

# SHARING HOUSE



## BEIC LIBRARY - MILAN -



**Architecture  
Designing Group**

SCHOOL OF ARCHITECTURE URBAN  
PLANNING CONSTRUCTION ENGINEERING

BUILDING ARCHITECTURE  
A.Y. 2022-2023



POLITECNICO  
MILANO 1863

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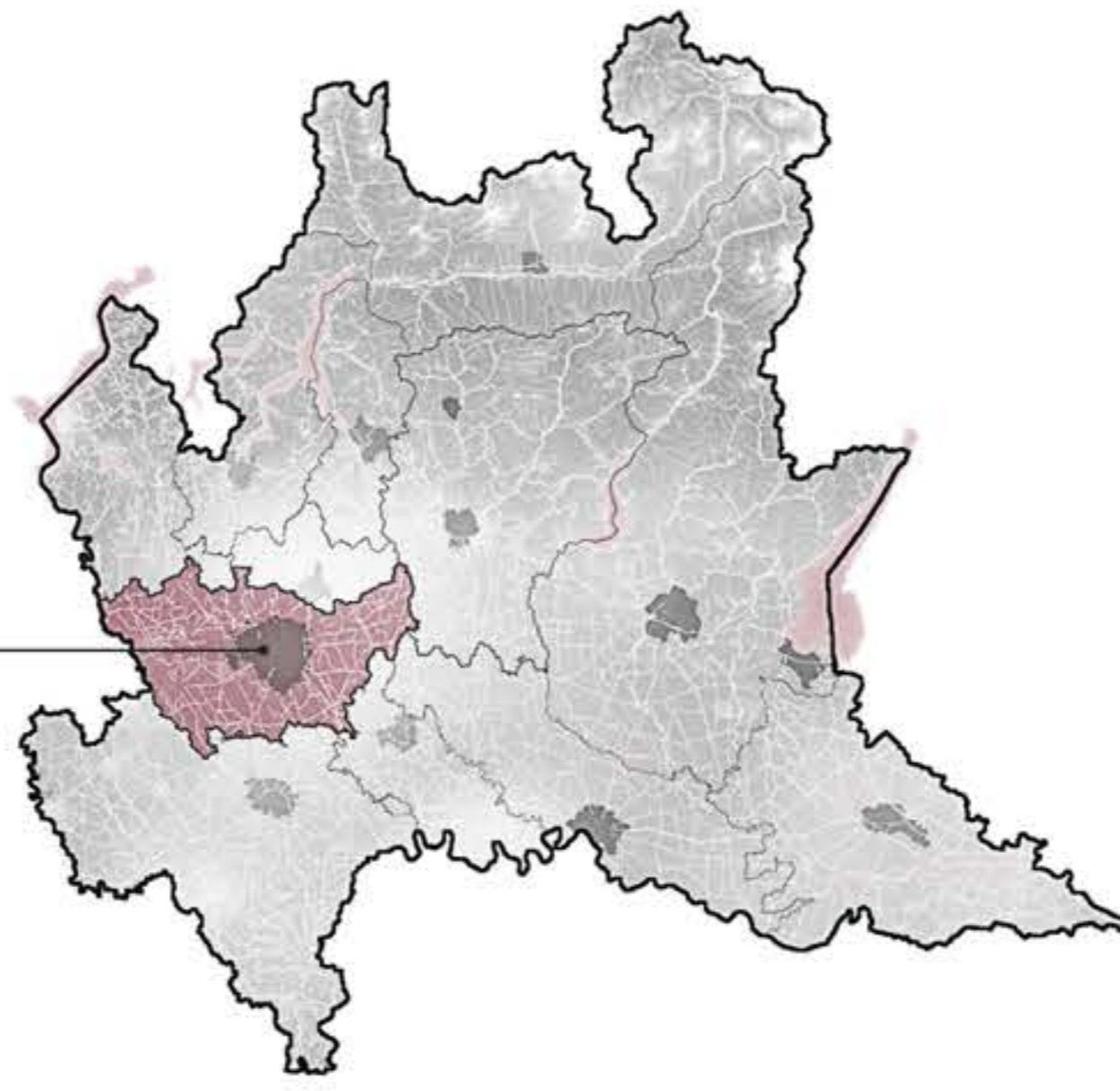
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**MILAN**  
Population: 1 371 498  
Area: 181.76 km<sup>2</sup>



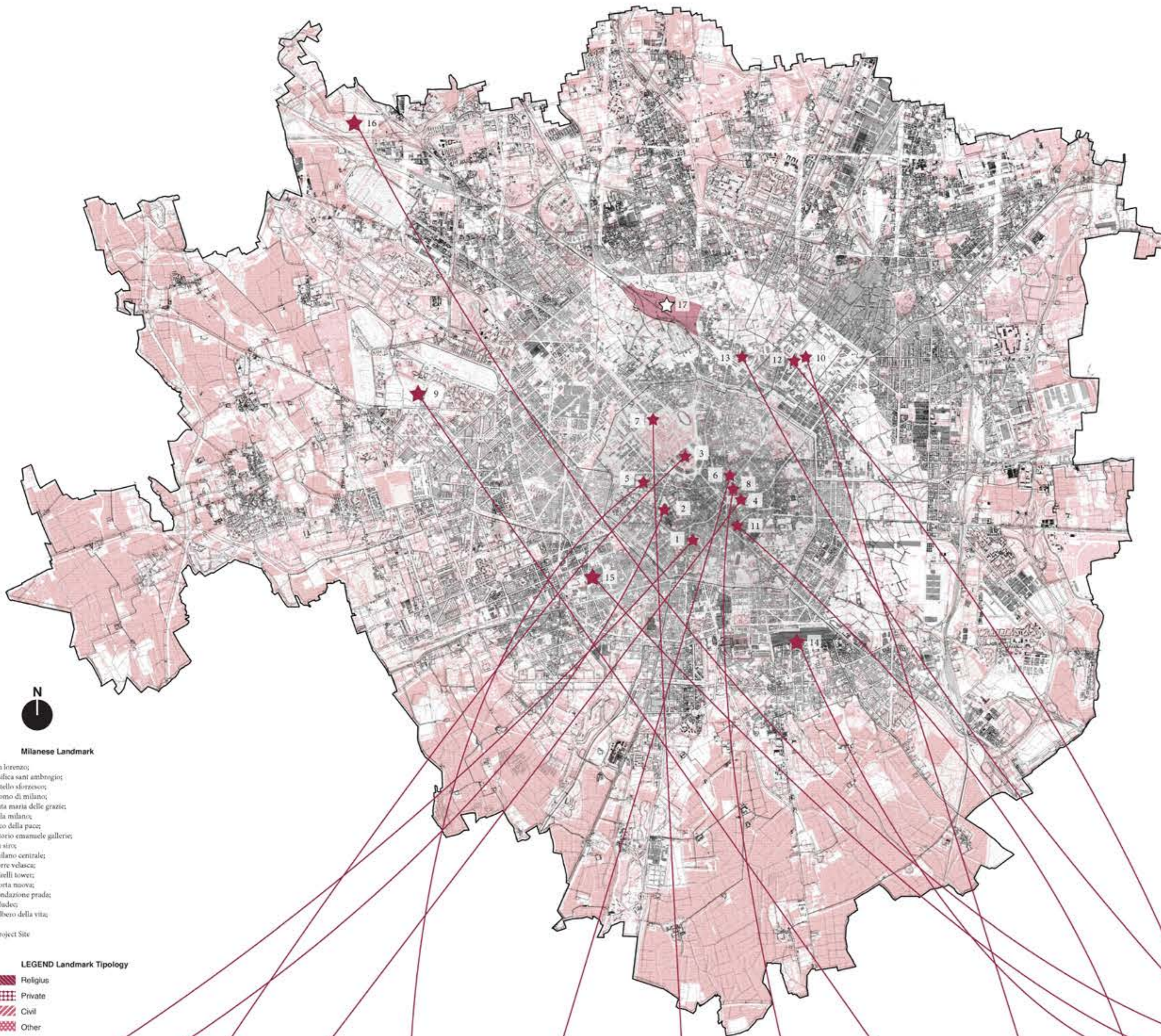
Milan is one of the most important cities in Italy and is considered the economic capital of the country. The significant economic growth of the city due to its rich industrial activity has brought a lot of opportunities to transform Milan into a city for the future. The metropolis has 1.3 million inhabitants and the area around the commune is one of the most densely populated areas in Europe.

Milan is intending to become the international representative of Italy of how the country will face these problems of climate crisis, societal inequalities and cultural loss in front of an international blended style. In fact, the city is a perfect candidate to export Italian tradition recognised all around the planet to a globalized level. Milan stands as a beacon of Italian culture on the international stage, radiating its rich heritage and contemporary dynamism to the world. Renowned as Italy's economic powerhouse and fashion capital, Milan embodies the essence of Italian style, innovation, and creativity. Beyond its cultural allure, Milan serves as a hub of commerce, finance, and technology, driving Italy's economic growth and influence on the world stage. Its bustling streets pulse with the energy of international trade and innovation, fostering collaboration and exchange across borders. Additionally, Milan's role as a global center for education and research, with prestigious universities and cutting-edge research institutions, underscores Italy's commitment to intellectual excellence and knowledge sharing. In essence, Milan serves as a microcosm of Italian culture and influence, embodying the country's rich traditions, forward-thinking spirit, and global impact. From around the world, Milan epitomizes the timeless allure and enduring relevance of Italian culture on the international scale.

Milan, renowned for its historical significance, artistic heritage, and vibrant contemporary culture, underscores the profound importance of a well-established library system in fostering intellectual growth, preserving cultural heritage, and promoting social cohesion. Libraries in Milan serve as bastions of knowledge, offering a sanctuary where individuals from diverse backgrounds can access a vast reservoir of information, literature, and educational resources. They provide a haven for lifelong learning, enabling citizens to expand their horizons, develop critical thinking skills, and engage in the intellectual discourse that underpins a thriving society. Moreover, these libraries safeguard the rich cultural legacy of Milan, housing invaluable collections of manuscripts, rare books, and historical documents that connect the present with the city's storied past. In this context, the library transcends its role as a repository of books; it emerges as a dynamic hub for cultural exchange, art exhibitions, and community events that foster a sense of belonging and inclusivity among Milan's diverse population. Consequently, the library emerges not only as a cultural public building but as a vital catalyst for Milan's continued intellectual, artistic, and social development.

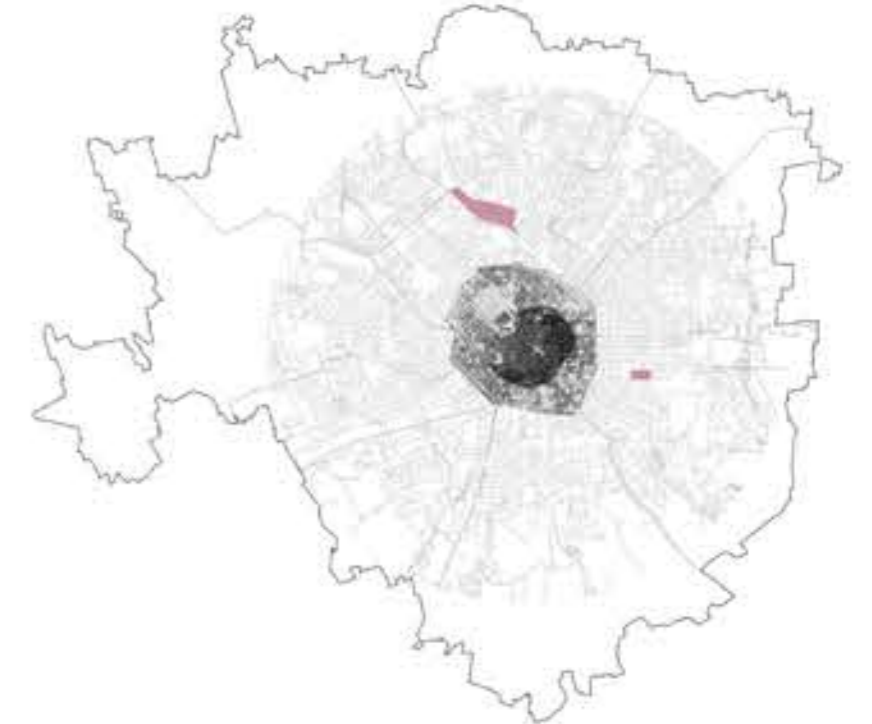
**Are Libraries landmark buildings?**

A library, as a social environment created for cultural exchange, learning, and community engagement, possesses the intrinsic qualities to be regarded as a landmark project. Serving as a beacon of knowledge, a hub of intellectual discourse, and a symbol of civic pride, through its impact on individuals and society, a library has the potential to leave an indelible mark on its surroundings, shaping the cultural landscape and promote a sense of collective identity and belonging.

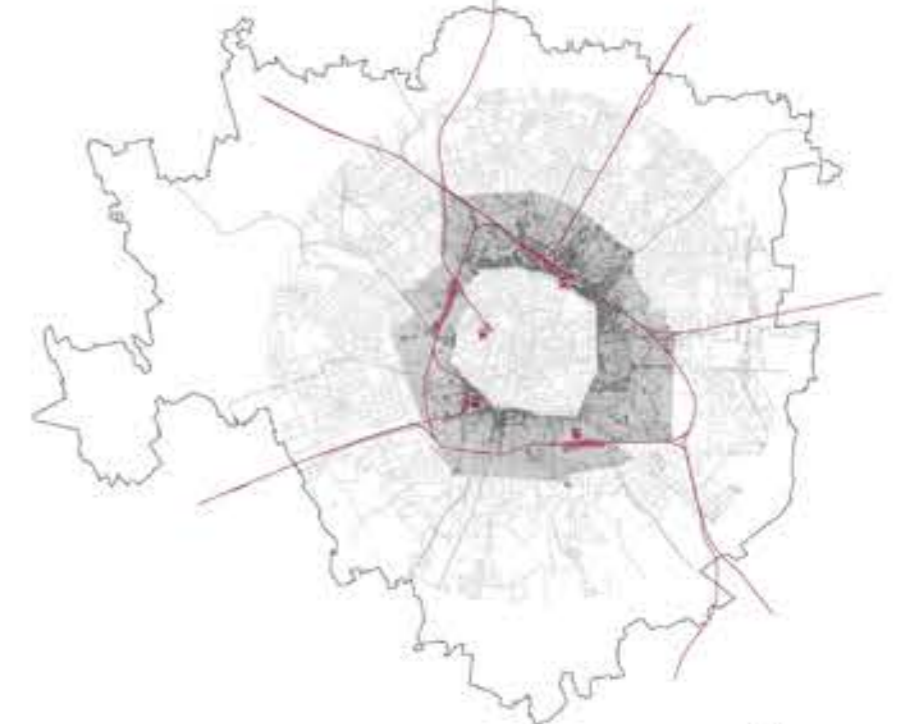


- Milanese Landmark**
- 1 San Lorenzo;
  - 2 basilica sant ambrogio;
  - 3 castello sforzesco;
  - 4 duomo di milano;
  - 5 santa maria delle grazie;
  - 6 scala milanese;
  - 7 Arco della pace;
  - 8 vittorio emanuele gallerie;
  - 9 san siro;
  - 10 milano centrale;
  - 11 torre velasca;
  - 12 pielli tower;
  - 13 porta nuova;
  - 14 fondazione prada;
  - 15 Mudec;
  - 16 Albero della vita;
  - 17 Project Site

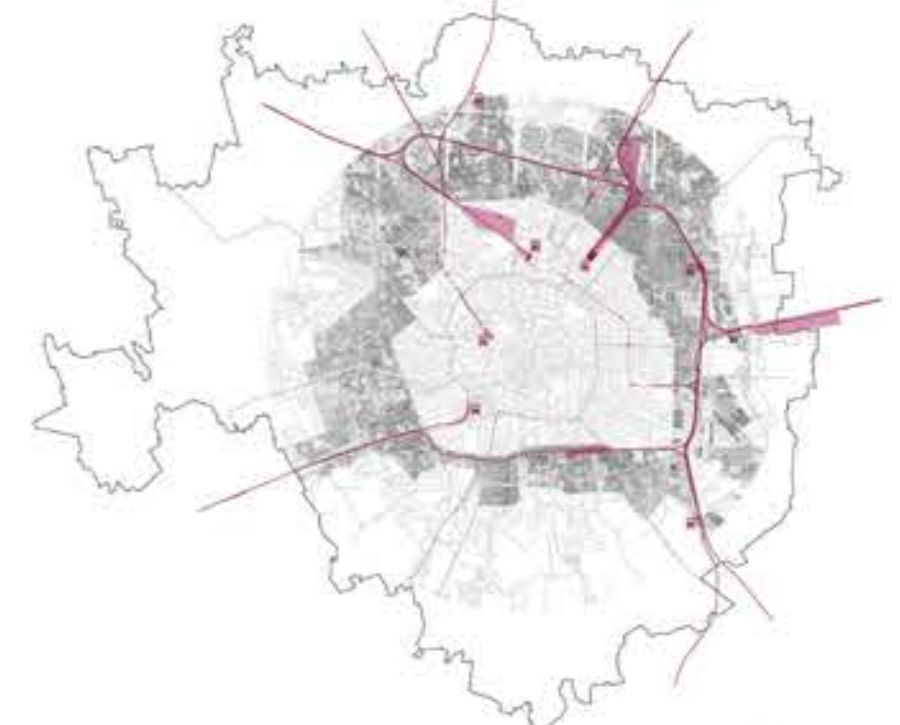
- LEGEND Landmark Typology**
- Religious
  - Private
  - Civil
  - Other



**HISTORY MAP OF MILAN: X-XVI CENTURY**



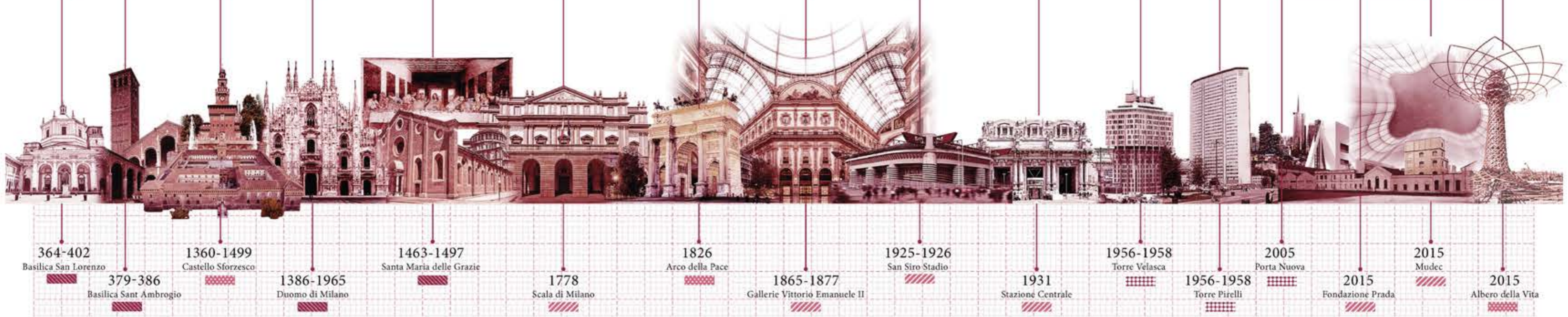
**HISTORY MAP OF MILAN: XVII-XIX CENTURY**



**HISTORY MAP OF MILAN: XX CENTURY**



**DENSIFICATION OF THE PUBLIC TRANSPORT NETWORK**



364-402	1360-1499	1463-1497	1778	1826	1865-1877	1925-1926	1956-1958	2005	2015	2015	2015
Basilica San Lorenzo	Castello Sforzesco	Santa Maria delle Grazie	Scala di Milano	Arco della Pace	Gallerie Vittorio Emanuele II	San Siro Stadium	Torre Velasca	Porta Nuova	Fondazione Prada	Mudec	Albero della Vita
379-386		1386-1965				1931	1956-1958	2015			
Basilica Sant Ambrogio		Duomo di Milano				Stazione Centrale	Torre Pirelli				



**New development areas**

The site we propose for the new BEIC project was in the past a railway deposit area used to store trains and wagons. In Italy, a railway «scalo» refers to a designated area within a railway station or depot specifically designated for the sorting, storage, and maintenance of trains and rail cars. Serving as a crucial logistical hub for the transportation of goods and passengers, a «Scalo» facilitates the efficient movement and organization of trains, ensuring smooth operations within the rail network. Typically equipped with multiple tracks, platforms, and storage sidings, a «Scalo» accommodates various types of rolling stock, including freight trains, passenger trains, and locomotives. Additionally, a «Scalo» may feature facilities for refueling, servicing, and repairing trains, enabling routine maintenance and emergency repairs to be conducted swiftly like it used to occur in Scalo Farini when the site was still in use. As a vital component of the railway infrastructure, a «Scalo» plays a pivotal role in optimizing the flow of traffic, enhancing operational efficiency, and supporting the seamless operation of the rail network.

Milan is counting diverse areas like this all around the city, most of which has been abandoned to move these infrastructure more far away from the city's borders, leaving unused areas with high urbanistic potential in strategic locations, for example Scalo porta Romana, which is going to host the Olympic village during the incoming Winter Olympic Games or Scalo porta Vittoria with the residential reconversion of area ex macello. Scalo Farini is probably one of the most awaited projects, possibly due to its closeness with the nearly completed Porta Nuova project. According to the plan Milano 2030 Farini is going to be a new essential district, which is going to include a large variety of functions such as a new university campus, residence area, business area, cultural activities, eco park and more.



1



**AREA EXPO**

Client: Milan municipality  
Design team: HOK

2



**BOVISA "LA GOCCIA"**

Client: Politecnico di Milano  
Design team: RPBW (Renzo Piano Building Workshop)

3



**SCALO FARINI**

Client: Milan municipality  
Design team: OMA

4



**ZONA GARIBALDI PORTA NUOVA**

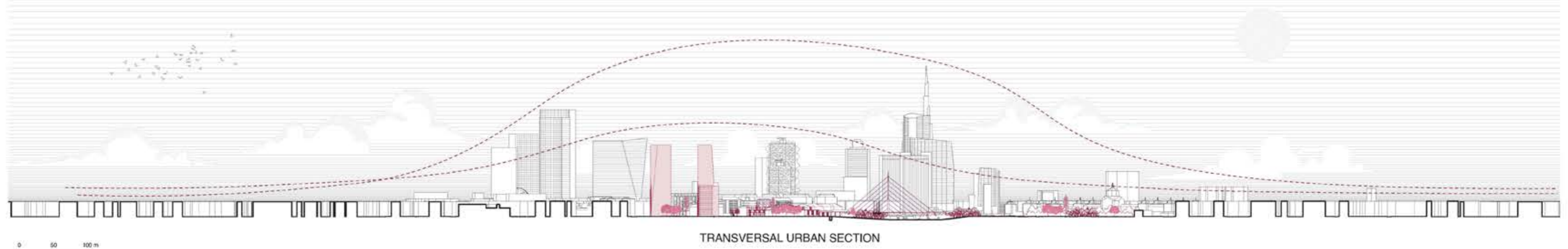
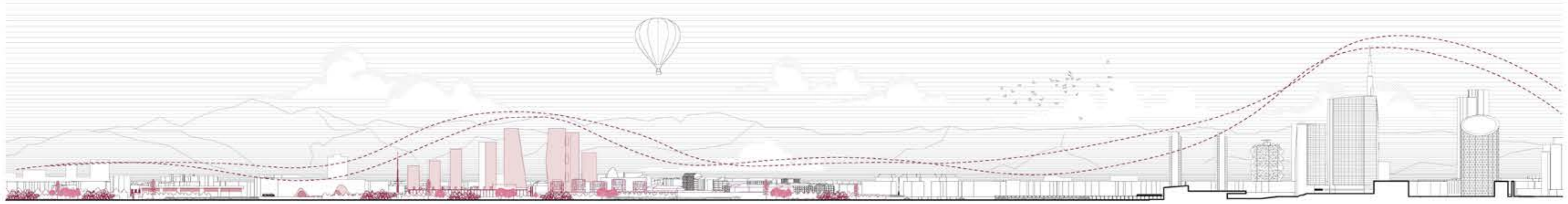
Client: Milan municipality

5



**AREA ACQUABELLA**

Client: Milan municipality

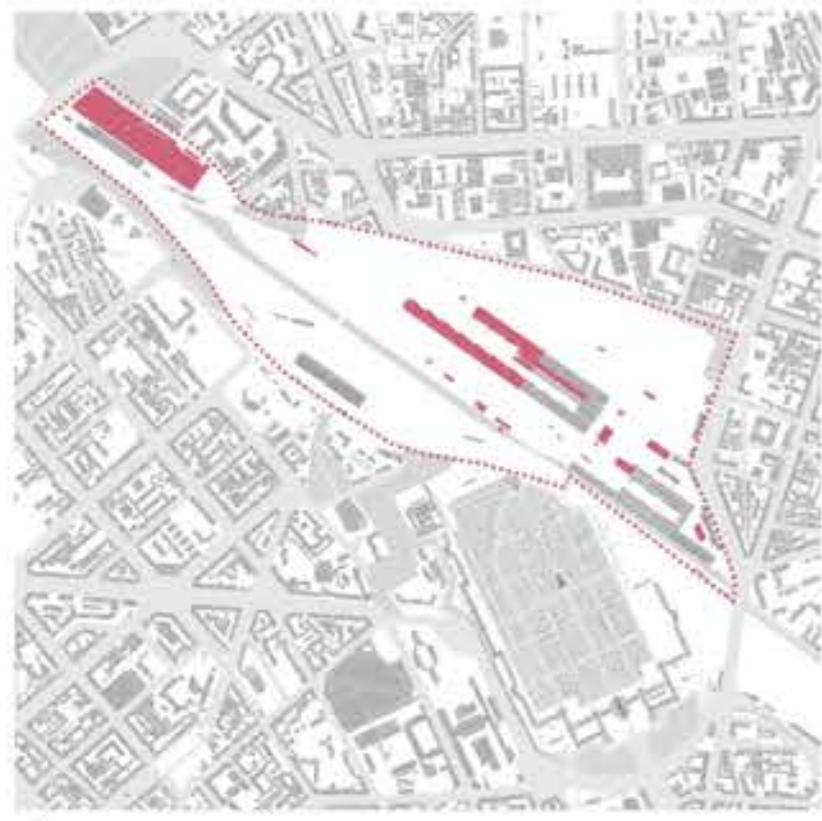


**OMA Winning Masterplan**

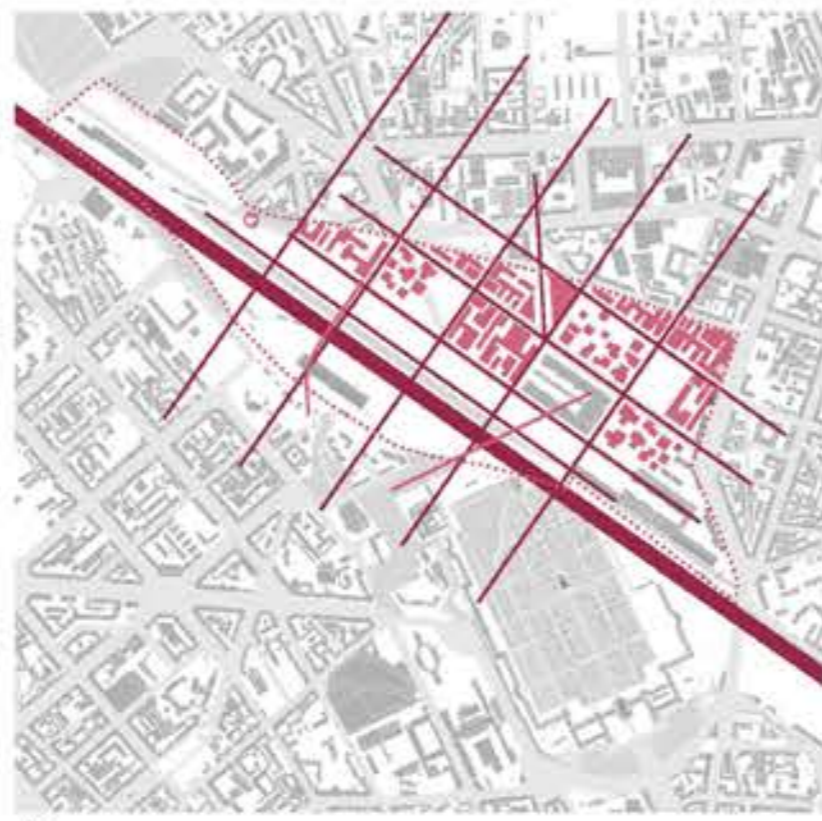
The current future of the urban plan development of Scalo Farini has been decided after an international competition won by the Dutch architecture firm founded by Rem Koolhaas OMA. The most significant point brought by the winning proposal was the procedural realisation of the project. OMA thought the district as an evolutive place that would grow accordingly to time and future needs. In this sense every plot would be used all time long by switching the functions until the completion of the works. In these regards the plot of land could start being used as an urban farm, moving to potential outdoor concerts and art exhibitions while waiting for the final establishment of a definitive building.

The winning master plan presents a really simple grid composition with rectangular dimensions. This sketch of the urban road is aligned with the railway line which is approximately rotated 60° counterclockwise in respect to the North. The dimensions of the grid are guided by the existing building and future Accademia di Brera, around 100 meters wide per 150 long. These dimensions allowed the insertion of three longitudinal roads per four transversal ones. This grid system creates a new contrasting identity compared to the existing city. This slight contrast is in our opinion really appropriate, because in our opinion it manages to clearly tell the visitor that they are entering a place that has seen different changes through eras. Anyway it's important to underline that, even with this contrast, every one of these new streets meets with existing roads, making the mobility clear and efficient.





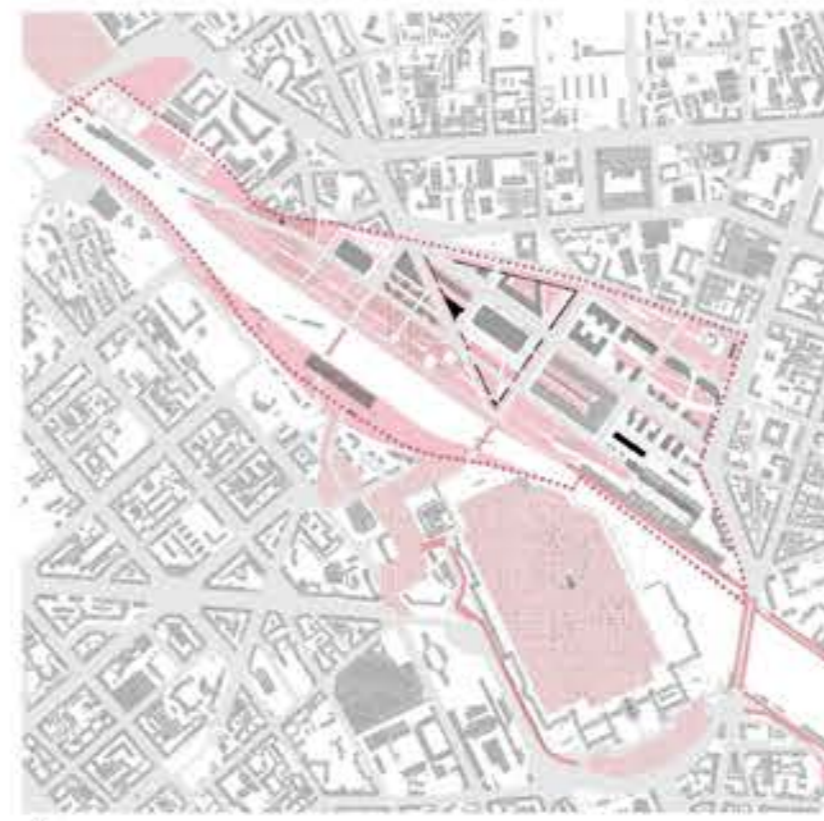
DEMOLITIONS



WINNING OMA PROJECT



MASTER PLAN MODIFICATIONS



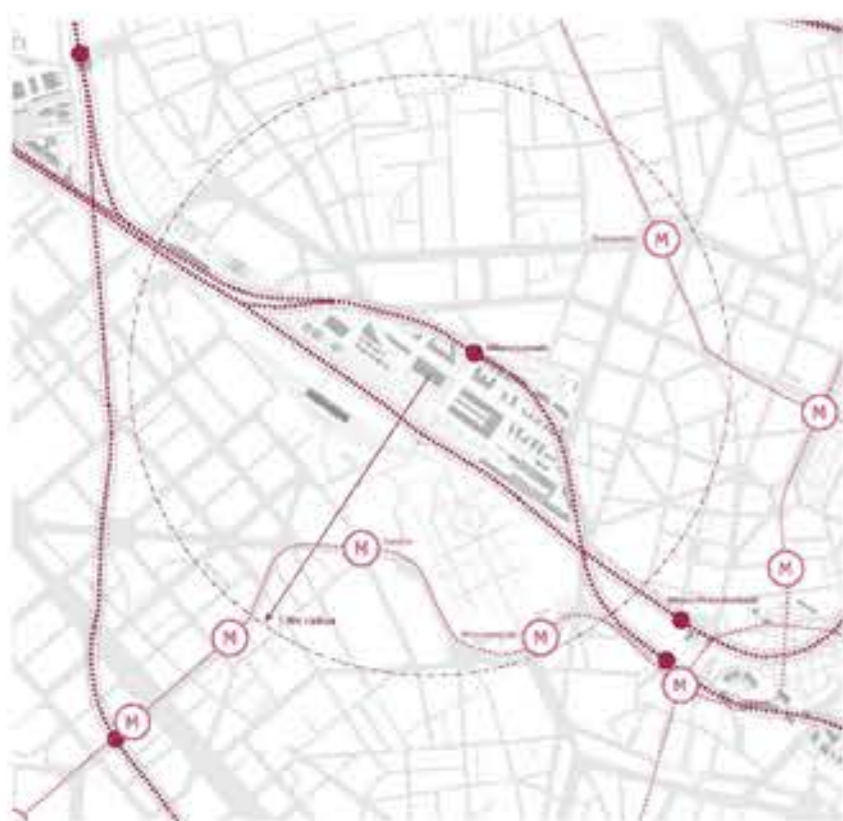
GREEN AREAS

**Masterplan changes**

For the design of the new library we decided to keep most of the decisions made in OMA's approved urban plan, because it is in our opinion quite appropriate for the site in terms of street network and urban functional arrangement. We studied a way to imagine the new buildings in the masterplan. Our building arrangement came to life by using historical recognition as poetry of the overall appearance of the Farini area.

Another aspect we took liberties from, was the break of the rigid grid with an oblique street.

The extension of "Via degli Imbriani", was an important addition for us because in addition to the improved quality of the urban space, it is directly aligned with the main axis of Monumentale cemetery, which is probably nowadays the most relevant landmark of the area. In a certain way we think that by adding this new cut we are bringing an additional respect towards this iconic milanese space.



METRO AND S-LINE

- Legend Transportation: Metro S-Line**
- S Line Railway
  - S Line Station
  - Metro Line
  - Metro Station



TRAM AND CYCLING

- Legend Transportation: Cycling tram**
- Cycling Path
  - Tram Line
  - Tram Station



PEDESTRIAN CIRCULATIONS

- Legend Transportation: Pedestrian**
- Principal pedestrian street
  - Secondary pedestrian street
  - Tertiary pedestrian Path



CAR TRAFFIC

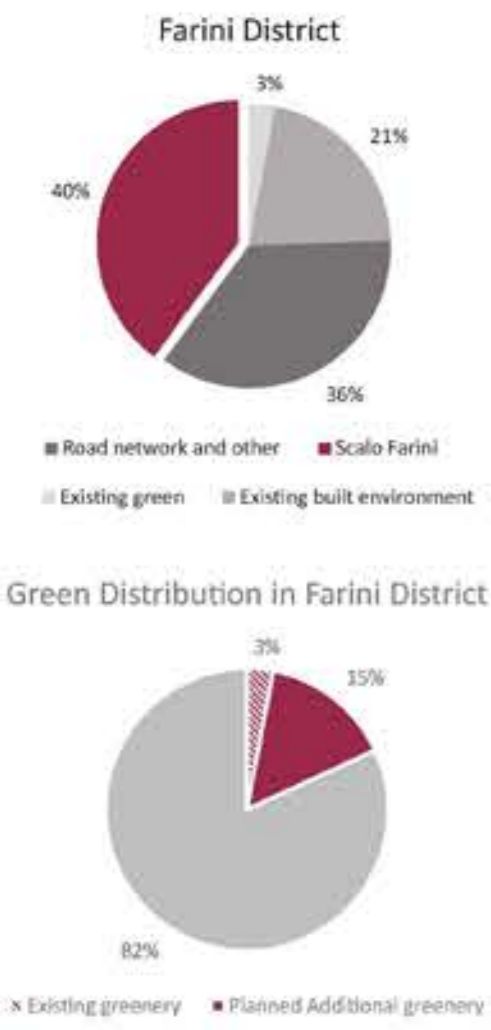
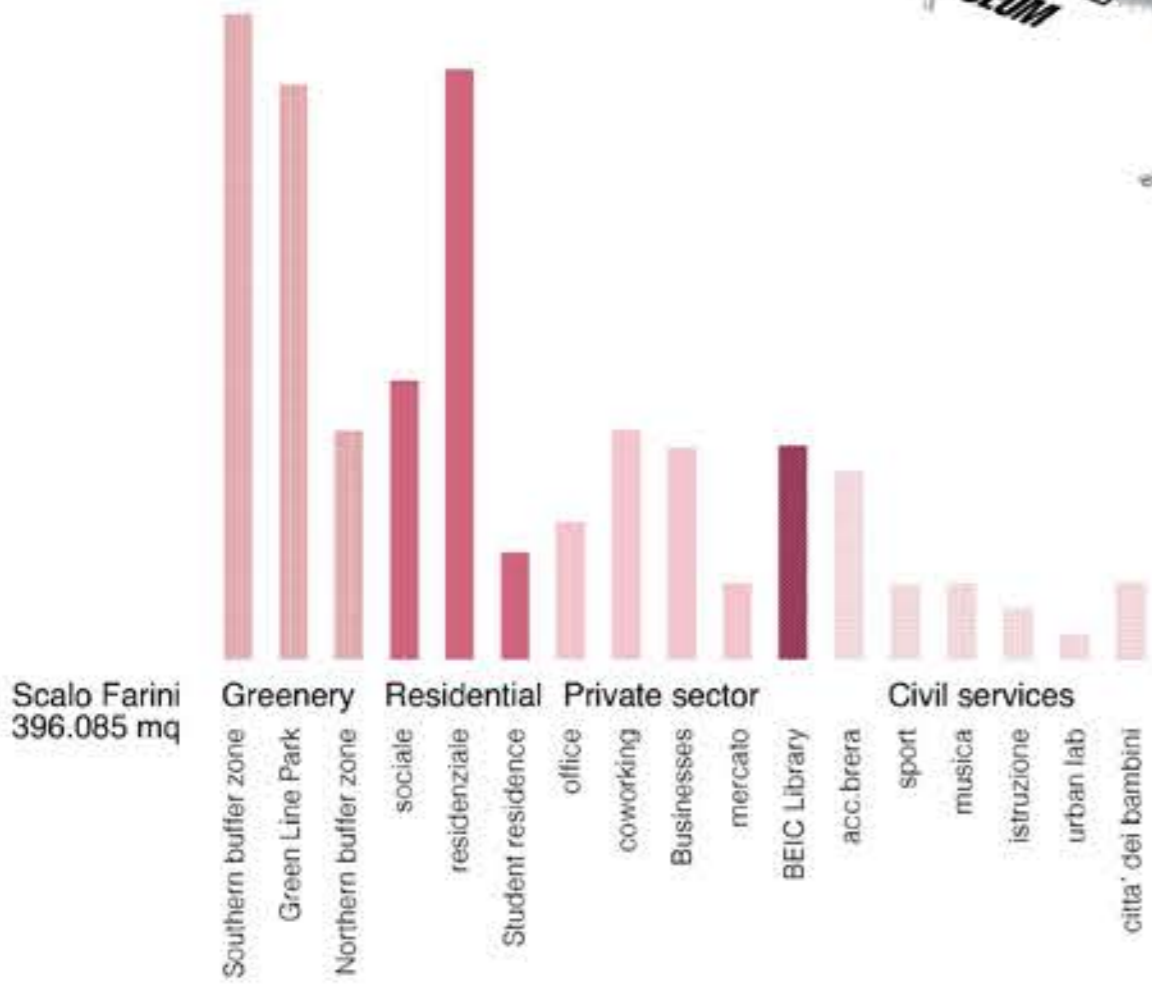
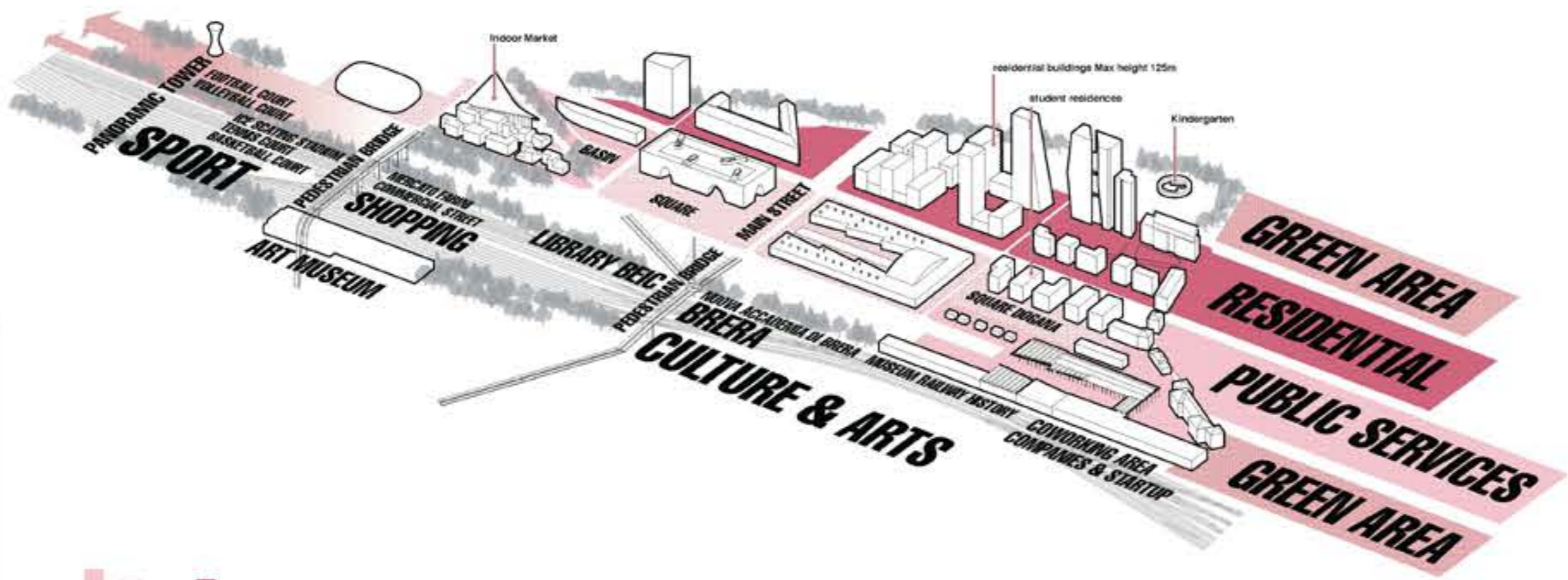
- Legend Transportation: Car**
- Primary Street
  - Secondary Street
  - Tertiary Street
  - Restricted Road
  - Parking

**Transportation**

In our masterplan sketch we reflected the transportation methods considering all kinds of mobility, we studied from the slow to the fast mobility trying to create the best solution for most of the users. This study isn't diverging from OMA's thoughts. As a first assumption we agreed the importance of prioritizing more sustainable sources of mobility such as public transportation or the so-called "slow mobility". We believe that we have a lot to learn from the knowledge present in a Dutch firm to design the urban transportation network with this envision. We studied in different layers those four transportation methods: pedestrian, cycling, public transportation, and car mobility.

The careful study and implementation of urban mobility strategies are paramount for the successful functioning of an urban plan. By prioritizing efficiency, sustainability, and accessibility in our transportation infrastructure, we not only enhance the quality of life for residents but also promote economic vitality, environmental resilience, and social equity within the community. As cities continue to evolve and grow, thoughtful consideration of urban mobility becomes increasingly essential in shaping vibrant, livable, and inclusive urban environments for generations to come.





In the development of our new master plan, we sought to adhere closely to the organizational principles established by the winning proposal of Rem Koolhaas team, ensuring continuity and coherence in the arrangement of building functions. By incorporating a mixed-use approach, we aimed to create a dynamic urban environment where diverse activities coexist harmoniously, fostering a sense of vitality and connectivity throughout the site. Our objective was to facilitate ease of access and navigation, allowing residents and visitors to seamlessly reach various destinations within the district from any point. Furthermore, we endeavored to incorporate a comprehensive range of functions within the master plan, striving to create a self-sustaining community that could thrive independently without placing undue strain on surrounding activities. Through thoughtful design and strategic planning, our master plan seeks to establish a vibrant, resilient, and cohesive urban district that enhances quality of life and promotes sustainable urban development.

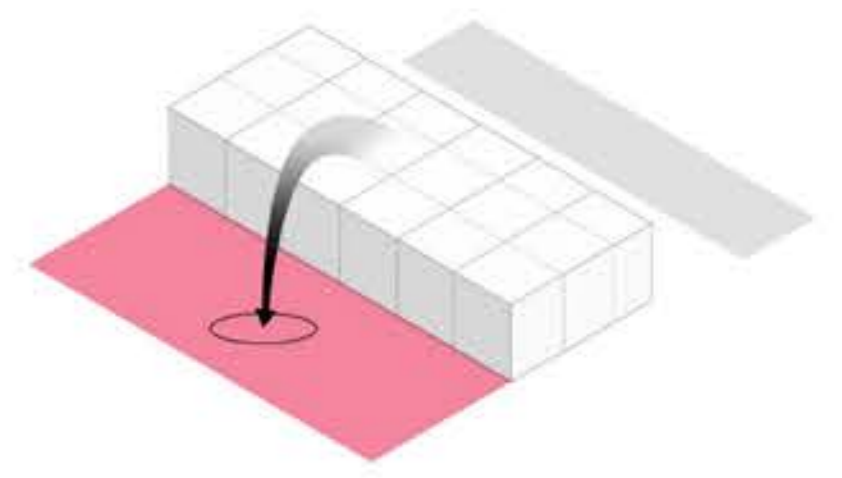
To define the density of the inhabitants that would live in the new Scalo Farini we studied the demography in the surrounding buildings to match a similar total number of inhabitants.

**Site implementation**

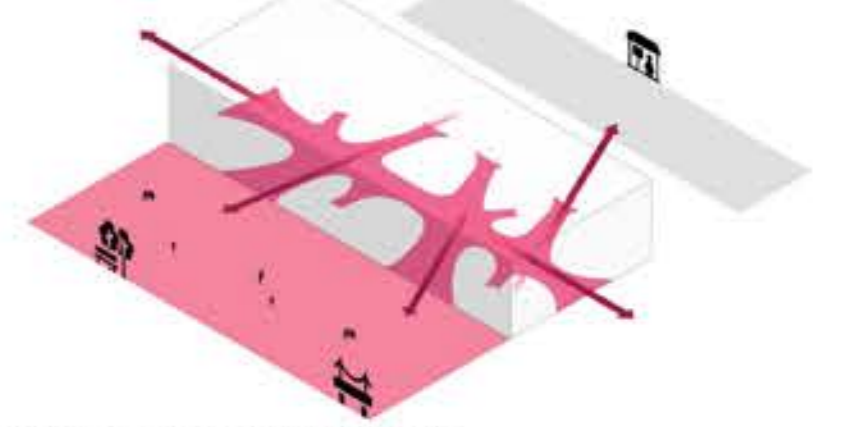
The site plot for the library is the most central block in the masterplan, this allowed to have a close connection with both architectural elements such as

the new Brera Campus in the south east, or the park "la linea" but also with transportation manners. For instance the main foot-bridge passing over the railway, brings the visitors coming from the M5 station, between the university building and our library site area. Additionally, the tram stop and Milano Lancetti station are located along the main avenue.

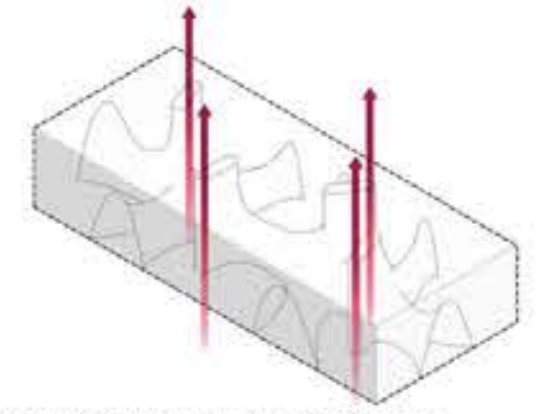
In implementing our library project within the site, we drew inspiration from the innovative design approach used in the Rolex Learning Center by Sanaa. Specifically, we reimagined the building entrance system to deviate from traditional conventions, opting instead to centralize entrances at the heart of the structure rather than along its periphery. This strategic placement facilitates accessibility and enhances user experience by eliminating the need for visitors to navigate around the building to locate the main entrance. This centralized entrance design enables people to approach from all directions, fostering a seamless flow of pedestrian traffic and ensuring ease of access from various points within the site from the pedestrian bridge, the Brera campus, the tram stop and the road coming from Via degli Imbriani. By adopting this approach, we not only prioritize convenience and functionality but also create a dynamic and inviting architectural presence, thanks to the unique shape resulting from this statement, that connects with the surrounding urban context.



