Study on Evaluation Method of Seismic Capacity of side Joints of High-Rise Building with Large Chassis

Song Guicai

Henan Technology College of Construction, Zhengzhou, Henan, China

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Abstract: High-Rise Buildings Are Typical Products of Economic and Social Development and Scientific and Technological Progress. the Improvement of China's Urbanization Level Has Promoted Urban Expansion and the Rise of Land Prices. High-Rise Buildings Have Always Been the Symbol of Local Economic Strength, So the Proportion of Urban Buildings is Also Increasing. China is in an Earthquake-Prone Area, Which Requires Buildings to Have High Seismic Capacity. Therefore, the Seismic Design of High-Rise Buildings Has Become an Urgent Task for Engineering Design. This Paper Reviews the Relevant Research on the Seismic Capacity of High-Rise Buildings in China, and Expounds the Structural System of High-Rise Buildings with Large Chassis. the Seismic Capacity of side Joints of High-Rise Buildings with Large Chassis is Analyzed, and the Optimization Design of the Seismic Capacity of side Joints of High-Rise Buildings with Large Chassis is Discussed from the Aspects of Seismic Design Key Points and Seismic Design Strategies. Hope That through the Discussion of This Article, It Can Provide Some Ideas for the Development and Improvement of High-Rise Building Industry.

1. Introduction

1.1 Literature Review

With the Increasing Trend of Population, the Demand for Housing is Becoming More and More Intense. under the Increasingly Tense Situation of Urban Land, High-Rise Buildings Have Become a New Design Trend of Residential and Commercial Buildings. At Present, There Are Many Theories about High-Rise Buildings in Academia and Engineering Street. High-Rise Buildings with Large Chassis Have Become a New Research Hotspot (Han and Luo, 2015) Because of Their Large Chassis, Interconnection and Increased Complexity of Structural Changes. the Research Objects of Ji Wuxian and Liu Guang Are Multi-Tower High-Rise Buildings with Large Chassis, and the Mechanical Performance of Their Structural Forms under External Forces is Analyzed. the Main Research Method is Mode Decomposition Response Spectrum Method, Which is Carried out by Finite Element Analysis Software Etabs. the Seismic Performance Law of High-Rise Building Structures is Analyzed under Different Connection Parameters (Ji and Liu, 2013). Wei Chunming et al. Used Finite Element Software Abaqus to Analyze the Seismic Performance of side Joints of High-Rise Buildings. the Hysteresis Curves and Skeleton Curves of Seven High-Strength Concrete Beam-Column Edge Joints Are Obtained by Analyzing the Software. Furthermore, on This Basis, Further in-Depth Analysis is Carried out to Study the Seismic Performance of High-Strength Concrete Beam-Column side Joints (Wei et al, 2018) by Setting the Influence Conditions of Different Axial Compression Ratios, the Extension Length of Concrete in Columns, and the Strength Grade of Concrete in the Core Area of Joints.

1.2 Research Purposes

At Present, the Application Scope of High-Rise Buildings with Large Chassis is More and More Extensive, Which Effectively Alleviates the Problem of Land Shortage and Population Density in Cities. in Order to Serve People Better, We Must Ensure the Safety and Reliability of Buildings While Solving the Needs of Living Housing and Leisure and Entertainment. in the Construction Process of High-Rise Buildings with Large Chassis, the Number and Scale of Construction

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Increased Significantly (Zhao et al, 2015). in This Process, High-Rise Buildings with Large Chassis Have Been Widely Used, and Their Building Structures Show Many Obvious Advantages. in Practical Application, in Order to Ensure the Safe Use of Buildings, It is Necessary to Ensure the Seismic Capacity of Buildings. by Reviewing the Existing Research Literature, It is Found That There Are Many Studies on Seismic Capacity Evaluation of High-Rise Buildings with Large Chassis. Based on the Existing Theory, This Paper Further Analyses the Seismic Capacity of the side Joints of High-Rise Buildings, and Discusses How to Ensure the Scientific and Rational Design of Buildings in the Process of Design and Construction.

