INVERSA DISTRICT

PRAGUE 2150

CORE REGENERATION

AD6 Fessler - Drahotova Studio summer semester 2023/24 Maria Dimitrova

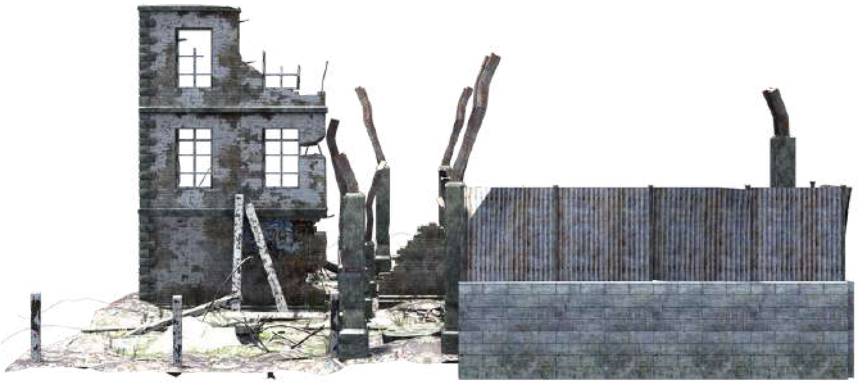
STUDIO BRIEF

What will **HERITAGE OF THE FUTURE** look like? By exploring the past and imagining the future we will get an idea for what to do today. We will have two basic parts to the semester: making city maps and proposing specific architectural scale projects for the year 2150. Upon the assumption the population will double, and society will change (to some degree). Architecture will be considered at a scale that is not quite building and not quite city.

contents.

WASHED AWAY

THE FLOOD THAT CHANGED EVERYTHING.



It is 2140. In the wake of an unforgiving natural disaster, the **Karlín neighbourhood lies submerged** beneath the water of the Vltava River. The city district once filled with cars, pollution, and chaos now stands as silent sentinels amidst the swirling waters. Trees bow to the force of the current, and streets become unrecognizable torrents.

For in the aftermath of destruction, the creator sees **not just devastation, but an opportunity**—an opportunity to rebuild, to innovate, and to create a new habitat, where community would flourish amidst the wreckage. A habitat where **cultural identity** is tied to **mass production** so that the doubled population of Karlin can be accommodated.

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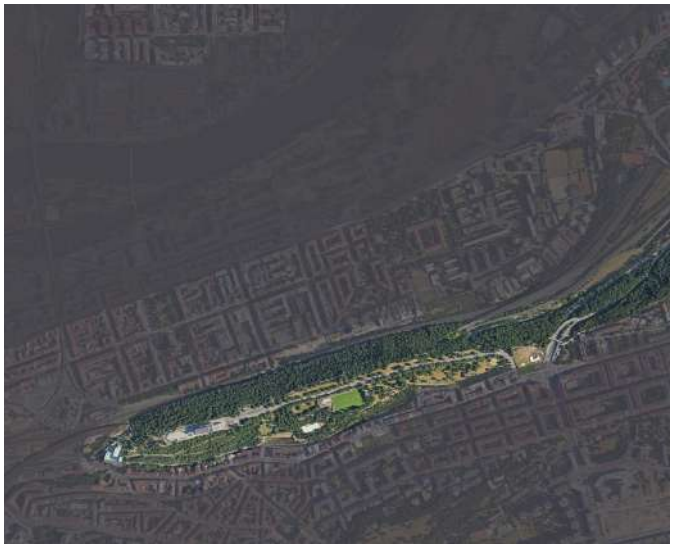
2023

Submerging



2140

ECHOES OF THE PAST,
VISIONS OF THE FUTURE

Inspiration

Paul Signac, 'In the Time of Harmony', **1895**

Paul Signac, 'In the Time of Harmony', **2150**

In this reinterpretation of "In the Time of Harmony," the vision extends beyond the boundaries of 19th-century France. Vibrant colors dance across the canvas, portraying a city pulsating with life and energy. Towers of glass and steel reache towards the sky, their geometric forms a testament to human ingenuity.

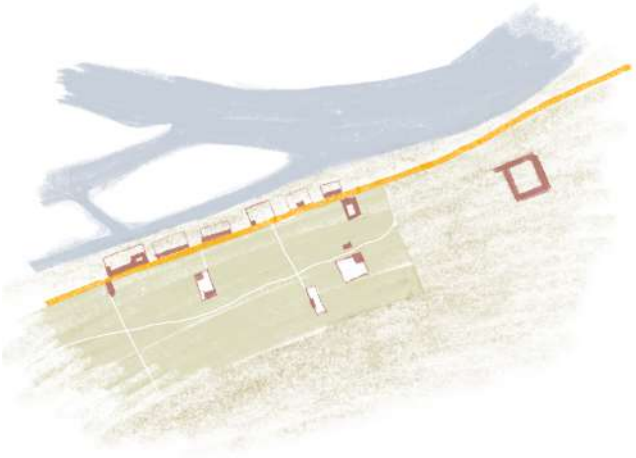
But amidst the sleek architecture and bustling streets, Signac infused his painting with a sense of harmony born not only from the balance of color and form, but from the **unity of humanity with its environment.**

Karlin, Holesovice, and Smichov

In the 19th century, Prague grew as an industrial and commercial centre, and the city experienced **rapid urbanization and densification.** This led to expansion of Karlin, Holesovice, and Smichov due to their strategic locations, access to transportation networks (including rivers and railways). The districts attracted factories and workers which resulted into construction of more residential buildings and infrastructure that followed **a not typical for Prague rectangular grid.**

Due to their perpendicular street grid, the three district are suitable for the project vision and the application of the investigated principle of **inverted block and street grid.**

The project specifically focuses on Karlin neighbourhood where Inversa district idea is applied to.



1800

Karlín is a formal agricultural settlement created on the road (nowadays Pobřežní str.)

1980

2003

2023

2140

The flood that leaves Karlin submerged and in ruins.

2150

The new master plan.

The project aims to test and investigate the possibility of creating urban districts on a **new type of street grid.** Instead of the traditional urban blocks and streets, **the space is inverted**, which means the typical position of buildings and infrastructure is switched. The built-up area **covers 40% less land** and creates homes for double the already existing population.

The programs of the new master plan are as before but with an **increased capacity by 2 times.**

The increased capacity is achieved by v**ertical building.** Nowadays, Karlín average floor number is around 4 floors, while Karlín in 2150 has an average floor number of 7 floors.

Mainly services and commercial spaces are situated at the ground levels, while the upper floors are dedicated to residential use, which are investigated more in detail.

Footprint: 335 000 m^2
Population: 12 000

Footprint: 230 000 m ^{2}
Population: 24 000

40% more free area

New Master Plan

The project accommodates double the population of nowadays Karlín and increases the service spaces. The new position of the built-up area creates the illusion of paradise in the urban tissue by having wide open areas serving as public spaces.

The built-up area is perforated on the ground level for a freely on ground circulation.

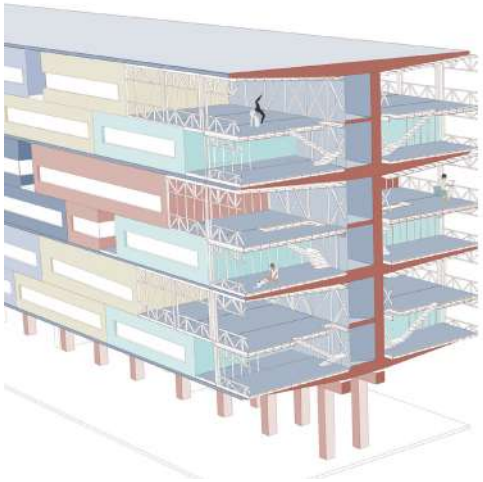
As a city of the future, the area is created for **limited access to cars** and places public transport as the main means of transportation.


Invalidovna
Elementary school and day-care Lyčkovo náměstí
Ss. Cyril and Methodius Church
0 25 50 100 200 300
1:5000

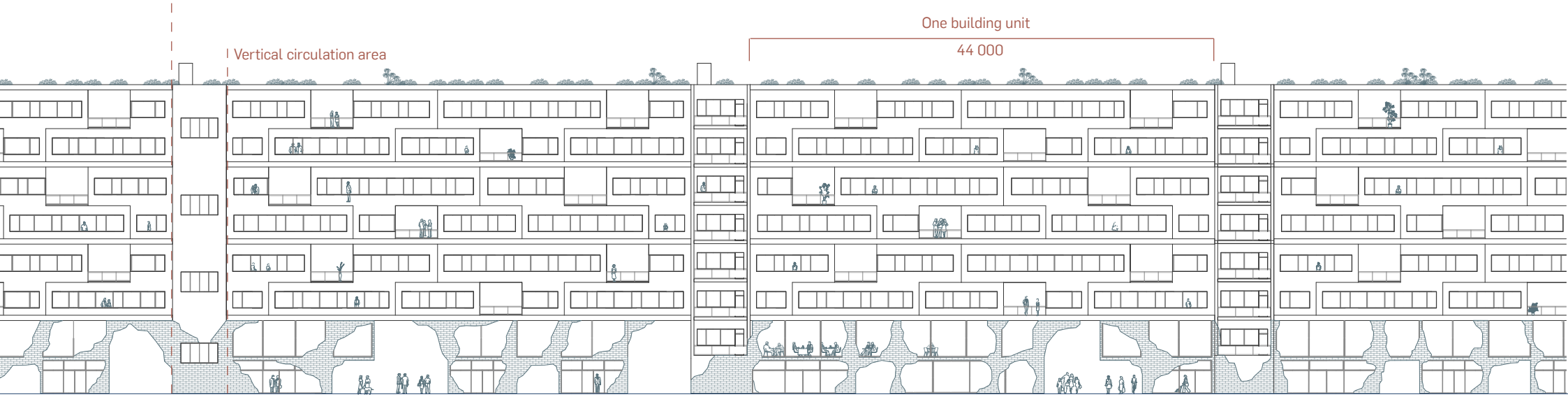
Idea

As the city's urban structure evolves, accommodating a projected doubling of its population in the future necessitates comprehensive planning and infrastructure development. This demographic shift will likely **exert significant pressure on existing resources and spatial configurations,** prompting a critical reassessment of urban planning strategies to ensure sustainable growth and equitable access to amenities and services. Another question is **how to preserve the identity of the area and increase its urban resources.**

Inversa district is built entirely from recycled materials and strives to be a zero-carbon neighbourhood. The question regarding population growth is resolved using modular residential units in different layouts to bring identity.



