



MODERN TYPES AND CONSTRUCTIVE SOLUTIONS OF METAL STRUCTURES USED IN THE CONSTRUCTION OF LARGE-SCALE BUILDINGS AND STRUCTURES

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Abstract This article analyzes the main types of modern metal structures used in the construction of large-scale buildings and structures, their structural solutions, and practical advantages. Structural features of spatial carcasses, farm systems, membrane structures, suspension and combined metal systems have been considered. Also, on the basis of modern construction technologies, issues of increasing the earthquake strength, strength and economic efficiency of metal structures are covered.

Keywords: metal structure, spatial structure, truss, frame system, suspended structure, membrane covering, industrial building, large-span structure.

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Today, metal structures are widely used in the construction of large-scale buildings and structures in the modern construction industry. Metal structures stand out from other building materials with their high strength, lightness, ease of assembly, and the ability to span large spans without supports. Metal structures are used as the main structural element in the construction of sports complexes, airports, industrial buildings, bridges, shopping malls, and multifunctional complexes.

As a result of the growing demands of modern architecture and engineering, new structural solutions for metal structures are being developed, expanding the functional and aesthetic possibilities of buildings.

Earthquake-resistant properties of spatial structures

1. Uniform distribution of loads

In spatial systems, the load is distributed along all elements. This prevents excessive force accumulation at certain points.

2. High spatial strength

The three-dimensional structure creates high strength and reduces deformation.

3. Light weight

Metal spatial structures are lighter than reinforced concrete.



Figure 1 Inertial force during an earthquake

During an earthquake, the inertial force is determined by the following formula:

$$F=ma$$

The smaller the mass, the smaller the seismic force.

4. Resistance to dynamic impacts

Spatial structures absorb and dissipate vibration energy well.

5. Symmetric operation

In symmetrical spatial systems, torsional deformations are reduced.

The experimental model consists of a shell with positive curvature at its center, to which triangular shells with negative curvature are attached on four sides. During the test of the shell model for resistance to the effects of a long-term static load, the features of vertical and horizontal displacements and the formation of cracks were determined. The deformation effect and failure characteristics of prestressing were analyzed.

Modern types of metal structures. Spatial grid structures are one of the most effective structural systems in large-span buildings and structures. These constructions are made up of steroidal elements and distribute loads spatially.

Advantages of spatial constructions:

- ability to close large intervals;
- ease of construction;
- high rigidity and strength;
- high earthquake resistance;
- architecturally modern appearance.

Such systems are widely used in stadiums, train stations, airport terminals, and exhibition pavilions.

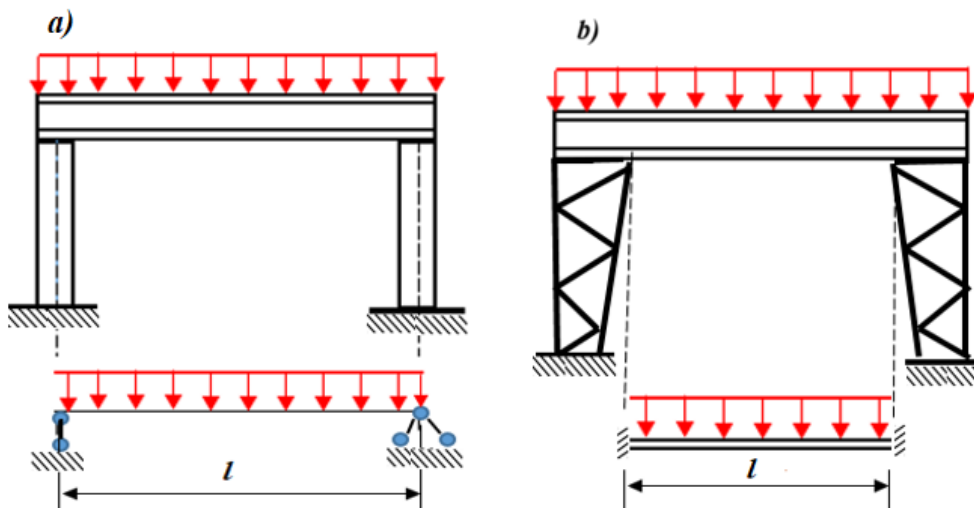


Figure 2. Large-span flat-roof structures with hinged supports and rigidly attached beams

Metal farms are one of the main load-bearing elements widely used in large industrial buildings and indoor structures. Farms work on the basis of triangular geometric shapes and effectively distribute loads.

The main types of modern farms:



- parallel-beam trusses;
- triangular trusses;
- trapezoidal trusses;
- segmental trusses;
- spatial trusses.

The main advantage of metal farms is their ability to carry large loads while reducing material consumption.

Ramali frame systems Ramali metal frame is widely used in multi-storey and industrial buildings. In this, the column and rigels are tightly connected and take the loads together.

Advantages of RAM systems:

- speed of installation work;
- the ability to freely plan the internal volume of the building;
- high seismic resistance;
- ease of re-construction.

