POLITECNICO DI TORINO

Green Building Engineering Master Degree

URBAN SURVEY OF THE BUILDING FABRIC OF CARIGNANO. PROPOSAL OF URBAN REGENERATION PROJECT IN THE AREA OF THE FORMER BONA WOOL MILL.

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SUMMARY

ABSTRACT

The present elaboration analyzes the phenomenon of the former dismissed industrial areas and in particular of the complex belonging to the wool trade industries of the Bona brothers located in Carignano. After a brief introduction on the history of the city and how the building morphology of the place has changed over the years, we will proceed to analyze in detail the area concerned: the former wool mill Bona. The 3D modeling work in Revit of the complex from the last years of the nineteenth century until today will be illustrated. This will be followed by the explanation of the concept of industrial archeology as a testimony of human activities and his past, addressing the theme of the reuse of these structures that today appear to be "empty spaces". After carrying out a survey on industrial reuse projects worldwide, then Europe, Italy and the piedmontese territory, the ultimate aim of this thesis work is to present a possible idea of reuse project of the Ex Bona Wool Milll, or rather of those spaces or buildings that have been neglected over the years, but which have a great historical and cultural importance for the city.

1. CARIGNANO: THE CITY AND ITS DEVELOPEMENT

Carignano is an Italian town located about 20 km south of Turin. The position of the municipality is totally flat, with a slight slope from south to north, with altitudes varying from 238 m (south-west end) to 224 m (strip along the Po River). A characteristic element is the vast territorial extension, equal to 50.68 square kilometers, one of the largest in all of Piedmont. The municipality is characterized by the presence of one of the most important historical centers of Piedmont [*Figure 1*], mainly baroque, with medieval parts.

Figure 1 – Historical city center of Carignano. In the center of the photo there is the Dome designed by Benedetto Alfieri and in de left corner one of the buildings of the former Bona wool mill.

Inside the historic center there are many religious, public and private buildings of significant historical and environmental interest.

A second element characterizing the territory is the Po River [*Figure 2*], which partly delimits the boundaries of the city. The third component that marks the historical-environmental context is constituted by the flat territory, totally cultivated and very fertile, with the presence of a widespread system of historic rural villages and isolated farmhouses.

It is interesting to see how the Bona factory has not brought an increase in the number of inhabitants: this means that it has given work to those already present in a period that was characterized by a strong widespread poverty.

The lot of the Bona factory is in the central area of the town and has an area of 15500 square meters [*Figure 2*]. The large building influences the entire surrounding area, consisting largely of 2-3 storey buildings with residential use.

Figure 2 – Aerial view of the Carignano's city center. The area in yellow is the one currently occupied by the Former bona wool mill, on the right side of the image, the Po River.

The very impressive dimensions of each individual factory building, and the current town hall create a real detachment from the surrounding buildings. The insertion of a large complex in the center of a city with a small number of inhabitants has led not only to a change in the architectural style of the buildings bordering the lot, but above all a clear change in the viability of the urban agglomeration. To summarize this insertion, the main changes to the Carignano road system are discussed below.

The city in medieval period is characterized by the presence of the castle and the doors that create an obligatory main path. There were two main roads, one north-south and one east-west [*Figure 3*], which allowed to easily cross the city. The demolition of the walls of the historic center took place in the year 1544. Following this event, the axis of the north-south crossing city moved westwards reaching the current Via Umberto I [*Figure 2.b*] and Piazza Carlo Alberto.

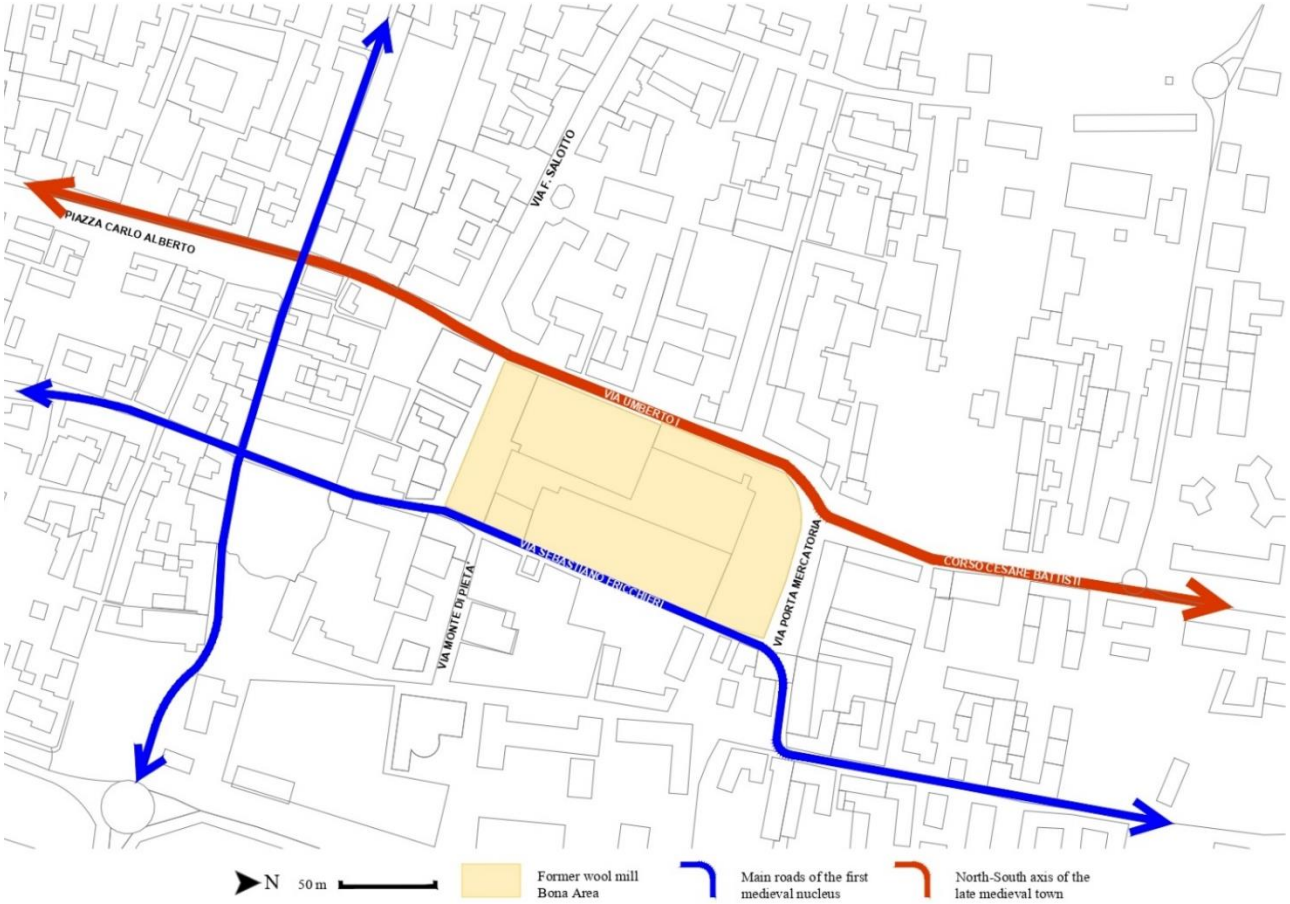


Figure 3 – Plan of the current historic center of Carignano, where the main axes of the city during the XV century are identified.

It is in this period that what is called the "compact city" can be identified: a main street divides the city into a historic area and a new urban center reachable thanks to new transversal streets, none of which will become main compared to the others.
In this period the parish and the old town hall are built, both on the main east-west street, in order to align with the castle.
In the lot of the wool mill there is the monastery of S. Chiara with a small church attached.
In the Baroque period there is a settling of the city. The development takes place along the main route, so that the city, when viewed from above, takes on an increasingly elongated shape. To the west, the strip previously occupied by rural buildings records a progressive consolidation of the road network and consequently the definition of a new urban fabric. The streets that characterize the formation of this new part of the city are the current Via Salotto and a new street parallel to the main one in a north-south direction [*Figure 4*]. To the east in the heart of the town there are four settlements of ecclesiastical buildings. In the following years there are essentially two grafts that go to modify the fabric the most: the hospice of Charity by Bernardo Vittone dating back to 1749, built along the main street, and the new parish of Benedetto Alfieri completed in 1764 and built in the historic center.

Figure 4 - Plan of the current historic center of Carignano, where the main axes of the city at the end of the XVII century are identified.

The nineteenth century is characterized by the crisis that delays development and generates poverty throughout the territory. From the urban point of view, you can only find public works such as the cemetery, north of the village, and the kindergarten (1861). Of central importance for the growth and evolution of the city is the large block occupied by the Bona wool mill. The history of the wool mill originated on July 9, 1888 when the Cologno Borgnana ceded every right and every obligation to the company of the Bona brothers. In that year, therefore, the former convent was bought in full by the Bona brothers who began the construction of the woolen mill.

Surely the transformation and the succession of events that will affect this area will lead to a change in the economic and social structure of the city.

The body of the factory, in the following years, will assimilate and gradually replace the structures of the ancient monastery of S. Chiara until it occupies the entire available area. From satellite photos it is clear how, on a "city" scale, the factory prevails over all the neighboring buildings [*Figure 4*].

This intervention, in addition to changing the urban structure, affects the viability. The north-south communication axis is becoming increasingly important, alongside the entire factory to pass near the main square. The shape of the city is increasingly elongated, and the transverse streets only serve more as internal connections.

The recovery of the wool mill, at the point of implementation originates in the 80s and sees the transformation of the factory for a complete change of destination and architectural style. This intervention does not change the road layout of the city, now defined. To facilitate the disposal of

extra-city traffic, a ring road is built between the center and the Po River, parallel to the north-south road axis [*Figure 5*].
The location of the Municipality changes, which is transferred to the recovered premises of the former wool mill. Today, therefore, the main urban communication route is only one, the one with a north-south axis connecting Turin and Carmagnola, a city that is located 30 km south of Turin. Municipality and parish remain aligned, but along a secondary street, both inserted between the historic center and the former wool mill area.

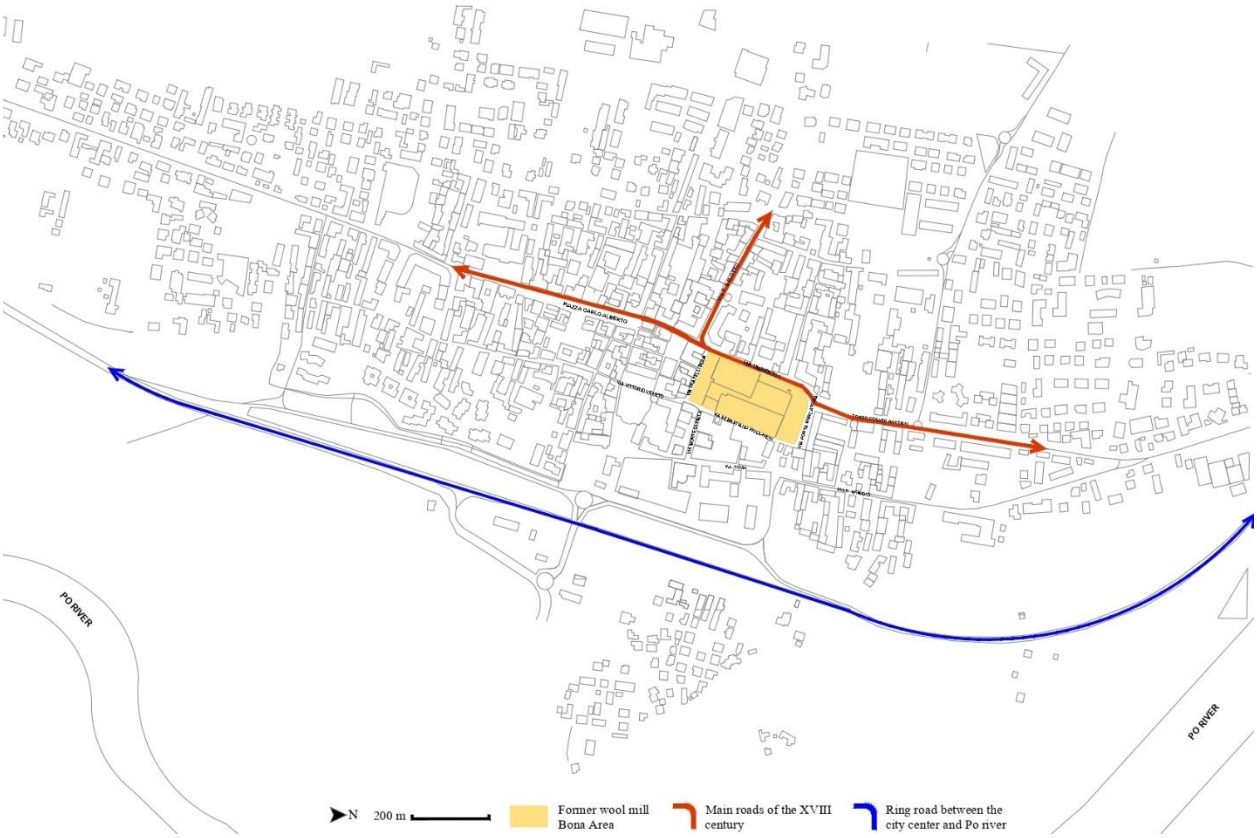


Figure 5 - Plan of the current historic center of Carignano, where the main axes of the city at the end of the XX century are identified.

2. THE INDUSTRIAL ERA IN CARIGNANO

With the term industrial era we can designate the historical phase in which those processes of generalized transformation of socio-economic and technical-productive structures developed. These processes have marked the territory and the city with modifications and new building interventions, often in contrast and break with the traditional structure. Carignano, even if it did not have macroscopic alterations of the urban form, was nevertheless affected by the transformations of the industrial era. The nineteenth century and the industrial era materially filtered the consistency and structure of the ancient city, due to a new organization of civil society, land ownership, production: irreversibly transforming the rest, building significant parts of the city and new structures thus expressing all the values and contradictions of the time. Among these testimonies it is certainly worth mentioning the wool mill complex, one of the most significant industrial works of the city for extension and consistency, which turns out to be an irreplaceable historical document that testifies: the specific methods of its settlement, the location in the urban center, the documentation of the technological evolution of industrial construction, of the professional roles and of the business sector connected to them, in a decisive period for the evolution of Italian industry.
In order to better understand how the integration of an industry of such dimensions in a city center took place and how this has changed the morphology of the place, a research was conducted on the history of the city and of the complex in particular, from which four 3D models were produced, that act as "photos" of the area in exam and that allow us to understand what was the transformation process for which it came to the Current status.
For the realization of the 3D models on Revit of the wool mill from the late nineteenth century until the mid-twentieth century, the heights of the buildings have been deduced from on the philological-conjectural surveys of the Institute of Technical Architecture of the Politecnico di Torino which refer to the conventional representation of historical urban aggregates mainly characterized by multiple buildings (extracted from the UNI 7310-74 standard) combined with the information obtained from the project tables of the wood mill preserved in the State Archive of Turin and the Municipal Archive of Carignano (longitudinal and transversal section and elevations of the monastery of Santa Chiara by Eng. Viotti). The undeniable importance of the former Lanificio Bona from an architectural point of view, has made it necessary, for cognitive purposes and to describe the peculiarity of the phenomenon of conversion from monastery to place of industrial activity, "telling the story" of the complex, highlighting the most relevant aspects and the stages of building transformation, based on a research curated by the "G. Rodolfo" Civic Museum of Carignano and collected in four volumes entitled Carignano, points for a reading of the city (1973-1980) and from the second volume of the “Quaderni Carignanesi” of 1971 by G.B. Lusso, on the "Pious places" (I Luoghi pii) of the city and as regards the building transformations of the complex, on the philological-conjectural surveys of the Institute of Technical Architecture of the Polytechnic of Turin carried out in 1975.

3. THE MONASTERY OF SANTA CHIARA: THE HISTORY

The history of the monastery of Santa Chiara has ancient origins, the first plant dates back to 1250 and was built outside the walls. The settlement on the site, now occupied by the woolen mill "V. E. F.lli Bona", took place around 1370 following the destruction of the first monastery due to a war.
The nuns were forced to leave the monastery and invited to take refuge in a palace of the Provana's family and some huts of their way at the Porta dei Meinardi, a refuge that they adapted to monastery and cloister after being able to obtain permission from the bishop of Turin. They also asked permission to build a church where, on June 3, 1372, the first mass was celebrated.
The Provana family, always devoted to the holy institution of the nuns of S. Chiara, bequeathed them much of the wealth of the family, expanding the spaces of the monastery more and more. The nuns were also offered the palace in Via S. Chiara now Via Frichieri which, following transformation works, was also adapted to a useful space for monastic life.
The new church did not seem to be the result of a single organic design, it was composed of five naves, with twenty-five altars, a rather high number that seems to have the sole purpose of offering noble families the possibility of having their own altar with its tomb.
The XV-XVI were centuries of severe reforms of monastic life, but also of wars and plagues that led to halving the number of nuns that the monastery hosted. The plague of 1630 and the calamities due to the Thirty Years' War took the suffering of the city to extremes, so much so that in that year there were only twelve nuns compared to forty-one in 1484.
Once the wars and plague epidemics ceased, life began to flourish again and following the entry into the monastery of about twenty-four novices, transformations and new construction interventions were necessary between 1674 and 1686.

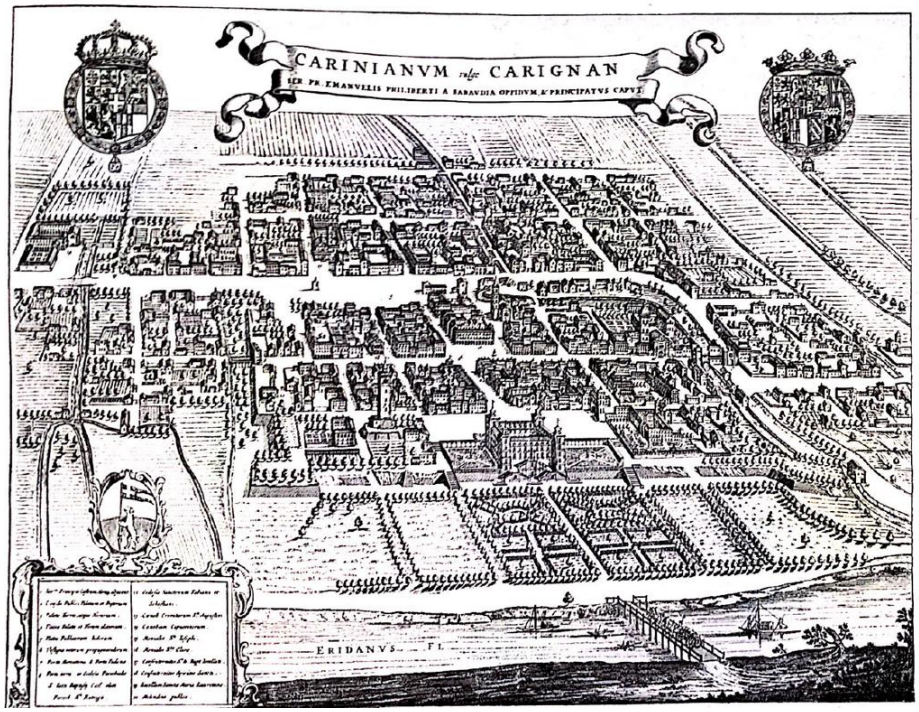


Figure 6 - Representation of the theatrum sabaudiae that reproduces the situation of the buildings around 1666.

These interventions concern the construction of a new building for the nuns and a new church [*Figure 7*] as the previous one, given its bulky volume, had been reduced over the years and was now in pitiful

conditions. The project for the new church completed in 1686 was entrusted to the engineer Francesco Lanfranchi who had prepared the drawings since 1667. In 1729 the bell tower was also raised.

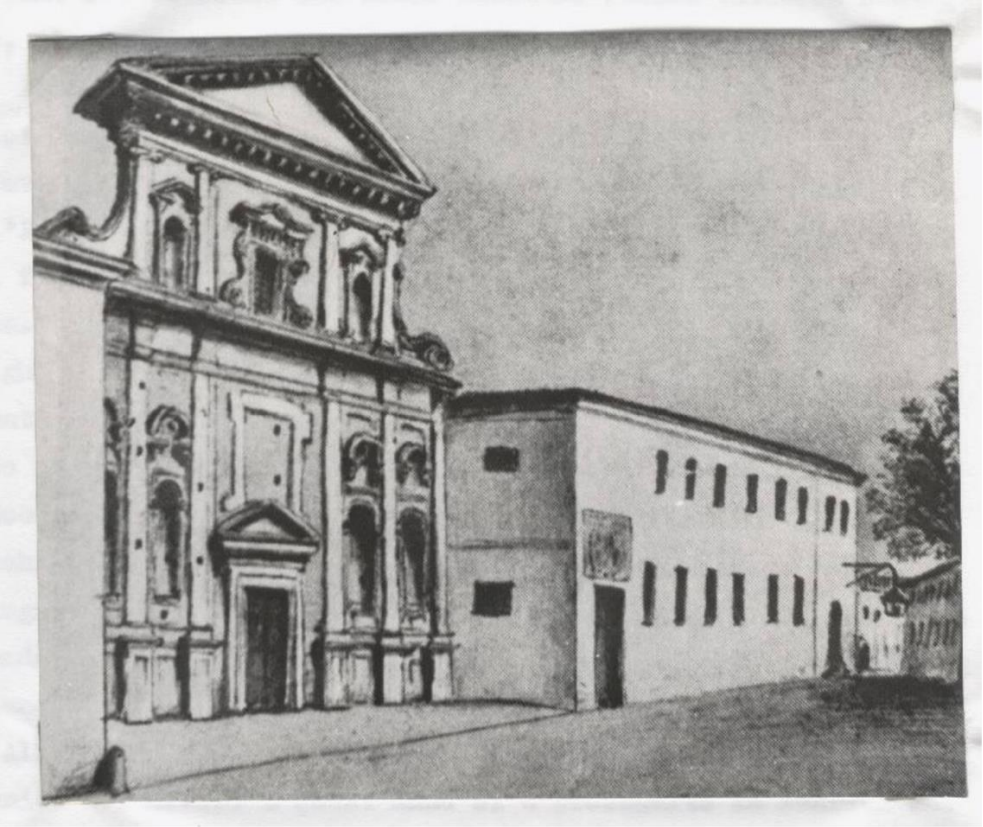


Figure 7 - Facade of the S. Chiara's church in Carignano.

In 1689 the nuns with the intention of further expanding the spaces of the monastery managed to give up the uncultivated space between the bealera river and the current Via Umberto I, thus occupying a large area in the city center.

With the French Revolution and the Napoleonic regime that followed, the city of Carignano was shaken by wars and riots that began to break out in 1797. Bloody struggles and persecutions against the church and religious orders in general followed, also because of the greed for the goods they possessed. In 1802 the cloister in the monastery of S. Chiara was violated and the nuns were forced to evacuate the monastery that became the property of the state. In the following years the monastery had been divided into many lodgings by the Municipality and a college had been implanted, a symbol of evolution of the new times, unlike the monastery.

Only after fourteen years of exile in September 1816, the nuns returned to the monastery. The quiet period, however, did not last long, because following the application of the law of the Kingdom of Sardinia on the suppression of religious congregations (Rattazzi law, of 29 May 1855), confirmed in the Kingdom of Italy with the laws of 7 July 1866 and 15 August 1867, the nuns were ordered to seize and requisition the goods in their possession, forcing them to live more and more in imprisonment.

The law of 7 July 1866, suppressing ecclesiastical orders that imported common life and forfeiture of their property to the State, promulgated in the middle of the III war of Independence, was among the first measures aimed at the readjustment of finances, in a serious situation for years. For Carignano, it is interesting to remember the art. 6 which provided for the communities of nuns, the faculty to

continue to live in convents, except for exclusion for public utility, and art. 20: "The buildings of the convents suppressed by this or previous laws shall be granted to the municipalities and provinces provided that they are requested (...) and the need for and use of schools, kindergartens, begging shelters, hospitals or other charitable and public utility works is justified" (r.d. n. 3036 , 7 July 1866). The law of 15 August 1867 concerns the forfeiture to the State Property of all the assets of ecclesiastical bodies, of which it provides for the alienation "through public auctions", "divided into small lots as far as possible, taking into account economic interests, agrarian conditions and local circumstances" (r.d. n. 3848, 15 August 1867).
It is in 1880 that the sisters leave the convent definitively joining the Salesian nuns of Arona and with the help of the archbishop of Turin, they found as a new arrangement the parish of S. Giovanni in Racconigi. In that year the church of S. Chiara was also closed forever to worship.

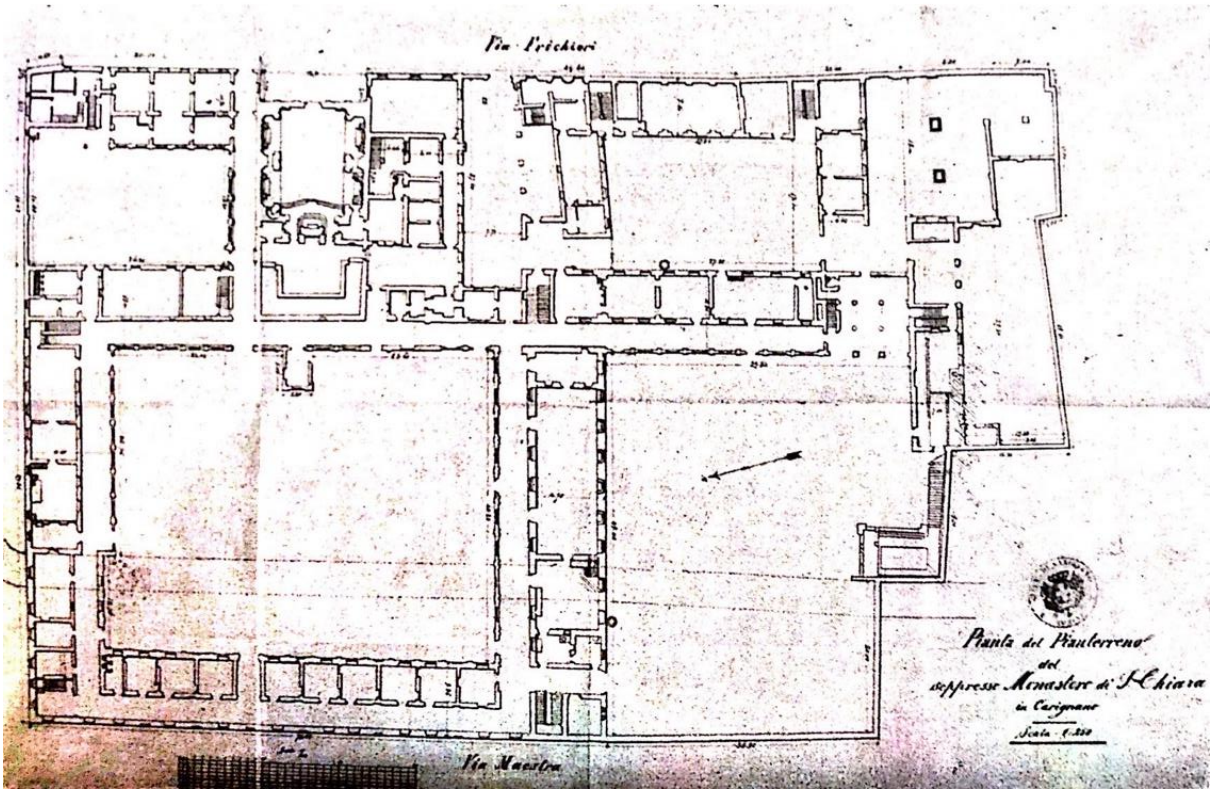


Figure 8 - Ground floor Plan of the suppressed monastery of S. Chiara, surveyed in 1881 by Ing. Viotti and preserved in the municipal archive of Carignano.

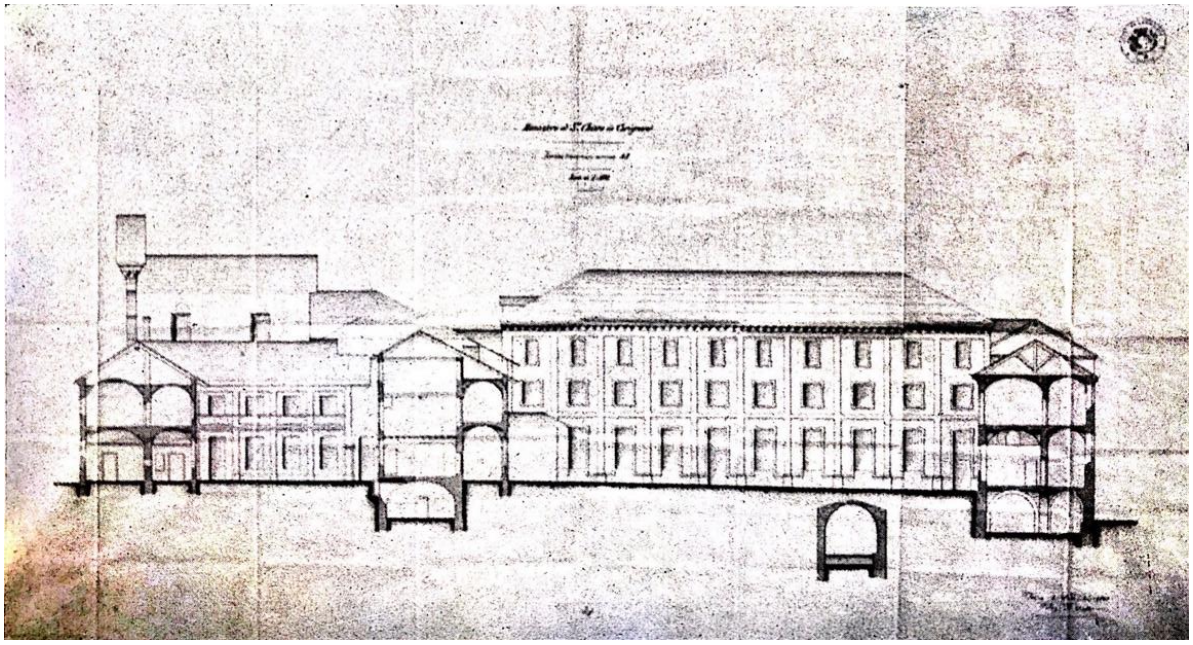
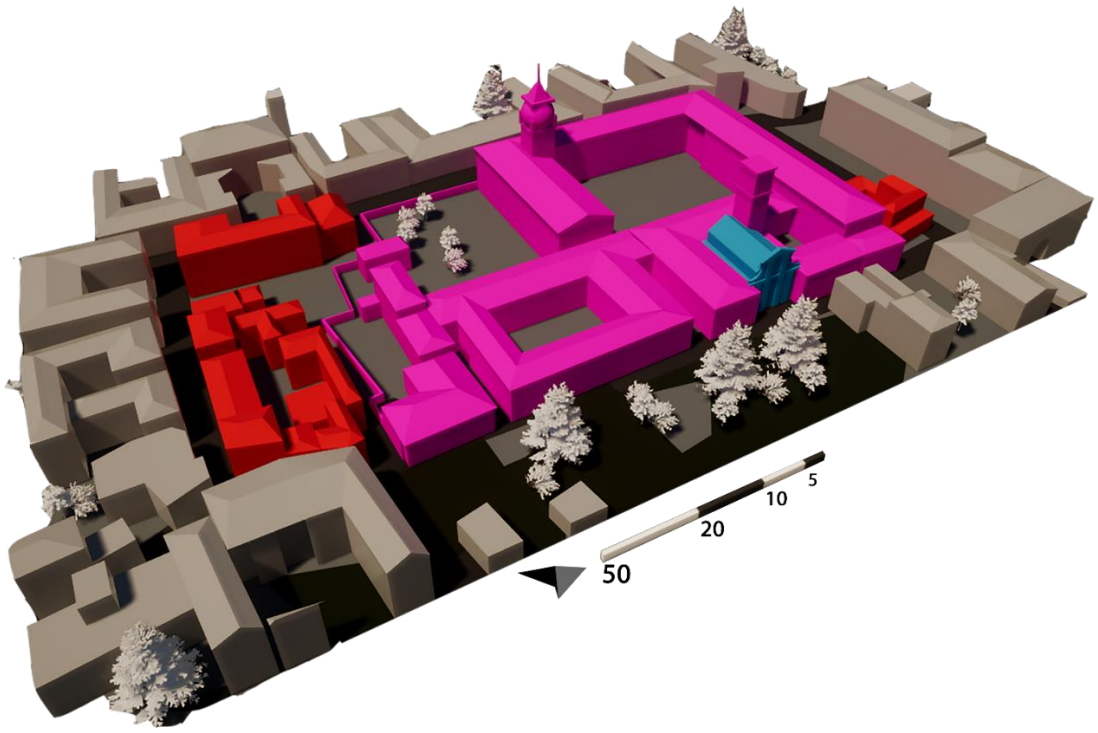


Figure 9 – Longitudinal section and elevation of the monastery of S. Chiara, surveyed in 1881 by Ing. Viotti and preserved in the municipal archive of Carignano.

