

## **Combining Mass Housing and Urban Agriculture**

A Sitopian way of thinking

# Brazil

## Geography

**Total population: 204 million**

**Surface area: 8,515,770 km<sup>2</sup>**  
**2% Urban areas: 134,981 km<sup>2</sup>**

**34% Agricultural areas: 2,879,182 km<sup>2</sup>**

**59% Forest: 5,060,071 km<sup>2</sup>**

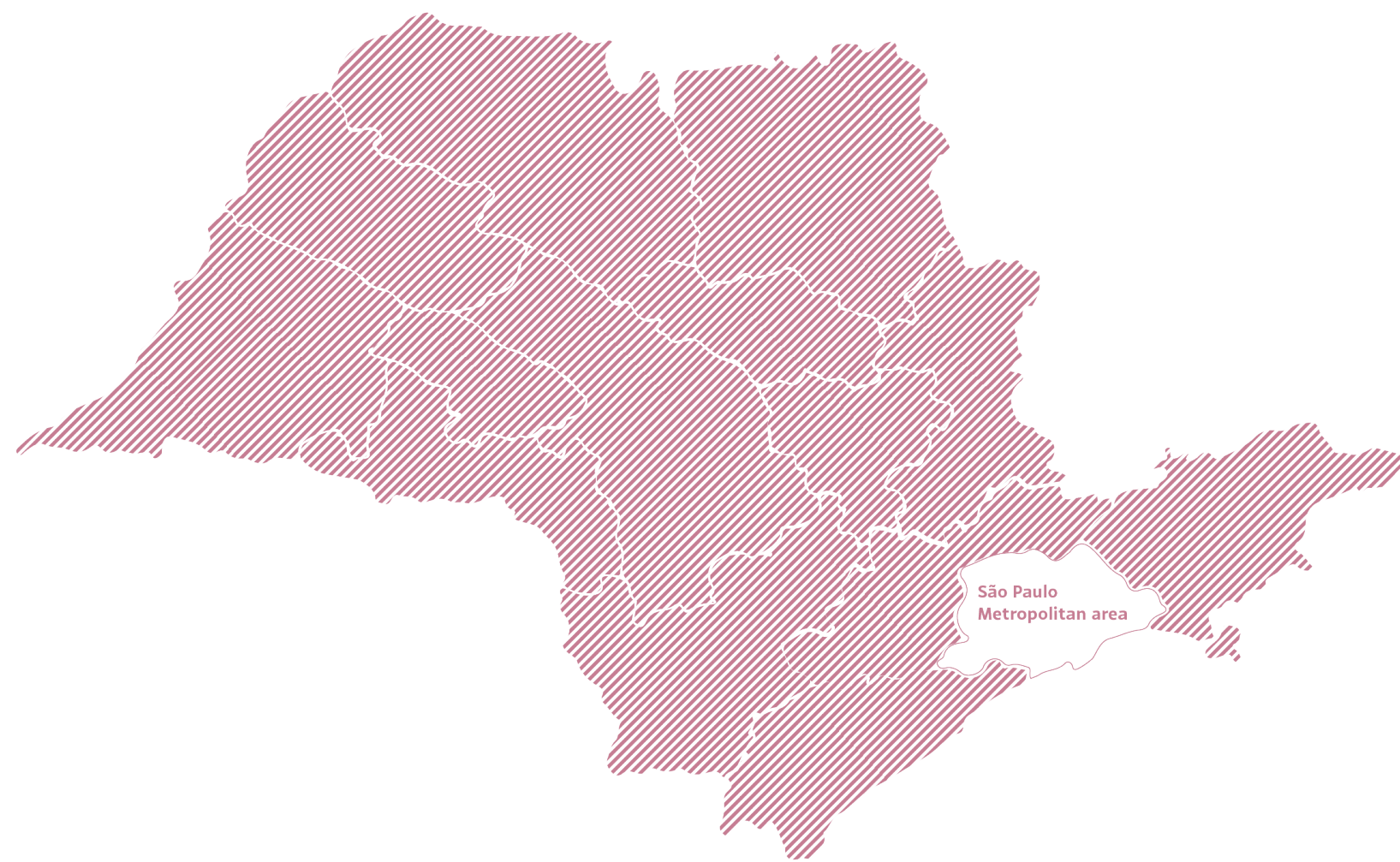
**2% Water areas: 157,630 km<sup>2</sup>**

The Brazilian territory contains about **12% of all fresh water** on the planet.

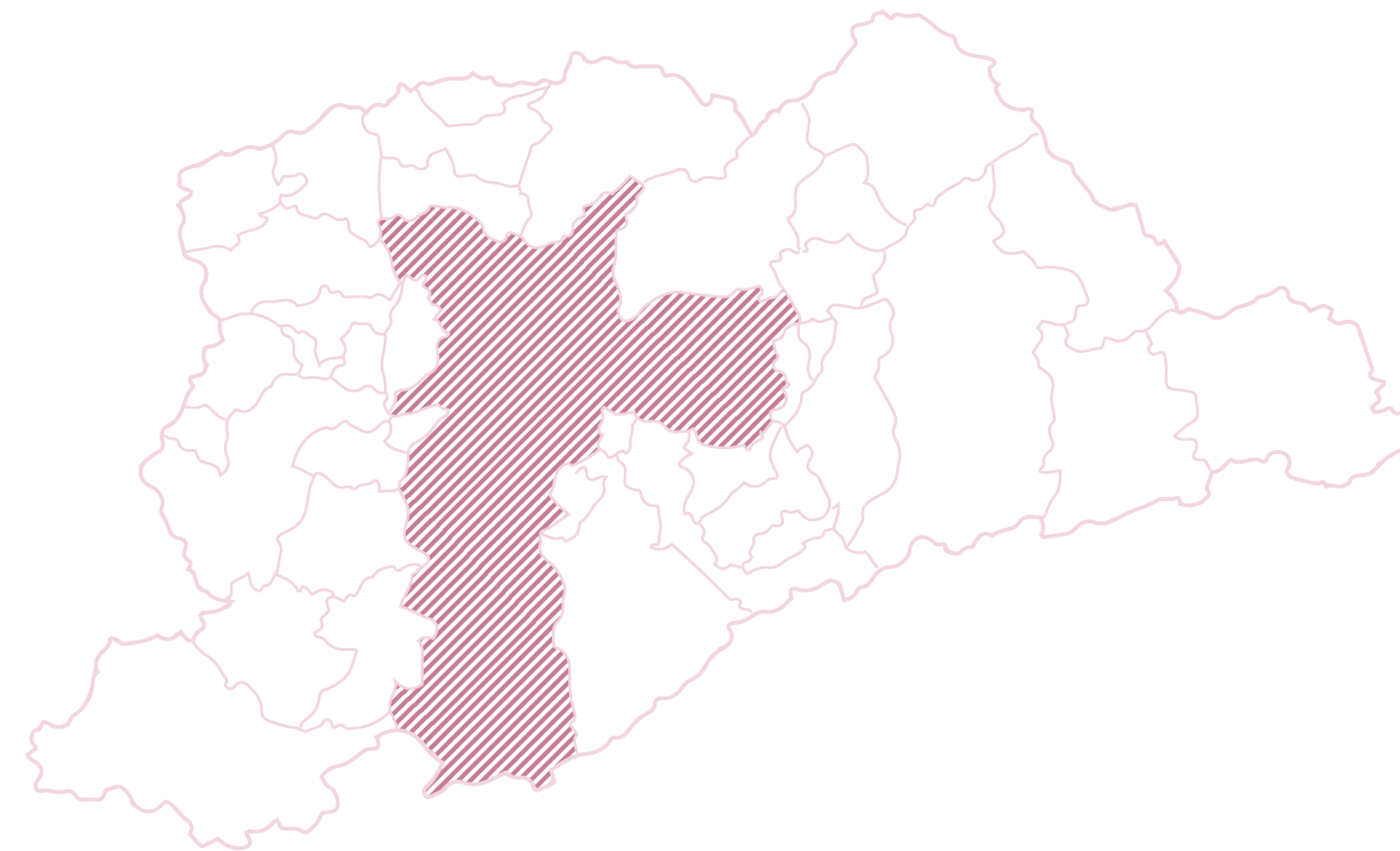


# São Paulo

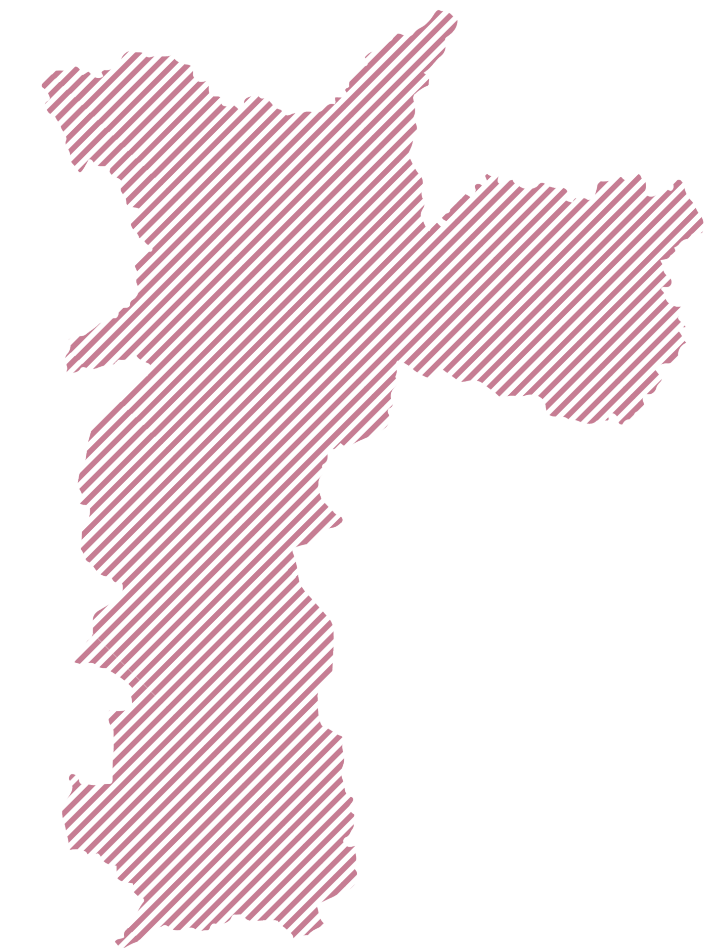
## Geography



**São Paulo state**



**São Paulo  
Metropolitan Region**



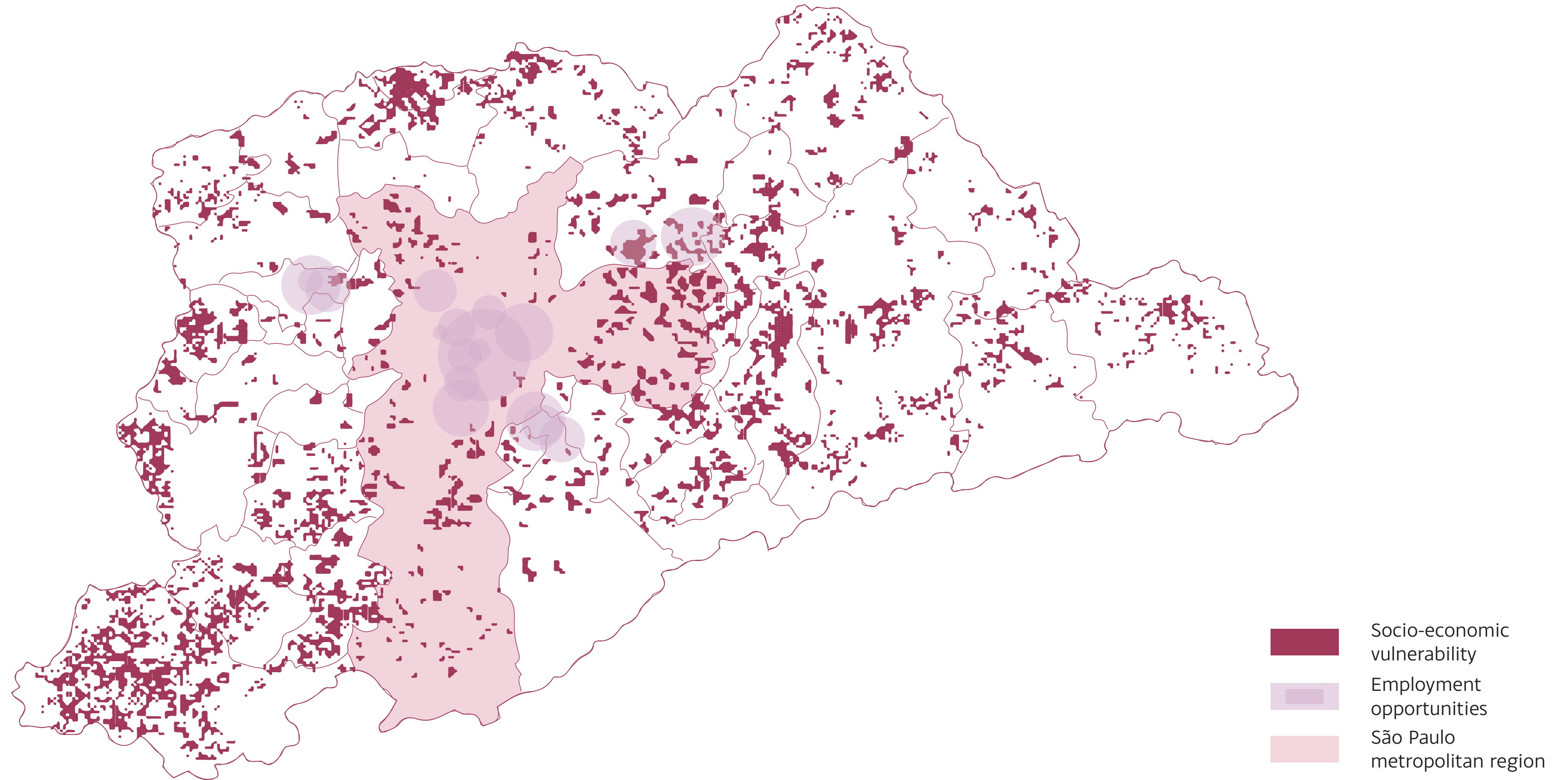
**City of São Paulo**

# Housing issues



# Socio-economic vulnerability

São Paulo metropolitan region



# Water insecurity

The lack of regular and permanent access to water is a reality for **12% of Brazilian population**.<sup>1</sup>

# Food insecurity

2021/2022

Over **125 million people** of the Brazilian population present some level of food insecurity.

15.5% of the Brazilian population (**33 million people**) suffer severe food insecurity.<sup>2</sup>

# Deforestation Amazon

Agriculture & climate change



# The dichotomy between abundance and scarcity





HOME



FOOD

**sitopia** (*food place*)  
sitos "food" + topos "place"





# Research question



How can **urban farming** and **mass housing** be combined to support **environmental recovery** and create opportunities for **income generation** in the peripheries of São Paulo?

# Jintai Village

Bazhong, China

by Rural Urban Framework

Mix of **traditional architecture with new technologies**

**Community center** with rooftop agriculture

**Individual rooftop farming** on each building

**Family-owned workshop** on the ground



roof follows agricultural stepped landscape

Space for family-owned workshop and gardens

Sheltered communal space with rooftop agriculture

# Jintai Village

Bazhong, China

by Rural Urban Framework



**Commerce:** family-owned workshops/agriculture



**Community center:** rooftop agriculture



**Community center:** sheltered meeting and dining space

# Cidades Sem Fome (Cities Without Hunger)

São Paulo/SP, Brasil

NGO

Reclaiming unviable urban land  
for **sustainable agriculture**

Both for **self-consumption** by the  
participants and for **commerce**

Allows the creation of **sustainable  
local & small businesses**

Contributes to **reduction of  
environmental impacts**



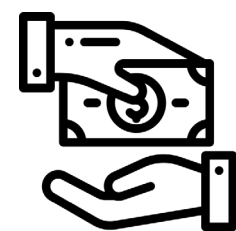
# Cidades Sem Fome (Cities Without Hunger)

São Paulo/SP, Brasil

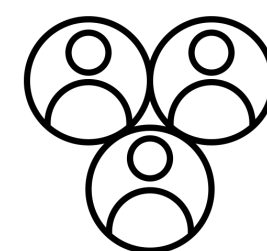
NGO



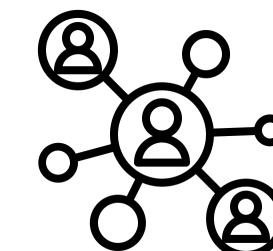
**Commerce:** facilitates small & local business



**Employment opportunity & meeting space:** green spaces for work and social activity



**Social sustainability:** community-based knowledge exchange



# Soil-less farms

Hydroponic & airoponic farming



Hydroponic farm<sup>1</sup>



Hydroponic vertical farm



Airoponic vertical farm



Hydroponic farm, LED controlled

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## Low tech

Low investment  
Little agricultural knowledge  
4x greater productivity

## High tech

High investment  
Extensive agricultural knowledge  
170x greater productivity

Image source 1: <https://www.inclusivebusiness.net/ib-voices/providing-small-scale-farmers-affordable-nutritious-crops-using-hydroponics>

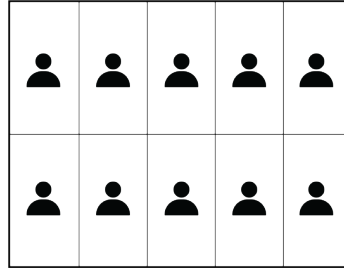
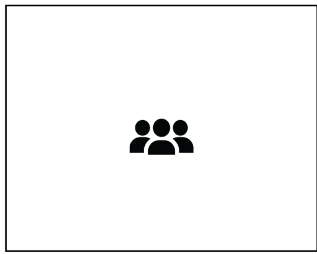
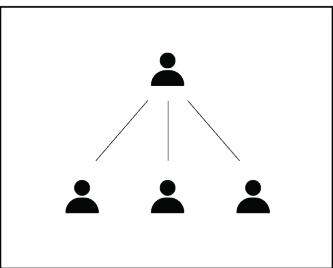
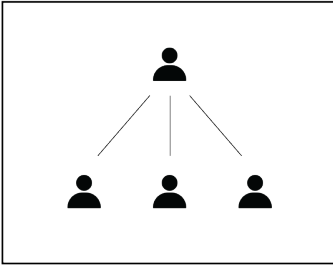
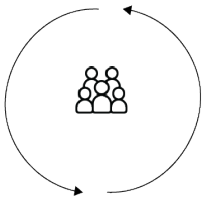
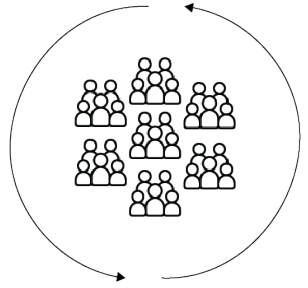
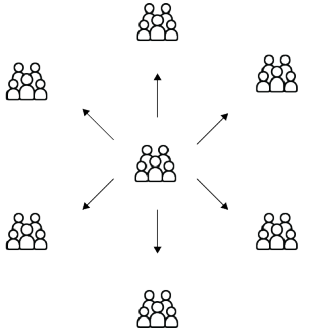
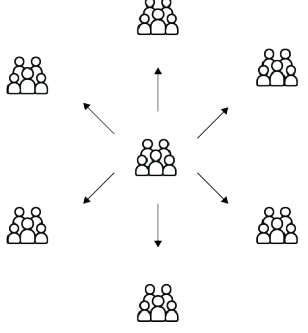
Image source 2: <https://www.timeout.com/news/the-worlds-largest-vertical-farm-is-being-built-in-the-uk-060922>

Image source 3: <https://psi.princeton.edu/tips/2020/11/9/the-future-of-farming-hydroponics>

Image source 4: <https://pinkfarms.com.br/>

# Urban farming

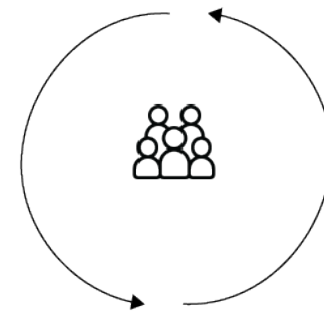
## Typologies

	Allotment garden	Community garden	Horizontal farm	Vertical farm
<i>Area division</i>	individual plots	by plant type/none	by plant type	by plant type
<i>Recreational area</i>	occurs	occurs	absent	absent
<i>Production technology</i>	soil	soil	soil/soil-less	soil/soil-less
<i>Production intensity</i>	low	low	medium	medium/high
<i>Ownership</i>				
<i>Production scale</i>				

# Urban farming

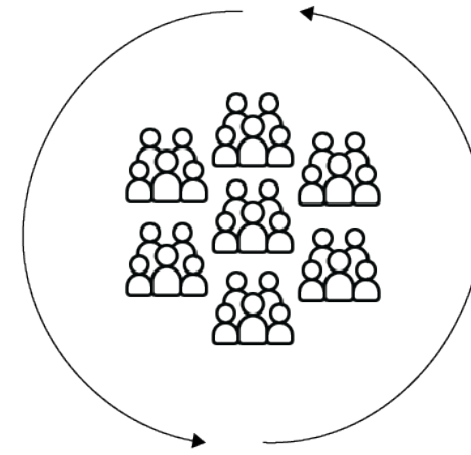
## Production scales

Private urban farming



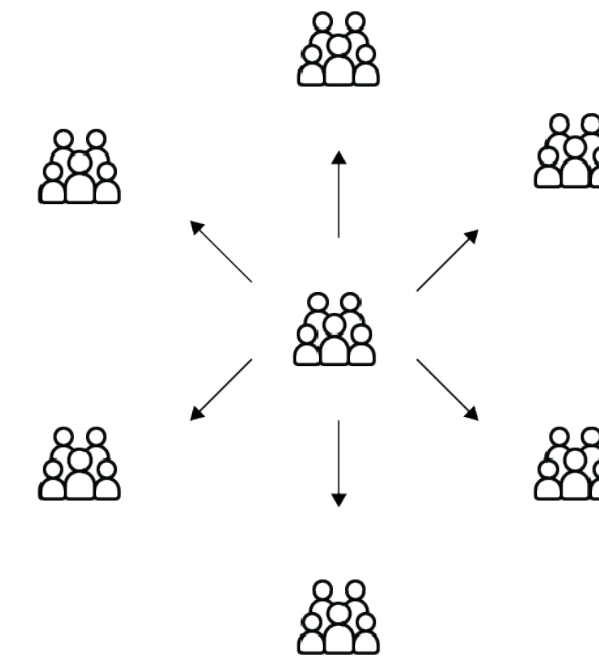
- Personal production
- Added nutritional value
- Saving money on fresh produce
- Basic agricultural knowledge

Community urban farming



- Communal production
- Added nutritional value
- Saving money on fresh produce
- Basic/moderate agricultural knowledge

Commercial urban farming

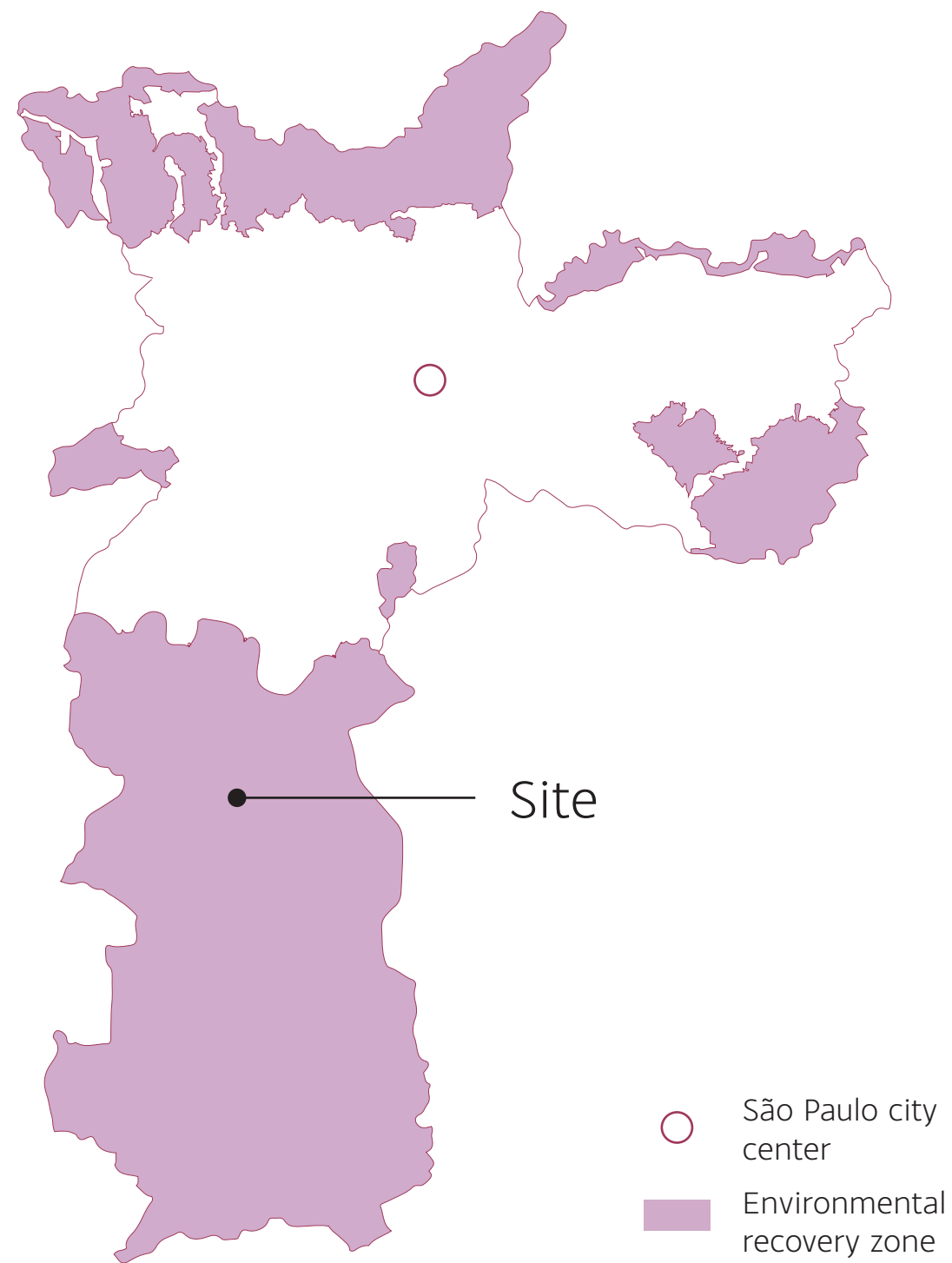


- Commercial production
- Employment opportunities
- Advanced agricultural knowledge

