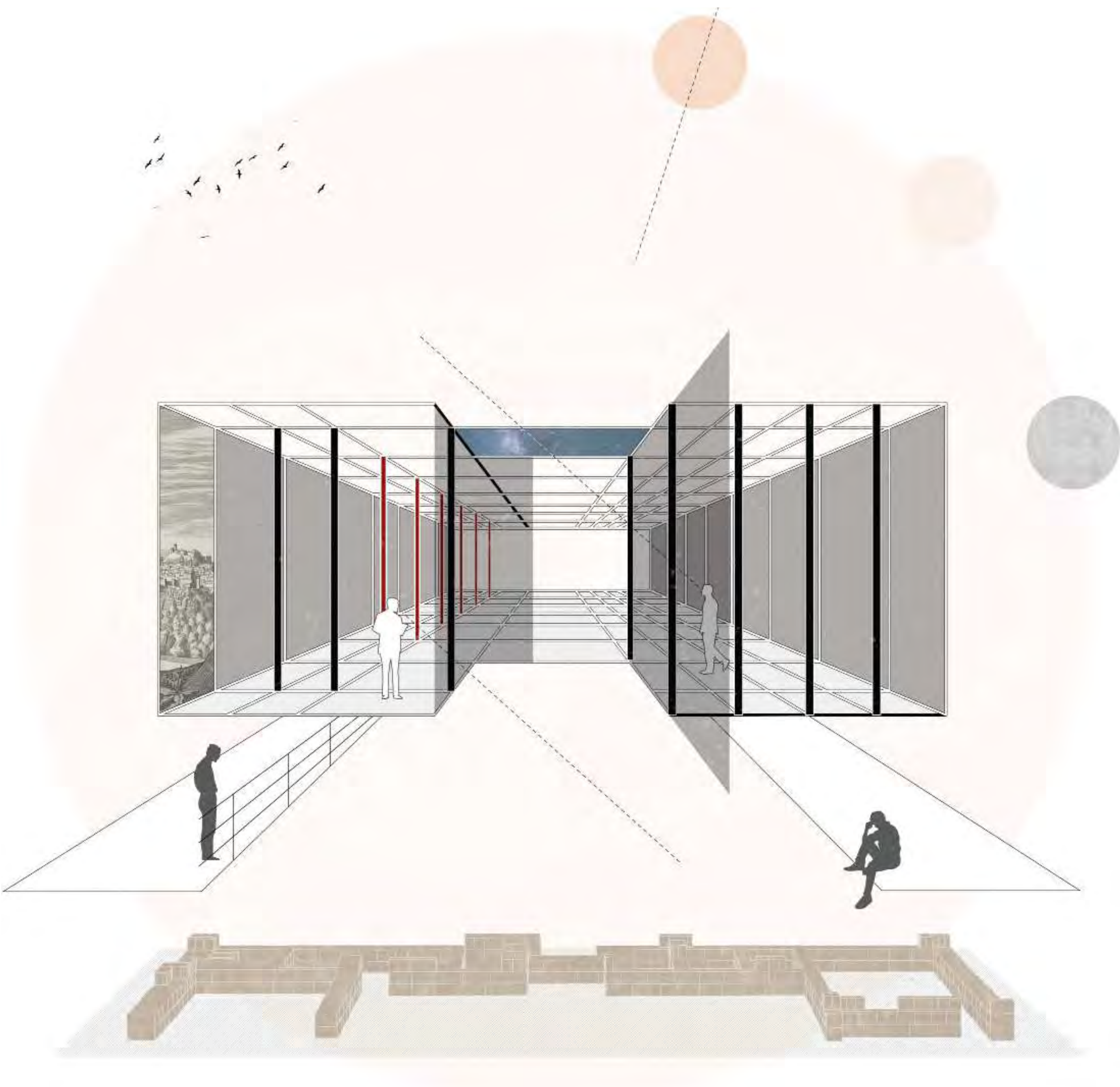
REPORT

ALEPPO CULTURAL CENTER



Politecnico di Milano 2018/2019
School of Architecture Urban Planning Construction Engineering
Master of Science in Architecture - Building Architecture
Aleppo cultural centre
M. G. Folli, C. Pecora, L. C. Tagliabue, F. Romano, G. Dotelli

Aleppo Cultural Center

Lorenzo Maria De Vecchi 897579
Nicolò Sciolti 897097
Vittorio Vaghi 897169

INDEX

ABSTRACT

In the aim of Syria post-war reconstruction, the project wants to be involved in the re-building of a national identity. On this purpose the design process is given through the analysis of one of the most damaged historical heritage of this country, Aleppo. In the most destroyed Unesco heritage site, the need of a conscious reconstruction belongs to the realization of a new "Image" of the city, the proper scenario for the further development of the whole country. In this sense the design process of a new cultural centre above the ancient madrasa al-Sultaniyya becomes the opportunity to integrate and express in a unique complex building a theme such as rebirth in its intimate connection with the commemoration necessity of a breakthrough event in the history of a people. Aleppo memorial and cultural centre provides to reach all of these purposes giving to the citizen a place to gather and study, to enrich knowledge and strengthen public sense of community. But the main goal achieved in the process is to give a reflection spot, an outlook to the bombing ruins of the recent history, to remember and be warned; the enlightening of a conscious memory.

Nell'ambito della ricostruzione post bellica, il progetto vuole essere parte del processo di ricostruzione della identità nazionale. Per questo il progetto è generato dall'analisi di una delle città maggiormente colpite dalle guerra, Aleppo. Nel sito Unesco che ha subito più danni per colpa della guerra, la necessità di una ricostruzione consapevole porta alla realizzazione di una nuova "immagine" della città, uno scenario adatto per il futuro sviluppo di tutto il paese. Per questo la progettazione di un nuovo centro culturale sopra l'antica madrasa al-Sultaniyya diviene l'opportunità di integrare ed esprimere con un unico gesto un tema come quello della rinascita nel suo intimo legame con la necessità di fare memoria di un evento così traumatico nella storia delle persone. (dei servizi pubblici, la connessione coi monumenti storici e la necessità di commemorare un evento così traumatico nella storia delle persone). Il memoriale e centro culturale di Aleppo vuole raggiungere questi obiettivi dando alla popolazione un luogo di ritrovo dove studiare, dove arricchire la propria cultura e dove rafforzare il senso di comunità. Ma l'obiettivo principale è di dare uno spazio di riflessione, una prospettiva sulle rovine bombardate al fine di farne memoria e monito, per generare una memoria consapevole.

the AIM

1 CHALLENGE: REBUILDING MEMORY

The embodied image of every design has always to represent the architectural expression of his design intention. In this sense, few scenarios offer design possibilities in which the building is shown as the representation of the spread of a very particular behaviour in a specific historical moment of his citizenship.

Aleppo is one of the most ancient founded city in the world with a heritage dated more than 6000 years ago. Because of the recent civil war and the next bombing period due to the conflict of external powers that found in Syria the main battle
field, nowadays Aleppo is heavily damaged and in search of the restoration of an historical identity loss and forgot in the footprints of his asylum-seeker population.

Here is outlined the picture of our scenario design. Following the purpose of one of the very first restoration competition proposal we took the advantage of the many resources to study the speculative process of a conscious building design and the expressive values that are necessary in this kind of works.

Memory as *Experience*

Figure 1:
11 September memorial Center
Michael Arad and Peter Walker, New York, 2014

Beyond the function of a cultural and memorial center it's necessary for the designer to represent, through the materialization of the concept design, an experiencial architecture in which the user is guided into the discovery of the expressed values.The will to wake the weaken.

"Remembrance is neither what happened nor what did not happen but, rather, their potentialization, their becoming possible once again"

The visitor has to live his past. The autonomous capacity of imagination had to be guided through a path in which, discovering the rest of the bombed ancient madrasa under a protecting roof, it becomes unavoidable to experience the empathetic feeling of the past commemoration. "Architecture has to fictionalise culture and reality, turning human settings into images", made perceivable through the metaphore of the ruin, that with his shape become the proof of the linking events that provoked his current situation.

Figure 2:
Vietnam veterans memorial,
Maya Lin, Washington D.C. 1982

Lin's conception was to create an opening or a wound in the earth to symbolize the gravity of the loss of the soldiers. "I imagined taking a knife and cutting into the earth, opening it up, and with the passage of time, that initial violence and pain would heal"

The sense of a "meaningful building" is given through a simulacra. The design incorporates in his écran the mistery of a well-garded and hidden proof of the event, making possible the discovery only in the most interior part of his enclosure.

"The sensory experience is layered, in associative and dynamic form, and his content provide the interaction with the desire of a memory".

Memory as *Layer*

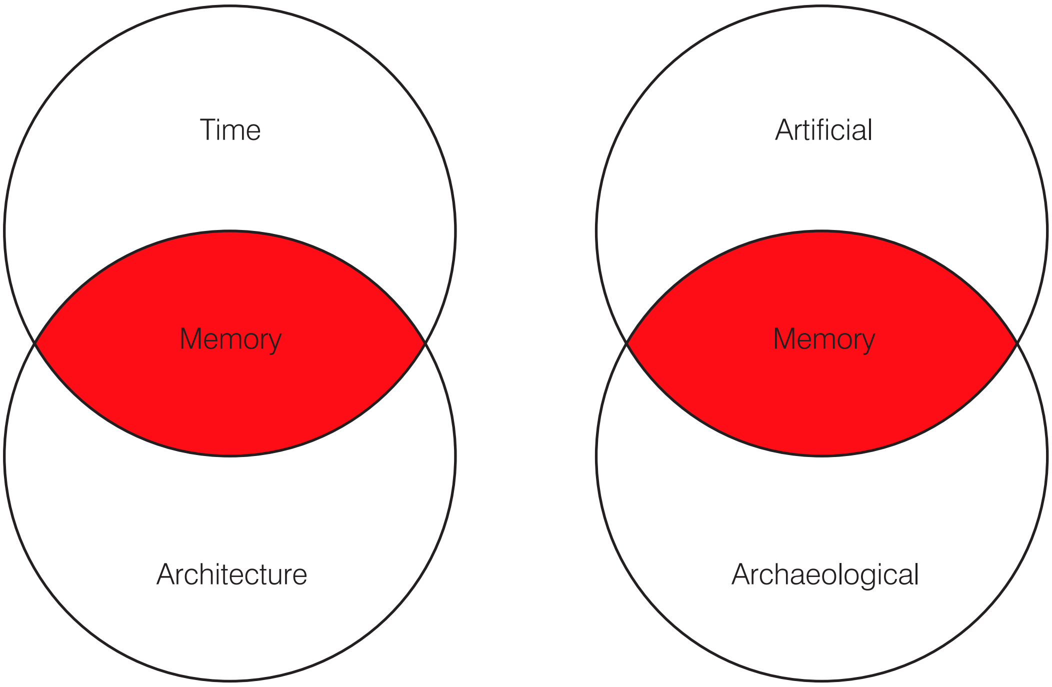


Figure 3:
The vesica piscis is a type of lens, a mathematical shape formed by the intersection of two disks with the same radius, intersecting in such a way that the center of each disk lies on the perimeter of the other. It represent the perfect "equilibrium" in the intersection of two different balanced realities. In this case it's used to explain how the "memory layer" as intersection of differents worlds.

The dialogue between the user and the buiding has to be the transposition in matter of the linking between his mind and his memory. The materialization of the layering history of Aleppo comes out in a temporal reinterpretation. The mosque Al-Sultanyyia becomes the "vesica piscis", central node in which the artificial world (the upper one, imposed by the construction of our building), is intersected with the layer of the ancient city, well preserved and still usable. The step
in which the Madrasa becomes a ruin, a monument, and no more a part of the "usable city", represent a will to stuck that moment in the time in which a particular event changed the shape and the meaning of his stones. This "intersecting layer" becomes the "resonant echo room" in which the user is involved in the memory experience.

Memory as *Archetypal Components*

Figure 4:
The primitive hut, Essai sur l'architecture, Marc-Antoine Laugier, Paris, 1753
The abstraction in archetypal components of every building, structural vertical elements and a covering roof.

"Architecture articulates characteristics and qualities of our fundamental existential experiences and feelings through the abstraction into archetypal componentes"

A roof as a symbolic shaping of a protection element. It expresses intimacy and the possibility of a self experience in the user interface. The horizontal boundary makes the visitor live a more direct and impactful sensation in the view of the covered object. In a certain way the courtyard that could represent an opening to the outer world, it's a symbolic limit of the perception field. Though the "memory object" represent the focal point of an introspective view. The preservation of a specific moment in Madrasa history permit to remember to the user the "everyday bombing" in Aleppo citizenship memories.
From outside the simulacra provides to hide the design intentions but a decontextualized enclosure is only the surface under which the experience happens.
Under the roof of Aleppo cultural center the bombing is always happening on Al-Sultanyyia mosque.

Memory as *Remembrance*

Figura 5:
Destruction in the Ancient City of Aleppo and Matbakh al-Ajami, 2014

Experiencing the emotional path of the musealization implies an identification with the historical moment represented by the musealized ruin itslef. In this sense the perception of the ruin, mostly to the Syrian user, will grab him into a memory path made of violence and disaproval of his recent history. An "un-denyability" sense made up to promote , living the experience of the memory-promenade, a sense of deep awareness. The full consciousness of what has to be avoided in the future. Observing the Al-Sultanyyia bombed ruin the user can listen an echo of what happened in that moment, what has been necessary to provoke it, and all the due consequences. A freezed moment. Perpetual and ethernal.
In many years, in the hearth of a re-build Aleppo, hopefully re-filled by the vibrant sounds and the colors which characterized it before the war; there will always be an awarness-spot in which the frozen destruction-moment will be present.

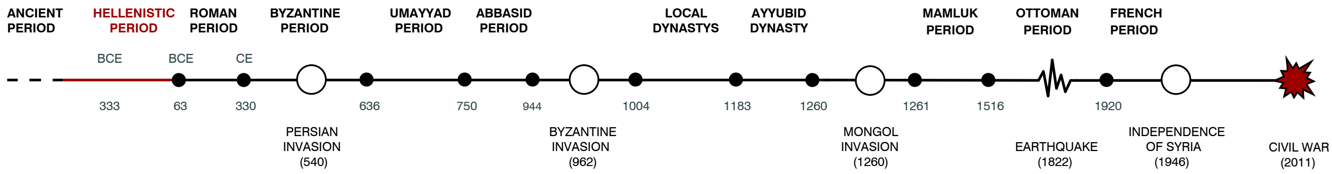
A continuos reminder.

The result will be the "collaged image" of an inter-temporal layered building in which the presence of the ruin will always act as a "nostalgic object of a memento mori feeling".
Iconizing the Madrasa it will be abstracted from his temporary line. The bombed ruin will be removed from his temporal limit of the moment of war and violence and set free with his powerful conceptual idea as a ethernal memorial reminder.

2 BRIEF HISTORY

Aleppo is one of the most ancient middle east city and it has always had a fundamental role for the commercial exchanges thanks to his position. For this reason it has been a combination of different cultures and dominations in his millenary history. The traces of these populations are nowadays still readable in the urban fabric. Therefore Aleppo is formed by the overlapping of different conceptions and ideas which had never deleted the previous traces but they had integrated and overlapped them.

Hellenic period



The first real plan of the city was thought by the Seleucid population. This empire understood the importance of the place to control the route where the caravans passed.
The city that was built, called *Beroia*, followed the rules of the Hellenistic Mediterranean cities[1]: the development was uniaxial and set on the east-west axis, called via recta. It linked the river on the west, where there was the Antioch Gate, to the acropolis on the east; this last one was built on an semiartificial topographical survey (this typology of topographical surveys are called tell in Syria). The urban fabric was built close to the *via recta* through the rule called *stringatio*, which consisted in the construction of rectangular neighbourhoods set on an orthogonal grid with fixed proportions.

Today the ancient via recta is the place of the central souqs and the traces of these neighbourhoods are still readable in the district[2].

1 *Neglia G. A., Aleppo: processi di formazione della città medievale, Bari, Poliba press, 2009, p.88*
2 The first studies about these preexistences were made in french period by Sauvaget. *Sauvaget J., Alep: essai sur le développement d'une grande ville syrienne des origines au milieu du XIXe siècle, Paris, Fondation de Clercq, 1941, p.47*

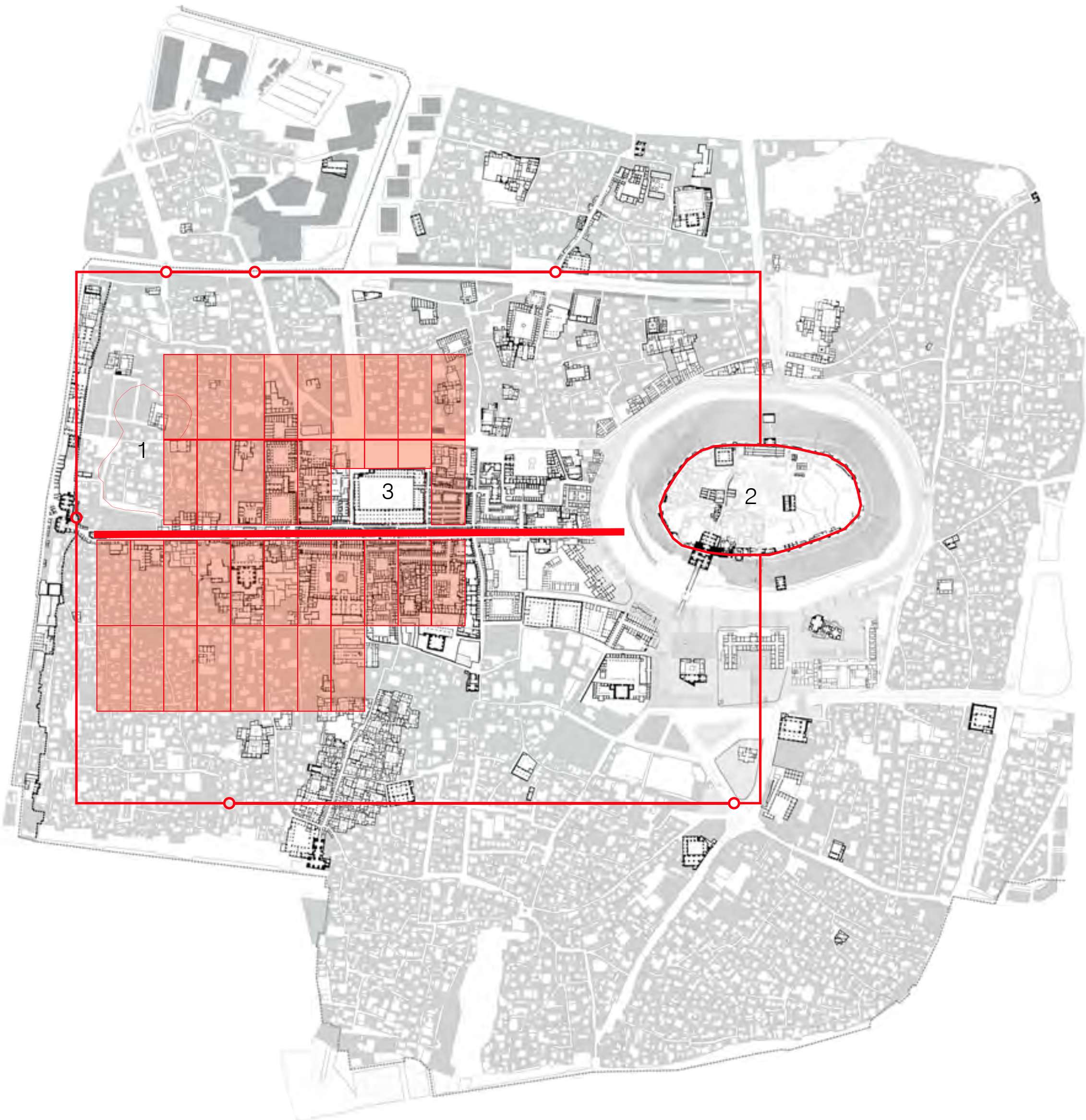
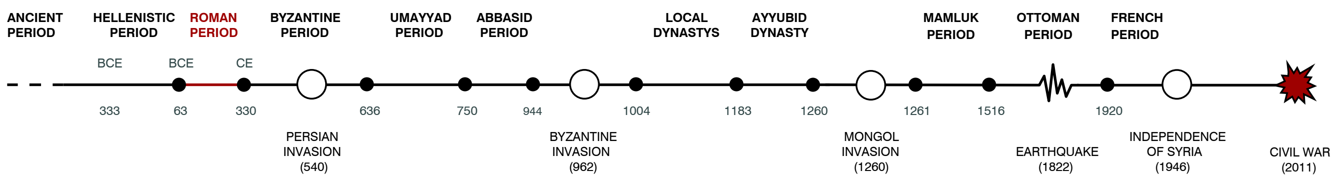


Figura 6:
Scheme of the Hellenistic re-foundation of Beroia
1: Tell el-Akabé
2: Citadel
3: Agorà

Roman period



The roman conquest of the region happened in 64 b.C. and they gave a big boost to the growth of Aleppo. The romans imposed their development scheme, the centuriation, which was set on two orthogonal axes: *cardo* and *decumano*.
In the first period of the roman domination the decumano retraced the ancient via recta while the cardo crossed the *decumano* in the old agora in order to create the foro. This position of axes was called *limitatio secundum coelum* because their orientation wasn't given by the morphology of the ground but by the north. The roman city developed on these axes whose traces are nowadays still present.
In the second period of the roman domination it happened that the scheme of organization of the territory changed: *cardo* and *decumano* were rotated of 18 degrees in order to adapt better themselves to the conformation of the territory. This new orientation is called *limitatio secundum naturam I*. The new *cardo* became an important connection with other cities of the Syria. This new orientation is particularly perceivable in the citadel south zone, where the project area is located. An orthogonal axis to the *decumano* coincides with the entrance of the citadel (whose architecture was built during Ayyubid epoch) and with the matrix route of the fabrics within the citadel. These alignments are prevalently set around a wide empty space located at the foot of the citadel and this void had been used through the ages in a different manner over the time, but always representing an abnormal large empty urban space: *musalla* or open air-place to pray, camel market or exchanges point[1]. Through the traces it has been hypothesized the existence of a roman *castellum*[2] in that void, which had been used as barrack.

1 *Sauvaget J.,* op. cit. p.76
2 This is an hypothesis made by the auctor of the book*; Neglia G. A.,* op. cit., p.p. 140-141

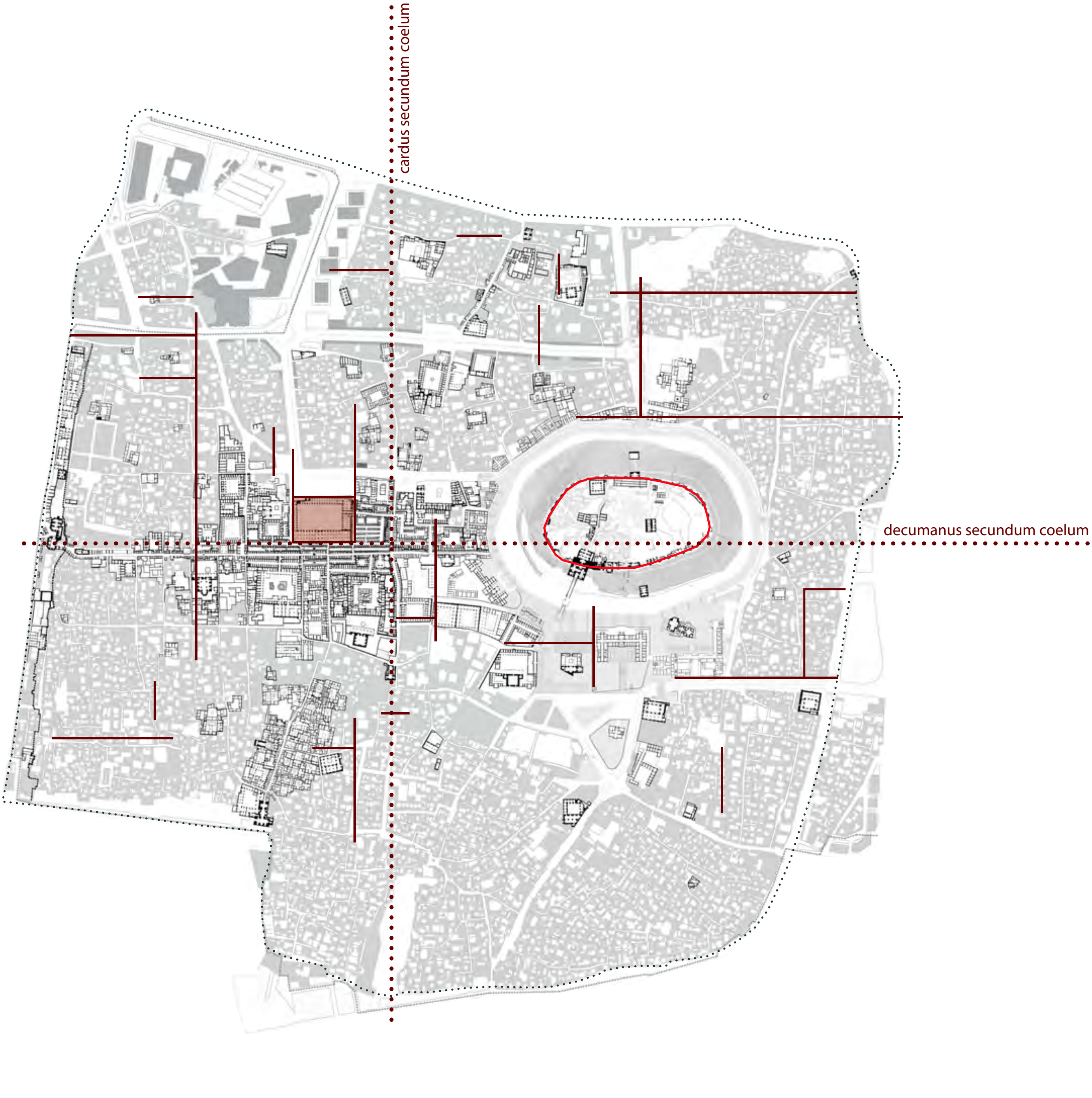


Figura 7:
Permanence in the urban fabric of Aleppo of Roman planned routes set in north-south / east-west direction. Location of the cardus and decumanus

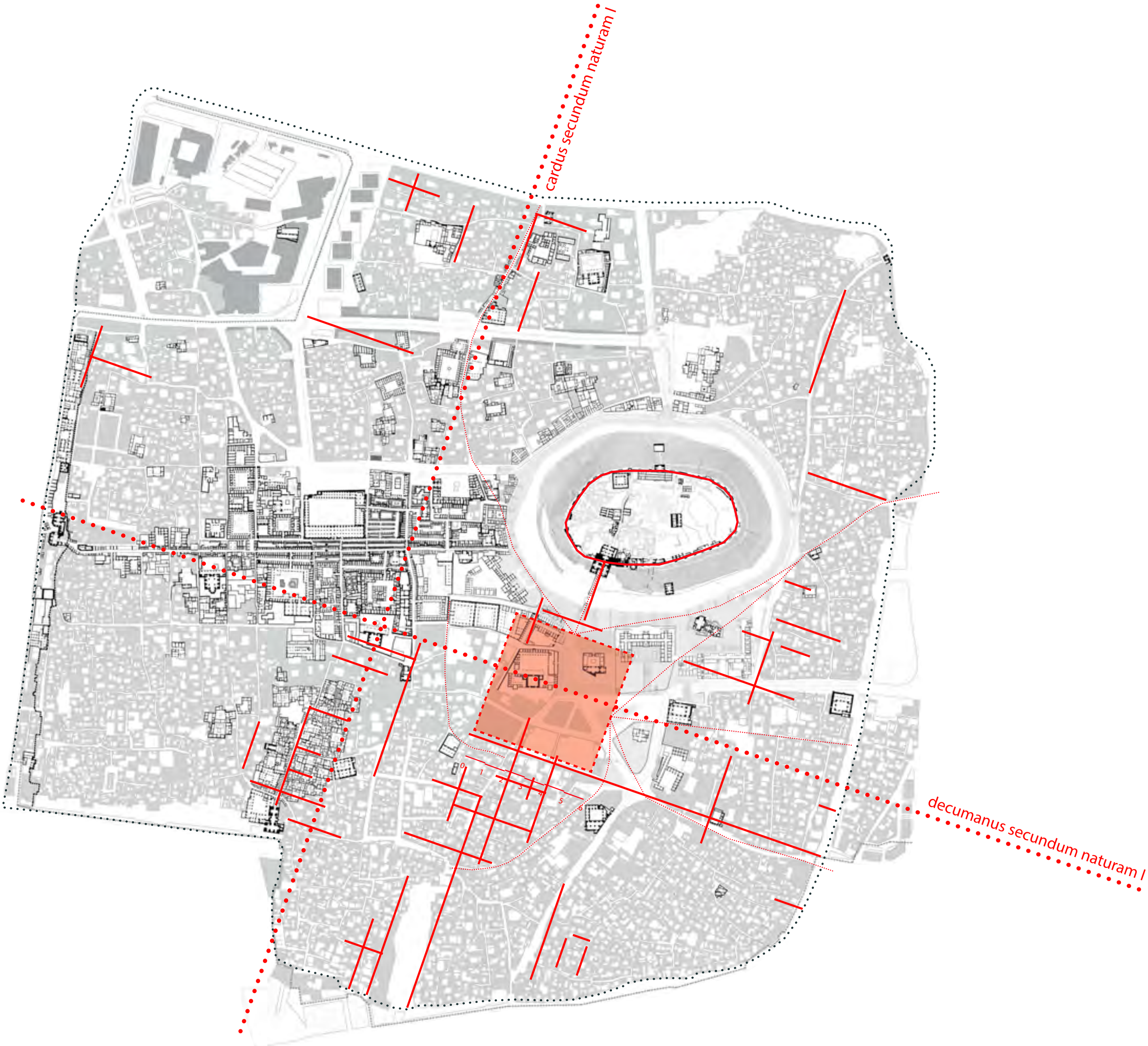


Figura 8 :
Permanence into the building fabric of Aleppo of planned routes rotated by 18 degrees with the regard to the north-south / east-west direction. Individuation of the cardus and decumanus. Permanence of the traces of the roman castellum southern the citadel. Individuation of the discarding and convergence routes towards the gates of the fortification

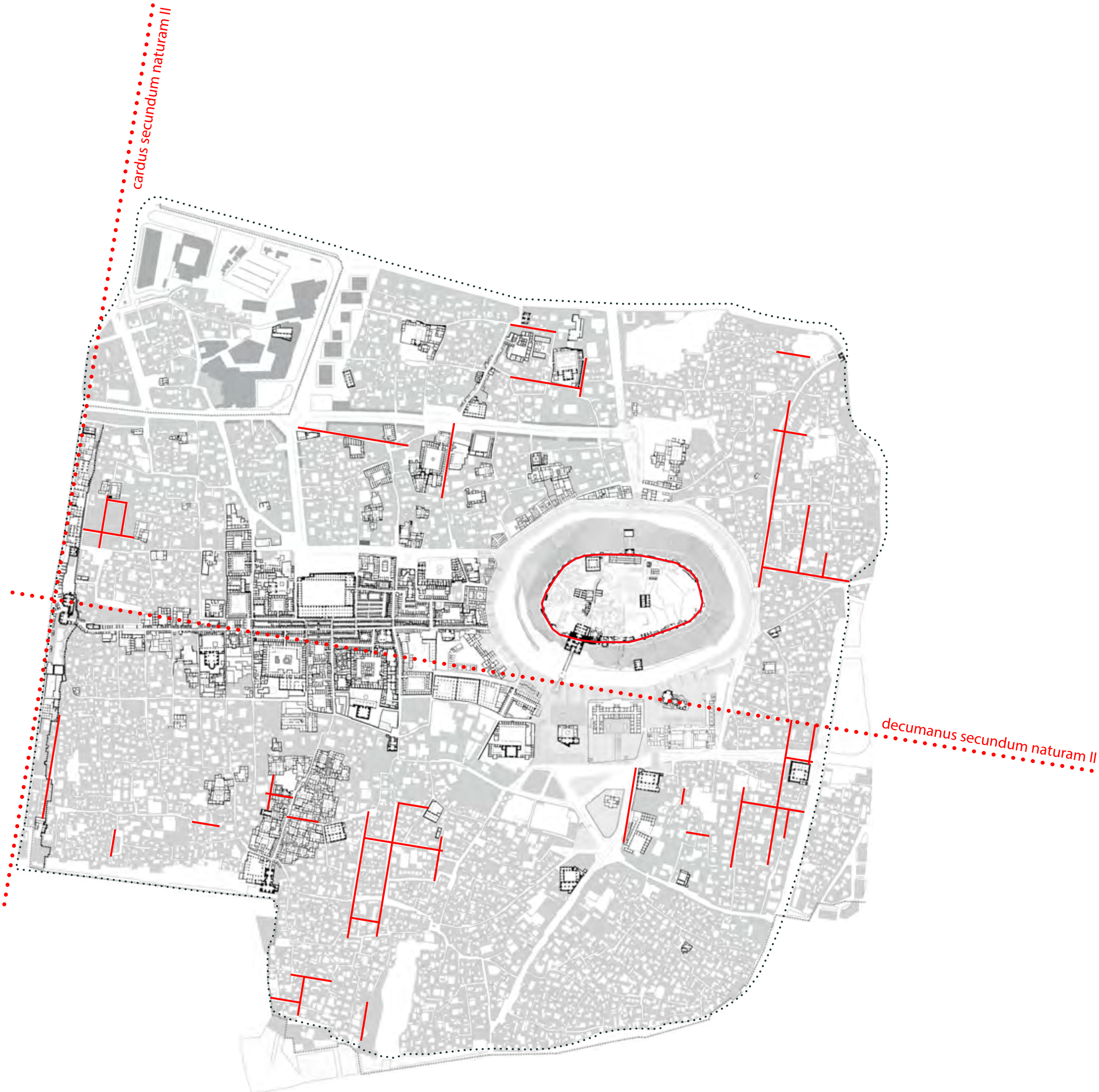
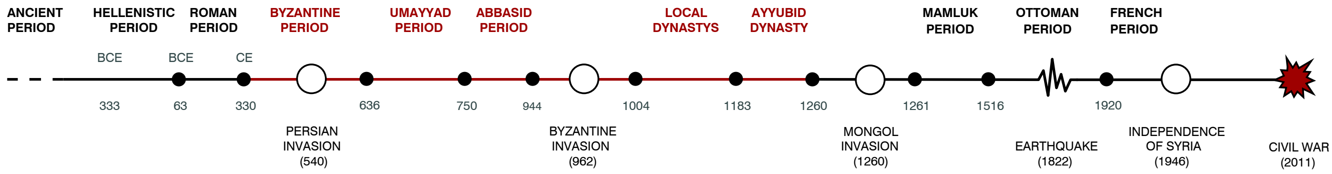


Figura 9:
Permanence into the building fabric of Aleppo of planned routes rotated by 10 degrees with the regard to the south-south / east-west direction. Individuation of the cardus and decumanus

The last period of the roman presence is characterized by a further axes rotation of 10 degrees than the secundum coelum rotation. This *limitatio secundum naturam II* is due to a necessity of agricultural land division and his traces are still readable only in the outer area of the old city.

