PROBLEMS AND STRATEGIES FOR CONSERVATION OF PIER LUIGI NERVI'S HERITAGE

CRISTIANA CHIORINO

Architect PhD, Pier Luigi Nervi Project Association, Turin, Italy and Brussels, Belgium, Docomomo Italy; cristiana@pierluiginervi.org

Editor's Note: Manuscript submitted 20 May 2013; revision submitted 8 July 2013; accepted 18 July 2013.This paper is open to written discussion, which should be submitted to the IASS Secretariat no later than March 2014.

ABSTRACT

Pier Luigi Nervi's heritage is today at risk. Some iconic works are undergoing heavy transformation while some others are facing serviceability losses and, in some cases, neglect or even abandon. It is important to raise awareness on this extraordinary legacy, define the criteria for selecting the works to be preserved at any cost as well as for their renovation and rehabilitation. The international travelling exhibition "Pier Luigi Nervi: Architecture as Challenge" represents a significant opportunity to refocus attention of the public opinion on the Italian grand master's heritage, and especially on some of his key works, while creating the necessary sensitivity for a process of their protection and programmed listing in the UNESCO World Heritage List.

Keywords: *Nervi, structural concrete, architectural heritage, ferrocement, conservation, renovation, rehabilitation, UNESCO World Heritage List*

1. INTRODUCTION

The grand legacy of the works built by the Italian engineer Pier Luigi Nervi (1891-1979) includes a number of buildings scattered all around the world between Italy, Europe, America and Australia, representing the symbol of excellence in technique and art of construction. Such an extraordinary patrimony is emblematic also of the complexity of conservation, restoration and reuse policies of great works of contemporary architecture, with special regard to structural concrete architectural heritage [1]. The reasons are not only connected with reduction or loss of serviceability and physical integrity (an issue of material and technical fragility), but also – and sometimes prevalently – with technological change, economic demand, market constraints, and the growth and modification of social and cultural ambient. In a society particularly sensitive to the functional requirements and the related legal responsibilities (as reflected in the progressive evolution and increase of codes and technical-administrative regulations), but much less to the historical memory, the choice of architectural objects to be preserved is often influenced by the former considerations. The responsibility to identify within the wider ambient of modern architecture, and to preserve for future generations, surviving masterpieces must be shared today by the cultural and scientific community of engineers and technicians on one side, and of historians and architects on the other. A kind of cross-fertilization is needed in establishing the fundaments of an advanced scientific approach, which is substantially virgin, to the documentation and conservation of structural architectural heritage. But it is of the utmost importance that the cultural and social values of such a mission are perceived and appreciated by the public and the institutions in general.

Recent exhibitions such as *Pier Luigi Nervi: Architecture as Challenge* [2] and the increasing interest in Nervi's figure and work in recent years [3,4,5] can help to refocus the attention on his extraordinary legacy [14]. But we also need to define criteria for the selection of a significant number of his fascinating masterpieces to be maintained at any cost, and to identify proper strategies for this scope. At this respect, a specific attention is currently being given to the project of listing some of Nervi's most relevant works in the UNESCO World Heritage List and, in what

concerns his shell and spatial structures, to the documentation program carried on by IASS WG 17 Historical Structures [6].

This paper gives a general overview of current status of preservation of Nervi's heritage and of the different situations characterizing some of his most renowned and iconic works, as well as of the different strategies and approaches being developed for their safeguard, renovation and rehabilitation. The paper is not focused on the types of material and structural degradation that affect these buildings, but rather on conservation policies and criteria in general. Happily enough, most of the structural architecture masterpieces conceived and built by Nervi are free from serious structural failure problems. The only suffered losses of a few of them were essentially due to World War II destructions. On the other hand, quite a few works are suffering usual degradation processes normally affecting structural concrete works, like *in primis* carbonation induced corrosion of reinforcement, thereby presenting a widespread decay of the surfaces. This problem is mostly caused by scarce concrete cover of reinforcing bars. In the particular case of very thin prefabricated ferrocement elements widely used by Nervi in his main works (wire-mesh and small-diameter reinforcement embedded in a thin concrete layer) the high quality of concrete mix and of production and curing techniques characterizing these works – descending from Nervi's double role of designer and builder – normally plays a counteracting role retarding the corresponding degradation process (see section 3.1) [7,8, 12].

2. NERVI'S BUILT HERITAGE: DIFFERENT SITUATIONS AND PRESERVATION APPROACHES

2.1 Demolitions

In the past the following works were lost: the unique geodetic structures of Orvieto, Orbetello and Torre del Lago aircraft hangars built in the thirties and destroyed during World War II (although the town of Orvieto wanted to try to reconstruct them on the basis of the few remains, but funds were lacking); the semicircle of the Milan Trade Fair Hall (1947), already altered by repeated re-use interventions and demolished in 2007 in the process of transformation of the former Fair setting; the bridge over the river Cecina (1922, initial project with Attilio Muggia) near Volterra demolished a few years ago; the springboard for the Kursaal (1950), the magic wheel symbol of Ostia (Rome), which was demolished and reconstructed in lamella wood (Figure 1).

