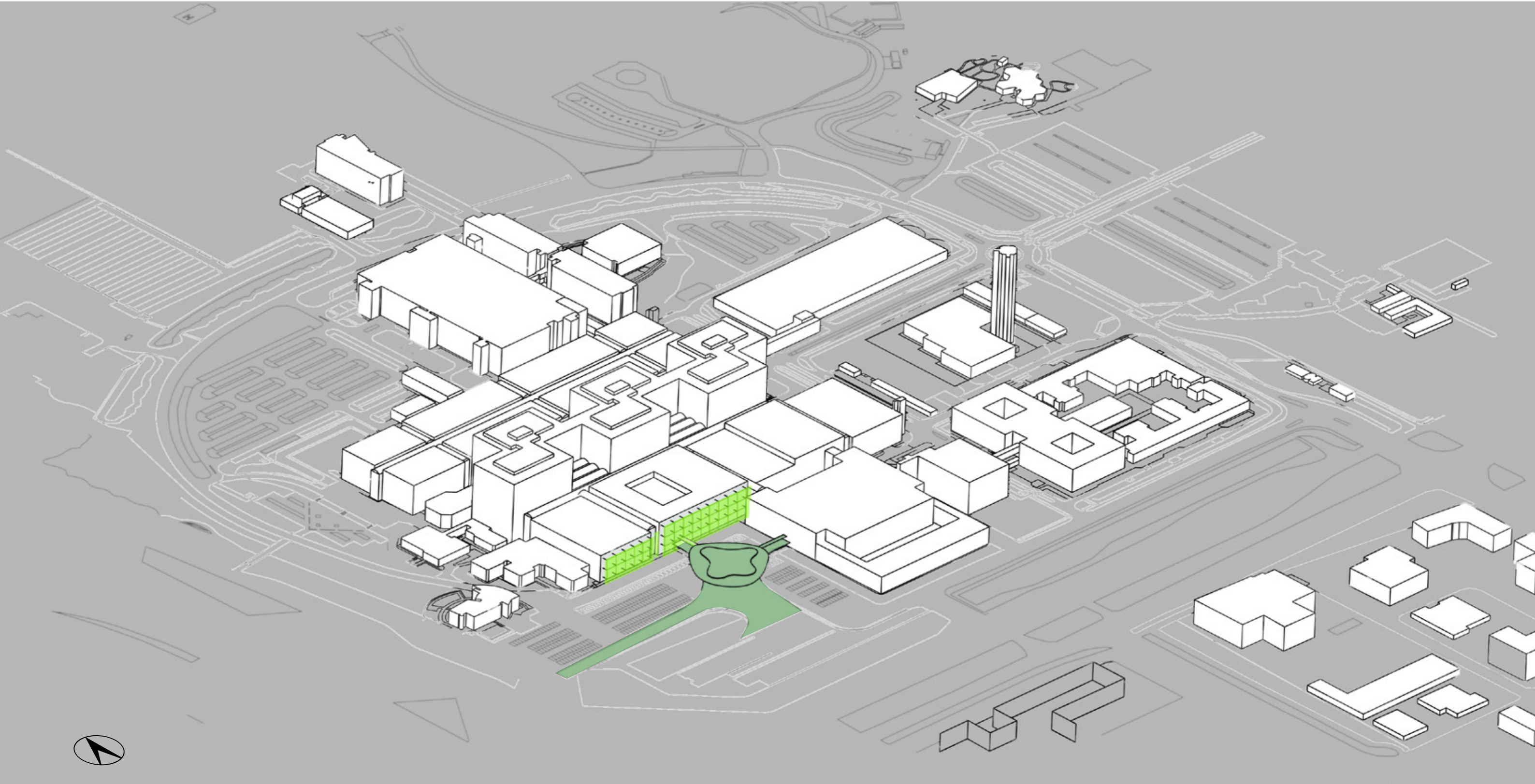
Summer



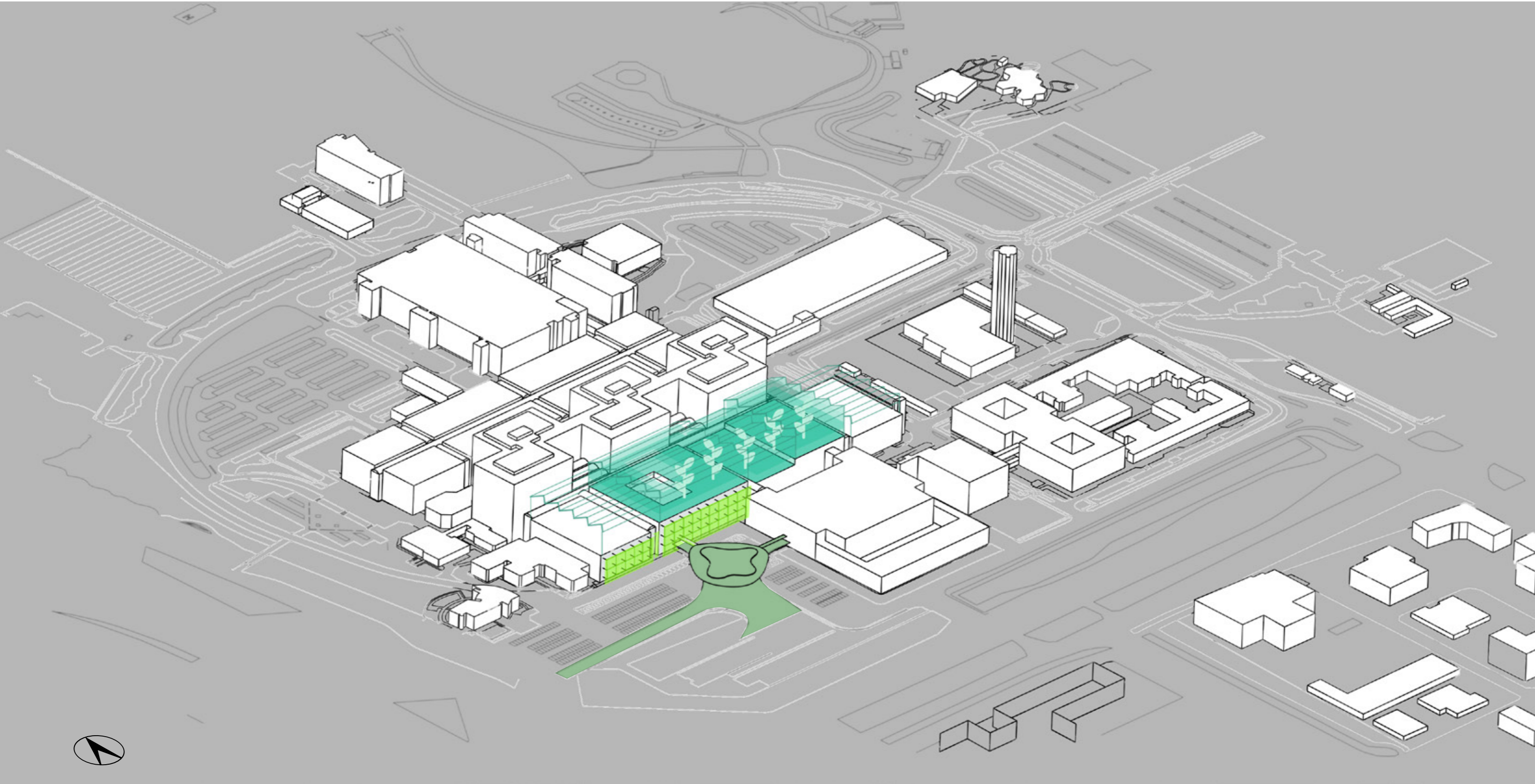
Winter



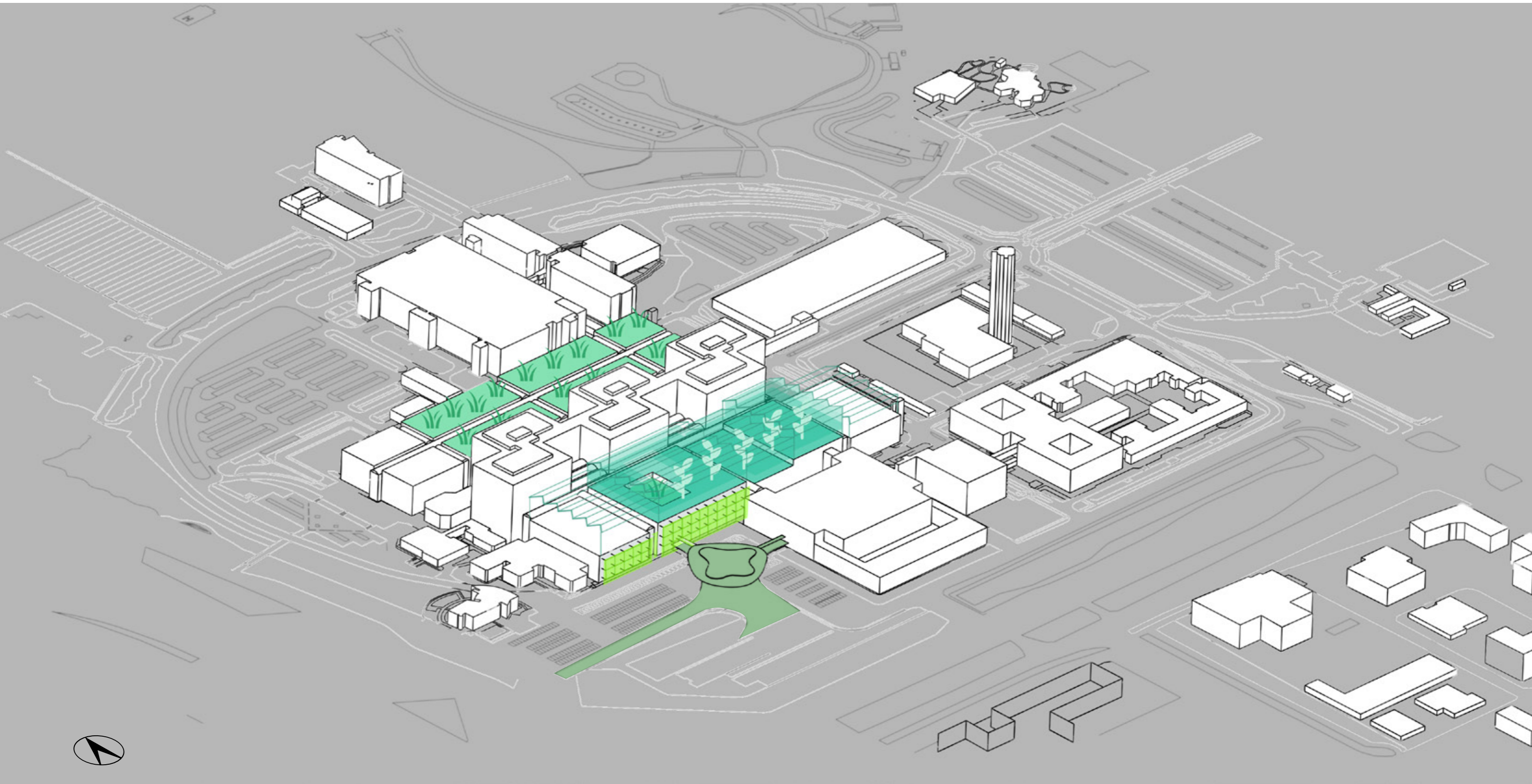
ENTRANCE DOUBLE FACADE



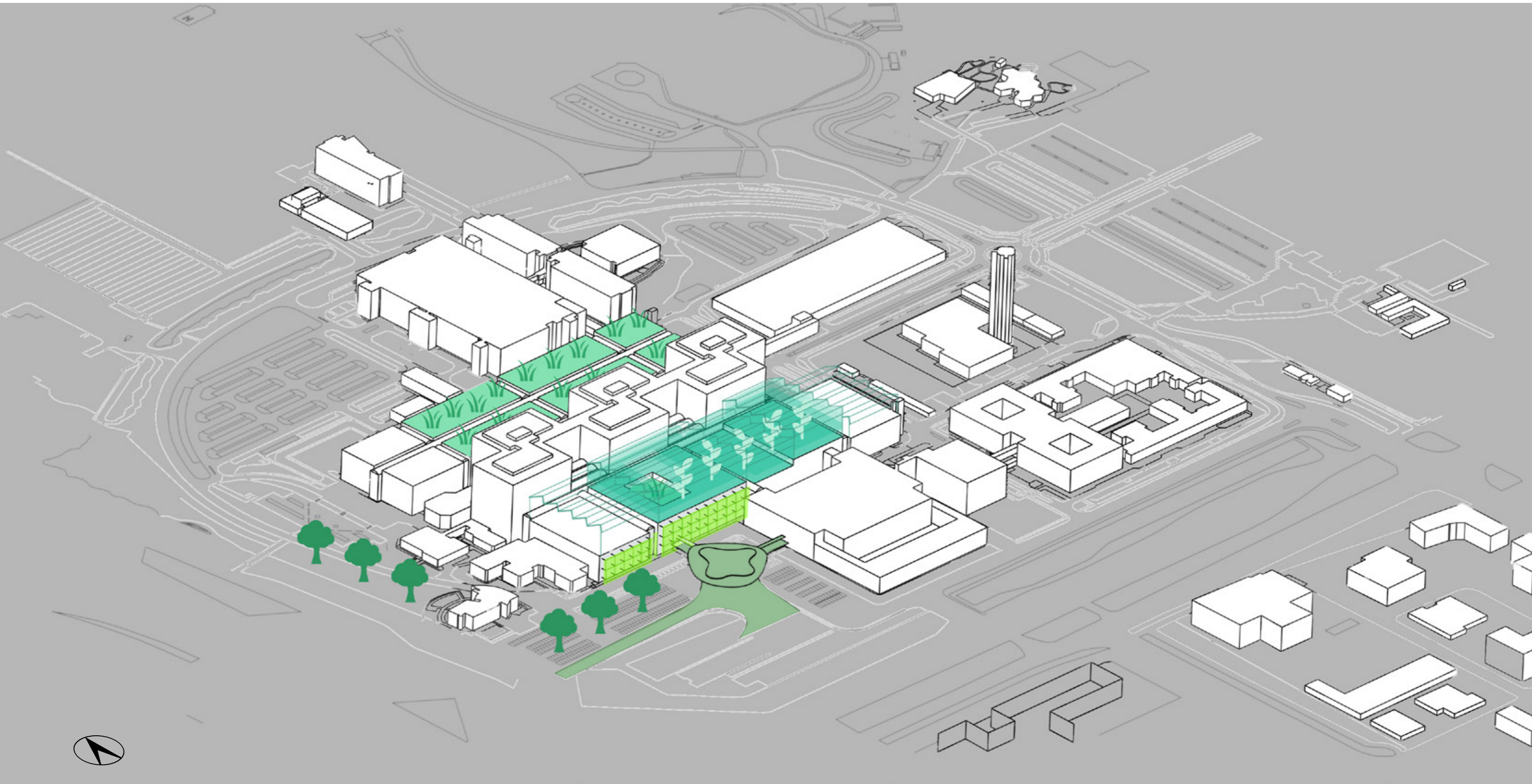
NORTH ROOFTOP GREENHOUSE



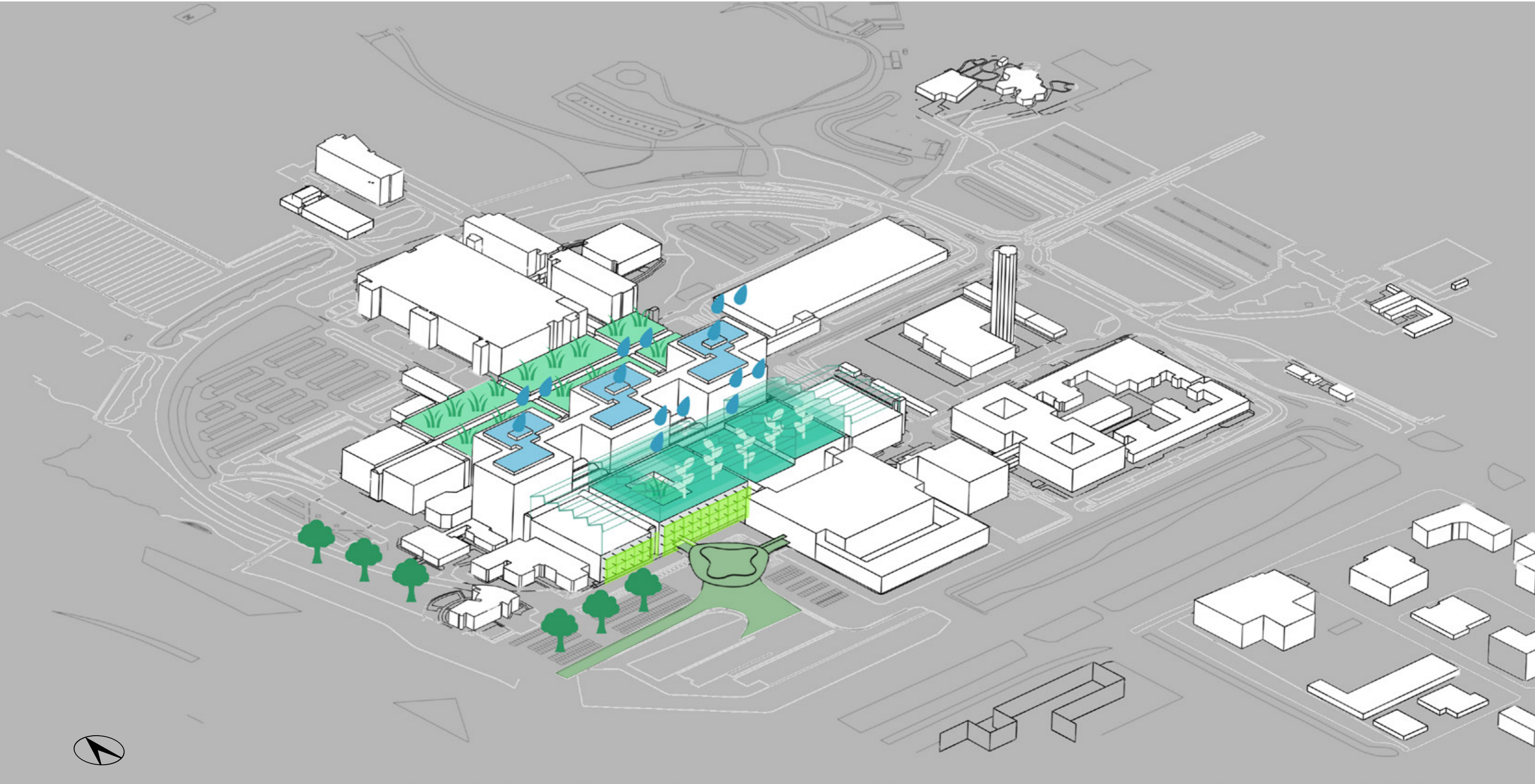
SOUTH ROOFTOP OPEN-AIR FARM



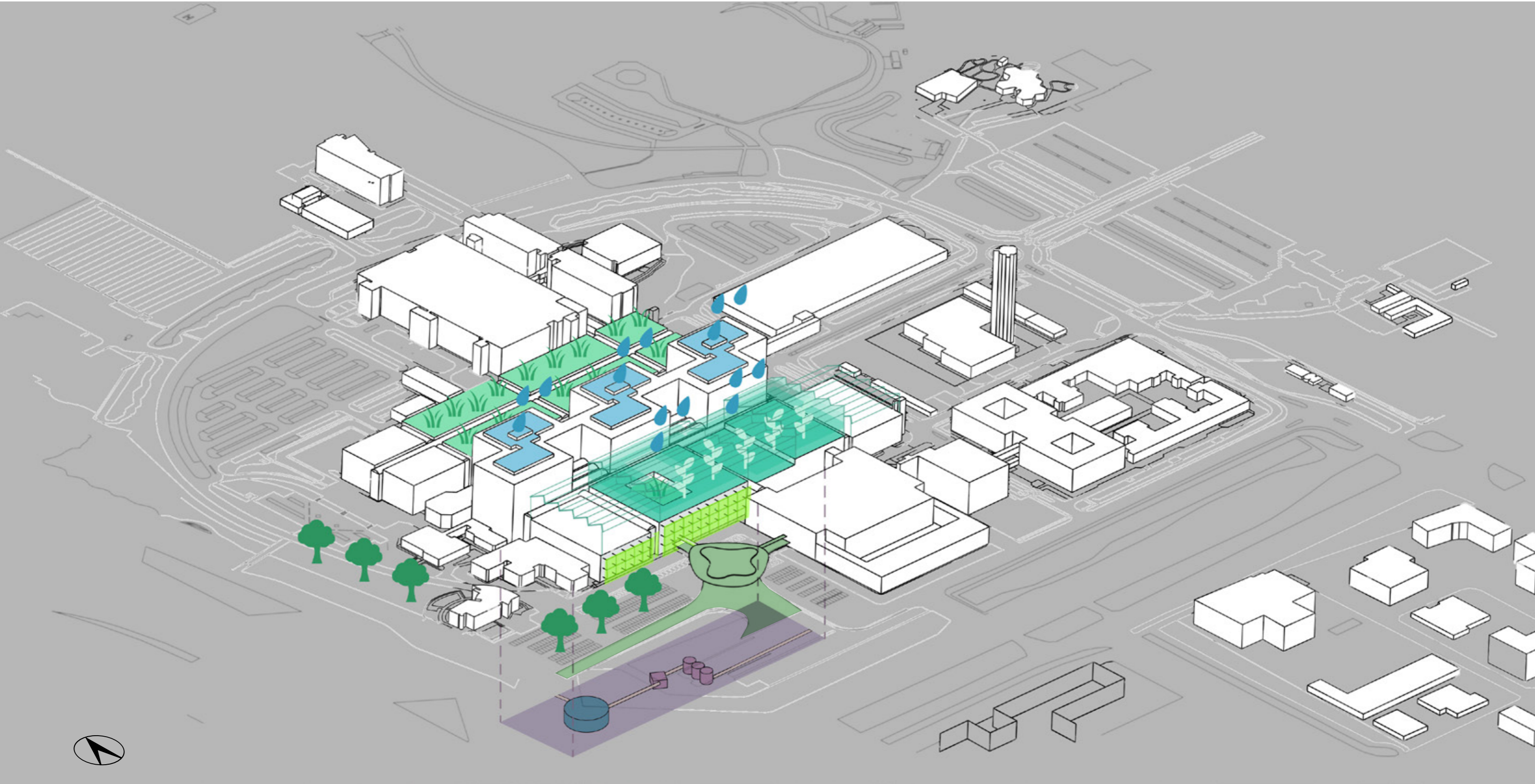
GROUND LEVEL FRUIT TREE



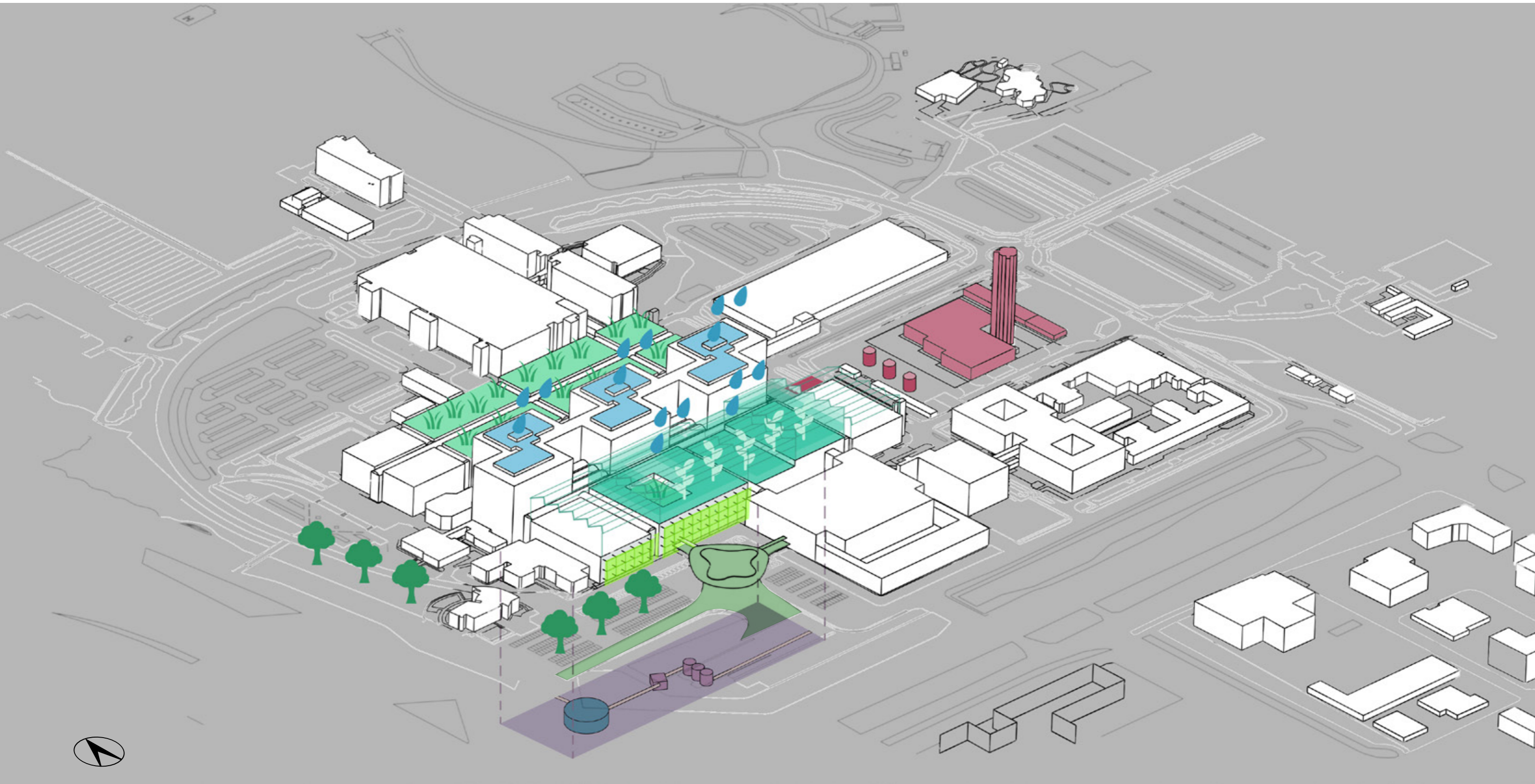
RAINWATER COLLECTION



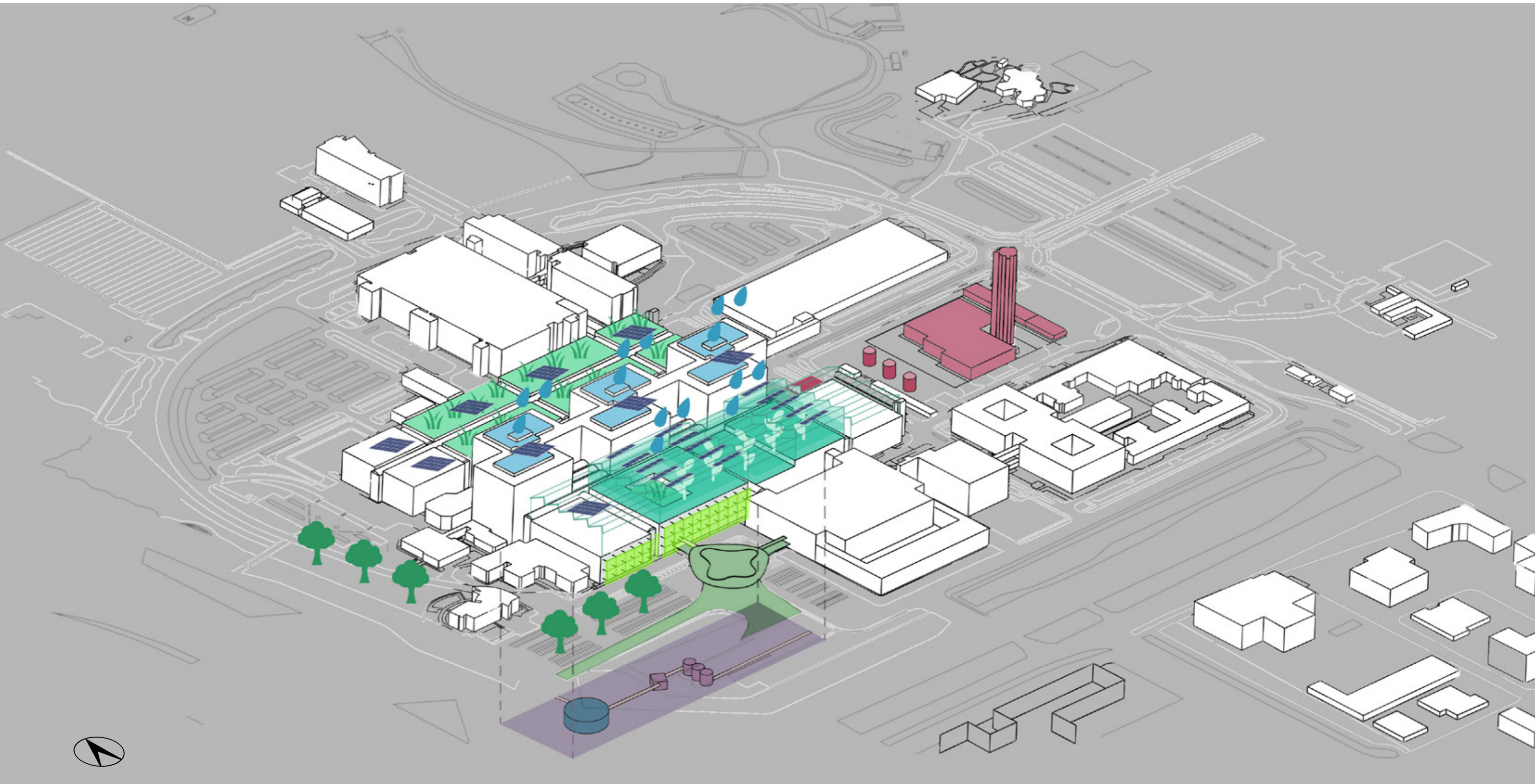
WASTE MANAGEMENT