Byzantine and Ayyubid periods



During the byzantine domination of Aleppo there were not big changes in the system of the city except for the construction of a wall system that surrounded the city and retraced the eastern wall of the roman castellum. After the conquest of Aleppo by the arab population of Omayyads in 637 the city had lost for centuries his importance and had stopped his urban development in favour of a densification of the existing urban fabric. This new process didn't upset the existing buildings but it worked with an integration of a new culture and new buildings in the pre-existence, for example with the construction of the big Omayyad Mosque in 705 in the void of the ancient agora. Only after the conquest of Aleppo by the Ayyubid dynasty, who chose Aleppo for the royal residence, the city had a new period of development.

Thanks to them the new system of citadel fortifications were built, among which the entrance block.
The sultan al-Malik al-Zahir Ghazi built in the void in front of the entrance the madrasa al-sultaniyya, consecrating the void of the ancient castellum to a religious function.

Figura 10:
The Byzantine city. Individuation of the fortification system; main architectures; built up area
1: Cathedral
2: Cemetery

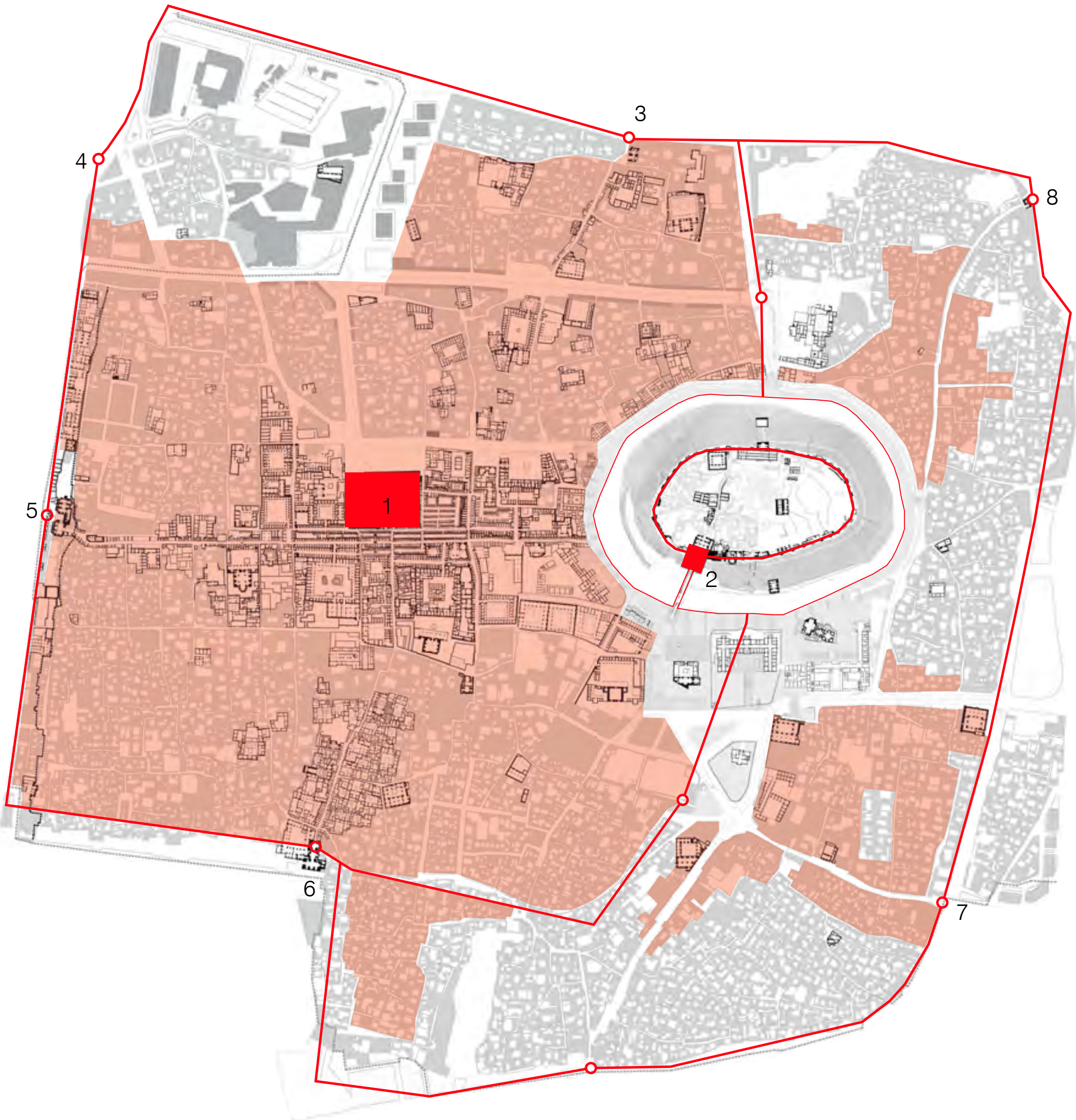
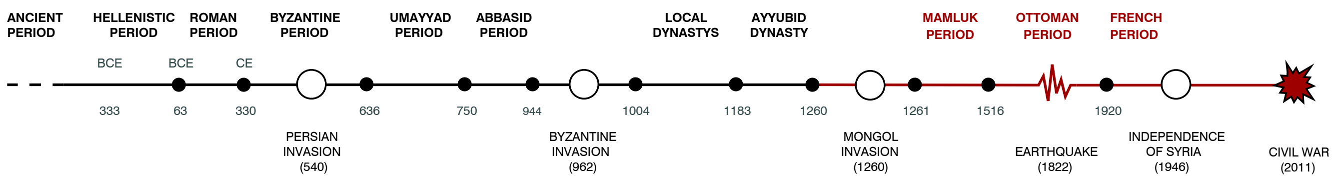


Figura 11:
The Ayyubid city. Individuation of the fortification system; individuation of the main urban and architectural restructuring
1 Great Mosque
2 Fortifications of the citadel
3 Bab al-Nasr
4 Bab al-Faraj
5 Bab Antakia
6 Bab Quinnasrin
7 Bab al-Neirab
8 Bab al-Hadid

From the Mameluk domination to the civil war



Mameluks conquered the city after the Ayyubid domination. They built a new external walls system which was further than the previous one in the citadel zone, close to the byzantine moat. Starting from that moment the old city fabrics didn't suffered big transformations except for consolidation and densification processes.
During the ottoman period these fabrics suffered substantial fragmentations in the norther part of the old city in order to follow that period city planning logics.

During the French domination after the world war 1 there were the first studies of the historical and archaeological urban development. Moreover in the south part of the citadel some important public building were built, such as the government house (Grand Serail) and the justice league.

Finally Syria acquired independence in 1946 and the general Hafiz al-Asad rose to the government in 1970 with Ba'th pan-arab party. His successor was his son Bashshar al-Asad that rose to the government in 2000.

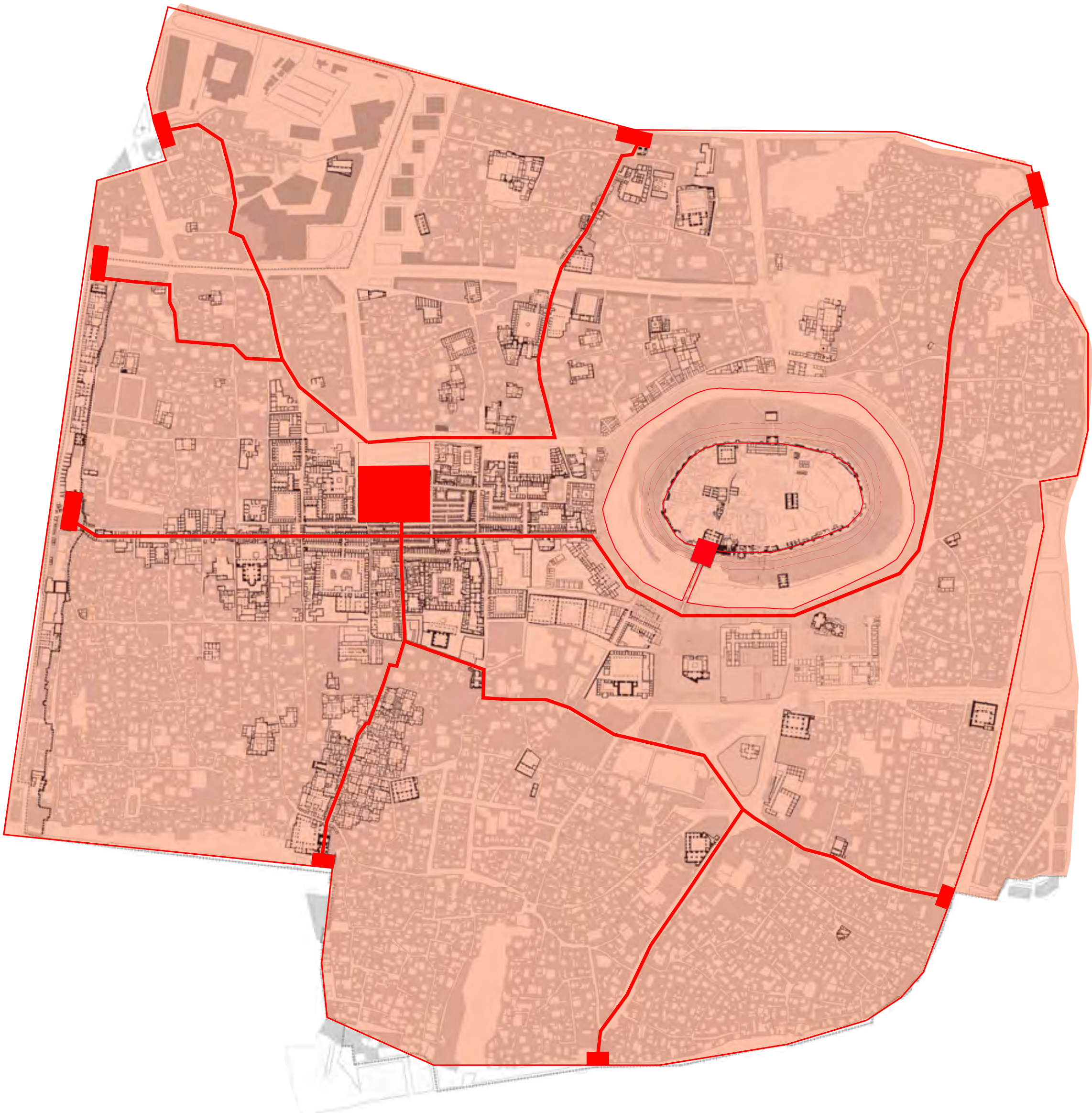


Figura 12:
The Ottomans city. Individuation of the main access system; individuation of the built up area

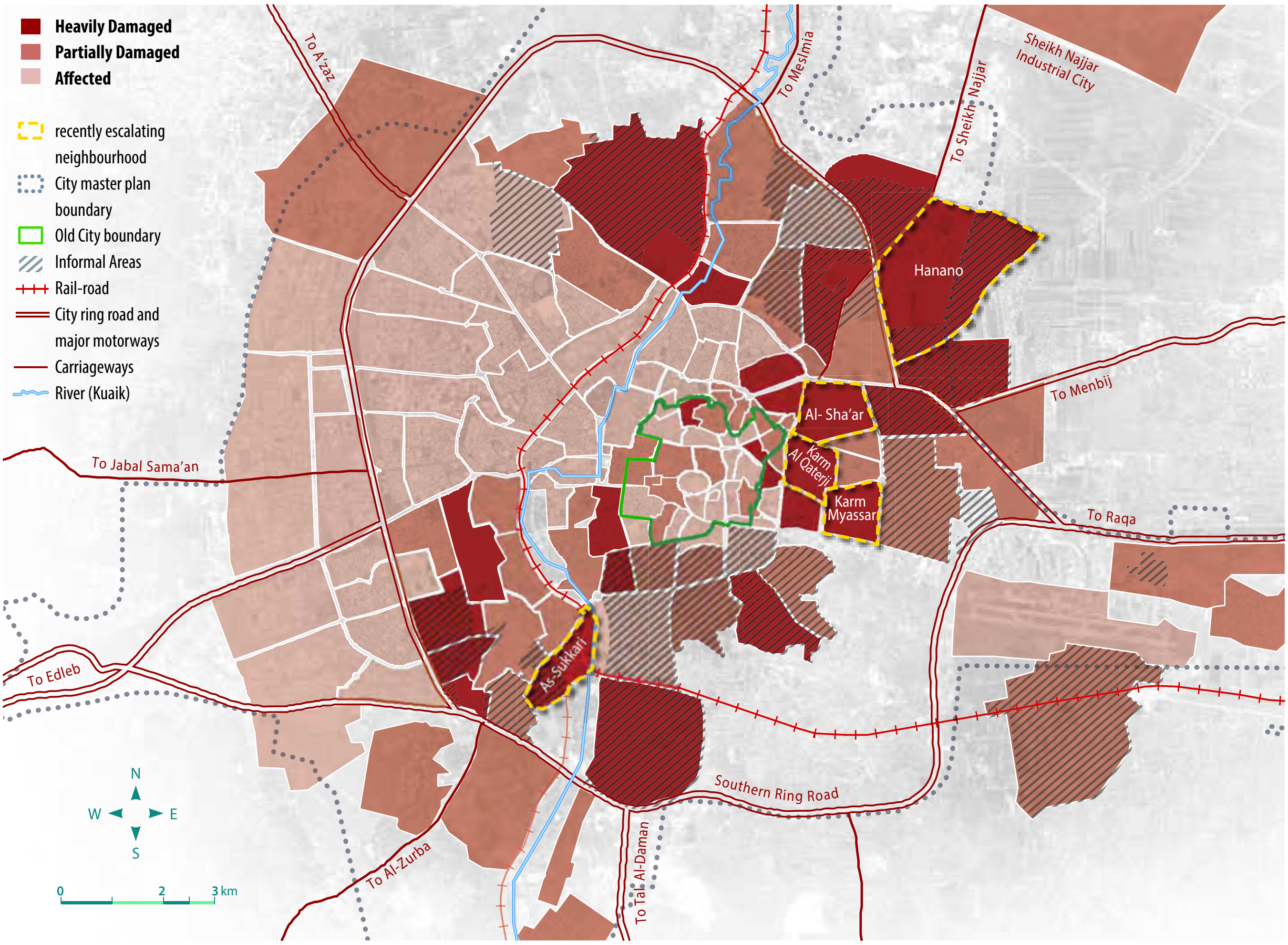


Figure 13: Damage analysis

The tension in the country blew up in the Syrian civil war in 2011 in which Damascus government, the rebels and islamic extremists were involved.

In this context the Battle of Aleppo had lasted for 4 years from 2012 until 2016. During this Battle Aleppo was divided between the Damascus troops and the rebel ones and it seriously damaged the central zone, the south-east, north-east and east zones of the city.
From a starting population of 4 049 021 it became of 1 700 000 in 2016[1]. The old city is one of the most damaged zone. His population passed from 124 701 to 70 000 people and almost half of the building were damaged.
About the historical buildings, whose a lot of them were protected by UNESCO, 56 of them were completely destroyed, around 352 were seriously or slightly damaged and only 28 were almost untouched[2].
Between the completely destroyed ones there are the Madrasa al-Sultaniyya, bombed in 2014 and the government house, the Grand Serail, which was destroyed by the explosion of a explosives storage located under the building[3].

1 *Kilcullen D., Rosenblatt N., Qudsi J., Mapping the conflict in Aleppo, Syria, Caerus Associates, 2014*
2 David J.C., Ruba K., Five years of conflict. The State of Cultural Heritage in the Ancient city of Aleppo, Paris, UNITAR, 2018
3 *Kutiefan L., Abdulkarim M., State Party report. On the state of conservation of the Syrian Cultural Heritage Sites, Syrian Ministry of Culture*

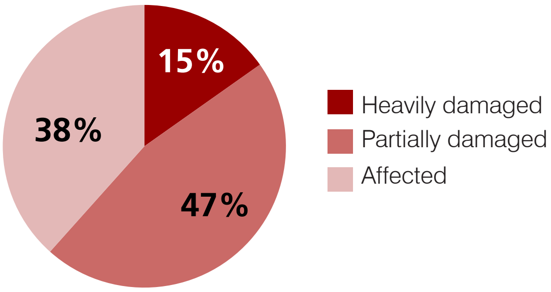


Figure 14: Neighbourhoods per damage level

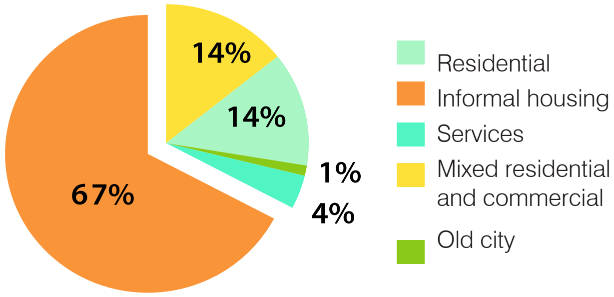


Figure 15: Distribution of heavy damage per land-use

Figure 16: Site analysis per damage level

MADRASA AL-SULTANIYYA

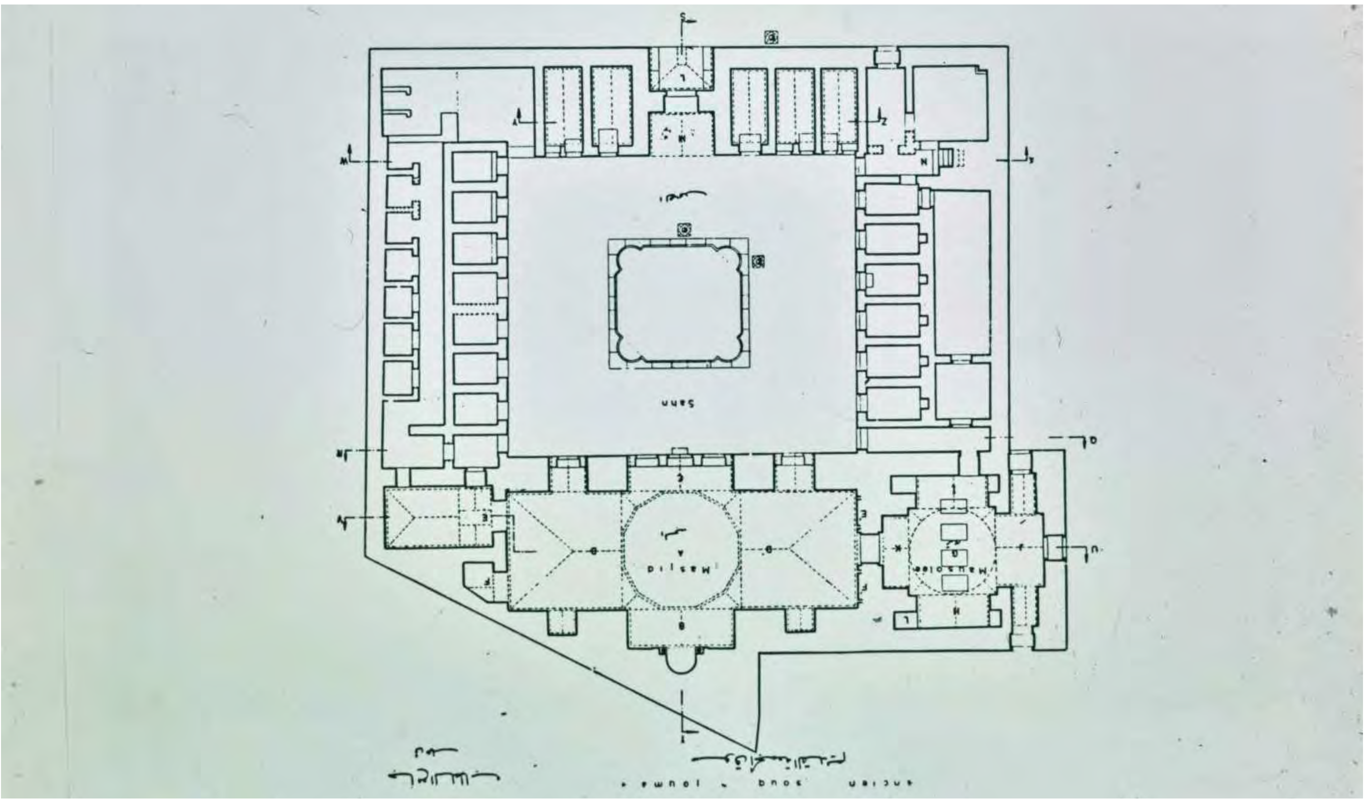


Figura 17:
Madrasa al-Sultaniyya ground plan, 1953

The construction of the Madrasa started under the sultanate of al-Malik al-Zahir Ghazi, lord of Aleppo and son of Salah al-Din, but it was finished in 1223 only after his death (1216) by his successor Atabek Toghrul. The madrasa is a religious islamic building dedicated to the teaching and the praying. The building appeared externally as a blind one, except for the entrance portal on the north side. This one led to the iwan (a covered entrance which is connected with the outside through a arc) that allowed the access to the central rectangular courtyard of 16,8x19,7 m. In the courtyard centre there was a pool. On the south part of the courtyard there was a block whose facade was composed by three blind arcs of which the central one was the biggest. In this last one there was the entrance to the place dedicated to the praying; this space was composed by a rectangular room covered by a central dome and two lateral arcs. In the middle of the southern wall there was the mihrab. In the south-east corner of the block there was the mausoleum of the sultan al-Malik al-Zahir Ghazi, whose entrance was by a narrow corridor practicable by the main entrance of the block. On the eastern and western blocks there were the students cells. The building was designed in the bare ayyubid style, in which the heavy stone walls prevail but there were a lot of inscriptions. Under the mamelukes domination in 1469 an octagonal minaret was added over the entrance portal. The 1822 earthquake damaged seriously the building and the Madrasa hadn't been used until 1884 when the Aleppo governor restored it. In 1979 a superior floor was added on the north-east corner. Finally the building was seriously bombed during the syrian civil war in 2014 and almost completely destroyed. Nowadays only the foundations of the building are still remaining.

Figura 18:
Madrasa al-Sultaniyya view, 1932

Figura 19:
Madrasa al-Sultaniyya entrance and minaret, 2002

The space around the madrasa has always been an anomaly in the dense urban fabric of Aleppo. During the centuries, it has had different functions: *castellum* in the roman period, *musalla* in the early Islamic period until the construction of the madrasa, and finally a market during 18th and 19th centuries until it was reconverted as a green public space in the second half of 19th century.

Figura 20:
The space in front of the Madrasa was also used as a parking, 1933

Figura 21:
Pray hall entrance, 1932

Figura 22:
Madrasa al-Sultaniyya view, 1910

Figura 23:
Pray hall, 2002

Figura 24:
Mihrab on the southern wall of the pray hall, 1932

Figura 25:
Madrasa al-Sultaniyya view, 1953

4 EXPLAINING THE *MANIFESTO*

One of the main reasons that led to the design choices is the richness of the historical urban pattern. The layering, still so well preserved and legible, was from the first time one of the main themes on which to start the design process.
It was even more at the origin of the process as it opened the doors to another key theme of our work: Memory. This is at the center of the mental scheme adopted to respond to the needs of a city that, destroyed by the civil war, risks losing its past under rubble and destruction. In a few years, in fact, the spatial, cultural and social order constituted in thousands of years of history has been subverted, as E. N. Rogers already stated in the post-war reconstruction period, in the second half of the twentieth century: “An era without memory is ephemeral and doomed to produce ephemeral objects”. A warning that has become reality in many cases of cities built through ephemeral objects, which have made their past a ‘tabula rasa’. Therefore the idea of working on Memory in opposition to Amnesia has emerged in us. At this point it was important that the design theme did not simply become a nostalgic ‘restoration’ of past destroyed layouts but rather an opportunity to express, through every aspect of the project, a look towards the future without forgetting the past, but restarting from it. And it’s here that the problems of memory and layering are met, in the common vision of overlapping of historical layers, from the oldest to the most recent, up to taking a look at tomorrow. The project becomes a symbol rich in meaning, but without the intent to solve the post-war situation. The goal is to see a first hope of rebirth and reconstruction, through a Cultural Center, a function that symbolizes the will to ‘reborn from the ashes’ for a better future.

Figura 26:
Manifesto

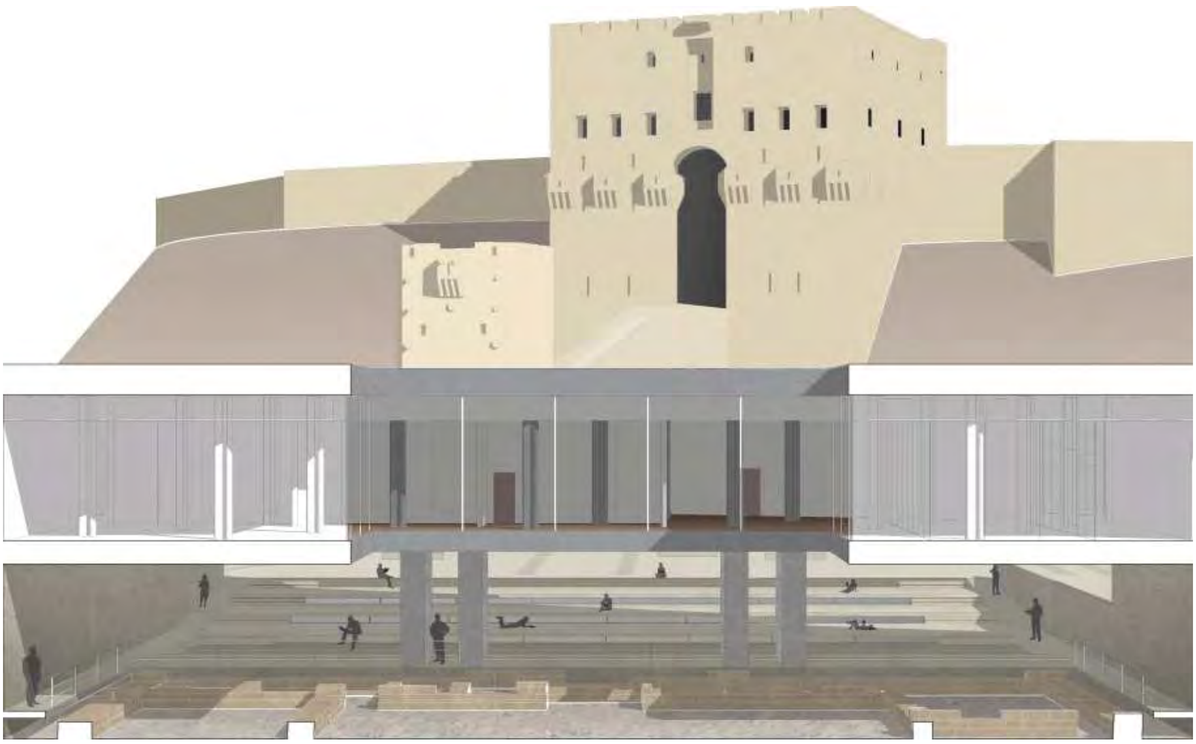


Figura 27:
Project view

the PROJECT

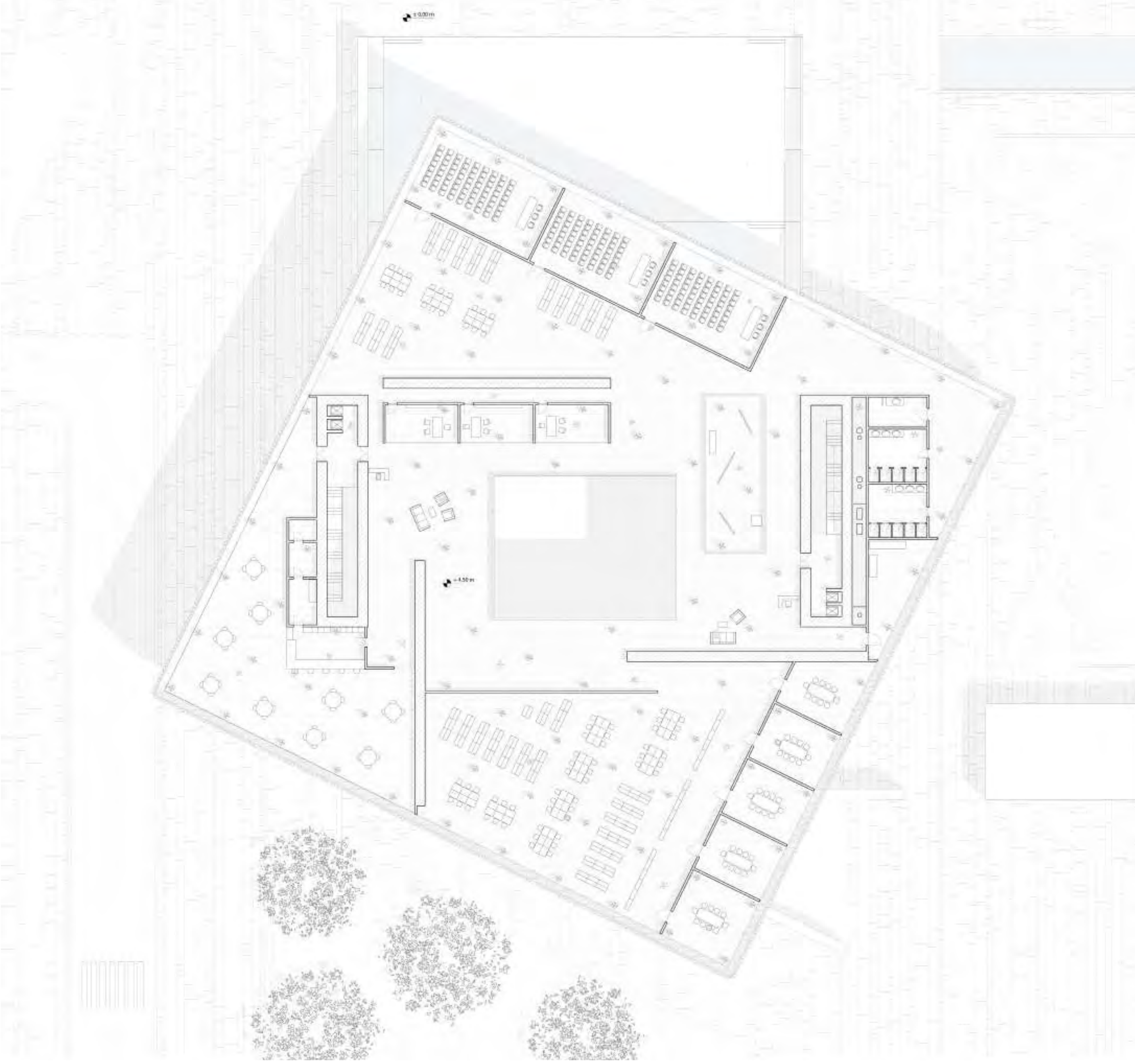
1 ARCHITECTURAL DESIGN

The embodied image of every design has always to represent the architectural expression of his design intention. In this sense, few scenarios offer design possibilities in which the building is shown as the representation of the spread of a very particular behaviour in a specific historical moment of his citizenship.

Aleppo is one of the most ancient founded city in the world with a heritage dated more than 6000 years ago. Because of the recent civil war and the next bombing period due to the conflict of external powers that found in Syria the main battle
field, nowadays Aleppo is heavily damaged and in search of the restoration of an historical identity loss and forgot in the footprints of his asylum-seeker population.

