Building Future through Preserving Past

Architectural Design Studio for Restoration and Transformation of Complex Construction Thesis 2023 July

POLITECNICO DI MILANO
School of Architecture Urban Planning Construction Engineering(AUIC)
Architectural Design Studio for Restoration and Transformation of Complex Construction

STUDENT: Nilufer E. Koroglu & Jian Deng
SUPERVISOR: Giulio M.Barazzetta
CO-SUPERVISOR: Sonia Pistidda, Lucia Toniolo, Angela Pavesi, Mauro E. Giuliani, Luca A. Pitera

Our project aims to rejuvenate a historic complex by transforming it into a modern research center. The building will feature a combination of glass, steel, and mesh elements, creating a unique architectural design. Additionally, a rooftop garden will be incorporated, adding a touch of greenery to the structure. By blending contemporary materials and incorporating sustainable features, our goal is to create a vibrant and environmentally friendly space for research and innovation.

THESIS

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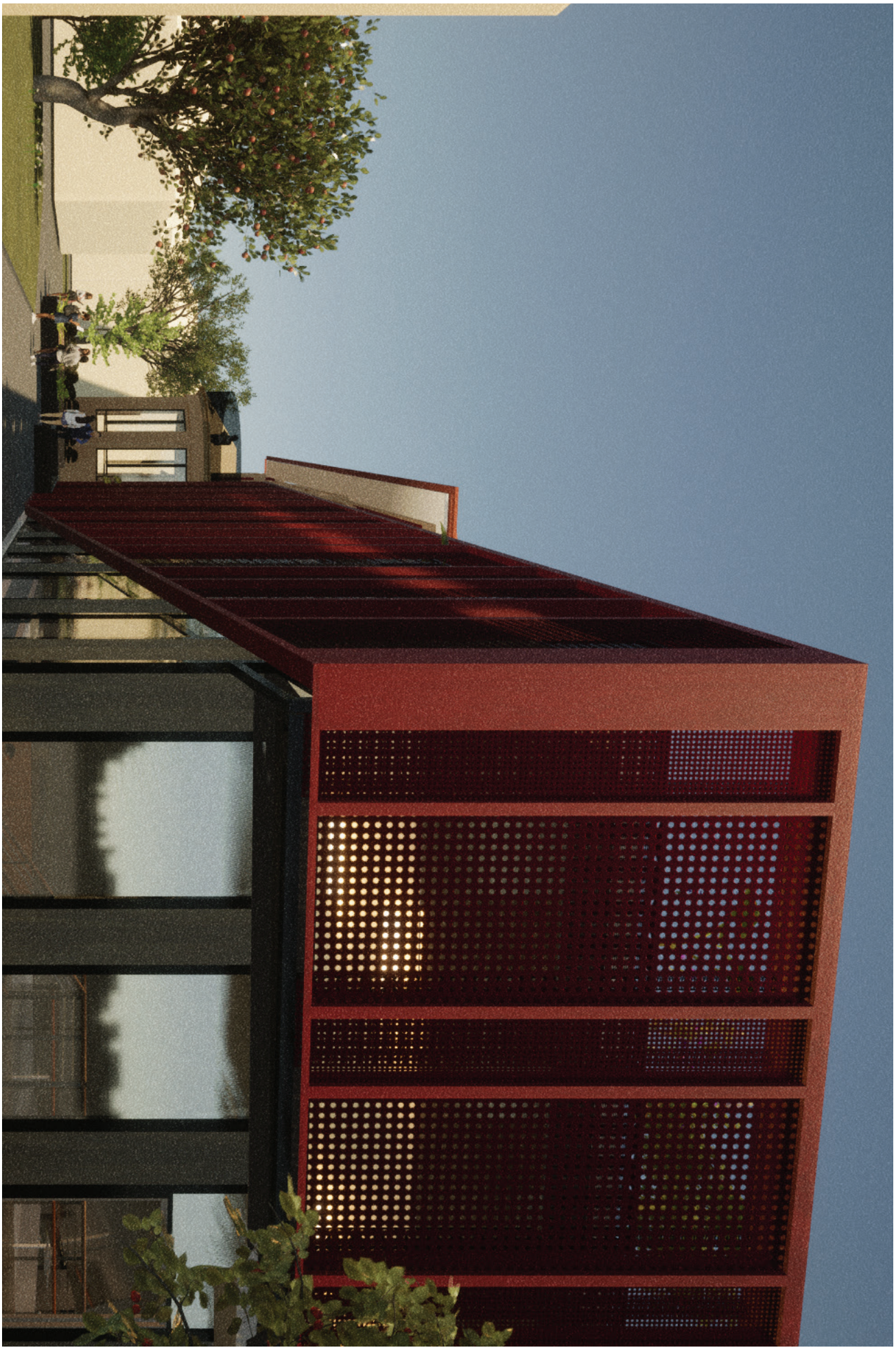
Architecture



ABSTRACT

This thesis project focuses on preserving and transforming the former animal clinic building in Milan's Citta Studi district, located within the Veterinaria campus. The objective is to maintain the historical essence of the area while introducing a new structure that enhances and supports the academic and functional aspects of the campus. By thoroughly analyzing the architectural typology and history of the site, we have gained a comprehensive understanding of its context. Keeping this concept in mind, we propose the addition of a steel structure with a mesh shell facade, serving as a lecture hall and computer laboratory to support the existing functions. Simultaneously, we will strengthen and repair the original parts, adapting them to the new research center. This new addition will be interlocked with the existing building, creating a harmonious yet contrasting connection between the structures. Through this approach, we aim to bring new vision to the site while preserving the historical integrity of the campus.

Keywords

Sustainability, Compatibility, Rhytm, Addition, Adaptability, Green architecture, Recognition

RIASSUNTO

Questo progetto di tesi si concentra sulla conservazione e trasformazione dell'ex edificio della clinica veterinaria nel campus di Veterinaria nel quartiere Città Studi di Milano. L'obiettivo è mantenere l'identità storica del contesto, al tempo stesso aggiungendo una nuova struttura che valorizzi e supporti gli aspetti accademici e funzionali del campus. Otteniamo una comprensione approfondita del sito analizzando la tipologia architettonica e la storia dell'edificio. Con queste informazioni in mente, proponiamo l'aggiunta di una struttura in acciaio con una facciata a rete come aula magna e laboratorio informatico per supportare le funzioni esistenti, rafforzando e riparando le parti originali adattandole alle nuove funzioni del centro di ricerca. Questa nuova aggiunta, interconnessa con l'edificio esistente, crea un collegamento armonioso ma contrastante tra le strutture e porta nuova vitalità al sito, mantenendo al contempo l'integrità storica del campus.

Parole chiave

Sostenibilità, Compatibilità, Ritmo, Addizione, Adattabilità, Architettura verde, Riconoscimento

CITTA STUDI

HISTORICAL BACKGROUND

The development of Città Studi can be traced back to the late 19th century. Milan experienced rapid growth in both industries and urban areas. In late 1800s, the need for specialized technical and scientific educational institutions to support the city's industrial and technological advancements were rising quickly. As a result, several educational institutions were founded in the area, laying the foundation for the growth of Città Studi. These institutions were established to meet the demand for skilled professionals in various fields and to contribute to the city's overall development.

Cascine Doppie, 1913

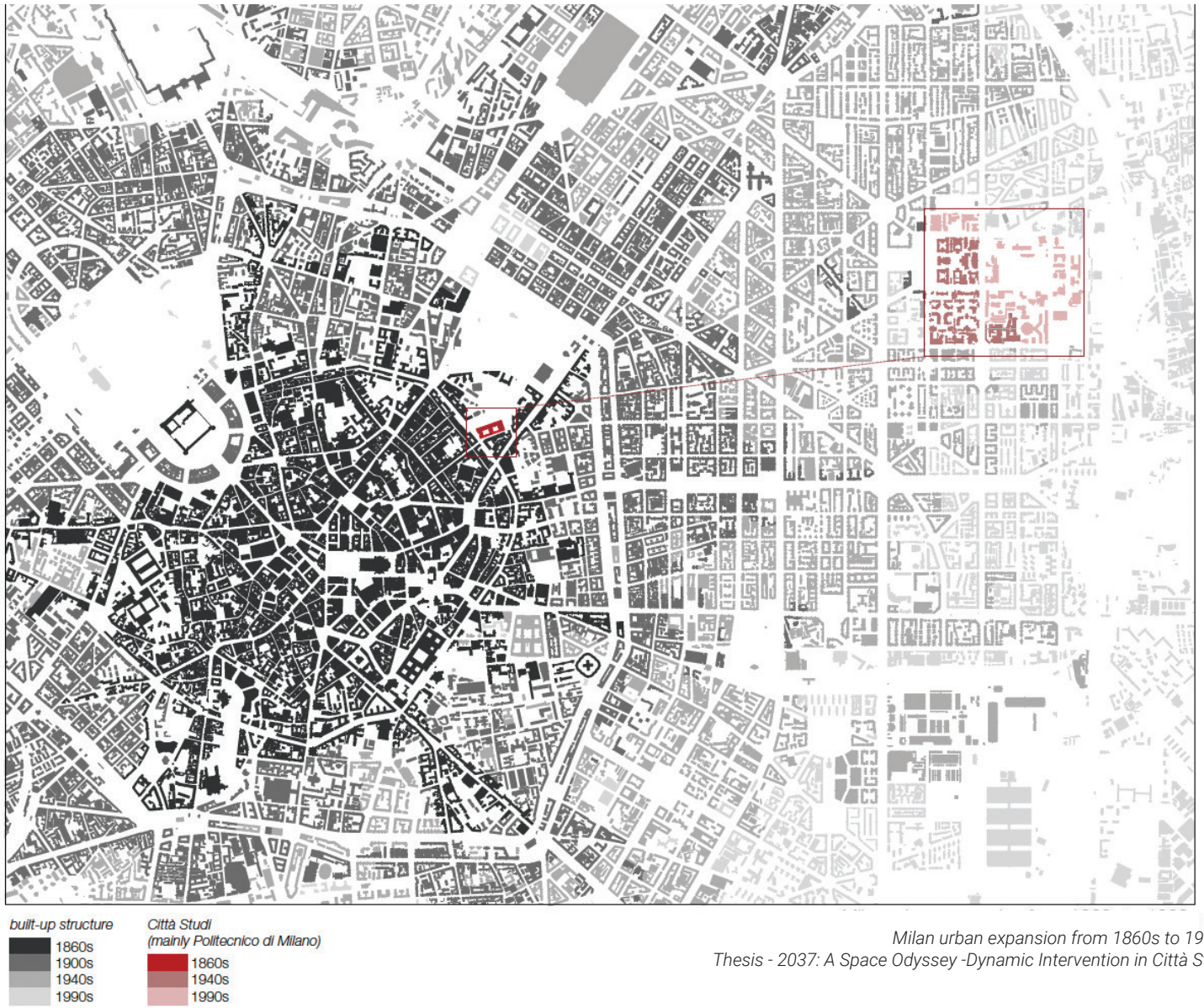
Cascina and Osteria Pulice 1910-15 (place where today I found the palace of Piazza Leonardo Da Vinci 7)

1910 Milan Map floor Pavia Masera - Bertarelli PRG the area of today's Citta Studi

The group of Cascine Doppie poste where today there is number 8 of Piazza Leonardo Da Vinci

MILAN

URBAN GROWTH



Milan urban expansion from 1860s to 1990s
Thesis - 2037: A Space Odyssey -Dynamic Intervention in Città Studi

The development of Città Studi can be traced back to the early 1900's with the establishment of Polytechnic University of Milan which played an important role in the development first location Collegio Elvetico on via Senato which is now the State Archive. It came into existence way back in 1863 and swiftly gained recognition as a prominent center for engineering and architecture studies. Few years later it was moved to a more worthy location to the Palazzo della Canonicabuilding in Piazza Cavour. Another notable contributor to the growth of Città Studi is the University of Milan, lovingly referred to as Università degli Studi di Milano. And several other educational institutes were established in the region, setting the foundation for of Città Studi as we know. As time passed, Città Studi expanded its boundaries to accommodate an extensive array of educational institutions, research centers, and laboratories.
In 1910 bringing the scattered higher learning together was on the table annd was decided in 1913. The capmus was moved to the place as we know today which was called Cascine Doppie 'double farm' . But tragedy strike as the construction had to be stopped in 1915. It resumed in 1920s and quickly completed.

CITTA STUDI
CAMPUS, FACILITIES, AND URBAN INTEGRATION

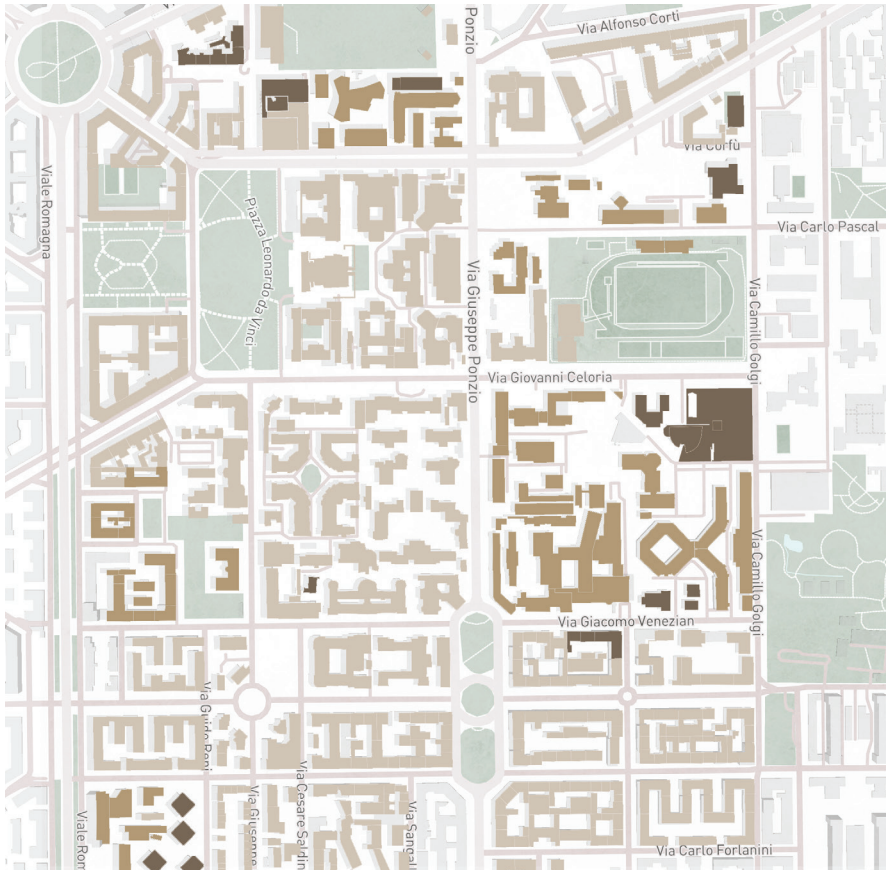
Città Studi is characterized by its university campuses and state-of-the-art research facilities, providing a dedicated environment for teaching, learning, and research activities. Within the district, the UNIMI Veterinaria Campus stands out as a notable facility, specifically focusing on veterinary medicine education and research. It encompasses various buildings, including Building 22090, which plays a crucial role in supporting the academic and practical needs of veterinary students and faculty. These facilities are equipped with advanced laboratories, lecture halls, libraries, and other resources necessary for high-quality education and research in the field of veterinary medicine. Città Studi is not solely an academic hub; it is also a vibrant residential and commercial district. The district seamlessly integrates into the fabric of Milan, offering a mix of educational, residential, and commercial spaces. It is well-connected to the rest of Milan through an extensive network of public transportation, making it easily accessible for students, faculty, and visitors. This integration allows for a dynamic and diverse community, where students can engage in academic pursuits while enjoying the amenities and cultural offerings of the city.

The expansion and development of Città Studi have contributed to Milan's urban context and growth in the 20th century. The expansion areas followed the Beruto plan, radiating in a ring-like fashion from the city center. The new areas respected the existing axes and grids, preserving Milan's historical layout and atmosphere. However, unlike the separated urban fabric of Milan's historical center, the expansion areas were more regular, presenting a grid form and built on a larger scale. The expansion was driven by urbanization and modernization, aiming for efficiency and cost-effectiveness. While influenced by internationalism and modernism, the architectural style still retained elements of Italian architecture, such as square windows, scales, and layouts. The development of the city also brought about interventions in the existing

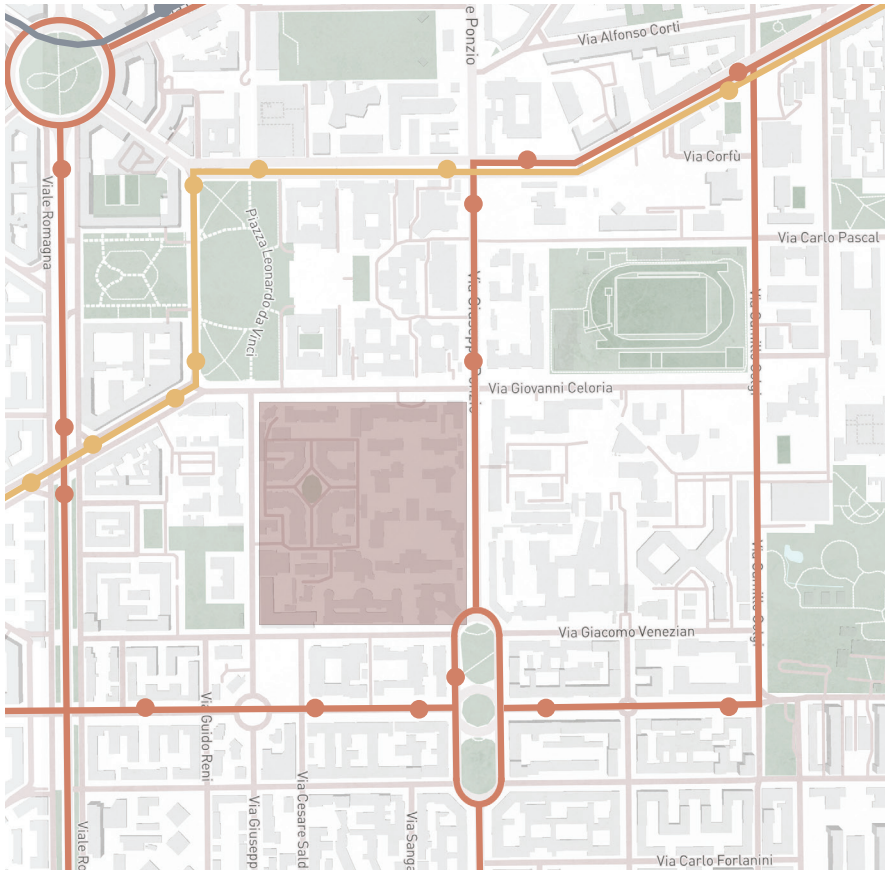
CITTA STUDI

ANALYSIS

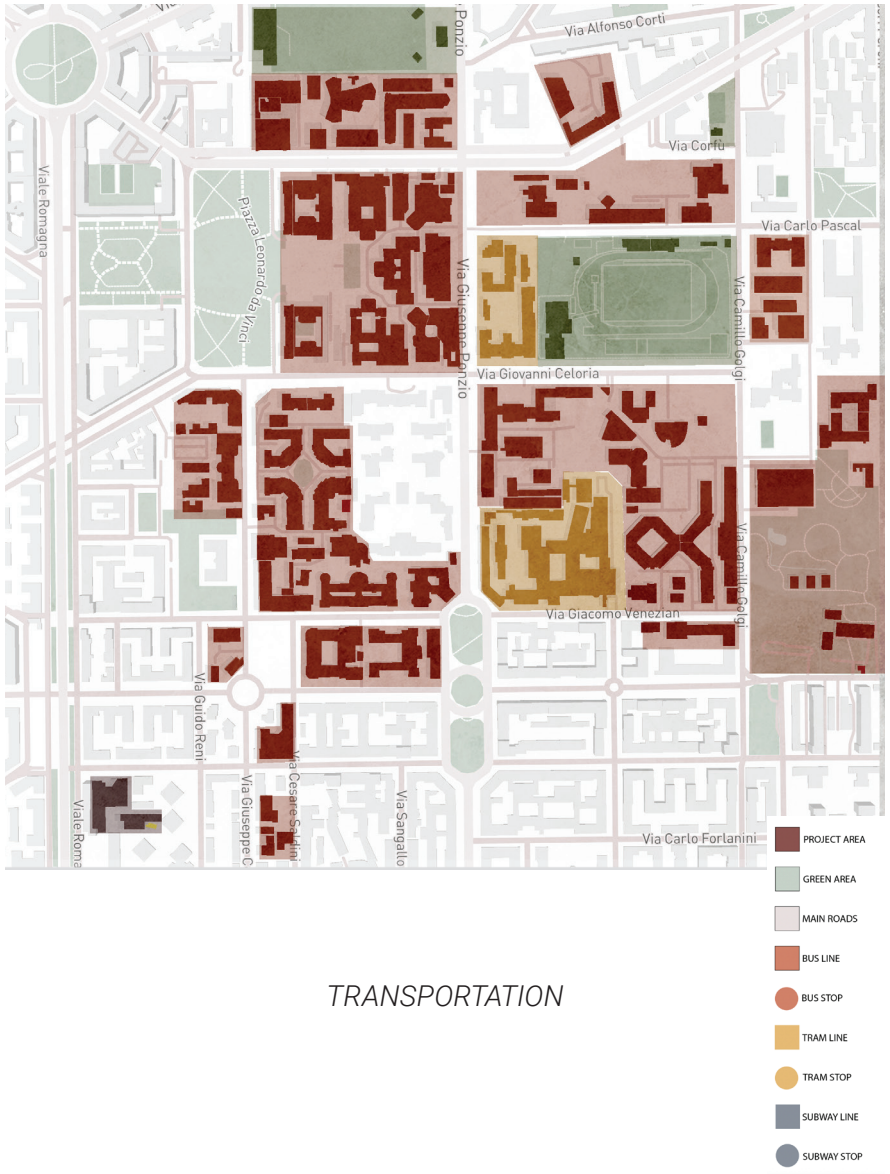
FIGURE AND GROUND



BUILDING AGES



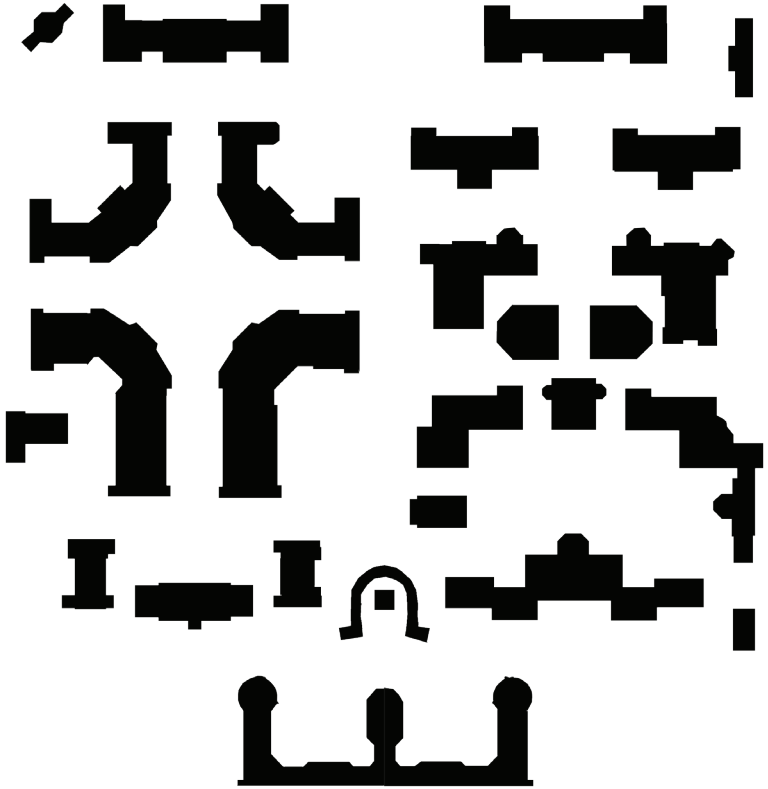
FUNCTION



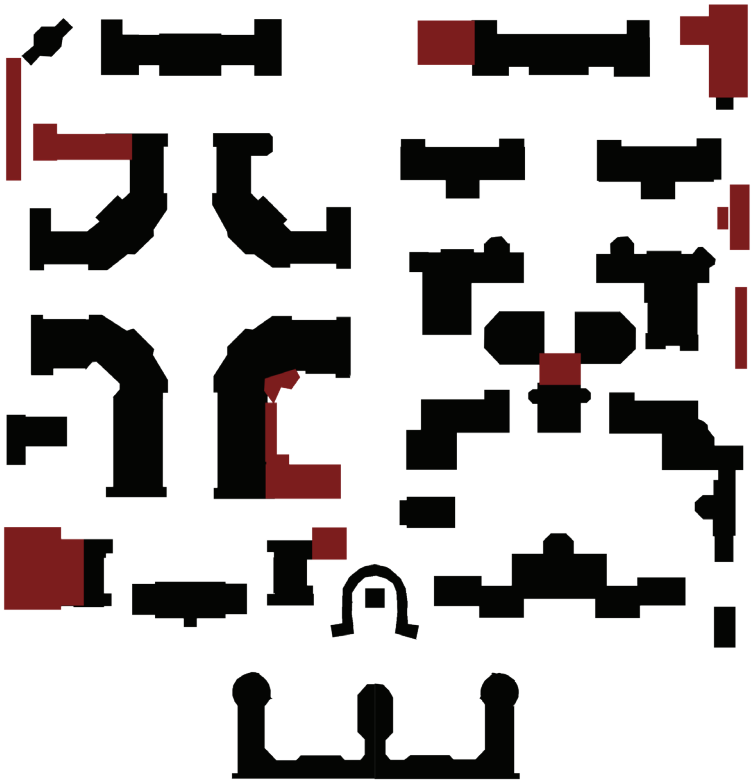
TRANSPORTATION

SITE

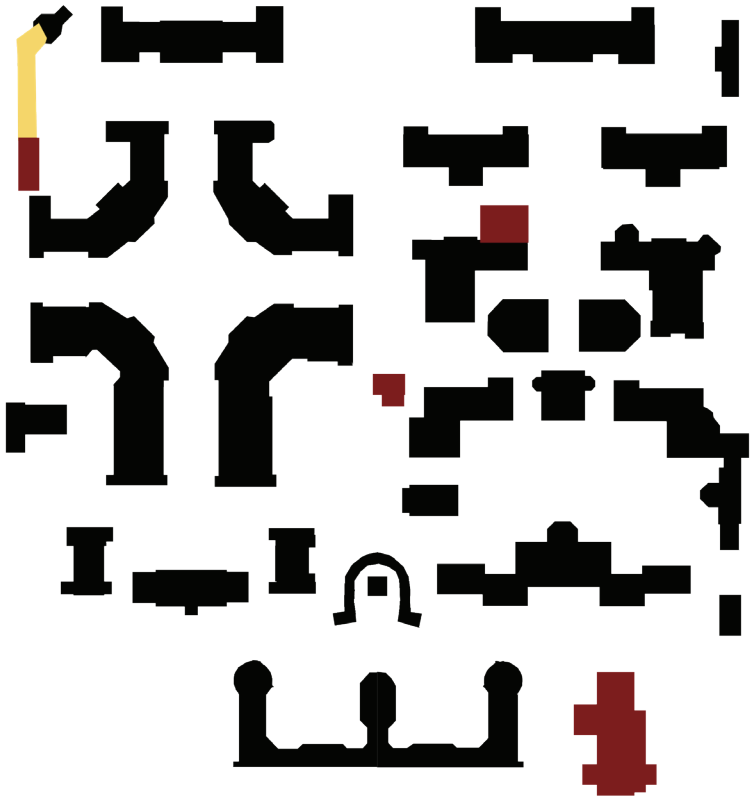
HISTORY AND DEVELOPMENT



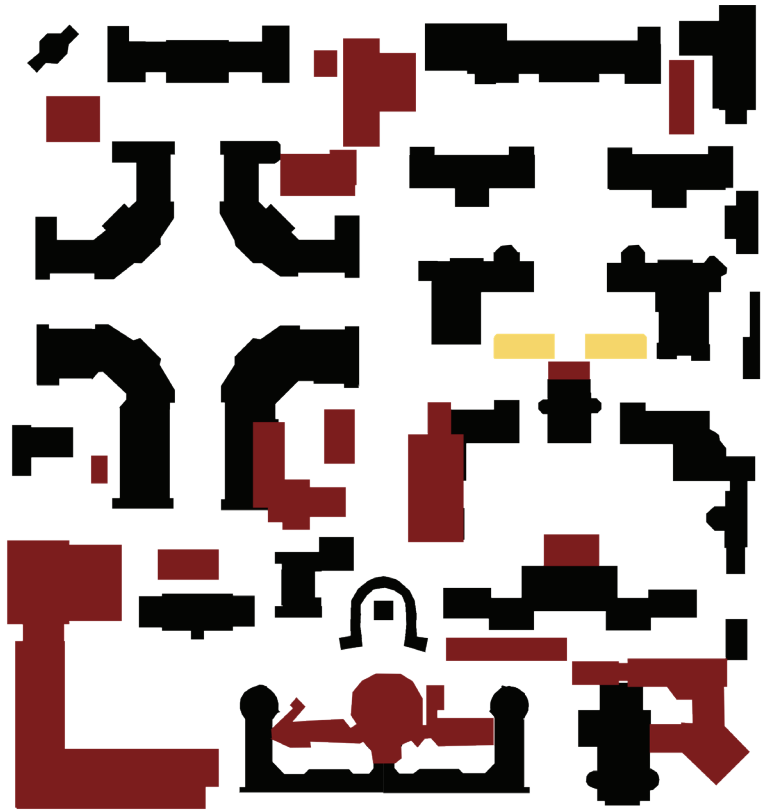
1910
Development of Agriculture and Animal Clinic



