ON THE TRAIL OF NERVI IN CAMPANIA: BETWEEN KNOWLEDGE AND CONSERVATION

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Abstract. The contribution of Nervi comes at a particular moment of cultural and social history of the twentieth century in Italy: the testing of the new material created by the combination of concrete and steel (the "cast stone" as the Master used to call it). The economic "miracle" after World War II and the successful cooperation between companies, professionals and research laboratories favoured the conquest of a role as protagonist of the Italian structural engineering. The extensive bibliography and recent international cultural initiatives (such as the travelling exhibition "Pier Luigi Nervi. Architecture as a challenge" opened in 2009) have demonstrated the great interest that his life and his works still arouse, even if, for the intensity and variety of his cultural and professional activities, some aspects are still unexplored. This is the case of works that Nervi has made in Campania, such as the most famous building, the Cinema -Theatre Augusto of Napoli. The study of Nervi archives has allowed to draw up a list of his works. Before the Second World War, near Salerno, Nervi built, perhaps, the first reinforced concrete structure prefabricated in Italy: a hangar for the Italian Air Force with a cover made up of 14 arches in prefabricated elements; in Pozzuoli he designed underground naphthal tanks and, on commission of the Autonomous Administration of State Monopolies, intervened in four tobacco industries: Napoli, Benevento, San Giorgio del Sannio and Scafati. The research tends to reconstruct another piece of the complex history of the most important professional and creative Italian engineer of the twentieth century and, at the same time, it contributes to the recognition of significant works (for the whole or for parts of them) in our area, in order to identify the correct methods of maintenance and recovery and to ensure their preservation.
1 INTRODUCTION

The long and prestigious professional activity of Pier Luigi Nervi (Sondrio 1891 - Roma 1979), engineer, architect and builder, has left an indelible mark on the history of architecture and engineering nationally and internationally. Through the creation of numerous works and great insights in the field of precast structures, Nervi elevates the profession of engineer to the status of a cultural profession and he acquires fame and popularity all over the world like the great designers of the Italian Renaissance, such as Brunelleschi and Michelangelo.

The figure of Nervi, in fact, in the dual role of designer and builder, is a point of excellence in the Italian scenery of the last century. His insights in the field of design and construction of reinforced concrete elements continue to be the subject of scientific research, not only with historical-documentary purposes, but also to contribute to the search for technological innovation in architecture and engineering.

Pier Luigi Nervi graduated at the Royal School of Application for Engineers in Bologna in 1913. In the early years of his career, he worked for the construction company of his professor Attilio Muggia. In this way, he was immediately in contact with the problems of reinforced concrete. He admired especially its ability to adapt to endless forms and, at the same time, its being monolithic. In the first work experience he began, therefore, to study their limitations, such as the large thermal sensivity, the withdrawal, the deformation under load and, above all, the high cost of formwork and failures due to disarmament, which he compared to “crisis of childbirth” [1].

He started with the first patent in 1917 (the “siderocemento”) that allowed him to develop his brilliant insights on the potential of reinforced concrete.

In the thirties he has already achieved fame at international level with the construction of the cinema-theatre Augusteo in Napoli (1924-29), and especially with the construction of the Municipal Stadium “Berta” in Firenze (1930-32), where – for the first time – the aesthetic quality of reinforced concrete structures is recognized [2].

The orders received between the mid-thirties and the war years by the Italian Air Force for the construction of hangars gave him the opportunity to experiment his structural insights in order to create large covers in precast elements; the post-war reconstruction and the Rome Olympics (1961) allowed him to create his masterpieces, developing his innovative technique of “ferrocemento” [3].

The malleability of the reinforced concrete – a sort of “cast stone” – allowed him to create form-resistant structures, ribbed textures of curved surfaces, and pillars variable section; Nervi shapes the material according to stress and he pursues the structural sincerity towards a “perfect model of justice and economical distribution” that reflects the “secret harmony of the universe”.

2 WORKS IN CAMPANIA

On the occasion of the thirtieth anniversary of the death of Nervi (2009), an international traveling exhibition was initiated by the Association of Pier Luigi Nervi Research and Knowledge Management Project in order to expose the highlights of the career of the engineer through models, photos and original designs.

