P5.0

SPONGE HOUSING

a flexible housing model for changing densities

JIENAN WANG

5117240

05/07/2021

INDEX

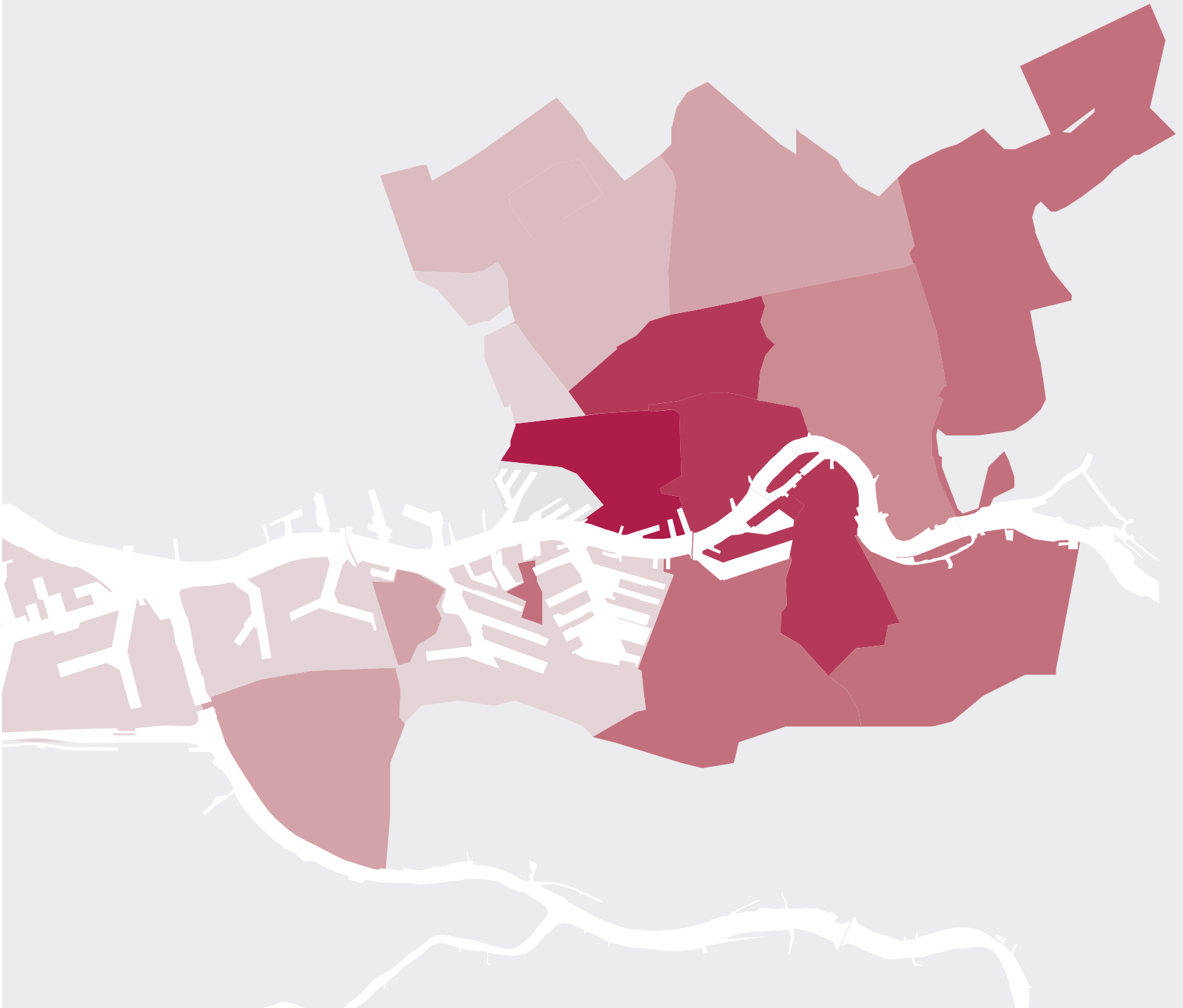
GENERAL INTRODUCTION

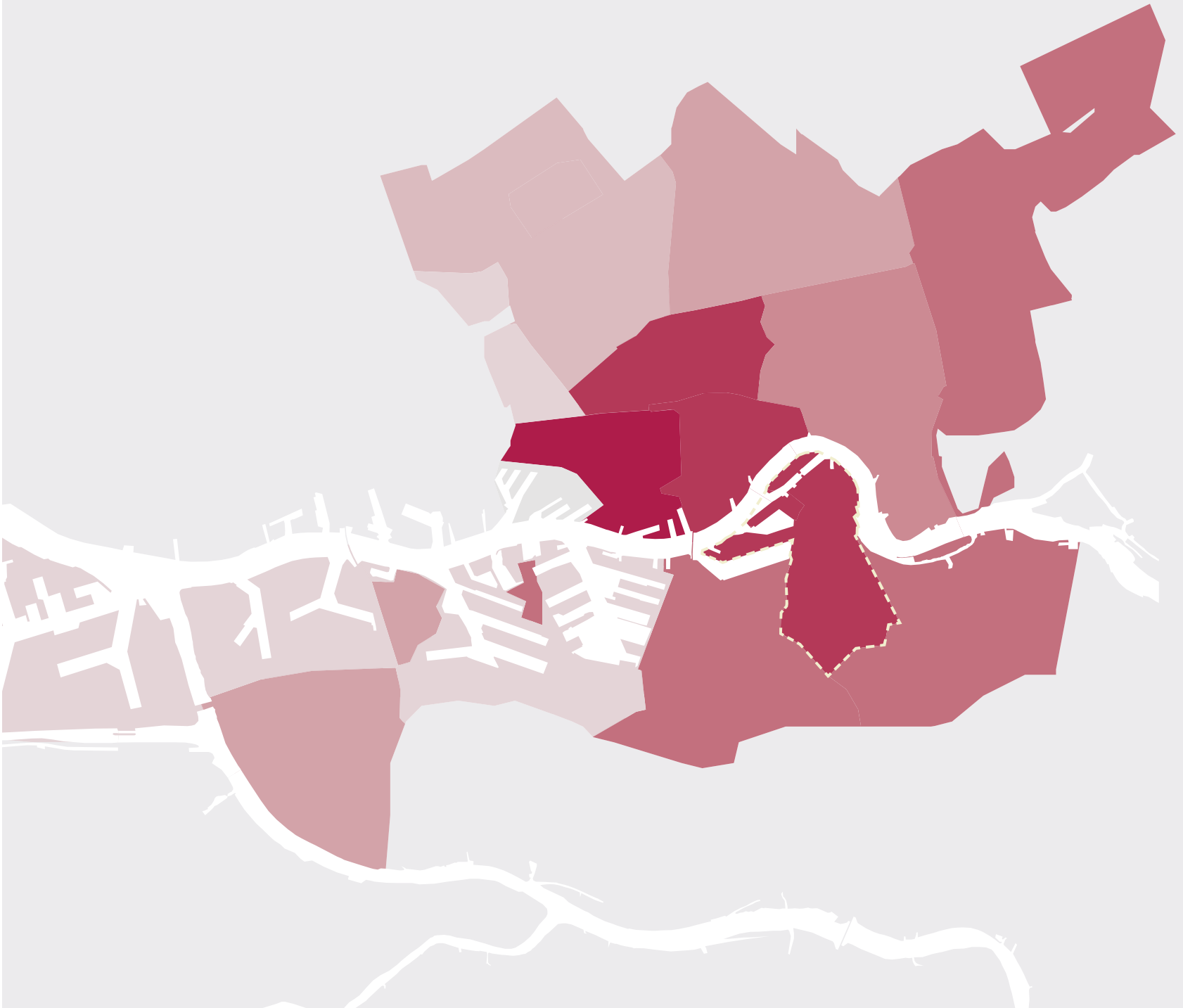
SUMMARY OF THE RESEARCH

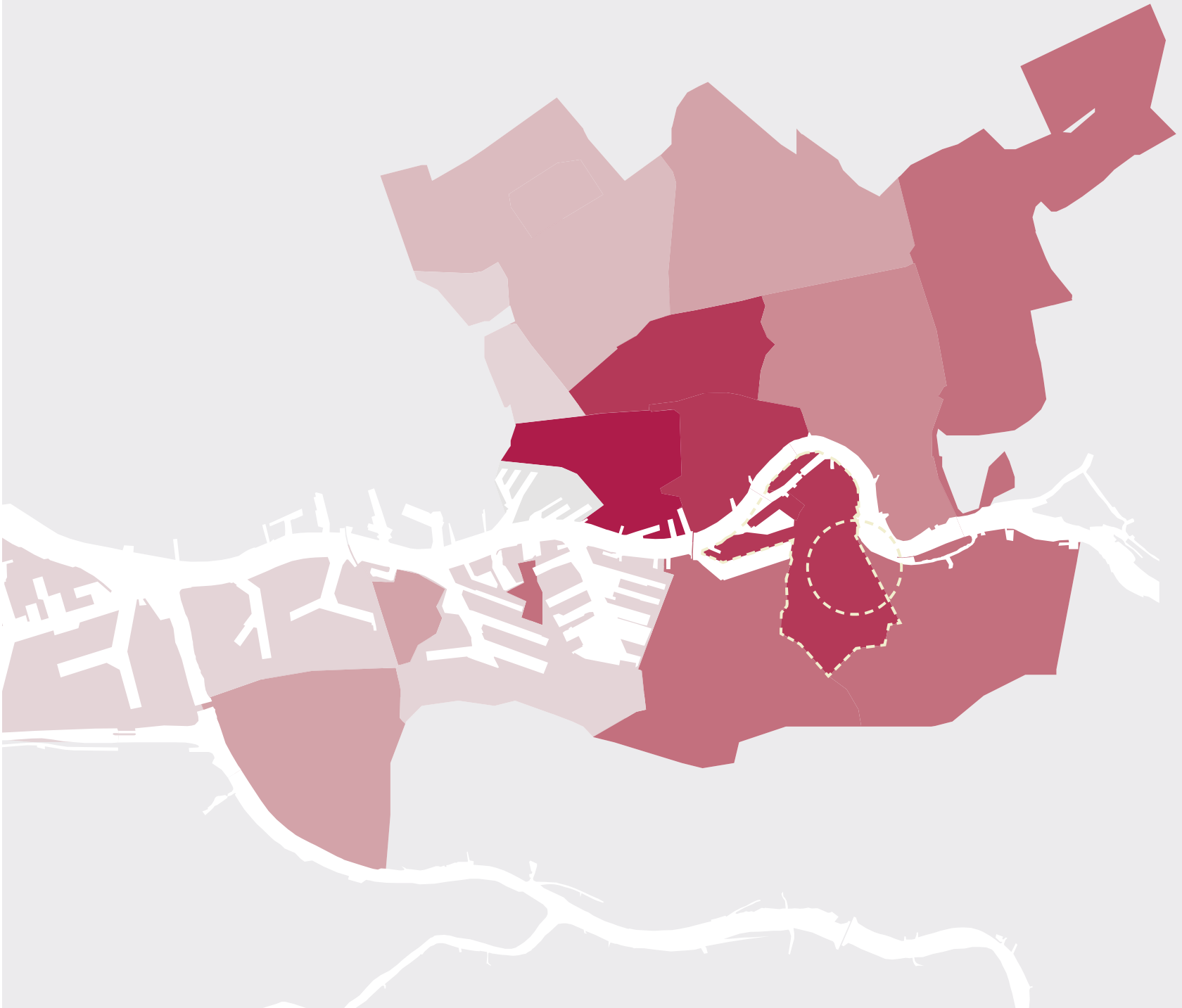
DESIGN BRIEF

SYSTEM CONCEPT

DESIGN PROPOSAL








FEIJENOORD AREA


ROTTERDAM CENTRAL
Rabobank

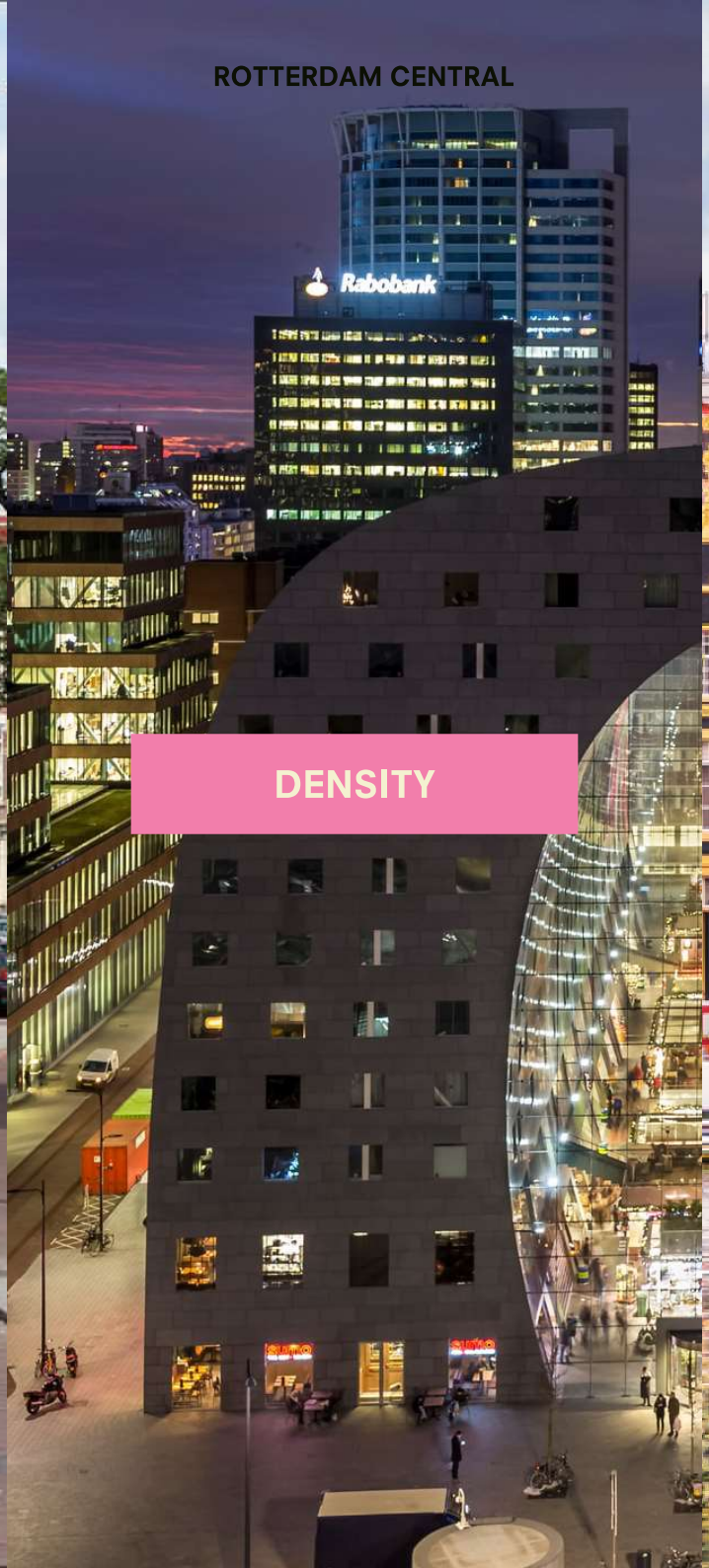

AMSTERDAM CENTRAL


FEIJENOORD AREA
662
Hectare
76,590
ppl


ROTTERDAM CENTRAL
Rabobank
413
Hectare
36,090
ppl


AMSTERDAM CENTRAL
625
Hectare
87,310
ppl

FEIJENOORD AREA



ROTTERDAM CENTRAL

DENSITY

AMSTERDAM CENTRAL

POPULATION DENSITY

Feijenoord area

11567
PPL./KM2

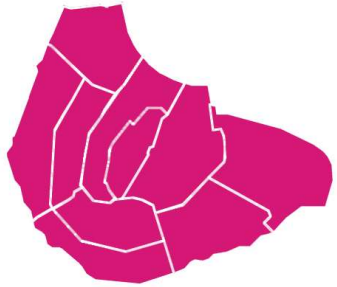
54
DWELLING/HECTARE

Rotterdam Central

8732
PPL./KM2

53
DWELLING/HECTARE

Amsterdam Central



12393
PPL./KM2

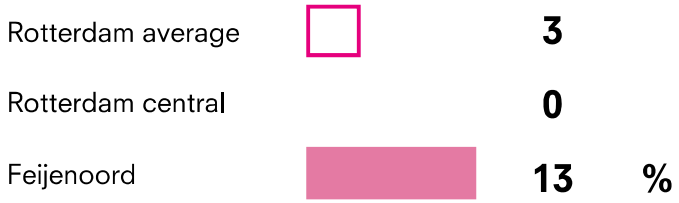
74
DWELLING/HECTARE

PARADOX

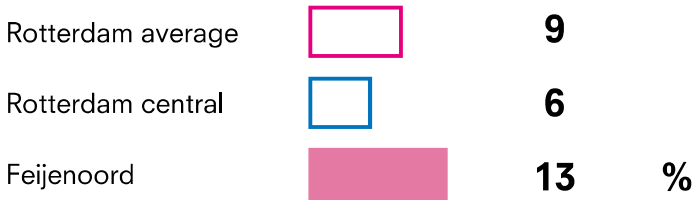
housing stock is not enough to accommodate population in Feijenoord

HOUSING PROBLEM

Homes with overcrowding

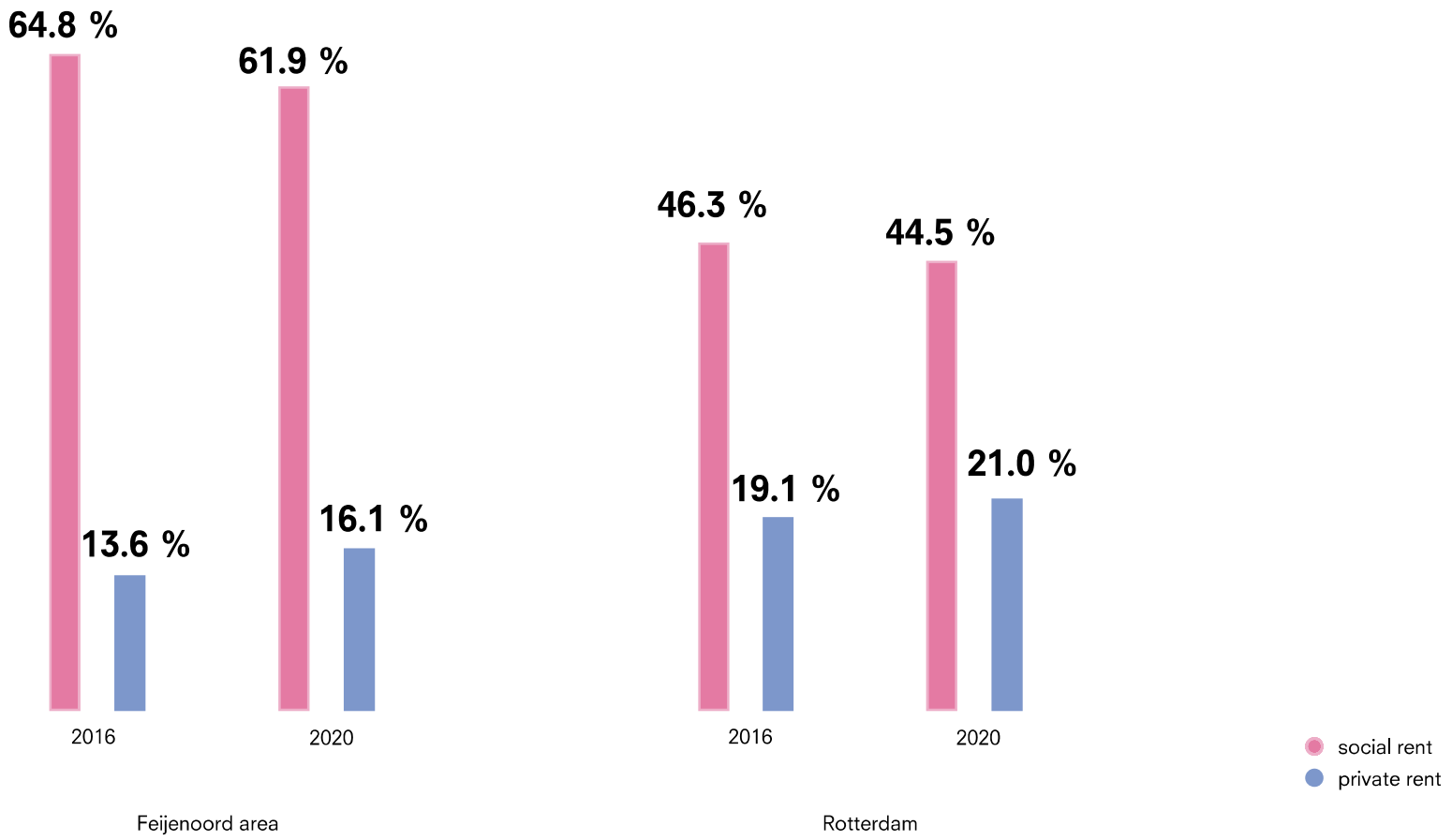


Small single-family houses



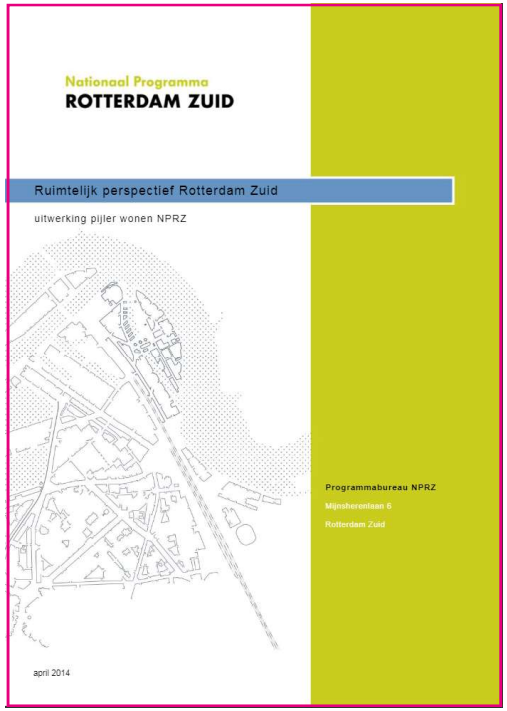
source: Gemeente Rotterdam

HOUSING STOCK ACCORDING TO POSSESSION



source: Gemeente Rotterdam

HOUSING VISION AND PLAN IN SOUTH



source: National Program Rotterdam South (NPRZ)

DILUTION

-2,550
current 35,915 houses in Feijenoord

merging/demolition leads to a **decrease in housing numbers**, this process is defined as **DILUTION**

source: National Program Rotterdam South (NPRZ)

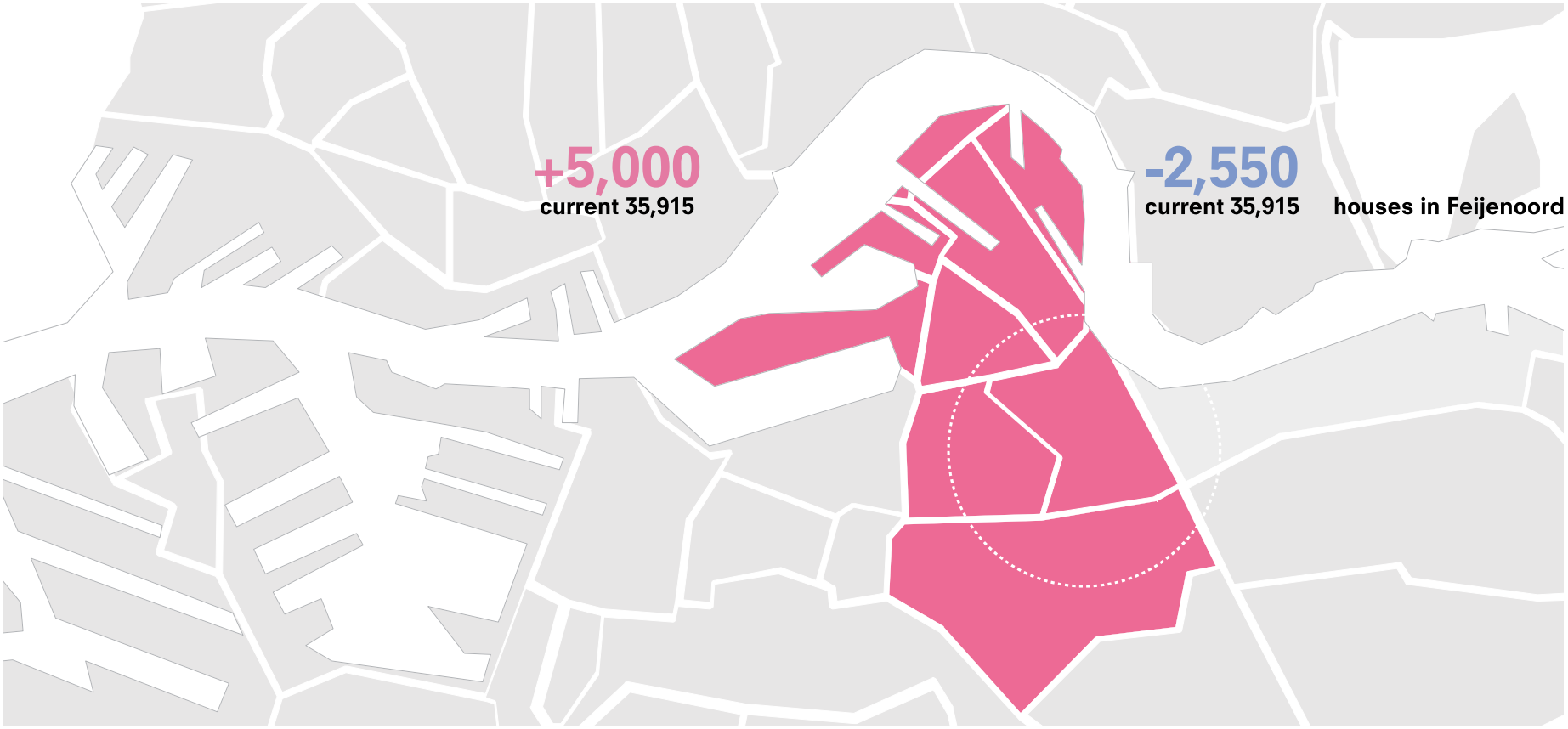
NEW HOUSES IN FEIJENOORD

+5,000
current 35,915 houses in Feijenoord

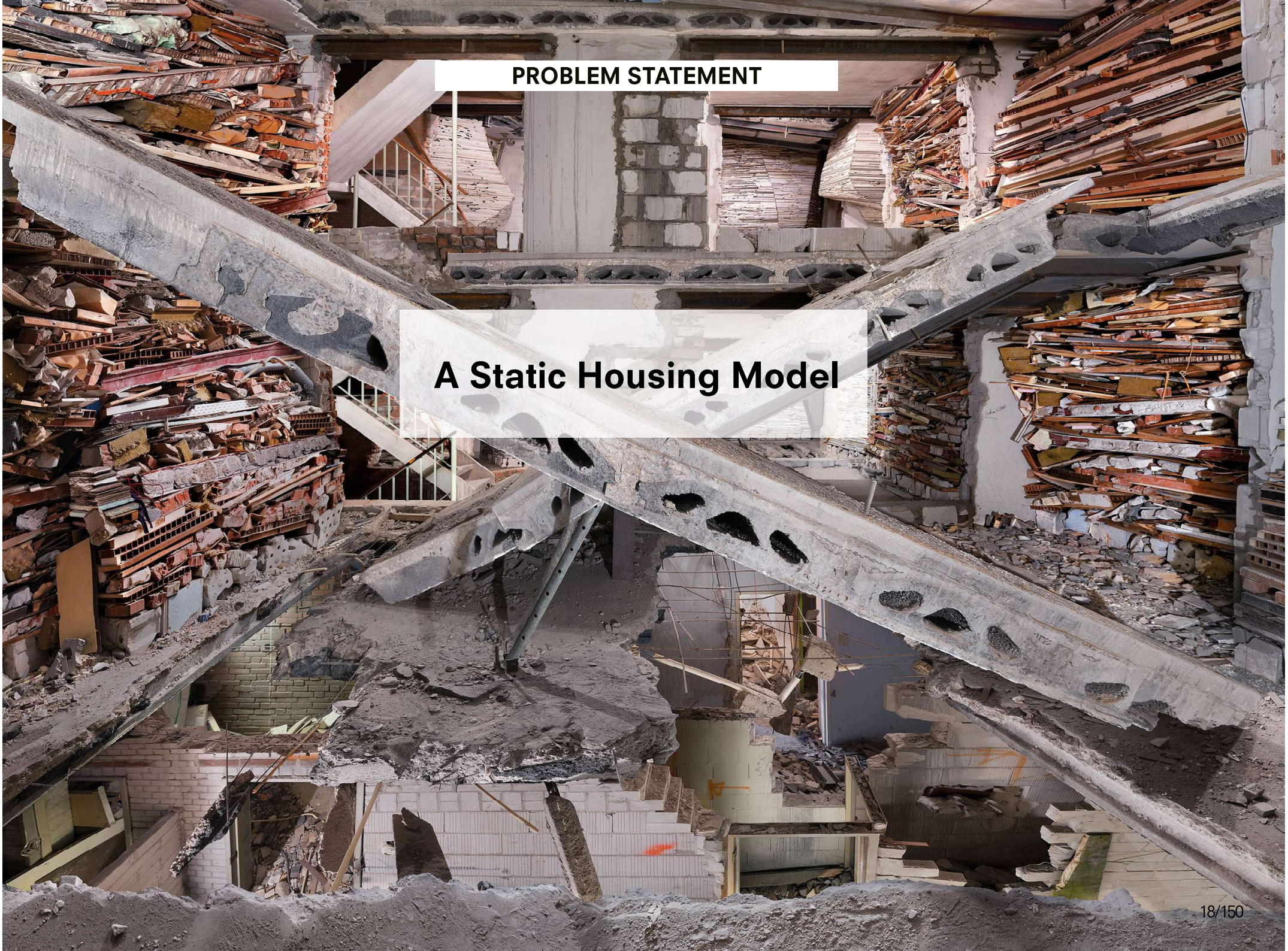
DENSIFICATION is needed to **increase the number of homes** for growing population

source: National Program Rotterdam South (NPRZ)

