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Exploring the Key Points of Structural Design for Complex High-rise and Super High-rise Buildings

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Abstract

Since the beginning of the 21st century, China's construction industry has developed rapidly, with more and more complex high-rise and super high-rise buildings rising up, to promote the great progress of the socialist modern society. Based on this, the influence of complex high-rise and super high-rise building structure design elements of research and analysis, from the environmental external conditions and construction factors comprehensive consideration, put forward a set of feasible building structure design scheme, realize the safety and stability of complex high-rise buildings, safeguard people's life and property safety, promote the development of people's livelihood.

Keywords

Complex high-rise and super high-rise; building structure; design points

Introduction

Since the beginning of the 21st century, the social economy has developed rapidly, the people's living standards have steadily improved, the urbanization process has accelerated, and the complex high-rise building market in my country has surged rapidly. In order to alleviate the urban population pressure brought about by large-scale population migration, more and more complex high-rise and super high-rise buildings have sprung up. Population migration drives urban development, and urban building development solves the problem of population migration and achieves mutual benefit. This article starts with the structural design of complex high-rise and super high-rise buildings to explore how to achieve the safety and stability of high-rise buildings.

1. Factors affecting the structural design of complex high-rise and super high-rise buildings

To ensure the safety and stability of complex high-rise buildings, it is necessary to consider from multiple angles. First, determine the selection of building loads. According to the actual building needs, determine the structural design load, which can effectively help the structural design of high-rise buildings. In addition, it is necessary to investigate and study other influencing factors to finally determine the best high-rise building structural design plan.

1.1 Influence of wind load

Due to the natural influence of the actual environment, in cities, the building levels are getting higher and higher, and the high-rise buildings are seriously affected by the urban wind, so it is necessary to focus on analyzing and considering the wind load information. For example, when designing high-rise buildings in coastal cities, it is not only necessary to analyze according to local design specifications, but also to conduct professional wind tunnel experiments and make proportional models to improve the wind resistance of the building and ensure its safety and stability.

Test it in a harsh environment to ensure the experimental effect while improving the design plan, improving the wind resistance of high-rise buildings, and reducing the impact of wind loads.

1.2 Impact of earthquake disaster

Based on the progress and development of science and technology, the earthquake prediction function has been realized. However, due to the limitations of environmental factors, it cannot be completely accurate and has certain limitations. Even Japan, which is famous for its earthquake research, cannot accurately predict the occurrence of earthquakes. Based on this, the design structure of high-rise buildings must comprehensively consider seismic factors and formulate the best structural design plan based on the actual local environment and the frequency of geological disasters to ensure the safety and stability of the building and improve its earthquake resistance [1].

1.3 Environmental impact of foundation

For complex high-rise buildings, a good foundation is the foundation for its long-term stability. For the construction of complex high-rise buildings, it is necessary to focus on the actual construction environment and conduct research and analysis on different foundation bases. For example, for soft geological environments such as mud, pile raft foundations or pile box foundations should be used to build the foundation. Different methods are used according to the actual environment. If the foundation is shallow, the concrete pile foundation is directly used to stabilize the foundation; for deeper rock bases, the properties of the rock layer can be used to borrow the frame-type underground continuous wall to build the foundation; if the natural environment conditions of the foundation are good, the raft foundation is directly used to stabilize the foundation. In addition, the design of the foundation in a complex environment should be combined with multiple considerations to formulate the most cost-effective solution.

1.4 Impact restrictions on building functions

Whether it is an office building or a residential building, it needs to be designed specifically to meet the use function. Therefore, when constructing a building, a reasonable architectural structure design should be carried out according to its use requirements. It is also necessary to comprehensively consider its additional attributes such as artistry, aesthetics, and applicability according to the different uses of the building. In addition, when formulating the design plan, it is also necessary to ensure that the existing technical conditions can meet the technical capability requirements of the design. It is not possible to talk about it on paper or make unrealistic ideas. It is necessary to reasonably analyze and formulate the best plan based on the actual situation. Based on this, with functional use as the core, auxiliary research is carried out according to the actual situation to achieve the design of the best plan [2].

2. Research on the structural design analysis of complex high-rise and super high-rise buildings

With the continuous advancement of urbanization and rapid population migration, the construction of complex high-rise buildings and super high-rise buildings has become a future development trend. More and more complex high-rise buildings are used in practice. Compared with ordinary house construction, their construction is more difficult. Therefore, in the design of house construction, a comprehensive analysis should be carried out to ensure the safety and stability of the building. According to historical experience, macro-control should be carried out for complex buildings, and the conceptual design should be improved to lay a good foundation for building safety. Based on this, the author summarizes and analyzes the structural design of high-rise buildings based on his own experience and puts forward the following opinions.