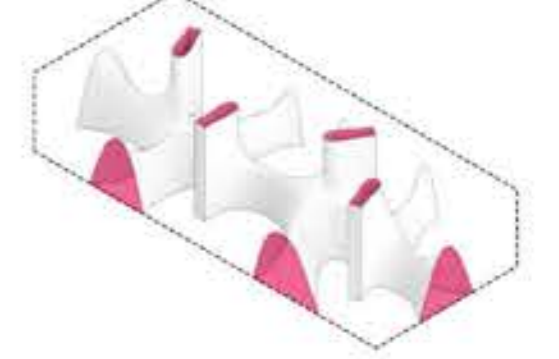
THE GRID



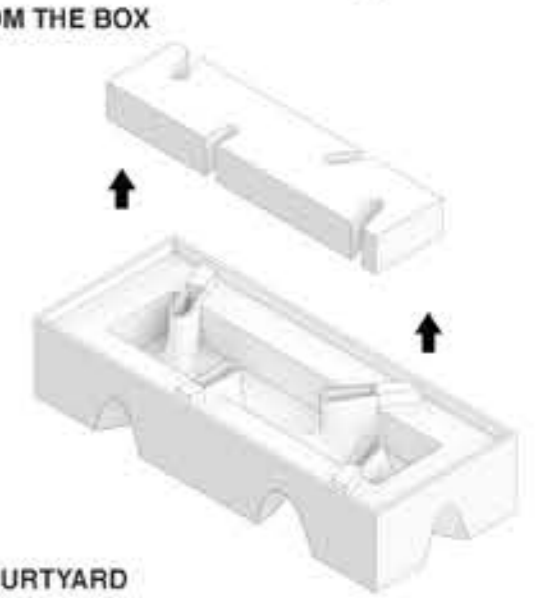
MAIN VIEWPOINTS AND CONNECTION



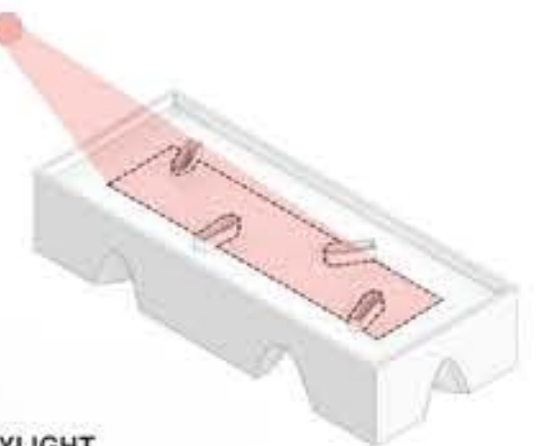
VERTICAL CONNECTION AND FORM THE SHELL



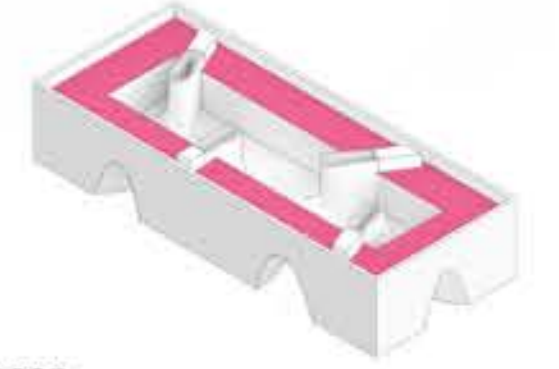
CUT OUT FROM THE BOX



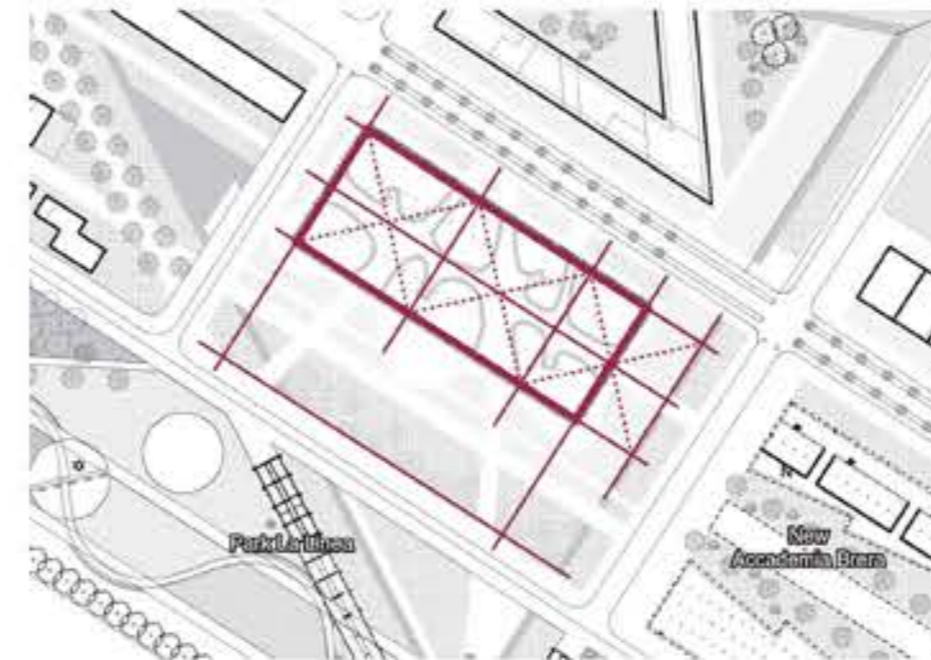
CREATE A COURTYARD



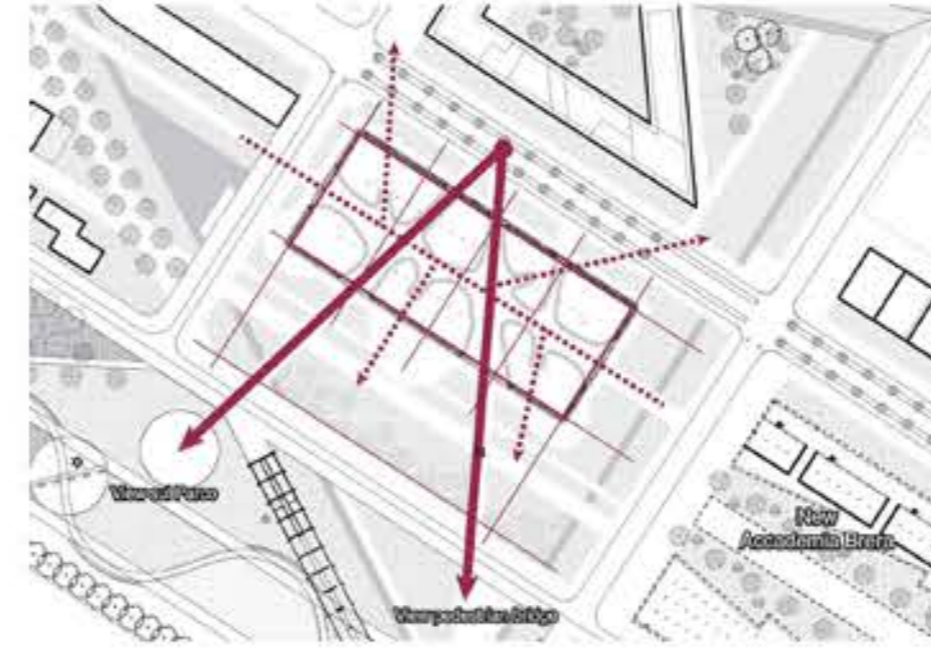
CREATE A SKYLIGHT



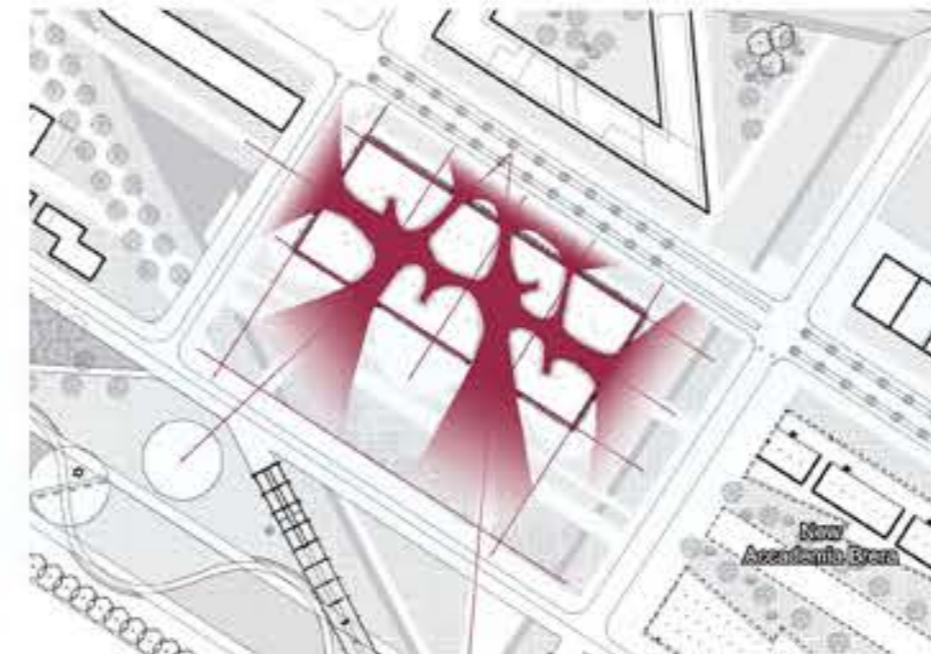
ADD GREEN ROOF



PROJECT PROPORTIONS



MAIN URBAN AXIS



VIEW POINTS DEFINING THE PUBLIC SPACE

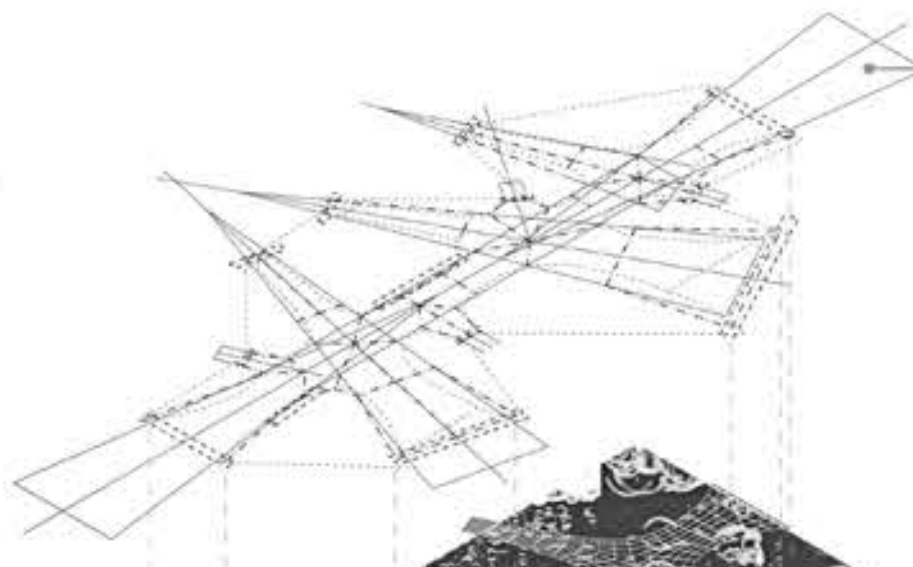




stay in a bubble  
so out of your bubble



Individualism Collectivism



THOUGHTFUL COMPOSITION  
CONSTRUCTION LINES



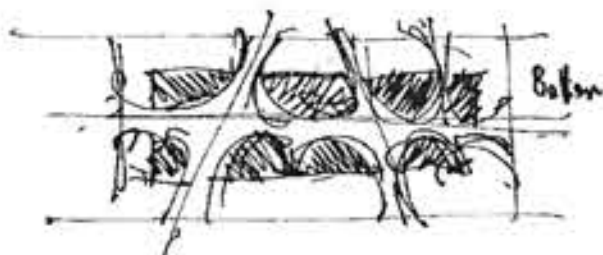
BUBBLE SPACES:  
FUNCTIONAL ARRANGEMENT



LINKING KNOWLEDGE  
INTERIOR CIRCULATIONS



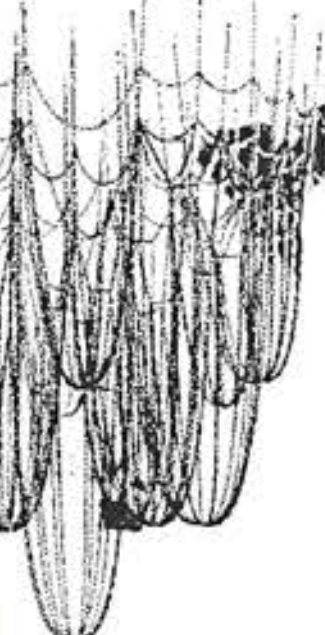
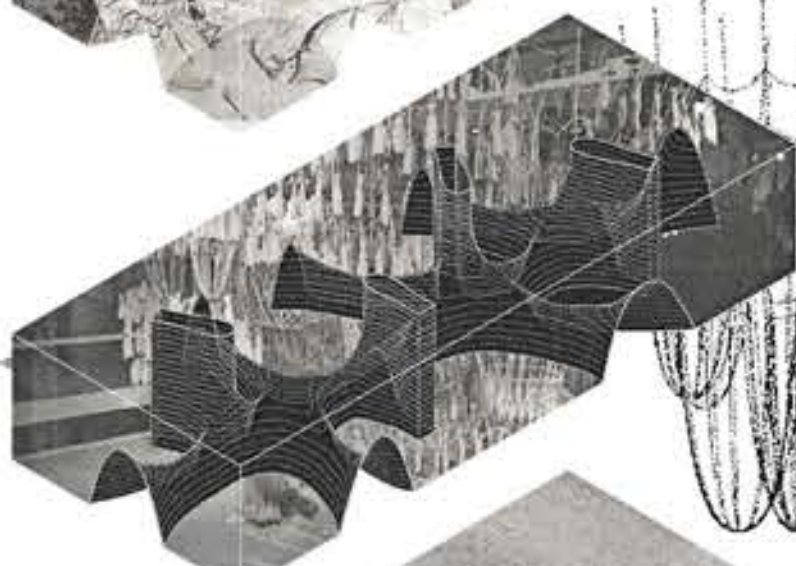
PROJECT POETRY  
A WELCOMING CAVE IMMERSED BY FOG



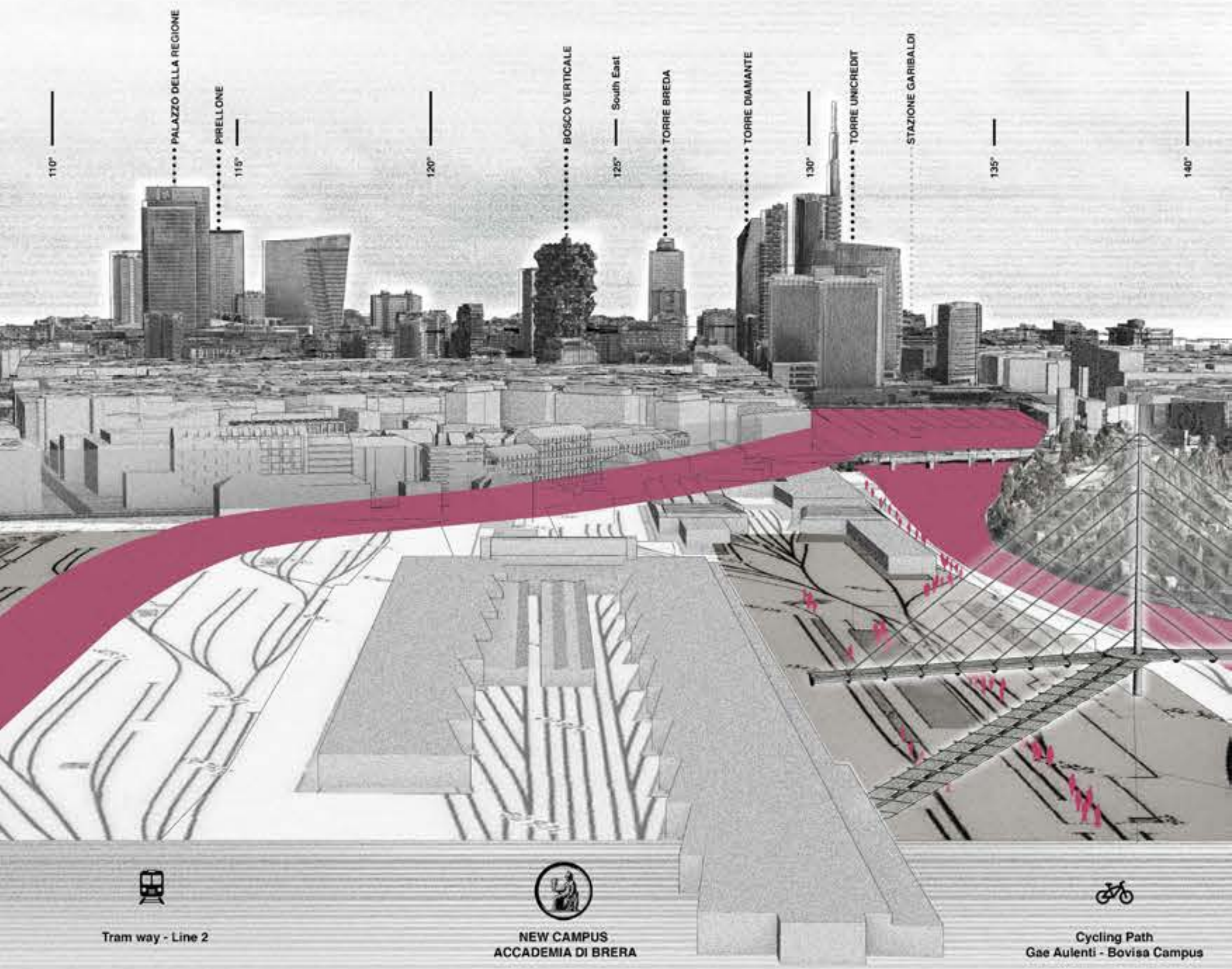
INSPIRED BY THE PAST



LOOKING TOWARDS THE FUTURE  
CATENARY LINES



A NEW LANDMARK



Tram way - Line 2



NEW CAMPUS  
ACCADEMIA DI BRERA



Cycling Path  
Gae Aulenti - Bovisa Campus



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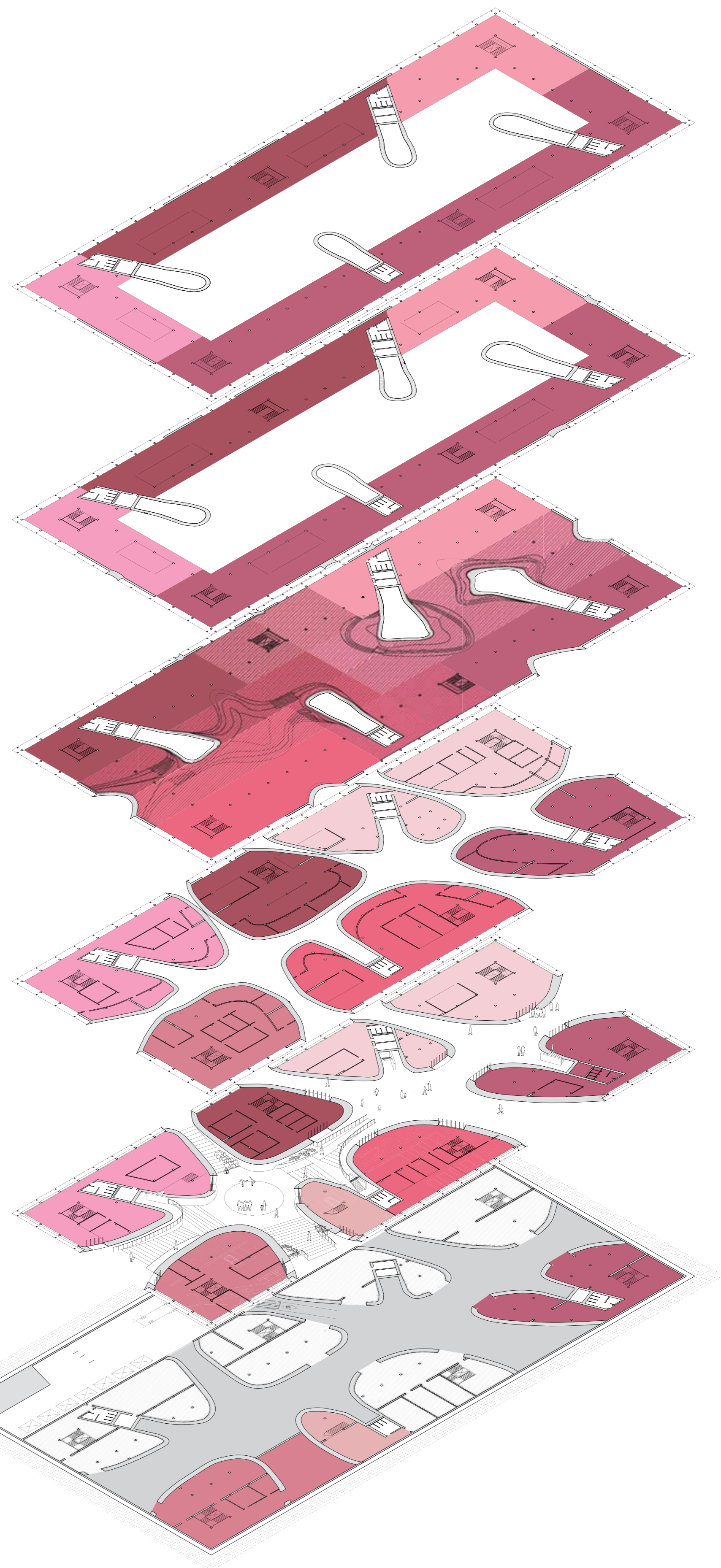
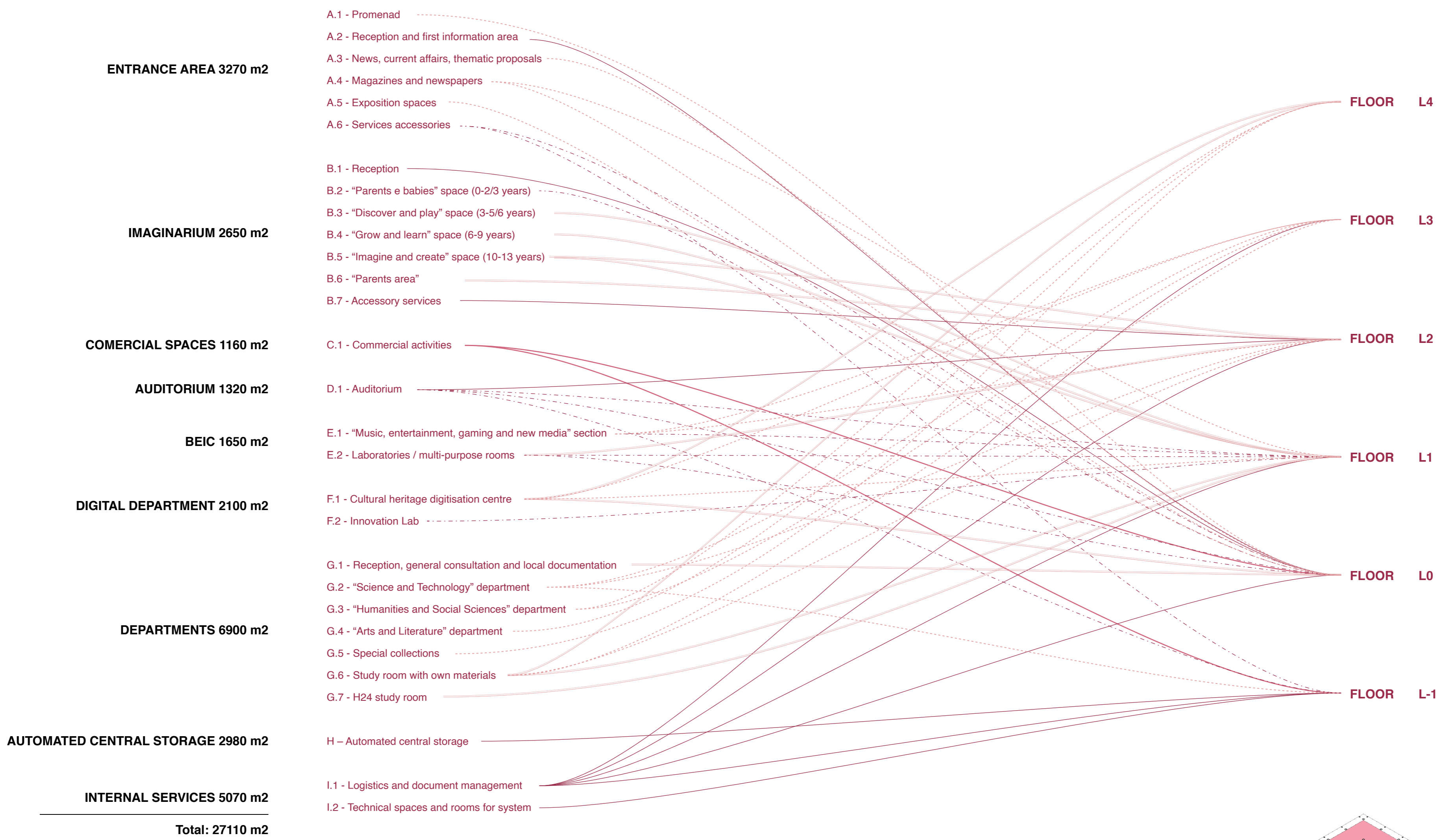
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**Functional Arrangement**

In designing the functional arrangement of the library building, we encountered a unique challenge due to its unconventional organic shape. At first look, the building's form may appear to dictate an unfocused or haphazard distribution of functions. However, through careful study and analysis of the programmatic requirements, we devised a strategic layout to ensure clarity and efficiency in user experience.

One of the primary considerations was the creation of dedicated entrances for essential areas such as the Imaginarium, the departments, BEIC (Biblioteca Europea di Informazione e Cultura), office spaces, and the 24-hour study room exclusively accessible to students.

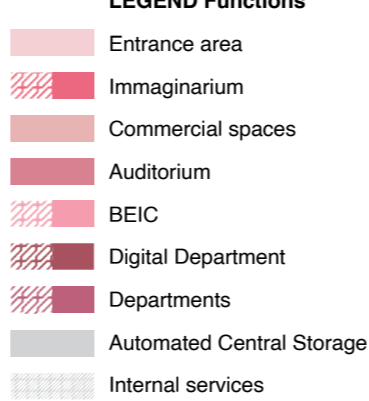
By strategically integrating these specific entrances into the building's design, we aimed to enhance functionality, accessibility, and user experience within the library. Despite the apparent complexity of the organic shape dividing the ground floor, our meticulous attention to programmatic requirements enabled us to devise a cohesive and intuitive layout that optimizes the utilization of space and supports the diverse needs of library patrons. Through thoughtful design decisions and a thorough understanding of user needs, we have created a functional arrangement that promotes efficiency, clarity, and ease of use, ensuring

that the library building serves as a welcoming and accessible resource for the community.

Continuing with the functional arrangement, we extended our design considerations vertically, ensuring coherence and efficiency across multiple levels of the library building. While the ground floor accommodates divided functions within the organic shape, we strategically consolidated these areas on the second floor, creating a seamless and inviting open space that spans the entire floor surface. This cohesive design approach fosters connectivity and fluidity between different library functions, promoting ease of navigation and enhancing user experience. Moreover, recognizing the need for privacy and enclosed spaces, we positioned rooms requiring such attributes, such as meeting rooms and study pods, between the ground floor and the second level. This placement optimizes spatial efficiency while maintaining an open and expansive atmosphere on the top floor, encouraging exploration and interaction among patrons.

By integrating both horizontal and vertical considerations into the functional arrangement, we have crafted a dynamic and versatile library environment that caters to the diverse needs and preferences of its users while maximizing the utilization of space and promoting a sense of unity and cohesion throughout the building.

**LEGEND Functions**



**Main Professor:**

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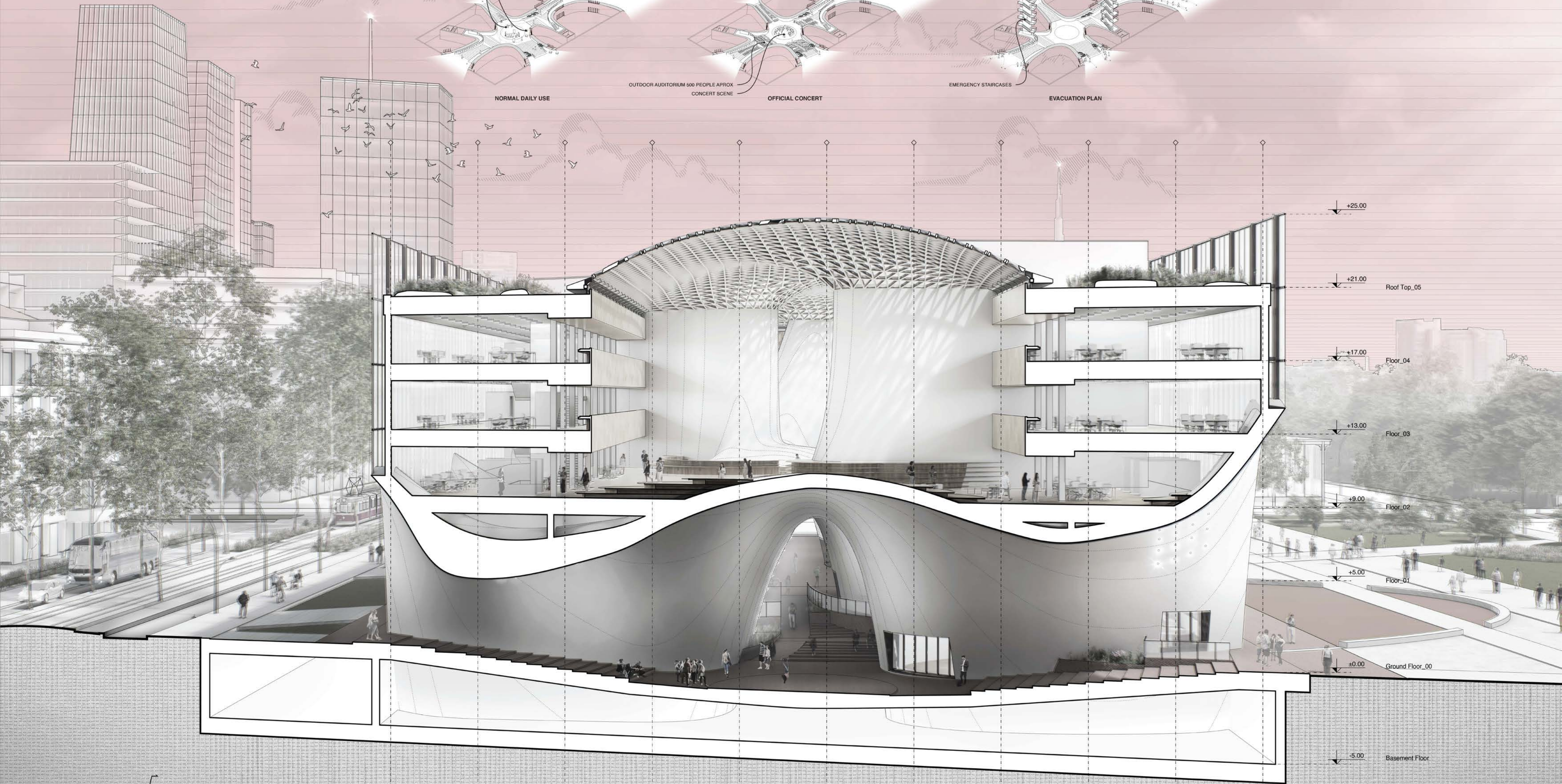
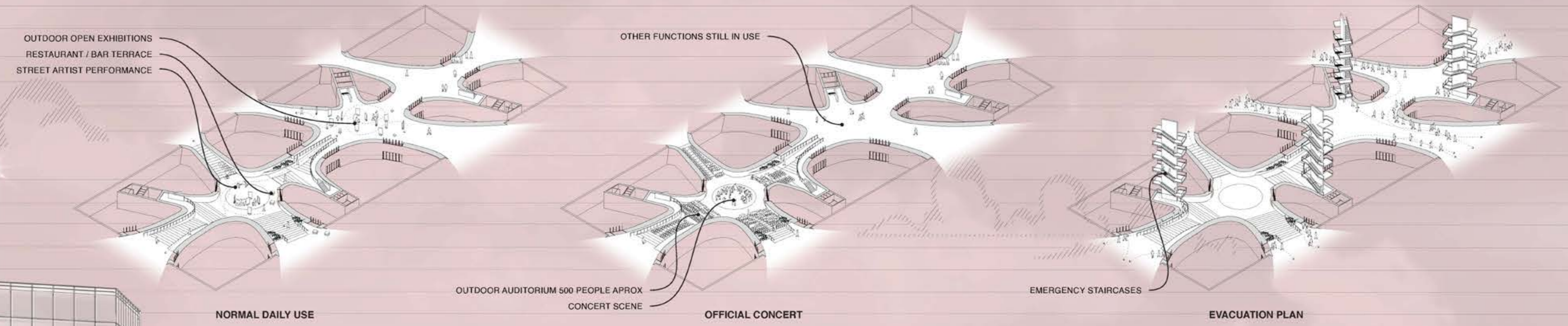
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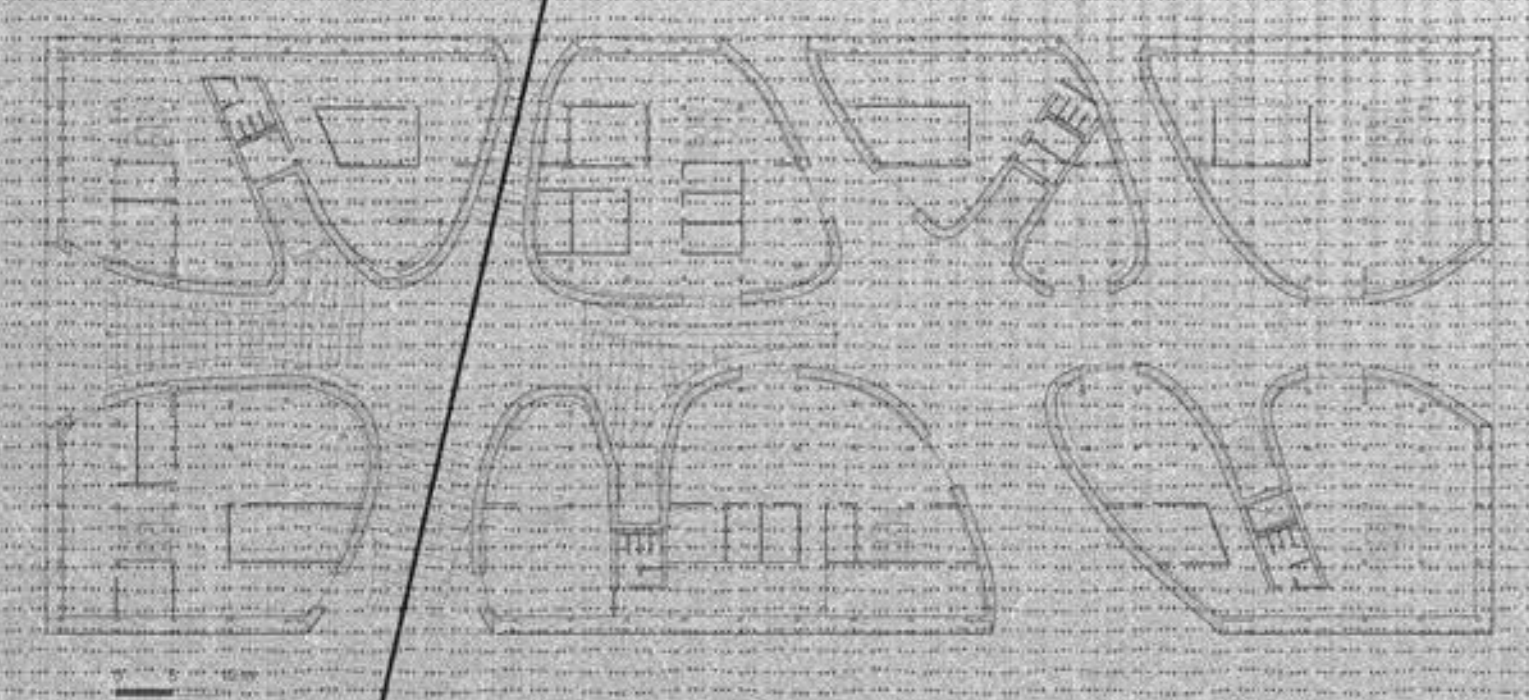
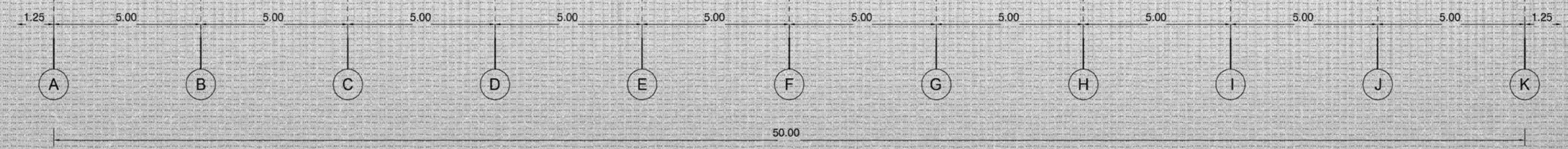
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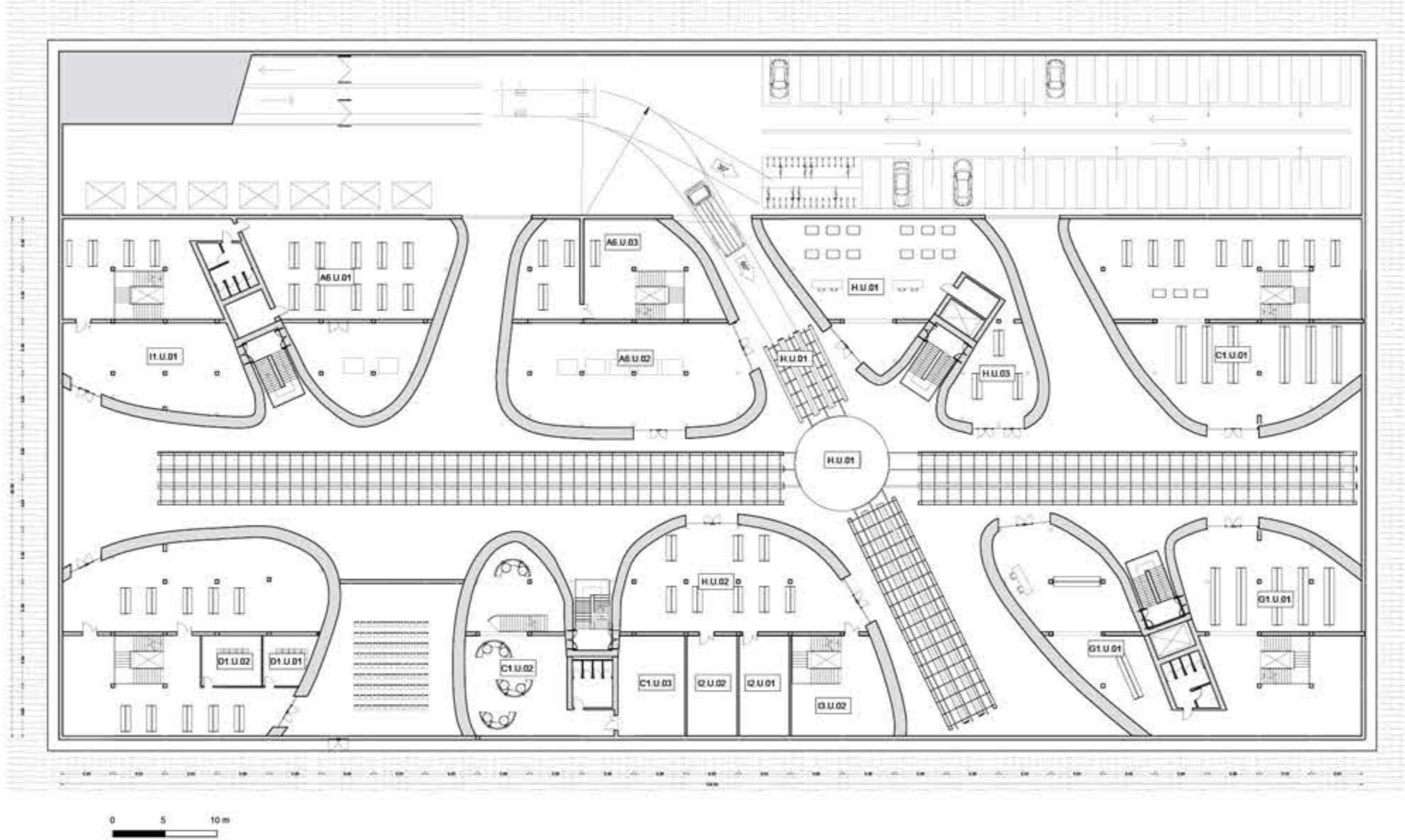




+25.00  
 +21.00 Roof Top\_05  
 +17.00 Floor\_04  
 +13.00 Floor\_03  
 +9.00 Floor\_02  
 +5.00 Floor\_01  
 ±0.00 Ground Floor\_00  
 -5.00 Basement Floor







**BASEMENT PLAN** SCALE 1/400

**ENTRANCE AREA**

A.6 - Servizi accessor

A6.U.01 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.)	280 m <sup>2</sup>
A6.U.02 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.)	350 m <sup>2</sup>
A6.U.03 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.)	40 m <sup>2</sup>
A6.U.04 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.)	160 m <sup>2</sup>
A6.U.05 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.)	210 m <sup>2</sup>

**COMERCIAL SPACES**

C.1 - Commercial activities

C1.U.01 bookshop	460 m <sup>2</sup>
C1.U.02 cafeteria/bistrot	110 m <sup>2</sup>
C1.U.03 kitchen for cafeteria/bistrot	60 m <sup>2</sup>

**AUDITORIUM**

D.1 - Auditorium

D1.U.01 dressing rooms	20 m <sup>2</sup>
D1.U.02 dressing rooms	30 m <sup>2</sup>
D1.U.03 lecture room	220 m <sup>2</sup>

**DEPARTMENTS**

G.2 - "Science and Technology" department

G2.U.01 unified floor storage	480 m <sup>2</sup>
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**AUTOMATED CENTRAL STORAGE**

H - AUTOMATED CENTRAL STORAGE

H.U.01 automated central storage	2720 m <sup>2</sup>
H.U.02 spaces for systems and machinery	190 m <sup>2</sup>
H.U.03 spaces for systems and machinery	70 m <sup>2</sup>

**INTERNAL SERVICES**

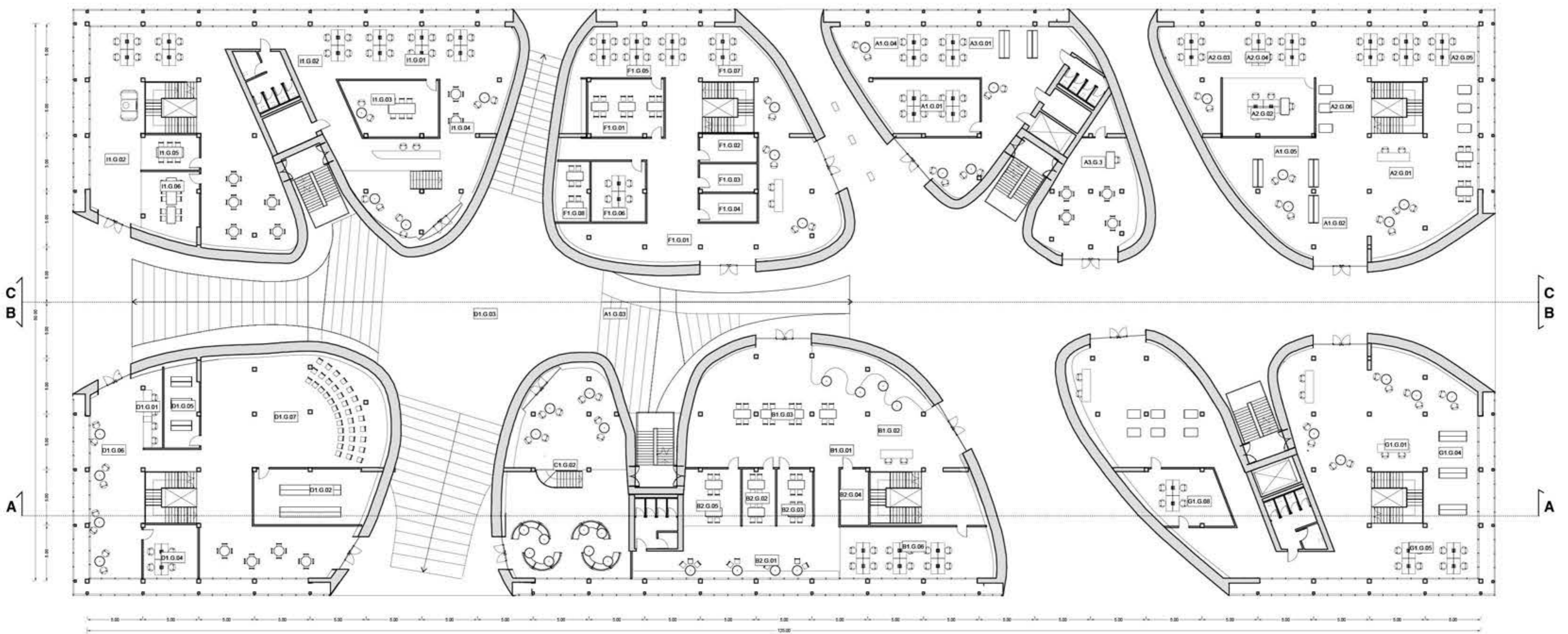
I.2 - Technical spaces and rooms for system

I2.U.01 spaces for systems and machinery	50 m <sup>2</sup>
I2.U.02 spaces for systems and machinery	50 m <sup>2</sup>

I.1 - Logistics and document management

I1.U.01 storage and support rooms	280 m <sup>2</sup>
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Total 5780 m<sup>2</sup>



**GROUND FLOOR PLAN** SCALE 1/250

**ENTRANCE AREA**

A.1 - Promenad

A1.G.01 sorting room for "book return" stations	50 m <sup>2</sup>
A1.G.02 foyer/circulation space	170 m <sup>2</sup>
A1.G.03 circulation space	2280 m <sup>2</sup>
A1.G.04 stopover spaces	50 m <sup>2</sup>
A1.G.05 foyer/circulation space	70 m <sup>2</sup>

**A.2 Reception and first information area**

A2.G.01 reception, orientation and first information counter	30 m <sup>2</sup>
A2.G.02 back-office workspace	40 m <sup>2</sup>
A2.G.03 quick OPAC/Internet	30 m <sup>2</sup>
A2.G.04 OPAC/Internet consultation	50 m <sup>2</sup>
A2.G.05 OPAC/Internet consultation	50 m <sup>2</sup>
A2.G.06 infopoint area	50 m <sup>2</sup>

**A.3 - News, current affairs, thematic proposals**

A3.G.01 exposition of volume	110 m <sup>2</sup>
A3.G.02 individual service workstations for room staff	10 m <sup>2</sup>
A3.G.3 unsystematic consultation	110 m <sup>2</sup>

**IMAGINARIUM**

B.1 - Reception

B1.G.01 foyer/circulation space	130 m <sup>2</sup>
B1.G.02 reception, orientation and first information counter	50 m <sup>2</sup>
B1.G.03 infopoint area	30 m <sup>2</sup>
B1.G.04 quick OPAC/Internet consultation	10 m <sup>2</sup>
B1.G.05 restroom	20 m <sup>2</sup>
B1.G.06 back-office workspaces	60 m <sup>2</sup>

B.2 - "Parents e babies" space (0-2/3 years)

B2.G.01 exposition of volumes (in shaped containers)	80 m <sup>2</sup>
B2.G.02 play and animation spaces	20 m <sup>2</sup>
B2.G.03 play and animation spaces	20 m <sup>2</sup>
B2.G.04 pit-stop room	10 m <sup>2</sup>
B2.G.04 storage for prams and pushchairs	30 m <sup>2</sup>

**COMERCIAL SPACES**

C.1 - Commercial activities

C1.G.01 pop-up stores	360 m <sup>2</sup>
C1.G.02 cafeteria/bistrot	170 m <sup>2</sup>

**AUDITORIUM**

D.1 - Auditorium

D1.G.01 reception counter/tickets desk	10 m <sup>2</sup>
D1.G.02 cloakroom	50 m <sup>2</sup>
D1.G.03 auditorium	200 m <sup>2</sup>
D1.G.04 simultaneous translation booths	20 m <sup>2</sup>
D1.G.05 storage and service rooms, adjacent to the stage	30 m <sup>2</sup>
D1.G.06 foyer/circulation space	80 m <sup>2</sup>
D1.G.07 lecture room	110 m <sup>2</sup>

**DIGITAL DEPARTMENT**

F.1 - Cultural heritage digitisation centre

F1.G.01 e-varies	200 m <sup>2</sup>
F1.G.02 digitalisation of books	10 m <sup>2</sup>
F1.G.03 digitalisation of books	10 m <sup>2</sup>
F1.G.04 digitalisation of books	10 m <sup>2</sup>
F1.G.05 rooms for special projects	40 m <sup>2</sup>
F1.G.06 audio, video and object digitisation	30 m <sup>2</sup>
F1.G.07 quality control (colour, foliation, naming, technical and structural metadata) and validation activities, metadata control and format conversion	20 m <sup>2</sup>
F1.G.08 audio, video and object digitisation	10 m <sup>2</sup>

**DEPARTMENTS**

G.1 - Reception, general consultation and local documentation

G1.G.01G.1 - Reception, general consultation and local documentation	30 m <sup>2</sup>
G1.G.04 general consultation and local	60 m <sup>2</sup>
G1.G.05 quick OPAC/Internet	50 m <sup>2</sup>
G1.G.08 ack-office workspaces	30 m <sup>2</sup>

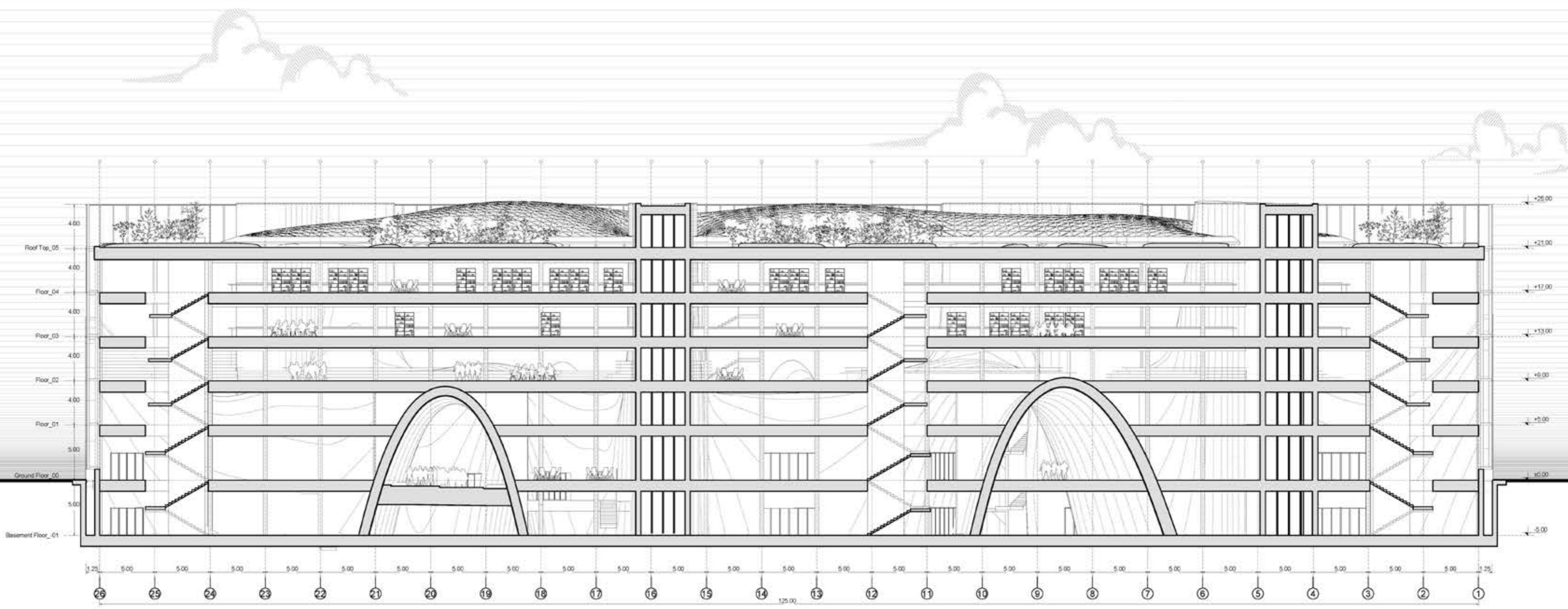
**INTERNAL SERVICES**

I.1 - Logistics and document management

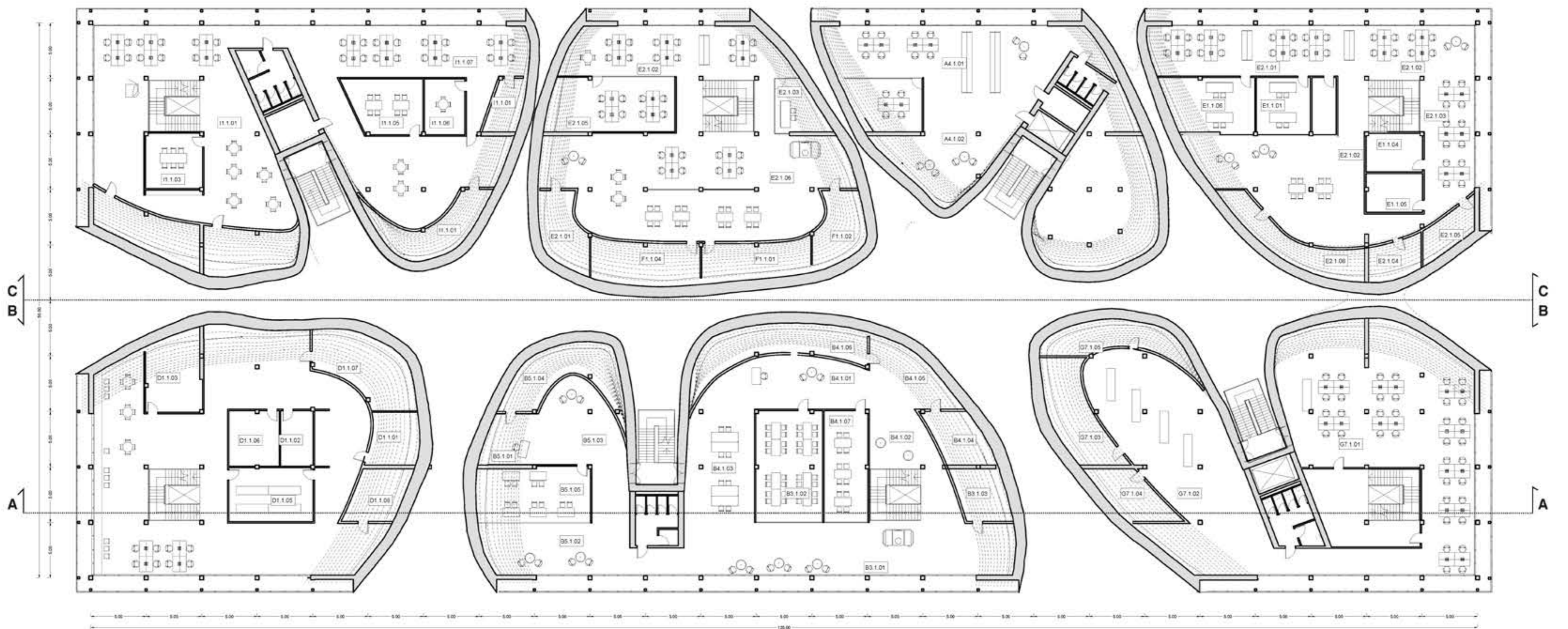
I1.G.01 IT	80 m <sup>2</sup>
I1.G.02 document management	360 m <sup>2</sup>
I1.G.03 document management	40 m <sup>2</sup>
I1.G.04 document management	20 m <sup>2</sup>
I1.G.05 document management	20 m <sup>2</sup>
I1.G.06 document management	30 m <sup>2</sup>
I1.G.07 restrooms	20 m <sup>2</sup>