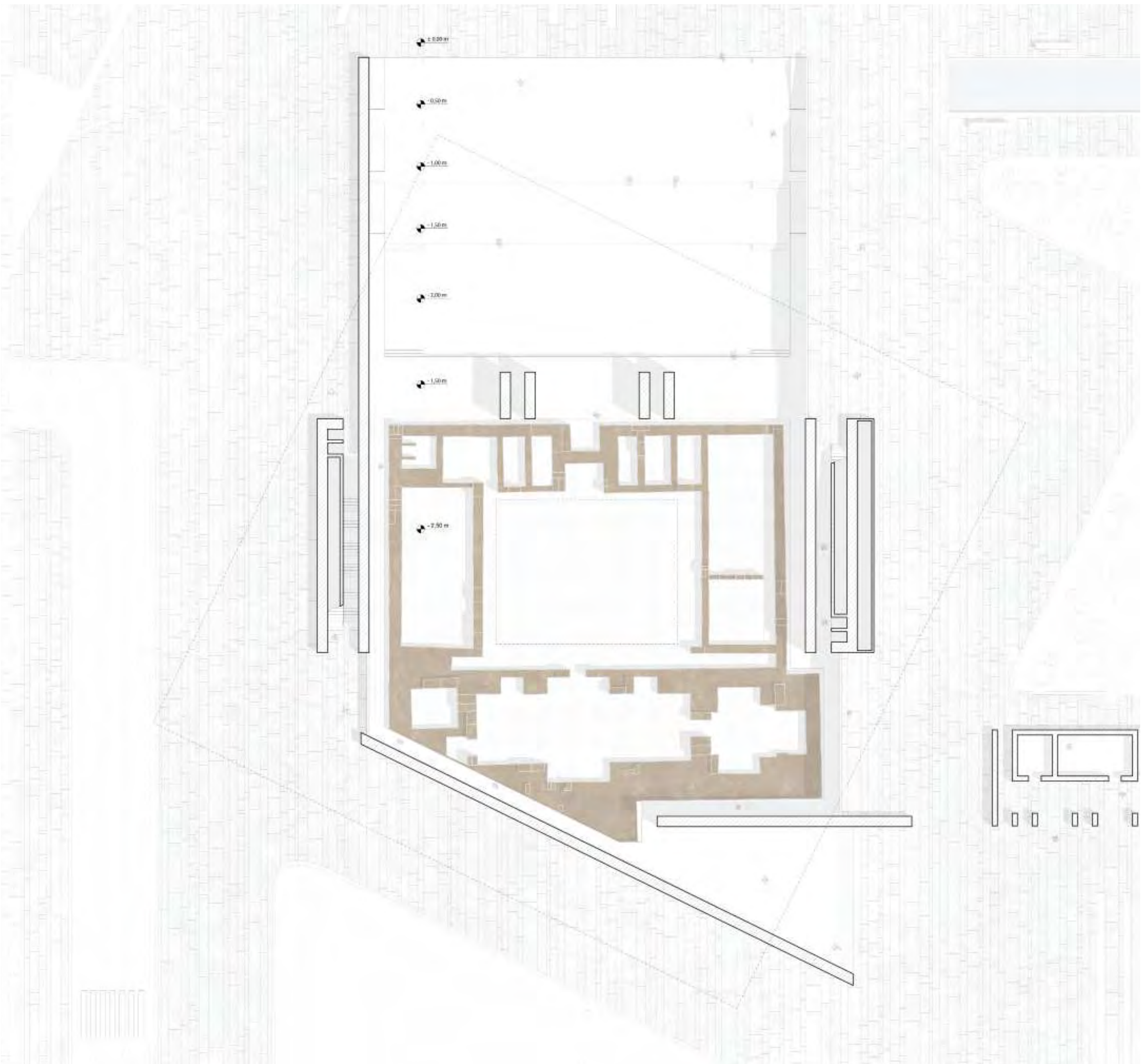
Here is outlined the picture of our scenario design. Following the purpose of one of the very first restoration competition proposal we took the advantage of the many resources to study the speculative process of a conscious building design and the expressive values that are necessary in this kind of works.

Masterplan



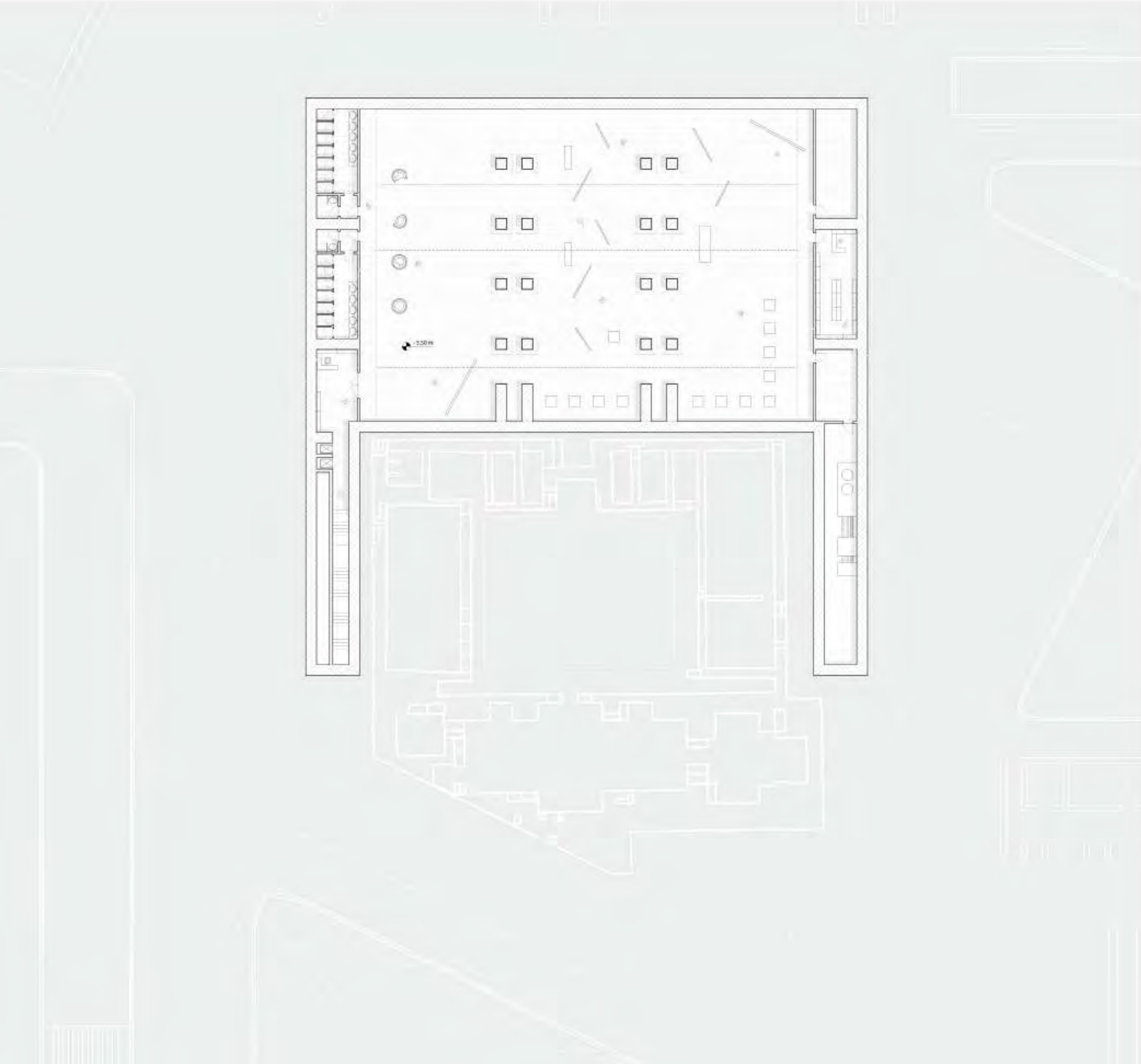
+4,5 floor plan

The +4.5 floor plan is designed to host the cultural center. His volume represents the mediation between the two different orientation of the city history and the courtyard is the extrusion of the ancient Madrasa original courtyard. In this sens his volume it's the proof of the different influences in this new upper layer. It hosts a library and many conference and meeting room. Many different gathering space to give the possibility to the citizenship to have a common space usable for everyone. The cafeteria represent the outdoor space in which the filtered light comes in from the outside giving to the user an open space in which the air flows but the solar radiation is filetred providing a better climatic condition.



ground floor plan

The first layer of the project is the one linked to the rest of the city and the sorroundings. It involves the integration in the masterplan and the linking to the other building of the “archaeological layer”. The ground floor is a space totally opened to the rest of the city in which the entrances are provided in the two structural parts of the building reaching the square floor. In the in-between space the musealization path permit to the visitor to see the bombed ruin of Al-Sultanyyia Madrasa. This space represents an enclosure area in which the user is linked to the ruin and apart from the rest of the city, perceivable only from very few openings and the auditorium. This “urban device” is the connection to the square and the open area facing the citadel. It’s the device which permit to be invited and guided into the discovery of the ruin through a gathering space totally opened to the square.



-5.5 floor plan

The museum is hosted in the -5.5 m level. It's the underground part of the auditorium slab and it's basically digged into the ground. The light comes in from the junction of the auditorium step and it provides a soft atmosphere of very few lighting. The internal coat continuous insulation provide to take the museum apart from the outside noise and make possible for the user to focalize his attention on the exhibition.

cross section

longitudinal section

In the section comes out clearly how it has been realized the separation of the project in different layers. The main concept of respect for the built and archaeological layer is evident in the resolution of the vertical supports. In this sense the design process provoked a suspended building, a sort of roof floating above the Madrasa. The other very strong idea of the connection with the square it's materialized with the construction of the auditorium which represents the continuity of the pedestrian flux from the square to the musealization path under the cultural center.

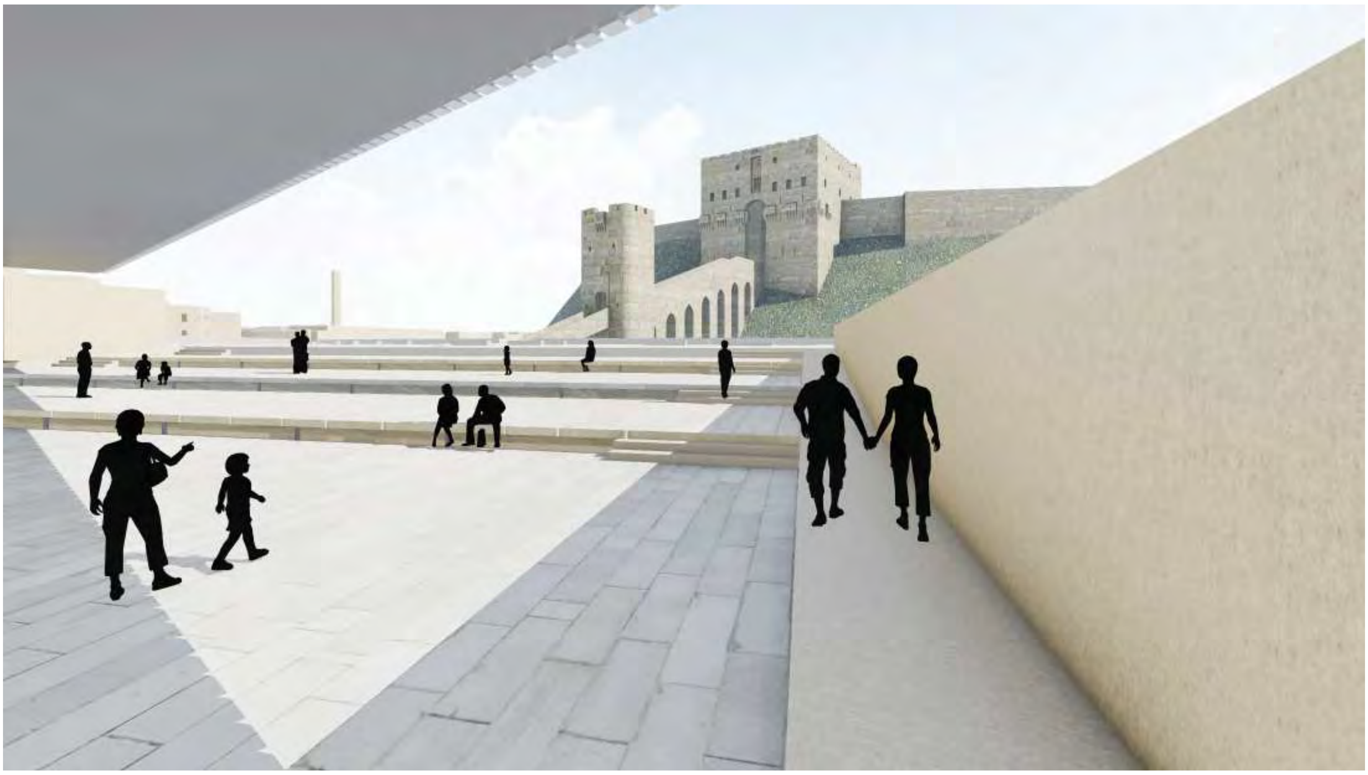
View from the square

View of the court

Night view from the west side

View from the west side

View of the musealization

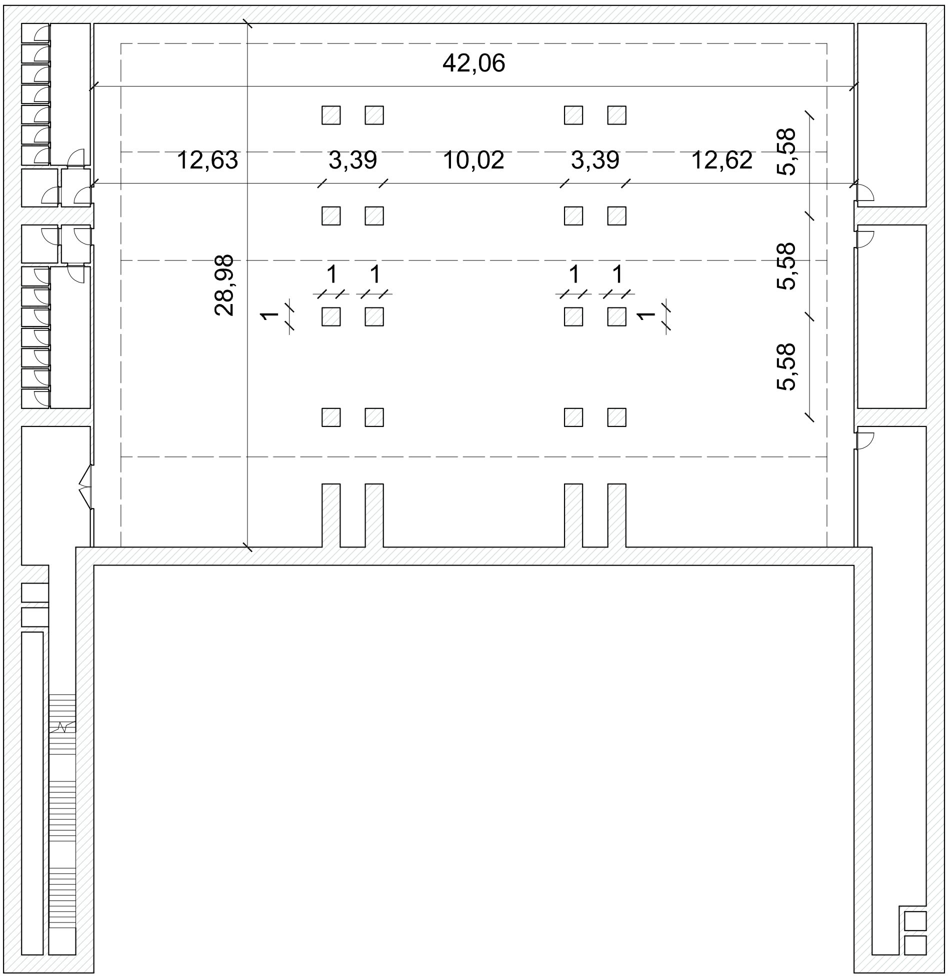


View from the auditorium

2 STRUCTURAL DESIGN

1 STRUCTURE DESCRIPTION

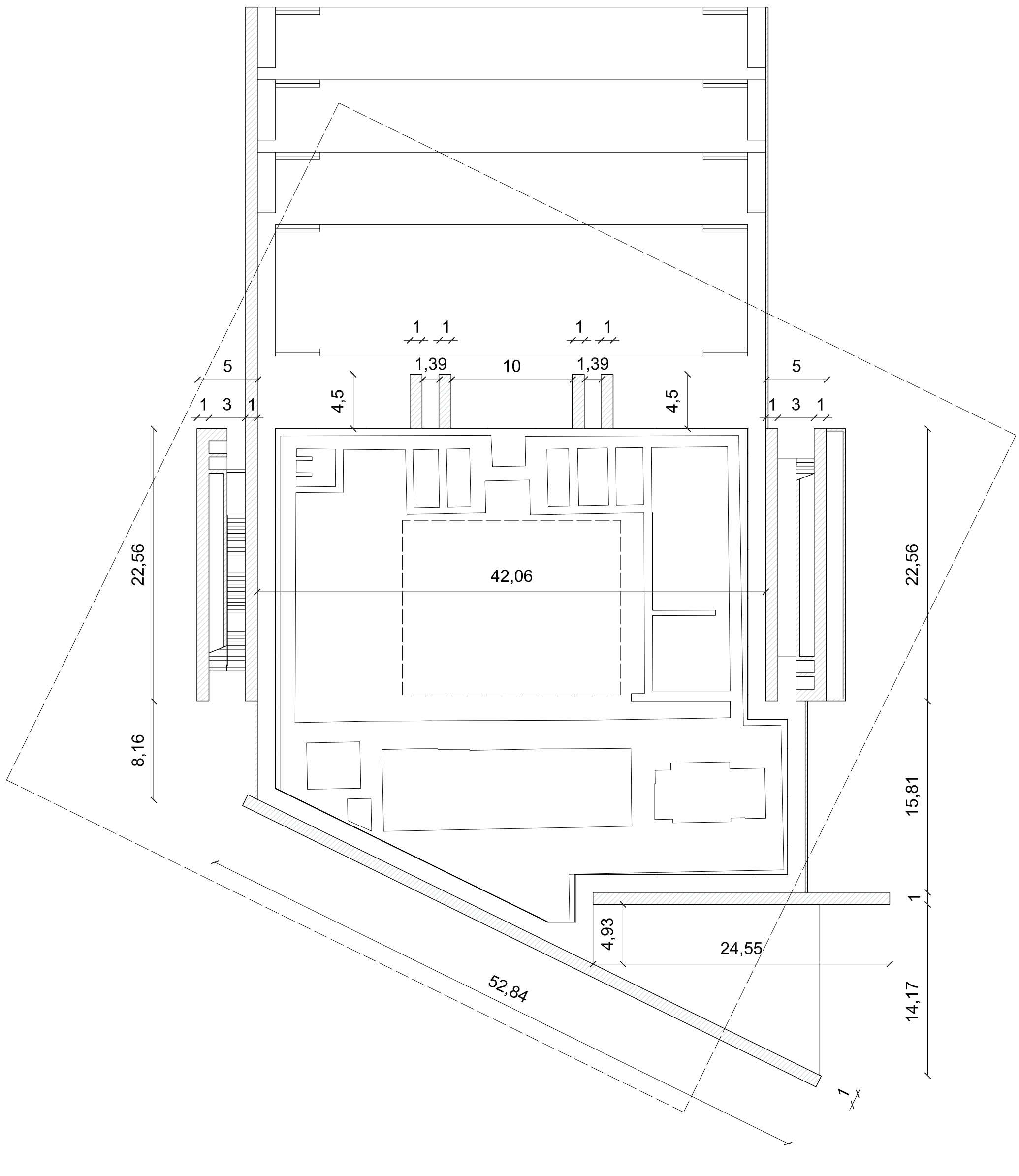
1.1 GEOMETRY AND DIMENSIONS, TECHNOLOGICAL AND TYPOLOGICAL CHOICE



-5,5 floor plan

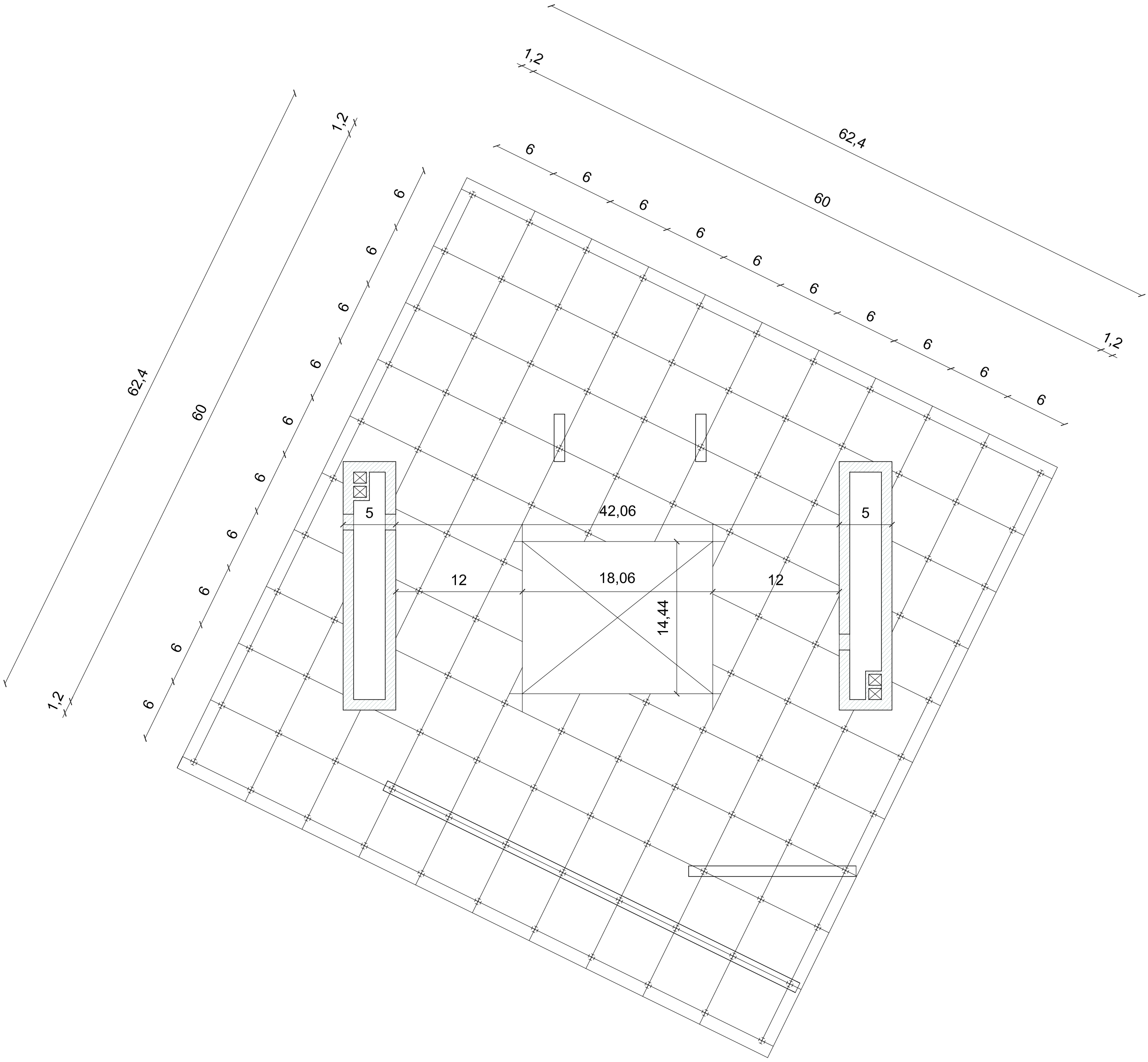
The architectural project is composed by three levels: an underground quote, in which is set the museum; a ground floor quote, in which there is the musealizatied mosque, and a flyover level where are disposed the library and the cultural center. The first two levels are designed in relation with the context of Aleppo for shape and geometry instead of the third one which follows a different logic.

The museum structure is born from the requirement of a covering composed by five concrete plates that form the upper auditorium: four of them are 20m long and 6m wide and the last one is twice as wide, disposed by shifted heights of 50cm. The other request is to keep the internal space as free as possible. For these reasons the structural choice is a concrete made structure formed by plates and pillars; two coupled pillars hold every plate and are set at 10m away. Two retaining walls help to complete the scheme.



Ground floor plan

For the ground level quote the structural choice is to use reinforced concrete walls disposed in a parallel way to the madrasa al-Sultaniyya. They are four variable length and 1m wide walls and two box shaped volumes 25m long and 5m wide composed by 1m wide walls. These volumes contain all the vertical connections of the building and form the stiffening core of the upper building. While all the other septa reach only the lower level of the upper building, the box shaped volume reach the superior level of it. The other main function of these walls, in addition to delimit the musealizated area, is to hold the superior building.

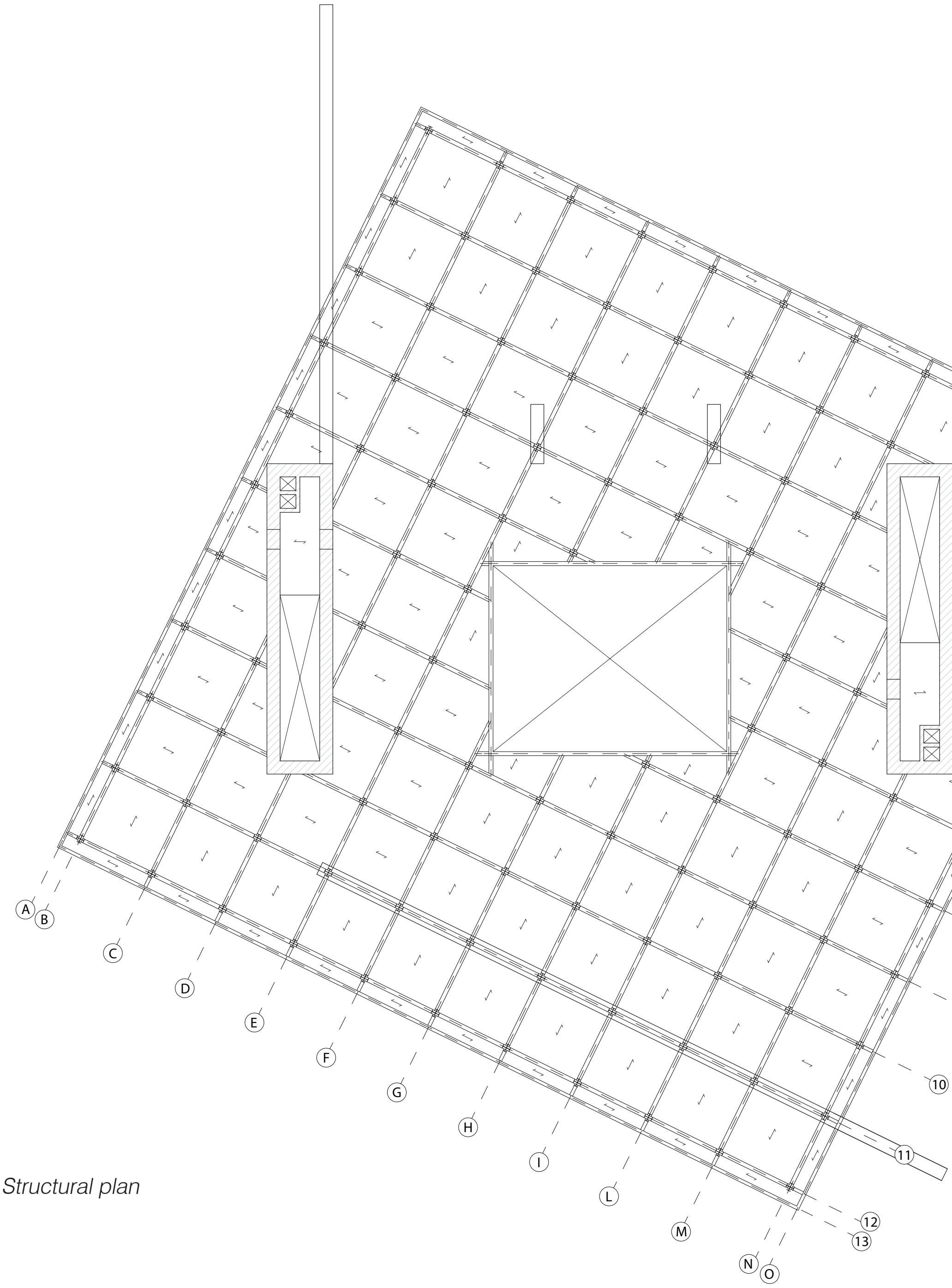


+4,5 floor plan

The upper building is a square planed building of 62,4mx62,4m and a central court is present. This building is 26 degrees rotated , while the court keep a north-south position. This situation brings the technological and structural choice: it is composed by vierendeel beams constituted by a 6mx6m mesh which follows the upper building orientation. These beams, set in both building directions 6m away, constitute the equivalent of a plate building which can distribute the forces on the lower concrete walls and can hold the cantilever. The functions of the cultural center will be set inside these plate of beams.

The junctions with the walls are fixed for both the walls and the box shaped volumes. In these last points the beams plate is interrupted, thus constituting the stiffening core of the building.

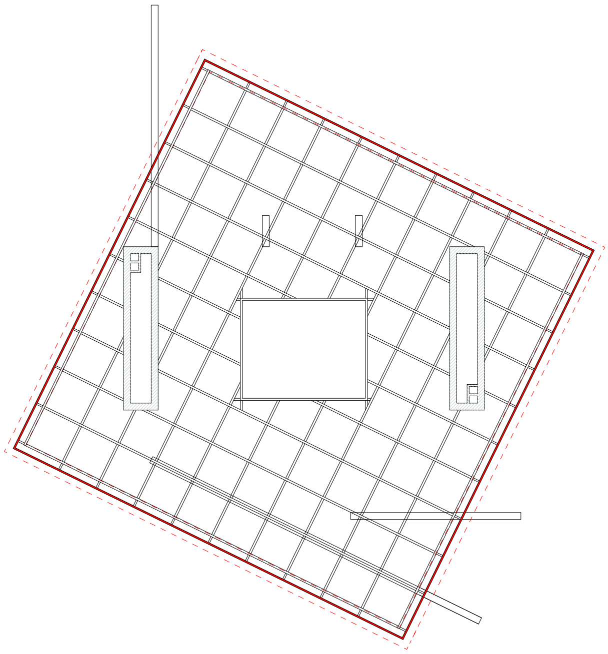
1.2 MATERIALS AND SECTIONS



Structural plan

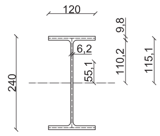
About the two lower levels the structure is made by reinforced poured concrete. A peculiarity of this concrete is that the aggregates are composed by recovered materials from the destroyed buildings, so that the concrete will take a typical coloration or the context of Aleppo.

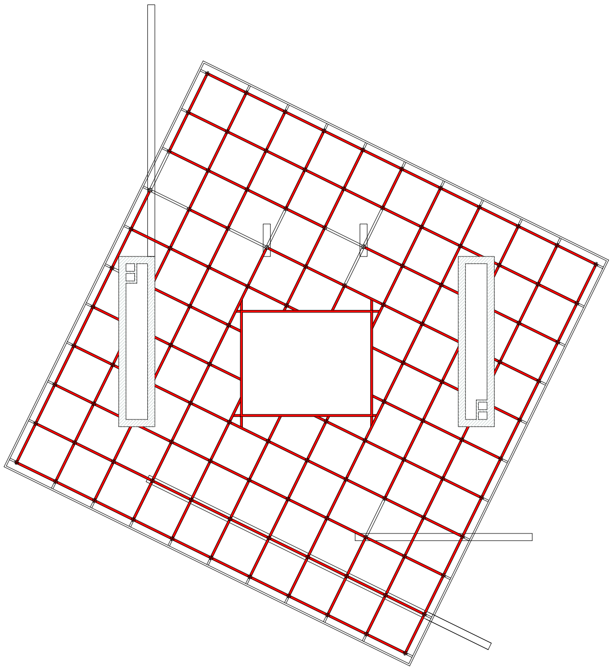
About the superior building it is necessary to use a strength steel; s355 for the elements of the vierendeel beams and s275 for the secondary and perimetral ones. There are different sections in the project: for the secondary and perimetral beams is used IPE 240 section. About the vierendeel beams are used HEM 550 section for the horizontal elements and cruciform section composed by HEM 550 for the vertical ones. This choice is due to the fact that the beams are in both the directions and the vertical elements are in common to perpendicular beams. Moreover in particular stressed points, for example close to the connection with the walls where the element's stress is higher, it is necessary to use reinforced sections: to the elements wings are welded steel plates made by the same dimensions of the wings. So section with a doubled wings is obtained.



