THE OLYMPIC BUILDINGS AS A NEW TYPOLOGY FOR ARCHITECTS AND ENGINEERS

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ABSTRACT

Integration between Architecture and Engineering is one of the cardinal elements of the IASS activities and is generally perceived either as a 'starting point', being a quality of the ancient Master Builders of Medieval and Renaissance times or as a 'final destination' to be eventually reached by the two disciplines in times to come. In both cases, such integration seems absent in contemporary buildings. In contrast, there has been in the recent past, also in the present and will be forthcoming in the future, particular occasions in which such a 'fusion' was not just a possible solution but consistent practice, a built fact. These special occasions are certainly represented by the buildings for the Olympic Games. The 'Olympic Buildings' are designed to represent both an architectural and an engineering challenge to the existing world of construction. They aspire to become icons of a particular time and to set a new standard in terms of building technologies/materials. It is not a coincidence that some of the most influential designers of our times linked their names to the Olympic Games. Indeed, figures like Pier Luigi Nervi (Rome 1960), Yoshikatsu Tsuboi (Tokyo 1964), Frei Otto (Munich 1972) and more recently, Mamoru Kawaguchi (Barcelona 1992) and Santiago Calatrava (Athens 2004) designed some of their masterpieces for such events.
This paper, which is an outcome of a broader, international and in-progress research on this topic, will, through a re-reading of some the most significant post-war editions of the Olympiads, illustrates the historical progress of so-called 'Structural Design'. Considering in depth the case-study of Rome 1960 as a starting point, and comparing it with buildings designed for other Olympiads, it became apparent that all of the works examined in this article, in spite of their international success, managed to keep what can be defined as a 'Regional character', distinctive of a particular culture in terms of architectonic language and technological resources. This characteristic seems to be lost in the most recent editions of the Games (Athens 2004 and Beijing 2008) and represents one of the challenges to the next Olympic cities, starting with London 2012.

KEYWORDS

Olympiads, Sports hall, Domes, Roofing, Nervi, Tsuboi, Otto, Kawaguchi, Calatrava

INTRODUCTION

The Olympiads are a global event followed by millions all over the World. In terms of an audience, nothing compares. They are a much more complex affair than a series of sports competitions. To host the Olympic Games represents a major political achievement and an explosion of both joy and pride for an entire nation. To participate, or deliberately not to participate, in the Games has a strong impact on formal relationships among countries. The host city is chosen by the International Olympic Committee (IOC) and the political significance of the choice is extended to the whole nation. Politically, the organization and hosting of the Olympiads can either reaffirm the power of the world-leading nations over the developing ones, or stress the 'passage of state' of a particular nation: Beijing 2008 is the clearest example of the latter case.

In the world of construction, the Summer Olympiads offered, after the Second World War, a unique and stimulating environment where architects and engineers could find the perfect balance. The infrastructures designed for the Games, mostly long spanned structures, have not only to function

perfectly, they must also be architecturally representative. The buildings must demonstrate to the entire World the standard achieved by a nation and the state of the art of its capacity through quality construction. This is the reason why in the post war era many famous designers, especially engineers, produced outstanding designs for the Olympiads. The involvement of figures like Nervi, Tsuboi, Otto, Kawaguchi and Calatrava, explains why some of these buildings became at the same time architectural icons and technological standards for their times, and their designers entered as champions in the boundary territory of Structural Architecture. In most cases these designers are equally appreciated both by architects and engineers, a circumstance quite rare. Indeed, the Olympic buildings can be considered as a project theme in its own right. Through the same principal typologies (stadia and sports halls) and at a constant cadence of four years, it is possible to read the progress of the Structural Architecture. An in-depth investigation of this proposed theme has not yet been produced: this article is a pilot project for wider and deeper research into the Olympic buildings already started by the author.

The present paper presents a selection of four editions of the Olympiads (Rome 1960, Tokyo 1964, Munich 1972 and Barcelona 1992) which well represent examples of buildings that integrate architectural aspects and structural achievements.