At the departure of the nuns, the Municipality began the practices to buy from the State Property the buildings and land of the former monastery (more than one hectare). Proposals for public destination were immediately made by the promoter of the acquisition, Councilor Avv.to Adamini, rather gloomy and substantially unproductive, such as conversion into a criminal asylum or prison establishment. Subsequently, differences on the approach and control of teaching, made the negotiations between the Municipality and Don Bosco for the installation of a school stalled; The only condition for the sale of the complex became the creation of an industrial plant and thus the creation of new jobs.
Below [*Figure 10*] is the plan and the 3D model of the situation affected by the lot that today houses the buildings of the bona industry. These documents are intended to make the reader understand the reconstruction process that has been done starting from all the various sources available in order to assemble what seems to be the most consistent idea with all the information.



Buildings of the former S. Chiara monastery before the conversion into wool mill.
Sources: from "Carignano: appunti per una lettura della città", Conjectural philological survey, late XIX century.

Private buildings that became property of the wool mill.
Sources: from "Carignano: appunti per una lettura della città", Conjectural philological survey, late XIX century.

S. Chiara's church
Sources: *Figure 6; Figure 14*

Figure 10 - Three-dimensional reconstruction of the morphology of the lot in the late XVIII century.

4. FROM MONASTERY TO BONA WOOL INDUSTRY

4.1 HISTORY OF THE SOCIETY

The birthplace of the Bona family was the Biellese, who already in the mid-nineteenth century held the supremacy of the wool industry in Piedmont, on the basis of the old wool and cotton settlements at the bottom of the valley of seventeenth-eighteenth-century derivation. From their native land the two brothers inherited the interest in the textile business, but it was not in the Biellesse area that they dedicated themselves to it, they did it in Carignano, which at that time was an eminently agricultural place. A great textile company, developed in progress and work, at the forefront of the industrial field, this was what they saw, and this was what pushed them forward.

Valerio Massimo and Eugenio acquired the basics of the technique working in Caselle Torinese for nine years in the ancient woolen mill Laclaire, in partnership with the brothers Battista and Basilio Bona. "In 1889, only Basilio remained in the wool mill of Caselle, they moved to Carignano, where they founded a new company, the “Lanificio V.E.Flli Bona”: February 1, 1889 was the official date of establishment. The first seat of the wool mill was precisely the old monastery of the nuns of S. Chiara which was adapted to an establishment in 1884. The beginnings were hard: it would be long to list the environmental difficulties that the two brothers had to overcome to progressively transform the primitive plant and gradually bring it to that production capacity required by the market, adapting entrepreneurial activity to the rapid change in economic, political and social conditions. Soon his nephew Lorenzo Delleani joined the management of the company, who facilitated its consolidation and development.

Valerio Massimo Bona died in 1898, the same year in which V.E.Flli Bona won the First Class Gold Medal at the Turin Exhibition. In 1913 another bereavement struck the company with the death of Eugenio, the other founder. He, in the will drawn up a few years earlier, had designated Lorenzo Delleani as universal heir.

In order not to break the path taken by the company, Lorenzo Delleani continued to keep alive the vital spirit of the family by calling under his direction the young forces: Lorenzo Valerio and Gaspare, sons of Valerio Massimo; Eugenio Delleani and Federico Maggia, his nephews.

The history of V.E.Flli Bona was, therefore, destined to develop closely around the story of a family.

The success of the company in those years can be seen from the number of workers employed in V.E.Flli Bona: in 1889 the number was around a hundred, in 1923, however, it reached the figure of 1800 employees, divided between Carignano, Voltri and in the third branch of the plant opened in Carmagnola, intended exclusively for weaving.

One of the predominant figures in the management of the company was Lorenzo Valerio Bona. Endowed with an eclectic culture, he took in himself the pioneering impulse of his elders and developed it in the art of conducting.

To get out of the post-war conversion phase and above all to overcome the "great crisis" of 1929 for the textile industry better than possible.

When the Second World War broke out, Lorenzo Valerio fought participating in operations on the Greek-Albanian line and retired as a senior in 1941. Gaspare Bona lost his life in the army in 1940 in an air conflict. The V.E.Flli Bona during the war, however, maintained production, trying to win large contracts with the Army Bodies for supplies of cloths for uniforms.

In 1944 the V.E.Flli Bona acquired the company MADA (Manifatture Abiti Divisa e Affini) in Turin, used for the façon processing of military cloths. Among the war damages declared by V.E.Flli Bona there were those related to the bombing of the Turin plant and numerous thefts, by "armed gangs" that is, by formations of partisans, goods and equipment.
By 1946 V.E.Flli Bona had reached a leading position on the wool fabric market, both for the modernity of the industrial equipment and for the breadth of its clientele.
Despite this rich financial situation, on 29 December 1947 the dissolution was formalized, on 20 August 1947, and the consequent passage into liquidation of the Company. The problems had arisen from within, therefore, "due to disputes arising between the partners", as we read in the first letters sent to the legal consultants in 1946. "It is not possible to continue the operation of the company in the current state of uncertainty, tension and nervousness": Federico Maggia wrote to Lorenzo Valerio Bona underlining an exhaustion of relationships.
The distribution projects were numerous and the controversy about it was heated. On 27 May 1949 a final solution was reached for the division into three lots:

- the first in Turin: headquarters and plant in the SASIT buildings, in via Bologna n° 220, with a covered area of 17924 square meters and complete with 50 frames and 900 carded spindles
- the second in Carignano: headquarters and factory in via Frichieri n ° 9, with a covered area of 29764 square meters and complete with 125 frames, 3000 carded spindles and 3000 combed spindles. This lot is called Carignano Vecchio
- the third in Carignano: with two plants, one in Carmagnola (3110 square meters) in the buildings already home to V.E.Flli Bona and the other in Carignano, to be built new, and complete with 125 frames, 3000 carded spindles, 3000 combed spindles.

In 1951, after a tender won by the company Monateri, work began on the construction of the new factory in Via Salotto called Carignano Nuovo. And on August 5, 1953 the liquidation of V.E.Flli Bona ended by drawing lots that assigned Federico Maggia the Turin plant; Lorenzo Delleani the Carignano Vecchio plant and Lorenzo Valerio Bona the Carignano Nuovo plant.
The economic results of the first financial years of the new company were not brilliant, due to the unhappy structural and economic conditions in which the company found itself at the beginning of its activity. The long period of liquidation of "V.E.Flli Bona" involved, in fact, a slowdown in company control, especially from the production point of view, and in the renewal of the machinery, and an outlay of huge capital in the construction of the new plant
Ultimately, only in October 1957, after a difficult but constant journey of business economics, began a new period that led to an effective reintegration of the "Lanifici Riuniti Bona e Delleani" in market competitions in the national and international field. After the first financial years closed at a loss, it came to a management of the "Lanifici Riuniti Bona e Delleani" widely active in the years 1959 and following.
In this way the delicate economic equilibrium was maintained until 1962, on the eve of the greatest sectoral crisis that the Italian wool industry has ever been able to endure. In 1962 the crisis coincided with a very serious renewal of the National Labor Contract, which marked the beginning of a process of wage inflation that almost doubled the cost of labor over the next four years. Lanificio Bona was tried very hard by the crisis throughout 1964 and most of 1965.
Unfortunately, despite numerous attempts at planning in order to find a new balance of production and expansion towards new textile fibers and also new partners overseas (USA), all efforts were in vain.

Lanificio Bona was unable to solve the problem of the precarious balance between equity capital and third-party capital. The dates on the preserved documents do not go beyond 1973: two years earlier Lorenzo Valerio Bona died, and it seems that the wool mill, launched more than eighty years ago, could not help but accompany its last great captain.

4.2 BUILDING INTERVENTIONS: 1888-1905

After a brief excursus on what was the birth, the period of maximum fertility and the fall of the company of the Bona Brothers it is necessary to understand the succession of events and therefore of the transformations that took place in the past which morphologically characterized the "structure" and "image" of the area. The first interventions of the Bona had a purely utilitarian character and, although poorly documented, consisted of some minimal internal changes and windows, in particular those along Via Umberto Primo. The only exception was the new entrance door entrusted to a renowned professional, Camillo Riccio, dated August 18, 1888 [*Figure 11*]

Figure 11 – View of the entrance in the early 900 where they are visible, in addition to the bell tower "dell'Ubbedienza" and that of Lanfranchi, two chimneys, one of which was later demolished.

The first major intervention in the area, however, was the reconstruction of a large part of the north sleeve of the perimeter buildings of the cloister, used as a weaving department [*Figure 12*]. The existing building was rebuilt with three floors, as originally, but adopting a scheme that minimized the overall dimensions of the structure: the load-bearing walls were replaced with a row of cylindrical brick pylons and above them a cubic capital. The choice of bricks was due to the problem of possible fires that could affect the factory and that with this material could be slowed down, or at least not accelerated. The attention of the Bona to this aspect is due to the previous fire of their factory in Caselle and is also evidenced by the choice to adopt a more modern electric lighting system, preferred to the gas one.

Figure 12 - View of the bealera river, before the covering in 1900, which ran in the open sky north of the northern city walls. In the photo it's possible to see the buildings of the former monastery and the chimney that a few years later was demolished.

In 1900 the complex was expanded in the northern and southern parts of the ancient monastery with the inclusion of warehouses illuminated with sheds, according to the most up-to-date guidelines of the technological organization of the processes. The documents concerning these interventions are kept in the (Porcheddu Archive, practice n. 578-10260; 2187).

The roofing of the spinning mill located south of the former and extensively remodeled convent was built in two stages: the first in 1906 saw the use of cast iron pillars and wooden structure, the second, dating back to 1920, in reinforced concrete. The building occupies an important part of the façade on Via Umberto I [*Figure 13*] and due to the narrowness of the street appears thickly serrated and full of signs. The module that is repeated ten times is that of a gabled front, in plastered masonry, symmetrically divided by three bands and marked by two large windows.

Figure 13 – View of Via Umberto I in the early XIX cantury, before the construction of the first part of the weaving building, in 1906.

The shed is set back to give space to a triangular tympanum with symmetrical slopes, whose converse are marked by the ornate entrances of the downpipes in sheet metal; and at the center of which is located a central oculus, once useful to house the fans of the laboratory.

In the following years the Bona bought the adjacent areas, included in the lot, and obtained the license for the coverage of the Bealera, so that the available area became equal to 1.5 ha.

Below [*Figure 14*] is shown the 3D model up to year 1905, reconstructed through the sources listed in the legend.

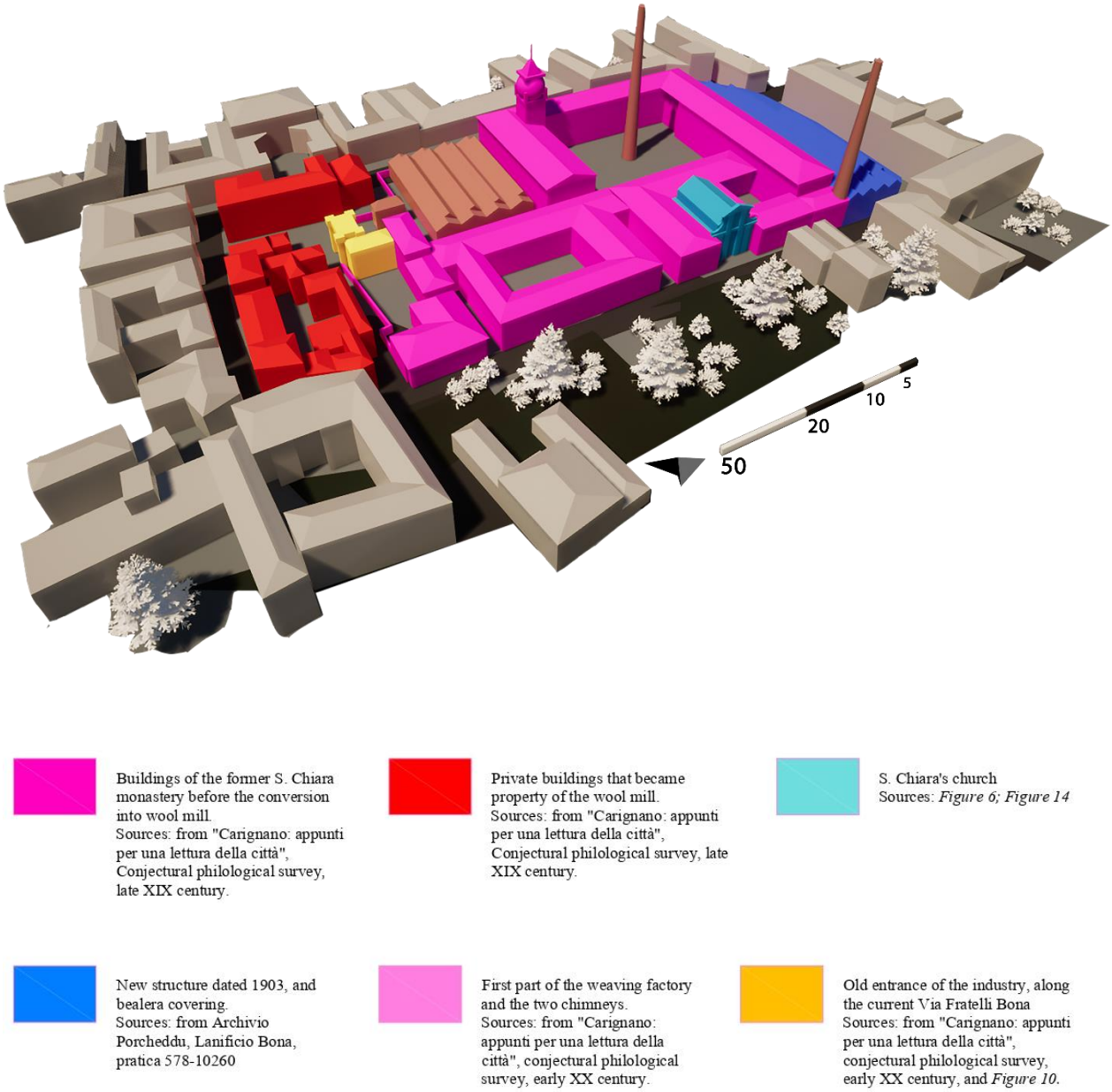


Figure 14 - Three-dimensional reconstruction of the morphology of the lot in the early XIX century.

4.3 BUILDING INTERVENTIONS: 1906-1970

In1906, after 20 years of neglect, the church of S. Chiara was demolished [*Figure 15*], after the bell tower had been demolished a few years earlier. The causes of these interventions were of a hygienic and economic-social nature. The space was occupied by the new dyeing department, designed by the Turin engineer Giuseppe Besozzi, inserted in a new warehouse with a flat roof with a slab made of reinforced concrete that adopts a Hennebique scheme like the previous ones.

Figure 15 – One of the last photos depicting the church of S. Chiara in the early 900s, seen from the gardens of the former town municipality. It is possible to see that the bell tower of Lanfranchi had already been demolished.

Of uncertain historical location, however not earlier than 1898, the construction of the building that was present in the current via Fricchieri on the corner with via Porta Mercatoria: a three-storey building organized on a grid of a modular structure, with a regular arrangement of large and uniform windows bordered by bands of plaster or grit, sometimes adorned. The narrow backgrounds were exposed brick. The destination of this building is thought to be offices or laboratories, but there is no absolute certainty. In 1920 another stretch of bealera was covered, the old entrance and two pre-existing houses were demolished to continue the trajectory of the spinning department on Via Umberto I.
After the war in 1920, characterizing is the construction of the office building and the adjoining entrance [*Figure 16*] not facing the city but placed in axis with Via Monte di Pietà, all designed by

Giuseppe Momo, illustrious engineer of the period. The crowning of the portal assumes a triangular tympanum shape that raises the coat of arms of the Bona house. The choice of such an unusual location for the main entrance to the building complex serves to facilitate transport with nearby Carmagnola and to bring the factory closer to the Bona villas. The predominant character of this door is the contrast that is created with the church of S. Giuseppe, attributed to Carlo Emanuele Lanfranchi, which closes the street on the other side, creating a sort of urban scenography.

Figure 16 – The current entrance of the former wool mill built in 1920, in line with Via Monte di Pietà.

The office building is spread over three floors and stands out for its external regularity, where the gray of the walls prevails on the windows, and for the detachment, from an architectural point of view, from the rest of the factory, such that it seems to want to highlight the prestige of administrative work compared to that in the factory. The structure, very regular, is made of reinforced concrete.
Of the two bell towers that existed on the lot, that of the church of S. Chiara and the one with the clock of the nuns, in the same year only the latter remains, but it will also be demolished in 1922 for the danger it posed to the establishment and the surrounding town. The clock was transferred to the bell tower of the *Chiesa della Misericordia*.
After the entrance door stands the building used for the sorting and preparation of wool. Built in 1926, it was located along Via al Teatro, the current Via F.lli Bona, and was characterized by modular regularity in reinforced concrete that reconnects to rationalist architecture.
The building that stood between the dyeing department and the office building, used as a fabric warehouse, mending, topping, and steam drying, resumed the typology of the prospectus of the dyeing plant. This construction built in the year 1924, based on rough setting of Momo, but according to a project of Eng. Antonio Gilberti, has a rectangular plan, of sides equal to 60 and 35 meters, and divided

into 12 bays on the long side and 7 on the short one, modular of 5 meters, was illuminated on the top floor by sheds. It was the most extensive intervention from the volumetric point of view of the whole complex. Its typology was then repeated in the constructive setting of the sleeve made by the same Eng. Gilberti along Via F.lli Bona. This building is part of the golden age of reinforced concrete structures, which in those years took over other types of construction, especially in the industrial field. This building completed the construction of the factory, to which was added only the renovation of the thermal power plant and a few completions works, such as the reconstruction of the north sleeve and the raising of a plane of the west sleeve, always by Eng. Momo.
After the years of crisis before 1929 the factory managed to maintain good standards of occupation but was hit in 1934 by curtailment policies and in 1935 by the import ban of wool for domestic consumption. Therefore, both building and industrial modernizations stopped. The last building intervention before moving to the new factory located in Via Salotto was the demolition of the south sleeve of the buildings of the old cloister.

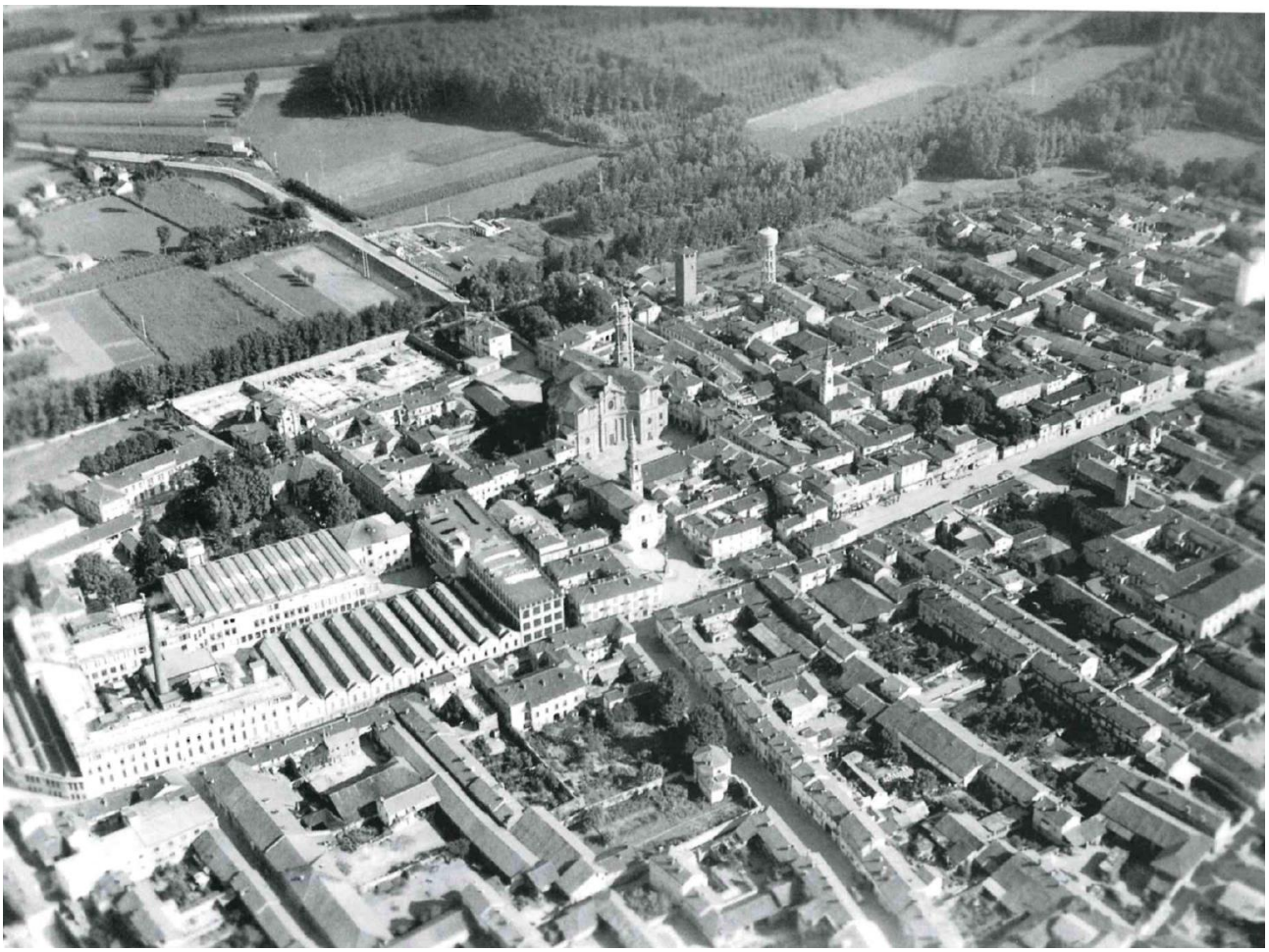


Figure 17 - Aerial view of the historic center of Carignano, 1953.

From the book *"Carignano: Appunti per una lettura della città"* is learned that in 1975 the factory was in poor condition, in several rooms were piled up disused machinery and abandoned material, while the new plant opened in the suburban area of the city had few workers. The entrance was inserted in the south side demolishing an old building that still existed; A chimney was built in the center of the courtyard that in the early 90s was the subject of transformation by the architect Alberto Sartoris.

Below [*Figure 18*] is shown the 3D model of the middle of the XX Century, reconstructed through the sources listed in the legend.

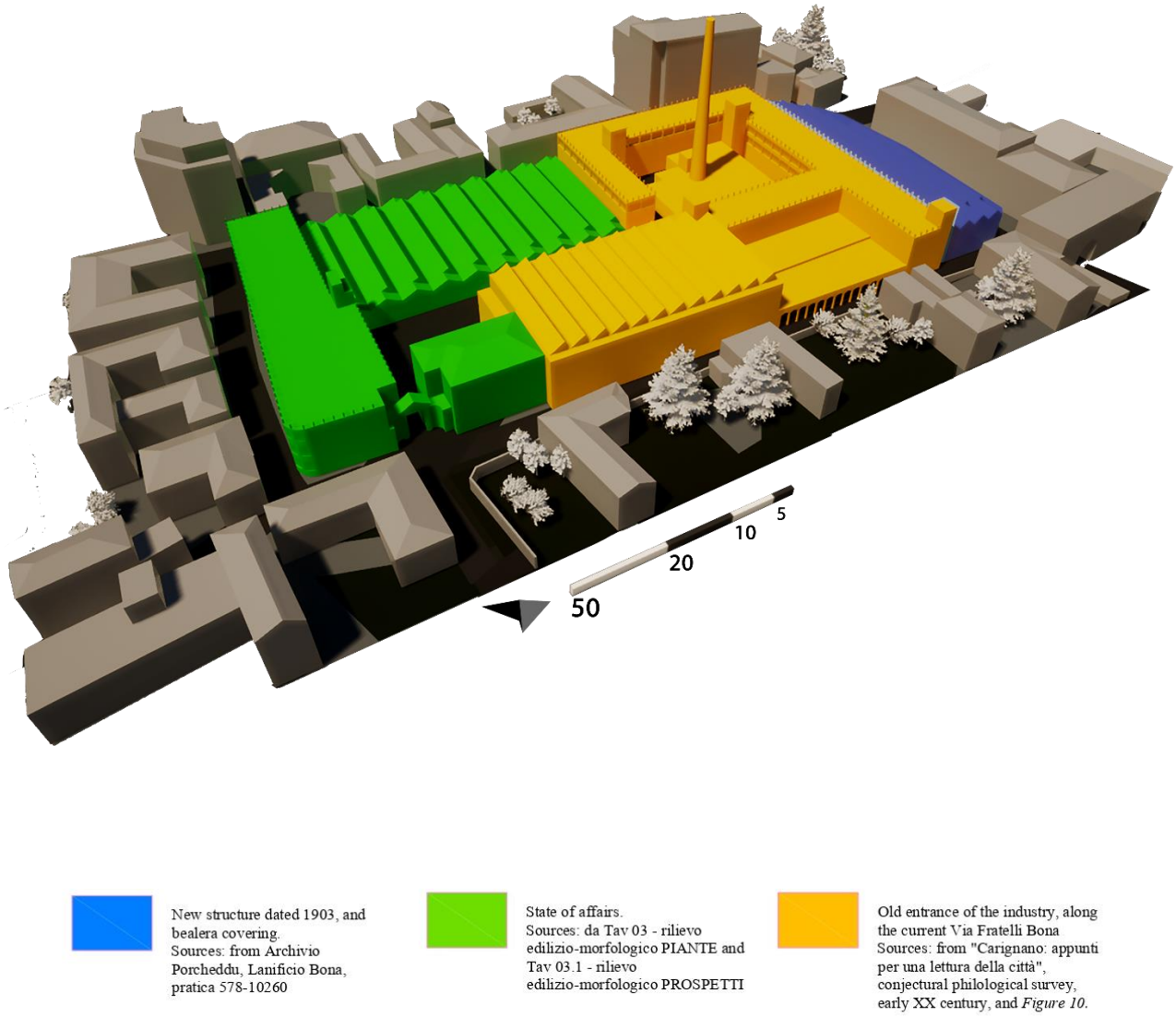


Figure 18 - Three-dimensional reconstruction of the morphology of the lot dated half of XX Century.

5. SARTORI'S RECOVERY PLAN FOR THE FORMER BONA WOOL MILL

A few years after the final abandonment of the factory, due to the saturation of the complex with the consequent transfer of production activity to the new plant in Via Salotto, a fierce debate arises in Carignano about the reuse of the unused structures.
In the article *A city within a city: Alberto Sartoris and the recovery of the former Wool Mill Bona in Carignano* (2018) by Gavello C., the author explains in detail what was the vision of the architect Alberto Sartoris, protagonist of the last phase of changes in the Bona area and provides an exhaustive description of the events that led the complex to the current situation. In the following lines is summarized what the author says in the article.
During the second half of the twentieth century, the city is subject to several expansions based on successive regulatory plans. The Municipality's involvement in the Bona Area began officially in May 1977 when a group of local researchers raised concerns about the preservation of the former wool mill during the presentation of the New Regulatory Plan. Their goal was to safeguard this industrial complex for future use. Consequently, the Municipality, in that year, mandated the development of a Detailed Plan covering the entire industrial area. This initiative later culminated in the approval of the 1985 Recovery Plan. The so-called "Bona area" is recognized as an authentic value both in relation to the historic center and the entire city of Carignano, considering the location, the size and originality of the industrial establishment as a building complex shaped over the years several times. The Sartoris project is the result of the involvement of the political, cultural and economic forces of Carignano that since 1979 have engaged with study days, exhibitions and conferences in search of a suitable redevelopment of the entire industrial complex. The conference titled *Sul futuro dell'area Bona*, held in Carignano on February 11, 1979, was attended by various stakeholders including members of the Municipal Administration, the authorities, academic figures but also the citizens that has been able to take an active part in the proposals. Teotimo Chicco, Mayor of Carignano from 1978 to 1983, seems to want to give large space to the debate, in order to orient the possible solutions of requalification not only of the Bona area but of the entire city. Among the proposals that emerged was the conscious revitalization of urban structures within smaller centers.
The conference participants emphasized the need to consider the Bona area in relation to the dynamics of the historic center conference establish a clear urban framework, and conduct studies to give the area a new purpose in response to societal demands.
This recovery project was not born from the intuition of a single group of designers but rather from a thorough analysis, verification, and feedback on the existing urban fabric.
Following conference proceedings' publication, the Municipal Administration directly commissioned Sartoris for a consultative inspection. He proposed three main solutions for transforming the building in relation to the needs of the entire city: demolishing the old factory to build new squares and buildings; maintaining the urban image of the existing with a new internal layout; saving and highlighting the industrial structure by renewing its external image, thinning the volume by creating penetrations from the outside to allow the city to regain possession of this space. And it's the latter solution the one chosen by Sartoris, who elaborates the so-called "Carta di Carignano", a document that outline nine fundamental principles for the recovery of the Bona area and the rebirth of surfaces, volumes and structures, accompanied by his very personal graphic elaboration in relation to the type

of intervention proposed. According to Sartoris himself, the objective of the restoration project should not merely involve demolishing, restoring, or straightforwardly replacing the existing structure. Instead, it should entail a genuine "organic metamorphosis" of both the architectural and urban complex. In this case, the establishment of a mutual trust relationship between the mayor, architect, and the community facilitated the creation of a truly exceptional endeavor. Through the "Carta di Carignano," Sartoris underscores the imperative need to rehabilitate the entire industrial facility. Without delving into any symbolic interpretations, his aim is to maximize the utilization of the available land to benefit the city and its residents, taking into account the requirements of the entire urban environment.

There arises, therefore, the need to transform the complex, updating functions of use in relation to the existing urban context, but also the need to draw up a recovery plan of the area closely linked with the historic center. Sartoris' intention is to maintain the monumental character of the building, but also to transform it into a large multifunctional structure, accessible and usable by citizens and adaptable to new functions.

The Recovery Plan proposals were based on these principles, seeking to maintain the monumental character of the building while adapting it for new functions. The former wool mill area represented a unique portion of Carignano's historic center, and Sartoris' careful redevelopment process connected the past with the present.

The preliminary project presented proposes a solution that includes not only the area of the industrial plant, but also fragments of the surrounding urban fabric, consequently initiating further processes of revitalization of the area, linking present and past. Sartoris emphasizes the redevelopment of the entire area pursuing the goal of a logical and rational distribution of spaces and functions, all public and of collective interest.

The structural and typological characteristics of the various parts that make up the entire industrial complex are just some of the elements that guide the choices and design solutions for the inclusion of new functions and intended uses. In 1987 the redevelopment project of the first lot was approved, including the new municipal offices, the Giacomo Rodolfo Civic Museum, the Civic Library and a multipurpose room. The first intervention, therefore, started only in 1990 and completed in May 1995, concerns the recovery of the main building [*Figure 19*] and its reuse for the relocation of the headquarters of the municipal offices on the ground floor and on the first, the new museum and the keeper’s accommodation on the second floor. The connection between the different functions takes place through the realization, on the different floors, of perimeter porches. With this ambitious project Sartoris wants to maintain, and enhance, the original structure of the industrial plant, giving it a completely new and unusual architectural look.

Figure 19 - Perspective view on Via Frichieri of the first intervention wanted by A. Sartoris.

On the main building Sartoris chooses to enhance the structure of the floors, highlighting the interweaving of the ceiling beams and working on the floor plate, creating a sort of internal vegetable garden that expands on each floor to the shed roof, maintained to ensure brightness and natural ventilation to the rooms. The existing structures of the plant are converted according to new functional needs, such as horizontal and vertical squares, municipal offices and a multipurpose hall with scene and 400 seats. The former woolen mill thus becomes a gigantic public rea, at the service of the citizen. The metamorphosis of the Bona area aims to obtain a renewed architectural and urban center, destined to become the revitalized heart of the entire city. Respect for the unity of the typological and architectural solutions underlined within the Recovery Plan is therefore obtained by operating on voids and solids and through specific choices relating both to the cladding materials of the facades, all in ceramic of different colors depending on the functions hosted, and to the size and shape of the openings. The element of the portico [*Figure 20*], which runs around the entire building, is also used by Sartoris to create walkways and covered paths, with the aim of mending the area of the former woolen mill with the surrounding urban fabric.

Figure 20 – Views of the refurbished complex. From left to right: the ground floor walkway, view from the inner courtyard and view of the building on via Frichieri.

The portico follows the traces of the ancient convent complex, connects the main public buildings and, through pedestrian connections, makes them easily accessible from the rest of the urban agglomeration. In addition, the choice of external cladding in ceramic tiles of different colors contributes to accentuate the symbolic detachment of the new historic center from the rest of the city fabric. Above all, the bright red of the covering of the perimeter pillars stands out, highlighting the ancient structure of the establishment and the intense blue of the structure of the stairs.
The treatment of the external surfaces, if on the one hand allows to highlight more explicitly the intervention of Sartoris from the pre-existing reinforced concrete structure and the compositional quality of the project, on the other hand helps to accentuate the separation between the large factory and the historic center. It so happens that the cladding of the building is perceived – by citizens and visitors – as a break desired by the civic administration to provide the community with a symbol: a new city center.
In 1998 Sartoris passed away and in the following year the municipality of Carignao decided to organize a conference in his memory: *"Riflessioni nel ricordo di Alberto Sartoris"*. That was a new opportunity to discuss the future of the part of the former wool mill Bona still to be recovered.
The transformation of the second lot, started in the 2000s, sees its concrete continuation with a recovery project, which includes the construction of new premises related to the "Norberto Bobbio" hotel management school [*Figure 21*], public parking and the so-called vertical square, inside the space where once stood the cloister of the old monastery.