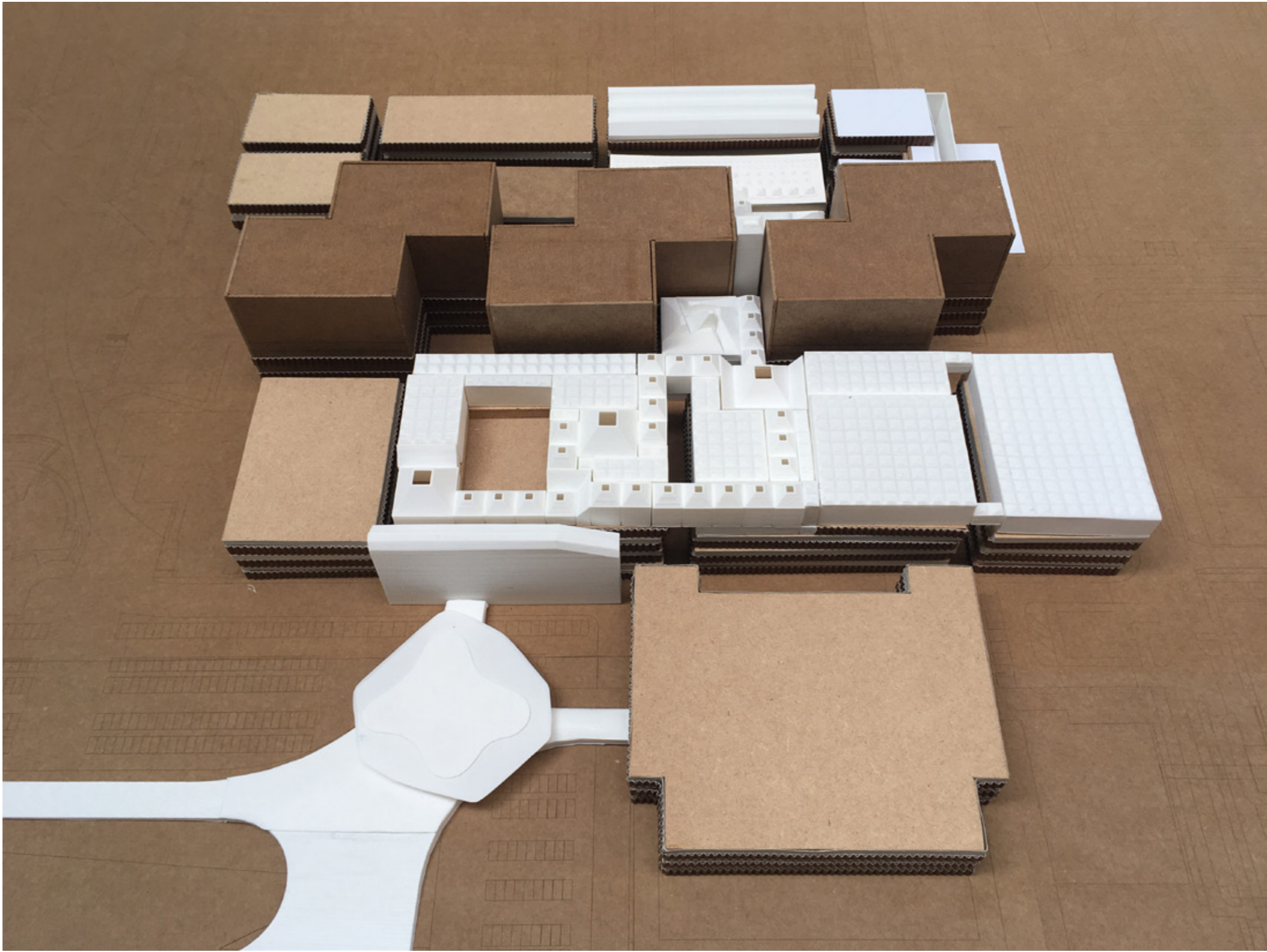


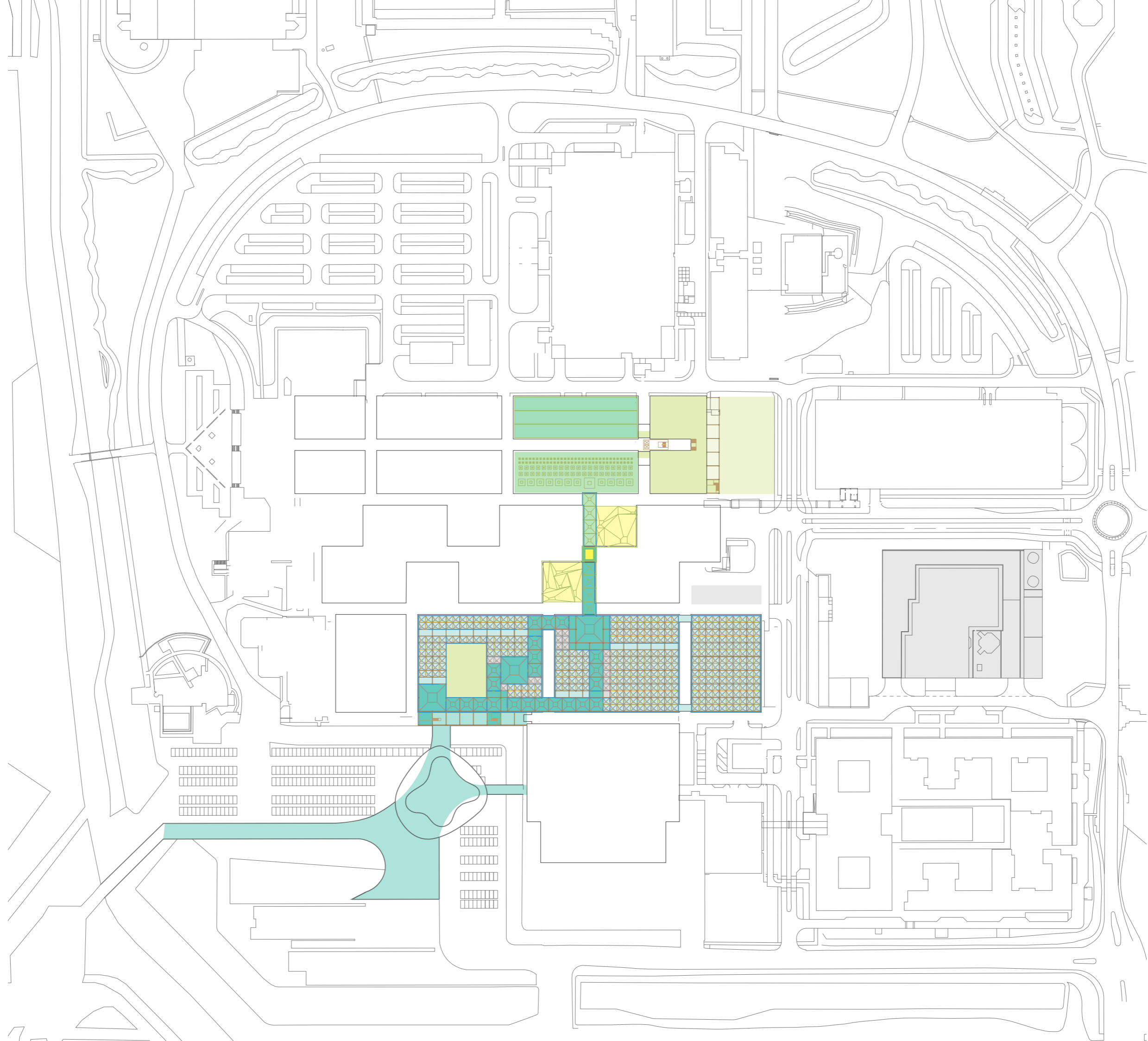
ANAEROBIC DIGESTION



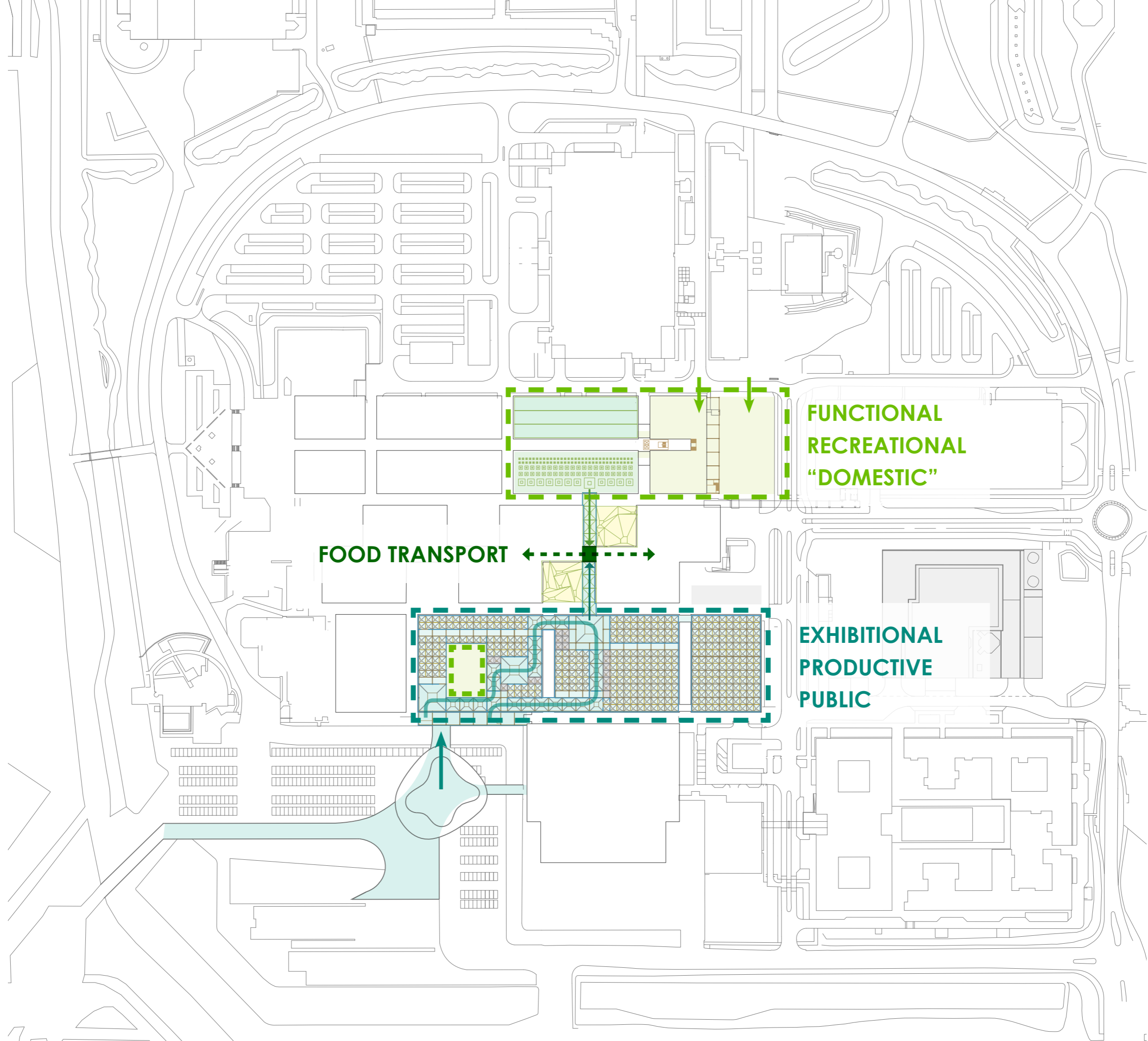
SOLAR PANELS







20m



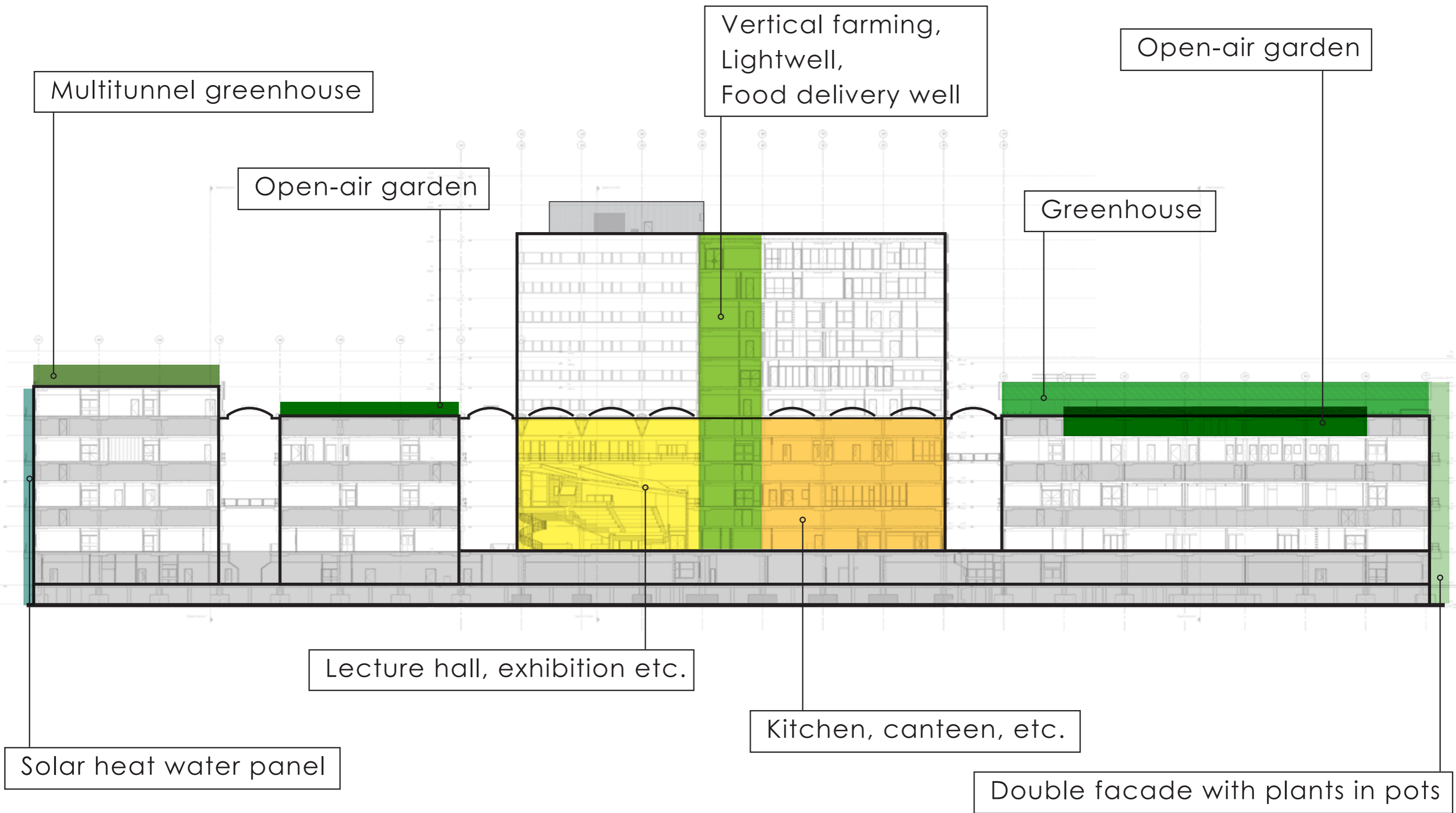
**FUNCTIONAL
RECREATIONAL
"DOMESTIC"**

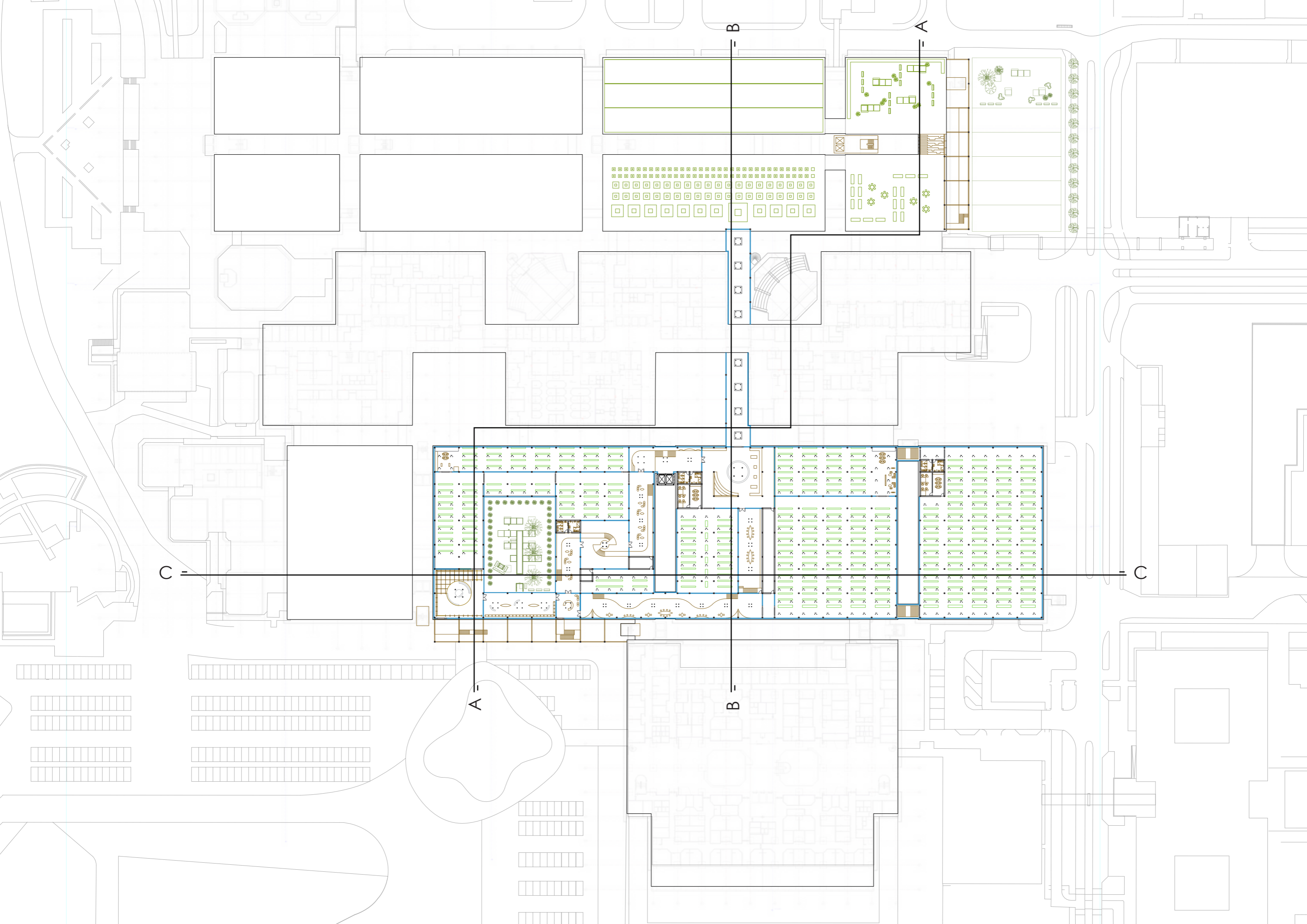
FOOD TRANSPORT ← - - - - - →

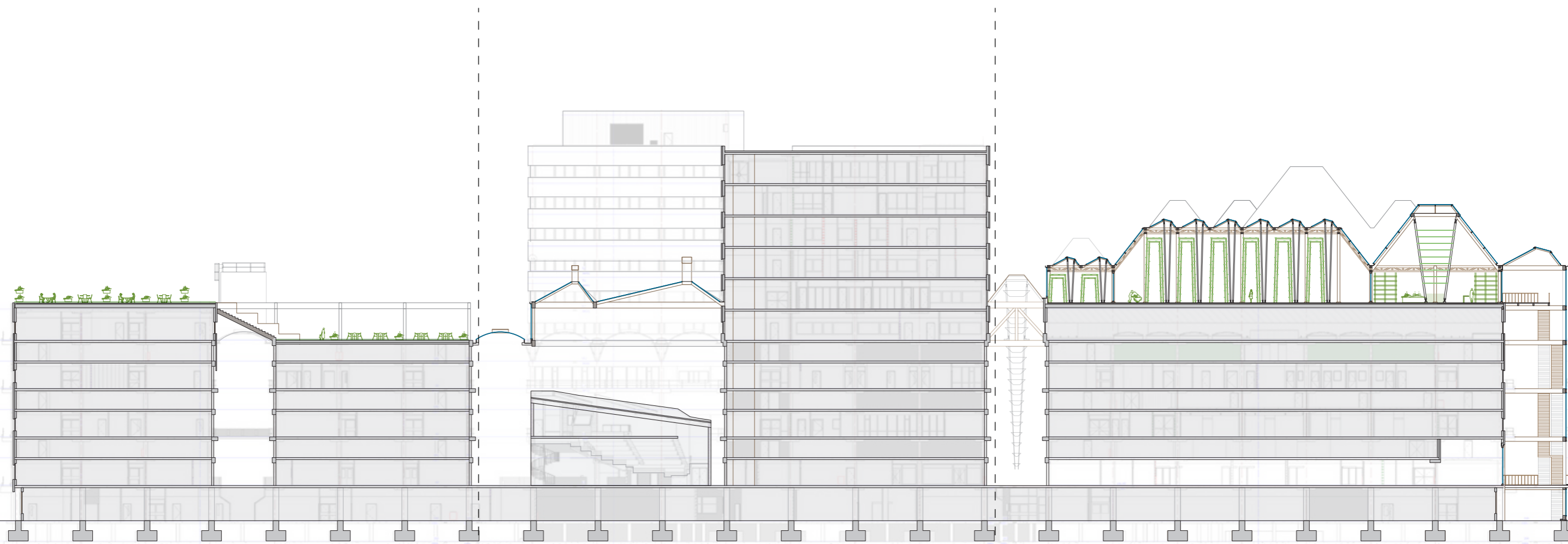
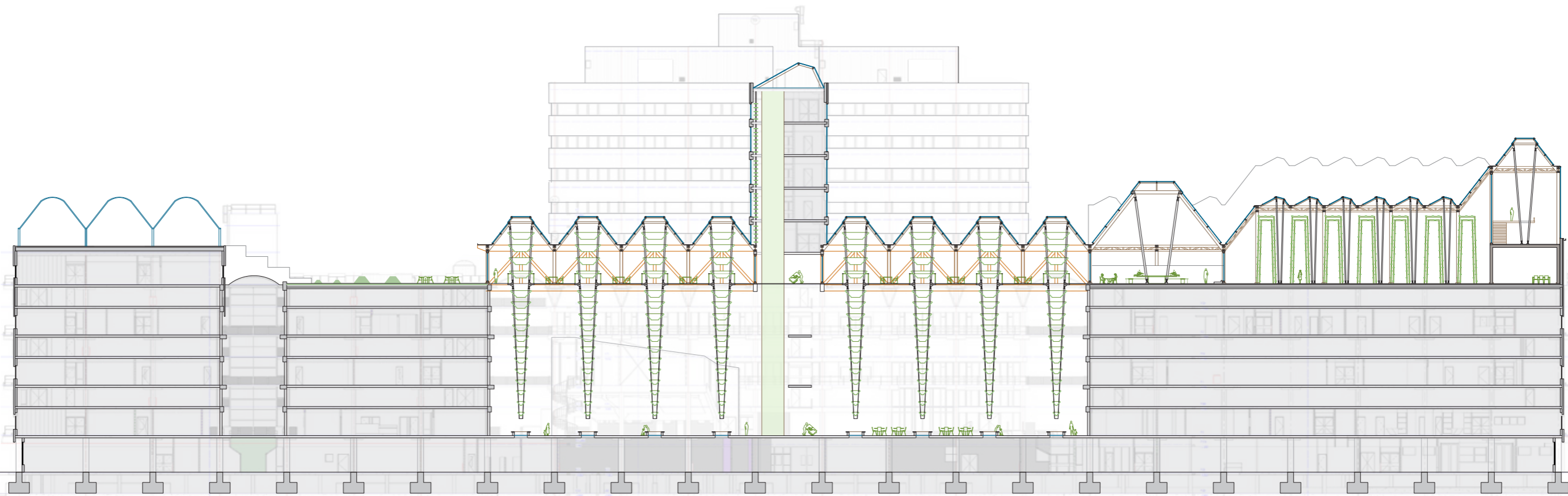
**EXHIBITIONAL
PRODUCTIVE
PUBLIC**

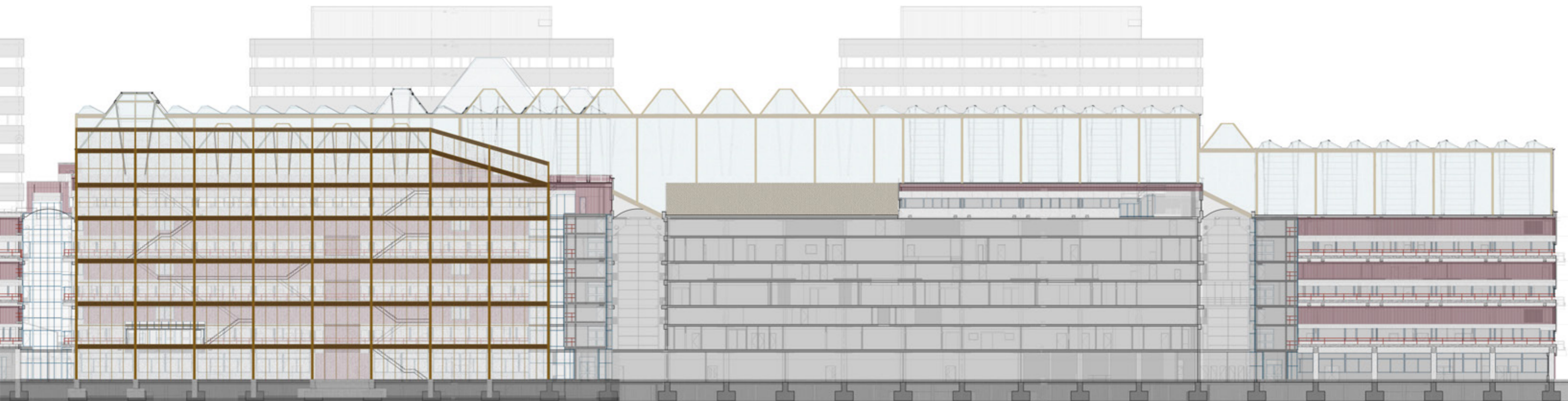
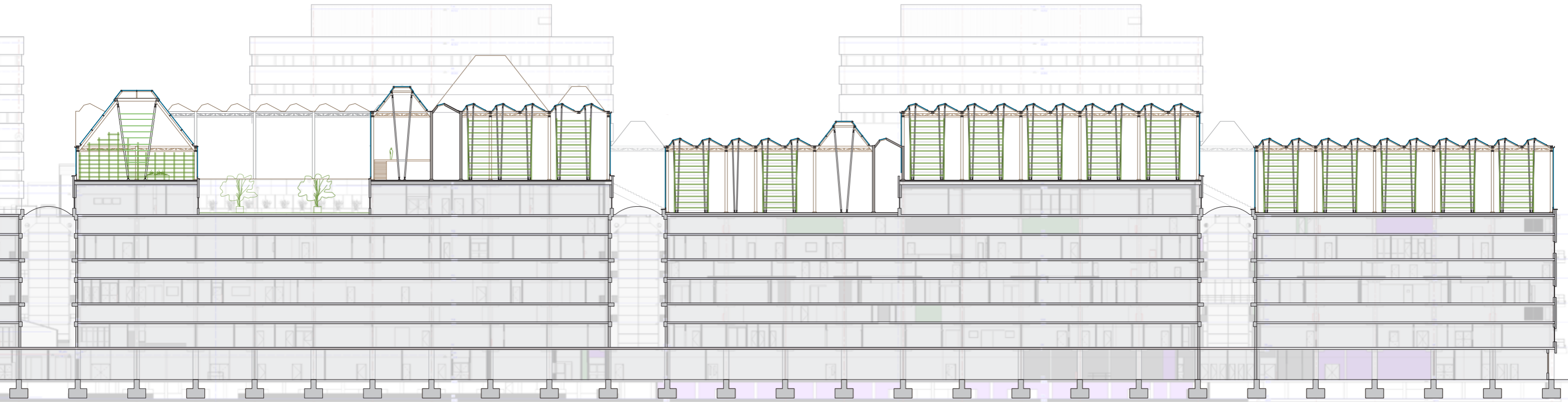


