SHARING HOUSE

BEIC LIBRARY
- MILAN -

POLITECNICO
MILANO 1863

SCHOOL OF ARCHITECTURE URBAN PLANNING CONSTRUCTION ENGINEERING

BUILDING ARCHITECTURE
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ABSTRACT

Project Name: BEIC Library-The Sharing House

Scale: 30000 square meters

Project Overview:

The Milan Farini Library project is a library located in the Farini district of Milan, Italy, covering an area of approximately 30,000 square meters. The design theme for this project is «Place of Sharing,» aiming to encourage people from diverse cultural backgrounds to gather here and promote mutual exchange and sharing. This project will apply modern design concepts and logic while utilizing emerging BIM design tools to create an open, diverse, and innovative library.

Design Concepts:

1.Multiculturalism: This library will serve as a gathering place for people from different cultural backgrounds, fostering the exchange and sharing of knowledge, ideas, and cultures. The interior layout and decor will reflect multicultural elements, creating an atmosphere of openness and inclusivity.

2.Modern Design: The design will incorporate modern architectural principles, integrating advanced technology and materials to meet the future needs of the library. Efficient lighting, ventilation, and energy management systems will ensure the building's sustainability.

3.BIM Design Tools: To enhance design and construction efficiency, we will extensively employ Building Information Modeling (BIM) technology to establish a comprehensive digital design and construction process, ensuring the project's successful implementation.

Architectural Features:

1.Free-Form Shell Structure: The library's exterior will feature a free-form shell design, providing a unique appearance. This design not only offers visual appeal but also maximizes the use of modern materials and technology, ensuring structural stability.

2.Finite Element Analysis: To guarantee the structural reliability of the building, finite element analysis will be conducted to assess structural performance under various loading conditions, ensuring the building's safety and stability.

3.Space Planning: The interior of the building will comprise versatile spaces, including reading rooms, study areas, meeting rooms, exhibition spaces, and creative studios. These spaces will cater to the diverse needs of user groups, providing various opportunities for learning and cultural exchange.

4.Digital Technology: The library will fully leverage digital technology, offering e-books, online learning resources, and a digital archive collection. Modern information technology will provide users with enhanced convenience and choices.

5.Sustainability:This project will prioritize sustainability, employing energy-efficient and environmentally friendly design and building materials to minimize adverse environmental impacts. An efficient energy management system will reduce operational costs while minimizing energy wastage.

Conclusion:

The Milan Farini Library will become a diverse, open cultural exchange center, designed to encourage people from different cultural backgrounds to share knowledge and ideas.

Through modern design and technological means, we will create a sustainable and engaging building, offering the community rich learning and cultural experiences. We look forward to the successful implementation of this project and believe it will have a positive impact on the Farini district.

Keywords: shotcrete; organic shape; shell structure; public architecture; library design

BUILDING A LIBRARY

In the present world the importance of cultural knowledge has been a clue element for the complex society we are living in. Culture plays a fundamental role in shaping an individual's personal identity and opinions. It provides a framework for understanding the world, influencing values, beliefs, and behaviors. Cultural background, traditions, and experiences contribute to a person's sense of self, influencing their perspectives, attitudes, and decision-making. This cultural lens helps individuals from their unique opinions on various issues, as it shapes how they interpret information, interact with others, and navigate societal norms and values. Ultimately, culture is a powerful force that shapes and informs personal identity and the formation of individual opinions. As a major exponent of cultural transmission we can find the library. Libraries stand from the other buildings' sources of cultural expression thanks to its main characteristic which is the importance of being a free and accessible bridge between the human and the cultural transcription.

History of libraries

Since the first primitive societies, diffusion of knowledge to future generations has been an important aspect of human kind. This transmission was transferred using all methods available, from the oral communication to a written one. Although its difficult to determine when oral transmission appeared we can more accurately estimate the arrival written one thanks

The history of libraries traces back to ancient civilizations, where the need to transmit knowledge and preserve cultural heritage led to the creation of early forms of libraries. While the concept of organized collections of written materials emerged later in human history, evidence of graphical transmission can be found in even earlier times. One of the earliest examples of such transmission can be seen in cave graffiti, dating back tens of thousands of years. Sites like Chauvet and Lascaux in France showcase intricate cave graffiti depicting hunting scenes, wildlife, and spiritual beliefs of ancient peoples. These cave paintings served as a form of visual communication, conveying essential information about cultural practices, survival techniques, and religious beliefs to future generations. Over time, as societies evolved and writing systems developed, libraries began to take shape as repositories of written texts, scrolls, and codices. Ancient civilizations such as Mesopotamian kingdoms, Egyptians, Greek city-states, and the Romans established libraries to house and preserve their literary, scientific, and philosophical works. The Library of Alexandria, founded in the 3rd century BCE, is one of the most famous examples of an ancient library, renowned for its vast collection of scrolls and its role as a center of scholarship and learning in the ancient world.

The history of libraries has undergone a remarkable internal transformation, evolving from exclusive repositories of knowledge accessible only to the elite into inclusive, community-focused institutions open to all. For much of the first millennium, libraries were indeed elite spaces, reserved for aristocrats, scholars, clergy, and who held privileged access to education and literacy. These early libraries, often associated with monasteries, universities, and royal courts, housed rare manuscripts, religious texts, and scholarly works, serving primarily as centers of intellectual pursuit and cultural prestige. Access to these libraries was restricted, and the lower social classes were discouraged from entering due to their limited education and literacy levels. However, with the advent of the printing press in the 15th century and the subsequent rise of literacy rates, the landscape of libraries began to change.

The Enlightenment period marked a significant turning point in the democratization of knowledge, as the ideals of individual liberty, reason, and universal education, spurred efforts to make information more accessible to the general populace. Public libraries began to emerge in cities across the world, offering free access to research works, books, and other educational materials. These early public libraries played a crucial role in promoting literacy, fostering intellectual curiosity, and empowering individuals from all walks of life. Moreover, the rise of public education systems in the 19th and 20th centuries further expanded the reach of libraries, as they became integral components of school curricula and community life.

In recent decades, libraries have undergone a renaissance, embracing new roles and functions to meet the evolving needs of society. Inspired by the principles of accessibility, inclusivity, and social engagement, libraries have transformed into dynamic hubs of learning, creativity, and civic engagement. One notable parallel can be drawn with the Centre Pompidou in Paris, also known as the Beaubourg, which revolutionized the museum experience by breaking down the traditional barriers and making art more accessible to the public.

…it was a fundamentally human concern, with the idea that culture belongs to everyone, the desire to make a building in which culture opens up to the public. … In Beaubourg, the first emotion was society. And the questions we asked ourselves all the time were: what is culture? What does "culture" mean? [1]
Renzo Piano, translated from French

Similarly, libraries have adopted innovative approaches to design, programming, and outreach, creating welcoming spaces that cater to diverse interests and demographics. From makerspaces and digital labs to community gardens and cultural events, libraries now offer a wide range of services and resources that extend beyond traditional book lending.

Crucially, libraries have embraced the concept of free and open access, ensuring that knowledge remains a public good accessible to all members of society. By actively reaching out to underserved communities and eliminating barriers to entry, libraries have become indispensable agents of social equity and empowerment. They provide vital support to vulnerable populations, offering resources and assistance for all forms of education. Moreover, libraries serve as catalysts for community development, dialogue, fostering connections, and collective action among residents.

1 PIANO Renzo, GASTON Vincent, MILLET Bernard, « *Sortir des limites* », La pensée de midi, 2006/2 (N° 18), p. 97-102. DOI : 10.3917/lpm.018.0097. URL : https://www.cairn.info/revue-la-pensee-de-midi-2006-2-page-97.htm

The future of libraries?

In conclusion, we can expect that the presence of a library, the most pure example of knowledge transmission, is a needed function for twenty-first century cities as much as the museums, theater halls or cultural events / expositions. The history of libraries reflects a profound shift from exclusive enclaves of intellectual privilege to inclusive centers of learning and empowerment.
Throughout history, libraries have played a pivotal role in the dissemination of knowledge, the advancement of scholarship, and the preservation of cultural heritage. From the great libraries of antiquity to the modern digital libraries of today, these institutions continue to serve as vital resources for education, research, and intellectual enrichment. Like the Centre Pompidou in Paris, which revolutionized the museum experience by democratizing access to art, libraries need to undergo a similar transformation in regards to accessibility, embracing openness, and community engagement. Today, libraries stand as beacons of innovation, knowledge, and social progress, enriching the lives of individuals and strengthening the fabric of society as a whole.

MALMÖ LIBRARY - CENTRAL HALL

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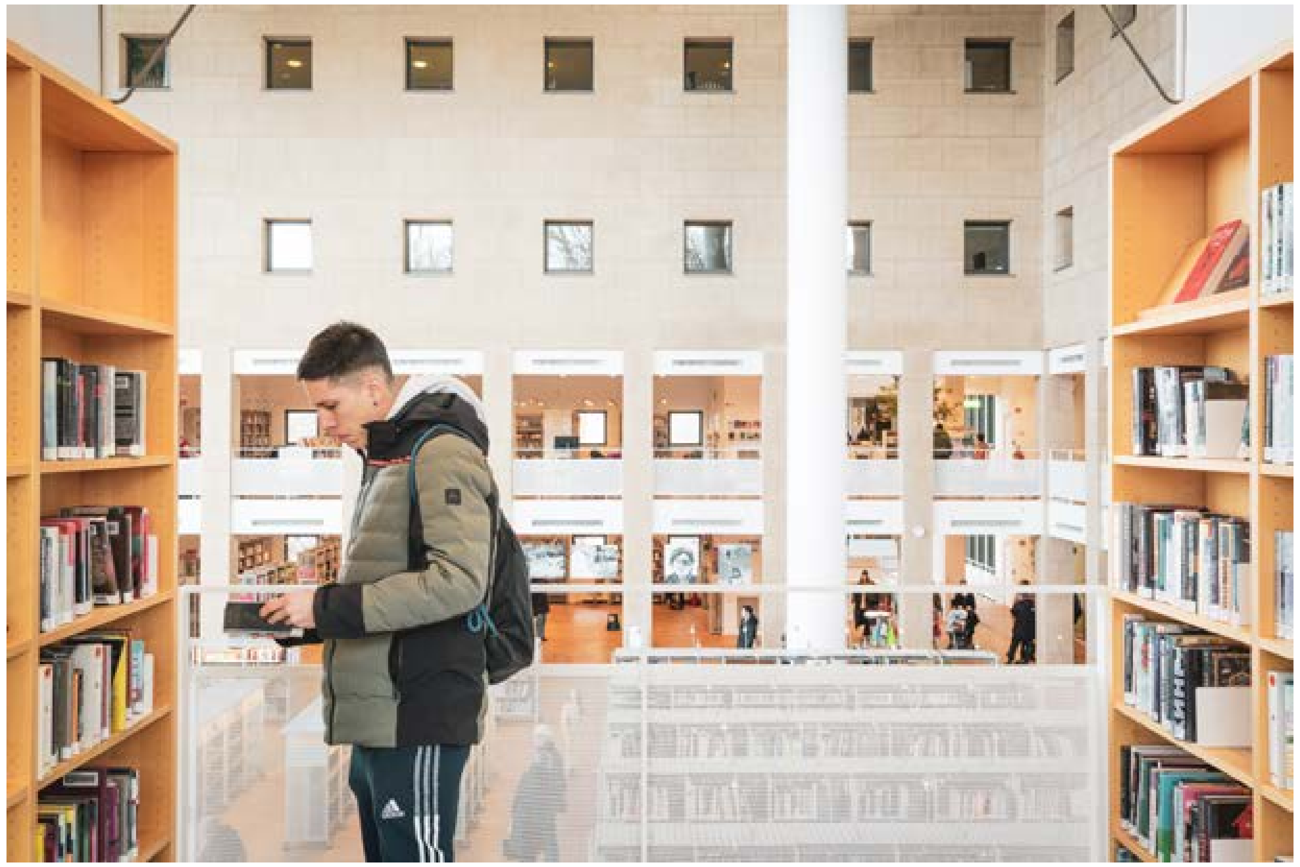

MALMÖ LIBRARY - SHELVES

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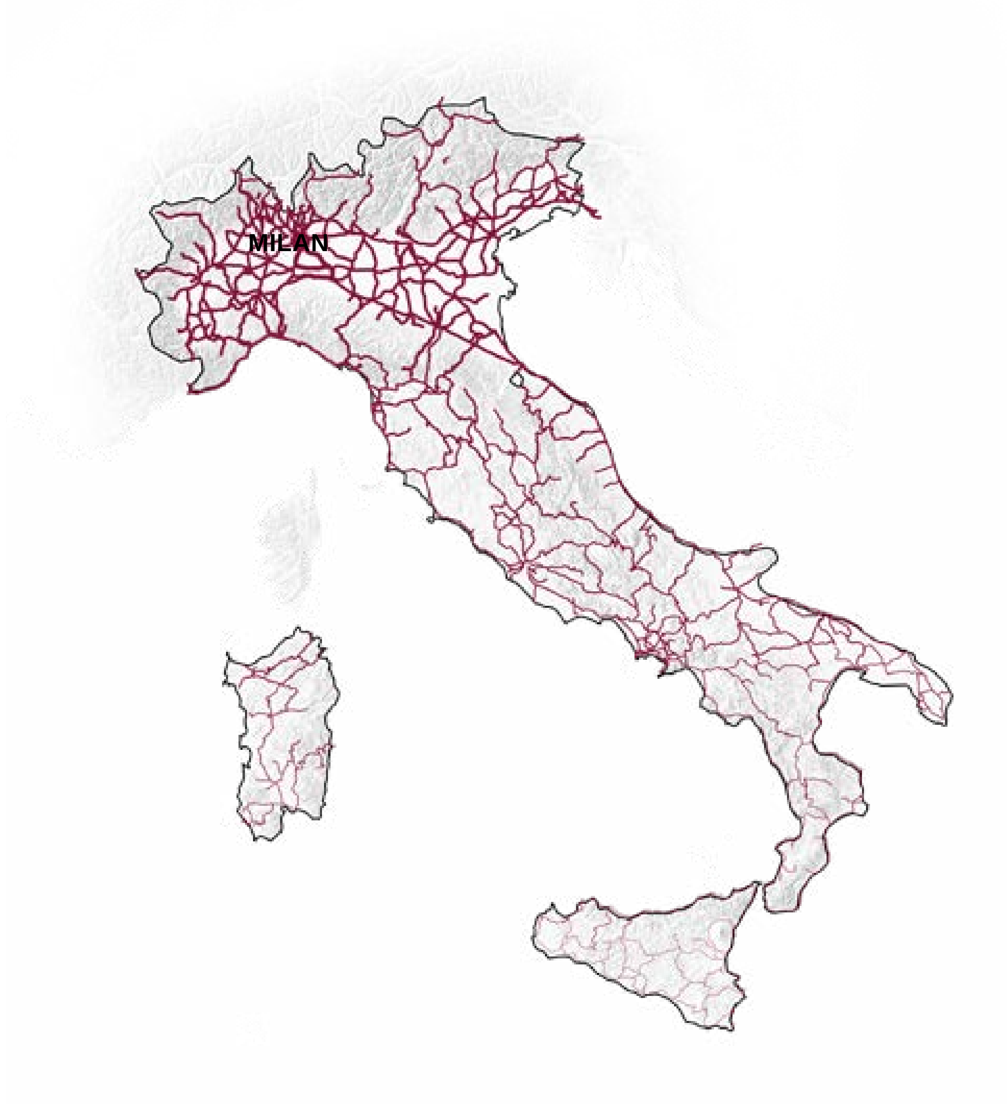
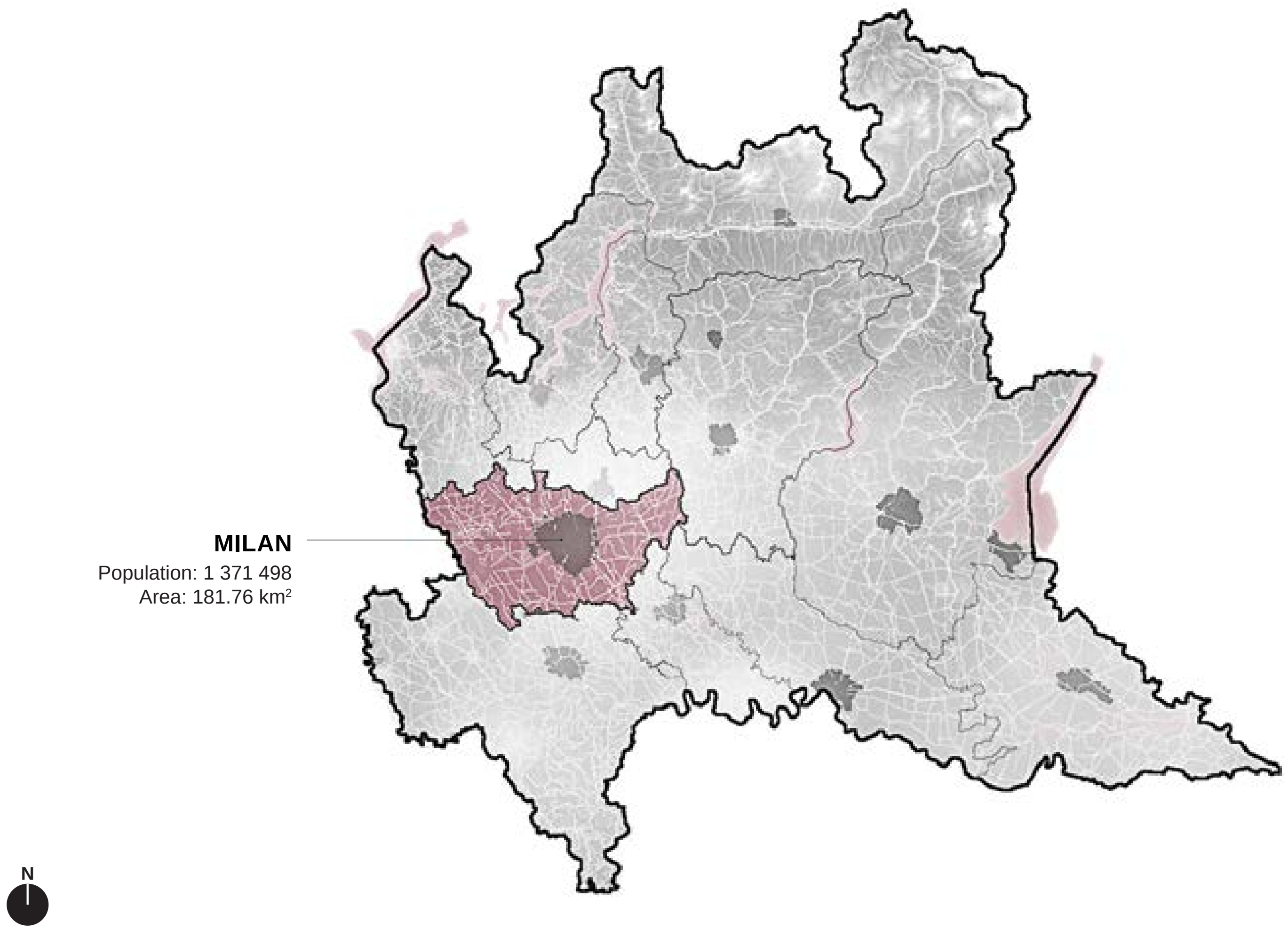
SITE ANALYSIS





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

Terrirorial analysis

Milan is situated in a strategic location at the center of Pianura Padana.
The Pianura Padana, or Po Valley, in Italy is a strategic geological region renowned for its vast agricultural land, efficient transportation networks, and robust industrial capabilities. Stretching across the northern part of Italy, encompassing regions such as Lombardy, Veneto, and Emilia-Romagna, the Pianura Padana is characterized by its flat terrain, fertile soils, and abundant water resources.

One of the key geological features that contribute to the agricultural prosperity of the Pianura Padana is its extensive network of rivers and waterways, most notably the Po River. The Po River, Italy's longest river, meanders through the valley, nourishing the surrounding lands with its waters and providing essential irrigation for crops. The fertile alluvial soils deposited by the river over millennia have created ideal conditions for farming, allowing the cultivation of a diverse range of crops, including cereals, rice, fruits, and vegetables. Additionally, the abundance of water supports the growth of lush pastures, fostering a thriving livestock industry.

Furthermore, the strategic location of the Pianura Padana at the crossroads of major transportation routes has facilitated its economic development and industrial prowess. The region serves as a vital transportation corridor connecting Italy to neighboring European countries, with well-developed road, railway networks crisscrossing the landscape but also with aerial transportation thanks to the presence of some of the most frequented airports in Europe, like Malpensa, Linate, Bergamo or aeroporto Venezia Treviso. This strategic connectivity enables efficient movement of goods and people, facilitating trade and commerce on both a national and international scale. Moreover, the presence of major ports along the Adriatic Sea and the Ligurian Sea provides access to global markets, further enhancing the region's economic competitiveness.
In addition to its agricultural and transportation advantages, the Pianura Padana boasts significant industrial potential, fueled in part by its abundant water resources. Water plays a crucial role in various industrial processes, including manufacturing, energy production, and cooling systems. The region's rivers and aquifers supply ample water for industrial use, supporting a wide range of industries, such as textiles, chemicals, metallurgy, and machinery manufacturing. Furthermore, the hydroelectric potential of the rivers in the Pianura Padana has been harnessed for electricity generation, contributing to the region's energy security and sustainability.

The fertile agricultural lands, combined with efficient transportation infrastructure and thriving industrial sectors, have fueled economic growth and prosperity in the region. Collectively, these geological advantages have propelled the Pianura Padana to become the wealthiest region in Italy and one of the most important economies in Europe.The Pianura Padana serves as a prime example of how geological features can shape and sustain vibrant economies, underscoring the critical interplay between geology, geography, and human activity in shaping the destiny of a region.

The Pianura Padana, while blessed with numerous strengths, also grapples with significant weaknesses that pose challenges to its sustainability and well-being. One of the most pressing issues is air pollution, exacerbated by geographical factors such as the surrounding mountain ranges, which trap pollutants within the valley. Additionally, the region experiences weak winds that impede the dispersion of pollutants, further exacerbating air quality concerns. The high level of industrialization in the Pianura Padana, coupled with intensive agricultural activities, contributes to the emission of pollutants such as particulate matter, nitrogen oxides, and volatile organic compounds. Furthermore, the rapid urbanization and massive exploitation of land in the region have led to environmental degradation, loss of biodiversity, and fragmentation of natural habitats. Socioeconomically, the influx of people from poorer areas into cities like Milan has fueled social inequalities, straining infrastructure, exacerbating housing shortages, and widening the gap between rich and poor. This influx has also resulted in challenges related to integration, access to healthcare, and education, further underscoring the need for comprehensive social policies to address these disparities.

In conclusion, amidst the challenges facing the Pianura Padana and more specifically its major cities like Turin, Bologna or Milan, the building sector and architecture, particularly through the development of major public libraries, can offer a pathway towards a more sustainable and equitable future. Public libraries, as community hubs and centers of knowledge dissemination, have the potential to address both social and ecological issues. Architectural design can prioritize sustainability by incorporating energy-efficient technologies, green building materials, and passive design strategies to mitigate environmental impacts. Additionally, libraries can serve as inclusive spaces that promote social cohesion, foster community engagement, and provide access to educational resources for all residents, regardless of socioeconomic background. By investing in sustainable architecture and community-focused development initiatives, the Pianura Padana can pave the way for a more resilient, equitable, and environmentally conscious future.

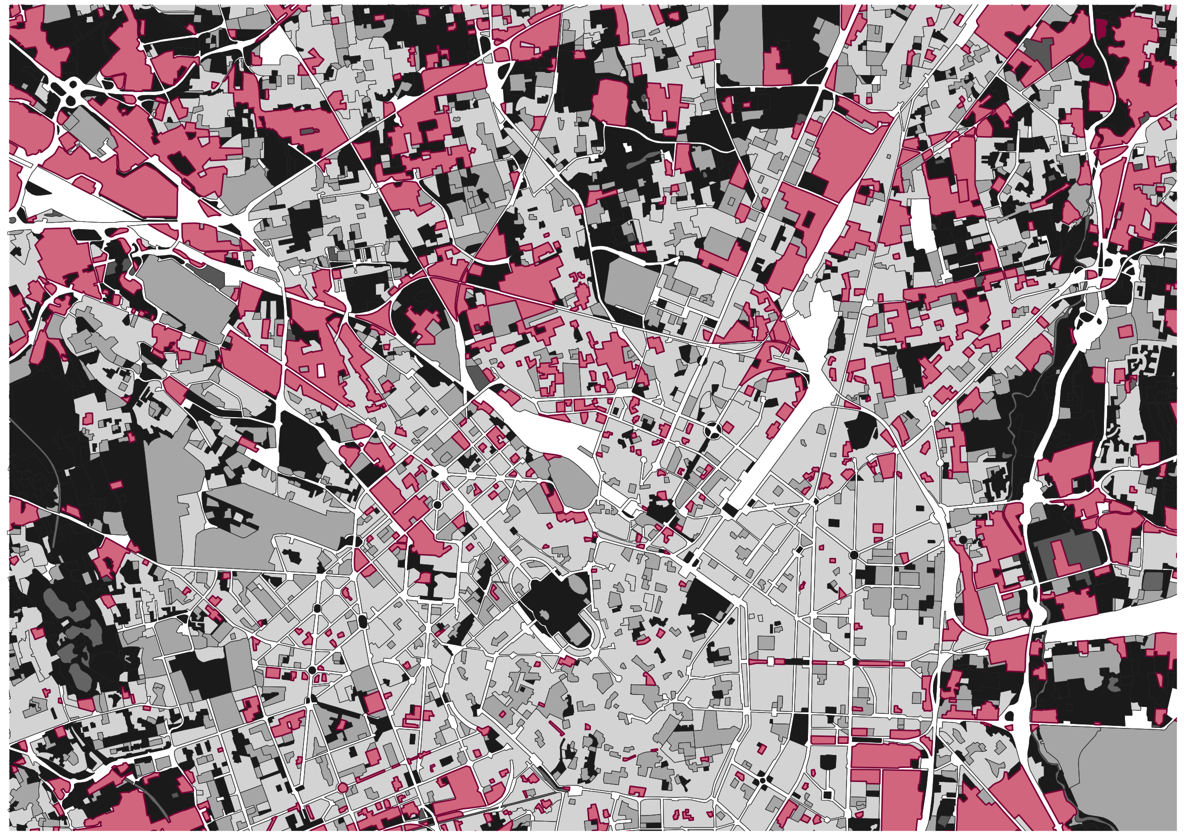
From the beginning of the XXI century Milan is in transformation to fit the necessities of the current world: societal changes, environmental crisis, new transportation needs and continuous technological revolutions. Milan wants to appear avant-garde, it is for these reasons that it undertakes many cultural and artistic projects; indeed, it is considered the capital of fashion and hosts one of the most important design biennials with the famous Fuorisalone.It can therefore be said that the city has worked on an urban aesthetic to attract the "creative" in its boundaries. Milan is the first immigrants' destination in Italy, with a number foreign residents that amount to 22% of the city population.

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.

However despite those characteristics of the Lombardy capital, when we have a look at the milanese landscape we can be surprised that the city doesn't have any major library. For this reason it wasn't a surprise to see Milan starting an open competition to design a new metropolitan library up to the task of representing Milan and Italian libraries on an international scale.

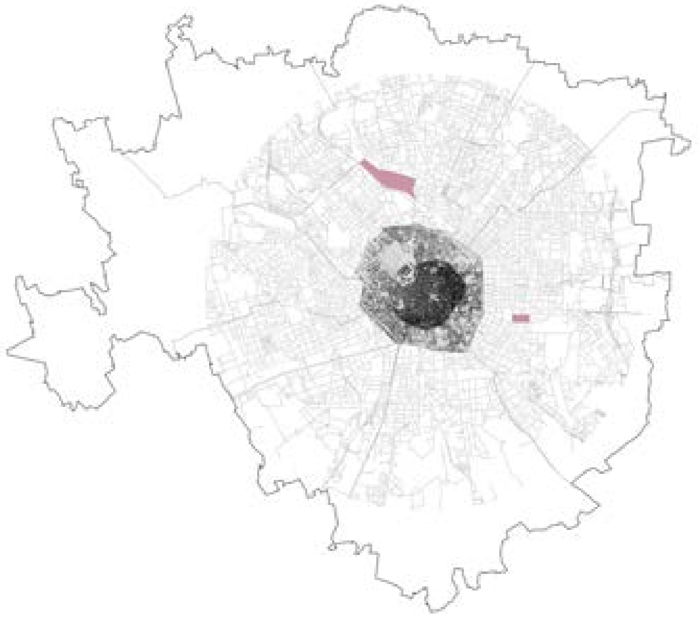
EVOLUTION OF THE LAND USES

1954



2018 - Current situation

N



**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**

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?

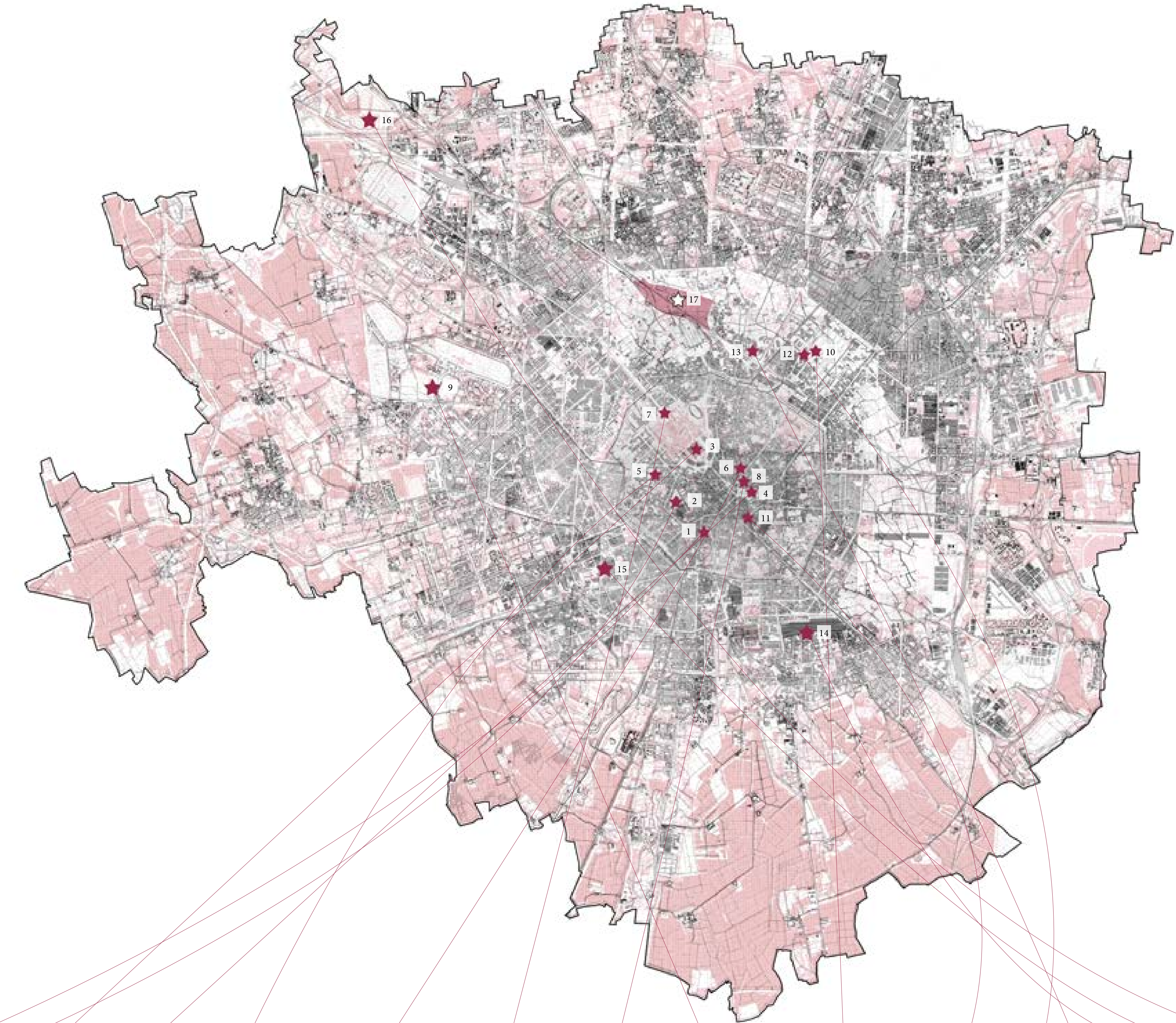
A library, as a social environment created for cultural exchange, learning, and community engagement, possesses the intrinsic qualities to be regarded as a landmark project. Serving as a beacon of knowledge, a hub of intellectual discourse, and a symbol of civic pride. Through its impact on individuals 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.

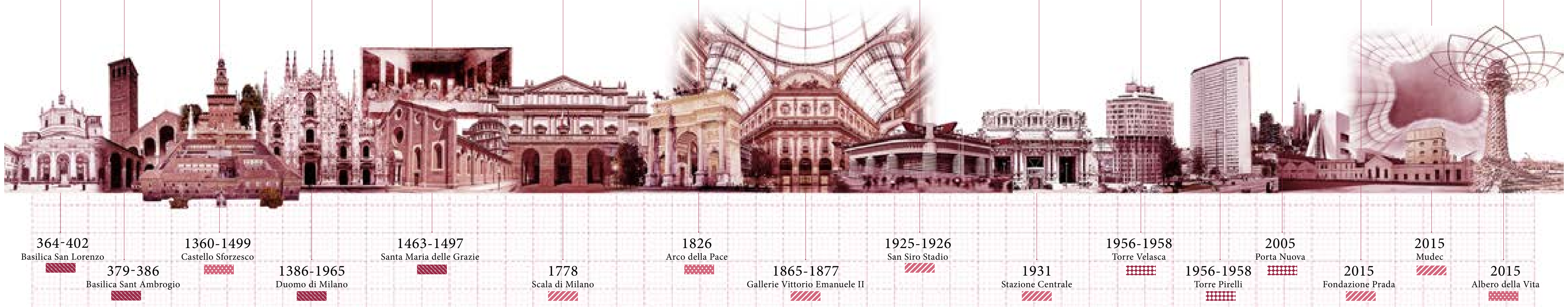
In regards to the statement that a library has the power to become an urban landmark, we examined other Iconic buildings of Milan to gain insight into the city's architectural evolution and socio-cultural dynamics. These buildings serve as critical touchstones for understanding Milan's urban fabric, historical trajectory, and identity. Among the landmarks considered, a notable pattern emerged in terms of their functions and historical periods. The oldest structures, such as San Lorenzo and Chiesa Sant'Ambrogio, date back to the early centuries and predominantly served religious or administrative purposes, reflecting the city's medieval origins and its status as a center of ecclesiastical and political power. Similarly, the Castello Sforzesco, Santa Maria delle Grazie, and the Duomo di Milano, with their imposing presence and historic significance, underscore Milan's rich heritage as a medieval stronghold and seat of authority.

As we move towards more recent centuries, we observe a shift in the typology and function of landmark buildings. The emergence of cultural and civic institutions, such as Teatro la Scala, the Galleria Vittorio Emanuele II, and the Arco della Pace, reflects Milan's growing prominence as a cultural and artistic hub during the Renaissance and Enlightenment periods. These buildings not only served as symbols of civic pride but also fostered intellectual exchange, artistic innovation, and social cohesion within the community. In the 19th and 20th centuries, Milan experienced rapid industrialization and urbanization, leading to the construction of iconic landmarks such as Milano Centrale railway station, Torre Velasca and the Pirelli Tower. These structures epitomize the city's transition into a modern metropolis, characterized by its economic vitality, technological advancement, and architectural experimentation. Moreover, the proliferation of corporate headquarters, commercial complexes, and transportation hubs underscores Milan's emergence as a global financial and commercial center.

In recent years, Milan has witnessed a resurgence of architectural creativity and urban regeneration, as evidenced by projects like Porta Nuova, Fondazione Prada, Mudec, and the Albero della Vita. These contemporary landmarks reflect the city's commitment to cultural revitalization, sustainable development, and inclusive urbanism. They serve as focal points for community engagement, artistic expression, and environmental stewardship, contributing to Milan's reputation as a vibrant and forward-thinking city.

By studying the functions and historical contexts of these landmark buildings, we gained valuable insights into Milan's urban morphology, socio-economic dynamics, and cultural identity. This knowledge helped us during our design approach, guiding us in crafting a project that respects the city's heritage while responding to its present-day needs and aspirations.





N

Milanese Landmark

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

17 Project Site

LEGEND Landmark Tipology

Religius
Private
Civil
Other

PORTA VITTORIA SWOT ANALYSIS

S

Good Location: *The porta Vittoria area is close to a large scale of commercial service area（mainly wholesale market）*

Transportation Alternatives:: *The porta Vittoria area is located in a strategic location in Milan, close to the city center and major transportation hubs.*

Favourable Micro-climate: *The surrounding large square provides good ventilation for the building and existing buildings are oriented towards the sun path which brings higher temperature during cold season*

W

Safety Concerns: *Milan has experienced issues with crime and safety in some neighborhoods, which could negatively impact community cohesion and social well-being in the porta Vittoria area.*

Noise Concerns: *Two train stations are close to the site and will bring noise*

Lack of Green Infrastructure: *The area has a history of industrial use, which could have resulted in soil contaminationand other forms of environmental degradation that could be expensive and time-consuming to address.*

Vulnerable Ecosystems: *Consider the presence of vulnerable ecosystems or habitats that may be at risk due to development activities.*

Distance From Center: *The distance between city center and porta vittoria is too far.*

O

Economically Attractive: *Development initiatives in porta Vittoria is going to attract more investments.*

Environmental Remediation: *The area's history of industrial use could be an opportunity for environmental remediation and rehabilitation, improving the overall environmental health of the area.*

Attractive To Tourists: *The historical significance of the area could attract tourists, generating revenue for the local economy.*

T

Economic Downturns: *Economic downturns could reduce the resources available for sustainable development in the area, and make it more difficult to attract businesses and investment*

Regulatory Challenges: *Consider regulatory hurdles or lack of enforcement that may hinder the implementation of environmentally sustainable practices.*

Resource Scarcity: *Evaluate the availability of essential resources like water and energy, and the potential risks associated with scarcity or inefficiency.*

Overload Of Public Transport: *as the number of people in the area will be highly increased , the exhisting transport can be overload.*

ZONA FARINI SWOT ANALYSIS

S

Advantageous location: *Close to the city life area and the transportation node Porta Garlibardi.*

Transportation Alternatives: *Assess the availability and use of public transportation, cycling lanes, and pedestrian-friendly infrastructure that reduces the area's carbon footprint and promotes eco-friendly commuting.*

Local Biodiversity: *Recognize the presence of local flora and fauna, as well as efforts to preserve or enhance biodiversity in the area.*

High Priority In The Future: *In the city's developement plan farini has high priority.*

W

Pollution Concerns: *Address any environmental pollution, such as air pollution, noise pollution, or water pollution, that may affect the quality of life in the area.*

Brownfield Sites: *Evaluate any contaminated or underutilized brownfield sites that require environmental remediation before redevelopment.*

Lack of Green Infrastructure: *Identify areas with a lack of green infrastructure, such as trees, green roofs, or permeable surfaces, that could lead to urban heat island effects and drainage issues.*

Vulnerable Ecosystems: *Consider the presence of vulnerable ecosystems or habitats that may be at risk due to development activities.*

O

New Immigrants: *There will be a large number of new people moving into the area, including a large number of young people*

Economically Attractive: *Due to the large number of jobs and residents is planned in farini area, it's going to attract more investments.*

Culture exchange: *The area's diversity and access to cultural resources could provide opportunities for cultural exchange and learning, fostering social understanding and cohesion in the area.*

Waste Management Innovation: *Encourage innovative waste management solutions, including recycling programs and waste-to-energy initiatives.*

T

Economic Downturns: *Economic downturns could reduce the resources available for sustainable development in the area, and make it more difficult to attract businesses and investment*

Regulatory Challenges: *Consider regulatory hurdles or lack of enforcement that may hinder the implementation of environmentally sustainable practices.*

Resource Scarcity: *Evaluate the availability of essential resources like water and energy, and the potential risks associated with scarcity or inefficiency.*

Porta Vittoria Against Scalo Farini

After the almost completion of the porta Nuova development project the city decided to put more attention on other Milanese strategic districts. More recently things are moving in the East of Milan. for example in Corso Indipendenza with the new Metro line (M4), Porta Vittoria, zona Ex Macello or Porta Romana. To follow this trend the new Library comes in the planners mind. The Beic library is planned to be built in the empty area over the underground Station of Porta Vittoria. This Milanese area is going through many changes. The close area context is well defined. Some high density middle-high residential buildings are present both in the north and in the south side and open to the city through the longitudinal axis (west-east).

We can imagine that inserting the new Library in Porta Vittoria district might be a way to increase the attractivity of the area. We are in the right to ask if The area wasn't chosen to give more to the district instead of giving more to the library itself.

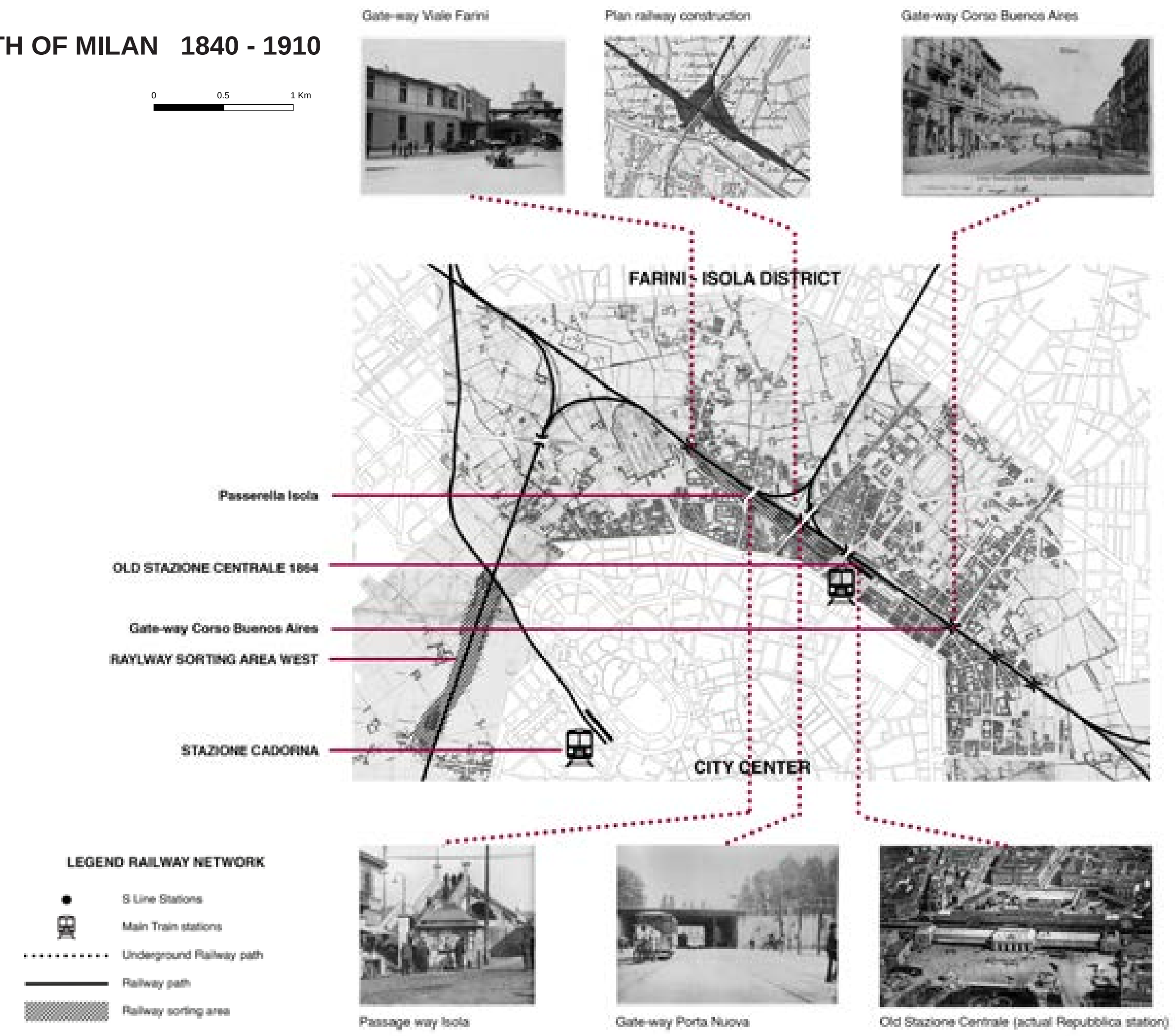
Based on the SWOT analysis we can better compare our two sites options for our project. Zona Farini, that we preferred and chose, and Porta Vittoria. Both districts are going to be renewed in the near future and they are both located in Milan's metropolitan area. For that reason they share similar opportunities and threats. But compared to each other, Zona Farini has a better advantages that can increase the number of daily visitors for the BEIC library. In Fact, due to the demographic history background of Milan, the Northern part of the city is more developed in terms of transportation network, attractive areas, and inhabitant density. Scalo Farini enters in a large scale urban project aimed to create a modern line, symbol of development and climate crisis fight, connecting all the areas from the site of expo 2015, the university of bovisa la goccia, zona garibaldi, area acquabella and potentially also Citta Studi, As the center point of the new axis, zona Farini seems to be a better option to construct the BEIC library of Milan.

New development areas

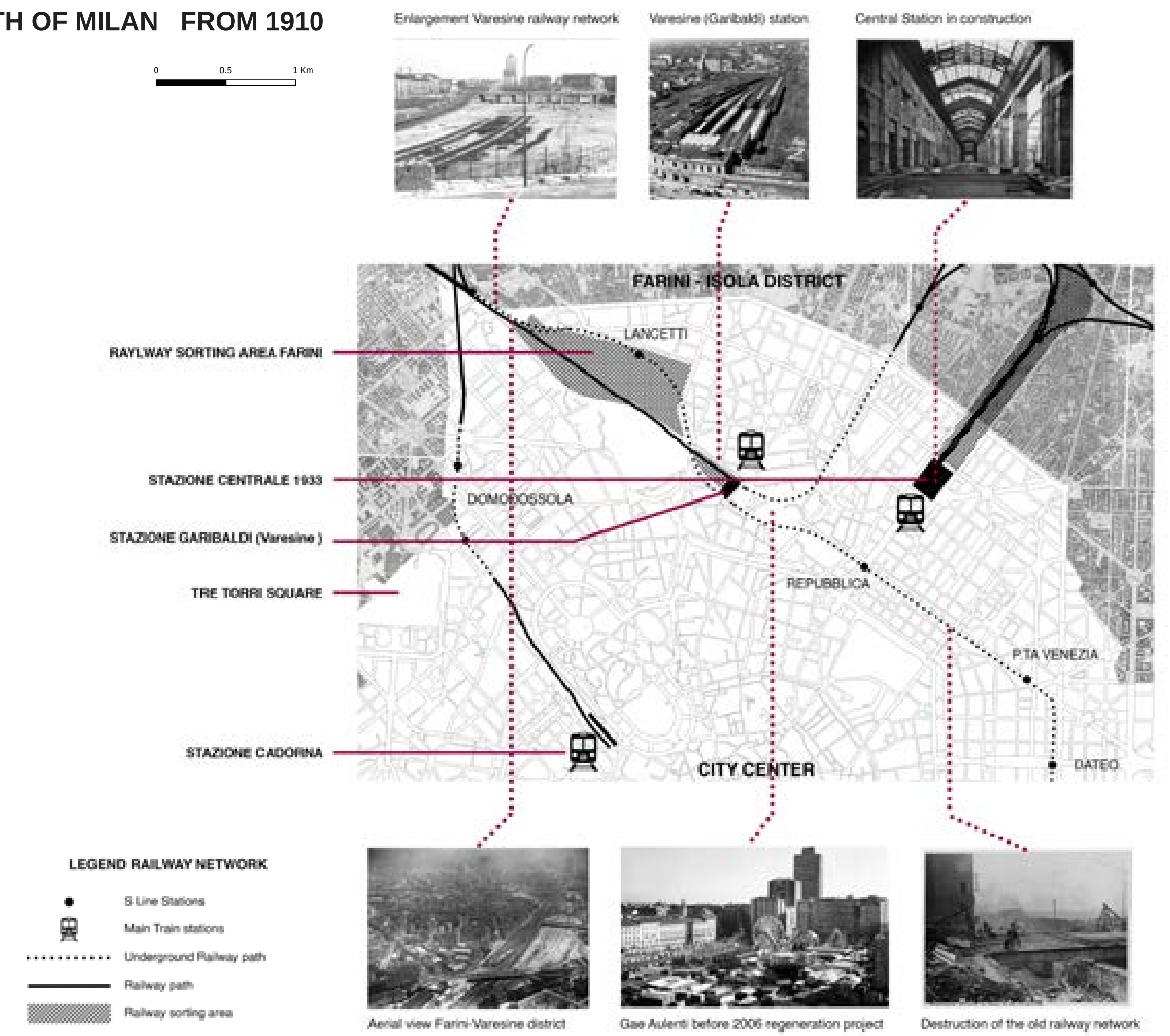
The site we propose for the new BEIC project was in the past a railway deposit area used to store trains and wagons. In Italy, a railway «scalo» refers to a designated area within a railway station or depot specifically designated for the sorting, storage, and maintenance of trains and rail cars. Serving 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.

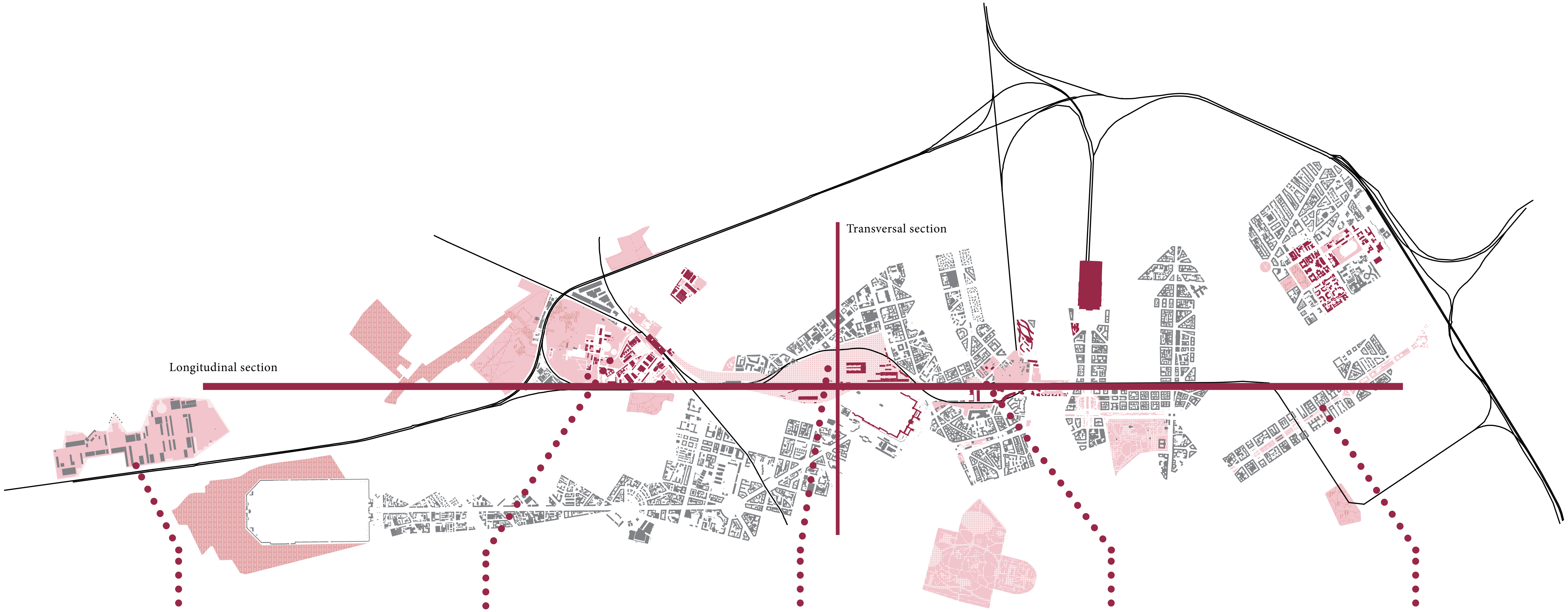
Milan is counting diverse areas like this all around the city, most of which has been abandoned to move these infrastructure more far away from the city's borders, leaving unused areas with high urbanistic potential in strategic locations. for example Scalo porta Romana, which is going to host the Olympic 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.

NORTH OF MILAN 1840 - 1910



NORTH OF MILAN FROM 1910





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

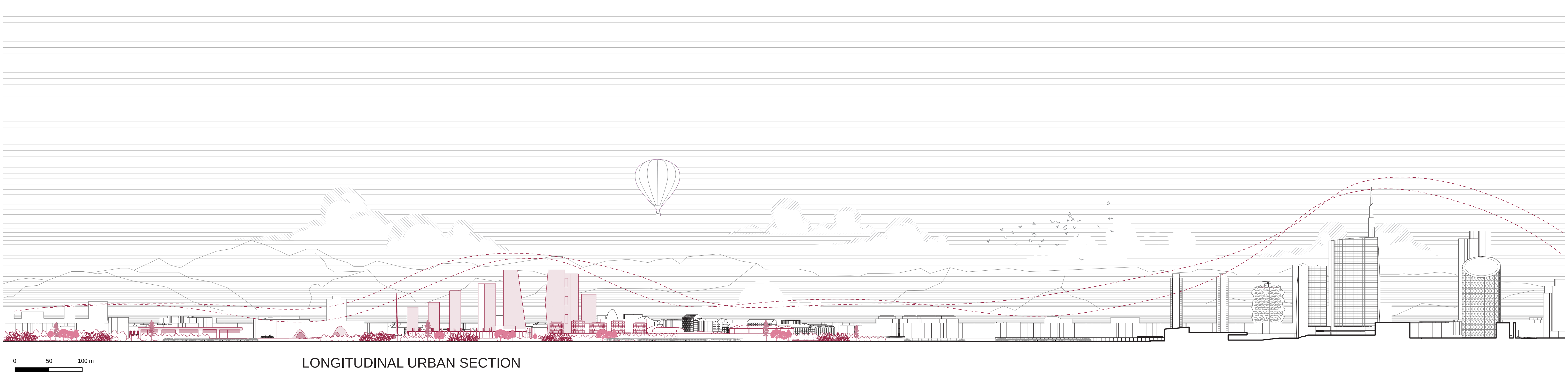
ZONA GARIBALDI PORTA NUOVA

Client: Milan municipality

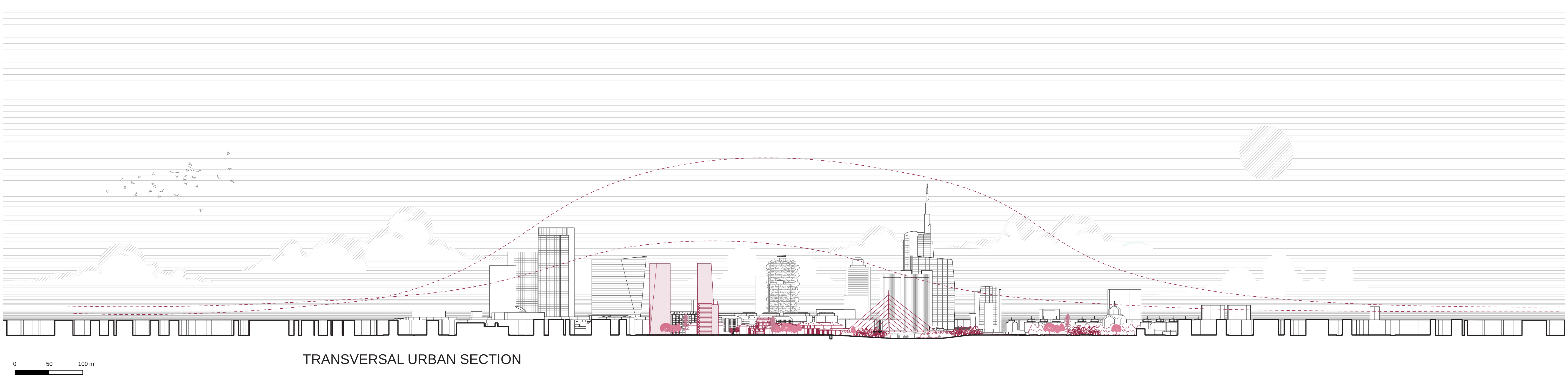
5

AREA ACQUABELLA

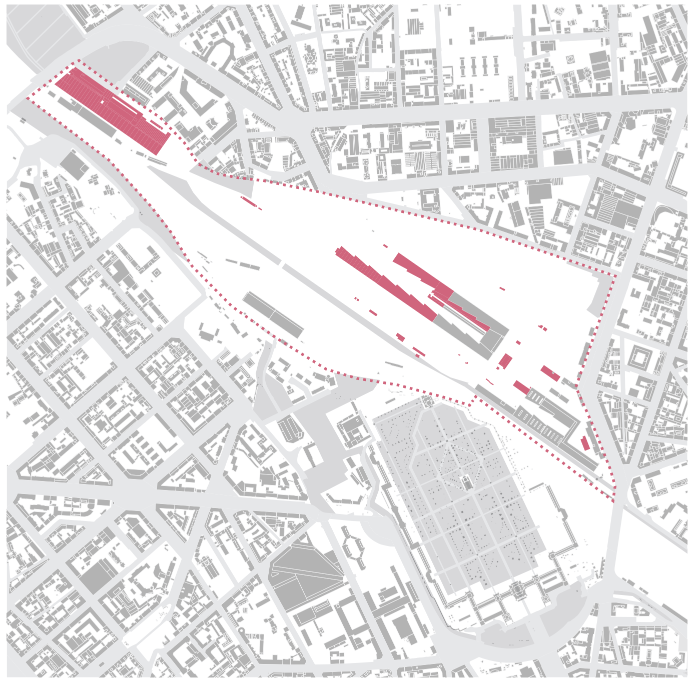
Client: Milan municipality



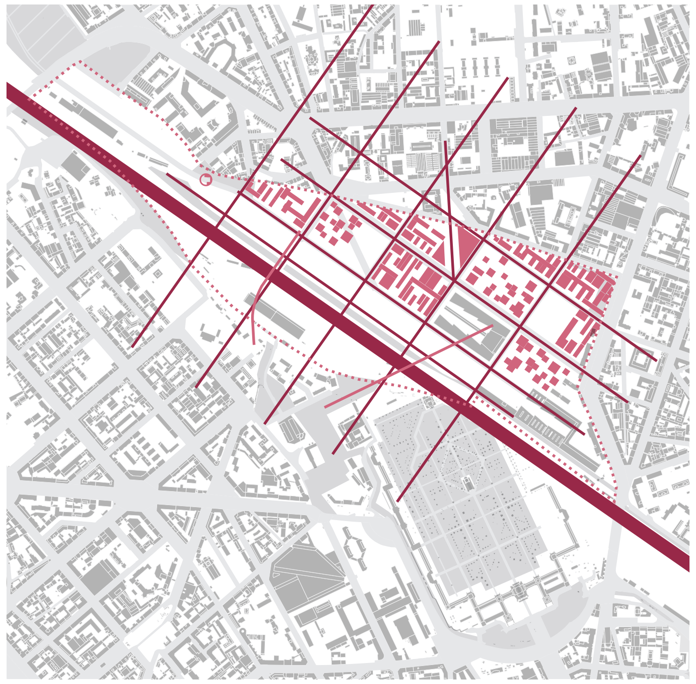
LONGITUDINAL URBAN SECTION



TRANSVERSAL URBAN SECTION



DEMOLITIONS



WINNING OMA PROJECT

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 a 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.

A weakness element that is constraining the possibility of building everything at once is the soil pollution, considering the history of the land it is evident that the railway infrastructure has caused the penetration of potential railway waste, for this reason the reconversion of the area will before hands require a de-pollution work to sanitize the soil before starting new construction work.

In a vision of sustainability and re-use, most of the existing buildings with historical value will be re-valorised in the master plan vision. Among those structures the train maintenance building in the center of the site will host the new university campus for accademia di Brera, the buildings in area dogana will maintain their administrative function and finally the second train hall will be reconverted to co-working spaces, study rooms, beverage and food kiosk, and a permanent exposition about Milanese railway history.