1949
Already planned as a campus



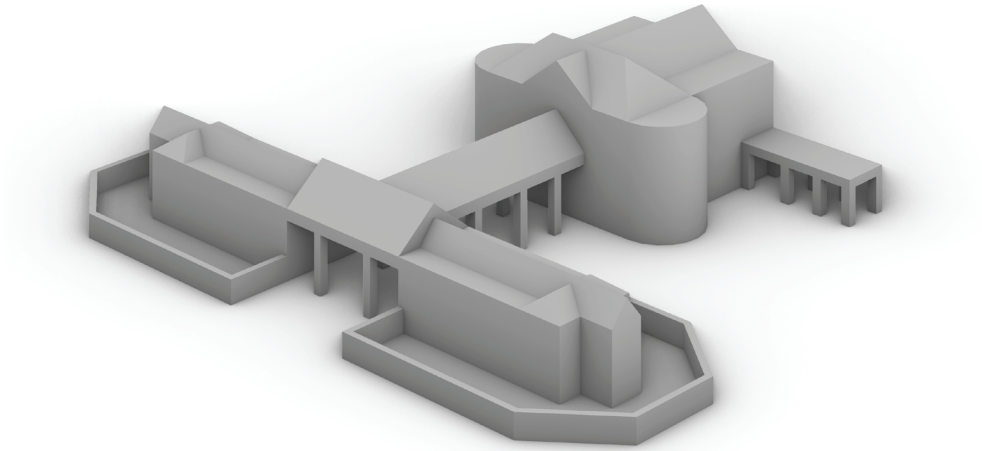
1949 - late 20s
Development and Construction



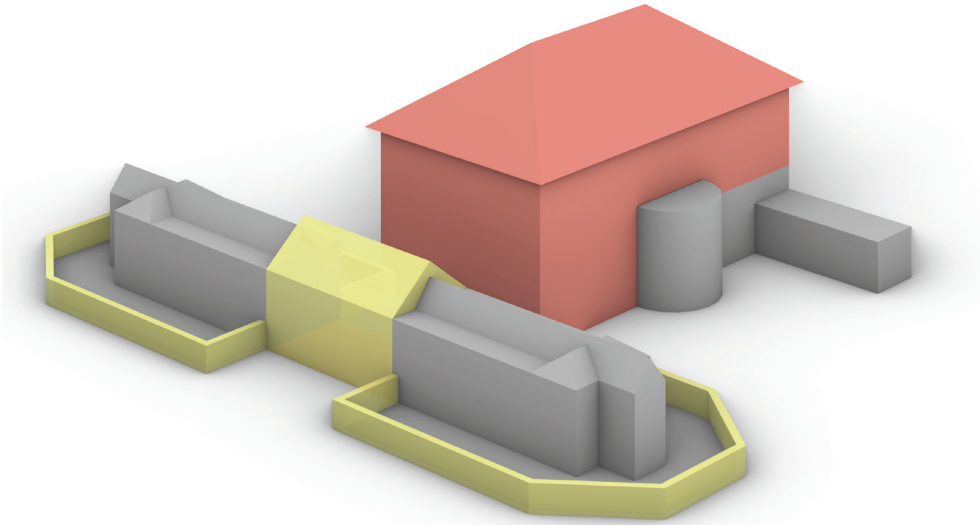
Current
Still on inovation as a multi-functional campus

SITE

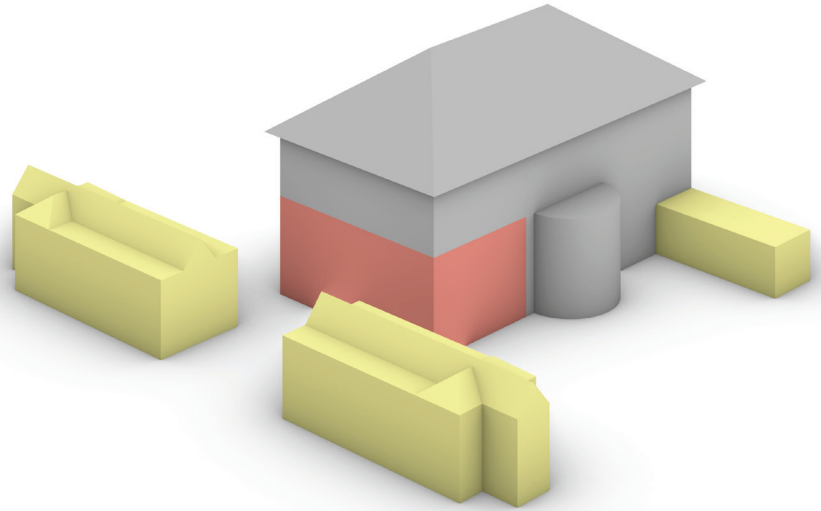
BUILDING 22090 THROUGH DECADES



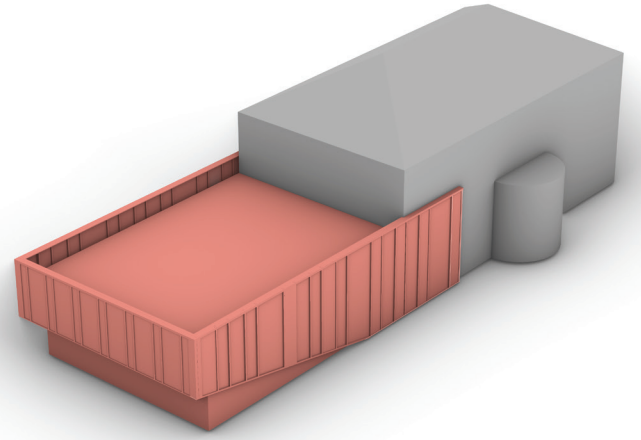
In 1910, a brick single-story building was constructed to serve as a peak animal clinic.



From 1943 to 1949, the northern section underwent an extension to accommodate obstetrics facilities and kennels.



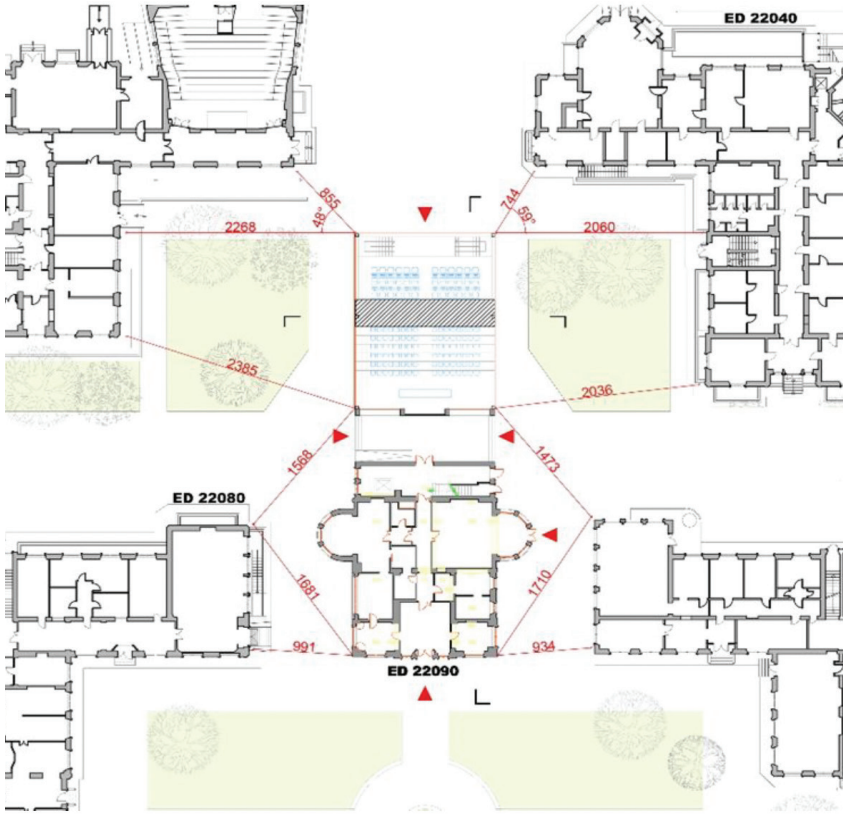
The current state of the property is that the two separate northern sections have been demolished and repurposed as an educational building.



Planned Future: North side is extended to create auditorium and computer lab. Existing building is also redesigned with improved office and classrooms.

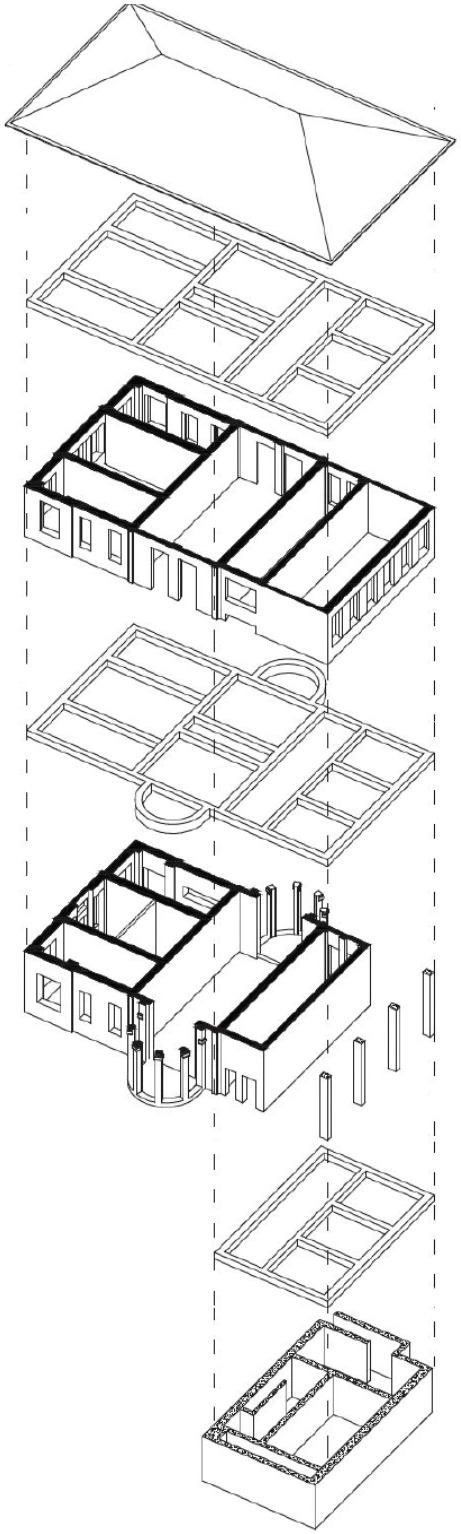
SURVEY

GEOMETRICAL & STRUCTURAL SURVEY



In our research, we intend to employ a triad of survey metodologies, namely polygonal survey, dimensional survey, and greenery positions survey. The polygonal survey shall serve to meticulously demarcate the boundaries of the site, facilitating the creation of an accurate cartographic representation. Complementing this, the dimensional survey will enable us to scrutinize the adherence of the design specifications, thereby permitting necessary adjustments if deemed essential.

Lastly, the greenery positions survey shall prove invaluable in our pursuit of preserving and managing the green spaces, furnishing us with vital insights that inform our decisions regarding optimal planting strategies and subsequent maintenance activities. By diligently implementing these survey techniques, we aim to gather imperative data, enabling us to make informed judgments and ensure the prosperous realization of the project.



After thoroughly examining the historic technical drawings and conducting an interior survey of the campus, we have made distinct assumptions regarding the structure of the older and newer parts of the existing building. For the older section, constructed between 1949 and 1950 and lacking a basement, our inference suggests the presence of brick walls and a concrete beam structure, reflecting the prevailing architectural style of classicism in post-war construction. Notably, our interior survey revealed numerous beams on the brick walls, further affirming our assumption of brick walls and concrete beams as the primary structural elements for the entire building.

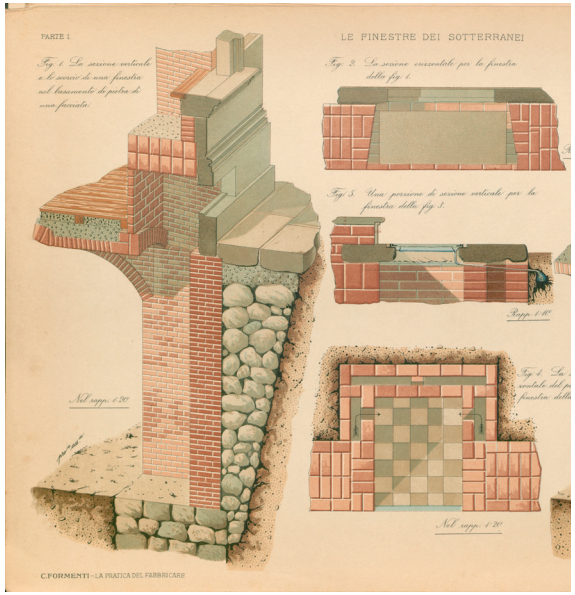
As for the newer part of the building, which includes a small basement specifically designed for technical and heating equipment, we have observed visible indicators both inside and outside. Notably, the presence of four concrete columns suggests the incorporation of a reinforced concrete structure during the building's subsequent renovations in the following decades. Consequently, we have utilized this observation to formulate a structural assumption for the entire building in the explosion drawing, enabling us to proceed with the appropriate consolidation measures for the demolition based on this assumption.

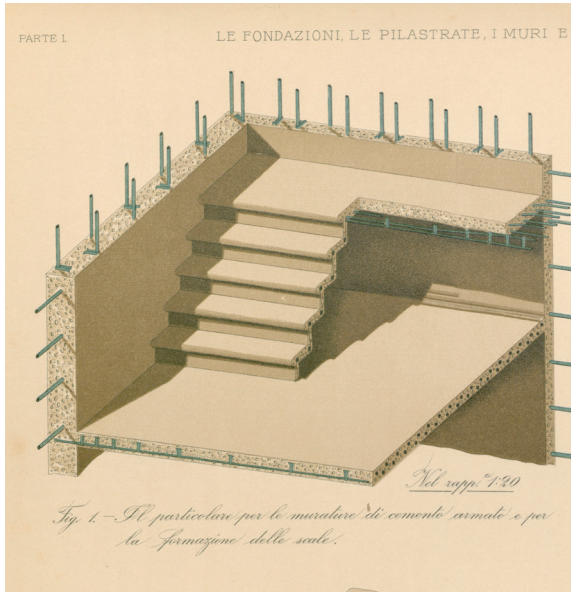
SURVEY

GEOMETRICAL & STRUCTURAL SURVEY *DETAIL REFERENCES*

1-) FOUNDATION
Regarding the foundation component, which regrettably eluded our on-site survey, we have resorted to analyzing both the previous structure and the technical drawings of the campus. Through this examination, we have found that the reference to brick and concrete foundation details aligns closely with our own assumptions. Furthermore, it is noteworthy that the thickness of the masonry wall, which interfaces with the foundation, mirrors that of the reference material.

2-) STAIRS
During our research, we came across pertinent technical drawings that bear resemblance to the photographs captured during the interior survey. By studying these details, we were able to make estimations regarding the height of a single story, which serves as a crucial piece of information for the creation of the survey section drawings. Moreover, this finding proves advantageous in conducting material analysis, particularly concerning the interior design aspects from the post-war era.



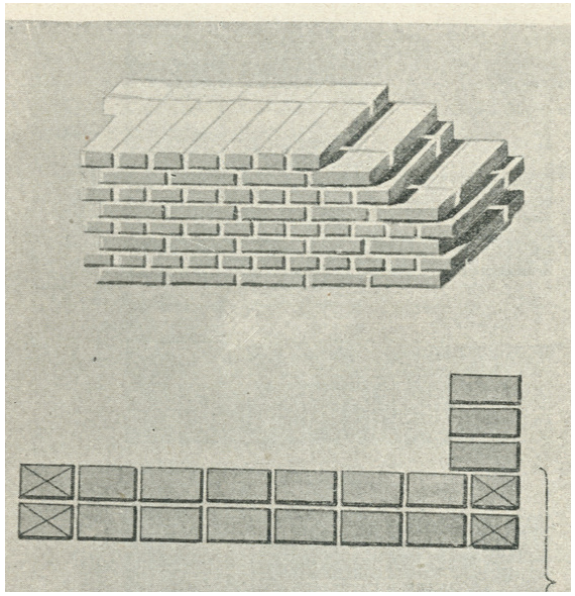


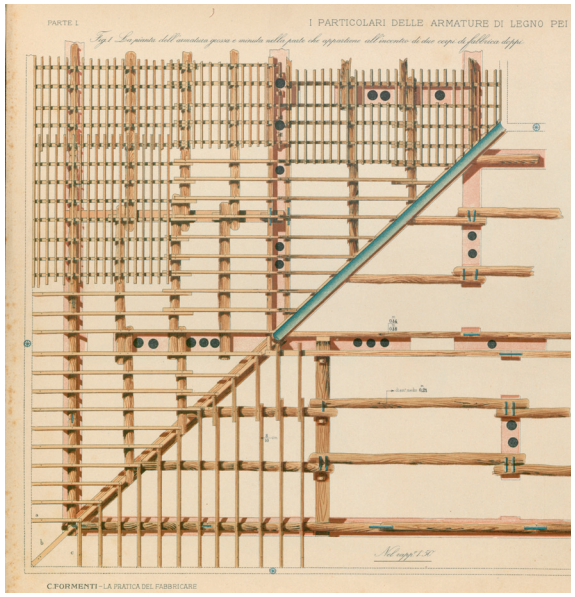
3-) BRICKS/WALLS

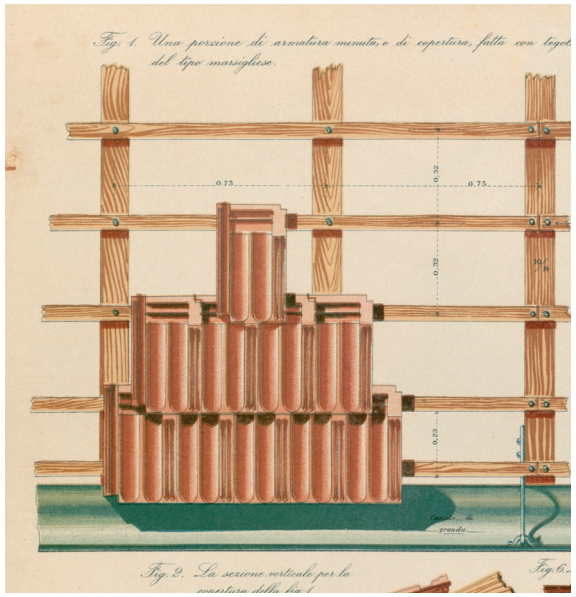
By examining the specifications of bricks, specifically their standard dimensions of 12cm x 25cm x 5.5cm, as well as those of hollow clay bricks measuring 16cm x 26cm x 16cm, we proceeded to compare them with the actual dimensions observed at the site. Through this analysis, we were able to confirm both the fundamental dimensions of the bricks and make assumptions about the presence of a brick structure, along with a hollow pot slab supported by concrete beams.

4-) ROOF

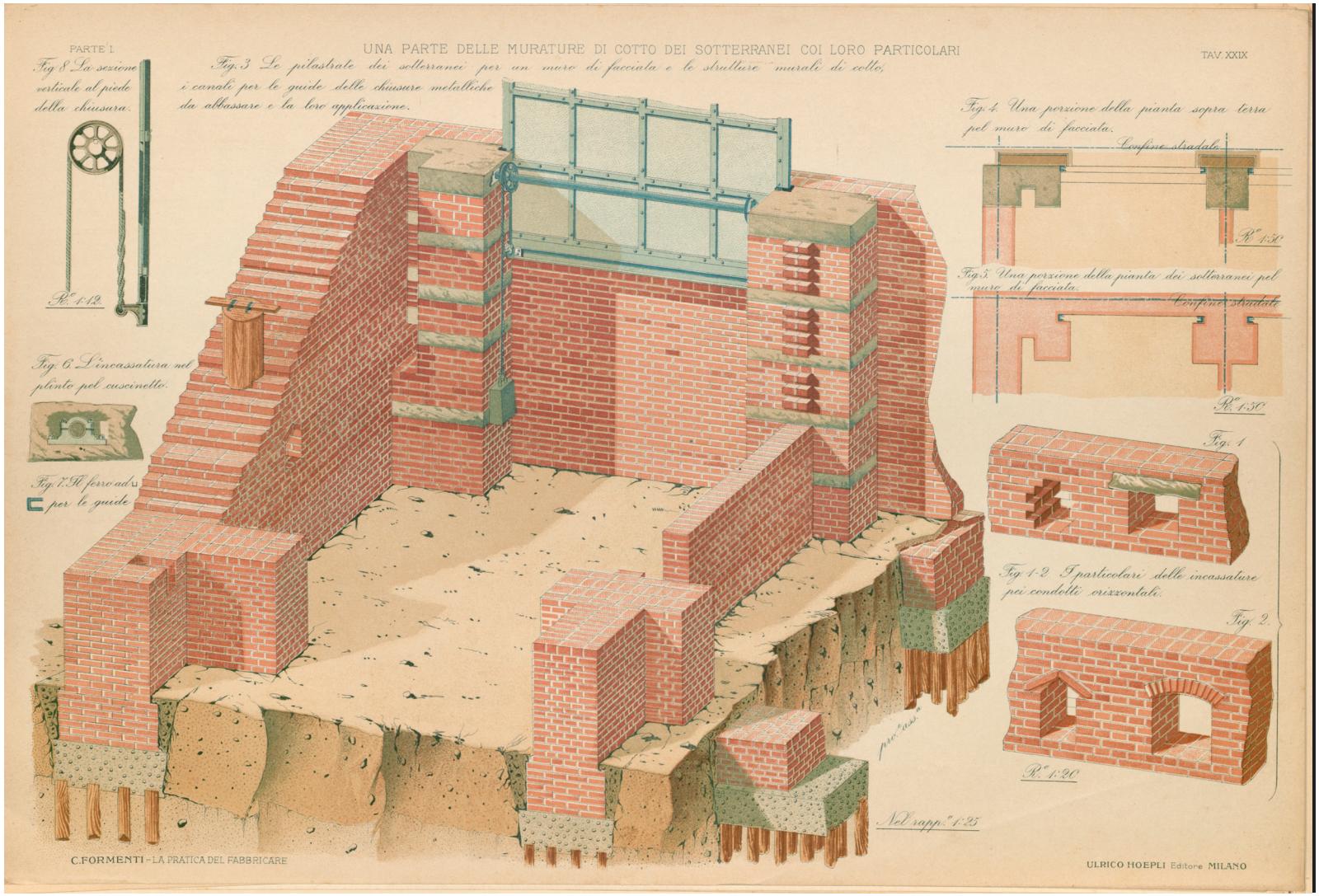
The roof of the preexisting structure poses an unseen facet during the survey, yet it encompasses a collection of well-defined traditional elements. Notably, it consists of a timber framework, accompanied by a dual-layered tile surface and an exterior metal drainage system, which is observable from the facades.