**Site**  
The Hamada farm

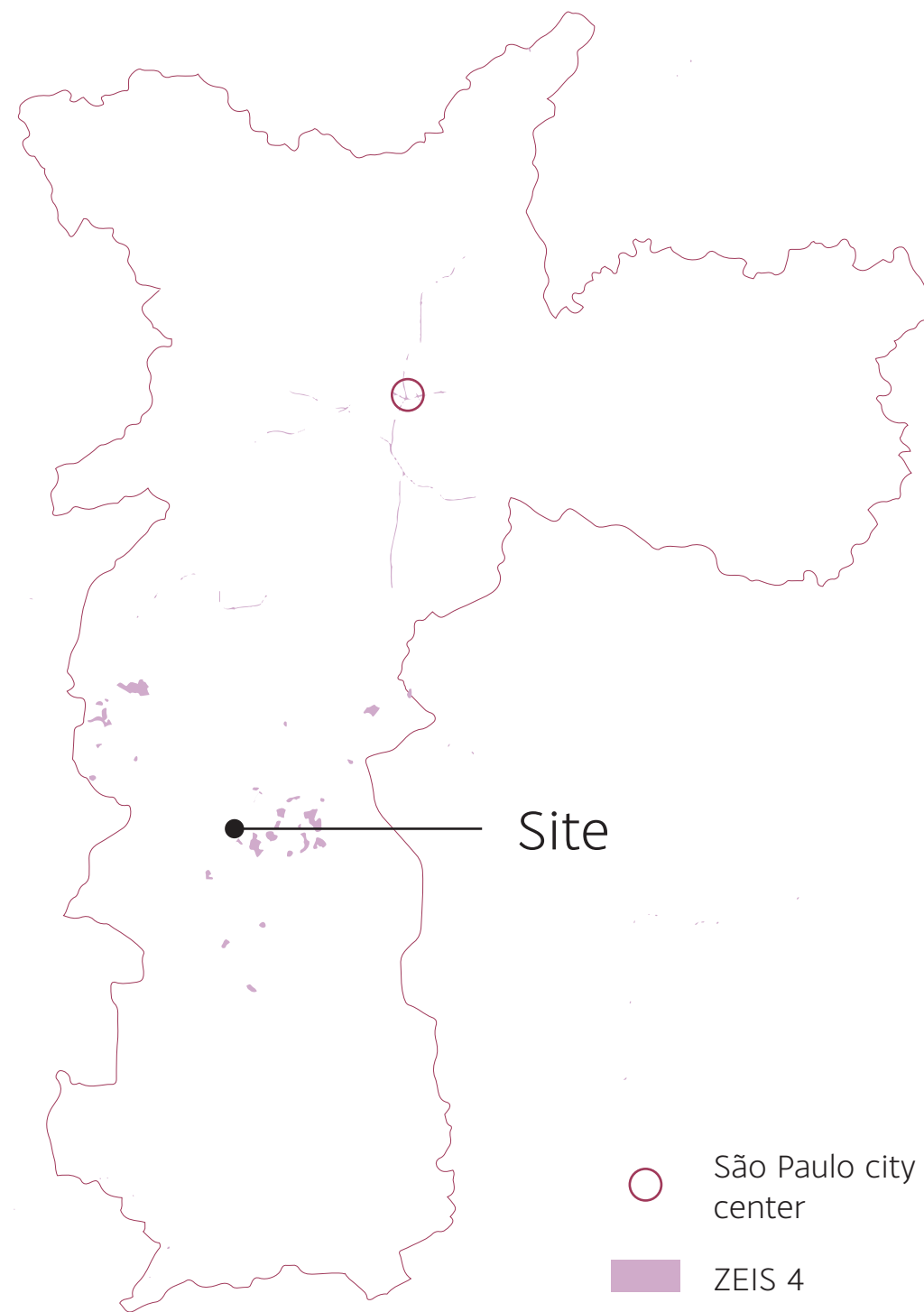
# São Paulo local Masterplan

**Environmental recovery zone**



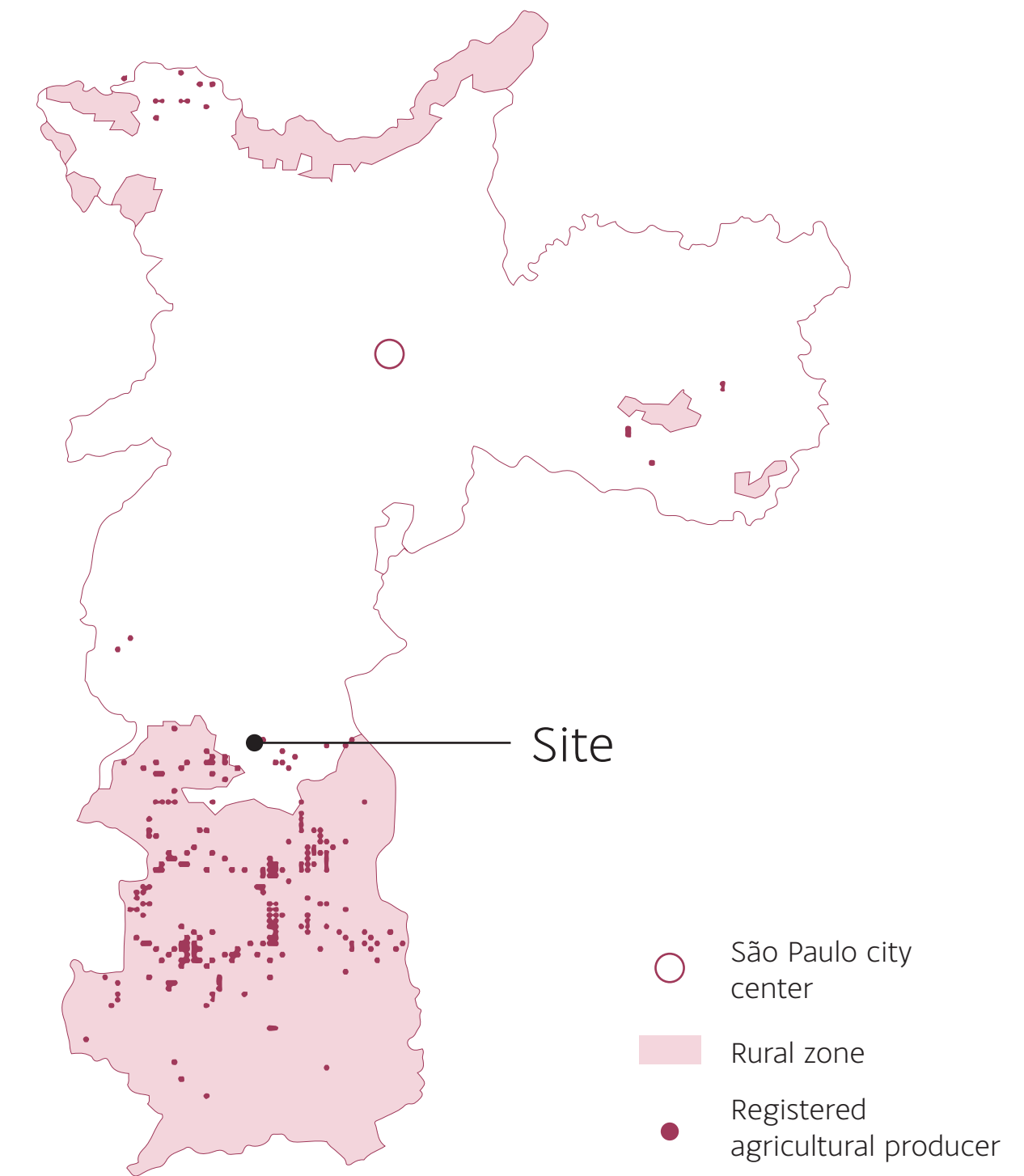
With site in Reduction Area of Urban Vulnerability and Environmental Recovery

**Zeis 4**



Areas characterized by vacant land, suitable for urbanization and construction, located in watershed protection areas.

**Rural zone & Agriculture**



Allocated SP rural zone with registered agricultural producers

# Neighborhood

Urban development



Google earth 2004



Google earth 2022

# Site

## Hamada Farm

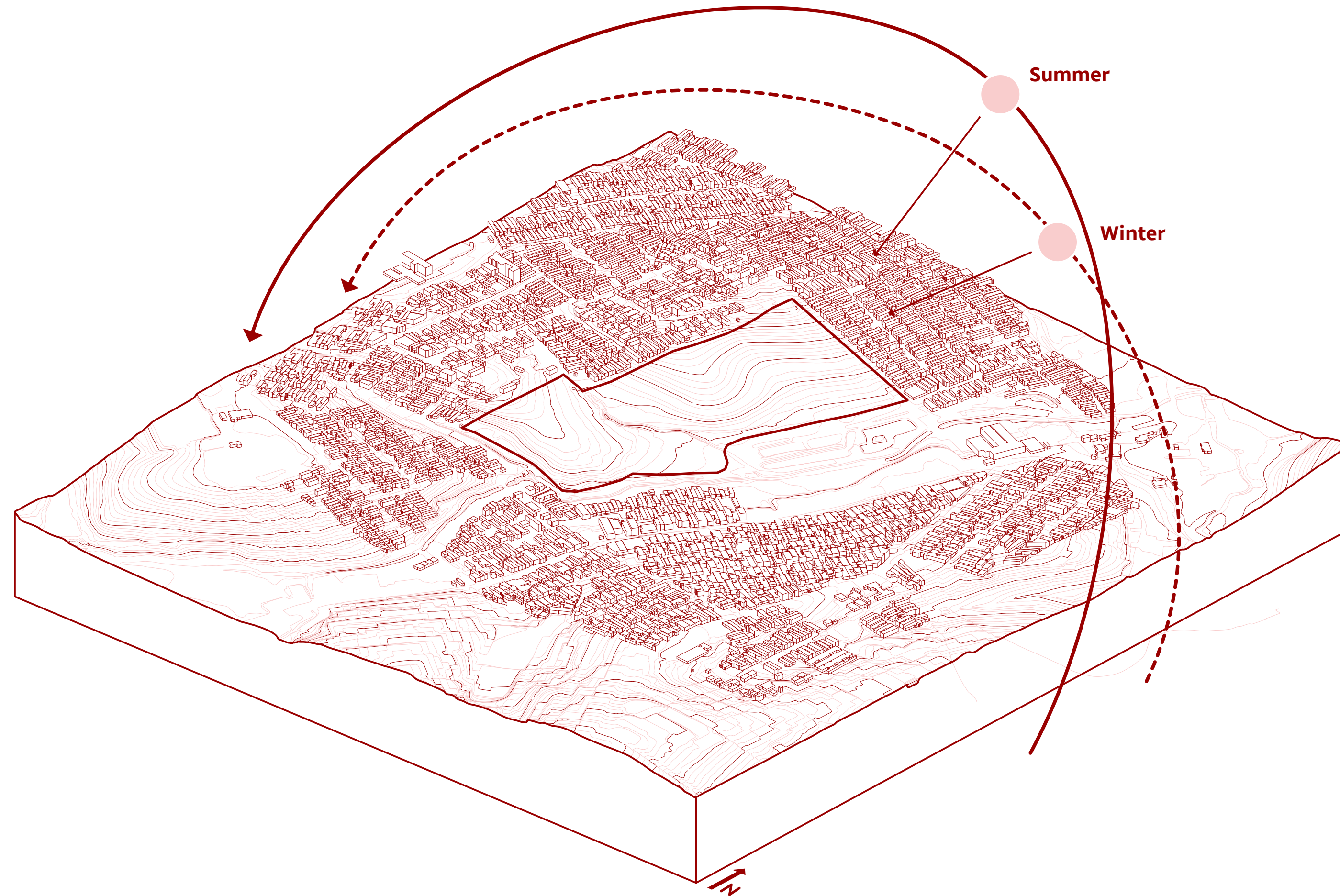


# Site



# Site

Topography & sunpath



# Site

## Hamada farm

### Current occupation

Hamada farm

### Gross site area

9,5 Ha

### Farm ground area

5,1 Ha

### Soil farm area

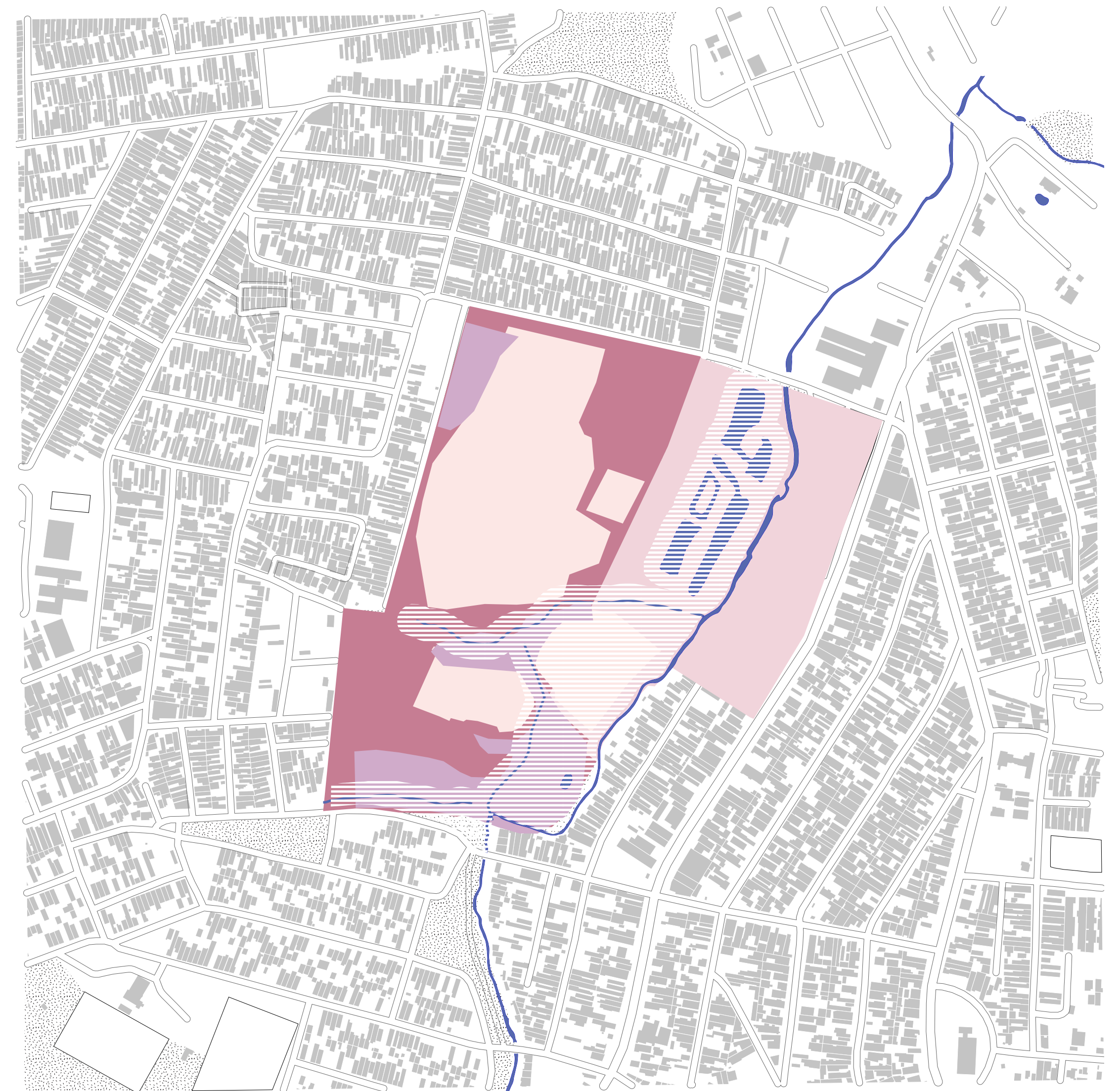
4,81

### Hydroponic farm area

0,24 Ha

### Buildable area

6,65 Ha



# Capturing the atmosphere



# Program of requirements

## **Housing**

70% HIS 1&2 housing  
30% HIS 3 housing

## **Low to mid rise, high density**

Neighborhood scale  
FSI of 1 - 1,5  
Density min 100 dw/ha

## **Environmental recovery**

Flooding protection  
Heavy rainfall drainage  
Discouraging individual car use  
Agroecological education

## **Income generation**

(micro) Businesses connected to farming  
Organic market  
Workshops for agri-blocks

## **Urban farming**

Community farm  
Allotment farm  
Commercial farm

## **Food security**

Restaurante Popular  
School garden  
Food education

## **Public amenities**

Sports facilities  
Cultural amenities  
Kindergarten  
Primary school  
Middle school