2. Summary of Structural System of High-Rise Buildings with Large Chassis

High-rise buildings are developing in the direction of multi-function recently, and a large number of high-rise buildings with complex structures have emerged. With the requirement of building multi-function and diversification of building shape, multi-tower building with large chassis has become one of the hotspots of high-rise building design. In multi-tower high-rise buildings with large chassis, the large chassis is a few floors of public space at the bottom, and the main structure is two or more towers at the top. If corridors are used in the design to connect some floors between towers, it will become a multi-tower connected structure with large chassis (Mei and Ma, 2016). When two or more towers are installed on the large chassis, the vibration mode complexity of the multi-tower structure with large chassis will be increased, which will result in complex torsional vibration. When the design of the whole multi-tower structure with large chassis is unreasonable, the torsional vibration response, the sudden change of vertical stiffness and the high mode effect will be aggravated (Wu et al, 2018). Moreover, the mechanical properties, vibration characteristics, failure modes, calculation methods and analysis models of high-rise buildings with large chassis are more complex than those of general high-rise buildings because of the connection of several towers or chassis.

Large chassis and multi-tower high-rise building structure system, at the bottom of many independent high-rise buildings, forms a large podium connected into a whole. This is also the main structural characteristics of multi-tower high-rise buildings with large chassis. Among them, there is a vertical irregular structure. That is to say, on the large chassis, a certain floor of the multi-tower high-rise building on the large chassis suddenly receives (Bao et al, 2018). In practical engineering design of multi-tower high-rise building with large chassis, the embedded end of the upper multi-tower can be set as the top floor of the large chassis structure. Generally speaking, residential buildings with underground parking garages belong to this type of structure.

3. Seismic Capacity Analysis of side Joints of High-Rise Buildings with Large Chassis

Connecting joints of high-rise buildings are the key to ensure the safety and reliability of the whole building, which directly affects the mechanical performance of the structure. Reasonable design of structural side joints not only guarantees the reliability and safety of structural bearing capacity, but also directly relates to the manufacturing of components and site installation quality (Lou and Li, 2018). Therefore, the design of the result edge joint is an important part of the whole high-rise building design work, which must be paid enough attention to.

The structure of the connecting part between the tower and the large chassis. The joint between the large chassis and the tower is prone to change its lateral stiffness and form a weak part. In the plane layout of the skirt house, the multi-tower structure changes greatly, and the upper structure receives revenue. When an earthquake occurs, the effect of the underlying structure is transmitted through the floor. In this process, the in-plane stress of the floor is larger. Therefore, for the floor parts of abrupt change in shape, the design of high-rise buildings should pay attention to the reinforcement of the reinforcement, colleagues through the negative moment reinforcement of the slab (Liu and Xiong, 2015). In practical engineering, the force on the floor of high-rise building with fully enlarged chassis is more complex, especially in the case of weak connection in plane, large size of concave and convex plane, and local weakening of large openings. In this case, the stress of high-rise buildings will be relatively concentrated, and the stress of complex floors should be analyzed in detail in the concrete design.

The structure of connecting parts with a large number of towers. High-rise buildings with large chassis usually have multiple towers, which will aggravate the degree of interaction, make the overall structure mode more complex and prone to torsional vibration (Shu and Tan, 2016). Moreover, the complex vibration modes of multi-tower buildings will have a greater impact on the internal forces of the structure. Especially when the distribution of mass and stiffness of each tower structure is not uniform, the torsional vibration response of the structure will be further increased, which will also aggravate the influence of high modes on internal forces. When the distribution of mass and stiffness is uniform, the order of mode will increase correspondingly and the mode participation coefficient will decrease rapidly when the traditional single-series rigid plate system is adopted. That is to say, the contribution of high modes to seismic action is small, and that of low modes to seismic action is more. Therefore, in the design of high-rise buildings, the first several modes can meet the accuracy requirements of earthquake action. However, in the multi-tower high-rise building structure, this rule is not applicable. Participation coefficients of some high modes are larger, while those of some even more low modes are lower. When evaluating the seismic capacity of multi-tower high-rise buildings, attention should be paid to the characteristics of mode selection.

