Plus que toute autre période de l'histoire, le XXe siècle incarne en architecture l'idée même d'innovation constructive. Celle-ci passe autant par le perfectionnement de techniques éprouvées que par l'introduction de technologies nouvelles, le plus souvent tributaires de la logique de la production industrielle qui finira par bouleverser le secteur de la construction tout entier. Comment restituer la variété et la complexité des systèmes constructifs du siècle dernier ? Par quels moyens conserver les témoins de cette histoire architecturale et technique ? Sans prétention d'exhaustivité, cet ouvrage explore les spécificités de différents systèmes constructifs industrialisés et préfabriqués emblématiques de cette période et analyse les problématiques relatives à la sauvegarde de l'architecture qui en découle. Souvent synonyme de production de masse et de patrimoine ordinaire, cette architecture récente met finalement au défi les conceptions et les pratiques établies de la restauration qui s'exercent sur elle.

Architecture in the twentieth century, more than any other period in history, embodies the very idea of innovation in building. Its innovation embraces both the continued refinement of proven techniques as well as the introduction of new technologies – as often as not dependent on the logic of industrialised production which in itself would come to revolutionise the entire construction sector. How do we recapture the diversity and complexity of the century's construction systems? How do we retain the evidence of its architectural and technical history? This study, while not claiming to be exhaustive in its treatment, explores the specifics of the era's more emblematic industrialised and prefabricated systems, and analyses the problems of architectural conservation that ensue. Ultimately, the architecture of the recent past, often synonymous with mass production and the heritage of the ordinary, demands a rethink of the concepts and common practices that inform heritage conservation in our time.

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Avec les contributions de

FRANCISCO ARQUES
PAOLA ASCIONE
JEAN-PIERRE CÊTRE
CRISTIANA CHIORINO
YVAN DELEMONTEY
FRANZ GRAF
CARLO NOZZA
ANDREAS VASS

Schweizerische Eidgenossenschaft
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Département fédéral de l'intérieur DFI
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DE L'ARCHITECTURE INDUSTRIALISÉE ET PRÉFABRIQUÉE AU XXe SIÈCLE

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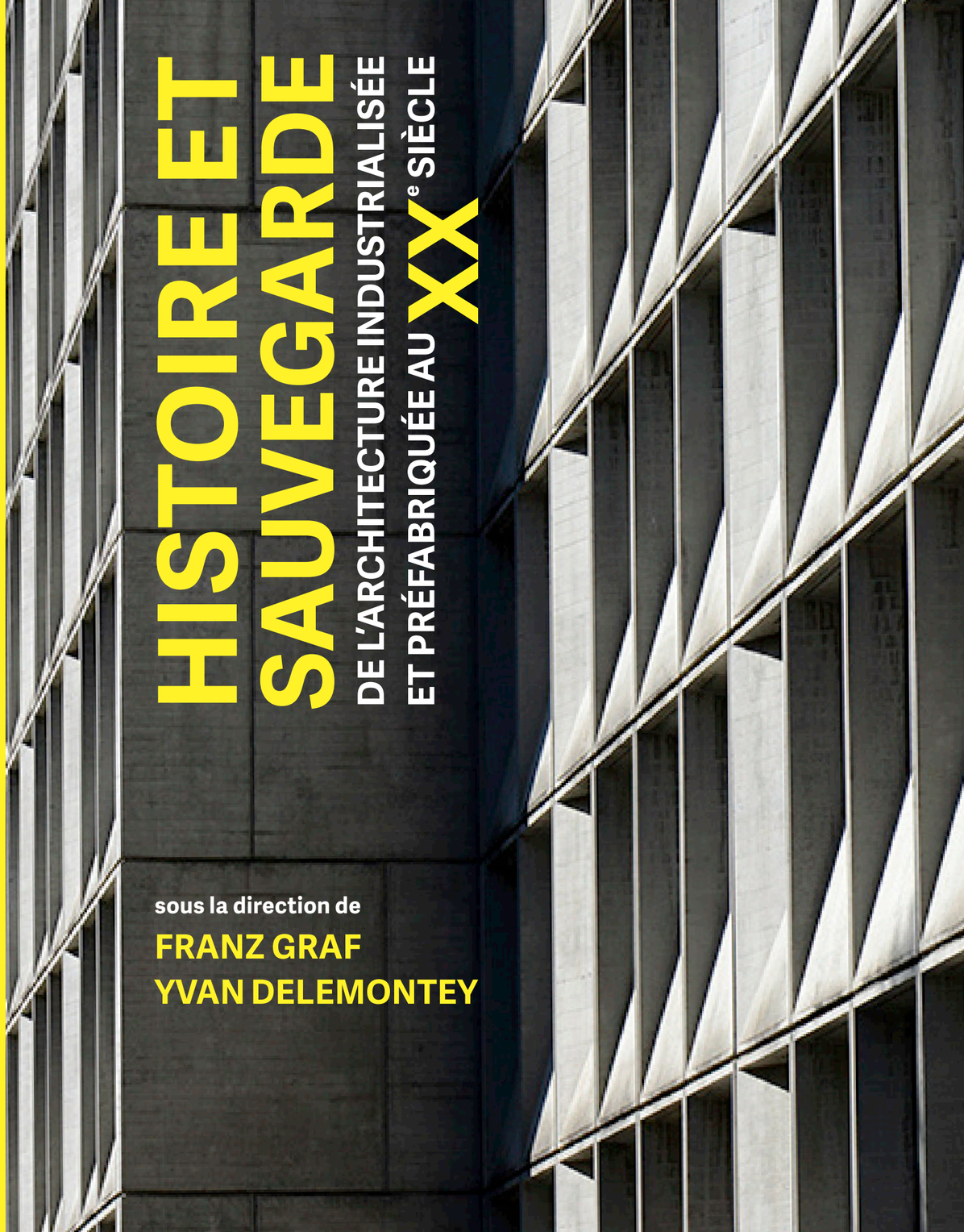

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Conception éditoriale
Franz Graf et Yvan Delemontey
Laboratoire des Techniques et de la Sauvegarde de l'Architecture Moderne
Faculté ENAC, École polytechnique fédérale de Lausanne

Coordination scientifique et éditoriale
Yvan Delemontey

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Yvan Delemontey

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PPUR, EPFL – Rolex Learning Center, CP 119, CH-1015 Lausanne,
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SUBTLE FUSION OF STRUCTURE AND SPACE
Construction, Life and Reuse of the Palazzo del Lavoro, Turin

Cristiana Chiorino

Viewed as a symbol of integration between structural and architectural invention, the Palazzo del Lavoro has fascinated entire generations by emphasizing, with a certain mannerism, the overly exposed role of the structure. The competitive tender for the construction of the 47,000 m^2 pavilion that, for the Centenary of Italian Unification, was to have hosted an important exhibition on labour, was won by Nervi & Bartoli with Pier Luigi Nervi, his son Antonio and Gino Covre in 1959. The project revolved around the subdivision of the square roof into 16 independent "umbrellas", each 40 meters per side, separated by continuous strip skylights and made from a sunburst pattern of steel beams fixed to a central column with a variable geometry, a recurring characteristic in Nervi's work. The perimeter gallery is instead constituted of Nervi's typical isostatic ribbed slabs, realized using moveable ferroconcrete formwork, based on a process widely tested by Nervi in various buildings. The proposal was deemed convincing for its simplicity and structural legibility and, thanks to the modular solution and differentiation in materials, it was the only submission capable of guaranteeing completion within the limited time available. Beyond the technical data, nonetheless impressive – 158 meters per side, 26 meters in height, and a total volume of 650,000 m^3 – the most innovative aspect of the building was, in reality, the organization of the building site. Work began in February 1960 and by late December the building was already complete. This huge architectural space, listed by the Ministry of Cultural Heritage in 2011, has continued to pose problems of reuse since the ending of the "Italia '61" celebrations. After years of abandon and neglect, a variant of the Master Plan, approved by the City Council in 2008, provided for a new use of the structure: the building, now privately owned, should be transformed into a shopping mall housing also boutiques, restaurants and public establishments.