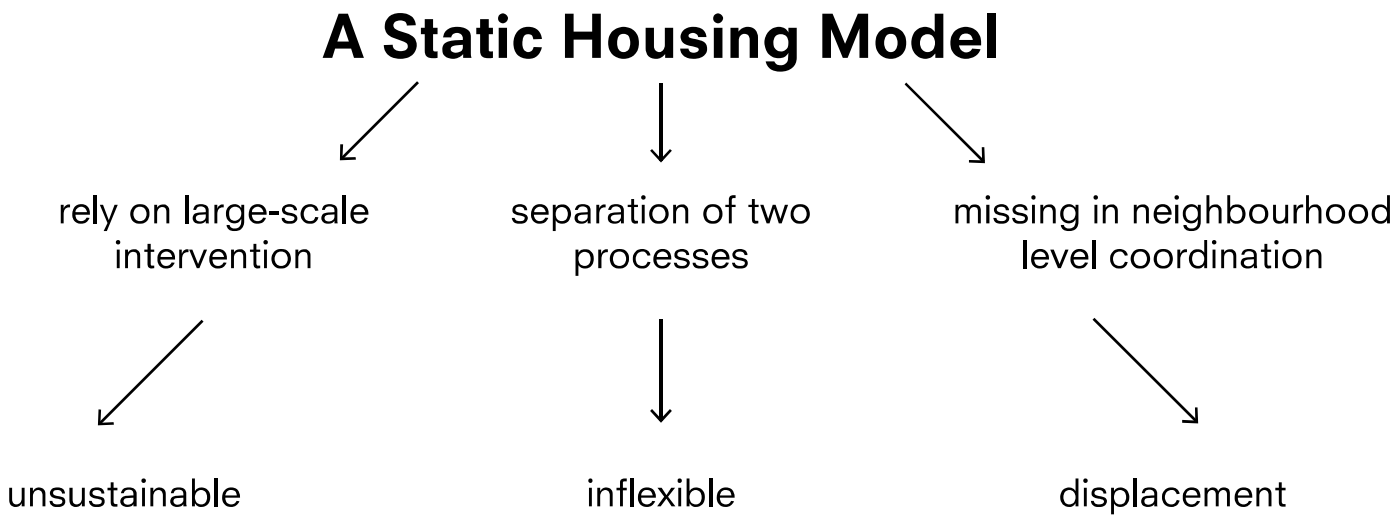
DENSIFICATION AND DILUTION

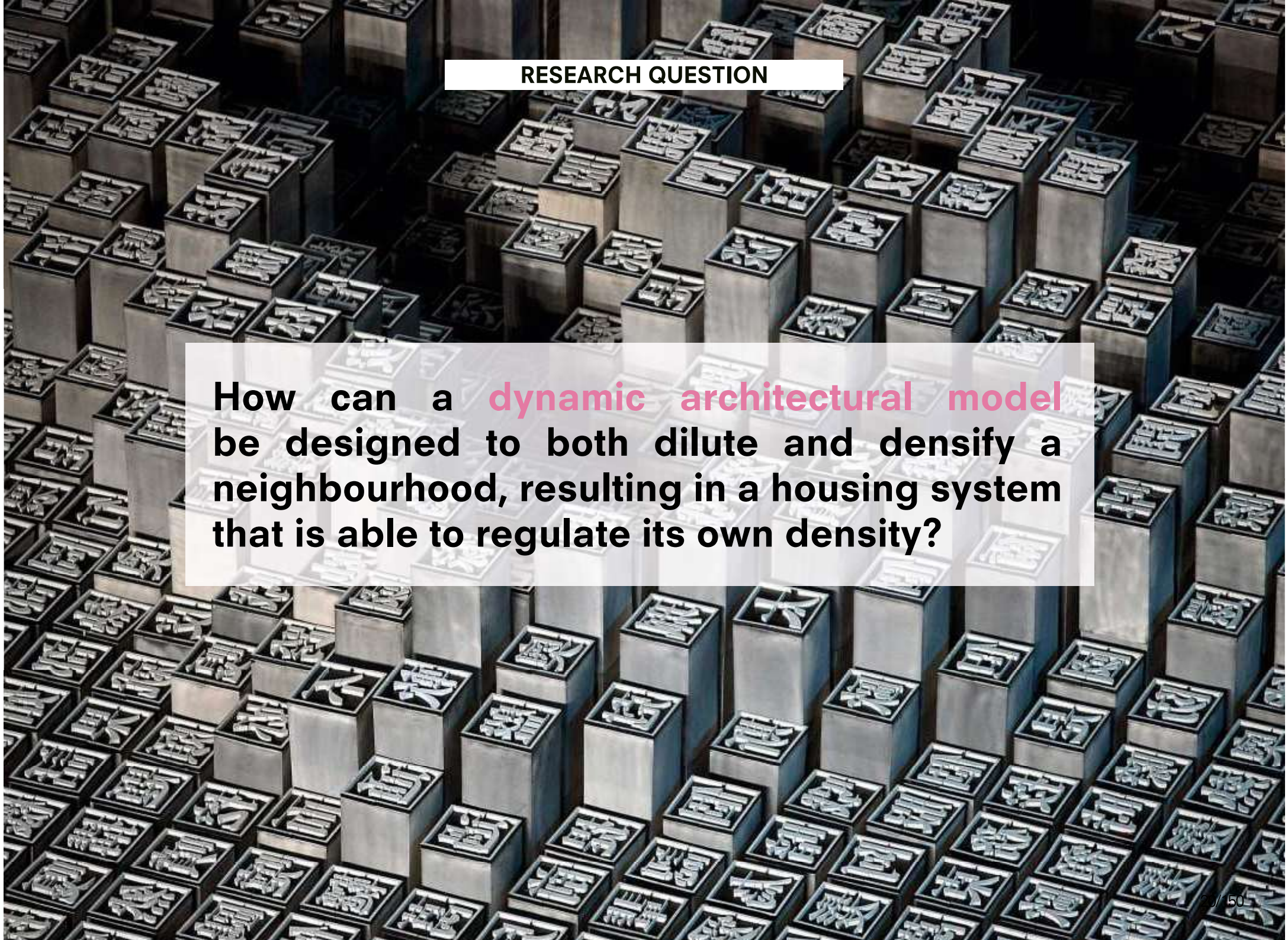


DENSIFICATION and **DILUTION** are separate processes of changing the number of houses



A Static Housing Model


A Static Housing Model
rely on large-scale intervention
separation of two processes
missing in neighbourhood level coordination
unsustainable
inflexible
displacement



RESEARCH QUESTION

How can a dynamic architectural model be designed to both dilute and densify a neighbourhood, resulting in a housing system that is able to regulate its own density?

AMBITION

To create a flexible housing model initiated at a neighbourhood level that can adapt to changing residential densities through dilution and densification at a small scale.

GENERAL INTRODUCTION

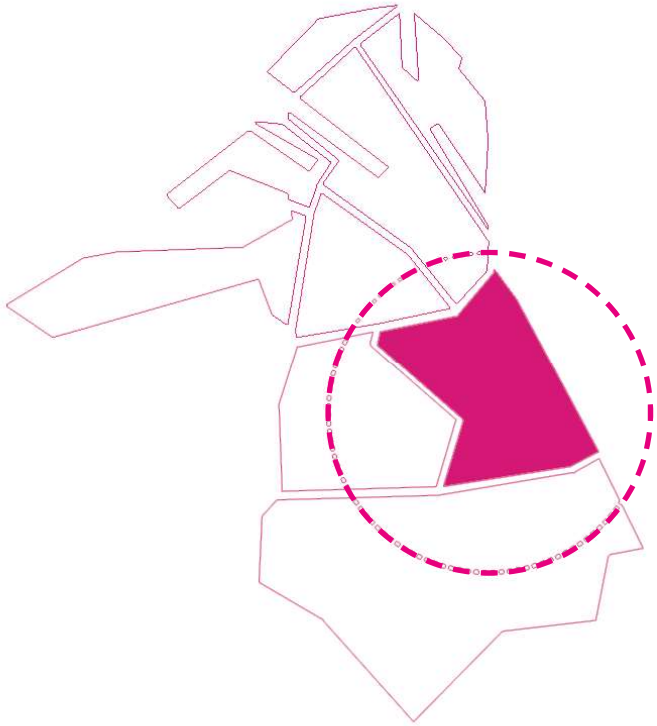
SUMMARY OF THE RESEARCH

DESIGN BRIEF

SYSTEM CONCEPT

DESIGN PROPOSAL

HILLESLUIS



Group site circle


71%
pre-war housing

NEIGHBOURHOOD DATA

90
Hectare

12,050
ppl

5142
houses

source: Gemeente Rotterdam

DESIGN FOR WIDER RANGE

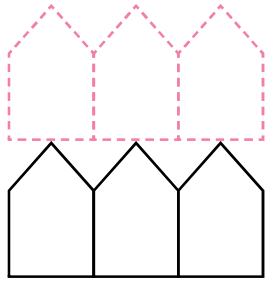
+3,000
new houses

5142
current houses

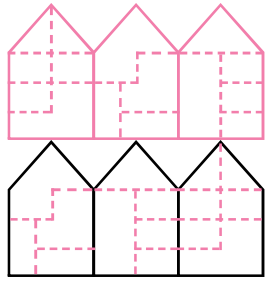
PROPOSAL IN TWO SCALES

flexible housing model in Hillesluis

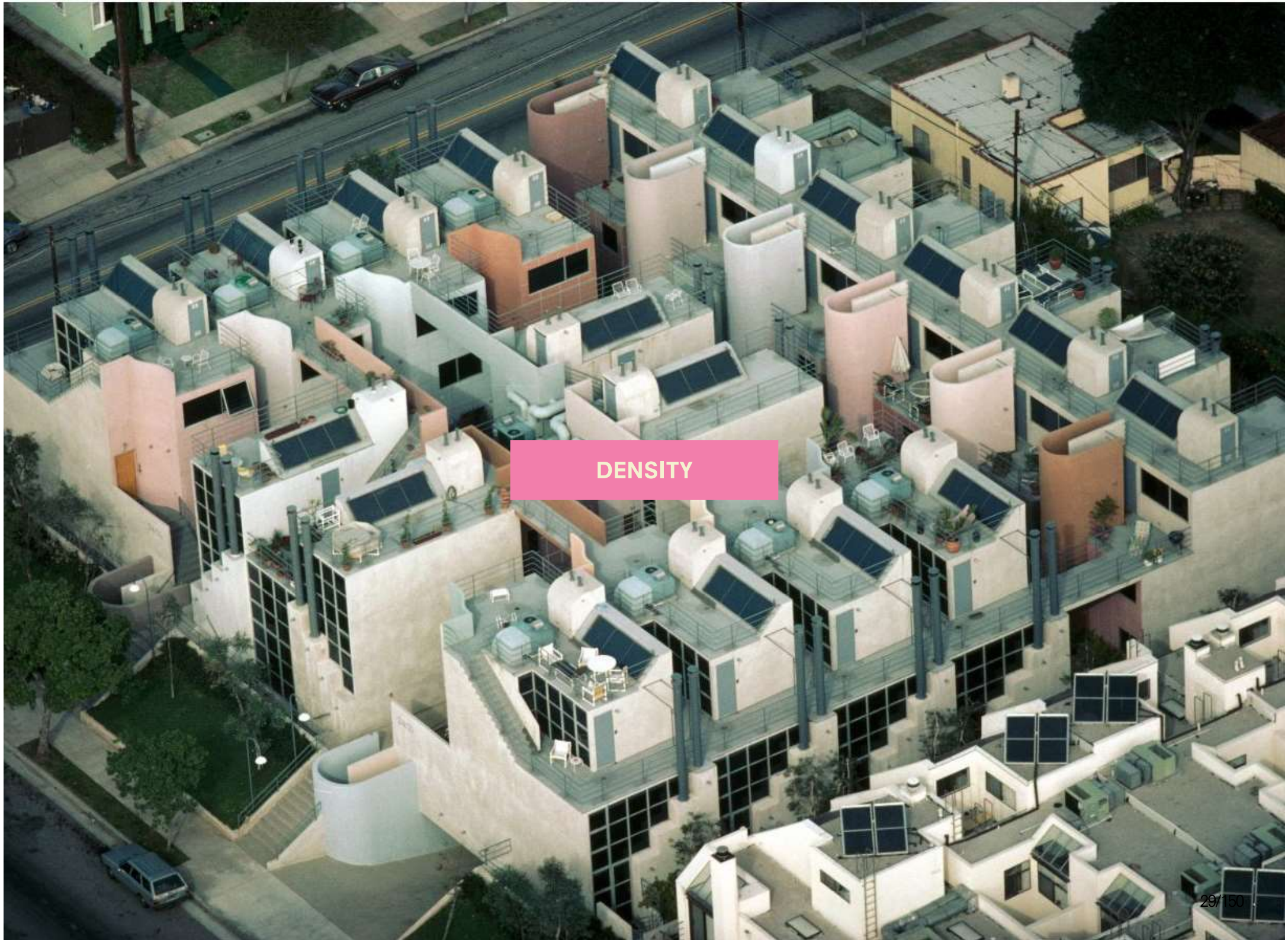
urban scale → *strategy* → **more houses**



building scale → *strategy* → densify and dilute through **flexible building**

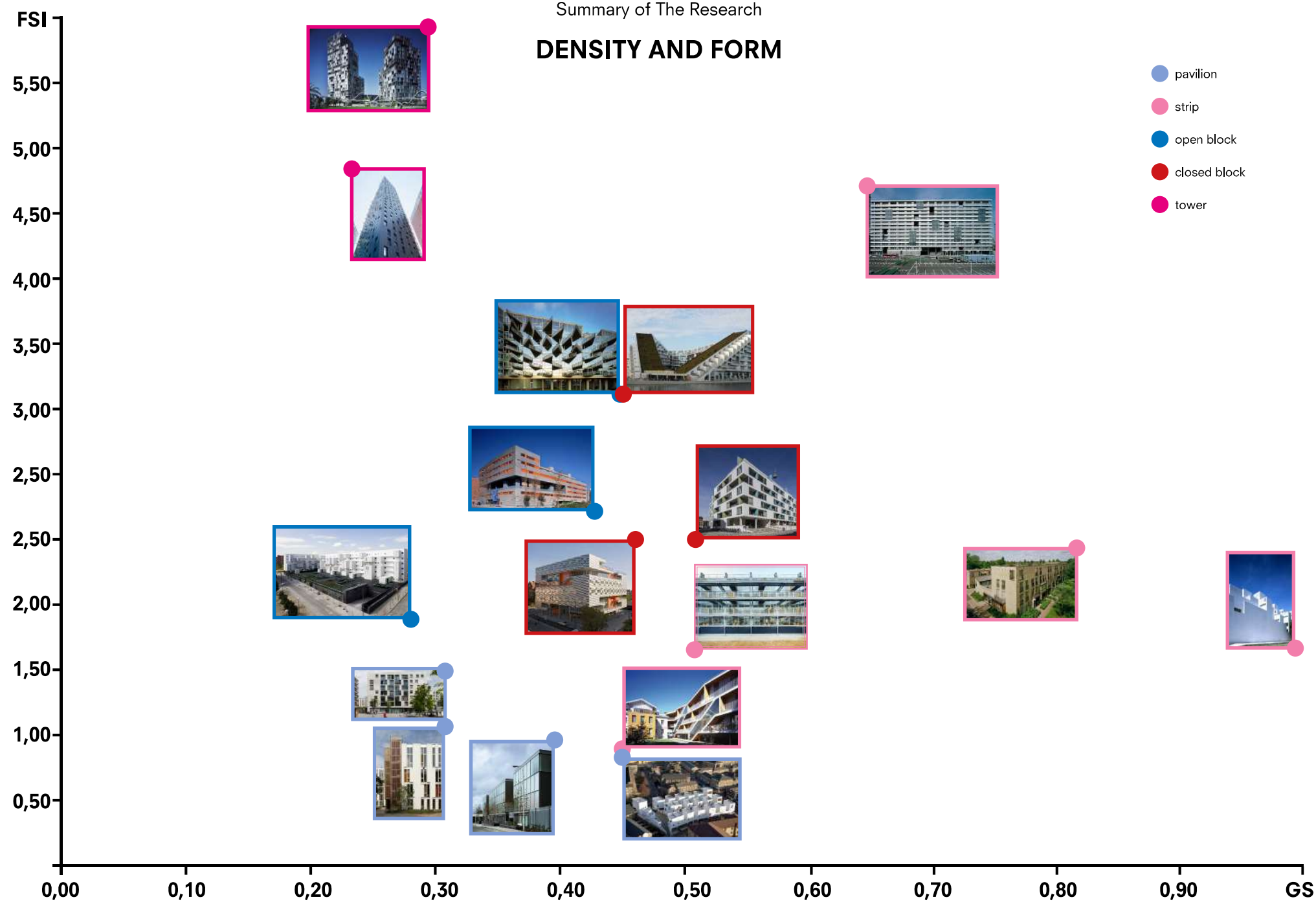


INITIAL PROJECT AMBITION


DENSITY

Summary of The Research

DENSITY AND FORM



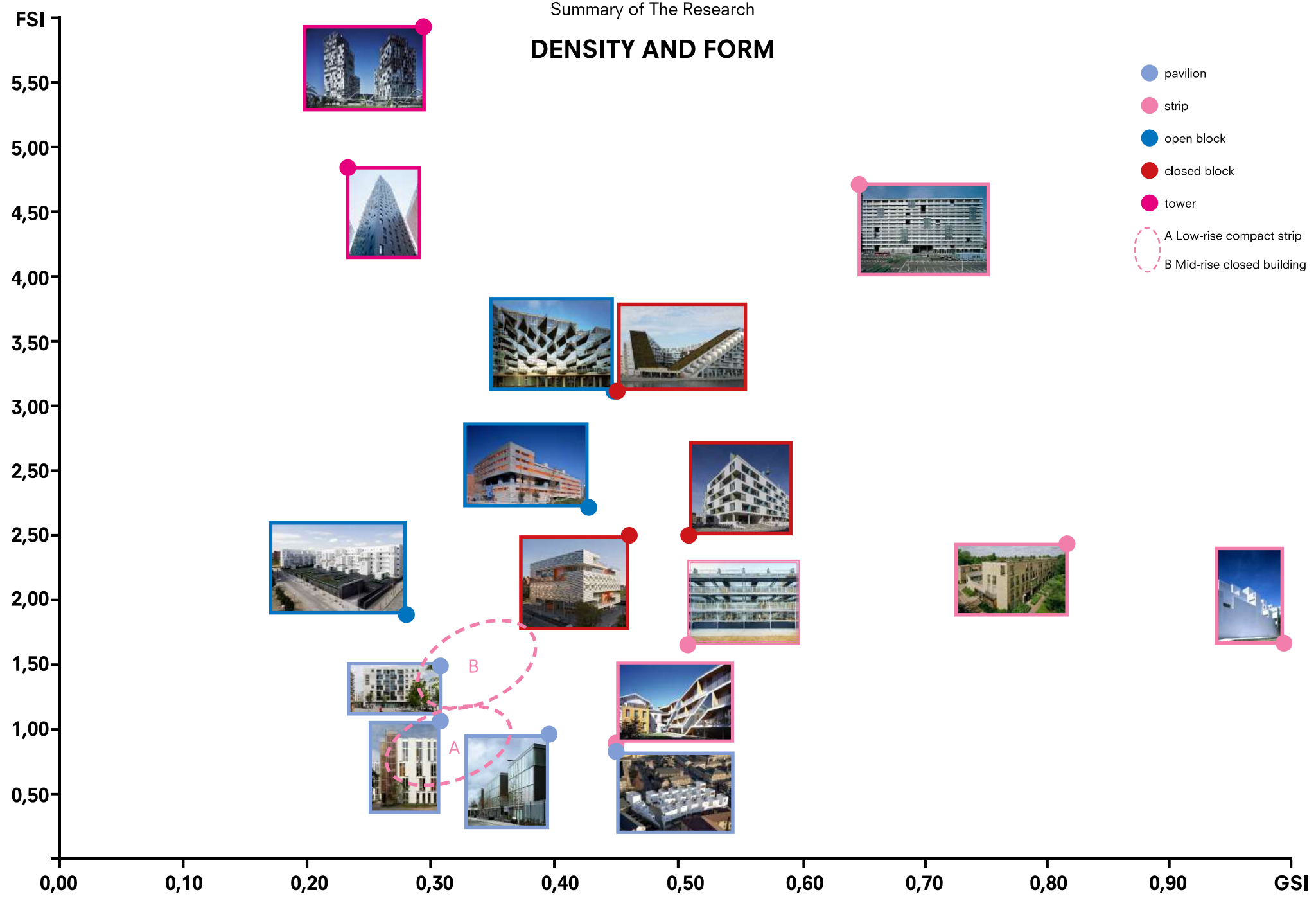
URBAN BUILDING TYPES IN HILLESLUIS

A: Low-rise compact strip

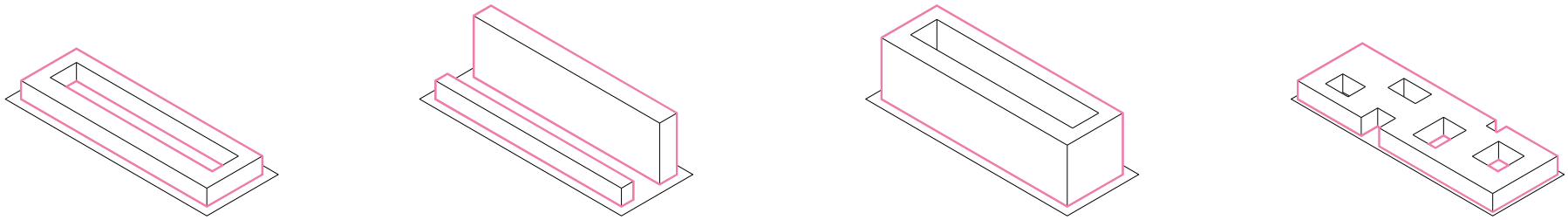
B: Mid-rise closed building blocks

Summary of The Research

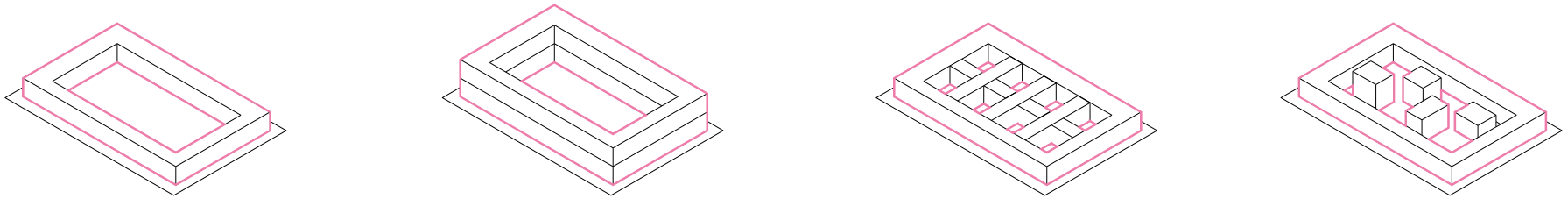
DENSITY AND FORM



DENSIFY STRATEGY

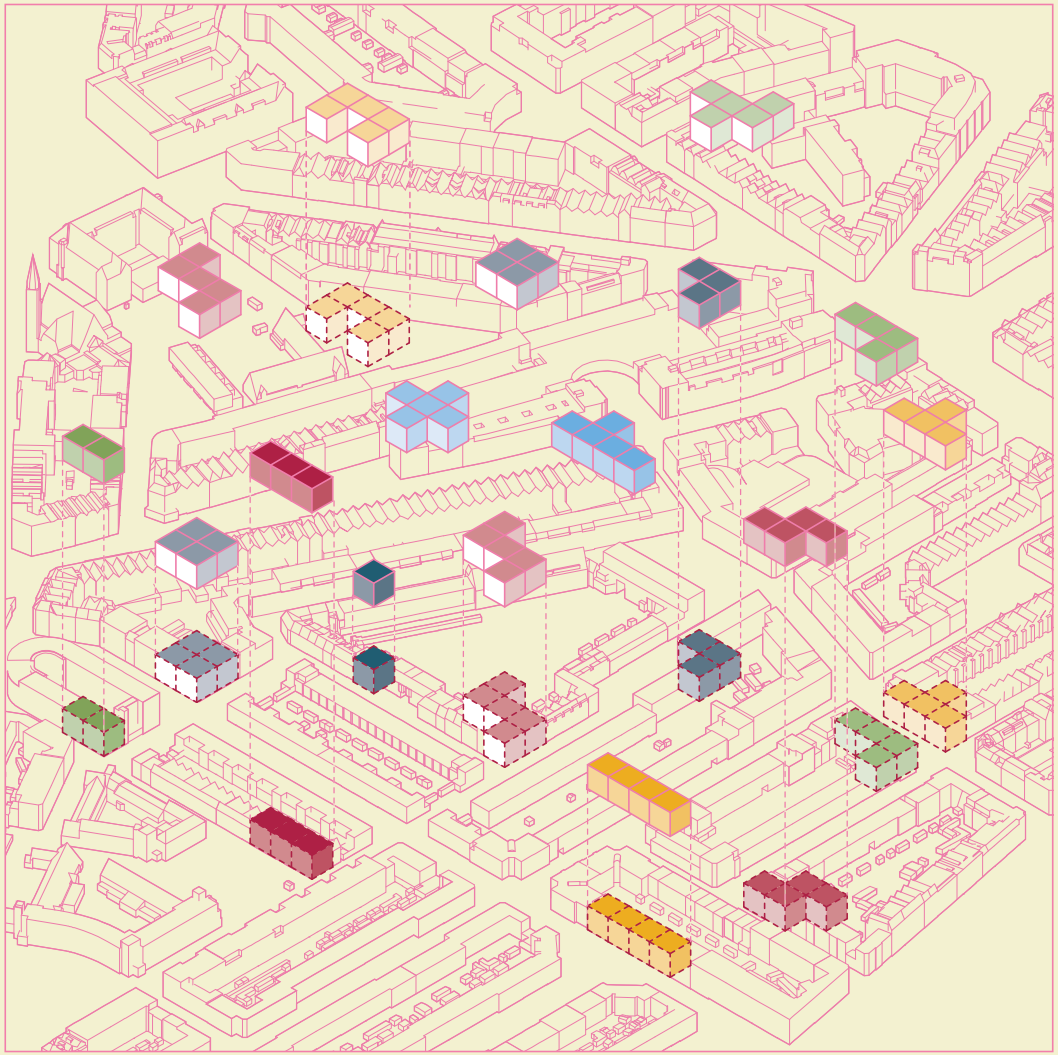


Low-rise compact strip



Mid-rise closed building blocks

URBAN AMBITION



GENERAL INTRODUCTION

SUMMARY OF THE RESEARCH

DESIGN BRIEF

SYSTEM CONCEPT

DESIGN PROPOSAL

GENERAL INTRODUCTION

SUMMARY OF THE RESEARCH

DESIGN BRIEF

site/program

SYSTEM CONCEPT

DESIGN PROPOSAL

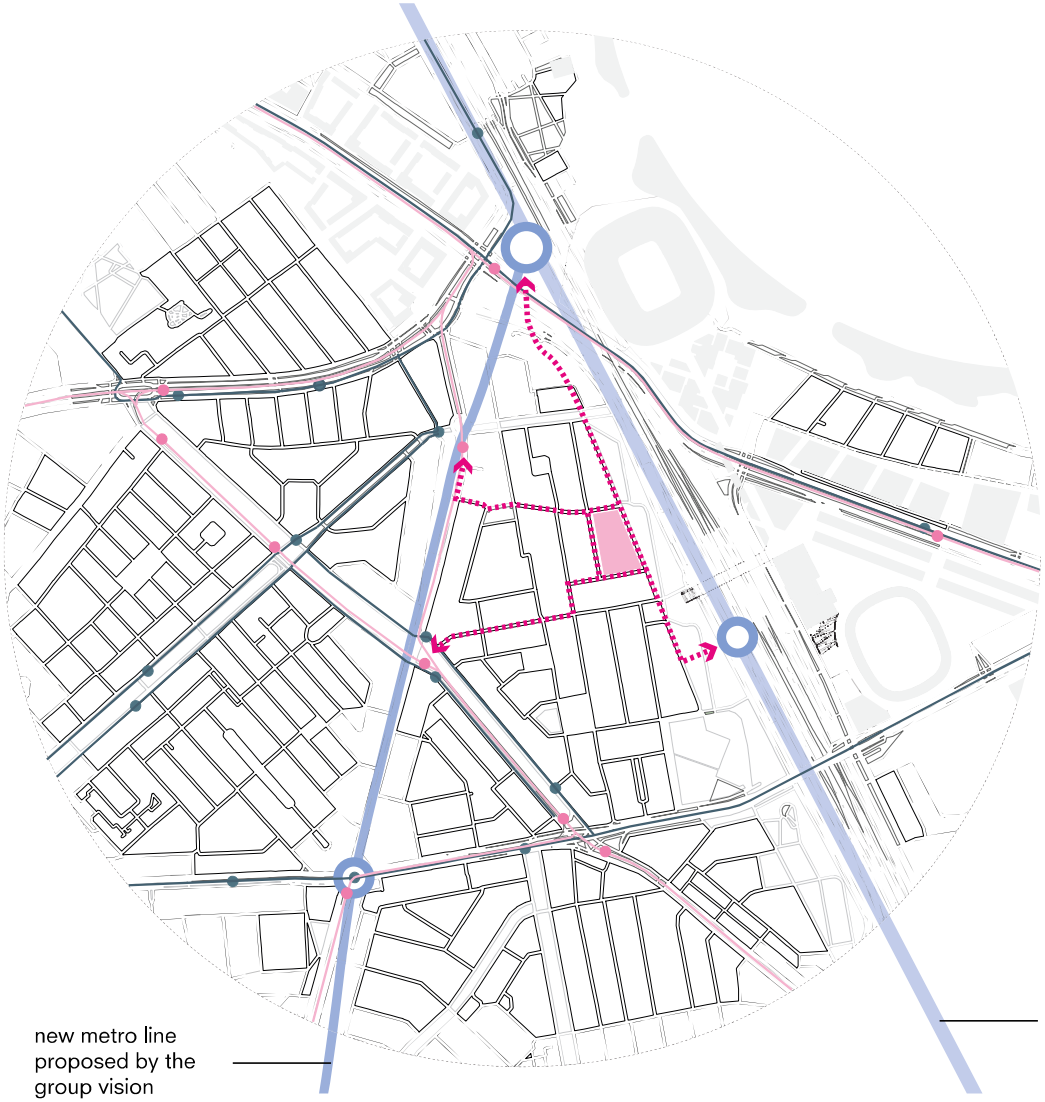

SITE LOCATION


SITE LOCATION
adjacent park

SITE LAYERS


residential
community
healthcare
cultural landmarks
religious
education
offices
commercial/retail