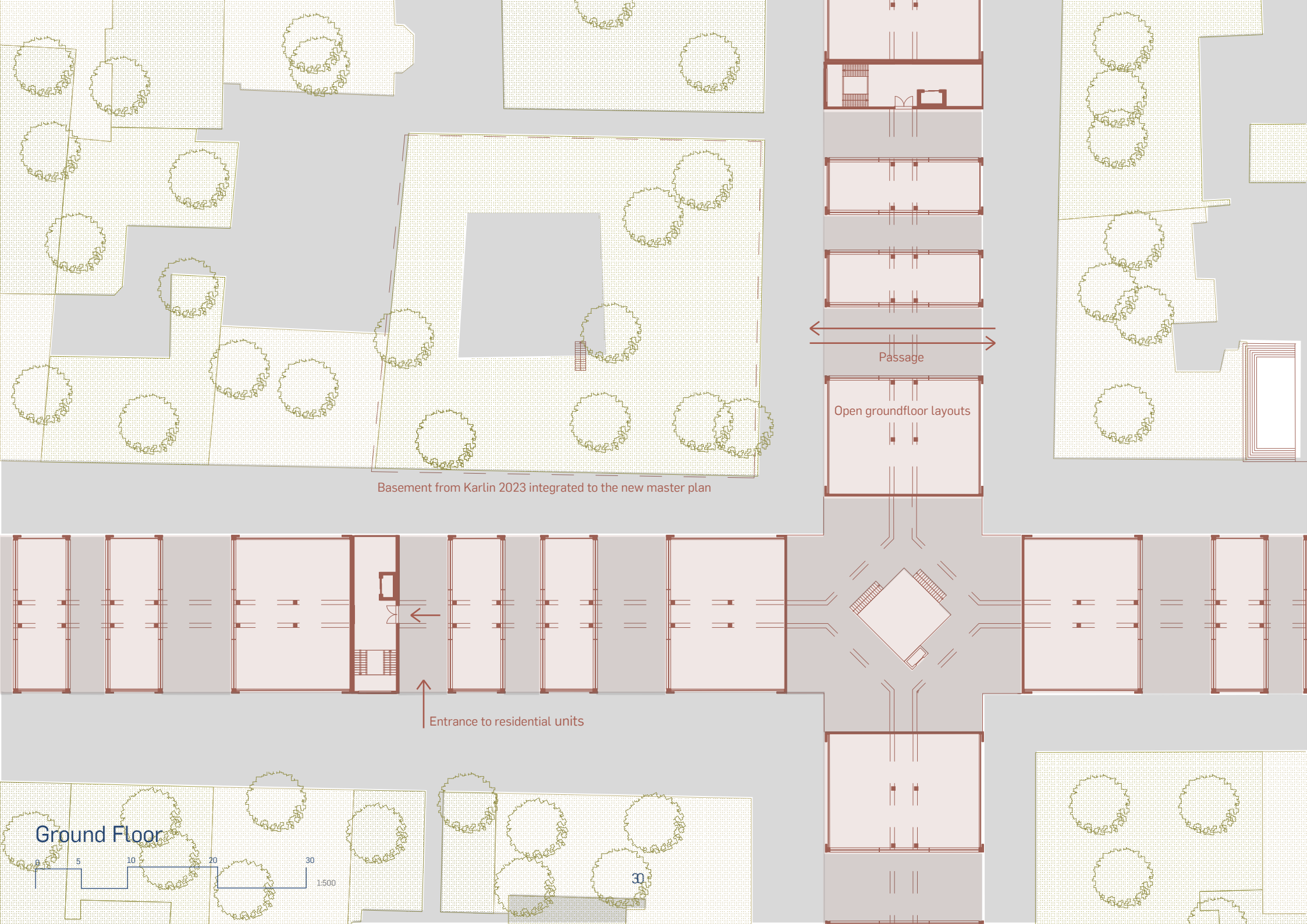
IN THE **GRID**


Vertical circulation area
One building unit
44 000

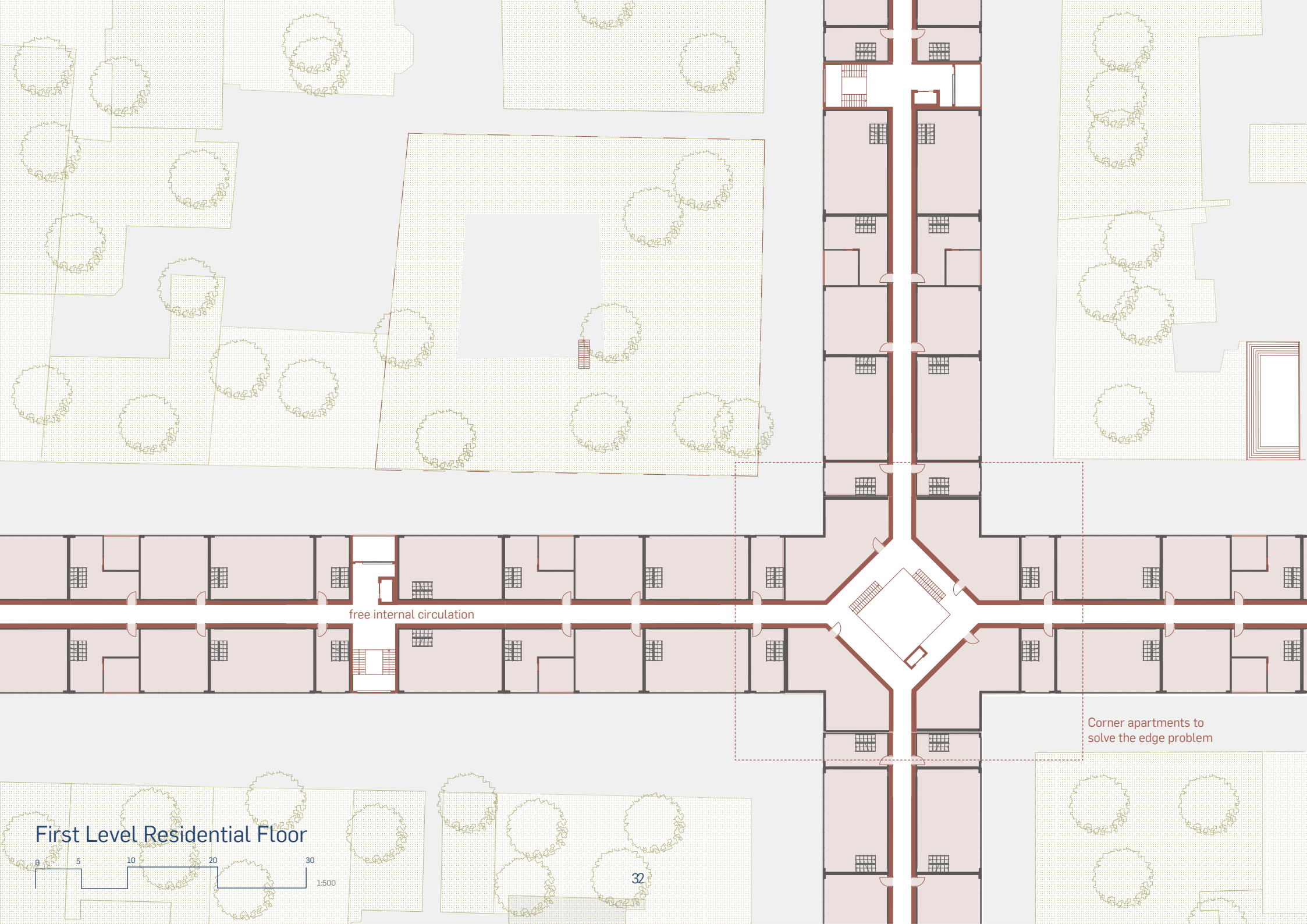
Each building unit has its own vertical circulation area, however the corridors of each unit are connected to its neighbouring building.