The Palazzo del Lavoro abandoned, 2012.

"If one considers the near future of construction, I think that we can glimpse a progressive separation between residential architecture and the great works of a collective nature which, driven by general progress, will increase their dimensions and thus progressively reduce the freedom of choice of their structural and constructive schemes. Indeed it is evident that, when the dimensions of a building are very large or, for any reason, important issues of statics are at play, the liberty of the schemes, shapes and dimensions of the resistant structures is diminishing until once certain limits have been reached they become virtually nil."[1]

Pier Luigi Nervi

The engineer and constructor Pier Luigi Nervi[2] spoke these words during a lecture at Oxford University in 1960. Perhaps he was referring to the "huge structure" of the Palazzo del Lavoro of Turin where the building work – which had begun in February 1960 – was coming to an end at the time of his Oxford lecture. Besides "static problems," numerous other factors had come into play while determining the project solution which enabled the Nervi & Bartoli Company to win the tender published by the Committee for the celebrations of the Centenary of Italian Unification (Italia '61). The entire question of Palazzo del Lavoro – from its design project to its construction – reflects the complexity of Nervi's design undertaking. It reveals the determination with which Nervi combined the roles of designer and entrepreneur throughout his career, thus maintaining a continuity between the moments of invention, calculation and then of execution so as to control all the economic and quality aspects of the work.[3] Seen as a symbol of the integration of structural and architectural invention and publicized by major national and above all international journals,[4] the Palazzo del Lavoro has fascinated entire generations.[5] By emphasizing, with a sort of mannerism, the way in which the structure is almost flaunted, it marks the transition to the third phase of Nervi's design activities, that of the great international commissions in which the "Nervi system" became a repertoire of solutions to be adopted around the world.

The tender

The call for tenders for the construction of the Palazzo del Lavoro, the exhibition pavilion in Turin built for the 1961 celebrations of the Centenary of Italian Unification to host the great exhibition on labour directed by Giovanni Agnelli and staged by Gio Ponti, was published on 4 July 1959.[6] Based on a preliminary plan by Ludovico Quaroni, it required the construction of a symmetrical pavilion along two principal axes at right angles to each other. The building was to provide 47,000 m^2 of usable surface area for exhibitions and a range of services, and was to be used subsequently as a National Centre for Professional Education.[7] The call for tenders,[8] which put the emphasis on low construction costs and the "expressive" use of construction techniques and materials, allowed three months for the development of a working plan, including structural calculations, estimated bill of quantities and financial quotation. The panel of judges was chaired by Vittorio Bonadè Bottino, head engineer of the Construction and Systems division at Fiat, and the panel members were Lodovico Barbiano di Belgioioso, Luigi Carlo Daneri, Franco Albini, Adalberto Libera, Giovanni Michelucci and Roberto Pane. Six Italian companies, with their associated architects and engineers, presented tenders: Borini and Padana with Roberto Gabetti, Aimaro Isola

1 Nervi, Pier Luigi, *Dentro l'immane struttura*, in "Domus", 374, 1961, pp. 1-17.

2 On Pier Luigi Nervi, cf. Olmo, Carlo, Chiorino, Cristiana (Eds.), *Pier Luigi Nervi. Architecture as Challenge*, Silvana Editoriale, Brussels 2010; Gargiani, Roberto, Bologna, Alberto, *The Rhetoric of Pier Luigi Nervi: Concrete and Ferrocement Forms*, EPFL Press, Lausanne 2016; Bianchino, Gloria, Costi, Dario (Eds.), *Cantiere Nervi. La costruzione di una identità. Storie, geografie, paralleli*, Skira, Geneva-Milan 2012; Iori, Tullia, *Pier Luigi Nervi*, Motta Architettura, Milan 2009; Greco, Claudio, *Pier Luigi Nervi. Dai primi brevetti al Palazzo delle Esposizioni di Torino 1917-1948*, Quart Verlag, Luzern 2008.

3 Mario, Nervi's son, remembers how his father loved to compare each building process to a three-legged table whose weight has to be evenly distributed over the three legs (client, architect, builder), in the sense that if one of the legs gives way, the equilibrium of the whole table is compromised; cf. *Pier Luigi Nervi e la sua opera: incontro di studio organizzato dal Comitato del Premio Ingersoll Rand Italia*, Circolo della Stampa, Milan 1980.

4 Italia '61, in "L'Architettura, cronache e storia", 70, 1961; Il palazzo del Lavoro, in "Architectural Record", 3, 1961; Il palazzo del Lavoro, in "Progressive Architecture", 11, 1960; Il palazzo del Lavoro, in "Architectural Review", 765, 1960; Nervi, P. L., *Dentro l'immane struttura*, in "Domus", art. cit.

5 *Le Corbusier to Nervi*, postcard of 25 May 1961 and answer of 1 June 1961, MAXXI, Archivio Pier Luigi Nervi.

6 On Italia '61, Chiorino, Critiana, Pace, Sergio, Rosso, Michela, *Italia '61. Identità e miti nelle celebrazioni per il centenario dell'Unità d'Italia*, Allemandi, Turin 2005.

7 The proposals for future uses ranged from the Egyptian Museum, exhibition headquarters for products produced by Turin industries to a hall for shows and sports displays, and to a supermarket, Archivio Storico della Città di Torino (ASCT), Fondo Comitato Torino 61 (FCTO61).

8 Call for tenders and related documents, ASCT, FCTO61.

The project presented by Pier Luigi Nervi, 1959.

and Riccardo Morandi; Dalmine with Sergio Nicola and Aldo Rizzotti; Guerrini with Carlo Mollino, Carlo Bordogna and Sergio Musmeci; Guffanti with Piero Locatelli; Nervi and Bartoli with Pier Luigi Nervi, his sons Antonio and Mario, and Gino Covre; and Recchi with Gino Levi Montalcini, Aristide Antoldi and Angelo Frisa.[9] On 20 October 1959 the jury judged that only Nervi and Bartoli's proposal was entirely suitable.

