



POLITECNICO DI MILANO
Scuola di Architettura, Urbanistica e Ingegneria delle costruzioni
Corso di Laurea Magistrale in Ingegneria Edile - Architettura
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**ENVIRONMENTAL PERFORMANCE
AND SOCIAL INCLUSION
IN ROCINHA FAVELA: AREA 1**
A PROJECT BASED ON IMM METHODOLOGY

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TERRITORIAL FRAMEWORK

Brazil is one of the richest countries on Earth, in culture, history, nature and resources; and the city of Rio de Janeiro is its window to the rest of the world. Rocinha, and favelas in general, are the dark shadow cast by the shining lights of Rio, places mostly unknown not just to the world at large, but by the Brazilian themselves, who have, and continue to, ignore these urban realities or think of them as just a problem to be solved.

While no urban intervention and architectural design can exist in a vacuum, an urban environment so far removed from what the First World countries consider "normal" requires an even deeper knowledge of the historical, geographical, economical and social conditions that saw its birth and growth.

This chapter aims to collect and display all the necessary knowledge that helped shape the project, from expanses of Brazil, down to the alleys of Rocinha. It provides the reader with a comprehensive, if abridged, picture to better understand the who, the where, the when, the what and the whys of this project.

INTRODUCTION

INTERVENTION FRAMEWORK

Rio de Janeiro

The metropolitan area of Rio de Janeiro occupies an area of 1182,3 km² and it can be divided in four main zones: the Central Zone, the South Zone, the North Zone and the West Zones. Each zone can be subdivided in other neighbourhoods, based on their peculiarities.



Rocinha

The "little farm", is a favela located in the South Zone of Rio de Janeiro. The favela occupies a surface of 1,44 km², where it seems that live from 70.000 (official estimates) to 200.000 people (unofficial estimates), reaching a high density between 48.611 to 138.888 inhab./km.



Intervention area

The site project is located in the western part of the favela. It is a steep slope area, which peaks up to 90%. The main connections with the city center and the surrounding environment are Estrada da Gavea, at the base of the area and Rua Dioneia, at the top of it. Important pre-existences located at in the lower part of the site are the first aid unit (1), the school "Ciep Bento Rubiao" (2) and a building used for the storage of gas cylinders "Waldemart" (3).



Project site



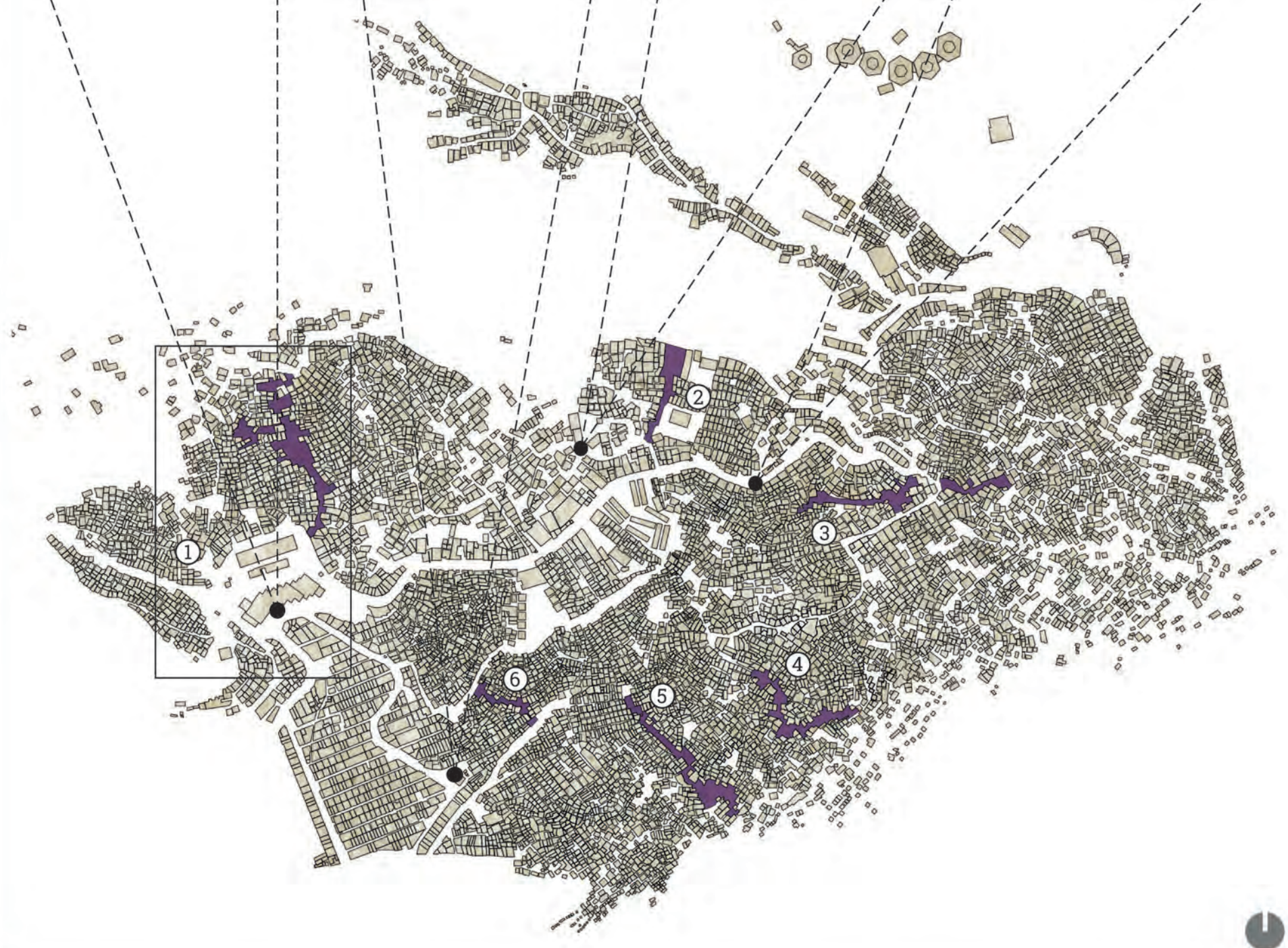
Largo do Boiadeiro



Il sorriso dei miei bimbi



Estrada da Gavéa





IMM METHODOLOGY

IMM is the acronym of Integrated Modification Methodology, an innovative design methodology, developed by IMMdesignlab, based on a specific process with the main goal of improving the CAS' (complex adaptive systems) energy performance, through the modification of its constituents and the optimization of the architecture of their ligands. Its approach is fundamentally Holistic, Multi-Layer, Multi-scale.

This methodology considers the city as a dynamic CAS comprised of the superimposition of an enormous number of interrelated components, categorized in different Layers or "Subsystems", (Themselves CAS) which through their inner arrangement and the architecture of their ligands provide a certain physical and provisional arrangement of the CAS.

The IMM investigates the relationships between urban morphology and energy consumption by focusing mostly on the 'Subsystems' characterized by physical characters and arrangements. The main object of this design process is to address a more sustainable and better performing urban arrangement, aligned to the UN Sustainable Development Goals 2030.



IMM HORIZONTAL ANALYSIS

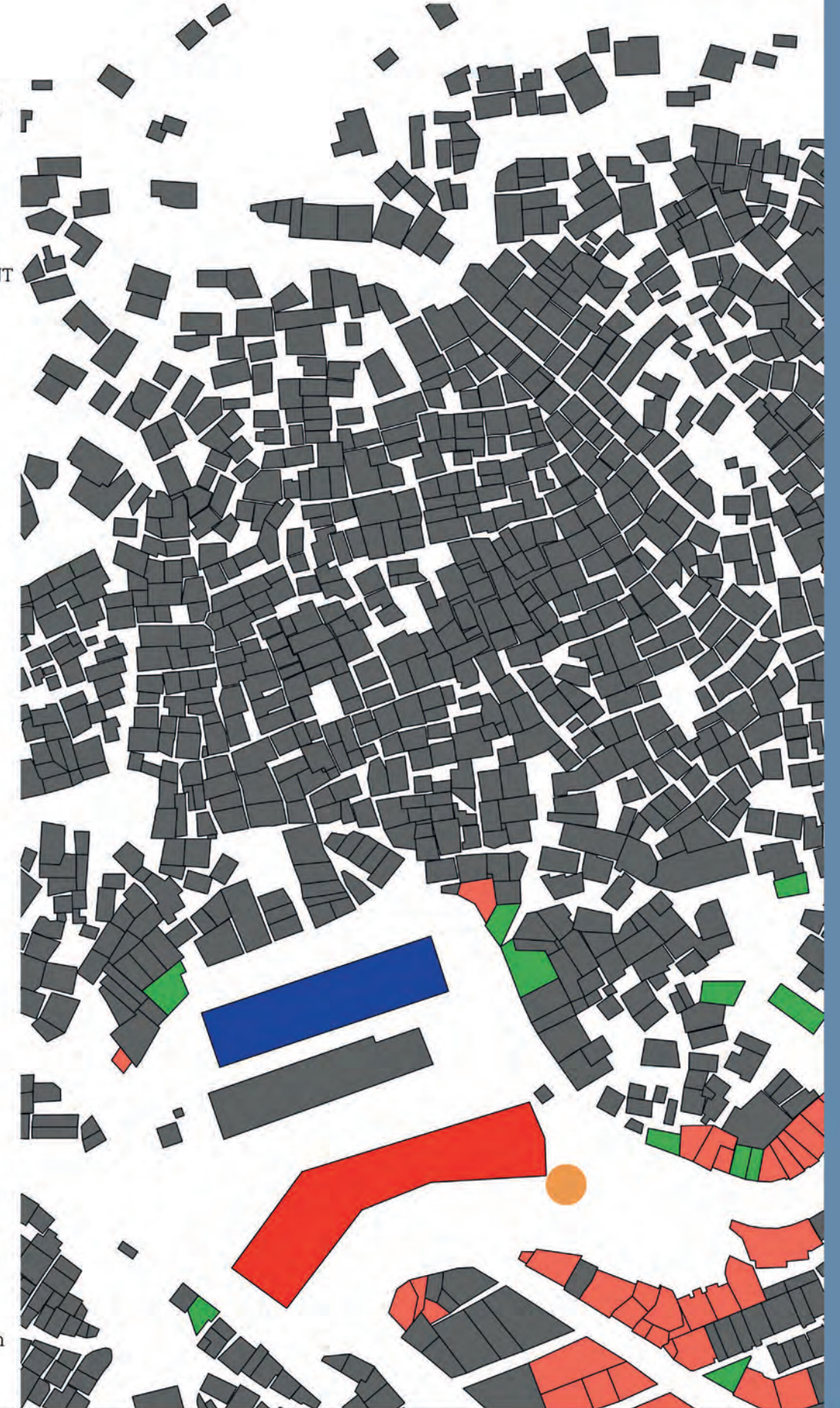
TRANSPORTATION

-  AUTOBUS
-  Bus Stop
-  Bus Line
-  Catchment area
-  TAXI BUS
-  Taxi Bus Stop
-  Taxi Bus Line
-  Catchment area
-  MOTO TAXI
-  Moto Taxi Parking
-  Moto Taxi Line
-  Catchment area
-  METRO
-  Metro station
-  Catchment area



FUNCTIONS

-  BANK/ATM
-  POST OFFICE
-  HEALTH SERVICE
-  SPORT SERVICE
-  WASTE COLLECTION
-  SHOPPING
-  MARKET (FOOD)
-  BAR/RESTAURANT
-  EDUCATION



IMM VERTICAL ANALYSIS

PROXIMITY

- Necessary regular activities
- Optional activities
- Necessary occasional activities
- Functions



ACCESSIBILITY

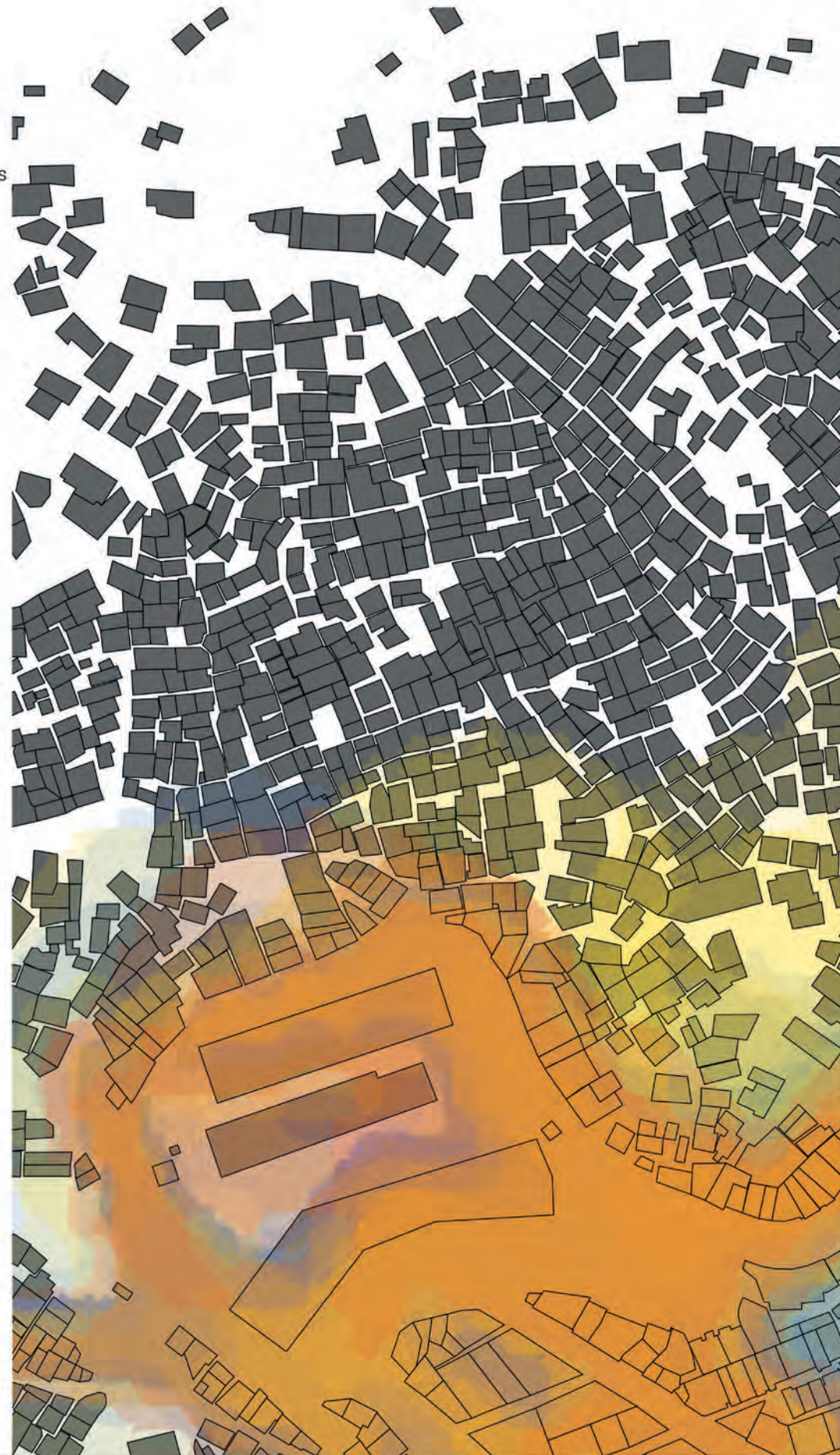
- AUTOBUS
 - Bus Stop
 - Bus Line
 - Catchment area
- TAXI BUS
 - Taxi Bus Stop
 - Taxi Bus Line
 - Catchment area
- MOTO TAXI
 - Moto Taxi Parking
 - Moto Taxi Line
 - Catchment area
- METRO
 - Metro station
 - Catchment area
- BANK/ATM
- POST OFFICE
- HEALTH SERVICE
- SPORT SERVICE
- WASTE COLLECTION
- SHOPPING
- MARKET (FOOD)
- BAR/RESTAURANT
- EDUCATION



IMM VERTICAL ANALYSIS

DIVERSITY

- Necessary regular activities
- Optional activities
- Necessary occasional activities



POROSITY

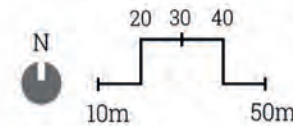
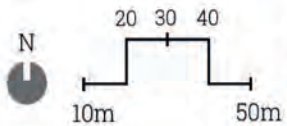
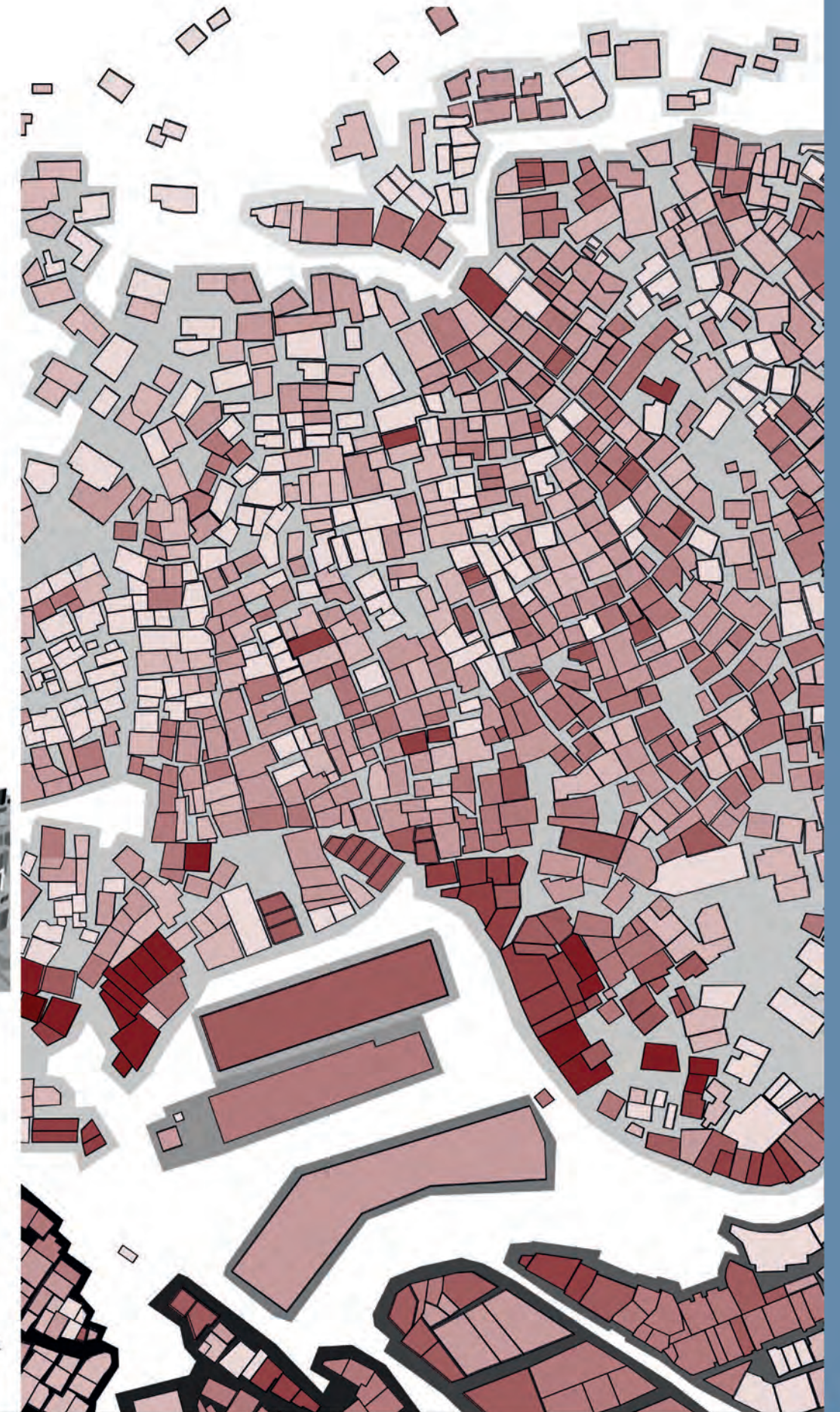
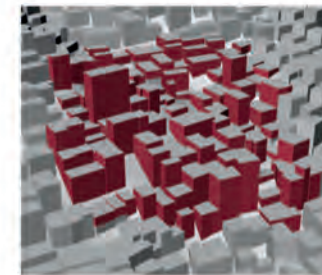
BUILDINGS

- 1 FLOOR (3m)
- 2 FLOORS (6m)
- 3 FLOORS (9m)
- 4 FLOORS (12m)
- 5 FLOORS (15m)
- 6 FLOORS (18m)
- 7 FLOORS (21m)
- 8 FLOORS (24m)

NEIGHBOURHOOD

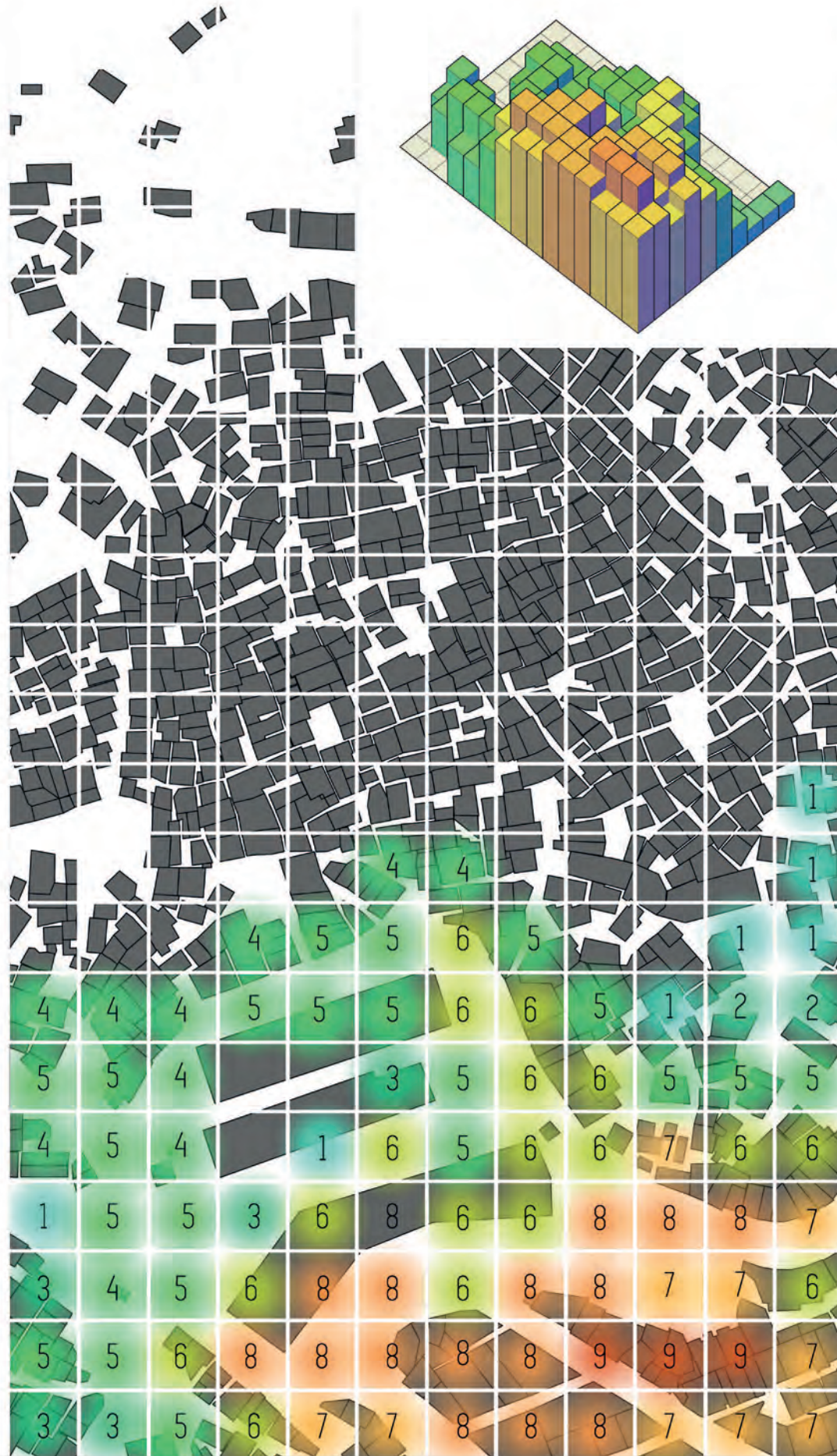
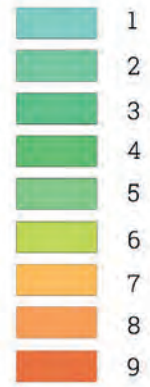
- 1 (4.445 m²)
- 2 (68.260 m²)
- 3 (1.673 m²)
- 4 (1.662 m²)
- 5 (2.630 m²)
- 6 (3.285 m²)
- 7 (2.779 m²)
- 8 (1.818 m²)
- 9 (5.017 m²)

VOLUME SAMPLE:
Free vertical surfaces

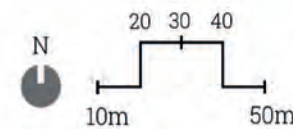
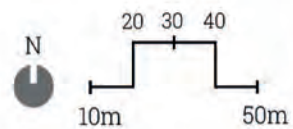


IMM VERTICAL ANALYSIS

EFFECTIVENESS



INTERFACE



IMM VERTICAL ANALYSIS: PERMEABILITY

DIRECTNESS

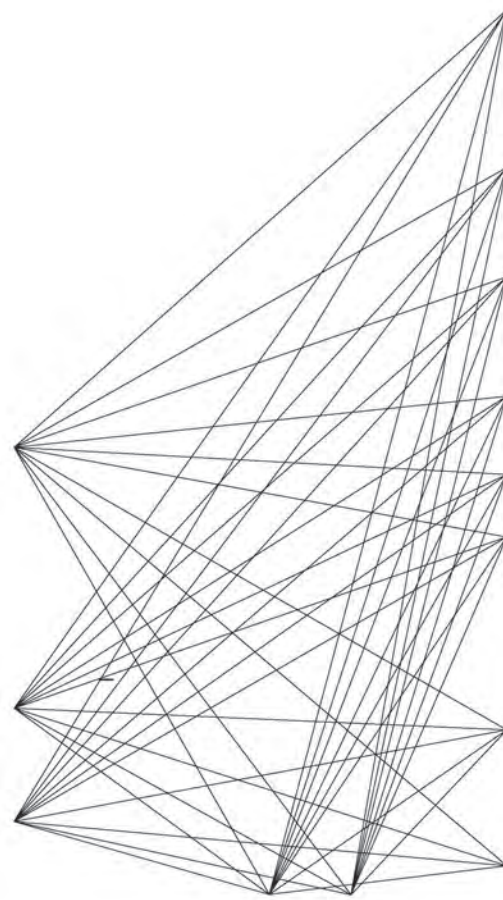
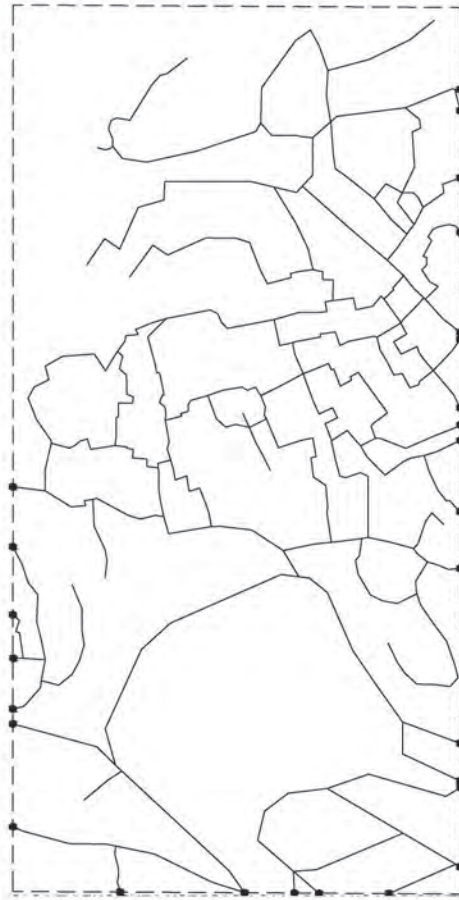
It represents how much an area encourages flow, or how easily it can be crossed. It measures how direct is the path between two points, comparing the distance as the crow flies to the shortest possible path following the street network.

$$Directness = \frac{L_d}{L_{sp}}$$

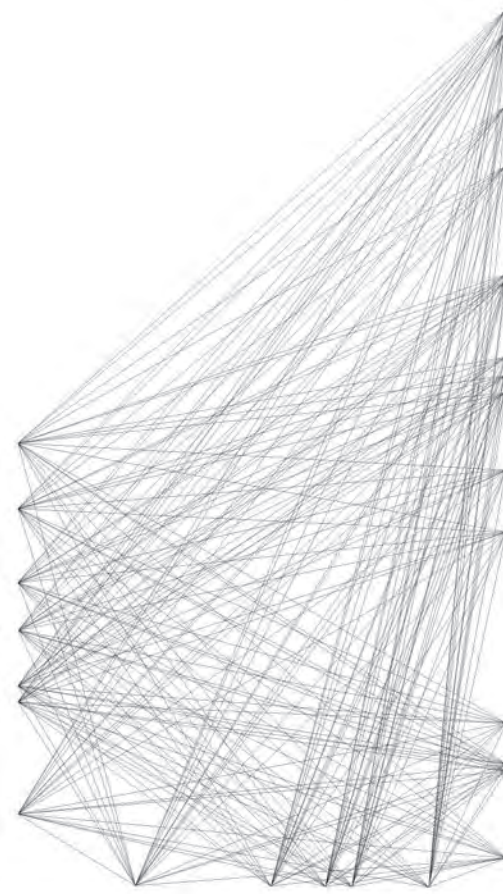
with:

L_d = Linear path, the distance measured as the crow flies [m].

L_{sp} = Shortest path, the shortest possible path following the street network [m].



The 57.5% value for Directness means that, on average, it takes half-again as much time to go from one point of the map to another, when compared to the linear route. Permeability also underscores how the issue of urban density is compounded to almost unsustainable levels by Rocinha's morphology. Topography reaches a value of 74.3%, which descends from the extreme values of the terrain's slope



LINK LENGTH

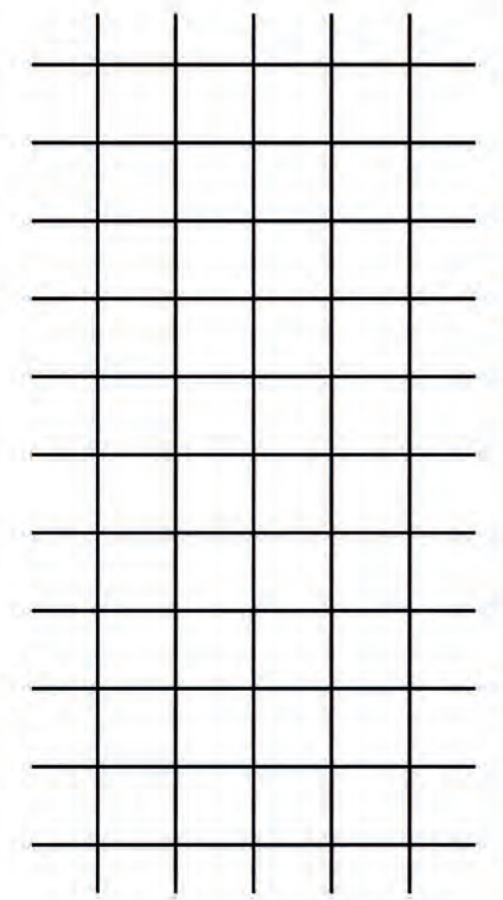
It represents the distance between intersections, in other words the easiness of changing routes and finding an alternative path within walking distance.

$$L_l = \frac{L_t}{N_{streets} \cdot L_{max}}$$

with:

$N_{streets}$ = Number of streets;

L_{max} = Maximum street length rounded to the nearest 50 m [m].



TORTUOSITY

It serves as the counterpart of the Directness, measuring the ease of a flow through a porous medium. In this investigation, the tortuosity has been computed using the TauFactor plug-in for Matlab.

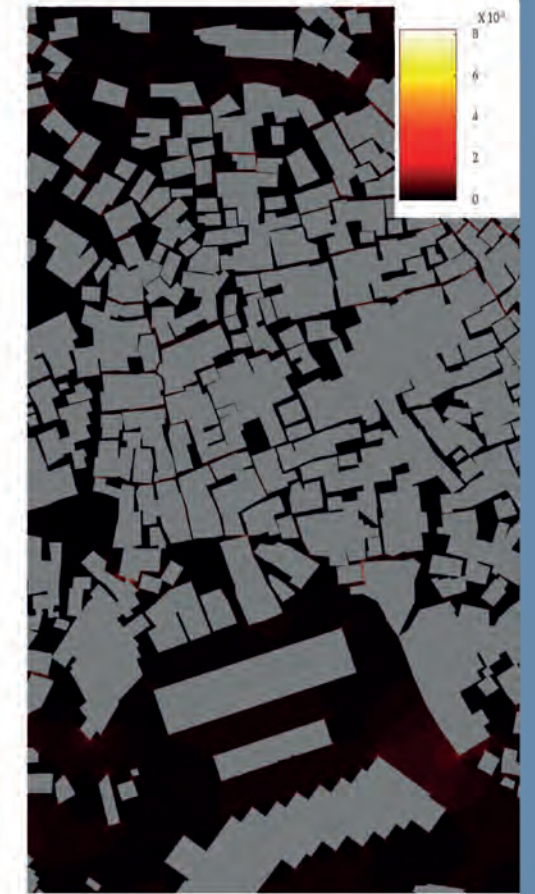
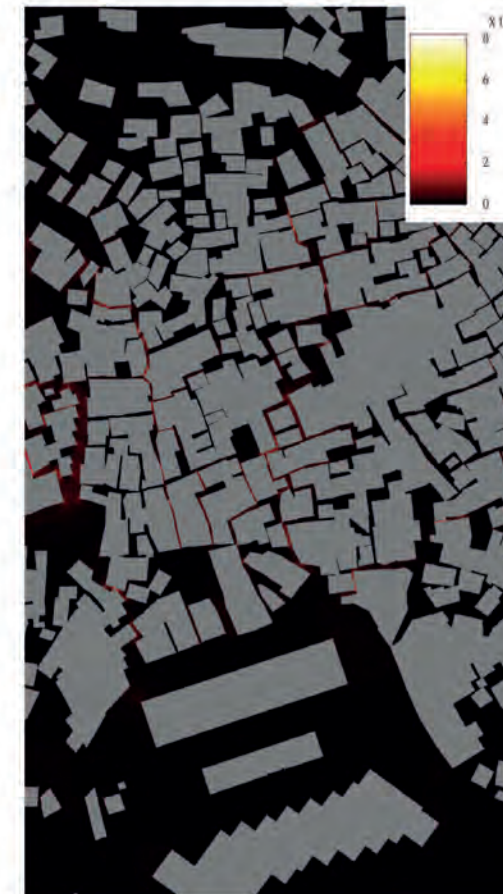
$$\tau_\gamma = \tau_x + \tau_y$$

with:

τ_x = Tortuosity measured by TauFactor on the x-axis;

τ_y = Tortuosity measured by TauFactor on the y-axis.

The Permeability investigation offers further insight into the issue, especially with the very low value Tortuosity (39.3%), though again the latter would be much lower in the densest neighbourhoods of the area.



PILOT PROJECTS

The informal urban environment that is a favela gives rise to a closely-knitted and fiercely independent community. Therefore, the people of Rocinha are very resistant, almost impervious, to change, especially when brought from the "outside".

At the same time, however, many basic human necessities are barely met in Rocinha, and demand improvements that oftentimes only state-level actors can provide.

Pilot projects are this intervention's answer to this duality of needs: small, easy-to-implement interventions, some made and managed by the community, placed at strategic junctures inside the project areas, that provide the population with immediate and tangible benefits, fostering the inhabitants themselves to spread them across Rocinha.

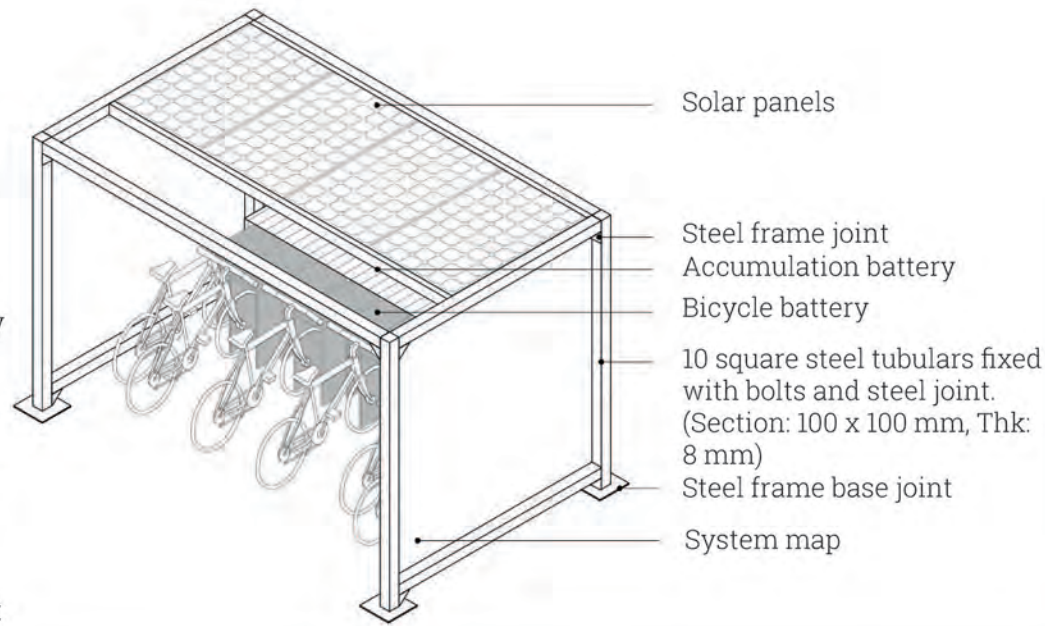
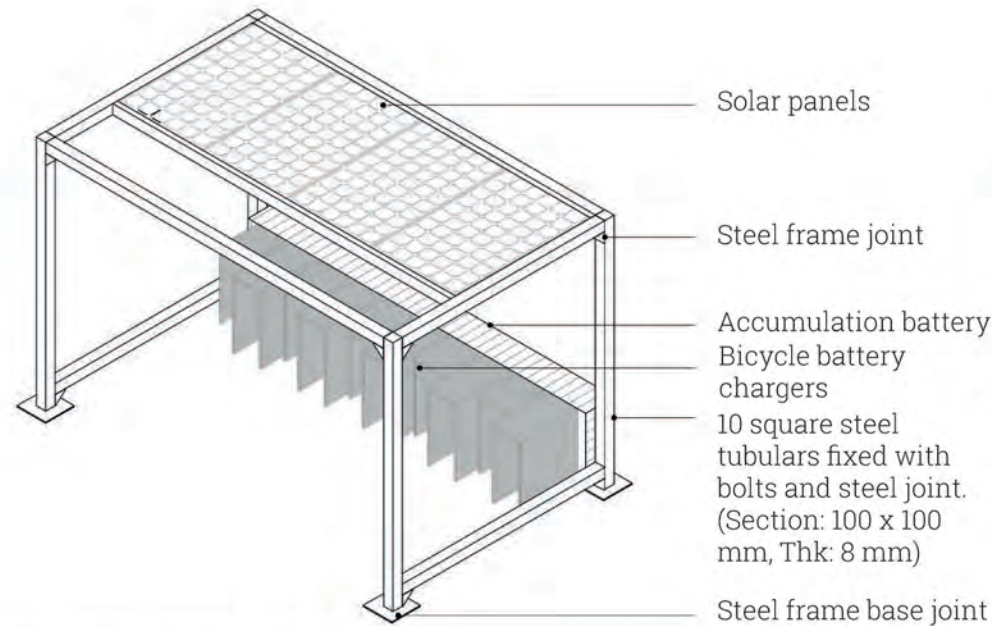
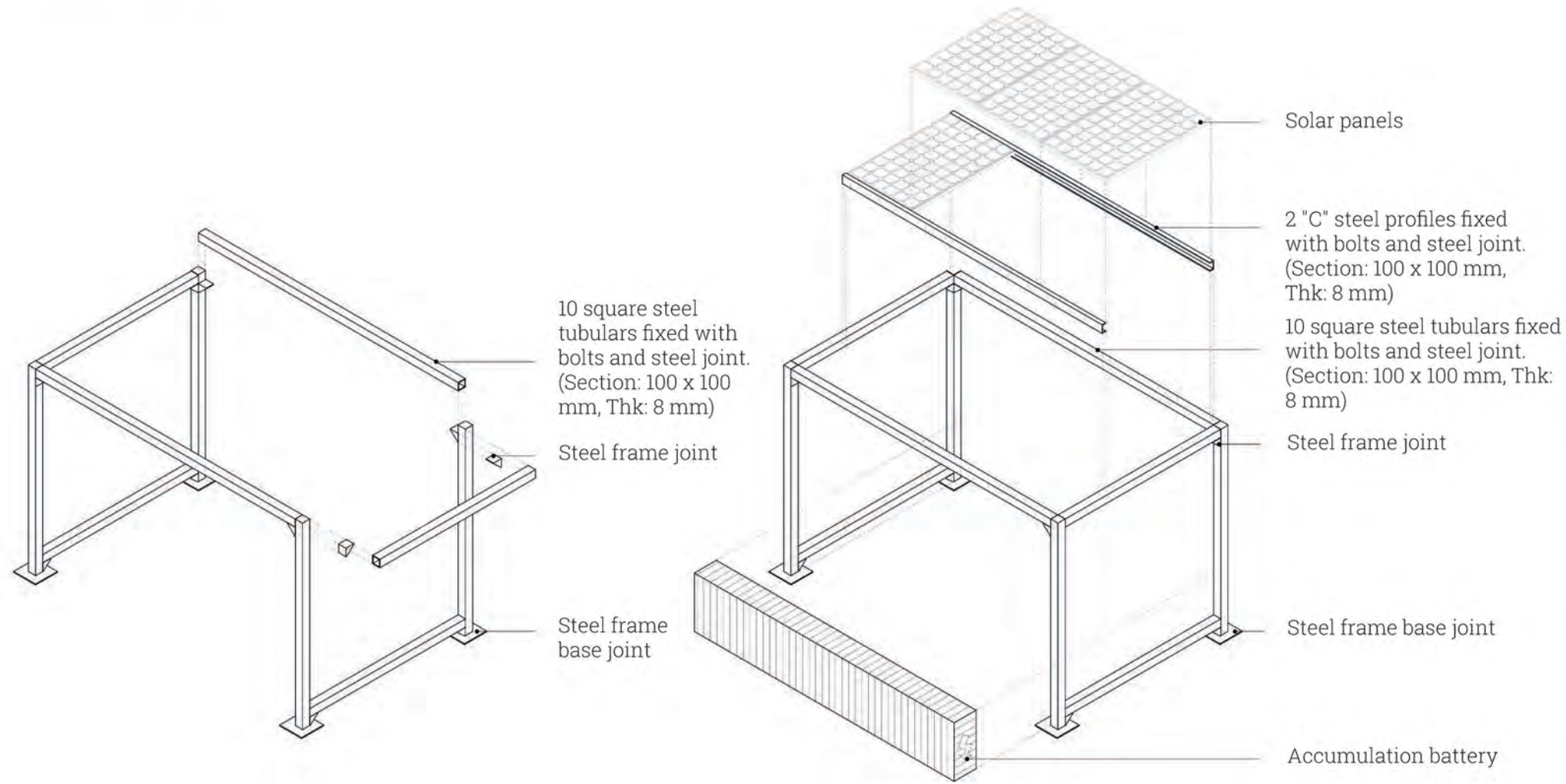
The following chapter will analyse the pilot projects developed by the PolimiparaRocinha team, both at the favela's level and intervention area 1's level. Detailing the design and construction processes, the needs met by each and the benefits brought to the community.