## **Urban infrastructure**

Public transportation  
Bike lanes  
Sidewalks

## **Waste cycles**

Reduce waste cycles within  
- Communities  
- Local agriculture





46°41'52.50"W  
23°45'58.20"S 23°46'58.20"S  
46°41'52.50"W













# Row house



# Row house

FSI: 0,96

dw/ha: 98

10 apartments

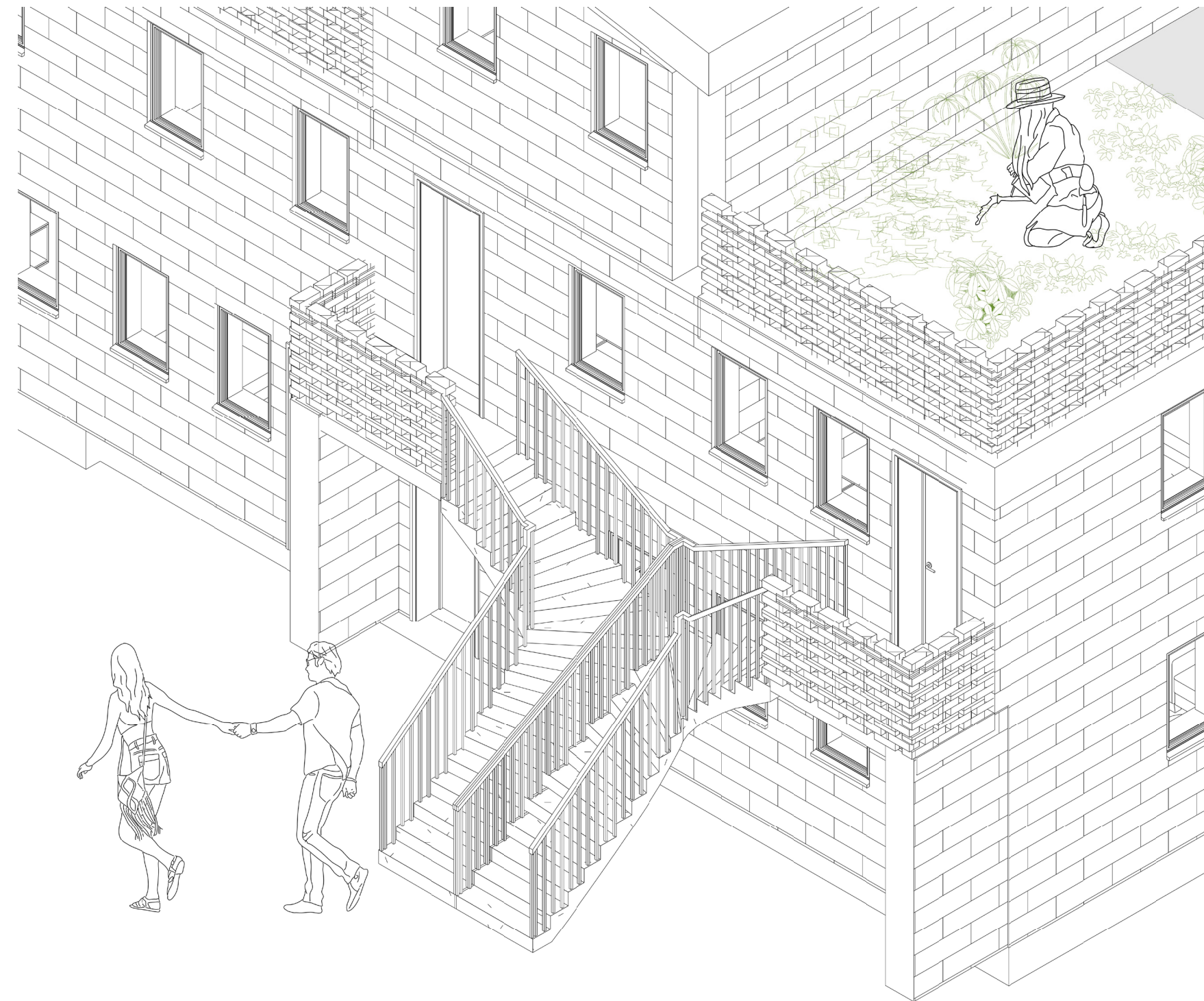
180 m<sup>2</sup> possible farmground





# Row house

## Entrance and gardens



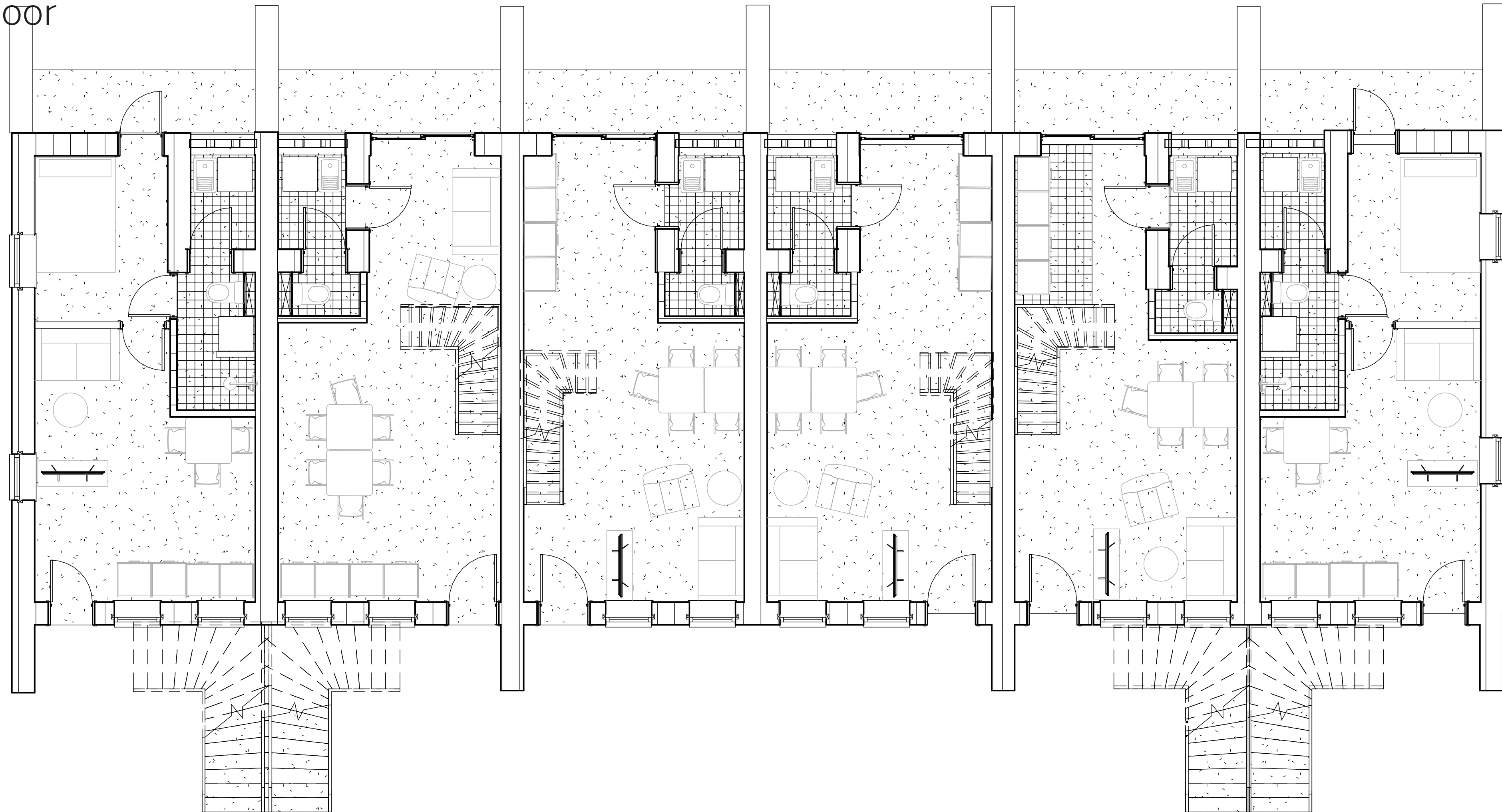
# Row house

## Sections



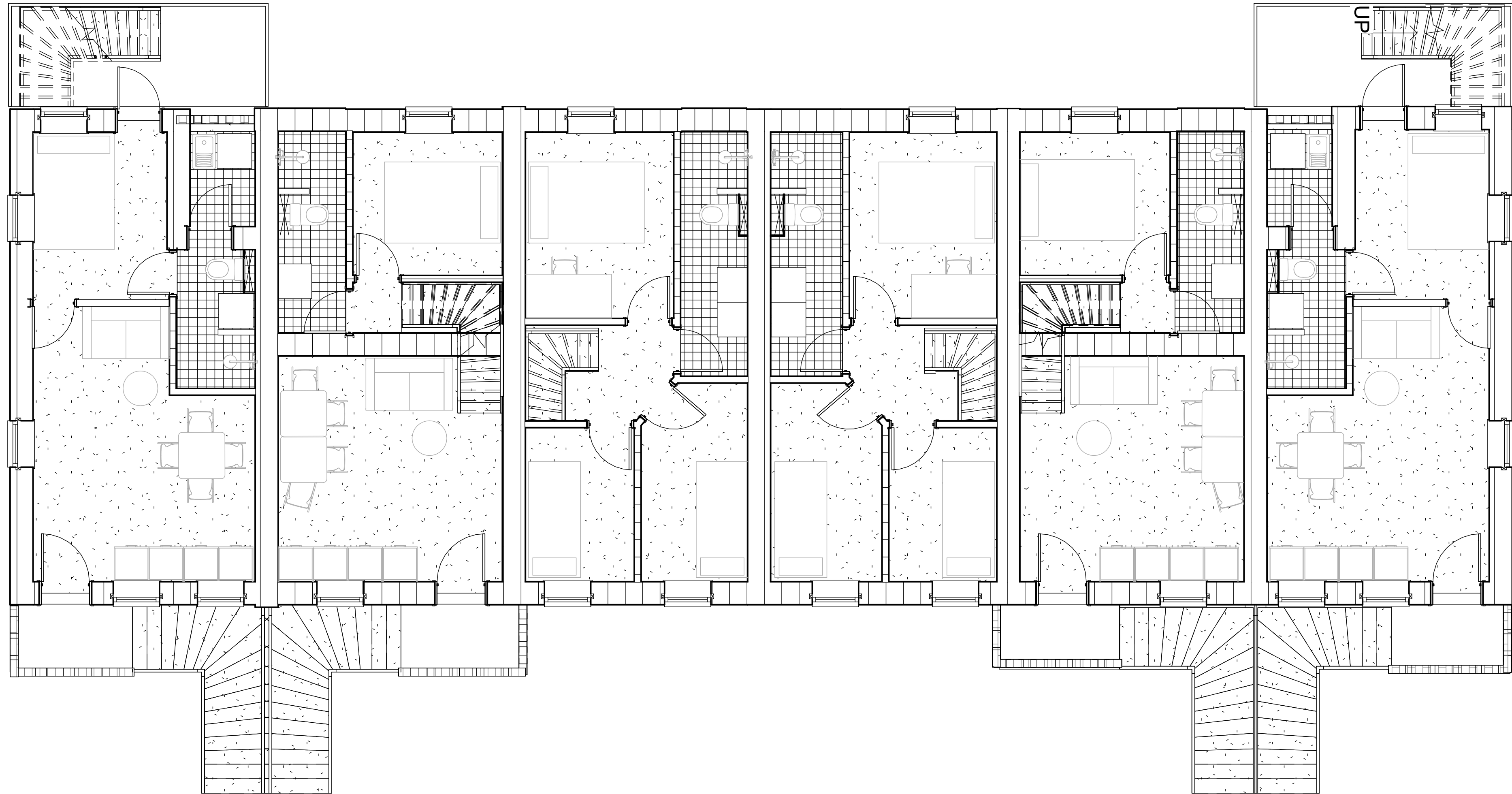
# Row house

Ground floor



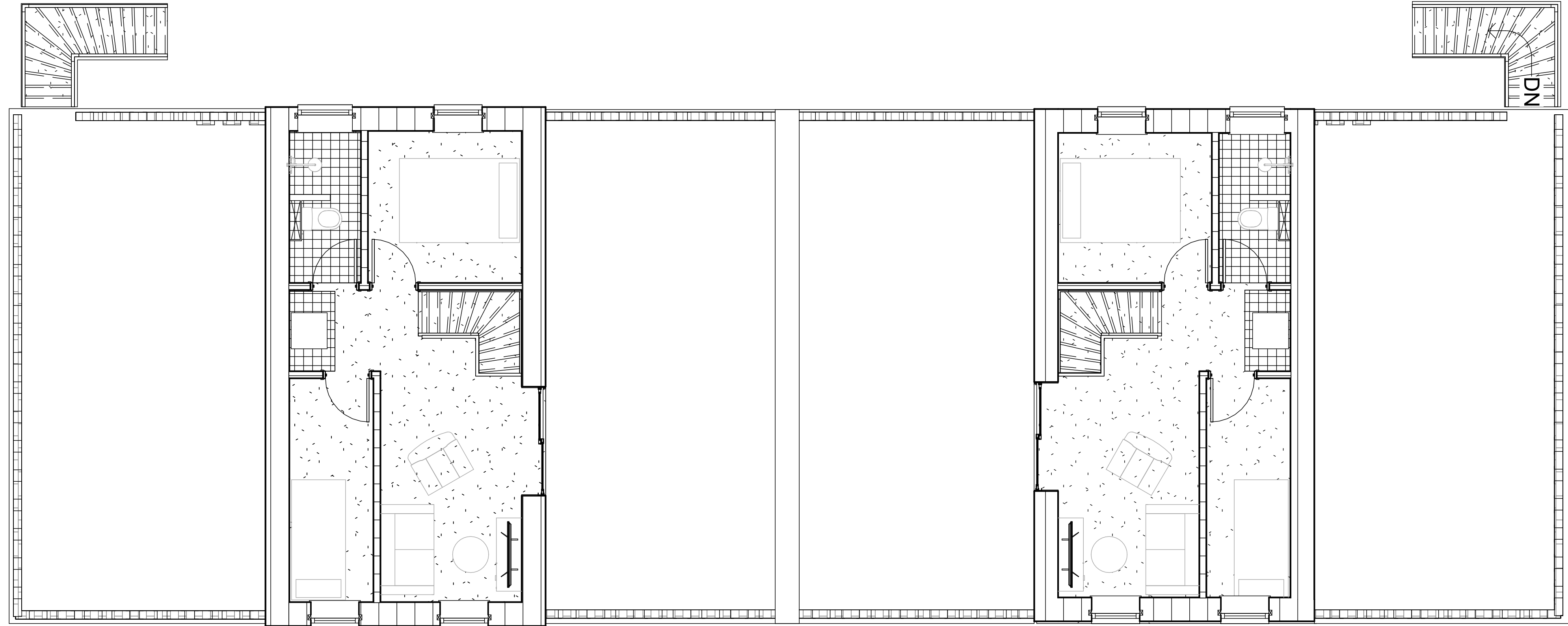
# Row house

First floor



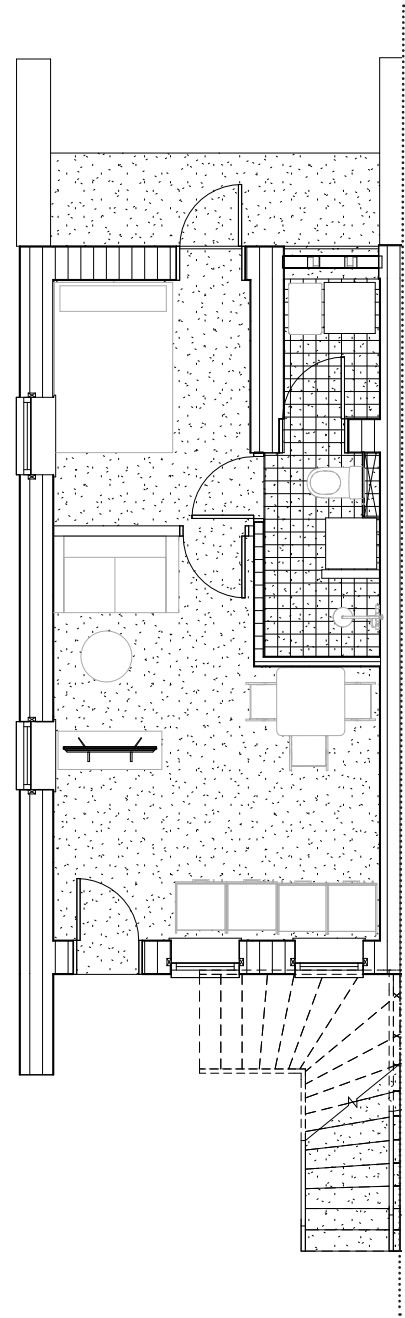
# Row house

Second floor



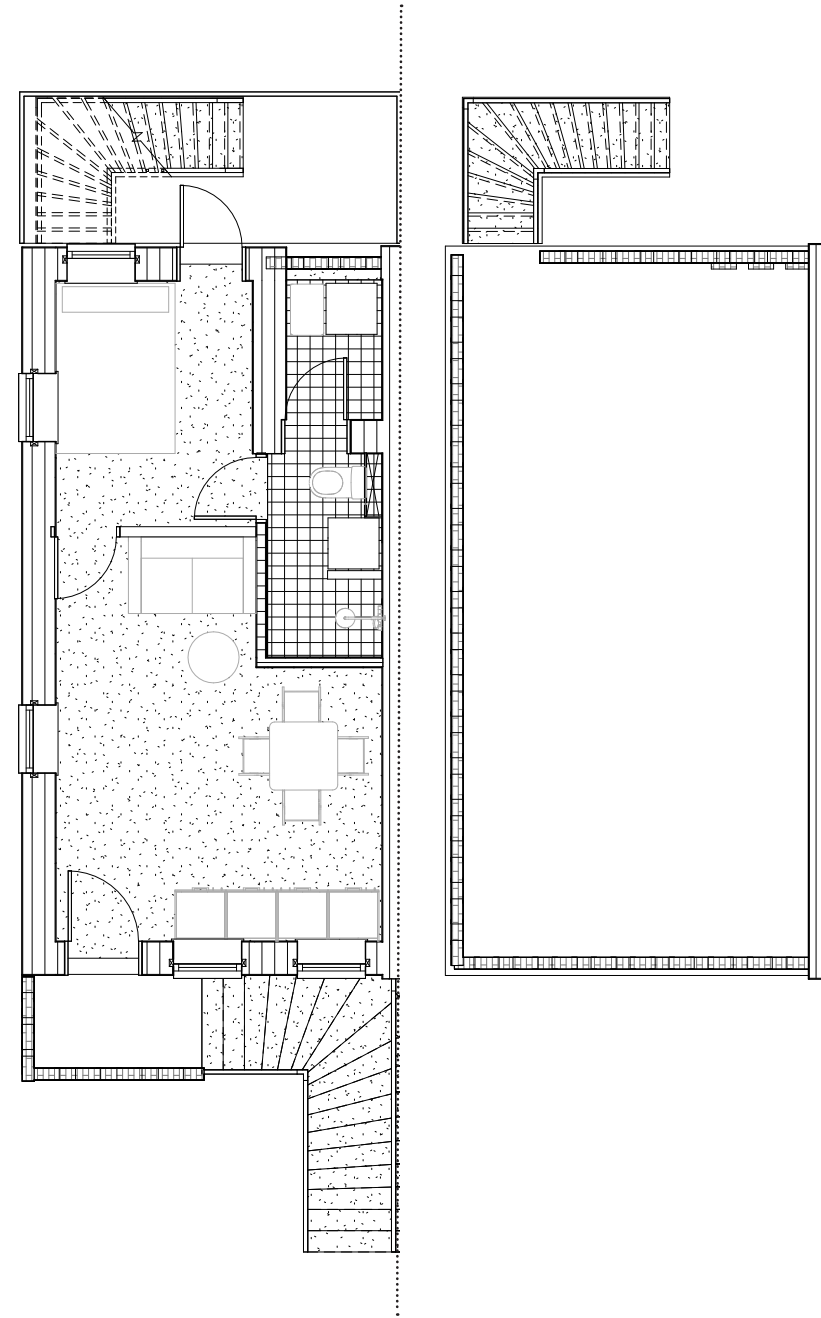
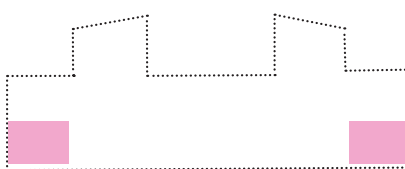
# Row house

## Apartment types



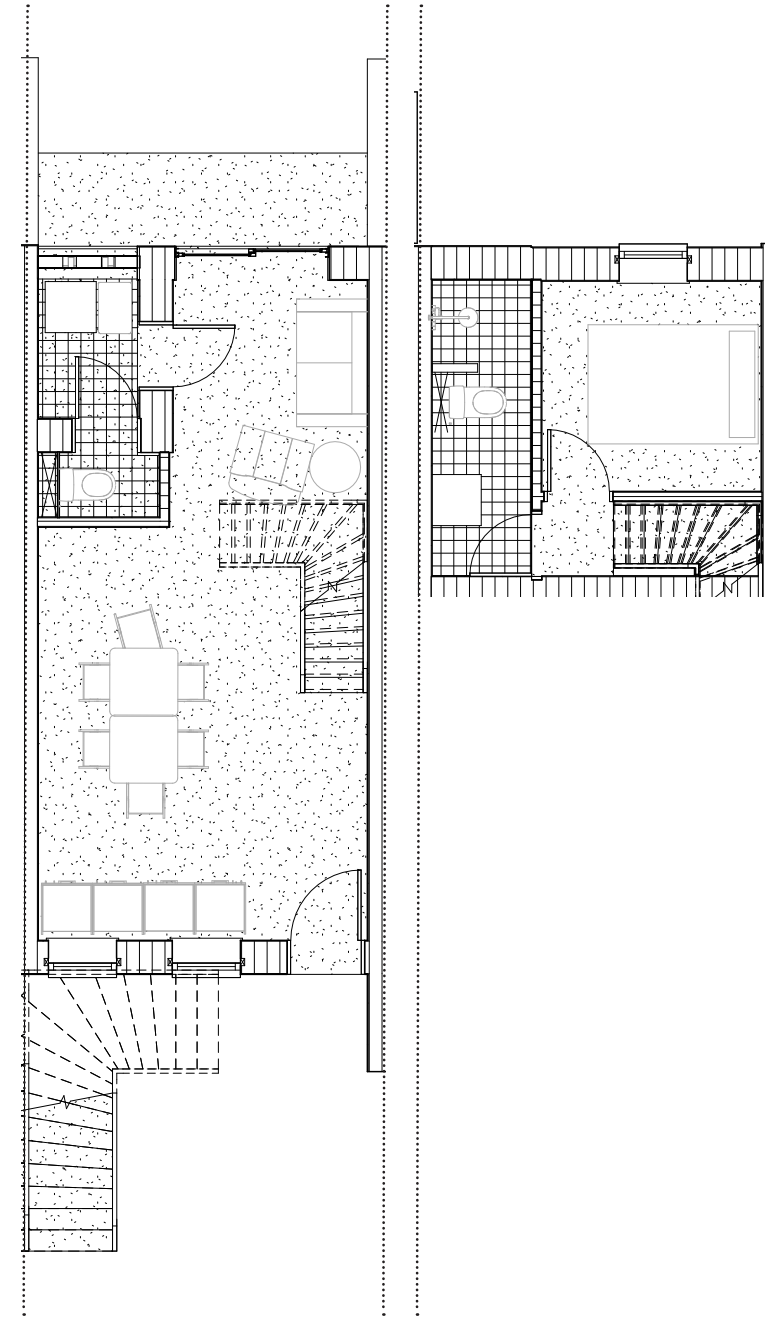
### Studio + garden

One bedroom  
35 m<sup>2</sup>  
HIS 1



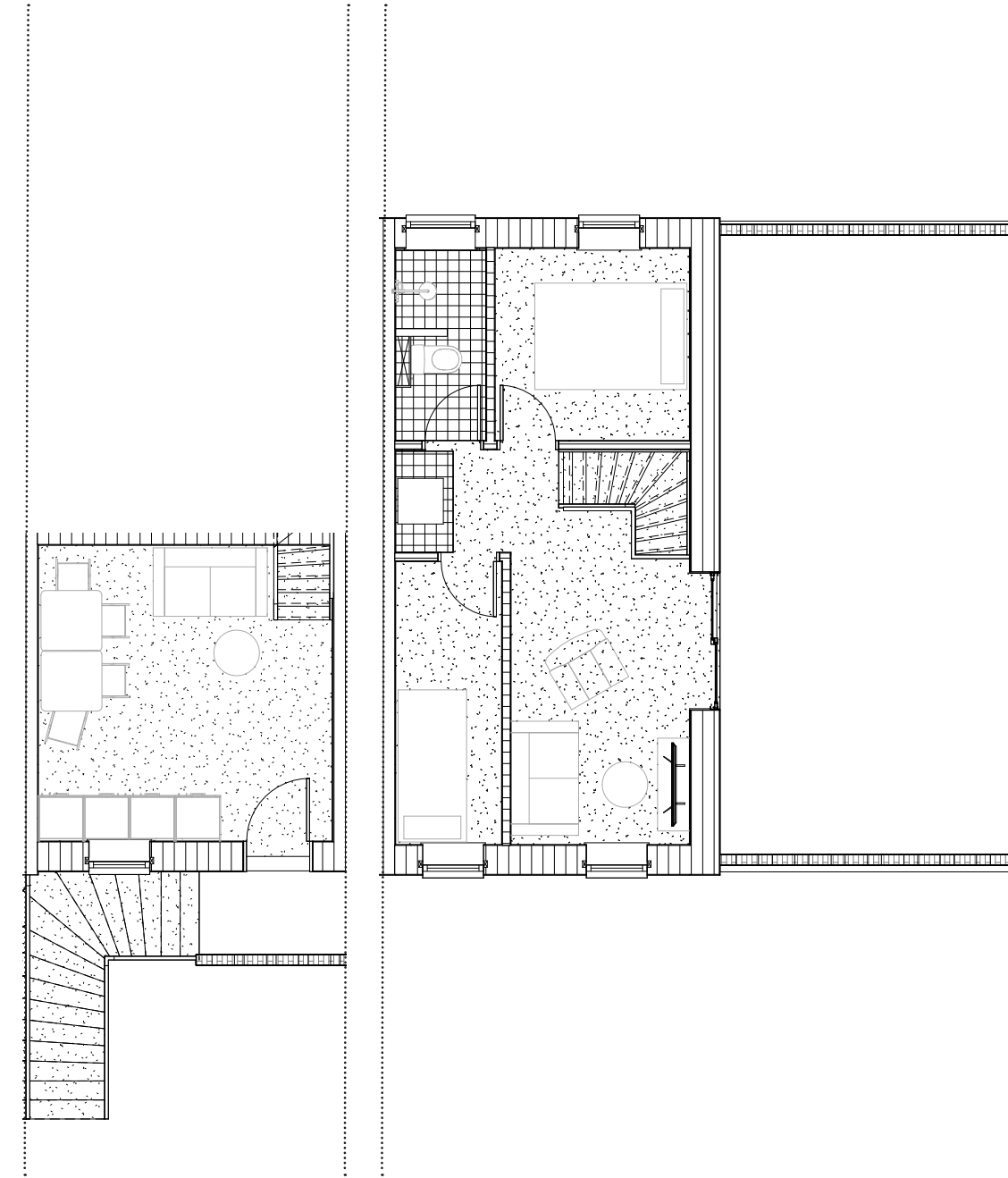
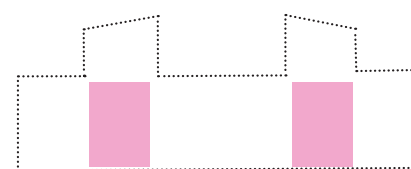
### Studio + rooftop garden

One bedroom  
35 m<sup>2</sup>  
HIS 1



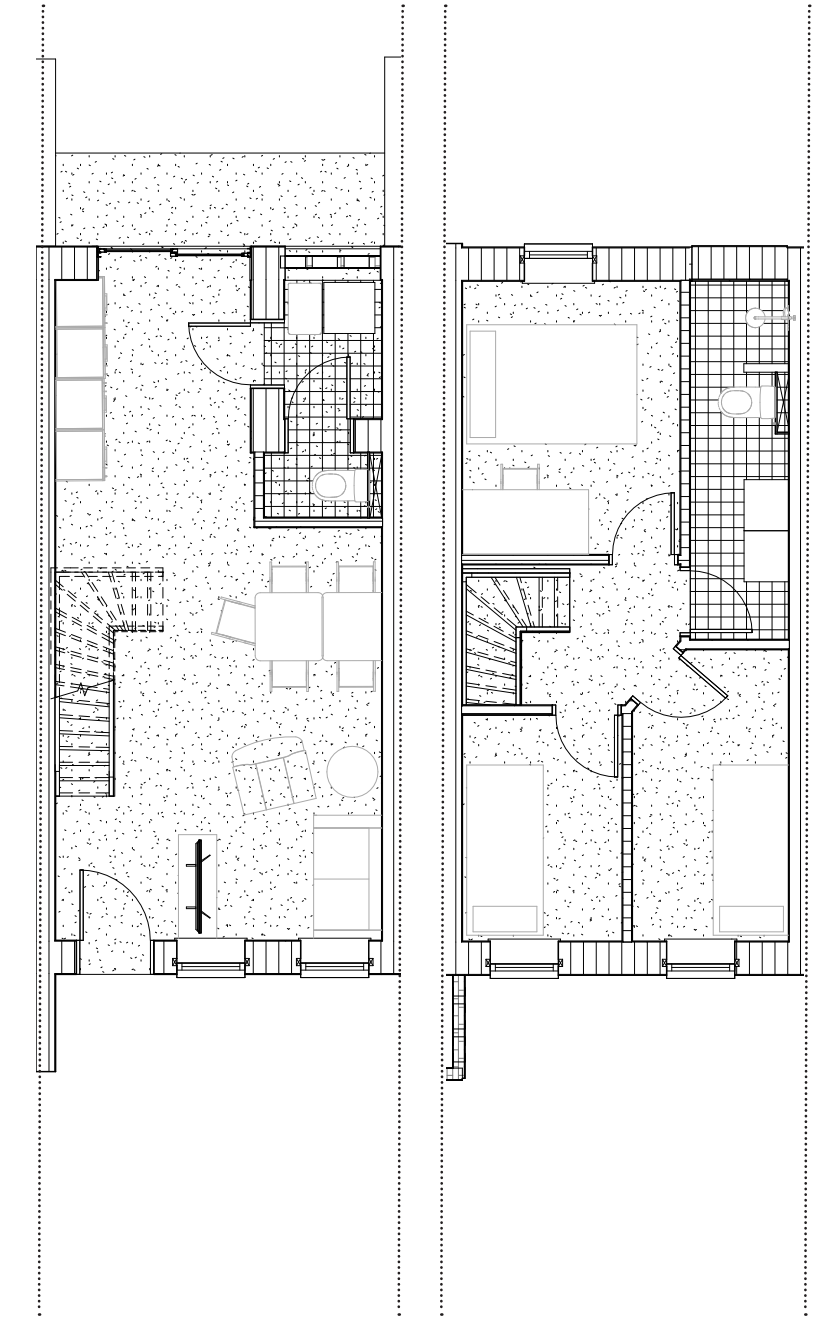
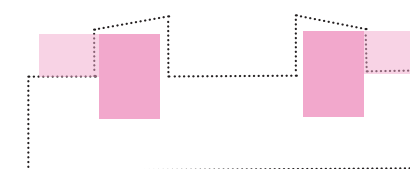
### Maisonette + garden