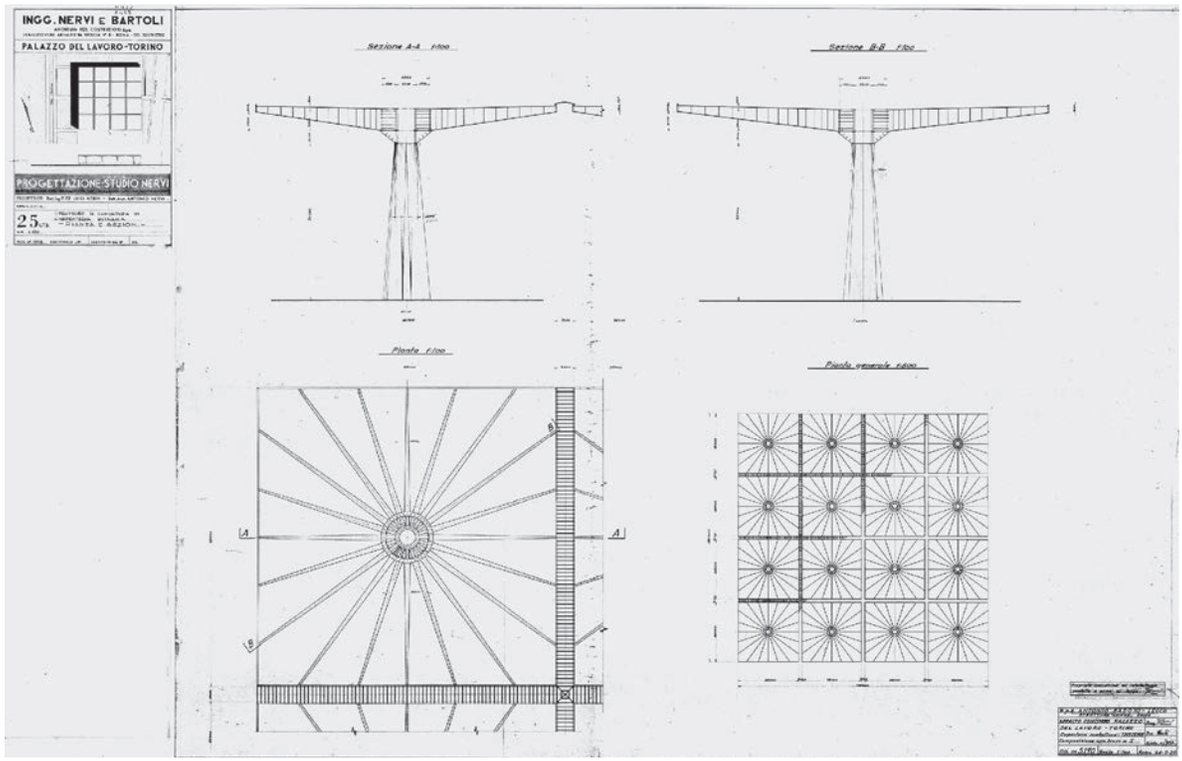
Although it lacked a number of the tender requirements, for example, having the unified surface broken up by pillars – which Turin-born architect Carlo Mollino[10] attacked in an eventually unsuccessful appeal – Nervi's proposal was convincing in its simplicity and structural legibility. The Nervi design,[11] the only one capable of meeting the very tight deadlines, was centered on the subdivision of the square roof into 16 independent umbrella-style elements with sides of 40 meters, separated by continuous strips of skylights and consisting of a central pillar with a cross-section varying continuously from a cruciform shape at the base to a circular shape at the top, and radiating steel beams. The independence of the individual umbrellas, taken as the inspirational motif, has continued to be the symbol of the building. The choice of the square structure was taken to be a declaration of honesty over extravagance, but it was above all the result of precise economic conditions, and it was the only possible answer in view of the time constraints. Having a year at most for its construction dictated the need for a modular structure based on the reproduction of identical independent units that were self-supporting and able to be executed separately. The variable geometry of the support structures is a recurrent feature in Nervi's work (Palazzo dello Sport, Rome 1959; Corso Francia viaduct, Rome 1960; Savona railway station 1961). Besides its indubitable value in terms of form, this above all dispensed with stability and construction issues. The modular solution and the differentiation of the materials would allow the almost simultaneous process of creating the structure and the finishing, and managing the problem of the casting and hardening times for the reinforced concrete.[12] The consensus of opinion between the designer and the company also worked in favor of efficiency and speed of execution, as had been the case in previous designs that Nervi had completed

9 *Idem* and *I progetti vincitori del concorso per il Palazzo del Lavoro a Torino*, in "Casabella continuità", 235, 1960, pp. 33-34.

10 "[...] I want to see you in that red-hot glass cage baked by the summer sun even if you put all the brise-soleil you want and which Nervi has not provided... I want to see whether that monumental Assyrian (structure) pleases Agnelli! And I want to see the final price, and how they will sort out the schools at the end of the exhibition, which Nervi has not even dreamt of solving in the teeth of the tender requirements! [...] It's up to you to make do in the midst of those four great columns that Nervi has dumped on you!", *Letter from Carlo Mollino to Gio Ponti*, 29/1/1960 and *Notes for the appeal, December 1959*, in Archivio Mollino, Biblioteca Centrale di Architettura (BCA), Politecnico di Torino.

11 All the drawings are at the Centro Studi Arte Contemporanea (CSAC), Parma, Fondo Pier Luigi Nervi.

12 Cf. Nervi, Pier Luigi, *Architettura strutturale con riferimento al Palazzo del Lavoro* in "Atti e rassegna tecnica della Società degli ingegneri e degli architetti in Torino", 6, 1961, pp. 165-190.



The square based umbrella at the base of the project, 1959.

in Turin and carried out with Bonadé Bottino: the Turin Exhibition halls (1948-1950), the Fiat factory buildings (1955) and the public tram depot (1954).[13]

Nervi had initially intended to use reinforced concrete for the roof, re-utilizing the system of ribbed umbrella structures he had adopted in previous works. Instead in September 1959 he called in Gino Covre,[14] one of the principal Italian engineers for steel structures. For the composition of the cantilevered beams, Covre had proposed two solutions for the tender: one with a solid I-beam section with vertical ribs to reinforce its core and another, more metallic version, composed of a lightened node framework and secondary points which had not been not established beforehand. The committee judging the tender chose the first solution, even though it was heavier and more expensive. Until that time not many buildings had been constructed using steel structure: the most important of these were the ENI office block by Marcello Nizzoli and Giuseppe Mario Oliveri (1956-1958) in San Donato and the Turin SIP office building by Domenico Morelli (1957),[15] while the Rinascente designed by Franco Albini and Franca Helg and built by the Badoni Company with Covre was still under construction in Rome. However, the solution that was adopted in the end used solid I-beams with reinforcing ribs left visible, connected

13 Cf. Pace, Sergio (Ed.), *Pier Luigi Nervi. Torino, la committenza industriale, le culture architettoniche e politecniche italiane*, Silvana Editoriale, Milan 2011.

14 Born in 1892, Gino Covre graduated in Milan in 1916. He moved to Rome and was already specializing in steel structures before the war. In 1937 he had taken part in the EUR arch project, which was not realized, proposing a solution in aluminium alloy as an alternative to Libera's project, on which instead Nervi & Bartoli worked with a solution in ferroconcrete and another in concrete segments without iron reinforcement, according to a procedure conceived by Pier Luigi Nervi himself. Together with Eduardo Vittoria, Covre had also designed the Stabilimento della Officina Meccanica Olivetti at San Bernardo in the 1950s. Covre worked with Nervi on the suspended structure of the Burgo paper mill in Mantova between 1961 and 1963; cf. Covre, Gino, *Il Palazzo del lavoro all'Esposizione Italia '61 di Torino*, in "Costruzioni metalliche", 2-3, 1961, pp. 141-144.

15 Cf. Notebook published in 1961 by Ufficio Italiano per lo sviluppo delle applicazioni dell'Acciaio (Italian office for the development of applications in steel).

The presentation of the winning project by Nervi (on the right), October 1959.

by a perimeter beam that served as a strengthening element for the entire system, with the effect of harnessing and redistributing the loads between the various projection beams. With sheet-steel insulated waterproofed cladding panels, the 16 squares of the roof covering were joined together by a network of 2-meter-wide skylights composed of metallic up-side-down V-frameworks with metal window pane holders without putty. From the functional organization standpoint the project envisaged the creation of two exhibition levels: one on the ground floor, below ground level, and the other about 10 meters above, supported on a mass of pillars and crossed by perimeter pillars with a square opening at the centre; on the intermediate floor there was a continuous perimeter gallery, the outside entrance and the services.

From tender to project execution

After various changes, the site of the Palazzo del Lavoro was defined on 23 November 1959 as being on the southernmost edge of the Italia'61 exposition complex with a parallel axis to the south radial road Corso Polonia which had been built in 1956. The competition project had to be finalized and executed with the supervision of the Fiat Constructions and Systems division.[16] The project was immediately subjected to a series of changes to ensure swifter execution and to satisfy the exhibition requirements which were defined in parallel with the start of construction. After various meetings with Gio Ponti, Ludovico Quaroni, and members of the executive committee of the Labour Exposition, in May 1960 the Nervi studio drew up the definitive project.[17] The basement floor was raised to ground level as requested by the adjudicating committee;[18] while the second level was deferred until after the celebrations. The 10-meter-perimeter gallery remained intact and was built with isostatic ribbed floors inspired by the isostatic lines of the bending moments, a variation on the orthogonal crossed ribbing patented by Nervi in 1949 which he had already used in 1953 for the Gatti Wool Mill in Rome. A basement floor was added for service areas, along with a day hotel and two projection rooms. Vertical access routes between the hall and the gallery, which varied in parallel with the exhibition solutions proposed by Ponti, were finalized as eight traditional staircases and seven escalators placed in correspondence with the perimeter pillars. Heating and ventilation systems were projected[19] whose realization was postponed until after the celebrations were over.[20]