Figure 21 – Photos of the second renovated lot. On the right the entrance of the "Norberto Bobbio" hotel management school and on the left a view of the school from the inner courtyard.

The third phase of works involves the completion of the transformation of the former wool mill with the construction of new commercial activities on the ground floor and residences on the upper floors. It is also planned to arrange the internal square with two underground floors of boxes and public parking with the aim of safeguarding the global project of the Recovery Plan conceived by Sartoris.
The completion of the interventions on the Bona area represents a fundamental objective in view of completing the process of integral transformation of the area, a concept that responds to Sartoris' design thinking.

6. THE STATE OF AFFAIRS

The last two interventions carried out, which lead to the current state of affairs of the complex, are the two extensions concerning the "Norberto Bobbio" hotel management school that mainly affected the building that was located on Via Umberto I, adjacent to the building with shed roof, located on the same street [*Figure 22*].

Figure 22 – Expansion of the "Norberto Bobbio" hotel management school. View from via Umberto I and from the internal courtyard

Sartori's project has returned to the city of Carignano large public spaces in a completely renovated building, otherwise abandoned, or even worse demolished. However, the conflictual relationship of the Carignanesi towards the memory of the past relating to the Bona area is clearly visible. The good intentions expressed by Teotimo Chicco during the Carignanese workshop in 1979 therefore seem to have been partially disregarded. The revitalized plant still seems to be generally referred to as a "foreign body". What at the beginning of the eighties is considered by critics as a bold and ultramodern architectural ensemble and a project capable of giving new life to the city of Carignano, today does not seem to fully meet the needs of a constantly evolving citizenship and some parts of the complex seem to have fallen into a state of neglect and in a state of advanced degradation.
What remains of the former wool mill Bona, the now crumbling complex between via Umberto I, via Fratelli Bona and via Frichieri, will be purchased by the Municipality: to sanction the operation, the resolution approved with unanimous enthusiasm by the City Council of 28 July 2022. With the acquisition of the missing piece, a new phase opens, that of finding resources for urban redevelopment and regeneration. A chapter closes to open one still to be written but on which the Administration has developed rather precise ideas to draw on the funding of the PNR and the European funds POR FESR, in agreement with the Metropolitan City.
"We are certainly not starting from scratch, we are not taking a leap in the dark. Indeed, we have been active for some time to get to this moment prepared, with very concrete hypotheses – explains the mayor Giorgio Albertino in an interview for the newspaper "Ieri Oggi Domani - Cronache, arte e cultura sul filo del Po "– *The first step is to create a gym for the Hotel management school, through a path started with the Metropolitan City to access the resources of the Integrated Urban Plans. In*

anticipation of this, last year we commissioned the Department of Structural, Building and Geotechnical Engineering of the Politecnico di Torino to survey and develop in detail a study on a specific portion".
The proposal of the Municipality is to build a gym that can be used by everyone, and not only during school hours, and also the realization, where there is now a simple internal courtyard, of an urban square open to the city as a center of cultural and social aggregation, capable of hosting activities promoted by the various social institutions.
The area of the former wool mill Bona purchased by the Municipality includes three distinct buildings dating back to different eras, for a total area of more than ten thousand square meters. The building examined are:

- The building on Via Fratelli Bona [*Figure 23*]: with a flat roof, it was part of the production area of the wool mill and is in complete abandonment. Lacking maintenance. The windows are old, mostly broken and without glass, absolutely not comparable to modern standards and above all not up to standard and no longer recoverable. The ground floor is currently used as warehouses and deposits.

Figure 23 – Building on via Fratelli Bona: on the right the view from the inner courtyard and on the left the façade on via Umberto I.

- The building along Via Re Umberto I [*Figure 24*]: it is the building in the worst condition. Due to the countless infiltration of rainwater, part of the wooden roof has collapsed, making the building unsafe and dangerous. The conditions of the glazed surfaces (both sheds and windows) are alarming because the windows are precarious and, as far as sheds are concerned, most of them are shattered. Internally the degradations are many, partly caused by the age and, in part, by rainwater percolations that have generated efflorescence, detachments and partial collapse of the wooden roofing system. Inside the building are currently located it was unused materials and/or waste.

Figure 24 – Building along via Umberto I, former waving facility: on the right the facade along the street and on the left a view on the shed roof.

– The old office building [*Figure 25*]: it is the building in the best condition. Although it is also affected by obvious degradation, mainly due to non-existent maintenance, it preserves its historical/architectural characteristics of the ancient building, especially in the entrance portal.

Figure 25 – The old office building set along Via Frichieri: on the right the façade along the street and on the left a view from the inner courtyard, where it's visible the entrance portal and a portion of the building on its left.

The design experience conducted in Carignano, still awaiting completion, inevitably leads to an important theoretical reflection on the issues of the recovery of important abandoned industrial buildings, also questioning the possible feasible solutions for the qualitative and quantitative reuse of an existing heritage, of great historical, material and cultural value, often forgotten.
Below [Figure 26] is shown the 3D model of the state of affairs, reconstructed through the sources listed in the legend.

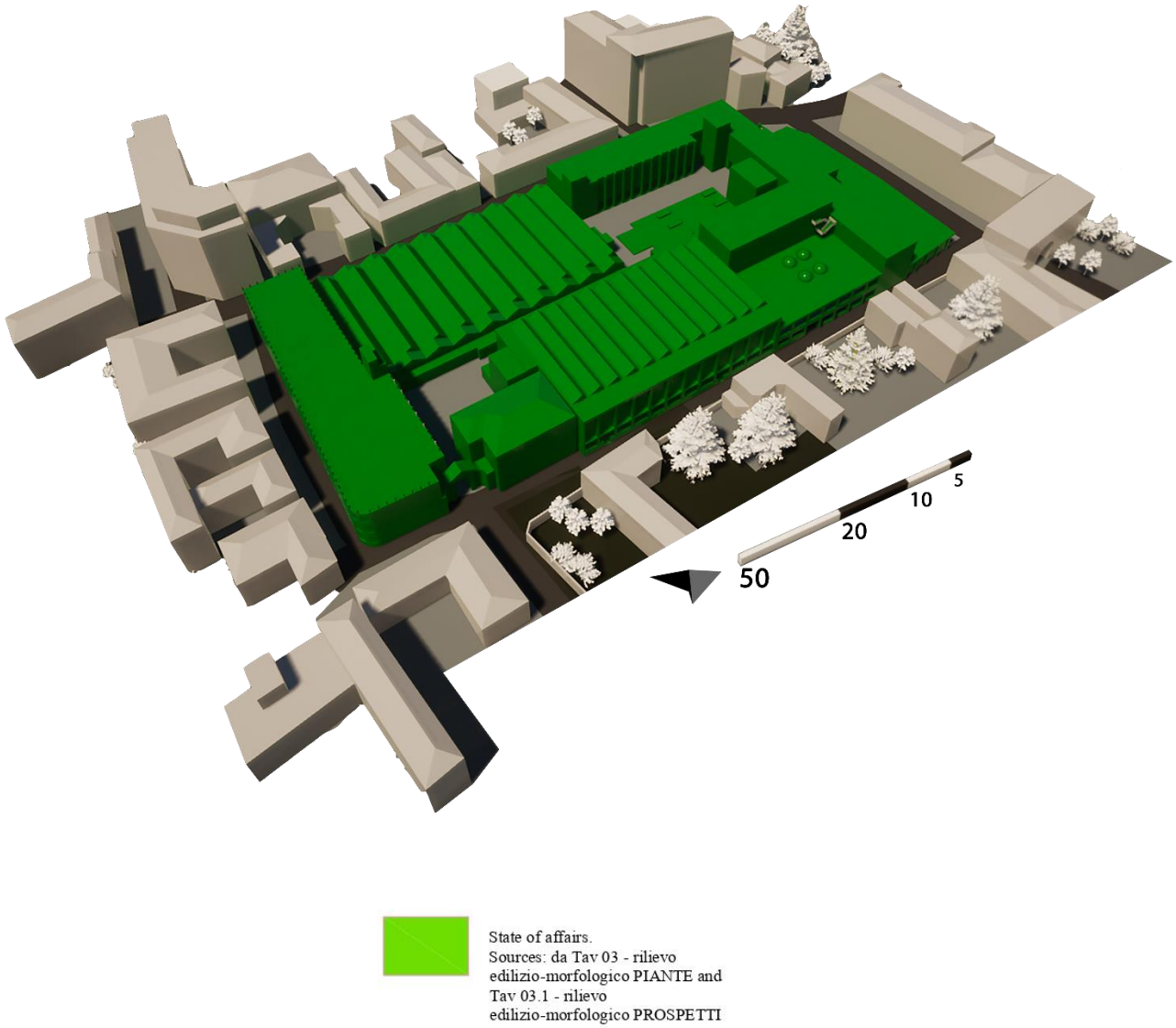


Figure 26 - Three-dimensional reconstruction of the morphology of the lot in the current situation.

It's fair to say that in the center of Carignano there is a find of industrial archeology? To answer this question, it's necessary to exhaustively define the term "industrial archaeology". In the following chapter the topic will be deepened and explained, submitting also some interesting case studies both overseas and in the examined territory.

7. INDUSTRIAL ARCHEOLOGY

The process of industrialization originated in England, in the second half of the eighteenth century, as a consequence of the industrial revolution. From there the spread of industrial plants has affected all continents, starting from the European one to the Asian one, passing through the developments of the American continent. However, while industrialization, albeit at different times, has seen a worldwide propagation, the states in which today the culture of safeguarding the industrial archaeological heritage is present are almost exclusively European and North American.

Industrial archaeology originated in Britain in the 1950s, after the postwar preoccupation with renewal had led to the destruction of much of the landscape associated with early industrialization.

The initial impetus for industrial archaeology in the UK was, then, the attempt to study, catalog, and preserve selected relics of the period when Britain was the world leader in the process of industrialization. Soon this inventory work on industrial sites followed in many European countries like France, Belgium, Norway and Sweden. Further afield, industrial archaeology in the heritage sense has made rapid progress in Australia since the 1960s with the Australian National Trust publishing lists of industrial sites and conserving many of them at state. In the United States, the Historic American Buildings Survey (HABS) was created in the 1930s but responsibility for recording industrial buildings and machinery is now shared by the Historical American Engineering Record (HAER), established in 1969.

The scope of this discipline is: to study *"the findings and testimonies* of the *period of the industrial revolution, in all its aspects and contents (...) and the economic and social consequences that derive from it. It is therefore a science that studies the origins and development of machine civilization and the marks left by the process of industrialization in everyday life, culture and society."* (Corti B., 1991)

The time span object of his investigation goes from the second half of the eighteenth century, then from the origin of the industrial revolution, and arrives to the present day.

However, in practice they fall within the scope of artifact studies that date back to earlier times, both pre-industrial but also medieval. Concretely, the objects of study make up a vast set of realities: mines, textile factories, bridges, mills, hydroelectric power plants, steel plants, and many others.

In Italy the issue about industrial archeology opened around the seventies, also thanks to the then recently approved new definition of cultural heritage by the Franceschini Commission which indicated this "any good that constitutes material testimony having the value of civilization". From that moment on, the discipline was increasingly structured, giving rise to magazines, many associations and commissions.

In this historical period the Western world is going through an important transition phase: from an economic production system focused on industry it is gradually moving to a system focused on services: companies and industrial companies that once flourished in the Italian territory now have to relocate production abroad as they are facilitated by low labor costs and leaner regulations. This phenomenon, however, has initiated an inevitable process of abandonment of industrial complexes and facilities that has shifted attention to the issue of recovery and functional conversion of these abandoned structures. The current crisis of the real estate market makes us reflect on the need to end, or at least slow down, the construction of new buildings on free land, by promoting urban and environmental sustaina bility, against the rapid and disorderly expansion of the city, the so-called "sprawl" phenomenon. This logic drives more and more towards the reuse of the already unexploited

built heritage and towards the transformation of the existing city. The metropolises, cities and towns are now saturated with empty, abandoned buildings and depressed areas while they are increasingly poor in social gathering centers and green spaces: adaptive reuse and redevelopment are the best way to find solutions to these problems.

According to reliable estimates in Italy about 150 cubic meters of old industrial buildings are dismantled every year and about 300 thousand tons of machinery and equipment are scrapped, while archives and drawings are generally destroyed after the five years required by law. However, there is a percentage of all this that must be considered well cultural and therefore preserved, studied and enhanced. In this sense, the Bona wool mill is an integral part of the Italian cultural heritage, given its great value as a witness of a bygone era.

Unfortunately, our legislation tends to preserve and enhance artistic and cultural assets, but almost completely ignores industrial ones. Probably this unwillingness to remember may have been influenced by the psychological rejection of a painful period and still very close to us, which was certainly that of the first industrializations, or perhaps it is the imprint of humanistic and crocian culture that considering truly worthy of man everything related to letters, philosophy and art, and almost disdains, or is indifferent to manual arts, and technicalities in general. However, there is a slow path of awareness on these issues and the situation of Carignano can offer excellent ideas in this regard.

Adaptive reuse should be the best way to recover brownfield industrial buildings. In the functionalization of an industrial building, there are countless possibilities for conversion of the intended use such as, for example, museums, residential units, commercial buildings, ateliers, studios, offices, lofts, schools, coworking spaces. They are buildings that characterize a landscape, help to define a “genius loci”, enrich the architecture of the city itself, characterizing them with a new and modern vital impulse.

Today the theme of the social cost of empty spaces is one of the most addressed issues in the urban disciplines of engineering and architecture. The progressive abandonment of industrial areas and districts leads as a consequence to the spread of degradation in the blocks and nearby areas not that to the resident communities inducing progressive lowering of the quality of life and the birth of a feeling of insecurity, in addition to a greater reluctance of operators to invest in these neighborhoods. This phenomenon is defined as "The Broken Window Theory" by George L. Kelling and James Q. Wilson, according to their study the presence of a broken window in an abandoned building is symbolically the signal of a worn-out community and heedless of the rules, so even this small episode could generate phenomena of emulation, cause further damage to the building, start a mechanism to a spiral of barbarism leading to progressive worsening of urban and social degradation

It has also been shown that the impact of these abandoned areas and buildings on the neighborhood is not at all limited to the building itself, therefore contained, but leads to the emergence and spread of phenomena of vandalism, illegal occupation, episodes of pyromania, crime, drug dealing and so on. These abandoned sites often seem to be totally out of the control of law enforcement and inevitably lead to disturbance of the peace and public health of the resident communities and the sharp collapse in the value of the surrounding properties,

However, the finds of industrial archeology still require special care and attention because, in addition to their perishability, just think of the numerous metal structures exposed to the elements, they are not yet widely considered as bearers of cultural values.

In common opinion, the production dimension still prevails when the factories have completed their task and finished their cycle they are often destroyed or recycled. In this way, however, the

technological, social and cultural memories linked to them are erased. The goal of academics and experts of industrial archaeology would instead be to keep the testimony alive, recovering it with a compatible reuse, even different from the original.
The recovery and reuse of the facilities would involve the elimination of a dead space within the city core and would give life to spaces in large contrast with the recent urban trends in the widespread city, which damage so much in terms of soil erosion (natural and agricultural) and pulverization of services and with all their negative values at a social level.In order to better understand the concept of 'adaptive reuse' in the following paragraphs are presented some of the most significant and interesting interventions concerning industrial archaeology in the world.
The complex under investigation in this thesis, has lost much of what was its value as a historical monument, given the recovery interventions of the early nineties that have completely distorted its physiognomy, and its value as a cultural asset is therefore no longer entrusted to the "whole", but to the individual surviving parts, for which it will be necessary to identify the components that characterize and attribute this value, to be able to preserve them with a view to recovery that does not provide for a reset of historical memory. The flexibility and distribution adaptability of heavy industrial buildings plays in favor of all this, making them available for uses not originally foreseen.
In order to better understand the concept of 'adaptive reuse' in the following paragraphs are presented some of the most significant and interesting interventions concerning industrial archaeology in the world.

7.1 ANTHOLOGY OF REUSE

There are many cases in which the realization of a project for the recovery of an archeology with its functional conversion has been possible: this chapter in fact wants to build a sort of "anthology of reuse" reporting some cases of redevelopment of industrial buildings.
The anthological research operation to identify the case studies was not carried out with the aim of selecting best practices but it was decided to report emblematic redevelopment projects of the existing heritage: different interventions were analyzed in terms of scope, importance, type and intended use and in particular attention was paid to interventions that could be relatable to the case study taken into consideration.
The cases detected were reported by going to "zoom" the research from overseas territories passing through the continental scale, then the Italian area and finally to the regional one. Indeed, Piedmont, thanks to its industrial past, in recent years has had to find a way to reinvent itself. The analysis included not only the majestic works of famous architects, but also small recovery projects undertaken in small local realities.
Two maps have been developed: worldwide [*Figure 27*] and national level [*Figure 28*], with the aim of making the reader understand the approach of the various countries on the theme of industrial archeology. By viewing the map it is possible to see how the density of case studies founded, is greater in the European territory, this is because Europe is the "old continent" and the industrial revolution has irreversibly marked the last two centuries of its history, transforming its landscapes and society.

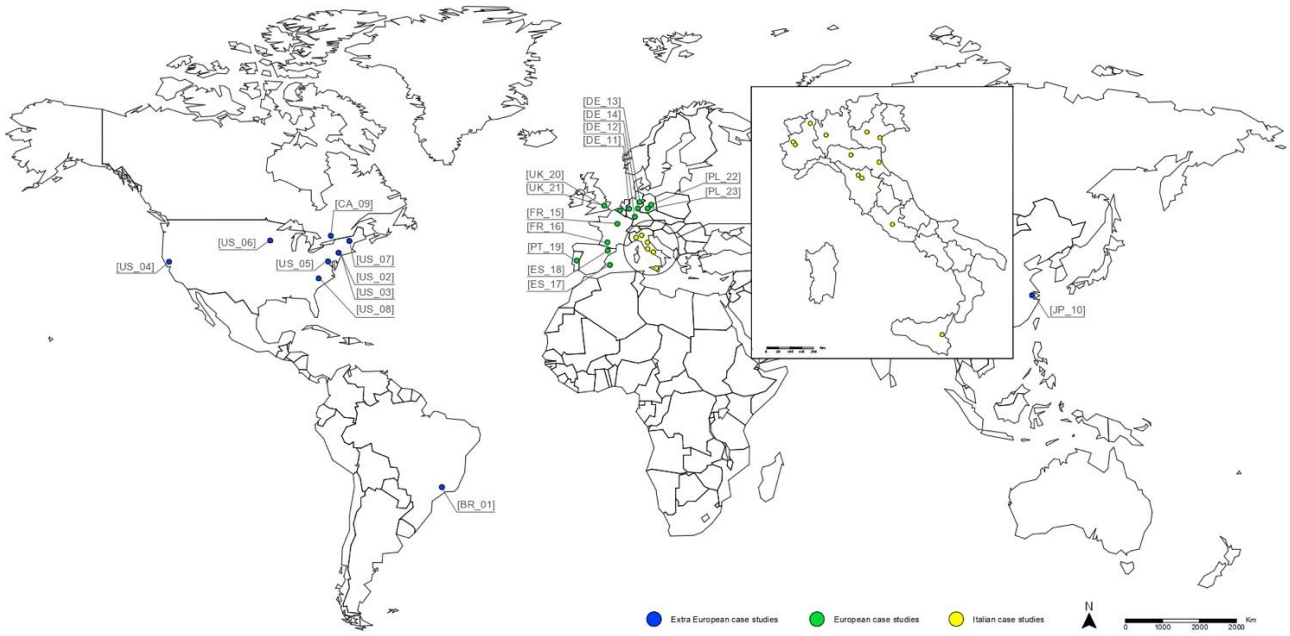


Figure 27 – Anthological research of examples of redevelopment of former industrial buildings worldwide.

Figure 28 – Anthological research of examples of redevelopment of former industrial buildings in the Italian territory.

Here follows the list of all the case studies, for each has been assigned an identification code that allows to easily read the maps [*Figure 27, 28*]. The first two letters stand for the country, the second two letters, where present, indicate the city followed by the numbering of the case study analyzed.

BR_01 Former warehouse now *Red House School Villa-Lobos*, 2022, São Paulo, Brazil
(amazingarchitecture.com)

US_02 Former Ice factory now *Dream Charter School*, 2023, New York, United States
(blog.wearedream.org)

US_03 Former railway line now public park, *The High Line*, 2009-1019, New York, United States
(thehighline.org)

US_04 Former vehicle assembly plant now multipurpose centre, *Ford Assembly Building*, 2009, Richmond, California, United States
(archdaily.com)

US_05 Former clothing factory now *Baltimore Design School*, 2013, Baltimore, Maryland, United States
(baltimoredesignschool.com)

US_06 Former flour mill now *Mill City Museum*, 2003, Minneapolis, Minnesota, United States
(msrdesign.com)

US_07 Former powerhouse now *Amherst College event space*, 2014, Amherst, Massachusetts, United States
(architizer.com)

US_08 Former tobacco industry now entertainment district, *American Tobacco Campus*, 2004, Durham, NC, United States
(americantobacco.co)

US_09 Former textile factory now Museum *Of Contemporary Art (MOCA),* 2015, Toronto, Ontario, Canada
(eraarch.ca)

US_10 Former factory building now retail space, *XC273 by XCOMMONS / dongqi Design*, 2022, Shanghai, Cina
(archdaily.com)

DE_11 Former coal mine now *LWL Museums of Industrial Culture*, 1980-2006, Dortmund, Germania
(lwl.org)

DE_12 Former foundries and steel factories now public park, *Völklinger Hütte*, 1994, Völklingen, Germania
(wikipedia.org)

DE_13 Former powerhouse now club, *Berghain Club*, 2004, Berlino, Germania
(wikipedia.org)

DE_14 Former cotton mill now cultural hub, *Spinnerei,* 2005, Lipsia, Germania
(urban-reuse.eu)

FR_15 Former railway station now museum, *Musée d'Orsay*, 1980-1986, Paris, France
(musee-orsay.fr)

FR_16 Former military industrial building now sport center, *L'Usine Escalade*, 2022, Tarbes, France
(idom.com)

ES_17 Former wool mill now social housing, *Can Ribas factory*, 2011, La Soletat, Palma di Maiorca, Spagna
(archdaily.com)

ES_18 Former texile factory now entertainment district, *El Nacional*, 2014, Barcellona, Spagna
(elnacionalbcn.com)

PT_19 Former cork industry now university polyfunctional space, *Robinson Factory*, 2011, Portalegre, Portogallo

(hicarquitectura.com)

UK_20 Former coal storing station now entertainment district, *Coal Drops Yard*, 2014, London, United Kingdom
(heatherwick.com)

UK_21 Former hydroelectric plant now museum, *TATE modern*, 2000, London, United Kingdom
(tate.org.uk)

PL_22 Former texile factory now polyfunctional space, *Manufaktura*, 2006, Łódź, Polonia
(wikipedia.org)

PL_23 Former tableware factory now *Museum of Contemporary Art Krakow*, 2011, Cracovia, Polonia
(claudionardi.it)

IT_FI_24 Former railway station now polyfunctional space, *Stazione Leopolda*, 1995, Firenze, Italy
(stazione-leopolda.com)

IT_PR_25 Former sugar factory now *Auditorium Paganini*, 2001, Parma, Italy
(teatroregioparma.it)

IT_MI_26 Former cork industry now *Italiana Hotels Milan Rho Fair*, 2009, Milano, Italy
(himilanrhofair.it)

IT_MI_27 Former steel factory now *Museo delle Culture (Mudec)*, 2015, Milano, Italy
(mudec.it)

IT_MI_28 Former steel factory now polyfunctional space, *Base Milano*, 2016, Milano, Italy
(base.milano.it)

IT_VI_29 Former wool mill now exhibition space, *Spazio Espositivo Lanificio Conte*, Shed e Turbine, 2007, Schio, VI, Italy
(museialtovicentino.it)

IT_VE_30 Former thermal power station now residential and offices space, *Palazzo Mazzoni*, 2010, Venezia, Italy
(laterizio.it)

IT_PO_31 Former wool mill now *Museo del tessuto*, 2003-2009, Prato, Italy
(museodeltessuto.it)

IT_RM_32 Former slaughterhouse now university polyfunctional space, *Città delle Arti, Facoltà di Architettura e D.A.M.S.*, 2013, Roma, Italy
(ar-architettiroma.it)

IT_RV_33 Former industrial storage space now polyfunctional space*, Centro Culturale/Espositivo nel Magazzino ex SIR*, 2014, Ravenna, Italy
(archilovers.com)

IT_CT_34 Former refinery now polyfunctional space, *Le Ciminiere*, 1984 – 2008, Catania, Italy
(provincia.ct.it)

IT_TO_35 Former vehicle manufacturing now polyfunctional space, *Lingotto - 8Gallery*, 1982 – 2003, Torino, Italy
(museotorino.it)

IT_TO_36 Former FIAT steel factory now public park, *Dora Park*, 2011, Torino, Italy
(comune.torino.it)

IT_TO_37 Former railway factory now polyfunctional space, *OGR - Officine Grandi Riparazioni*, 2008-2017, Torino, Italy
(ogrtorino.it)

IT_TO_38 Former railway factory now university space, *Classrooms R – Politecnico di Torino*, 2021, Torino, Italy
(masterplan.polito.it)

IT_TO_39 Former military arsenal now private school, *Holden School*, 2013, Torino, Italy
(comune.torino.it)

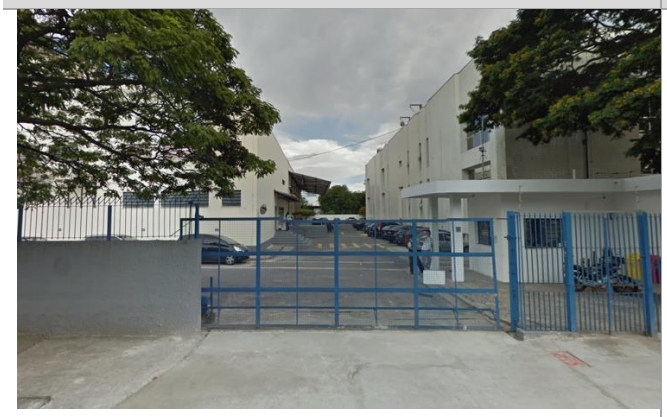
IT_TO_40 Former slaughterhouse now music school, *La Maison Musique - Il Circolo della musica*, 2003, Rivoli, TO, Italy
(regione.piemonte.it)

IT_VB_41 Former iron factory now polyfunctional space, *Il Forum di Omegna*, 1999, Omegna, VB, Italy
(forumomegna.org)

Of all the case studies listed above, the author has chosen to select the most significant in order to analyse them in detail. Each project sheet shows a comparison scheme between what was there before and what is there now, after recovery. The information on the history of the plant and on the project have been collected, organized in a logical manner and reported without further elaboration by the author of this work: the sources have been reported at the bottom of the page in order to give the reader the opportunity to go back to the site or document from which they were taken. In the section "Project" of the following sheets, the author of this thesis work reported the design aspects which it's considered to be more relatable to the complex of the former Bona wool mill. Indeed, the research focused on projects that included the adaptive reuse of former industrial buildings turned into facilities for the education, sports centres, polyfunctional spaces and green and public outdoor areas always taking into account the sustainability aspect.

2022 _ RED HOUSE SCHOOL VILLA-LOBOS [BR_01]

Former electronics warehouses - San Paolo, Brasil

BEFORE	AFTER
	

Location	Rua Froben - Vila Leopoldina (residential area)	Type of intervention	Partial restoration
Destination	Electronics warehouses	Destination	Preschool and primary school
Designer	Info not avaliable	Designer	Studio Dlux
Opening year	1978	Year	2022
End of activity	Info not avaliable	End of activity	Still in use
Site Area	11.000 m^2 (sita area)	Project Area	7.794 m^2 (built area)
		Project cost / Budget	

HISTORY AND DESIGN

Red House School Villa-Lobos is located in a privileged area of Sao Paulo, with almost 11 thousand square meters, next to Villa-Lobos Park, The Villa-Lobos campus is aiming to become a reference to international and bilingual schools in Brazil. The mega structure is composed of renovated industrial sheds and has over 7.5 thousand square meters of built area, with two main buildings, each one built to attend the exclusive and tailored educational methodology of the school. One of the blocks features the preschool, kids' cafeteria and the indoor sports court. The second block contains the elementary school and high school areas. Both buildings are connected through a distinct overpass. You will also find a library, makerspaces, arts & music rooms, an auditorium, another cafeteria, and an ample and modern sports complex in the school area. These environments promote a complete learning experience, in and outdoors.

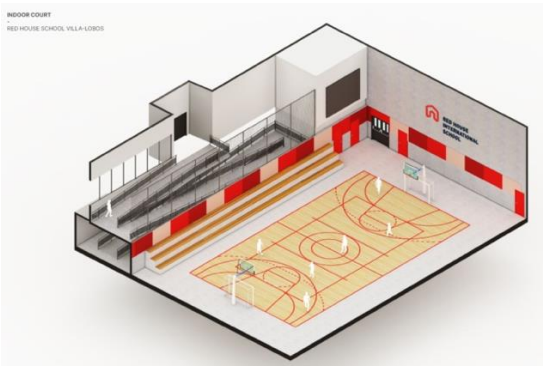
The project involved the adaptive reuse of two concrete structures from 1978. The blocky, two-story structures were originally utilized as electronics warehouses. The designers used vanilla-colored plaster on the facades and added robust lattices made of "ecological wood" and plastic. A new metal sky bridge was built to connect the two blocks.

A kindergarten, café, and indoor sports court are all housed in one of the buildings. The primary and high school areas, as well as a library, a maker space, and music rooms, are located on the other side of the building. The team included fun elements like gabled forms, circular cutouts, and swaths of brilliant color throughout the school. Vinyl flooring, foam acoustical panels, and plywood are among the interior finishes.

A multi-sports court, a sand court, an athletics track, a playground, and a park were built outside the buildings.

PROJECT

IMPLANTATION
RED HOUSE SCHOOL VILLA-LOBOS



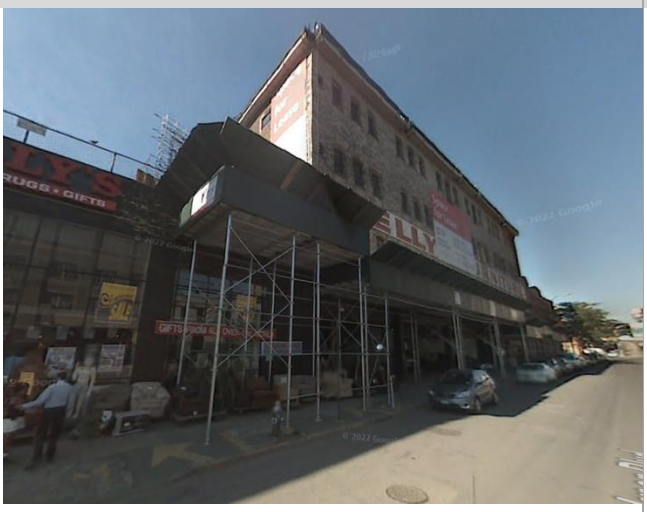
The images above represent the general masterplan, a 3D model of the gymnasium, and an aerial view of the campus.
The architecture process was developed in conjunction with the school's pedagogical staff (including head teacher, educators and main teachers), who are fundamental pieces to have a better understanding of the specific needs and methodologies applied in the school.
The key points of this project are: the smart use of the spaces both inside and outside, in particular the indoor gymnasium that is designed to house championships and large events outside of the school organisation and adaptive reuse of the already existing concrete structure without demolishing and consequently waste.

