The Halls of Torino Esposizioni: From Conservation Management Planning to Future Use

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Abstract. Pier Luigi Nervi described reinforced concrete as the most beautiful construction system that mankind has discovered to date. Intervening today in a respectful way without altering the balance of Nervi's architecture between form, structure and function is a challenge that requires an in-depth and multidisciplinary approach. In this context, a Conservation Management Plan is an indispensable tool for outlining key guidelines for the conservation and maintenance of this architectural heritage. In 2019, the Getty Foundation awarded the Keeping it Modern initiative grant to develop a Conservation Plan for the exhibition center Torino Esposizioni, designed and built by Pier Luigi Nervi in Turin. Thanks also to an unprecedented campaign of experimental investigations, a multidisciplinary team led by the Politecnico di Torino produced a conservation plan that played a key role in the recent implementation of the plan to renovate and reuse this complex. The project is currently taking shape in the new civic library and new university spaces.

Keywords: Conservation Management Plan, Torino Esposizioni, Exhibition Center, Pier Luigi Nervi, Experimental Test Campaign, Reuse.

1 Introduction

In the vision of Pier Luigi Nervi, creating cast stones of any shape and capable of resisting tension better than natural ones has something magical in itself[1]. Engineer, pioneer, and entrepreneur, in his long-lived activity Nervi demonstrated his ability to exploit the full potential of this construction technique (Huxtable 1960; Greco 2008;

[1] See Nervi 2014, p. 77: «il più bel sistema costruttivo che l'umanità abbia saputo trovare fino ad oggi. Il fatto di poter creare pietre fuse, di qualunque forma, superiori alle naturali poiché capaci di resistere a tensione, ha in sé qualche cosa di magico».

Gargiani & Bologna 2016). Intervening today in a respectful way without altering the balance of Nervi's architecture between form, structure and function is a challenge that requires an in-depth and multidisciplinary approach. In this context, a Conservation Management Plan (CMP) becomes an indispensable tool for outlining key guidelines for the conservation and maintenance of this architectural heritage.

In 2019, the Getty Foundation awarded the Keeping It Modern (KIM) Initiative grant to develop a CMP for the exhibition center Torino Esposizioni (Fig. 1), designed and built by Pier Luigi Nervi in Turin. A multidisciplinary team was then created lead by Prof. Rosario Ceravolo from Politecnico di Torino, involving various research institutions and industrial companies, including Iuav of Venice, the Foundation Pier Luigi Nervi Project (PLN), Buzzi Unicem, and many others. They conducted an in-depth assessment, also on the basis of an unprecedented experimental investigations campaign, to produce a CMP for this complex.

The KIM Getty grant project (2019-2022), together with the constant support of S.C.R. (Piedmont region commissioning company) and the City of Turin, played a key role in the recent implementation of the rehabilitation and reuse project (funded by the European Recovery and Resilience Plan – RPP), which includes the creation of the new civic library (Hall B) and an expansion for the School of Architecture of Politecnico di Torino (Hall C).

Fig. 1. Aerial view of the exhibition center Torino Esposizioni in 1954 (Archivio Storico Fiat).

2 Case study

The exhibition center Torino Esposizioni was commissioned by FIAT (Comba 2010, 2012), and was designed and built by Pier Luigi Nervi and his company "Ingg. Nervi & Bartoli – Anonima per costruzioni" (Nervi 1948, 1950, 1951; AA.VV. 1957) between 1947 and 1953. This large complex, designed as an exhibition space for FIAT annual car show (Figs. 2, 3), sits along the Po River within the Valentino Park area.

Torino Esposizioni is composed of many pavilions; the two main ones are referred to as Hall B and Hall C. This complex is the first large scale implementation of Nervi's ferrocement systems, which are the distinguishing feature of this architecture (Chiorino & Leslie 2018, Chiorino 2022). In addition to his best-known ferrocement patent, Nervi also registered other patents in the field of building construction (Greco 2008; Iori 2009; Faccio 2023) (Fig. 4).

Fig. 2. Hall C, International Car Show, 1950 (Archivio Storico Fiat).

Fig. 3. Hall B, The first Motor Show in 1948 (Archivio Storico Fiat).