OMA's design didn't go to a deeper level in the definition of every new building. Indeed we can say that, apart from the main buildings such as the market hall as an example, none of the other buildings have been clearly defined by its boundaries, heights and characteristics. Instead, Rem Koolhaas's team focused more on the appearance and space qualities of the urban environment. From the hidden squares, the water basins and to the parks.

advancement work 2024

advancement work 2027

advancement work 2035

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.

One of the biggest arguments brought by OMA was in the introduction of new urban green areas. In Fact the analysis of Farini district quotes the weak presence of green spaces compared to other functions. With the recovery of the abandoned Scalo, that is representing about 40% of the district covering, could reverse this constant. Rem Koolhaas's team showed to the municipality two big buffer green areas in the master plan, the biggest one is using the bottom string next to the railway path to create a linear park that would connect the park "Biblioteca degli Alberi" in porta Nuova, with the university campus in Bovisa.
Those new park areas would be accessible for both the new residents and the existing inhabitants of Farini and nearby districts.

Finally, the last component implemented in the masterplan decision was the introduction of two pedestrian foot-bridge connecting the two sides of the city, currently divided by the railway path. Those two elevated platforms are really important elements, essential for the good development of the future new district, because in addition to improving the slow mobility it improves the urban transportation network, by linking the Metro 5 line Cenisio with the Milano Lancetti underground S station.

Historical picture looking at Scalo Farini, 1958-1960

Masterplan changes

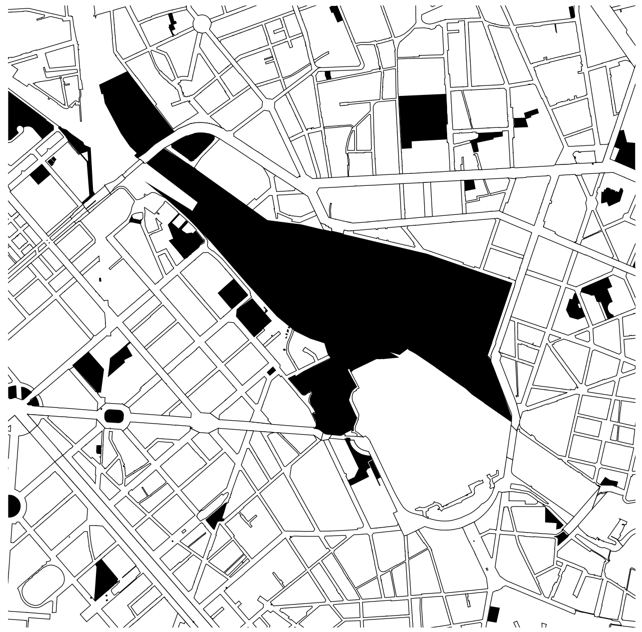
For the design of the new library we decided to keep most of the decisions made in OMA's approved urban plan, because it is in our opinion quite appropriate for the site in terms of street network and urban functional arrangement.

Anyway due to the evolutive realization of the master plan, we didn't want to leave the master plan buildings un defined. For this reason we studied a way to imagine the new buildings in the masterplan. Our sketches came to life by using historical recognition as poetry of the overall appearance of the Farini area. Our first concern with the sketch by OMA was that the plan is imagining some extremely dense residential blocks distributed around the road grid. This over-densification was removing the historical appearance of Scalo Farini. By looking at a Nolli plan, this land, which nowadays is mostly determined as an empty space in the dense Milanese scene, in OMA's plan the building distribution would make this identity disappear, recreating the same density present in the rest of the district. To keep this identity of void alive we worked on a redistribution of the buildings without avoiding the possibility of implementing a high rise in the southeastern part of scalo Farini in order to reduce the land covering of buildings.

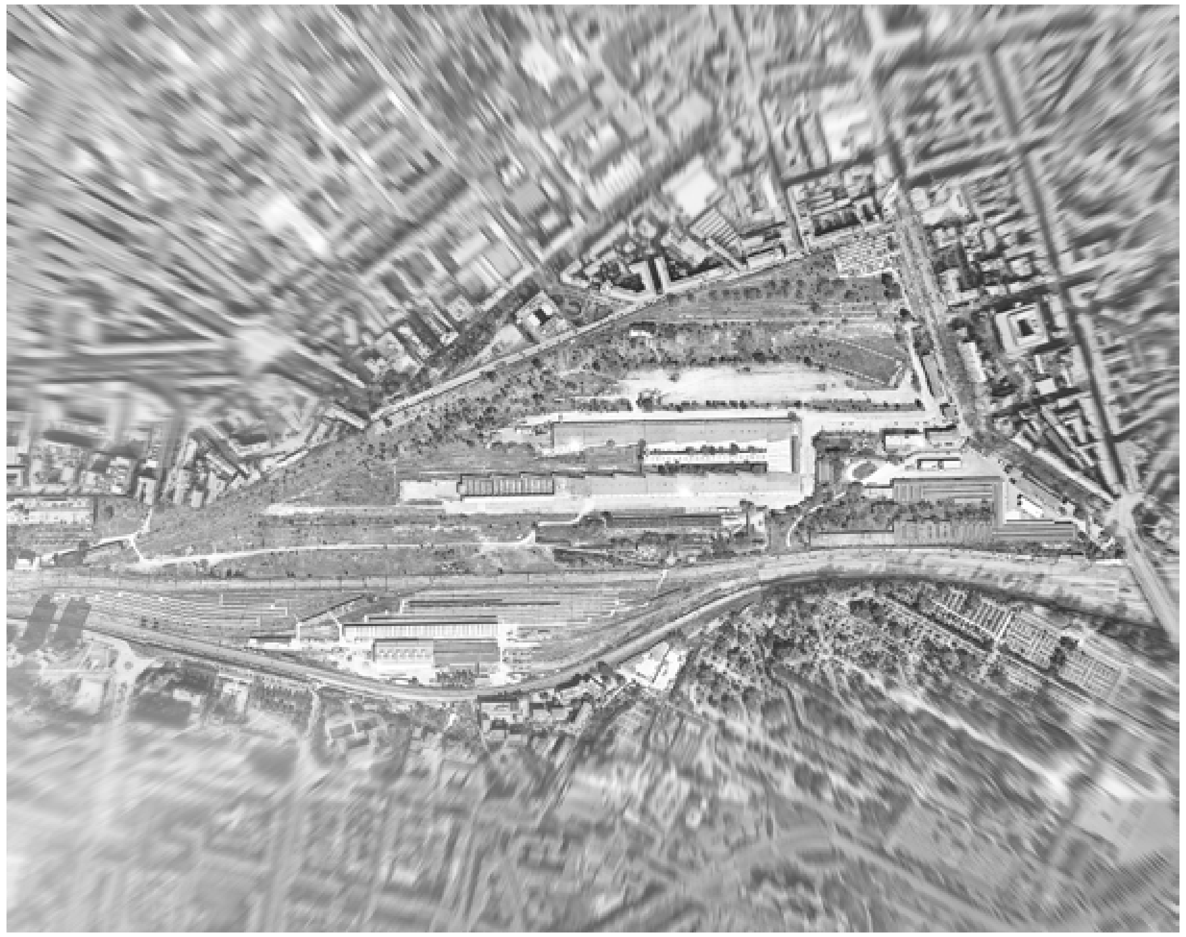
We believe that the city as a whole is composed of heterogeneous neighborhoods, built at different times. This characteristic echoes Colin Rowe's "Collage City" which explains that the city is a collage of neighborhoods and buildings that sometimes agree in an incoherent and contradictory way. We must therefore accept that the environment is in confrontation and build with these urban constraints. With Aldo Rossi the city is redefined from architecture. In his book "L'architettura della città" written in 1966 he explains that the city is created from a superposition of layers and eras. The Italian architect speaks of layers of geography, monuments, identification of neighborhoods and genius of place.
It is important to create a discussion between the architecture and the existing by the principle of adaptation of the latter. However, the error in this field remains a real but acceptable risk if the architect

OCCUPIED AND VOID BLOCKS

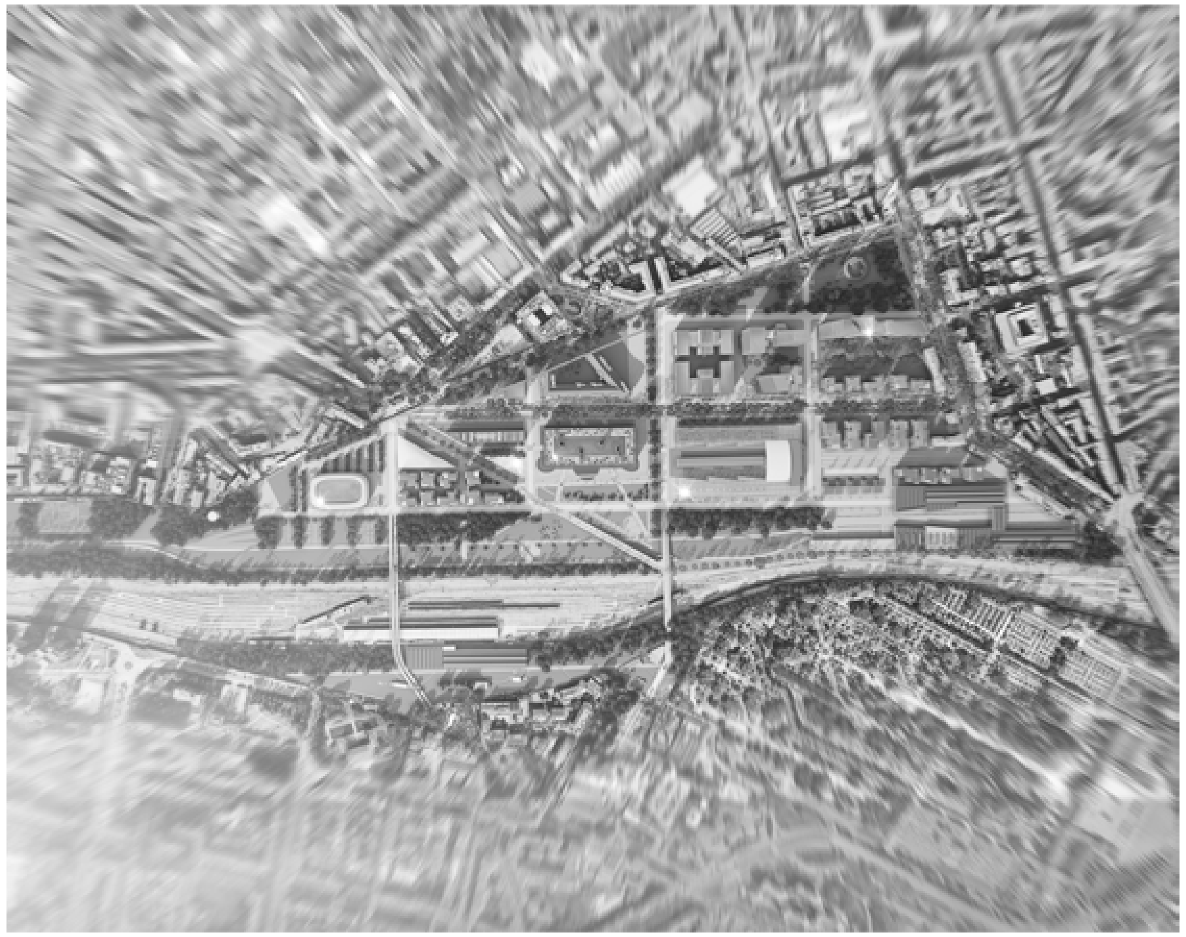
NOLLI PLAN



SQUARES, PARK AND EMPTY AREAS



SCALO FARINI - Current situation



SCALO FARINI - New master plan Project

demonstrates that he tried to create a link. The design of its architecture offers vocations to future constructions that can decide to accept or take liberties.

Another aspect we took liberties from, was the break of the rigid grid with an oblique street. This new road is just an extension of "Via degli Imbriani " that would continue his path inside the Scalo Farini area. This Cut would act similarly as with Broadway in New York. This extension of the street , completely pedestrian, 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.
The extension of "Via degli Imbriani " helped us to also design the new two pedestrian foot-bridge connecting the two sides of the city. Indeed we think the two links are a good idea in the urbanistic point of view but their appearance according to what Rem Koolhaas planned is in our opinion not correctly taking in account the actual surrounding context of Scalo Farini. In our architectural decisions we envisioned to create a spire bridge, accessible only with slow mobility, by bike or walk. The spire placement is aligned with the Monumentale cemetery. It is placed in the continuation with the main axis of the cemetery and it symbolizes both the end of "Via degli Imbriani " and the beginning of the elevated foot-bridge.

Green areas

for the green areas we didn't make many changes with the existing winning proposal from OMA. In fact we agreed with the idea of imagining the green areas as buffer zones that would create a division between the existing and new masterplan buildings. These new elongated parks would create an oxygen machine to make the district breathe again. In addition to the improved air quality and space appearance, those new green spots will help to reduce the land surface temperature which is a really important factor to consider since the summer ground temperature around the Scalo Farini reaches some of the highest values in the whole city of Milan.

MASTER PLAN MODIFICATIONS

GREEN AREAS

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.

For the pedestrian circulations we firstly analyzed the large scale of the surrounding context. This study resulted in the awareness of the future objectives of Milan. In fact we discovered that the city is planning by the end of the decade to transform plenty of the existing street next to Isola and Dergano District into fully pedestrian walk-ways. By this comprehension we envisioned our master plan to follow this instinct. For this reason we decided to transform most of the new secondary streets of Scalo Farini, to pedestrian paths.

Cycling transportation is the least developed method in the metropolitan area. Unfortunately the badly designed network is not encouraging users to consider this method for daily use. anyway cycling transportation has demonstrated in plenty of places around europe that it is a suitable and efficient method to move in a city environment. As examples we can study cities from the north of Europe like in Denmark or Holland where the citizens use their bikes for most of the daily commissions. Some important metropolitan areas are replacing car lanes with a bike path and the statistics clearly show an improvement in the overall mobility in addition to being environmentally friendly and reducing the appearance of serious accidents. For all those reasons we designed our urban spaces thinking of how the cycling mobility could be implemented and connected with the future bike path lines, planned to be built in the near future all around Milan.

For public transportation we envisioned two visions. One for the underground lines and another one for the above ground components. In the first case we only considered the existing mobilities and looked at how we could study the surface exits to improve the circulation network for both existing inhabitants and the new residents. We decided to implement three new aboveground exits for the Milano Lancetti station along the new main and central longitudinal street in the Scalo Farini Masterplan. Finally, the new two foot-bridge above the railway path, that we specified in the previous chapter, allows a five minutes walk connection with the metro line 5 station Cenisio. For the above ground public mobility we kept the idea from OMA to deviate the tram 2 path inside the new Scalo Farini to improve the insite connection with the rest of the metropolitan area.

Finally we studied private heavy mobility. For the cars we defined four kinds of spaces with different levels of importance. depending on the importance of the axis in the overall city disposition. We realized that Via Valtellina seems to have gained the status of prioritized mobility to connect the Sarpi district with the Viale Edoardo Jenner and Maciachini area. For this reason we considered that most of the car mobility would be passing by this area. Accordingly, we gave this street the status of principal street. By doing this we avoided a principal street to cross the new district to give more power to other sources of mobility as explained previously. In the new Scalo Farini only the central avenue will accommodate a continuous line of car traffic. The other roads will accommodate tertiary paths for only residents' use and emergency vehicles.
In conclusion, as demonstrated in the previous paragraph detailing our approach to pedestrian, cycling, public mobility, and car transportation design in the new master plan project for Farini in Milan, 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.

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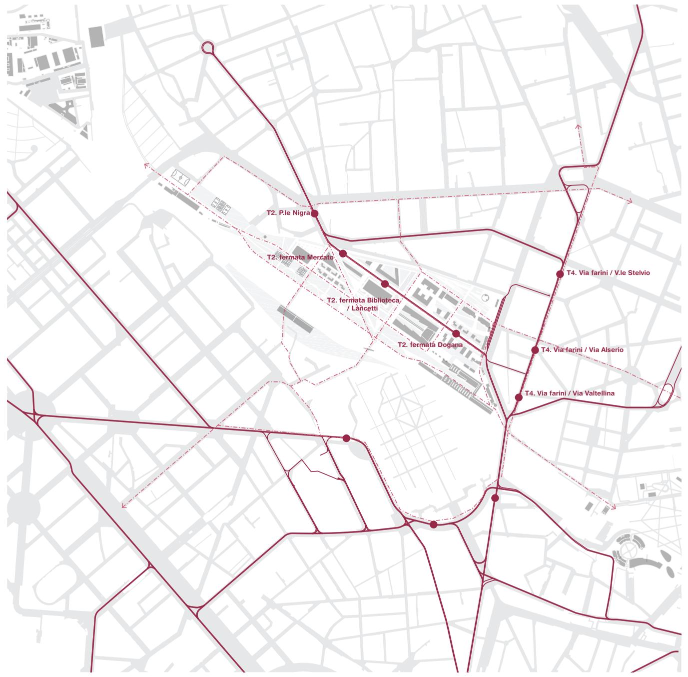
PEDESTRIAN CIRCULATIONS

Legend Transportation: Pedestrian

- Principal pedestrian street
- Secondary pedestrian street
- Tertiary pedestrian Path



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TRAM AND CYCLING

Legend Transportation: Cycling tram

- Cycling Path
- Tram Line
- Tram Station

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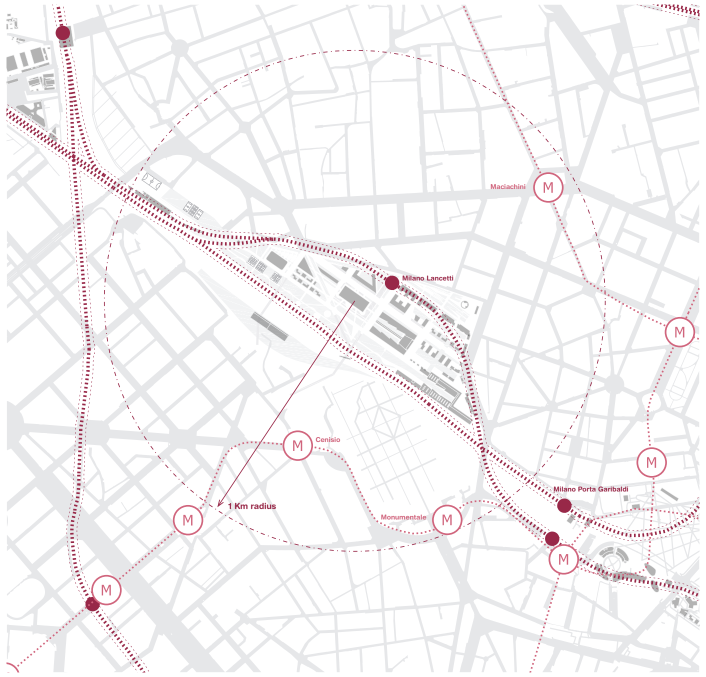
CAR TRAFFIC

Legend Transportation: Car

- Primary Street
- Secondary Street
- Tertiary Street
- Restricted Road
- P Parking



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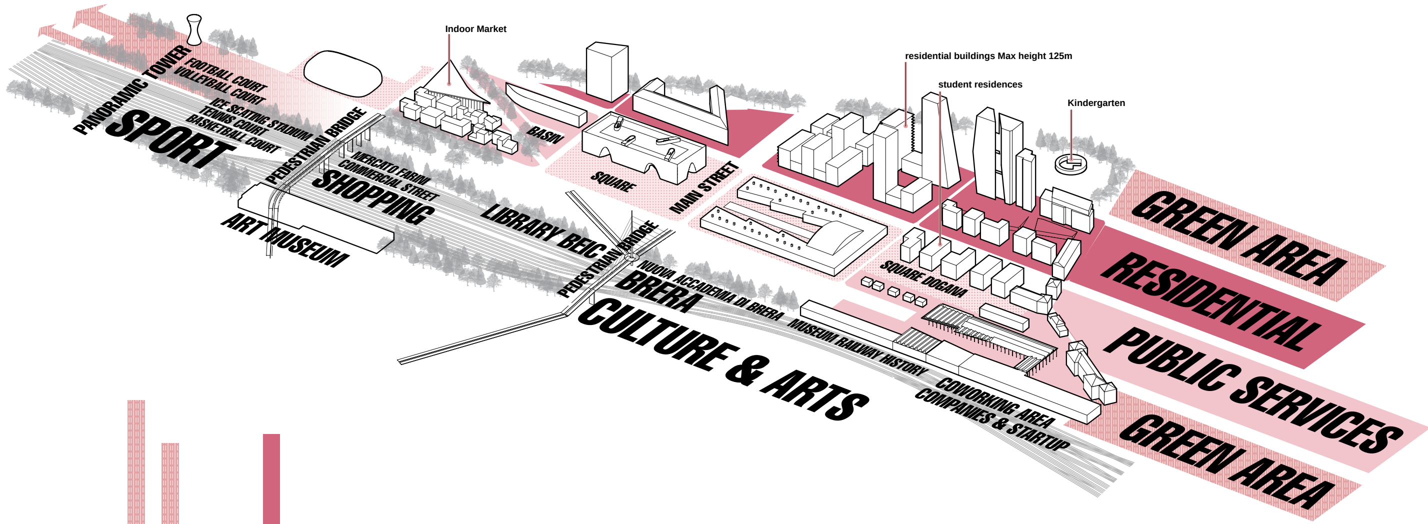
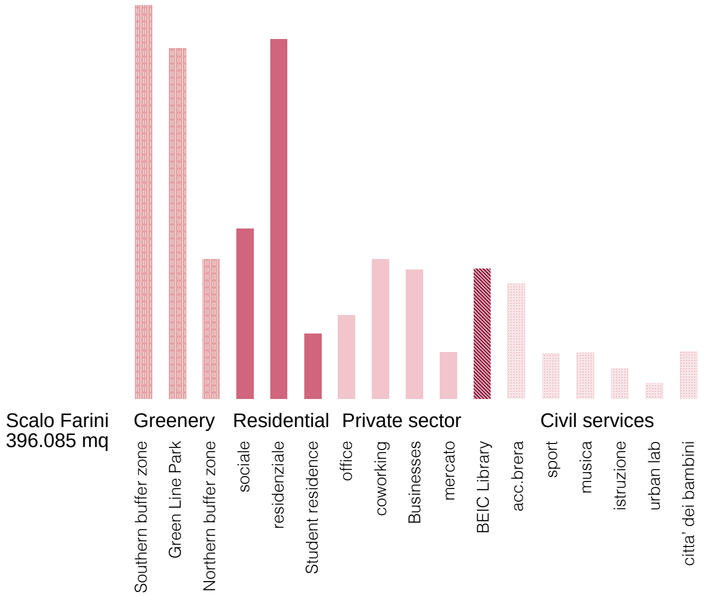
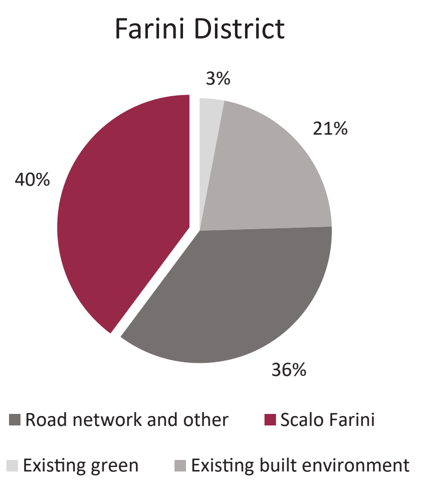
METRO AND S-LINE

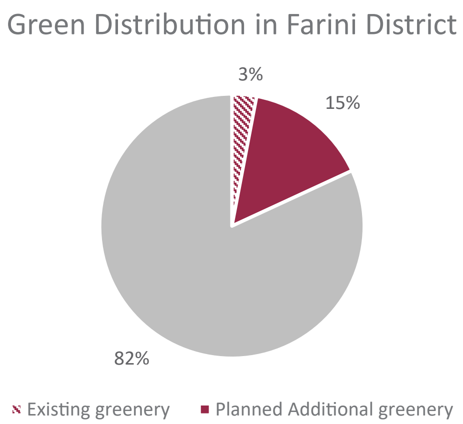
Legend Transportation: Metro S-Line

- S Line Railway
- S Line Station
- Metro Line
- M Metro Station



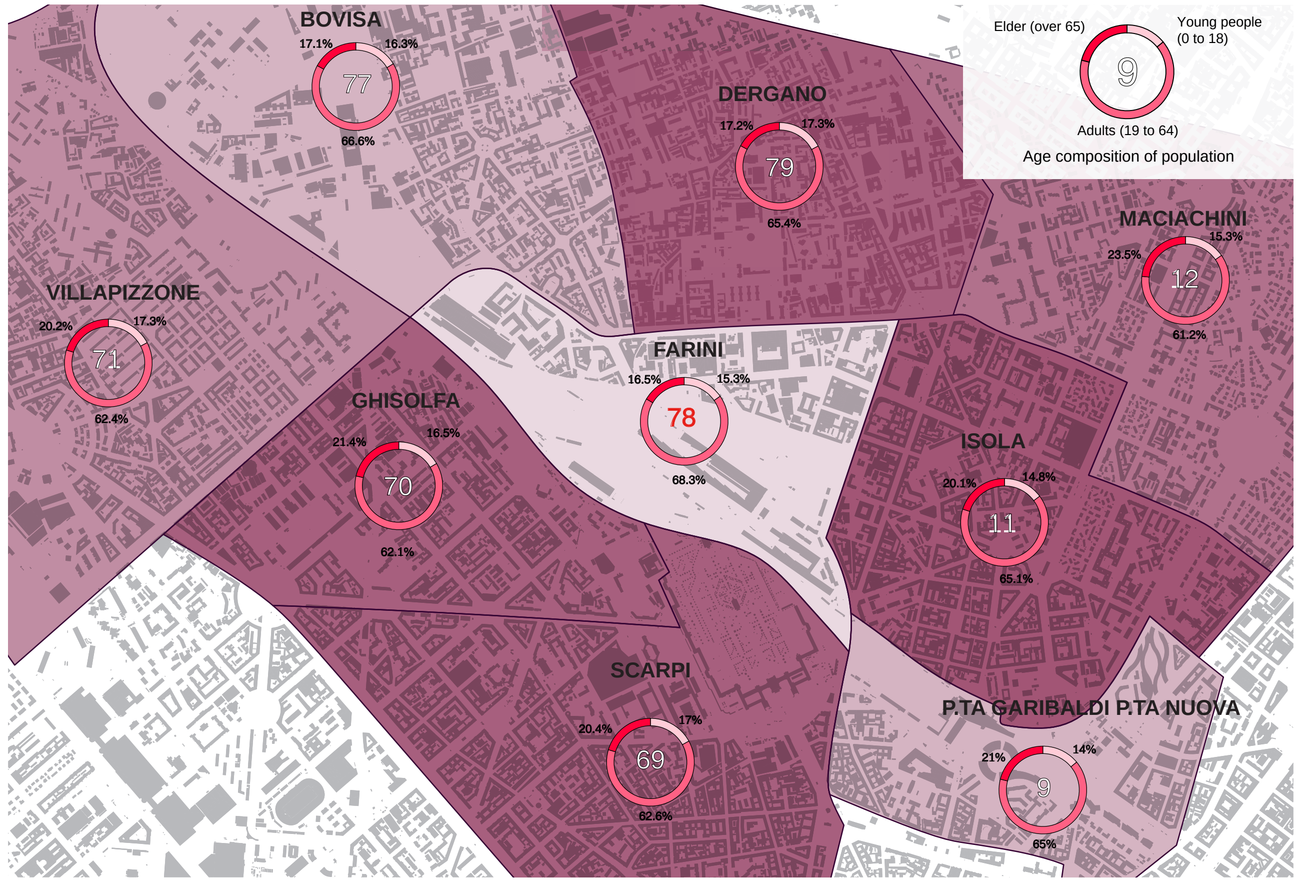






As cities continue to evolve and grow, thoughtful consideration of urban mobility becomes increasingly essential in shaping vibrant, livable, and inclusive urban environments for generations to come.

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.
In formulating the functional arrangement for our master plan, we adopted a cohesive concept centered around the distribution of topologies along longitudinal lines parallel to the railway path. This approach aims to optimize accessibility and efficiency while promoting a balanced and harmonious urban environment. The first longitudinal axis, located next to the park “La Linea”,



DEMOGRAPHIC MAP - Current situation

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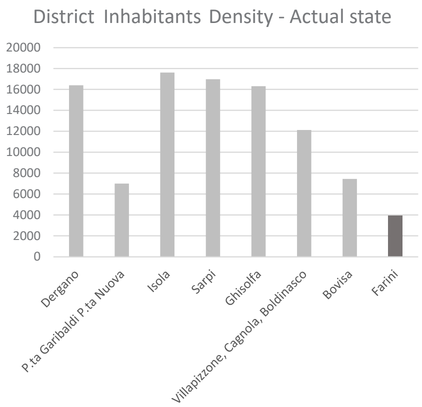
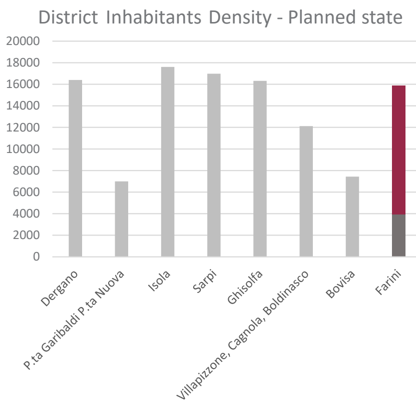
is dedicated to civil and business services, including essential amenities such as libraries, sports facilities, schools for the young childrens, laboratories, shops, restaurants, coworking spaces for students and start-up, and office buildings. This concentration of services along a central spine enhances convenience and connectivity for residents and visitors alike. Parallel to this axis, the secondary longitudinal line is predominantly reserved for residential buildings, catering to a diverse range of housing needs, from traditional apartments for small and large families to student accommodations and social housing units. To reduce the land coverage, we planned to introduce some high rise buildings in the southeastern part with a maximum height of a hundred twenty five meters above ground. The location of these tall buildings have been thought of in order to minimize the shade over the existing buildings.
Finally, a significant portion of the land area is allocated to green spaces, fulfilling a critical need in the district’s urban fabric. These green areas not only provide recreational opportunities and enhance the aesthetic appeal of the environment but also contribute to ecological sustainability, fostering biodiversity and mitigating the urban heat island effect. By integrating these elements within our master plan, we aim to create an inclusive, vibrant, and environmentally conscious community that enriches the lives of its inhabitants and sets a new standard for urban living.
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.





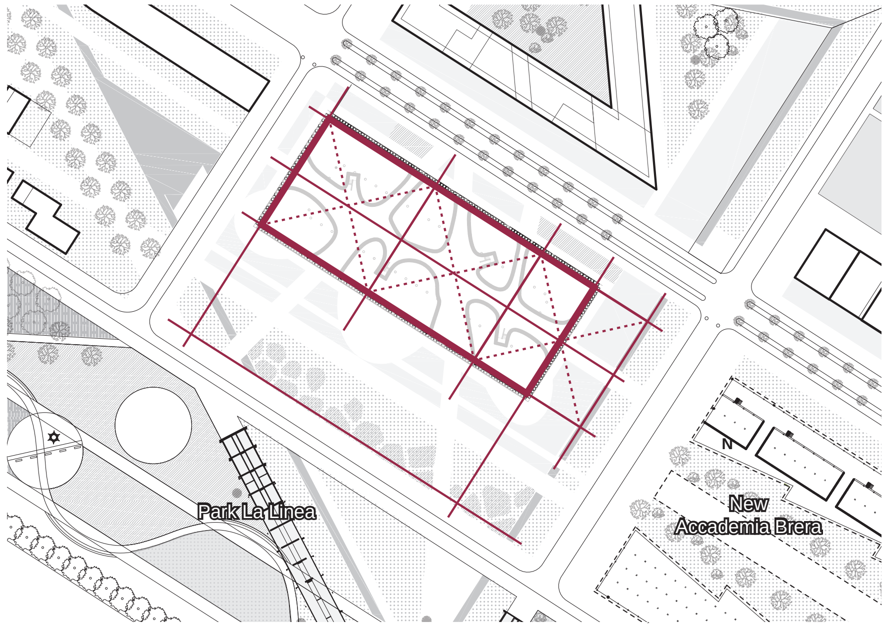
SITE IMPLEMENTATION

The territorial analysis previously produced gave us the right tools to imagine an integrated project of a 25000 meters square library that would both consider the existing buildings, respect the surrounding landmarks and serve as bastions of knowledge for the Metropolis of Milan. The objective of the study made on site, brought to the result of the project and its not project doing the opposite to its surrounding. 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.

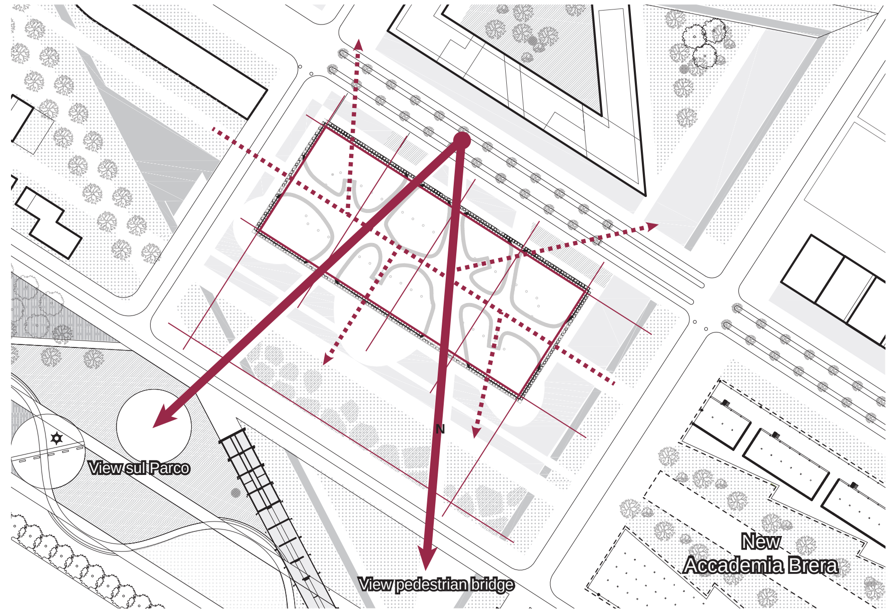
*"One cannot make architecture without studying the condition of life in the city. "*1 *Aldo Rossi*

Our first thoughts in the design phase was to ask ourselves how the form of the project can be directly influenced by the territory and the landscape. Due to the longitudinal street orientations and the closeness to Brera we decided to orient the BEIC along these axes.
Considering the important dimensions of the plot, we decided to keep half of the area as an empty space and to align the volume's north-east facade with the Future Brera building. This created a 50 meters wide square used as a relaxation area for the students, workers and visitors coming in the area. The created "Parvis" comes as an additional area to the line park and exists to break the rigidity of the green area and to invite greenery inside Scalo Farini.
In implementing our library project within the site, we drew inspiration from the innovative design approach exemplified by 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. Similar to the Rolex Learning Center, 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.

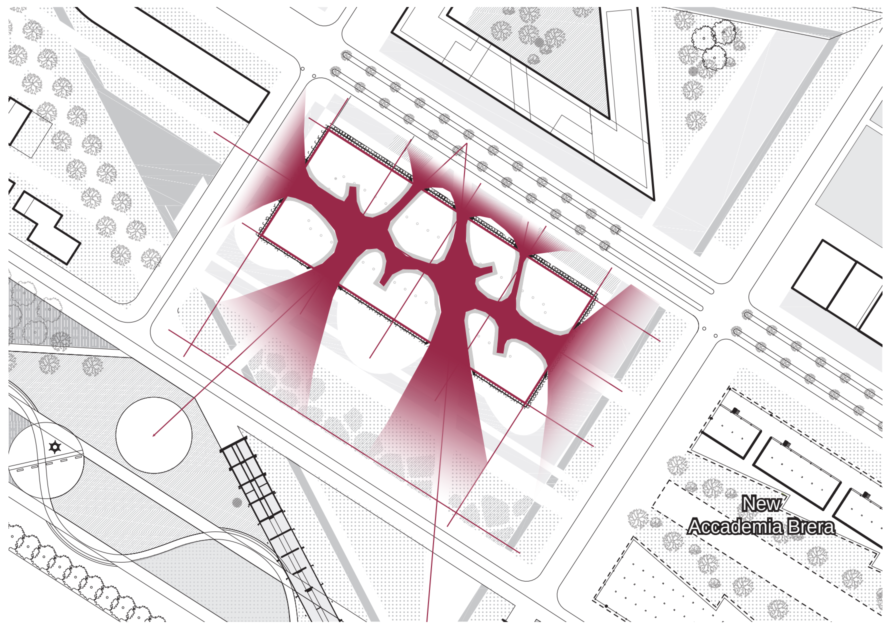
1 Aldo Rossi, 1966 , *Architettura Della Città*, op. cit



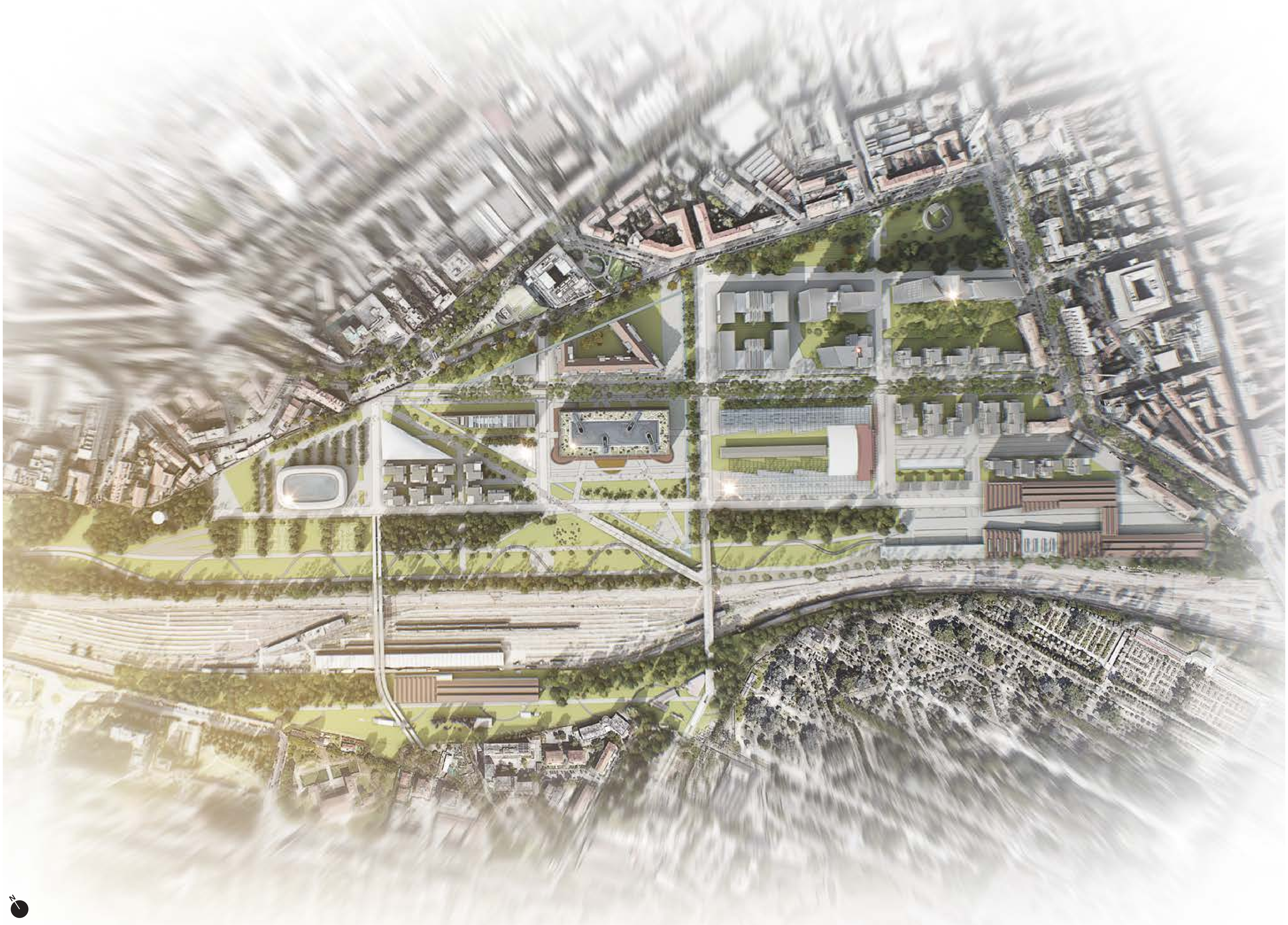
PROJECT PROPORTIONS



MAIN URBAN AXIS



VIEW POINTS DEFINING THE PUBLIC SPACE



PROJECT CONCEPT

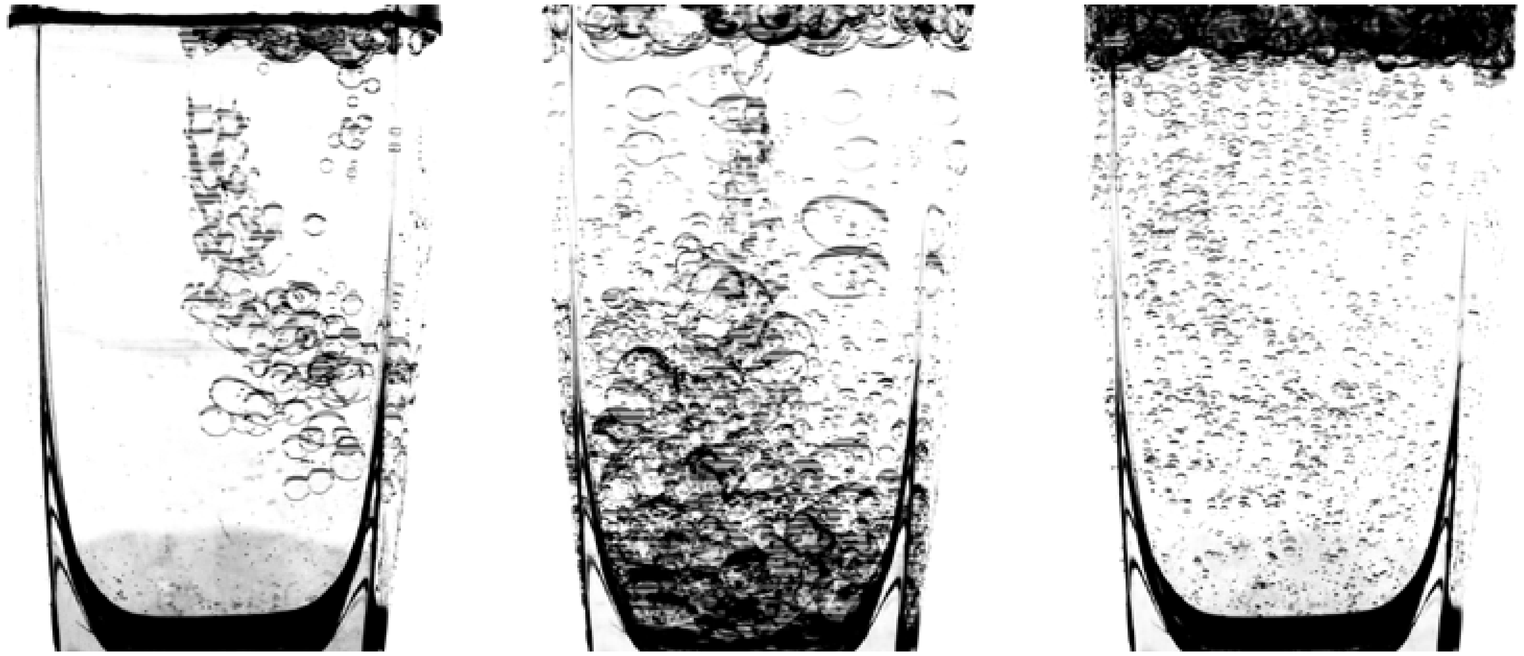
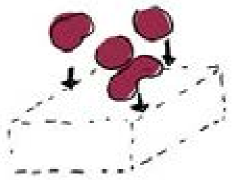
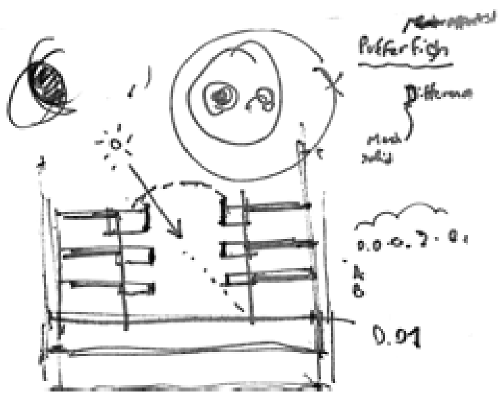
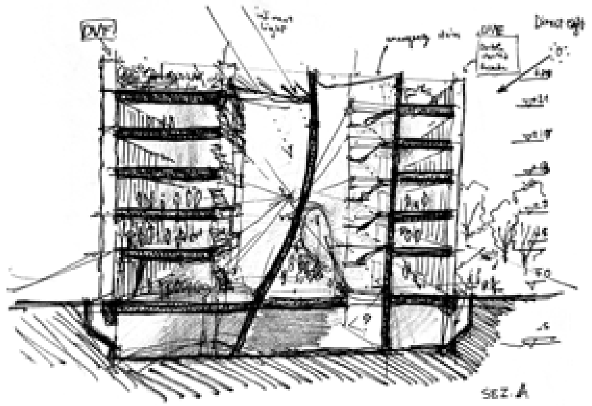


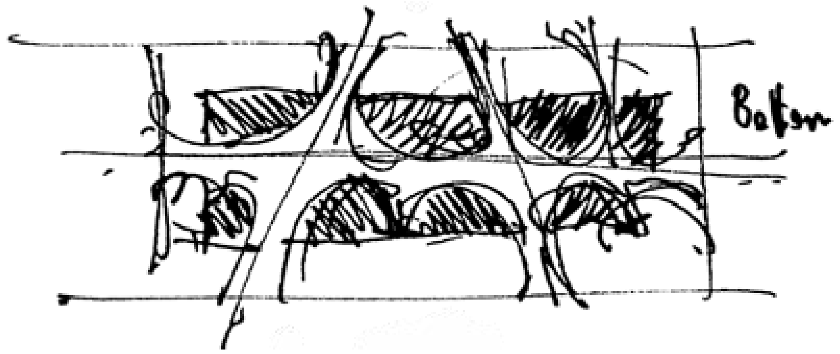
Photo made trowing oil bubbles in a glass of water

IDEA SHARING HOUSE









Project's poetry

In architecture, the integration of multidisciplinary approaches is paramount, as it ensures holistic and comprehensive design solutions that address various aspects of a project. Neglecting any discipline can result in suboptimal outcomes and missed opportunities for innovation. In our project development, we recognized the importance of multidisciplinary collaboration from the outset, prioritizing architectural, structural, material, and sustainability considerations in tandem.

"In my job you need to be different things at a time: a builder in the morning, a poet at lunchtime and a humanist in the afternoon. It is one of the oldest and most adventurous things you can do. I can't think of a better way to spend my time every day. " **1**
Renzo Piano

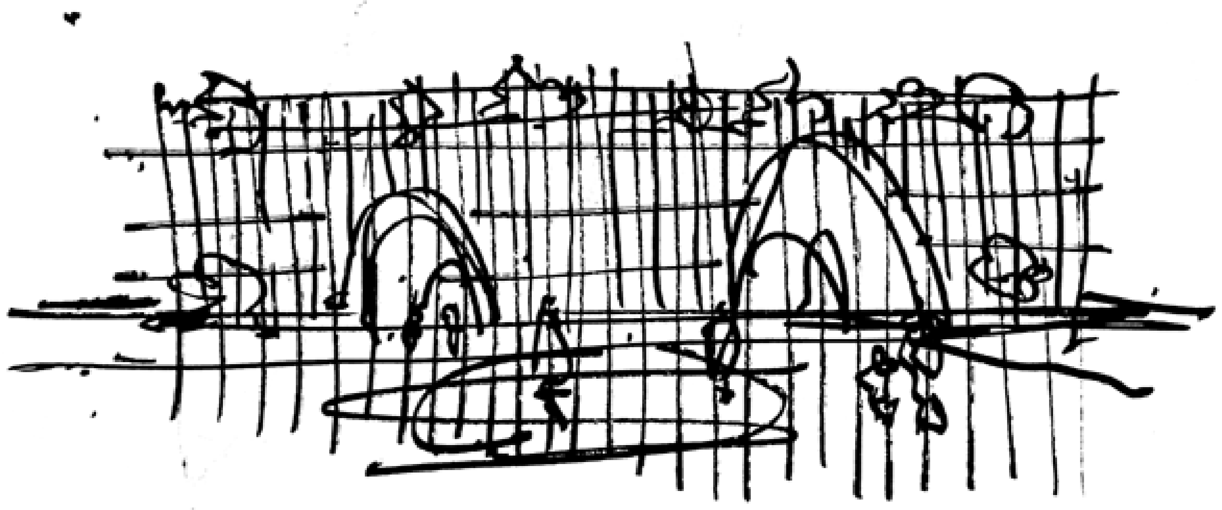
Each discipline was given a distinct concept to guide their contributions to the project. For the architectural concept, we envisioned the library as a «sharing house,» a communal space where people learn, gather, and interact from one another. This concept informed the internal circulation patterns, spatial layout, and programmatic elements of the design, connectivity, emphasizing inclusivity and engagement.

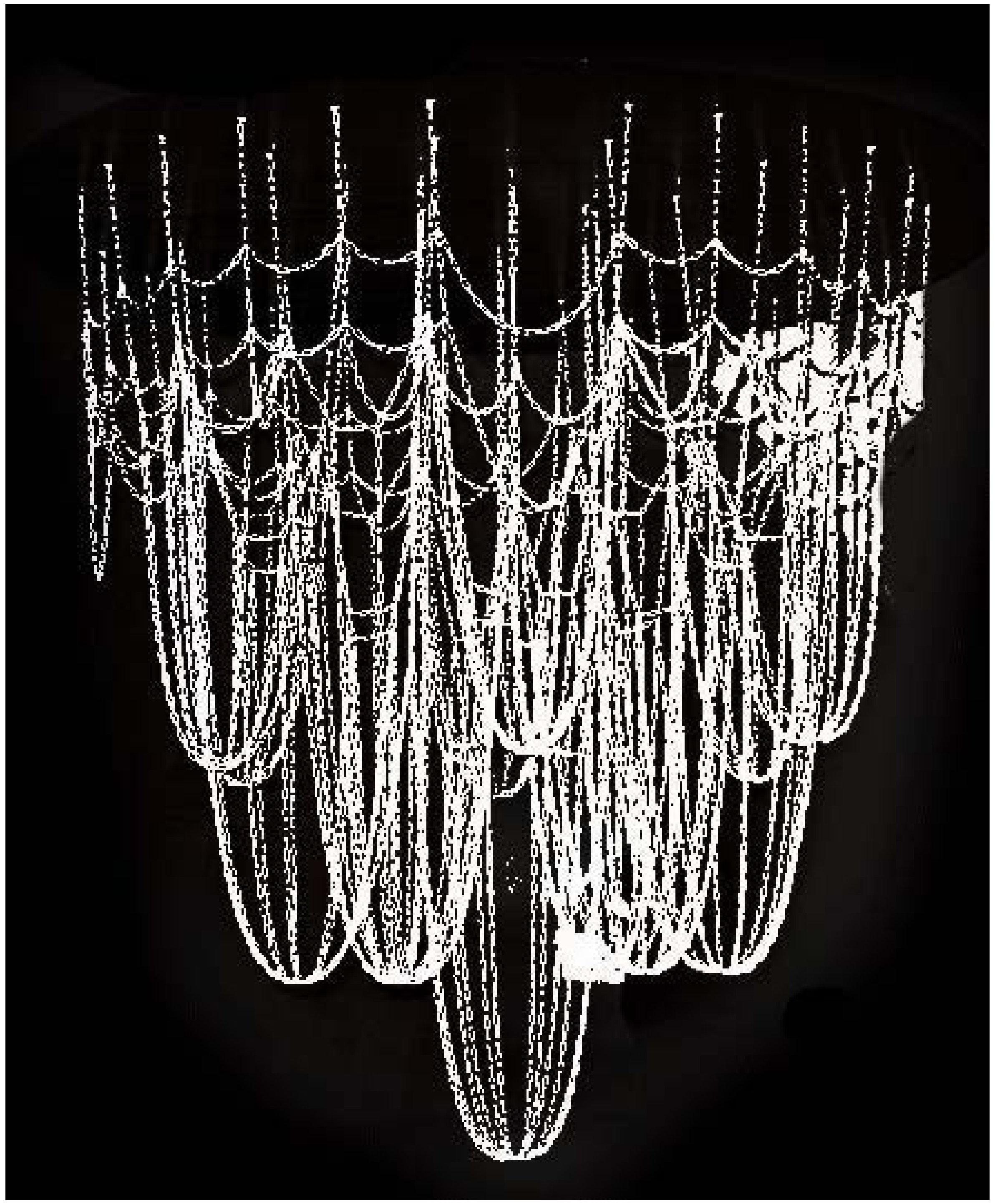
neuronal arborization picture

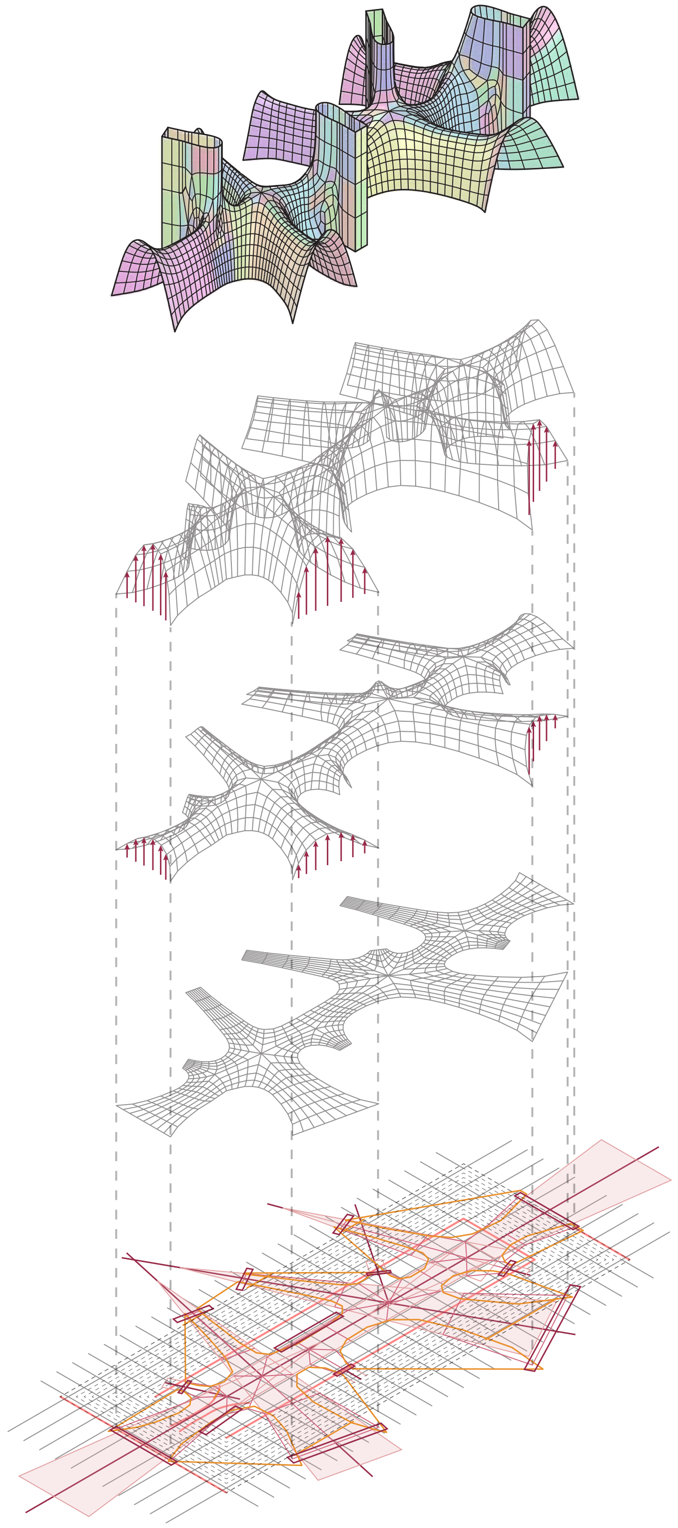
1 Conférence Renzo Piano, 2018, *The genius behind some of the world's most famous buildings* [en ligne], TED, Avril 2018 [consulté le 06/04/2021], URL: https://www.ted.com/talks/renzo_piano_the_genius_behind_some_of_the_world_s_most_famous_buildings.

For materials, we conceptualized the building as a cave system, drawing parallels between its protective qualities in a natural environment. We envisioned the library as a refuge from the outdoor elements, symbolized by a thick layer of fog, by employing materials that evoke a sense of solidity, security, and warmth but also translucency and brightness on the facades of the building. By integrating these multidisciplinary concepts throughout the design process, we were able to create a library that not only serves as a functional and aesthetically pleasing space but also embodies our values of innovation, community, and sustainability.

Finally, In terms of structure, we drew inspiration from both historical precedents and contemporary techniques, employing catenary arches reminiscent of those found in Antoni Gaudí's iconic Sagrada Família. These arches not only provided structural support but also added aesthetic intrigue and visual dynamism to the building's form.







ADJUST THE SHAPE

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

CATENARY CURVE SIMULATION

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

ROUNDED EDGES

The ronded edges are generated with Grasshopper's Plugin Kangaroo

2D BASE SHAPE

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

In the architectural realm, the poetic concept of envisioning a library project as a cave, a house of knowledge akin to prehistoric cave graffiti, offers a profound metaphorical exploration of the role of libraries as sanctuaries of learning and havens of solace. Much like the primal caves adorned with ancient paintings, libraries serve as repositories of wisdom, preserving the collective knowledge of humanity across time and space.
They evoke a sense of mystery and discovery, inviting exploration into the depths of human understanding. Furthermore, this metaphor extends to the idea of the library as a comforting shelter amidst the fog of bad weather outside. Just as a cave provides protection from the elements, libraries offer refuge from the storms of life, providing warmth, security, and illumination amidst the darkness.

Within their walls, individuals find solace in the company of books, embarking on journeys of imagination and enlightenment. Thus, the poetic vision of the library as a cave not only honors the ancient origins of human creativity but also celebrates the enduring power of knowledge to illuminate and uplift the human spirit.