SOURCES

Text: zeelproject.com
Images: google.it/maps; amazingarchitecture.com; redhouseschool.com.br (11/09/23)

2022 _ DREAM CHARTER SCHOOL [US_02]

Former ice warehouse – New York, NY, United States

BEFORE	AFTER
	

Location	20 Bruckner Blvd, South Bronx (residential area)	Type of intervention	Total restoration
Destination	Ice warehouses	Destination	Primary to High School
Designer	Info not avaliable	Designer	Adjaye Associates
Opening year	1978	Year	2023
End of activity	Info not avaliable	End of activity	Still in use
Site Area	18.580 m^2	Project Area	18.580 m^2
		Project cost / Budget	$50 million

HISTORY AND DESIGN

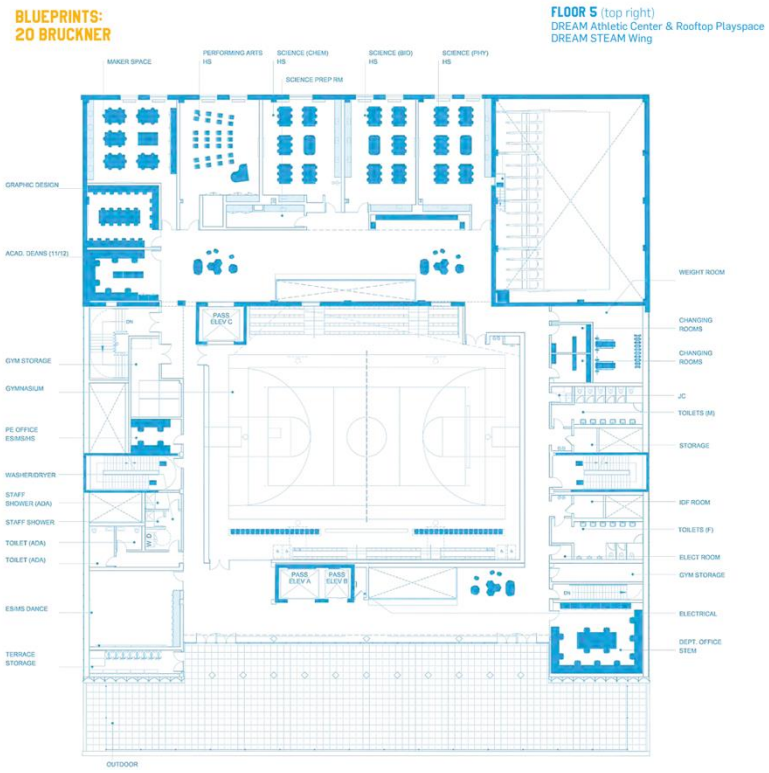
After sitting abandoned for 40 years, a 120-year-old brick building on the Harlem River has been rejuvenated into a striking public school by Adjaye Associates. The building, a former ice factory known as 20 Bruckner, has become the latest location of Dream Charter School, a 30-year-old nonprofit with seven facilities focused on educating youth communities in East Harlem and the South Bronx. An ode to the architectural beauty of the original structure, the new facility embraces fragments of its history which retains the exposed steel work, red brick, barrel vaulted ceilings, and large arched windows. Cultivating a peaceful transition between the street edge and the building's interior programs, the design introduces two covered outdoor entry spaces defined by wooden benches and cascading ramps and stairs. As visitors advance into the building, they are immersed in natural light via two strategically positioned lightwells on the north and south sides. These lightwells introduce visual connections vertically between floors and horizontally between classrooms. A counterpoint to the covered outdoor entryway, the building culminates with a landscaped open-air rooftop overlooking the city.

Rising above the original structure, the building culminates with a new addition encompassing a state-of-the-art gymnasium, a science quad, and an outdoor rooftop. Flanked by a landscaped garden, the rooftop is designed as an outdoor classroom, athletic center, and potential auxiliary event space.

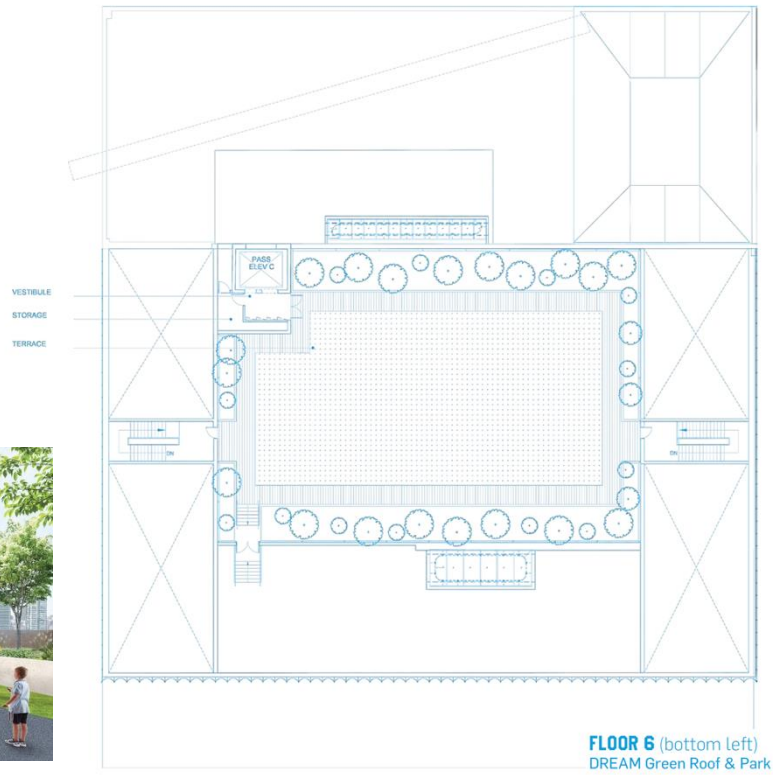
The fact that a building of this caliber was built in one of the poorest districts of the city, is not accidental. They wanted to give to the students in the South Bronx a new hope, proving that there are people people who are willing to invest in them and in their future.

PROJECT

The adaptive reuse project has as object of study a five storey building. Each floor houses a different level of education, starting from the bottom to the top we find: early childwood, elementary school, middle school and High scool then in the fifth floor there is the athletic center and in the top of the sixth floor there is the green roof and park. It's an intresting choiche to put the sports court in the second to last floor. The gym will be home to DREAM's team sports, as well as serve as an event space with a 400-person capacity.



The rooftop will be transformed into a full recreational space/ playground for the students. 20 Bruckner's rooftop will serve as a 520 sqm playspace, as well as an outdoor classroom and garden. The Green Roof & Park will roll out under the shadow of the building's billboard overlooking the Harlem River.

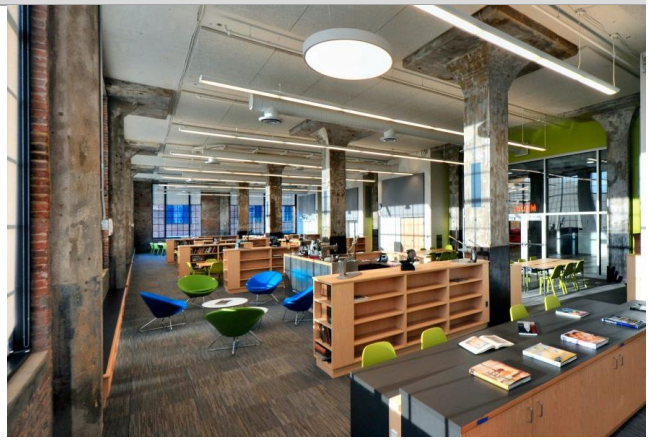


SOURCES

Text: nytimes.com; wearedream.org
Images: google.it/maps; amny.com; thenextbigdream.org (11/09/23)

2013 _ BALTIMORE DESIGN SCHOOL [US_05]

Former Clothing Factory - Baltimore, MD, United States

BEFORE	AFTER
	

Location	1500 Barclay St	Type of intervention	Total restoration
Destination	Clothing Factory	Destination	Middle and High School
Designer	Info not avaliable	Designer	Ziger/Snead Architects
Opening year	1915	Year	2013
End of activity	1985	End of activity	Still in use
Site Area	10.683 m^2	Project Area	10.683 m^2
		Project cost/budget	$25 million

HISTORY AND DESIGN

Baltimore Design School is a Baltimore City Public combined middle and high school with a focus on Fashion Design, Architectural Design, and Graphic Design. The new 115,000-square foot school is created from an abandoned historic factory building. Built in 1914, the building was first designed to serve as a machine shop for a bottle cap company and was then a coat factory for decades. The building was shuttered in 1985 and remained abandoned and a major blighting influence on the city's burgeoning Arts District.

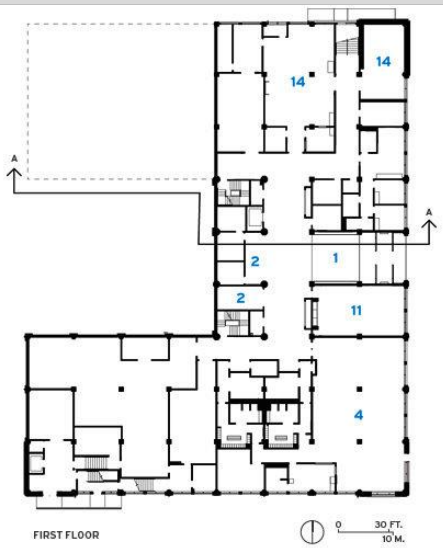
The building's transformation from blight to a state-of-the-art facility within the confines of a minimal budget demonstrates the power of design through exposed systems and best practices for historic renovation, adaptive reuse, educational design, and sustainable design.

The design exposes and contrasts the building's historic fabric with modern interventions that stimulates student's curiosity of the building's history and their role in creating the school and its future. The new exterior additions are modern and restrained in expression, clearly demarcating the difference between new and old. The interior aesthetic is that of an open industrial loft where existing walls and structure that remain are cleaned and sealed and left exposed to view.

The open-ended and creatively adapted environment supports and frames the unique, design-thinking focused curriculum of the school. The design encourages students to interact with, question, and change their environment, skills they will carry with them as future designers and thoughtful and engaged citizens. Throughout the building are areas that encourage interaction and the exchange of ideas. The building is intended to act as a canvas that promotes a dialogue inside and outside of the classroom.

The school is the first purpose-built public school in Baltimore City in decades and aims to be a national model for design education.

PROJECT



1 ENTRY
2 GALLERY
3 OFFICES
4 GYMNASIUM
5 MEDIA CENTER
6 CAFETERIA/MULTIPURPOSE
7 OUTDOOR STAGE
8 FASHION LAB
9 FABRICATION LAB
10 ARCHITECTURE LAB
11 CLASSROOM
12 BREAKOUT/STUDY AREA
13 LOUNGE
14 METAL/WOOD SHOP
15 STUDIO
16 CRIT SPACE

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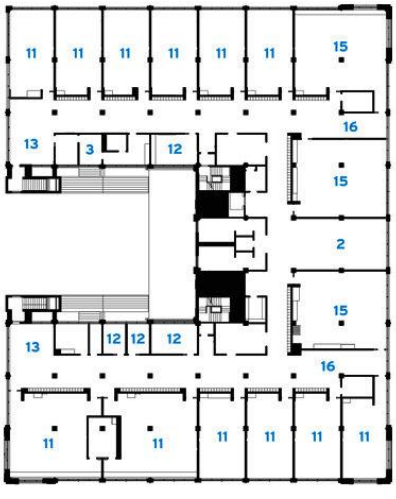
16 CRIT SPACE



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12 BREAKOUT/STUDY AREA
13 LOUNGE
14 METAL/WOOD SHOP
15 STUDIO
16 CRIT SPACE

The existing 115,000-square-foot building had a leaky roof, spalling concrete, and thick vegetation growing out of its walls. It needed structural repairs, new windows, and a complete systems overhaul. Below are listed the main key point of the project:
low budget
maintaining as much of the existing structure as possible
restoration of masonry and concrete elements
installed energy-efficient windows with profiles replicating the original ones
design of the courtyard stairs in steel framing
roof restoration with metal and insulation panels.

Award received concerning the preservation of historical heritage and sustainable design.

2013 President's Award — Preservation Maryland

2014 Wintergreen Project Award for Historic Major Renovation — US Green Building Council, Maryland

2014 Historic Preservation Award — Baltimore Heritage

2015 Preservation Award — Maryland Historical Trust

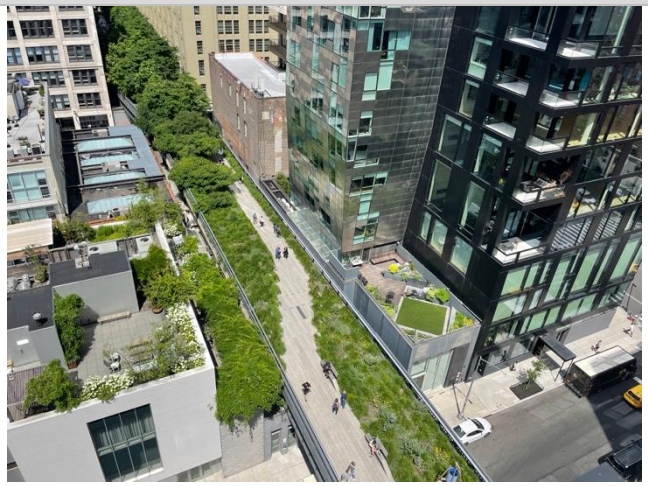
2015 Driehaus Preservation Award — National Trust for Historic Preservation »

SOURCES

Text: baltimoredesignschool.com, zigersnead.com
Images: architecturalrecord.com; baltimoredesignschool.com (11/09/23)

2009 _ THE HIGH LINE [US_03]

Former railway line – New York, NY, United States

BEFORE	AFTER
	

Location	Manhattan (city center)	Type of intervention	Total restoration
Destination	Railway line	Destination	Public park, walkway
Designer	Info not avaliable	Designer	James Cornel and Piet Oudolf
Opening year	1933-1934	Year	2009-2019
End of activity	1980	End of activity	Still in use
Site Area	2.33 km	Project Area	2.33 km
		Project cost/budget	

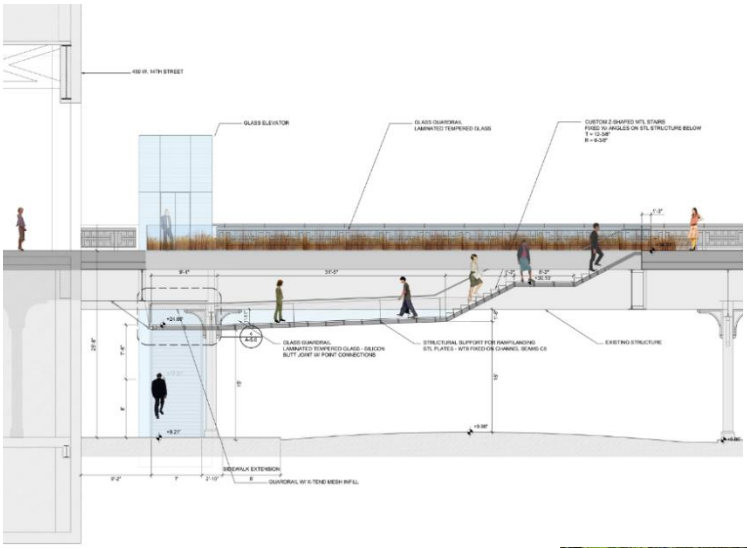
HISTORY AND DESIGN

The High Line is a 1.45-mile-long (2.33 km) elevated linear park, greenway and rail trail created on a former New York Central Railroad spur on the west side of Manhattan in New York City. In 1993, the first train ran on the High Line—which was then called the “West Side Elevated Line.” The line was fully operational by 1934, transporting millions of tons of meat, dairy, and produce. Train use dwindled due to the rise in trucking. The southernmost section of the High Line, from Spring to Bank streets, was demolished in the 60s. The decline continued through the 70s, with all traffic stopped by the 80s. Calls for total demolition of the structure soon followed. In the decades of disuse, many people were calling the High Line an ugly eyesore (Mayor Giuliani signed a demolition order, one of his last acts in office). But few of these critics saw what had secretly taken over the structure: a thriving garden of wild plants. The High Line's design is a collaboration between James Corner Field Operations, Diller Scofidio + Renfro, and Piet Oudolf. The abandoned spur has been redesigned as a "living system" drawing from multiple disciplines which include landscape architecture, urban design, and ecology. Converting each section of the High Line from an abandoned rail line to a public landscape entailed not only years of planning, community input, and design work, but also more than two years of construction for each section. Construction began with removing everything on the structure, including rail tracks, gravel ballast, soil and plantings, debris, and a thin layer of concrete. Environmental sustainability is a core value of the High Line. The park is an inherently green structure, as it repurposes a piece of industrial infrastructure into a uniquely designed public space. Equally important is the way the High Line operates—every day, we strive toward sustainability with the same level of care reflected in the park’s design.

PROJECT

Before the new concrete structure could take shape, it was necessary to eliminate all elements of the former, since the steel rails, gravel, earth and debris and the first layer of old concrete. All that was needed to reach the steel structure of the High Line and make the necessary repairs. Some of these repairs were waterproofing for the steel beams in concrete and drainage systems must be installed on the old structure.

In some places, the beams are removed to allow the stairs cut the structure of the High Line from the visitors center and meet face to face with the steel beams on their way to the park.



As each section of rail track was removed, it was tagged, surveyed, and stored—many of the rails and other artifacts were returned to their original locations and integrated into the landscape design. After removals, the steel elements of the High Line were sandblasted to remove the original lead paint. A containment tent was used to envelope one 25-foot section of the High Line at a time. After the sandblasting operation was complete, the steel was then repainted to match the original color of the High Line. Finally, concrete repairs and waterproofing work was completed.

Whenever possible, materials are sourced from within a 100-mile radius and the plant selection on the High Line favors native, drought-tolerant, and low-maintenance species, cutting down on the resources that go into the landscape. The High Line's ecosystem also provides food and shelter for wildlife species, including native pollinators.

SOUCES

Text: thehighline.org; wikipedia.org
Images: thehighline.org; it.wikipedia.org (11/09/23)

2011 _ ROBINSON FACTORY [PT_19]

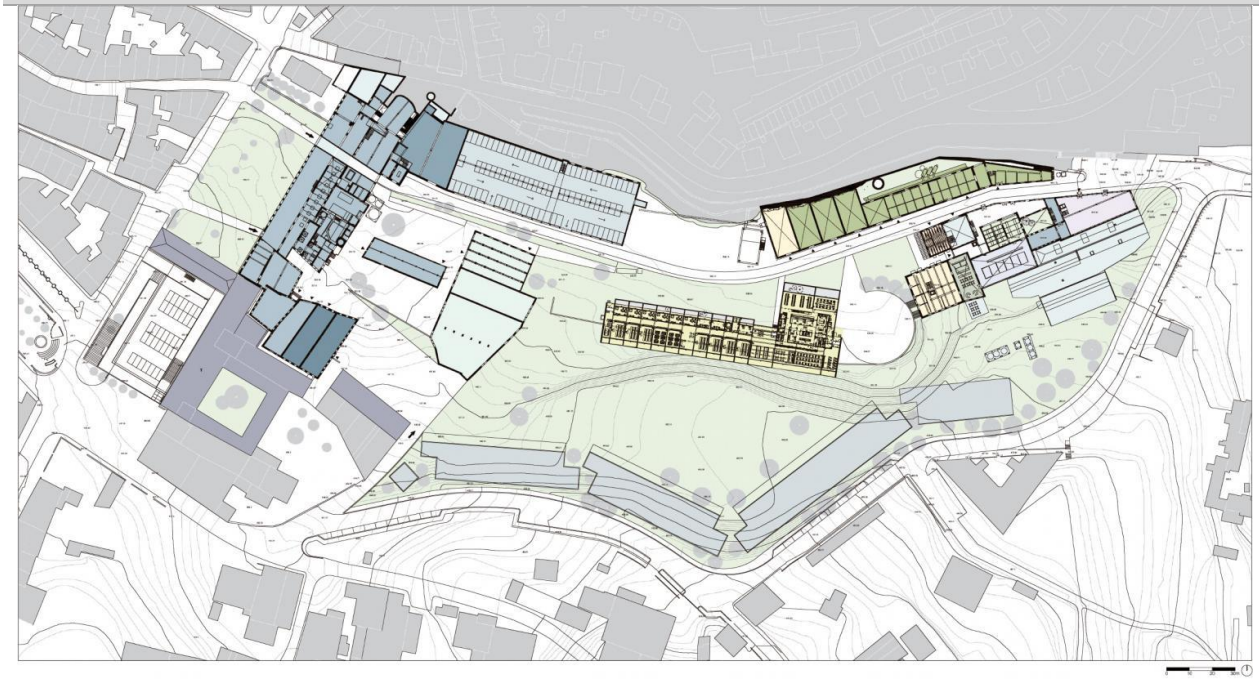
Former Robinson Cork factory - Portalegre, Portugal

BEFORE		AFTER	
			
Location	Rua Froben - Vila Leopoldina (residential area)	Type of intervention	Total restoration
Destination	Cork industry	Destination	University polifunctional space
Designer	Info not avaliable	Designer	Arch Souto de Moura and Correia/Ragazzi Arch.
Opening year	1847	Year	2011
End of activity	Info not avaliable	End of activity	Still in use
Site Area	60.000 m^2 (site area) 37.670 m^2 (built area)	Project Area	37.670 m^2 (restored area) 2.785 m^2 (new area)

HISTORY AND DESIGN

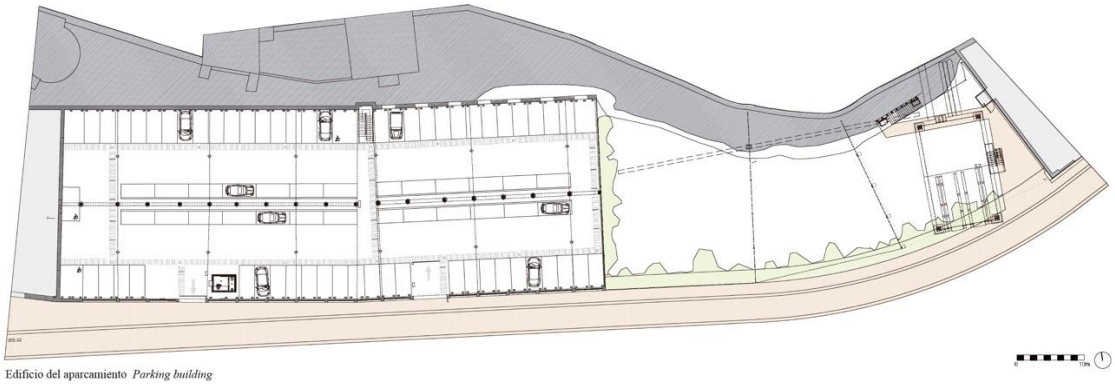
Robinson Brothers Cork Growers Factory was founded in 1841 by brothers George, John and William Robinson. The production activity was focused on the production and processing of cork. In 1847 the family bought this factory and in 1900 they became the largest cork producers in Portugal employing almost 2000 workers. The subsequent transfer of production to a new industrial area in the suburbs freed up a 60,000 m2 lot in a central area of Portalegre, which includes an important industrial heritage of hangars, warehouses and offices. The management plan of the environments by Souto de Moura and Graça Correia proposes the creation of a complex formed by the combination of new and old buildings. The buildings and lots of an old cork factory are thus transformed into a multifunctional area dedicated to the arts, tourist culture, education and local services. The general rehabilitation plan for the 60,000 m^2 was designed by Portuguese architects Correia, Ragazzi in collaboration with the Souto de Moura office team. Among the plants built so far, there is a new car park, located in a former industrial building of the factory that was directly connected to the road and the surrounding buildings: it was possible to recover this large building, very bright and naturally ventilated, avoiding having to build a new, more expensive structure. In addition, the proximity to the school of Tourism, the hotel and other educational units such as musical associations, attended mainly by young people, makes it possible to use the structure for all sorts of musical events, concerts and events. The southernmost area is used as the seat of the tourism management school and the construction of a hostel. The project is presented as a prism defined by a large central gallery to which all the main areas of the school are connected: classrooms, library, meeting room, restaurant and bar. To the north, the building is divided into two volumes where the offices overlook small courtyards; An auditorium with a vaulted concrete structure and ceramic slab façade was also designed.

PROJECT



1 *cork museum*
2 *firefighters museum*
3 *parking*
4 *art museum and artists residence*
5 *pousada of the San Francisco convent*
6 *auditorium A for the tourism school*
7 *auditorium B for the cultural associations*
8 *ICT-VR (International Centre for Virtual Reality)*
9 *tourism school*
10 *students square*
11 *cultural associations*
12 *residential area*

Above there is the masterplan of the project which includes the construction of a covered car park, a new headquarters for the hotel management school and a hostel.
Among the installations built so far for the Reconversion of the Robinson Factory developed by Souto de Moura together with Correia/Ragazzi Architects stands the car-park, located in a former industrial building from the cork factory. The car-park has two clearly defined openings in the facade which will be used for the entry and exit of vehicles, in accordance with the circulations defined in the General Plan.
The side open to the space between the Auditorium and this building will be terminated with a steel mesh of approximately 2.50 m height.
In this steel mesh, as well as in the existing metal structure that is to be kept, a vine type vegetation will be placed, such as wisteria or a Kiwi. This sort of plantation will provide the necessary freshness to this space, a climatic solution traditionally used in this region.



Edificio del aparcamiento *Parking building*

SOURCES

Text: metalocus.es; bmiaa.com; archilovers.com; hicarquitectura.com
Images: hicarquitectura.com; flickr.com; bmiaa.com (11/09/23)

2022 _ *L'USINE*: A MULTIPURPOSE SPORT CENTRE [FR_16]

Former military industry building - Tarbes, France

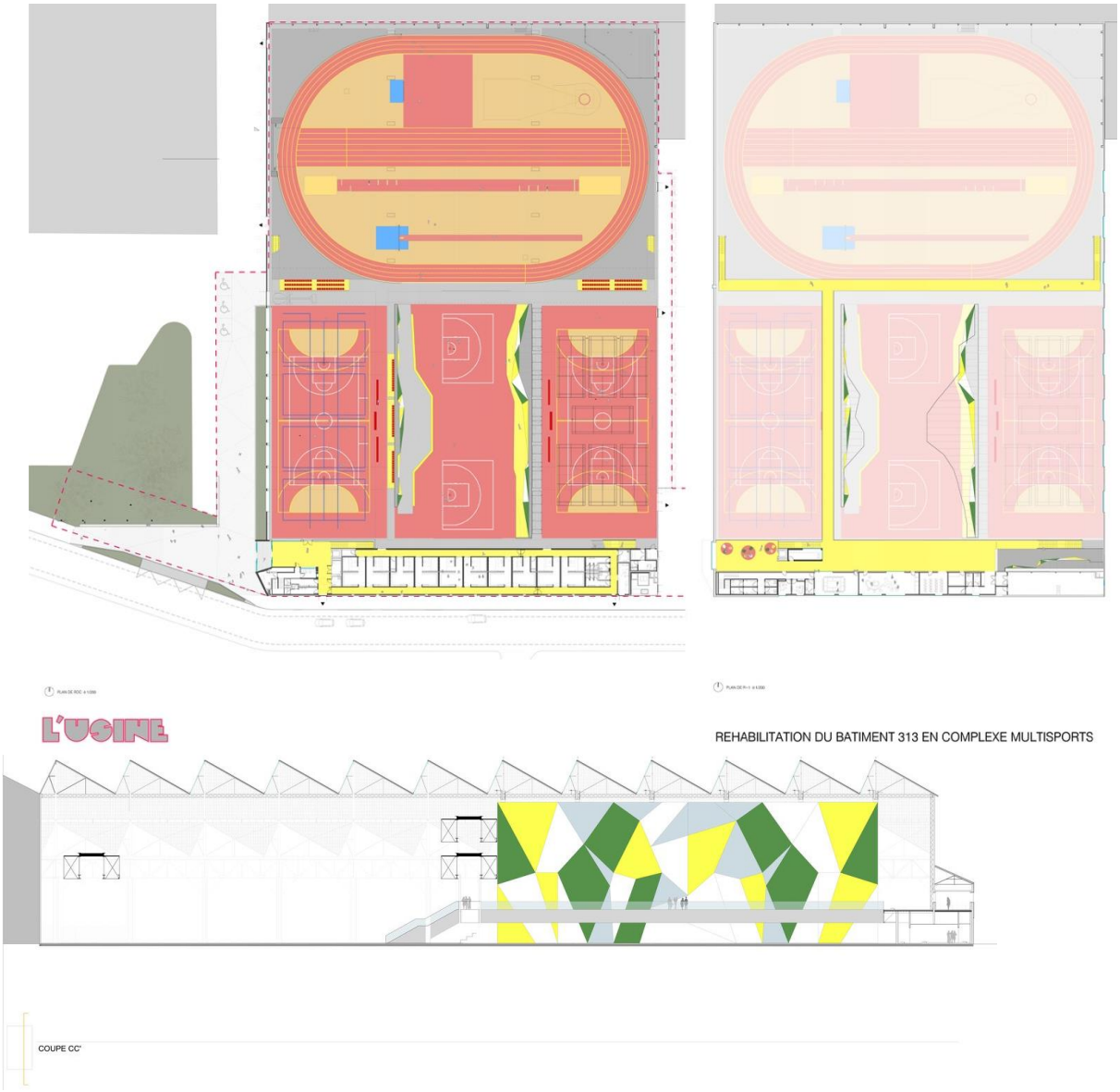
BEFORE	AFTER
	

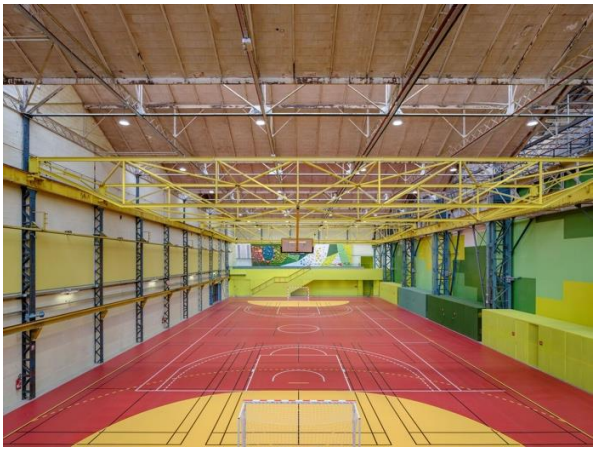
Location	Avenue des Forges (outside the city center)	Type of intervention	Total restoration
Destination	Military industry building	Destination	Multipurpose sport centre
Designer	Info not avaliable	Designer	IDOM, DUFFAU & ASSOCIÉS
Opening year	Early 20th century	Year	2022
End of activity	Info not avaliable	End of activity	Still in use
Site Area	12175 m^2	Project Area	11.000 m^2
		Project cost / Budget	8.766.982 €

HISTORY AND DESIGN

The project is the result of an ideas competition for the transformation of an old military industry building from the early 20th century into a large sports center of reference for the city, the region and the country.
The building, oriented north-south, measures 125 m long by 85 m wide, organized into a 20 m high central building and two 13 m high side buildings. Endowed with a clear and repetitive geometry with a sawtooth roof, the buildings emulate the nobility of a cathedral, despite a very poor exterior appearance, the result of the passage of time, of neglect and the absence of a façade cladding. This nobility is confirmed in the interior thanks to the expressiveness of the polychrome structure that, although worn by the passage of time, defines the character of the space with the spectacular zenithal light that penetrates the glazed roof across fifty percent of its surface. Our proposal aims to maintain the value of the pre-existence, while fully preserving the perception of its original character, even with the introduction of a new, light and colorful world, characteristics linked to the playful character that the building should express. On the one hand, we intervened on the flooring, hitherto gray, filling it with colors to define the new sports areas: athletics, basketball, handball, badminton and climbing. On the other hand, the requirements of the new sports program (lobby, changing rooms, federation rooms, offices) are resolved with a block of intense yellow color that in turn forms two large climbing walls that are the protagonists of the central space of the project. It is perceived as weightless, floating in the industrial cathedral space thanks to the fact that it is embedded in the large pillars of the building and hangs from the pre-existing bridge cranes, thus giving them a new life. This piece also becomes the upper tier for spectators and the element that defines the boundaries between the different sports areas. Finally, our design provides the building with a new façade consisting of a brick base, in harmony with the architecture of the neighborhood, and white cladding that extends to the edge of the roof. The latter has been resolved with white mini-wave sheet metal, commonly used in the industrial world, in which new strategic openings are inserted to express the public purpose of the new building and open it up to a more permeable relationship with its surroundings.

PROJECT





Key point of the project:

- maintaining the value of what is already there, preserving the perception of its original character;
- smart subdivision of spaces both in plane and in height, creating a first floor where the services have been placed;
- the use of color to define zones;
- preservation of the existing metal structure;
- harmony with the architecture of the neighborhood by keeping the façade with exposed brikwork.

SOURCES

Text: idom.com

Images: idom.com; google.it/maps; archdaily.com

2014 _ COAL DROPS YARD [UK_20]

Former coal discharge and storage station – London, United Kingdom

BEFORE	AFTER
	

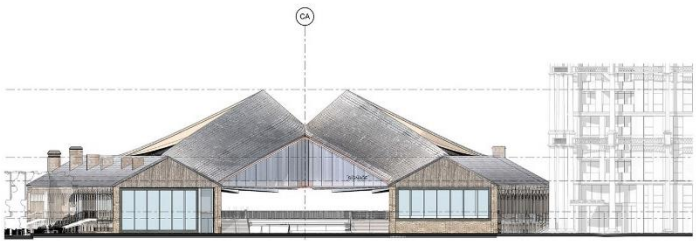
Location	Stable Street (industrial area)	Type of intervention	Total restoration
Destination	Coal discharge and storage station	Destination	Entertaimment / Shopping centre
Designer	Info not avaliable	Designer	Thomas Heatherwick
Opening year	1850-1860	Year	2014
End of activity	Late 1990s	End of activity	Still in use
Site Area	13.500 m^2	Project Area	13.500 m^2

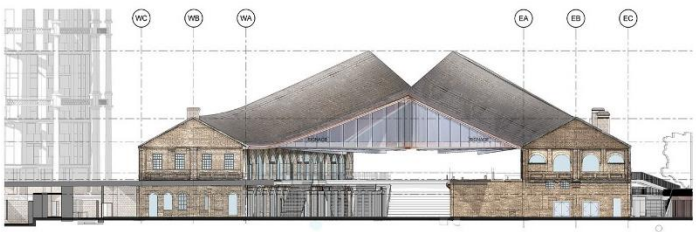
HISTORY AND DESIGN

Built in 1850 to receive coal for London as it arrived by rail from the North of England, the two-storey brick and cast-iron structures were later adapted for light industry, storage and nightclubs until they fell into disuse by the late 1990s.