4. Optimum Design of Seismic Capacity of side Joints of High-Rise Buildings with Large Chassis

4.1 Key Points of Seismic Design for High-Rise Buildings with Large Chassis

The main points of seismic design of high-rise buildings usually include three levels. First, horizontal load control. The gravity load and horizontal load of high-rise buildings are directly related to the axial force, shear force and bending moment of buildings. Moreover, the height of high-rise buildings is positively correlated with these factors. Among them, the horizontal load of the high-rise building causes the bending moment of the whole structure, and the axial force formed in the components is proportional to the height of the building. Secondly, horizontal stiffness control. Horizontal stiffness of building structure is the most important design point in seismic structure design. The floor of a high-rise concrete building determines the seismic force transmitted to the transverse wall, which makes the structure produce anti-overturning moment. At the same time, there is a certain axial force in the vertical component of the structure. Horizontal moment is positively correlated with the height of the building structure, which leads to lateral displacement or even collapse. Thirdly, building lateral displacement control. When the lateral displacement scale of the building structure is large, the internal force of the building structure itself will be produced. When the internal force and external force act together, the eccentric force will exceed the numerical limit, which will lead to large displacement or even dumping of high-rise concrete buildings. Affected by seismic loads, the horizontal shear force will appear in the building structure, which will cause the lateral displacement of the building. Therefore, in the seismic design of high-rise concrete buildings, it is necessary to ensure the stability, stiffness and strength of buildings and avoid lateral displacement.

4.2 Seismic Design Strategy of High-Rise Building Structures with Large Chassis

According to the stress characteristics of high-rise buildings and the key points of seismic design, the specific seismic design strategies can be divided into the following points.

Firstly, the structural design of the building should be carried out from the overall perspective of the building. Seismic design can not ignore any part of the building, and the effect of each part should be fully considered. If we do not pay attention to the interaction or cooperation between parts, we will not be able to play the role of a single component. There are different destructive orders among different components in the process of earthquake damage to buildings. When the components are organically linked, they show greater flexibility and load-carrying capacity, and thus have the energy to withstand earthquake releases. The overall seismic capacity of the building will be enhanced, which will effectively weaken the destructive effect of the earthquake. Therefore, the seismic design of high-rise buildings with large chassis must be carried out from the overall perspective of the building.

Secondly, when high-rise buildings choose the design address of foundation, they choose to design foundation on solid, open, flat and hard soil. Therefore, in the course of foundation design and concrete construction, the geological conditions are deeply analyzed. When conducting geological exploration, we should fully understand the local rocky soil and water, conduct rigorous sampling analysis and scientific demonstration, and lay a solid and reliable foundation for the structural design of high-rise buildings.

Thirdly, considering the structural design and layout of the building, combined with the structural design of the building. The relevant principles of seismic design are the basic principles that must be followed in the design of building structures. A large number of practical situations and scientific research have shown that the higher the symmetry and regularity of the building structure, the better the seismic capacity of the building itself. Moreover, reasonable and scientific design of building structure can consume the ability of earthquake release, extend and weaken the seismic effect, and reduce the damage of buildings caused by earthquake.

Fourthly, seismic structural system is the key to seismic design. At present, there are many types of architectural structures in China. From the point of view of structural material, it includes steel-concrete structure, masonry structure, steel structure and concrete structure. From the point of view of structural form, it includes shear wall structure, tube structure and frame structure. In the seismic design of high-rise buildings, the seismic capacity of different structures is different. Building height, seismic fortification intensity and so on will have different effects on the bearing capacity of the seismic system, so designers in the development of seismic structure design. It must be considered comprehensively and chosen rigorously.

5. Conclusion

With the rapid development of modern society, the construction industry is developing well. In order to make the construction process safe enough and ensure the safe operation of buildings, it is necessary to strengthen the seismic design of buildings. In this regard, this paper evaluates and analyses the seismic capacity of high-rise buildings with large chassis, and puts forward specific optimization design strategies according to the mechanical characteristics of high-rise buildings and the key points of seismic design. Among them, in the actual design process, only by strengthening the seismic performance design of buildings, can the safety and practicability of buildings be improved more comprehensively.

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