ASSEMBLY PROCESS OF UNIQUE BUILDINGS USING LARGE - SPAN SPACE SHELL STRUCTURES

Razzoqov Nurmuhammadhon Sayidmahsud o'g'li [1]
Maqsudov Mirfayz Ismatilloyevich [2]
Elboyev Botir Nuriddin ugli [3]
Senior Teacher Ph.D [1]
Master's degree [2]
Master's degree [3]
[123] Samarkand State University of Architecture and Construction named after Mirzo Ulugbek,Uzbekistan (Samcasu).
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Abstract:

Objective. The article explains the development of improved methods for calculating the stressstrain state of unique buildings with long spans, using shell structures during the assembly and disassembly stages, as well as the development of recommendations for the use of effective construction methods and computational design of large-span buildings.

Methods. The practical significance of the article is the development of improved structural solutions for reinforced concrete shells of modern combined assembly methods, the use of which is explained by the reduction of material consumption, labor costs for production, assembly and disassembly, and the weight of metal equipment used for their construction.

Results. Also, as a result of the research of the assembly process of spatial shell structures using the method of physical modeling, a new cost-effective structural solution for practice and calculation methods, effective methods of assembly and disassembly of structures have been developed, and practical instructions for ensuring the safety of transportation and assembly of structures have been presented.

Conclusion. When using this method in the proposed 96x96 m shell cover installation, compared to the use of collector conductors, labor costs are reduced by 26%, and the weight of installation equipment is reduced by 2.4 times. Compared to the use of the column method, labor costs are reduced by 33%, and the weight of assembly equipment is reduced by 2.25 times.

Keywords: spatial shell constructions, span unique buildings, physical modeling, assembly and disassembly, large span, geometric surface, shell.

Introduction.

In the world, the process of construction of modern large-scale buildings is being carried out by scientific research aimed at shortening the investment period, accelerating the introduction of scientific and technical achievements, ensuring the quality and efficiency of construction structures and the materials used. In this regard, the main part of the costs of covering unique buildings is the cost of materials and construction labor, special attention is being paid to reducing these costs.

Currently, the use of reinforced concrete shells in the construction of unique buildings occupies one of the leading places in the world. Reinforced concrete and metal shells with the same geometric surface are widely used among the types of large - span coverings worldwide. The analysis of the design and use of such shells in construction showed that the use of shells in the construction of unique structures ensures a small size of the structures. In this regard, it is important to increase the economy of material consumption and labor costs for construction.

Level of study of the issue. In the field of construction, the theory of calculation of unique buildings in which large - span spatial shell structures are used and researching issues related to stress-deformation states abroad, A.A. Gvozdev, V.Z. Vlasov, I.E. Mileikovsky, K. Khaidukov, O.D. Oniashvili, GV.I. Trofimov, N.P. Abovsky, V.S. Bartenev, P.G. Yeremeev, A.S. Jiv, E.Z. Zhukovsky, Ya.Sh. Ishakov, V.I. Kolchunov, L.M. Lyudkovsky, Yu.I. Nemchinov, V.S. Plevkov, Ya.F. Khlebnoy, A.A. Seitlin, Yu.V. Chinenkov, V.V. Shugaev, V.F. Shablyas were engaged.

Studies on stress - deformation conditions of rare buildings in our republic where large - span spatial shell structures are used M.T. O’rozboev, V.Q. Qabulov, Q.S. Abdurashidov, S.R. Razzakov, Q.I. Ro’ziev, G.S. Done by Friedman et al.

Recently, scientists who have made a significant contribution to this field, as a result of annual research, have achieved important scientific and practical results aimed at improving the regulatory framework in the field of increasing the efficiency of using spatial systems in large - span buildings.

The use of shells as one of the effective solutions of building covers can successfully contribute to the achievement of the planned goals in this field. Currently, the development of shell mechanics has reached such a level that the calculation of spatial structures with mathematical models has become the privilege of highly qualified specialists. In particular, the exact methods of calculating shells using computer technologies are worthy of attention, but it should be noted that creating a program for the assembly of various types of shells is a very complex responsibility and requires a lot of work. In this case, it is important to develop practical methods for calculating spatial systems based on the experimental modeling method to evaluate different stages of the changing stress-strain state during the assembly process. In recent years, methods of linear calculation of shells under the influence of static and dynamic loads have been developed, but they do not sufficiently take into account the conditions of construction and operation. The current regulatory documents "Closing and intermediates" and "Sets of rules" do not adequately reflect the conditions of installation and operation of shells. Important factors related to the changing working conditions and properties of construction materials are not taken into account during the stages of construction of shells and during the transition to the operation state.