IPE 240

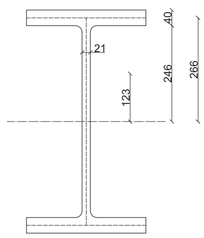
perimetral beams
secondary beams

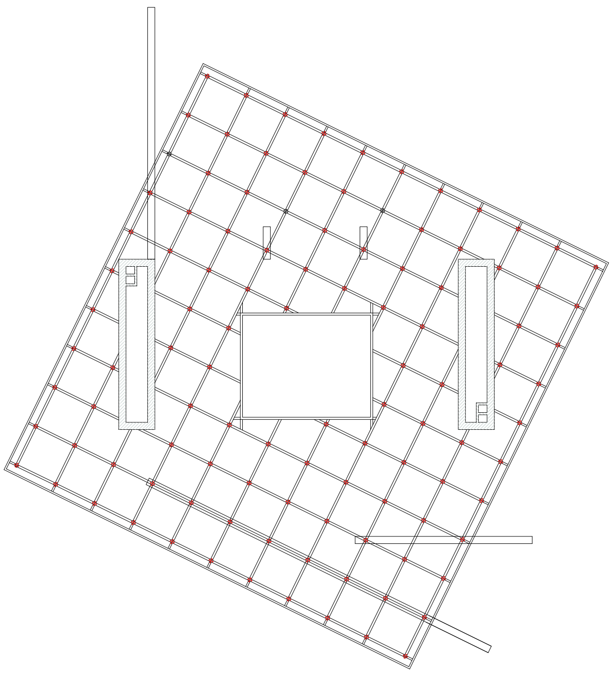




HEM 550

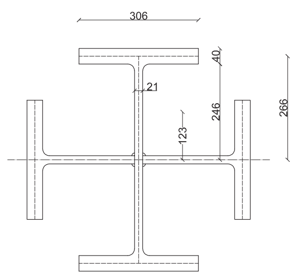
vierendeel horizontal elements





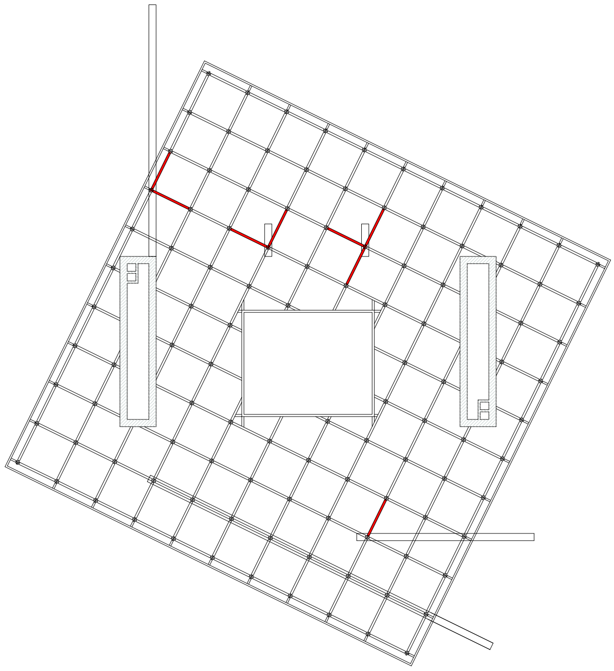
CRUCIFORM HEM 550

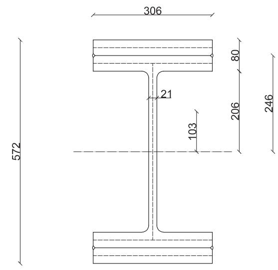
vierendeel vertical elements



REINFORCED HEM 550

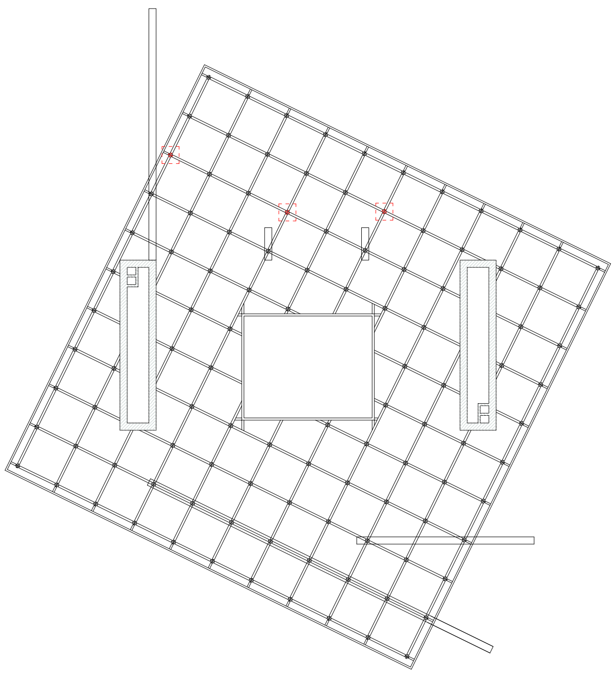
vierendeel horizontal elements

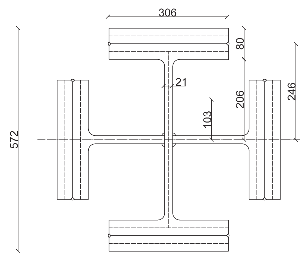




REINFORCED CRUCIFORM HEM 550

vierendeel vertical elements





2 LOADS ANALYSIS

About the loads analysis the reference is the regulation NTC 2008 for the loads classification.

2.1 PERMANENT AND VARIABLE LOADS

The permanent loads are divided in structural permanent loads G1 and not structural ones G2 while the variable ones are connected with the use of the building. The wind and snow loads are neglectable because for the first one the low height of the building allows that simplification and for the second one the weather of Aleppo doesn't allow plentiful snowfall.

2.2 COMBINATIONS

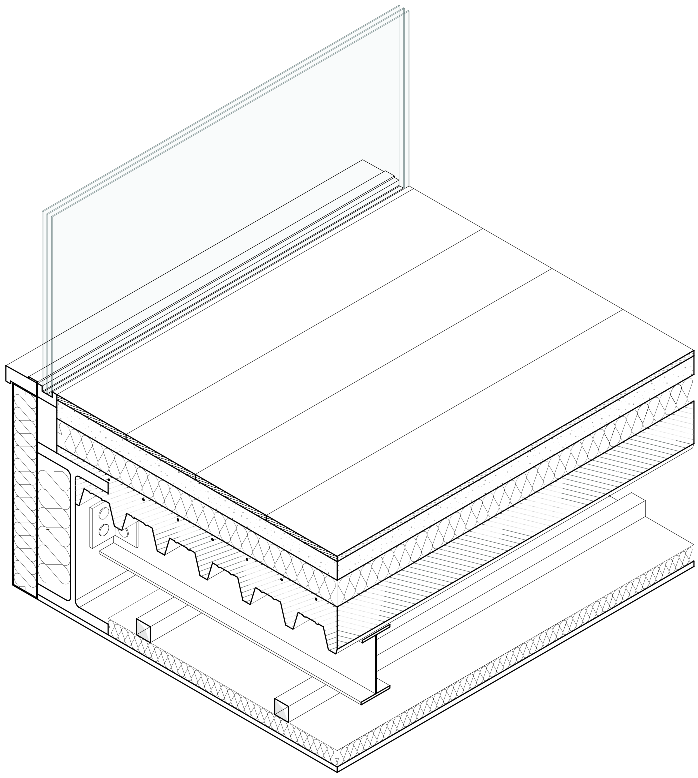
Due to the regulation NTC 2008 the calculation of the loads is made at the Limit States, in particular at Ultimate State Limit (U.S.L.) for the axial forces, the shear and the bending and Serviceability Limit State (S.L.S.) for the vertical displacement. The different loads are made by the sum of the singular loads multiplied for coefficient establish by the regulation, thus generating different combinations.

G_1

		load (kg/m)	
HEB 500		30,71	0,30 kn/m
IPE 240		278	2,73 kn/m

$G_{2.1}$ (Lower slab stratigraphy)

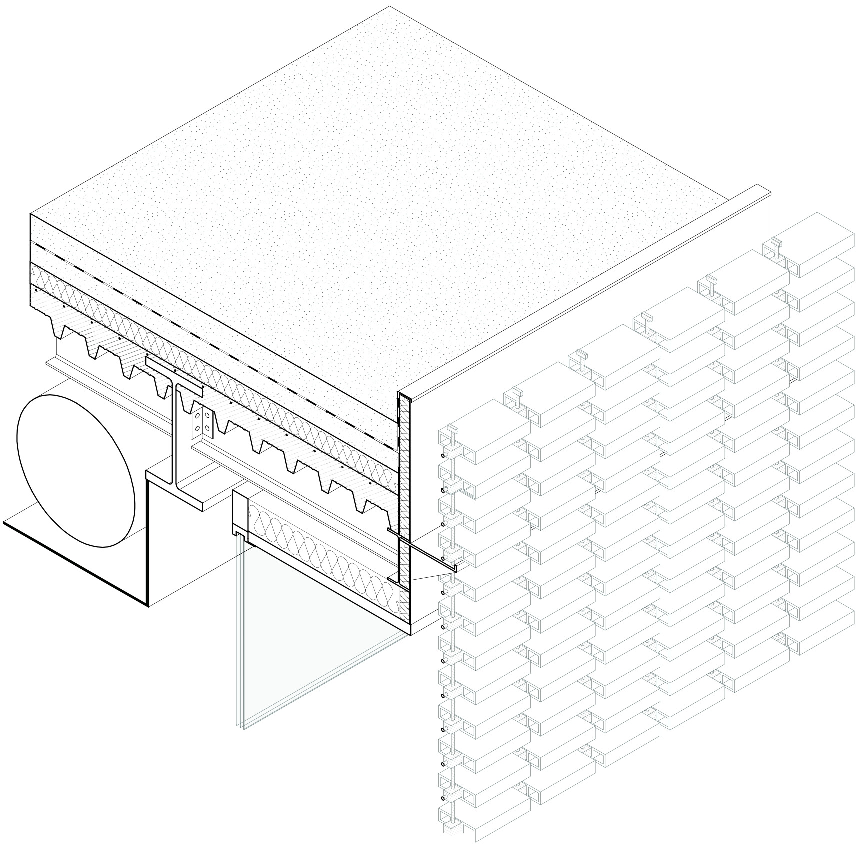
	thickness cm	load (kg/mq)	
False ceiling Knauf D11 system and panels	-	30	
Steel trapezoidal corrugated sheet, EGB 2000		22,38	
Structural concrete floor (Leca cls 1600 Rck 35) and welded mesh	18	169	
Knauf insulation panels expanded polystyrene	10	1,92	
Non-structural concrete floor (Lecacem maxi) and vapour barrier	7	42	
Floor finishing	4	20	
Internal partitions	-	100	
		385,3	3,78 kn/mq



Axonometry of the inferior slab

$G_{2.2}$ (Superior slab stratigraphy)

	thickness cm	load kg/mq	
False ceiling Knauf D113 system	-	30	
Building systems	-	100	
Steel trapezoidal corrugated sheet, EGB 2000		22,38	
Structural concrete floor (Leca cls 1600 Rck 35) and welded mesh	18	169	
Knauf insulation panels expanded polystyrene	10	1,92	
Lecacem maxi and waterproof case	10	42	
Lecacem expanded clay skin	12	20	
		385,3	3,78 kn/mq



Axonometry of the superior slab

$G_{2.3}$ (Perimetral closures)

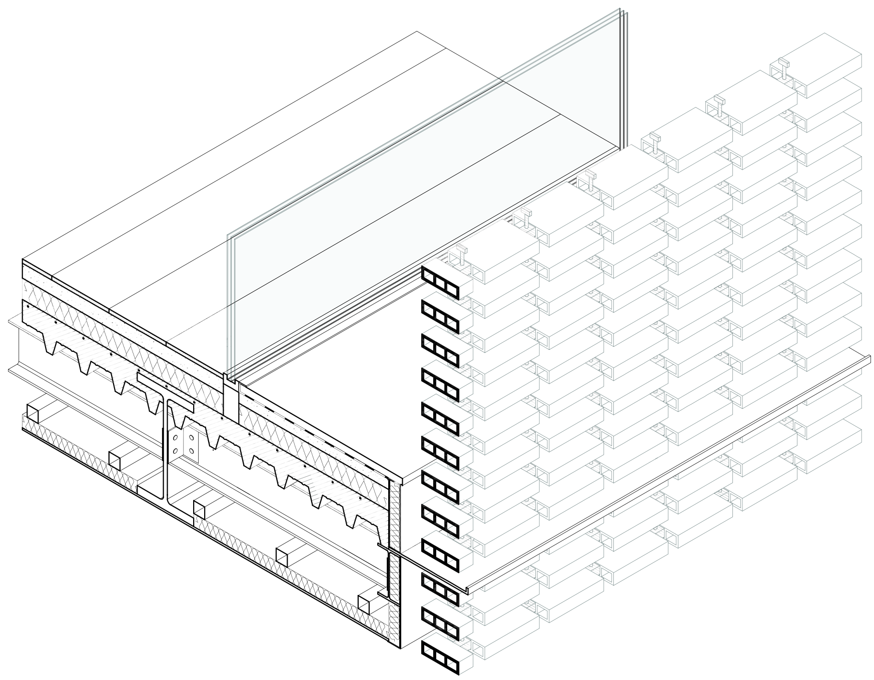
	load kg/m	
Glass facade	275,6	2,70 kn/m

$G_{2.4}$ (Cladding)

	dimensions cm	load kg/m	
Ceramic cladding	30x20x6	488,44	4,79 kn/m

q

	load (kn/mq)
Cat. E1: Areas for accumulation of goods and related access points, such as libraries, archives, warehouses, manufacturing laboratories	6



Axonometry of the inferior slab/facade

3 PREDIMENSIONING

3 PREDIMENSIONING
About the predimensioning of the elements is used the software Strian in order to create a simple static model; after this, through the application of the loads, it is possible to obtain the values of the forces in order to dimension the elements. This operation is made for the main elements of the projects: secondary beams, perimetral beams and vierendeel beams.

3.1 SECONDARY BEAMS
About the loads oh these beams it is important to consider la distance between the beams, which is 1m.
Due to the forces obtained is supposed to use a IPE 240 section.

SECONDARY BEAMS

Typology	Loads			
Dead Load	G_1	0,3	kn/m	
Dead Load	$G_{2.1/2}$	3,78	kn/mq	
Live Load	q	6	kn/mq	
				L=6m
S.L.S	$1{,}3*G_1+1{,}5*G_2+1{,}5*Q_1$	15,06	Kn/m	
U.L.S.	$G_1+G_2+Q_2$	10,08	Kn/m	

Diagram of the shear (S.L.S.)

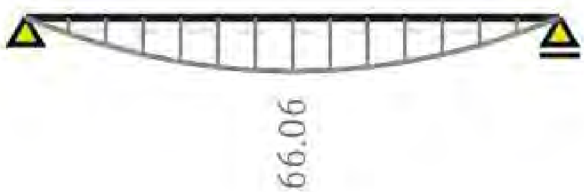


Diagram of the bending (S.L.S.)

1 SECONDARY BEAMS

Section property (IPE 240)

Geometry		u.m.	Static and material		u.m.
h	240	mm	$W_{pl,x}$	366650	mm^3
b	120	mm	f_{yk}	275	N/mm^2
t_w	6,2	mm	γ_{MO}	1,05	
t_f	9,8	mm	J_y	3891,63	cm^4
r	15	mm	J_z	283,63	cm^4
A	3912	mm^2			
A_v	1914,76	mm^2			

U.L.S. forces

		u.m.
V	44400	N
M	66600000	Nmm

Verifications

	$M_{c,Rd}$	96027380,95		
	V_{rd}	289532,3623		
S.L.S	$M_{ed}/M_{c,Rd}$	0,69	<	1
	V_{ed}/V_{rd}	0,15	<	1

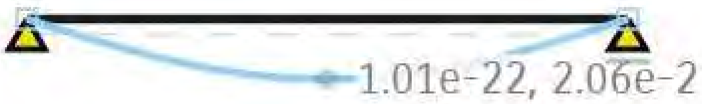


Diagram of vertical displacement (U.L.S.)

Diagram of vertical displacement (U.L.S.q)

3.2 PERIMETRAL BEAMS

The perimetral beams are the ones used to confine the structure and the only load that acts over them is due to the cladding.

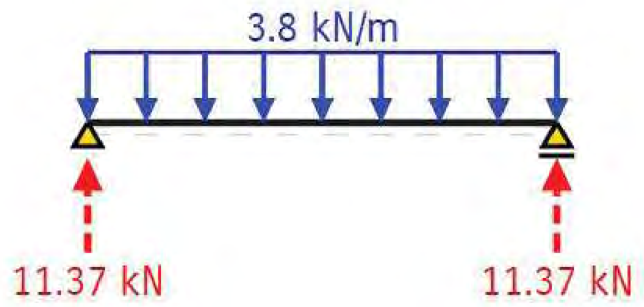
Due to the forces obtained is supposed to use a IPE 240 section.

PERIMETRAL BEAMS

Typology	**Loads**		
Dead Load	G_1	0,3	kn/m
Dead Load	$G_{2.4}$	4,79	kn/m

L=6m

S.L.S	$1,3*G_1+1,5*G_2+1,5*Q_1$	7,57	Kn/m
U.L.S.	$G_1+G_2+Q_2$	5,09	Kn/m



Scheme of the structure

Diagram of the shear (S.L.S.)

2 PERIMETRAL BEAMS

Section property (IPE 240)

Geometry		u.m.	Static and material		u.m.
h	240	mm	$W_{pl,x}$	366650	mm^3
b	120	mm	f_{yk}	275	N/mm^2
t_w	6,2	mm	γ_{MO}	1,05	
t_f	9,8	mm	J_y	3891,63	cm^4
r	15	mm	J_z	283,63	cm^4
A	3912	mm^2			
A_v	1914,76	mm^2			

U.L.S. forces

		u.m.
V	11370	N
M	17050000	Nmm

Verifications

	$M_{c,Rd}$	96027380,95		
	V_{rd}	289532,3623		
S.L.S	$M_{ed}/M_{c,Rd}$	0,18	<	1
	V_{ed}/V_{rd}	0,04	<	1

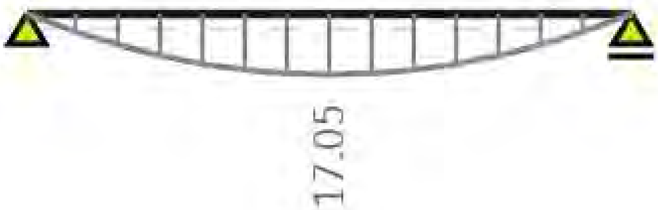


Diagram of the bending (S.L.S.)

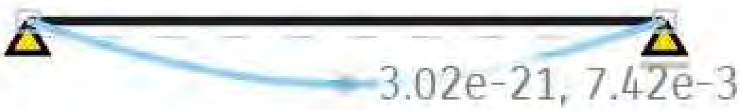
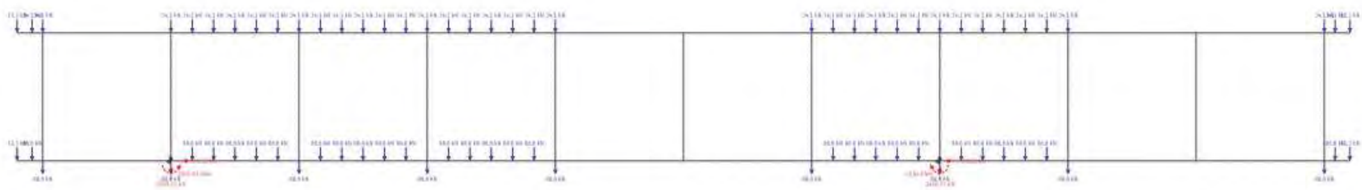


Diagram of vertical displacement (U.L.S.)

3.3 VIERENDEEL BEAMS

The loads that act on the Vierendeel beams are the ones deriving from the secondary beams; for this reason the load in applied as consequence of the analysis made in the point 3.1.
Due to the forces obtained is supposed to use a HEM 550 section for the horizontal elements and a cruciform pillar composed by HEM 550 for the vertical ones.



Scheme of the structure

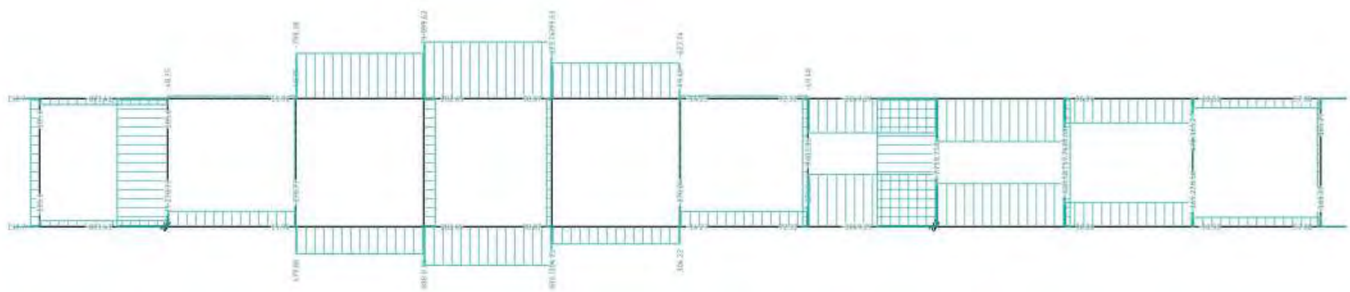


Diagram of the axial forces (S.L.S.)

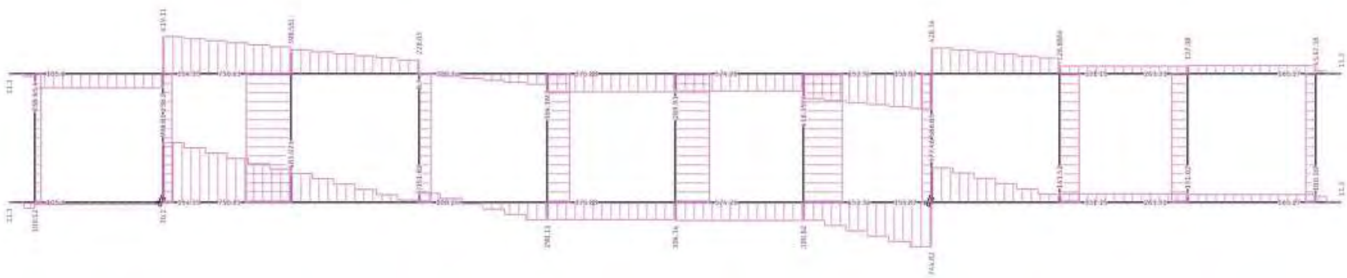


Diagram of the shear (S.L.S.)

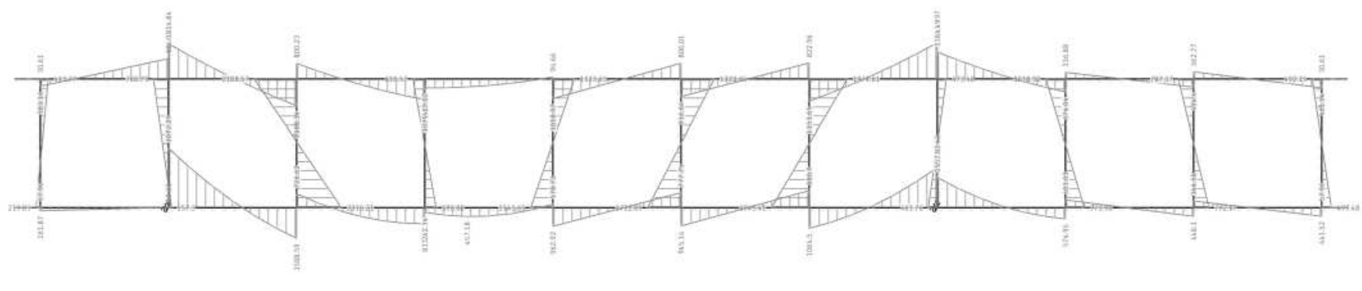


Diagram of the bending (S.L.S.)

3 VIERENDEEL BEAM

HORIZONTAL ELEMENTS

Section property (HEM 550)

Geometry		u.m.	Static and material		u.m.
h	572	mm	$W_{pl,x}$	7993000	mm^3
b	306	mm	f_{yk}	355	N/mm^2
t_w	21	mm	γ_{MO}	1,05	
t_f	40	mm	J_y	198000	cm^4
r	27	mm	J_z	19160	cm^4
A	35440	mm^2			
A_v	13960	mm^2			

U.L.S. forces

		u.m.
V	744920	N
M	2072290000	Nmm
N_-	999662	N
N_+	730850	N

Verifications

$M_{c,Rd}$	2702395238
V_{rd}	2724983,299
$N_{c,Rd}$	11982095,24
$N_{t,Rd}$	11982095,24

S.L.S	$M_{ed}/M_{c,Rd}$	0,77	<	1
	V_{ed}/V_{rd}	0,27	<	1
	$N_{Ed}/N_{c,Rd}$	0,08	<	1
	$N_{Ed}/N_{t,Rd}$	0,06	<	1

VERTICAL ELEMENTS

Section property (cruciform HEM 550)

Geometry		u.m.	Static and material		u.m.
h	572	mm	$W_{pl,x}$	7993000	mm^3
b	306	mm	f_{yk}	355	N/mm^2
t_w	21	mm	γ_{MO}	1,05	
t_f	40	mm	J_y	198000	cm^4
r	27	mm	J_z	19160	cm^4
A	70880	mm^2			
A_v	13960	mm^2			

U.L.S. forces

		u.m.
V	750630	N
M	2188570000	Nmm
N_-	1049000	N
N_+	202650	N

Verifications

$M_{c,Rd}$	2702395238
V_{rd}	2724983,299
$N_{c,Rd}$	23964190,48
$N_{t,Rd}$	23964190,48

S.L.S	$M_{ed}/M_{c,Rd}$	0,81	$<$	1
	V_{ed}/V_{rd}	0,28	$<$	1
	$N_{Ed}/N_{c,Rd}$	0,04	$<$	1
	$N_{Ed}/N_{t,Rd}$	0,01	$<$	1

4 VERIFICATIONS

4.1 SECONDARY BEAMS

1 SECONDARY BEAMS

Section property (IPE 240)

Geometry		u.m.	Static and material		u.m.
h	240	mm	$W_{pl,x}$	366650	mm^3
b	120	mm	f_{yk}	275	N/mm^2
t_w	6,2	mm	γ_{MO}	1,05	
t_f	9,8	mm	J_y	3891,63	cm^4
r	15	mm	J_z	283,63	cm^4
A	3912	mm^2			
A_v	1914,76	mm^2			

U.L.S. forces

		u.m.
V	44400	N
M	66600000	Nmm

S.L.S. vertical displacement

δ_{max}	20,79325189	mm
δ_2	12,38922655	mm

Verifications

$M_{c,Rd}$	96027381	L/250	0,004
V_{rd}	289532,362	L/300	0,0033

S.L.S	$M_{ed}/M_{c,Rd}$	0,69	<	1
	V_{ed}/V_{rd}	0,15	<	1
U.L.S.	δ_{max}/L	0,0035	<	0,004
	δ_2/L	0,0021	<	0,0033

4.2 PERIMETRAL BEAMS

2	PERIMETRAL BEAMS

Section property (IPE 240)

Geometry		u.m.	Static and material		u.m.
h	240	mm	$W_{pl,x}$	366650	mm^3
b	120	mm	f_{yk}	275	N/mm^2
t_w	6,2	mm	γ_{MO}	1,05	
t_f	9,8	mm	J_y	3891,63	cm^4
r	15	mm	J_z	283,63	cm^4
A	3912	mm^2			
A_v	1914,76	mm^2			

U.L.S. forces / **S.L.S. vertical displacement**

		u.m.			
V	189008	N			
M	44210000	Nmm	δ_{max}	5,286069994	mm

Verifications

$M_{c,Rd}$	96027381	L/250	0,004
V_{rd}	289532,362		

S.L.S	$M_{ed}/M_{c,Rd}$	0,46	<	1
	V_{ed}/V_{rd}	0,65	<	1
U.L.S.	δ_{max}/L	0,0009	<	0,004

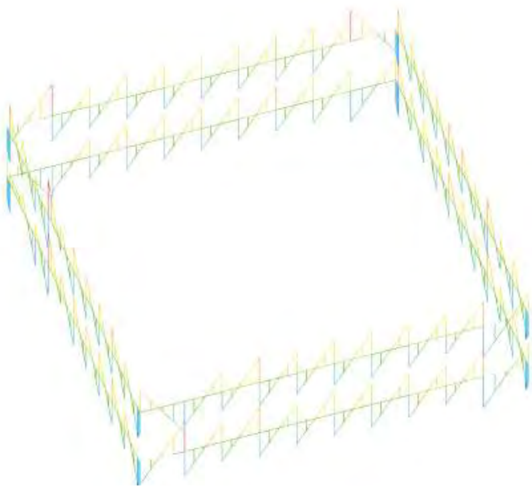
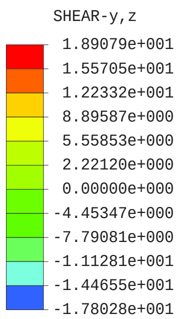



Diagram of the shear (S.L.S.), u.m. KN

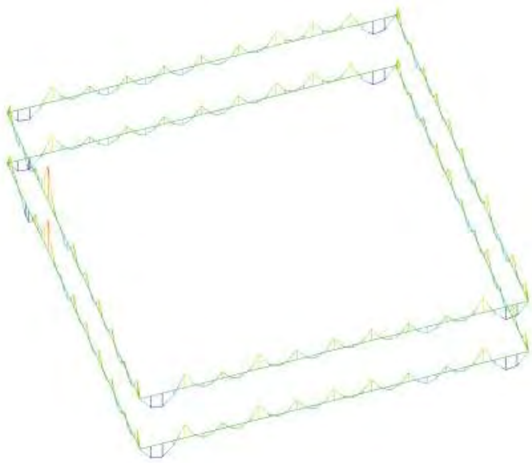
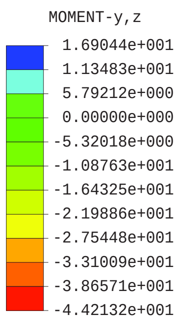



Diagram of the bending (S.L.S.), u.m. KNm

4.3 VIERENDEEL BEAMS

4.3.1 Horizontal elements

3 VIERENDEEL BEAM

HORIZONTAL ELEMENTS

Section property (HEM 550)

Geometry		u.m.	Static and material		u.m.
h	572	mm	$W_{pl,x}$	7993000	mm^3
b	306	mm	f_{yk}	355	N/mm^2
t_w	21	mm	γ_{MO}	1,05	
t_f	40	mm	J_y	198000	cm^4
r	27	mm	J_z	19160	cm^4
A	35440	mm^2	i_y	23,64	cm
A_v	13960	mm^2	i_z	7,35	cm
l	600	cm	l_0	300	cm

U.L.S. forces

		u.m.
V	1189800	N
M	2674700000	Nmm
N_-	2551470	N
N_+	2827020	N

Verifications

$M_{c,Rd}$	2702395238	
V_{rd}	2724983,3	
$N_{c,Rd}$	11982095,2	
$N_{t,Rd}$	11982095,2	

S.L.S	$M_{ed}/M_{c,Rd}$	0,99	<	1
	V_{ed}/V_{rd}	0,44	<	1
	$N_{Ed}/N_{c,Rd}$	0,21	<	1
	$N_{Ed}/N_{t,Rd}$	0,24	<	1

$N_{b,Rd}$	11813350,46	N		
χ	0,99		<	1
Φ	0,52			
$\bar{\lambda}$	0,17			
α	0,21	curve a		
N_{cr}	455643038,2	N		
λ	12,69		<	200
$N_-/N_{b,Rd}$	0,22		<	1

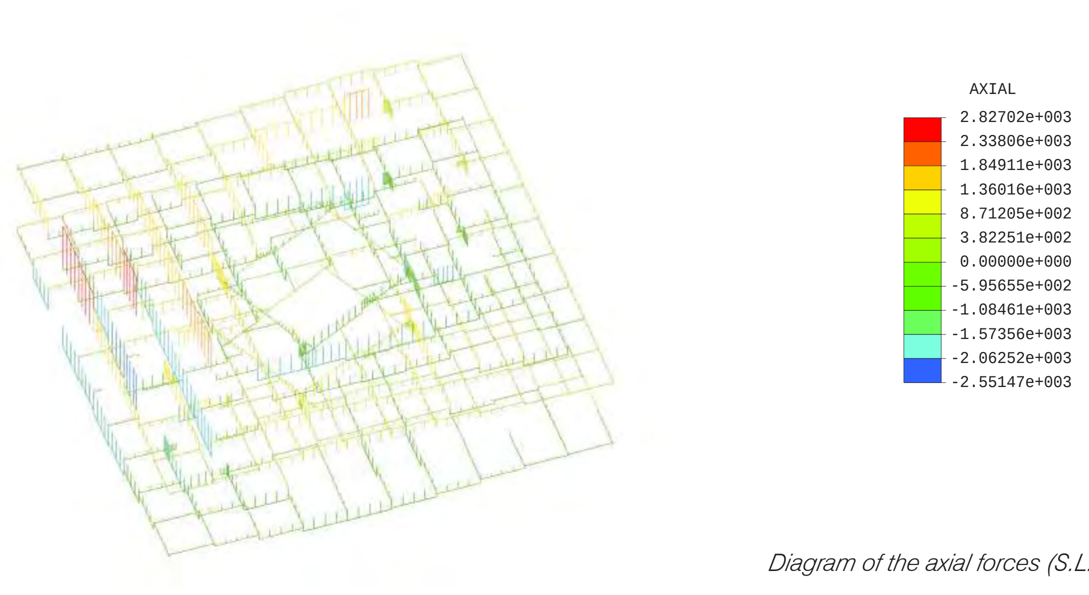


Diagram of the axial forces (S.L.S.), u.m. KN

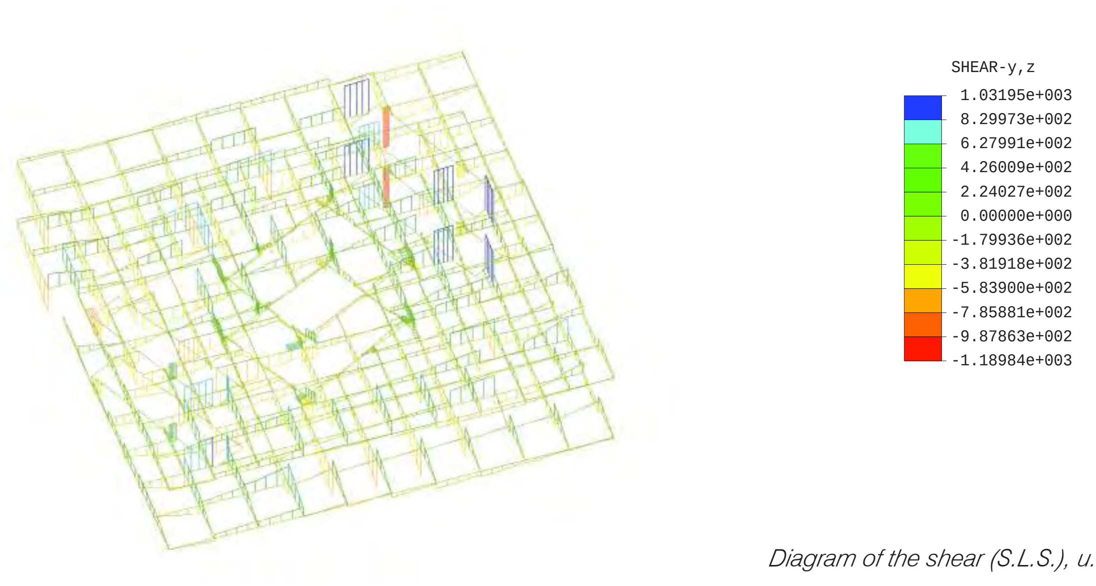


Diagram of the shear (S.L.S.), u.m. KN

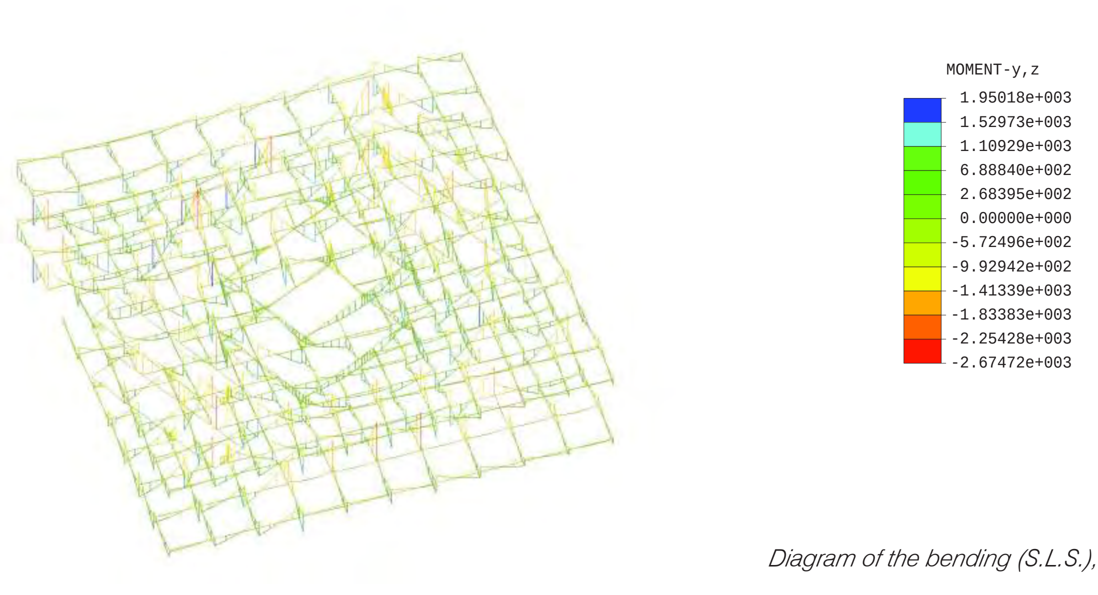


Diagram of the bending (S.L.S.), u.m. KNm

4.3.2 Vertical elements

VERTICAL ELEMENTS

Section property (cruciform HEM 550)

