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7. Enlargement and Restructuring of the Stadium of Palermo (Italy)

Owner: *Municipio di Palermo*

Designers: *Arch. Giuliano Guiducci, Milano*
Ing. Innocente Porrone – ICIS s.r.l., Torino

Contractors: *Ponteggi Dalmine s.p.a., Milano*
Edilscavi s.p.a., Palermo
Vincenzo Giordano – Impresa Costruzioni, Palermo

Works duration: *24 months*

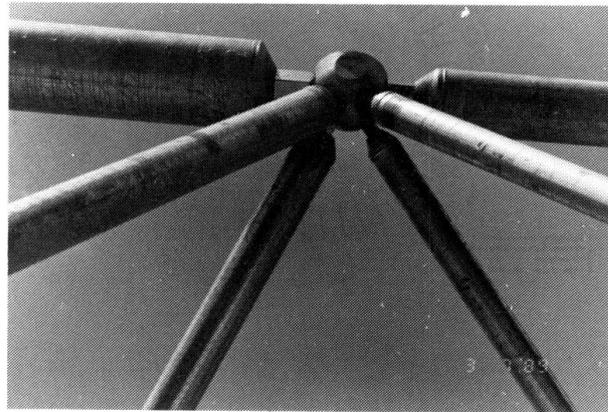
Service date: *1990*

The recent restructuring of the Stadium of the City of Palermo, situated in the «La Favorita» Park, was for the purpose of meeting the required safety standards and seating capacity.

The design is strongly characterised from the architectural point of view but has nonetheless managed to preserve the existing structures (which are protected by the State due to their historical value).

Three different structural changes were carried out in order to obtain a capacity of 40000 seats – namely:

- the construction of a new grandstand cover supported by four post-tensioned reinforced concrete towers
- the enlargement of the grandstands by means of a third row of tiers
- the restructuring of the existing entrance building involving the demolition of the existing reinforced concrete cover and its substitution with a new grandstand placed on top of the building itself. This design conforms to the seismic forces required by the Italian codes (D.M. 24.01.86) assuming a seismic-protection coefficient of 1.4.



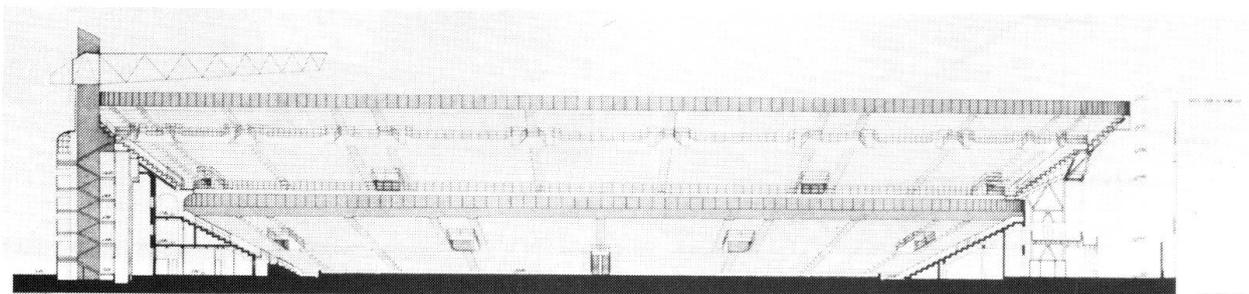
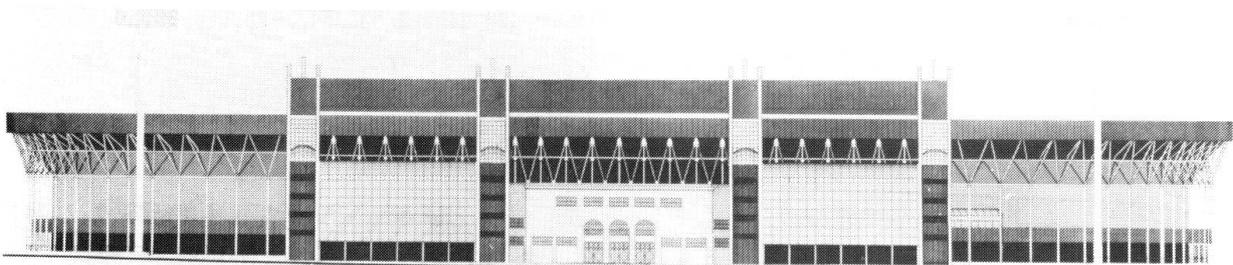
Typical knot of a new grandstand

Grandstand cover and supporting towers

The grandstand cover has a 30 m overhang and is supported by 21 cantilevered steel trusses made of pipes connected by cast half-spheres. These trusses have a triangular section and height that varies between 4.8 and 2 m.

Each truss weighs 45 kN and is rigidly fixed to a continuous rectangular section (4.5 × 5 m) steel truss, which is subject mainly to torsion.

This large truss weighs 4500 kN and has a span of 114 m. It is rigidly fastened to four post-tensioned reinforced concrete towers by the heads of the tensioning bars. Each tower at the top is divided into two parallel slabs 8 m high and 0.7 m thick. Their flexibility is easily capable of absorbing the thermal expansion of the superimposed truss.



View and cross section of the stadium



Tier support structure

Foundation soil tests showed that wide natural cavities (up to 50 m² and 2 m high) are located at a depth of 18 – 20 m under the four towers, thus the foundation of each tower consists of 9 piles (1.2 m dia.) each 30 m long.

Tier support structure

The reticular trusses adopted are made up of steel pipes connected by pins. This makes the theoretical model easily analysable – thus contributing to a «clean» structural outline.

The new ring of tiers rests on the existing structure and consists of the repetition of a module having a three-dimensional static behaviour. Each module is supported by 13.5 m columns made with 406 mm outside dia. steel pipe (11 m wall thickness) carrying a tier-holding beam made with an HEA 320 I-beam. The precast reinforced concrete tiers have an overhang of 2.9 m near the joints which allows for a simplification of the support structure.

Restructuring of the existing entrance building

The beams and columns of the existing building have been reinforced by encasing them in reinforced concrete

with an average thickness of 20 cm in order to enable them to carry the loads transferred by the new row of tiers, which in turn are supported by a reticular steel structure similar to the one adopted for the enlargement of the grandstands.



Kit of reticular beam