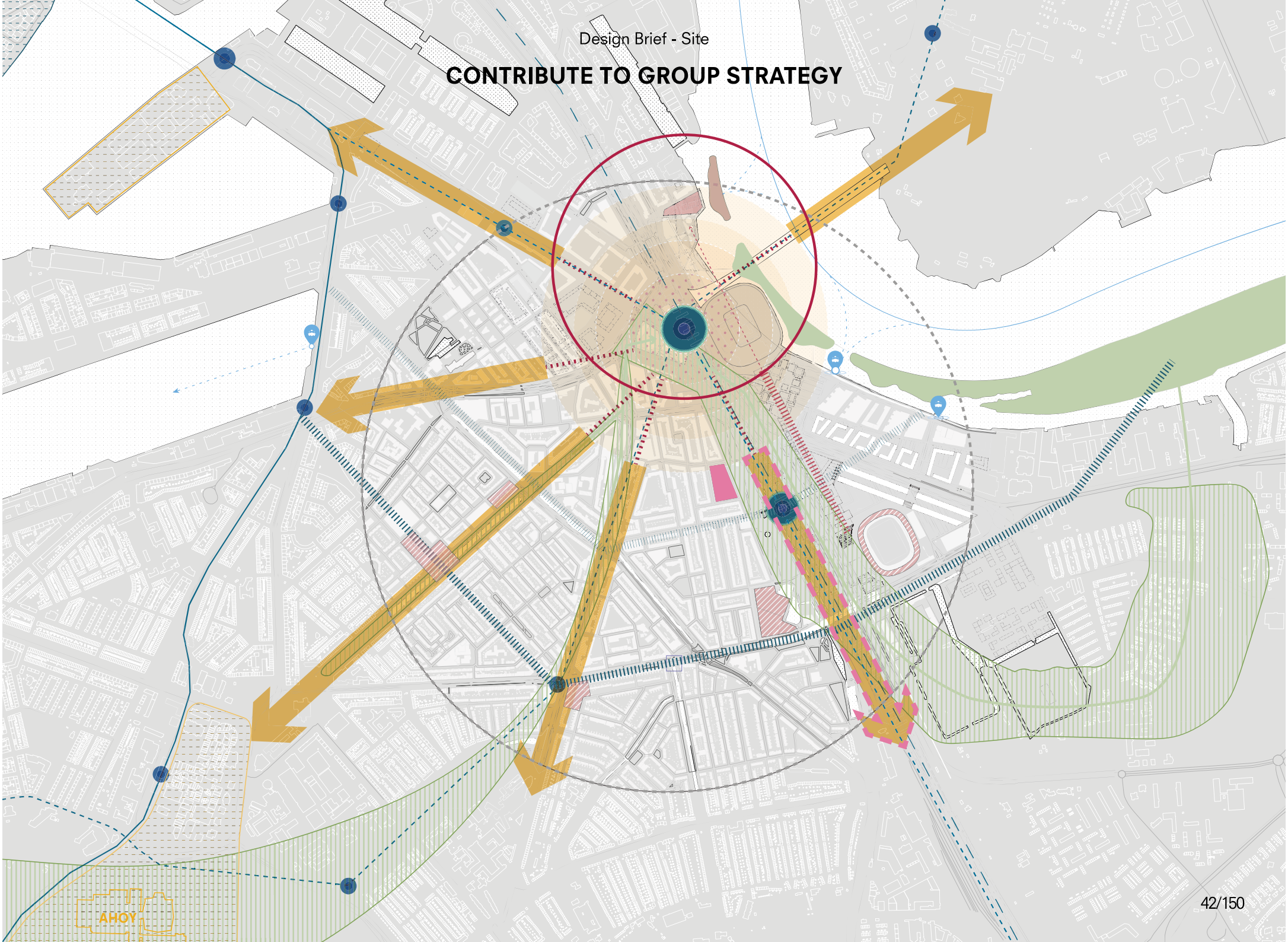
SITE LAYERS


new metro line proposed by the group vision
new metro line proposed by the government
access to public transportation
metro line
bus line
tram line
site

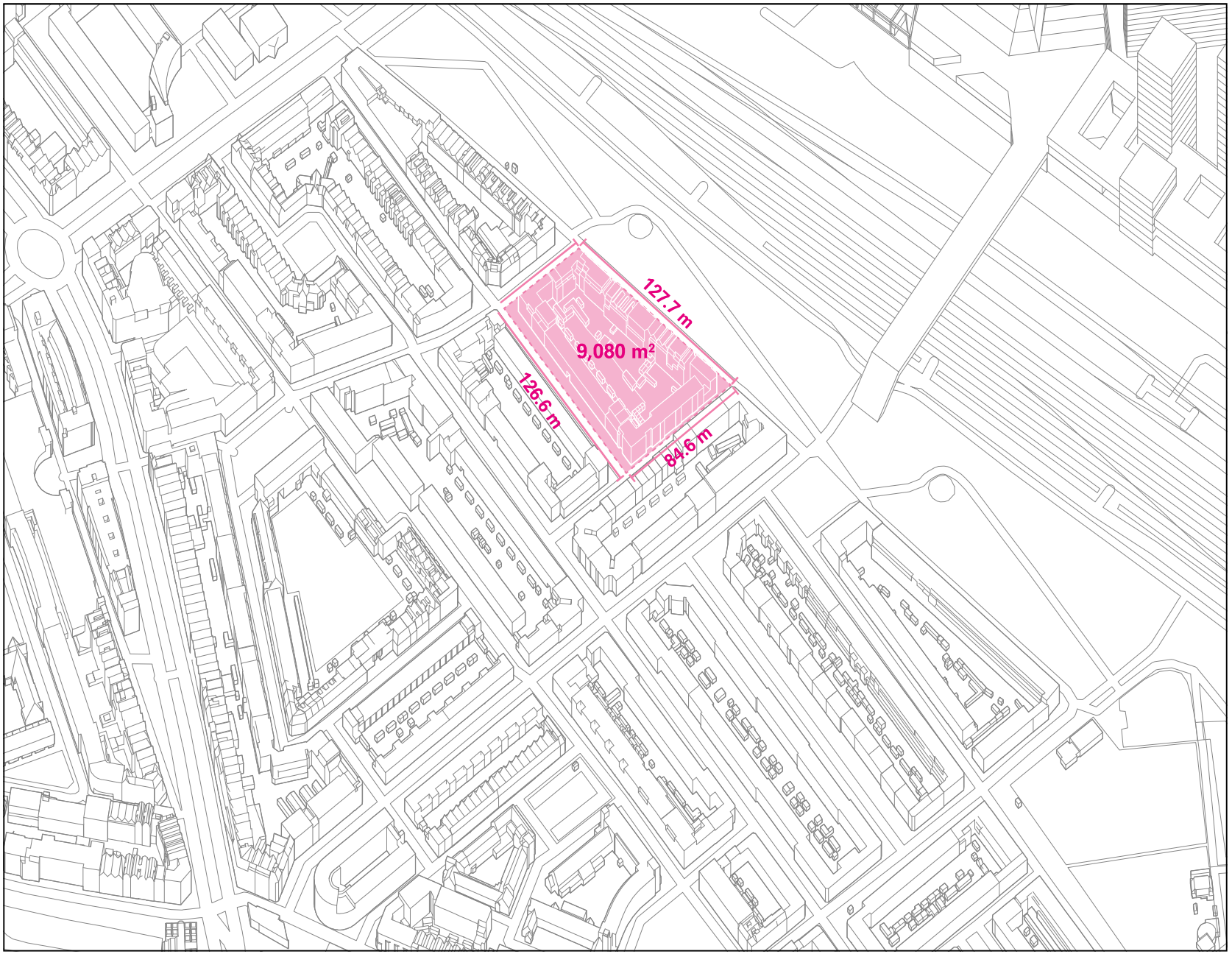
SITE QUALITIES

Design Brief - Site

CONTRIBUTE TO GROUP STRATEGY

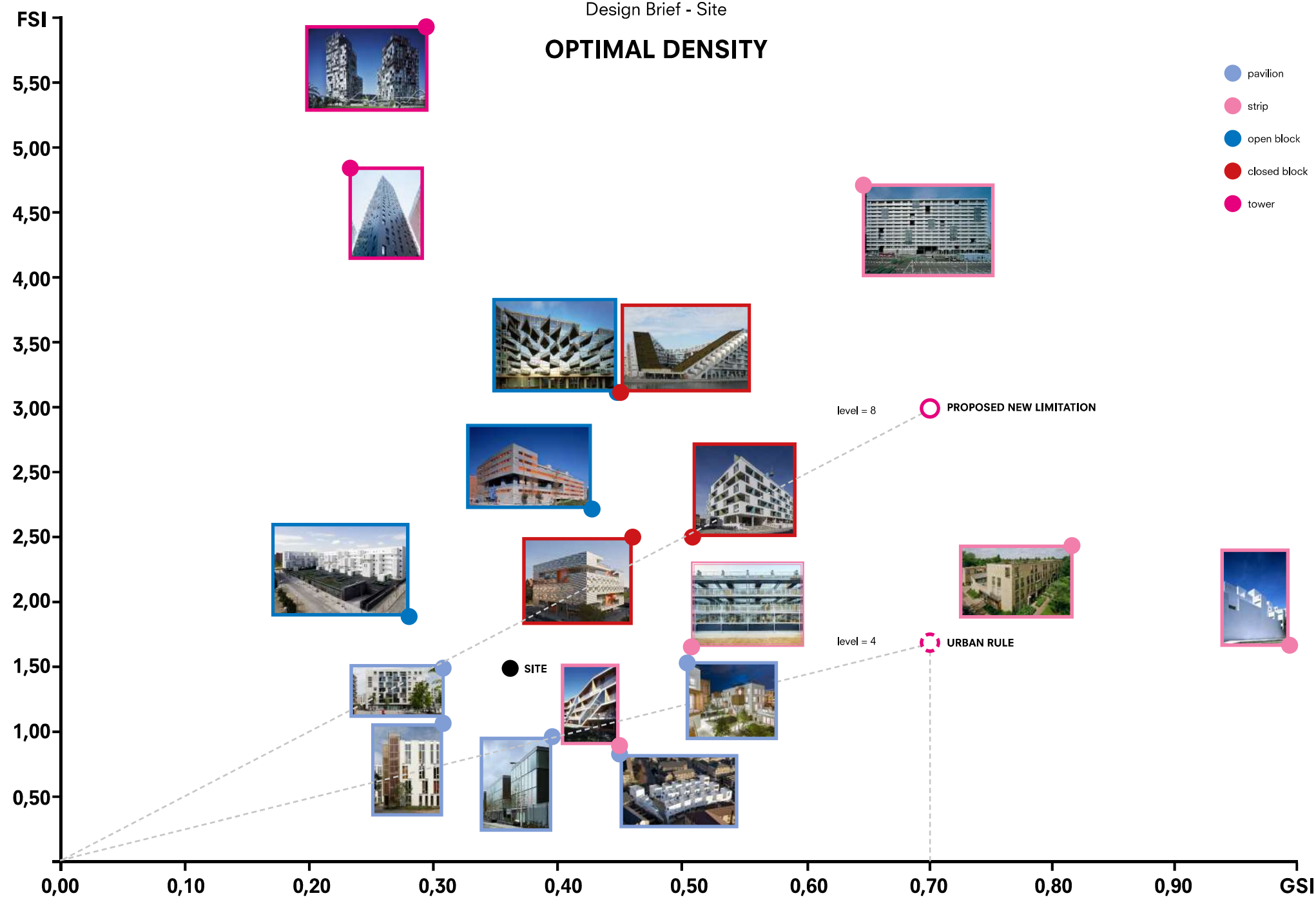


SITE AREA



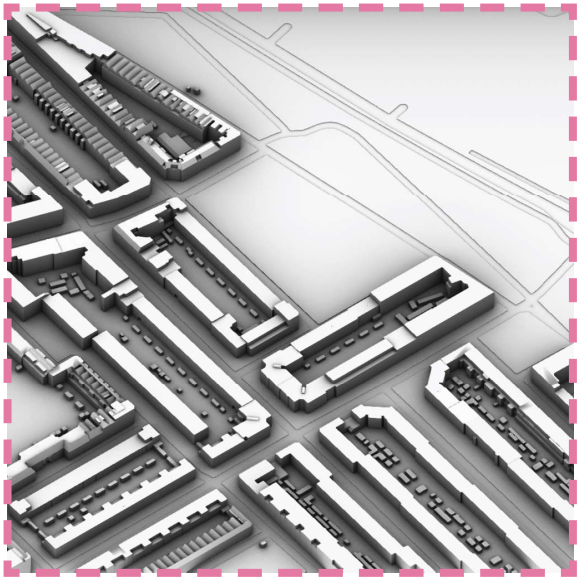
Design Brief - Site

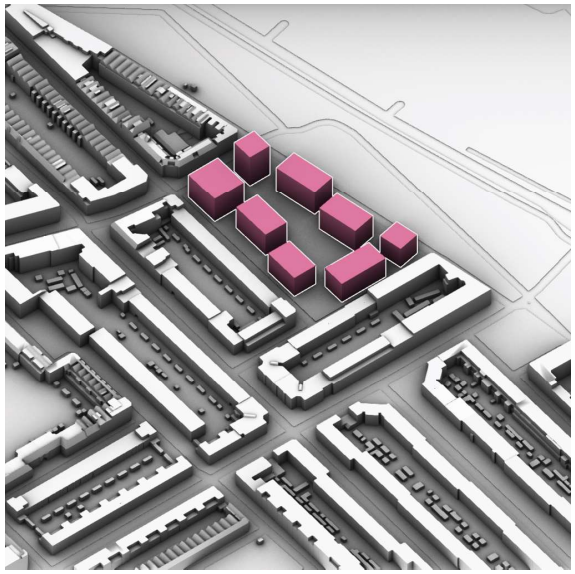
OPTIMAL DENSITY

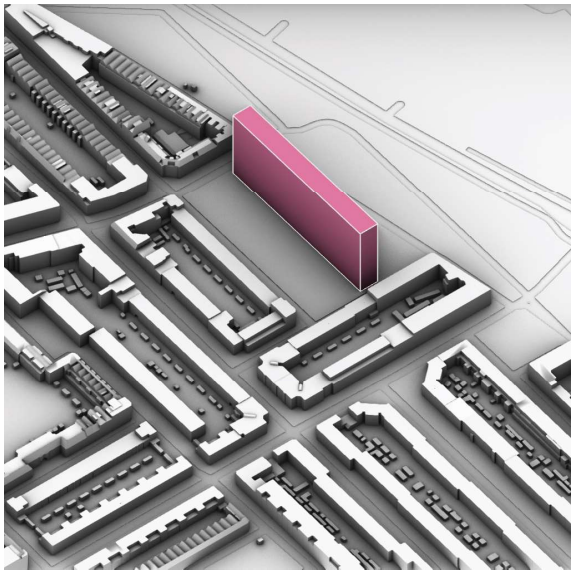


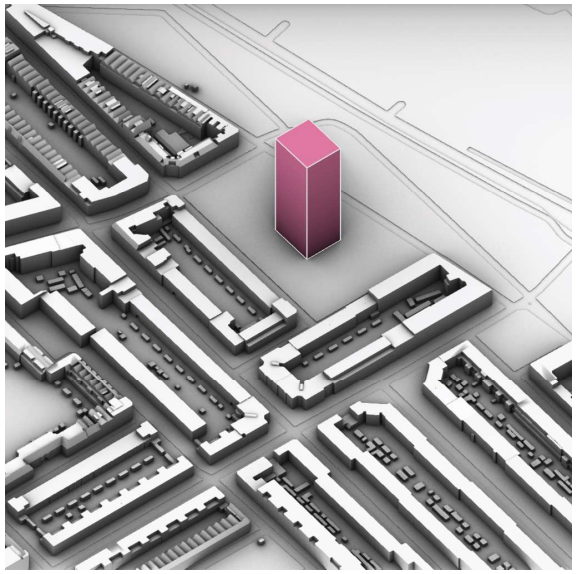
MASSING STUDY

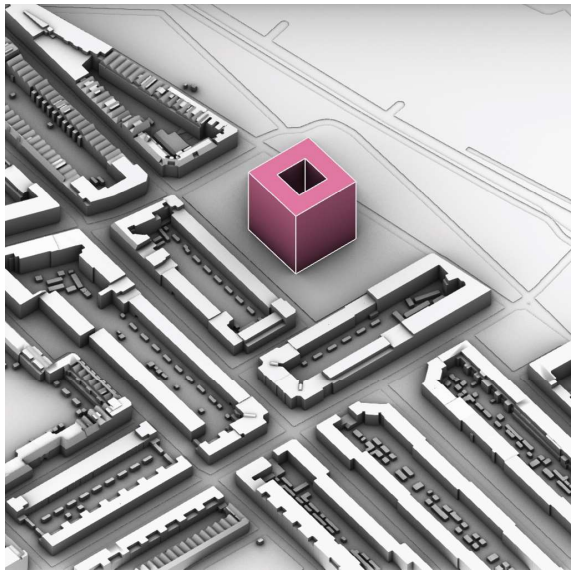
Build on an empty lot

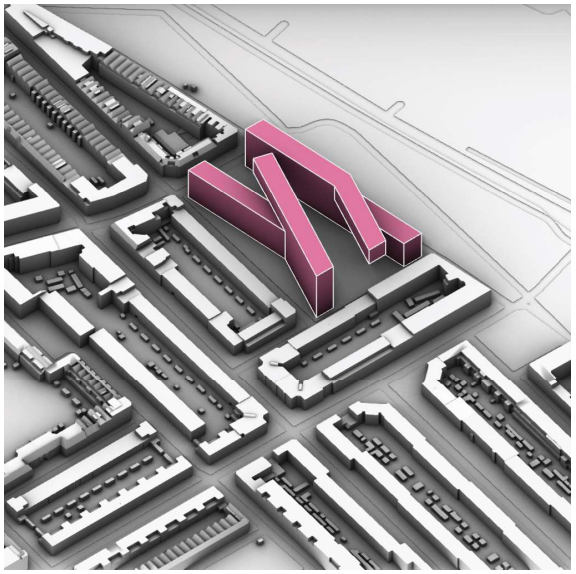












GENERAL INTRODUCTION

SUMMARY OF THE RESEARCH

DESIGN BRIEF

site/program

SYSTEM CONCEPT

DESIGN PROPOSAL

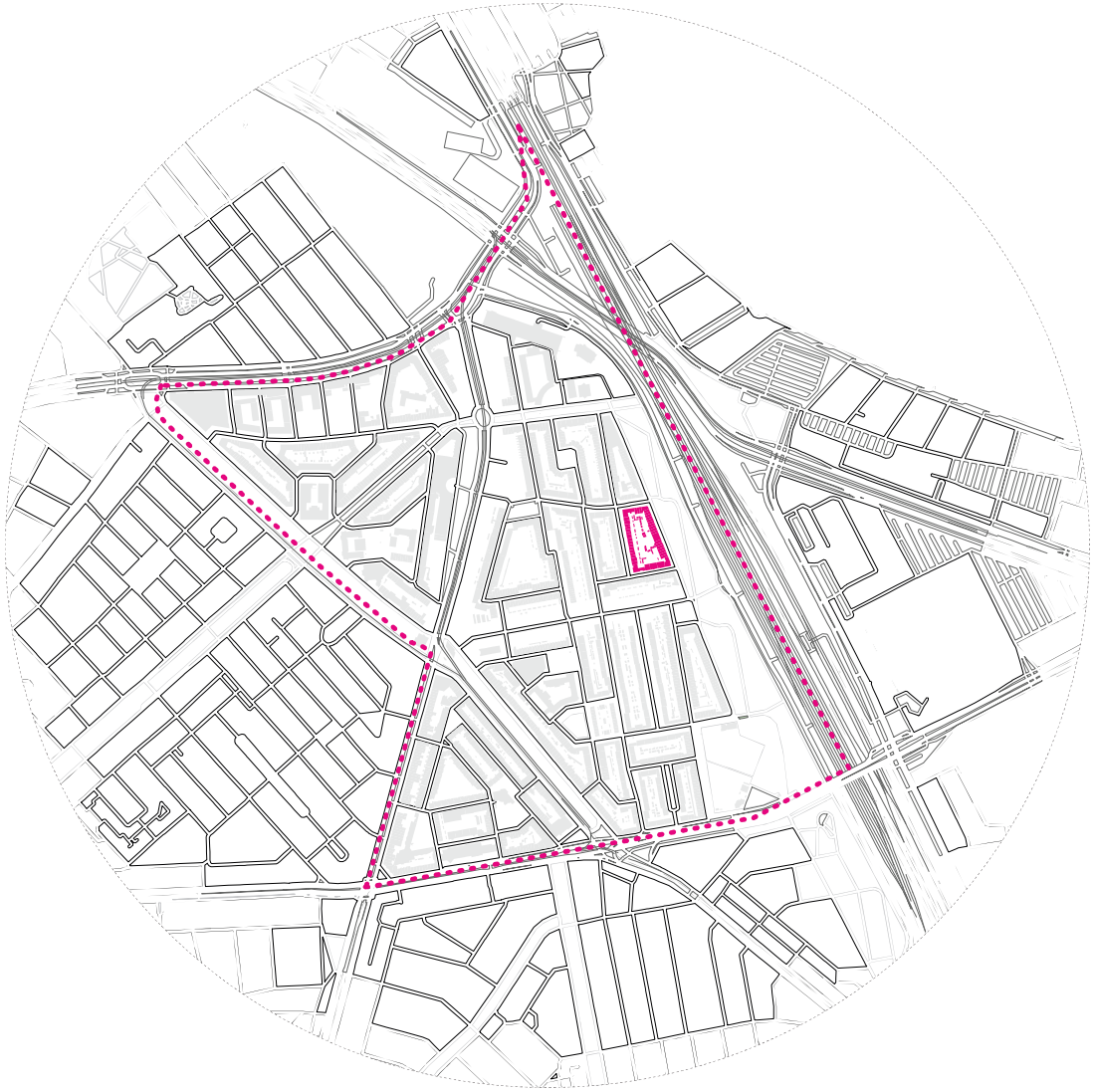
DESIGN FOR WIDER RANGE

+3,000
new houses

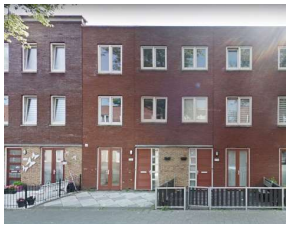
5142
current houses

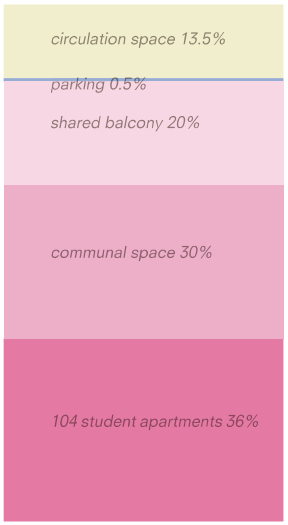
BUILDING BLOCK ON SITE

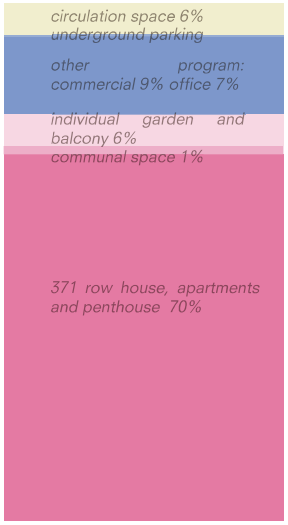
~60
new houses



BENCHMARK







Location: Denmark
Architect: C.F. Moller
Plot area: 4,397 m2
Floor area:11,000 m2
Dwelling: 102

Density: 232 dw/ha

Location: Denmark
Architect: AART
Plot area: 2,495 m2
Floor area: 6,950 m2
Dwelling: 107

Density: 429 dw/ha

Location: Denmark
Architect: BIG
Plot area: 18,299 m2
Floor area: 61,000 m2
Dwelling: 471

Density: 257 dw/ha

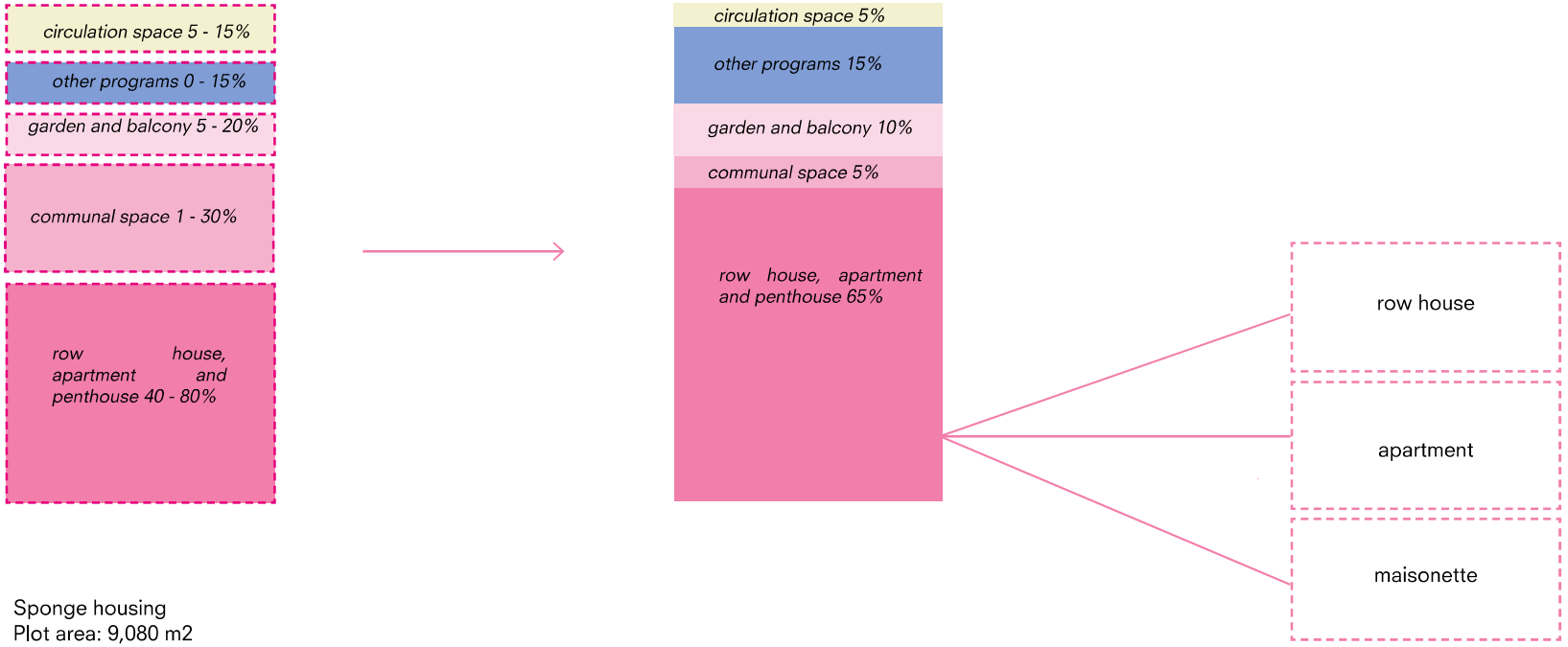
Location: Hillesluis, Rotterdam
Plot area: 9,080 m2
Floor area: 3,274 m2
Dwelling: 112

Density: 123 dw/ha

Sponge housing
Plot area: 9,080 m2
Floor area: 25,000 m2
Dwelling: 112 - 172

Density: ~ dw/ha

PROGRAMS



Sponge housing
Plot area: 9,080 m2
Floor area: 25,000 m2
Dwelling: 112 - 172

Density: ~ dw/ha

INTRODUCTION

SUMMARY OF THE RESEARCH

DESIGN BRIEF

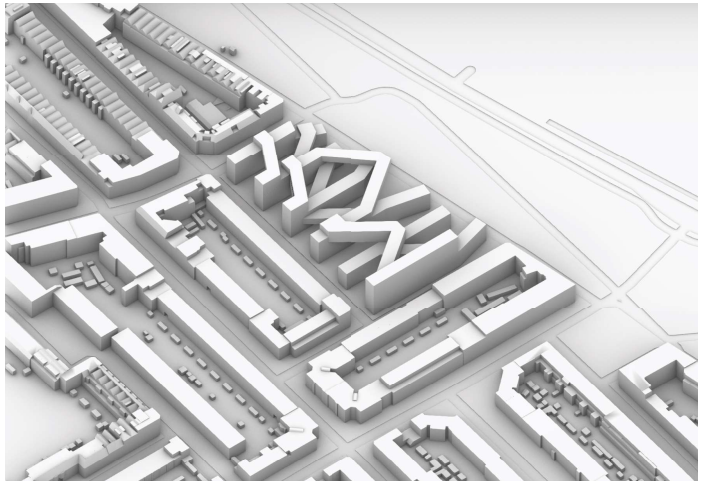
SYSTEM CONCEPT

DESIGN PROPOSAL

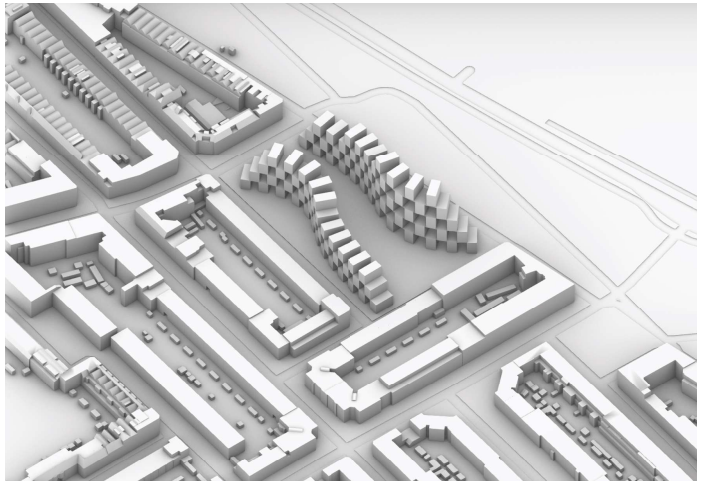
DESIGN QUESTIONS

1. What is flexible and what is permanent?
flexible programs (houssing, public program), permanent structure
2. How the houses can be added?
3. How the extra space created for flexibility can be used?

CONCEPTUAL MASSING STUDY

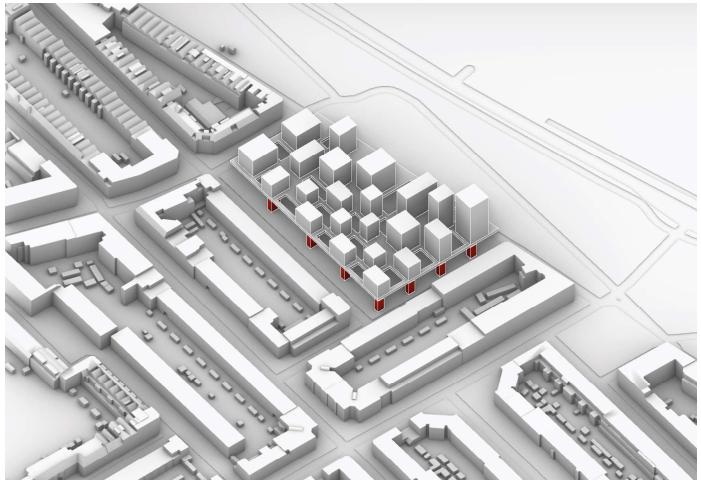


1. house grow in two sides



2. modular houses stack on top and insert in between

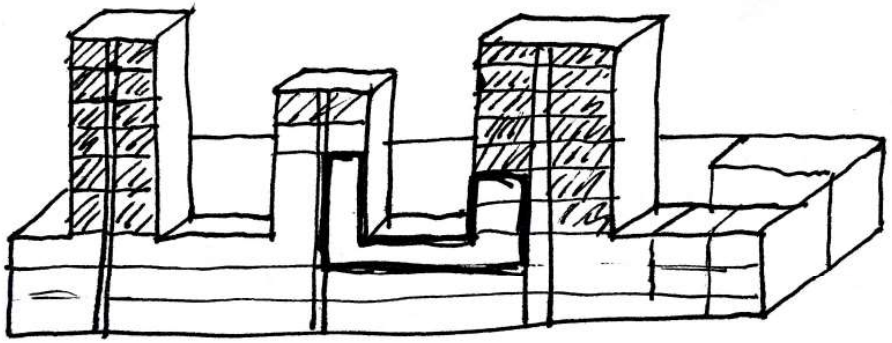
3. add houses in pre-defined infrastructure



4. add houses under the platform

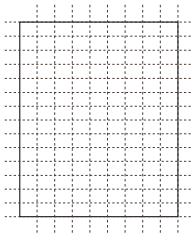
CONCEPTUAL MASSING

CONCEPT - UP TO DOWN

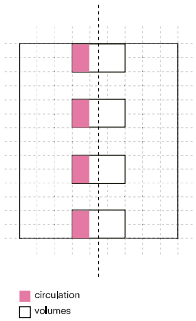


SYSTEM FOR DILUTION AND DENSIFICATION

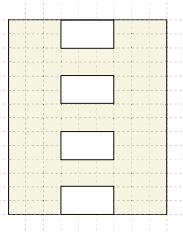
STEP 1
/choose a site.
/draw the grid of 4m×5m.