2.1 Macro control and perfect conceptual design

More complex high-rise and super high-rise buildings are being applied in practice, which poses a huge challenge to construction. The implementation of high-rise buildings often requires the coordination and cooperation of many departments due to their huge size. In order to ensure the quality of construction, the construction team needs to conduct macro-control and formulate the best and most standardized design plan through comprehensive analysis. Recently, the design of complex high-rise buildings has introduced a new design plan, namely conceptual design, which is to conduct macro-control and comprehensive consideration when designing high-rise buildings. While ensuring the stability of the building, the concept of symmetry is integrated into the architectural design, which improves the stability of the building and forms symmetrical beauty, giving people a sense of beauty. In addition, during the

construction process, we must always keep in mind the measurement criteria, use various high-tech measurement methods to ensure accurate engineering measurement, provide data support for subsequent construction, and at the same time, lay a good foundation for the safety and stability of high-rise buildings. For the overall design of a building, any slight mistake will lead to an irreparable accident. Based on this, designers must conduct meticulous analysis and consideration of every detail of the building to give full play to its advantages, make every engineering component play its due role, and achieve the improvement from quantitative change to qualitative change. This is not only a requirement for designers, but also a basic guarantee for achieving building stability. Finally, achieving reasonable allocation of resources and efficient operation are also inevitable requirements for construction [3].

2.2 Design and analysis of lateral force-resisting structures

Through the design and analysis of the lateral force resistant structure of complex high-rise and super high-rise buildings, the safety and stability of complex high-rise buildings can be effectively promoted, and a good stability foundation can be laid for the future use of the building. Through the lateral force resistant structure design of complex high-rise buildings, the stability and safety of the future working environment can be effectively guaranteed. In order to ensure the effective design of the lateral force resistant structure, it is necessary to conduct a scientific and comprehensive analysis of the actual height of the building, the actual building materials, the building geographical environment, etc. In addition, for each important component of the building materials, it is necessary to ensure that its connection is stable and form a unified whole, to ensure that every small building material in the building can play its due role, from quantitative change to qualitative change, to ensure the safety and stability of the building. For the construction of high-rise buildings, first of all, a comprehensive consideration and analysis should be carried out based on the actual local environmental conditions and building materials structure, and then a lateral force resistant structure design plan should be formulated for the building, and finally, the safe use of the building should be guaranteed.

2.3 Comprehensive analysis of seismic design

As the height of building layers increases, environmental factors pose a huge challenge to the design of buildings. Based on this, for the design of complex high-rise and super high-rise building structures, the focus of seismic design should be put into the building design. So that complex high-rise buildings can ensure the safety of people's lives and property under a certain magnitude of earthquake. First of all, in the early stage of the construction of complex high-rise buildings, it is necessary to carefully consider the actual environment of the building and select the best seismic materials for construction. The selection of scientific and reasonable seismic materials can play a positive role in promoting the seismic effect of the later buildings to a large extent, and can still maintain the safety and stability of high-rise buildings in large earthquakes. Secondly, before the seismic design of complex high-rise building structures, it is necessary to formulate practical and feasible plans for the deformation elasticity of the building structure according to the height and environment of the complex high-rise building, to ensure that it can meet the safety requirements in the earthquake environment, to ensure that it is within the safety elastic deformation, and to prevent the safety risks caused by excessive elastic displacement. For complex high-rise and super high-rise buildings, small deformations will cause dangers that cannot be ignored in future earthquakes, "a thousand-mile embankment collapses in an ant hole." Therefore, it is necessary to fully understand the characteristics of building structures, scientifically select materials, understand building deformation and deformation range, ensure its later earthquake resistance effect, and extend the service life of complex high-rise and super high-rise buildings. In addition, if the actual environment of complex high-rise buildings is located in earthquake-prone areas, that is, in an environment where earthquake disasters occur frequently, earthquake resistance design should be carried out according to the actual situation. When designing the plan, it is necessary to increase the earthquake resistance level by several levels to ensure that its compressive strength is still excellent under special circumstances, and achieve better results than expected, so as to achieve the real purpose of earthquake resistance. The effective implementation of earthquake-resistant design of building structures can, intuitively speaking, ensure the earthquake resistance of future buildings and the safety of people's lives and property. Based on this, architectural designers should consult a large amount of literature and analyze the specific locations of complex high-rise and super high-rise buildings, and comprehensively consider and formulate the most efficient earthquake-resistant design plan. It lays a good safety foundation for the later engineering and even the commissioning of complex high-rise buildings. The seismic design of complex high-rise and super high-rise buildings requires a comprehensive analysis and consideration of the natural environment, building material

structure, and local historical background to ensure that the seismic characteristics of complex high-rise and super high-rise buildings can be used exceptionally well in practice and to ensure the safety of people's lives and property.