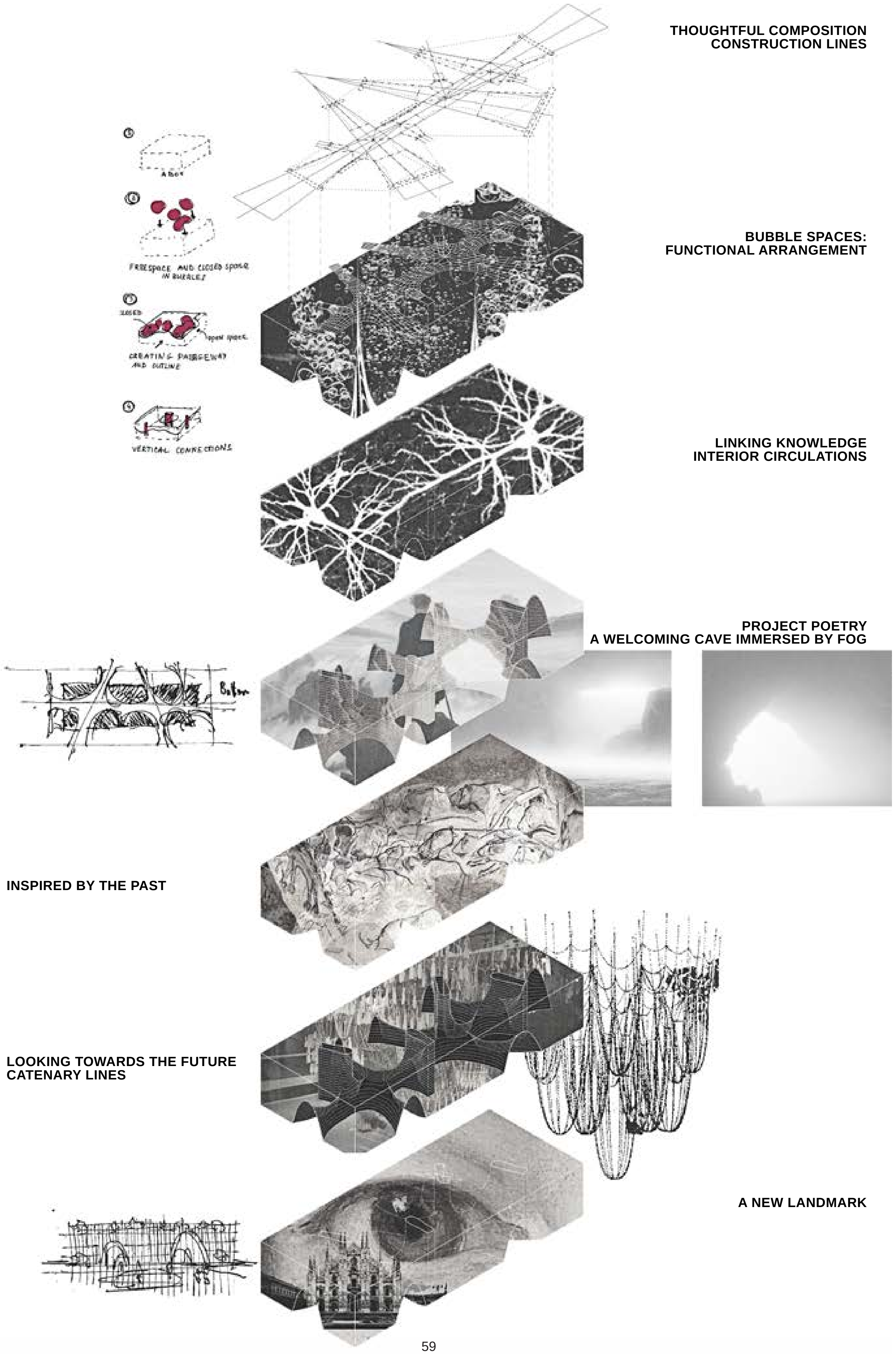
Formal evolution of the project

The project underwent many modifications from the beginning to the end. As the structure is strongly connected to architectural solutions, all aspects of the project had to be adapted within it.
I. With the first presentation of the idea we went with an approach where we wanted to see the bubble not only on plan but also in section. The approach required us to have extra structural elements considering 'the bubbles as non-structural elements'. In this way the regular structure has started to argue with the spheres and to interfere with the shapes where it was not really needed.

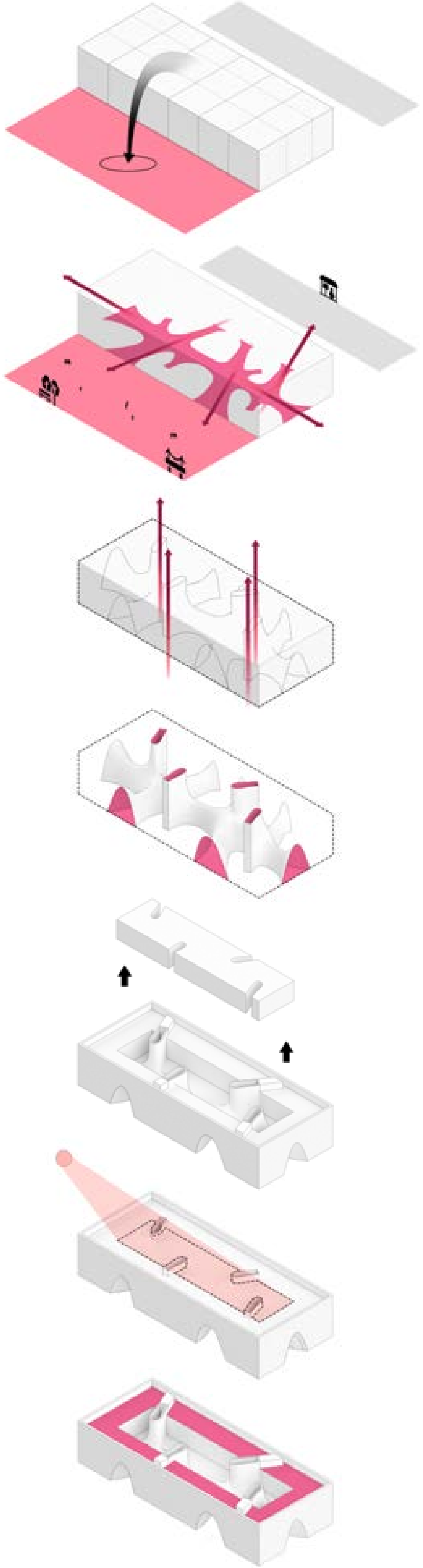
II. As a second attempt the project required us to reconsider understanding of a bubble and go from a physical meaning to meaning more theoretical. The bubble was translated through space organization and functions. Where the building was created out of 2 parts: a self supported shell and a regular building with a courtyard with load bearing structure.

III. The second approach was taken to the final thesis considering minor changes to comply with requirements of sustainability and reliable construction solutions.

The organic shape was unified to have repeating elements which allowed us to have precast elements and decrease the amount of concrete used. Creating better controlled organic shape made it easier to also calculate loads and find weak points of the shell.



ARCHITECTURAL PART



Idea of the Shell

Through the creation of a shell, we delineate the building into interior spaces dedicated to functions and exterior spaces representing distribution areas and vertical connections. This shell serves as a portal, bridging the gap between the external environment and the internal spaces. While seamlessly integrating with the regularity of the box-shaped building, it introduces large portals—arches—that invite individuals to traverse and experience the organic volume from within. This design concept extends throughout the entirety of the building, culminating in an immersive journey that extends to the rooftop, blurring the boundaries between inside and outside.

The steps of the formation:

1- The grid.

Understanding the unit measure, volume and proportion of the building in a horizontal plane.

2- Finding the main viewpoints and connection.

Create the route.considering the main passageways from West to East and from the main viewpoints/ transportation stations.

3- Create a vertical connection and form the shell.

Use the catenary curves to create a self supported element. Therefore creating vertical connections for external fire stairs and engineering pipes inside the shell.

4- Cut out from the box.

Create an outdoor passageway within the inner space of the shell and open skylights.

5- Create a courtyard.

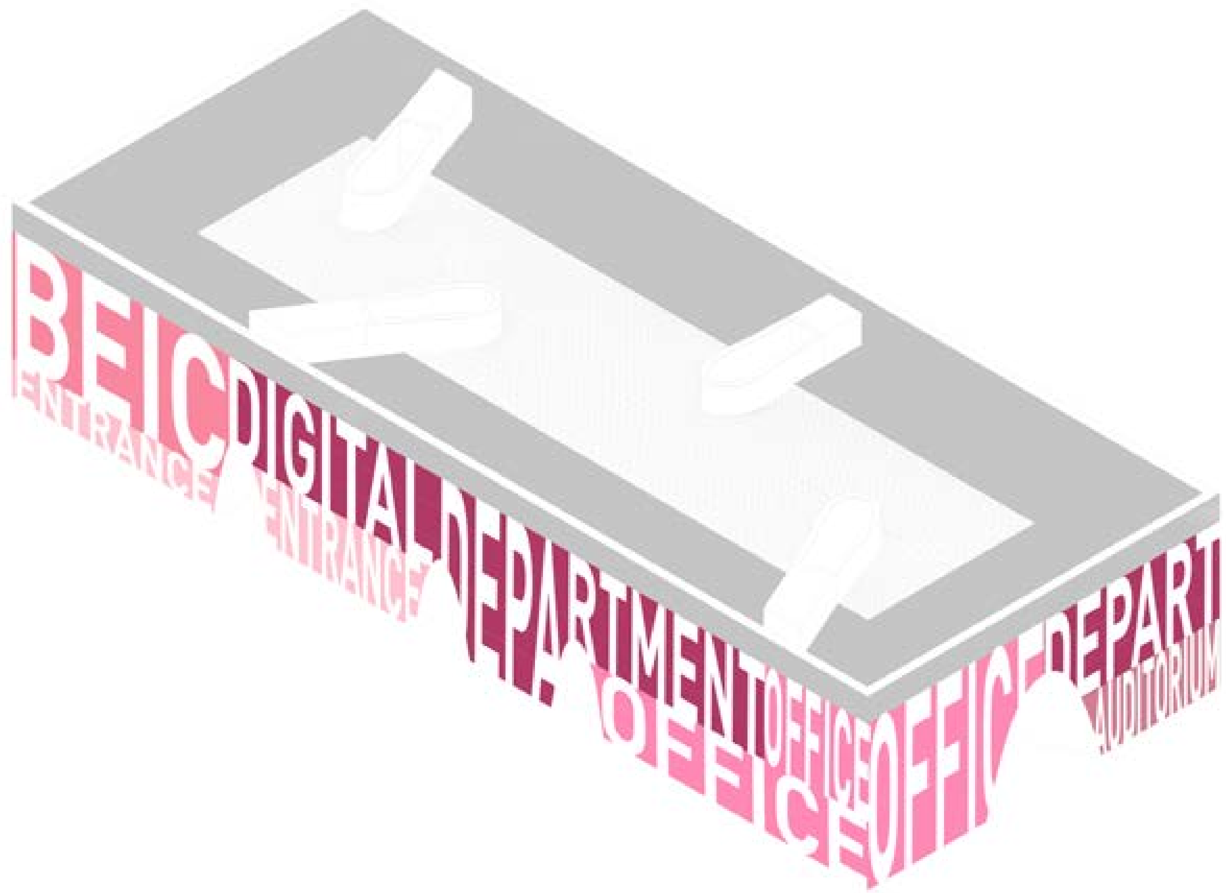
Cut out a rectangular volume to bring more light to the inside.

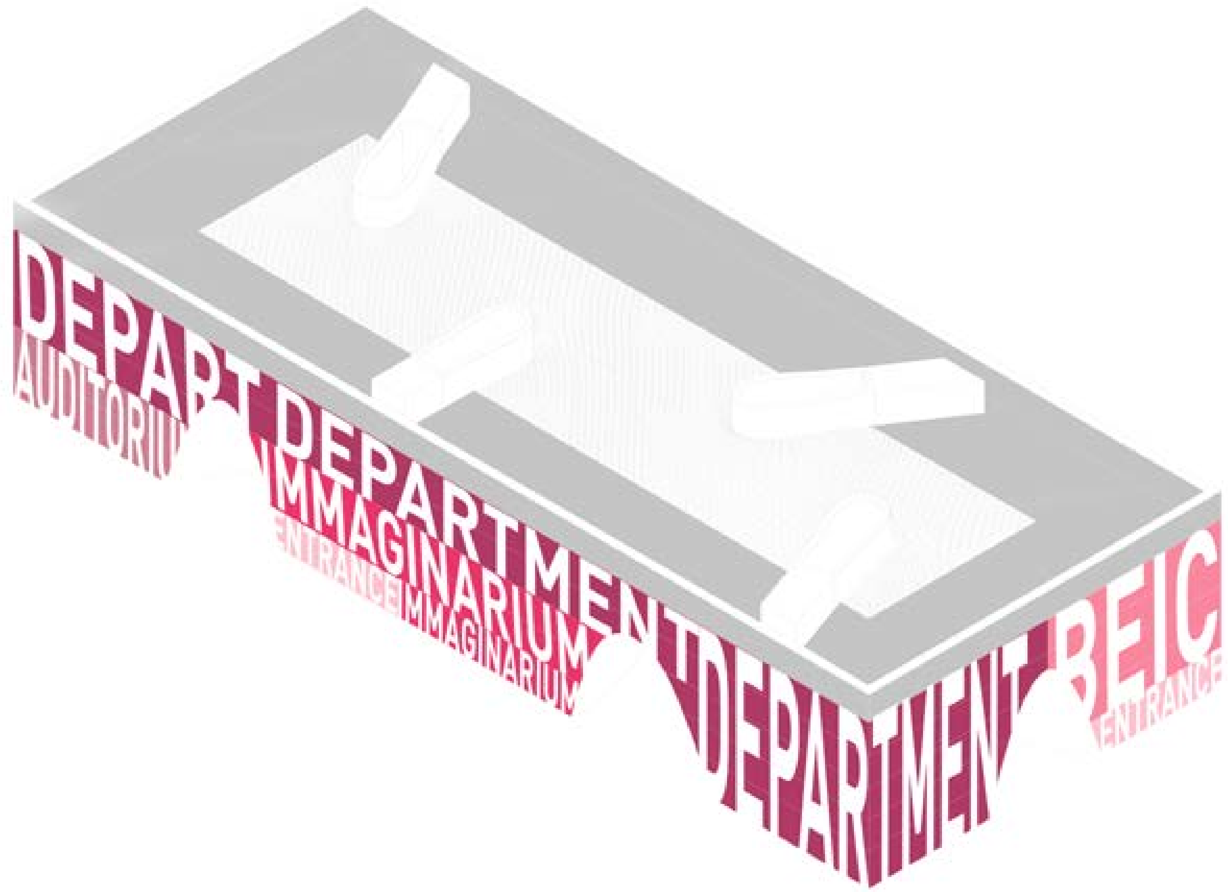
6- Create a skylight.

Bring more light to the space, while requirements of square meters are still considered. It allows the shell not only from outside, but also experiences it from inside, interacting with it.

7- Add green roof.

Green roof is a part of sustainable solutions applied to the building. It prevents buildings from being exposed to solar radiation and helps to keep heat during winter.





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.

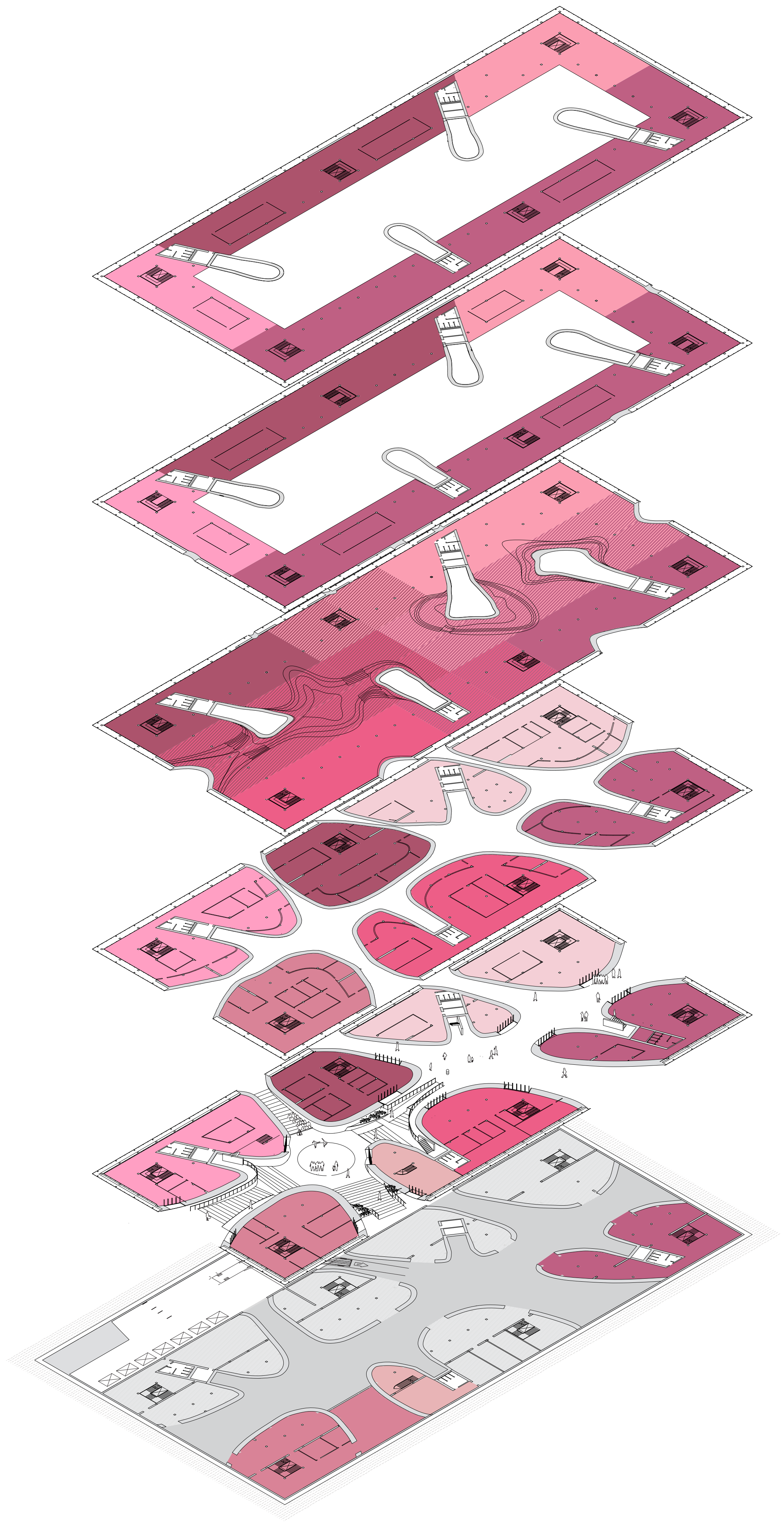
By strategically integrating these specific entrances into the building's design, we aimed to enhance functionality, accessibility, and user experience within the library. Despite the apparent complexity of the organic shape dividing the ground floor, our meticulous attention to programmatic requirements 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.

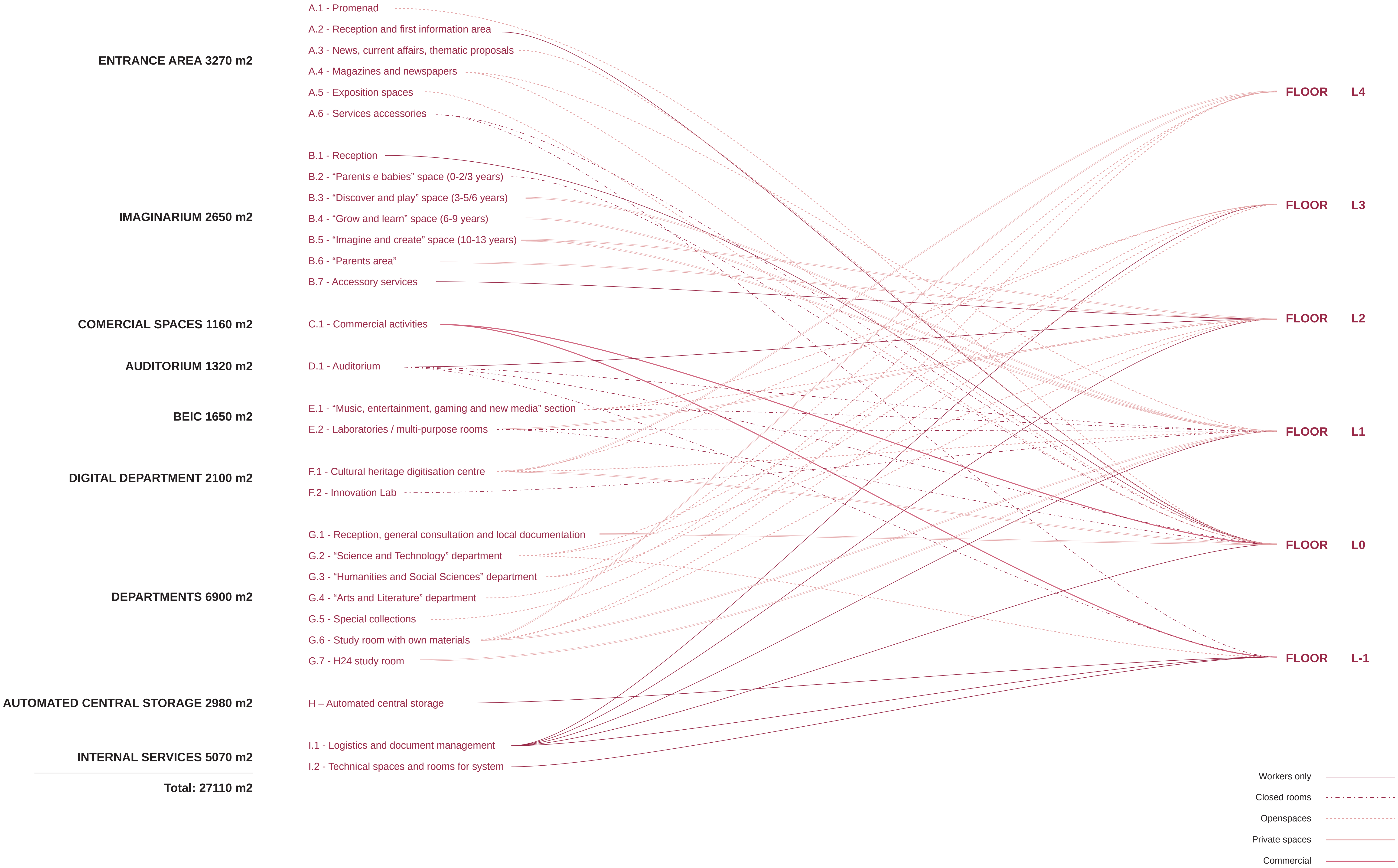
Continuing with the functional arrangement, we extended our design considerations vertically, ensuring coherence and efficiency across multiple levels of the library building. While the ground floor accommodates divided functions within the organic shape, we strategically consolidated these areas on 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

- Entrance area
- Immaginarium
- Commercial spaces
- Auditorium
- BEIC
- Digital Department
- Departments
- Automated Central Storage
- Internal services




ENTRANCE AREA 3270 m2
A.1 - Promenad
A.2 - Reception and first information area
A.3 - News, current affairs, thematic proposals
A.4 - Magazines and newspapers
A.5 - Exposition spaces
A.6 - Services accessories
IMAGINARIUM 2650 m2
B.1 - Reception
B.2 - “Parents e babies” space (0-2/3 years)
B.3 - “Discover and play” space (3-5/6 years)
B.4 - “Grow and learn” space (6-9 years)
B.5 - “Imagine and create” space (10-13 years)
B.6 - “Parents area”
B.7 - Accessory services
COMERCIAL SPACES 1160 m2
C.1 - Commercial activities
AUDITORIUM 1320 m2
D.1 - Auditorium
BEIC 1650 m2
E.1 - “Music, entertainment, gaming and new media” section
E.2 - Laboratories / multi-purpose rooms
DIGITAL DEPARTMENT 2100 m2
F.1 - Cultural heritage digitisation centre
F.2 - Innovation Lab
DEPARTMENTS 6900 m2
G.1 - Reception, general consultation and local documentation
G.2 - “Science and Technology” department
G.3 - “Humanities and Social Sciences” department
G.4 - “Arts and Literature” department
G.5 - Special collections
G.6 - Study room with own materials
G.7 - H24 study room
AUTOMATED CENTRAL STORAGE 2980 m2
H – Automated central storage
INTERNAL SERVICES 5070 m2
I.1 - Logistics and document management
I.2 - Technical spaces and rooms for system
Total: 27110 m2
FLOOR L4
FLOOR L3
FLOOR L2
FLOOR L1
FLOOR L0
FLOOR L-1
Workers only
Closed rooms
Openspaces
Private spaces
Commercial

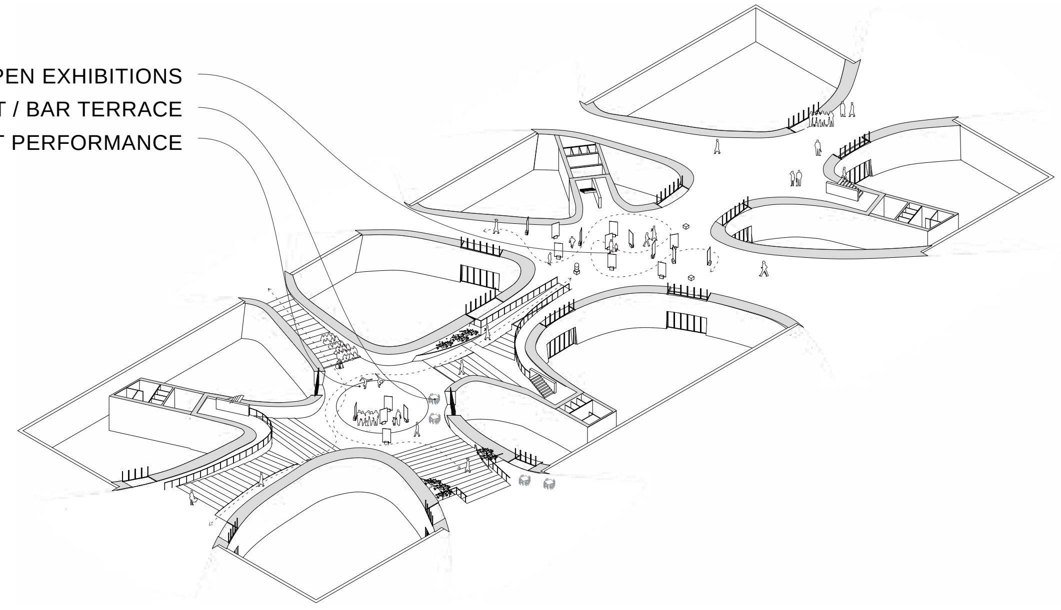
multifunctionality of the interior shell

The space inside the organic shape of the library serves as a versatile and dynamic hub that adapts to various functions and activities, offering an inviting and engaging environment for visitors.

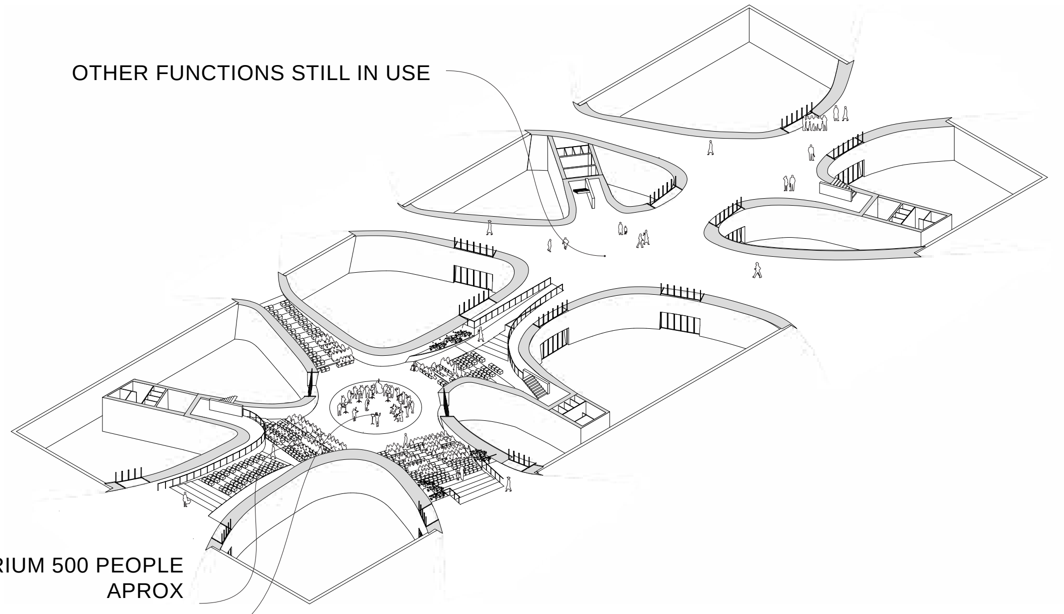
Designed as an outdoor covered space, it provides a myriad of uses, catering to the diverse needs and interests of the community. On a typical day, the space functions as a vibrant gathering place, hosting exhibitions that could even be related to the accademia di Brera, welcoming visitors, and showcasing street artist performances. Its open-air design fosters a sense of connectivity with the surrounding urban fabric, inviting the citizens to engage with the library and its offerings.

Moreover, the integration of an auditorium within the organic shape adds another layer of functionality, enabling the space to accommodate official events, conferences, and cultural gatherings. With seating capacity for approximately 500 people, the auditorium provides a venue for lectures, presentations, and performances, enhancing the library's role as a cultural and intellectual hub within the community. We have created a space that not only serves as a functional and aesthetic centerpiece of the library but also fosters a sense of belonging, creativity, and community engagement, enriching the lives of all who encounter it.

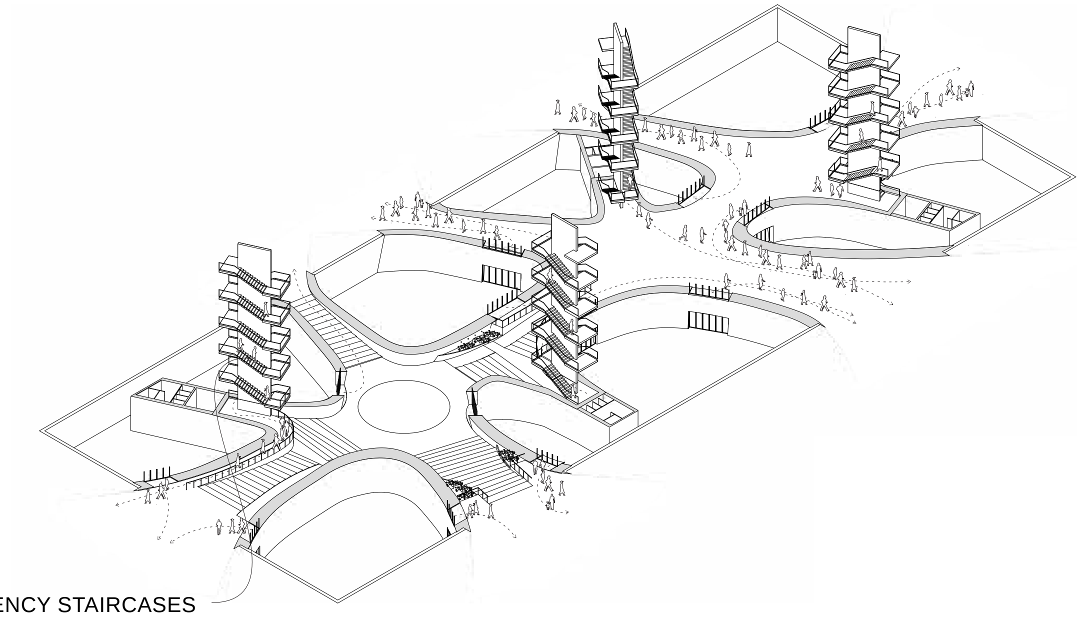
In addition to the multifunctionality of the space inside the organic shape, we meticulously addressed technical requirements, including the critical aspect of evacuation planning. Recognizing the importance of ensuring security and safety for occupants, particularly in the event of emergencies, we integrated innovative design solutions to meet these needs. Given that the interior of the organic shape is conceived as an outdoor space, we seized the opportunity to strategically conceal emergency staircases within the architectural form. By sculpting the shape to seamlessly incorporate these essential elements, we not only maintain the integrity of the design but also ensure efficient and secure evacuation routes in case of incidents. This thoughtful integration of technical considerations into the overall design underscores our commitment to prioritizing user safety and well-being while upholding the functional integrity and aesthetic of the library building.



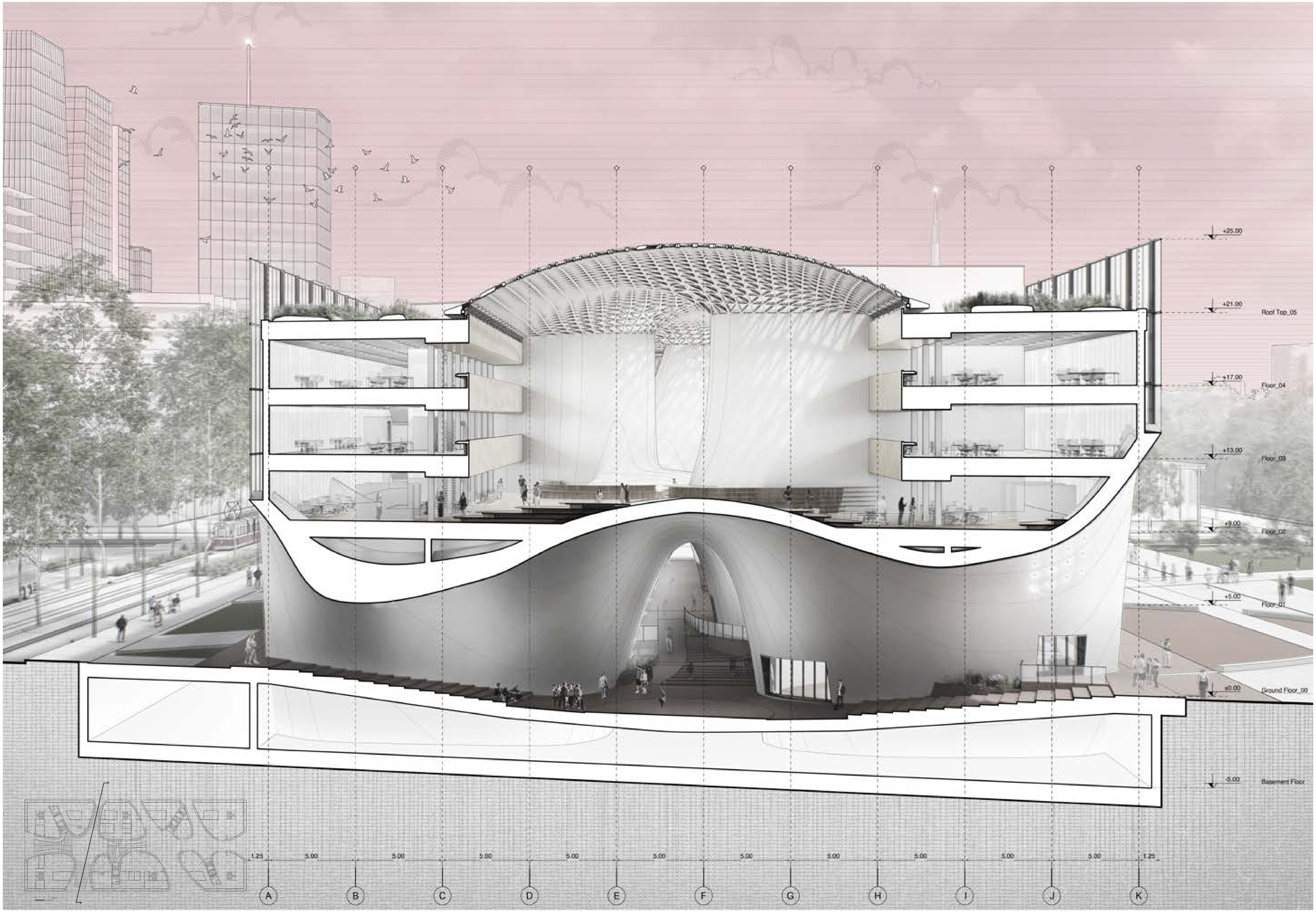
NORMAL DAILY USE



OFFICIAL CONCERT



EVACUATION PLAN



+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
1.25
5.00
5.00
5.00
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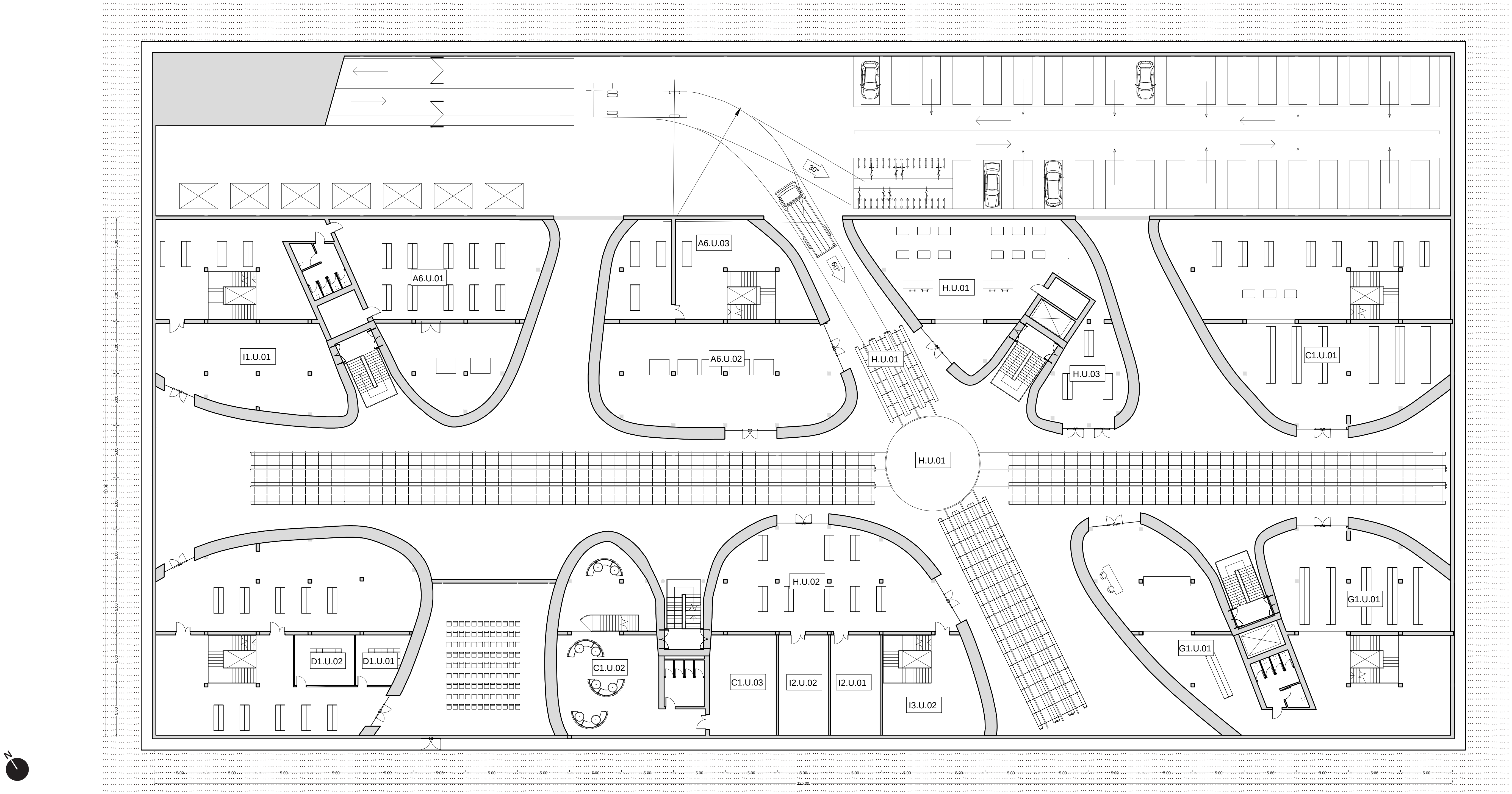


BASEMENT PLAN **SCALE 1/400**

0 5 10 m

ENTRANCE AREA

A.6 - Servizi accessor

A6.U.01 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.)	280 m²
A6.U.02 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.)	350 m²
A6.U.03 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.)	40 m²
A6.U.04 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.)	160 m²
A6.U.05 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.)	210 m²

COMERCIAL SPACES

C.1 - Commercial activities

C1.U.01 bookshop	460 m²
C1.U.02 cafetteria/bistrot	110 m²
C1.U.03 kitchen for cafetteria/bistrot	60 m²

AUDITORIUM

D.1 - Auditorium

D1.U.01 dressing rooms	20 m²
D1.U.02 dressing rooms	30 m²
D1.U.03 lecture room	220 m²

DEPARTMENTS

G.2 - "Science and Technology" department

G2.U.01 unified floor storage	480 m²

AUTOMATED CENTRAL STORAGE

H – AUTOMATED CENTRAL STORAG

H.U.01 automated central storage	2720 m²
H.U.02 spaces for systems and machinery	190 m²
H.U.03 spaces for systems and machinery	70 m²

INTERNAL SERVICES

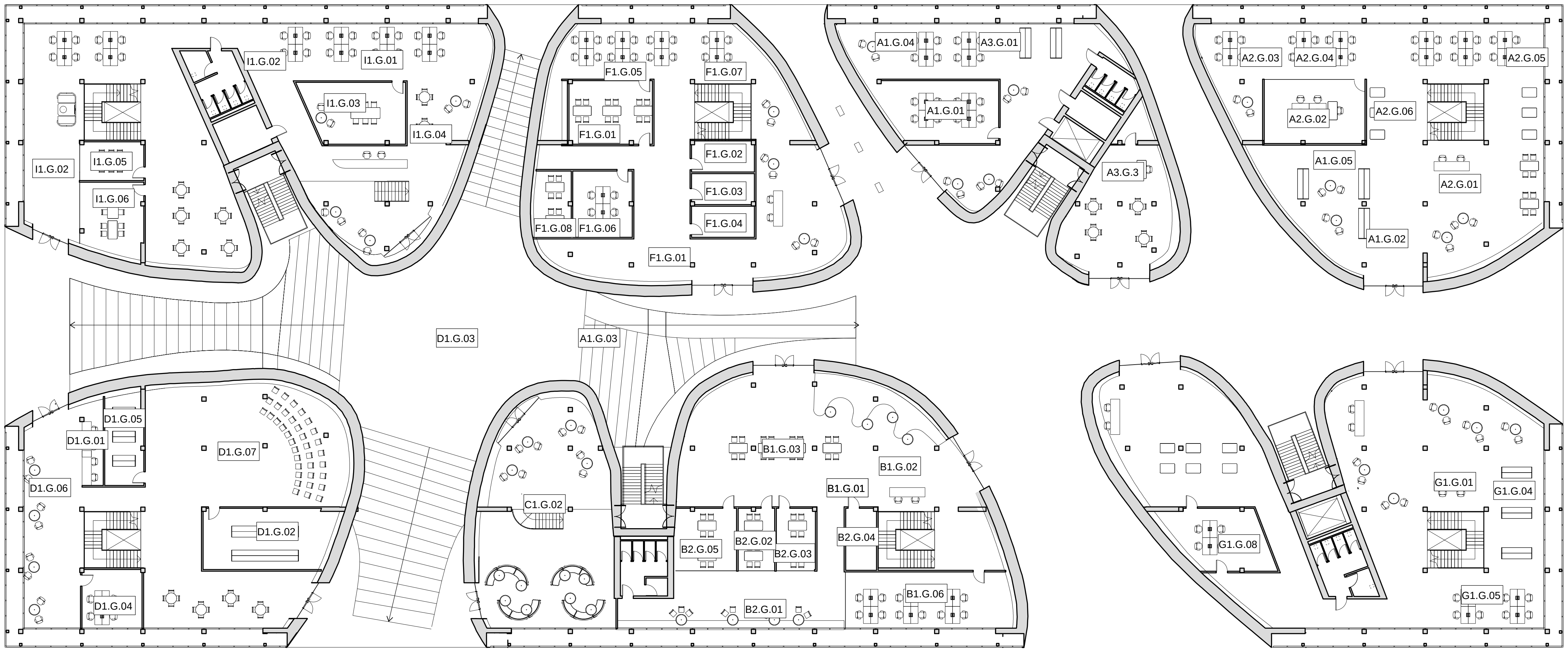
I.2 - Technical spaces and rooms for system

I2.U.01 spaces for systems and machinery	50 m²
I2.U.02 spaces for systems and machinery	50 m²

I.1 - Logistics and document management

I1.U.01 storage and support rooms	280 m²

Total 5780 m²



GROUND FLOOR PLAN SCALE 1/400

0 5 10 m

ENTRANCE AREA

A.1 - Promenad

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

A.2 Reception and first information area

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

A.3 - News, current affairs, thematic proposals

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

IMAGINARIUM

B.1 - Reception

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

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

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

COMERCIAL SPACES

C.1 - Commercial activities

C1.G.01 pop-up stores 360 m^2
C1.G.02 cafetteria/bistrot 170 m^2

AUDITORIUM

D.1 - Auditorium

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

DIGITAL DEPARTMENT

F.1 - Cultural heritage digitisation centre

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

DEPARTMENTS

G.1 - Reception, general consultation and local documentation

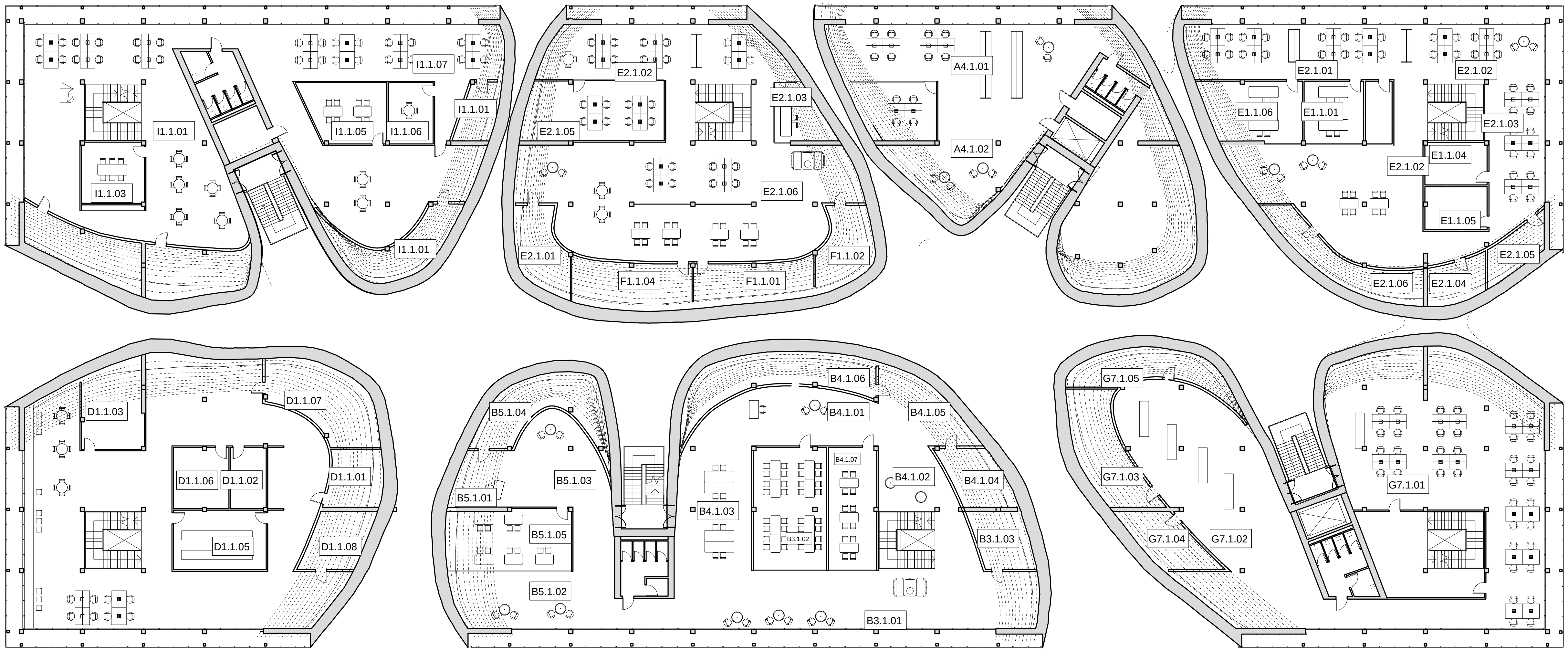
G1.G.01G.1 - Reception, general consultation and local documentation 30 m^2
G1.G.04 general consultation and local 60 m^2
G1.G.05 quick OPAC/Internet 50 m^2
G1.G.08 ack-office workspaces 30 m^2

INTERNAL SERVICES

I.1 - Logistics and document management

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

Total 5630 m^2



N

FIRST FLOOR PLAN

SCALE 1/400

0 5 10 m

ENTRANCE AREA

A.4 - Magazines and newspapers

A4.1.01 exposition of magazines 100 m^2
A4.1.02 unsystematic consultation 80 m^2

IMAGINARIUM

B.3 - "Discover and play" space (3-5/6 years)

B3.1.01 exposition of volumes (in shaped containers
and on low-lying shelves) 140 m^2
B3.1.02 play, reading and animation spaces 60 m^2
B3.1.03 consultation spaces for adults and children 20 m^2

B.4 - "Grow and learn" space (6-9 years)

B4.1.01 exposition of volumes (in shaped containers
and on low-lying shelves) 90 m^2
B4.1.02 exhibition of volumes and thematic areas 70 m^2
B4.1.03 spaces for reading, unsystematic
consultation, play and relax activities 60 m^2
B4.1.04 storage 20 m^2
B4.1.05 storage 10 m^2
B4.1.06 individual service workstations
for room staff 10 m^2
B4.1.07 coding laboratory 40 m^2

B.5 - "Imagine and create" space (10-13 years)

B5.1.01 individual service workstations for room staff 10 m^2
B5.1.02 exposition of volumes (in shaped containers
and on low-lying shelves) 60 m^2
B5.1.03 spaces for reading, unsystematic consultation,
play and relax activities 70 m^2
B5.1.04 storage 40 m^2
B5.1.05 educational robotics laboratory 50 m^2

AUDITORIUM

D.1 - Auditorium

D1.1.01 dressing rooms 20 m^2
D1.1.02 dressing rooms 10 m^2
D1.1.03 lecture room 30 m^2
D1.1.04 cloakroom lockers for bags, 370 m^2
D1.1.05 cloakroom lockers for bags, 40 m^2
D1.1.06 cloakroom lockers for bags, 20 m^2
D1.1.07 cloakroom lockers for bags, 40 m^2
D1.1.08 cloakroom lockers for bags, 20 m^2

BEIC

E.2 - Laboratories / multi-purpose rooms

E2.1.01 laboratories / makerspace / fablab 80 m^2
E2.1.02 laboratories / makerspace / fablab 220 m^2
E2.1.03 laboratories / makerspace / fablab 50 m^2
E2.1.04 storage rooms 20 m^2
E2.1.05 storage rooms 10 m^2
E2.1.06 storage rooms 20 m^2

E.1 - "Music, entertainment, gaming and new media" section

E1.1.01 audiovisual storage 30 m^2
E1.1.04 video room 20 m^2
E1.1.05 video room 20 m^2
E1.1.06 recording room 30 m^2

DIGITAL DEPARTMENT

F.1 - Cultural heritage digitisation centre

F1.1.01 long-term archiving; mediumterm archiving;
monitoring of all management functionalities
(access, monitors, librarianship modules,
security, setting, etc.) 30 m^2
F1.1.02 storage 30 m^2
F1.1.03 quality control (colour, foliation, naming,
technical and structural metadata) and validation
activities, metadata control and format conversion 110 m^2
F1.1.04 llong-term archiving; mediumterm archiving;
monitoring of all management functionalities
(access, monitors, librarianship modules,
security, setting, etc.) 30 m^2

F.2 - Innovation Lab

F2.1.01 storage 30 m^2
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^2
F2.1.03 Robo Lab 20 m^2
F2.1.04 storage 10 m^2
F2.1.05 VR Lab 50 m^2
F2.1.06 AI & Machine Learning Lab 40 m^2

DEPARTMENTS

G.7 - H24 study room

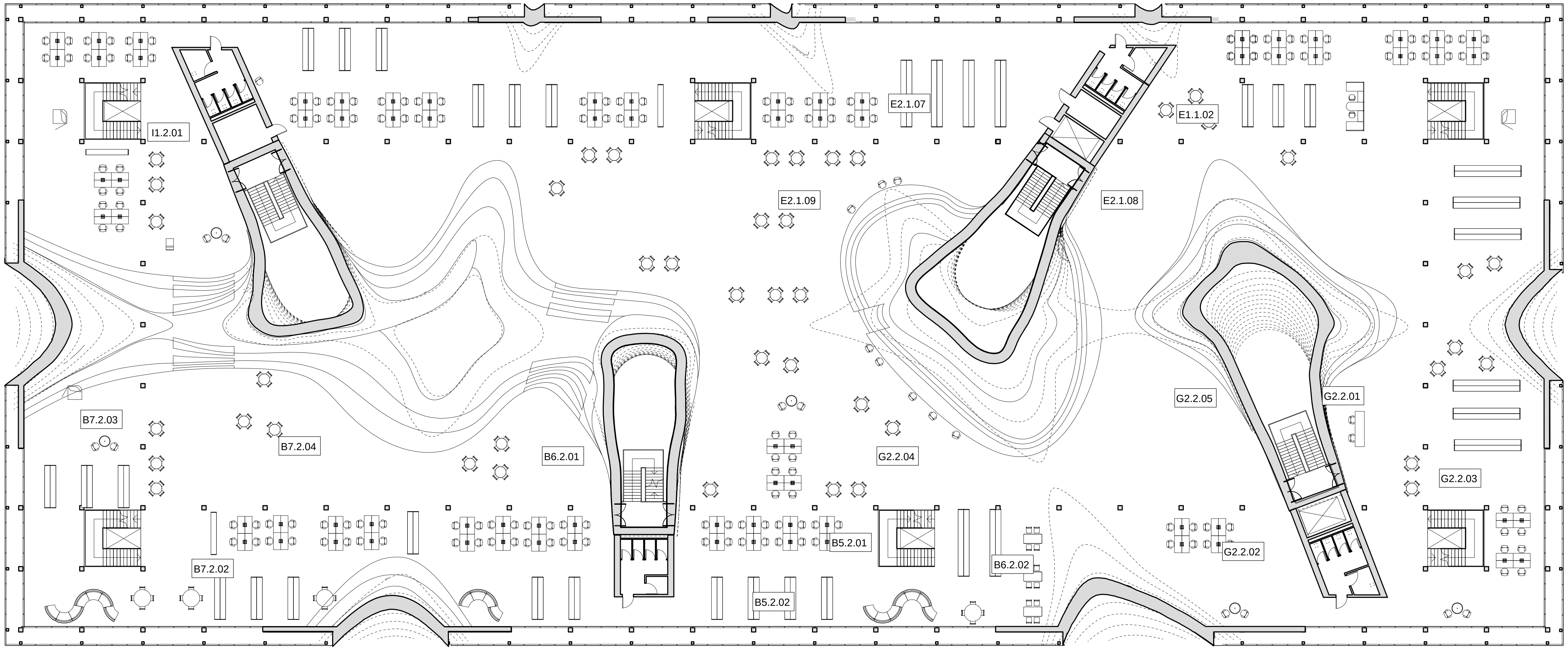
G7.1.01 study room 250 m^2
G7.1.02 relax room 240 m^2
G7.1.03 reading and consultation 30 m^2
G7.1.04 storage 20 m^2
G7.1.05 audiovisual storage 20 m^2

INTERNAL SERVICES

I.1 - Logistics and document management

I1.1.01 document management 510 m^2
I1.1.02 document management 30 m^2
I1.1.03 document management 30 m^2
I1.1.05 document management 30 m^2
I1.1.06 document management 20 m^2
I1.1.07 document management 510 m^2

Total 4010 m^2



SECOND FLOOR PLAN **SCALE 1/400**

0 5 10 m

ENTRANCE AREA

A.6 - Services accesses

A6.U.01 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.) 280 m²

A6.U.02 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.) 350 m²

A6.U.03 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.) 40 m²

A6.U.04 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.) 160 m²

A6.U.05 service rooms (for storage of cleaning trolleys, equipment for exhibition area, etc.) 210 m²

COMERCIAL SPACES

C.1 - Commercial activities

C1.U.01 bookshop 460 m²

C1.U.02 cafetteria/bistrot 110 m²

C1.U.03 kitchen for cafetteria/bistrot 60 m²

AUDITORIUM

D.1 - Auditorium

D1.U.01 dressing rooms 20 m²

D1.U.02 dressing rooms 30 m²

D1.U.03 lecture room 220 m²

DEPARTMENTS

G.2 - "Science and Technology" department

G2.U.01 unified floor storage 480 m²

AUTOMATED CENTRAL STORAGE

H – AUTOMATED CENTRAL STORAGE

H.U.01 automated central storage 2720 m²

H.U.02 spaces for systems and machinery 190 m²

H.U.03 spaces for systems and machinery 70 m²

INTERNAL SERVICES

I.2 - Technical spaces and rooms for system

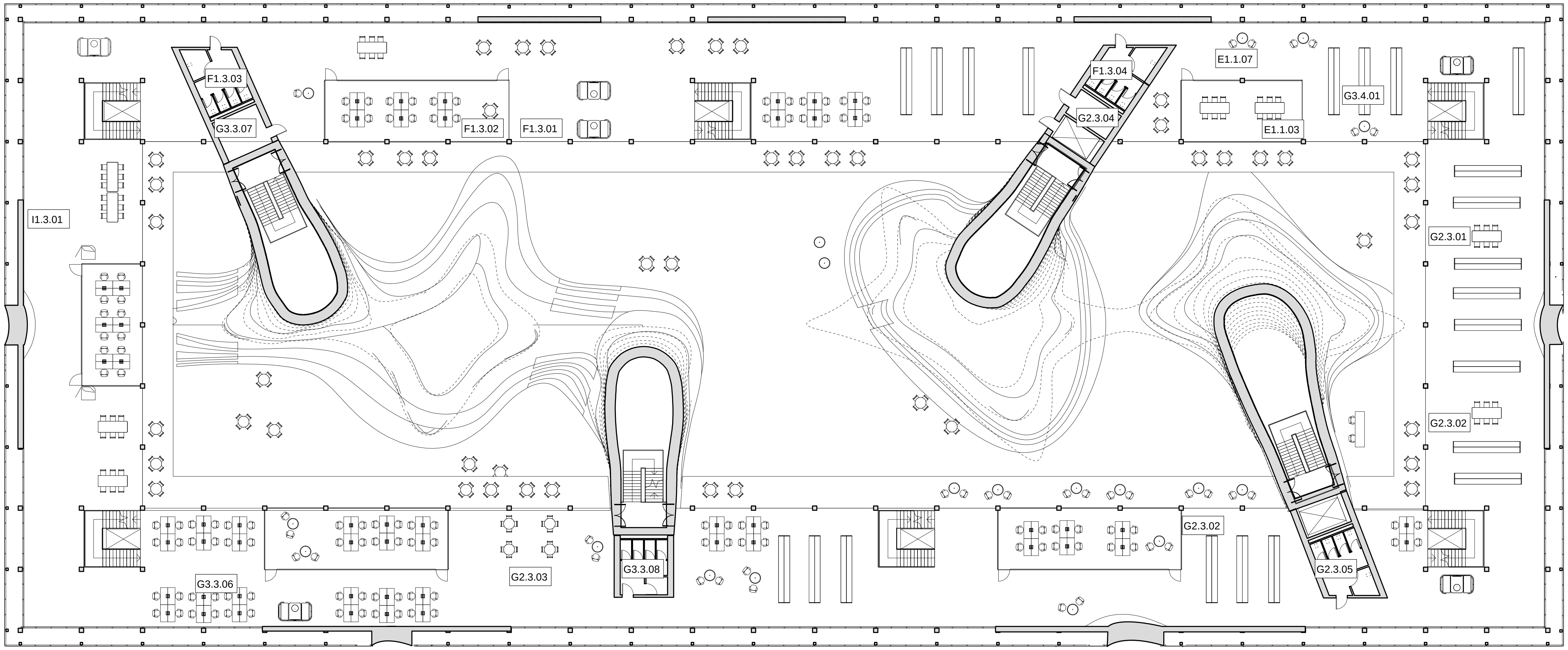
I2.U.01 spaces for systems and machinery 50 m²

I2.U.02 spaces for systems and machinery 50 m²

I.1 - Logistics and document management

I1.U.01 storage and support rooms 280 m²

Total 5780 m²



THIRD FLOOR PLAN

SCALE 1/400

0 5 10 m

BEIC

E.1 - "Music, entertainment, gaming and new media" section

E1.1.03 Hi-End listening room 50 m²

E1.1.07 unsystematic consultation 50 m²

DIGITAL DEPARTMENT

F.1 - Cultural heritage digitisation centre

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 m²

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 m²

F1.3.03 toilets and service rooms (indicative quantification) 20 m²

F1.3.04 toilets and service rooms (indicative quantification) 20 m²

DEPARTMENTS

G.2 - "Science and Technology" department

G2.3.01 Thematic area A 350 m²

G2.3.02 Thematic area B 590 m²

G2.3.03 Thematic area C interdisciplinary documentationù 520 m²

G2.3.04 server 10 m²

G2.3.05 toilets and service rooms (indicative quantification) 20 m²

G.3 - "Humanities and Social Sciences"