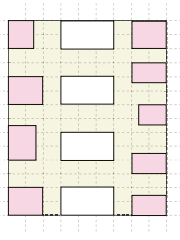
STEP 2
/choose the longer axis in the center and place the volumes.



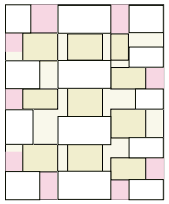
STEP 3
/add the platform of 2 storey's high.



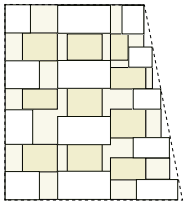
STEP 4
/add different types of towers on the platform based on the distance and orientation.



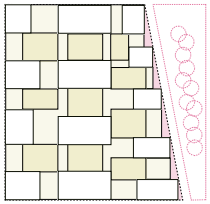
STEP 5
/add volumes under the platform and define the courtyard based on the programs on the base.



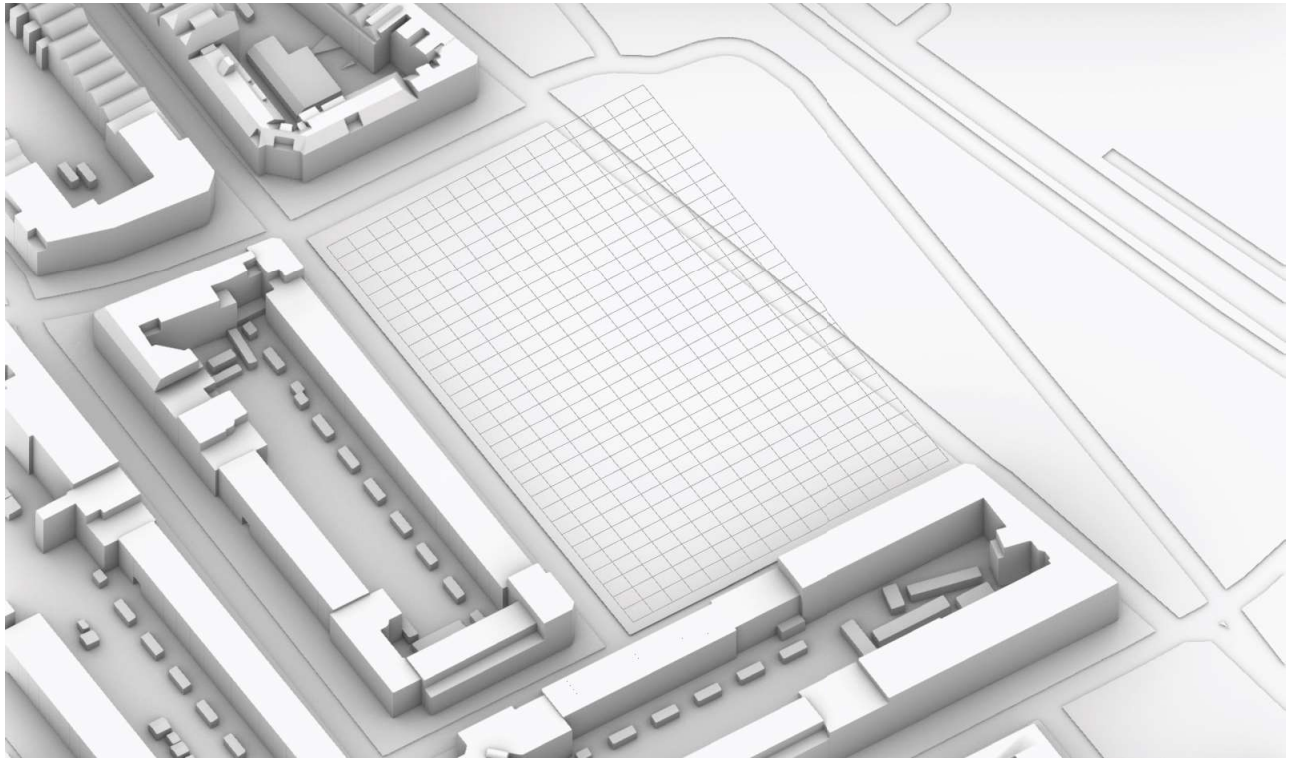
STEP 6
/if the site is at the angle to the grid, push the building out to meet the road.



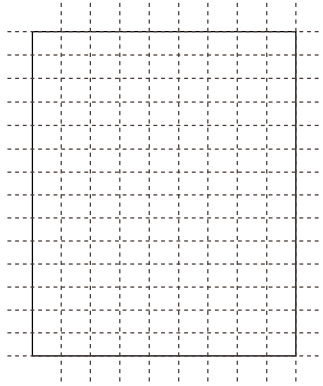
STEP 7
/stretch the platform to respond to special condition in the context (e.g. park) to address the entrance.



GRID ON SITE

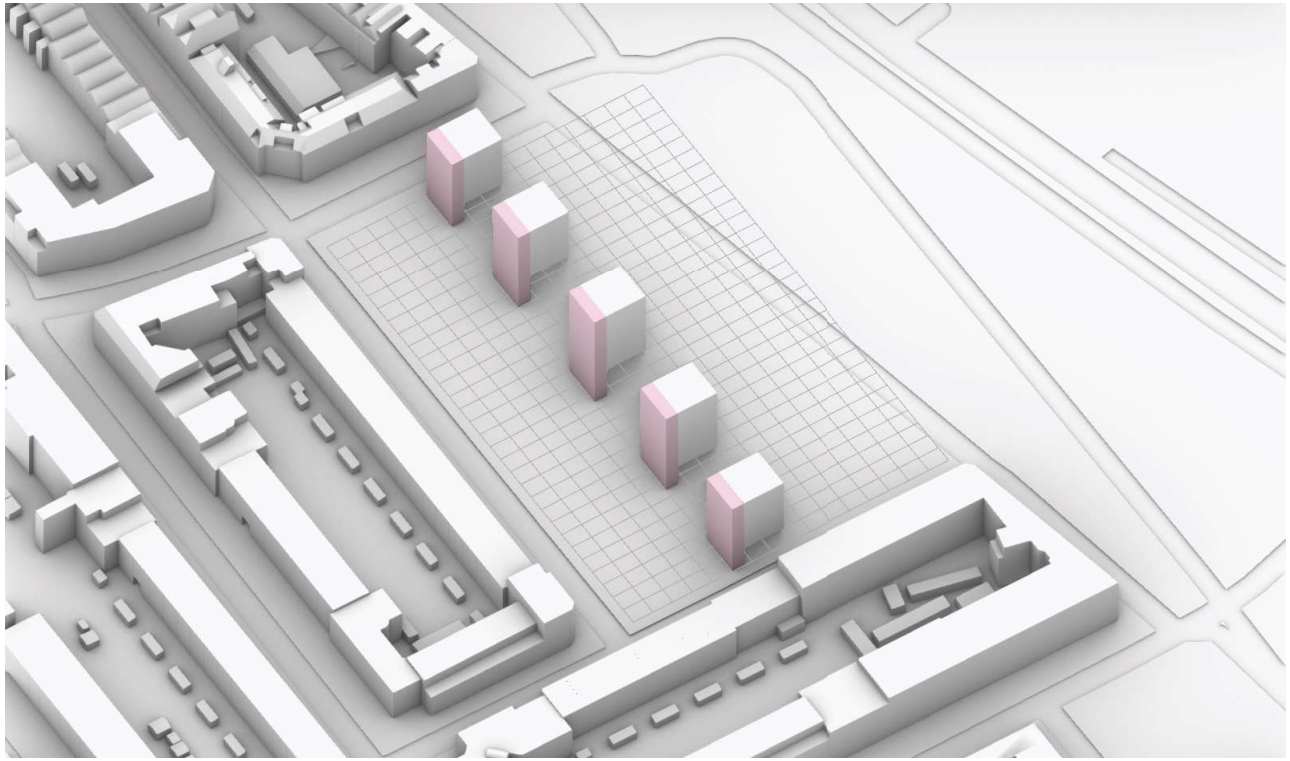


STEP 1
/choose a site.
/draw the grid of 4m×5m. (it is considered as the most appropriate structural grid size for housing)

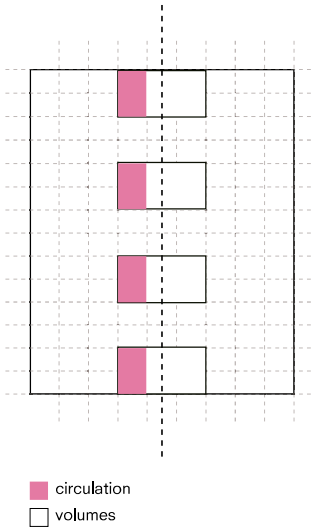


source: Flexible Housing

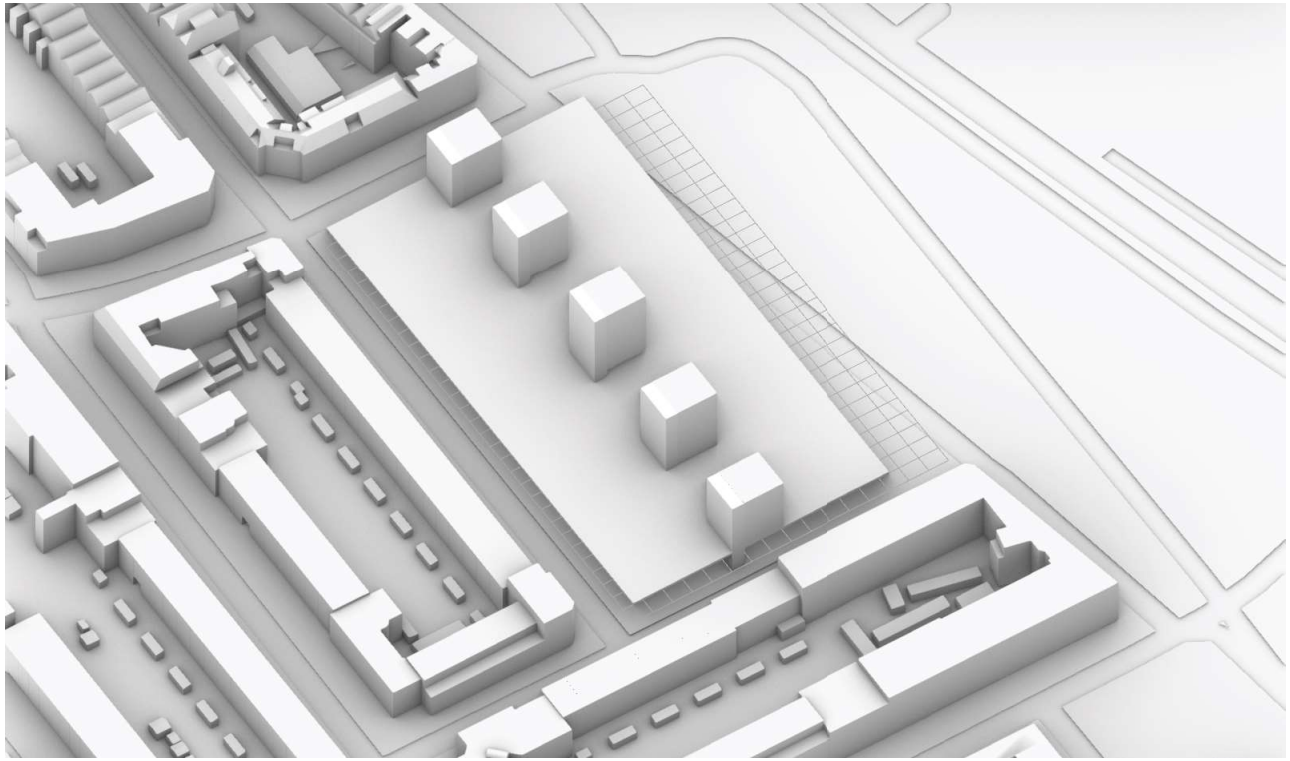
CENTRAL SPINE



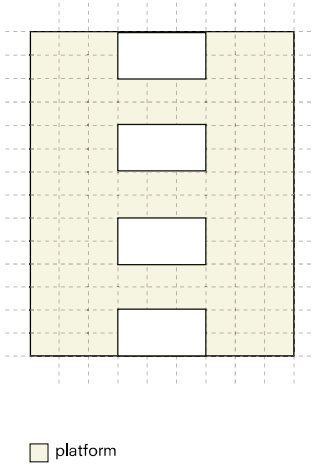
STEP 2
/choose the longer axis in the center and place the volumes.



SECOND FLOOR PLATFORM

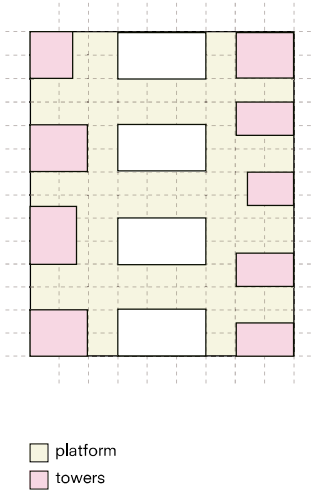


STEP 3
/add the platform of 2 storey's high.

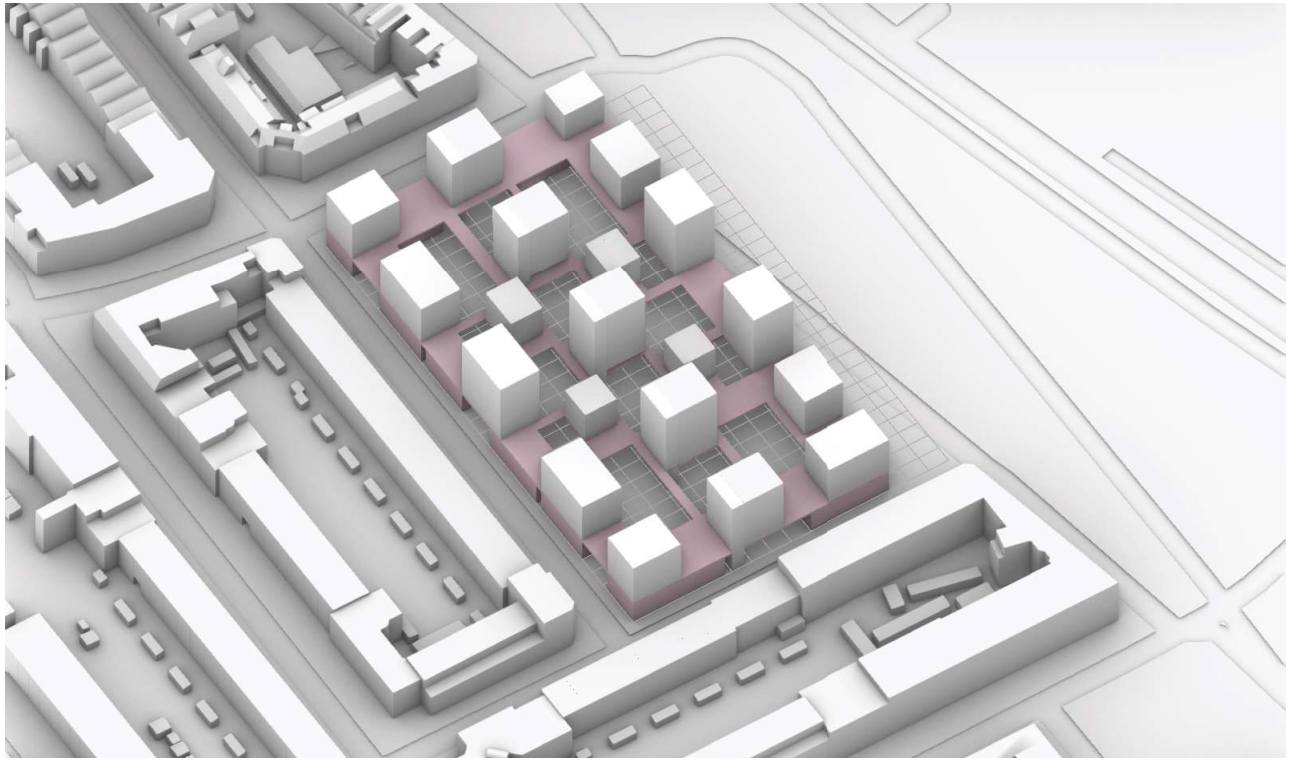


ADD TOWERS

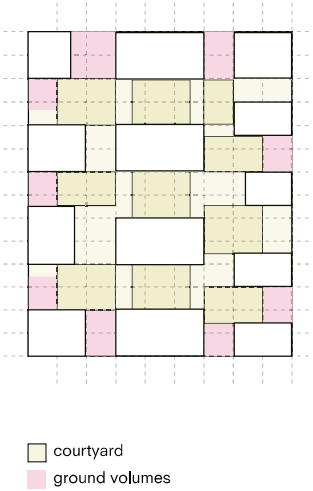
STEP 4
/add different types of towers on the platform based on the distance and orientation.



DEFINE COURTYARDS & PERMEABLE GROUND

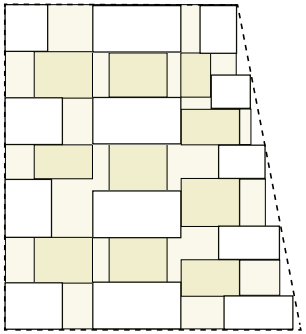


STEP 5
/add volumes under the platform and define the courtyard based on the programs on the base.

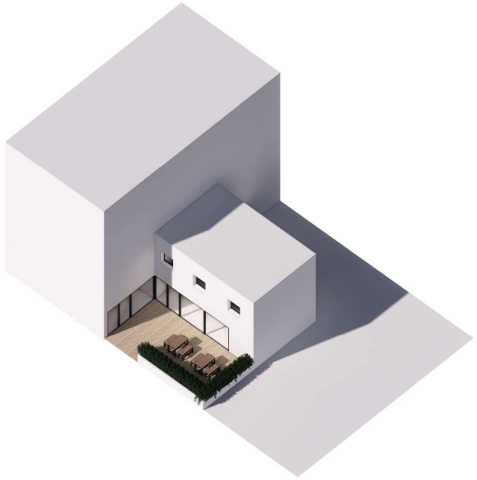


MOVE ALONG THE BOUNDARY

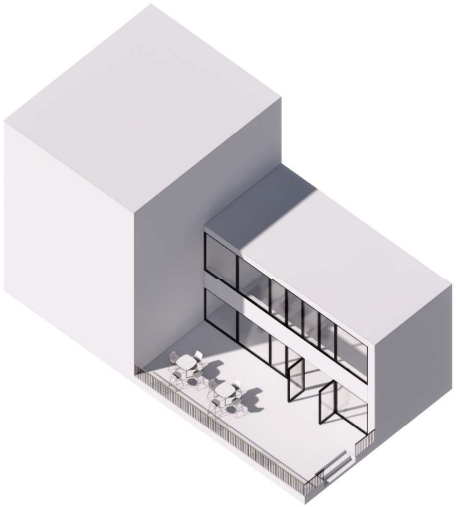
STEP 6
/if the site is at the angle to the grid, push the building out to meet the road.



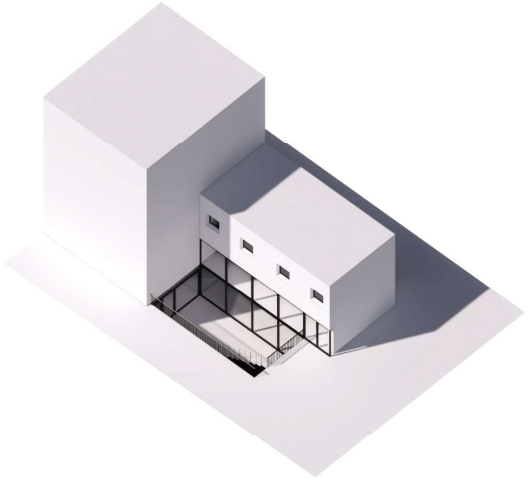
CORNER CONDITION POSSIBILITIES



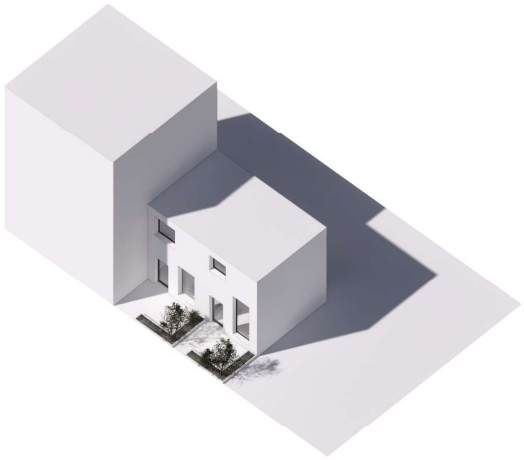
corner entrance



elevated platform

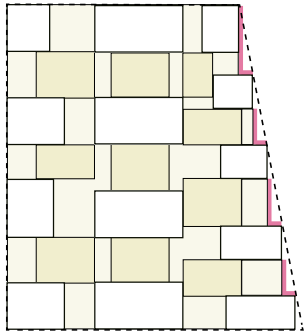


corner sunken

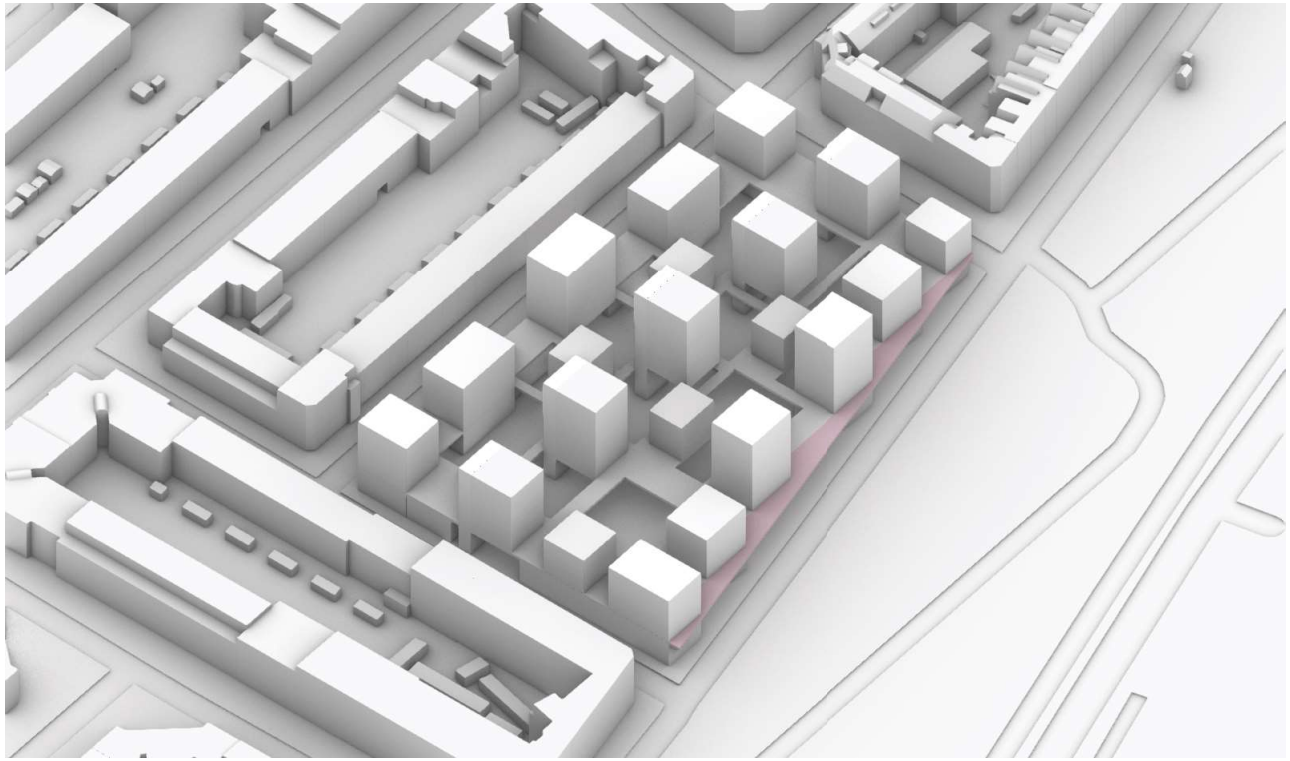


corner garden

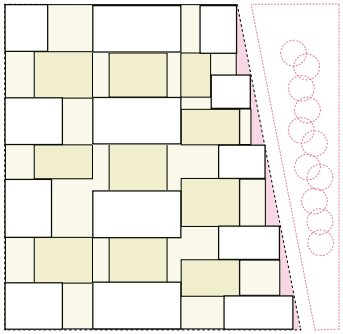
STEP 6
/if the site is at the angle to the grid, push the building out to meet the road.
/corners can function in different ways depending on the program and context.



EXTENDED PLATFORM AS CANOPY



STEP 7
/stretch the platform to respond to special condition in the context (e.g. park) to address the entrance.