CASE STUDIES

Rome 1960

Arguably, it was exactly in Rome 1960, in a re-gained peaceful era (Germany and Japan were not invited to the first Olympiads after the War, hosted in London in 1948) and in the pioneering time of satellite communications, that the Olympiads really became a World Wide event. The opportunity to show to the International community that Italy had finally reached a status of a power nation after the political and economical disaster of the Fascist Regime came with the Olympic Games. Given the importance of ancient history and the monumental presence of classic architecture, the Italian Olympic Committee (CONI) decided to stress the historical link between the ancient capital of the Empire and the contemporary city of Rome. The logo of the Games is the clearest example of this; designed by Armando Testa, a classical capital surmounted by the she-wolf with Romulus and Remus, the mythological twins who founded the city of Rome. Furthermore, the CONI decided to place several sport events in ancient sites: Wrestling in the Basilica of Maxentius, Gymnastics at Caracalla's Baths and the Marathon around the main classical monuments. For the latter, a route rich in classical evocations for which the start of the race was at the foot of the great staircase of the Capitolium and the finishing point at the Arch of Constantine (it is interesting to note that for the first time since the modern Olympiads were revived, the Marathon has neither started nor finished in the main stadium).

The political intention was to immerse the whole Games in an historical environment and to counterpoint this atmosphere with the most advanced technology and ultra-modern construction systems. The main issue was to find a designer who could conjugate Modernism with Classicism. Pier Luigi Nervi had already proved that he was capable to conceive and build large structures quickly and economically. Moreover, Nervi’s inclination towards symmetry and therefore, in the eyes of the Committee, Classicism made him the perfect choice. Nervi’s practice undertook different roles, designing nearly every structure and infrastructure for the Olympiads. He designed and constructed two covered sports halls (the Palazzetto dello Sport and the Palaeur), a stadium (the Stadium Flaminio, in collaboration with his son Antonio) and an urban high speed elevated motorway (Via Olimpica). As a structural designer, he took part in the project for the Olympic Village, designed by a pool of Architects. Nervi was also shortlisted for the projects of the velodrome and of the new International Airport.

The Palazzetto dello Sport, one of Nervi’s most famous works, was conceived as a sports hall in the area of the Olympic Village where the athletes could exercise and train before the official

competitions which would take place in the bigger Palazzo (Palaeur). The architect Annibale Vitellozzi, who was at the time the head architect of CONI, conceived the preliminary design. His simple idea consisted of a central space, clear of vertical structures, to be covered by a dome. The idea behind it was to obtain a building that could be adapted to different disciplines (boxing, wrestling, basketball) in a very short time. This seemingly simple concept was not easy to realise. The circular area had a diameter of 60 metres. Internally, the seating tiers follow a crescent shape, and the playground of the arena was placed 3 metres below ground level. In this cultural atmosphere, Nervi was called to design a dome, a dome in Rome.

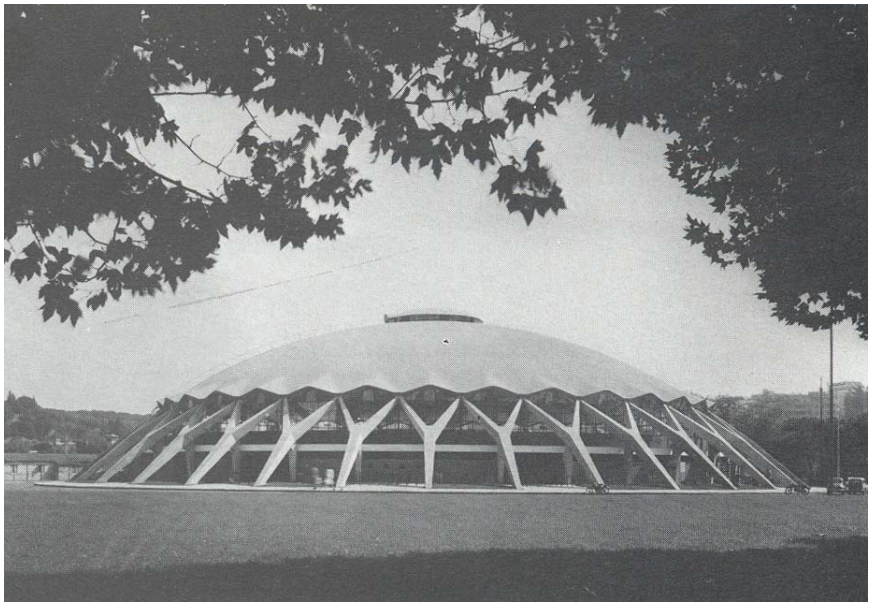

Fig 1. The Palazzetto dello Sport, Rome 1960

Although he certainly was not the first builder to do this, it was a crucial moment in his career. Internationally acknowledged as an innovative designer of contemporary structures, he was now called to face one of the most classical themes in the purest tradition of Italian architecture. Nervi could have been influenced by many wonderful examples that Rome, but the closest reference was the Pantheon. There are many similarities between the two buildings: Firstly, the plan.
The Pantheon is a paradigmatic example of the circular plan. Until now Nervi had not built a perfectly centrally planned building, although a certain tendency towards symmetrical organisms was already apparent in his work. In the case of Palazzetto, apparently A. Vitellozzi was the architect who proposed a circular building; however Nervi's contribution in its definition is substantial. Moreover, he also used an identical solution for the plan of the bigger sports hall, the Palaeur, which was designed entirely by him. Functional reasons explaining these choices in relation to their particular typology (a sports hall) are belied by the buildings designed and built for the ensuing Olympic Games.