SURVEY


PARTE I.
UNA PARTE DELLE MURATURE DI COTTO DEI SOTTERRANEI COI LORO PARTICOLARI
TAV. XXIX
Fig. 3. Le pilastrate dei sotterranei per un muro di facciata e le strutture murali di cotto; i canali per le guide delle chiusure metalliche da abbassare e la loro applicazione.
Fig. 8. La sezione verticale al piede della chiusura.
R.e 1:12.
Fig. 6. L'incassatura nel plinto pel cuscinetto.
Fig. 7. Il ferro ad U per le guide
Fig. 4. Una porzione della pianta sopra terra pel muro di facciata.
Confine stradale
R.e 1:50
Fig. 5. Una porzione della pianta dei sotterranei pel muro di facciata.
Confine stradale
R.e 1:50
Fig. 1
Fig. 1-2. I particolari delle incassature pei condotti orizzontali.
Fig. 2.
R.e 1:20
Nel rapp.e 1:25
C. FORMENTI - LA PRATICA DEL FABBRICARE
ULRICO HOEPLI Editore MILANO

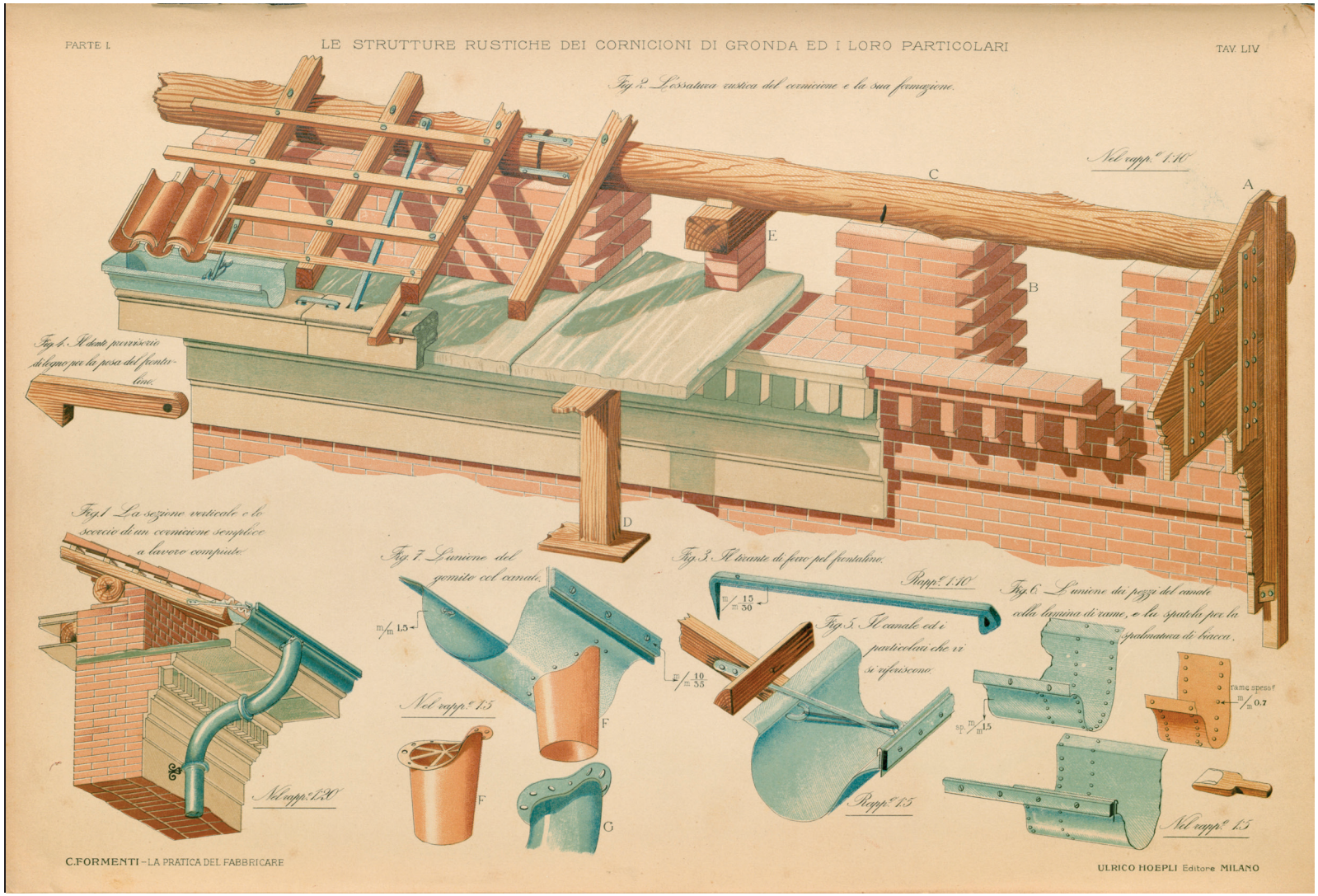
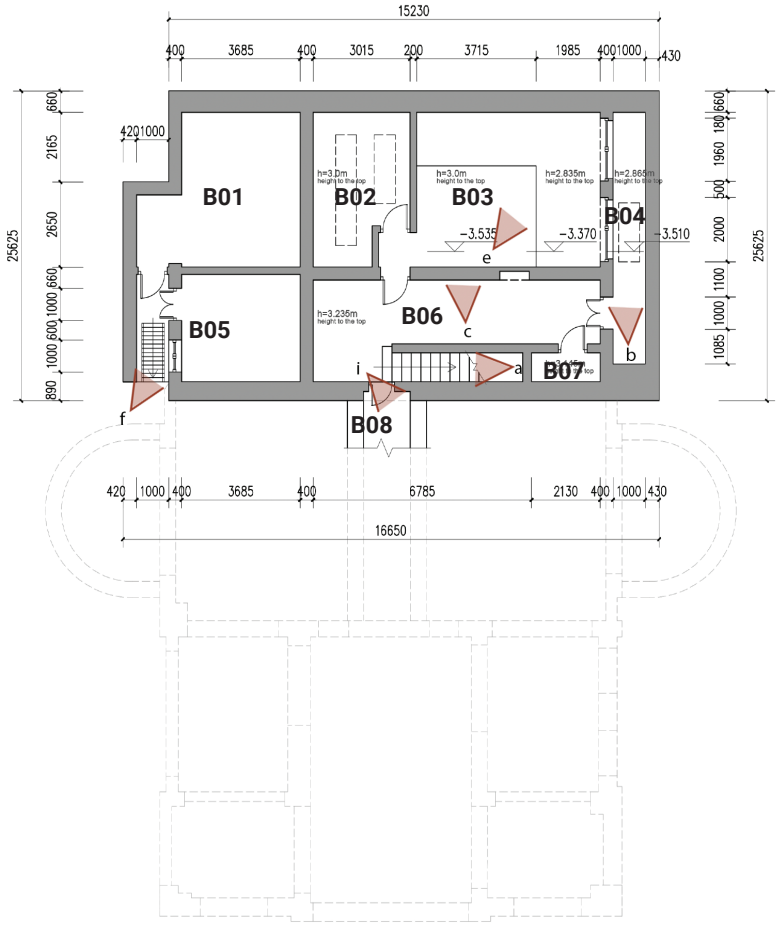


Fig 2. L'ossatura rustica del cornicione e la sua formazione.
Nel rapp.e 1:10
A
B
C
D
E
Fig 4. Il dente provvisorio di legno per la posa del frontalino.
Fig 1. La sezione verticale e lo scorcio di un cornicione semplice a lavoro compiuto
Nel rapp.e 1:20
Fig 7. L'unione del gemito col canale.
m/m 1,5
Nel rapp.e 1:5
F
F
G
Fig 3. Il tirante di ferro pel frontalino.
Rapp.e 1:10
m/m 15/30
m/m 10/35
Fig 5. Il canale ed i particolari che vi si riferiscono.
Rapp.e 1:5
Fig 6. L'unione dei pezzi del canale colla lamina di rame, e la spatola per la spalmatura di biacca.
sp. m/m 1,5
lame spess.e m/m 0,7
Nel rapp.e 1:5

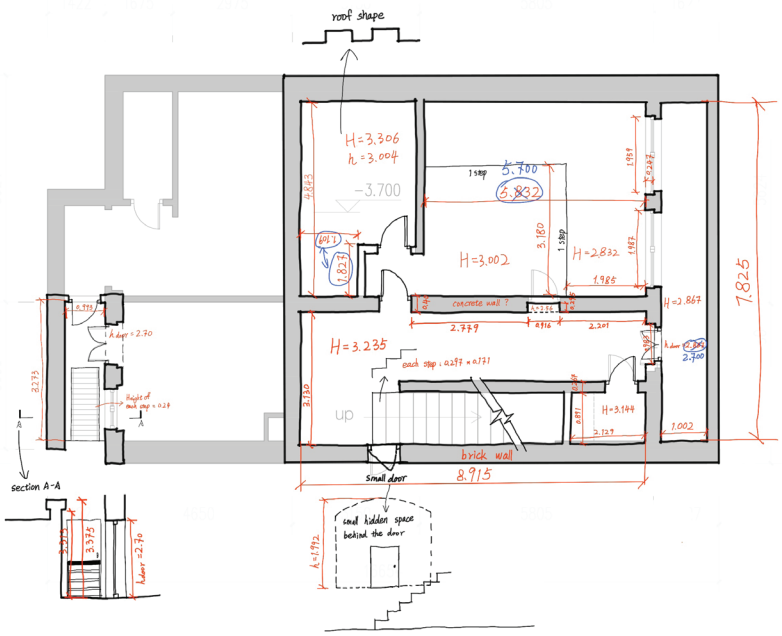
SURVEY

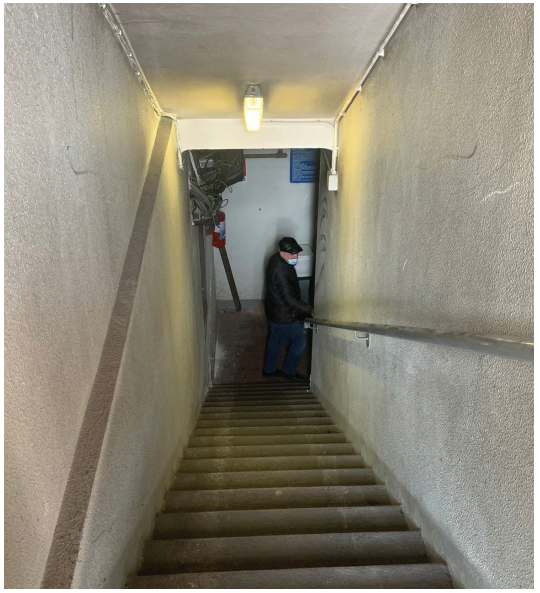
INTERIOR EXPLORATION - BASEMENT

When considering the architectural aspects of the building, it is important to highlight the basement, which has undergone recent renovations to address the heating and ventilation needs, primarily consisting of technical and service areas alongside accessible staircases for convenient entry, characterized by its utilitarian nature, serving as a functional space to house essential infrastructural systems and supporting services, while certain sections of the basement floor remain inaccessible due to specialized requirements or restricted access.

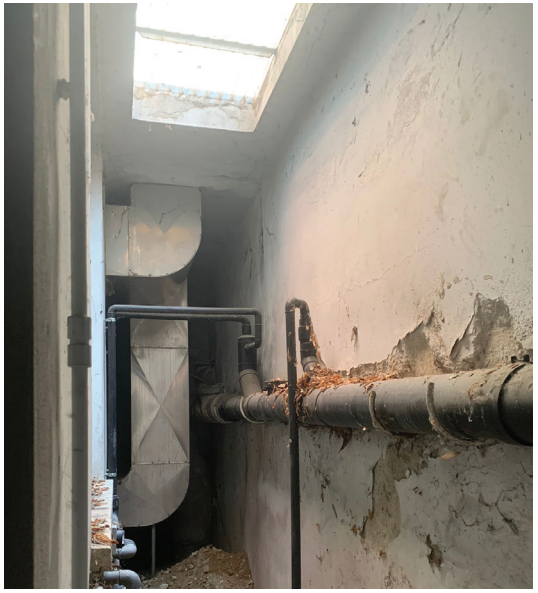


Room Analysis			
Room Code	Department	Function	Area
B01	Technical Space	Technical Room	20.8
B02		Machine Room	13
B03		Machine Room	29.6
B04		Ventilation	8.6
B05		Thermal Power Station	12.6
B06	Distribution	Hall	20.5
		Staircase	6
B07	Service	Storage	2
B08		Other	-





a.B01

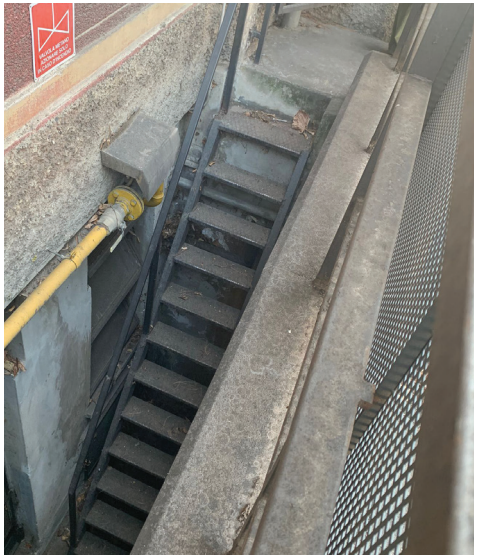


b.B02

c.B03

d.B04

e.B05



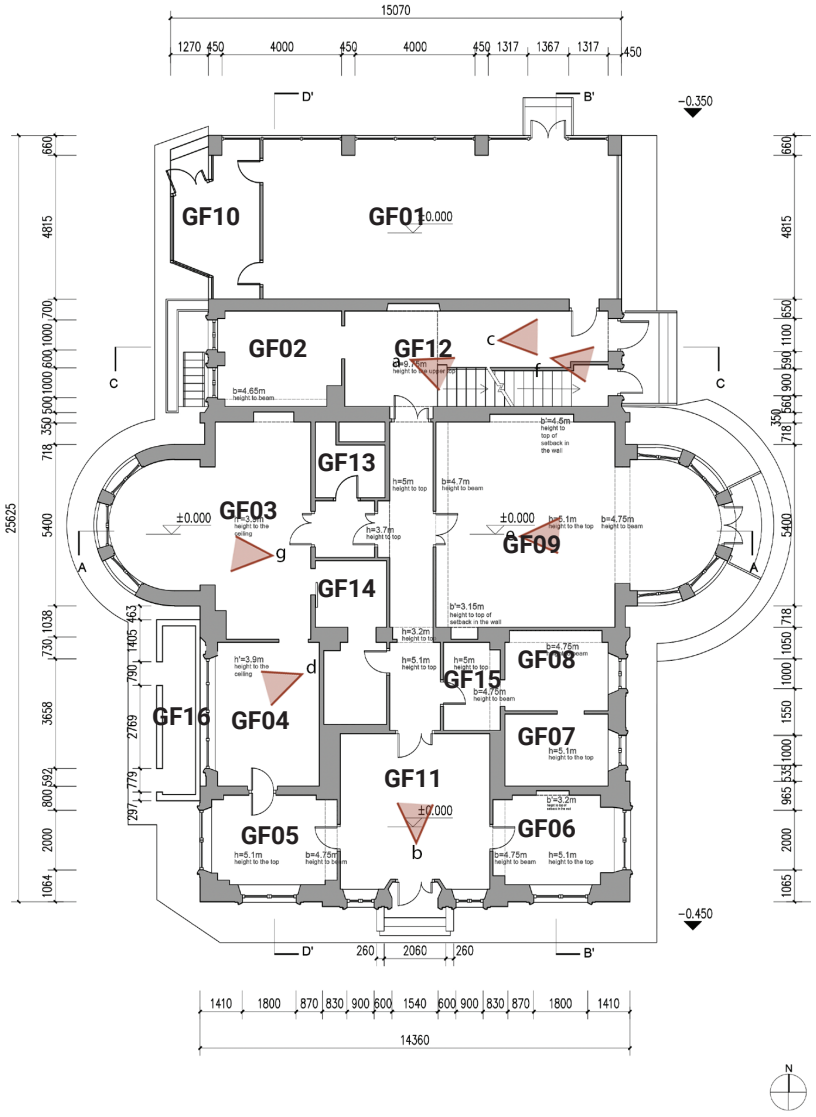
f.B06

SURVEY

INTERIOR EXPLORATION - GROUND

In examining the ground floor layout, we discover a noteworthy feature: five entrances thoughtfully designed to cater to different user groups. Students attending lessons from the campus primarily utilize the entrances located in the northern and western corners, while professors and researchers gain access to their respective labs and offices through the entrances in the southern and eastern sections. These separate entrances ensure efficient circulation, tailored to the needs of each user group. Notably, the interior of the building reveals the presence of visible beams, which can be conveniently measured using laser distance measuring instruments. By following these discernible beams, we can make informed conjectures about the potential locations of load-bearing walls and deduce the primary foundation position of the building. This comprehensive understanding of the structural elements contributes to our overall assessment of the site and aids in planning subsequent interventions.

Room Analysis			
Room Code	Department	Function	Area (m2)
GF01	Didactic	Classroom	62.5
GF02		Office	12.5
GF03		Laboratory	35.9
GF04		Laboratory	16.6
GF05		Office	12.7
GF06		Office	12.5
GF07		Office	8.5
GF08		Office	9.6
GF09		Office	58.6
GF10	Distribution	Hall	11.7
GF11		Hall	25.1
GF12		Hall	48.7
		staircase	
GF13	Service	Storage	5.8
GF14		Wc	11.4
GF15		Storage	5.5
GF16	Technical Space	Technical Room	6.3



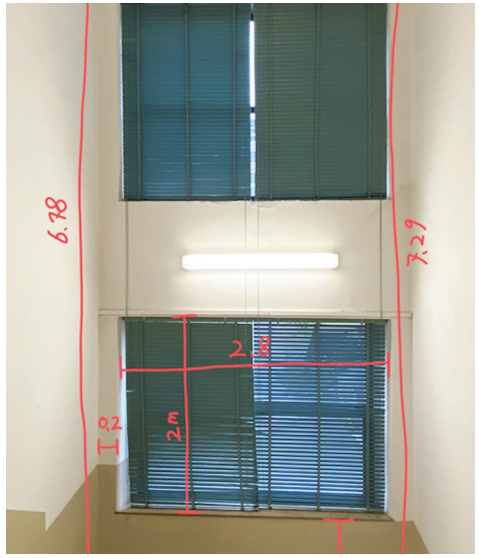
a. GF01

b. GF02

c. GF03

d. GF04

e. GF05



f. GF06

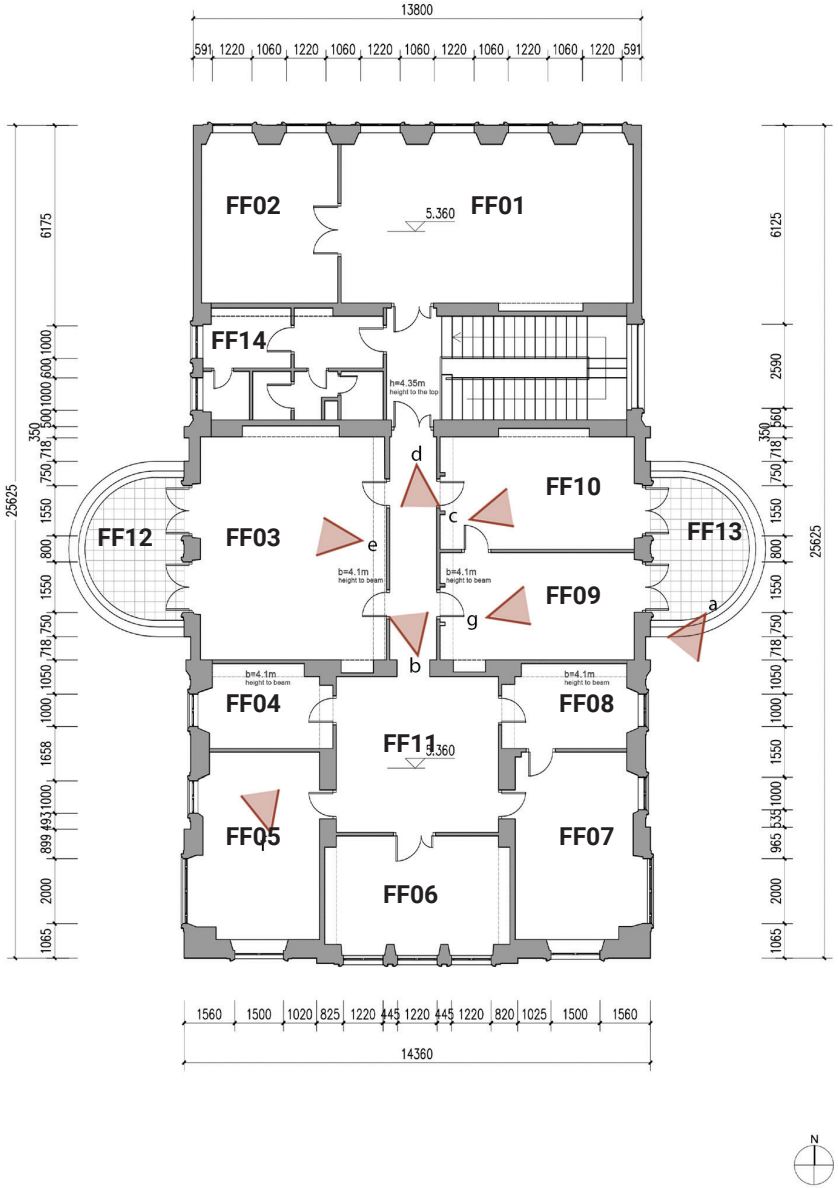
g. GF07

SURVEY

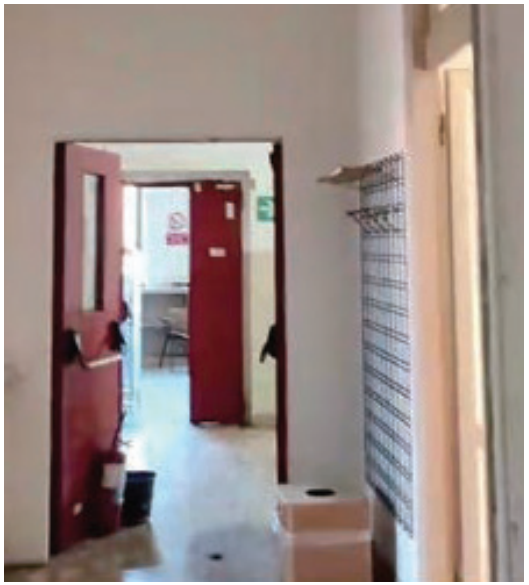
INTERIOR EXPLORATION - FIRST

In this exploration of the first-floor interior, our focus was primarily directed towards the semi-circular balconies, which proved elusive in both the orthophotos and general interior surveys. It was this specific survey that served as a crucial source for outlining the configuration of the first floor. Additionally, further validation are required to ensure the structural soundness of the identified beams and load-bearing walls.
To gain a more comprehensive understanding of the functions attributed to various rooms, the utilization of videos has proven indispensable. These videos provide valuable insights into the current purpose of each room. Certain rooms have already undergone a thorough cleaning pro-cess in preparation for their transformation into new functional spaces, aligning with our vision for the project.

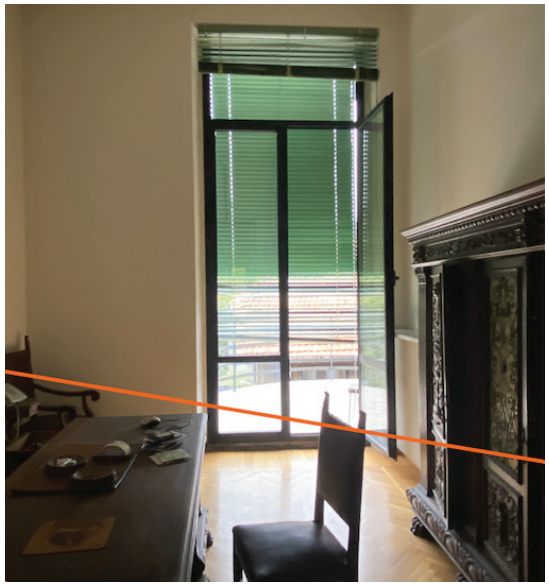
Room Analysis			
Room Code	Department	Function	Area (m2)
FF01	Didactic	Laboratory	46.8
FF02		Laboratory	22.3
FF03		Laboratory	41.4
FF04		Office	9.9
FF05		Laboratory	22.2
FF06		Laboratory	20.2
FF07		Office	21.8
FF08		Office	10.2
FF09		Office	20
FF10		Office	
FF11	Distribution	Hall	42
FF12		Balcony 1	16
FF13		Balcony 2	16
FF14	Service	Wc	18.6



a. FF01

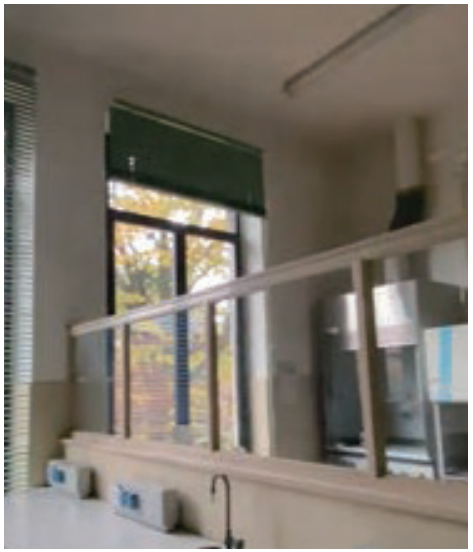


b. FF02



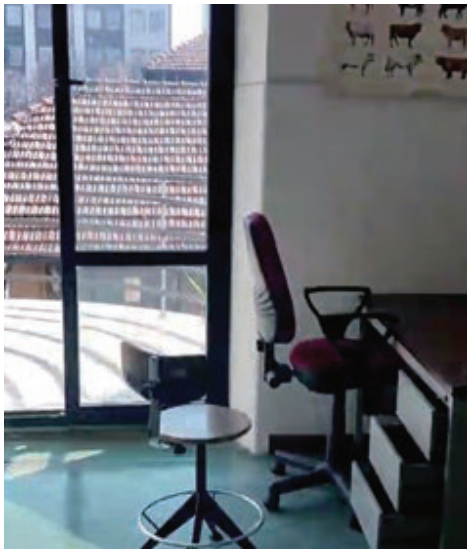
c. FF03

d. FF04



e. FF05

f. FF06



g. FF07

SURVEY

ORTHOPHOTO

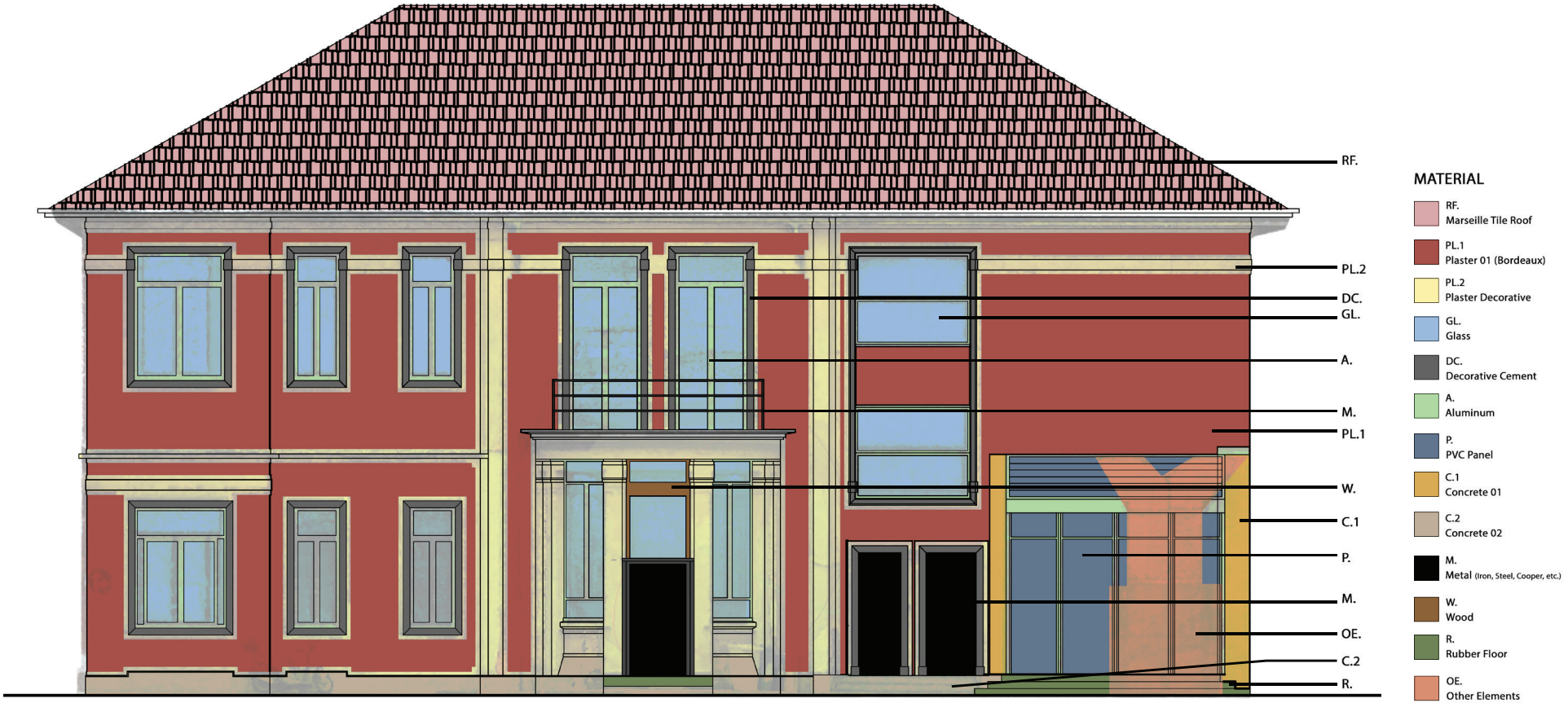
EAST FACADE
SCALE 1/100

NORTH FACADE

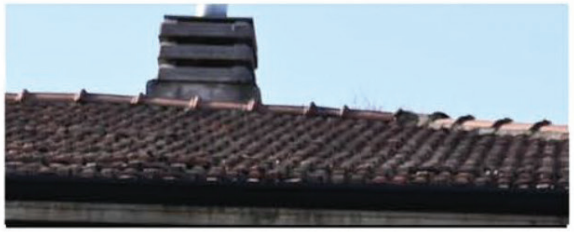
SOUTH FACADE

SURVEY

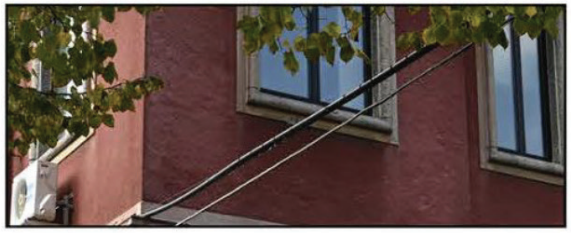
MATERIAL MAPPING



RF.

