The Study for the Application of Architecture Structure Design Optimization Method in the House Structure Design

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Abstract

There are five basic considerations in designing architecture structure, including safety, construction convenience, economy, practicability and aesthetics. Also it requires designer to optimize structure of building and lower construction costs on the premise of satisfying same functions. This essay briefs the significance and features of optimized methods in architecture structure design, stating the necessity of optimized methods applied in designing house structure. And it elaborates the practical application of architecture optimized method in house structure design.

Keywords

Optimized design; architecture structure; structure optimization.

1. Introduction

When designers are blueprinting a house, the selection and arrangement of the house structure have included related issues concerning whether it is ok to optimize since architecture plan formed. The whole process of house construction could be optimized with the following deliberate plan and precise calculation. The application of optimized method for building structure in house structure design will be disserted in the following chapters and referenced for readers.

2. The Significance of Optimization in Architecture Structure

Design cost has huge impact on the total development cost though it only takes up a small portion. The design of optimized house structure plays an essential role in cost control. Steel and cement are two main materials in basic house construction. But the production of steel and cement consume a lot as they are not renewable. To reduce primary investment of construction is a way to save materials and energy. With the growing development of social economy, the competitiveness in construction market has also enhanced. Cost control enjoys strategic significance to make sure enterprises could survive in fierce environment. House structure investment takes up higher ratio in house construction. The utilization of optimized structure design could not only ensure the safety and quality of the construction but also lower the project cost and increase profits for enterprise. [1]

3. Detailed steps for Implementation of Architecture Structure Optimized Design

3.1 The Objective Function Selection

When conducting design optimization for architecture structure, designers should first confirm the objective function of architecture structure in consideration of safety standard and construction area parameters together, and further confirm the construction cost for design optimization according to the construction material use situation. After that, designers need to make analysis on the calculated centralized construction cost plans and choose the best one with lowest costs, so as to maximize the economic benefits on the basis of satisfying the needs of buildings in different aspects.

3.2 Section Headings

The Variable Selection for Architecture Structure Design

At the designing phase of construction engineering, the selection of variable can also be a critical part. After determining the objective function, designers should also select the variables according to the structural form of construction engineering itself, which can be regarded as the process where designers control and analyze the potential factors that may influence the architecture structure design. In this process, designers always choose a variable that has a great impact on the design of architecture structure, then control it and make corresponding calculation, so as to fully display the optimization process for the architecture structure.

3.3 The Constraint Condition Selection

The optimization and innovation for the reliability of architecture structure can help accurately determine the contents of ration and constraint conditions in the architecture structure, make the constraint conditions within the engineering standards for buildings and further realize the best optimization for the architecture structure design. For example, when determining the constraint conditions such as stress, size and structural strength, designers should select factors based on the real situation of the building structures.

4. Application of Architecture Structure Design Optimization Method

4.1 The Overall and Local Optimization for Architecture Structure

In the optimized design for house constructional structure, it contains two characteristics, complexity and hierarchy. In terms of complexity of architecture structure design, the designing contents include selection of construction materials and architecture structure types. In terms of hierarchy of architecture structure design, the contents for architecture structure design optimization include the overall design of building, local structure design of building, the building facility, electrical design and installation system, etc. Under these systems, there are many subsystems, which can form a large structural system through the connection with each other. [2]Through the optimization in both overall structure design and local structure design, designers cannot improve the safety and rationality of house buildings to a large degree but also reduce the costs for engineering construction. Besides, in the process of architecture structure design optimization, designers also need to consider the coordination between the overall plane and construction structure, which is able to improve the aesthetics level of buildings. To guarantee the overall coordination optimization of architecture structure, designers should adhere to the concise principles and try to avoid the dislocation cases of walls and pillars. The section area needs to be coordinated with the height of architecture and the proportion of two should stay within the optimum range. For the structure optimization for elevators or stairs in the construction, designers need to reduce the weight as much as possible and select the materials with good load-bearing capacity in order to keep the stability of the elevator or stairs. In the overall structure design optimization, it is better to use the concise geometric structure, which keeps the architecture stability but also improves the aesthetics of buildings. Through the rational selection of structure plans, the overall structure optimization can be improved. And the local structure optimization of architecture can be accumulated so as to realize the improvement for the overall architecture optimization [3]. In the process of design optimization, designers can choose the best local structure design plan for each optimization of the local structure can help improve the overall architecture structure design.