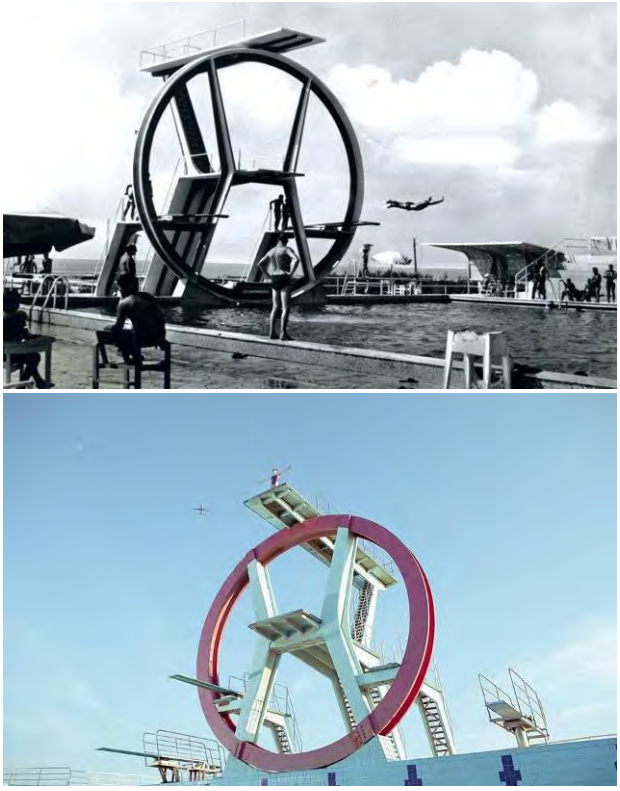

Figure 1. *Kursaal (1950), the wheel symbol of Ostia (a), was demolished and reconstructed in lamella wood (b)*

2.2 Radical transformations

Many are the projects of restoration and re-use currently undertaken to be watched over. Among the most recent renovations, the one of the railway station in Savona (1959-1960) (Figure 2) was completed in November 2009. The original facade, characterized by a predominantly horizontal development with the glass frames divided into bays by 10 pillars with a characteristic ribbed curved surface (a typical sign of Nervi's design), was transformed in a two-story building, deaf to any rule of overlapping structural hierarchical order. The building was not listed and the intervention was realized without any control by the institutions devoted to the protection of monuments and architectural heritage.

The famous Berta stadium in Florence (1930-32) – combining daring constructive solutions, like the

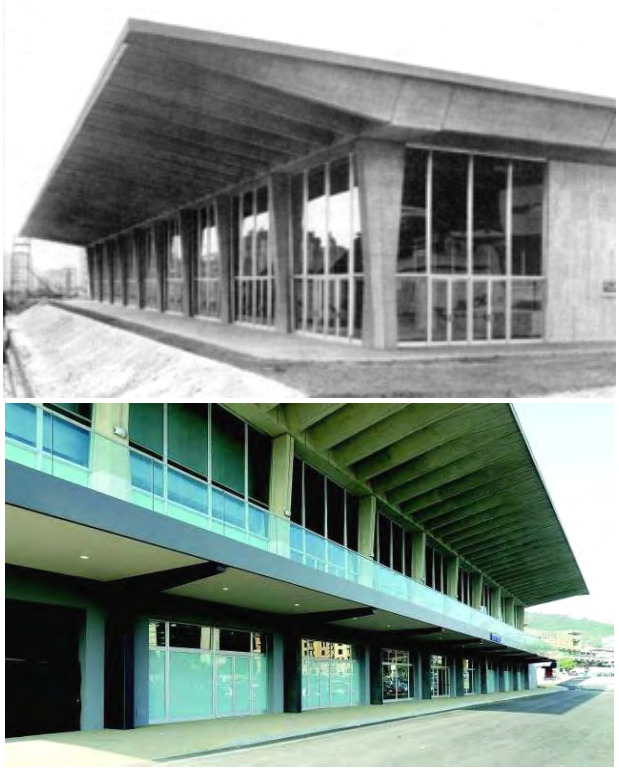

Figure 2. *Railway station of Savona (1958-1961) before and after the renovation of 2009*

iconic tapered cantilever structures of the roof and the external helicoidal staircases, and being characterized by an original exceptionally low cost of construction mainly due to the modularity and extreme rationality of the project – was heavily transformed in recent years. A global renovation was carried on in 1990 for the World Football Cup with an heavy intervention of reorganization, expansion and restoration of the facilities. Entrusted to architect Italo Gamberini in 1984 (with Loris Macci, Henry and Joan Novelli Slocovich) the project was put into operation in 1988 and concluded in 1990 among large debate. Designers originally pursued two main objectives: rationalization of general services, access and security, and increased receptivity. Not being possible to elevate the existing grandstands, as they were declared national monument under the protection of Ministry of Cultural Heritage, it was decided to lower the pitch and eliminate the athletics track. The restoration of the apparent main reinforced concrete structures included the elimination of previous additions, restoring the original state. Several new functional and technological additions deemed necessary, though absolutely incongruous, were however introduced, like additional external and internal stairs, new volumes to host technical installations and new metal cantilevered canopies at both sides of Nervi's celebrated reinforced concrete roof structure (Figure 3). The external perimeter wall inhibiting the view of the structures was replaced with a metal fence. A general reset of surrounding area, with new parking, reorganization of the road, increase of green and the construction of gyms and swimming pools for the neighbourhood, was also carried out with large total expense. These modernization works were attacked as a "cynical massacre" perpetrated without respect for culture and with the complacent consent of the local department of the Ministry of Cultural Heritage. The complex risks today to be abandoned or again deeply transformed because, in spite of previous transformation works, it is considered inappropriate and not up to standards.

Figure 3. *Berta stadium in Florence (1930-1932): original state (a); with the new stairs (b), and new metal canopies at both sides of Nervi's concrete roof (c).*

As for the Paul VI Audience Hall at Vatican City (1964-1970), the situation is more complicated. Perfectly preserved inside, the building was covered in 2008 by photovoltaic panels replacing the original ferrocement ones, which created a sort of cushion and ventilation duct and that were still in excellent condition. It is difficult to criticize an action intended to increase the energetic sustainability of the building, but it cannot be avoided to remark a lack of sensitivity and of protection of the building's materiality (Figure 4).