Total 5630 m<sup>2</sup>





SECTION A SCALE 1/250



FIRST FLOOR PLAN SCALE 1/250

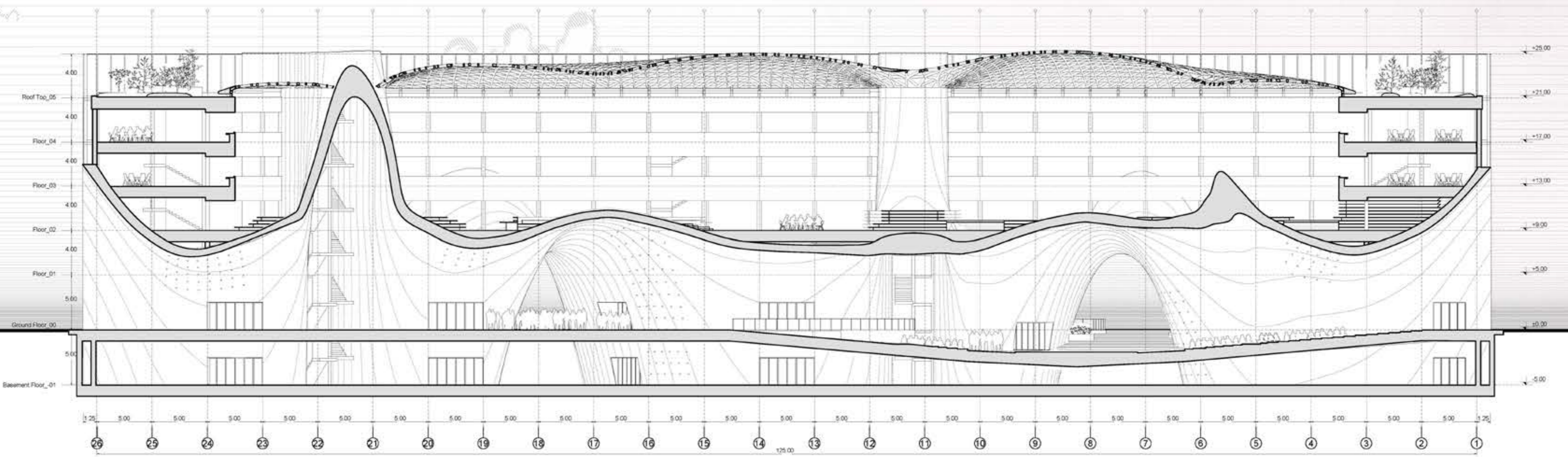
<b>ENTRANCE AREA</b>	
A4.1.01 exposition of magazines and newspapers	100 m <sup>2</sup>
A4.1.02 unsystematic consultation	80 m <sup>2</sup>
<b>IMAGINARIUM</b>	
B3.1.01 "Discover and play" space (3-5/6 years)	140 m <sup>2</sup>
B3.1.02 exhibition of volumes (in shaped containers and on low-lying shelves)	60 m <sup>2</sup>
B3.1.03 play, reading and animation spaces	60 m <sup>2</sup>
B3.1.03 consultation spaces for adults and children	20 m <sup>2</sup>
B4 - "Grow and learn" space (6-9 years)	
B4.1.01 exposition of volumes (in shaped containers and on low-lying shelves)	90 m <sup>2</sup>
B4.1.02 exhibition of volumes and thematic areas	70 m <sup>2</sup>
B4.1.03 spaces for reading, unsystematic consultation, play and relax activities	60 m <sup>2</sup>
B4.1.04 storage	20 m <sup>2</sup>
B4.1.05 storage	10 m <sup>2</sup>
B4.1.06 individual service workstations for room staff	10 m <sup>2</sup>
B4.1.07 coding laboratory	40 m <sup>2</sup>
B5 - "Imagine and create" space (10-13 years)	
B5.1.01 individual service workstations for room staff	10 m <sup>2</sup>
B5.1.02 exposition of volumes (in shaped containers and on low-lying shelves)	60 m <sup>2</sup>
B5.1.03 spaces for reading, unsystematic consultation, play and relax activities	70 m <sup>2</sup>

B5.1.04 storage	40 m <sup>2</sup>
B5.1.05 educational robotics laboratory	50 m <sup>2</sup>
<b>AUDITORIUM</b>	
D1 - Auditorium	
D1.1.01 dressing rooms	20 m <sup>2</sup>
D1.1.02 dressing rooms	10 m <sup>2</sup>
D1.1.03 lecture room	30 m <sup>2</sup>
D1.1.04 cloakroom lockers for bags, D1.1.05 cloakroom lockers for bags, D1.1.06 cloakroom lockers for bags, D1.1.07 cloakroom lockers for bags, D1.1.08 cloakroom lockers for bags,	370 m <sup>2</sup>
<b>BEIC</b>	
E2 - Laboratories / multi-purpose rooms	
E2.1.01 laboratories / makerspace / fablab	80 m <sup>2</sup>
E2.1.02 laboratories / makerspace / fablab	220 m <sup>2</sup>
E2.1.03 laboratories / makerspace / fablab	50 m <sup>2</sup>
E2.1.04 storage rooms	20 m <sup>2</sup>
E2.1.05 storage rooms	10 m <sup>2</sup>
E2.1.06 storage rooms	20 m <sup>2</sup>
E1 - "Music, entertainment, gaming and new media" section	
E1.1.01 audiovisual storage	30 m <sup>2</sup>
E1.1.04 video room	20 m <sup>2</sup>
E1.1.05 video room	20 m <sup>2</sup>
E1.1.06 recording room	30 m <sup>2</sup>

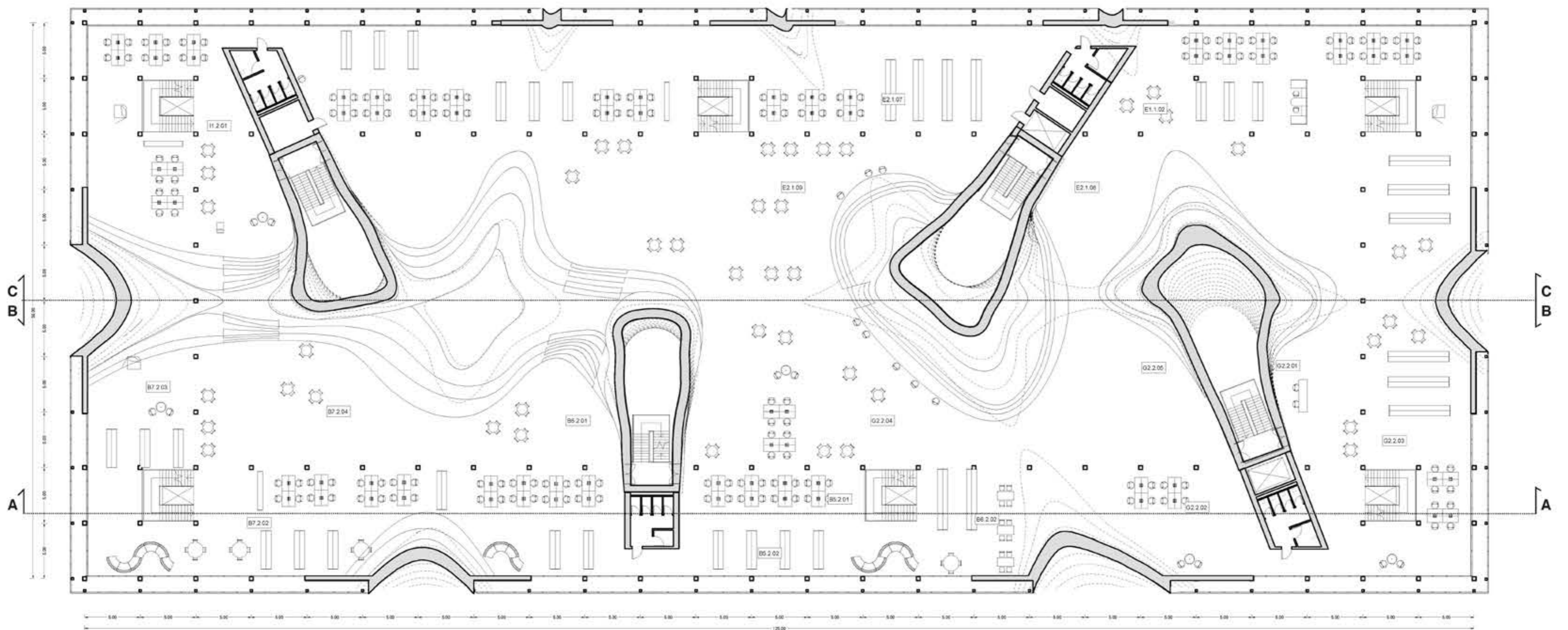
<b>DIGITAL DEPARTMENT</b>	
F1 - Cultural heritage digitalisation centre	
F1.1.01 long-term archiving; medium-term archiving; monitoring of all management functionalities (access, monitors, librarianship modules, security, setting, etc.)	30 m <sup>2</sup>
F1.1.02 storage	30 m <sup>2</sup>
F1.1.03 quality control (colour, foliation, naming, technical and structural metadata) and validation activities, metadata control and format conversion	110 m <sup>2</sup>
F1.1.04 long-term archiving; medium-term archiving; monitoring of all management functionalities (access, monitors, librarianship modules, security, setting, etc.)	30 m <sup>2</sup>
E2 - Innovation Lab	
F2.1.01 storage	30 m <sup>2</sup>
F2.1.02 rooms for special projects (B.E.I.C. and digital portal management, virtual exhibitions, in-depth workshops, educational and tourist blogs, social activities)	20 m <sup>2</sup>
F2.1.03 Robo Lab	20 m <sup>2</sup>
F2.1.04 storage	10 m <sup>2</sup>
F2.1.05 VR Lab	50 m <sup>2</sup>
F2.1.06 AI & Machine Learning Lab	40 m <sup>2</sup>
<b>DEPARTMENTS</b>	
G7 - H24 study room	250 m <sup>2</sup>
G7.1.01 study room	240 m <sup>2</sup>
G7.1.02 relax room	240 m <sup>2</sup>

G7.1.03 reading and consultation	30 m <sup>2</sup>
G7.1.04 storage	20 m <sup>2</sup>
G7.1.05 audiovisual storage	20 m <sup>2</sup>
<b>INTERNAL SERVICES</b>	
I1 - Logistics and document management	
I1.1.01 document management	510 m <sup>2</sup>
I1.1.02 document management	30 m <sup>2</sup>
I1.1.03 document management	30 m <sup>2</sup>
I1.1.05 document management	30 m <sup>2</sup>
I1.1.06 document management	20 m <sup>2</sup>
I1.1.07 document management	510 m <sup>2</sup>
<b>Total 4010 m<sup>2</sup></b>	





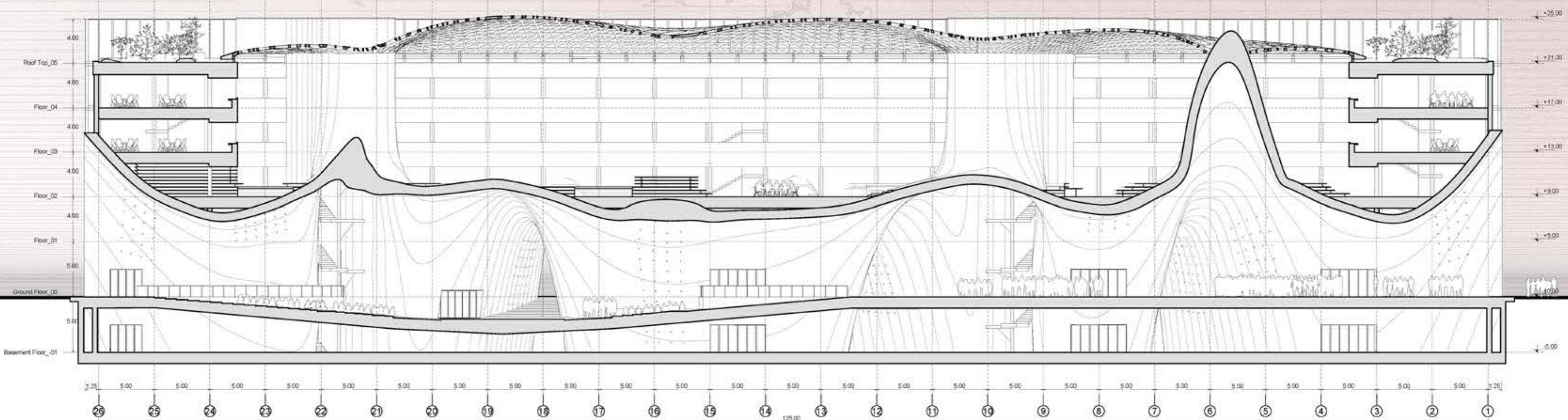
SECTION B SCALE 1/250



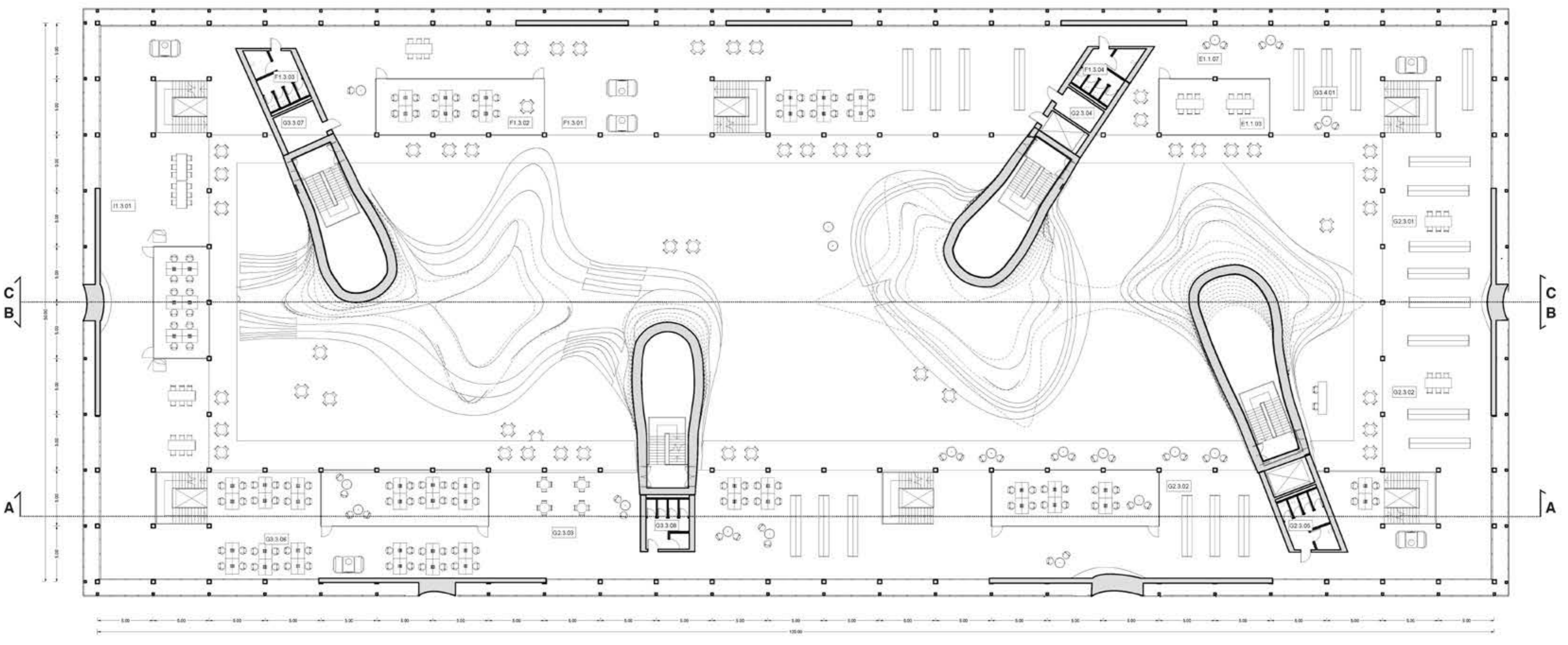
SECOND FLOOR PLAN SCALE 1/250

<b>ENTRANCE AREA</b>	
A.6 - Services accesses	
A6.U.01 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.)	280 m <sup>2</sup>
A6.U.02 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.)	350 m <sup>2</sup>
A6.U.03 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.)	40 m <sup>2</sup>
A6.U.04 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.)	160 m <sup>2</sup>
A6.U.05 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.)	210 m <sup>2</sup>
<b>COMMERCIAL SPACES</b>	
C.1 - Commercial activities	
Cl.U.01 bookshop	460 m <sup>2</sup>
Cl.U.02 cafeteria/bistro	110 m <sup>2</sup>
Cl.U.03 kitchen for cafeteria/bistro	60 m <sup>2</sup>
<b>AUDITORIUM</b>	
D.1 - Auditorium	
D1.U.01 dressing rooms	20 m <sup>2</sup>
D1.U.02 dressing rooms	30 m <sup>2</sup>
D1.U.03 lecture room	220 m <sup>2</sup>

<b>DEPARTMENTS</b>	
G.2 - "Science and Technology" department	
G2.U.01 unified floor storage	480 m <sup>2</sup>
<b>AUTOMATED CENTRAL STORAGE</b>	
H - AUTOMATED CENTRAL STORAGE	
H.U.01 automated central storage	2720 m <sup>2</sup>
H.U.02 spaces for systems and machinery	190 m <sup>2</sup>
H.U.03 spaces for systems and machinery	70 m <sup>2</sup>
<b>INTERNAL SERVICES</b>	
I.2 - Technical spaces and rooms for system	
I2.U.01 spaces for systems and machinery	50 m <sup>2</sup>
I2.U.02 spaces for systems and machinery	50 m <sup>2</sup>
I.1 - Logistics and document management	
I1.U.01 storage and support rooms	280 m <sup>2</sup>
<b>Total 5780 m<sup>2</sup></b>	



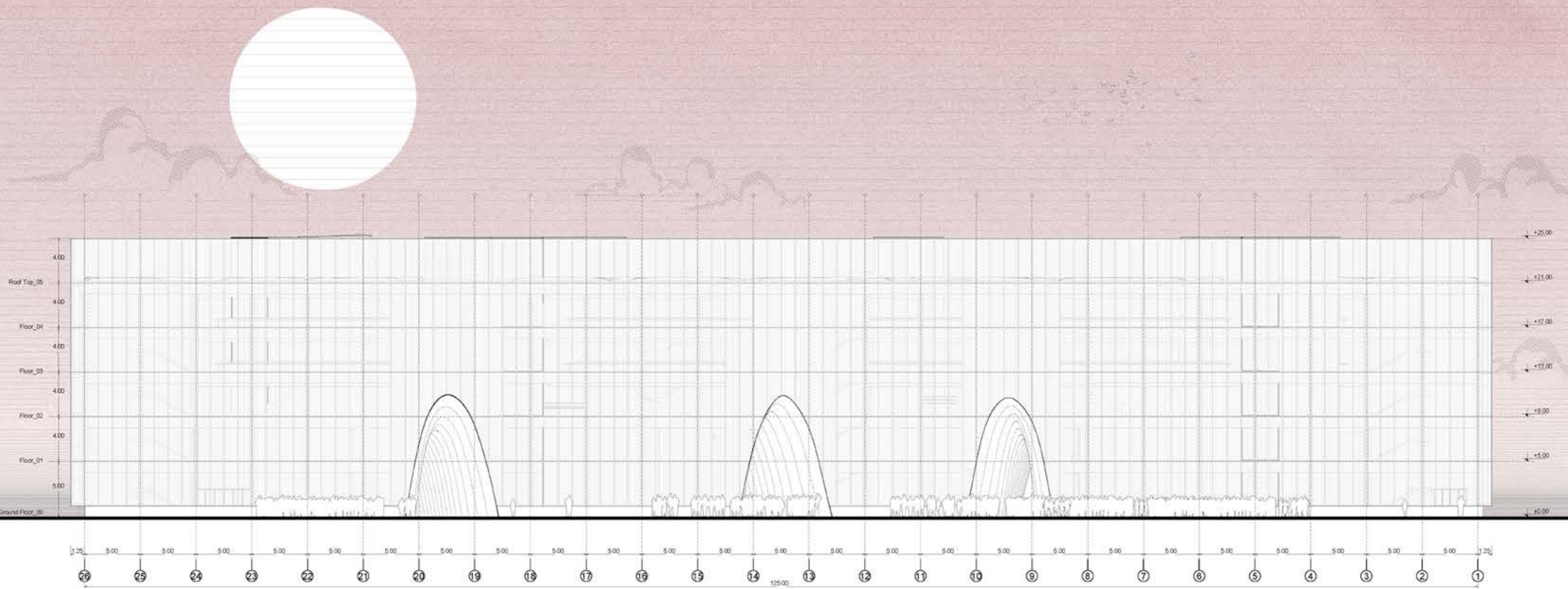
SECTION C SCALE 1/250



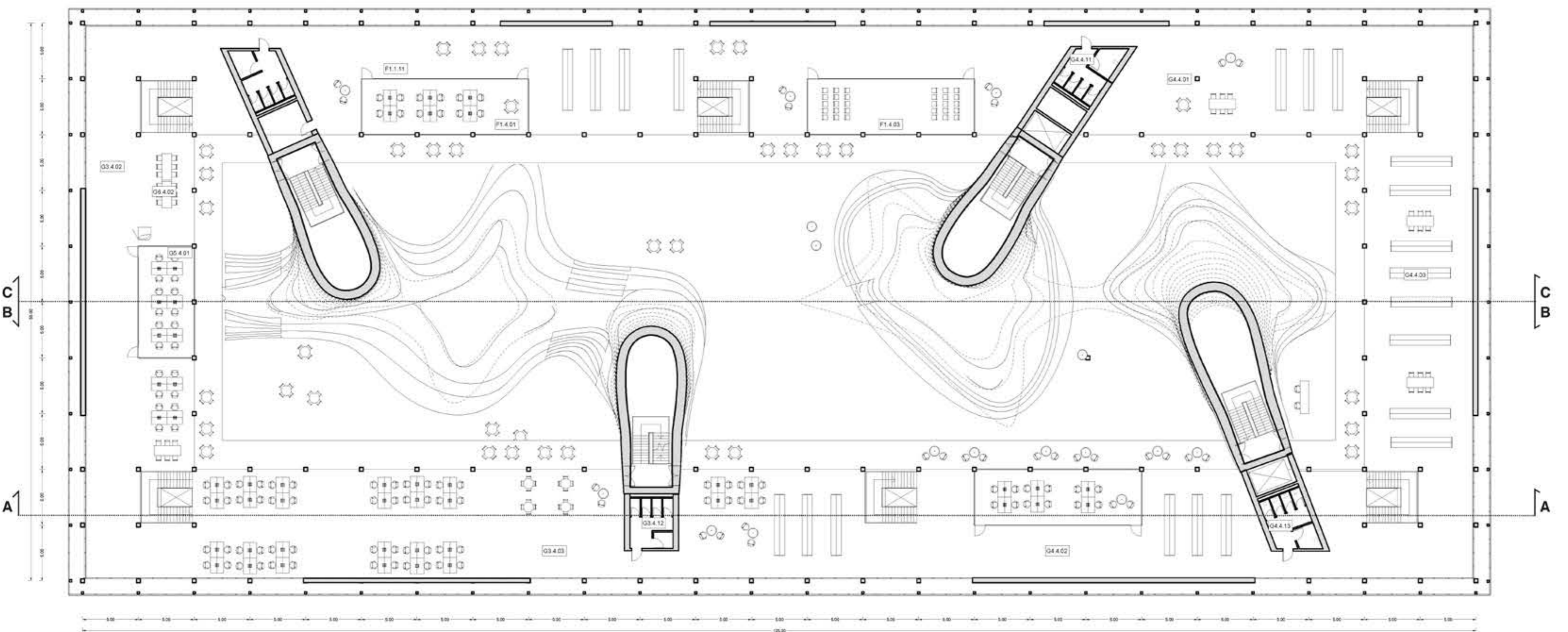
THIRD FLOOR PLAN SCALE 1/250

<b>BEIC</b>		<b>G.3 - "Humanities and Social Sciences"</b>	
E.1 - "Music, entertainment, gaming and new media" section		G3.3.06 Thematic area B	
E1.1.03 III-End listening room	50 m <sup>2</sup>	interdisciplinary documentation	170 m <sup>2</sup>
E1.1.07 unsystematic consultation	50 m <sup>2</sup>	G3.3.07 server	10 m <sup>2</sup>
<b>DIGITAL DEPARTMENT</b>		G3.3.08 toilets and service rooms	
E.1 - Cultural heritage digitisation centre		(indicative quantification)	20 m <sup>2</sup>
F1.3.01 rooms for special projects (B.E.I.C. and digital portal management, virtual exhibitions, in-depth workshops, educational and tourist blogs, social activities)	910 m <sup>2</sup>	G3.4.05 rooms for groups	40 m <sup>2</sup>
F1.3.02 rooms for special projects (B.E.I.C. and digital portal management, virtual exhibitions, in-depth workshops, educational and tourist blogs, social activities)	80 m <sup>2</sup>	G3.4.01 Thematic area A	90 m <sup>2</sup>
F1.3.03 toilets and service rooms	20 m <sup>2</sup>		
F1.3.04 toilets and service rooms	20 m <sup>2</sup>	<b>G.6 - Study room with own materials</b>	
		G6.4.04 rooms for groups	80 m <sup>2</sup>
<b>DEPARTMENTS</b>		<b>INTERNAL SERVICES</b>	
G.2 - "Science and Technology" department		I.1 - Logistics and document management	
G2.3.01 Thematic area A	350 m <sup>2</sup>	I1.3.01 document management	90 m <sup>2</sup>
G2.3.02 Thematic area B	590 m <sup>2</sup>		
G2.3.03 Thematic area C interdisciplinary documentation	520 m <sup>2</sup>	<b>Total 3100 m<sup>2</sup></b>	
G2.3.04 server	10 m <sup>2</sup>		
G2.3.05 toilets and service rooms	20 m <sup>2</sup>		
(indicative quantification)			





NORTH-EAST FACADE SCALE 1/250

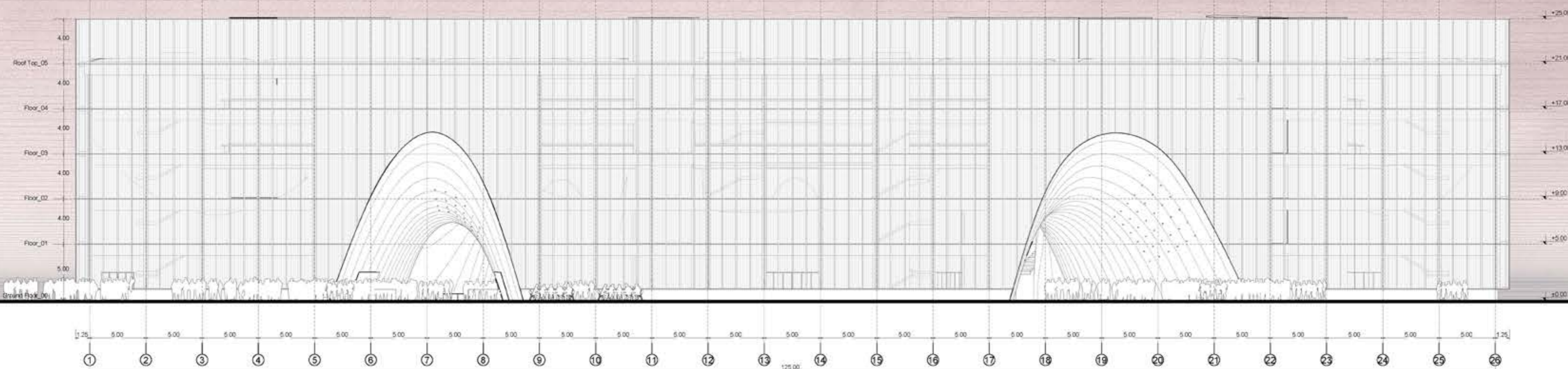


FOURTH FLOOR PLAN SCALE 1/250

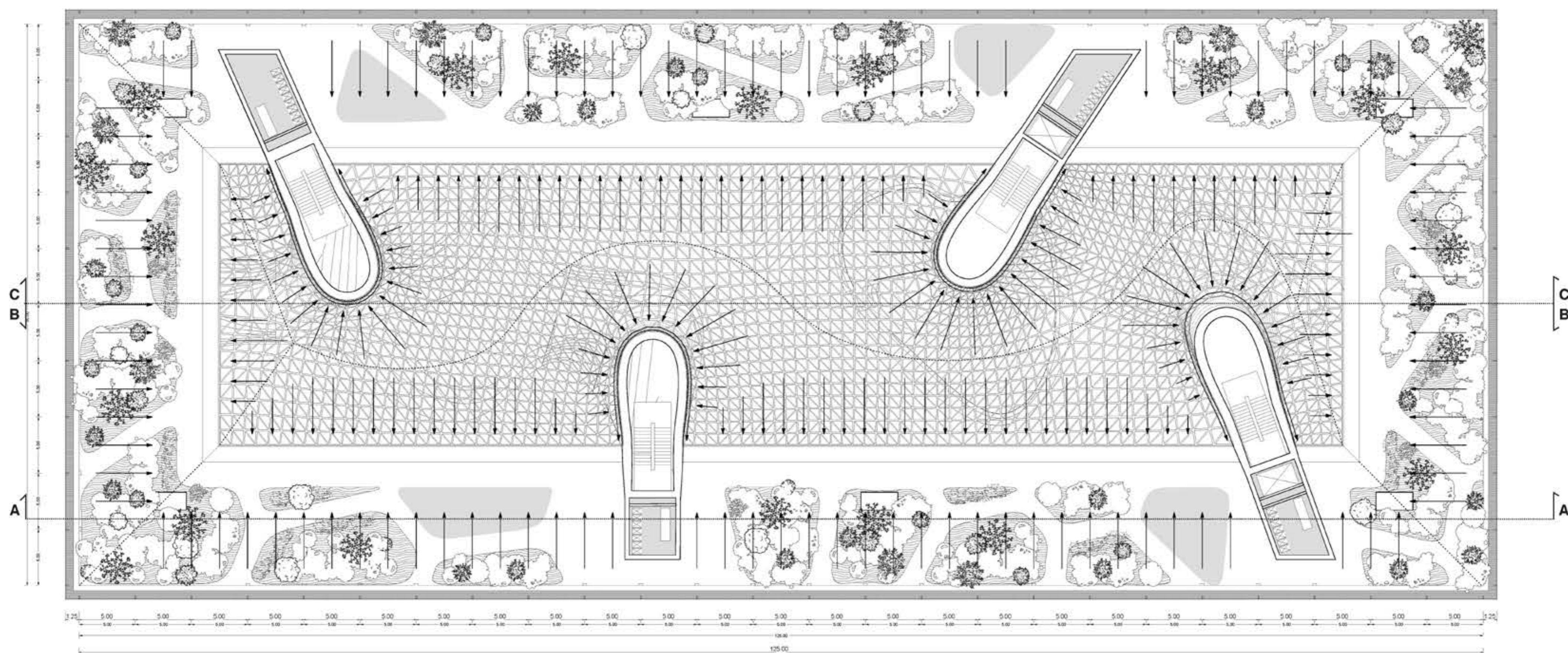
<b>BEIC</b>	
E.1 - "Music, entertainment, gaming and new media" section	
E1.1.03 Hi-End listening room	50 m <sup>2</sup>
E1.1.07 unsystematic consultation	50 m <sup>2</sup>
<b>DIGITAL DEPARTMENT</b>	
E1 - Cultural heritage digitisation centre	
F1.3.01 rooms for special projects (B.E.L.C. and digital portal management, virtual exhibitions, in-depth workshops, educational and tourist blogs, social activities)	910 m <sup>2</sup>
F1.3.02 rooms for special projects (B.E.L.C. and digital portal management, virtual exhibitions, in-depth workshops, educational and tourist blogs, social activities)	80 m <sup>2</sup>
F1.3.03 toilets and service rooms (indicative quantification)	20 m <sup>2</sup>
F1.3.04 toilets and service rooms (indicative quantification)	20 m <sup>2</sup>
<b>DEPARTMENTS</b>	
G.2 - "Science and Technology" department	
G2.3.01 Thematic area A	350 m <sup>2</sup>
G2.3.02 Thematic area B	590 m <sup>2</sup>
G2.3.03 Thematic area C interdisciplinary documentation	520 m <sup>2</sup>
G2.3.04 server	10 m <sup>2</sup>
G2.3.05 toilets and service rooms (indicative quantification)	20 m <sup>2</sup>

<b>G.3 - "Humanities and Social Sciences"</b>	
G3.3.06 Thematic area B interdisciplinary documentation	170 m <sup>2</sup>
G3.3.07 server	10 m <sup>2</sup>
G3.3.08 toilets and service rooms (indicative quantification)	20 m <sup>2</sup>
G3.4.05 rooms for groups	40 m <sup>2</sup>
G3.4.01 Thematic area A	90 m <sup>2</sup>
<b>G.6 - Study room with own materials</b>	
G6.4.04 rooms for groups	80 m <sup>2</sup>
<b>INTERNAL SERVICES</b>	
I.1 - Logistics and document management	
11.3.01 document management	90 m <sup>2</sup>
<b>Total</b>	<b>3100 m<sup>2</sup></b>



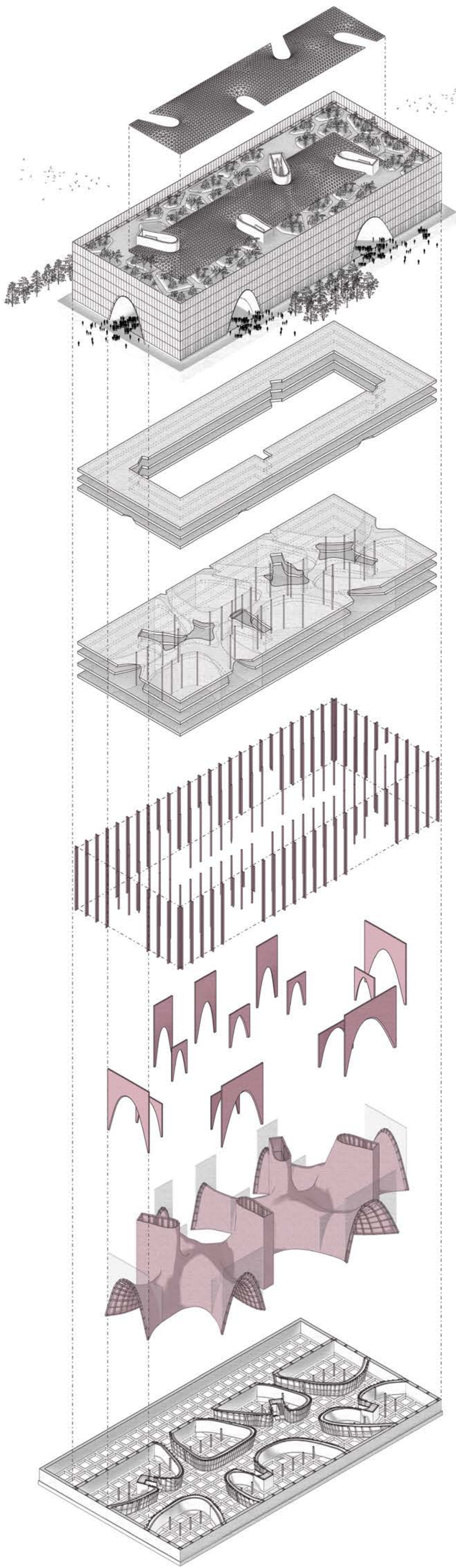


SOUTH-WEST FACADE SCALE 1/250

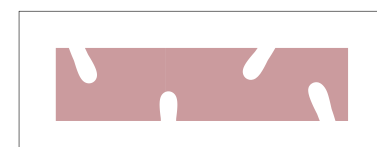


ROOFTOP PLAN SCALE 1/250

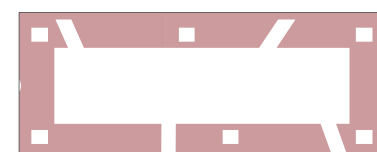




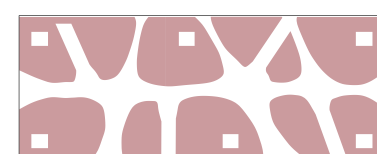
GLAZED ROOFTOP



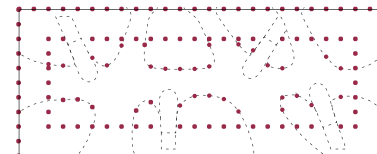
TOP FLOORS



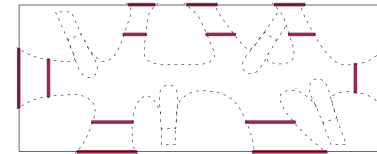
BOTTOM FLOORS



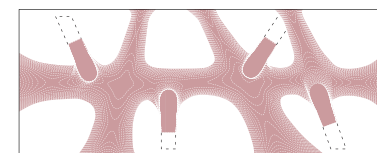
INTERIOR COLUMNS



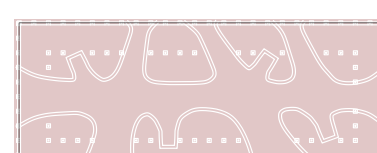
DISCHARGE ARCHES

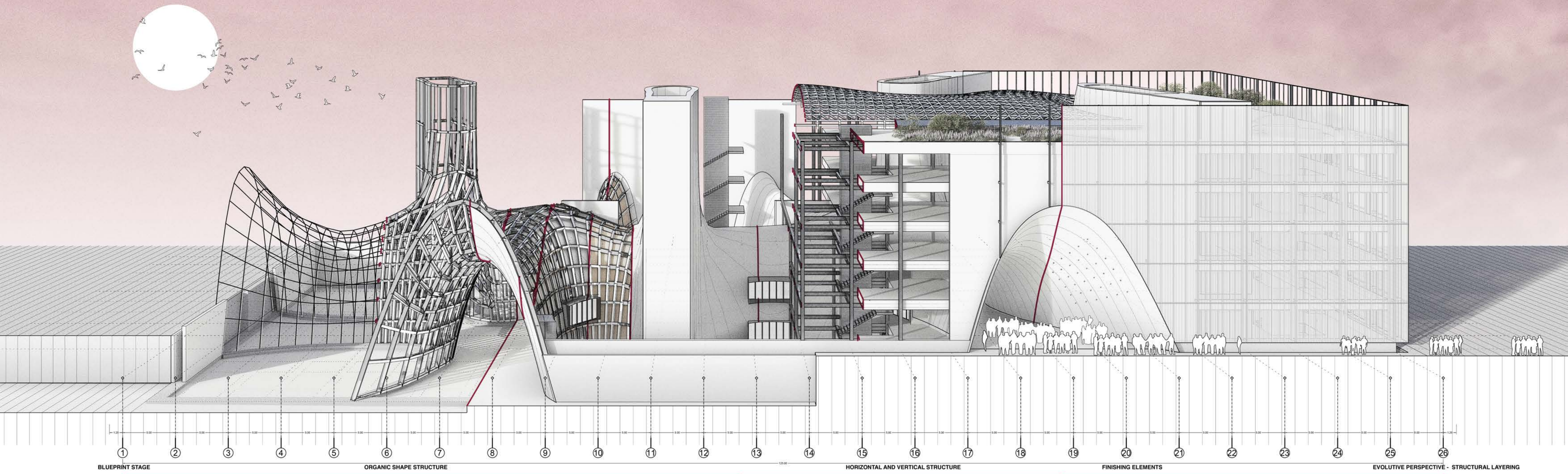


BIONIC SHAPE SHELL



SLAB FOUNDATIONS





1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26

BLUEPRINT STAGE ORGANIC SHAPE STRUCTURE HORIZONTAL AND VERTICAL STRUCTURE FINISHING ELEMENTS EVOLUTIVE PERSPECTIVE - STRUCTURAL LAYERING

WIREFRAME OF THE STEEL STRUCTURE

STEEL STRUCTURE

EXTERIOR FINISHING PANELS

STONEWool INSULATION

ENTRANCES OPENINGS

SPRAYED REINFORCED CONCRETE

INTERIOR FINISHING PLASTER

COLUMNS

PRIMARY / SECONDARY BEAMS

FLOOR SLABS

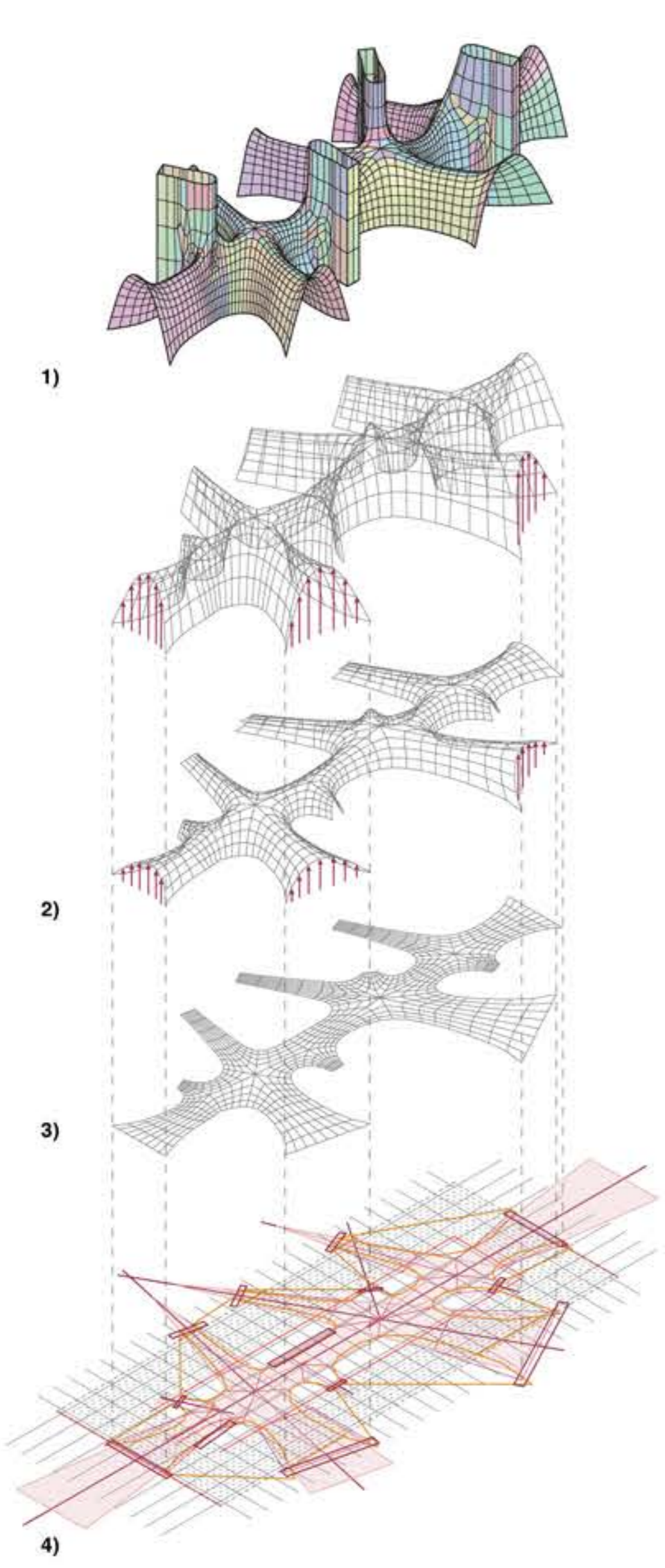
ARCHED WALL

FACADE STRUCTURE

ARTIFICIAL LIGHTS

FACADE

ROOFTOP GREENERY



1) ADJUST THE SHAPE

some manual adjustments to the shape allow to enlarge the building entrances and to add the skylights

2) CATENARY CURVE SIMULATION

From the flattened wireframe of the organic shape a load simulation has been done

3) ROUNDED EDGES

The rounded edges are generated with Grasshopper's Plugin Kangaroo

4) 2D BASE SHAPE

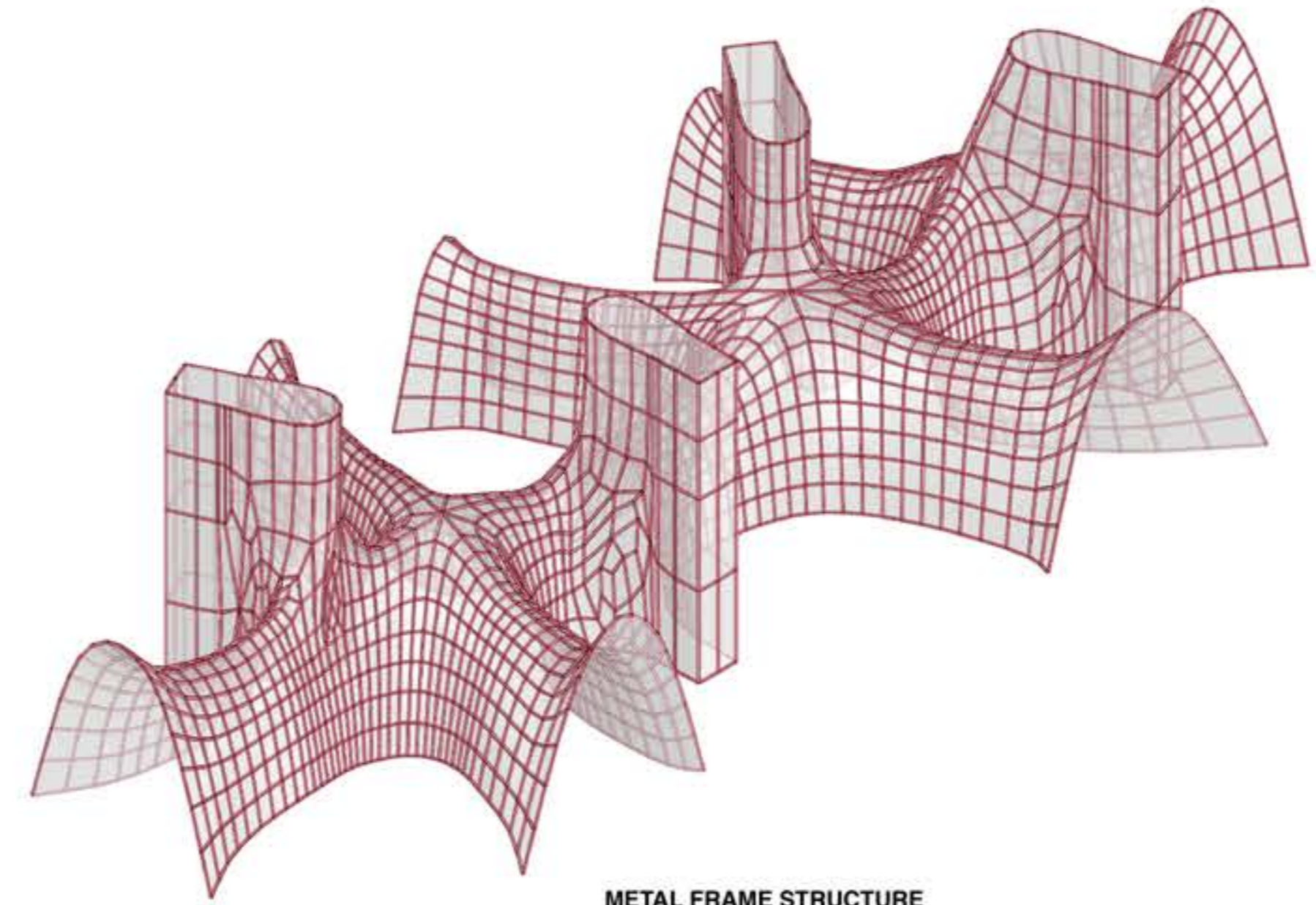
The lines have been drawn manually to control every aspects of the shape

**Structural Principle**

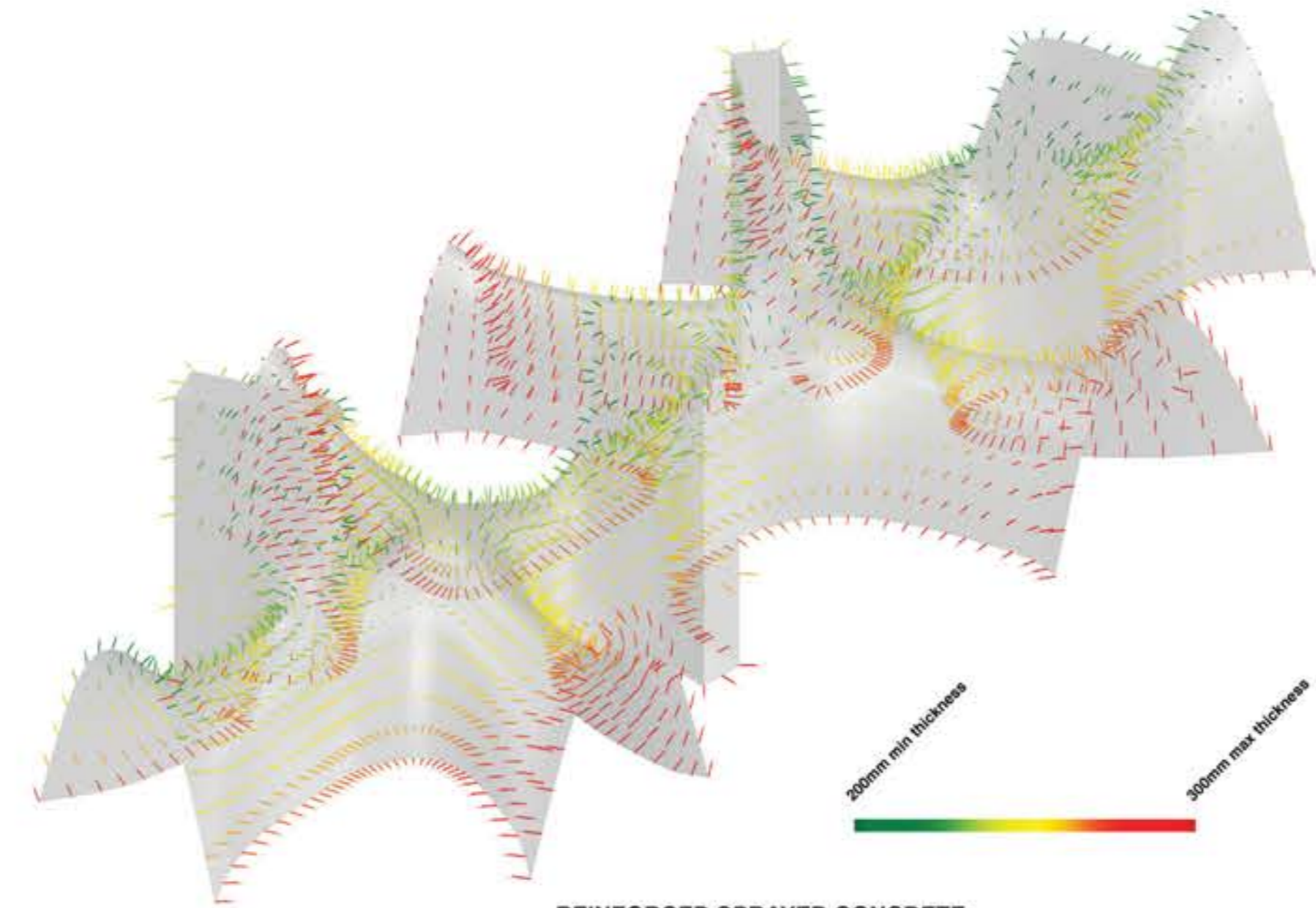
In the structural design of our building, we faced the challenge of achieving both aesthetic excellence and structural integrity while minimizing material usage and construction costs. To achieve this, we devised a structural principle that could be efficiently implemented across the entire project, balancing aesthetics with practicality. Our approach involved dividing the project into two distinct structural systems: the organic shape and the regular beam/column system used for the main floor slabs.