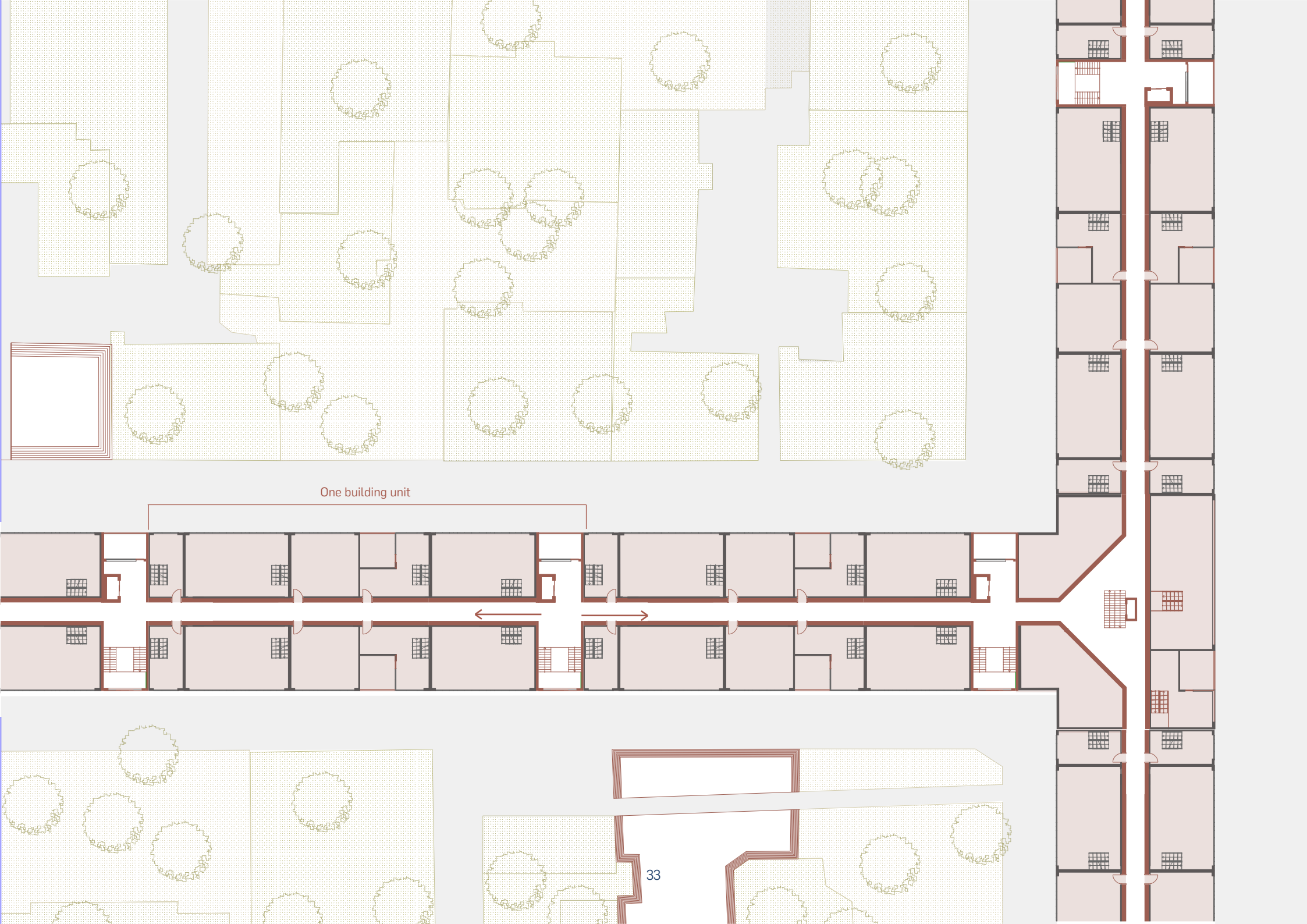
0 5 10 20 30

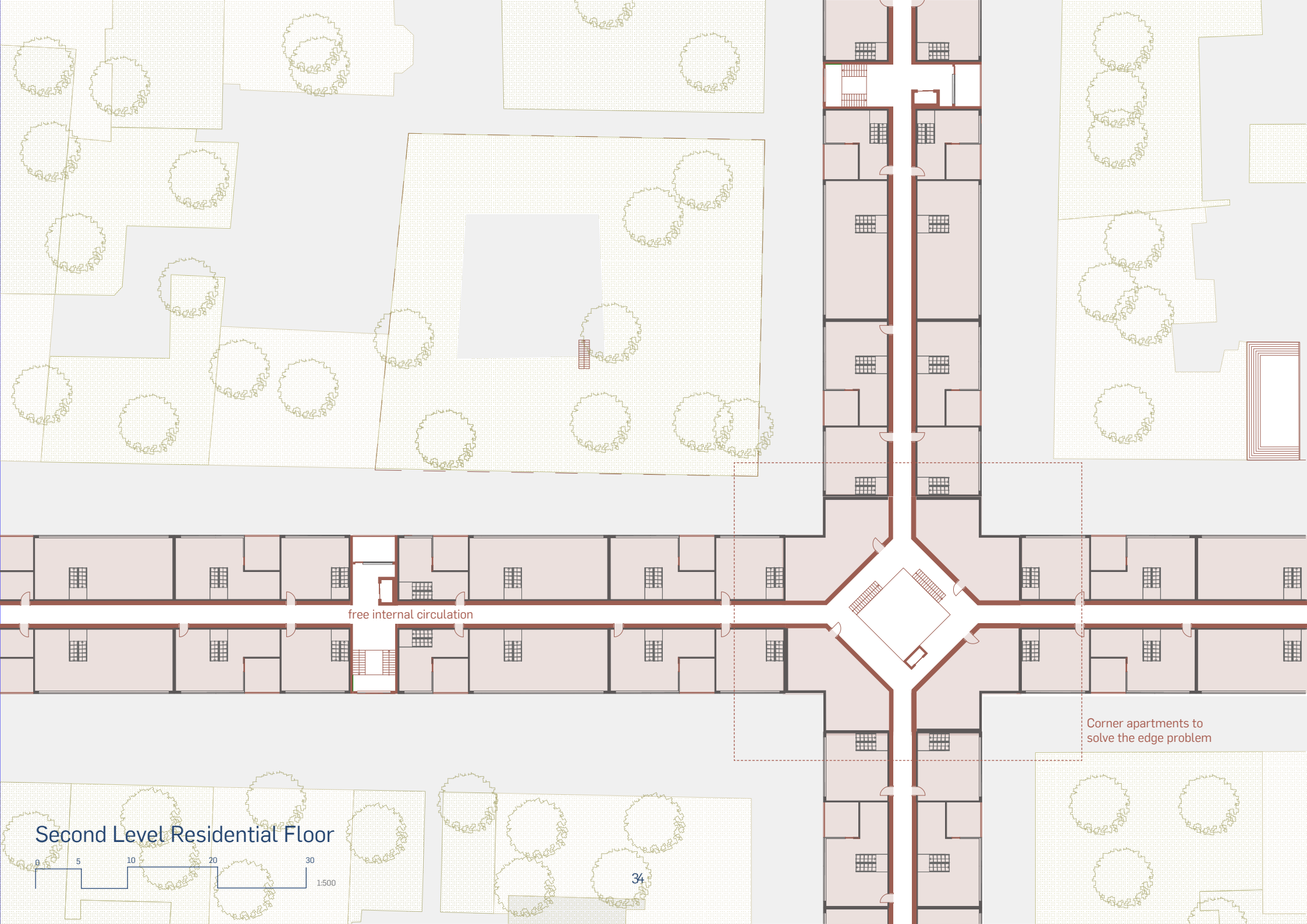
1:500

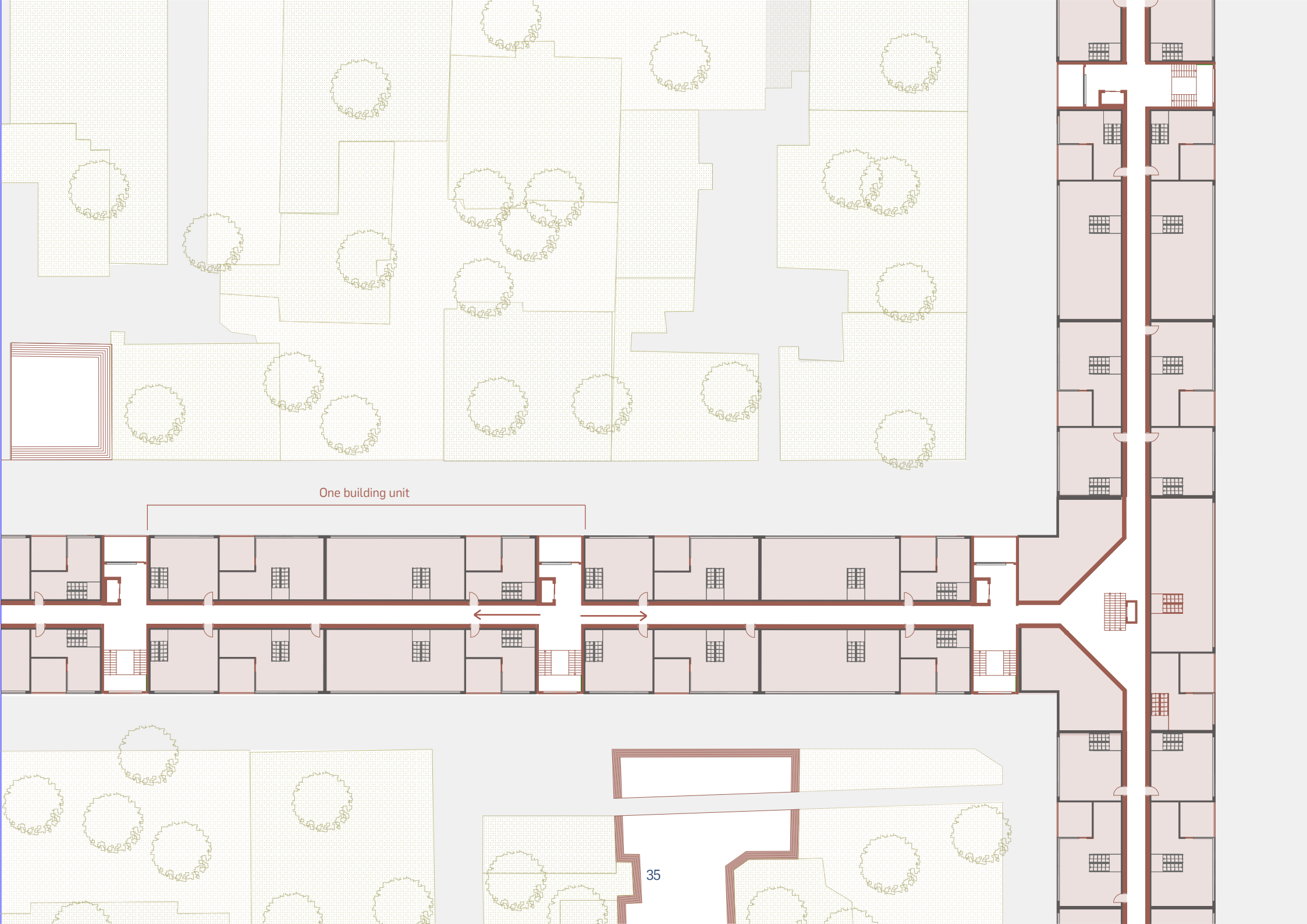

Passage
Open groundfloor layouts
Basement from Karlin 2023 integrated to the new master plan
Entrance to residential units
Ground Floor
0
5
10
20
30
1:500


Basement from Karlin 2023 integrated into public a space
Passage
open groundfloor layouts
Entrance to residential units
Basement from Karlin 2023 integrated into public a space
Open groundfloor layouts
31


free internal circulation
Corner apartments to
solve the edge problem
First Level Residential Floor
0
5
10
20
30
1:500
32

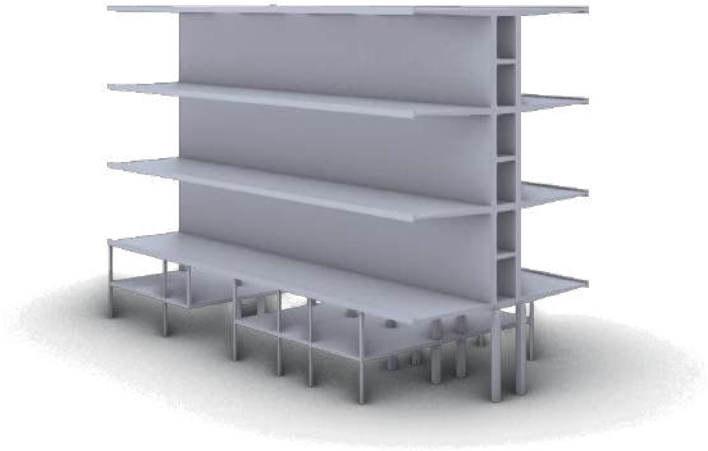

One building unit
33


free internal circulation
Corner apartments to
solve the edge problem
Second Level Residential Floor
0
5
10
20
30
1:500
34


One building unit
35

AT THE CORE

BEYOND THE EDGE



Structure

The project is divided into **two major structural systems:** core and modules. The build-up area follows linear grid, created from the already existing road structure leading to x and y-axis buildings. In each of the centres of these linear axis a core structure is placed, which functions as the main load-bearing system. The spaces are created by a modular system, placed on the two sides of the core structure.

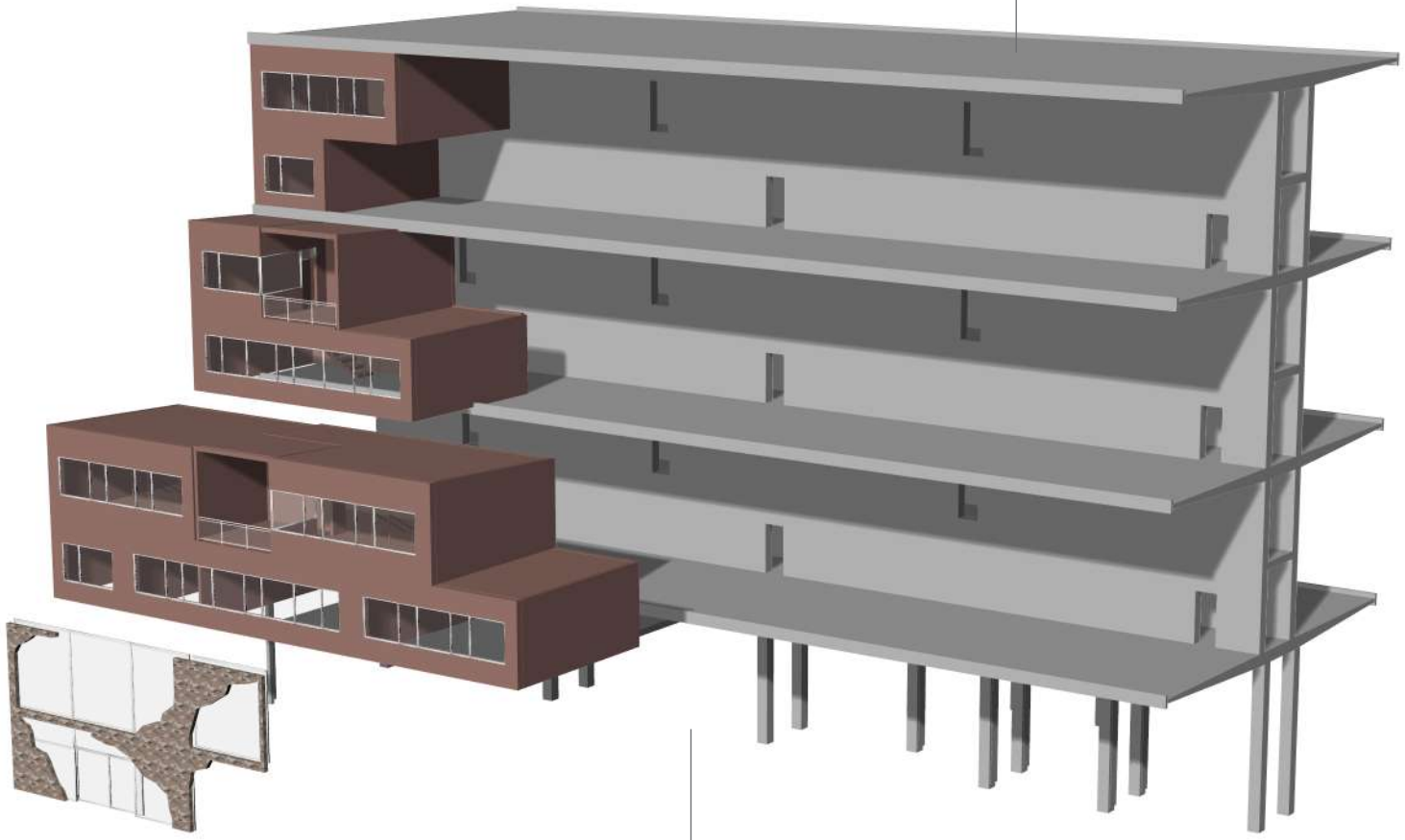
The entire structure's load is carried by the core.