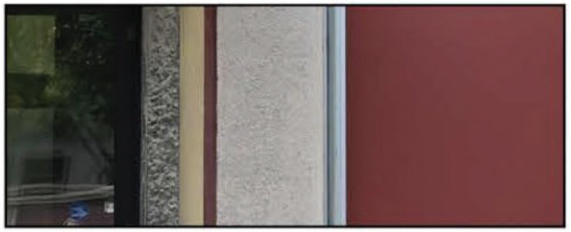


PL. 1



PL. 2

C. 1

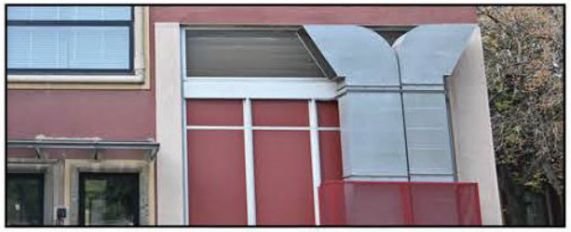


C. 2

P.

M.

OE.



DC.

W.

R.

A.

SURVEY

DECAY MAPPING

Cracks 01

Individual fissure, clearly visible by the naked eye, resulting from separation of one part from another.

Bursting 02

Local loss of the stone surface from internal pressu- re usually manifesting in the form of an irregularly- sided crater.

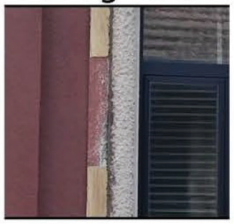
Peeling 03

Shedding, coming off, or partial detachment of a superficial layer (thickness : submillimetric to milli- metric) having the aspect of a film or coating which has been applied on the stone surface.

Erosion 05

Loss of portions of the primary surface, leading to smoothed shapes. It is common to find on the facade, where most of the detailing elements have degradated their edges.

Missing Parts 06



Loss of three-dimensional elements obviously located in the place of some formerly existing parts (Corner of a window frame, basement relief , piece of a relief decoration, etc.).

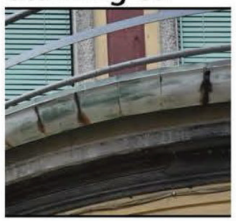
Discoloration 07

Change of the stone colour in one to three of the colour parameters : hue, value and chroma.

Black Compact Deposit 08

Accumulation of exogenic material of variable thick- ness. Some examples of deposits : splashes of paint or mortar, sea salt aerosols, atmospheric particles such as soot or dust, remains of conservation mate- rials such as cellulose poultices, blast materials etc.

Staining 09



Localized chromatic variation of the surface, correlated both to the presence of certain natural components of the material and to the presence of foreign materials (water, oxidation products of metallic materials, organic substances, paints, microorganisms).

Bio Colonization 10

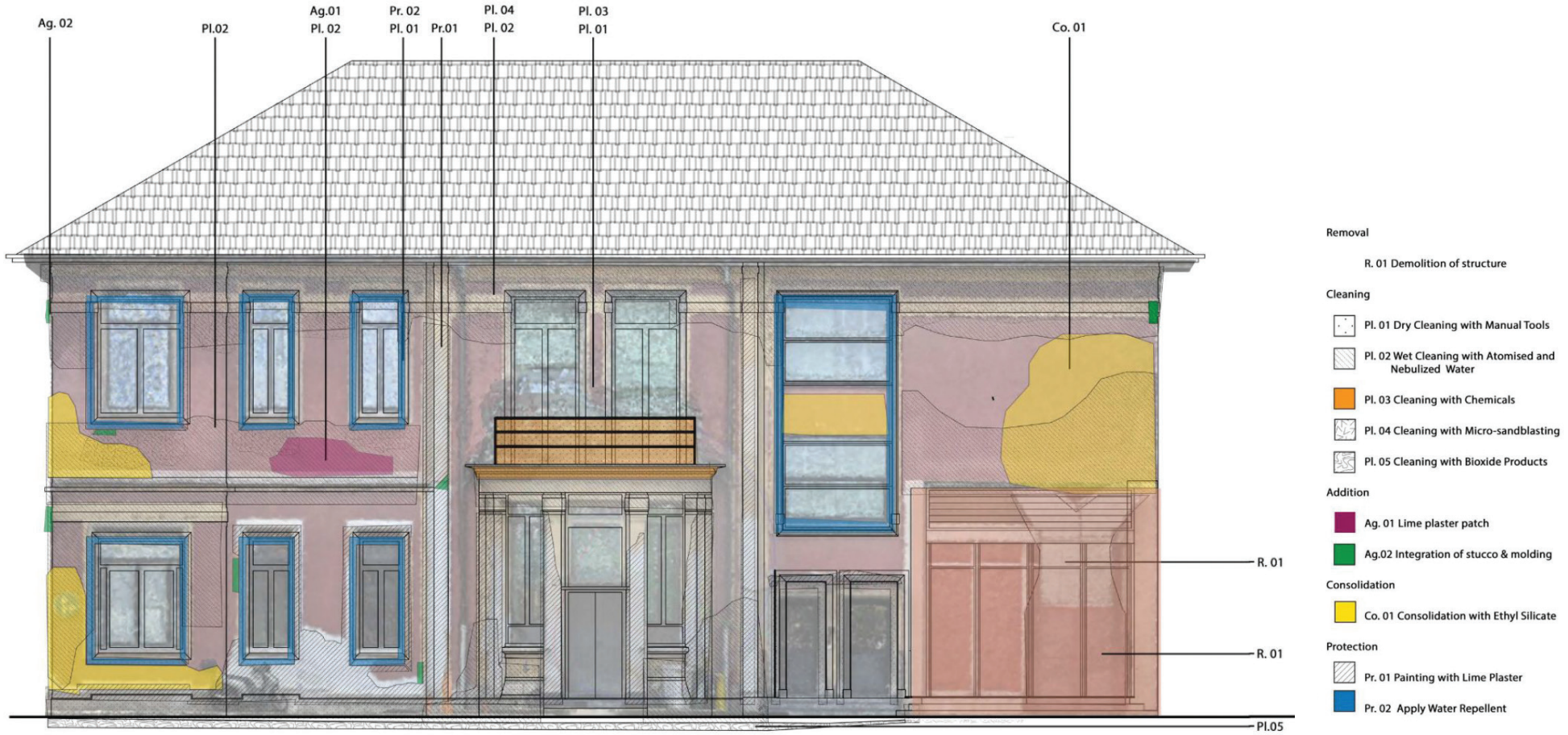
Presence of a small herbaceous organism with root system anchored to the discontinuity present between rubber steps.

Uncompatible Interventions 11

Interfaces between the original and restoration materials , regarding the discontinueties stresses or at the surface.

SURVEY

CONSERVATION AND DIAGNOSTIC



DIAGNOSTIC SCHEME

Make use of crack part for investigation

Make use of mechanical damage part for investigation

P: Samples for investigation in laboratory
Apply material championship preliminaries in the laboratory to check following parts: chemical-physical characterization, investigation on mineralogical petrographic, characterization quantitative of certain comp

St: Inv
Explo
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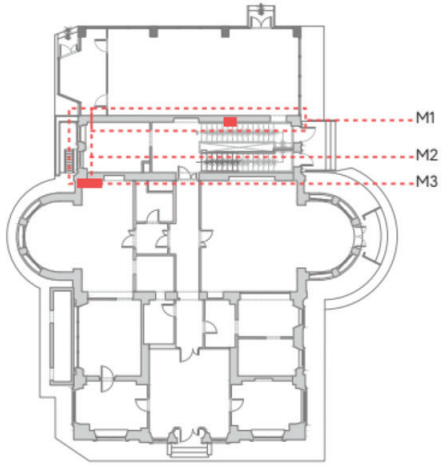
renov
needs
differ

Diagnosis



Ground Floor Plan shows tested spots.

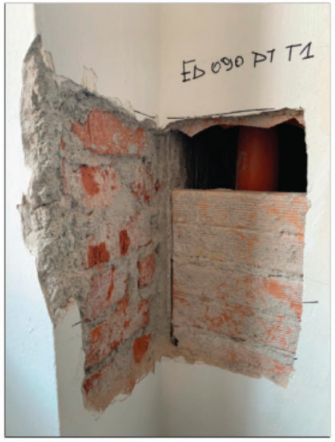


Figure M1

Figure M3

Figure M2

Location : M1, M2, M3

As a verification , interior walls were examinated and the investigation was extended to the rooms.

Examination: Removing of layers.
To understand the structure, composition of masonry walls, and installations of the pipes and where they are located. Different compositions of bricks are seen. Masonry walls are composed of bricks and the location of the service system can be seen as hollow bricks. To make sure, the investigation was extended to the rooms.

Note: Tests are already done

Examination: Based on visual survey, it is noticed that there is chromatic variation which can be assumed as a discoloration, focalized alteration on the wall which can cause detachment and hairline cracks on the east façade in some regions which makes the façade non-homogeneous. Morever, incoherent intervention in terms of both chemically and phsically on the east façade in some regions which cause cracks and incompability.

Test:

Thermography
This test can be applied in terms of identifying crack patterns caused by humidity and different materials seen mainly on the eastern and general façade of the building.

Endoscopy
The technique is useful to understand the composition and the thickness of the masonry and anchoring of the elements in the existing building, it is an important test to discover if there are any internal problems with the structure.

Sonic Auscultation
The analysis allows discovering the quality of the structure of the existing building including the roof while evaluating the resistance and behavior of material regarding the respond of the masonry to the specific stress.

PROJECT

PROJECT

CASE STUDY - HOX HAUS

Manchester-based architecture and interior design practice 74 has completed a major project to extend and remodel a Grade II-listed, two-storey, Victorian brick building in a semi-rural location in Englefield Green, just outside Egham. The repurposed 453 sq m building – Hox Haus – will serve as the central focus, clubhouse and social amenity for Hox Park student campus, newly-created by developers Moorfield Group for students attending Royal Holloway, University of London.

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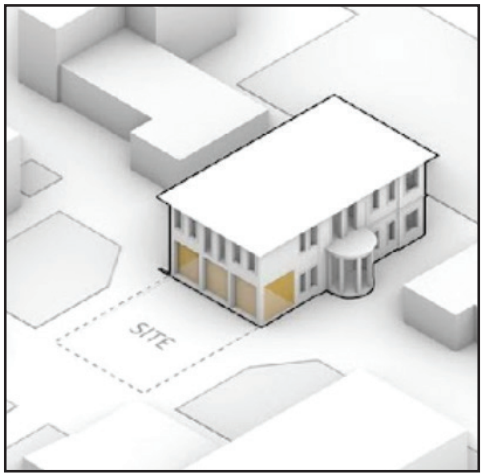
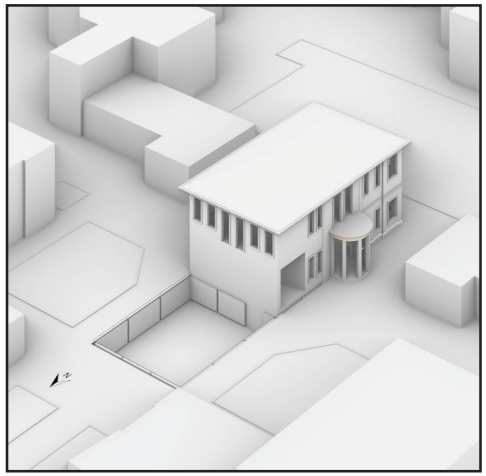
PROJECT

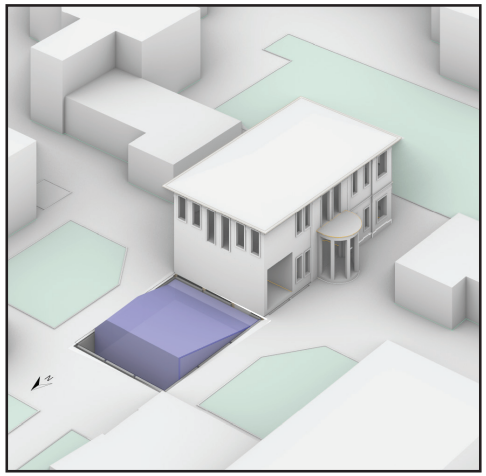
CONCEPTUAL APPROACH



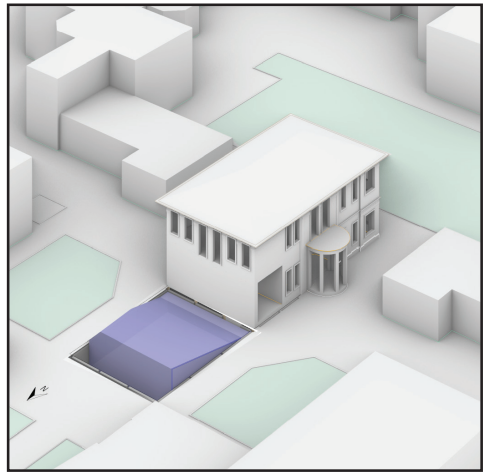
DEMOLISHMENT
Demolish the classroom and redefine it as corridor



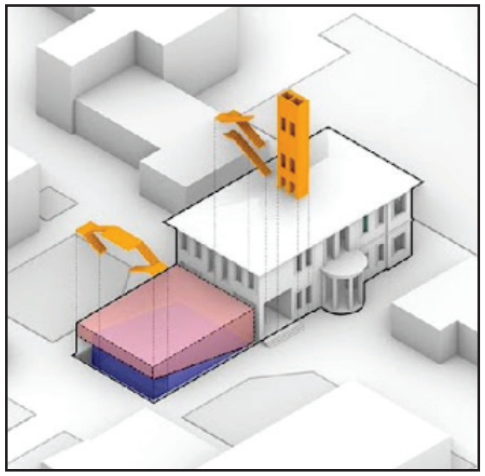
EXCAVATION
(The basement of the original building enlarges to the north.



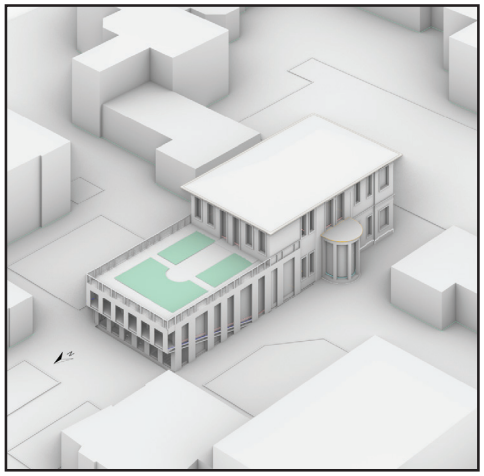
ADDITION
(The computer classroom is located on the underground floor



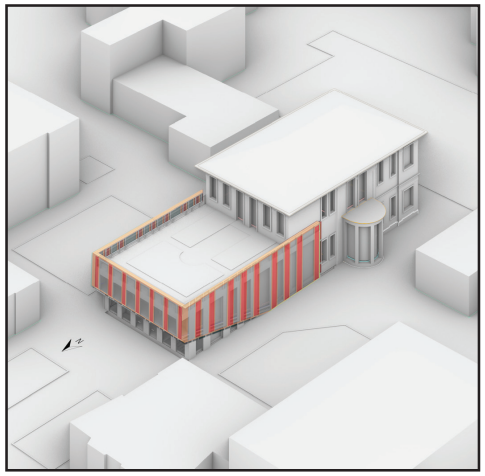
EXTRUSION
(The lecture hall is located on the ground floor



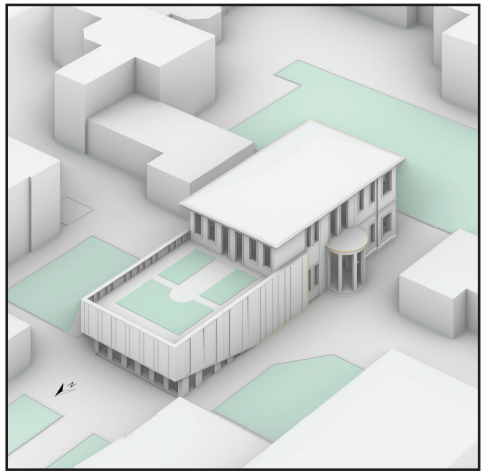
CIRCULATION
The new staircase is located inside the new volume. The elevator is located in the demolished part of the existing building)



GREEN ROOF



PROPORTION
(The dimension of the new mullions corresponds to the north facade of the exisung punding



LANDSCAPE

PROJECT

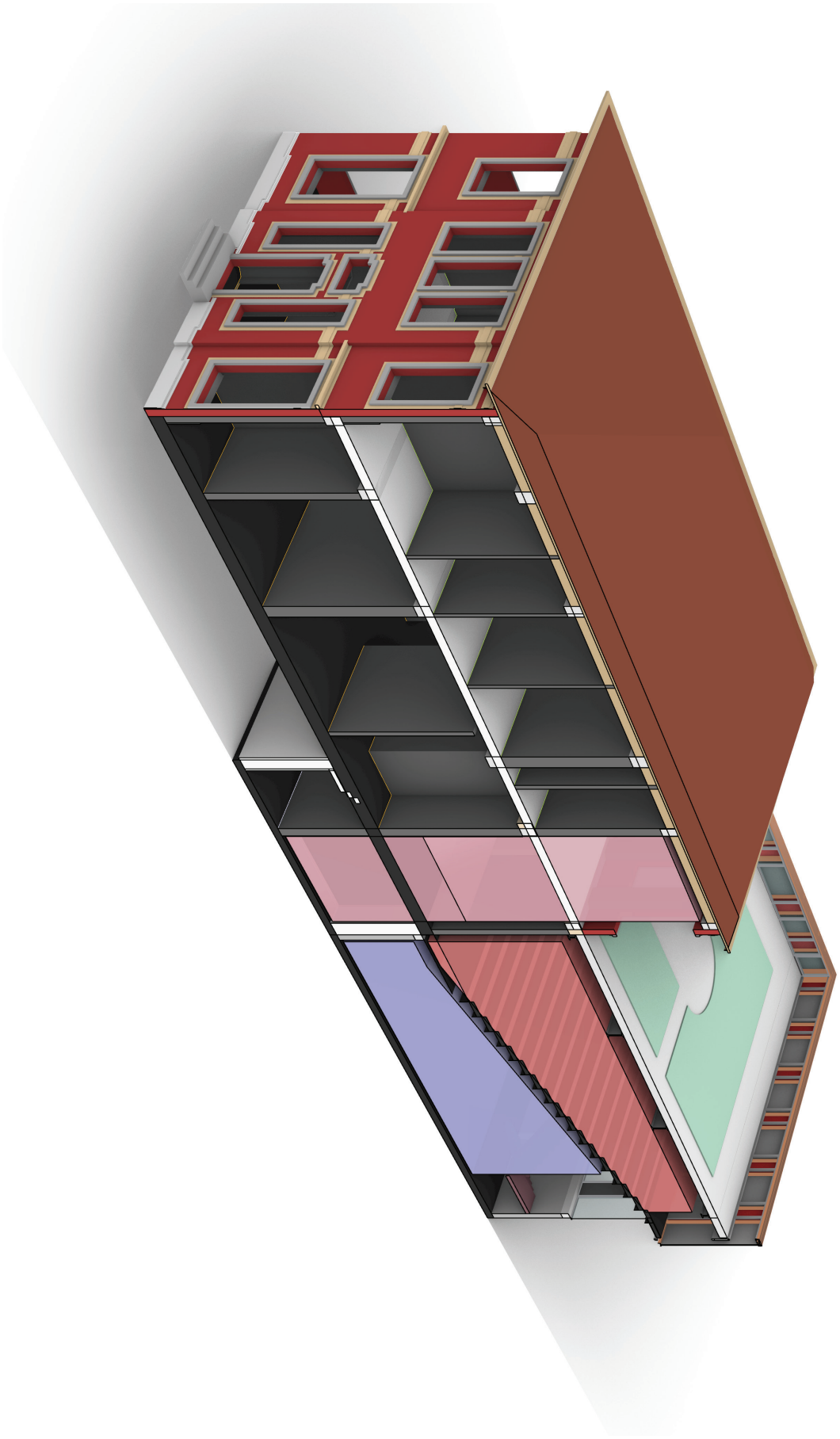
DESIGN APPROACH

We designed an addition to the existing building with an auditorium and an Info lab. We started with studying the alignments with the surrounding buildings, the dimensions required and we found the best location for the project.

In our concept design, the newest wing of the existing building is removed and that space will host a foyer where the main entrances of the buildings are.

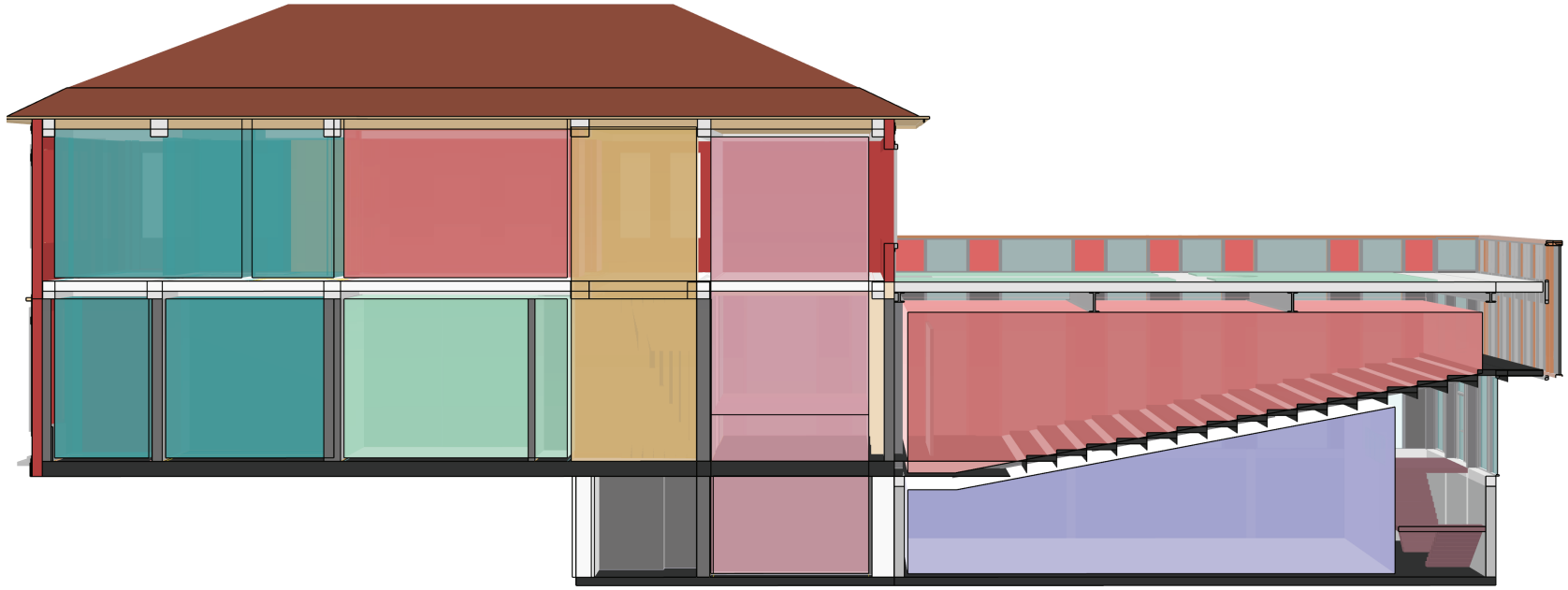
On the northern side we designed the addition, an independent steel structure box that will include the auditorium (ground floor and mezzanine) and the info lab (ground floor and underground level). For fire emergency and better circulation the info lab will have two entrances: one in the existing building and one from the northern side at ground level.

On top of the auditorium we designed a green roof top that will be used as a observatory of the campus and a quite space where to relax and study.