Figure 4. *Paul VI Audience Hall in the Vatican City (1964-1970): the new photovoltaic roof (2008, credit Solar World) replaced the original ferrocement panels (top)*

2.3 Projects of transformations

On the contrary, many buildings by Nervi are likely to be transformed.

The Flaminio Stadium (1957-1958) in Rome, built for the 1960 Olympic games, is currently threatened by a project of transformation that features to double the seats from 24,300 to 41,845 (Figure 5); a project unlikely to be achieved in compliance with the main architectural features of the building. In 2012 PLN Pier Luigi Nervi Project Association finally obtained, after long discussion with the Municipality, a stop for the project. The building structure is however not in very good shape. The degradation is caused by the combined action of rainwater infiltrating through holes realized to fix the new seats and carbonation. Tests with phenolphthalein detected an average carbonated layer of about 4 cm, causing reinforcement oxidation and in some cases considerable reduction of cross sections of bars [7,8].

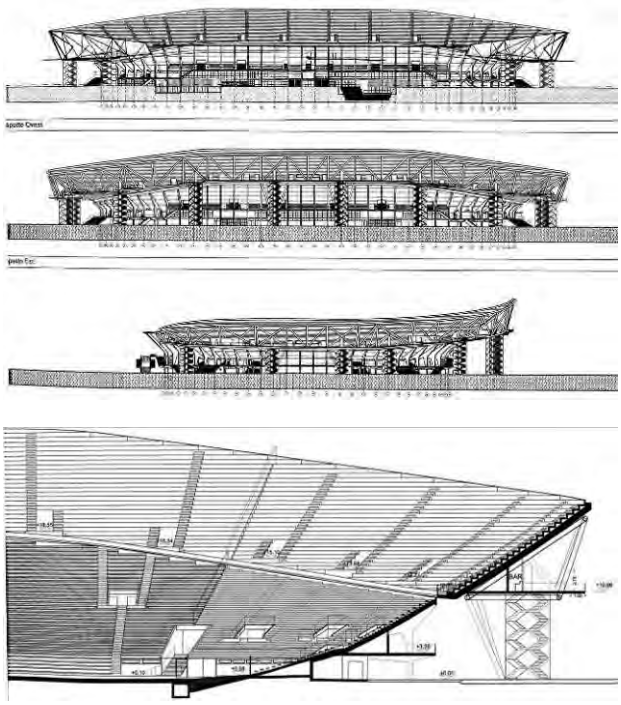

Figure 5. *Flaminio Stadium in Rome (1957-1958): the enlargement project presented in 2011 by Studio Shesa.*

As for the only project carried out by Nervi in New York City, the Port Authority is planning a radical expansion and transformation of George Washington Bridge Bus Terminal (1960-1962) for an investment of 180 million dollars (Figure 6). Save for a realignment of the arrival concourse to provide for more buses, the upper portion, with its winged silhouette, is unchanged. The lower level, meanwhile, will be glassed in, with all buses arriving on the deck above.

Figure 6. *George Washington Bridge Bus Terminal in New York (1960-1962): present state and renovation project by STV (2012, credit NY Port Authority)*

Scheduled for completion in late 2013 (the 50th anniversary of the station's opening) the project, entrusted to architecture and engineering firm STV, was stalling for lack of finance but it revived in 2012.

Meanwhile protection associations such as Docomomo NY/Tri-State and Modern Architecture Working Group have been lobbying both city and state landmarks agencies to insure that the building remains true, in its entirety, to the original 1962 design. On February 28, 2013, Community Board 12 voted to approve the project. In its presentations the Port Authority acknowledged the historic significance of the rooftop truss level and noted that it had consulted with the Landmarks Preservation Commission regarding plans for the renovation and new bus loading platform. (The station is not an individual landmark as buildings owned by the Port Authority are exempt from NYC Landmark Law). The Port Authority has agreed to convene a preservation advisory committee for the project.

The project will dramatically change much of the original station, however the fact that all parties involved have publicly acknowledged the significance of Nervi's upper level structure is positive.

2.4 Lack of maintenance, loss of function. Buildings to be monitored

Quite a few buildings by Nervi are suffering total lack of maintenance.

The Corso Francia viaduct, built for the Olympic games in 1960, is in rather poor conditions (while the other Olympic structures such as the Palazzetto and the Palazzo dello Sport are well maintained; see section 2.5). The viaduct is currently kept as a freeway overpass but the columns were plastered with no respect for the apparent concrete ruled hyperbolic paraboloid (hypar) surfaces.

Always in Rome, the former Gatti wool-mill with its characteristic isostatic ribbed floor slabs (1951) is in good condition. Its underground hall houses a mechanical workshop, but every time the upper hall changes function (it was for many years a supermarket, and now is a sporting department store) there is a risk that the underground hall is incorporated in some transformation.