The Pantheon and the Palazzetto were designed to be perceived essentially as domes. In the Roman edifice the dome dominates the entire building and is, in the end, the building. Furthermore, like the Palazzetto, it is a perfectly hemispherical dome. In both cases, even though with a different solution, the opportunity to perceive the pure geometry of the dome is provided only from an internal inspection. This led to another similarity between the two architectures: the Pantheon is one of the first architectures of the past in which the interior space determines the external aspect. The Palazzetto is no different; once inside, the presence of the internal *Cupola*, amplified by the converging ribs, which are not dissimilar in terms of the visual effect provided by the concentric lines of coffers in the Pantheon, suggests that the main viewpoint of both buildings is from inside. The similar use of geometry in plan, implies similar structural solutions for the two works; one is

certainly the use of a ring foundation. Both the Pantheon and the Palazzetto have a concrete ring foundation. Of course, in two thousand years building techniques have evolved, with a subsequent reduction of the resistant sections. The principle, though, is exactly the same for the two buildings. The foundations of the Palazzetto represent a very interesting case. In order to support the horizontal force transmitted by the Y-shaped external columns, tangentially aligned to the dome, Nervi had to devise a new kind of foundation. In fact, due to the horizontal component of the forces transferred by the pilasters, the foundation also had to bear the tensile strain. For this reason, he designed a pre-stressed reinforced concrete ring (81 metres in diameter) which was used here for the first time in Italy. Structurally, the pre-stressed ring is for the Palazzetto what the drum is for any classical dome. Another important similarity between the two structures is the building material. The Pantheon is the triumph of Roman concrete, being one of the most wonderful works ever built in this material, its structure represents a marvel even for today's engineers. The dome is constructed of stepped rings of solid concrete, decreasing in density as lighter aggregate (pumice) was used, diminishing in thickness to about 1.2 m at the edge of the oculus. (Reinforced concrete, of course, did not exist at that time). Nervi used a very similar, light material nearly 2000 years later. Nervi's previous studies were focused on perfecting the technology of reinforced concrete and on the reduction of the proper weight. These two objectives brought him to ferro-cemento, a lighter and stronger type of reinforced concrete, already used and tested by Nervi in previous buildings.
Finally, both these two domes contain an element which has to be regarded as the main symbol of the existing link between the two architectures: the *Oculus*.

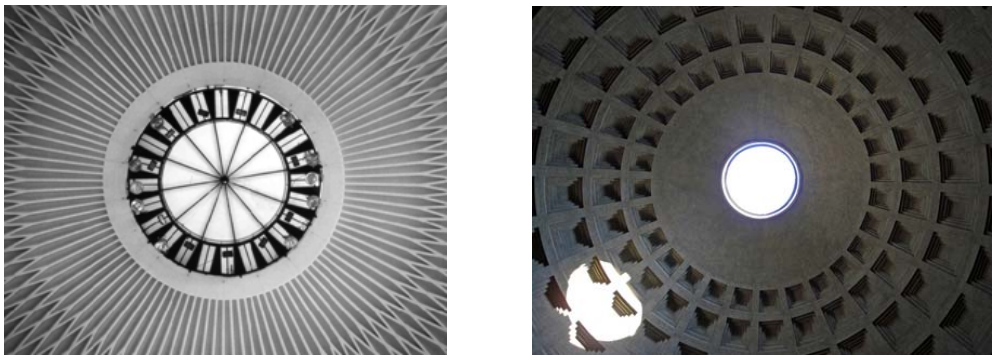

Fig 2,3 The Oculii in the Palazzetto (left) and in the Pantheon’s dome

The central *oculus* (the circular opening at the top of the dome) in the Palazzetto is a clear quotation from the Pantheon. This opening, absolutely necessary from a functional point of view in the Hadrian’s building was in Nervi's structure completely superfluous: light and air are in fact provided entirely by the electrical plant.
Whether it is possible to consider all the above choices, with particular regard to the central opening, a spontaneous homage from Nervi to the Eternal City or an architectural interpretation of the imposed link (by CONI) between the new structures for the Olympiads and the Ancient History of Rome is difficult to ascertain. However, it is worthy of note that Nervi, who designed other similar domes, adopted this solution only in his two Roman sports halls. The significance of Nervi’s choice can be understood when he repeated the same move in his other dome for the Olympiads, the Palaeur.