G3.3.06 Thematic area B interdisciplinary documentation 170 m²

G3.3.07 server 10 m²

G3.3.08 toilets and service rooms (indicative quantification) 20 m²

G3.4.05 rooms for groups 40 m²

G3.4.01 Thematic area A 90 m²

G.6 - Study room with own materials

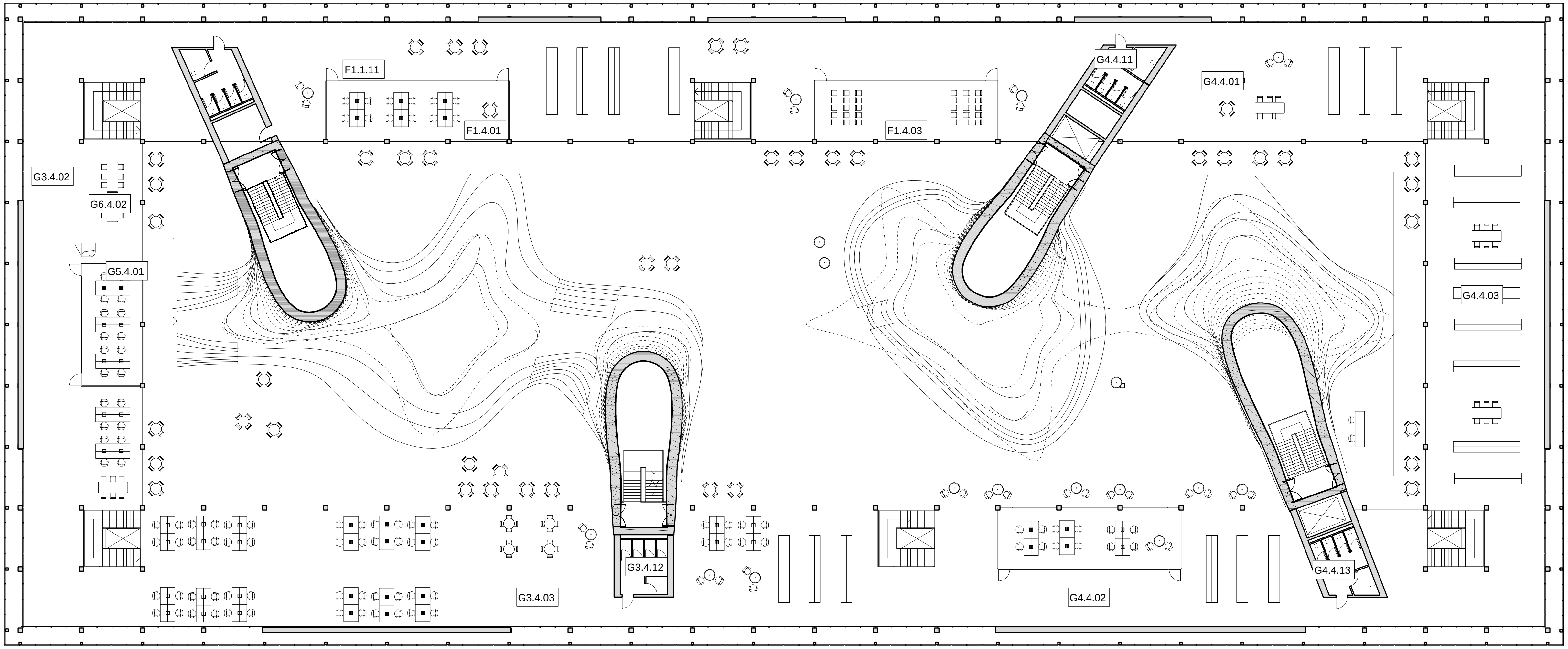
G6.4.04 rooms for groups 80 m²

INTERNAL SERVICES

I.1 - Logistics and document management

I1.3.01 document management 90 m²

Total 3100 m²



FOURTH FLOOR PLAN SCALE 1/400

0 5 10 m

BEIC

E.1 - "Music, entertainment, gaming and new media" section

E1.1.03 Hi-End listening room	50 m²
E1.1.07 unsystematic consultation	50 m²

DIGITAL DEPARTMENT

F.1 - Cultural heritage digitisation centre

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 m²
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 m²
F1.3.03 toilets and service rooms (indicative quantification)	20 m²
F1.3.04 toilets and service rooms (indicative quantification)	20 m²

DEPARTMENTS

G.2 - "Science and Technology" department

G2.3.01 Thematic area A	350 m²
G2.3.02 Thematic area B	590 m²
G2.3.03 Thematic area C interdisciplinary documentationù	520 m²
G2.3.04 server	10 m²
G2.3.05 toilets and service rooms (indicative quantification)	20 m²

G.3 - "Humanities and Social Sciences"

G3.3.06 Thematic area B interdisciplinary documentation	170 m²
G3.3.07 server	10 m²
G3.3.08 toilets and service rooms (indicative quantification)	20 m²
G3.4.05 rooms for groups	40 m²
G3.4.01 Thematic area A	90 m²

G.6 - Study room with own materials

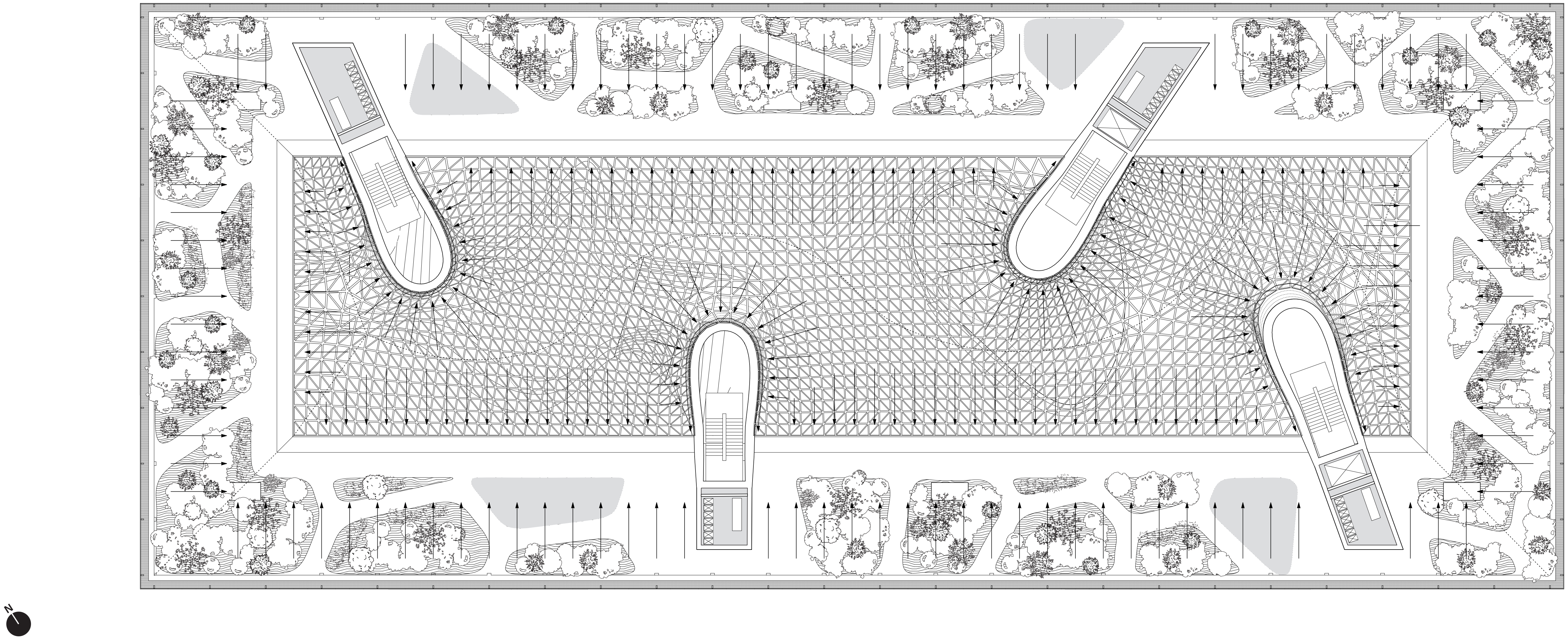
G6.4.04 rooms for groups	80 m²

INTERNAL SERVICES

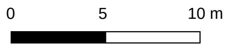
I.1 - Logistics and document management

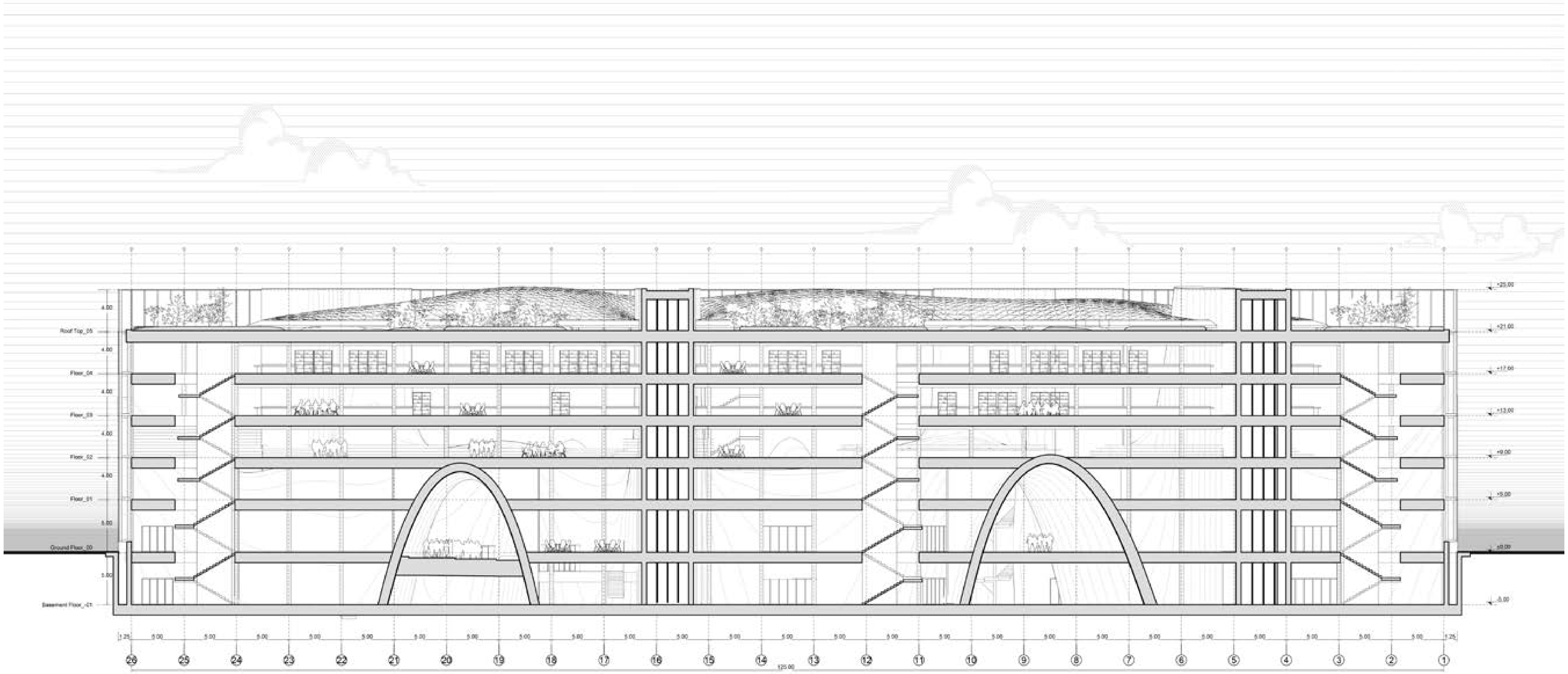
I1.3.01 document management	90 m²

Total 3100 m²



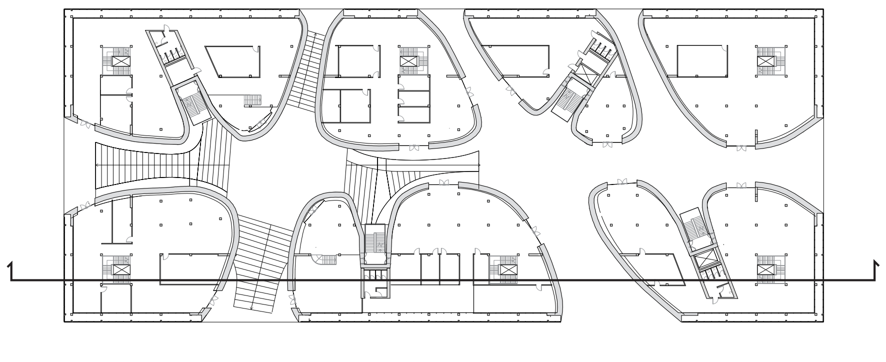
ROOF FLOOR PLAN **SCALE 1/400**

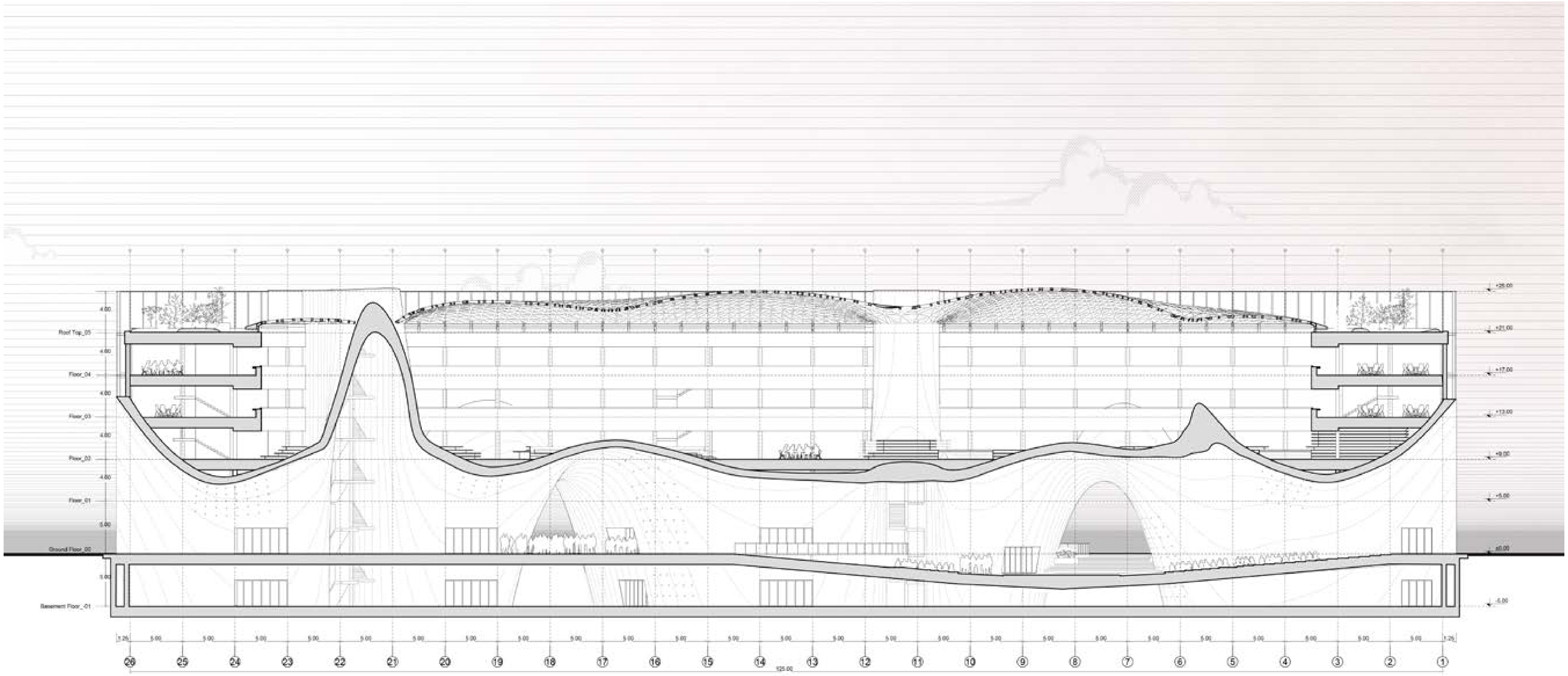




SECTION A **SCALE 1/400**

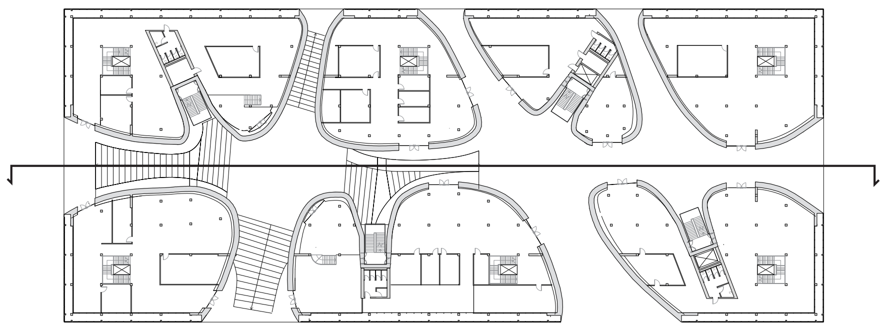
0 5 10 m

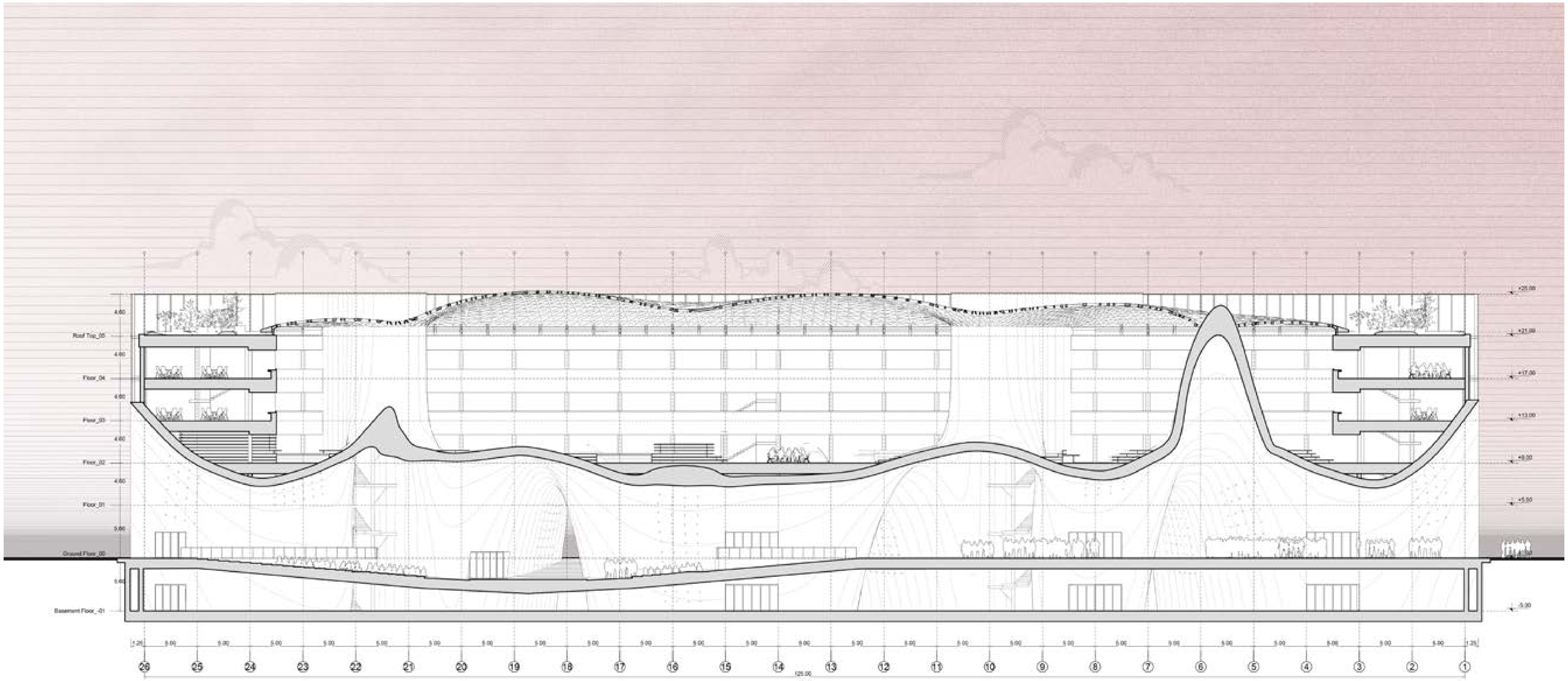




SECTION B **SCALE 1/400**

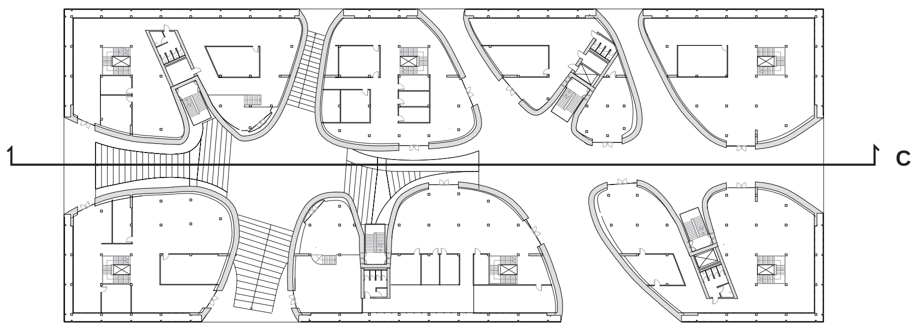
0 5 10 m

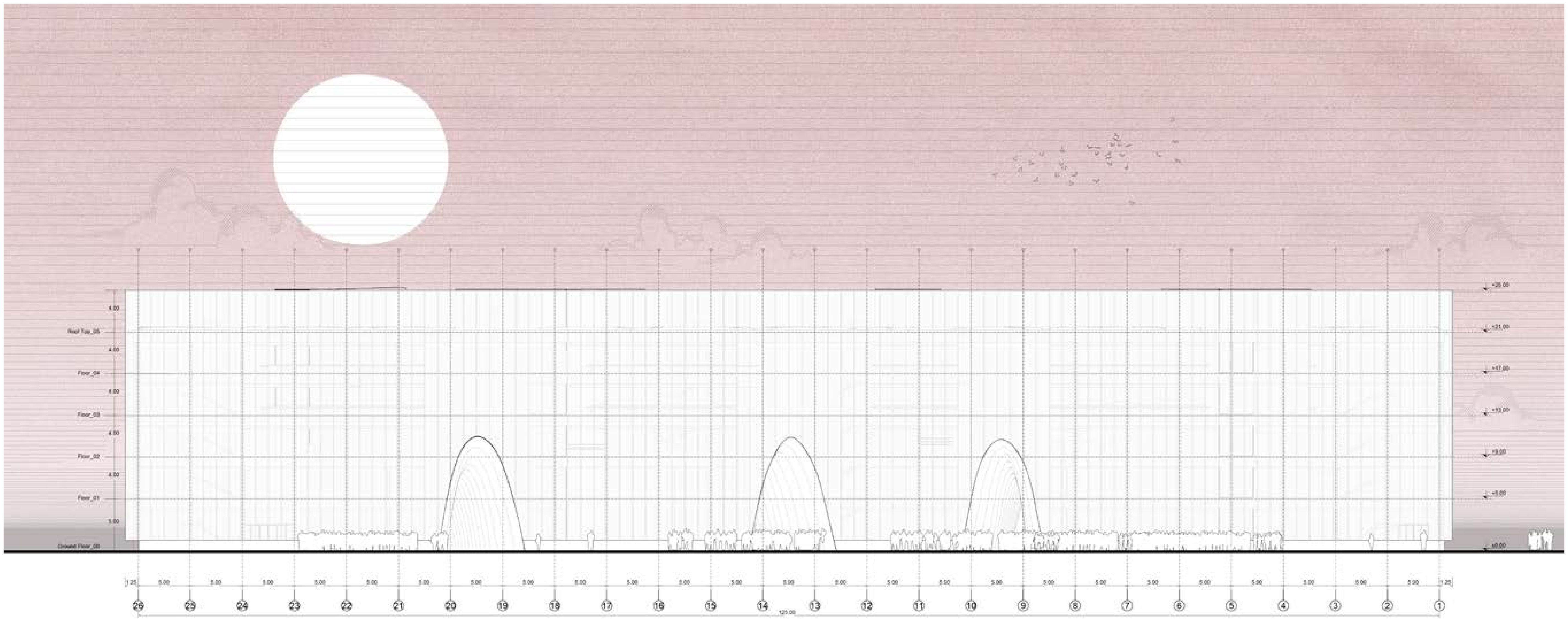




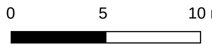
SECTION C **SCALE 1/400**

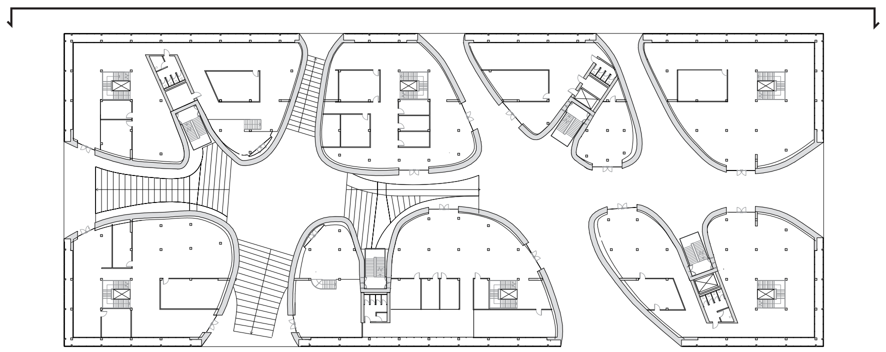
0 5 10 m



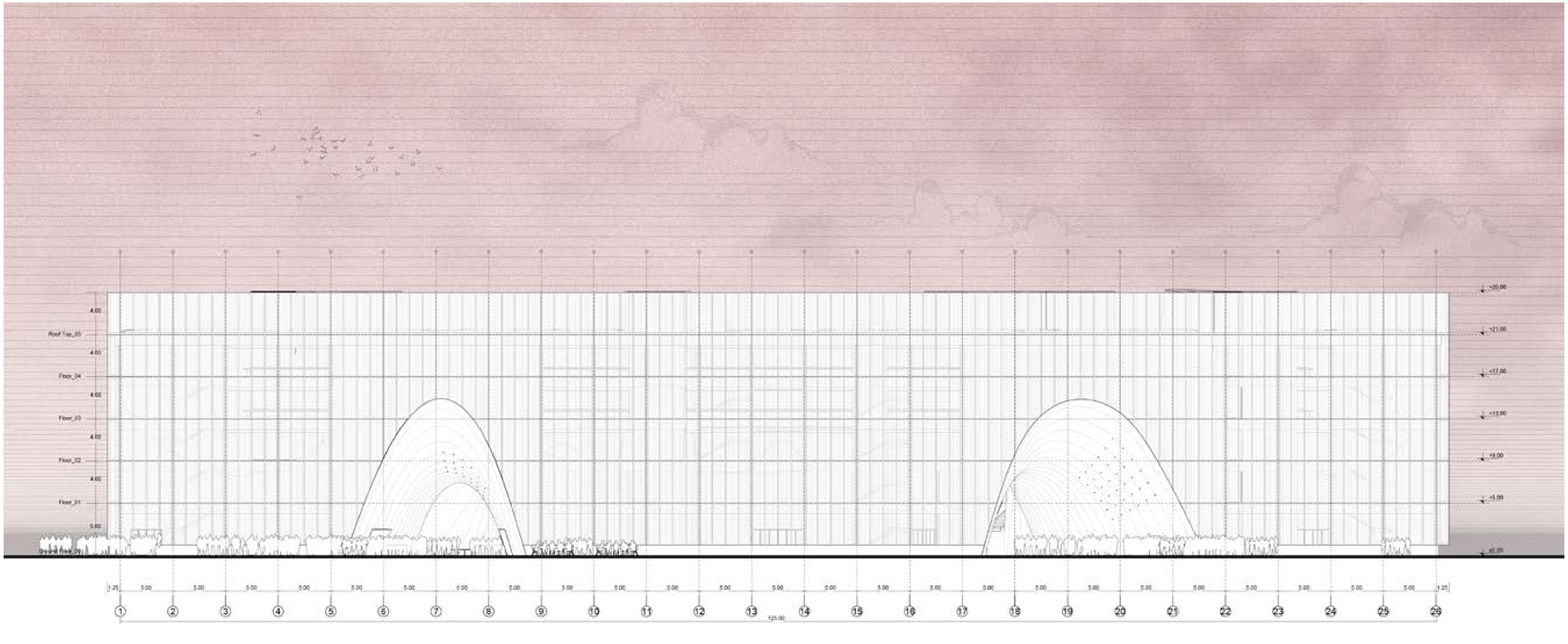


NORTH-EAST FACADE **SCALE 1/400**

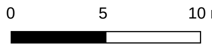


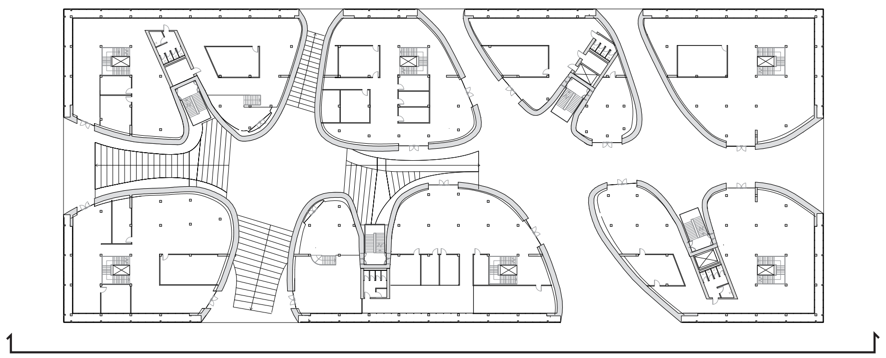


NORTH-EAST FACADE



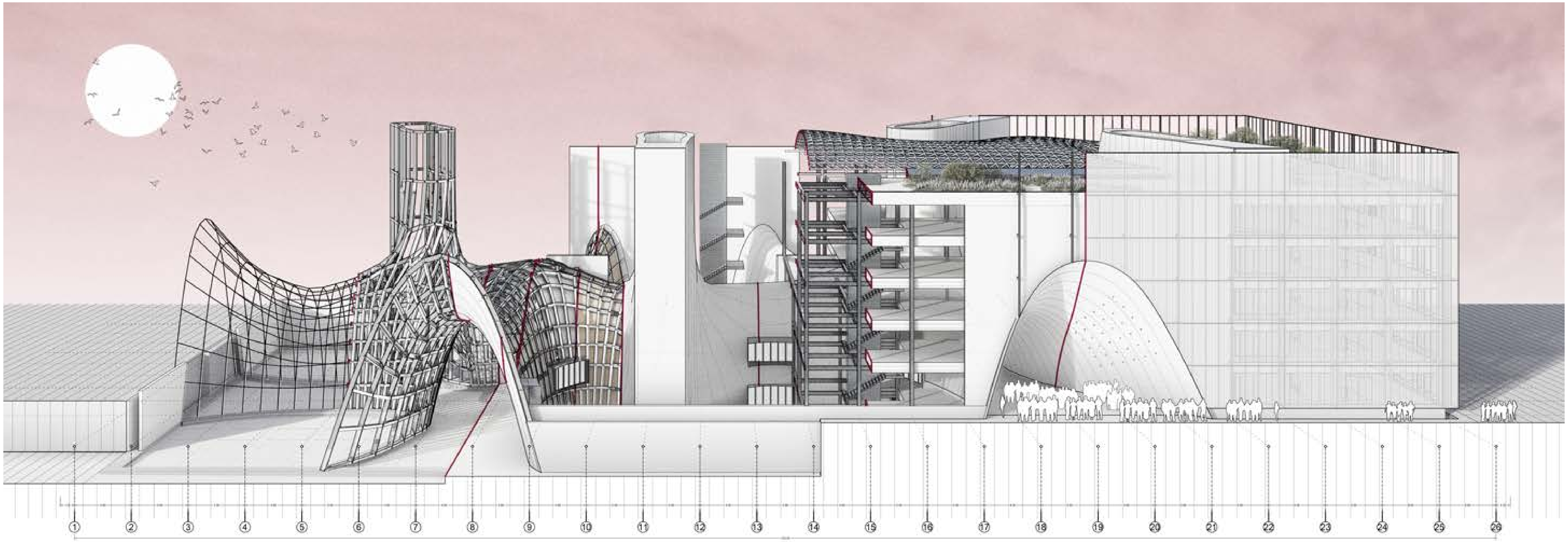
SOUTH-WEST FACADE **SCALE 1/400**





SOUTH-WEST FACADE

STRUCTURAL PART



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

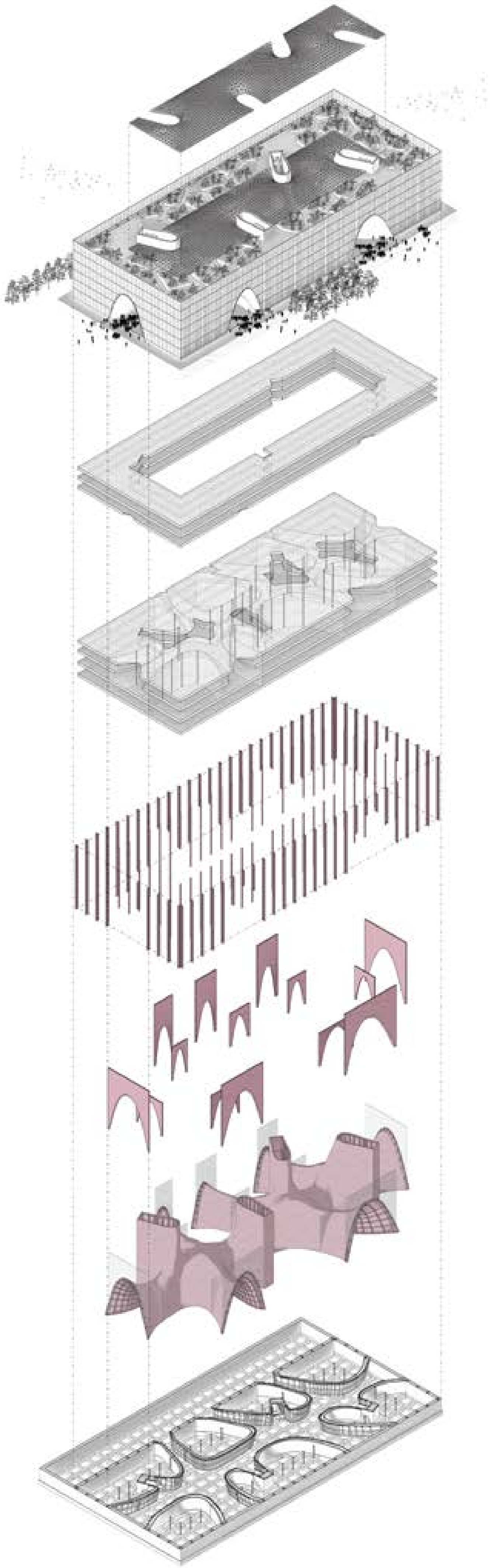
ARCHED WALL

FACADE STRUCTURE

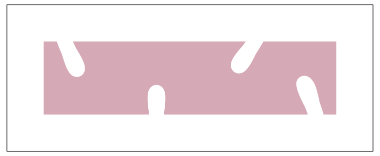
ARTIFICIAL LIGHTS

FACADE

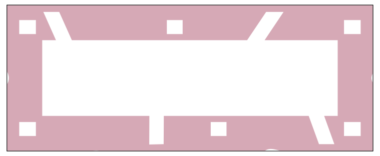
ROOFTOP GREENERY



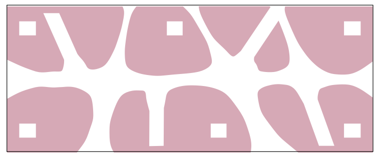
GLAZED ROOFTOP



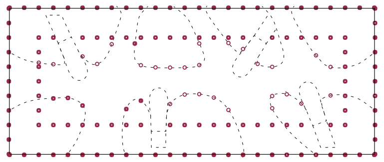
TOP FLOORS



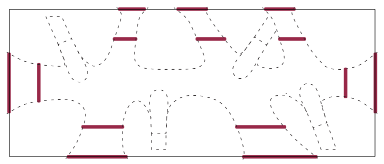
BOTTOM FLOORS



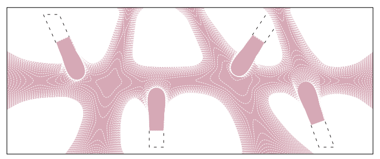
INTERIOR COLUMNS



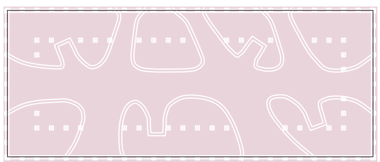
DISCHARGE ARCHES



BIONIC SHAPE SHELL



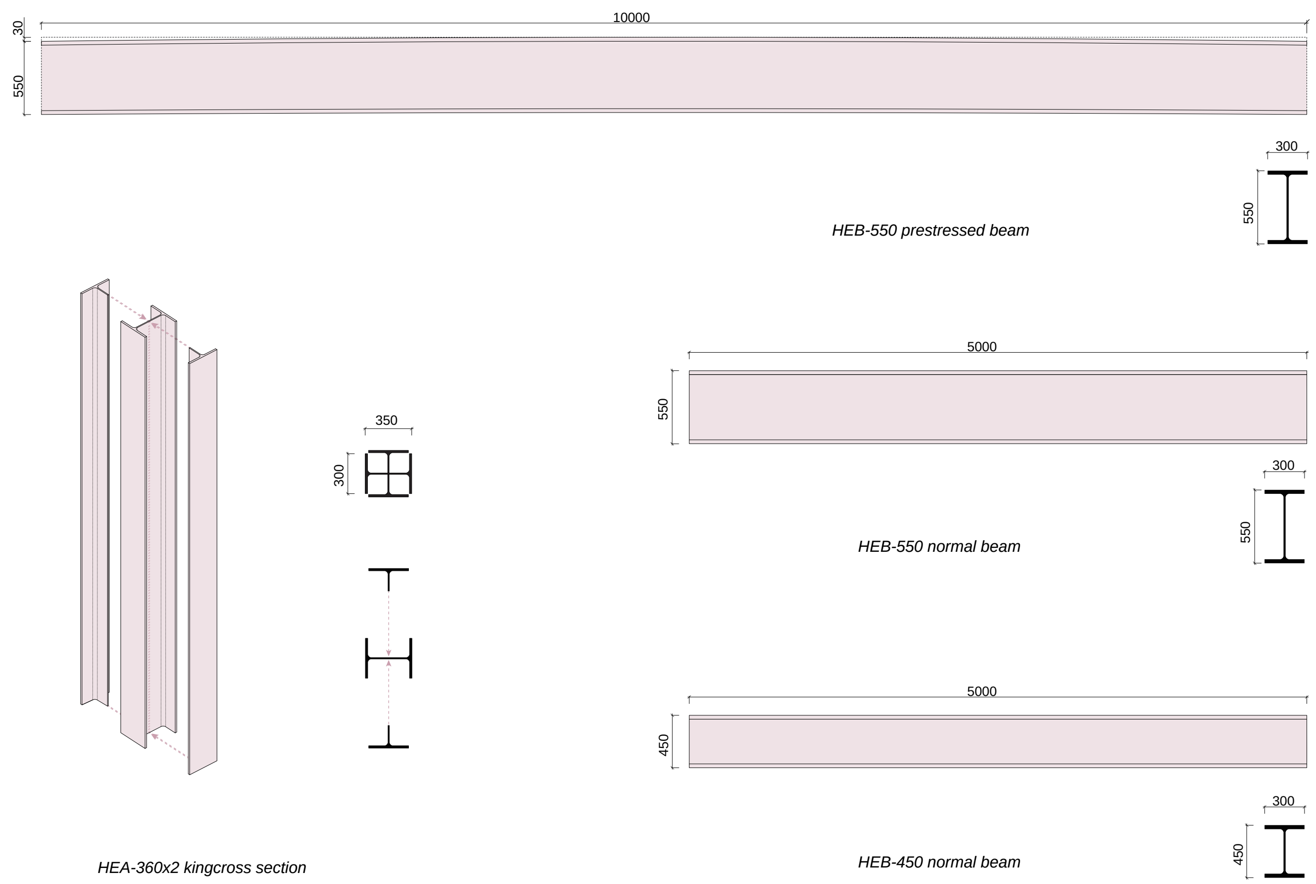
SLAB FOUNDATIONS



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 skylights in order to minimize the number of unique elements and portions.

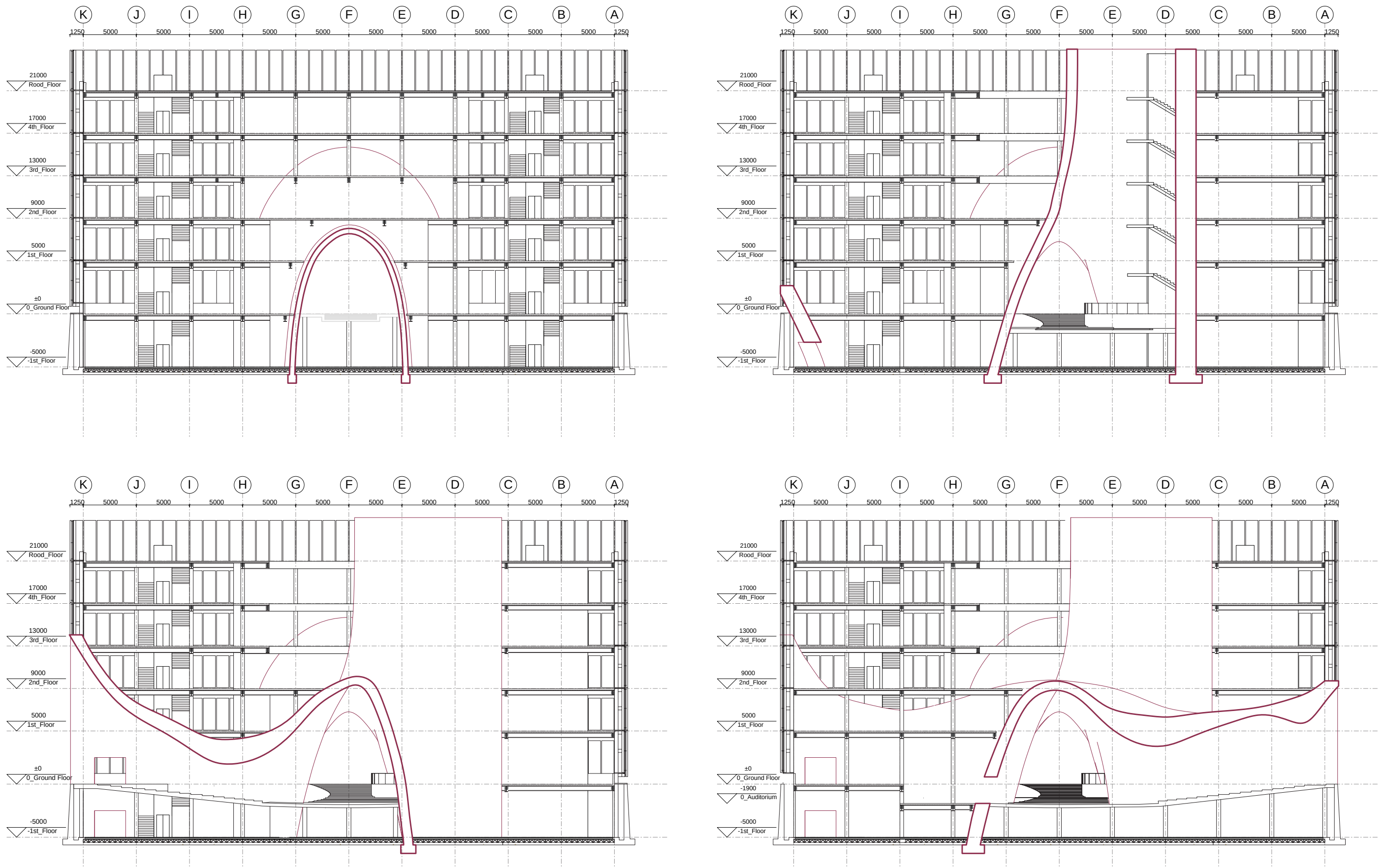
In contrast, the beam/column system complements the organic shape and stands as dominant support for the main floor slabs. At the junction points between these two systems, the organic shape and orthogonal one, we incorporated an additional structural element to maintain stability without compromising 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.

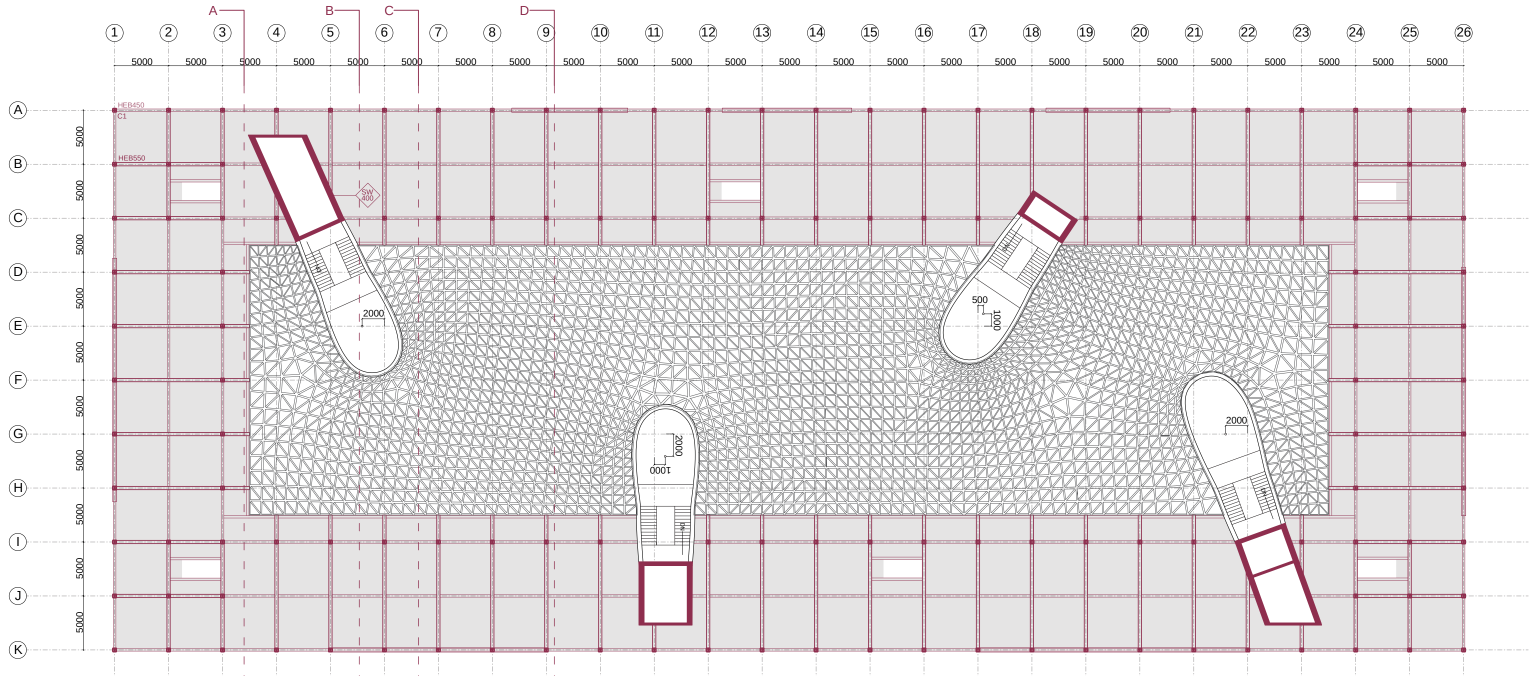


To determine the proper section size for the orthogonal structure required meticulous calculations and analysis to ensure structural stability and performance. Employing a combination of manual calculations and reference to manufacturers' documents, we systematically evaluated the ULS (ultimate limit state) and SLS (serviceability limit state) of the beams, as well as verifying the buckling behavior of the interior columns.

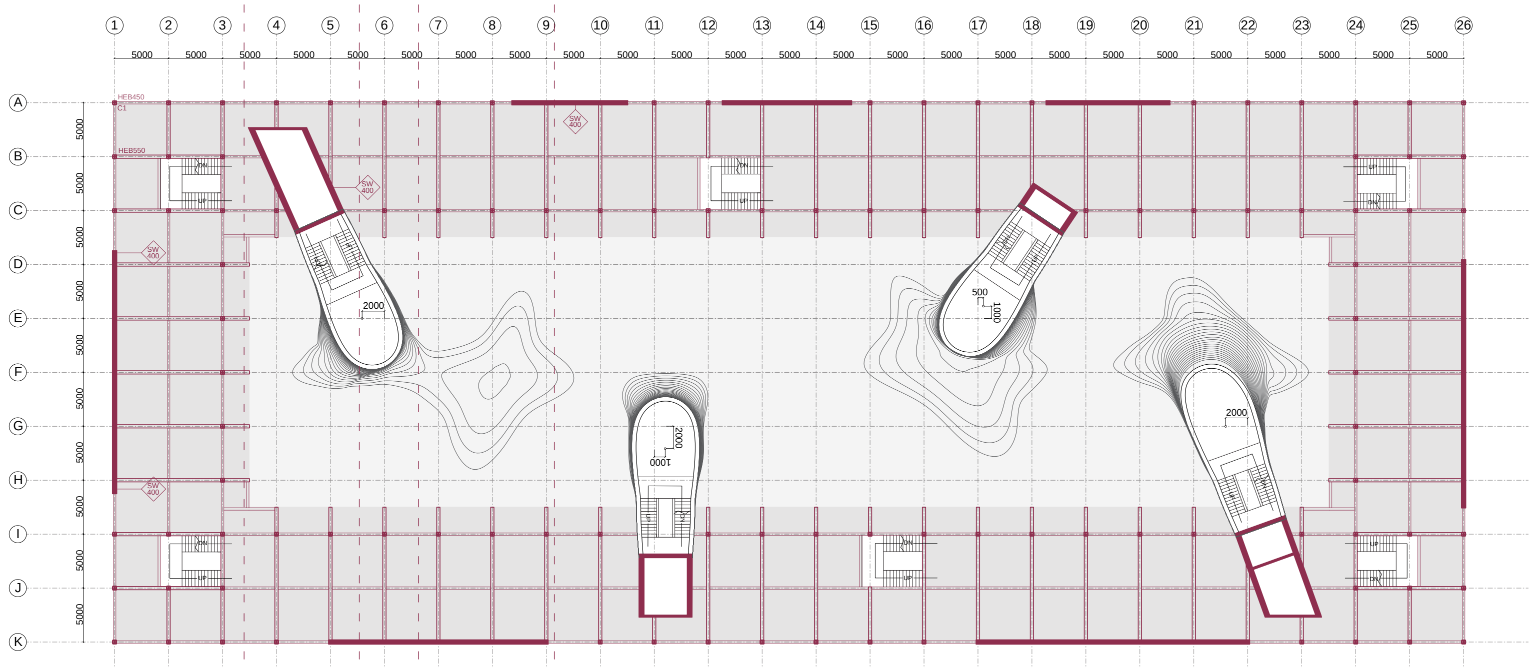
For the beams, our calculations focused on assessing the maximum loads they could withstand under various loading conditions, considering factors such as dead loads, live loads of a building like the library, and the Milanese environmental conditions for the roof slab calculations. By analyzing the beam's cross-sectional properties, including its moment of inertia and section modulus, we determined that the optimal size that would provide sufficient strength and stiffness we should use HEB 550 as primary beams and HEB 450 for the secondary ones.

Additionally, we conducted buckling analyses for the interior columns to ensure their stability under compressive loads. This involved evaluating the critical buckling load and comparing it to the applied loads to prevent premature failure due to buckling instability. In our case we decided to use kingcross beams HEA 360. Throughout this process, we adhered to industry standards and codes to ensure compliance with safety regulations and structural performance criteria.