The organic shape, envisioned as a self-sustaining structure, utilizes catenary structures to propagate forces throughout most of its form. To ensure stability, additional reinforcement is strategically placed at the skylight portions to accommodate potential load variations. However, to follow the challenge of material usage and construction costs we decided to uniformize the top part of every unique elements and portions.

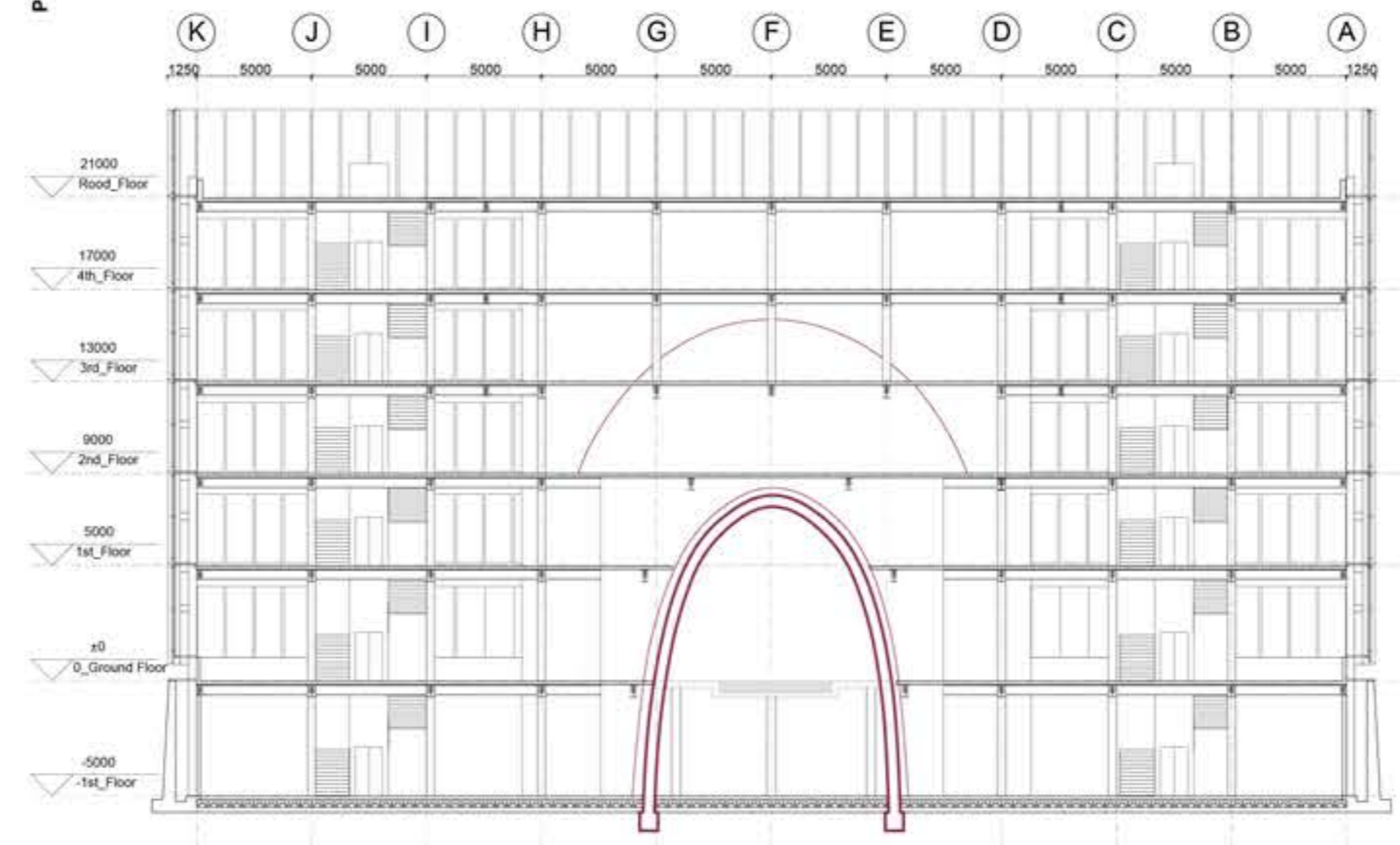
In contrast, the beam/column system complements the organic shape and stands as a dominant support for the main floor slabs. At the junction points between these two systems, the organic shape and orthogonal one, we incorporated an additional structural element to maintain stability without compromising the architectural vision. Specifically, we designed discharge arches walls to replace columns, following the rounded shape of the shell without making direct contact. This innovative solution effectively transfers loads from above elements to the ground, ensuring structural coherence while preserving the integrity of the organic shell. Through meticulous planning and innovative design strategies, we have achieved a harmonious balance between structural efficiency and architectural expression, resulting in a building that not only stands as a testament to design excellence but also prioritizes sustainability and resource optimization.



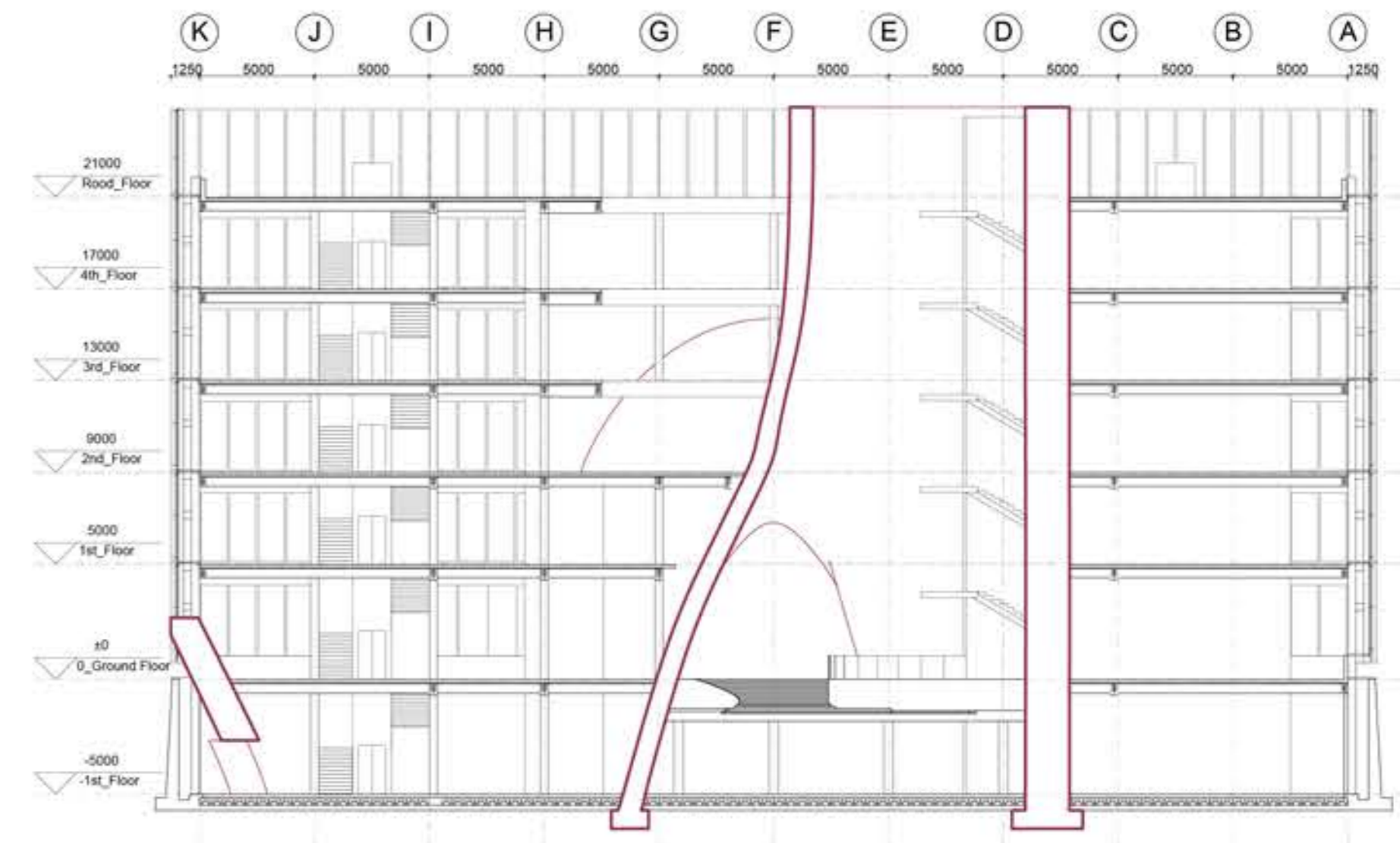
METAL FRAME STRUCTURE



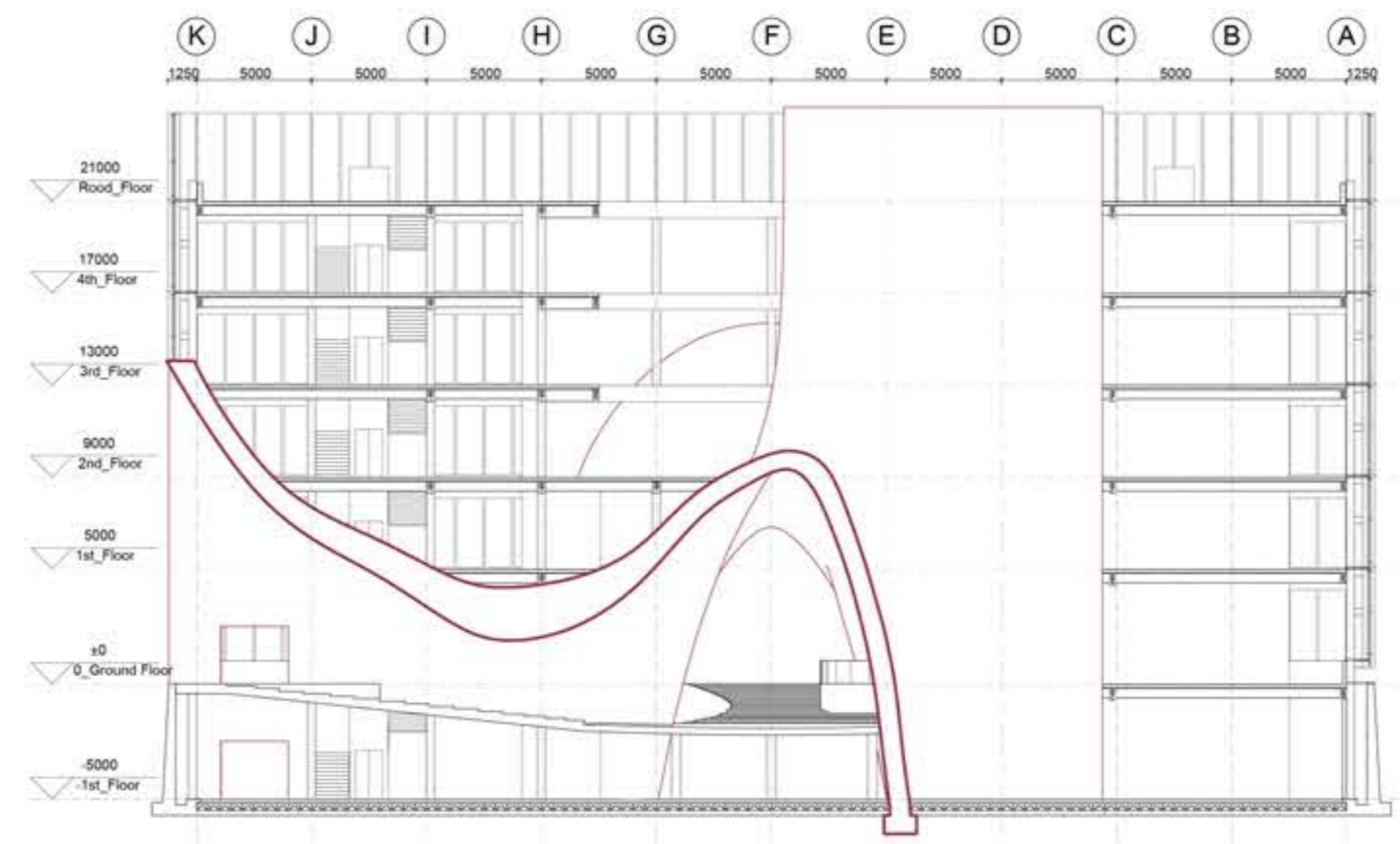
REINFORCED SPRAYED CONCRETE



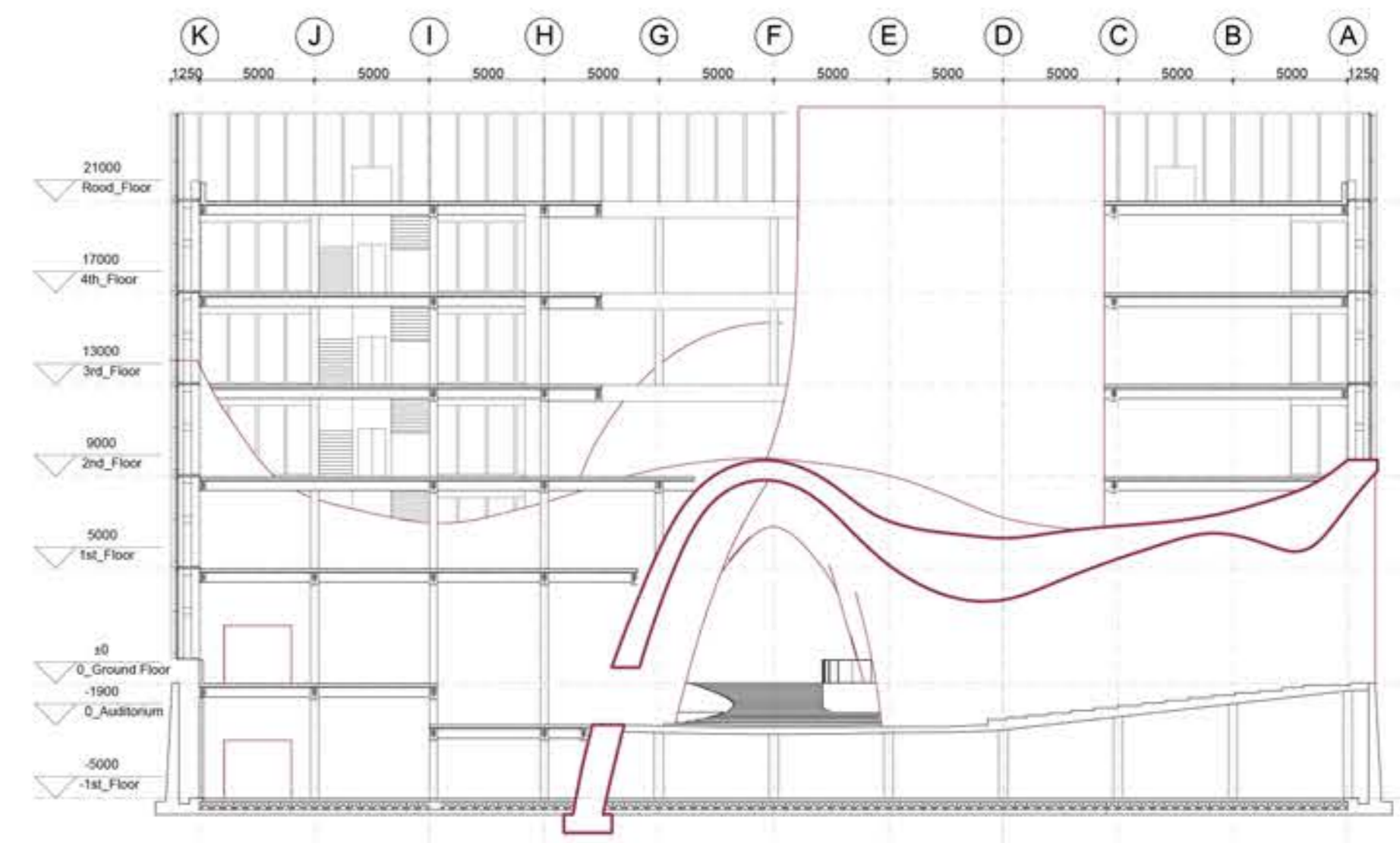
SECTION A-A 1:250



SECTION B-B 1:250

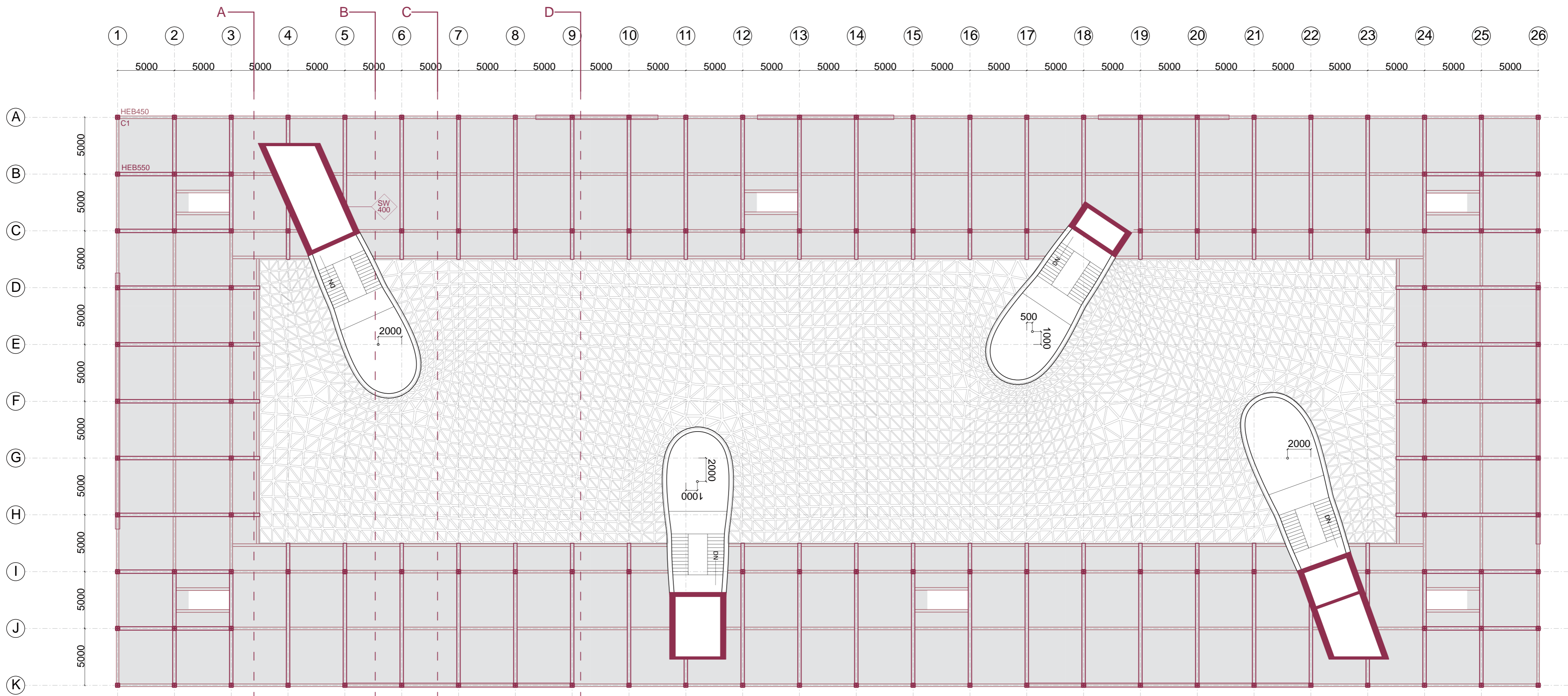


SECTION C-C 1:250

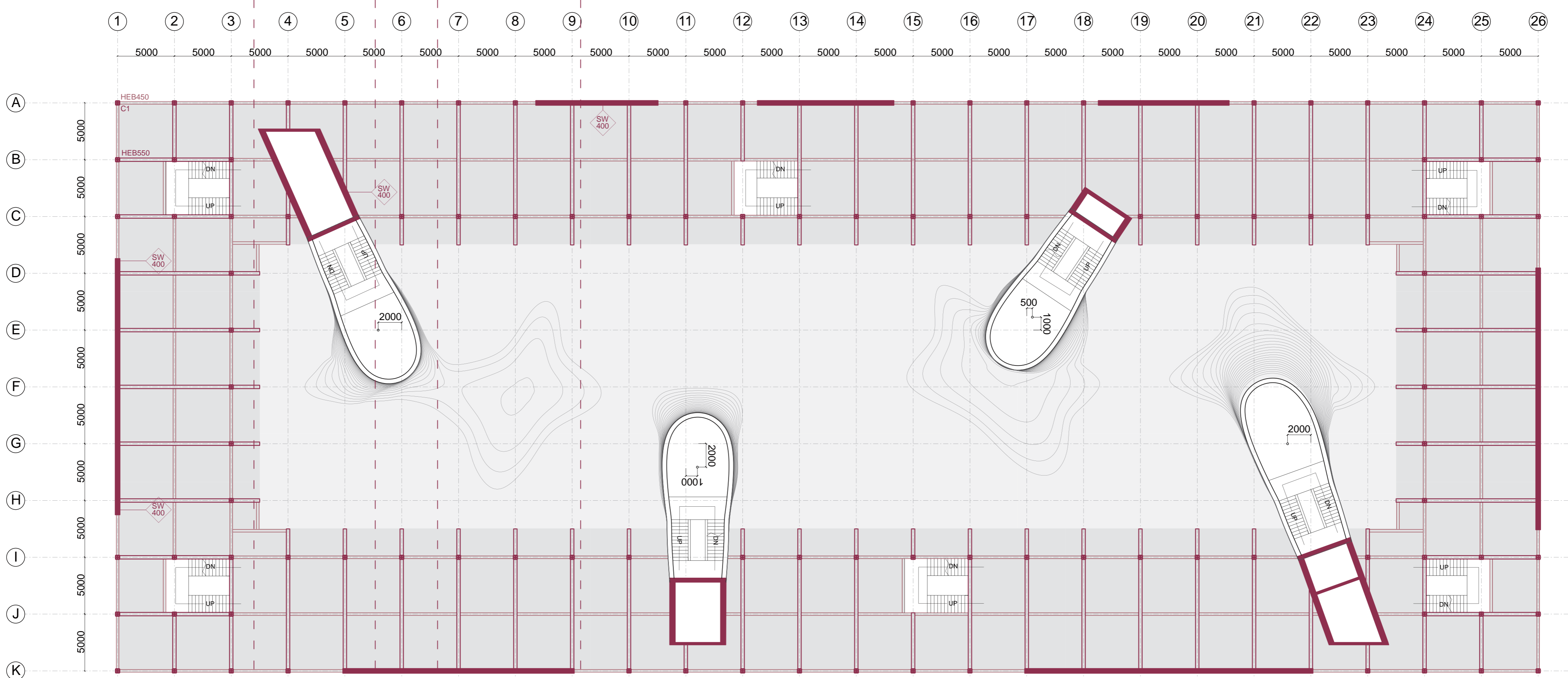


SECTION D-D 1:250

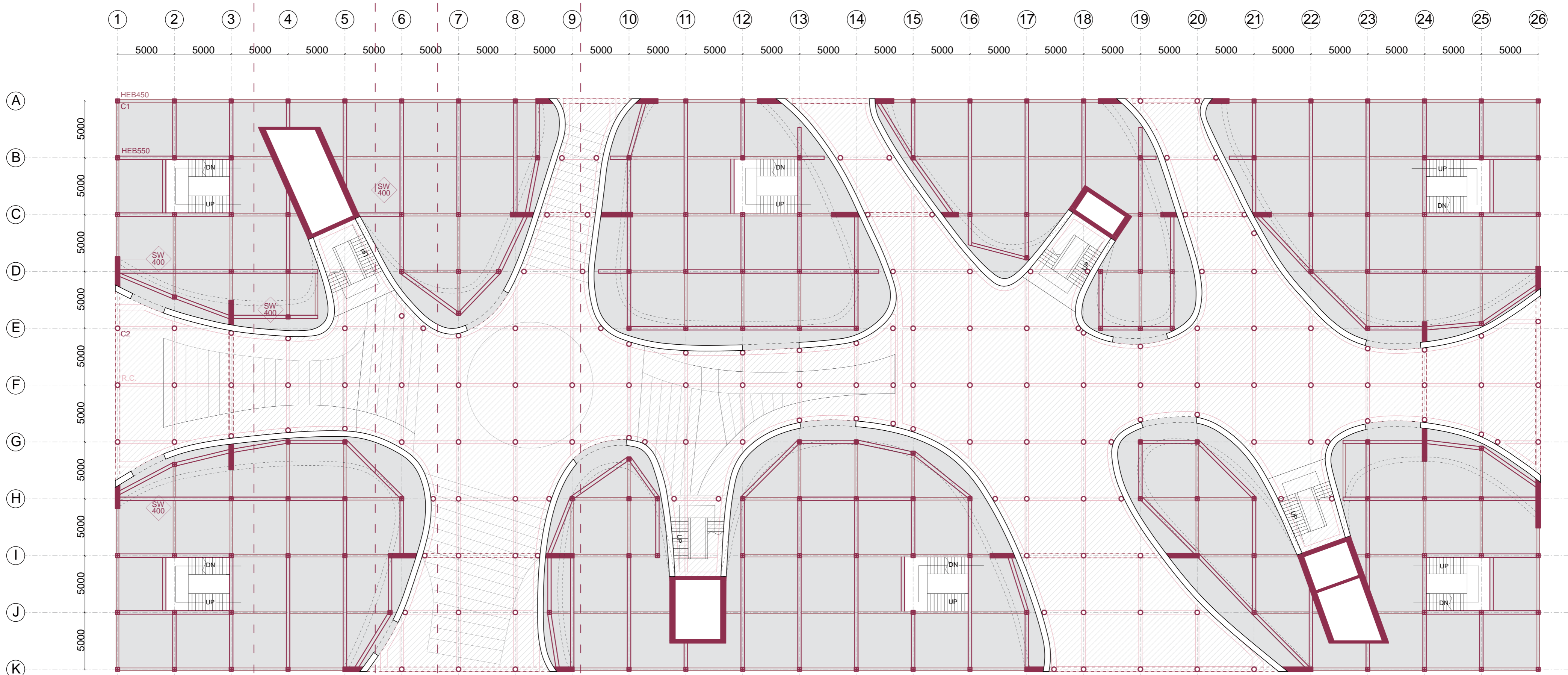




ROOF PLAN 1:250

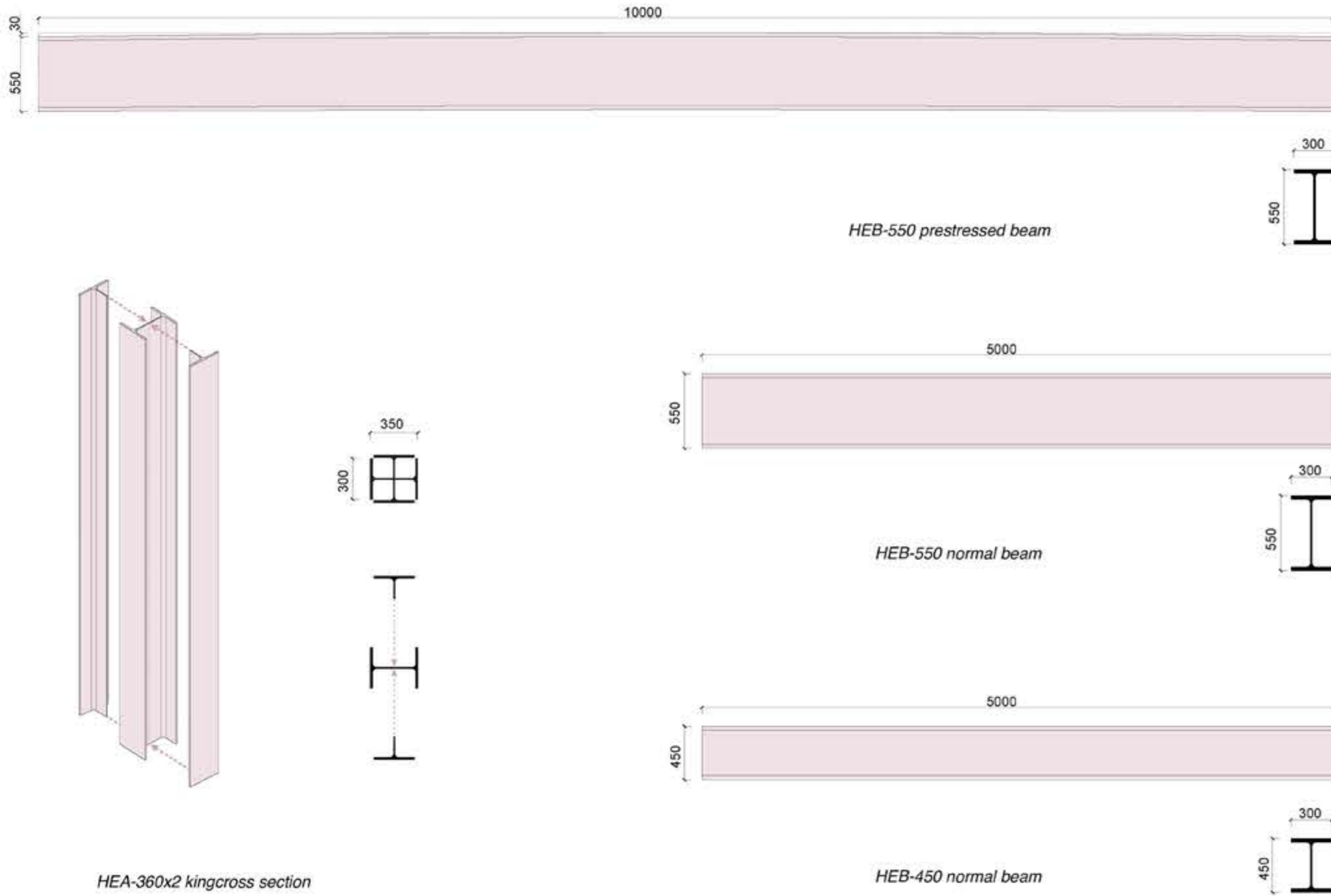


THIRD FLOOR PLAN 1:250



GROUND FLOOR PLAN 1:250





**PART 1: STEEL BEAM LOAD CALCULATIONS**

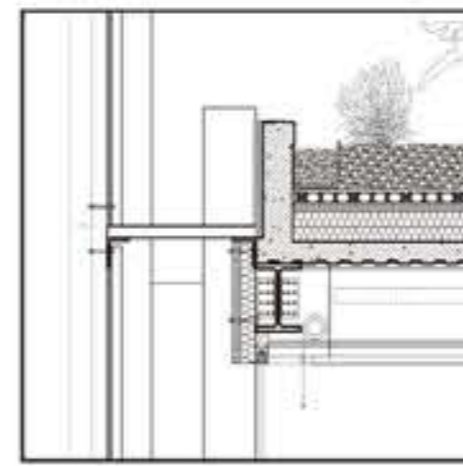
**ROOF**

Dead load: Beam self-weight

Primary beams	HEB550		
Type:			
Normal weight	199 kg/m	0.199 kN/m	
Linear load <b>g1</b>		<b>0.2 kN/m</b>	

Dead load: Floor self-weight

Layer	Material	Thickness	Weight
Soil	subsoil(mix with expanded clay)	300 mm	2.7 kN/m <sup>2</sup>
	Blue Roof Filtration Fleece	25 mm	0.1 kN/m <sup>2</sup>
	Blue Roof Geocell(fill)	65 mm	1.5 kN/m <sup>2</sup>
Finishing	bituminous sheeting(Polydan 180-40 P ELAST)	3.5 mm	0.0 kN/m <sup>2</sup>
	screed	65 mm	0.2 kN/m <sup>2</sup>
Insulation	stone wool insulation	200 mm	0.1 kN/m <sup>2</sup>
Structure G2	R.C.	150 mm	3.6 kN/m <sup>2</sup>
Plant	integrated ventilation duct	mm	0.6 kN/m <sup>2</sup>
Ceiling	suspended ceiling soundproofed(WOODGIPS)	50 mm	0.5 kN/m <sup>2</sup>
<b>Area load G2+G3</b>			<b>9.3 kN/m<sup>2</sup></b>



1.1 ROOF TOP SLAB Planted  
 Subsoil mixed with expanded clay 300  
 Blue Roof \* filtration fleece  
 Blue Roof \* geocell  
 Bituminous sheeting(Polydan \* 180-40P Elast)  
 screed 65  
 Stonewool insulation 200  
 R.C. 150  
 HEB-550 prestressed steel beam  
 Integrated ventilation duct  
 Woodgips \* suspended ceiling soundproofed 50

Live load: Accessible roof

Accessible roof standard live load Area load **Q** **2 kN/m<sup>2</sup>**

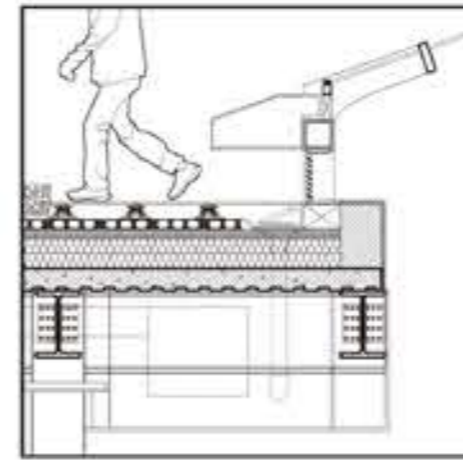
**ROOFTOP BALCONY**

Dead load: Beam self-weight

Primary beams	HEB550		
Type:			
Normal weight	199 kg/m	0.199 kN/m	
Linear load <b>g1</b>		<b>0.2 kN/m</b>	

Dead load: Floor self-weight

Layer	Material	Thickness	Weight
Pavements	WEISS raised floor system(32mm wood floor)	32 mm	0.5 kN/m <sup>2</sup>
Finishing	bituminous sheeting(Polydan 180-40 P ELAST)	3.5 mm	0.0 kN/m <sup>2</sup>
	screed	65 mm	0.2 kN/m <sup>2</sup>
Insulation	stone wool insulation	200 mm	0.1 kN/m <sup>2</sup>
Structure G2	R.C.	150 mm	3.6 kN/m <sup>2</sup>
Plant	integrated ventilation duct	mm	0.6 kN/m <sup>2</sup>
Ceiling	suspended ceiling soundproofed(WOODGIPS)	50 mm	0.5 kN/m <sup>2</sup>
<b>Area load G2+G3</b>			<b>5.6 kN/m<sup>2</sup></b>



1.2 ROOF TOP SLAB walkable  
 Wood floor 32mm  
 Weiss' raised floor system  
 Bituminous sheeting(Polydan \* 180-40P Elast)  
 screed 65  
 Stonewool insulation 200  
 R.C. 150  
 HEB-550 prestressed steel beam  
 Integrated ventilation duct  
 Woodgips \* suspended ceiling soundproofed 50

2. SKYLIGHT SKELETON  
 Temporary rain storage-system  
 HSS-200 steel beam  
 Ventilation shutter  
 Aluminium skeleton  
 Double glazing glass

Live load: Accessible roof

Accessible roof standard live load Area load **Q** **2 kN/m<sup>2</sup>**

**Skylight**

Perimeter	340 m		
Double glazing Glass(12mm)	1674 m <sup>2</sup>	30.0 kg/m <sup>2</sup>	
Load of Glass	50220 kg	502.2 kN	
Aluminium skeleton	6094 m	7.8 kg/m	
Load of skeleton	47716.02 kg	477.2 kN	
distributed load			<b>2.9 kN/m</b>

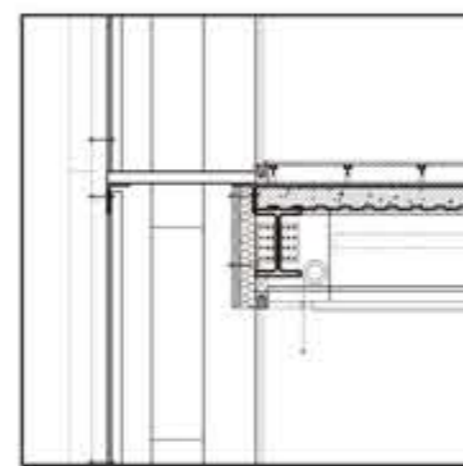
**FLOORS**

Dead load: Beam self-weight

Primary beams	HEB550		
Type:			
Normal weight	199 kg/m	0.199 kN/m	
Linear load <b>g1</b>		<b>0.2 kN/m</b>	

Dead load: Floor self-weight

Layer	Material	Thickness	Weight
Pavements	WEISS raised floor system(32mm wood floor)	32 mm	0.5 kN/m <sup>2</sup>
Finishing	screed	25 mm	0.1 kN/m <sup>2</sup>
	EPS sound insulation	5 mm	0.1 kN/m <sup>2</sup>
Structure G2	R.C.	150 mm	3.6 kN/m <sup>2</sup>
Plant	integrated ventilation duct	mm	0.6 kN/m <sup>2</sup>
Ceiling	suspended ceiling soundproofed(WOODGIPS)	50 mm	0.5 kN/m <sup>2</sup>
Partition wall	lightweight partition wall		0.6 kN/m <sup>2</sup>
<b>Area load G2+G3</b>			<b>6.0 kN/m<sup>2</sup></b>



3. TYPICAL FLOOR SLAB  
 Wood floor 32mm  
 Weiss' raised floor system  
 Transit for systems  
 Screed 25mm  
 EPS sound insulation 5mm  
 R.C. 150mm  
 HEB-550 prestressed steel beam  
 Integrated ventilation duct  
 Woodgips \* suspended ceiling soundproofed 50mm

Live load: Book storage

Book storage standard live load Area load **q** **5 kN/m<sup>2</sup>**

**BALCONY**

Dead load: Beam self-weight

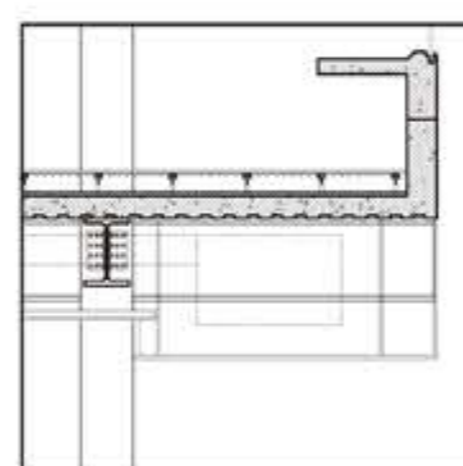
Primary beams	HEB550		
Type:			
Normal weight	199 kg/m	0.199 kN/m	
Linear load <b>g1</b>		<b>0.2 kN/m</b>	

Dead load: Floor self-weight

Layer	Material	Thickness	Weight
Pavements	WEISS raised floor system(32mm wood floor)	32 mm	0.5 kN/m <sup>2</sup>
Finishing	screed	25 mm	0.1 kN/m <sup>2</sup>
	EPS sound insulation	5 mm	0.1 kN/m <sup>2</sup>
Structure G2	R.C.	150 mm	3.6 kN/m <sup>2</sup>
Plant	integrated ventilation duct	mm	0.8 kN/m <sup>2</sup>
Ceiling	suspended ceiling soundproofed(WOODGIPS)	50 mm	0.5 kN/m <sup>2</sup>
Partition wall	lightweight partition wall		0.6 kN/m <sup>2</sup>
<b>Area load G2+G3</b>			<b>6.2 kN/m<sup>2</sup></b>

Live load: Reading room in library

Reading room in library live load Area load **q** **4 4 kN/m<sup>2</sup>**



3. TYPICAL FLOOR SLAB  
 Wood floor 32mm  
 Weiss' raised floor system  
 Transit for systems  
 Screed 25mm  
 EPS sound insulation 5mm  
 R.C. 150mm  
 HEB-550 prestressed steel beam  
 Integrated ventilation duct  
 Woodgips \* suspended ceiling soundproofed 50mm



**PART 2: STEEL BEAM CHECK**

FLOORS		
ULS,SLS,Bending Moment Calculation		
Beam Length L	10.0 m	10000 mm
Influence area width I	5.0 m	5000 mm
Linear load g1	0.2 kN/m	Dead load: Beam self weight - Structural
Area load G2	3.6 kN/m <sup>2</sup>	Dead load: Floor Self weight - Structural
Linear load g2	18.0 kN/m	
Area load G3	2.4 kN/m <sup>2</sup>	Dead load: Floor Self weight - Non Structural
Linear load g3	11.9 kN/m	
Area load Q1	5.0 kN/m <sup>2</sup>	Live load: Book storage
Linear load q1	25.0 kN/m	
Load_ULS COMB	76.7 kN/m	1.3*(g1+g2+g3)+1.5*q1
Load_LIVE COMB	25.0 kN/m	q1
M_ED_ULS	958.5 kNm	958468125 Nmm
Calculate Wpl & Choose steel class and Beams		
Wpl	3659606 mm <sup>3</sup>	3660 10^3 mm <sup>3</sup>
Steel class S...	275	
fyk	275 MPa	
γs	1.05	
fyd	261.9 MPa	
Beam chosen	HEB550-Prestressed	
Wpl chosen	5591 10^3 mm <sup>3</sup>	Wpl chosen > Wpl
Iy chosen	136700 10^4 mm <sup>4</sup>	
E	206000 MPa	

Check maximal displacements for combination (D + L) and for liveload(L)

**Check maximal displacements for combination (D + L)**

delta_max L/250	40 mm	
delta simple beam	35.5 mm	
delta=delta simple beam-prestressed displacement	5.5 mm	delta simple beam-delta_max

**Check maximal displacements for liveload(L)**

delta_max L/300	33.3 mm	
delta simple beam	11.6 mm	delta simple beam-delta_max

ROOF		
ULS,SLS,Bending Moment Calculation		
Beam Length L	10.0 m	10000 mm
Influence area width I	5.0 m	5000 mm
Linear load g1	0.2 kN/m	Dead load: Beam self weight - Structural
Area load G2	3.6 kN/m <sup>2</sup>	Dead load: Floor Self weight - Structural
Linear load g2	18.0 kN/m	
Area load G3	5.7 kN/m <sup>2</sup>	Dead load: Floor Self weight - Non Structural
Linear load g3	28.4 kN/m	
Area load Q1	2.0 kN/m <sup>2</sup>	Live load: Accessible roof
Linear load q1	10.0 kN/m	
Load_ULS COMB	75.6 kN/m	1.3*(g1+g2+g3)+1.5*q1
Load_LIVE COMB	10.0 kN/m	q1
M_ED_ULS	945.3 kNm	945343125 Nmm
Calculate Wpl & Choose steel class and Beams		
Wpl	3609492 mm <sup>3</sup>	3609 10^3 mm <sup>3</sup>
Steel class S...	275	
fyk	275 MPa	
γs	1.05	
fyd	261.9 MPa	
Beam chosen	HEB550-Prestressed	
Wpl chosen	5591 10^3 mm <sup>3</sup>	Wpl chosen > Wpl
Iy chosen	136700 10^4 mm <sup>4</sup>	
E	206000 MPa	

Check maximal displacements for combination (D + L) and for liveload(L)

**Check maximal displacements for combination (D + L)**

delta_max L/250	40 mm	
delta simple beam	35.0 mm	
delta=delta simple beam-prestressed displacement	5.0 mm	delta simple beam-delta_max

**Check maximal displacements for liveload(L)**

delta_max L/300	33.3 mm	
delta simple beam	4.6 mm	delta simple beam-delta_max

BALCONY		
ULS,SLS,Bending Moment Calculation		
Beam Length L	2.5 m	2500 mm
Influence area width I	5.0 m	5000 mm
Linear load g1	0.2k N/mD	ead load: Beam self weight - Structural
Area load G2	3.6k N/m <sup>2</sup>	Dead load: Floor Self weight - Structural
Linear load g2	18.0 kN/m	
Area load G3	2.6k N/m <sup>2</sup>	Dead load: Floor Self weight - Non Structural
Linear load g3	12.9k N/m	
Area load Q1	4.0k N/m <sup>2</sup>	Live load: Reading room in library
Linear load q1	20.0k N/m	
Load_ULS COMB7	0.5k N/m1	.3*(g1+g2+g3)+1.5*q1
Load_LIVE COMB	20.0k N/mq	1
M_ED_ULS	220.2 kNm2	202420313 NmmQ uk*L^2/2
Calculate Wpl & Choose steel class and Beams		
Wpl	840924 mm <sup>3</sup>	841 10^3 mm <sup>3</sup>
Steel class S...2	75	
fyk	275 MPa	
γs1	.05	
fyd2	61.9 MPa	
Beam chosen	HEB550	
Wpl chosen	5591 10^3 mm <sup>3</sup> W	pl chosen > Wpl
Iy chosen	136700 10^4 mm <sup>4</sup>	
E2	06000M Pa	

Check maximal displacements for combination (D + L) and for liveload(L)

**Check maximal displacements for combination (D + L)**

delta_max L/250	10 mm	
delta simple beam	1.2 mm	delta simple beam-delta_max

**Check maximal displacements for liveload(L)**

delta_max L/300	8.3m m	
delta simple beam	0.3 mm	delta simple beam-delta_max

ROOFTOP BALCONY		
ULS,SLS,Bending Moment Calculation		
Beam Length L	2.5 m	2500 mm
Influence area width I	5.0 m	5000 mm
Linear load g1	0.2 kN/m	Dead load: Beam self weight - Structural
Area load G2	3.6 kN/m <sup>2</sup>	Dead load: Floor Self weight - Structural
Linear load g2	18.0 kN/m	
Area load G3	2.0 kN/m <sup>2</sup>	Dead load: Floor Self weight - Non Structural
Linear load g3	9.8 kN/m	
Area load Q1	2.0 kN/m <sup>2</sup>	Live load: Accessible roof
Linear load q1	10.0 kN/m	
Area load S1	0.0 kN/m <sup>2</sup>	Live load: Snow Load (Zone I-M)
Linear load s1	0.0 kN/m	
Load_ULS COMB	51.4 kN/m	1.3*(g1+g2+g3)+1.5*(q1+s1)
Load_LIVE COMB	10.0 kN/m	q1+s1
M_ED_ULS	196.6 kNm	196576046 Nmm Quls*L^2/2+Lsly*L
Calculate Wpl & Choose steel class and Beams		
Wpl	750563 mm <sup>3</sup>	751 10^3 mm <sup>3</sup>
Steel class S...	275	
fyk	275 MPa	
γs	1.05	
fyd	261.9047619 MPa	
Beam chosen	HEB550	
Wpl chosen	5591 10^3 mm <sup>3</sup>	Wpl chosen > Wpl
Iy chosen	136700 10^4 mm <sup>4</sup>	
E	206000 MPa	