Fig 4. The Palaeur, Rome 1960

All the above considerations lead us to the conclusion that Nervi, in designing the two buildings which became the icons of Rome 1960, managed to link these modern structures to the complex context of a historical city like Rome. The results were excellent, the domes proved to be at the same time functional and evocative, a perfect balance between Structure and Architecture, exactly as their ancient predecessor.

Fig. 5 The Pantheon, Rome 125

Tokyo 1964

In a political situation similar to Italy four years earlier, Tokyo hosted the Olympic Games in 1964. In Yoyogi Park, a particular site for the Tokyo and the entire Japan (it was the area of the American occupation forces Headquarters after WWII), the architect Kenzo Tange conceived two buildings that certainly became symbols of that particular edition of the Games. Tange, similarly to Nervi, was trying to connect the principles of the Modernist movement (in terms of formal solutions and structural technologies) to traditional Japanese values. Arguably, the Gymnasium and Swimming pool, are the best examples of this difficult compromise. In plan both edifices resemble a spiral. The smaller building, the Gymnasium, also develops this shape in elevation. The spiral, taken from the world of Nature, shows a possible connection between these architectures and the organic world of Japanese iconology.

However, again similar to Nervi's arenae in Rome, the roofing solutions are the most interesting aspects of the two sports halls. In the larger building, the swimming pool, the evocation of a traditional temple roof by the architect is counterbalanced by the revolutionary tensile structure of the covering conceived by the engineers. This technology had been known and used since the late 1950s (le Corbusier, Saarinen) but it was for the first time here that Prof. Tsuboi and his young colleague, Kawaguchi managed to apply it on a huge scale, indeed, in 1964 the tensile structure used in the swimming pool was the largest in the world. As it will be shown later in this article, similar suspension roof technology was used in 1972, by Frei Otto to design the covering of the Olympic Stadium in Munich (1972).

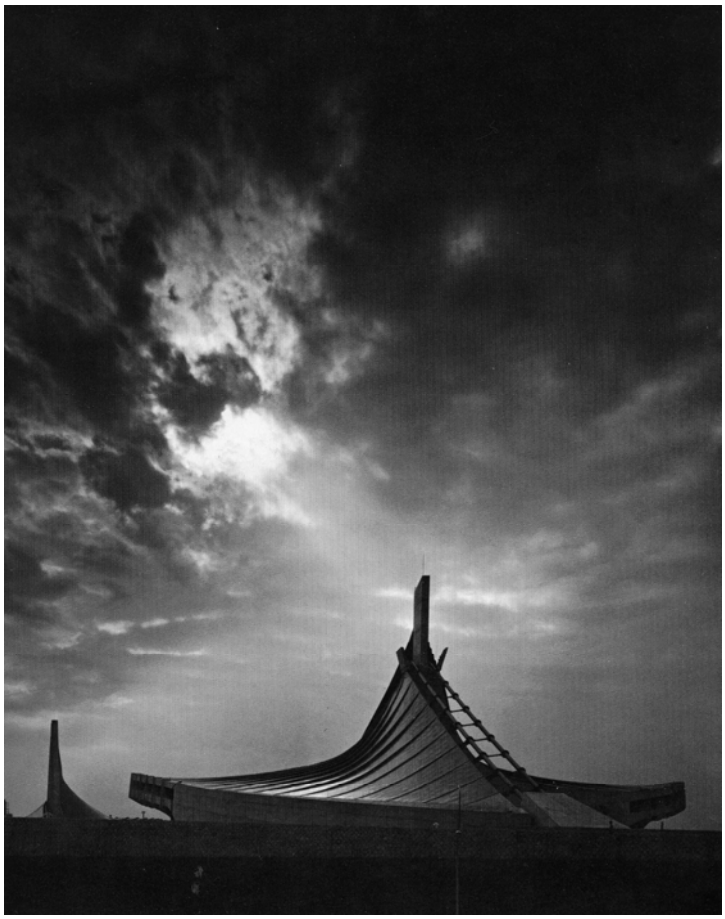

Fig. 6 The Olympic buildings, Tokyo 1964

Munich 1972

'The Happy Games' of 1972 organized in Munich, Germany, was the attempt of a modern democracy to erase the military memories of the past. Unfortunately, they became one of the saddest in recent times: The terroristic act of the Palestinian group named 'Black September' eventually resulted in a bloodbath was to be remembered as one of the most bitter tragedies connected with sports events.