Ponti urged the elimination of the second level supported by what he did not hesitate to call "a jungle of 182 little pillars that left visible only the four central columns and obscured the view of the others." Ponti frequently laid claim to his role in the transformation

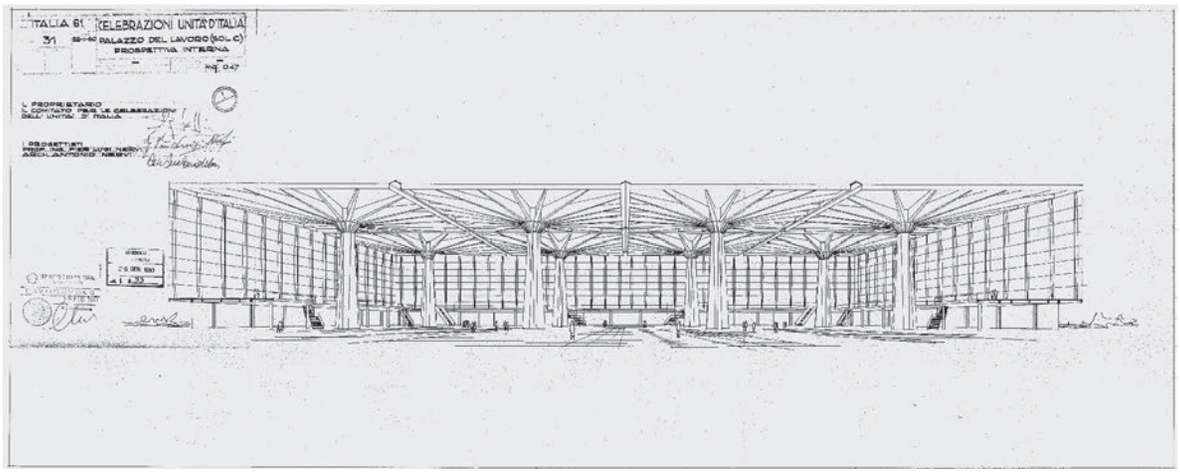
16 The role of the Fiat Works Management, which had already worked with Nervi for the halls of Torino Esposizioni in 1948-1950, was fundamental, as can be deduced from the number of tables and charts present in the Archivio Servizio Costruzioni e Impianti Fiat which later became Fiat Engineering (AFE, rag. 0084, opera 004, *Palazzo del Lavoro*).

17 The final drawings by Nervi are dated 22 January 1960. The request for building permission is dated 29 January 1960, Archivio Edilizio della Città di Torino (AECT).

18 The basement floor planned by Nervi would not have provided sufficient illumination for the subsequent school that was planned: "The examining committee recommends that the possibility of considerably raising the floor of the building should be studied, both for the building and for the green area", BCA and AFE.

19 Nervi's project was particularly detailed in the structural part but completely lacking as regards the systems, which were developed by the Fiat Constructions and Systems division. After various solutions, in February 1960 an air conditioning system was chosen with a network of large air supply channels on the roof, a floor return air system and a radiant floor, a perimeter channel outside the building containing the air pipes and the pipes to supply the air vents and convector heaters of the future Professional School. The main heating system was set outside the building, AFE.

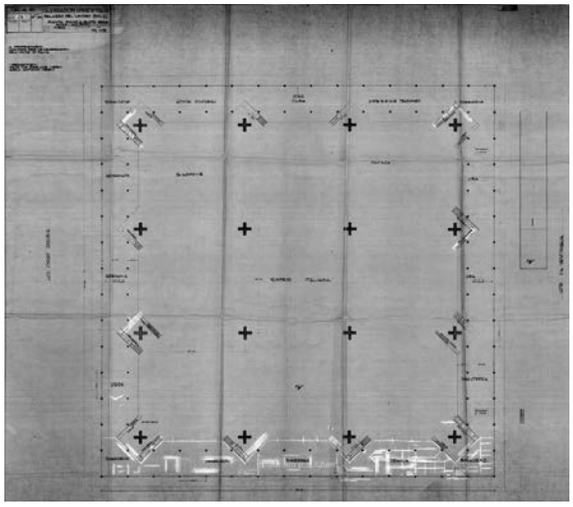
20 Nervi had won with his bid of 1,64 billion lire, excluding heating and systems, which would then reach 1,88 billion lire. The total cost amounted to 2,72 billion plus 648 million for the work subsequent to the celebrations. To this sum should be added one billion for the design of the exhibition according to Ponti's project. Cf. AFE, Archivio di Stato di Torino (AST), Fondo Comitato Italia 61 (FCIT61) and ASCT, FCTO61.



The new project approved, 22 January 1960, perspective cross section.

of Nervi's project,[21] a contribution that his friend Nervi never failed to acknowledge.[22] Also at an advanced stage of the works, Ponti suggested a series of changes to the project. In particular he wanted the lighting of the exhibition space to come only from below so as to highlight the columns and the umbrella effect of the beams, but Nervi disagreed.[23]

In the competition project there was a series of details that had remained unsolved, including the glass walls.[24] "Of this excellent project," as Bruno Zevi wrote on the day after the results of the competition were announced, "the only worrying aspect is the inconsistency of the envelope. Each modular scheme presents the problem of figuratively concluding the



The new project approved, 27 January 1960, plan.

21 "It is thanks to Mr Ponti, Nervi's devoted friend, that in Turin the structure by our Master has been able to appear in all its beauty and in the isolation of its elements. It is thanks to myself that this gallery has been eliminated, taking advantage of the time constraints Nervi was allowed for the execution, and namely that the 16 columns have been brought to the fore, which is the pure beauty of this building", *Letter from Gio Ponti to Cesare Merzagora with copy to Pier Luigi Nervi*, 7/6/1961 MAXXI, Archivio Pier Luigi Nervi. See also, *Letter from Gio Ponti to Giovanni Agnelli with copy to Filiberto Guala, Pier Luigi Nervi and Vittorio Bonadé Bottino*, 2/11/1959, Milan, Archivio Gio Ponti (AGP) and *letter from Gio Ponti to Arrigo Castellani*, 15/5/1961, Milan, AGP.

22 Cf. *Lettera di Pier Luigi Nervi al presidente del Senato On. Cesare Merzagora*, 26/6/1961, AGP.

23 "Everything in your pavilion is aesthetically coherent and also the glass joints overhead between one element and another is a delight in its purity. What it is necessary to avoid in the first appearance of your work is that row of large hanging lamps, which jar with the rest. As I shall not be using them you really must have them removed, for the purity of your creation, then if necessary they can put them back later on", *Letter from Ponti to Nervi*, 2/12/1960, MAXXI; "With this aberrant light and with that (equally aberrant) perimeter lighting the capitals and the entire ceiling will look black and flat against the light, losing all their plastic value", *Letter from Gio Ponti to Pier Luigi, Antonio and Mario Nervi*, 11/4/1960, AGP.

24 Among the causes for the increase in price compared to the solution provided in response to the call for tenders was the increase in the glass surface and the choice of the moulded uprights solution instead of that of beam uprights.

repetition of the modules, of connecting its rhythms to the outer walls, designing the latter in conformity with the structural language. From what one can make out from the scale model, Nervi has not yet tackled the issue, the glass walls that provide the envelope are vague and anonymous, while the reinforcing corner pillar is weak and out of context. Identifying the construction method of a building of this type is to travel 99% of the path to art; but this will be achieved or not by solving the last 1% which means exactly the moulding of the envelope in its two-dimensional rhythm."[25] The elaborate external wall was worked out later by Covre. It is 19 meters high and divided in two by an opaque strip of the same thickness as the floor to be completed later, which was completely independent from the structure and was left undefined for the tender competition. The external facade is composed of a curtain wall constructed from the inside, with brise-soleil[26] and sheet-metal shafts fixed at the bottom on cardan joint supports and at the top on piston rods, absorbing horizontal movement and expansion.[27] The windows of the façade are in aluminium while the doors are in iron.[28] The independence of the outside envelope compared to the internal structure is further highlighted by the removal of the four corners, a solution that intends to underline the leading role played by the structure in architecturally connecting the building. In reality only night views – when the envelope virtually disappears – or indoor views make it possible to grasp the majestic movement Nervi imprinted on the structural arrangement. During the day the envelope alone is absolutely impenetrable: cutting off the rhythm of the interior pillars, it does not express the umbrella structure.