The core structure consists of reinforced concrete columns, irregular-shaped concrete slabs, and lightweight concrete walls. On the ground level, the load is transferred by columns that are placed under the corridor walls on the upper levels.

In between two-floor heights (or every 6.4 meters) a slab is placed. The shape of the slab is characterised by its sloped bottom. The edge connected to the corridor walls is 20% wider than the edge on the other side. This allows the structure to stand without any additional columns by **bringing all the load to the centre of the structure.** Furthermore, the load on the two sides of the core centre is mirrored so an equilibrium is achieved.

Core Structure

load-bearing element



Modular Units

non-load bearing double floor elements

Brick Facade

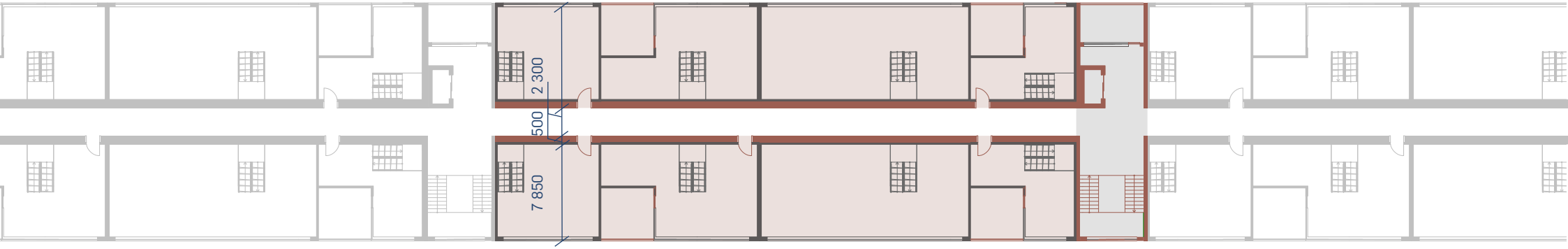
*taken from Karlin 2023 buildings

Ground Floor

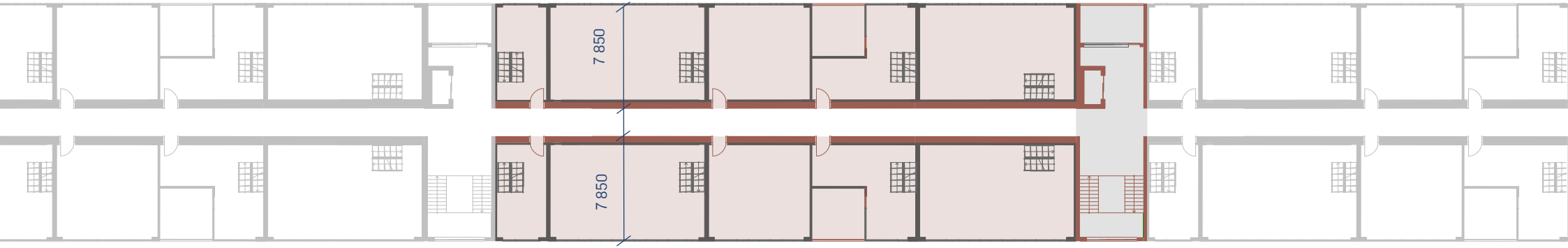
open layout and glass facade
load-bearing columns

0 1 2 4 8 12

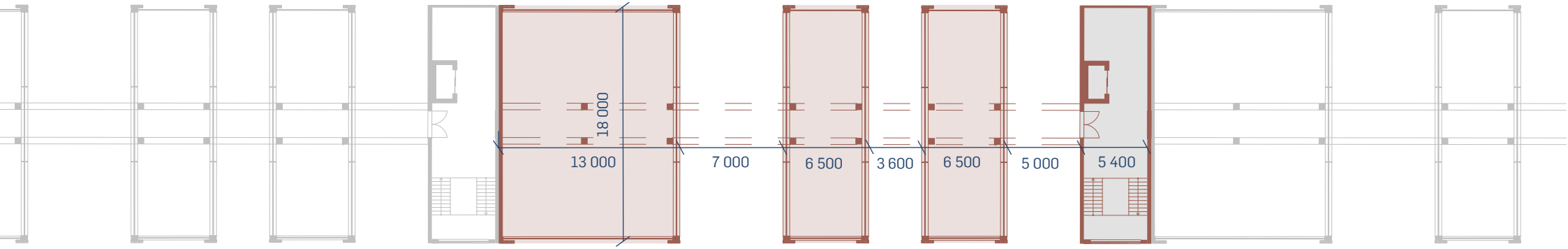
1:200



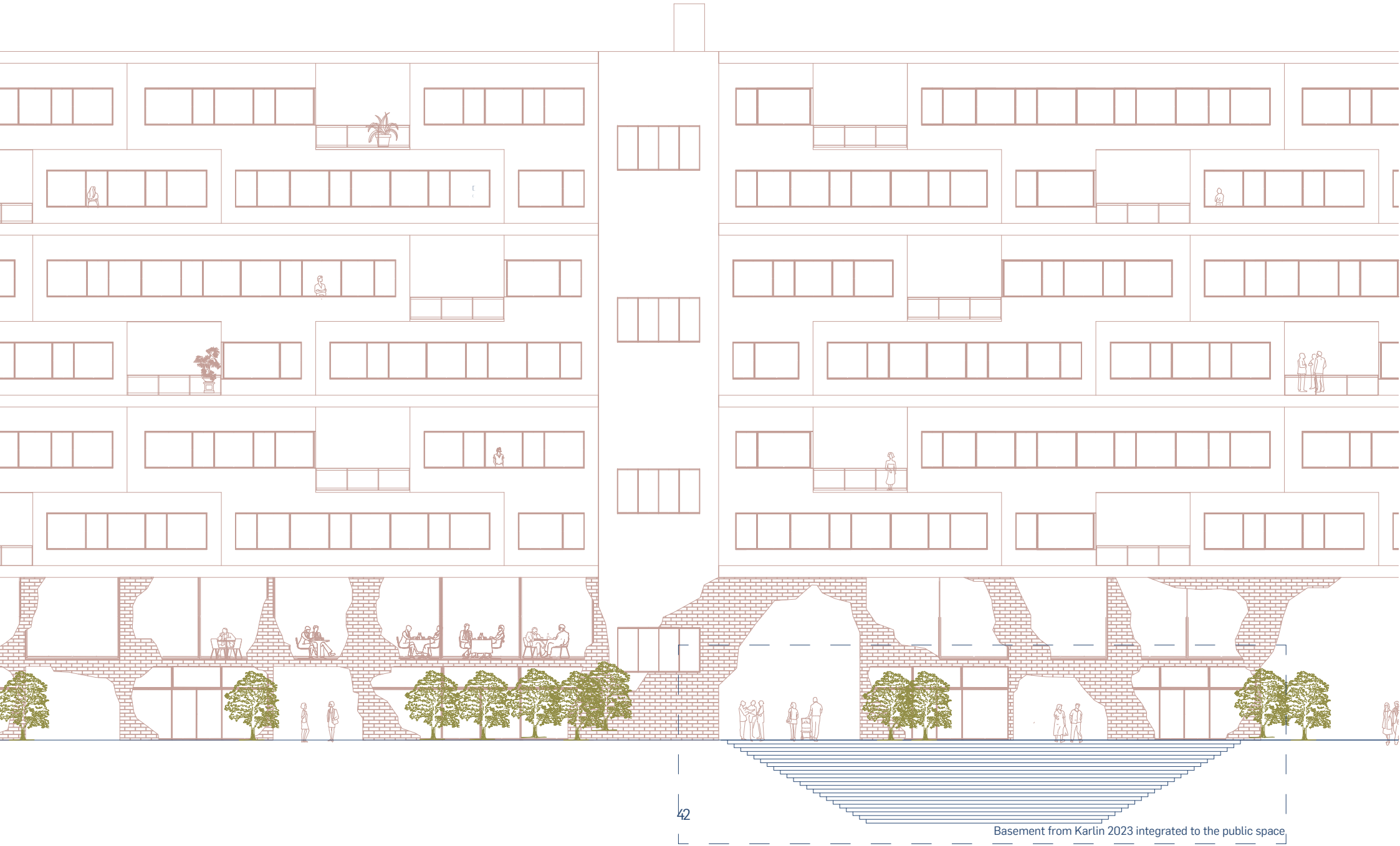
Second Level Residential Floor



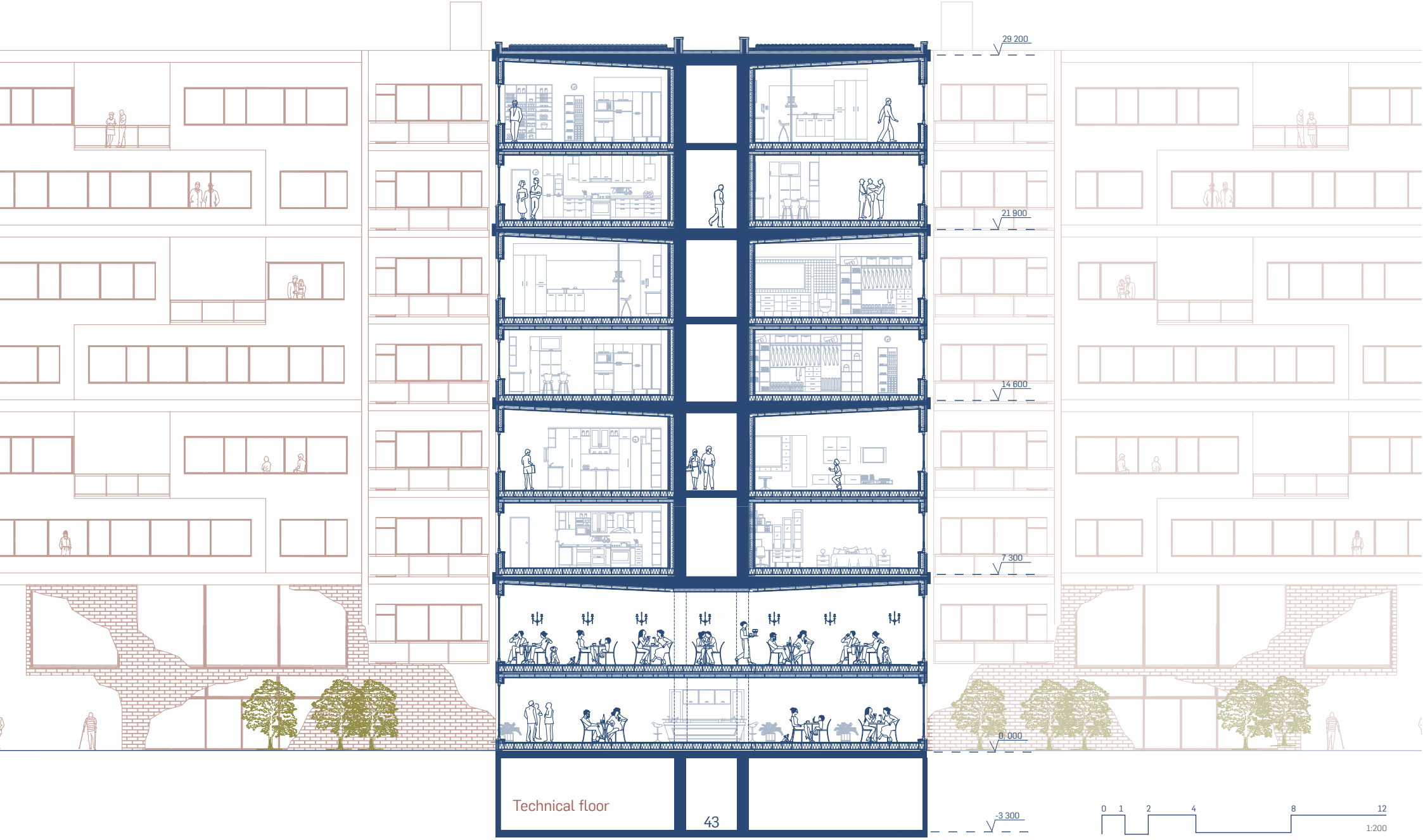
First Level Residential Floor



Ground Floor



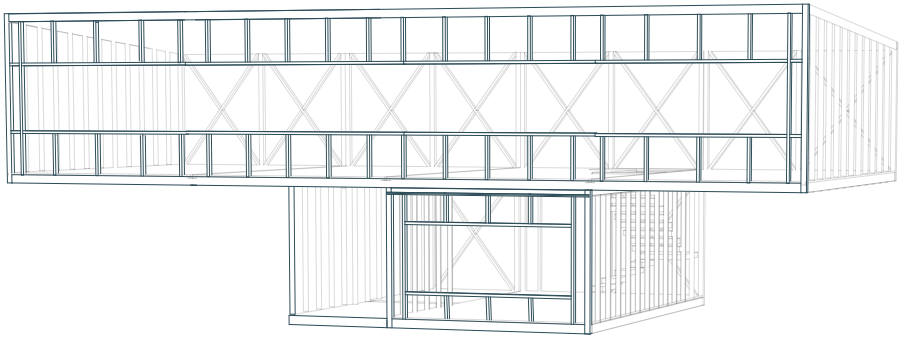
Basement from Karlin 2023 integrated to the public space