HOUSING COMPLEX

INTRODUCTION

SUMMARY OF THE RESEARCH

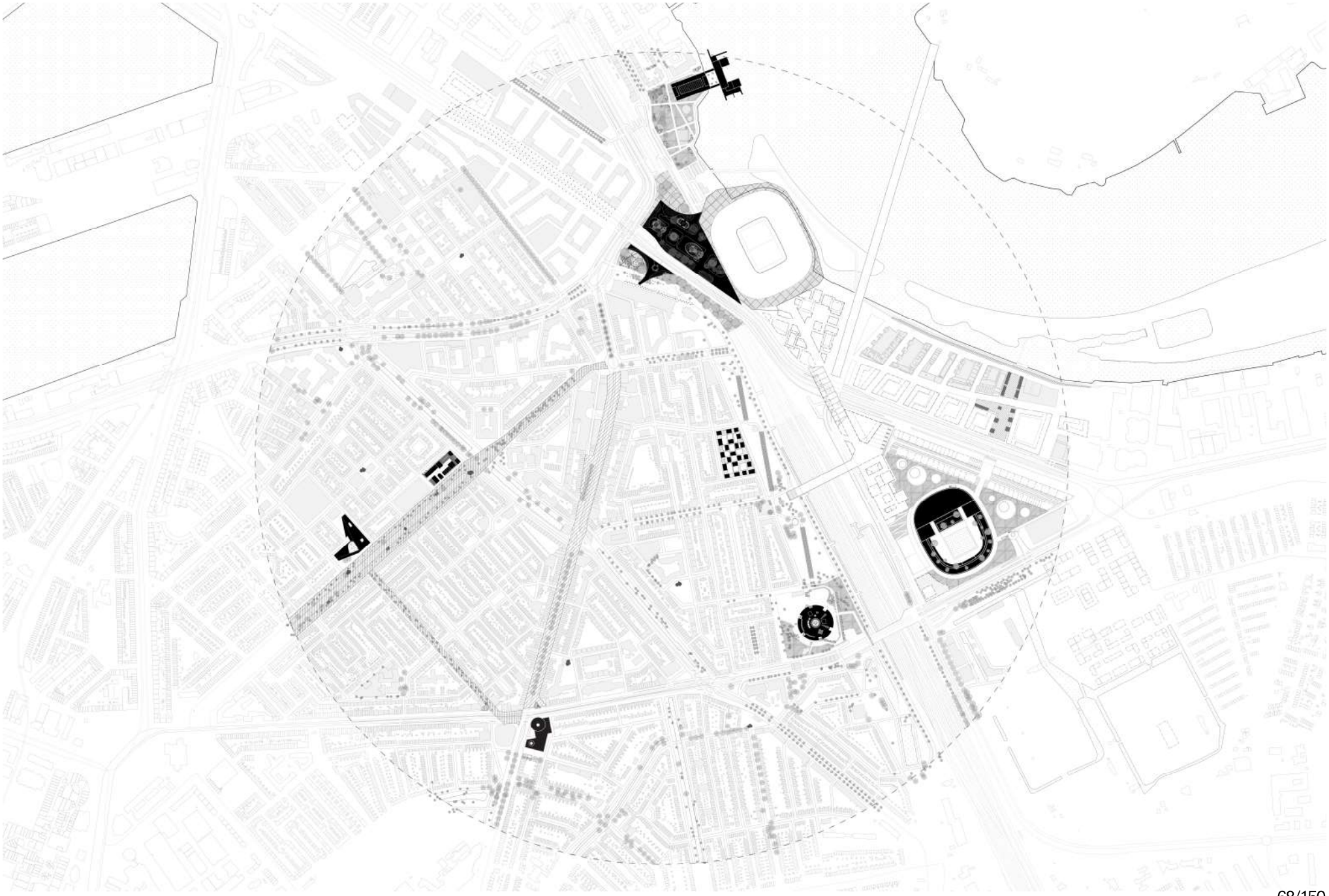
DESIGN BRIEF

SYSTEM CONCEPT

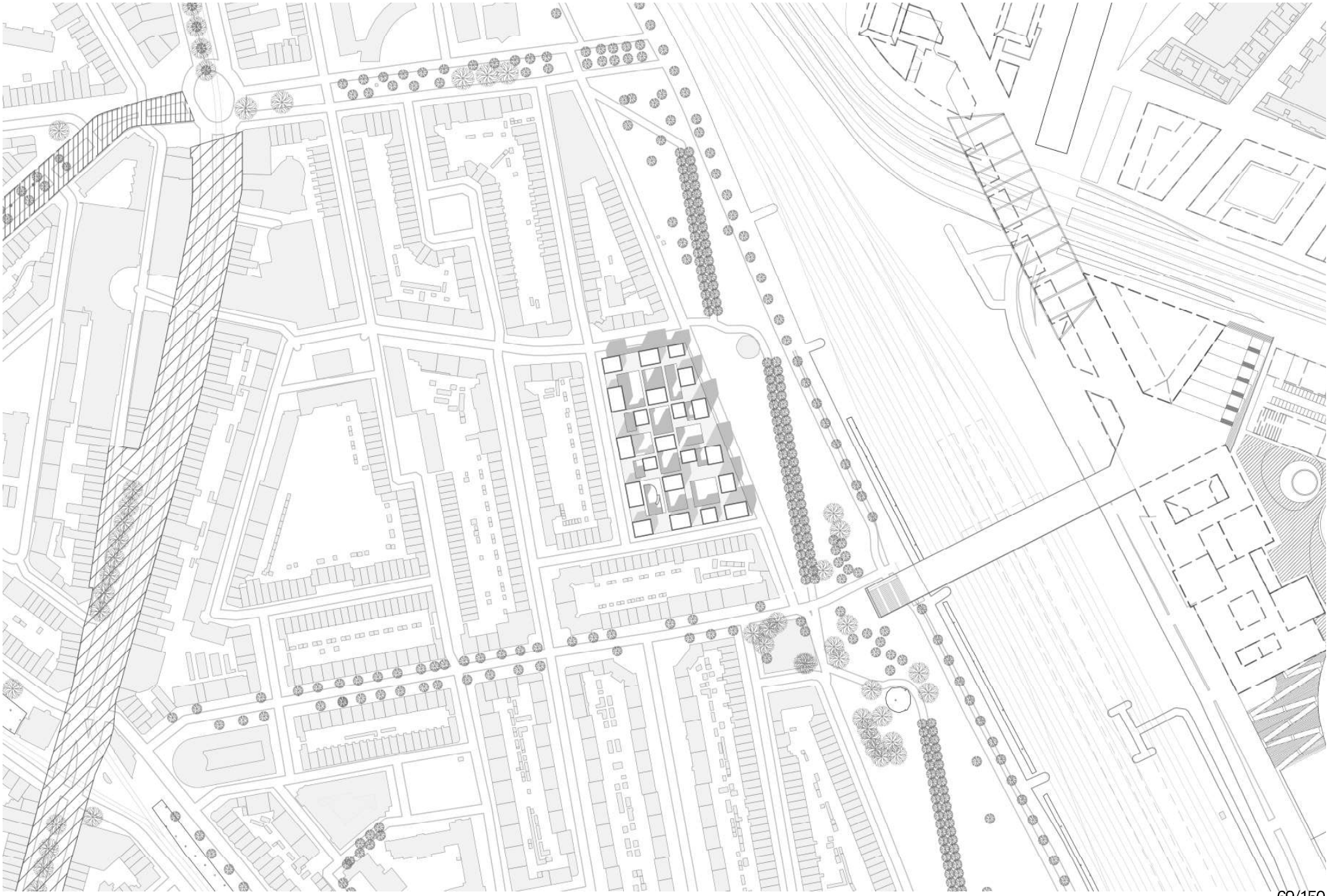
DESIGN PROPOSAL

DRAWINGS

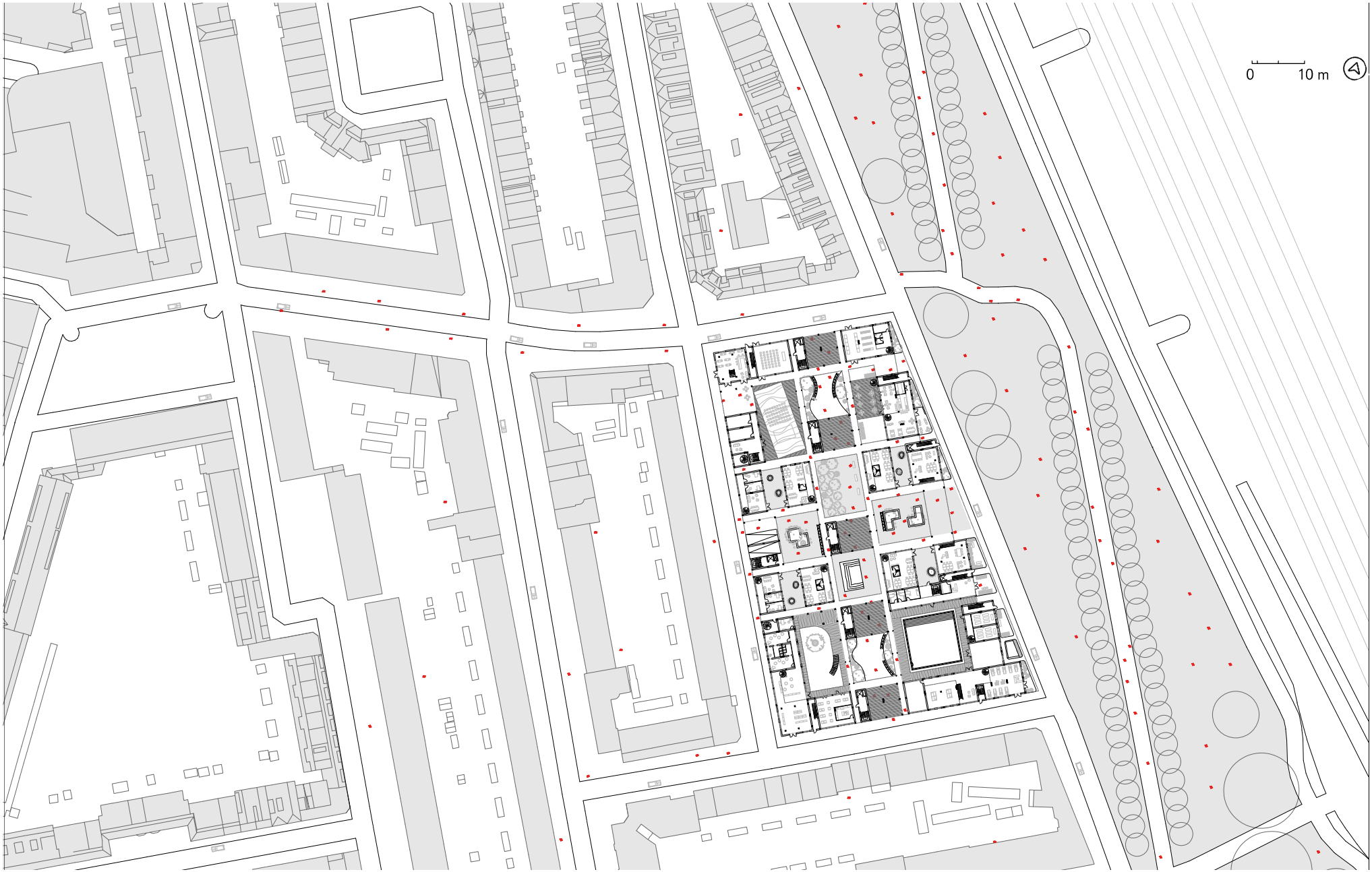
GROUP SITE PLAN 1:10000



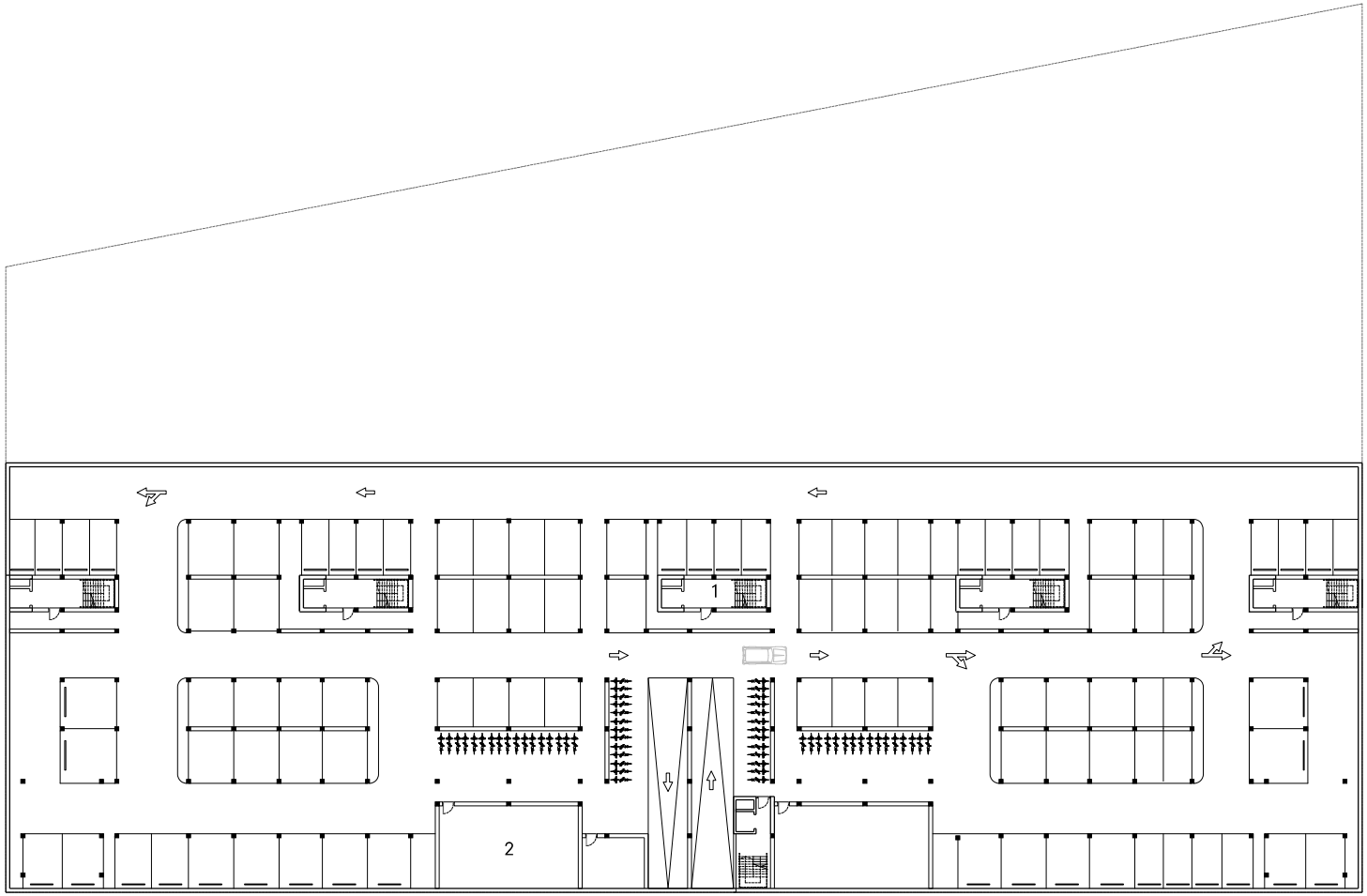
SITE PLAN 1:1000



URBAN IMPLEMENTATION 1:500



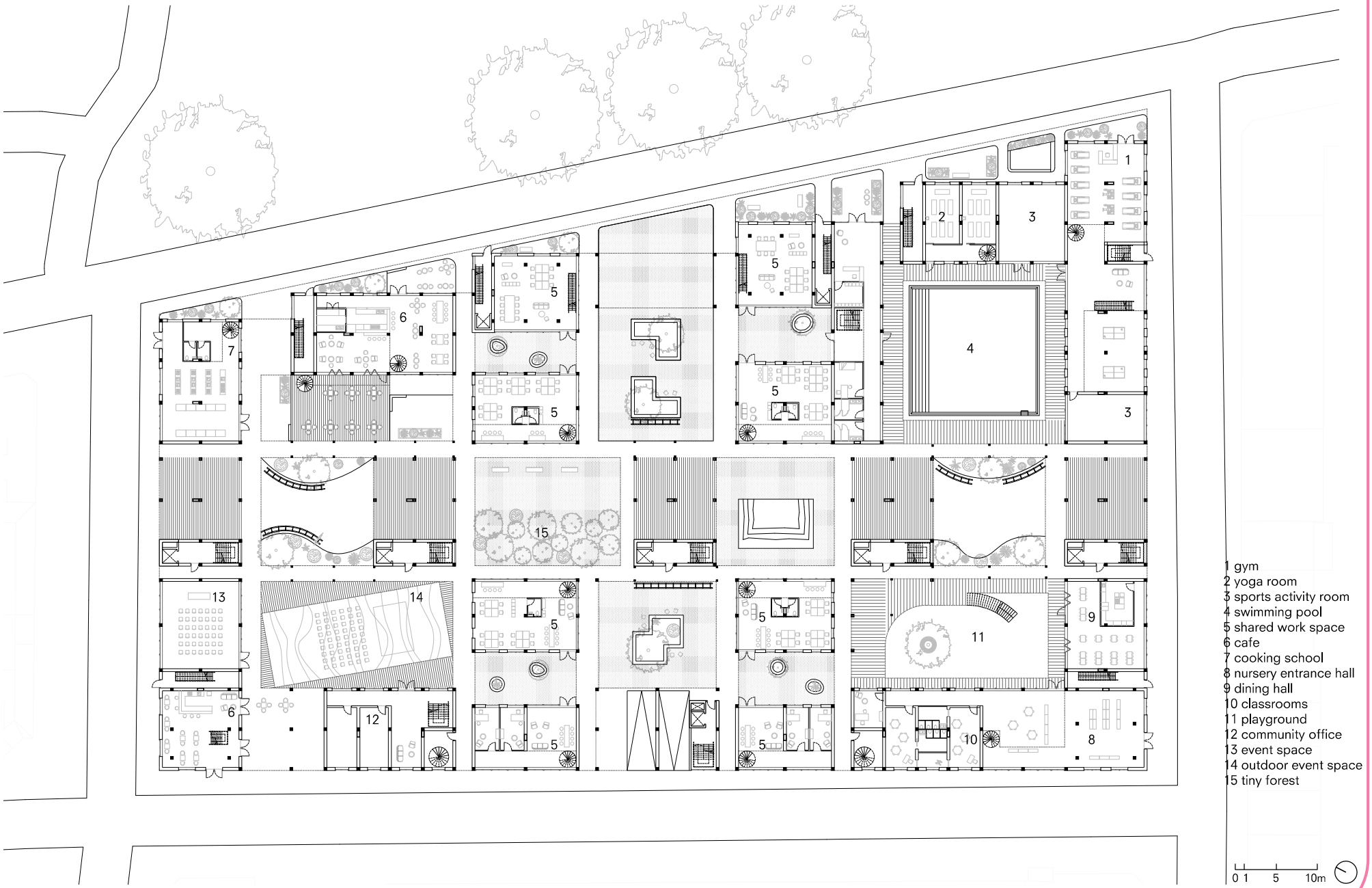
LEVEL -1 - PARKING



1 circulation core
2 service room

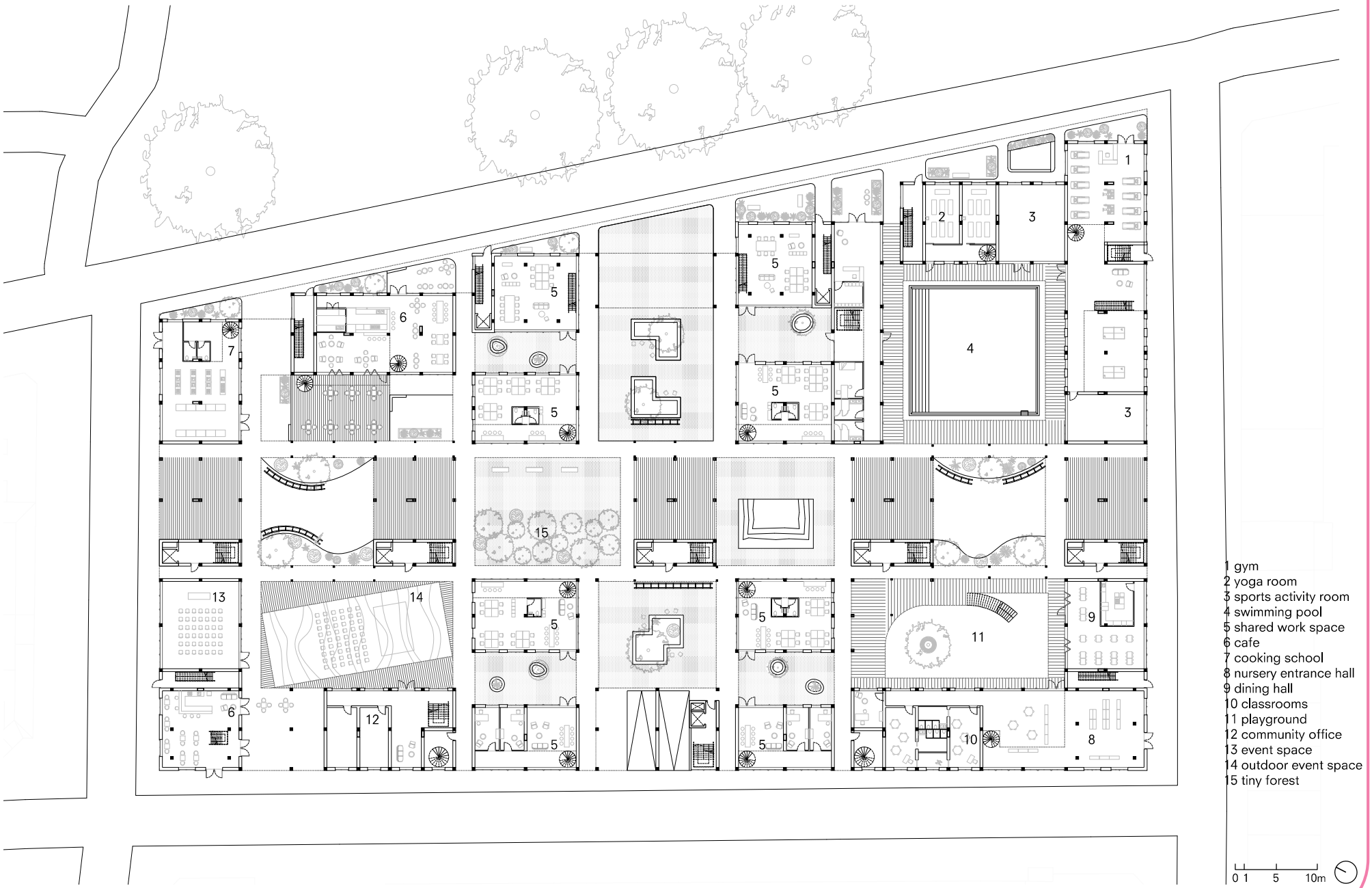
0 1 5 10m

GROUND FLOOR - MULTIPLE COURTYARDS



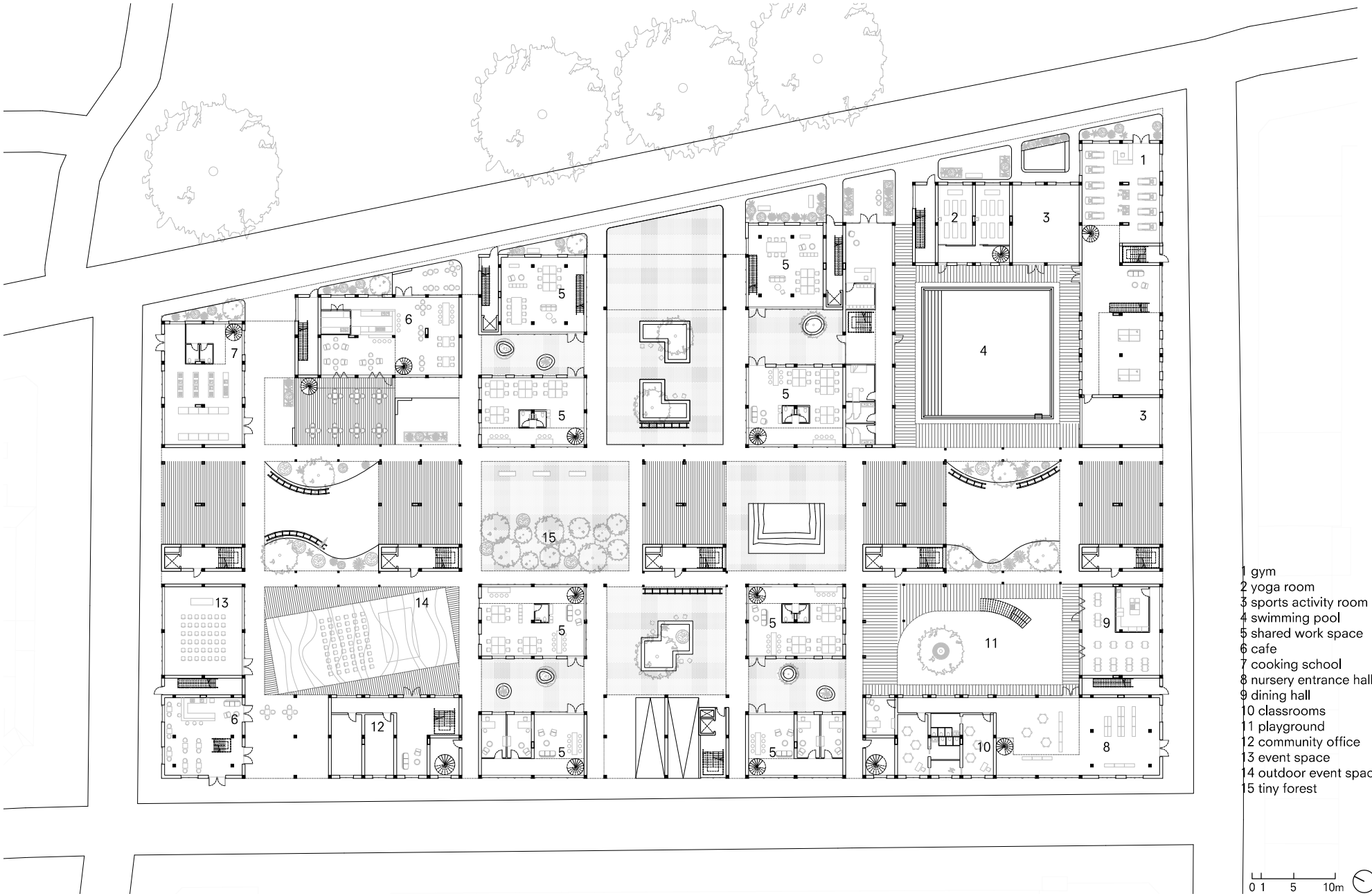
GROUND FLOOR - VIEW TO THE COURTYARD

GROUND FLOOR - MULTIPLE COURTYARDS



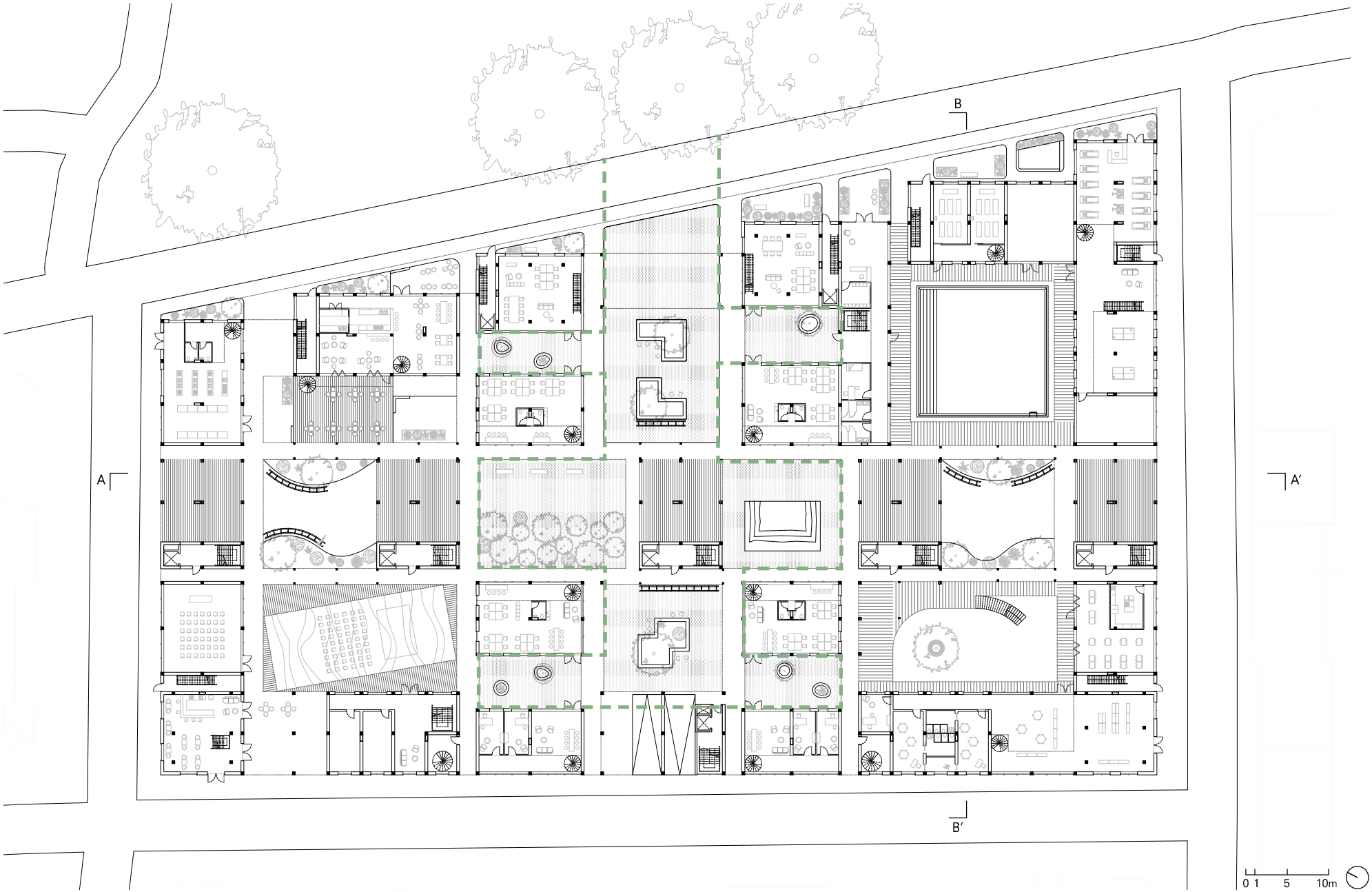
GROUND FLOOR - VIEW TO THE COURTYARD

GROUND FLOOR - MULTIPLE COURTYARDS



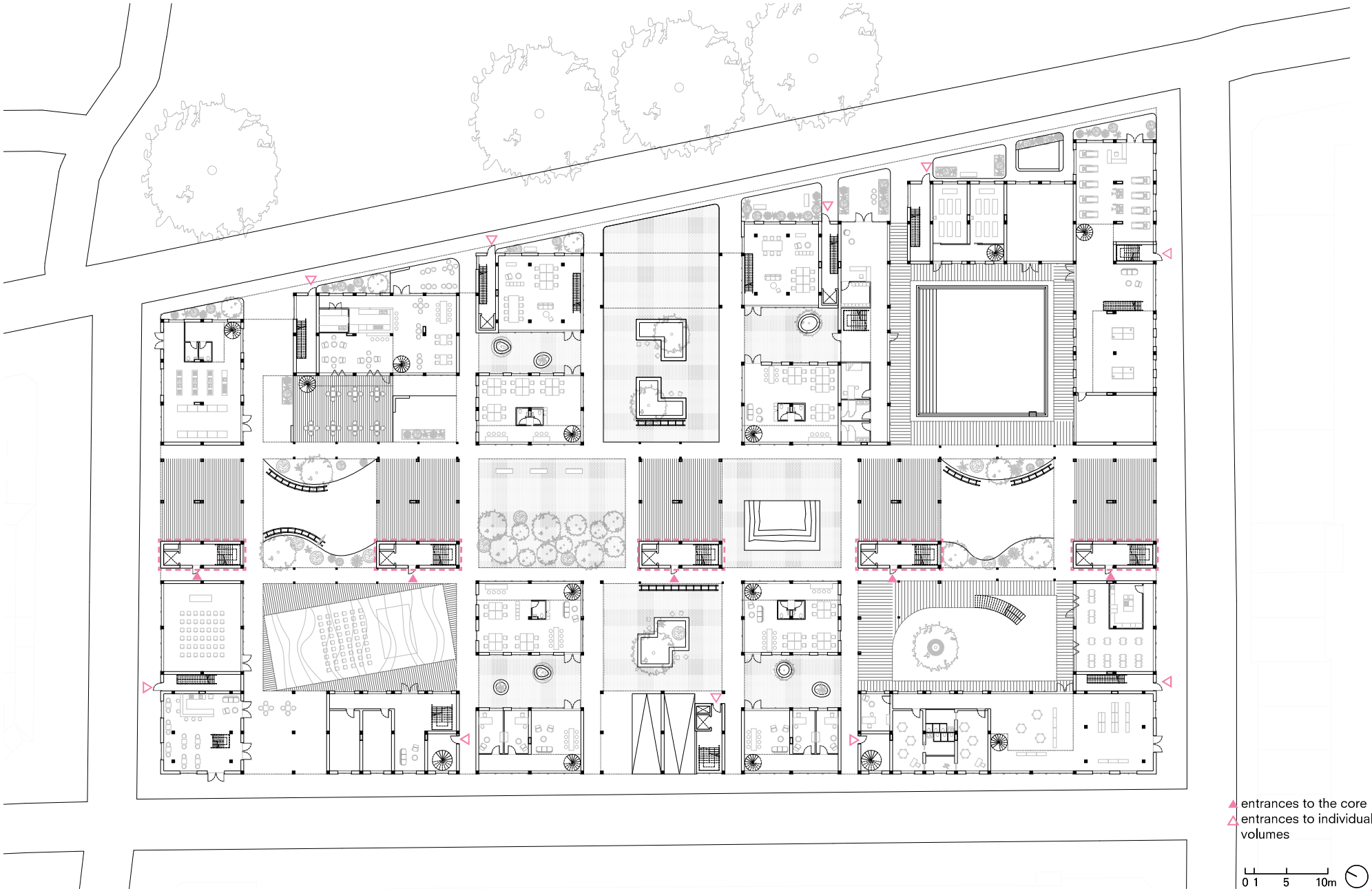
GROUND FLOOR - VIEW TO THE COURTYARD

GROUND FLOOR - CONTINUATION OF GREEN



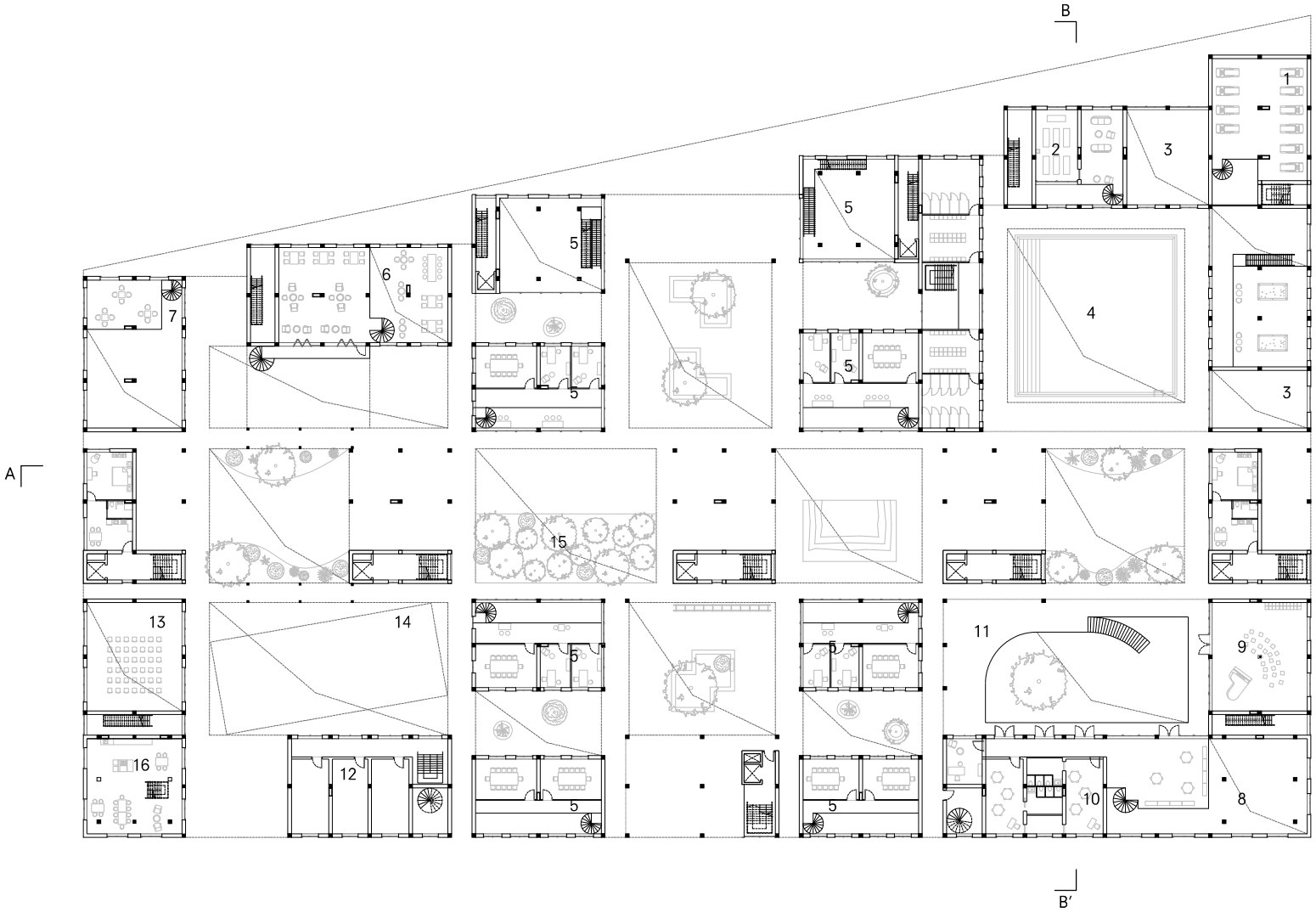
GROUND FLOOR - CONTINUATION OF GREEN

GROUND FLOOR - CIRCULATION



GROUND FLOOR - ENTRANCE TO THE CORE

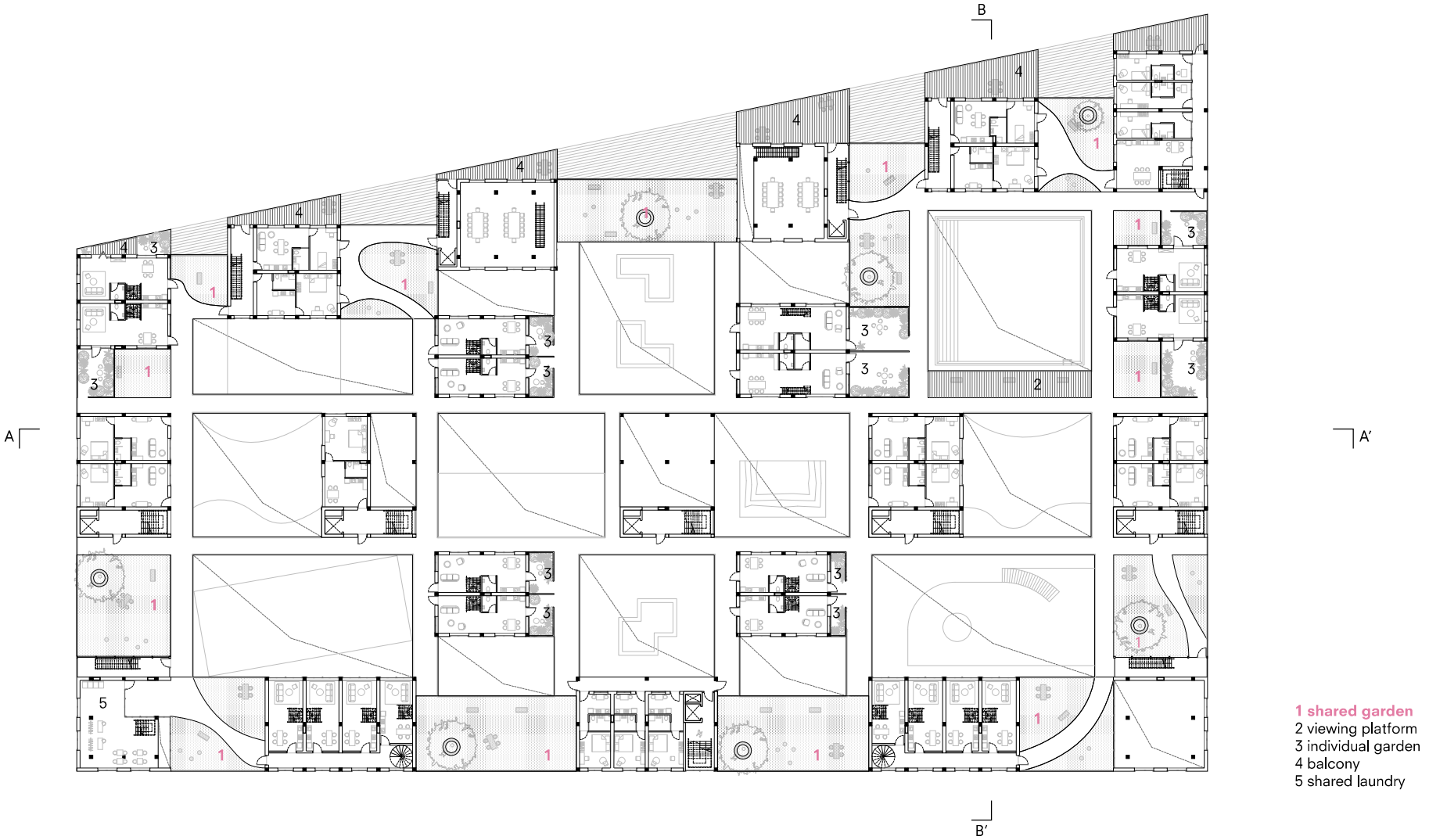
LEVEL 1



1 gym
2 yoga room
3 sports activity room
4 swimming pool
5 shared work space
6 cafe
7 cooking school
8 nursery entrance hall
9 bigger classroom
