Analysis of the Application Example of the Assembled Over-limit and High-rise Seismic Design

Zhou Lijun1, Zhao Qinghong2

1Rizhao Polytechnic, 276826
2Rizhao Seismic Station, 276826

Abstract: The paper focuses on the analysis and research of the high-rise seismic design of prefabricated over-limits, and analyzes and explores the specific cases, systematically analyzes the design method of the entire prefabricated structure, especially important for the seismic design of building structures. It lays a good guarantee for ensuring the overall safety and stability of the prefabricated building structure.

1. Introduction
The prefabricated over-limit and high-rise seismic design should be within the entire service life. When an unfavorable geological disaster occurs, it is necessary to minimize the impact and effectively divided properly within the standard. It is also necessary to ensure that the entire design cost of the assembled structure is scientific and reasonable, so as to effectively realize the economic benefits of the entire construction.

2. Analysis of the application example of the assembled over-limit and high-rise seismic design
An analysis and research is carried out on the design of a prefabricated over-limit and high-rise building in certain area of China. The total area of the project is about 108,000 square meters, the total construction area is 310,000 and the floor ratio is 2.0. The key areas include large office and rental apartment. The building is equipped with a large underground garage and corresponding supporting facilities. According to the relevant design requirements of the prefabricated structure, detailed analysis and research are carried out on the seismic design of the prefabricated over-limit and high-rise building to effectively ensure the seismic performance of the entire prefabricated structure and improve the overall stability.

2.1 Preliminary design
Through the analysis and research on the prefabricated building engineering studied in this study, the preliminary seismic structure design scheme is worked out. The prefabrication rate shall be more than 15%. The preliminary design scheme is shown as follows:

1) In accordance with the provisions of the fabricated over-limit and high correlation among top prefabricated shear wall structure, needing to take in the bottom of the prefabricated shear wall structure concrete, and the 4th floor and underground for cast-in-situ concrete structures. Prefabricated shear wall is set in five layers to the roof over the wall and internal shear wall structure. Prefabricated shear wall structure is adopted, the cast-in-site concrete shear wall panels and the thickness of the wall panel are set to 250 mm, the edge of the prefabricated shear wall structure is concrete cast-in-situ construction structure[1].
(2) The prefabricated shear wall vertical plate structure uses reinforced grouting connection, and a complete whole is formed by grouting. The connection between assembled components is safer and more reliable, which can fully meet the earthquake resistance security requirements.

(3) Prefabricated shear wall structure through the building’s roof level to determine the size. In the construction of the lower shear wall structure under the need to set aside the installation position of the steel structure of the floor slab, and at the same time later in the concrete pouring construction, to ensure effective connection between panel and steel structure to improve the entire panel intersect the stability of the structure.

2.2 Calculation and analysis of prefabrication rate
In seismic design of the fabricated over-limit and high-rise, prefabricated shear wall structure is adopted. The monomer prefabricated parts prefabrication rate calculation is as follows: size calculation elevation of 0.000 above, the independent building as the design of the corresponding unit, calculating formula for precast ratio = A + B, among them the volume of the precast concrete components are set to 0.000, cast-in-situ concrete volume set to more than 0.000. Of the precast concrete frame, the main external protection layer includes the building structure and reinforced concrete walls, the stress of the reinforced concrete structure size between the slabs and the effective comparison of the bearing size. For example, building internal shear wall structure and exterior of prefabricated shear wall structure is needed to set out for the corresponding layer, effectively ensure the safety and stability[2].

3. Seismic calculation of assembled structures

3.1 Seismic loading
According to the relevant review technical regulations in the seismic design of prefabricated high-rise buildings in the seismic design, it is necessary to judge the high-rise residential structure between the high-rise building and the single-storey. The size of the structure height and the ratio of the structure height and width need to ensure that the relevant design parameters meet the requirements of the over-rise high-rise seismic design. In the case of no vertical plane compression and conversion of vertical high-rise, it is necessary to judge the torsional displacement. According to the prefabricated building structure requirements, the torsional displacement ratio is set to 1.2. The requirements for the seismic design of prefabricated buildings stipulate that for some special high-rise prefabricated building structures, it is necessary to plan the shape and component layout reasonably. As the opinions of the seismic review of the prefabricated building structure to meet the calculation accuracy of the over-limit and high-rise building, corresponding seismic construction measures are taken as follows:

(1) A structural difference of 1.5 meters in height is set between the assembled structure and the ceiling of the underground garage, which effectively prevents the shear damage caused by earthquake. Extra reinforcement treatment is carried out in the split-level area of the building structure, and the overall seismic performance of the vertical members of the building structure was ensured. The seismic grade of the vertical members is set to one, effectively ensuring the magnitude of the seismic horizontal force at the embedded end [3].

(2) The seismic of the shear wall structure above the ground is expanded by 1.1 times on the basis of effectively meeting the current regulatory requirements, and the reinforcement design of the cast-in-place shear wall structure is carried out. Precast structures and cast-in-place concrete structures need to be effectively divided to fully guarantee the stability of the entire structure.