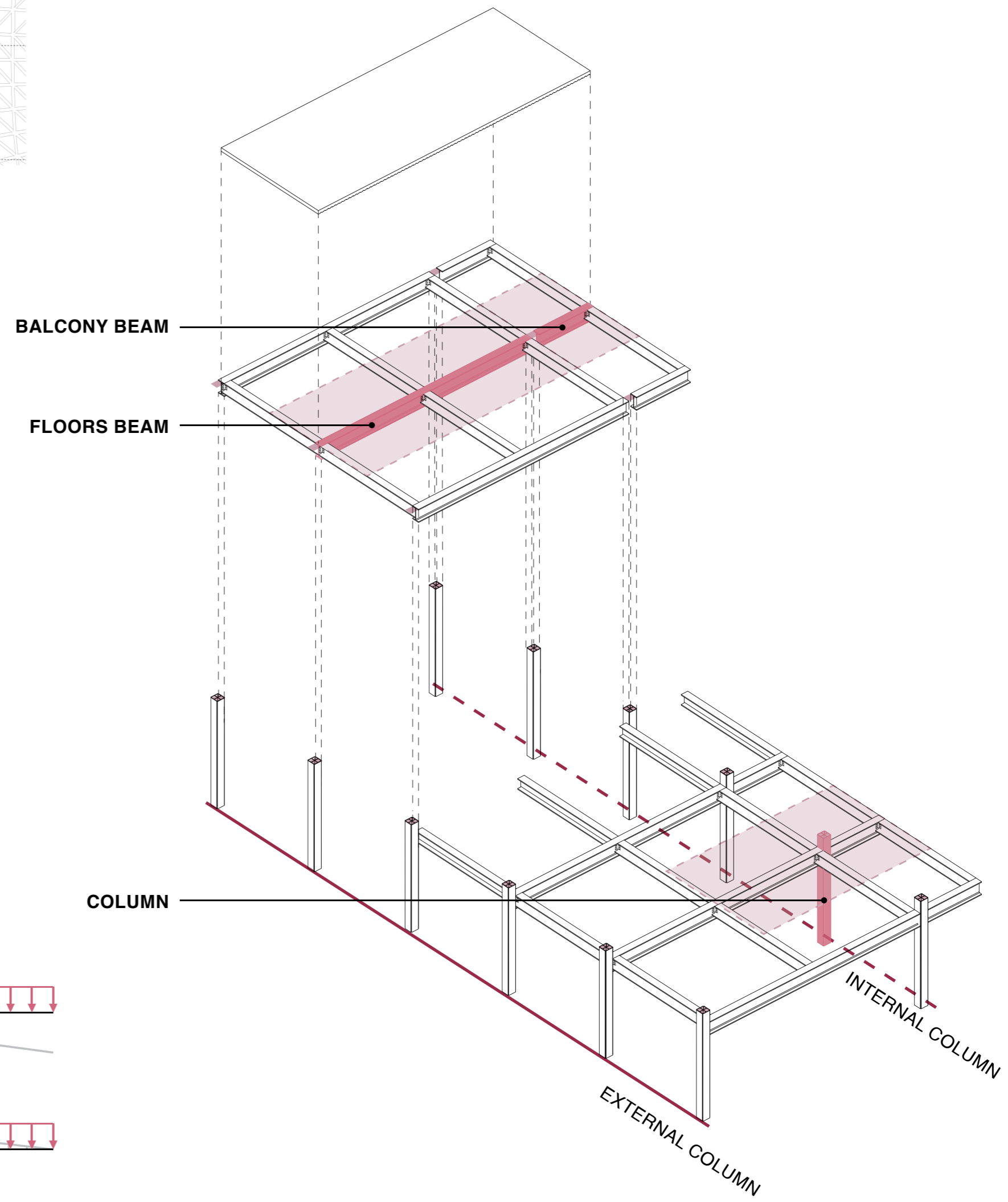
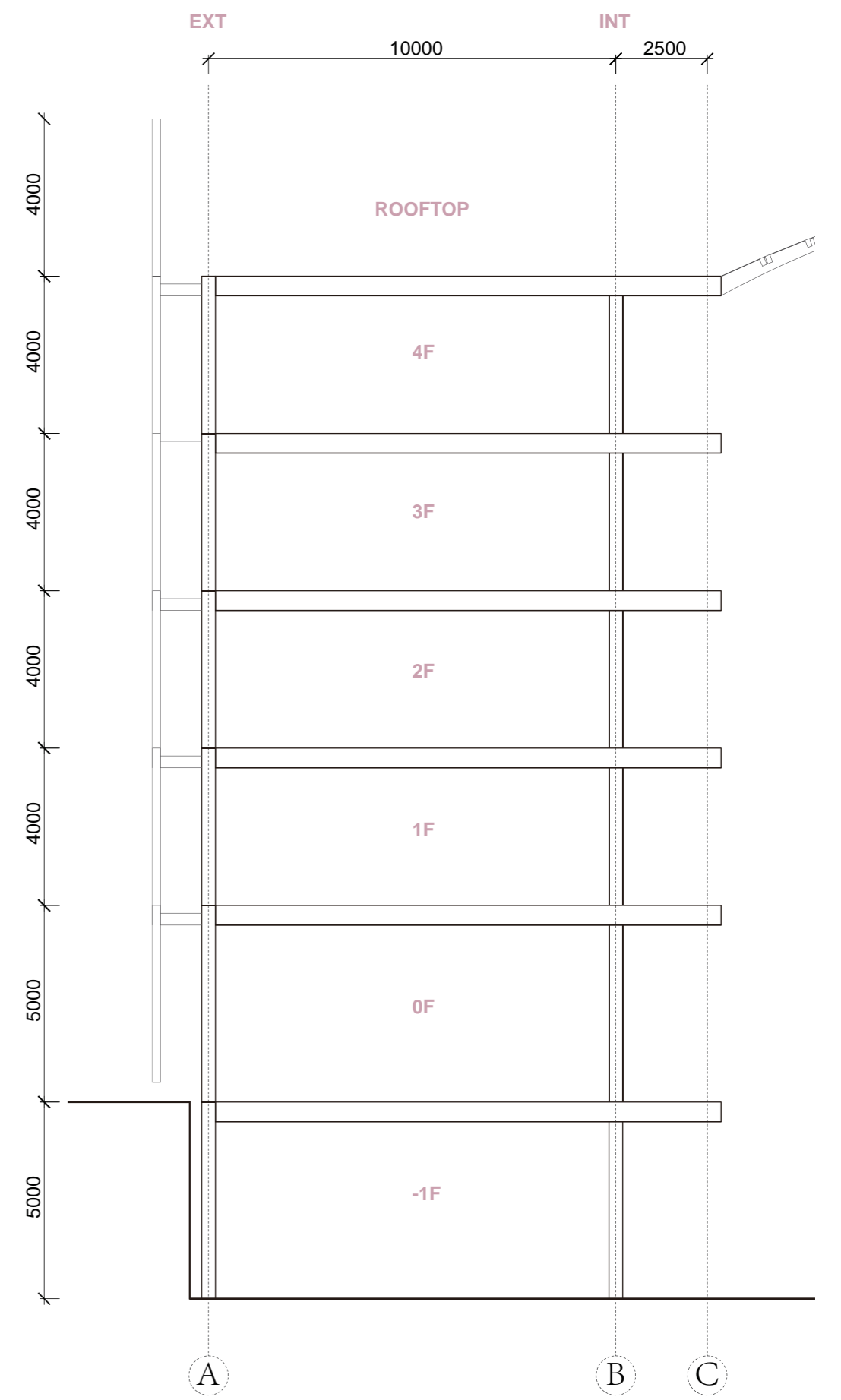
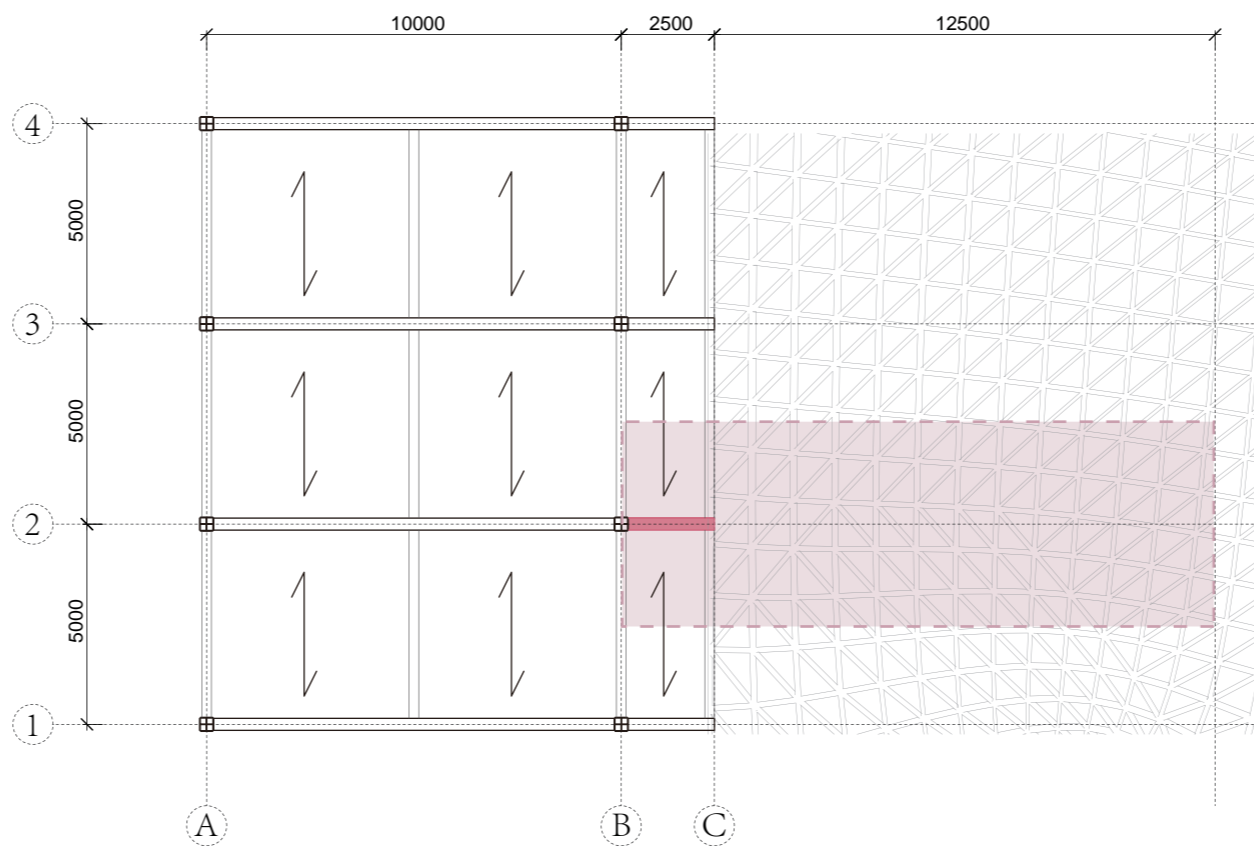
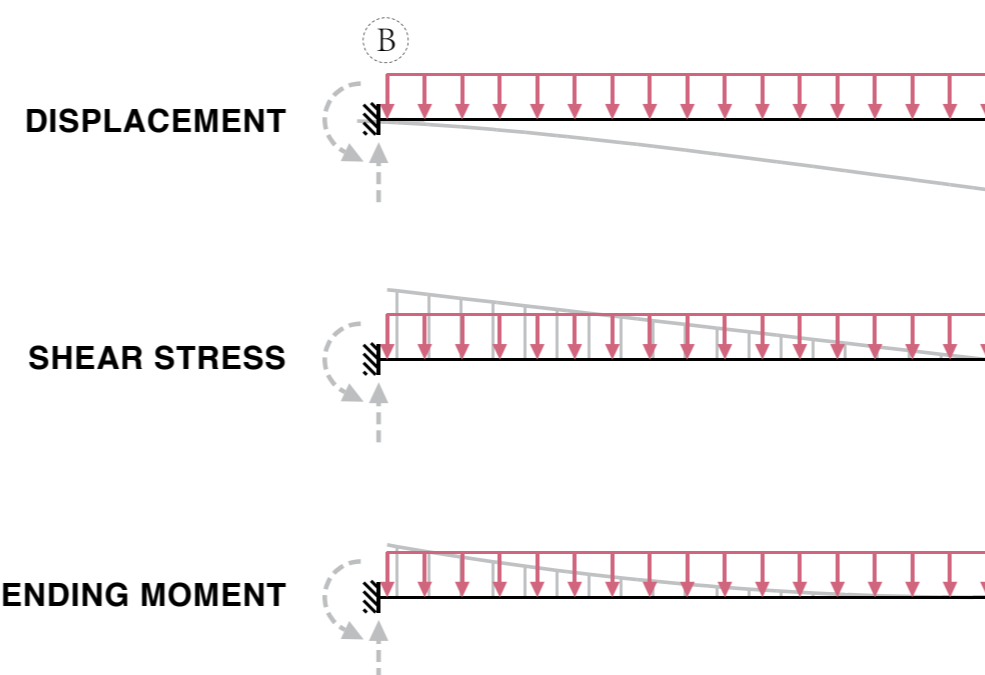
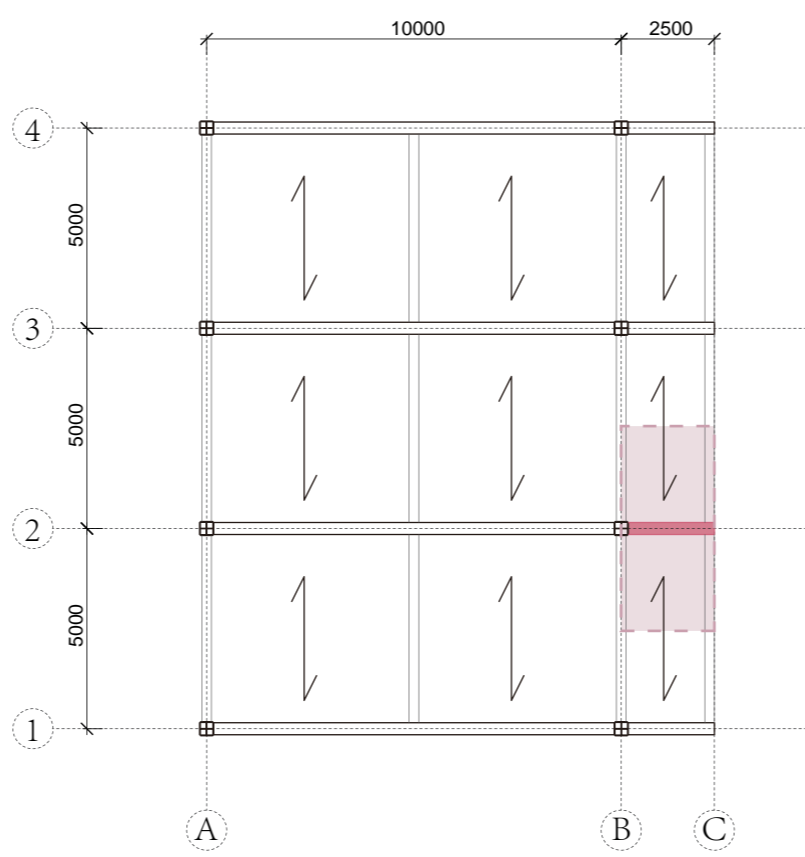
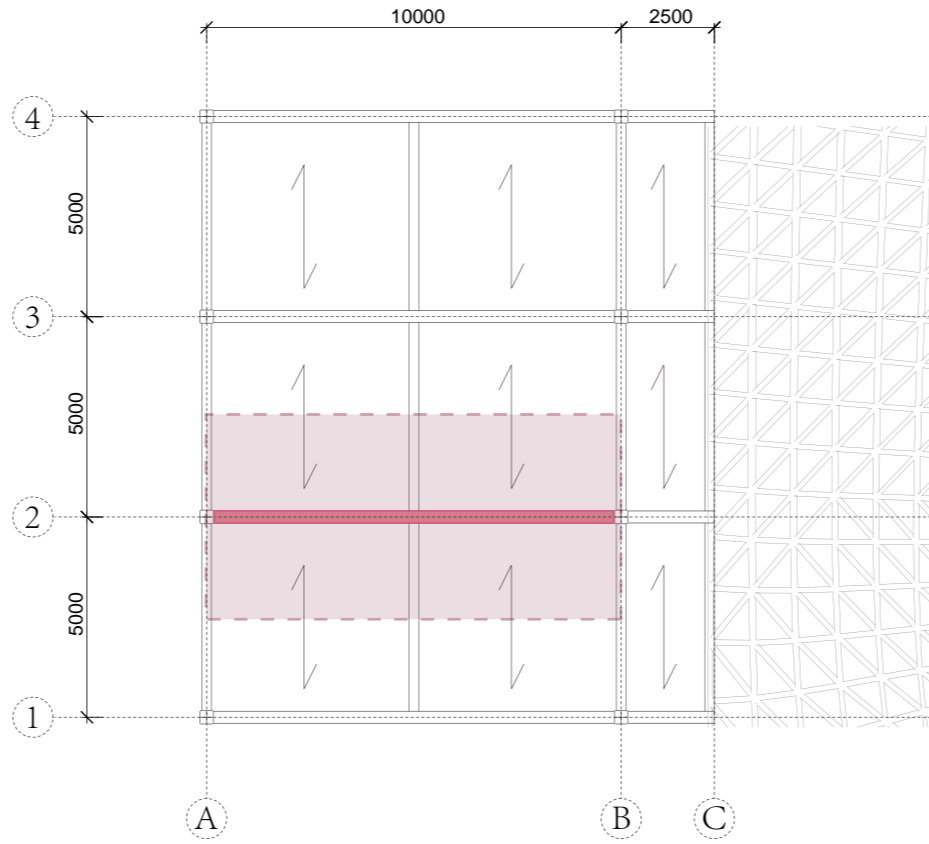
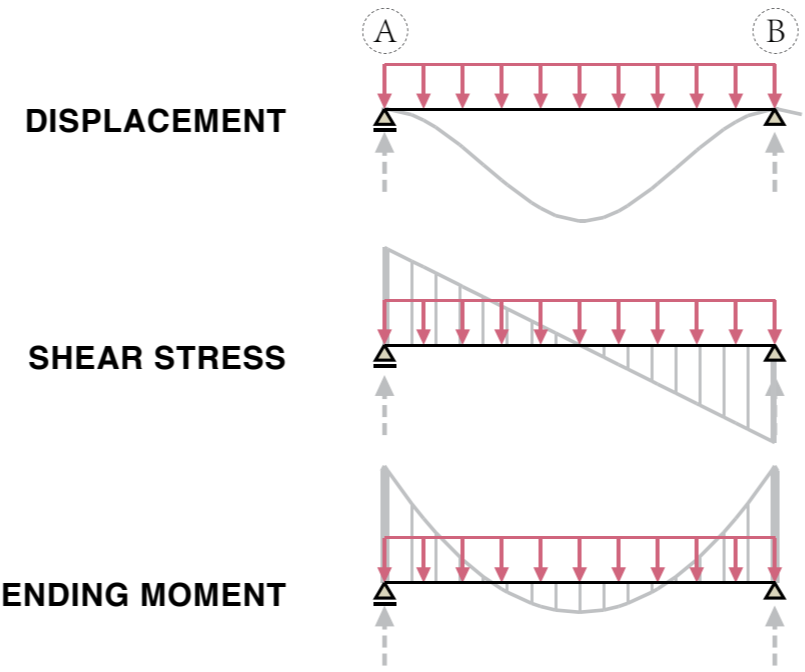
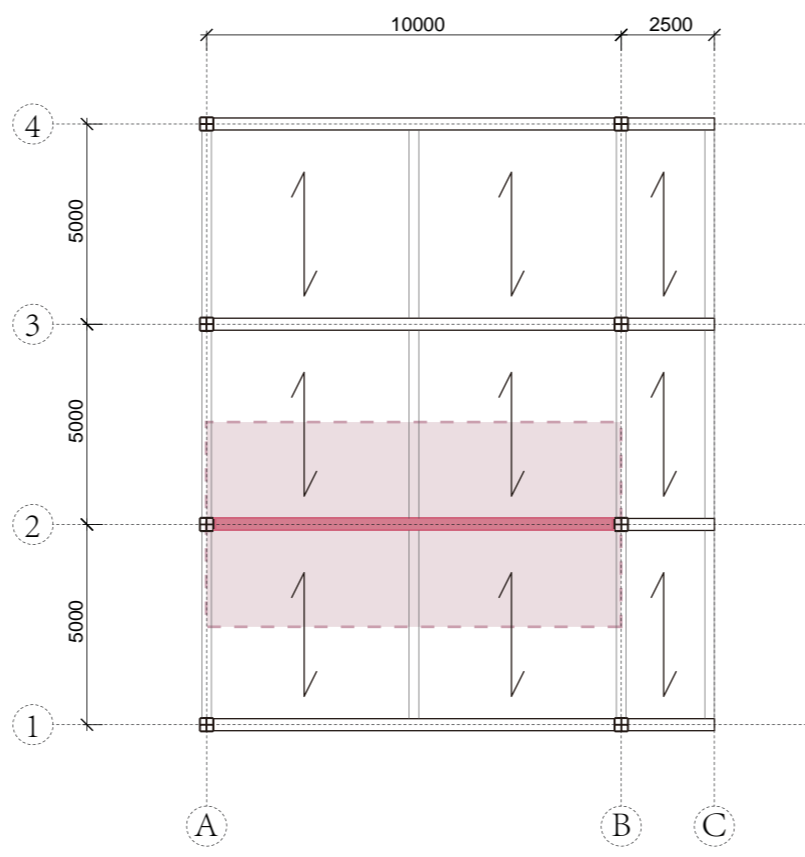
Check maximal displacements for combination (D + L) and for liveload(L)

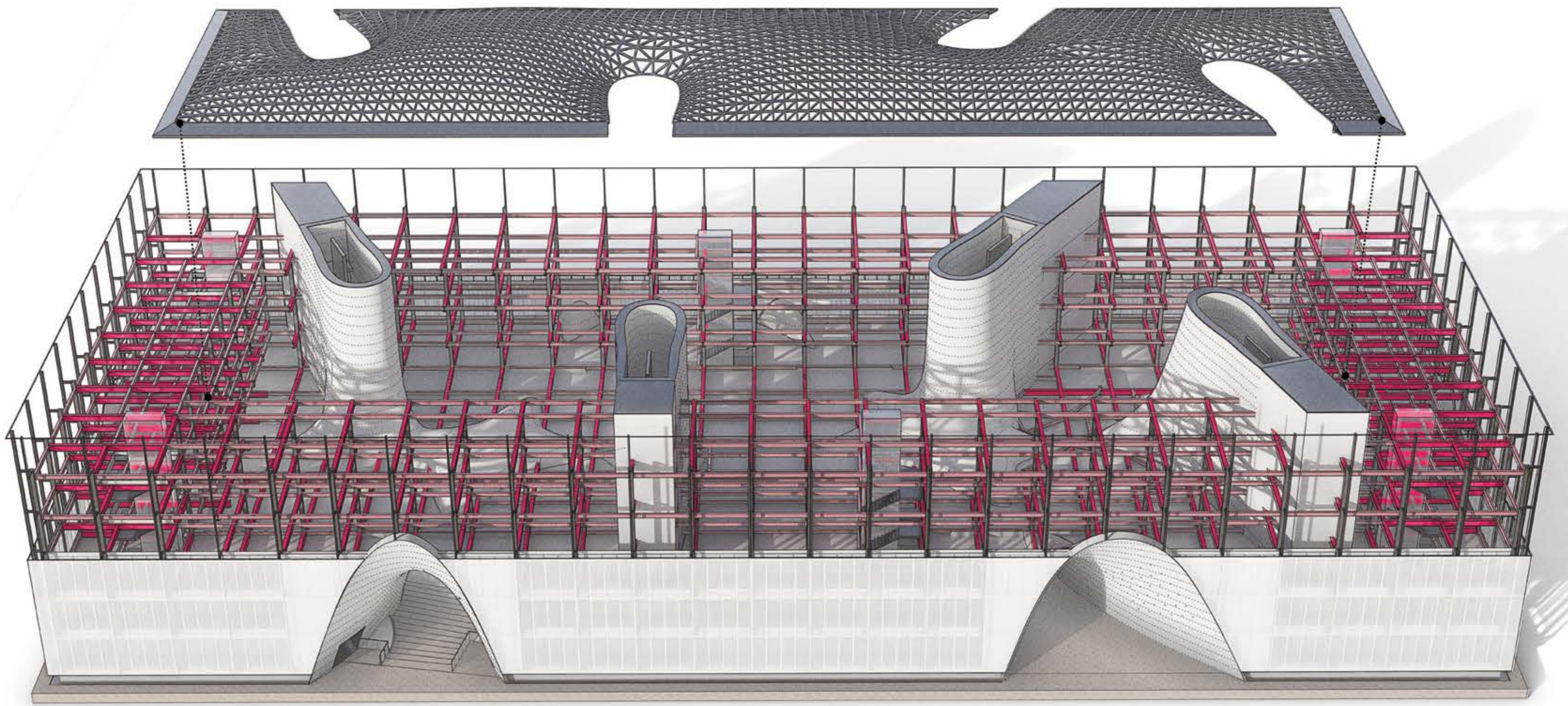
**Check maximal displacements for combination (D + L)**

delta_max L/250	10.0 mm	
delta simple beam	0.9 mm	displacement caused by uniform load
	0.3 mm	displacement caused by concentrated load
	1.2 mm	delta simple beam-delta_max

**Check maximal displacements for liveload(L)**

delta_max L/300	8.3 mm	
delta simple beam	0.2 mm	delta simple beam-delta_max





**PART 3: STEEL COLUMN LOAD CALCULATIONS**

**EXTERNAL COLUMN**

Load Beam 1 Quls floor	76.7k N/m
Load Beam 1 Quls rooftop	75.6k N/m
Lenght Beam	10.0m
Load Support Beam Ruls floor	383.4k N
Load Support Beam Ruls rooftop	378.1 kN

Pillar Type	HE360AX2 King cross section	
Norminal weight	224 kg/m	.24k N/m
Facade Type	doubb layer polycarbonate	
Norminal weight of polycarbonate	7.4 kg/m <sup>2</sup>	0.074 kN/m <sup>2</sup>

Load on Pillar 6 4F	390.1k N4	m
Load on Pillar 5 3F	392.6k N4	m
Load on Pillar 4 2F	392.6k N4	m
Load on Pillar 3 1F	392.6k N4	m
Load on Pillar 2 0F	395.0k N5	m
Load on Pillar 1 -1F	394.6k N5	m
<b>TOTAL PILLAR LOAD Puls</b>	<b>2358 kN</b>	

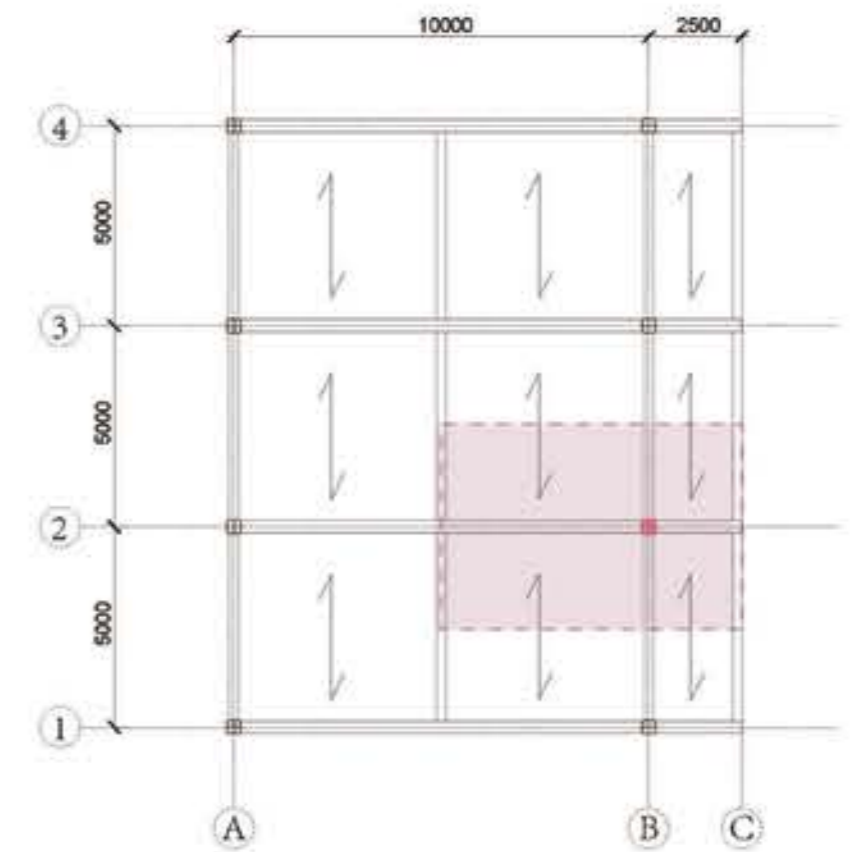
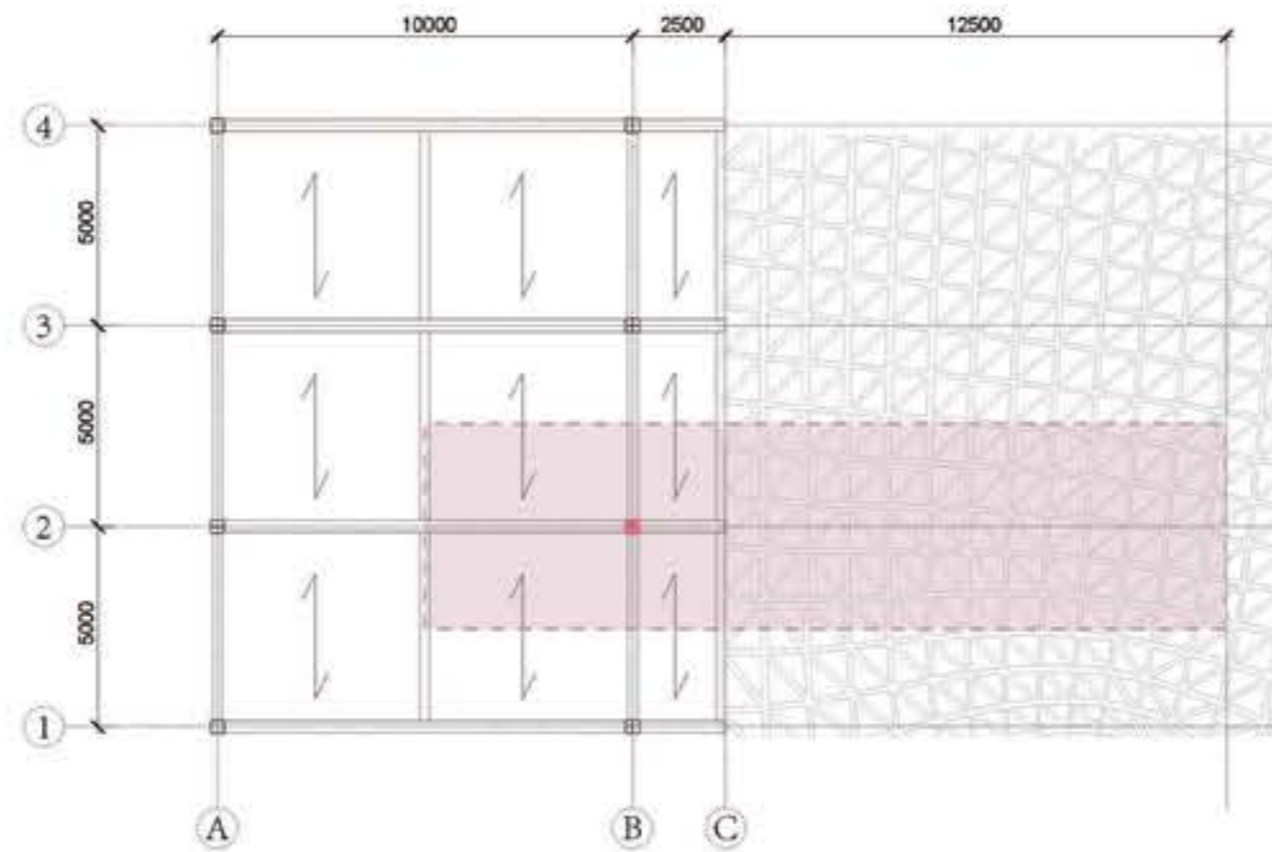
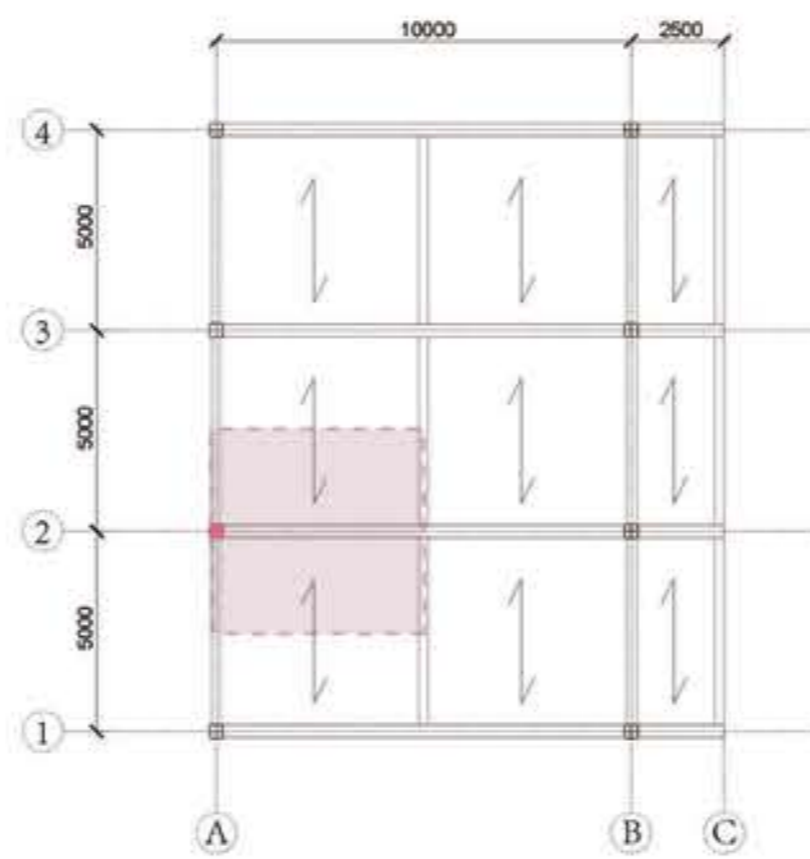
**INTERNAL COLUMN**

Load Beam 1 Quls floor	76.7k N/m
Load Beam 1 Quls rooftop	75.6k N/m
Lenght Beam	10.0m
Load Support Beam Ruls floor	383.4k N
Load Support Beam Ruls rooftop	378.1 kN

Load Beam 2 Quls floor	70.5k N/m
Load Beam 2 Quls rooftop	51.4k N/m
Lenght Beam	2.5m
Load Support Beam Ruls floor	176.2k N
Load Support Beam Ruls rooftop	142.9k N

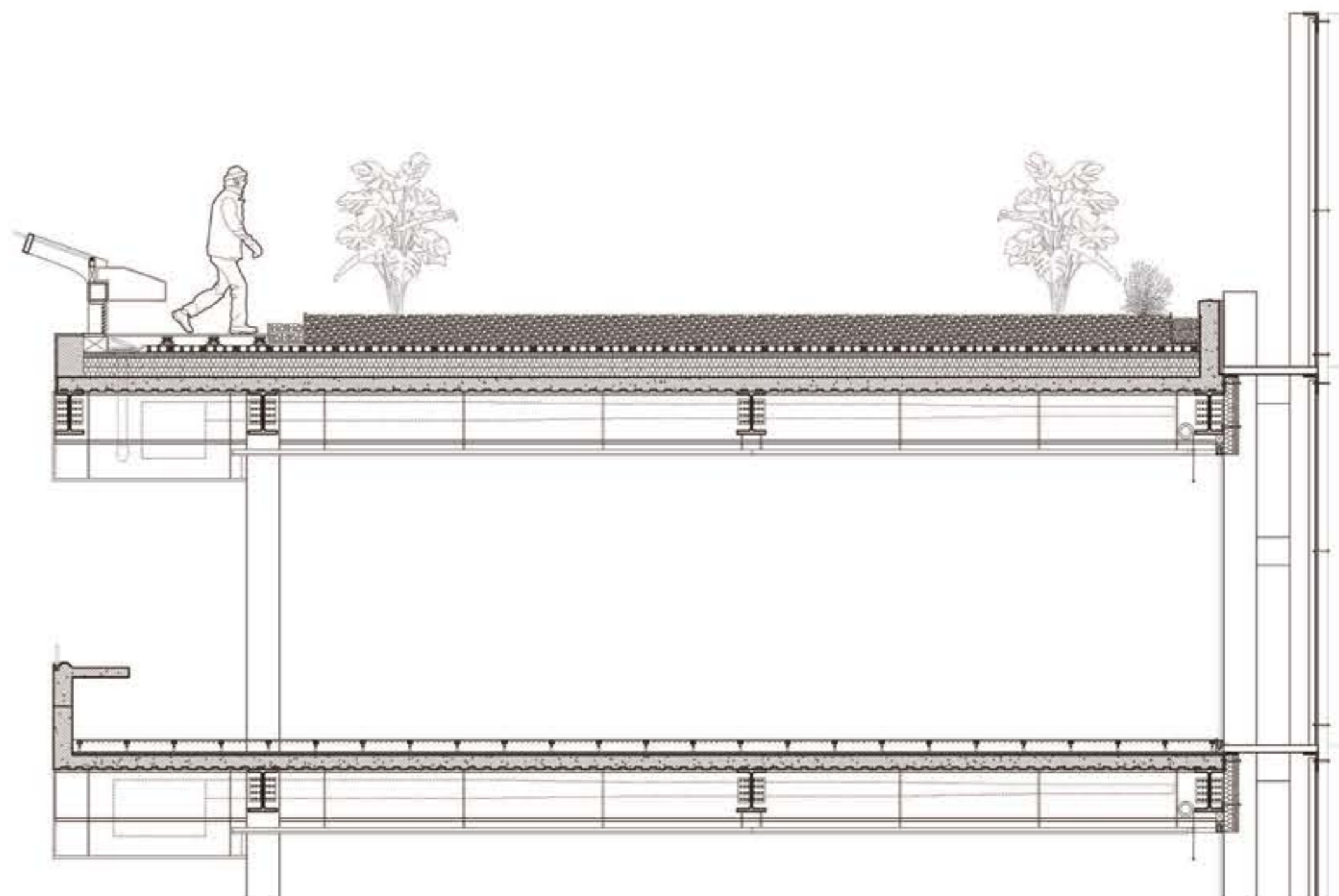
Pillar Type	HE360AX2 King cross section	
Norminal weight	224 kg/m	
Pillar SELF-WEIGHT Puls,self5	8.2 kN	

Load on Pillar 6 4F	521.0k N4	m
Load on Pillar 5 3F	559.6k N4	m
Load on Pillar 4 2F	559.6k N4	m
Load on Pillar 3 1F	559.6k N4	m
Load on Pillar 2 0F	559.6k N5	m
Load on Pillar 1 -1F	559.6k N5	m
<b>TOTAL PILLAR LOAD Puls</b>	<b>3319 kN</b>	



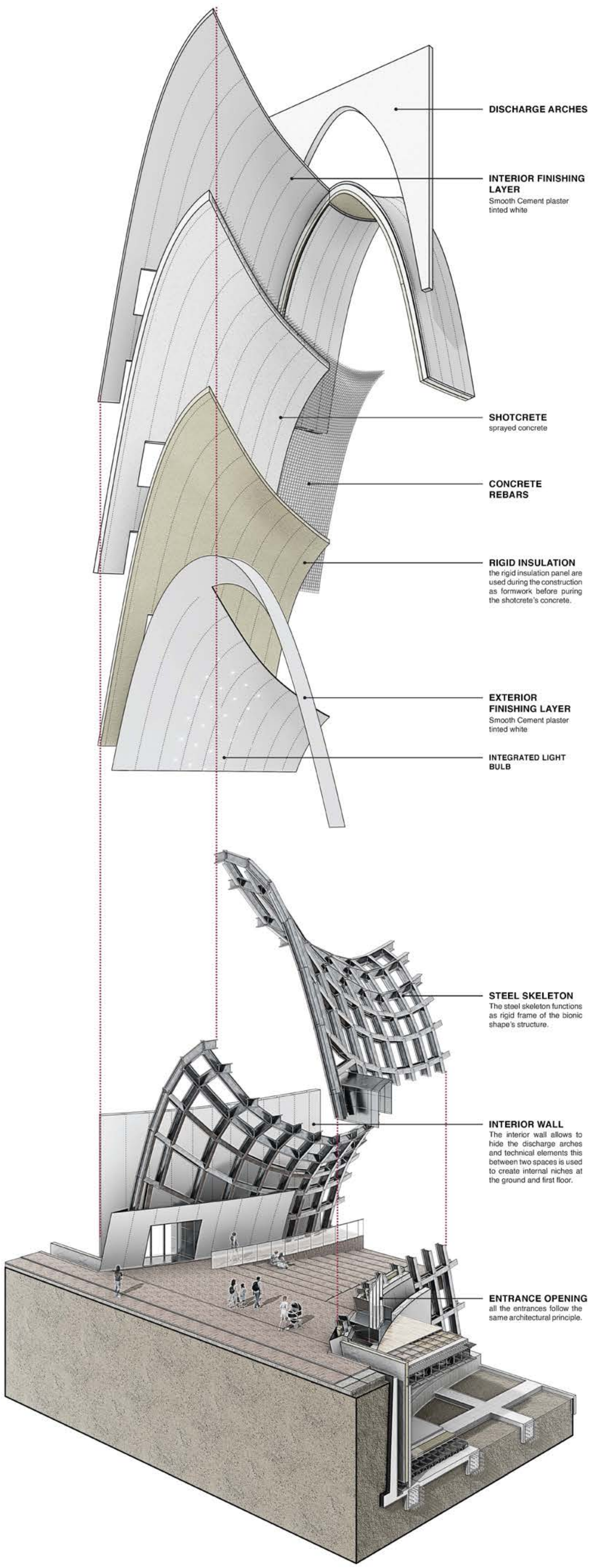
**PART 4: STEEL COLUMN CHECK**

<b>INTERNAL COLUMN</b>				
N <sub>ED</sub>	3319 kN	3318900 N		
pre-selected profile	HE360AX2 King cross section	Steel class :	235	
	As	285.6 cm <sup>2</sup>	28560 mm <sup>2</sup>	0.02856m <sup>2</sup>
buckling curve	c			
α	0.49			
σ̄	1600 daN/cm <sup>2</sup>		160 Mpa	
i <sub>min</sub>	152.2 mm			
f <sub>y</sub>	235 MPa		235000000 Pa	
γ <sub>m1</sub>	1.05			
E	206000 MPa		2.06E+11 Pa	
fixed-hinge scheme	l	5 m5	000 mm	
	l <sub>0</sub> =0.75l	3.75 m	3750m m	
Slenderness check	λ	24.63863338	<1 50	OK
	w	1.04		
Allowable stress check	σ	120856306.4 Pa	120.8563064 Mpa	< σ̄ OK
	J	661587830.4 mm <sup>4</sup>	0.000661588 m <sup>4</sup>	
	P <sub>cr</sub>	95554575.8 N9	5554.6 kN	
Limit state check	λ̄	0.265025272	φ = 0.551050389	0.96694587
	N <sub>Rd</sub>	6180718.0 N	6180.7 kN	>N <sub>ED</sub> OK



**DETAIL SECTION SCALE 1/50**





**DISCHARGE ARCHES**

**INTERIOR FINISHING LAYER**  
Smooth Cement plaster tinted white

**SHOTCRETE**  
sprayed concrete

**CONCRETE REBARS**

**RIGID INSULATION**  
the rigid insulation panel are used during the construction as formwork before puring the shotcrete's concrete.

**EXTERIOR FINISHING LAYER**  
Smooth Cement plaster tinted white

**INTEGRATED LIGHT BULB**

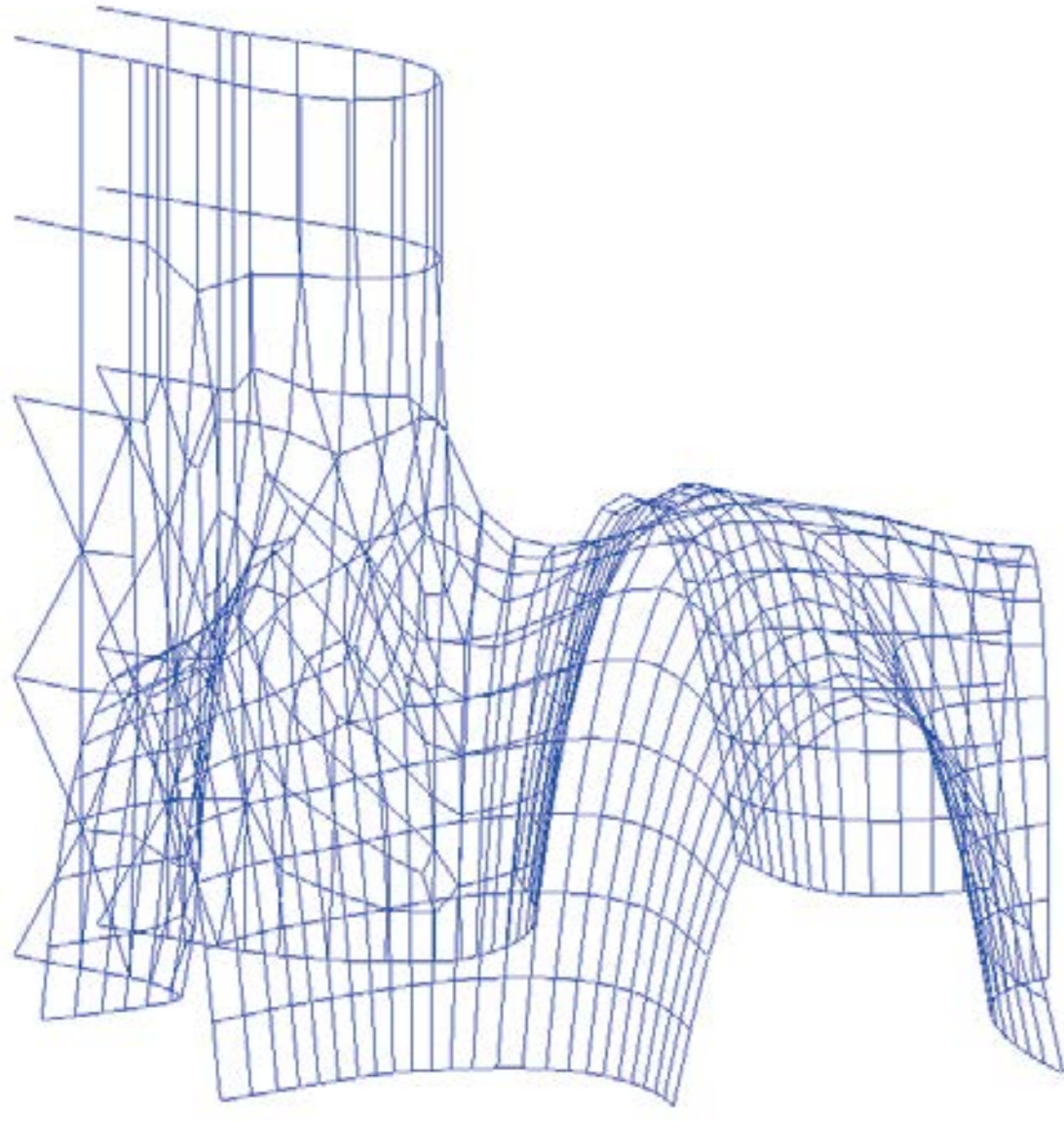
**STEEL SKELETON**  
The steel skeleton functions as rigid frame of the bionic shape's structure.

**INTERIOR WALL**  
The interior wall allows to hide the discharge arches and technical elements this between two spaces is used to create internal niches at the ground and first floor.

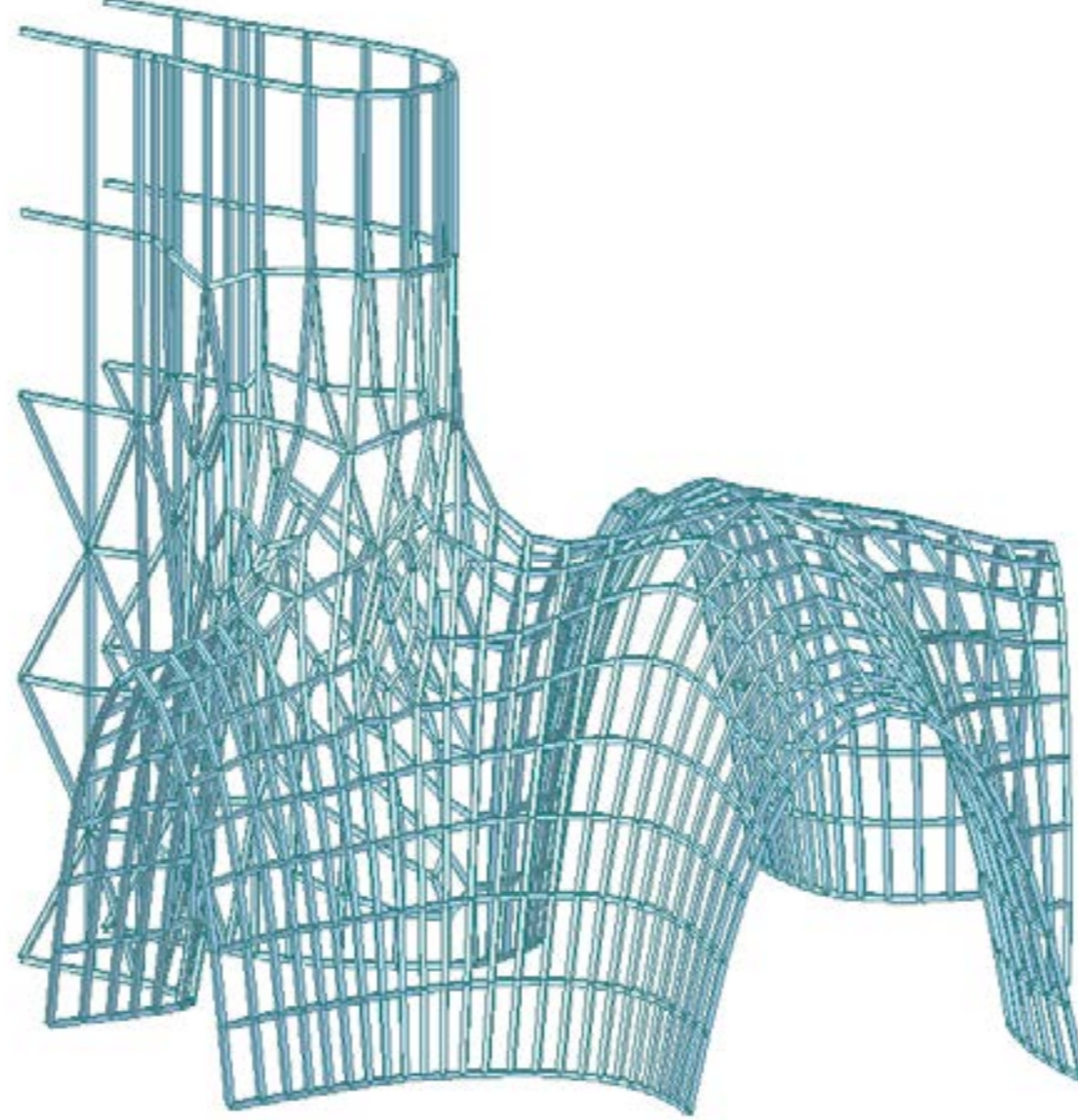
**ENTRANCE OPENING**  
all the entrances follow the same architectural principle.



