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Cadamosti Dario
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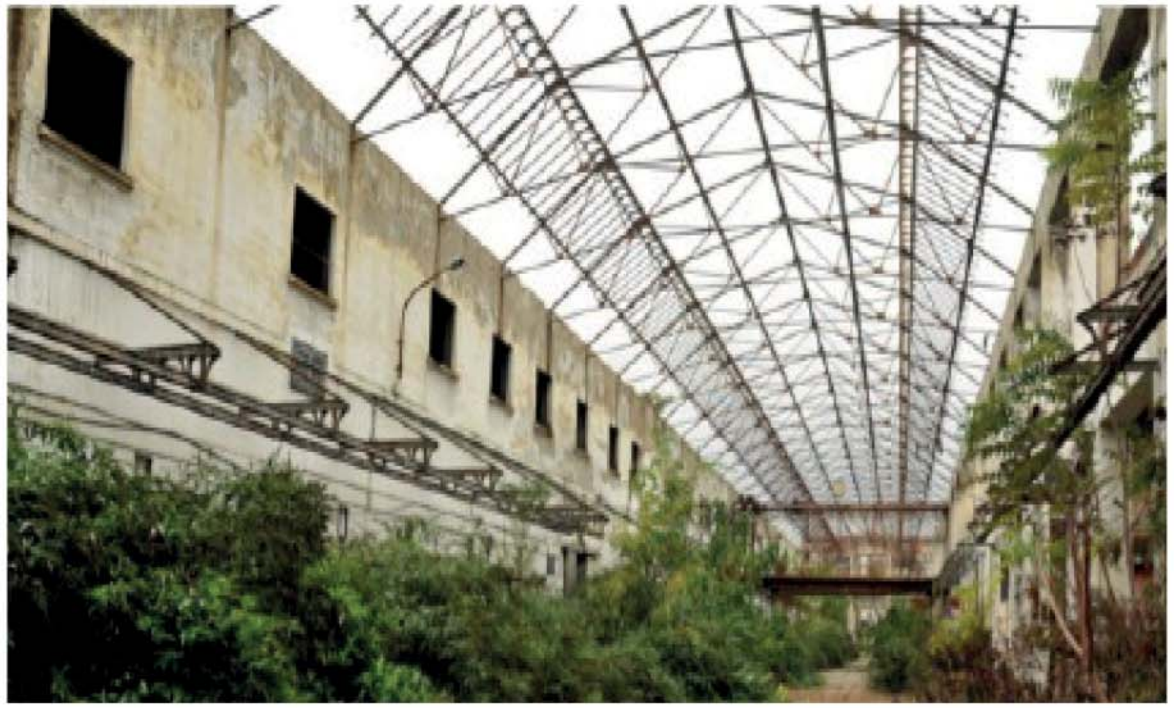
GREEN-HILL RESEARCH CENTER

RENOVATION OF EX SLAUGHTERHOUSE IN MILAN

THE GALLERY'S STATE OF AFFAIRS

- Location: Milan, Italy
- Year of construction: 1920-1950
- Investors: Municipality
- Area: 3000 m^2



The Ex Macello site is a disused area spanning around 15 hectares, the site of the communal slaughter house and of the poultry and rabbit market in the real estate compendium of the Milan wholesale market. The large covered passage, where the gallery is defined by tables and articles found in the archive, is part of a complex with several volumes intended for the preparation and slaughter of meat. the long passage, or covered gallery, is a connecting element between the slaughtering galleries and the refrigeration departments. With a basilica section, it has two double-height gabled facades, tripartite and oriented along the east-west axis.

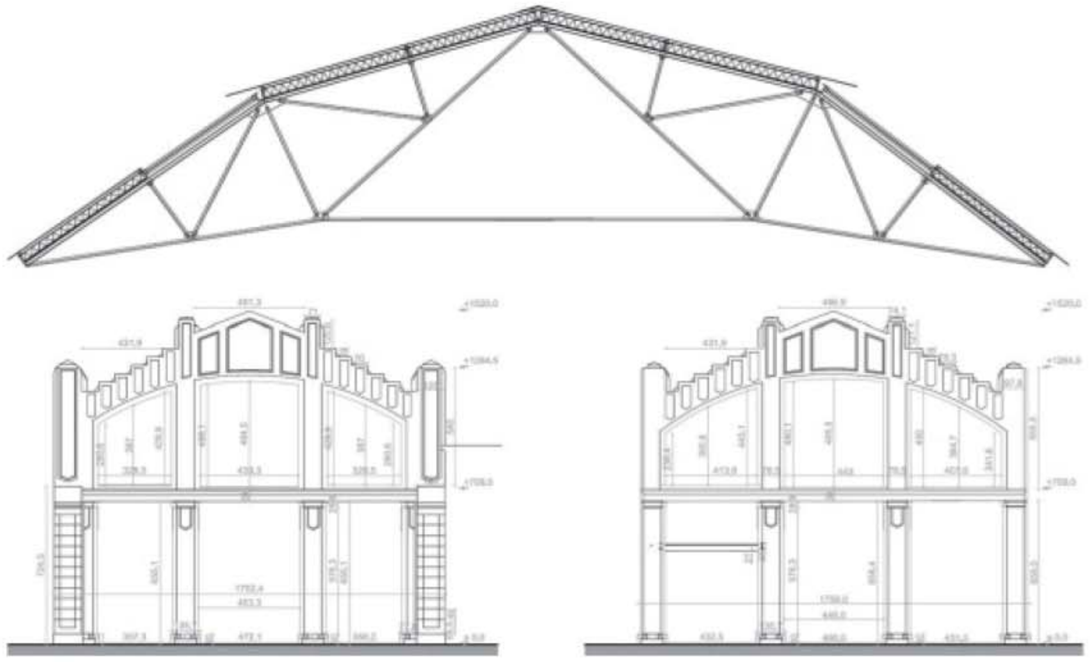
The building has an internal width of 15 meters and a length of about 200 meters. along the walls, on both levels, there are windows of different sizes. It is assumed that many openings located at the top and facing the outside were made following the covering of the long passage, to facilitate ventilation. In fact, it is unusual for the roof trusses to unload their weight above the openings and not on the solid wall partitions. Twenty-seven iron trusses support the roof consisting of two decks and wooden joists.

Situated in the south-east district of the city, in the district of Calvairate in Municipality 4, the area is a stone's throw away from the Milan Porta Vittoria station , which is served by the suburban lines that link the metropolitan area to the city centre through the railway link. This enables the business centre of Porta Nuova and Repubblica to be reached in a few minutes, as with the Rogoredo station, which is served by high-speed trains, and the Forlanini station, linked to Linate airport by the M4. The Milan 2030 Plan identifies one of the "Piani Attuativi Obbligatori" (obligatory implementation plans) on site, one of the areas in which is provided a specific town planning regulation aimed at managing the regeneration of the areas. It provides a mix of urban functions including social housing at accessible prices.

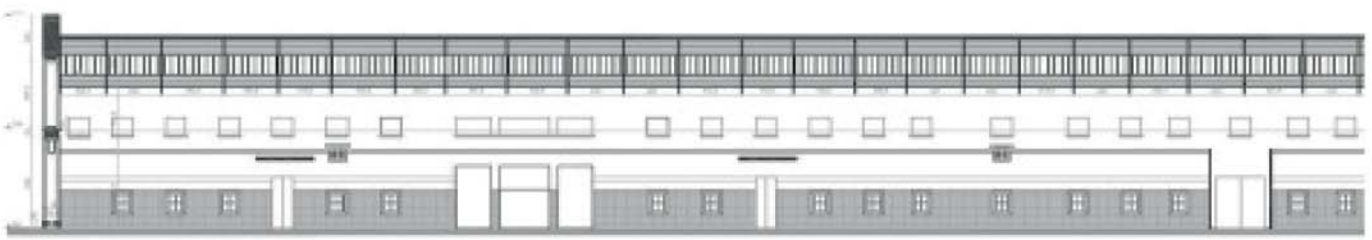
In the years 20, the connecting road between the various slaughterhouses has emerged as an important space inside the slaughterhouse. Those on the short sides became the symbol of the whole complex. In the 50's, as a result of hygienic-sanitary needs, and due to the importance of the gallery within the complex, it was decided to create a roof, defining a real covered road.
The roof is very deteriorated due to the fact that the glass in the skylights is now completely absent and has an asbestos infill.

ARCHITECTURAL DRAWINGS

The drawings were taken from the Archives of Milan ("Cittadella degli archivi"). Reference was made to the old documents containing designs of the former altar of the city of Milan throughout the ages and all the stages it went through in construction. We were able to arrive to the current state of the new slaughterhouse and of the buildings surrounding it; these are considered as an interconnected whole.
Other material was collected from the technical sheets given by the Reinventing Cities Competition, from here it was possible to determine the state of each part of the building: from the structural building materials to the finishes.
The conclusion is that the gallery building in the middle was important to be kept and not be demolished like the others.
This building has two hudge portals designed as one piece of concrete that has a majestic appearance.
The other main feature of the gallery is the roof: It is a metal truss structure, with on top of it two strips of glass and the rest was covered with a laminated sheet.

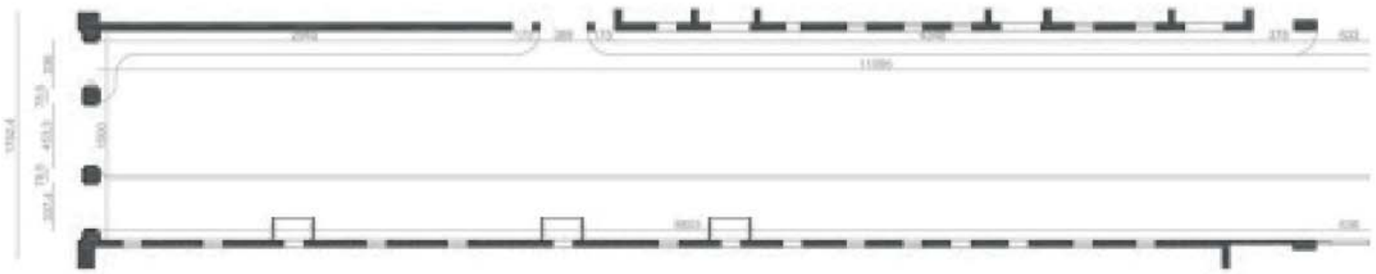


ELEVATION

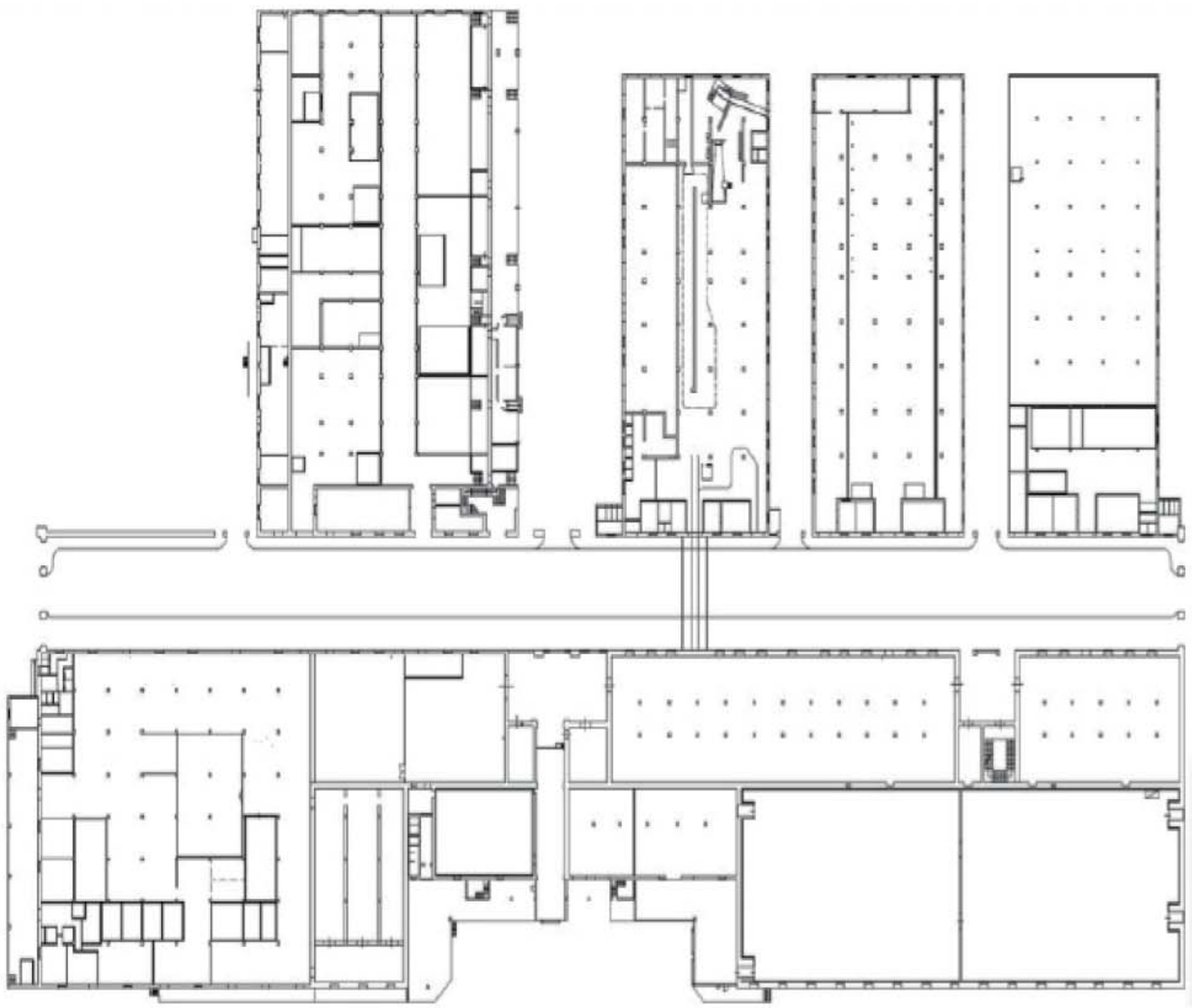


SECTION

ELEVATION



PLAN



PLAN

HORIZONTAL INVESTIGATION

VOLUMES

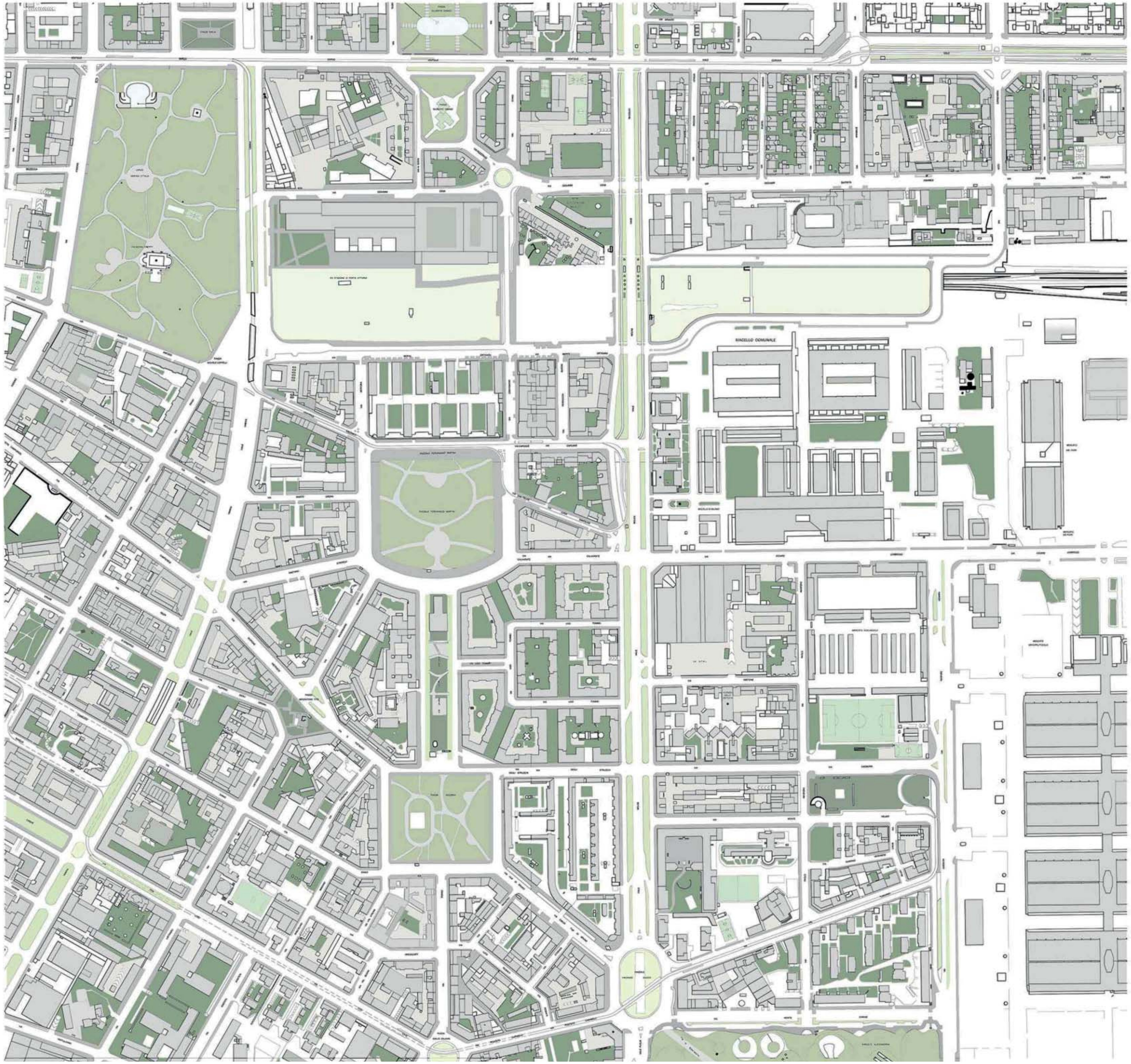
- 1 - 10 m
- 11 - 20 m
- 21 - 30 m
- 31 - 40 m

SCALE 1:5000

HORIZONTAL INVESTIGATION

VOIDS

- Agriculture
- Building's belongings
- Community garden
- Parks
- Sport Fields
- Boulevards
- Rotundas
- Unmantained greenery
- Construction site
- Pedestrian passages
- Parks pedestrian passages
- Water



SCALE 1:5000

HORIZONTAL INVESTIGATION

TRANSPORTATION

Cycling paths

Tram paths

Railway station Porta Vittoria

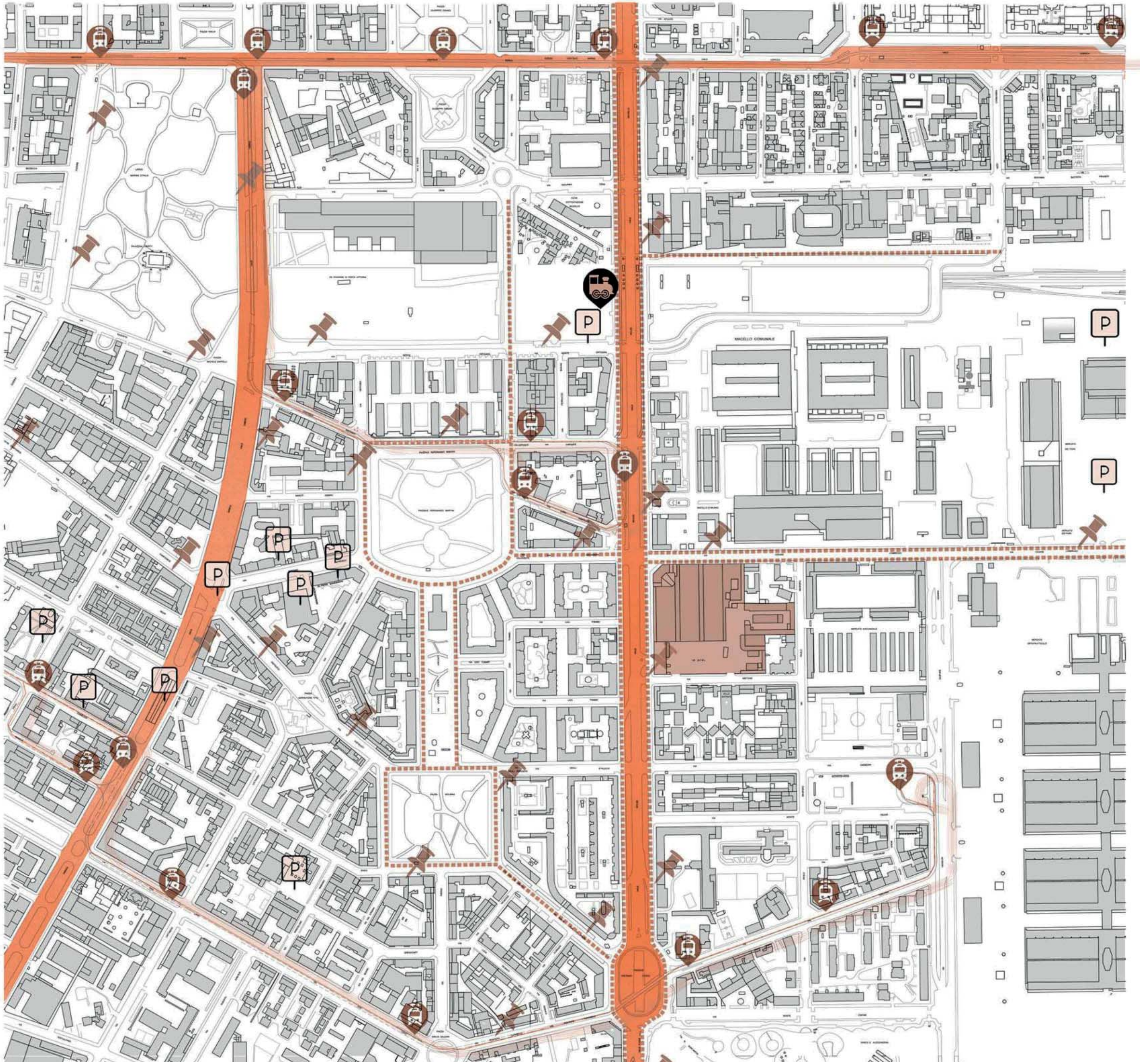
Tram stop

Bus stop

Parking zones

ATM railway deposit

Higly trafficated zones

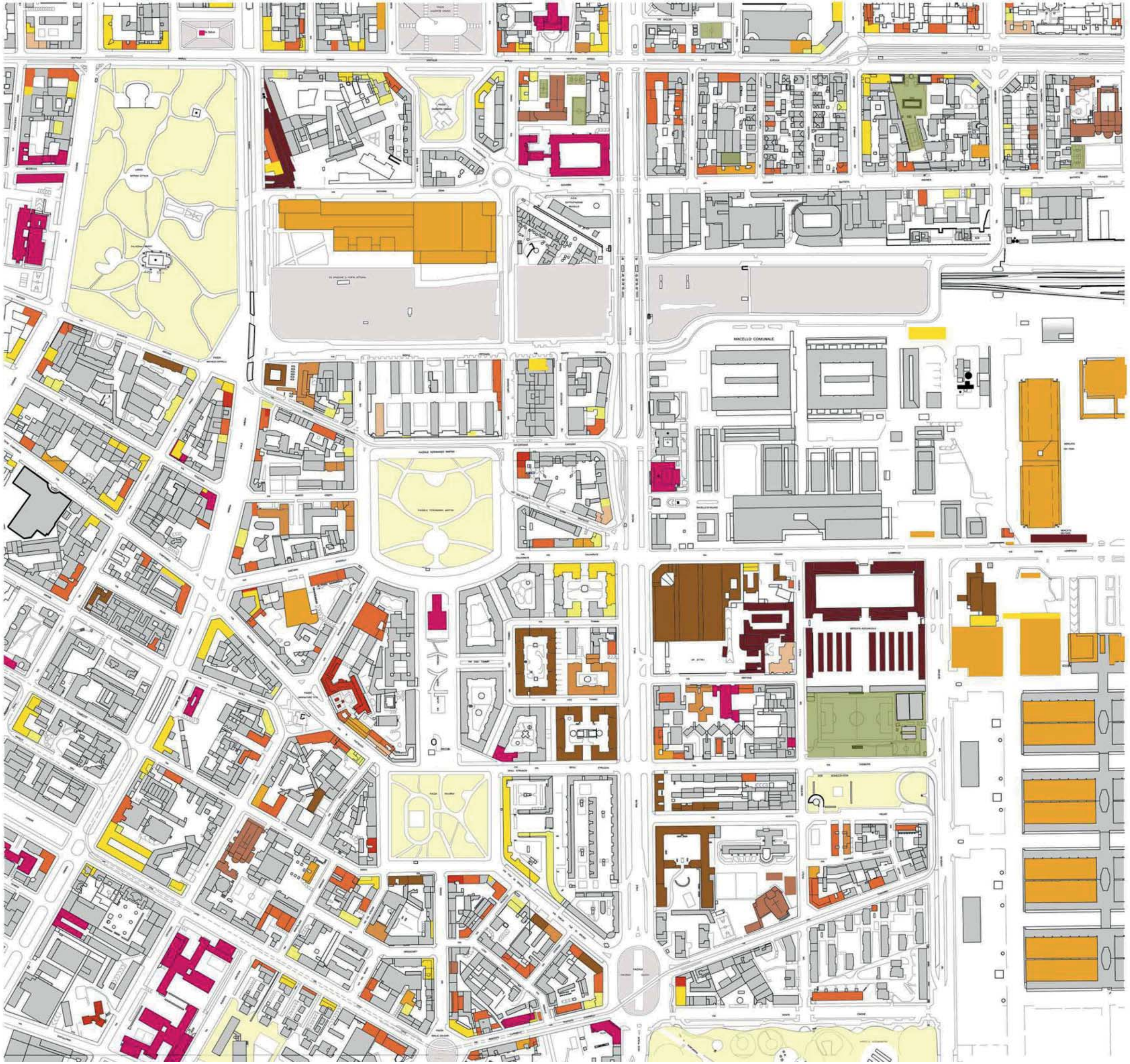


SCALE 1:5000

HORIZONTAL INVESTIGATION

TYPE OF USES - FUNCTIONS

- Parks - Gardens
- Bars and cafe's
- Restaurants
- Market places
- Retail stores
- Hotel - Accomodation
- Healthcare
- Business sector
- Relegious
- Public [Gov + Education]
- Warehouses - Storages
- Sports and Recreation



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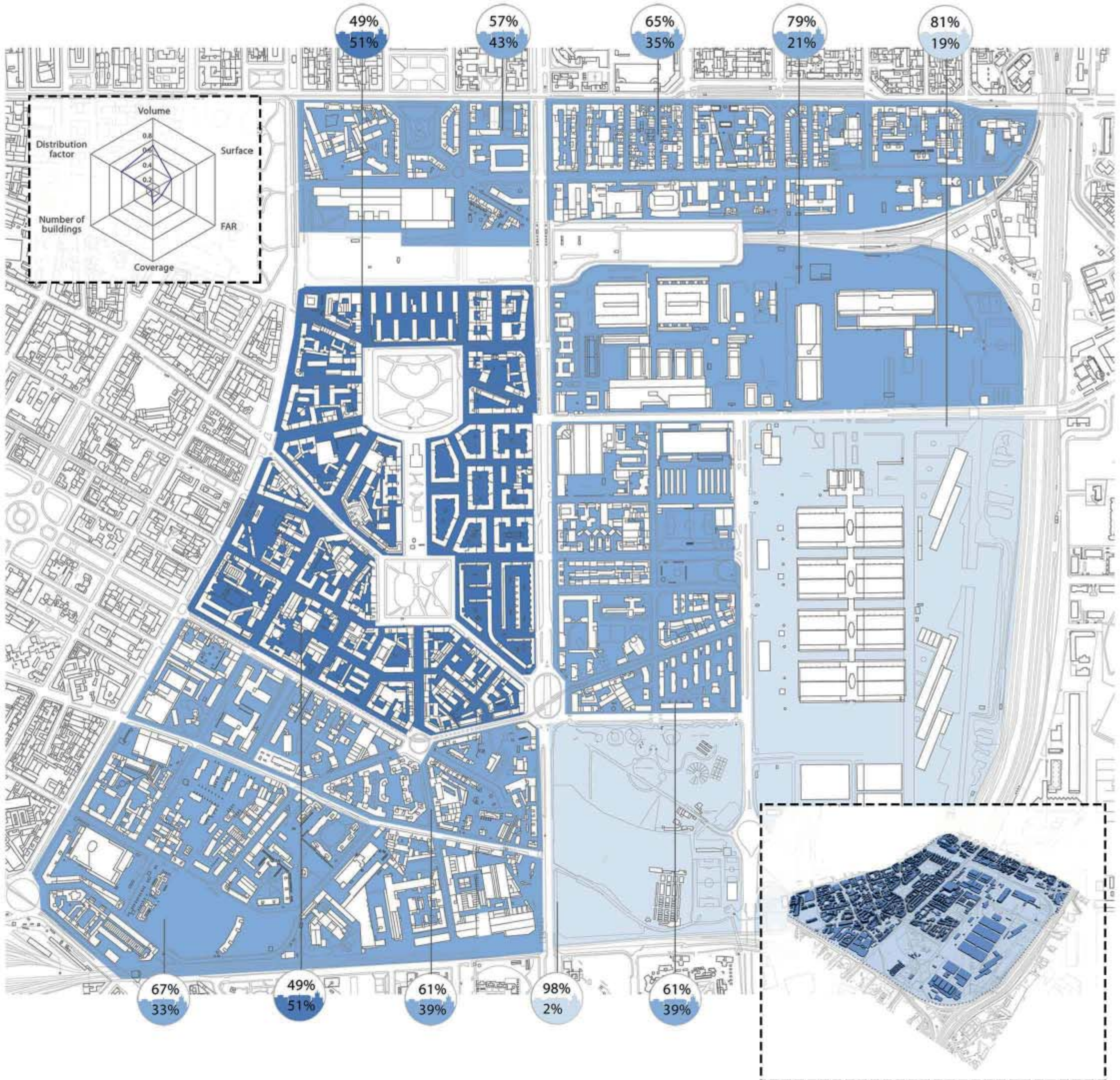
POROSITY
VOID X VOLUME



57% 43% VOID (%) VOLUME (%)

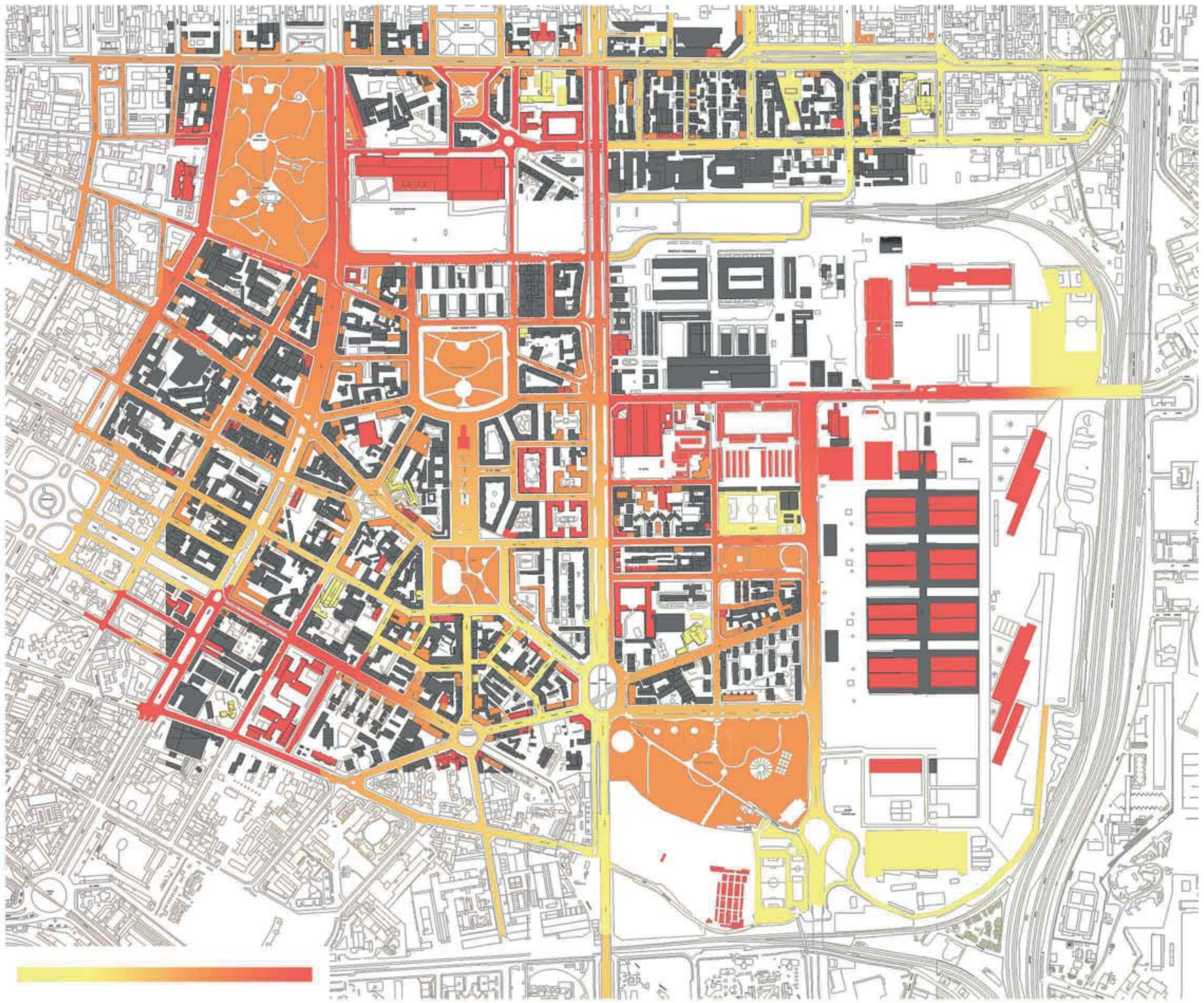
VOLUME 1-20%

VOLUME 21-50%

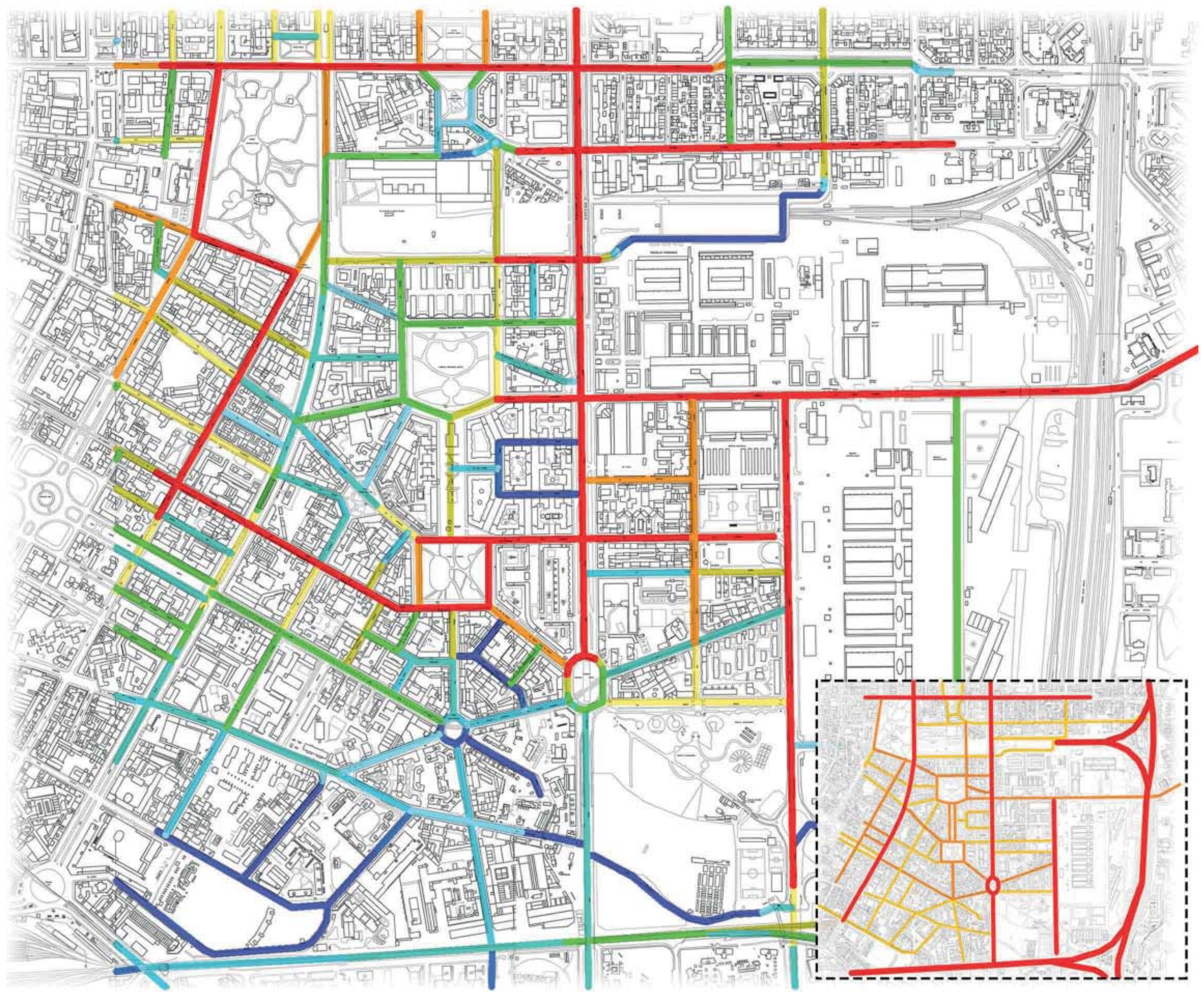
VOLUME 51-100%

PROXIMITY
LINKS X TYPES OF USES

DIVERSITY
VOID X TYPES OF USES



PERMEABILITY + INTERFACE
VOID X LINKS



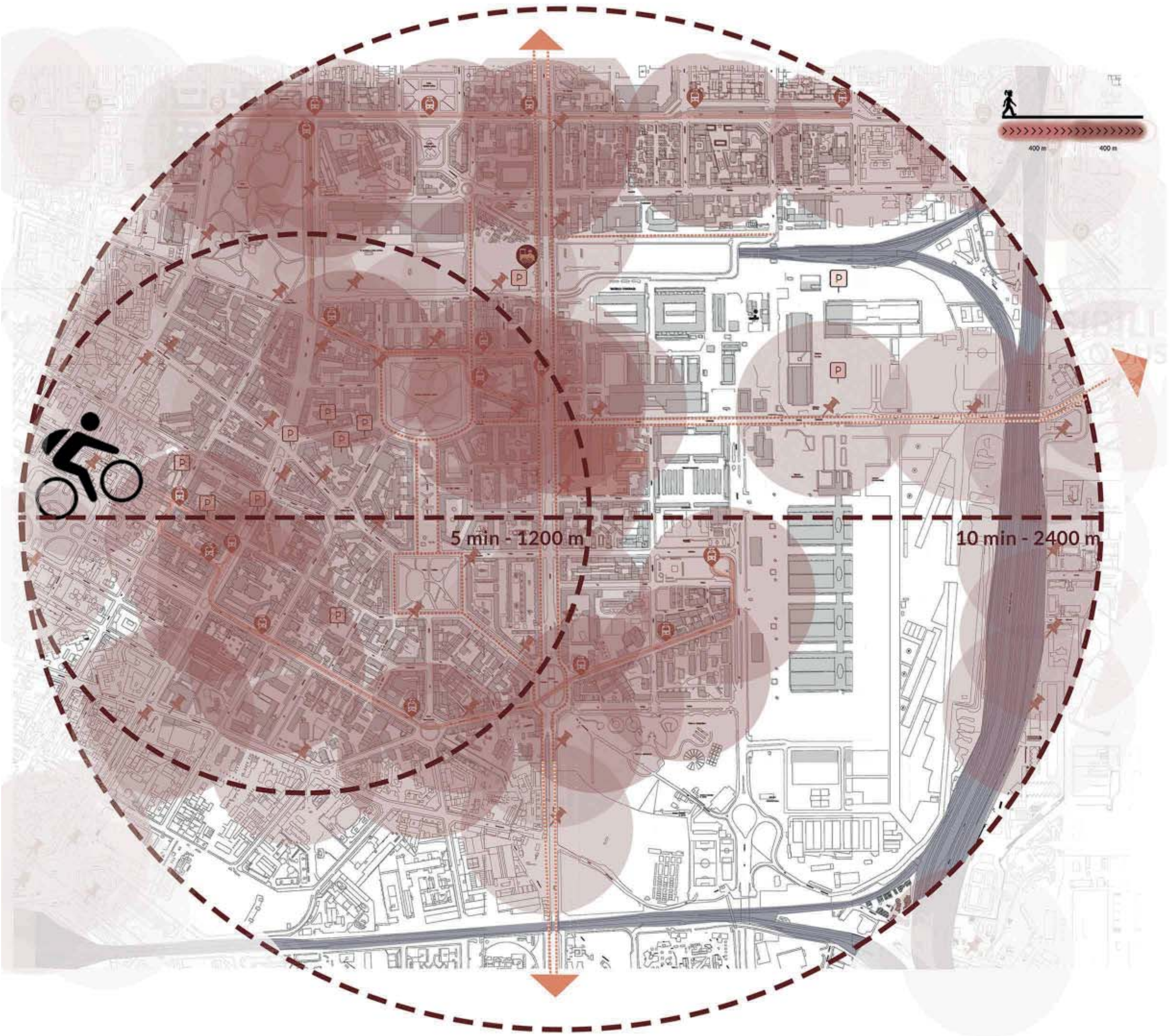
Optional
Sport complexes
Relegious (Chiesa)
Shops
Restaurants

Necessary Occasional
Hotels - Accomodation
Bars and cafe's
Bank
Healthcare
Parks

Necessary Regular
Education
Business sector
Market places
Governmental
Warehouses - Storages

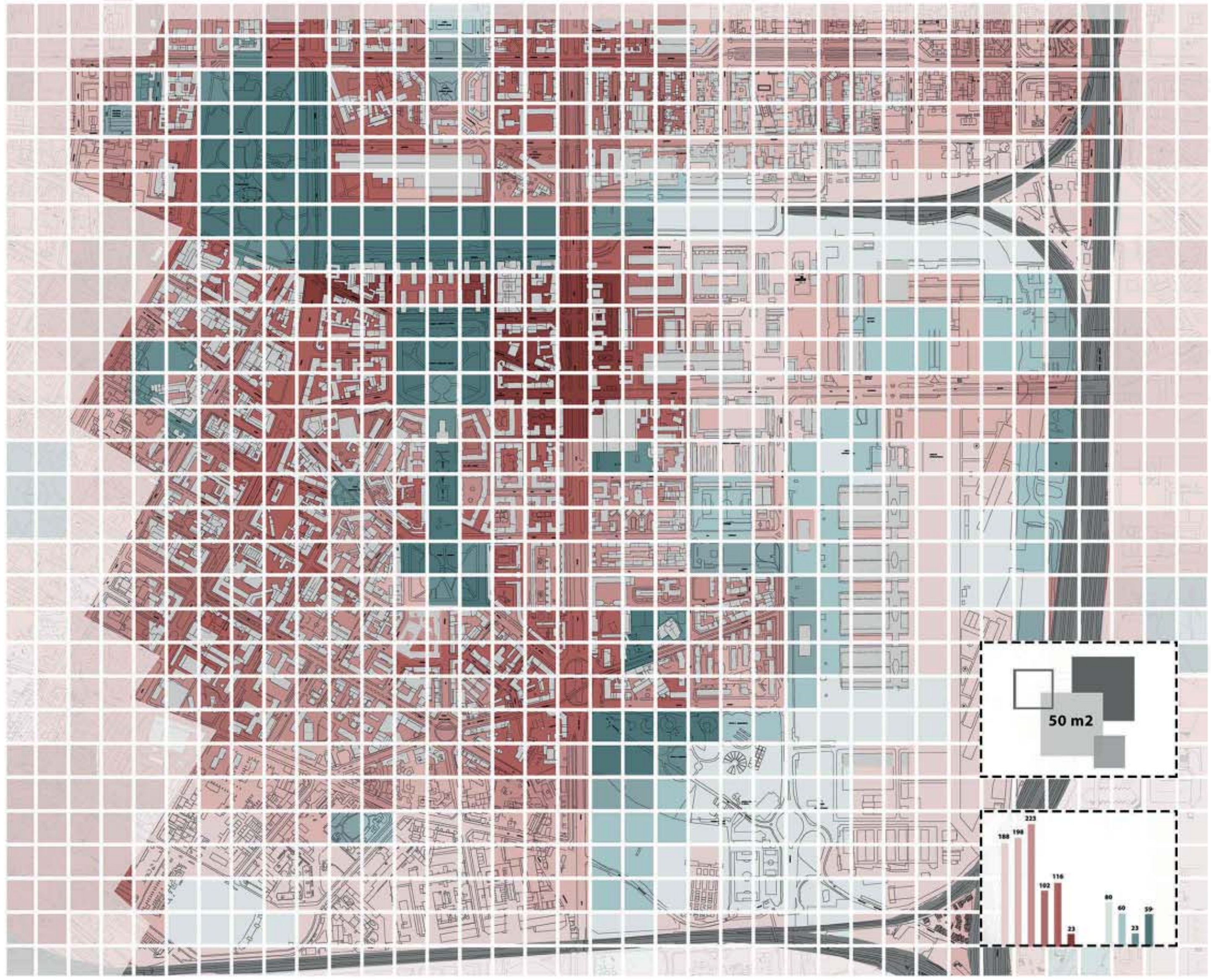
LOW INTEGRATION — HIGH INTEGRATION

ACCESSIBILITY
LINKS X TYPES OF USES



PORTA VITTORIA | TRAM | CYCLING PATH | TRAM PATH | ATM RAILWAY DEPOSIT | HIGH TRAFFIC | PARKING | BUS STOP

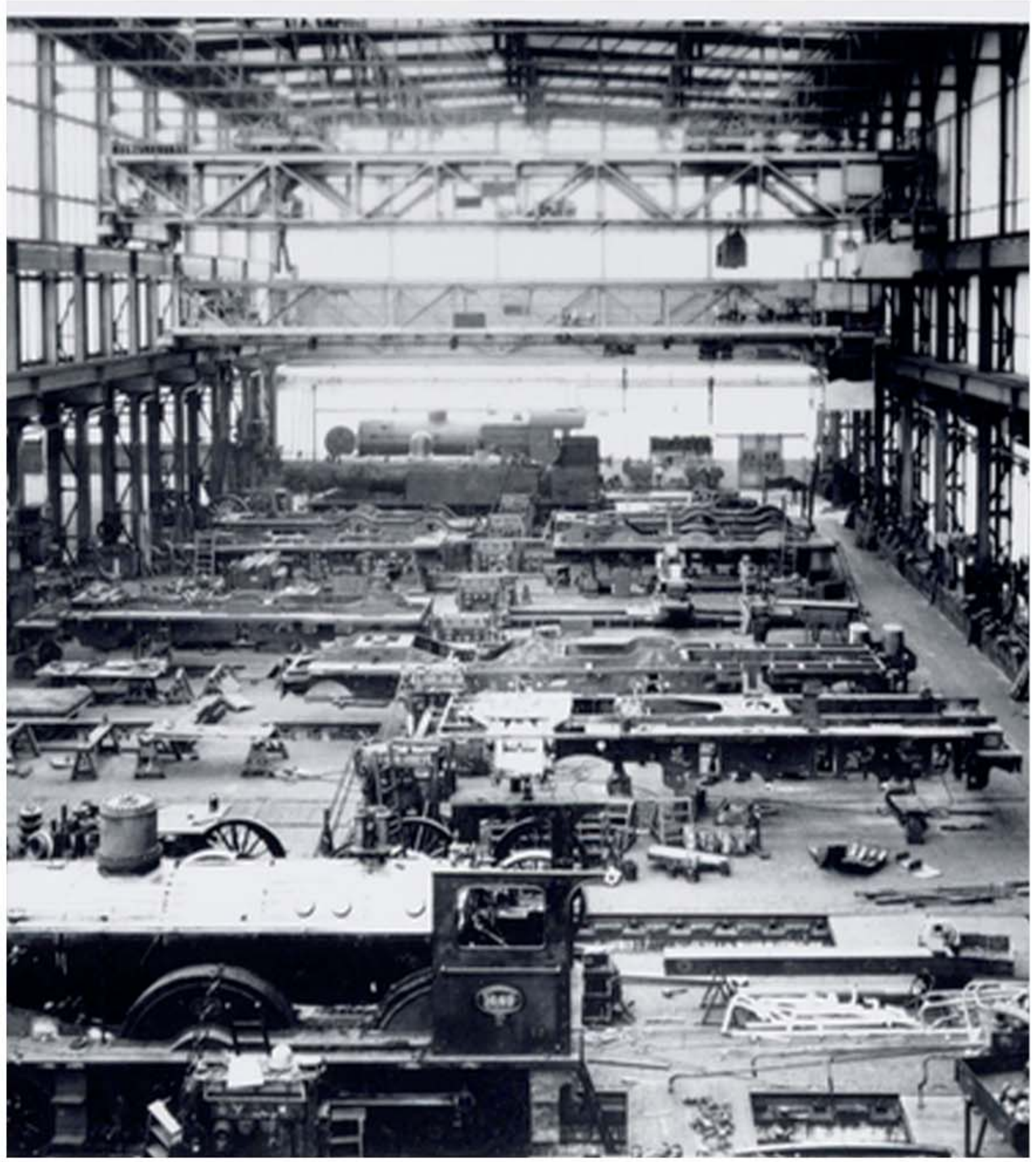
EFFECTIVENESS
LINKS X VOLUME



EFFECTIVENESS | POTENTIAL

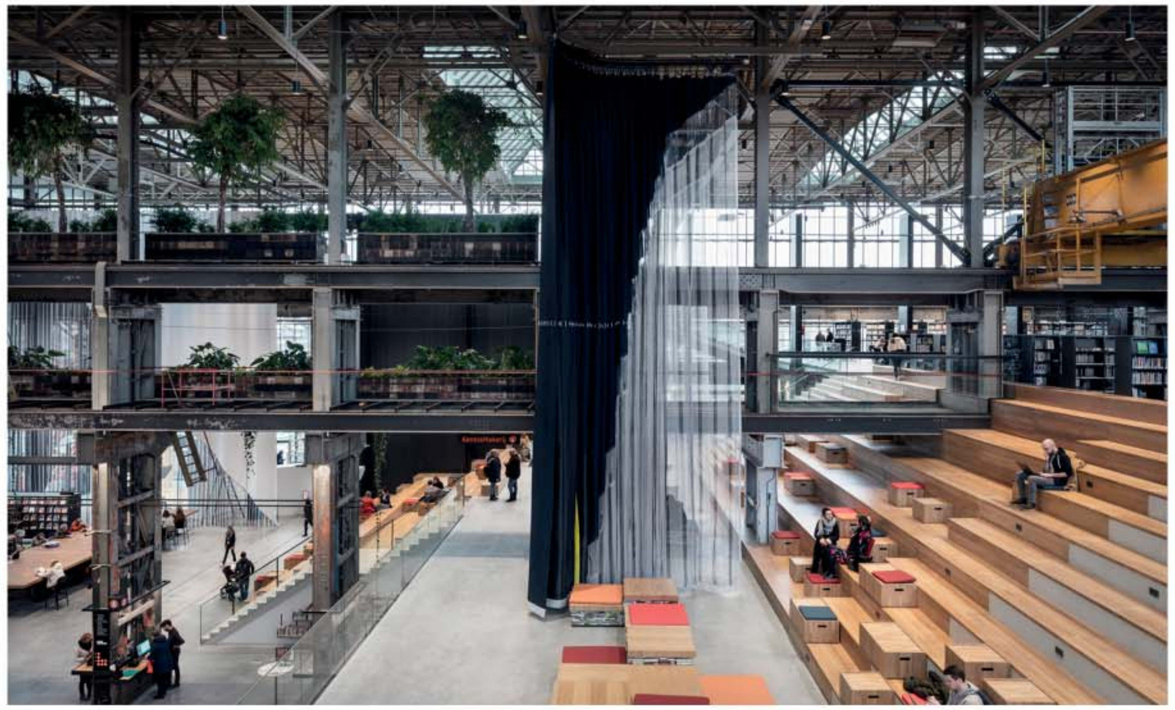
Lochall library Tilburg

• Location: Tilburg, The Netherlands
• Year of construction: 2018
• Architect: Braaksma & Roos architectenbureau, CIVIC architects, Mecanoo
• Investors: Università degli Studi Roma 3 – DiPSA
• Area: 11 200 m2



The building is an instant classic with the people of Tilburg. All of this, in what used to be a locomotive hall in the up-and-coming 'Spoorzone' area. At the beginning of the 21st-century locomotives were built and repaired here. The municipal monument dating back to 1932, has been converted into a modernist epicentre of design filled with glass, stunning wooden staircases and the grand old skeleton from its industrial days. The building will unite and activate public routes and places all around. Its location in the middle of a public transport node and the transparency of its construction will turn the building into an attractive hub for sharing knowledge and information for the entire region.

