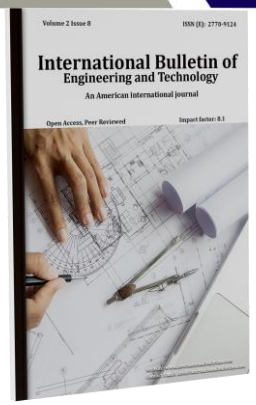

A METHOD OF COVERING THE ROOF OF A LARGE PROLYOT FOOTBALL STADIUM USING A STEEL FRAME

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Abstract: In this article, a constructive solution to the project of completely covering a large-scale football stadium with the help of a steel frame is proposed.

Key words: Membrane coating, polymer material ETFE, steel frame, movable steel arch, cantilever truss.

Introduction: The construction of indoor sports arenas in large cities is important for holding sports competitions with the participation of a large number of spectators, in any weather and at any time of the year. Indoor stadiums are one of the types of buildings that play an important role in urban development and serve as an architectural and artistic advantage in the development and planning of cities. The importance of such structures is determined primarily as part of large sports ensembles, the creation of which requires the development or reconstruction of large urban areas, the solution of various transport problems, and major work on their beautification [1]. The main architectural feature of indoor stadiums is the correlation of their external and internal appearance with the adopted structural system and methods of their construction. Many sports facilities, such as indoor stadiums, ice arenas, arenas, volleyball and basketball courts, and indoor tennis courts, have a large area and can be seen without the presence of load-bearing columns inside the building.

Large-scale architecture has always occupied and continues to occupy a special place in world history. It has its own technical direction in the design and construction of such large objects. This direction has maintained its interest in the professional environment to this day. That is why large-scale projects have become a characteristic feature of modern large cities. These are mainly public buildings, and the specific characteristics of such structural systems - both functional and aesthetic - should be able to clearly manifest themselves.

Large-scale structures are made of various materials: steel, reinforced concrete, wood, special fabrics, rope, carbon-plastic, etc. can be used in individual elements. Large prolyot constructions are designed as single prolyot. Due to the different requirements placed on them, architectural solutions can be different. Buildings can be rectangular in plan - this is typical for buildings intended for industrial and special purposes. Planned public buildings can be round, polygonal, oval.

The main part The world's first indoor stadium was built in 1899 in Montreal, Canada [2] (Figure 1). This stadium is designed for a hockey game. The capacity of the stadium was 10,000 people, including 4,300 seats. For the first time, artificial ice was used in this stadium in 1915. Due to a great fire in 1918, this stadium does not exist today.

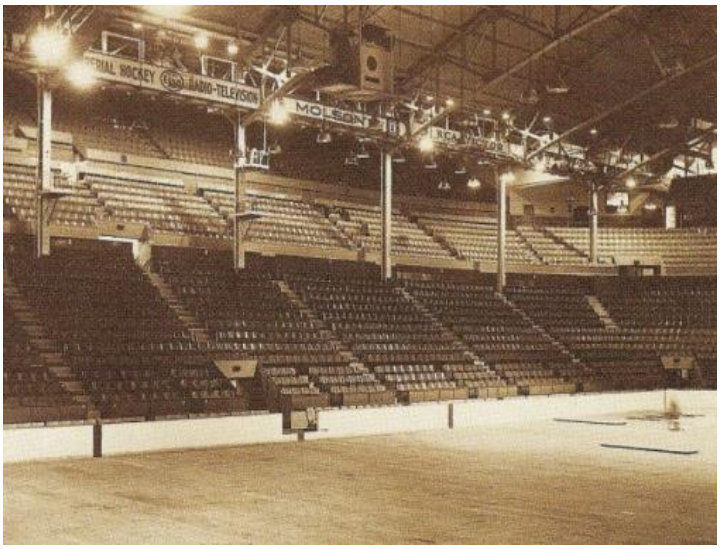

Figure 1. The world's first indoor stadium is in Montreal, Canada

The construction of large-scale indoor sports facilities began in the 20th century in the USA, where various technical solutions were introduced much earlier than in other countries. A little later, in the 1930s, sports facilities began to be built in Europe, in Russia, this construction began later, in the 1950s, and taking into account the accumulated experience in the construction of facilities, it was carried out without sufficient use of diversity [2].

In many sports facilities, the covering structure is integrally related to their planning scheme, in particular, the arrangement of spectator seats. This situation can be seen in constructions such as the indoor sports arena in New Haven. The same situation was used in Yoyogi swimming pool. The indoor sports arena in Rayleigh and the city gym in Ludwigshafen are examples of how well the selected construction solutions fit together (Figure 2).

Figure 2. Yoyogi sports complex

A small gymnasium in Rome with 4,000 permanent seats is covered with a precast reinforced concrete dome. The supports protruding from the contours of the building receive the loads falling from the dome (Fig. 3). The structural solution of the building is an excellent example of a solution based on architectural requirements.

Figure 3. A small sports palace in Rome

Figure 4. Sports palace in Mexico

The Sports Palace in Mexico can accommodate 15,500 spectators in permanent stands and 7,000 spectators in folding stands. The building is covered with a net dome consisting of star-shaped triangles connected to spatial polygons, the tops of which are connected by stars.

The filling of the structural grid is made of thin wooden adhesive panels with an external coating with the necessary insulating materials and copper sheets (Fig. 4).

Thus, in the practice of building sports facilities, there are spatial covering structures in the form of panels, shells, domes and suspended structures, with specific load-bearing elements such as trusses, girders and frames, and made of various materials. The universal use of indoor stadiums ensures the need for a large and diverse inventory, for their storage, spacious and conveniently located utility rooms should be designed.