3. Structural design strategies for complex high-rise and super high-rise buildings

3.1 Reasonable coordination of column spacing and beam spacing

3.1.1 Reduce the distance between columns

In the design of complex high-rise buildings, a frame structure is used to tightly connect various types of steel materials such as beams and columns of the building to form a unified steel frame. Based on the characteristics of the steel frame structure, its compressive strength is affected by the column section and the number of beams and columns. Therefore, by reducing the distance between the columns, the stability of the entire steel frame system can be effectively guaranteed.

3.1.2 Reduce the distance between beams

Based on the characteristics of the frame structure, increasing the number of beams in the frame can not only improve the overall rigidity of the frame, but also ensure that it still maintains its efficient compressive resistance under a larger load environment.

3.2 Ensure the effective performance of beams and columns

By reducing the distance between columns and increasing the number of beam foundations, the overall anti-push stiffness of the frame can be improved from the basic properties of the frame structure. In addition, reasonable matching and coordination of the number of beams and columns can not only improve the anti-push stiffness, but also improve the building's wind load resistance, achieving a promoting effect from quantitative change to qualitative change.

3.3 Use of the bending-shear dual structural system

In complex high-rise building structures, after long-term experience accumulation, a new bending-shear dual lateral force resistance structure is adopted. That is, two different shaped components, bending type and shear type, are organically combined to form an integral structure. Through the use of the bending-shear dual lateral force resistance structure, the movement between building materials and the inter-layer displacement between floors can be reduced.

3.3.1 Use of frame-wall system

Complex high-rise buildings are easily affected by various natural factors such as wind, which can cause them to shift horizontally. In the past, the displacement characteristics of the frame alone were small displacement of the upper layer and large displacement of the lower layer. The displacement characteristics of the shear wall alone were large displacement of the upper layer and small displacement of the lower layer. By using the frame-shear dual structure in cooperation, it can effectively ensure that the building is subjected to the same force under the action of horizontal force, reducing displacement, thereby greatly improving the building's load resistance.

3.3.2 Use of frame-support system

The effects of the frame-support system and the frame-wall system are equivalent, both of which ensure the overall force between the coordinated frames so that the force is even, so as to achieve the effect of reducing component offset and inter-story displacement.

3.3.3 Use of the Simplified-within-Simplified system

The use effect of the simple-in-simple system is similar to that of the frame-wall and frame-support systems, both of which combine two components to achieve the effect of reducing component displacement and inter-layer displacement.

3.4 Reasonable setting of rigid arm

For complex high-rise buildings, they are mainly subjected to the bending effect of horizontal lateral forces, that is, high-rise buildings bend in the horizontal direction, and the bending force is mainly borne by the core. As the core of the building, the core bears the horizontal lateral force of the entire building. The deformation of the core controls

the lateral displacement curve of the building. At the same time, the size of the core is affected by the vertical service facilities of the building. Based on this, in order to reduce the overall impact of lateral forces on the building, reduce the bending of the building in the vertical direction, and achieve the purpose of overall safety and stability of the building, special areas can be set up in appropriate ranges in complex high-rise buildings for building heavy frames. As the rigid arm of the building, the rigid arm is used to connect the core with the outer frame of the building to form an organic whole, reduce the force on the core, reduce the impact of horizontal forces on the deviation of the building, and make the overall frame of the building more stable. Through the use of rigid arms, the core is connected with the whole building to achieve an organic combination and promote the safety and stability of the building.

4. Conclusion

The urbanization process is accelerating, and a large number of people are migrating to cities. The construction of complex high-rise and super high-rise buildings is the future development trend. Through overall macro control of high-rise buildings, the best design plan can be formulated to achieve the goal of building safety and stability. Based on this, a comprehensive analysis must be conducted on foundation construction, building material selection, and frame facilities, and the best plan must be formulated and implemented according to actual construction capabilities to achieve the best design effect and ensure the stability of the building structure.

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