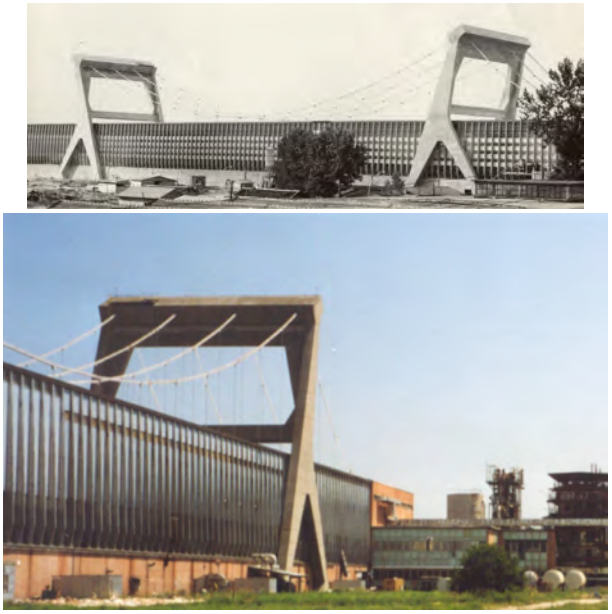

Figure 7. *Burgo Paper Mill in Mantua (1961-63): original and present state*

One of Nervi's late works, the Burgo paper mill (1961-1963) whose elegant bridge-like silhouette hovers over the Mantua lake, is one of the most important architectural landmarks among 20th century industrial buildings. It was abandoned in February 2013 after the owner corporate decision to cease the production process at this plant (Figure 7). The building, recalling a suspension bridge, is

composed by a main structure with metal roof (designed with Gino Covre) supported by two monumental "Y" shaped frames in reinforced concrete 50 meters high [9]. PLN Project Association and Docomomo Italia, the Italian branch of the International non profit Association for the Documentation and Conservation of Modern Movement recognized by UNESCO, published a petition pledging for a fast reactivation or for a conversion of the building; not to allow the degradation of the structure, but to take the opportunity to perform a careful restoration and enhancement of the factory site. The present conservation state is quite good, especially thanks to the continuous maintenance performed by the technical office of the factory. Lacking this continuous monitoring, degradation is likely to occur rapidly.

If we now consider some of the minor works by Nervi, also for quite a few of them there are concerns and calls for alarm by various associations. The Italian Association for Industrial Heritage is monitoring the protection of industrial buildings designed and built by Nervi between the thirties and the fifties, like the Solvay silo at Rosignano in Tuscany (1938). Many of the salt and tobacco warehouses and aircraft hangars pertaining to the same period were acquired by private developers or public agencies. The salt warehouses in Cagliari (1955 and 1958), now owned by Sardinia Region but abandoned, were recently submitted to urgent interventions to preserve adequate structural safety. For the ones in Tortona (1951) – being the first ones using Nervi's patented system of prefabricated lozenge-shaped elements adopted in the same period for the more complex structure of Hall C at Turin Exhibition center – there is still no idea of new function (Figure 8, with evidence of degradation).

On the other hand, the hangars at Marsala (1938-1943) are now the focus of a restoration project, while those for the military airport of Pantelleria (1937) were refurbished in the eighties.

These warehouses and hangars are mostly designed as simple series of parallel parabolic arches. Although they cannot compete with the fascinating iconic geodetic structures of the unfortunately lost series of hangars at Orvieto, Orbetello and Torre del Lago, still they represent admirable examples of spatial structures worth to be preserved.

Figure 8. *Salt warehouse in Tortona (1951): present state*

2.5 Good practices

If we begin with Rome, the city that hosts the largest amount of Nervi's works, we may observe that the buildings for the 1960 Olympics, as the Palazzetto (1956-1957, with Annibale Vitellozzi) and the Palazzo dello Sport (1958-1959, with Marcello Piacentini and others), are perfectly preserved. They underwent several interventions but all with a high attention to the original architecture. The Magliana Hall (1944-1945) on the outskirts of Rome, being the first experimental structure built by Nervi in ferrocement, is still used today as a parking lot despite the inclusion in the "Quality Charter" of the Master Plan of the city (identifying significant elements of architectural quality of the twentieth century). It was recently restored by a research team headed by Tullia Iori of the Università of Tor Vergata using a special cement based material. The restoration will be finished by September 2013 and the pavilion will host the exhibition "Privato romano interno", by international designer Costantin Grcic [10].

The dining hall of the Kursaal pavilion at Ostia Lido (Rome), built in 1950 (Figure 9), with its dome supported by a central column and a cantilever perimeter structure realized with precast

Figure 9. *Kursaal restaurant in Ostia (1950) before and after the renovation of 2012*

lozenge shaped elements, was also recently well restored using additional carbon fiber reinforcement.

In Milan the Pirelli skyscraper (1956-1960, with Gio Ponti) underwent a complex restructuring a few years ago since an airplane had partially destroyed the facade. The restoration allowed to reopen the bottom floor Auditorium with its characteristic crossed-beams structure.

With regard to Nervi's works around the world, Victoria Place Tower in Montreal (1961-1966, with Luigi Moretti et al.), St. Mary's Cathedral in San Francisco, with its iconic dome characterized by the hypar geometry (1963-1971, with Pietro Belluschi et al.), the Norfolk Scope Arena (with Williams and Tazewell et al., 1965-1971) with its huge spherical dome, the two arenas at Darmouth College, New Hampshire (1962, 1976), and the Italian Embassy in Brasilia (1969-1979, with Antonio Nervi), to quote just a few, are still in use and kept in good conditions.

The UNESCO headquarters in Paris designed by Marcel Breuer, Nervi and Bernard Zehrfuss (1952-1958) recently underwent an important restoration completed in September 2009. Architect Jean-Loup Roubert was responsible for the project. The interventions included improvements in soundproofing, thermal protection and new heating system. The seven-story building on 72 pillars was also closed around the entire perimeter to meet more stringent safety rules. The attached main hall, which is characterized by the fascinating folded exposed concrete structure of the walls and roof conceived by Nervi, was cleaned up allowing to appreciate once again the effect of light through the large windows.