The project



The main goal of the architects was to refurbish this hudge building of 90x60m with a hight of 15m, keeping in consideration the old function. The recovery of memory and history becomes the common thread to imagine a new life for the area.
The building remind a cathedral in steel and glass and was very important in the memory of the locals, maintaing the original structure, the imperfection of the old materials and their maintainance contribute to rebring the authentic atmosphere.
To lighten the hudge steel structure, it has been decided to use a chromatic register with warm shades (red and orange), stairs in wood and soft mobile textile screens to create private and intimate spaces.

The building located in Tilburg, was renovated after a competition that made possible the transformation from an industrial deposit built on 1932 into a public library.
The LocHal houses the Midden-Brabant Library, the cultural institutions Kunstloc and Brabant C and the co-working spaces of Seats2meet. The LocHal is a space for both young and old to read, learn, study, meet and gather. It is a place for testing, creating, exhibiting and presenting the latest innovations.
Mecanoo's playful and innovative interior design forms striking contrasts by combining characteristic historical elements with new oak and steel additions.
There is a diversity of settings for meeting, collaboration, and concentrated work. The building is locally and adaptively conditioned for mixed use. The open city hall has a climate concept tailored to its role of a roofed forum. Seating on the landscape of stairs will be heated and cooled and offices will have their own sub-climate. This creates a flexible and comfortable climate while preserving the monumental shell.

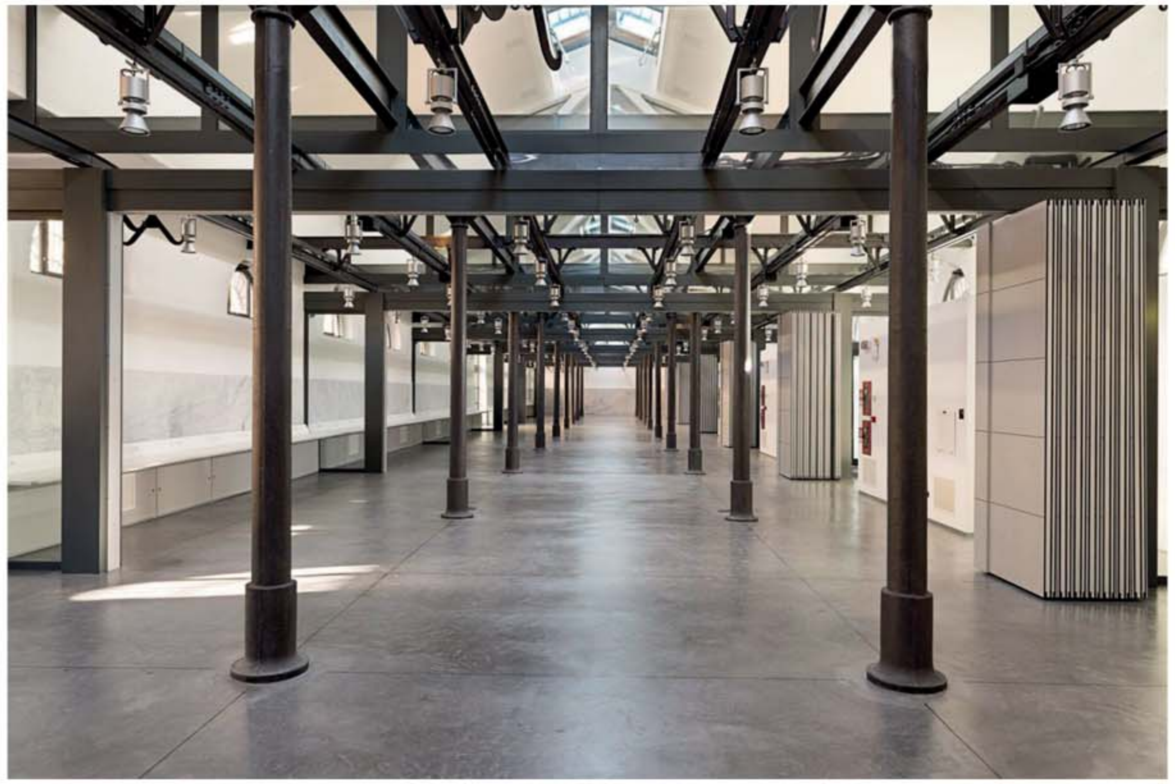
The halls have been "redesigned", placed in a firmly different perspective with the elevated stepped landscape and the monumental textiles. A harmonious contrast in which the play of incident and filtered light emphasizes and enhances the spherical perspective, the steam of yesteryear, and allows the whole to be admired again. It is a place where the Tilburger can connect with the past, but where he should above all feel at home.

Ex Slaughter-house
Testaccio, Rome

• Location: Rome, Italy
• Year of construction: 1992-2013
• Architect: Luciano Cupelloni, Insula, Stefano Cordeschi
• Investors: Università degli Studi Roma 3 – DiPSA
• Area: 111.8 m2

The slaughterhouse, designed between 1888 and 1891, was built to replace the existing structures, built under the pontificate of Pope Leo XII, and describes the transition from papal Rome to Rome capital. The project was included in the Rome master plan of 1893, which determined the industrial nature of the Testaccio area, a neighborhood that was supposed to host workers' residences and important production complexes.
Located in Testaccio neighbour, the slaughterhouse is the most advanced product of the time: it represents the identity of an era of great changes.

The project



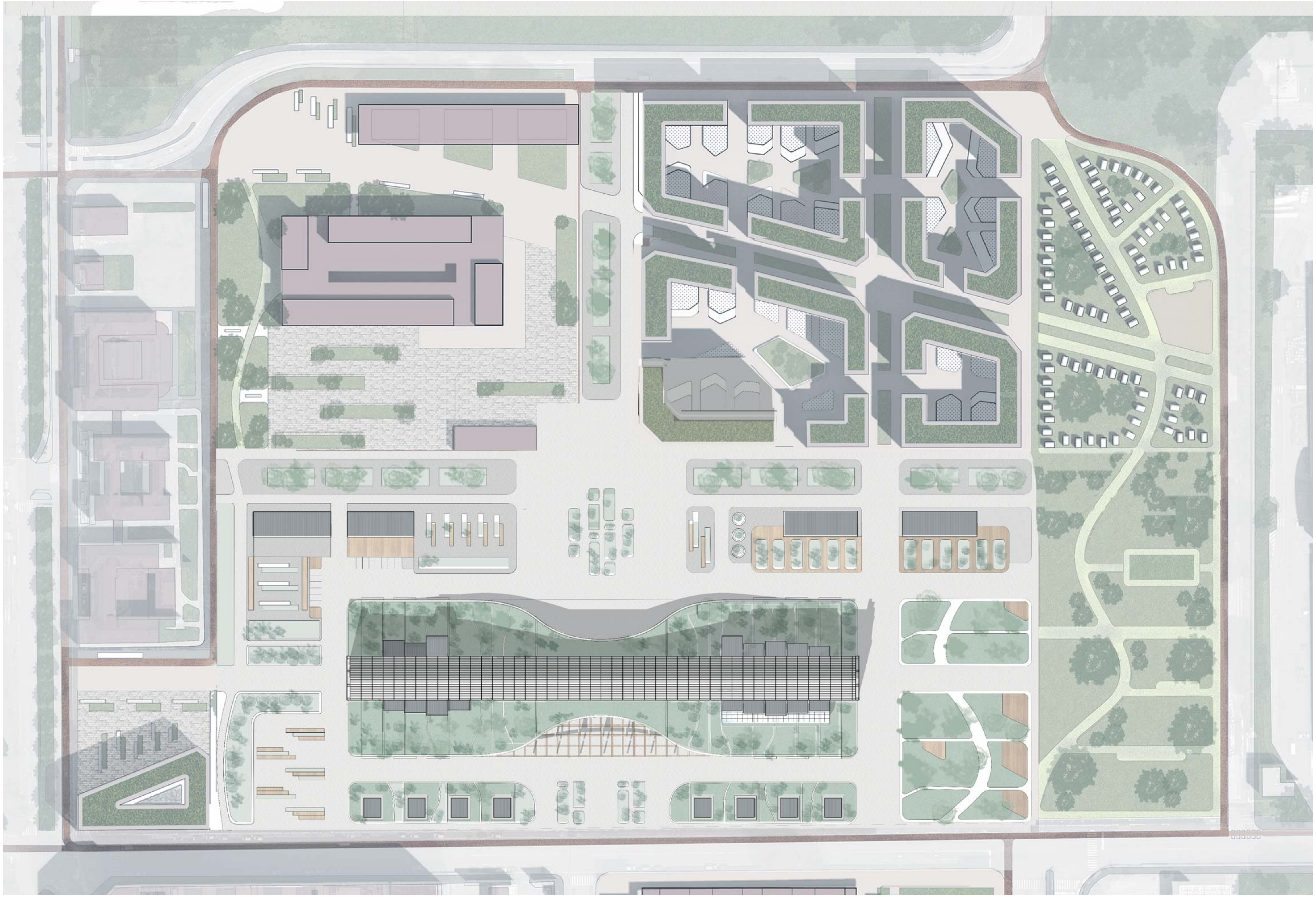
The slaughterhouse has not been in operation since 1975. In 2000, the renovation project of the entire complex was approved, resulting in a functional subdivision: the MACRO Future, acronym for the Museum of Contemporary Art in Rome, university activities for the Academy of Art and for the Faculty of Architecture in Rome Three, while the shelters of the Foro Boario, the spaces for the scales and the sheds host the City of the Other Economy.

The first intervention (in 2002) concerned pavilions number 6 (toilets and thermal power station) and 7, a large covered area (85 x 15 x 10 meters) illuminated by four large skylights. With the aim of creating three laboratory classrooms and a 260-seat lecture hall, Insula's design choice enhances the industrial body and creates separate and acoustically isolated areas, through the insertion of three dividing walls with a steel structure: transverse diaphragms partially transparent, linear, light (made with materials such as iron, wood, glass) and essential colors (white, gray and blue). The large geometric veils and the long hanging perimeter tables re-establish the human scale and accentuate the volume of the building, reaffirming the university use of the place.
school and the library. As in the previous intervention, Insula decided to preserve the volume and articulate the large internal space -840 square meters- through mobile partitions, tracing the The project of Pavilion 2B (visible in the scheme in the right) foresaw the recovery of the building to guarantee flexible locations for classes and workshops, together with a collective space as a link between the architecture original division in 7 stables (demolished in 1932). Six walls are placed between the trusses, and show a stable part (glass and steel) and a central opaque part (long 9 and high 3 meters) made by a folding panel system easy to move for creating different size ambiences, depending on the needs (from 120 to 729 square meters).

The intervention was carefully aimed to restore and preserve what is left of the original Ersoch project: as well as on the outside, where the façades and the decorations have been philologically restored.

ARCHITECTURAL PROJECT

PLANS, SECTIONS, ELEVATIONS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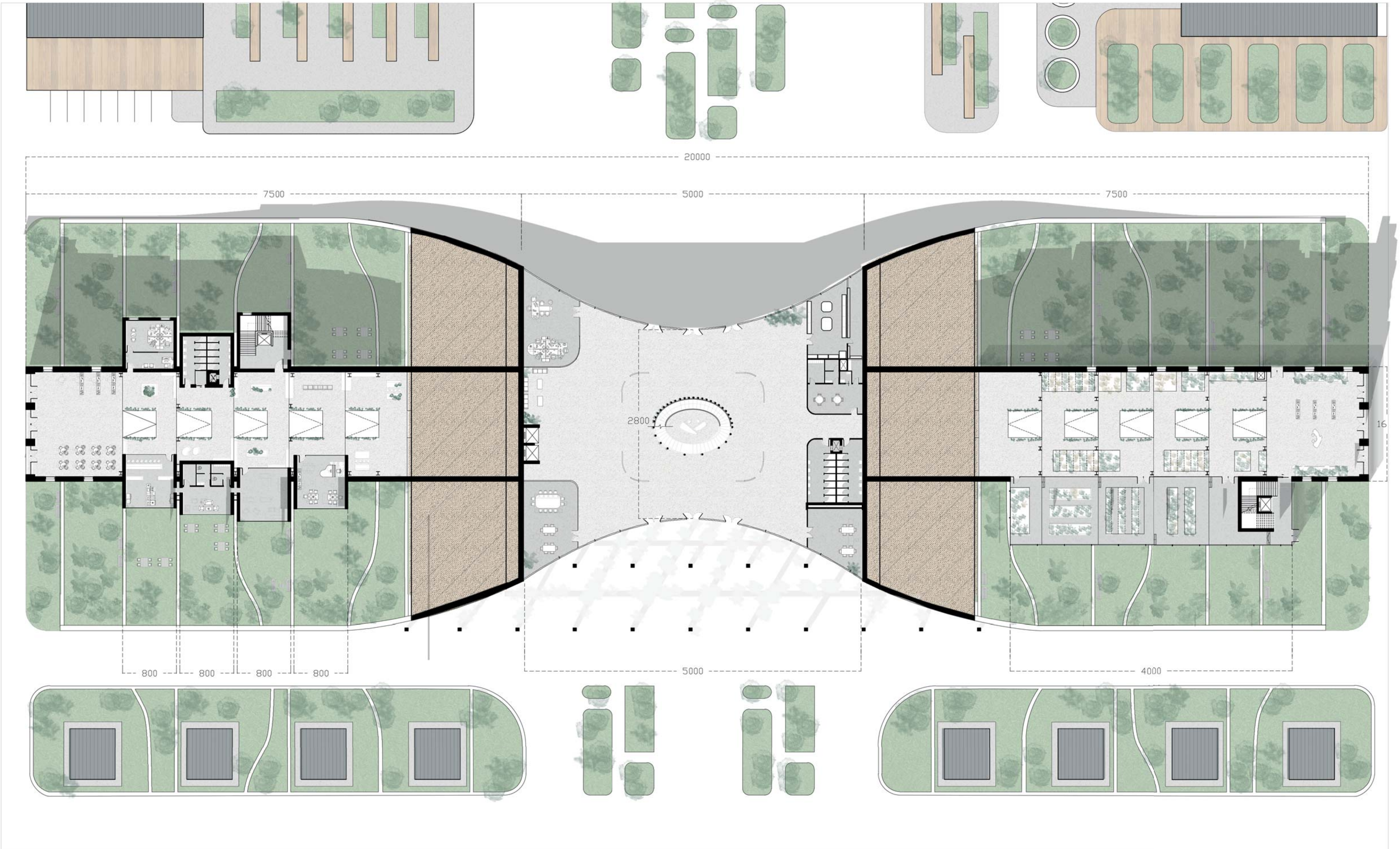

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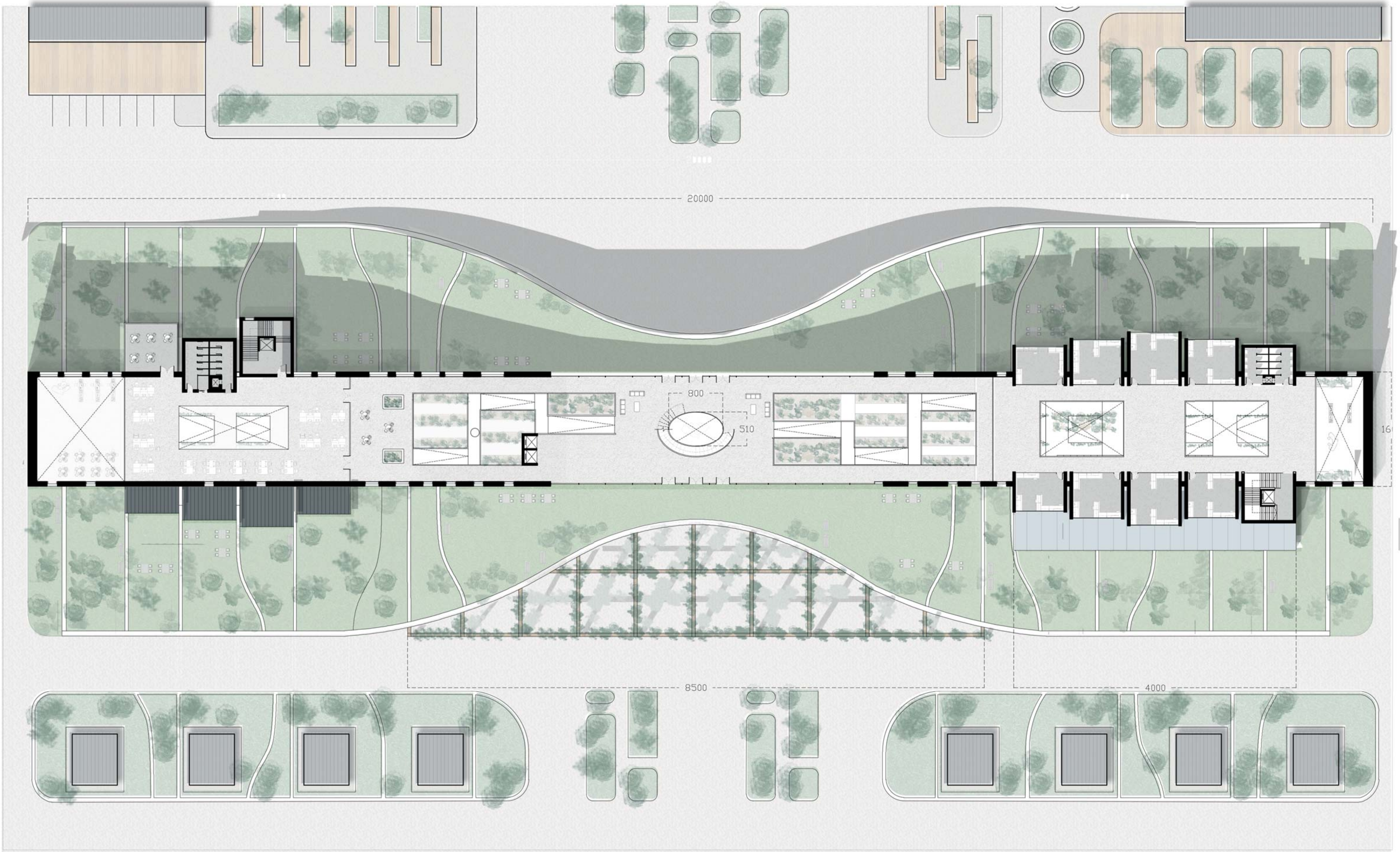
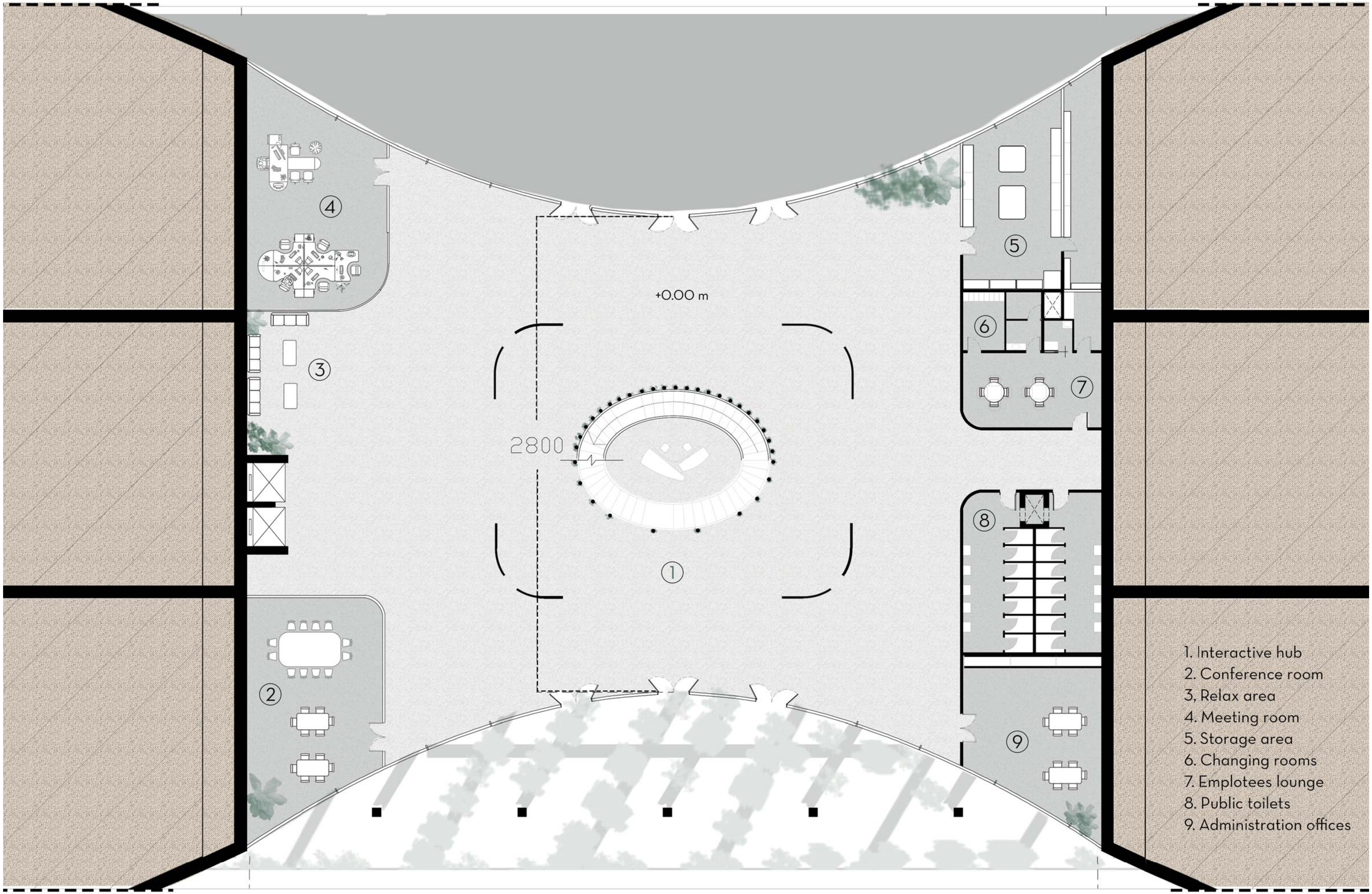
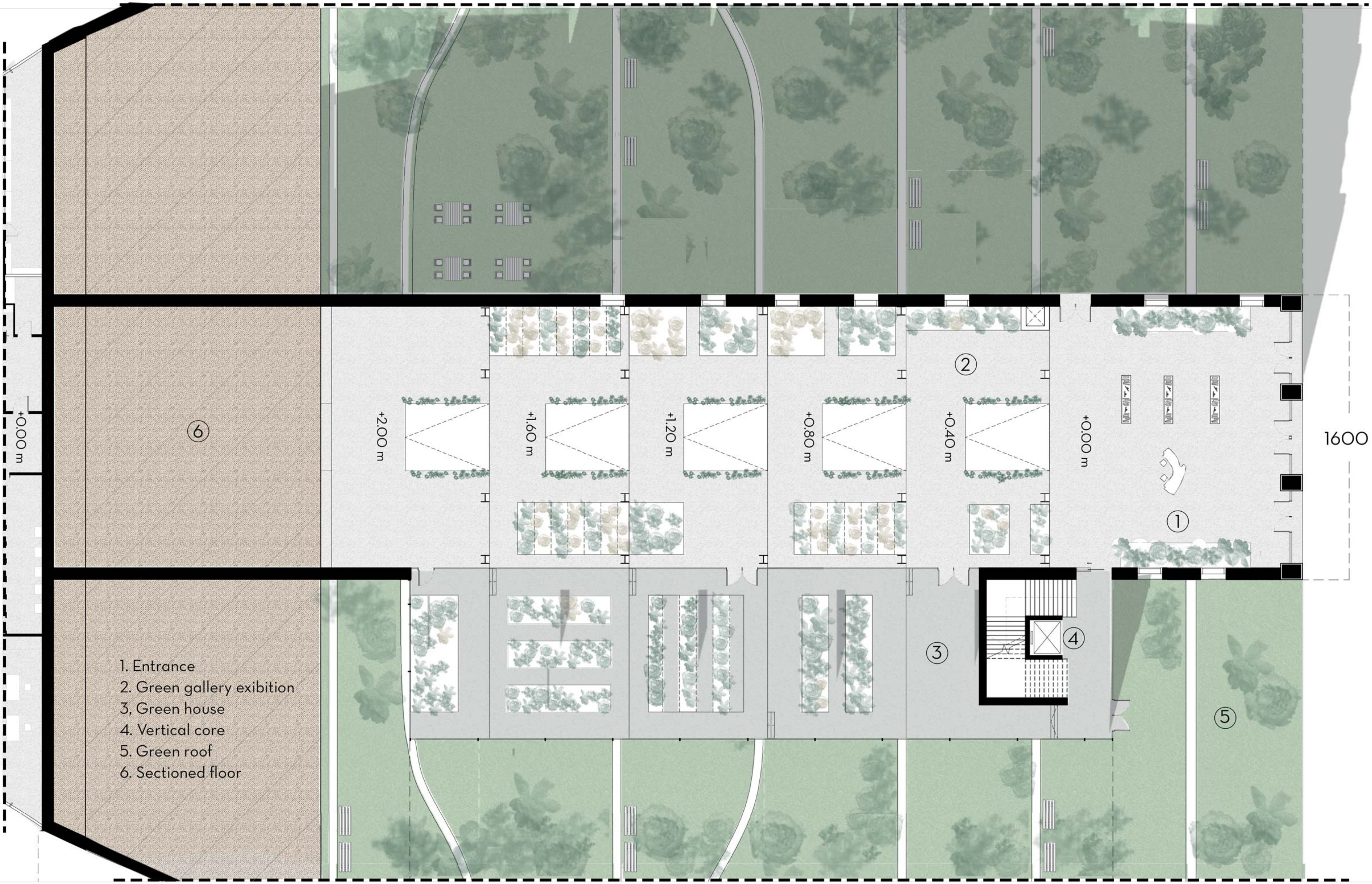

20000
800
510
8500
4000

1. Entrance
2. Administration
3. Toilets
4. Vertical core
5. Bar and Cafe
6. Lounge
7. Kids room
8. Dining area
9. Green roof
10. Sectioned floor

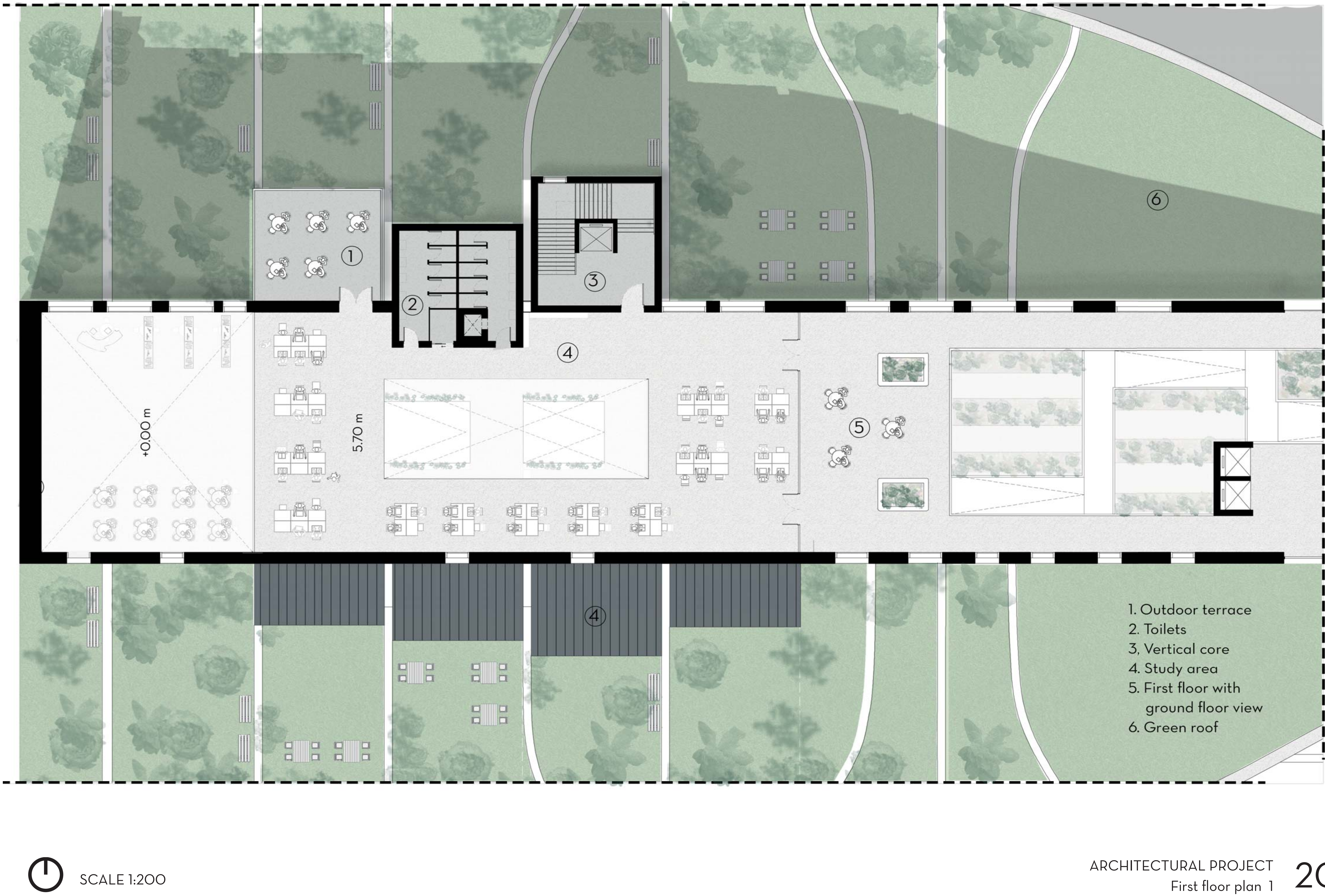
SCALE 1:200


+0.00 m
2800
1
2
3
4
5
6
7
8
9
1. Interactive hub
2. Conference room
3, Relax area
4. Meeting room
5. Storage area
6. Changing rooms
7. Emplotees lounge
8. Public toilets
9. Administration offices

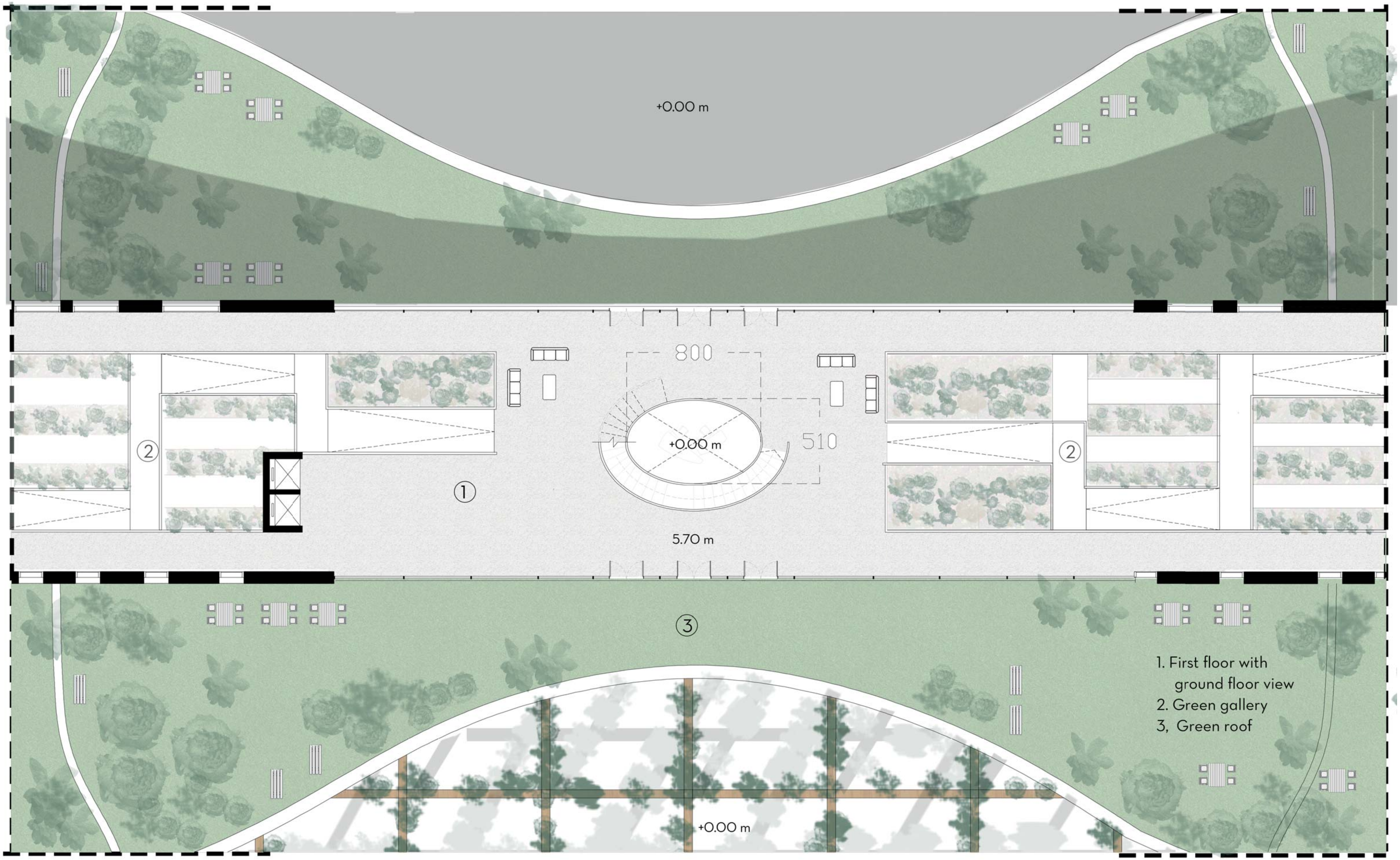
SCALE 1:200


⑥
+0.00 m
+2.00 m
+1.60 m
+1.20 m
+0.80 m
+0.40 m
+0.00 m
②
①
③
④
⑤
1600
1. Entrance
2. Green gallery exibition
3. Green house
4. Vertical core
5. Green roof
6. Sectioned floor

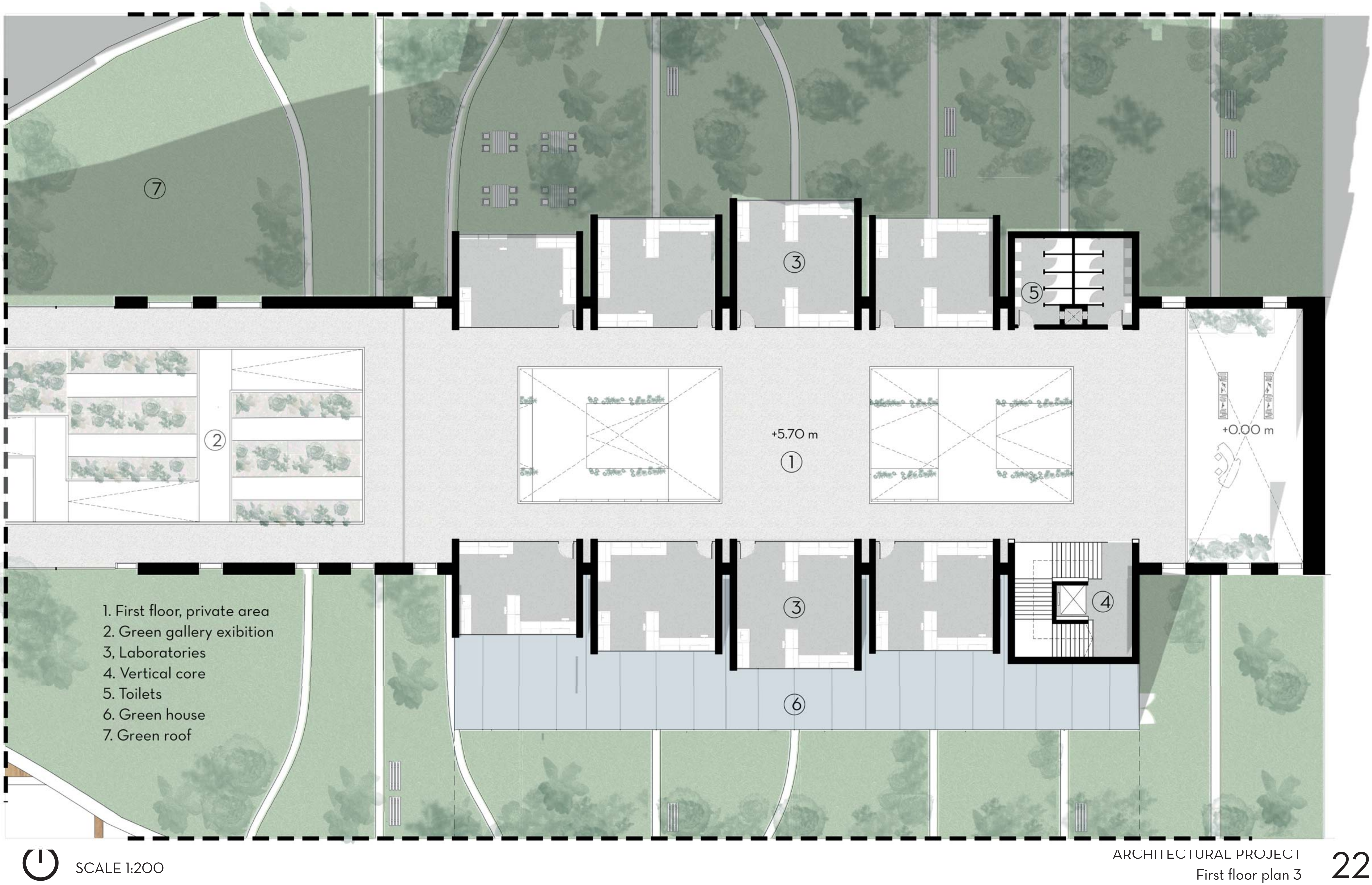
SCALE 1:200



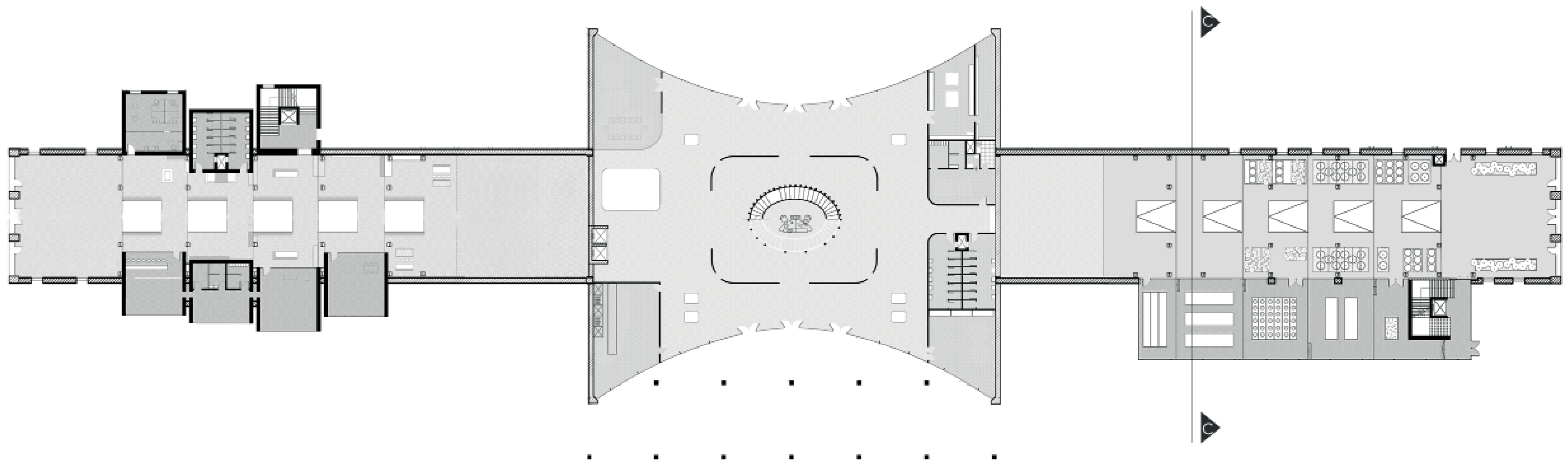
1
2
3
4
5
6
4
+0.00 m
5.70 m
1. Outdoor terrace
2. Toilets
3, Vertical core
4. Study area
5. First floor with
ground floor view
6. Green roof
SCALE 1:200