29 200
21 900
14 600
7 300
0. 000
-3 300
Technical floor
43
0 1 2 4 8 12
1:200

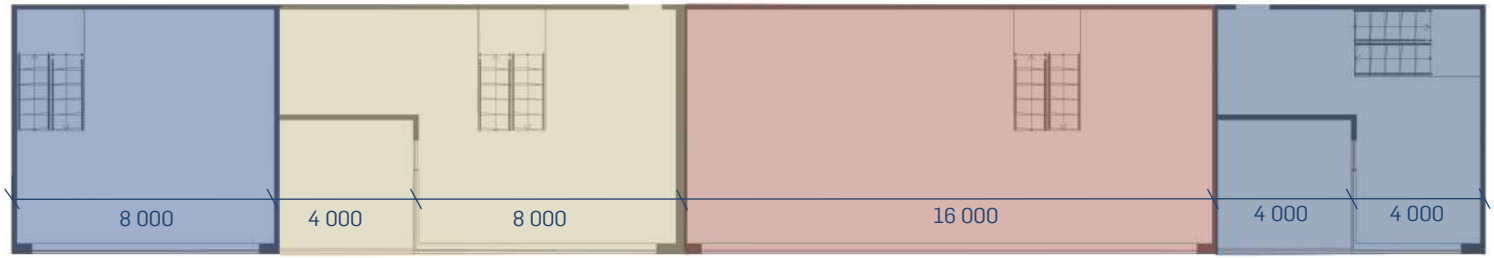
Modules

A modular system is used for the creation of the living units. There are 6 types of modules that depending on the assemble the 6 types of residential units are created. The units are mainly duplexes, meaning one unit spans vertically between two irregular shaped slabs.

The modules are corner-supported, and one-side supported **light steel frame structures,** meaning the load is transmitted through corner and intermediate posts. These modules use longitudinal beams at floor and ceiling levels that span between the corner posts.