In most cases, frame systems are used in combination with reinforced concrete elements.

Suspended metal structures Suspended structures are used in large-span sports facilities and roofs. In these systems, the main load is transferred through tension cables or cables.

The main advantages of suspended structures:

- small construction mass;
- the ability to cover large spans;
- economic efficiency;
- aesthetic architectural solutions.

Such systems are widely used in stadium roofs and large exhibition centers.

Membrane structures are formed using thin metal sheets or polymer materials. They are distinguished by their elasticity and lightness.

Membrane systems:

- sports complexes;
- used in the construction of trade pavilions;
- temporary structures;
- exhibition halls.

These structures provide great opportunities for creating modern architectural forms.

Modern structural solutions in the current era, factory-made modular metal structures are becoming more common. In this case, structural elements are prepared at the manufacturing enterprise and quickly assembled at the construction site.

Advantages of modular systems:

- reduction of construction time;
- improvement of quality control;
- reduction of installation costs;
- convenience of transportation and logistics.

Combined structures In modern construction, the combination of metal and reinforced concrete elements is widely used. In such systems, the high strength of metal and the



compressive strength of reinforced concrete are effectively combined.

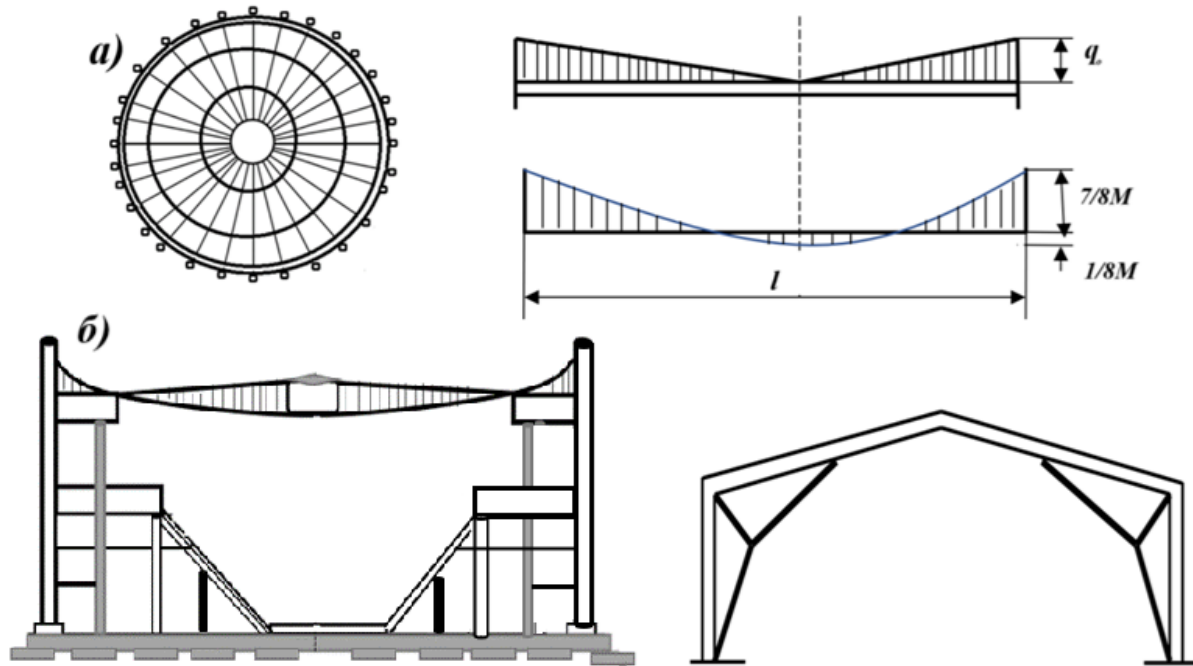


Figure 3. Plan and section view of a circular roof structure designed on a radial system

Combined systems are used in:

- skyscrapers;
- industrial facilities;
- bridges;
- shopping and business centers.

Light steel thin-walled structures Light steel structures are developing as an energy-efficient and cost-effective system in modern construction. They are particularly widely used in fast-built buildings and prefabricated structures.

Advantages:

- small mass;
- quick assembly;
- corrosion resistance;
- energy efficiency.

Modern metal structures have the following advantages:

- high load-bearing capacity;
- long service life;
- possibility of industrial production;
- high speed of assembly work;
- effective use in seismic areas;
- possibility of building buildings with large spans;
- variety of architectural forms.

At the same time, it is important to protect metal structures from corrosion, increase fire resistance, and ensure technical control during operation.

Conclusion: Modern metal structures are widely used as an important structural solution in the construction of large-scale buildings and structures. Spatial frames, trusses, suspension

and membrane systems allow for covering large spans, reducing the mass of the structure, and improving the aesthetic appearance of buildings. Modular and combined metal structures, developed using modern technologies, increase construction efficiency and provide high economic and technical results.

In the future, high-strength steels, digital design technologies, and innovative protective coatings will serve as the main directions for the development of metal structures.

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