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On the Effectiveness of the Spatial Constructions with Stergen and Their Use

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Abstract: Today, in domestic and foreign construction practice, spatial constructions with earthquake-resistant beams are widely used. The article analyzes the work carried out on the study of the effectiveness of their use and summarizes the relevant conclusions.

Keywords: Spatial constructions with rods, efficiency, types, structural solutions, geometric appearance, types of support, grids of plates.

Today, a number of scientific research and experimental construction works are being carried out on a large scale in order to increase the efficiency of the use of earthquake-resistant spatial constructions in domestic and foreign construction practice.

The main purpose of the research and design of spatial constructions with sterjen is to ensure the earthquake resistance of buildings and structures, to create new structural solutions of this type of constructions, to improve calculations, to use modern computer programs in calculations, to ensure the reliability, durability and integrity of existing constructions, to reduce the cost and consumption of materials. 1].

It is known that the strength of spatial constructions with stergen depends to a large extent on the quality of the materials used in their preparation and other requirements.

Today, the general direction of the development of building structures is further industrialization, unification and standardization of structural elements, which ensures serial and mass production, reducing the weight of structures, reducing their installation time and the total cost of construction [2].

In the same way, the above-mentioned earthquake resistance requirements are met by rigid spatial constructions and their constructive solutions.

Improvement of attachment methods, use of new solutions, correct selection of covering elements in the use of spatial constructions with beams are the main elements that ensure the strength and stability of the entire building. Therefore, it is important to analyze the structural solutions of existing compounds used in rigid spatial constructions, to study their advantages and disadvantages, to introduce effective compounds into production, to recommend various structural solutions, taking into account the operating conditions of buildings.

Today, structural solutions that include complex technological processes along with simple structures are used in spatial constructions with stergens put into practice [1,2].

Structural solutions of various geometric shapes were used as the main load-bearing structures in these constructed buildings.

Spatial constructions with spars have high strength indicators, priority, high level of load distribution in constructions, 20-30% less consumption of metal materials than traditional constructions, earthquake resistance up to 9 points, the possibility to reduce the height of constructions by 1.5-2.0 times, and finally, the price and the significant positive indicators of cost force their wider use.

An overview of constructive solutions that are widely used today is presented in Figure 1. In these constructive solutions, different solutions of crystal lattices were used, taking into account the characteristics of the building under construction, while at the same time increasing the architectural appeal.

Compared to buildings covered with ordinary farms, their weight and height are small, the size of buildings and structures is drastically reduced, and the possibility of placing various communications between the fences has raised their use to a new level.

The geometric forms of structural spatial constructions that are widely used in construction practice today are presented in Figure 1.