light-weight steel frame construction



Second Level Residential Floor

First Level Residential Floor

Loft Studio

90 m²

Duplex B

170 m²

Duplex A

120 m²

Studio

60 m²

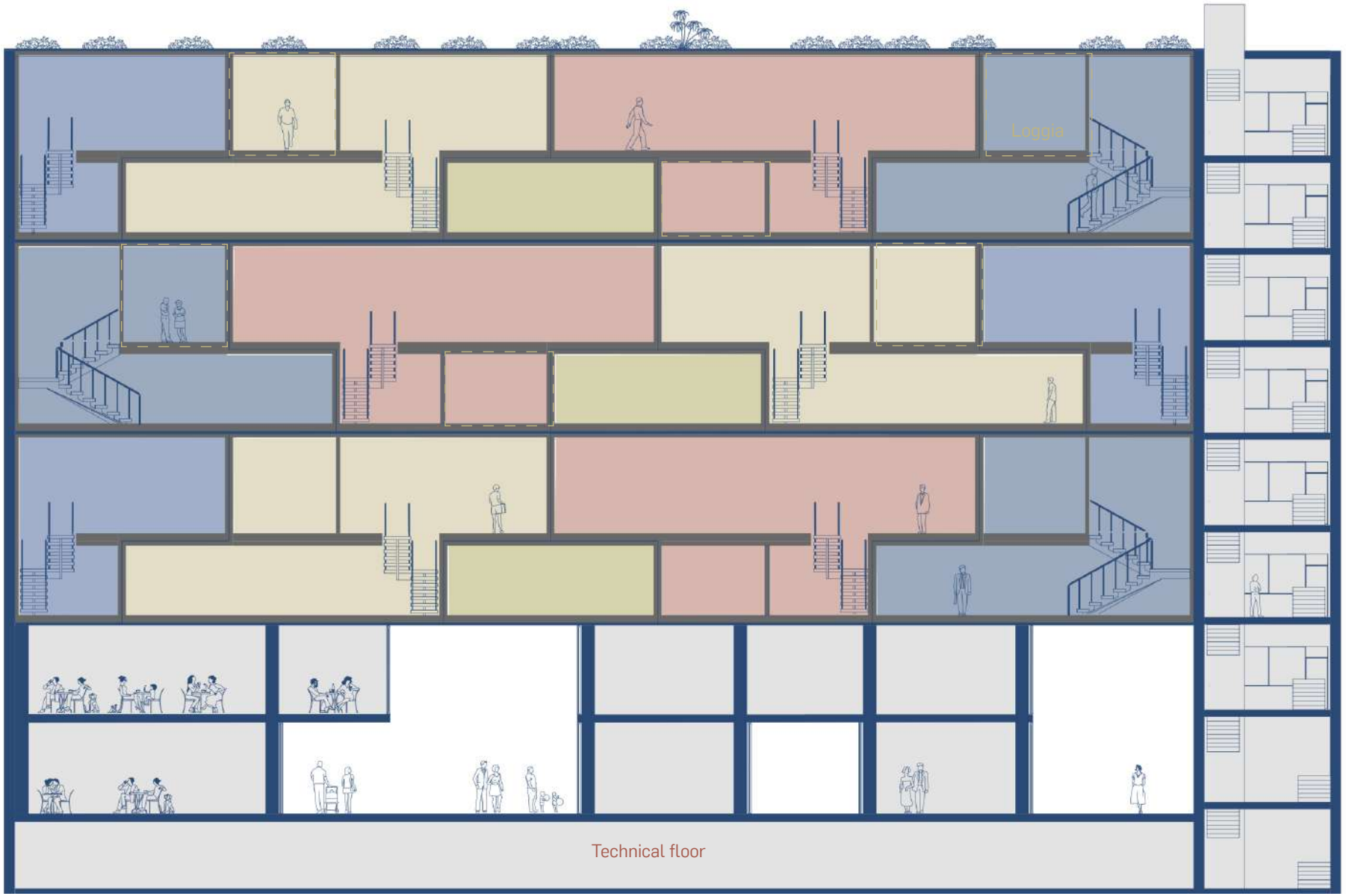
Duplex C

120 m²

Residential Units Grid

0 1 2 4 8 12

1:200



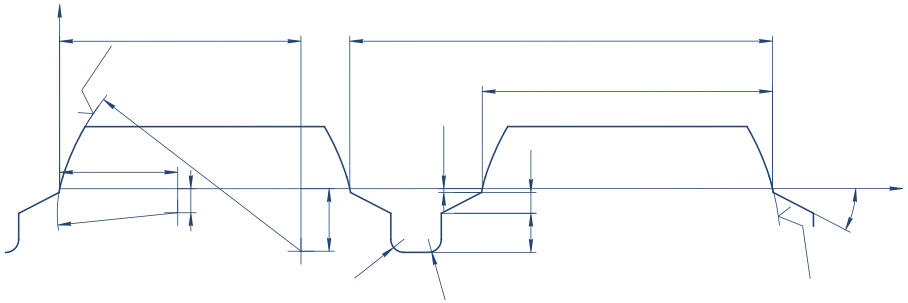
Residential Units Internal Circulation

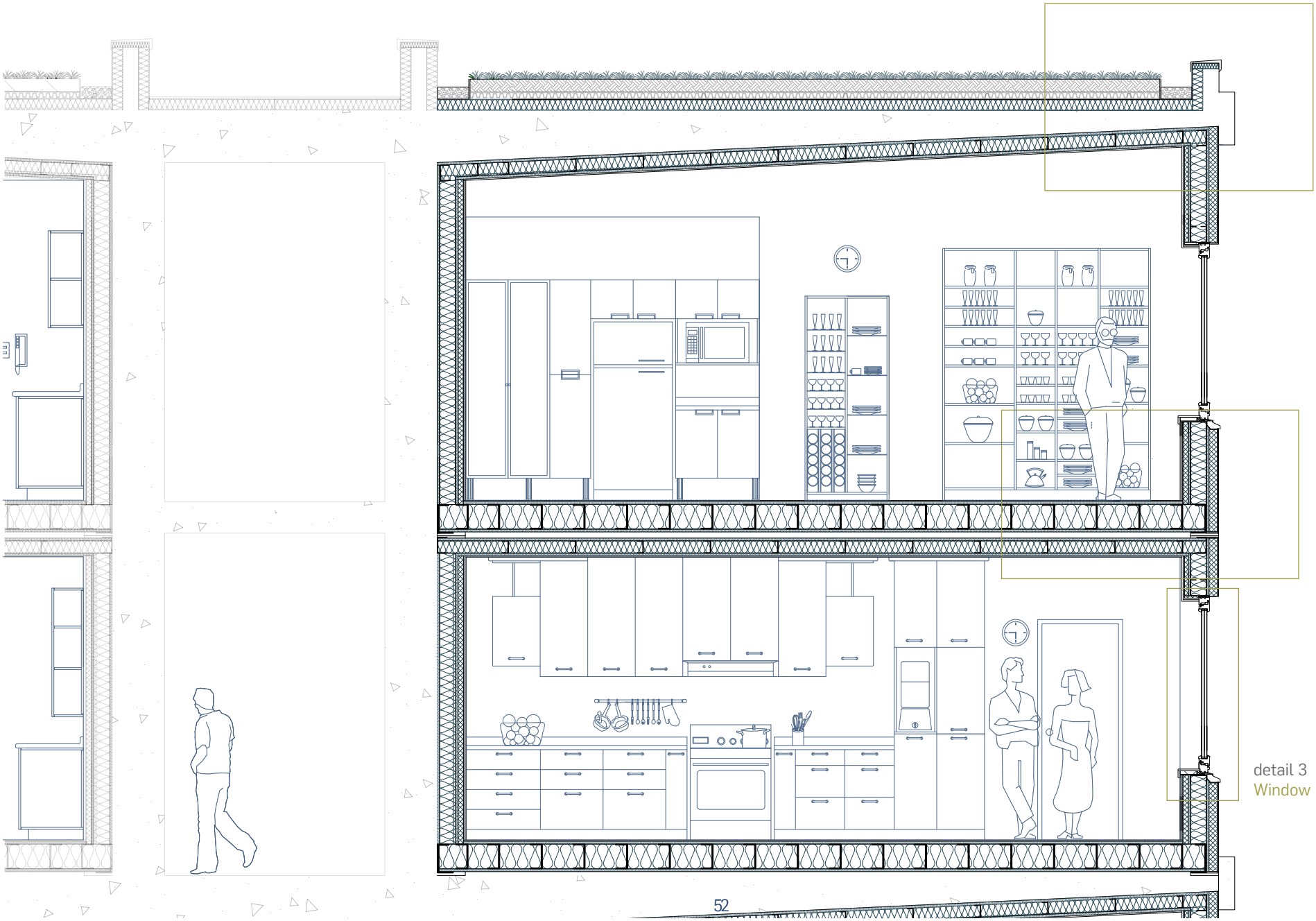
0 1 2 4 8 12

1:200

BUILDING

DETAILS

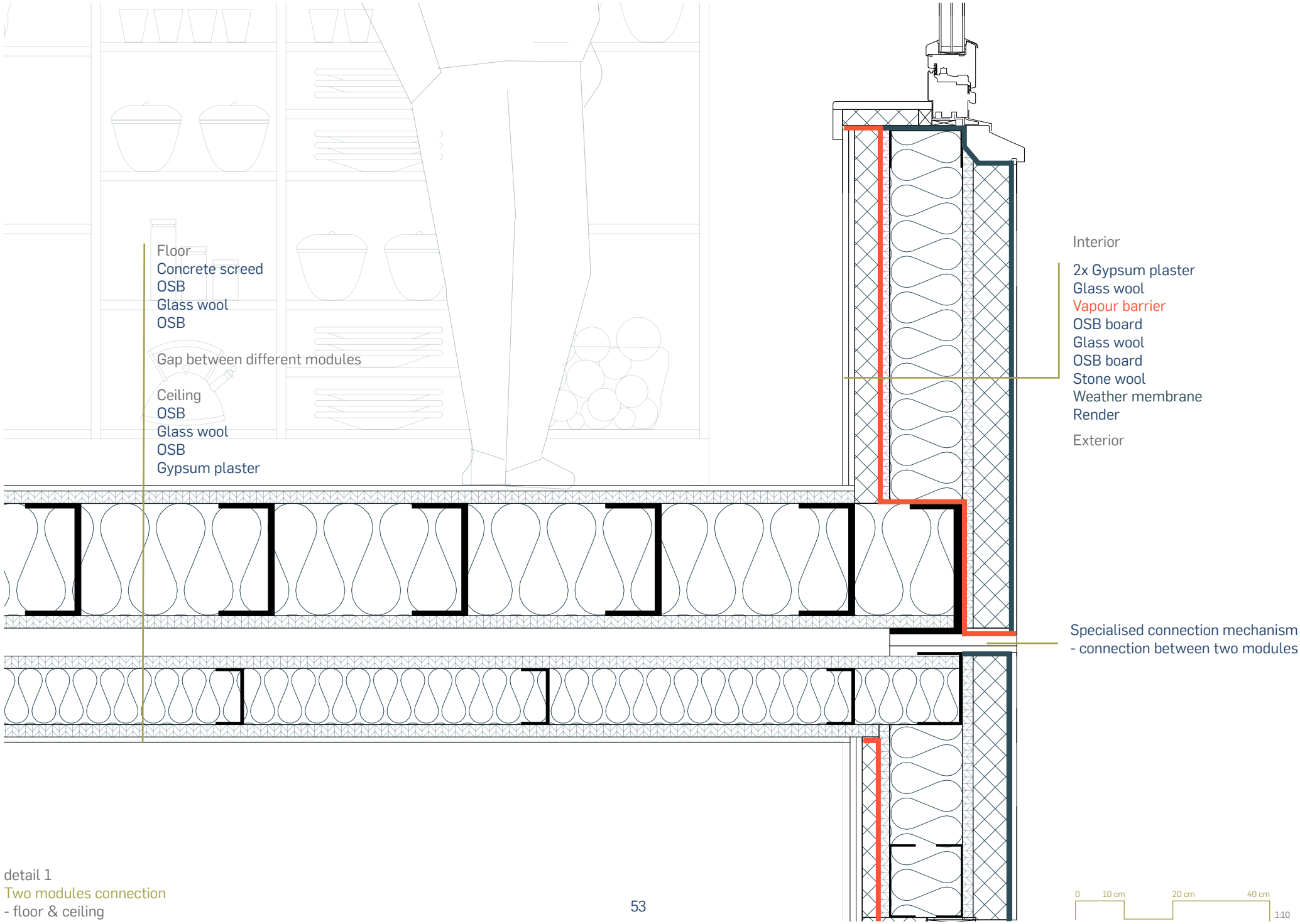




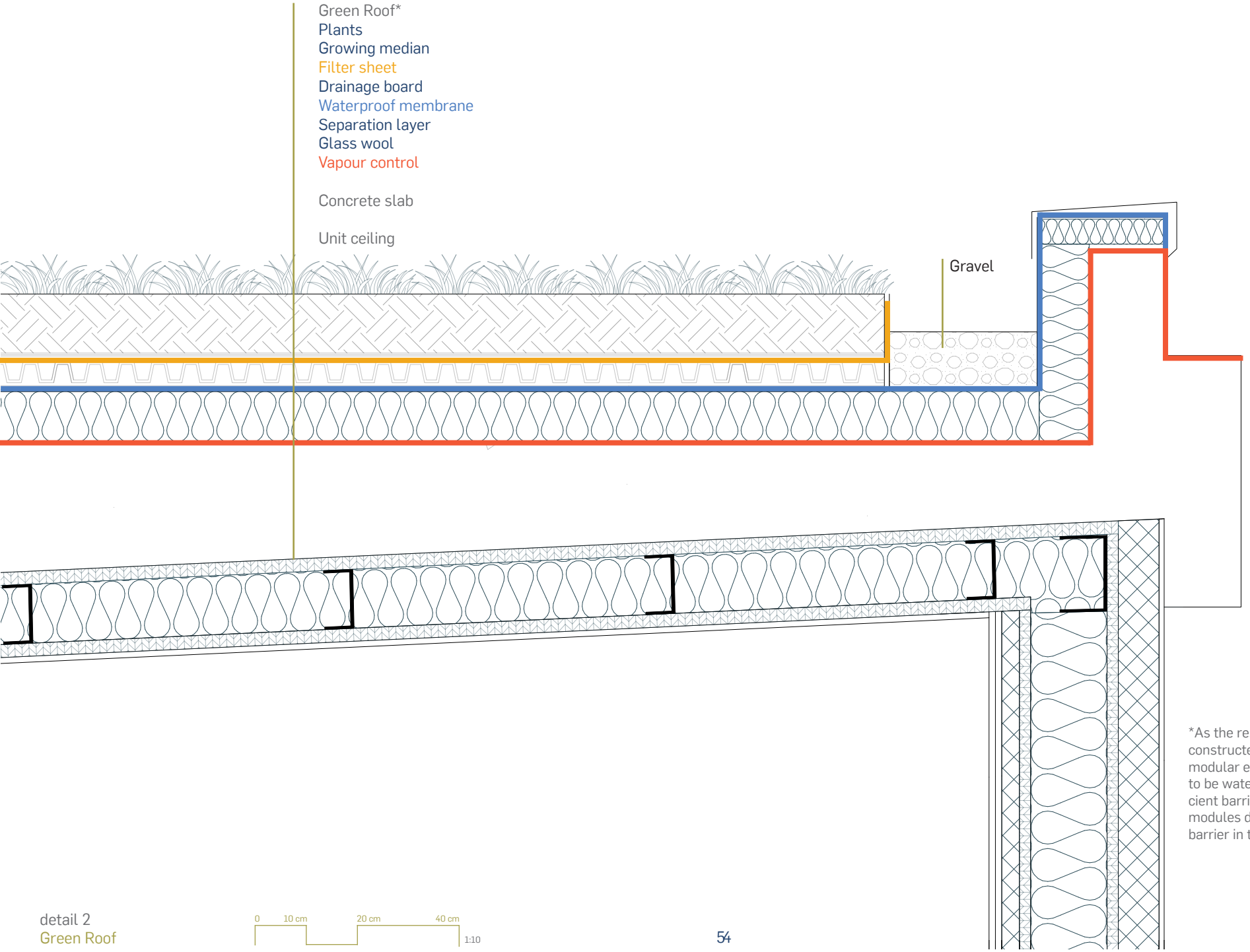
detail 2
Green Roof

detail 1
Two modules
connection
- floor & ceiling

detail 3
Window



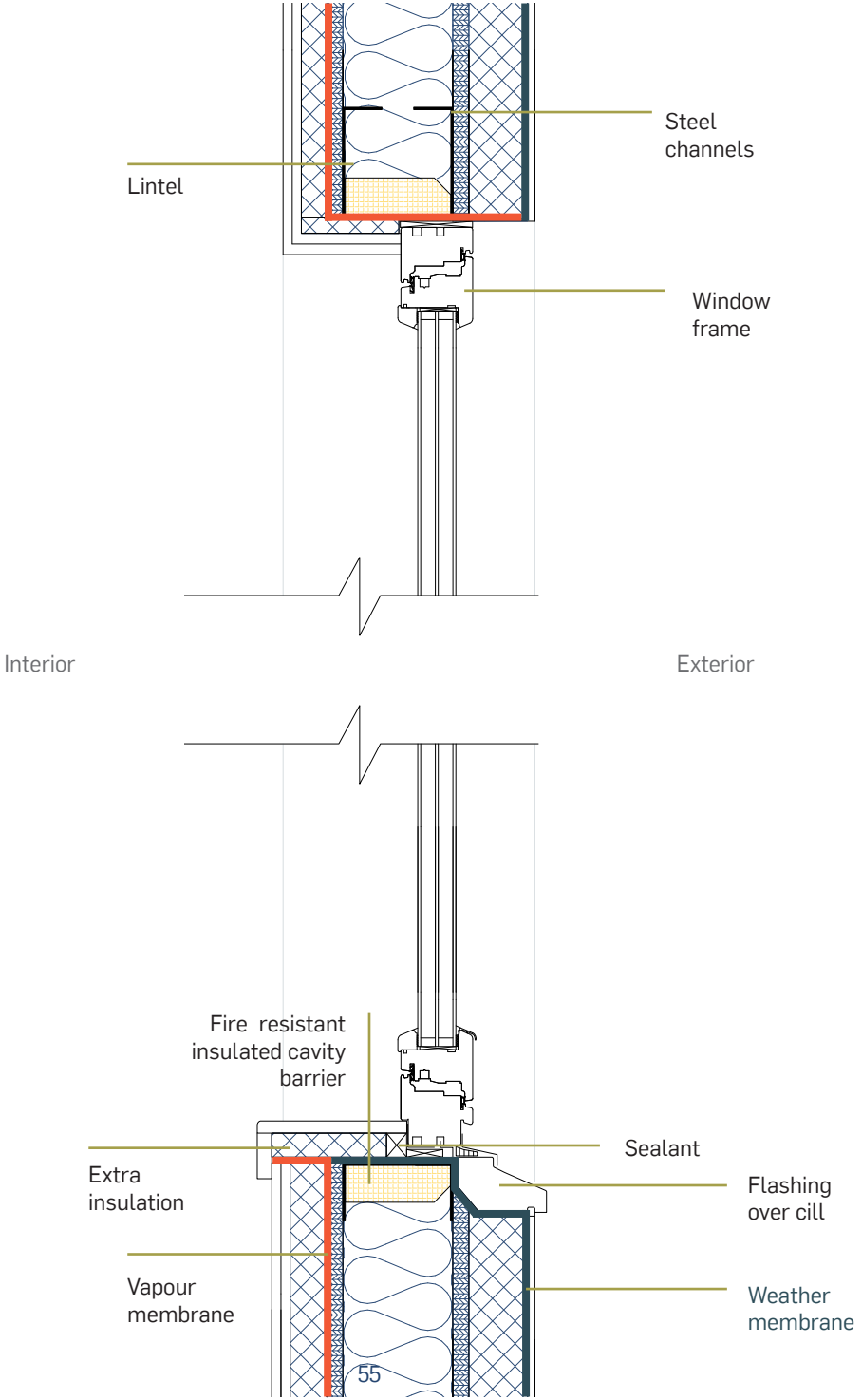
detail 1
Two modules connection
- floor & ceiling