Among recent ongoing projects that should be mentioned is the recovery of the former tobacco factory in Bologna (1952) as a Regional Technology Centre. An international design competition launched in 2010 was won by German

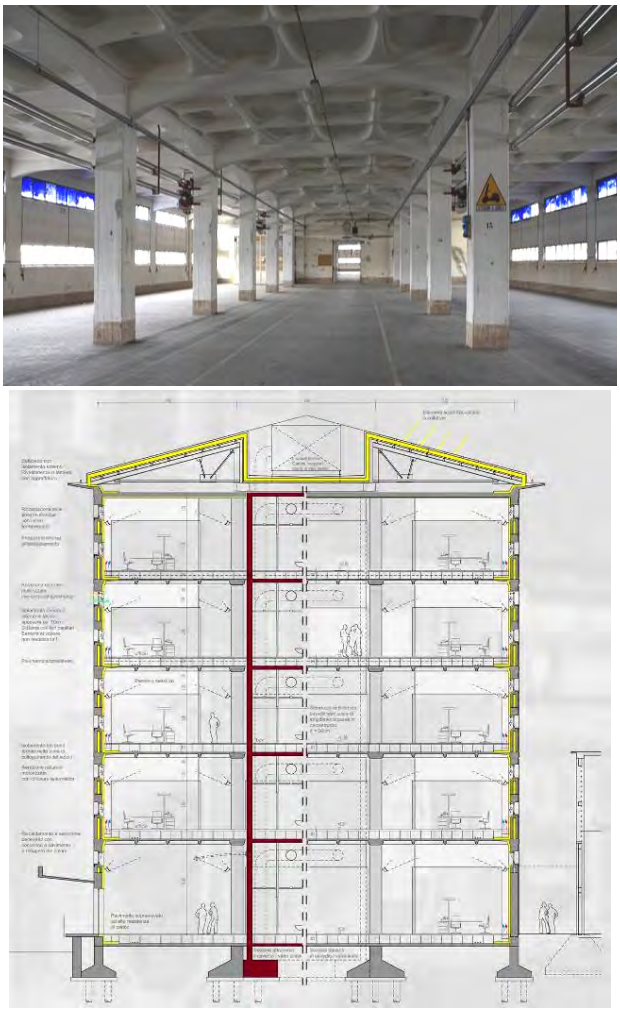

Figure 10. *The Ballette building of the former tobacco factory in Bologna (1952) with the typical ceilings with orthogonal ribs: present state, and cross section of reuse-restoration project (courtesy Clemens Kusch)*

architects GMP (Von Gerkan, Marg and Partners) with Clemens Kusch, et al. The factory facilities are carefully modernized and converted to accommodate new functions. The existing buildings characterized by the typical ceiling with orthogonal crossing ribs patented by Nervi in 1949 will be upgraded for improved energy conservation and earthquake resistance, and restored to their former architectural aesthetics, using floating raised floors in order to leave the ceilings free of any technical equipment. This new technology center will comprise an exhibition hall, laboratories, offices, a seedbed center for research affiliated with the university, and teaching facilities such as lecture halls and university institutes (Figure 10).

3. TWO CASE STUDIES

3.1 Turin Exhibition Center, Halls B and C

Turin Exhibition Center consists of the main Hall B and the smaller adjacent Hall C, both designed and constructed by Nervi (1947-1948, and 1950).

Hall B, conceived like a cathedral, consists of a nave, measuring 95 m in width and 110 m in length covered by an undulated vault, and of an apse with a ribbed hemispherical dome (Figure 11). In this work, Nervi combined for the first time in a large-scale project his personal technique of ferrocement with an extensive use of prefabrication. Ferrocement was used for its lightweight and resistance and represented the simplest and most satisfying solution. Extraordinary aesthetic results were obtained. The same technique will be adopted later by Nervi in the mentioned elegant domes of the Palazzetto and the Palazzo dello Sport.

The arched vault of Hall B, whose center line approaches the funicular of permanent loads, is formed by the union for each arch of 15 pre-fabricated thin ferrocement undulated elements of approximately 4.5 m weighing 1500 kg each. Their ends are stiffened by diaphragms leaving an empty space of 4 cm to be filled with cement mortar. The system is completed by reinforced cement ribs cast on site, arranged in the valleys and ridges of the waves. Each element was raised by means of an elevator and moved to its final position on rails disposed over the scaffolding (Figures 12 , 13).

The slanted pillars supporting the vault and absorbing the thrust are connected to the undulated

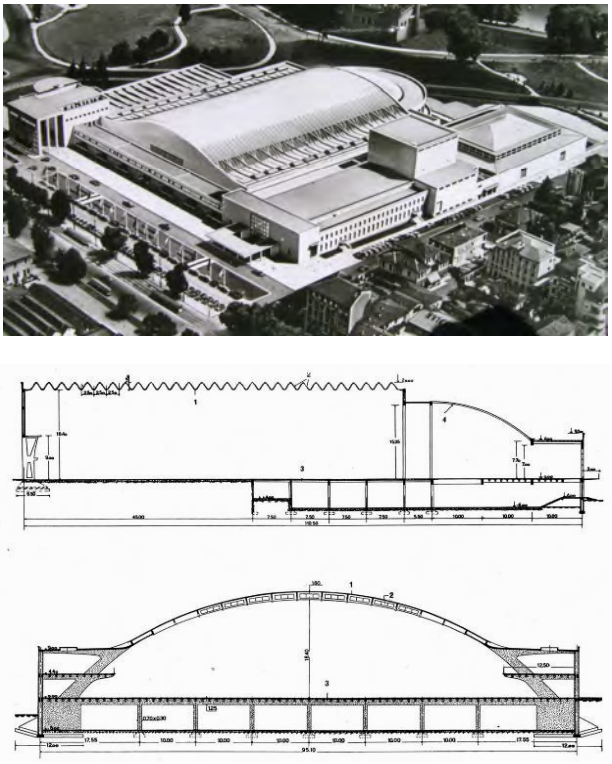

Figure 11. *Turin Exhibition Center: aerial view of Hall B (1947-1948) and Hall C (1950) at right corner; longitudinal and transversal sections of the Hall C*