The building site

Apart from the technical or purely quantitative data – 158 meters long by 26 meters high with 650,000 m^3 of volume – the construction site and its organization constituted the most innovative aspect. The building works started with outlining the foundations on 1 February 1960,[29] and the construction was finished on 31 December of the same year.[30] The excavation and backfilling began in mid January and went on until April, while the palification of the foundations was concluded in June.[31] The foundations were outlined at the same time as the plinths and load-bearing walls: work on continued into August as they were built step-by-step the pillars were while being completed. About 300 people worked on the Nervi Company building site. To these should be added the workers putting up the metal structures, those involved with the doors, windows and systems, technicians and draughtsmen, for a total of about 1,000 people.[32]

The site data[33] reveal that the pillars and roof were constructed over a period of a month: each pillar corresponded to construction of one unit of roofing. The building of the pillars began on 1 April at the rhythm of a pillar and a half per month: by 30 July ten of them had already been completed. The assembly plan for the roof and perimeter floor casting[34] reveals that the metal roof started from one side of the perimeter, then the roofing of an adjacent perimeter pillar and a central one was laid, and from this point work proceeded

25 Zevi, Bruno, *Degni seguaci di Guarini e Antonelli*, in "Cronache di architettura", 288, 1978.

26 Antonio Nervi initially opted for brise-soleil in aluminium, then he fell back on steel for reasons of costs. The executive drawings were realized by the Fiat Constructions and Systems division which dealt with the inclination studies, AFE.

27 Maintenance of the glass wall was provided for with crowbars running along a monorail situated in the cavity between the brise-soleil and the glass wall. Window and door frames, uprights and brise-soleil were painted with gloss finish martinorint of a color called London smoke grey, AFE.

28 Semi-double glazing was used for the steel laminate door frames, with 5 + 6 millimeter plate glass for the gallery frames in light alloy, excluding the mirror effect below which uses an insulation panel and tempered glass, 8-9 millimeter plate glass for the main glass walls, with wire mesh glass for the skylights. Opaque rolled figured plate glass was used for the cleaning service areas; cf. *Elenco ditte Palazzo del Lavoro*, in "L'Architettura, cronache e storia", 70, 1961.

29 Cf. *Riunione del 12 gennaio 1960 presso la Divisione Costruzioni e Impianti della Fiat*, AFE.

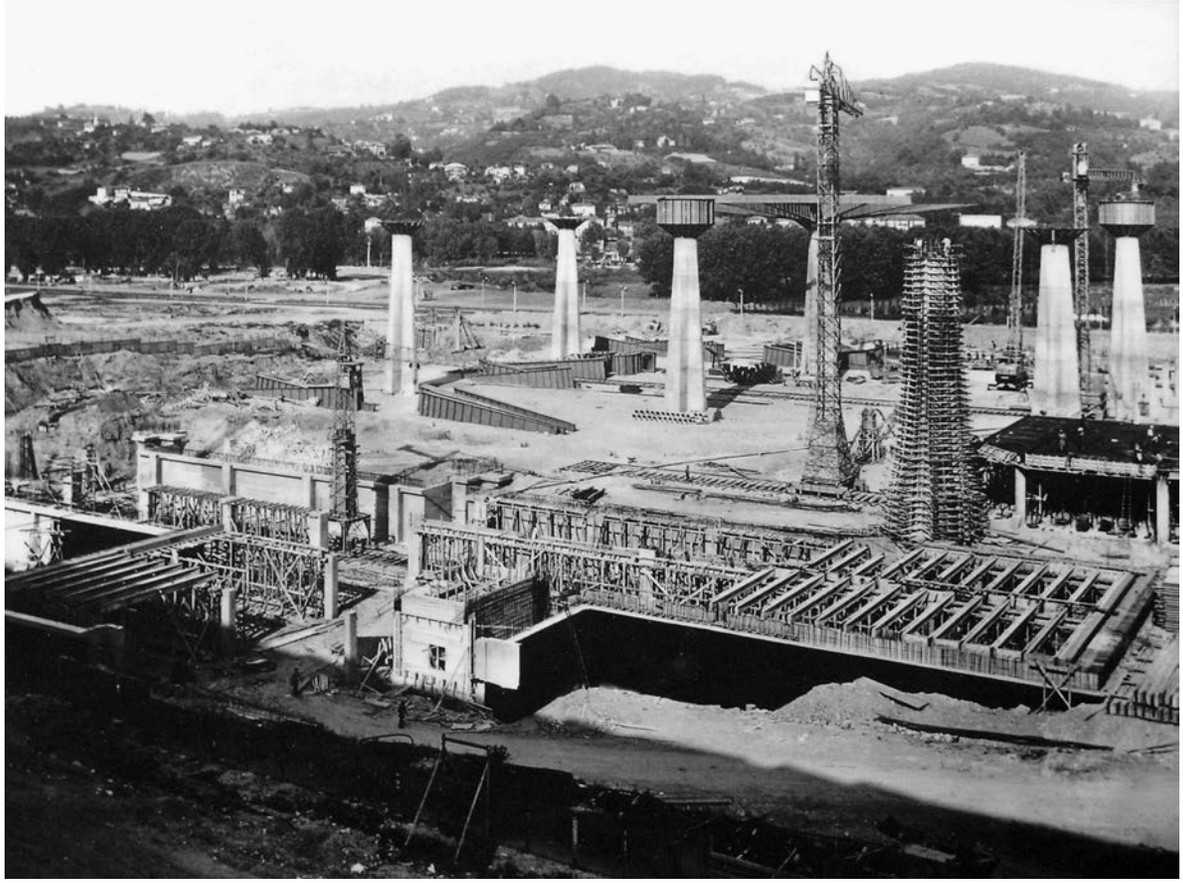
30 Four prefabricated wooden shacks were placed on the worksite for the Works Management and Site Management; a varying number of prefabricated shacks were on site to recover various materials and for site requirements; there was a small experimental laboratory for testing the concrete and for granulometric analysis of the grades (of sand and gravel); an area for metalwork and one for carpentry: *Pianta degli scavi e sistemazione cantiere*, 31 December 1959, CSAC and *Palazzo del Lavoro, Planimetria sistemazione di cantiere*, 4 March 1960, AFE.

31 The foundations stand on 500-millimeter-diameter Franki piles. The ground has a 5-meter-layer of landfill, a 5-meter-layer of sand and loose silt and a 20-meter-bank of sand and gravel. The pile heads are about 30 meters deep, *Esecutivi Palazzo del Lavoro, Programma dei lavori* in c.a., AFE.

32 The total time was about 50 thousand working days. On the site were three pile drivers used for the Franki piles, four tower cranes, five mobile cranes, one bulldozer, two dumpers, and one concrete mixing centre with a daily production of 100 m^3 of concrete with compressed air systems to transport the concrete.

33 The work site is documented with pictures conserved at the MAXXI and at AST.

34 Cf. *Esecutivi Palazzo del Lavoro*, Production phases of the pillars and assembly plan of the metal roof and mobile deck pouring of concrete floor, July-October 1960, AFE.