After several stages, the exhibition took place at Salerno and allowed to start a search for works of Nervi in Campania, for the most part not yet known and studied.

The research on the works which Nervi has designed and/or constructed in Campania began from the traces left in the numerous documents, photos, graphics conserved in the archives of the
National Museum of XXI Century Arts (MAXXI) in Roma and the Centre for Studies Archives and Communication (CSAC) in Parma. The fund is made up of the Pier Luigi Nervi’s professional archive, that is, the set of papers produced, received, acquired and used by the engineer in the course of its business, which lasted from the 20s of the last century until 1979, the year of his death.

Particularly interesting are the studies that Nervi effected by drawing perspective, a tool that he usually used to study the spatiality of his works and the different solutions. He also loved to document his work sites in construction. So you can find many vintage photos depicting his trials and the different phases of construction of his works.

The research in the archives allowed us, therefore, to draw up an initial list of works in the Campania region that could be attributed in whole or in part to Nervi, even though most of the documents found did not allow us an accurate and complete reconstruction of the events, nor a clear location of the works. Subsequently research has been conducted in some local archives and surveys on places in order to recognize the fullest possible contribution left from Nervi and therefore make possible the preservation and enhancement of what still exists.

2.1 The cinema-theatre Augusteo (Napoli, 1924-29)

The process of design and construction of the third funicular in Napoli with the cinema-theatre Augusteo distinguished itself for the different solutions that followed and the succession of designers and builders. Also for this reason the contribution of Pier Luigi Nervi was for some time almost forgotten. Only recently, thanks to important discoveries of archival documents from a local professional (who oversaw the restoration of the theatre in the nineties), we are reconstructing the events that led to the submission of the first project proposal in 1921, signed by Giovan Battista Comencini and Nicola Daspuro, at the inauguration of the theatre (November 8, 1929) [4]. The initiative was promoted by a group of individuals in agreement with the public administration. The purpose was to connect the city centre with the Vomero hill, creating a cinema above the station of Via Toledo, in a densely built and layered context.

When Comencini died in 1924, Nervi intervened with his company, the Nervi & Nebbiosi, and with the architect Arnaldo Foschini who designed mainly both internal and external finishes. His contribution is distinguished by the new structural design that, unlike the first projects in which the reinforced concrete structure seemed completely separated from the architectural composition, rotate the theatre by 90° respect to the design of Comencini in order to take advantage of the slope. Nervi eliminated a series of pillars and built a circular pit, and not oval, marked by rectangular perimeter columns with a 30 metres free span; the pillars, connected at the top by a circular Vierendeel beam, support a radial ring consisting of eighteen trusses with an opening skylight in the middle. The modern theatre hall was, then, finally opened on 8 November 1929.

After the war, the cinema-theatre underwent a lot of changes with the addition of an external shelter and the construction of a heavy ceiling in wood, plaster and straw. The ceiling hid the elegant structure designed by Nervi, so as to put into oblivion for years even the memory of his intervention.

Only the careful restoration done by Pippo Caccavale has given to the theatre Augusteo his appearance and his memory, freeing it from the accretions and unveiling it to the public on November 8, 1992, exactly 63 years after his first inauguration.
2.2 The hangar of the Italian Air Force (Pontecagnano, province of Salerno, 1939)

For almost a decade from 1935 Nervi had the opportunity to work for the Italian Air Force to design and construction hangars for the storage of aircraft. After building an initial set of reinforced concrete structures with traditional technology, Nervi studied a faster and especially cheaper method: in November 9th, 1939 he patented the prefabricated system for large covers called "building system for the construction of resistant frames of vaults, domes and typically static systems, using components that are manufactured off site and jointed with reinforced concrete."

The second series of hangars allowedhim, therefore, the development of two different structural types: the first, the most popular, used for the hangars of Orvieto, Orbetello, and Torre del Lago and the second type of hangar that is smaller than the other. Four copies of the latter type were made throughout Italy: two of these are still existing, but unused, in Marsala and a hangar is situated in Pontecagnano (Salerno). This hangar is the less known even though it is perfectly preserved and still used by the Carabinieri Regional Command.

The design of Pontecagnano hangar is contemporary to the most famous hangars, but a plan of the Ministry of Aeronautics shows that it had already been completed in April 1939, seven months before the filing of the patent and, therefore, it is probably the first structure that Nervi realized in Italy with the prefabricated system.