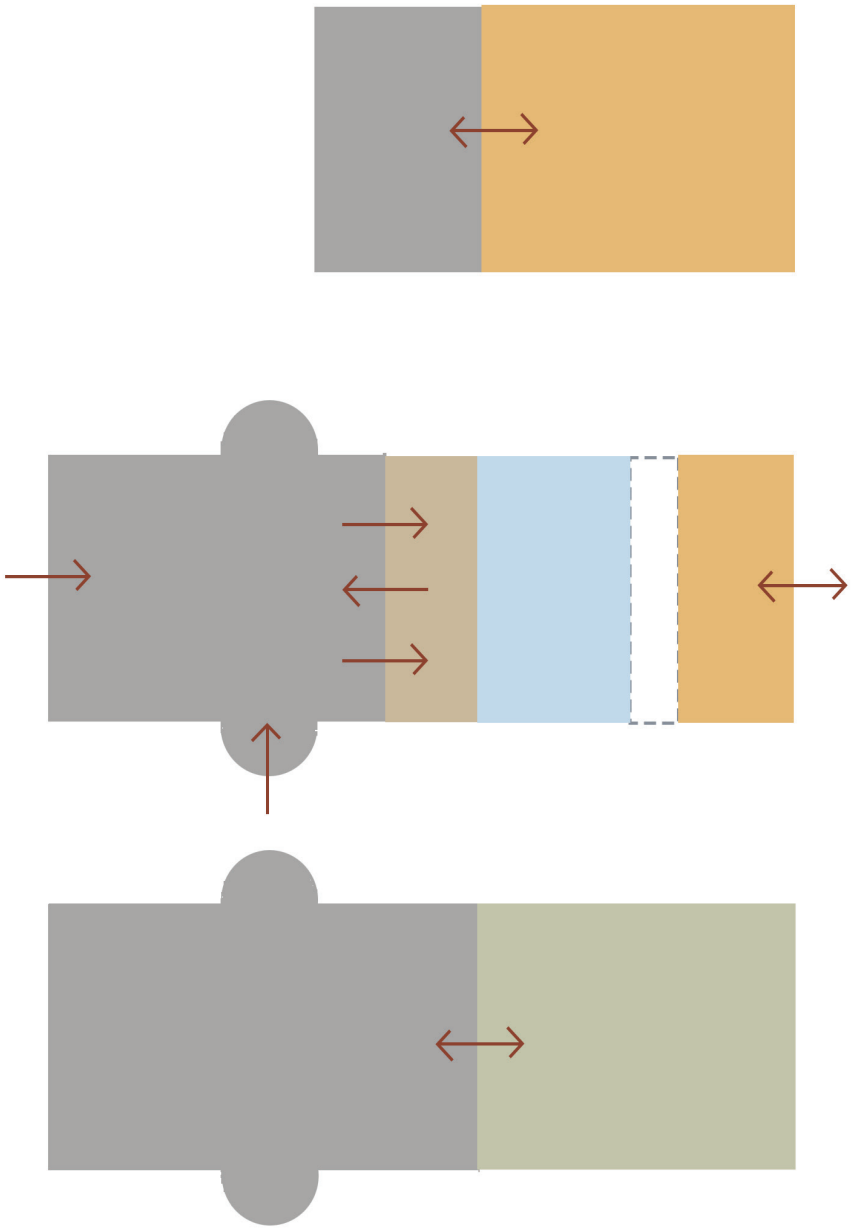


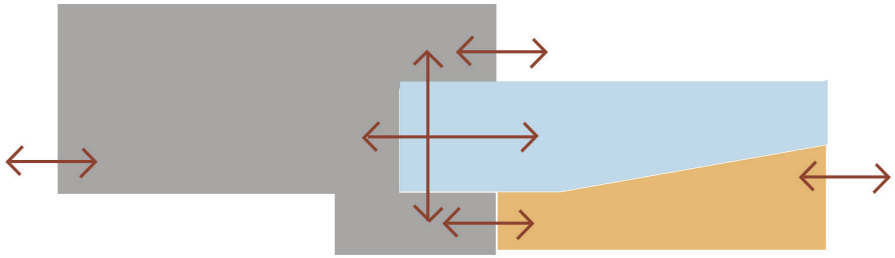
PROJECT

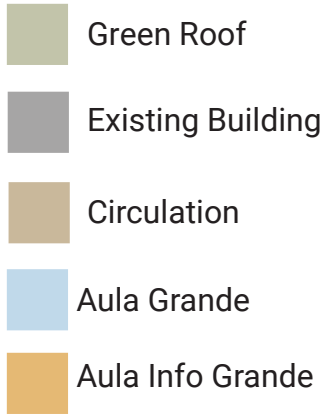
DESIGN APPROACH



- Green Roof
- Existing Building
- Circulation
- Aula Grande
- Aula Info Grande

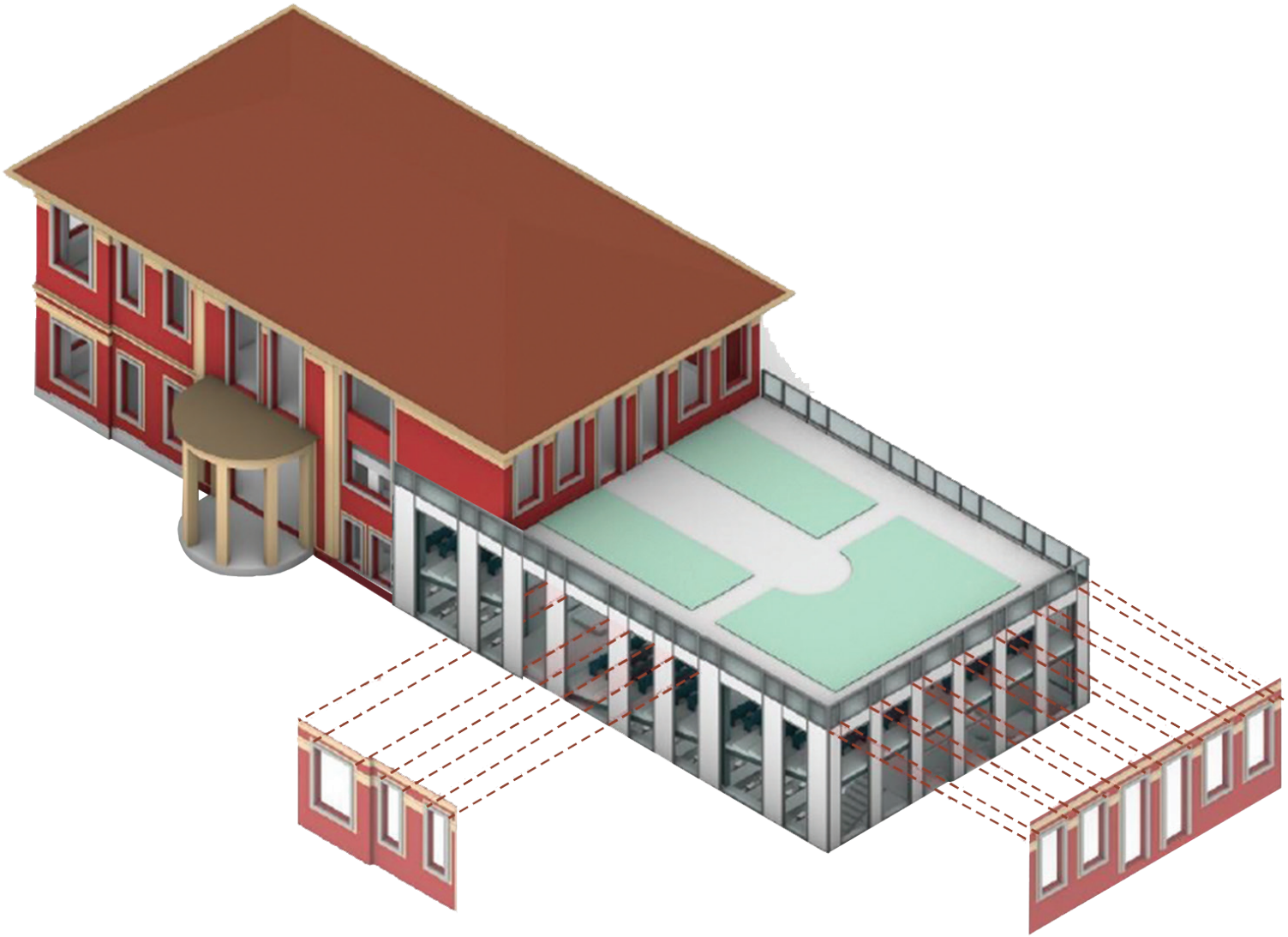


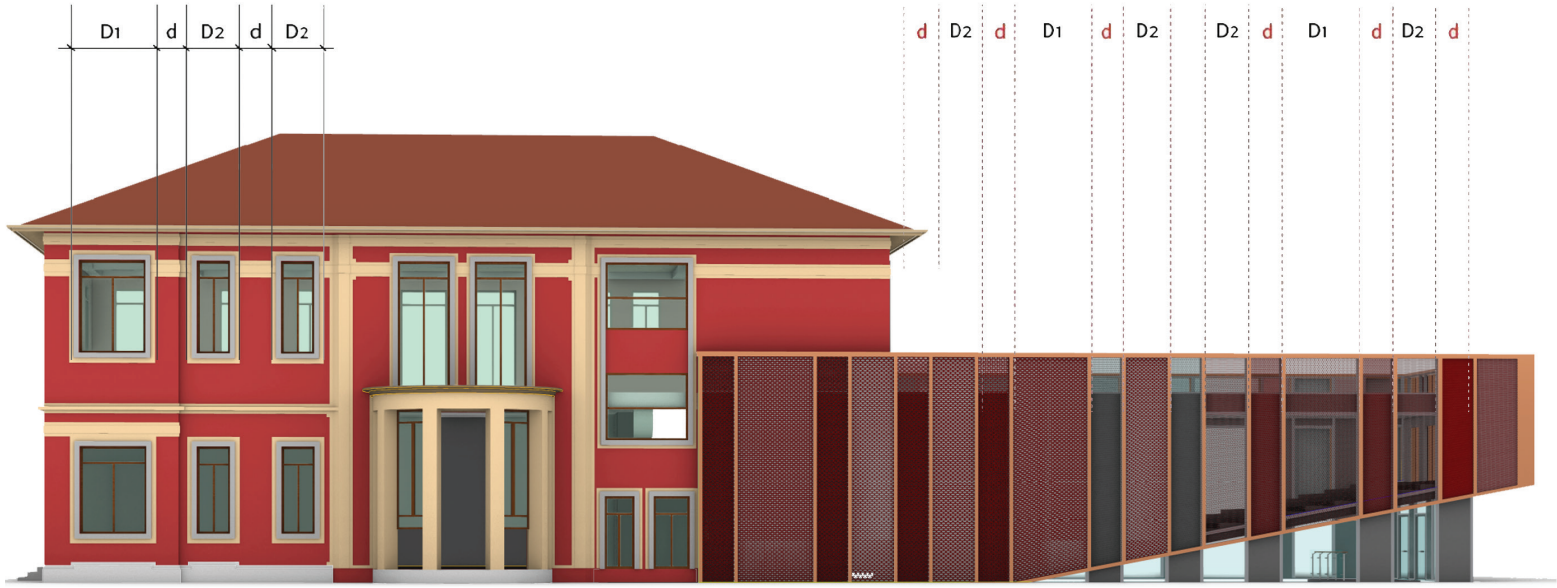



Green Roof
Existing Building
Circulation
Aula Grande
Aula Info Grande

PROJECT

DESIGN APPROACH

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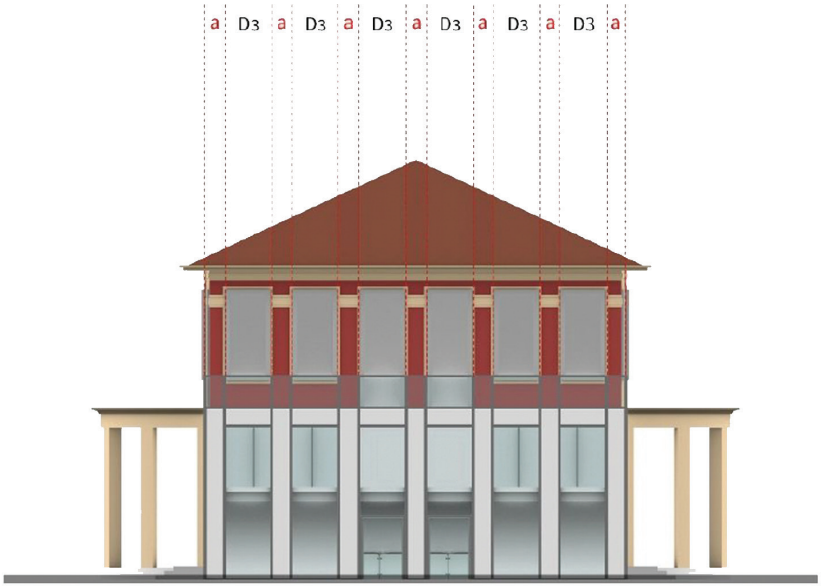
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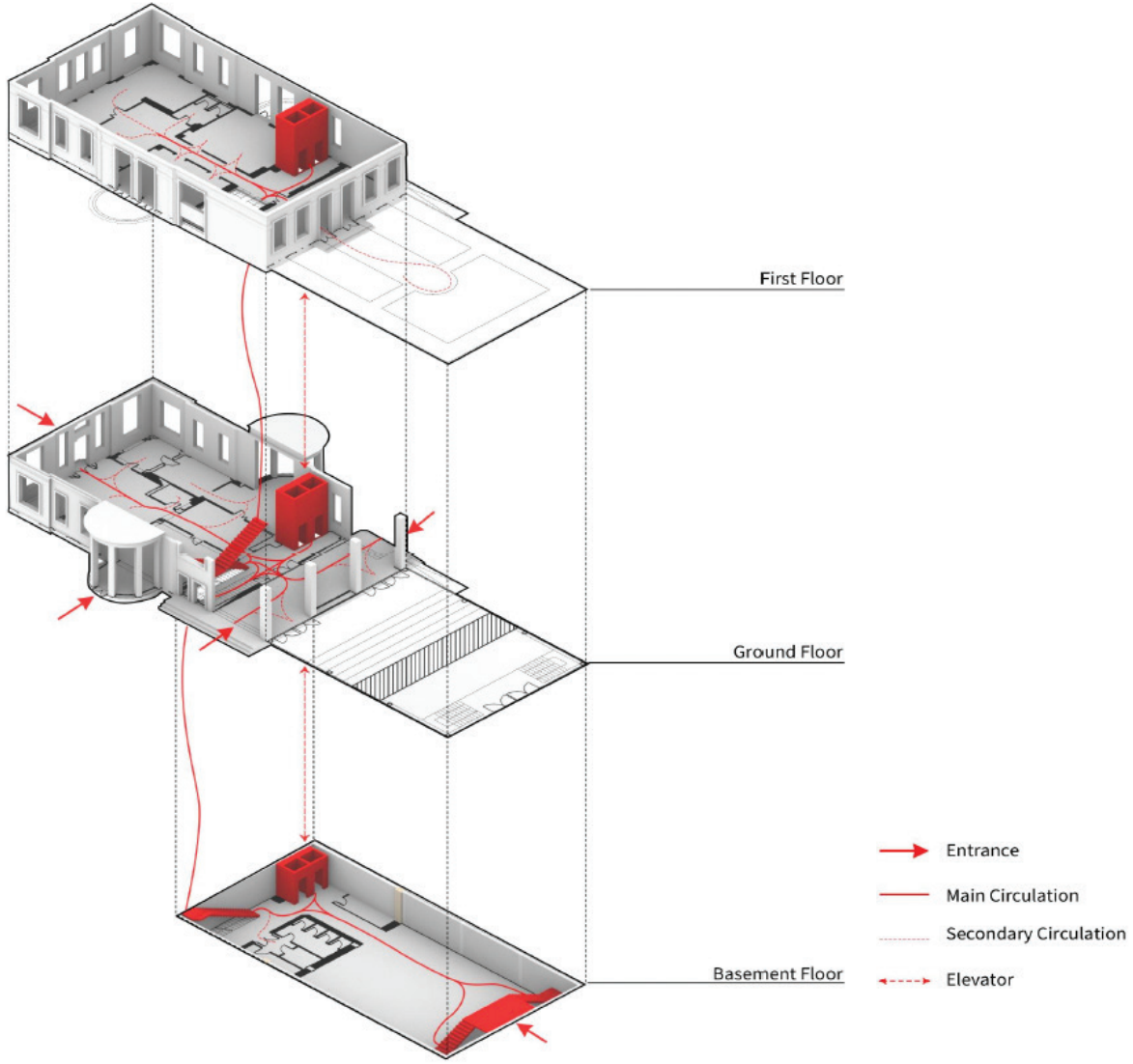
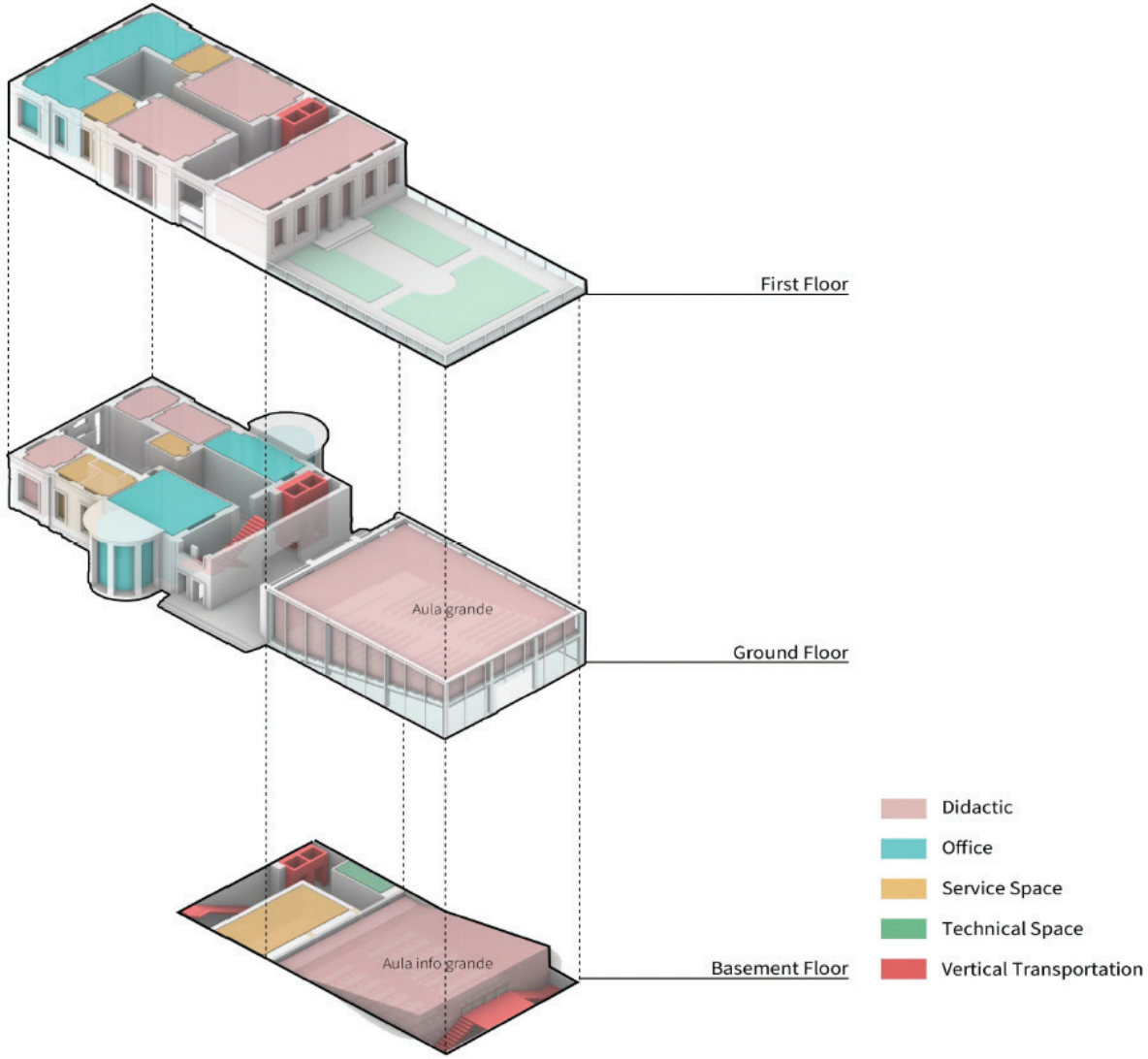
PROJECT

FUNCTIONAL BRIEF - WBS

circulation



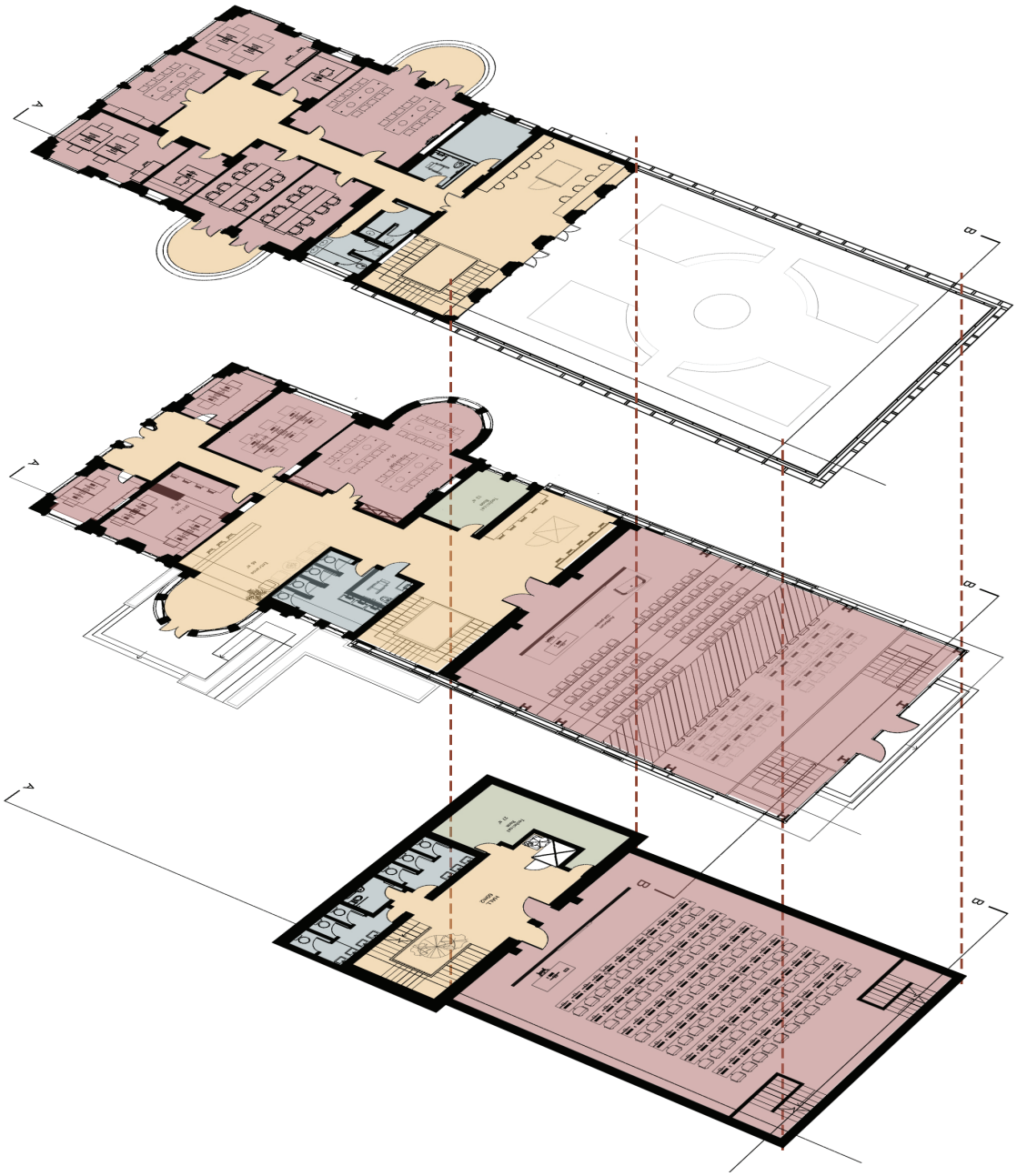
functional wolume analisis



PROJECT

FUNCTIONAL BRIEF - WBS

WBS				
Building	**Level**	**Department**	**Function**	**Area (sqm)**
22090	Basement	Didactic	Aula grande	249.78
	Ground floor	Distribution	Aula info grande	202.00
	First floor	Service space	Laboratory	104.10
		Administration	Classroom	65.25
		Technical space	Hall & Corridor	239.52
			Office	156.61
			Meeting room	16.32
			Toilet	77.24
			Storage	6.00
			Technical room	10.90



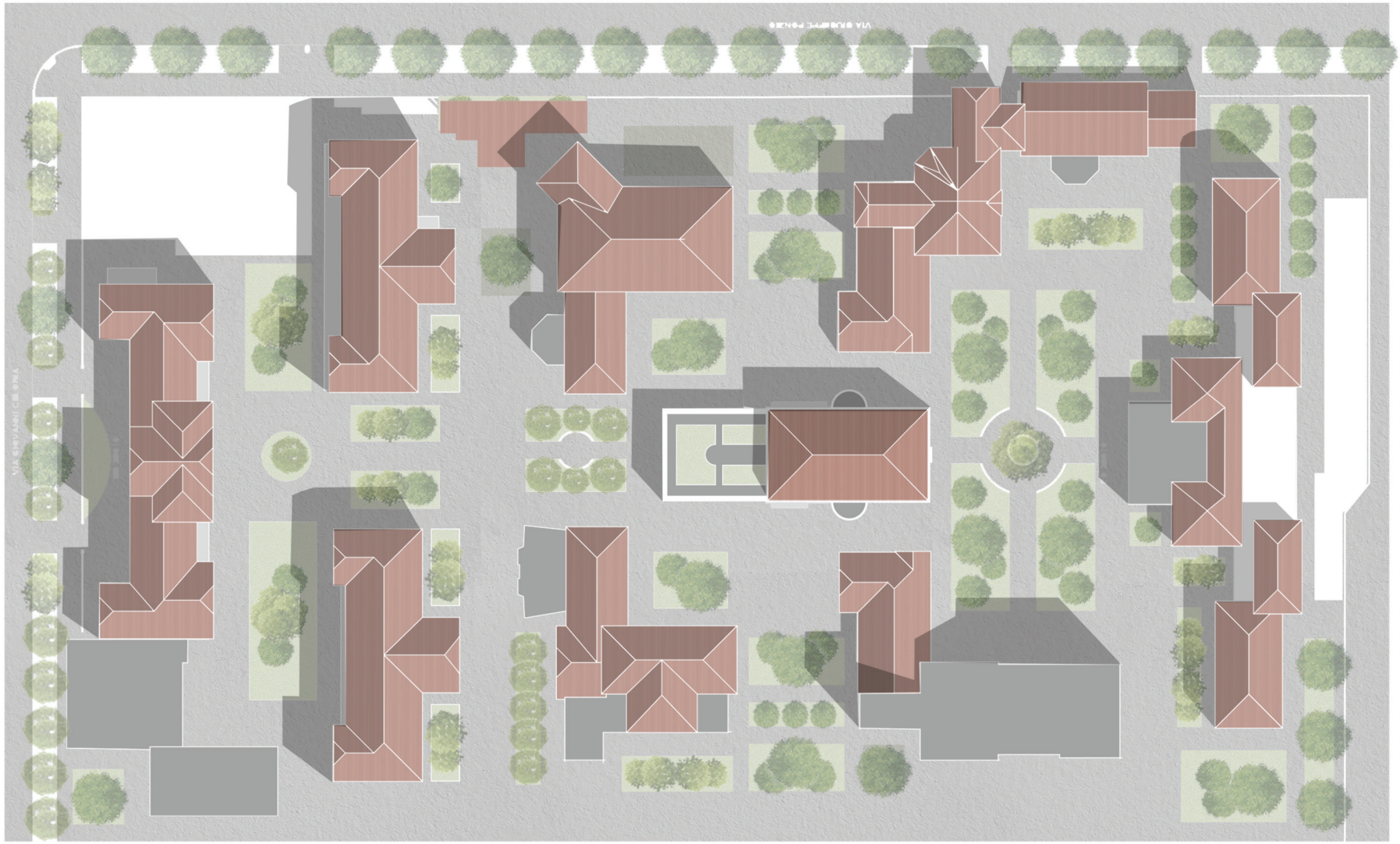
Didactic
Distribution
Service
Technical

PROJECT

DESIGN PROCESS : PLAN

On site plan design, we insist the original symmetry on the plan design, including the new addition and the landscape design. Transiton volume with glass and steel frame is specially emphasised between the old and the new construction proposal, from the roof top plan, it is also obvious of the gradient privacy from existed building as academic research center, transition area as main entrance and the roof of lecture hall as green roof open to the public.

