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Artikel: "Marcantonio Bentegodi" Stadium in Verona (Italy)
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10. «Marcantonio Bentegodi» Stadium in Verona (Italy)

Owner:	*Municipality of Verona*
General Designer:	*Dr. Eng. Silvano Zorzi*
General Contractor:	*Impresa Mazzi Costruzioni S.p.A., Verona*
Works Duration:	*20 months*
Service Year:	*1989*

General

The existing stadium, completed in 1963, was already a multifunctional facility, for football and track-and-field sports, fully and continuously used.

The bowl around the field, which is itself a polycentrical figure in plan, is developed into an 11-row lower floor with 10800 seats, a first ring with 5 rows of seats for 5500 seats and further superposed tiers with 14 rows for 15200 seats; the overall capacity is 31500, with a seat to seat distance of 0.45 m.

In 1986, the completion of a first section of the extension project, which envisaged a third ring of tiers and the covering, by means of a 30-m cantilever roofing, of all the seats underneath, increased the capacity by 4000 seats.

At the beginning of 1989 with a view to «Italia 90», the World Football Cup, the new seating ring and the roofing were already complete, perfectly matching the structures included in the above-mentioned first section of the project, thus reaching a capacity of 46500 seats, all of them covered.

Besides, the adaptation of the new stadium to the World Cup, has involved heavy re-structuring, extension and plant engineering works within the large space available under the tiers of the existing construction. As regards the Press Hall, it is housed in the new «Table Tennis Hall» purposely built near the stadium, to which it is connected by means of a short underground passageway.

The end result is an extension which allows a visual transparency between the new and the existing structures, exhibiting a compact, solid superstructure without sacrificing of continuity, in order to obtain the maximum capacity with the maximum space-savings, both in plan and in height.

The insertion of the new tiers ring has not lead to noticeable changes in the surrounding urban environment, but, if anything, to an enrichment from the monumental point of view.

Fig. 1: The completed stadium in Verona (aerial view)

Fig. 2: The completed stadium in Verona (view from inside)

Structural solution and construction procedures

The new structure, consisting of the 3rd tiers ring and in the roofing for all the stands (both the new ones and the existing ones), has been designed to be totally independent of the one already in use for over 25 years.

It consists of a single row of columns standing outside the old structure and aligned radially with the frames supporting it.

Cantilever beams protrude from each column, at three levels, so as to support the horizontal floors for circular paths and services, the elements of the 3rd ring tiers and the new cantilever roof.

At every third span the stairs leading to the 3rd ring floor wind round the column and the landings are located at the floors of the existing tiers.

All the cantilever roof structures (corrugated sheet-metal roofing, cantilever box-shaped main girders, tie-rods and columns) are made of steel.

The other structural elements (foundation footings, columns, stairs, cantilever beams, floors and tiers) are of ordinary reinforced concrete or prestressed concrete.

With a view to speeding up the construction and improving the mechanical properties of concrete as well as the quality of the finished surfaces, prefabrication was widely used: actually, only foundations and columns were cast in place; climbing forms were employed for the columns as well.

The massive use of prefabrication required keeping structural dimensions and weights within values consistent with the transport and lifting requirements and, consequently, of splitting up the structures into numerous elements to be assembled in place by means of steel connecting bars and sealing castings; also the use

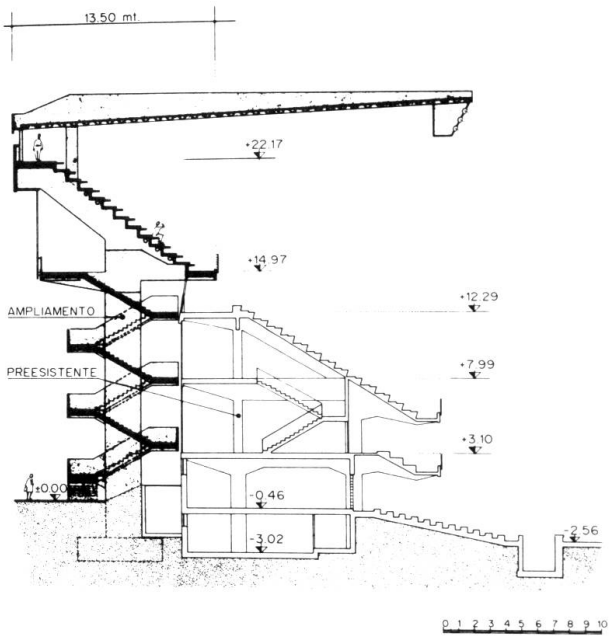

Fig. 3: Typical section

of materials having good mechanical properties (Class 400-500 concretes, high strength reinforcing steel, prestressing and connections by means of Dywidag steel, non-shrink mortar sealings, etc.) became necessary.

As already mentioned, the foundations (consisting of footings, unpiled) and the columns were cast in place and then the precast horizontal cantilever beams of the first level were placed and anchored radially to the field.