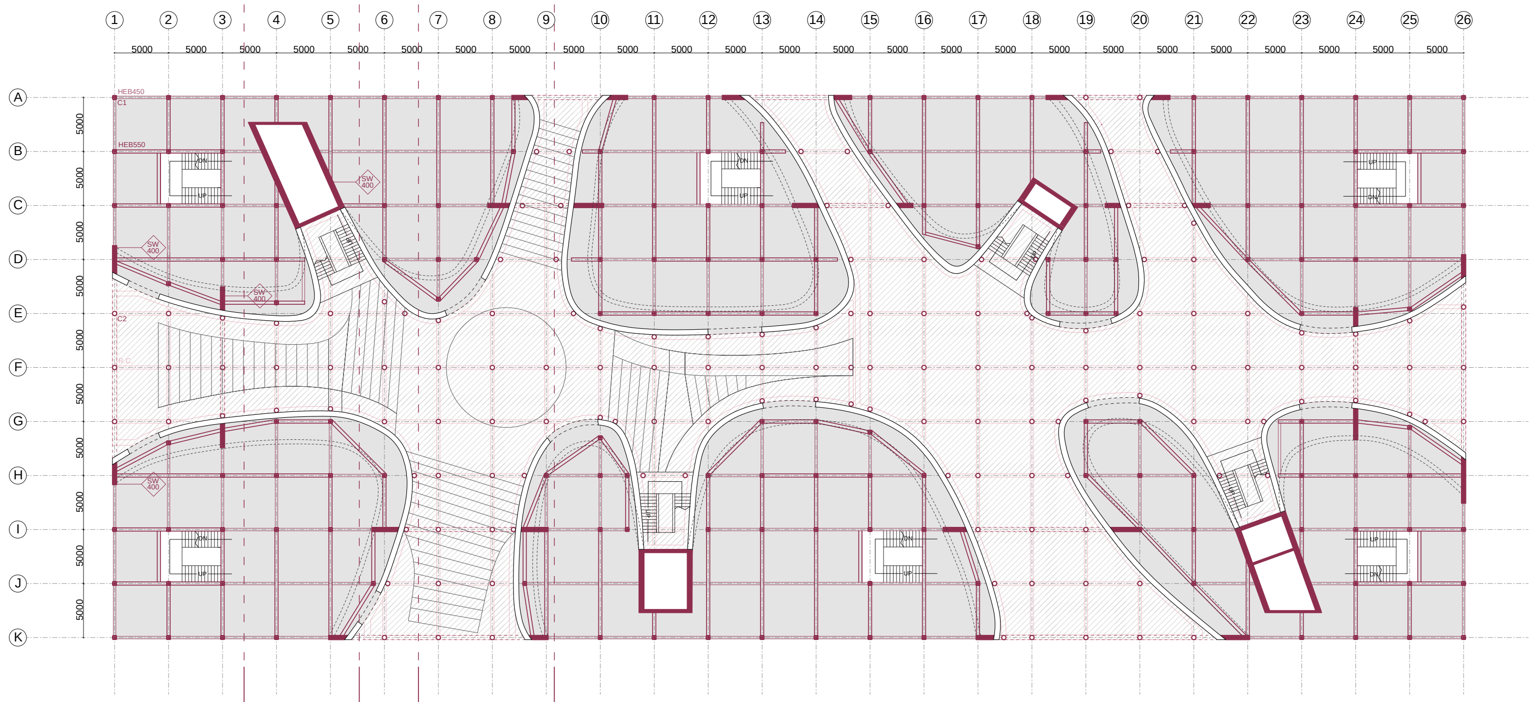




ROOF PLAN 1:250



THIRD FLOOR PLAN 1:250



GROUND FLOOR PLAN 1:250

PART 1: STEEL BEAM LOAD CALCULATIONS

ROOF

Dead load: Beam self-weight

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

Dead load: Floor self-weight

Layer	**Material**	**Thickness**	**Weight**
Soil	subsoil(mix with expanded clay)	300 mm	2.7 kN/m2
	Blue Roof Filtration Fleece	25 mm	0.1 kN/m2
	Blue Roof Geocell(full)	65 mm	1.5 kN/m2
Finishing	bituminous sheeting(Polydan 180-40 P ELAST)	3.5 mm	0.0 kN/m2
	screed	65 mm	0.2 kN/m2
Insulation	stone wool insulation	200 mm	0.1 kN/m2
Structure G2	R.C.	150 mm	3.6 kN/m2
Plant	integrated ventilation duct	mm	0.6 kN/m2
Ceiling	suspended ceiling soundproofed(WOODGIPS)	50 mm	0.5 kN/m2
Area load G2+G3			**9.3 kN/m2**

Live load:Accessible roof

Accessible roof standard live load	**Area load Q**	**2 kN/m2**

ROOFTOP BALCONY

Dead load: Beam self-weight

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

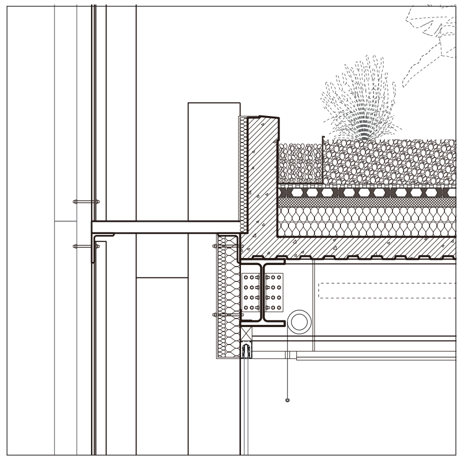
Dead load: Floor self-weight

Layer	**Material**	**Thickness**	**Weight**
Pavements	WEISS raised floor system(32mm wood foor)	32 mm	0.5 kN/m2
Finishing	bituminous sheeting(Polydan 180-40 P ELAST)	3.5 mm	0.0 kN/m2
	screed	65 mm	0.2 kN/m2
Insulation	stone wool insulation	200 mm	0.1 kN/m2
Structure G2	R.C.	150 mm	3.6 kN/m2
Plant	integrated ventilation duct	mm	0.6 kN/m2
Ceiling	suspended ceiling soundproofed(WOODGIPS)	50 mm	0.5 kN/m2
Area load G2+G3			**5.6 kN/m2**

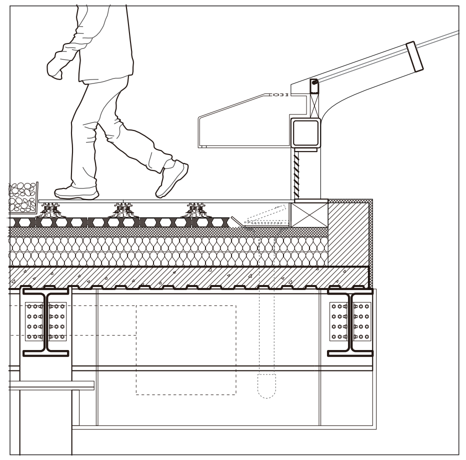
Live load:Accessible roof

Accessible roof standard live load	**Area load Q**	**2 kN/m2**

Skylight	Perimeter	340 m	
	Double glazing Glass(12mm)	1674 m2	30.0 kg/m2
	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		**2.9** kN/m



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



1.2 ROOF TOP SLAB walkable
Wood foor 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

PART 1: STEEL BEAM LOAD CALCULATIONS

FLOORS

Dead load: Beam self-weight

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

Dead load: Floor self-weight

Layer	**Material**	**Thickness**	**Weight**
Pavements	WEISS raised floor system(32mm wood foor)	32 mm	0.5 kN/m2
Finishing	screed	25 mm	0.1 kN/m2
	EPS sound insulation	5 mm	0.1 kN/m2
Structure G2	R.C.	150 mm	3.6 kN/m2
Plant	integrated ventilation duct	mm	0.6 kN/m2
Ceiling	suspended ceiling soundproofed(WOODGIPS)	50 mm	0.5 kN/m2
Partition wall	lightweight partition wall		0.6 kN/m2
Area load G2+G3			**6.0 kN/m2**

Live load:Book storage

Book storage standard live load	**Area load q**	**5 kN/m2**

BALCONY

Dead load: Beam self-weight

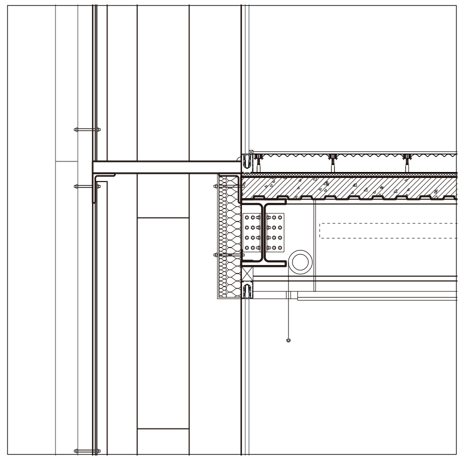
Primary beams		
Type:	HEB550	
Normal weight	199 kg/m	0.199 kN/m
Linear load g1		**0.2 kN/m**

Dead load: Floor self-weight

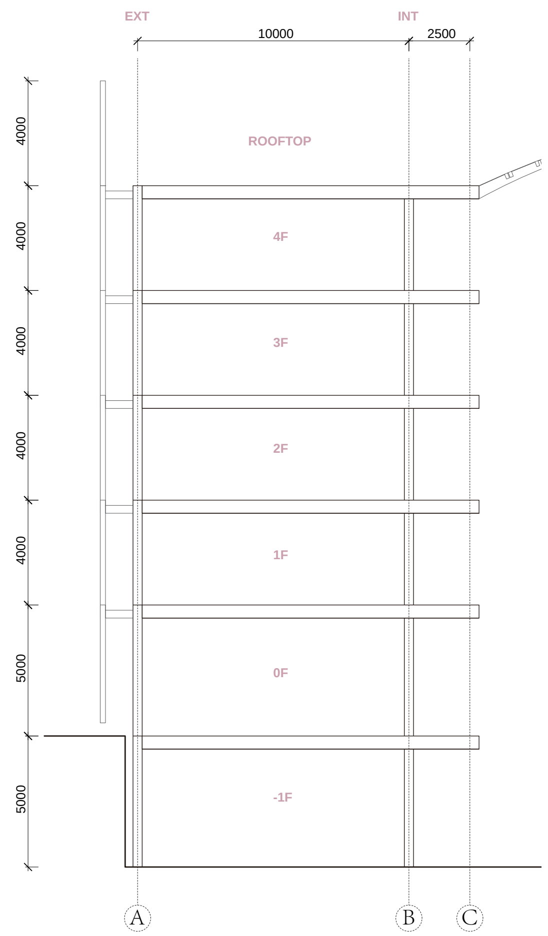
Layer	**Material**	**Thickness**	**Weight**
Pavements	WEISS raised floor system(32mm wood foor)	32 mm	0.5 kN/m2
Finishing	screed	25 mm	0.1 kN/m2
	EPS sound insulation	5 mm	0.1 kN/m2
Structure G2	R.C.	150 mm	3.6 kN/m2
Plant	integrated ventilation duct	mm	0.8 kN/m2
Ceiling	suspended ceiling soundproofed(WOODGIPS)	50 mm	0.5 kN/m2
Partition wall	lightweight partition wall		0.6 kN/m2
Area load G2+G3			**6.2 kN/m2**

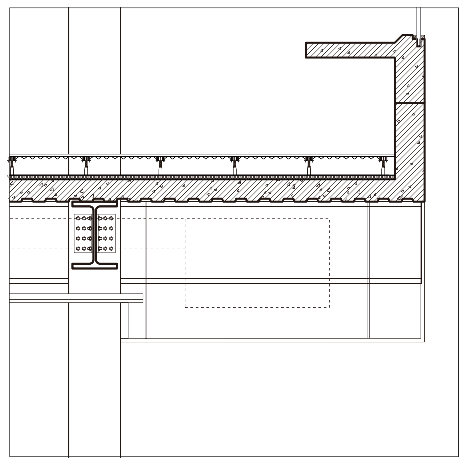
Live load:Reading room in library

Reading room in library live load	**Area load q**	4	**4 kN/m2**

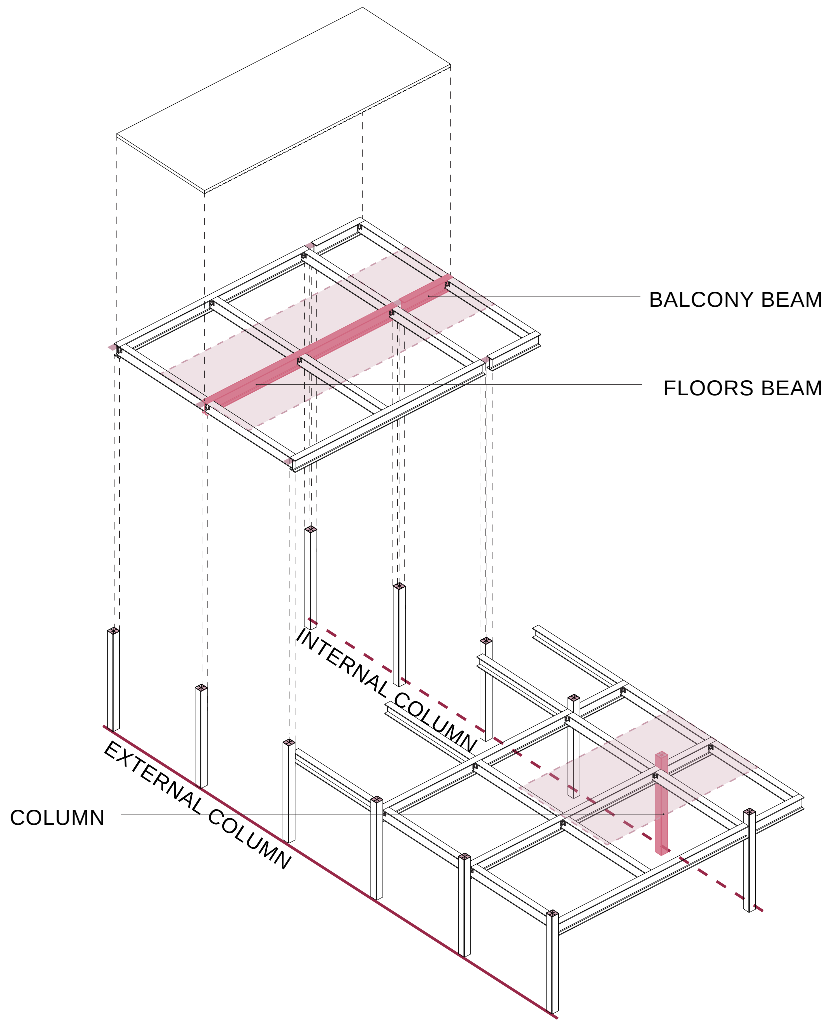


3. TIPICAL FLOOR SLAB
Wood foor 32mm
Weiss® raised floor system
Transit for systems
Screed 25mm
EPS sound insulation 5mm
R.C. 150mm
HEB-550 prestressed steel beam
Integrated ventilation duct.
Woodgips ® suspended ceiling soundproofed 50mm





3. TIPICAL FLOOR SLAB
Wood foor 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



FLOORS

ULS,SLS,Bending Moment Calculation

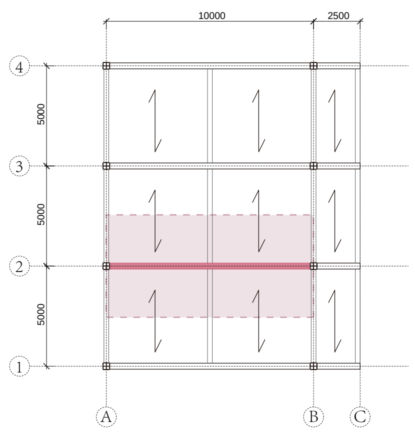
Beam Lenght L	10.0 m	10000 mm	
Influence area width I	5.0 m	5000 mm	
Linear load g1	0.2 kN/m	Dead load: Beam self weight - Structural	
Area load G2	3.6 kN/m2	Dead load: Floor Self weight - Structural	
Linear load g2	18.0 kN/m		
Area load G3	2.4 kN/m2	Dead load: Floor Self weight - Non Structural	
Linear load g3	11.9 kN/m		
Area load Q1	5.0 kN/m2	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	

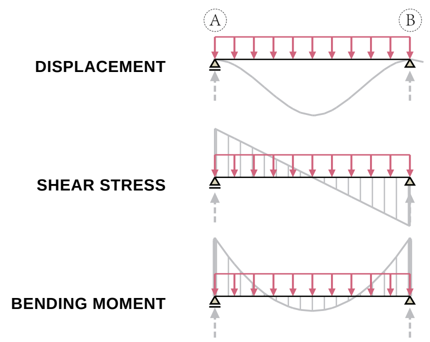
Calculate Wpl & Choose steel class and Beams

Wpl	**3659606 mm3**	**3660 10^3 mm3**	
Steel class S...	275		
fyk	275 MPa		
γs	1.05		
fyd	261.9 MPa		
Beam chosen	**HEB550-Prestressed**		
Wpl chosen	**5591** 10^3 mm3	Wpl chosen > Wpl	**OK**
Iy chosen	136700 10^4 mm4		
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	**OK**
Check maximal displacements for liveload(L)			
delta_max L/300	33.3 mm		
delta simple beam	**11.6** mm	delta simple beam<delta_max	**OK**





ROOF

ULS,SLS,Bending Moment Calculation

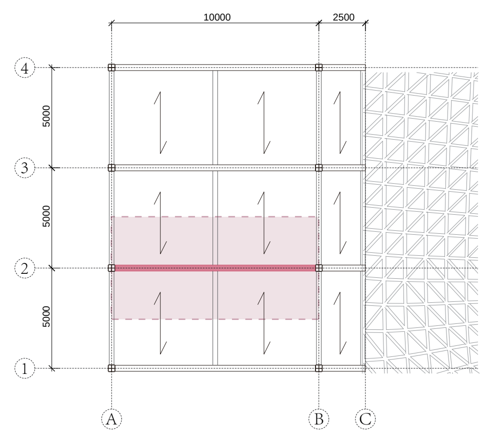
Beam Lenght L	10.0 m	10000 mm	
Influence area width I	5.0 m	5000 mm	
Linear load g1	0.2 kN/m	Dead load: Beam self weight - Structural	
Area load G2	3.6 kN/m2	Dead load: Floor Self weight - Structural	
Linear load g2	18.0 kN/m		
Area load G3	5.7 kN/m2	Dead load: Floor Self weight - Non Structural	
Linear load g3	28.4 kN/m		
Area load Q1	2.0 kN/m2	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	

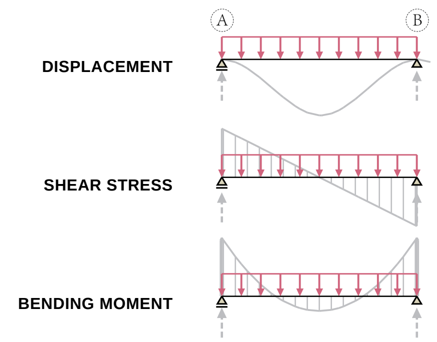
Calculate Wpl & Choose steel class and Beams

Wpl	**3609492 mm3**	**3609 10^3 mm3**	
Steel class S...	275		
fyk	275 MPa		
γs	1.05		
fyd	261.9 MPa		
Beam chosen	**HEB550-Prestressed**		
Wpl chosen	**5591** 10^3 mm3	Wpl chosen > Wpl	**OK**
Iy chosen	136700 10^4 mm4		
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	**OK**
Check maximal displacements for liveload(L)			
delta_max L/300	33.3 mm		
delta simple beam	**4.6** mm	delta simple beam<delta_max	**OK**





PART 2: STEEL BEAM CHECK

BALCONY

ULS,SLS,Be nding Moment Calculation

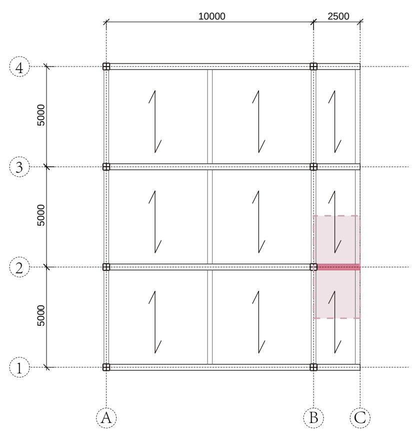
Beam Lenght L	2.5m	2500 mm		
Influence area width I	5.0m	5000 mm		
Linear load g1	0.2k N/mD	ead load: Beam self weight - Structural		
Area load G2	3.6k N/m2	Dead load: Floor Self weight - Structural		
Linear load g2	18.0 kN/m			
Area load G3	2.6k N/m2	Dead load: Floor Self weight - Non Structural		
Linear load g3	12.9k N/m			
Area load Q1	4.0k N/m2	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	uls*L^2/2	

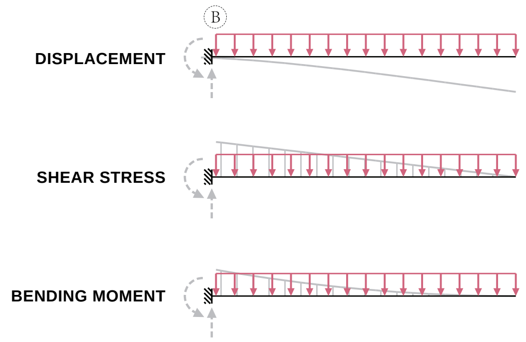
Calculate Wpl & Choos e stee l class and Be ams

Wpl	**840924 mm3**	**841 10^3 mm3**		
Steel class S…2	**75**			
fyk	275 MPa			
γs1	.05			
fyd2	61.9 MPa			
Be am chos en	**HEB550**			
Wpl chosen	**5591** 10^3 mm3W	pl chosen > Wpl		**OK**
Iy chosen	136700 10^4 mm4			
E2	06000M Pa			

Check maximal displacements for combination (D + L) and for live load(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	**OK**
Check maximal displacements for live load(L)			
delta_max L/300	8.3m m		
delta simple beam	**0.3** mm	delta simple beam<delta_max	**OK**





PART 2: STEEL BEAM CHECK

ROOFTOP BALCONY

ULS,SLS,Bending Moment Calculation

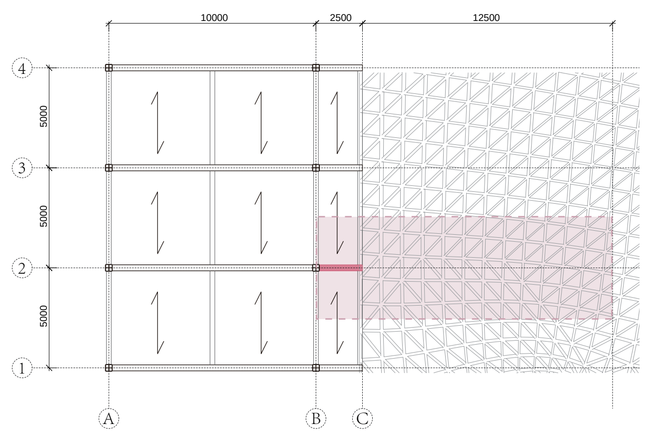
Beam Lenght L	2.5 m	2500 mm	
Influence area width I	5.0 m	5000 mm	
Linear load g1	0.2 kN/m	Dead load: Beam self weight - Structural	
Area load G2	3.6 kN/m2	Dead load: Floor Self weight - Structural	
Linear load g2	18.0 kN/m		
Area load G3	2.0 kN/m2	Dead load: Floor Self weight - Non Structural	
Linear load g3	9.8 kN/m		
Area load Q1	2.0 kN/m2	Live load: Accessible roof	
Linear load q1	10.0 kN/m		
Area load S1	0.0 kN/m2	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+Lsky*L

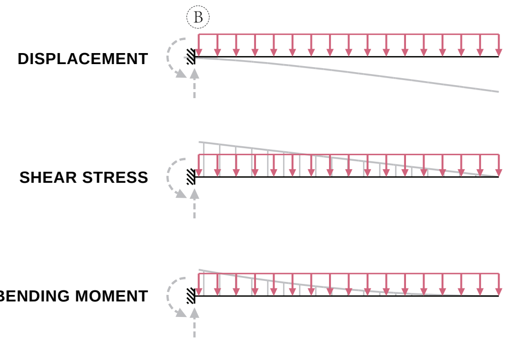
Calculate Wpl & Choose steel class and Beams

Wpl	**750563 mm3**	**751 10^3 mm3**	
Steel class S…	275		
fyk	275 MPa		
γs	1.05		
fyd	261.9047619 MPa		
Beam chosen	**HEB550**		
Wpl chosen	**5591** 10^3 mm3	Wpl chosen > Wpl	**OK**
Iy chosen	136700 10^4 mm4		
E	206000 MPa		

Check maximal displacements for combination (D + L) and for live load(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	**OK**
Check maximal displacements for live load(L)			
delta_max L/300	8.3 mm		
delta simple beam	**0.2** mm	delta simple beam<delta_max	**OK**





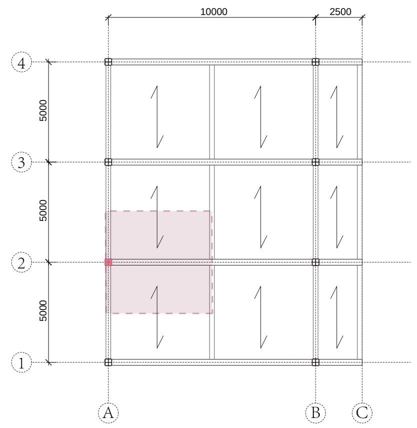
PART 3: STEEL COLUMN LOAD CALCULATIONS

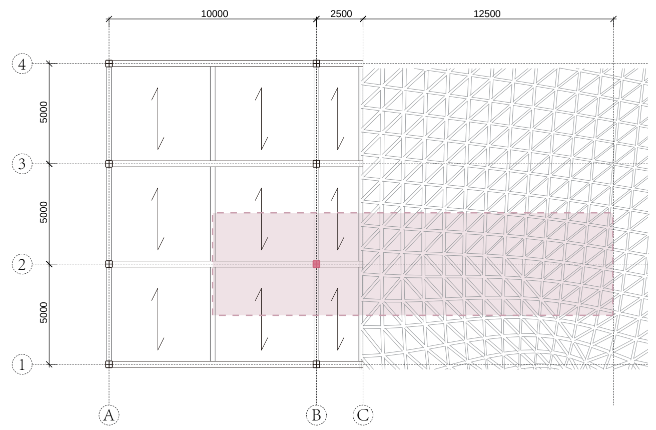
EXTERNAL COLUMN		
Load Beam 1 Quls floor	76.7k N/m	
Load Beam 1 Quls rooftop	75.6k N/m	
Lenght Beam	10.0m	
Load Support Beam Ruls floor	383.4k N	
Load Support Beam Ruls rooftop	378.1 kN	
Pillar Type	HE360AX2 King cross section	
Norminal weight	224 kg/m2	.24k N/m
Facade Type	double layer polycarbonate	
Norminal weight of polycarbonate	7.4 kg/m2	0.074 kN/m2
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
TOTAL PILLAR LOAD Puls	**2358 kN**	

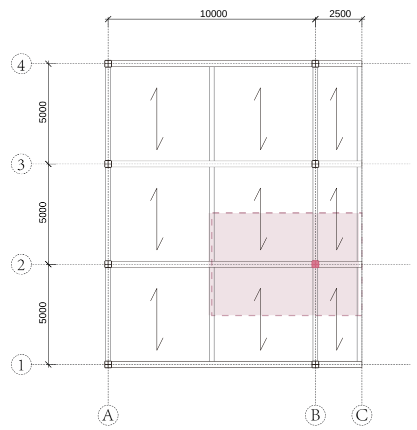
INTERNAL COLUMN		
Load Beam 1 Quls floor	76.7k N/m	
Load Beam 1 Quls rooftop	75.6k N/m	
Lenght Beam	10.0m	
Load Support Beam Ruls floor	383.4k N	
Load Support Beam Ruls rooftop	378.1 kN	
Load Beam 2 Quls floor	70.5k N/m	
Load Beam 2 Quls rooftop	51.4k N/m	
Lenght Beam	2.5m	
Load Support Beam Ruls floor	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
TOTAL PILLAR LOAD Puls	**3319 kN**	

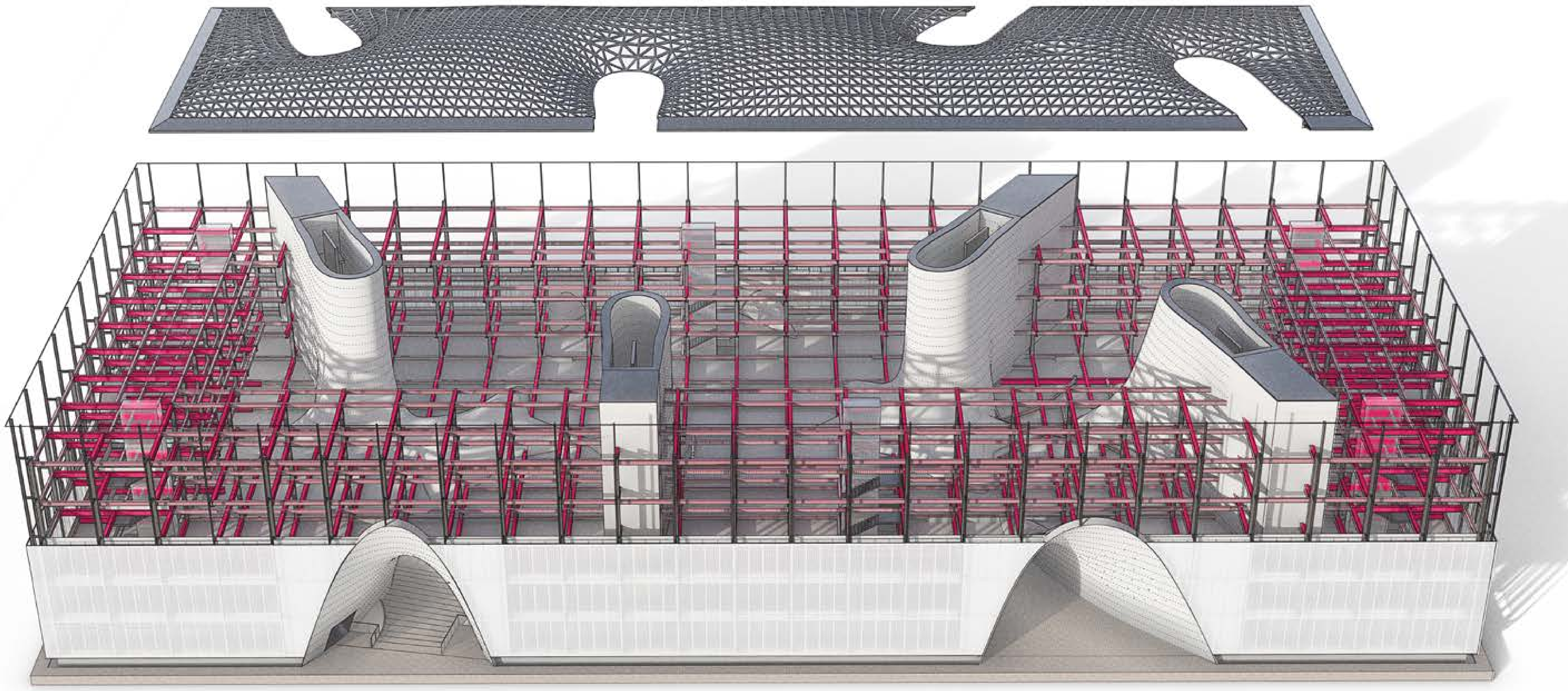
PART 4: STEEL COLUMN CHECK

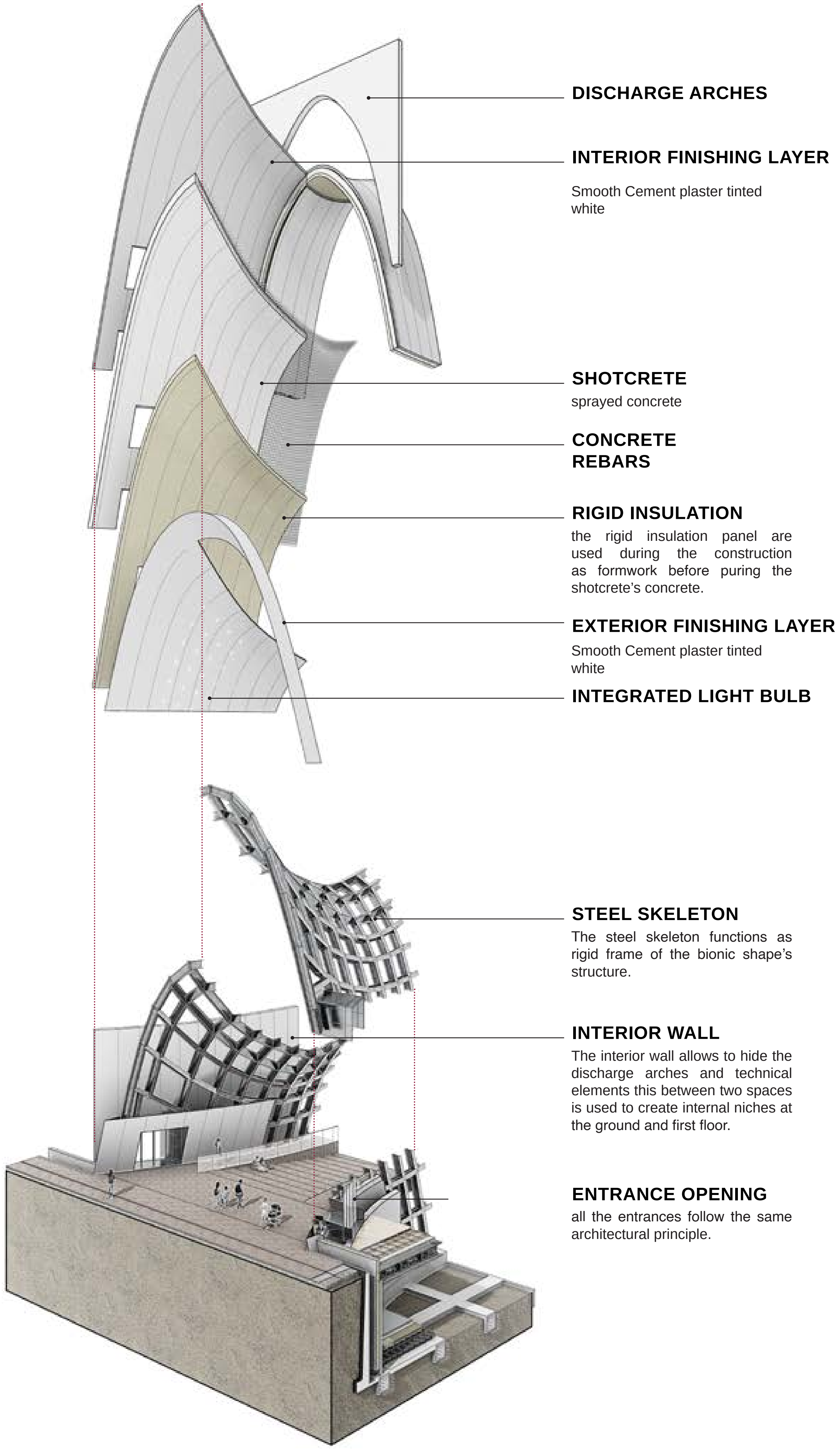
INTERNAL COLUMN							
	N_ED=	3319 kN		3318900 N			
pre-selected profile	HE360AX2 King cross section		Steel class :	235			
	As	285.6	cm2	28560	mm2	0.02856m 2	
	buckling curve	c					
	α =	0.49					
	$\bar{\sigma}$ =	1600	daN/cm2	160	Mpa		
	i_min	152.2	mm				
	fy	235	MPa	235000000	Pa		
	γ_{m1}	1.05					
	E	206000	MPa	2.06E+11	Pa		
fixed- hinge scheme	l	5	m5	000	mm		
	lo =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	< $\bar{\sigma}$	**OK**
	J=	661587830.4	mm4	0.000661588	m4		
	P_{cr}=	95554575.8	N9	5554.6	kN		
	$\bar{\lambda}$=	0.265025272	Φ =	0.551050389	χ=	0.96694587	
Limit state check	N_Rd=	6180718.0	N	6180.7	kN	>N_ED	**OK**







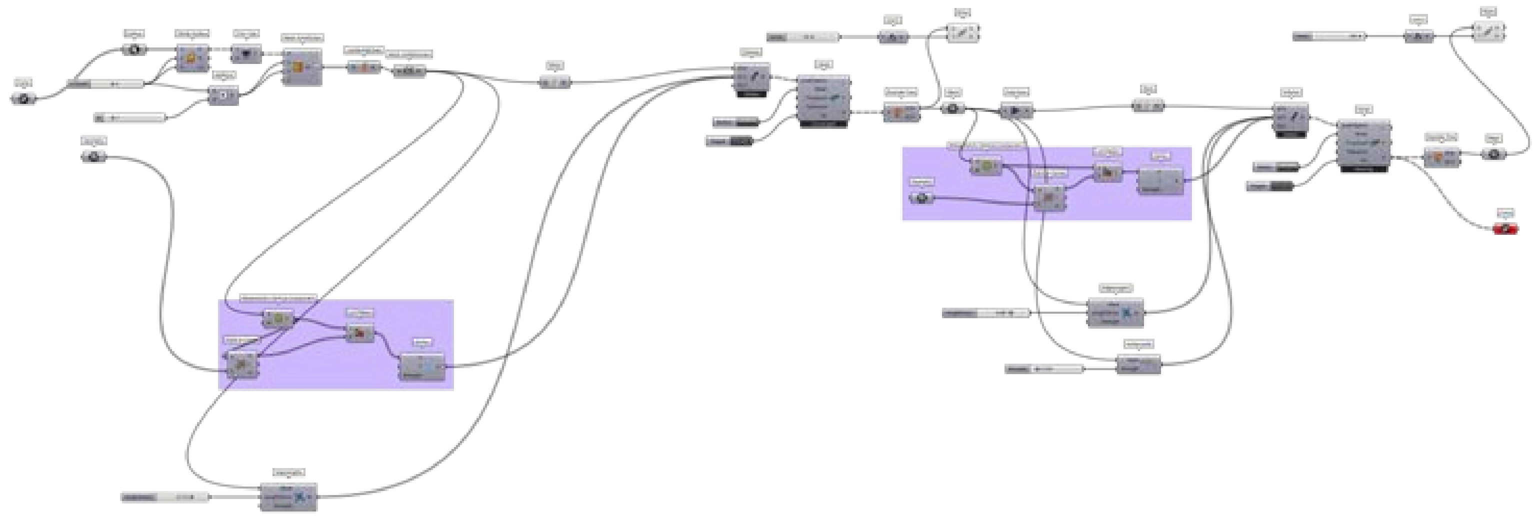


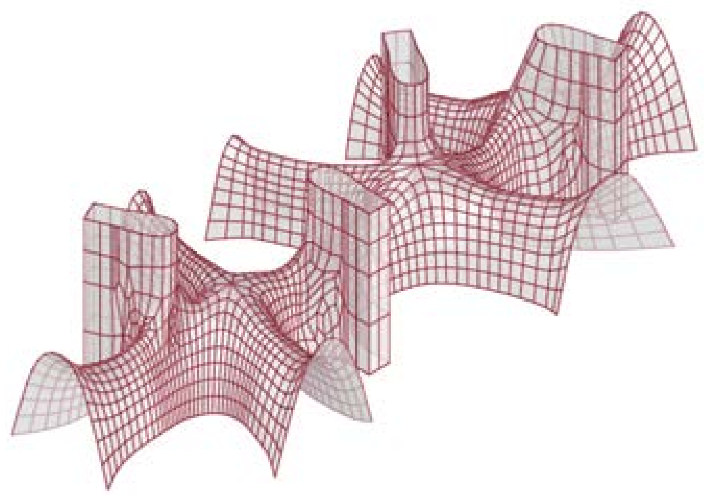


In our process to model the organic shape, our approach underwent several iterative steps to achieve the desired form. Initially, during the concept phase, we relied on a combination of hand sketching and digital tools such as Rhino to visualize and refine the complex shape. This iterative process allowed us to explore different design iterations and refine the organic meaning we wanted to give to our form to meet our aesthetic, library idea and functional objectives.

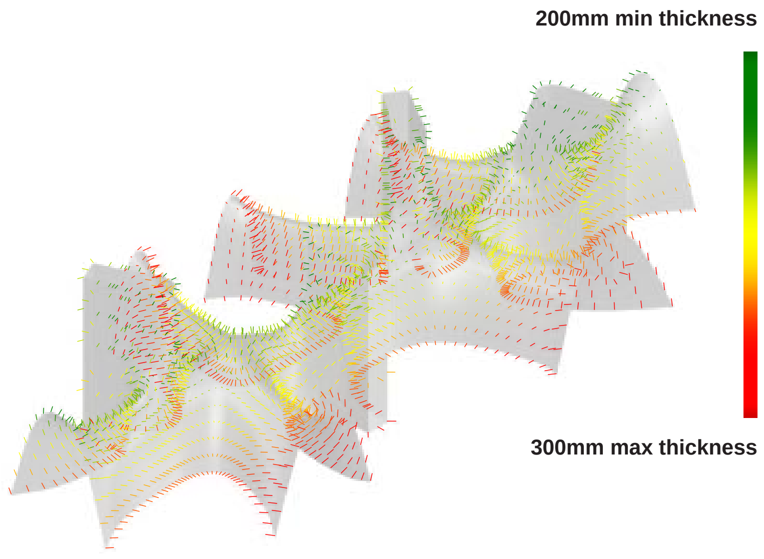
As the design evolved, we transitioned to using parametric software such as Grasshopper, which enabled us to generate catenary simulations and develop a self-supporting structure for the organic shape. By leveraging parametric design techniques, we were able to optimize the structural performance of the shape while maintaining its visual complexity and organic character.

To validate the structural integrity of the organic shape, we employed the advanced structural analysis software Midas Gen. This software allowed us to conduct detailed structural analyses and simulations to assess the behavior of the shape under various loading conditions. By inputting the geometry and material properties into the software, we were able to simulate the structural response of the organic shape and determine the thicknesses of concrete required to ensure its stability and safety. The results obtained from the structural analysis informed our design decisions and enabled us to refine the structural detailing of the organic shape, ensuring that it met all safety and performance requirements.



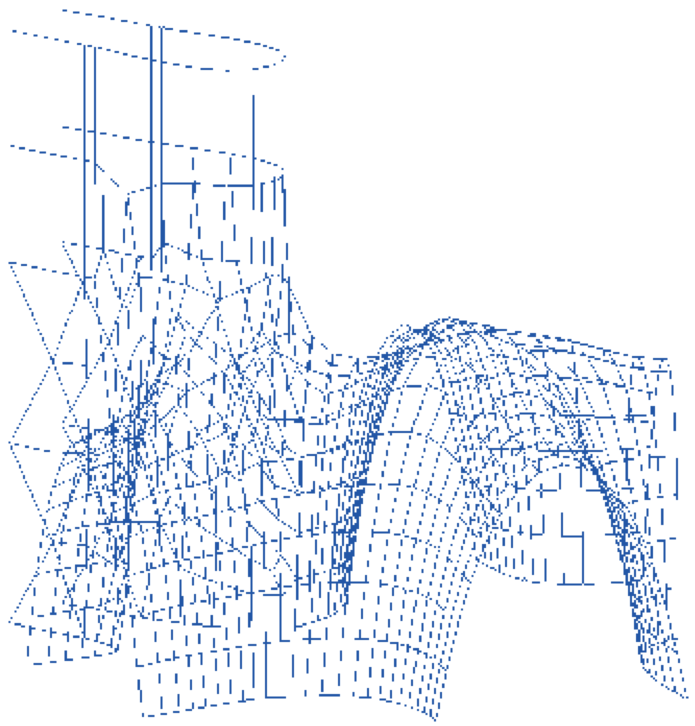


METAL FRAME STRUCTURE

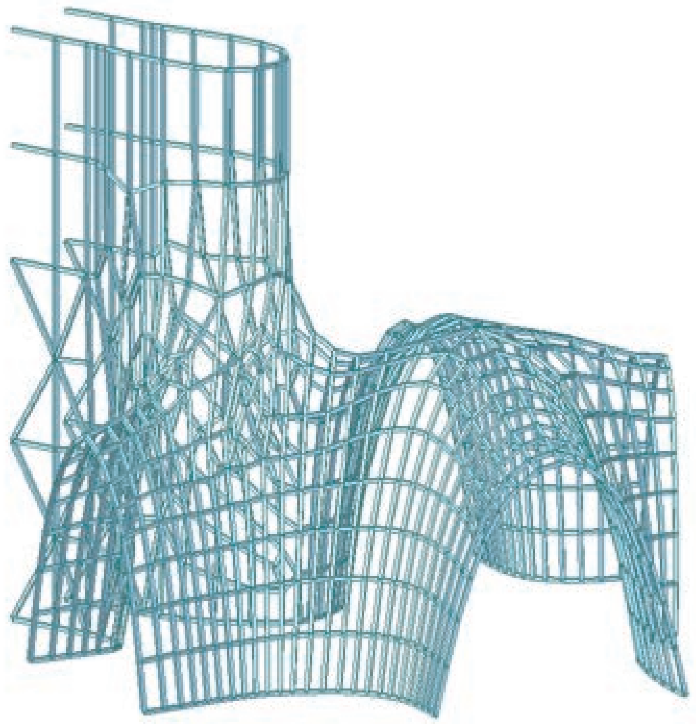


REINFORCED SPRAYED CONCRETE

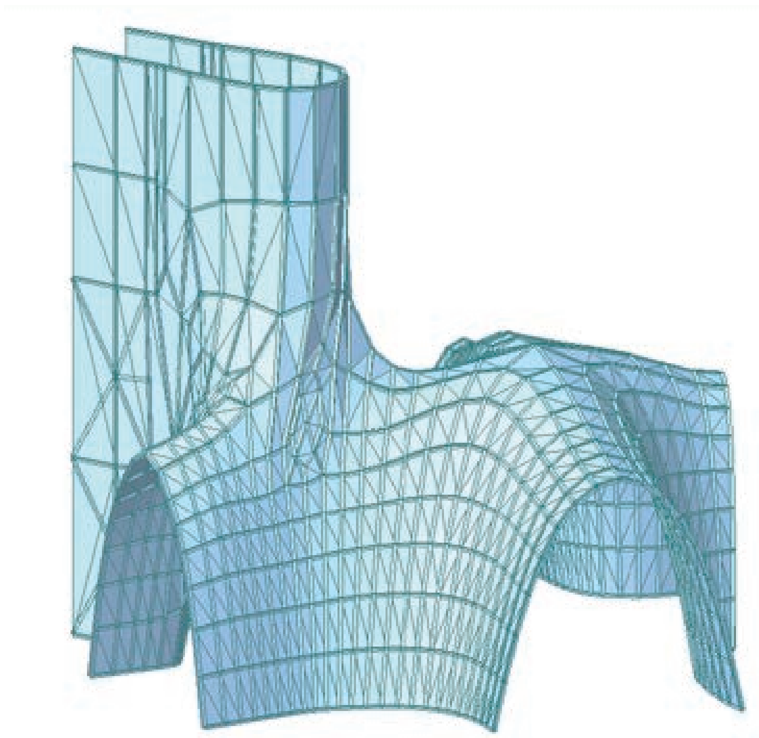
CONSTRUCTING SIMULATION MODEL



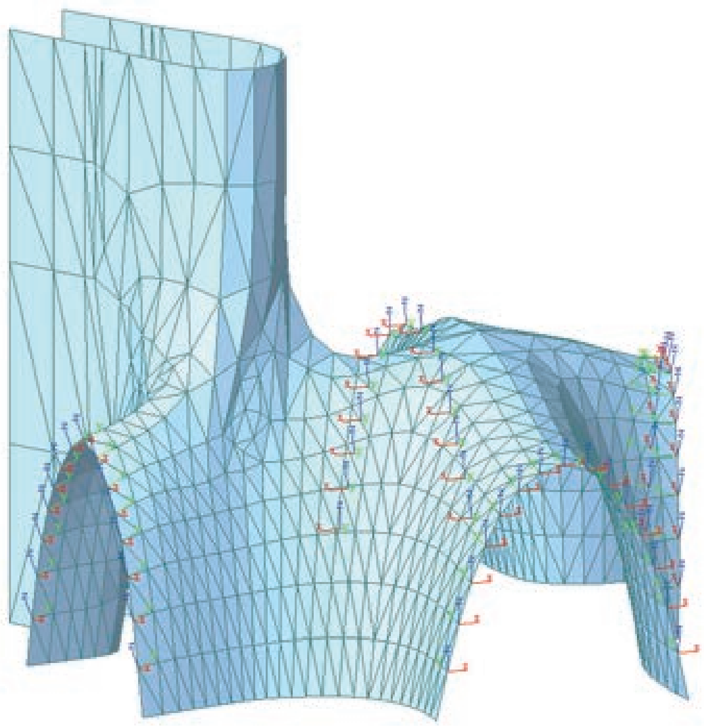
1. STRUCTURE LINES



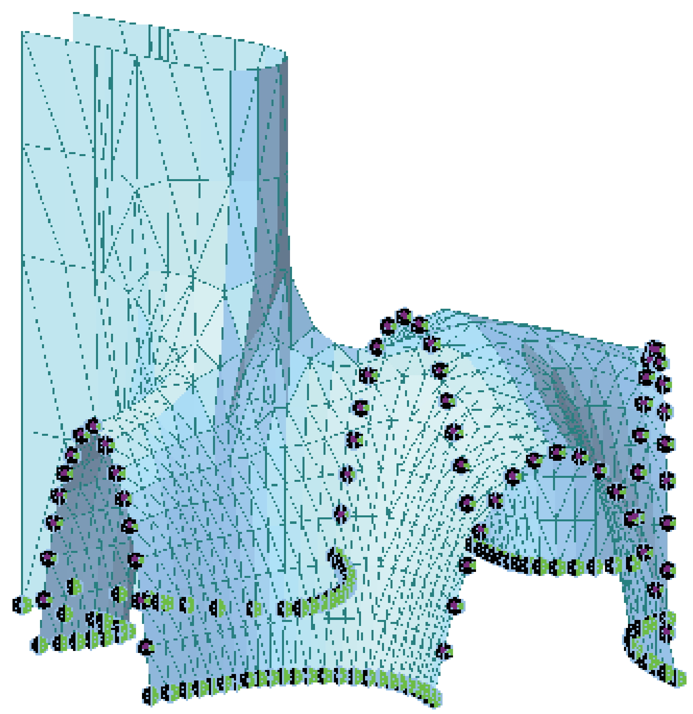
2. SKELETON



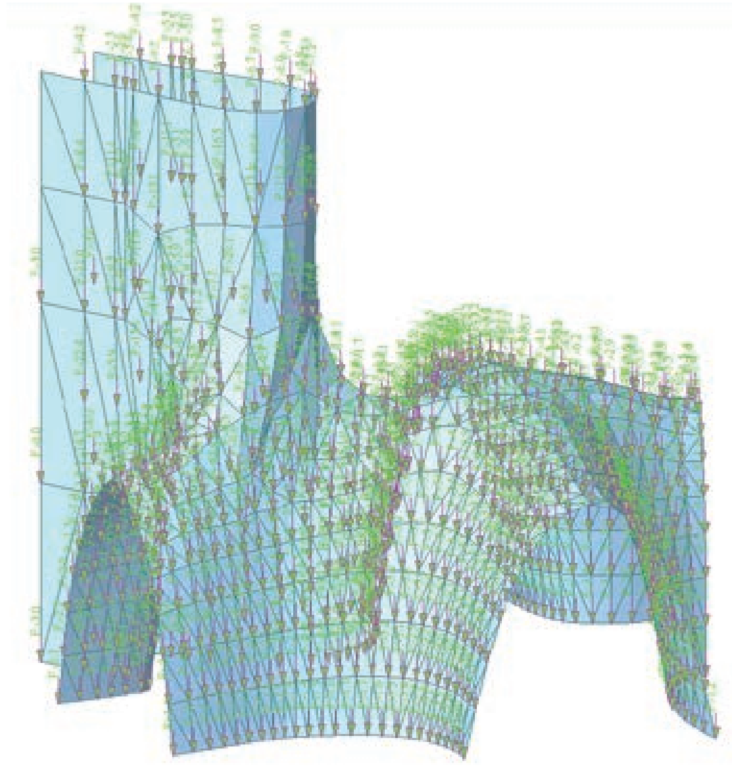
3. SKELETON WITH SHOTCRETE



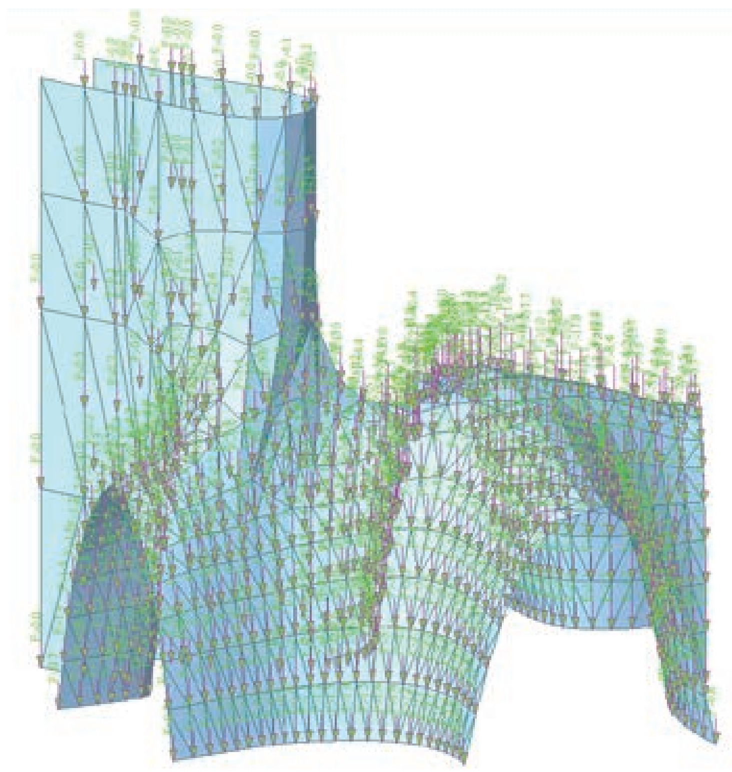
4. DEFINING AXIS OF RESTRAINT



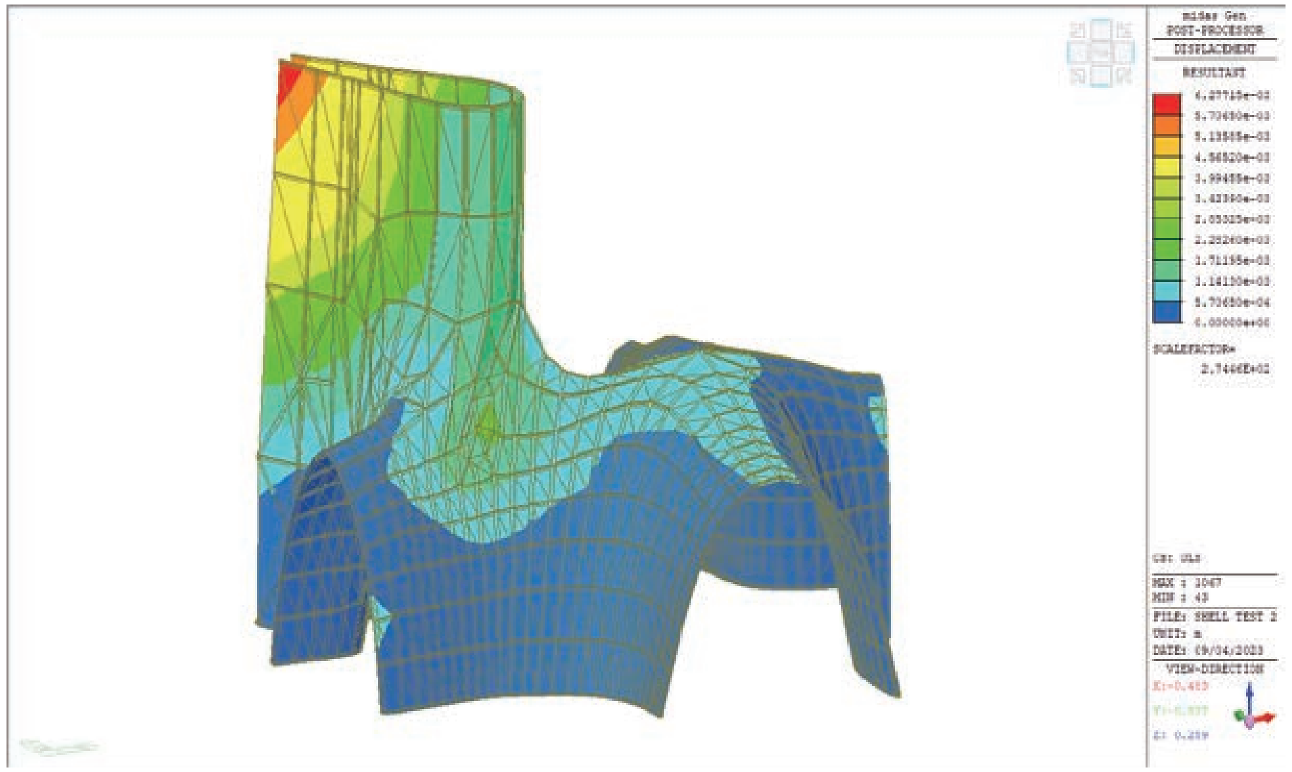
5. FIXED AND PINNED RESTRAINS



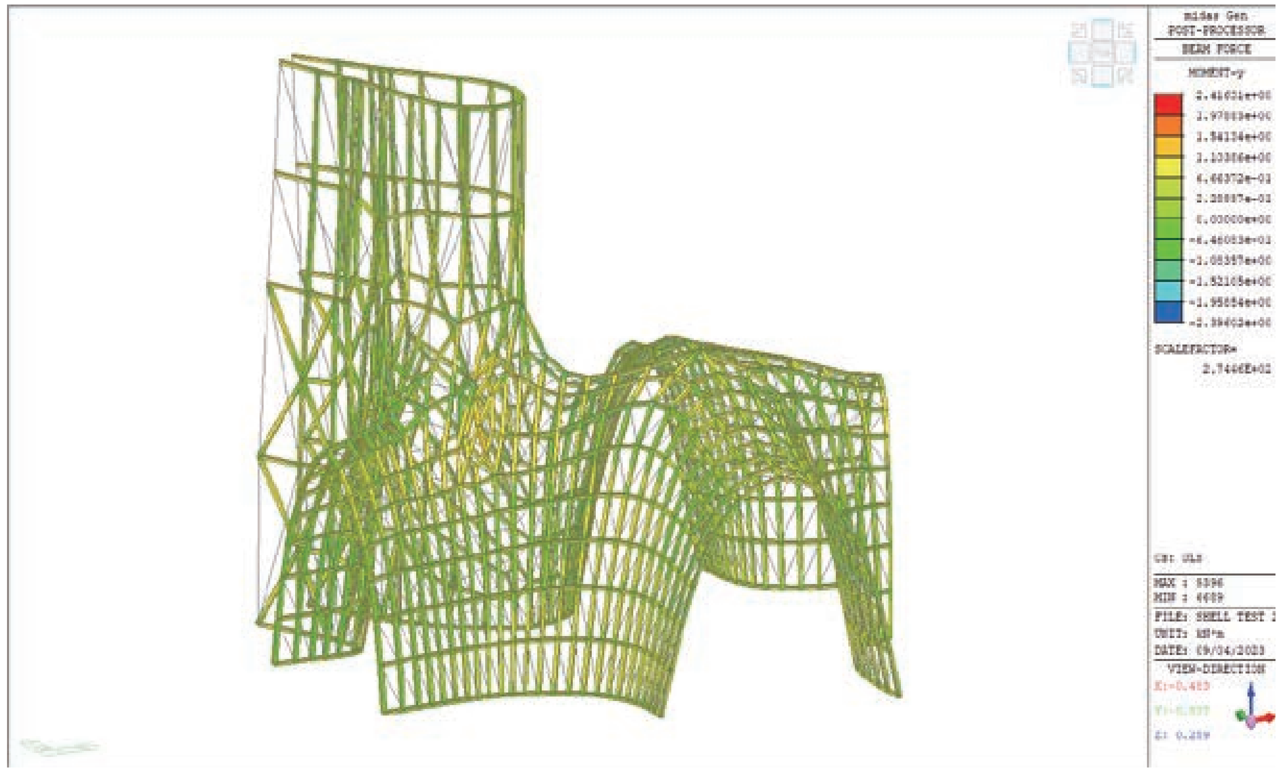
6. APPLYING CONCRETEPANELS LOAD



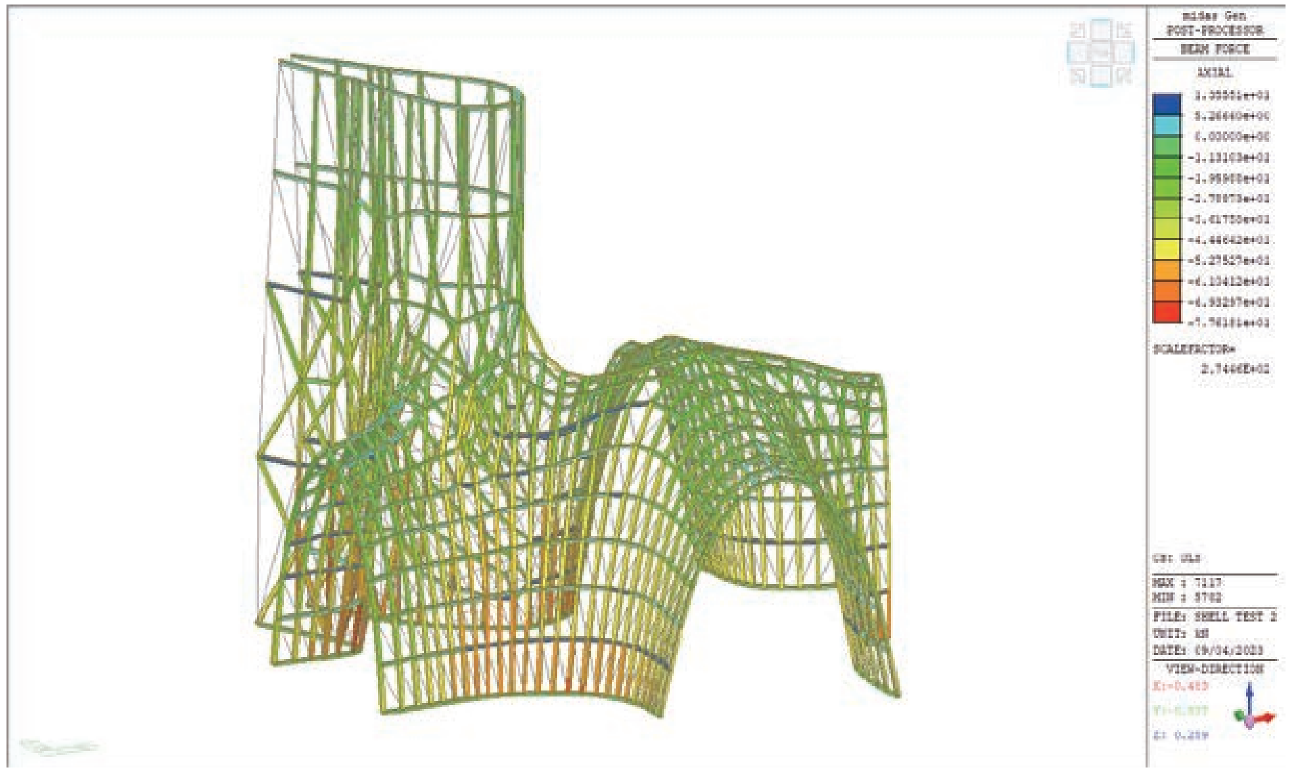
7. APPLYING LIVELOAD



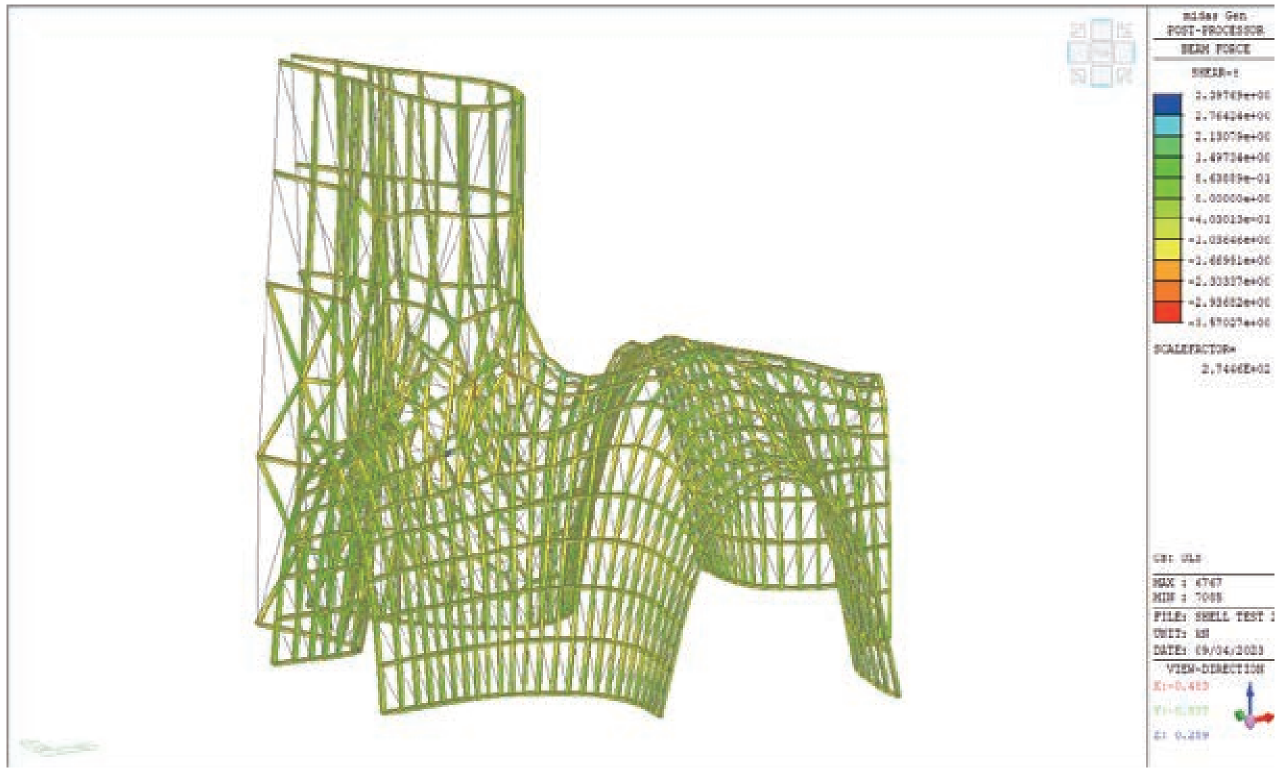
Displacement - ULS



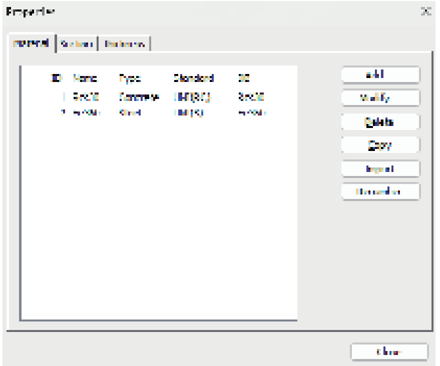
Bending moment - ULS



Axial force - ULS

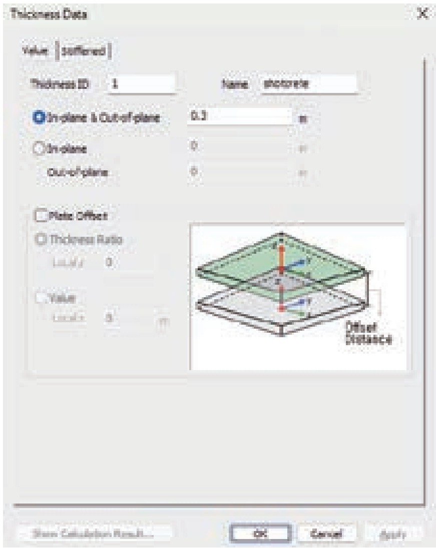


Shear force - ULS

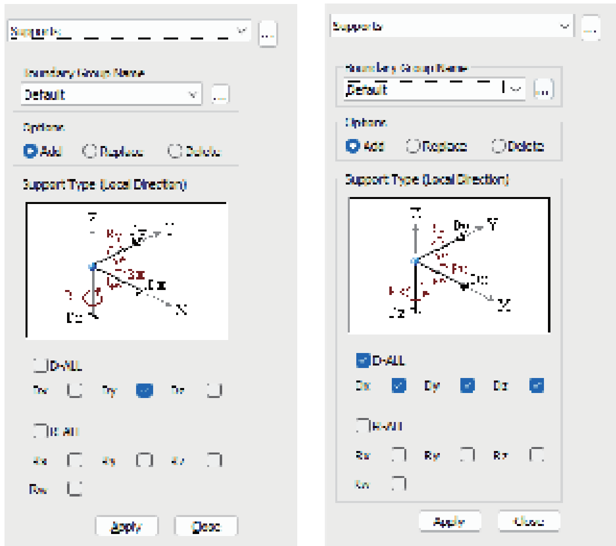


1. STRUCTURE LINES
(material list)

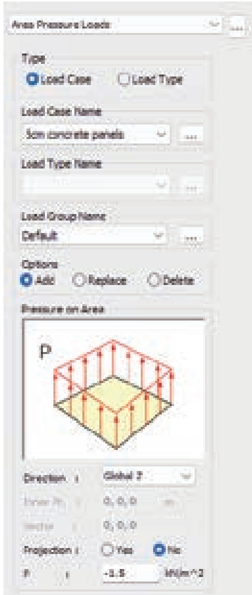
2. SKELETON
(skeleton section)