General view of the construction site.

with the roofing of the first and then the second row of pillars (so as to have two complete rows); in the third row two non-adjacent roof coverings were laid and then the fourth row was dealt with, concluding with the central column. Nearly 21 meters high, the 16 reinforced concrete pillars rose from a cruciform base (5 x 5 m), and they were progressively tapered and moulded to close at the top with a circular supporting area with a 2.5-meter outside diameter. The need to have a self-centring, freestanding formwork (without internal tie-rods) whose weight could be lifted by a crane and with a volume that allowed casting to be concluded in a day led to the subdivision of the formwork into six shafts, marked with a 2 x 2 channel to separate concrete pouring and absorb the inevitable differences in color of the cement mixture. The work plan set the pace of completion at ten days for each pillar: once the formwork had been mounted, the cement was laid in 24 hours with the night shift, and then the next shaft (1 day) was done and the two areas of concrete were poured in the 24 hours and so on for the three shafts for a total of seven days which became ten with the cleaning of the formwork. Produced externally with an iron beam framework, on the inside the individual type moulds were fully lined with a double layer of wooden planks. The planks on the inside, which were no higher than 12 centimeters, were cleaned and planed after each pour.[35]

To facilitate the organization of the building site and to aid work progress also in bad weather, scaffolding was built with waterproof sheeting spread over the top to cover the entire pillar, and heating was provided inside this provisional worksite structure

35 Just the formwork cost over 10 million lire: the cost was written off as it was reutilized for all 16 pillars.

The construction of the "umbrellas".

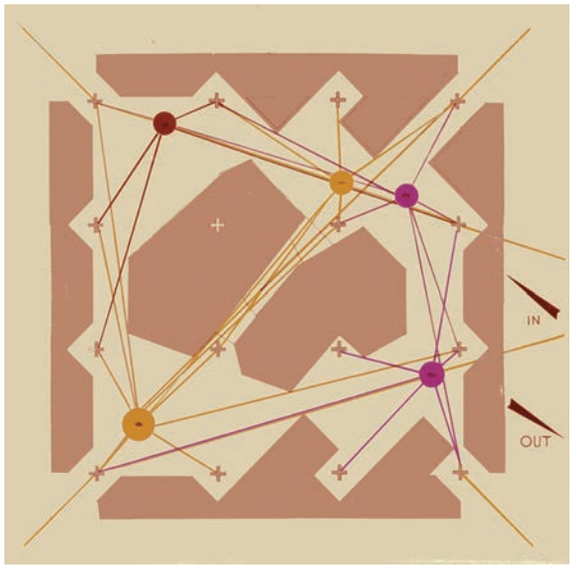
The construction site.

The construction site: welding roofing sheets.

to enable complete drying of the concrete.[36] At the same time, the roof beams were being constructed in the workshops and transported to the site by the Badoni Company from Lecco. At the top of the pillars was a truncated cone capital, anchored to the concrete structure by means of fastening screws, and a polyhedral corona joined to the fixed-joint drum of the 20 cantilevered I-beams connected by a perimeter beam that served as a strengthening element for the entire system. The total weight of each square was about 125,000 kg. The ground level floor was made up of the main beams poured on site

36 Cf. Bossi, W., *Nel cantiere del Palazzo del Lavoro*, in "Notiziario Italia 61", 1, 1960, pp. 11-12; Pavia, N., *Centinaia di operai, mezzi potentissimi. Nell'enorme cantiere si lavora giorno e notte*, in "Notiziario Italia 61", 4, 1961, pp. 4-9.

onto which were laid 10-meter-prefabricated beams at a distance of 1,66 meters. On these rested prefabricated slabs reinforced with poured concrete joints above the secondary beams between one floor slab and another. The isostatic ribbed slab on a mobile deck, which is the real synthesis of Nervi's work and of his concepts of economy with a constant quest for the aesthetic appearance through the application of the laws of statics, was realized using formworks in ferro-cement. These were composed of individual assembled modules which were rolled along rails and lifted again by jacks where they were set ready for the next span of the slab to be poured, according to a procedure Nervi had already widely experimented with in various buildings including the Gatti Wool Mill (1951-1953) in Rome, the Manifattura Tabacchi in Bologna (1951-1953) and the Mirafiori workshops in Turin (1954). During the executive phase the passage from concrete pillars to steel roofing looked incongruous. As speed of execution was paramount, the mixture of heterogeneous materials was not left to its authentic look. The steel was painted utilizing a rather cement-like light grey gloss paint, which defeated any intent of contrast and tended to conform it with the concrete, revealing Nervi's propensity for the original idea of a building all in ferro-concrete, including the roofing.



The design by Gio Ponti, perspective views on the columns, 29 April 1960.

Interior view of the exhibition setting.

Inside setting

The setting and layout of the exhibition, coordinated by Ponti but with the involvement of the most advanced architectural and artistic culture of the day, from Ettore Sottsass to Marco Zanuso, and from Lucio Fontana to Bruno Munari, was strongly influenced by the imposing structure of the building, "rejecting any solution that did not leave all the columns visible":[37] it consisted of extremely light, ephemeral partitions in aluminium, and panels clad in translucent, reflecting stainless steel which enclosed the Italian section. These slender translucent or mirrored elements represent a deliberately transitory construction arranged alongside the monumental expression of Nervi's columns. In the choice of setting it is possible to glimpse Ponti's difficulties in structuring an exhibition layout in a gigantic hall without proportions. Nervi's building is imposing with its monumental columns but it lacks spatial rhythm, it is a static space that is not designed, and it needs another substructure to be inserted for it to be shaped and modulated. Before this immense space, which excludes views and stands empty and inert, Ponti built crooked 12-meter high walls that broke up the rigid geometry of the container. The main criticism leveled at the Palazzo del Lavoro after its inauguration was that "it is an enormous umbrella that needs to be rebuilt inside for it to be utilized".[38]

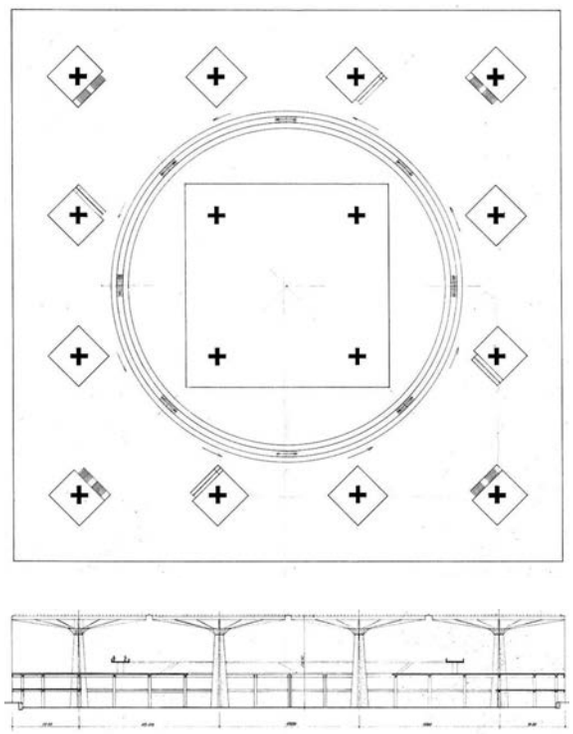
37 Gio Ponti to Nervi, 12 November 1960 and 28 November 1960.

38 Buzzati, Dino, in "Corriere d'informazione", 7-8 June 1961.

From 1961 until today: abandoned and reutilized

In Ugo Gregoretti's 1963 film *Omicron*, the buildings of Italia '61 depict the backdrop of a science fiction future metropolis[39] worthy of the best scenarios of the Mickey Mouse universe. The future of that imaginary city instead became a chronicle of demolitions, increasing neglect and missed opportunities. Bruno Zevi had already identified the difficulties that would be encountered in utilizing those structures: "Architects plan buildings independently from their contents, then architects arrive to set up the exhibition and they have difficulty filling the general predetermined spaces. At the root of all the aesthetic and technical defects of exhibition architecture is this procedural dissociation. The perimeter of the Colosseum is 527 meters, that of Palazzo del Lavoro reaches 640, the Basilica of St Peter's covers an area of 15,160 m^2 and the Palazzo del Lavoro 25,000 m^2. But who is interested in these data? The positive verdict for Italia '61 is restricted to the town plan. The rest is rhetoric, more or less mechanistic futility is folklore given that nobody has yet invented a possible rational utilization of Palazzo del Lavoro when the party is over."[40] Despite the various solutions for a possible reutilization proposed by Nervi himself in the public tender of 1959, including for sports facilities,[41] on the day after the exhibition closed there were already reports on the utilization of the buildings and works constructed for the centenary celebrations.[42] It was predicted that 3 billion lira would be required for the adaptation of the building in the absence of the initial project's requirements. Initially it was thought that the Italia '61 structures could become the headquarters of one or more education centers of high, middle and low-level professional training. In 1962 the Nervi office was entrusted with the project of transforming the building into a professional center. The cost of this operation turned out to be unsustainable, so the only option was to propose that the Palazzo del Lavoro should become the headquarters of the United Nations International Labour Organization so as to attract foreign capital into the city.