However, the Olympiads in Munich are also remembered for a much more joyful reason: the magnificent covering of the Olympic Stadium. As mentioned previously, tensile structures had been known since the 1950s and the Japanese edition of the Olympiads in 1964 demonstrated their possibilities. However, Frei Otto in the Institute of Lightweight Structures in Stuttgart started developing his own variation of tensile structure. His experimental pavilion was constructed in the area of the Institute and was the prototype for the 1967 German Stand at the Montreal Expo.

The Design team for the Olympic village area (which included the Swimming pool and Stadium) was based in Stuttgart with Gunther Benisch as the main architect and Jorg Sclaich as a young structural designer. The outcome of their work was, again, a perfect example of integration between Architecture and Engineering and also the expression of the particular design culture of the host country. Here, however, the reference was not formal as in Rome and Tokyo but rather 'structural'. Also, differently from the previous case studies and probably due to a precise political decision, the principle behind this project was not the attempt to link the present with the past but to proudly show the height of research achieved in Germany or, in other words, to link the present with the future: a challenge which was embraced again, and pushed forward twenty years later in Barcelona.

Fig. 7 The Olympic Area, Munich 1972

Barcelona 1992

The Catalan Architect, Oriol Bohigas, head of the design team of the Olympic Master plan for Barcelona, had a fundamental intuition: to design functional infrastructures which work not only for the Games but also afterwards. The idea of the Games as a passing circus was transformed into an opportunity to re-think the urban tissue of a specific city. For the first time, the theme of the Games was attacked as a whole, not as a series of single episodes. For example, the Olympic Village was designed not as a temporary container for the athletes but as a new, central district, in front of the Mediterranean Sea, to be regained by the City once the Games were over. The Olympic Village and the *Barceloneta*, the other adjacent district, are nowadays one of the most refined and expensive areas to live in. The new approach and the final results were equally appreciated by local people and by the design community. This is testified by the unprecedented decision of the RIBA (Royal Institute of British Architects) to award the City of Barcelona the prestigious Gold Medal in 1999.

Despite the number and calibre of the invited international designers (A. Isozaki, V. Gregotti, N. Foster) the Barcelona Games were intrinsically Catalan; not only for the idea expressed above, i.e. to 'use' the Olympiads for the benefit of the City (and not the other way around) but also for the presence of a building that became the symbol of Barcelona 1992. The Communication tower in the Olympic Area of Montjüic, by Santiago Calatrava, linked perfectly the contemporary Architecture of Barcelona to some of the most important figurative research expressed in the past in the same city, from Gaudi to Dalì. In this respect a result very similar to that which was achieved in the other Games treated in this article, Rome, Tokyo and Munich.

Fig. 8 The Communication Tower, Barcelona 1992

CONCLUSIONS

As shown through the examples above, Olympic buildings have provided common ground for architects and structural designers to work together and deliver structures which satisfy issues of both form and function. This approach has been consistent throughout the whole series of Olympiads of the post WWII era, of which the selection in this article is just a portion.

If the most recent Olympiads are considered, Athens 2004 and Beijing 2008, there is no doubt that this approach continues in the design of sports infrastructures. However, it is questionable whether the other aspect stressed in this paper, the concept of 'Regionalism' is still a value in the design of new works. The Olympic stadium in Athens by S. Calatrava is certainly a building which perfectly melds formal choices and structural solutions, however the clear link between this building designed by a Spaniard and the architectural culture of Athens/Greek is somehow missed; The personality of the designer and his 'style' has become predominant over contextual influences; Similarly, in the almost completed (May 2008) Olympic stadium in Beijing by Herzog & De Meuron, a Swiss practice, it is hard to find a connection with China, excluding perhaps the overuse of steel; Again, it appears that the personal research and prestige of the designers are preponderant over attention to the local design culture.

Whether this is a mere consequence of the effects of globalisation, it is complicated to establish and invites further contribution. Certainly, the adherence to local research and the re-use of a national language is a challenge that the new Olympiads must face, starting with the next one, London 2012.

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CREDITS