One bedroom  
50 m<sup>2</sup>  
HIS 1&2



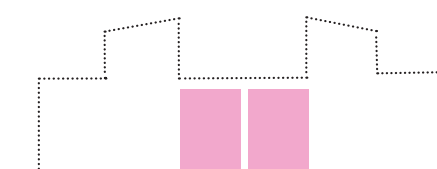
### Maisonette + rooftop garden

Two bedroom  
52 m<sup>2</sup>  
HIS 1&2

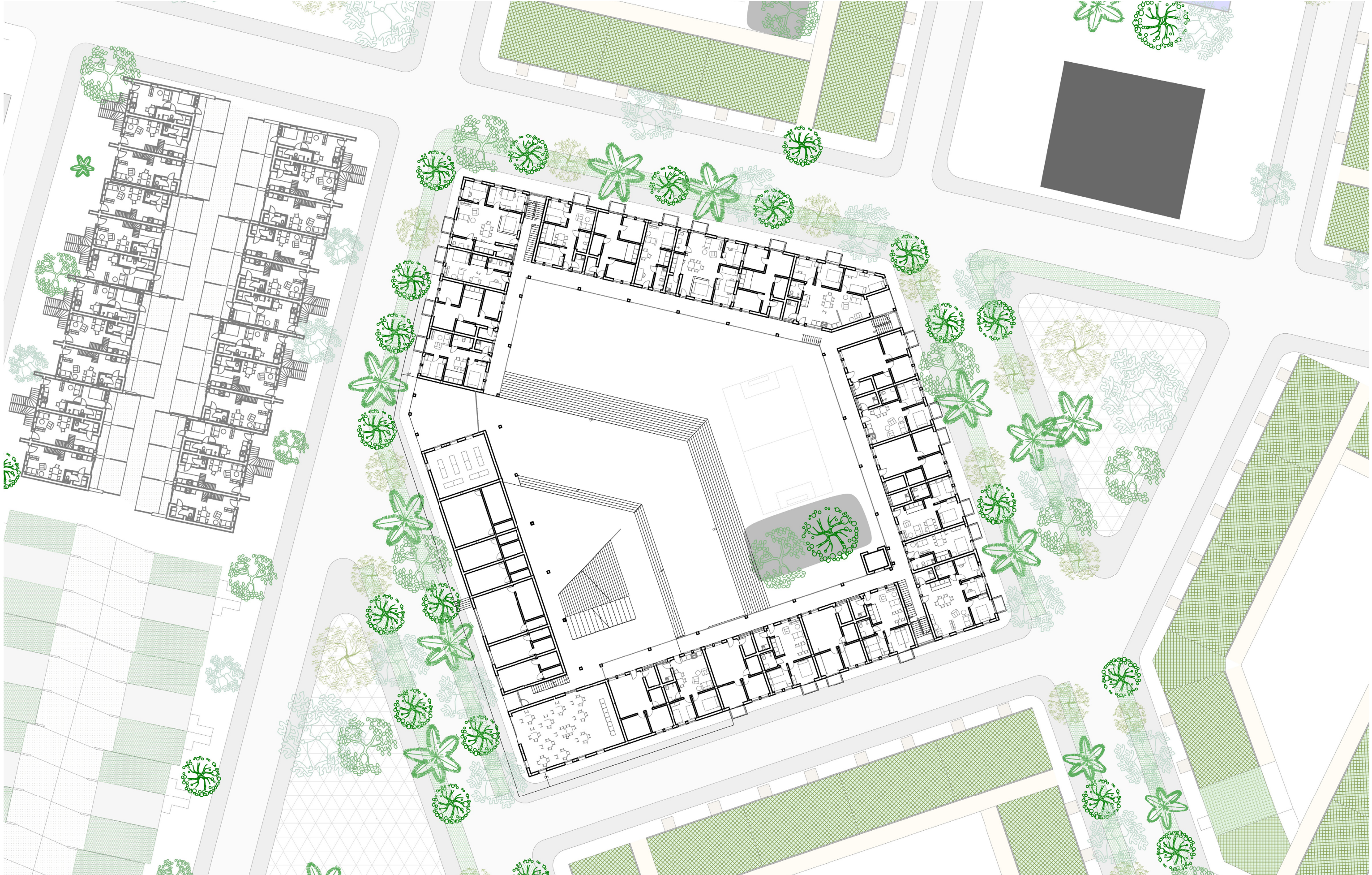


### Two story + garden

Three bedroom  
64 m<sup>2</sup>  
HIS 2&3



# Courtyard block



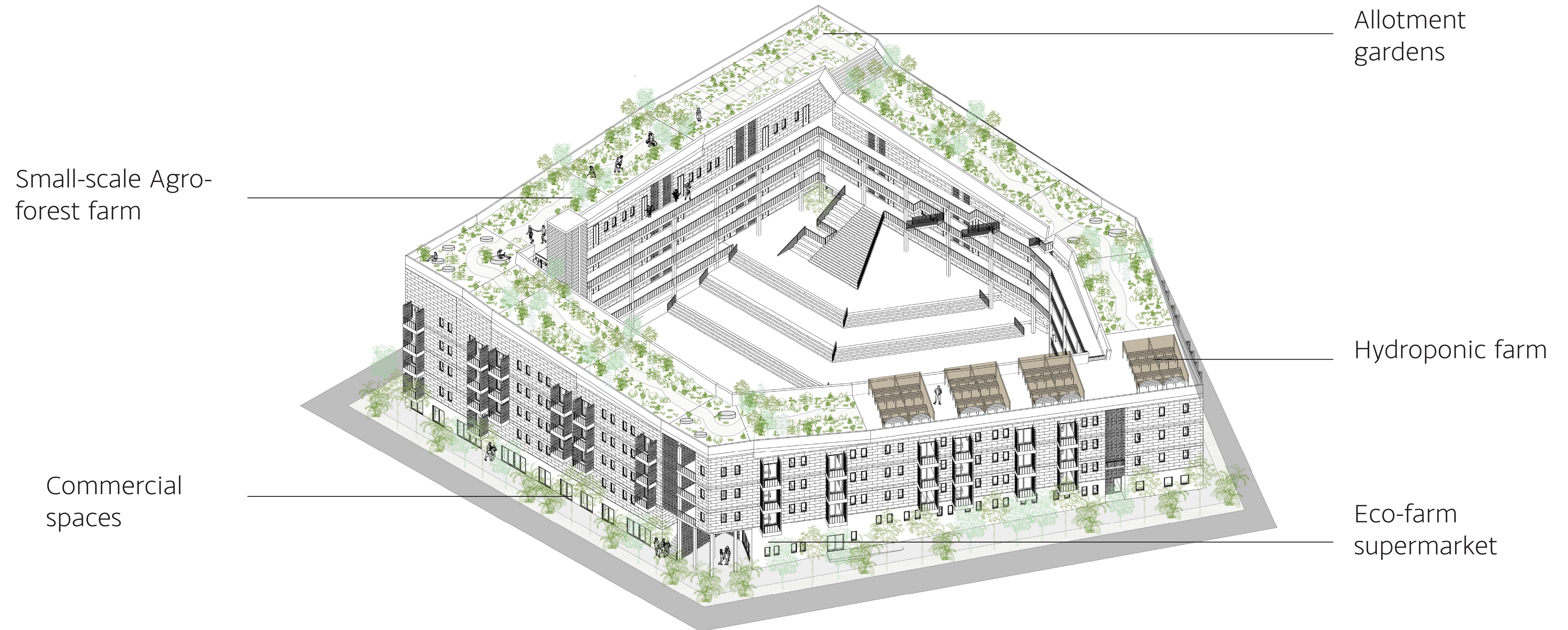
# Courtyard block

FSI: 1,15

94 apartments

dw/ha: 182

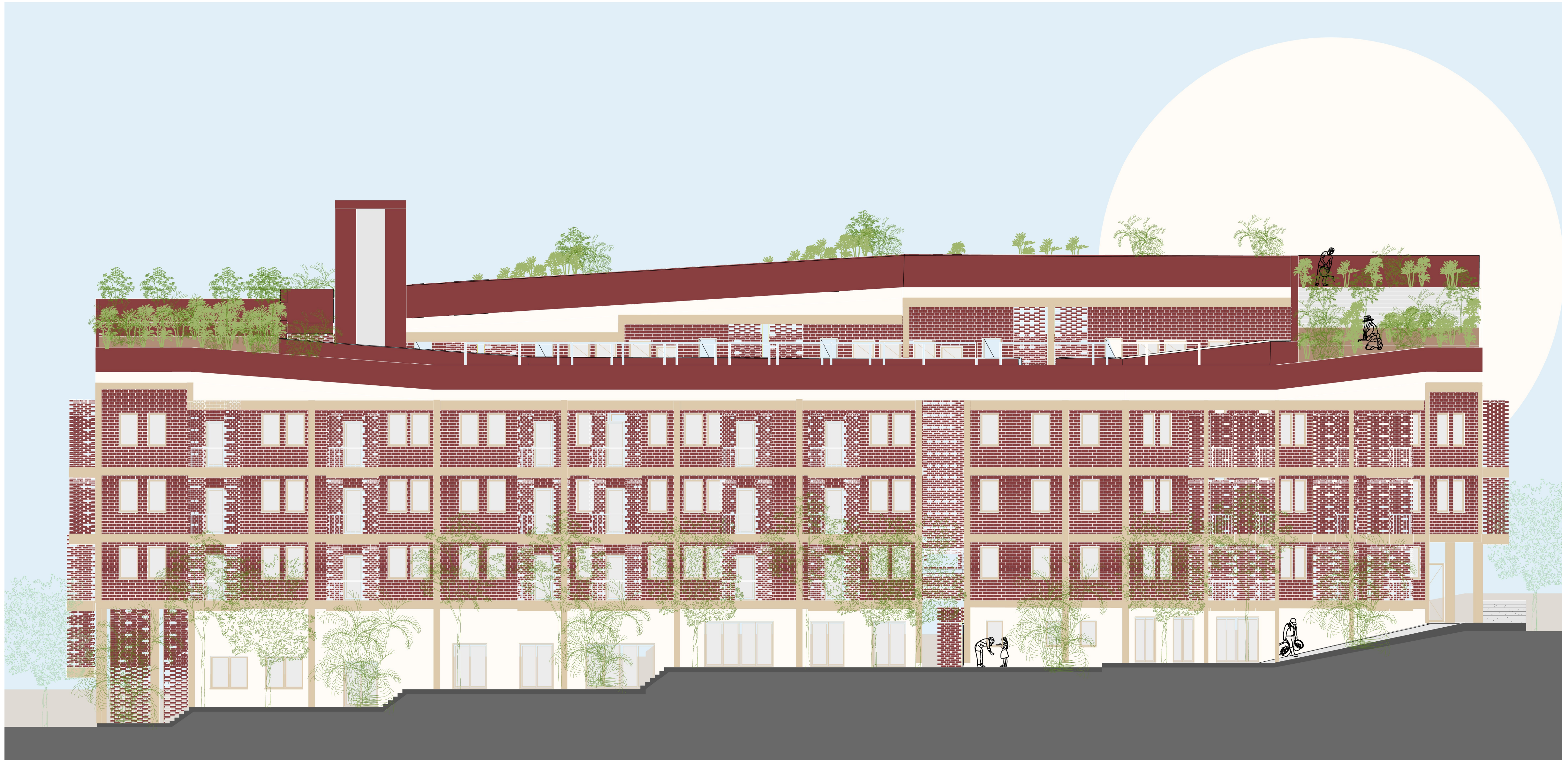
376 m<sup>2</sup> rooftop farmground



# Courtyard block

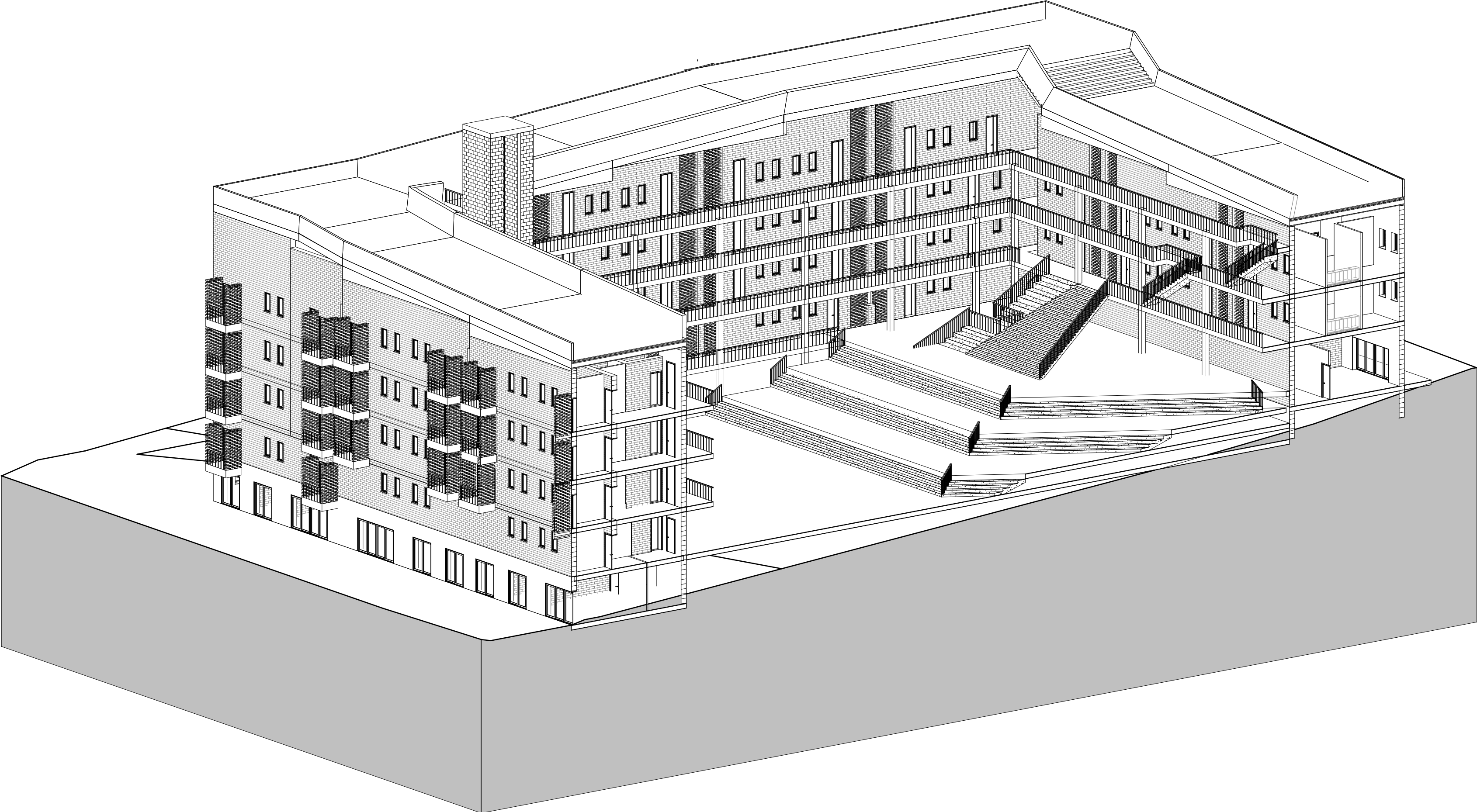
## Section





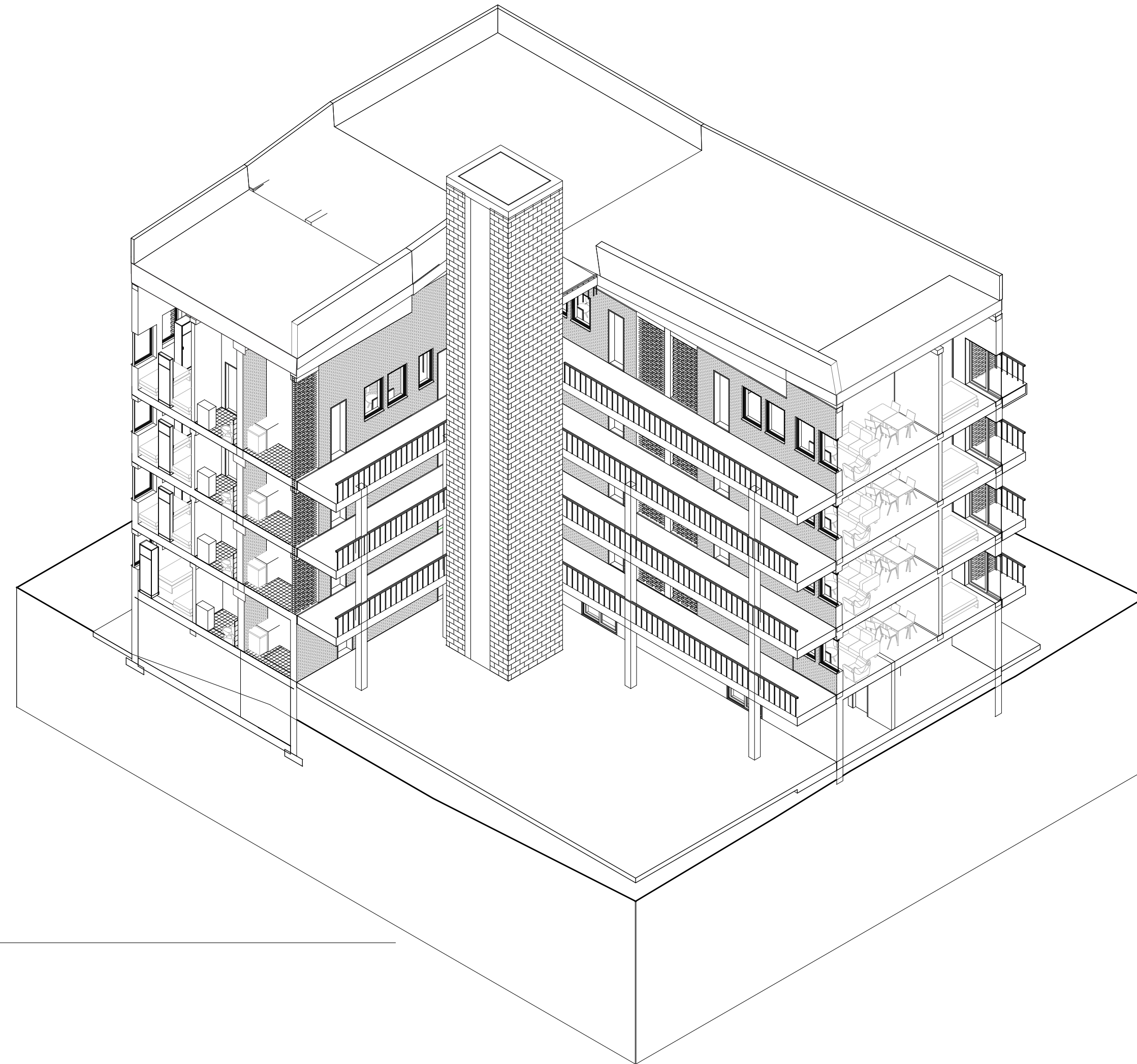
# Courtyard block

Iso section



# Courtyard block

Iso section



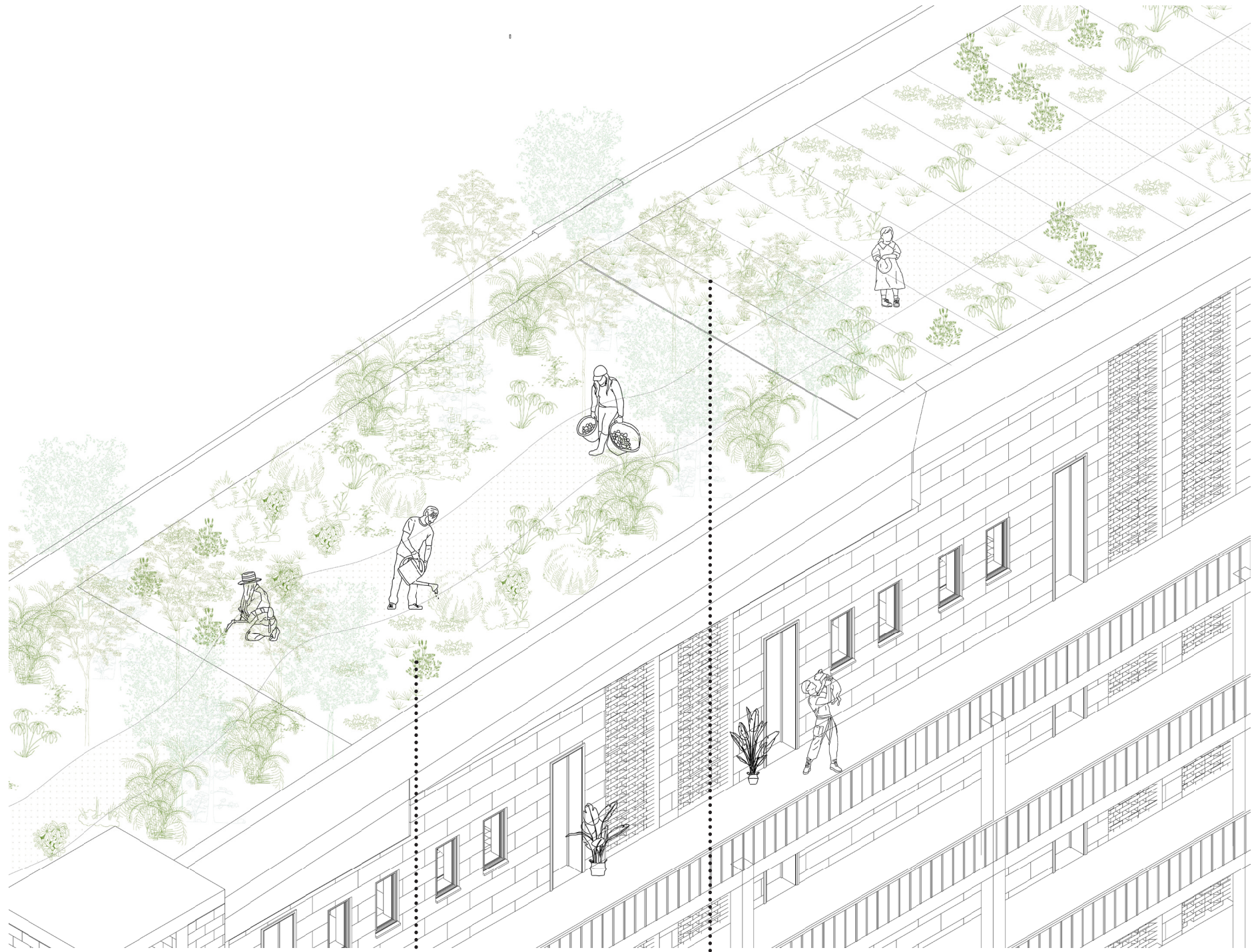
# Courtyard block

Entrance



# Courtyard block

Rooftop farming