Thus in December 1963 the Ministry of Finance (owner of the building but not of the land on which it stood) entrusted the building to the Comune (municipality) with a convention of 19 years to make it the headquarters of the United Nations International Labour Organization which took up residence there in 1965 after important reconversion works.[43] The most important work was the construction of a second and third floor (partly based on the project by Studio Nervi with the executive project of the Fiat Constructions and Systems division). The staircases that led to the intermediate gallery were eliminated in favor of four groups of fixed staircases and escalators in the corners behind a wood panelling screen where the various systems were installed. Above all the roof panels



The proposal to reuse the Palazzo as a sports center designed by Nervi himself, 10 October 1959.

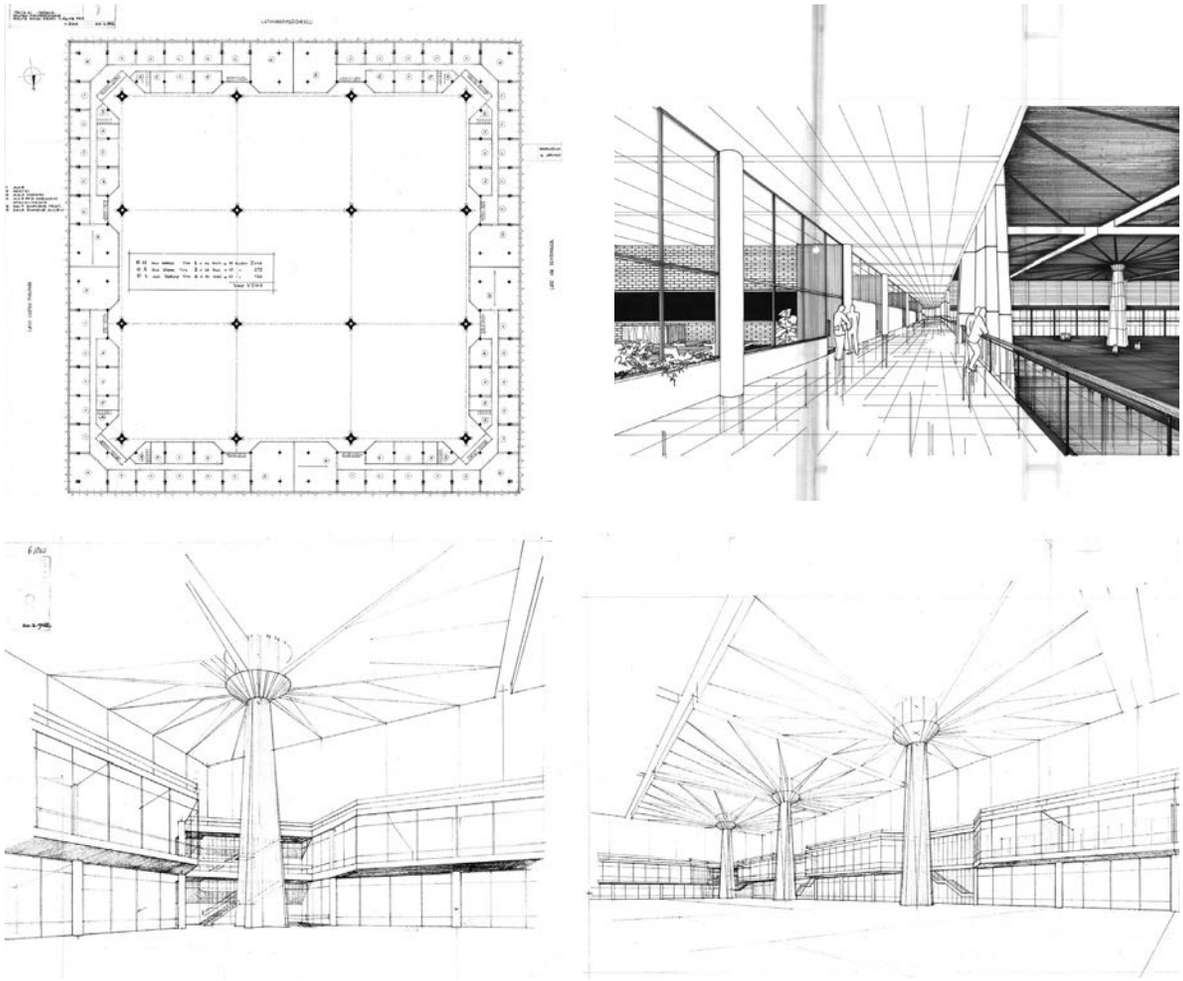
39 Cf. Bertetto, Paolo, *Torino nel cinema: l'identità imperfetta*, in Luigi Mazza, Carlo Olmo, (Eds.), *Architettura e urbanistica a Torino 1945-1990*, Allemandi, Turin 1991, p. 170; Portis, Benjamin, *Images de villes idéales: les expositions universelles*, Centre canadien d'architecture, Montreal 1993.

40 Zevi, Bruno, *La dissociazione architettonica, tara delle Esposizioni*, in "L'Architettura, cronache e storia", 70, 1961, p. 219.

41 In the drawings deposited at the CSAC there is a drawing for a possible use for education with classrooms and a series of hypotheses for a sports center.

42 Cf. Speech by Engineer Giacomo Bosso in the *Comune*, 2 December 1961, in "L'Unitá", Sunday 3 December 1961, p. 4.

43 Nervi also built the headquarters of the United Nations International Labour Organization in Geneva (1969-1973).



The project by Studio Nervi to host the headquarters of the United Nations International Labour Organization (ILO), 1962.

in thin sheet steel had turned out to be unstable[44] and insufficiently insulated: these had to be substituted with prefabricated ferro-cement panels. Moreover the building required insulation work to be inhabitable (new doors and windows, double-glazing on the facade, wire mesh glass for the skylights, insulation and waterproofing of the roofing), with modular divisions (new porches at the ground floor entrances and interior movable partition walls), new technical equipments (false ceilings for cables along the isostatic ribbed ceilings of the first level, plumbing improvements, drinking water, fire security devices, hot water), and new air conditioning and fan coil units along the outside walls, convection heaters for the rooms facing inwards onto the hall, electric fans on the ceilings, underfloor radiant heating panels for the central hall covering the whole floor in Montecatini marble, and a new heating and cooling station. All this cost about 2 billion lira.

At the beginning of the 1970s the City of Turin tried to utilize unsuccessfully a part of the Palazzo del Lavoro for the installation of a public sports complex including a swimming pool, sports fields and an athletics track. The United Nations International Labour Organization abandoned the building in the mid 1980s after constant increases in maintenance costs with problems of infiltration from the roof and leaks from

44 Cf. Minutes of the Technical Consultancy Commission for the Committee for the International Centre for Professional and Technical Development, ASCT.

The opening ceremony of the ILO,
October 1965.

The roof before (left) and after (right) the addition
of the cooling/heating pipes, 1961-1965.

the radiant panel systems. The building continued to be partially used by the Regional Administration Authority which installed the regional cartographic center, a vocational training center and the Giorgio Quazza Institute for Information Technology and Electronics there. During this period there was also the idea to convert the Palazzo into a conference centre,[45] still using a Studio Nervi project for a cost of about 10 billion lira, but this was never realized.

The roof before (top) and after (bottom) the substitution of the steel panes into prefabricated ferro-cement ones.