Geometry		u.m.	Static and material		u.m.
h	572	mm	$W_{pl,x}$	7993000	mm^3
b	306	mm	f_{yk}	355	N/mm^2
t_w	21	mm	γ_{MO}	1,05	
t_f	40	mm	J_y	198000	cm^4
r	27	mm	J_z	19160	cm^4
A	70880	mm^2	i_y	16,71	cm
A_v	13960	mm^2	i_z	5,20	cm
l	600	cm	l_0	300	cm

U.L.S. forces

		u.m.
V	812802	N
M	2449400000	Nmm
N_-	3025370	N
N_+	337548	N

Verifications

$M_{c,Rd}$	2702395238	
V_{rd}	2724983,3	
$N_{c,Rd}$	23964190,5	
$N_{t,Rd}$	23964190,5	

S.L.S	$M_{ed}/M_{c,Rd}$	0,91	<	1
	V_{ed}/V_{rd}	0,30	<	1
	$N_{Ed}/N_{c,Rd}$	0,13	<	1
	$N_{Ed}/N_{t,Rd}$	0,01	<	1

$N_{b,Rd}$	23267027,45 N		
χ	0,97	<	1
Φ	0,54		
$\bar{\lambda}$	0,24		
α	0,21 curve a		
N_{cr}	455513520 N		
λ	17,95	<	200
$N_-/N_{b,Rd}$	0,13	<	1

Diagram of the axial forces (S.L.S.), u.m. KN

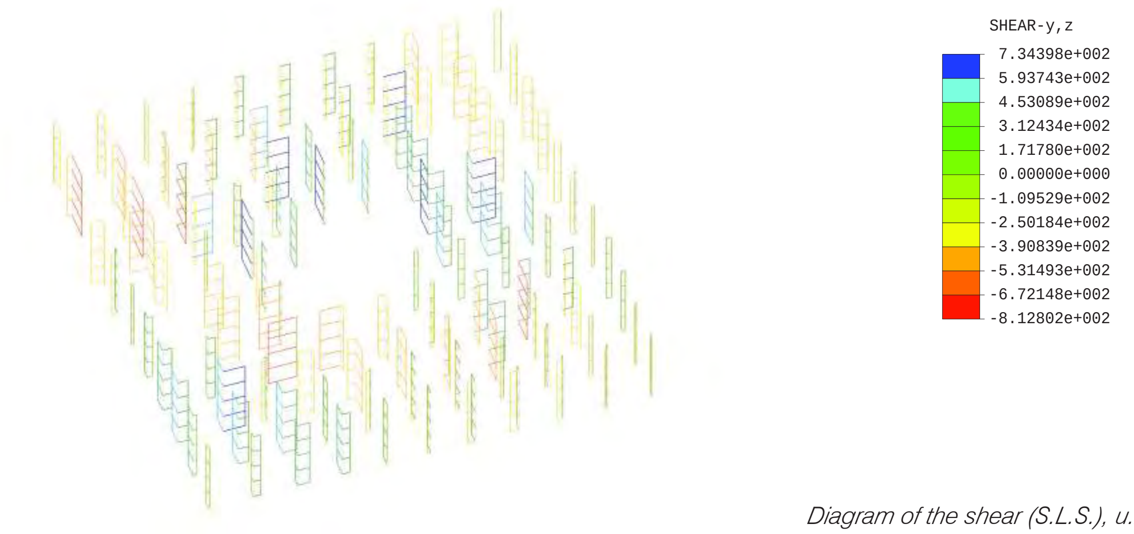


Diagram of the shear (S.L.S.), u.m. KN

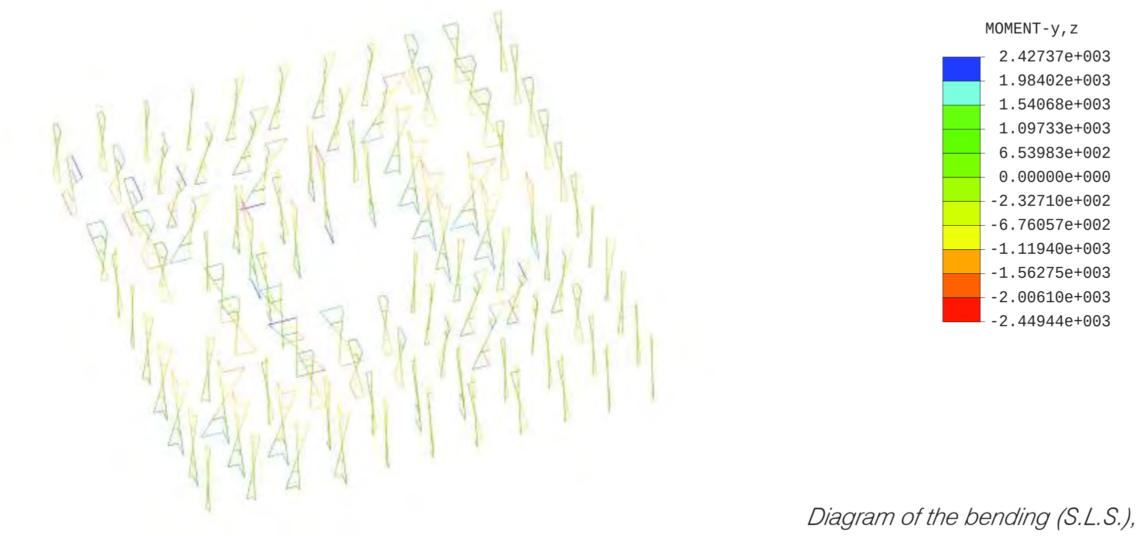


Diagram of the bending (S.L.S.), u.m. KNm

4.4 REINFORCED BEAMS

4.4.1 Horizontal reinforced elements

4 REINFORCED ELEMENTS

HORIZONTAL ELEMENTS

Section property (HEM 550)

Geometry		u.m.	Static and material		u.m.
h	572	mm	$W_{pl,x}$	12202797,2	mm^3
b	306	mm	f_{yk}	355	N/mm^2
t_w	21	mm	γ_{MO}	1,05	
t_f	80	mm	J_y	349000	cm^4
r	27	mm	J_z	31300	cm^4
A	59920	mm^2	i_y	23,64	cm
A_v	13960	mm^2	i_z	7,35	cm
l	600	cm	l_0	300	cm

U.L.S. forces

		u.m.
V	933877	N
M	3424300000	Nmm
N_-	1661230	N
N_+	1632460	N

Verifications

					$N_{b,Rd}$	19973362,29 N		
	$M_{c,Rd}$	4125707626			χ	0,99	<	1
	V_{rd}	2724983,3			Φ	0,52		
	$N_{c,Rd}$	20258666,7			$\overline{\lambda}$	0,17		
	$N_{t,Rd}$	20258666,7			α	0,21 curve a		
					N_{cr}	770376152,7 N		
S.L.S	$M_{ed}/M_{c,Rd}$	0,83	<	1	λ	12,69	<	200
	V_{ed}/V_{rd}	0,34	<	1				
	$N_{Ed}/N_{c,Rd}$	0,08	<	1	$N_-/N_{b,Rd}$	0,08	<	1
	$N_{Ed}/N_{t,Rd}$	0,08	<	1				

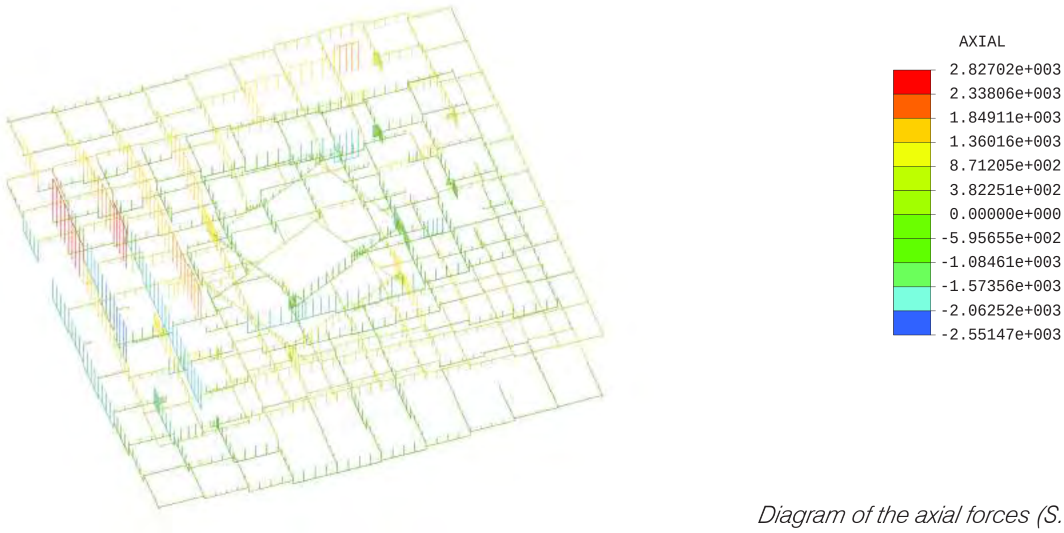


Diagram of the axial forces (S.L.S.), u.m. KN

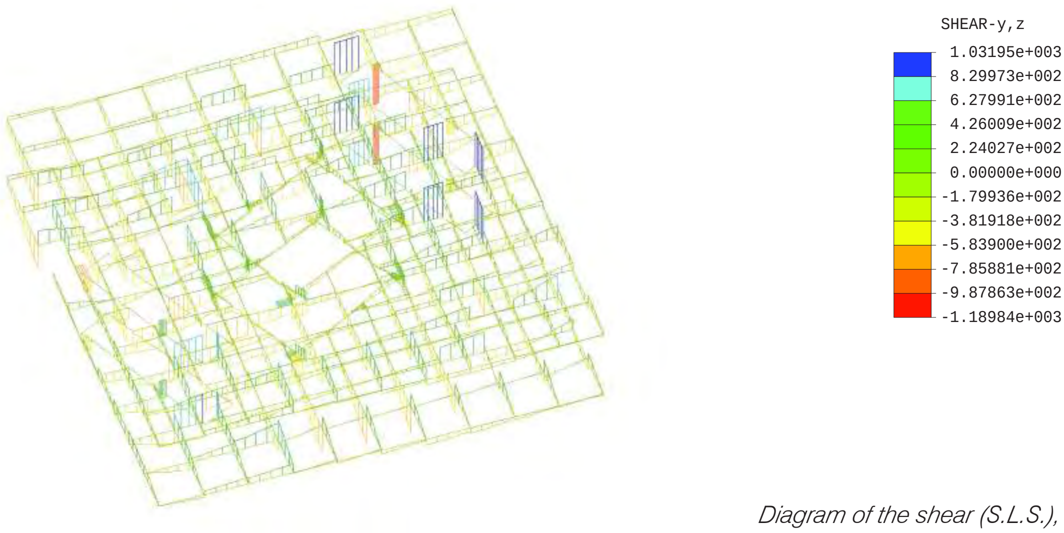


Diagram of the shear (S.L.S.), u.m. KN

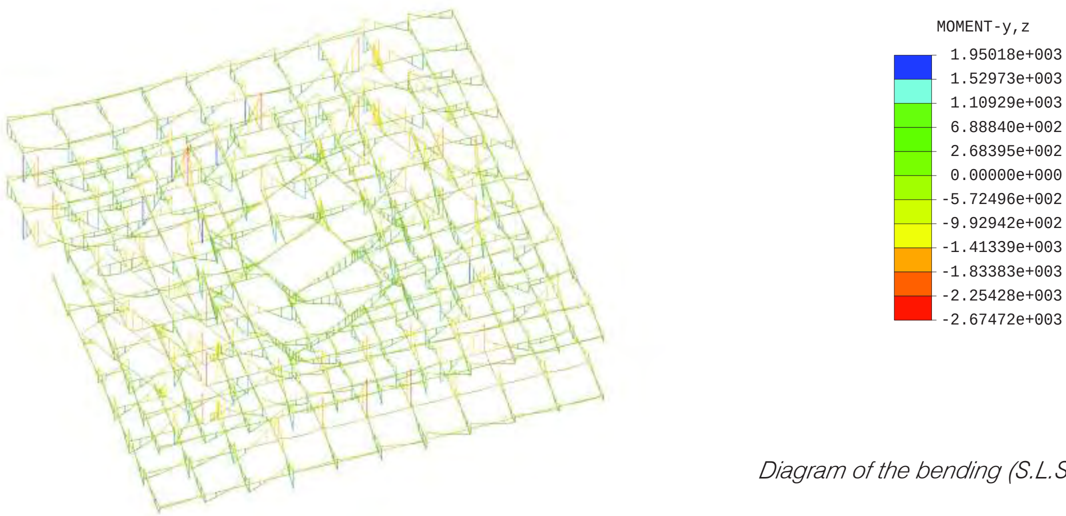


Diagram of the bending (S.L.S.), u.m. KNm

4.3.2 Vertical elements

VERTICAL ELEMENTS

Section property (cruciform HEM 550)

Geometry		u.m.	Static and material		u.m.
h	572	mm	$W_{pl,x}$	7993000	mm^3
b	306	mm	f_{yk}	355	N/mm^2
t_w	21	mm	γ_{MO}	1,05	
t_f	40	mm	J_y	198000	cm^4
r	27	mm	J_z	19160	cm^4
A	70880	mm^2	i_y	16,71	cm
A_v	13960	mm^2	i_z	5,20	cm
l	600	cm	l_0	300	cm

U.L.S. forces

		u.m.
V	812802	N
M	2449400000	Nmm
N_-	3025370	N
N_+	337548	N

Verifications

					$N_{b,Rd}$	23267027,45	N		
	$M_{c,Rd}$	2702395238			χ	0,97		<	1
	V_{rd}	2724983,3			Φ	0,54			
	$N_{c,Rd}$	23964190,5			$\bar{\lambda}$	0,24			
	$N_{t,Rd}$	23964190,5			α	0,21	curve a		
					N_{cr}	455513520	N		
S.L.S	$M_{ed}/M_{c,Rd}$	0,91	<	1	λ	17,95		<	200
	V_{ed}/V_{rd}	0,30	<	1					
	$N_{Ed}/N_{c,Rd}$	0,13	<	1	$N_-/N_{b,Rd}$	0,13		<	1
	$N_{Ed}/N_{t,Rd}$	0,01	<	1					

Diagram of the axial forces (S.L.S.), u.m. KN

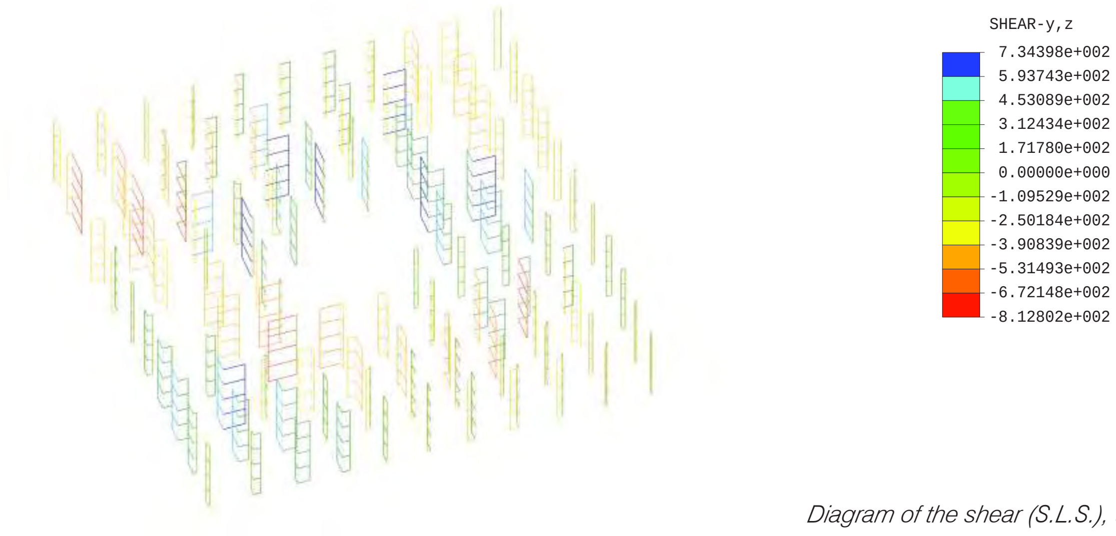


Diagram of the shear (S.L.S.), u.m. KN

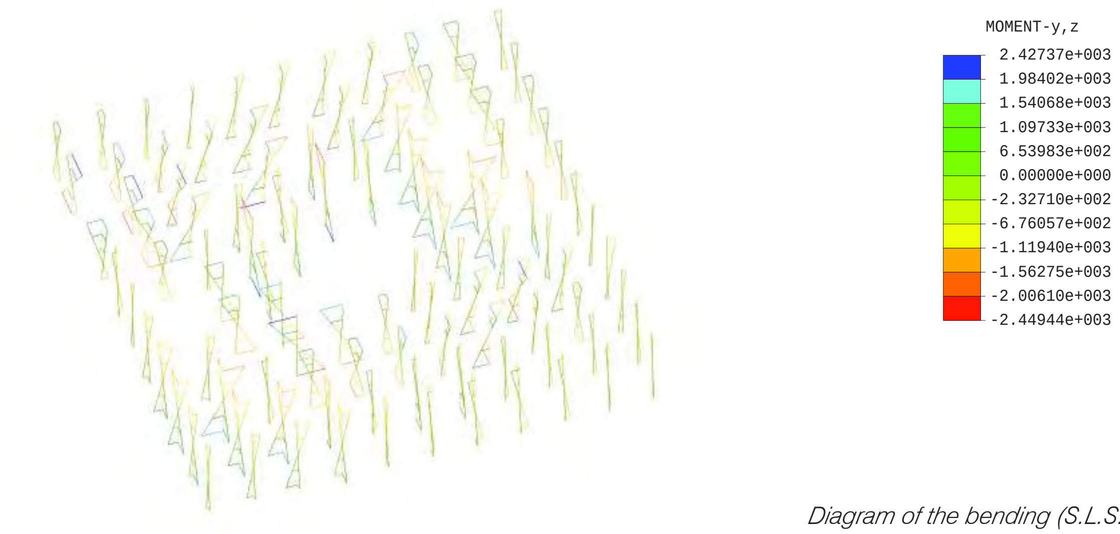


Diagram of the bending (S.L.S.), u.m. KNm

4.4 REINFORCED BEAMS

4.4.1 Horizontal reinforced elements

	4	**REINFORCED ELEMENTS**				

HORIZONTAL ELEMENTS

Section property (HEM 550)

Geometry		u.m.	Static and material		u.m.
h	572	mm	$W_{pl,x}$	12202797,2	mm^3
b	306	mm	f_{yk}	355	N/mm^2
t_w	21	mm	γ_{MO}	1,05	
t_f	80	mm	J_y	349000	cm^4
r	27	mm	J_z	31300	cm^4
A	59920	mm^2	i_y	23,64	cm
A_v	13960	mm^2	i_z	7,35	cm
l	600	cm	l_0	300	cm

U.L.S. forces

		u.m.
V	933877	N
M	3424300000	Nmm
N_-	1661230	N
N_+	1632460	N

Verifications

					$N_{b,Rd}$	19973362,29 N		
	$M_{c,Rd}$	4125707626			χ	0,99	<	1
	V_{rd}	2724983,3			Φ	0,52		
	$N_{c,Rd}$	20258666,7			$\overline{\lambda}$	0,17		
	$N_{t,Rd}$	20258666,7			α	0,21 curve a		
					N_{cr}	770376152,7 N		
S.L.S	$M_{ed}/M_{c,Rd}$	0,83	<	1	λ	12,69	<	200
	V_{ed}/V_{rd}	0,34	<	1				
	$N_{Ed}/N_{c,Rd}$	0,08	<	1	$N_-/N_{b,Rd}$	0,08	<	1
	$N_{Ed}/N_{t,Rd}$	0,08	<	1				

Diagram of the axial forces (S.L.S.), u.m. KN

Diagram of the shear (S.L.S.), u.m. KN

Diagram of the bending (S.L.S.), u.m. KNm

4.4.2 Vertical reinforced elements

VERTICAL ELEMENTS

Section property (cruciform HEM 550)

Geometry		u.m.	Static and material		u.m.
h	572	mm	$W_{pl,x}$	12202797,2	mm^3
b	306	mm	f_{yk}	355	N/mm^2
t_w	21	mm	γ_{MO}	1,05	
t_f	40	mm	J_y	349000	cm^4
r	27	mm	J_z	31300	cm^4
A	95360	mm^2	i_y	23,64	cm
A_v	13960	mm^2	i_z	7,35	cm
l	600	cm	l_0	300	cm

U.L.S. forces

		u.m.
V	1585100	N
M	3424260000	Nmm
N_-	1661230	N
N_+	1632460	N

Verifications

$M_{c,Rd}$	4125707626		
V_{rd}	2724983,3		
$N_{c,Rd}$	32240761,9		
$N_{t,Rd}$	32240761,9		
S.L.S			
$M_{ed}/M_{c,Rd}$	0,83	<	1
V_{ed}/V_{rd}	0,58	<	1
$N_{Ed}/N_{c,Rd}$	0,05	<	1
$N_{Ed}/N_{t,Rd}$	0,05	<	1

$N_{b,Rd}$	31786712,76 N		
χ	0,99	<	1
Φ	0,52		
$\bar{\lambda}$	0,17		
α	0,21 curve a		
N_{cr}	1226019191 N		
λ	12,69	<	200
$N_-/N_{b,Rd}$	0,05	<	1

Diagram of the axial forces (S.L.S.), u.m. KN

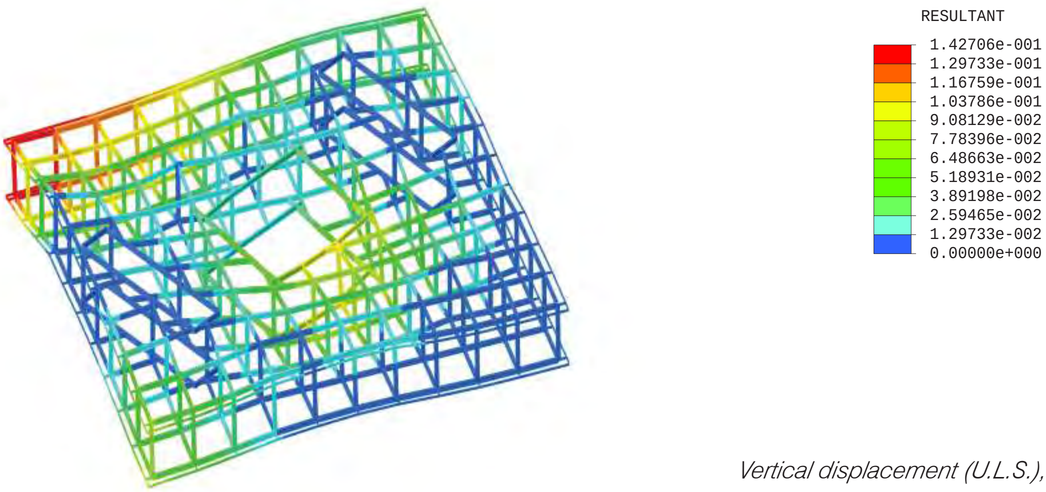
Diagram of the shear (S.L.S.), u.m. KN

Diagram of the bending (S.L.S.), u.m. KNm

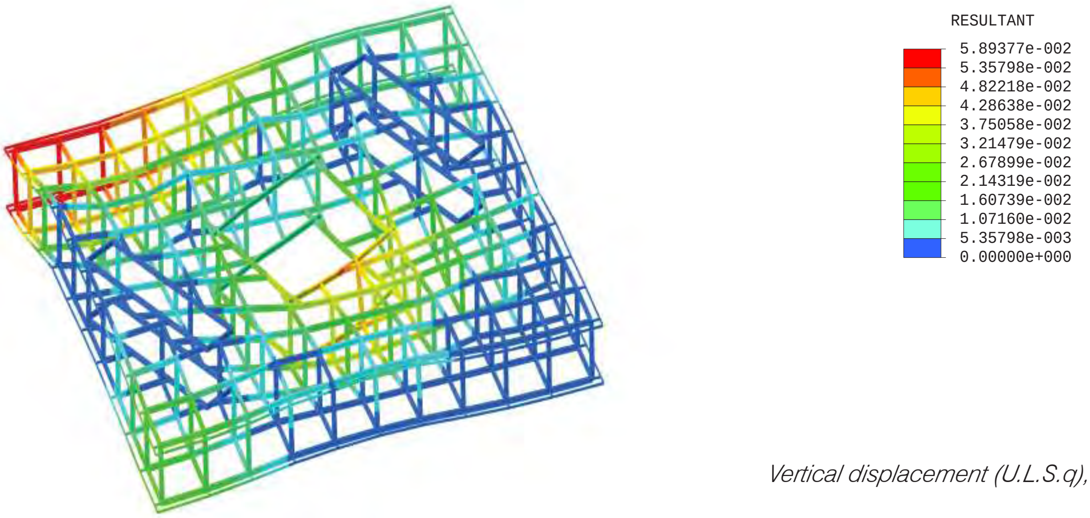
4.5 VERTICAL DISPLACEMENT (U.L.S.)

S.L.S. vertical displacement

		u.m.				u.m.	
$\delta_{max,1}$	142,7	mm	<	$2L_1/250$	152	mm	L_1=19m
$\delta_{2,1}$	58,9	mm	<	$2L_1/300$	126,67	mm	
$\delta_{max,2}$	100	mm	<	$2L_2/250$	136	mm	L_2=17m
$\delta_{2,2}$	49	mm	<	$2L_2/300$	113,33	mm	



Vertical displacement (U.L.S.), u.m. cm



Vertical displacement (U.L.S.q), u.m. cm

3 INNOVATIVE MATERIALS FOR ARCHITECTURE

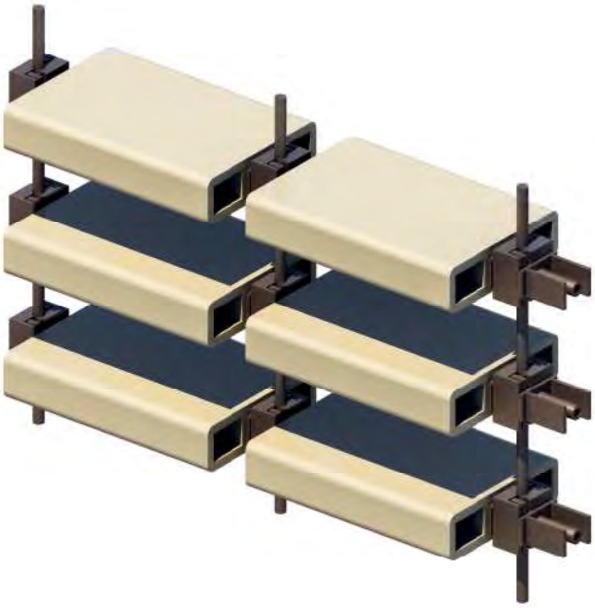
1 SYRIAN CERAMIC

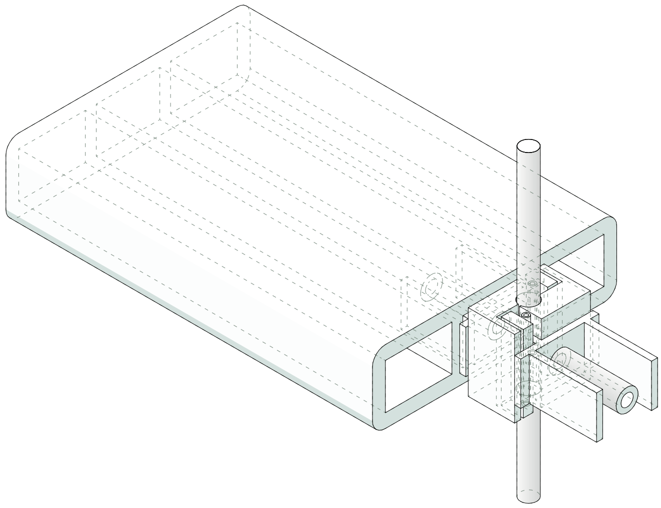
Ceramic details intein Zeynab mosque in Damascus

Ceramic pottery 11th century, “Biconical bowl”, METmuseum

According to archaeological discoveries in northern Syria, handmade pottery and ceramics date back to as early the fifth millennium BC. Ceramic has always been used not only in pottery and house stuffs, bur even for facade detailing and and many other little urban furniture. In this sense the discovery of this kind of material has been for us the strating point of our material detailing and technology solution.

2 FACADE TECHNOLOGY





Due to the reflective proerties of the material, simulated in the luminance simulator Velux, we chose the traditional ceramic material as the shading for our facade. Following the idea of having a facade as a filter for interior lightening wh studied a structure in which the ceramic tiles are separated and suspended by a steel cable structure linked to our facade.

1. The cable structure provides to substain and keep together the ceramic tiles. With a diameter of 6 mm it's able to host the cores which are the junctions to the ceramic tiles hookings. It his necessary for the distances between the ceramic tiles. In this sense, they make possible the lighting of the building.

2. The ceramic tile is something very important belonging to the material aspect of the building. They provide both the shadingand and the lighting; the massiveness and light aspect. In the approach of the facade design they express the shape of a stone but in the meanwhile they permit the enlightening of the interior space due to the reflective propriety of every single tile.

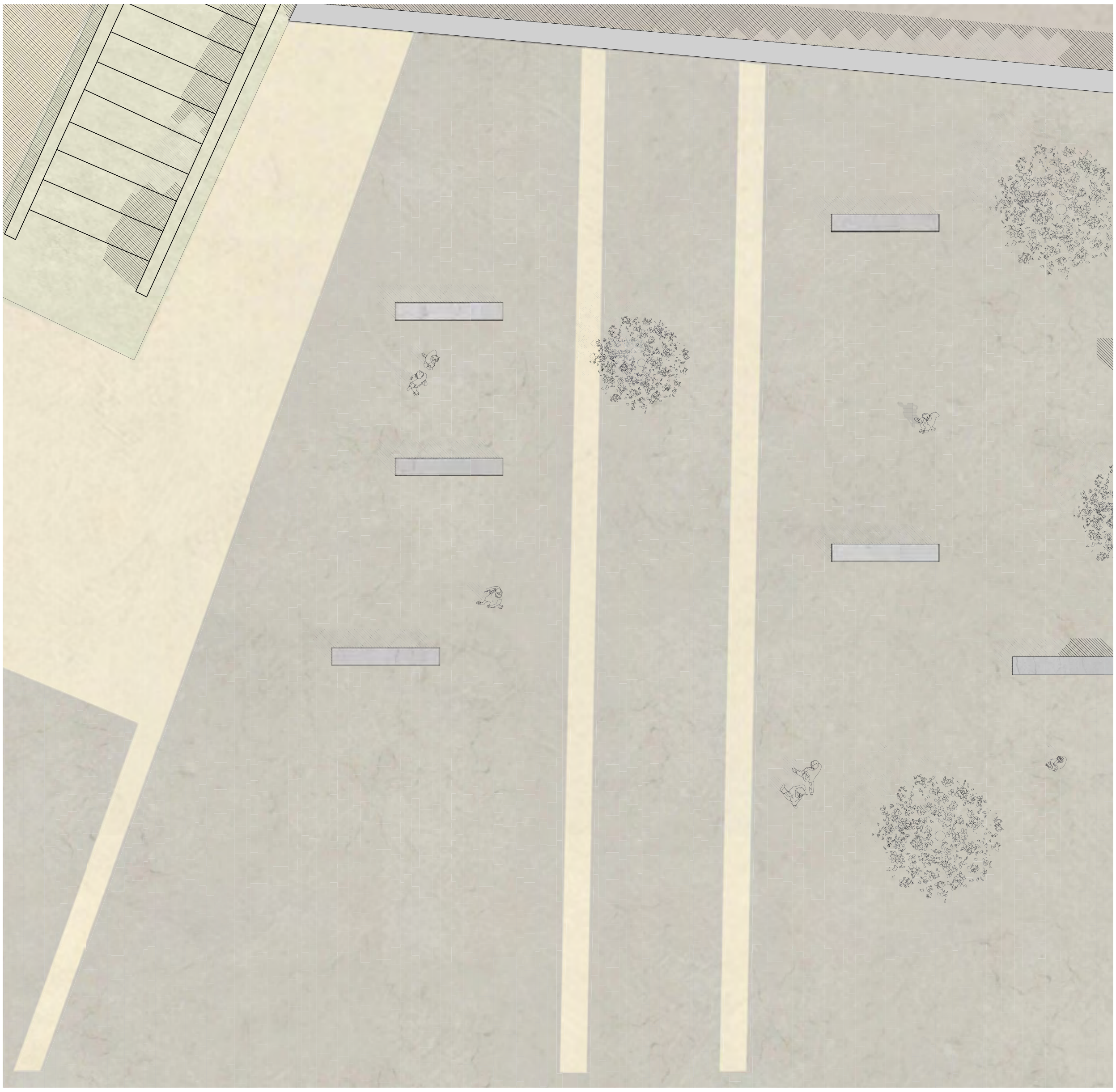
3. The core is welded to the central cable, It's the main linking between the structural cable and the rest of the support-tile structure. It host the hole to fix the linear support and provide to fasten it.