The Thomas Heatherwick studio's design opens up the area to the public, linking the long viaducts and the yard between them to create a space for people to enjoy. The relationship between the preexisting historical and the 'new' is expressed through a series of connecting paths made up of footbridges and staircases that connect, both vertically and horizontally, to the two two-storey linear bodies in which 9,290 square metres of catering and commercial activities take place. The commercial space is reached through the empty central courtyard which guarantees a stable relationship between the different parts of the project and the bodies of those who live there. Completing the space is its large cover which acts as a point of conclusion and arrival: a sinuous and enveloping line, stretching 35 metres, which rises from the existing structure and which takes its material characteristics. Composed of more than 80,000 elements coming from the same Welsh quarry used for the construction of the Victorian building, the colours of the building play on the original blue-grey tones of area. Supported by 52 new steel columns hidden in the pre-existing body, the central area of the building is said 'kiss itself' (according the the designers) at the point in which the emptiness is completed by a big inhabited and habitable area from when you can see a panorama of the surrounding city. As stated by the designer, the the project called to "radically remodel this Victorian infrastructure to meet the needs of modern urban development without losing what made it special".

PROJECT





Rather than making a box element colliding with the geometry of the existing roofs, the gabled roof of each building rises up and stretches towards the other, meeting to form a new upper storey that gives the project a central focus. The use of digital models helped to optimize the steelwork usage, which lead to a steel and concrete framing solution, threaded through the original buildings founded on new mini-piles squeezed within internal bays. The upper level is enclosed in a tapering 8m tall structural glass façade. This spans vertically between the slabs and trusses, relying purely on the glass panels arranged in a folded geometry. The system is bonded with structural silicone to increase the stiffness and load-bearing capacity of the façades. The new sculpted roof has a 32 m clear span and supports a suspended floor via steel hangers.

SOURCES

Text: architetturaecosostenibile.it, heatherwick.com, area-arch.it
Images: architectural-review.com, heatherwick.com (11/09/23)

2014 _ EX SIR RA [IT_RV_33]

Former storage warehouse SIR – Ravenna, Italy

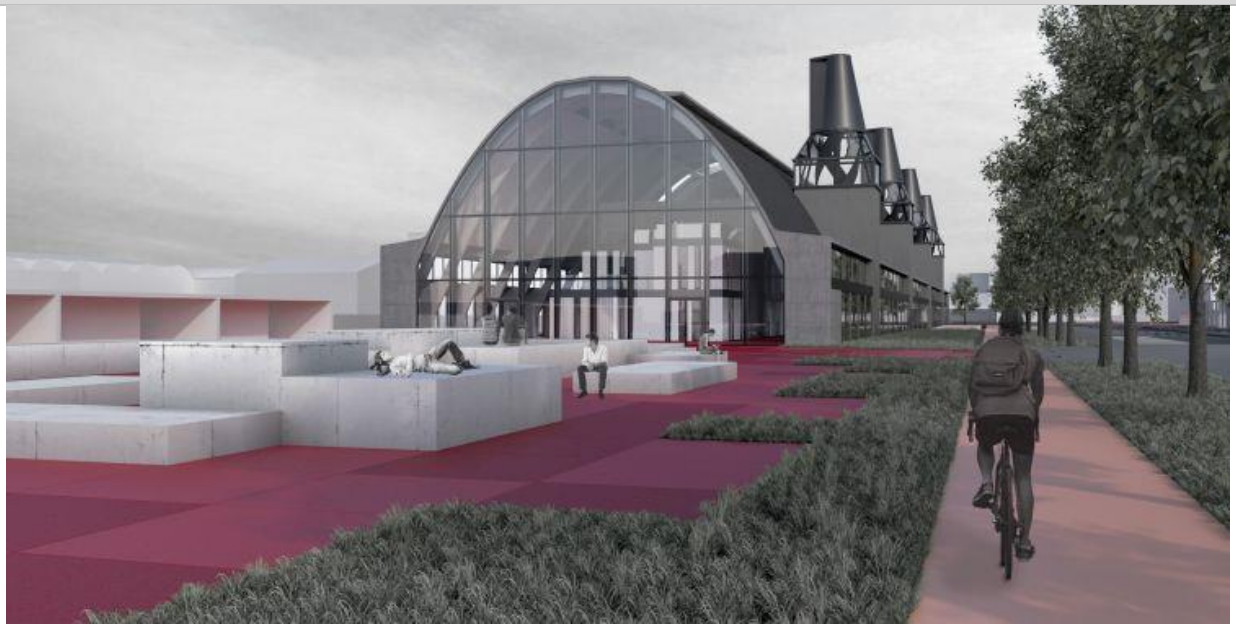
BEFORE	AFTER
	

Location	Via Maramotti (city center)	Type of intervention	Total restoration
Destination	Ice warehouses	Destination	Polifunctional space
Designer	Ing. Elio Segala	Designer	Arch. Marco Mattei
Opening year	1957	Year	2014
End of activity	1985	End of activity	Still in use
Site Area	5.250 m^2	Project Area	5.250 m^2
		Project cost / Budget	

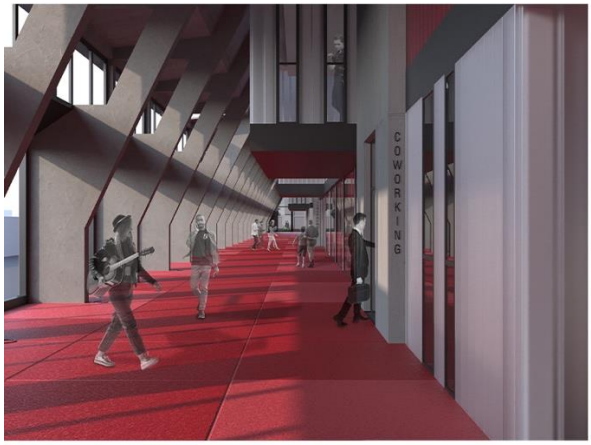
HISTORY AND DESIGN

This building (slang nicknamed "cigarone" for its shape) is a true icon of the industrial memory of the Darsena of the city of Ravenna, for the great particularity of the structure, as well as for its size. Built between 1955 and 1957 on a project by the Ferrarese engineer Elio Segala, it was used until the mid-80s for the storage of chemical fertilizers for agriculture. The structure of the building is marked in series by the ogival ribs in reinforced concrete, of great spatial impact and very scenic, has the shape of a rectangle of 30 x 175 m, and a covered area of 5,250 m^2 and consists of a succession of 34 parabolic frames arranged transversely with respect to the longitudinal axis of the building. The arches are connected to each other by masonry floors, which develop from an altitude of + 7.20 m to the top of the shed located at an altitude of + 17.35 m. The exterior looks like a continuous canopy, interrupted by entrance towers to the interior space, which represents a continuous gallery, illuminated by a long skylight. The structural concept is particularly interesting: the typological scheme adopted takes up the static model of the parabolic arch with three hinges designed in the '30s by Pier Luigi Nervi. The architectural form of the pavilion, of particular beauty, recalls the image of a modern "cathedral" of work. Used as a deposit of building material until relatively recently, it is the subject of mobilization by the citizens of Ravenna and public discussions on its reactivation. The main objective of the project is to save the pavilion from its possible demolition and to fully safeguard its internal spatiality and original architectural configuration. The project involves the recovery of the industrial building for a set of exhibition and cultural functions, auditorium, music school, theater laboratory, library, library, cafeteria, restaurant and other commercial activities. The project aims to respond to the need for new spaces for culture and leisure to be allocated to the younger generations. Spaces almost completely absent in a "young", multiethnic and rapidly changing neighborhood like that of the Darsena di Ravenna.

PROJECT



The project does not only aspire at the redevelopment of the industrial archeology find but at the regeneration of the entire urban area enhancing the possibilities offered by these architectural testimonial memories. No aspect of the pre-existence shell has been neglected, neither from the historical-architectural point of view (connoting this as a peculiar case of industrial archeology), nor from the formal aesthetic one, nor from the constructive point of view in the final attempt to obtain an effective balance between the old and the new in a radical functional reinterpretation.



It was chosen to operate through an intervention approach capable of taking into account and systematizing every relevant aspect connoting the pre-existing building to be treated and in particular: the historical-architectural value, the aesthetic and morpho-typological value, seeking a functional reinterpretation without compromising the image of the building, the constructive value of the existing, in the final attempt to mitigate potential structural vulnerabilities; and finally the potential offered by the geometric and structural peculiarities of industrial archaeology object of intervention in order to identify possible transformation strategies compatible with the highest sustainability criteria. The architectural elements and geometric characteristics detected made it possible to profitably exploit passive natural factors for the improvement of the environmental comfort of the recovered building volumes.

SOURCES

Text: archistart.net; archilovers.com; spaziindecisi.it; infobuildenergia.it
Images: archistart.net; archilovers.com (11/09/23)

2003 _ PRATO TEXTILE MUSEUM [IT_PO_31]

Former “cimatoria” Campolmi and wool mill - Prato, Italy

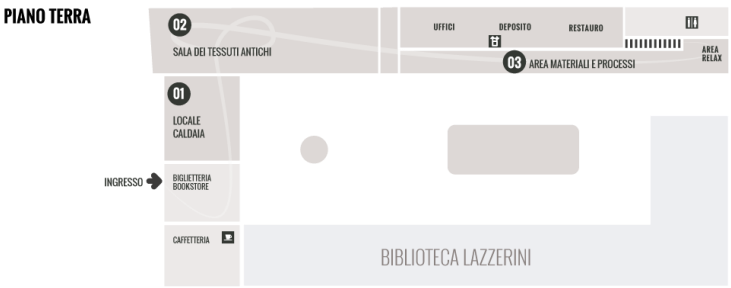
BEFORE	AFTER
	

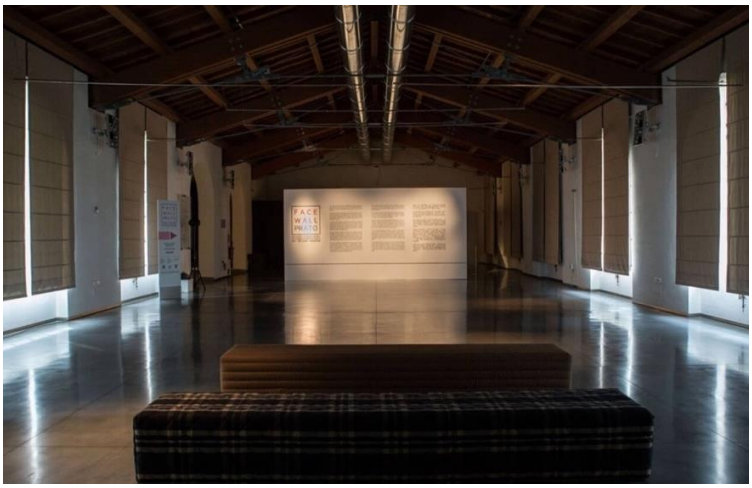
Location	Via Puccetti (Historic center)	Type of intervention	Partial restoration
Destination	Wool mill	Destination	Museum, library and cultural hub
Designer	Info not avaliable	Designer	Arch. Marco Mattei
Opening year	1863	Year	2003-2009
End of activity	1968-1994	End of activity	Still in use
Site Area	8.500 m^2	Project Area	4000 m^2

HISTORY AND DESIGN

The former Cimatoria Campolmi, was born in a somewhat hidden area of the historic center of Prato. Leopoldo Campolmi & Co. was born as a factory specialized in “cimatoria”, that is a phase of fabric processing that consists in cutting and regularizing the hairy surface of the tissues. Later it expanded to accommodate all stages of fabric processing including dyeing. At the end of the nineteenth century the building looks like a quadrilateral on two floors around a rectangular courtyard, with a large tank for collecting water and a brick chimney 40 meters high. The factory reaches the extension and the current conformation only in the mid-twentieth century thanks to changes and extensions, such as the construction of the beautiful ogival vaulted dyeing that today houses the entrance to the library. The activity of the plant ceased in 1968 but some processes continued until the definitive closure of the production of fabrics in 1994. Inside you can still admire a gigantic nineteenth-century steam boiler and in the inner courtyard the splendid chimney, the highest in Prato that stands out among the roofs of the historic center. The intervention involved a total area of about 10,000 m^2, including, in addition to the factory, the central courtyard with basin and chimney and the square adjacent to the medieval walls. The restoration of the building has been strictly conservative and has allowed to preserve the original characteristics of the structure and the subsequent historical stratifications: from the ancient factory sign to the steam boiler room, from the vaulted ceiling of the antique fabric room to the ancient wooden beams on the first floor. The internal courtyard has been returned to its original configuration, indelibly characterized by the large basin and the imposing chimney. The Museum occupies half of the entire architectural complex, for about 3000 m^2 and was built with the first batch of works, while the other half houses the Municipal Library "A. Lazzerini", with which it forms the main cultural center of the city.

PROJECT





Key points of the project:

- the area on which the project was developed was a former woolen mill built in the heart of the medieval city of Prato
- this is an example of how abandoned production sites can be converted into spaces for culture
- It is interesting the choice to keep the external appearance of the industrial complex unchanged so as not to distort the appearence of the historic center of the city

SOURCES

Text: museodeltessuto.it; archiportale.com

Images: giovaniartisti.it; archiportale.com (11/09/23)

2013 _ FACULTY OF ARCHITECTURE – PAV 2B [IT_RM_32]

Former slaughterhouse - Roma, Italy

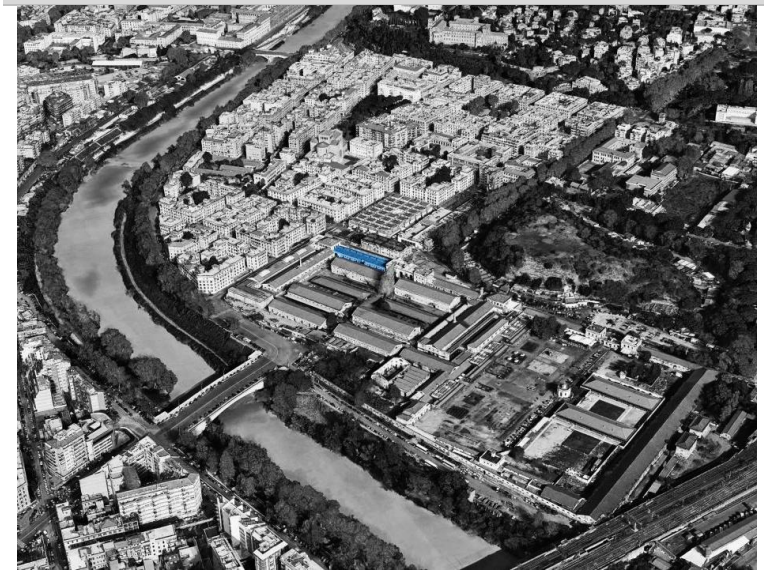
BEFORE	AFTER
	

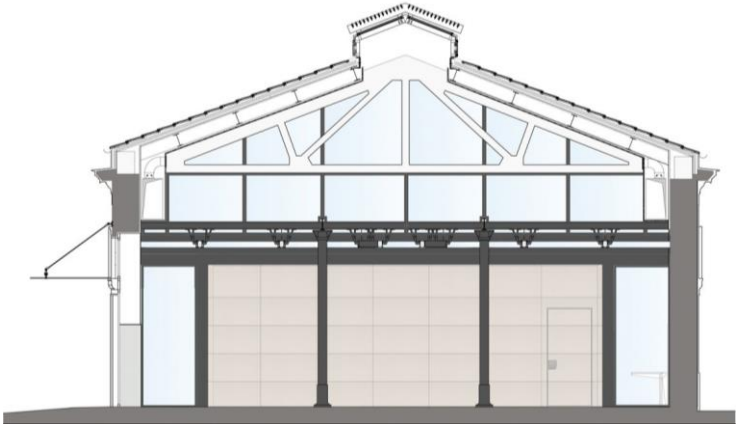
Location	Piazza Orazio Giustiniani (Historic center)	Type of intervention	Partial restoration
Destination	Slaughterhouse	Destination	Architecture Department, showroom, City of Arts
Designer	Arch. Gioacchino Ersoch	Designer	Insula - Cordeschi, DiPSA
Opening year	1859-1890	Year	2013
End of activity	1975	End of activity	Still in use
Site area	25.000 m^2	Project area	3.530 m^2

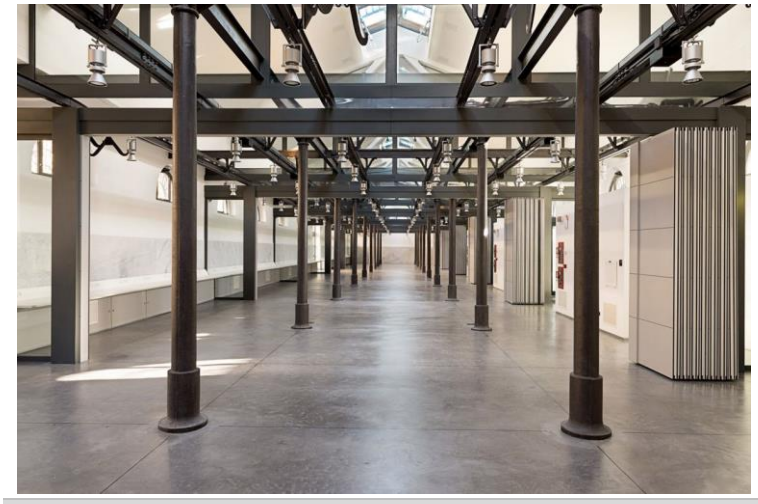
HISTORY AND DESIGN

The Mattatoio di Testaccio, in Rome, is an industrial complex of great architectural, historical and monumental value built between 1859 and 1890 by the architect and engineer Gioacchino Ersoch, located in a popular district in the southern part of the historic center of Rome. The designer conceived it as a set of pavilions with a regular morphology and an essential but highly technological and functional construction system and for this reason it is still considered an excellent example of nineteenth-century civil engineering. Included in a Plan of Use wanted by the Municipality of Rome in the early Zero Years, the complex is undergoing, after its decommissioning in 1975, an important work of recovery and reconversion. The creation of a Campus for the Faculty of Architecture, together with a part of the Macro Museum of Contemporary Art and the headquarters of the Academy of Fine Arts, will constitute a real "City of Arts". From the building point of view, the interventions are divided into various types ranging from restoration and conservative rehabilitation, to demolition of the later additions, up to the increase of internal surfaces. Pavilion 2B, inaugurated in 2013, has been transformed into six classrooms, for design seminars and extraordinary activities (workshops, exhibitions, etc.). It was a large hall about 60 m long and 12 m wide covered by a pitched roof supported by pairs of reinforced concrete trusses. The interior space was punctuated by iron and cast-iron structures that supported the suspended rails with hooks for moving meat. In fact, in its original configuration, the pavilion was divided into seven contiguous stables separated by six heavy transverse spine walls that were demolished in 1932 with the aim of creating a large room for the sale of meat and the load-bearing function of the walls was replaced by creating pairs of reinforced concrete trusses. The project was based on the recovery of the original elements common to both historical phases of the pavilion. The project intervention on the environment of 840 m2 involved the insertion of six partition walls of easy movements that allow an extraordinary flexibility of space, allowing to realize in a few minutes various configurations of environments of different sizes from a single room of about 840 m^2 of surface, to all intermediate solutions with combinations of environments.

PROJECT







Key points of the project:

- careful restoration of the masonry and roofs, integrating, where necessary, the gaps with materials equal to those already in place
- demolition of the most recent superfetations and adaptation to new functional requirements through the insertion of "light" superstructural elements
- maintenance of the architectural structure and the original equipment in their authenticity, obtaining a flexible space through reversible interventions

- articulation of the interior space through mobile dividing elements, which follow the original subdivision into seven rooms used as stables (demolished in 1932). The six walls placed between the pairs of trusses consist of a fixed perimeter part (glass and steel) and an opaque central consisting of maneuverable and foldable panels, which allow the preparation of environments of various sizes very quickly.

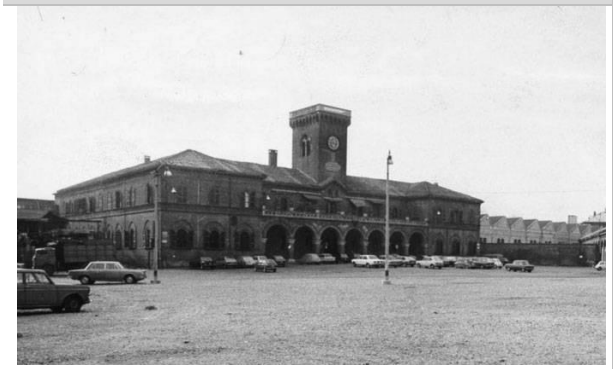
SOURCES

Text: artribune.com; theplan.it; ar-architettiroma.it; archiportale.com

Images: brdconsulting.it; arte.it; insulainrete.it (11/09/23)

2013 _ HOLDEN SCHOOL HEADQUARTER [IT_TO_39]

Former military arsenal – Torino, Italy

BEFORE	AFTER
	

Location	P.zza Borgo Dora (residential area)	Type of intervention	Total restoration
Destination	Military Arsenal	Destination	School
Designer	Giovanni Castellazzi	Designer	Info not avaliable
Opening year	1867	Year	2013
End of activity	1945	End of activity	Still in use
Site area	4.840 m^2	Project area	4.300 m^2
		Project cost / Budget	3.000.000 €

HISTORY AND DESIGN

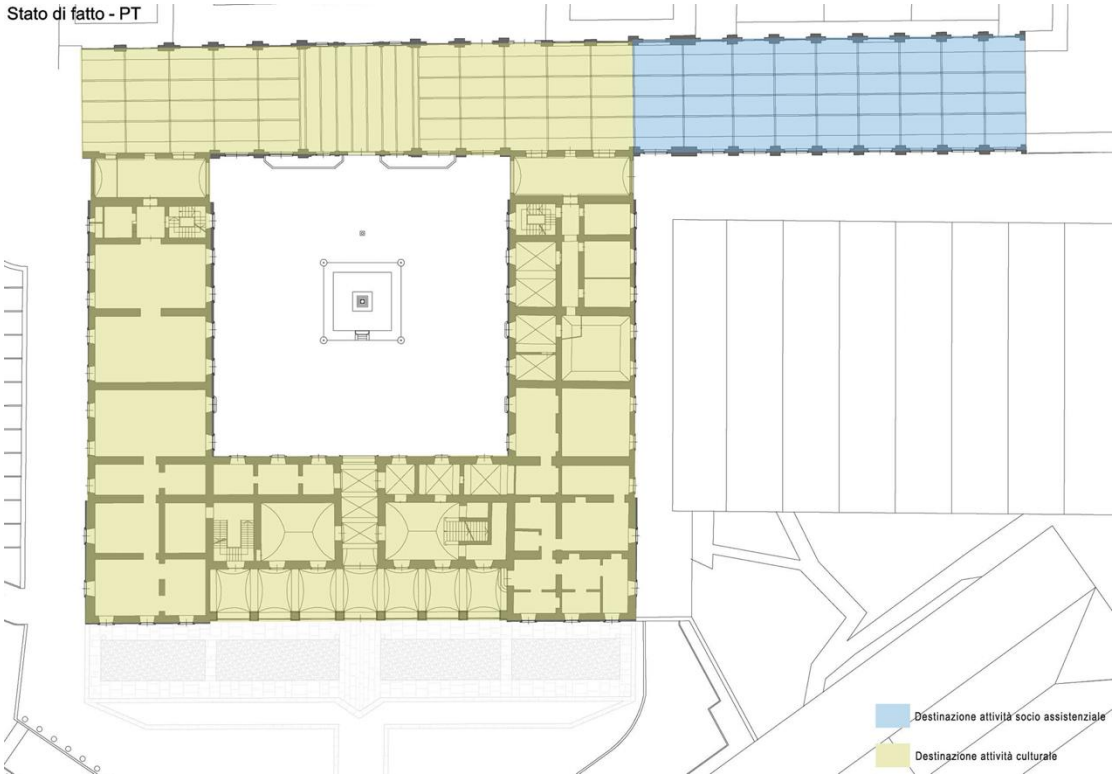
The set of historic buildings located in the district of Borgo Dora in Turin was intended for military use from the sixteenth to the twentieth century and has been the subject of several renovations. After a devastating fire, it was renovated in the second half of the nineteenth century with the construction of workshops, warehouses for the storage of materials, a barracks and a porticoed structure called Caserma Cavalli. During the Second World War (1942-1943) the complex was severely damaged several blitzes which led to the destruction of the canopies, warehouses and workshop, the collapse of the walls and the damage of the vaults.

The former Caserma Cavalli went through a very long period of abandonment, until from a nineteenth-century weapons factory it became the new headquarters of the Holden school, a forge of writers for years to come. Inside this former military arsenal of 1867 there are now classrooms, offices, common areas where you can study and work. With a unique operation of collaboration between public and private, the Municipality of Turin has granted the school this space for thirty years, in the heart of the city, in one of the liveliest and most multiethnic neighborhoods of Turin. The renovation of the Caserma Cavalli, which also took place thanks to the collaboration of the partners Eataly Media and Feltrinelli Group, is an excellent conversion of an abandoned urban space, according to eco-sustainability canons that make this project a model to follow.

The concession of the spaces of the former Caserma Cavalli to the Holden writing school is part of a redevelopment project of the former arsenal of Borgo Dora, a process that has already made many other abandoned spaces, but of historical value, accessible to the Turin's citizens.

PROJECT

The former military factory consists of a closed courtyard structure, with two floors, with an extension of the North sleeve that develops on a single mezzanine floor. The area that will be occupied by the Holden School occupies about 4,300 square meters, but an additional wing of about 500 square meters will be assigned to Sermig for social welfare activities and will be integrated into the current Arsenal of Peace.



Above was reported the state of affairs of the building before the realization of the project that included: the construction of an attic floor in a mixed wood-concrete structure, with laminated wood beams, planks and concrete casting, local reinforcements of the wooden roof structure, consolidations of the reinforced concrete structures, intended for auditorium and the construction of new spaces for services and technical rooms.
The project turns out to be an excellent conversion of a disused urban space, according to eco-sustainability canons.

SOURCES

Text: comune.torino.it; scuolaholden.it; it.wikipedia.org
Images: comune.torino.it; architelling.it (11/09/23)

2011 _ DORA PARK [IT_TO_36]

Former iron and steel Fiat factory – Torino, Italy

BEFORE	AFTER
	

Location	Borgo Dora - C.so Umbria, Via Borgaro (residential area)	Type of intervention	Total restoration
Destination	Iron and steel factory	Destination	Public park, event area
Designer	Info not avaliable	Designer	Arch. Giulio Desiderio, Arch. Carlo Pession
Opening year	1920	Year	2011 - 2016
End of activity	1992	End of activity	Still in use
Site area	90.000 m^2	Project area	90.000 m^2
		Project cost / Budget	17.000.000 €

HISTORY AND DESIGN

The park stands on a former historic industrial area of the city of Turin, where factories related to the automotive sector active for almost a century settled since the late nineteenth century. The Dora park is one of the largest green lungs of the city and consists of large sectors that take their name from the factories themselves: Vitali, Ingest, Valdocco (corresponding to the three lots of Ferriere Fiat), Michelin and Mortara. Each compartment integrates naturalistic environments and pre-existing ones deriving from the industrial past of the area, preserved or refunctionalized. The comparison with the history of the place and its industrial character is the dominant component of the transformation of the area, which is reflected in the plant, materials and use of vegetation. The other fundamental element for the park is the presence of water, through the Dora river, which is enhanced through the redevelopment of the banks and, for a stretch of the south bank, made accessible, and the creation of fountains, canals and water games inside the park. The project transforms the five former industrial areas, according to key themes that have provided for the re-emergence of the Dora river which, previously underground, has become a supporting element of the new park. In the area, green lawns have thus arisen that integrate the cooling tower of the former Michelin (in whose former canteen a museum dedicated to the environment has also arisen) and studied tree plantings recall the grid of the supporting structures of the old warehouses (Valdocco lot). To the west, more elaborate designs create water tanks and stone gardens in the form of hortus conclusus in what were the concrete bases of the structures of the former Ingest, closer to the church of the Holy Face which also recovers the old chimney transforming it into a modern bell tower illuminated at night by a luminous spiral. Or, again, the recovery of the former stripping shed of Vitali which, emblematic standard-bearer of the whole intervention next to what remains of its twin, keeps the memory of the past more visible by creating under the roof a multifunctional space connected with the neighboring Ingest by a new pedestrian walkway that crosses the busy Via Borgaro.

PROJECT

The general themes pursued by the project concern three main aspects: the visual and functional integration of the park with the river, the aesthetic and functional metamorphosis of the preserved industrial pre-existences, the connection and dialogue with the remaining part of the city. The project is characterized and unified by the use of a few "poor" materials (cement, galvanized steel, gabions) consistent with the functional language of the industry, as well as simple and durable design details, such as satin curbs made of metal plate, combined with careful connections between the different lawn surfaces, in shot peened asphalt or in stabilized aggregates. The environmental sustainability of the park has also been developed with particular attention thanks to the use of LED lighting fixtures, adopting innovative reclamation techniques and privileging, rather than the economic aspects, selection criteria that would bring environmental improvements such as the compensation of CO2 (carbon footprint) produced by construction activities.

The preserved structures of the Vitali steelworks, with the processing canopy, as high as a 9-storey building and 308 meters long, is the most evident example of how the metamorphosis of the industrial structures at the service of the new functions has been fully successful.

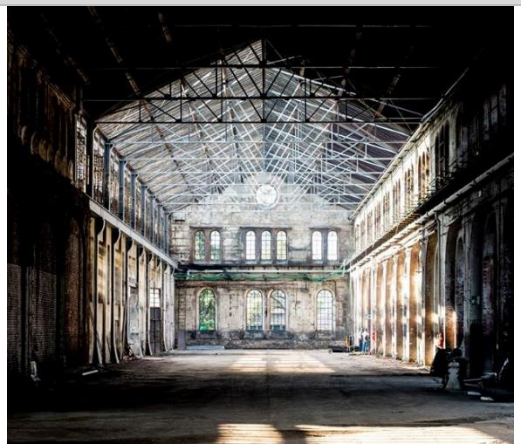
SOUCES

Text: museotorino.it; comune.torino.it; acomeambiente.org

Images: museotorino.it; torinostoria.com; acomeambiente.org (11/09/23)

2017 _ OGR – OFFICINE GRANDI RIPARAZIONI [IT_TO_37]

Former railway vehicle maintenance factory – Torino, Italy

BEFORE	AFTER
	

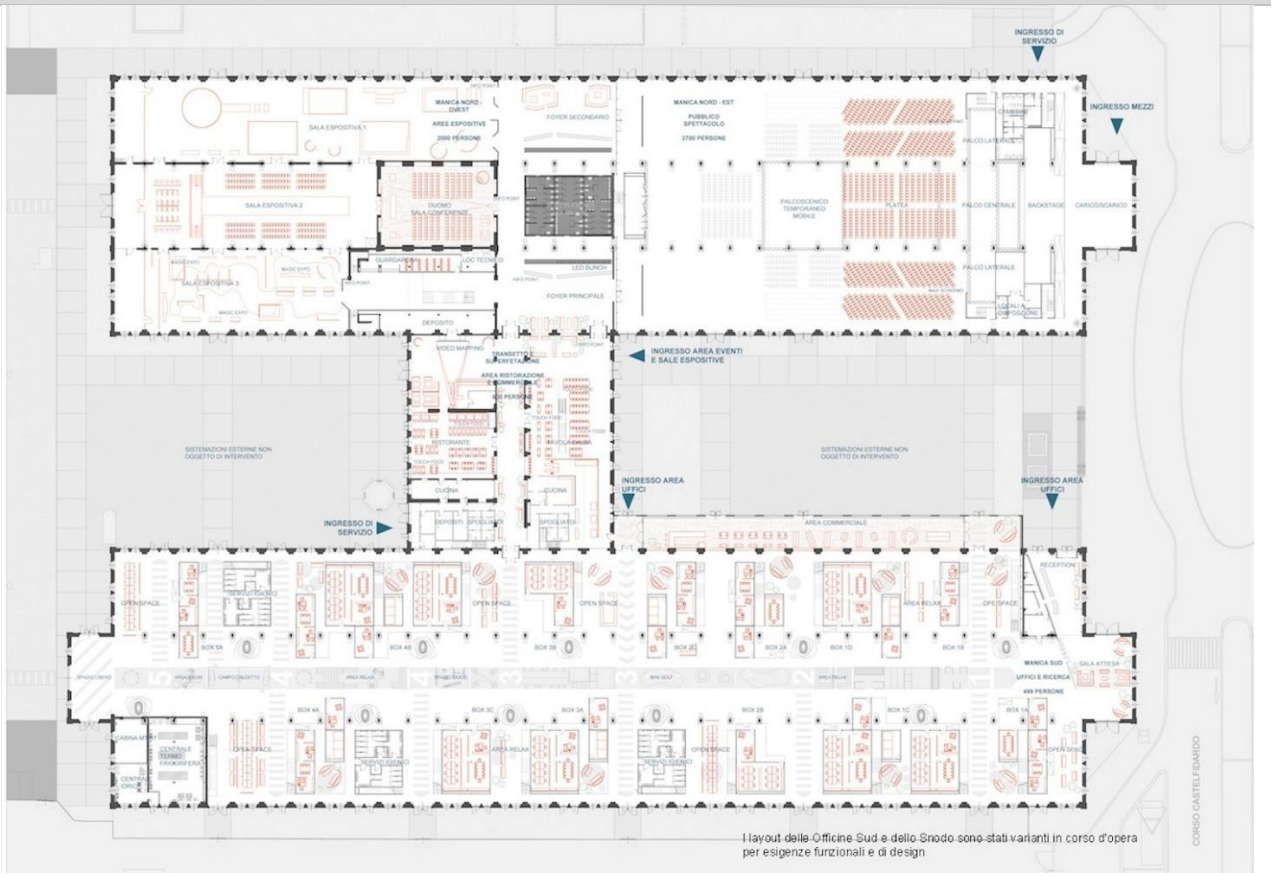
Location	Corso Castelfidardo (residential area)	Type of intervention	Total restoration
Destination	Railway factory	Destination	Polifunctional area
Designer	Info not avaliable	Designer	Building group
Opening year	1895	Year	2008 - 2017
End of activity	1992	End of activity	Still in use
Site area	35.000 m^2	Project area	35.000 m^2
			100.000.000 €

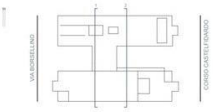
HISTORY AND DESIGN

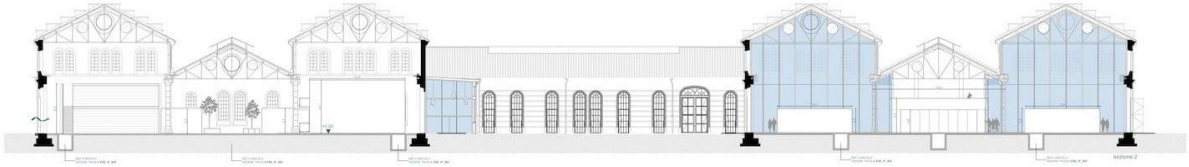
The OGR were the oldest and most important Italian railway wharehouses for the construction and repair of locomotives and railway vehicles built around the mid-nineteenth century. Based on the logistical needs of production, transport and delivery of materials, they were settled in the area of Porta Nuova and Porta Susa but almost immediately united for reasons of space in a single complex, which at the time was far from the residential area. The new OGR are the only European example of adaptive reuse of an industrial complex with multiple uses organized in three different thematic areas with three different complementary "souls": “The Officine Nord” where visual and performing arts meet, with the creation of spaces for concerts, exhibitions, performances, dance and entertainment, “Le Officine Sud”, starting from 2018, a hub for the collaborative creation and incubation of ideas for the future, focused on start-ups, creative and smart industries and therefore intended for scientific, technological and industrial research and “The junction”, in the transept, a food district focused on the promotion of food and wine culture with the establishment of food & beverage administration activities.