The structure is divided into fourteen transverse arches with distances of 4.25 meters. Except those on the two fronts, the arches are composed of 26 modules, each for a total of 312 truss joists. The “network” is complemented by 390 longitudinal beams, less thick, but also a meter high.

Each joist was made at the work in wooden formwork that were used for multiple items. Once you reach the proper resistance, these modules were placed on a curved scaffold. The arcs have a length of 61 meters and cover an area of approximately 2,600 m² that can hold up to 46 aircraft. The internal height is 8 meters, equal to about half the height at the centerline. On the lateral bands there are services such as spaces for motorists, gunsmiths, squadron offices, warehouses for parachutes.
2.3 The tanks of naphtha (Pozzuoli, province of Napoli, 1930s)

During the same period, at the end of the thirties, Pier Luigi Nervi designed a series of underground tanks made of reinforced concrete for the Navy. They were built for the storage of oil in Pozzuoli, in the western province of Napoli. The location was strategic because the tanks had underground tunnels (diameter 1,20 m and height 2,50 m), which put them in direct communication with the port area, where the oil could be easily loaded and unloaded. As other works by Nervi in Campania, we had also lost track of them and now we are trying to reconstruct the whole story, starting from the designs found in the archives of Parma [5].

Currently the tanks are buried and it has not yet been possible to verify the actual condition. Three of them are located between the cemetery and A. Artiaco street, while eight (or more) tanks are in an area along Solfatara street, near the monumental necropolis in Celle street.

The tanks have a circular shape with an inner diameter of 29,50 meters, one outside of 33,50 meters and an internal height of 17,00 meters. A circular plate made of reinforced concrete forms the basement, which is constituted by a layer of perforated blocks. An inner tube, then, allowed to convey any losses of naphtha to an interspace that was placed at the same height of the bottom. The peculiarity of the tanks is, however, especially in the boundary mantle, designed to allow a "forcing quote". The wall contains a masonry interposed between an outer layer of "blocks forcing", cement blocks containing a tube that performs an action bordering on the mantle, and an inner layer of cement blocks with a tube for conveying gas to the surface.

The covering structure is constituted by a system of reinforced concrete vaults and internal pillars. Superiorly, then, a series of brick walls allow the passage of gas to the surface. The roof is completed by tuff masonry bag, a layer of rubble and finally the ground.
The tobacco factories

Among the works which Nervi has made in Campania, the most numerous are related to industrial contracts for the Autonomous Administration of State Monopolies, with whom he worked for nearly thirty years, between 1930 and 1960, both as a designer and as a builder [6].

He created more than twenty works, such as new Tobacco Manufactures, post-conflict reconstruction and expansion of factories, warehouses and Agencies Tobacco Cultivation, in several Italian cities, including, among the most famous, Lecce, Firenze, Perugia, Ancona, Torino, Roma and Bologna [7].

In Campania he had the opportunity to work on four tobacco factories: Benevento, Scafati (Salerno), Napoli and San Giorgio del Sannio (Benevento).

Because of the crisis in the tobacco sector beginning of the nineties, many of these buildings are now abandoned and in poor condition [8].

2.4.1 The agency cultivation of tobacco in Benevento (1946-47)

For the agency cultivation of tobacco in Benevento Nervi won with his company the contract of post-war reconstruction of buildings which were damaged by bombing in 1943. The Nervi & Bartoli has worked in Benevento since April 10, 1946 to March 10, 1947. The most interesting intervention is the reconstruction of the shed roof in the halls. The structure is made entirely with traditional technologies, however, the pattern of the truss recalls the Nervi typical lightness. The shed scheme covers a large space (about 10 metres) where it was done the processing of tobacco and it allows the illumination of the interior in addition to the necessary ventilation.

Among other work Nervi rebuilt the roof of one of the office buildings with a reinforced concrete truss that is still visible today.

After its decommissioning at the end of the nineties, the agency was destined to warehousing and luckily it still retains all the original features, although some areas are degraded. The building is located near the city centre and its recovery would bring a huge benefit to the city of Benevento.
2.4.2 The tobacco factory in Scafati (Salerno, 1948)

On the tobacco factory of Scafati we have little information and we are able to go back to an intervention of Nervi by the discovery of some archival documents: a series of drawings by one of the buildings that represent machining manufacturing. However, the graphs are incomplete and do not bear any date. It was possible to fit them chronologically around 1948 only according to the numbering of the papers.