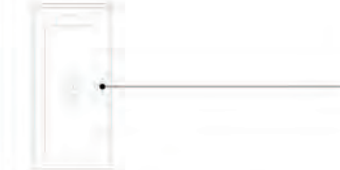
PILOT PROJECT

BIKE SHARING

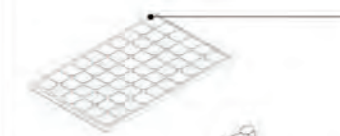
PRIVATE SOLUTION



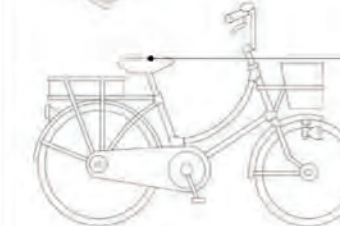
FIXED SOLUTION



ACCUMULATION BATTERY:
-Power: 7 kW
-Annual production: 1508 kWh/year



PHOTOVOLTAIC PANEL:
-N° of panels per station: 12
-Nominal power: 0,275 kWp
-Panel efficiency: 17%



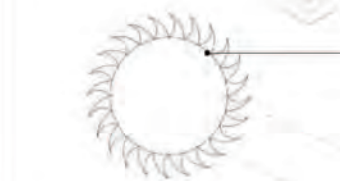
E-BICYCLE:
-Total N° of E-bikes: 180
-Power of the battery: 300 W
-Autonomy: 40 km



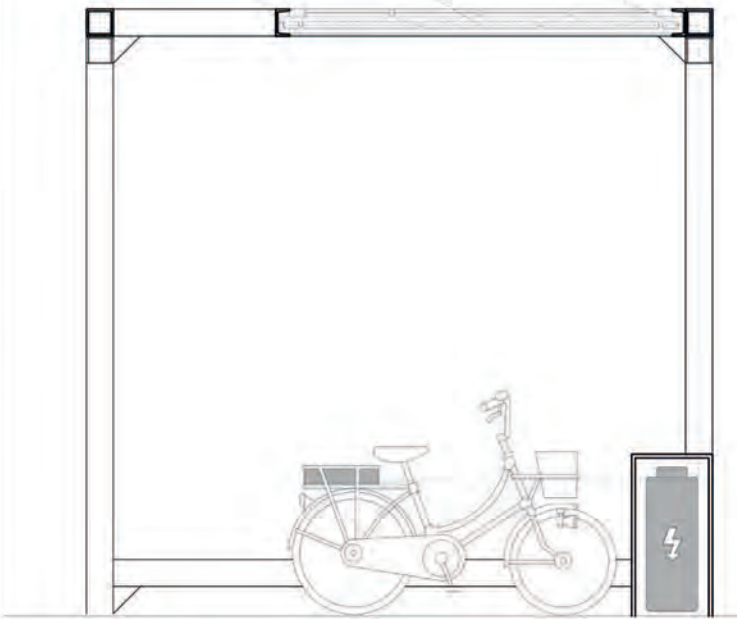
BICYCLES' RACKS:
-N° of racks per station: 2
-N° of E-bikes per rack: 15
-Plug system connected to the accumulation battery
-Dimensions: 1,65 x 0,992 m.
-Panel cost: 130 €



STEEL FRAME ELEMENTS AND JOINTS:
-N° of steel elements/station: 10
-Section: 100 x 100 mm
-Thk: 8 mm



SOLAR POTENTIAL:
-Average daily irradiation: 5,6 kWh/m2/
-Minimum daily irradiation: 3,5 kWh/m2/



PILOT PROJECT

VEGETABLE BOX SYSTEM

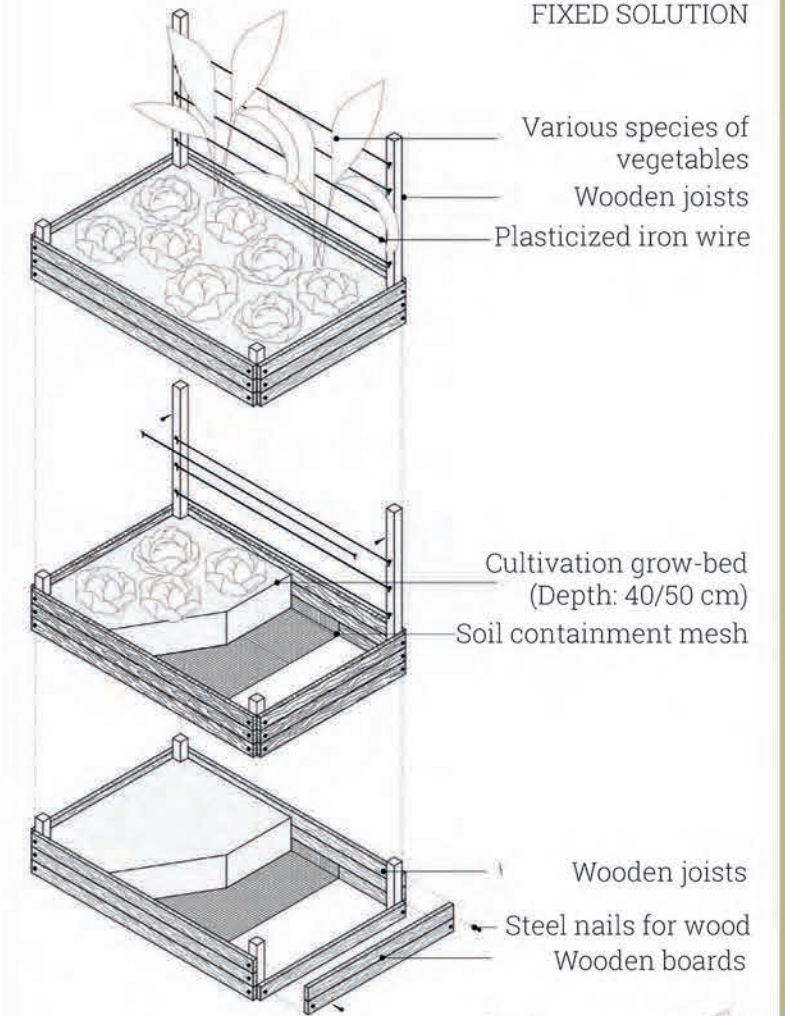
PRIVATE SOLUTION



PUBLIC SOLUTION

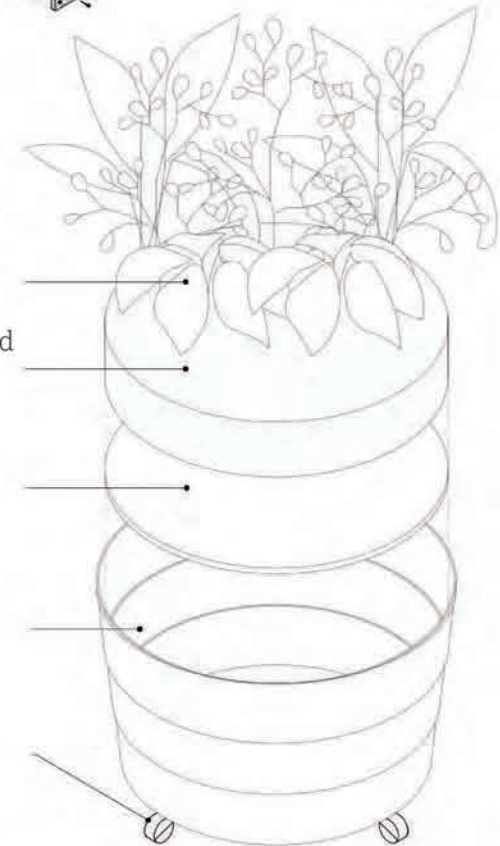


FIXED SOLUTION



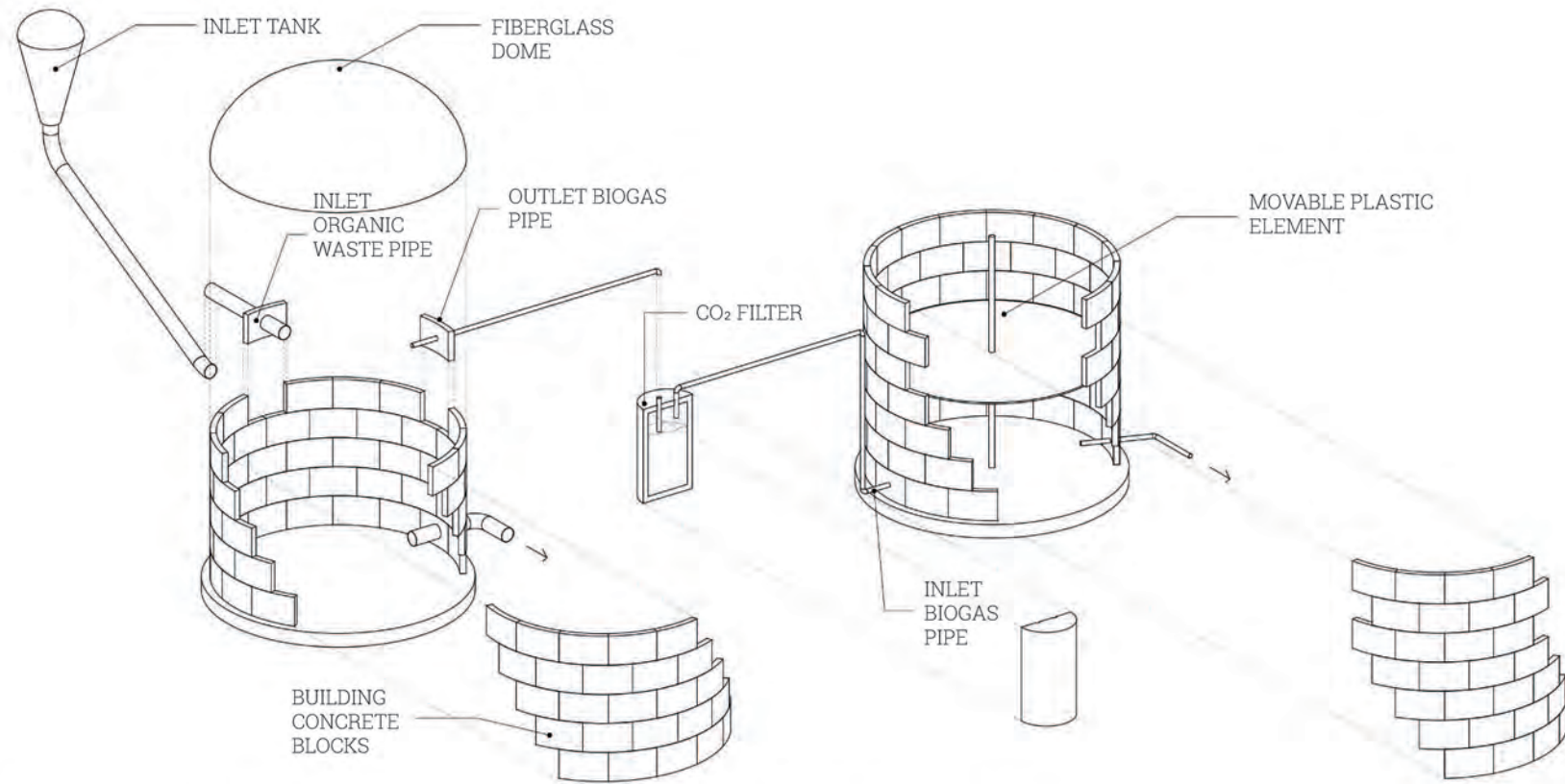
MOBILE SOLUTION

Various species of vegetables
 Cultivation grow-bed (Depth: 40/50 cm)
 Circular OSB panel
 Fish Tank (Water volume: 1000 l)
 Wheels for moving the box

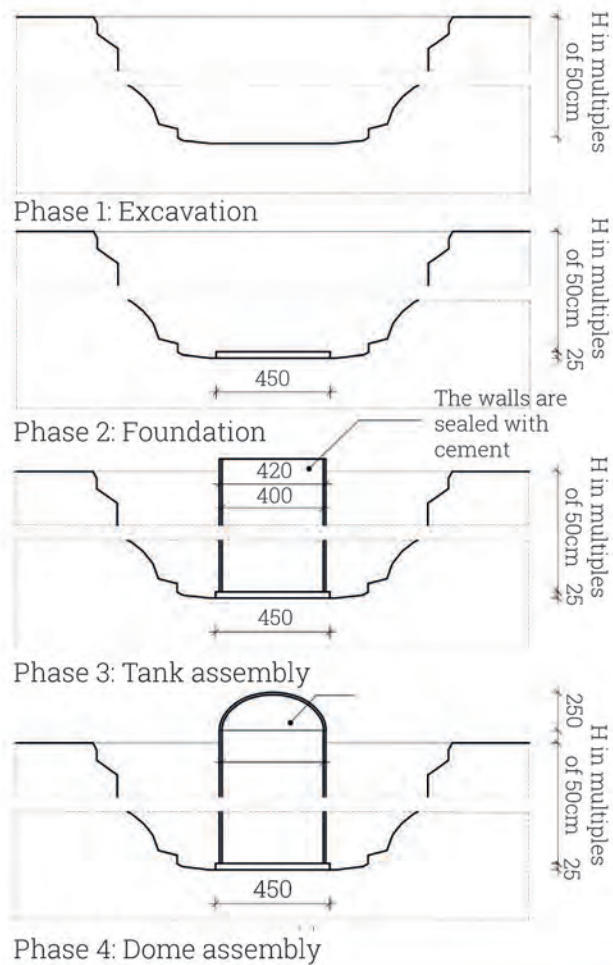


PILOT PROJECT

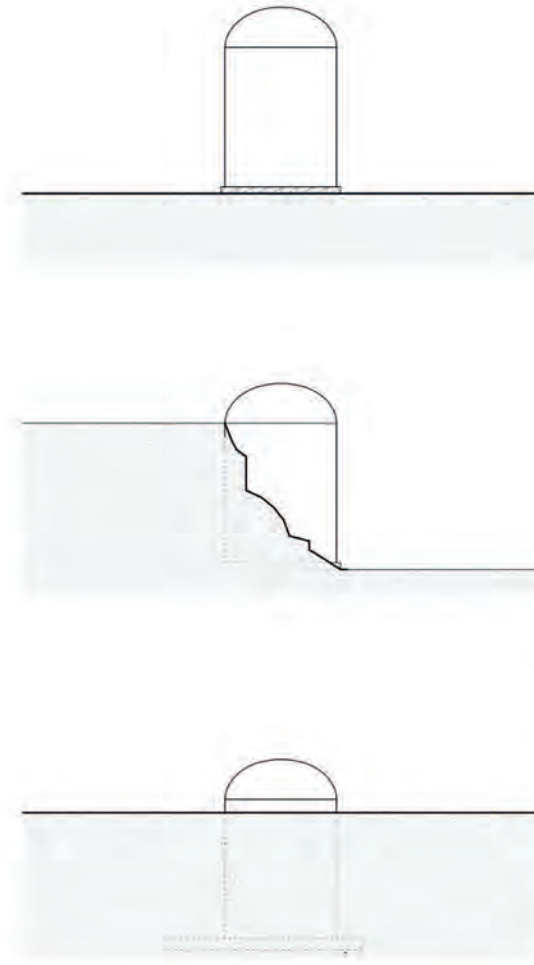
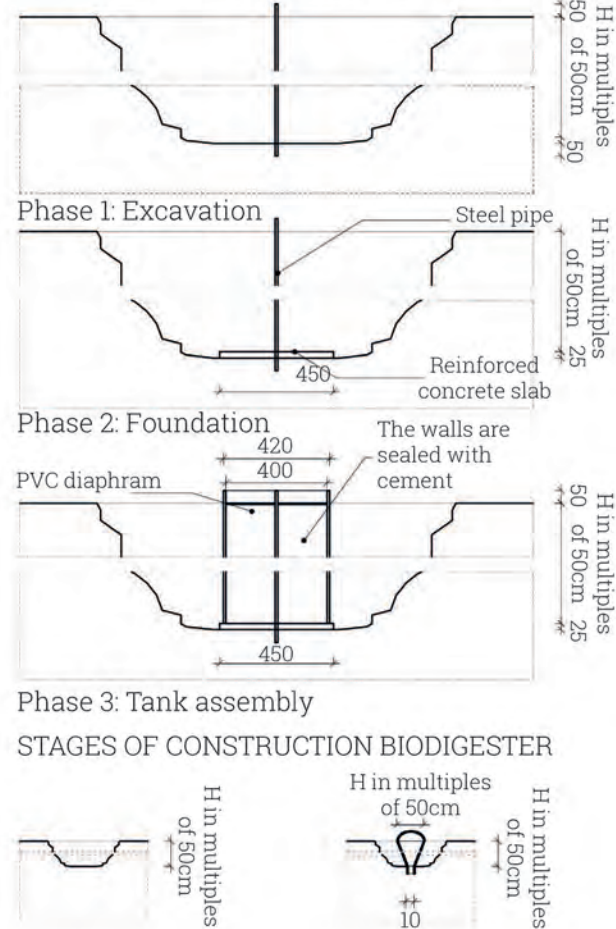
BIOGAS PLANT



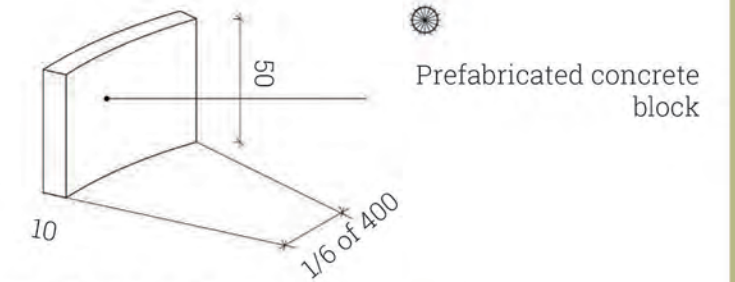
STAGES OF CONSTRUCTION BIODIGESTER



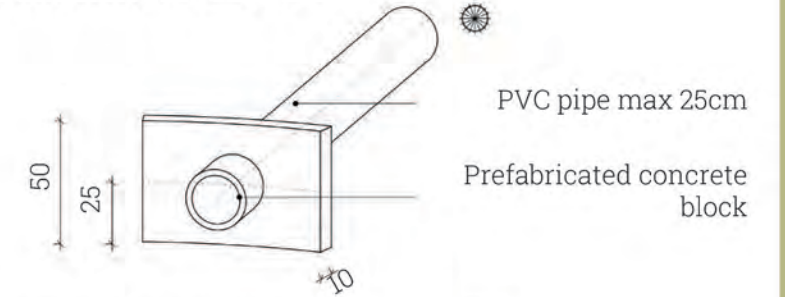
STAGES OF CONSTRUCTION STORAGE TANK



BUILDING BLOCK



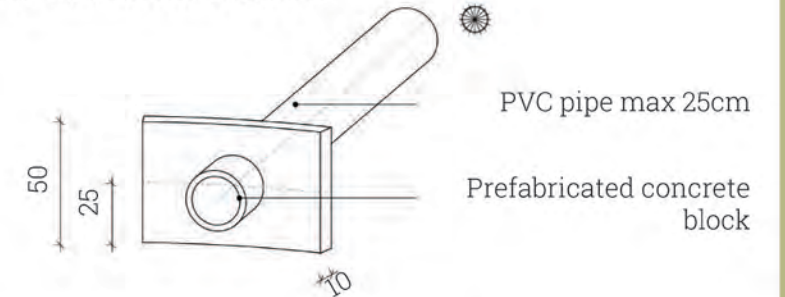
BIOFERTILIZER OUTLET PIPE



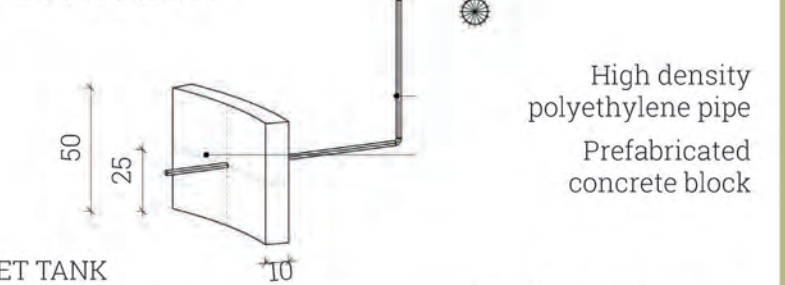
COVERT FIBERGLASS DOME



INLET ORGANIC WASTE PIPE



OUTLET BIOGAS PIPE

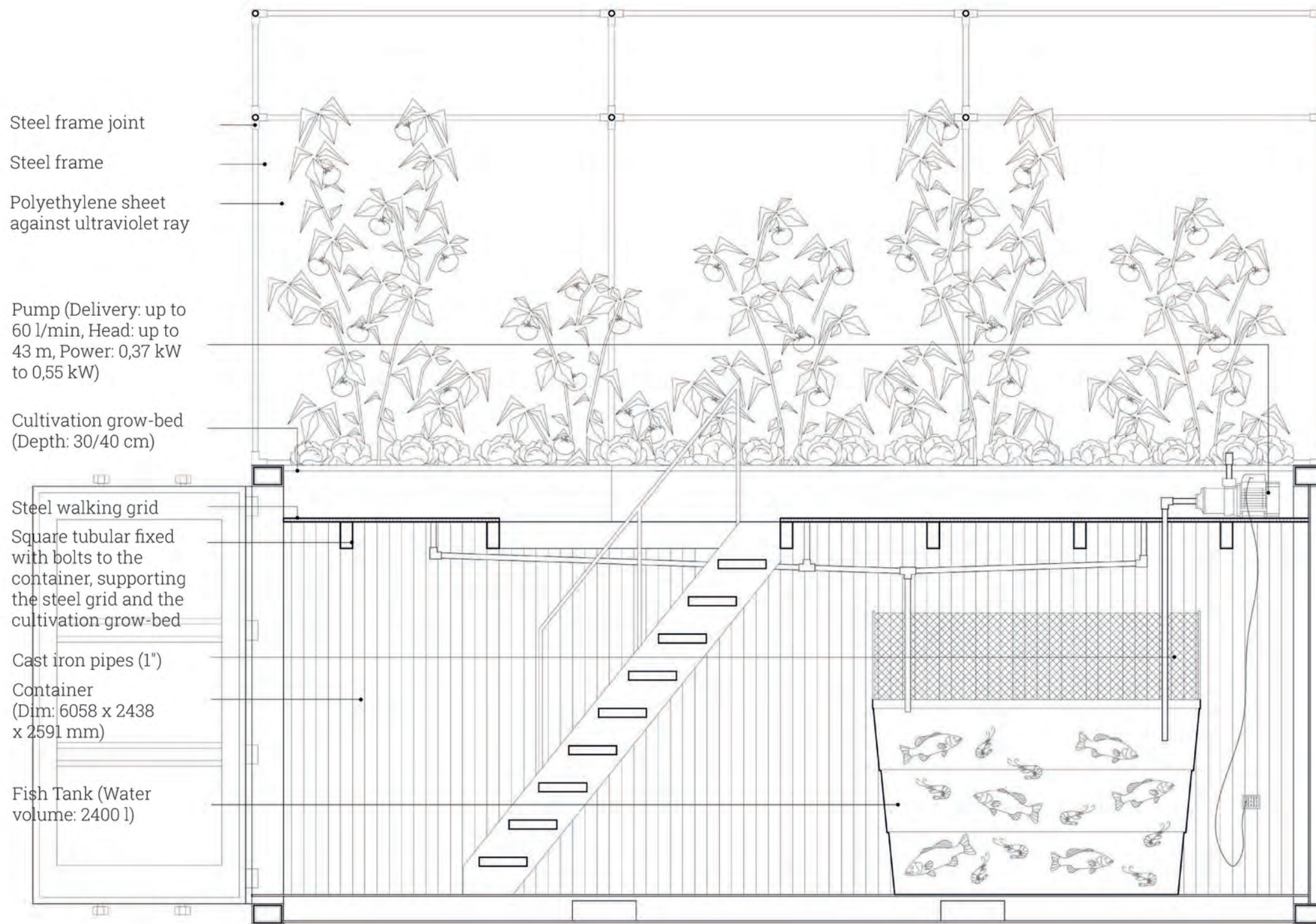


INLET TANK



PILOT PROJECT AQUAPONIC SYSTEM

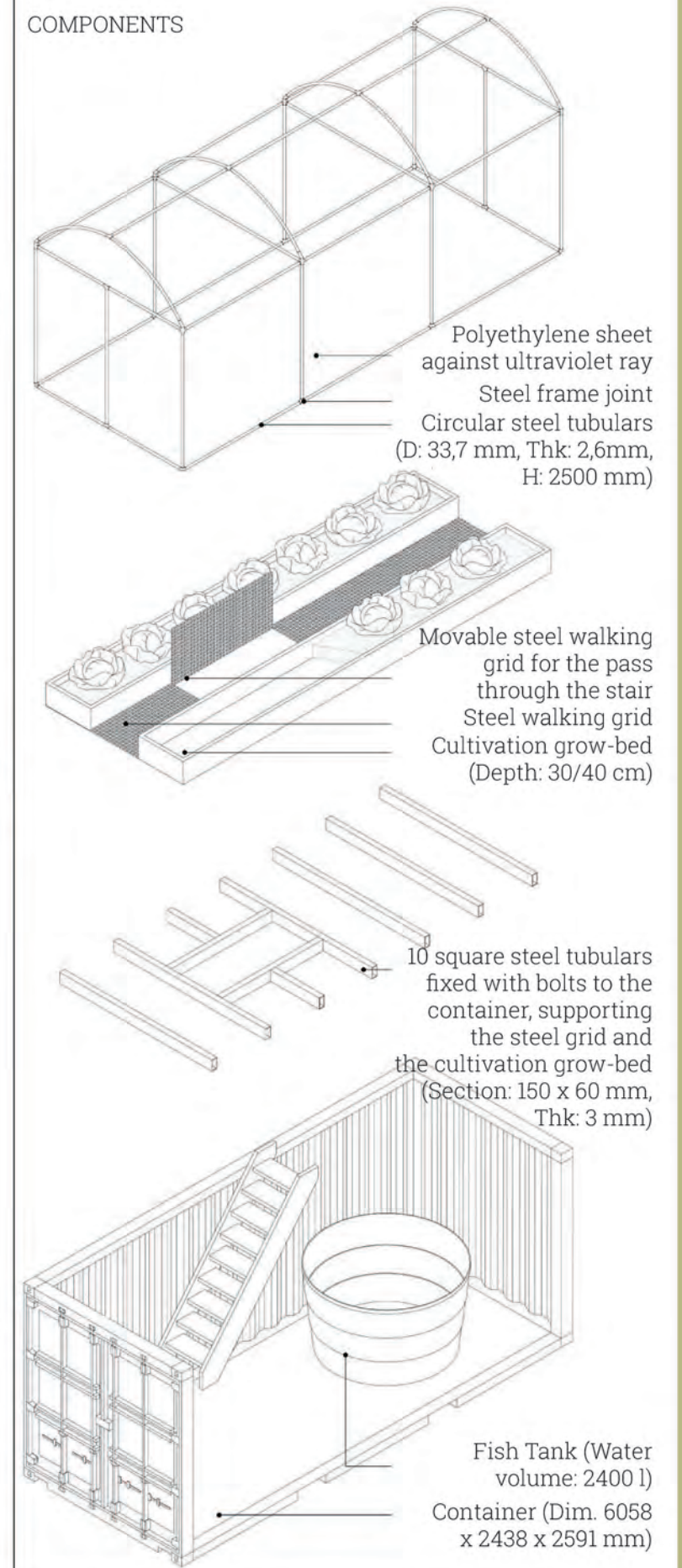
BUILDING BLOCK



PRODUCTION:

- 60kg OF FRESH VEGETABLES
- 120kg OF FRESH FISH PER ANNUM

COMPONENTS

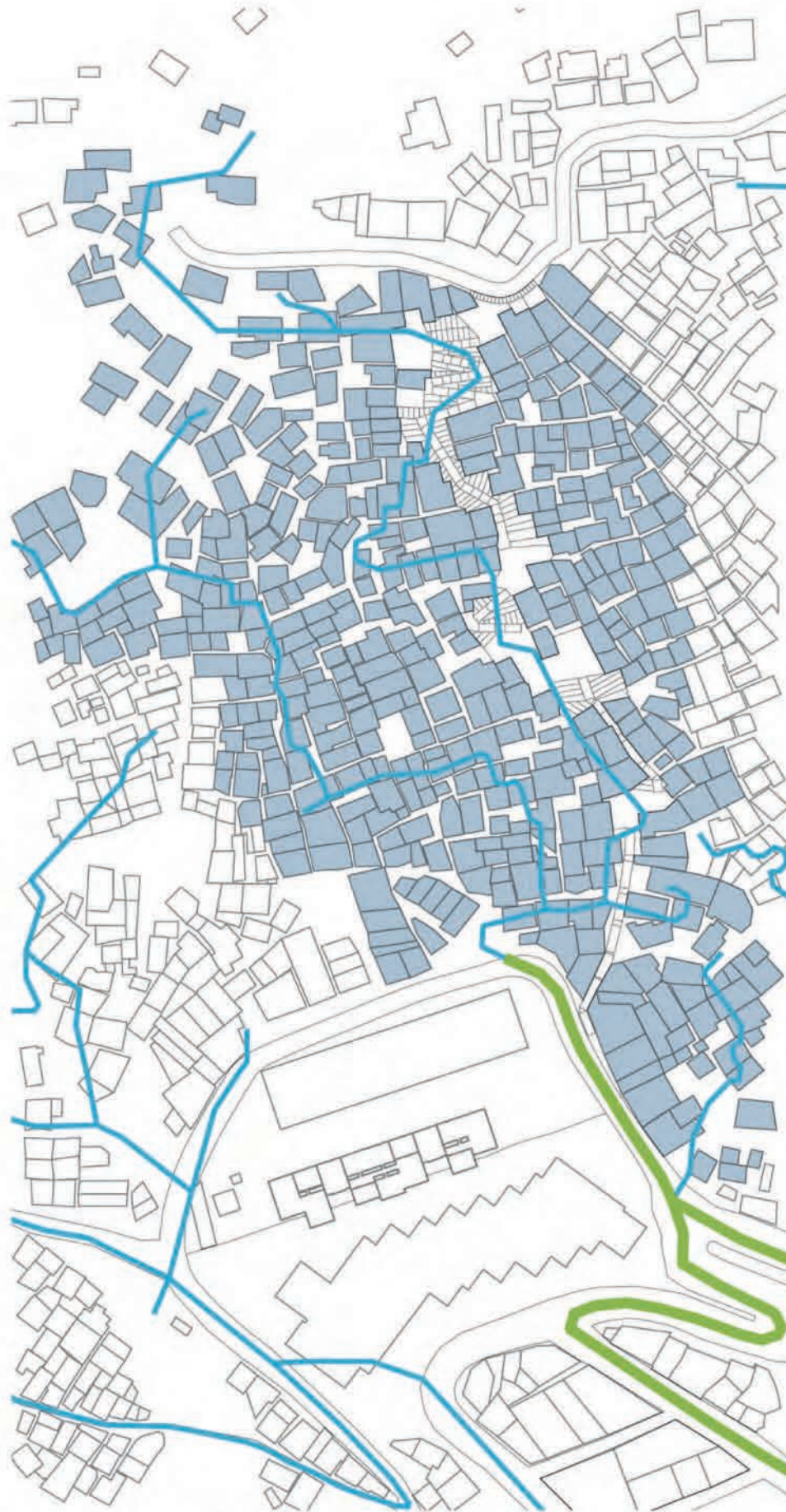


PILOT PROJECT

SEWAGE SYSTEM

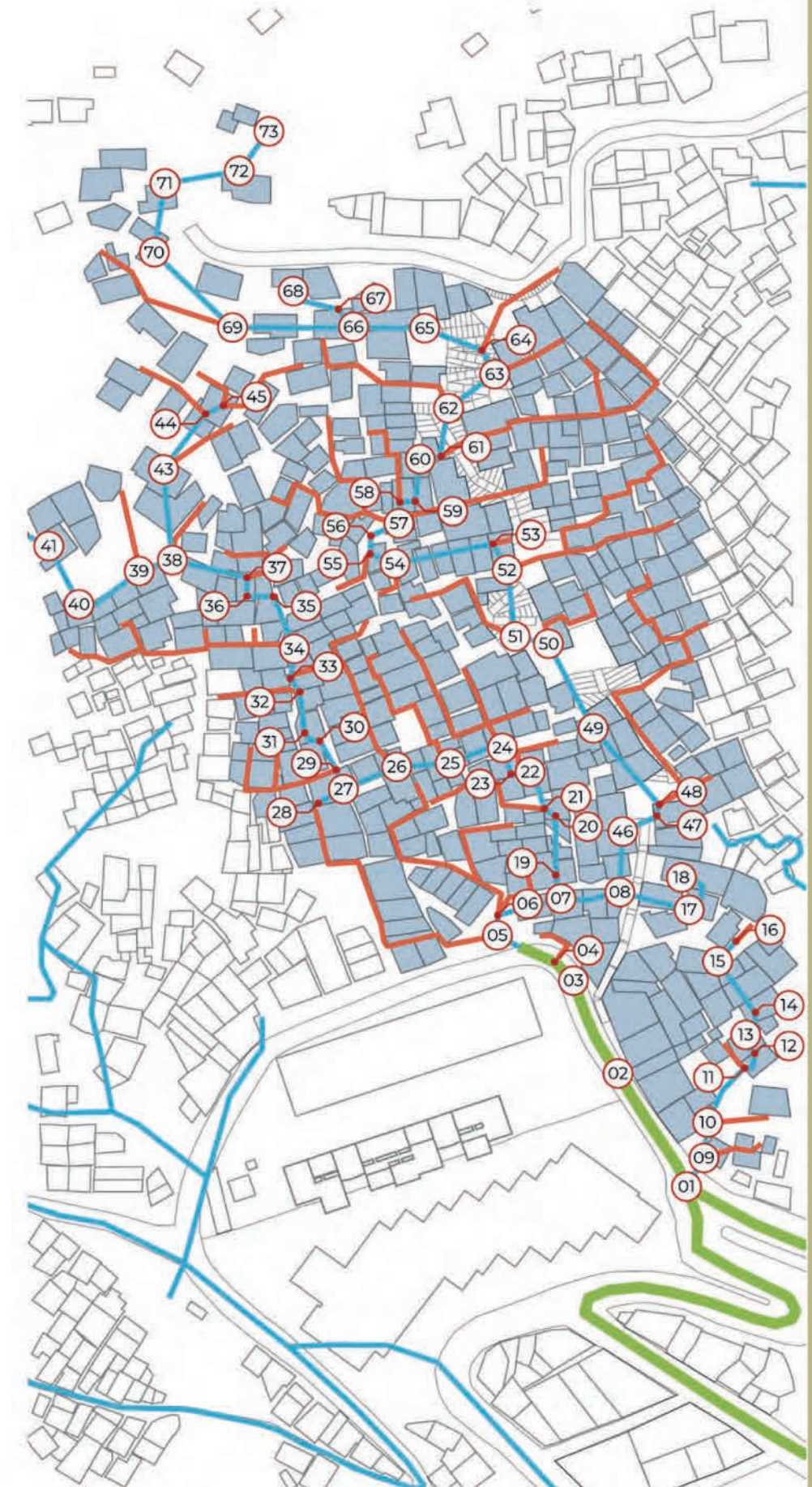
Legend

- Pipeline Ø150
- Pipeline Ø600
- Basin 1



Legend

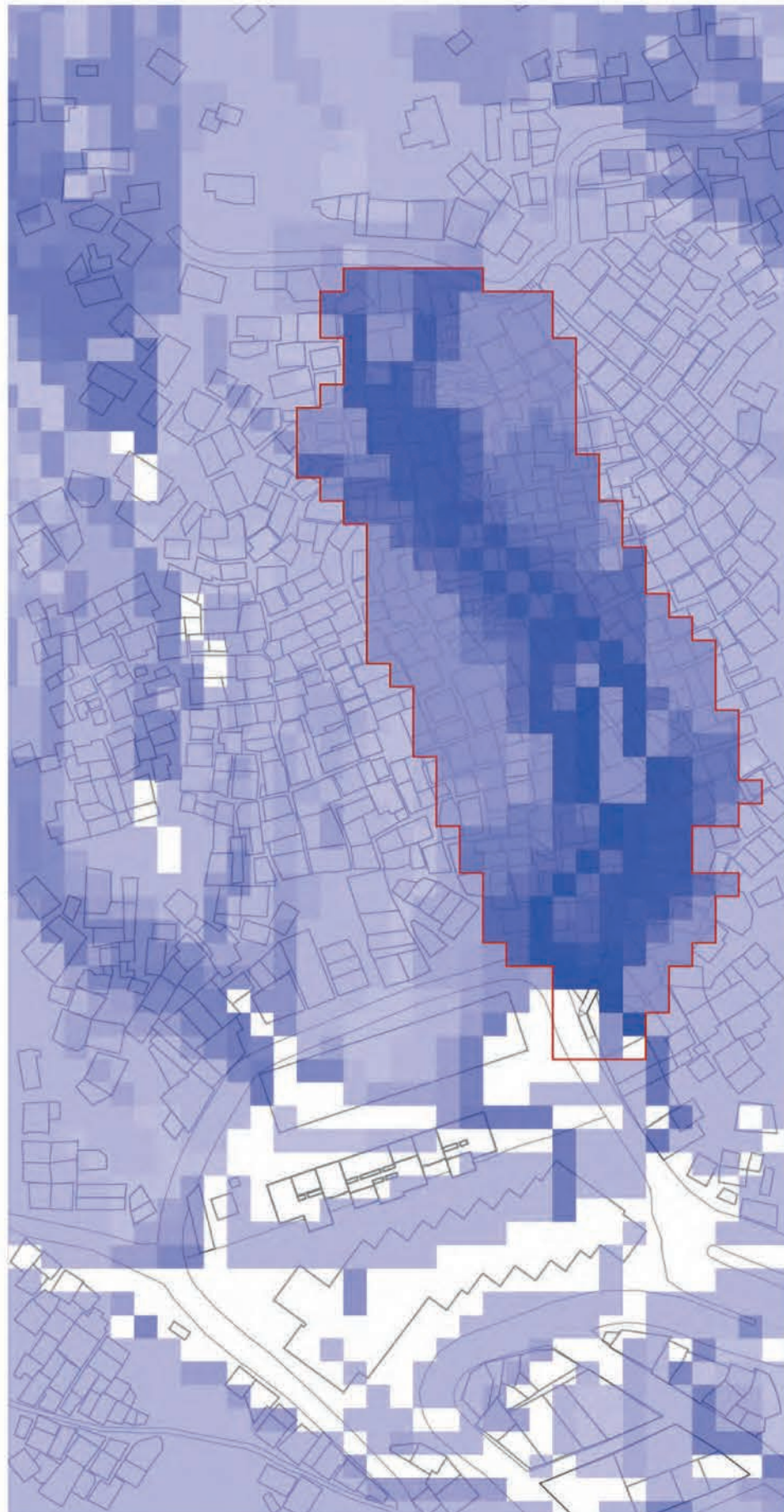
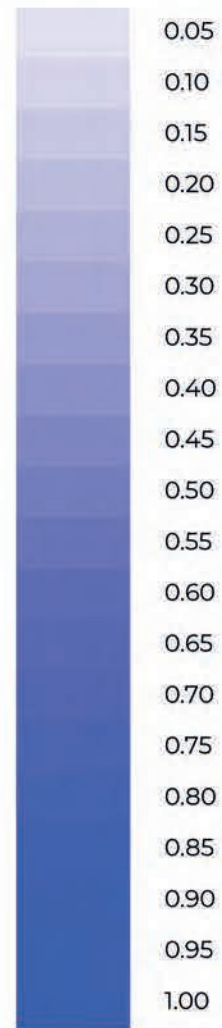
- Pipeline Ø150
- Pipeline Ø200
- Pipeline Ø300
- Pipeline Ø400
- Network Node
- Basin



PILOT PROJECT

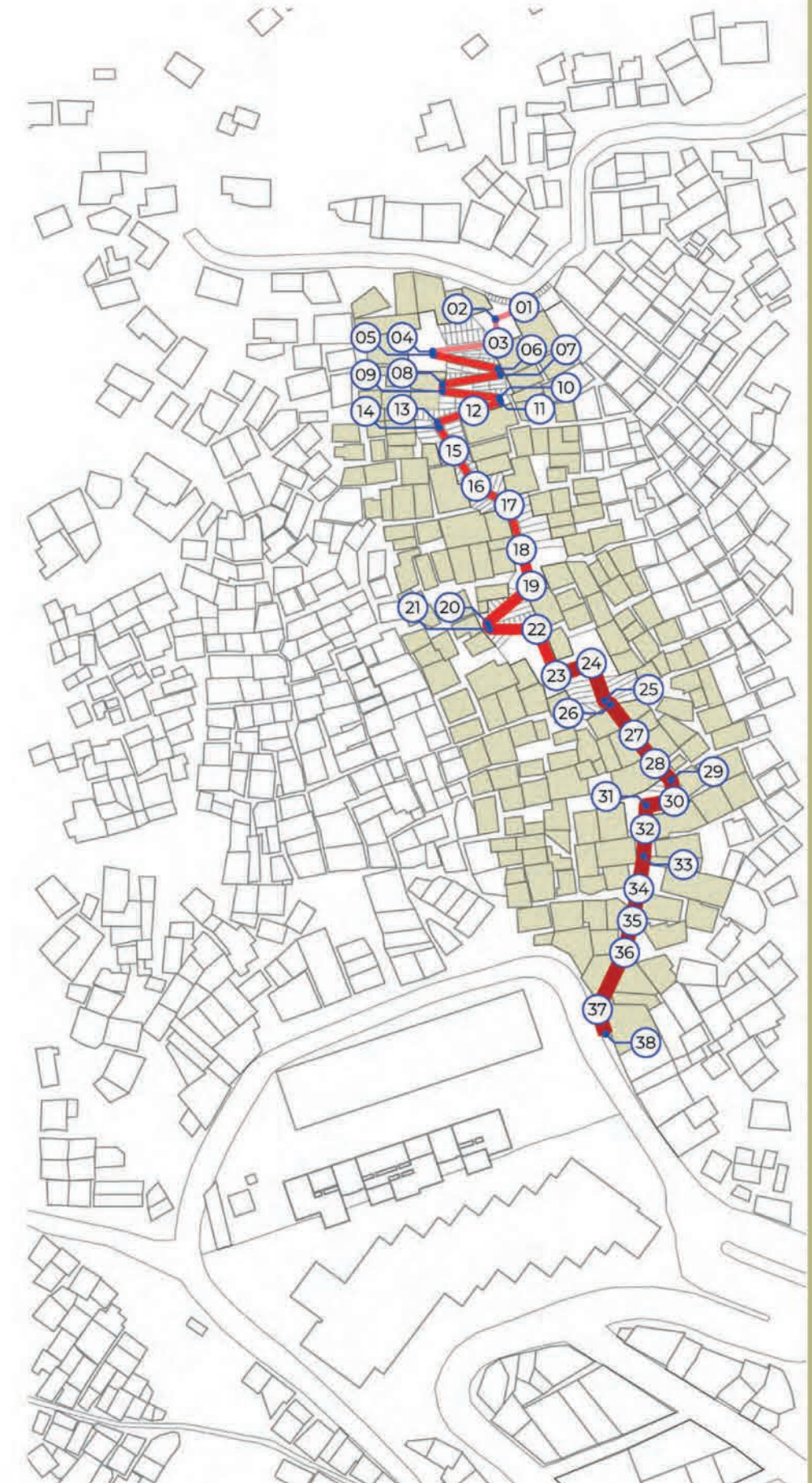
DRAINAGE SYSTEM

Runoff index



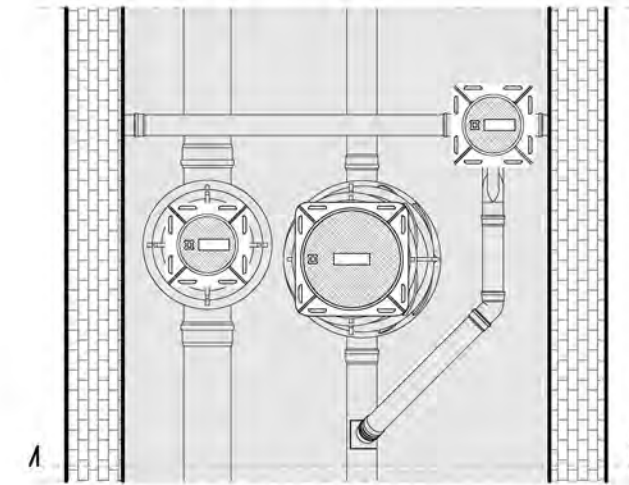
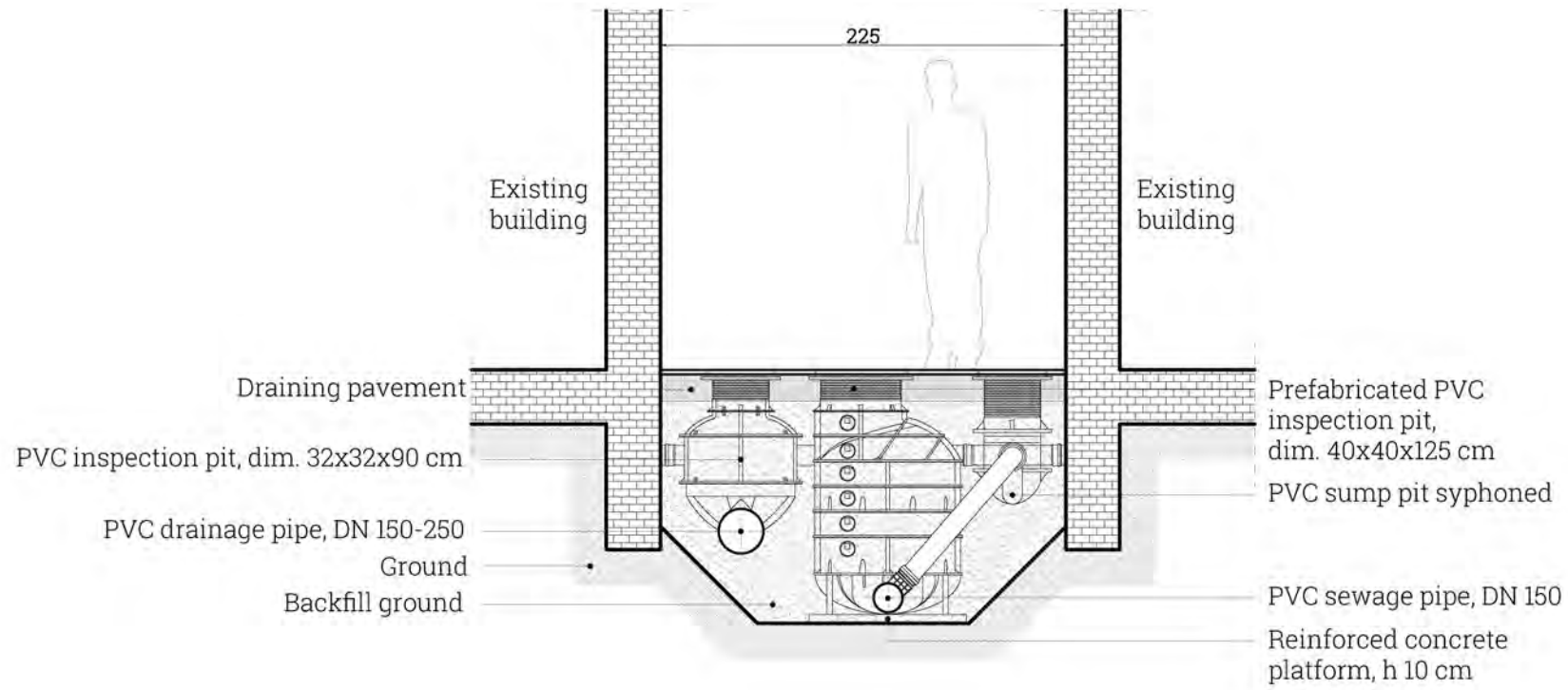
Legend