In addition, two squares were built, the East Court and the West Court respectively on Corso Castelfidardo and Via Borsellino. The project of recovery and grafting of the new interventions safeguard the perception of volumes and heights, minimizing the impact on the original archeology; they are also reversible and clearly distinguishable according to materials, color and construction details. The restoration intervention was very complex due to the desire to protect and safeguard both the industrial architectural identity of the complex and the historical memory of the monument: taking into account all the architectural, historical and artistic constraints was not easy. In addition, the degree of deterioration of the structures abandoned for years, the size of the building, the characteristics of the site, the presence of environmental pollutants and weapons of war, the differentiation of functions and potential users, energy and accessibility adjustments etc. have required a great capacity for coordination and continuous adaptation of the project.

PROJECT







The OGR buildings have a covered surface of about 20.000 sqm with an H-shaped plan, and they are composed by two buildings parallel and with a rectangular shape, 183 m long and 48 m wide, united by a central building 40 meters long and 39 meters wide. The maximum height of the structures is about 19 meters. Above were reported the ground floor plan of the whole complex and a cross section that makes us understand the organization of the two North and South sleeves. To understand the complexity and extent of work needed to achieve those objectives, some useful figures can reflect the complexity and size of the OGR. The project foresees: 20,000 m^2 of flooring, replacement of about 24,000 m^2 of pitched roof, replacement 1,125 windows, 5 km of pipes and underground utilities, 50,000 m^2 of different types of paint to coat the metal structures, intervention on outdoor areas, electrical system and extremely flexible technology, air conditioning unit and under-floor heating in all areas.

SOURCES

Text: museotorino.it; ogrtorino.it; fondazionecrt.it
Images: museotorino.it; torinostoria.com (11/09/23)

2021 _ CLASSROOMS R - POLITECNICO DI TORINO

[IT_TO_41

Former changing rooms of OGR complex – Torino, Italy

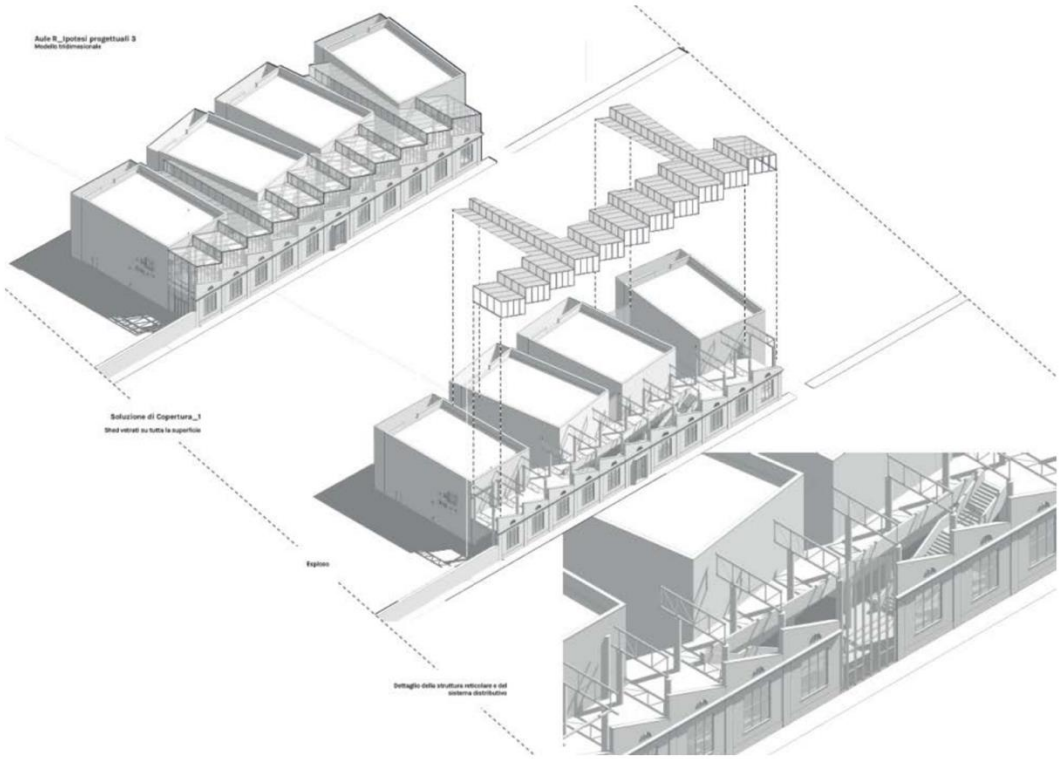
BEFORE	AFTER
	

Location	Via Paolo Borsellino (residential area)	Type of intervention	Partial restoration
Destination	OGR – changing rooms	Destination	New lecture and study hall
Designer	Info not avaliable	Designer	Masterplan team of Politecnico di Torino
Opening year	1895	Year	2021
End of activity	1992	End of activity	Still in use
Site area	m^2	Project area	

HISTORY AND DESIGN

The area covered by the intervention is inserted within the context of the “Cittadella politecnica” bordering Via Borsellino. The west side of the intervention area is identified by the stone and brick wall of about three meters high that stands on the border of the city street. The lower limit to the south of the area is defined by the current pedestrian entrance of via Borsellino n. 53. The portion of green area defines the border on the eastern front, while moving northwards the area extends to the border belonging to the University. To arrive at the design solution, the context and the insertion area were examined, making the conservation needs of the historic industrial façade dialogue, with the typical card profile, with the requests expressed by the University, which expressed the need to make the new construction flexible to guarantee the use of different types of classrooms and to identify spaces for students. It is therefore proposed a scheme of independent volumes recognizable externally only from the internal side of the Polytechnic Citadel, and connected on the side of Via Borsellino by a connective volume obtained by preserving the façade and the scan to sched of the roof, which will be raised through large windows set back from the wire of the current façade, so that the preserved historic building and the new volumeters that houses the spaces of connection and aggregation of new teaching blocks.From the planimetric point of view, four blocks have been created for stepped rooms for teaching and conferences, alternating with irregularly shaped spaces for greater usability and livability of the building, characterized by the creation of glimpses of view that cross the building and allow you to see portions of the historic Ex Fucine building and the alternation of materials, that make recognizable the preserved historic building and the new volume, for a total capacity of 1,800 people. The four new blocks house two study rooms, two-bathroom blocks, four technical rooms, four 300-seat conference rooms and four 150-seat classrooms.

PROJECT



The scheme proposed consists of four independent volumes recognizable externally only from the internal side of the "Cittadella politecnica" and connected on the side of Via Borsellino by a connective volume obtained by preserving the façade and the shed scan of the roof, which will be raised through large windows set back from the edge of the current façade.
From the planimetric point of view, the design hypothesis involves the definition of four blocks intended for teaching and conference rooms and a connection space for internal, horizontal and vertical distribution. This configuration allows to create irregularly shaped spaces for greater usability and livability of the building, and the creation of glimpses of view that cross the building and allow you to see portions of the Ex Fucine building.

The flat roof of the four blocks will be used as a technical space for the positioning of the photovoltaic panels. The four different covers will each be accessible by a flight of the external safety stairs block. The façade exceeds the edge of the roof, acting both as a parapet and as a mask for photovoltaic panels. The part covered with the sheds will be made with a sandwich package in insulated sheet metal of limited thickness in order to recall the old industrial mantle in the façade.

SOURCES

Text: polito.it; masterplan.polito.it
Images: google.com/maps; masterplan.polito.it (11/09/23)

7.2 CONCLUSIONS OF THE ANTHOLOGY RESEARCH

After deepening the research, the final thought that has been made is that restoration proves to be a real art, capable of being declinable in different forms of interventions and, above all, of shaping and contextualizing each artifact. It is noted how the theme of abandoned industrial ruins, of great importance and constant relevance, has managed over time to find decisive responses in the form of redevelopment and repurposing, reversing an initial coefficient of degradation into a new and modern economic factor. The analysis of the different case studies has shown that the approach of the restorer follows a certain tendency: when the objective is to carry out an architectural re-functionalization while preserving the existing configuration, the critical restoration seems to be the most appropriate, as it can have a positive impact on the theme of transformation and reuse. In relation to the different design metamorphoses, the concept of compatibility has led to interesting results: The creation of new compositional solutions, while preserving the original character of the site, required an indispensable and binding respect for the old, which, however, also made it possible to evaluate which functional developments could be achieved and concretized. The stylistic language that has developed in these projects is therefore built on the theme of recognizability, through the preservation of the volume and the linear character of the work, which confirms and reinforces the character that has always conditioned the social fabric. Having become aware of the great cultural depth that the dialectic architecture/industry has acquired, man has developed over time a new planning matrix, no longer focused on pure invention, but on the goal of restoration. Thank you to this important conceptual revolution, industrial archaeology today represents a new attractive path, both in economic and urban planning terms, and the modern architect is projected in this way towards a new planning frontier, that is not only architectural but perhaps also and above all civil, and in which restoration is confirmed as an essential instrument of renewal.

8. THE PROJECT

LOCATION OF THE INTERVENTION AND ANALYSIS OF THE STATE OF AFFAIRS

The project area, as already mentioned above, is located in Carignano [*Figure 29*], a town 20 km south of Turin with the following climatic data [*Table 1*]:

Figure 29 - Area under the province of Turin. Municipality of Carignano is highlighted in red.

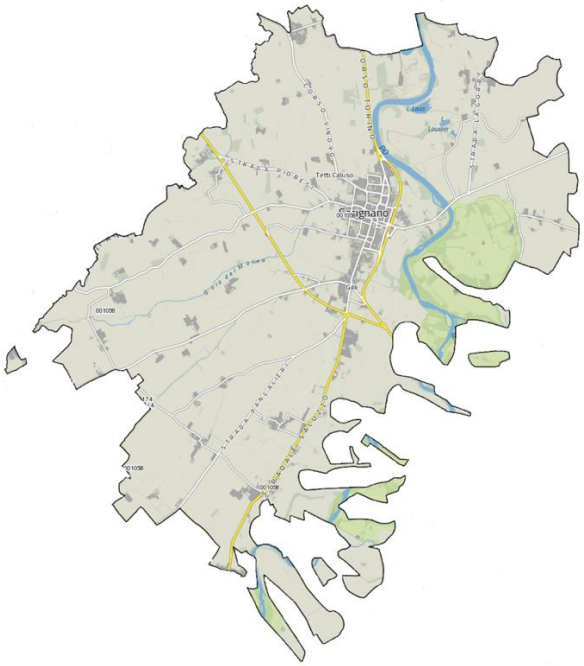


Figure 30 – Carignano municipality boundaries..

City of Carignano	
Altitude	235 m s.l.m.
Latitude and Longitude	44°54′21″N 7°40′21″E
Seismic zone	3
Climatic Zone	E
Degree days	2578

Table 1 - Climatic data of Carignano.

The area of about 154 m^2 is inserted within the historic building fabric of the city [*Figure 31*], a few steps from the Cathedral of S.S. Giovanni Battista e Remigio. The west side of the intervention area is identified by the stone and brick wall of about 8 meters high that belongs to the former weaving building and by the most recent expansion of the hotel management school that stand on the border of the main North South axis of the city, Via Umberto I. The southern limit of the area is defined by the three-storey building overlooking Via Fratelli Bona. The building that now houses the Municipality, on Via S. Fricchieri, defines the border on the eastern front, while moving northwards the area extends to the border of Via Porta Mercatoria.

Figure 31 - Ortophoto of the historic center of Carignano.

Looking at the extract of PRGC [*Figure 32*] which concerns the area under esteem, the buildings affected by the transformation and redevelopment project are those highlighted in yellow.

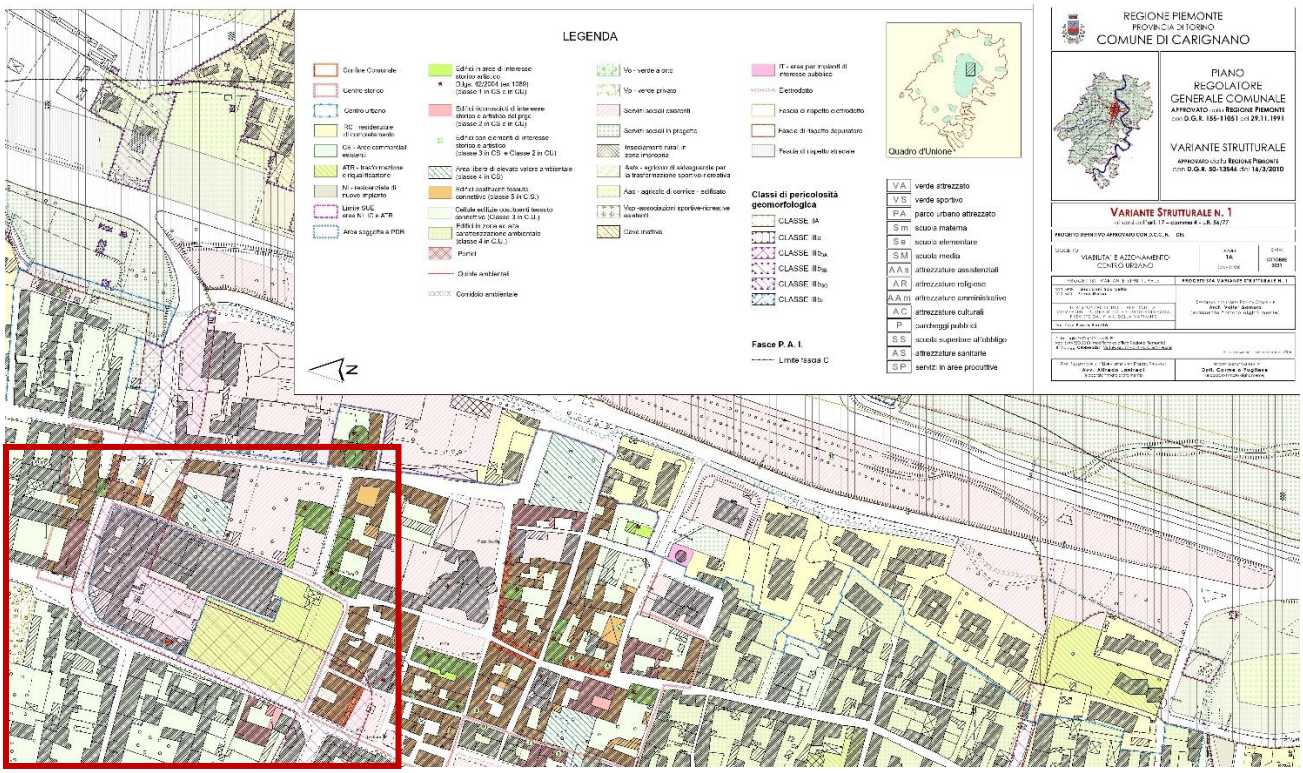


Figure 32 – Extract of the PRGC. The Bona area is highlighted by the red line.

The Carignano municipality has recognized significant potential in the former Bona industry complex following its closure. They aim to revitalize and transform it into a new and beneficial asset for the city.

The project involves the construction of a gym for the school, which can also be used as a sports center by all municipal bodies and citizens and the construction of an urban square in the inner courtyard of the former industrial complex.

To reach the design solution, however, it is essential to also take into consideration the urban context and the insertion area. Observing the masterplan of the current state of affairs [*Figure 33*] it feasible to observe how the project area is strategically located; in fact, being bordered on one side by the main road axis of the city that connects Turin to Carmagnola, it is easily accessible by suburban public transport. This factor means that the new socio-cultural pole that will be built in the area can also be a point of interest for neighboring cities.

In the city there is no real bike path, but some roads are also suitable for traffic on cycles.

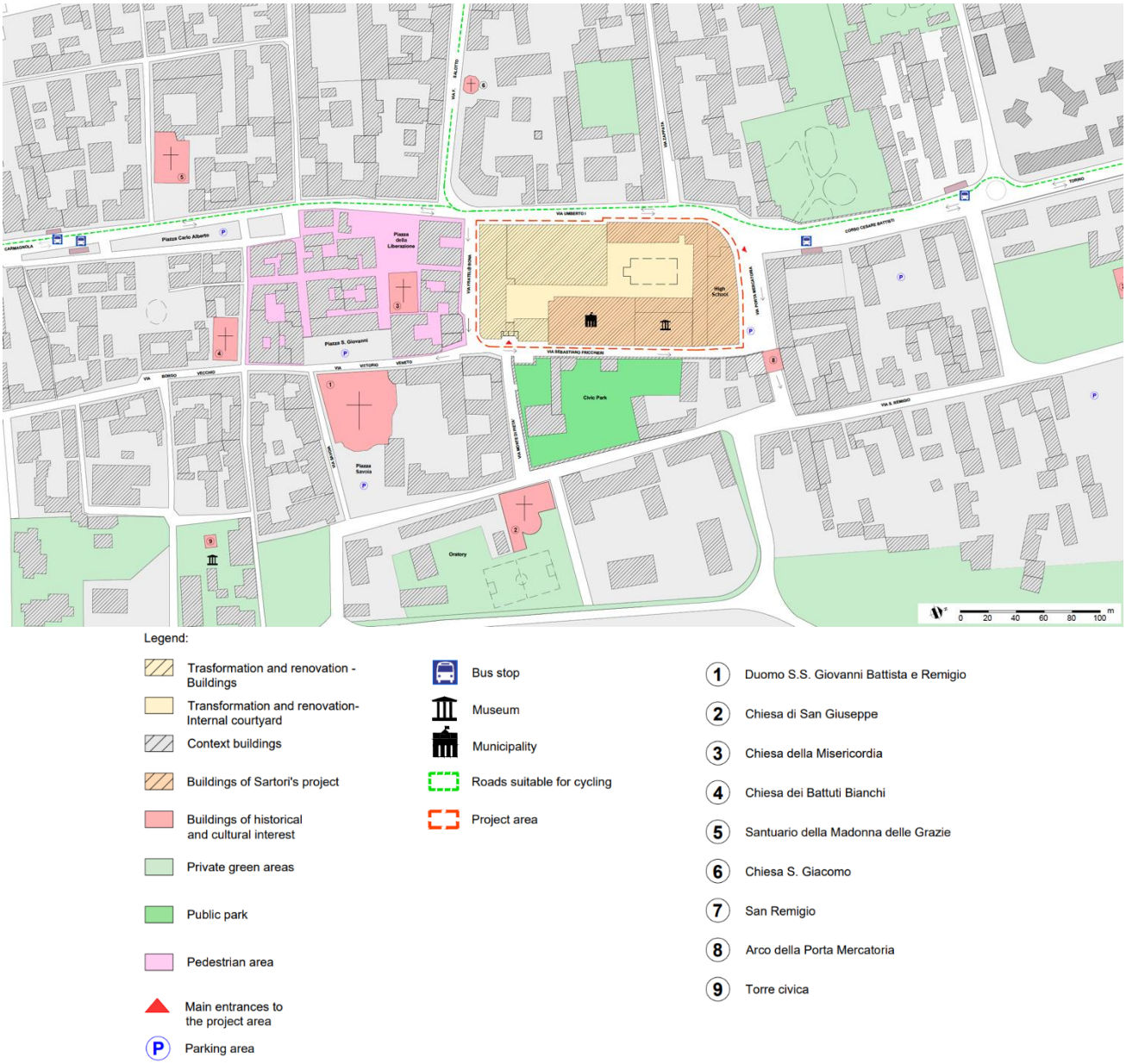


Figure 33 - Territorial organization.

The area is currently equipped with outdoor parking areas both inside and outside the perimeter of the complex and an underground car park with entrance on Via Porta Mercatoria which contains 59 parking spaces.

Taking a deeper look to the project area, in the [*Figure 34*] has been analyzed the entrances to the lot, the subdivision of the spaces at the ground floor level, their function and users' paths.

The marked entrances are two: the historic one of the former wool mill, located along Via Fricchieri in line with Via Monte di Pietà, and the entrance to the secondary school building, which is located on Via Porta Mercatoria. It's also possible to access the lot through a series of openings that are located along the eastern side and allow reach the inner courtyard area passing through the porticoed area designed by Sartoris for the town hall. The element of the portico is in fact a characteristic element of the entire project of the Turin architect so that it is also repeated in the school building and in its subsequent extension.

In the covered section on the ground floor, vertical connecting blocks provide access to the upper levels, where there is the municipal museum, library, and historical archive. The inner courtyard is accessible to vehicles, with entry available from Via Fricchieri, leading to the wider courtyard area currently serving as a parking lot.

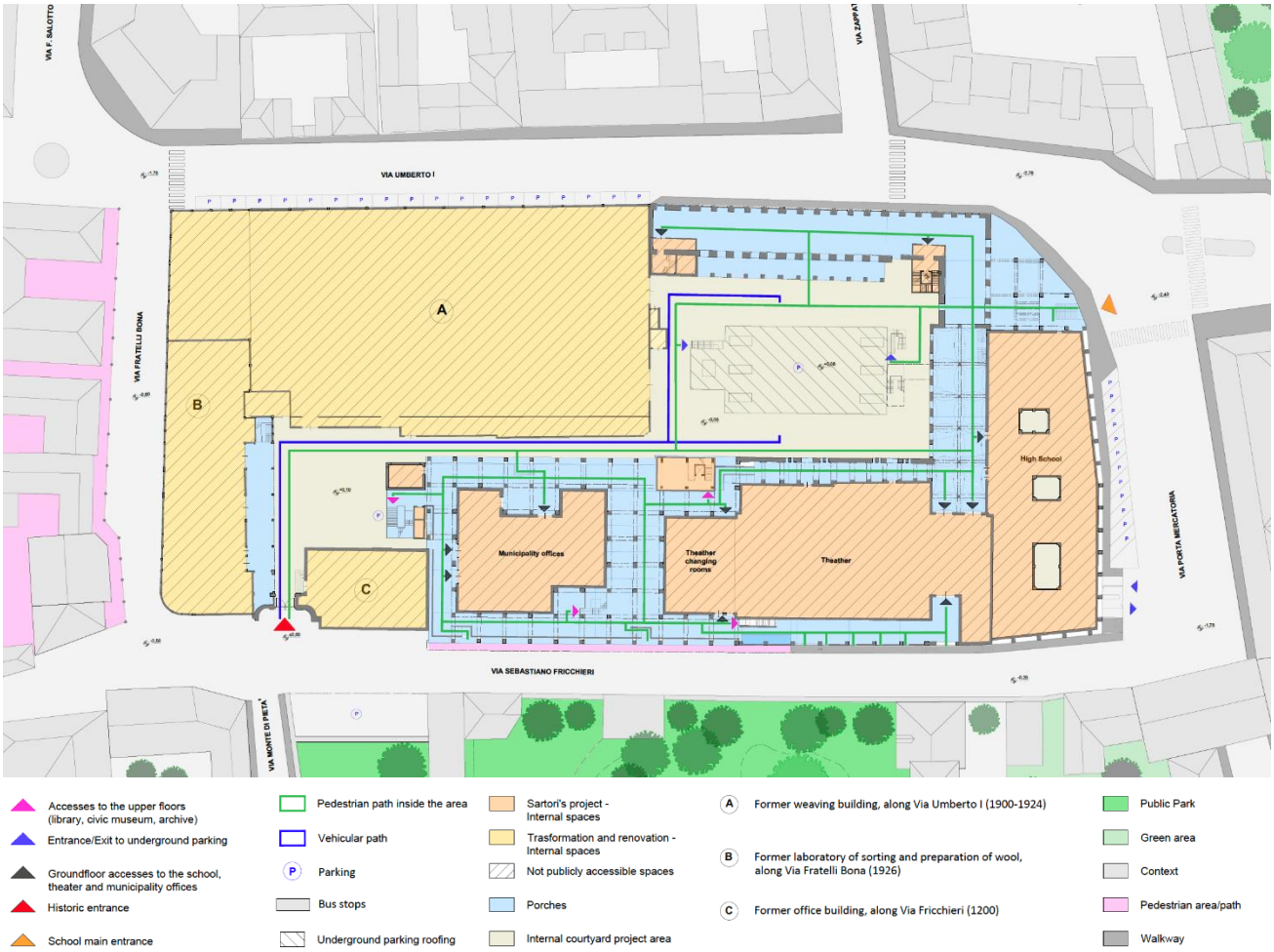


Figure 34 – Analysis of the users and subdivision of the spaces.

8.1 THE INTERNAL COUTYARD: PHOTOGRAPHIC SURVEY

The courtyard and internal roads, from the analysis of the current state of affairs, are in evident lack of maintenance, the space indeed is currently used as a parking lot by school staff or municipal employees and as a connective between the buildings that surround it.
The area for a total of about 270 m^2 could serve as a gathering place for the city, but the lack of green spots and decay makes it a cramped and unpleasant space.
As for the pavement, the historical "pavé" [*Figure 35, 36, 37*] made with stones, has remained for most of the area, while in the wider area, the one in [*Figure 42*] there is a concrete slab that serves as a cover for the underground parking. In fact, there are two stairs blocks to access the parking area in the level below the courtyard.
In [*Figure 40*] is also visible the emergency staircase made of metal carpentry for the school complex leading to the collection point in the center of the courtyard.
The survey is completed with 25 pictures, in this specific case taken with a Nikon D3500 Reflex camera and an iPhone X camera [*Figure 35*].

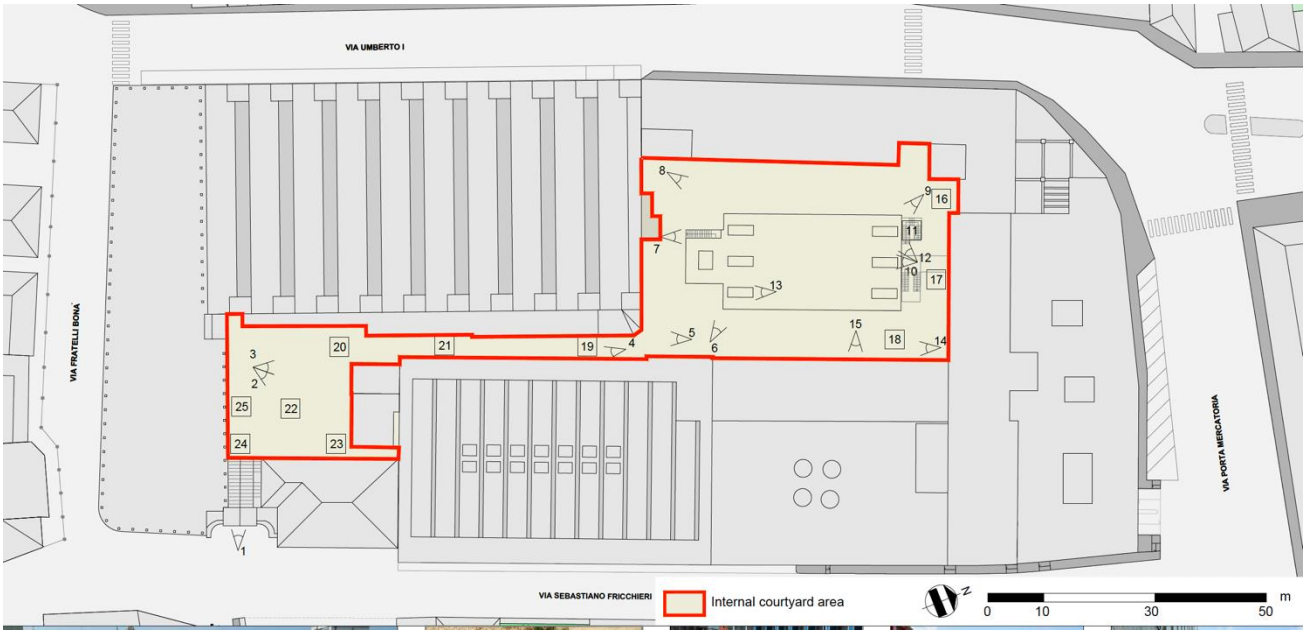


Figure 35 - Planimetry with the indications of the photographic shoots.

Figure 36 – View from the historic entrance portal.

Figure 37 - View of the historic entrance portal from inside the lot.

Figure 38 – View of the internal viability in between the current municipality building on the right and the former weaving building on the left.

Figure 39 – View of the internal viability in between the current municipality building on the left and the former weaving building on the right.

Figure 40 - View of the internal viability in between the current municipality building on the left and the former weaving building on the right.

Figure 41 – View of the internal courtyard surrounded by the school complex on the north-westside and part of the municipality building on the east-south side.

Figure 42 - Detail of the staircase to access the underground parking.

Figure 43 - View of the internal courtyard surrounded by the school complex on the north-westside and part of the municipality building on the east-south side.

Figure 44 - View of the internal courtyard surrounded by the school complex on the north-westside and part of the municipality building on the east-south side. Picture taken from the top of the emergency staircase of the school.

Figure 45 - Detail of the staircase to access the underground parking. Picture taken from the top of the emergency staircase of the school.

Figure 46 - Detail of the flooring of the internal courtyard. Picture taken from the top of the emergency staircase of the school.

Figure 47 - Detail of the air inlets for the natural ventilation of the underground parking.

Figure 48 - View of the east side of the internal courtyard adjacent to the municipality building.

Figure 49 - Detail of the openings and the flooring of the east side of the internal courtyard.

Figure 50 - Detail of the flooring of the internal courtyard adjacent to the school building.

Figure 51 - Detail of the flooring of the internal courtyard adjacent to the school building. Picture taken from the emergency staircase of the school.

Figure 52 - Detail of the flooring of the east side of the internal courtyard.

Figure 53 - Detail of the flooring on the internal viability.

Figure 54 - Detail of the flooring of the southern area of the internal courtyard.

Figure 55 - Detail of the flooring of the internal viability.

Figure 56 - Detail of the flooring of the southern area of the internal courtyard.

Figure 57 - Detail of the flooring of the southern area of the internal courtyard.

Figure 58 - Detail of the flooring near the historic entrance portal.

Figure 59 - Detail of the flooring near the historic entrance portal.