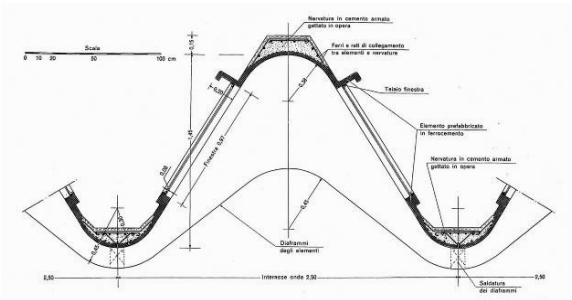

Figure 12. *Turin Exhibition Center, Hall B: cross section of undulated ferrocement elements of the vault*

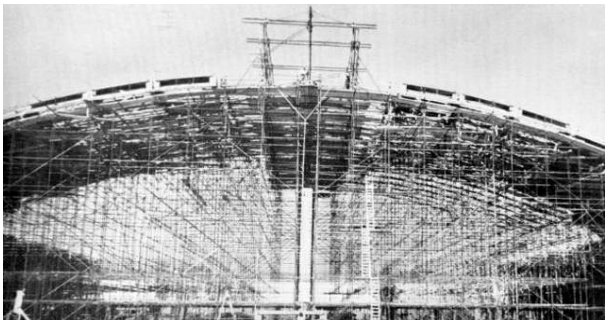

Figure 13. *Turin Exhibition Center, Hall B: construction stage*

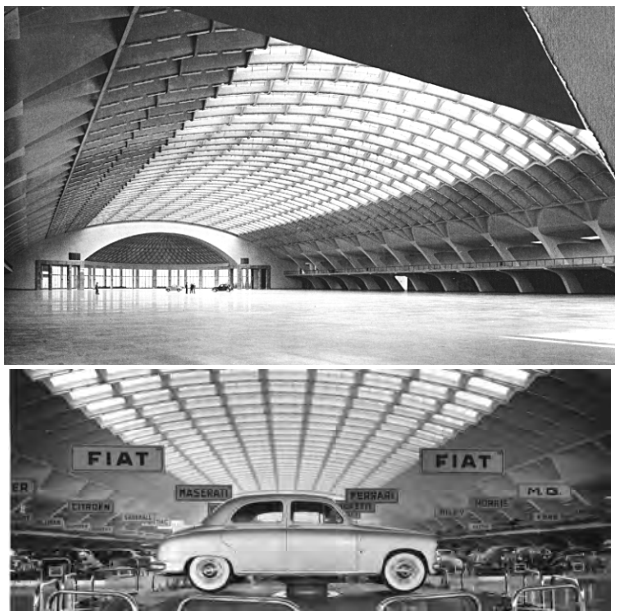

Figure 14. *Turin Exhibition Center, Hall B: original state in the 1950s (credits Archivio FIAT)*

roof by means of three very elegant fanned arms. Prefabricated ferrocement tile elements, connected by reinforced concrete cast on site in the lateral ribs and on their tops, are used for the hemispherical dome of the apse (Figures 14, 15).

Nervi adopted the same technique for the extremely elegant ribbed vault of Hall C (with lozenge shaped tiles) supported by sculpturally shaped slanted arch frames (Figure 16).

The complex of *Turin Exhibition Center*, initially conceived primarily for the Turin annual automobile show hosted until the middle 1980s, housed also a series of other exhibitions. The Center was included in 2000 by Docomomo Italy in the selection to be submitted to UNESCO for World Heritage List [11].

Ordinary maintenance carried on over the past years by the former managing company for exhibitions left the halls in rather good conditions of preservation. However, in Hall B dark painting of the 2,700 roof windows to attenuate zenith lighting generated high temperatures and extensive cracking in the glass elements. Over the years widespread rainwater infiltration was experienced, leading to the need to restore bitumen waterproofing. The hall closed as an exhibition space in June 2001. In 2006 it was designated to host hockey competitions for the Winter Olympics.

Figure 15. *Turin Exhibition Center, Hall B: present state*

Figure 16. *Turin Exhibition Center, Hall C: present state*

The main item of restoration undertaken in that occasion was represented by the insertion of air conditioning, to meet temporary requirements of winter sports and, especially, to permit future permanent exhibitions, as indoor summer climate conditions proved to be unacceptable. The related piping was inserted outside the roof. Safety requirements for inspection and maintenance of the ceiling windows led to their subdivision in smaller elements with an undesirable loss of the original aesthetical appearance (Figure 15).

On the occasion of these restoration works, an extended program of structural assessment, inspection and non-destructive testing was performed on structural concrete. Structural analysis checks of the vault by F.E.M. demonstrated the correctness of the original structural conception and design. In what concerns durability, while limited usual defects of carbonation and corrosion were detected in the traditional parts of reinforced concrete in external zones of the structure, inspection of the vault showed very high quality of preservation of ferrocement roof elements, due to the high-quality concrete cover, which was confirmed by tests indicating practical absence of carbonation [12].