10 classrooms
11 outdoor gallery
12 community room
13 event space
14 outdoor event space
15 tiny forest
16 shared kitchen

0 1 5 10m

LEVEL 2 - PLATFORM

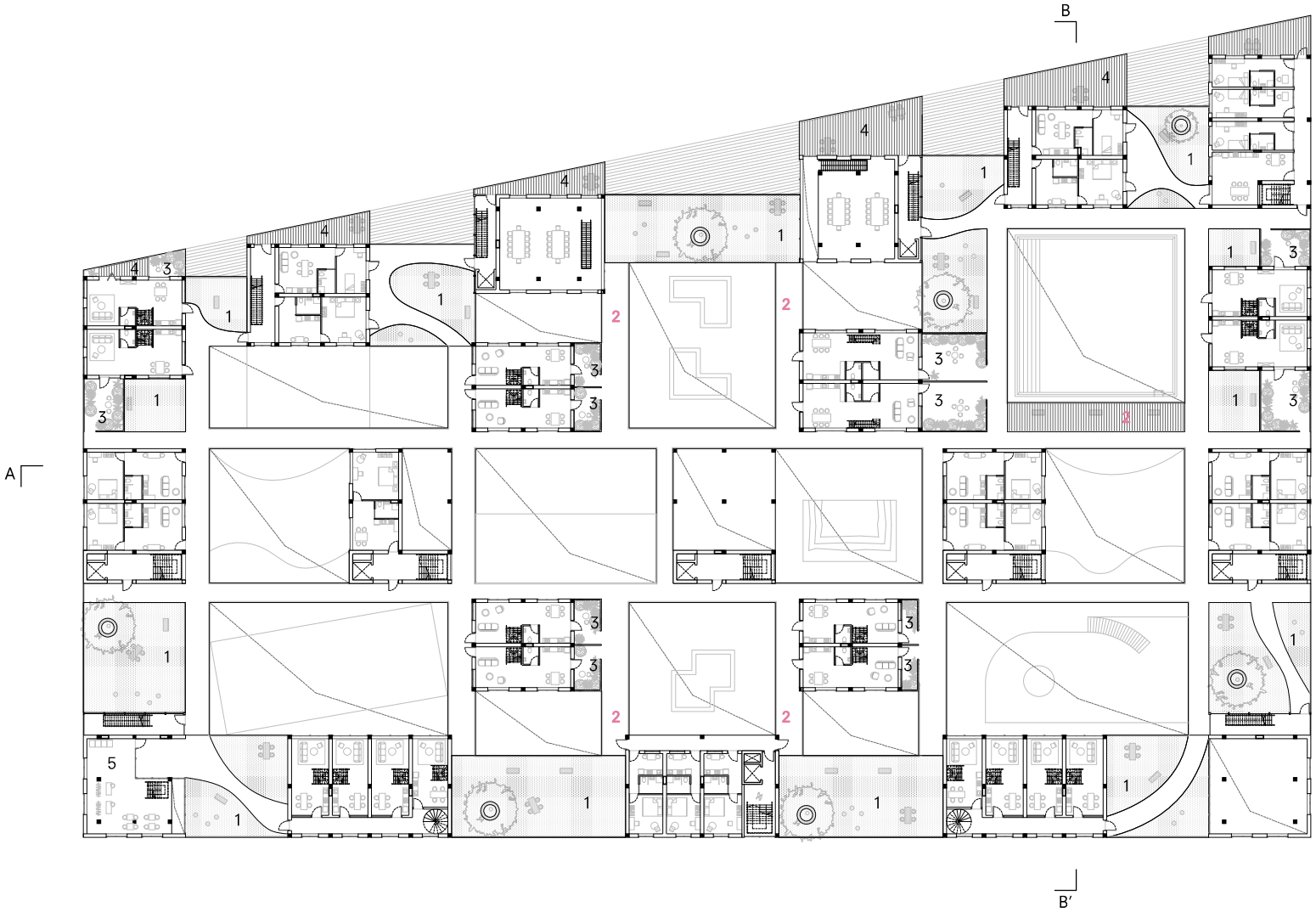


1 shared garden
2 viewing platform
3 individual garden
4 balcony
5 shared laundry

0 1 5 10m

LEVEL 2 - PERSPECTIVE TO THE PLATFORM

LEVEL 2 - PLATFORM

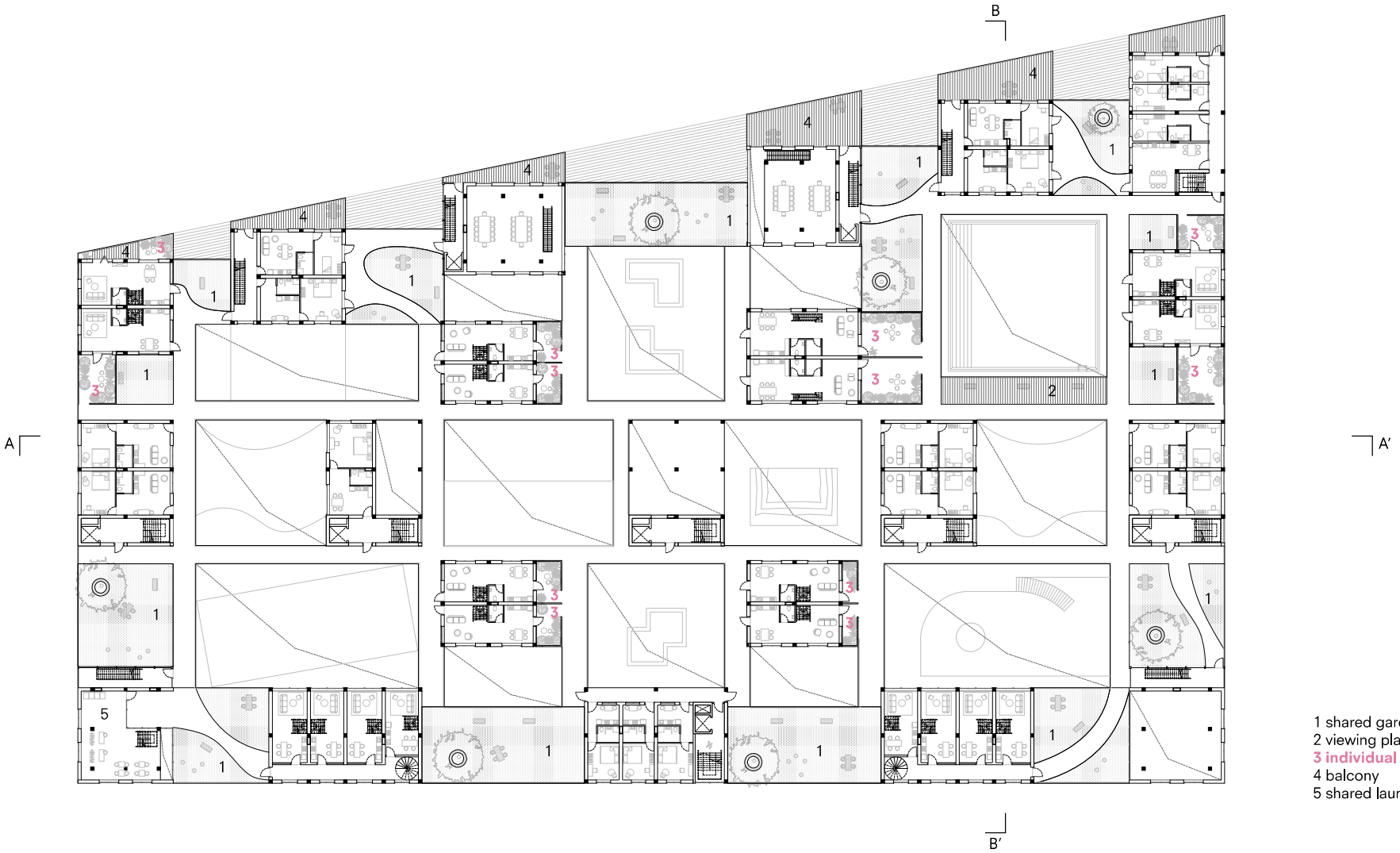


1 shared garden
2 viewing platform
3 individual garden
4 balcony
5 shared laundry

0 1 5 10m

LEVEL 2 - PERSPECTIVE FROM PLATFORM

LEVEL 2 - PLATFORM

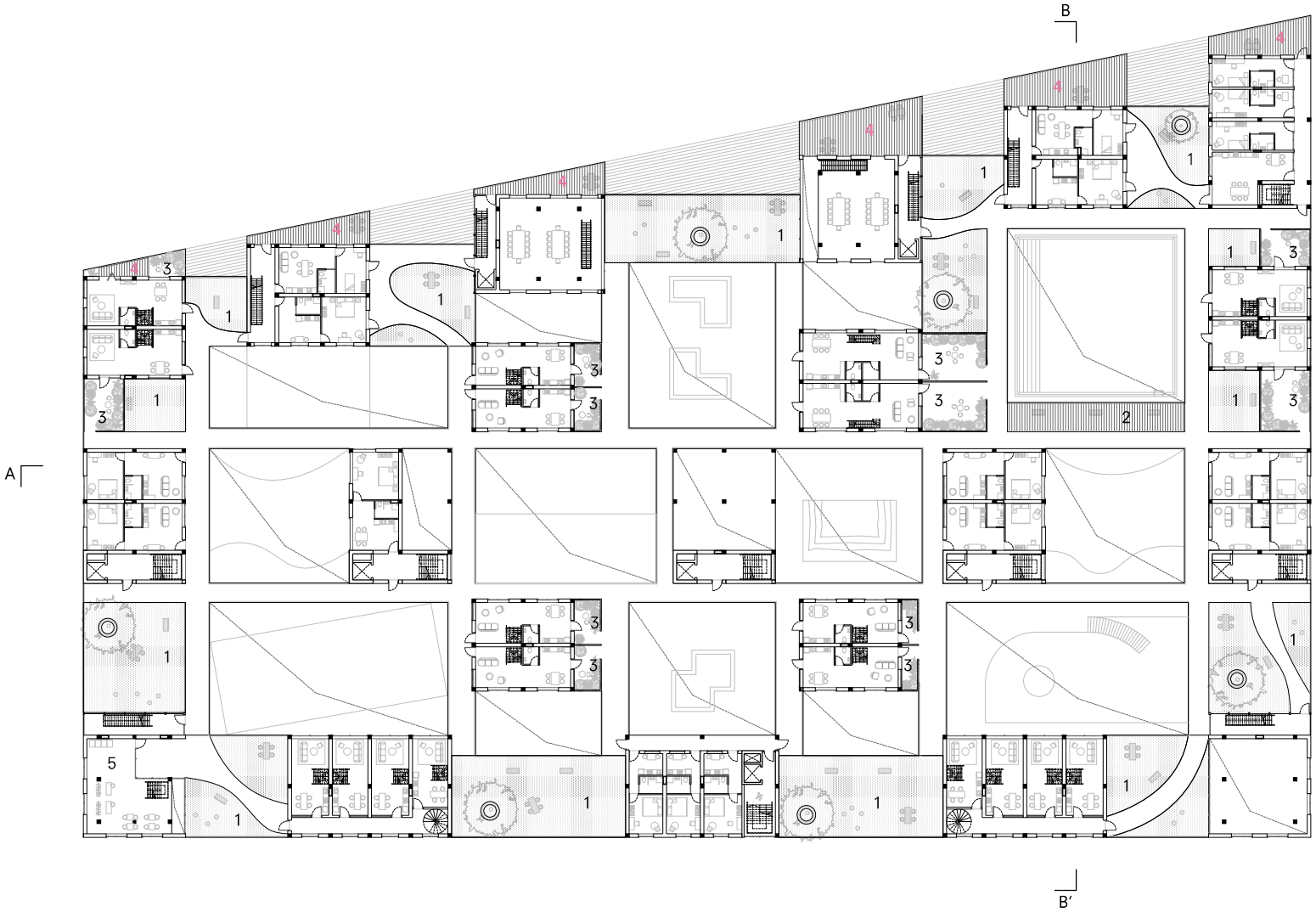


1 shared garden
2 viewing platform
3 individual garden
4 balcony
5 shared laundry

0 1 5 10m

LEVEL 2 - PERSPECTIVE TO THE GARDEN

LEVEL 2 - PLATFORM

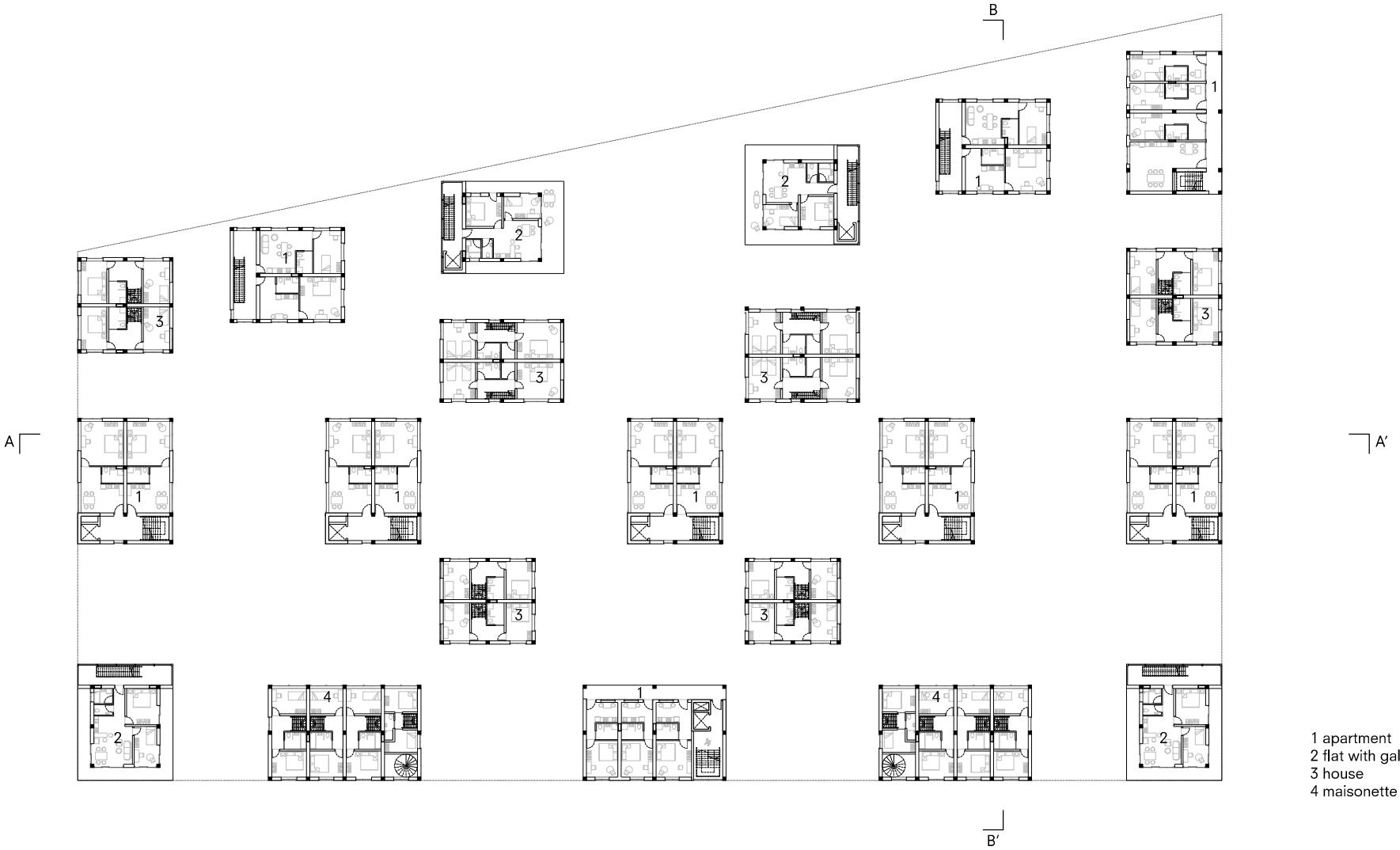


1 shared garden
2 viewing platform
3 individual garden
4 balcony
5 shared laundry

0 1 5 10m

LEVEL 2 - PERSPECTIVE TO THE BALCONY

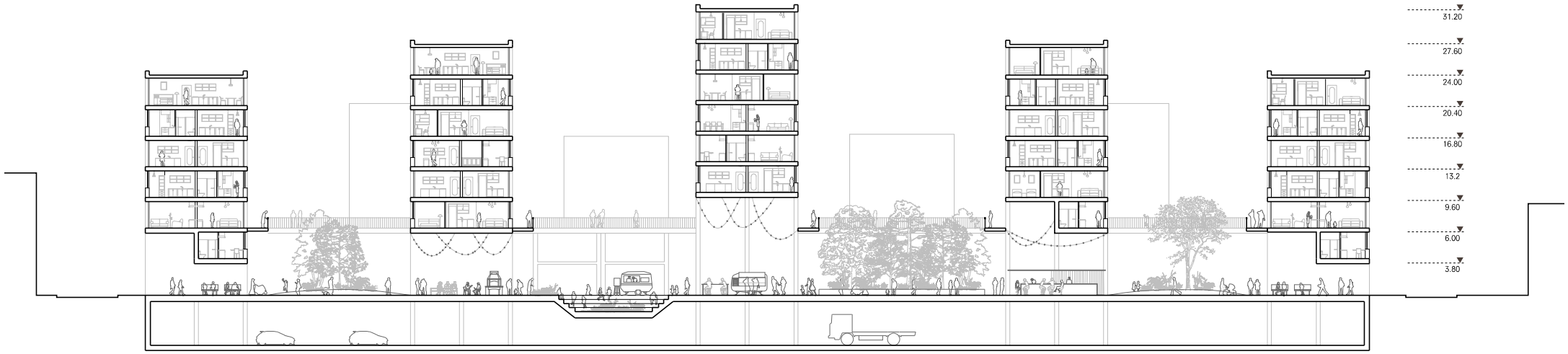
LEVEL 3 - HOUSING



1 apartment
2 flat with gallery
3 house
4 maisonette

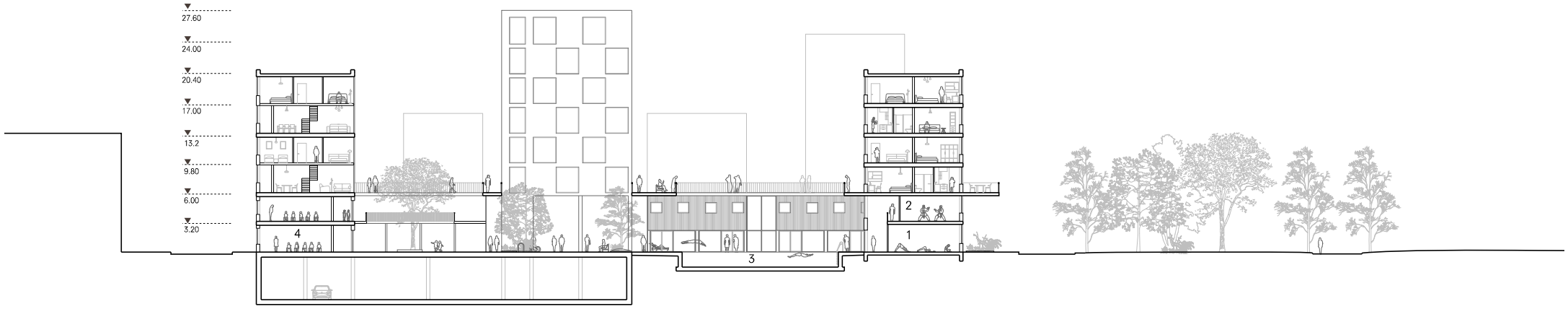
0 1 5 10m

SECTION AA'



0 1 5 10m

SECTION BB’



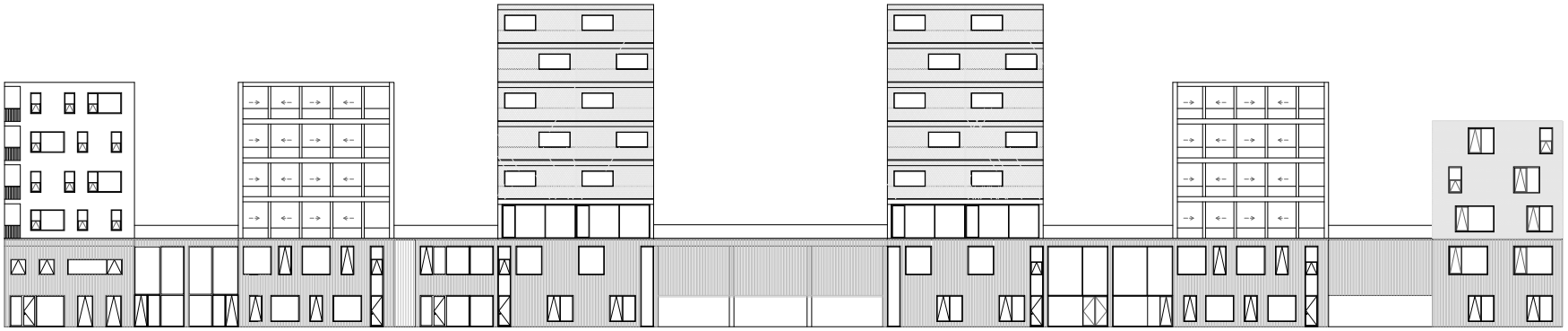
1 yoga room
2 activity room
3 swimming pool
4 classroom