8.2 THE PROJECT MASTERPLAN

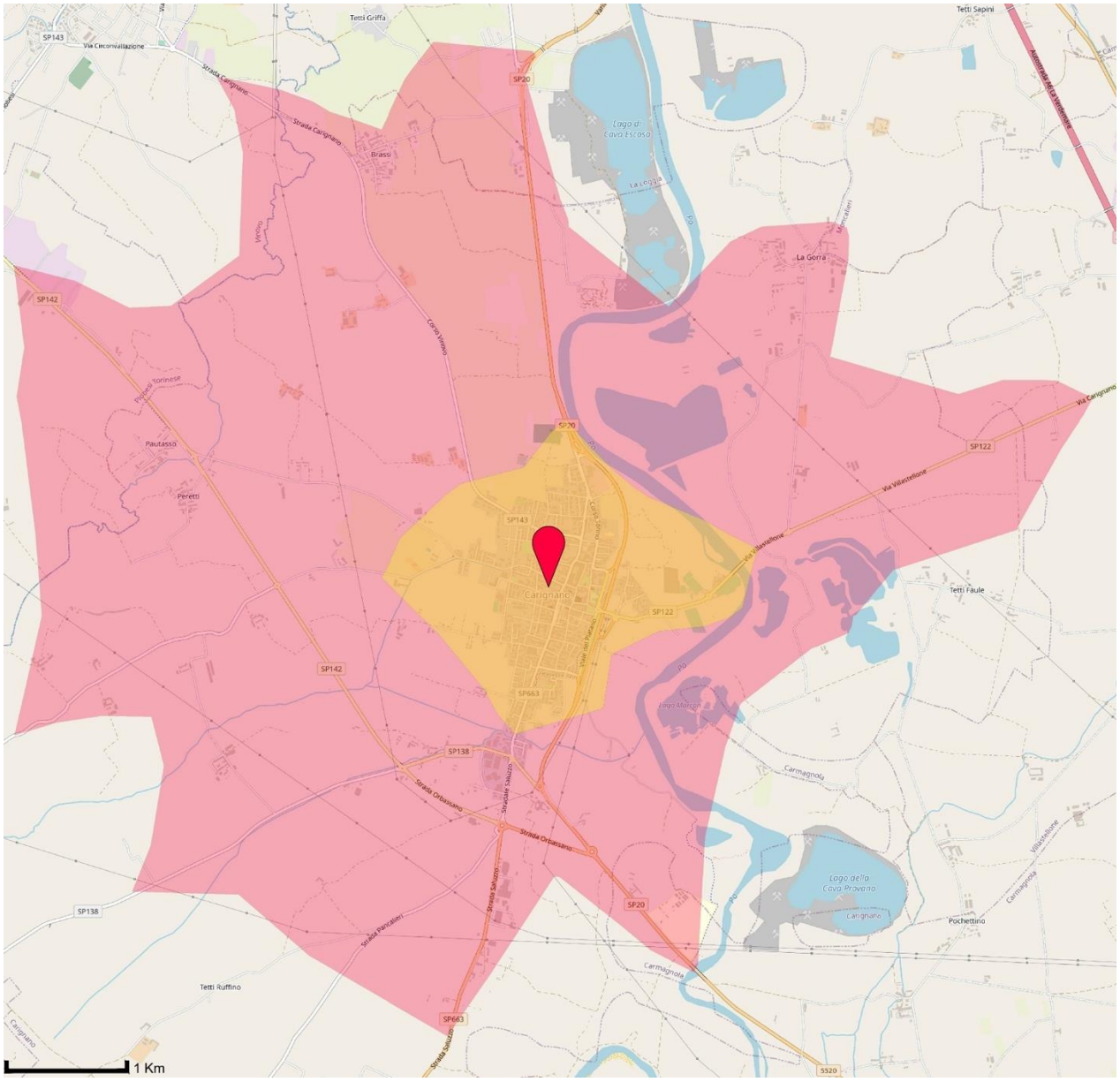
The main purpose of the project is to donate to the city of Carignano new public gathering spaces, giving a second life to the abandoned buildings, those belonging to the former Bona Wool Mill that have not faced any renovation over the years.
The project proposal involves the realization of:

- a Gymnasium that can be used both for school activities, but also for sports events organized by other organization and associations;
- the redevelopment of the building along Via Fratelli Bona, destined to be the new wing of the hotel management institute;
- the inner courtyard of the lot that will become a new urban square.

In this thesis work the design of the new urban square will be deepened.

In order to present a project that could meet the needs of the city, an analysis of the tertiary sector was conducted through isochronous curves [*Figure 60*], the services available within a 15-minute walk and bike ride from the project area were taken into account. The categories into which the tertiary sector has been divided have been identified on the basis of information obtained from the website of the municipality of Carignano, and hare are listed:

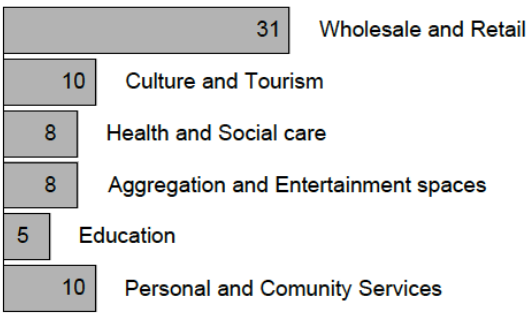
- Wholesale and retail: small shops and wholesale stores, supermarkets:
- Tourism and culture: museums, accommodation, restaurants, churches, theatres, libraries;
- Health and social care: hospitals, pharmacies, nursing homes, Croce Rossa, polyclinic, general practitioner;
- Aggregation and entertainment spaces: parks, oratories, social clubs, gyms, event rooms
- Education: all types of school, of all levels;
- Personal and community services: offices, studios, municipality, banks, post offices.



Isochronous from Municipality, Carignano, TO, on foot.
Travel time: 15 min.

Isochronous from Municipality, Carignano, TO, with bike.
Travel time: 15 min.

Analysis of the therthiary sector services in the radius of 15 min on foot.



Analysis of the therthiary sector services in the radius of 15 min with bike.

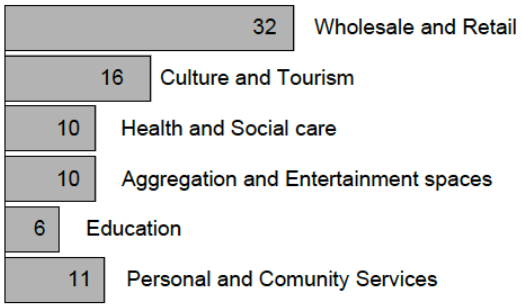


Figure 60 – Analysis of the therthiary sector in Carignano and its surroundings with isochronous curves.

From the analysis it is possible to see that the results between the two isochronous are not significantly different, as in 15 minutes by bike you cannot reach other municipalities comparable to Carignano and therefore that can offer the same level of services, but only small towns.
Looking at the graphs it turns out that the municipality is well supplied from the point of view of wholesale and retail and culture and tourism. The week points seem to be the presence of facilities for education and spaces of aggregation. Considering that the municipality has already planned to refurbish the building along Via Fratelli Bona to expand the spaces for the school, it was decided to transform the space of the inner courtyard into a new gathering space.
Looking at the project masterplan [*Figure 61*] it's possible to see the major changes made to the area under consideration.
It was decided to place the Gymnasium building where currently there is the former weaving building that has been preserved in the worst way. The windows are mostly broken, and the shed cover is unsafe due to infiltration. The recovery was therefore possible only for the façade on Via Umberto I.
The entire Gymnasium project was centered around the preservation of the historic industrial façade with its typical shed-like profile. The first 8 out of 10 modules of the existing facade and the first two rows of pillars were refurbished. The shed structure was preserved for approximately the first 14 meters of the roof. Subsequently, a steel structure for the roof of the playground part was designed. In this case Polonceau-type beams was used. These beams allow for the use of highly compact resistant sections, reducing the number of pillars and enabling wider spans, up to 30 meters.

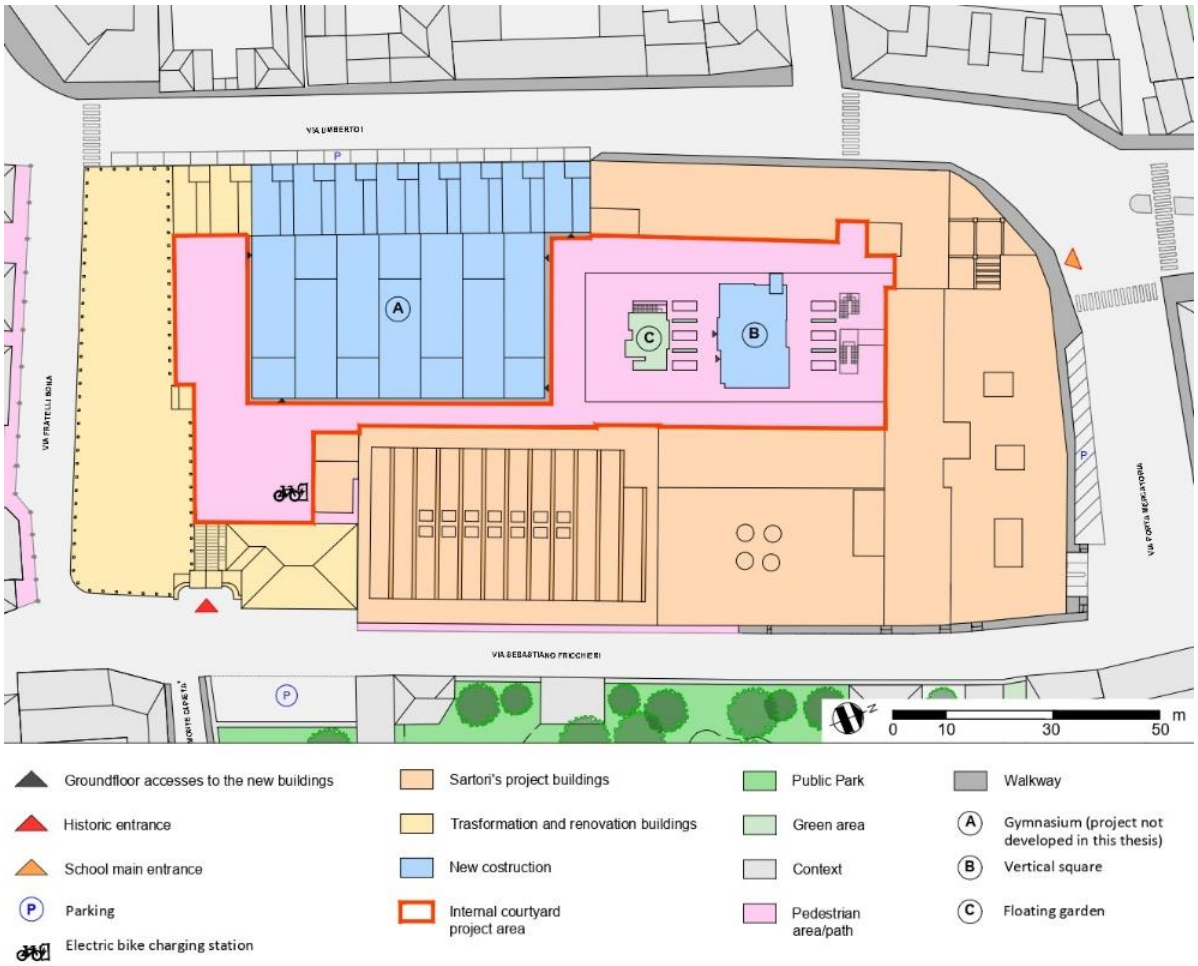


Figure 61 – Project masterplan.

As for the area of the inner courtyard, the general theme pursued by the project concern the visual and functional integration of the area with the aesthetic and functional metamorphosis of the preserved industrial pre-existences and the already restored buildings. For the design solution, an organization is proposed that wants to make this space more livable and sustainable.
The first important change is the closure of the area to vehicular traffic, so it remains an area accessible only to pedestrians or cycles, in particular the latter can access from the former entrance of the wool mill on Via Fricchieri, which will be restored, but will remain mostly unchanged. Near the entrance, a special area has been set up for parking bikes and charging stations for electric vehicles.
The biggest change was certainly made in the area between the municipal building, the school, and the former weaving building that in the project will become the new gymnasium [*Figure 62*].

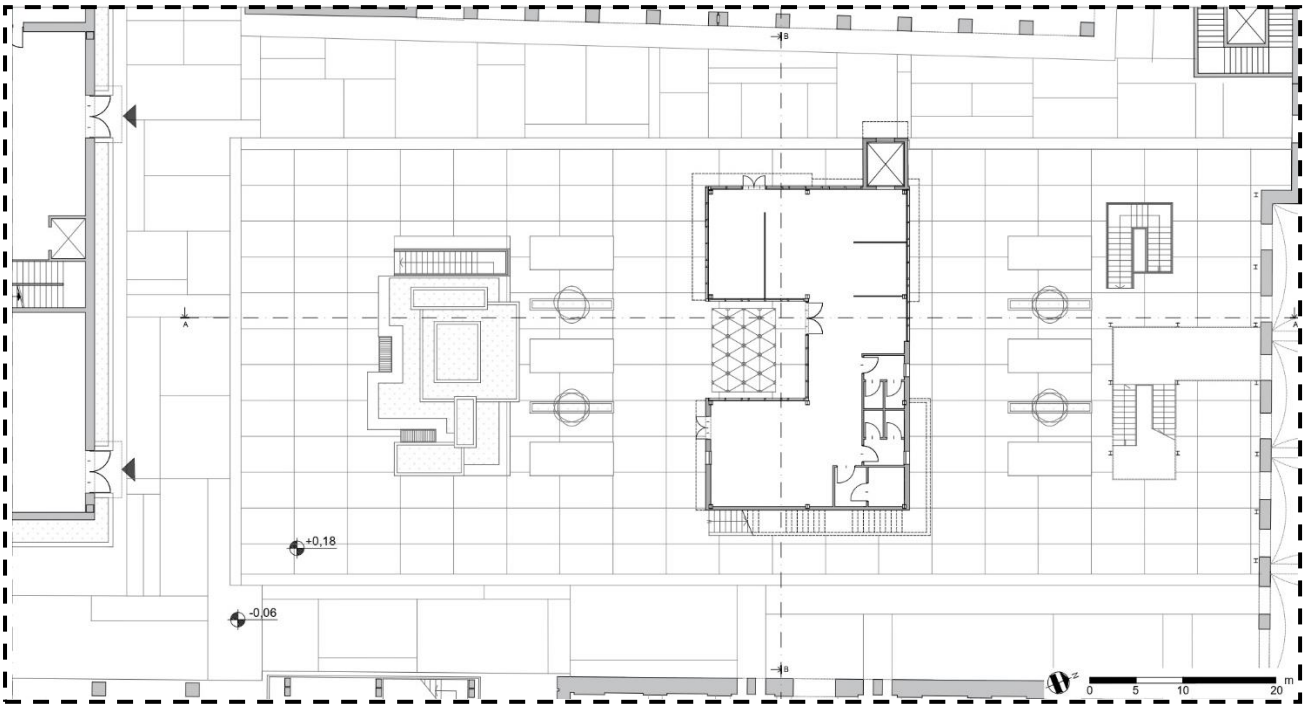


Figure 62 – Area of the internal courtyard between the municipal building, the school and the former weaving building.

In this space, which covers an area of about 194 m^2, the construction of a "vertical square" was planned, following in part the conceptual idea of the vertical square that had been conceived by Sartoris, but which was never realized. He had thought of building, in correspondence with the underground car park, a square that rise from the ground for two more floors, and that would serve as a connective space between the municipality building and the school. Below are reported the elevations of the vertical square designed by Arch. Sartoris [*Figure 63*].

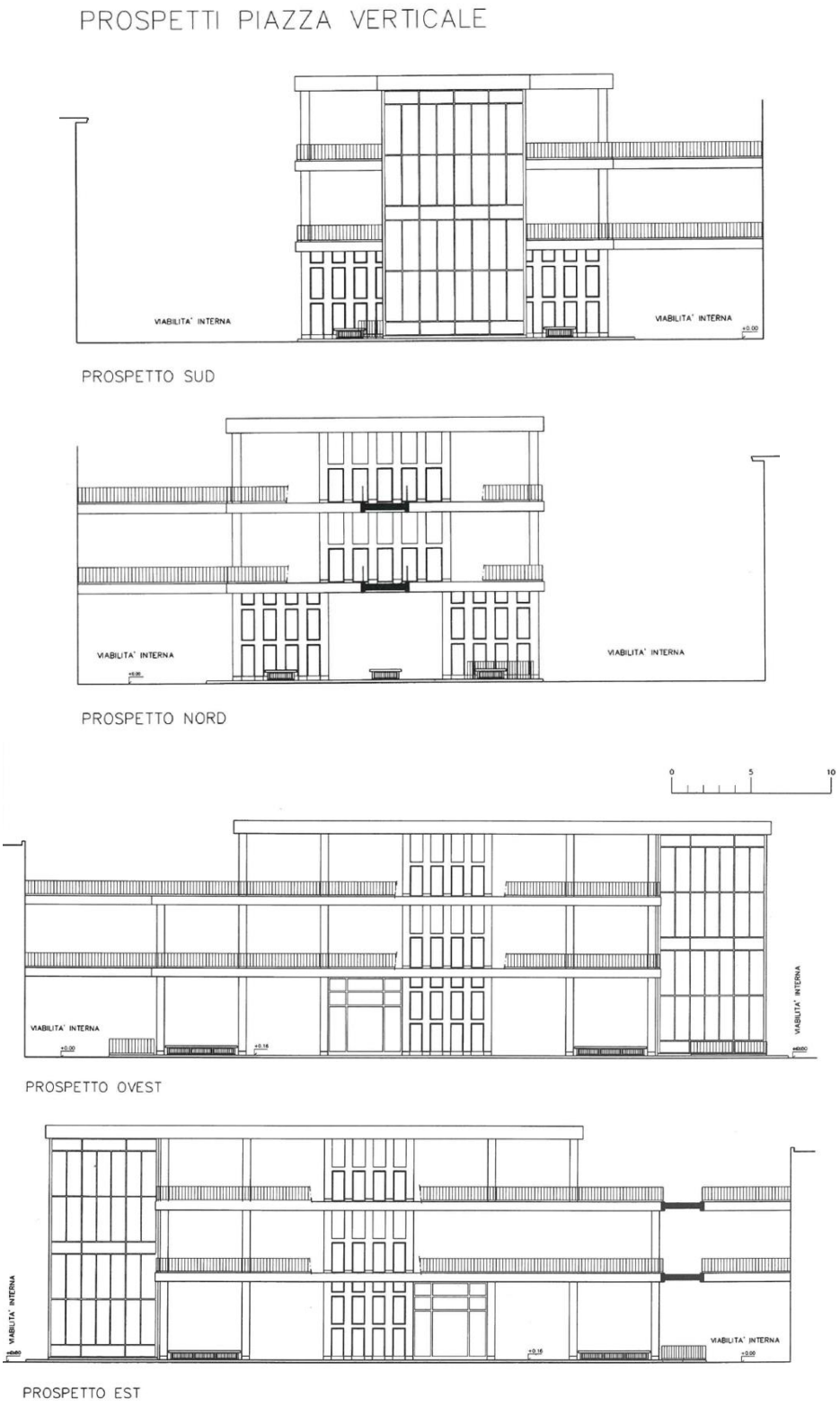


Figure 63 – Elevation of the "vertical square" designed by Sartoris A. that was never realized.

The design solution that was chosen for the vertical square includes the construction of a steel structure that occupies only part of the current surface of the underground parking cover and that rises one floor above ground level. The original positions of the openings for the natural ventilation of the underground car park and the two access stairs to the underground floor are maintained.

To mitigate the site main constraints, it was decided to realize a structure that encases and conceals the several preexisting lift heads, stairwells, utilities and access points, creating a sort of "floating garden" [fig] composed of the project's signature rectangular frames that reference the simple architecture of the surrounding buildings.

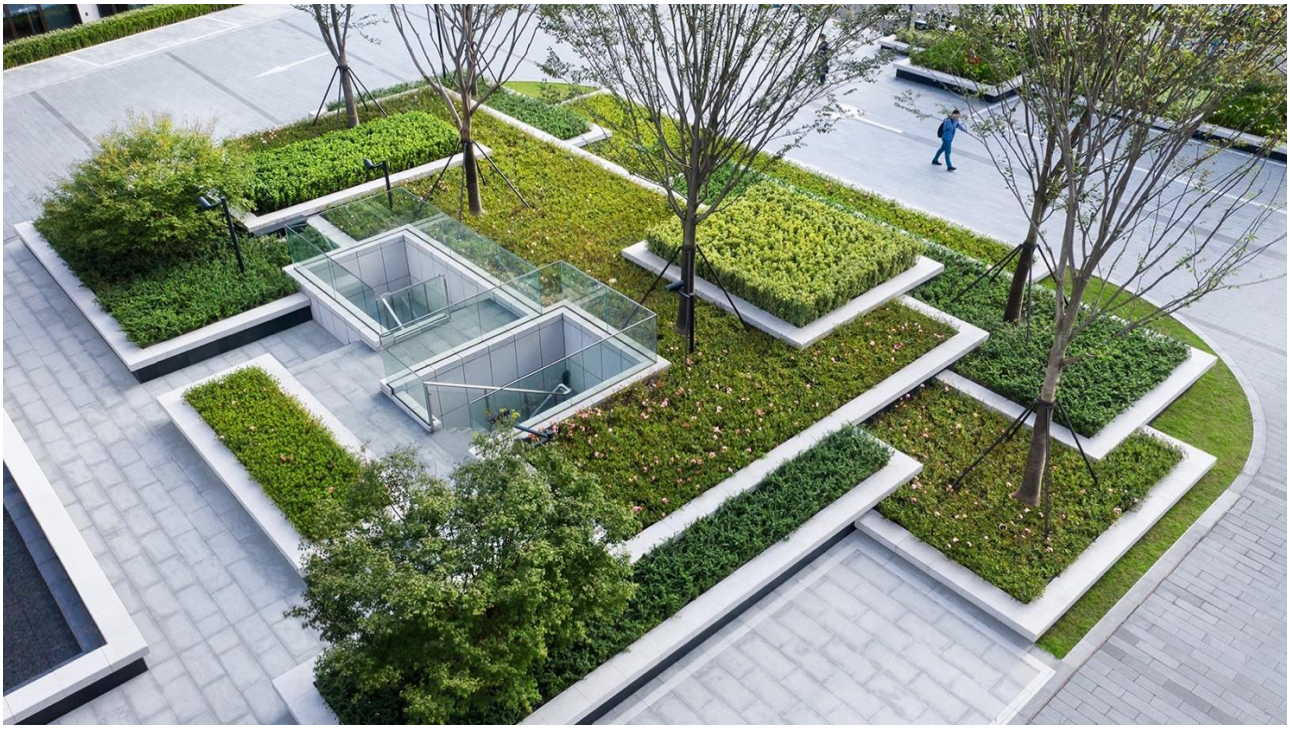


Figure 64 – Floating gardens designed by ASPECT Studios for the Sunbow Financial Centre in Shanghai, China.

The project carried out by the Turin architect has as its characterizing element the use of the 25x15 cm tile that is re-proposed in the form of multiples in all the elements of the building such as openings, windows, pillars and floors. To give continuity between the existing and the new, it was decided to use the tile module and apply it to all the geometries of the square.

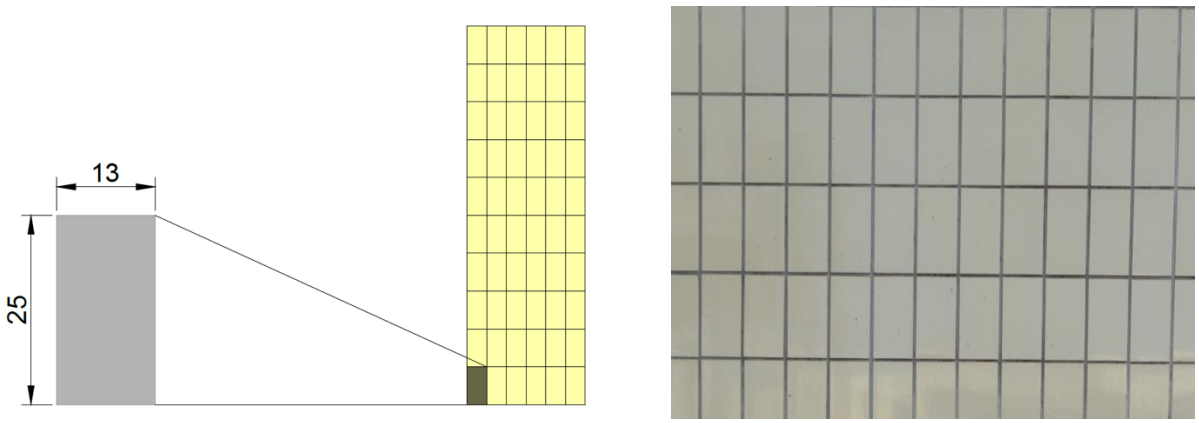


Figure 65 – Representative scheme of the Sartori's module and a detail of the tiles used on a façade.

8.3 VERTICAL SQUARE

8.3.1 GROUND FLOOR

At the ground floor level of the vertical square there are two entrances both arranged on the façade facing south, inside the room the space has been organized as follows:

1) Bar / refreshment area
2) Toilet
3) Study room
4) Kinetic floor
5) Relax/reading corner
6) Co-working room

On the east side of the square there is a staircase that allows access to the upper floor. The building has also been equipped with an elevator, west side, with the possibility of accessing both from inside and outside the room. The positioning of the vertical connections outside the structure is not accidental as the green roof of the vertical square has been designed to be used even during the closing hours of the multipurpose center.

Looking at the ground floor plan, at the main entrance of the building a specific flooring [*Figure 53*] was placed. It is an "Energy Floor" or a floor that uses the energy produced by the foot traffic to produce clean energy. For further information about this topic see *§ 9.2*.

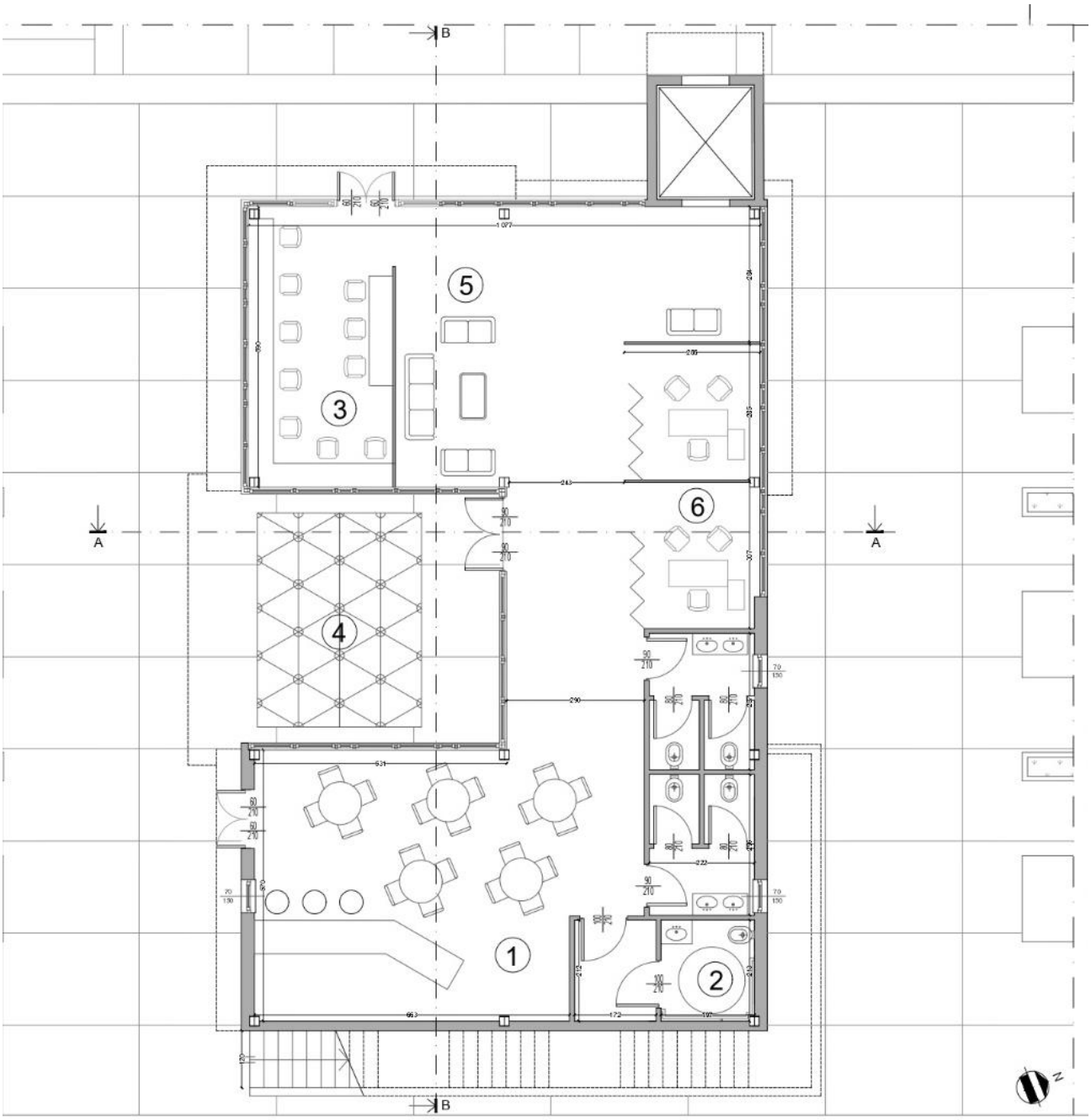


Figure 66 - Ground floor planimetry of the Vertical Square.

8.3.2 FIRST FLOOR

To regain public green spaces, on the first floor of this vertical square a garden has been designed that recalls the idea of the floating garden mentioned above. A system flower beds, and benches have been arranged in order to create a space that that give the impression of being immerse in the nature.
A distinctive trait of the building are the green terraces that lean out from the vertical surfaces and surround the entire perimeter of the building, a choice that not only meets aesthetic needs, but also environmental ones. Further in depth on *§ 9.1*.

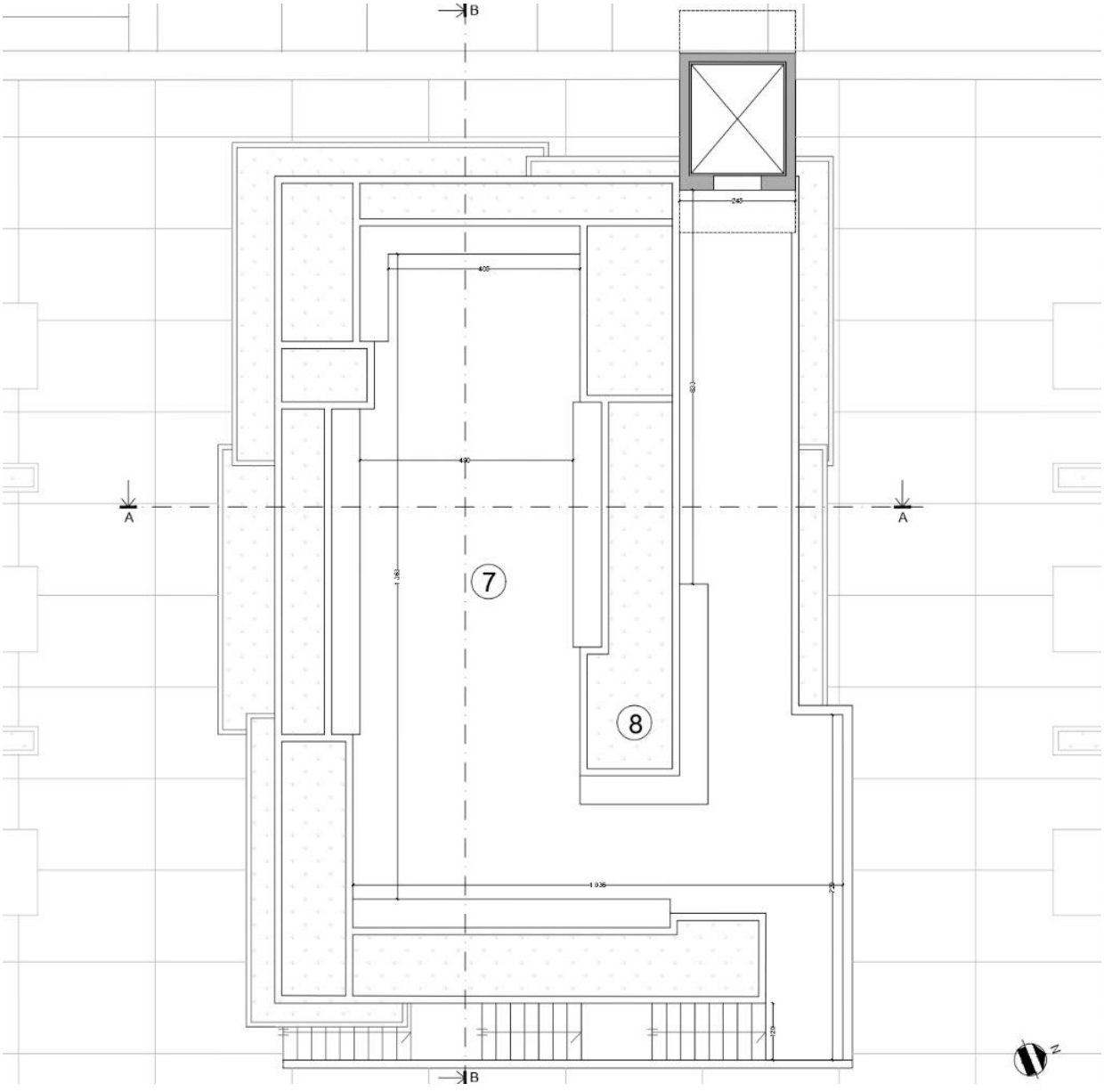


Figure 67 - First floor planimetry of the Vertical Square.

8.3.3 ELEVATIONS

The peculiarity of the vertical facades is certainly the curtain wall used on the ground floor. The colors of the large windows, blue, red and yellow, want to be a reference to the project of Sartoris who had used color as the fourth dimension. Even for the opaque walls the reference to the architect's work is present, in fact it was decided to re-propose the 25x15 tile as a finish for the vertical walls.