+0.00 m
800
510
+0.00 m
1
2
2
5.70 m
3
+0.00 m
1. First floor with
ground floor view
2. Green gallery
3, Green roof

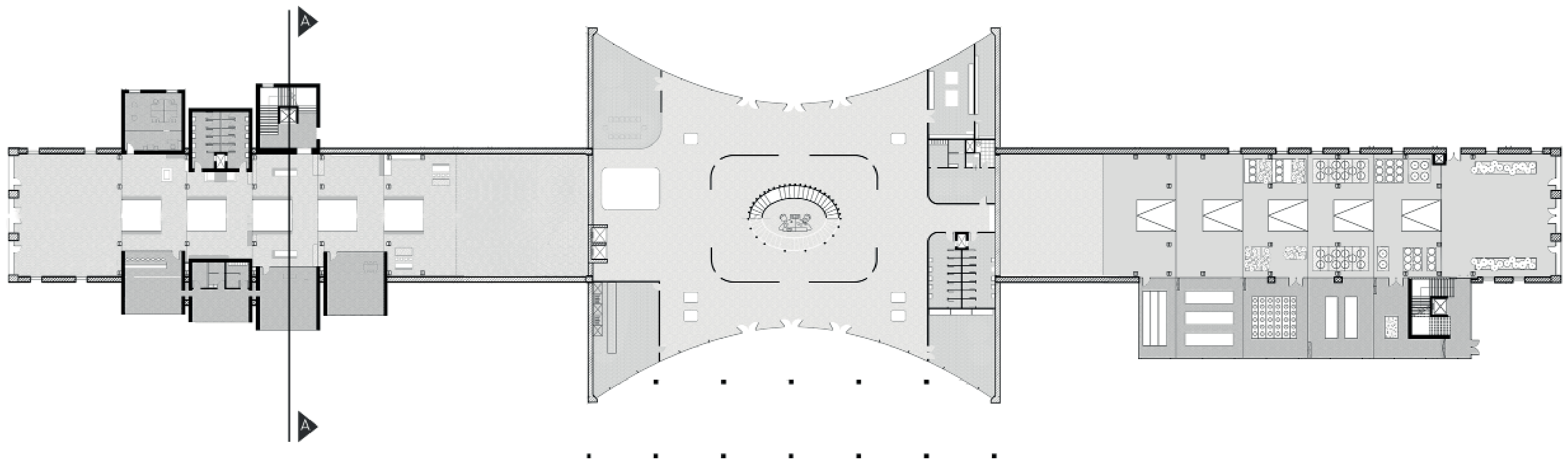
SCALE 1:200


7
3
5
2
+5.70 m
1
+0.00 m
3
4
6
1. First floor, private area
2. Green gallery exibition
3, Laboratories
4. Vertical core
5. Toilets
6. Green house
7. Green roof
SCALE 1:200

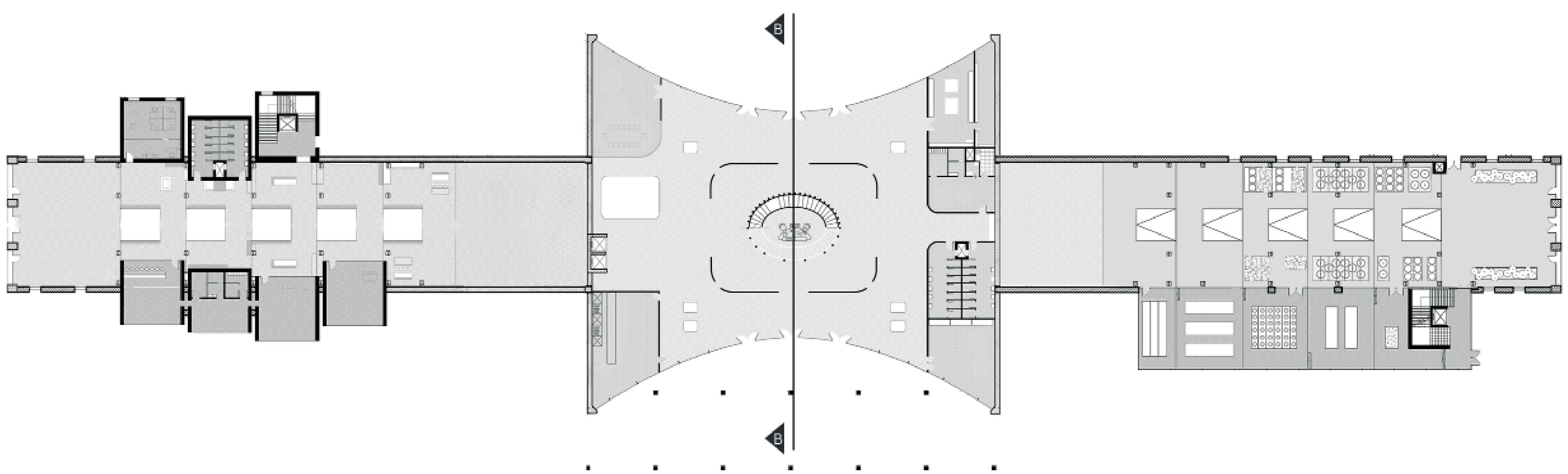
Section A-A'
Commercial

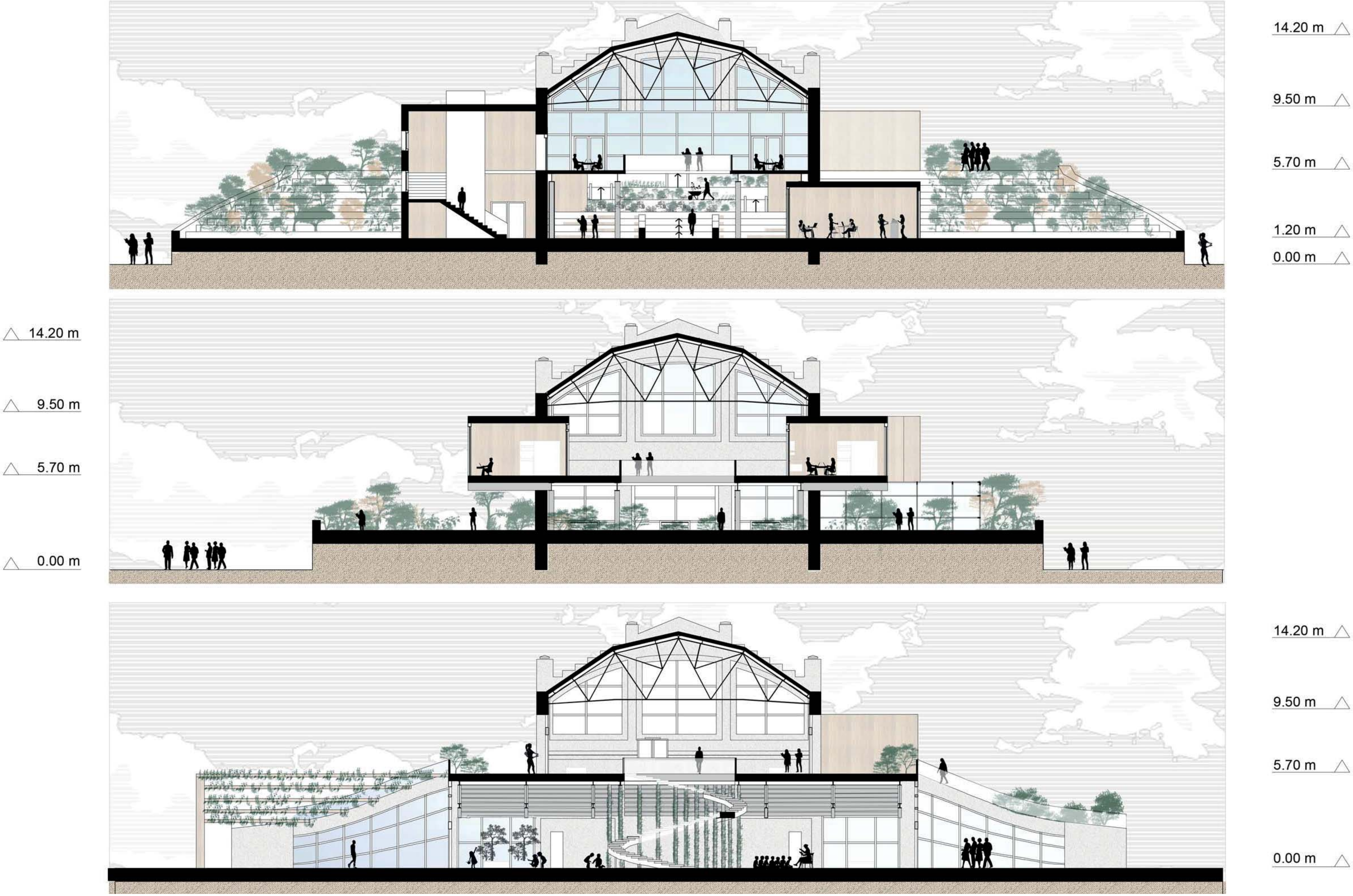


Section B-B'
Laboratories

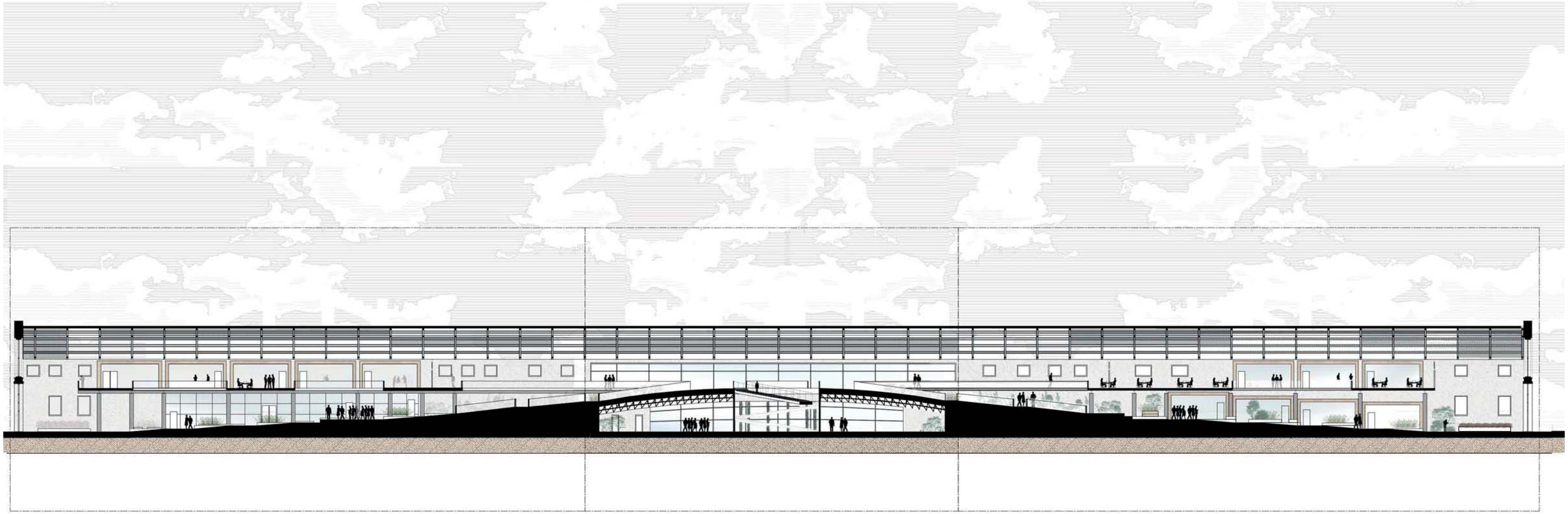


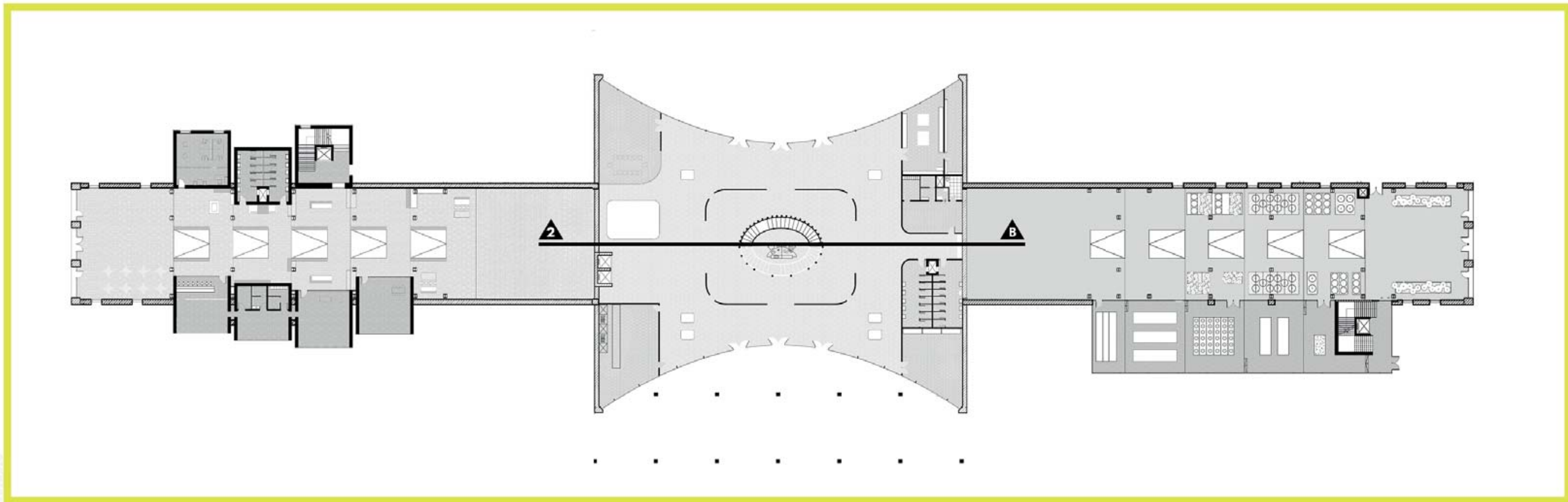
Section C-C'
Entrance




14.20 m
9.50 m
5.70 m
1.20 m
0.00 m
14.20 m
9.50 m
5.70 m
0.00 m
14.20 m
9.50 m
5.70 m
0.00 m

SCALE 1:200





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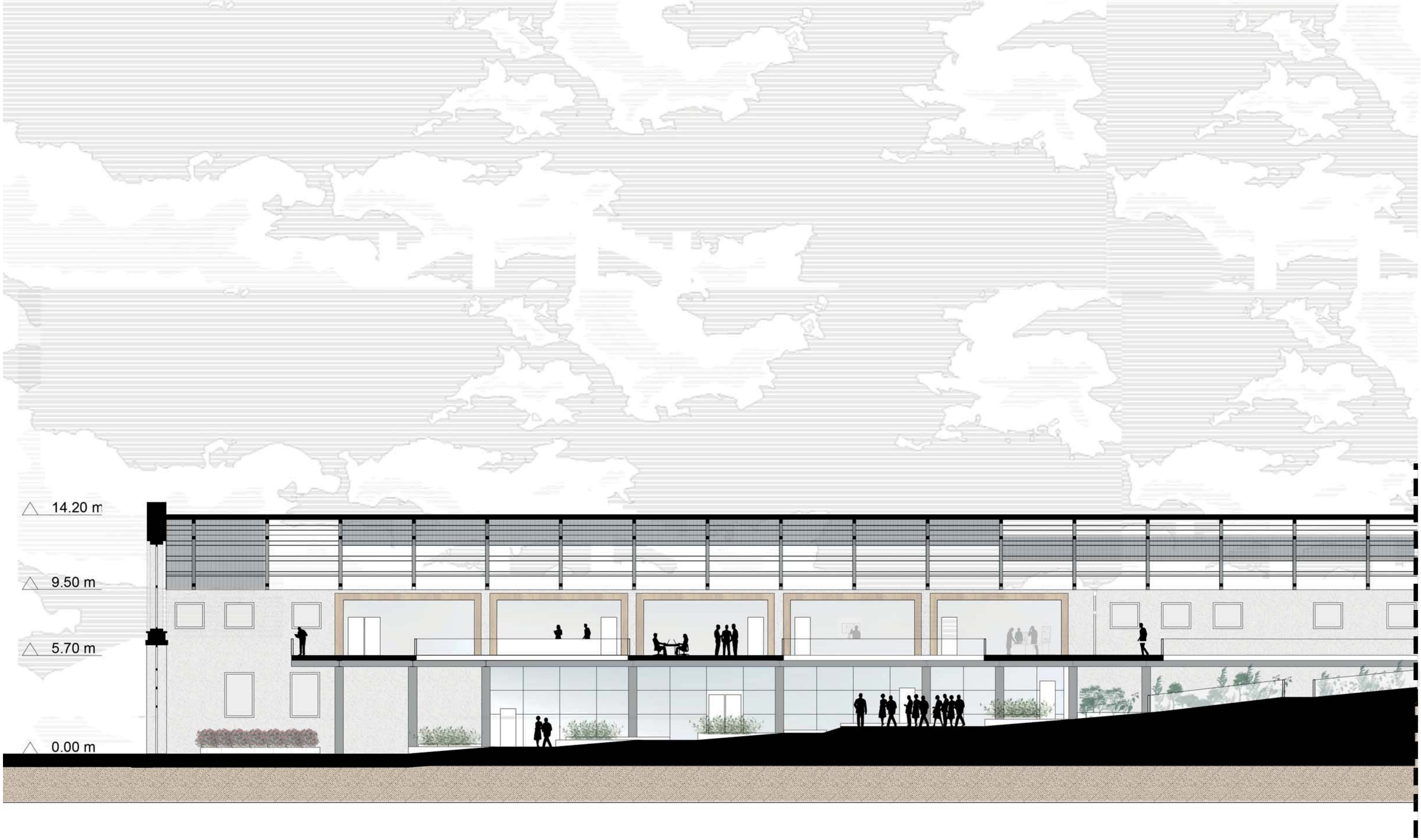
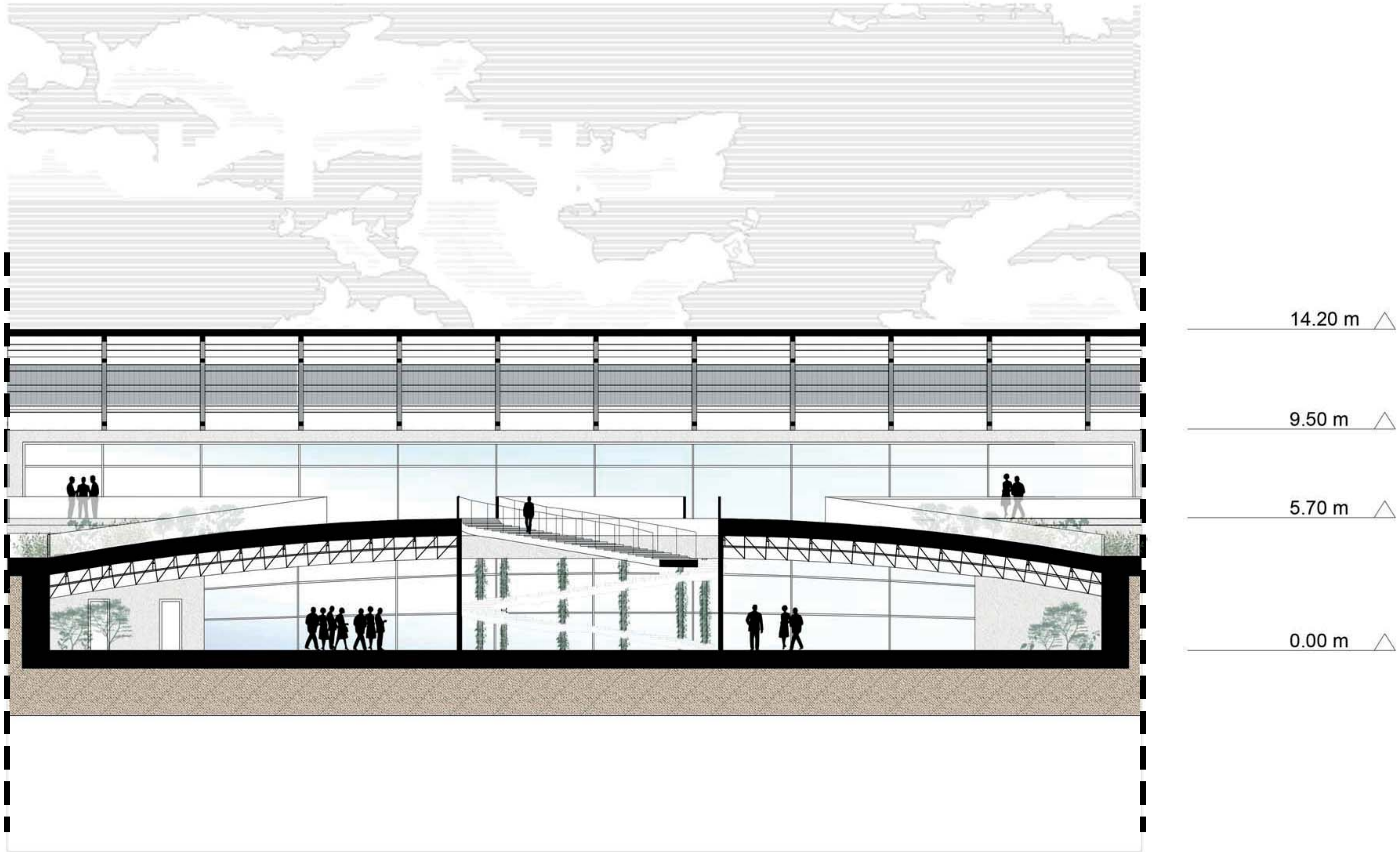
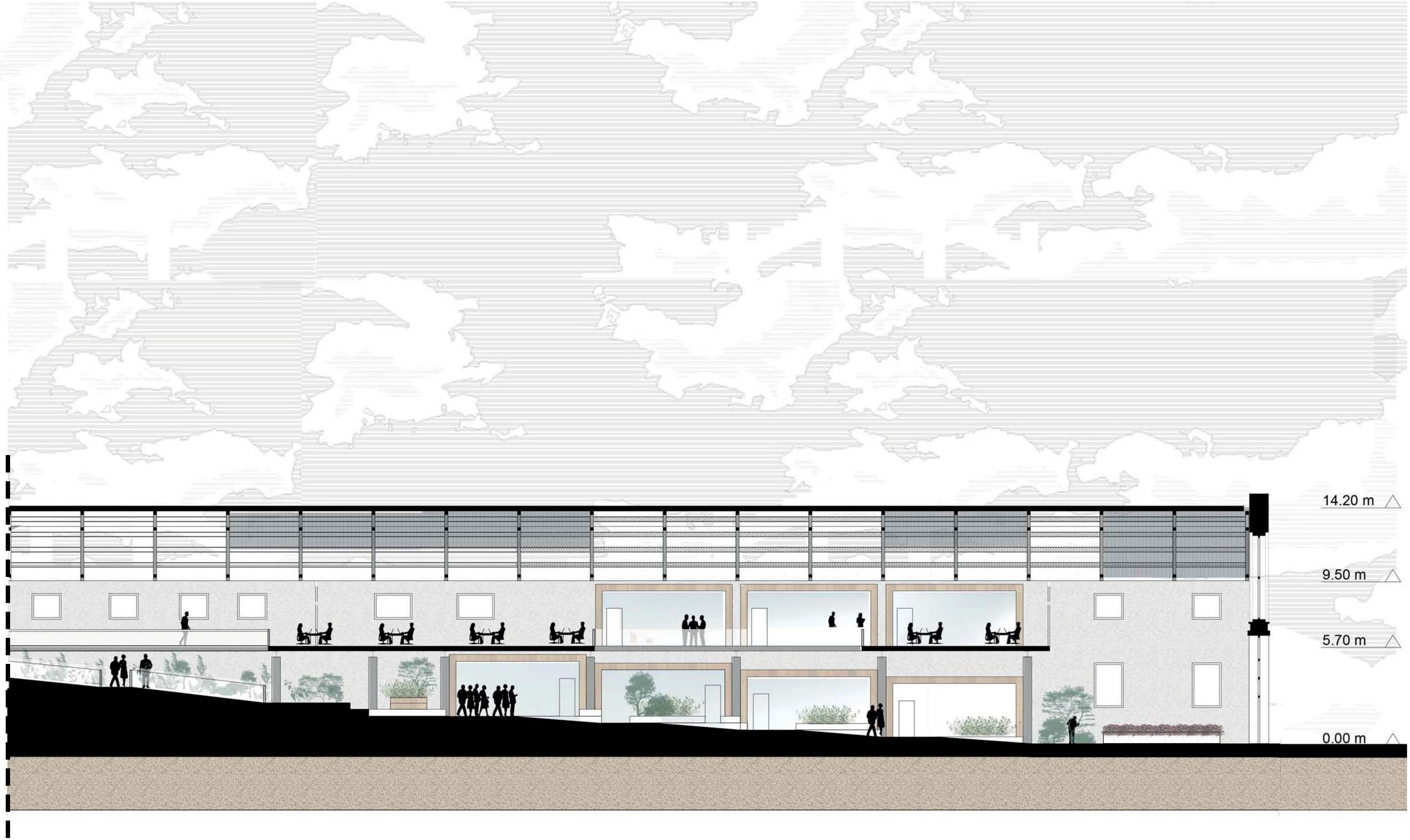


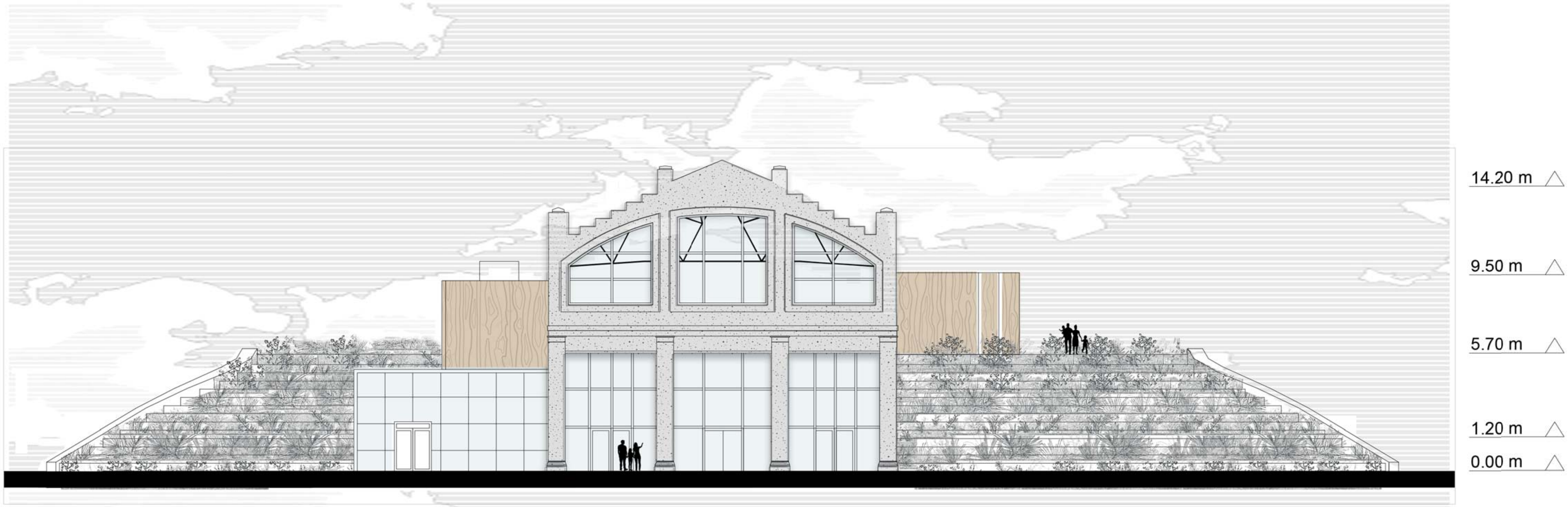
SCALE 1:200

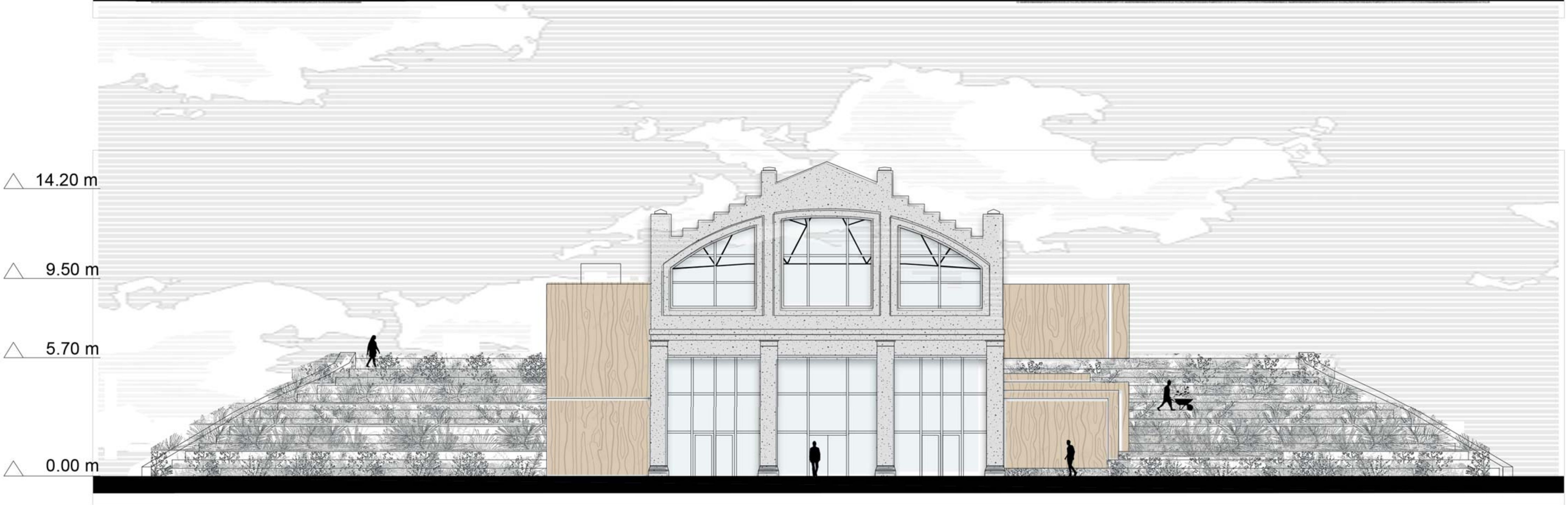


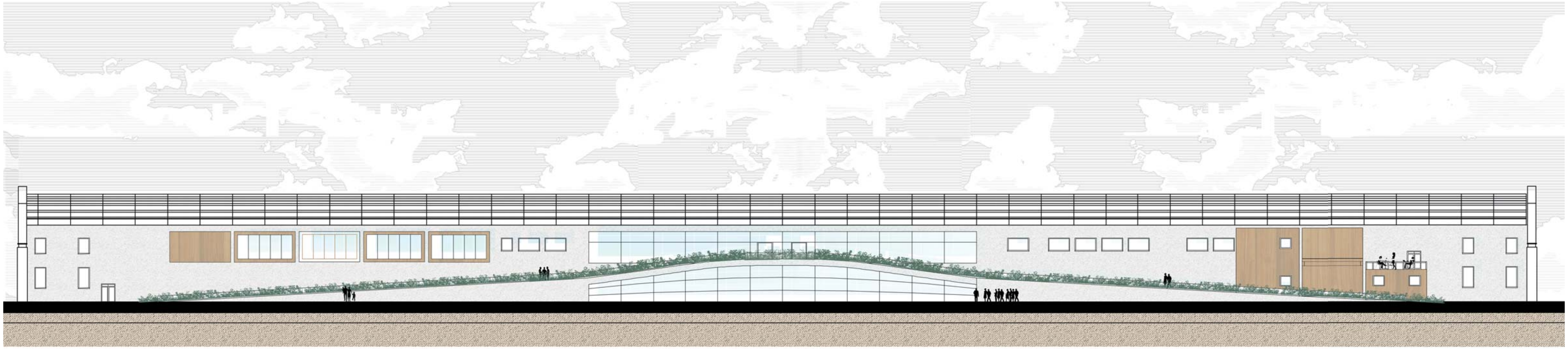
SCALE 1:200

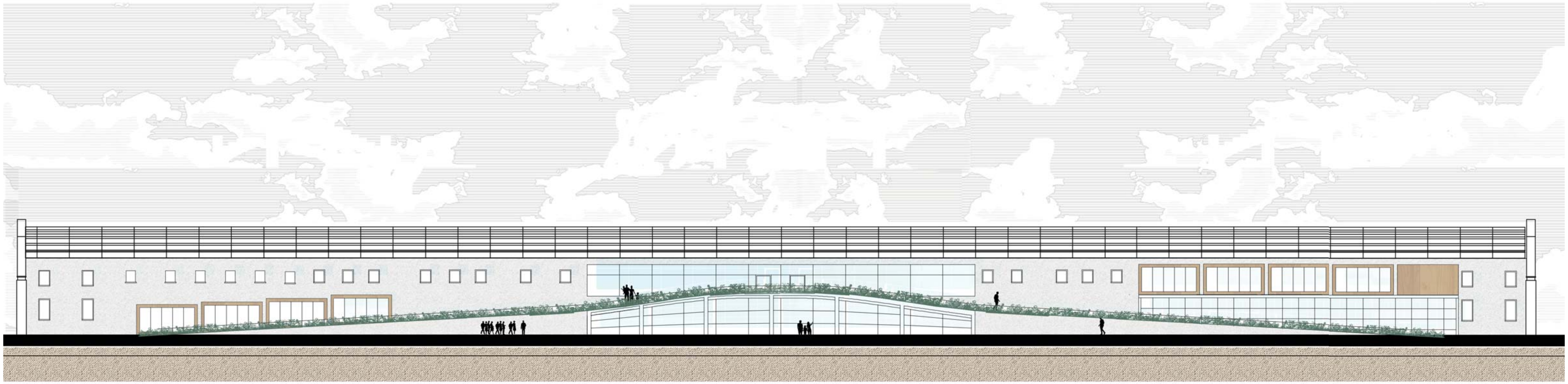


SCALE 1:200


14.20 m
9.50 m
5.70 m
1.20 m
0.00 m

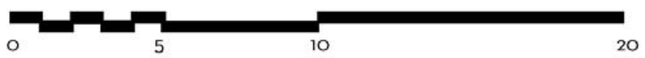

14.20 m
9.50 m
5.70 m
0.00 m

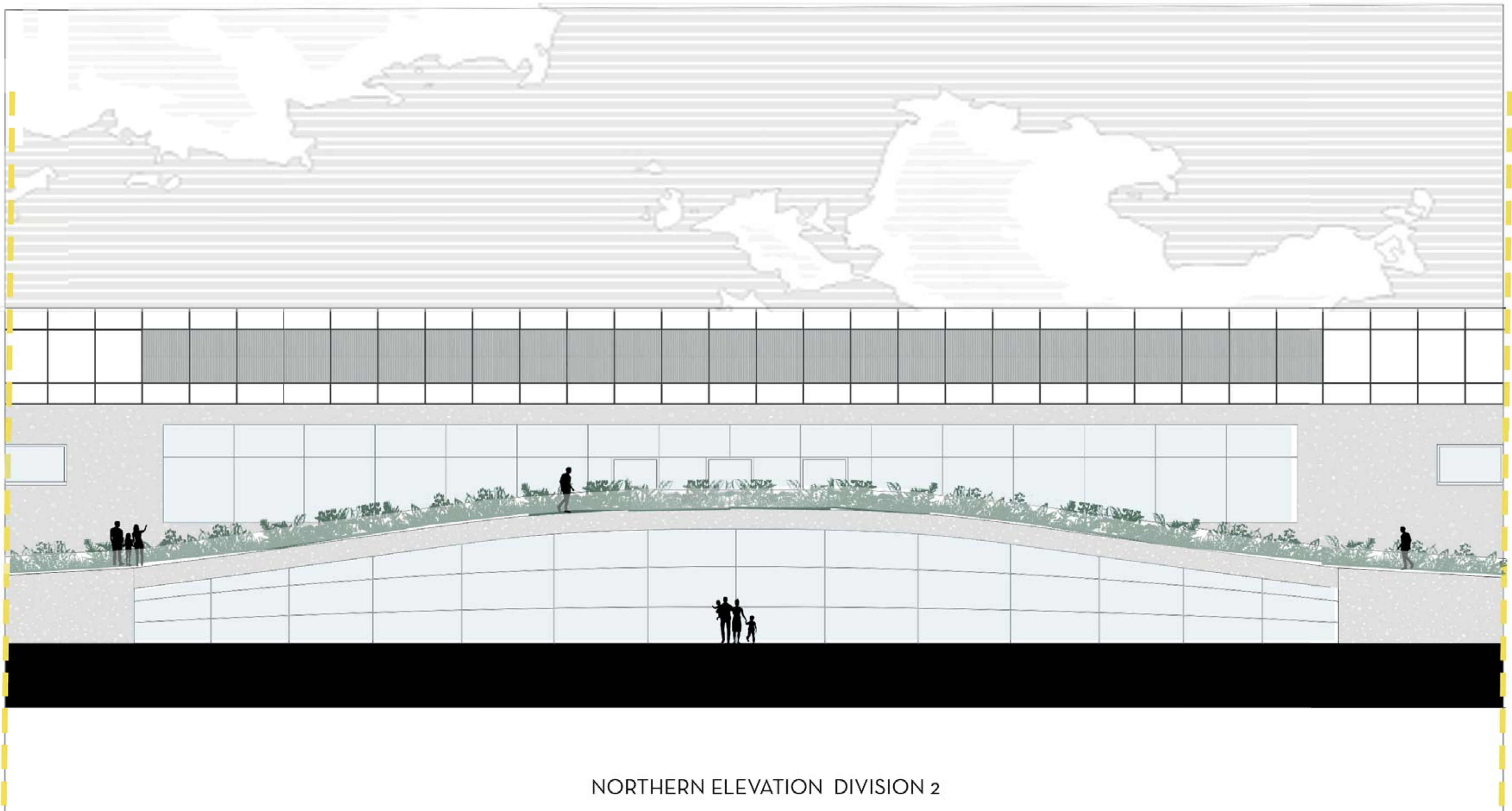




NORTHERN ELEVATION DIVISION 1

SCALE 1:200





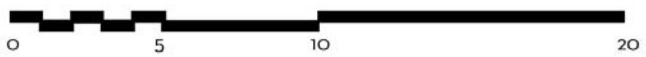
NORTHERN ELEVATION DIVISION 2

SCALE 1:200

0 5 10 20

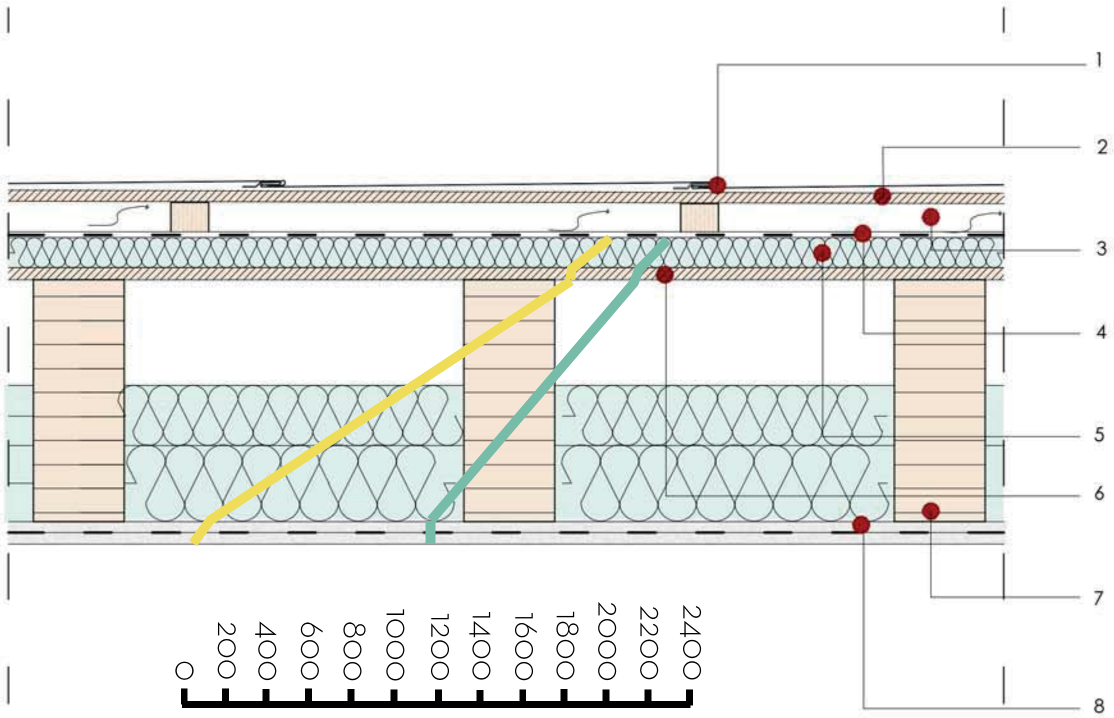
NORTHERN ELEVATION DIVISION 3

SCALE 1:200



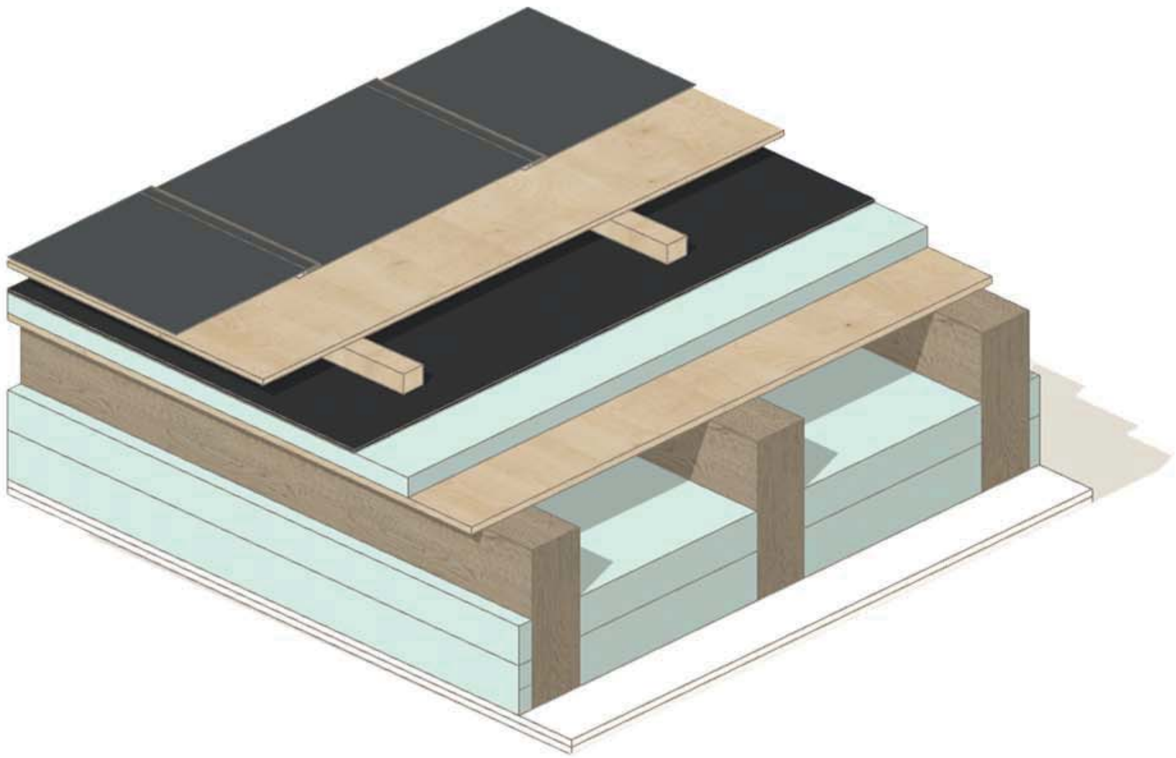
TECHNOLOGICAL PROJECT

BLOW UP, STRATIGRAPHY, NODES



Partial vapour pressure   Vapour saturation pressure

1. FINISH: Pre-patinated zinc sheet with double angular crimping, th. 0.8 mm, Zintec type Conductivity λ [W / mK]:109
2. SUPPORT: Wooden plank as a structure for finishing, th. 10 mm
3. IVENTILATION: Ventilation layer. Th. 50 mm
4. MEMEBRANE: Breathable membranes ROOF TRASPIR Rothoblaas. Th. 0.4 mm
5. INSULATION: Insulated material XPS. Th. 50 mm. Thermal transmittance equal to ψ = 0.034 W /mK
6. INFILL: infill panels in OSB panels, Th. 15 mm
7. STRUCTURE: Platform frame in lamellar wood beams. Inside there are 2 layers of Rockwool insulation. Density 40 Kg/mc. Th. 80 + 100 mm
8. FINISH LAYER: Double plasterboard coated with vapor barrier, type "Knauf GKB + Kasa"