4. The junction part provide to keep together the main hooking, dealing to the structural cable, to the adapter of the single tile.

5. The adapter is the device which provide to enlarge the section of the linear support to make it perfectly fit inside the hole of the ceramic tile.

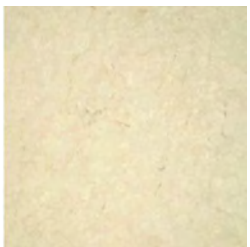
6. The linear support fit perfectly into the provided spot in the core and it provides to fasten the adapter between him and the core.

3 OUTDOOR MATERIALS



2.

2.



3.

4.

1 Rubble

In the context of our design it has been very important for us to describe the ruin of the ancient Madrasa al-Sultaniyya and to preserve it as the center of our design process. But in a heavly damaged place like the historical center of the city of Aleppo other opportunities come out from the rest of the city.

2. Recycled concrete

The leavings of the five years bombing period made this part of the city a rubble deposit. A place in which it's not possible to restore and re-build houses because of the heavy damages. In this sense the "waste" produced from the remaining houses can be used to have another life useful in restoration process, they can be aggregates for the concrete of the new buildings.

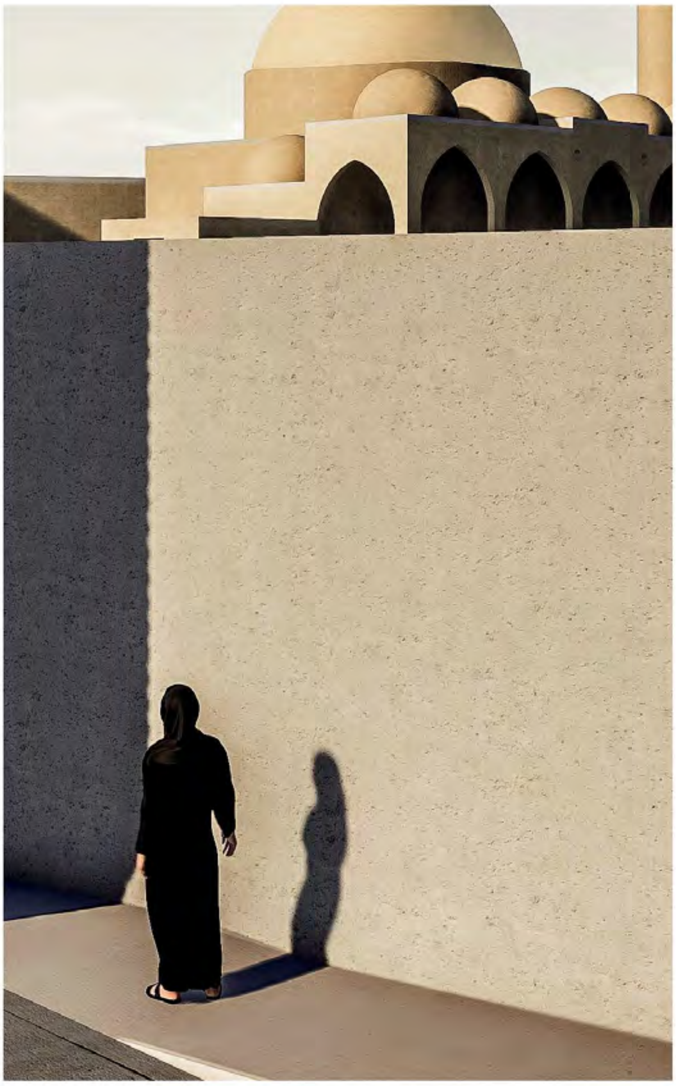
3. Syrian beige limestone

'Assyr' beige limestone is introduced following the pre-existing project made for the square by Aga Khan. The different chromatic aspect of this linear element provide to create optical axes from the outer part of the 'ring' around the Citadel to the focal center of the entrace tower.

4. Syrian white limestone

'Atlantis' white limestone is the material choosen for the public square. A sandblasting process can give to every tile the surface roughness that can relate the "new stone" to the ones of the existing buildings. In this sense a new material can become, at leat for the user eyes, part of something already existing and perfectly integrated in the context.

3 RECYCLED AGGREGATE AND CONCRETE

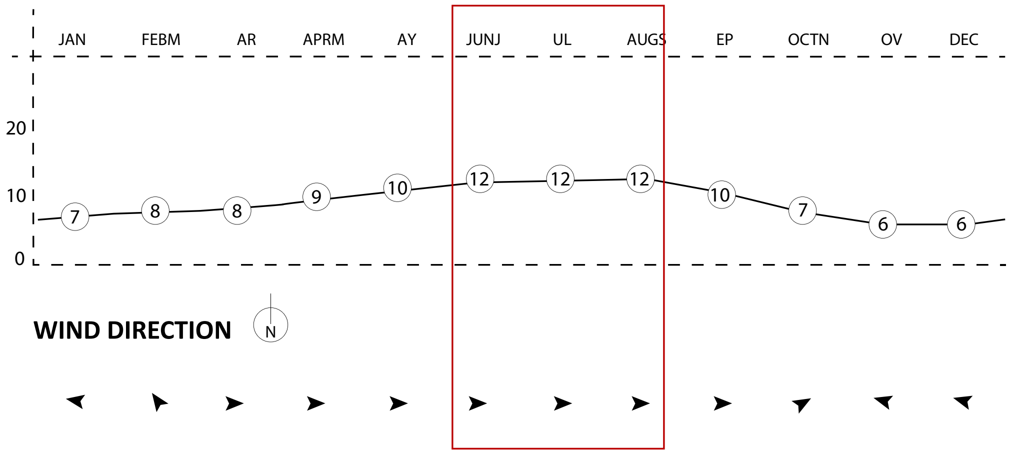


Recycled concrete aggregates are produced in stationary recycling plants similar to those used for natural crushed aggregate production. Processing usually includes two-stage crushing (primary with jaw crushers and secondary with impact crushers), removing the contaminants and screening. After primary crushing, the residual reinforcement is removed by large electromagnets. All types of contaminants, such as dirt, plaster, gypsum and other building waste must be carefully removed by water cleaning or air sifting. RCA can also be processed in mobile recycling plants. They are typically used for demolition sites with large amount of homogeneous waste which is going to be reused on site (rebuilding of roads and highways, large industrial facilities). In mobile recycling plants, processing is limited to one-stage crushing, magnetic separation and screening.
In Aleppo due to the recent bombing war all of the surrounding context has been destryed and turned into ruin. In this situation it come out the opportunity to use the grabble in a percentage until the 23% as aggregate recycled concrete for the production of new concrete. The new city will be build from his ashes.

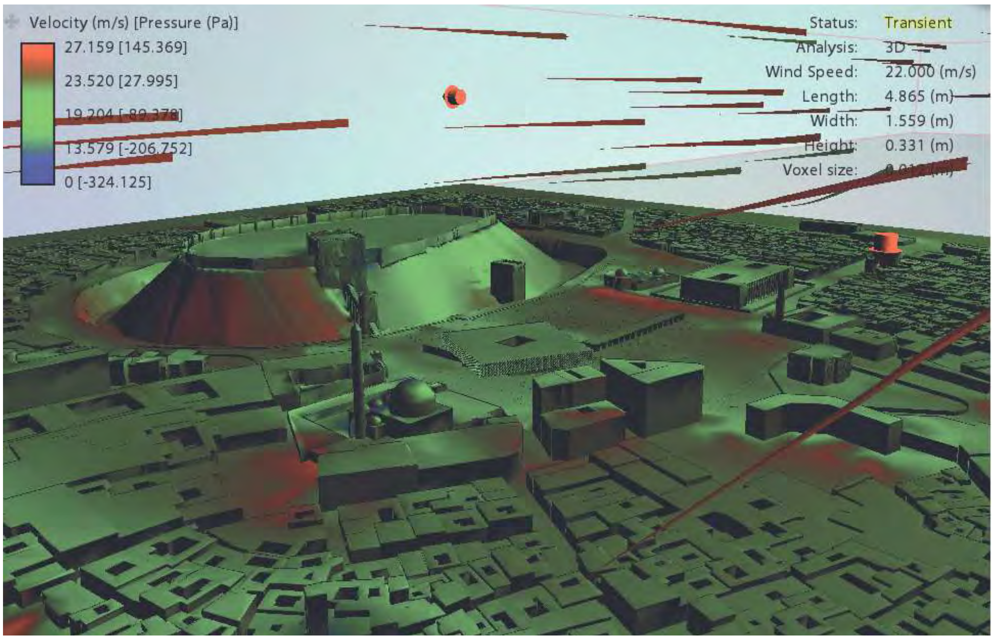
4 TECHNOLOGY AND DESIGN IN BIM ENVIRONMENT

1 AUTODESK FLOW DESIGN

MAXIMUM WIND FLOW SPEED (KTS)



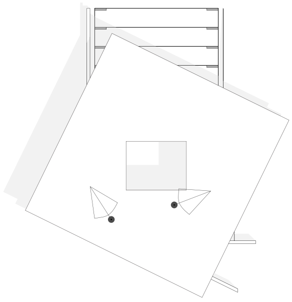
LIMIT CONDITION ANALYZED WITH AUTODESK FLOW DESIGN:
Month= July
Wind speed = 22 m/s (12kts)
Direction : W

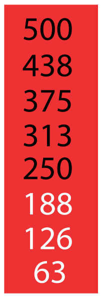


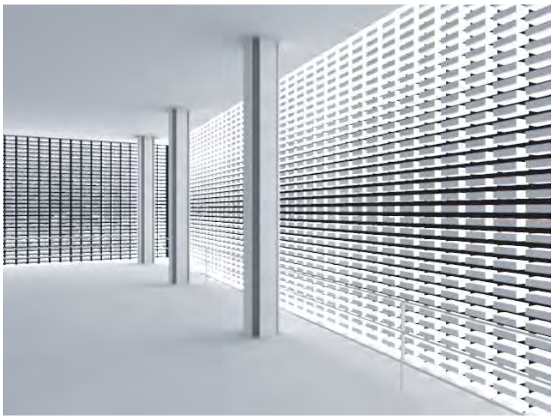
The Autodesk Flow deign software per mitted us to check the horizontal loads due to the wind action on the surface of our facade. In this way we confirmed that because of the context buil-ding s that have the same height of our building, the wind flow has a very reduced impacton our facade. To check thisload we analyzed the wors wind situation following the climate data as seen in the upper picture.

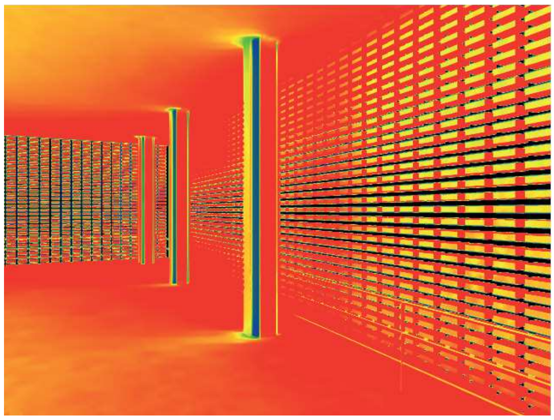
2 VELUX

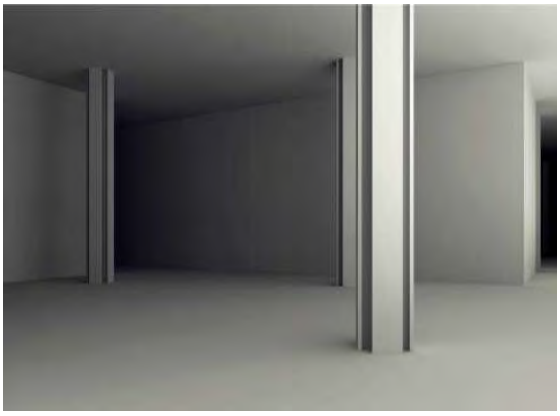
LIGHTING LUMINANCE ANALYSIS WITH VELUX SOFTWARE
21of September h:12.30

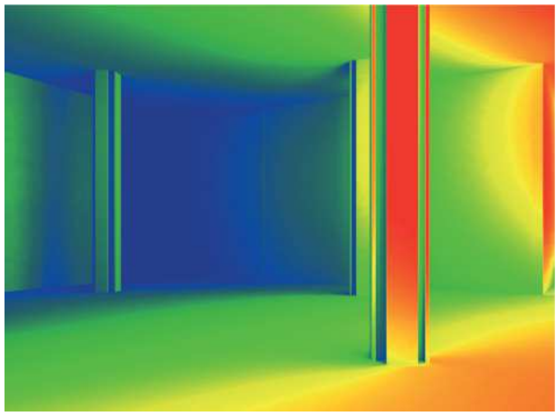










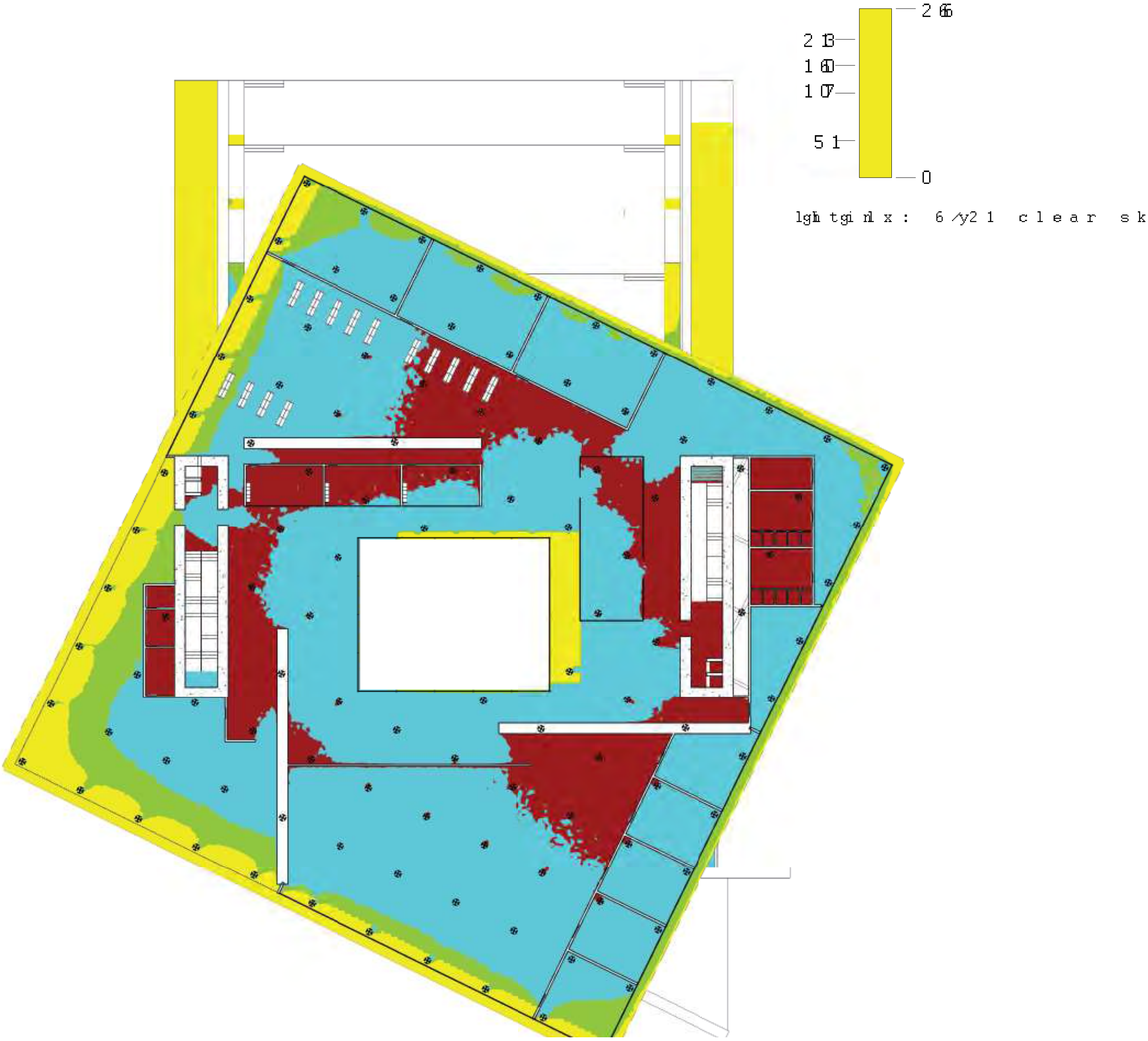


Velux lighting simulation software permitted us to prove the efficiency of our design and material choices. The idea to express massiveness with a facade that also had to permit the lighting of the interior space was not that easy. During our work we simulated various proposal of density for the pattern facade (studied with Grasshopper script on Rhino) and then we processed the obtained proposal into this simulation software.

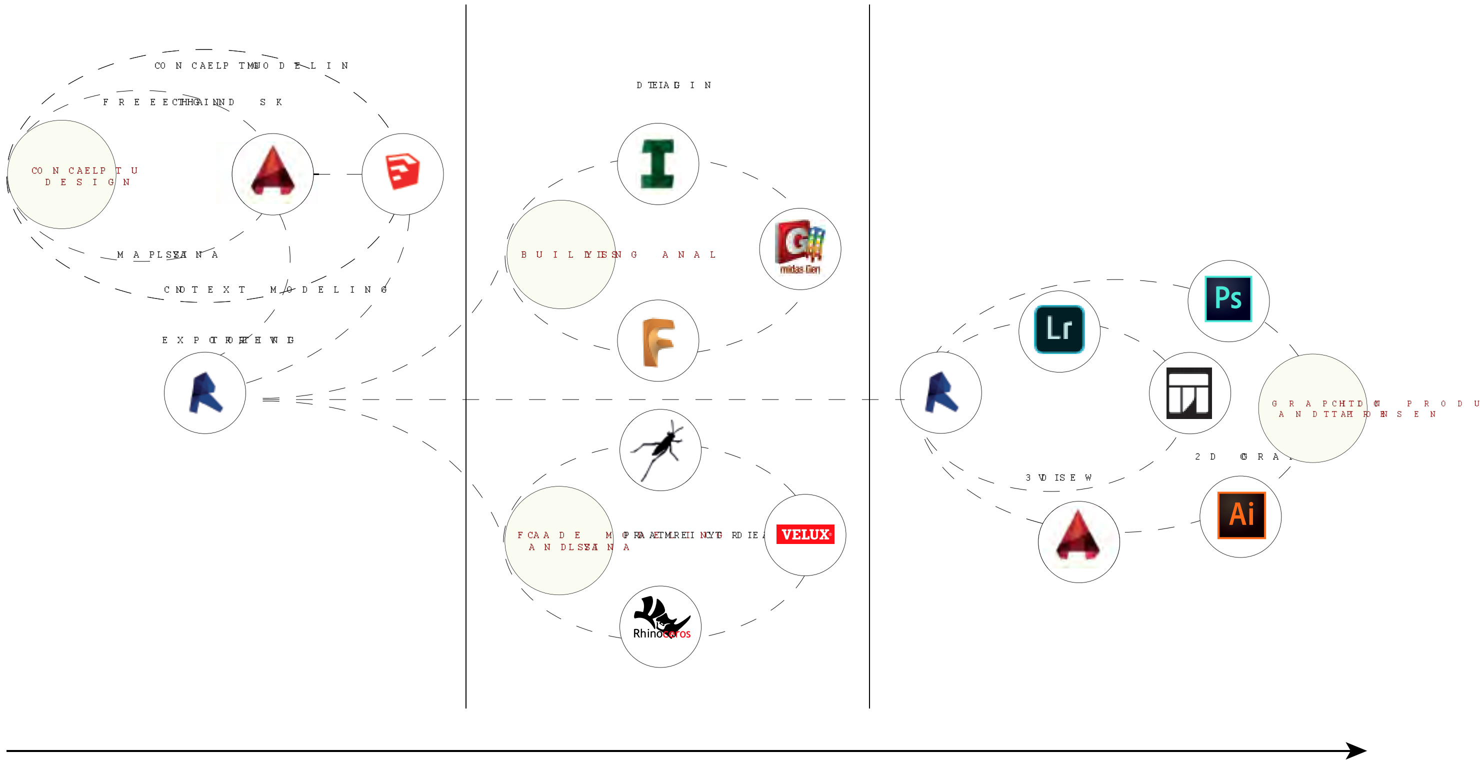
Clearly from the simulation we discovered how the material choice of the ceramic could reach the right lighting effect for the interior space. As it's seen in the upper picture, even the back of the ceramic tile is lighted because of the reflectivity of the material.
Then we discovered how the interior cirrculation between the courtyard glass and the exterior facade was darker than the outer parts. But it was still acceptable because of the use of this kind of circulation spots.

3 AUTODESK INSIGHTS

SOLAR ILLUMINANCE ANALYSIS WITH AUTODESK INSIGHTS



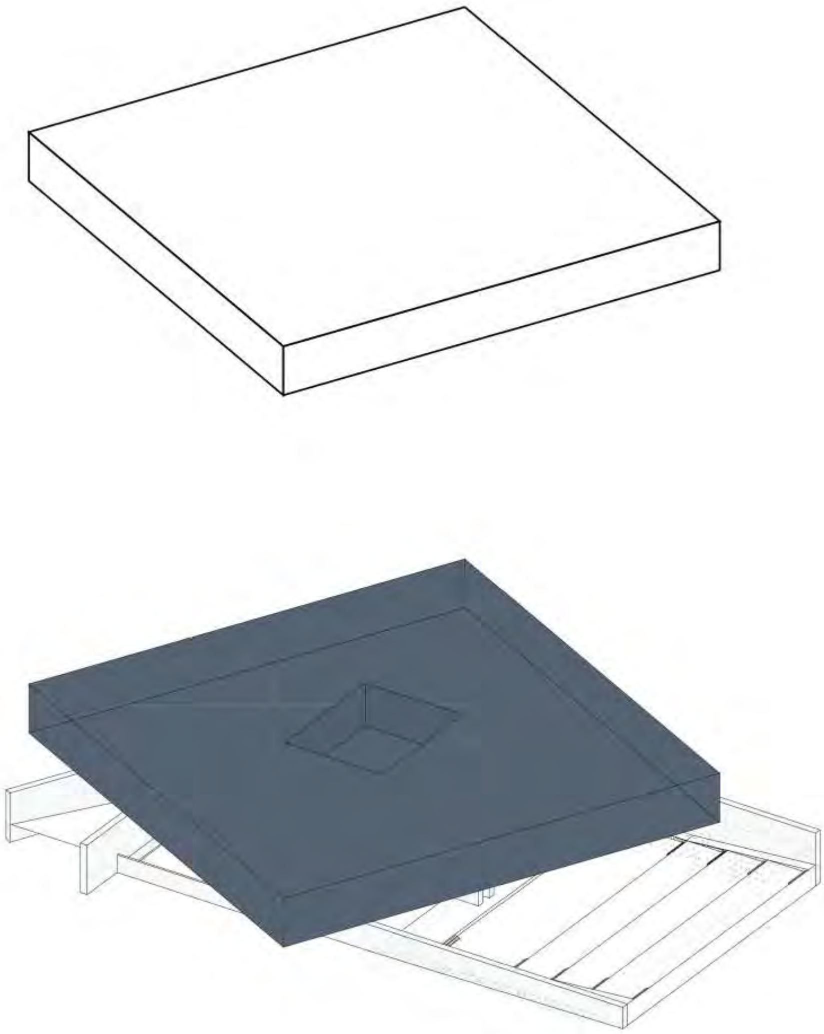
Using Autodesk Insights software we have been able to measure the illuminance of the building. In this way after measuring the human perception of the light with velux we could critically analyze the spread of the light inside our building. Though illuminance describes the measurement of the amount of light falling onto (illuminating) and spreading over a given surface area.



5 BUILDING SERVICES DESIGN

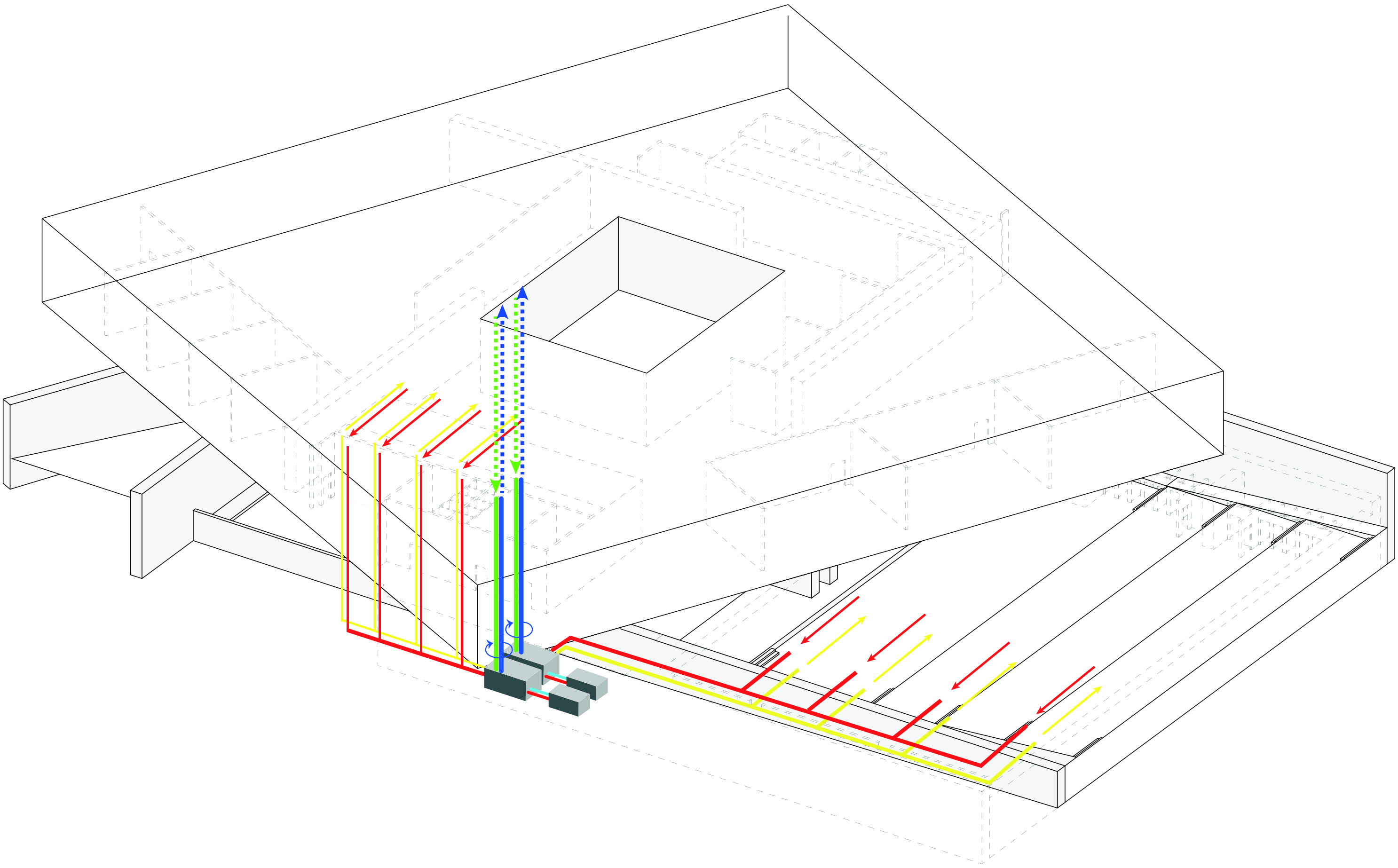
1 CULTURAL CENTER

HVAC SYSTEM



Our project is basically divided into two units that can be studied in two different moments of the process . They re very different belonging to the envelope and the geometrical concept but mostly important the belong to two very different envelope surfaces. The main building, the library, is rectangular volume four meters above the ground and the only relationship with the surroundings are the staircase which support the totalweight. In the total calculation of the transmittances of the envelope the septum and the linking with the ground are neglected. Much more interest is given to a detailed calculation of the glass facade behind the shading ceramic system. In a volume completely closed by glass window the detailed calculation of every single element, the frame with his thermal break and the window (triple selective Saint Gobain) are very important choices for a more substainable building.