The drawings signed by Nervi show a reinforced concrete building with a rectangular plan and a regular grid of columns (0.35 x 0.35 m), which is spread over two levels, with an average distance between the pillars of about 5.30 m. On the long side there is a small volume of a single level with masonry pillars. Outside there is a skylight in the roof, while inside, precast beams and hollow flat blocks are used for the floor. For the lack of documentation, it is difficult to understand the extent of the contribution of Nervi. It is not known whether he designed the building or just drafted a recovery of an existing structure. Although further studies are still in progress [9], the banality of the structural scheme, which does not denote special construction, argues in favour of the latter.
2.4.3 The tobacco factory in Napoli (1947-54)

At the end of the forties, Nervi was engaged in the project of another tobacco factory, far more important than the other: the new modern tobacco factory in G. Ferraris street in Gianturco, a district in the east of Napoli. Here he designed three buildings, and its work is recognized by the peculiarities of some structural elements that are also found in other of his best known works.

In the building of the entrance to the manufacture we can recognize the variable section tapered pillars that define the access and a shelter, located towards the interior of the lot; in another part of the building Nervi adopts an elegant solution to the cover with a hinged frame that reminds its solutions for the Pirelli skyscraper.

The most important intervention, however, is that for the building manufacture cigarettes. With a size of 168 m on the long side and the short side of 20 m, it is divided into three blocks from joints with a single central staircase and an entrance on the short side by a walkway. It is built on five levels with an interior changeable height. Among the drawings it is also shown a perspective that highlights the particular solution of the slab: prefabricated joists variable section with a corrugated slab in the two directions, which reaches the thickness of 12 cm at the centre-line. A drawing of prefabricated joists with the date February 11, 1948 testifies to the long period that he dedicated to this project.
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Figure 6: Internal perspective of the building manufacture cigarettes in Napoli (CSAC, Nervi archive).

Figure 7: Building manufacture cigarettes in Napoli. Details of the floor signed by Nervi (CSAC, Nervi archive).
2.4.4 The agency cultivation of tobacco in San Giorgio del Sannio (Benevento, 1954)

The research in the Nervi archives has allowed us to find a series of papers (plans, plans, sections, elevations and details) concerning the agency cultivation of tobacco in San Giorgio del Sannio (BE). They report the heading of the Nervi & Bartoli, and are dated November 23, 1954.

Historical records are equivalent of the geometric relief although there are many differences in the details of construction, such as in the diagram of the sheds. It is not possible to determine, therefore, whether or not the building was designed by Nervi. However, there is the possibility that his company, the Nervi & Bartoli, was involved in its construction.

The Agency is divided into a series of spaces with a central courtyard. The structure is articulated with a dense and regular pattern of pillars.

Currently, the building is the subject of restoration work with the aim of creating a centre of excellence for applied industrial research and advanced services.

![Agency cultivation of tobacco in San Giorgio del Sannio Details of the coverage (CSAC, Nervi archive).](image)

3 CONCLUSION

During his long and successful professional career Pier Luigi Nervi returned several times in our region called by government entities or private; about twenty-five years pass from the realization of the Theatre Augusteo in Napoli to the intervention on tobacco factory in San Giorgio del Sannio and we find him again to work for the design of bridges on the rivers Matiano, Tenza and Fortore or building Texas Instruments in Aversa (Caserta), and other public and private works that are still to be ascertained.
The results obtained in the research focused on the works of Nervi made in Campania have already identified certain technological insights of the Master that, although related to the economic and productive period, are still of particular interest to specific areas of application (you see for example the system of "forcing quote" provided for underground tanks), but mostly they have identified some significant works of the twentieth century Italian who had been forgotten.

Subsequent phases of the study undertaken will allow, therefore, to reconstruct a further element of the complex story of the most important professional and creative Italian engineer of the twentieth century, but at the same time it will help to ensure the preservation of significant works (for the whole or for parts of them) in our area, through the identification of correct methods of maintenance and recovery.

REFERENCES