- Pipeline \varnothing 150
- Pipeline \varnothing 200
- Pipeline \varnothing 300
- Pipeline \varnothing 400
- Network Node
- Basin

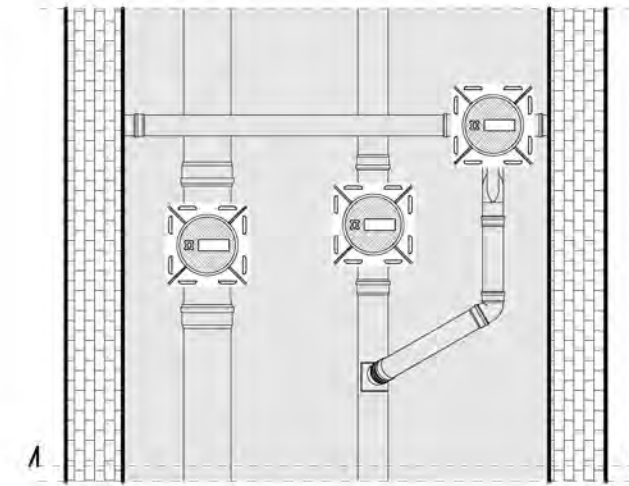
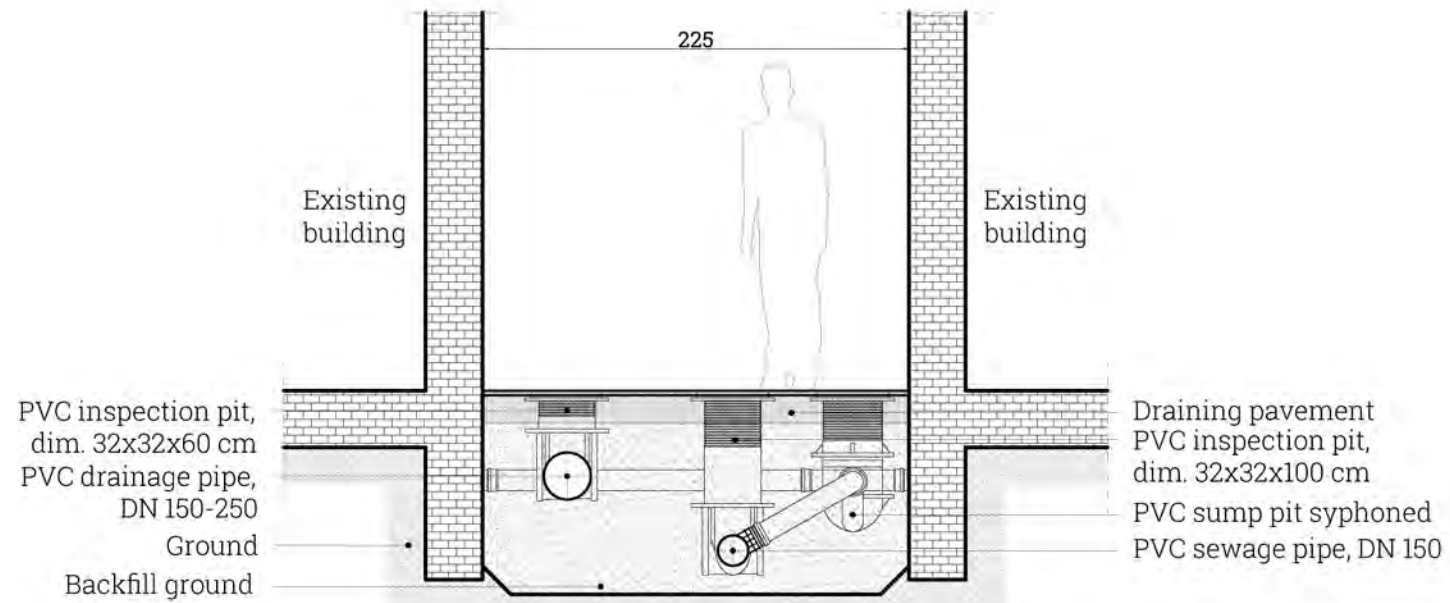


PILOT PROJECT

SEWAGE AND DRAINAGE SYSTEM SECTIONS



Section 1.1. Scale 1:40

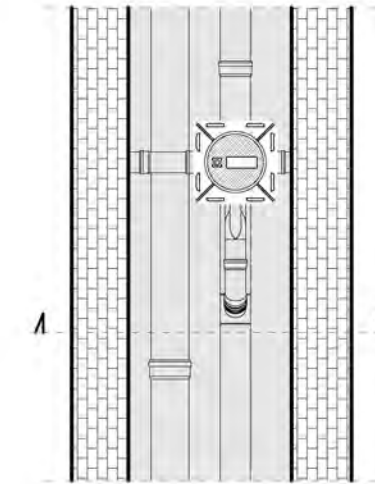
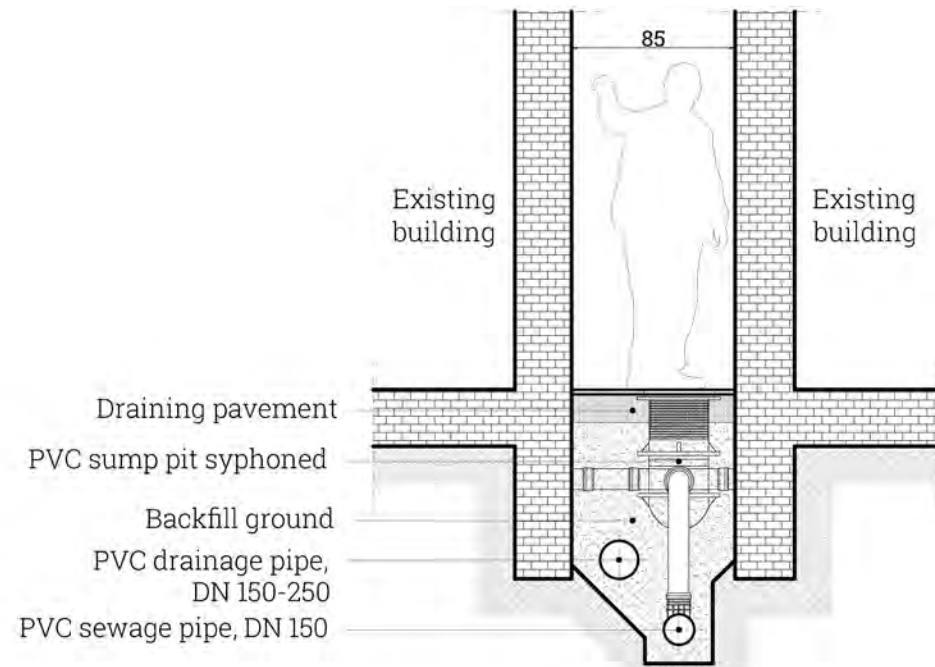


Section 1.2. Scale 1:40

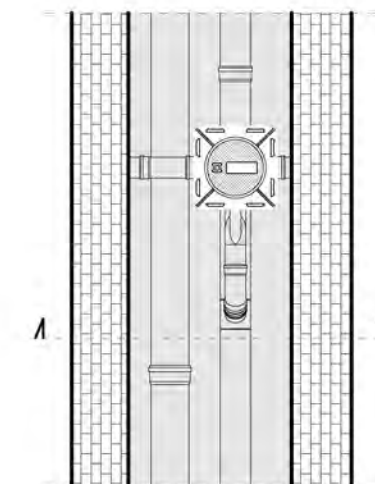
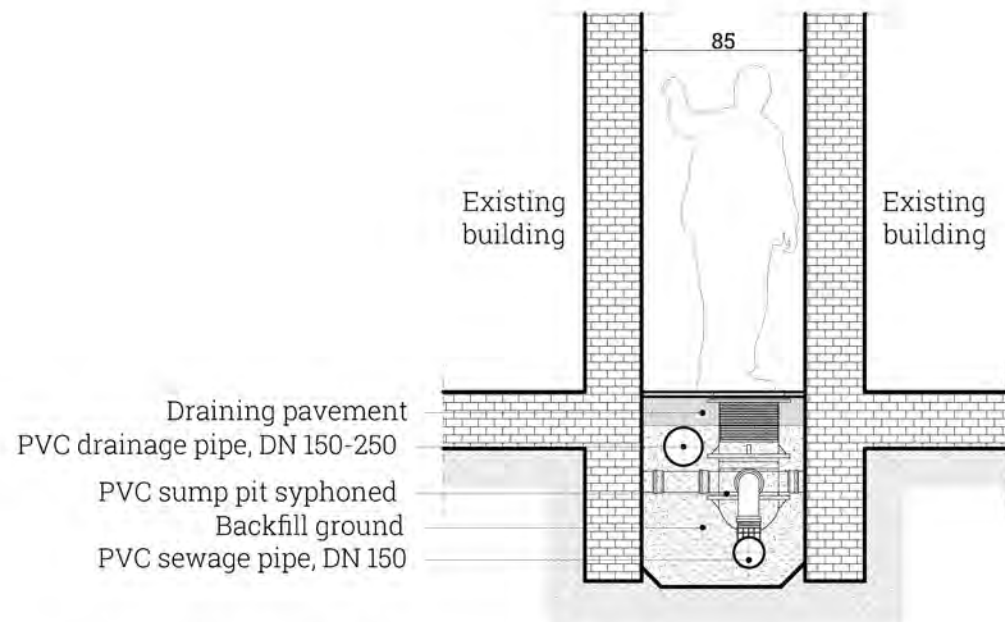


PILOT PROJECT

SEWAGE AND DRAINAGE SYSTEM SECTIONS



Section 2.1. Scale 1:40

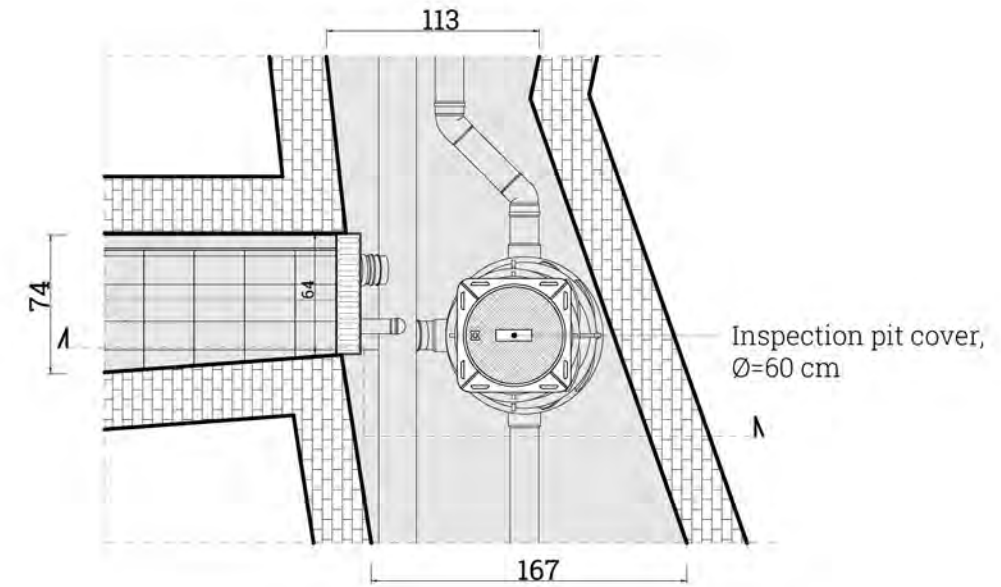
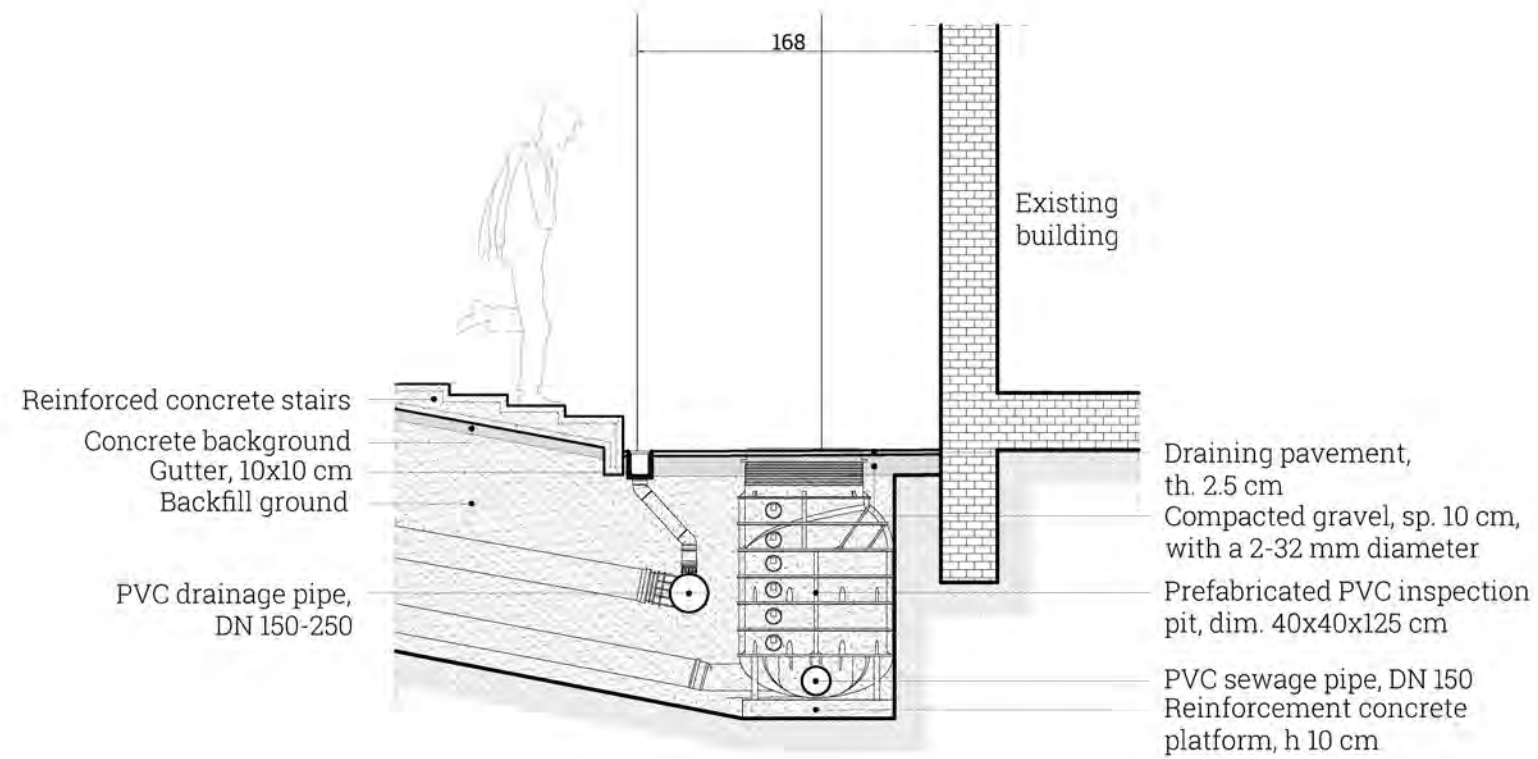


Section 2.2. Scale 1:40

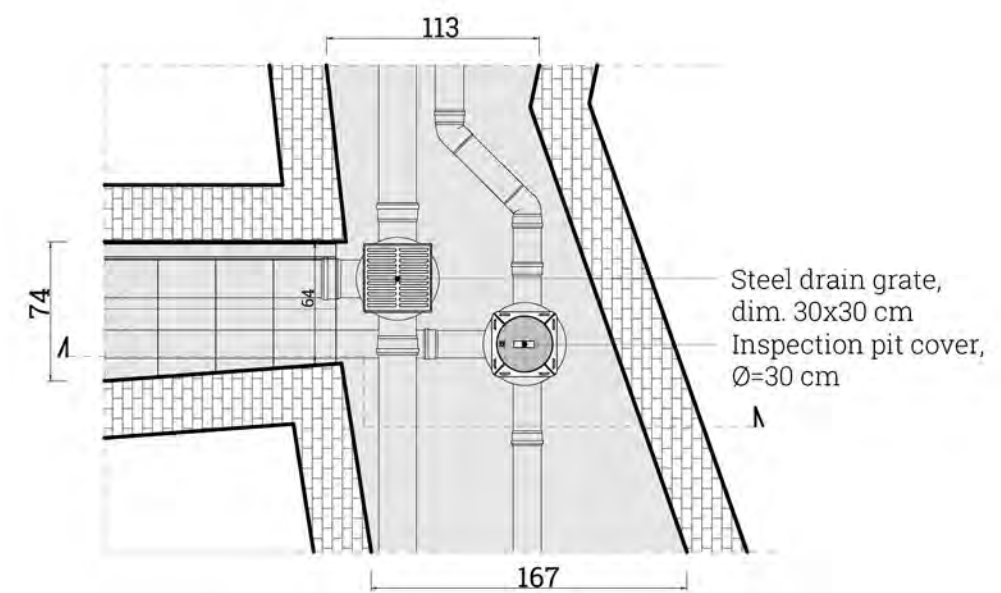
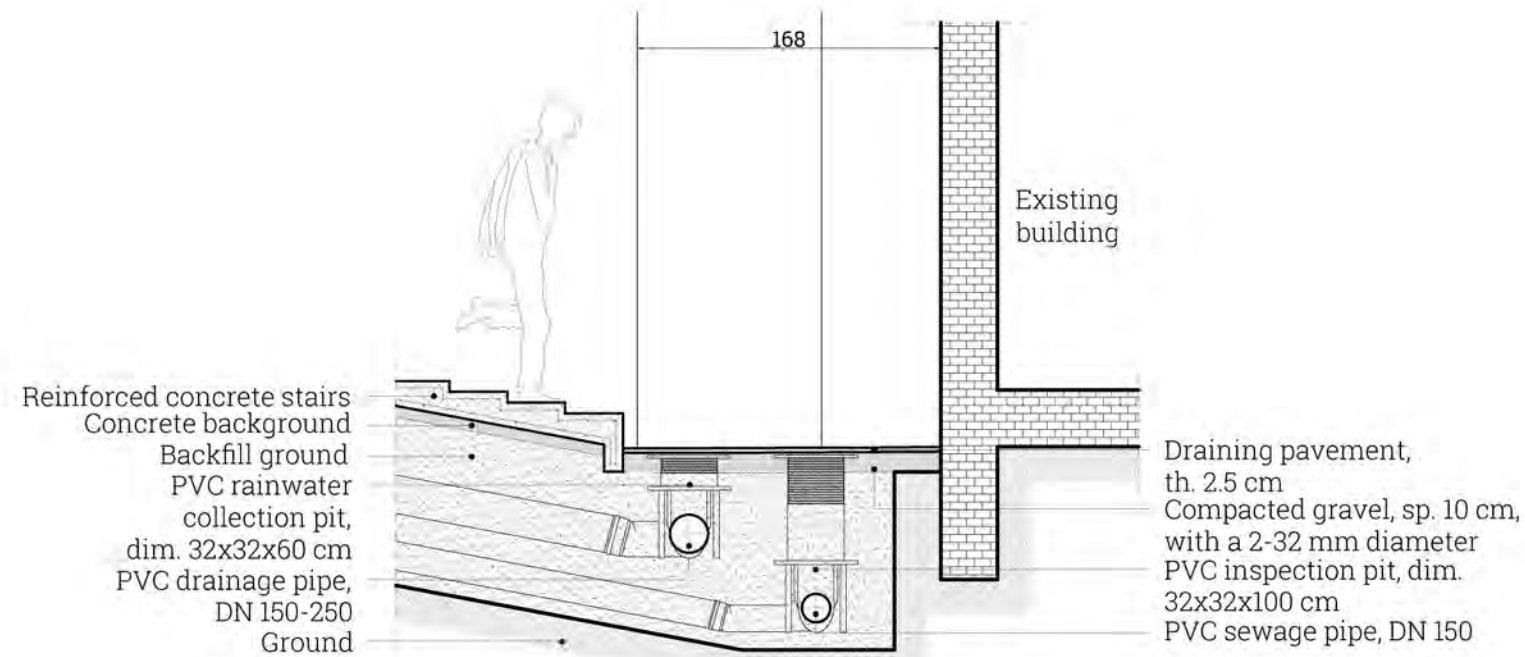


PILOT PROJECT

SEWAGE AND DRAINAGE SYSTEM SECTIONS



Section 3.1. Scale 1:40

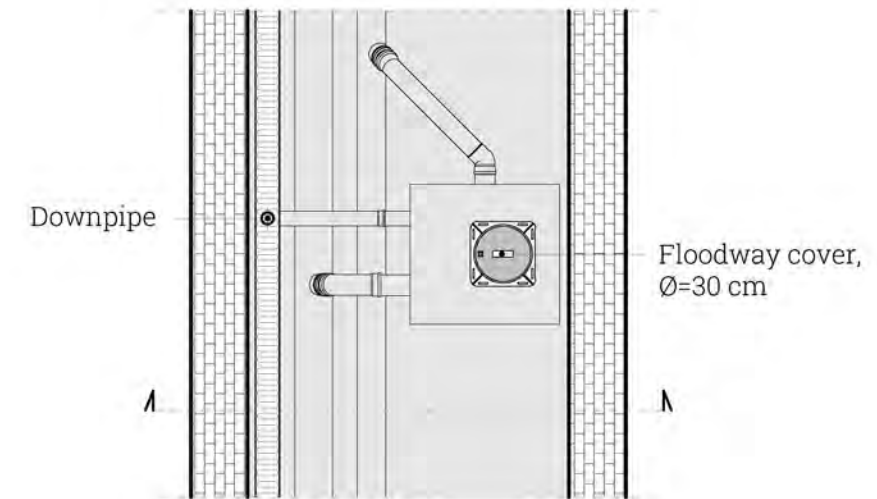
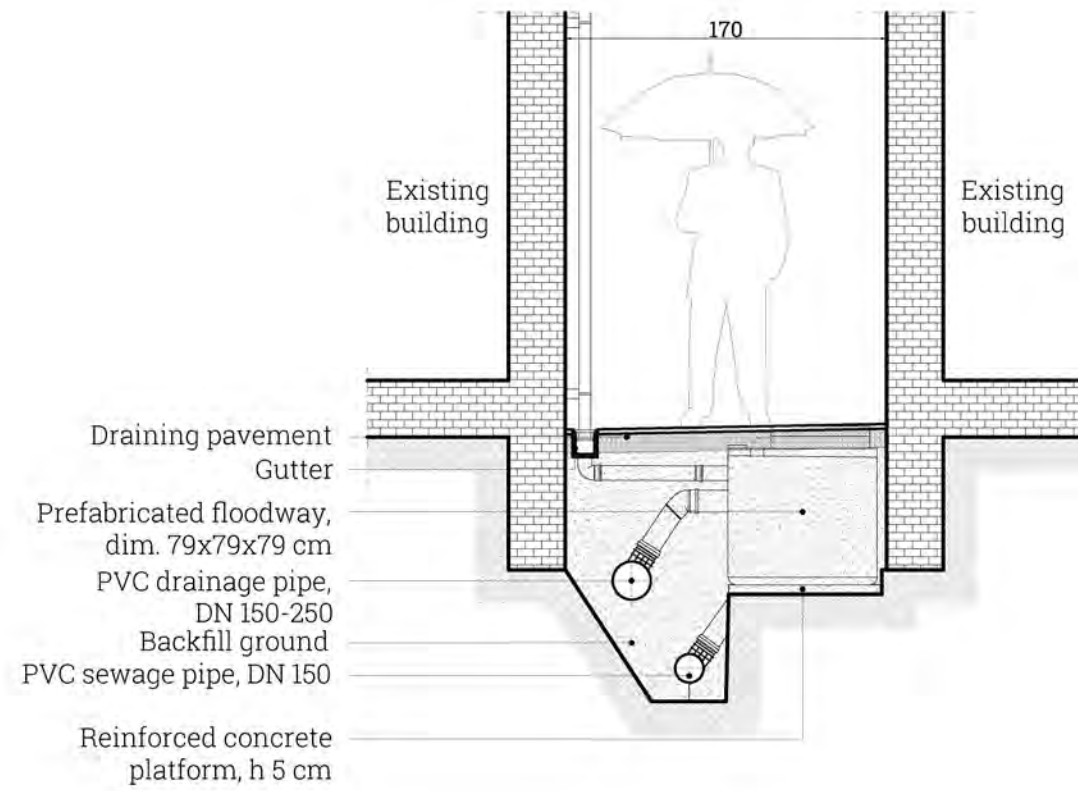


Section 3.2. Scale 1:40

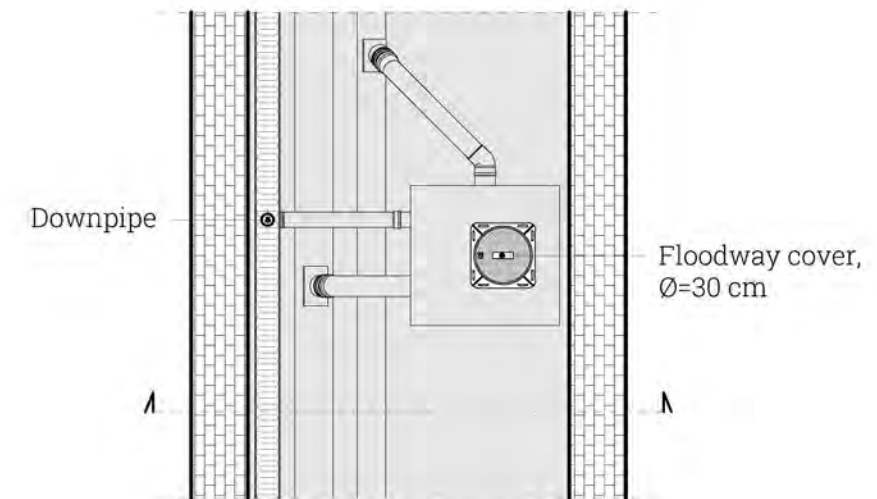
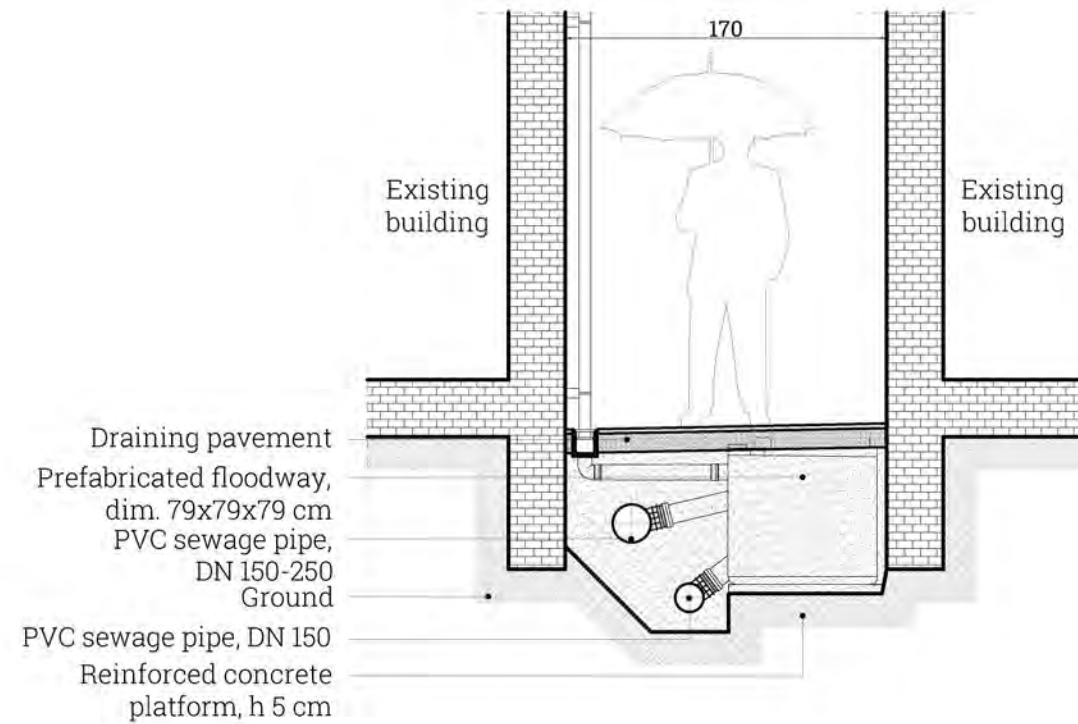


PILOT PROJECT

SEWAGE AND DRAINAGE SYSTEM SECTIONS



Section 4.1. Scale 1:40



Section 4.2. Scale 1:40

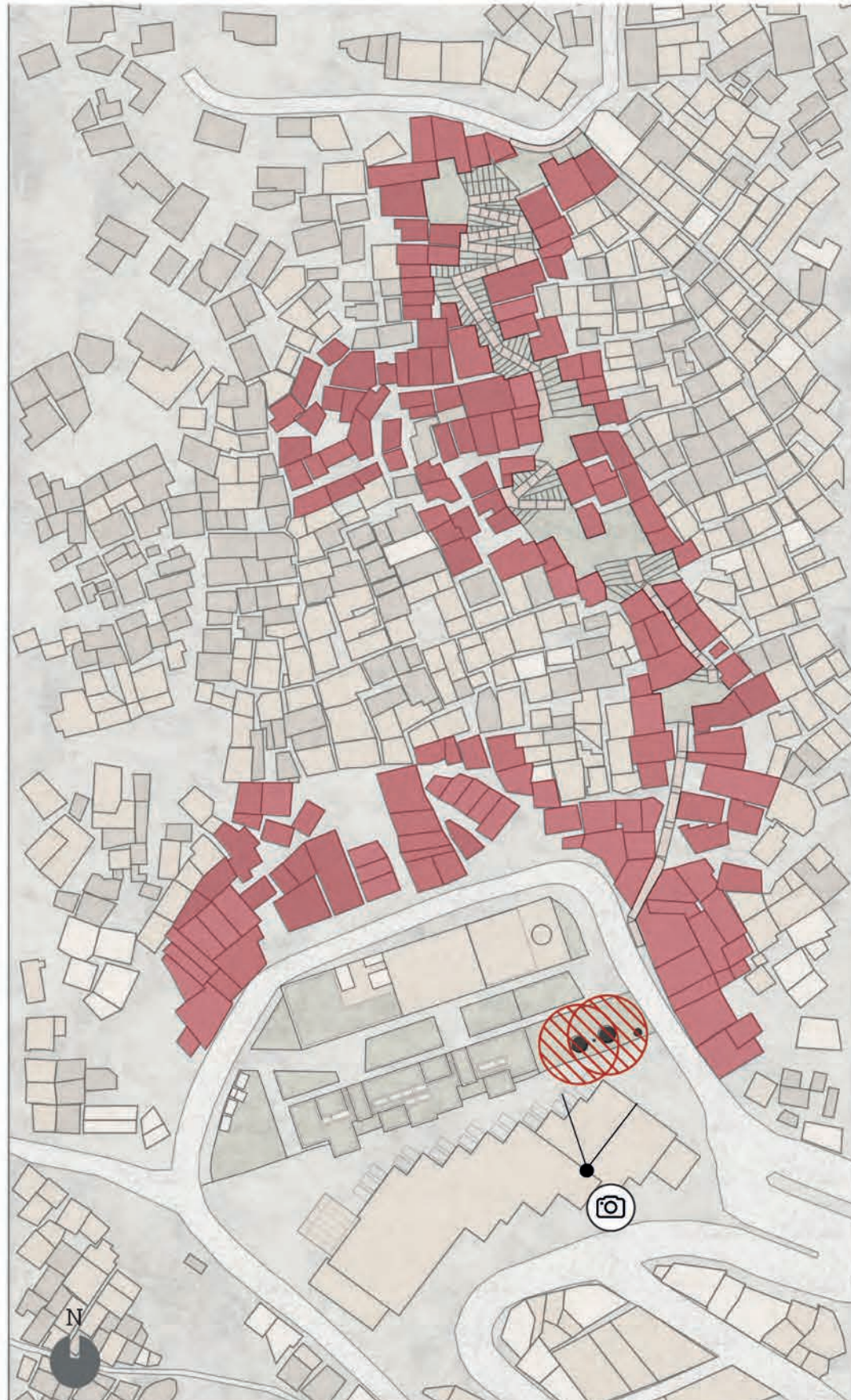


PILOT PROJECT

BIOGAS PLANT

Legend

-  Biogas Plant
-  Danger Zone
-  Basin

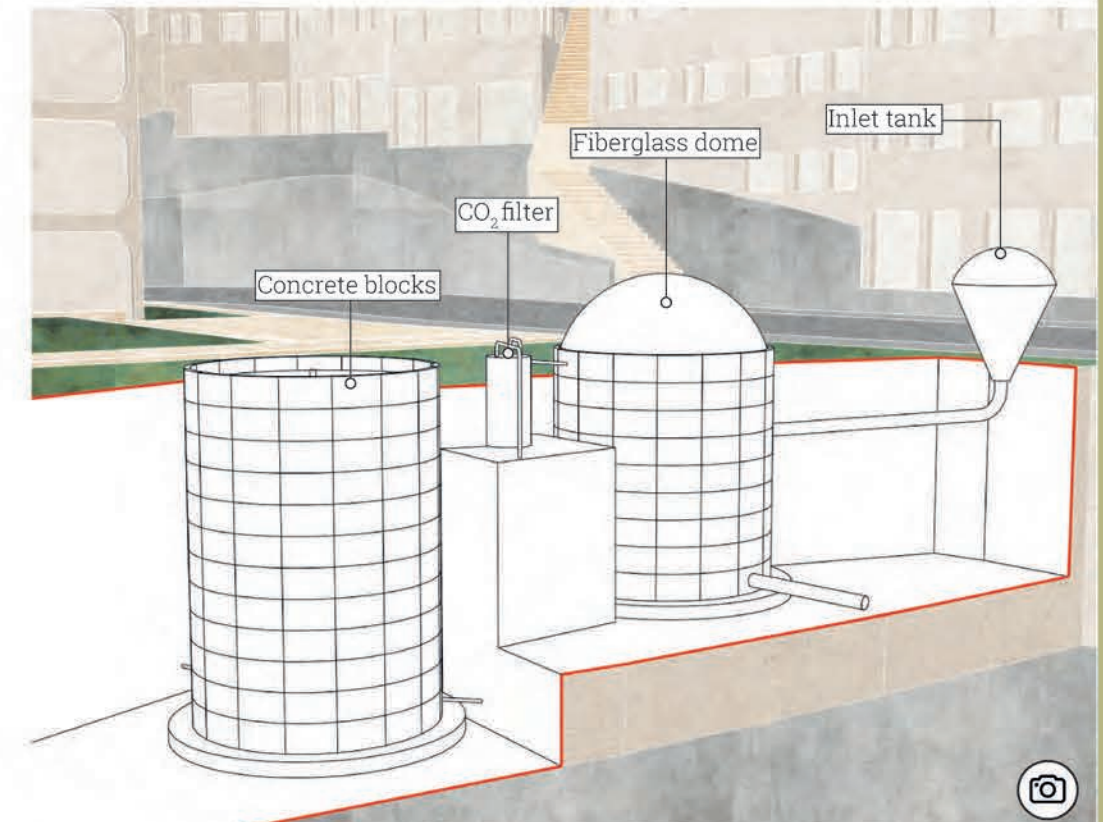


Legend

-  Inlet Tank
-  Biodigester
-  CO₂ Filter
-  Biogas Tank
-  Pipes
-  Danger Zone



Zoom



4



MASTERPLAN AND RETROFITTING

The tortuous paths snaking through the bowels of Rocinha makes reaching the highest parts of the favela a challenge even for its inhabitants. The necessity of new, improved connections has been underscored in the previous urban analysis is, therefore, the main aim of the intervention presented in the next chapter.

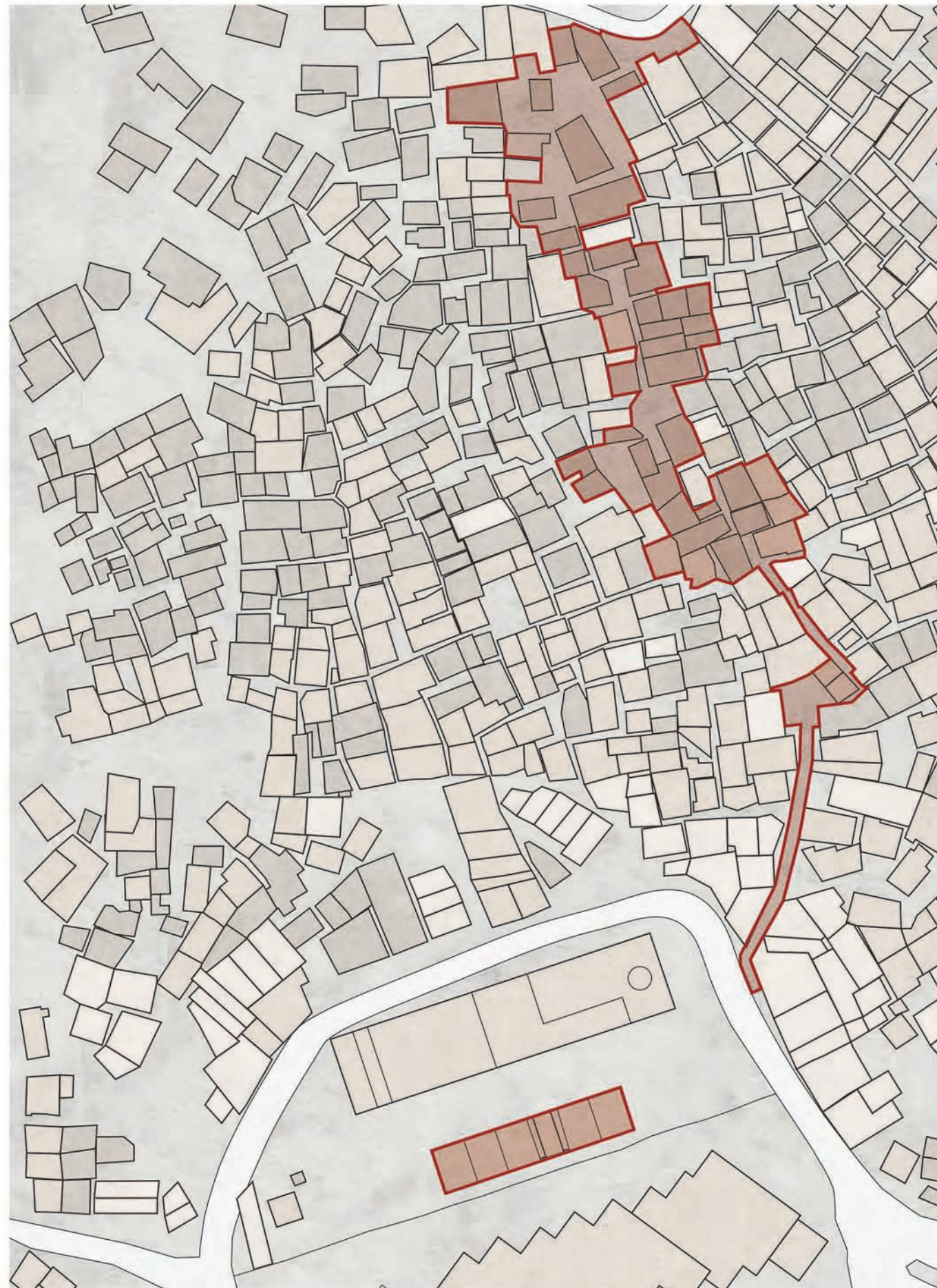
At the same time, the pilot projects analysed in the previous chapter will also be included here, presented as the interconnected system they were intended to be, alongside the peculiarities and rationales of the urban intervention proper.

Further, the final phase of the IMM analysis (retrofitting) occupies the last section of this chapter, translating the intervention into numerical values to be compared to those obtained by the initial survey, in order to make the improvements manifest.

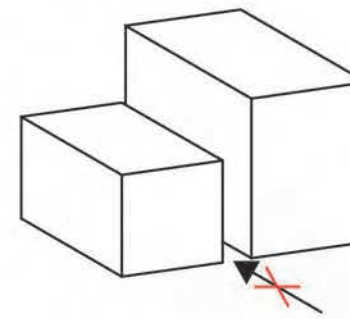
Lastly, comes the Masterplan of the architectural project, which serves as an introduction to the final chapter.