HVAC COMPONENTS DIAGRAM



Air s ly

Airextracti n

Air s ly

Air s ly

1 Air han ling h nit

2 Ther al C⁄ ling nit

BUILDING COMPONENTS

- Upper slab

	THICKNESS (m)	THERMAL CONDUCTIVITY (W/mk)	THERMAL RESISTANCE (m²k/W)	TRASMITTANCE
Lecacem expanded clay skin	0,12	0,160	,75	
Lecacem maxi and waterproof case	0,10	,126	0,793650794	
Knaufinsulation panels expanded polystyrene	0,10	,028	3,571428571	
Lecacls 1600 Rck 35 (average thickness)	0,18	0,54	0,333333333	
steel trapezoidal corrugated sheet EGB 200	0,0750	,2	0,375	
Knaufinsulation panels expanded polystyrene	0,055	0,0281	,964285714	
External counter ceiling panel	0,01	0,20	,05	
			U(W/m²k) =	0,127588477

- Lower slab

	THICKNESS (m)	THERMAL CONDUCTIVITY (W/mk)	THERMAL RESISTANCE(m² k/W)	TRASMITTANCE
Floor finishing teak panel Intwood	0,02	0,16	0,125	
Lecacem maxi	0,07	0,126	0,555555556	
Knaufinsulation panels expanded polystyrene	0,10	,028	3,571428571	
Lecacls 1600 Rck 35 (average thickness)	0,18	0,54	0,333333333	
steel trapezoidal corrugated sheet EGB 200	0,0750	,2	0,375	
Knaufinsulation panels expanded polystyrene	0,06	0,0282	,142857143	
External counter ceiling panel	0,01	0,20	,05	
			U(W/m²k) =	0,139798069

- Wall typology 1

	THICKNESS (m)	THERMAL CONDUCTIVITY (W/mk)	THERMAL RESISTANCE (m²k/W)	TRASMITTANCE
External aquapanel plaster	0,01	0,20	,05	
Knaufinsulation panels expanded polystyrene	0,16	0,028	21,42857143	
concrete wall	0,22	,1	0,095238095	
Knaufinsulation panels expanded polystyrene	0,60	,028	21,42857143	
plaster	0,0151		0,015	
			U(W/m²k) =	0,023246418

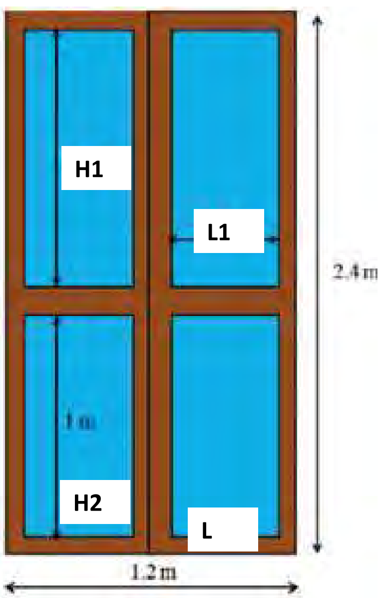
DETAILED CALCULATION GLASS FACADE
- Window, glass and frame

Dimensions			u.m.		
	L8		m		
	H4	,38m			
	L1	3,8m			
	H1	4,2m			
	H2	0,0m			
	Aw	35,04	m2		
	Ag	31,92	m2		
	Af	3,12	m2		
	% frame8	,9%	%		
	Lg	47,2m			
Materials properties					
	Ug	0,60	W/m2K		
	Uf	1,10	W/m2K		
	⊠ g0	,26W	/mK		
	Ag·Ug	19,152W	/K	54,9%	glass on Uw
	Af·Uf3	,432	W/K9	,8%	frame on Uw
	Lg·⊠g	12,272W	/K	35,2%	thermal bridge gap between windows on Uw
	Uw	**0,99**	**W/m2K**		

$$U_w = \frac{U_g \cdot A_g + U_f \cdot A_f + \psi_g \cdot L_g}{A_w}$$

Legenda

	u.m.	Descrizione	
Uw	W/m2K	global transmittance window	w= window
Aw	m2	global surface window	
Ug	W/m2K	glass transmittance	g=glass
Ag	m2	Surface glass part	
Uf	W/m2K	transmittance frame	f=frame
Af	m2	superficie telaio	
⊠g	W/mK	linear transmittance thermal bridge gap frame	
Lg	ml	enght thermal bridge fram(	lenght dimension of the glassafme contact

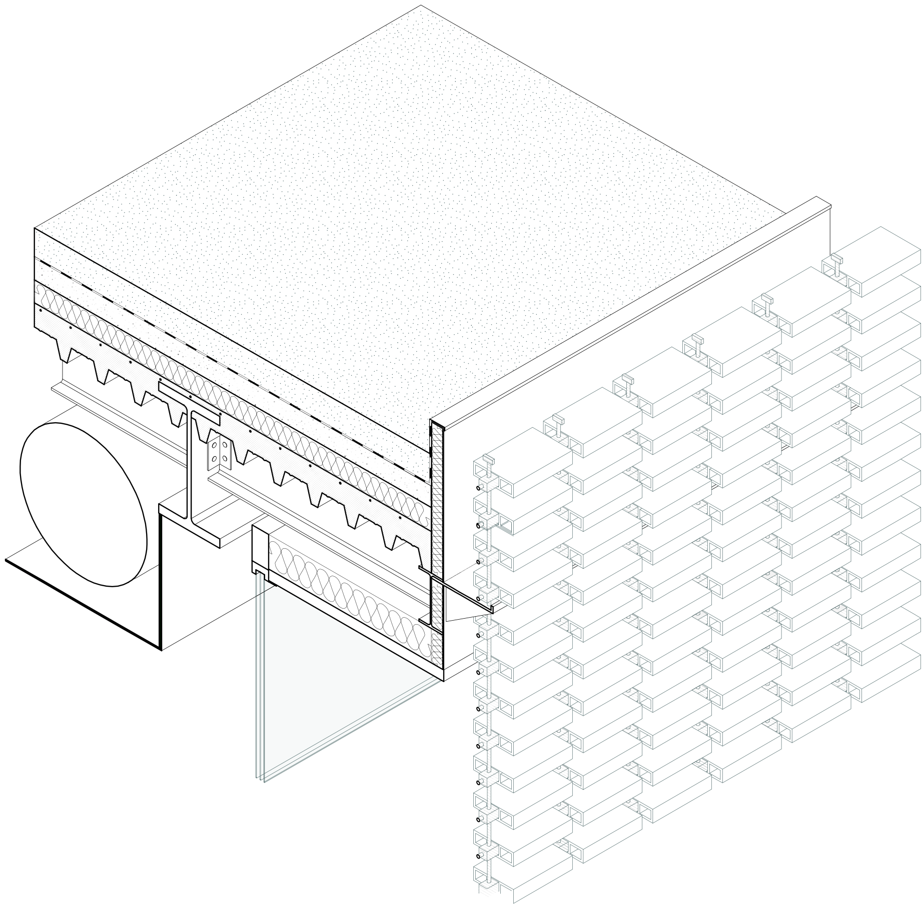


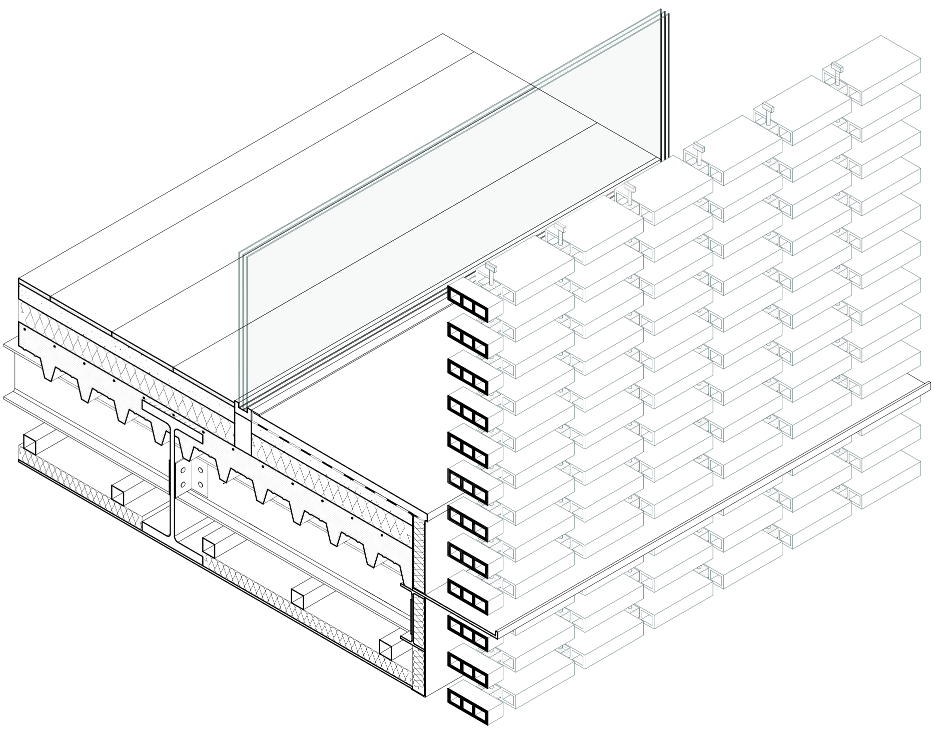
- Frame Uf values table reference

FRAME **Uf values**

Material	Technical details	Trasmittance Uf (W/m2K)
PUR	metal profile thickness of PUR ≥ 5 mm	2,8
PVC	2 provided gaps 3 provided gaps	2,2 2,0
	5 provided gaps	1,2
	6 provided gaps	1,0
Wood type1 (rovere, mogano, iroko)	thickness 50 mm	2,2
	thickness 60 mm	2,0
	thickness 70 mm	1,9
	thickness 90 mm	1,6
Wood type 2 (pino, abete, larice, douglas, hemlock)	thickness 50 mm	2,0
	thickness 60 mm	1,8
	thickness 70 mm	1,6
	thickness 90 mm	1,3
Metal	no thermal break	7,0
Metal thermal break provided	dim.: 45-55 mm thermal break bars: 14-16 mm	2,8
	dim.: 60-70 mm thermal break bars: 22-28 mm	2,5
	dim.: 70-75 mm thermal break bars: 30-36 mm	2,2
	dim.: 70-75 mm thermal break bars: 36-42 mm cave filled with foam	1,6
	dim.: 90 mm thermal break bars: 52-58 mm cave filled with foam	1,1

DRAWINGS
- upper slab
- lower slab





SUMMER LOAD INPUT DATA

Dati Generali				Note
Località		Milano	-	
Temperatura esterna progetto	T_e	37	°C	*Valore compreso fra 5 e 17 °C
Escursione termica giornaliera*	$?T_e$	11	°C	**Valore compreso fra:
Umidità assoluta esterna massima	X_e	23,44	g/kg	pareti verticali: 100 e 700 kg/mq
Latitudine		36	°o	rizzontale sole: 50 e 400 kg/mq
		13	'o	rizzontale ombra: 100 e 300 kg/mq
Temperatura ambiente progetto	T_a	26	°C	***Valore compreso fra 150 e 730 kg/mq
Umidità ambiente progetto	X_a	10,38	g/kg	**RIEMPIRE CAMPI CON BORDO ARANCIONE**
Massa in pianta***	M_a	670	kg/mq	
Portata aria esterna di rinnovoV		19274,6	mc/h	

Dati Involucro							
	Superfici Opache			Finestre			
Esposizione	U_p	$M_{f,p}$**	S_p	U_F	f	F=SC F_{vs}	S_F
	W/(mq K)	kg/mq	mq	W/(mq K)	--		mq
NORD	0,02	350	72,0	0,99	0,9	0,35	228
EST	0,02	350	72,0	0,99	0,9	0,35	228
OVEST	0,02	350	432,0	0,99	0,9	0,35	129,2
SUD	0,02	350	222,0	0,99	0,9	0,35	76
ORIZZONTALE OMBRA	0,078233	85	3324				
ORIZZONTALE SOLE	0,06615	85	3324				

Carichi Interni			
Carico interno sensibile costante	$Q_{int,s,cost}$	7200,525	W
Carico interno latente costante	$Q_{int,l,cost}$	7389,96	W

Carichi interni totali	Ora	Costante	Variabile	Costante	Variabile
	H	$Q_{int,s,cost}$	$Q_{int,s,var}$	$Q_{int,l,cost}$	$Q_{int,l,var}$
	h	WWW			W
	8	7200,525		7389,96	0
	9	7200,525	119286	7389,96	58239
	10	7200,525	119286	7389,96	58239
	11	7200,525	119286	7389,96	58239
	12	7200,525	119286	7389,96	58239
	13	7200,525	119286	7389,96	58239
	14	7200,525	119286	7389,96	58239
	15	7200,525	119286	7389,96	58239
	16	7200,525	119286	7389,96	58239
	17	7200,525	119286	7389,96	58239
	18	7200,525	119286	7389,96	58239
	19	7200,525	119286	7389,96	58239
	20	7200,525		7389,96	
	21	7200,525		7389,96	0
	22	7200,525		7389,96	0
	23	7200,525		7389,96	0
	24	7200,525		7389,96	0

SENSIBLE AND LATENT LOAD

Transparent - conduction Qtte	
Windows surface6	61 m2
Windows transmittance	0,99 W/(m2k)
External temp3	7° C
Intenal temp	26 °C
E-I temp	11 °C
QTTE	7198,29 W

Ventilation of envelope	
Volume	13296 m3
ACH	0,055
Air density	1
specific heat of air	1
te-int	11

Qvs 2,23446667

qtte +qvs
7200,5245

Ventilation through envelope Qvl	
V	13296 m3
ACH	0,055
air density	1,23 kg/m3
latent heat water vapro	2264,71
xe	23,44 g/kg
xa	10,38 g/kg
xe-xa	13,06 kg/kg

Qvl 7389,95989

pp	678
sensible	45 W/pp
latent	75 W/pp

sensible 70398 W
latent 50850 W

Equipment (sensible)	tot:
lighting 12 (w/m2)	39888 (w)
laptop 100 x 90	9000 (w)

SUMMER LOAD OUTPUT DATA

CARICO SENSIBILE (POTENZA IN W)

Ora del giorno			**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
NORD	Pareti	Trasmissione	1,5	2,2	2,7	3,3	3,9	5,8	7,8	9,4	10,7	11,5	12,1	12,1	12,7	11,3	9,9	8,5	7,1
	Finestre	Trasmissione	699,7	970,6	1.241,5	1.523,6	1.805,8	2.087,9	2.370,1	2.482,9	2.370,1	2.257,2	2.144,3	1.896,0	1.647,8	1.365,6	1.083,5	801,3	519,2
	Finestre	Irraggiamento	1.200,5	1.460,8	1.662,2	1.830,1	1.989,7	2.124,0	2.283,5	2.375,8	2.476,6	2.535,3	1.989,7	1.737,8	1.527,9	1.368,4	1.200,5	1.099,8	1.007,4
EST	Pareti	Trasmissione	5,1	18,0	24,7	26,5	27,3	20,2	17,0	15,7	14,7	14,8	15,0	14,4	13,9	13,1	12,3	10,9	8,9
	Finestre	Trasmissione	699,7	970,6	1.241,5	1.523,6	1.805,8	2.087,9	2.370,1	2.482,9	2.370,1	2.257,2	2.144,3	1.896,0	1.647,8	1.365,6	1.083,5	801,3	519,2
	Finestre	Irraggiamento	######	######	######	######	######	######	######	9.556,7	8.536,1	7.979,4	7.237,1	6.402,1	5.752,6	5.010,3	4.639,2	4.175,3	3.525,8
OVEST	Pareti	Trasmissione	30,5	30,5	30,5	37,6	44,7	57,0	69,3	103,5	131,1	166,3	191,2	201,1	186,4	156,2	111,5	82,3	61,3
	Finestre	Trasmissione	396,5	550,0	703,5	863,4	1.023,3	1.183,1	1.343,0	1.407,0	1.343,0	1.279,1	1.215,1	1.074,4	933,7	773,8	614,0	454,1	294,2
	Finestre	Irraggiamento	736,5	683,9	683,9	683,9	701,5	894,4	1.332,8	1.946,5	2.595,4	3.051,3	3.209,2	2.735,7	2.349,9	2.051,8	1.806,3	1.595,8	1.438,0
SUD	Pareti	Trasmissione	5,9	7,9	9,5	26,8	36,7	53,8	64,0	67,6	69,7	65,7	60,1	49,3	42,8	37,4	33,2	28,5	24,3
	Finestre	Trasmissione	233,2	323,5	413,8	507,9	601,9	696,0	790,0	827,6	790,0	752,4	714,8	632,0	549,3	455,2	361,2	267,1	173,1
	Finestre	Irraggiamento	1.577,3	2.474,2	3.525,8	4.453,6	5.381,5	6.123,7	6.525,8	6.494,9	6.092,8	5.288,7	4.577,3	4.020,6	3.525,8	3.123,7	2.752,6	2.505,2	2.257,7
OR. OMBRA	Pareti	Trasmissione	373,2	396,6	416,1	591,6	745,0	1.054,5	1.363,9	1.650,0	1.958,2	2.088,2	2.201,3	2.177,9	2.158,4	1.982,9	1.825,5	1.517,4	1.231,3
OR. SOLE	Pareti	Trasmissione	1.842,6	1.862,4	1.994,3	2.140,6	2.528,6	3.276,3	3.779,8	4.057,9	4.563,7	4.934,2	5.156,2	5.139,8	4.897,9	4.749,5	4.693,4	4.431,7	4.173,4
INFILTRAZIONI			######	######	######	######	######	######	######	######	######	######	######	######	######	######	######	######	######
CARICHI INTERNI		Costanti	7.200,5	7.200,5	7.200,5	7.200,5	7.200,5	7.200,5	7.200,5	7.200,5	7.200,5	7.200,5	7.200,5	7.200,5	7.200,5	7.200,5	7.200,5	7.200,5	7.200,5
		Variabili	0,0	######	######	######	######	######	######	######	######	######	######	######	0,0	0,0	0,0	0,0	0,0
Totale			**48.195**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**79.583**	**68.730**	**58.420**	**47.902**	**37.292**
MASSIMO CARICO SENSIBILE											**230992**								

CARICO LATENTE (POTENZA IN W)

Ora del giorno		**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
INFILTRAZIONI		######	######	######	######	######	######	######	######	######	######	######	######	######	######	######	######	######
CARICHI INTERNI	Costanti	7390,0	7390,0	7390,0	7390,0	7390,0	7390,0	7390,0	7390,0	7390,0	7390,0	7390,0	7390,0	7390,0	7390,0	7390,0	7390,0	7390,0
	Variabili	0,0	######	######	######	######	######	######	######	######	######	0,0	######	0,0	0,0	0,0	0,0	0,0
Totale		**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**
MASSIMO CARICO LATENTE										**275484**								

WINTER LOAD

Transmission toward external

QT,e= 27947,79 (W)

	exposition factor	Trasmission towards unheated spaces	Surface	Building component trasmittance	Interior temperature	Exterior temperatureD	elta
	e,i	b,u	S	U	T,i	T,e	T,i-T,e
NE wall	1,2	0,5	360	0,99	20	2	18
SE wall	1,1	0,5	360	0,99	20	2	18
SO wall	1,05	0,5	360	0,99	20	2	18
NO wall	1,15	0,5	360	0,99	20	2	18
Roof		0,7	3324	0,06615	20	2	18
Floor		0,8	3324	0,078233	20	2	18

20949,39 (W)

Qv =

Qv = qv ·ρ·cp · (θe-θa) (W)

19274,56*1,2*0,29*(2-20) **-120736**

	Trasmission towards unheated spaces	Lenght of thermal bridge	Lineic thermal transmittance of thermal bridge	Interior temperature	Exterior temperature	Delta
	b,u	L,i	ψ,i	T,i	T,e	T,i-T,e
NE wall	0,5	60	0,81	20	2	18
SE wall	0,5	60	0,81	20	2	18
SO wall	0,5	60	0,81	20	2	18
NO wall	0,5	60	0,81	20	2	18
Roof	0,7	240	0,81	20	2	18
Floor	0,8	240	0,81	20	2	18

6998,4 (W)

Qtot=

155682,0341

AIRFLOW CALCULATION DUE TO UNI 10339

Air change due to UNI 10339

Function	Area (m2)	Expected crowding factor (f)	l/s each person	vol/h	A*f		Air change
Library	1632	0,2	5,5		326,4		6462,72
Exhibition	90	0,3	6		27		583,2
offices/meeting room	320	0,8	10		256		9216
open space/ circulation	570	0,12	11		68,4		2708,64
Restrooms	97			8			304
					678		
						TOTAL=	19274,56

	Air (m3/h)	Provided device
Library zone 1	3960	
		AIRCARE MA10 Q250 : 12 units

	Air (m3/h)	Provided device
Library zone 2	2502	
		AIRCARE MA10 Q250: 10 units

	Air (m3/h)	Provided device
offices type 1 (conference room)	4600	
3 units		
1st unit	1533,33	AIRCARE MA10 Q 250 6 units
2nd unit	1533,33	AIRCARE MA10 Q 250 6 units
3rd unit	1533,33	AIRCARE MA10 Q 250 6 units

	Air (m3/h)	Provided device
offices type2(meeting room)	4616	
5 units		
1st unit	923,2	AIRCARE MA10 Q 250 : 4 units
2nd unit	923,2	AIRCARE MA10 Q 250 : 4 units
3rd unit	923,2	AIRCARE MA10 Q 250 : 4 units
4th unt	923,2	AIRCARE MA10 Q 250 : 4 units
5th unt	923,2	AIRCARE MA10 Q 250 : 4 units

	Air (m3/h)	Provided device
restrooms	304	
10 units		
9 (public units) (3 services)	243,6	AIRCAR MA10 Q 100 : 3 units
1 (cafeteria unit)7	0,4	AIRCAR MA10 Q 100 : 1 units

	Air (m3/h)	Provided device
Exhibitions	583,2	
	3 units	AIRCAR MA10 Q200 : 3 units

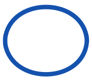
	Air (m3/h)	Provided device
open space/circulation	2708,64	
		AIRCAR MA10 Q 200 : 12 units
		AIRCAR MA10 Q 100 : 3 units

DUCT	ACTIVITIES AND AIRFLOW DUE					DEVICES			
Duct A	library zone 1	circulation				AIRCAR MA10 Q100	AIRCAR MA10 Q150	AIRCAR MA10 Q200	AIRCAR MA10 Q250
Q=4818	3960	800						41	6
Duct B	Meeting rooms	2 restrooms							
Q=4818	4616	162,4				2			20
Duct C	conference rooms	circulation							
Q=4818	4600	200						12	0
Duct D	restroom	library zone 2	exhib	circulation	cafeteria				
Q=4818	81,2	2502	583,2	1500	70,4	1		12	10

DUCTS SIZING

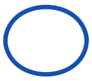
SIZING

Q	19274,56	m3/h	Airflow
Q5	,35m	3/s	
w=	9,0m	/s	speed
A0	,59	m2	section
Rectangular section duct:			
h0	,80m		h dimension
L0	,74m		b dimension
Equ. circular section duct:			
D0	,870	m	hydraulic dim. Equ
Dce=0	,843	mc	ircular dim. Equ



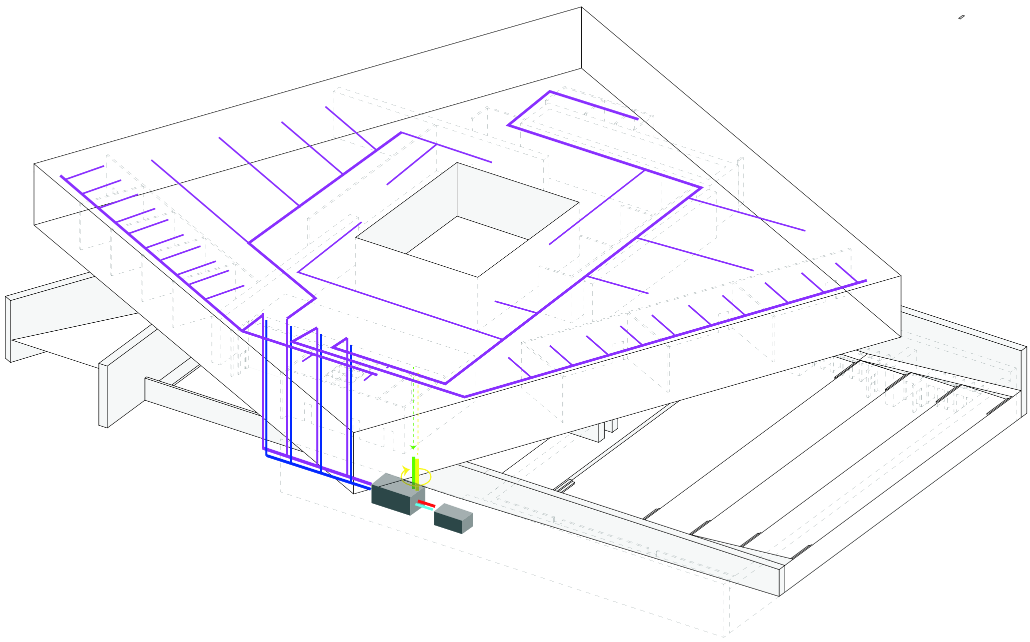
4 main ducts

Q	4818,64	m3/h	Airflow
Q1	,34m	3/s	
w=	5m	/s	Speed
A0	,27	m2	section
rectangular section duct:			
h0	,55h		dimension
L0	,49b		dimension
Equ. circular section duct:			
D0	,584	m	hydraulic dim. Equ
Dce=0	,565	mc	ircular dim. Equ



Because of the large dimension of the duct we made the choice to hypotize two different sizing processes. The first one designing a circular section (the most common one) , and the second one with a rectangular section . In this case the greatest advantage is the possibility to reduce the depth dimension of the duct. This make possible to have a reduced space in the counterceiling and to have the possibility to intersect air supply layout and extraction layout on two different layers.

SHAFT

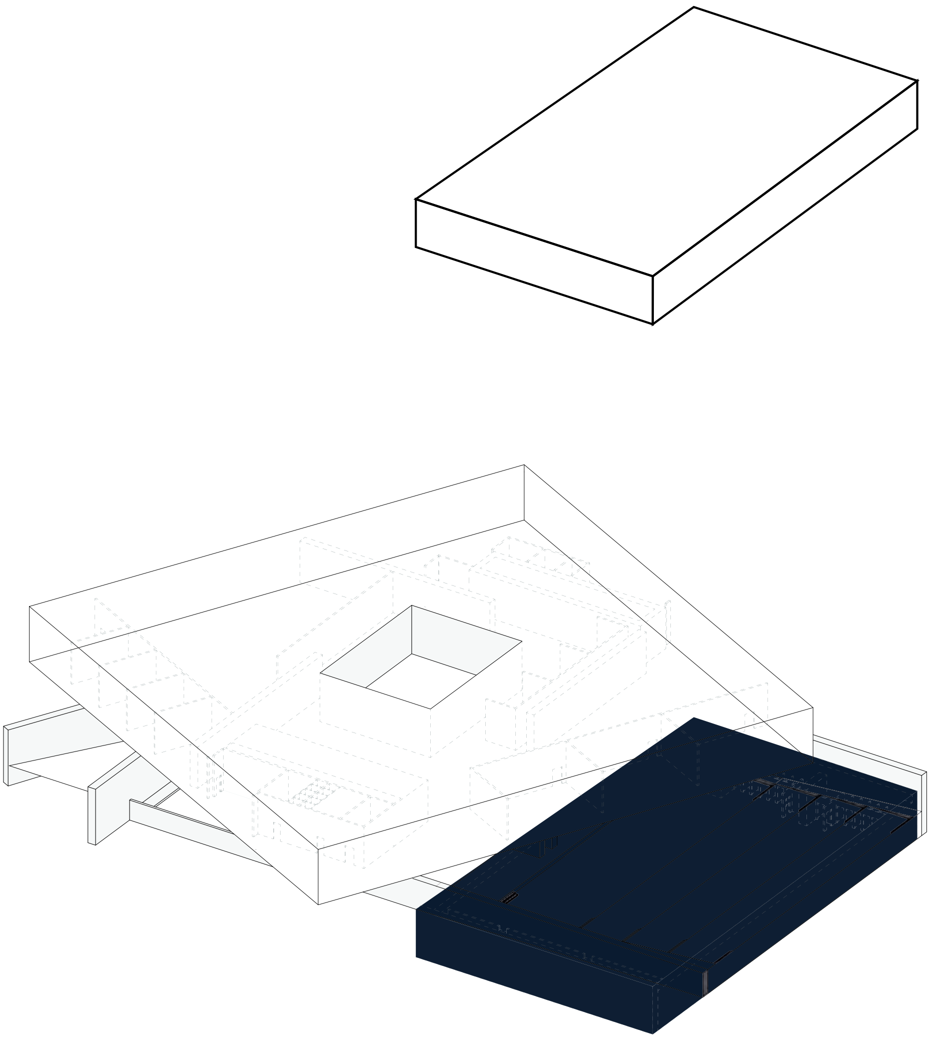


Even if the two units are completely different in terms of thermal conditions and environmental situations it has been useful for a concept design process to place the shaft in a single spot. Belonging to the idea of the suspended volume we designed a large shaft just on the side of the staircase avoiding to have any other linking to the surrounding soil. In this way any other vertical element on the ground is avoided and all of the technical pipes (ventilation, electricity and water supply and discharge) can find the right place for their ducts in the provided shaft.

DUCTS SIZING

2 MUSEUM

HVAC SYSTEM



The Second part of the project, the museum, has totally different properties from the first block. The architecture is no more flying upon the ground but it's dig in the soil and part of the human public environment of the square. In this sense the thermal properties of the building are totally different from the previous analyzed block. Three sides are facing the ground while the roof is the floor of the public auditorium. All of the interior space has been isolated with an internal continuous coat finishing. In this sense all of the thermal bridges are avoided and even the acoustic of the exhibition space can be well isolated from the outside public life.

BUILDING COMPONENTS

- Lower slab

	THICKNESS (m)	THERMAL CONDUCTIVITY (W/mk)	THERMAL RESISTANCE (m²k/W)	TRASMITTANCE
Ceramic tiles	0,0121		0,012	
lean concrete	0,04	0,73	0,054794521	
Iglù® underground air vehiculation	0,27	1,20	,225	
concrete perlite vermiculite perlideck	0,20	,151	,333333333	
ground		2		

U(W/m²k) = 0,615336201

- Upper slab

	THICKNESS (m)	THERMAL CONDUCTIVITY (W/mk)	THERMAL RESISTANCE(m² k/W)	TRASMITTANCE
Floor finishing limestone tiles	0,03	0,70	,042857143	
bituminous sheath	0,0080	,260	,030769231	
reinforced concrete wall	0,25	2,30	,108695652	
drywall	0,0750	,2	0,375	
Knaufinsulation panels expanded polystyrene	0,06	0,0282	,142857143	
plaster	0,0151		0,015	

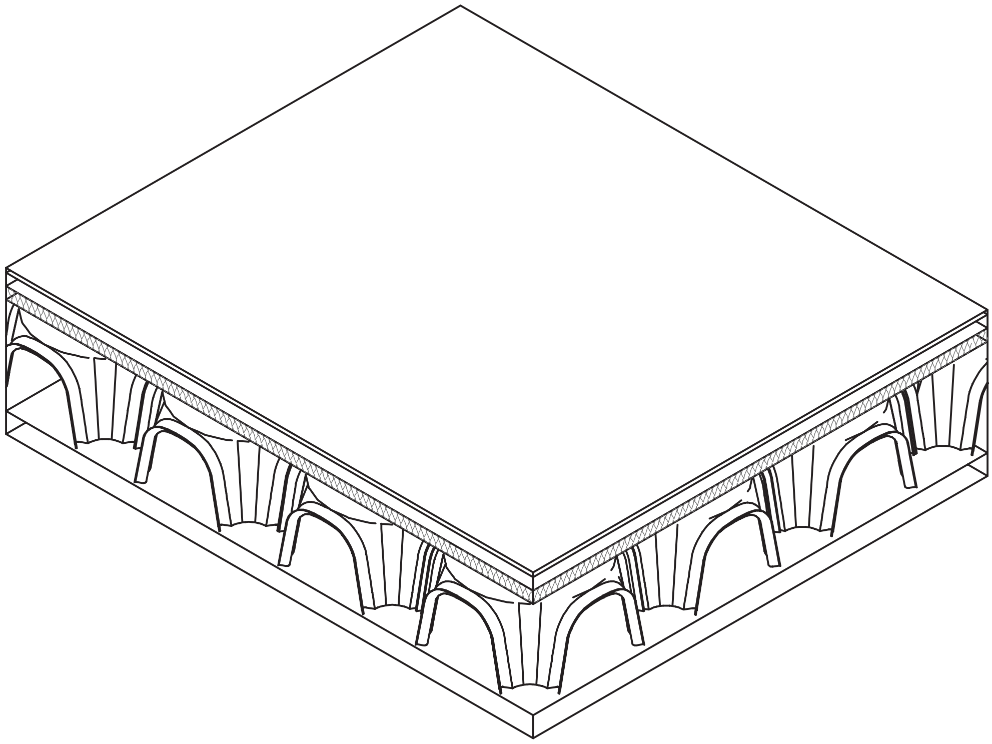
U(W/m²k) = 0,36829982

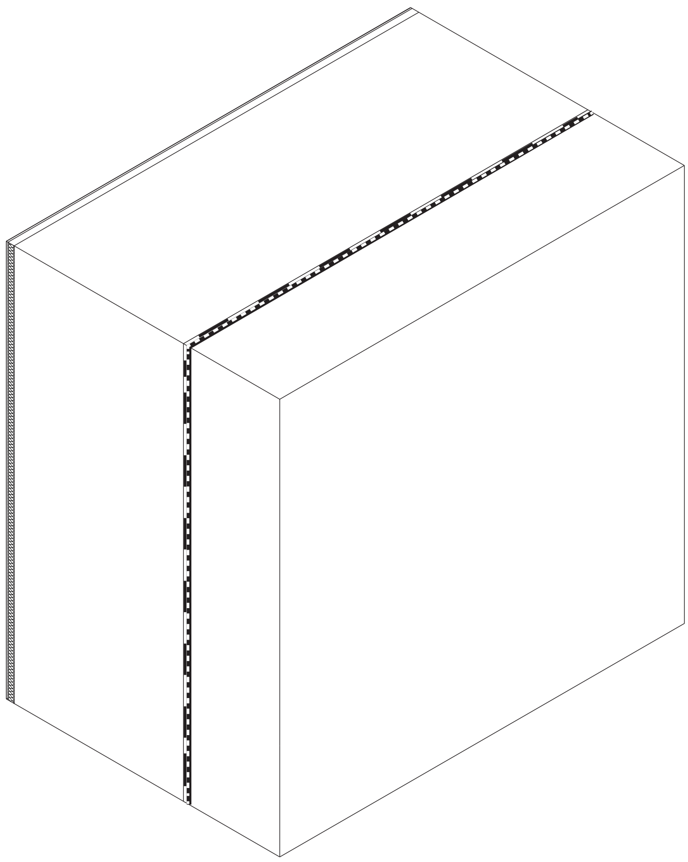
- Retaining wall

	THICKNESS (m)	THERMAL CONDUCTIVITY (W/mk)	THERMAL RESISTANCE (m²k/W)	TRASMITTANCE
polyethylene sheet	0,0020	,350	,005714286	
extruded polystyrene xps	0,12	0,0353	,428571429	
bituminous sheath	0,0080	,260	,030769231	
reinforced concrete wall	0,25	2,30	,108695652	
Knaufinsulation panels				
expanded polystyrene	0,60	,028	21,42857143	
plaster	0,0151		0,015	

U(W/m²k) = 0,039972304

DRAWINGS
- lower slab
- retaining wall





SUMMER LOAD INPUT DATA

Dati Generali				Note
Località		Milano	-	
Temperatura esterna progetto	T_e	37	°C	*Valore compreso fra 5 e 17 °C
Escursione termica giornaliera*	?T_e	11	°C	**Valore compreso fra:
Umidità assoluta esterna massima	X_e	23,44	g/kg	pareti verticali: 100 e 700 kg/mq
Latitudine		36	°o	rizzontale sole: 50 e 400 kg/mq
		13	'o	rizzontale ombra: 100 e 300 kg/mq
Temperatura ambiente progetto	T_a	26	°C	***Valore compreso fra 150 e 730 kg/mq
				RIEMPIRE CAMPI CON BORDO
Umidità ambiente progetto	X_a	10,38	g/kg	**ARANCIONE**
Massa in pianta***	M_a	350	kg/mq	
Portata aria esterna di rinnovoV		7561,6	mc/h	

Dati Involucro							
	Superfici Opache			Finestre			
Esposizione	U_p	$M_{f,p}$**	S_p	U_F	f	F=SC F_{vs}	S_F
	W/(mq K)	kg/mq	mq	W/(mq K)	--		mq
NORD	0,04632	320	231,0				
EST	0,04632	320	127,0				
OVEST	0,04632	320	127,0				
SUD	0,04632	320	231,0				
ORIZZONTALE OMBRA	0,61533	10	1475				
ORIZZONTALE SOLE0	,3682	70	1475				

Carichi Interni						
Carico interno sensibile costante	$Q_{int,s,cost}$		1,2325	W		
Carico interno latente costante	$Q_{int,l,cost}$		4076,26	W		
Carichi interni totali		OraC	ostante	Variabile	Costante	Variabile
		H	$Q_{int,s,cost}$	$Q_{int,s,var}$	$Q_{int,l,cost}$	$Q_{int,l,var}$
		h	WWW			W
		81	,2325)		4076,26	0
		91	,2325	59664	4076,26	25200
		10	1,2325	59664	4076,26	25200
		11	1,2325	59664	4076,26	25200
		12	1,2325	59664	4076,26	25200
		13	1,2325	59664	4076,26	25200
		14	1,2325	59664	4076,26	25200
		15	1,2325	59664	4076,26	25200
		16	1,2325	59664	4076,26	25200
		17	1,2325	59664	4076,26	25200
		18	1,2325	59664	4076,26	25200
		19	1,2325	59664	4076,26	25200
		20	1,2325		4076,26	
		21	1,2325)		4076,26	0
		22	1,2325)		4076,26	0
		23	1,2325)		4076,26	0
		24	1,2325)		4076,26	0