Fig. 4. This photo of the construction site shows the mobile scaffolding system used to build the vault (Archivio Privato Ravelli).

Only limited interventions and minimal maintenance have been carried out since the complex was completed. The largest intervention was the renovation of Hall B for temporary use as an ice-skating arena during the 2006 Olympic Winter Games (a limited structural assessment was performed for this purpose). The intervention included the addition of mechanical equipment on the roof, a sprinkler system across the structure, and the installation of partition walls under the lateral balconies. Since the change in ownership that occurred in the 1980s, when the complex became the property of the City of Turin, Torino Esposizioni has been in disuse and abandoned for most of the time (Chiorino 2015). After and despite the many years of neglect, in 2020 the complex was finally declared of Cultural Interest (as per Art. 10, para. 1, and Art. 12 of Legislative Decree 42/2004), and thus became a National Historic Landmark.

3 The path of knowledge

The CMP was drafted based on an interdisciplinary approach, as is appropriate when working on a heritage structure. In particular, a specific knowledge path was developed that intertwined information from different sources: archival documents, original project documents, photographic documentations, the building code at the time of construction, and oral history (Pasqual 2021).

A large survey campaign was carried out using multiple approaches, due to the complex and differentiated morphology of the halls. The first phase of in-depth research and study of the original documents made it possible to understand Nervi's design intentions, to identify each construction element (coding system), and to develop the best strategy for the test campaign. A complex 3D metric survey campaign was undertaken based on laser scanner and photogrammetric technologies (terrestrial and from UAV - Unmanned Aerial Vehicle) to obtain an accurate description of the entire complex, both externally and internally (Sammartano et al. 2021). In addition to innovative solutions in the field of mobile mapping system technologies (Bonfanti et al. 2021), numerous results were obtained from the study and processing of multiscale and multisensor 3D models. The geomatics team also provided original contributions to the assessment of the structural arches, with their parabolic curves designed by Nervi, and above all to the general digital twinning approach pushed up to defining an HBIM cognitive model (Spanò et al. 2023).

After the 3D survey, an extensive testing program was conceived and executed in both halls (Lenticchia et al. 2023b, 2024), which included a wide range of destructive and non-destructive mechanical tests to study and understand the condition of the structural elements, including the reinforced concrete elements and the ferrocement roofing system (Fig. 5). Direct investigations were also carried out on selected areas of the surface of both halls based on historical information and the changes made to the structure over time. This study thus revealed a forgotten feature, that is the polychromies of the halls (Bruschi 2023a), which were conceived by Nervi himself as an integral and distinctive part of this architecture. The structural analysis and the seismic assessment revealed limited construction deficiencies that are to be primarily

attributed to the lack of seismic provisions at the time of construction. Furthermore, deterioration of the materials was observed on some elements and areas. This could be attributed to the lack of maintenance and the long period of abandonment, which accelerated the deterioration mechanisms of the steel reinforcement.

For the ferrocement system, an experimental campaign was designed and conducted in the laboratory to study the performance and durability of this unique material (Lenticchia 2023a, Ceravolo et al. 2024). Due to limited accessibility during the fieldwork and the fragile nature of this system, various types of mock-ups were created in the laboratory following Nervi's original recipe. Different surface treatment methods were applied to evaluate their effectiveness in minimizing the need for replacement of the original material.

Fig. 5. Hall B, after the clearing and cleaning operations for the execution of the tests of the Getty Keeping It Modern project (courtesy of Fabio Oggero, 2022).

4 The Conservation Management Plan

The CMP consisted of a report accompanied by tables with views of 3D models, orthophotos, graphic schemes, and drawings that summarized all the work carried out during the study phase, based on which the intervention hypotheses had been developed (Ceravolo et al 2022). Each table briefly illustrates the path of knowledge devel-

oped during the research phase, based on the deconstruction and coding processes. The deconstruction process, aimed at identifying each construction element, was designed specifically for this case study: it is based on the peculiarities of the “Sistema Nervi” and identifies the elements that were cast on-site, the prefabricated elements, and the ferrocement elements, without neglecting the connection castings needed to guarantee the monolithic nature of the system.