(3) The connection degree of prefabricated shear wall panels in the horizontal joint area is relatively weak, so it is relatively obvious to be affected by external factors during use. In actual construction, it is necessary to accurately calculate the bearing capacity of the horizontal joint surface of the preset shear wall panel to effectively reduce the deformation and collapse or failure.

(4) In order to effectively improve the overall stability of the building structure and reduce the adverse damage caused by the earthquake to the top floor of the building, the cast-in-place shear wall
structure form is adopted in the top floor design and the prefabrication of various levels. The shear wall structure has been reinforced to improve the stability of the assembled structure [4].

3.2 Mechanical model model analysis

Compared with the traditional building concrete structure, the prefabricated structure is divided into the following aspects in the overall design model.

(1) According to the requirements of the structure of the site engineering, the strength grade of the concrete material of the precast concrete member cannot be lower than C35, and the strength grade of the cast-in-place concrete structure cannot be less than C30. It is necessary to fully ensure the total number of edge members stability of use.

(2) In the design for prefabricated buildings, according to the relevant design points in the building structure model, the prefabricated walls can be individually designed to effectively ensure that the precast shear wall structure belongs to the wall in the middle. It is completed by precast pouring, and the high-rise stairs are secured by sliding pillars.

(3) Among the boundary conditions, 50% of the prefabricated wall panels are used for the external of the prefabricated integral structure. The load of the external walls of the prefabricated wall panel structure is relatively large, and the periodic reduction rate of the shear wall structure ranges between 0.8 to 1.1. The range of periodic reduction of cast-in-situ concrete wall structure is between 0.9 and 0.95, and the reduction rate of the entire fabricated building structure is between 0.85 and 0.90. The external connection of the shear wall structure needs to be rigidly connected to improve and stability. Through the two cast-in-place concrete construction methods, the overall stability of the precast shear wall structure is effectively improved. The thickness of the prefabricated integral structure design floor slab cannot be less than 150mm, and the thickness of the in-situ shear wall structure bidirectional wall slab is set between 120mm and 150mm [5].

3.3 Main structure calculation results of assembly integral structure

In the design of prefabricated structures, it is necessary to fully consider the relevant influencing factors such as the displacement angle, shear ratio, maximum displacement angle of the ground floor between different building floors. The shear wall structure is an important part of the assembly seismic design. It is necessary to effectively increase the rigidity of the shear force within a certain height to prevent the formation of undesirable damage caused by external forces. To effectively ensure the good stability of the inner wall structure after the plastic conditions of the shear wall structure appear, it is necessary to effectively improve the strong resistance to damage of the shear force, so as to prevent the appearance of the bottom of the shear wall structure after an earthquake, which effectively improves the support stability of the bottom.

Through the inspection and analysis of the horizontal gap of the prefabricated shear wall, the connection of the horizontal joint of the ground is effectively supplemented. When the building structure has an earthquake impact to effectively ensure the quality of the joint of the shear wall panel in the splicing area, it is necessary to base on the seismic fortification. As a standard, accurately calculate the shear resistance of the joint area of the shear wall panel. In some rare and large earthquakes, the cross-section bearing capacity of the prefabricated shear wall panel in the horizontal row also needs to be calculated for yield. It is necessary to ensure that the shear compression ratio is less than 1 to effectively ensure the overall stability.

3.4 Seismic over-limit structure adjustment and measures

The types of prefabricated components in the prefabricated building structure are relatively complex, and the emphasis includes shear walls, inner walls, outer walls, and surrounding maintenance walls. In the engineering cases of this study, the cast-in-place concrete structure is still used for the basement structure and the four-floor above the ground. From the four-floor above-ground structure to the roof, the cast-in-place concrete structure for the shear wall is used, which covers cast-in-place concrete shear wall structure. In the prefabricated shear wall floor elevation and roof elevation, a continuous
shear wall post-casting belt structure is set, the thickness of the post-casting belt is 150mm, and the top layer of the outer wall of the middle shear wall of the unit is a cast-in-place concrete structure. In the vertical direction of the prefabricated shear wall structure, the reinforced casing barrel grouting connection is still used, and the lateral of the outer wall uses metal bellows for positioning connection, so as to effectively ensure the reliability of the positioning connection. In the design of prefabricated floor and roof elevation, it is necessary to reserve corresponding steel plates and cast-in-place steel plates through the lower prefabricated shear wall structure, which needs to be integrated with the entire building panel to ensure the overall building balance to improve the overall earthquake resistance[7].

4. Conclusion
Compared with the traditional cast-in-place concrete high-rise structure, the prefabricated has certain differences. According to the relevant design regulations of the prefabricated concrete structure in China, the height of it must reach the corresponding project and structural requirements. The seismic of the assembled high-rise structure needs to reach more than two levels, effectively improving the overall seismic performance.

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