SENSIBLE AND LATENT LOAD

Transparent - conduction Qtte	
Windows surface	55,2m 2
Windows transmittance	0,99 W/(m2k)
External temp3	7° C
Intenal temp	26 C
E-I temp	11 C
QTTE	601,128 W

Ventilation of envelope	
Volume	7334 m3
ACH	0,055
Air density	1
specific heat of air	1
te-int	11

Qvs 1,23251944

qtte +qvs
602,3605

Ventilation through envelope Qvl	
V	7334 m3
ACH	0,055
air density	1,23 kg/m3
latent heat water vapor	2264,71
xe	23,44 g/kg
xa	10,38 g/kg
xe-xa	13,06 kg/kg

Qvl 4076,26097

pp	336
sensible	45 W/pp
latent	75 W/pp

sensible 37392 W
latent 25200 W

Equipment (sensible)		tot:	
lighting	12 (w/m2)		22002 (w)
laptop	3	90	270 (w)

SUMMER LOAD OUTPUT DATA

CARICO SENSIBILE (POTENZA IN W)

Ora del giorno			**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
NORD	Pareti	Trasmissione	7,7	13,5	18,3	24,1	28,9	44,8	61,8	74,9	85,2	90,6	96,4	96,4	98,2	87,0	75,8	63,7	52,4
	Finestre	Trasmissione	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Finestre	Irraggiamento	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
EST	Pareti	Trasmissione	17,8	79,9	108,8	113,5	114,8	79,7	64,5	60,5	57,2	59,2	61,2	58,5	55,9	52,4	49,5	43,3	34,0
	Finestre	Trasmissione	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Finestre	Irraggiamento	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
OVEST	Pareti	Trasmissione	17,8	17,8	17,8	23,6	29,5	38,8	48,2	74,8	96,1	121,5	139,9	144,8	130,9	106,8	70,9	51,7	37,9
	Finestre	Trasmissione	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Finestre	Irraggiamento	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
SUD	Pareti	Trasmissione	8,9	14,7	19,5	68,2	95,8	140,5	165,1	171,7	177,0	162,9	146,5	118,8	101,6	89,3	78,2	66,0	54,9
	Finestre	Trasmissione	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Finestre	Irraggiamento	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
OR. OMBRA	Pareti	Trasmissione	553,6	1.043,8	1.452,2	2.405,2	3.349,1	4.837,6	6.326,1	7.324,4	8.331,9	8.785,7	8.431,7	7.941,6	7.533,2	6.580,2	5.554,6	4.547,1	3.548,8
OR. SOLE	Pareti	Trasmissione	1.705,3	1.993,2	2.900,1	4.409,9	6.245,6	8.418,0	######	######	######	######	######	######	######	######	9.623,6	8.369,1	7.054,8
INFILTRAZIONI			7.852,7	######	######	######	######	######	######	######	######	######	######	######	######	######	######	8.992,6	5.826,2
CARICHI INTERNI		Costanti	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
		Variabili	0,0	######	######	######	######	######	######	######	######	######	######	######	0,0	0,0	0,0	0,0	0,0
Totale			**10.165**	**73.721**	**78.114**	**83.808**	**89.794**	**96.656**	**######**	**######**	**######**	**######**	**######**	**######**	**38.470**	**33.197**	**27.613**	**22.135**	**16.610**
MASSIMO CARICO SENSIBILE											**108213**								

CARICO LATENTE (POTENZA IN W)

Ora del giorno			**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
INFILTRAZIONI			######	######	######	######	######	######	######	######	######	######	######	######	######	######	######	######	######
CARICHI INTERNI		Costanti	4076,3	4076,3	4076,3	4076,3	4076,3	4076,3	4076,3	4076,3	4076,3	4076,3	4076,3	4076,3	4076,3	4076,3	4076,3	4076,3	4076,3
		Variabili	0,0	######	######	######	######	######	######	######	######	######	0,0	######	0,0	0,0	0,0	0,0	0,0
Totale			**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**	**######**
MASSIMO CARICO LATENTE											**111605**								

WINTER LOAD

Transmission toward external

QT,e= 22282,77 (W)

	exposition factor	Trasmission towards unheated spaces	Surface	Building component trasmittance	Interior temperature	Exterior temperatureD	elta
	e,i	b,u	S	U	T,i	T,e	T,i-T,e
N wall	1,15	0,5	231	0,039	20	2	18
E wall	1,1	0,5	127	0,039	20	2	18
S wall	1	0,5	231	0,039	20	2	18
O wall	1,05	0,5	127	0,039	20	2	18
Roof		0,7	1475	0,3682	20	2	18
Floor		0,8	1475	0,7142	20	2	18

22282,77 (W)

Qv =

Qv = qv ·ρ·cp · (θe-θa) (W)

7561,6*1,2*0,29*(20-2)

-47365,9

	Trasmission towards unheated spaces	Lenght of thermal bridge	Lineic thermal transmittance of thermal bridge	Interior temperature	Exterior temperatureD	elta
	b,u	L,i	ψ,i	T,i	T,e	T,i-T,e
N wall		0				
E wall		0				
S wall		0				
O wall		0				
Roof		0				
Floor		0				

0(W)

Due to the provided insulation finishing system with internal coat all of the thermal bridges negligible

Qtot=

69648,6321

AIRFLOW CALCULATION DUE TO UNI 10339

Air change due to UNI 10339

Function	Area (m2)	Expected crowding factor (f)	l/s each person	vol/h	A*f		Air change
Exhibition	1120	0,3		6		336	7257,6
Restrooms	65				8		304
						TOTAL=	7561,6

Restrooms	Air (m3/h)		Exhibition	Air (m3/h)
11	52		17	257,6
11	52			
AIRCAR MA10 Q150 2 units			AIRCAR MA10 Q250 29 units	

	AIRCAR MA10 Q150	AIRCAR MA10 Q200	Q max
duct A0		9	1890,4
duct B2		81	890,4
duct C0		9	1890,4
duct D0		9	1890,4

LEGENDA:
Q = portata d'aria [m³/h]
LxH = dimensioni nominali [mm]
Vi = velocità di immissione [m/s]
Δp = perdita di carico [Pa]
LT = lancio riferito a velocità d'aria terminale Vt=0,5 [m/s] e velocità residua Vr=0,25 [m/s]
NR = indice di rumorosità (norme ISO) [dB]

DUCTS SIZING

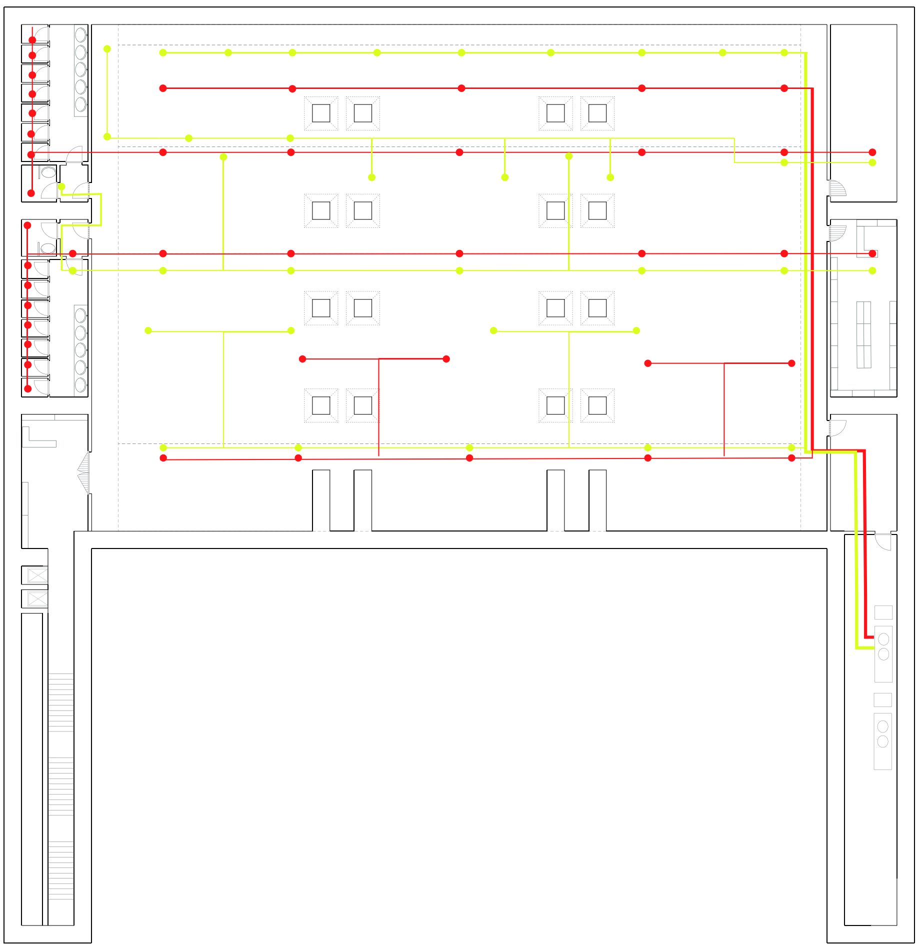
SIZING

Q	7561,6	m3/h	Airflow
Q	2,10	m3/s	
w=	9,0	m/s	Speed
A	0,23	m2	Section
Nel caso di canale a sez. rettangolare:			
h	0,50	m	h dimension
L	0,47	m	b dimension
Nel caso di canale a sez. circolare:			
D	0,545	m	hydraulic dim. Equ
Dce=	0,528	m	circular dim. Equ

4 main ducts

Q	1890,4	m3/h	Airflow
Q	0,53	m3/s	
w=	5	m/s	Speed
A	0,11	m2	Section
Nel caso di canale a sez. rettangolare:			
h	0,35		h dimension
L	0,30		b dimension
Nel caso di canale a sez. circolare:			
D	0,366	m	hydraulic dim. Equ
Dce=	0,354	m	circular dim. Equ

11.VENTILATION PLAN

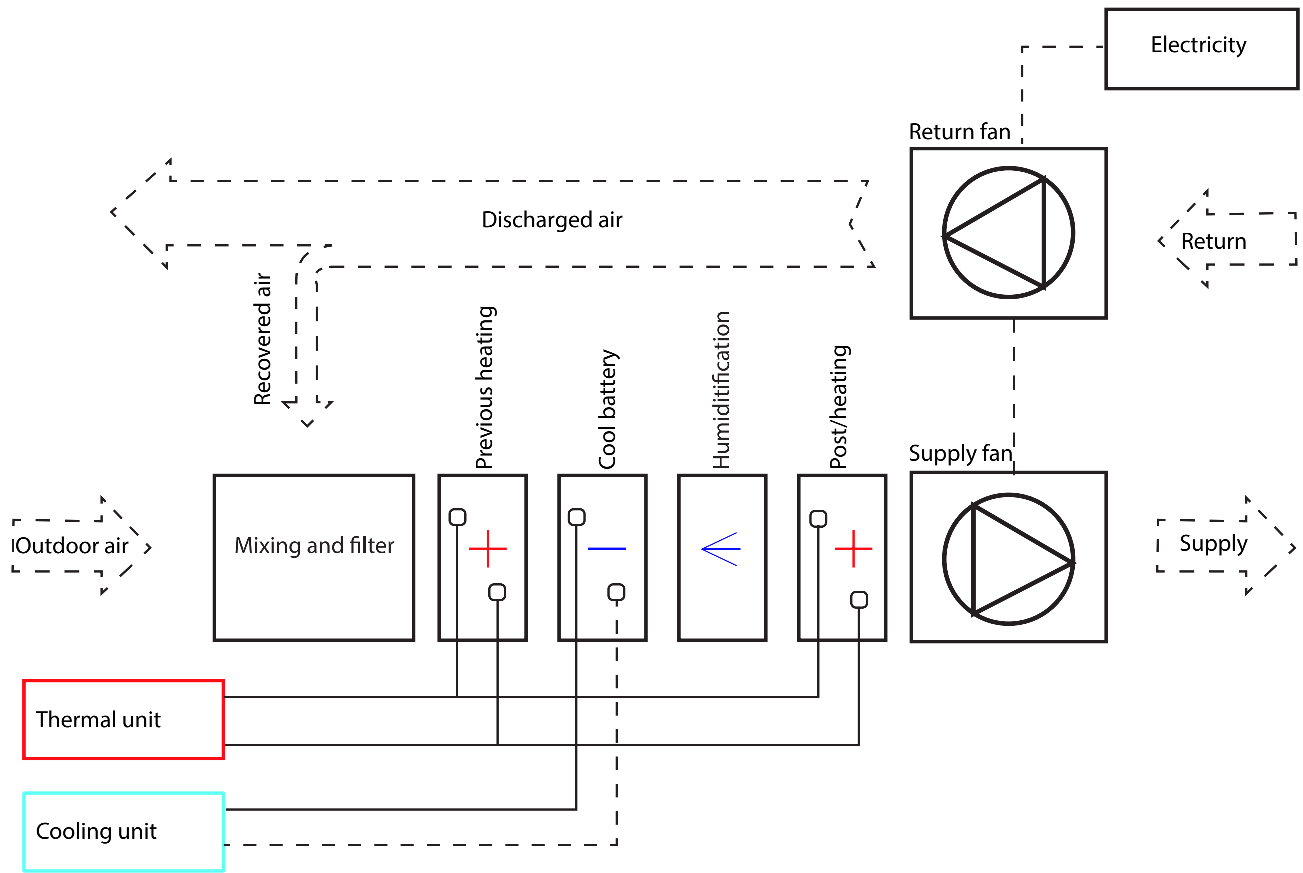


AIR HANDLING UNIT DEVICES

Air handling unit Ferolli UTA with VD/VR thermal and cooling unit

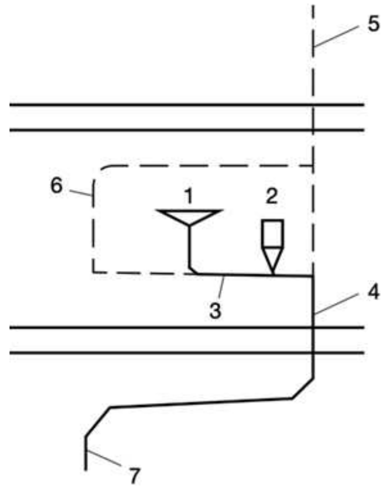
		Dimension:			
Cultural Center:					
Airflow (m3/h)	31000	H (mm):	3200	Total amount of winter load:	155682 (W)
Thermal Power (kw)	376	B (mm):	5000	Total amount of summer load:	506476 (W)
Cooling Power(kw)	429	L (mm):	2400	(detailed calculation in report)	
Museum:					
Airflow (m3/h)	8500	H (mm):	1800	Total amount of winter load:	69648 (W)
Thermal Power (kw)	167	B (mm):	2400	Total amount of summer load:	219818 (W)
Cooling Power(kw)	181	L (mm):	2400	(detailed calculation in report)	

AHC DIAGRAM SYSTEM

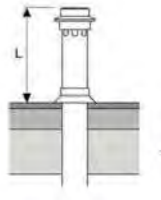


3 WASTE WATER DRAINAGE SYSTEM

EN UNI 12056-2



1 wash basin
2 wc
3 branch discharge pipe
4 stack
5 stack vent
6 branch ventilating pipe
7 drain



(5)
L=30cm

DISCHARGE UNIT (DU)

Appliance	System I	System II	System III	System IV
	DU l/s	DU l/s	DU l/s	DU l/s
Wash Basin, Bidet	0,5	0,3	0,3	0,3
Shower without Plug	0,6	0,4	0,4	0,4
Shower with Plug	0,8	0,5	1,3	0,5
Single Urinal with Cistern	0,8	0,5	0,4	0,5
Urinal with Flushing Valve	0,5	0,3	-	0,3
Slab Urinal	0,2*	0,2*	0,2*	0,2*
Bath	0,8	0,6	1,3	0,5
Kitchen Sink	0,8	0,6	1,3	0,5
Dishwasher (Household)	0,8	0,6	0,2	0,5
Washing Machine up to 6 kg	0,8	0,6	0,6	0,5
Washing Machine up to 12 kg	1,5	1,2	1,2	1,0
WC with 4,0 l Cistern	**	1,8	**	**
WC with 6,0 l Cistern	2,0	1,8	1,2 to 1,7***	2,0
WC with 7,5 l Cistern	2,0	1,8	1,4 to 1,8***	2,0
WC with 9,0 l Cistern	2,5	2,0	1,6 to 2,0***	2,5
Floor Gully DN 50	0,8	0,9	-	0,6
Floor Gully DN 70	1,5	0,9	-	1,0
Floor Gully DN 100	2,0	1,2	-	1,3

* per person
** not permitted
*** depending upon type (valid for WC's with siphon flush cistern only)
\- not used or no data

Type: System II

Single discharge stack system with small bore discharge branch pipes. Sanitary appliances are connected to small bore branch discharge pipes. The small bore branch discharge pipes are designed with a filling degree of 0.7 (70%) and are connected to a single discharge stack.

VENTILATION SYSTEM CONFIGURATION

Type: Primary ventilated system configurations
Control of pressure in the discharge stack (4) is achieved by air flow in the discharge stack and the stack vent (5).

Drainage branches type: Ventilated discharge branch configurations
Control of pressure in the discharge branch (3) is achieved by ventilation of the discharge branch (6).

Calculation of Library toilet facilities

FREQUENCY COEFFICIENT AND WWFLOW RATE

Waste water flowrate $Q_{ww} = k\sqrt{\sum DU}$

k = 0,5 (intermittent use e.g. in office)

Qww = 0,5 x sqrt(2,1+0,9+9,9+9)
= 0,5x sqrt(21,9)
= 2,25 l/s

Ventilated discharge branches

Nominal Diameter (DN) -

Q_{max} l/s	System I DN	System II DN	System III DN	System IV DN
	Branch/Vent	Branch/Vent	Branch/Vent	Branch/Vent
0,60	*	30/30	see table 6	30/30
3,00	50/40	40/30		40/30
1,50	60/40	50/30		50/30
2,25	70/50	60/30		60/30
3,00	80/50**	70/40**		70/40**
3,40	90/60***	80/40****		80/40****
3,75	100/60	90/50		90/50

* not permitted
** no WC's
*** not more than two WC's and a total change in directions of not more than 90°
**** not more than one WC

- Limitations

Limitations	System I	System II	System III	System IV
maximum length (L) of pipe	10,0 m	no limit	see table 9	10,0 m
maximum number of 90° bends*	no limit	no limit		no limit
maximum drop (H) (45° or more inclination)	3,0 m	3,0 m		3,0 m
minimum gradient	0,5 %	1,5%		0,5%

* Connection bend not included

branch 1
2,1 l/s

branch 2
0,9 l/s

branch 3
9,9 l/s

branch 4
9 l/s

Primary ventilated discharge stacks

- Nominal Diameter (DN)

Stack and stack vent	System I, II, III, IV	
	Q_{max} (l/s)	
DN	Square entries	Swept entries
60	0,5	0,7
70	1,5	2,0
80*	2,0	2,6
90	2,7	3,5
100**	4,0	5,2
125	5,8	7,6
150	9,5	12,4
200	16,0	21,0

* minimum size where WC's are connected in system II

** minimum size where WC's are connected in system I, III, IV

branch 1
14,4 l/s

branch 2
2,1 l/s

Calculation of Museum toilet facilities

FREQUENCY COEFFICIENT AND WW FLOW RATE

Waste water flowrate $Q_{ww} = k\sqrt{\sum DU}$

k = 0,5 (intermittent use e.g. in office)

Qww = 0,5 x sqrt(14,4+2,1)
= 0,5 x sqrt(16,5)
= 2 l/s

Ventilated discharge branches

- Nominal D iameter (DN)

Q_{max}	System I	System II	System III	System IV
l/s	DN	DN	DN	DN
	Branch/Vent	Branch/Vent	Branch/Vent	Branch/Vent
0,60	*	30/30	see table 6	30/30
0,75	50/40	40/30		40/30
1,50	60/40	50/30		50/30
2,25	70/50	60/30		60/30
3,00	80/50**	70/40**		70/40**
3,40	90/60***	80/40****		80/40****
3,75	100/60	90/50		90/50

* not permitted

*** not more than two WC's and a total change in directions of not more than 90°

** no WC's

**** not more than one WC

- Limitations

Limitations	System I	System II	System III	System IV
maximum length (*L*) of pipe	10,0 m	no limit		10,0 m
maximum number of 90° bends*	no limit	no limit	see	no limit
maximum drop (*H*) (45° or more inclination)	3,0 m	3,0 m	table 9	3,0 m
minimum gradient	0,5 %	1,5%		0,5%
* Connection bend not included				

Primary ventilated discharge stacks

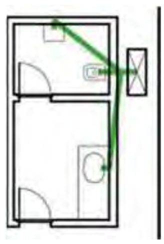
- Nominal Diameter (DN)

Stack and stack vent	System I, II, III, IV Q_{max} (l/s)	
DN	Square entries	Swept entries
60	0,5	0,7
70	1,5	2,0
80*	2,0	2,6
90	2,7	3,5
100**	4,0	5,2
125	5,8	7,6
150	9,5	12,4
200	16,0	21,0

* minimum size where WC's are connected in system II

** minimum size where WC's are connected in system I, III, IV

Calculation of Cafe toilet and kitchen facilities



branch
2,7 l/s

FREQUENCY COEFFICIENT AND WW FLOW RATE

Waste water flowrate $Q_{ww} = k\sqrt{\sum DU}$

k =0,7 (frequent use e.g.in restaurant)

Qww = 0,7 x sqrt(2,7)
= 1,15 l/s

Ventilated discharge branches

Nominal Diameter (DN) -

Q_{max} l/s	System I DN	System II DN	System III DN	System IV DN
	Branch/Vent	Branch/Vent	Branch/Vent	Branch/Vent
0,60	*	30/30	see table 6	30/30
0,75	50/40	40/30		40/30
1,50	60/40	50/30		50/30
2,25	70/50	60/30		60/30
3,00	80/50**	70/40**		70/40**
3,40	90/60***	80/40****		80/40****
3,75	100/60	90/50		90/50

* not permitted

** no WC's

*** not more than two WC's and a total change in directions of not more than 90°

**** not more than one WC

- Limitations

Limitations	System I	System II	System III	System IV
maximum length (*L*) of pipe	10,0 m	no limit	see table 9	10,0 m
maximum number of 90° bends*	no limit	no limit		no limit
maximum drop (*H*) (45° or more inclination)	3,0 m	3,0 m		3,0 m
minimum gradient	0,5 %	1,5%		0,5%

* Connection bend not included

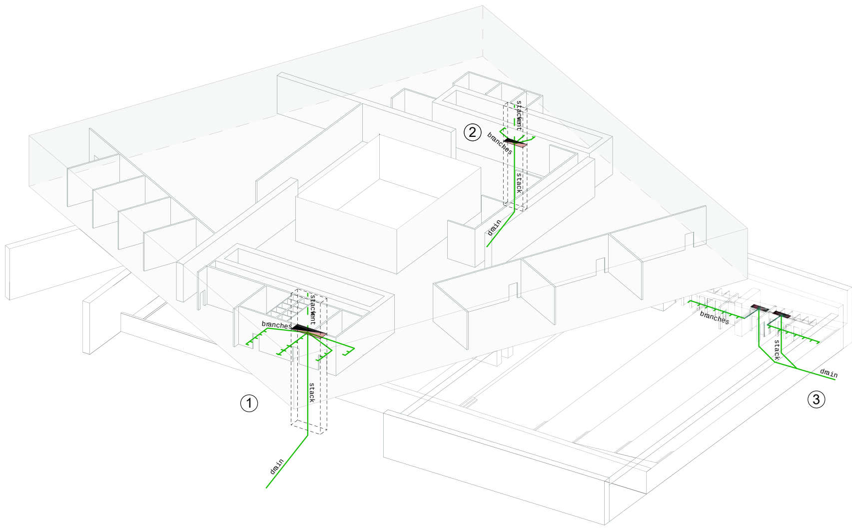
Primary ventilated discharge stacks

- Nominal Diameter (DN)

Stack and stack vent DN	System I, II, III, IV Q_{max} (l/s) Square entries	Swept entries
60	0,5	0,7
70	1,5	2,0
80*	2,0	2,6
90	2,7	3,5
100**	4,0	5,2
125	5,8	7,6
150	9,5	12,4
200	16,0	21,0

* minimum size where WC's are connected in system II

** minimum size where WC's are connected in system I, III, IV



3 RAINWATER DRAINAGE SYSTEM

EN UNI 12056-2

Rainwater:

Water resulting from natural precipitation that has not been deliberately contaminated

AVERAGE PRECIPITATION

Precipitation in Aleppo amounts to 330 mm per year, and occurs between October and May, but it's moderate only in winter, while it never rains from June to September. During winter, from December to February or early March, cold spells, lasting a few days, with snow and frost, may occur. During some years, the rains from December to March can be abundant.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Prec.(mm)	60	50	45	35	20	2	0	0	2	20	35	60	330
Days	13	14	10	7	4	1	0	0	1	4	7	11	72

Calculation done with online spreadsheet:

Design of gutters and pipes for vertical discharges in roof rainwater drainage
http://youpipe.picenumplast.com

Roof width	*61 m*
Roof length	*61 m*
Roof slope	*2°*
Projection roof surface (roof divided into 4 areas)	*867 m²*
Rainfall intensity	*6 mm/h*
Rainfall Flow-rate	*1,3 l/s*

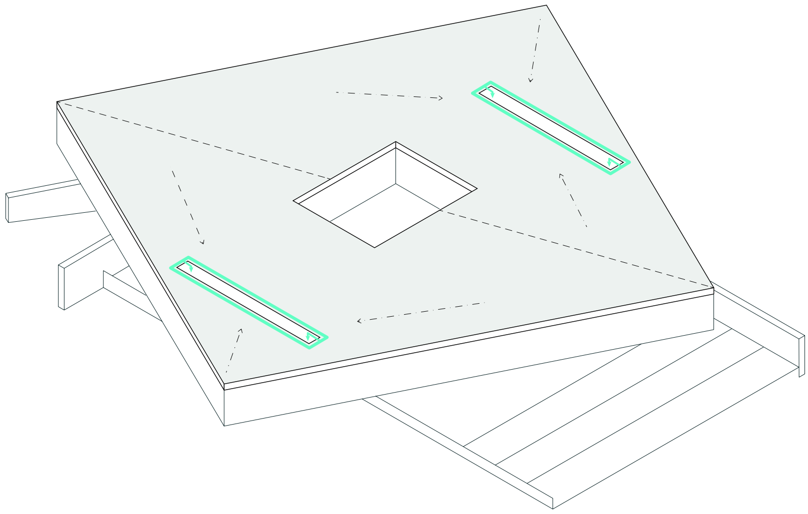
Channel choice

Channel type	*10x10 cm*
Suggested slope	*0,5 %*
Channel flow rate	*3,3 l/s*

Since:
Channel flow rate > Rainfall Flow-rate (3,3 > 1,3) — *Channel is sufficient*

Vertical pipe choice

Pipe DN	*100*
Number of pipes	*4*
Distance between pipes	*29,4 m*



WATER SUPPLY

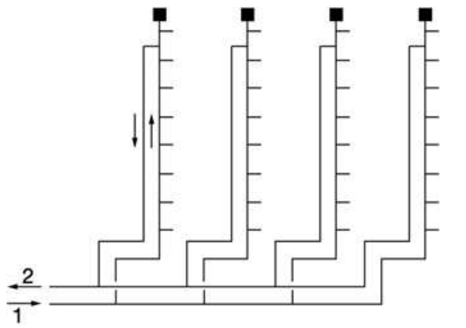
EN UNI 806-3

Hot and recirculation distribution

Scheme: System with bottom-up water supply and hot water preparation at bottom level

- supply and recirculation manifolds at the bottom
- supply pipe (column) rising water
- recirculation pipe descending water

1 supply
2 recirculation



HOT AND COLD PIPE SIZING CALCULATIONS

- Loading Unit (LU)

Draw-off point	Q_A	Q_{min}	Loading units
	l/s	l/s	
Washbasin, handbasin, bidet, WC-cistern	0,1	0,1	1
Domestic kitchen sink, washing machine [a], dish washing machine, sink, shower head	0,2	0,15	2
Urinal flush valve	0,3	0,15	3
Bath domestic	0,4	0,3	4
Taps /garden/garage)	0,5	0,4	5
Non domestic kitchen sink DN 20, bath non domestic	0,8	0,8	8
Flush valve DN 20	1,5	1,0	15

[a] For non domestic appliances check with manufacturer.

determination of pipe diameters - plastic materials

Table 3.8 — PEX/AL/PE-HD resp. PE-MD/AL/PE-HD											
Max. load	LU	3	4	5	6	10	20	55	180	540	1 300
Highest value	LU			4	5	5	8				
d_a x s	mm	16 x 2,25/16 x 2,0			18 x 2	20 x 2,5	26 x 3	32 x 3	40 x 3,5	50 x 4	63 x 4,5
d_i	mm	11,5/12,0			14	15	20	26	33	42	54
Max length of pipe	m	9	5	4							

Calculation of Library toilet facilities

7 washbasins + 11 WC cisterns = 18 LU (1,8 l/s)

DN 26

Calculation of Museum toilet facilities

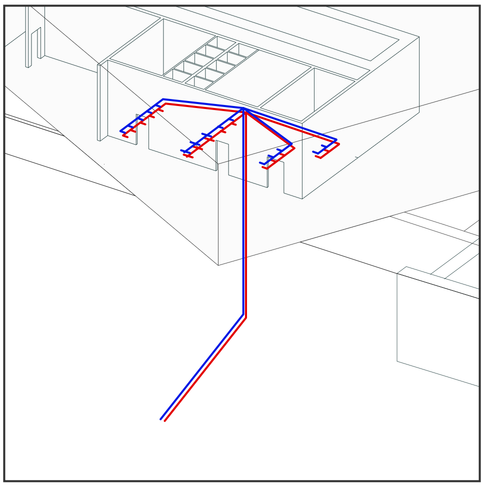
14 washbasins + 16 WC cisterns = 30 LU (3 l/s)

DN 32

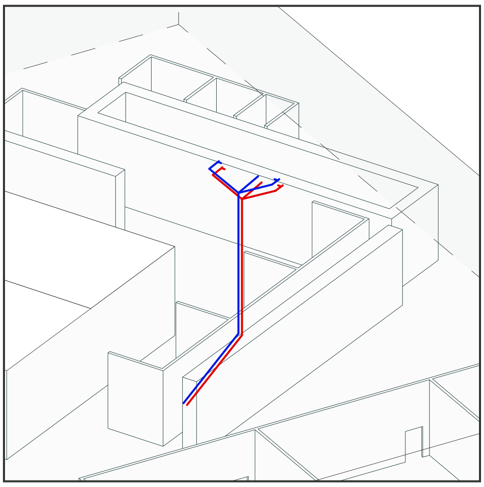
Calculation of Cafe toilet and kitchen facilities

DN 20

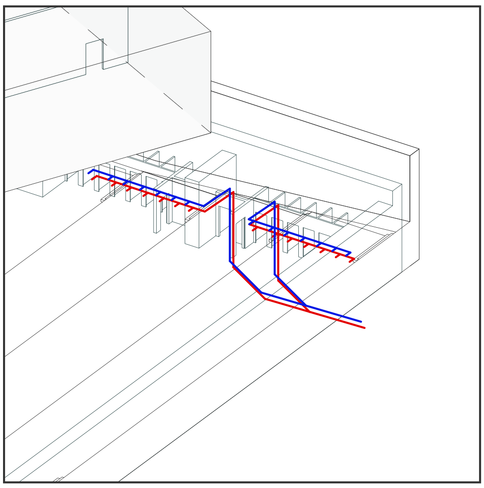
1



2



3



BIBLIOGRAPHY

- Pallasmaa Juhani, The Embodied Image: Imagination and Imagery in Architecture, Chichester, Wiley, 2011
- Holl Steven, Parallax, Boston, Princeton Architectural Press, 2000
- Kostof S., The city assembled: the elements of urban form through history, London, Thames & Hudson, 1999
- Rogers E. N., Gli elementi del fenomeno architettonico, Napoli, Guida, 1981
- Sauvaget J., Alep: essai sur le développement d'une grande ville syrienne des origines au milieu du XIXe siècle, Paris, Fondation de Clercq, 1941
- Neglia G. A., Aleppo: processi di formazione della città medievale, Bari, Poliba press, 2009
- Neglia G. A., An interpretation of the urban fabric: the structure of the pre-islamic Aleppo, Bari, Poliba press, 2006
- David J.C., Alep, Paris, Flammarion, 2002
- Mortada H., Traditional islamic principles of built environment, London, Routledge, 2003
- Gonnella, J., The Citadel of Aleppo, Geneva, Aga Khan Trust for Culture, 2007
- Bianca S., Syria: Medieval Citadels Between East and West, Italy, Aga Khan Trust for Culture, 2007
- Bianca S., Urban form in the Arab World, past and present, London, Thames and Hudson, 2000
- Ruggles D. F., Islamic gardens and Landscapes, University of Pynnsylvania , 2008
- Savignoni D., Bressan M., Siria: il perché di una guerra, Salerno, Salerno editrice, 2017
- Quirico D., Succede ad Aleppo, Bari, Laterza, 2017
- Guidetti M., Aita S., Siria : dalle antiche città-stato alla primavera interrotta di Damasco, Milano, Jaca Book, 2006
- David J.C., Ruba K., Five years of conflict. The State of Cultural Heritage in the Ancient city of Aleppo, Paris, UNITAR, 2018
- Kilcullen D., Rosenblatt N., Qudsi J., Mapping the conflict in Aleppo, Syria, Caerus Associates, 2014
- Kutiefan L., Abdulkarim M., State Party report. On the state of conservation of the Syrian Cultural Heritage Sites, Syrian Ministry of Culture, 2017
- Qudsi J., Rebuilding old Aleppo. Postwar sustainable recovery and urban refugee resettlement, New York, 2018