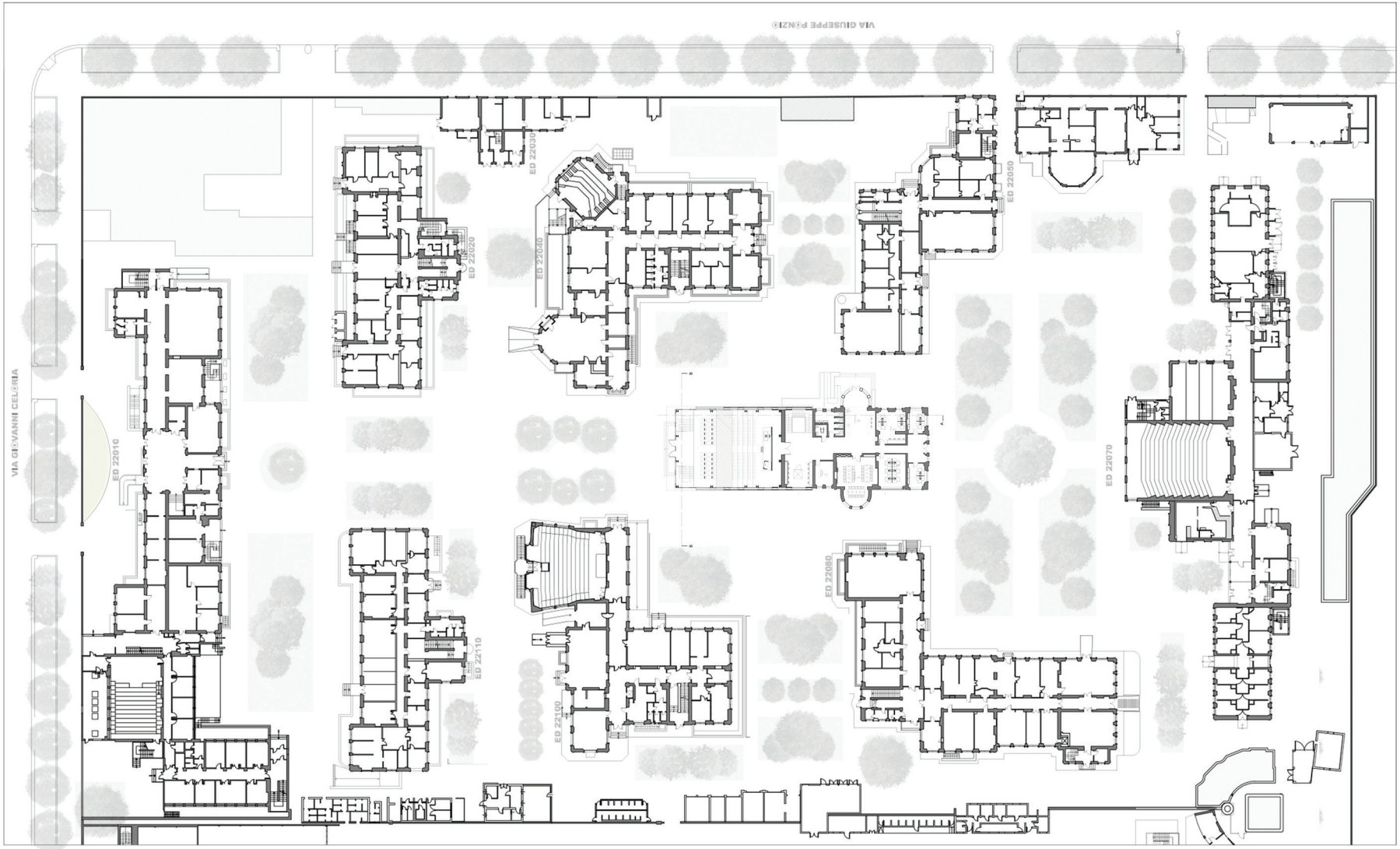
In the landscape surrounding the Building 22090, we tried our best to preserve the existed trees on site and moditfied landscape proposal to match our renovation project. The southern part has more urban furnitures to link with the public green roof, while the northern part that has more shadows was designed as a traffic functional landscape.



SITE PLAN 1/500

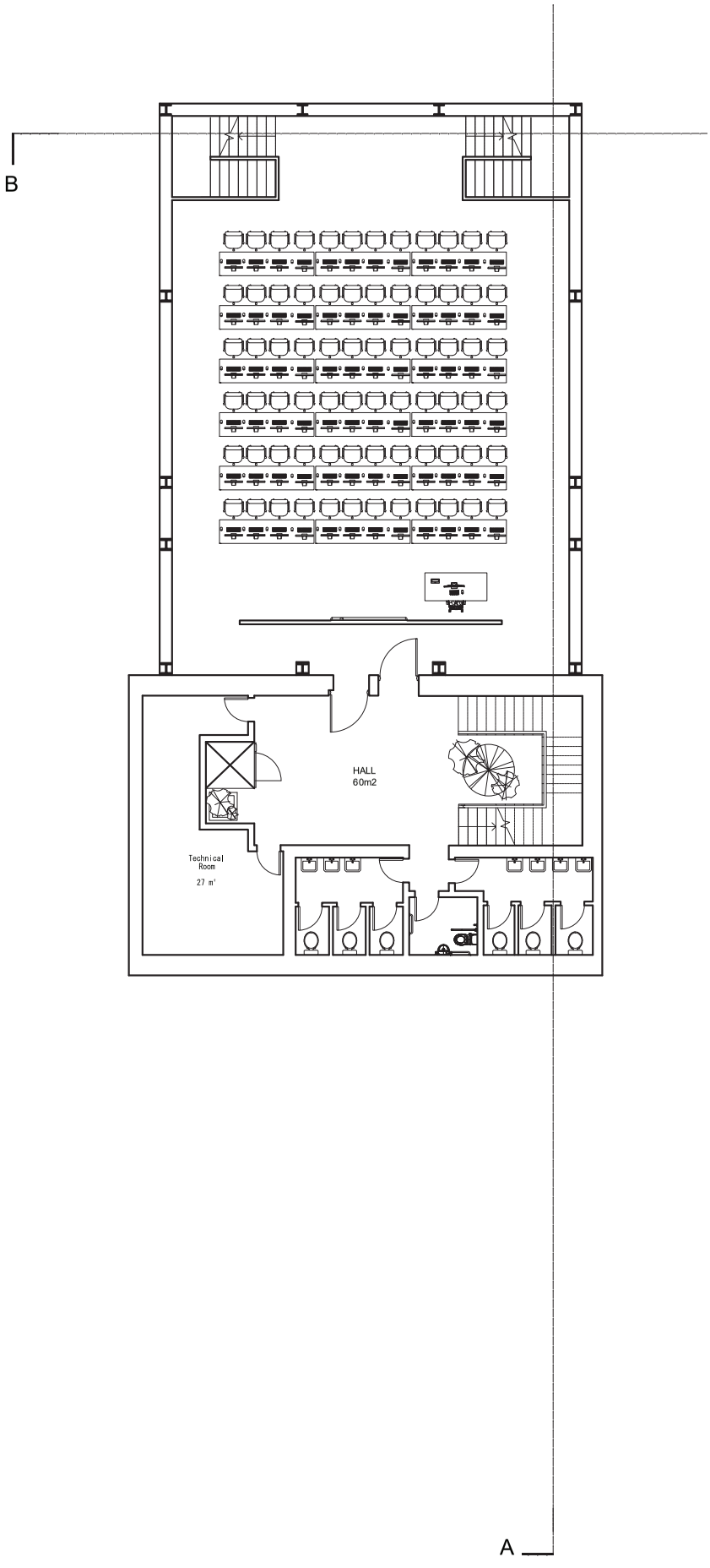
PROJECT

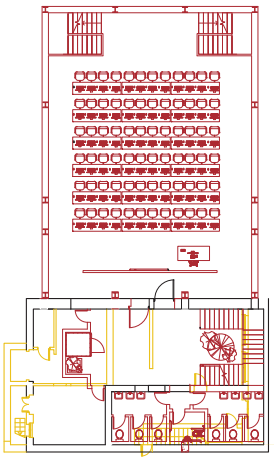
DESIGN PROCESS : PLAN



MASTERPLAN

GROUND FLOOR SITE PLAN 1/500

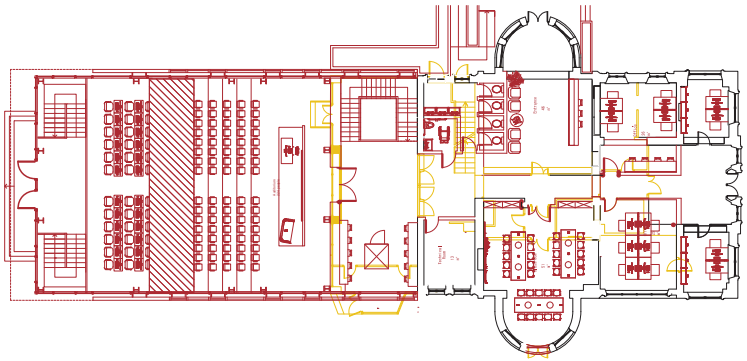


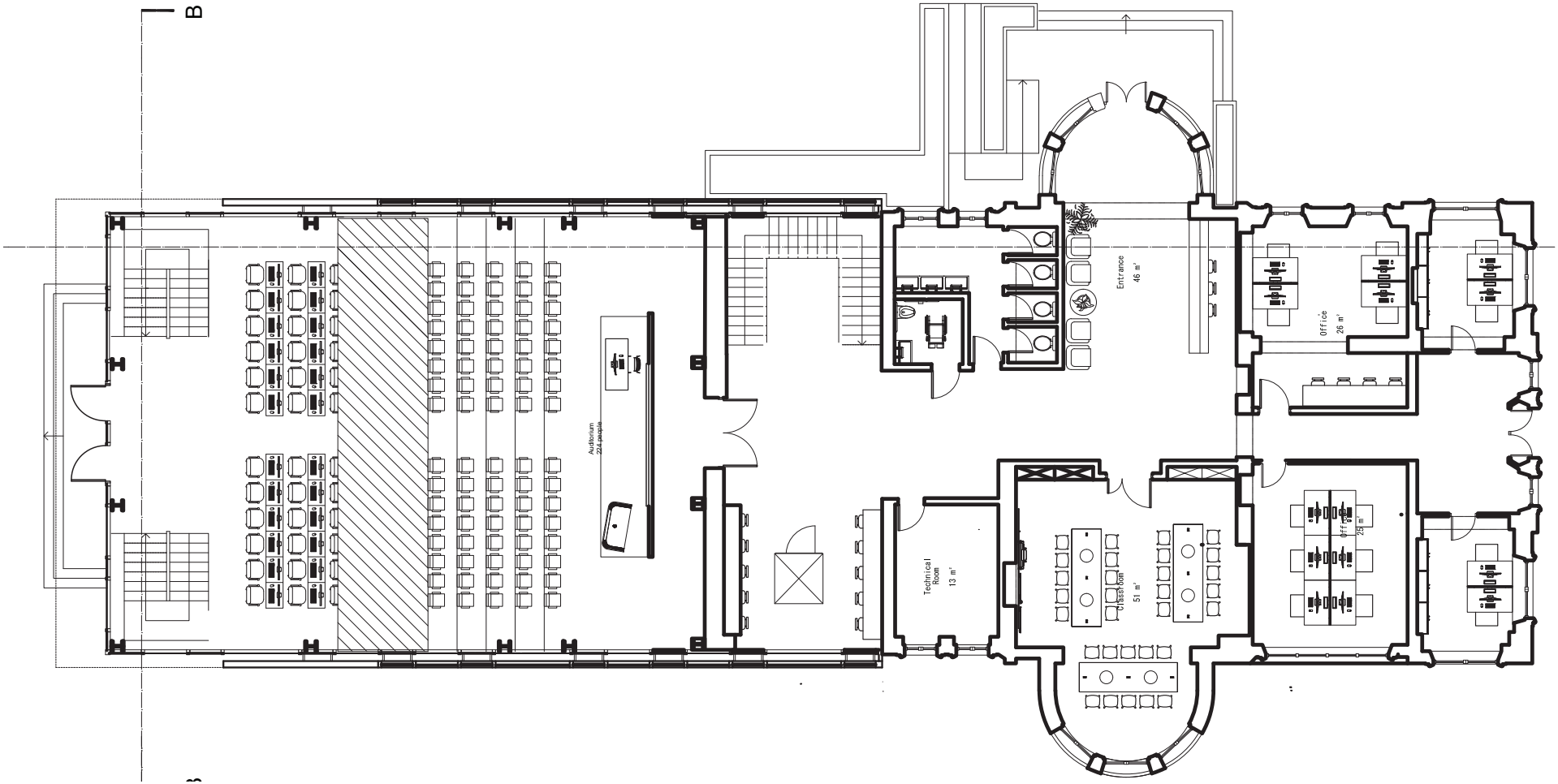


BASEMENT PLAN 1/200

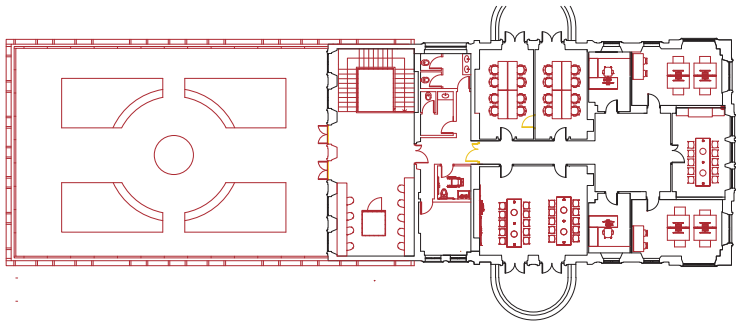
PROJECT

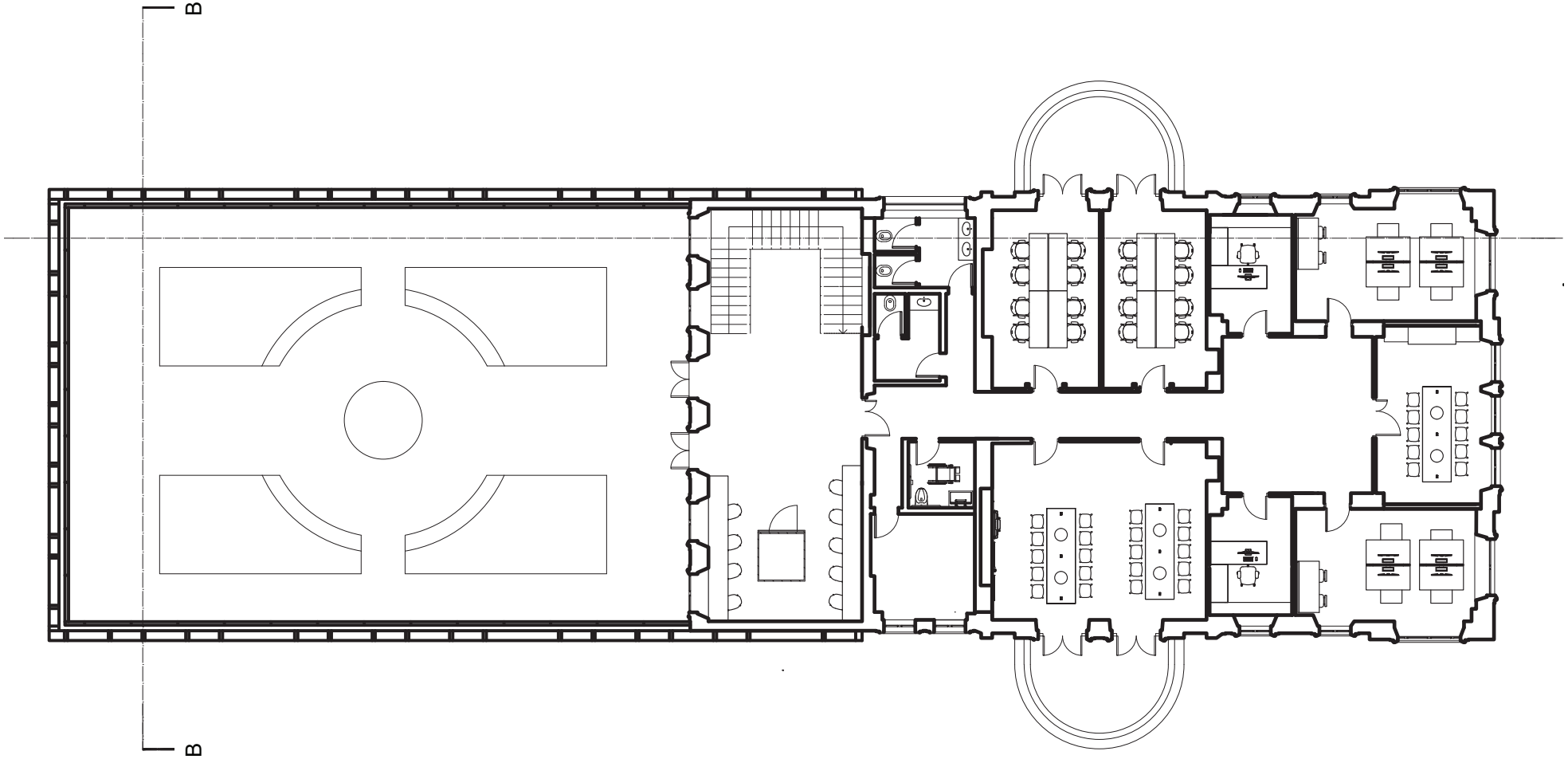
DESIGN PROCESS : PLAN





GROUND FLOOR PLAN 1/200

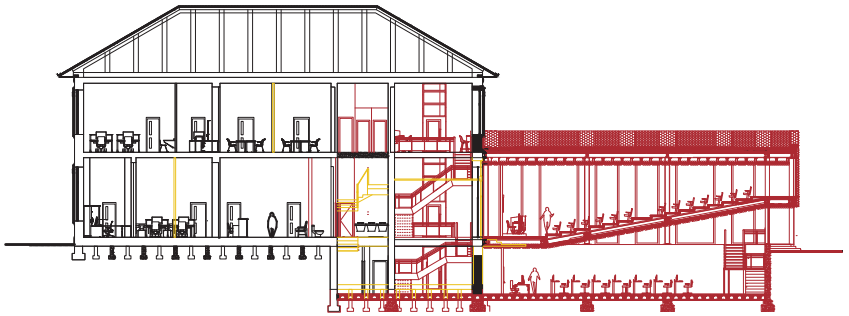




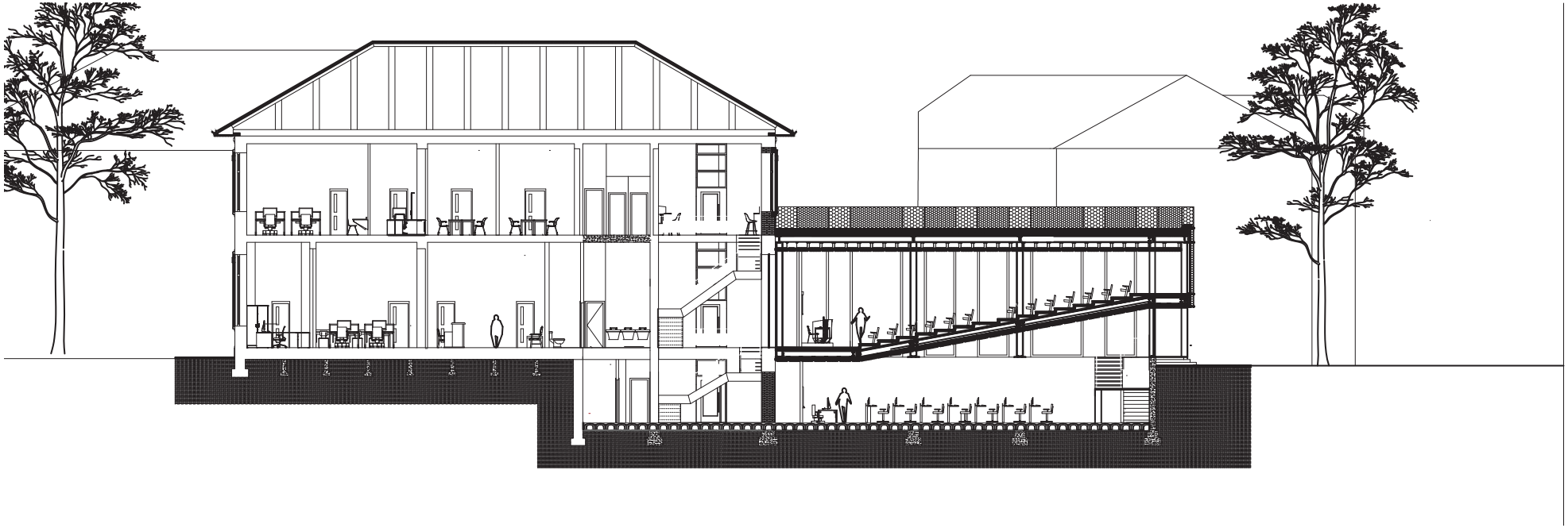
FIRST FLOOR PLAN 1/200

PROJECT

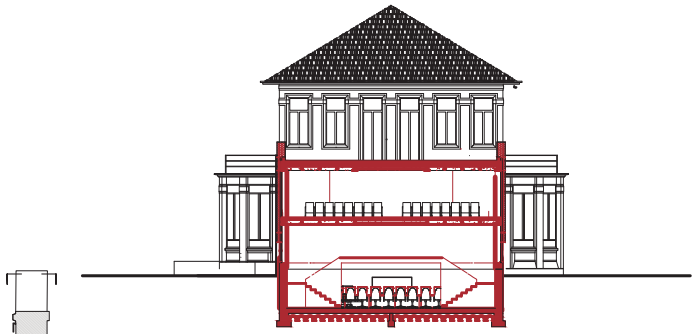
DESIGN PROCESS : SECTION



LONGITUDINAL SECTION AA
additions and demolitions



SECTION A-A 1/200



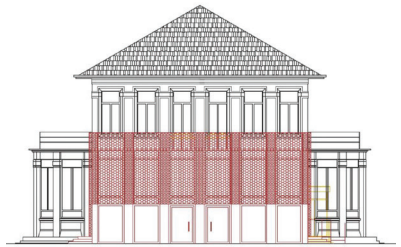
CROSS SECTION BB
additions and demolitions

SECTION B-B 1/200

PROJECT

DESIGN PROCESS : ELEVATION

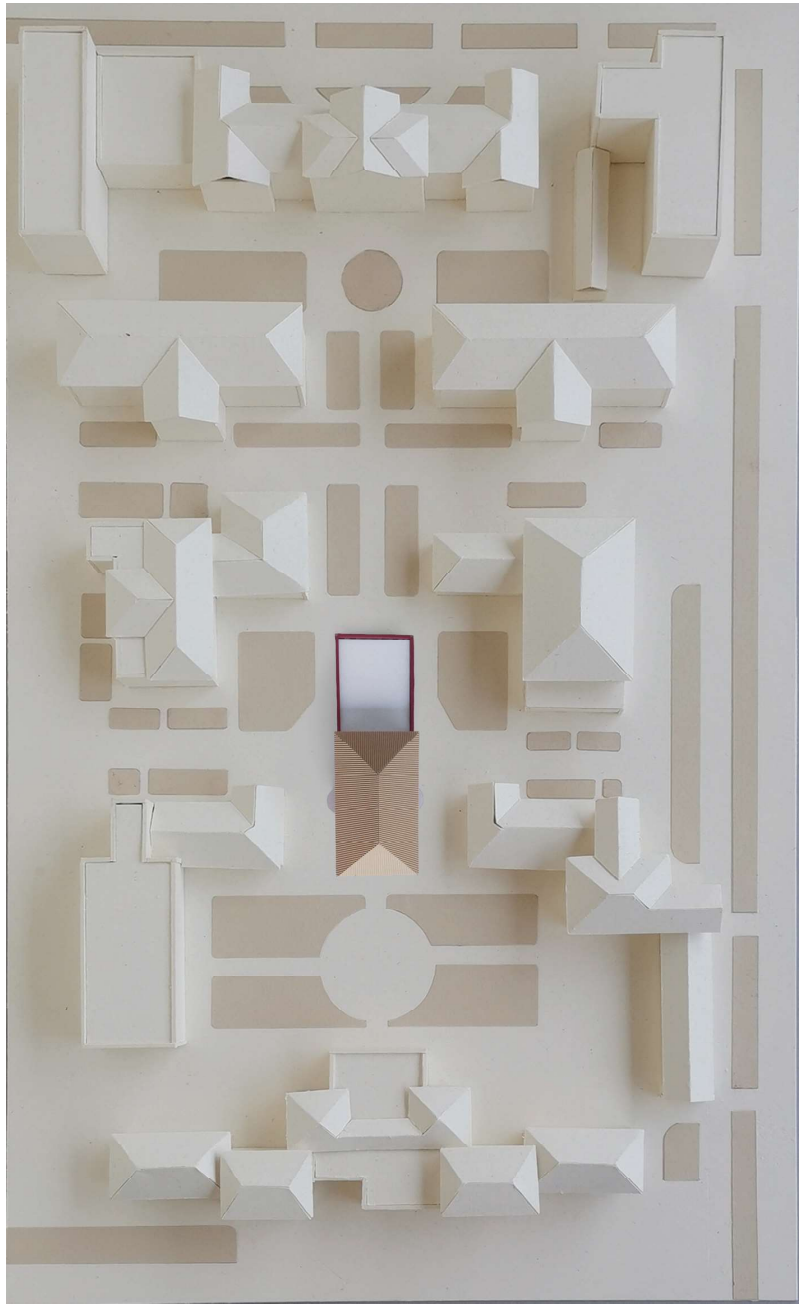
EAST ELEVATION 1/200



NORTH ELEVATION 1/200

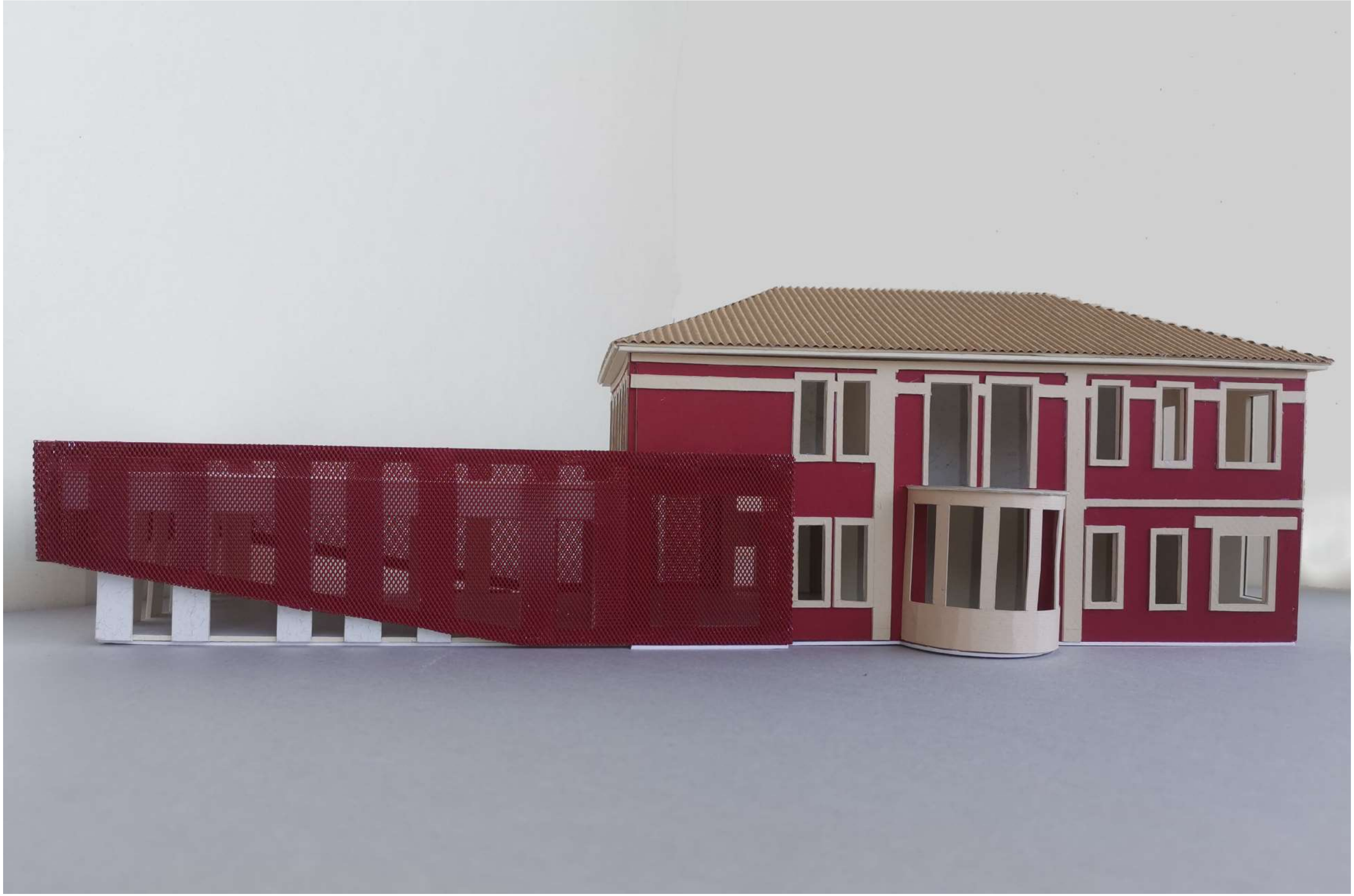
PROJECT

DESIGN PROCESS : PHYSICAL MODEL



THESIS

Architecture



PROJECT

DESIGN PROCESS : 3D VIEWS EXTERIOR

PROJECT

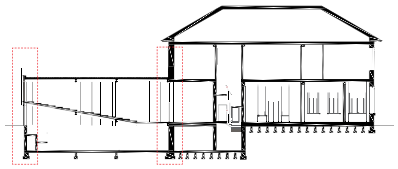
DESIGN PROCESS : 3D VIEWS EXTERIOR

PROJECT

DESIGN PROCESS : 3D VIEWS INTERIOR

STRUCTURE

DETAILS



1. Sloped floor
   Steam barrier
   Component for thermal insulation
   Waterproof anti-root covering
   FSD 20 [82 mm]
   Stabilfilter SFI [1,47 mm]
   Roof soil 1 [130 mm]
   Roof semina [20 mm]
   Lawn
   Sprinkler system