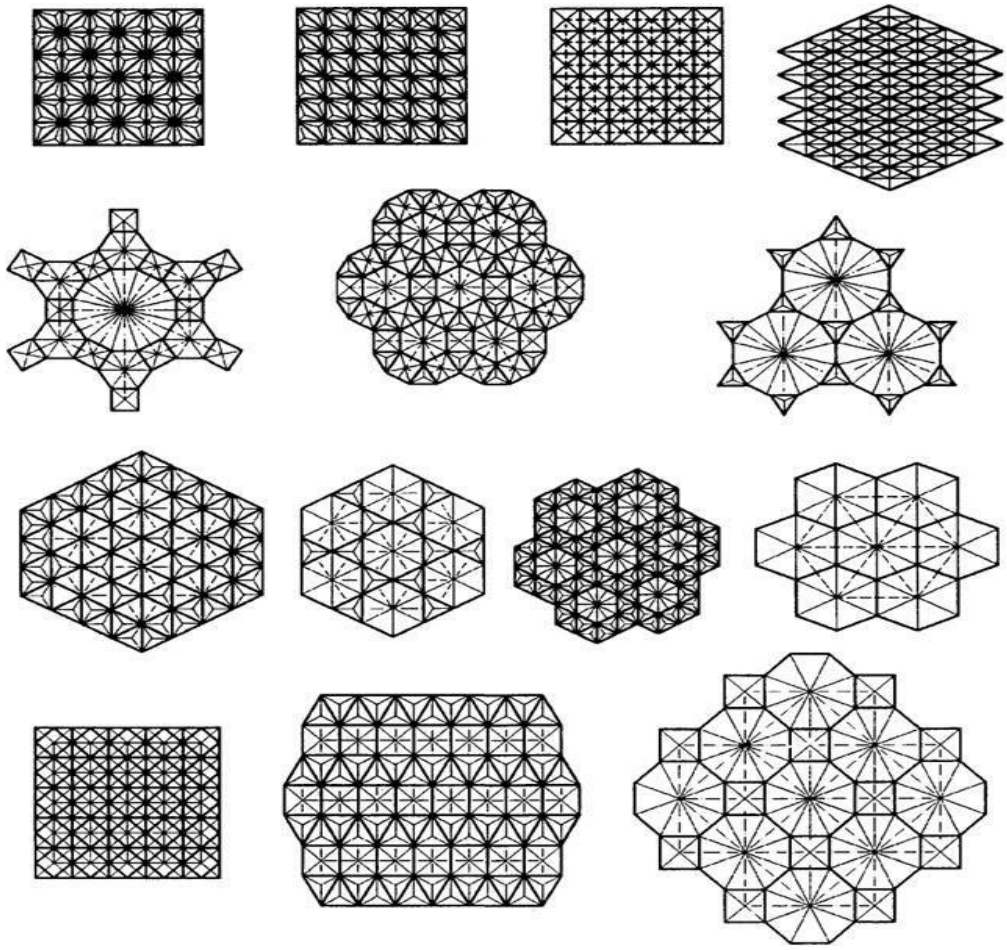

Figure 1. Geometric forms of structured spatial constructions

In the structural solutions presented in the picture, the consumption of materials is relatively evenly distributed. As a result of unevenly distributed and changing loads on the constructions, it is possible to make light constructions as a result of which all the struts receive the stresses, which is more effective than the multi-support constructions.

The possibility of creating bars of different sizes in the girders of the constructions, the possibility of making different sizes of the bars makes it possible to simplify the use of suspension lifting mechanisms.

Another of the most important advantages of structures belonging to this class is the reliable distribution of stresses in multi-connector systems, often in statically uncertain systems, along with high strength properties. Because, in this case, the ability to accept the stresses in the broken booms is equalized as a result of plastic deformation, it creates conditions for their smooth operation, and spare strength is created in the booms.

The multi-connectivity feature of structural spatial constructions, the spatial work system allows to design covers with a height of 2 times less than that of flat constructions, and this indicator is taken in the ratio of 1/15...1/25 compared to the arch.

Another important advantage of structured space structures is their ease of assembly and installation with light cranes and devices on the working mark due to their lightness and ease of assembly.

Due to the universality of this type of construction, covering large areas and using a small number of supports in it, it is possible to build open-type industrial buildings, magnificent public buildings, etc. in a short period of time.

The effectiveness of the construction work depends to a large extent on the placement of the supports of the structures. Figure 2 shows the layout of supports in structural solutions.

Placement of the supports of structural spatial constructions largely depends on the type of buildings, the size of the constructions, operating conditions, the type of materials, the structural solutions of nodes, the dimensions of the cross-sectional surface, etc.

The geometric structures mentioned above are also important when choosing the constructions of the supporting elements.

At the same time, the placement of the supports also depends on the orthogonal schemes of the spatial constructions.