*As the residential units are constructed by universal modular elements, the roof has to be waterproofed and an efficient barrier for moisture. The modules do not have a vapour barrier in their ceiling layering.

detail 2
Green Roof

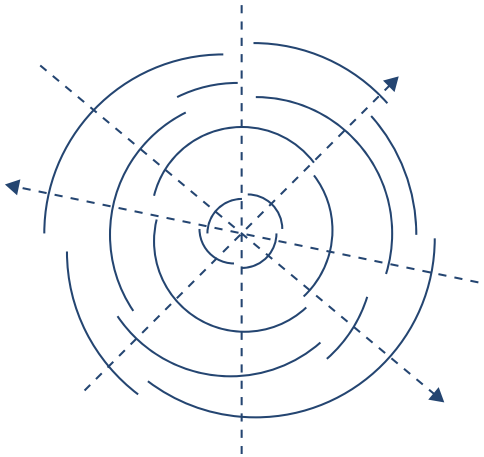
0 10 cm 20 cm 40 cm
1:10

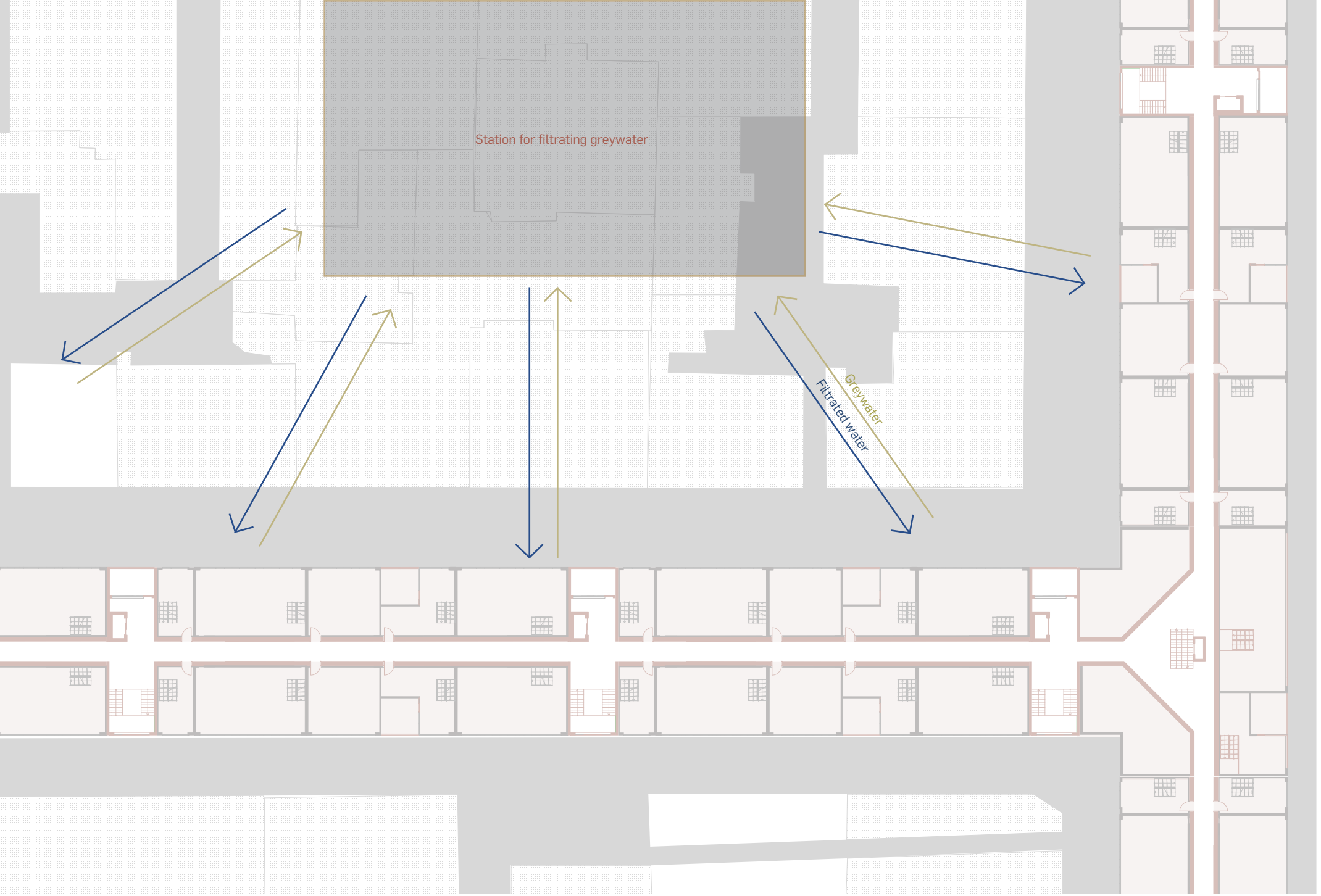


detail 3
Window

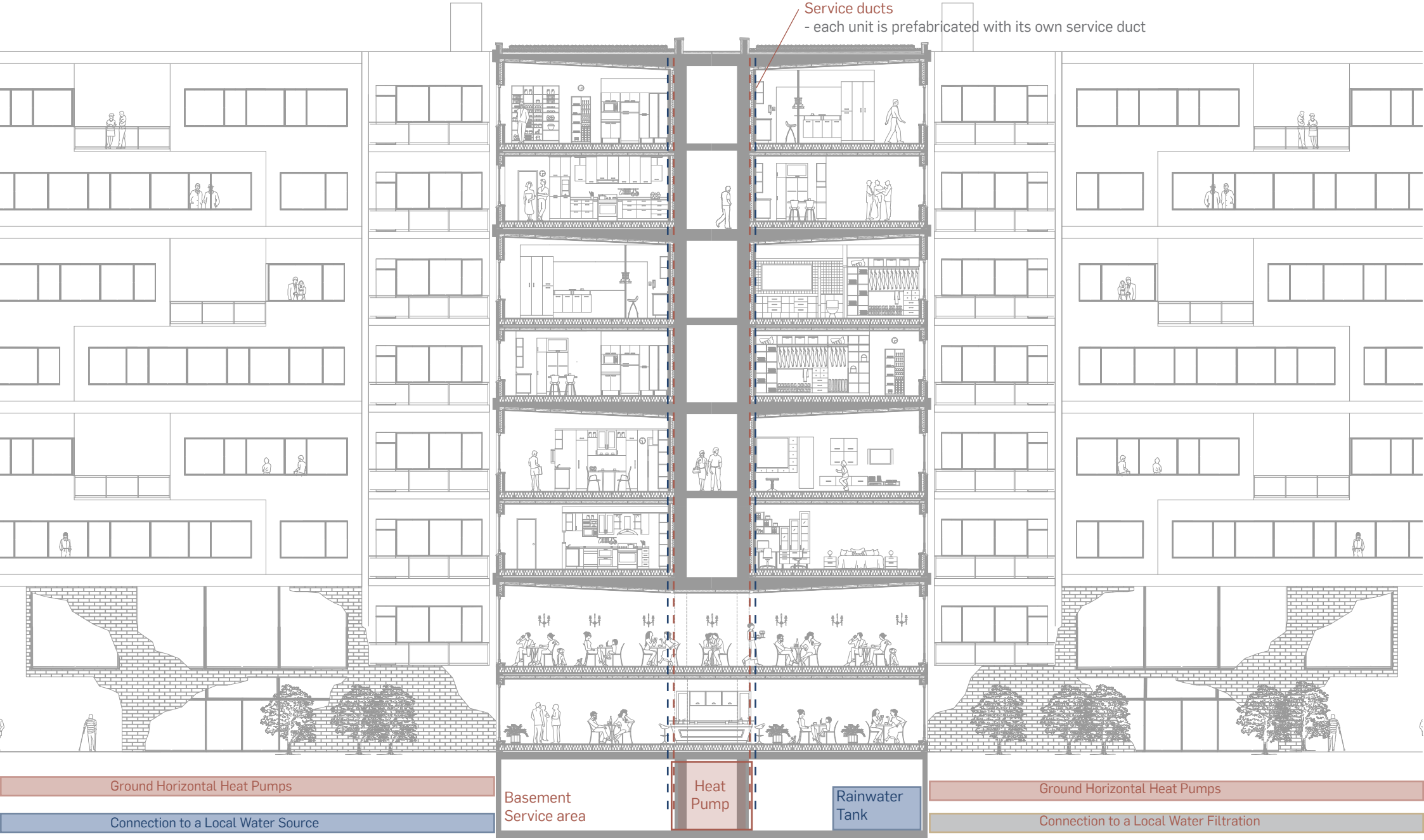
0 10 cm 20 cm 40 cm
1:10

BUILDING
SYSTEMS



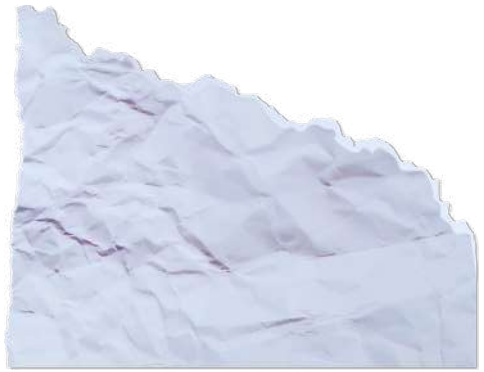


Water Management


Service ducts
- each unit is prefabricated with its own service duct
Ground Horizontal Heat Pumps
Connection to a Local Water Source
Basement
Service area
Heat
Pump
Rainwater
Tank
Ground Horizontal Heat Pumps
Connection to a Local Water Filtration

COVER

REPORT



1.0 Introduction

1.1 Studio brief

What will HERITAGE OF THE FUTURE look like? By exploring the past and imagining the future we will get an idea for what to do today. We will have two basic parts to the semester: making city maps and proposing specific architectural scale projects for the year 2150. Upon the assumption the population will double, and society will change (to some degree). Architecture will be considered at a scale that is not quite building and not quite city.

1.2 Location

The studio site is the entire Prague city, and the students' projects are divided into three categories: Core, Middle, and Periphery projects. Each category investigates different region of the city and its problems.

The individual research is part of the Core projects and focuses on the 19th-century industrial quarters of Prague, more specifically Karlín cadastral area, a territory part of the Municipality of Prague 8 district.

The residential and working neighborhood is situated on the east side of Prague 1 and south of Vltava River, organized by three main horizontal axes: Pobřežní str., Sokolovská str., and Křižíkova str. The area is enclosed between the Negrelli Viaduct on the west, Vitkov Hill on the south, and Vltava River on the north.

1.3 Flood 2150

In the year 2150, after excessive use of the Earth's resources and the ongoing climate change, Vltava floods once again hitting the Karlin district and leaving abandoned buildings and ruins. The water level is 15 meters making it the biggest flood for the region in written history.

Every piece of material is precious, every fragment of the old Karlin is a resource for the new. From the wreckage, a new quarter will emerge, a symbol of resilience in the face of catastrophe. An opportunity for innovative architecture, urbanism, and ideas.

2.0 Concept

2.1 Statement of objective

As the city's urban structure evolves, accommodating a projected doubling of its population in the future necessitates comprehensive planning and infrastructure development. This demographic shift will likely exert significant pressure on existing resources and spatial configurations, prompting a critical reassessment of urban planning strategies to ensure sustainable growth and equitable access to amenities and services. Another question is how to preserve the identity of the area and increase its urban resources.
Inversa district is built entirely from recycled materials and strives to be a zero-carbon neighbourhood. The question regarding population growth is resolved by the use of modular residential units in different layouts to bring identity.