URBAN INTERVENTION PHASES

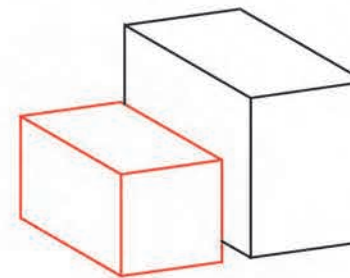
INTRODUCTION AND METHODOLOGY



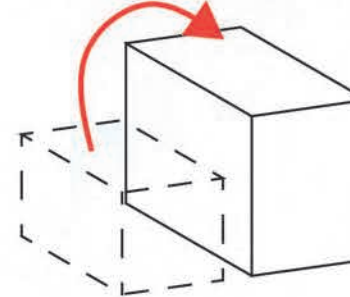
CURRENT SITUATION



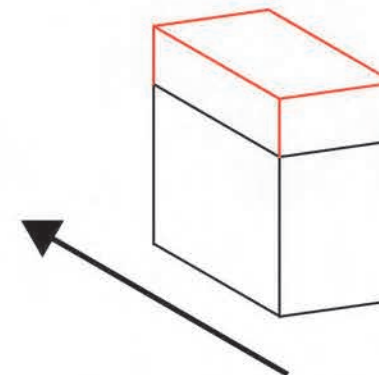
PHASE 1: BUILDINGS' IDENTIFICATION



PHASE 2: BUILDINGS' RELOCATION

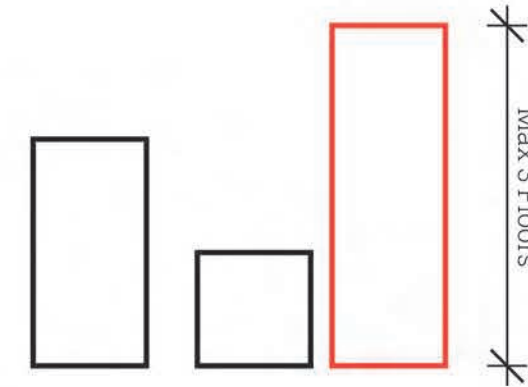


PHASE 3: INTERVENTION

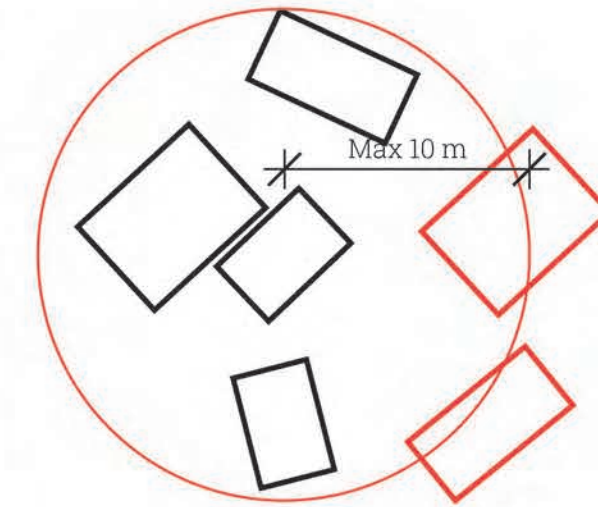


BUILDING'S CHOICE PARAMETERS

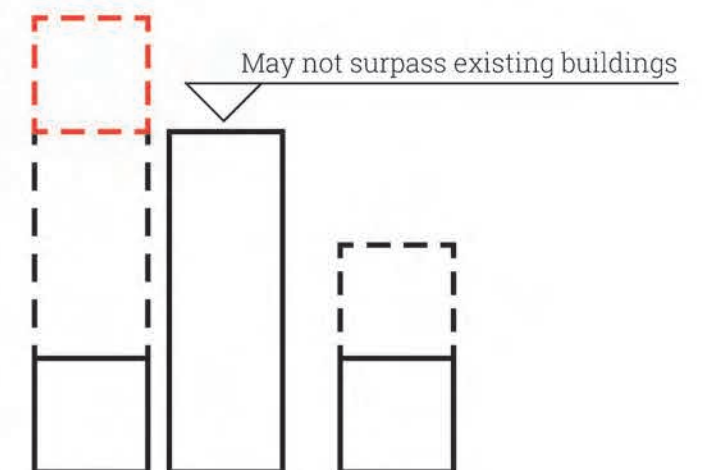
1st PARAMETER: REMOVED BUILDINGS' HEIGHT



2nd PARAMETER: RELOCATION PROXIMITY



3rd PARAMETER: NEW BUILDINGS' PROFILE



URBAN INTERVENTION PHASES

CURRENT SITUATION

EXISTING BUILDINGS

- 1 STOREY
- 2 STOREYS
- 3 STOREYS
- 4 STOREYS
- 5 STOREYS
- 6 STOREYS
- 7 STOREYS
- 8 STOREYS



PHASE 1: BUILDINGS' IDENTIFICATION

EXISTING BUILDINGS

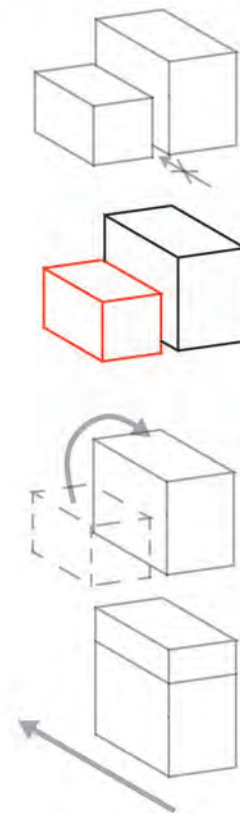
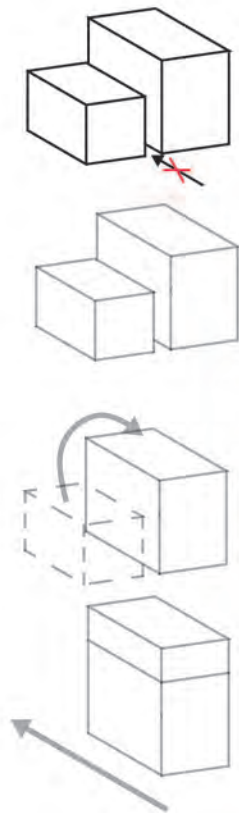
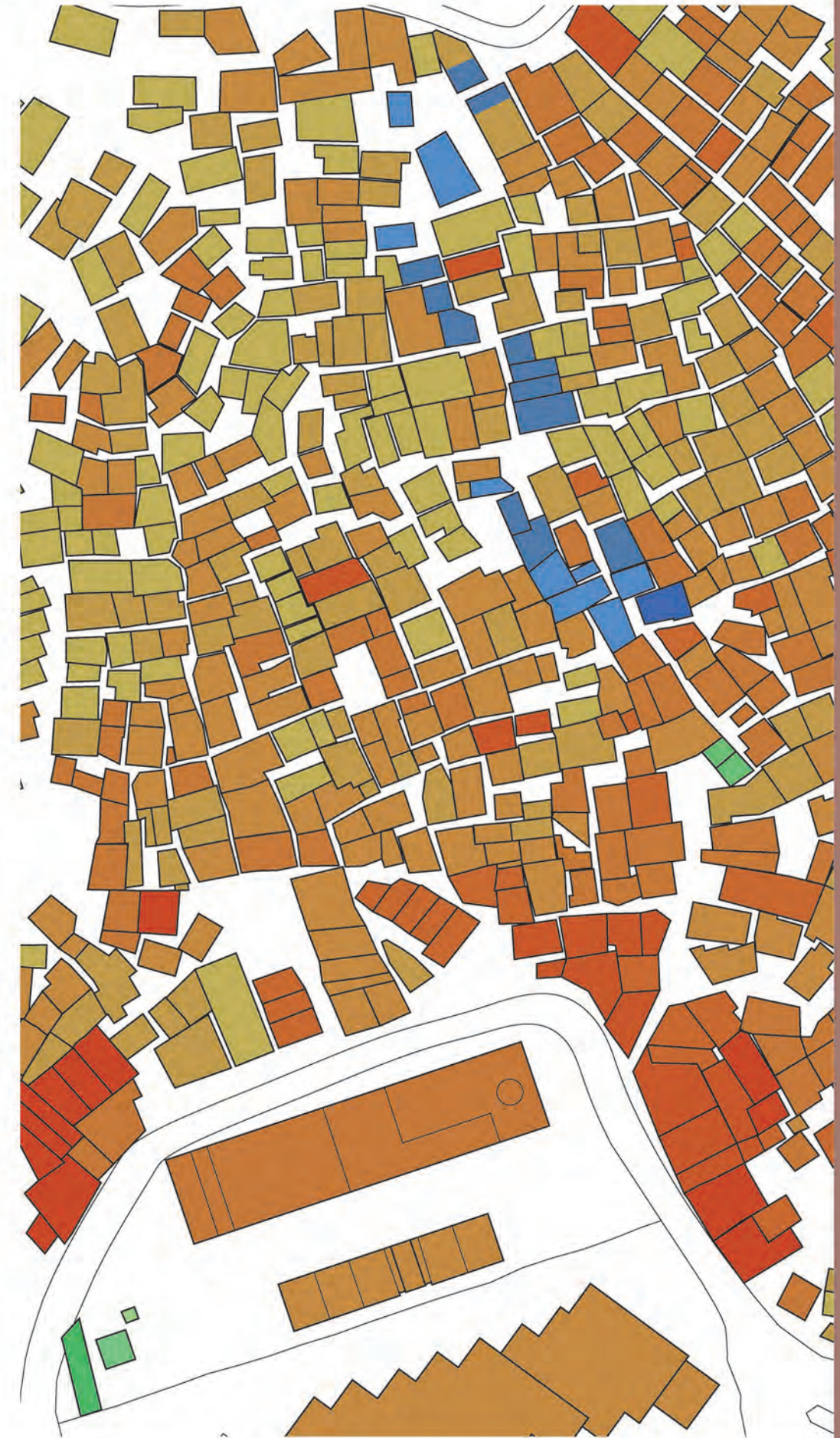
- 1 STOREY
- 2 STOREYS
- 3 STOREYS
- 4 STOREYS
- 5 STOREYS
- 6 STOREYS
- 7 STOREYS
- 8 STOREYS

REMOVED BUILDINGS

- 1 STOREY
- 3 STOREYS
- 4 STOREYS
- 6 STOREYS

RELOCATED BUILDINGS

- 1 STOREY
- 2 STOREYS
- 3 STOREYS



URBAN INTERVENTION PHASES

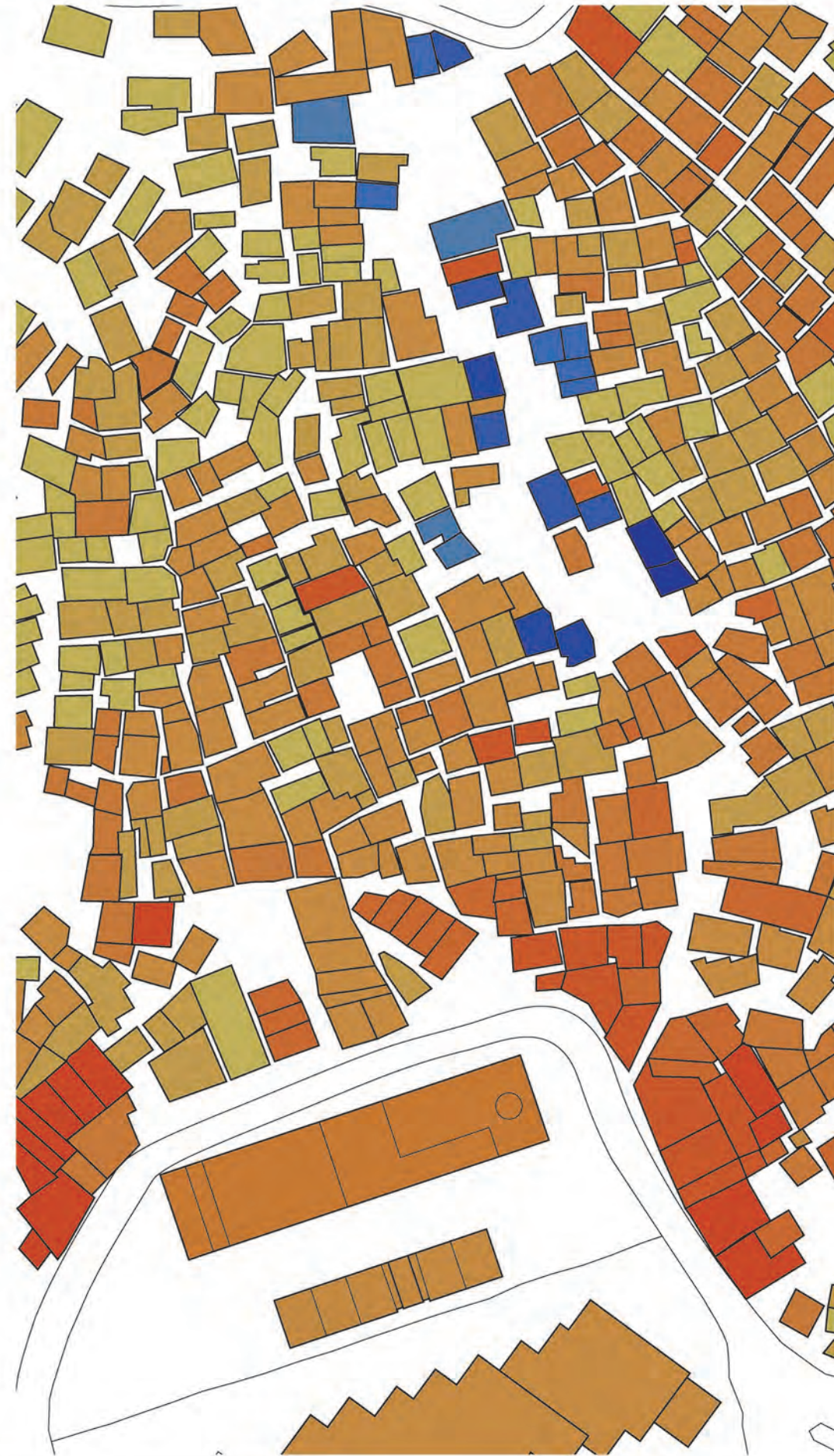
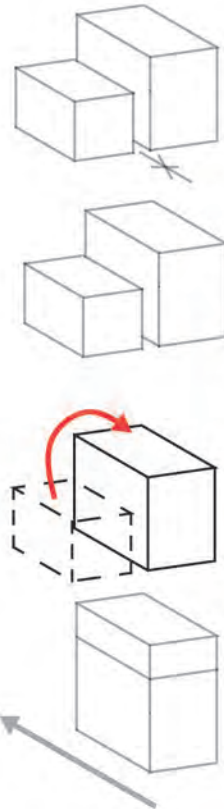
PHASE 2: BUILDINGS' RELOCATION

EXISTING BUILDINGS

- 1 STOREY
- 2 STOREYS
- 3 STOREYS
- 4 STOREYS
- 5 STOREYS
- 6 STOREYS
- 7 STOREYS
- 8 STOREYS

RELOCATED BUILDINGS

- 2 STOREY
- 3 STOREYS
- 4 STOREYS
- 5 STOREYS
- 6 STOREYS



PHASE 3: INTERVENTION

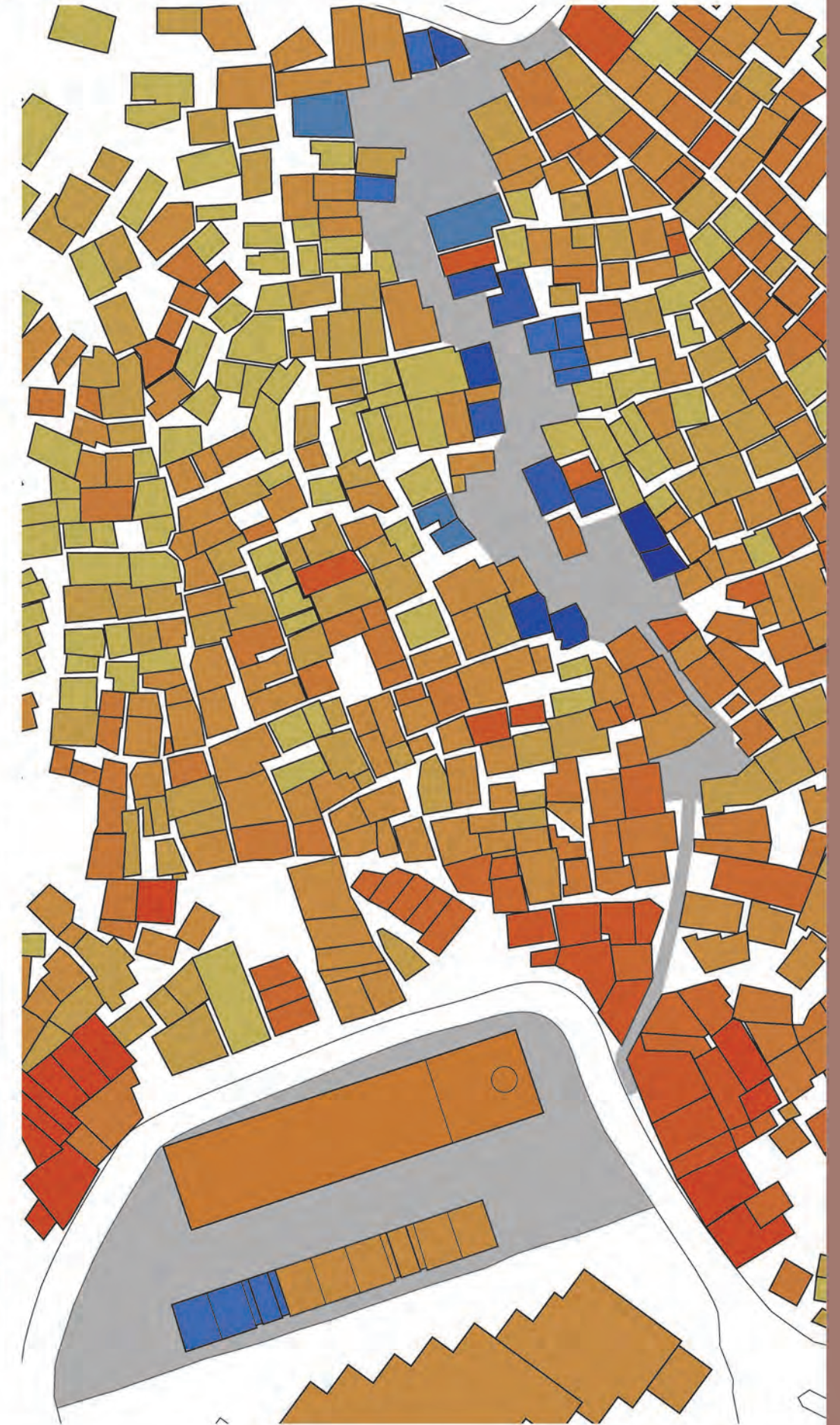
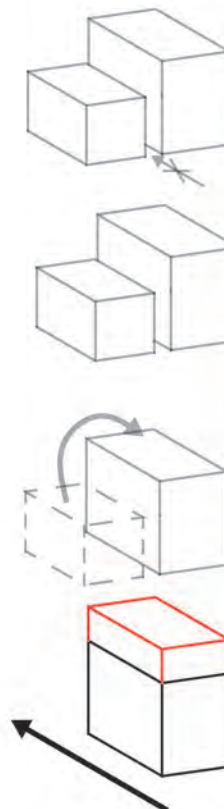
EXISTING BUILDINGS

- 1 STOREY
- 2 STOREYS
- 3 STOREYS
- 4 STOREYS
- 5 STOREYS
- 6 STOREYS
- 7 STOREYS
- 8 STOREYS

RELOCATED BUILDINGS

- 2 STOREY
- 3 STOREYS
- 4 STOREYS
- 5 STOREYS
- 6 STOREYS

PROJECT AREA

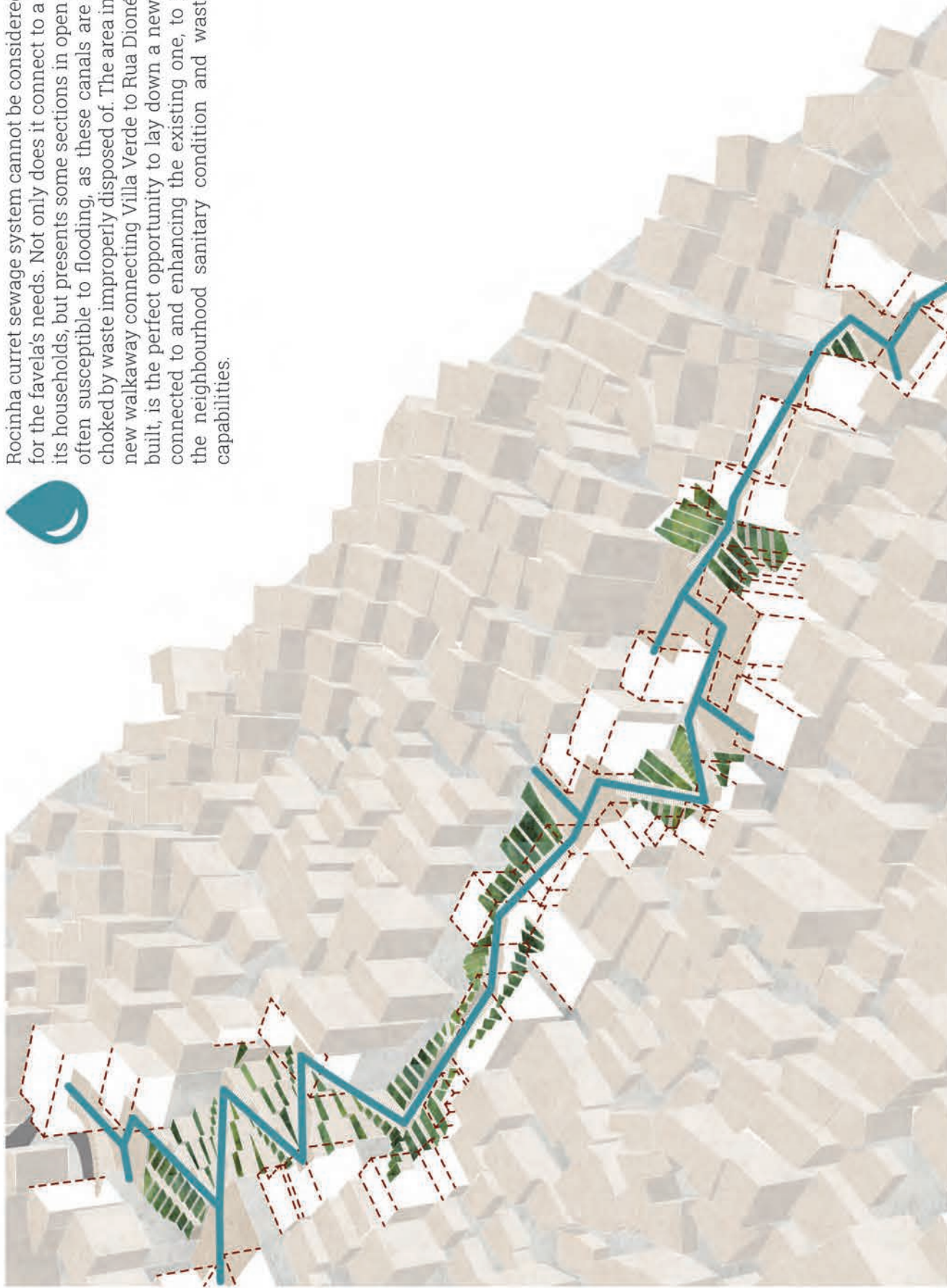


URBAN INTERVENTION: WALKWAY FUNCTIONS

Rocinha curret sewage system cannot be considered adequate for the favela's needs. Not only does it connect to a fraction of its households, but presents some sections in open air and it's often susceptible to flooding, as these canals are frequently choked by waste improperly disposed of. The area in which the new walkway connecting Villa Verde to Rua Dionédia will be built, is the perfect opportunity to lay down a new sewerage, connected to and enhancing the existing one, to ameliorate the neighbourhood sanitary condition and waste disposal capabilities.



SEWERAGE



Rocinha arguably possesses one of the most densely built urban environment in the world that, combined with its geomorphological characteristics (a bowl-shaped valley with rocky terrain and high slopes) and Brazil's climate, makes flooding an everyday occurrence. Thus, it becomes imperative to enhance soil retention in the area. This will be accomplished by building numerous terraces along the walkway, both planted and paved.



DRAINAGE



URBAN INTERVENTION: WALKWAY FUNCTIONS

In Portuguese, Rocinha means "little farm", as its inhabitants used to possess their own vegetable plot. Moreover, it has been shown that, inside the favela, empty spaces with no function will soon be utilized in some fashion. Consequently, the green terraces will not only be used for water drainage, but also as communal gardens for fruit trees. Four types of trees will be planted (apple, banana, mango and maracuja), as those can best provide a year-long harvest.



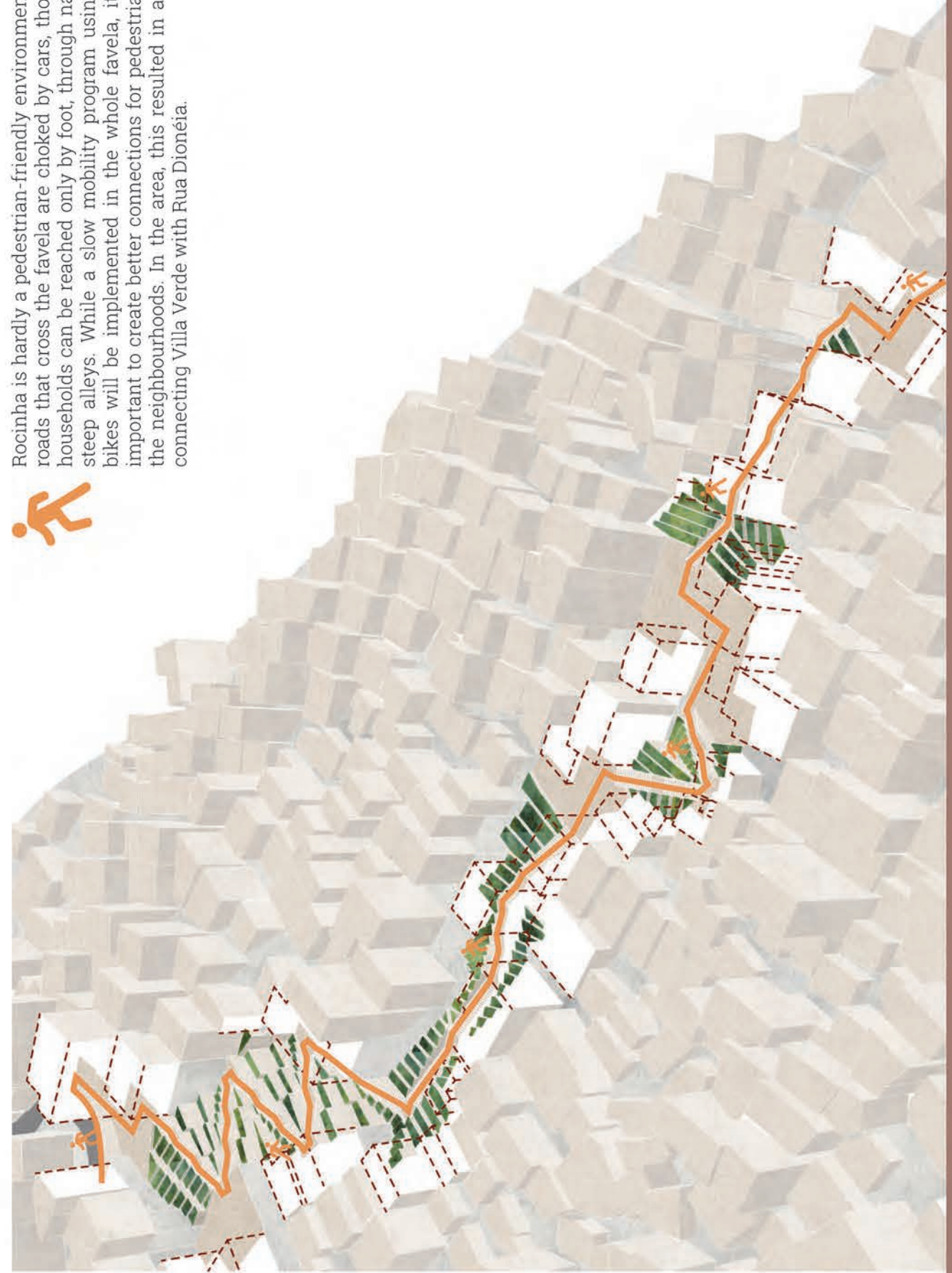
FOOD



Rocinha is hardly a pedestrian-friendly environment, the few roads that cross the favela are choked by cars, though most households can be reached only by foot, through narrow and steep alleys. While a slow mobility program using electric bikes will be implemented in the whole favela, it remains important to create better connections for pedestrians inside the neighbourhoods. In the area, this resulted in a walkway connecting Villa Verde with Rua Dionéia.



MOBILITY



URBAN INTERVENTION

CONCLUSIONS



REMOVED BUILDINGS

Number	Floor Srf. [m ²]	Storeys	Srf. Tot. [m ²]
1	70,74	6	424,44
2	36,00	3	108,00
3	6,13	1	6,13
4	25,00	4	100,00
5	19,86	4	79,44
6	54,96	1	54,96
7	57,48	3	172,44
8	54,45	1	54,45
9	37,37	1	37,37
10	49,07	1	49,07
11	12,48	1	12,48
12	59,29	2	118,58
13	51,93	2	103,86
14	30,91	2	61,82
15	22,53	1	22,53
16	71,67	2	143,34
17	35,98	2	71,96
18	30,19	2	60,38
19	29,40	2	58,80
20	43,57	2	87,14
21	26,91	2	53,82
22	33,42	2	66,84
23	34,19	1	34,19
24	94,32	1	94,32
25	30,12	1	30,12
26	26,41	2	52,82
27	31,09	2	62,18

Initial Habitable Srf. [m²] 2221,48

Initial Open Srf. [m²] 1341,10

RELOCATED BUILDINGS

Number	Floor Srf. [m ²]	Storeys	Srf. Tot. [m ²]
1	51,35	2	102,70
2	45,25	2	90,50
3	38,20	2	76,40
4	54,36	2	108,72
5	32,50	1	32,50
6	33,83	1	33,83
7	66,70	1	66,70
8	38,71	2	77,42
9	41,54	2	83,08
10	49,00	2	98,00
11	20,54	1	20,54
12	26,93	2	53,86
13	36,02	2	72,04
14	31,44	2	62,88
15	71,90	2	143,80
16	43,27	2	86,54
17	104,87	1	104,87
18	37,73	1	37,73
19	92,92	1	92,92
20	38,45	2	76,90
21	34,52	2	69,04

Habitable Srf. [m²] 1590,97

REFURBISHED WALDEMAR DEPOT

Type	Floor Srf. [m ²]	Number	Srf. Tot. [m ²]
Single	40,25	4	161,00
Double	80,50	8	644,00
Triple	78,40	4	313,60

Habitable Srf. [m²] 1118,60



URBAN INTERVENTION

3D VIEW



Politecnico di Milano-Polo Territoriale di Lecco
Scuola di Architettura urbanistica e ingegneria del costruito

Environmental performances and Social Inclusion
A project for the Rocinha's Favela

Relatore: Arch. Massimo Tadi
Correlatore: Ing. Gabriele Masera

Leonardo Biondi
Arianna Trombini

URBAN INTERVENTION

3D VIEW



Politecnico di Milano-Polo Territoriale di Lecco
Scuola di Architettura urbanistica e ingegneria del costruito

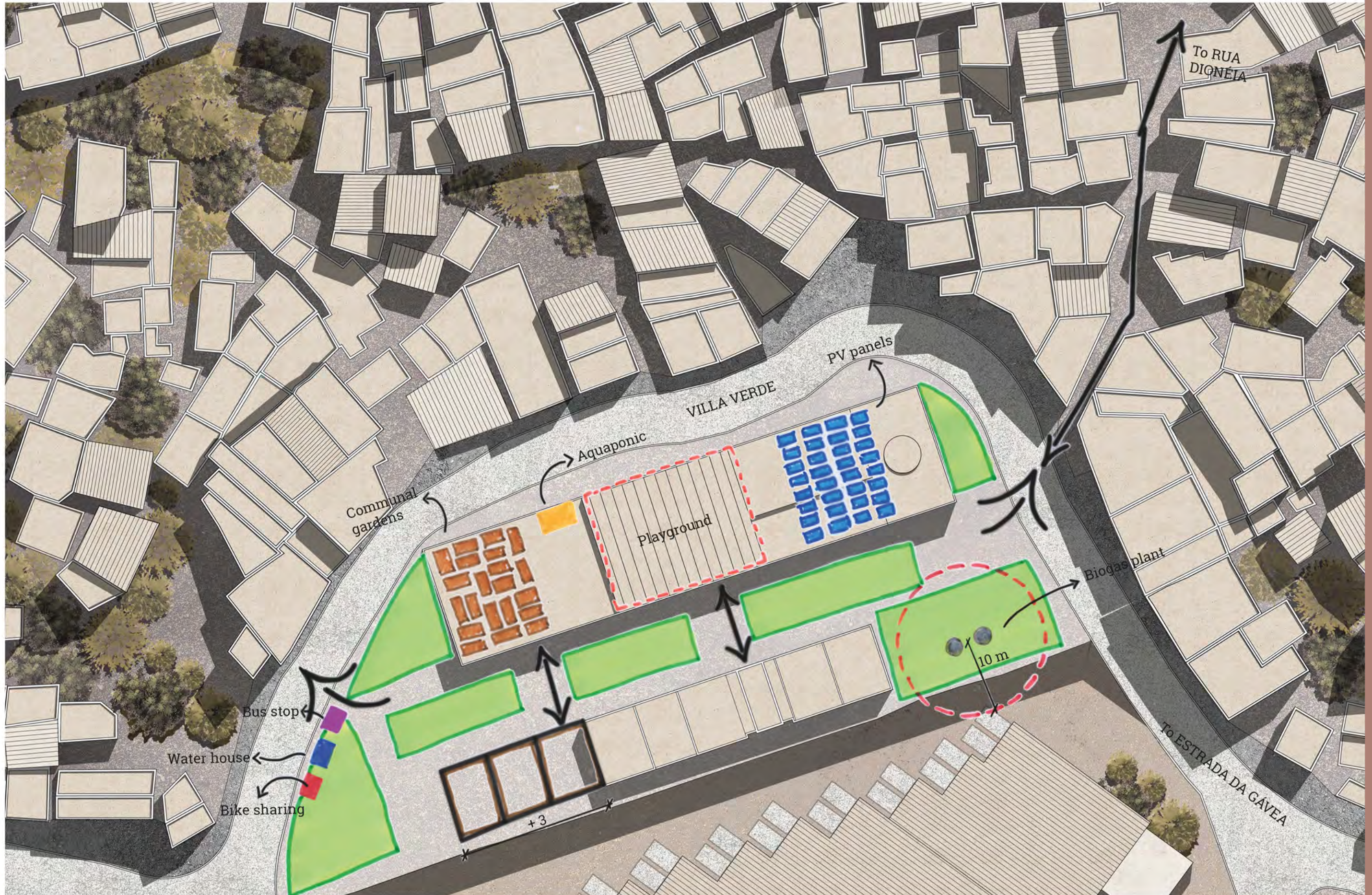
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URBAN INTERVENTION

SCHEMATIC DESIGN



URBAN INTERVENTION

MASTERPLAN



Politecnico di Milano-Polo Territoriale di Lecco
Scuola di Architettura urbanistica e ingegneria del costruito

Environmental performances and Social Inclusion
A project for the Rocinha's Favela








Relatore: Arch. Massimo Tadi
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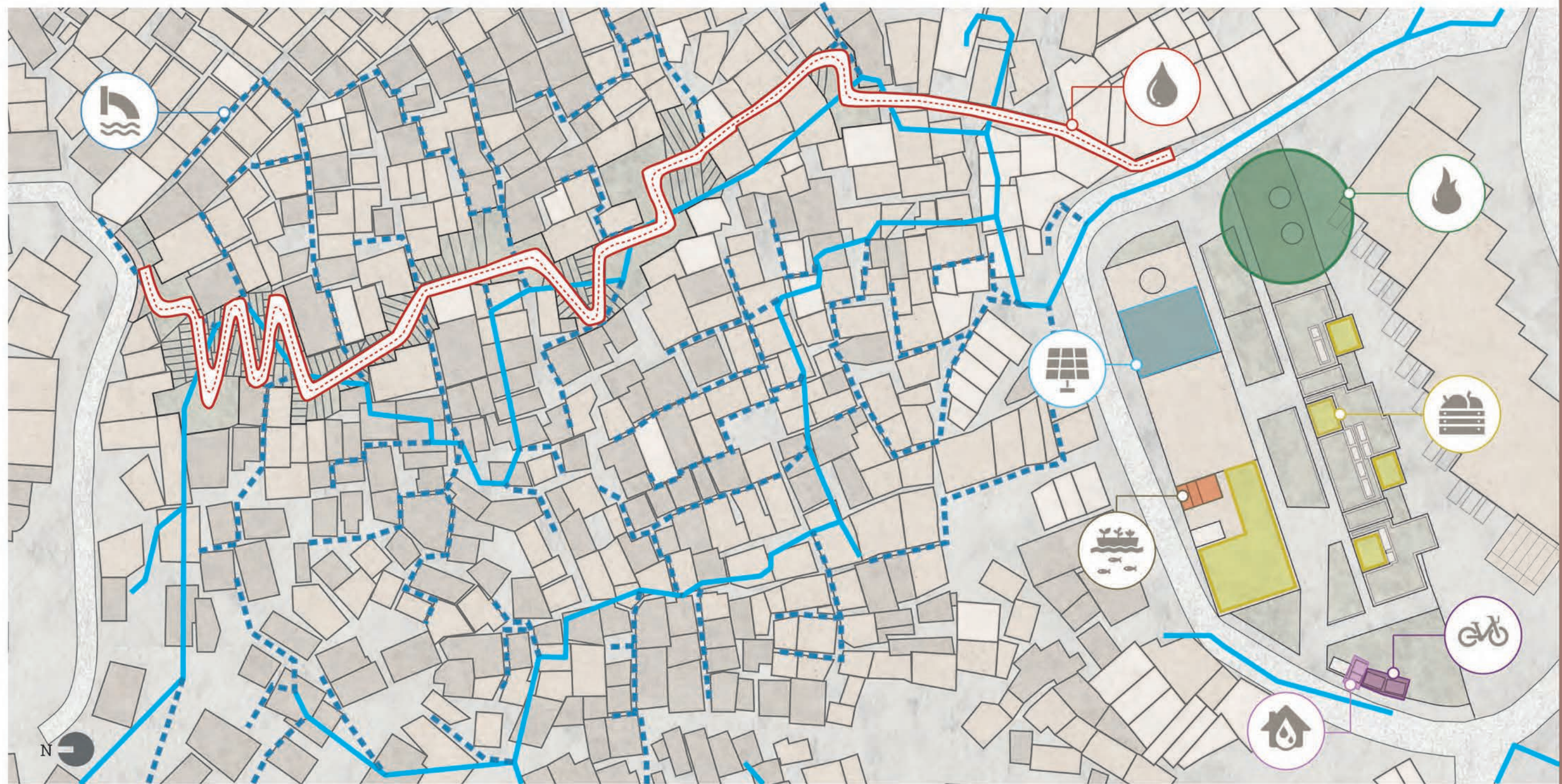
Leonardo Biondi
Arianna Trombini

URBAN INTERVENTION

PILOT PROJECTS' IMPLEMENTATION

Legend

-  New sewerage
-  Drainage system
-  Biogas plant
-  Photovoltaic panels
-  Vegetable box system
-  Current sewerage
-  Aquaponic system
-  Bike sharing
-  Water house





IMM RETROFITTING Horizontal Analysis

TRANSPORTATION

-  AUTOBUS
-  Bus Stop
-  Bus Line
-  Catchment area

-  TAXI BUS
-  Taxi Bus Stop
-  Taxi Bus Line
-  Catchment area

-  MOTO TAXI
-  Moto Taxi Parking
-  Moto Taxi Line
-  Catchment area

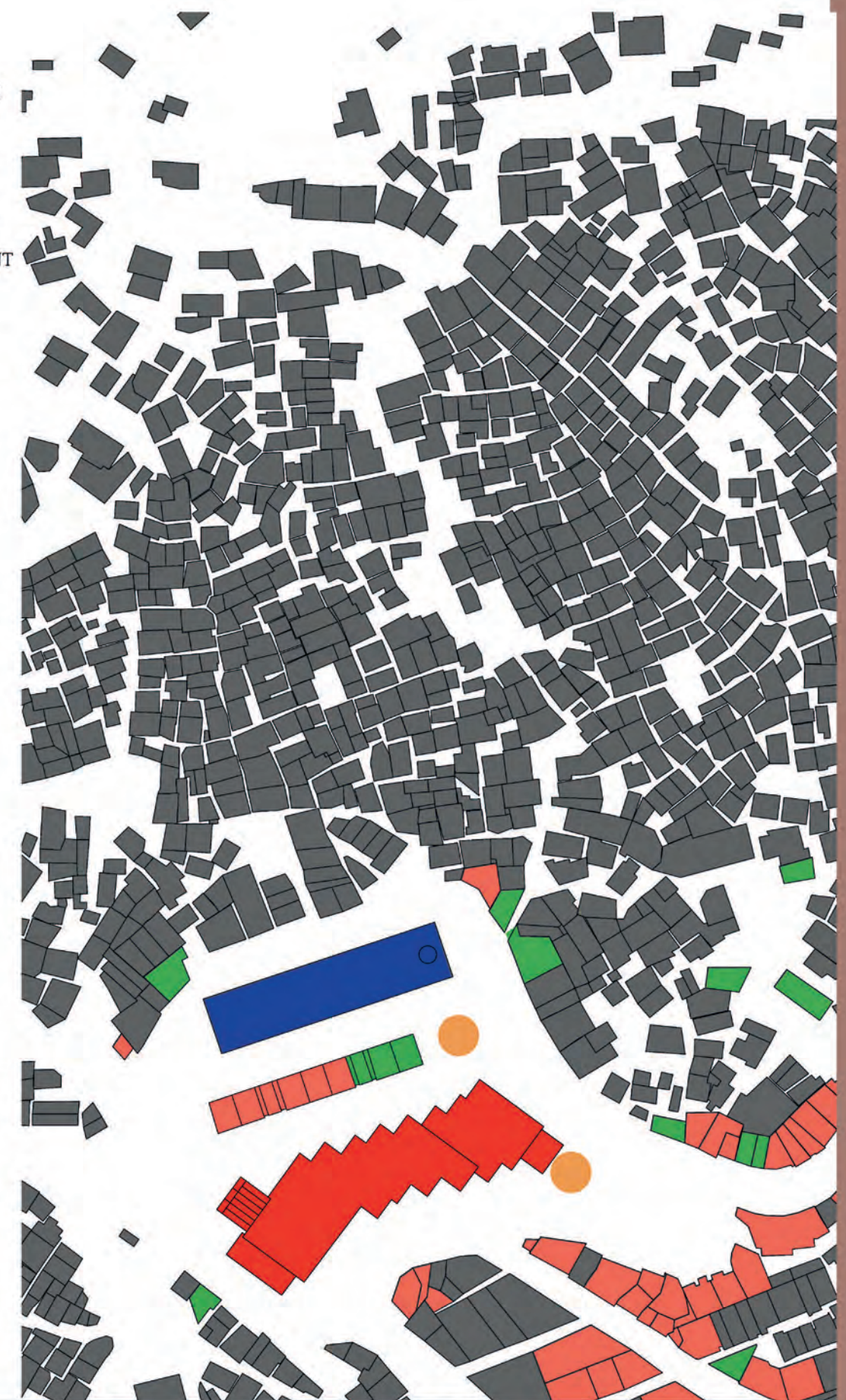
-  METRO
-  Metro station
-  Catchment area

-  BIKE SHARING
-  Bike station
-  Catchment area



FUNCTIONS

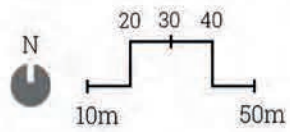
-  BANK/ATM
-  POST OFFICE
-  HEALTH SERVICE
-  SPORT SERVICE
-  WASTE COLLECTION
-  SHOPPING
-  MARKET (FOOD)
-  BAR/RESTAURANT
-  EDUCATION



IMM RETROFITTING Vertical Analysis

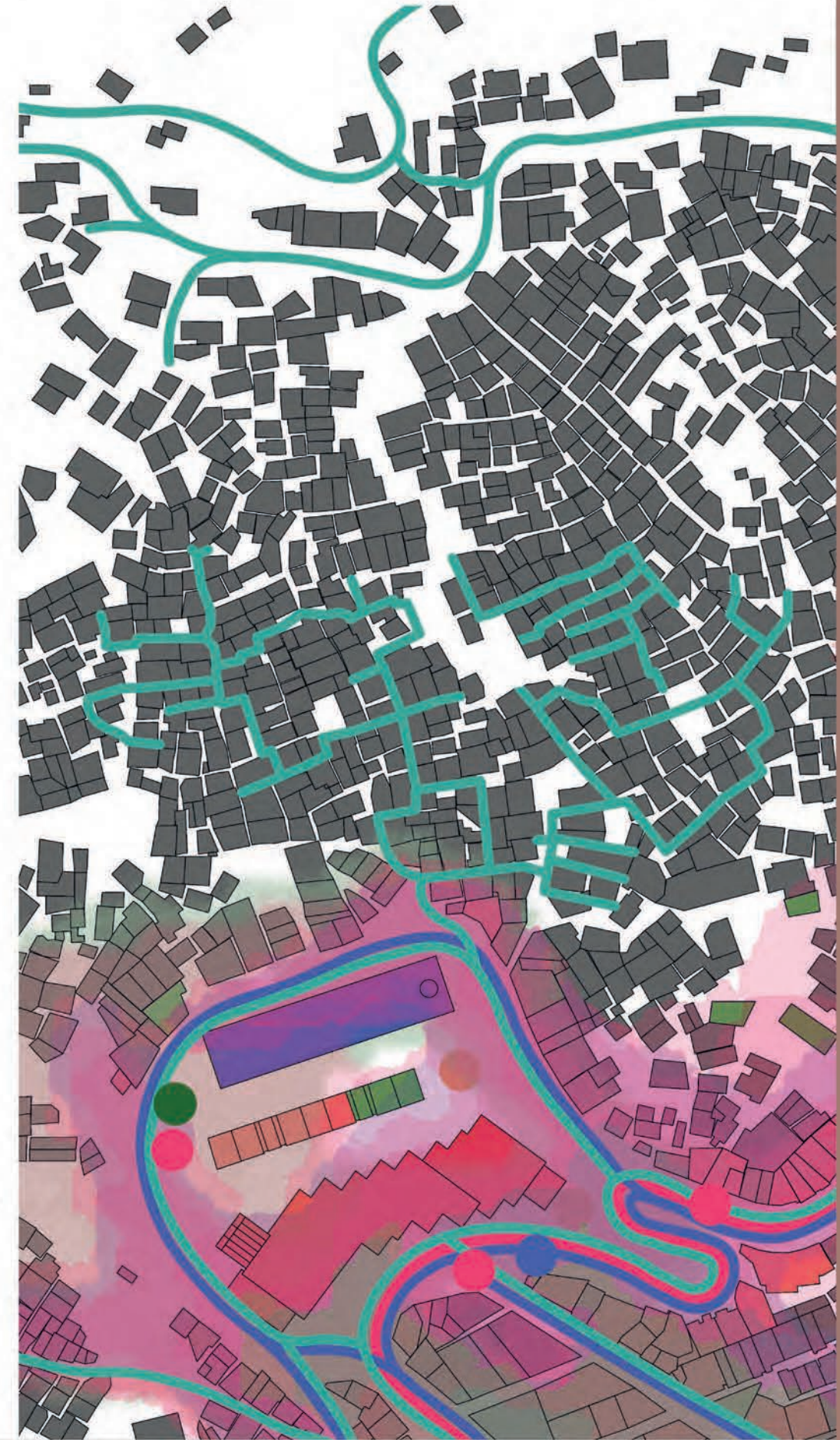
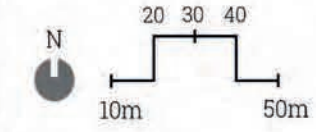
PROXIMITY

- Necessary regular activities
- Optional activities
- Necessary occasional activities
- Functions



ACCESSIBILITY

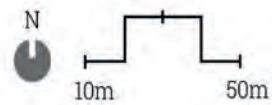
- AUTOBUS
 - Bus Stop
 - Bus Line
 - Catchment area
- TAXI BUS
 - Taxi Bus Stop
 - Taxi Bus Line
 - Catchment area
- MOTO TAXI
 - Moto Taxi Parking
 - Moto Taxi Line
 - Catchment area
- METRO
 - Metro station
 - Catchment area
- BIKE SHARING
 - Bike station
 - Catchment area
- BANK/ATM
- POST OFFICE
- HEALTH SERVICE
- SPORT SERVICE
- WASTE COLLECTION
- SHOPPING
- MARKET (FOOD)
- BAR/RESTAURANT
- EDUCATION



IMM RETROFITTING Vertical Analysis

DIVERSITY

- Necessary regular activities
- Optional activities
- Necessary occasional activities



POROSITY

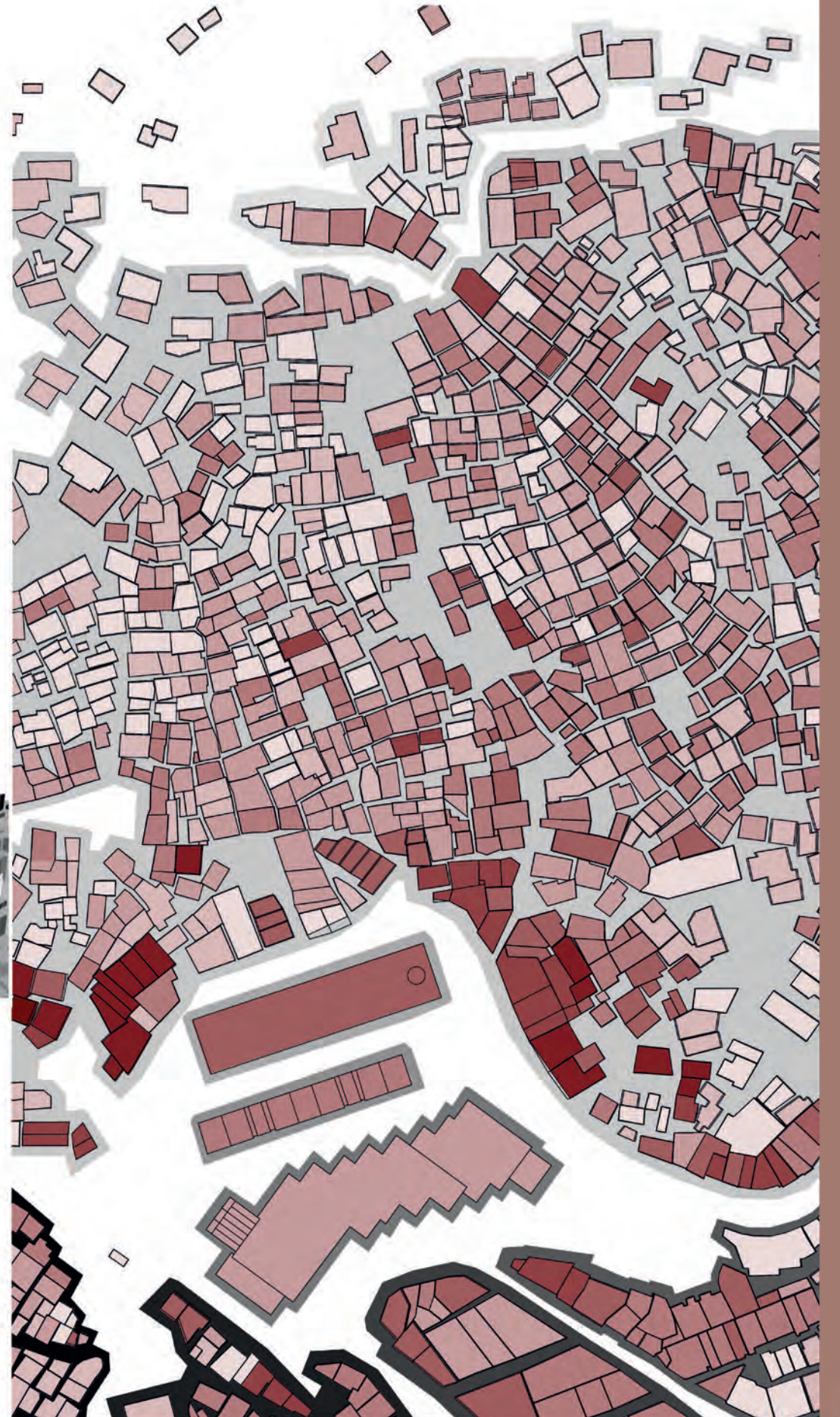
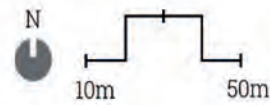
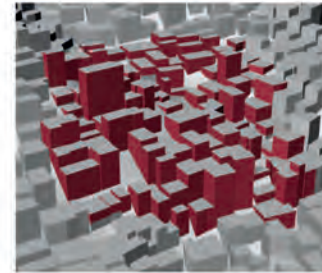
BUILDINGS