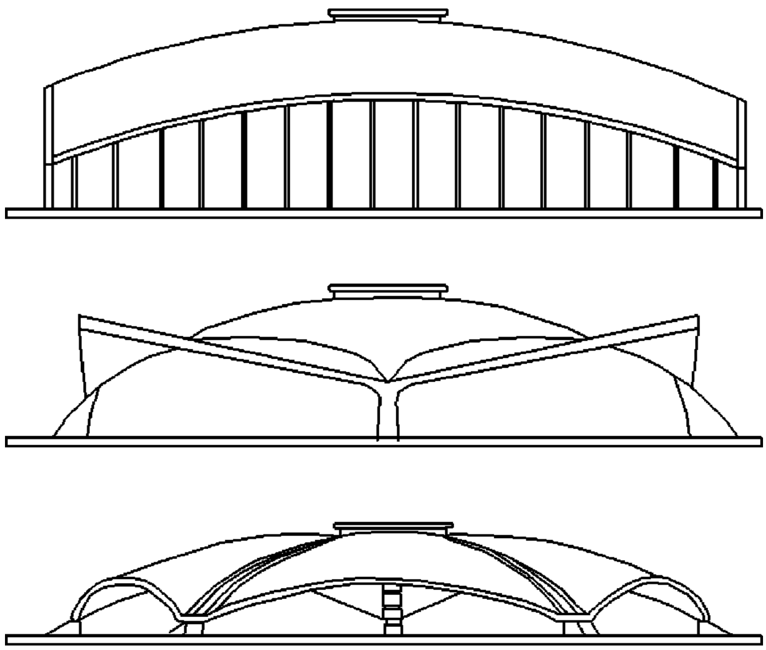

Figure 1. Researched structural schemes of flat shells with a span of 96 m at the assembly stage.

In the development of new constructive solutions of unique buildings with shell covering, conducting theoretical and test studies, assessing their strength, priority, uniqueness, crack resistance, due to the fact that less studied complex studies are considered, a cost-effective modeling method was used in the process of assembly and operation. Experimental studies were carried out by using the results of large- scale, M 1:4 and M1:10 models in the experimental construction of natural objects (Fig. 1) [24].

Specific issues of developing recommendations for wide application in the experimental design and construction of unique buildings with the use of working shells in the assembly and operational state of these constructions were solved. The structural characteristics of the research object, natural shells and their models are presented in Table 1[24]. On the basis of our research, the experience of using the results of testing the models of reinforced concrete spatial structures in natural structures was analyzed, generalized and developed.

The assembly of the shell was carried out according to the author's proposal by using the combined method of enlarging the panels into the arched block in advance. In this case, 3 3x6 m panels are mounted on square cell single-beams mounted on enlarged arched block 3x18 m, thinned 18x18 m mounting supports. After the dismantling of the shell, the single beams are permanently left and serve to ensure its priority. In the same way, the contour zones of the shell with a distance of 12 m are assembled from 3x12 m arc - shaped blocks with enlarged panels. Sprengel-type inventory drawer is placed from the bottom of the panels. The longitudinal ribs of the panels are connected by means of non-concrete welded joints.

The work of the shells under the influence of static load in the case of assembly, removal of supports and exploitation was studied in two different models. The study of the assembly condition of the flat - ribbed shell (Fig. 2, Table 1) was carried out by installing the combined method of assembling the panels by enlarging the panels proposed by the author by installing the same interconnected single beams unified on four sides on the mounting columns with an interval of 18x18 m.

Conclusions and suggestions. A precast integral reinforced concrete shell with positive Gaussian curvature, developed for the cladding of unique public buildings, is effective. It is recommended to use the method based on the combination of the 3x6 m cylindrical panels with the 18 m arc-shaped block, which is enlarged and the method of assembling the gable support. In this case, the 3x18 m mounting element is fixed to the shell contour and several rows of permanent single beams and mounting posts.

On the basis of the conducted research, it is recommended to use the proposed effective structural solutions of composite reinforced concrete shells with positive Gaussian curvature, their calculation and assembly methods in the construction of unique buildings with large spans. In addition to creating wide opportunities to apply research results in various regions, it leads to reduction of material consumption, costs of construction and exploitation process, labor volume and price.

When using this method in the proposed 96x96 m shell cover installation, compared to the use of collector conductors, labor costs are reduced by 26%, and the weight of installation equipment is reduced by 2.4 times. Compared to the use of the column method, labor costs are reduced by 33%, and the weight of assembly equipment is reduced by 2.25 times. Based on the application of the modern modeling method, a method of researching shells with a new constructive solution has been developed. The state of stress - deformation during assembly and de-supporting of M1:10, M1:4, M1:1 precast integral shell was studied in a condition that ensured high accuracy and reliability of variable calculation parameters. Especially in this case, special attention was paid to ensuring the strength, uniqueness, priority and safety of constructions. The method of calculation of the enlarged element in the state of assembly was carried out and numerous experiments were carried out, taking into account the variable characteristics of the calculation scheme and the working condition, and the results were analyzed. In evaluating the work of the shells at the stages from the loading process to their failure state, based on the comparison analysis of the experimental and calculation results, the most reliable method is to use the calculation method based on modeling. approved. The stress - deformation conditions of the proposed 96x96 m and larger span buildings were studied. Methods of preserving them from damage during the process of preparation and assembly are proposed. A method of taking into account the structural features of the shells in the case of local damage is proposed to ensure the load carrying capacity and priority.

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