The hall was then temporarily converted into an extension of the Turin Modern Art Gallery, and subsequently housed, until 2011, the collection of the National Automobile Museum in Turin under restructuring. This last transformation, with the exhibition of ancient cars, had the merit to bring in some way the building back to its initial function. On the contrary, the architectural design of exhibit installations completely misinterpreted the original architectural concept: 5 meter high partitions deconstructed the internal space and closed the apse perspective towards the Po river. The local government department responsible for historical buildings did not oppose these interior partitions because they were supposedly light and removable; but in reality they became quasi-permanent, the cost of their dismantling being very high (Figure 15).

In what concerns adjacent Hall C, after years of total abandon, in 2011 it was selected by PLN Project Association to host the Turin venue of the international exhibition *Pier Luigi Nervi: Architecture as Challenge*. A structural assessment, inspection and non-destructive testing program was performed on this occasion.

Today the entire complex of Turin Exhibition Center is once again abandoned, the two halls looking like huge empty boxes. Lack of maintenance is starting to induce serious preservation problems. Search of a new function is underway by the Municipality of Turin owning the Center. Reuse programs, still partly under discussion, foresee the location of the City Library. It is hoped that the project will maintain the perception of large space being the main characteristic of the building.

3.2 Palazzo del Lavoro

The Palazzo del Lavoro in Turin (1959-1961, with Antonio Nervi) was built to host the international section dedicated to the myths of labor and technical progress during the *"Italia '61"* celebrations of the Centenary of the Italian Unification in 1961 [13].

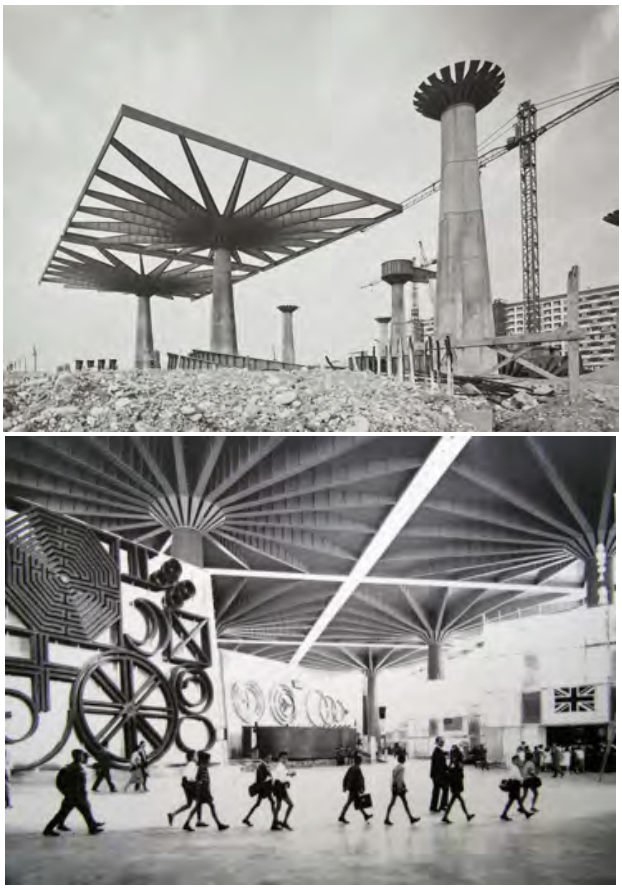

Figure 17. *Palazzo del Lavoro in Turin(1959-1961): construction stage and during "Italia '61" celebrations*

The large square space of 158 m per side is split into 16 smaller squares of 36 m. The structure consists of 16 reinforced concrete huge pillars located at the center of the smaller squares and covered by steel mushroom roofing. These 16 structural ensembles are constructively and statically independent, and are separated by continuous orthogonal strips of horizontal skylights providing excellent lighting in the central area.

The cast-on-site pillars with exposed concrete surfaces are cross-shaped at their base, becoming progressively circular while approaching the summit steel capital from which the umbrella steel

spokes depart (Figures 17, 18). The resulting stylish skew geometrical surfaces are approximately represented once more by hypar sectors, a recurring trait in Nervi's column design (see the paper by Perugini and Andreani in this issue of the Journal). The ribs of lateral balcony floors are gracefully designed to respond to the internal statical distribution of stresses in plates, approximately following the tracks of the isostatic lines of bending moments: in this case too an artifice frequently adopted by Nervi in other works (see the paper by Halpern et al. in this issue of the Journal).

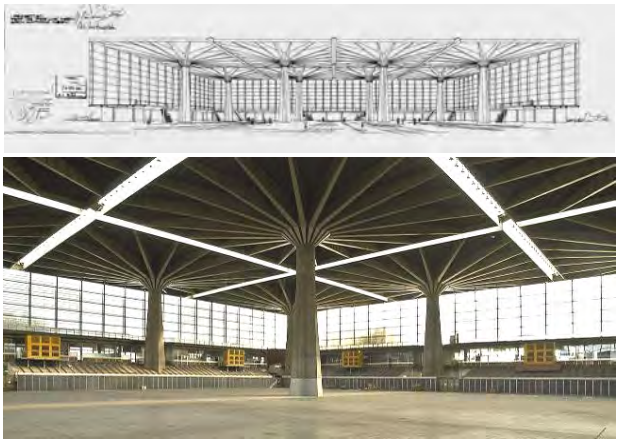

Figure 18. *Palazzo del Lavoro: original rendering signed by Pier Luigi and Antonio Nervi, and present state*

A glass wall (19 m high) runs continuously between the balcony and roof, being stiffened by a set of steel vertical elements resting by means of hinges on reinforced concrete corbels at the balcony level.