- 1 FLOOR (3m)
- 2 FLOORS (6m)
- 3 FLOORS (9m)
- 4 FLOORS (12m)
- 5 FLOORS (15m)
- 6 FLOORS (18m)
- 7 FLOORS (21m)
- 8 FLOORS (24m)

NEIGHBOURHOOD

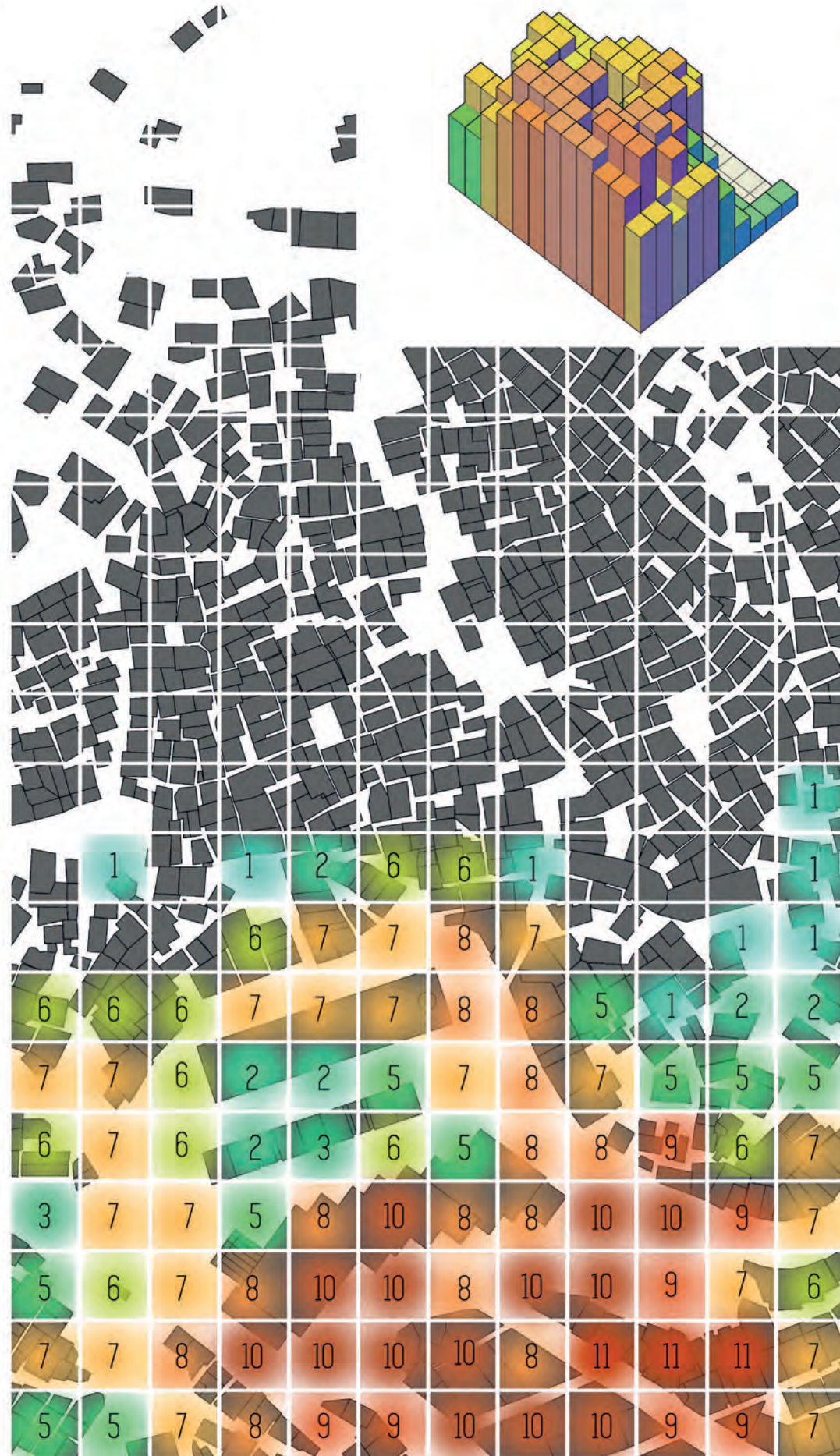
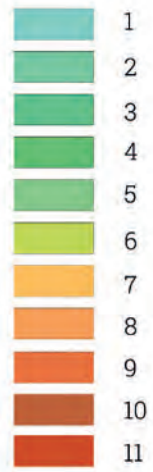
- 1 (4.445 m²)
- 2 (68.260 m²)
- 3 (1.673 m²)
- 4 (1.662 m²)
- 5 (2.630 m²)
- 6 (3.285 m²)
- 7 (2.779 m²)
- 8 (1.818 m²)
- 9 (5.017 m²)

VOLUME SAMPLE:
Free vertical surfaces

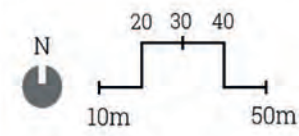
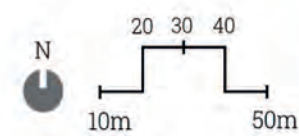
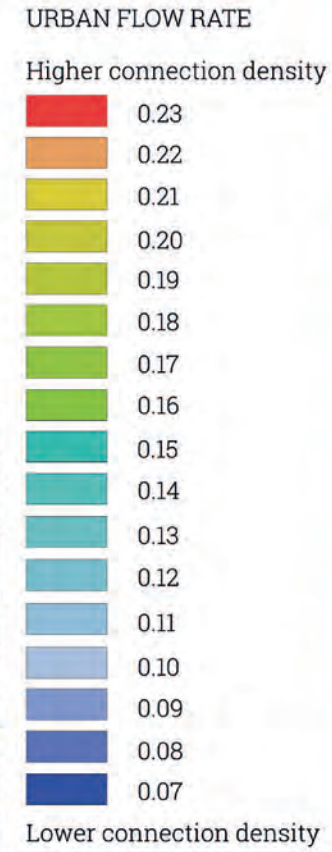


IMM RETROFITTING Vertical Analysis

EFFECTIVENESS



INTERFACE



IMM RETROFITTING VERTICAL ANALYSIS: PERMEABILITY

DIRECTNESS

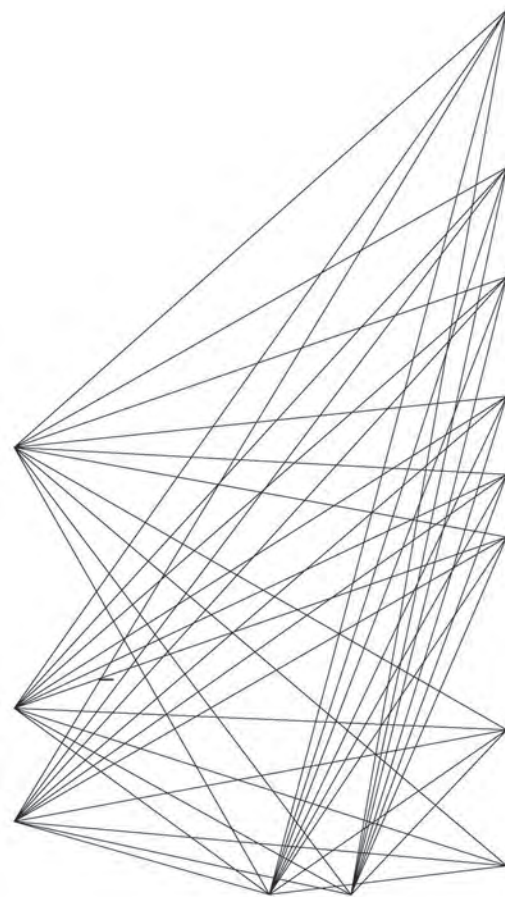
It represents how much an area encourages flow, or how easily it can be crossed. It measures how direct is the path between two points, comparing the distance as the crow flies to the shortest possible path following the street network.

$$Directness = \frac{L_d}{L_{sp}}$$

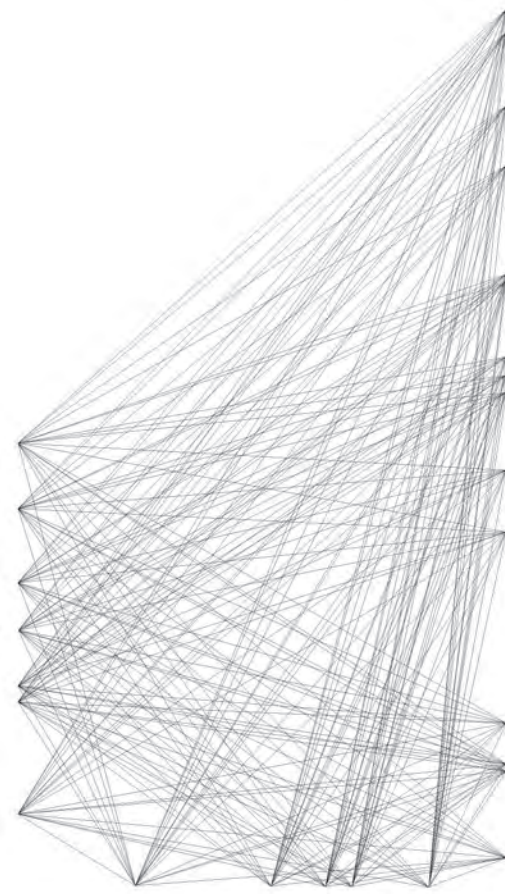
with:

L_d = Linear path, the distance measured as the crow flies [m].

L_{sp} = Shortest path, the shortest possible path following the street network [m].



The value for Directness increased slightly to 59.1%, meaning that, while it has become a bit easier to move from one point of the map to another, it still takes almost half-again as much compared to the linear path. As the intervention has moved only a few buildings, the issue of urban density has been ameliorated but not solved. Topography hasn't changed from the investigation phase, its value still at 74.3%.



LINK LENGTH

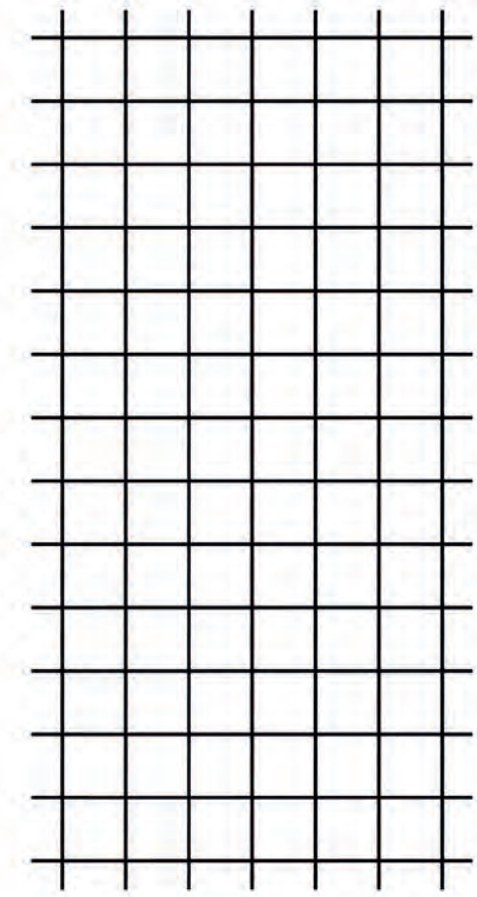
It represents the distance between intersections, in other words the easiness of changing routes and finding an alternative path within walking distance.

$$L_l = \frac{L_t}{N_{streets} \cdot L_{max}}$$

with:

$N_{streets}$ = Number of streets;

L_{max} = Maximum street length rounded to the nearest 50 m [m].



TORTUOSITY

It serves as the counterpart of the Directness, measuring the ease of a flow through a porous medium. In this investigation, the tortuosity has been computed using the TauFactor plug-in for Matlab.

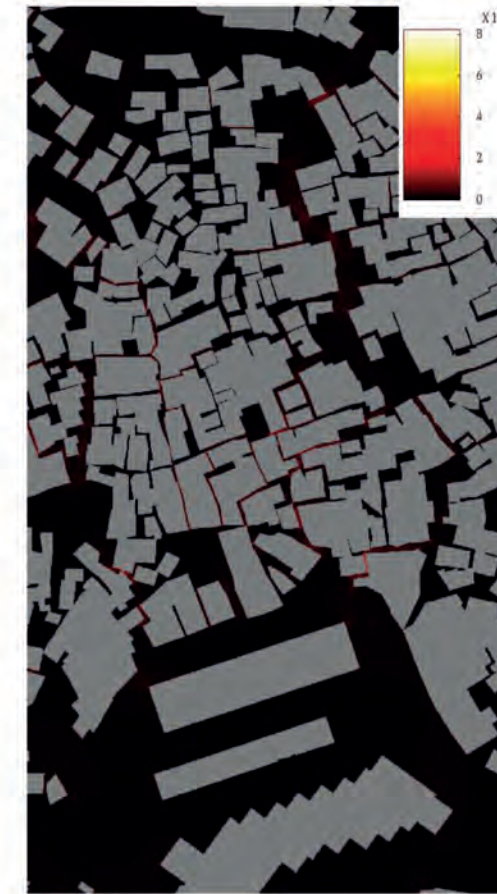
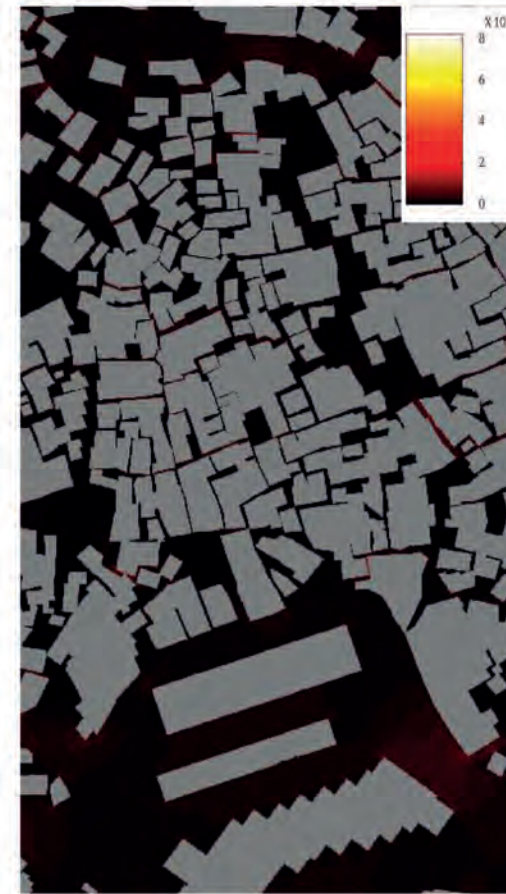
$$\tau_\gamma = \tau_x + \tau_y$$

with:

τ_x = Tortuosity measured by TauFactor on the x-axis;

τ_y = Tortuosity measured by TauFactor on the y-axis.

Thanks to the intervention, the value of Tortuosity has improved slightly (34.6%), mirroring the changes to the urban landscape of Area 1.



ARCHITECTURAL DESIGN

As discussed in previous chapters, no single intervention or building can significantly impact the current living conditions of Rocinha. On that level, the architectural intervention presented in the next chapter shouldn't be debated on its own, but rather as a centrepiece of the projects described above.

The building designed in the following sections, a refurbishment of the Waldemar gas depot inside Villa Verde, will turn one of the most useless and potentially dangerous extant functions of Area 1 into a physical representation of the overall project for the betterment of the favela.

Brazilian contemporary residential architecture, especially when related to favelas, has been analysed in order to determine appropriate living spaces for the apartments to be placed in the new building.

Moreover, a specific section will cover the structural design of the precast reinforced concrete frames which will bear the loads of the new addition to the existing edifice.



ARCHITECTURAL DESIGN

3D VIEW



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Arianna Trombini

PLANS 1:200
GROUND FLOOR



PLANS 1:200

FIRST FLOOR



PLANS 1:200

SECOND FLOOR

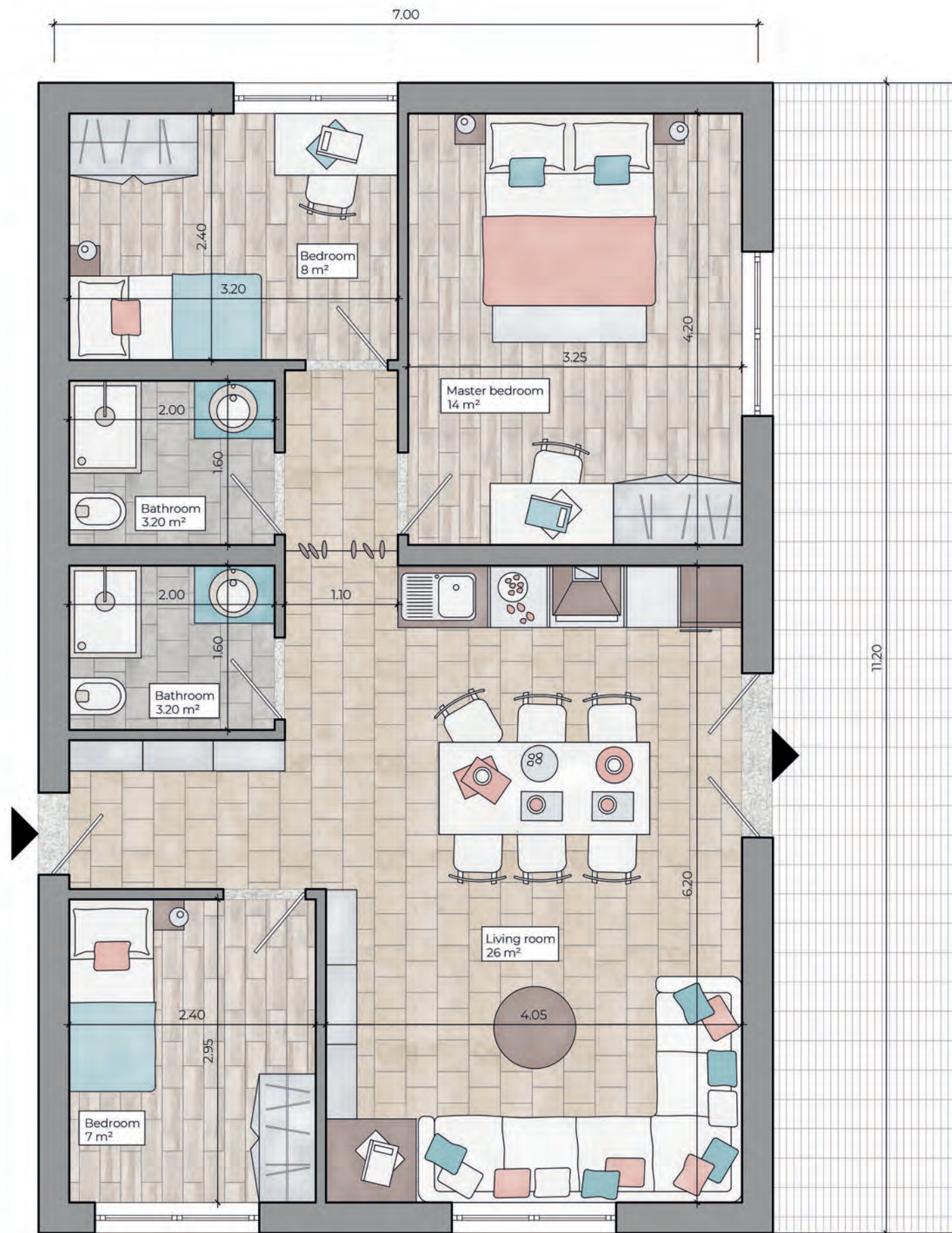


PLANS 1:200
ROOF

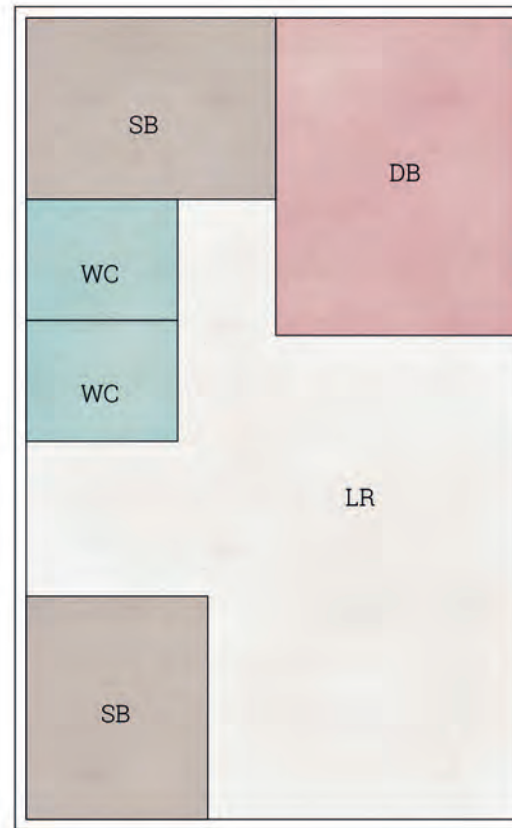


APARTMENTS DESIGN 1:50

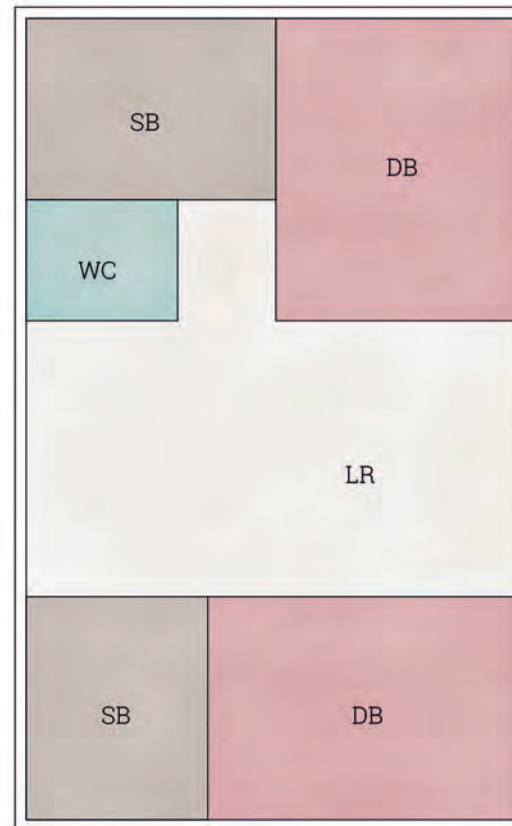
THREE BEDROOM APARTMENT



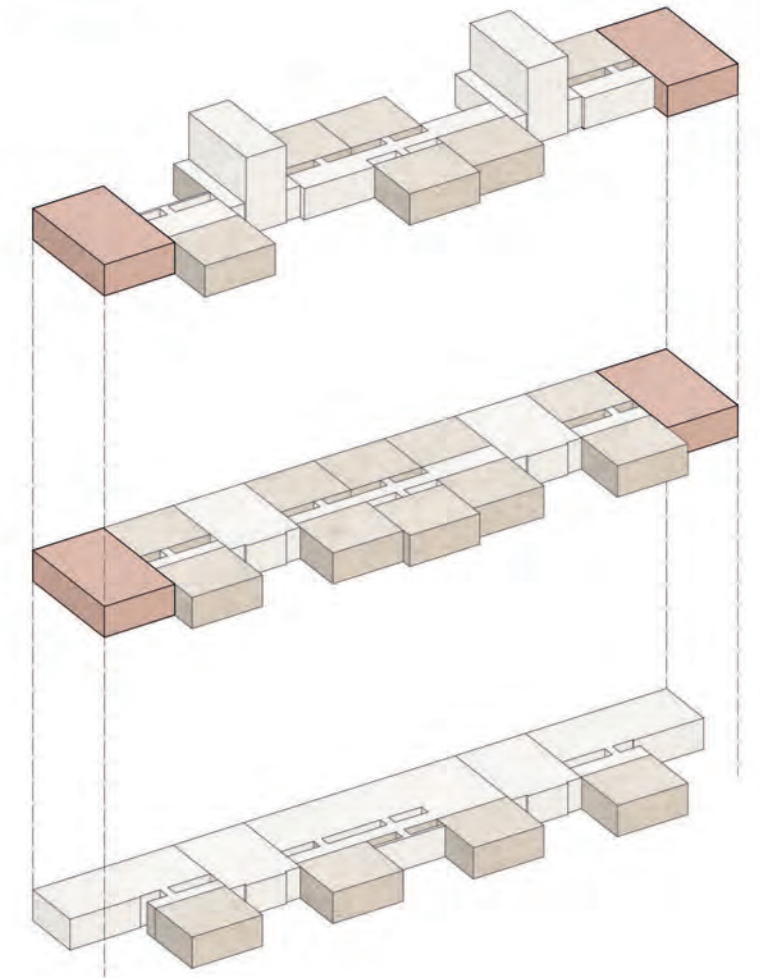
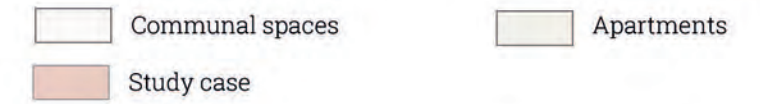
OPTION A 1:100



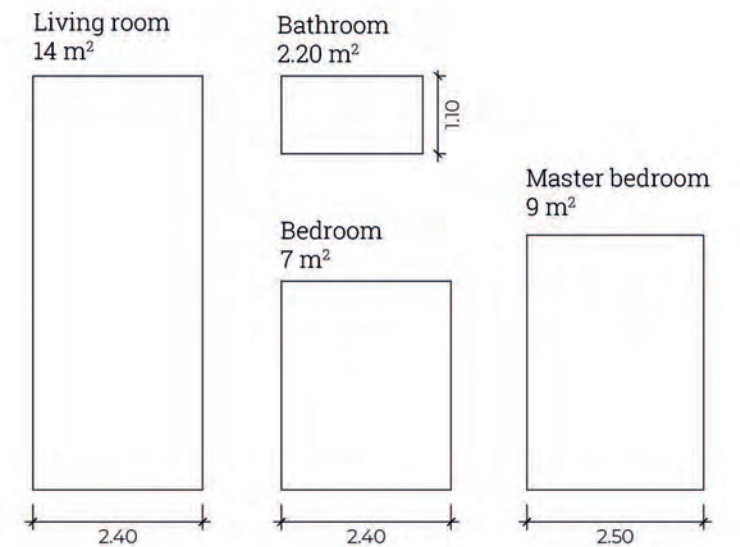
OPTION B 1:100



BUILDING KEYPLAN

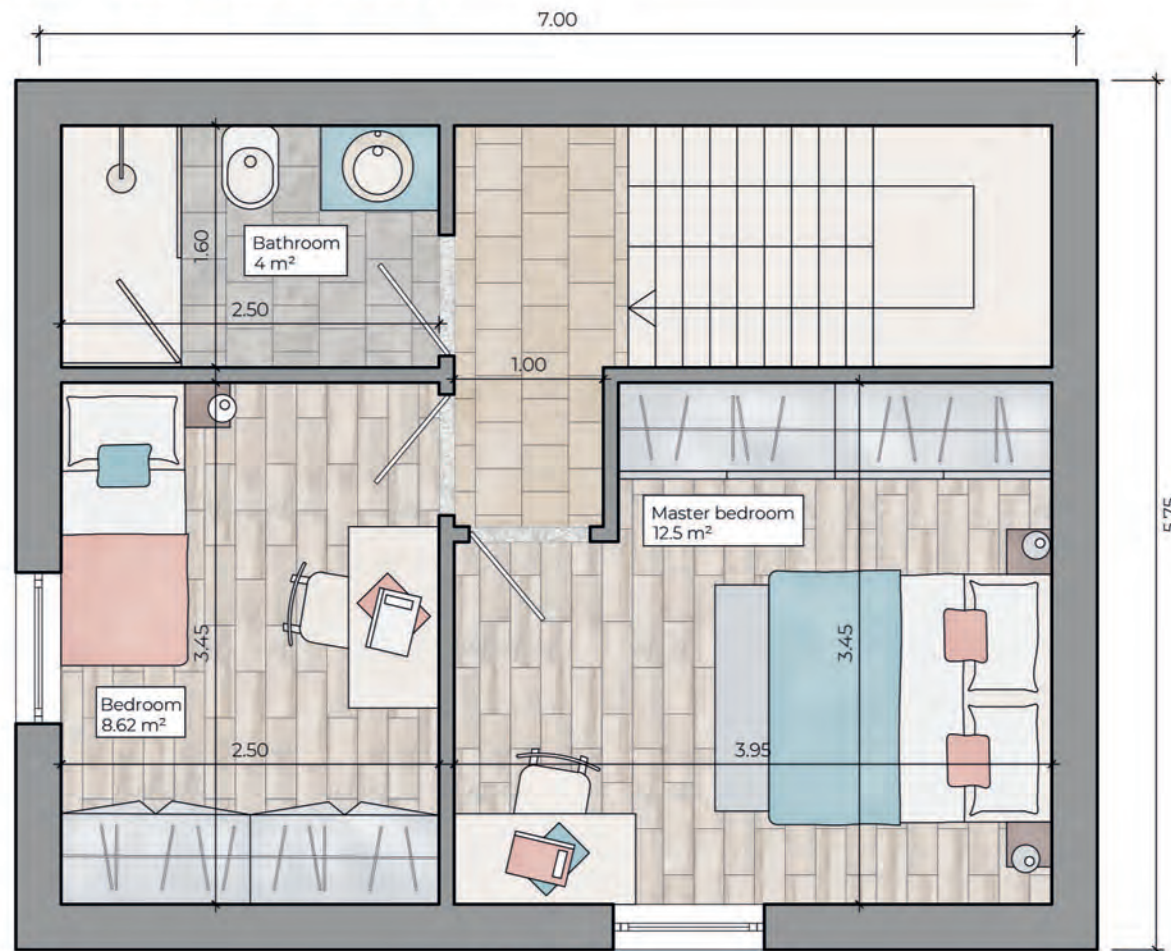


BRASILAN MINIMUM STANDARDS 1:100

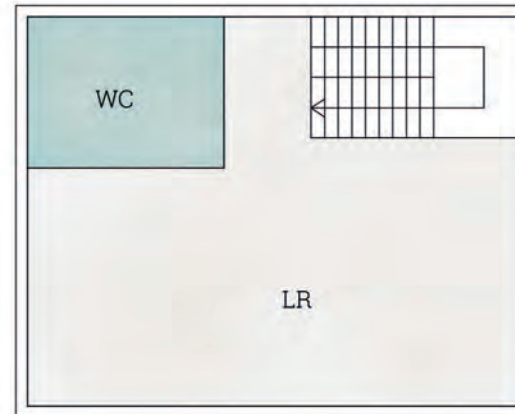
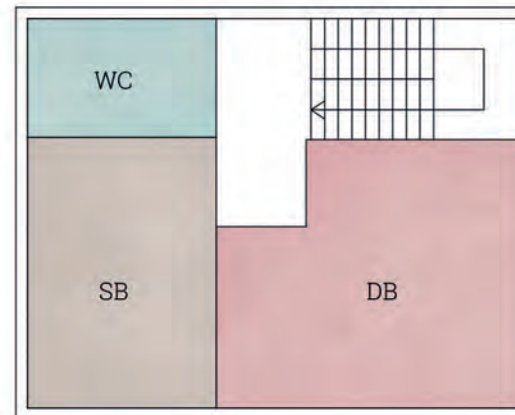


APARTMENTS DESIGN 1:50

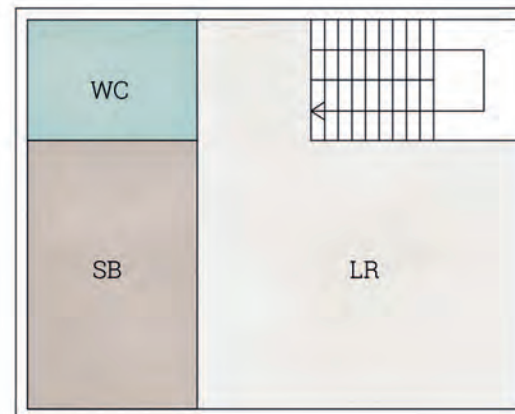
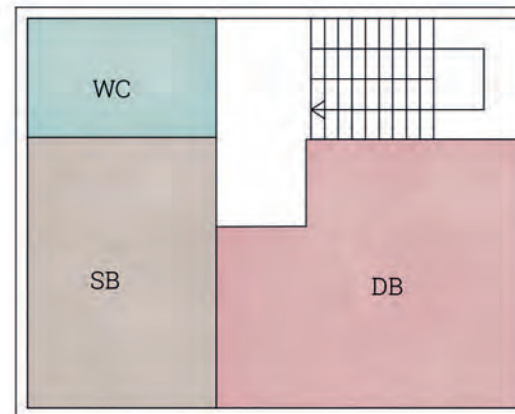
DUPLEX APARTMENT



OPTION A 1:100

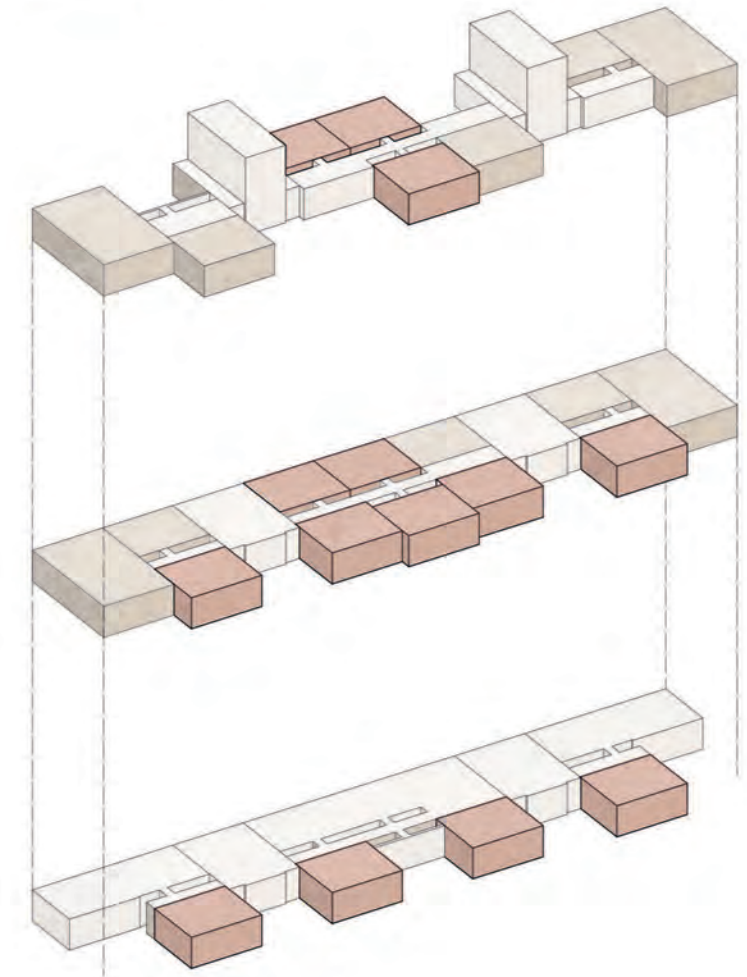


OPTION B 1:100

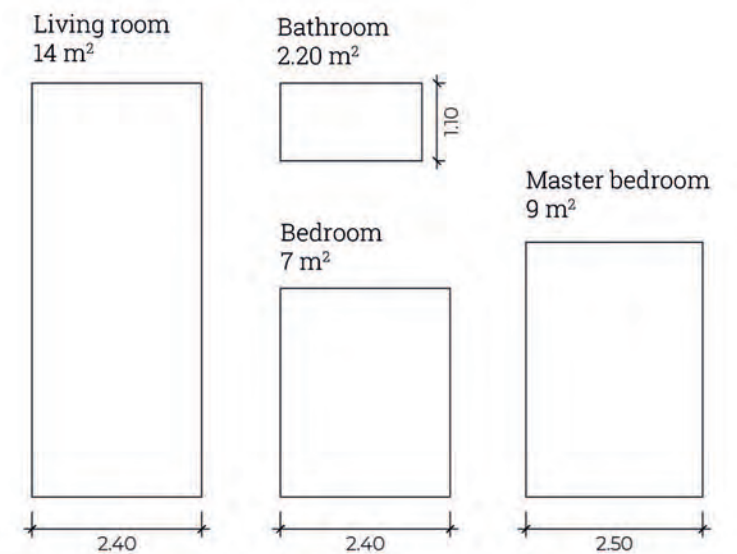


BUILDING KEYPLAN

- Communal spaces
- Study case
- Apartments



BRASILAN MINIMUM STANDARDS 1:100

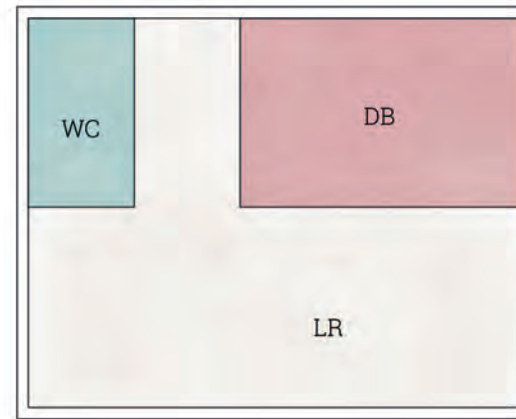


APARTMENTS DESIGN 1:50

SINGLE BEDROOM APARTMENT



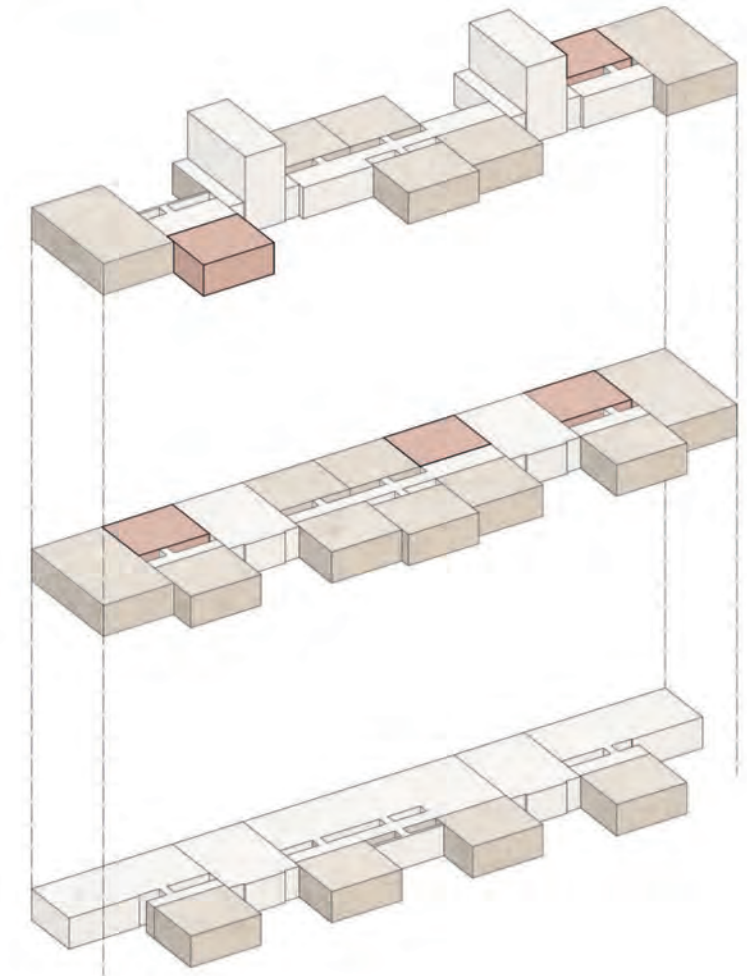
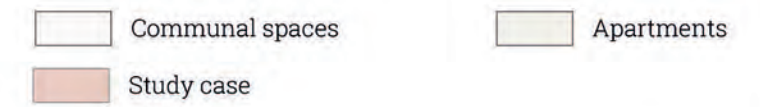
OPTION A 1:100



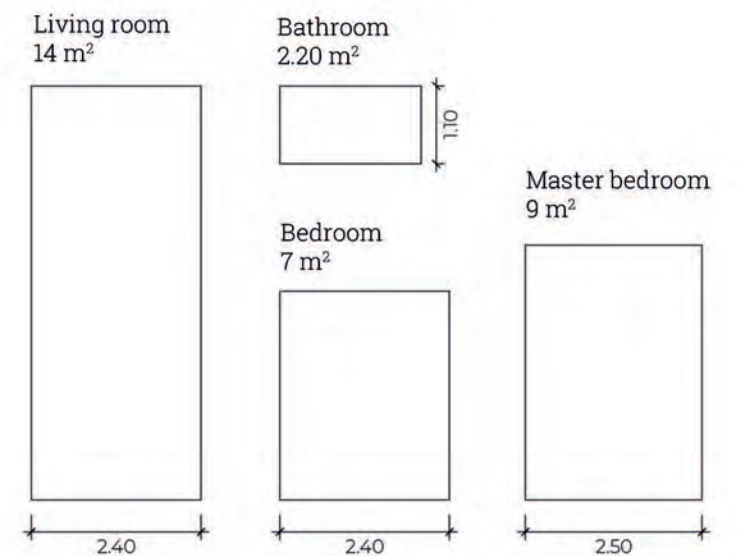
OPTION B 1:100



BUILDING KEYPLAN



BRASILAN MINIMUM STANDARDS 1:100



SECTION 1:100
SECTION A-A'



ELEVATION 1:200

FRONTAL VIEW



Elevation A-A'



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ELEVATION 1:200
LATERAL VIEWS



Elevation B-B'



Elevation C-C'



ELEVATION 1:200

REAR VIEW



Elevation D-D'