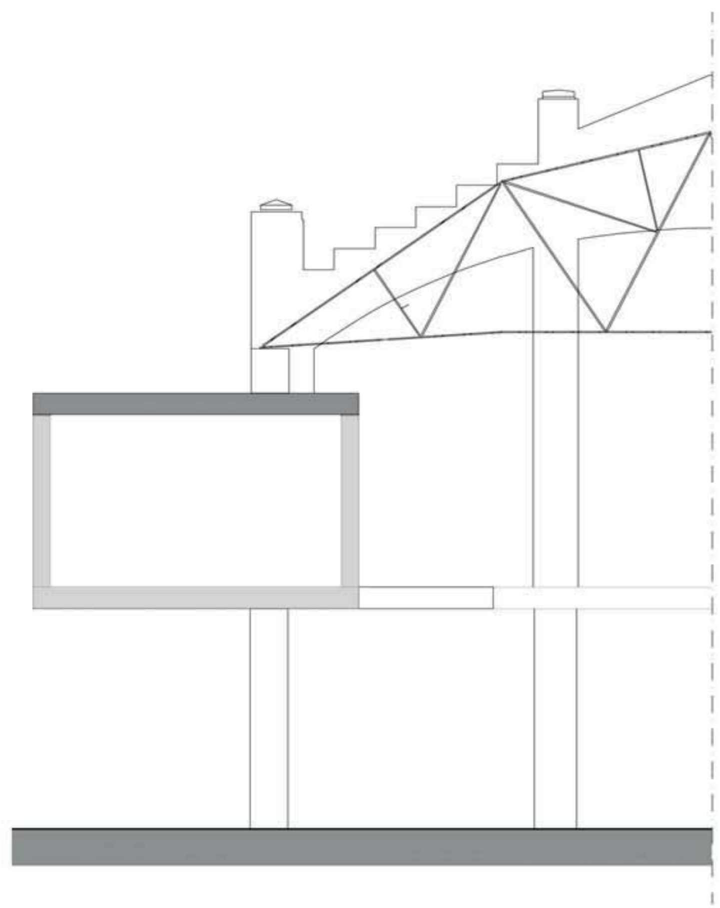


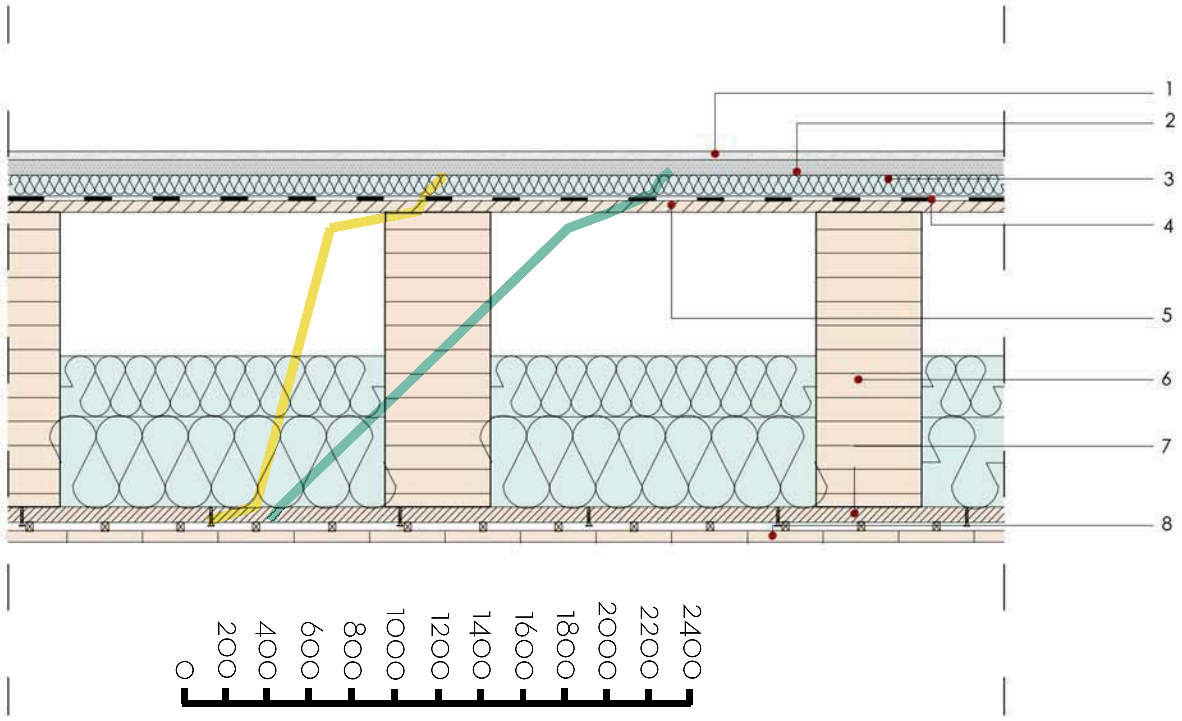
Climate informations

The municipality of Milan
Climate Zone: E, Degrees Day 2404
Indoor T (° C): 20.0
Outdoor T (° C): -5.0
Internal U (%): 52.0
External U (%): 38.7

Surface mass (Kg / m2): 42
Thermal resistance (m2K / W): 6.854
Total thickness (mm): 264

Transmittance: 0.146 W / m2K
Law value 0.3 W / m2K

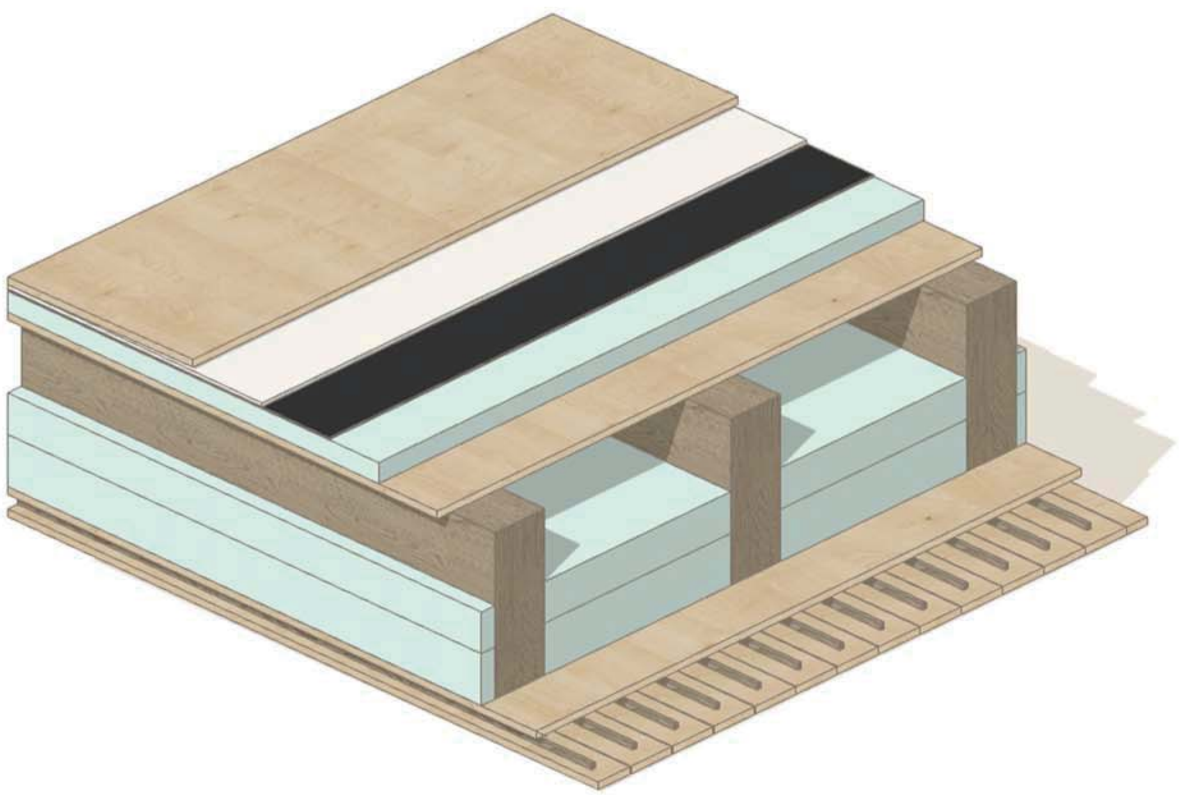




Partial vapour pressure

Vapour saturation pressure

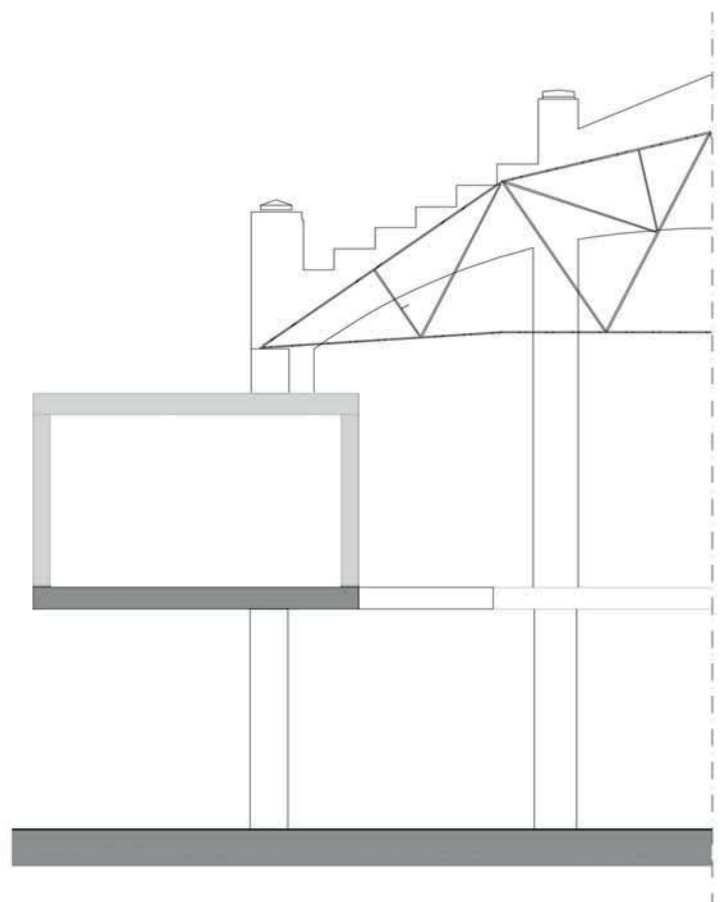
1. FINISH: resin for interiors, light gray "Resinfloor" type. Composition: 200 m2 transparent, opaque protective paint layer, 1500 m gray epoxy self-leveling resin layer, 350 m epoxy resin smoothing layer.
2. DRY LAYING LAYER: gypsum-fiber slab with rabbeted edge for continuous laying, size 1200 x 600 mm, thickness 18 mm, type "F145 Knauf"
3. INSULATION: Insulated material XPS. Th. 50 mm. Thermal transmittance equal to ψ = 0.034 W /mK
4. VAPOR RESISTANT: polyethylene impermeable to water vapor, thickness 2 mm, R98 series. Specific for the "Giacomini Dry" package
5. INFILL: infill panels in OSB panels, Th. 15 mm
6. STRUCTURE: Platform frame in lamellar wood beams. Inside there are 2 layers of Rockwool insulation. Density
7. INFILL: infill panels in OSB panels, Th. 15 mm
8. FINISH LAYER: Wood cladding, weather board larch. 25 mm



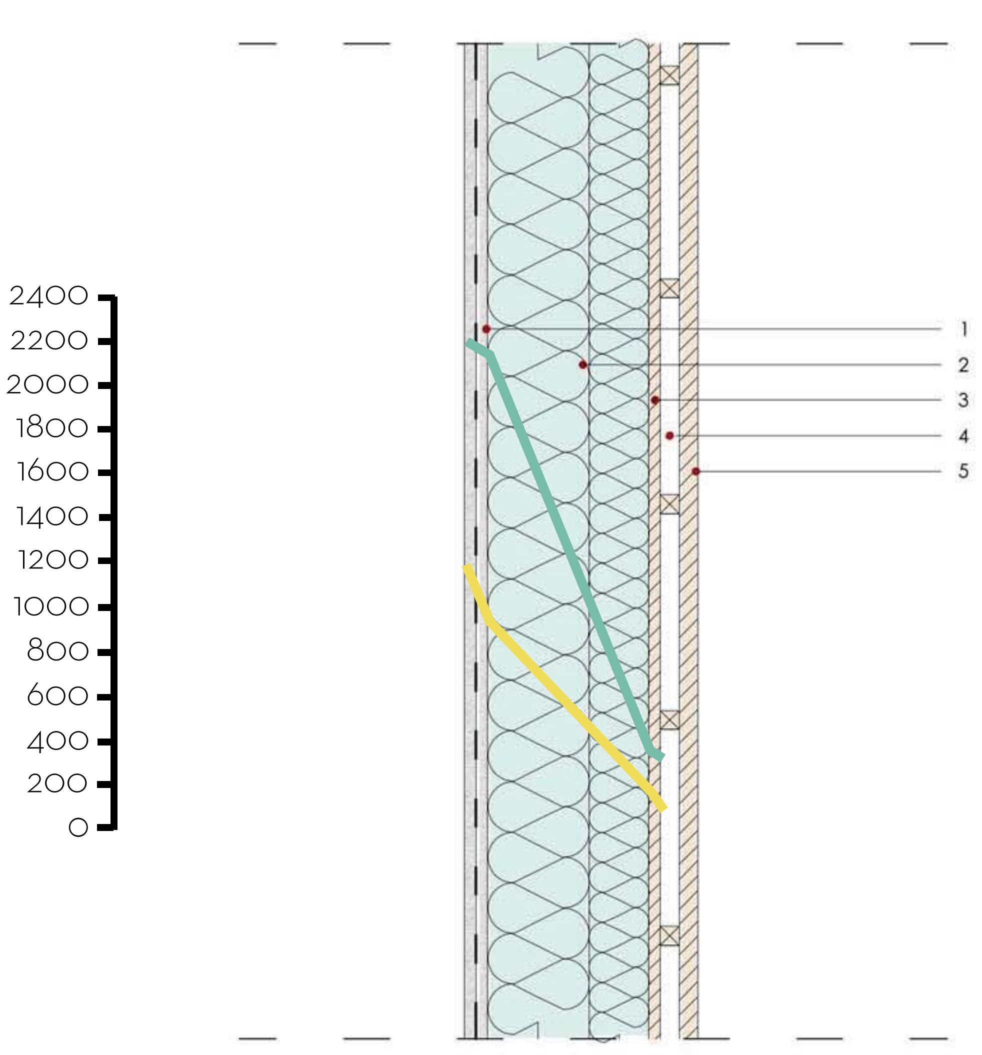
Climate informations
The municipality of Milan
Climate Zone: E, Degrees Day 2404
Indoor T (° C): 20.0
Outdoor T (° C): -5.0
Internal U (%): 52.0
External U (%): 38.7

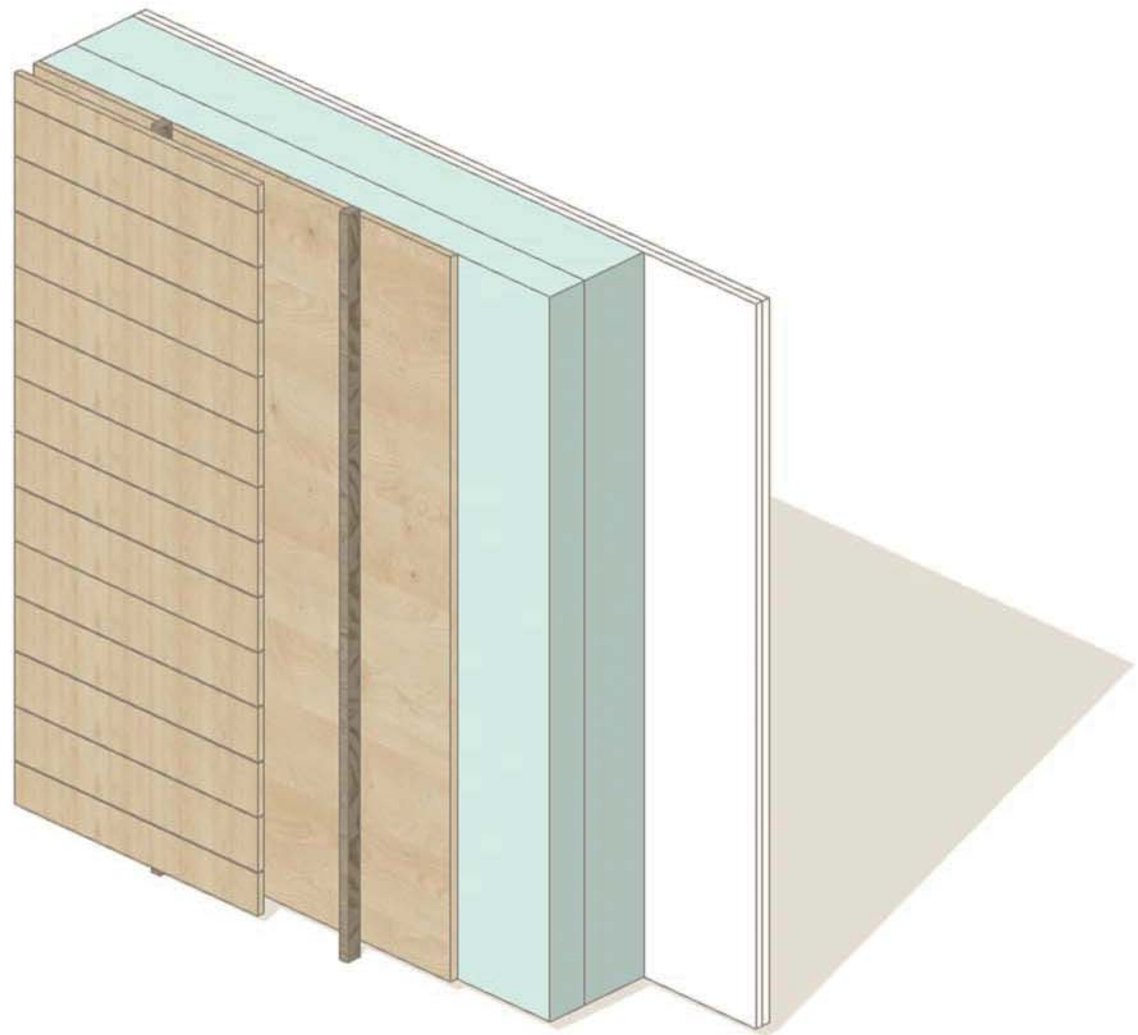
Surface mass (Kg / m2): 49
Thermal resistance (m2K / W): 5.856
Total thickness (mm): 258

Transmittance: 0.171 W / m2K
Law value 0.3 W / m2K



WALL STRATIGRAPHY AND GLAZER DIAGRAM. Scale 1:10





Partial vapour pressure

Vapour saturation pressure

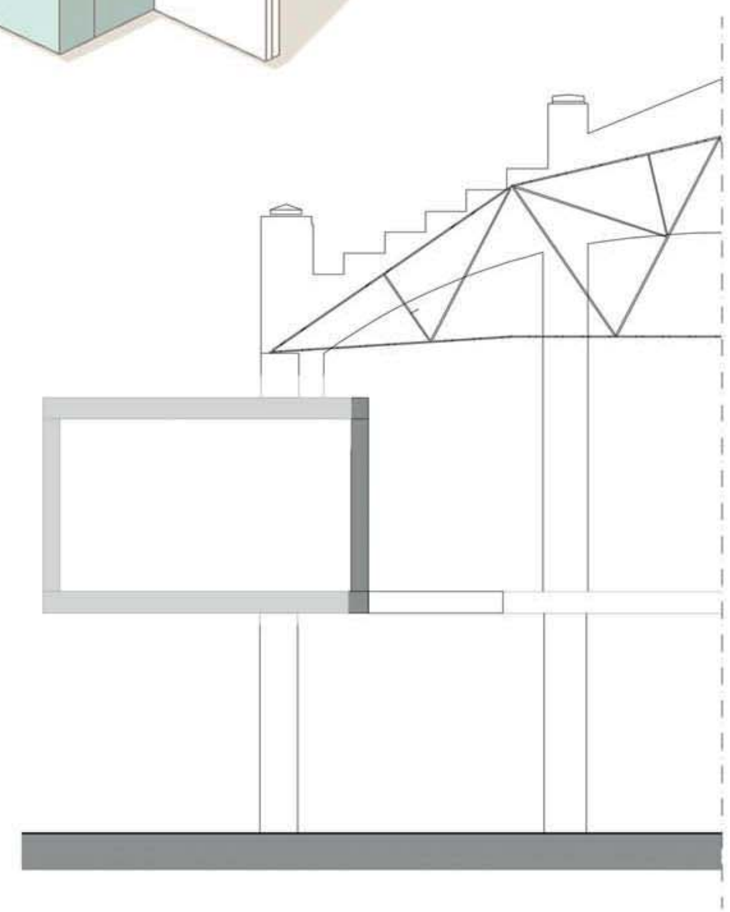
1. **FINISH:** double plasterboard coated with vapor barrier, type "Knauf GKB + Kasa"
2. **STRUCTURE:** load-bearing structure consisting of a frame made of wooden uprights (8x20cm) with a center distance of 62.5 cm. With two layers of thermal-acoustic panel insulation Rockwool panels (density 40 kg / mc)
3. **INFILL:** infill panels in OSB panels, Th. 15 mm
4. **SUPPORT LAYER:** Wood support structure 2,5 x 2,5 cm every 30 cm
5. **FINISH LAYER:** Wood cladding, weather board larch. 25 mm

Climate informations

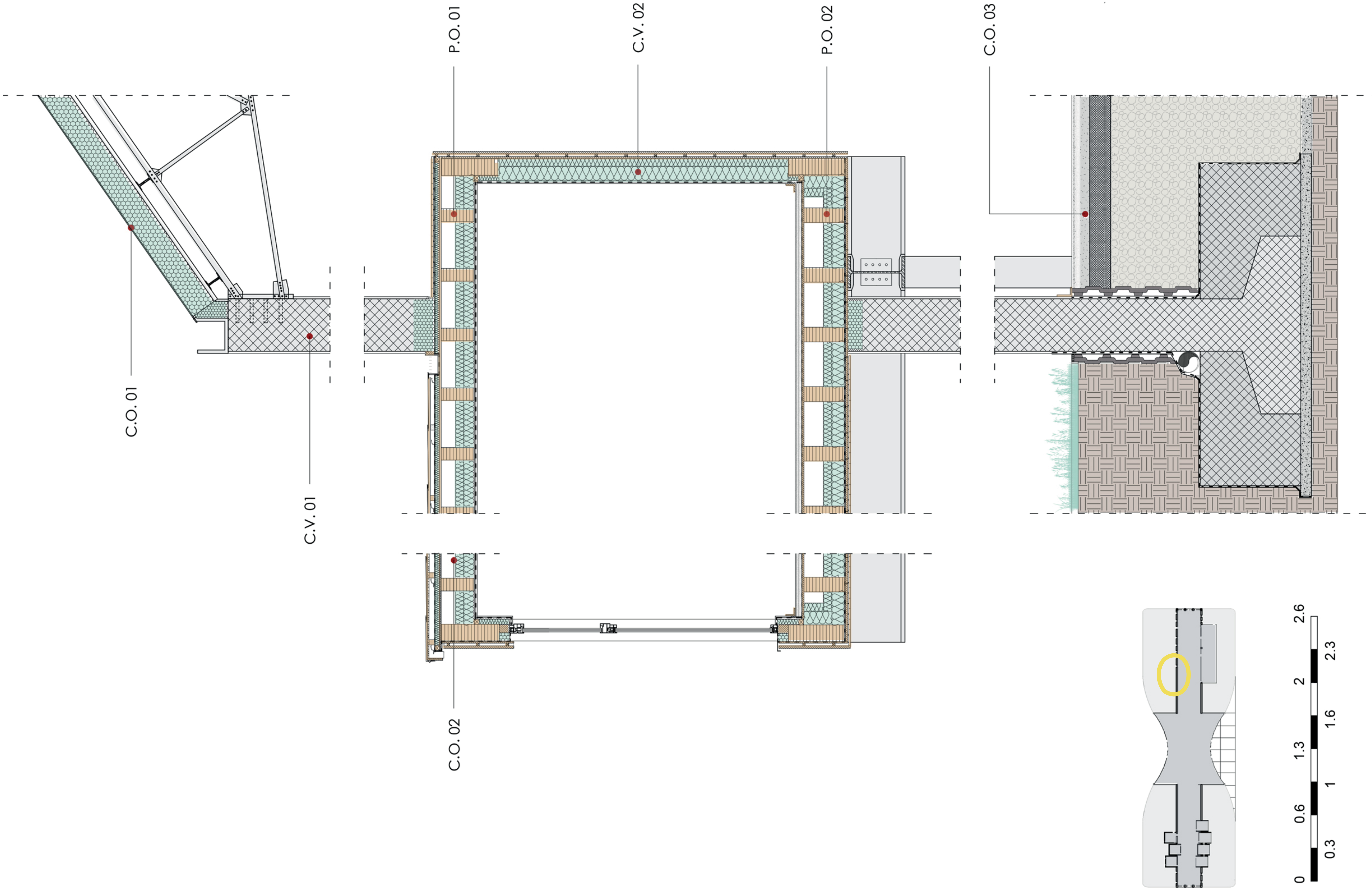
The municipality of Milan
Climate Zone: E, Degrees Day 2404
Indoor T (° C): 20.0
Outdoor T (° C): -5.0
Internal U (%): 52.0
External U (%): 38.7

Surface mass (Kg / m2): 33
Thermal resistance (m2K / W): 6.08
Total thickness (mm): 227.5

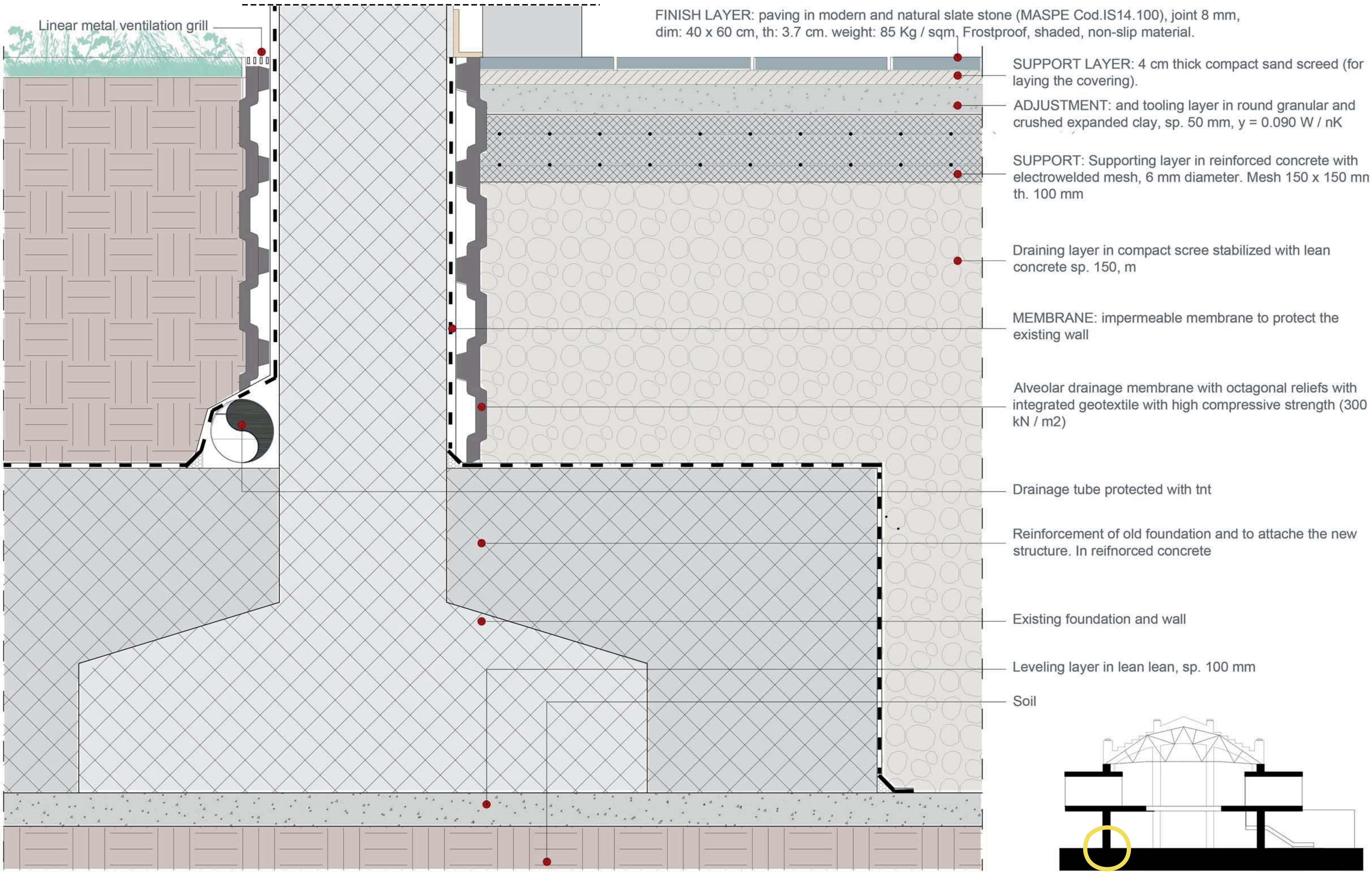
Transmittance: 0.164 W / m2K
Law value 0.3 W / m2K



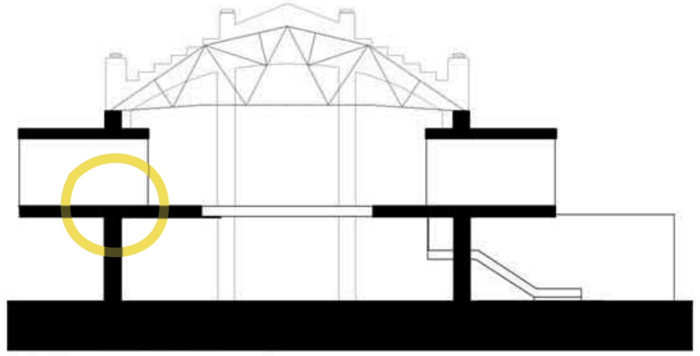
Section in the laboratorie part

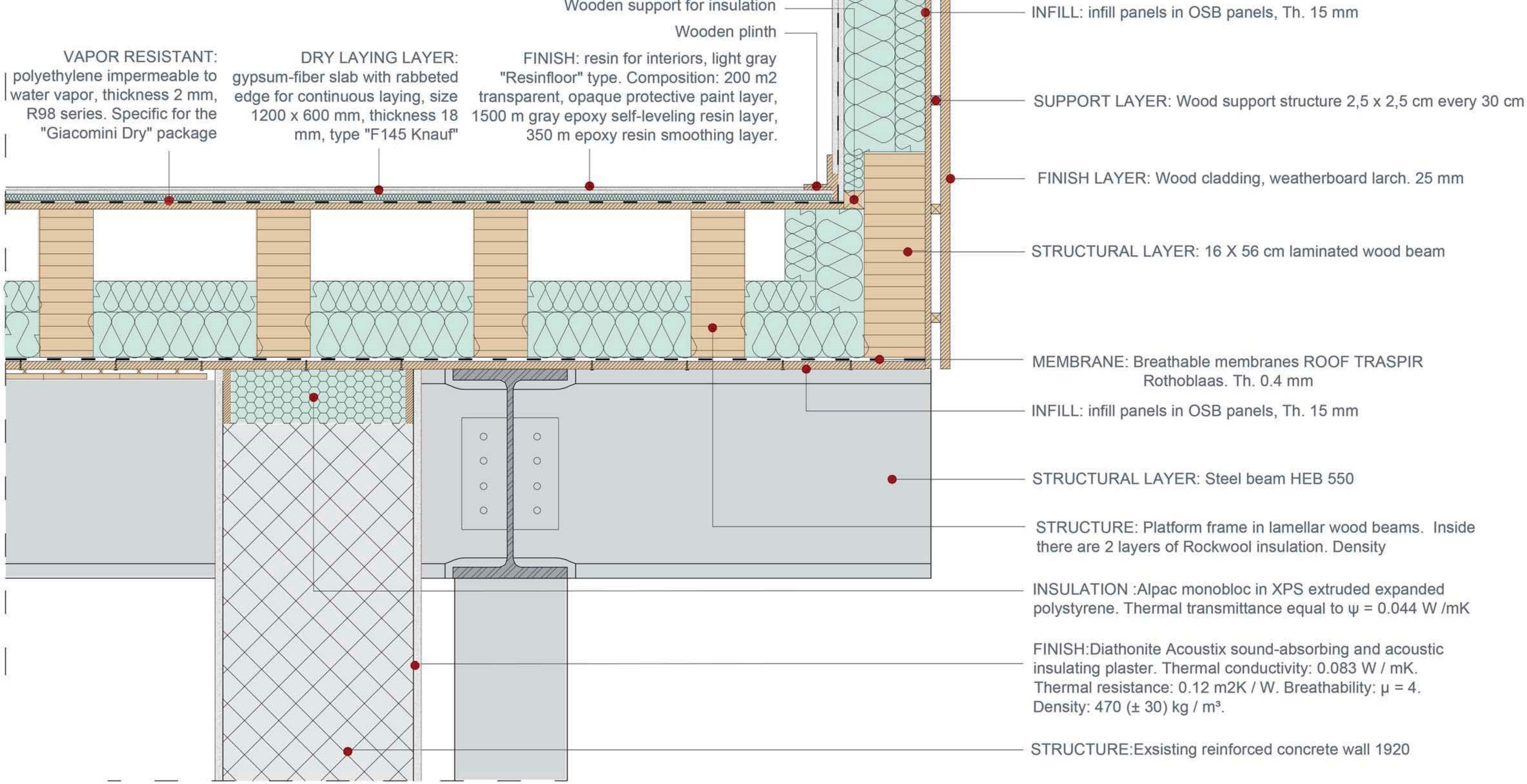


FOUNDATION DETAIL. Scale 1:10

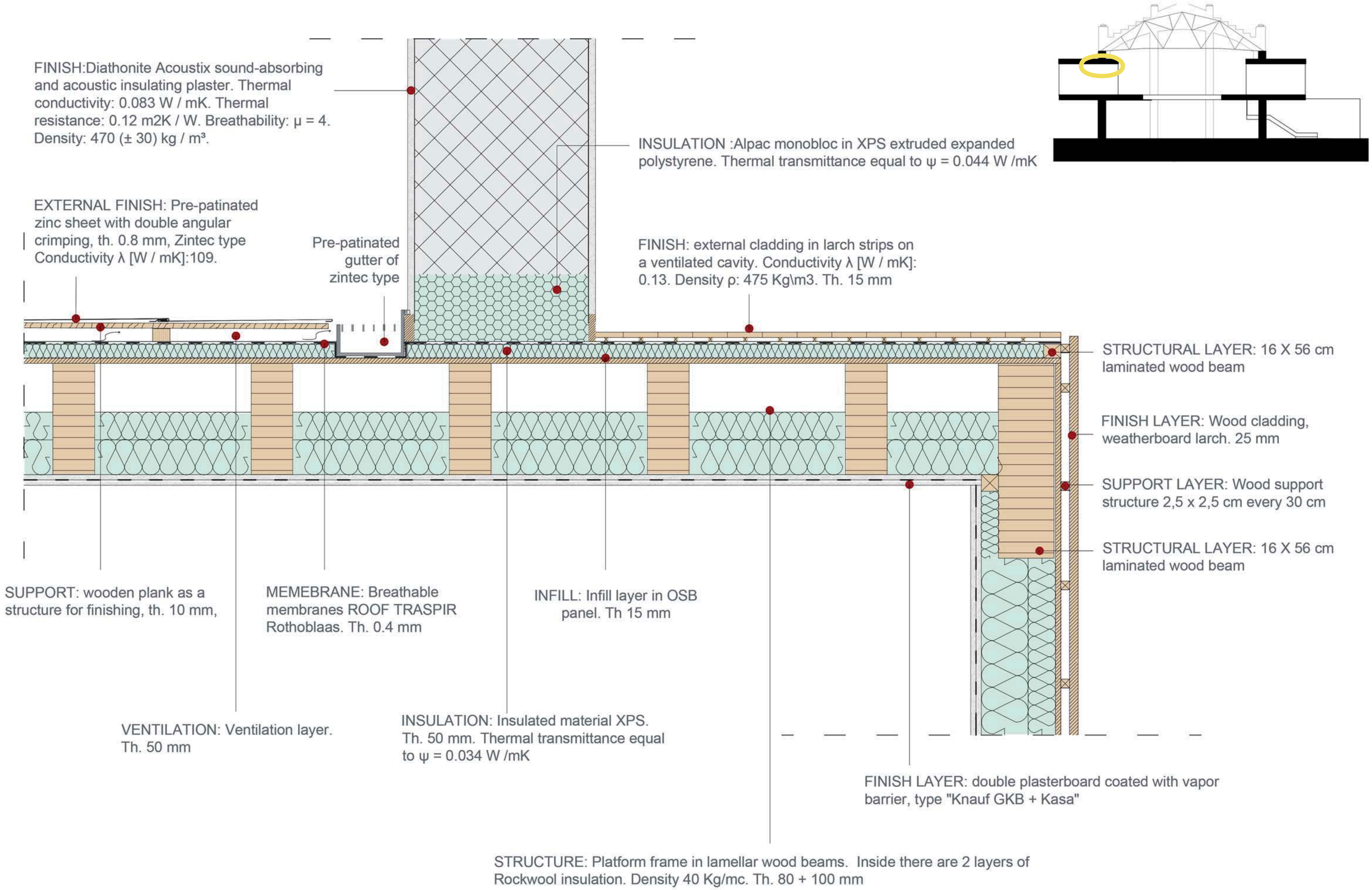


CONNECTION BETWEEN NEW BOX AND EXISTING WAL. Scale 1:!O

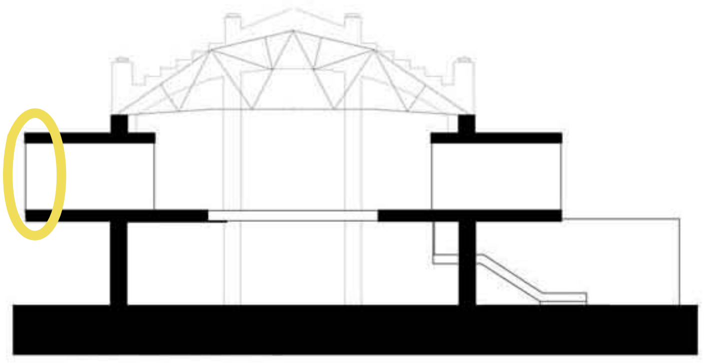


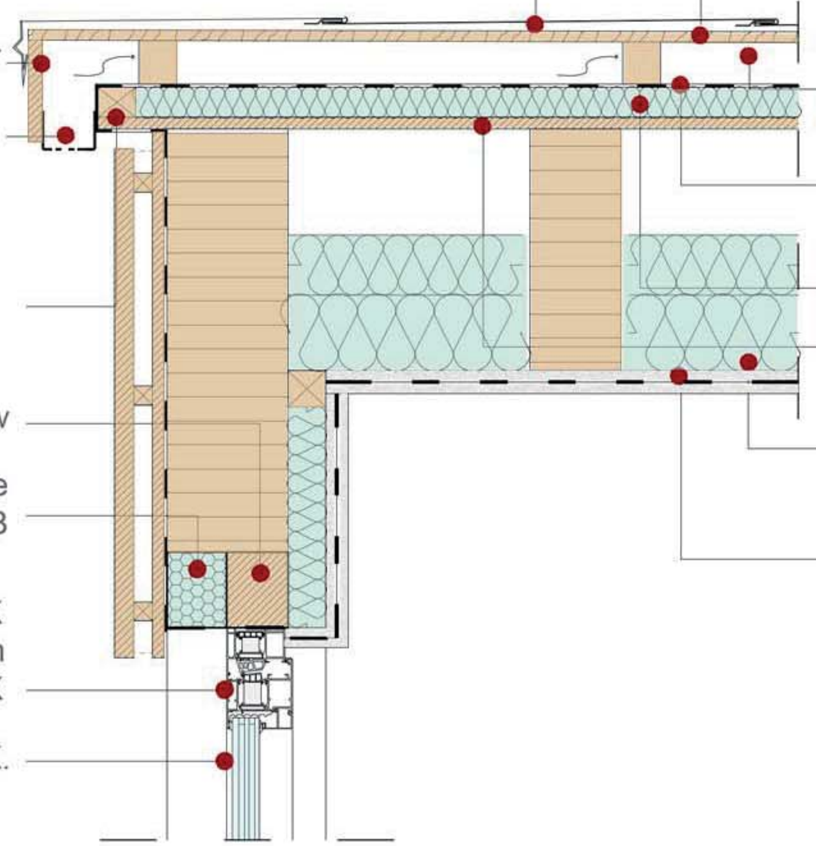


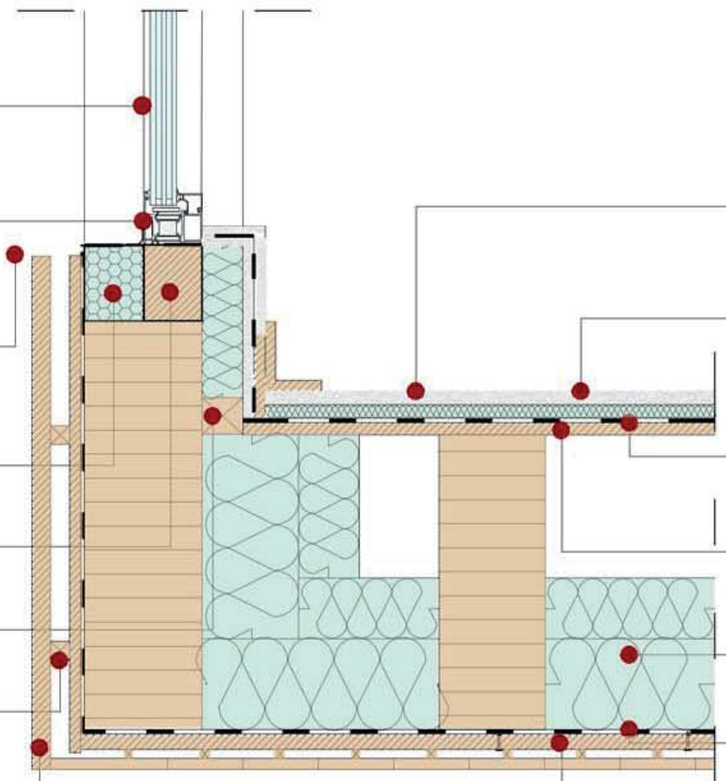
CONNECTION BETWEEN NEW BOX AND EXISTING WAL. Scale 1:10