In Uzbekistan, there are no large indoor stadiums. Stadiums in Uzbekistan are not completely closed, but partially closed for the part of the tribune where the audience is located.

Figure 5. View of Samarkand "Dinamo" stadium

Due to the fact that indoor stadiums are important in urban development and are one of the types of buildings that serve for the development of cities, the idea of covering the stadium "Dinamo" located in the city of Samarkand was put forward. Considering that the city of Samarkand is a large touristic city, it is important to build indoor sports fields, where sports competitions can be held in any weather and at any time of the year with the participation of a large number of spectators.

One of the stadiums located in the center of the city of Samarkand, where various events are planned, is the "Dinamo" stadium (Fig. 5). Dinamo Stadium was built in 1963, the playing field is 72 m wide, 112 m long, 8064 m2 in area, and has a capacity of 13800 spectators. The outside size of the stadium is 120 m wide and 220 m long.

Figure 6. polymer material "ETFE" membrane

In Samarkand, it would be appropriate to hold sports competitions in any weather and at any time of the year with the participation of a large number of spectators. The world experience of covering the "Dinamo" stadium located in the city of Samarkand has been studied and it is planned to use modern light materials. One of such materials is the ETFE (Ethylene tetrafluoroethylene - Ethylenetetrafluoroethylene (ETFE)) membrane made of polymer material Fig. 6.

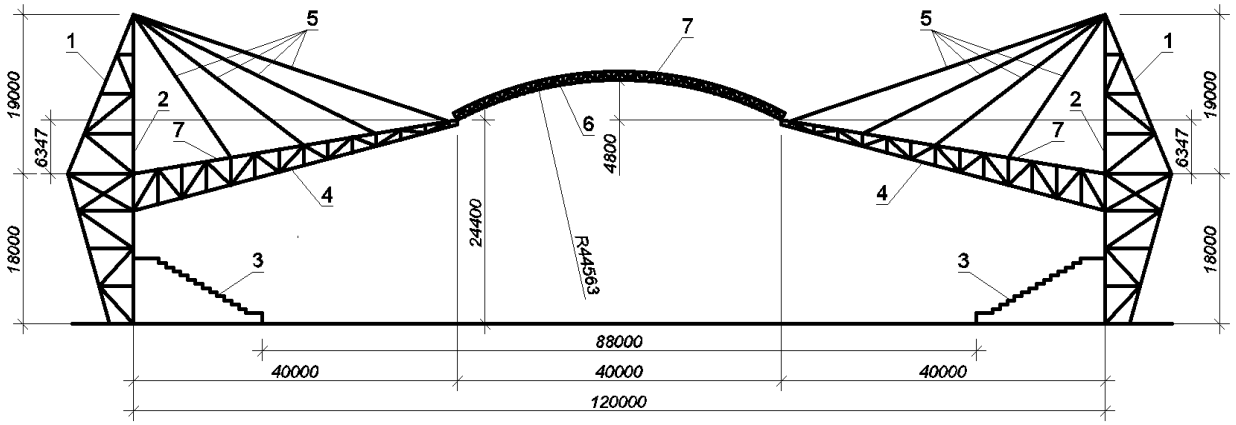

Figure 7. The proposed construction scheme for covering the Dynamo stadium.

1. main load-bearing steel column, 2. vertical brace placed to increase the rigidity of the steel column, 3. spectator stand, 4. console truss, 5. steel rods, 6. bracket. Arch cover made of stainless steel, 7-polymer material. ETFE membrane

ETFE membrane can be used as a cover for the whole stadium. ETFE polymer material has the following advantages:

1) very light
2) has great durability
3) fire resistant
4) resistant to hot and cold climate temperatures
5) the possibility of long-term exploitation
6) resistant to chemical corrosion
7) resistant to wind and snow loads.

Currently, this ETFE polymer material is used to cover the world's leading stadiums. Therefore, based on world experience, it was suggested to cover the "Dynamo" stadium with

ETFE polymer material. Fig. 7 shows the structural scheme of the proposed cross section for covering the Dynamo stadium. The main load-bearing steel column (1) is mounted on two pile foundations. Taking into account that the base of the steel column will have a very large bending moment force, it is appropriate to use a pile foundation. In order to increase the rigidity of the steel column, a vertical anti-bending bracket (2) is attached. Steel columns are placed outside the spectator stands (3). A cantilever truss (4) is mounted on a steel column. Steel braces (5) are used to hold the cantilever truss. A movable steel arch (6) is installed at the end of the cantilever truss. This steel arch can be opened or closed using a special electronic trolley depending on the weather conditions. Electric wheelchairs are remotely controlled from below. A polymer material ETFE membrane (7) is drawn over the movable arch and cantilever trusses to protect them from precipitation and solar radiation.

Conclusion:

1. The main load-bearing structures for closing the "Dynamo" stadium can be made from local steel materials. There will be no difficulties in material construction. polymer material ETFE membrane does not overload the structure due to its lightness.

2. Unlike other stadiums, Dynamo Stadium can be opened or completely closed depending on weather conditions. Nowadays, many stadiums are closed only to the spectators' tribune. The main field of the stadium is not protected from the weather.

3. The proposed structural scheme for covering the "Dinamo" stadium differs from the analogues of the structural scheme used in other world arenas. A steel column vertical truss form was used to support the cantilever truss and the movable arch. It is distinguished by the metal consumption of the structure and the ease of its construction and installation.

Currently, the researcher is looking for cost-effective options for the steel column, the main structure in the proposed construction scheme for covering the Dinamo stadium.

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