4.2 The Optimized Design for Superstructure

The superstructure of buildings usually adopt multiple types, and the most common types include masonry-concrete structure, shear wall structure, frame structure, steel structure, etc. For the design optimization for superstructure, designers should adopt different optimized measures according to different types of structures [4]. (1) The optimization measures for masonry-concrete structure. Measures: At the designing phase, it is not advisable to adopt large holes or wrong holes and other unfavorable conditions to the load-bearing walls. Besides, the pier length of both sides of the hole, the setting of structural columns and related constructional measures, all should satisfy the current regulatory requirements. The layers and floor height of buildings is better within the relevant

regulatory requirements. And it is not advisable to use mixed load-bearing structures in case of undefined force transmission or structural calculation. (2)The optimization measures for shear wall structure: In the setting process of shear wall structure plans, it is advisable to make the barycenter of structure coincide with the centroid of building plane in order to avoid uneven distribution of structure stiffness on the building plane. In the premise of ensuring the safety of structure calculation, it is better to make shear wall coincide with the partition wall, which helps improve the space utilization and comfort. In addition, the length of wall should be not too long or too short so as to keep the stability. And the quantity of coupling wall column can reduced as well to reduce the construction difficulty and also save concrete, rebar, formwork and other materials. The shear walls should be set up continuously from the bottom to the top in order to avoid overhanging, overlapping, dislocation and other unfavorable conditions. For the reinforced wall of superstructure of shear wall structure, designers can consider to reduce the thickness of the wall so as to further reduce the reinforcement ratio of the shear wall and improve the economy of structure. (3) The optimization measures for frame structure: In the setting process of frame structure plans, it is advisable to combine with structural calculation together. The confirmation of rational column grid and spacing can ensure the structural safety and economy. In terms of overall layout, it is advisable to reduce the stiffness in the middle of the building and increase the stiffness on both sides of the building in order to avoid excessive torsion and enhance the overall seismic performance of the structure. The section of frame beams and columns should not be too large or small, otherwise it will cause the waste of materials. The section which is too large will not only affect the visional effect, but also will affect the space utilization if set in special locations. The central line of beams and columns should be coincided with each other. If the distance between them are too large, it is advisable to add haunches to beams so as to reduce deviations. The corner columns should appropriately increase the section, and frame columns should be set up at the 4 sides of staircases in order to strengthen the structure collapse resistance.

4.3 The Foundation Design Optimization

In the process of architecture design, the optimization for the fundamental structure design, considered as one of the critical units in the constructional structure, can be quite necessary. Among the basic structure of buildings, the most common foundations include independent foundation, bar foundation, raft foundation, pile foundation, etc. For the foundation structure design optimization, designers should first satisfy the requirements of corresponding design and construction standards, and then select the foundation types rationally based on different structural types and geological conditions, which cannot only ensure the safety of structure, but also greatly reduce the construction difficulty and period, so as to further reduce the costs for project investment [5]. For example, some architecture adopts the original design as the pile raft foundation. After optimization of the structure design, designers change the pile raft foundation into the raft foundation and set two pile bearing platforms, three pile bearing platforms, four pile bearing platforms and beam bearing platforms. In this part of optimization, what designers need to consider is that the shortest transmission path of the foundation transmission force is, the more materials can be saved, but the premise is that the total sedimentation value and uneven sedimentation value should be guaranteed. Compared to raft foundation, the pile raft foundation adds an overall raft and transfer the overall force into the local force, which has increased the transmission path but also increased the material use. However, although this design can waster more materials, it has a certain controlling function towards uneven sedimentation. According to the real situation, if designers want to satisfy the requirements of total sedimentation, uneven sedimentation and foundation bearing capacity, it is more economical to use the natural foundation than the raft foundation. Meanwhile, construction is more convenient, completion time is relatively shorter and cost is quite cheaper, which can be a much better choice.

5. Conclusion

Generally speaking, the optimized way of architecture structure design applied in designing house structure is accordance with outlook of sustainable development and demand of architecture. With the use of this method, the best performance of construction materials will be reflected. And safety

and beauty of buildings could be improved as well as the reduction of construction cost, which is an enhancement in economic benefits for house construction. The optimization of building structure is related with the overall and local optimization of architecture, which is a systemic design optimization project. Therefore, designers should continue to improve themselves in order to follow up trend of the world and provide safety for people.

References

[1] Feng Chao. Analysis of New Method in Architecture Structure Optimization Design. China House Facility.
[2] Wang Jiang. The Realization of Optimized Architecture Structure Design in House Structure Design. China House Facility.
[3] Fan Guoxing. The Research on Application of Architecture Structure Optimized Design in House Structure Design. Jixi University Journal.
[4] Zhou Hanjie. The Application Architecture Structure Optimized Design in House Structure Design. Jixi University Journal. China House.
[5] Liao Wenzhi. The Research on Application of Architecture Structure Optimized Design in House Structure Design. Jixi University Journal. Sichuan Cement.