Communal agroforestry

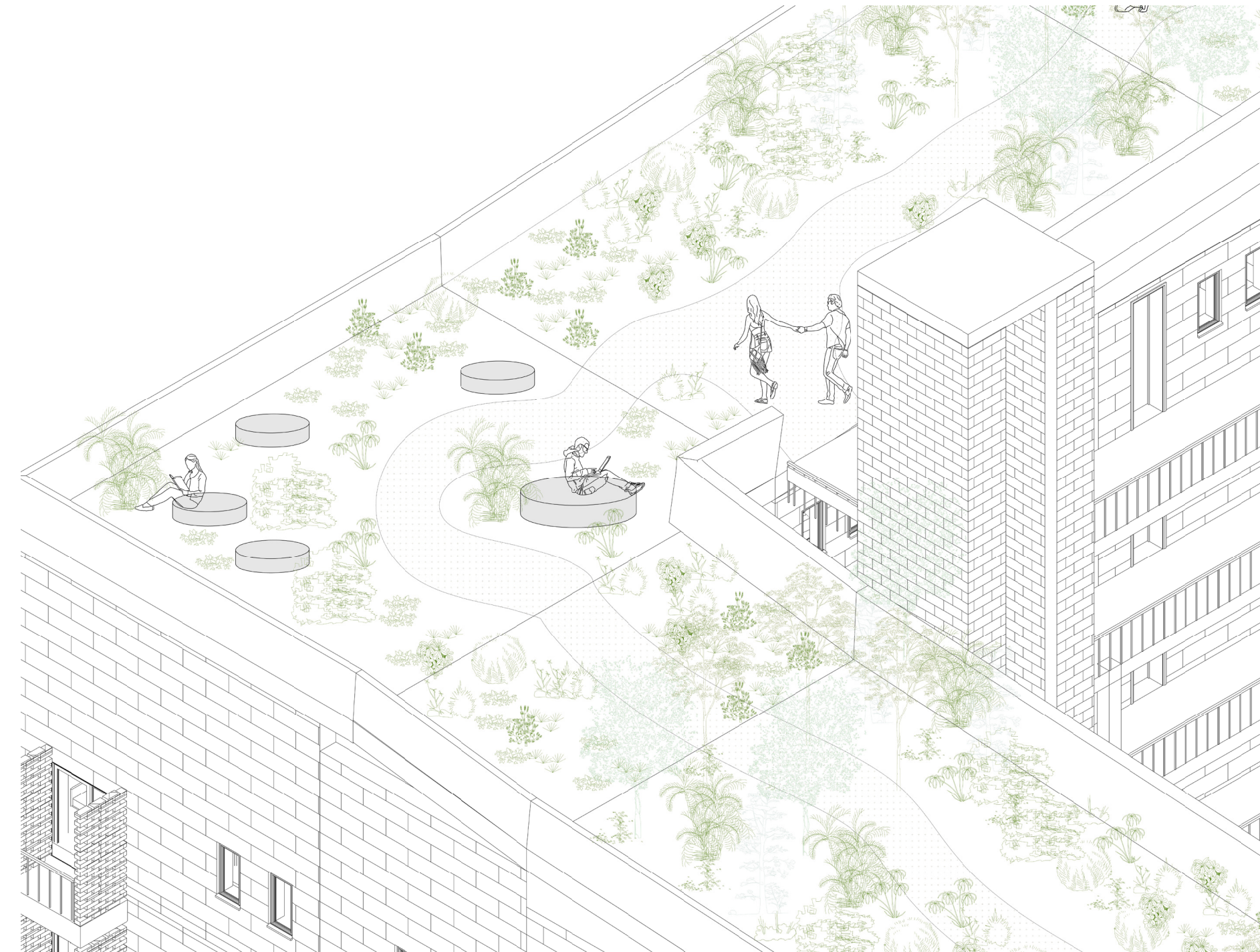
Private allotments



Communal hydroponic

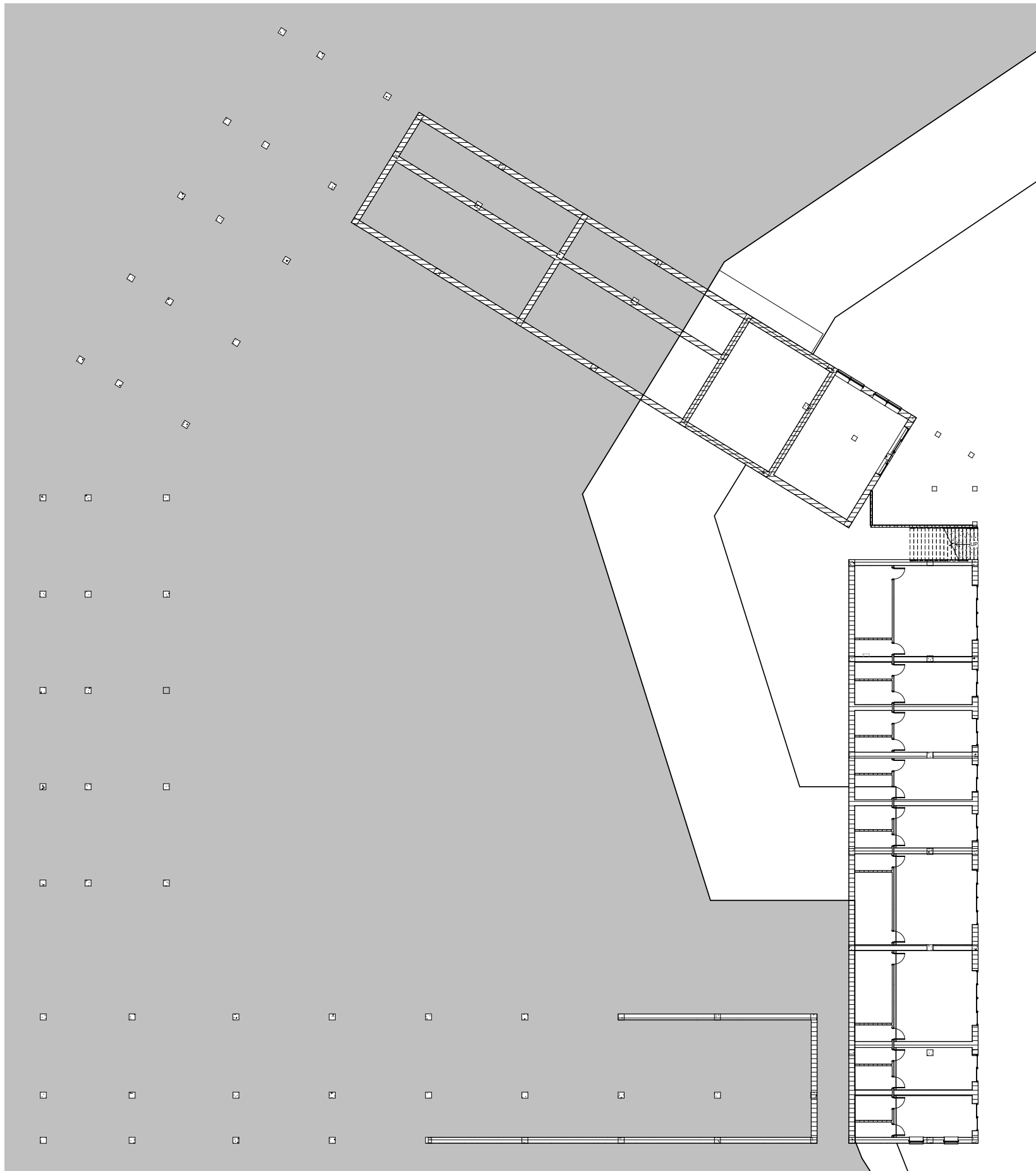
# Courtyard block

Leisure platforms

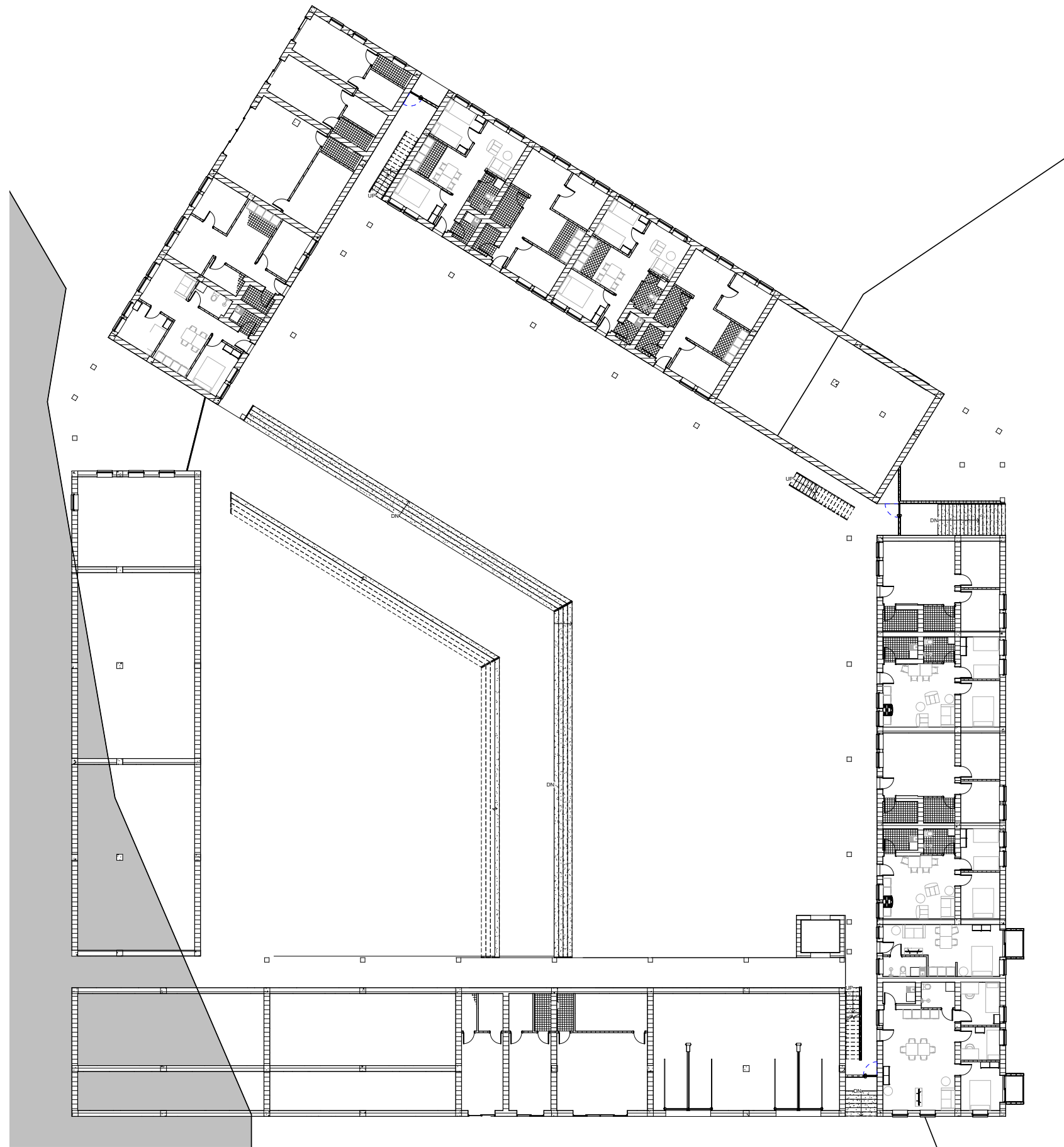


# Courtyard block

Ground floor access



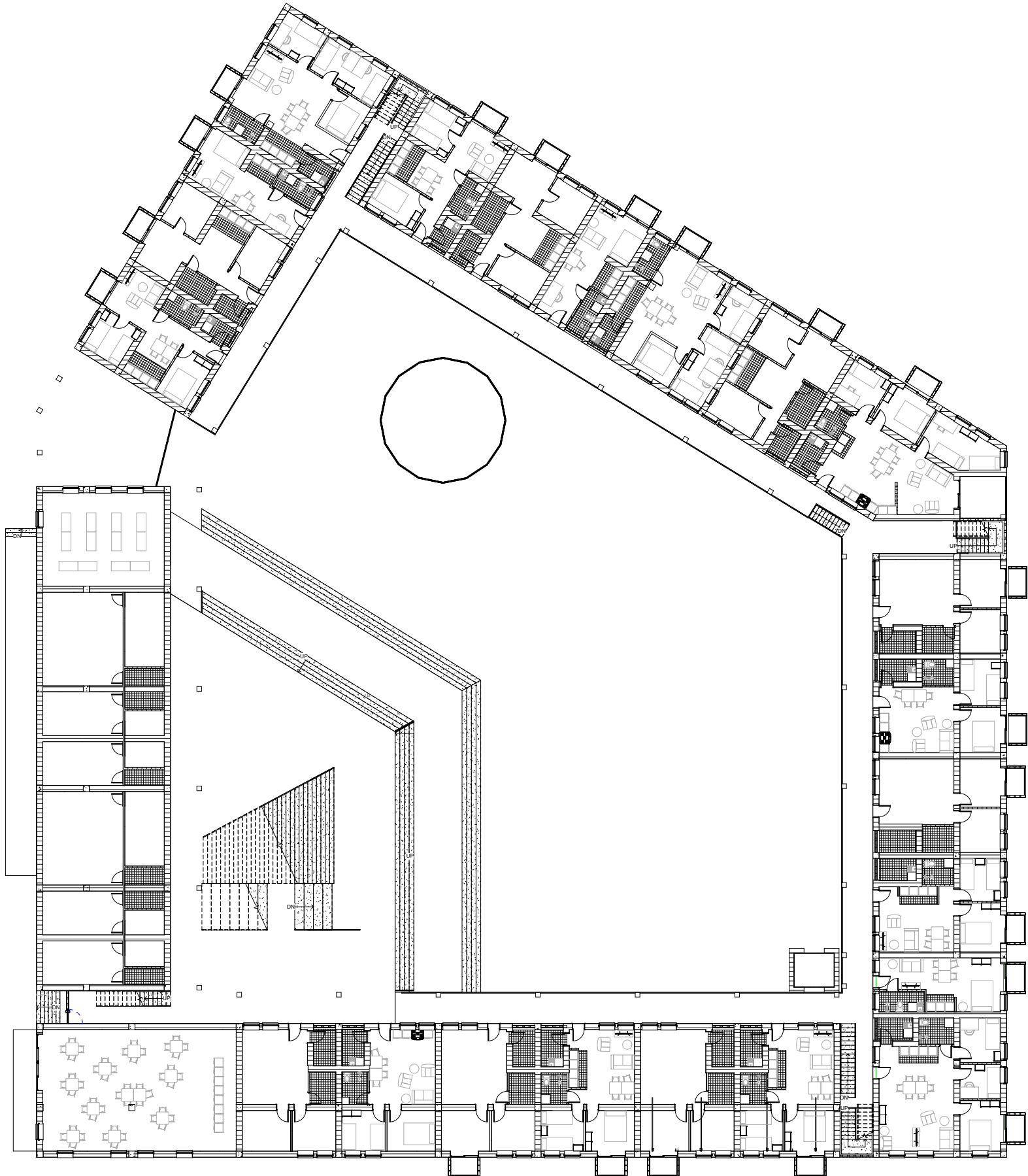
Level -2



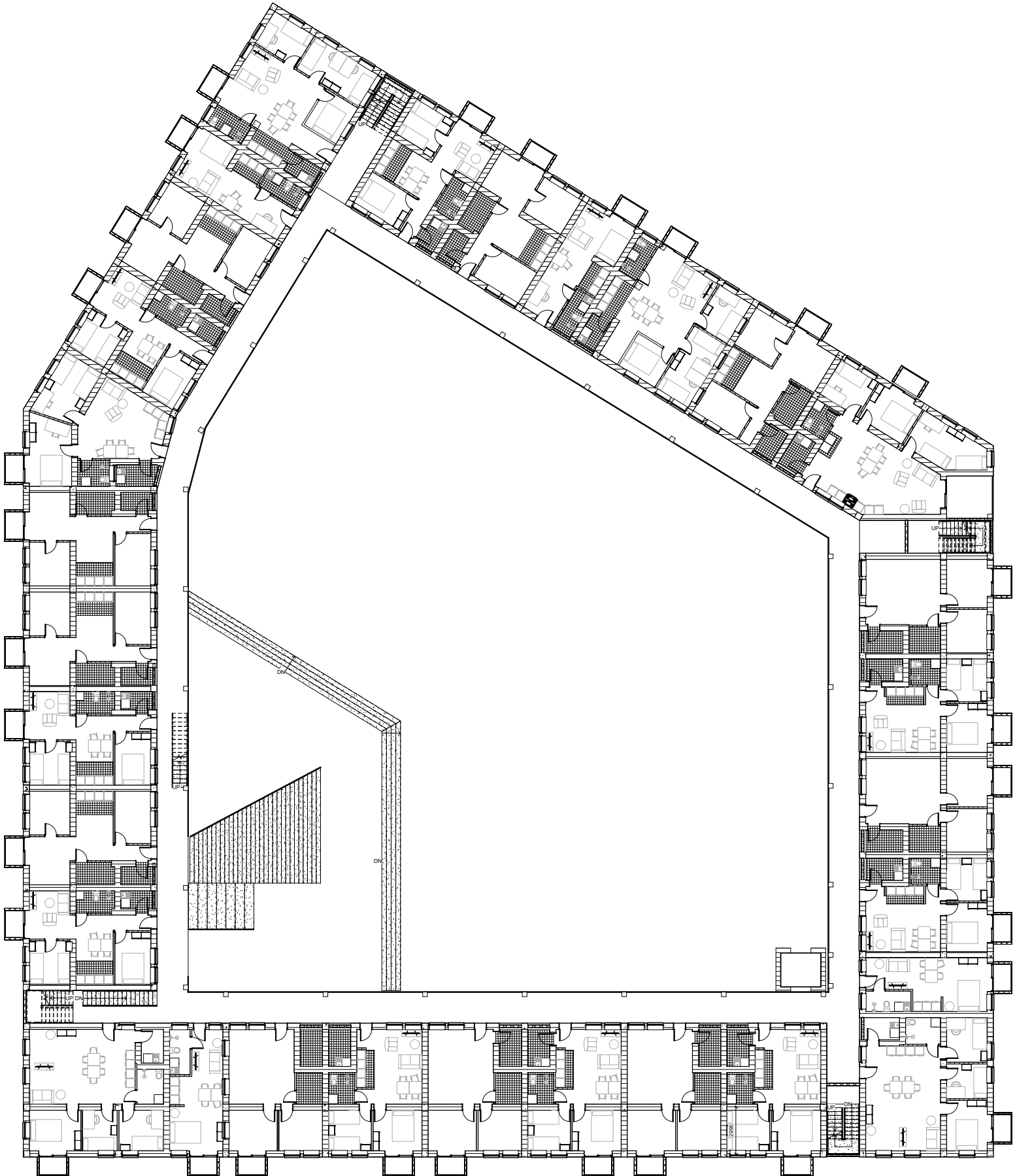
Level -1

# Courtyard block

## Floorplans



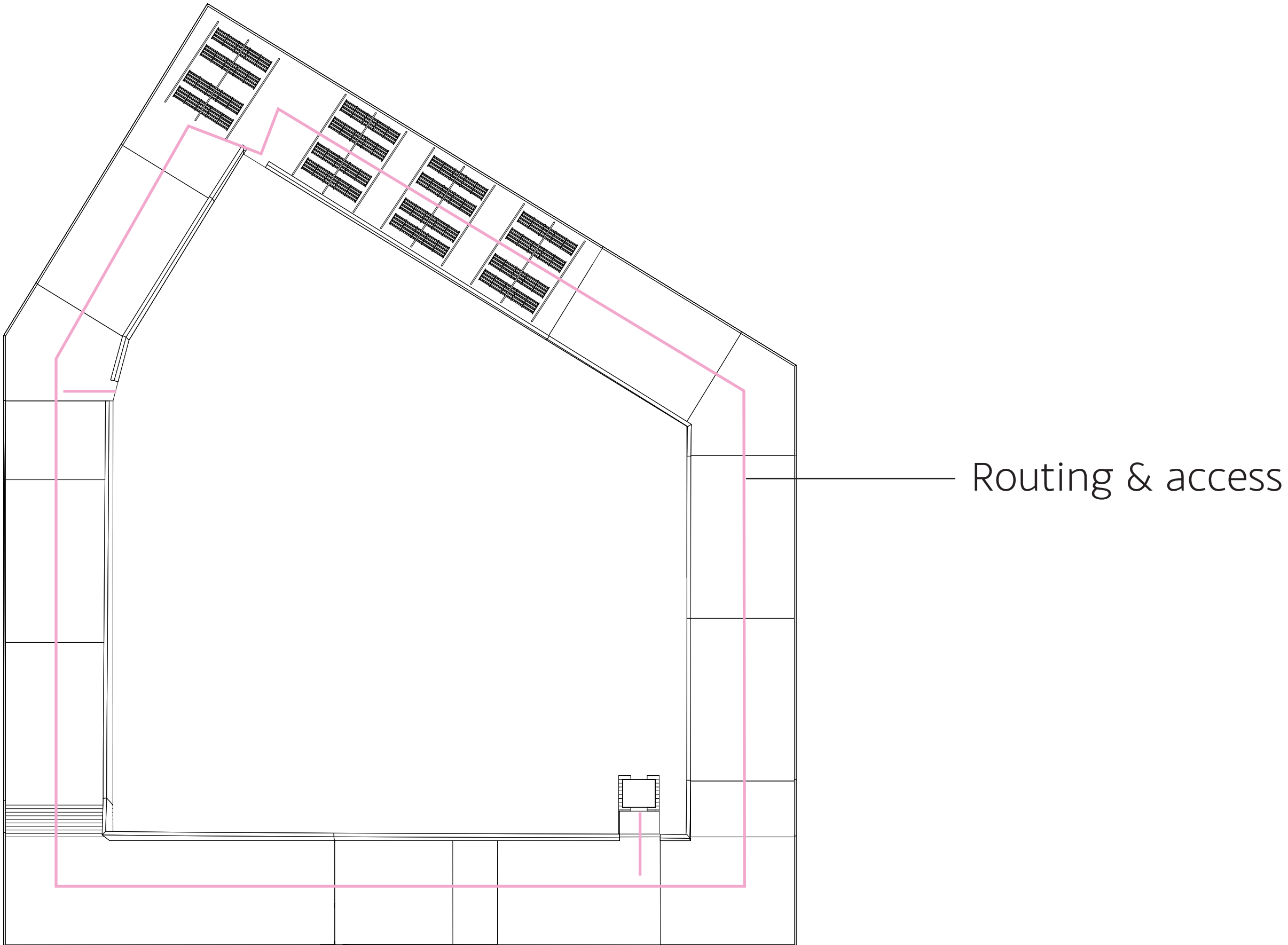
Level 0



Level 1-3

# Courtyard block

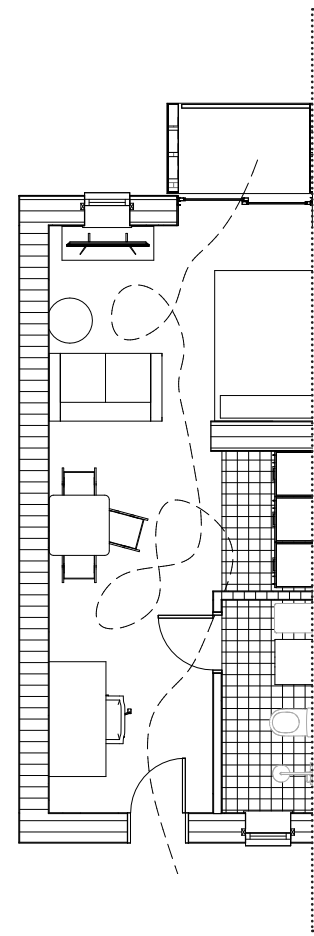
Roof



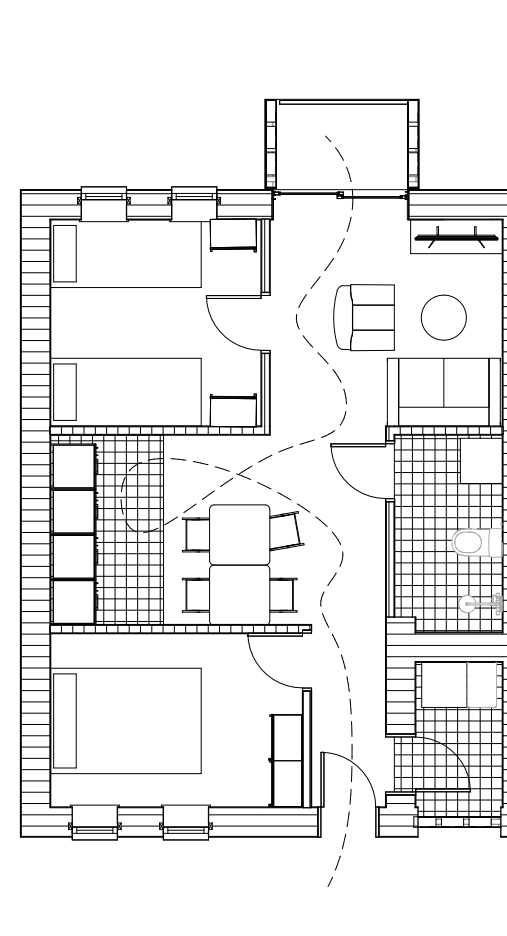
Roof

# Courtyard block

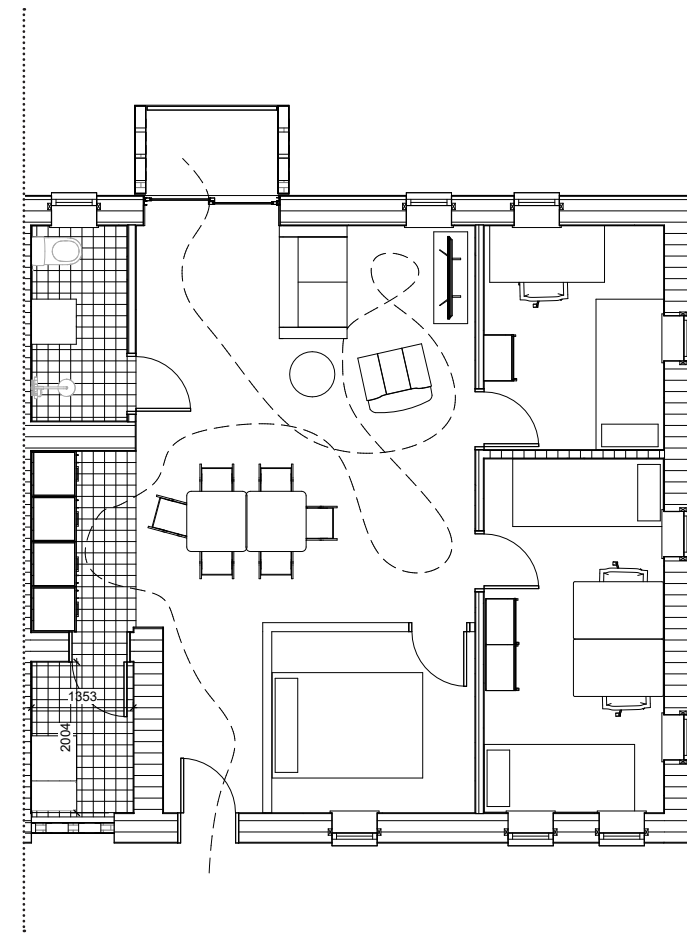
## Regular apartment types



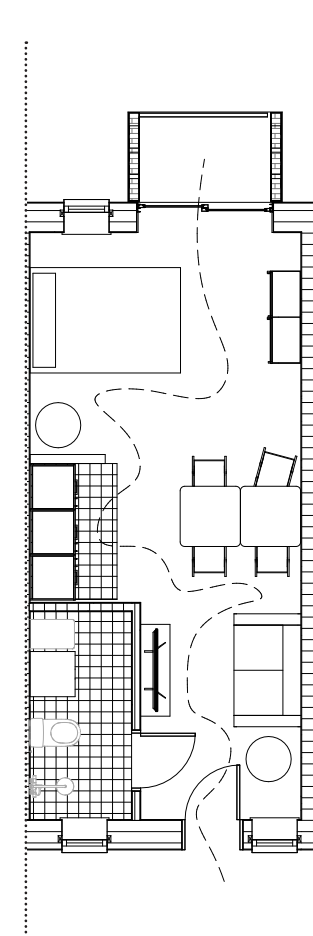
**Studio**  
One bedroom  
32 m<sup>2</sup>  
HIS 1