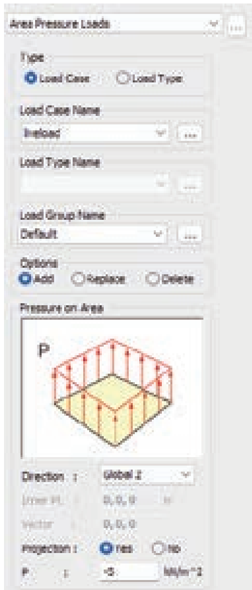
3. SKELETON WITH SHOTCRETE
(thickness of shotcrete)



5. FIXED AND PINNED RESTRAINS
(restraint on the cutting) (restraint on the base)

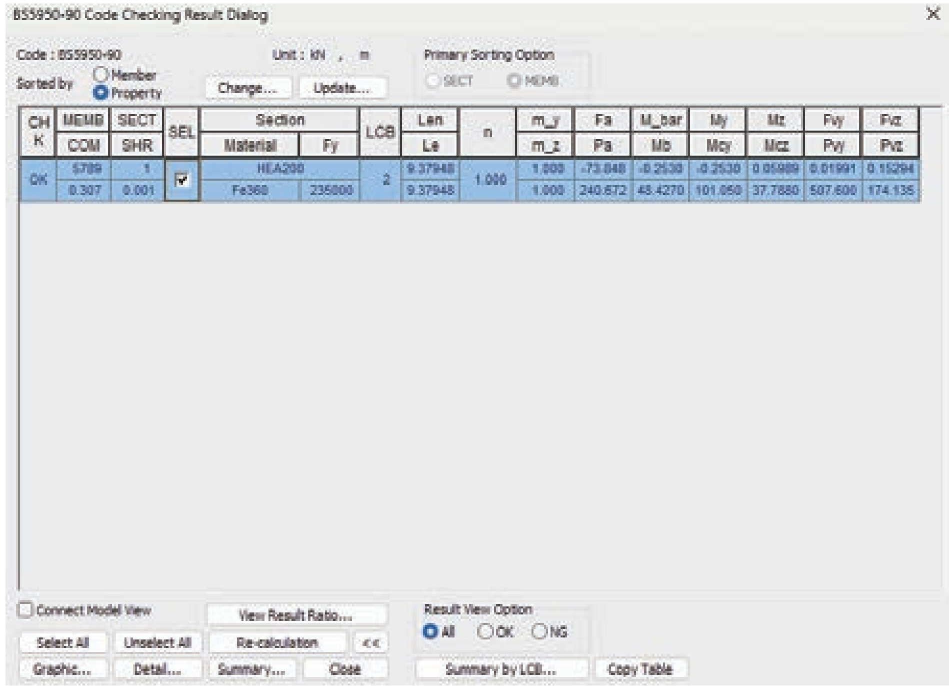


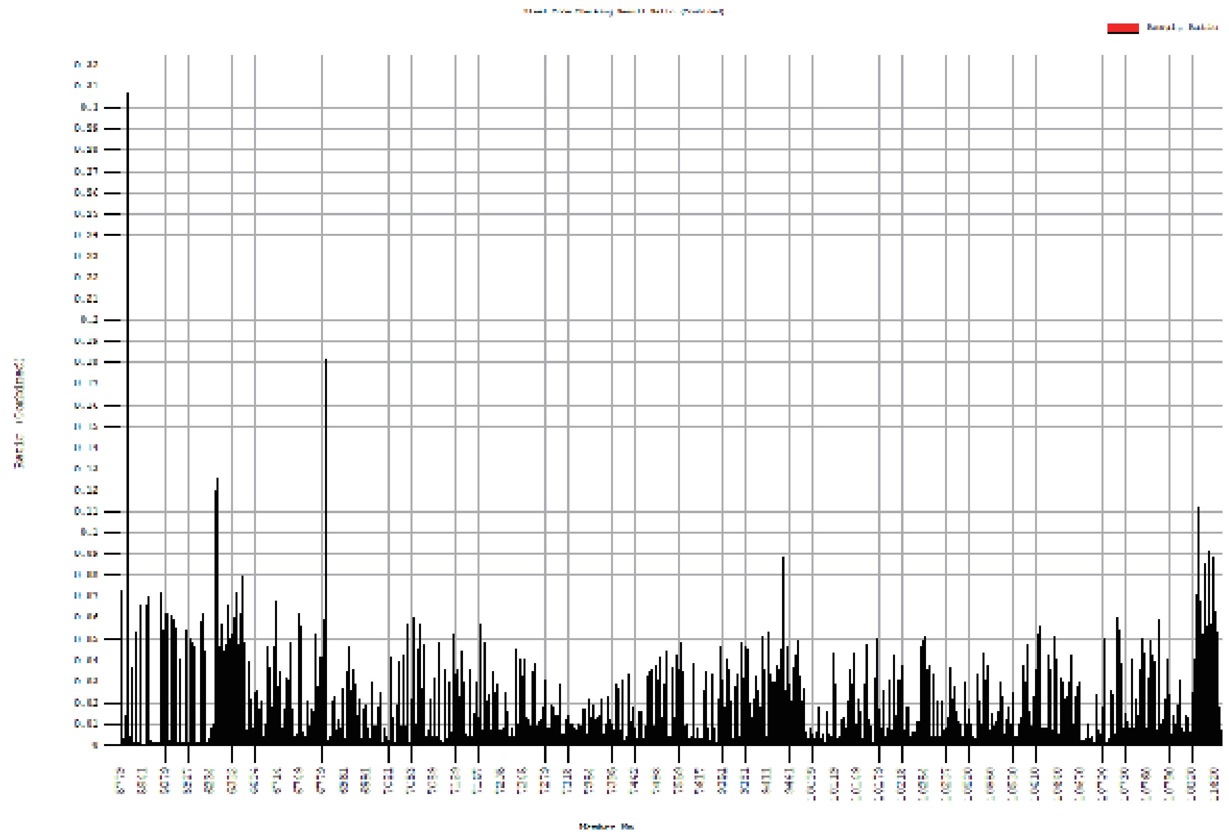
6. APPLYING
CONCRETEPANELS LOAD



7. APPLYING LIVELOAD

CODE CHECKING



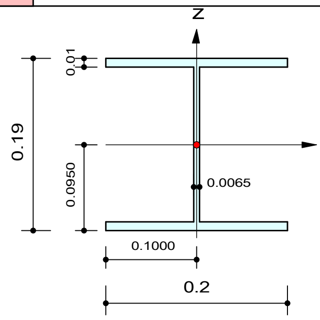


midas Gen **Steel Checking Result**

MIDAS	Company		Project Title	
	Author	zkf953	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



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

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)

3. Design Parameters

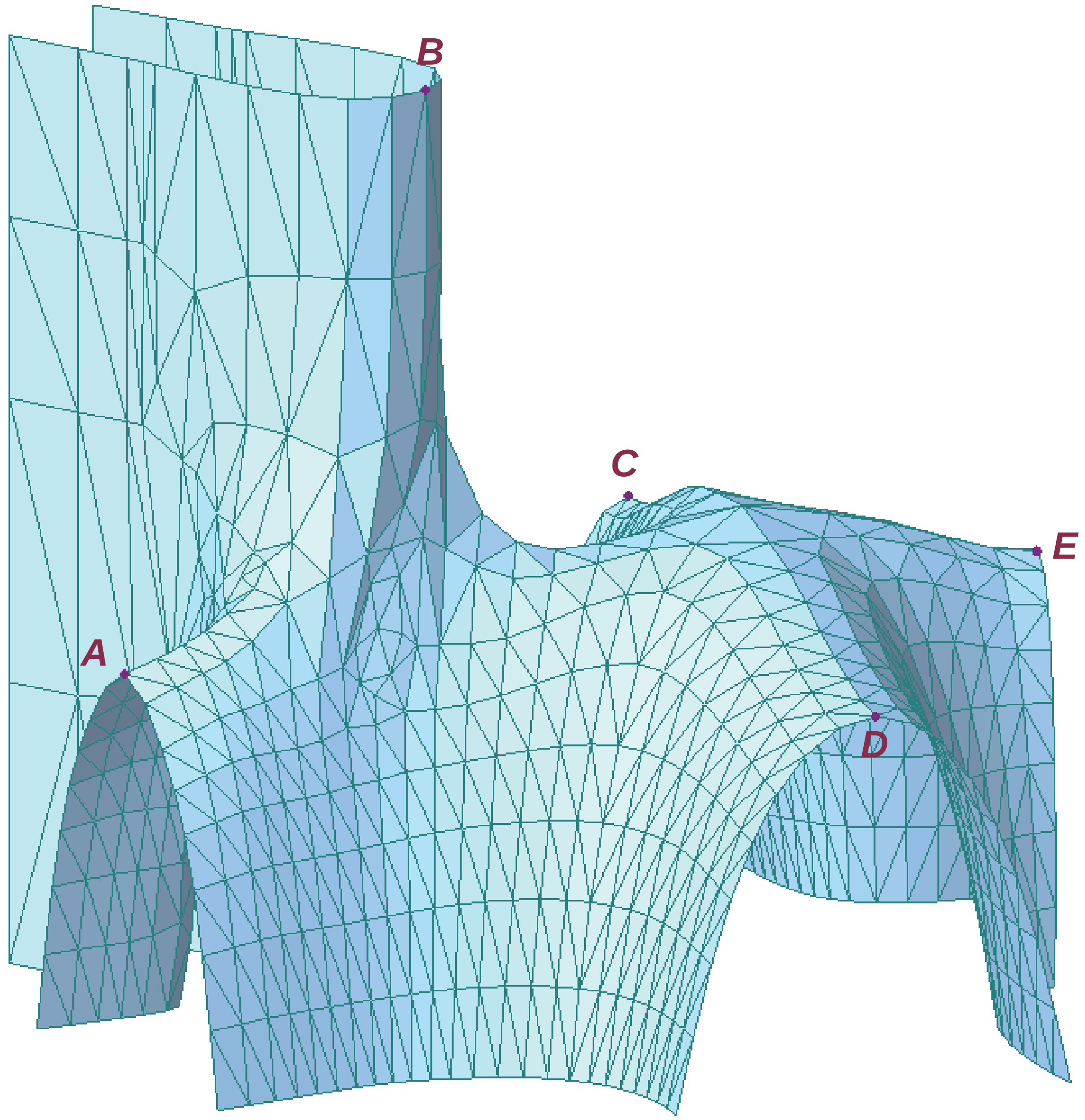
Effective Length for LTB Le = 9.37948
Effective Length Factors Ky = 1.00, Kz = 1.00
Equivalent Uniform Moment Factors / Slenderness Correction Factor
m_y = 1.00, m_z = 1.00, n = 1.00

4. Checking Result

Slenderness Ratio
KL/r = 79.0 < 200.0 (Memb:6775, LCB: 2)................................. O.K
Axial Resistance
Fc/Pc = 73.848/240.672 = 0.307 < 1.000 .... O.K
Bending Resistance
My/Mcy = 0.253/101.050 = 0.003 < 1.000 .... O.K
Mz/Mcz = 0.0599/37.7880 = 0.002 < 1.000 .... O.K
Combined Capacity (Compression+Bending)
Rmax1 = (My/Mry)^2 + Mz/Mrz
Rmax2 = MAX[Fc/Pc, My/Mcy, Mz/Mcz]
May = MIN[Mcy*(1-F/Pcy)/(1+0.5*F/Pcy), Mb*(1-F/Pcy)]
Maz = Mcz*(1-F/Pcz)/(1+0.5*F/Pcz)
Rmax = MAX[Rmax1, Rmax2, m_y*My/May + m_z*Mz/Maz] = 0.307 < 1.000 .... O.K
Shear Resistance
Fvy/Pvy = 0.000 < 1.000 .... O.K
Fvz/Pvz = 0.001 < 1.000 .... O.K

Modeling, Integrated Design & Analysis Software
http://www.MidasUser.com
Gen 2022
Print Date/Time : 09/04/2023 11:41

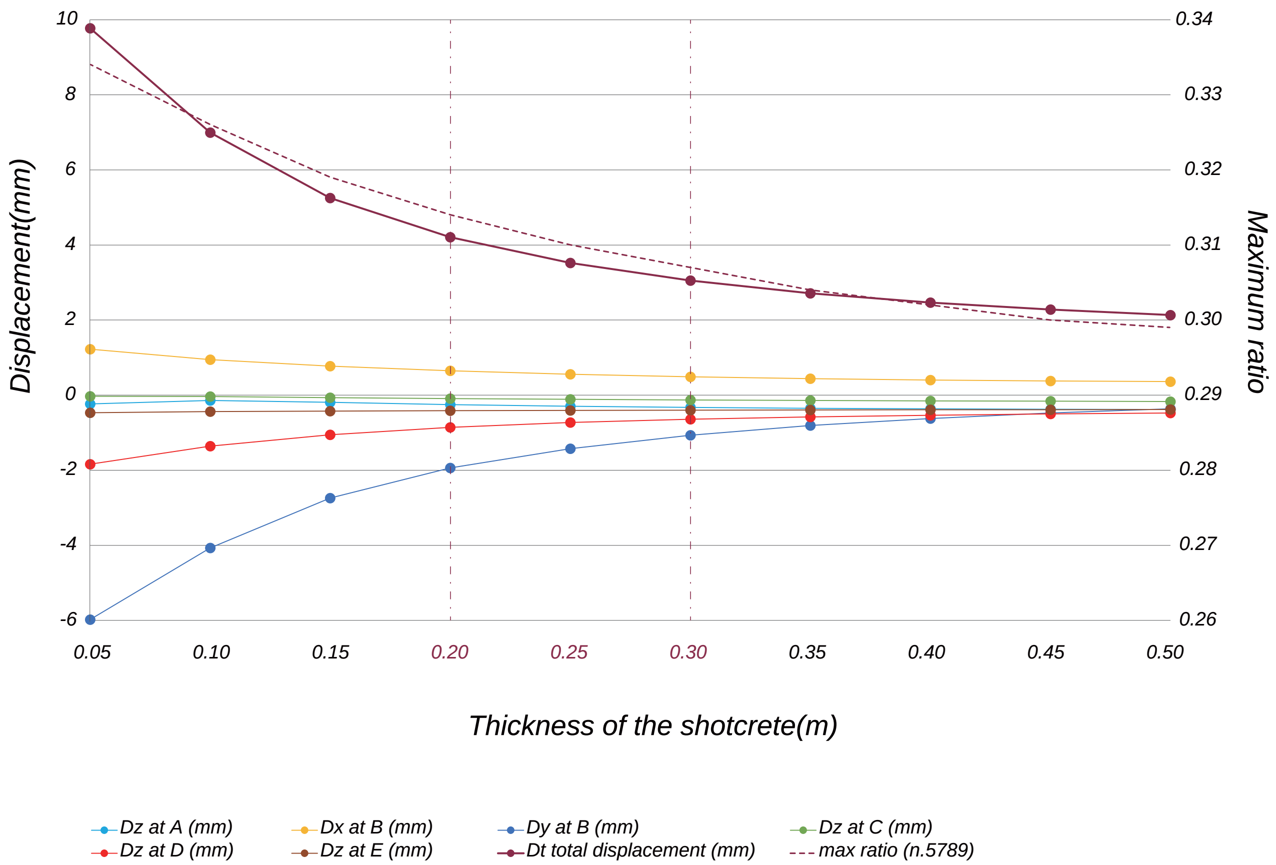
Research over the thickness of shotcrete



Key points

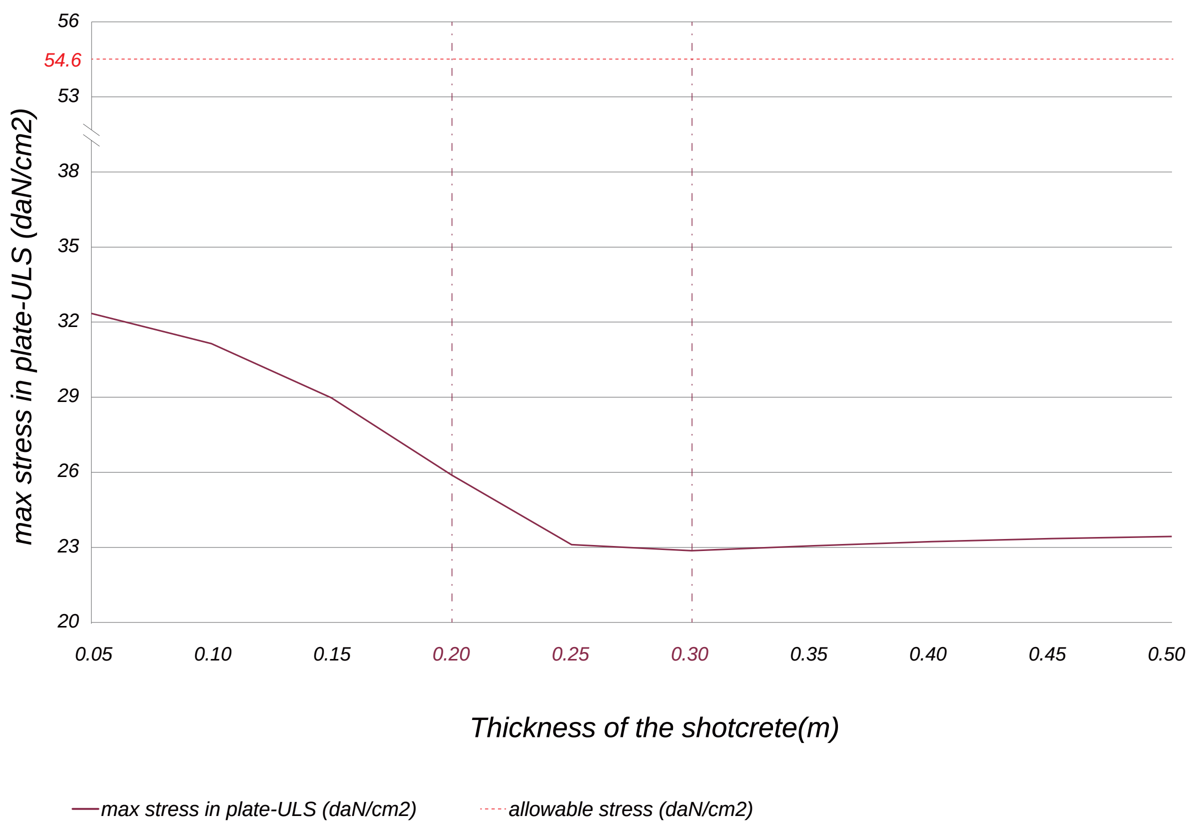
thickness of the shotcrete (m)	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50
Dz at A (mm)	-0.23552	-0.14105	-0.19099	-0.25078	-0.29574	-0.327164	-0.34903	-0.36436	-0.37517	-0.38278
Dx at B (mm)	1.225383	0.94912	0.771039	0.648217	0.556267	0.488461	0.439482	0.404548	0.379804	0.36235
Dy at B (mm)	-5.97856	-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 I



Rck 30 allowable stress (daN/cm2)	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^2)	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/cm2)	32.3485	31.1413	28.9763	25.892	23.1141	22.8691	23.0679	23.2269	23.3493	23.4397

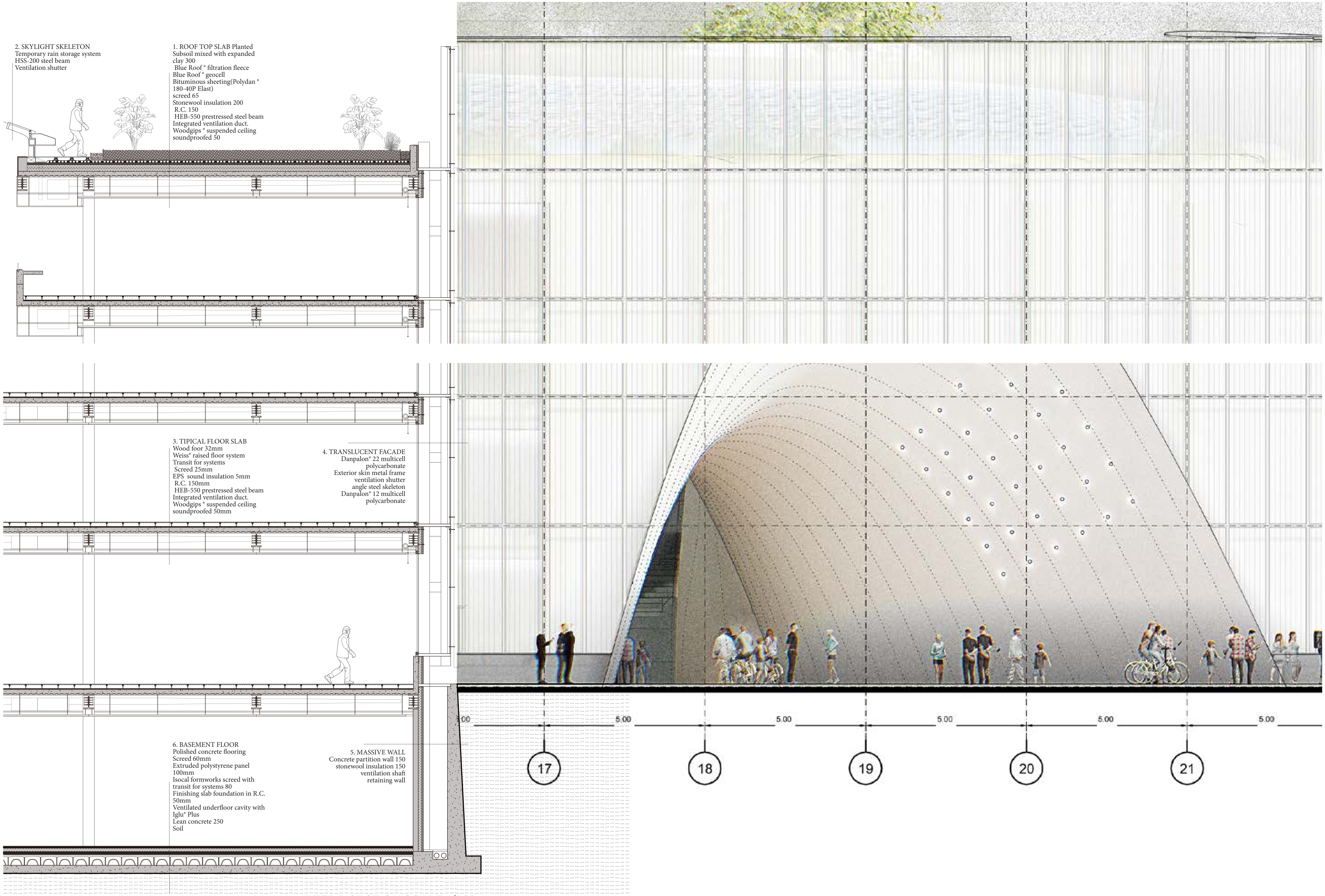
Chart II



MATERIALS AND SUSTAINABILITY PART

As explained in the poetry of the project, our design approach for the library project, we conceptualized the building as a cave system, emphasizing its protective qualities against the outdoor elements. To symbolize this refuge, we employed materials that evoke solidity, security, and warmth while also incorporating elements of translucency and brightness on the building's facades. In our project, we embraced a dual approach to material appearance, drawing inspiration from the metaphor of the cave in the fog. The organic shape of our building, reminiscent of a complex and smooth cave system, embodies urban connectivity, architectural thought, and structural technologies. To achieve this, we used concrete. The concrete mix is infused with titanium dioxide powder, resulting in a surface that mimics the mass and solidity of natural rock formations while also offering lightness and a slight reflective quality. Moreover, the inclusion of titanium dioxide imparts self-cleaning properties to the surface, reducing maintenance needs and ensuring longevity. Complementing this, we employed polycarbonate panels to cover the orthogonal facades of the building. These panels not only possess excellent thermal properties but also introduce a translucency effect, symbolizing a sense of lightness and openness. By juxtaposing these two materials, we created a dynamic interplay between solidity and translucency, grounding the building in its surroundings while also inviting visitors to engage with its organic form. The use of polycarbonate panels on the facades further serves to hide the behind building, enhancing the massive part of the architecture which visually emerges from its surroundings and beckoning visitors to explore its interior spaces.

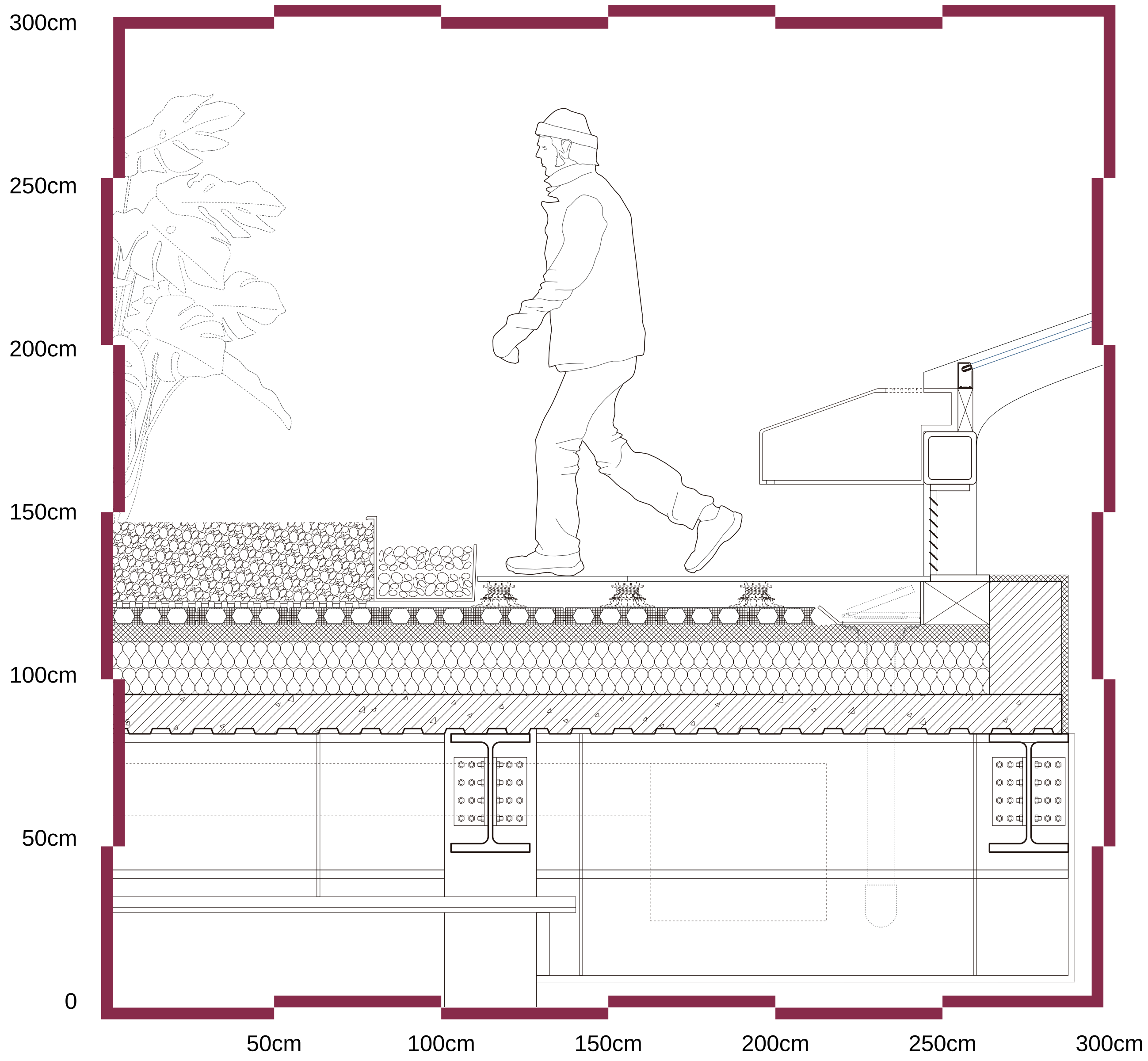


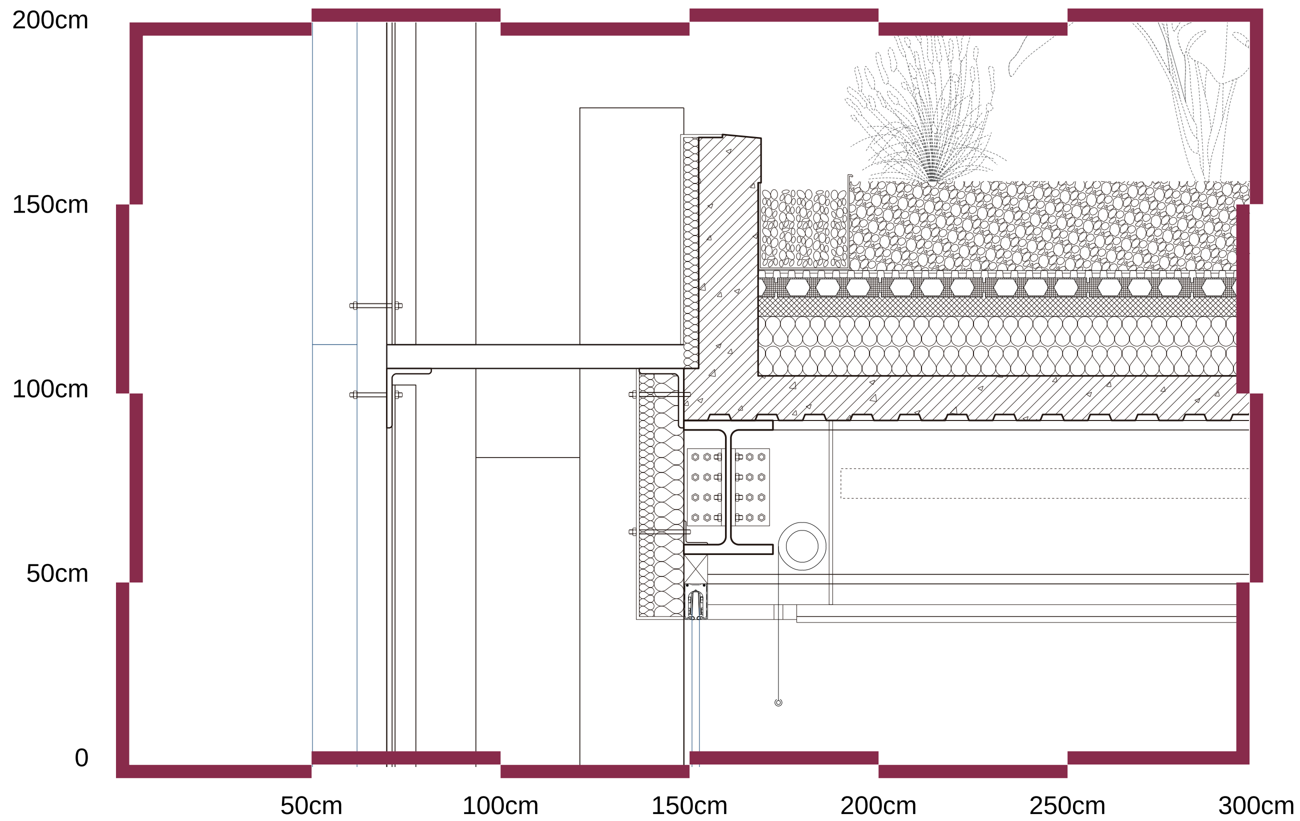
DETAIL SECTION SCALE 1/100

1.2 ROOF TOP SLAB (walkable) Scale 1/25
Wood foor 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

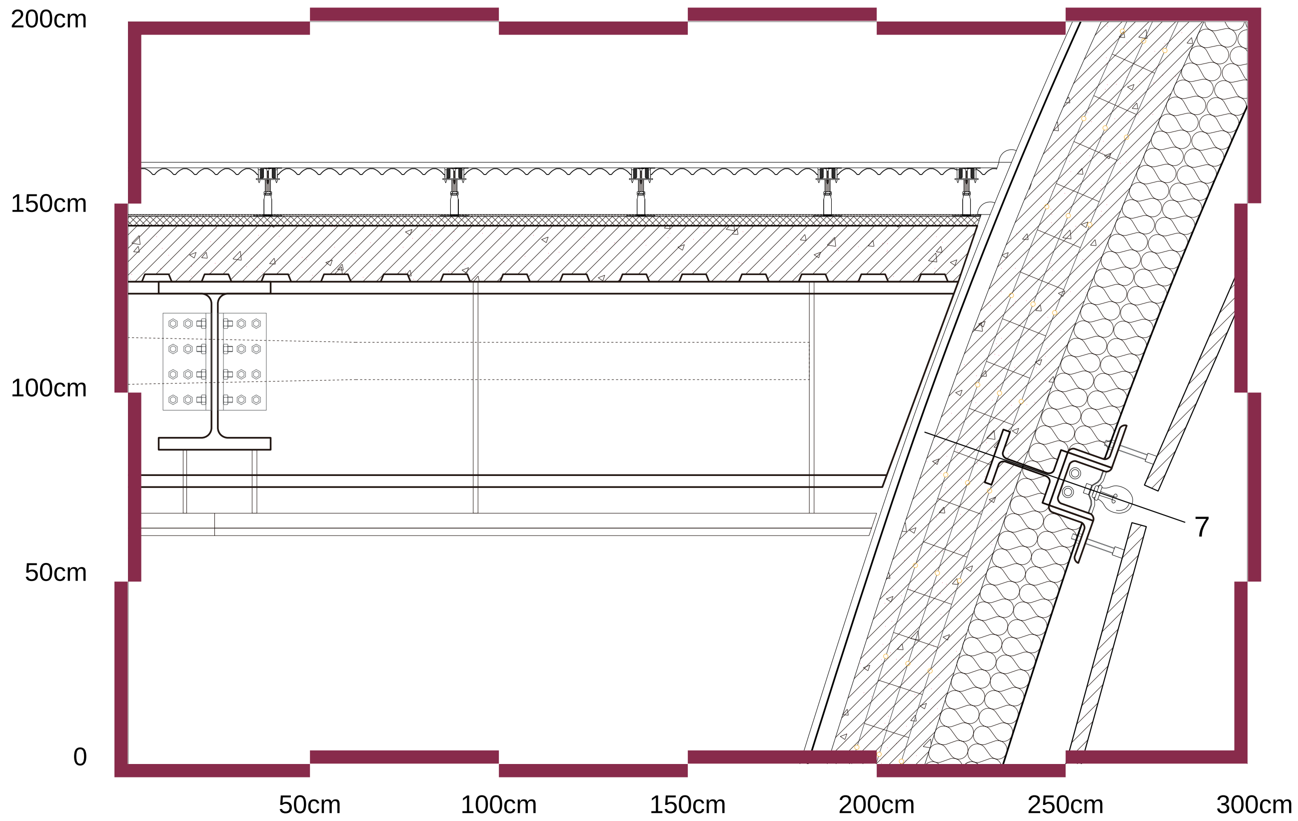
2. SKYLIGHT SKELETON
Temporary rain storage system
HSS-200 steel beam
Ventilation shutter
Aluminium skeleton
Double glazing glass



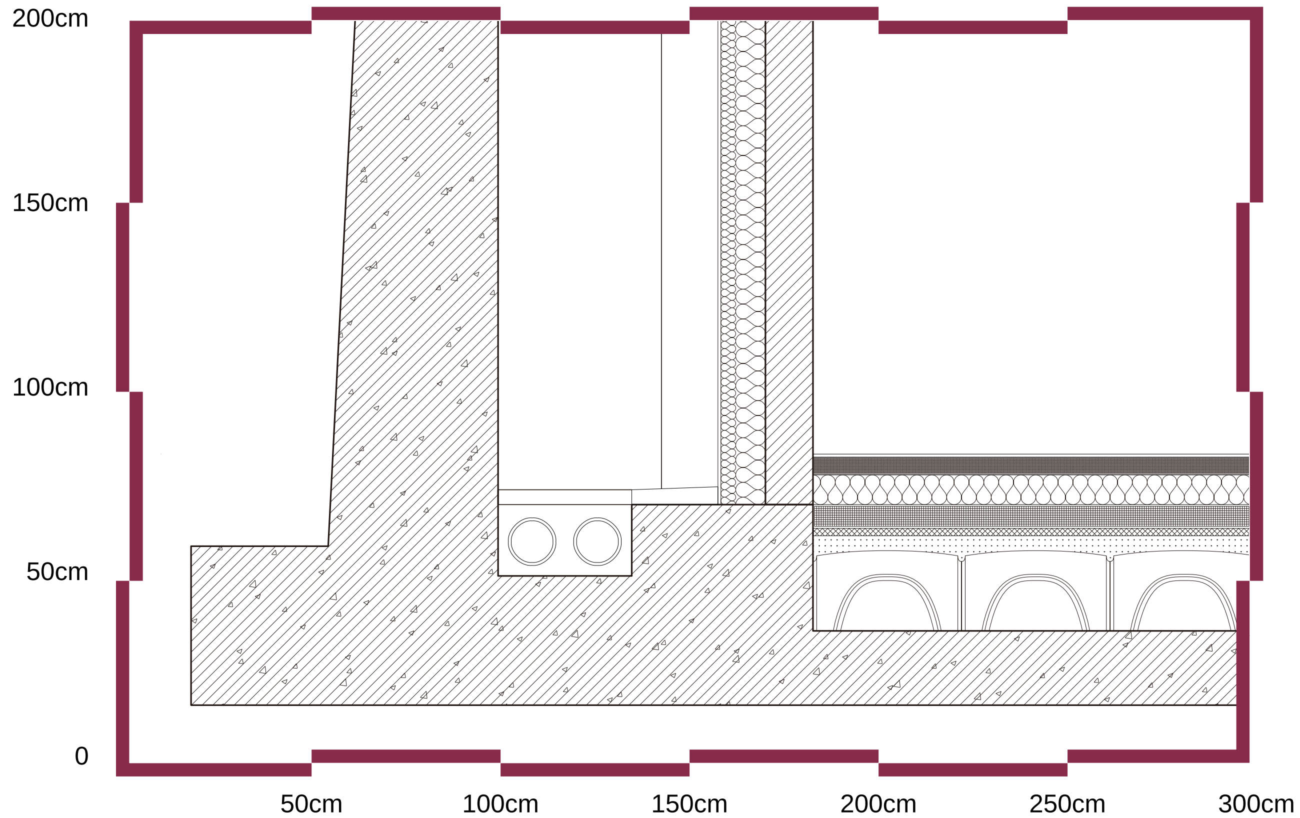
1.1 ROOF TOP SLAB (Planted) Scale 1/25
Subsoil mixed with expanded clay 300
Blue Roof ® filtration fleece
Blue Roof ® geocell
Bituminous sheeting(Polydan ® 180-40P Elast)
screed 65
Stonewool insulation 200
R.C. 150
HEB-550 prestressed steel beam
Integrated ventilation duct.
Woodgips ® suspended ceiling soundproofed 50



7. BIONIC SHAPE SHELL Scale 1/25
Interior concrete plaster finishing
Screed 50mm
Shotcrete 200-300mm
Rebars
HEA-200 Shell skeleton
Stonewool insulation 200mm
Transit for systems
Light bulb
Suspendend ceiling panel
Exterior concrete plaster finishing



6. BASEMENT FLOOR Scale 1/25
Polished concrete flooring
Screed 60mm
Extruded polystyrene panel 100mm
Isocal formworks screed with transit for systems 80
Finishing slab foundation in R.C. 50mm
Ventilated underfloor cavity with Iglu® Plus
Lean concrete 250
Soil



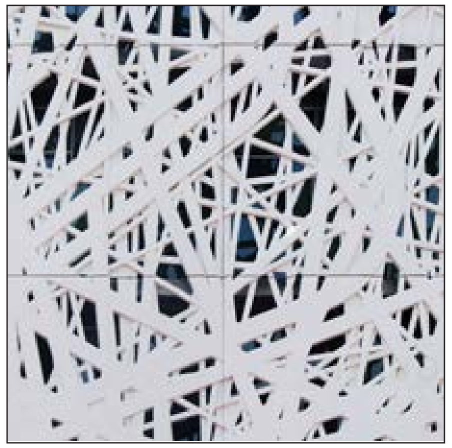
BLUEROOF SYSTEM
Sorting water above the waterfroofing layer Radmat Geocell Blue roof system provides a method of regulated control to meet a limited discharge consent in accordance with SuDS design principles.

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
Raied 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.

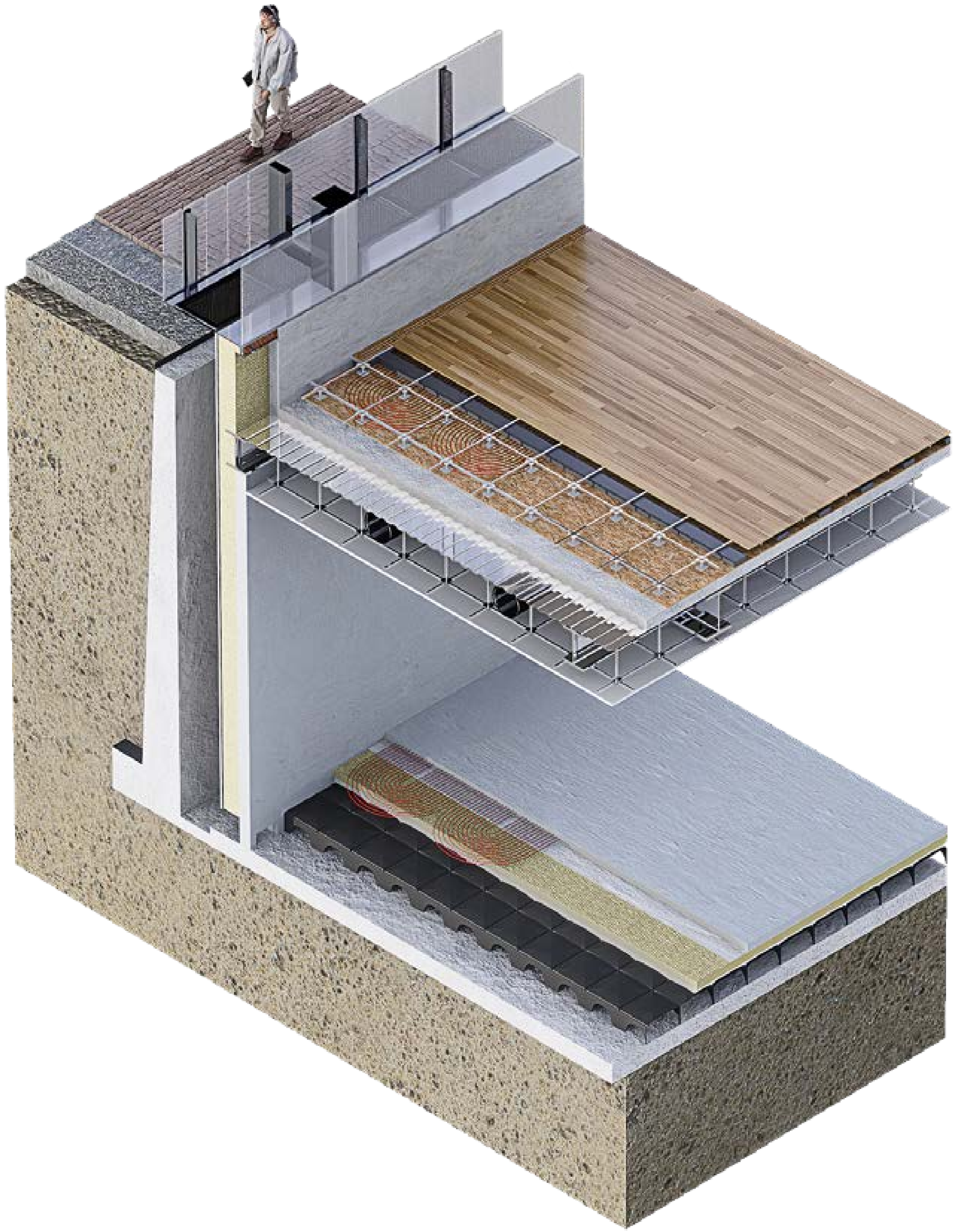
POLYCARBONATE FACADE SYSTEM
Danpalon® offers innnovative and flexible solutions for the building envelope, which ensure the comfort of natural light and high-quality thermal performance.



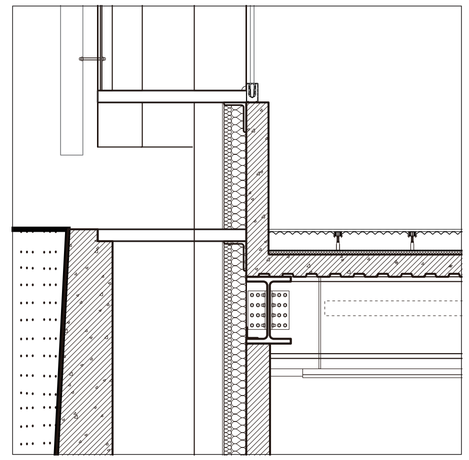
TITANIUM DIOXIDE POWDER
A mixture of cement and titanium dioxide, captures pollution and converts it into a harmless salt that easily rinses off the walls when it rains keeping the surface clean.
More than that, this adjuvant makes the concrete coloured white.

IGLU SYSTEM
The modular, plastic iglù 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.

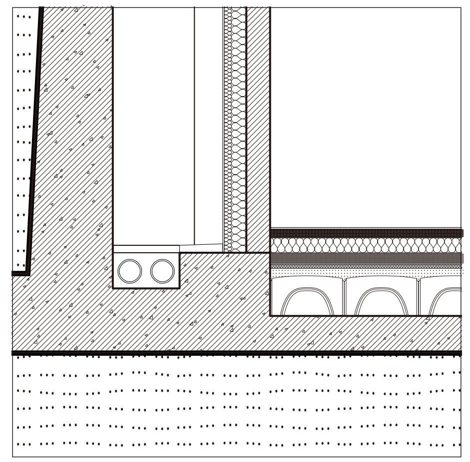
ROCKWOOL INSULATION
the project both uses rigid and soft insulation panels. the rigid panels used as unreusable concrete formwork when spraying the concrete of the bionic shape shell.
while the soft insulation is used on a second step to reach the 200mm thickness required for the external insulation.



4. TRANSLUCENT FACADE
Danpalon® 22 multicell polycarbonate
Exterior skin metal frame
ventilation shutter
angle steel skeleton
Danpalon® 12 multicell polycarbonate



6. BASEMENT FLOOR
Polished concrete flooring
Screed 60mm
Extruded polystyrene panel 100mm
Isocal formworks screed with transit for systems 80
Finishing slab foundation in R.C. 50mm
Ventilated underfloor cavity with Iglu® Plus
Lean concrete 250
Soil

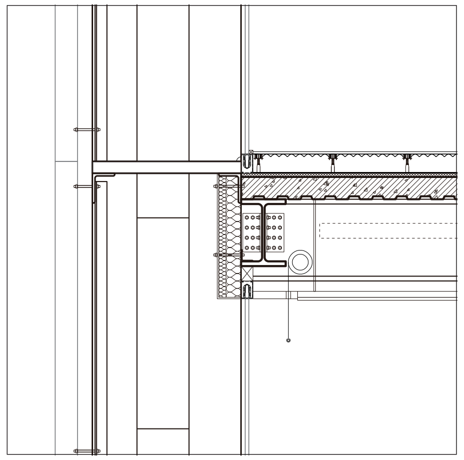


In our architectural design process, meticulous attention to detail was required to achieve a cohesive and visually compelling final product not only at the macro scale but also at the micro one.

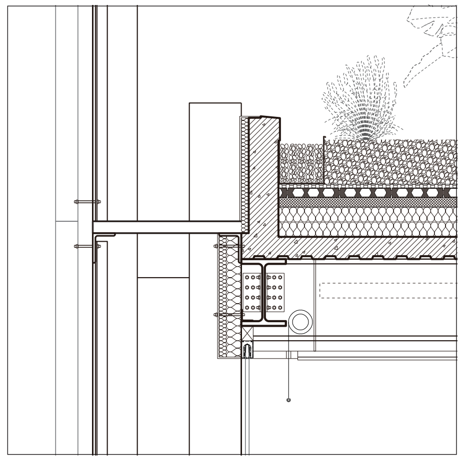
To this finality, we dedicated significant effort to the drawing of architectural details, focusing particularly on the facade elements of both the organic massive shape and the polycarbonate facade. The translucent facade, functions as a double-vented facade, we meticulously delineated the intricate components and mechanisms involved. Comprising two layers of polycarbonate panels separated by a ventilated space, this facade system offers thermal insulation while allowing for controlled airflow. At the top of the facade, a sophisticated system enables us to regulate air circulation, providing flexibility to either retain warmth between the polycarbonate layers or facilitate natural cooling through the venturi effect, driven by differences in air pressure.

We conducted studies of the architectural detail in a close scale section and plan, spanning from the basement floor to the rooftop. This comprehensive analysis allowed us to fully understand the vertical integration of the facade system and its interaction with other building elements. We meticulously documented the various layers, materials, and structural components involved in the facade assembly. This detailed examination enabled us to identify potential challenges and opportunities for optimization and technical feasibility. Moreover, by visualizing the facade system in sections, we gained valuable insights into its spatial relationships with interior spaces, circulation pathways, and mechanical systems, informing our decision-making process and enhancing overall design coherence.

3. TIPICAL FLOOR SLAB
Wood foor 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



1. ROOF TOP SLAB
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



Library shear wall composition

Exterior wall
created on 26.2.2023

Thermal protection

U = 0,16 W/(m²K)

GEG 2020 Bestand*: U<0,24 W/(m²K)

excellent insufficient

Moisture proofing

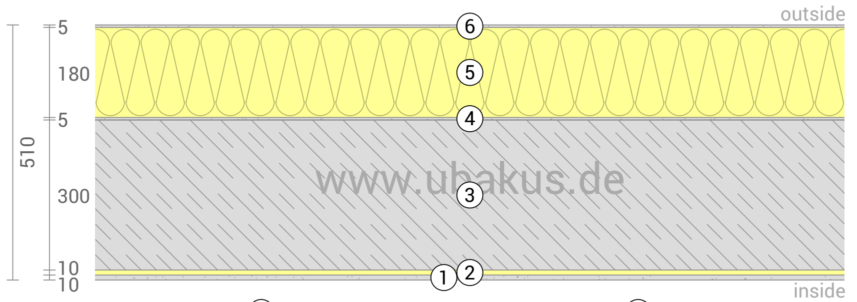
No condensate

excellent insufficient

Heat protection

Temperature amplitude damping: >100
phase shift: non relevant
Thermal capacity inside: 576 kJ/m²K

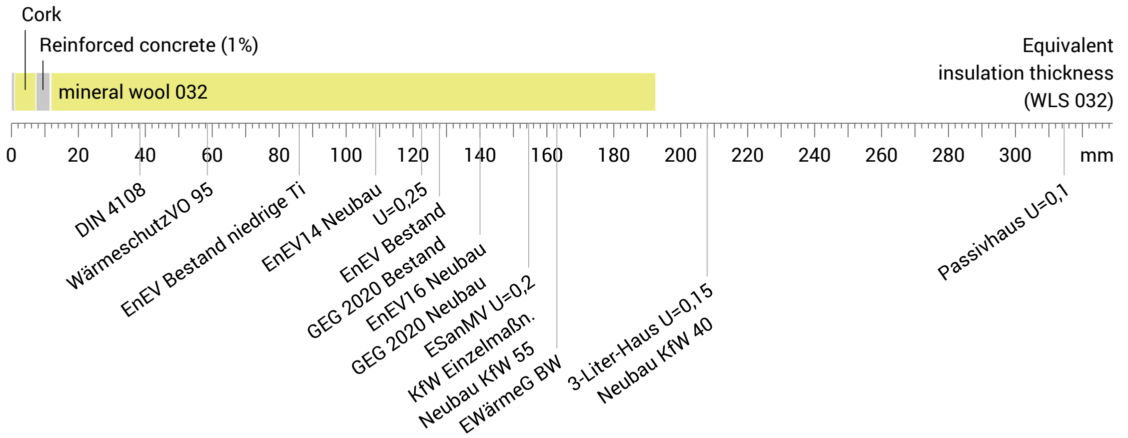
excellent insufficient



1. Gypsum plaster (10 mm)
2. Cork (10 mm)
3. Reinforced concrete (300 mm)
4. Klebe- und Armiermörtel (5 mm)
5. mineral wool 032 (180 mm)
6. Klebe- und Armiermörtel (5 mm)

Impact of each layer and comparison to reference values

For the following figure, the thermal resistances of the individual layers were converted in millimeters insulation. The scale refers to an insulation of thermal conductivity 0,032 W/mK.

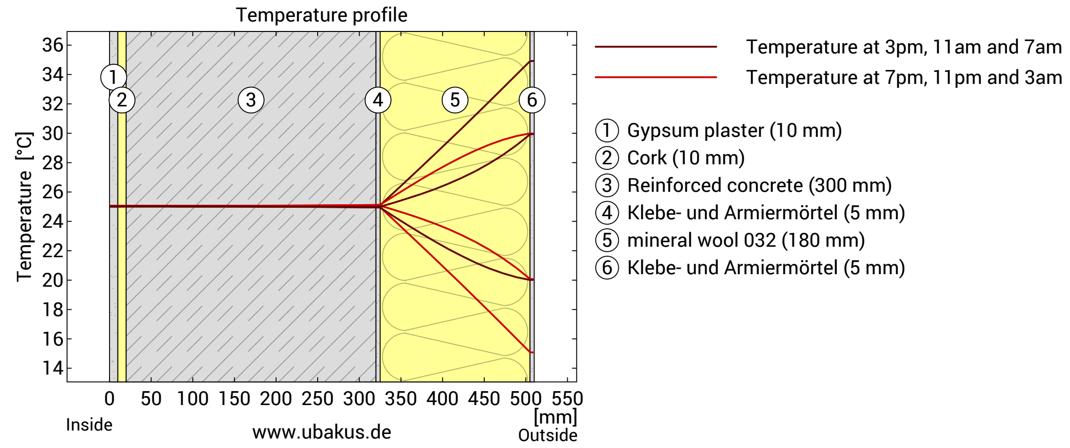


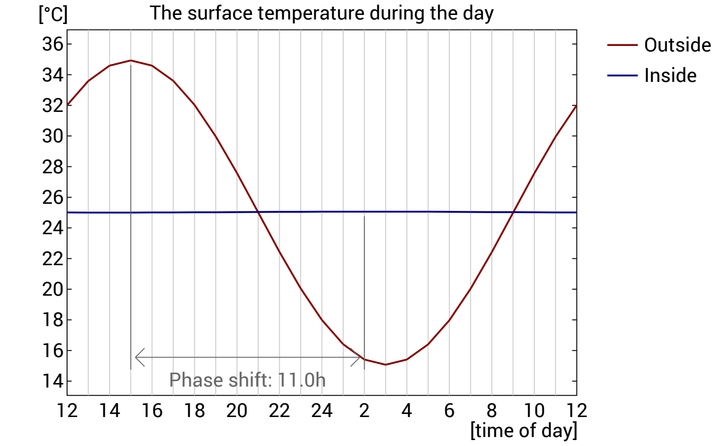
Inside air :	20,0°C / 50%		Thickness:	51,0 cm
Outside air:	-5,0°C / 80%	sd-value: 24,4 m	Weight:	719 kg/m²
Surface temperature.:	19,0°C / -4,8°C		Heat capacity:	638 kJ/m²K

*Vergleich mit dem Höchstwert gemäß GEG 2020 für erstmaligen Einbau, Ersatz oder Erneuerung von Außenwänden (Anlage 7, Zeile 1a,1b).

Heat protection

The following results are properties of the tested component alone and do not make any statement about the heat protection of the entire room:





Top: Temperature profile within the component at different times. From top to bottom, brown lines: at 3 pm, 11 am and 7 am and red lines at 7 pm , 11 pm and 3 am.
Bottom: Temperature on the outer (red) and inner (blue) surface in the course of a day. The arrows indicate the location of the temperature maximum values . The maximum of the inner surface temperature should preferably occur during the second half of the night.

Phase shift*	non relevant	Heat storage capacity (whole component):	638 kJ/m²K
Amplitude attenuation **	>100	Thermal capacity of inner layers:	576 kJ/m²K
TAV ***	0,003		

* The phase shift is the time in hours after which the temperature peak of the afternoon reaches the component interior.
** The amplitude attenuation describes the attenuation of the temperature wave when passing through the component. A value of 10 means that the temperature on the outside varies 10x stronger than on the inside, e.g. outside 15-35 °C, inside 24-26 °C.
*** The temperature amplitude ratio TAV is the reciprocal of the attenuation: TAV = 1 / amplitude attenuation

Note: The heat protection of a room is influenced by several factors, but essentially by the direct solar radiation through windows and the total amount of heat storage capacity (including floor, interior walls and furniture). A single component usually has only a very small influence on the heat protection of the room.

ubakus All statements without guarantee

Library shear roof slab composition_

Flat roof
created on 26.2.2023

Thermal protection

U = 0,12 W/(m²K)

EnEV Bestand*: U<0,2 W/(m²K)

excellent insufficient

Moisture proofing

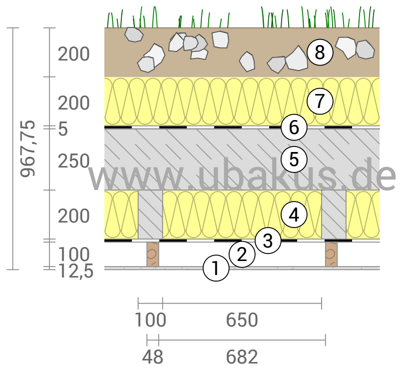
No condensate

excellent insufficient

Heat protection

Temperature amplitude damping: >100
phase shift: non relevant
Thermal capacity inside: 485 kJ/m²K

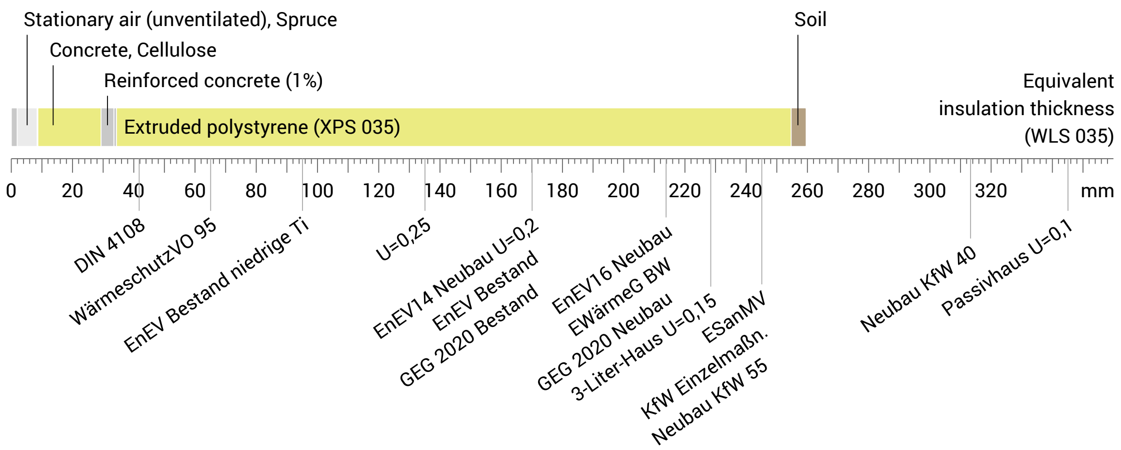
excellent insufficient



① Gypsum board (12,5 mm)
② Stationary air (100 mm)
③ pro clima INTELLO®
④ Cellulose (200 mm)
⑤ Reinforced concrete (250 mm)
⑥ Bitumen membranes
⑦ Extruded polystyrene (200 mm)
⑧ Soil (200 mm)

Impact of each layer and comparison to reference values

For the following figure, the thermal resistances of the individual layers were converted in millimeters insulation. The scale refers to an insulation of thermal conductivity 0,035 W/mK.