2. Drainage

3. 30mm plywood
   25mm oak boarded
   8mm waterproof layer
   200mm thermal insulation
   (wooden supporting inside)
   5mm vapour barrier
   25mm oak boarded cladding
   200mm aluminum alloy mesh

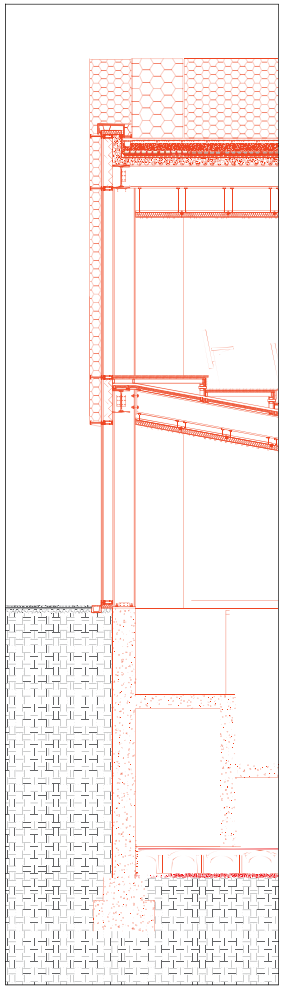
4. 260*260mm secondary beam

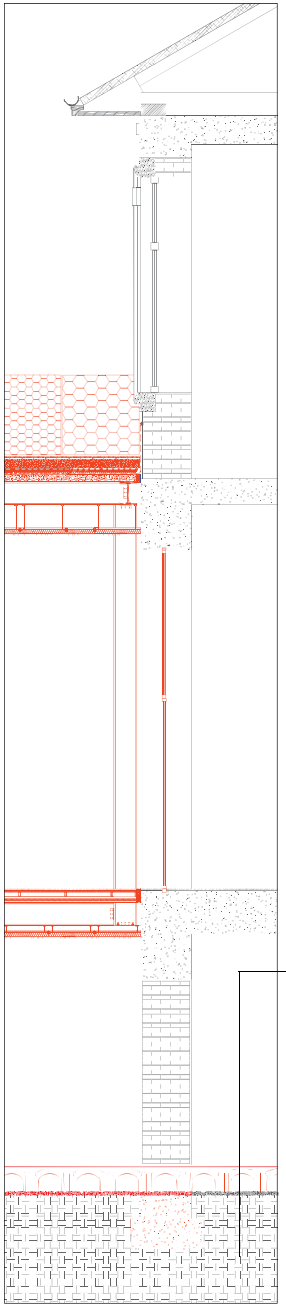
5. Acoustic Ceiling

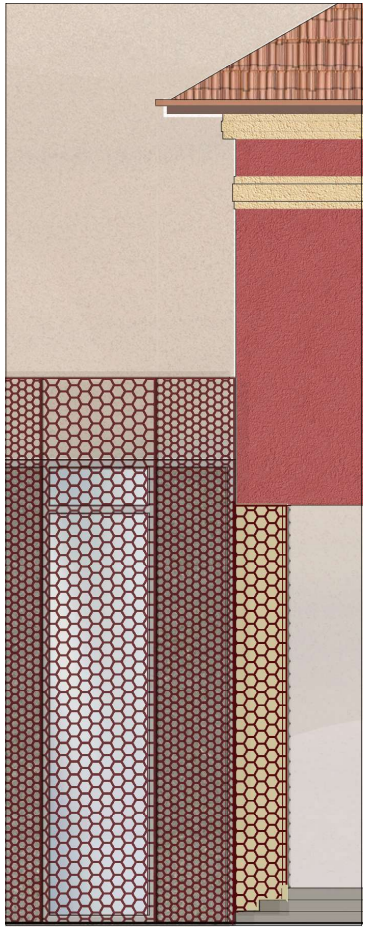
6. 20mm wooden pavement
   10mm Acoustic layer
   80mm Concrete layer

7. 20mm pavement
   20mm Screed
   5mm vapour barrier
   150mm Insulation
   10mm bitumen membrane
   30mm Screed
   350mm iglu system
   50mm Concrete layer

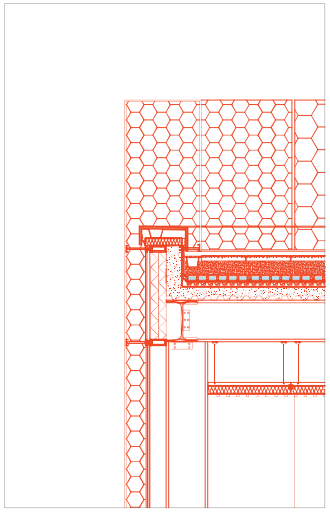
8. 450mm Retaining Wall

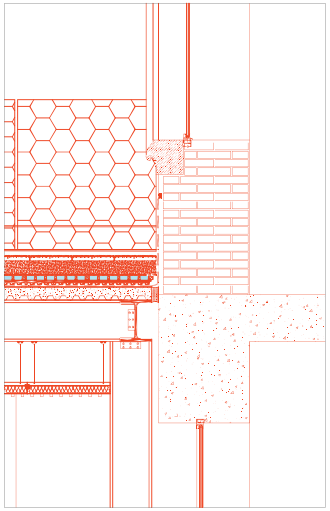


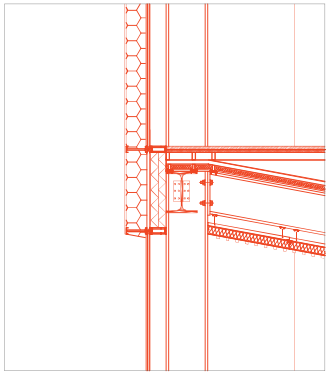


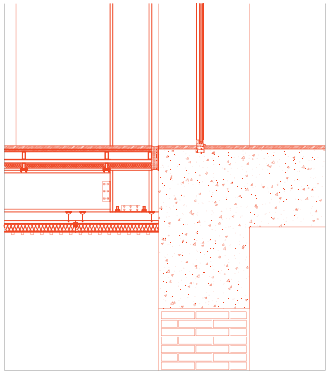


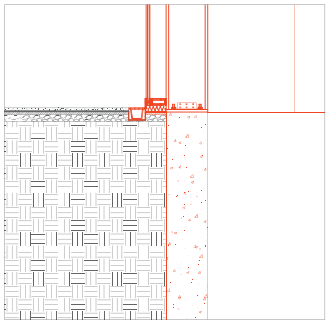
20mm	pavement
20mm	Screed
5mm	vapour barrier
150mm	Insulation
10mm	bitumen membrane
30mm	Screed
350mm	iglu system
50mm	Concrete layer

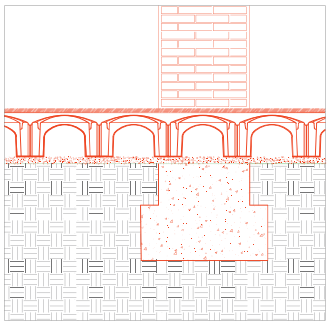












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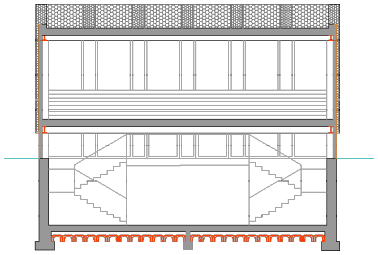
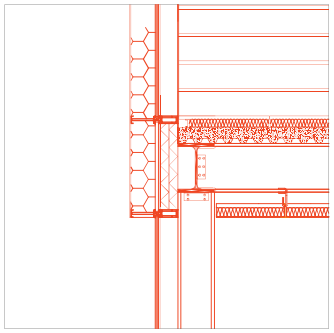
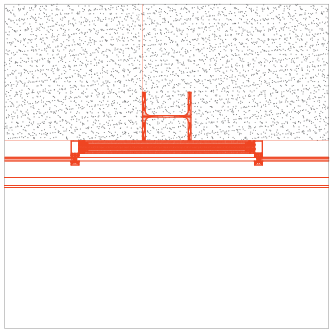




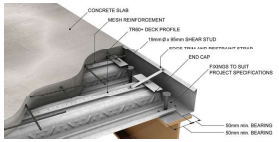


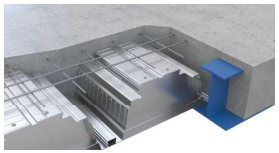
STRUCTURE

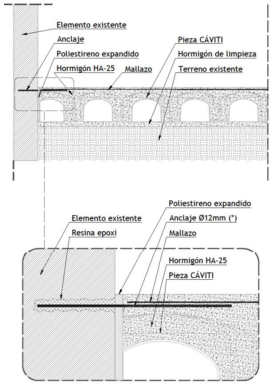
The original building of the site is a brick masonry structure, and after a construction, some areas are reinforced concrete structures.

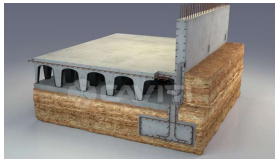
In our project, the newly built part is located on the north side of the old building and connected to it. The main structure of the basement part is reinforced concrete structure, and the above ground part is divided into steel structure, using 300*450H steel as the main beam, 300*300H steel as the auxiliary beam, and adding steel rib distributed stress in the middle.

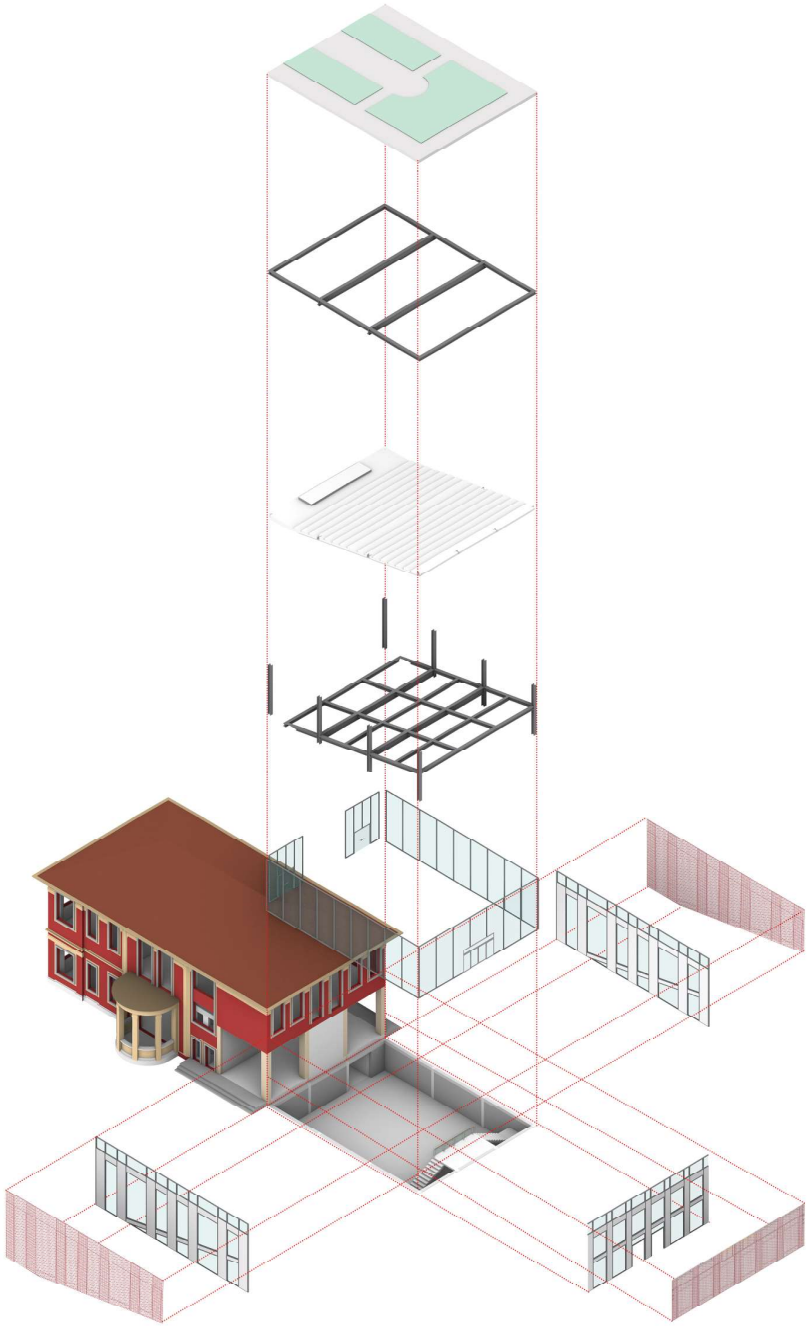
The outer covering structure of the added part is a porous aluminum alloy panel, which is connected with the internal main structure through connecting parts to meet the structural force requirements. The different density of aluminum alloy panels are arranged according to the modulus of the old building facade to form the facade rhythm











ROOF
Profiled Steel Sheet

FRAME
H - Section Steel

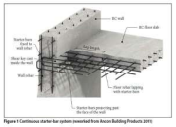
STAIRS
Profiled Steel Sheet

COLUMN
H - Section Steel

ENVELOPE
Aluminum alloy perforated plate

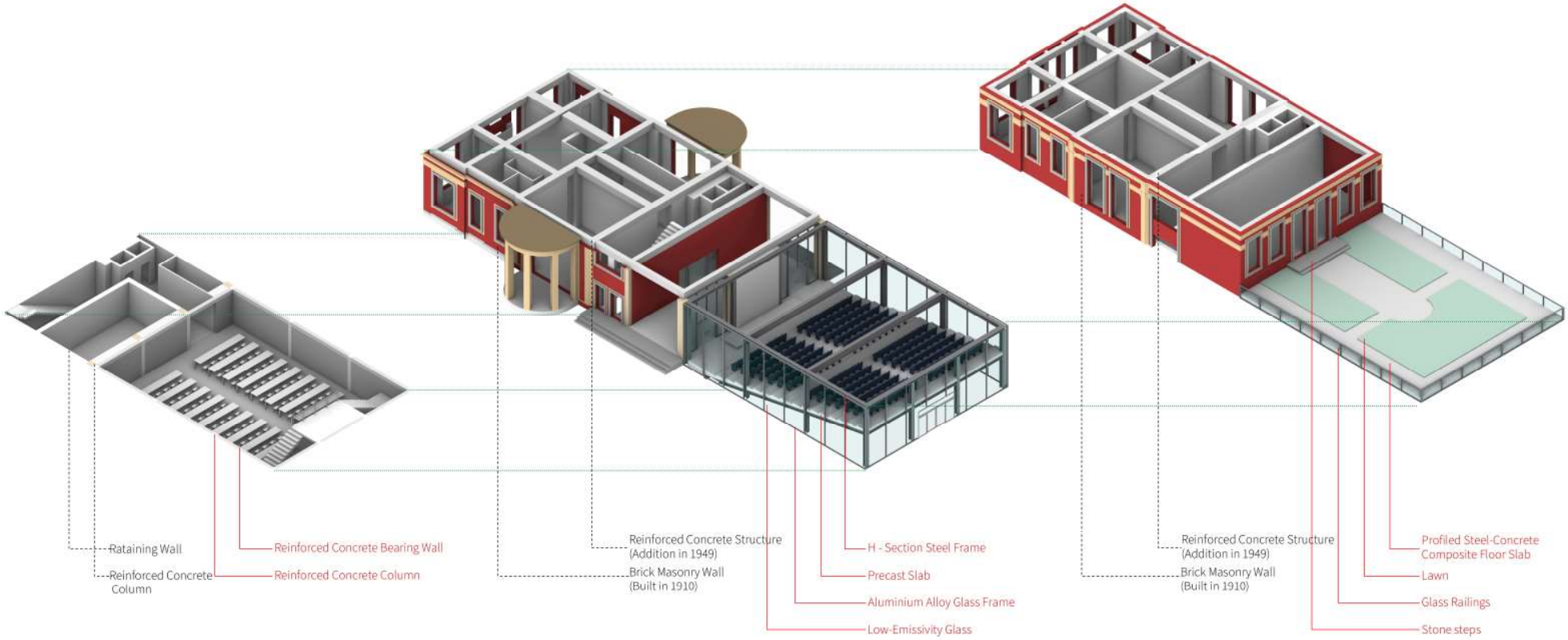
COLUMN
Reinforced Concrete Structure

BEARING WALL
Reinforced Concrete Structure

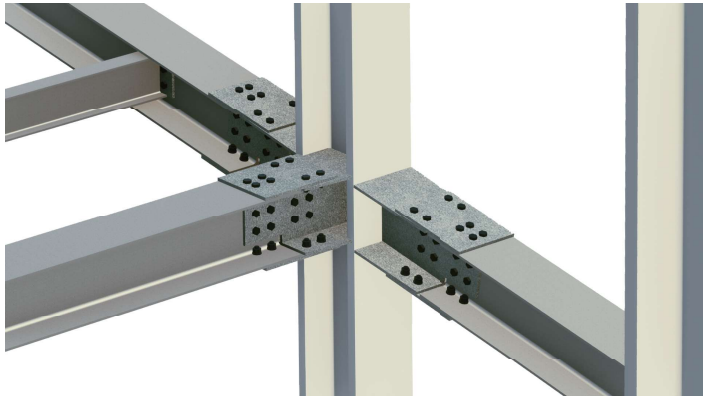


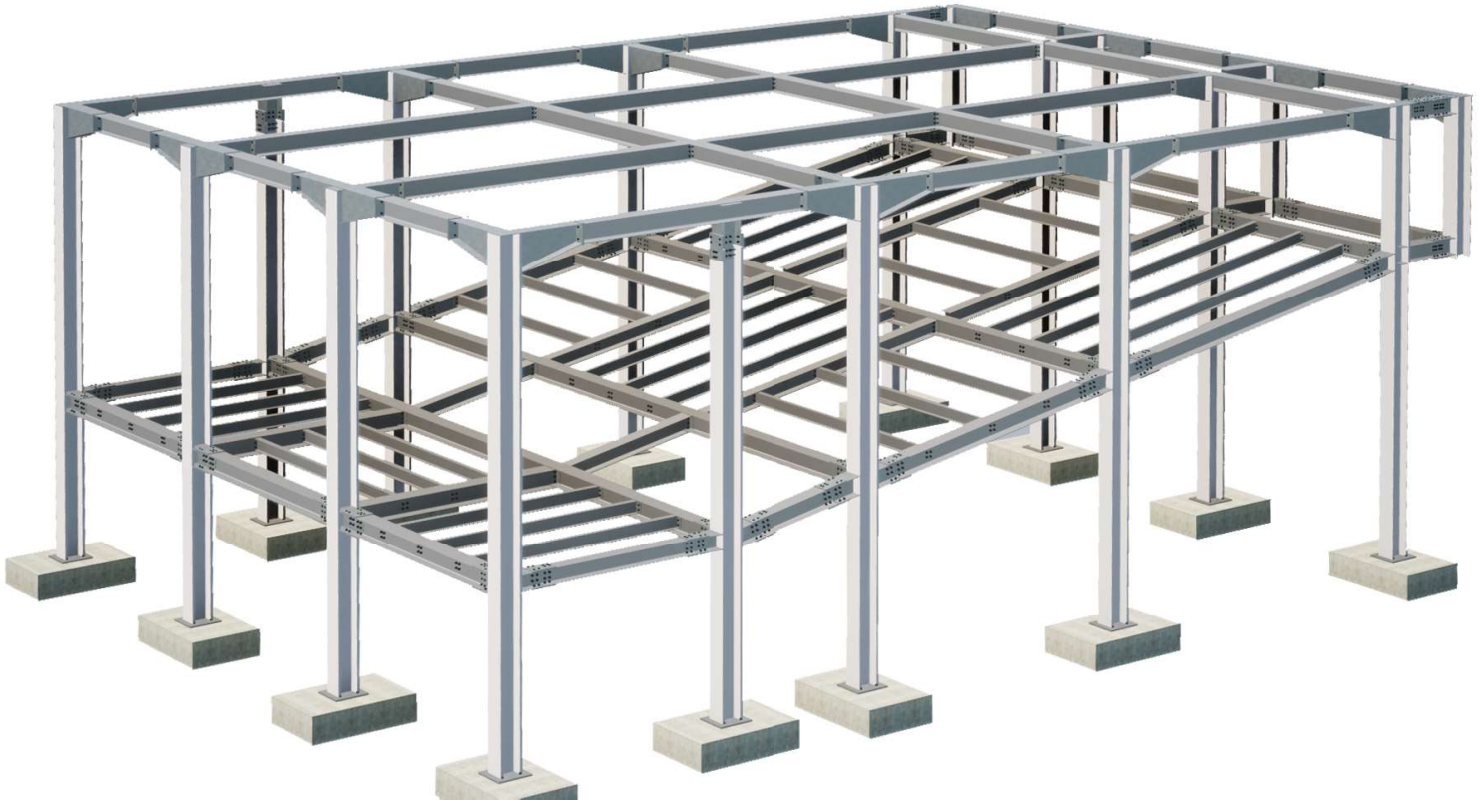
STRUCTURE

EXPLODED VIEW OF THE STRUCTURE



REVIT STRUCTURE MODEL AND DETAIL



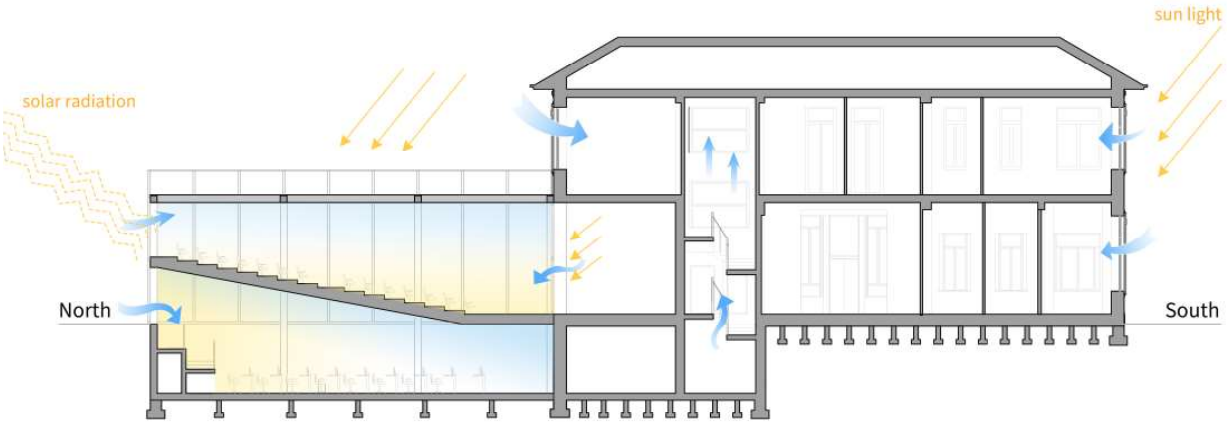


TECHNOLOGY

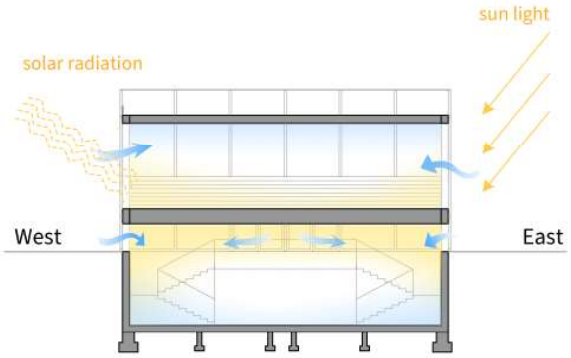
SUSTAINABLITY APPROACH

The combination of green roof and sun shading system allows us to save of energy.

We simulated the daytime solar exposure and the distribution of shadows on the summer and winter solstices, respectively. The overall sunlight is sufficient in the summer can we could consider the outdoor green space and the roof garden to have agood atmosphere for activities. Besides, we also found that the new extension part to the north still enjoys more daylight in the winter, even though it is less than in the summer.



LONGITUDINAL SECTION



CROSS SECTION

TECHNOLOGY

SUSTAINABLITY APPROACH

The combination of green roof and sun shading system allows us to save of energy.

We decided to use recycled materials as recycled steel and concrete for the new structure, to save CO2. We also opted for an intervention that would limit the works on the existing building to the minimum, to reduce the quantity of carbon dioxite produced in the process of demolition. After calculations we plan to design green areas with trees to balance what we consumed.

