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Unique Design of Sports School Column: Innovation and Practical Application

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Abstract: This article provides rules for designing and calculating unique roof structures of sports schools. In addition, information is given on modern materials used in unique roof constructions of sports schools.

Keywords: Design, ceilings, sports schools, unique, structures, concrete, metal, features.

Introduction. Modern sports schools require not only high-quality sports equipment and infrastructure, but also innovative construction solutions. One of the key elements of the building is the floor - a structure that not only performs the function of dividing the space, but must also meet specific requirements for safety, acoustics, light and thermal comfort.

The shape of the hall plan and the size of its spans do not unambiguously predetermine the shape of the roof. Its choice is greatly influenced not only by the plan, but also by the shape of the building determined by the functional features. As is known, in demonstration sports halls, the capacity and location of the stands determine the asymmetric or centrally symmetrical composition of the building, with which the choice of the roof shape should be consistent. Suspended roofs harmonize well with an asymmetrical shape of the building, while both vaulted and suspended roofs harmonize well with a symmetrical shape. For buildings centric in plan, centric roof designs (domed, membrane) are applicable. The final choice of the roof shape, in addition to functional ones, is determined by structural, technological, technical and economic, and architectural and artistic requirements. According to the latter, the design of a unique large-span building should contribute to the creation of an expressive, tectonic, individual, large-scale architectural form. The introduction of spatial suspended structures and rigid shell structures has provided unprecedented and multi-variant architectural possibilities. By combining different types, numbers, and sizes of elementary shells, an architect, with the help of a designer, can achieve the required scale division of form and individualization of its appearance, and originally place overhead light openings in the covering.

Main part. This article examines the features of a unique floor structure for a sports school, including innovative materials and technologies, as well as their impact on the performance characteristics of the building.

1. Basic requirements for sports facility ceilings

Sports school ceilings perform several key functions that must be taken into account when designing them:

- **Load characteristics**: Sports halls often use heavy equipment and may also be subject to dynamic loads (from jumping, moving sports objects, etc.). Therefore, the floors must be highly durable and resistant to deformation.
- **Acoustic parameters**: Sports events are accompanied by loud sounds that can create acoustic discomfort. Proper acoustic insulation of the ceiling helps reduces noise levels, creating a comfortable atmosphere.
- **Energy efficiency**: Sports schools must be energy efficient, which includes thermal insulation and light transmittance of the floors.
- **Fire safety characteristics**: Sports facilities must be equipped with ceilings that meet strict fire safety requirements.

2. Innovative materials and technologies in the construction of floors

To solve the above-described problems in the design of sports school ceilings, innovative materials and technologies are actively used:

- **Lightweight reinforced concrete floors**: The use of reinforced concrete slabs reinforced with new technologies allows for the creation of structures that have excellent strength with a relatively low weight. This is important for reducing the load on supporting structures and increasing durability.
- **Sandwich panels with insulation**: Modern sandwich panels, consisting of two layers of steel sheet with an internal layer of insulation, provide excellent thermal insulation, help reduce heat loss and reduce heating costs in winter.
- **Composite materials**: In recent years, composite materials such as carbon and fiberglass composites have been actively developed. They have high strength with less weight, which allows reducing the load on the foundation and improving the characteristics of the floor in terms of seismic resistance and durability.
- **Modular Floors**: Modular floor systems assembled from prefabricated elements allow to significantly speed up the construction process and increase the accuracy of installation. Such systems can be used to create multifunctional sports facilities with the possibility of rapid reconstruction.

3. Features of designing floors for sports schools

The process of designing a sports school ceiling requires taking into account several factors that are typical for this type of building:

- **High loads**: Calculations related to dynamic loads that may occur in sports halls are especially important. It is important to take into account possible vibrations of the floor caused by the actions of athletes, the movement of heavy equipment and other factors.
- **Soundproofing**: Sports schools often combine a variety of activities, from indoor to outdoor training. Floors should be designed to minimize the transmission of sound vibrations between floors and adjacent rooms.
- **Light and air permeability**: The use of glass inserts, stained glass or transparent panels in the ceilings allows for sufficient natural light in the sports halls and also promotes good ventilation.

- **Adaptation to changes and loads**: Sports schools often use floors to create multifunctional spaces. Therefore, an important task is the ability to adapt the floor to different operating conditions - from sports events to cultural or educational events.

4. Examples of unique solutions in the construction of sports schools

As an example, we can consider several unique projects of sports schools that use innovative ceilings:

- **Sports school project in Moscow (2022)**. This project uses a combined floor covering with sandwich panels and lightweight concrete slabs. A special feature is the presence of built-in skylights, which significantly reduces the need for artificial lighting.

Figure 1. Sports complex for volleyball school "Nika" will be built in 2022

- **Sports complex in Kazan (2023)** . Here, the technology using modular floors with composite panels was applied, which ensured high construction speed and improved thermal insulation of the building.

Figure 2. Cultural and sports complex "KAI OLIMP"

5. Prospects and challenges

The future of sports school roof design lies in the use of new technologies that can improve the efficiency of building construction and operation. This includes the use of smart materials (such as sensor roofs that can respond to changes in temperature and humidity) and integration with sustainable energy sources, such as solar panels placed on sports school roofs.

However, there are also challenges associated with the high costs of innovative materials, as well as the need to comply with all building codes and standards, especially in terms of safety and durability of structures.

Conclusion. Unique structures of sports school ceilings play an important role in creating comfortable and safe conditions for sports and the educational process. The use of modern building materials and technologies allows to significantly improve the operational characteristics of buildings, reduce energy costs and increase the durability of structures. In the

future, we can expect further improvement of such solutions taking into account new requirements for energy efficiency, safety and functionality.

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