2.2 Idea

The project aims to test and investigate the possibility of creating urban districts on a new type of street grid. Instead of the traditional urban blocks and streets, the space is inverted, which means the typical position of buildings and infrastructure is switched. The built-up area covers 40% less land and creates homes for double the already existing population.

To eliminate the sense of 'being put in a box', the ground level is perforated by passages of different sizes and shapes, creating a free circulation inside the district.

The problem of future overpopulation is resolved by implementing a modular architecture that offers a flexible and scalable solution. The technological advancements and the fast and easy mass production of modular elements will accommodate the doubled population. To meet ecological needs the entire structure is made of recycled materials taken from the old buildings. The new elements are reassembled in a flexible way, with only a permanent position of the core structure.

Through the innovative use of inverted street and block grid and the implementation of modular design principles, the project aims to create resilient and liveable urban environments that can effectively meet the evolving needs of the growing communities.

3.0 Site analysis

3.1 Historical development

Karlín is a formal agricultural settlement created on the road (nowadays Pobřežní str.) that connected Prague and Libeň. It was originally a separate village outside the walls of the city. Over time, it became increasingly integrated into the growing city of Prague.

In the 19th century, Prague grew as an industrial and commercial centre, and Karlín experienced rapid urbanization and densification. This led to the construction of more residential buildings and infrastructure that followed a not typical Prague rectangular grid, a feature that differentiates Karlín from the other neighbourhoods.

3. 2 Topography

The area of interest is relatively flat with an average of 186 m above sea level and a less than 5 meters inclination on the north side, towards Vltava River.

3.3 Climate

The site lies in one climatic area and there is no drastic difference in rainfall, snowfall, and temperature. Moderate land surface temperature for Prague city territory.

3.4 Vegetation

The south part of Karlín touches Vitkov Hill and unmanaged greenery. On the north side is the Rohanský Ostrov, an area of potential floodings with low-rise vegetation.

There are several small green areas, typical for an urban district.

3.5 Built environment

Typical residential buildings of height 4 to 6 floors having mainly masonry brick structure.

3.6 Use of territory

There are several buildings and areas of cultural significance: Kostel sv. Cyrila a Metoděje, Elementary school, and daycare Lyčkovo náměstí (one of the oldest buildings in the district), and Invalidovna.

Majority of the buildings are with residential and working characteristics.

3.7 Connectivity and public transport

In the area is situated Florenc station, a main transportation hub in Prague. It serves as an interchange station for two metro lines (Line B and Line C) as well as numerous tram and bus lines. Its central location makes it easily accessible not only for residents of Karlín but also for commuters and tourists traveling to and from other parts of the city.

4.0 New master plan

4.1 Basic information

As stated above (3.2 Idea), for the project a new master plan is created. The built-up area and the street infrastructure are inverted, meaning the proposed buildings are following the street grid, while the area where the old structures were placed is now an open public space.

The project accommodates double the population of nowadays Karlín and increases the service spaces. The new position of the built-up area creates the illusion of paradise in the urban tissue by having wide open areas serving as public spaces.

As a city of the future, the area is created for limited access to cars and places public transport as the main means of transportation.

4.2 Built-up areas

A) Basic information

As mentioned above, the build-up area follows a linear grid, created from the already existing road structure. This means that built-up area follows a linear axis and can be divided into x and y – axis structures.

B) Grid

Hierarchically, two types of buildings are introduced: 22 meters wide and 18 meters wide. The first ones are the middle the x and the y-axis building strips that are connected to each other at a full cross at 90° angle. These buildings accommodate the major public services like

hospitals, kindergartens, schools, etc. They differ from the other buildings with their central positioning, allowing the creation of the new communal centre under the shape of a cross.

There are two moments of connection: full cross and semi-cross. These are moments where x-axis building meets y-axis building at 90° angle and a special principle for internal space division is introduced.

C) Height principle

The height level difference is said to be gradual, meaning there are no big height differences between neighbouring structures.

D) Programs

The programs of the new master plan are as before but with an increased capacity by 2 times.

The increased capacity is achieved by vertical building. Nowadays, Karlín average floor number is around 4 floors, while Karlín in 2150 has an average floor number of 7 floors.

Mainly services and commercial spaces are situated at the ground levels, while the upper floors are dedicated to residential use, which is investigated more in detail.

4.3 Traffic structure

The entire circulation of the unit is managed by one main street, hosting both public transportation and cars. The idea is to create a walkable neighbourhood with limited car access.

Additionally, pedestrian streets are added. The main internal circulation is through pathways and car-free zones. The use of electric scooters and bikes is encouraged.

Despite the limited car access, if needed cars can be rented from two garages on the west side, directly connected to the main road. However, there is only one road allowing cars.

5.0 Structure

5.1 Basic Information

The project is divided into two major structural systems: core and modules. As mentioned above (4.1 Basic information), the build-up area follows linear grid, created from the already existing road structure leading to x and y-axis buildings. In each of the centres of these linear axis a core structure is placed, which functions as the main load-bearing system. The spaces are created by a modular system, placed on the two sides of the core structure.

5.2 Core structure

The core structure consists of reinforced concrete columns, irregular-shaped concrete slabs, and lightweight concrete walls.

The reinforced concrete columns are placed on the ground level of the structure with a double floor height. They support the lightweight 70-cm concrete walls that shape the corridors in the residential areas. In between the two structures are the irregularly shaped concrete slabs.

A) Ground level

Part of the idea is the free flow in between the new neighbourhood. The ground floor is perforated by passages. Three types of passages are introduced:

1) Main road artery (see 4.3 Traffic structure) passage which is 24 meters wide and accommodates major road in two directions, public transport, and two walk sides.
2) Middle passages which are 18 meters wide and accommodates public transportation and two walk sides.
3) Minor passages which are between 5 and 8 meters and is dedicated to pedestrians.

The load above the passages is carried by the Core structure.

B) Upper levels

In the residential area the main load-bearing structures are the corridor's walls. The corridor is placed in the middle of the structure and carries most of the load, bringing it to the ground.

In between two-floor heights (or every 6.4 meters) a slab is placed. The shape of the slab is characterised by its sloped bottom. The edge connected to the corridor walls is 20% wider than the edge on the other side. This allows the structure to stand without any additional columns by bringing all the load to the centre of the structure. Furthermore, the load on the two sides of the core centre is mirrored so an equilibrium is achieved.

C) Staircases and lifts

Every 44 meters the core structure is interrupted by the horizontal load-bearing system in the shape of a box that accommodates the staircase and elevator of the living units.

5.3 Modular system

A modular system is used for the creation of the living units. There are 6 types of modules that depending on the assemble the 6 types of residential units are created. The units are mainly duplexes, meaning one unit spans vertically between two irregular shaped slabs.

The modules are corner-supported, and one-side supported light steel frame structures, meaning the load is transmitted through corner and intermediate posts. These modules use longitudinal beams at floor and ceiling levels that span between the corner posts.

A) Typical residential units

There are 5 types of typical residential units, which are created from different modules:

1) 60 m^2 Studio, assembled from 2 modules
2) 90 m^2 Loft studio, assembled from 3 modules
3) 120 m^2 Duplex A, assembled from 5 modules
4) 170 m^2 Duplex B, assembled from 6 modules
5) 170 m^2 Duplex C, assembled from 6 modules

B) Modules

As mentioned above the modules that are used are corner-supported and one-side supported light-steel structures. The corner-supported units are used between the one-sided modules, meaning the second ones are placed at the edges of the living units. These types of modules are implemented because the load must be transferred to the core of the structure. Additionally, a cross bracing is added to each outer wall to ensure the transfer of the load.

Because of the irregular shape of the slabs, the elements used as the second floor of the duplexes have slopped ceiling with an angle of 4° degrees, resulting in floor-to-ceiling height at the side of the inside wall of 2.5 meters and 3 meters height at the side of the façade.

The modules used below the slopped ceiling are regular parallelepipeds with 2.5 meters in height.

6.0 MEP

6.1 Basic information

The underground is dedicated to the services, so the roof is empty allowing adding of new floor units in the future.

As the modules are to be in different combinations the service ducts are placed on the wall next to the core structure, meaning each unit has its own internal service void. The positioning is universal for all units, making it flexible for different arrangements of the units and their positioning into the core structure.

6.2 Mechanical systems

A) HVAC

Cooling, heating, and ventilating is served by Ground heat pumps. The system is implemented because of the underground location, allowing additional floors to be added to the units if needed.

As the grid creates large open spaces, a horizontal Ground heat pump system is suitable for the project.

Note: The use of a horizontal ground heat pump system will change the temperature and in the long term properties of the soil are expected to change as well.

6.3 Electrical systems

Electricity enters a one building unit (see 5.2 Core structure) through a service entrance, located on the exterior. The service entrance includes meters to measure how much electricity is used and disconnect switches for safety.

A) Solar panels

Additional to the connection to a local electricity transmitter, the roof is occupied with solar panels that harness renewable energy from the sun.

Due to the large outdoor spaces in the urban grid, implementation of solar panels in these areas is possible.

6.4 Plumbing

A) Water source

There is centralized municipal water supply system and water is being reused (see below).

B) Cooling and heating

Consumption of hot water is lowered and the use of it in washing machines and dishwashers is regulated. Solar water heating system is implemented.

C) Rainwater harvesting

As the new proposed plan covers over 230,000 m2 of area, a rainwater collecting system is implemented. From the roof, the rainwater is collected to tanks situated at the ground level. After filtration and purifying the water can be used for landscape irrigation and all inside non-potable fixtures.

D) Recycling greywater

Bathtub, shower, sinks, and washing machines are connected to an external surge tank, where the water is filtered. Recycled grey water is used for landscape irrigation and flushing toilets.

E) Fixtures

For efficient water use adoption of low-flow taps and dual-flush toilets is implemented to the project.

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7.0 Materials

7.1 Reuse and recycling

As mentioned above (1.3 Project background), the project is based in the future after a disastrous flood heavily hits Karlín and leaves behind abandoned district and ruins. These tons of building materials are called construction and demolition waste (CDW) and is the main source of building materials. Several questions how to extract pure recycled concrete grains and how to deal with the construction waste during the process arise.

A) Concrete

Nowadays, the use of recycled aggregate materials is starting to be a common practice and is promoted in the building industry due to the pollution and excessive use of raw resources. However, vital innovations in technology are expected. Consequently, by the year 2150, the realization of pure recycled concrete aggregates appears inevitable.

To facilitate this transition, the establishment of advanced waste management facilities within the new district is imperative. This strategic placement aims to minimize transportation and mitigate additional environmental pollution. Situating these facilities near the Vltava River serves a dual purpose: it provides direct access to a water source, which is vital as recycled aggregates possess high water absorption properties. However, it's essential to note that these waste management plants necessitate a substantial amount of grey energy, which constitutes the energy required for manufacturing processes.

B) Steel

As mentioned above (5.3 Modular system), the modules are constructed from light steel frames that are recycled from the old buildings. Steel is excellent for recycling in construction because about 90% of it can be reused without losing its quality or physical properties.

C) Glass

To date, there exists no technological capability to produce recycled window glass panels. Nevertheless, glass recycled from the old buildings finds utility in the fabrication of fiberglass insulation.

8.0 Conclusion

The project looks upon architectural ideas from the last century and tries to embody them in the context of the future. As trends come and go, looking at the past and reworking traditional ideas keeps the development of humankind and drives the ideas to contextual needs.

In conclusion, the project embodies a significant endeavor in confronting the complexities of overpopulation and creating a better quality of life. Through the strategic adoption of modular architectural principles and the implementation of advanced recycling methodologies, the Inversa District gives people sufficient accommodation with spacious units bigger than the traditional size of public spaces and greenery. Functionality, comfort, and sustainability are met.

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