TECHNICAL DATA

Thickness of the system (without vegetation)	cm ca.	23,00
Weight when saturated (without vegetation)	kg/mq	192,00
Total amount of water for the vegetation	l/mq	69,00
Air volume at pF1	l/mq	64,50

All technical data in this document are indicative values, used to describe the product. DAKU might modify the data when improving to product: clients should verify to have the latest versions of the documents.

SYSTEM COMPONENTS

1. Grass
2. DAKU ROOF SOIL 1 (substrate, 15 cm thick)
3. DAKU STABILFILTER SFI (Filter)
4. DAKU FSD 20 (component for drainage and water storage)

TECHNOLOGY

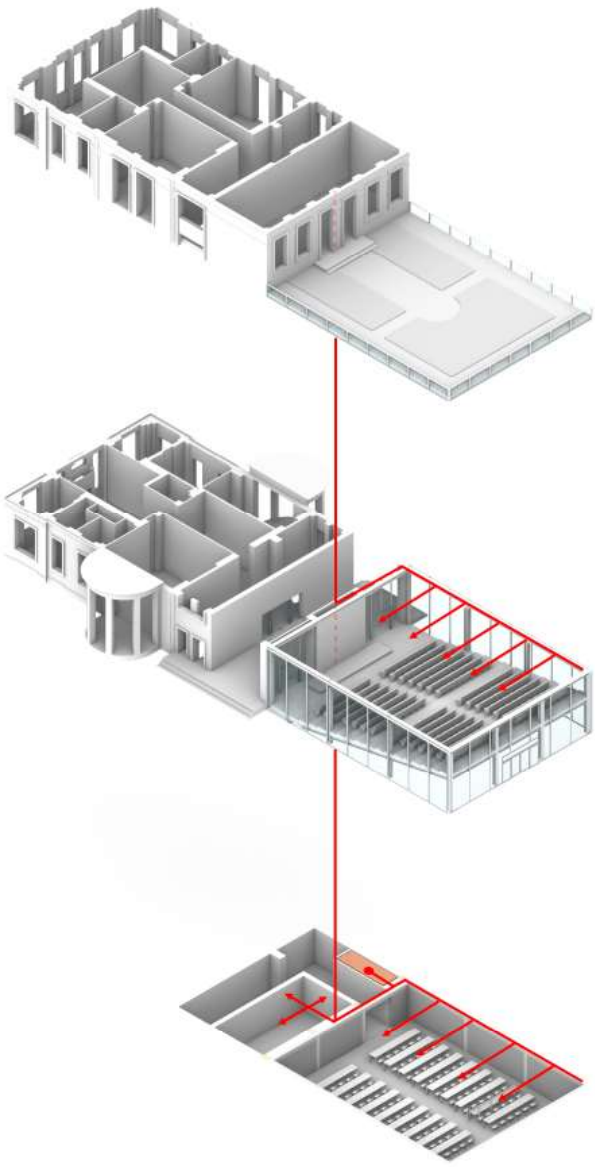
SYSTEMS

The service concept focuses on ventilation, water supply and drainage systems.

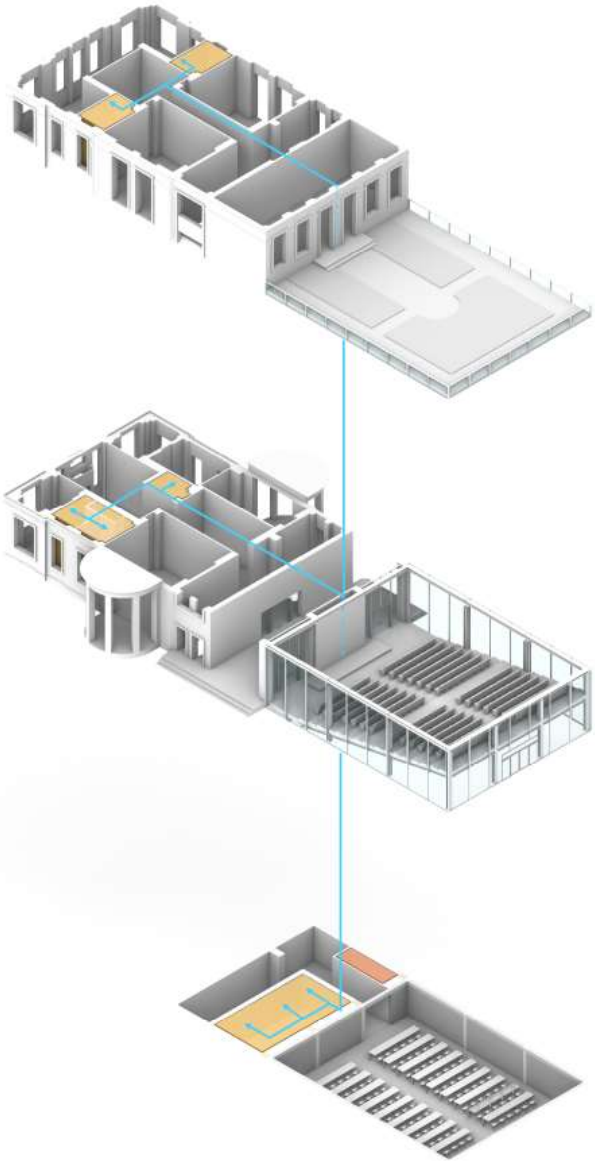
Ventilation systems are mainly designed for lecture Hall and Computer Lab. Ventilation systems of different densities and thicknesses are arranged according to the different sizes and population requirements of the two rooms.

The water supply system is connected to each floor through hollow walls.

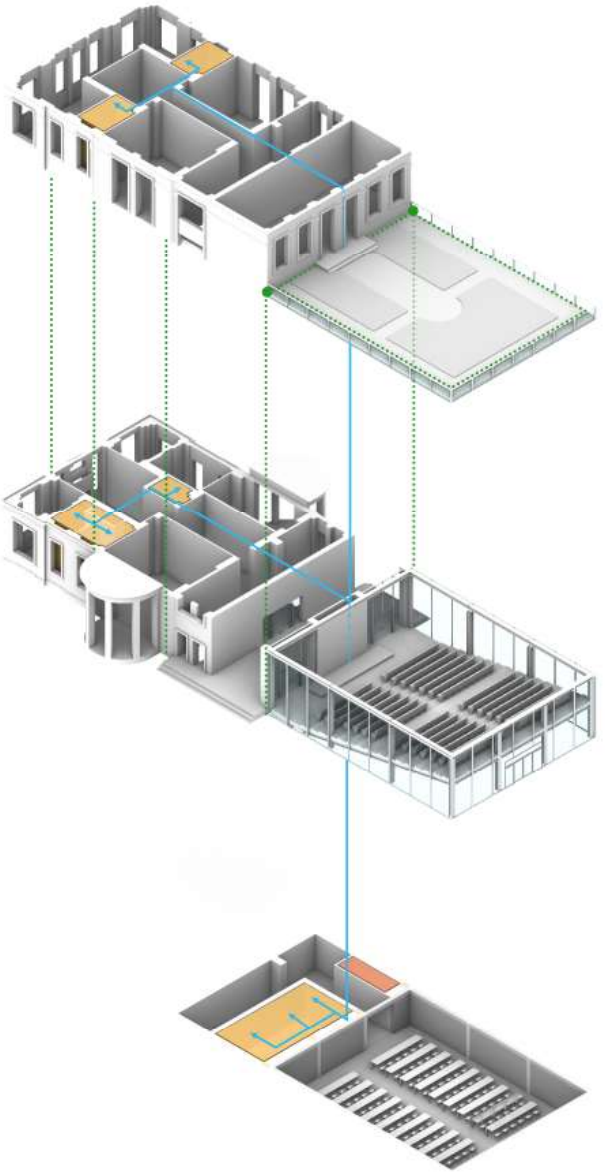
The drainage system uses pipes on the outside of the existing building to drain rainwater, while the sewage flows out of the interior through redesigned pipes.



VENTILATION



WATER SUPPLY



DRAINAGE

TECHNOLOGY

VENTILATION

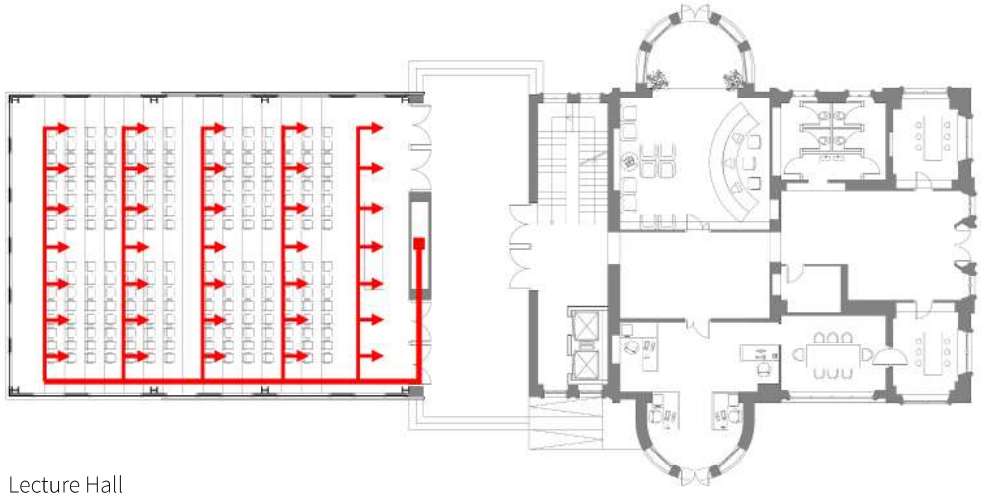
Overall information
As described before, new addition has provided individual ventilation system and relative technical room for lecture hall and computer lab. For this reason, we calculate airflow and duct sections seperately.

Section calculation
Firstly, the total air flow includes air flow for area and airflow for person, we also need decide the air velocity for primary tubes and secondary tubes. All formulas and calculations are mainly for the fresh air flow.

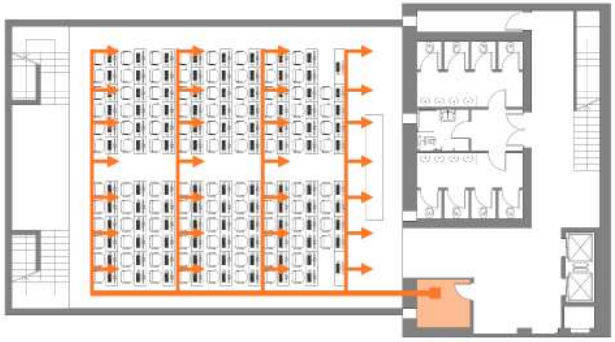
Duct size decision
When we take consideration on choosing proper duct size of ventilation, compared with circle shape, rectangular shape is better choice for the limited height of ceiling space.

Technical room
We designed individual techinical room directly for each classroom, where ventilation and heating machines could be put.

Room	Area [㎡]	Qs [L/(S*㎡)]	People	Qp [L/(S*Pers)]	Q [L/S]	Q [m³/h]	Vp [m/s]	Vs [m/s]	Ap [㎡]	As [㎡]
Lecture	244	0.5	224	6	1466	5277.6	6	5	0.24433	0.05864
								Duct size	**500*500**	**300*200**
Computer Lab	196	0.5	108	6	746	2685.6	6	5	0.12433	0.0373
								Duct size	**500*250**	**250*150**



Lecture Hall



Computer Lab

TECHNOLOGY

WATER SUPPLY

The water supply for this project is the branch system. In this type of installation, the various fixture units are connected one after the other to the same trunk line, generally using tee fittings.
Also, as there are only three bathrooms in this project that require hot water supply, we have adopted the simpler method of installing individual water heaters on each floor.

1. First step of dimension the supply pipes is to calculate the water flow in a specific way, and here we calculated according to EN806.
The loading units method is used (LU, Loading Units) with: 1 LU=0.1 l/s
Get the loading units for different points of use, LU:
Washbasin, WC = 1
Urinal with outlet valve = 3

2. Starting with the last fixture that is connected to the network, the sum of the LUs is calculated for each section of pipe. In this way we got the sum of LU.

3. The European standard EN806-3 presents a simplified method for pipe dimensioning. Based on the type of material used for the pipes and the LUs calculated, the diameter of each section of pipe is determined.

Supply	Point of use	LU tot
	WC	1
	Washbasin	1

Floor	Section	LU tot	Diameter [mm]
Under ground	A9-A10	1	16*2.25
	A8-A9	2	16*2.25
	A7-A8	3	16*2.25
	A2-A7	4	16*2.25
	A5-A6	1	16*2.25
	A4-A5	2	16*2.25
	A3-A4	3	16*2.25
	A2-A3	4	16*2.25
	A1-A2	8	18*2
	A0-A1	9	18*2

Floor	Section	LU tot	Diameter [mm]
Under ground	B9-B10	1	16*2.25
	B8-B9	2	16*2.25
	B7-B8	3	16*2.25
	B1-B7	4	16*2.25
	B5-B6	1	16*2.25
	B4-B5	2	16*2.25
	B3-B4	3	16*2.25
	B2-B3	4	16*2.25
	B1-B2	5	16*2.25
	B0-B1	9	18*2

Floor	Section	LU tot	Diameter [mm]
Ground floor	C5-C6	1	16*2.25
	C4-C5	2	16*2.25
	C3-C4	3	16*2.25
	C2-C3	4	16*2.25
	C1-C2	5	16*2.25
	C0-C1	6	18*2

Floor	Section	LU tot	Diameter [mm]
First floor	D3-D4	1	16*2.25
	D0-D3	2	16*2.25
	D1-D2	1	16*2.25
	D0-D1	2	16*2.25
	F-D0	4	16*2.25
	E3-E4	1	16*2.25
	E0-E3	2	16*2.25
	E1-E2	1	16*2.25
	E0-E1	2	16*2.25
	F-E0	4	16*2.25

	Section	LU tot	Diameter [mm]
Vertical	C0-F	8	18*2
	B0-C0	14	20*2.5
	B0-A0	18	20*2.5
	O-B0	40	32*3

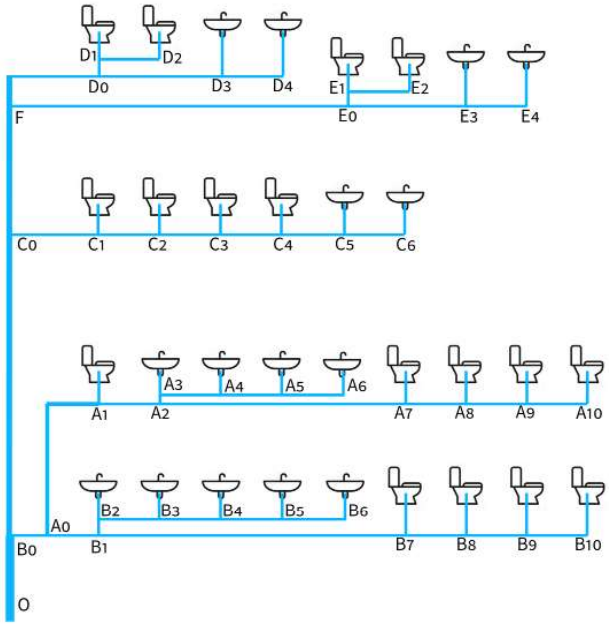
Supply	Point of use	LU tot
	WC	1
	Washbasin	1

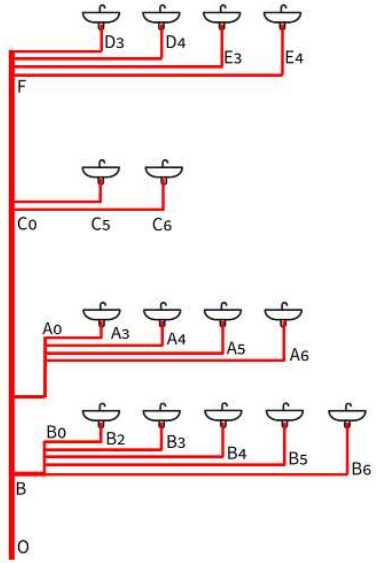
Floor	Section	LU tot	Diameter [mm]
Under ground	B0-B6	1	16*2.25
	B0-B5	1	16*2.25
	B0-B4	1	16*2.25
	B0-B3	1	16*2.25
	B0-B2	1	16*2.25
	A0-A6	1	16*2.25
	A0-A5	1	16*2.25
	A0-A4	1	16*2.25
	A0-A3	1	16*2.25

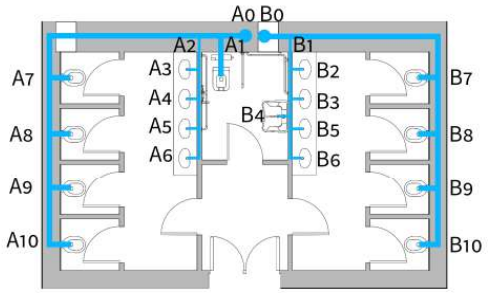
Floor	Section	LU tot	Diameter [mm]
Ground floor	C0-C6	1	16*2.25
	C0-C5	1	16*2.25

Floor	Section	LU tot	Diameter [mm]
First floor	F-E4	1	16*2.25
	F-E3	1	16*2.25
	F-D4	1	16*2.25
	F-D3	1	16*2.25

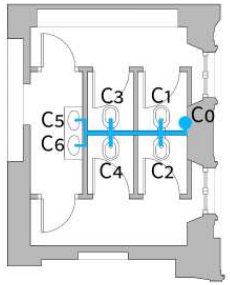
	Section	LU tot	Diameter [mm]
Vertical	C0-F	4	16*2.25
	B-C0	6	18*2
	O-B	15	20*2.5



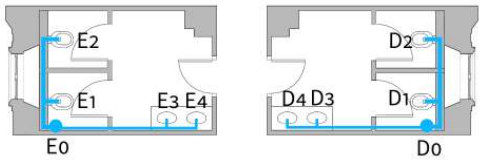




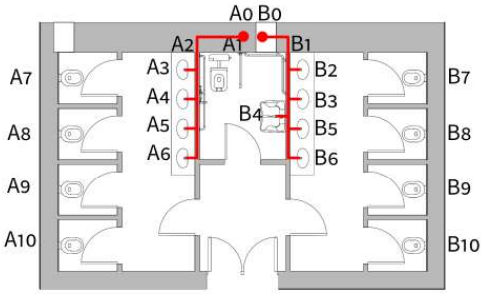
Toilet Underground



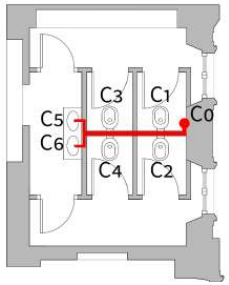
Toilet Ground Floor



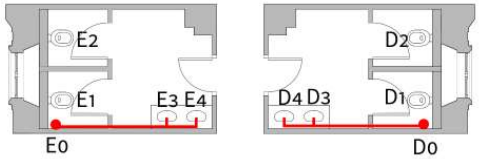
Toilet First Floor



Toilet Underground



Toilet Ground Floor



Toilet First Floor

TECHNOLOGY

WASTE SYSTEM

The standard that regulates the dimensioning of gravity waste systems inside buildings is the European Standard UNI EN 12056. The dimensioning process of a waste system can be divided up into the following phrases:

1. Calculation of the flow rates in relation to the drainage units of the sanitary fixtures connected. So we got the flow rate of each sanitary fixture according to the Standard, DU(l/s):
Washbasin = 0.5 l/s
WC (9 litre cistern) = 2.5 l/s
Wall urinal =0.2 l/s
And as our system doesn't have continuous flow rates or waste water pumps, then the total flow rate for each section is equal to the flow rate of the waste waters caused by sanitary fixtures (l/s):
Qtot=Qww=K*sqrt (sum DU), for our school project, the coefficient K is 0.7.

2. Determination of the diameters of branches that connect the sanitary fixtures to the waste stacks.

3. Select the general gradient as 1cm/m, and according to the diagram, select the right size of pipe.

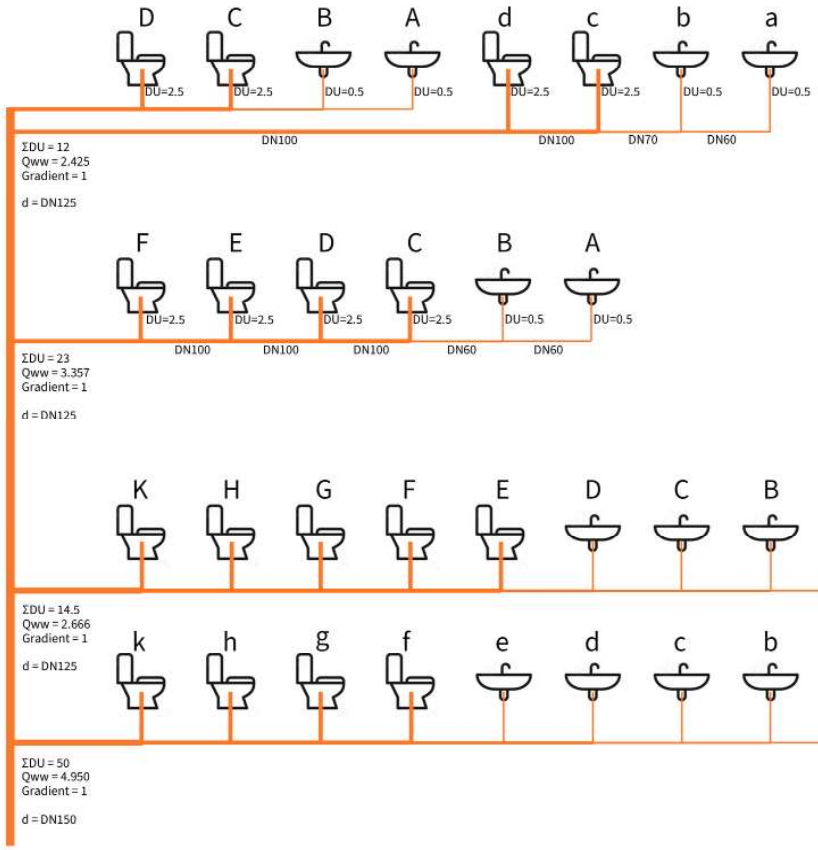
Branch	Sanitary fixture	DU (L/S)	Sum DU (L/S)	Formula	Qww (L/s)	Branch DN
A	Washbasin	0.5	0.5			DN60
B	Washbasin	0.5	1	0.7*sqrt1	0.700	DN70
C	WC (9 litre cistern)	2.5	3.5	0.7*sqrt3.5	1.310	DN100
D	WC (9 litre cistern)	2.5	6	0.7*sqrt6	1.715	DN100

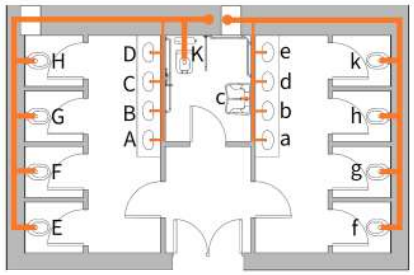
Branch	Sanitary fixture	DU (L/S)	Sum DU (L/S)	Formula	Qww (L/s)	Branch DN
a	Washbasin	0.5	0.5		0.495	DN60
b	Washbasin	0.5	1	0.7*sqrt1	0.700	DN70
c	WC (9 litre cistern)	2.5	3.5	0.7*sqrt3.5	1.310	DN100
d	WC (9 litre cistern)	2.5	6	0.7*sqrt6	1.715	DN100

Branch	Sanitary fixture	DU (L/S)	Sum DU (L/S)	Formula	Qww (L/s)	Branch DN
A	Washbasin	0.5	0.5		0.495	DN60
B	Washbasin	0.5	1	0.7*sqrt1	0.700	DN70
C	WC (9 litre cistern)	2.5	3.5	0.7*sqrt3.5	1.310	DN100
D	WC (9 litre cistern)	2.5	6	0.7*sqrt6	1.715	DN100
E	WC (9 litre cistern)	2.5	8.5	0.7*sqrt8.5	2.041	DN100
F	WC (9 litre cistern)	2.5	11	0.7*sqrt11	2.322	DN100

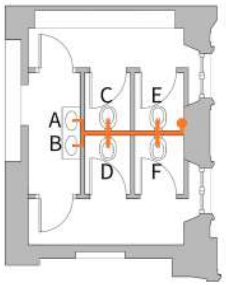
Branch	Sanitary fixture	DU (L/S)	Sum DU (L/S)	Formula	Qww (L/s)	Branch DN
A	Washbasin	0.5	0.5			DN60
B	Washbasin	0.5	1	0.7*sqrt1	0.700	DN70
C	Washbasin	0.5	1.5	0.7*sqrt1.5	0.857	DN70
D	Washbasin	0.5	2	0.7*sqrt2	0.990	DN80
E	WC (9 litre cistern)	2.5	4.5	0.7*sqrt4.5	1.485	DN100
F	WC (9 litre cistern)	2.5	7	0.7*sqrt7	1.852	DN100
G	WC (9 litre cistern)	2.5	9.5	0.7*sqrt9.5	2.158	DN100
H	WC (9 litre cistern)	2.5	12	0.7*sqrt12	2.425	DN100
K	WC (9 litre cistern)	2.5	14.5	0.7*sqrt14.5	2.666	DN125

Branch	Sanitary fixture	DU (L/S)	Sum DU (L/S)	Formula	Qww (L/s)	Branch DN
a	Washbasin	0.5	0.5			DN60
b	Washbasin	0.5	1	0.7*sqrt1	0.700	DN70
c	Washbasin	0.5	1.5	0.7*sqrt1.5	0.857	DN70
d	Washbasin	0.5	2	0.7*sqrt2	0.990	DN80
e	Washbasin	0.5	2.5	0.7*sqrt2.5	1.107	DN80
f	WC (9 litre cistern)	2.5	5	0.7*sqrt5	1.565	DN100
g	WC (9 litre cistern)	2.5	7.5	0.7*sqrt7.5	1.917	DN100
h	WC (9 litre cistern)	2.5	10	0.7*sqrt10	2.214	DN100
k	WC (9 litre cistern)	2.5	12.5	0.7*sqrt12.5	2.475	DN125

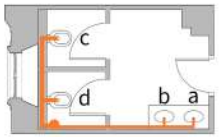


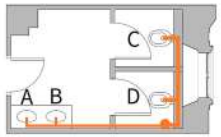


Toilet Underground

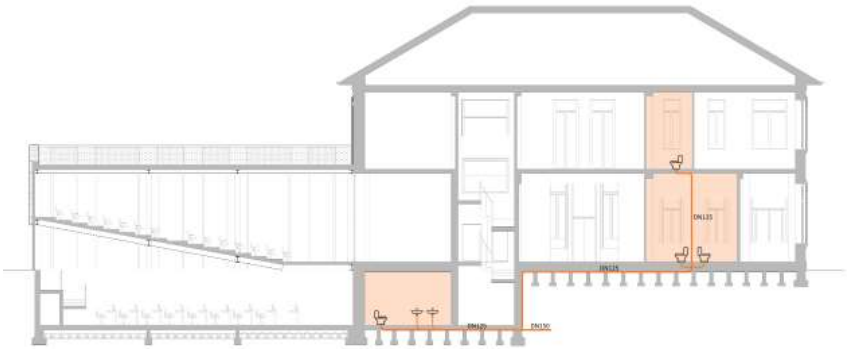


Toilet Ground Floor





Toilet First Floor



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