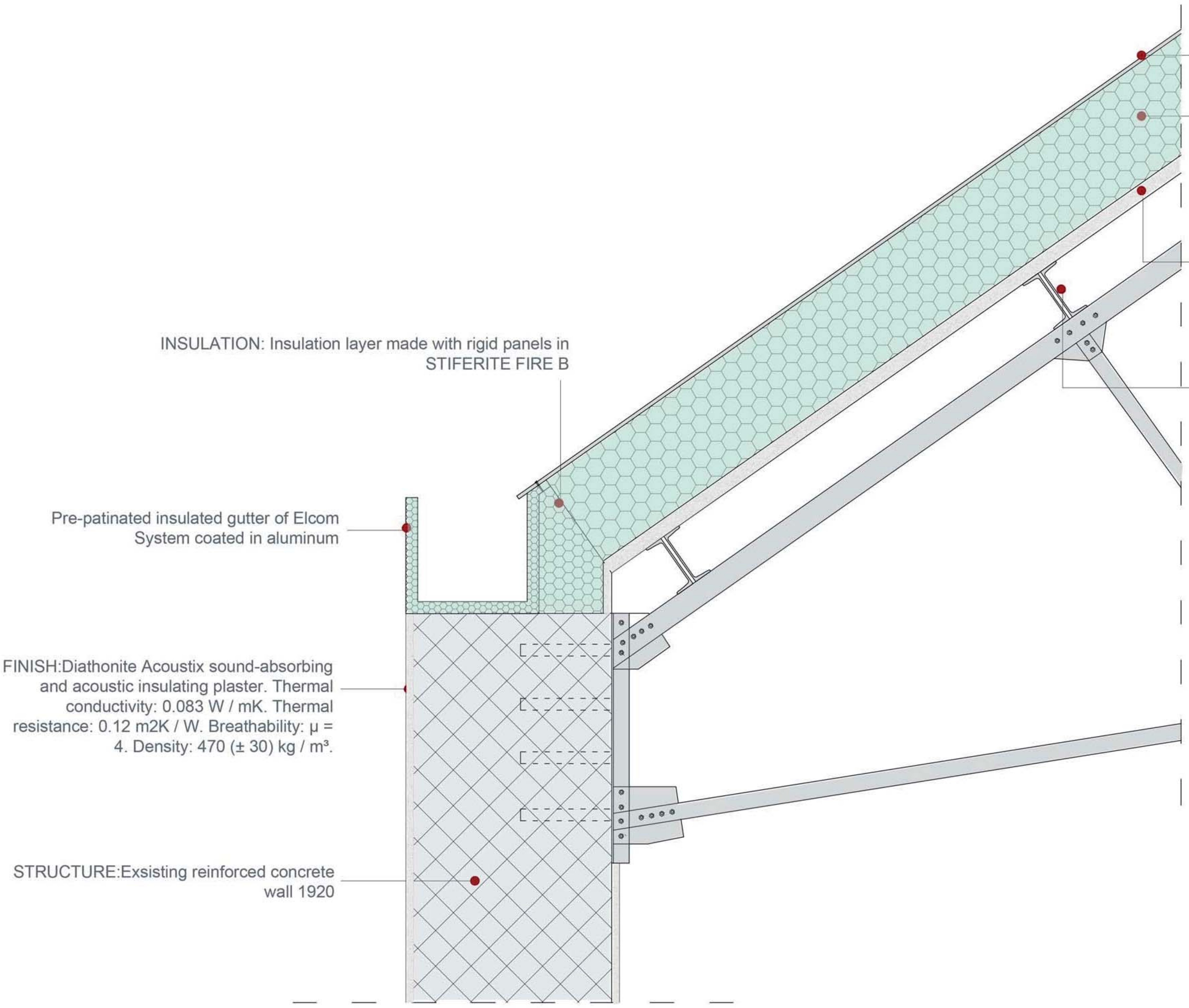
BOX DETAIL. Scale 1:10

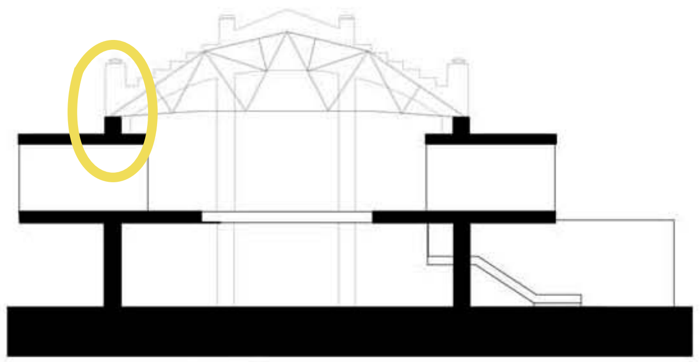






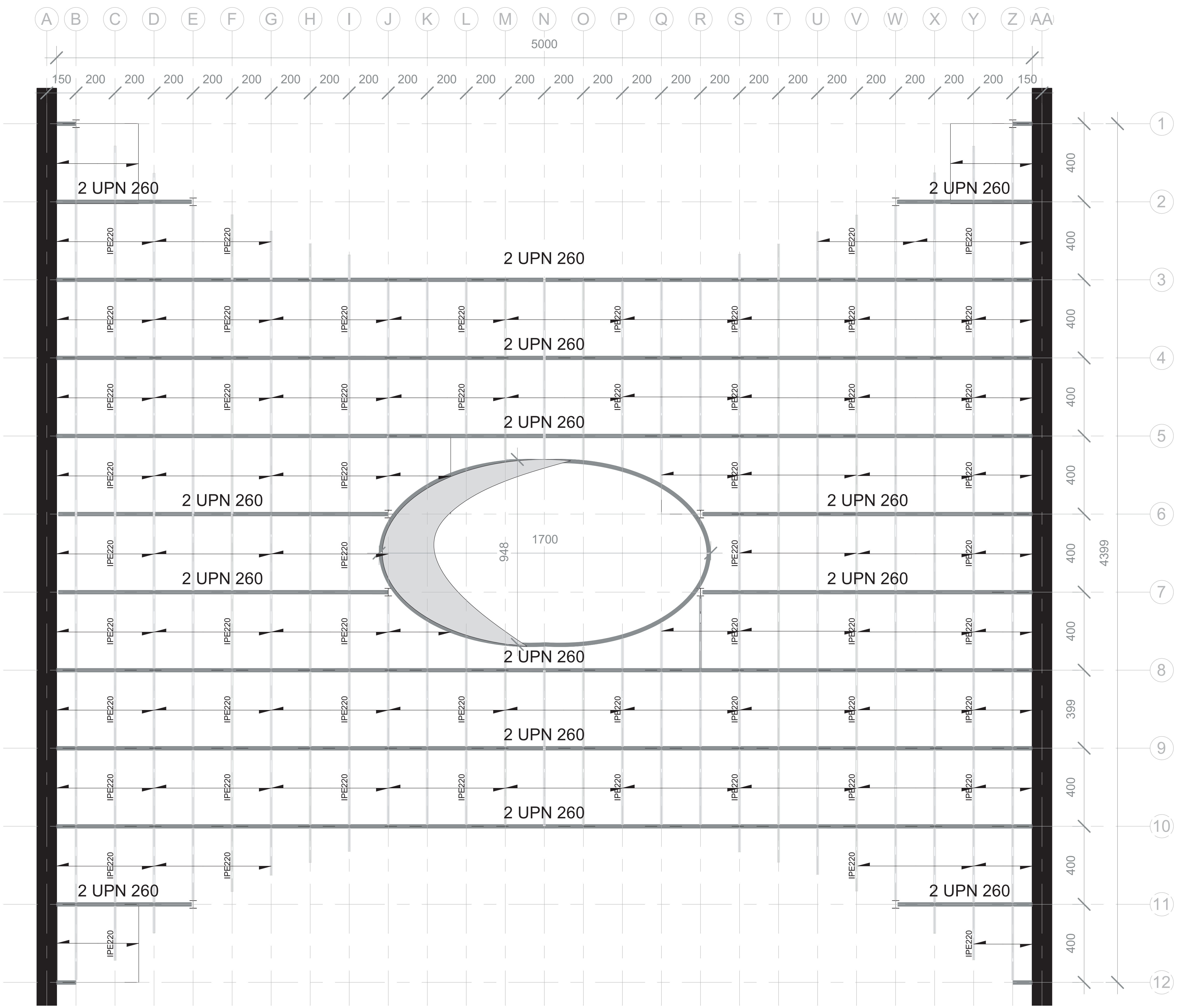
CONNECTION BETWEEN EXISTING WALL AND ROO. Scale 1:10

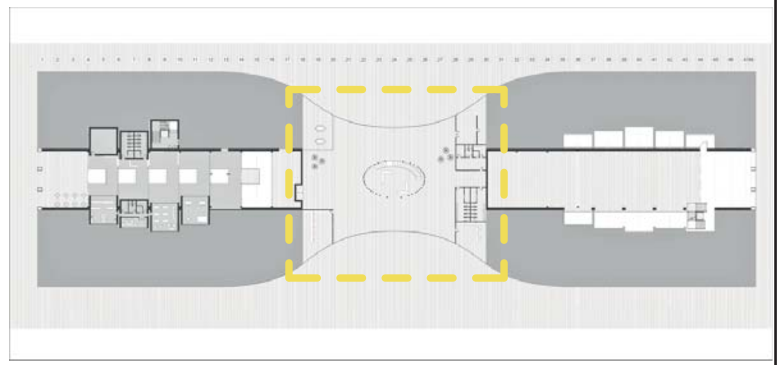




STRUCTURAL PROJECT
TRUSS, FIRST FLOOR SLAB, BOXES

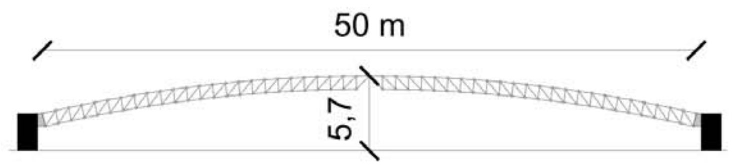
Structural plan scale 1: 200

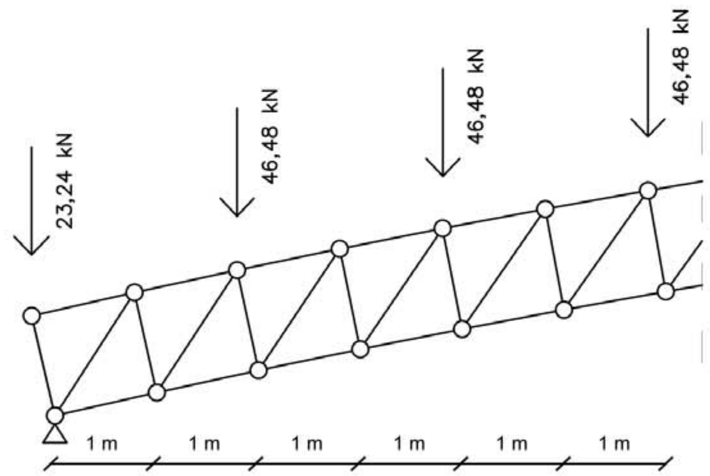




STEEL CHARACTERISTICS (UNI EN10025-2)	
Type	275
Yielding strength fyk	275 MPa
Ultimate tensile strength ftk	430 MPa

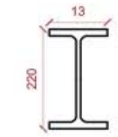
GEOMETRY	
	m
Primary beams span	50
Secondary beams span	4
Primary beams interax	4
Secondary beams interax	2



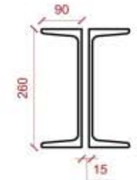


Structural plan scale 1: 50

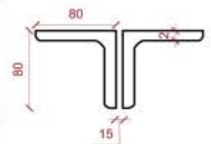
IPE	Dimensions	
	h	b
Units	mm	mm
IPE 220	220	110



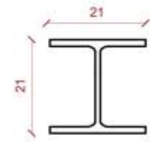
UPN	Dimensions	
	h	b
Units	mm	mm
UPN 260	260	90



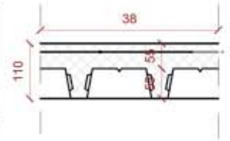
LUP	Dimensions	
	h	b
Units	mm	mm
L 80 x 80 x 7	80	80

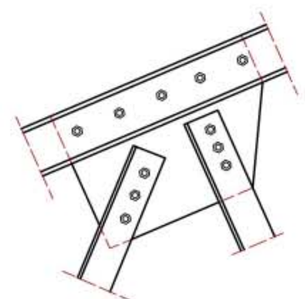


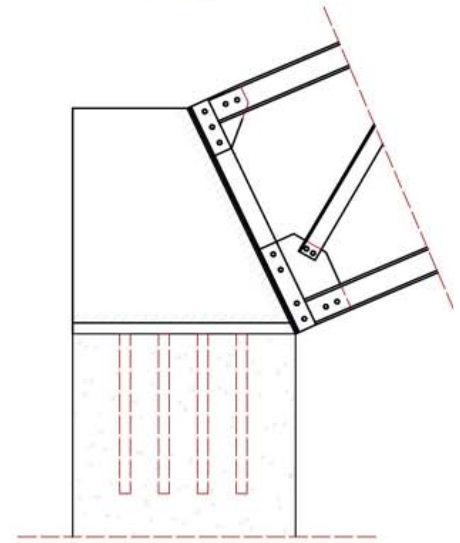
HEB	Vertical elements	
	h	b
Units	mm	mm
HEB 180	180	180



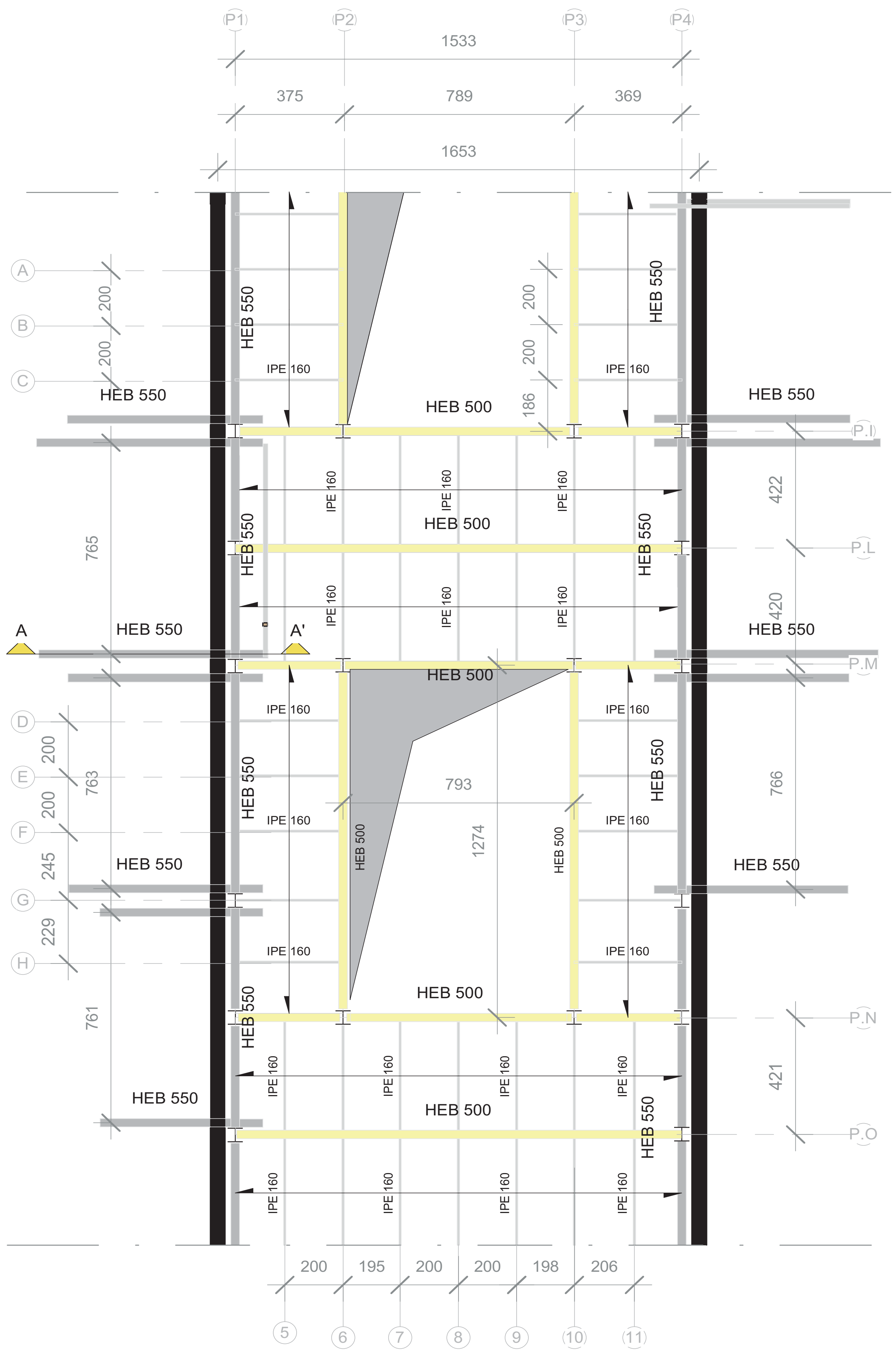
HI- BOND 55/P600	Slab
	h
Units	mm
Hi- bond	110

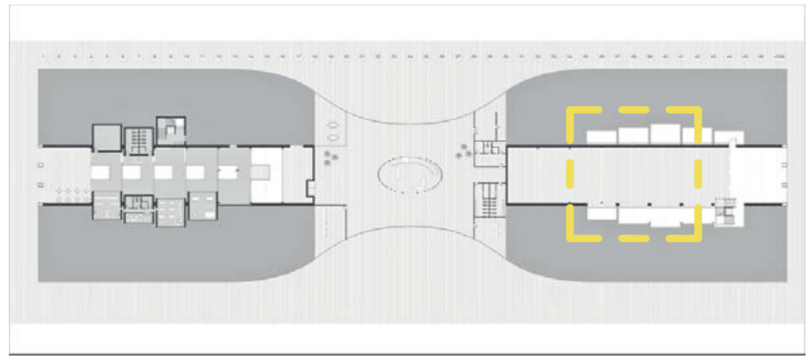


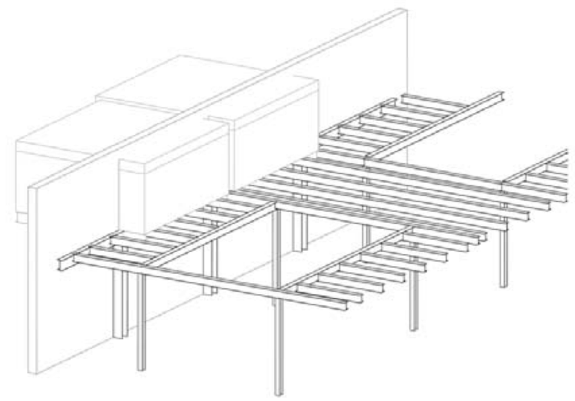




Structural plan scale 1: 200







Existing wall

Steel Primary HEB 550

Steel Primary HEB 500

Steel Secondary IPE 160

Selection position

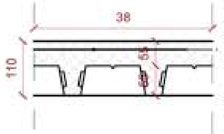
P.N — Primary beams vertical direction

N — Secondary beams vertical direction

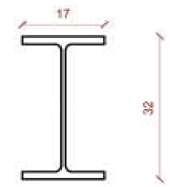
P.L — Primary beams horizontal direction

L — Secondary beams horizontal direction

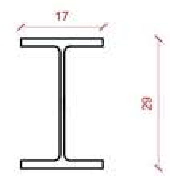
HI- BOND 55/P600	Slab
	h
Units	mm
Hi-bond	110



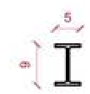
HEB 550	Dimensions	
	h	b
Units	mm	mm
HEB 550	550	330



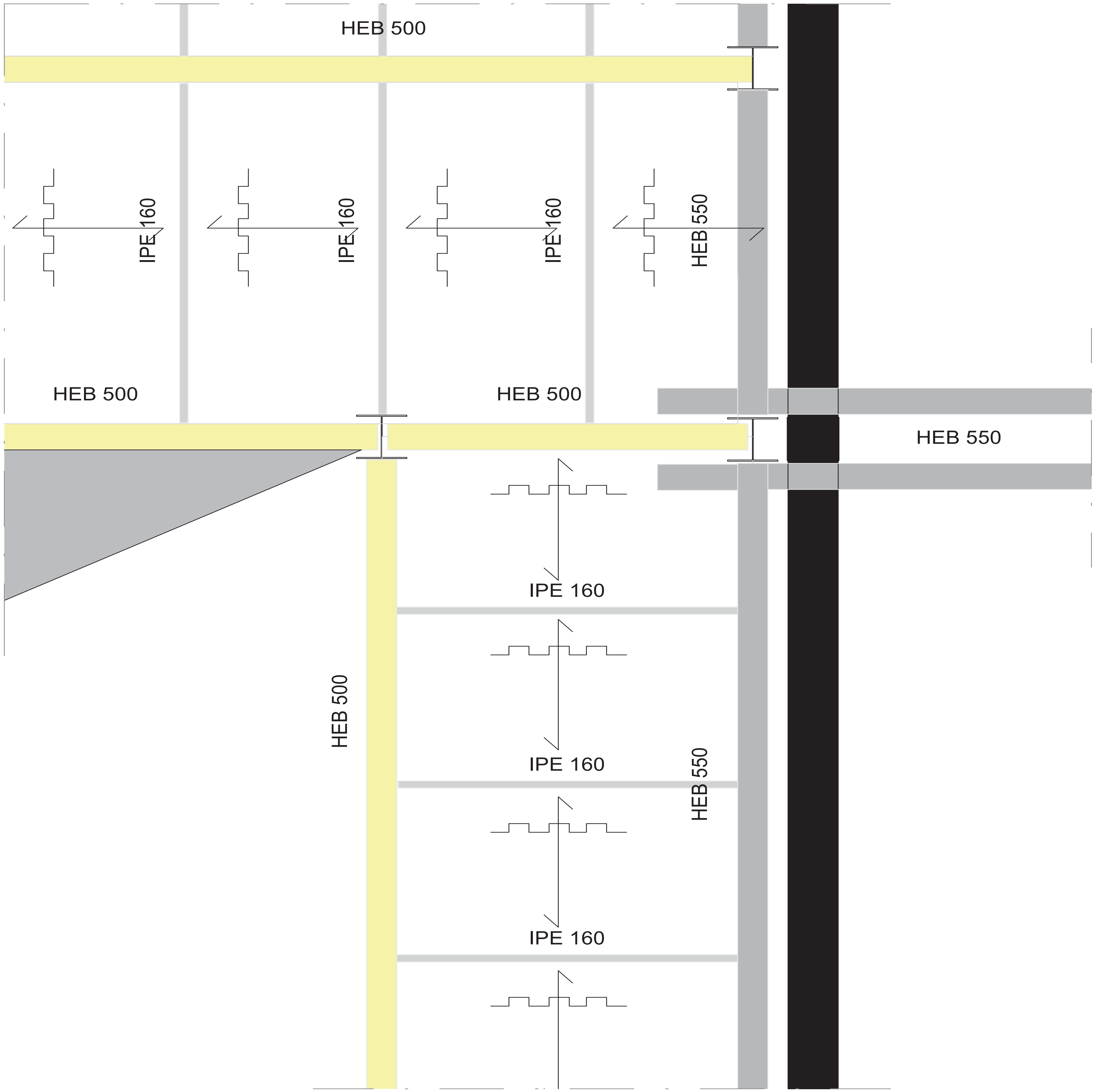
HEB 500	Dimensions	
	h	b
Units	mm	mm
HEB 500	500	300

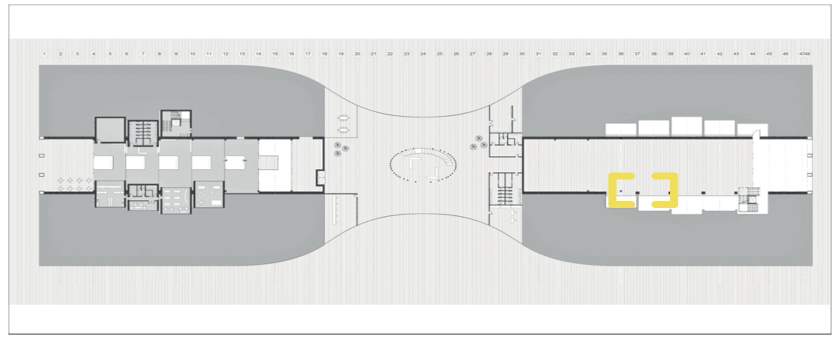


IPE 160	Dimensions	
	h	b
Units	mm	mm
IPE 160	160	82



Structural plan scale 1: 50





Existing wall

Steel Primary HEB 550

Steel Primary HEB 500

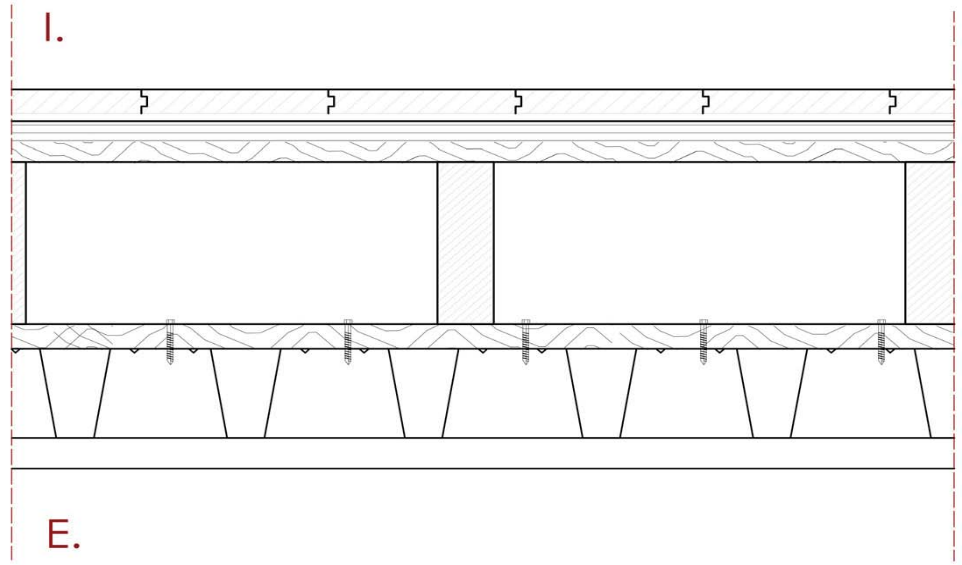
Steel Secondary IPE 160

P.N Primary beams vertical direction

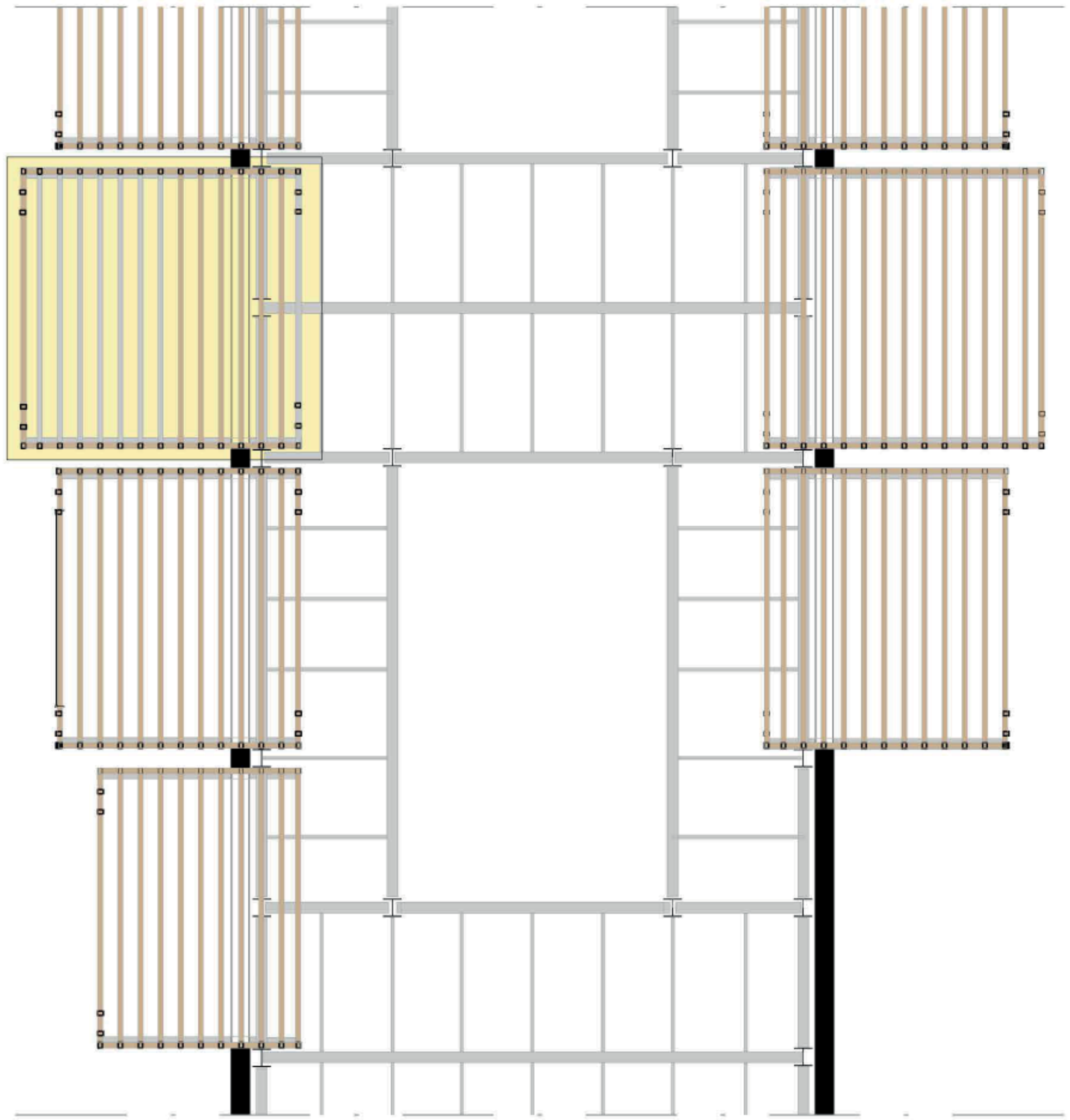
N Secondary beams vertical direction

P.L Primary beams horizontal direction

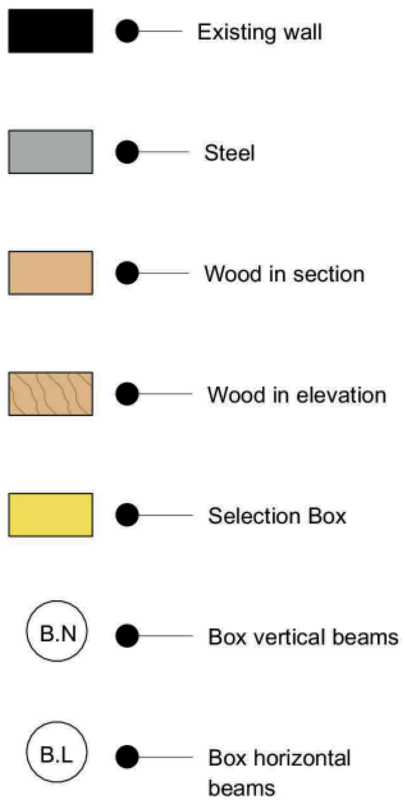
L Secondary beams horizontal direction

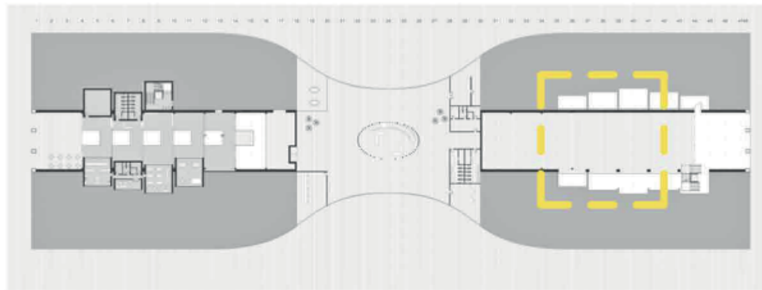


Structural plan scale 1: 200

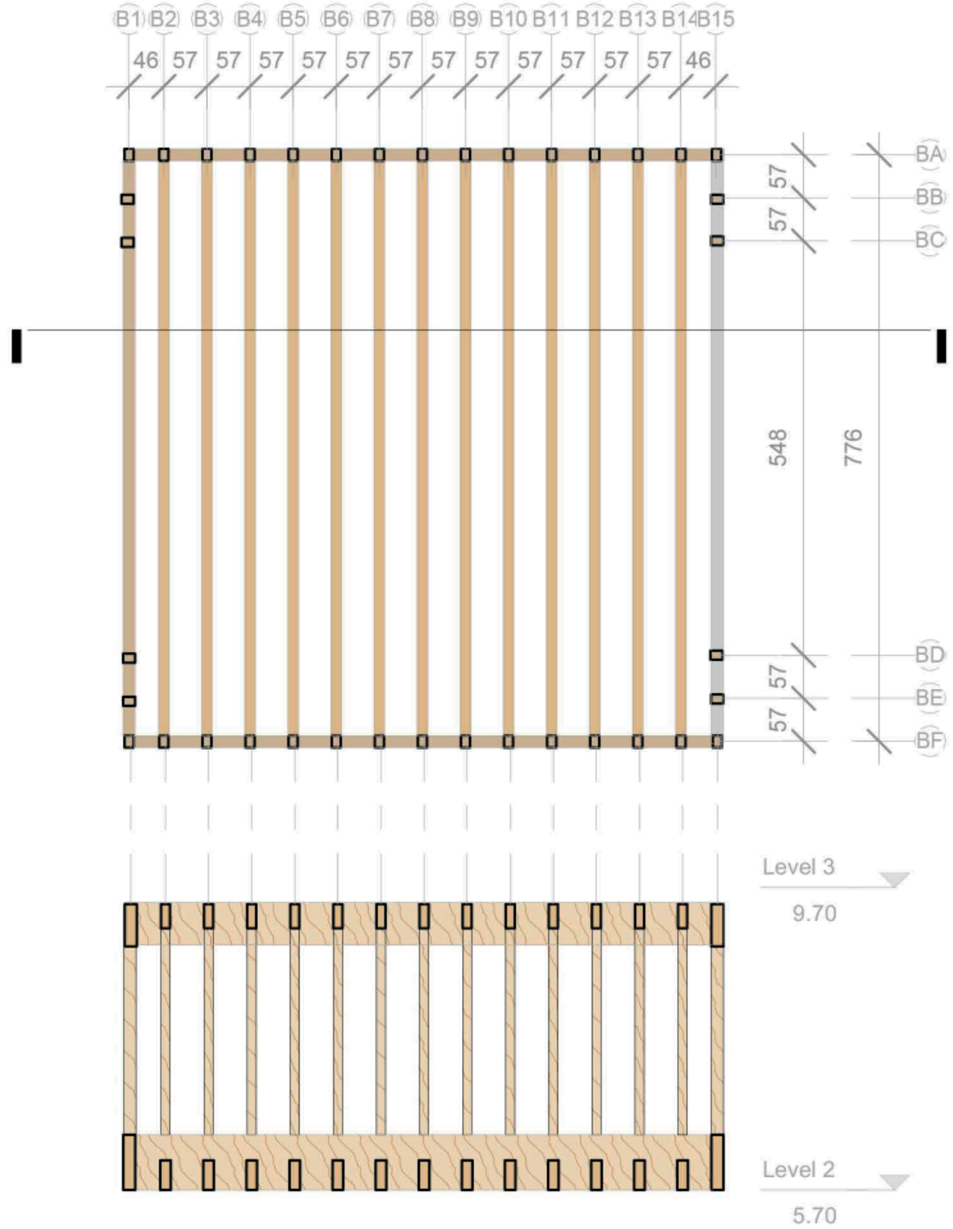


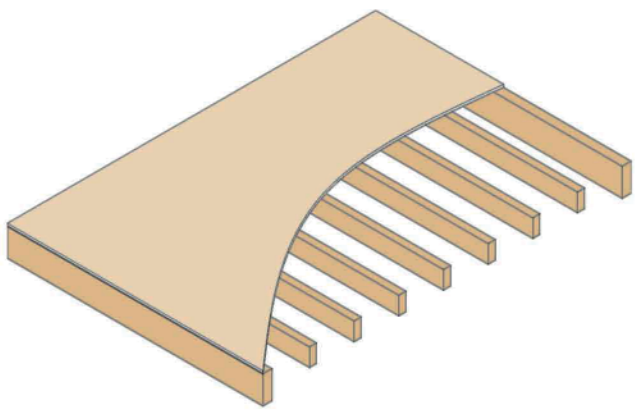
Legend





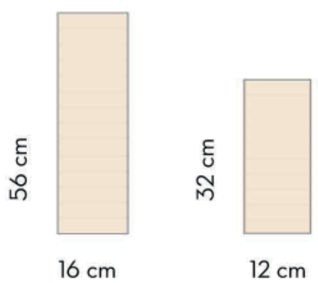
Structural plan and section scale 1:100



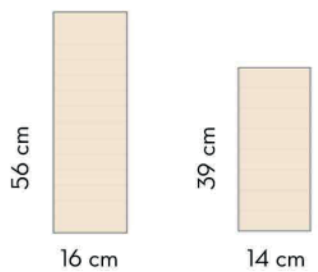


OSB - Structural load distribution

ROOF BEAMS

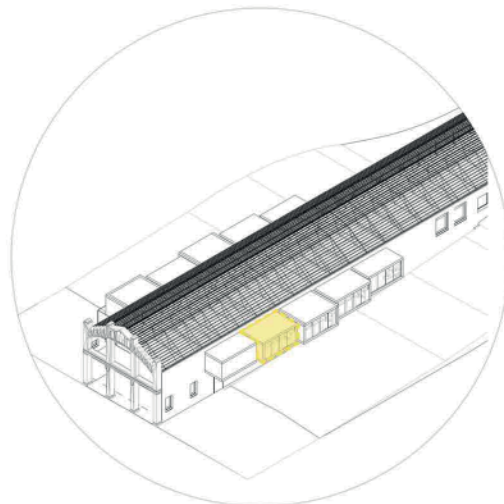


SLAB BEAMS



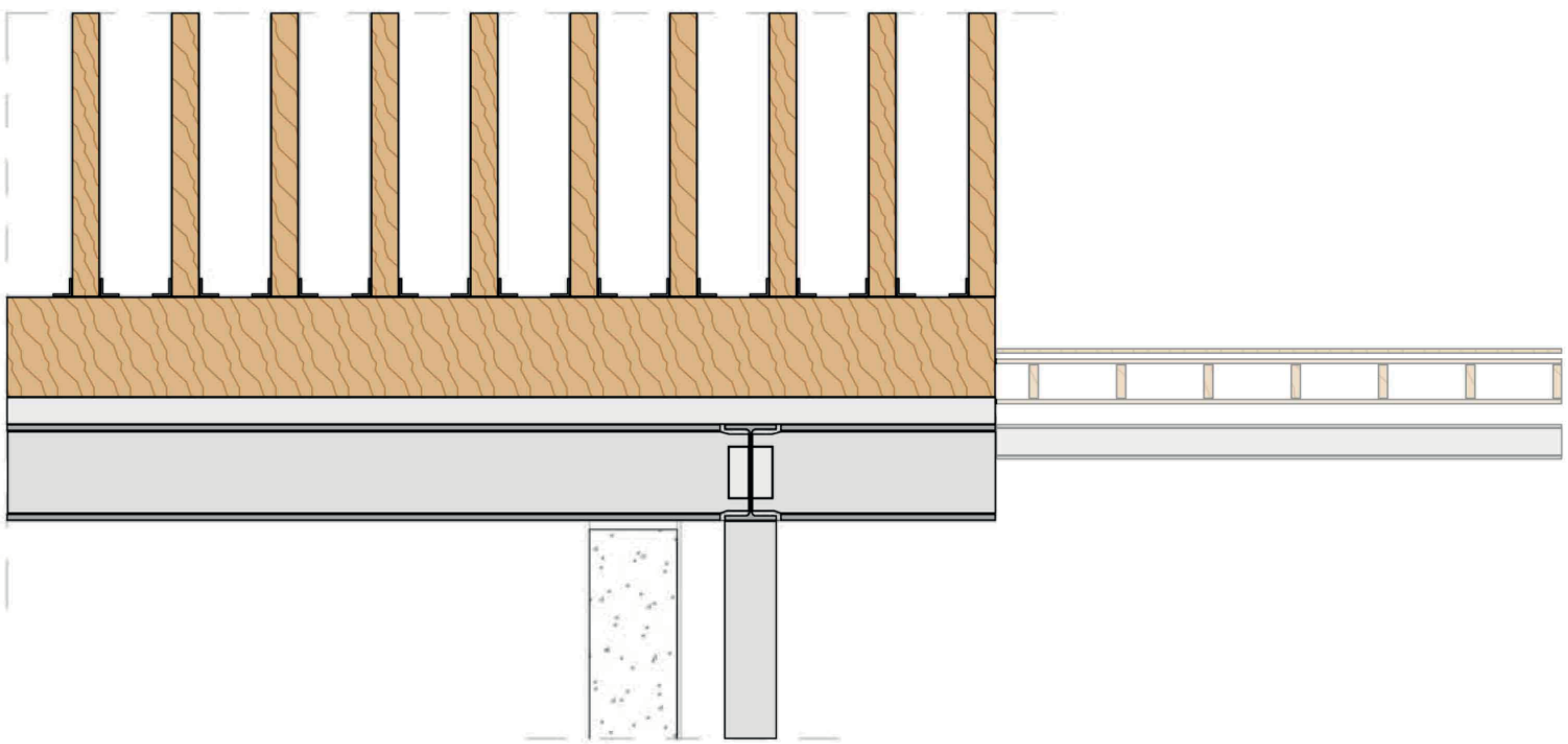
SOFTWOOD GLULAM (EN1194)	
Type	GL36h
Flexion $f_{m,g,k}$	36
Characteristic density $\rho_{g,k}$	450

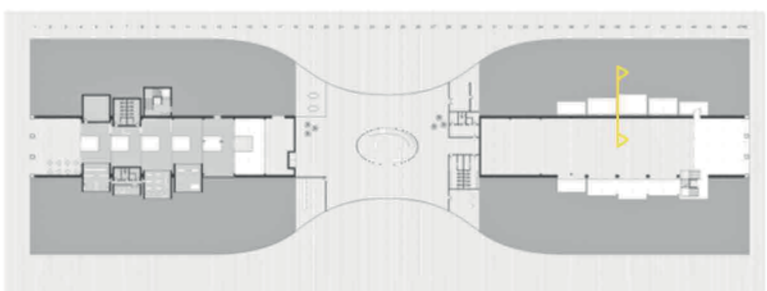
GEOMETRY	
	m
Primary beams span	8
Secondary beams span	8
Primary beams interax	4
Secondary beams interax	0.57



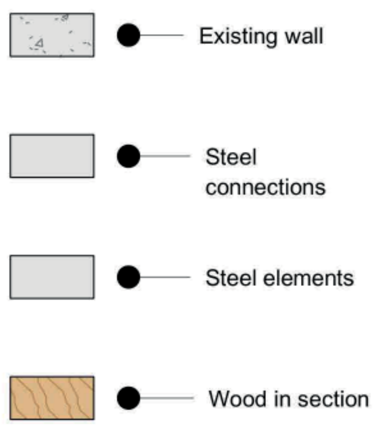
This section represents the connection between wood and steel structures of the boxes.
Is also possible see the relationship between old and new elements.
The new structure was thought to work separately from the pre-existance, both to better distinguish them and to solve the problems related to seismic actions at the outset.

