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CONTEMPORARY APPROACH TO THE STRUCTURAL DESIGN OF COVERING THE «CAIR» CITY STADIUM IN NIS

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Abstract. The paper presents some contemporary stadiums constructed worldwide, which were used as inspiration for the conceptual design of reconstruction of the «Cair» city stadium. Consideration of contemporary global trends and the dictate of the function resulted in the design of the stand covering having a unique form and structural composition, comprising supporting cable elements under tension. The conceptual design of reconstruction won the second prize at the competition.

Contemporary architectonic-structural designs in the world

The usual stand covering systems were based on cantilever beams, spatial trusses, suspended linear beams. The new era of covering the stands which have the circular or oval layouts, began at the beginning of 90's of the 20th century, with the application of suspended, pre-tensioned radially distributed cable semi-trusses. By dividing the cable support in two parts, and using one of its halves, transfers the tension forces in the main and stabilizing cable to the interior circular or interior arched cable (figure 1.1, mark 1) which connects all the semi-trusses (3) and establishes balance in the system. This causes emergence of high horizontal forces in the support points of the cable semi-trusses in the outer ring (2) which causes the pressure stress in this element.

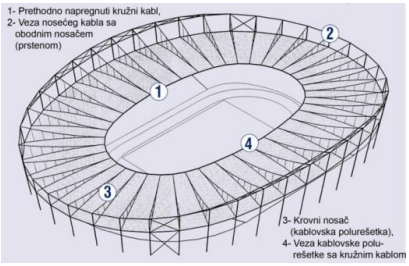


Figure 1.1. Structural plan of the suspended pre-tensioned roof

In the global building practice, this covering concept was implemented in numerous sports facilities of great spans, constructed for representative sports events. In the professional opinion, the most representative, both in terms of span and elegance, structural-esthetic characteristics, of the importance of the sporting events and investments are the stadiums presented in figure 1.2.

A. Pusan (2001, South Korea), B. Delle Alpi Torino (1990, Italy), C. AWD Arena Hanover (2005, Germany), D. «Gottlieb–Daimler» u Stuttgart (1993, Germany), E. Commerzbank Arena in Frankfurt (2005, Germany), F. National stadium in Kuala Lumpur (1998, Malaysia)

Figure 1.2. Contemporary stadiums in the world

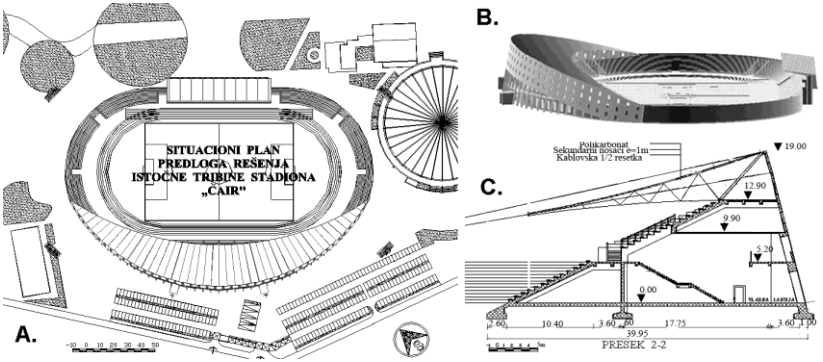
Town planning design of the «cair» stadium

Reconstruction and extension of the existing City stadium in Nis should provide a capacity for 20.000 visitors, and mixed-use space underneath the stands. The separate design of the east stands covering and of the design of the entire stadium are a part of the design specifications.

The building is located in the Sport Center «Cair», on the periphery of the city park bearing the same name (Figure 1.3).

The location of the building is characterized by a very favorable position within the city, thus it fully satisfies the functions provided in this design, in terms of sports and other uses.

Fast and easy communication with the city environment as well as the designed parking lots facilitate successful functioning of the planned functions of the building.