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


Relatore: Arch. Massimo Tadi
Correlatore: Ing. Gabriele Masera

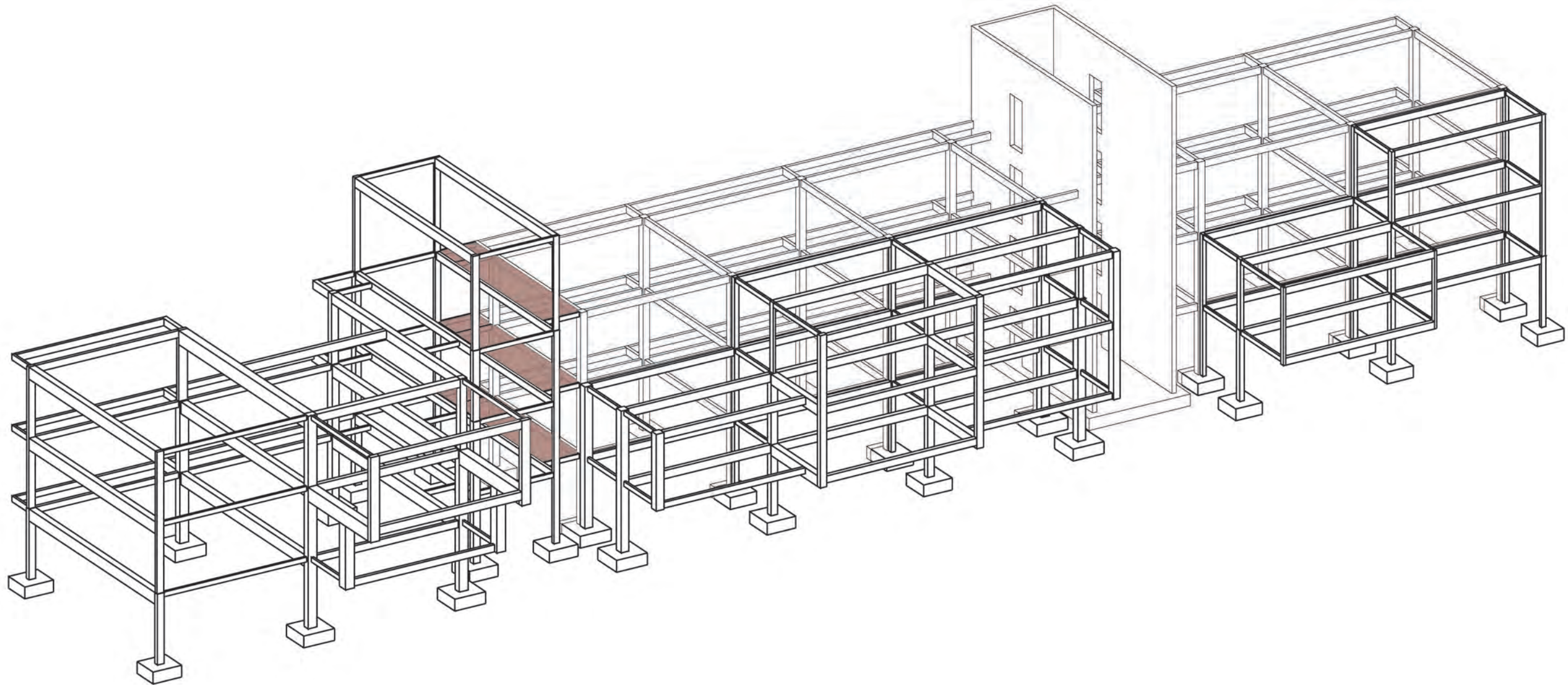
Leonardo Biondi
Arianna Trombini

STRUCTURAL DESIGN

STRUCTURAL 3D VIEW

Legend

-  Existing structure
-  New structure
-  Connection S6/S14

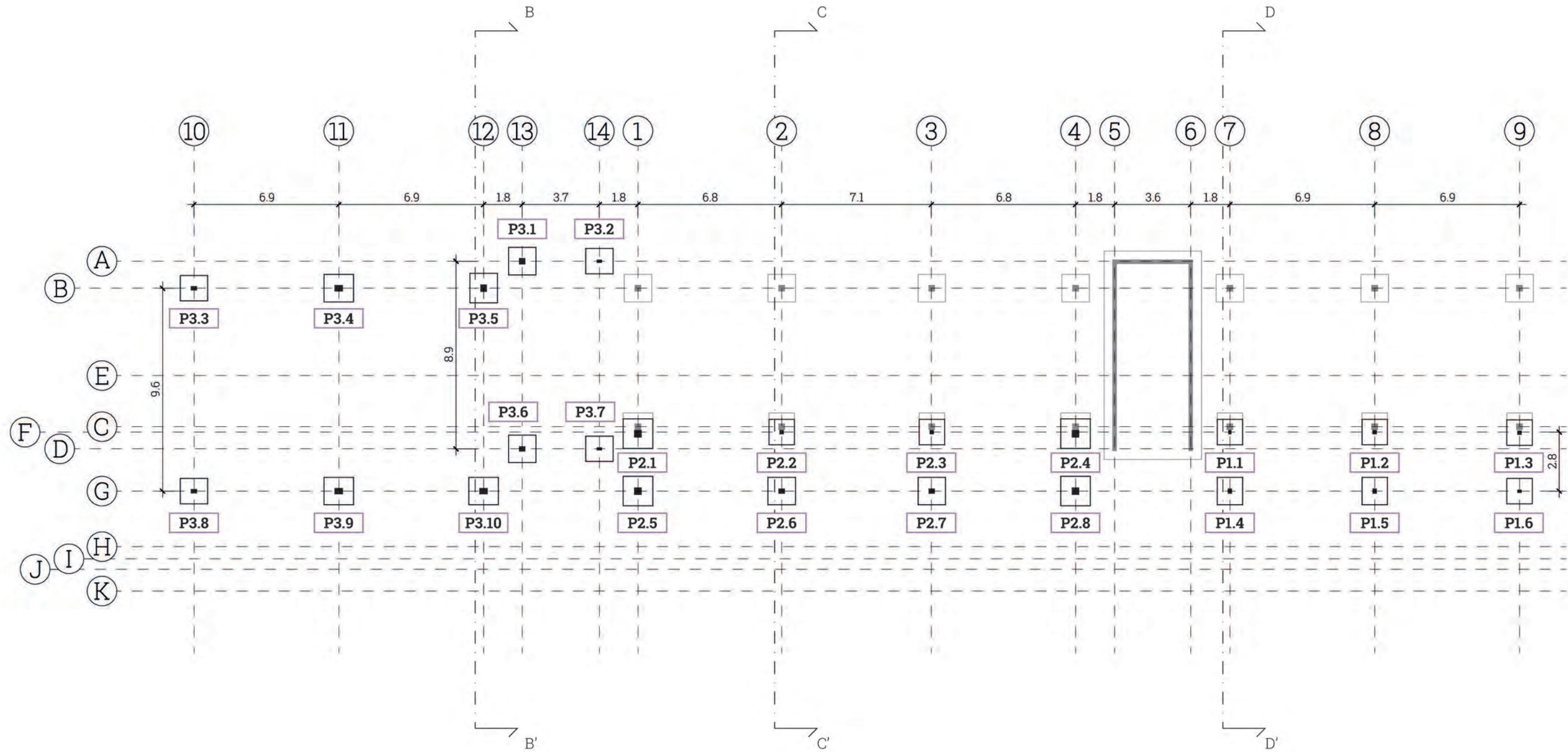


STRUCTURAL DESIGN

STRUCTURAL PLANS - FOUNDATIONS

Legend

- P Pillars
- B Beams
- S Floors

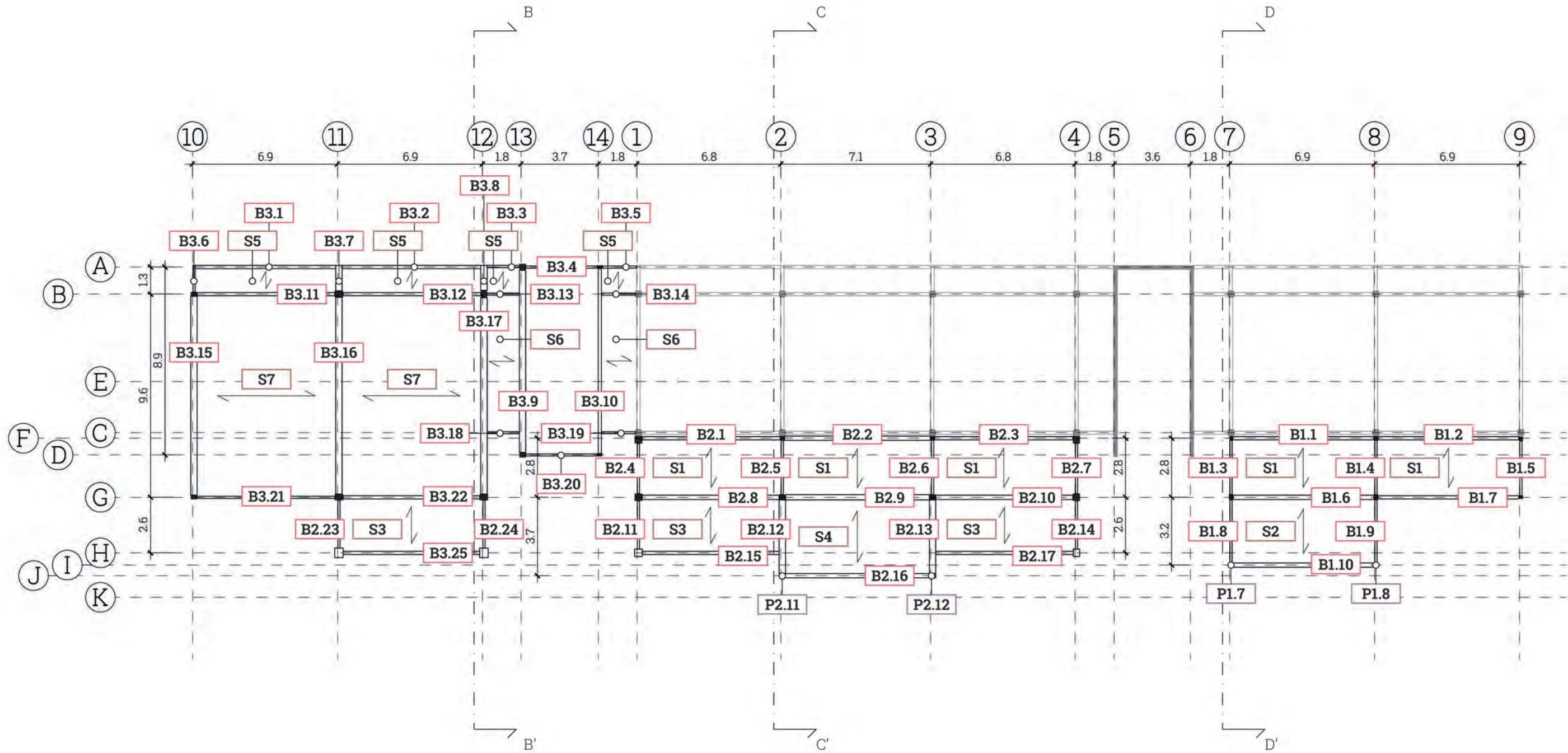


STRUCTURAL DESIGN

STRUCTURAL PLANS - FIRST FLOOR

Legend

- P Pillars
- B Beams
- S Floors

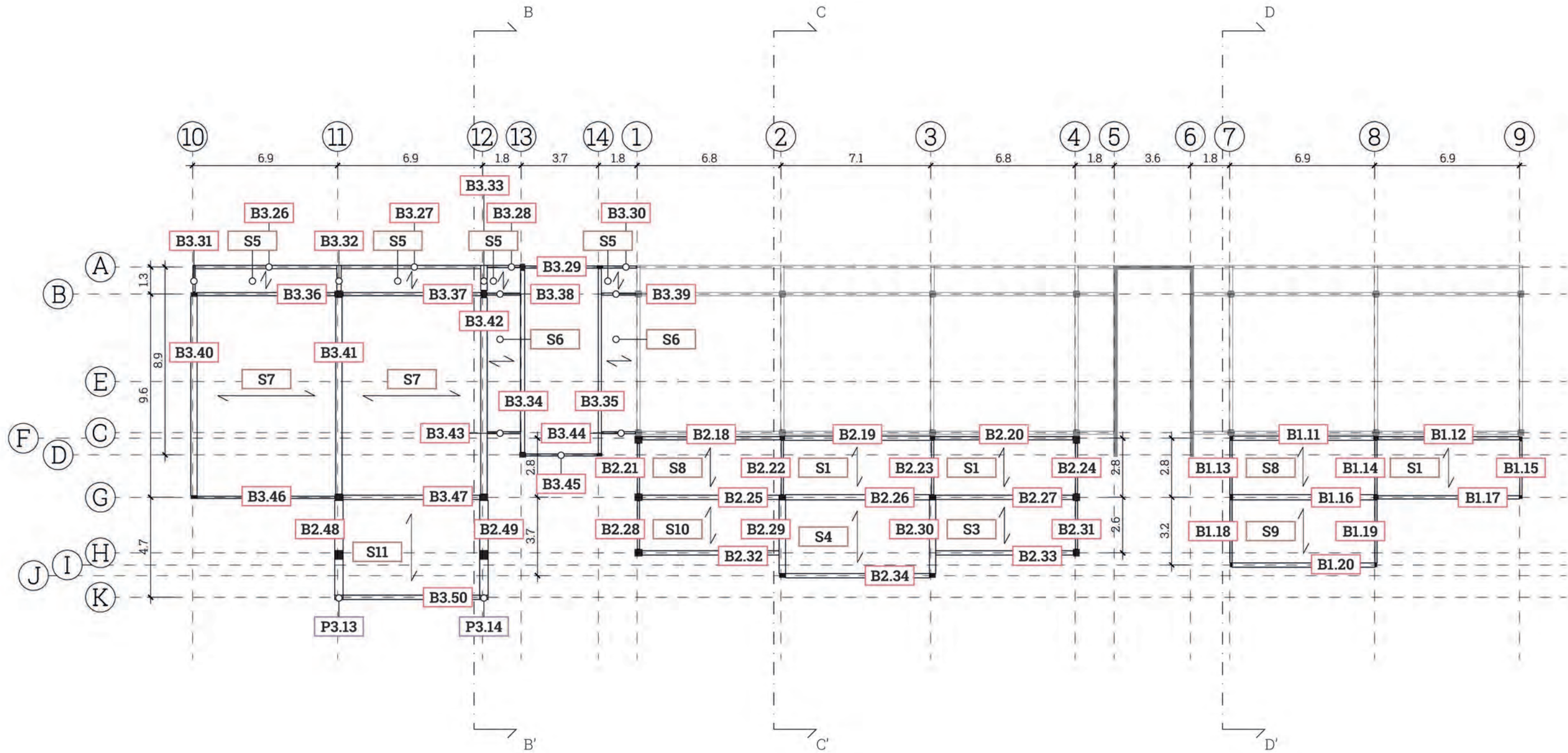


STRUCTURAL DESIGN

STRUCTURAL PLANS - SECOND FLOOR

Legend

- P Pillars
- B Beams
- S Floors

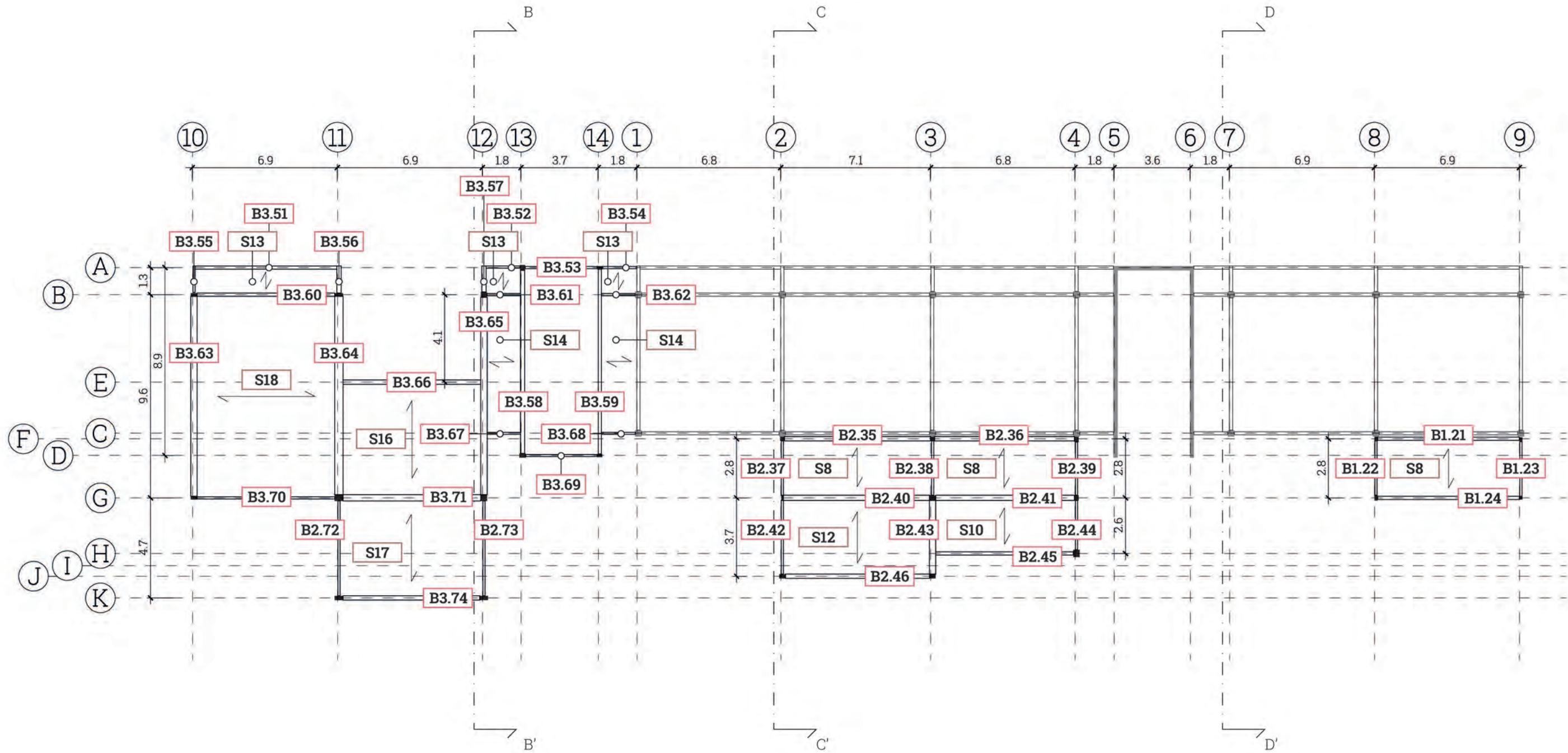


STRUCTURAL DESIGN

STRUCTURAL PLANS - ROOF

Legend

- P Pillars
- B Beams
- S Floors

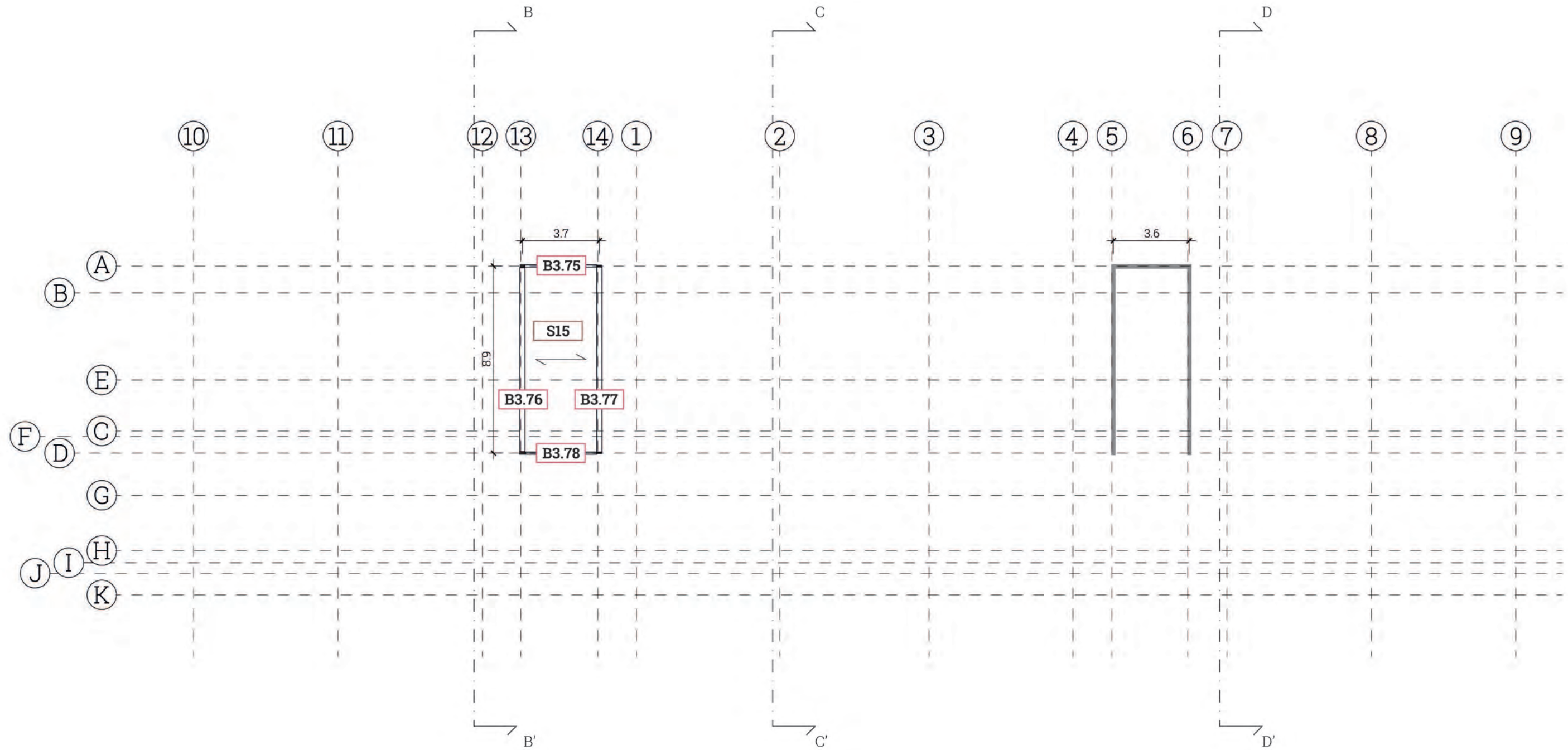


STRUCTURAL DESIGN

STRUCTURAL PLANS - ROOF

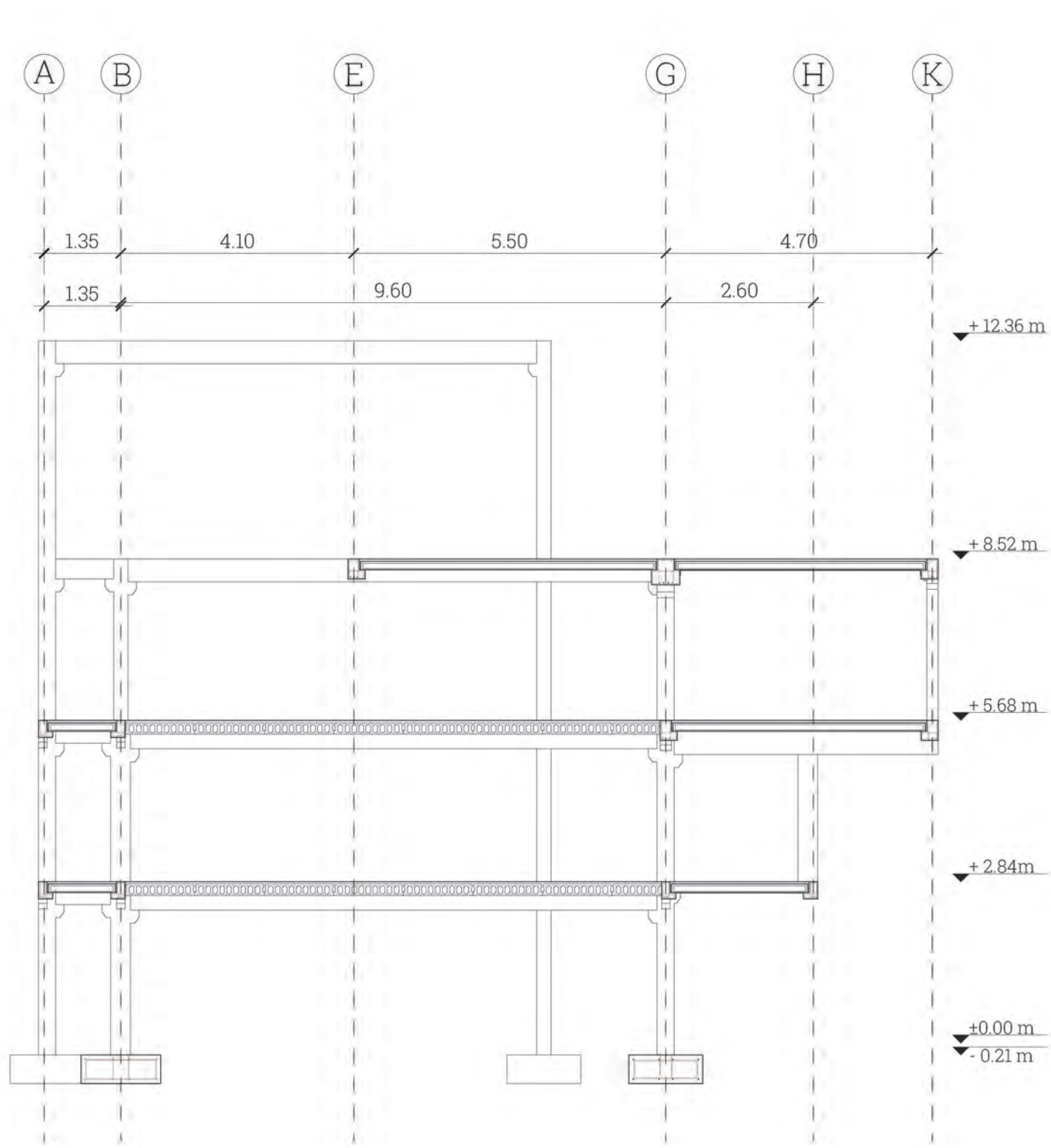
Legend

- P Pillars
- B Beams
- S Floors

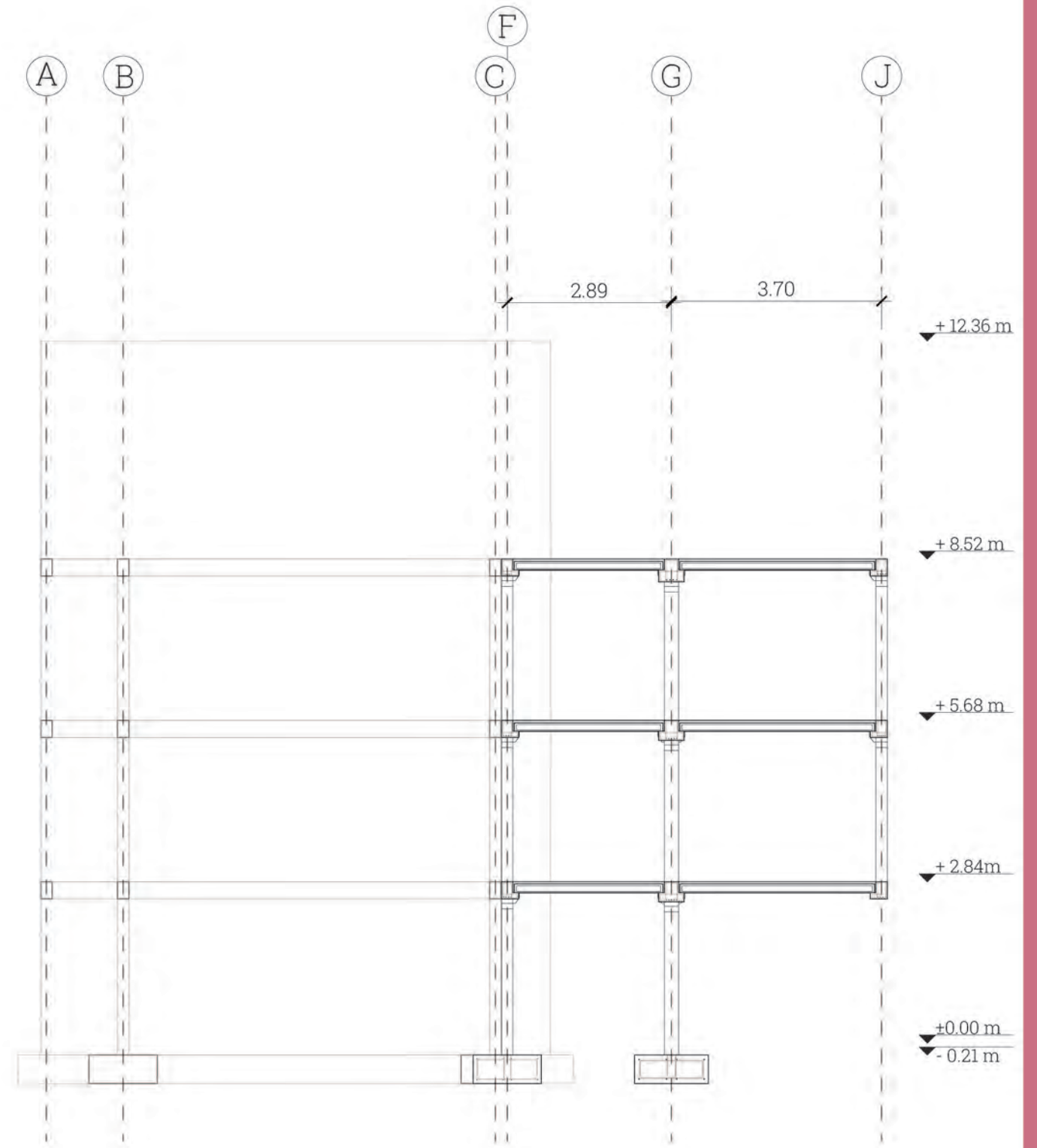


STRUCTURAL DESIGN

STRUCTURAL SECTIONS



Section B-B'

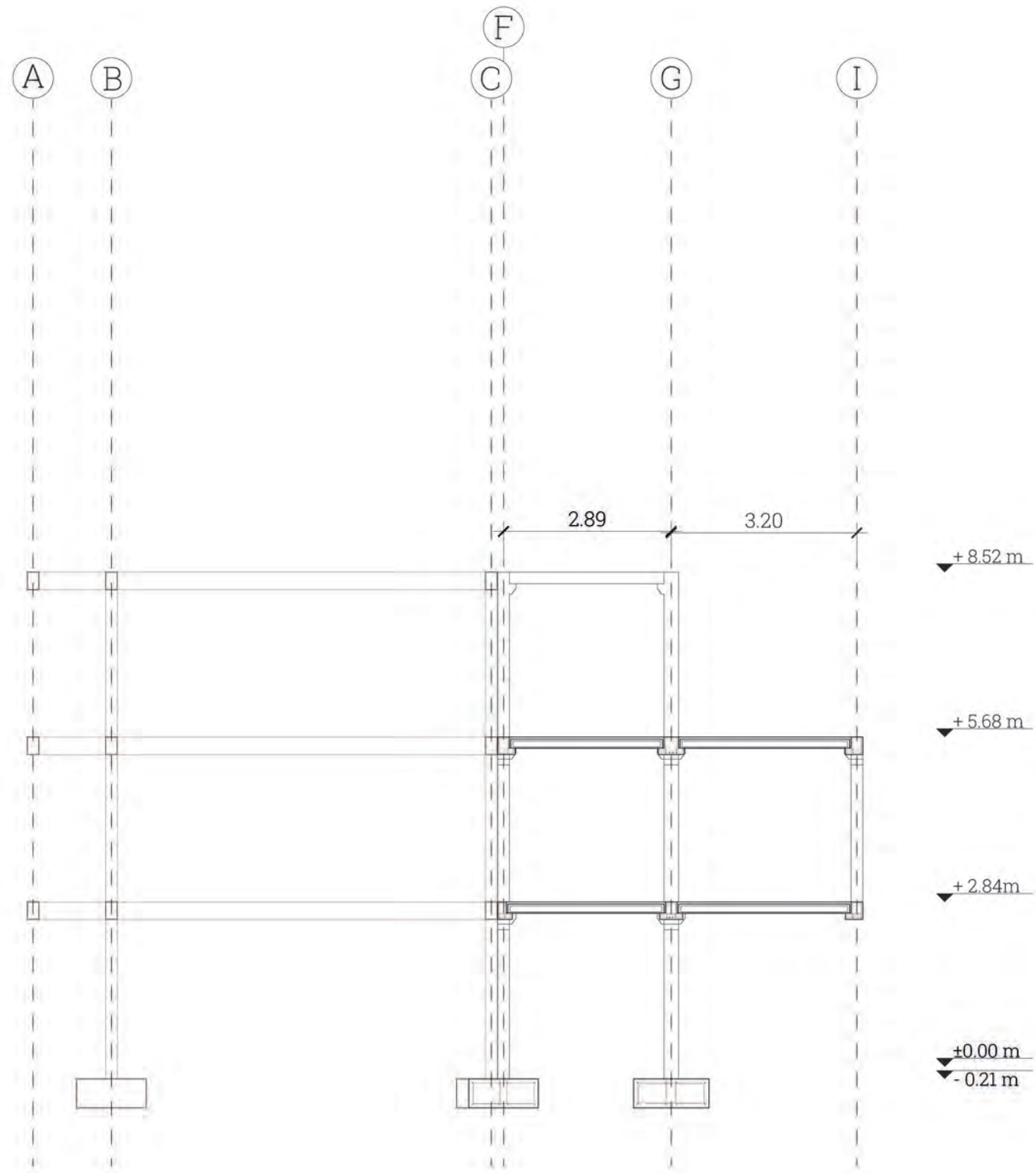


SECTION CC'



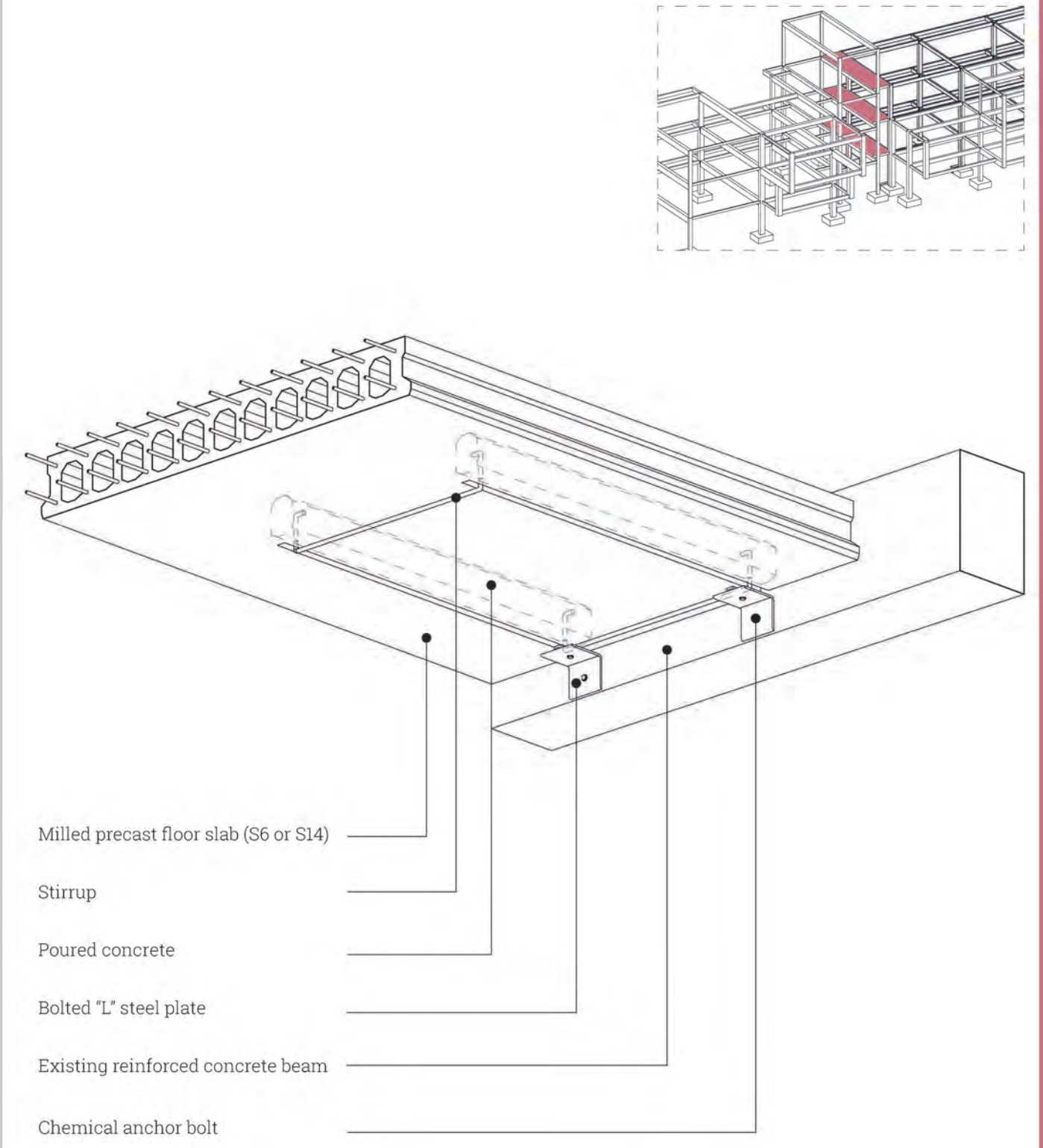
STRUCTURAL DESIGN

STRUCTURAL SECTIONS



Section D-D'

CONNECTION DETAIL

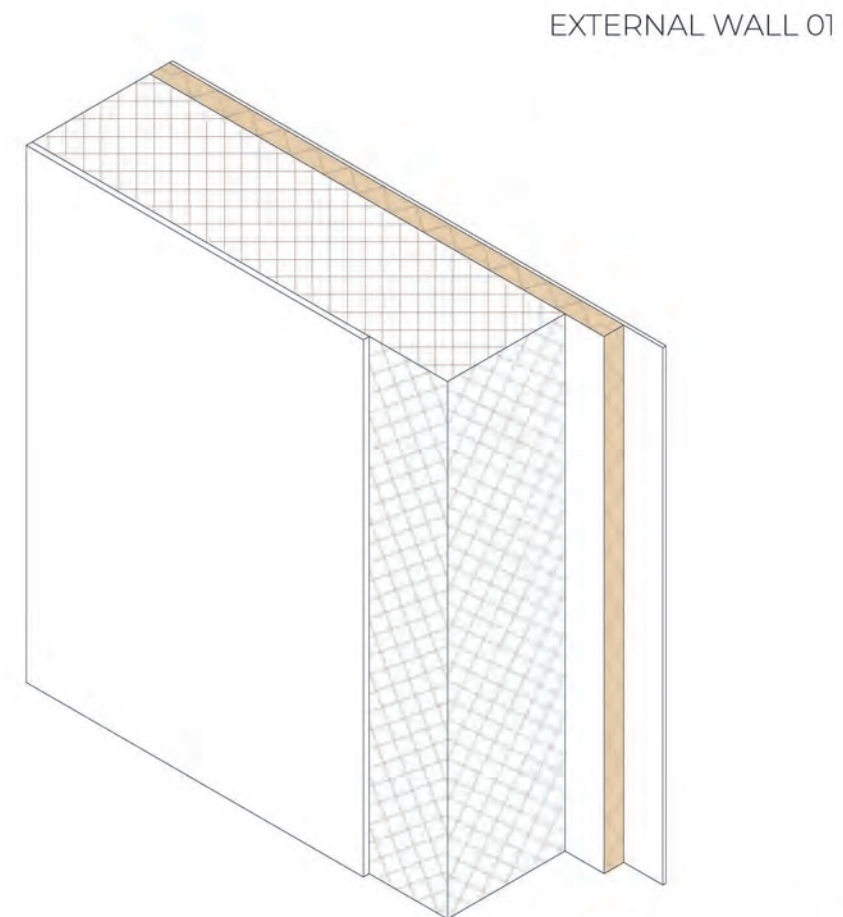
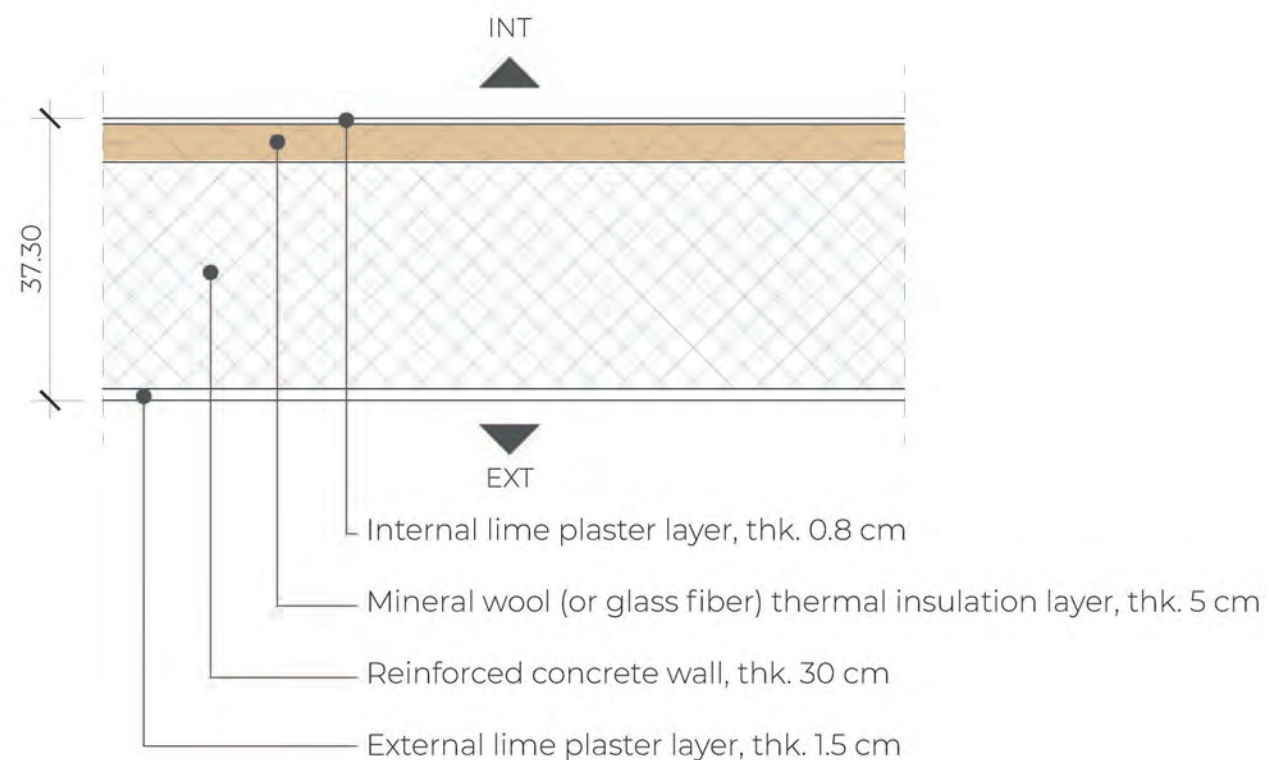
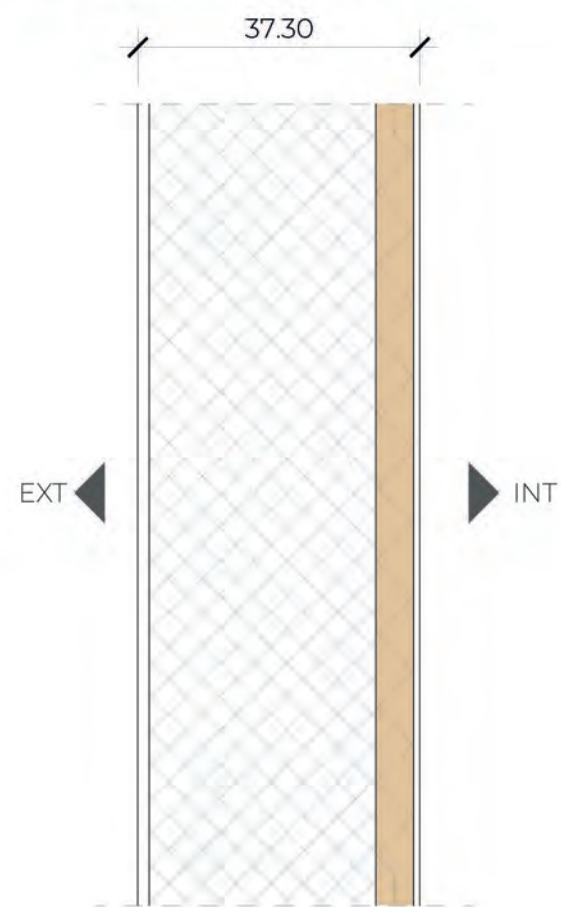


S6 & S14 Connection detail

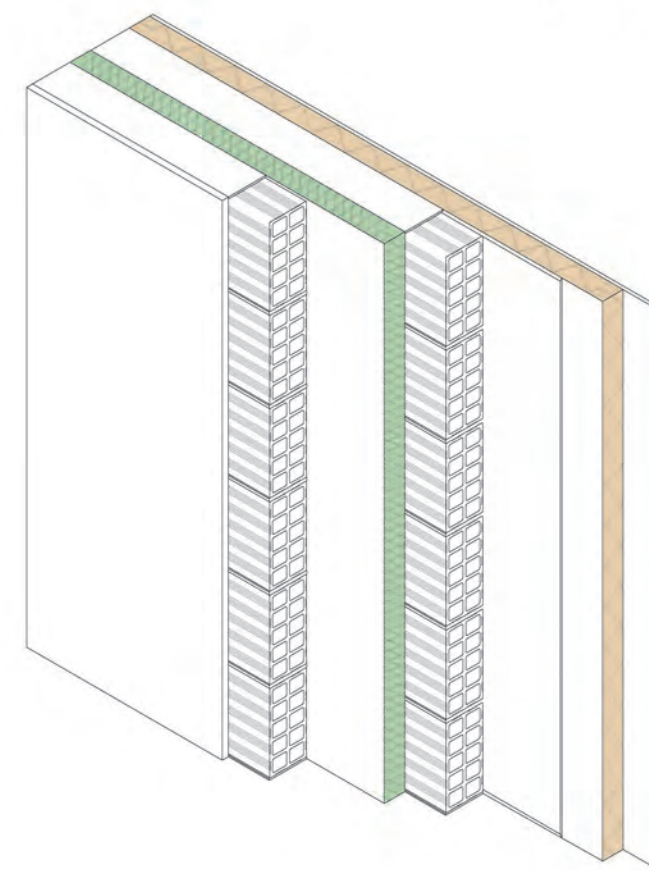
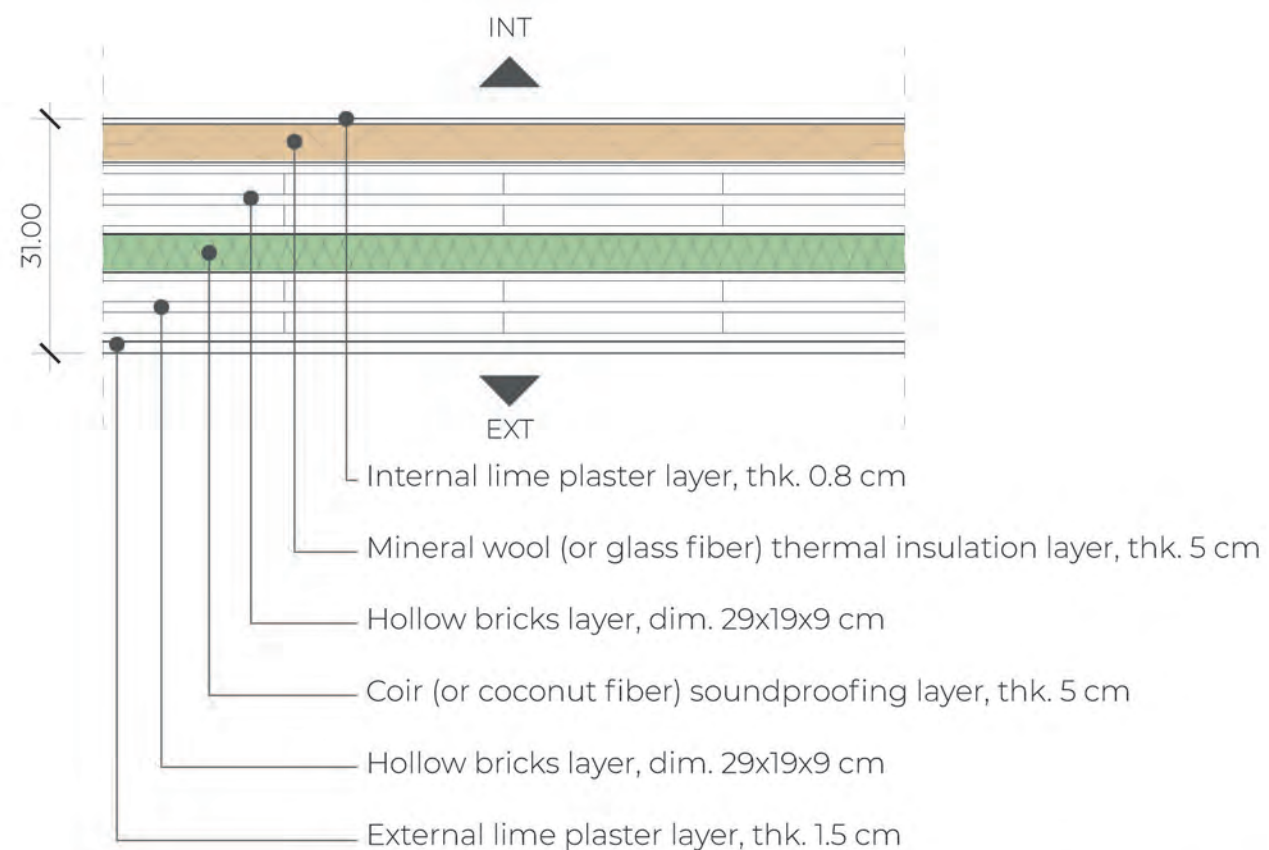
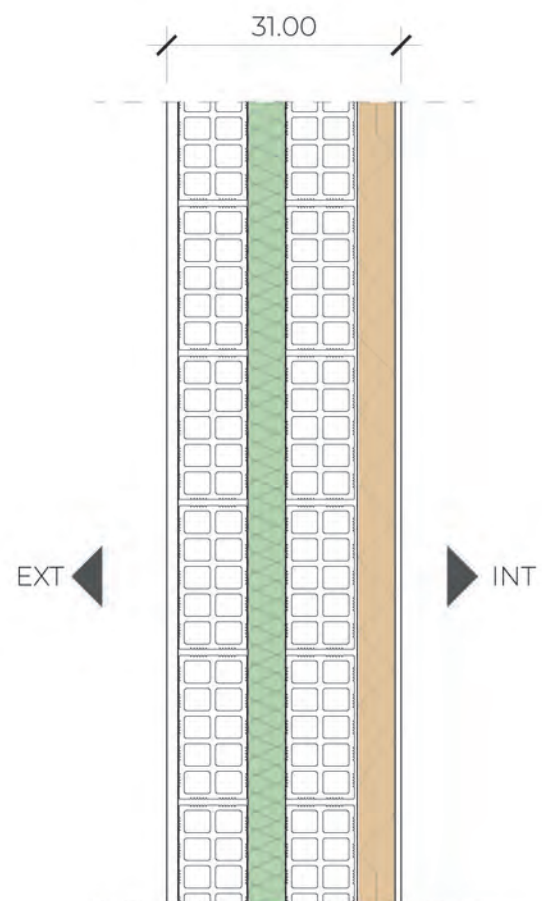