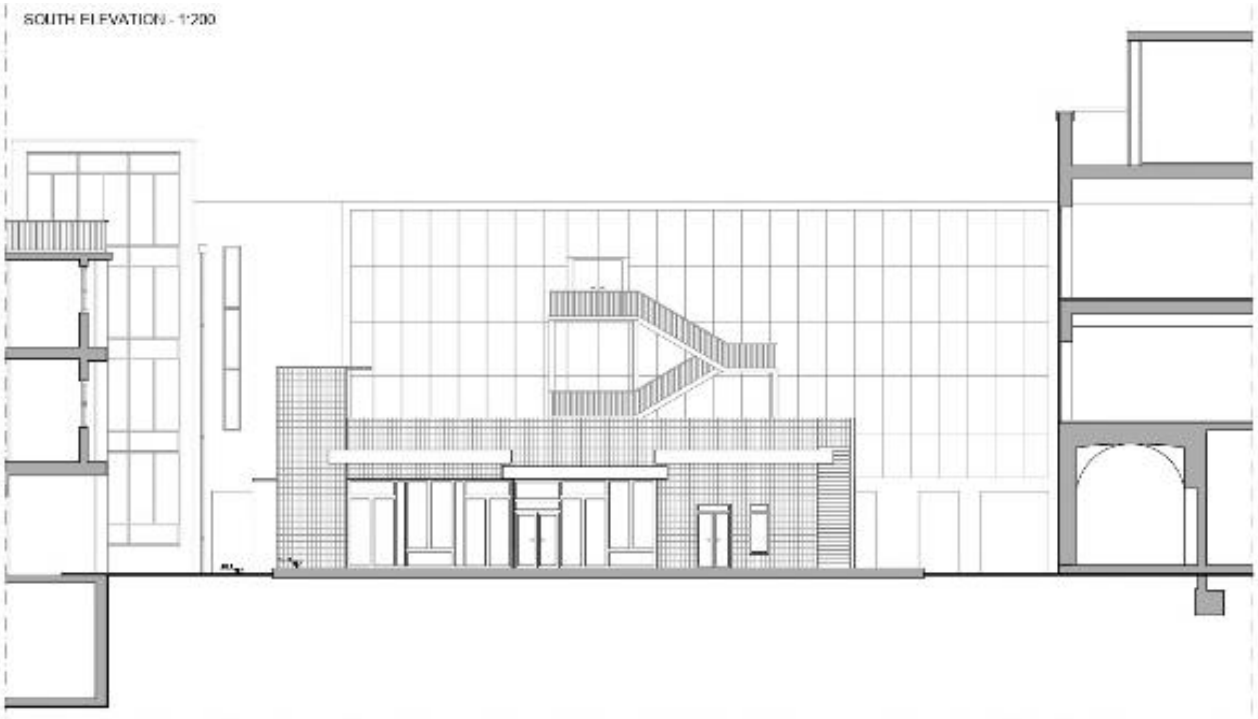


Figure 68 – South facade elevation of the Vertical Square.

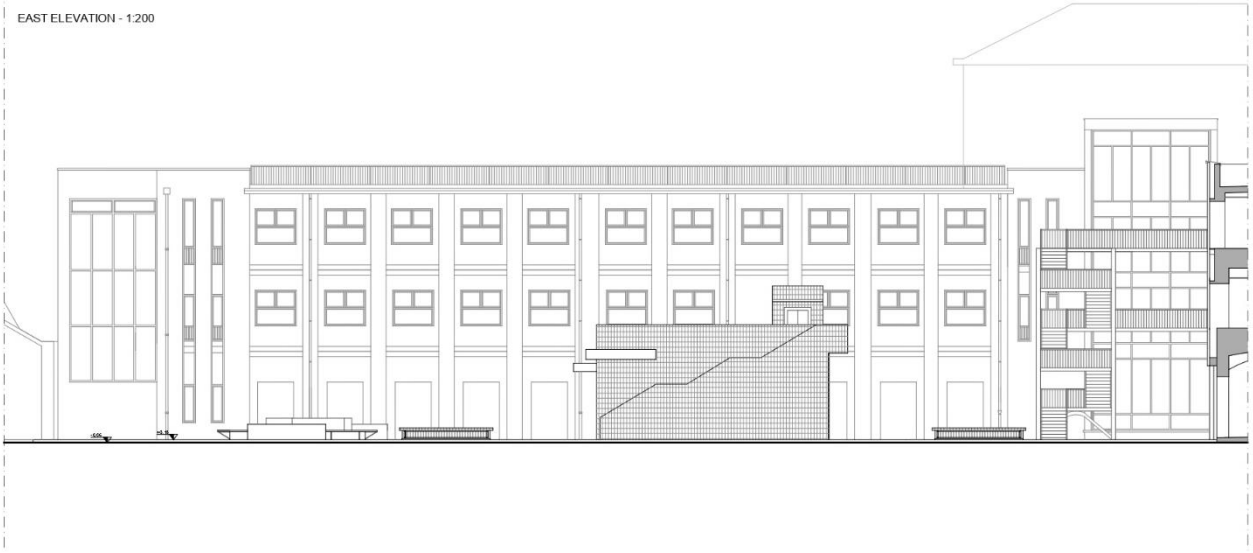


Figure 69 - East facade elevation of the Vertical Square.

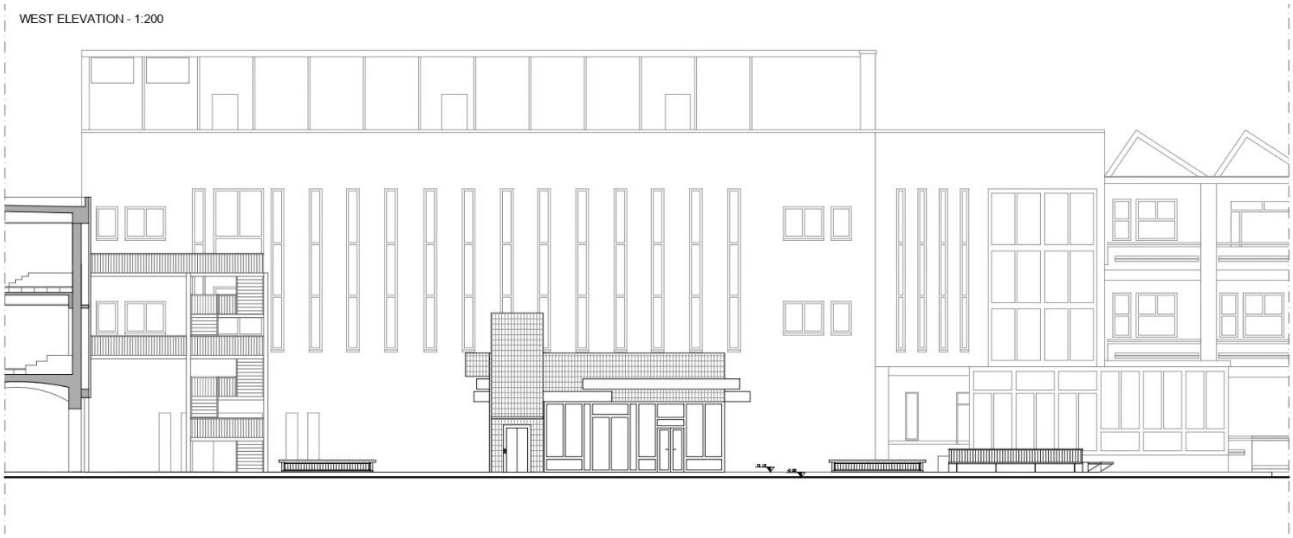


Figure 70 - West facade elevation of the Vertical Square.

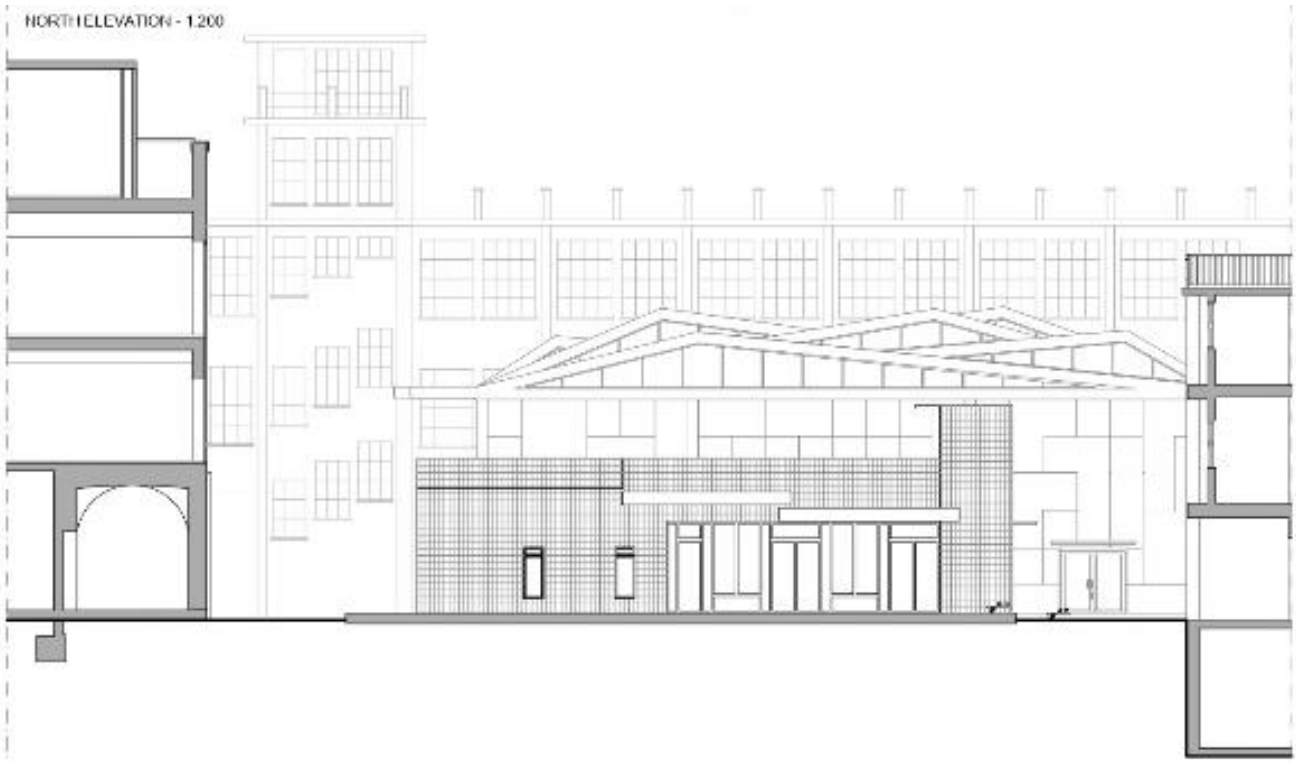


Figure 71 – North facade elevation of the Vertical Square

8.3.4 SECTIONS

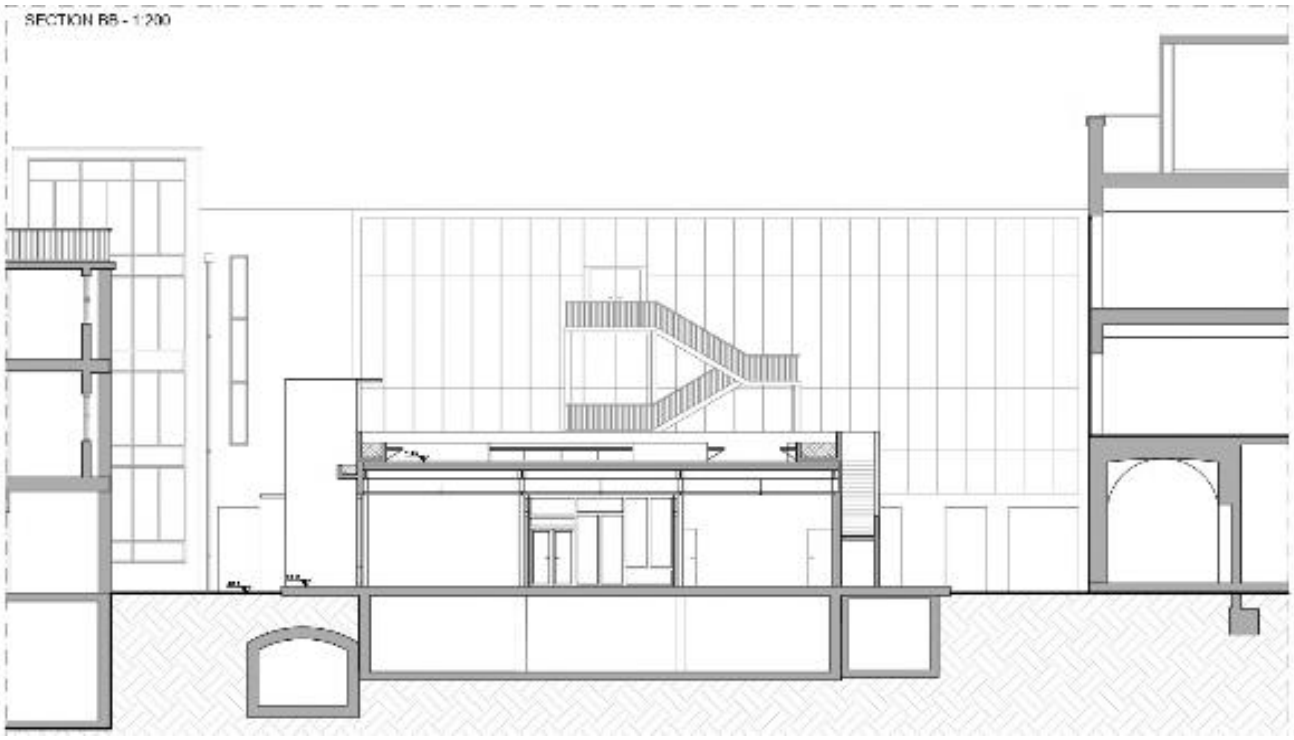


Figure 72 - Section B-B of the Vertical Square.

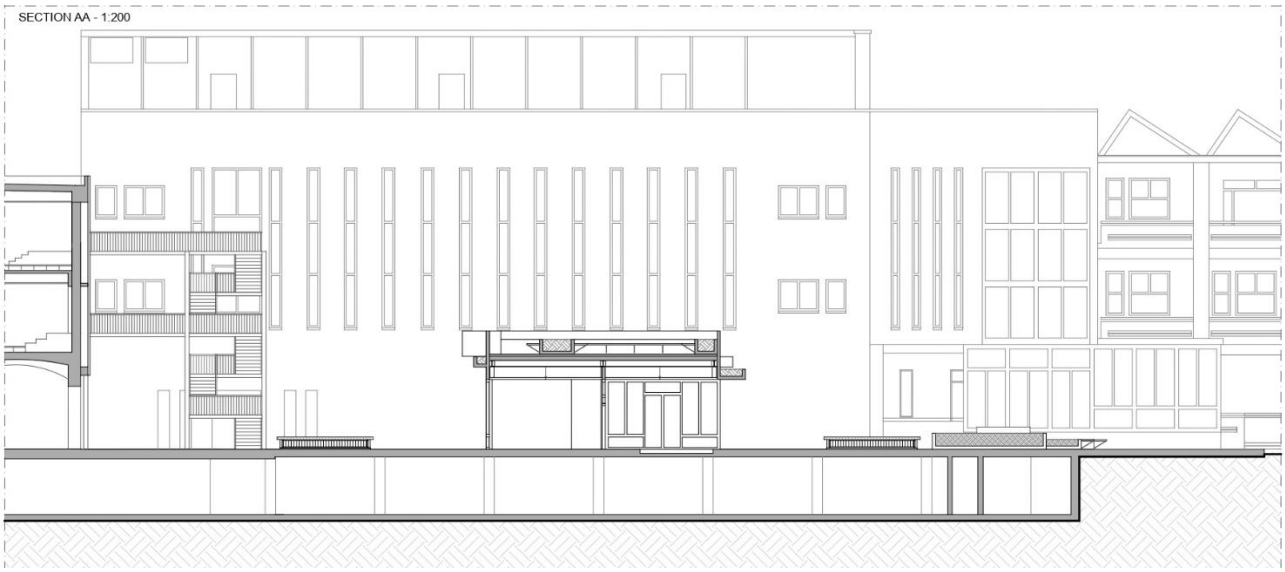


Figure 73 - Section A-A of the Vertical Square.

8.3.5 TRIDIMENSIONAL VISUALIZATION

To conclude the design work developed in this thesis, a 3D model of the new urban space was created using Autodesk's Revit modeling software. This model was then further refined using Twinmotion for the production of the renders presented below [*Figure 73-78*].

Figure 74 – Render of the internal courtyard designed. Foreground: "the floating garden".

Figure 75 - Render of the internal courtyard designed.

Figure 76 - Render of the internal courtyard designed.

Figure 77 - Render of the internal courtyard designed. First floor view: roof garden.

Figure 78 - Render of the interiors of the vertical square. View: reading area.

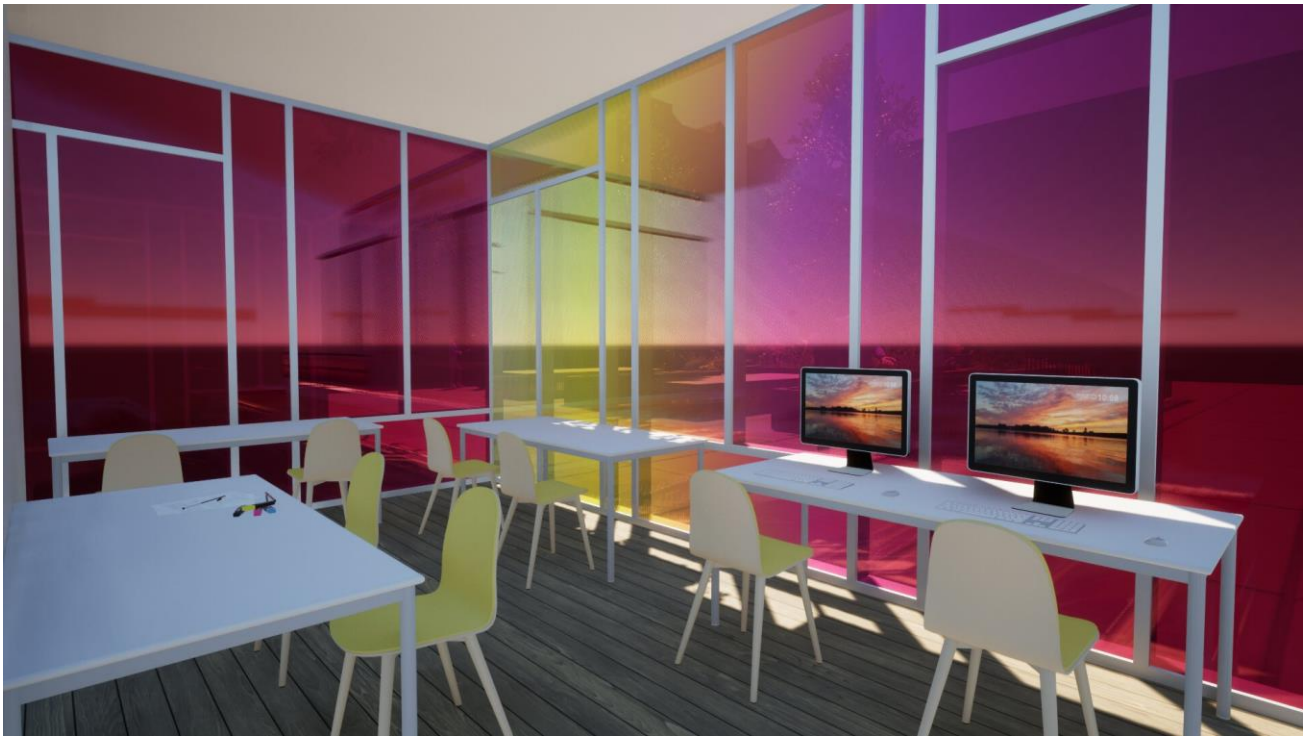


Figure 79 - Render of the interiors of the vertical square. View: study area.

9. SUSTAINABILITY OF DESIGN CHOICES

The principles of environmental sustainability and energy saving were considered in all the steps of the entire design processes. A careful balance between functionality, maintainability, sustainability and aesthetic guided the choice of materials and building techniques.
In September 2015, the United Nations signed the “2030 Agenda”, a program of action "to achieve a better and more sustainable future for all". This project incorporates 17 Sustainable Development Goals and "they address the global challenges we face, including those related to poverty, inequality, climate change, environmental degradation, peace and justice" (*Take an Action For the Sustainable Development Goals*, United Nations Organization).
The role of construction industry in the pursuit of sustainability objectives is crucial, of the 17 goals there are 9 in which construction industry can contribute significantly.

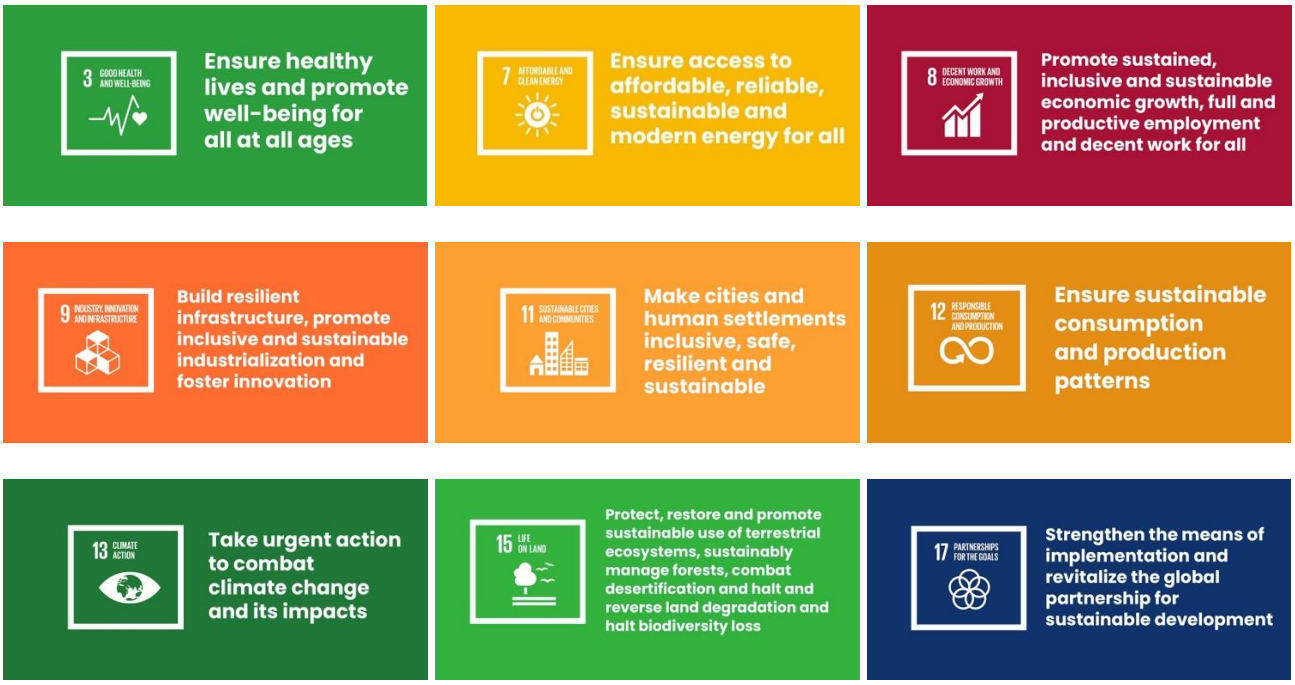


Figure 80 – Sustainable Development Goals related to the construction industry.

"The commitment of the coming years requires a leap in scale from the size of the building to the territorial one. These are the cities, neighborhoods and communities, the scenarios in which Green Building Council Italia will be increasingly confronted: areas in which buildings will play their part as catalysts for a change increasingly oriented towards structural, technological and environmental integration between buildings, infrastructures and open spaces in search of a new balance between the needs of man and those of the sustainable natural environment” (G. Dall’Ò, GBC President, conference on Green Building & Sustainable Development Goals, 2019).
Each phase of the project was therefore designed with a circular building perspective, reinventing the construction process starting from the design, the choice of construction techniques and materials used. Urban design plays a key role in being able to start the transition to the circular economy, improving the use of resources used in all processes, minimizing the production of waste products and closing process cycles. In fact, urban centers must start again by abandoning the idea of uncontrolled expansion beyond borders, resulting in dispersion, but reorganizing the structure of existing infrastructures through urban regeneration plans.
Adaptive reuse has proven to be an approach that allows you to act according to the prerogatives described so far, bringing social, economic and cultural benefits at different levels. Orienting adaptive reuse according to the circular economy perspective is therefore one of the main challenges for

architectural and urban design. Two other aspects related to the energy sustainability of the building, introduced in the project elaborated in this thesis work are: the use of advanced façade technologies, like green façade, and the use of innovative mechanism of energy harvesting, such as the kinetic floors.

9.1 ADVANCED FAÇADE TECHNOLOGIES: THE USE OF VEGETATION TO INCREASE THE ENERGY EFFICIENCY OF BUILDINGS

During heat waves, which are becoming more common as climate change intensifies, the urban heat island effect can have deadly consequences. The use of vegetation systems in urban areas, recently, have been increasingly considerated not only as a decorative and ornamental element, but above all as a natural element able to improve and / or rebalance the microclimate and the environment of cities, in particular those densely built-up. The advantages of greater vegetation in urban areas, in addition to the purely ecological aspects, also include those that refer to the improvement of the energy performance of buildings. The experimental study conducted by the Department of Energy Efficiency Unit (DUEE) of ENEA, described in the report entitled *The use of vegetation to increase the energy efficiency of buildings and the use of renewable air conditioning systems*, demonstrates the potential of vegetation systems applied to the external walls of buildings to reduce the heat flux inside buildings during the summer, with advantages in terms of energy costs and climate conditioning. The plant species selected in the study have proven to be suitable to create a natural barrier on the walls of the building helping to shield them from the sun.
The results recorded a reduction in the heat flux entering the building of about 40% when the value of the bioclimatic indicator Kv (green constant) was equal to 0.7, a value that indicates a particularly dense vegetation. In addition, decreases in the surface temperature of the walls of more than 12 ° C were observed on the walls with vegetation compared to those without. The relative humidity in the cavity between the building and the plant wall was on average 10% higher than the external one. For green roofs, surface temperature analysis showed differences of about 25°C between a roof without vegetation and one with a green cover. The ceiling temperatures of the interior below the green roof have decreased between 2 ° C and 3 ° C. The thermal transmittance of the green roof has been reduced by 43% compared to a roof without vegetation.
The first analyses of the temperature and humidity values inside the building with plant walls showed that they are in line with comfort standards. In addition, there was a temperature difference of about 2° C between 2017 when the vegetation was not very dense (Kv = 7.8), and 2018, when the vegetation was particularly dense (Kv = 1). These results indicate an improvement in interior comfort, especially during the summer, with less heat flow to the interior of the building. The only problem that emerged from the study is that it's important to correctly design the irrigation systems considering also the type of vegetation used in order to avoid excessive water consumption.
It's significant also to mention that, improving insulation, they also enhance heat retention in buildings during the colder months lowering energy costs and reducing energy use in cities, ending up in releasing less carbon dioxide, methane, and other pollutants into the atmosphere.
During precipitation events, green roofs can help not to overload the drainage system thanks to the plant life and substrate layers that have the capabilities to store and filter a huge amount of water, removing harmful toxins, and lowering the risk of drinking water contamination.
One example of the use of vegetation in favor of the energy efficiency of the building in the world is the One Central Park in Sidney, Australia. The building constracted between 2008 and 2014 by the architect Jean Nouvel Les Ateliers consist of two iconic towers , 34-story residential apartment and a 12-story serviced apartment. The peculiarity of this project is that approximately 50% of the building's façade is coverade in vegetation [*Figure 81*]. The "green" helps to: protect from direct radiation avoiding overheating effect; protect from the wind, let natural light into the building, release humidity, capture dust particles reducing the amount of pollution entering; produce oxigen and reduces acoustic pollution.

Figure 81 –One Central Park by Jean Nouvel Les Ateliers, Sidney, Australia.

Even though green roofs are considered as a potential opportunity for pollution control and an attempt to retrieve the natural hydrology in urban areas, the demanding situations which restrict their use still stay because of the high initial cost, unawareness of the green roofs' construction mechanics and maintenance costs and so forth.

9.2 INNOVATIVE MECHANISM OF ENERGY HARVESTING: PIEZOELECTRIC FLOOR SYSTEM BY PAVEGEN

Another peculiarity of the project concerning the sustainability and reuse of energy sources is the integration of energy generating floor technology.
The kinetic floor works like all other technologies of energy harvesting, the basic concept is to obtain the electrical energy by an energy conversion from a wasted heat, a vibration, a mechanical deformation, a potential energy. All energy harvesting systems, consist of three main components, as well as a source of power:

- Transducer/Collector: This is the part of the system that collect and converts ambient energy from the source into electrical energy.
- Interface circuit: the interface circuit extracts the maximum possible amount of energy from the transducer and makes the energy fit for use by conditioning it into a form suitable for the desired application.
- Sensor: it is the part of the system that accumulates the energy produced or conveys it towards its use.

The kinetic floor has a modular structure in which the modular element is the tile. The principle of operation lies in the conversion into electrical energy of that generated by the pressure due to foot traffic, which allows the surface to lower by a few millimeters and then return to its place, thus converting the vibrations of the possible pedestrians trampling into clean electricity.
One of the most common methods uses piezoelectric devices. The Piezoelectric transducers produce electricity from kinetic energy in the form of vibration, sound, or movement. The transducer converts the kinetic energy into an alternating current which is then conditioned into a suitable form and stored in a thin film battery or supercapacitor. The principle of piezoelectricity lies behind the crystals. Electric voltage is induced when crystalline materials are subjected to external force, pressure or deformation, which are capable of polarizing and creating a potential difference. There are several types of natural crystals, found on the surface or deep within the earth, that can be used today to apply the piezoelectric effect such as clear quartz and amazonite. The efficiency of piezoelectric devices is influenced by the type of crystals due to the variety of their properties. However, lead zirconate (PZT) titanium crystals are widely used to achieve high piezoelectric effect. Ease of manufacturing any complex shape, high material strength and long service life, resistance to moisture and heat at temperatures above 100°C, are all distinctive factors of PZT. In California above all, the analysis of crystals to create new piezoelectric roads and pavements is increasing, but is still in the testing phase, since, as shown in the [*Figure 62*], the energy efficiency is still very low.

Energy Sources	Overall Efficiency	Output Power	Available Condition
Vibrations (human motion)	10%–30%	0.84 m μW–4.13mW	Body motion (swing, shock, walk)
Vibrations (machine motion)	20%–40%	200 μW–40 mW	Mechanical motion (vibration, rotation), moving parts

Figure 82 - The advantages and limitations of different ambient energy sources.

In relation to this sector, the industrial designer Laurence Kemball-Cook, founder of the British company Pavegen, has patented an innovative piezoelectric floor. It is a smart floor capable of transforming the kinetic energy of the steps of the people who walk on it, into electricity through

electromagnetic induction. The model presented by Pavegen System is a flooring system with piezoelectric elements connected directly to a light source. Each tile is made up of a double panel with iron structures and recycled material coverings, in the center there is a light device connected directly to the piezoelectric device. When stepped on, the transparent element lights up. This innovative flooring is made up of three-sided tiles, with a flywheel positioned for each of the corners and three coils generating approximately 5W for each step. The step then imparts a pressure capable of flexing and releasing the tile by 5 mm [*Figure 63*] and the kinetic energy generated is captured and stored in a lithium battery. The energy can then be used directly or accumulated for up to three days and then used later.

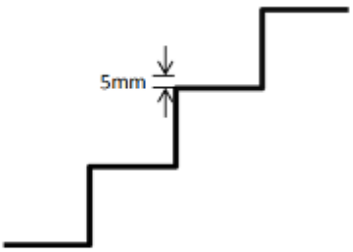


Figure 83 – Representative scheme of the flexing and releasing mechanism of the tiles.

On a shorter-term test, Kemball-Cook says he took the pavers to an outdoor festival where 250,000 footsteps created enough juice to charge 10,000 cell phones. To evaluate the amount of power generated by a footstep has been estimated that if for one cell phone it's needed about 3.68W per hour for 2 hours to be fully charged. Based on these data it's possible to evaluate that for each footstep the energy produced is:

10000*2*3.68Wh = 73.6kWh

Energy per footstep = 73.6kWh / 250000 footsteps

= 0.294Wh per footstep on average.

Figure 84 – Kinetic tiles by Pavgen.

The tiles themselves have been subjected to numerous tests and trials, from which more than encouraging and satisfactory results have emerged. The product life cycle has been estimated to be 20 million steps. Furthermore, the tiles are waterproof and can be installed as well as indoors and outdoors. One of the main advantages of the Pavegen system is that the tiles are made of 80% recycled materials. In particular, tires from cars, trucks and cement recovered from structures on the way to demolition are used. All of this basically translates into clean energy and respect for the environment during the production cycle. Furthermore, other advantageous aspects of this system are the possibility of integrating the piezoelectric elements under the cladding element, the low maintenance costs, even if constant over time, the possibility of applying these tiles both in external and internal environments and the safety of the polarization system. However, although it is a sector that has been emerging in recent years, the energy efficiency generated by flooring is still low.

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