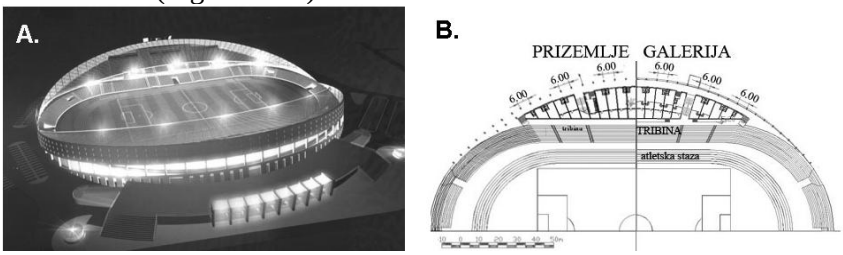
A. Town planning layout, B. Model of the design of reconstruction of the east stand only, C. Cross-section

Figure 1.3. Conceptual design of reconstruction and extension of the stadium

Architectonic design

The architectonic design is inseparable from the structural design. The design of the transparent covering of the east stand facilitates covering of a part of north and south stands.

An alternative design, including the west stands too, enables envisioning the final concept of the stadium, which will have the capacity of 20 000 seats (Figure 1.4 a).



A. Model of the entire stadium, B. Floor plan of the extended part in the ground level and of the elevated gallery

Figure 1.4. Conceptual design of reconstruction and extension

The design of the building architecture is such that it houses a number of functions underneath the stands – mixed-use spaces, retail, service and other functions. (Figure 1.4b).

The east stand alone, in its ground level, has the same uses and functions as the rest of the stadium; its extension, with the radially organized

structural concept at the top level, facilitates space for VIP boxes and/or sports commentators' seats.

The esthetic peculiarity of the structure and its architectonic appeal are reflected in the architectonic form of an opened sea-shell (when the alternative construction of the west stand is completed), or if viewed separately as a part of the barrel – «*shape of barrel»* (Figures 1.4a and 1.5). This conceptual design won the second prize at the public competition in the year 2000, under the code «Barrel».

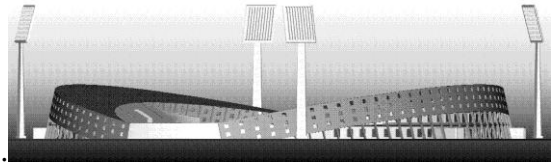


Figure 1.5. The Model of the stadium at the parking level

The architecture with the external supports provides all the interior spaces of the structure with natural light and ventilation, both at the ground and the gallery levels.

The implemented design meets all the standards of the international football association related to comfort, view angles, rate of evacuation of the stadium, ease of communication and primarily functionality of the facility.

Structural system

The structure of the facility and the covering of the stands was constructed with the practiced technology, with easy and fast building and at low cost.

The reinforced concrete frame structure served as a support for the stands and as a bearing structure to the roof supports. The spatial arrangement of the frame is radial, with mutual spacing of 6,0m.

The roof structure is a system of steel, pre-tensioned cable semi-trusses, composed of a bearing and stabilizing cable and diagonal members. The cables are mutually linked with special connectors, thus constituting a support in vertical plane (Figure 1.4c). The median lines of cable trusses form an inclined plan, with the mark at the elevation of 6,60m. In this inclined plane is the main tensioning cable, which provides tension of the entire cable system. The main contour cable is anchored in RC diaphragms at the periphery of the north and south stand. (Figure 1.4 and 1.5).

The covering was realized with the double-layered polycarbonate which has a prismatic profile on its lower surface, so in the periods of the day when there is intensive sunlight, the space under the cover is shaded (east stand, and parts of south and north stand).

The advantage of such roof construction is lightweight structure, fast construction and low cost.

Conclusion

An evidence of keeping up with the contemporary global achievements in the architectonic and structural design of sport stadiums in our country is the «Barrel» – the second prize at the competition for reconstruction, extension and covering of the east stand of the «Cair» stadium in Nis.

The attractiveness and all the advantages of the presented new structural system have not been widely implemented in our country. IA great obstacle to application of these systems in Serbia is the lack of knowledge of the potential of application of modern covering materials and the reluctance of the contractors to implement a new structural system for the first time.

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