For each construction element, the CMP reports:

(1) A general table for each macro-element (e.g., slab) containing the following fields: *History* (consisting of some historical notes relating to the particular macro-element); *Construction phases* (considered as the constructive and transformative phases in the 1947-1953 period); and subsequent *Transformations* (understood as the most recent transformations, mainly related to the use of the complex); *Coding* (i.e., identification of the sub-elements); *Geometrical survey* (containing the information relating to the peculiarities); *Structural Analysis* and *Monitoring*; up to *Possible indirect and direct interventions* (the general tables present extensive interventions which are then detailed in other tables); *Critical Issues* (related to all the analyses considered); and finally, the *Maintenance* schedule.

(2) A detailed table relating to each deconstructed and coded sub-element (e.g., north balcony) and containing additional fields: *Material characterization* (containing specific information derived from historical and bibliographical research); *Analyses* (including results of specific laboratory tests on individual elements or materials); *State of conservation* (related to the specific element considered); *Possible punctual conservation techniques* (including the techniques most suited to the specific element); and *Critical issues* (intended here as interferences between the different analyses, in particular concerning safety and conservation).

Closing, a summary table summarizes the most significant issues of each hall. The aim of these tables is to bring back attention to unitary nature of the architectural complex, after having split it into parts for detailed analysis and accurate design of interventions.

5 Critical issues

The overall analysis highlighted, as is natural in these cases, some problems of coexistence between conservation and safety, mainly collected within the *Critical issues* section of the general tables of the CMP. The discussion concerns above all the choice of acceptable safety levels for the protection of human lives, especially with respect to seismic action, and the consequent structural improvement interventions that can lead to losing the historical fabric (Figs. 6, 7). In this sense, the case of Torino Esposizioni is particularly complex because it highlights the need to preserve Pier Luigi Nervi's structural concept while also having the building comply with standards on and resist to horizontal actions that could not be taken into account when the exhibition center was originally designed and built.

The actions reported in the general tables of the CMP aim to improve the performance of the construction element, but at the same time highlight the possible conflicts that may arise in case of direct intervention.

Fig. 6. The bichrome area between the beige wall and the brown plinth, visible in the lower areas of the walls of Hall C and the pillars of Hall B.

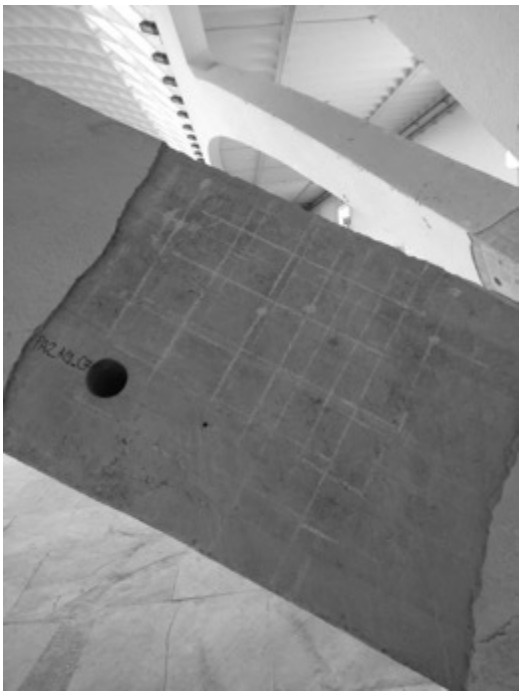

Fig. 7. Grid for non-destructive testing (ultrasonic, rebound hammer, half-cell potential) on one of the inclined arches of Hall C. The grid was also useful for locating the positions of the reinforcing bars and allowed for coring in the most suitable position.

6 Present and future developments

Interest in the reuse and conservation of this iconic architectural complex started brewing in 2014. At that time, the City of Turin and Politecnico di Torino signed a Memorandum of Understanding for the reuse and conservation of Torino Esposizioni and envisaged a project for re-developing Hall B and transforming it into the new Civic Library of the city. Following this MoU, an international competition was launched for awarding the feasibility study on the proposed location of the new Civic Library; in 2015 it was won by a consortium of professionals formed by ICIS Srl, Rafael Moneo, Isolarchitetti et al. However, despite the interest of the city in it, the project was not realized, due to poor funding.