Structural section scale 1: 100

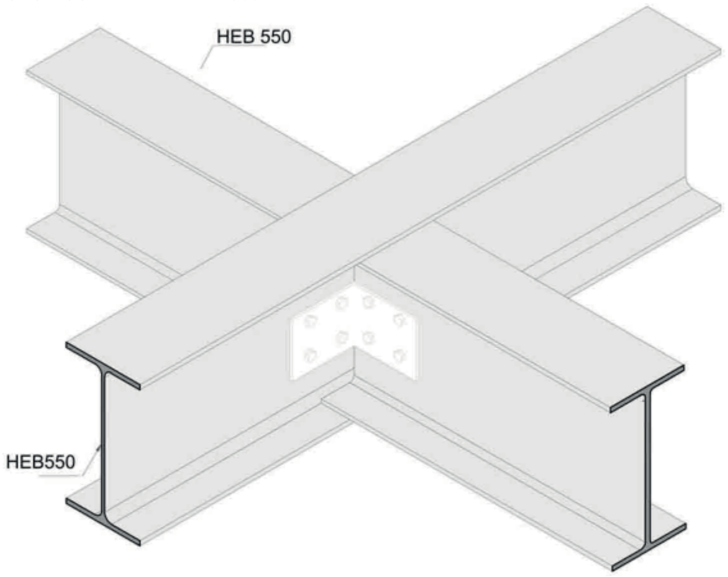




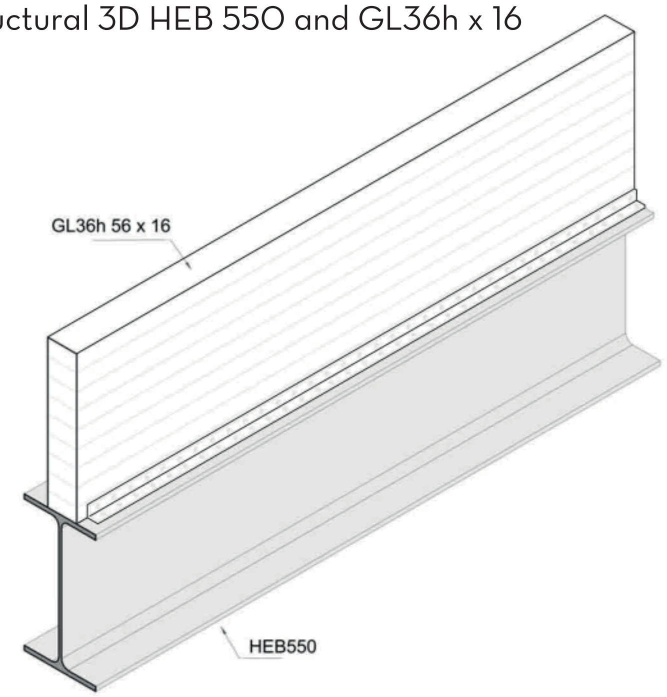
Legend



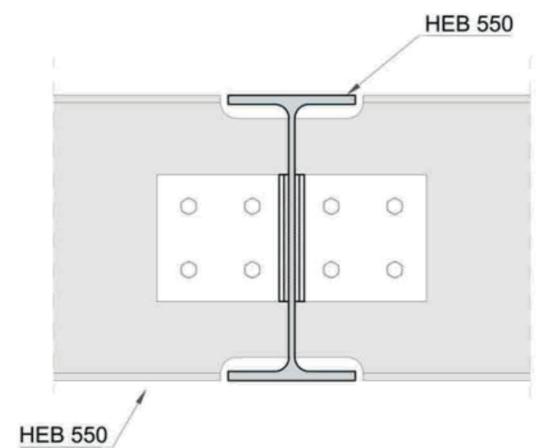
Structural 3D of two HEB 550



Structural 3D HEB 550 and GL36h x 16



Structural elevation of two HEB 550

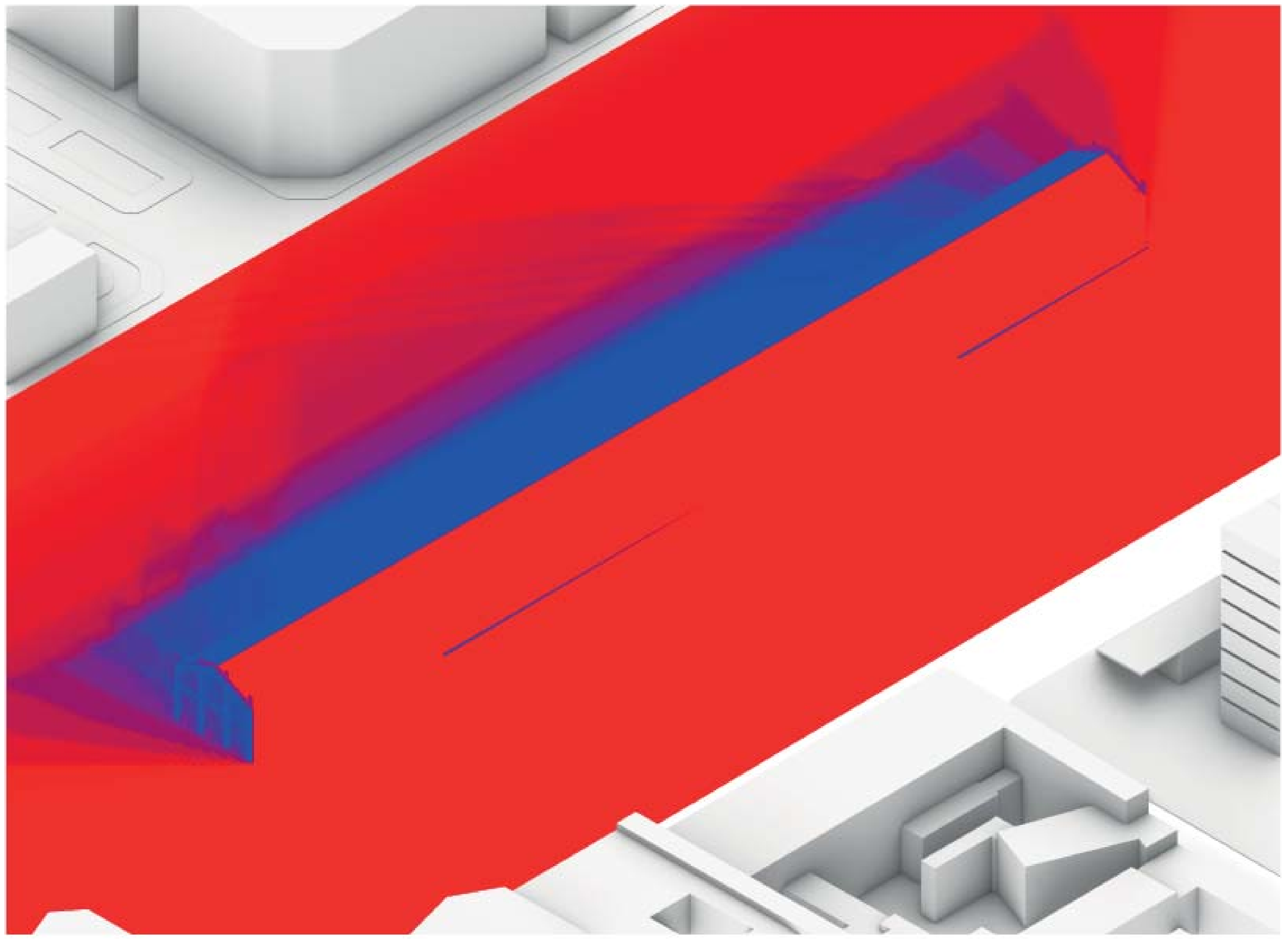


ENERGETIC PROJECT

DAYLIGHT, ILLUMINANCE, SHADINGS, ENERGY PRODUCTION

ANNUAL DAYLIGHT HOURS - DECEMBER

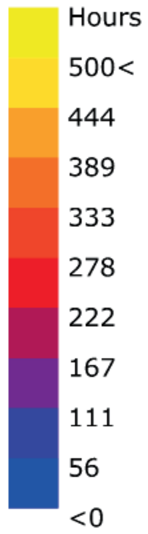
State of affairs



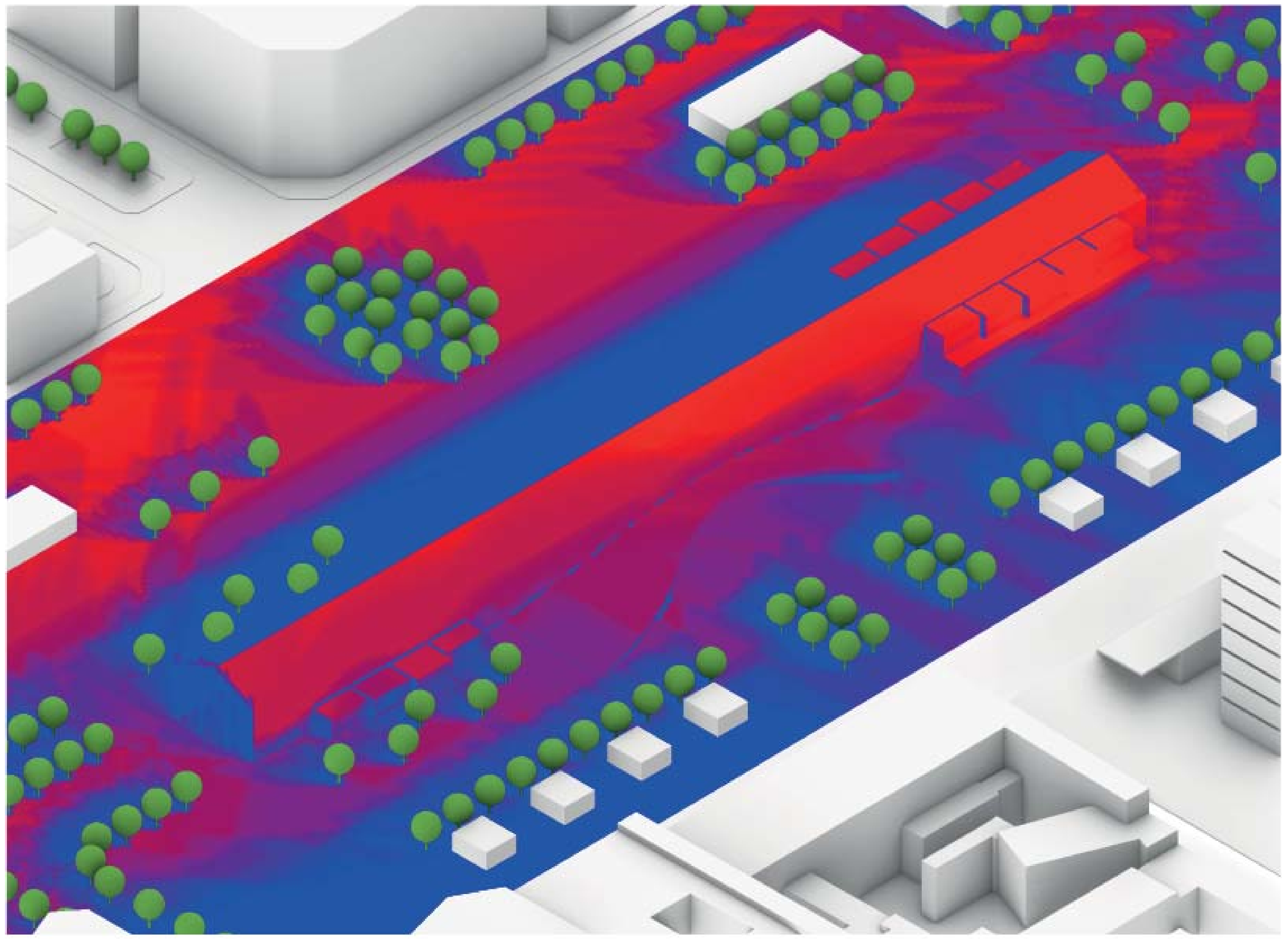
Axonometric View

Plan View

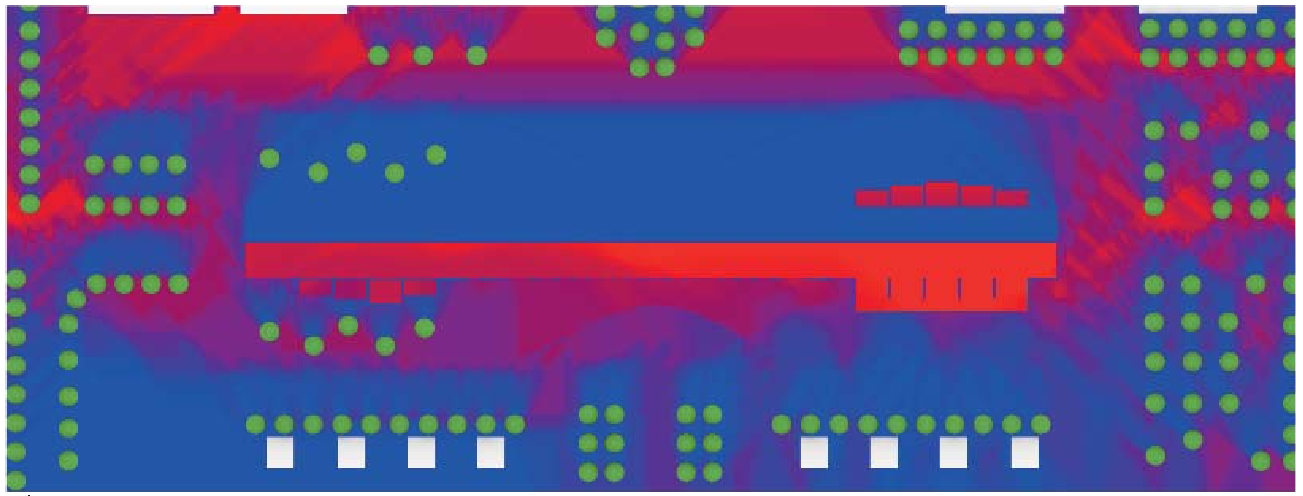
During the shortest month of the year we can observe, from the monthly analysis, how the site was affected by the sunlight in the previous state with an empty surroundings. We can clearly see that the building itself is the only shading element of the site in fact only the part on the back and the western faca de have just few hours of sun during the month of December.
This situation isn’t problematic during winter but will give some problems expecially in summer.



State of project



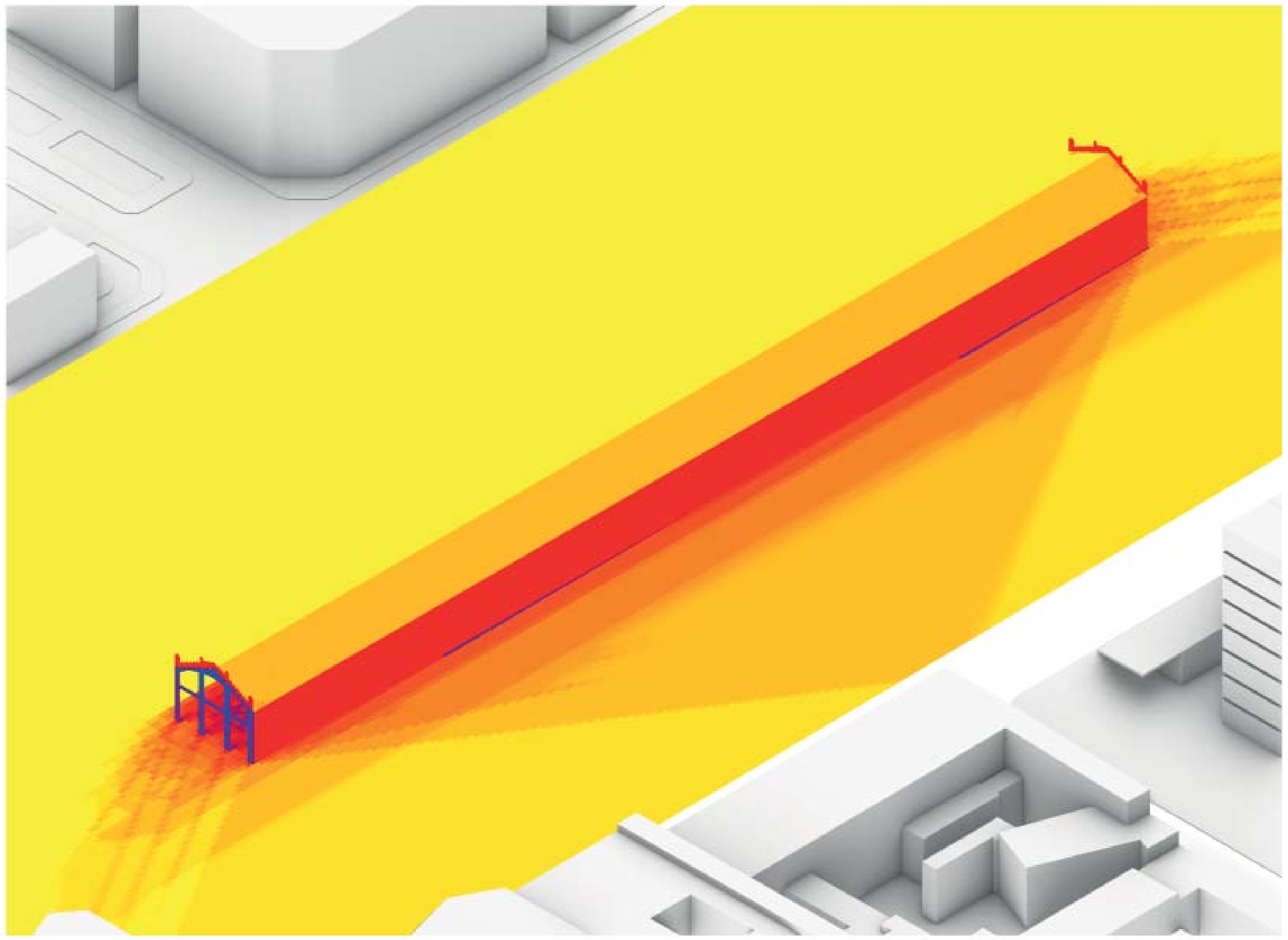
Axonometric View



Plan View

In this case, we analysed the state of project and we can observe how the added elemen-ts such as the trees, the curved green roof and the small buildings around reduces the sunlight hours on the pavement and on some parts of the building itself.
This could be seen as a worsening compared to the previous scenario but this choices work expecially in summer that is the most problematic period for the outdoor comfort.

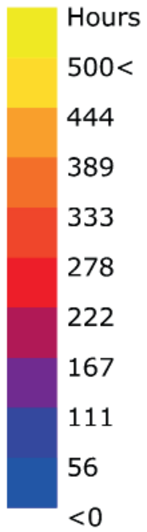
State of affairs



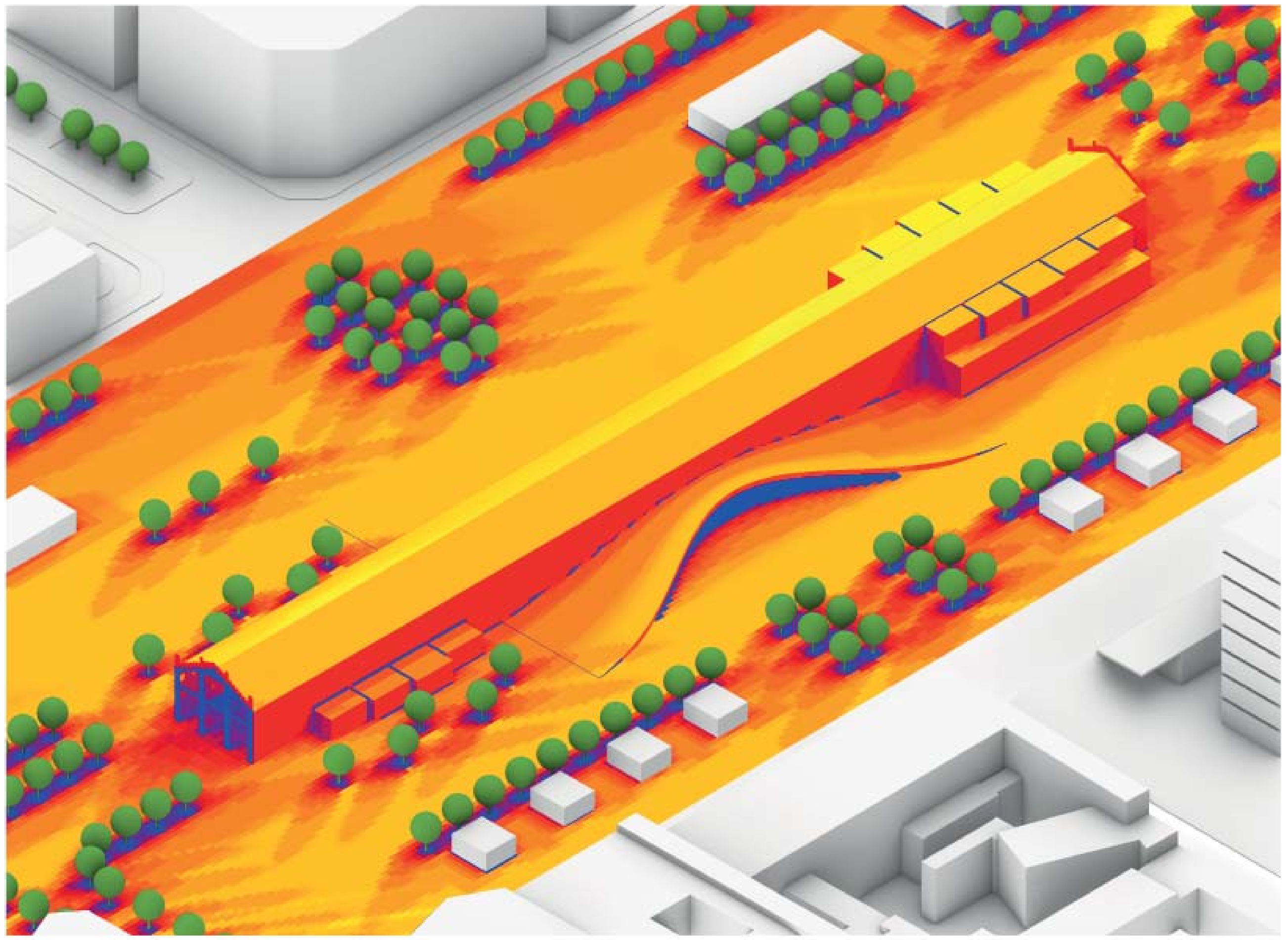
Axonometric View

Plan View

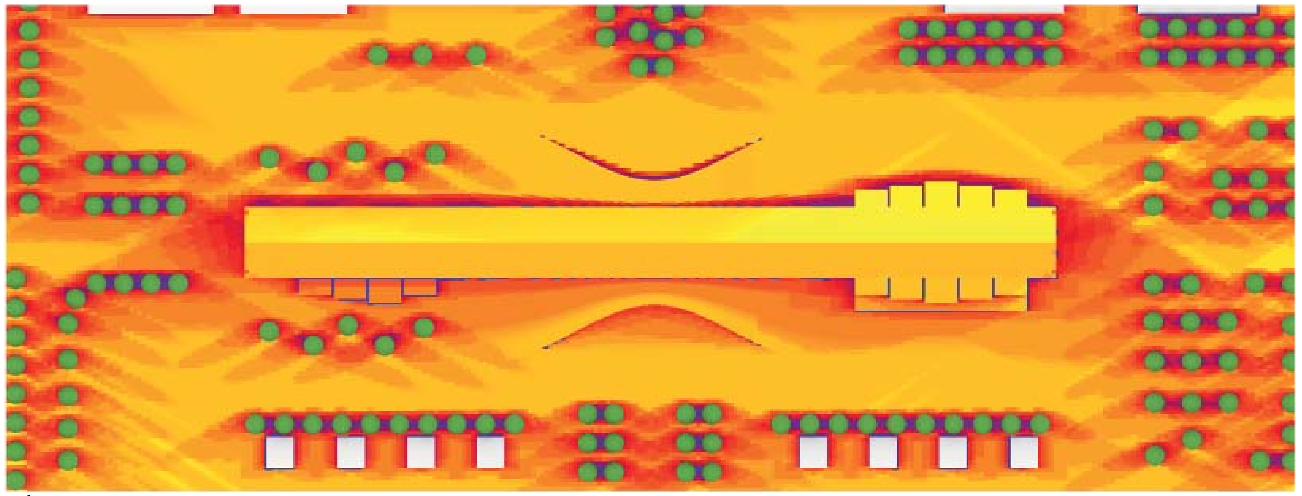
The scenario is the opposite of the winter one, in fact the southern part have less hours of sun because the building bring hadows during the morning, while the western facade remain in the same condition.
This analysis shows clearly that during this period the site is totally oversunlit, so our design decisions were taken trying to reduce the amount of direct sun on the surroundings.



State of project



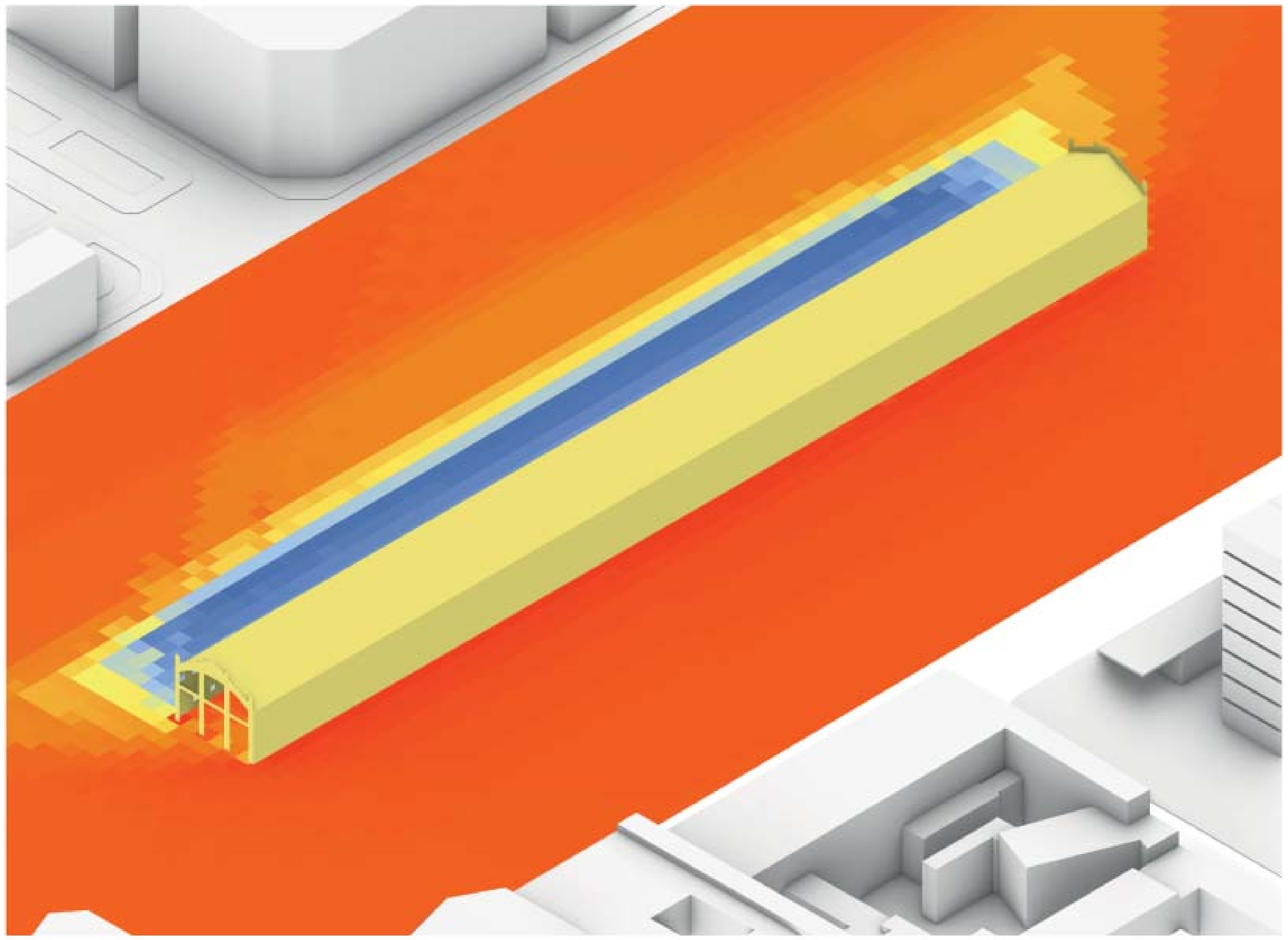
Axonometric View



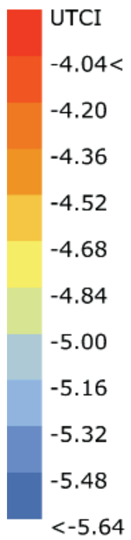
Plan View

The addition of shading elements such as the trees, the curved roof and the design of the new parts of the building itself, changed totally the amount of the sun hours on the surface, creating different shading areas and improving the feeling of the people.

State of affairs



Axonometric View



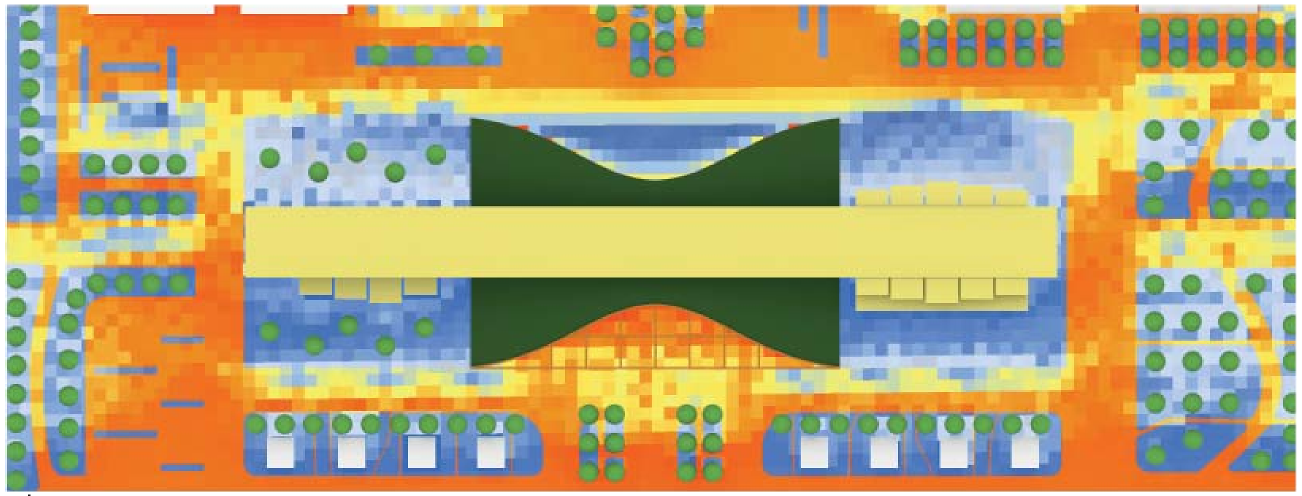
Plan View

The outdoor comfort of the coldest week of the year in this scenario is given mostly by the sunligth.
Actually it is difficult to improve the UTCI index during the winter period.

UTCI (°C)	Stress category
UTCI > 46	extreme heat stress
38 < UTCI < 46	very strong heat stress
32 < UTCI < 38	strong heat stress
26 < UTCI < 32	moderate heat stress
9 < UTCI < 26	no thermal stress
0 < UTCI < 9	slight cold stress
-13 < UTCI < 0	moderate cold stress
-27 < UTCI < -13	strong cold stress
-40 < UTCI < -27	very strong cold stress
UTCI < -40	extreme cold stress

State of project

Axonometric View

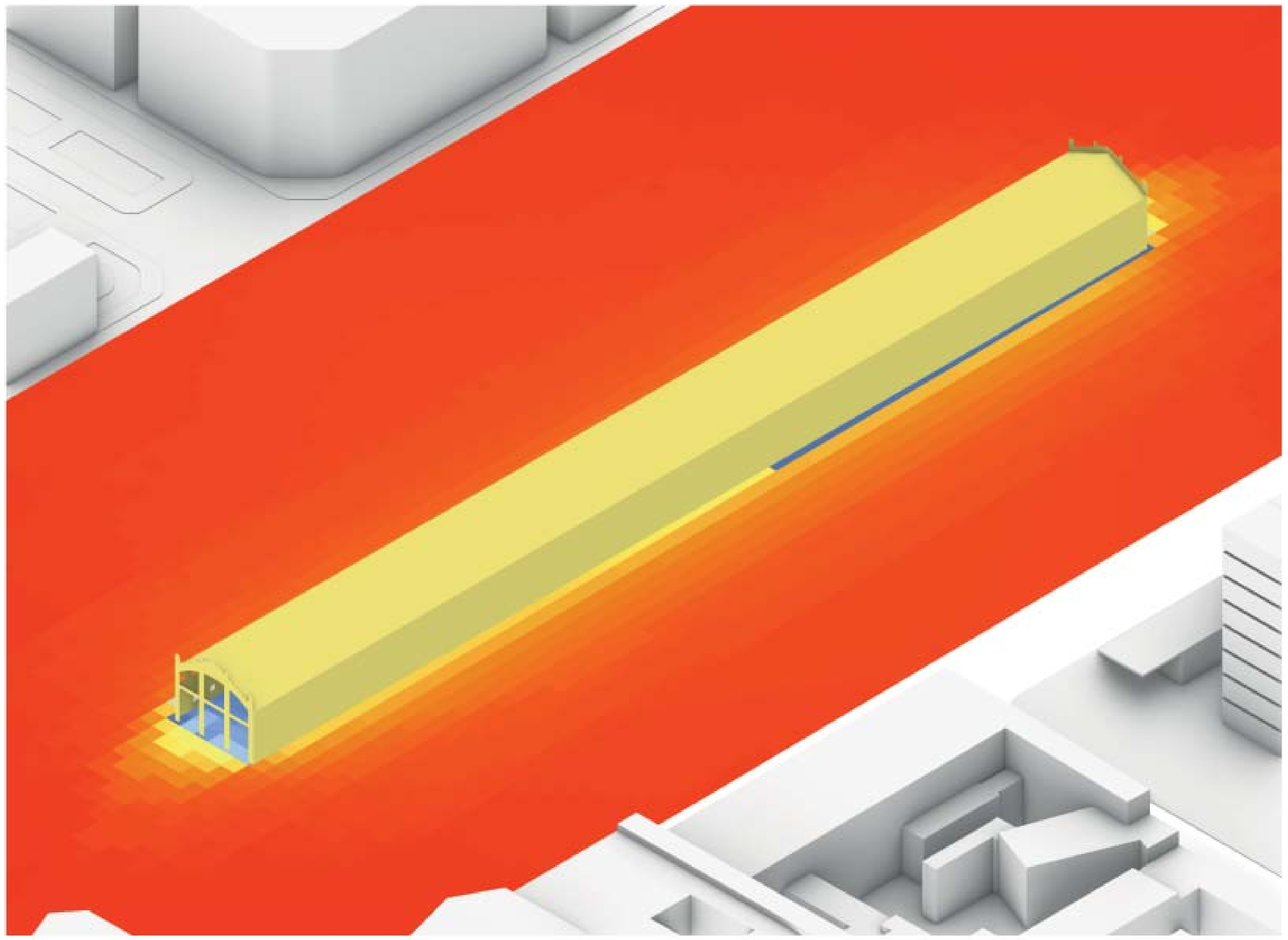


Plan View

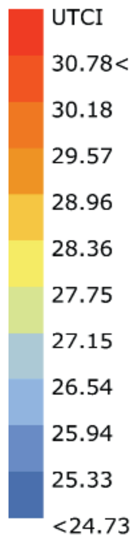
The addition of the shading elements, such as trees, the curved green roof, the parts of the building itself and the greenery in winter time is not so effective during winter time because it reduces the UTCI index.
We will see bigger improvements during the month of June.

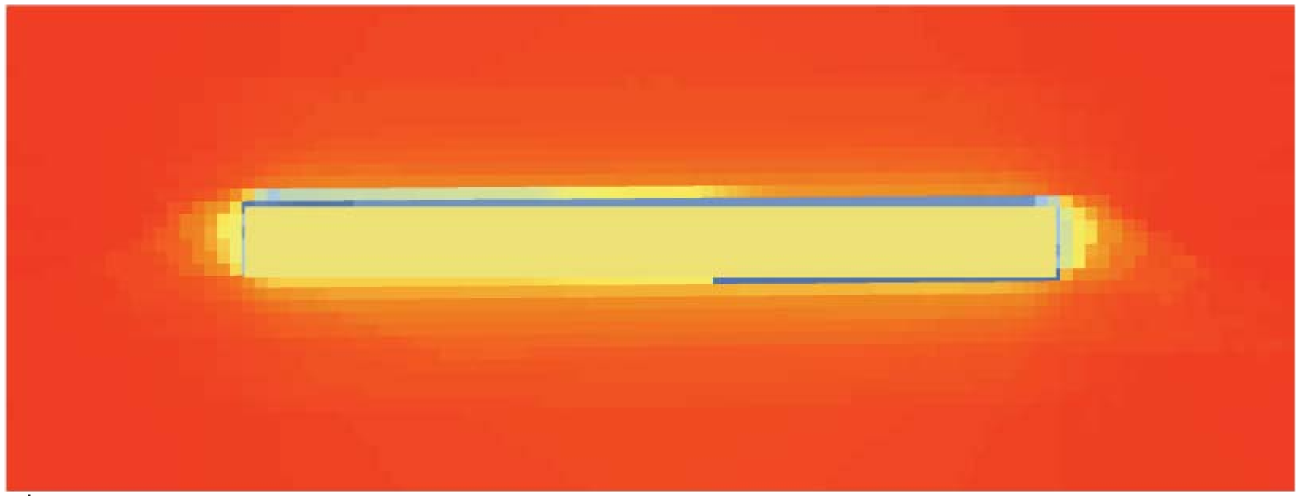
HOTTEST WEEK OF THE YEAR - OUTDOOR COMFORT ANALYSIS - UTCI INDEX

State of affairs



Axonometric View

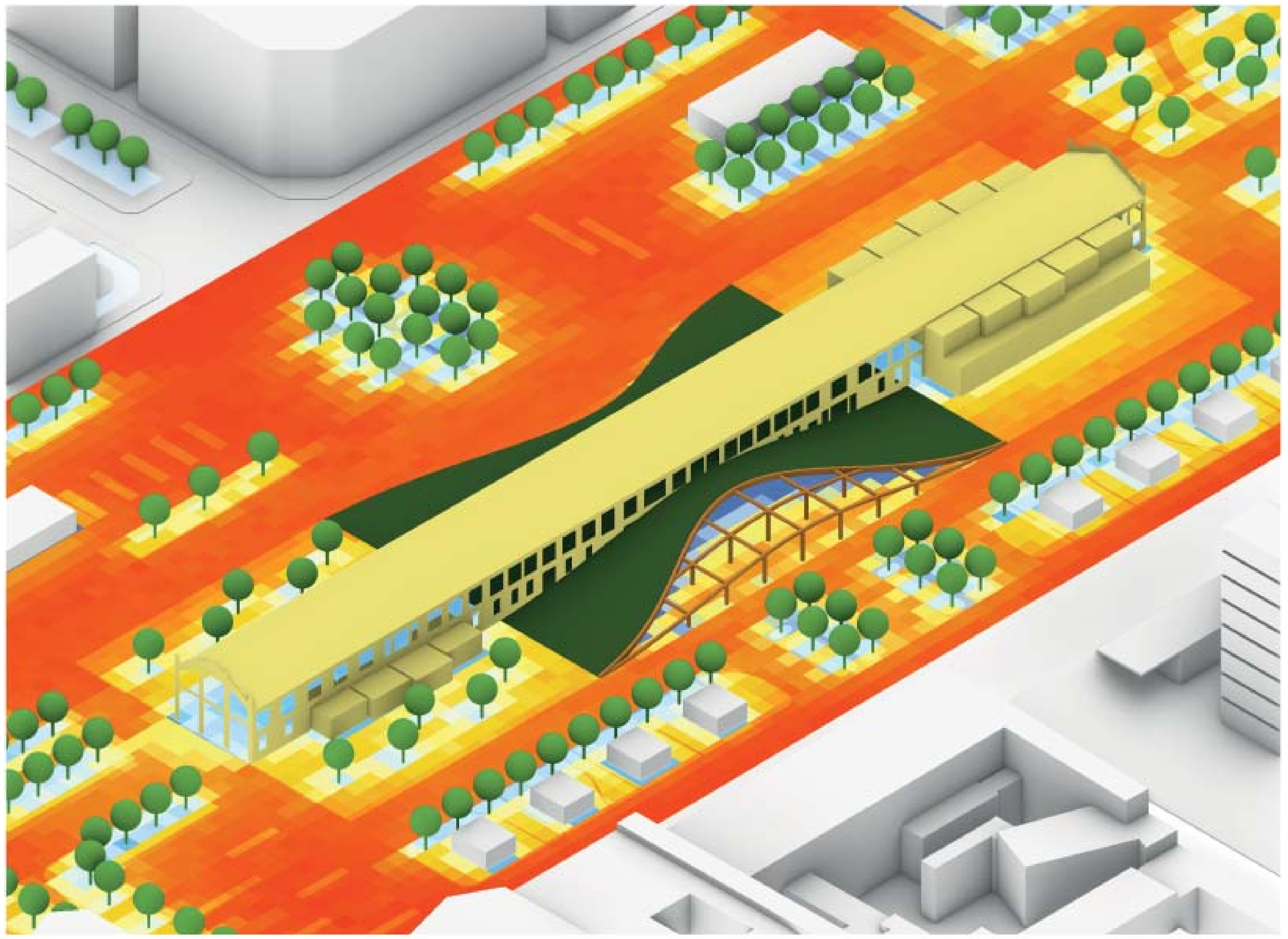




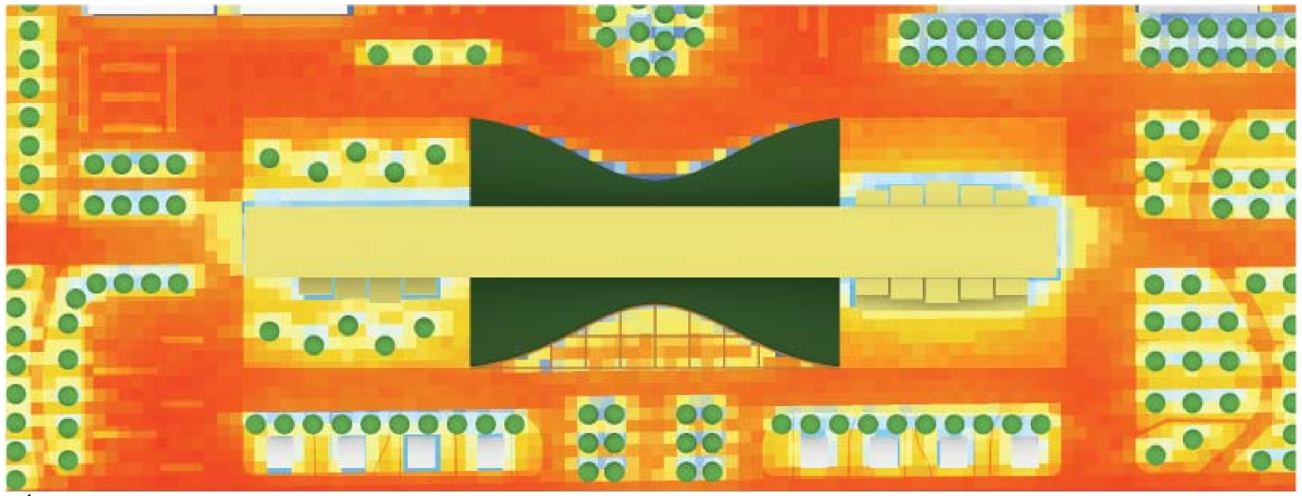
Plan View

The outdoor comfort during the hottest week of the year reaches critical levels on our project site.
The addition of shading elements is necessary to decrease the UTCI index,

State of project



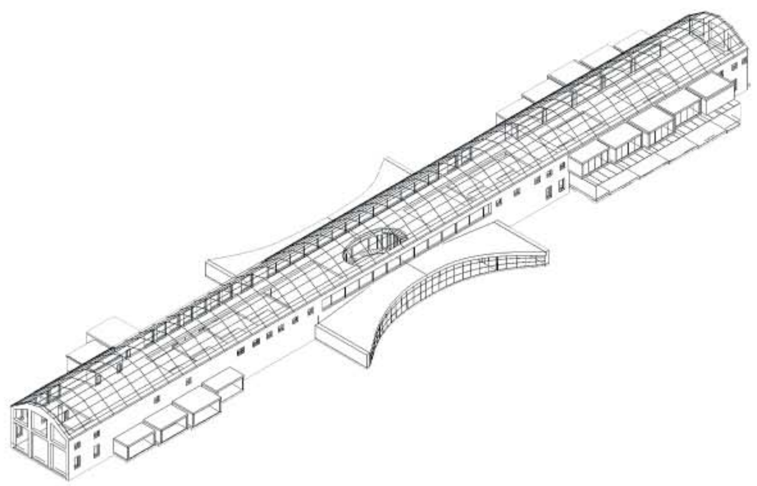
Axonometric View



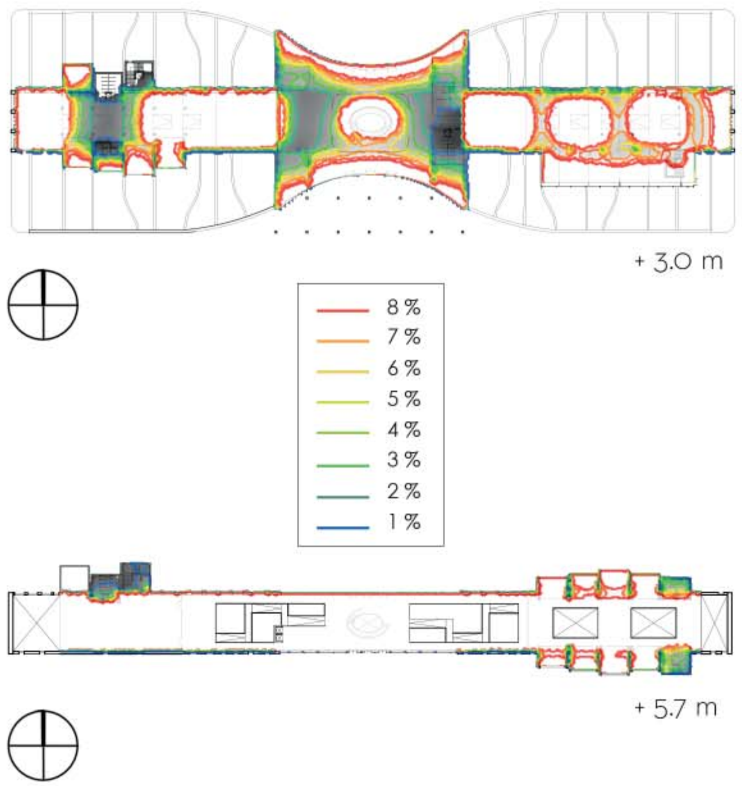
Plan View

The outdoor design choices are mostly related to the improvement of the outdoor comfort.
The natural elements are used reduce the UTCI index locally with the help of the green areas thanks to the evaportranspiration of the soil.

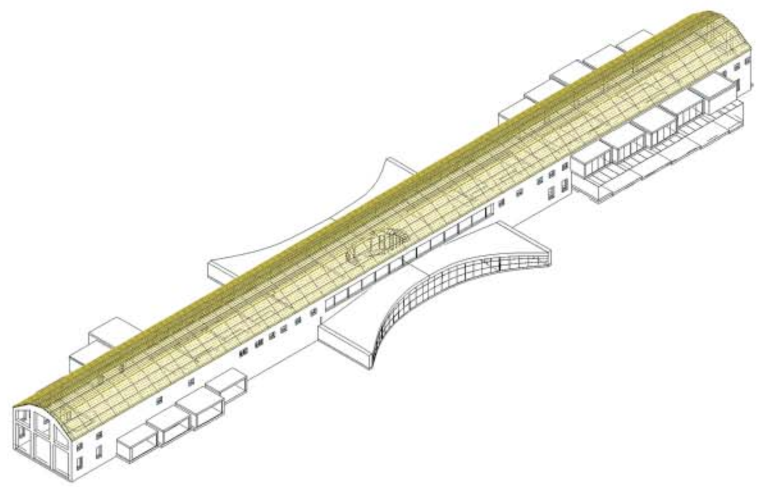
Complitely glazed roof



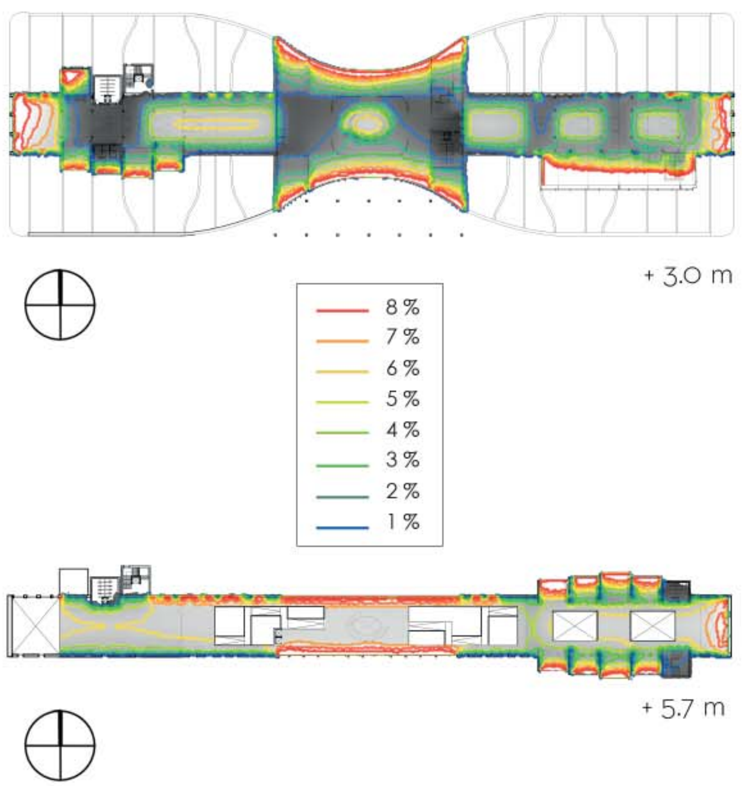
The first attempt was done on a roof complitely glazed to facilitate the entry of natural light for the greenery. From the plans it is visible the excessive amount of daylight hours especially on the upper floor where all the has Daylight factor is all above the treshold.



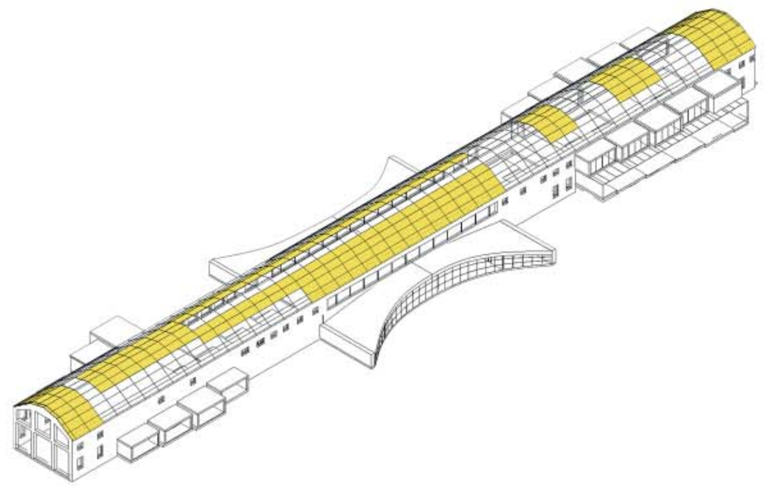
Shading strips on the roof



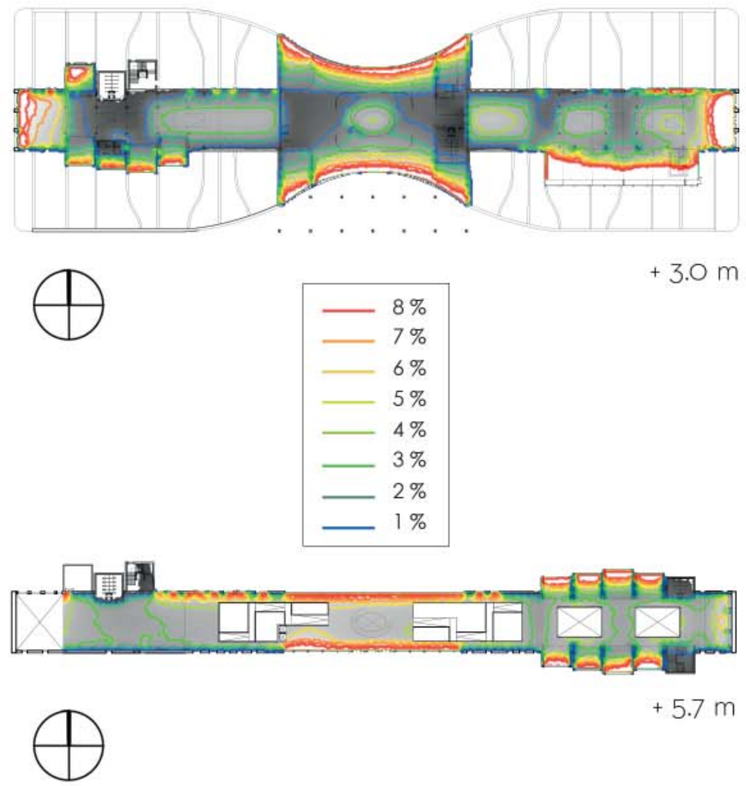
Since the values were to high, some shading strips were added all along the roof to reduce the glare.
Here we can see a big reduction of Daylight factor, reaching accettable values, exept for some areas.