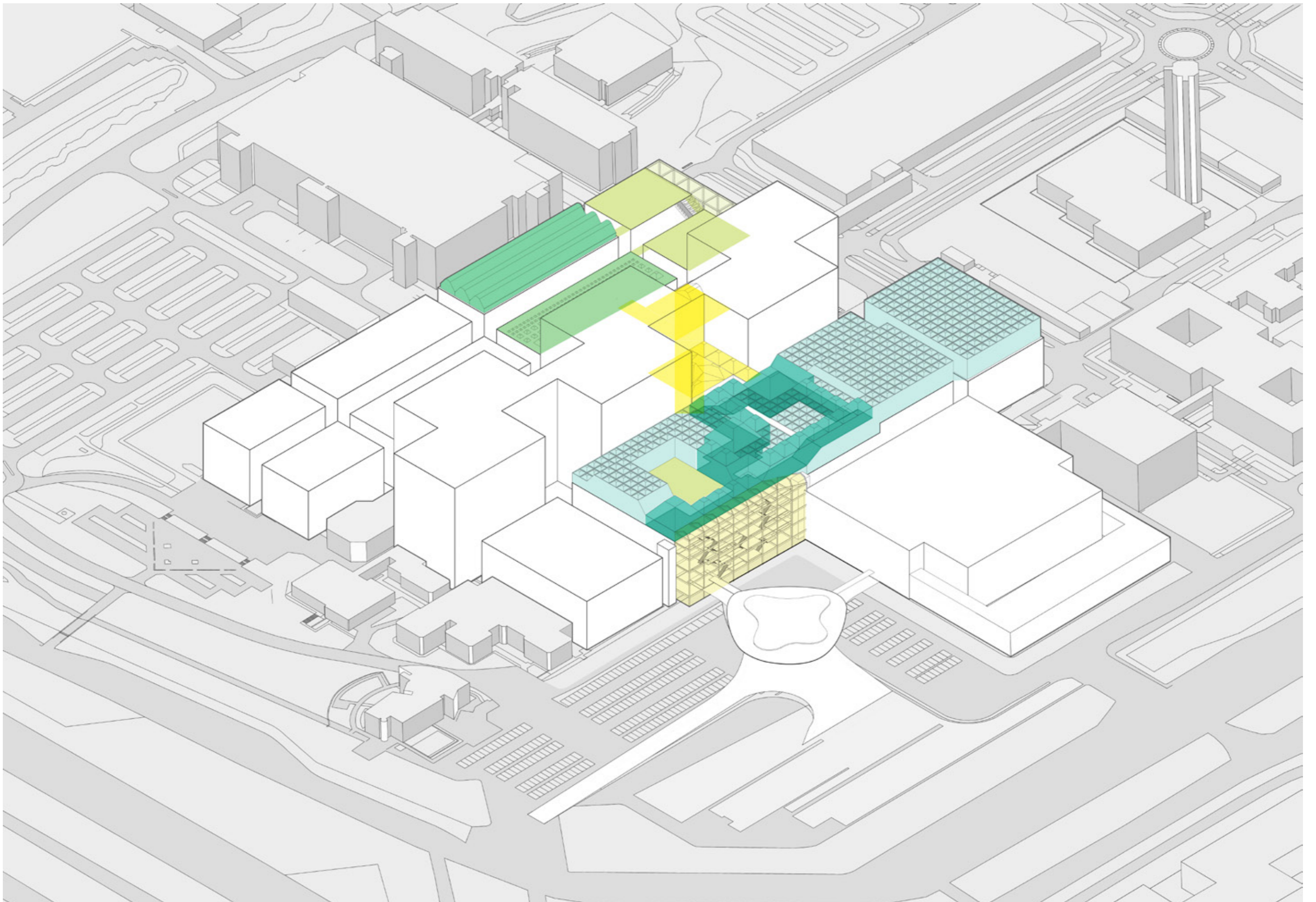
20m



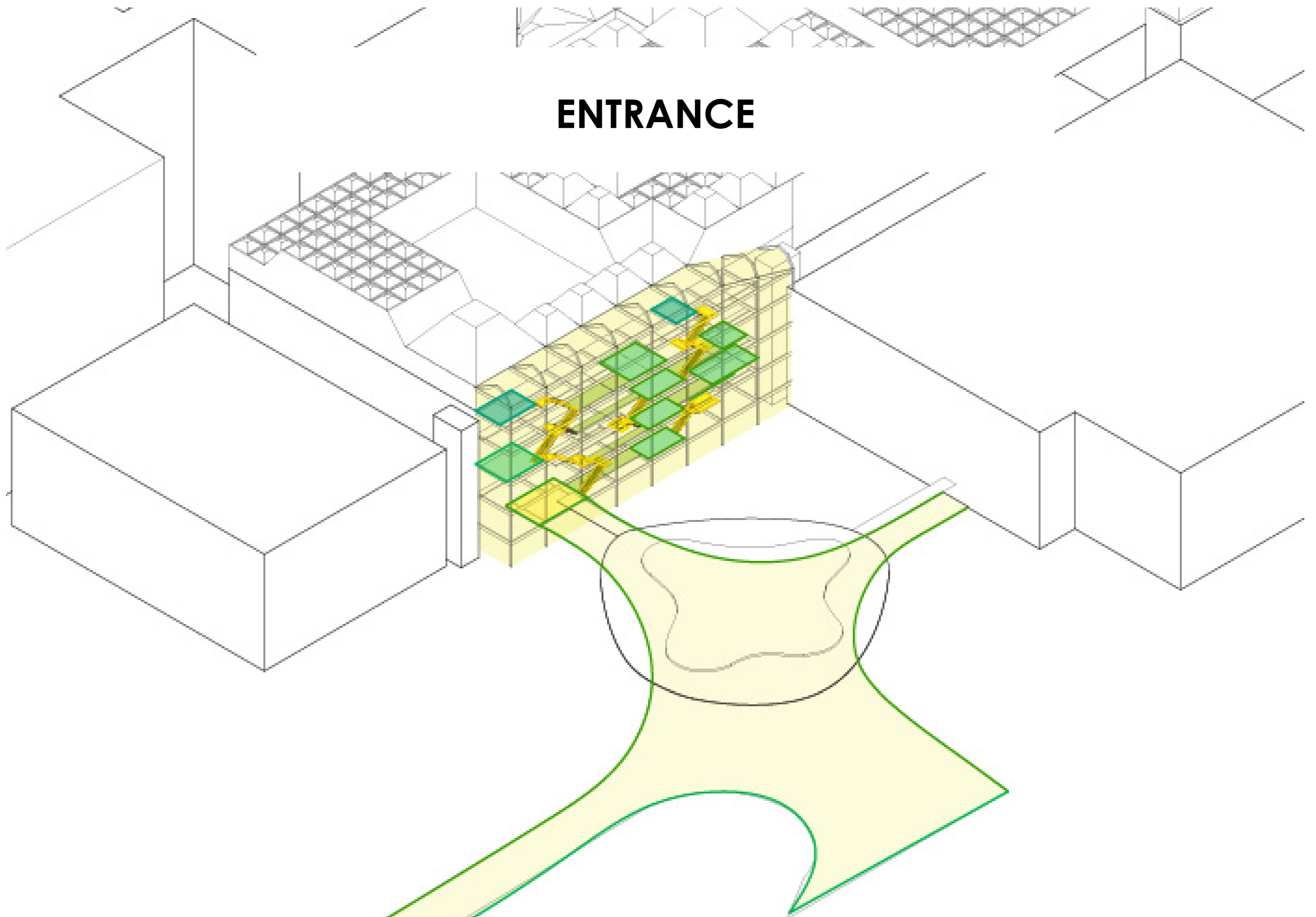


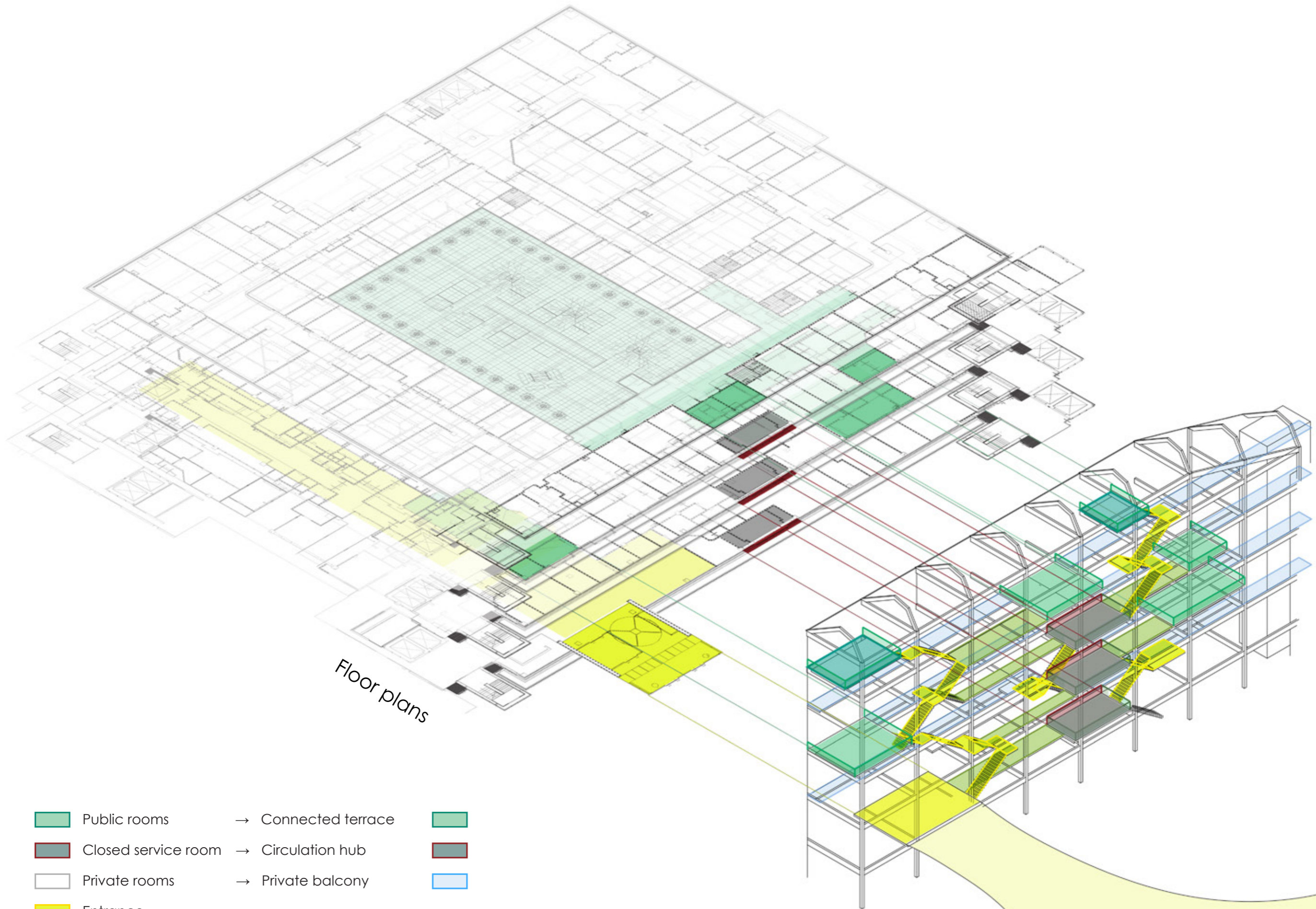






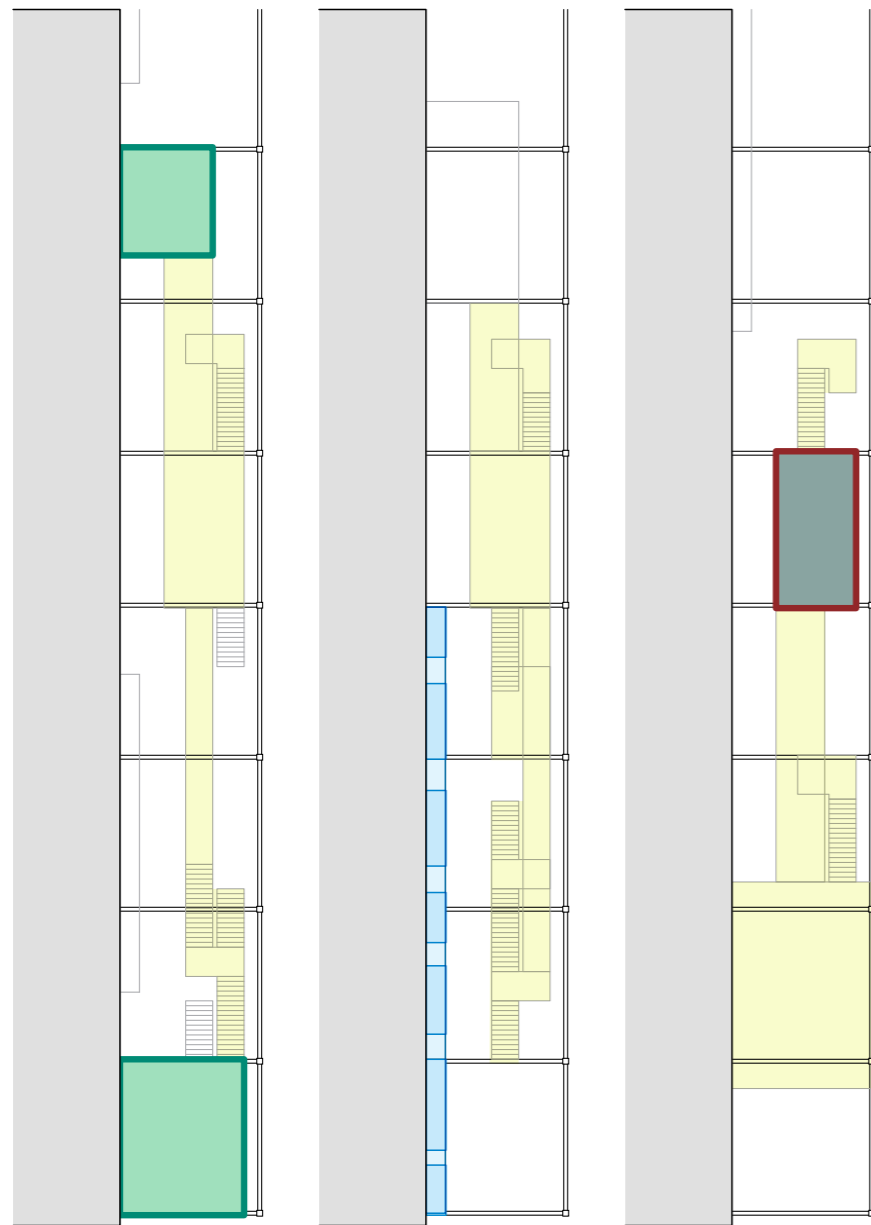
ENTRANCE





Floor plans

- | | | |
|---|---|---|
| Public rooms | → | Connected terrace |
| Closed service room | → | Circulation hub |
| Private rooms | → | Private balcony |
| Entrance | | |

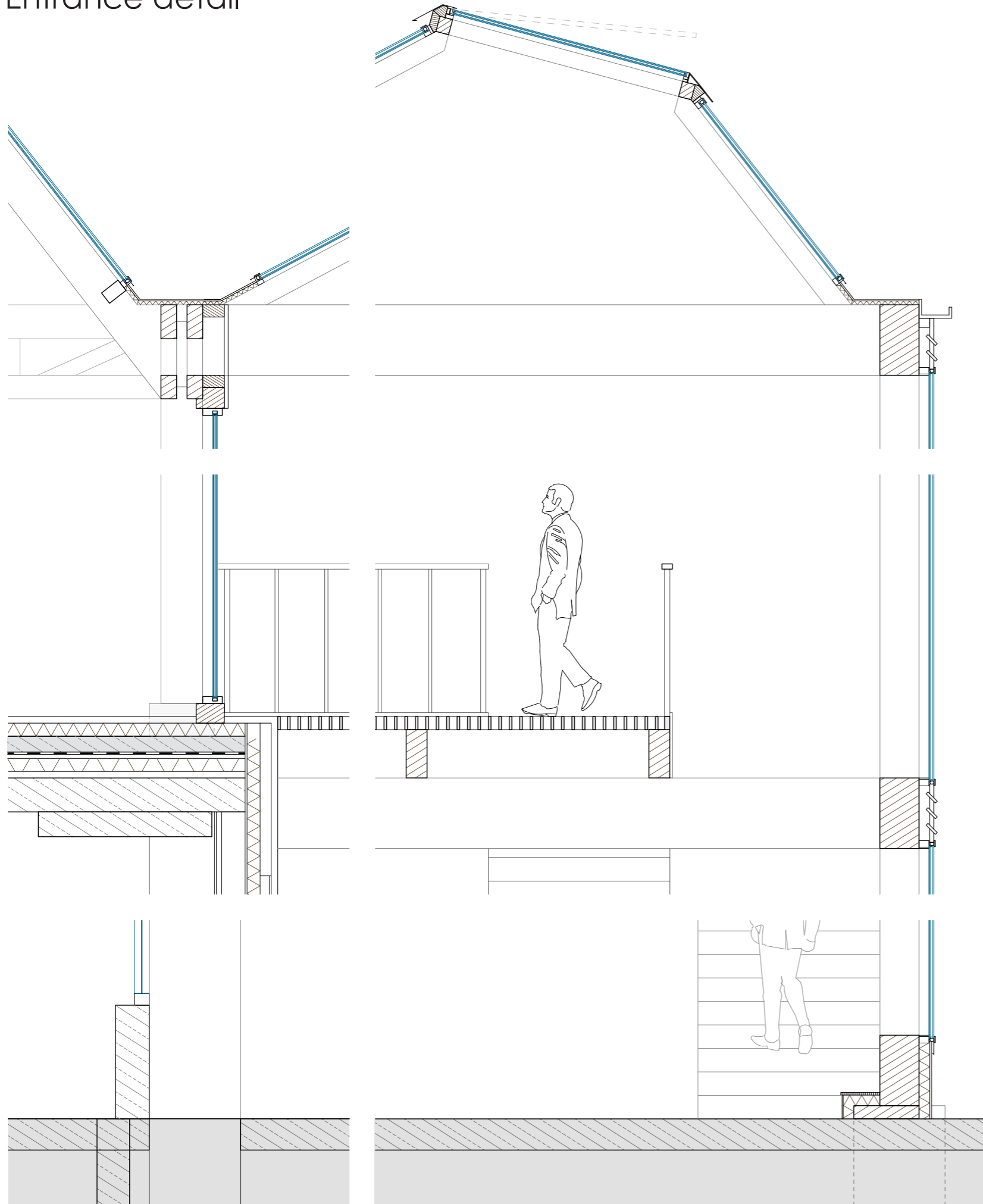


- Connected terrace
- Private balcony
- Circulation hub
- Circulation

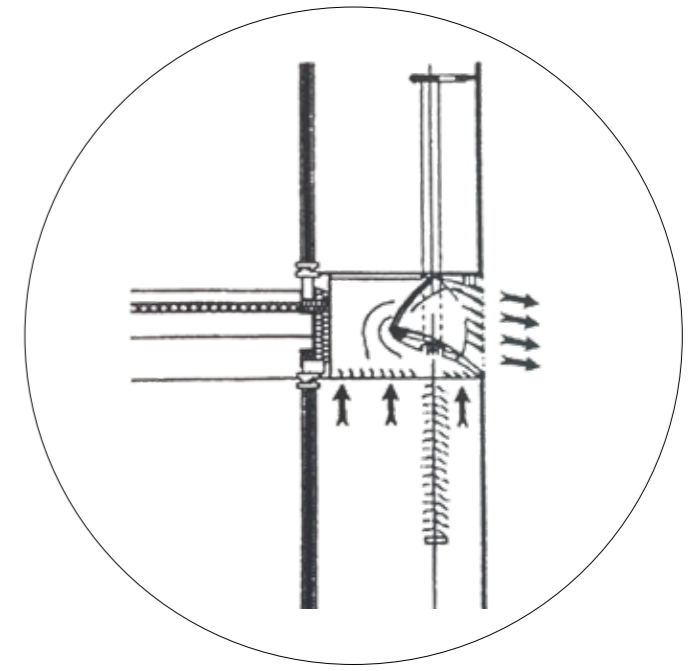


Source from: KCAP

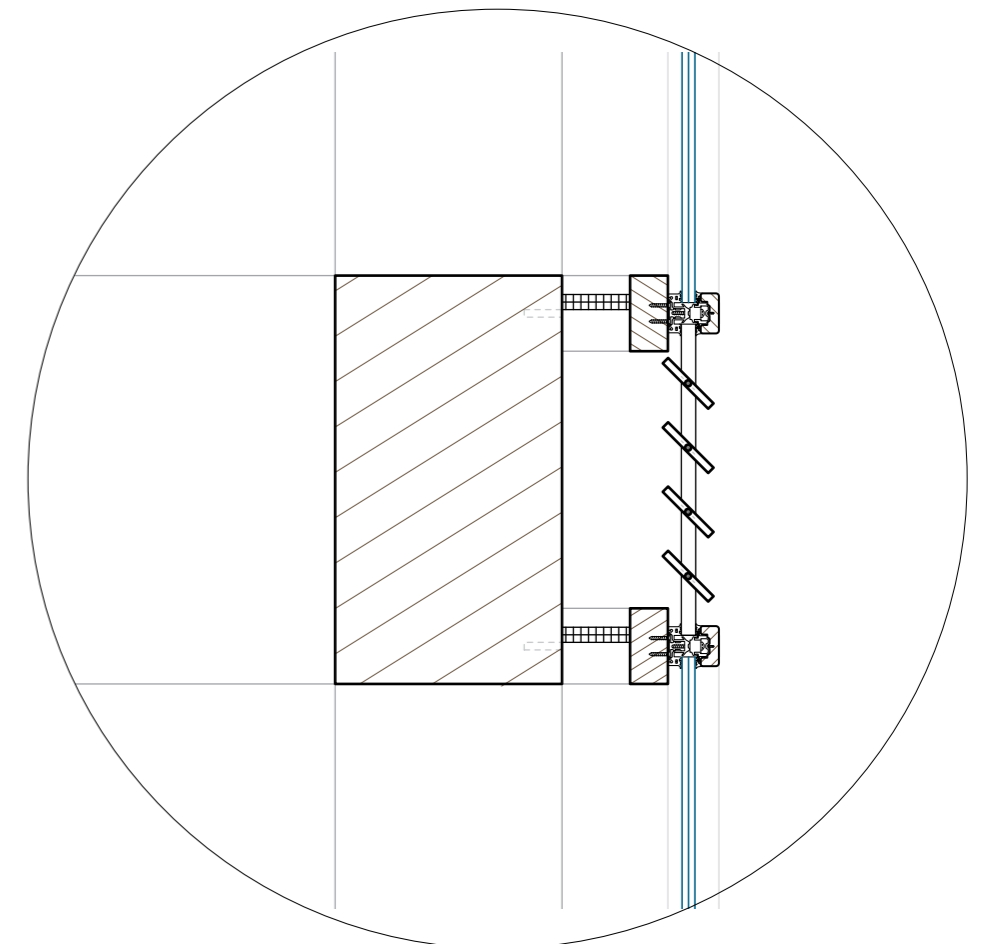
Entrance detail

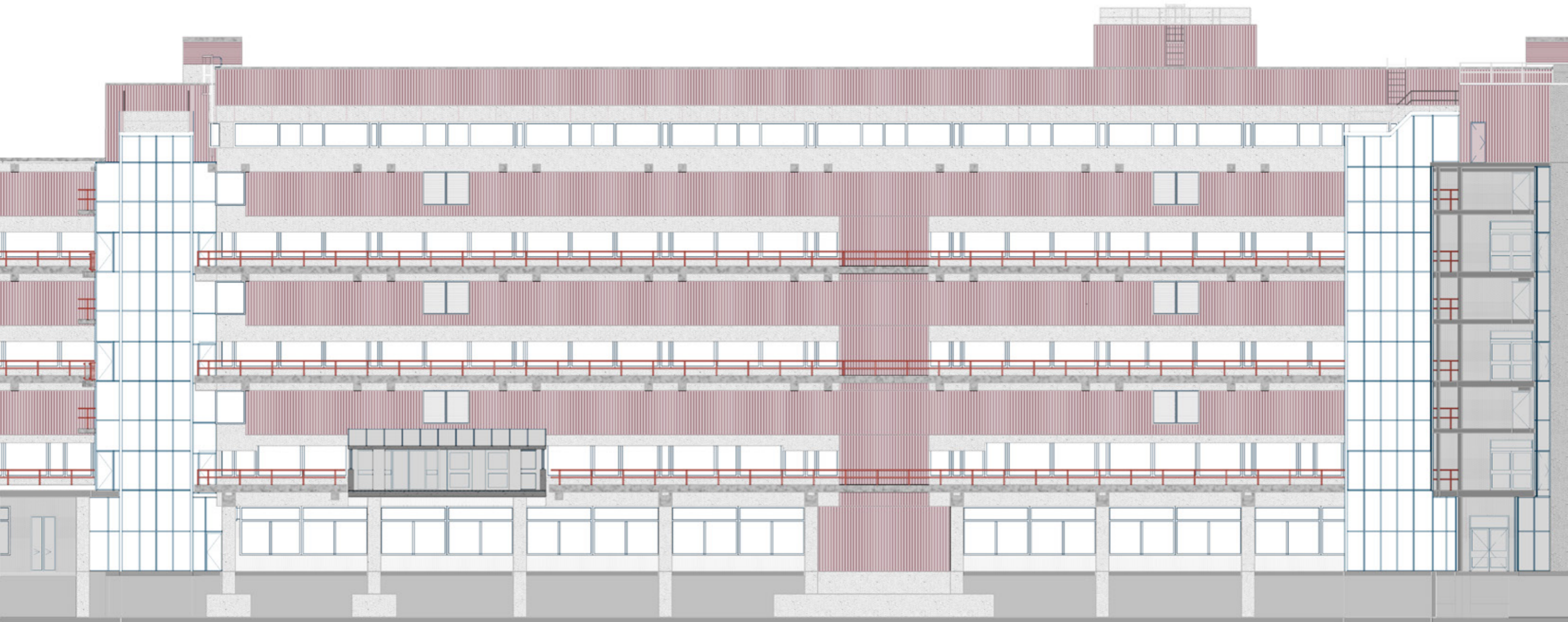


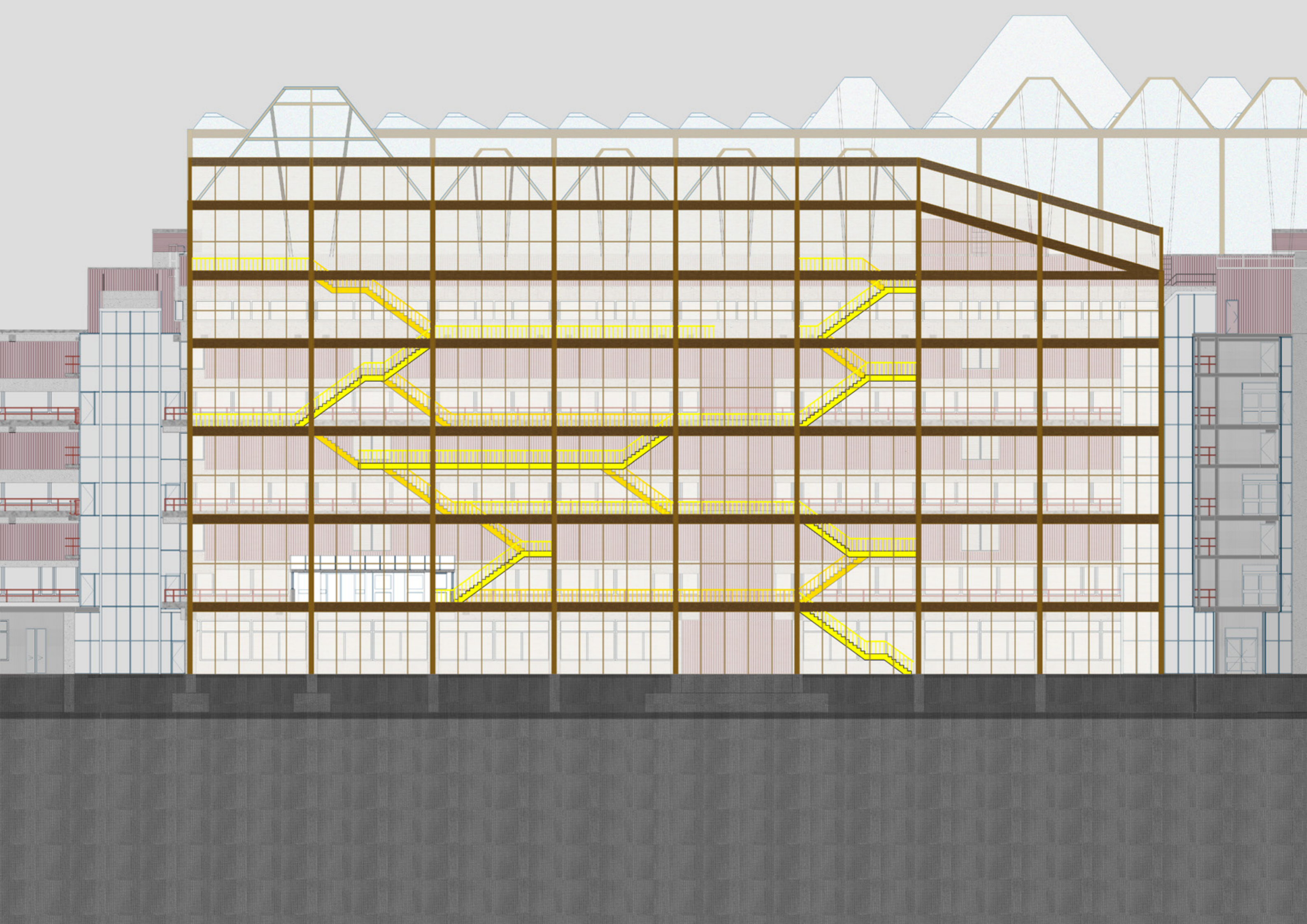
Ref.



Ventilated opening at joint area

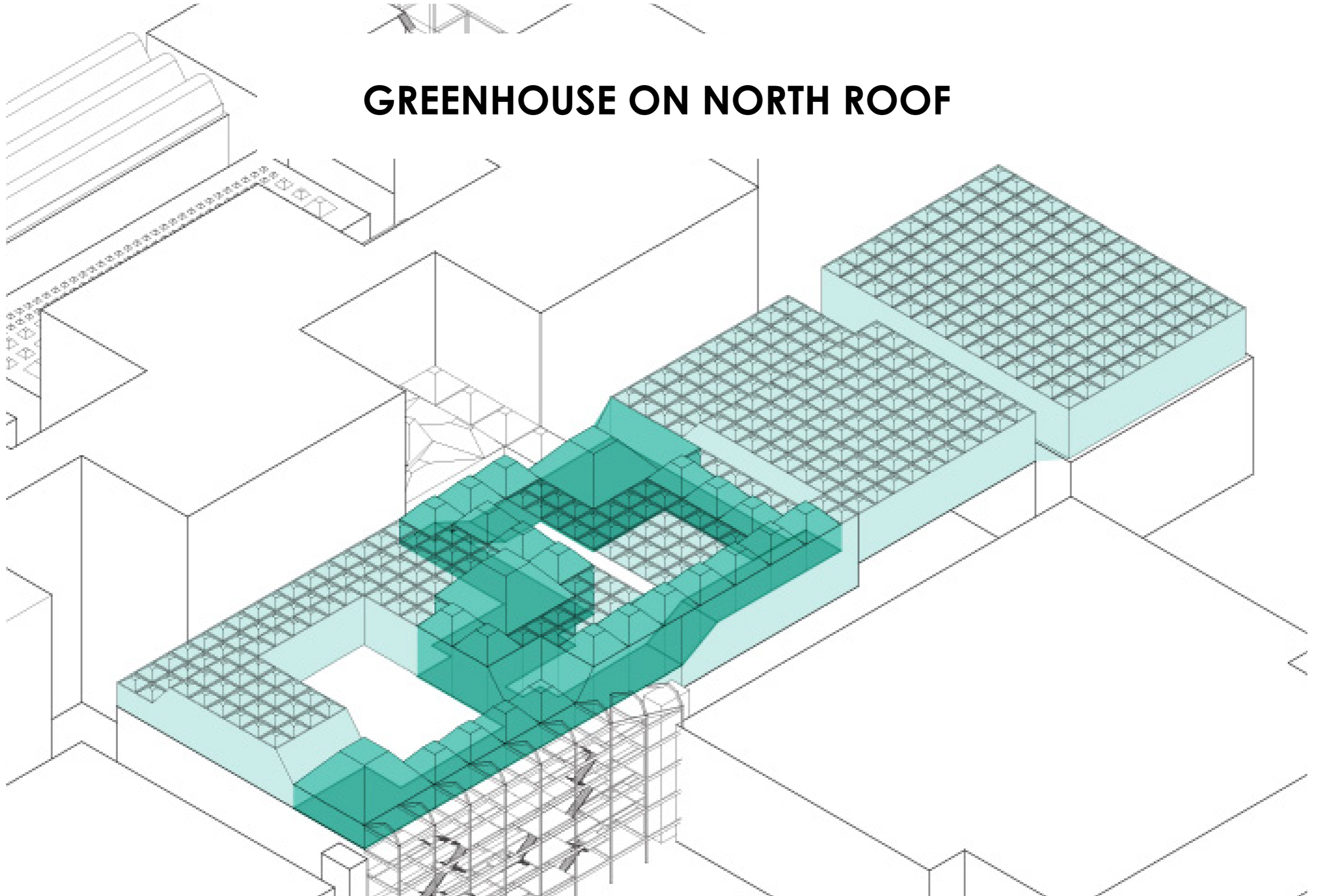




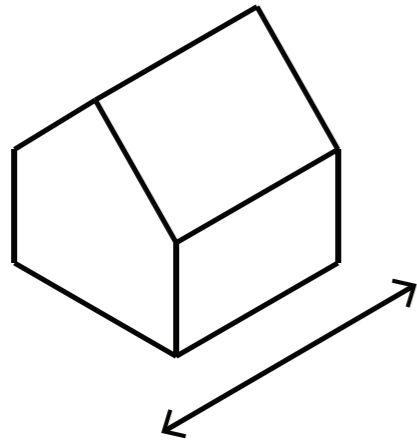




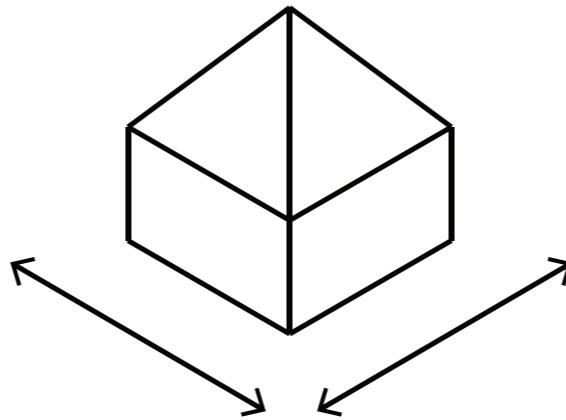
GREENHOUSE ON NORTH ROOF



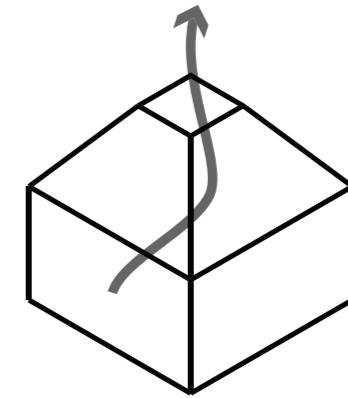
FORMATION OF UNIT



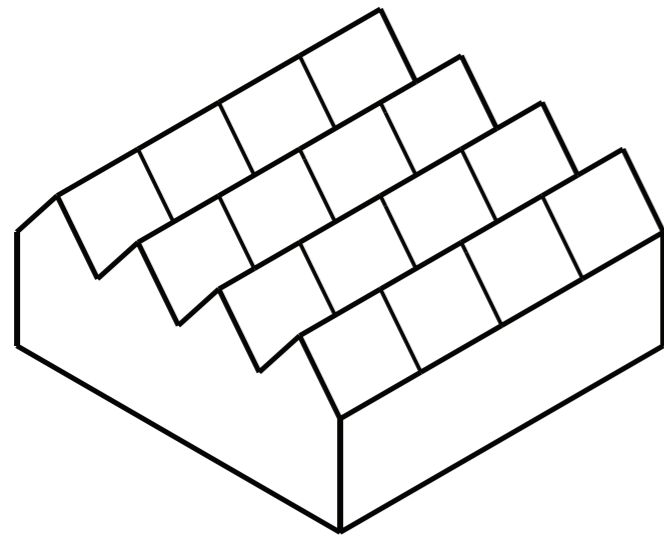
Traditional



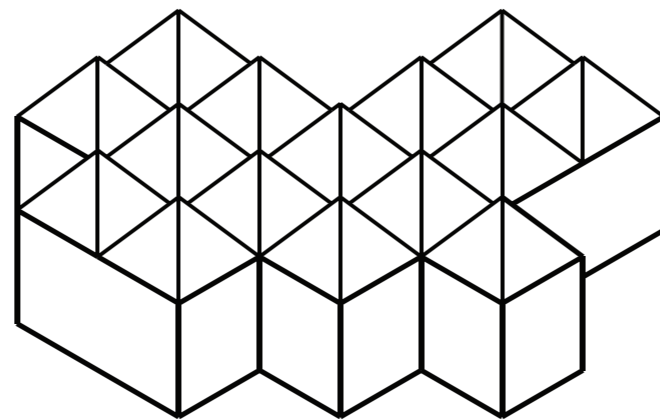
Square unit



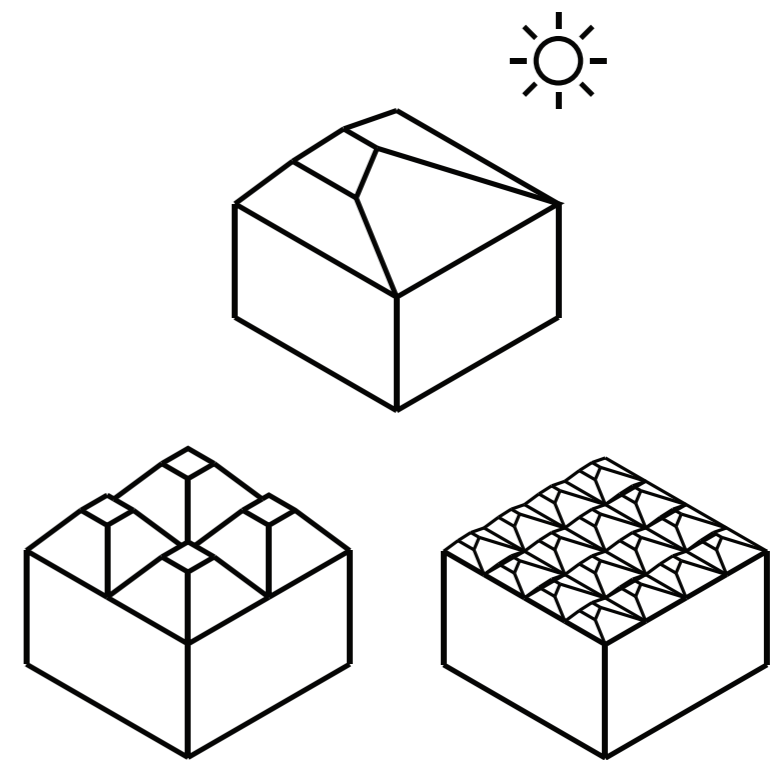
Opening for ventilation



Strong in one orientation

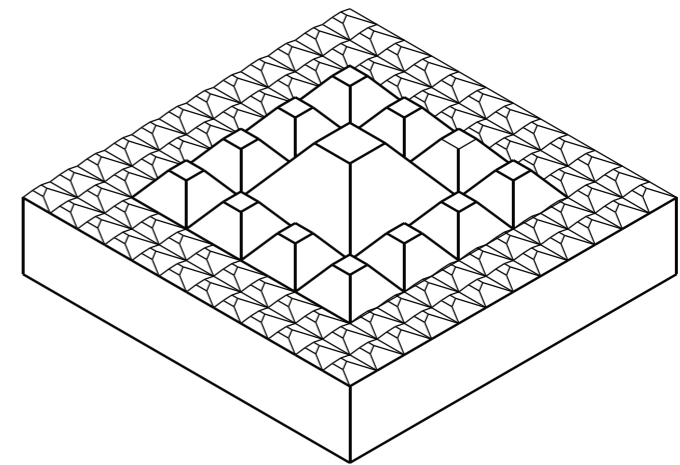
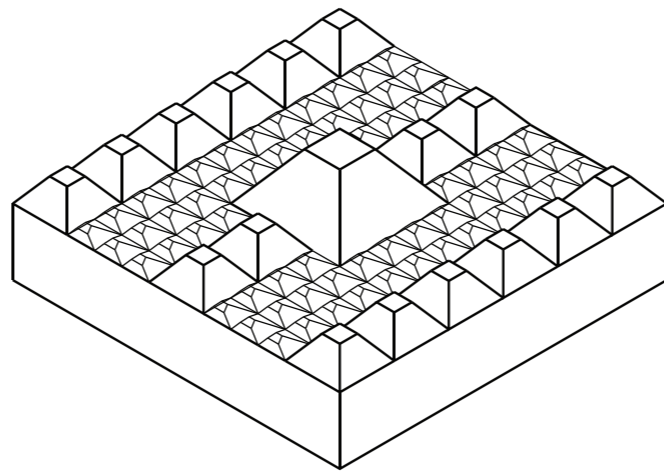
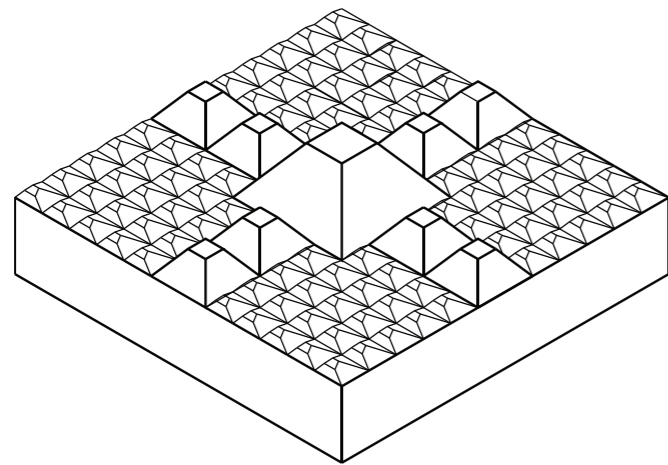
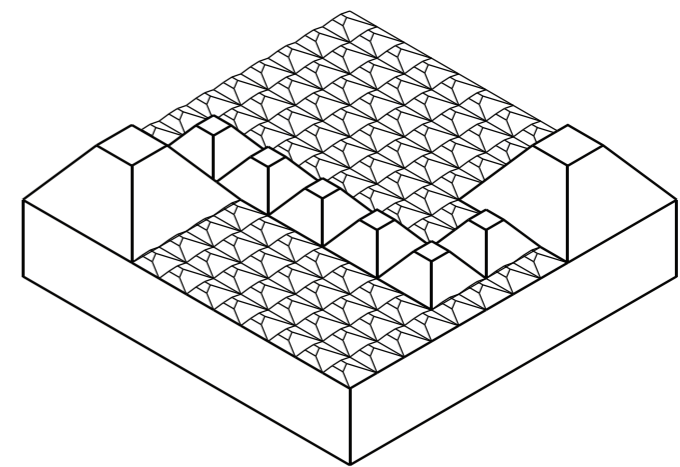
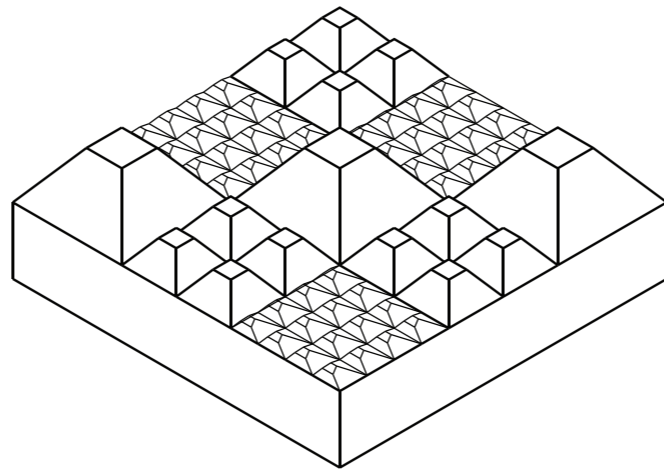
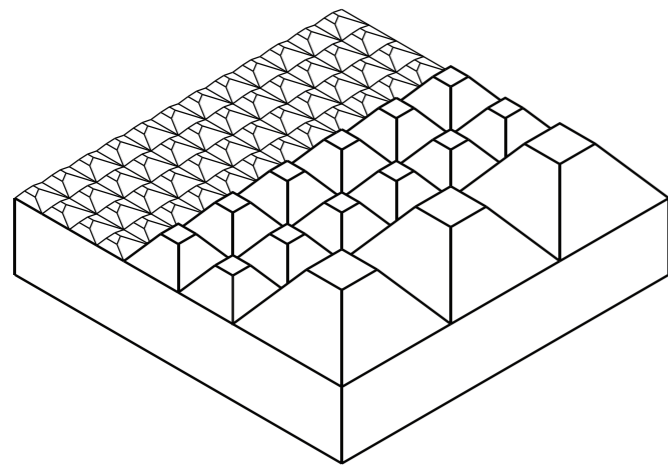