0 1 5 10m

MATERIALIZATION

ELEVATION

Elevation towards residential area

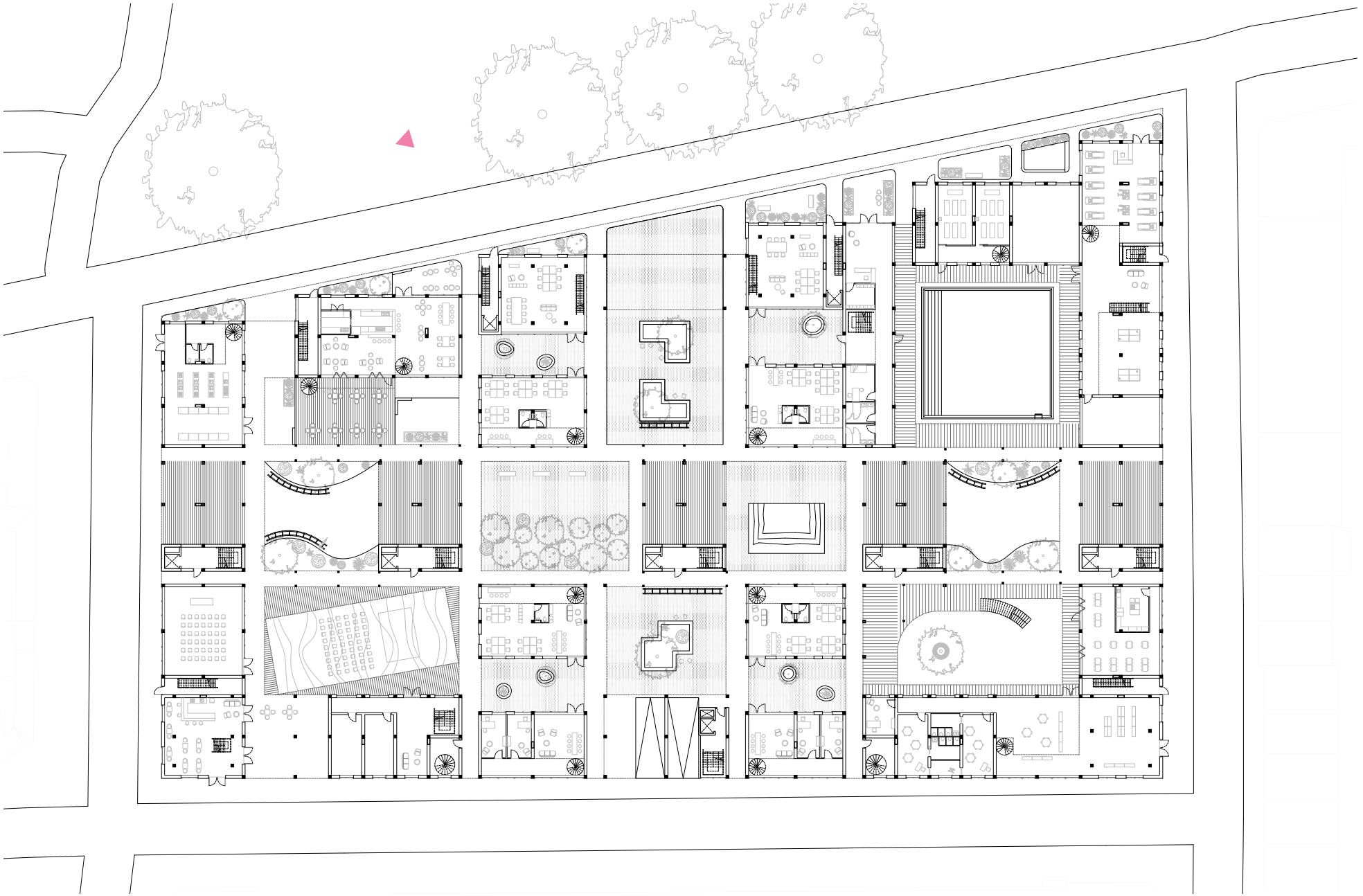


Elevation towards park

0 1 5 10m

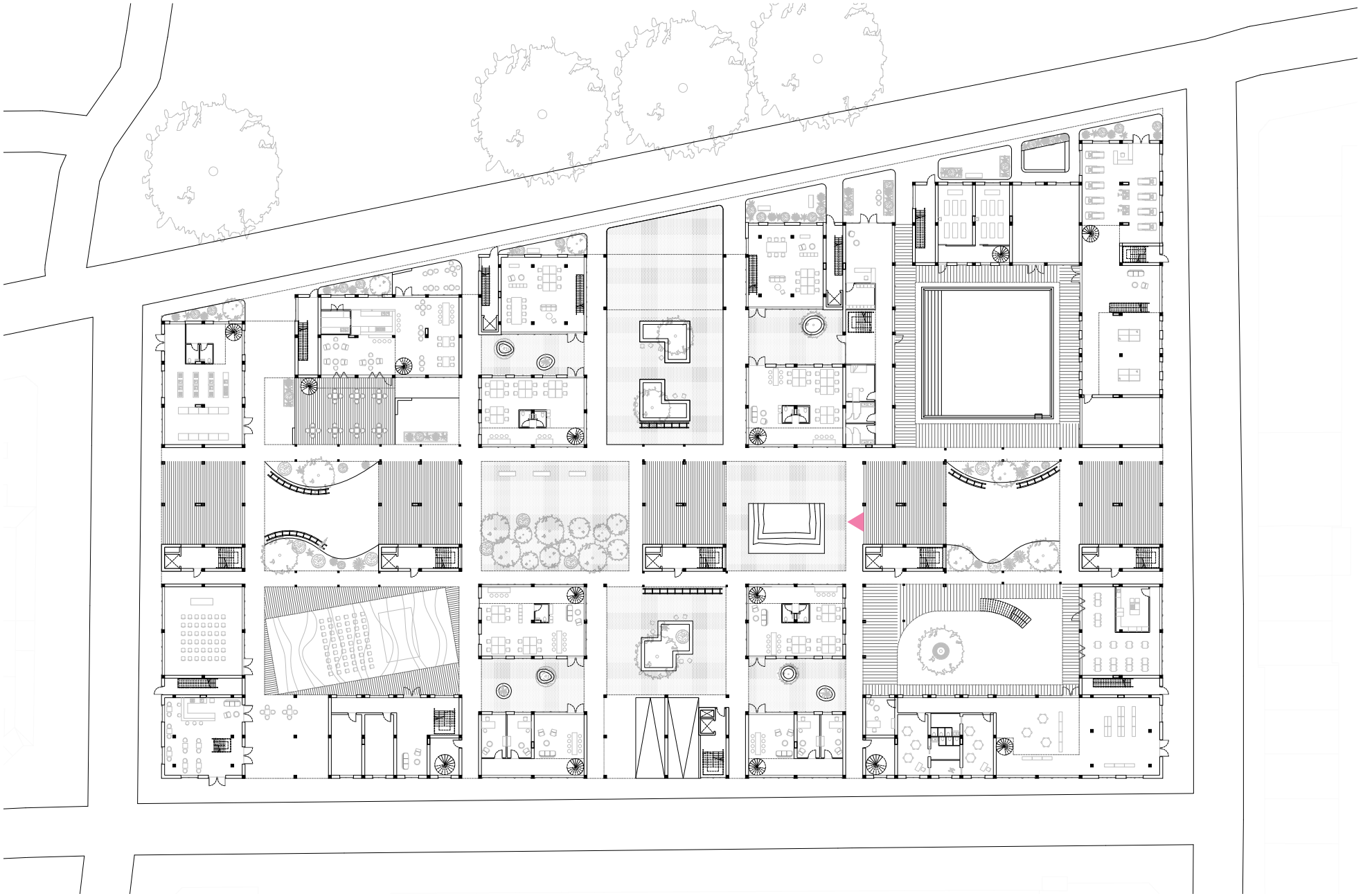
AXONOMETRIC VIEW

PERSPECTIVE: VIEW TO THE CENTRAL SPINE



PERSPECTIVE: VIEW TO THE EAST FACADE

PERSPECTIVE: VIEW TO THE CENTRAL SPINE



PERSPECTIVE: VIEW TO THE CENTRAL SPINE

FLEXIBILITY & DENSITY

TYPOLOGY FOR FLEXIBILITY

A. TOWERS

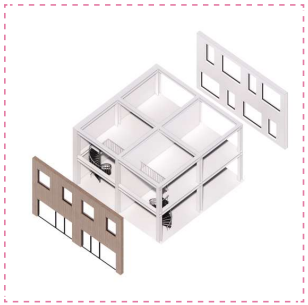
A1 apartment

A2 flat with gallery

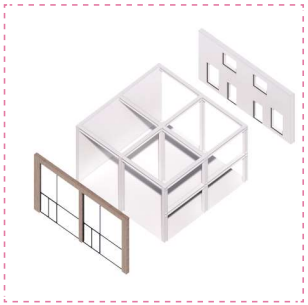
A3 maisonette

A4 house

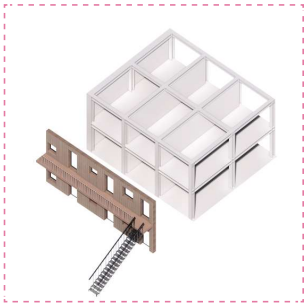
B. BASE



B1



B2

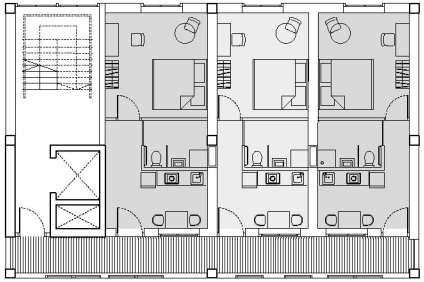


B3

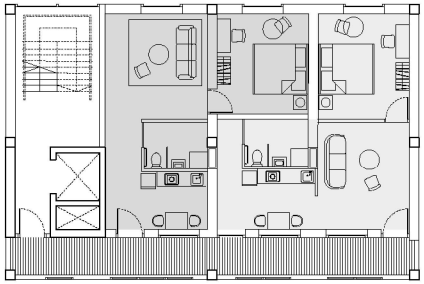
C. SPINE

C1 apartment + maisonette

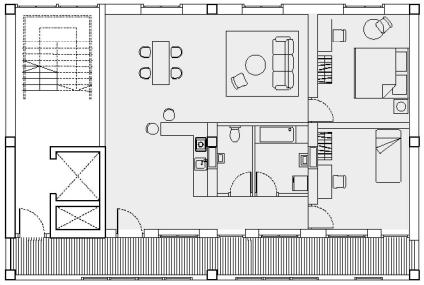
APARTMENT



densification: 3 apartments



densification: 2 apartments

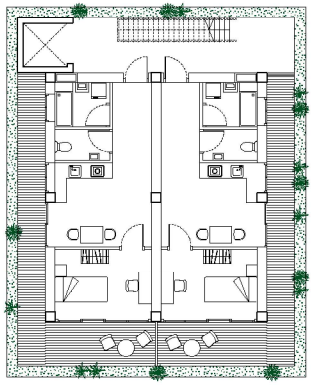


dilution: 1 apartment

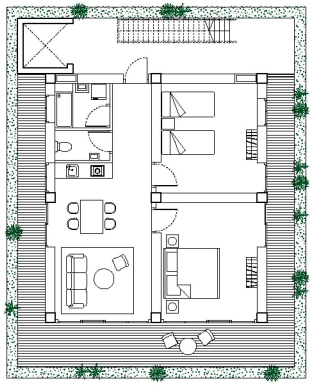
A. TOWERS

A1 Apartment
maximum unit number (densification):
30
minimum unit number (dilution):
10

FLAT WITH GALLERY



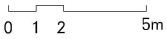
densification: 2 flats



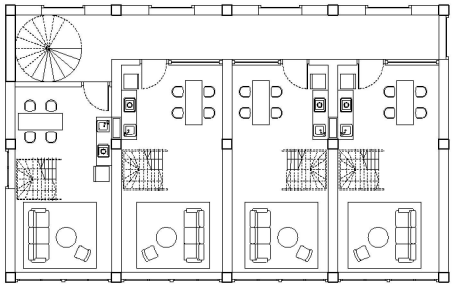
dilution: 1 flat

A. TOWERS

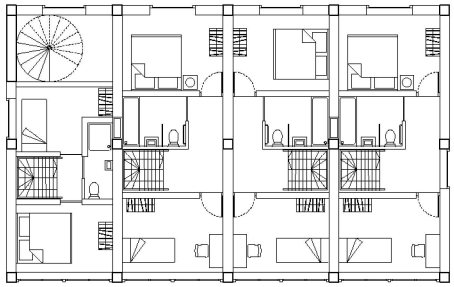
A2 Flat with gallery
maximum unit number (densification):
36
minimum unit number (dilution):
18



MAISONETTE

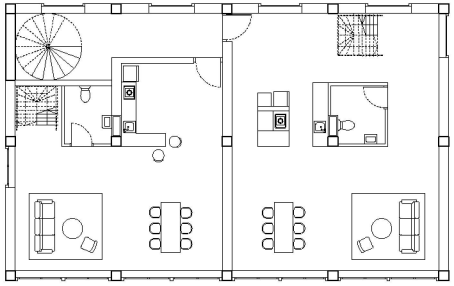


level 1

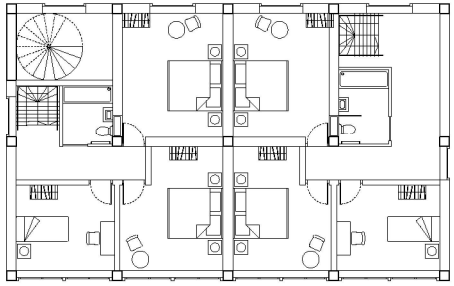


level 2

densification: 4 maisonettes



level 1



level 2

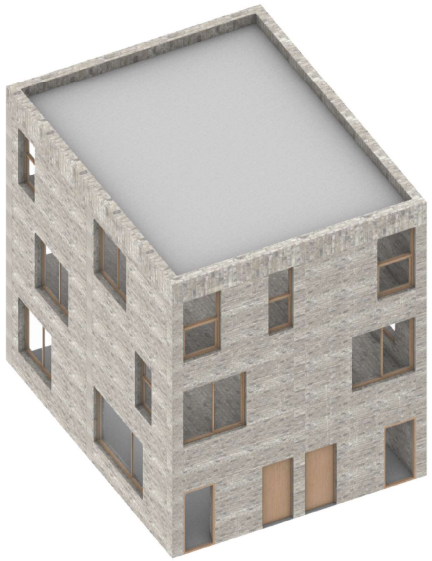
dilution: 2 larger maisonettes

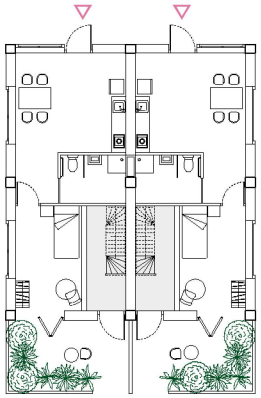
A. TOWERS

A3 Maisonette
maximum unit number (densification):
28
minimum unit number (dilution):
8

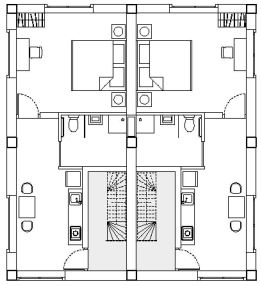
0 1 2 5m

HOUSE



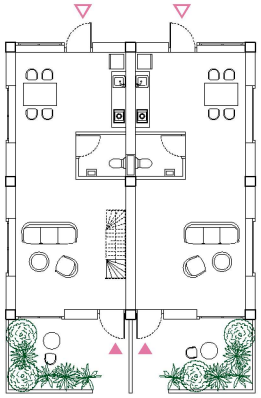


level 1

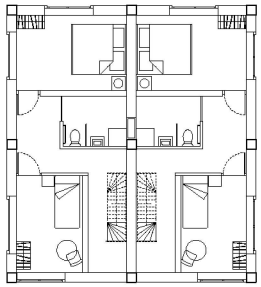


level 2

densification: 6 apartments in one block



level 1



level 2

dilution: 2 houses in block

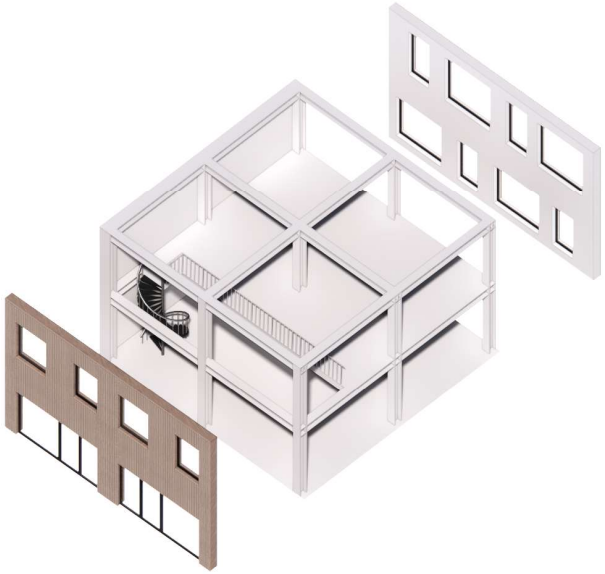
A. TOWERS

A4 House
maximum unit number (densification):
18
minimum unit number (dilution):
6

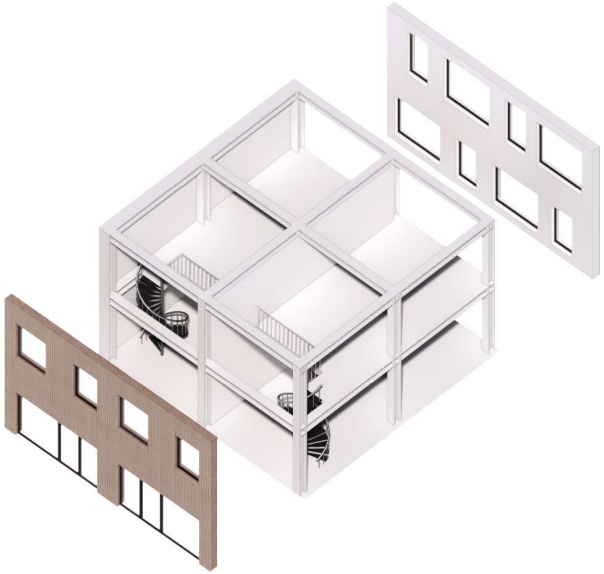
0 1 2 5m

▲ shared entrance
△ individual entrance

B1 TYPOLOGY UNDER THE PLATFORM



dilution: public programs



densification: 2 maisonette

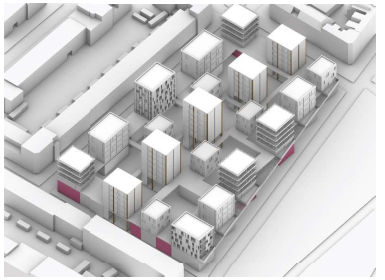
B. BASE

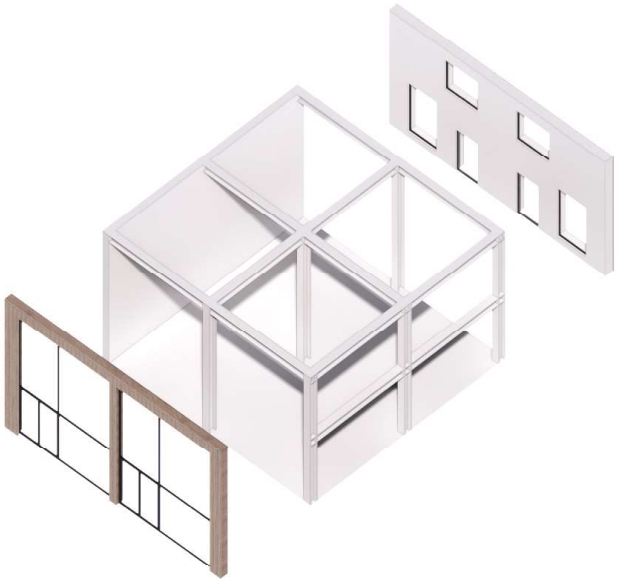
B1
maximum unit number (densification):
14
minimum unit number (dilution):
0

B2 TYPOLOGY UNDER THE PLATFORM

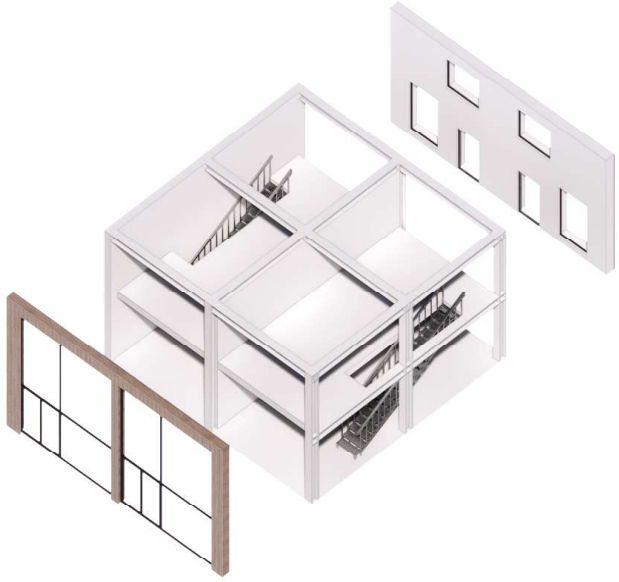
B. BASE

B2
maximum unit number (densification):
21
minimum unit number (dilution):
0





dilution: public programs



densification: 2 maisonette

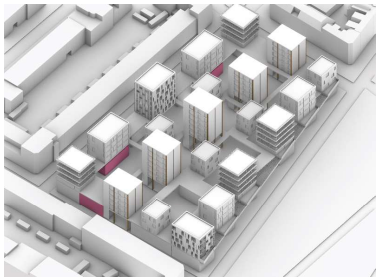
B3 TYPOLOGY UNDER THE PLATFORM

dilution: public programs

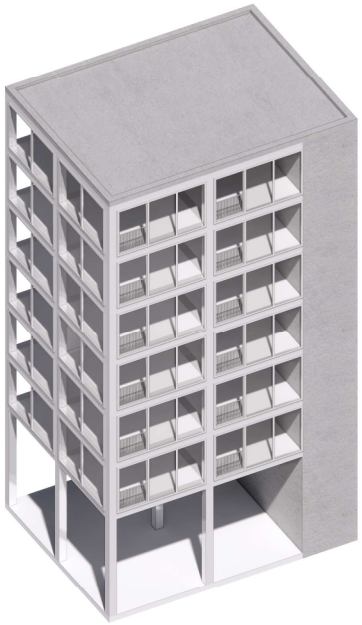
densification: 6 apartments

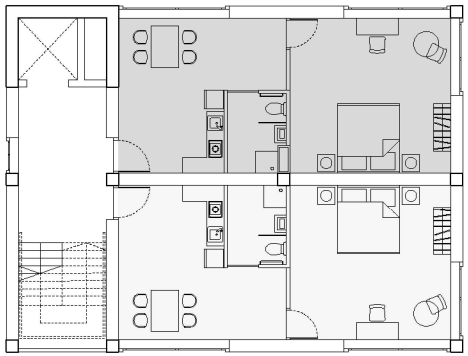
B. BASE

B3
maximum unit number (densification):
24
minimum unit number (dilution):
0

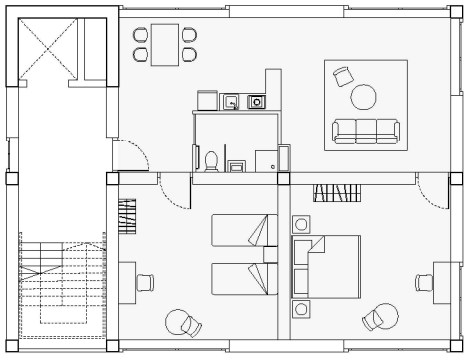


C1 APARTMENT + MAISONETTE





densification: 2 units



dilution: one unit

C. SPINE

C1 apartment + maisonette
maximum unit number (densification):
66
minimum unit number (dilution):
29

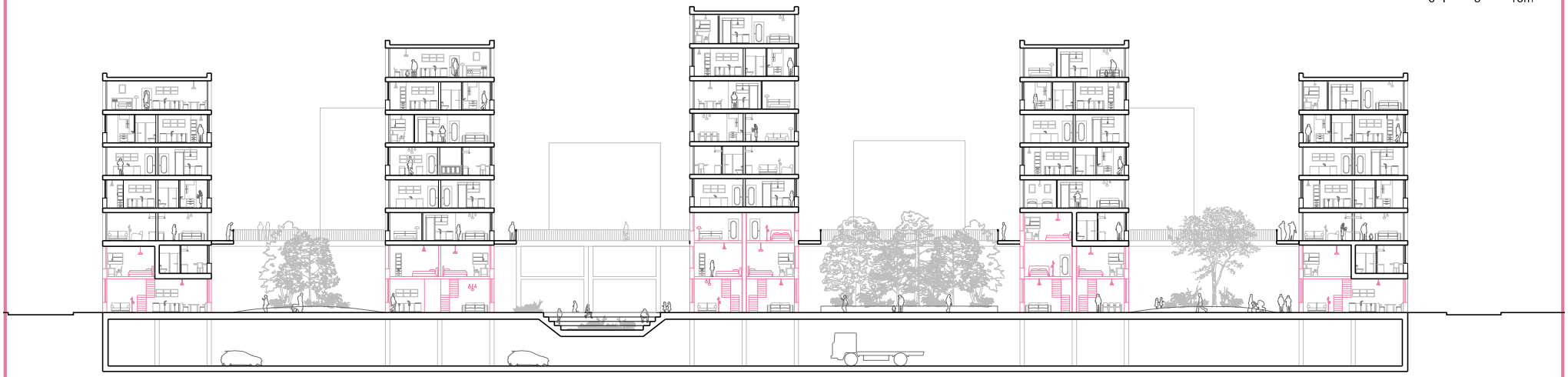
0 1 2 5m

C1 APARTMENT + MAISONETTE

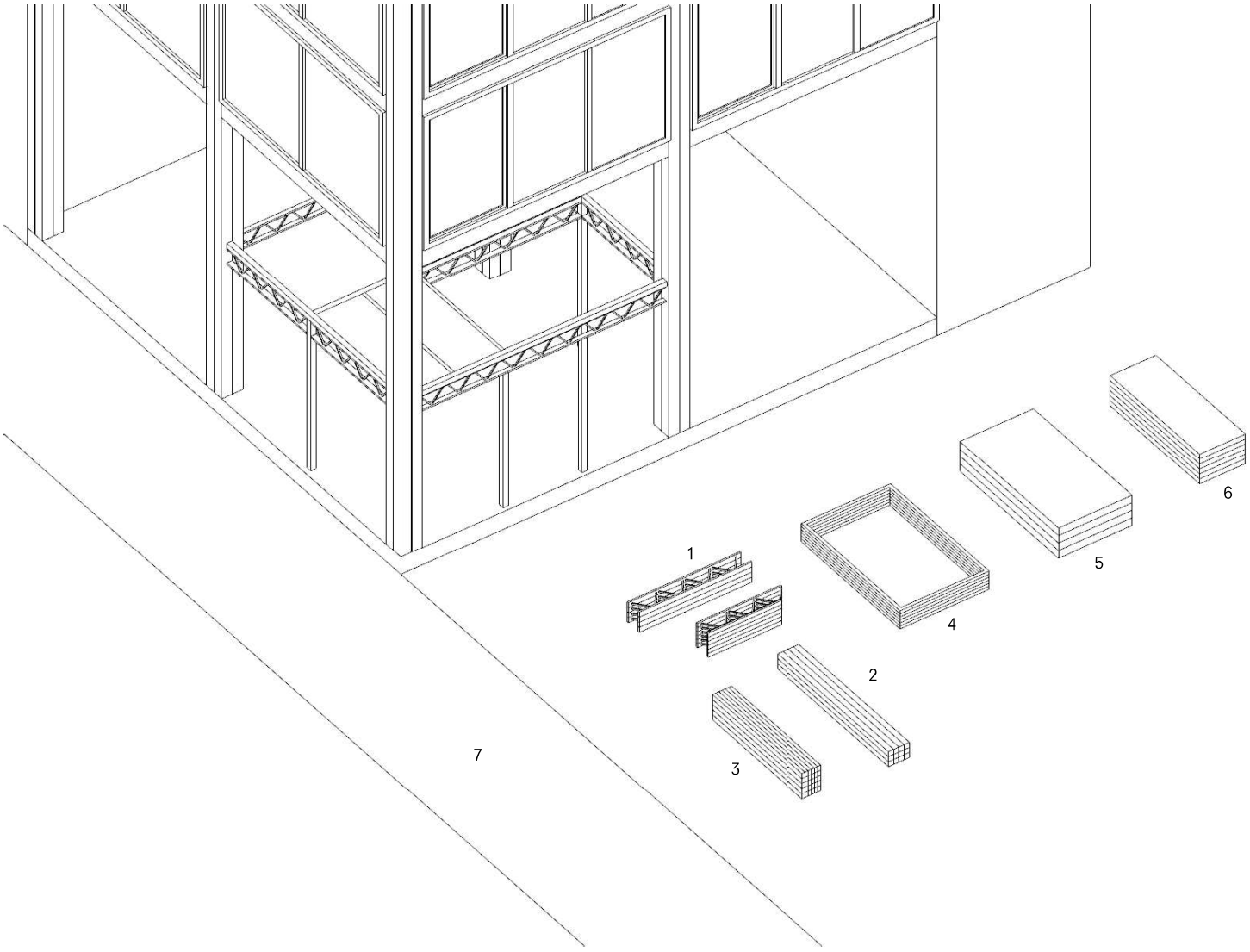
C. SPINE

C1 apartment + maisonette
maximum unit number (densification):
66
minimum unit number (dilution):
29

0 1 5 10m



DENSIFICATION PROCESS

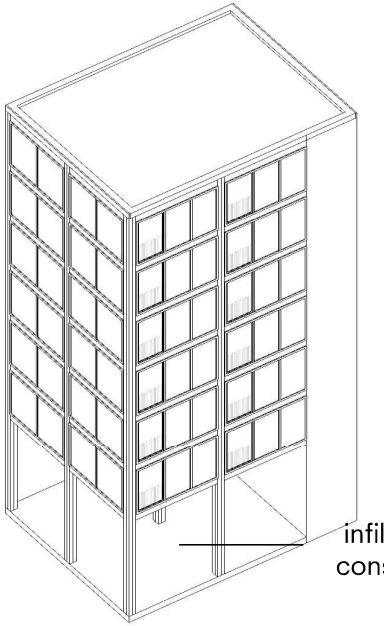


C. SPINE

C1 apartment + maisonette
maximum unit number (densification):
66
minimum unit number (dilution):
29

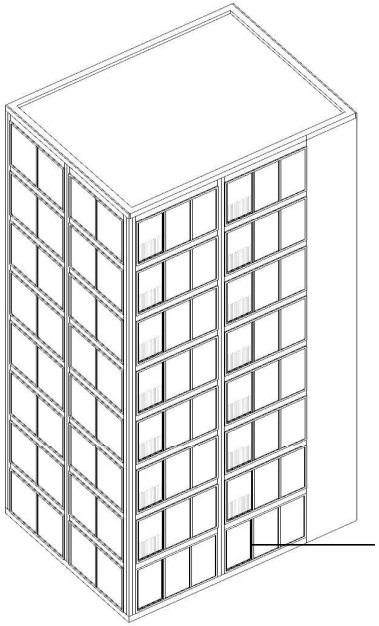
1 lattice truss
2 columns
3 angles
4 window frame
5 wall panel
6 floor panel
7 path of 3m wide

C1 APARTMENT + MAISONETTE



infill with prefab steel
construction living unit

after densification



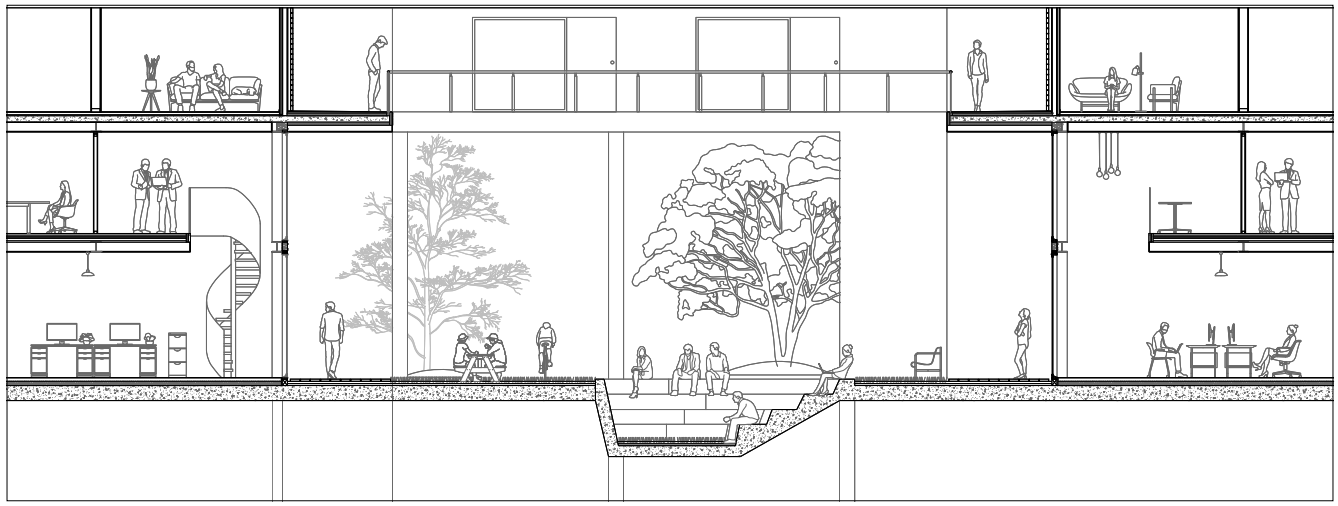
same facade pattern

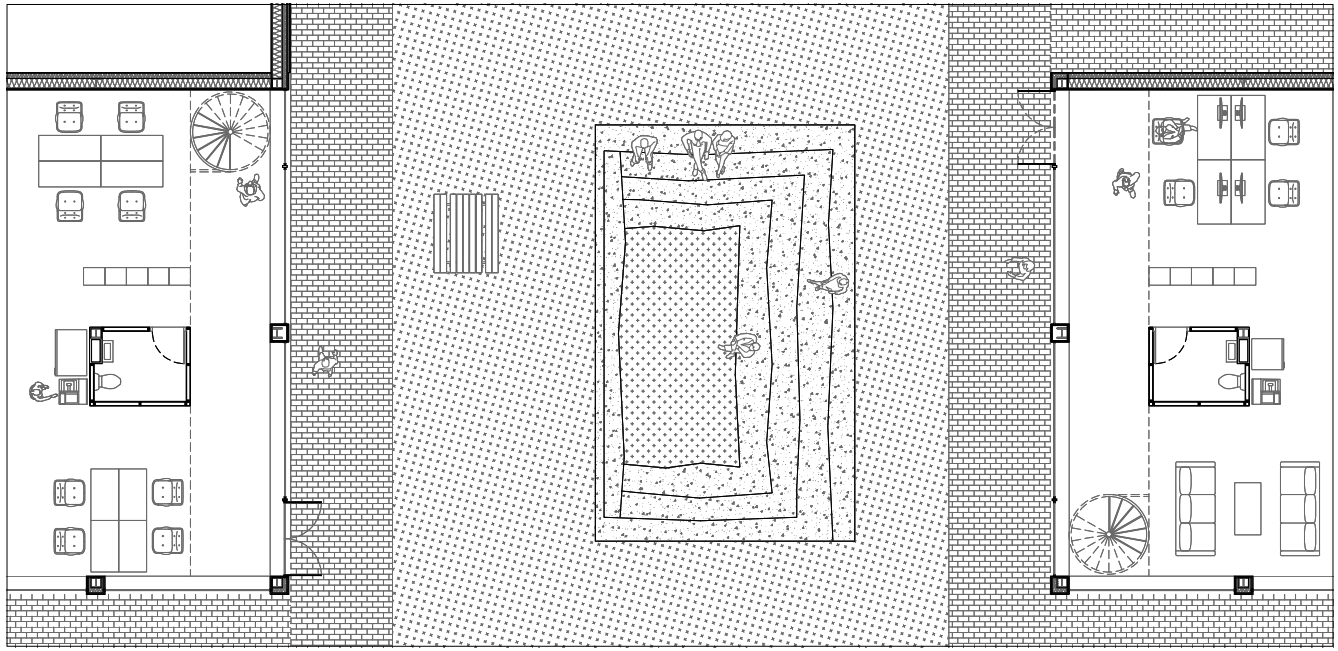
C. SPINE

C1 apartment + maisonette
maximum unit number (densification):
66
minimum unit number (dilution):
29