TECHNICAL PACKAGES 1:10

EXTERNAL WALLS



EXTERNAL WALL 01



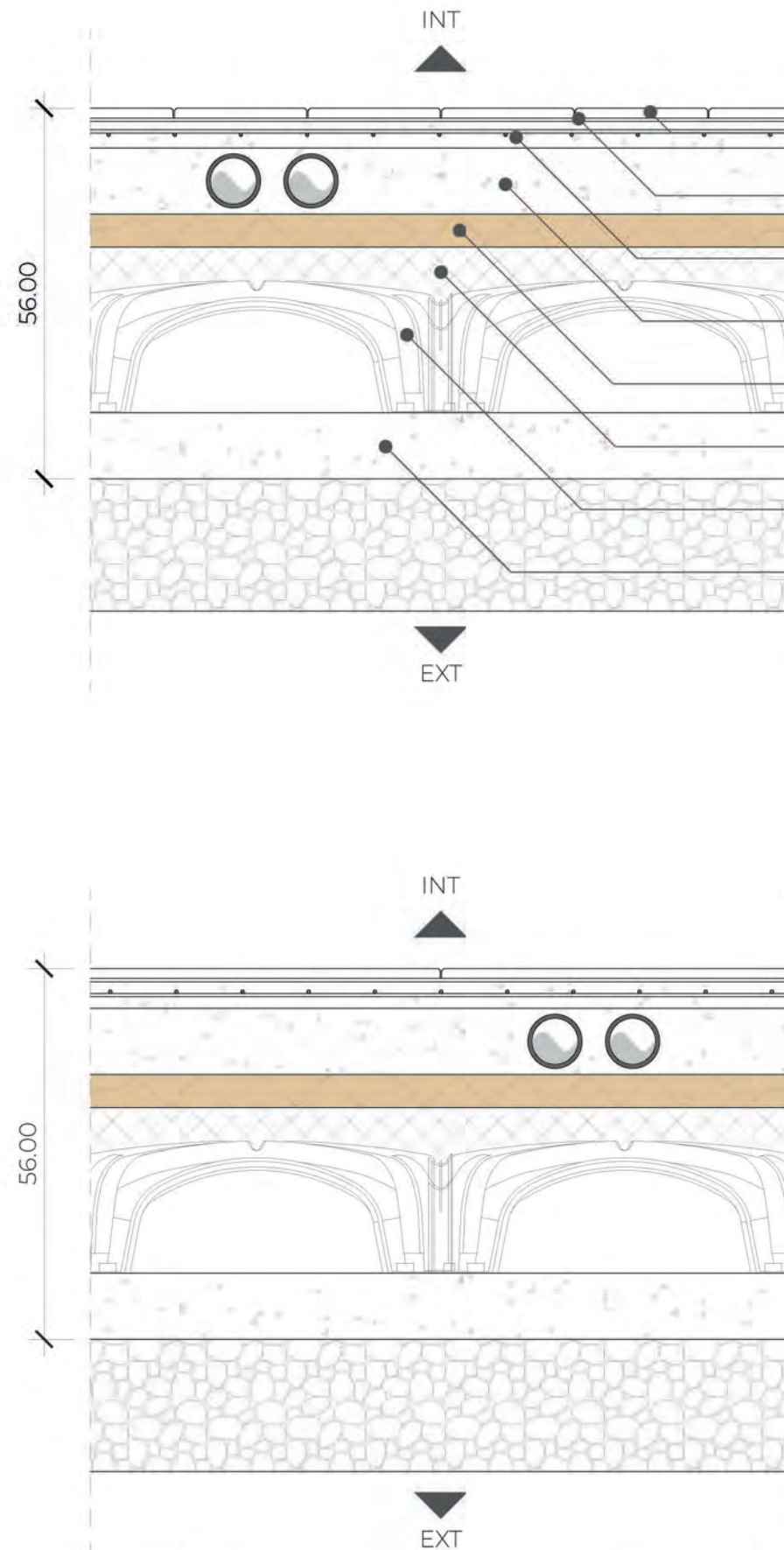
EXTERNAL WALL 02



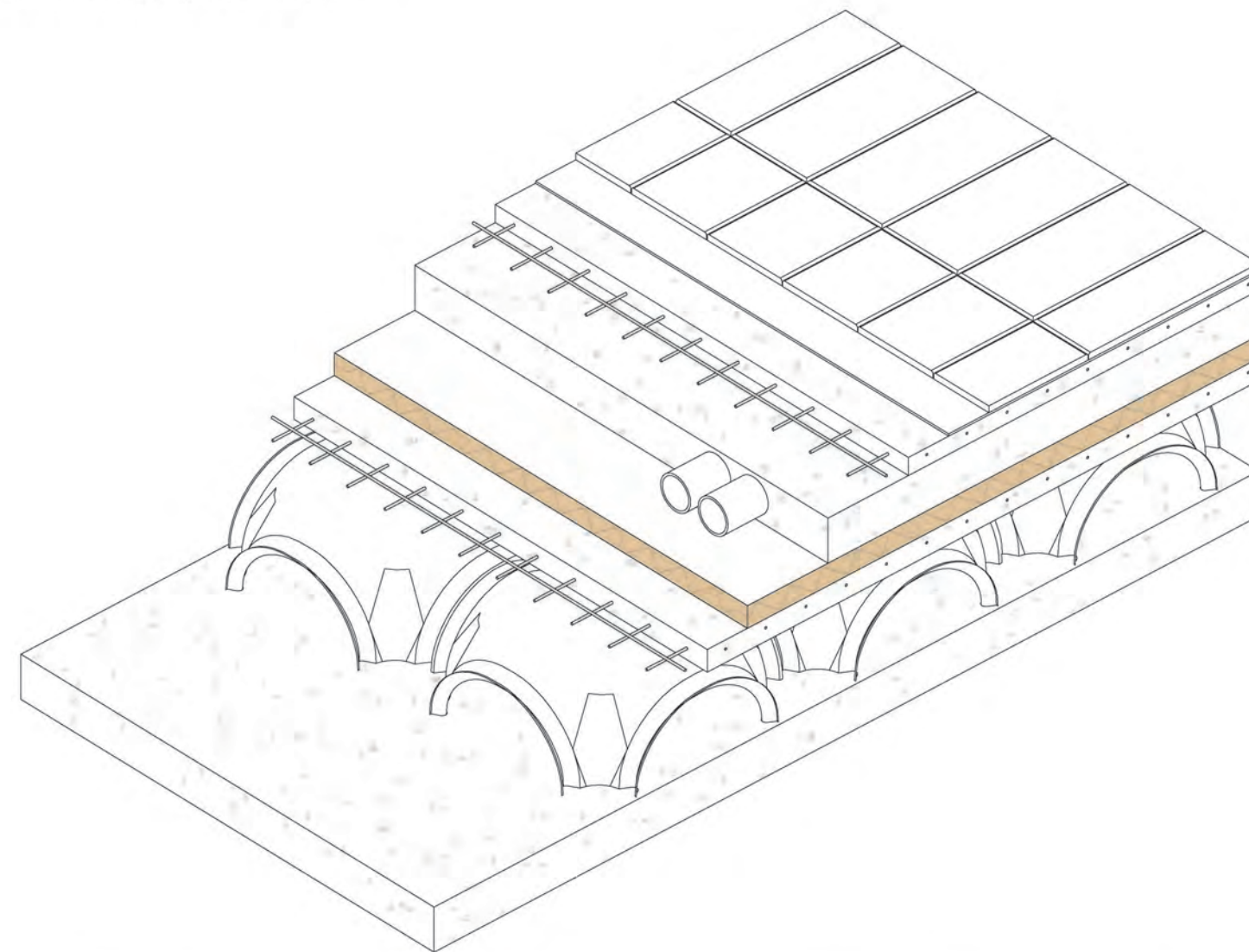
TECHNICAL PACKAGES 1:10

HORIZONTAL FLOORS

HORIZONTAL FLOOR 01



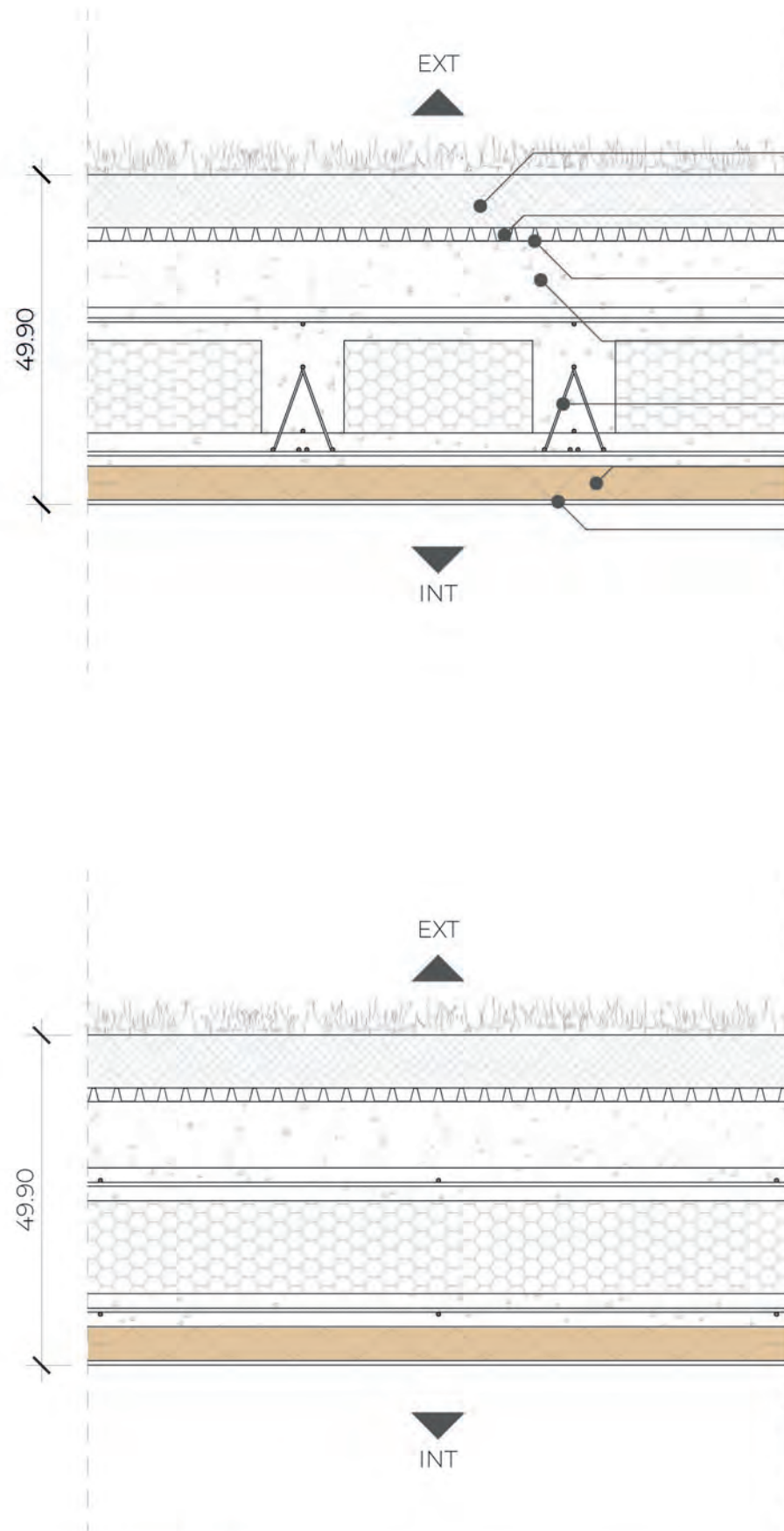
- Porcelain tiles layer, dim. 60x20x1.5 cm
- Adhesive (or mortar) layer, thk. 0.5 cm
- Cement screed layer with welded mesh, thk. 4 cm
- Cement service layer, thk. 10 cm
- Mineral wool (or glass fiber) thermal insulation layer, thk. 5 cm
- Reinforced concrete floor, thk. 5 cm
- Polypropilene formworks layer, dim. 59x59x20 cm
- Lean concrete layer, thk. 10 cm



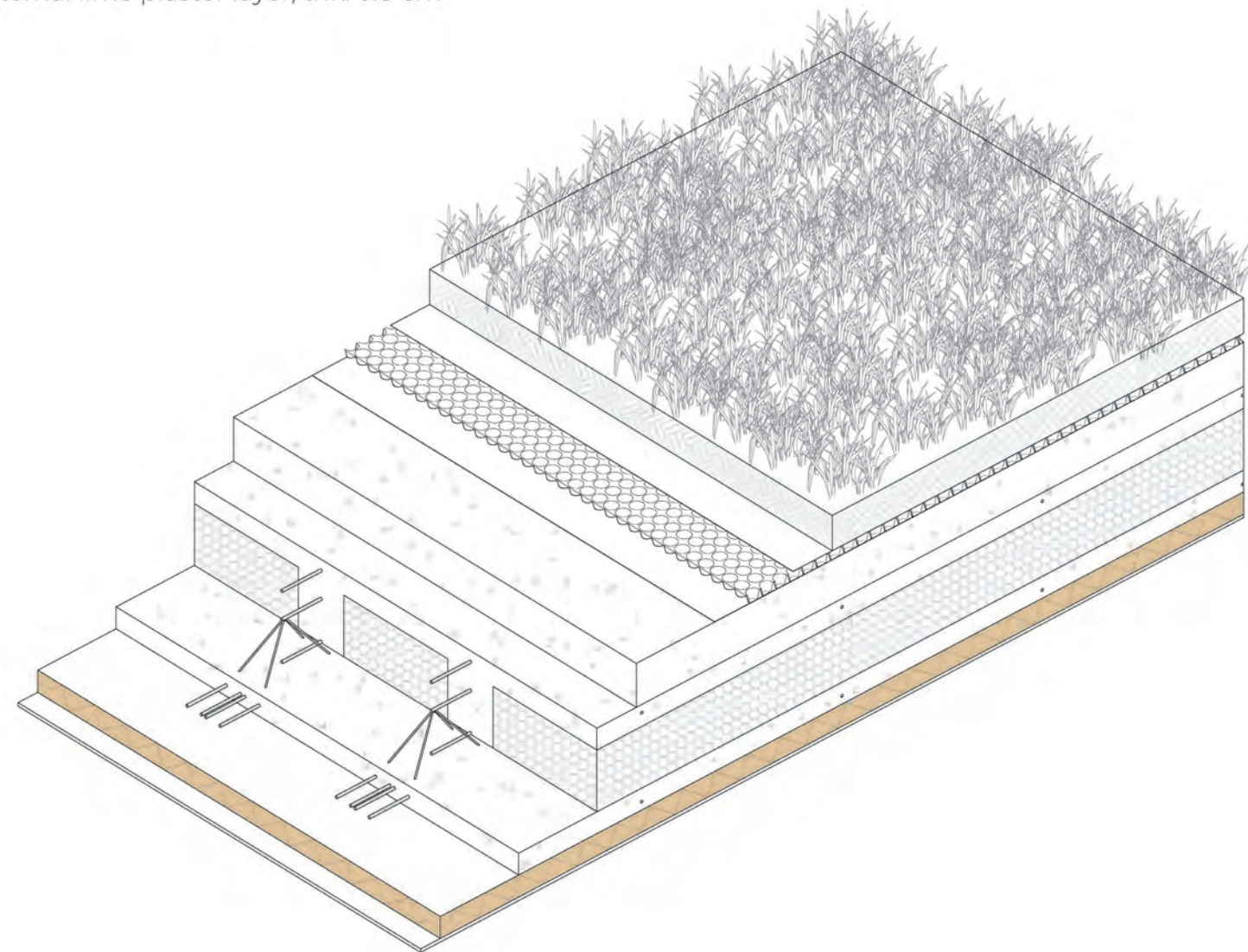
TECHNICAL PACKAGES 1:10

HORIZONTAL FLOORS

HORIZONTAL FLOOR 02A



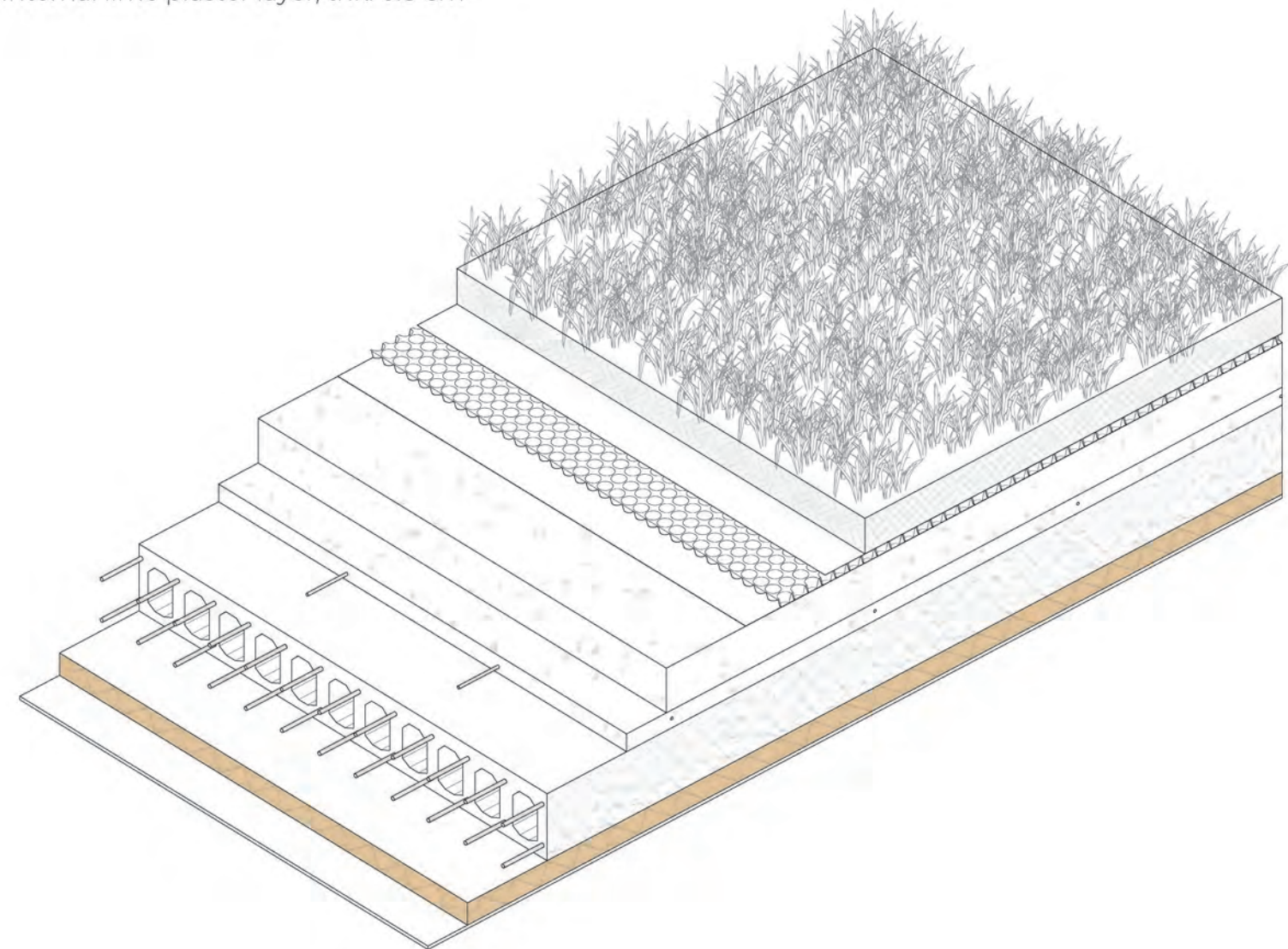
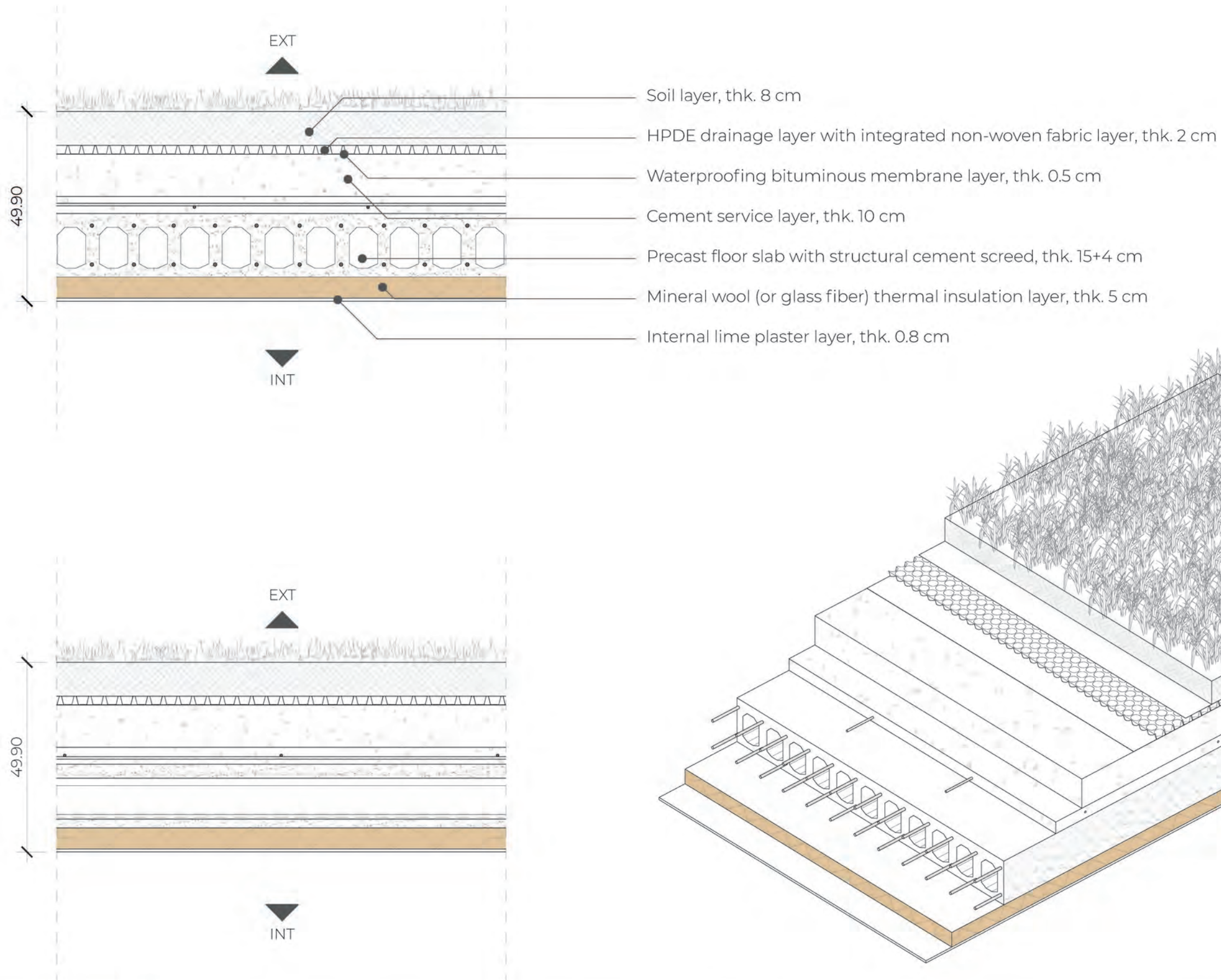
- Soil layer, thk. 8 cm
- HPDE drainage layer with integrated non-woven fabric layer, thk. 2 cm
- Waterproofing bituminous membrane layer, thk. 0.5 cm
- Cement service layer, thk. 10 cm
- Predalles floor slabs, thk. 24 cm
- Mineral wool (or glass fiber) thermal insulation layer, thk. 5 cm
- Internal lime plaster layer, thk. 0.8 cm



TECHNICAL PACKAGES 1:10

HORIZONTAL FLOORS

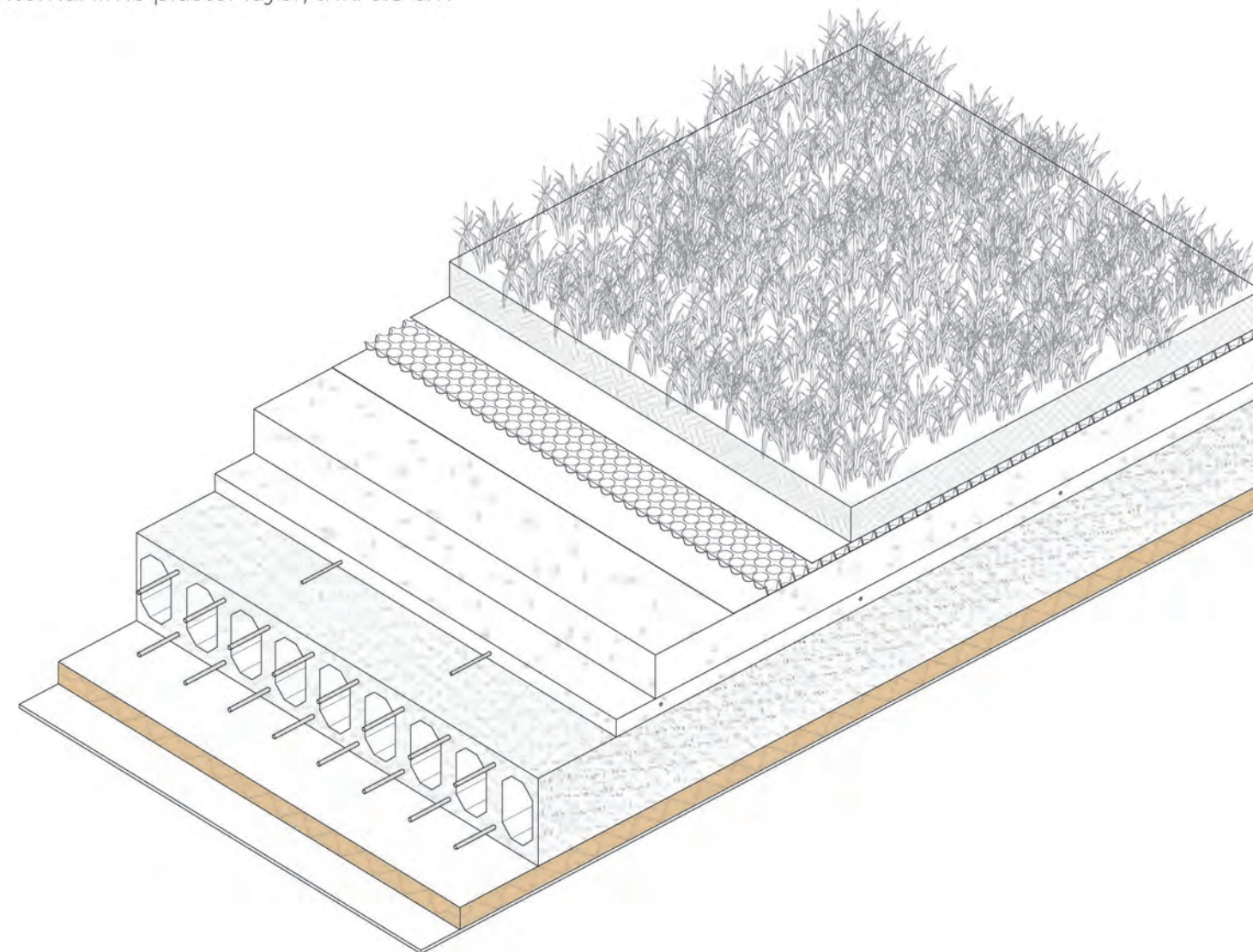
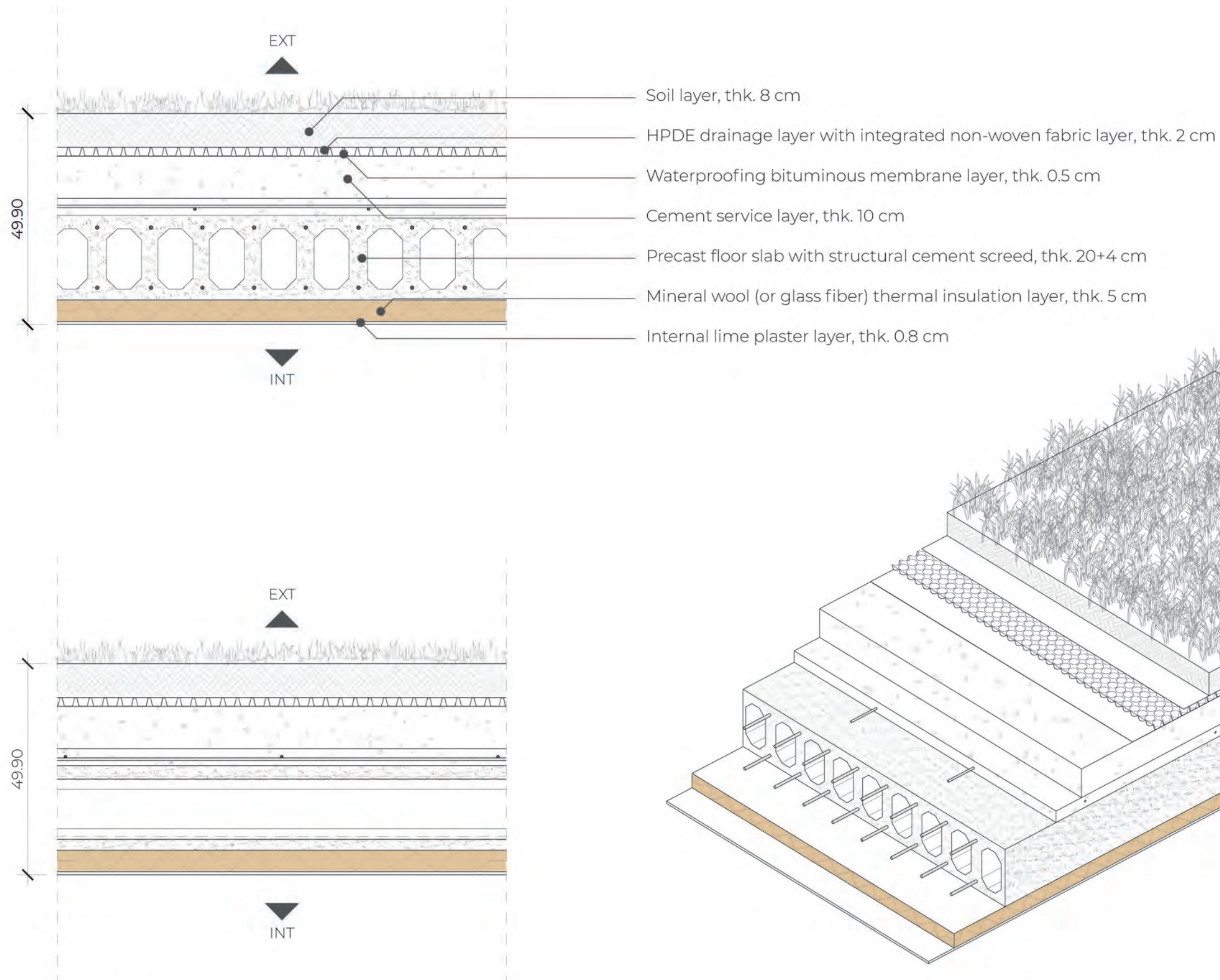
HORIZONTAL FLOOR 02B

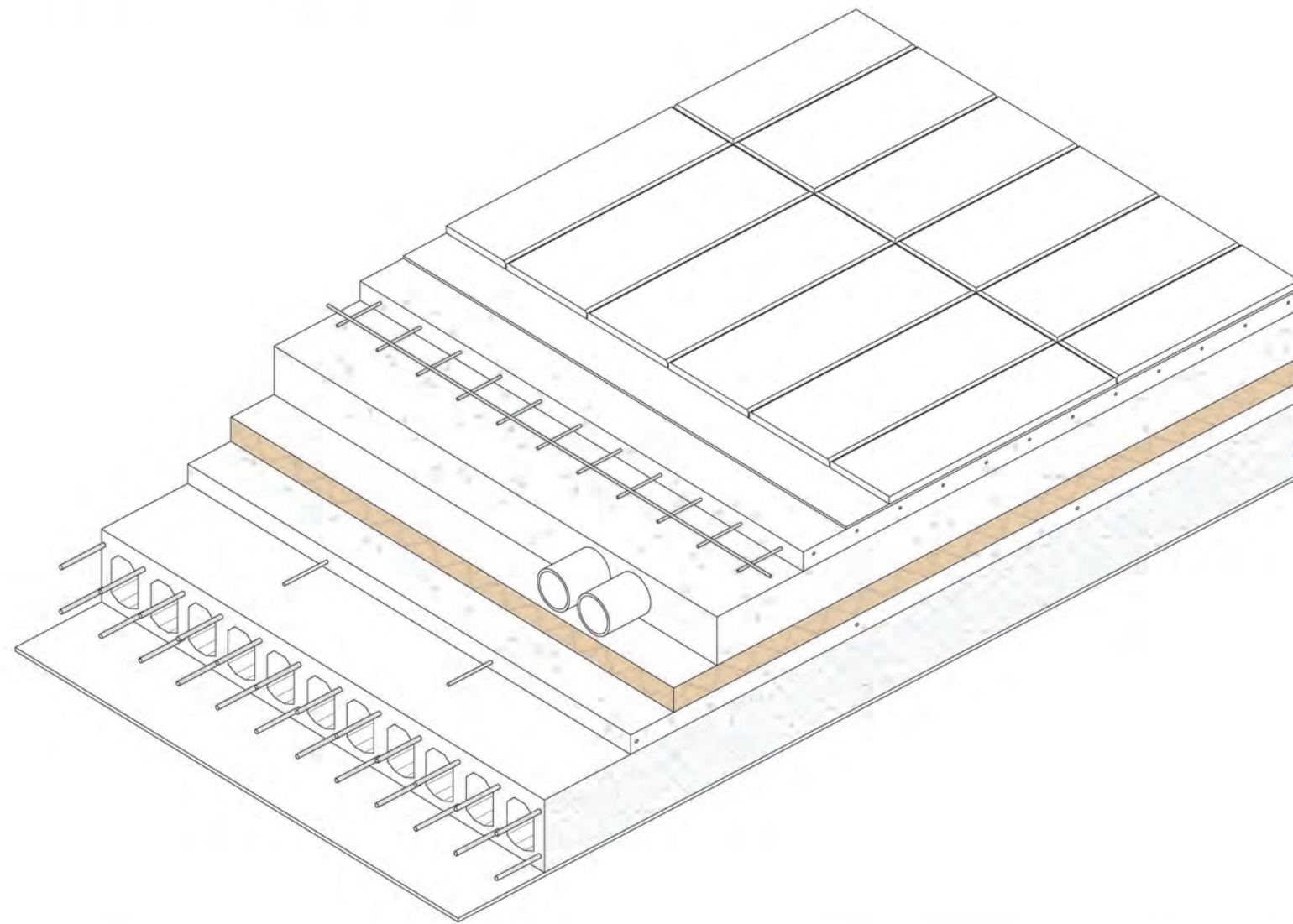
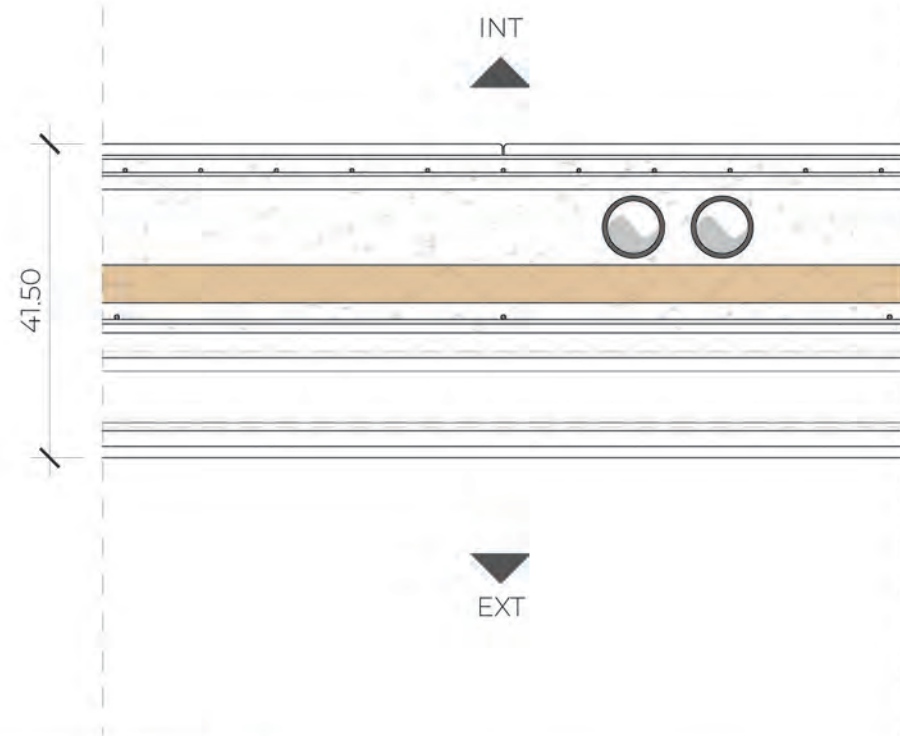
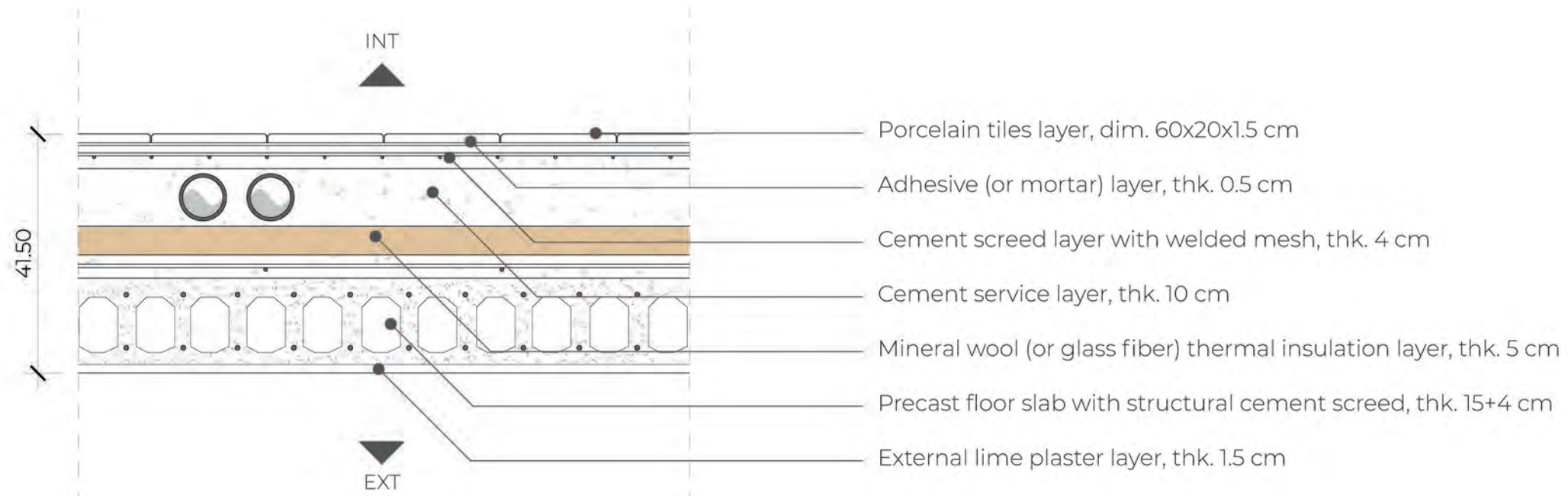