Flexible for diverse combination

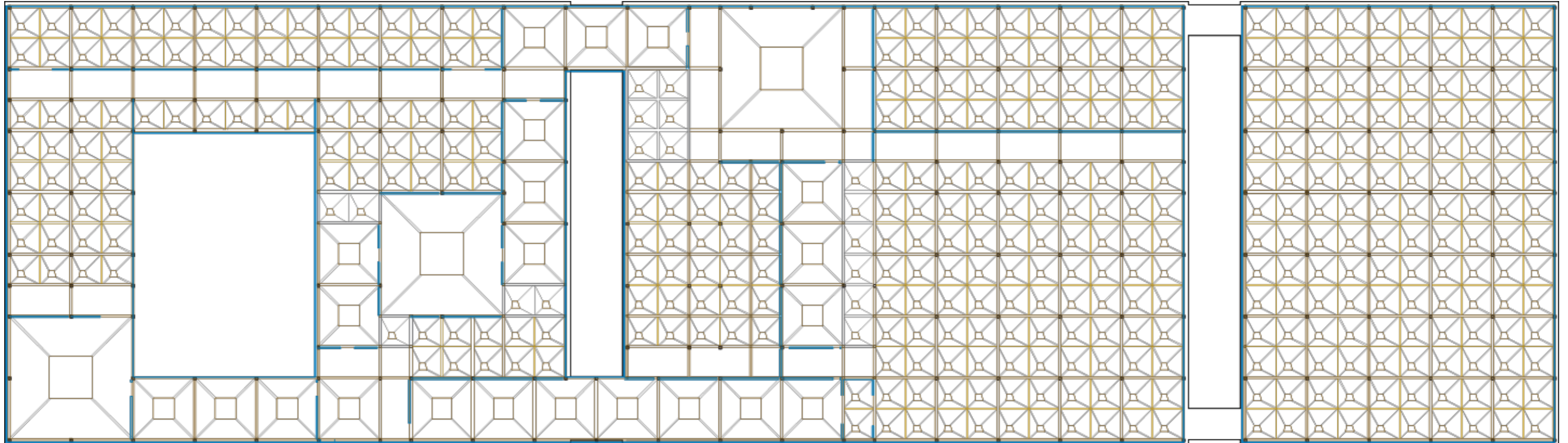


Vary in size & direction

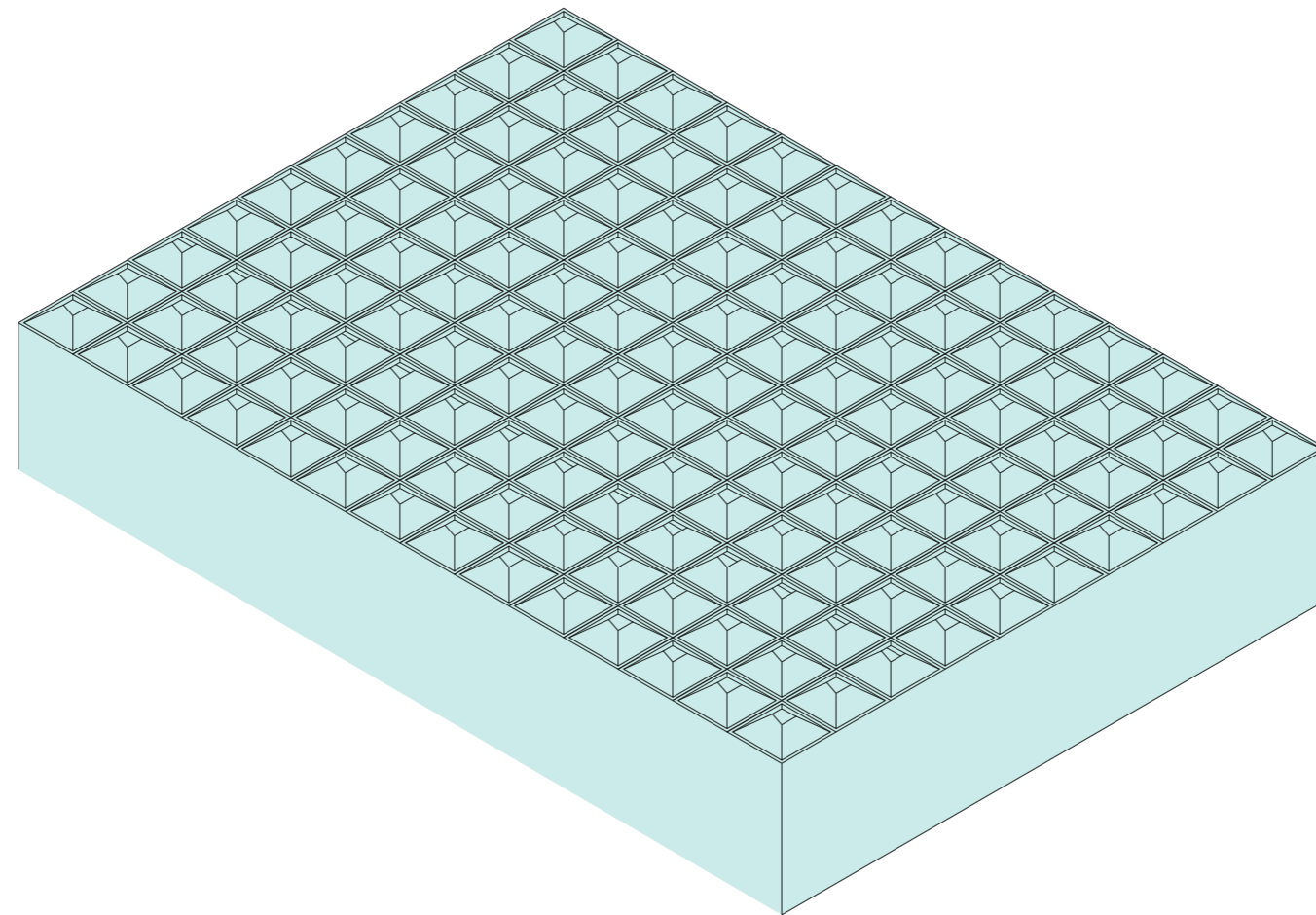
COMBINATION OPTIONS



ROOF PLAN



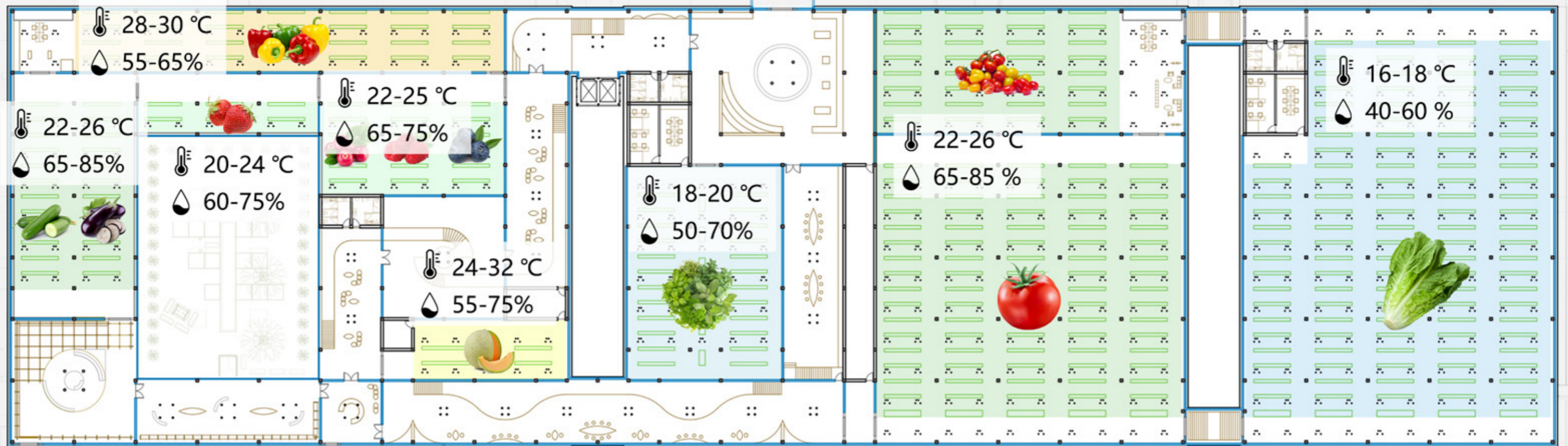
PRODUCTIVE GREENHOUSE



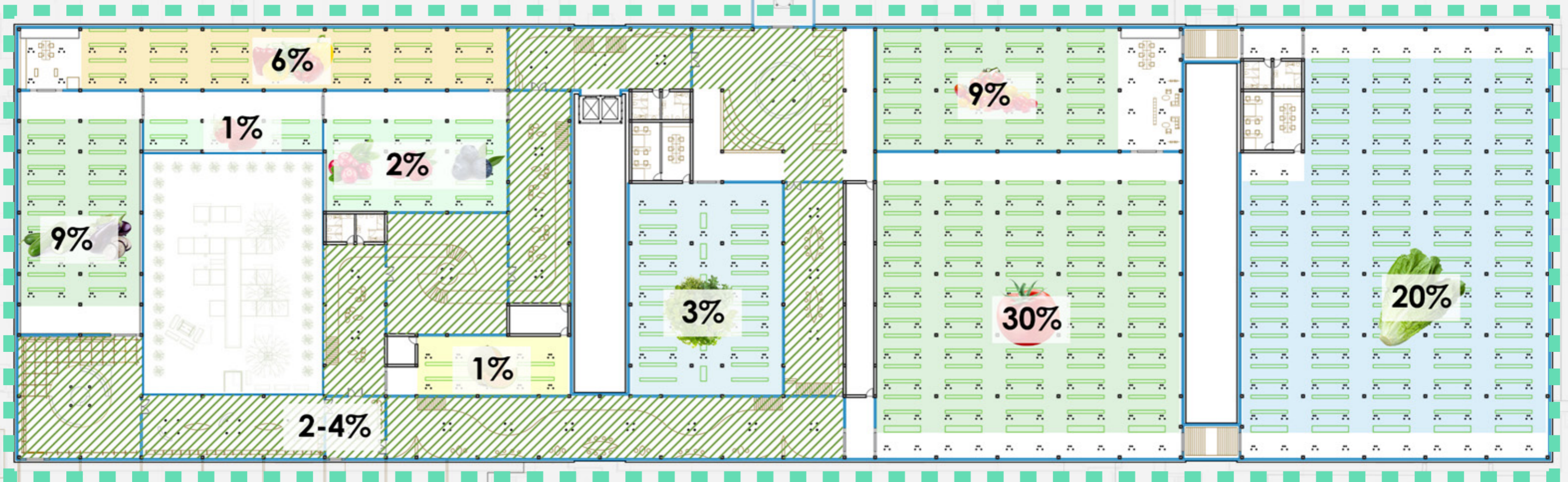
Food plant plan



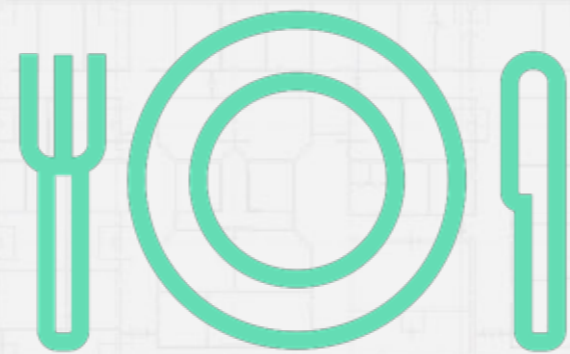
Requirement of indoor climate



Food production



DEMAND: 694,732 kg/year



Meet approx.
85%

Water requirement



Water demand per month

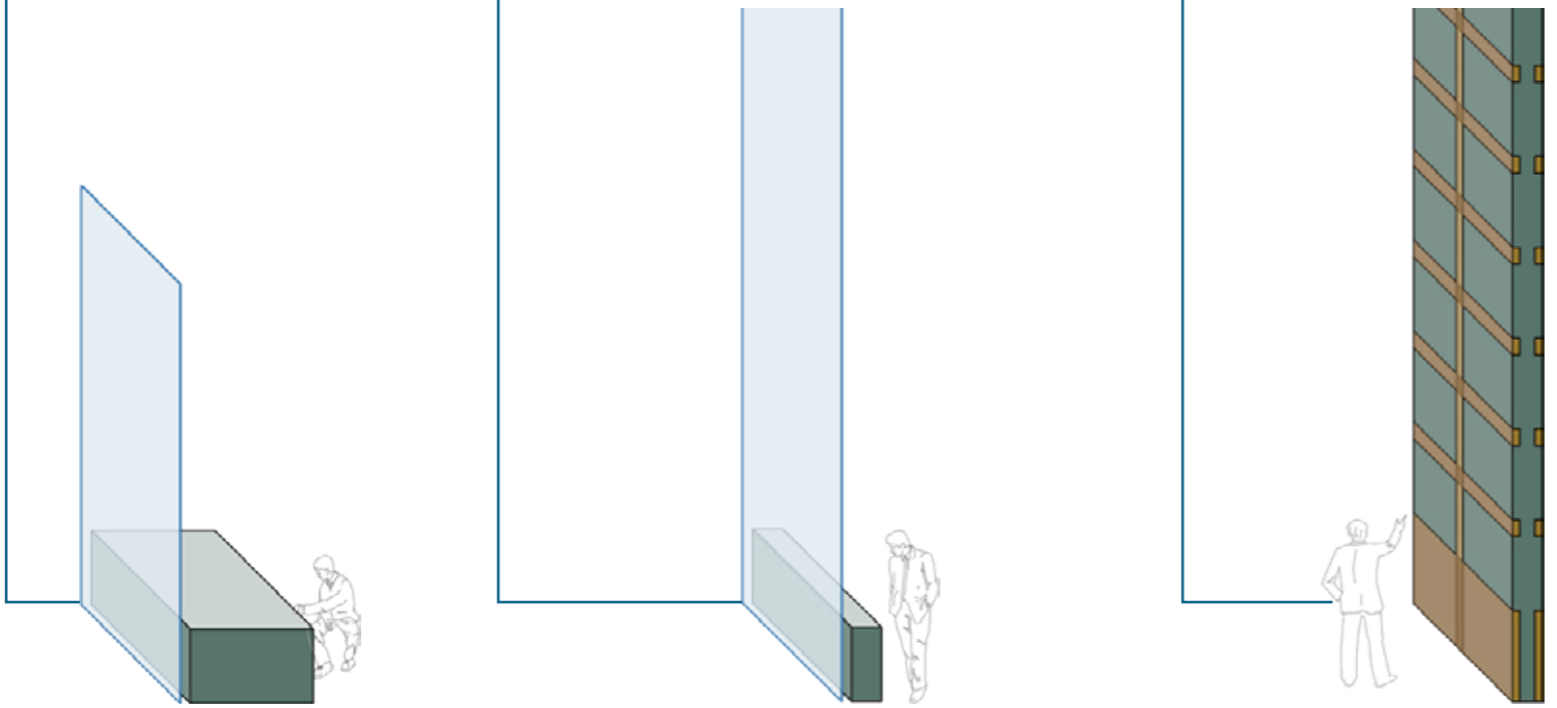
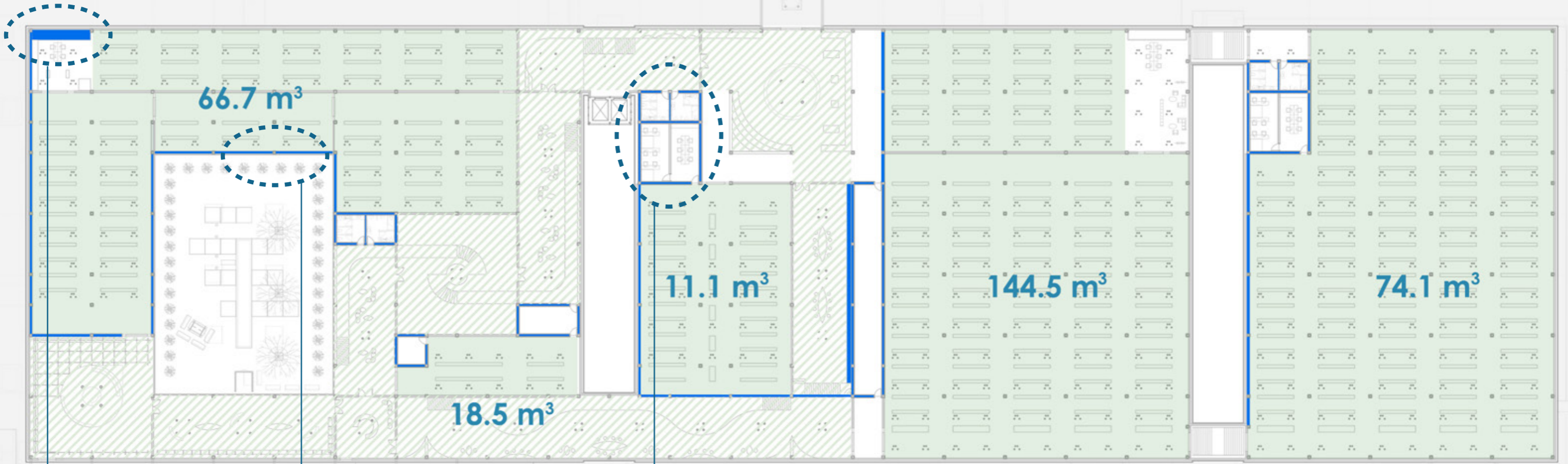




 AMS precipitation 766 mm/year

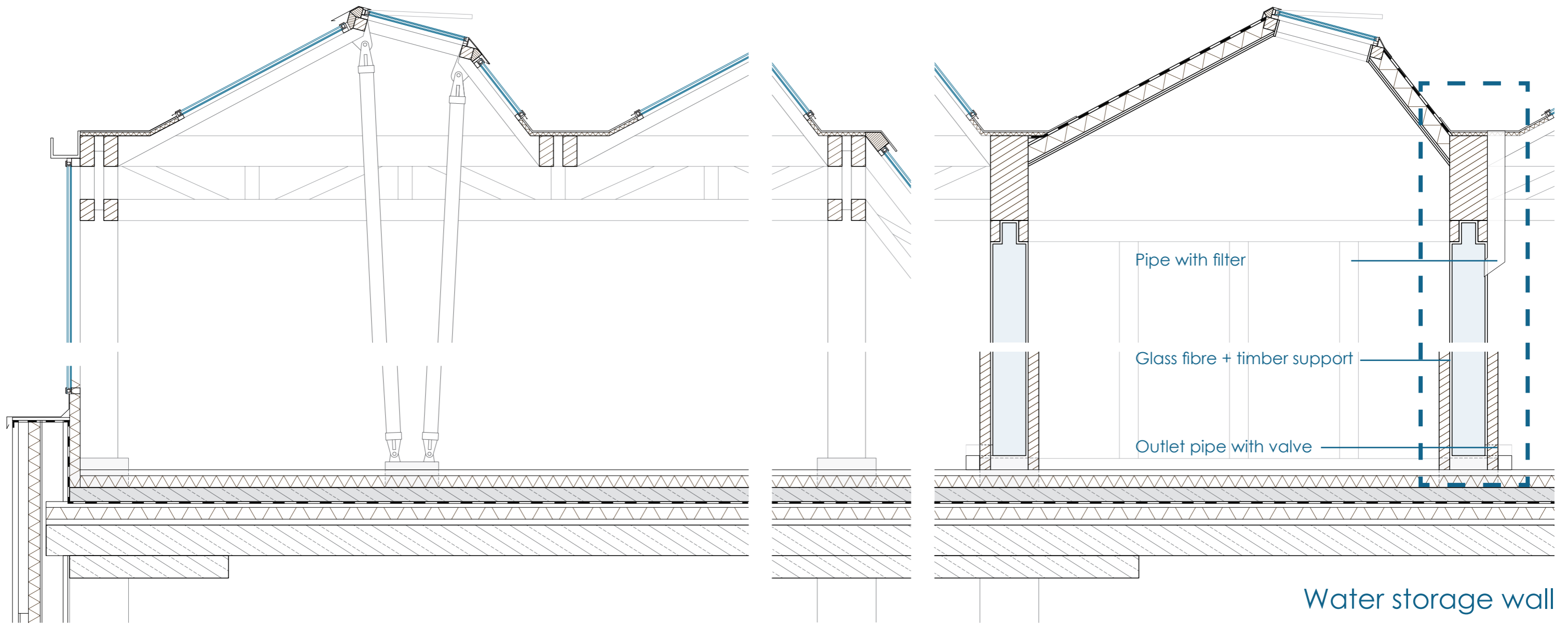
 Roof area: 9,248 m²

Rainwater collected: 7,083,968 L/year

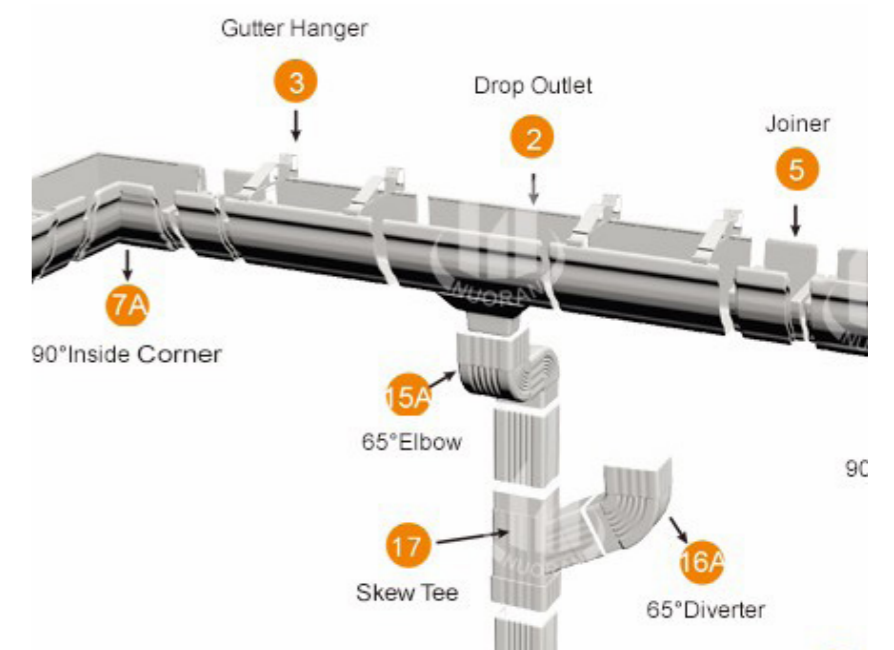
Total water need: 3,799,342 L/year



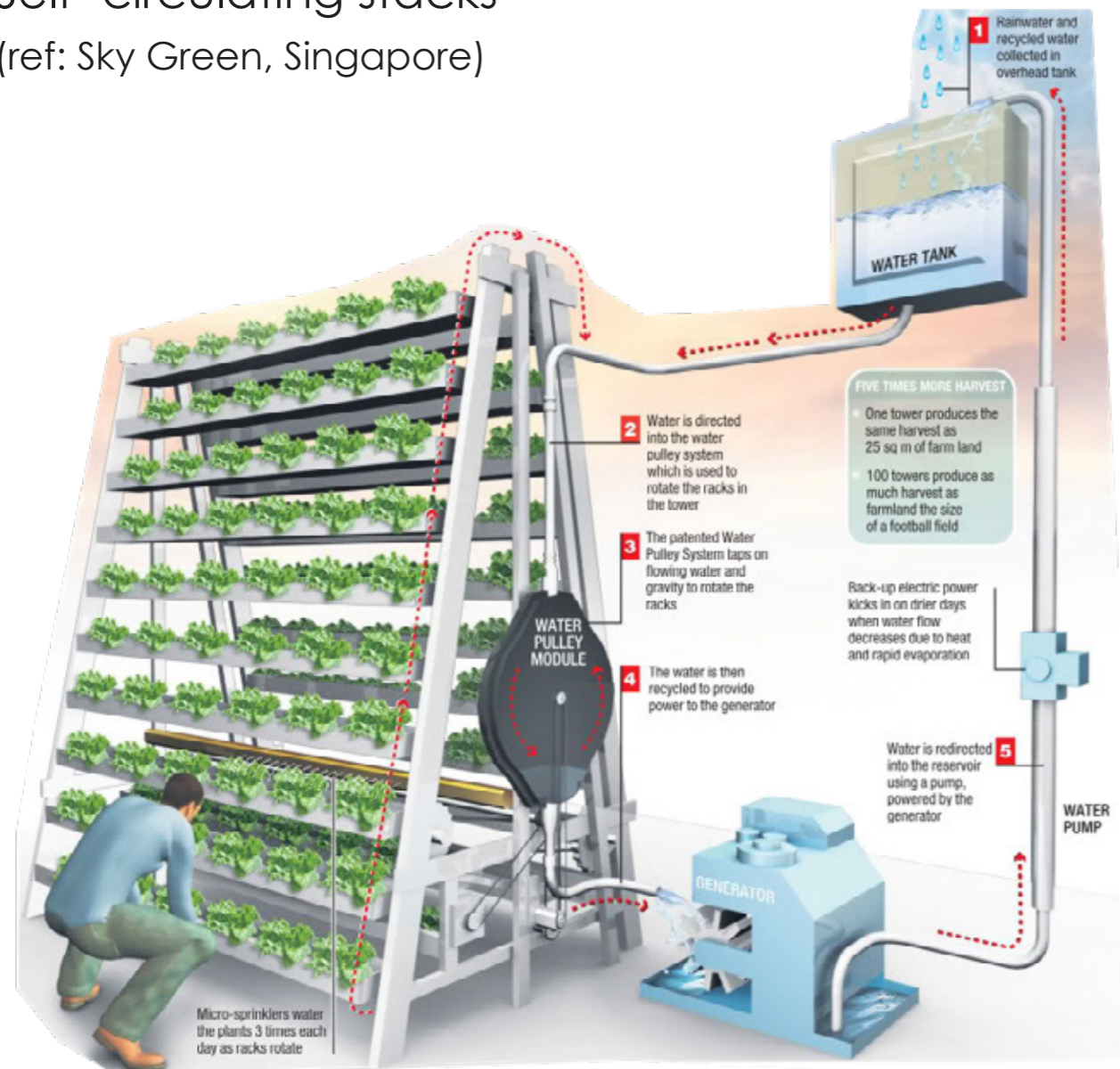
Polyethylene	V.S.	Fibre glass
		
Max. 50,000 gallons (189,270 L)		Stronger - can bear load
Economical		Costly
Flexible - plastic		Ideal for large, custom- designed tank
Dark hue inhibiting growth of algae		Need internal lining for algae reduction



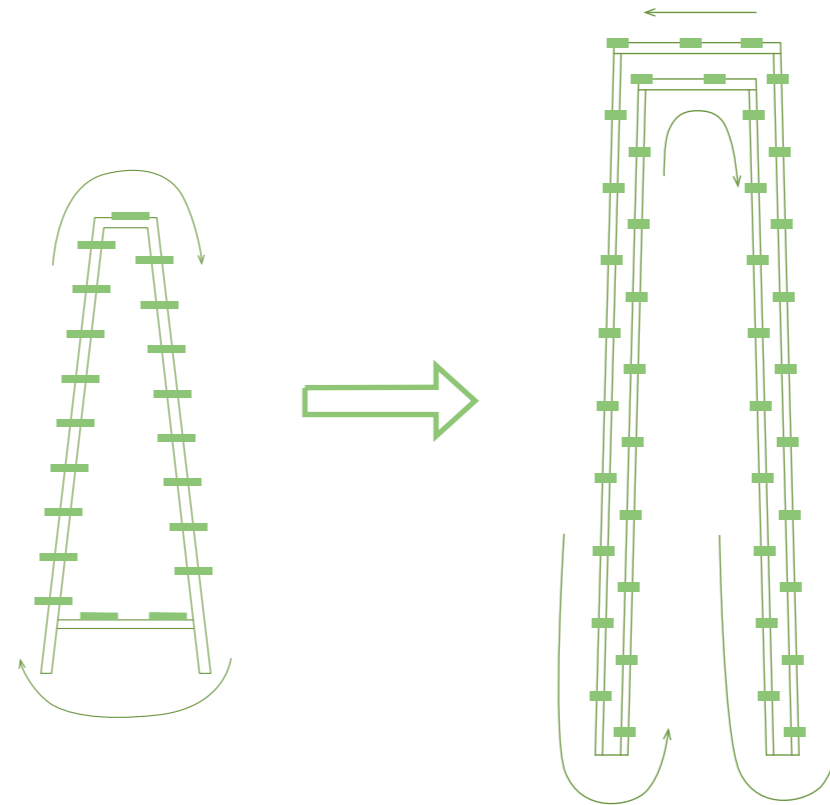
Water storage wall



Self-circulating stacks
(ref: Sky Green, Singapore)