In 2019 the Getty Foundation of Los Angeles awarded the Keeping It Modern grant to the team led by Politecnico di Torino, as fully discussed in this article. Thanks to the media campaign triggered by this important international recognition[2], local and regional authorities proposed using part of the residual funds from the 2006

[2] e.g. https://torino.repubblica.it/cronaca/2019/07/18/news/la_getty_foundation_di_los_angeles_il_padiglione_nervi_di_torino_esposizioni_tra_i_capolavori_dell_architettura_900_-231469818/

Turin Winter Olympics (Law 65/2012). Also, in the wake of this renewed interest, and before the CMP was completed, in April 2021 the City of Turin, owner of Hall B, received funds from the European Recovery and Resilience Plan (RPP) to be allocated for the rehabilitation of Hall B. In addition, the RPP plan also covered the creation of the new Civic Library in Hall B, together with the rehabilitation of Teatro Nuovo and the redevelopment of the surrounding urban area of Valentino Park. At the same time, S.C.R., the contracting purchasing body of Piedmont Regional Authority, was appointed to monitor and guide the implementation of the project, including its technical and economical feasibility.

As regards the adjacent Hall C, after years of total neglect, in 2011 it was selected by the Foundation PLN Project as a venue for the international exhibition "*Pier Luigi Nervi: Architecture as Challenge*". In March 2022, the City of Turin and Politecnico di Torino signed a Memorandum of Understanding for Pavilion 3a (former Hall C), giving Politecnico di Torino the permission to reuse the pavilion and create additional classrooms and teaching spaces for the School of Architecture.

The final report of the Getty Keeping It Modern project was completed in August 2022. The resulting CMP, released in its final form in spring 2023[3], aimed to provide detailed information concerning the chronological changes occurred to the building, according to the results obtained from diagnostic evaluations and structural and seismic analyses, as well as a series of guidelines for interventions and maintenance for future preservation work. Thus, the City of Turin has recognized the CMP as the main tool to support and guide the current rehabilitation project of this complex.

The coordination between S.C.R. and the CMP Team led by Prof. Rosario Ceravolo played a fundamental role in the progress of the project plans and activities. The CMP analysis provided a basis for the new Technical and Economical Feasibility Project led by ICIS and for the advancement of the project, within the constraints imposed by the RPP plan, up to the tender phase (Executive Phase) of the work. The project for the new Civic Library was awarded in March 2023 and is currently in the execution phase, led by the construction company Cobar with Abdr Architects, Manens Tifs, and Mjw Structures Massimo Majowiecki. Use of European funds has imposed the project a tight schedule, and therefore the Getty Keeping It Modern Team and the PLN Project Association are committed to help the CMP in the implementation and execution of the work for protecting and enhancing Torino Esposizioni as part of Nervi's legacy and an iconic piece of Modern Architectural Heritage belonging to both Italy and the world.

7 Conclusions

In the light of the interdisciplinary path of analysis undertaken, the iconic architecture of Torino Esposizioni and the new function it has been assigned a priori (and Hall B

[3] The CMP will be published in the Getty depository (Keeping It Modern report library) in the upcoming months (https://www.getty.edu/foundation/initiatives/current/keeping_it_modern/report_library/).

as the Civic Library in particular), it is important to highlight and reflect on some issues.

The complex relationship between form, structure, and function that characterizes Nervi's architecture is crucial when intervening on this architecture. Conservation and safety must coexist in a non-conflicting way, without one prevailing over the other, and fully respecting the original fabric. The issues of safety and conservation should go hand in hand, and this is precisely the approach followed in the preparation of the CMP for Torino Esposizioni.

From the analysis of Nervi's halls, it emerges that identifying for them a new function that is compatible with the existing building can resolve the above-mentioned conflict. Defining an architectural project in relation to a suitable function will make it possible for all (or most) issues to be held together, according to the idea of "integrated conservation"[4].

It is essential that the vulnerabilities and peculiarities highlighted in this study as well as all possible indirect and direct actions and the critical issues they may entail are taken into consideration for developing the architectural project.

Finally, as highlighted in the CMP, the issue of structural safety should not overshadow other conservation issues, i.e., the respect for the original features and fabric of Torino Esposizioni and its polychromy in particular (Bruschi 2023b).

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[4] European Charter of the Architectural Heritage.

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