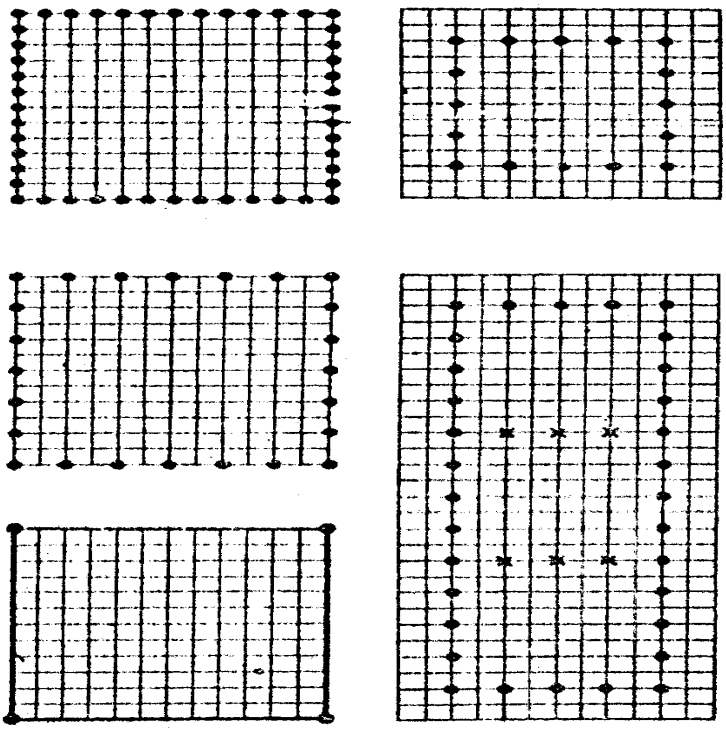

Figure 2. Schemes of placement of supports in spatial constructions with a beam:

a – along the contour of the building; b - placement within the contour.

Nodes of spatial constructions with stergons - "crystals" of the nodes of the above-mentioned solutions consisting of stergons located on their edges in various forms are in the form of a pyramid (tetrahedron and semi-octahedron), parallelepiped and many other angles.

Geometric organizers of structures are of great interest to architects and designers due to the availability of their various forms (Fig. 3).

Due to the wide variety of constructive solutions of connecting nodes of spatial constructions with rods, it is difficult to describe the advantages and disadvantages of all of them.

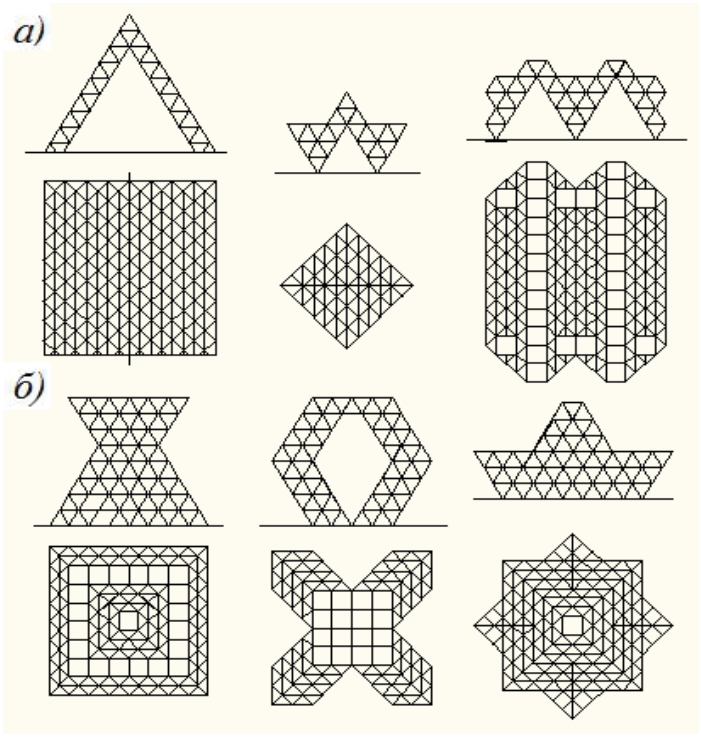

Figure 3. Shapes of structural spatial constructions in the form of a square base: a - tetrahedron and (b) – octahedron

In total, about 130 different structural systems have been confirmed in world practice, most of which have some degree of differences in the connection nodes of the sterns.

"Mero" MARxI" type solutions are among the constructive solutions widely used today, which meet a number of positive requirements according to designers and constructors.

An overview of this node is shown in Figure 3.

Connection of the masts and nodes of the MArxI type spatial constructions with the help of connectors allows the use of pipes with a round diameter of 60/3 to 146/10, lengths of 1.5, 2 and 3 meters.