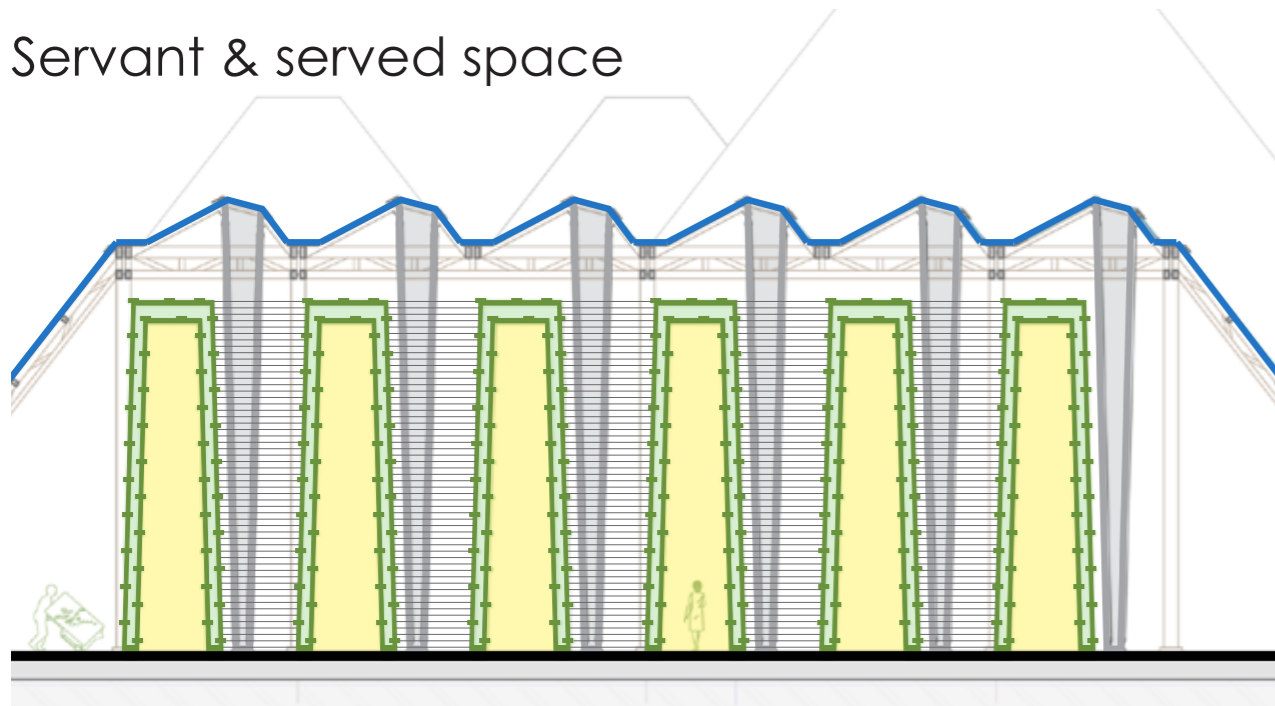
Double layer
- better use of space

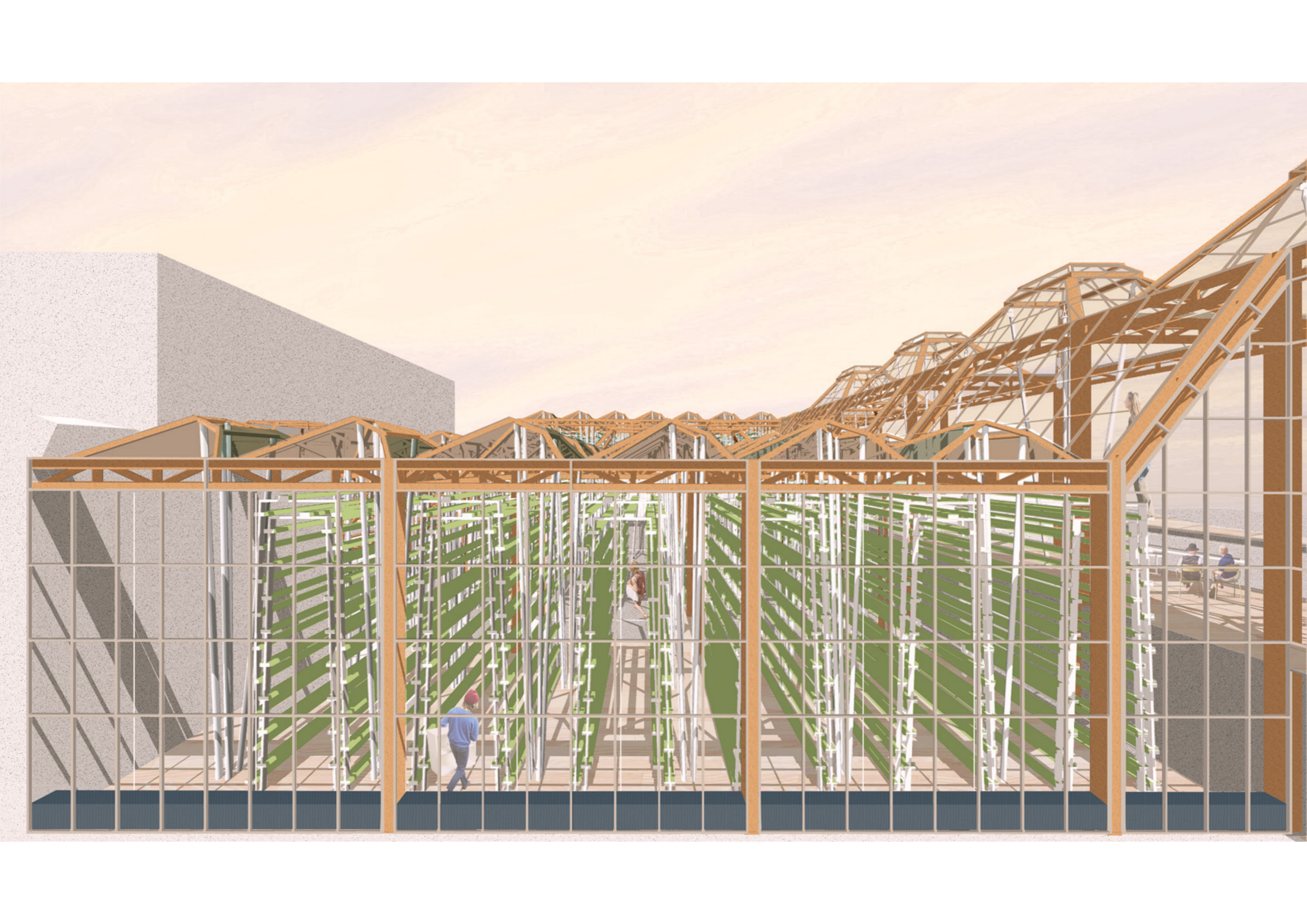


Light supplyment on core

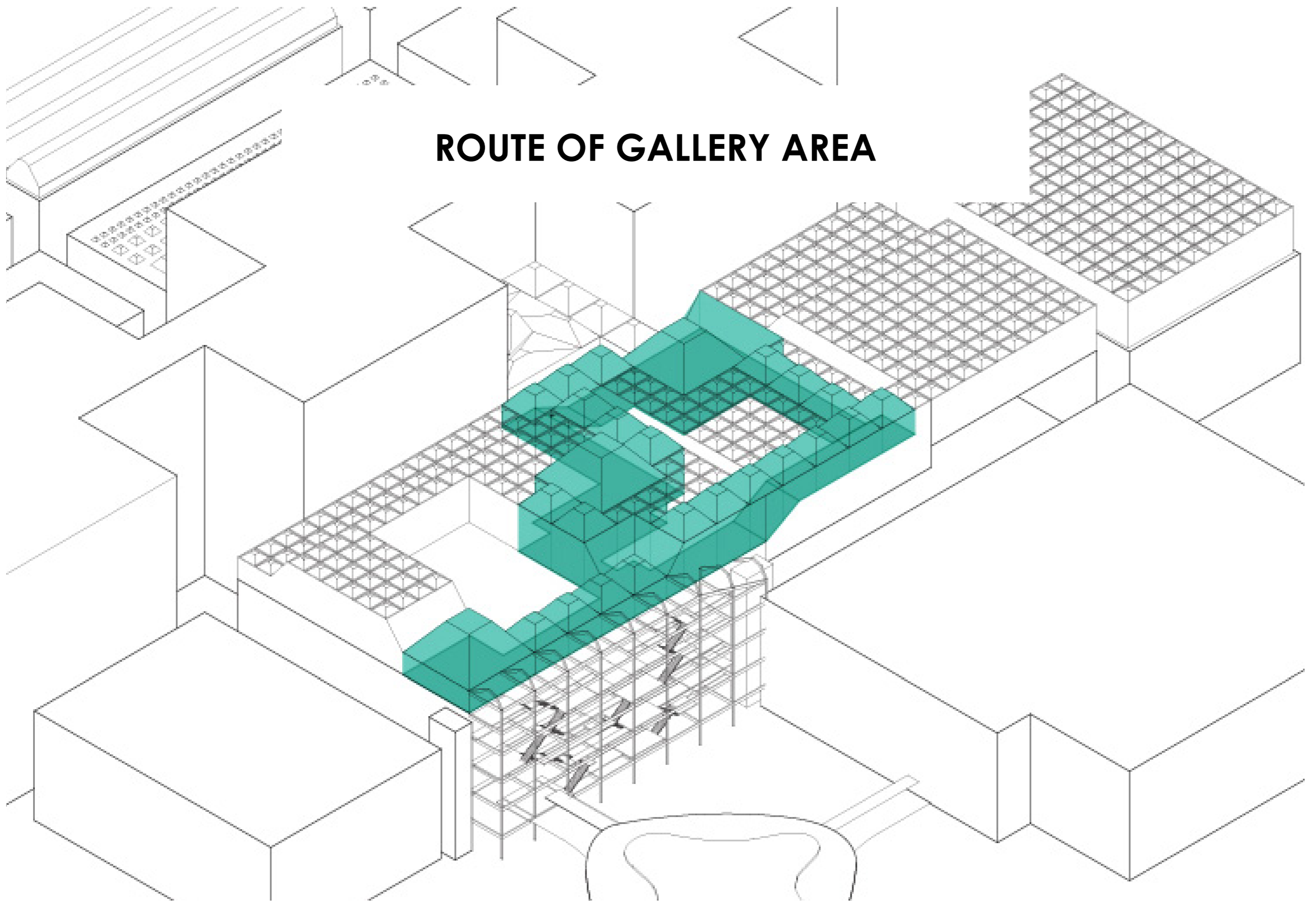


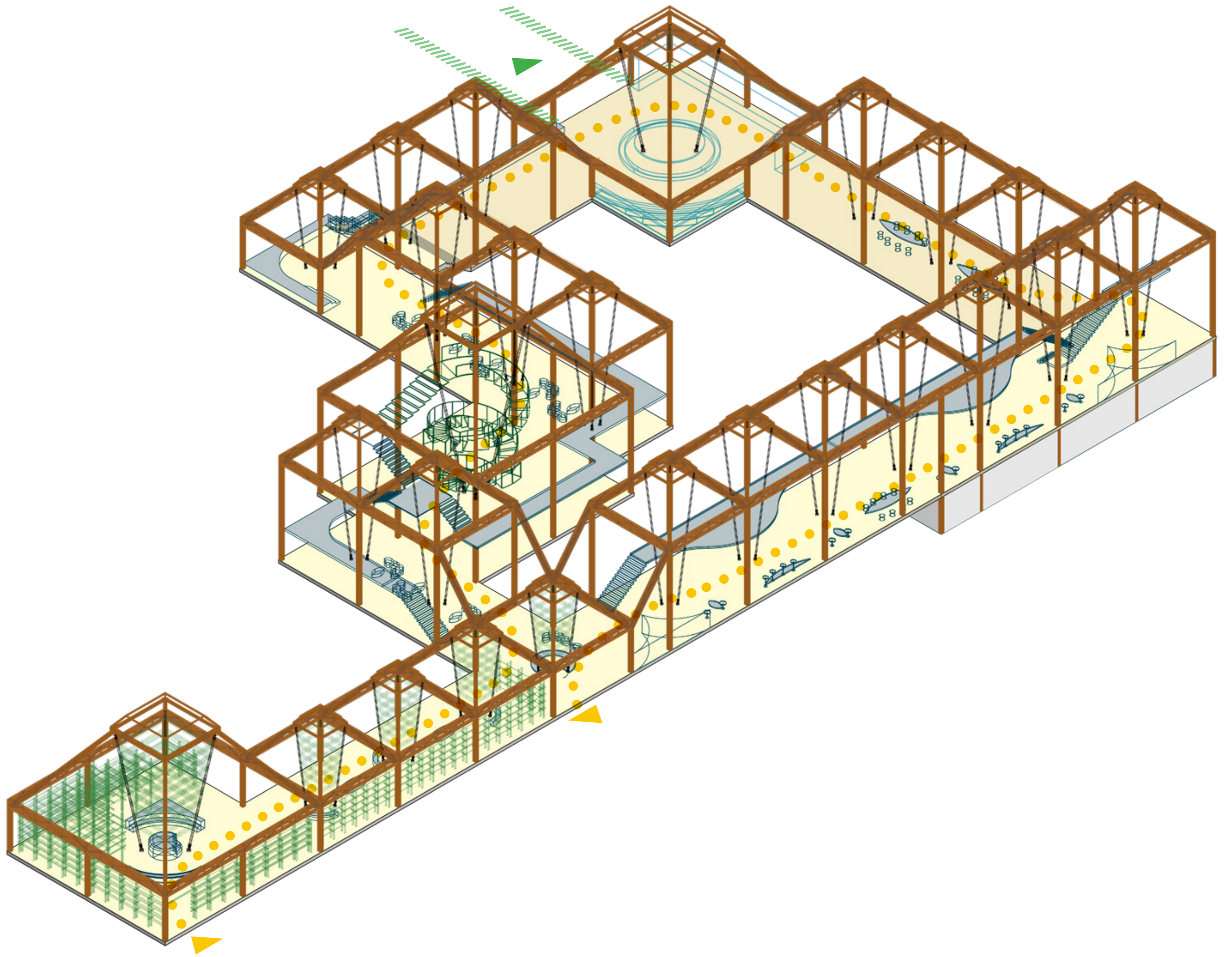
Servant & served space

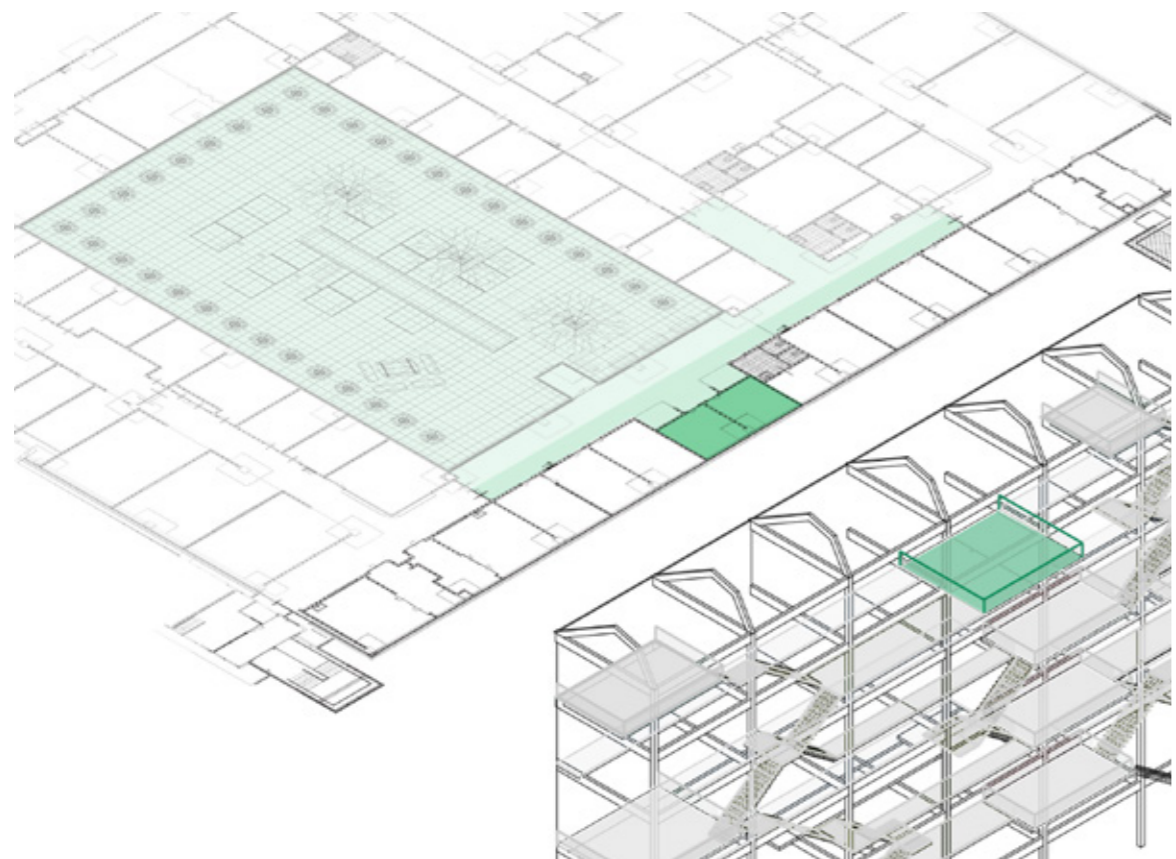
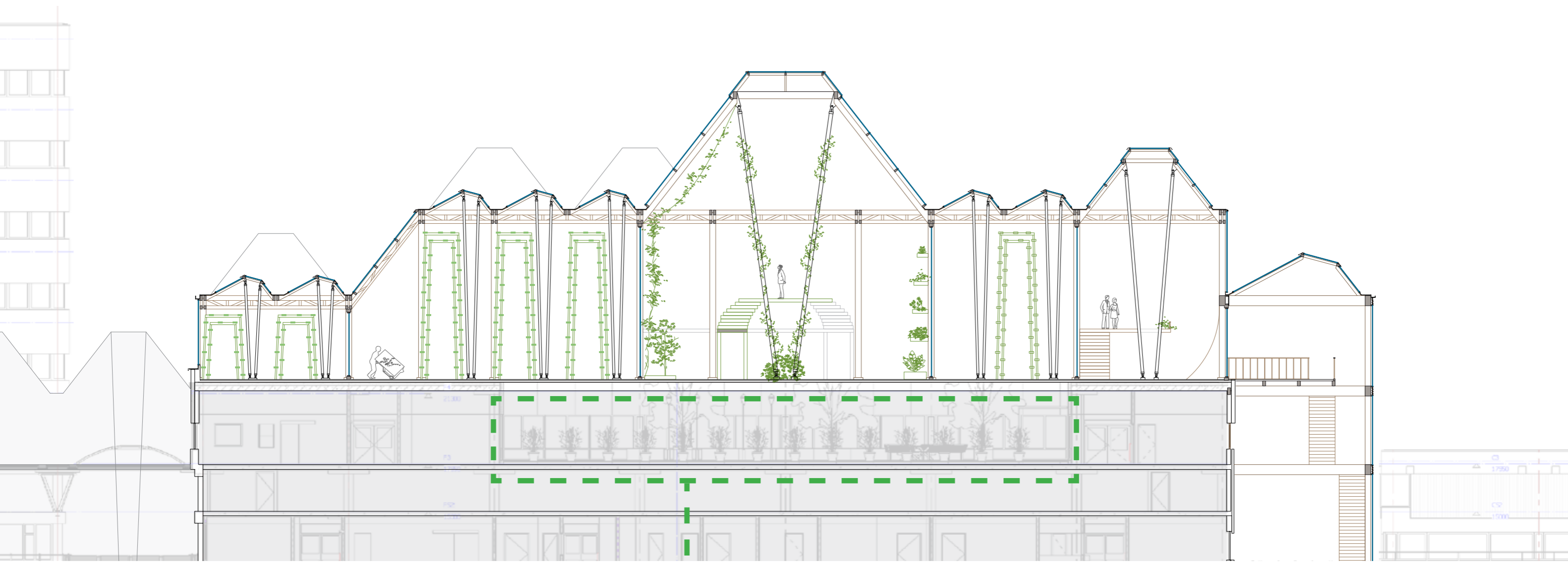