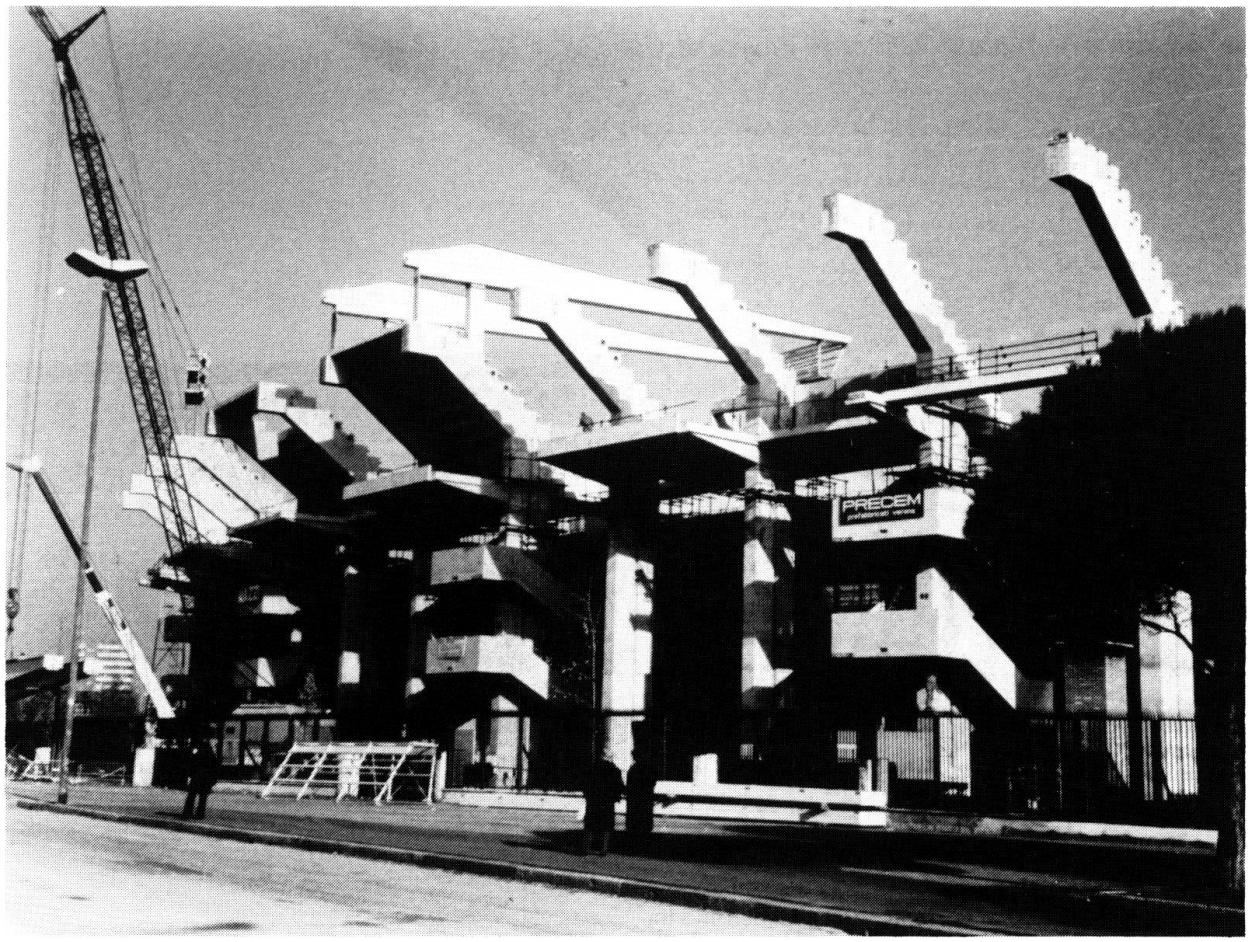

Fig. 4: During construction

The precast floor panels were then laid, arranged orthogonally and supported by the cantilever beams. The panels were jointed together and to the beams by reinforcing bars and in-situ concrete castings. The next construction stage was the placing of a second precast cantilever beam, aligned with the preceding one but with an inclined profile according to the outline of the tiers. The beam was connected to the underlying beam to the column by means of prestressing vertical bars.

The precast tiers were laid on the top faces, properly shaped, of the beams and joined together by a suitable number of dowels and steel plates sealed with non-shrink mortar.

The 3rd ring structure was completed by the placing of secondary elements (prestressed bracing members, top slab, edge ribs, steps, etc.), all precast and connected in place, as stated above.

The steel roofing conforms to the structural design of the ring underneath: radial beams and floors parallel to the tiers. For the obvious reason of visibility the beam overhangs from a steel column standing on the outer edge of the new tiers and is held by a tie-rod located on the outer edge of the ring (the upper passage of the 3rd tiers ring is situated) between the column and the tie-rod.

The column and the tie-rod are anchored to the tiers-supporting beam by means of rag-bolt plates and prestressing vertical bars, respectively.

The cantilever roofing consists of very thick corrugated sheet steel, to cover the 7 – 10 m spans between the cantilevers, without any intermediate structure. The roofing is protected by waterproof material and with interposition of an insulating layer, acting as a noise barrier, against the rain.

The stairs were erected during the assembling of the precast elements and quite independently. The load-bearing elements are the landings, which are connected to the columns by prestressing horizontal bars and with interposition of sealing concrete. Next, the flights of stairs, provided with hand railing, were placed and connected to the landings by means of welded sections and protective placed concrete.

The construction and erection of the complete structure were accomplished at the rate of approx. one bay every 8 calendar days.

The above-described works did not cause any slowing-down or stoppage of the normal activity of the multifunctional stadium (football and track-and-field sports), because every operation was performed outside the perimeter of the existing stadium.

(Silvano Zorzi)