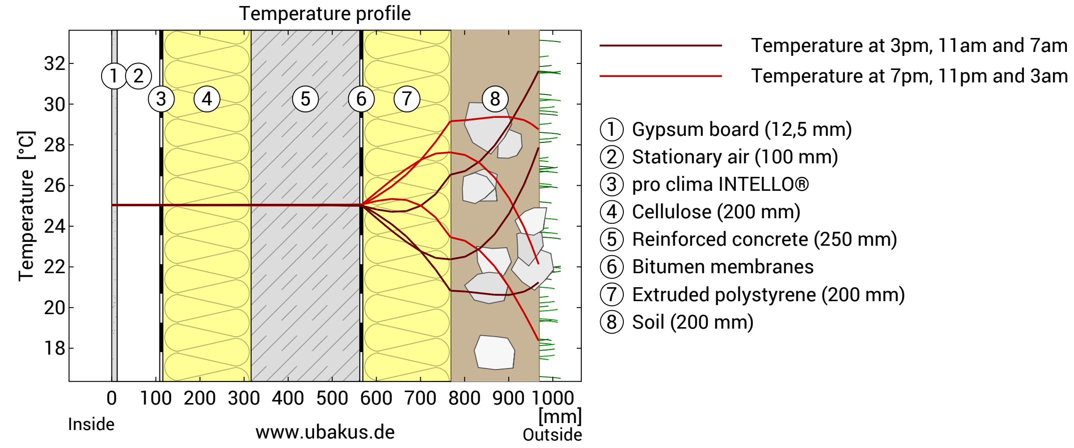
Inside air :	20,0°C / 50%			Thickness:	96,8 cm
Outside air:	-5,0°C / 80%	sd-value:	302,9 m	Weight:	1032 kg/m²
Surface temperature.:	18,8°C / -4,9°C			Heat capacity:	952 kJ/m²K

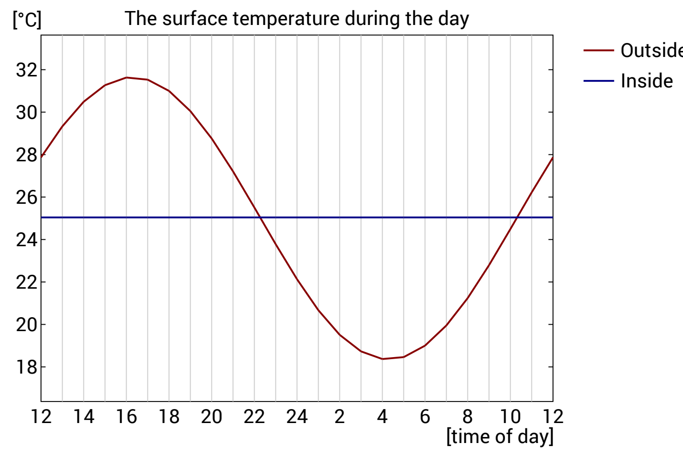
*Vergleich mit dem Höchstwert gemäß EnEV 2014/2016 für erstmaligen Einbau, Ersatz oder Erneuerung von Dachflächen mit Abdichtung (Anlage 3, Tabelle 1, Zeile 4b).

ubakus All statements without guarantee

Heat protection

The following results are properties of the tested component alone and do not make any statement about the heat protection of the entire room:





Top: Temperature profile within the component at different times. From top to bottom, brown lines: at 3 pm, 11 am and 7 am and red lines at 7 pm , 11 pm and 3 am.
Bottom: Temperature on the outer (red) and inner (blue) surface in the course of a day. The arrows indicate the location of the temperature maximum values . The maximum of the inner surface temperature should preferably occur during the second half of the night.

Phase shift*	non relevant	Heat storage capacity (whole component):	952 kJ/m²K
Amplitude attenuation **	>100	Thermal capacity of inner layers:	485 kJ/m²K
TAV ***	0,000		

* The phase shift is the time in hours after which the temperature peak of the afternoon reaches the component interior.
** The amplitude attenuation describes the attenuation of the temperature wave when passing through the component. A value of 10 means that the temperature on the outside varies 10x stronger than on the inside, e.g. outside 15-35 °C, inside 24-26 °C.
*** The temperature amplitude ratio TAV is the reciprocal of the attenuation: TAV = 1 / amplitude attenuation

Note: The heat protection of a room is influenced by several factors, but essentially by the direct solar radiation through windows and the total amount of heat storage capacity (including floor, interior walls and furniture). A single component usually has only a very small influence on the heat protection of the room.

The calculations presented above have been created for a 1-dimensional cross-section of the component.

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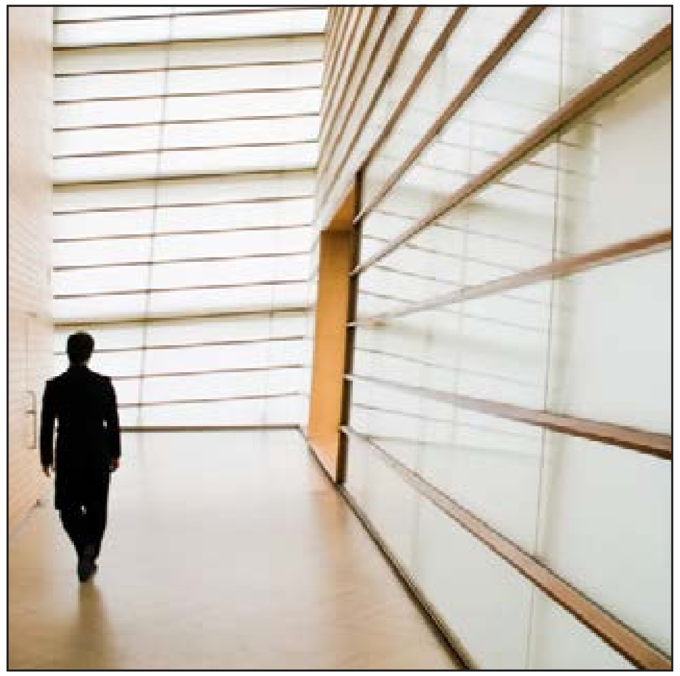
INSPIRATION FOR THE MATERIAL IMPRESSIONS
HERZOG & DE MEURON, ELBPHILHARMONIE HAMBOURG

© Yueqi Jazzy Li

INSPIRATION TRANSITION BETWEEN CYLINDRICAL HOLE AND THE FACADE
TADAO ANDO, HOLY THEATER SHANGHAI



© Fernando Carrasco

RAFAEL MONEO, SAN SEBASTIAN PALACIO KURSAAL

© Fabrice Fouillet

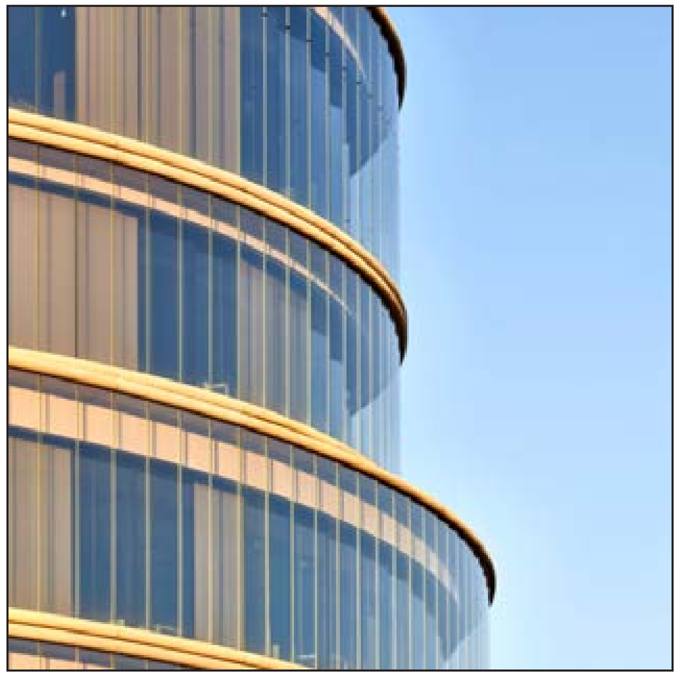
RAFAEL MONEO, SAN SEBASTIAN PALACIO KURSAAL

© Lucas K. Doolan

INSPIRATION FOR THE CONSTRUCTION APPROACH
TOYO ITO, TAICHUNG METROPOLITAN OPERA HOUSE

© Peter Durant

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



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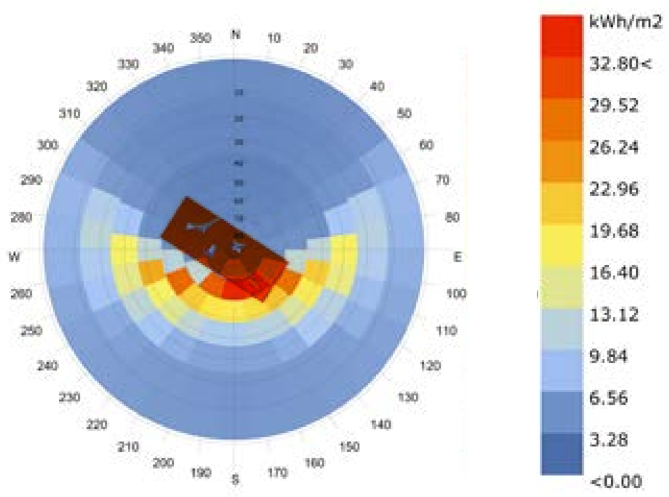
FACADE DETAIL RENDERING: DAYTIME

FACADE DETAIL RENDERING: NIGHT TIME

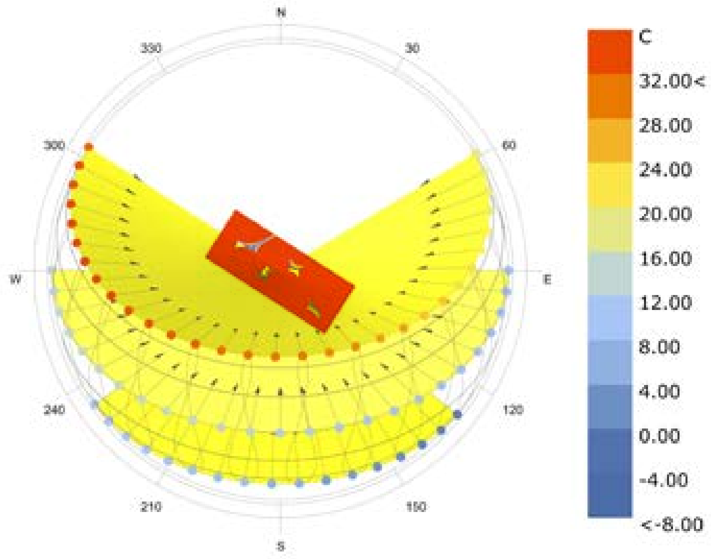
Utilizing renders and visualizations throughout both daylight and evening hours is instrumental in comprehensively exploring the transparency and aesthetic impact of the facade, particularly when illuminated. By simulating various lighting conditions, we can evaluate how the facade interacts with artificial lighting in the evening and natural light during the day. This approach enables us to assess the interplay between transparency, materials, and lighting design, offering valuable insights into the building's visual appearance and ambiance at different times of the day. Additionally, it allows for the refinement of design elements to optimize both functional performance and aesthetic appeal, ultimately contributing to the creation of a dynamic and visually engaging architectural expression.

Creating renders that incorporate the building within its surrounding context allows us to capture the overall impression of the area and understand how the structure fits within its environment. By integrating the building into its surroundings, we gain a sense of its proportions, scale, and visual impact within the broader context of the site. This approach provides stakeholders with a realistic depiction of how the building interacts with neighboring landscapes, structures, and urban fabric.

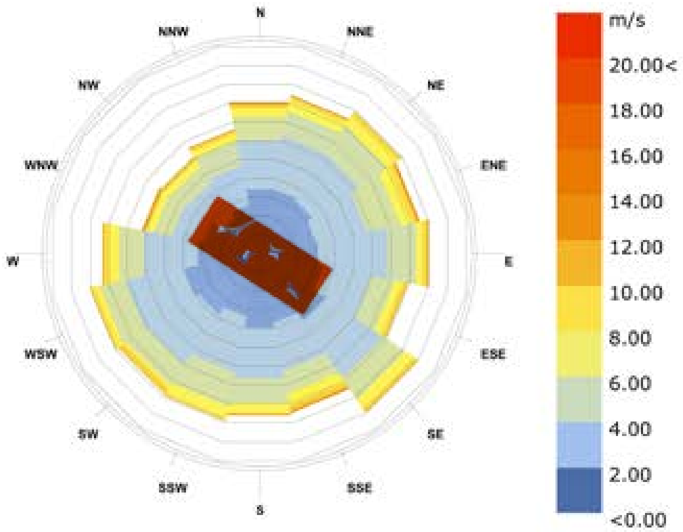
Additionally, it facilitates informed decision-making regarding design elements such as orientation, massing, and landscaping, ensuring that the building harmonizes effectively with its surroundings while contributing positively to the overall functional and aesthetic qualities of the area.



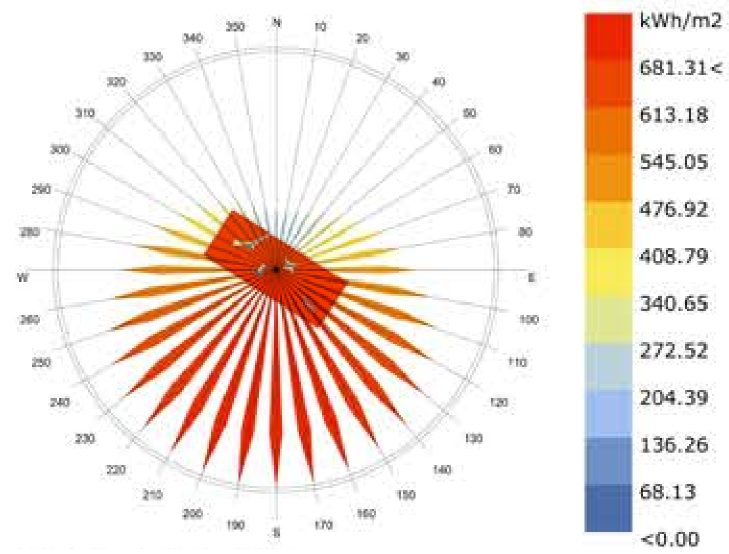
SUN SPHERE RADIATION



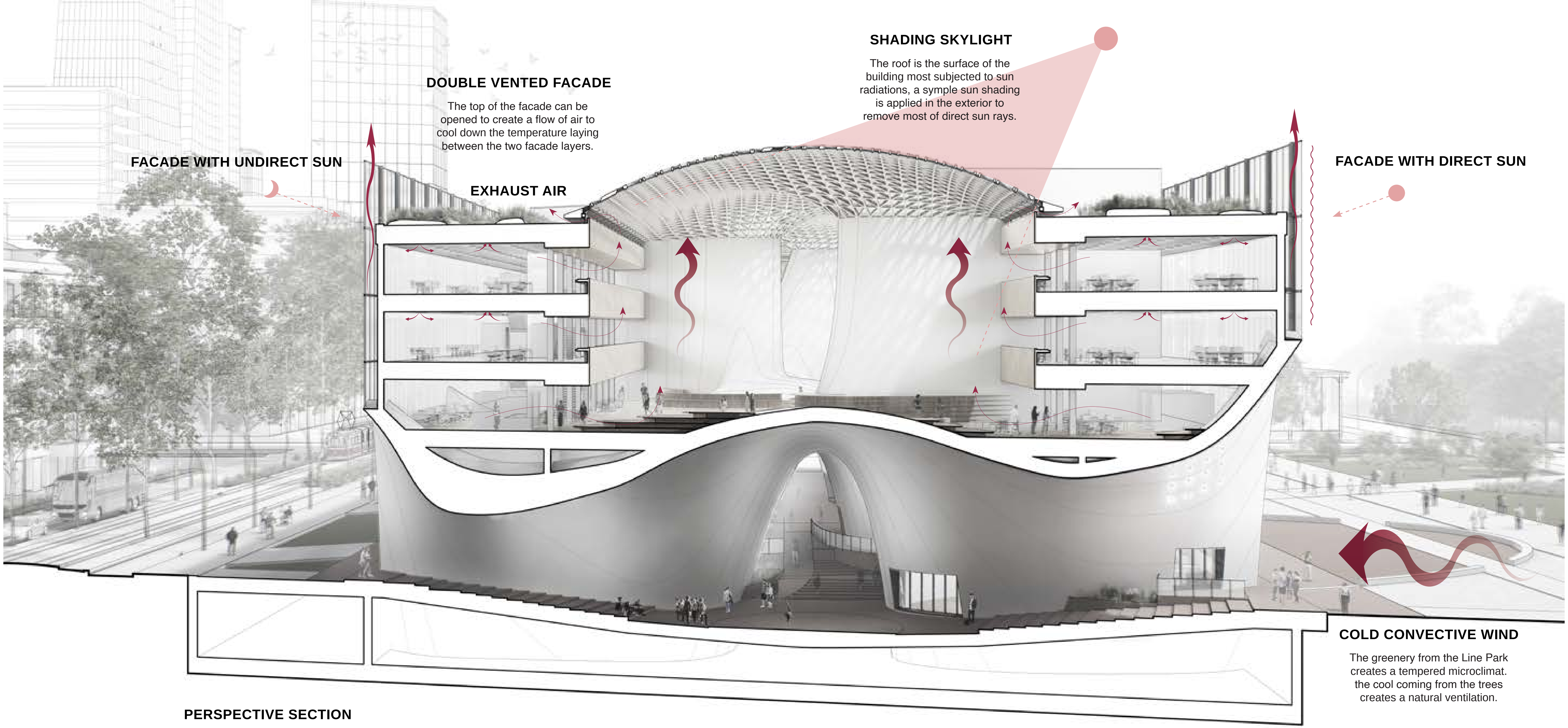
SUN PATH



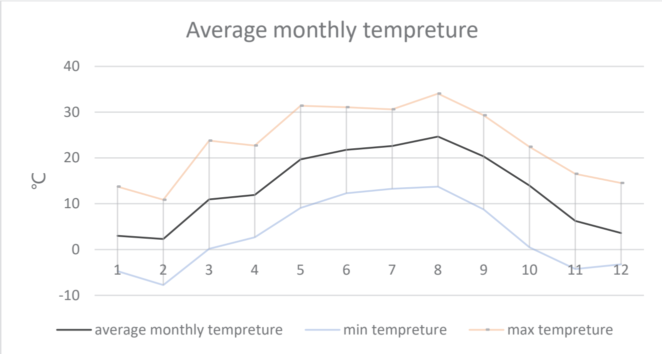
WIND ROSE

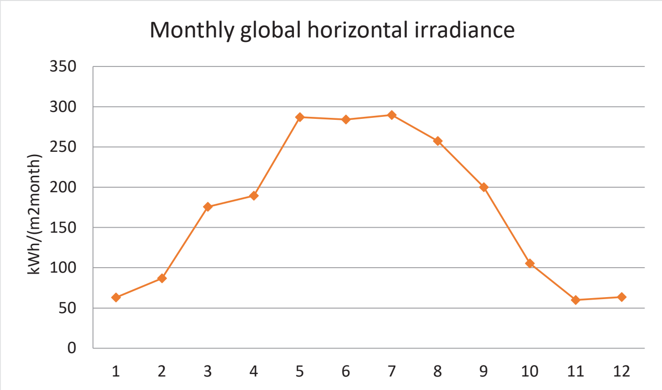


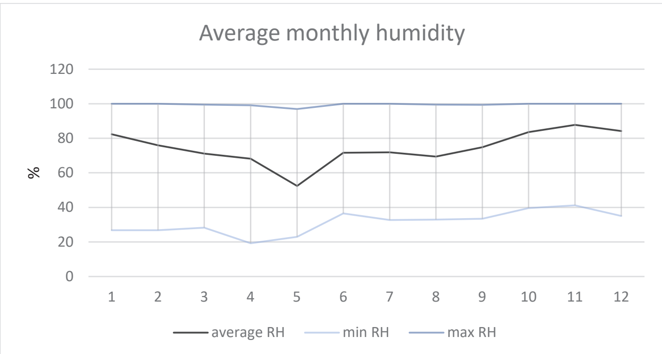
RADIATION

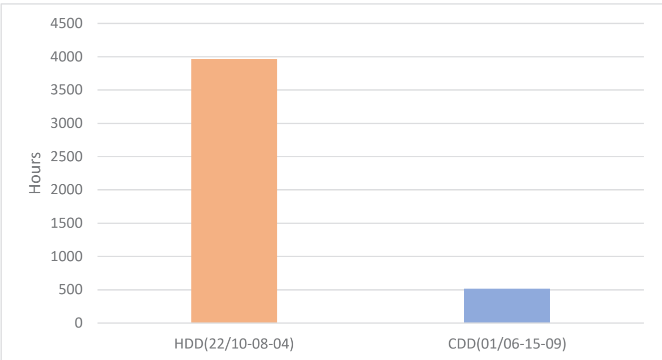


PERSPECTIVE SECTION





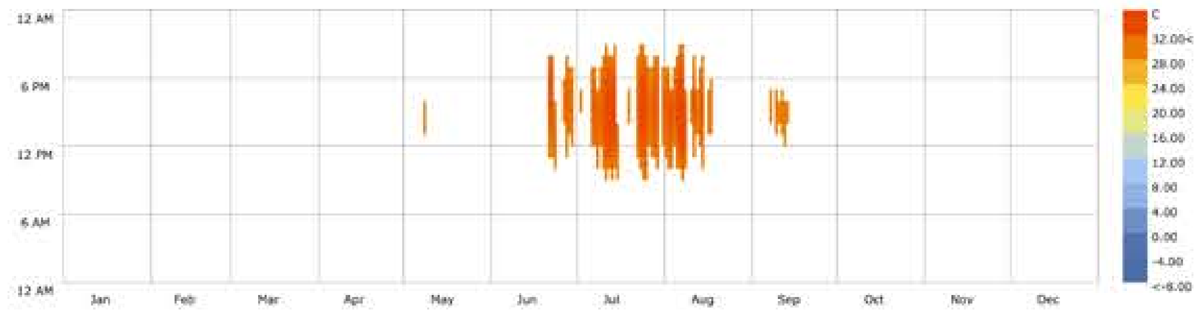




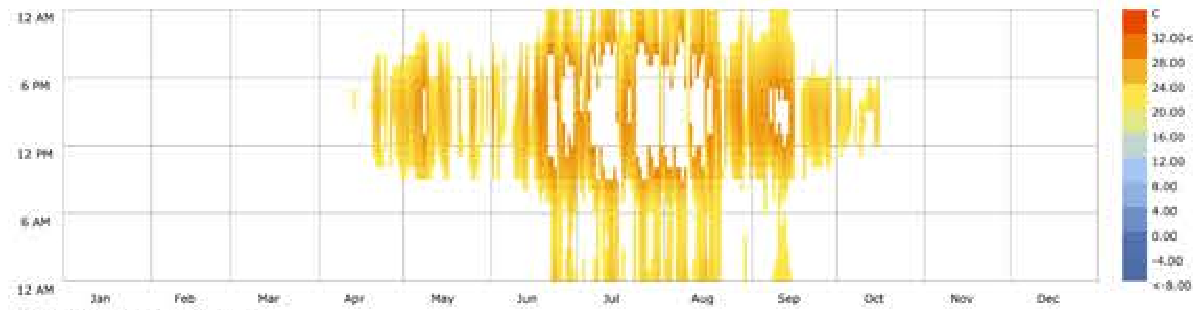
Technology

To conduct our weather analysis for the library site, we used weather EPW data available online and coming from the Linate Airport. Our analysis revealed crucial patterns regarding outdoor temperatures, highlighting the predominant need for heating over cooling in Milan's climate. With approximately 4000 heating hours compared to only 500 cooling hours, heating emerged as a primary concern for ensuring interior comfort throughout the year. However, we also recognized the potential challenges posed by direct sun exposure, particularly in terms of solar radiation-induced overheating within the building. As such, our weather analysis underscored the importance of adopting a holistic approach to environmental design, balancing the need for effective heating strategies with measures to mitigate solar heat gain and ensure optimal thermal comfort for occupants.

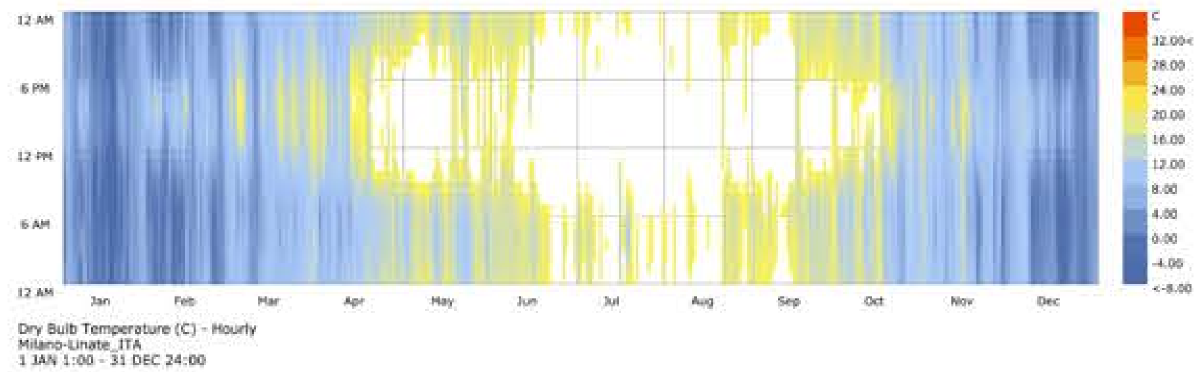
CDD-COOLED PERIOD >27°C

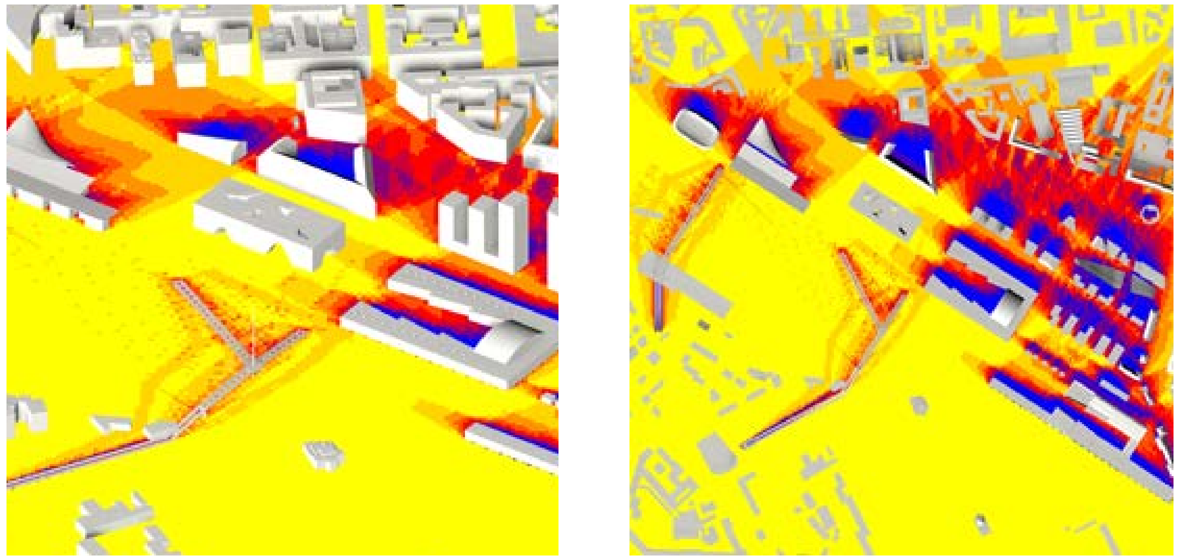


TEMPERED PERIOD

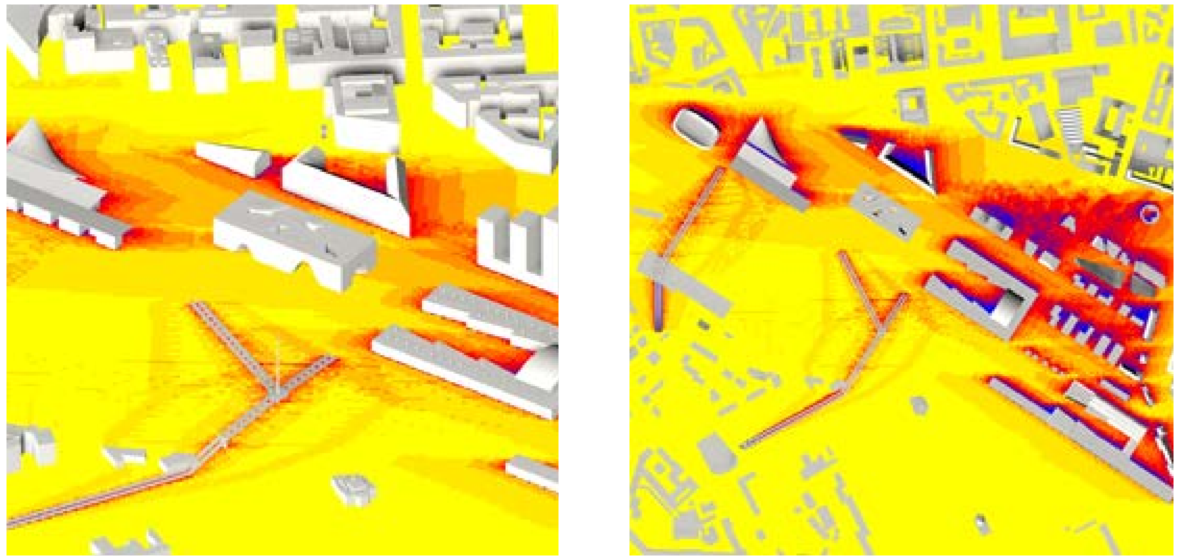


HDD-HEATED PERIOD <19°C

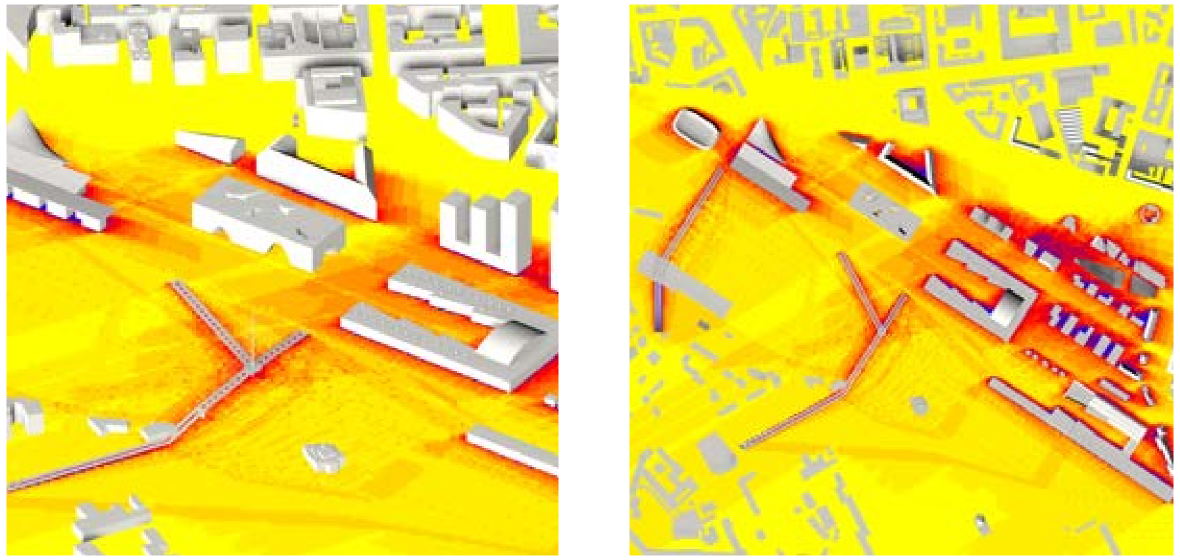




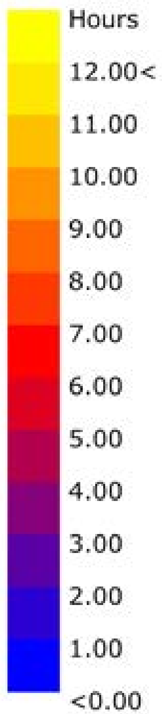
WINTER

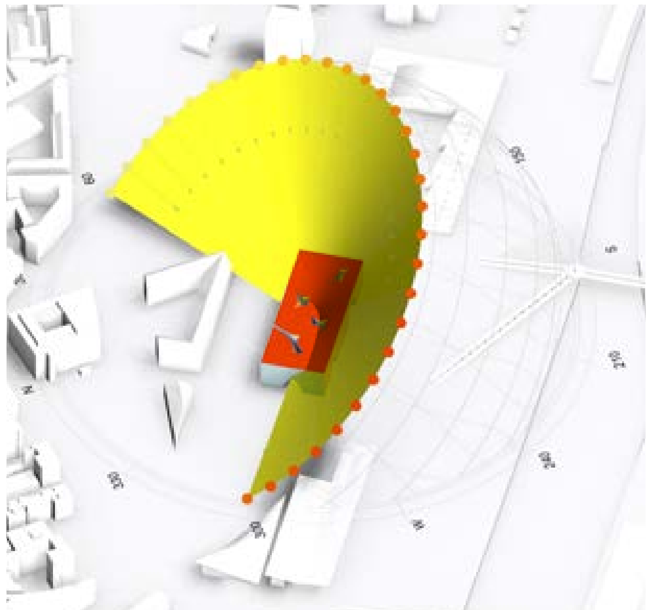


MIDDLE-SEASON



SUMMER





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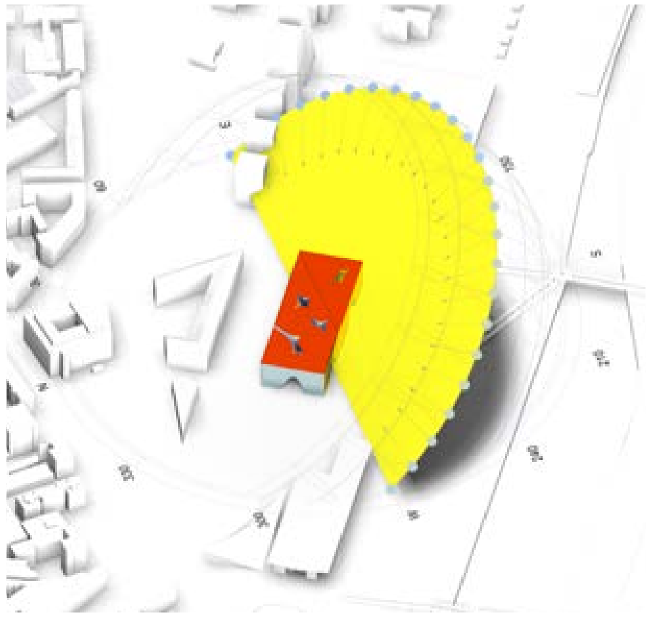
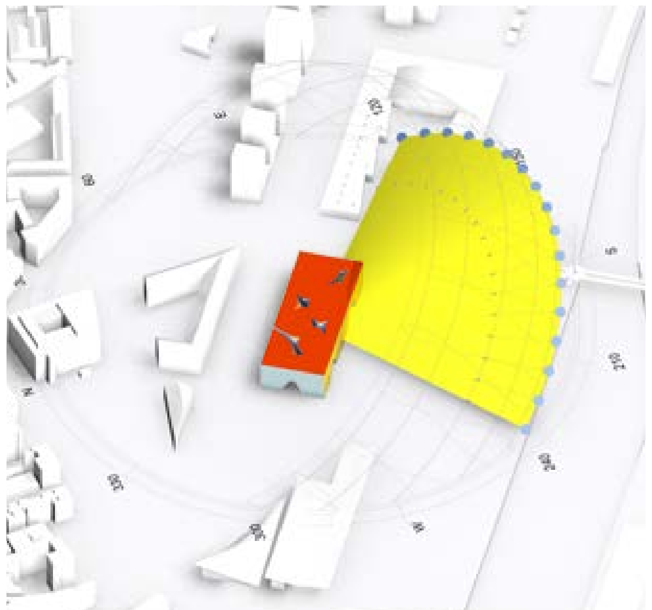
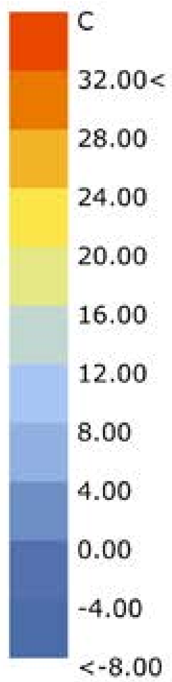


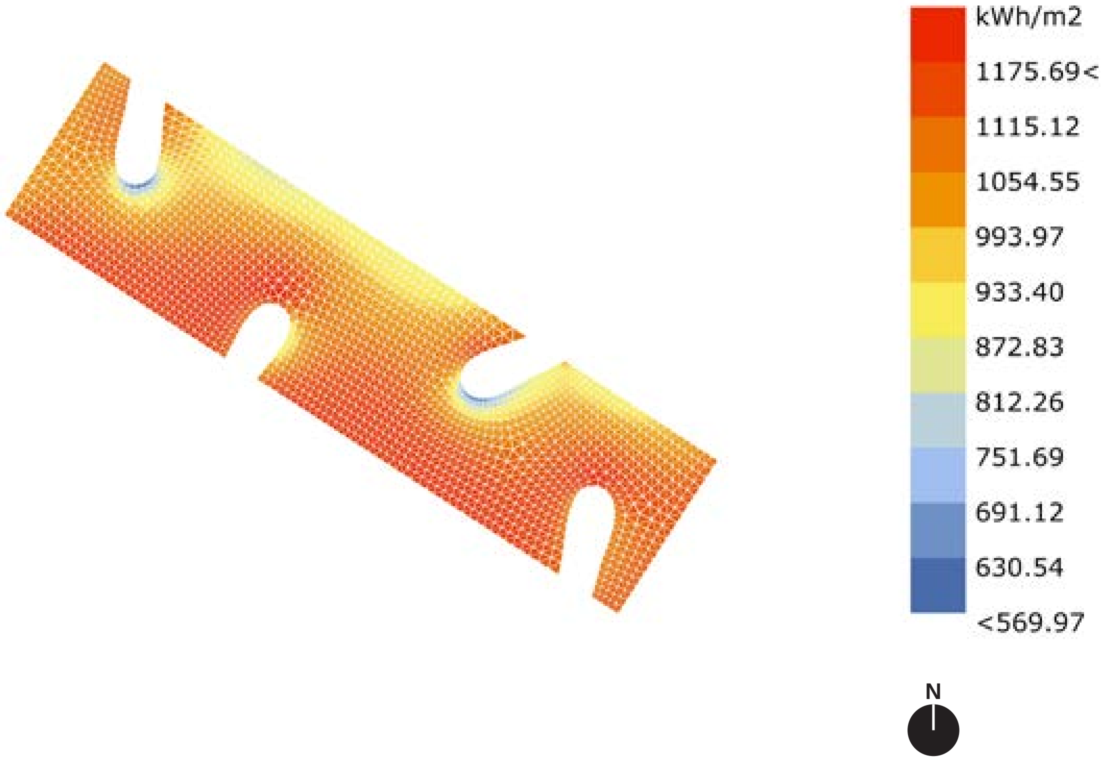
MIDDLE-SEASON



WINTER

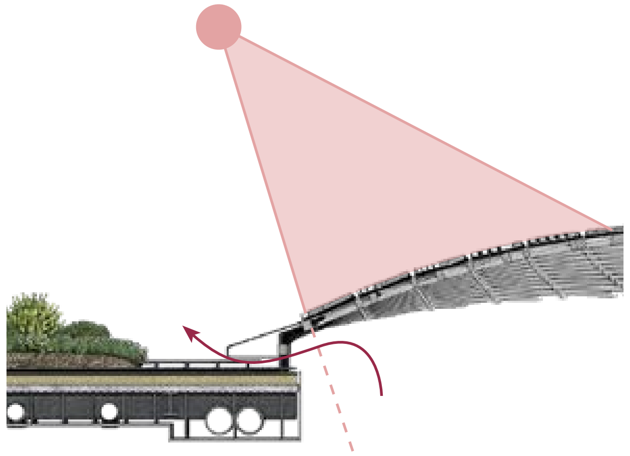
Building upon our recognition of the potential challenges posed by direct sun exposure, we sought to further investigate its impact through virtual weather simulations conducted over the project's geometry. These simulations showed the uninterrupted presence of sun radiation throughout the day, owing to the absence of surrounding obstacles. While this consistent sunlight offers numerous benefits, including enhanced internal and external light quality, it also necessitates specific strategies to mitigate the risk of greenhouse effects within the building. With the sun's rays penetrating deep into the interior spaces, there arises the potential for overheating, compromising occupant comfort and energy efficiency. As such, we recognized the critical importance of implementing targeted design interventions to manage solar heat gain effectively while harnessing the benefits of natural light.

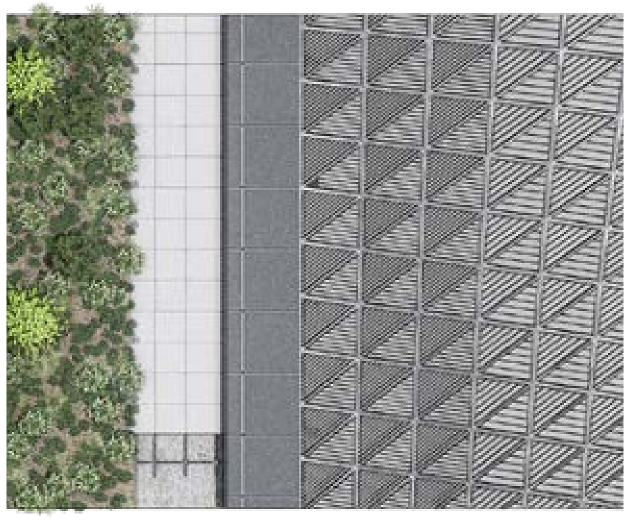


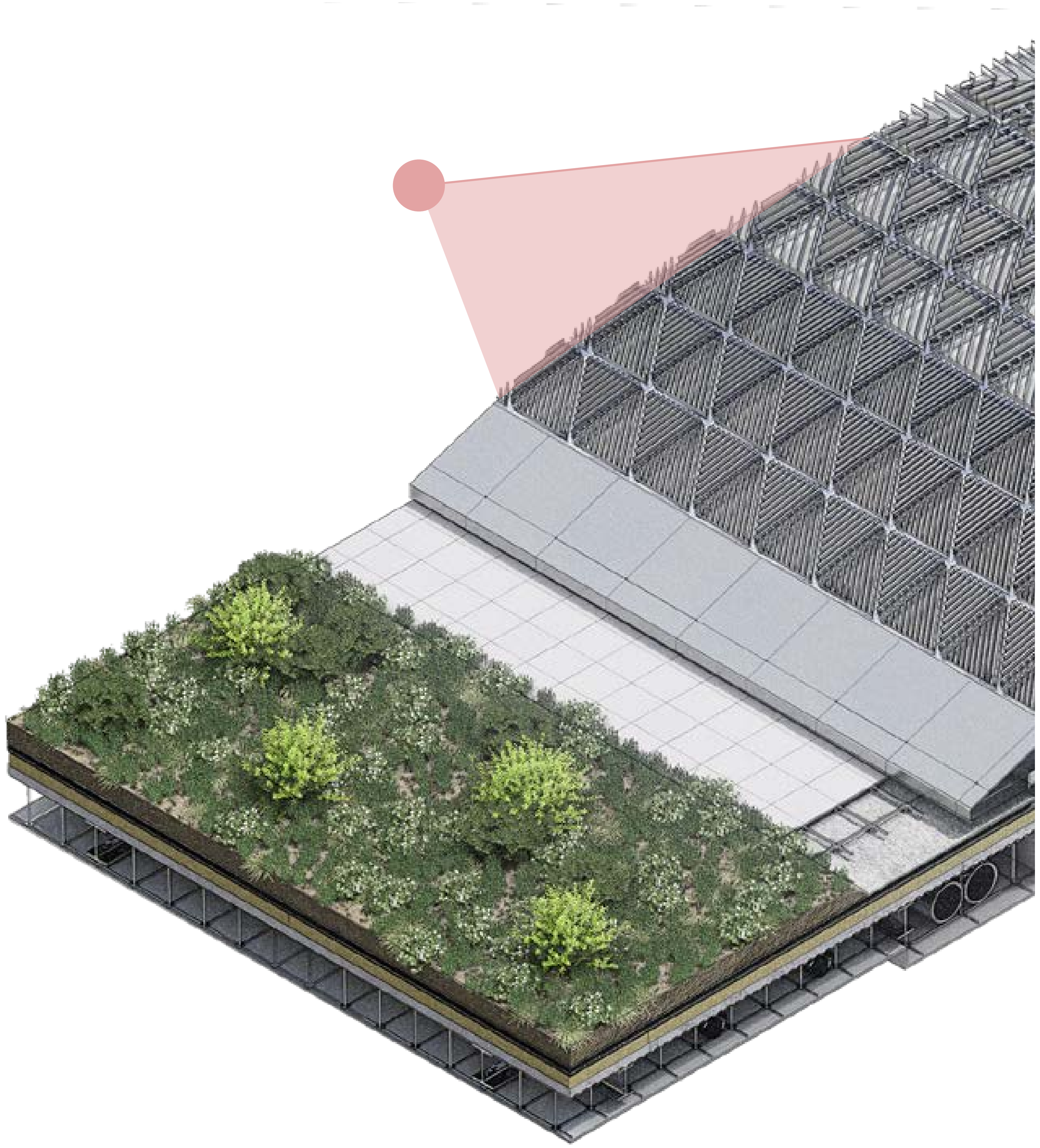


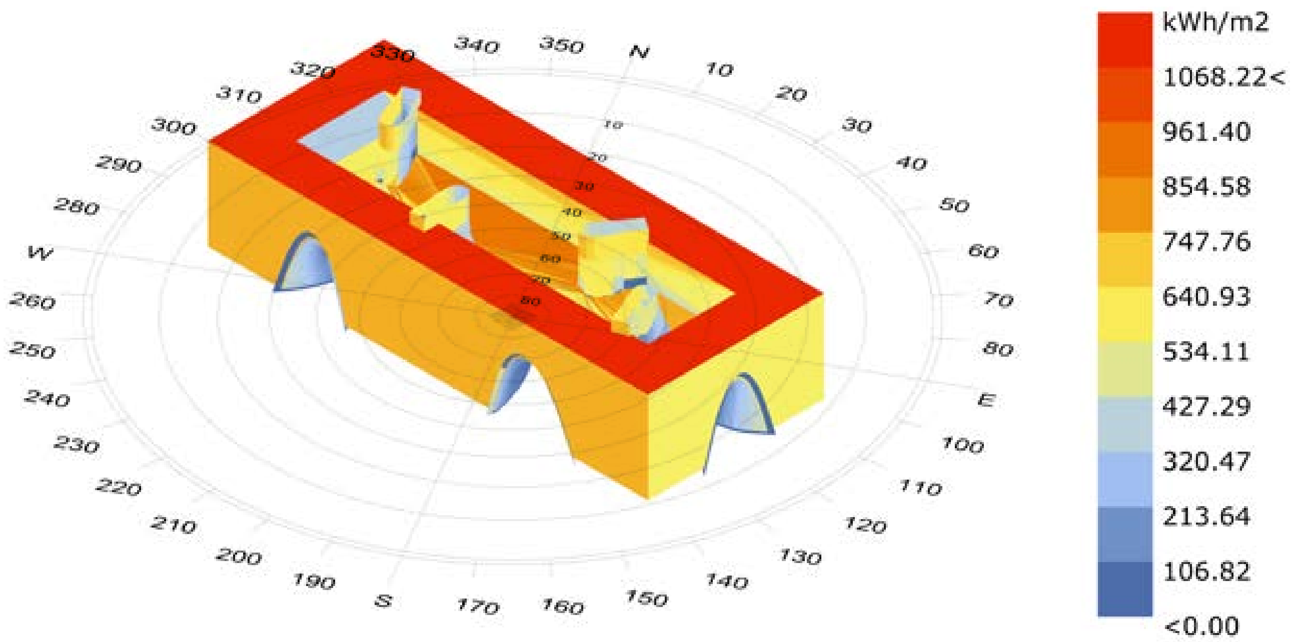
Rooftop skylight

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.



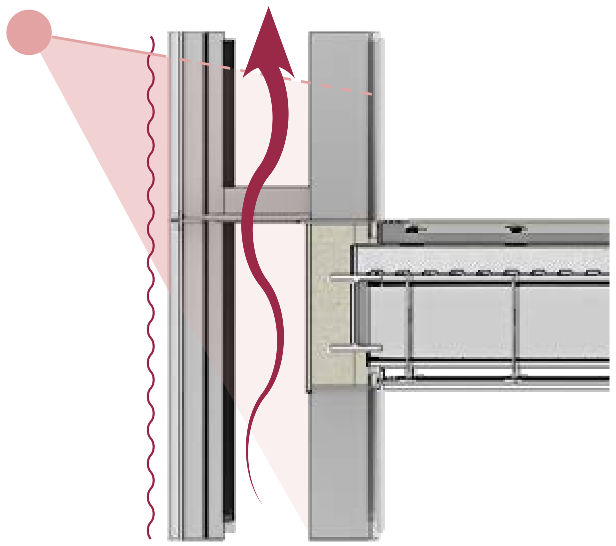


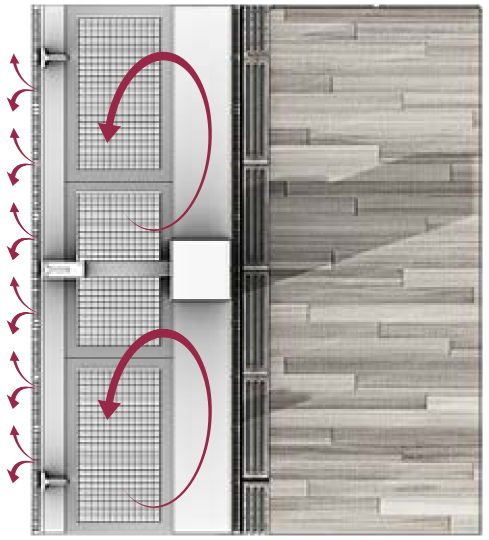


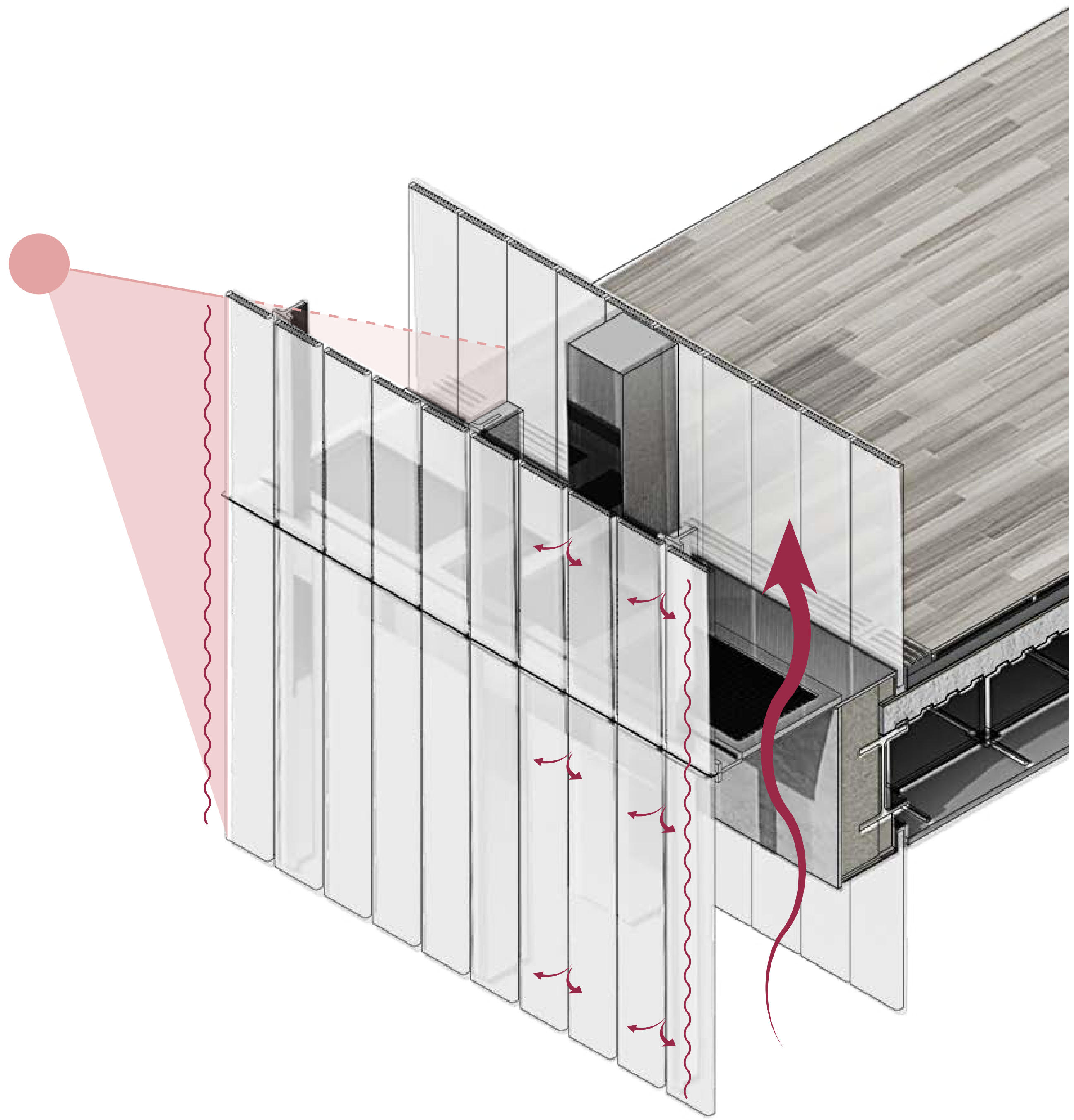


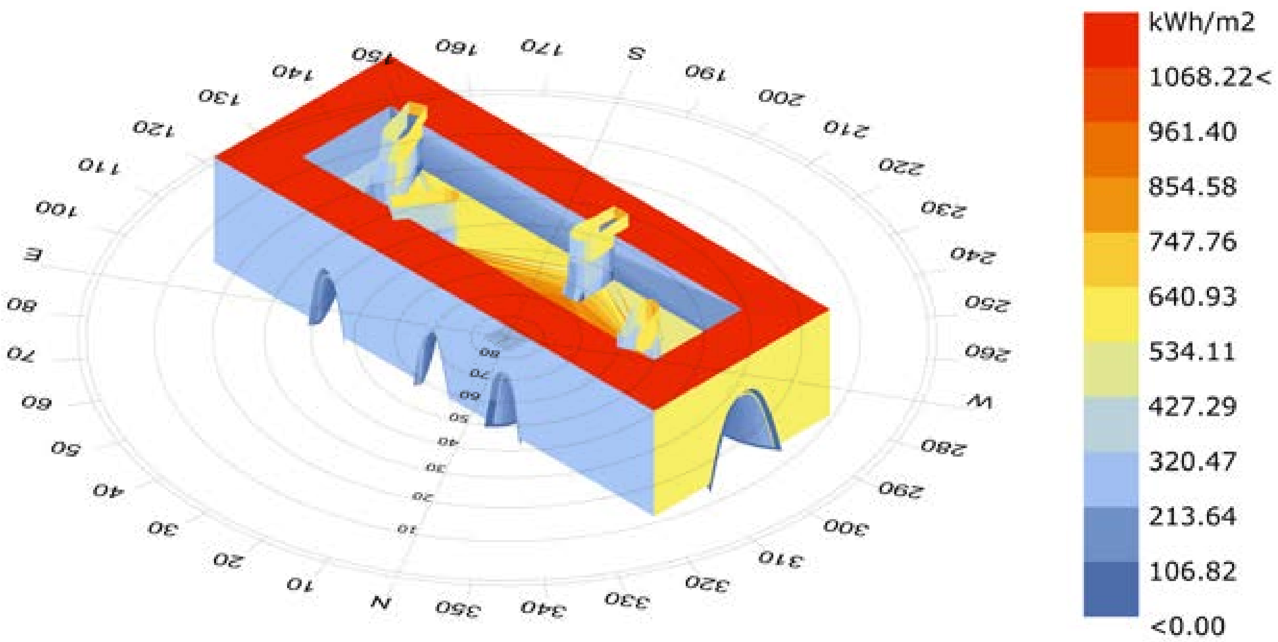
FACADES WITH DIRECT SUN

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.