The blend of structural and architectural conception results in an amazing grandiose interior architectural space evocating the monumentality of Egyptian temples. Seen as symbol of an extraordinary typological exactness and of an extreme constructional coherence in terms of absolute integration between structural and architectural invention, this astonishing object has roused a largely diffused sense of admiration, which is part of the fascination deriving from the difficulties in clearly distinguishing between the technical and artistic sources of inspiration. It must be however recognized that in this case Nervi's design – as much as it intends to exalt, in the city of Taylorism, the myths of the celerity of a construction that is seen as a machine and of the technique considered as the indispensable instrument for the economic miracle – tends perhaps to place an excessive and quasi mannerist emphasis on the role excessively exhibited of the structure.

This huge architectural space always posed problems of reuse since the ending of *"Italia '61"* celebrations. Permanent use was limited to the perimeter zones, the rest of the space being reserved to temporary events due to the high costs and difficulties of a general re-engineering, with particular regard to climate control. Progressive inappropriate usage and related unsuitable interventions, internal additions, and a total lack of essential maintenance have strongly harmed the appearance of the building and the durability of its structural and architectural components. The basic reasons being once more the deleterious entangling of economical reasons, bureaucratic indecision and blindness, and, above all, lack of sensitivity and cultural appreciation.

Figure 19. *Palazzo del Lavoro: project of transformation as a shopping mall (courtesy Studio Rolla)*

After years of abandon and neglect, a variant of the Master Plan, approved by City Council in 2008, provided a new use of the structure: the building, now privately owned, will be transformed into a shopping mall housing also boutiques, restaurants and public establishments (Figure 19). Author of the transformation project is Turin architect Alberto Rolla, with Corio international group. Surrounding areas in conditions of neglect and currently not accessible by the public will be rehabilitated and upgraded for public use. Below the external areas, a large parking will serve these new functions.

The building was listed by the Ministry of Cultural Heritage in 2011. It will not be an easy task to avoid the new project to substantially change the perception of the original building.

4. CONCLUSIONS

The present review of the state of preservation of an extended number of Nervi's works shows that his heritage is facing risk. Although an adequate number of buildings is still in use under good conditions, on the other hand some losses were suffered and quite a few iconic works are undergoing heavy transformations, while some others are progressively facing serviceability declines and, in some cases, neglect or even abandon.

The extended critical research developed as a premise to, and in parallel with, the international exhibition *Pier Luigi Nervi: Architecture as Challenge* represents a remarkable opportunity to refocus attention on the Italian grand master's heritage, while creating the necessary sensitivity and culture for defending it. A scope that can be tackled either by individuating the works to be preserved at any costs, pursuing also the target of listing a few of them in the UNESCO World Heritage List, or by defining proper strategies for a wise conversion and re-use, debating good and bad practices, with reference also to some recent case studies.

PHOTO CREDITS

Unless otherwise indicated, all black-and-white photos and figures are courtesy of PLN Project Association, while colour photos are by the author.

REFERENCES

[1] ***Chiorino, C.*** Structural concrete architectural heritage; problems and strategies for documentation and conservation. The case study of Turin, *Proc. of the 2nd International fib Congress,* Naples, 2006

[2] ***Chiorino, C., and Olmo, C., (eds),*** *Pier Luigi Nervi. Architecture as Challenge,* Silvana Editoriale, Milan, 2010

[3] ***Chiorino, C.,*** Eminent Structural Engineer: Pier Luigi Nervi (1891–1979), Art and Science of Building, *Structural Engineering International,* Vol. 20, No. 1, February 2010

[4] ***Iori, T.,*** *Pier Luigi Nervi*, Motta Architettura, Milano, 2009

[5] ***Bianchino, G. and Costi, D., (eds),*** *Cantiere Nervi. La costruzione di un'identità* , Skira, Ginevra-Milano, 2012

[6] ***IASS WG 17,*** Documentation of Spatial Structures, *http://iasswg17.com*

[7] ***Ruggieri N., and Tampone G.,*** The Pier Luigi Nervi's work: technological values, typical degradations, conservation criteria, *Proceedings of 8th International Docomomo* Columbia University, New York, 2004

[8] ***Ruggieri N., and Tampone G.,*** Structural invention and production process in the Pier Luigi Nervi's work, *Proceedings First International Congress on Construction History*, Madrid, 2003

[9] ***Chiorino, C., and Bologna, A.,*** La fabbrica sospesa. Pier Luigi Nervi, Gino Covre e la Cartiera Burgo a Mantova (1961-64), In Pace S. (ed.), *Pier Luigi Nervi. Architettura come sfida. Torino, la committenza industriale, etc.,* Silvana Editoriale, Milano, 2011

[10] ***Iori T.,*** Restaurer le ferrociment de Pier Luigi Nervi: deux opportunités récentes, *Proc. of Journée d'étude: La restauration des grandes œuvres de l'ingénierie du XXe siècle. Autour de la figure de Pier Luigi Nervi*, Lausanne (2013)

[11] ***Sharp D., C. Cooke (eds),*** *The Modern Movement in Architecture Selections from the Docomomo Registers,* 010 Publishers, Rotterdam, 2000.

[12] ***Napoli, P., Ceretto, W, and Orza, C.,*** Assessment and functional requalification of a building by Pier Luigi Nervi, *Proc. of the 2nd International fib Congress,* Naples, 2006

[13] ***Chiorino, C.,*** 1961 Exposition in Turin, Italy. Engineers take command, *ICE Engineering History and Heritage journal*, Vol. 165 Issue EH3, 2012

[14] ***Chiorino C.,*** La sauvegarde des oeuvres de Pier Luigi Nervi: campagnes et projets en cours, *Proc. of Journée d'étude: La restauration des grandes œuvres de l'ingénierie du XXe siècle. Autour de la figure de Pier Luigi Nervi*, Lausanne (2013)