The Region also abandoned the building, and in the mid 1980s the Palazzo returned to the State Property Office. Between the 1990s and the early 2000s it was utilized only partially by the Faculty of Economics and Business, and by the Central Police Headquarters. The years went by without there being a proper strategy for the building's use. In 2000 a feasibility study conducted by the Turin Polytechnic and coordinated by Professor Aimaro Isola was commissioned by the Province of Turin. The study proposed its conversion into a Science Center; then there was the hypothesis to make it the headquarters of the prestigious Egyptian Museum; and after that the idea was put forward to make the Palazzo the headquarters of Fiat Engineering. However, none of the projects tackled the crucial problem, which was also the original defect: that it should be reintegrated into the urban fabric with a real collective use. The sheer volume of the building was a great stumbling block. Any conversion project had to take into account the problem of heating a volume of this size or whether to use the complex as an enormous covered square in which to build a series of independent volumes.

In 2004 the Turin Municipality decided to purchase it: the asking price was 20 million euros. However, the procedure was long and complex. Despite the Mayor's provocative proposal to have it wrapped up – literally – so as to hide it from sight during the 2006 Olympic Winter Games, the Palazzo del Lavoro continued its wretched existence as a sporadic exhibition hall. In October 2005 a variation of the zoning use clauses of the Town Planning Regulations was approved (which at that time specified its use as an exhibition space) into "new zoning use for tourism, culture, exhibition and the service sector, conferences, research, university, services for people and for enterprises". This might be a way out, although there may be concerns about the broad spectrum of the uses permitted and proposals advanced. There is again the idea of using the building as an umbrella for smaller structures which, however, could still be six storeys high. In 2007 Fintecna, the estate agent of the Ministry of Finance, chose the ideal partners for a real estate portfolio, and the Turin estate agent Gefim was picked. The final variation of the Town Planning Regulations was

45 Project by *Studio Nervi* which contains interesting notes on the degree of flexibility of the structure for different uses, ASCT.

The central exhibition space.

The interiors with false ceiling covering the isostatic ribbed slabs.

approved in July 2009. It allows for a change in the zoning use of the Palazzo for commercial uses and for a considerable increase in its construction volume. Moreover, it should bring into the Municipal coffers at least 3.7 million euros for development of the building and 8 million euros for the planning fees. It was only in 2010 that Pentagramma, a company composed of 50 % Fintecna and 50 % Gefim, was able to identify the final user: the Dutch group Corio which builds shopping malls using a pension fund. The project was presented in 2011 and for the urban planning aspect it was signed by the Turin architect Alberto Rolla who maintains that he intends to faithfully pick up the hypothesis developed by Nervi for the conversion of the building during the tender phase in 1959. In reality, however, his project proposes the construction of bulky internal volumes.

The original ceiling with isostatic ribbed slabs.

In July 2011, when the building celebrated its 50th anniversary, it finally came under the constraints of the cultural heritage code. The constraint that was imposed referred, however, to the relational value of a commemorative event, which is heteronomous as regards the values of the work. It is not clear why it was decided that the Palazzo shouldn't be protected for its intrinsic value.[46] In the report the salient features of the internal space and the architectural concepts in relation to the structural aspects are not indicated. This in effect prevents any specific limitation by the Soprintendenza (government department responsible for the environment and historical buildings). Hypothetical limitations would include, among other aspects: the height of any volumes, which should not exceed that of the perimeter gallery; their arrangement and the amount of space they occupy; and their distance from the pillars so as to respect the internal perspective space defined by the succession of pillars and by the interplay of light. As the building is now private property, the Soprintendenza can give its approval on the basis of a preliminary project without acting as tutor throughout the project process. The public administration is the only authority remaining that can impose the protection guidance that would result from this work. At the beginning of 2012 the city of Turin set up a specific committee for the refurbishment but this was done more to respond to the inhabitants' perplexity over the building of yet another shopping mall than to protect an architectural monument of the 20th century, to the extent that only local

46 Using art. 10, comma 3, lett.a, of the Codice dei beni culturali (D. Leg.vo n.42/2004).

The Palazzo in 2017.

politicians sit on this committee, with the owners, and no architects.

In June 2012 the regional administrative court blocked the project following a complaint[47] by the company that manages the shopping mall in the nearby ex-Fiat factory Lingotto, an icon of modern movement built between 1915 and 1922 and transformed by Renzo Piano Building Workshop into a multipurpose center in the 1990s. The project for the Palazzo was therefore suspended. Being a celebration of Italian technique and know-how admired around the world the building was likely to become a symbol of immobility. Suddenly in August 2015 the southern part of the building was devastated by fire. From this fire, the municipal authority has made a commitment to accelerate and conclude within one year the approval process. In December 2015 the planning agreement was finished, and it was approved by the Turin City Council in mid-January 2016: the transformation of the Palazzo was then scheduled for completion by fall 2018, but then always postponed for regulatory and economic reasons. No transformation is documented until the beginning of 2019. The failure to fully utilize the Palazzo due to its high maintenance costs is a reminder of how policies relating to major events may fail if they are not connected to the real economic and social requirements of the city, despite in this case the innovative formal and technological qualities of its architecture.

47 The complaint, confirmed in May 2013 by the Council of State, focused on the change to the Town Planning Regulation that was approved as a simple variation and not as a structural one with strategic environmental impact assessment and on the evident violation of the standards (from 6,000 m^2 of commercial area to 13,000 m^2).

Une subtile alliance entre structure et espace. Construction, vie et réutilisation du Palazzo del Lavoro à Turin

Cristiana Chiorino

KEYWORDS

Curtain-wall, Ferro-cement (formworks), Floor (Isostatic ribbed slab), Metal structure (roof), Modular standardization, Moveable ferroconcrete formwork, Nervi (system), On-Site prefabrication, Organization of the building site, Patent, Reinforced concrete structure (cast in-situ, frame), Speed of execution.

Abandonment (disuse), Change of use, Decay of metal components (oxidation), Infiltrations, Maintenance, Protection measures (national listing), Replacement (of roof covering), Reuse, Transformation.

Synthèse remarquable d'inventions structurelles et architecturales, le Palazzo del Lavoro, à Turin, a fasciné des générations entières en mettant l'accent, non sans un certain maniérisme, sur le rôle ostentatoire de la structure. L'appel d'offre pour la construction d'un pavillon de 47 000 m² destiné à accueillir, dans le cadre du centenaire de l'unification italienne, une importante exposition sur le travail est remporté en 1959 par l'entreprise de construction Nervi & Bartoli avec Pier Luigi Nervi, son fils Antonio et l'ingénieur Gino Covre. Le projet tourne autour de la subdivision d'une toiture carrée en 16 « parapluies » indépendants de 40 mètres de côté, séparés par des verrières zénithales constituées d'un assemblage de poutres en acier disposées en motif rayonnant autour d'un pilier central à géométrie variable – caractéristique récurrente dans l'œuvre de l'ingénieur italien. La galerie qui entoure la halle est en revanche constituée de dalles nervurées isostatiques réalisées au moyen de coffrages mobiles en ferrociment, basées sur un procédé largement éprouvé par Nervi dans plusieurs de ses édifices. Retenue pour sa simplicité et sa lisibilité structurelle, cette proposition est alors la seule capable de garantir l'achèvement des travaux dans les délais impartis, grâce à sa modularité et la différentiation dans le choix des matériaux. Au-delà de ses dimensions impressionnantes – 158 mètres de côté, 26 mètres de haut pour un volume total de 650 000 m³ –, l'aspect le plus novateur du projet réside dans l'organisation du chantier. Commencé en février 1960, celui-ci est achevé en décembre de la même année. Après la clôture des festivités « Italia 61 », cet immense espace architecturale, inventorié en 2011 par le ministère du Patrimoine culturel, ne cesse de poser la question de sa réutilisation. Après des années d'abandon, le Conseil municipal approuve en 2008 une variante du Plan directeur qui prévoit une nouvelle affectation : désormais privatisé, le bâtiment devrait être transformé en centre commercial abritant boutiques, restaurants et établissements publics.