

## Summary of Research on Seismic Resistance of Special-shaped Column Structures

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### Abstract

With the development of economy, people put forward higher requirements for residence, the traditional structure has not meet the requirements, special-shaped column frame as a new structure applied in this paper, the main structure with special-shaped columns in domestic and overseas research course and phase characteristics of special-shaped columns are introduced, analyzed the common problems in seismic design of special-shaped column structure, finally, to summarize the article.

### Keywords

Reinforced concrete special-shaped column; Seismic performance; Frame structure.

### 1. Research status of reinforced concrete special-shaped columns

In 1986, Tianjin University carried out a lot of research work on the bearing capacity of T-shaped and L-shaped members under biaxial eccentric compression. In the 1990s, six L-shaped, 14 T-shaped, eight cross-shaped and square-shaped reinforced concrete columns were tested under biaxial eccentric compression and under normal section bearing capacity and ductility. On this basis, a program for calculating the bearing capacity of normal section is compiled by means of numerical analysis method. The program is used to calculate the bearing capacity of several special-shaped columns. The unified calculation method is attempted to be given at once, and the unified formula for calculating the eccentric moment increasing coefficient of special-shaped columns is also given. In 1993, 10 L-shaped, 4 T-shaped and cross-shaped RC columns under biaxial eccentric compression were tested in Dalian University of Technology. The conclusion is that the working mechanism of the normal section of the special-shaped columns under biaxial eccentric compression is similar to that of the unilateral eccentric columns. From the beginning of loading to failure, the cross-section strain basically keeps plane, and the member presents eccentric compression failure mode. However, the cross-section axis does not coincide with the bending moment action plane, and the reinforcement stress varies from place to place, and the longitudinal stress of the bending moment action angle is the largest. In 1995, Guangdong Institute of Real Estate Development and Design and South China University of Technology carried out an experiment on 11 reinforced concrete members with equal L-shaped cross-section under biaxial compression. It was proved that the deformation of the cross-section remained basically plane during the whole process of loading and failure. A calculation method and formula for the bearing capacity of the normal cross-section of the members with L-shaped cross-section under biaxial eccentric compression were put forward. The computer aided design of XY biaxial eccentric compression columns with special-shaped columns is discussed. Since 2000, many experts and scholars have studied the bearing capacity of special-shaped columns in various aspects, and put forward many new directions and opinions for the development of special-shaped column structures.

### 2. Characteristics of reinforced concrete special-shaped columns

Advantage:

- (1) The column wall of special-shaped column frame is equal to the filling wall in thickness, and the wall surface is prominent without column corrugation, which is conducive to the use of housing space and the decoration of the house, and can increase the use area by 8%-10%.
- (2) The plane layout of the column network is flexible, and the light wall materials used only play a protective role, which are non-load-bearing walls. It is convenient for users to re-separate the use space and meet the requirements of users for large-bay buildings, and the wall materials meet the requirements of environmental protection.
- (3) The cost of special-shaped column frame structure house is higher than that of brick-concrete structure house, but it can build high-rise house, save land, and make full use of the function of filling wall. Its cost is lower than that of general frame house, so it is a more economical and reasonable structure form.

Disadvantages:

- (1) Because of the particularity of the section, the stiffness contrast between the inside and outside directions of the wall is quite different, which leads to the small consistency of the stiffness in each direction and the great difference of the bearing capacity in each direction.
- (2) For long columns, the effect of shear deformation can be considered slightly. When the control of axial compression ratio is small, the force is clear and the anti-deformation ability is better. For short columns, shear deformation accounts for a considerable proportion, and the deformation resistance of members decreases. Special-shaped columns are usually used in the short column range and belong to thin-walled members. Even if ductile bending failure occurs, the curvature of special-shaped columns is smaller because of its truncation, which makes the bending deformation performance limited and ductility poor.
- (3) Because the special-shaped column is smaller than the rectangular column, it has the situation that the flange column limb is compressed, and its ductility is worse.

Existing Problems and Development Direction of Frame Structures with Special-shaped Columns

In the research of special-shaped columns, there are still some problems, mainly in the following aspects.

- (1) Most of the computational methods used are finite element analysis, and there is no systematic and unified theoretical calculation method. Up to now, the seismic performance and dynamic characteristics of special-shaped column members and frame structures have been studied, but they have not really been unified to form a perfect theoretical system.
- (2) Because the whole structure is composed of many different components in various ways, the overall mechanical performance and the way of force transmission are more complex than a single component. At present, there are more studies on single special-shaped column member, but less on the whole structure of special-shaped column. However, the overall performance of the structure is not a simple superposition of the performance of individual components, so more attention should be paid to the analysis and research of the overall structure.
- (3) Most of the studies on the overall seismic performance of special-shaped column frame structures are focused on multi-story frames, and the application of special-shaped column structures in high-rise structures needs further study.
- (4) There are few studies on the elastic-plastic and dynamic properties of integral frame structures with special-shaped columns in middle and high-rise buildings. Only the calculation models and restoring force models used in calculating the dynamic characteristics of structures are discussed, and no complete analysis system has been formed.

### 3. Conclusion

The reinforced concrete frame structure with special-shaped columns is a "strong column and weak beam" structure which meets the requirements of the code. It has better seismic energy dissipation capacity. Moreover, the use of light wall makes the self-weight of the structure greatly reduced and

is beneficial to earthquake resistance. Nevertheless, it should be clearly recognized that the seismic performance of the special-shaped column frame structure itself is inadequate; for residential buildings with low height, the special-shaped column structure system can better meet the requirements of building function and use. With the continuous research and exploration of designers and researchers, more and better structural types will emerge. With the continuous improvement of people's living standards, the functional requirements and aesthetic concepts of residential buildings are also constantly improving. Special-shaped column frame structure will play an important role. Special-shaped columns will also be further studied and developed.

## References

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