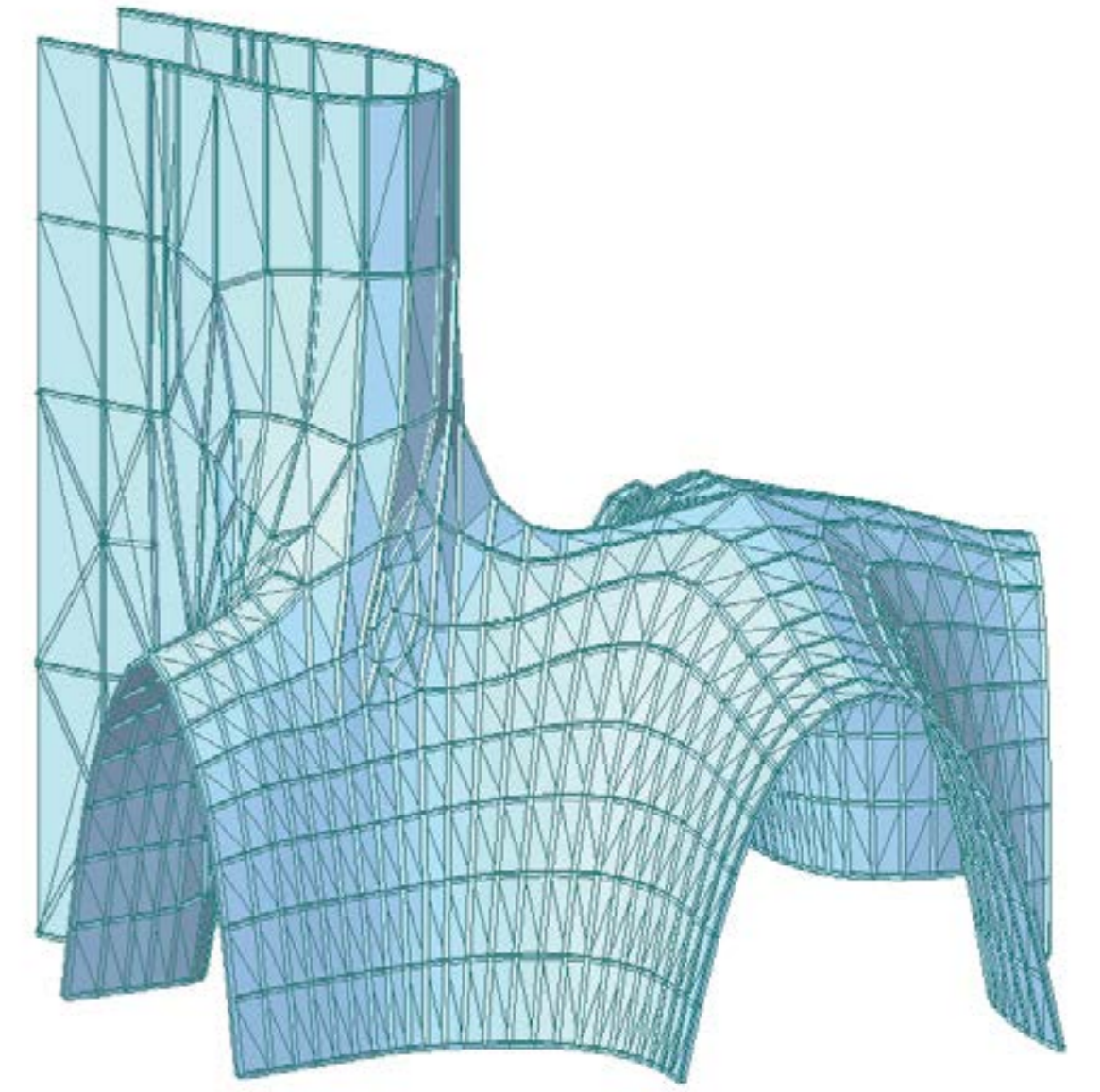
## Constructing simulation model



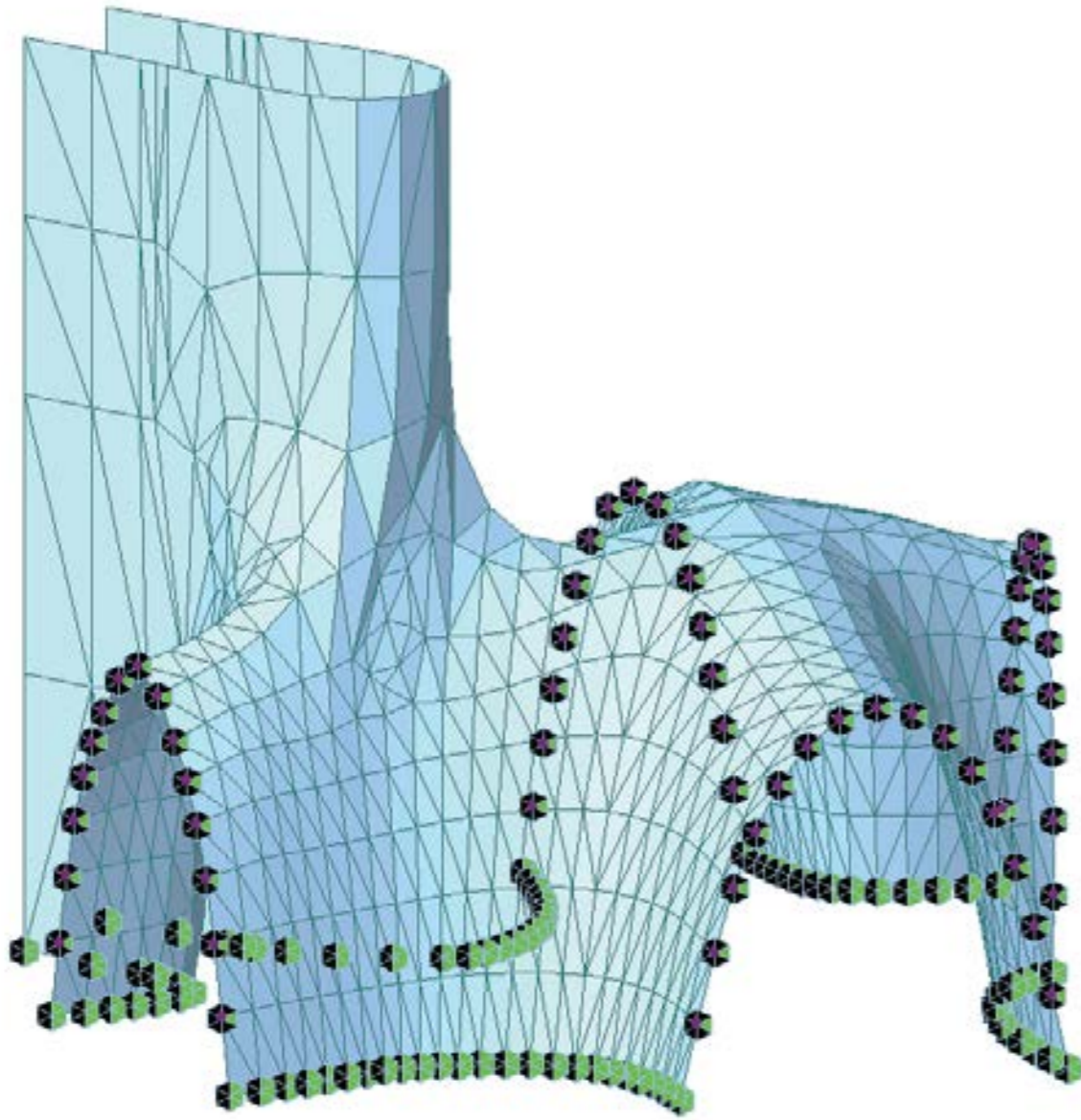
structure lines



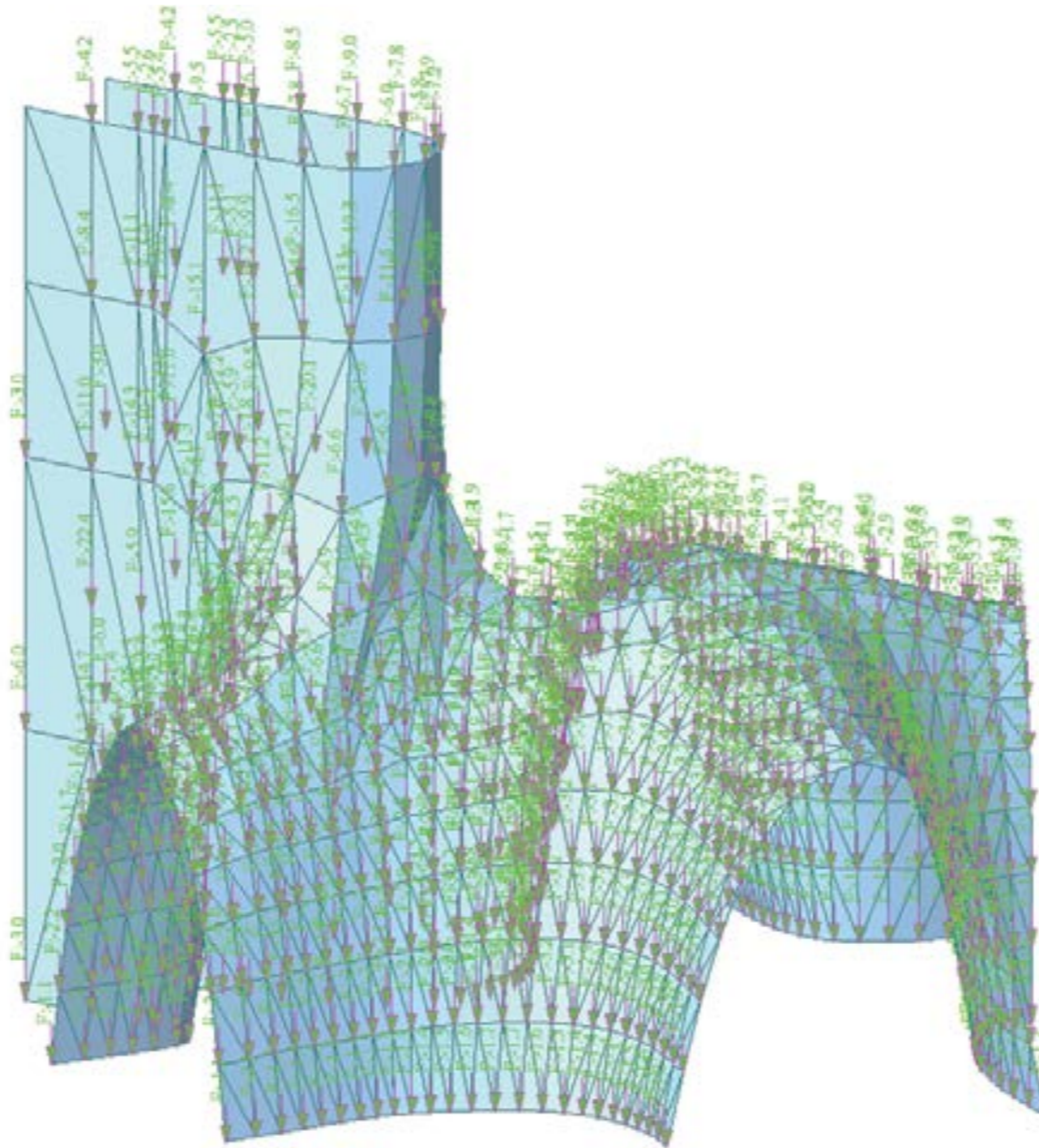
skeleton



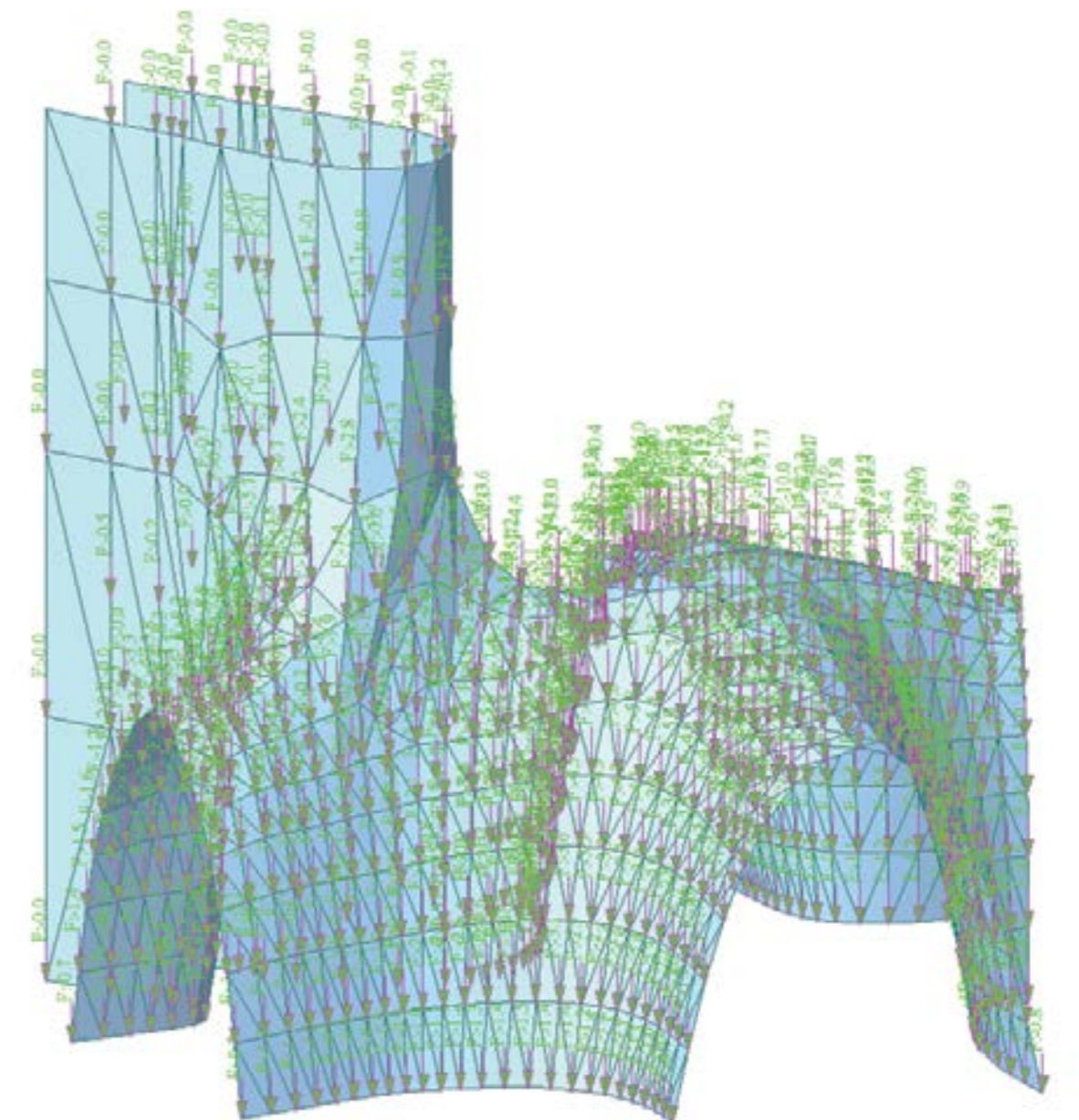
skeleton with shotcrete



two types of restraint

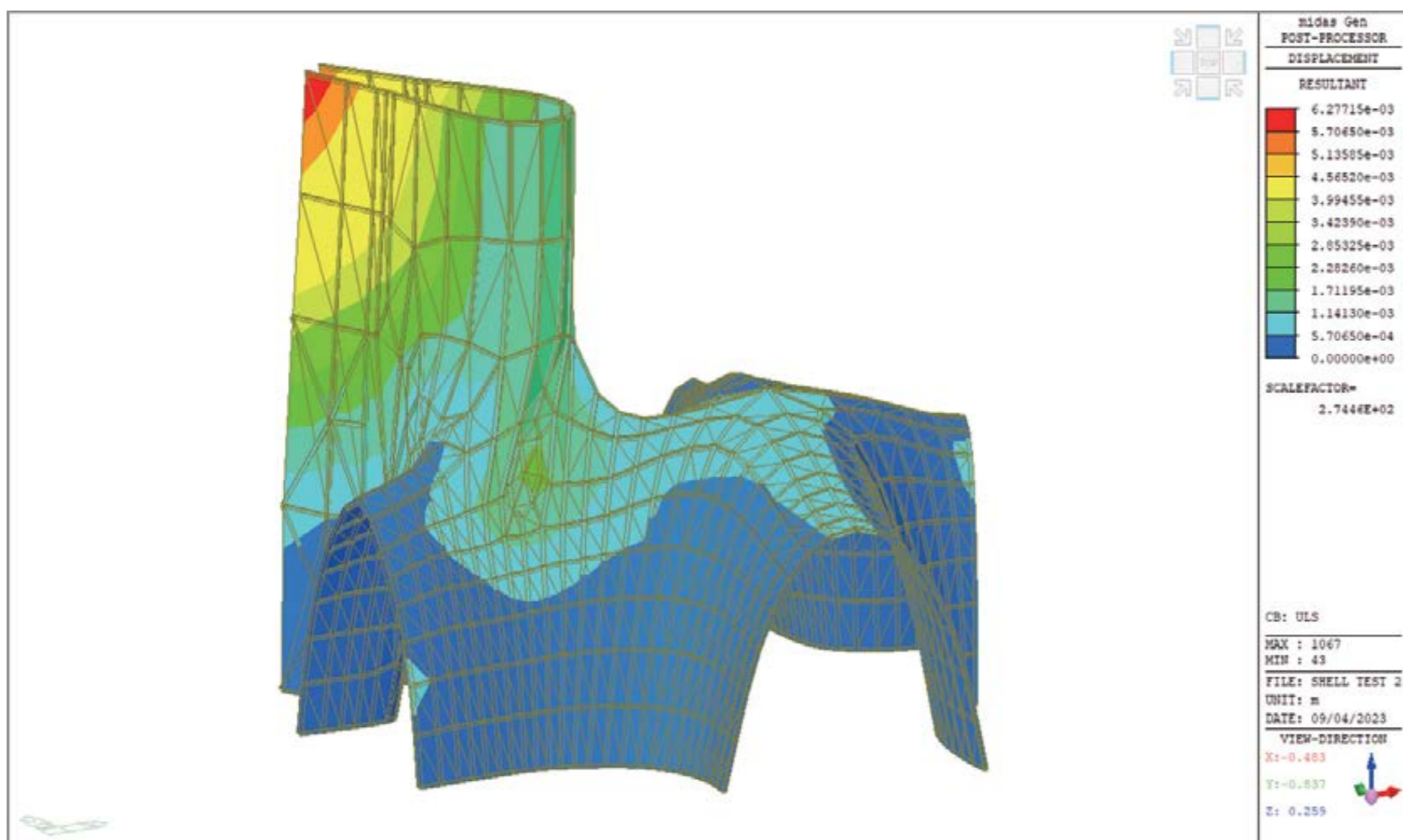


applying concrete panels' load

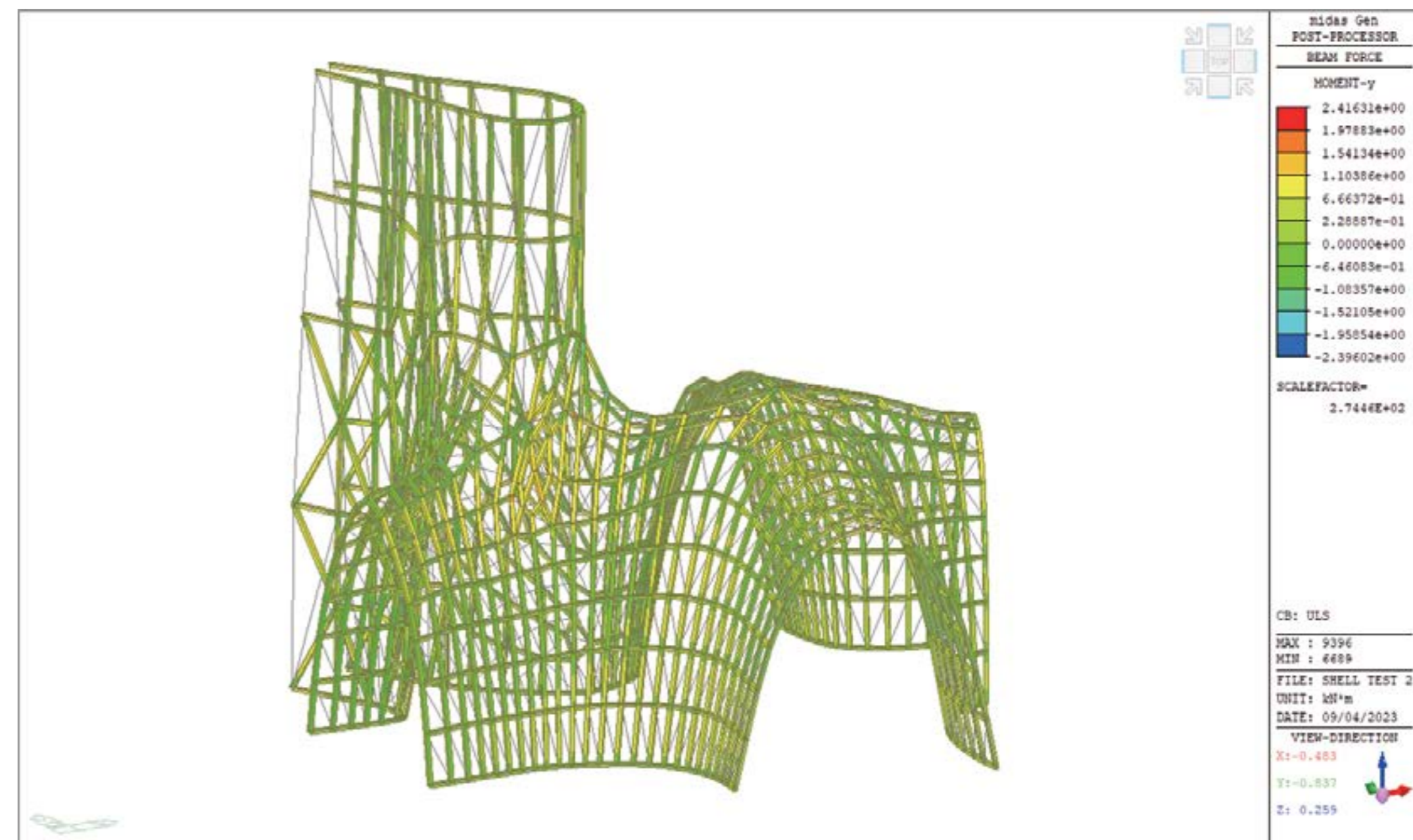


applying liveload

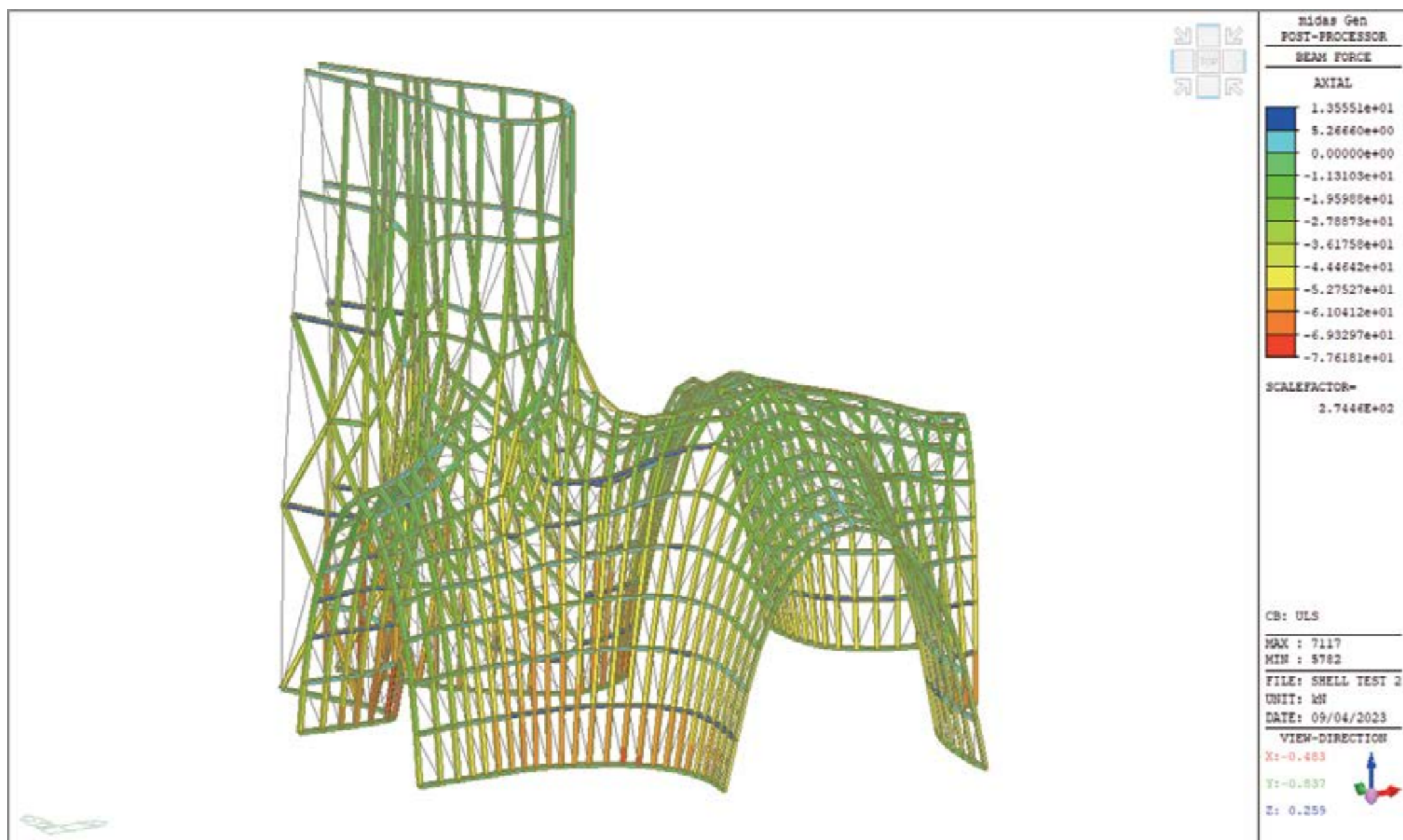
## Performing simulation



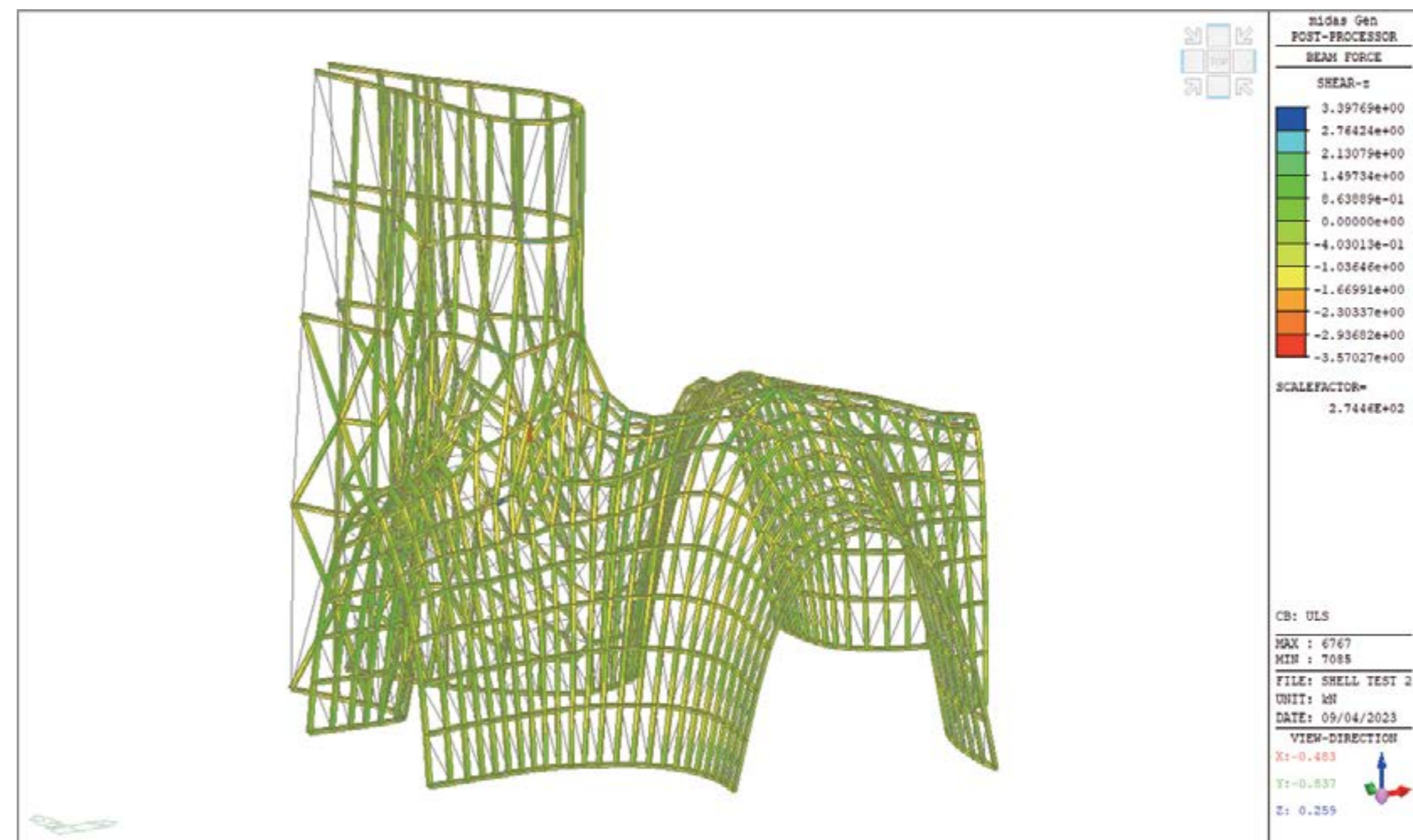
displacement-ULS



bending moment-ULS

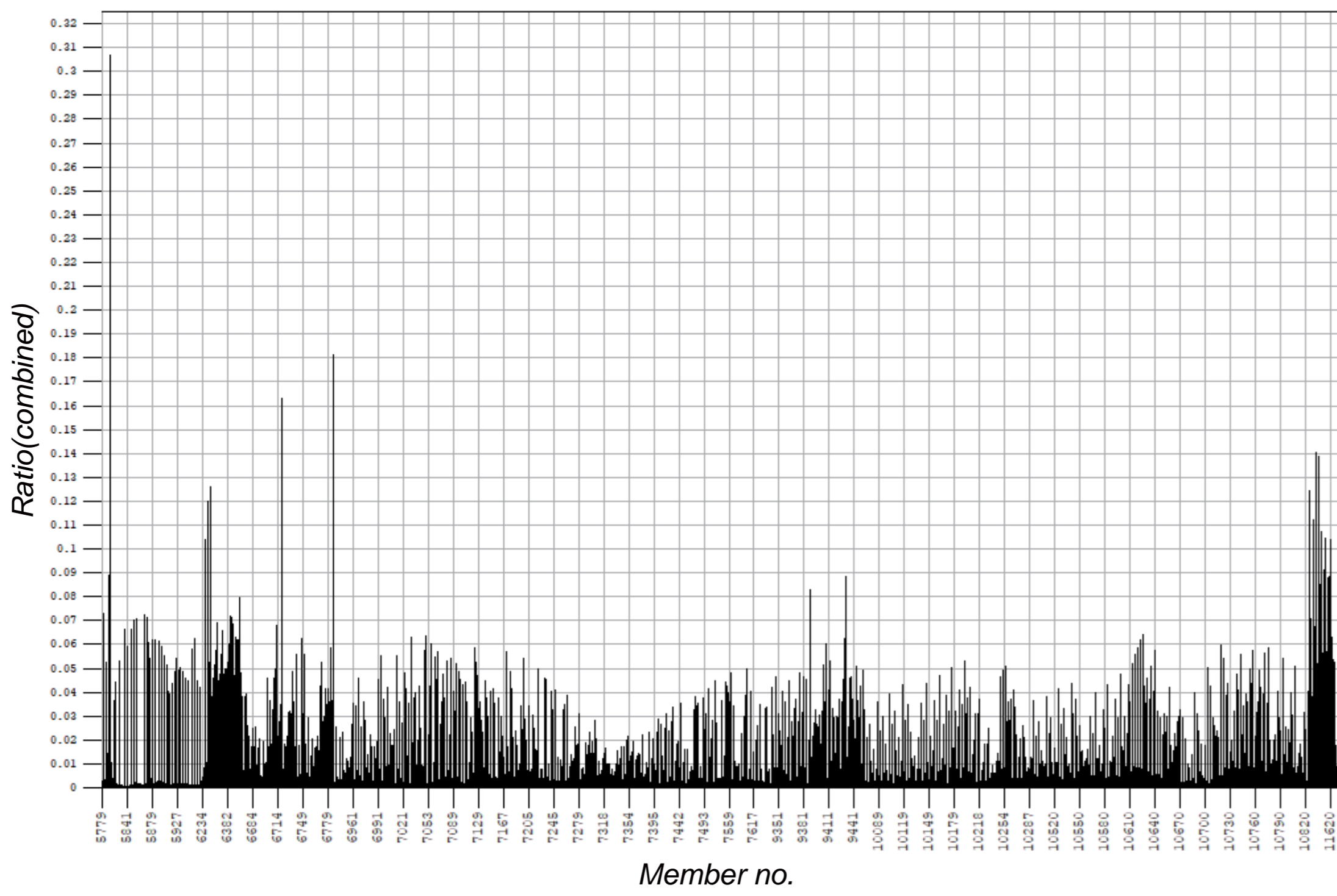


axial force-ULS



shear force-ULS

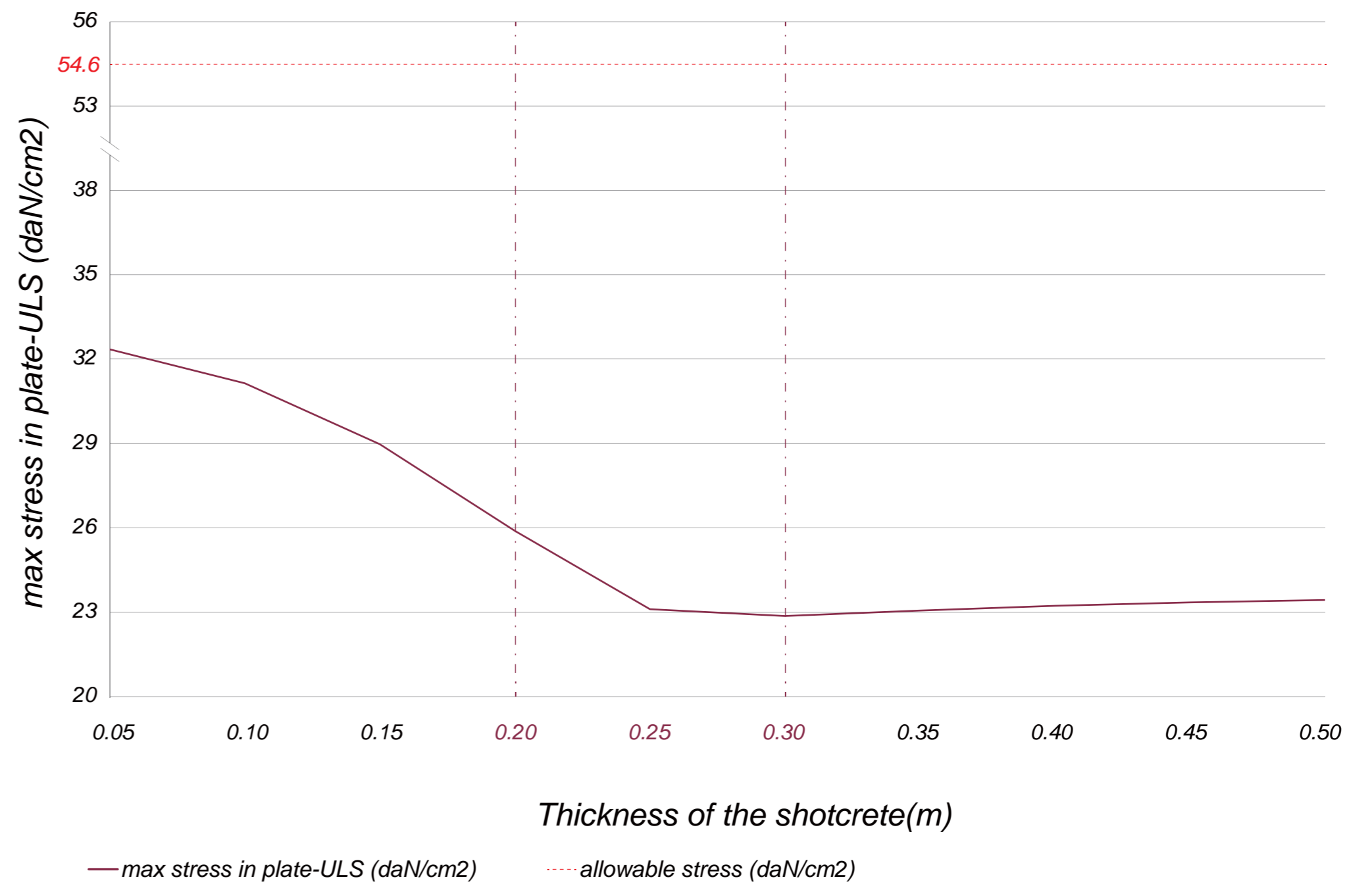
## Verification of steel elements



## Verification of shotcrete

Rck 30 allowable stress (daN/cm <sup>2</sup> )	54.6									
thickness of the shotcrete (m)	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50
max stress in plate-ULS (kN/m <sup>2</sup> )	3234.85	3114.13	2897.63	2589.2	2311.41	2286.91	2306.79	2322.69	2334.93	2343.97
max stress in plate-ULS (daN/cm <sup>2</sup> )	32.3485	31.1413	28.9763	25.892	23.1141	22.8691	23.0679	23.2269	23.3493	23.4397

Chart I

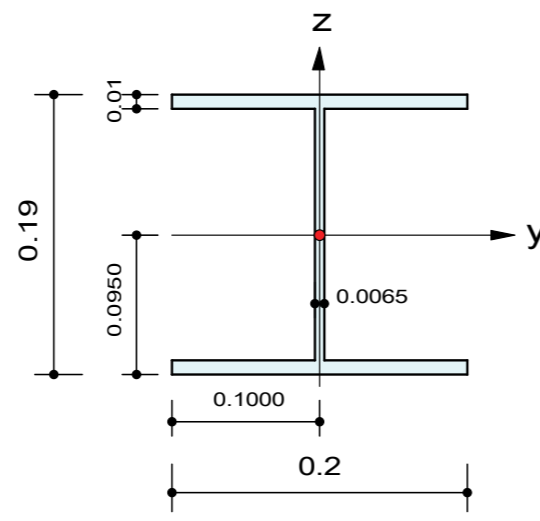


## Calculation over the element with max ratio

midas Gen		Steel Checking Result		
	Company		Project Title	BEIC Library
	Author	Group Mo	File Name	F:\...\BOOK\midas\shell test 2.mgb

### 1. Design Information

Design Code BS5950-90  
 Unit System kN, m  
 Member No 5789  
 Material Fe360 (No:2)  
 (Fy = 235000, Es = 206000000)  
 Section Name HEA200 (No:1)  
 (Rolled : HEA200).  
 Member Length : 9.37948



### 2. Member Forces

Axial Force Fxx = -73.848 (LCB: 2, POS:J)  
 Bending Moments My = -0.2530, Mz = 0.05989  
 End Moments Myi = 0.07551, Myj = -0.2530 (for Le)  
 Myi = -0.0079, Myj = -0.2530 (for Ly)  
 Mzi = 0.01610, Mzj = 0.05989 (for Lz)  
 Shear Forces Fyy = 0.01991 (LCB: 2, POS:1/4)  
 Fzz = 0.15294 (LCB: 2, POS:J)

Depth	0.19000	Web Thick	0.00650
Top F Width	0.20000	Top F Thick	0.01000
Bot.F Width	0.20000	Bot.F Thick	0.01000
Area	0.00538	Asz	0.00123
Qyb	0.03130	Qzb	0.00500
Iyy	0.00004	Izz	0.00001
Ybar	0.10000	Zbar	0.09500
Zyy	0.00039	Zzz	0.00013
ry	0.08280	rz	0.04980

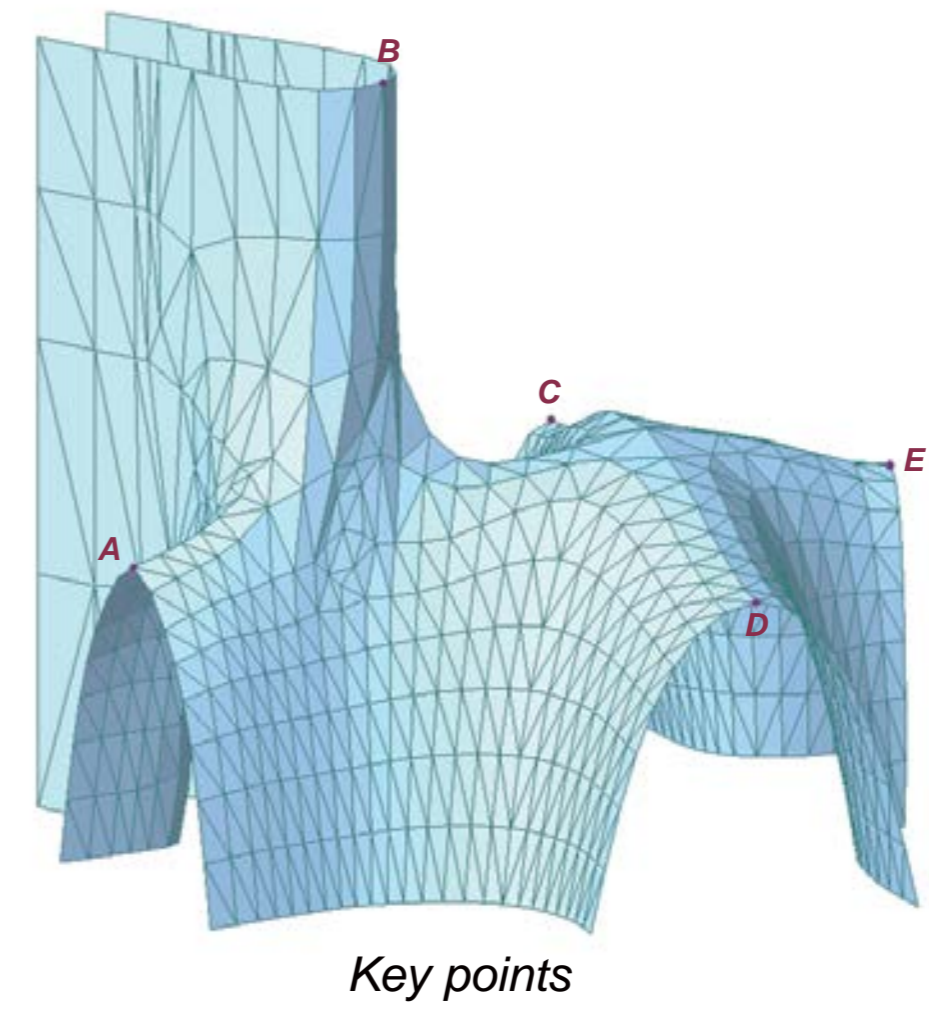
### 3. Design Parameters

Effective Length for LTB Le = 9.37948  
 Effective Length Factors Ky = 1.00, Kz = 1.00  
 Equivalent Uniform Moment Factors / Slenderness Correction Factor  
 m\_y = 1.00, m\_z = 1.00, n = 1.00

### 4. Checking Result

Slenderness Ratio  
 $KL/r = 79.0 < 200.0$  (Memb:6775, LCB: 2)..... O.K  
 Axial Resistance  
 $F_c/P_c = 73.848/240.672 = 0.307 < 1.000$ ..... O.K  
 Bending Resistance  
 $M_y/M_{cy} = 0.253/101.050 = 0.003 < 1.000$ ..... O.K  
 $M_z/M_{cz} = 0.0599/37.7880 = 0.002 < 1.000$ ..... O.K  
 Combined Capacity (Compression+Bending)  
 $R_{max1} = (M_y/M_{cy})^2 + M_z/M_{cz}$   
 $R_{max2} = \text{MAX}[F_c/P_c, M_y/M_{cy}, M_z/M_{cz}]$   
 $M_{ay} = \text{MIN}[M_{cy}(1-F/P_{cy}), (1+0.5F/P_{cy}), M_b(1-F/P_{cy})]$   
 $M_{az} = M_{cz}(1-F/P_{cz})/(1+0.5F/P_{cz})$   
 $R_{max} = \text{MAX}[R_{max1}, R_{max2}, m_y M_{ay}/M_{ay} + m_z M_{az}/M_{az}] = 0.307 < 1.000$ ..... O.K  
 Shear Resistance  
 $F_{vy}/P_{vy} = 0.000 < 1.000$ ..... O.K  
 $F_{vz}/P_{vz} = 0.001 < 1.000$ ..... O.K

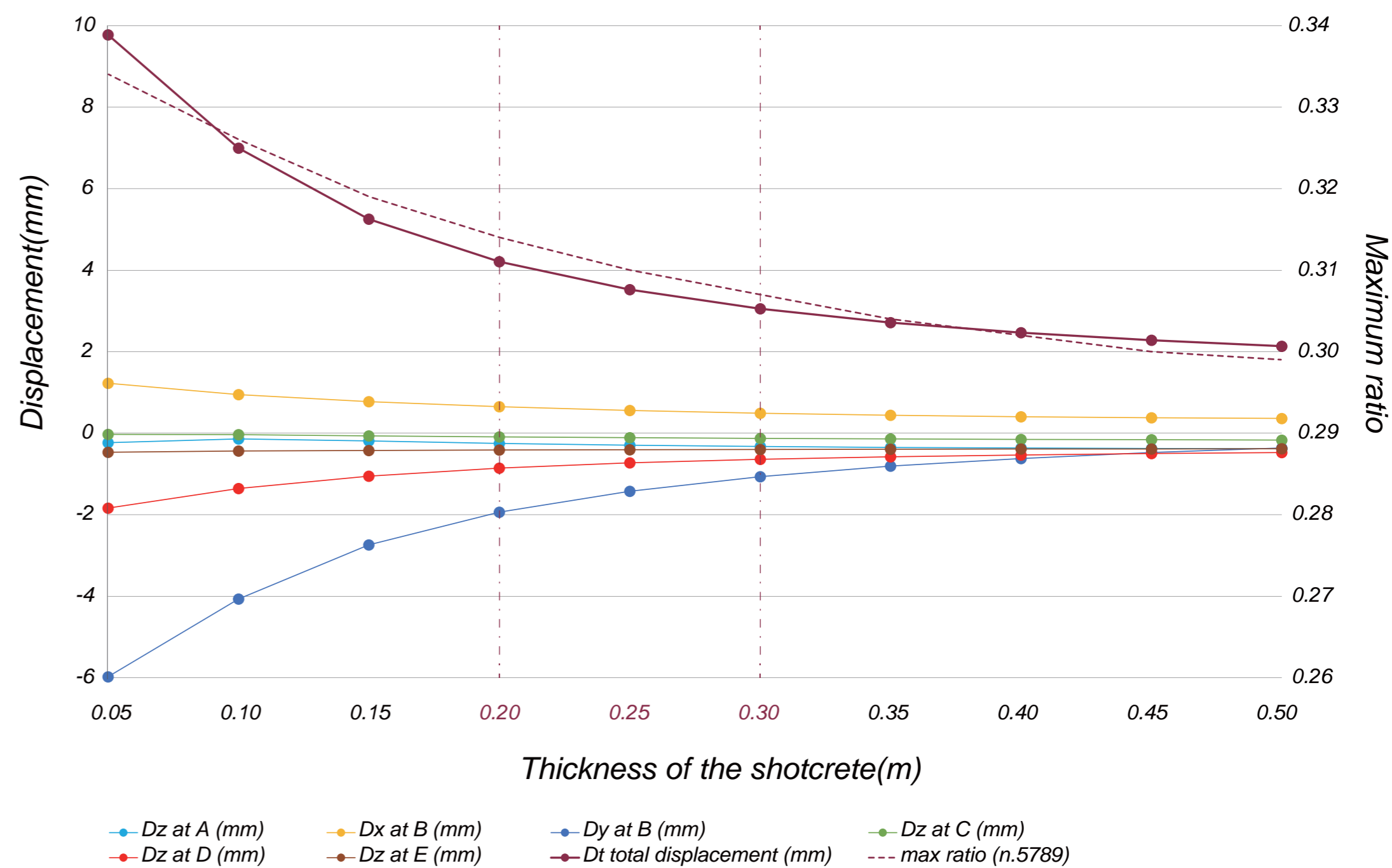
## Research over the thickness of shotcrete



Key points

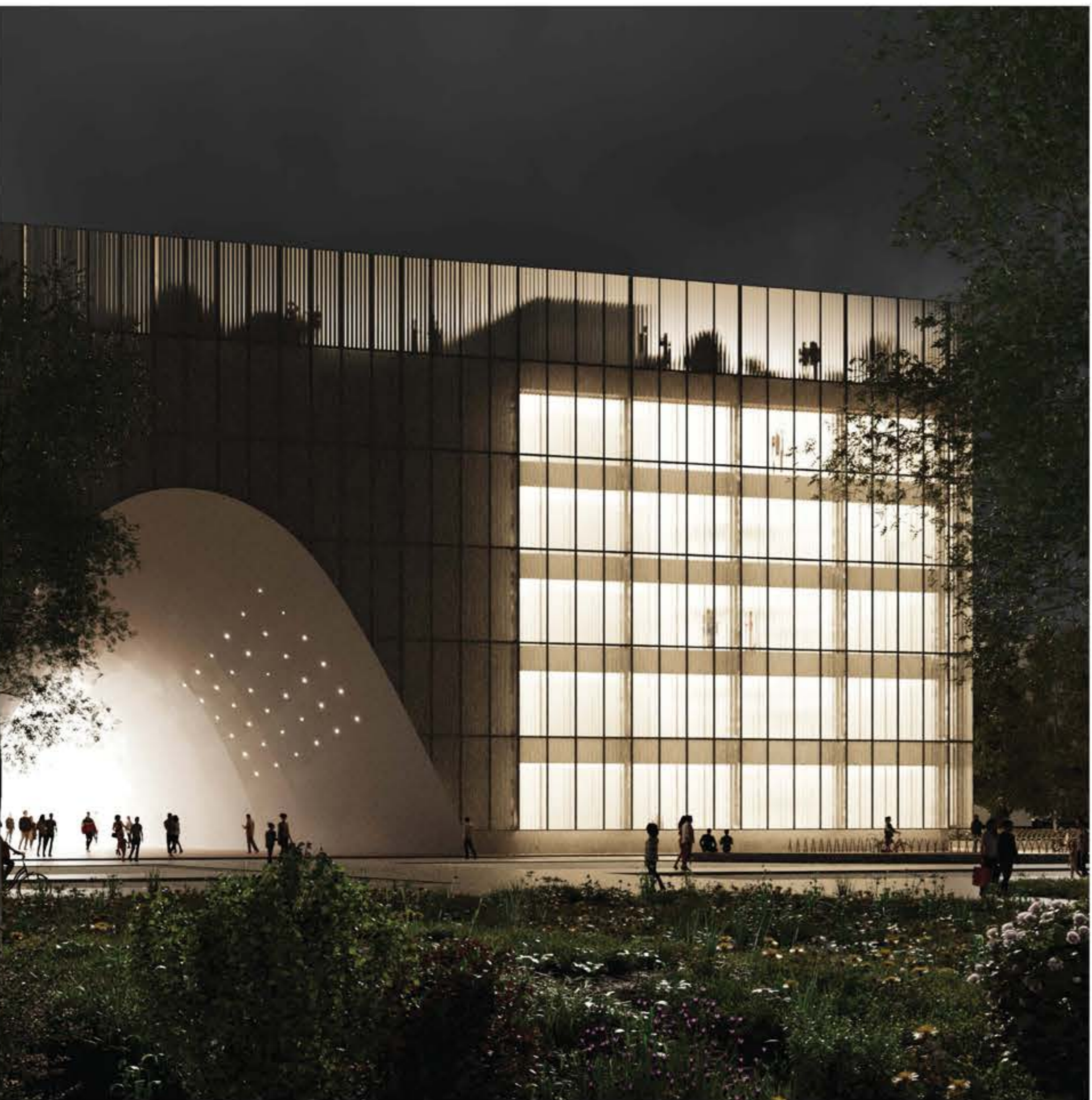
thickness of the shotcrete (m)	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50
Dz at A (mm)	-0.23552	-0.14105	-0.19099	-0.25078	-0.29574	-0.327164	-0.34903	-0.36436	-0.37517	-0.38278
Dx at B (mm)	1.225383	0.94912	0.771039	0.648217	0.556267	0.488461	0.439482	0.404548	0.379804	0.36235
Dy at B (mm)	-5.97856	-4.07083	-2.74107	-1.94113	-1.4229	-1.066091	-0.80983	-0.61982	-0.47523	-0.36273
Dz at C (mm)	-0.02992	-0.0358	-0.06972	-0.09313	-0.11192	-0.127644	-0.14092	-0.15217	-0.16174	-0.16994
Dz at D (mm)	-1.83893	-1.35995	-1.05755	-0.85978	-0.72961	-0.641623	-0.57995	-0.53516	-0.50157	-0.47569
Dz at E (mm)	-0.46826	-0.4355	-0.42453	-0.41573	-0.40792	-0.401200	-0.39542	-0.39038	-0.38589	-0.38185
Dt total displacement (mm)	9.776579	6.992258	5.254886	4.208776	3.524362	3.052183	2.714637	2.466436	2.279406	2.135339
maximum ratio (n.5789)	0.334	0.326	0.319	0.314	0.310	0.307	0.304	0.302	0.300	0.299

Chart II





FACADE DETAIL RENDERING: DAYTIME



FACADE DETAIL RENDERING: NIGHT TIME



**BLUEROF SYSTEM**  
Sorting water above the waterproofing layer Radmat Geocell Blue roof system provides a method of regulated control to meet a limited discharge consent in accordance with SuDS design principles.



**PERFORATED WOODEN ACUSTIC PANELS**  
By virtue of its mass per unit area and mating with a wood fiber panel, WOODGIPS is used for the sound insulation of partition walls, false walls and false ceiling, and even when there is a simultaneous requirement to improve thermal insulation



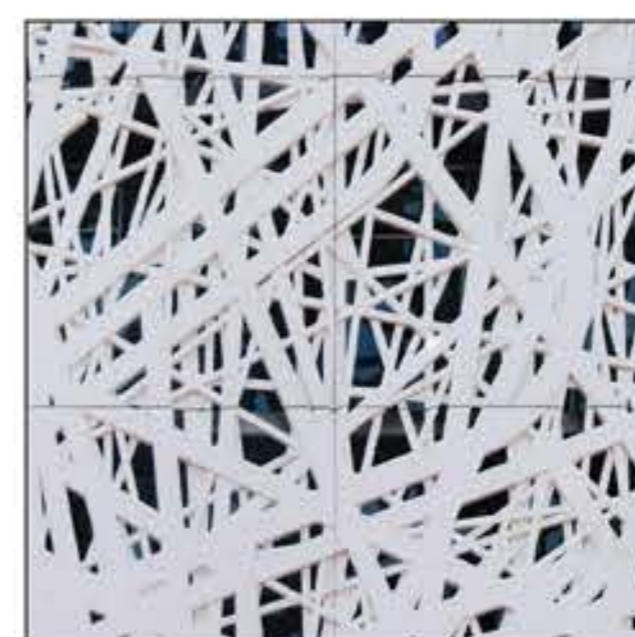
**RAISED FLOOR SYSTEM**  
Raised floors create an additional installation level, depending on the application, for example, cables or wirings get managed through the space created by pedestals and panels.



**SPRAYED CONCRETE SHOTCRETE**  
the concrete mix contain adjuvants in order to have a fluid texture, to penetrate deeply within the rebars mesh, and needs also to have high plastic consistency in order to stay fixed in place without falling away.



**POLYCARBONATE FACADE SYSTEM**  
Danpalon® offers innovative and flexible solutions for the building envelope, which ensure the comfort of natural light and high-quality thermal performance.



**TITANIUM DIOXIDE POWDER**  
A mixture of cement and titanium dioxide, captures pollution and converts it into a harmless salt that easily rinses off the walls when it rains keeping the surface clean. More than that, this adjuvant makes the concrete coloured white.



**IGLU SYSTEM**  
The modular, plastic iglu formworks, placed side by side in the sequence according to a predefined direction, make it easy to quickly create a crawlspace to ventilate the basement and avoid humidity to appear in the underground floor. With the below cavity area it is possible to also add some systems.

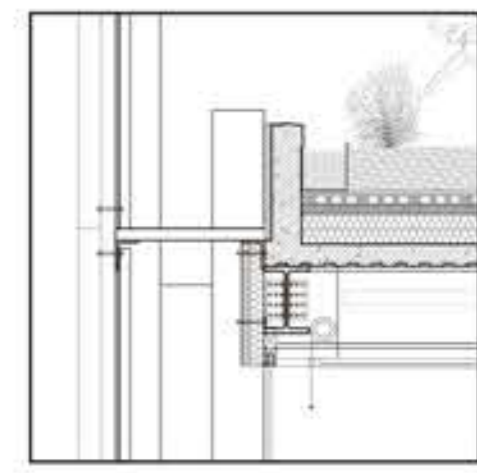


**ROCKWOOL INSULATION**  
The project both uses rigid and soft insulation panels. the rigid panels used as unreusable concrete formwork when spraying the concrete of the bionic shape shell, while the soft insulation is used on a second step to reach the 200mm thickness required for the external insulation.