ROUTE OF GALLERY AREA

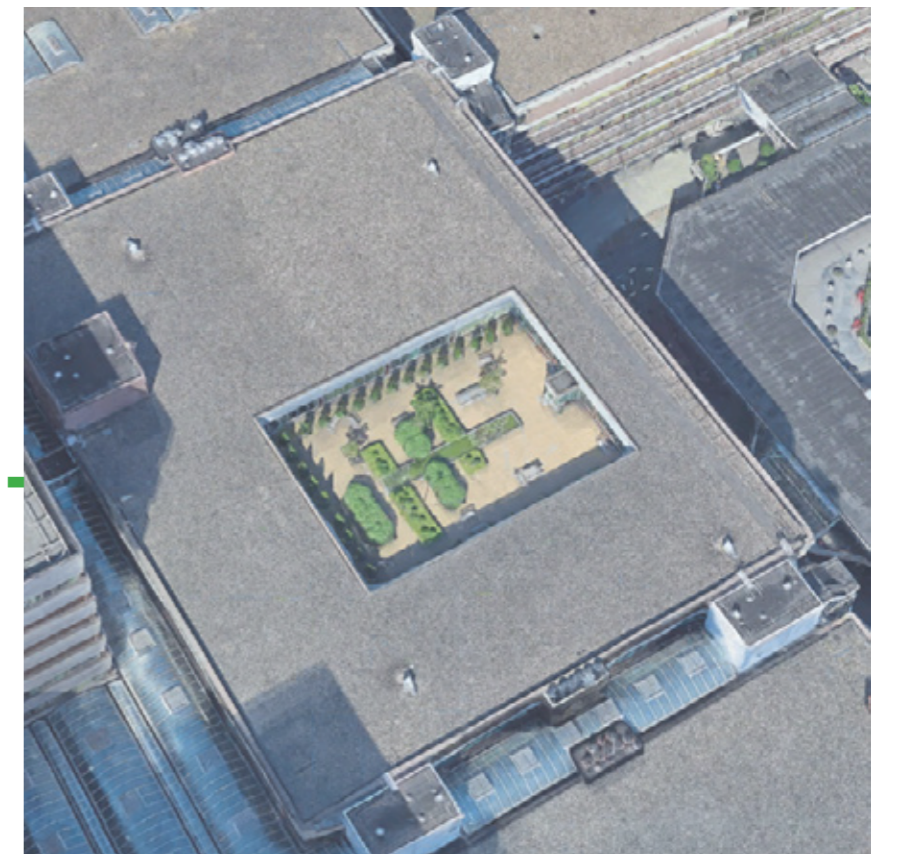




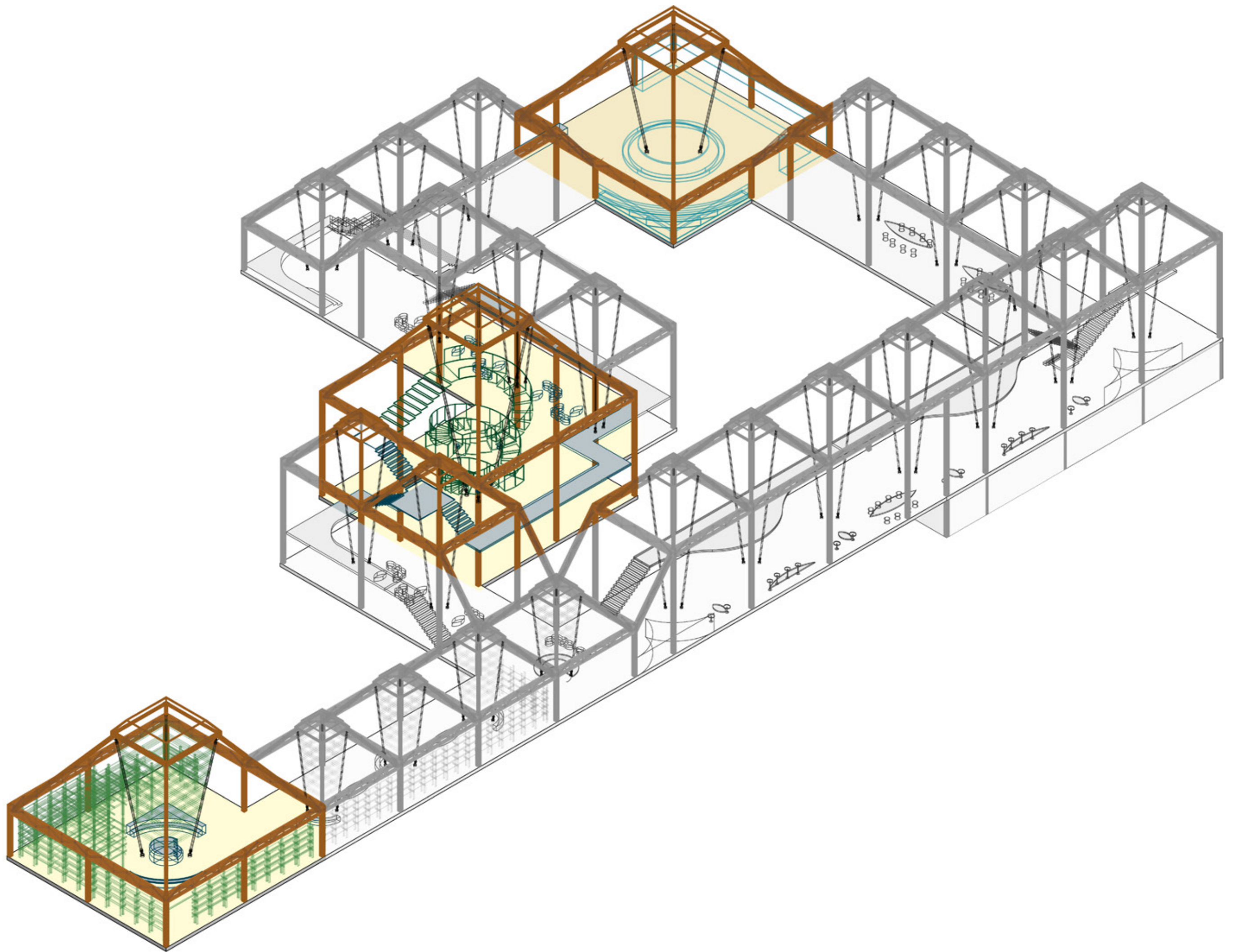


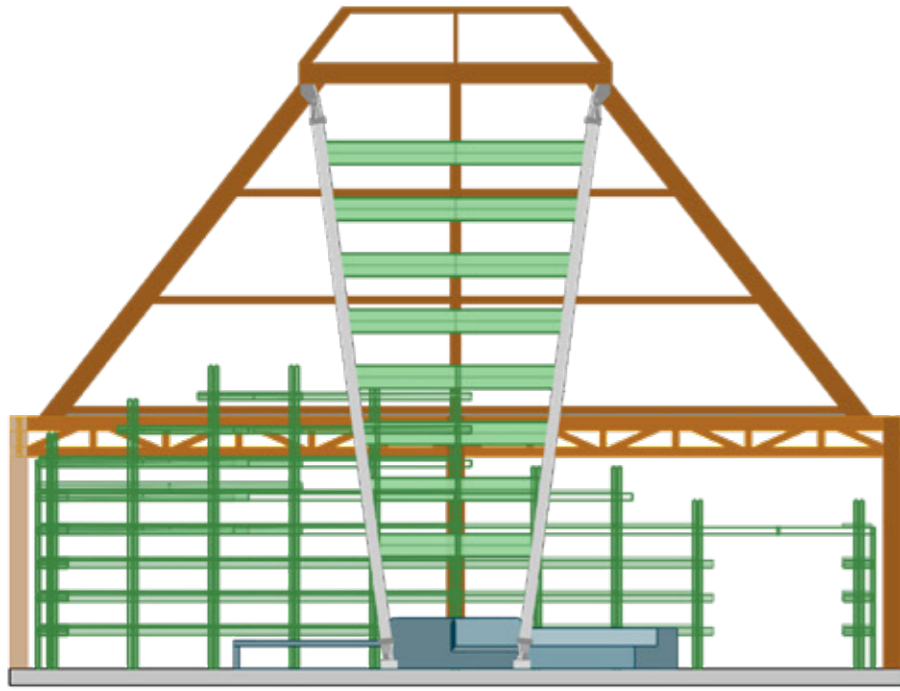
Original roof garden

- kept for patients
- connect to staircase

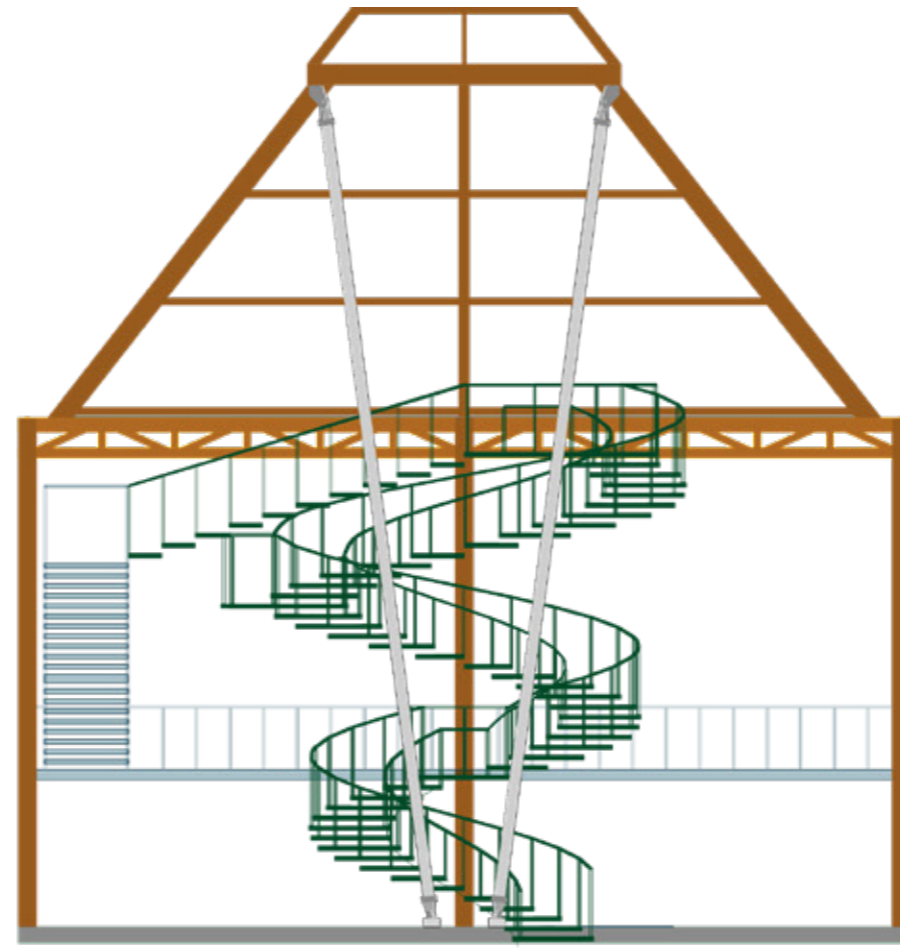




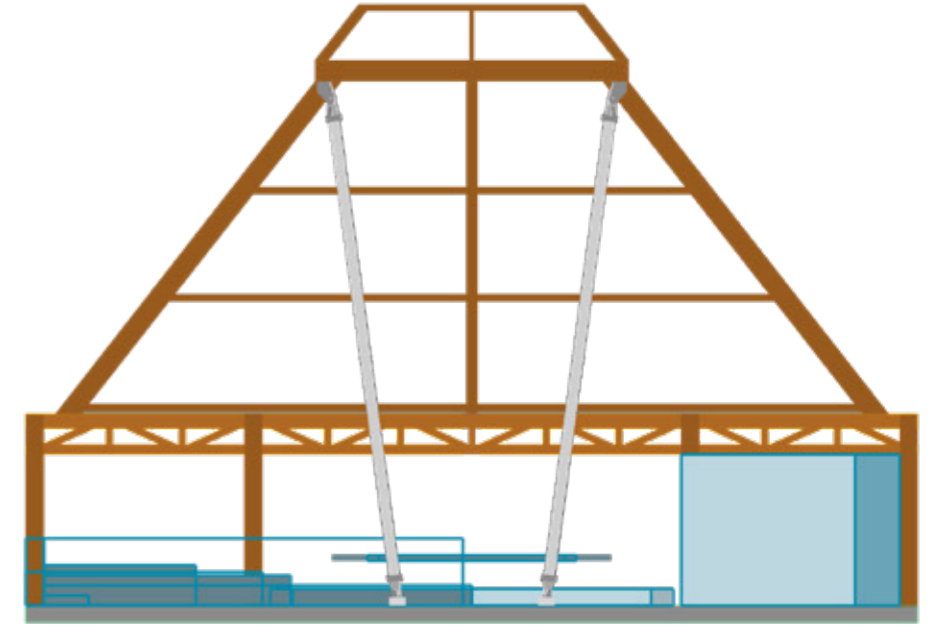




Introductory



Interpenetrated



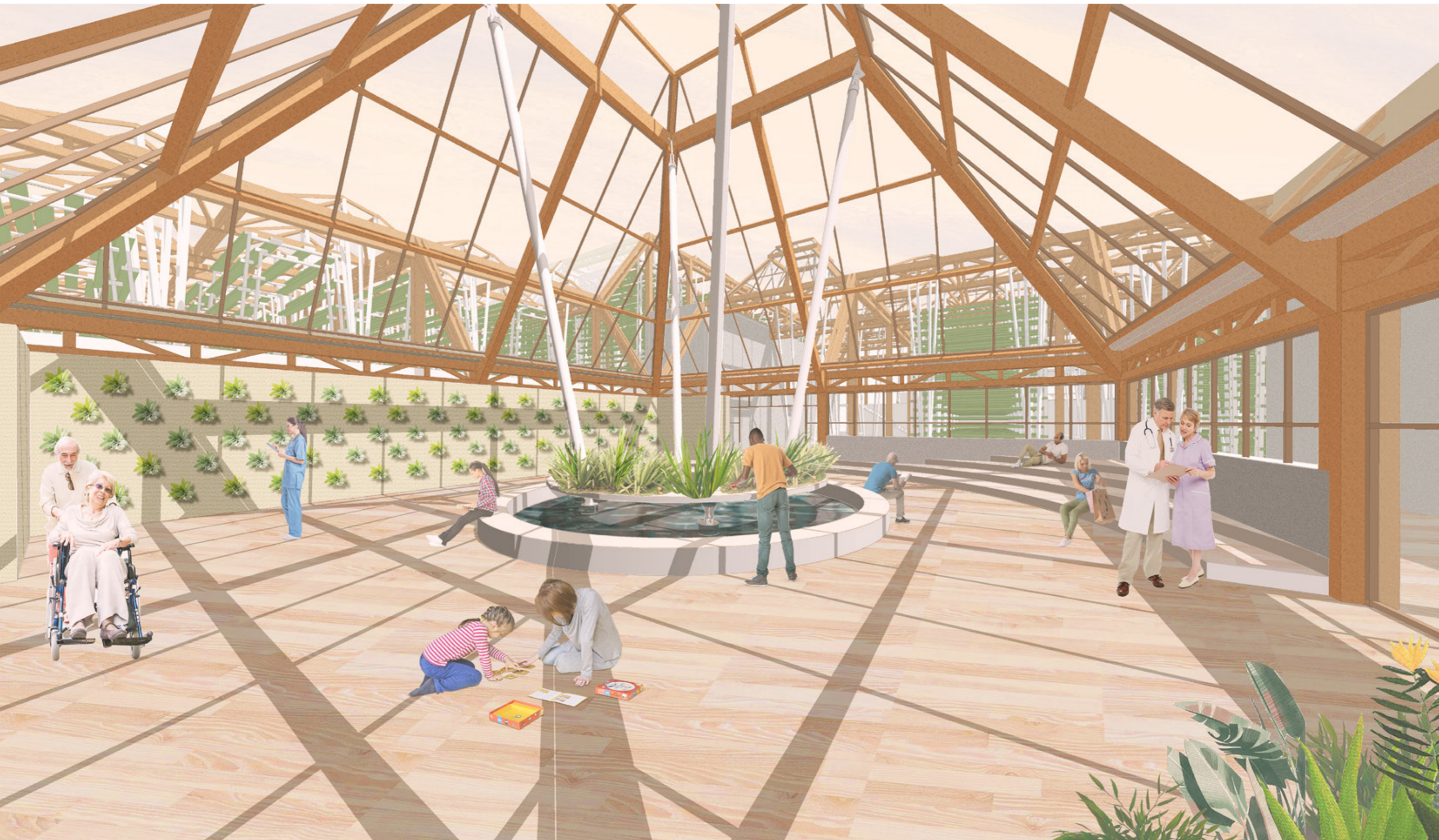
Interactive



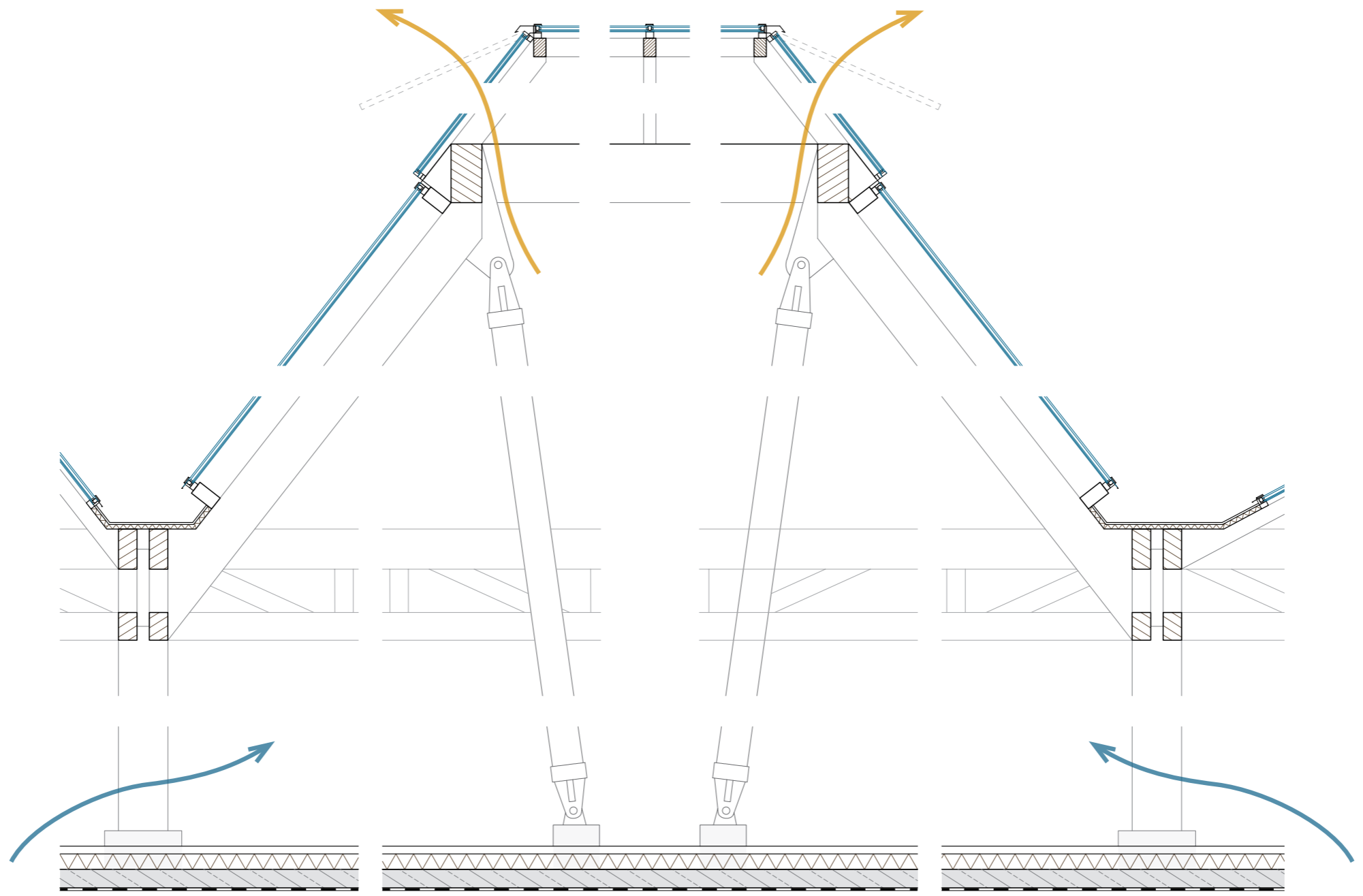








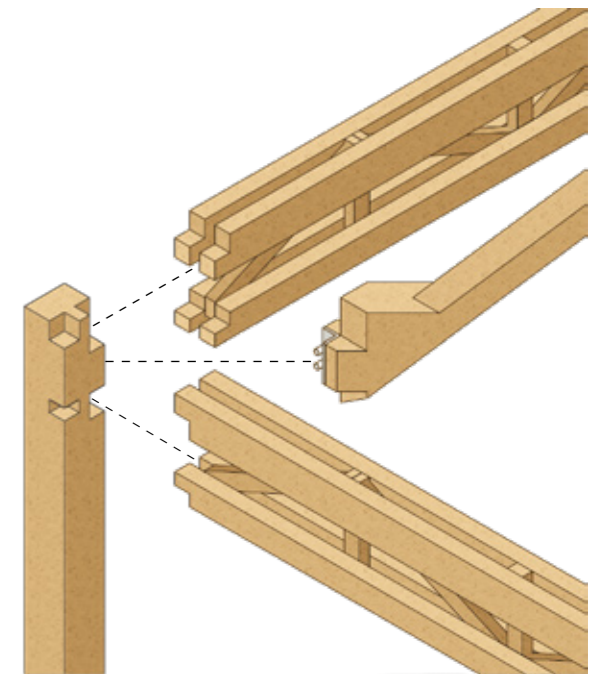
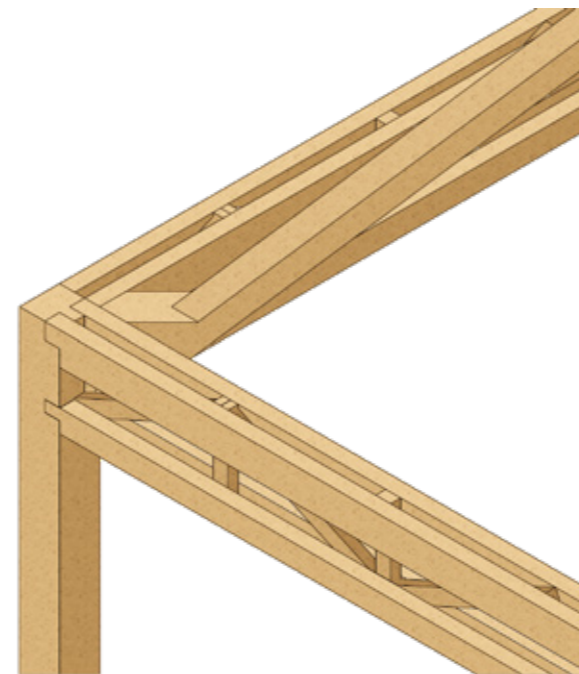
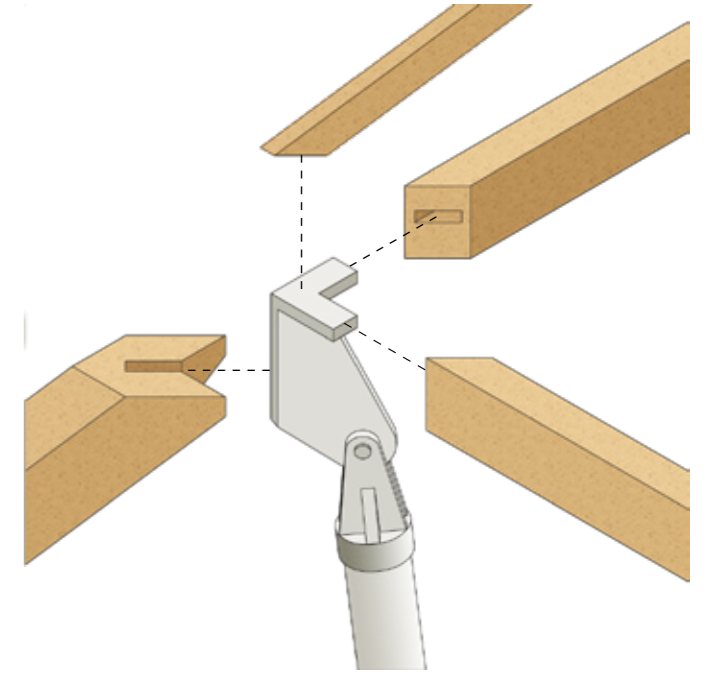
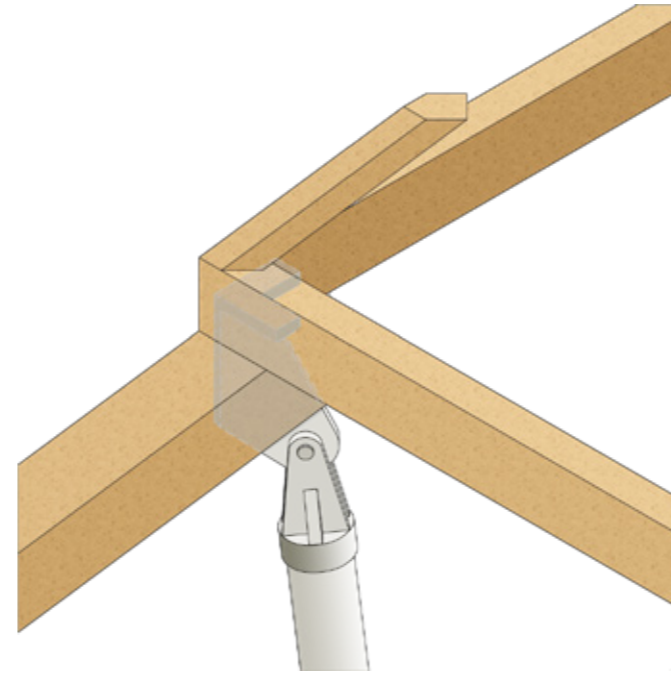
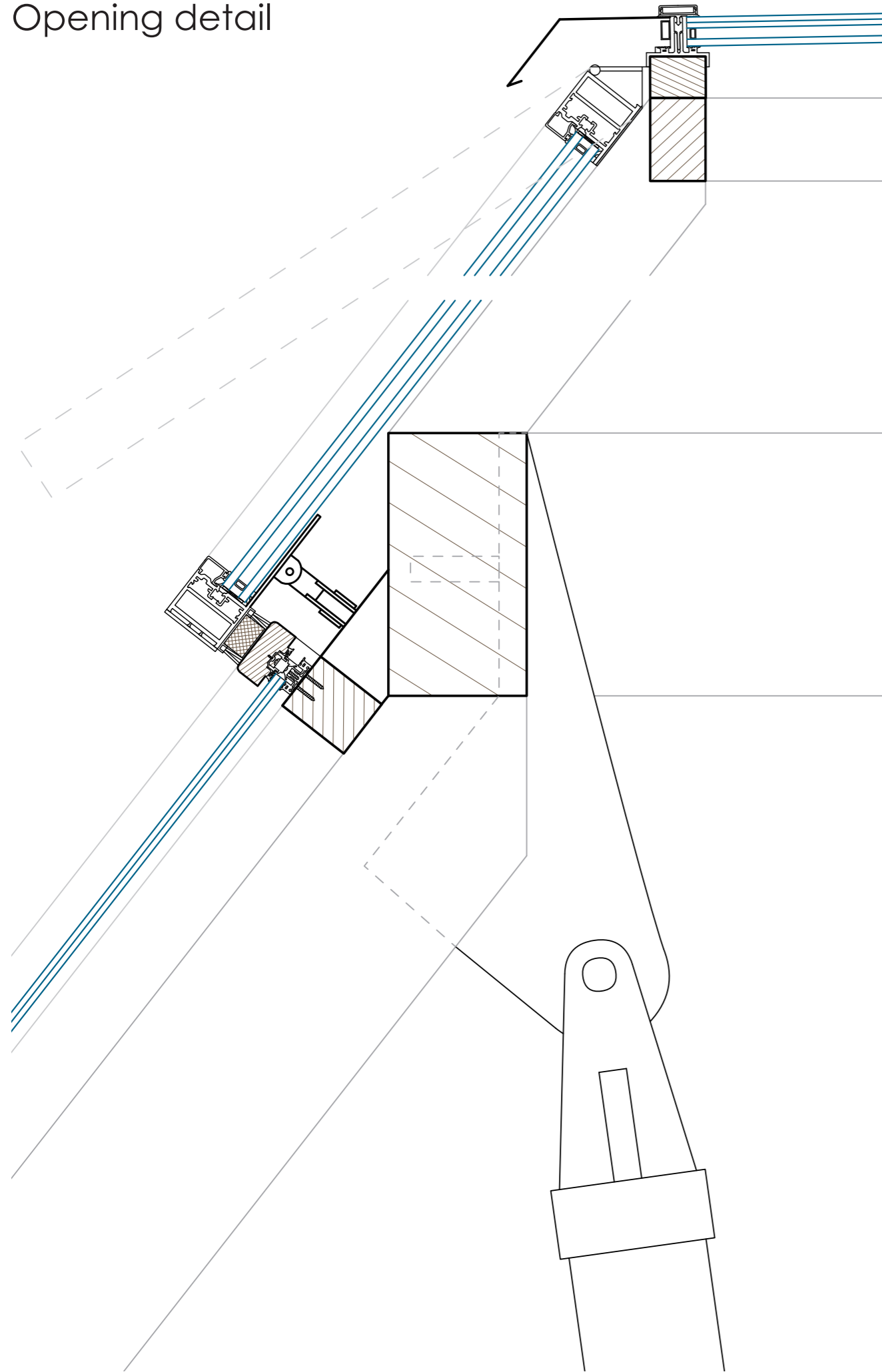




Natural ventilation + HVAC supplement

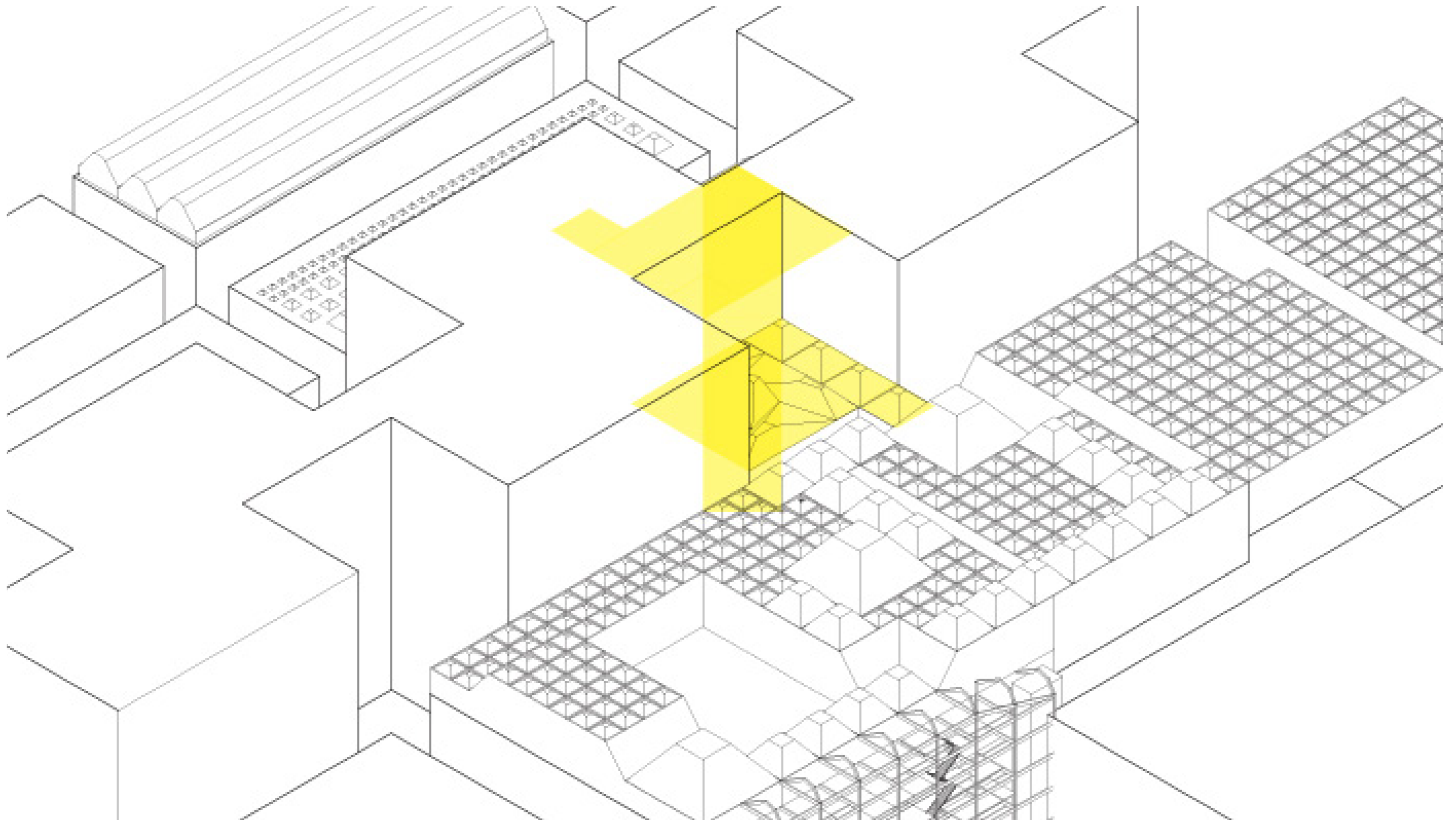


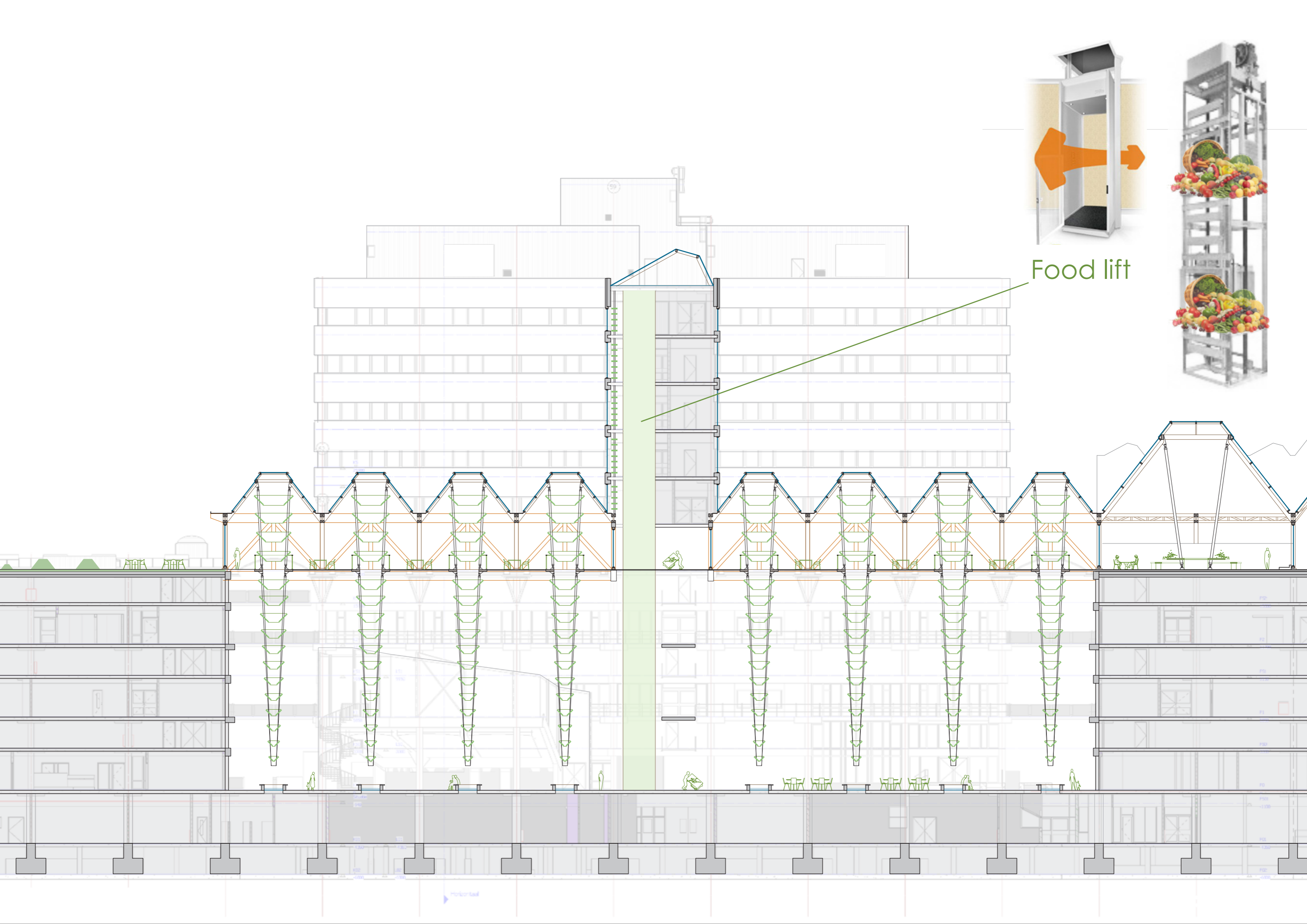
Opening detail





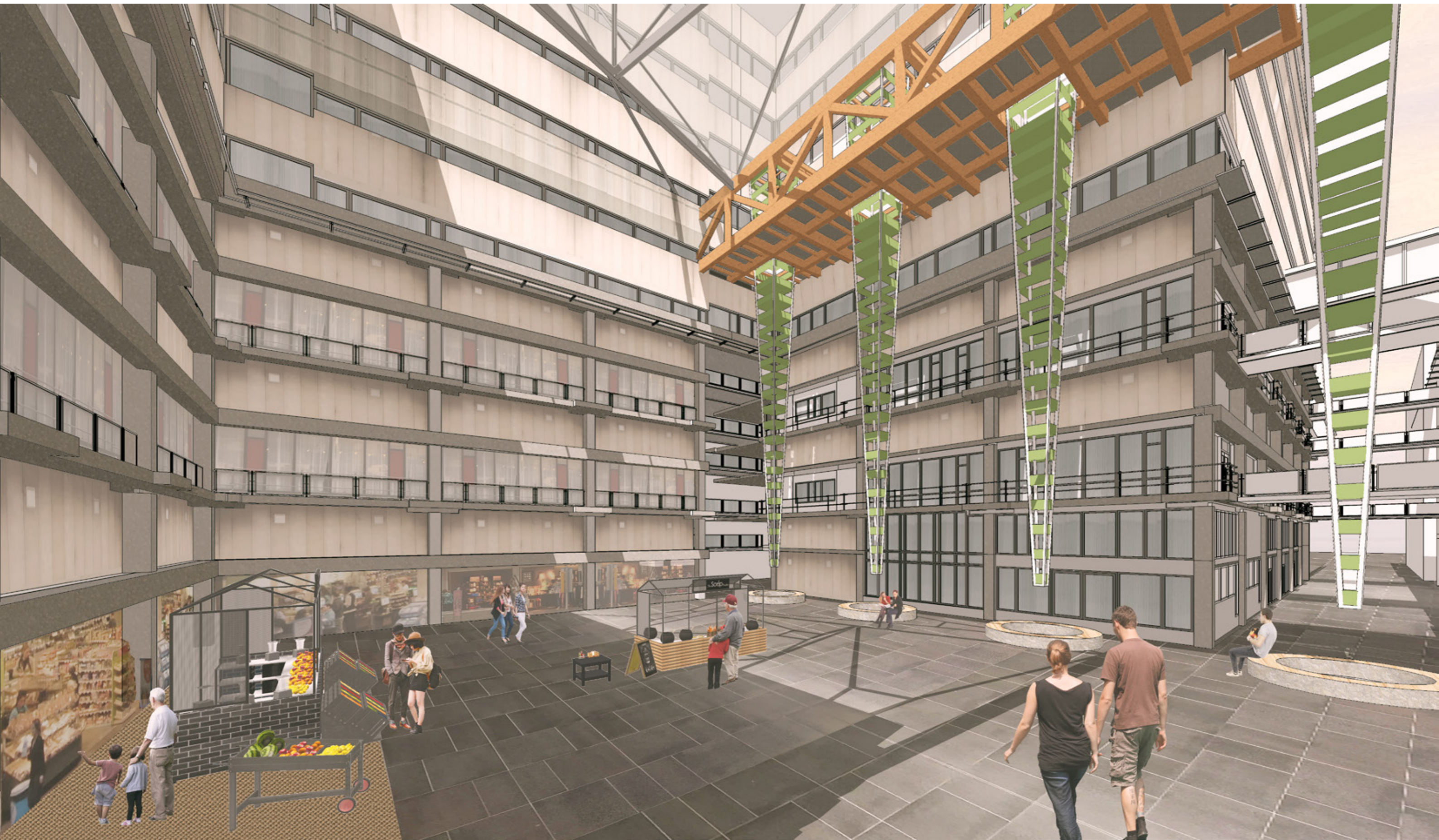
ATRIUM + ROOFTOP CONNECTION





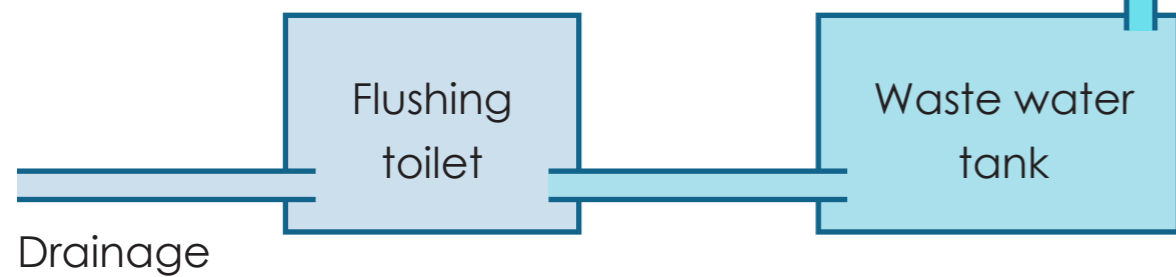
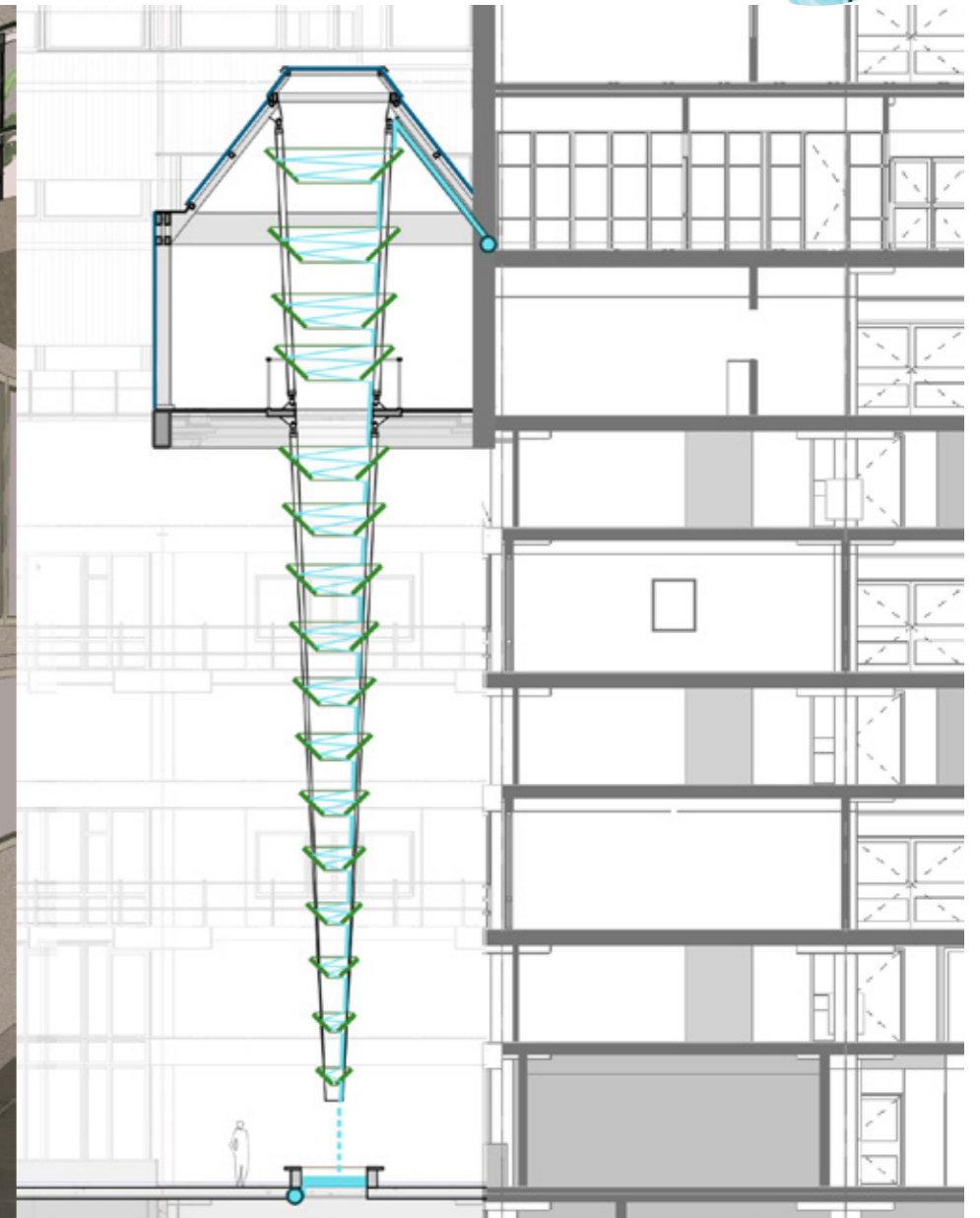
Food lift