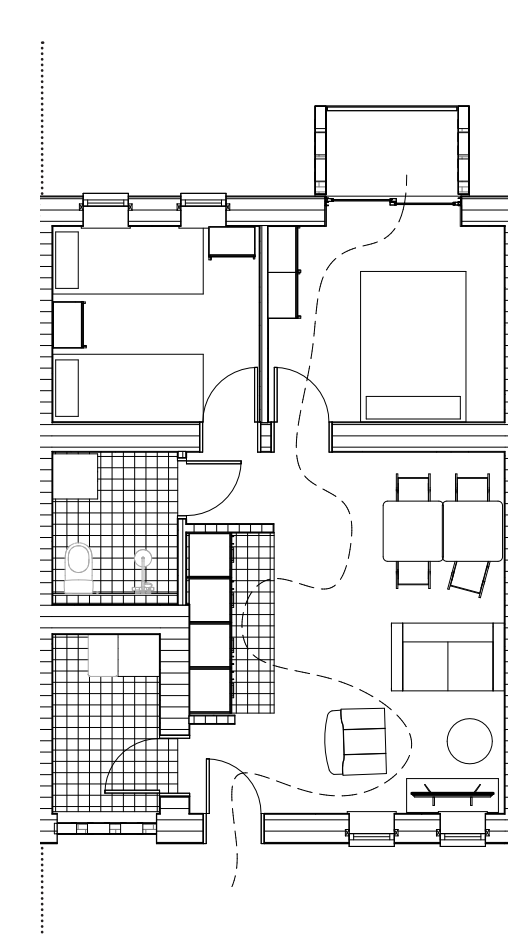
**One story app**  
Two bedroom  
52 m<sup>2</sup>  
HIS 1&2



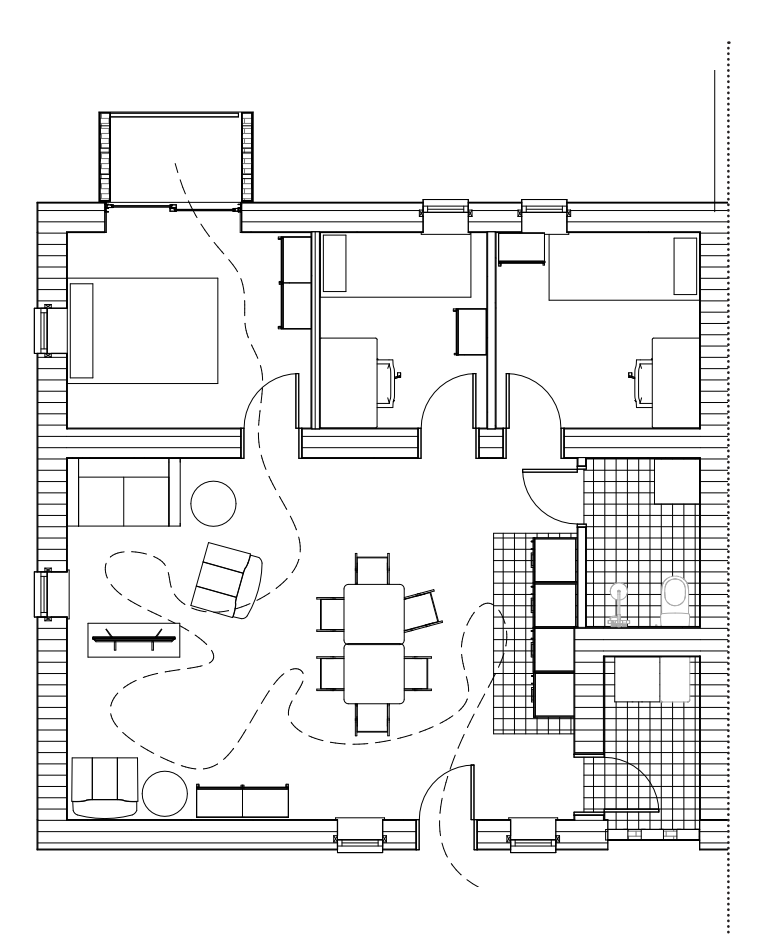
**One story app**  
Three bedroom  
72 m<sup>2</sup>  
HIS 2&3



**Studio**  
One bedroom  
32 m<sup>2</sup>  
HIS 1



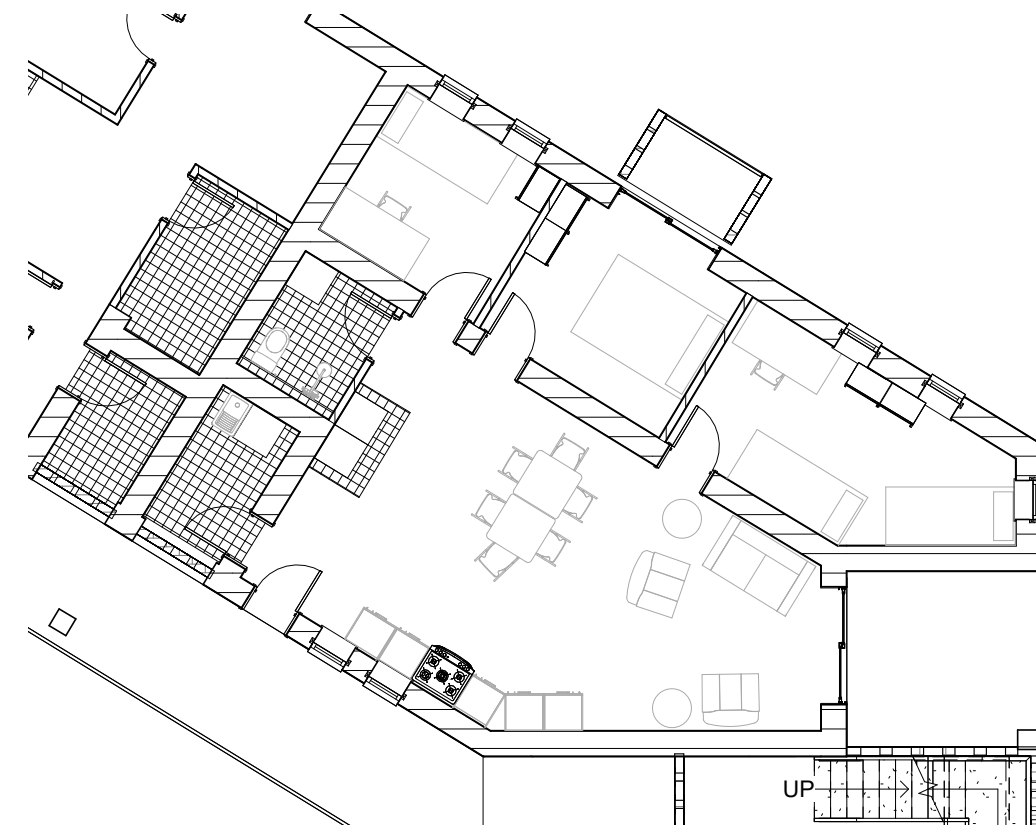
**One story app**  
Two bedroom  
52 m<sup>2</sup>  
HIS 1&2