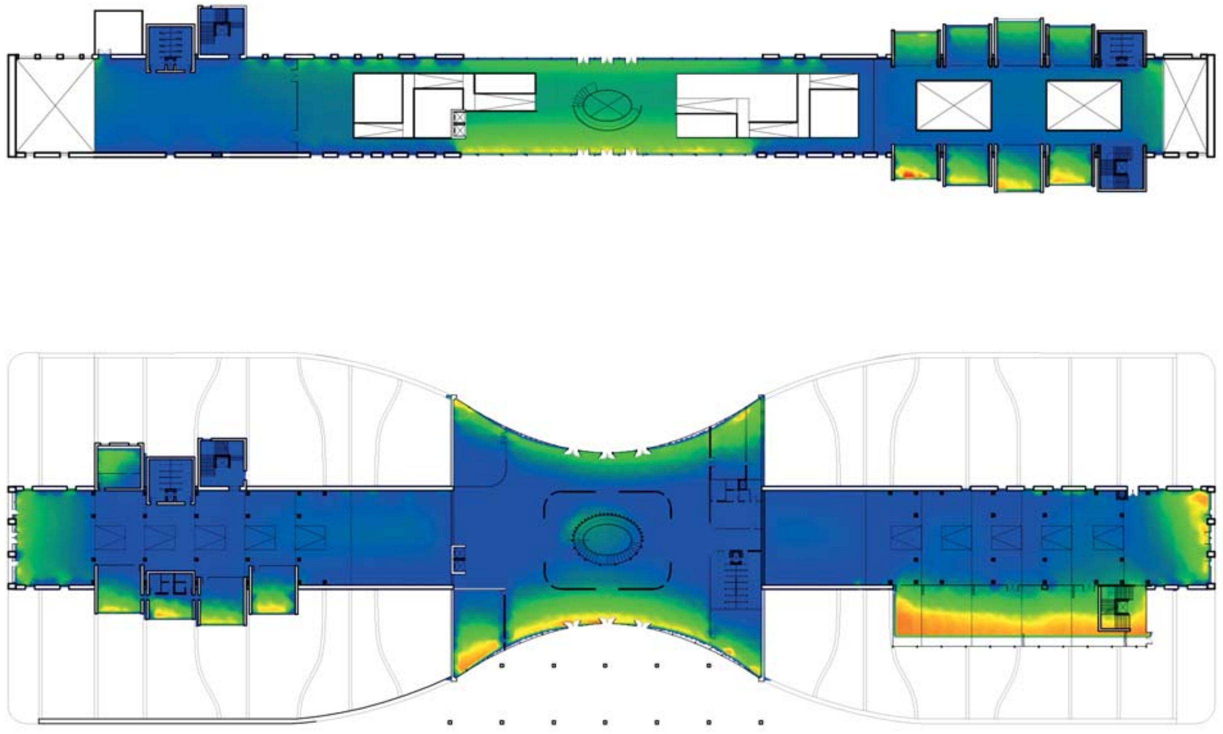


Addition of opaque panels

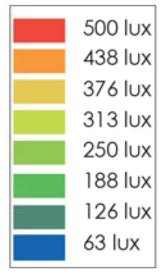


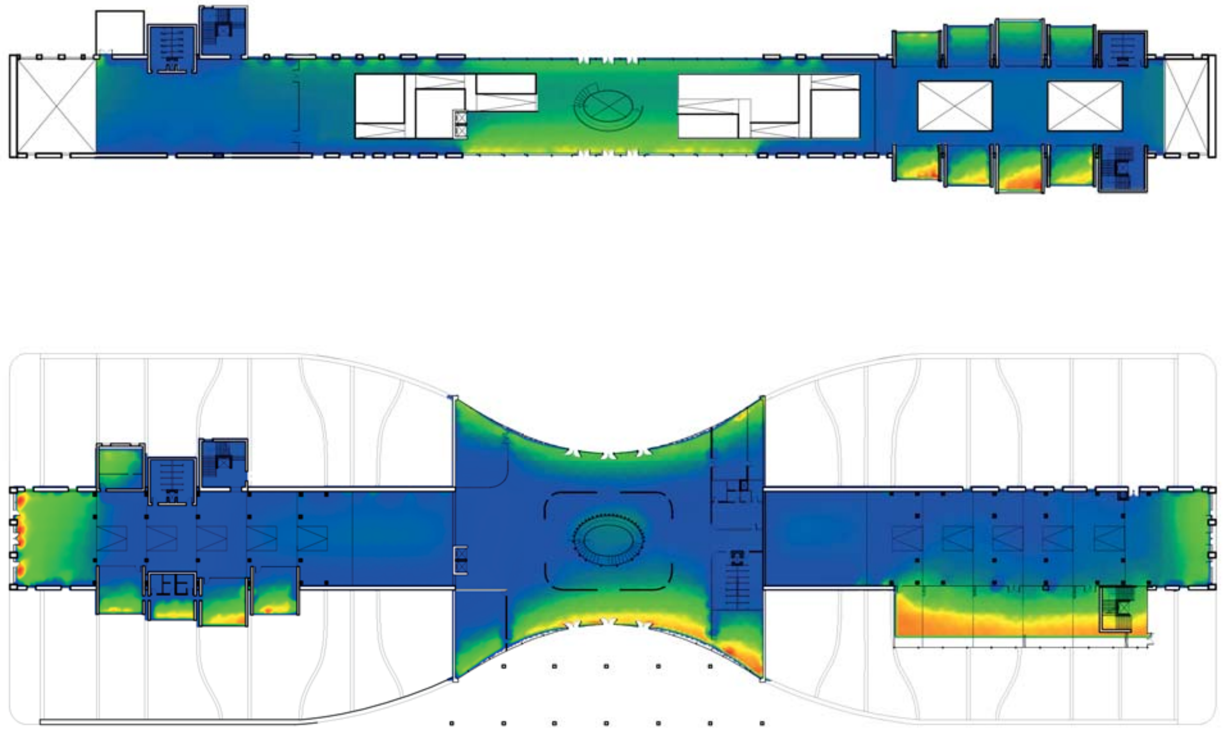
The last step was to replace some glass panels with opaque, sandwich panels. This was done in the areas where, due to the function, it was necessary to reduce eaven more the value.



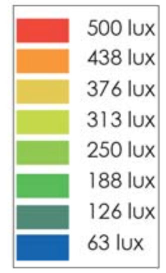


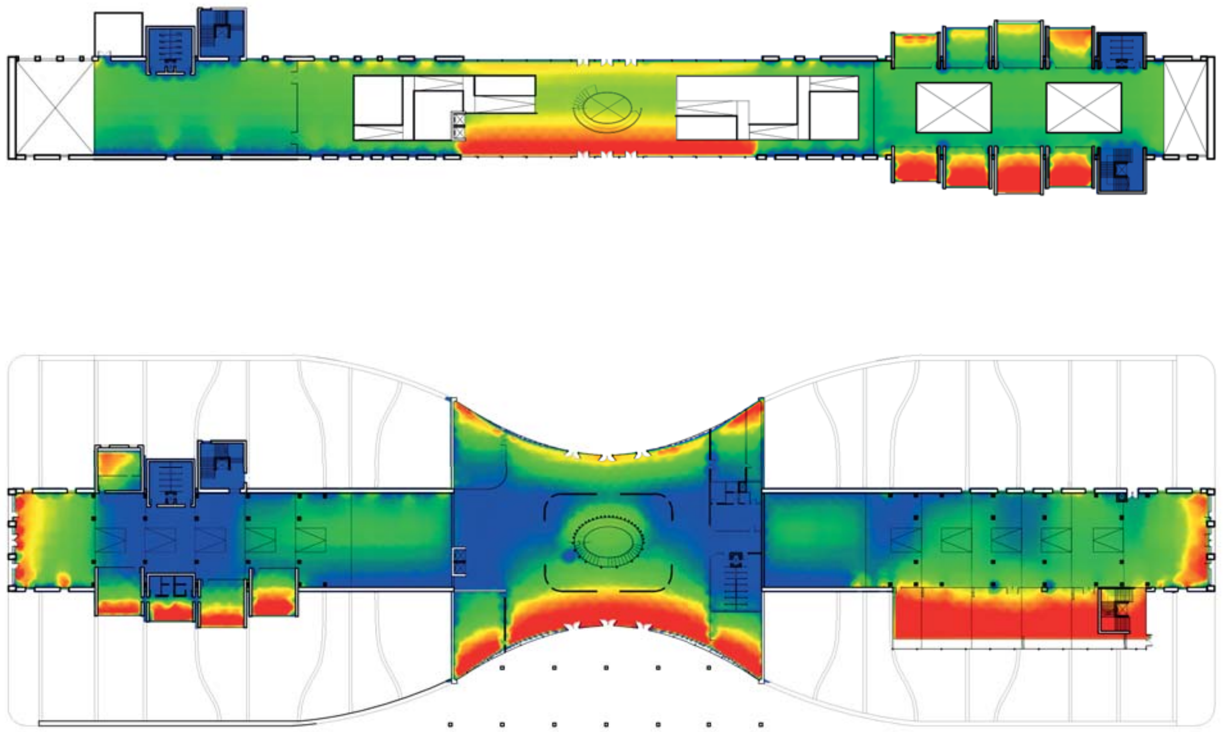
Illuminance (Lux) - 21 December h. 09.00
Clear Sky

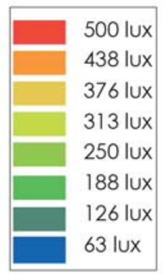




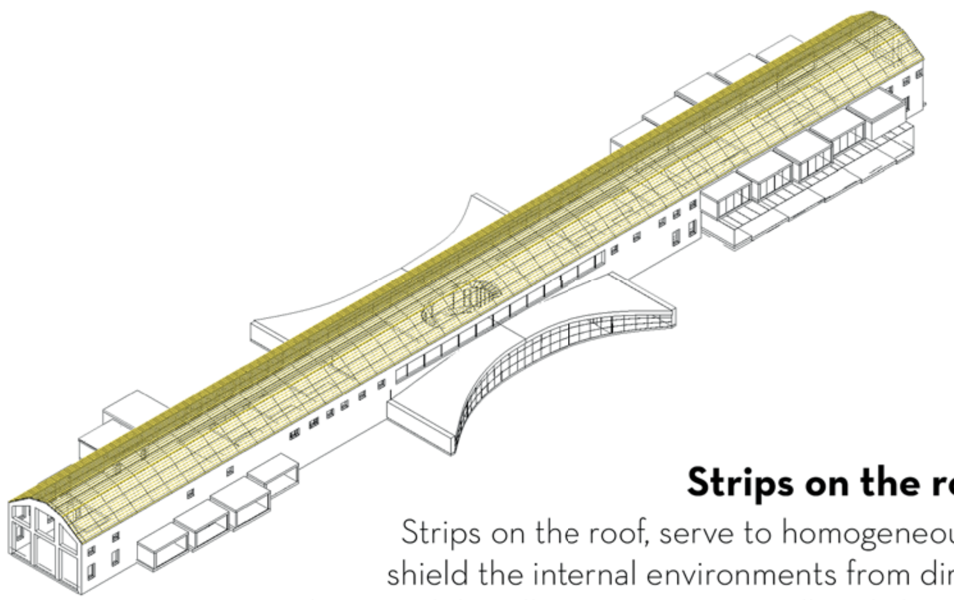
Illuminance (Lux) - 21 December h. 15.00
Clear Sky





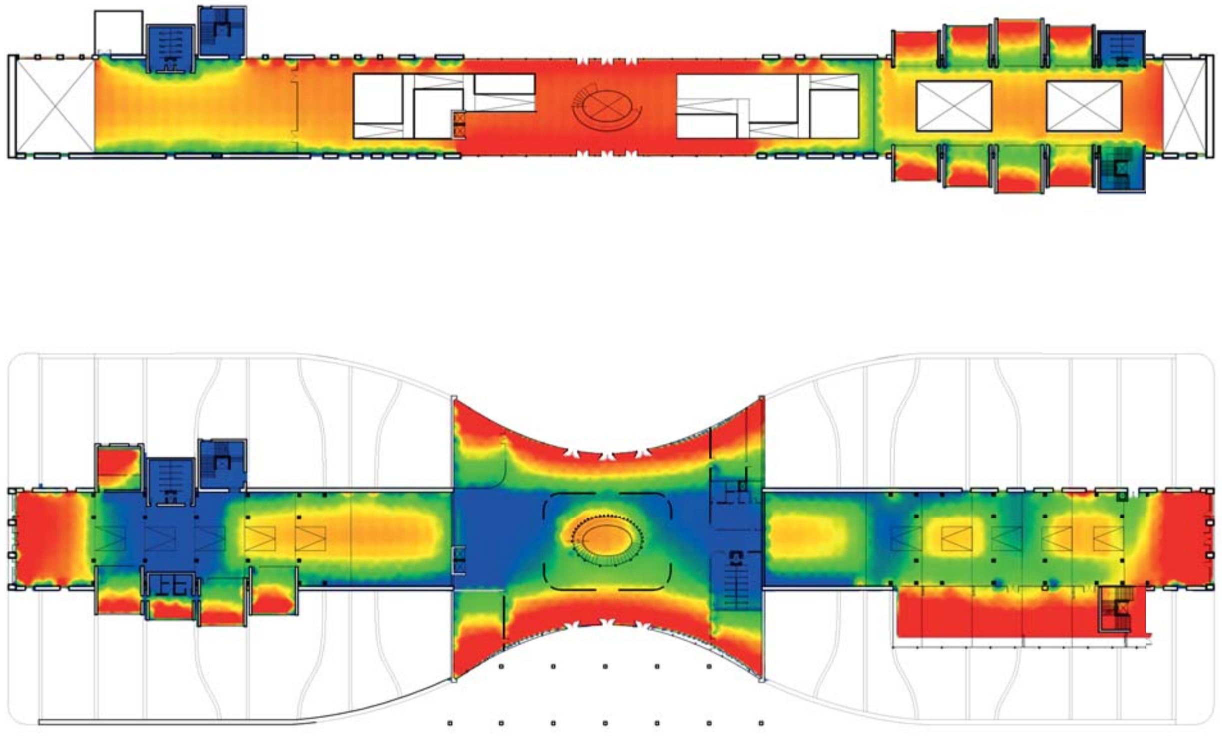


Illuminance (Lux) - 21 December h. 12.00
Clear Sky

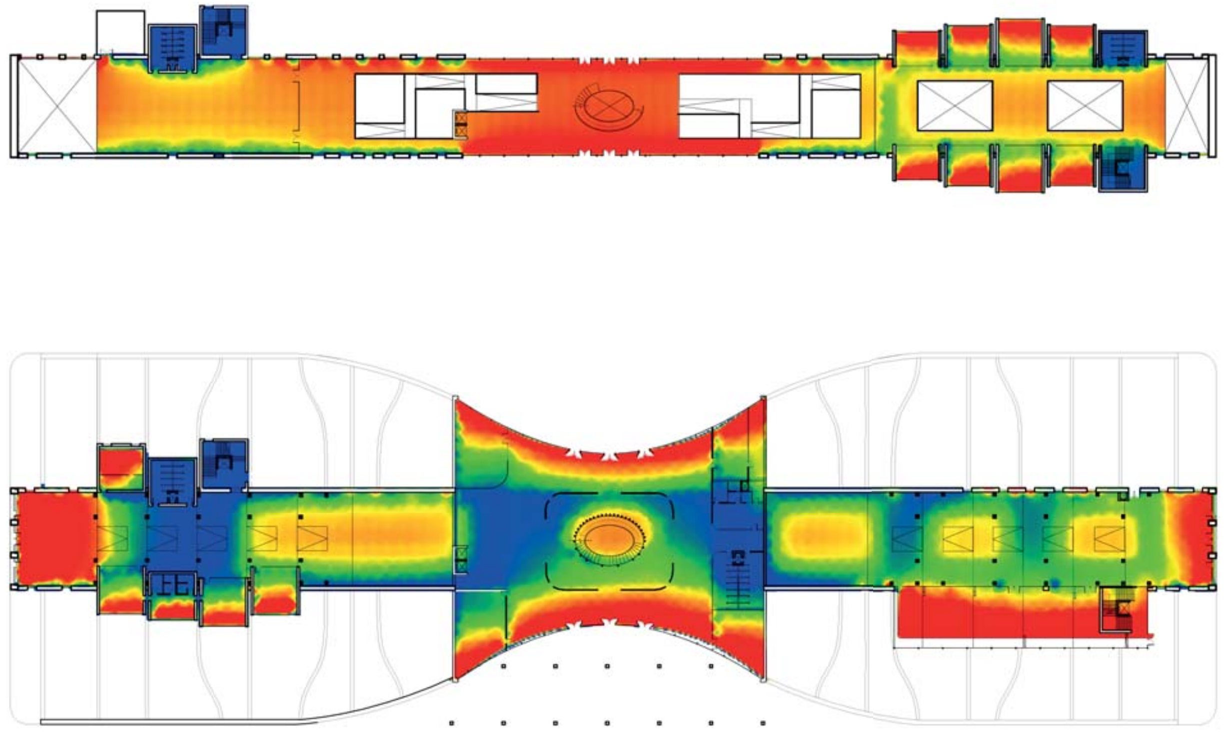


Strips on the roof

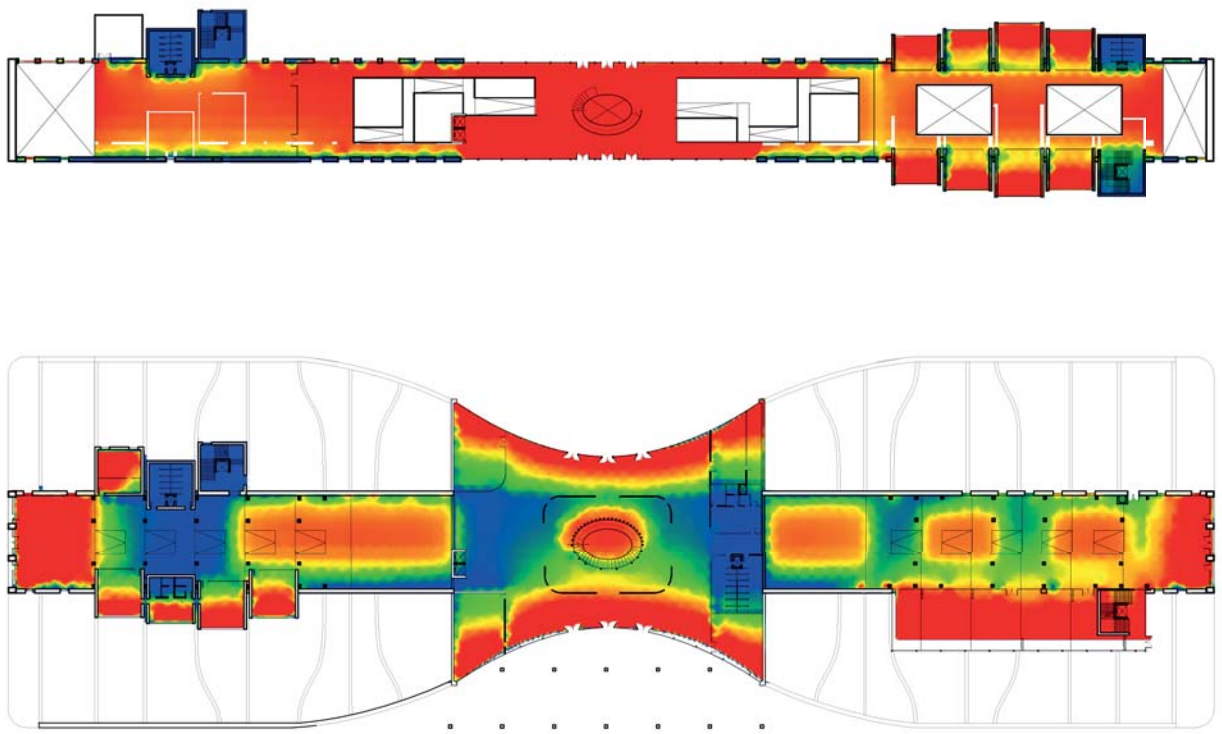
Strips on the roof, serve to homogeneously shield the internal environments from direct radiation, while still guaranteeing excellent light entry



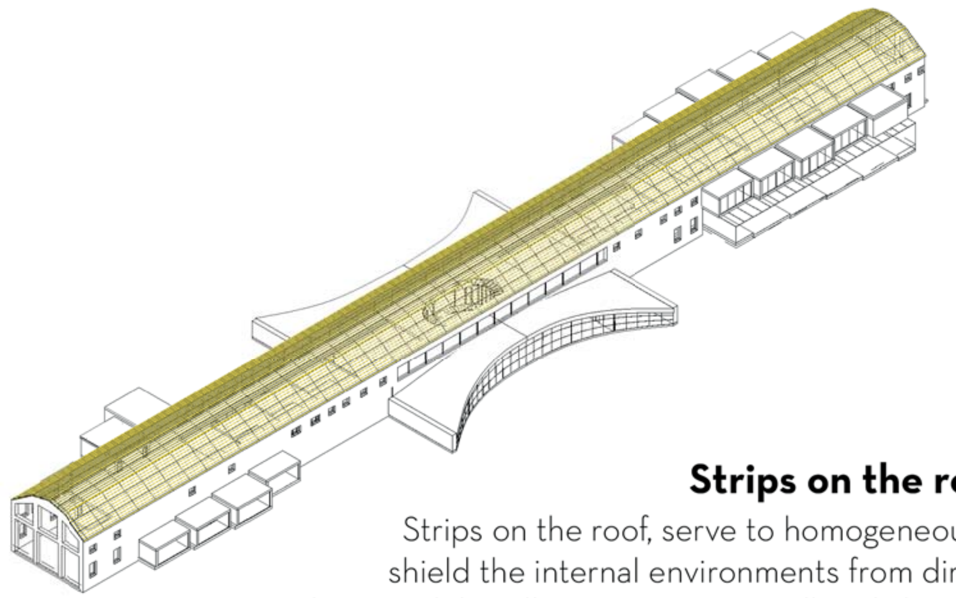
Illuminance (Lux) - 21 June h. 09.00
Clear Sky



Illuminance (Lux) - 21 June h. 15.00
Clear Sky



Illuminance (Lux) - 21 June h. 12.00
Clear Sky



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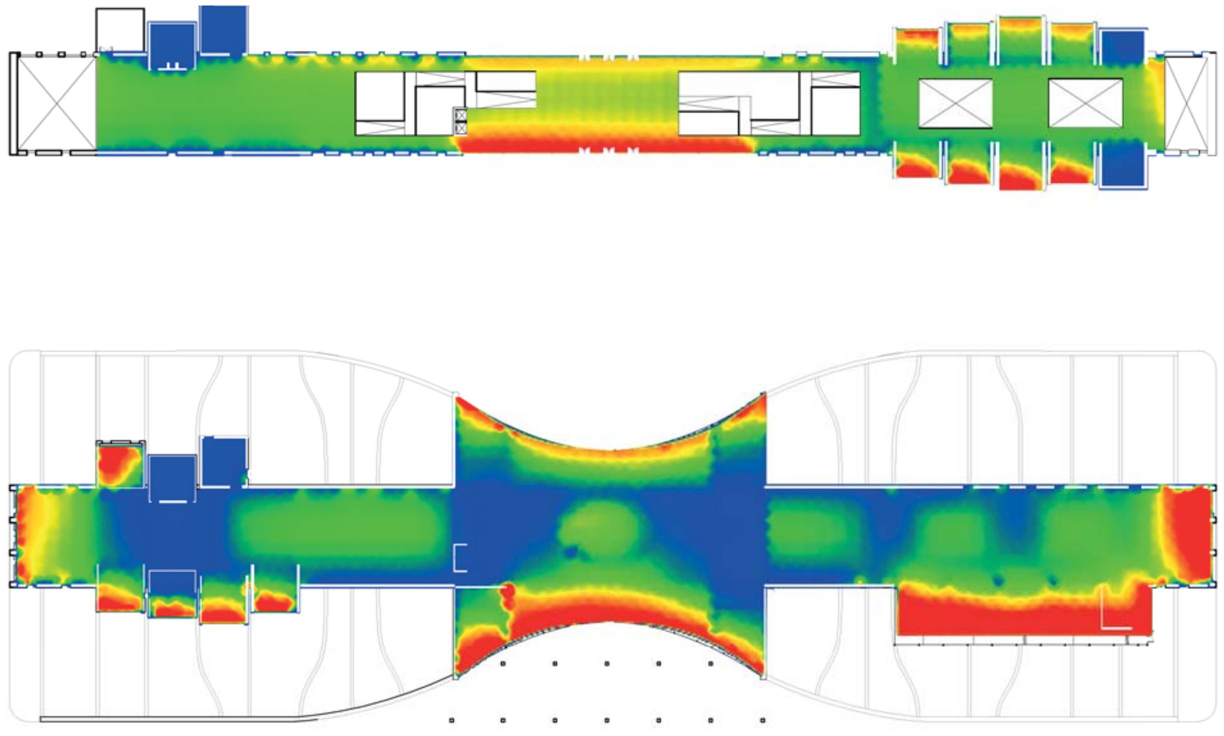
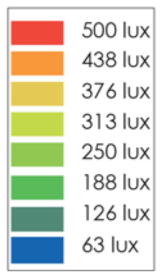
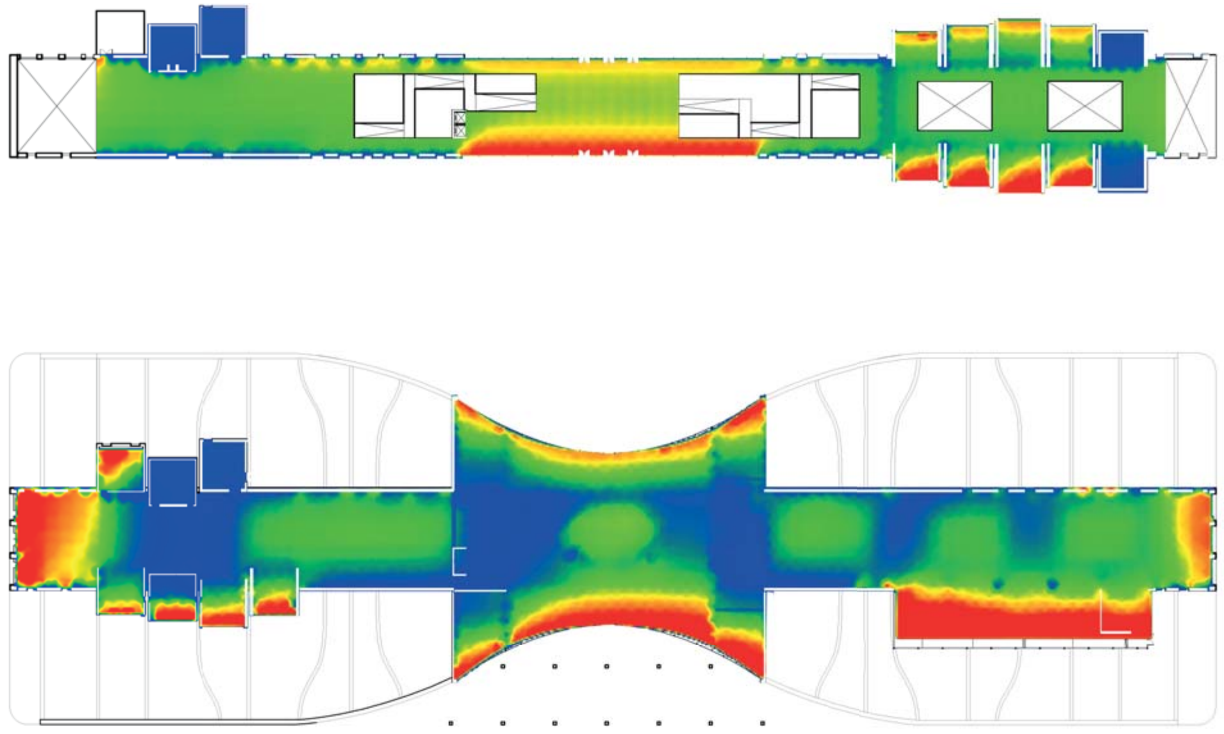
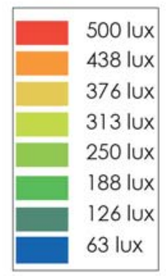


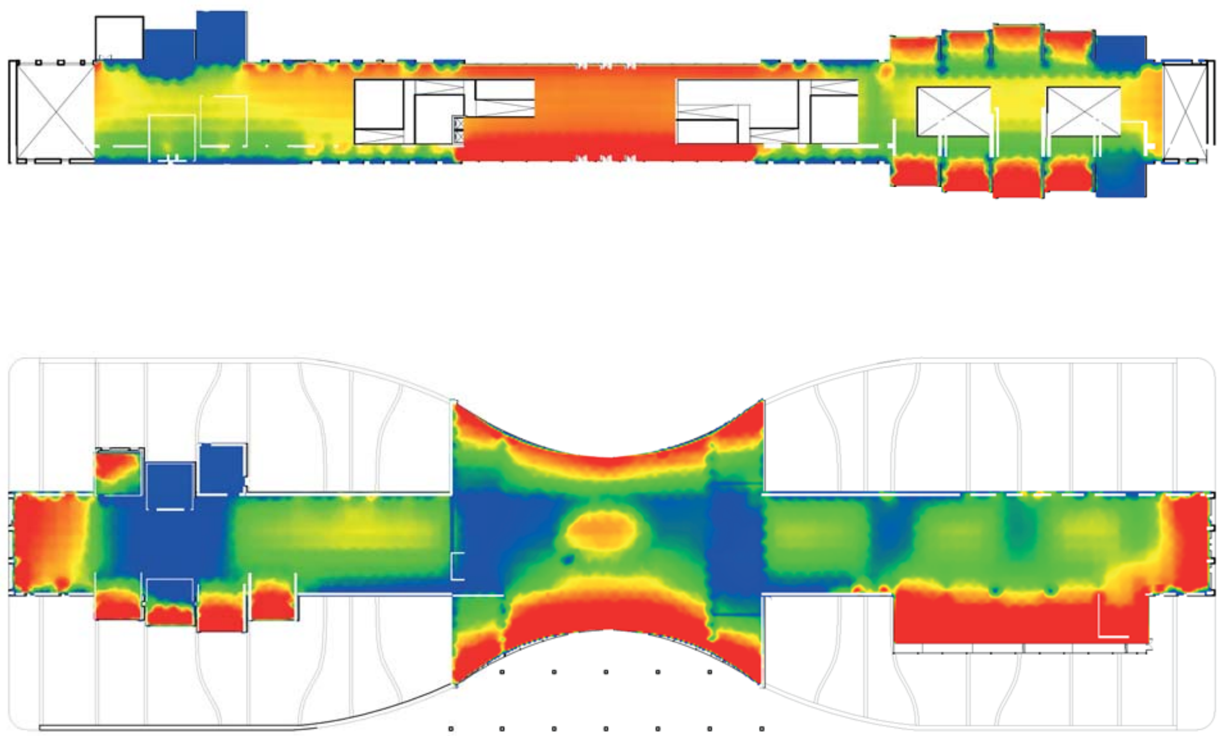


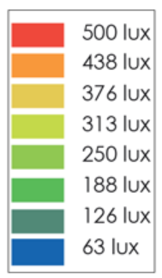
Illuminance (Lux) - 21 March h. 09.00
Clear Sky





Illuminance (Lux) - 21 March h. 15.00
Clear Sky





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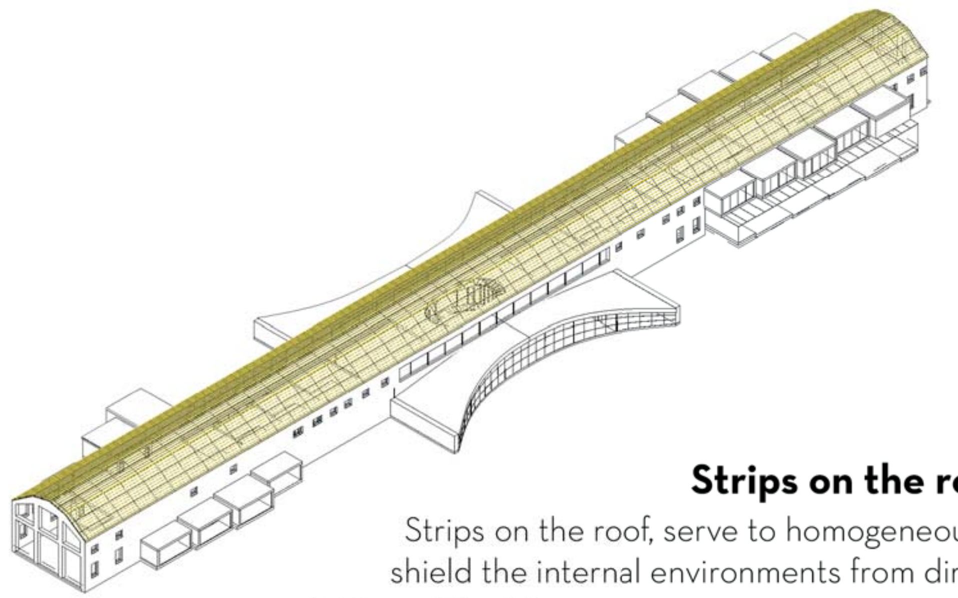
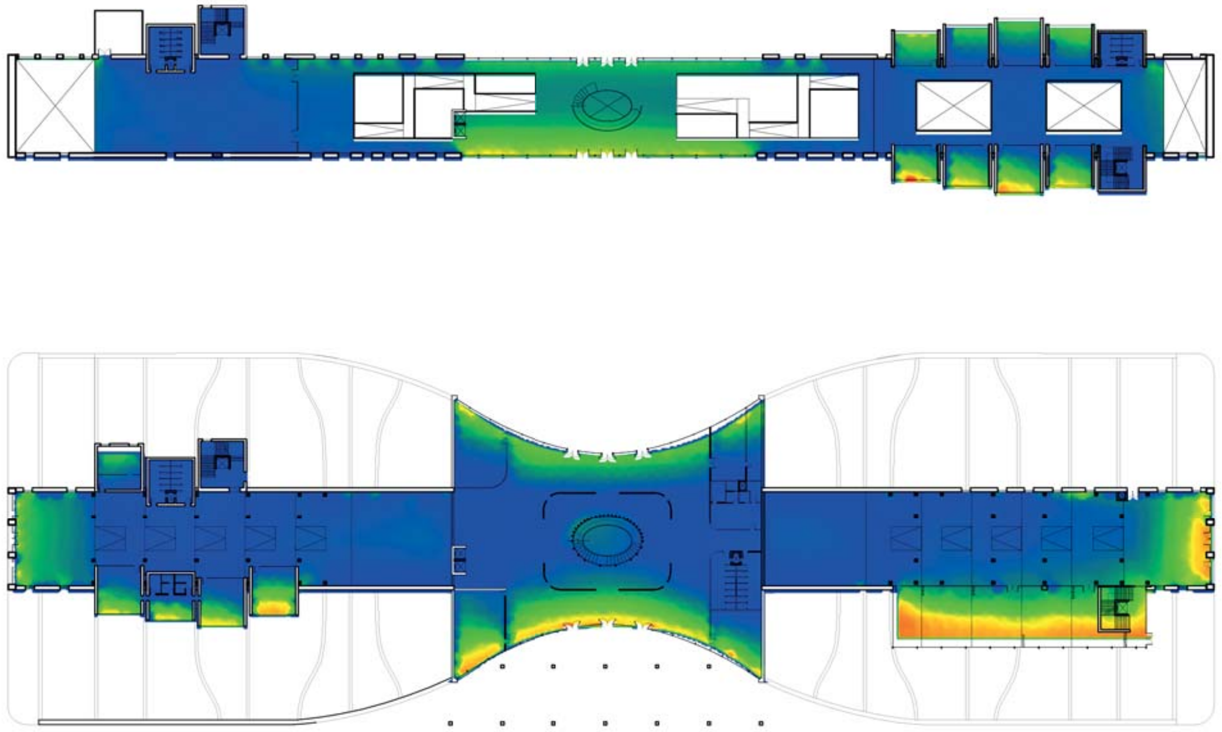


Strips on the roof

Strips on the roof, serve to homogeneously shield the internal environments from direct radiation, while still guaranteeing excellent light entry



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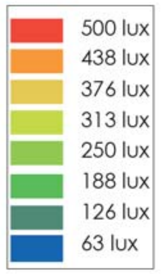
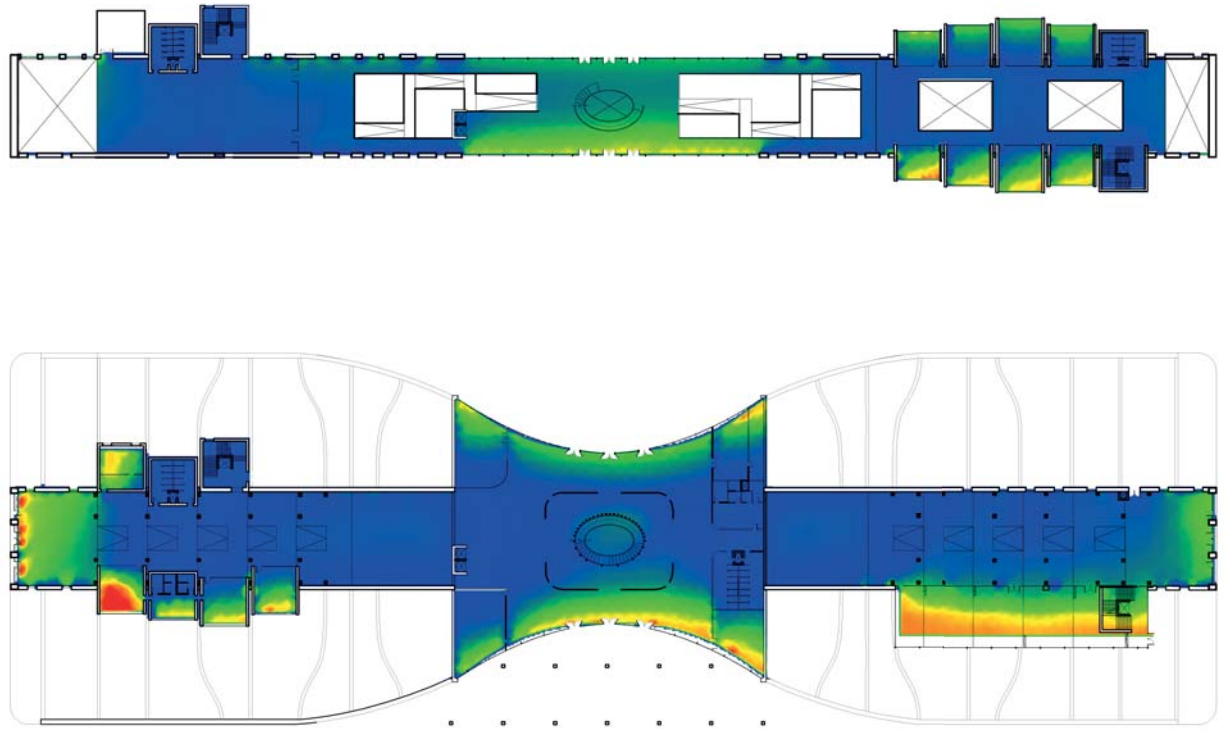
Clear Sky





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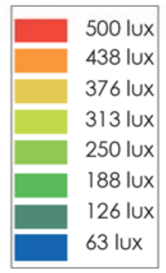
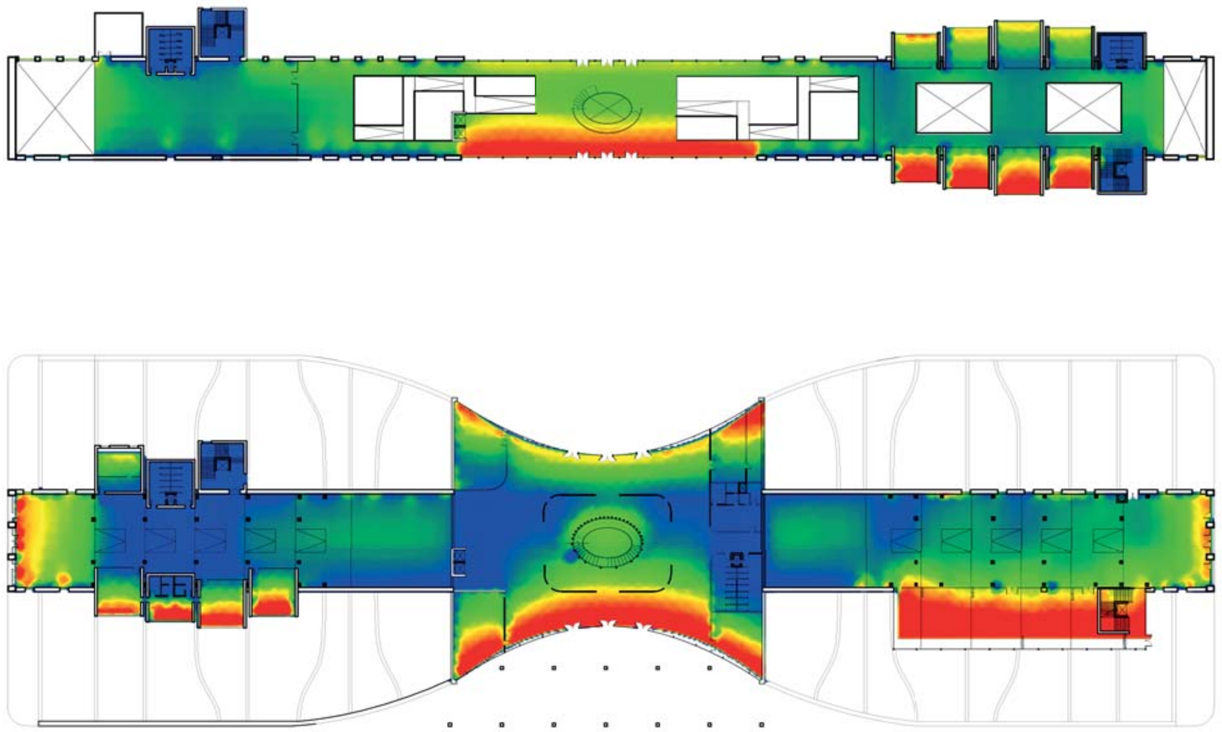
Clear Sky





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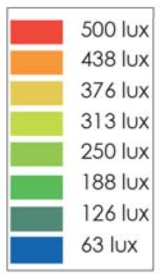
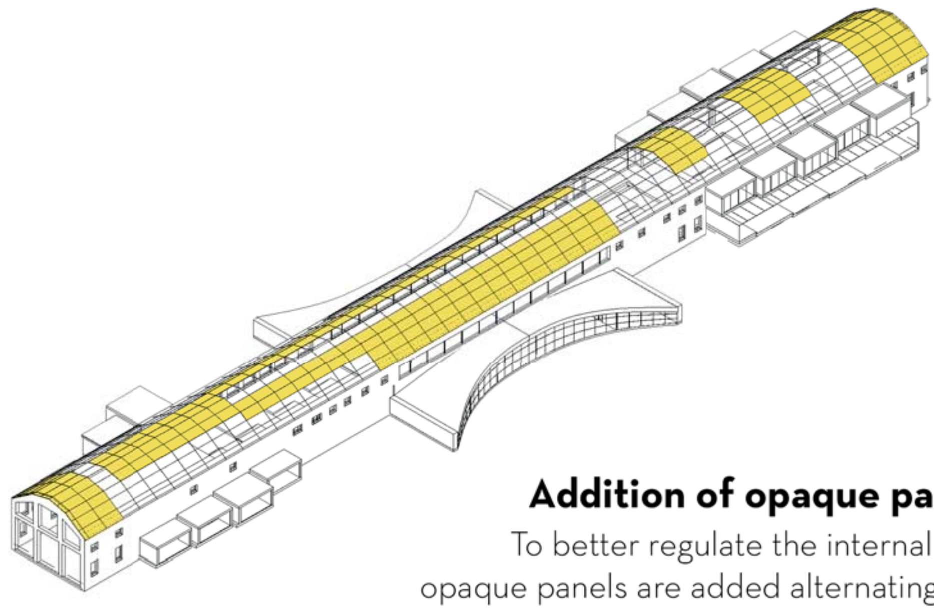
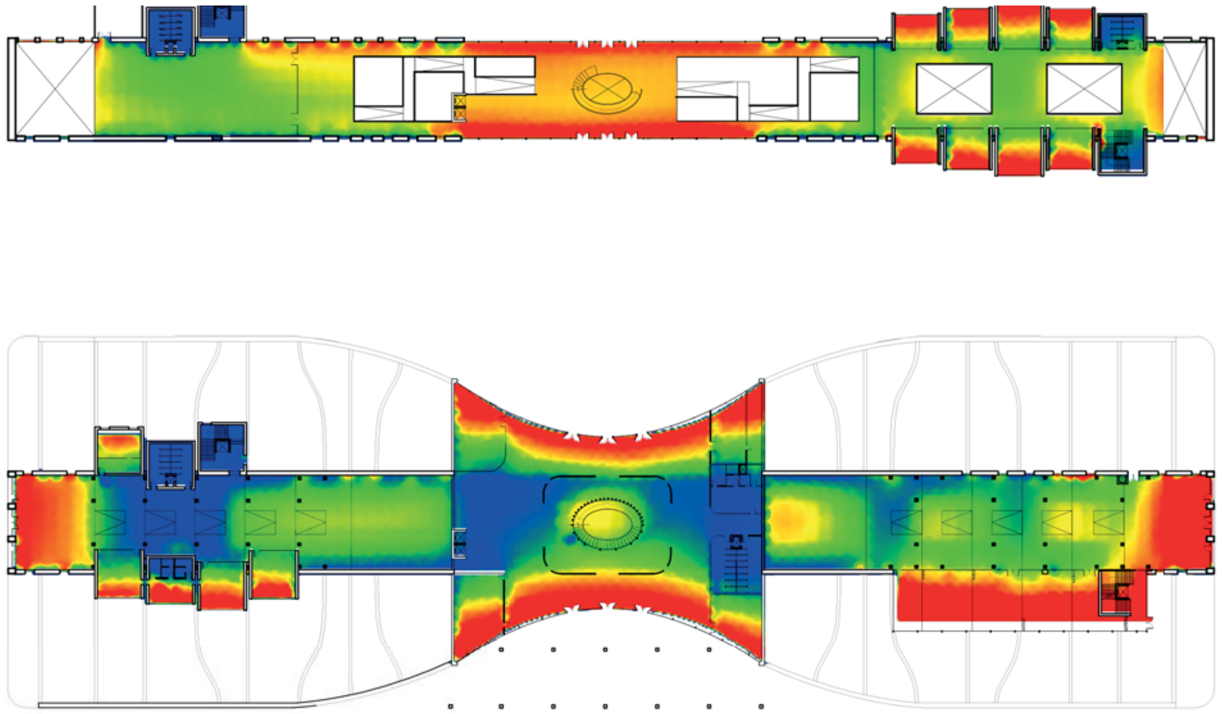


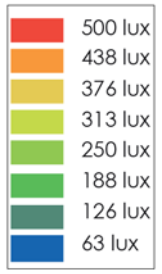


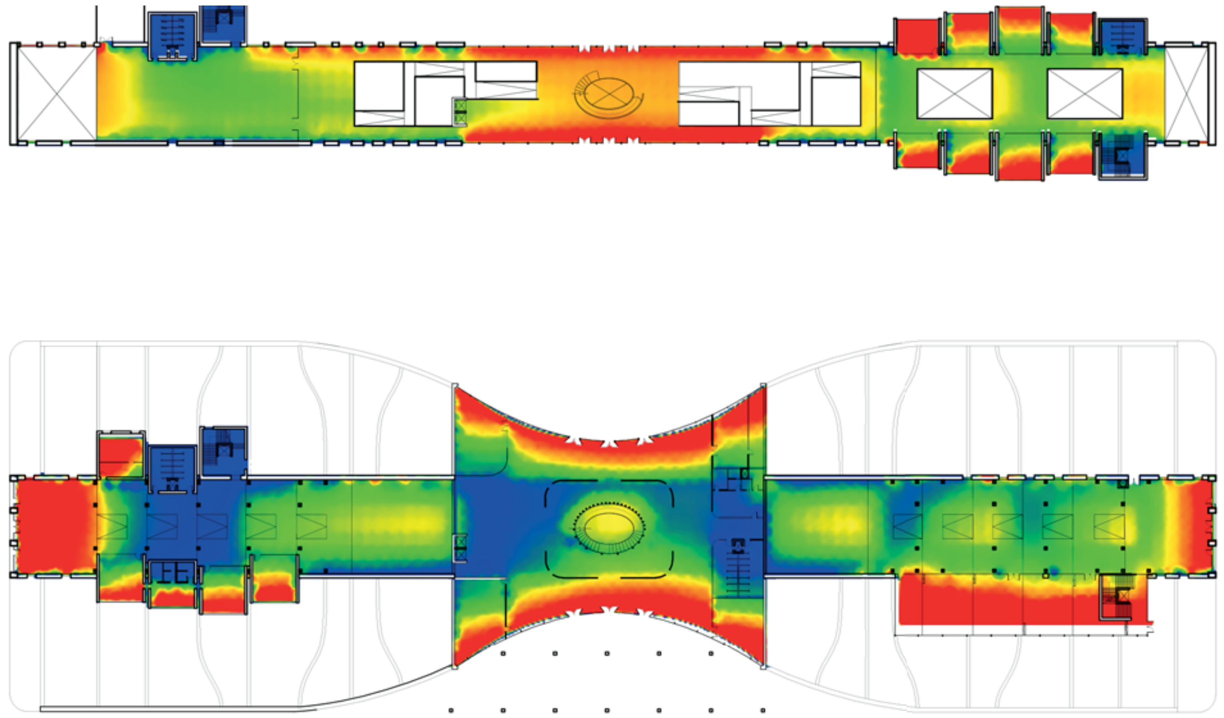
Addition of opaque panels

To better regulate the internal light, opaque panels are added alternating with glazed ones on the rooms that require screening at critical times of the year.