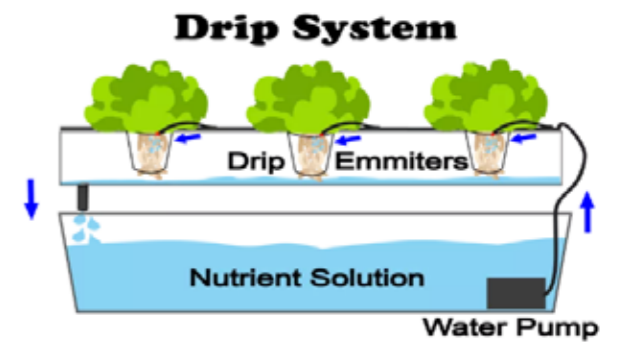


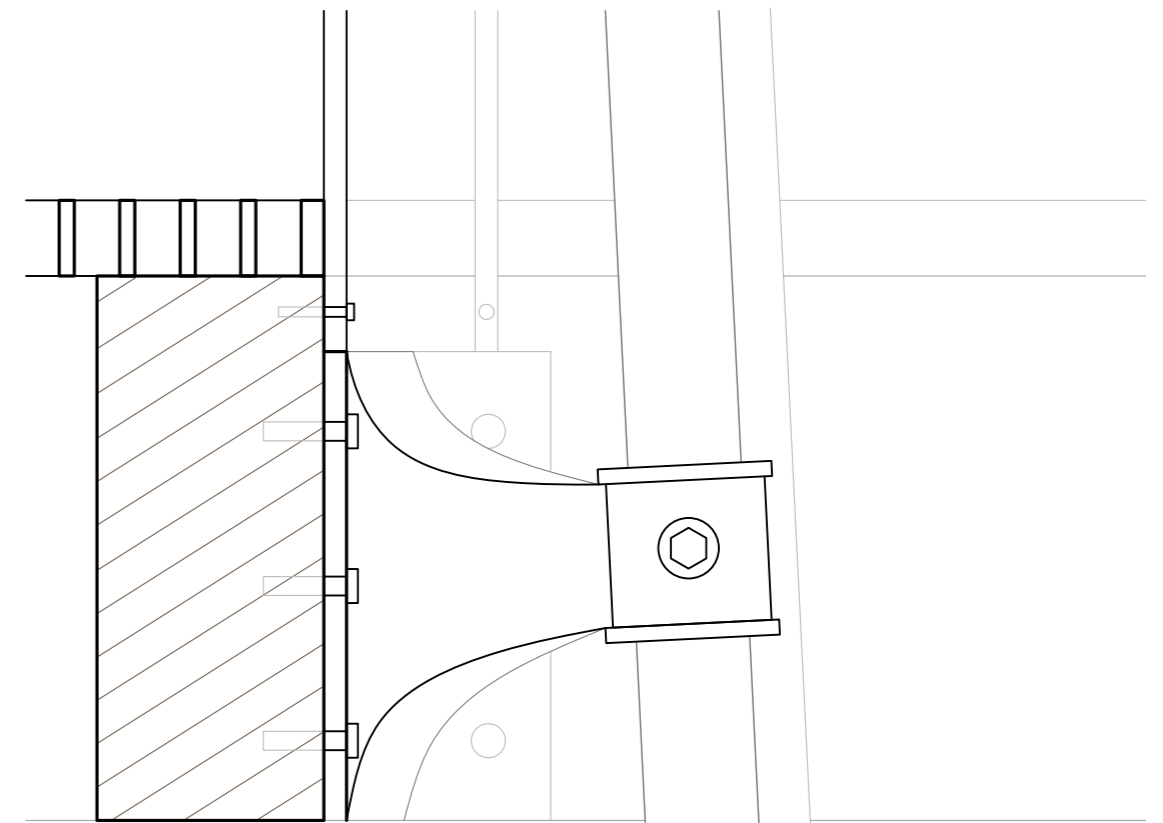
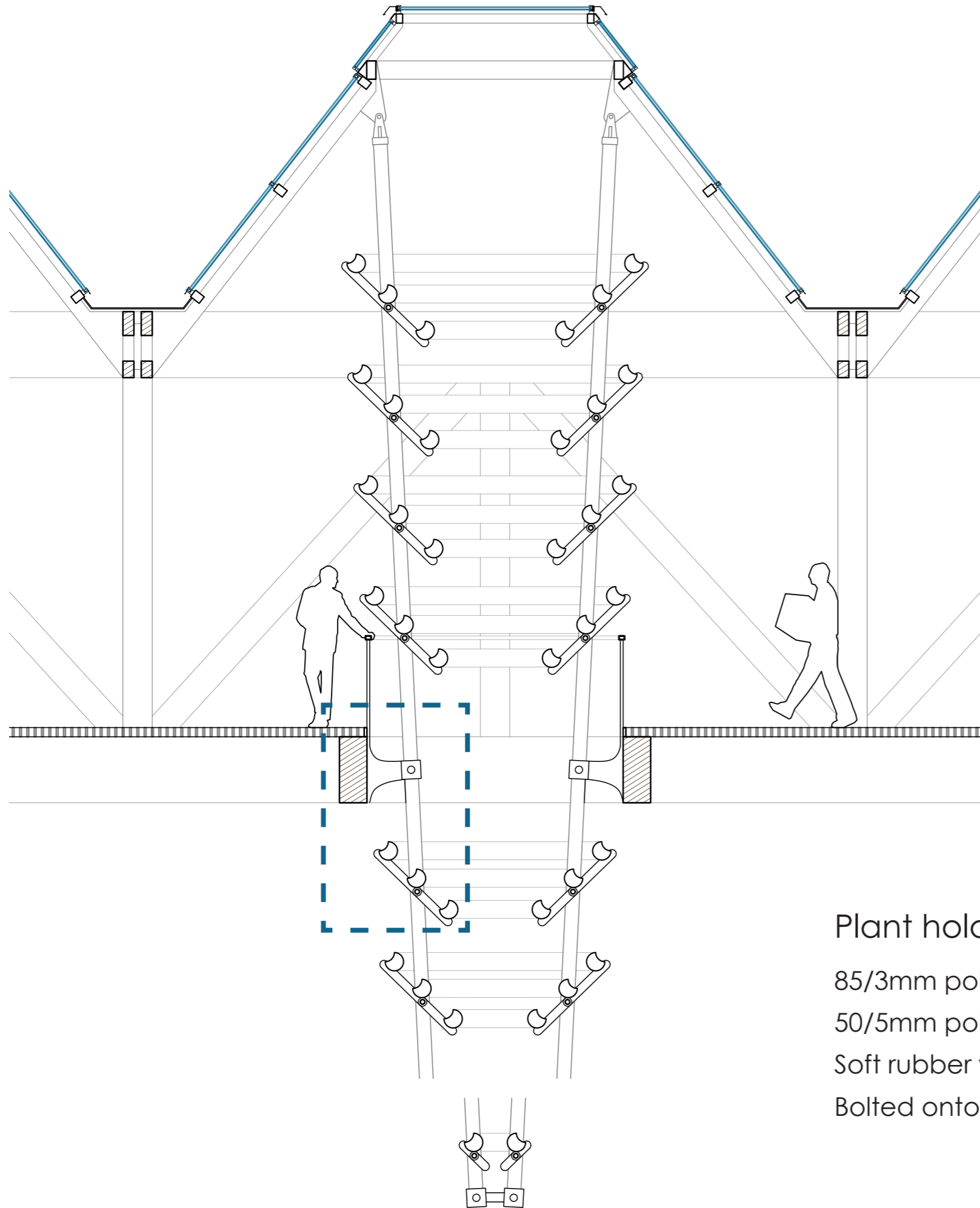


Water supply from existing system



30L per time,
3 times/day

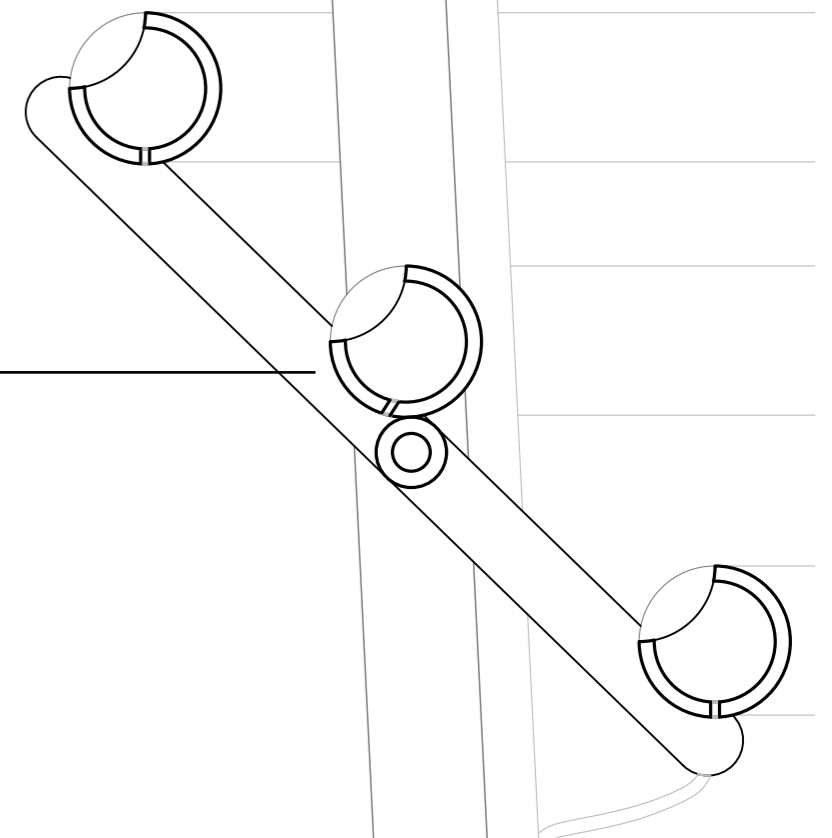


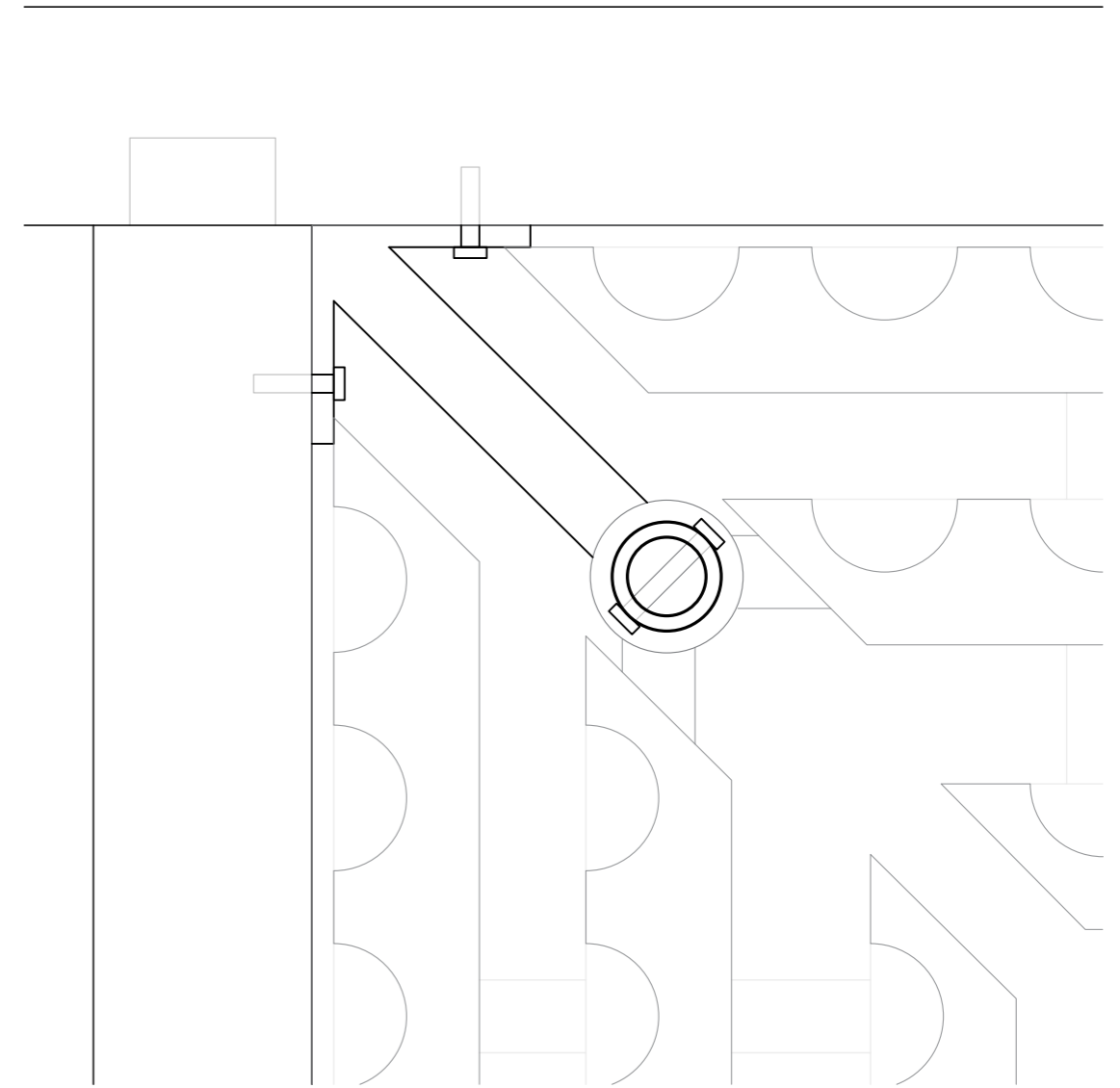
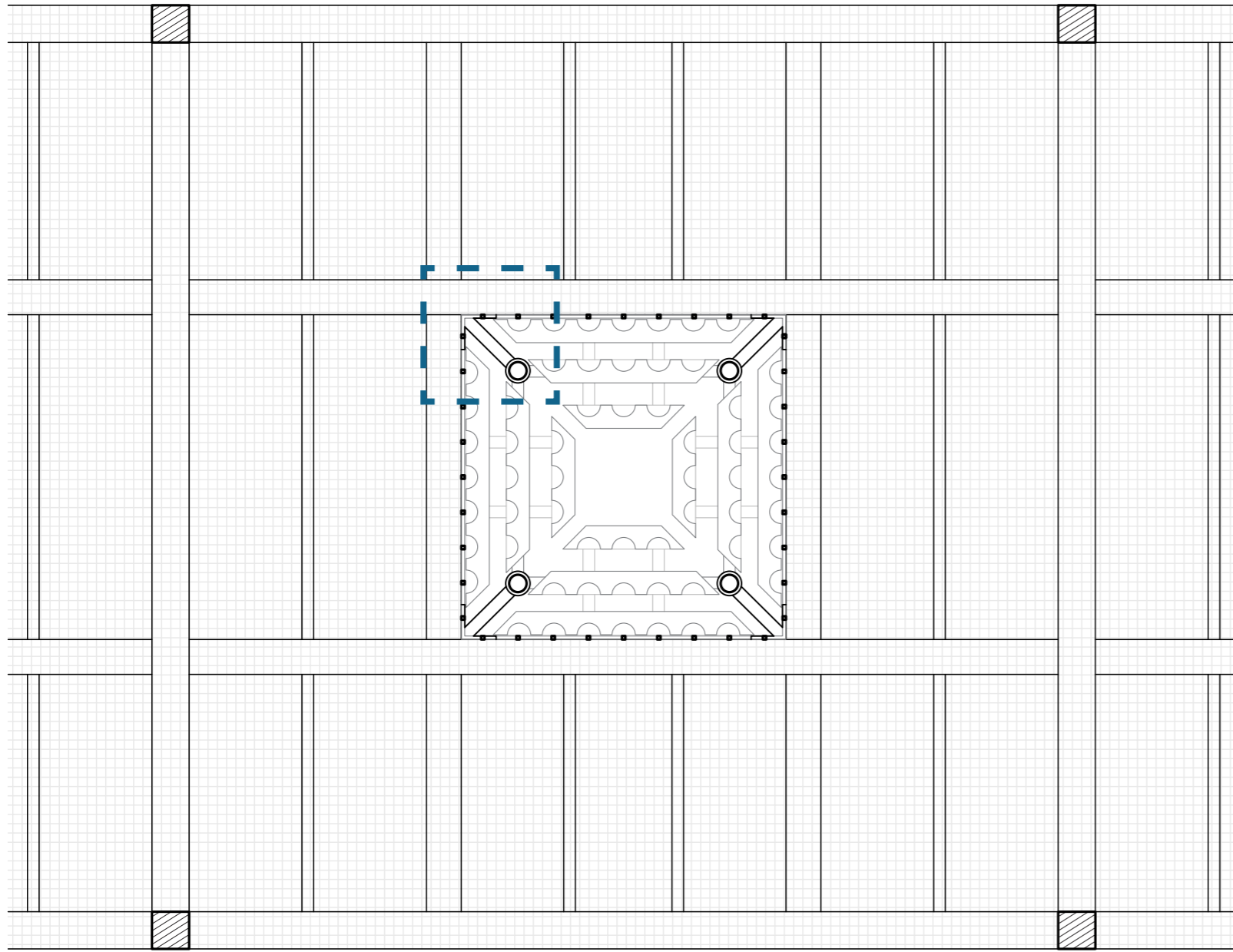


Bolted rod holder

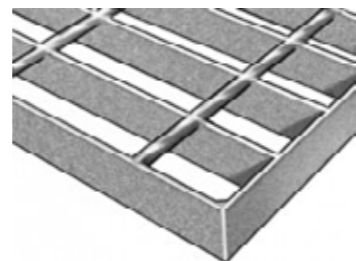
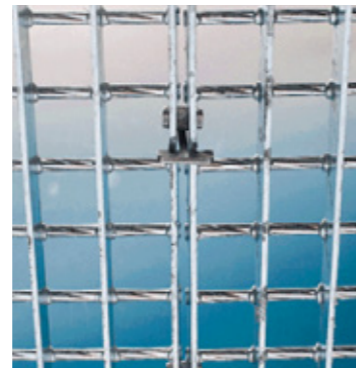
Plant holder

- 85/3mm polyethylene tube
- 50/5mm polyethylene tube supporter
- Soft rubber water pipe attached
- Bolted onto steel column

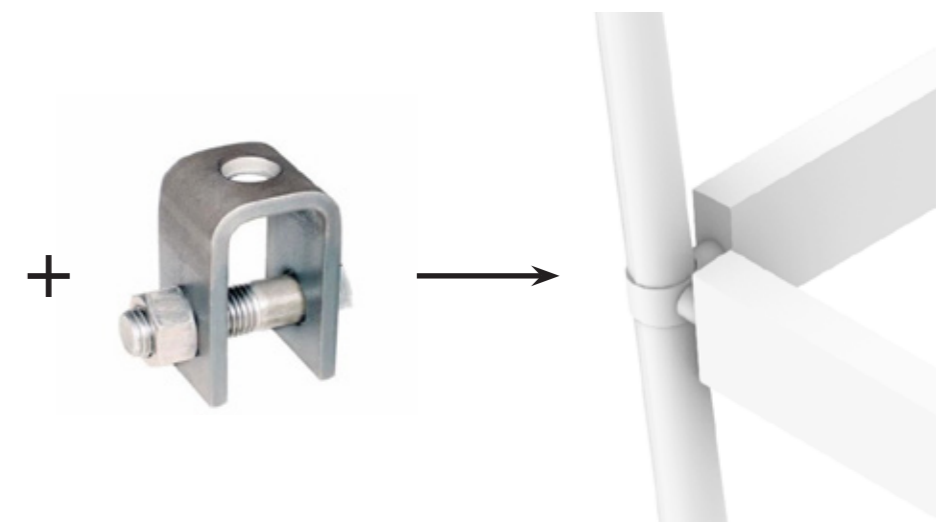
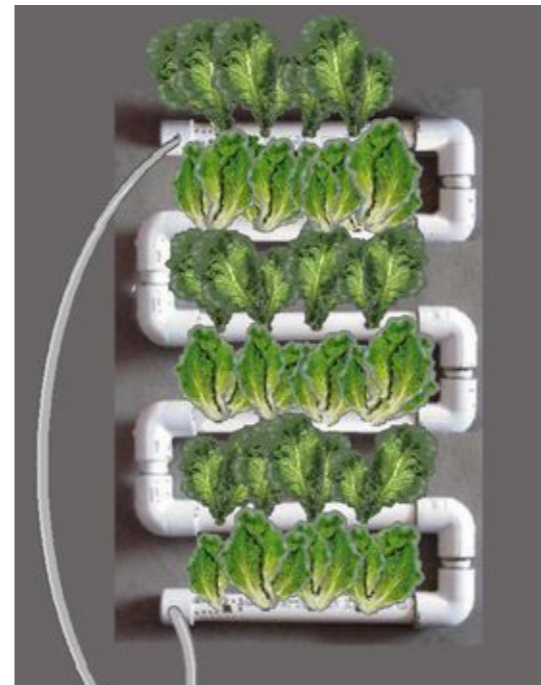




Grating floor

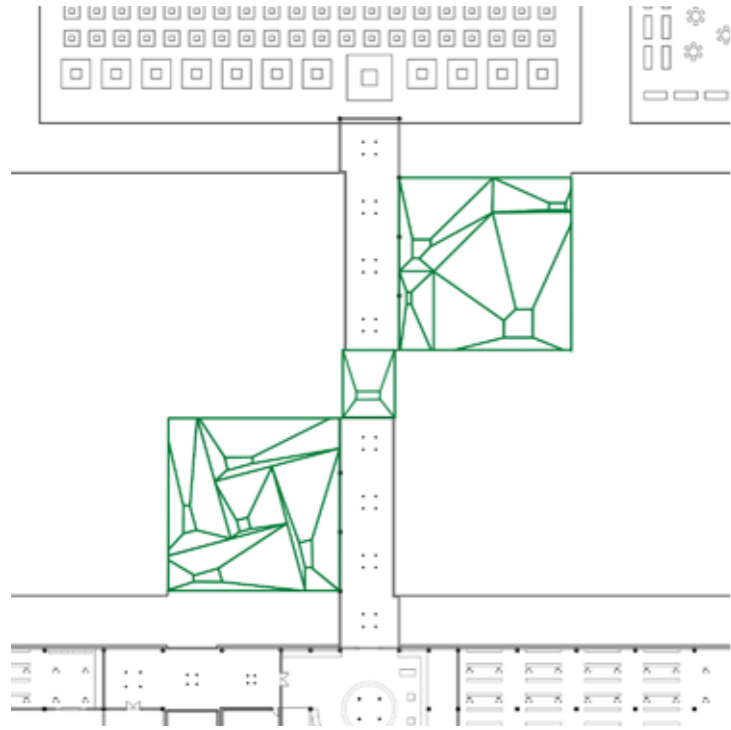


Hydroponic plant holder



Atrium

Roof plan



Floor plan



Lecture hall



Exhibition



Restaurant

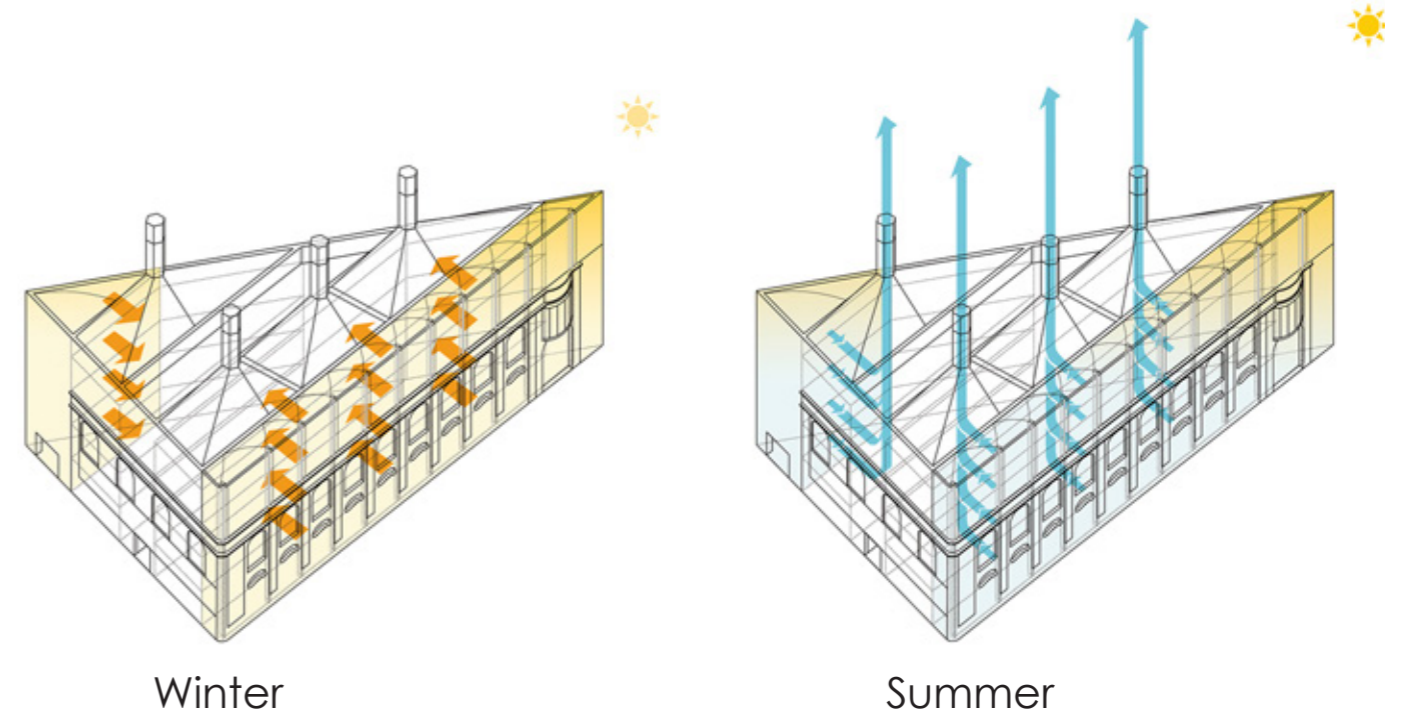


Kitchen

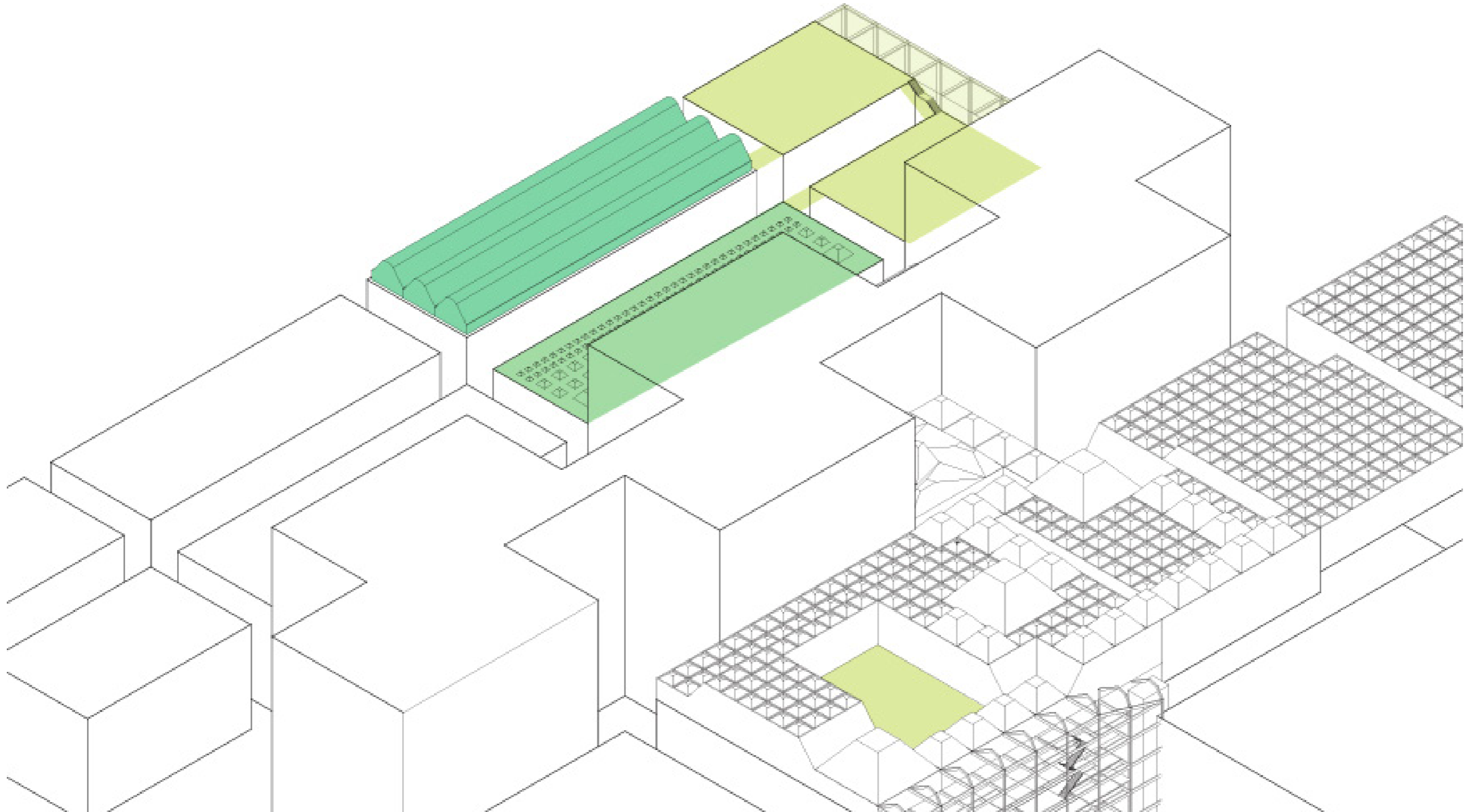


Market

Case: Cristalleries Planell, Barcelona
(renovate into civic centre)