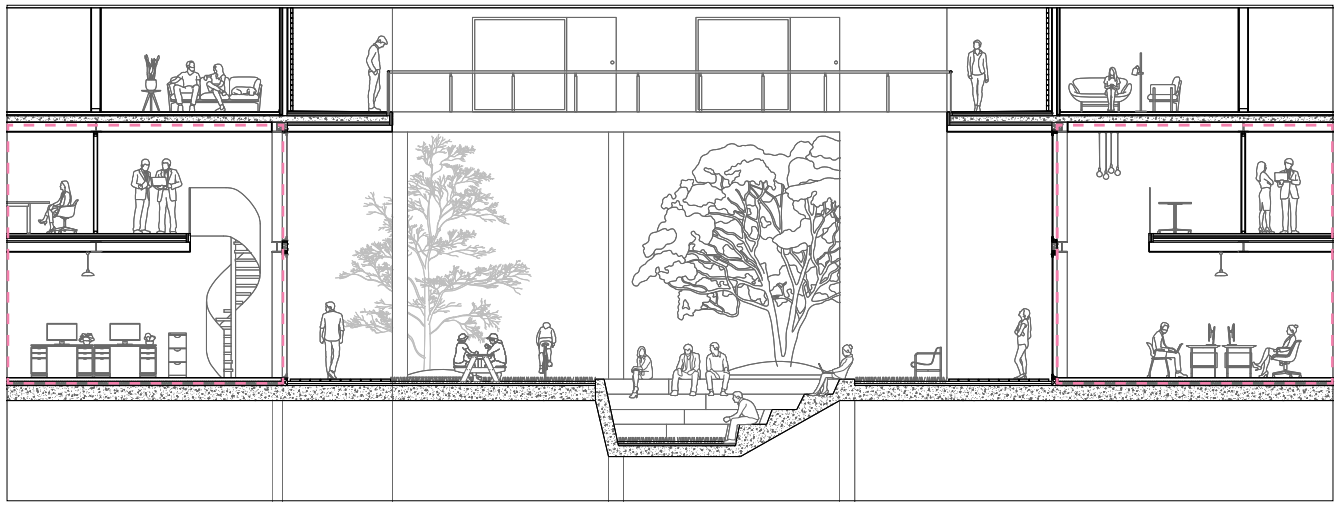
DETAILING

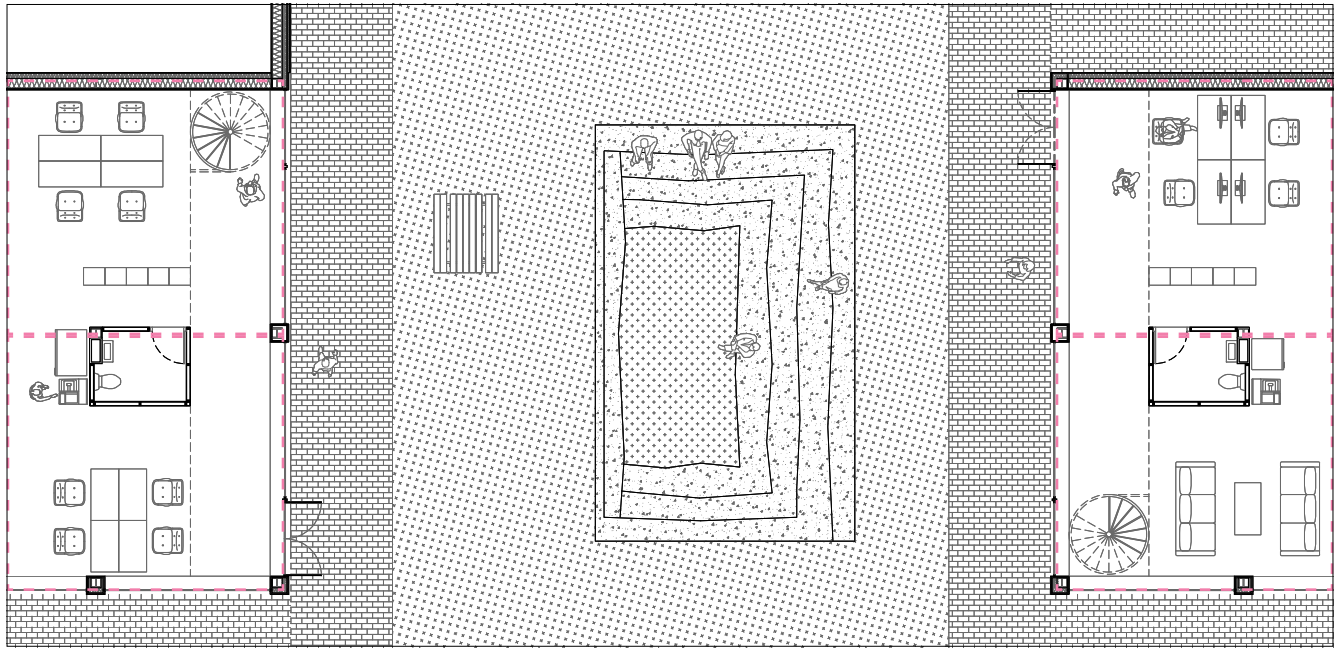
1:50 COURTYARD DETAIL





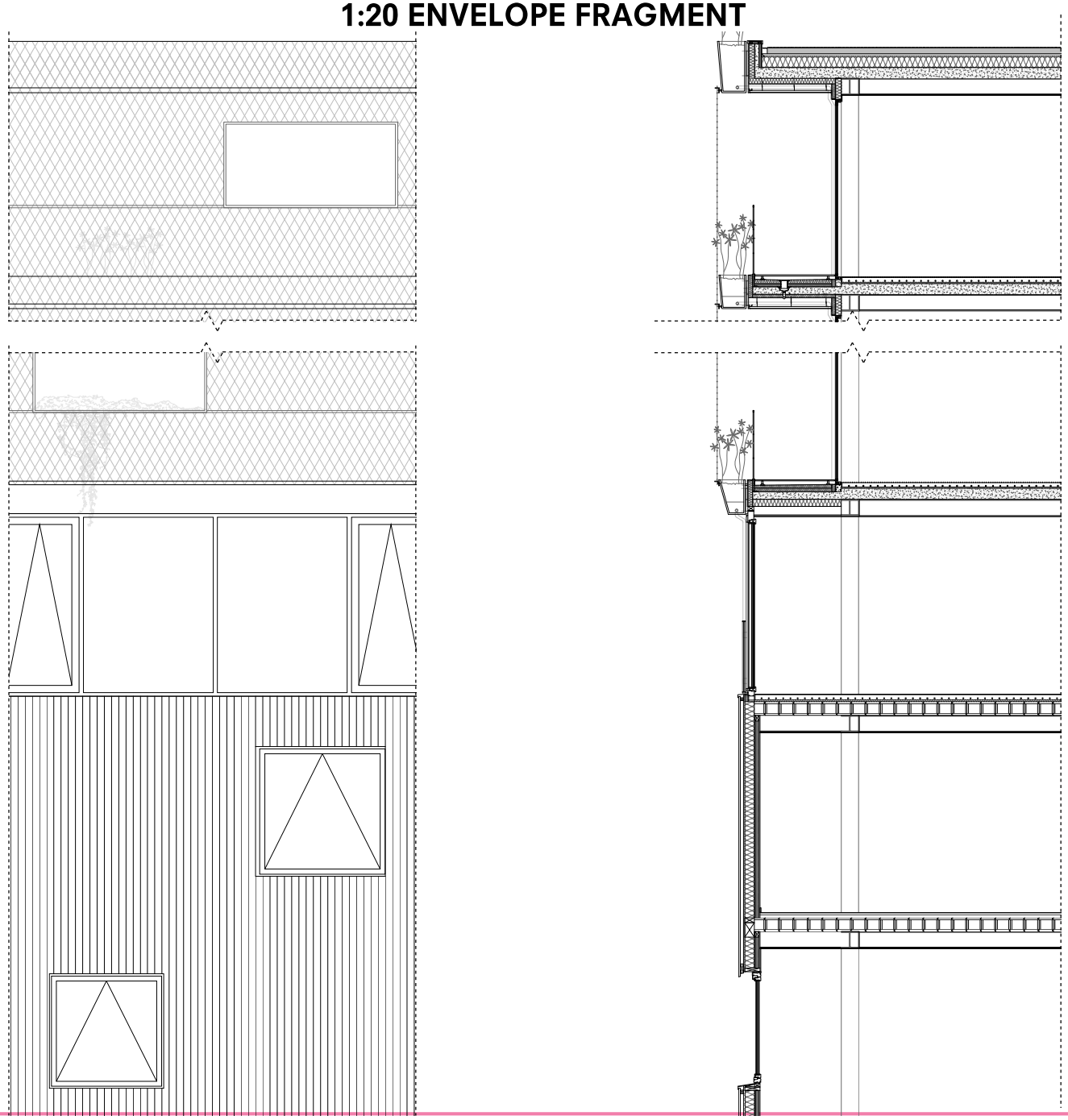
1:50 COURTYARD DETAIL





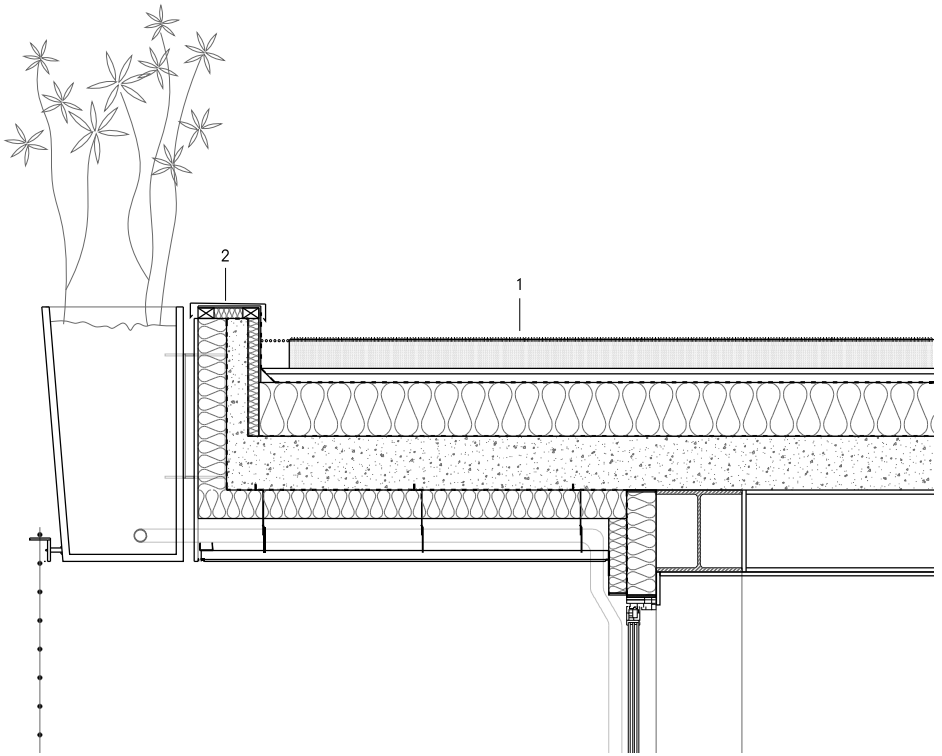
GREEN FACADE

1:20 ENVELOPE FRAGMENT



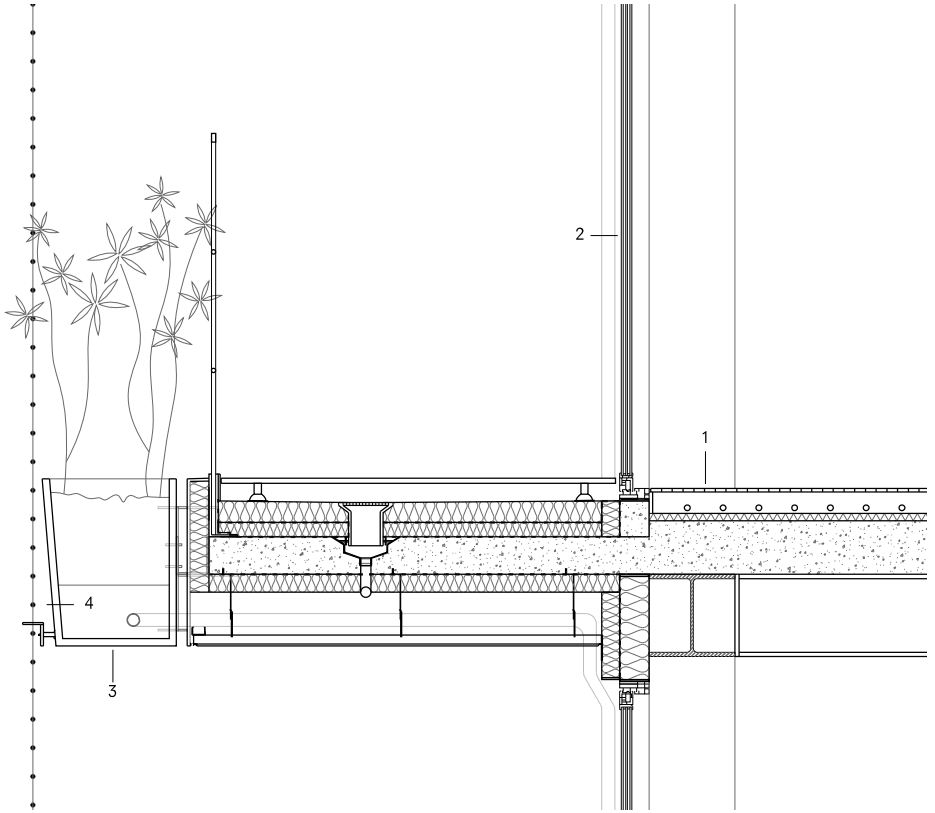
1:5 DETAIL

1. Roof construction
-100 mm extensive green roof
-15 mm filter fleece
-25 mm drainage layer
-sealant layer
-rigid foam thermal insulation
-vapour barrier
-concrete ceiling slab
2. steel parapet covering

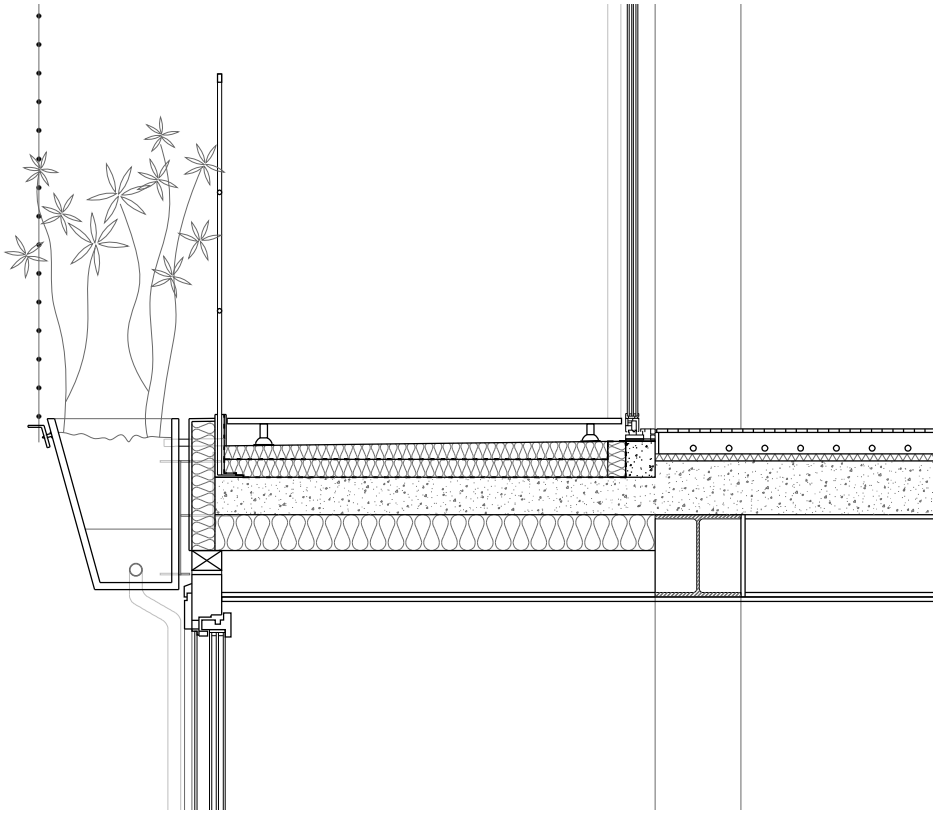


1:5 DETAIL

1. Balcony construction
-heart pine floor boards
-plastic raised floor support
-XPS thermal insulation
-sealant layer
-PIR thermal insulation
-vapour barrier
-concrete ceiling slab
2. Balcony sliding door: tripple glazing
3. Aluminium sheed metal plant box
4. Dainage layer

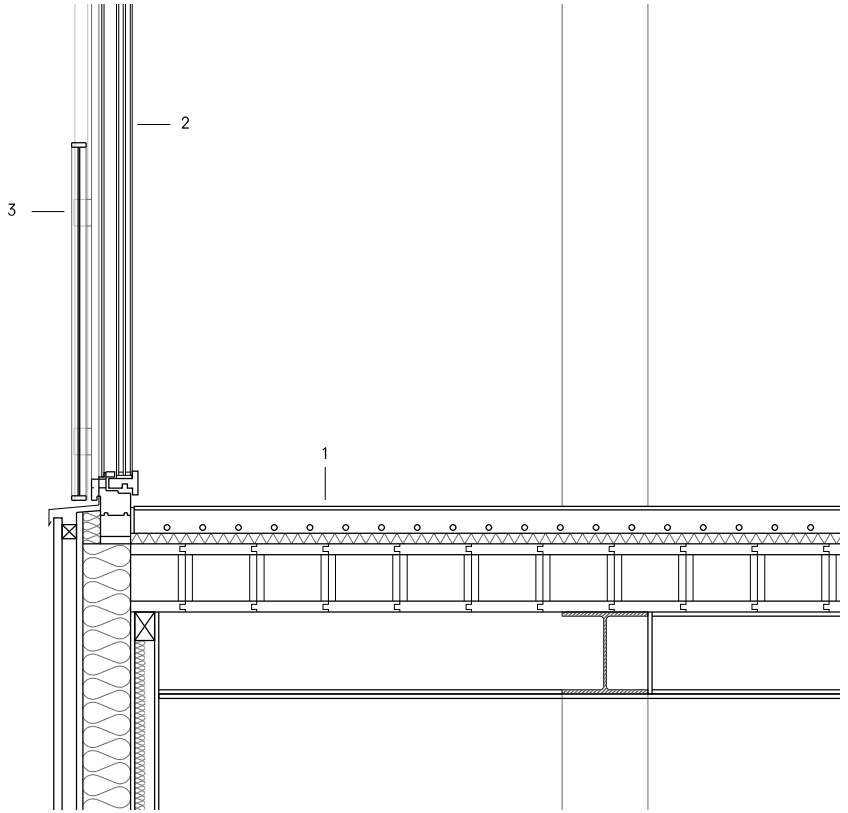


1:5 DETAIL



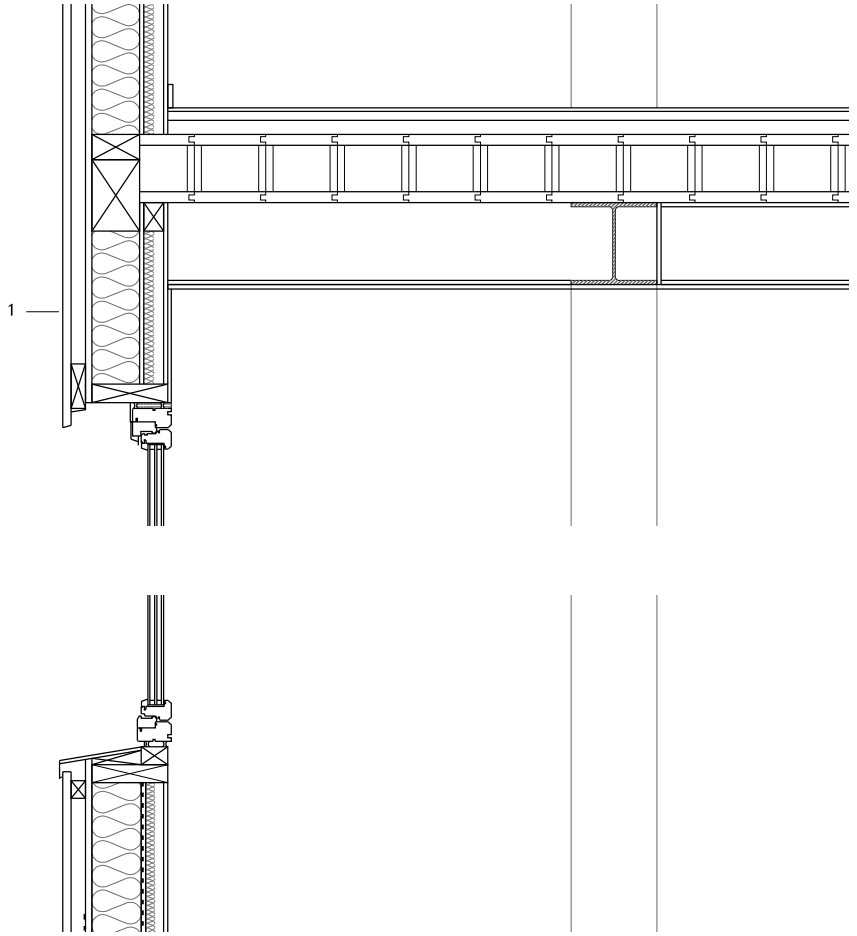
1:5 DETAIL

1. Floor construction
-floor covering parquet flooring
-dry top floor with underfloor heating
-impact sound insulation
-timber box element floor
-steel beams
2. Balcony door: triple glazing
3. Balcony balustrade



1:5 DETAIL

1. Wall construction
-wood cladding panel
-battens, ventilated cavity
-rock-wool insulation
-soft-board (airtight membrane)
-thermal insulation, frame
-vapour check
-sound insulation
-battens (space for services)
-wood-cement particleboard



CLIMATE

NATURAL COOLING EFFECT

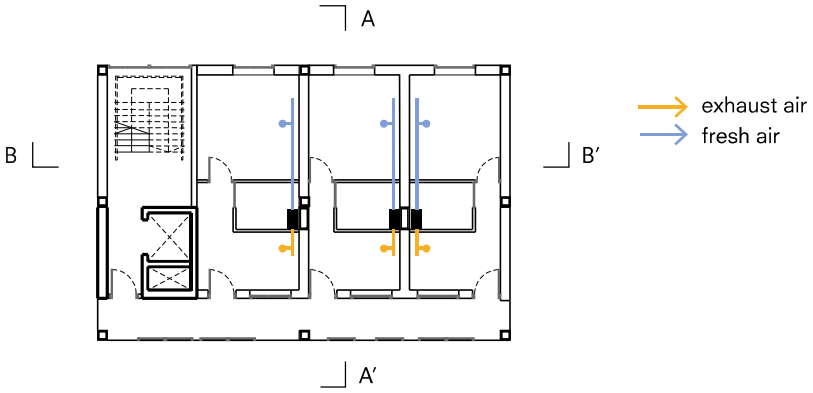
Green platform
/less heat absorbed
/lower the surface temperature

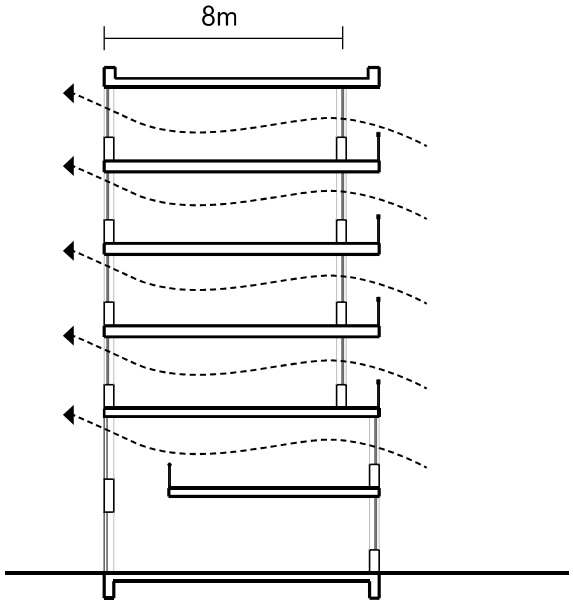
Green walls and green roof
/reduce heat transmission into buildings

Small green spaces
/reduce air temperature
/reduce surface temperature via shade provision

Increased albedo
/more heat reflected
/more cooling from evaporation

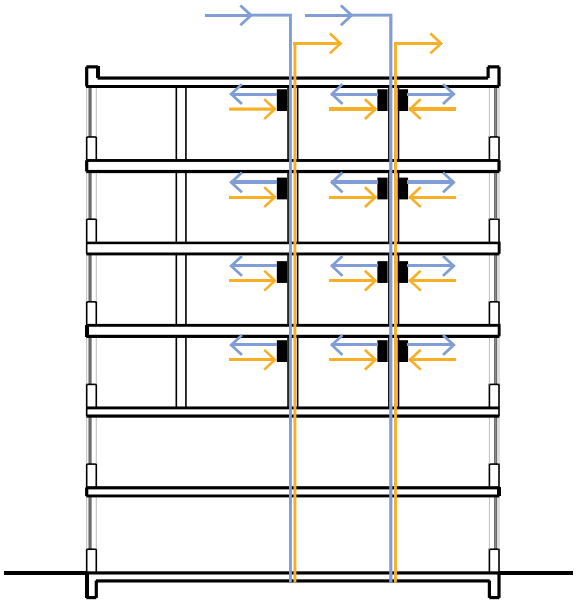
VENTILATION





natural ventilation

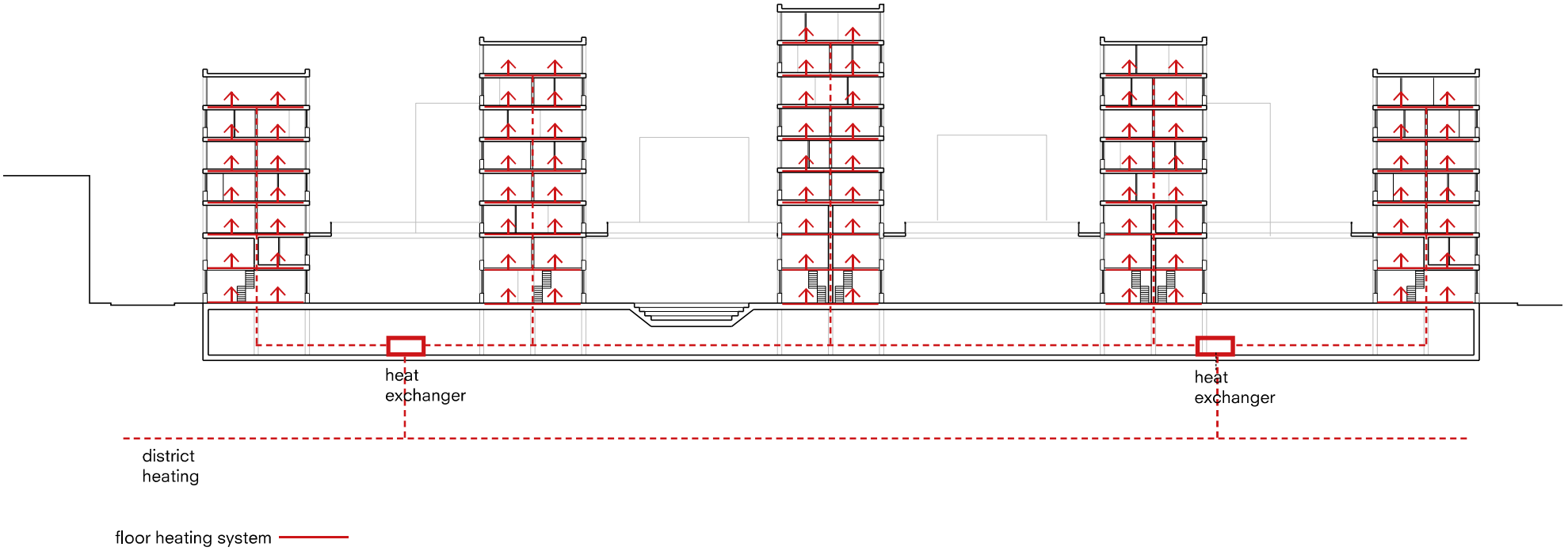
section AA'



mechanical ventilation - decentralized AHU

section BB'

DISTRICT HEATING



REFLECTION


THANK YOU