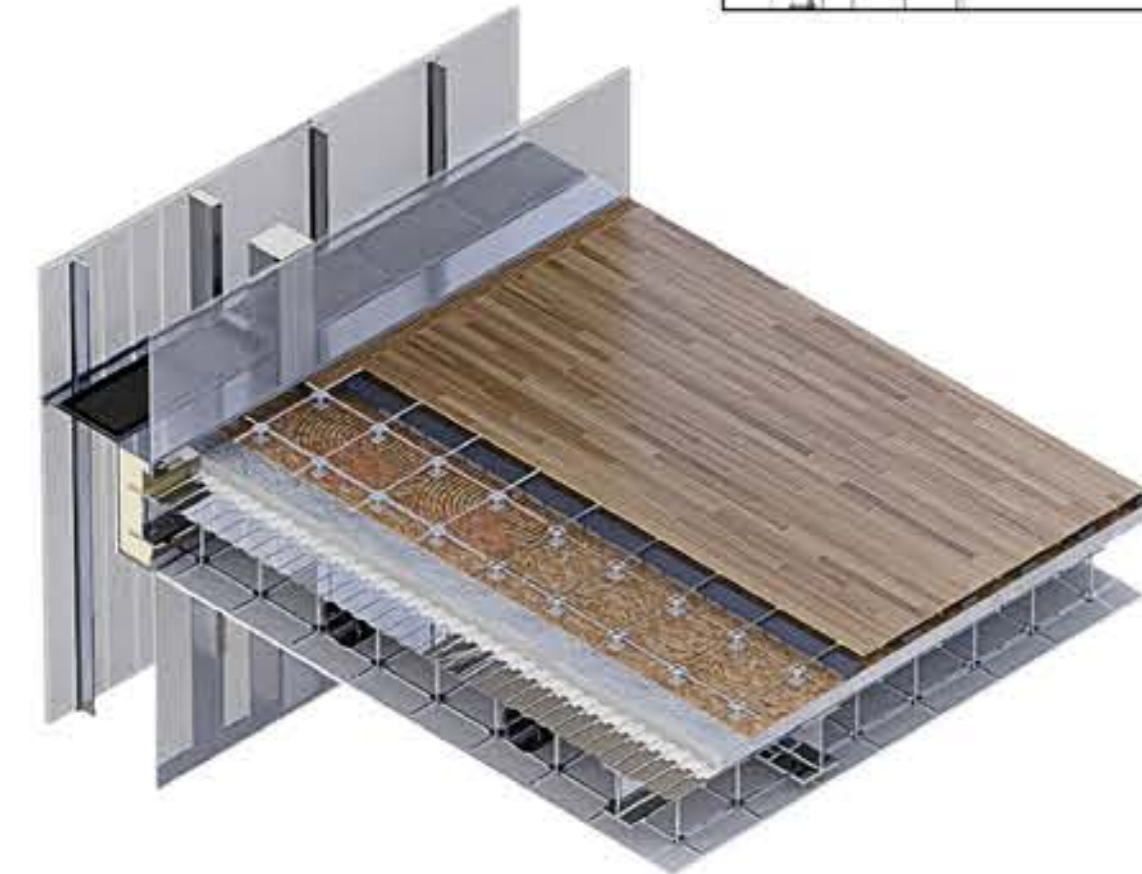
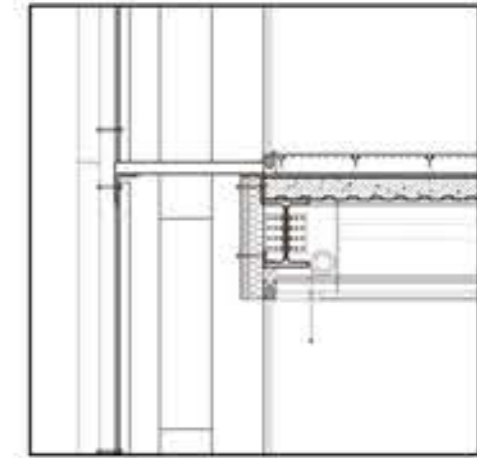




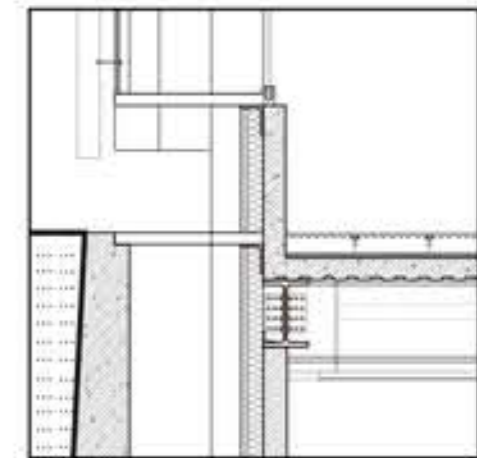
**1. ROOF TOP SLAB**  
 School steel with expanded clay 300  
 Blue Roof\* filtration fleece  
 Blue Roof\* gravel  
 Bituminous sheeting/Polydan\* 180-40P (flat)  
 screed 60  
 Stuccowool insulation 200  
 R.C. 150  
 HEB-550 precast steel beam  
 Integrated ventilation ducts  
 Woodgips\* suspended ceiling soundproofed 50



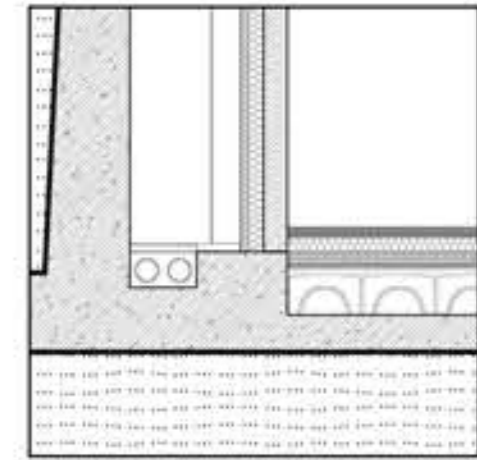
**3. TYPICAL FLOOR SLAB**  
 Wood floor 32mm  
 Water mixed floor system  
 Transit for systems  
 Screed 25mm  
 EPS sound insulation 5mm  
 R.C. 150mm  
 HEB-550 precast steel beam  
 Integrated ventilation ducts  
 Woodgips\* suspended ceiling soundproofed 50mm



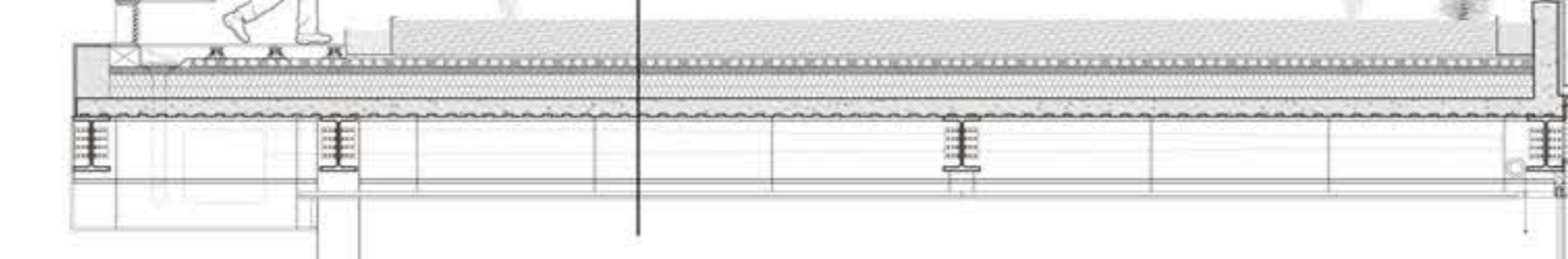
**4. TRANSLUCENT FACADE**  
 Duplex® 22 multilayer polycarbonate  
 Exterior aluminum frame  
 ventilation shutter  
 angle steel drainage  
 Duplex® 12 multilayer polycarbonate



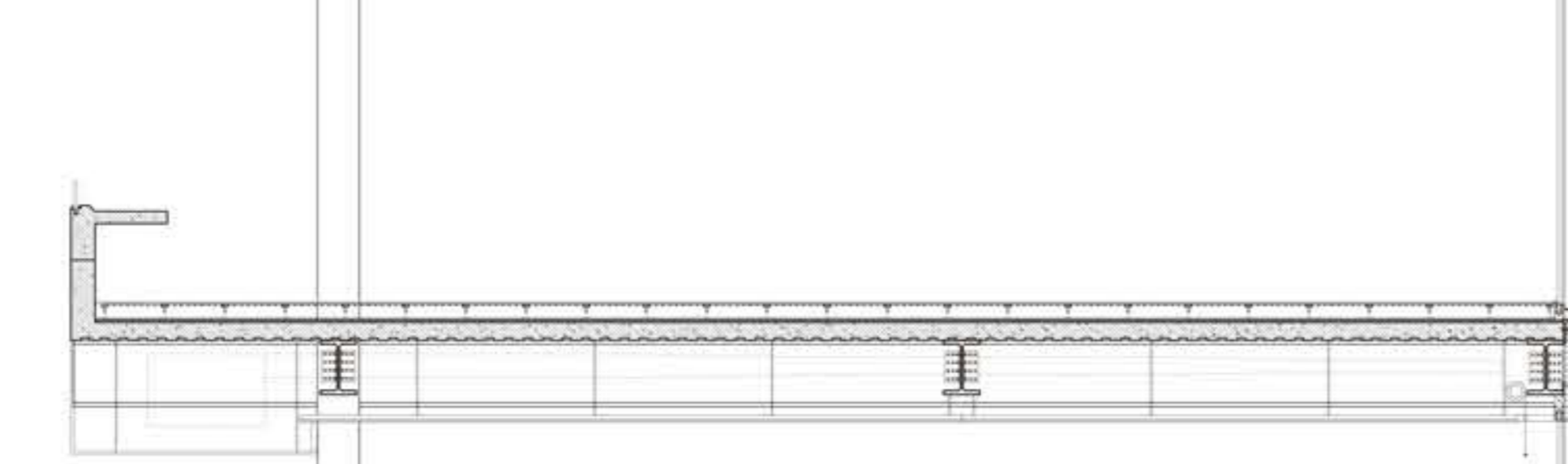
**6. BASEMENT FLOOR**  
 Polished concrete flooring  
 Screed 60mm  
 Extruded polystyrene panel 100mm  
 local ferromesh screed with transit for systems 80  
 Finishing slab foundation in R.C. 100mm  
 Ventilated underfloor cavity with light Plus  
 Lean concrete 210  
 Soil



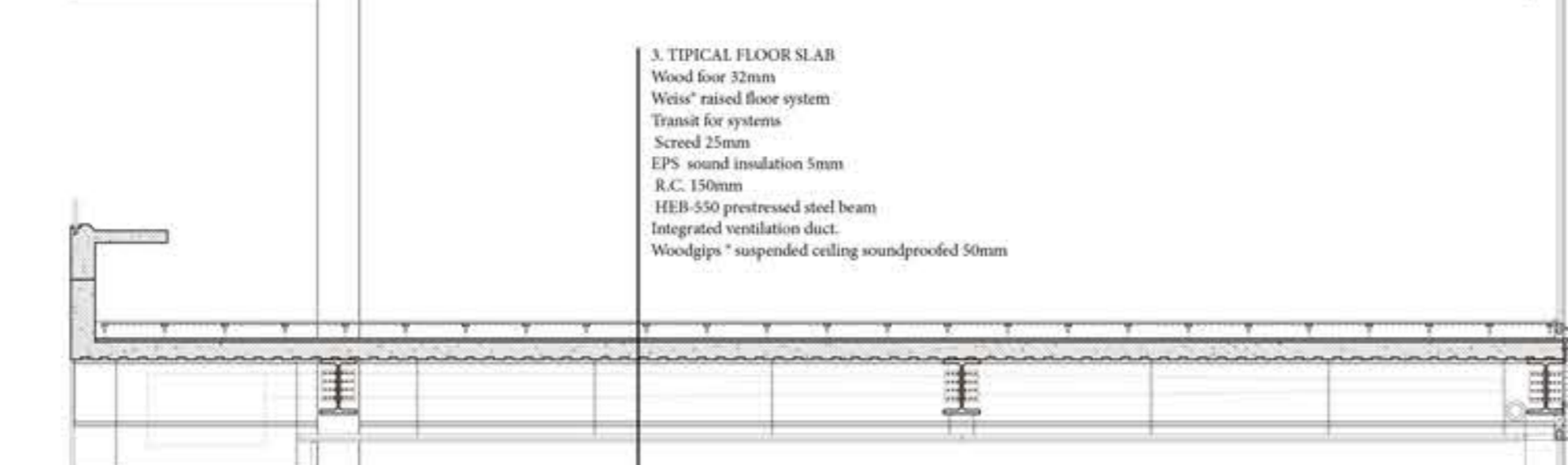
**2. SKYLIGHT SKELETON**  
 Temporary rain storage system  
 HEB-200 steel beam  
 Ventilation shutter



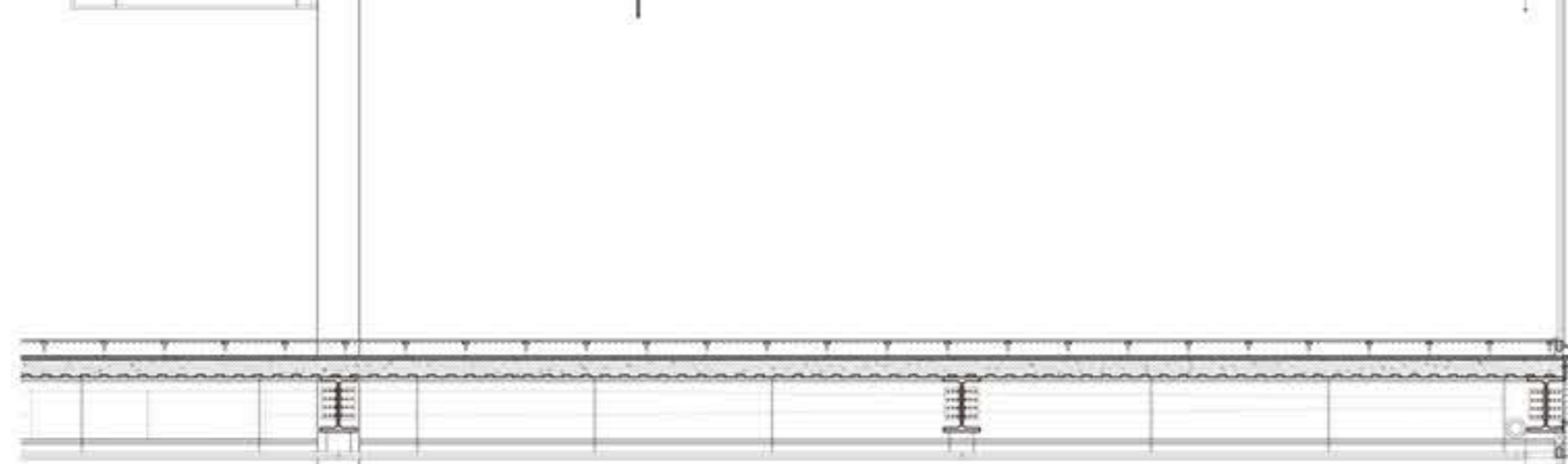
**1. ROOF TOP SLAB Planted**  
 School steel with expanded clay 300  
 Blue Roof\* filtration fleece  
 Blue Roof\* gravel  
 Bituminous sheeting/Polydan\* 180-40P (flat)  
 screed 60  
 Stuccowool insulation 200  
 R.C. 150  
 HEB-550 precast steel beam  
 Integrated ventilation ducts  
 Woodgips\* suspended ceiling soundproofed 50



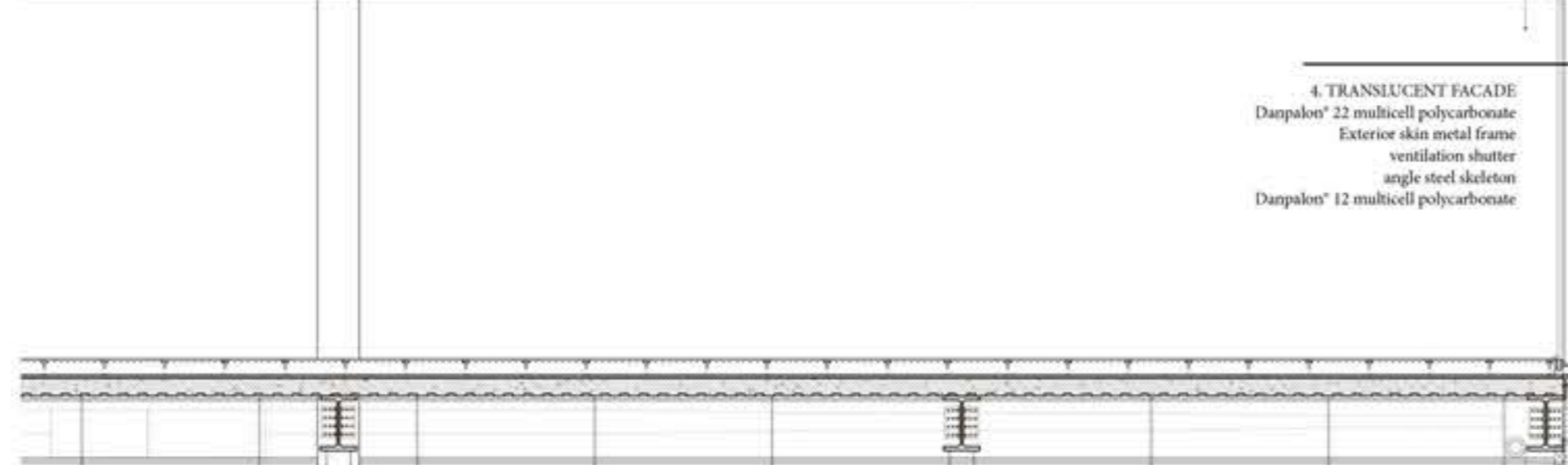
**3. TYPICAL FLOOR SLAB**  
 Wood floor 32mm  
 Water mixed floor system  
 Transit for systems  
 Screed 25mm  
 EPS sound insulation 5mm  
 R.C. 150mm  
 HEB-550 precast steel beam  
 Integrated ventilation ducts  
 Woodgips\* suspended ceiling soundproofed 50mm



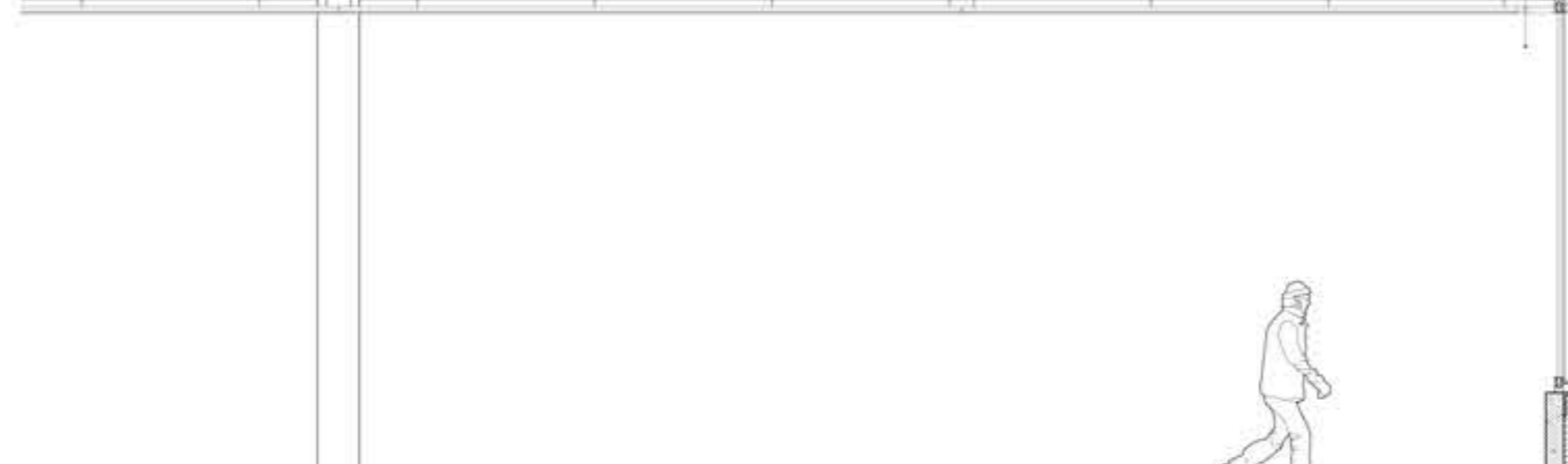
**4. TRANSLUCENT FACADE**  
 Duplex® 22 multilayer polycarbonate  
 Exterior aluminum frame  
 ventilation shutter  
 angle steel drainage  
 Duplex® 12 multilayer polycarbonate



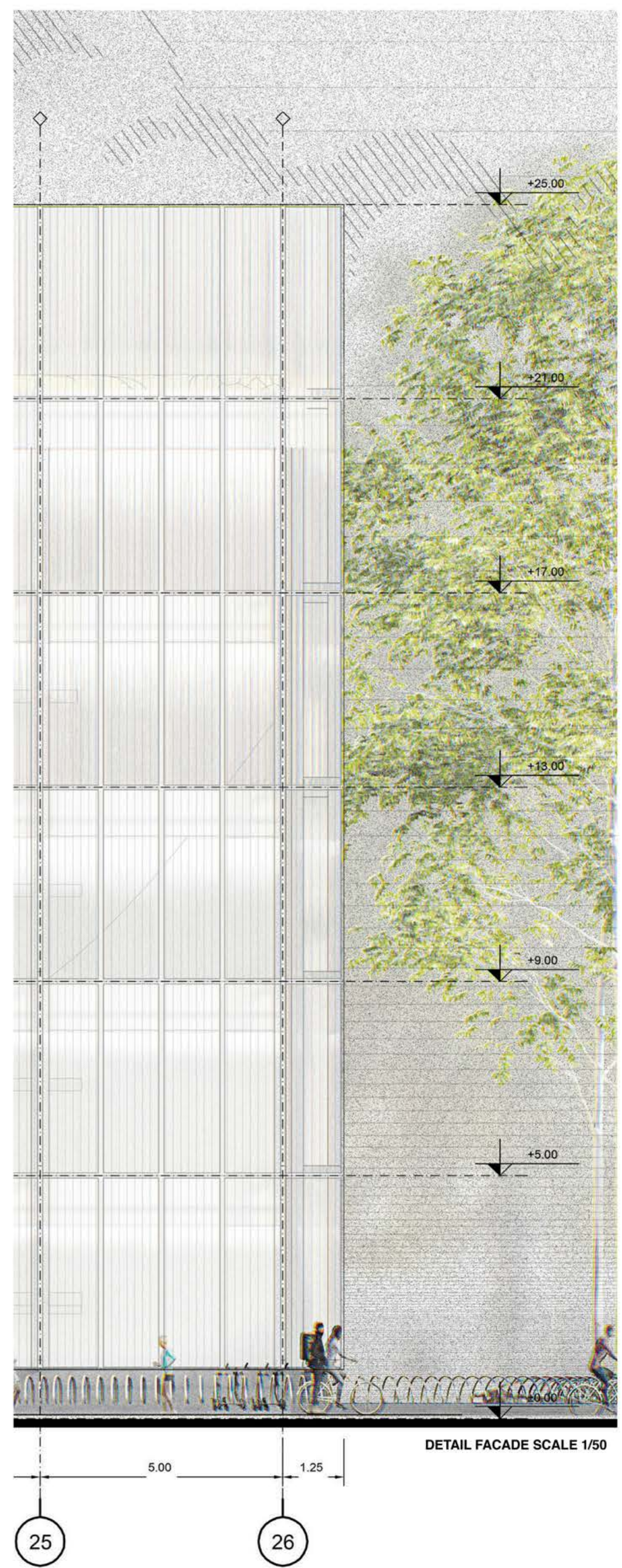
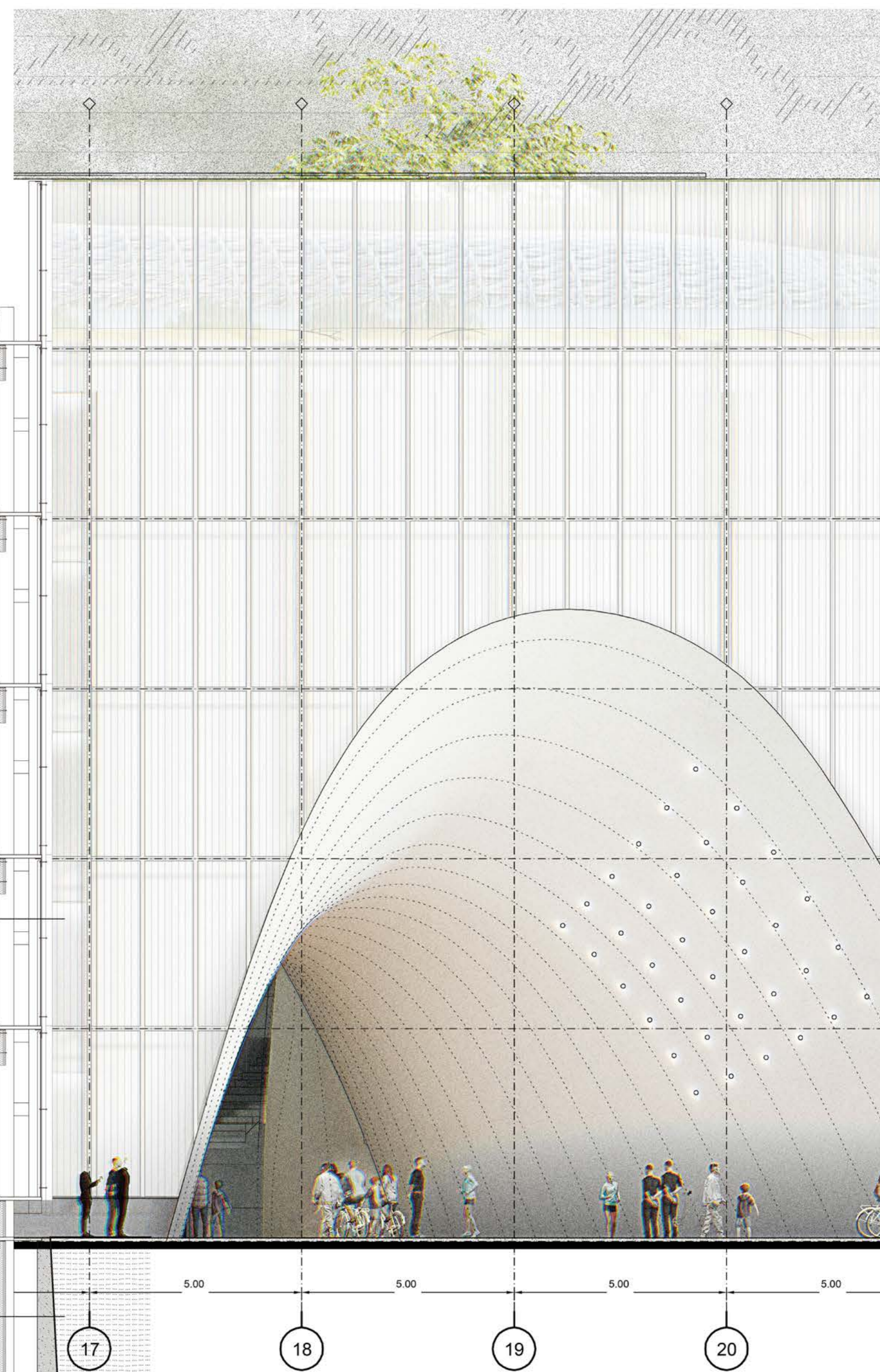
**5. MASSIVE WALL**  
 Concrete partition wall 150  
 stuccowool insulation 130  
 ventilation shaft  
 retaining wall



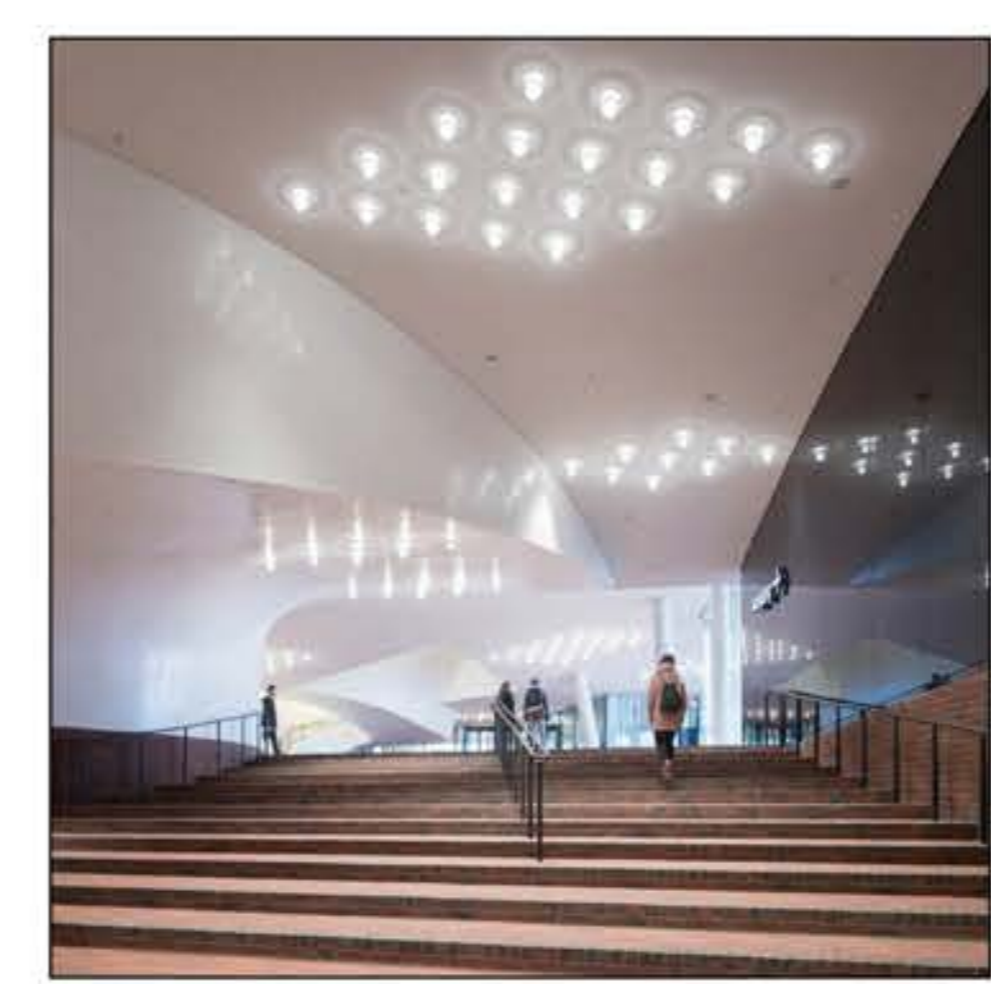
**6. BASEMENT FLOOR**  
 Polished concrete flooring  
 Screed 60mm  
 Extruded polystyrene panel 100mm  
 local ferromesh screed with transit for systems 80  
 Finishing slab foundation in R.C. 100mm  
 Ventilated underfloor cavity with light Plus  
 Lean concrete 210  
 Soil



DETAIL SECTION SCALE 1/50



DETAIL FACADE SCALE 1/50



INSPIRATION FOR THE MATERIAL IMPRESSIONS  
 HERZOG & DE MEURON, ELBPHILHARMONIE HAMBURG © Ivan Baan



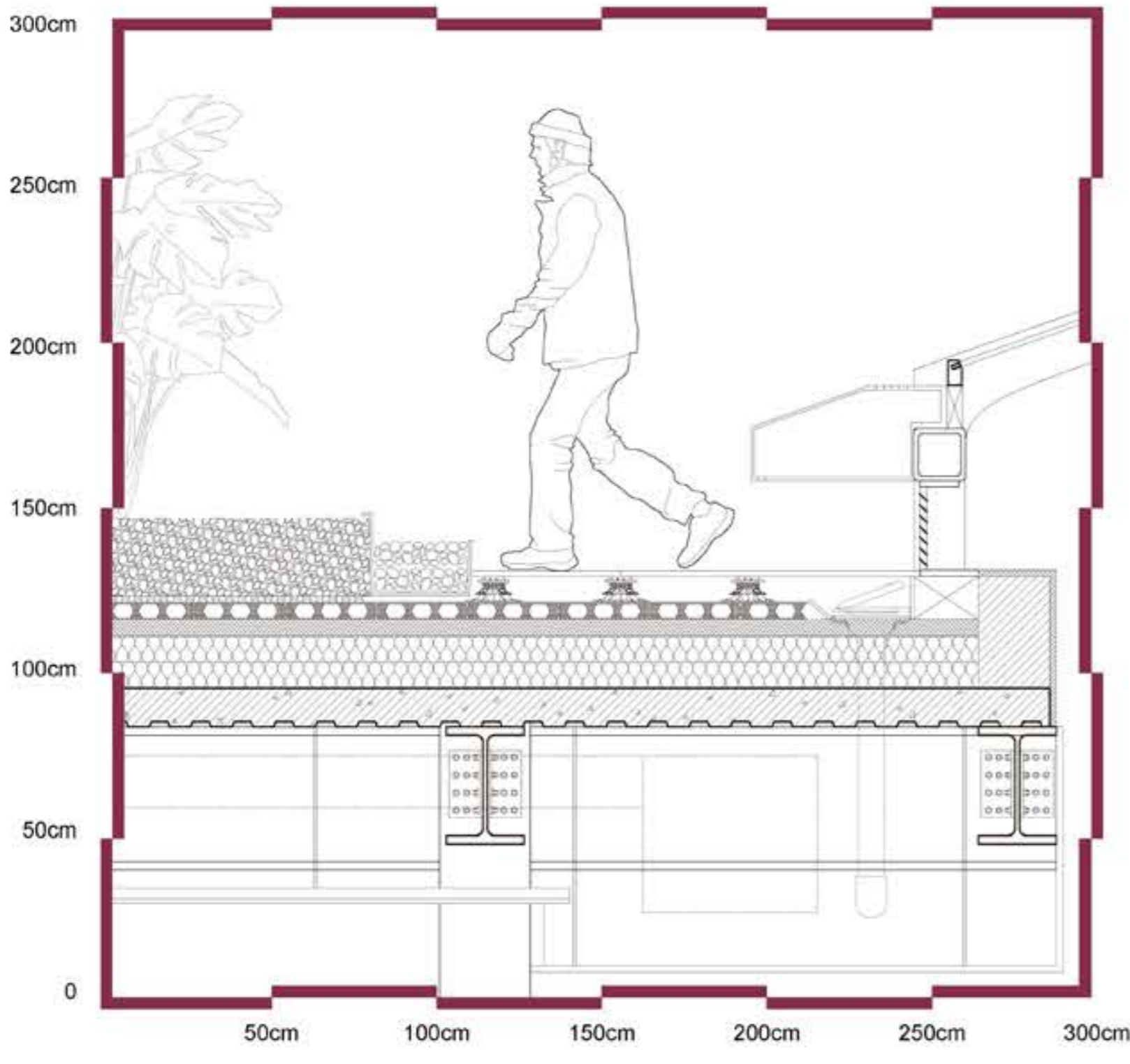
INSPIRATION TRANSITION BETWEEN CYLINDRICAL HOLE AND THE FACADE  
 TADAO ANDO, HOLY THEATER SHANGHAI © Young Jazzy Li



INSPIRATION FOR THE CONSTRUCTION APPROACH  
 TOYO ITO, TAICHUNG METROPOLITAN OPERA HOUSE © Lucas K. Dodson

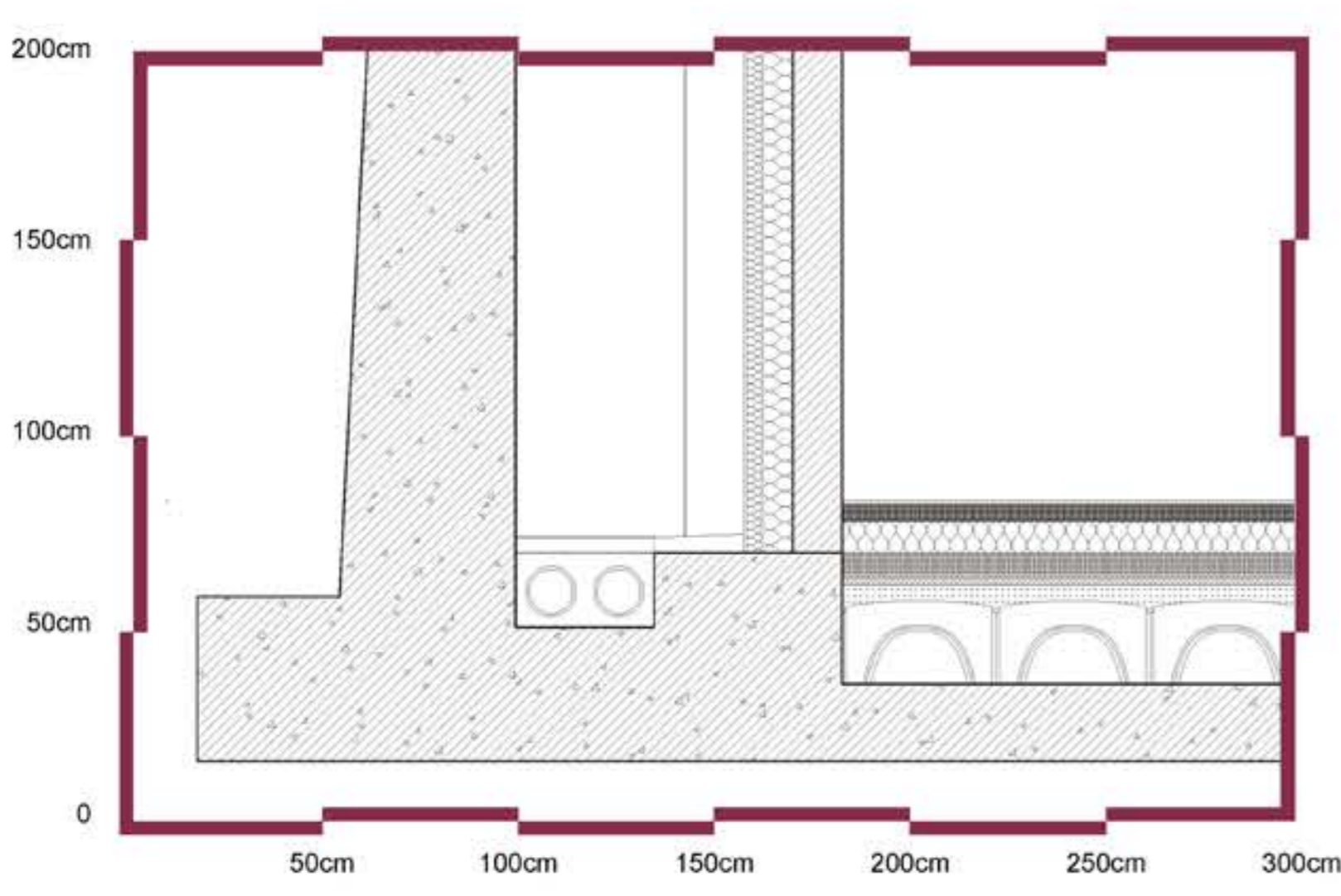


INSPIRATION FOR THE USE OF POLYCARBONATE  
 HERZOG & DE MEURON, LABAN DANCE CENTRE, LONDON © Peter Durand

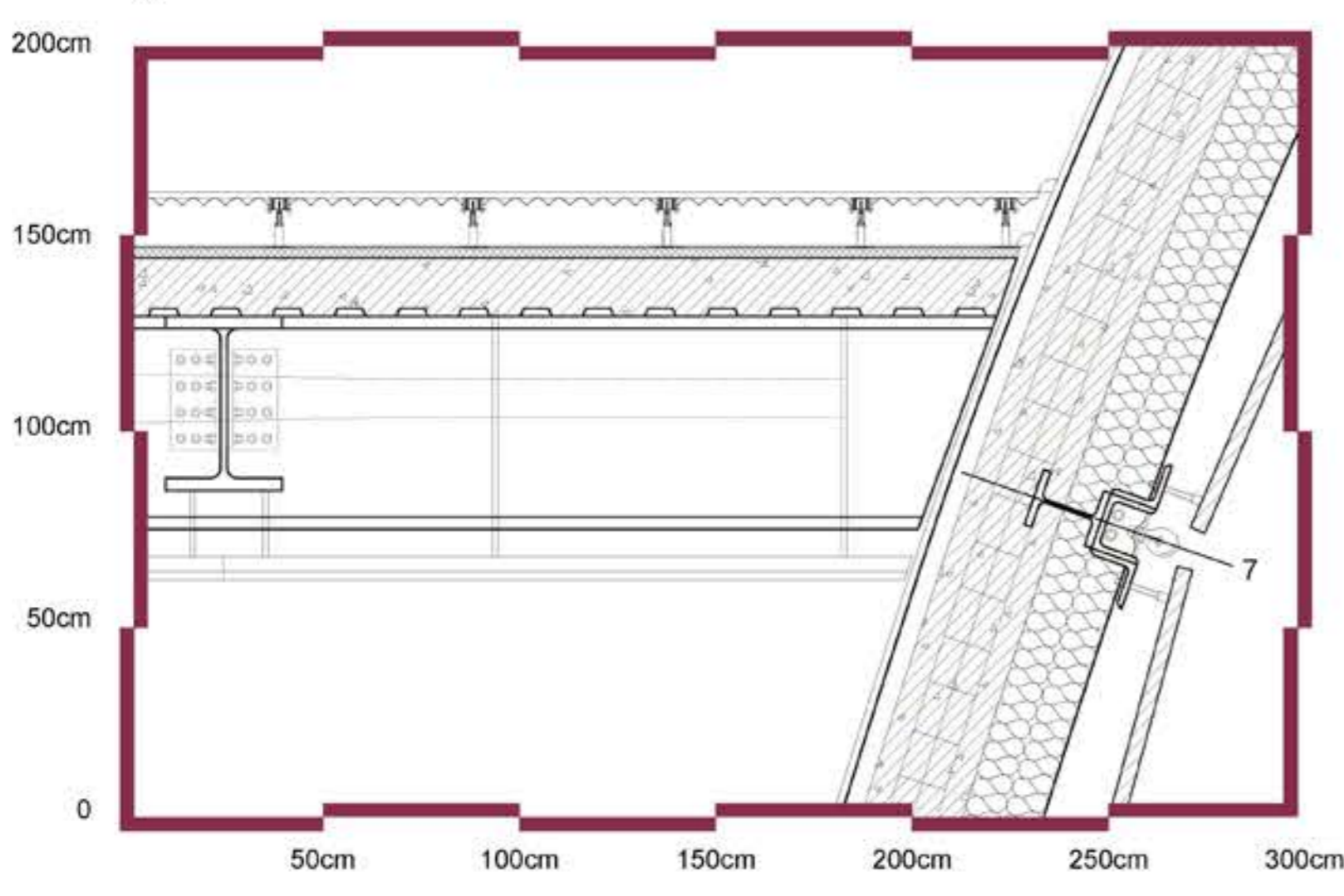


1.2 ROOF TOP SLAB (walkable) Scale 1/20  
 Wood floor 32mm  
 Weiser raised floor system  
 Bituminous sheeting/Polyclan\* 180-40P Elast)  
 screed 65  
 Stone wool insulation 200  
 R.C. 150  
 IEB-550 prestressed steel beam  
 Integrated ventilation duct.  
 Woodplips\* suspended ceiling soundproofed 50

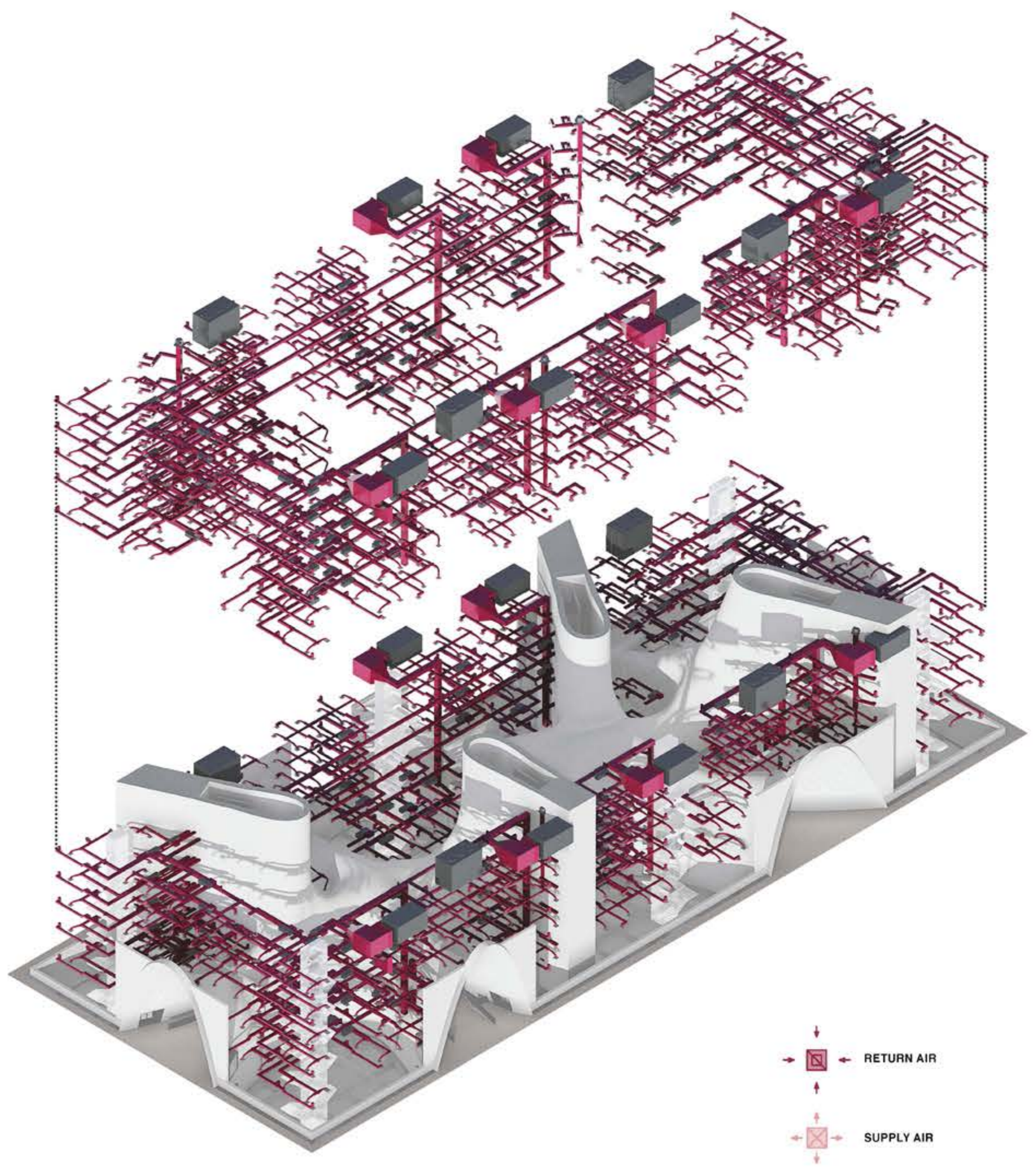
2. SKYLIGHT SKELETON  
 Temporary rain storage system  
 IHS-200 steel beam  
 Ventilation shutter  
 Aluminium skeleton  
 Double glazing glass



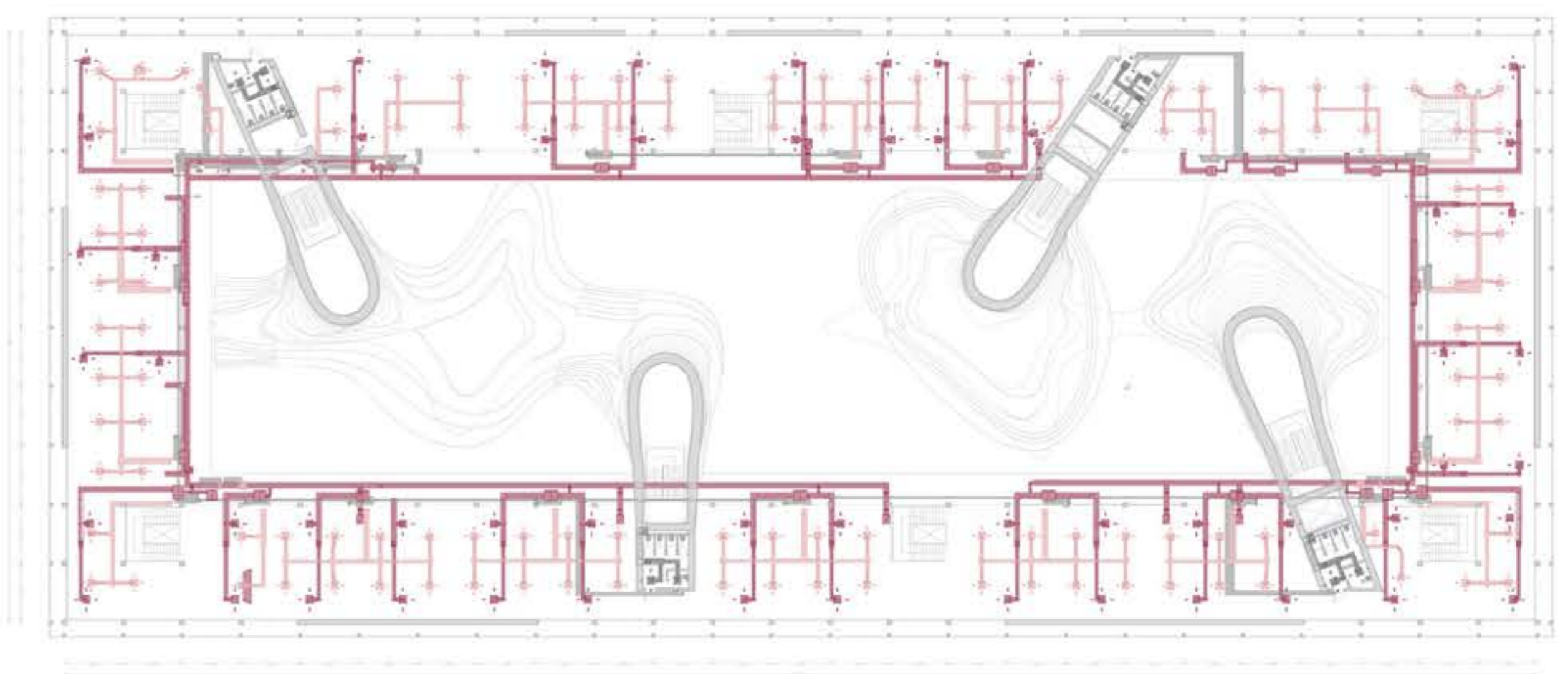
6. BASEMENT FLOOR Scale 1/20  
 Polished concrete flooring  
 Screed 60mm  
 Extruded polystyrene panel 100mm  
 local formworks screed with transit for systems 80  
 Finishing slab foundation in R.C. 50mm  
 Ventilated underfloor cavity with light Plus  
 Lean concrete 250  
 Soil



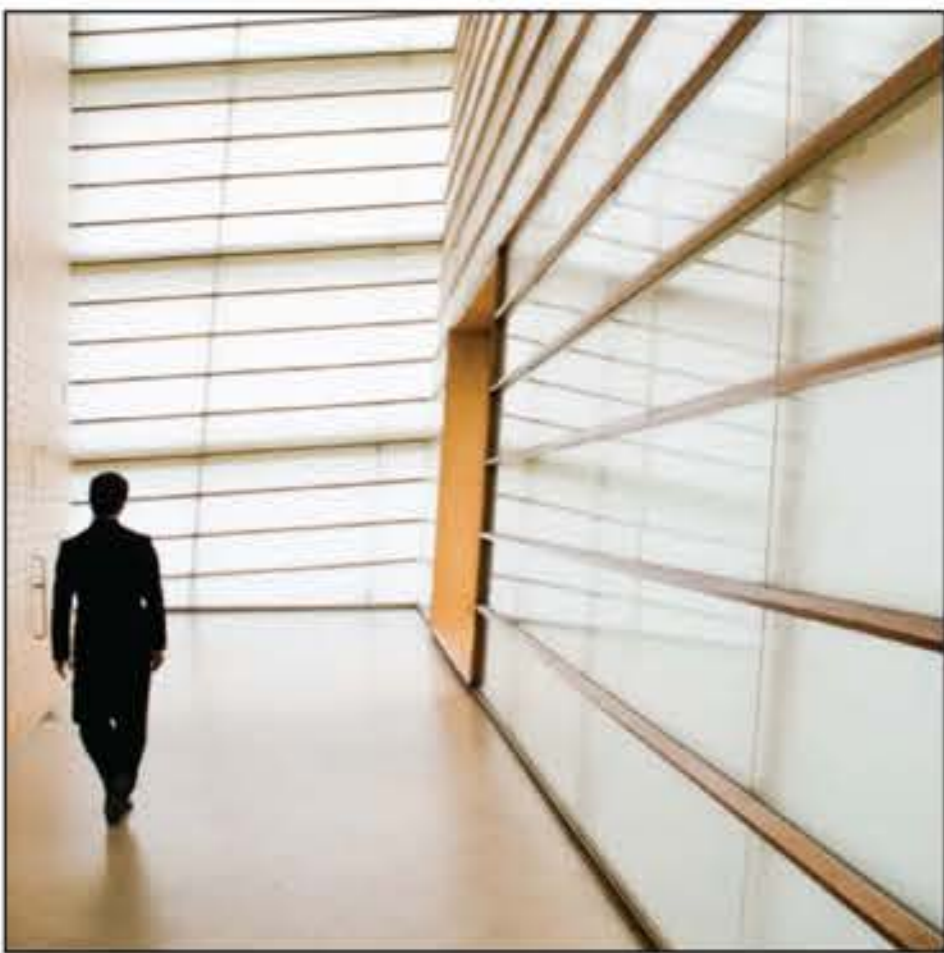
7. BONK SHAPE SHELL Scale 1/20  
 Interior concrete plaster finishing  
 Screed 50mm  
 Shotcrete 200-300mm  
 Rebars  
 HEA-200 Shell skeleton  
 Stone wool insulation 200mm  
 Transit for systems  
 Light bulb  
 Suspended ceiling panel  
 Exterior concrete plaster finishing