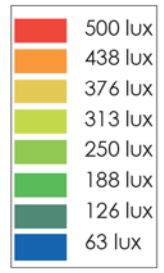


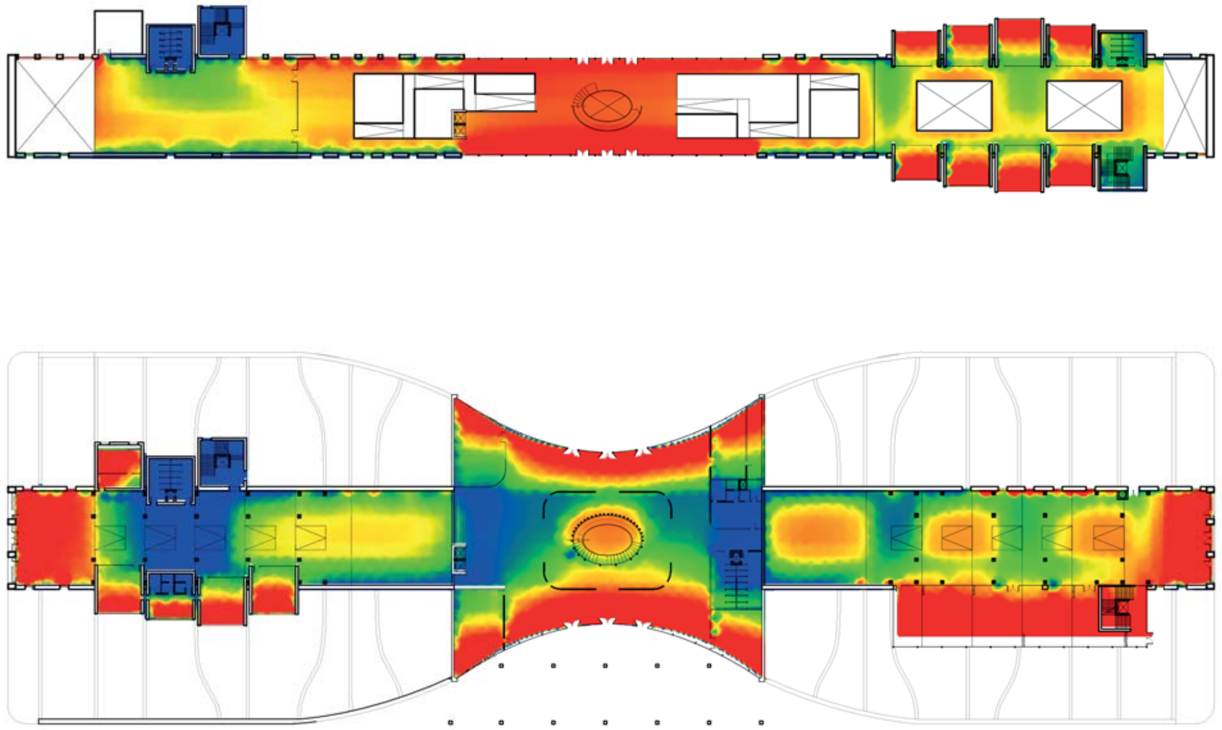
Illuminance (Lux) - 21 June h. 09.00
Clear Sky





Illuminance (Lux) - 21 June h. 15.00
Clear Sky





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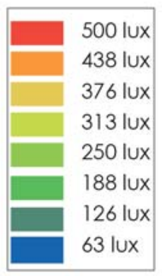
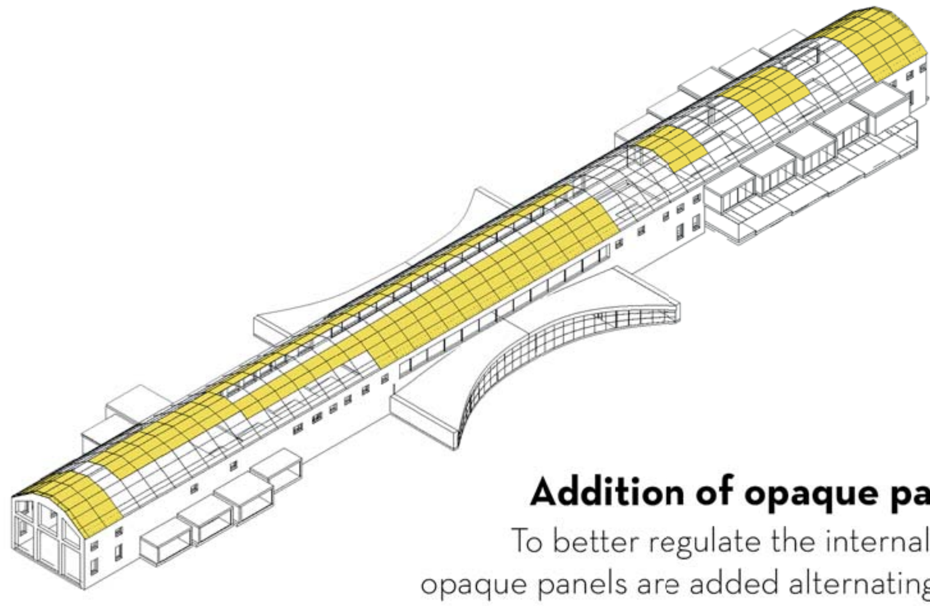
Clear Sky





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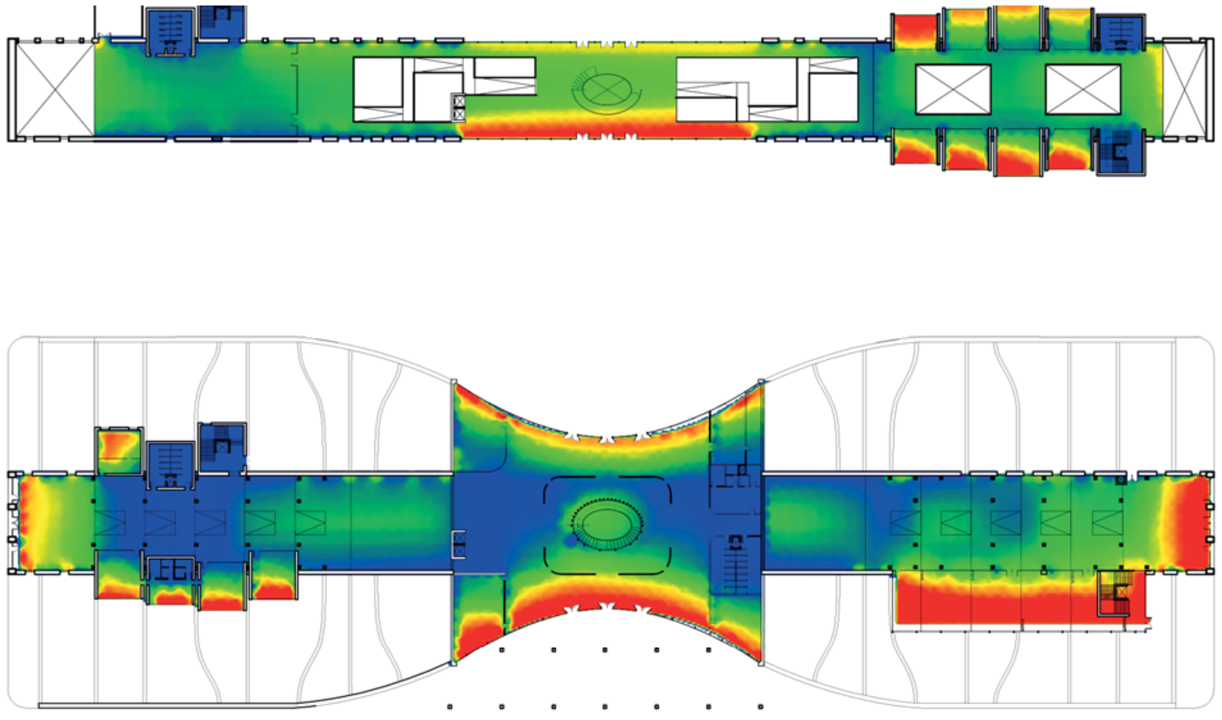
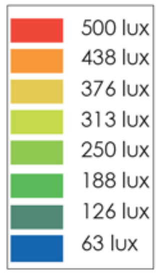
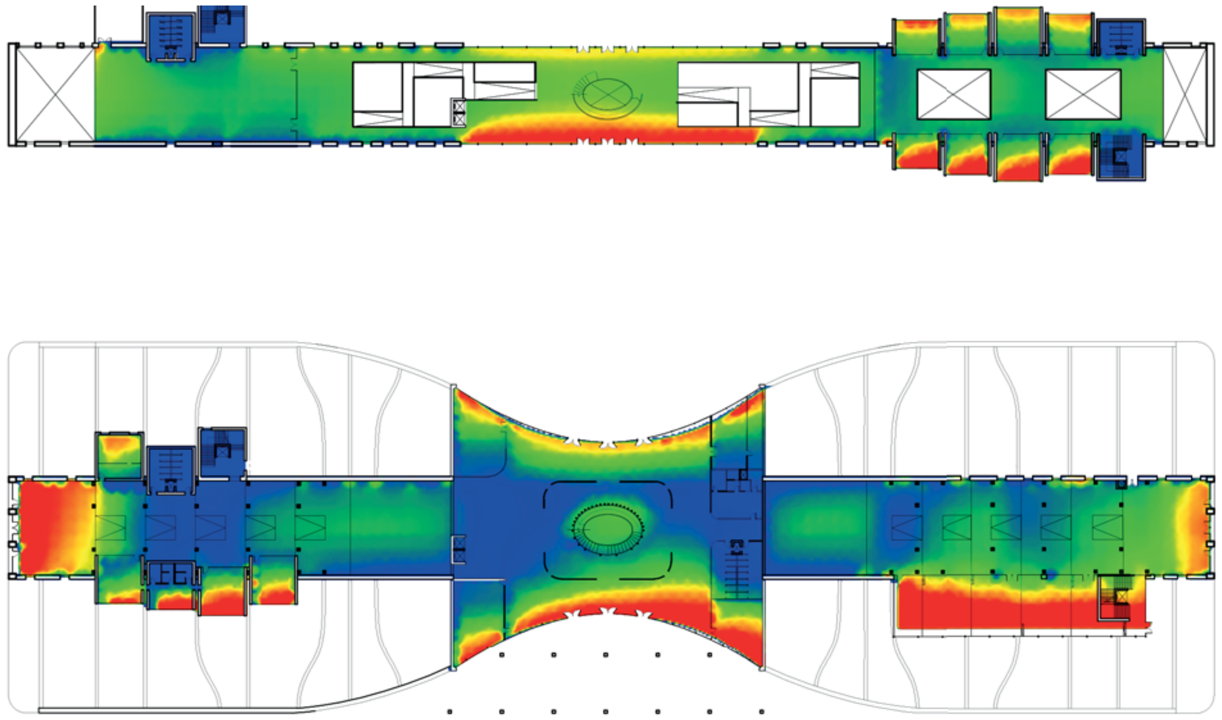
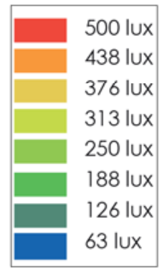


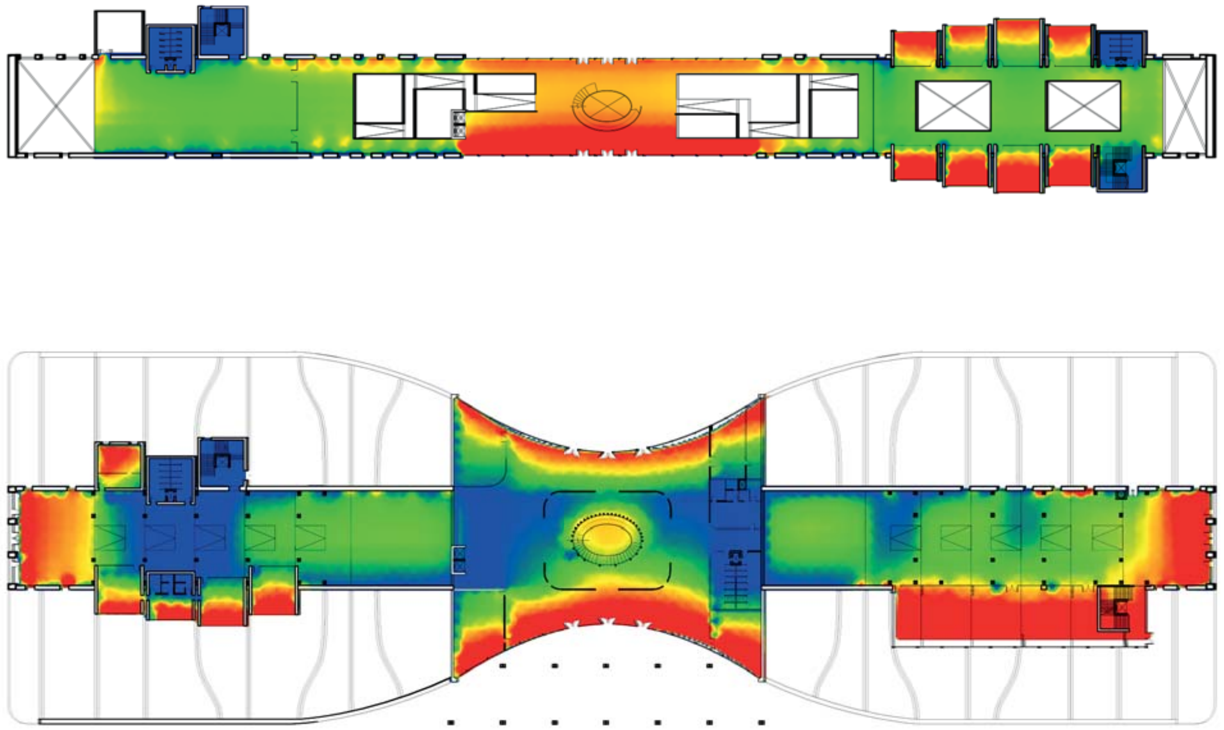


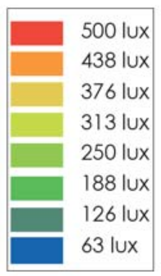
Illuminance (Lux) - 21 March h. 09.00
Clear Sky



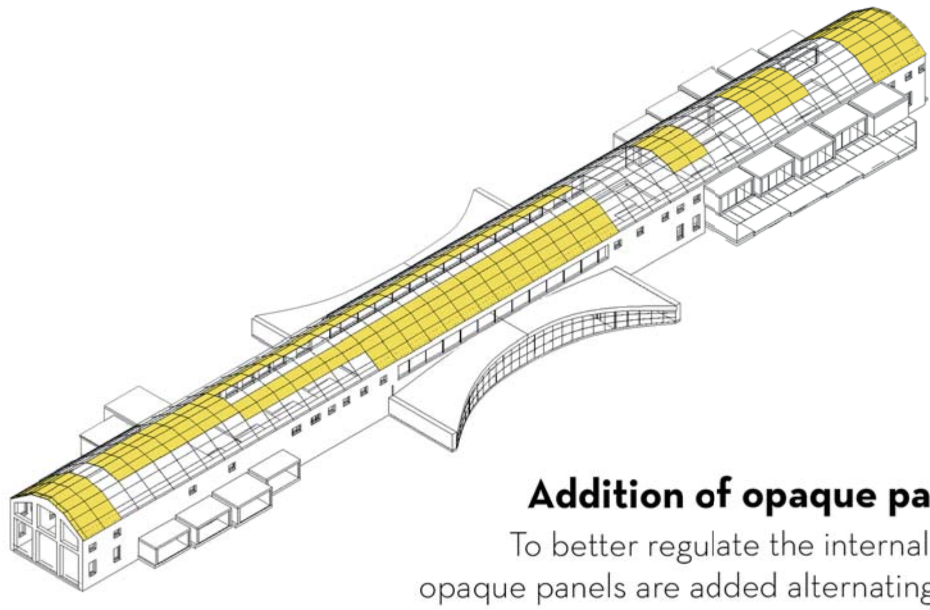


Illuminance (Lux) - 21 March h. 15.00
Clear Sky





Illuminance (Lux) - 21 March h. 12.00
Clear Sky



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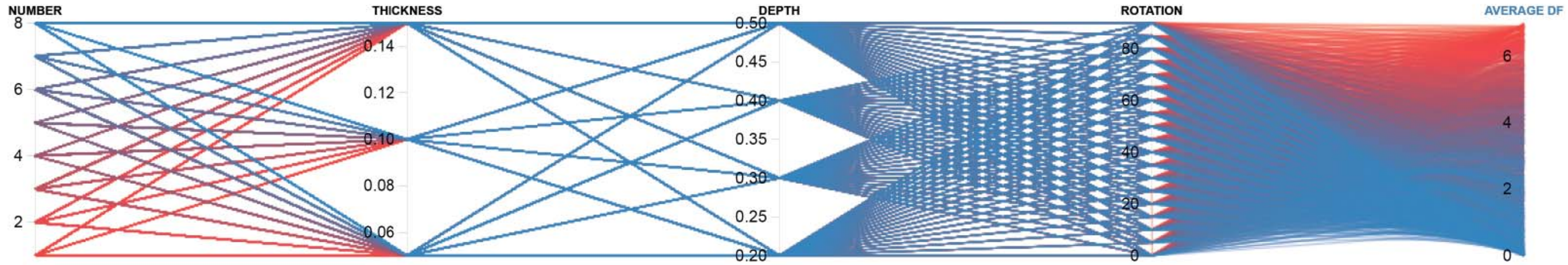
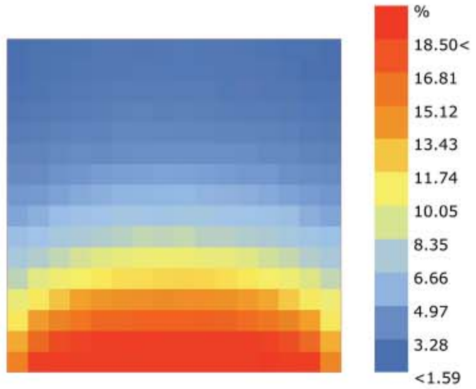
LABORATORIES - SHADING AND DAYLIGHT FACTOR OPTIMIZATION

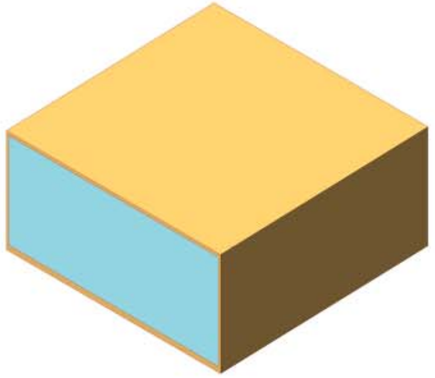
The shading system of the laboratory boxes on the southern facade was designed through an operation of optimization based on the annual dayligth factor (DF).
We printed 1842 different solution combining the number of the elements, the thickness, the depth and the degree of the rotation.
The purpose was to find a DF close to 2% for more than the 80% of the surface of the lab.
Here are reported just some example that synthetize the process until the perfect solution suitable for our needs.

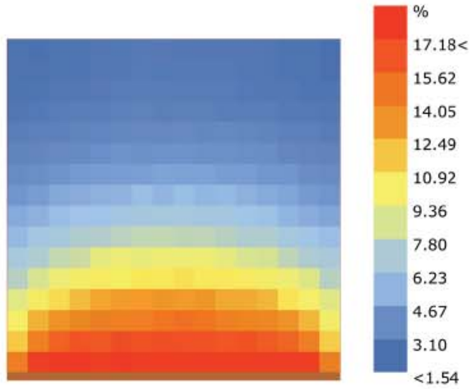


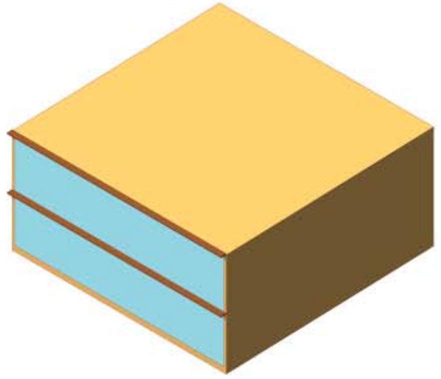
Design Explorer Optioneering Graphic

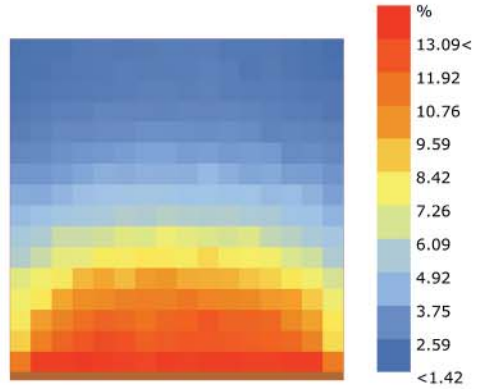


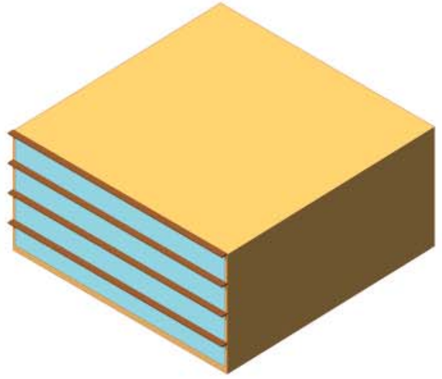
Initial step: no shading elements

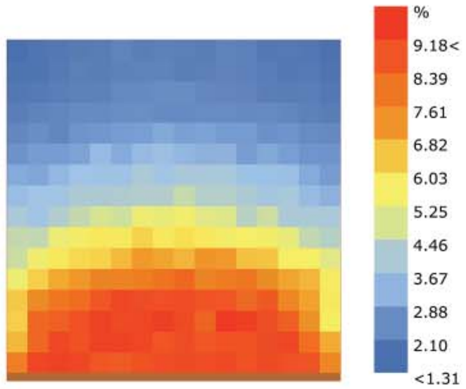

Axonometric view of the laborartory box

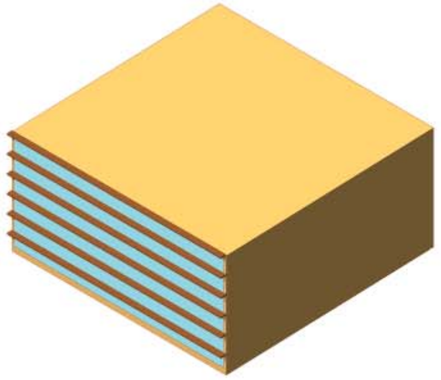


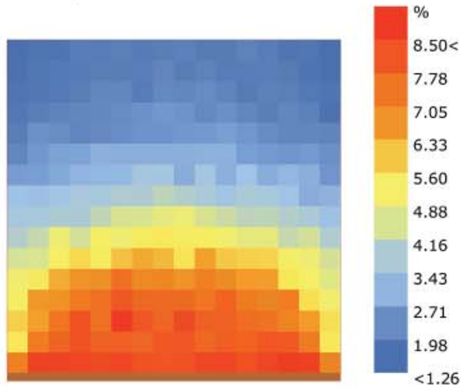

Elements Number 2 - Thickness 5 cm - Depth 20 cm - Rotation 0°

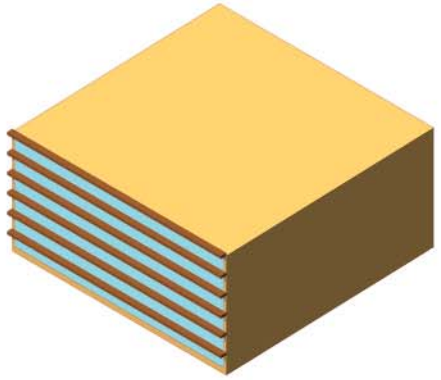


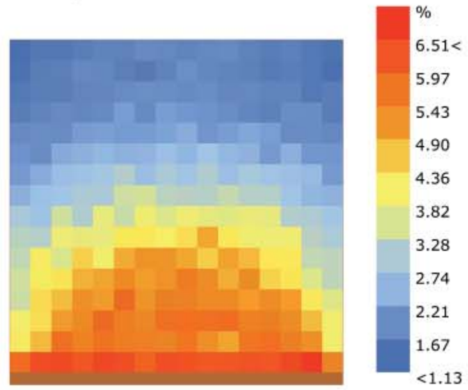

Elements Number 4 - Thickness 5 cm - Depth 20 cm - Rotation 0°

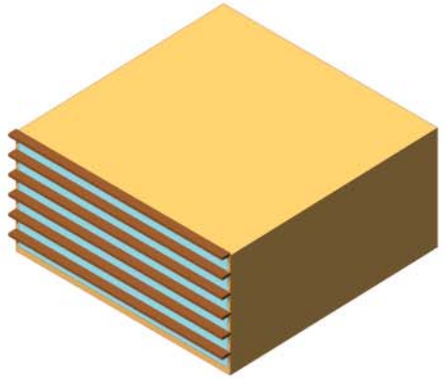


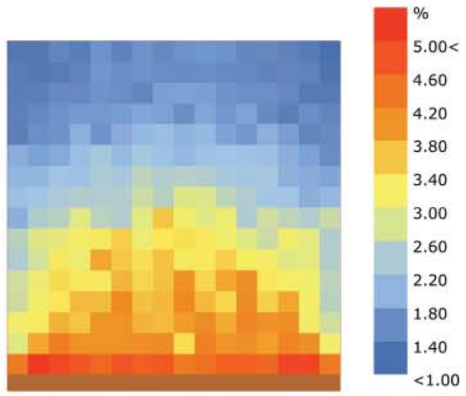

Elements Number 6 - Thickness 5 cm - Depth 20 cm - Rotation 0°

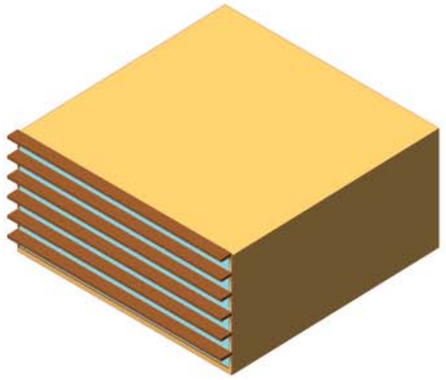


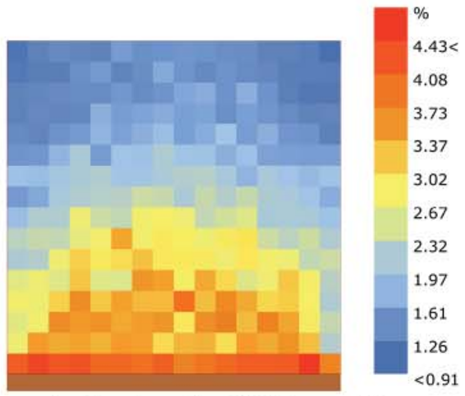

Elements Number 6 - Thickness 10 cm - Depth 20 cm - Rotation 0°

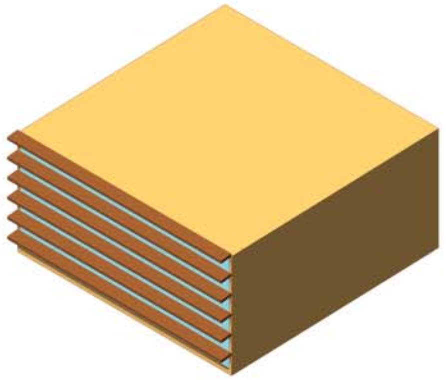


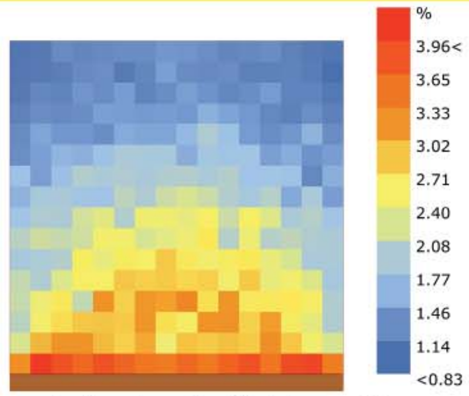

Elements Number 6 - Thickness 10 cm - Depth 30 cm - Rotation 0°

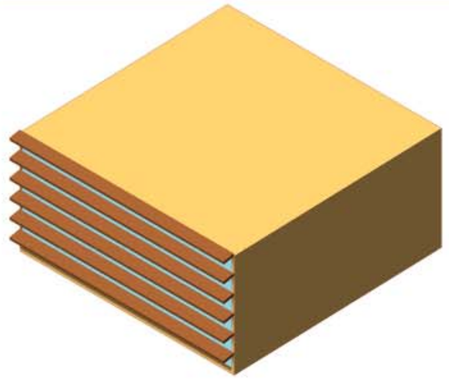



Elements Number 6 - Thickness 10 cm - Depth 40 cm - Rotation 0°



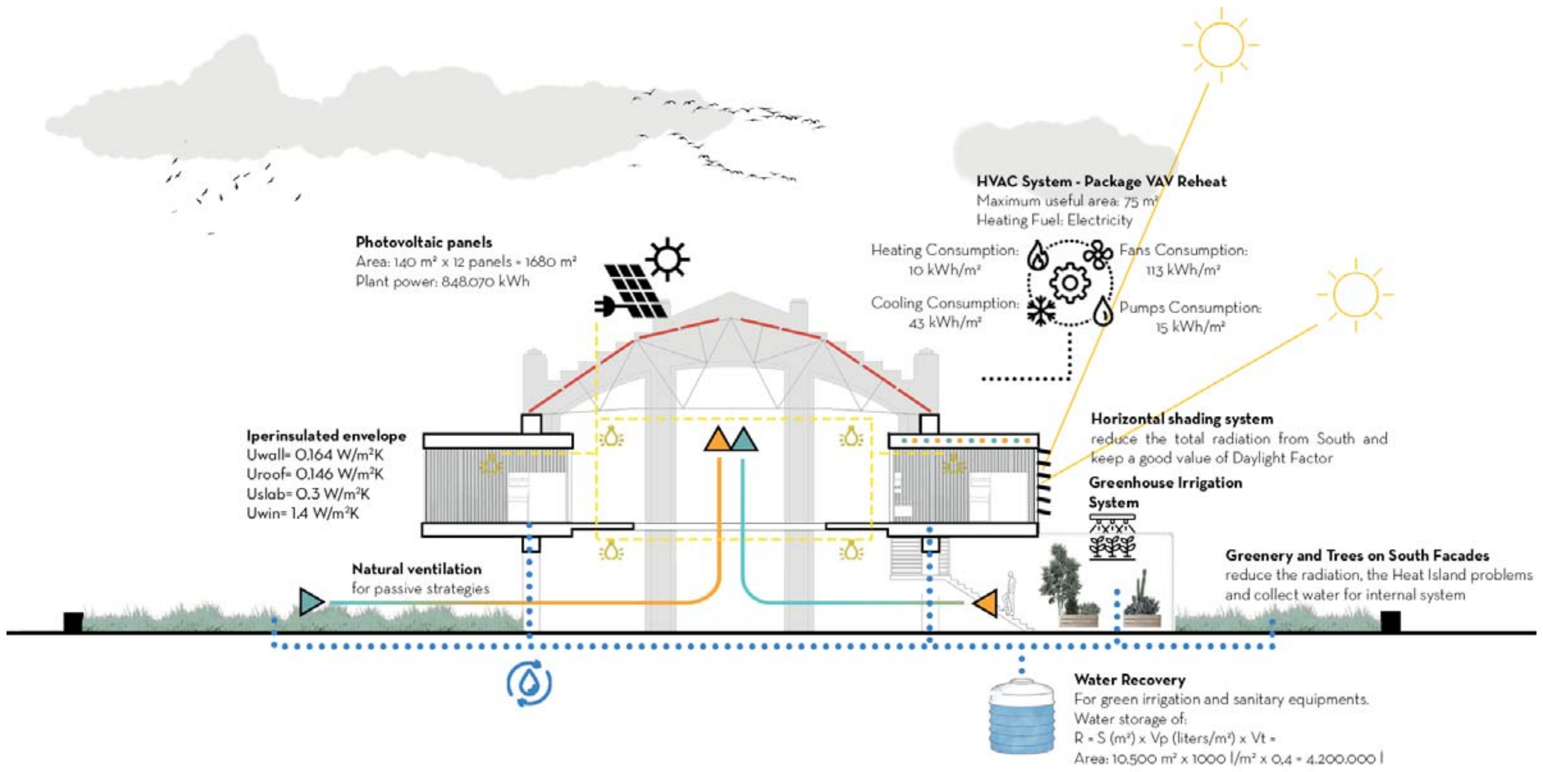

Elements Number 6 - Thickness 10 cm - Depth 40 cm - Rotation 5°




Elements Number 6 - Thickness 10 cm - Depth 30 cm - Rotation 10°

Final Solution

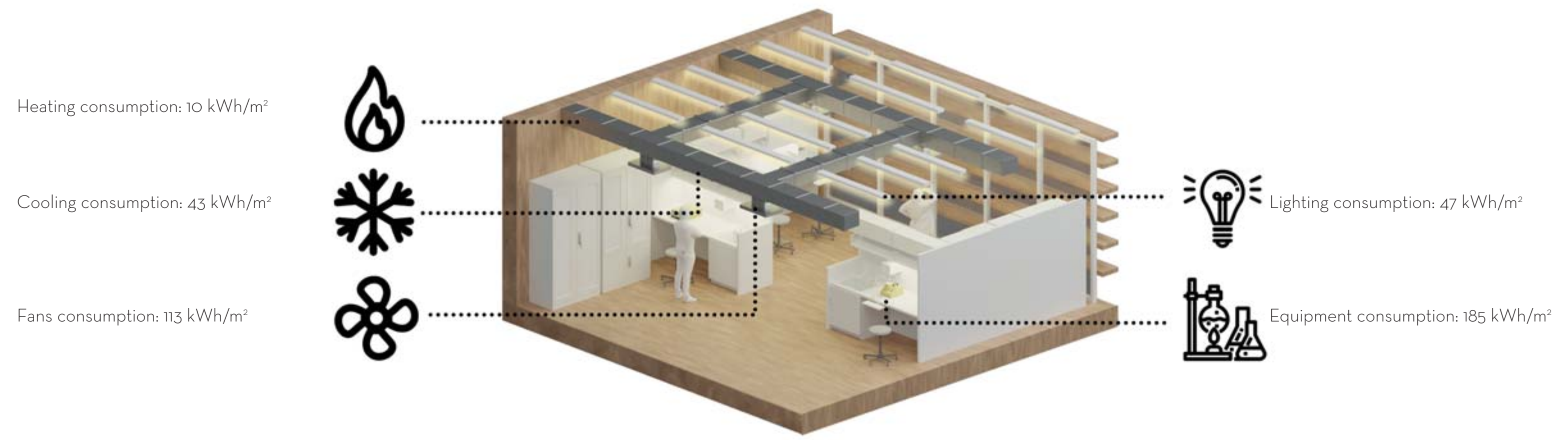
BUILDING ENERGY CONSUMPTION



Schematic Design Section - Energetic strategies

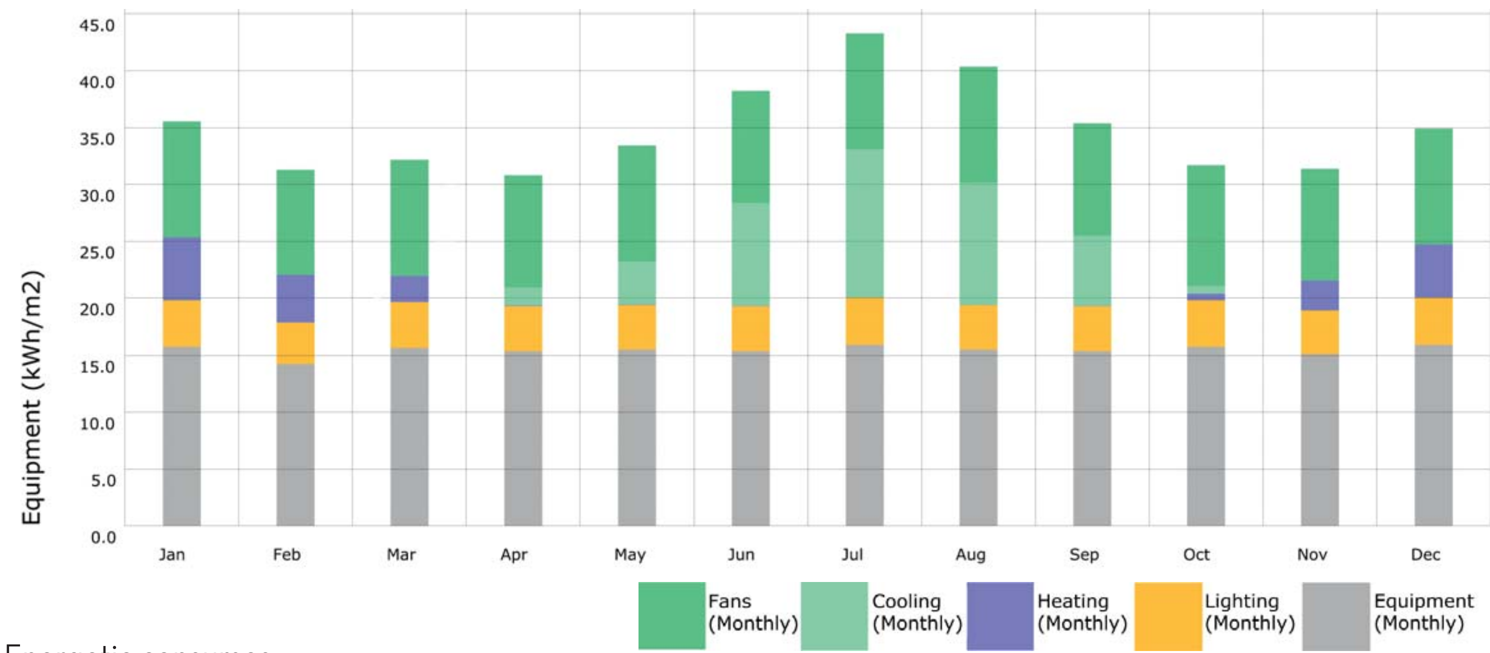
Photovoltaic panels disposition - Axonometric view

The installation of shading system with an integration of photovoltaics cells all along the roof of the building allow us to produce a huge amount of green energy to use for heating and cooling purposes, as well as, reducing the amount of electric consumes due to the artificial ligths and expecially the technological equipment of the laboratories.

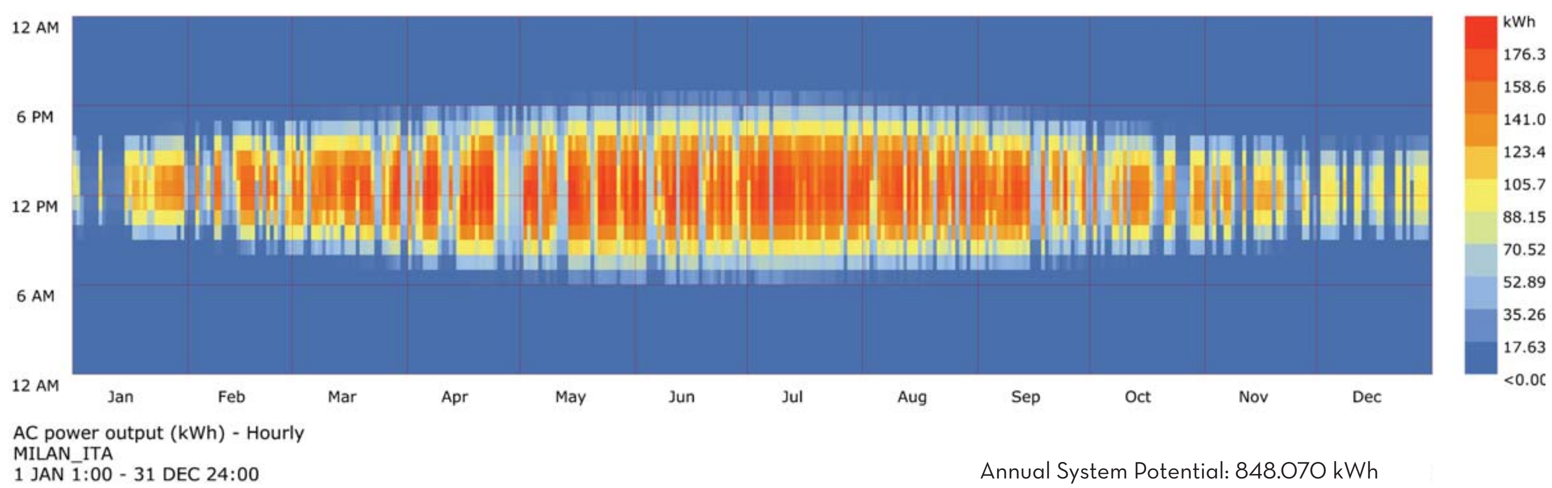


Laboratory consumption - Axonometric view

Photovoltaic shading panel view



Energetic consumes



Graphical rapresentation of the monthly energy production