**One story app**  
Three bedroom  
72 m<sup>2</sup>  
HIS 2&3

# Courtyard block

Corner connection apartments

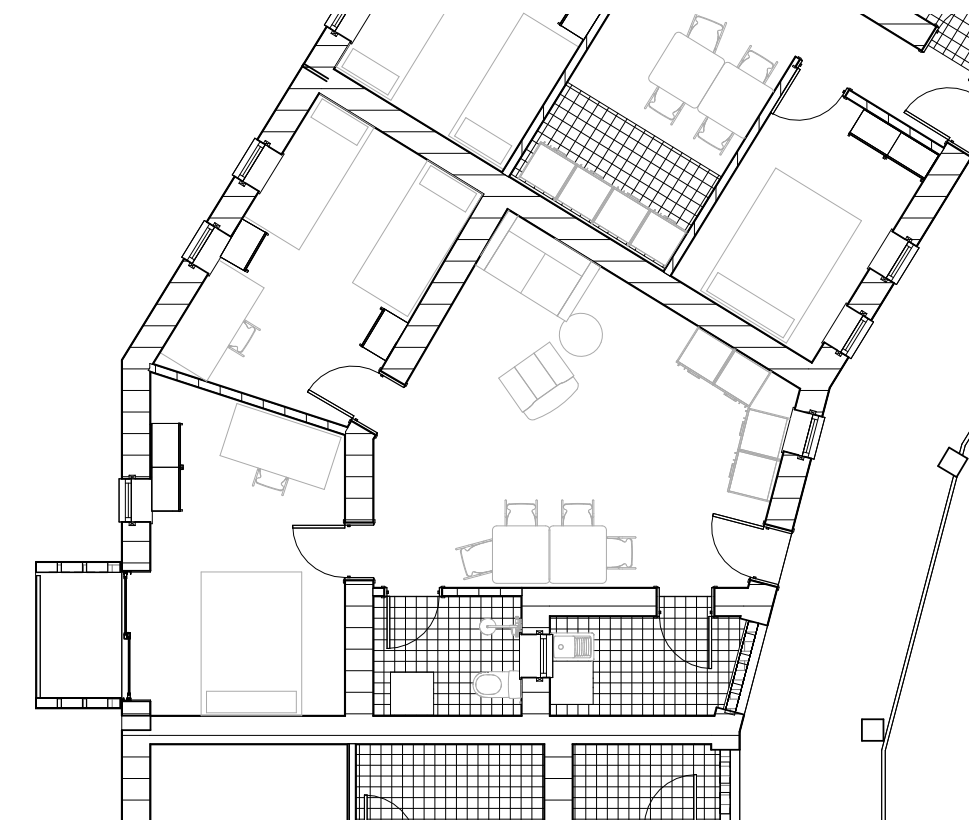


**One story app**

Three bedroom

82 m<sup>2</sup>

HIS 3



**One story app**

Two bedroom

52 m<sup>2</sup>

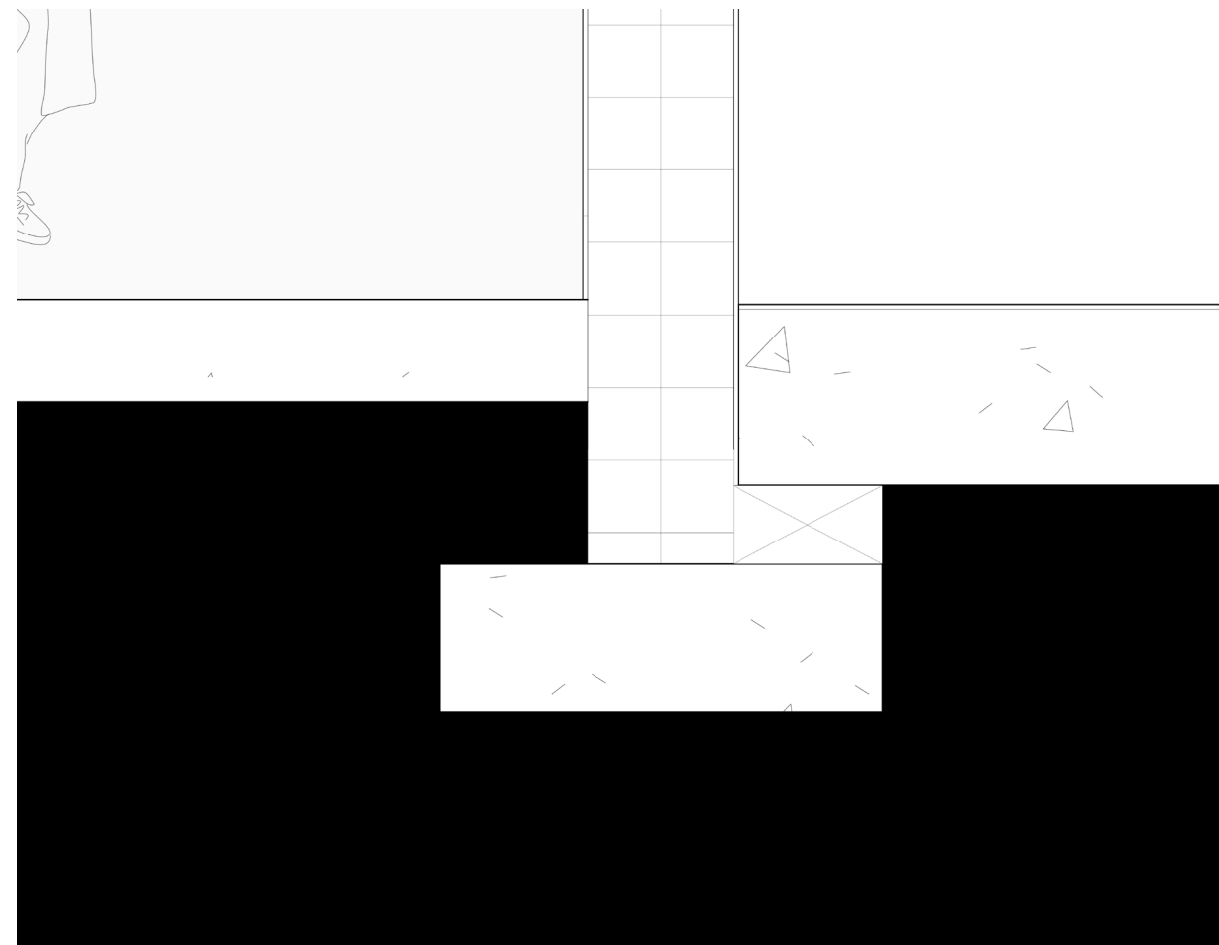
HIS 2&3

# Building technology

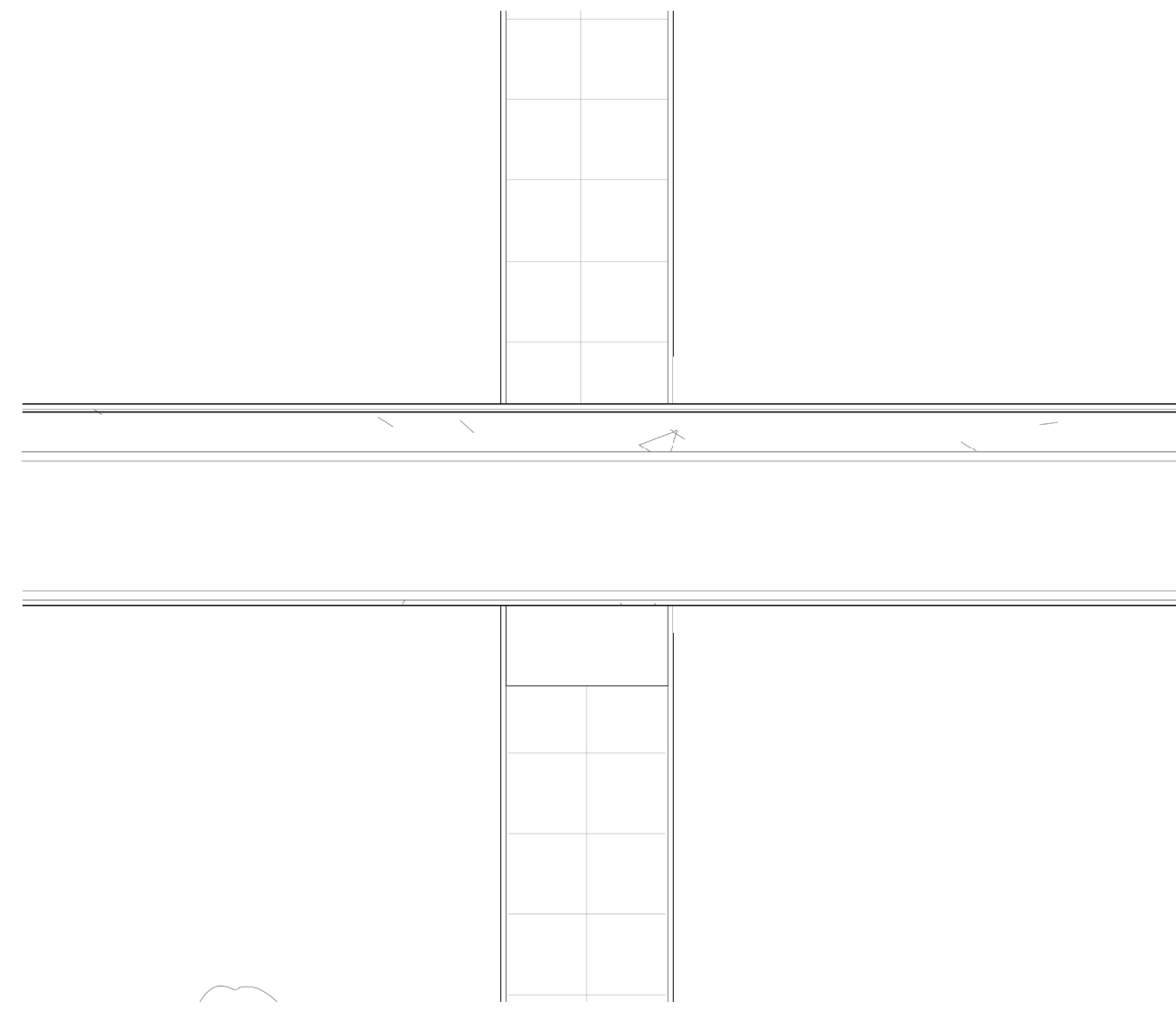
Section 1:20



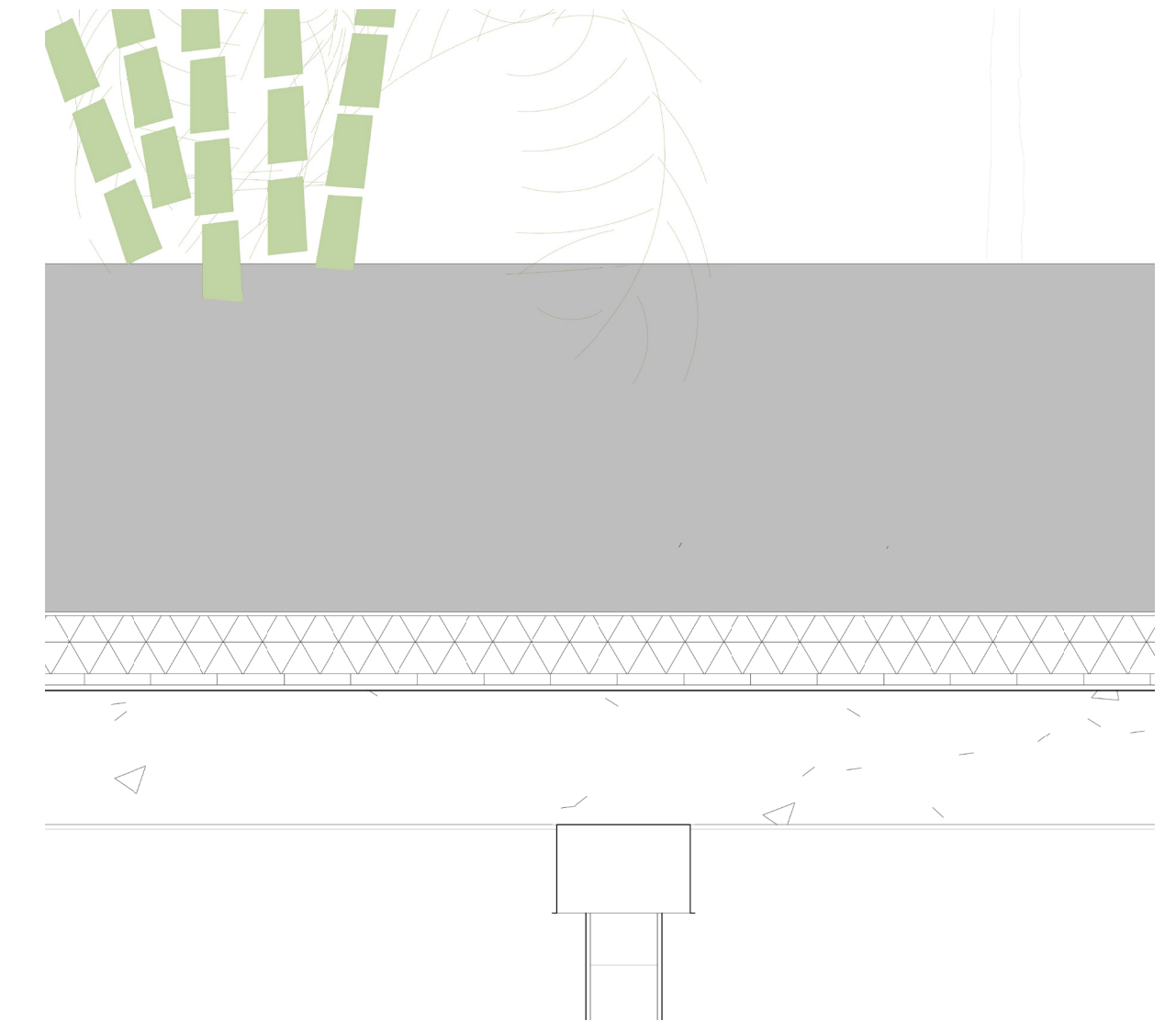
# Details



Foundation detail

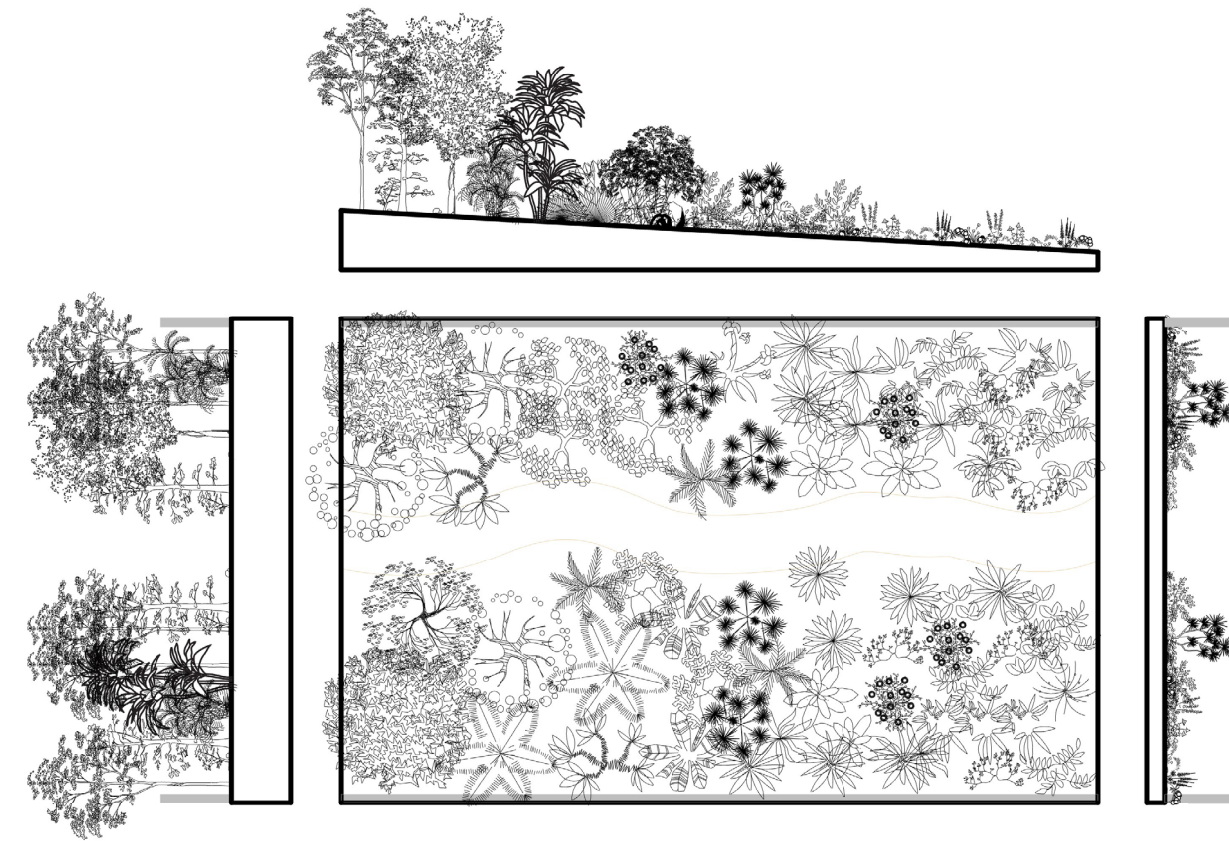


Level connection detail

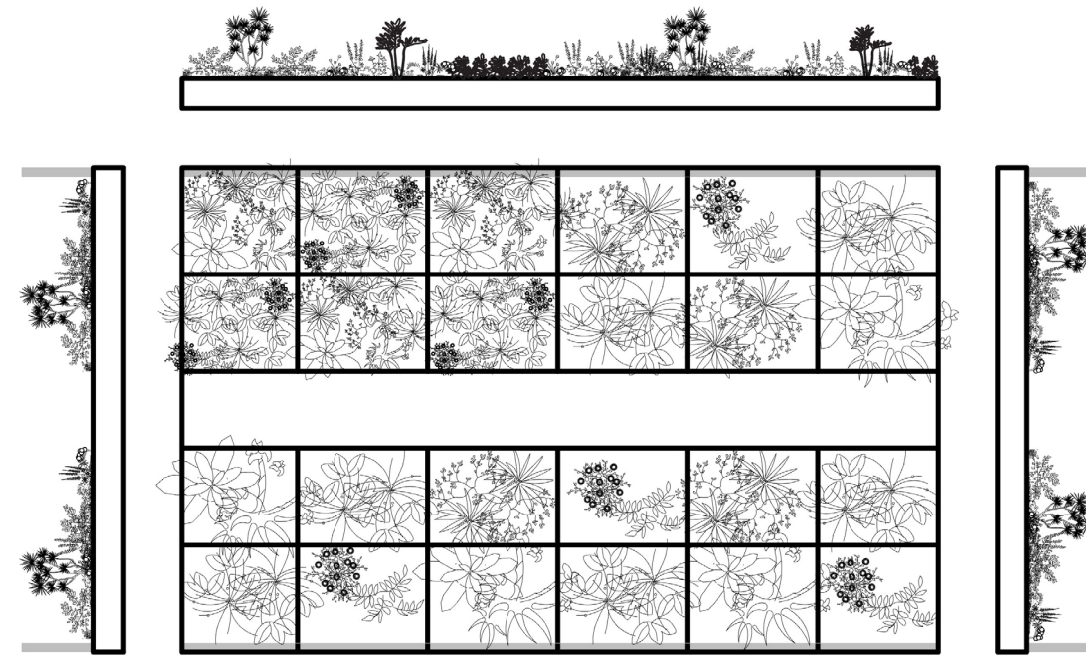


Green roof detail

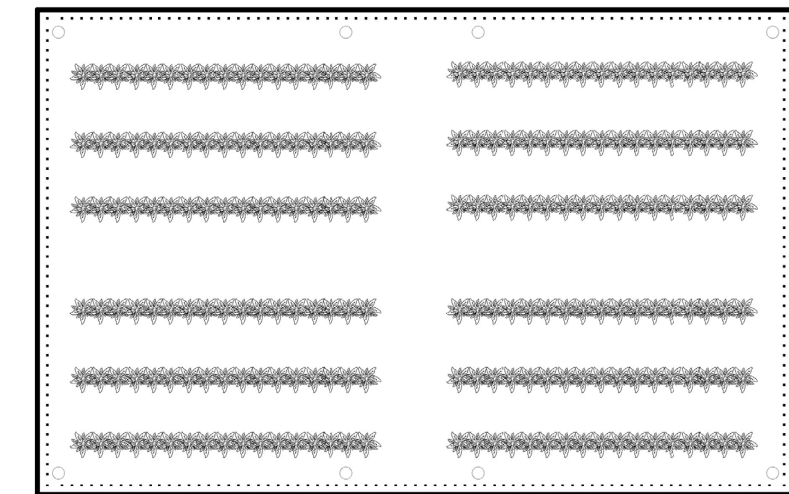
# Roof elements



**Community agro roof**



**Allotment roof**



**Hydroponic roof**

# Agroforestry

## Principles

### UN Food & Agriculture definition:

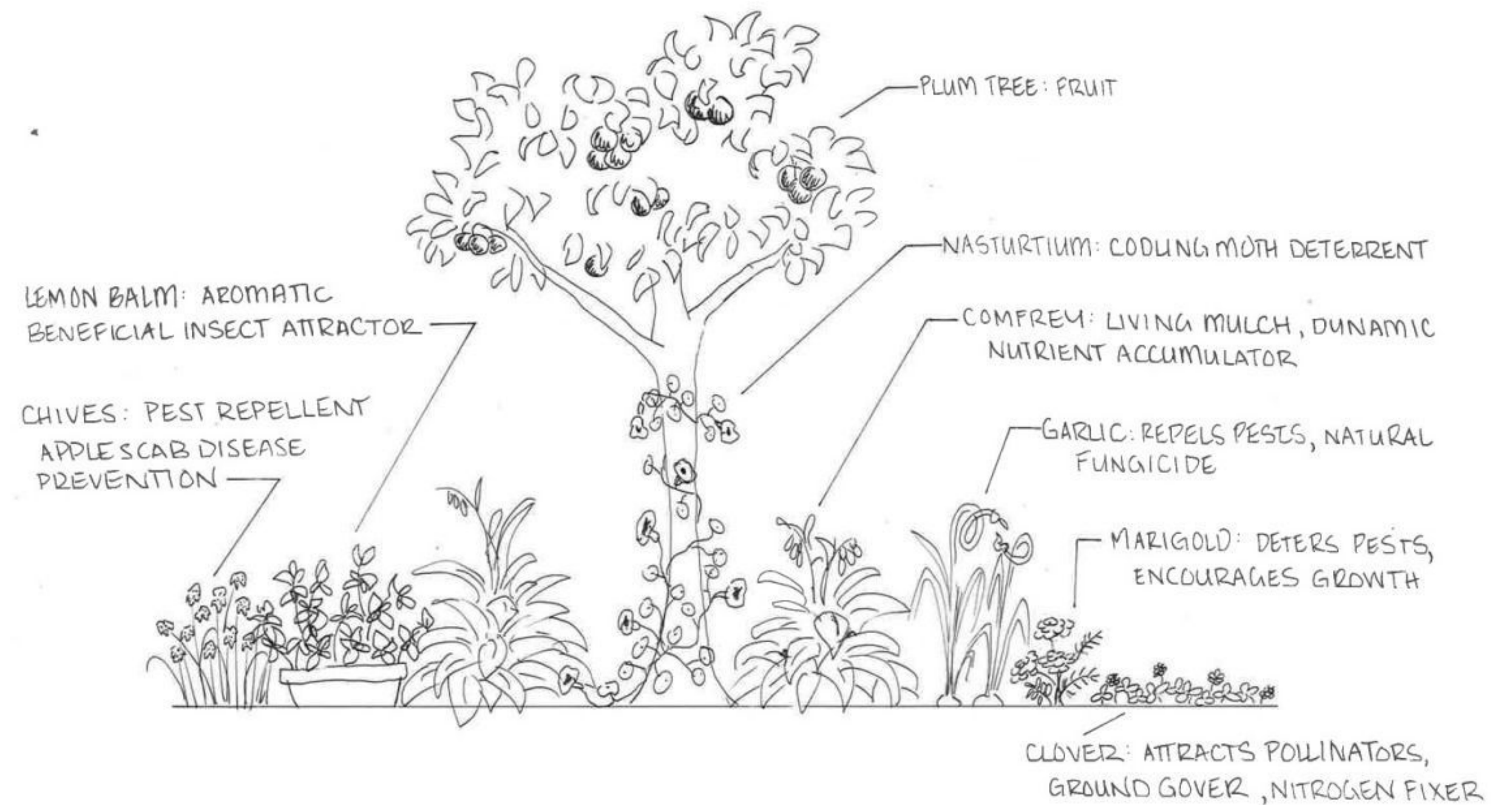
"Land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land-management units as agricultural crops and/or animals"

### Reasons for Adoption:

- Chemura et al (2021): Climate-resilient agricultural systems

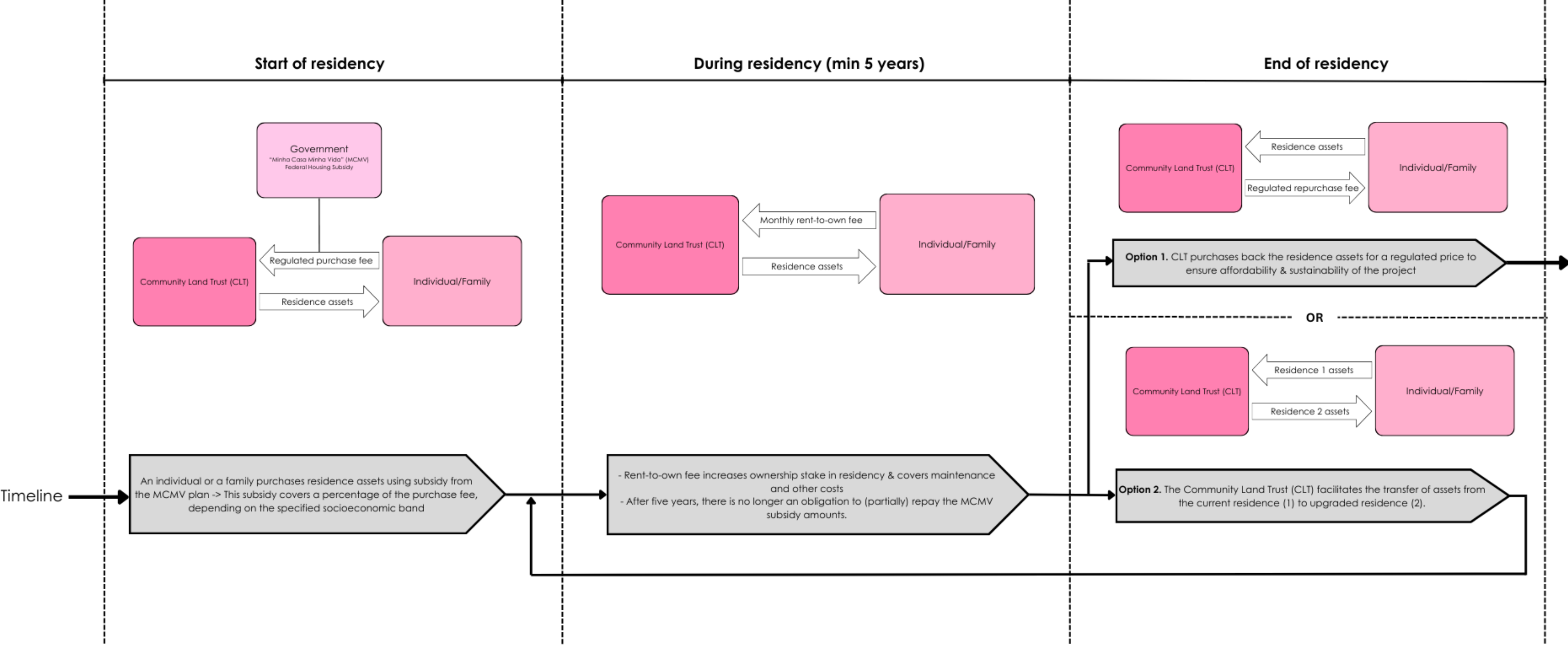
- Kuyah et al. (2019): Yield/productivity enhancement:

"Studies reviewed suggest agroforestry can significantly increase crop yield through improved soil fertility, improved water regulation, improved microclimate and better soil properties"