OPEN-AIR + TRADITIONAL



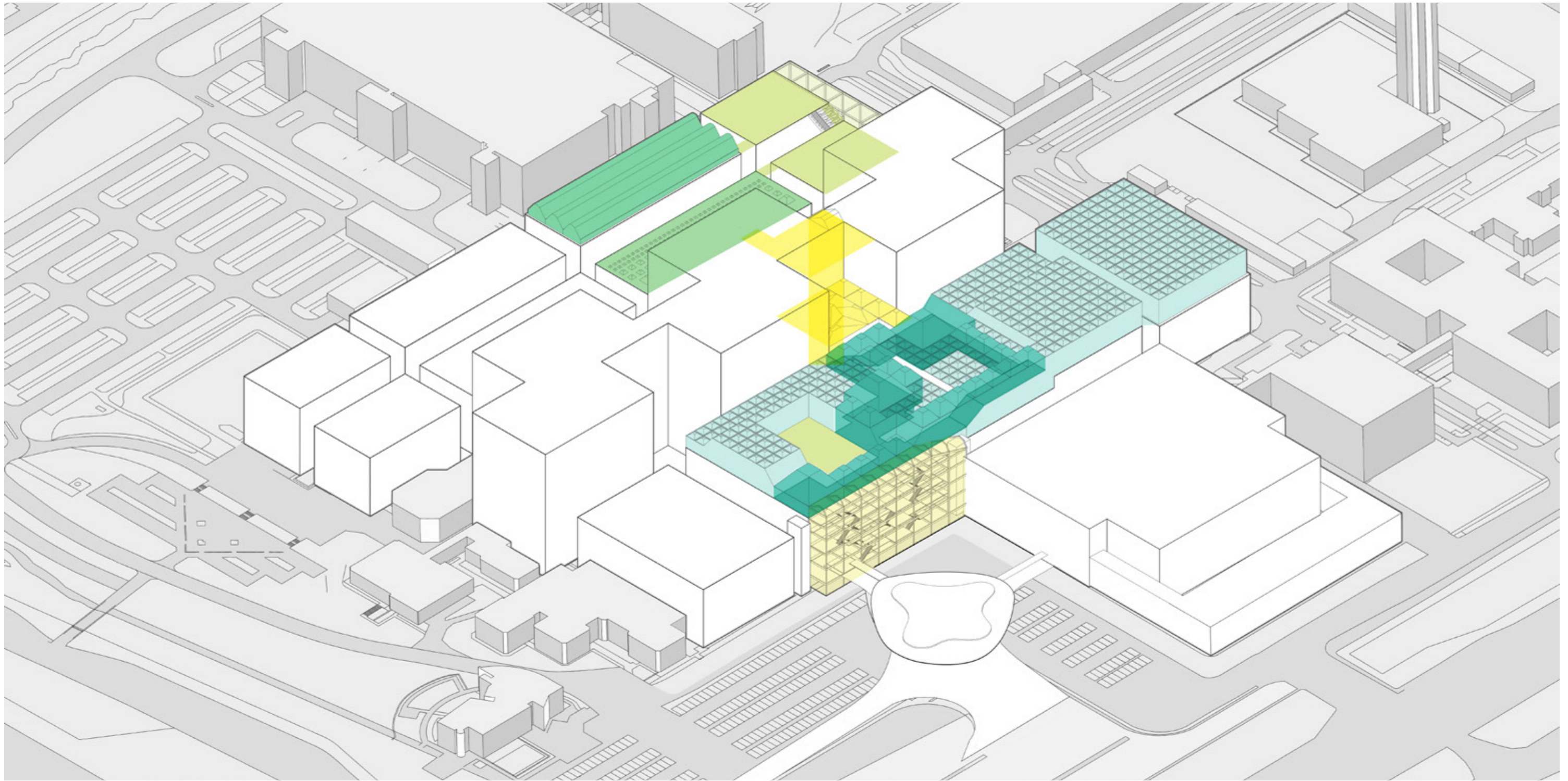
Other ways of food production



Recreational area

- for staff / students / visitors who are familiar with AMC





Medical staff



Outpatient



Inpatient



Accompanying



Students



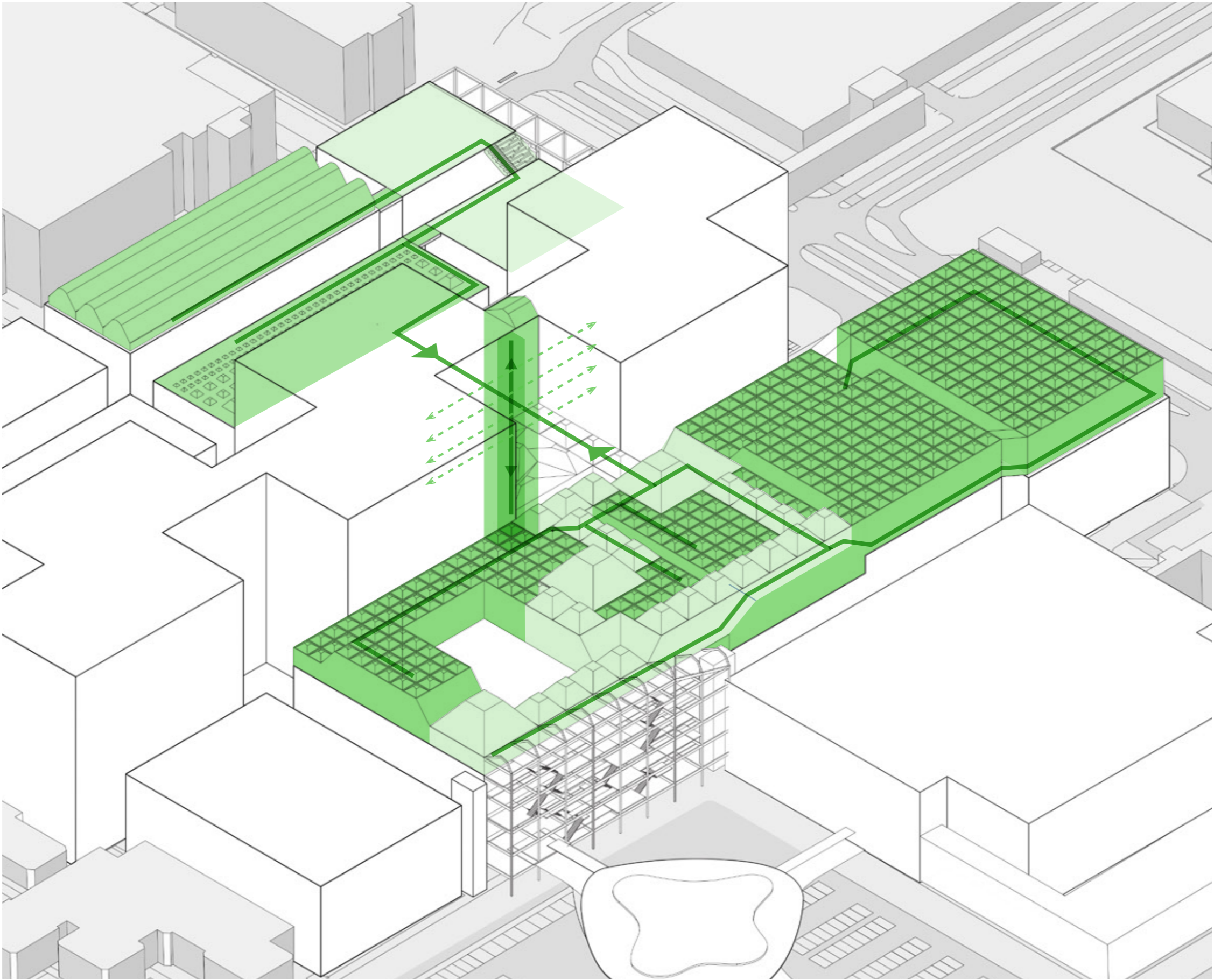
Researcher



Other staff

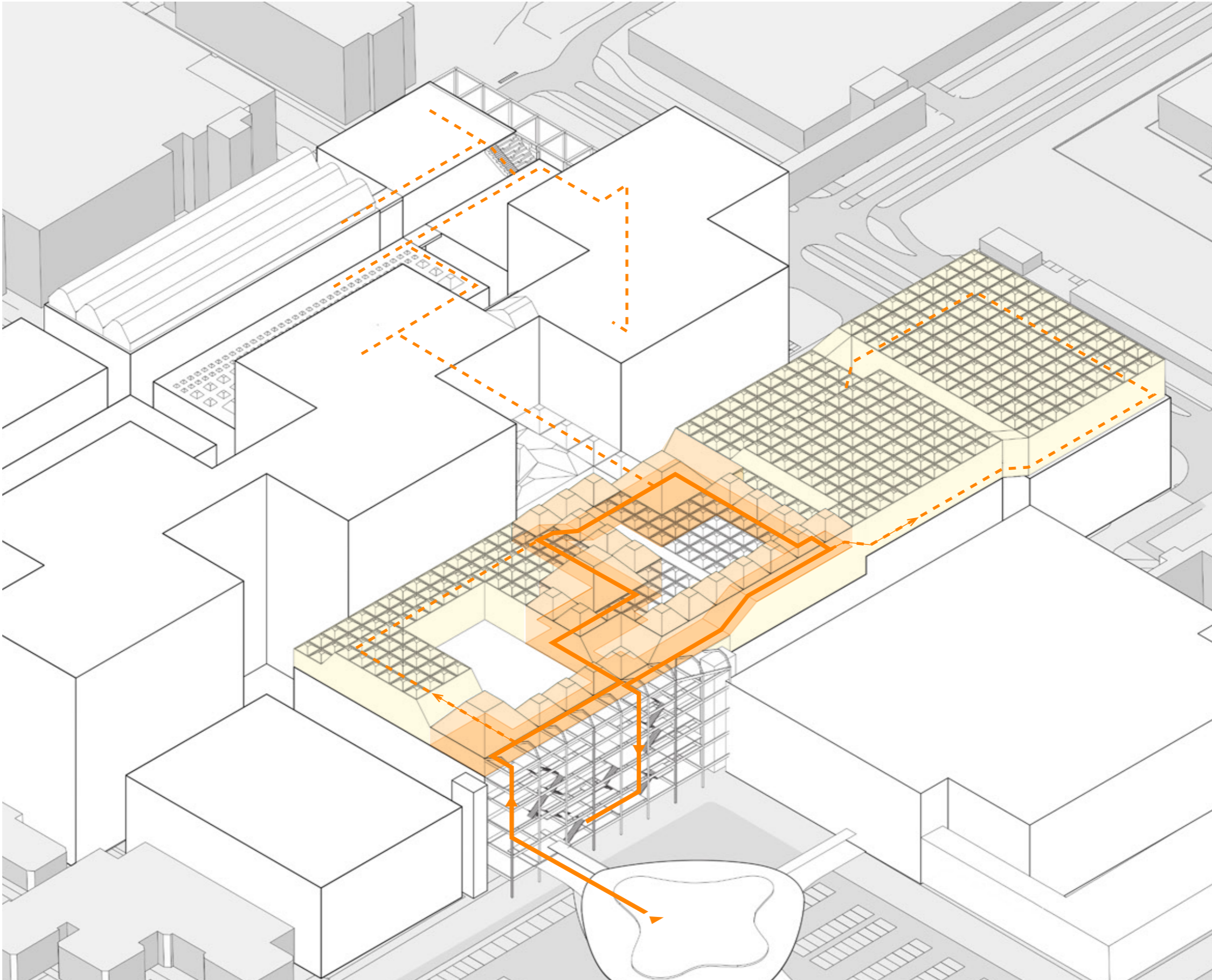


Neighbours



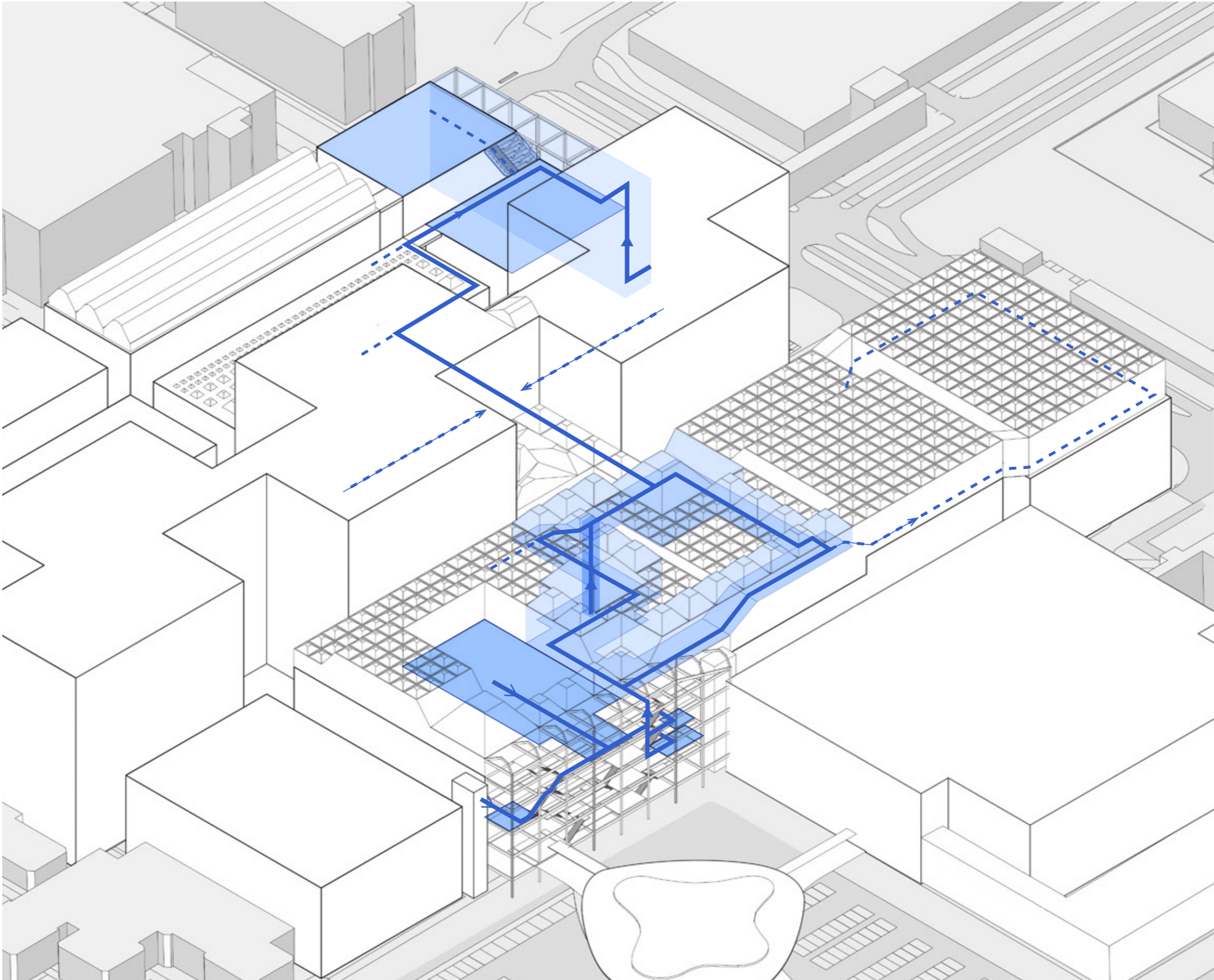
Food production





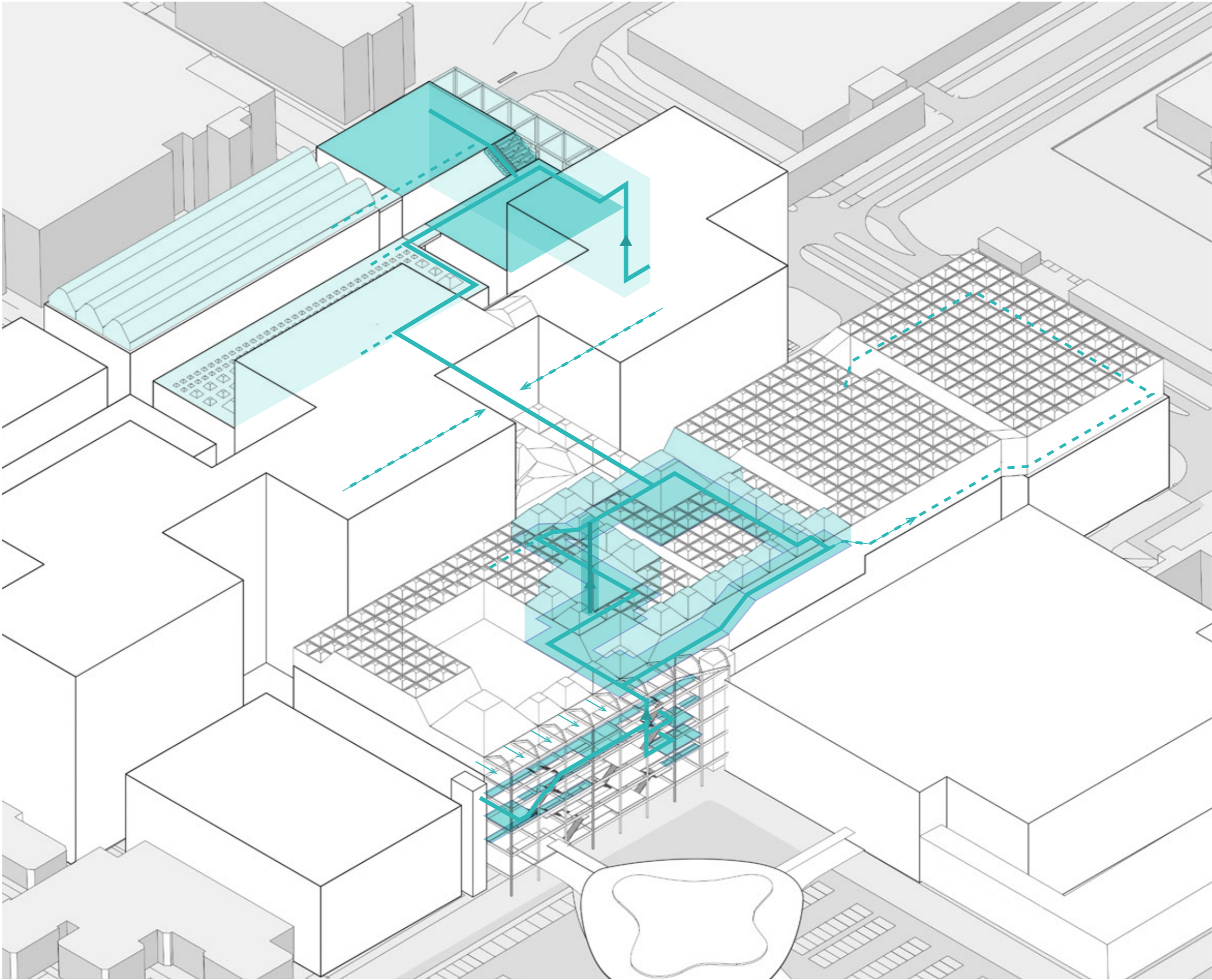
Public visitors





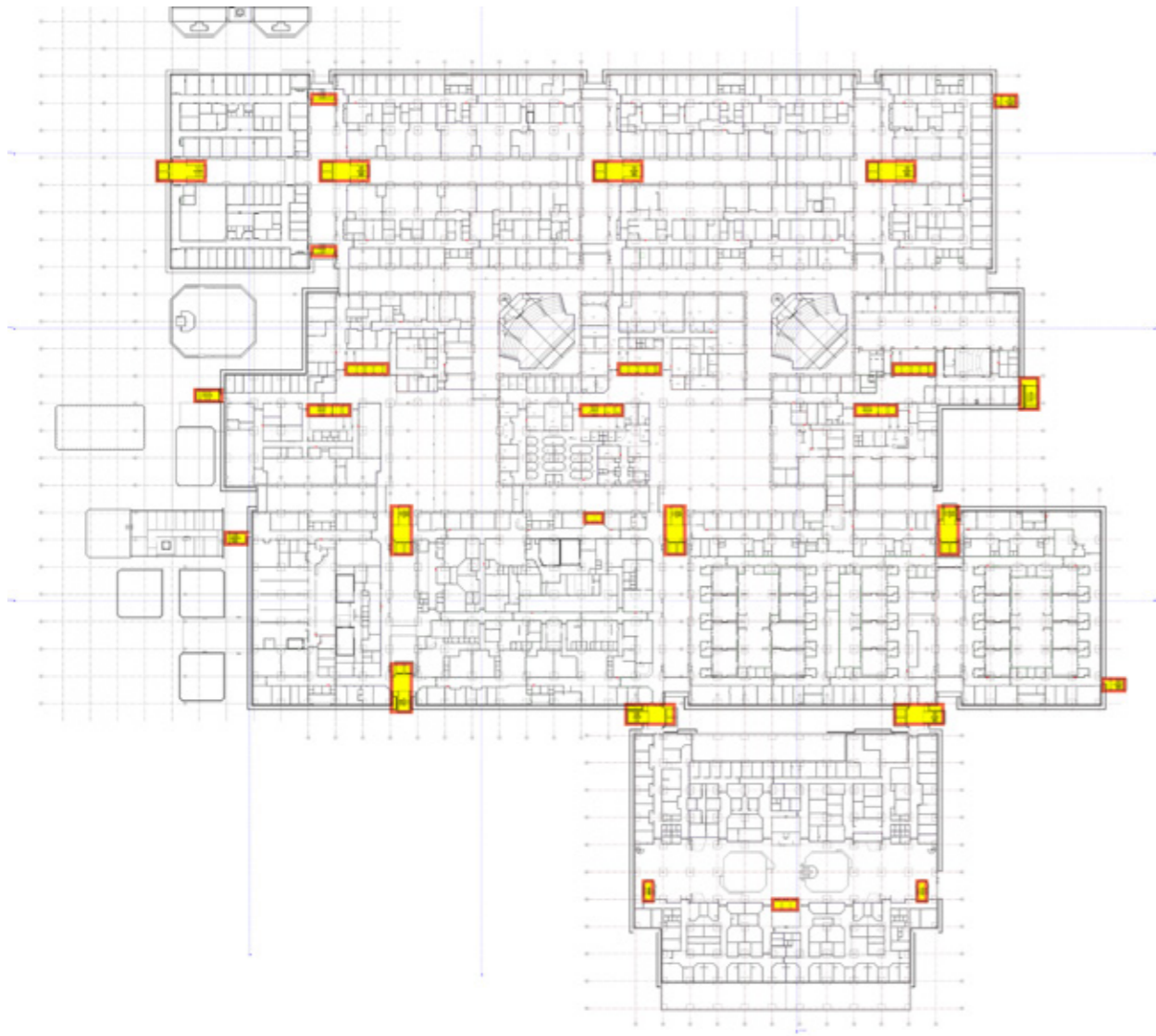
Patients





Staffs





Existing staircase & lifts



Added & using existing



Indoor lift



Platform of indoor stairs



Glazing box staircase

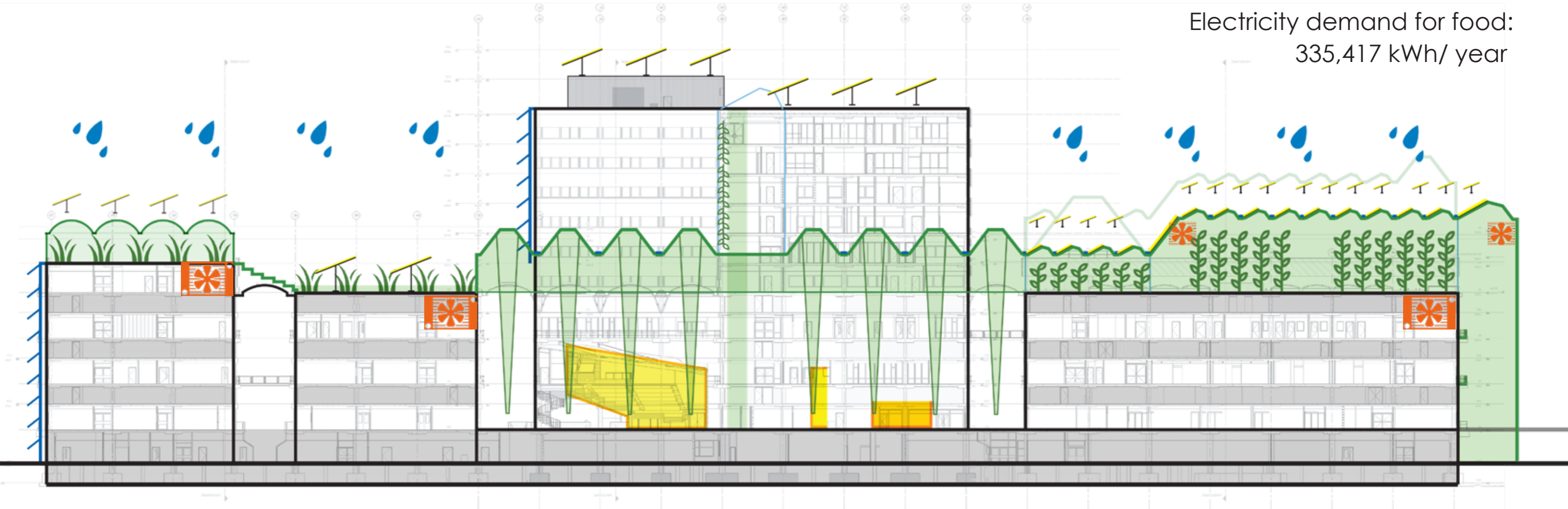


Escaping staircase



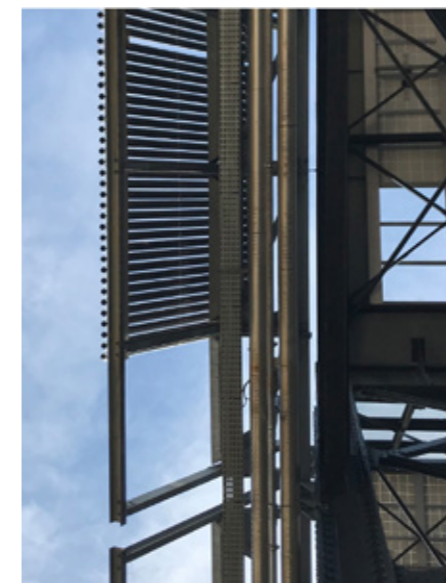
GH roof: 2,375m²
432,822 kWh/year

Electricity demand for food:
335,417 kWh/ year

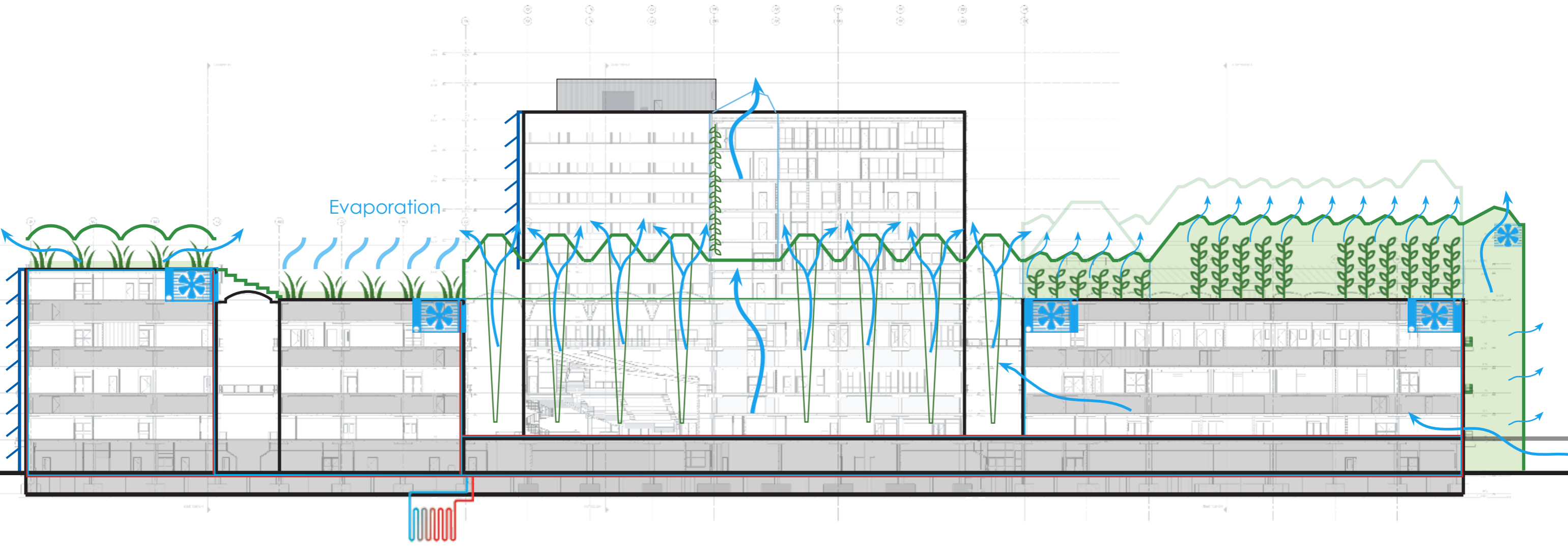
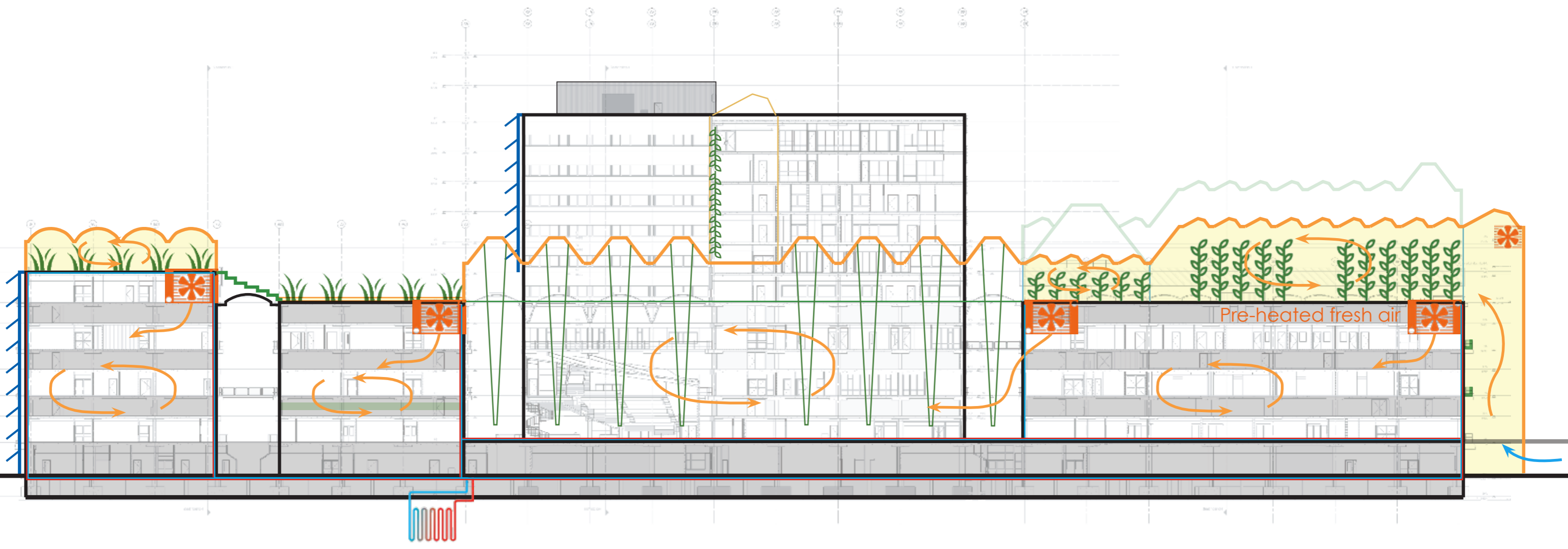


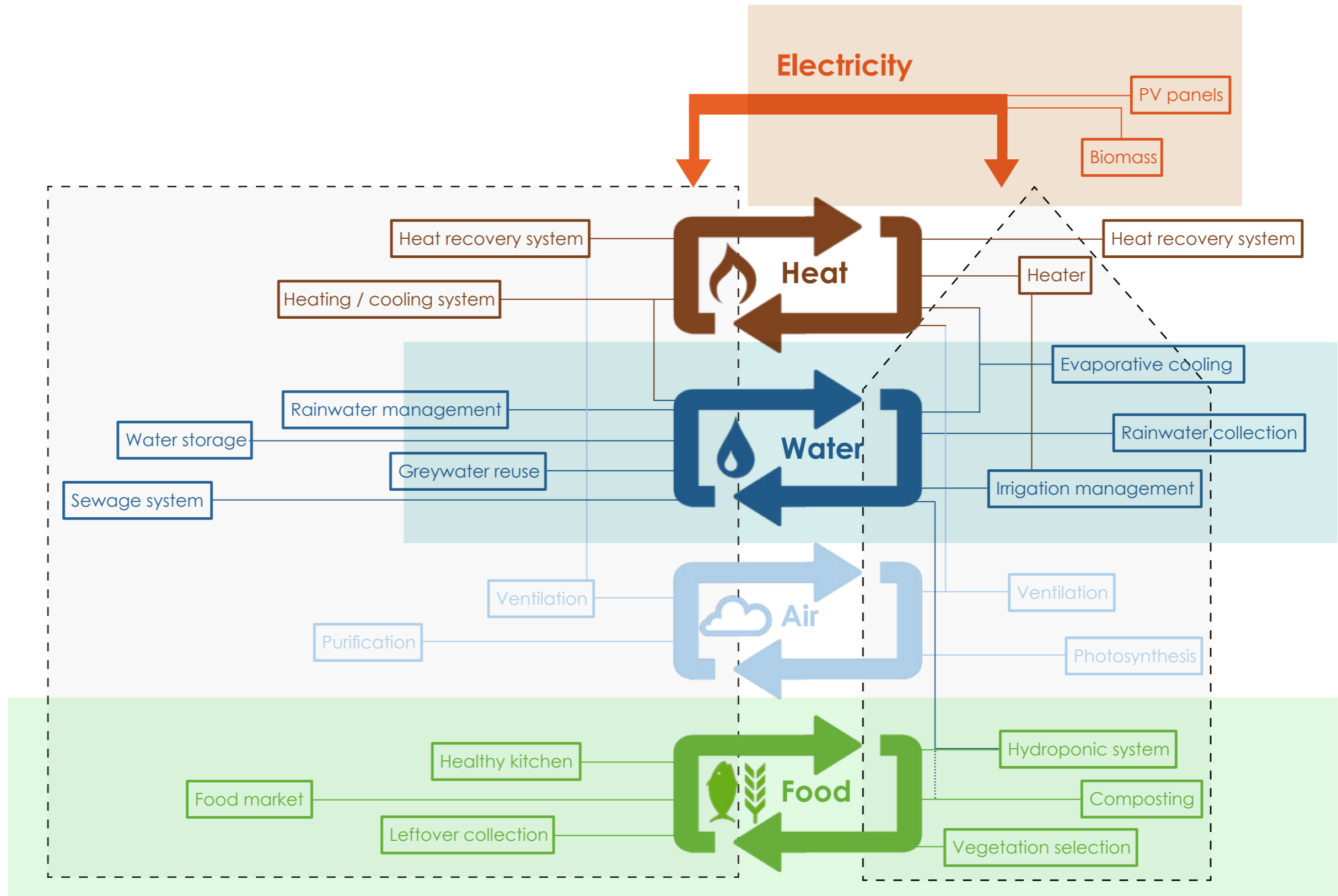
Solar heat water panel - Halle pajol, Paris

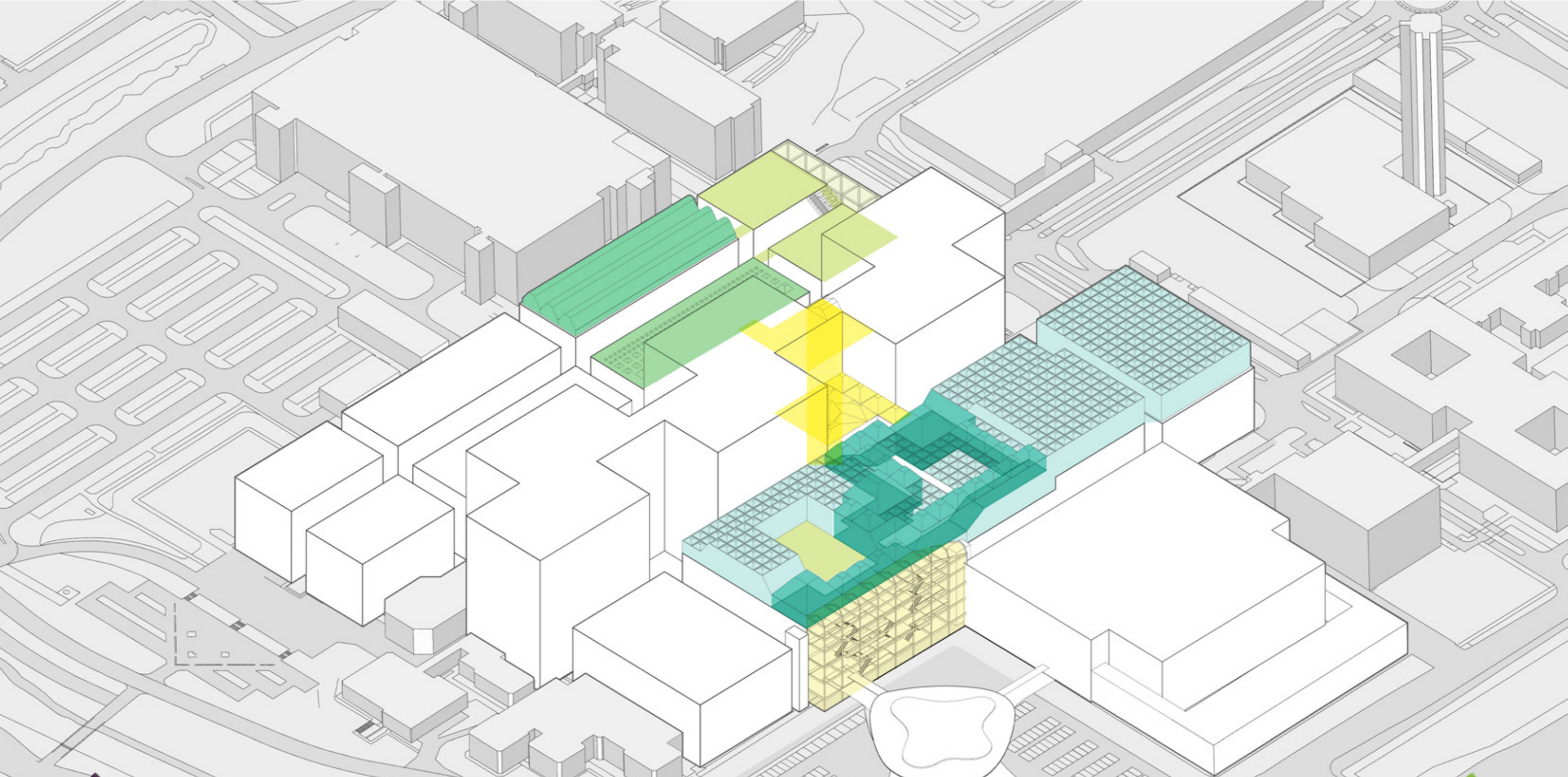
BIPV transparent solar panel



Source from: Solar choice







HEALTH



COMMUNITY



EDUCATION

ENVIRONMENT



INFRASTRUCTURE



ECONOMY





DISCUSSION / QUESTIONS