TECHNICAL PACKAGES 1:10

HORIZONTAL FLOORS

HORIZONTAL FLOOR 02C

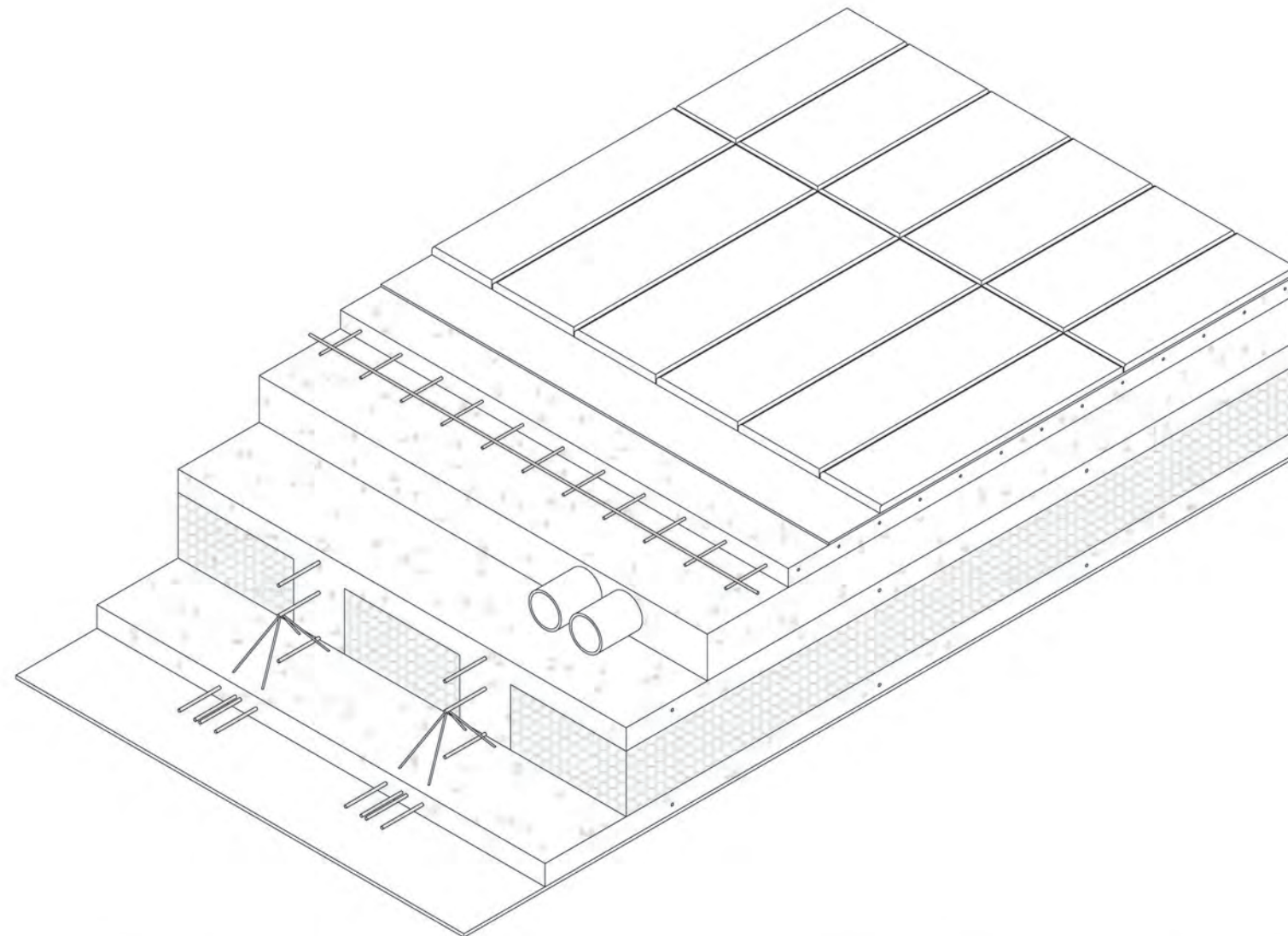
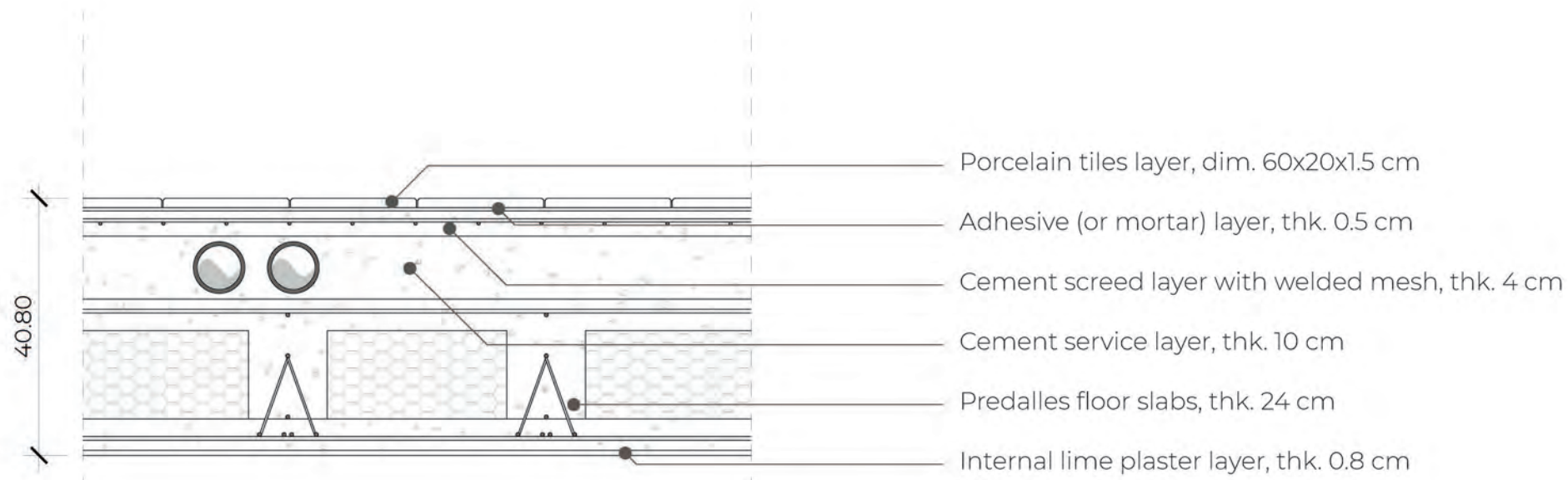




TECHNICAL PACKAGES 1:10

HORIZONTAL PARTITIONS

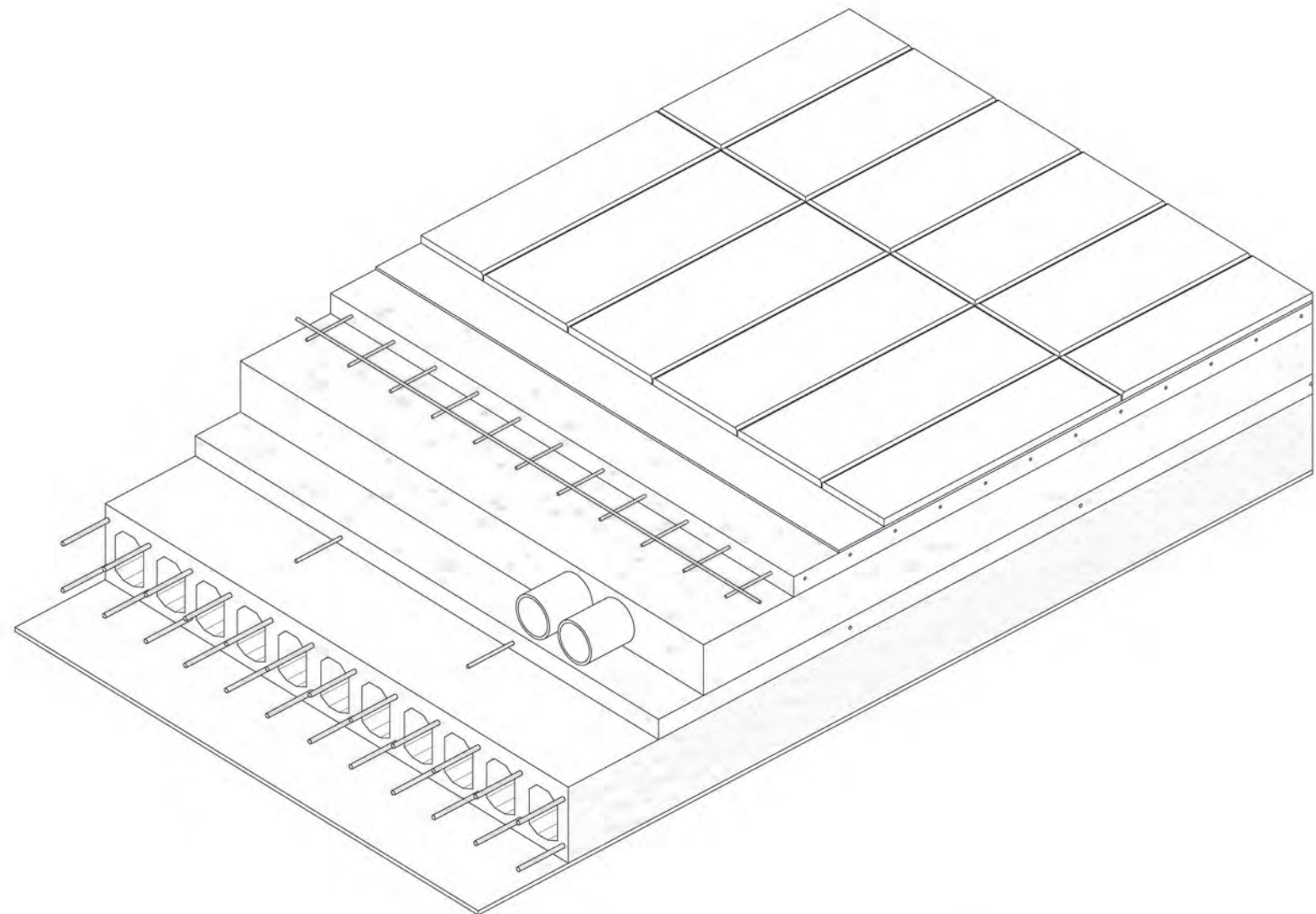
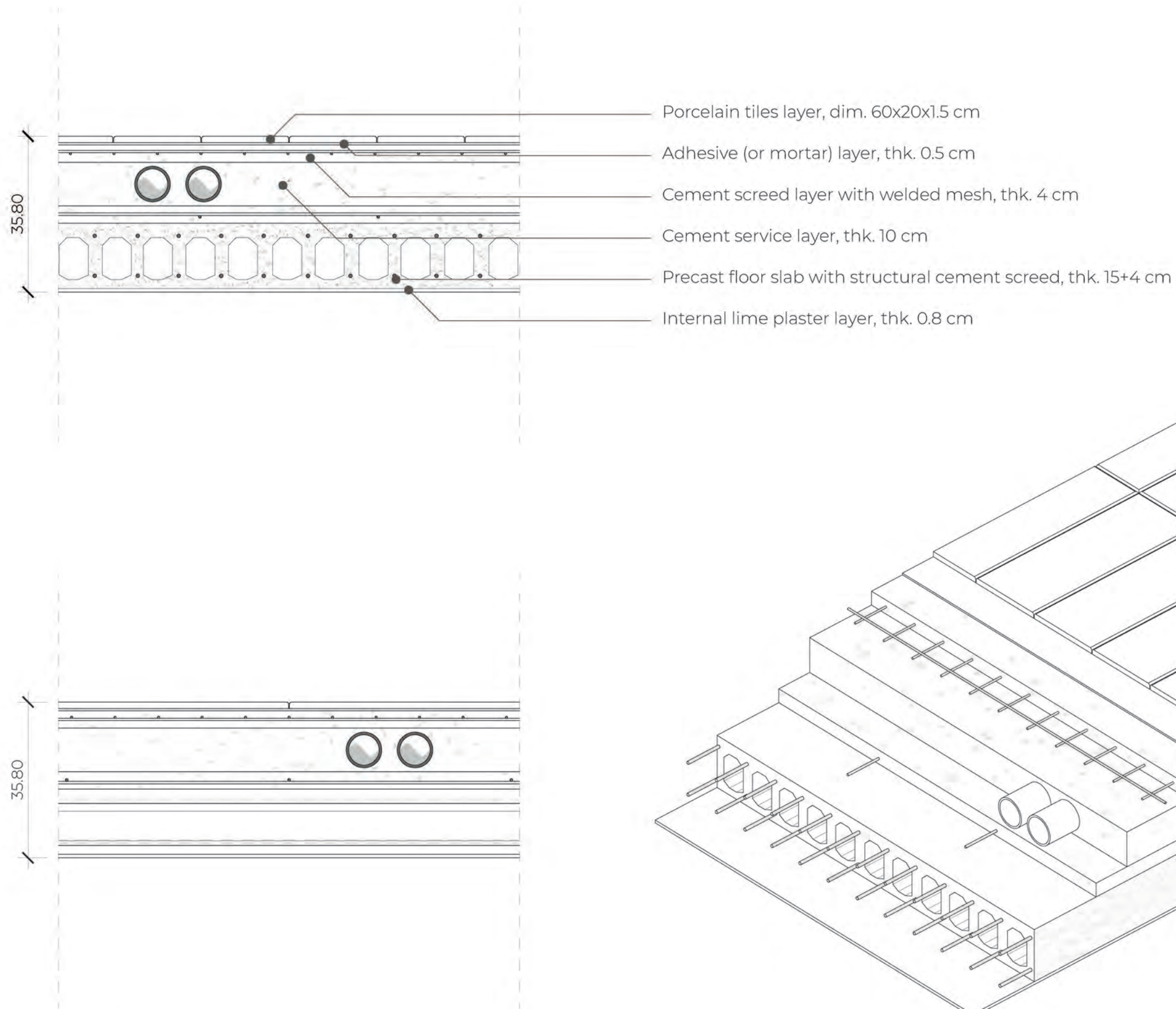
HORIZONTAL PARTITION 01A



TECHNICAL PACKAGES 1:10

HORIZONTAL PARTITIONS

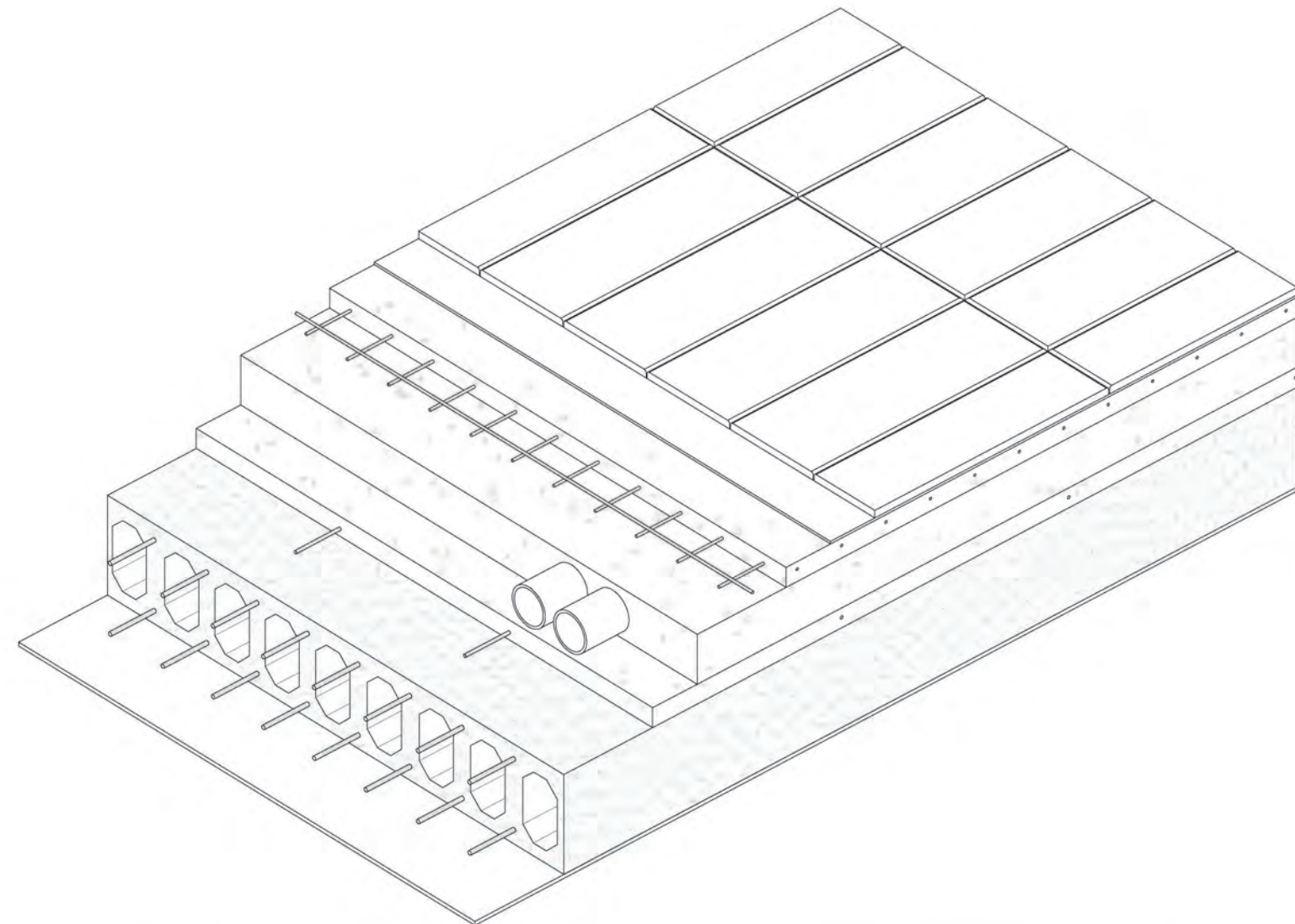
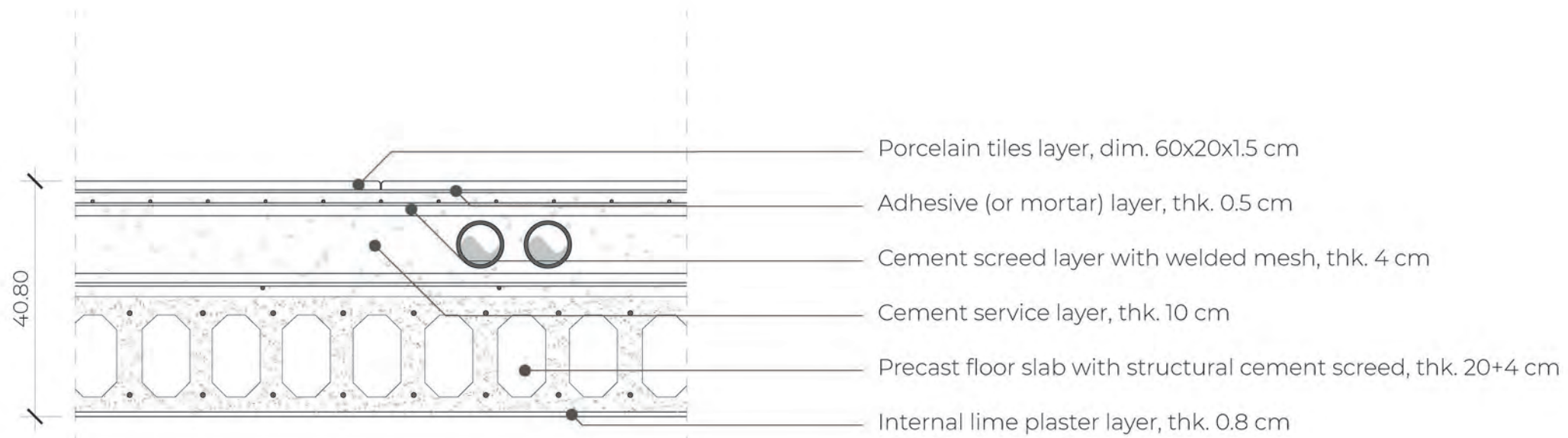
HORIZONTAL PARTITION 01B



TECHNICAL PACKAGES 1:10

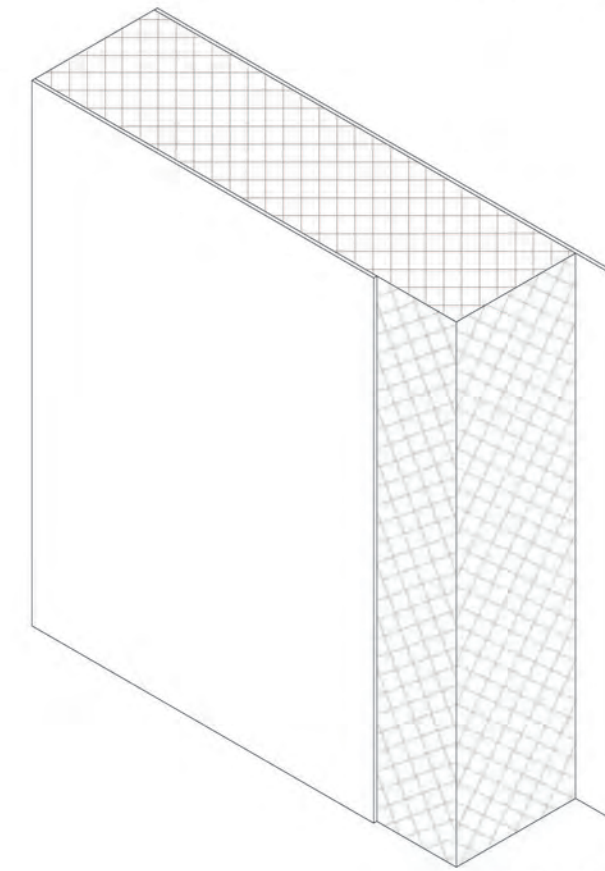
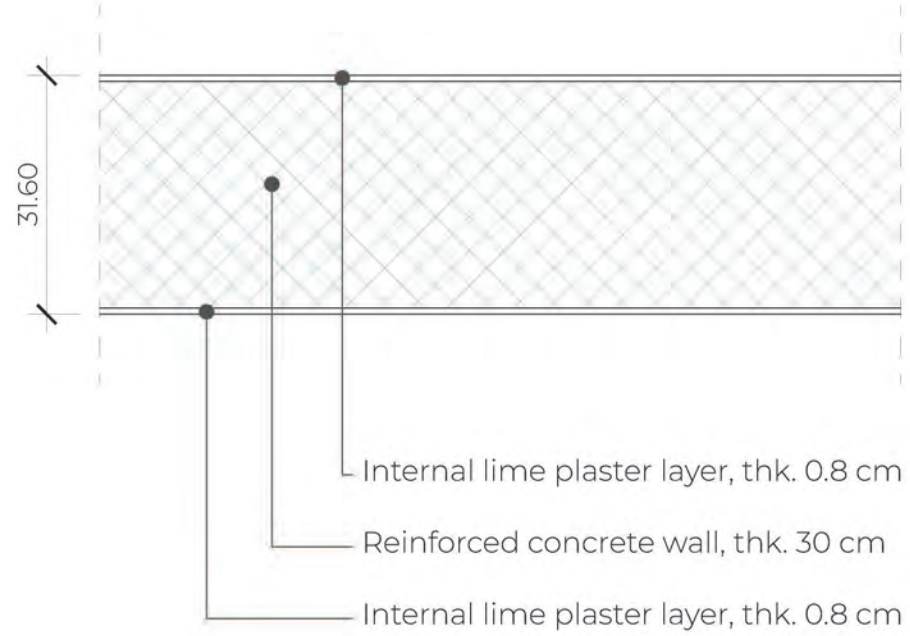
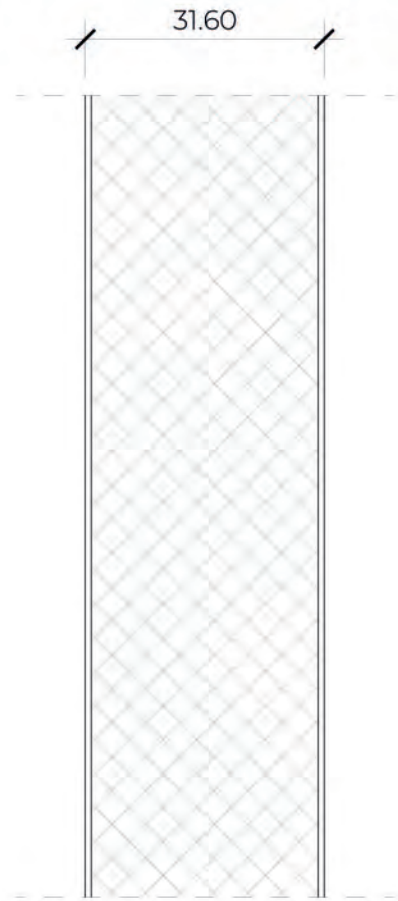
HORIZONTAL PARTITIONS

HORIZONTAL PARTITION 01C

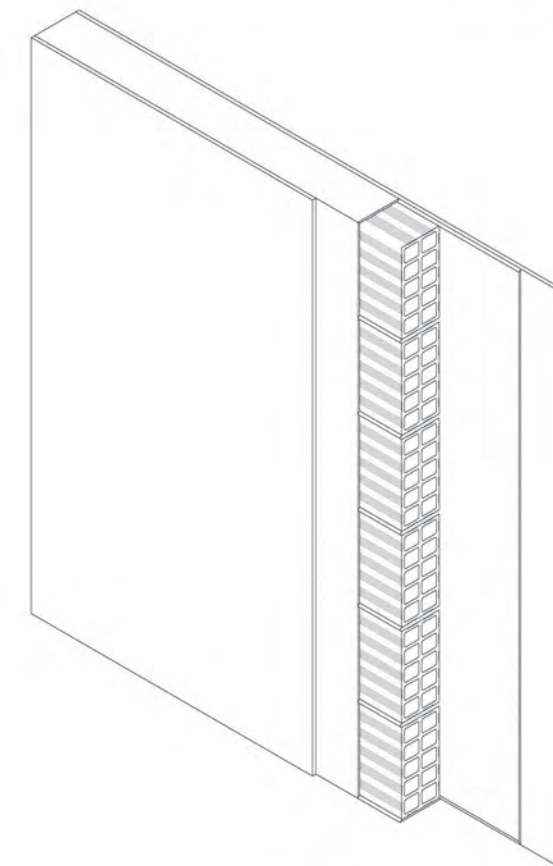
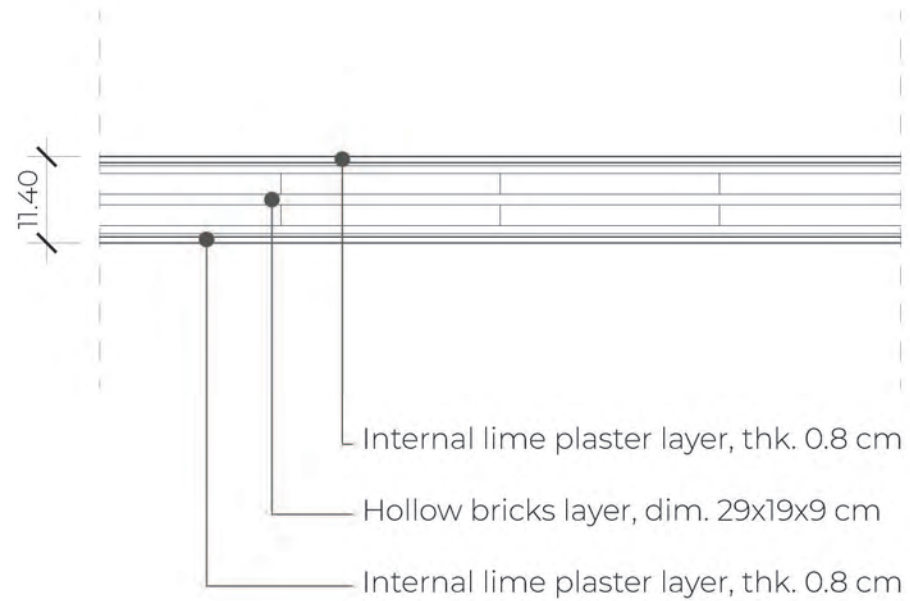
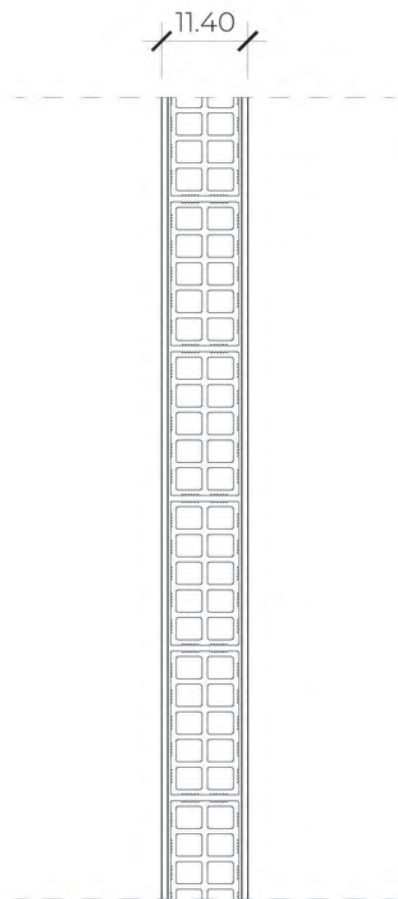


TECHNICAL PACKAGES 1:10

VERTICAL PARTITIONS



VERTICAL PARTITION 01

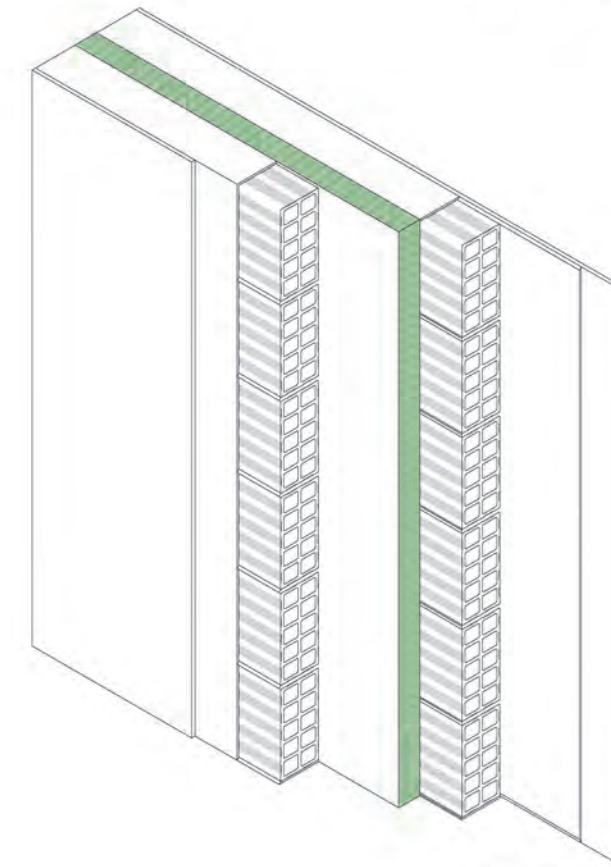
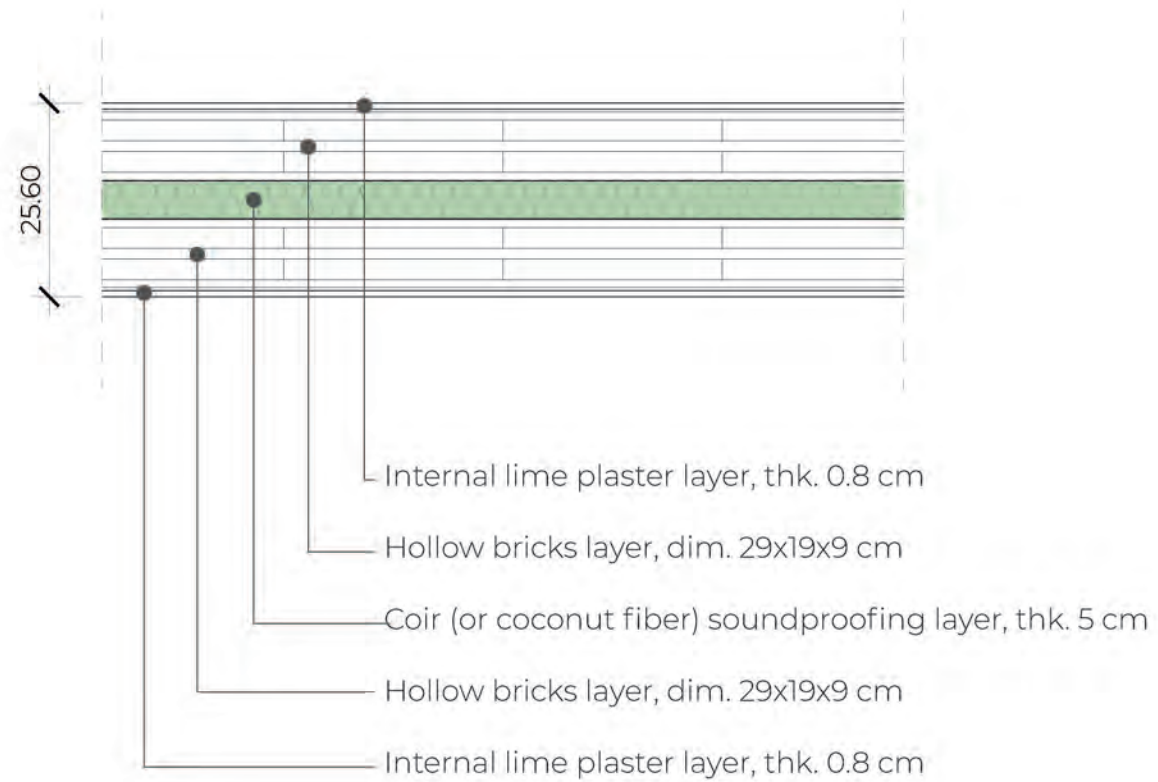
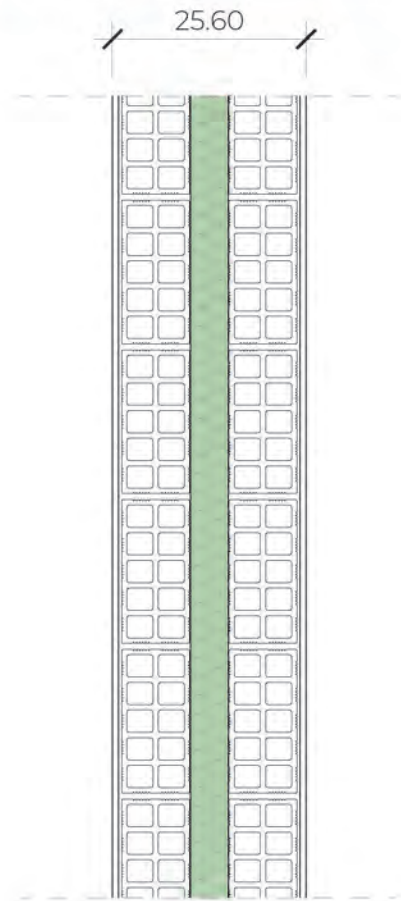


VERTICAL PARTITION 02

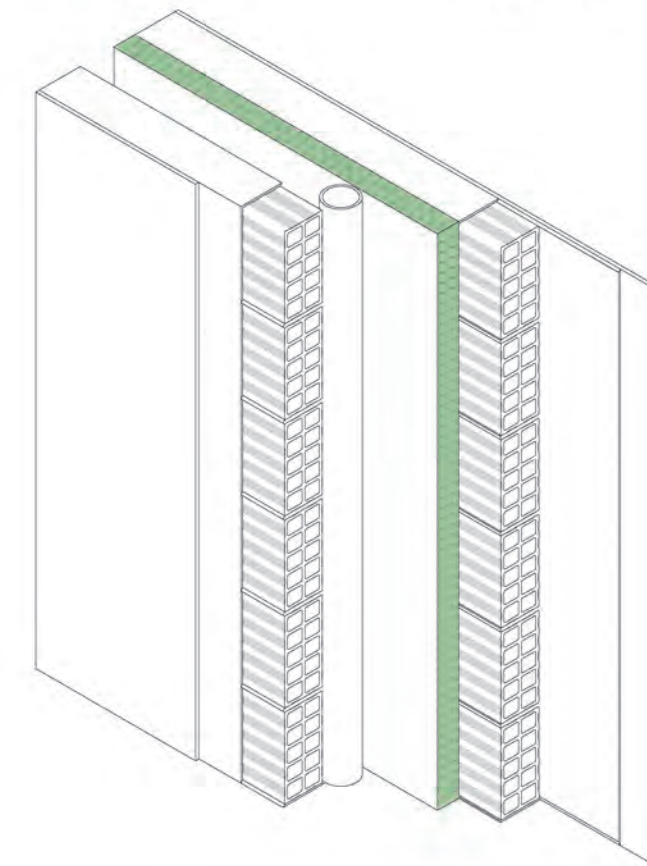
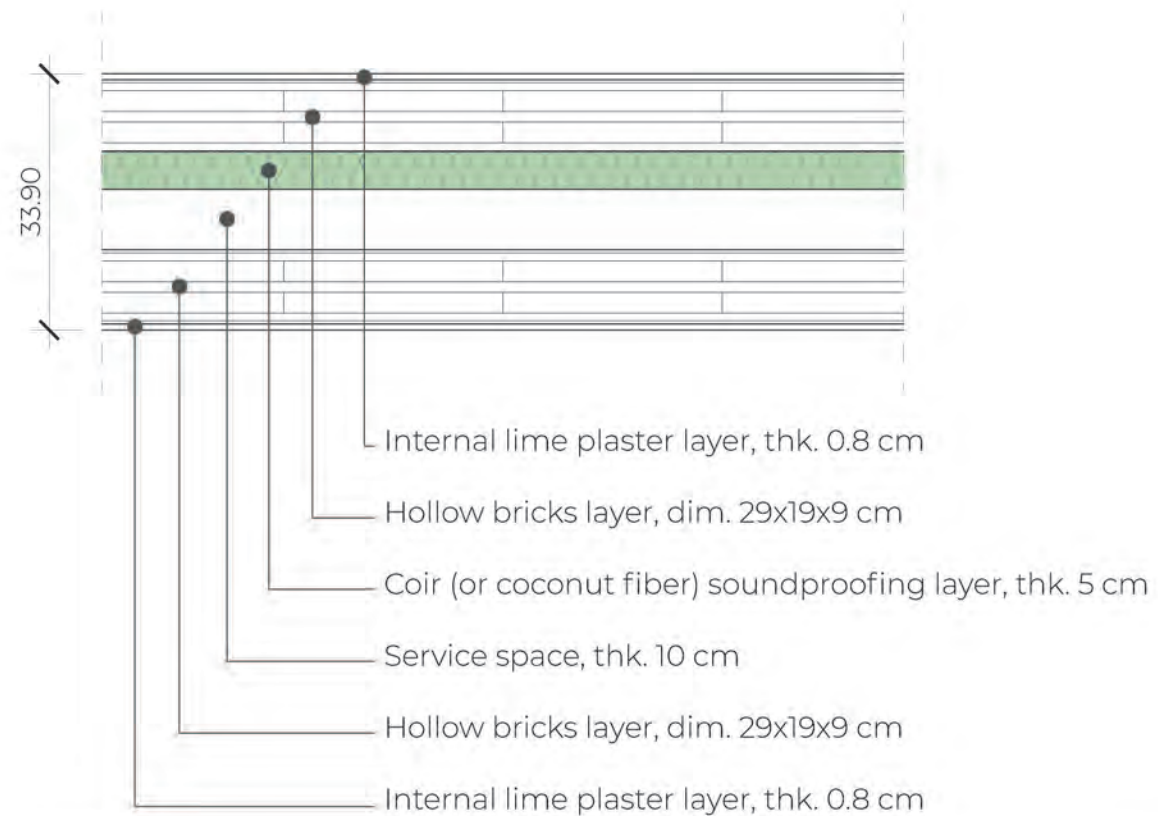
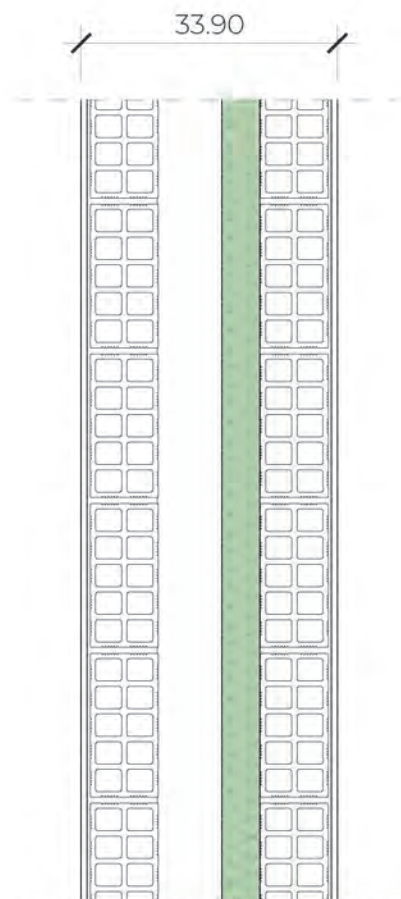


TECHNICAL PACKAGES 1:10

VERTICAL PARTITIONS



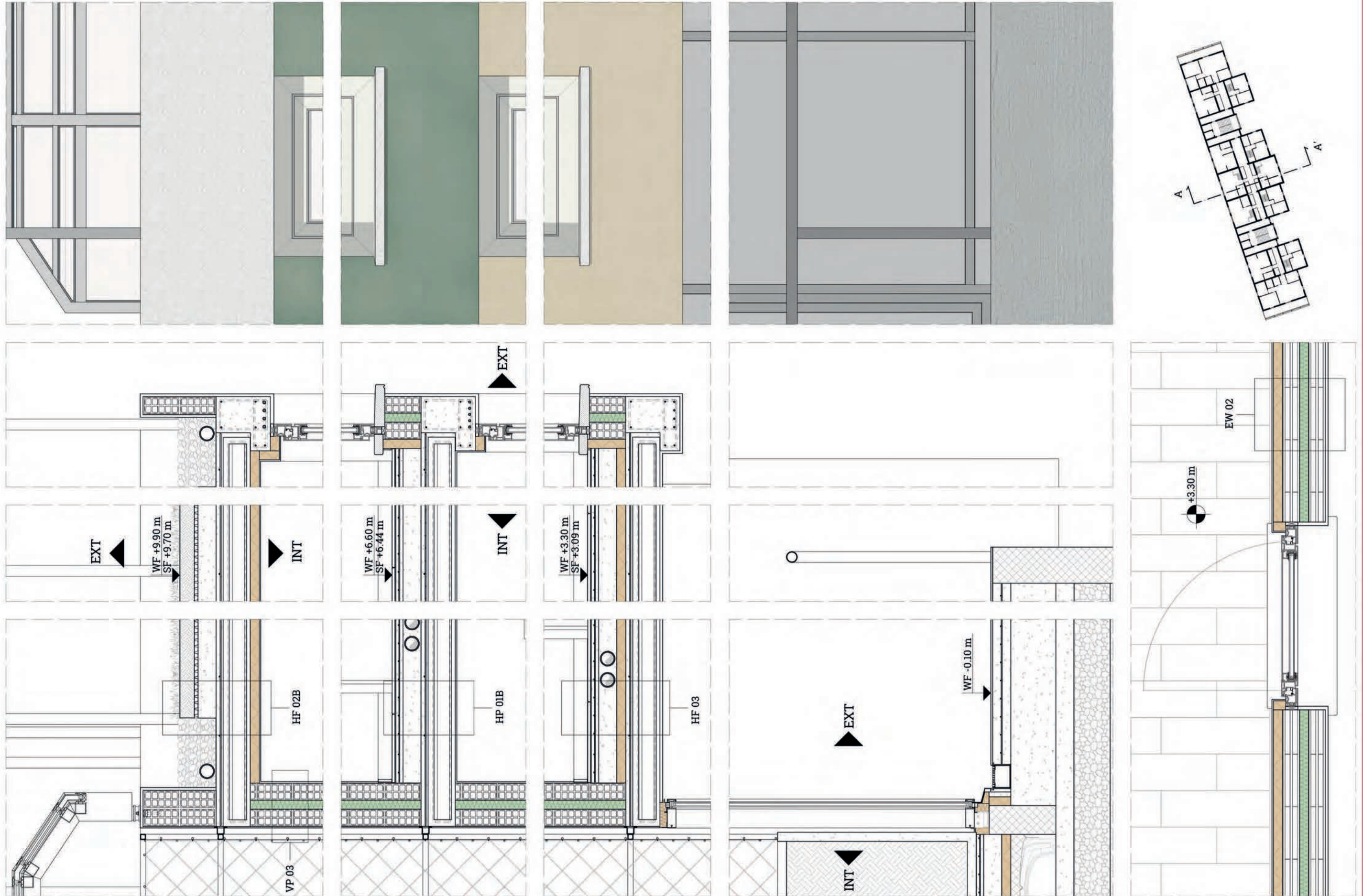
VERTICAL PARTITION 03



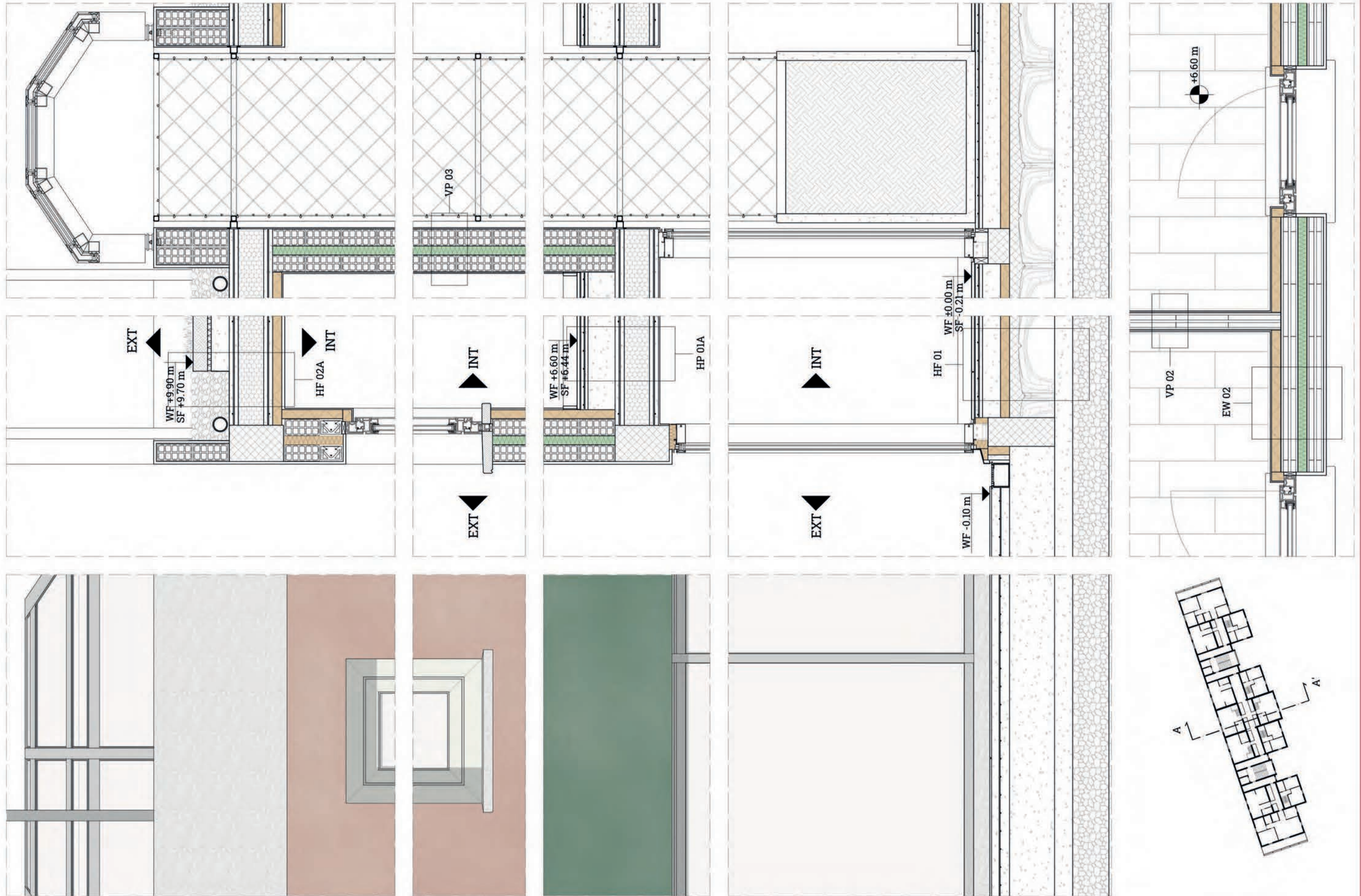
VERTICAL PARTITION 04



BLOW UP 1:20
SECTION A-A'



BLOW UP 1:20
SECTION A-A'



ARCHITECTURAL DESIGN

3D VIEW



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