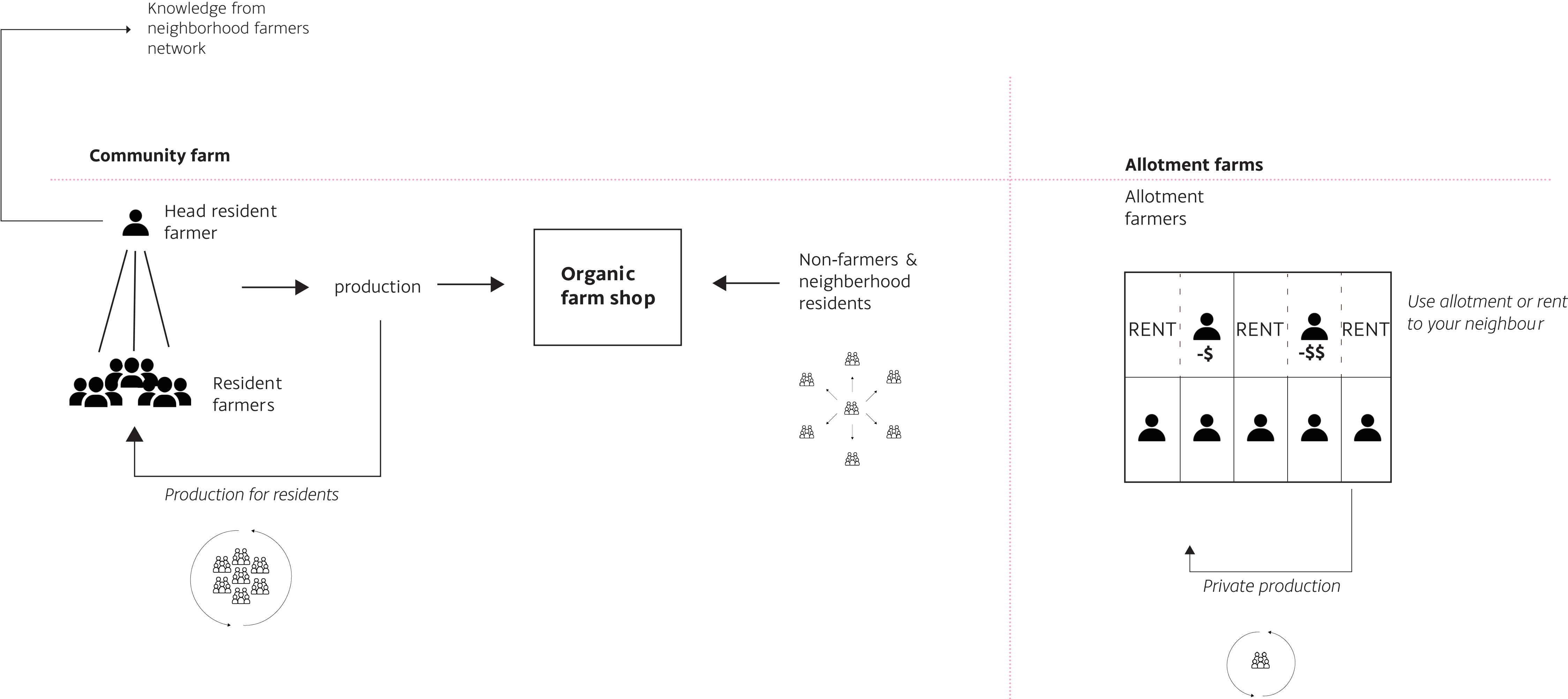


# Managerial strategies

# Ownership strategy

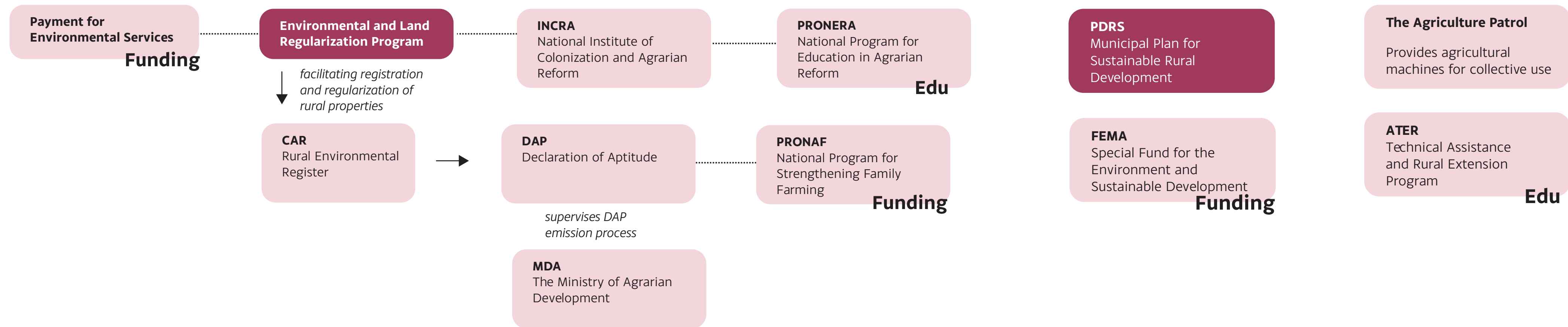


# Courtyard farming strategies



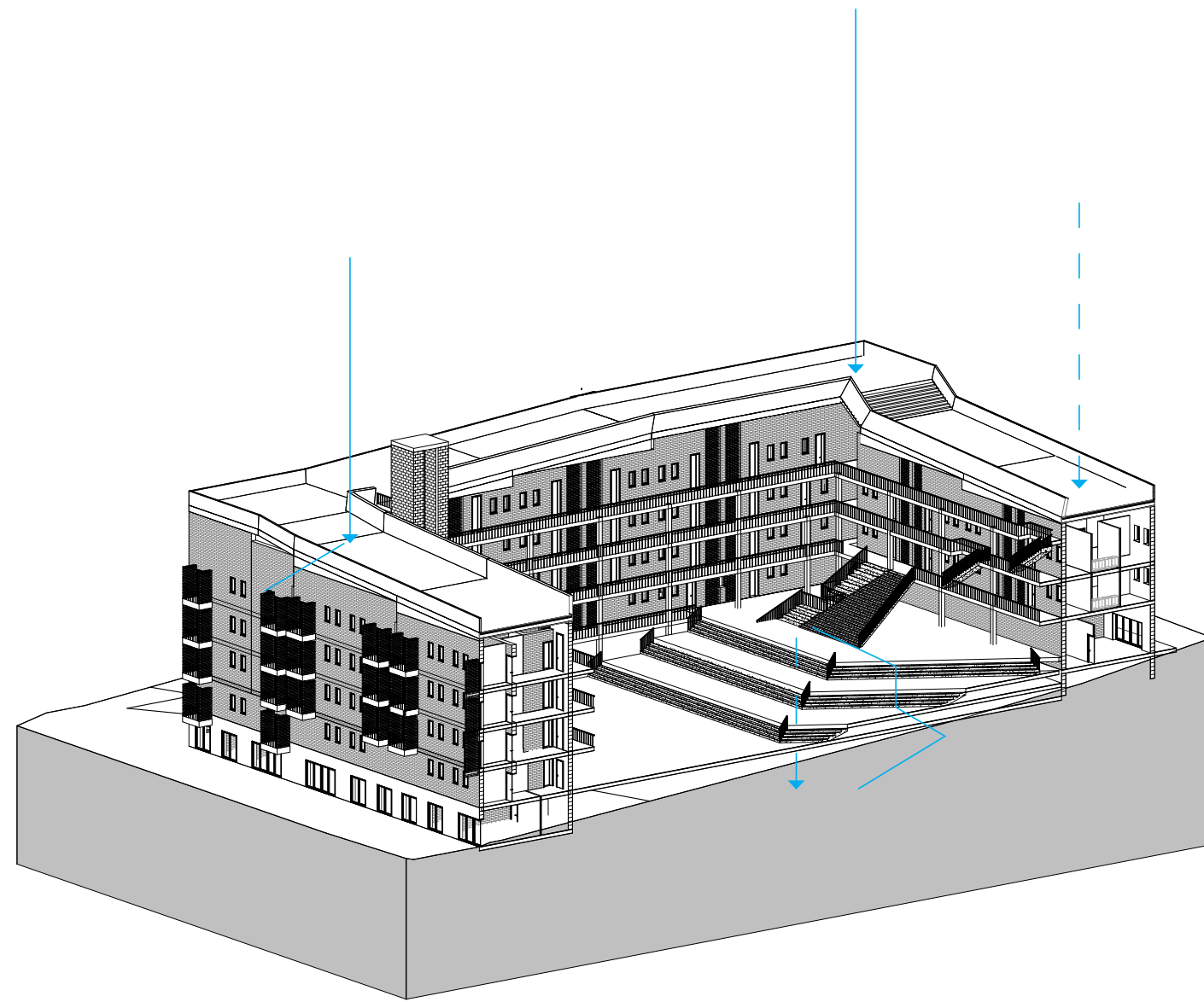
# Agricultural value chain

Municipal public policies related to local agriculture

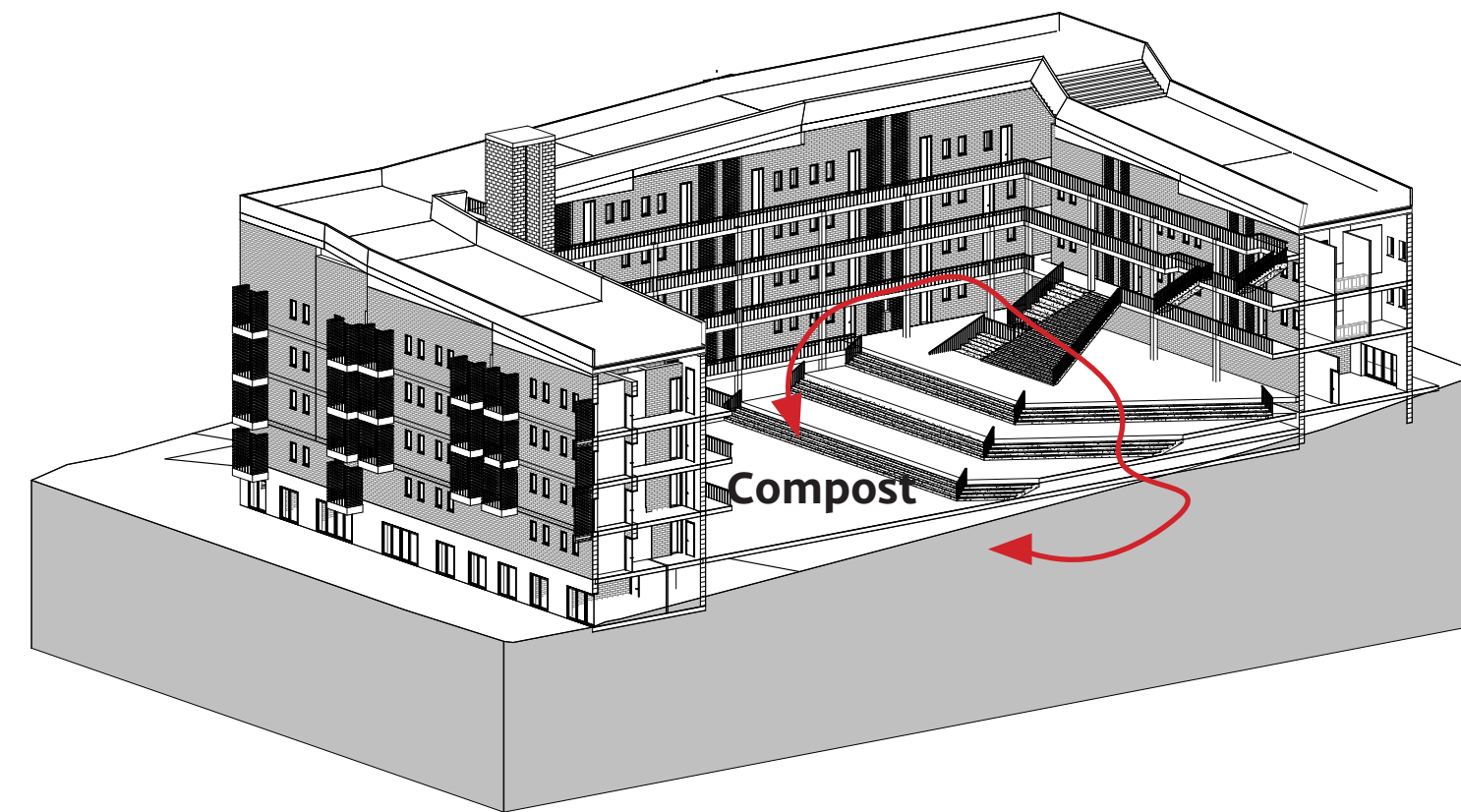


# Waste cycles courtyard

Waste to farm



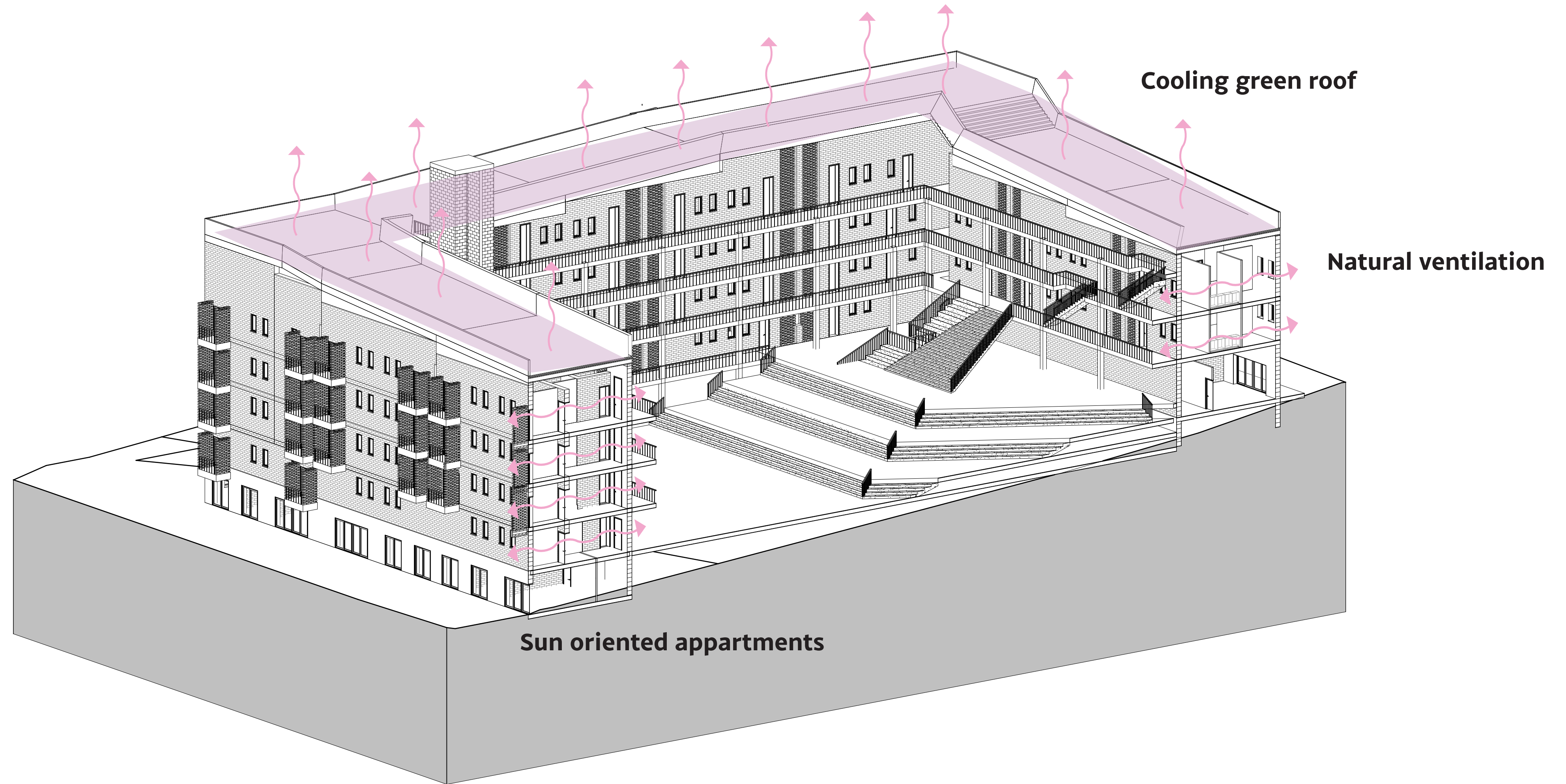
Rain Water



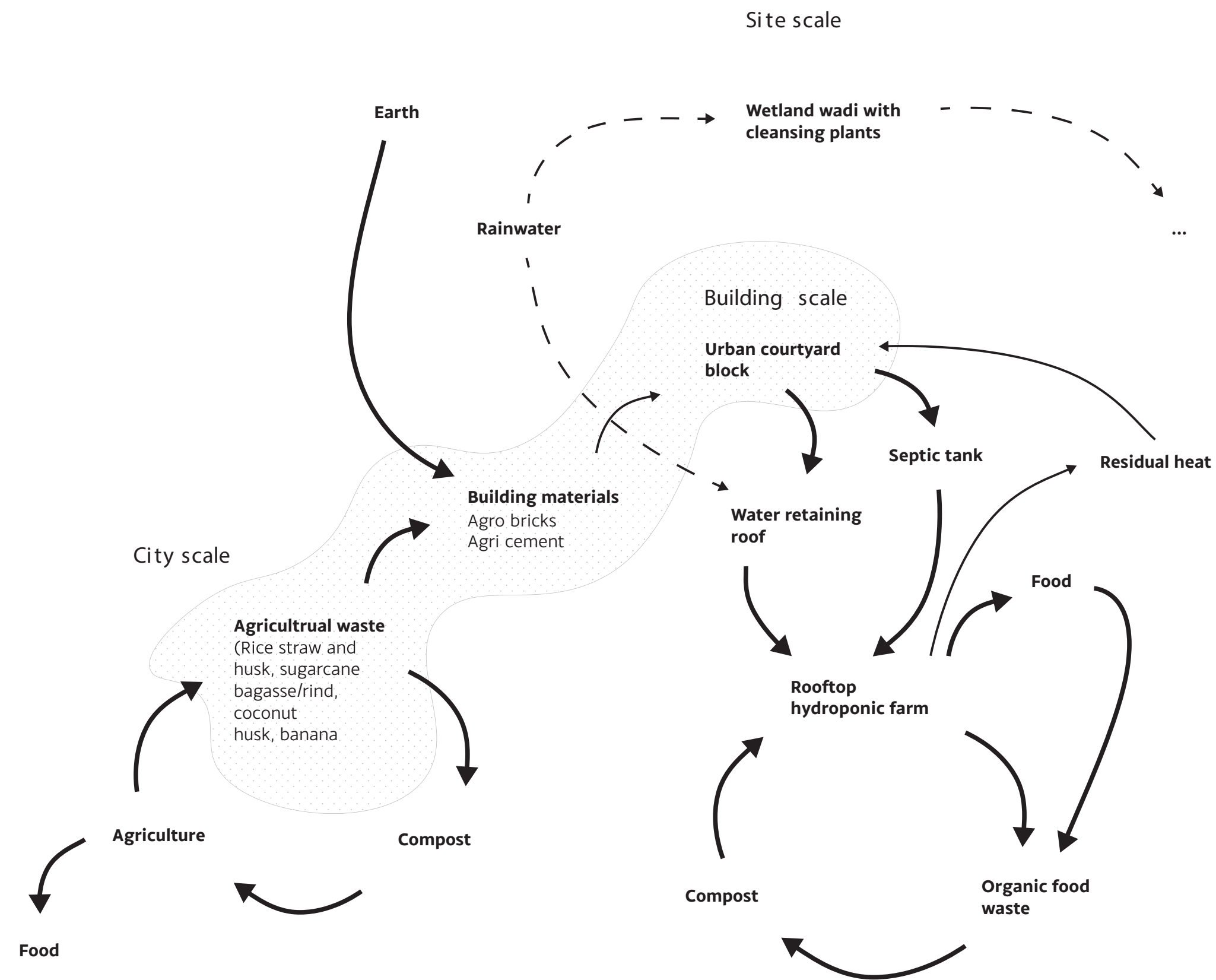
Food waste

# Building technology

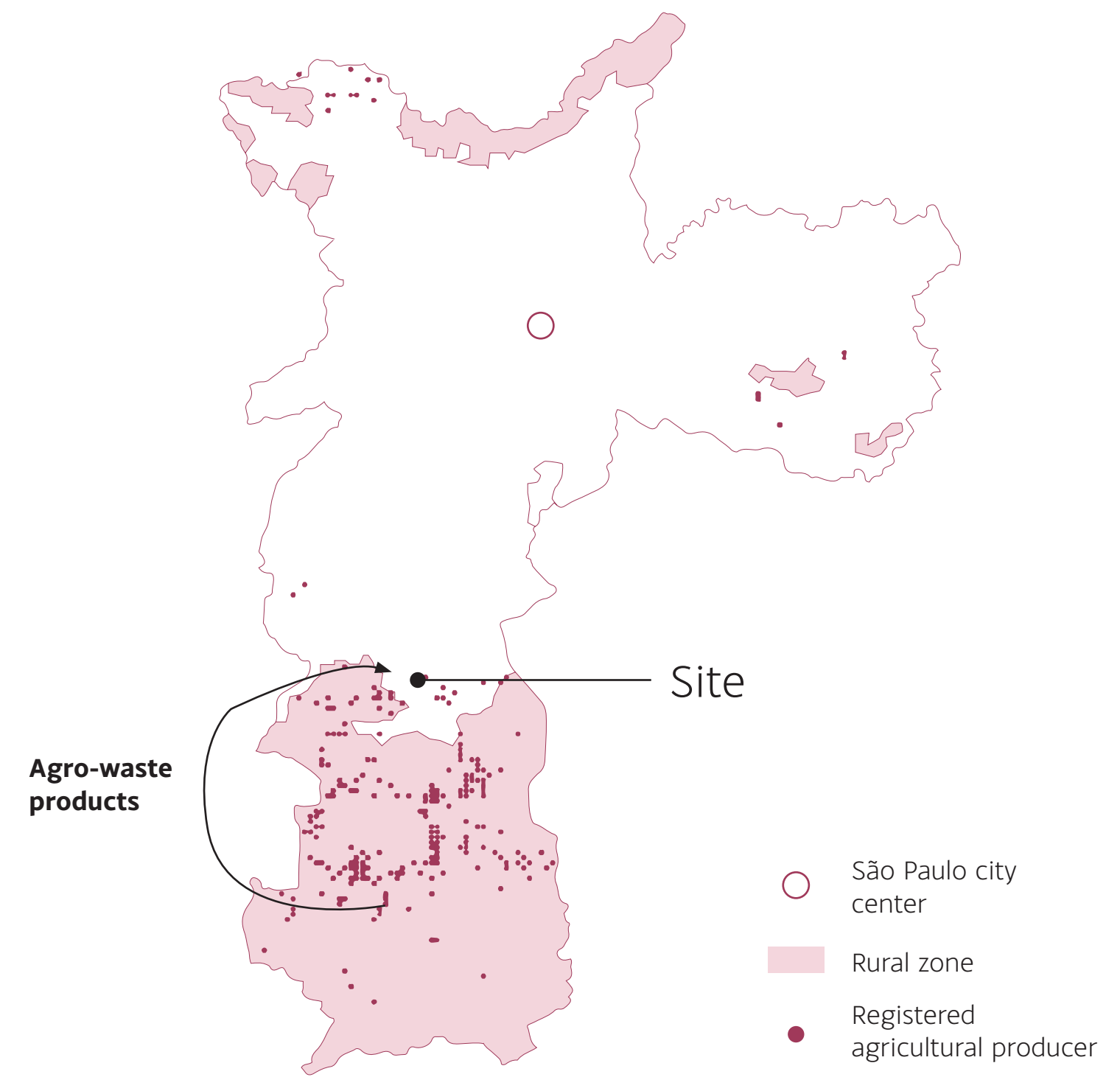
Climate control



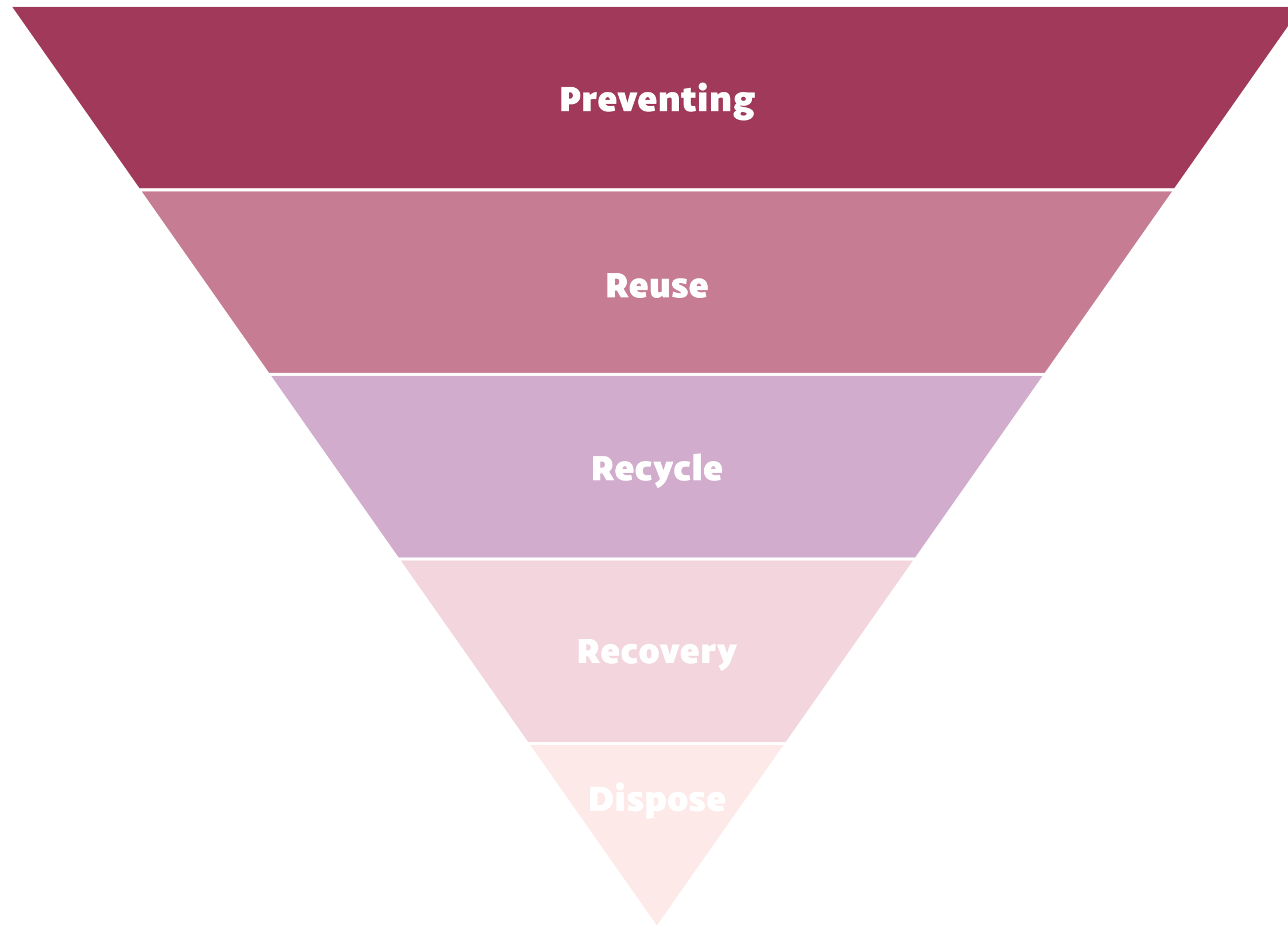
# Agro-waste to building material



## Rural zone & Agriculture



# Waste pyramid



## Food waste<sup>1</sup>

Avoiding food waste, food banks, consumer awareness

Processing and reprocessing for human food, use for animal food, raw materials for industry

Composting for fertilizer or generating fertilizer and sustainable energy with cofermentation

Burning as waste (objective is destruction, energy production possible)

Dumping in landfill (unacceptable)

## Construction<sup>2</sup>

Using less material in desing and manufacturing. Keeping products for longer. Using less hazardous material

Checking, cleaning, repairing, refurbishing

Turning waste into a new substance or product

Anaerobic digestion, incineration with energy recovery, gasification and pyrolysis which produce energy

Dumping in landfill (unacceptable)

1: Moermans Ladder for Food Waste. 2: Defra 2011 publication, Guidance on applying the waste hierarchy

# Ago-waste to construction

## Main agro-waste materials Brazil

### Rice straw and husk

Biofuel, packaging films, conducting paper, cellulose nanofibrils, cellulose nanocrystals, ceiling boards, soil stabilizer, paper, paperboard, tableware

### Sugarcane bagasse, rind

Biofuel, conducting paper, cellulose nanofibrils, cellulose nanocrystals, bricks, soil stabilizer, paper, tableware

### Coconut husk

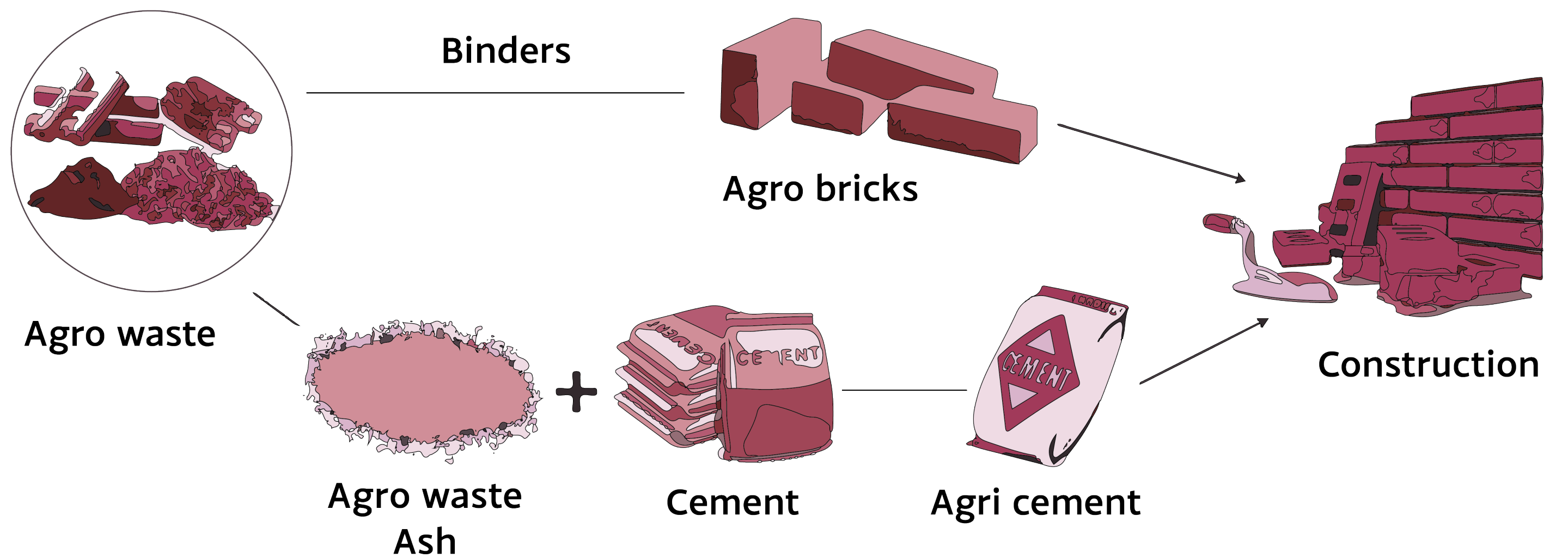
Cellulose nanowhiskers, bricks, soil stabilizer

### Banana pseudostem

Packaging films, cellulose nanofibrils, cellulose nanocrystals, soil stabilizer, paper



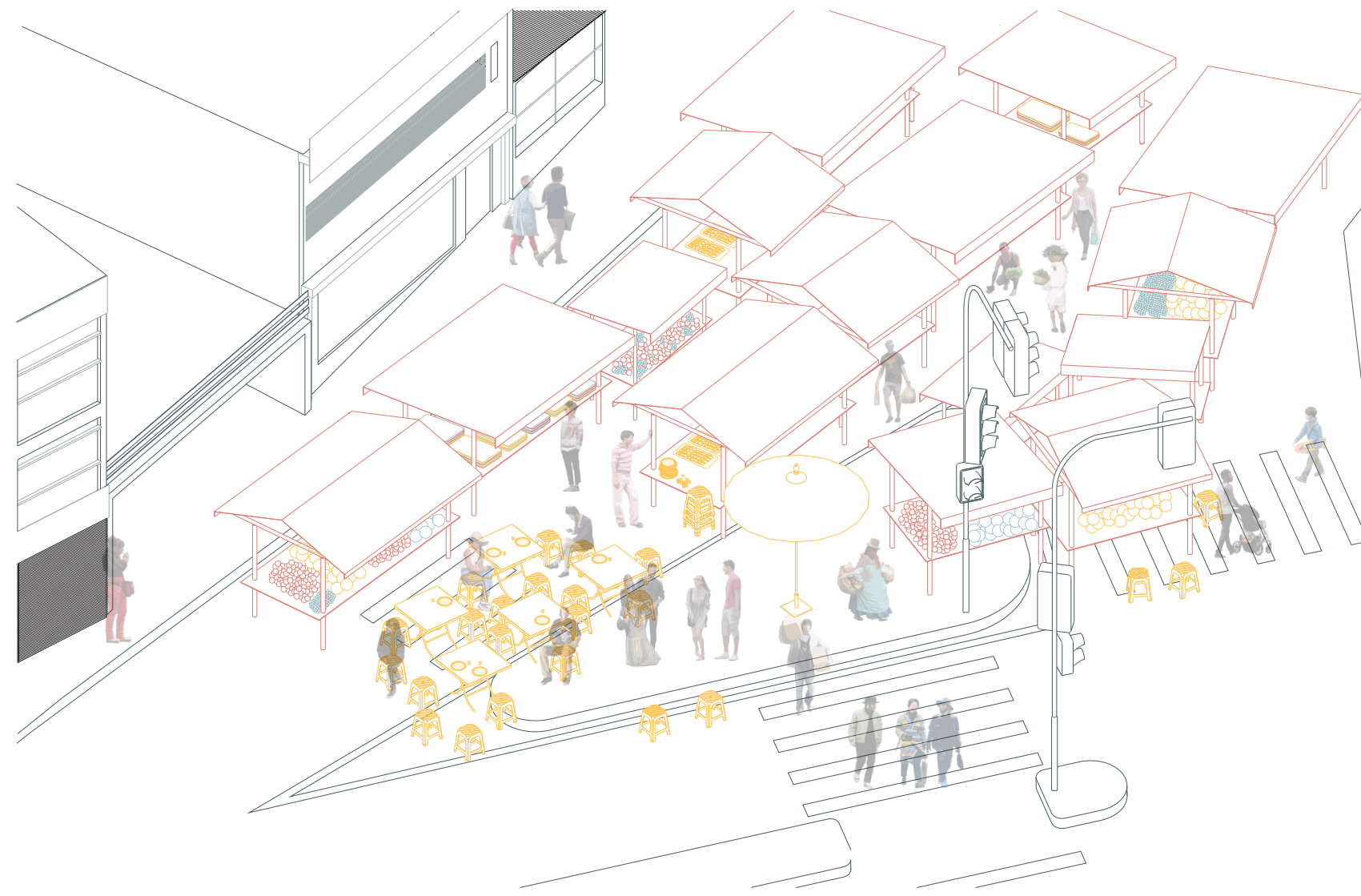
Terra roxa



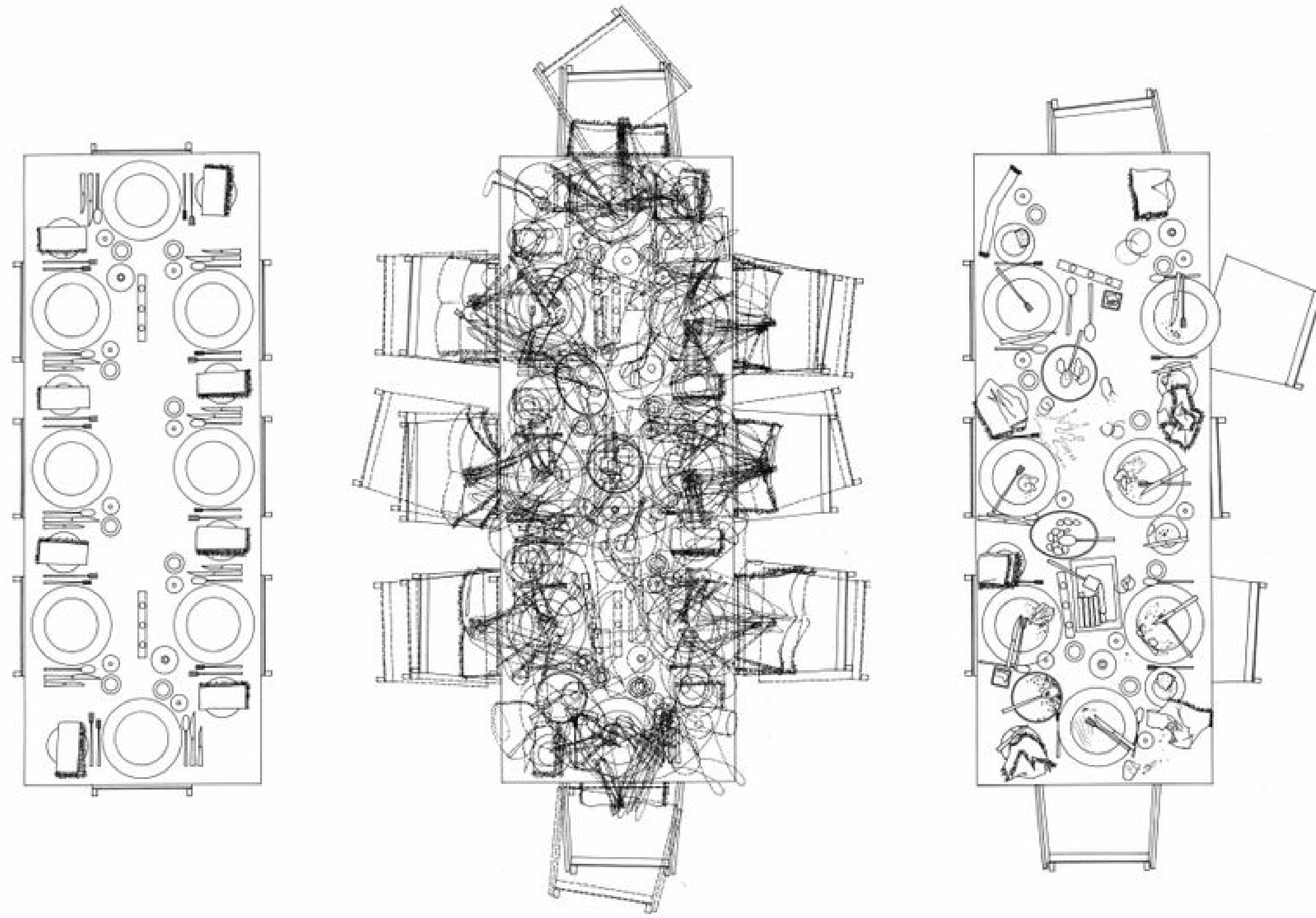








# Setting the table



# Food for thought