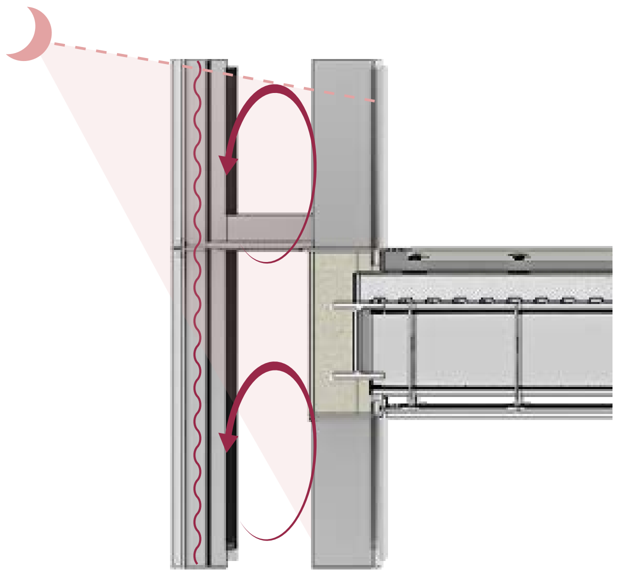






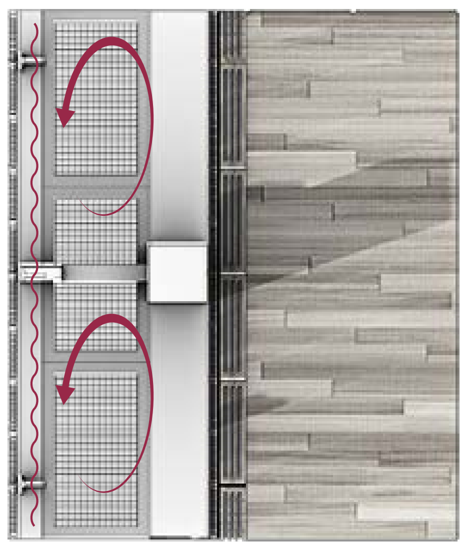


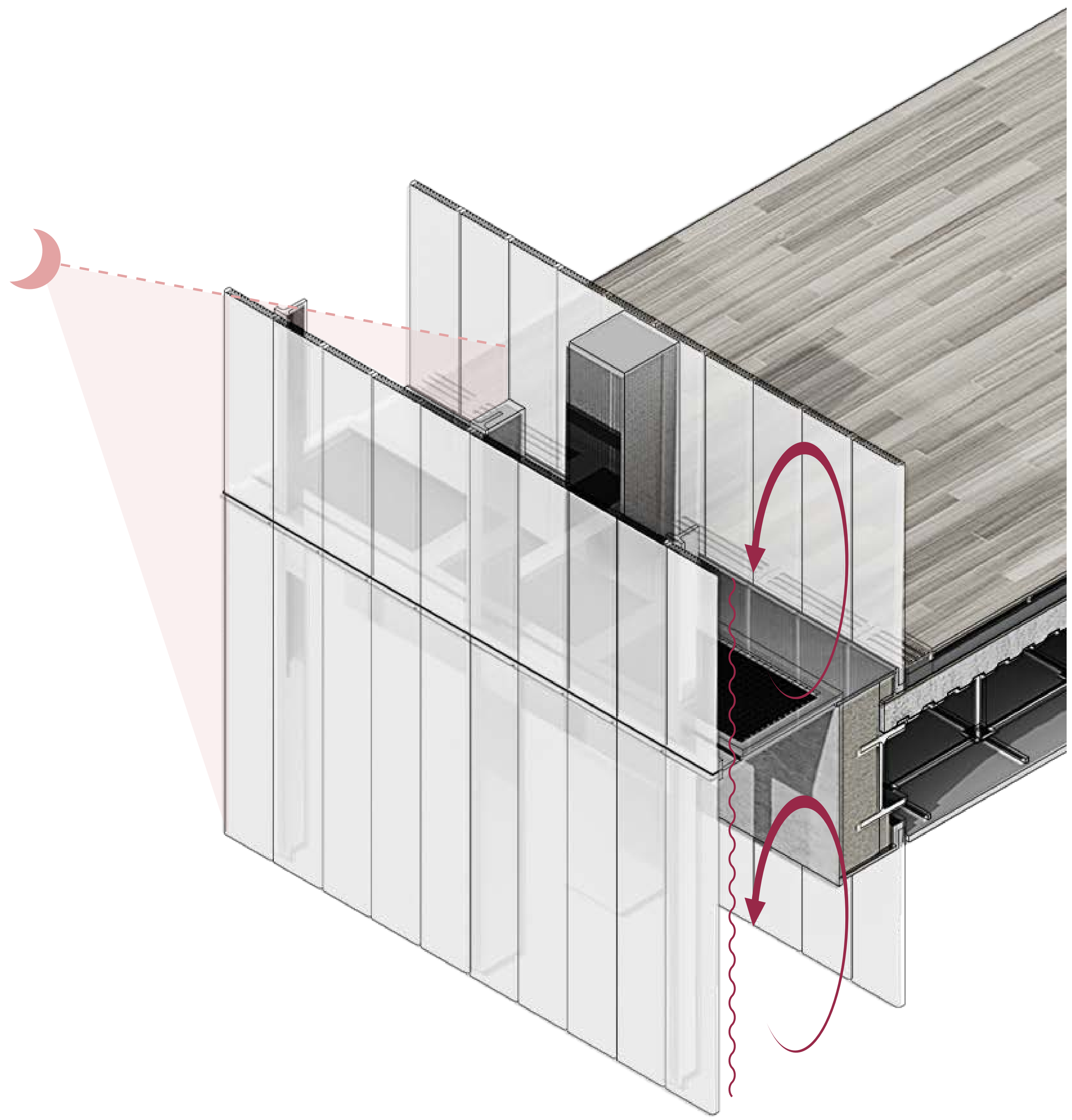
FACADES WITH UNDIRECT SUN

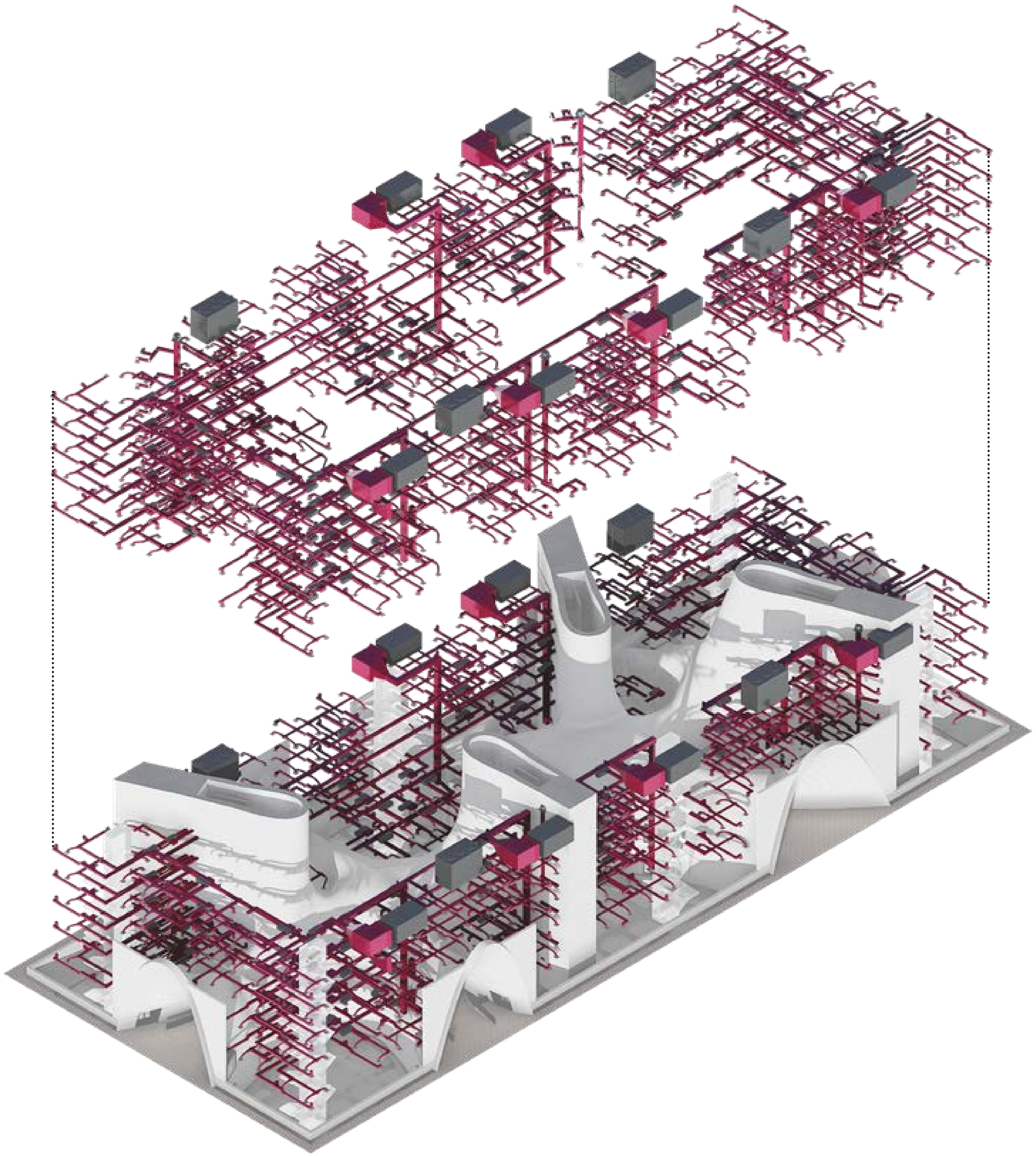


FACADES WITH UNDIRECT SUN

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.



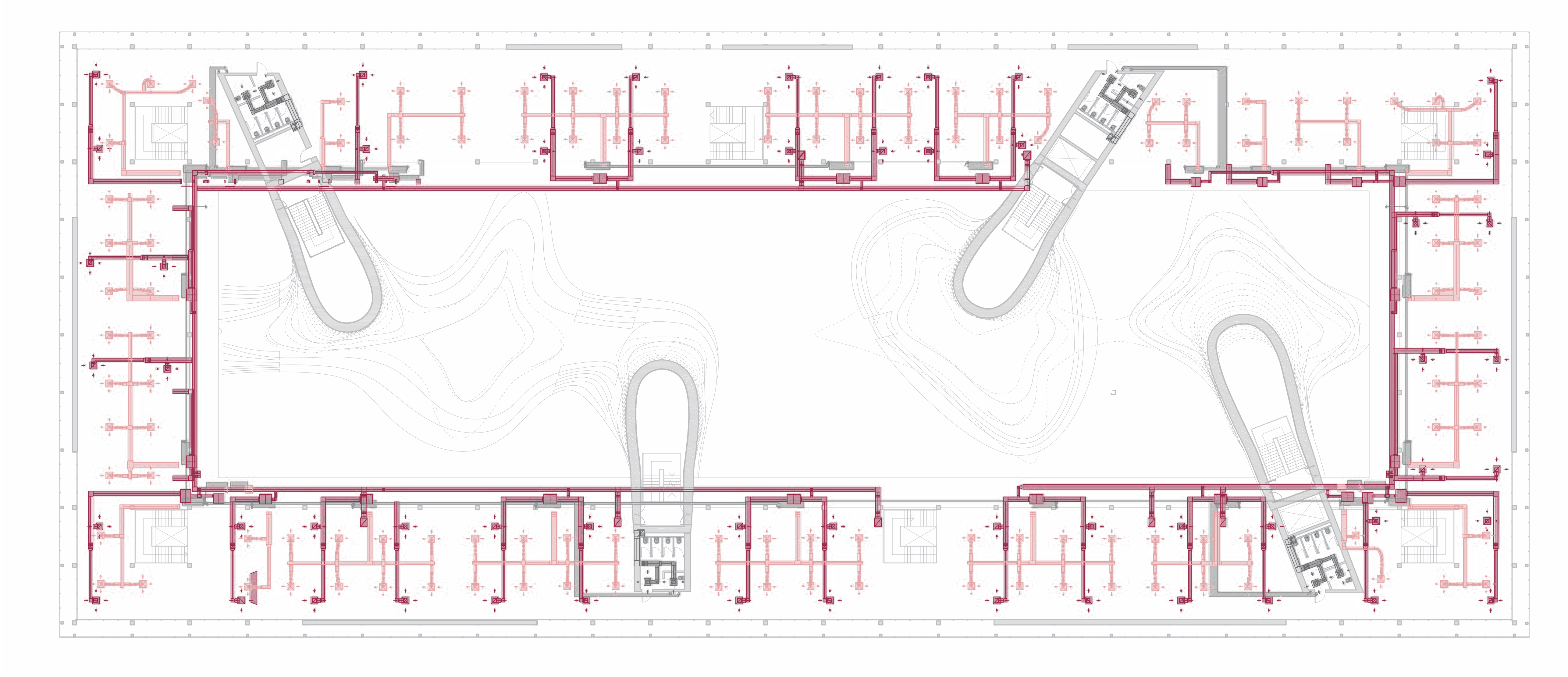




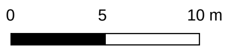
Technical services (MEP)

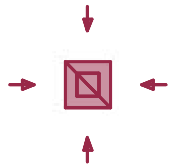
In the process of developing MEP (Mechanical, Electrical, and Plumbing) services, particularly with a focus on HVAC (Heating, Ventilation, and Air Conditioning), careful attention was given to the arrangement of Supply and Return diffusers within the open spaces of the building. Understanding the approximate capacity of the building was essential in this process. Additionally, for areas like bathrooms where ventilation is imperative, strategic placement of ventilation systems was vital, including installation within corridors and individual cabins. These decisions were informed by meticulous calculations that took into account various factors such as the overall size and layout of the building, levels of insulation, anticipated occupancy rates, and pertinent local climate data. This comprehensive approach ensured that HVAC equipment was sized accurately to meet the specific needs of the building while optimizing efficiency and comfort levels for its occupants.

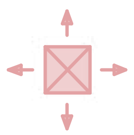
The core principle guiding the HVAC arrangement was to establish a vertical duct connecting all floors of the building, facilitating the movement of air to the cooling system situated atop the rooftop. This design approach ensures efficient airflow distribution throughout the building, allowing for centralized cooling operations while minimizing space utilization. The system optimizes the use of available space and streamlines the airflow path, enhancing overall HVAC performance and energy efficiency. Moreover, this configuration simplifies maintenance and servicing procedures, as components are centralized and easily accessible. Ultimately, the implementation of a vertical duct system represents a strategic approach to HVAC design, balancing space optimization, functionality and operational efficiency.

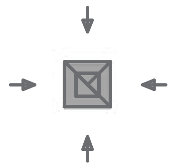


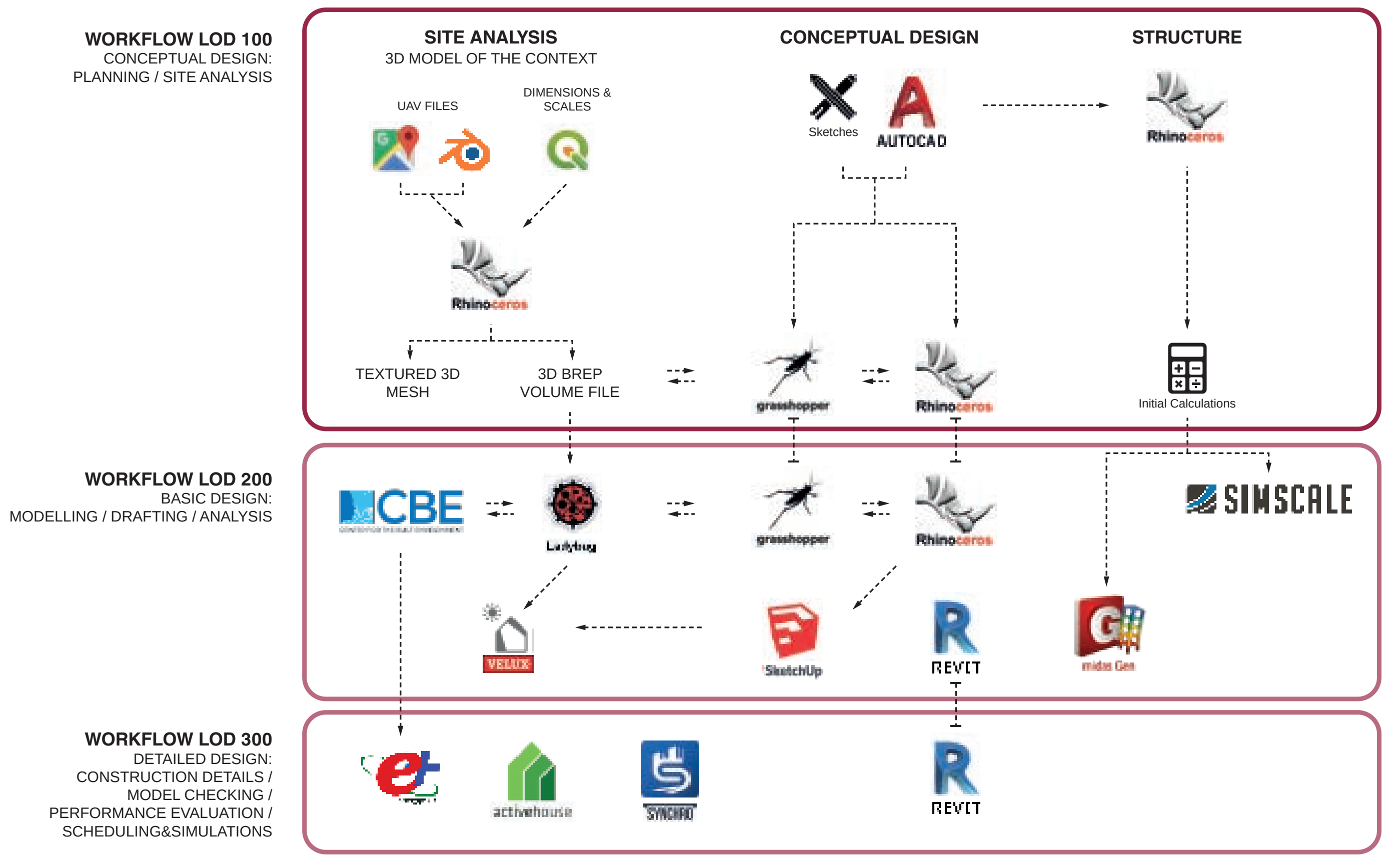
SERVICE SYSTEM TYPICAL PLAN SCALE 1/400

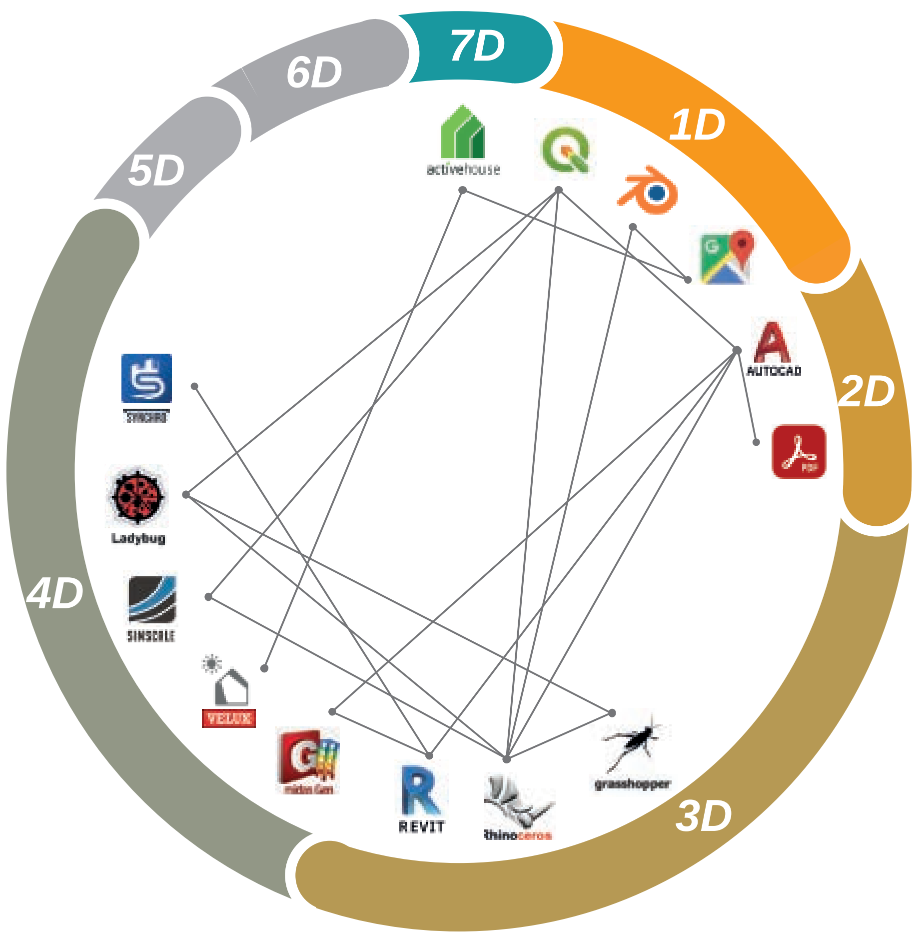



RETURN AIR


SUPPLY AIR


EXHAUST AIR





Bim Workflow

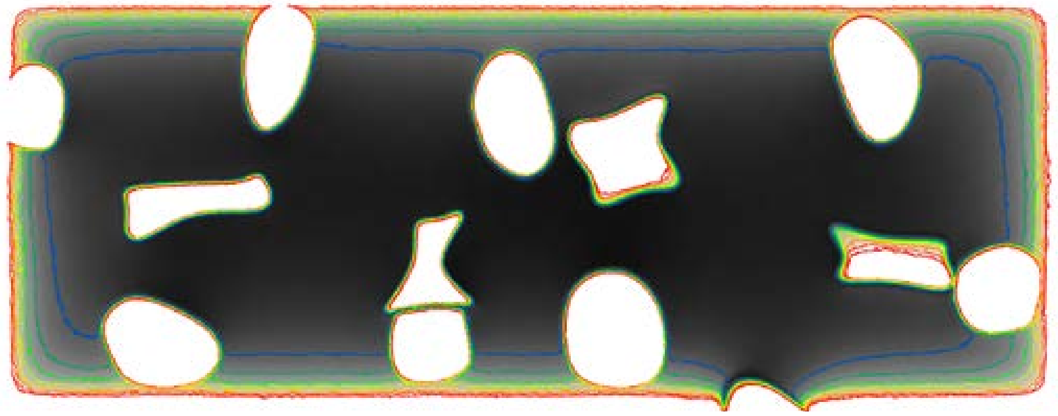
The project development commenced with a thorough site analysis facilitated by QGIS. This geospatial analysis platform enabled us to gain valuable insights into the surrounding environment, including topographical features, land use patterns, and ecological considerations. By harnessing the capabilities of QGIS, we were able to assess various site characteristics such as slope, orientation, and proximity to natural amenities or potential hazards. This comprehensive understanding of the site's context informed subsequent design decisions and allowed us to create a more responsive and site-specific solution. From identifying optimal building placement to mitigating environmental impacts, QGIS served as a foundational tool in shaping the project's development process.

The structural framework and architectural plans were meticulously crafted using Revit, enabling us to accurately estimate the volumes and capacities of the building. This data serves as a foundational basis for conducting detailed HVAC and carbon calculations. By harnessing the capabilities of Revit, we can seamlessly integrate architectural and engineering data, facilitating a holistic approach to design and analysis. This workflow allows for the precise determination of cooling, heating and ventilation requirements, as well as the quantification of carbon emissions associated with the building's materials.

Rhino with Grasshopper played a pivotal role throughout all stages of the project development, offering sophisticated capabilities for parametric design of both the shell and the facade. Additionally, these tools were instrumental in refining structural details and conducting comprehensive solar radiation analysis. The integration of Rhino and Grasshopper empowered our team to explore complex design iterations and optimize structural performance while maintaining a focus on sustainability. By using parametric modeling and analysis features, we were able to achieve a high level of precision and efficiency in the design process, ultimately resulting in a more innovative solution.

We decided to perform an acoustic analysis inside the organic shell to understand the internal propagation of sound. It was important for better control of the interior echo, and also for the interior auditorium. After we finished the simulations we realized that the organic shape additionally to the structural performances allows the sound to propagate homogeneously and exit the building without bouncing repeatedly over the massive surfaces.

To conclude the presentation of our BIM workflow, we worked with other tertiary softwares to study specific parts of the building. for example Synchro, that helped us to define a hypothetical time planning for all phases during construction, Or Active House, that introduced us to the objectives of energy, environment and comfort.



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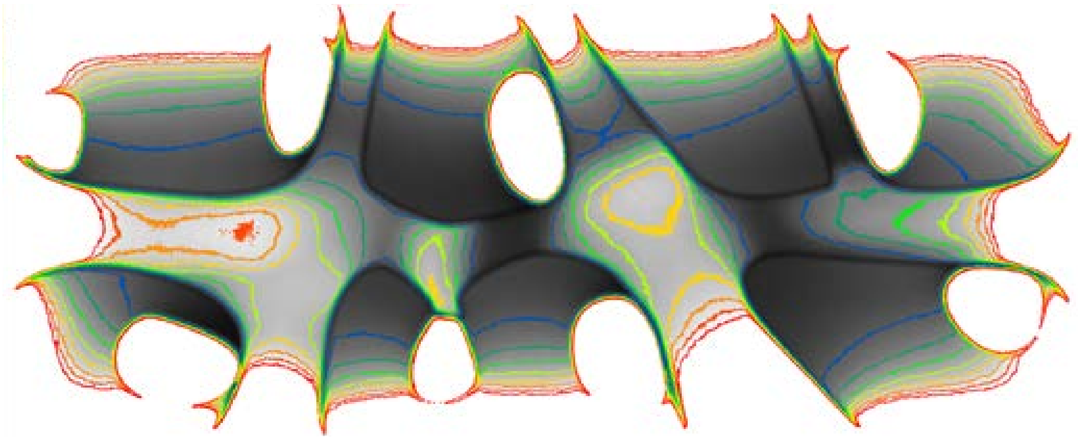
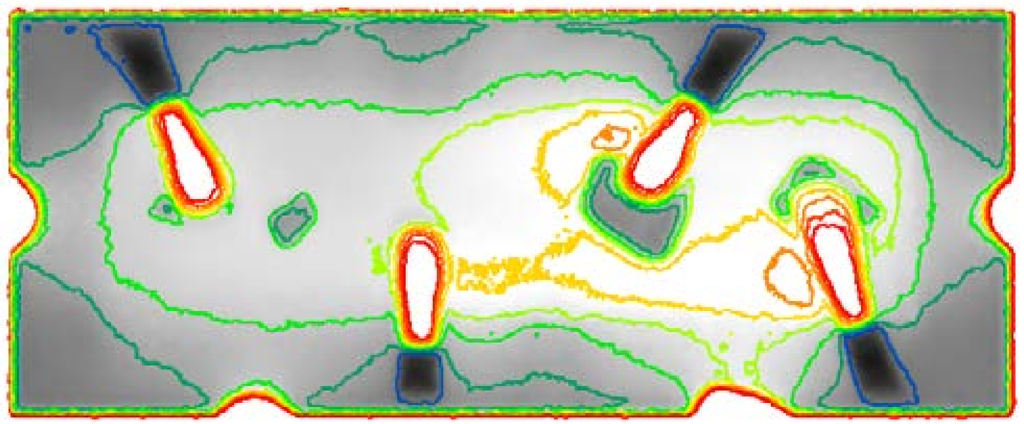


FIRST DESIGN - VELUX ANALYSIS GROUND FLOOR



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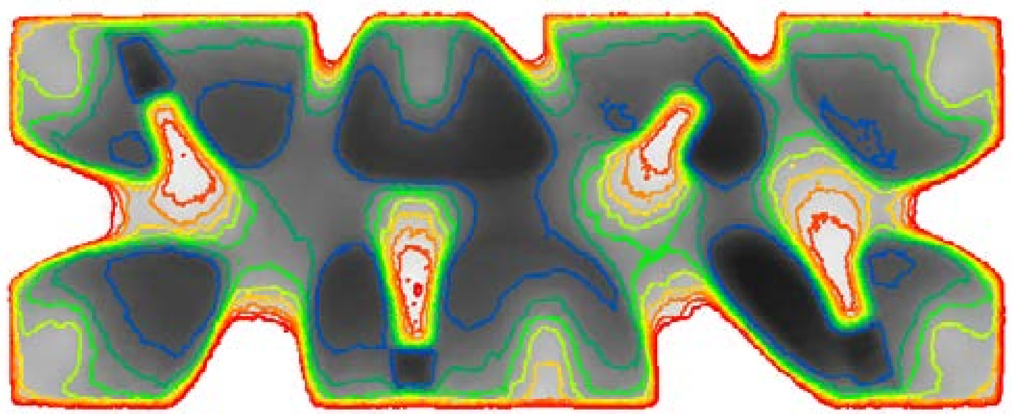

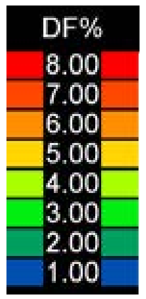

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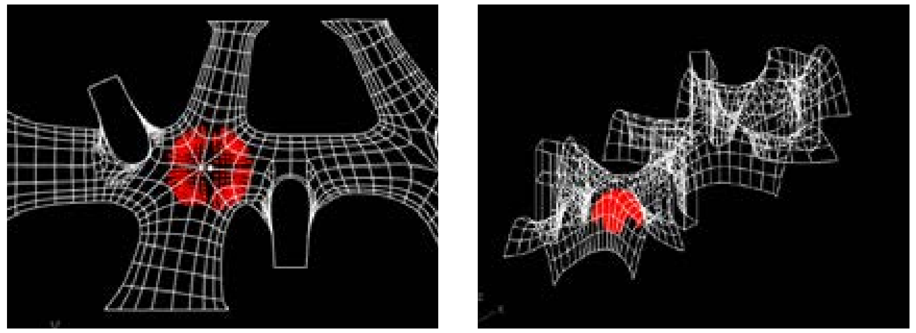

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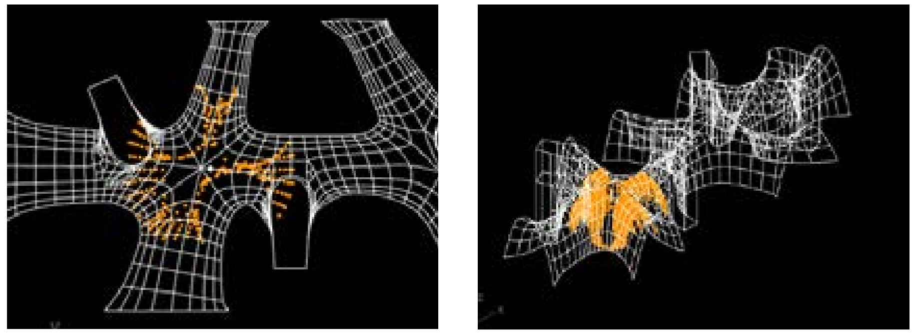

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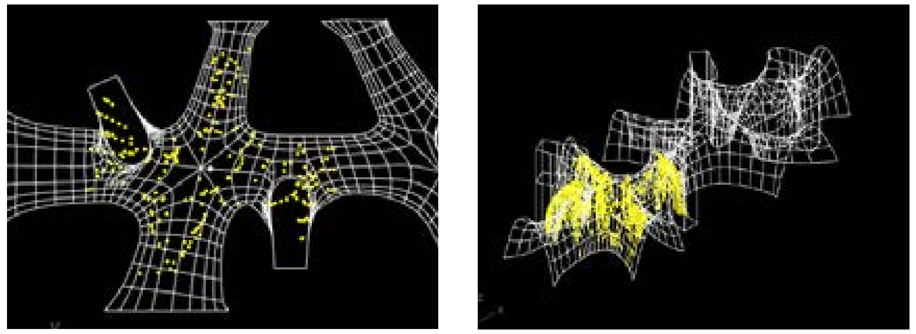

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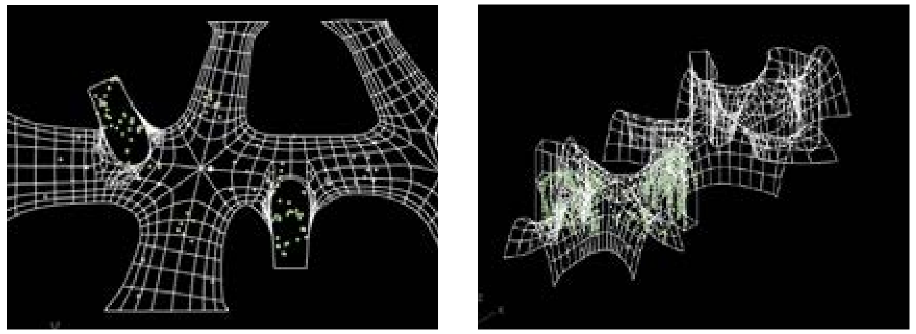

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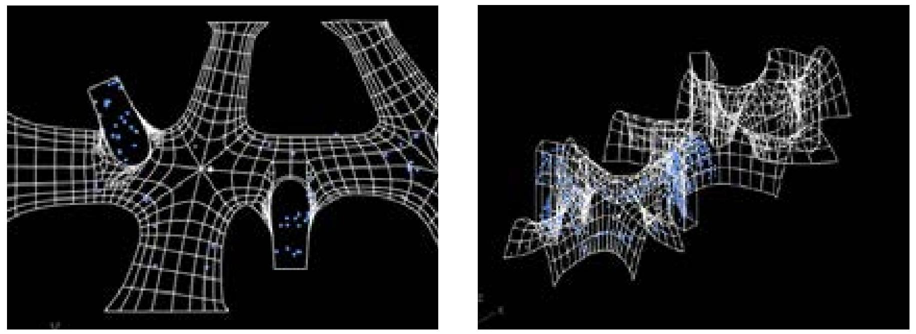

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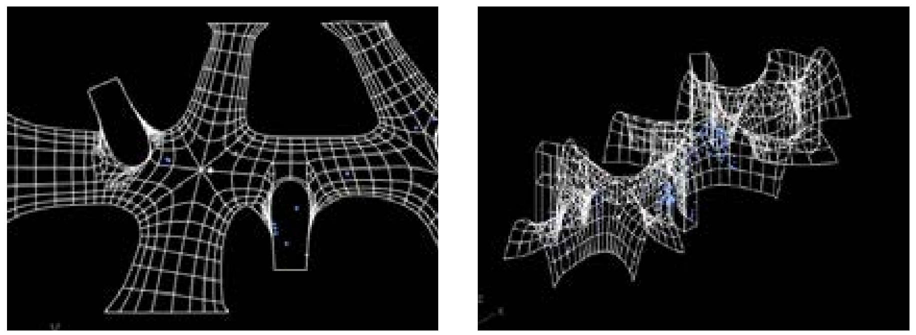

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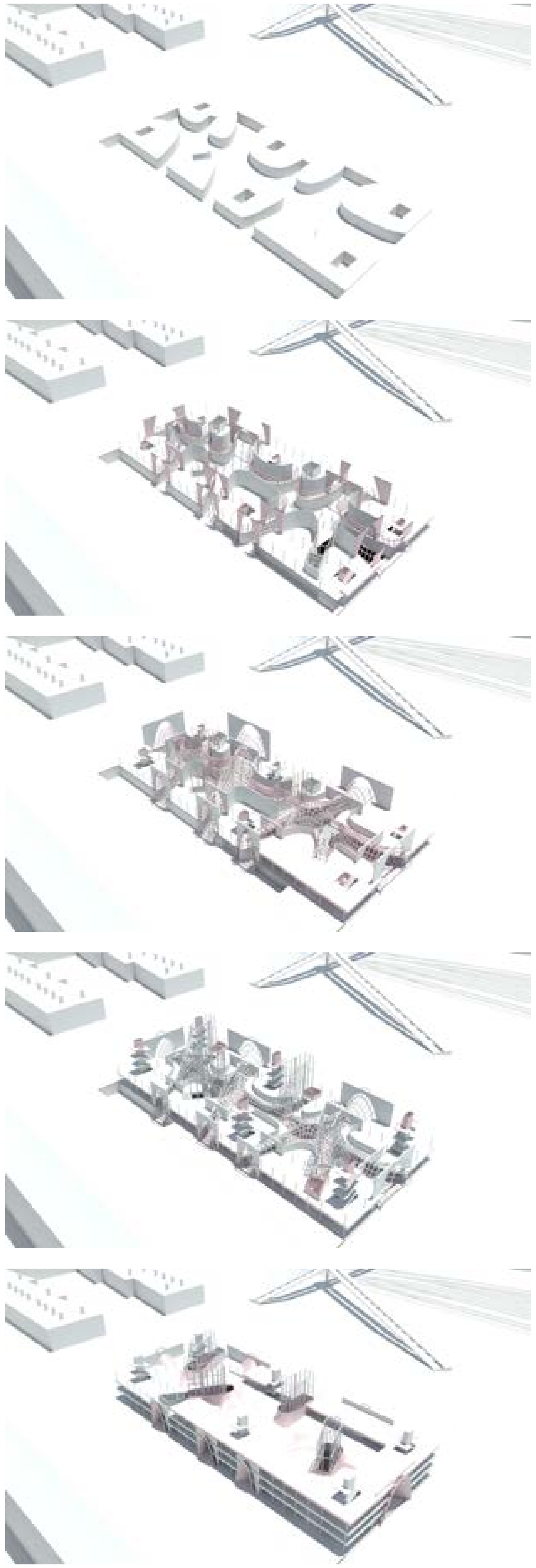


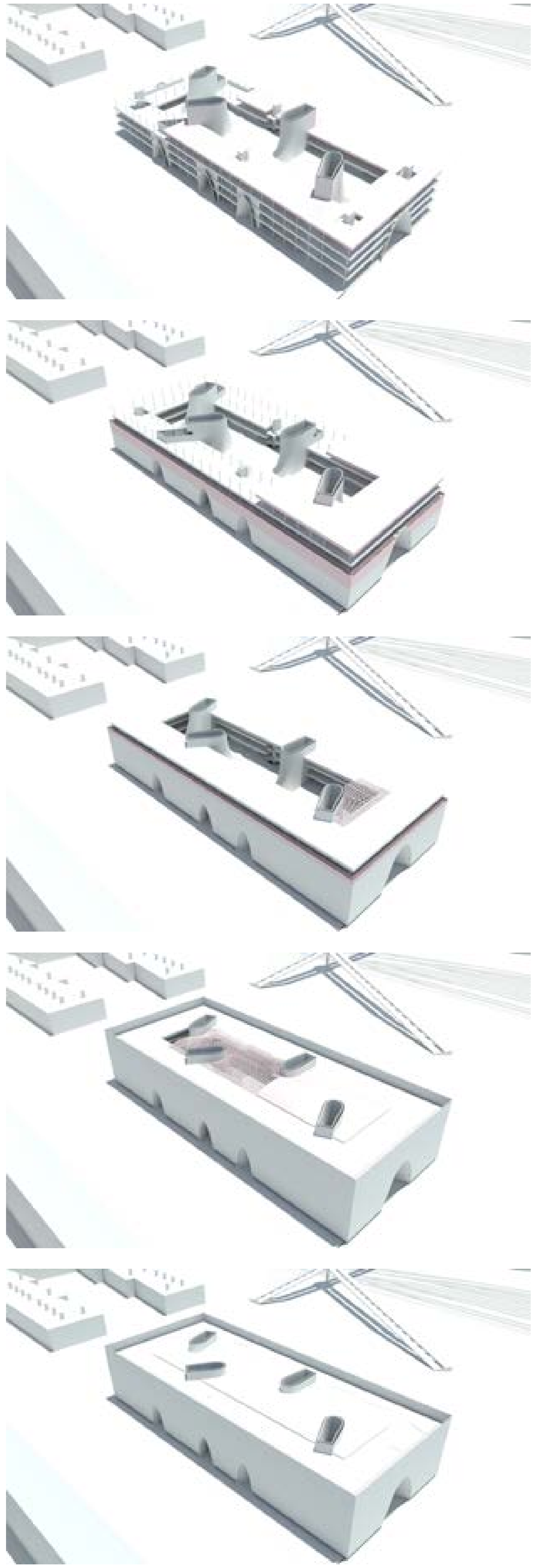
Rhinoceros → SYNCHRO

Milestone 1.
excavation and site preparation

Milestone 2.
finish foundation and start
construction of the shell structure

Milestone 3.
installation of the fa-
cade

Milestone 4.
installation glazed
rooftop



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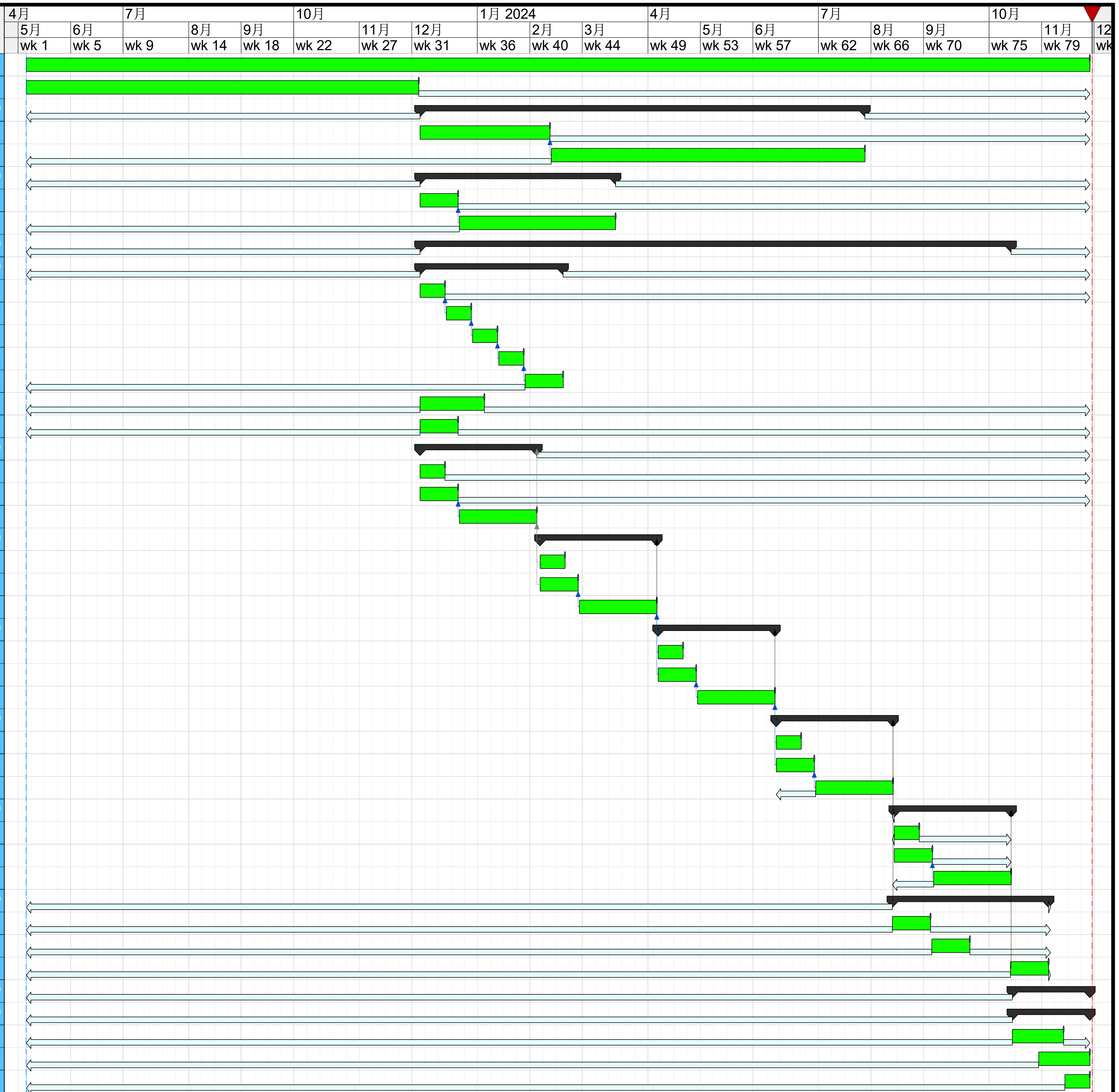
1	EQ11	EQUIPMENT	406d	9:00 2023/5/11	17:00 2024/11/28	1
2	EX11	Excavation & Preperation	150d	9:00 2023/5/11	17:00 2023/12/6	1
3	**CON11**	**SHELL**	**170d**	**9:00 2023/12/7**	**17:00 2024/7/31**	(2)
4	CON21	constructions of shell's structure	50d	9:00 2023/12/7	17:00 2024/2/14	1
5	CON32	applying shotcrete and panelsof the shell	120d	9:00 2024/2/15	17:00 2024/7/31	1
6	**CON36**	**AUDITORIUM**	**75d**	**9:00 2023/12/7**	**17:00 2024/3/20**	(2)
7	CON31	construnctions of concrete columns in -1 floor	15d	9:00 2023/12/7	17:00 2023/12/27	1
8	CON22	concrete slabs in the nave and auditorium	60d	9:00 2023/12/28	17:00 2024/3/20	1
9	**CON46**	**FLOORS**	**226d**	**9:00 2023/12/7**	**17:00 2024/10/17**	(22)
10	**CON56**	**Staircases**	**55d**	**9:00 2023/12/7**	**17:00 2024/2/21**	(5)
11	CON41	constructions of staircases in -1 floor	10d	9:00 2023/12/7	17:00 2023/12/20	1
12	CON51	constructions of staircases in ground floor	10d	9:00 2023/12/21	17:00 2024/1/3	1
13	CON58	constructions of staircases in 1 floor	10d	9:00 2024/1/4	17:00 2024/1/17	1
14	CON62	constructions of staircases in 2 floor	10d	9:00 2024/1/18	17:00 2024/1/31	1
15	CON64	constructions of staircases in 3 floor & elevators	15d	9:00 2024/2/1	17:00 2024/2/21	1
16	CON66	construction of primary shear wall	25d	9:00 2023/12/7	17:00 2024/1/10	1
17	CON71	construction of secondary shear wall	15d	9:00 2023/12/7	17:00 2023/12/27	1
18	**CON76**	**1F**	**45d**	**9:00 2023/12/7**	**17:00 2024/2/7**	(3)
19	CON61	constructions of iron columns in ground floor	10d	9:00 2023/12/7	17:00 2023/12/20	1
20	CON91	constructions of shafts in ground floor	15d	9:00 2023/12/7	17:00 2023/12/27	1
21	CON81	beams and application of prfabrecated slabs of 1 floor	30d	9:00 2023/12/28	17:00 2024/2/7	1
22	**CON88**	**2F**	**45d**	**9:00 2024/2/9**	**17:00 2024/4/11**	(3)
23	CON101	constructions of iron columns in 1 floor	10d	9:00 2024/2/9	17:00 2024/2/22	1
24	CON111	constructions of shafts in 1 floor	15d	9:00 2024/2/9	17:00 2024/2/29	1
25	CON121	beams and application of prfabrecated slabs of 2 floor	30d	9:00 2024/3/1	17:00 2024/4/11	1
26	**CON109**	**3F**	**45d**	**9:00 2024/4/12**	**17:00 2024/6/13**	(3)
27	CON131	constructions of iron columns in 2 floor	10d	9:00 2024/4/12	17:00 2024/4/25	1
28	CON141	constructions of shafts in 2 floor	15d	9:00 2024/4/12	17:00 2024/5/2	1
29	CON151	beams and application of prfabrecated slabs of 3 floor	30d	9:00 2024/5/3	17:00 2024/6/13	1
30	**CON135**	**4F**	**45d**	**9:00 2024/6/14**	**17:00 2024/8/15**	(3)
31	CON161	constructions of iron columns in 3 floor	10d	9:00 2024/6/14	17:00 2024/6/27	1
32	CON171	constructions of shafts in 3 floor	15d	9:00 2024/6/14	17:00 2024/7/4	1
33	CON181	beams and application of prfabrecated slabs of 4 floor	30d	9:00 2024/7/5	17:00 2024/8/15	1
34	**CON145**	**5F**	**45d**	**9:00 2024/8/16**	**17:00 2024/10/17**	(3)
35	CON155	constructions of iron columns in 4 floor	10d	9:00 2024/8/16	17:00 2024/8/29	1
36	CON165	constructions of shafts in 4 floor	15d	9:00 2024/8/16	17:00 2024/9/5	1
37	CON175	beams and application of prfabrecated slabs of 5F	30d	9:00 2024/9/6	17:00 2024/10/17	1
38	**CON86**	**FACADES**	**60d**	**9:00 2024/8/15**	**17:00 2024/11/6**	(3)
39	CON96	application of facades gf-1f	15d	9:00 2024/8/15	17:00 2024/9/4	1
40	CON106	application of facades 2f-3f	15d	9:00 2024/9/5	17:00 2024/9/25	1
41	CON116	application of facades 4f-rooftop	15d	9:00 2024/10/17	17:00 2024/11/6	1
42	**CON126**	**ROOFTOP**	**30d**	**9:00 2024/10/18**	**17:00 2024/11/28**	(3)
43	**CON136**	**SKYLIGHT**	**30d**	**9:00 2024/10/18**	**17:00 2024/11/28**	(2)
44	CON146	beam string system structure	20d	9:00 2024/10/18	17:00 2024/11/14	1
45	CON156	curtain system & solar panels	20d	9:00 2024/11/1	17:00 2024/11/28	1
46	CON166	Botanic garden	10d	9:00 2024/11/15	17:00 2024/11/28	1



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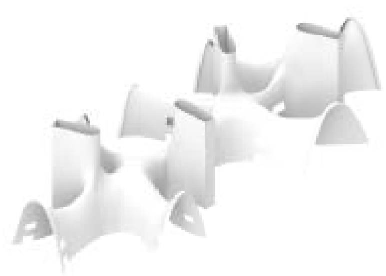
Client		Notes			

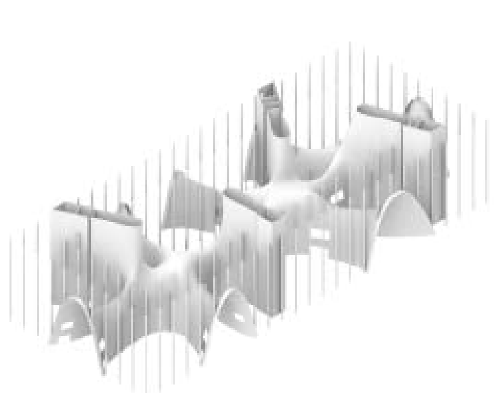
SYNCHRO CONNECT Edition

Printed: 14:17 2023/5/22

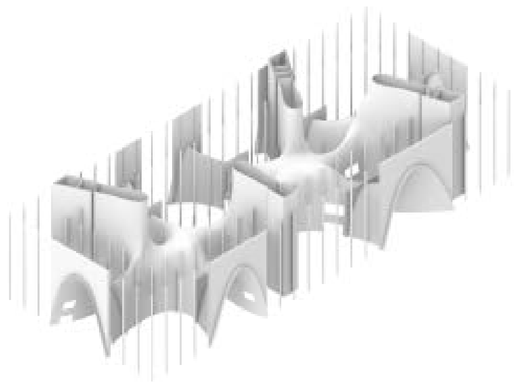


SHELL 20219.3 M²

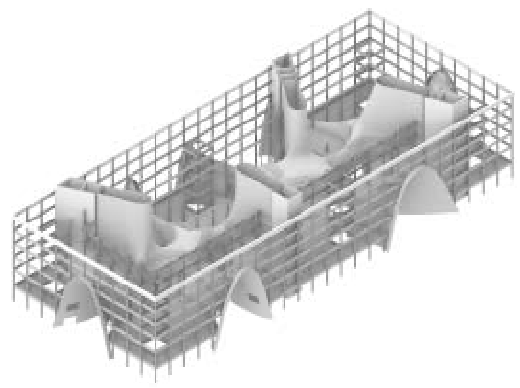
CORE 3736 M³



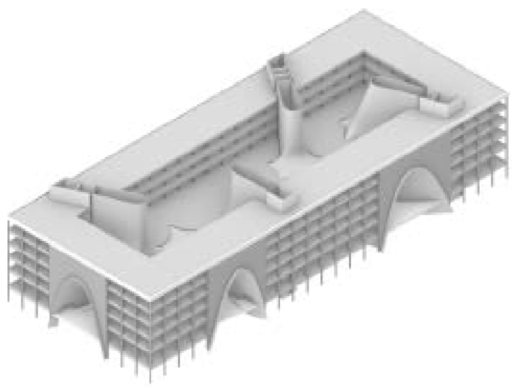
COLUMNS 373.4 M³



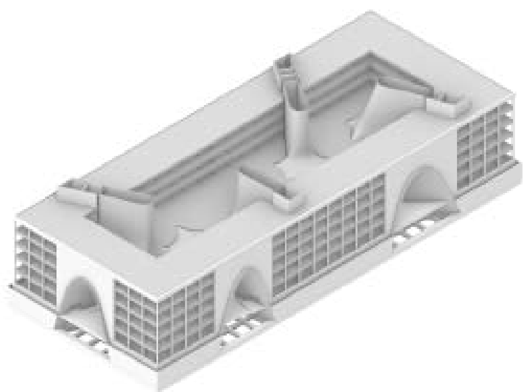
LOAD BEARING WALL 1155 M³



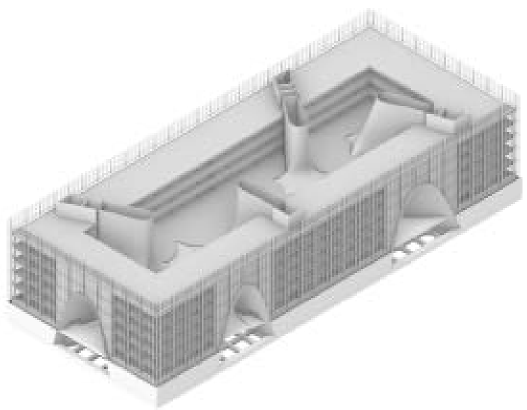
BEAMS 341.1 M³



FLOORS 5480 M³

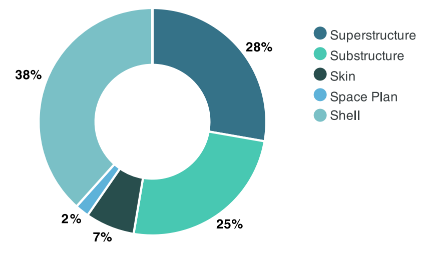


SUBSTRUCTURE 1079 M³



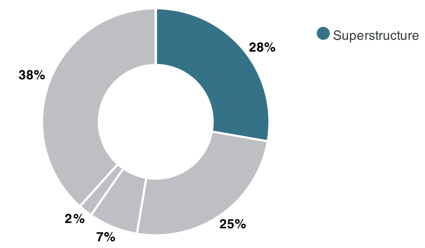
FACADE 2543 M²

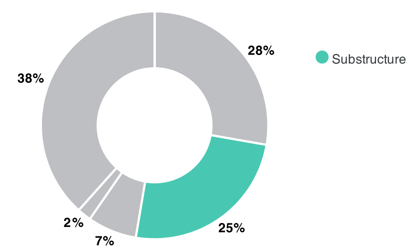
For sustainability purposes, we've undertaken an assessment to estimate the carbon footprint of the building, aiming to pinpoint areas where carbon is more concentrated in our design. To quantify carbon emissions, we utilized a software tool called Carbonscape 2, which was made available by MVRDV specialist Arend van Waart. Arend van Waart specializes in Sustainable Innovation and Computational Design within the company. He is currently dedicated to reducing embodied carbon emissions during the early stages of design. By gaining insights into the amount of carbon stored within the building materials, we can make informed decisions to select options that are more beneficial for both the design and the environment.

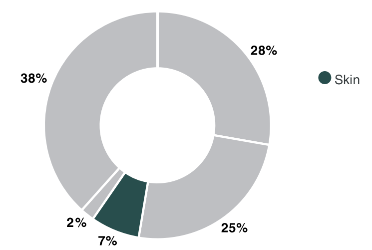


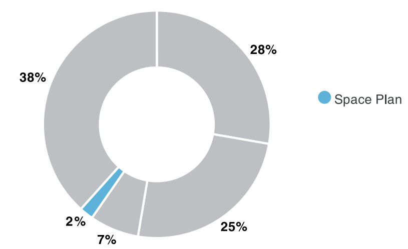
391 $kgCO2_{eq}/m^2$

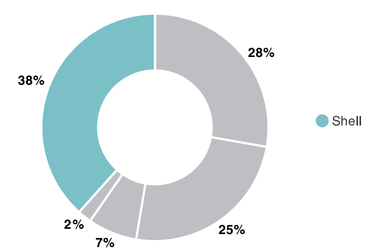
Gross floor area	27400	m^2
Total carbon	10702	tCO_2
Total carbon per m^2 gfa	391	$kgCO2 / m^2$

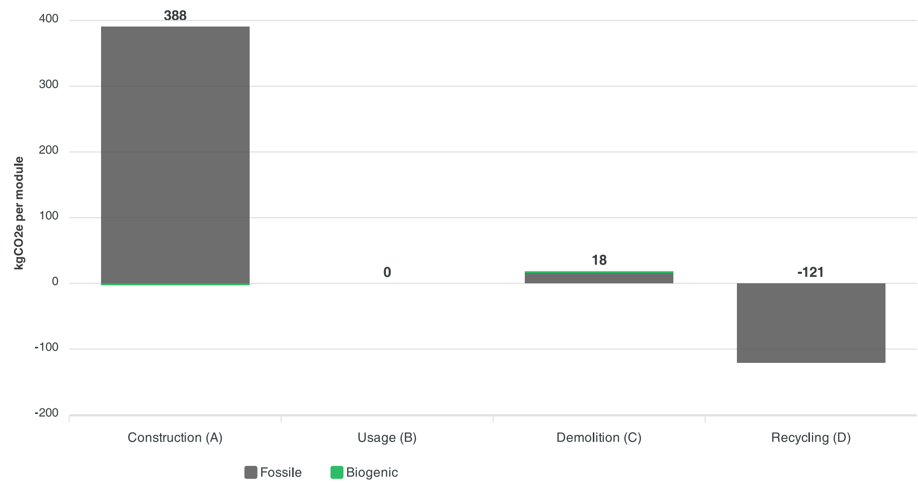


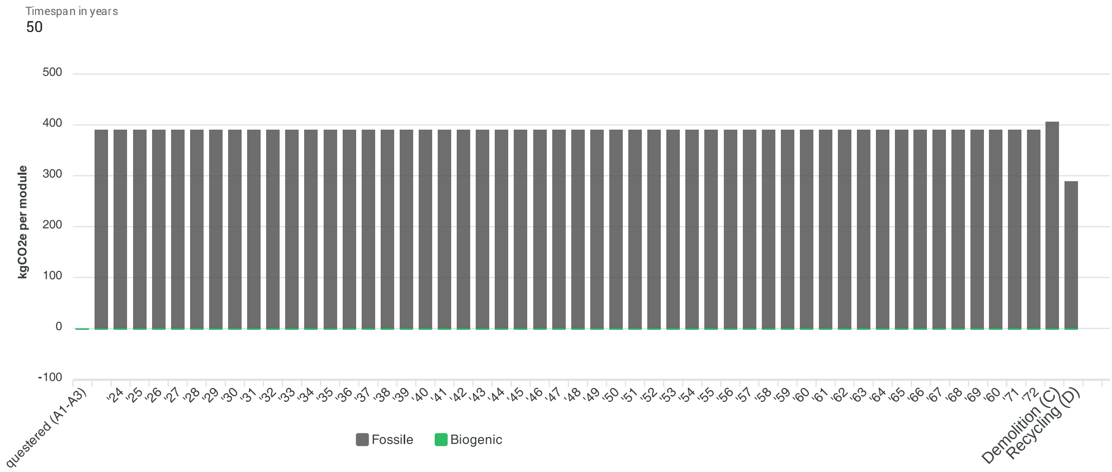












By reusing the most of the structure of the existing building it is possible to save up to **391 kgCO2eq/m².**

How much carbon is this?

269798 Rainforest trees (30 year)

37550119 km Distance traveled by Plane

Highest rating

The carbon emission is 391 kgCO2eq/m². To put this into perspective, this amount is equivalent to preserving the emissions absorbed by approximately 269,798 rainforest trees over a span of 30 years. Alternatively, it's comparable to mitigating the carbon footprint generated by traveling a distance of around 37,550,119 kilometers by plane. These figures underscore the significant environmental benefits associated with embracing sustainable practices such as building reuse, contributing to the preservation of vital ecosystems and the reduction of greenhouse gas emissions on a global scale.

269798 m²
Rainforest trees
(30 year)

Recognizing this, the logical progression towards enhancing the sustainability of our design entails a concerted effort to modify the shell's structure, opting for materials with superior performance characteristics. By prioritizing the selection of high-performance materials for the shell, we aim to bolster the building's overall resilience, energy efficiency, and environmental impact. This strategic shift not only aligns with our sustainability objectives but also holds the potential to significantly reduce long-term operational costs and enhance occupant comfort.

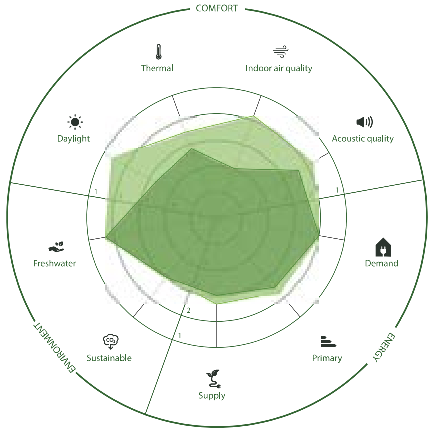
Overall we want to point out that our experience with measuring carbon in the design process was positive and gave us a better understanding in terms of carbon footprint and the importance of choosing materials in general. Exploring the equivalence of CO2 to understandable measurements like distance in km and number of trees we could evaluate the impact of our choices in the design.

activehouse

01-25	
Mean active score	2.8
Daylight score	3.3
Thermal environment score	3.2
Indoor air quality score	4
Acoustic quality score	2.4
Energy demand score	2
Primary energy score	2.5
Energy supply score	3
Sustainable construction score	3
Freshwater score	1.7

05-10 Library Sharing hou...	
Mean active score	2.1
Daylight score	1.4
Thermal environment score	2.5
Indoor air quality score	1.8
Acoustic quality score	1.7
Energy demand score	2
Primary energy score	2.3
Energy supply score	2.7
Sustainable construction score	3
Freshwater score	1.7

FIRST DESIGN (2023-01)



COMPARAISON TWO RESULTS

LATEST DESIGN (2023-05)

GRAPHS WITH THE GENERAL ANALYSIS RESULTS

FIRST DESIGN (2023-01)

LATEST DESIGN (2023-05)

COMPARAISON TWO RESULTS

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Aurélien L.

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