AXONOMETRY SERVICE SYSTEM



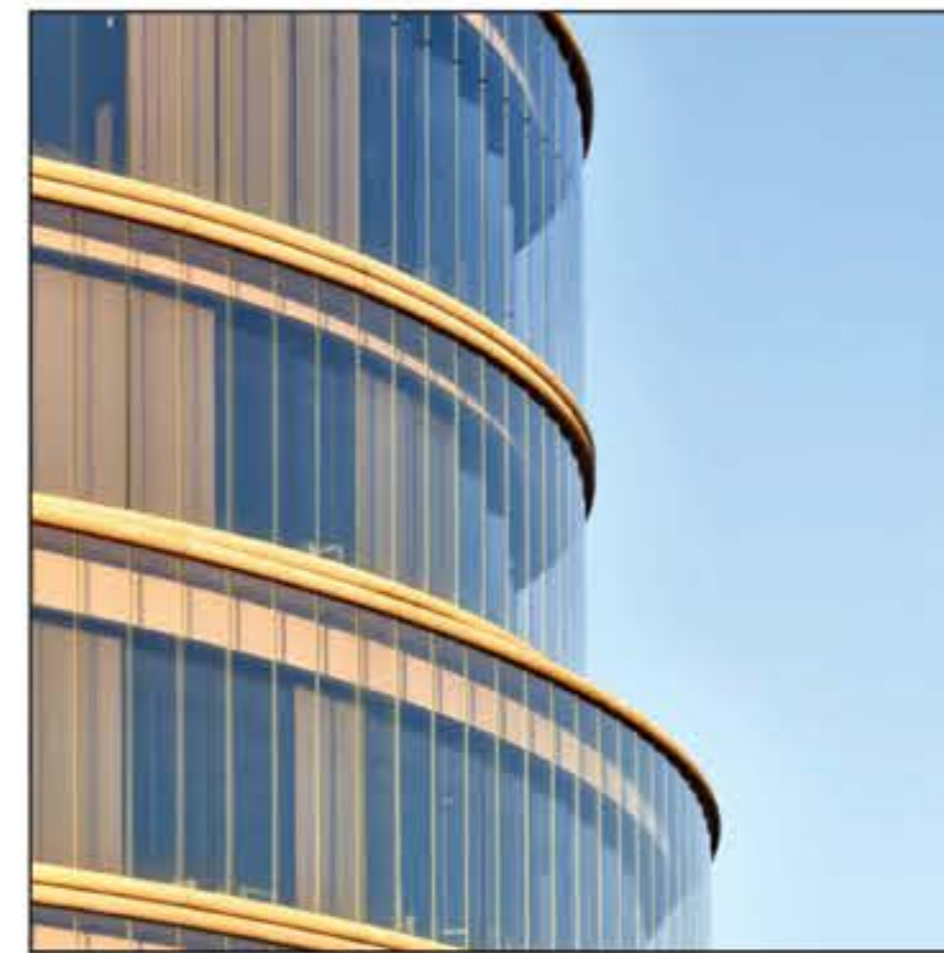
SERVICE SYSTEM TYPICAL PLAN SCALE 1/400



RAFAEL MONEO, SAN SEBASTIAN PALACIO KURSAAL © Fernando Carrasco



RAFAEL MONEO, SAN SEBASTIAN PALACIO KURSAAL © Fabrice Fouillot

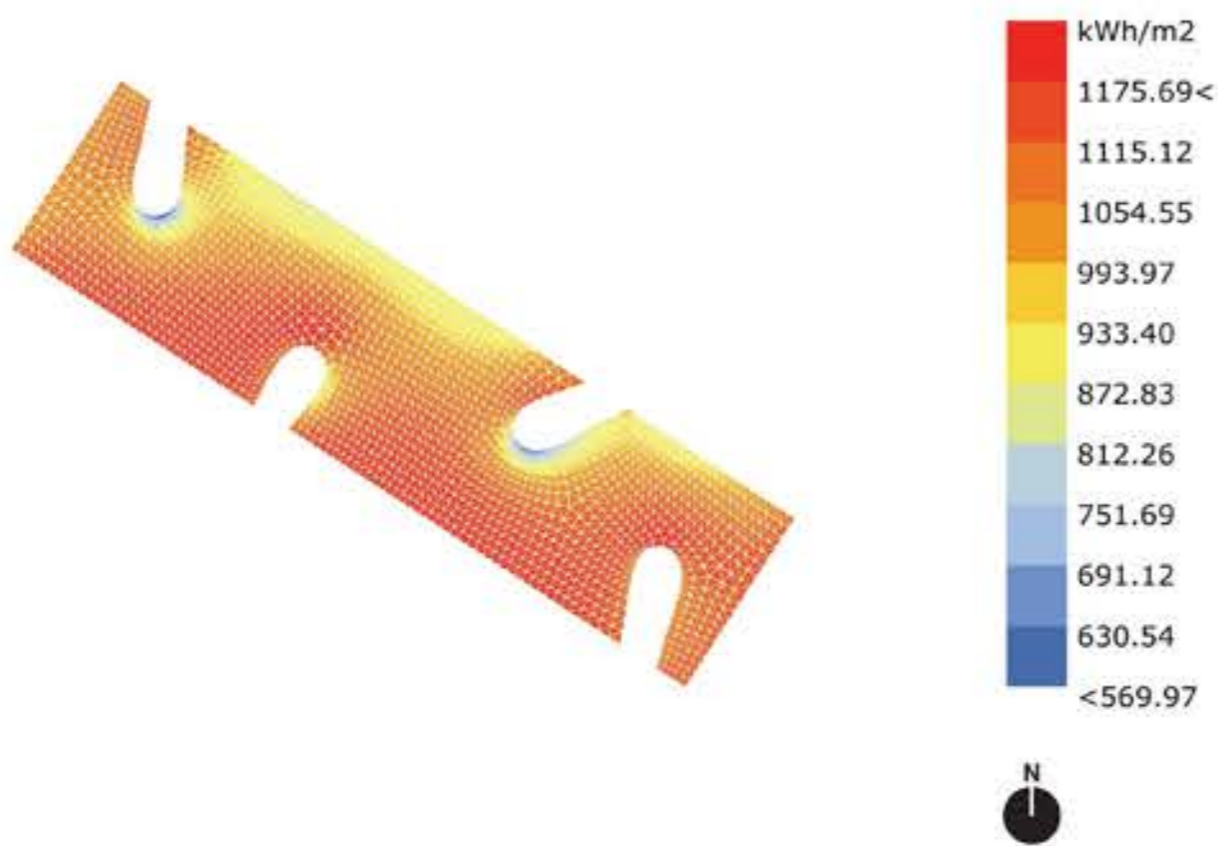


HERZOG & DE MEURON, 387 BLAVATNIK SCHOOL OF GOVERNMENT, OXFORD © Herzog & de Meuron



HERZOG & DE MEURON, 387 BLAVATNIK SCHOOL OF GOVERNMENT, OXFORD © Herzog & de Meuron

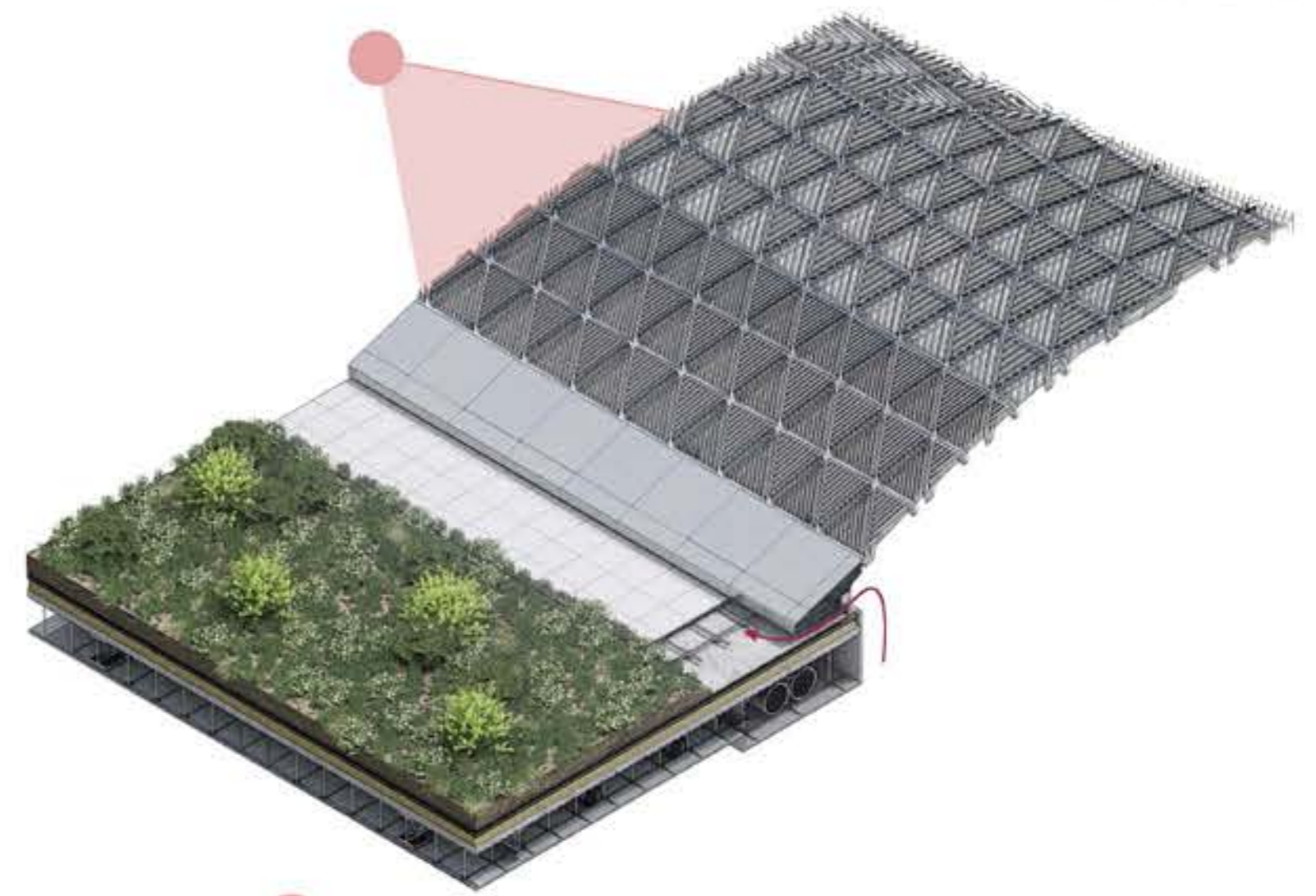




**Rooftop skylight**

To address the challenge of overheating over the rooftop glazed skylight, we devised a multifaceted solution aimed at mitigating solar heat gain while maintaining visual transparency and architectural integrity from the interior. Given the complex structure of the skylights, incorporating a mechanically controlled sunshade system proved unfeasible. Instead, we opted for a passive shading approach by integrating immovable lamellar shading elements strategically positioned to obstruct direct sunlight. These shading elements serve as a barrier, diffusing incoming solar radiation and reducing the

intensity of heat penetration into the interior spaces below. Furthermore, to facilitate natural ventilation and dissipate excess heat buildup, we incorporated a ventilation gap along the perimeter of the skylight. This gap allows warm air to rise and escape, promoting airflow and thermal comfort while preventing the accumulation of heat within the building. By combining passive shading with natural ventilation strategies, we have effectively minimized the risk of overheating over the rooftop skylights, ensuring a comfortable and sustainable indoor environment for building occupants.



**SHADING SKYLIGHT**

The roof is the surface of the building most subjected to sun radiations, a simple sun shading is applied in the exterior to remove most of direct sun rays.

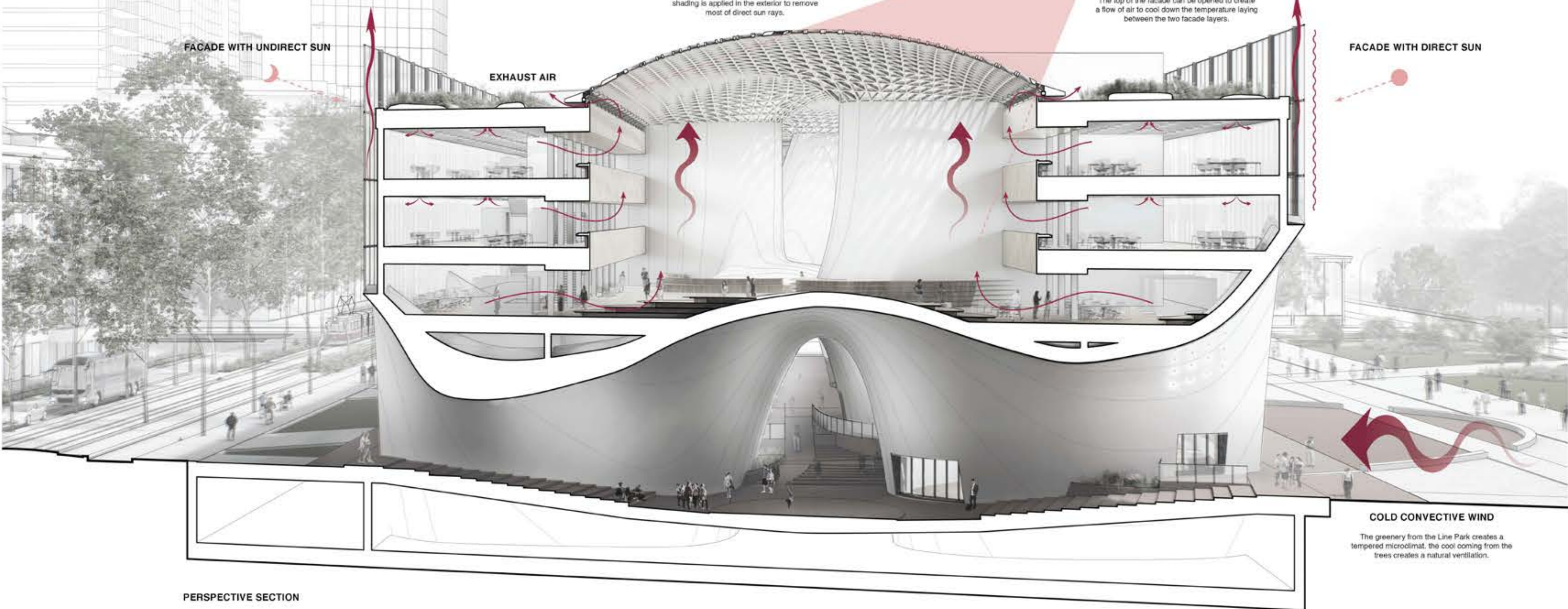
**DOUBLE VENTED FACADE**

The top of the facade can be opened to create a flow of air to cool down the temperature laying between the two facade layers.

**FACADE WITH UNDIRECT SUN**

**EXHAUST AIR**

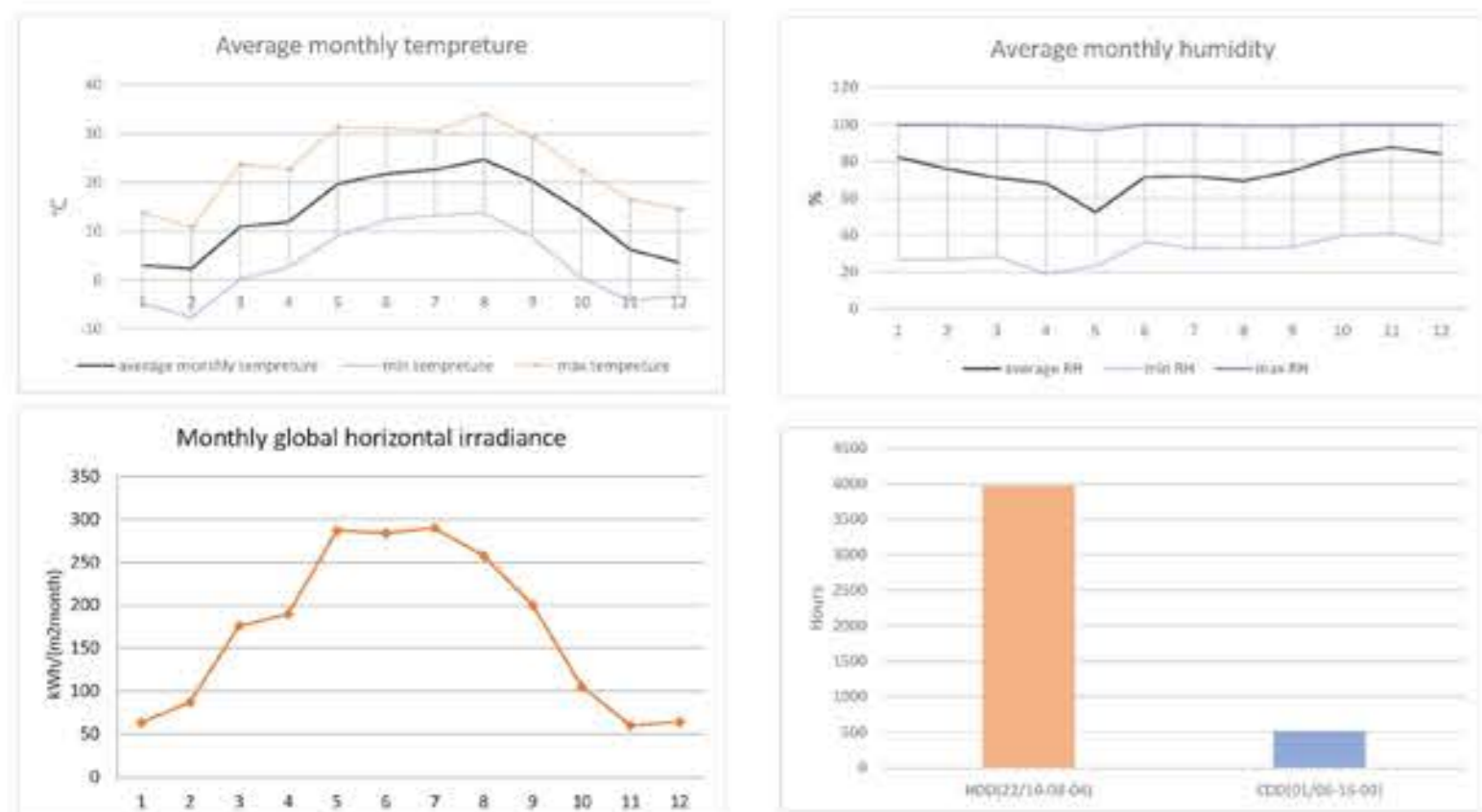
**FACADE WITH DIRECT SUN**



**COLD CONVECTIVE WIND**

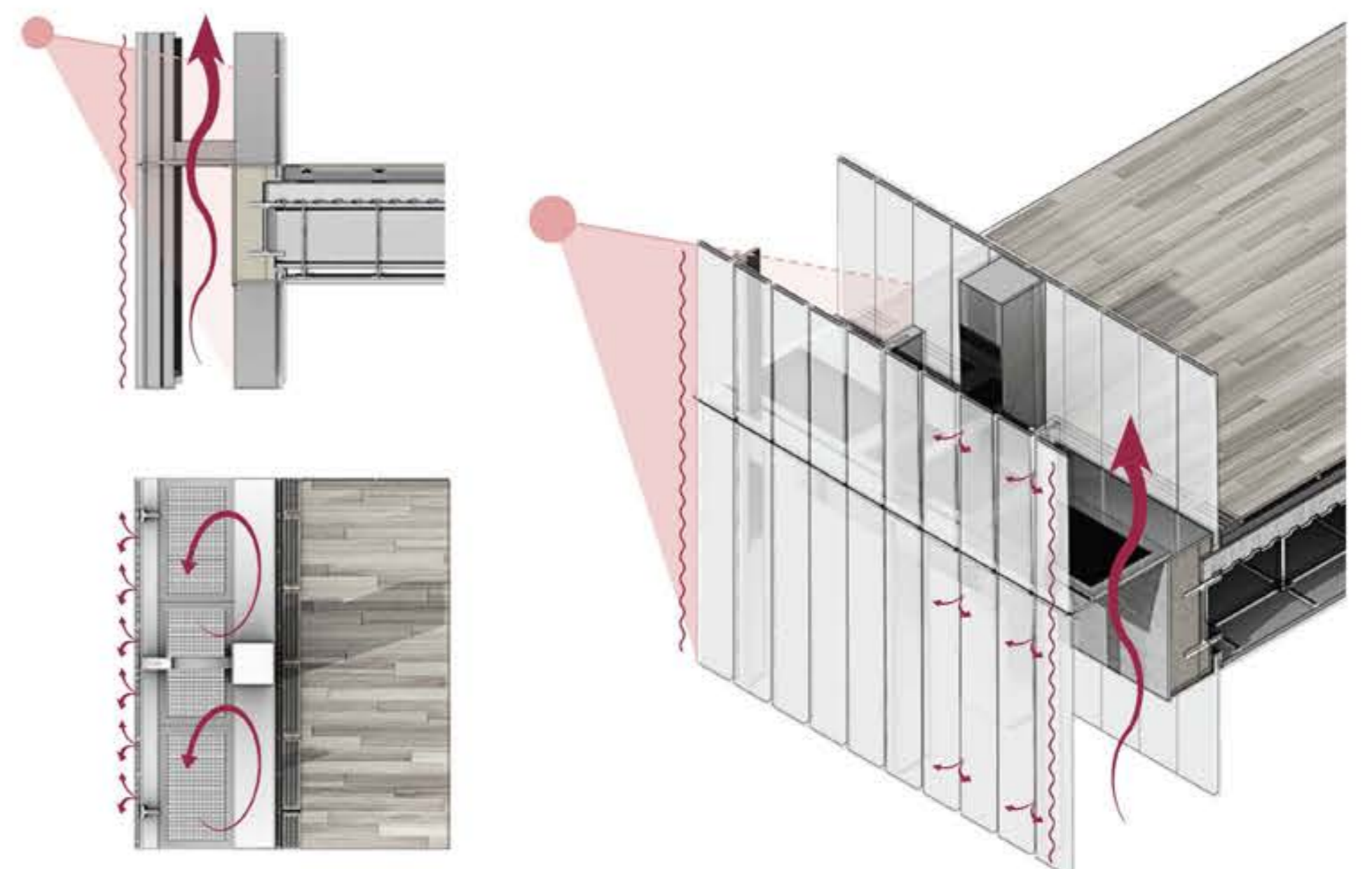
The greenery from the Line Park creates a tempered microclimate, the cool coming from the trees creates a natural ventilation.

**PERSPECTIVE SECTION**



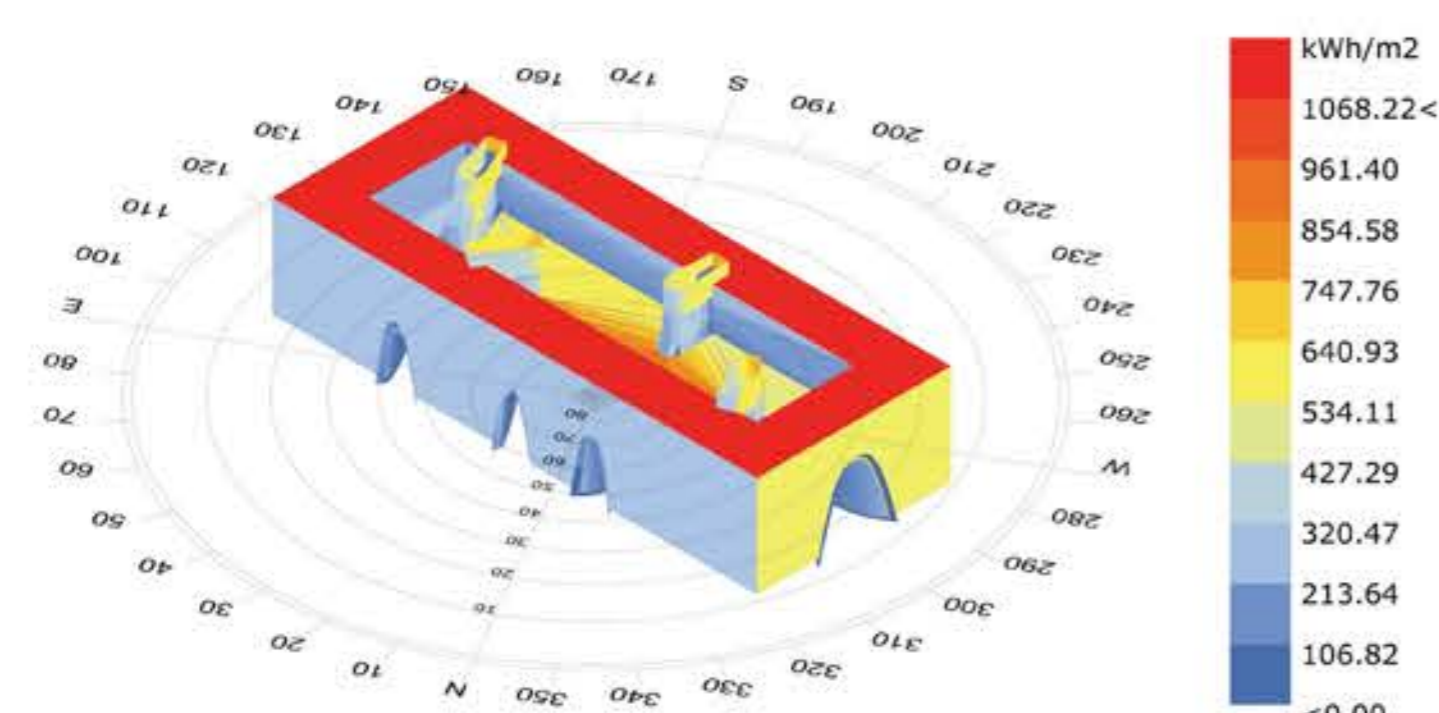
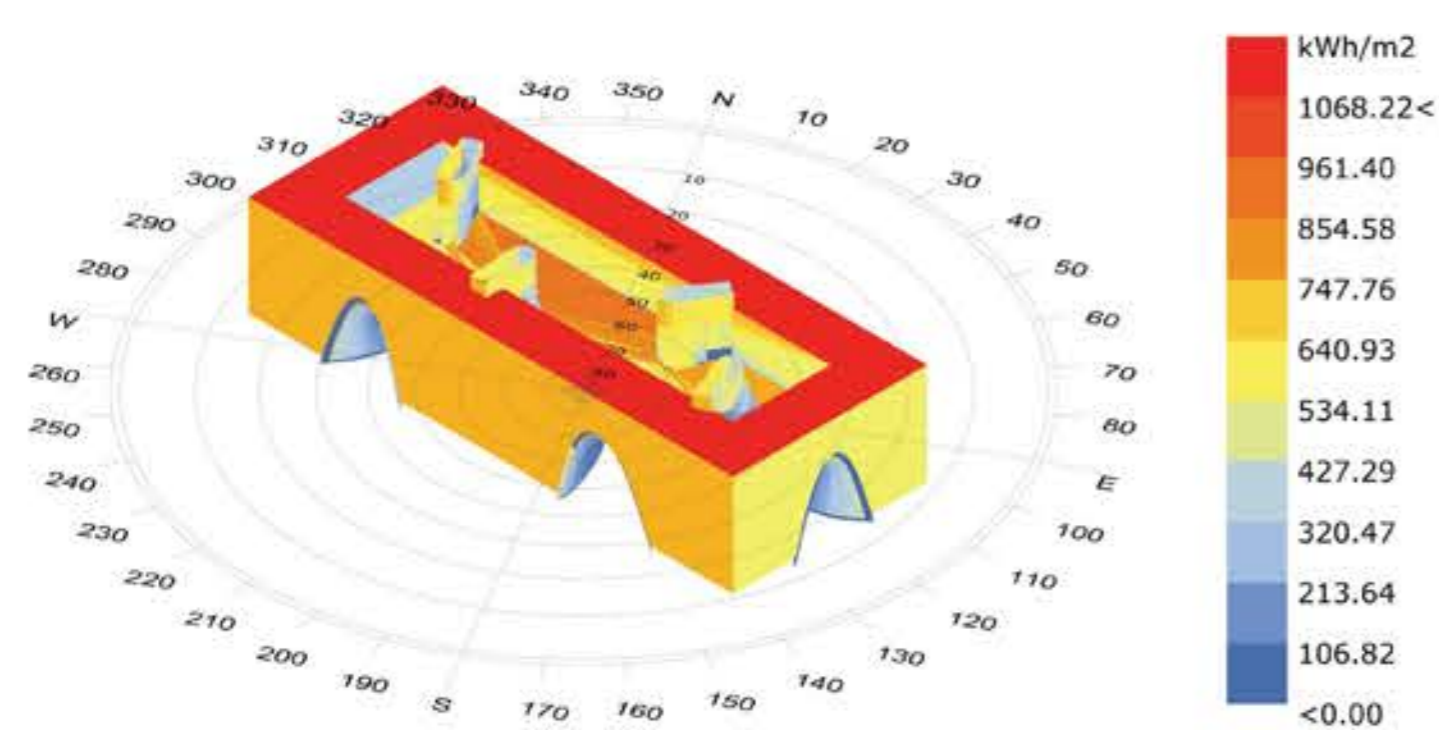
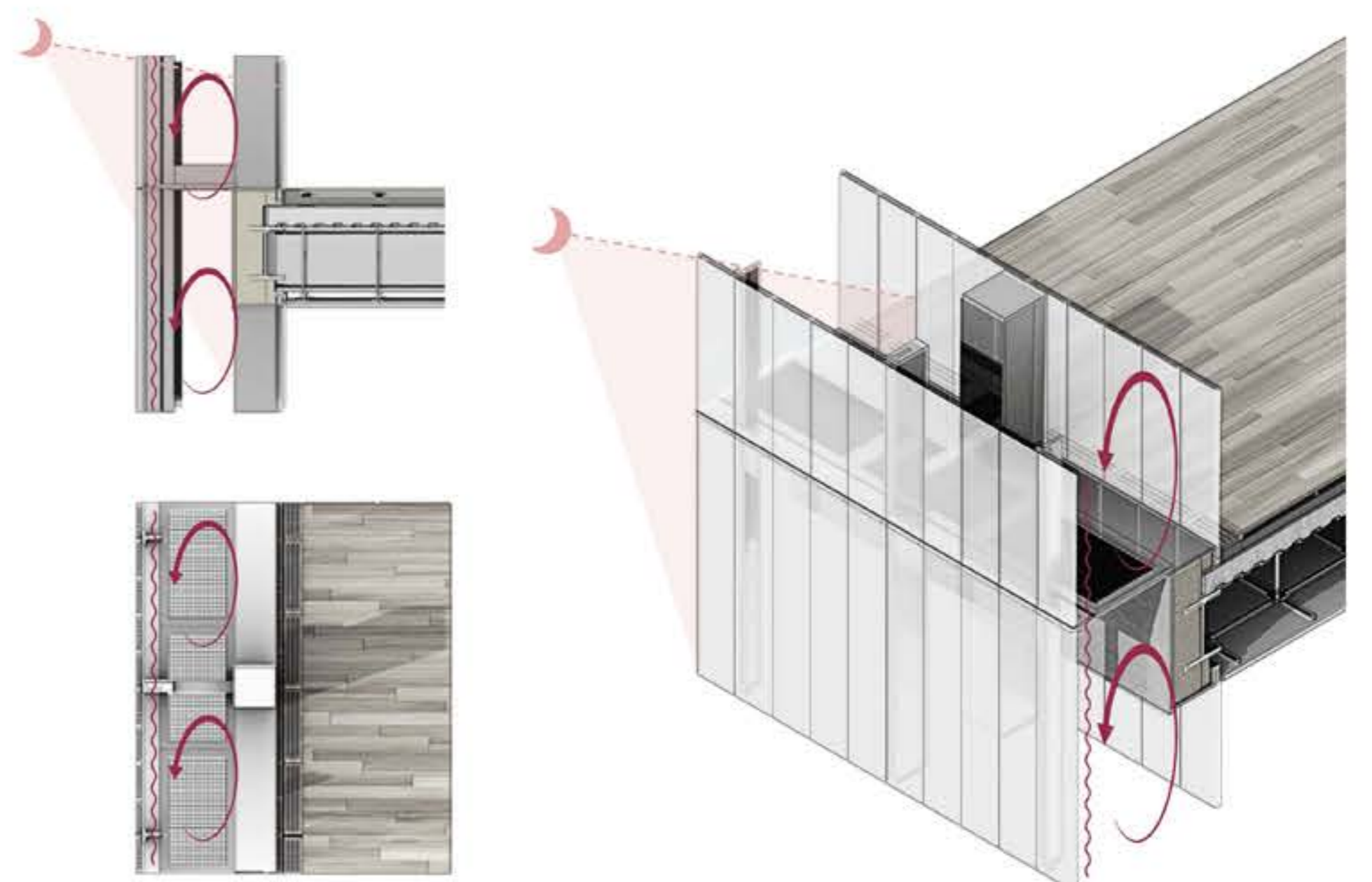
**FACADES WITH DIRECT SUN**

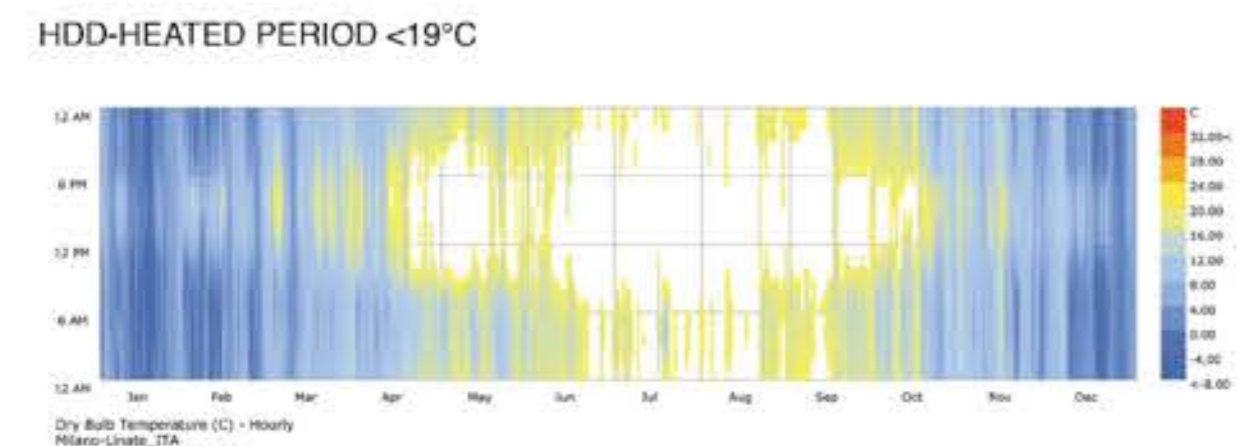
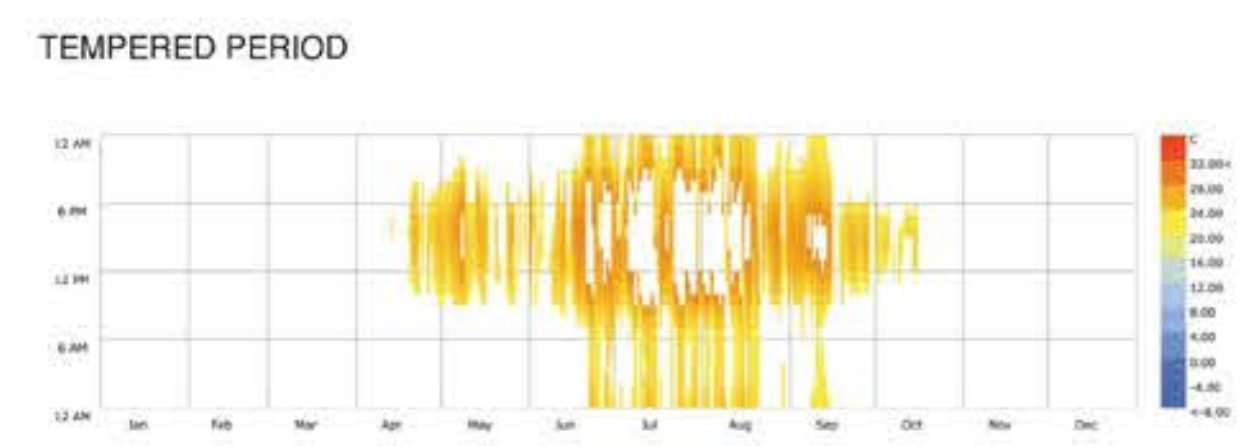
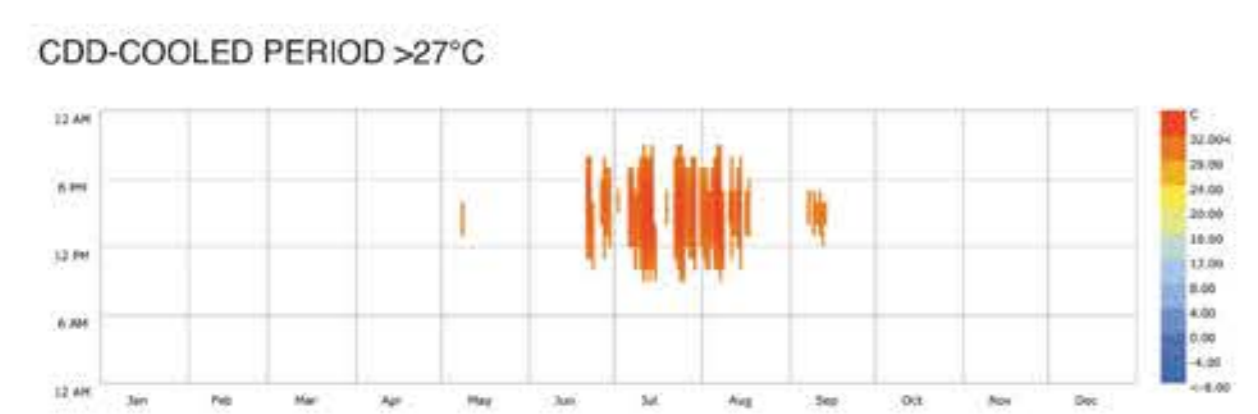
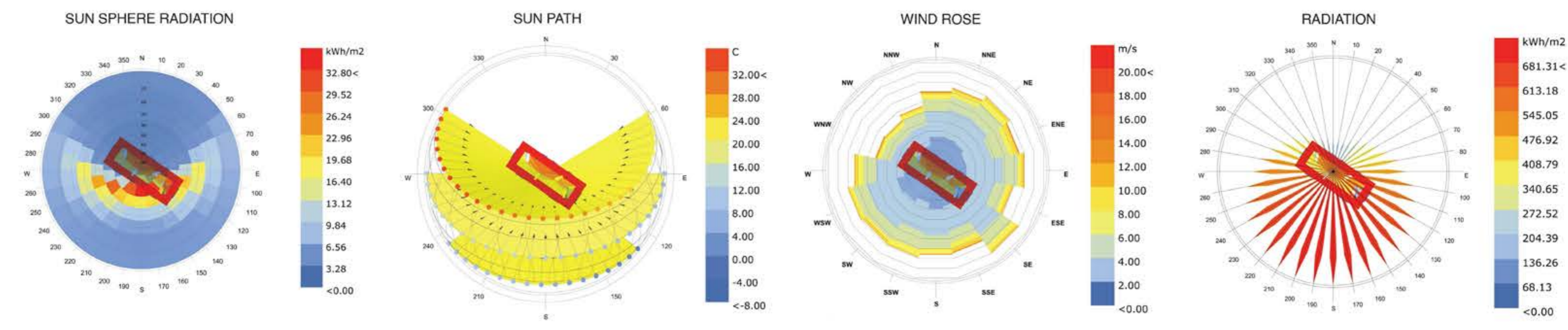
In regards to the challenge of overheating over the polycarbonate facades, particularly on the southern exposures where direct sunlight is prevalent, we implemented a strategic solution inspired by the innovative approach employed in Herzog & de Meuron's Blavatnik School of Government project. Given that our facade comprises a double-vented system, with the primary concern being the potential overheating of the air trapped between the two layers, we sought a solution that would effectively dissipate heat without the need for additional complex detailing. To achieve this, we introduced a simple design feature: a small void gap left between the two panels of the outermost polycarbonate surface. This gap, of just a few centimeters, serves as a conduit for air movement, allowing hot air to be directly expelled out from the building, therefore preventing its buildup and subsequent overheating. By incorporating this passive ventilation strategy into the facade design, we not only mitigate the risk of overheating but also optimize energy efficiency and occupant comfort without losing the general appearance of the building.



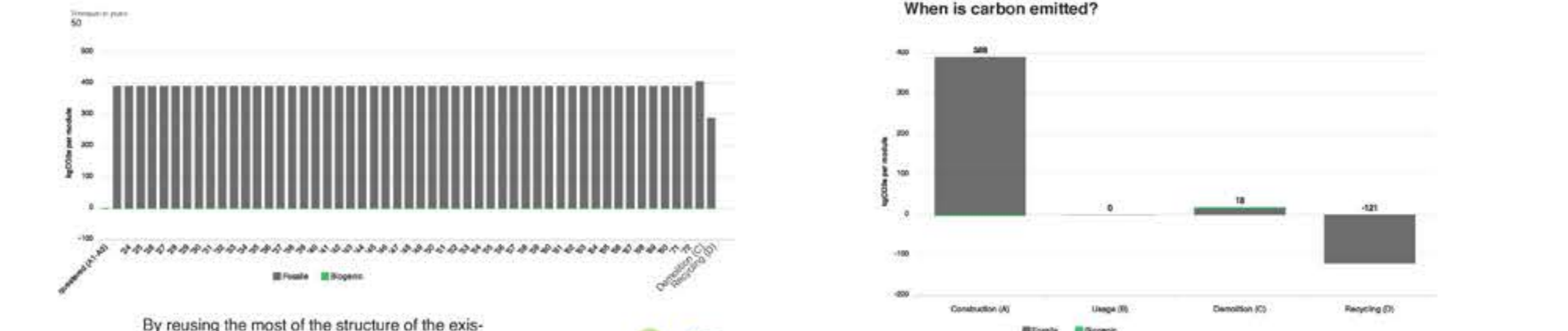
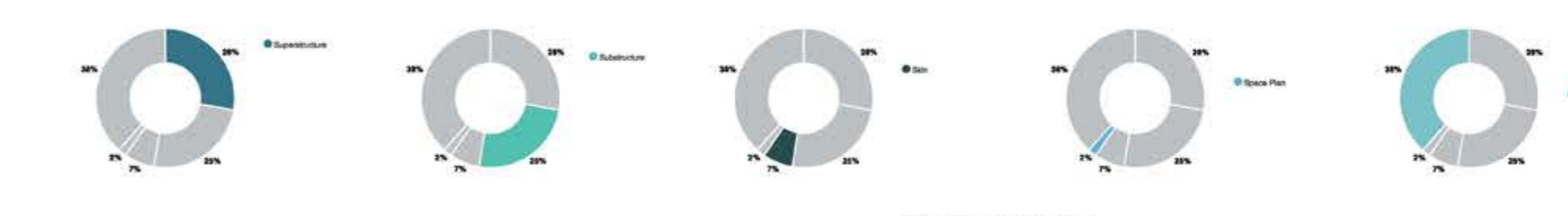
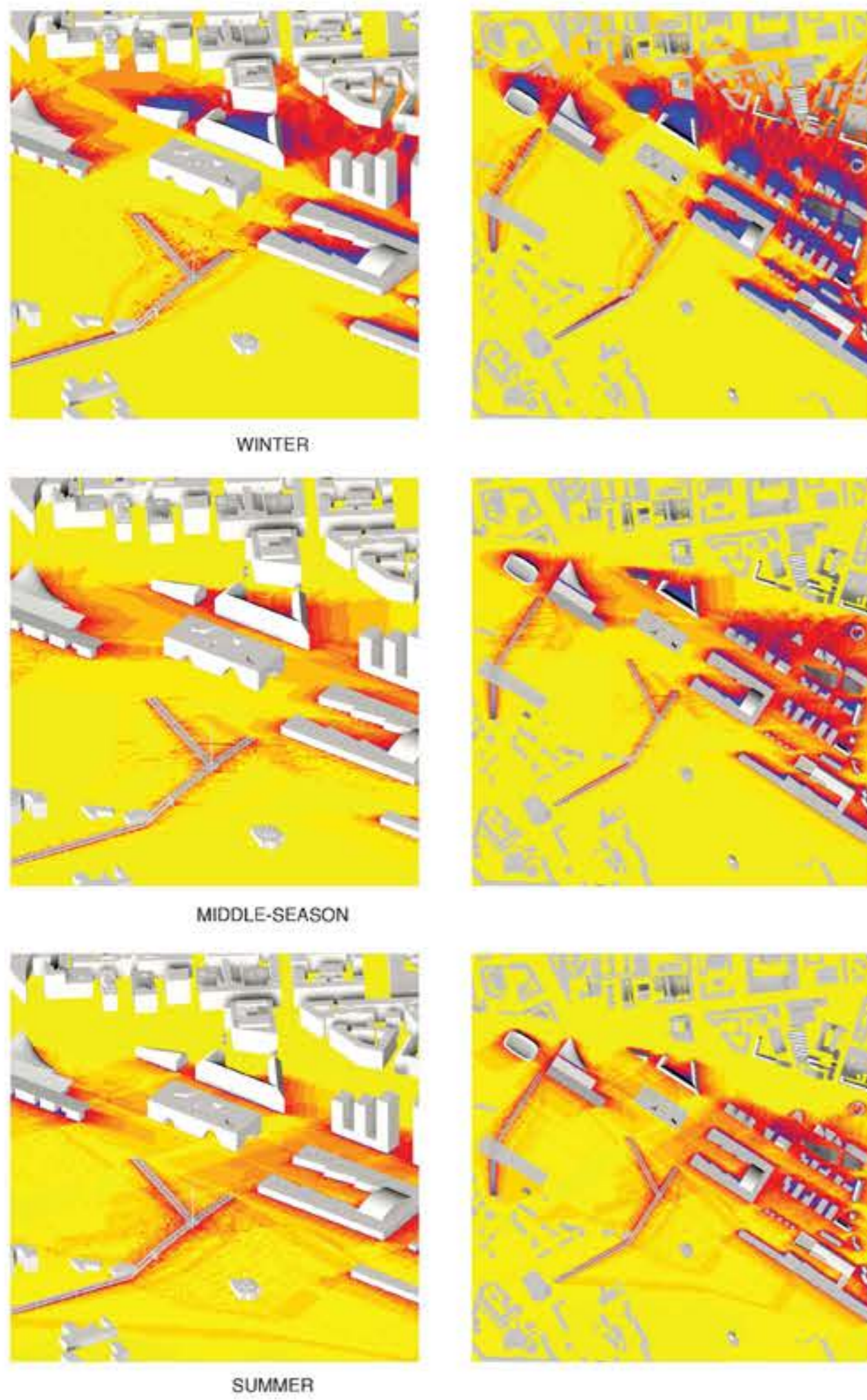
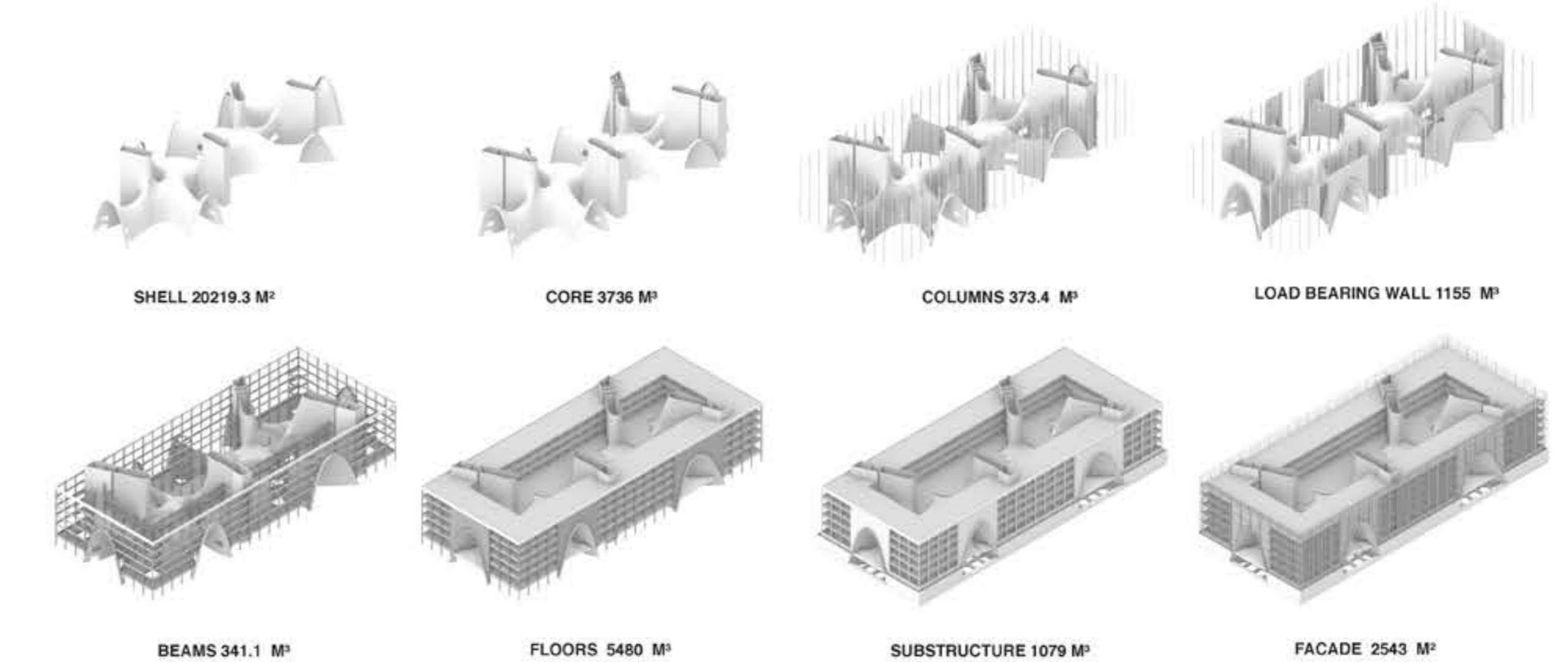
**FACADES WITH UNDIRECT SUN**

Conversely, for the indirect facades, we adopted a different approach to maximize the performance of the double-vented facade system. Recognizing that these facades receive less direct sunlight and are more susceptible to heat loss during the winter months, we made the decision to close the air gap between the two polycarbonate panels of the external layers. By sealing this gap, we effectively minimize heat dissipation from the building's interior during colder periods, thereby improving thermal insulation and reducing energy consumption for heating purposes. Additionally, this configuration allows us to capitalize on the double-vented facade's inherent ability to regulate temperature and airflow, ensuring a comfortable and energy-efficient indoor environment year-round. During the summer months, the mechanical system on top of the facade can regulate air circulation, providing flexibility to either retain warmth between the polycarbonate layers or facilitate natural cooling while in winter, it serves to retain warmth within the building envelope. This adaptive approach to facade design not only optimizes thermal performance but also enhances occupant comfort and reduces the building's overall environmental impact.





month	1	2	3	4	5	6	7	8	9	10	11	12
average monthly temprature	3 °C	2 °C	11 °C	12 °C	20 °C	22 °C	23 °C	25 °C	20 °C	14 °C	6 °C	4 °C
min temprature	-5 °C	-8 °C	0 °C	3 °C	9 °C	12 °C	13 °C	14 °C	9 °C	1 °C	-4 °C	-3 °C
max temprature	14 °C	11 °C	24 °C	23 °C	31 °C	31 °C	31 °C	34 °C	29 °C	22 °C	17 °C	15 °C
average RH	82%	76%	71%	68%	52%	72%	72%	69%	75%	84%	88%	84%
min RH	27%	27%	28%	19%	23%	37%	33%	33%	33%	40%	41%	35%
max RH	100%	100%	99%	99%	97%	100%	100%	100%	99%	100%	100%	100%
av. Global horizontal irradiance	63	87	176	190	287	284	290	257	200	106	60	64



By reusing the most of the structure of the existing building it is possible to save up to **391 kgCO<sub>2</sub>eq/m<sup>2</sup>**.

How much carbon is this?

- 269798 Rainforest trees (30 year)
- 37550119 km Distance traveled by Plane

**269798 m<sup>2</sup>** Rainforest trees (30 year)

**CONCLUSION:**  
The biggest takeaways are for Superstructure and Shell if the building. Knowing that, the next steps in order to make our design more sustainable would be to try to change the structure of the Shell to materials with better performance.

Overall we want to point out that our experience with measuring carbon in the design process was positive and gave us better understanding in terms of carbon footprint and the importance of choosing materials in general. Exploring the equivalence of CO<sub>2</sub> to understandable measurements like distance in km and number of trees we could evaluate the impact of our choices in the design.

**Excellent 391 kgCO<sub>2</sub>eq/m<sup>2</sup>**  
Highest rating

Where is carbon emitted?  
 Total carbon: 10702 kgCO<sub>2</sub>/m<sup>2</sup>  
 Total carbon per m<sup>2</sup> of gfa: 391 kgCO<sub>2</sub>/m<sup>2</sup>