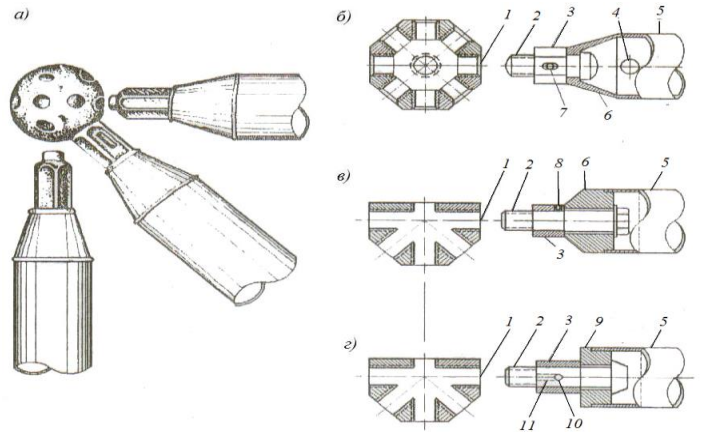

Figure 4. "Mera" type system node and its modifications:

a and b - overview, node element and details; v, g – "MArxI" and "Tubular elements and details of the Weimer-type system. 1 – internal grooved hole; 2 – bolt; 3 – guide nut;

4 – mounting hole; 5 – groove; 6 – end of the groove; 7 – index finger; 8 – fixator; 9 – puck; 10 – pin; 11 - cut on the nut

In recent years, welded joints have been widely used in spacial constructions. Some of their types are shown in Figure 4.

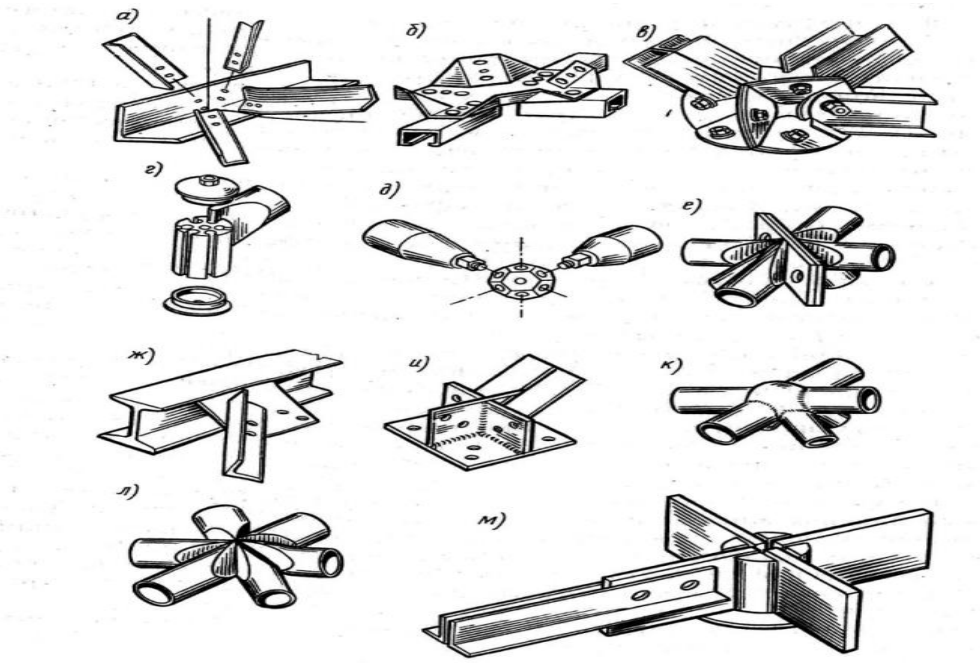

Figure 5. Types of structural solutions performed with welded joints.

An important feature of structural solutions of the "Mero" and "MARXI" type is the ability to prepare details in machine-building factories through automated processes.

The difference of the "Mero" solution compared to other solutions is that the spherical polygonal node element is attached through a special guiding bushing. The advantage is the presence of a cross-sectional hole on the cross-sectional surface of the bolt, which allows to increase the strength of the tensile elements. Therefore, in this solution, hot-worked solid bolts with a diameter of 8.8, 10.9, 12.9, are used.

Therefore, today, large-scale pavilion-type constructions, unique industrial and public buildings are widely used in earthquake-prone areas as a highly effective solution based on scientific research [3].

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