Summary of Research and Application of Concrete Filled Steel Tubular Columns

Shuai Wang, Qianqian Zhou

North China University of Science and Technology, Tangshan 063009, China

Abstract

The concrete-filled steel tubular concrete column structure is a new type of structural system with rapid development in recent years. It has many advantages such as improving the internal structure of the building, reducing the structural weight and reducing the construction cost. Therefore, it has been widely used in practical engineering. . Through the test and theoretical analysis, the calculation formula of bearing capacity of concrete-filled steel tubular columns is improved. The test results show that the concrete-filled steel tubular columns have high bearing capacity and good plastic deformation ability. Under large axial pressure conditions, the ductility is better. In the research of rectangular steel tubular concrete special-shaped column frame, the concrete-filled steel tubular special-shaped column and the steel beam joint have strong bearing capacity, and the ductility performance can meet the requirements of elastoplastic ultimate deformation. The energy consumption of the core area of the joint is strong and the seismic capacity is good.

Keywords

Concrete filled steel tube; special shaped columns; bearing capacity; seismic performance.

1. Introduction

The concrete-filled steel tubular column structure refers to a steel-reinforced concrete composite structure in which a steel pipe is embedded in a special-shaped column and a certain structural steel bar is arranged, and is divided into a square steel tube concrete shaped column and a circular steel tube concrete shaped column. With the maturity of building technology, people have higher requirements for the aesthetics and safety factor of the building structure. Therefore, the special-shaped column structure has developed rapidly as a new type of structure system that is more in line with the public aesthetics. Concrete-filled steel tubular columns have high bearing capacity in the vertical direction and can bear large vertical loads; especially the concrete core cylinder, which has large lateral stiffness and can effectively resist earthquake impact. The outer steel tube and the inner core concrete together bear loads from different directions, while the outer steel tube provides a strong restraining effect on the core concrete. This combination method further makes the seismic performance of the concrete-filled steel tubular columns more than the conventional ordinary reinforced concrete special-shaped columns. As a combination of the above two types of concrete-filled steel tubular columns, the mechanical properties are good and the construction is convenient. It is widely used in various engineering fields.

2. Analysis of Mechanical Properties of Concrete Filled Steel Tubular Columns

The mechanical properties of concrete-filled steel tubular columns are currently focused on static performance. Through a number of studies, the scholars have analyzed in detail the bending, shear, axial compression, biasing properties and mechanical properties of concrete-filled steel tubular columns.

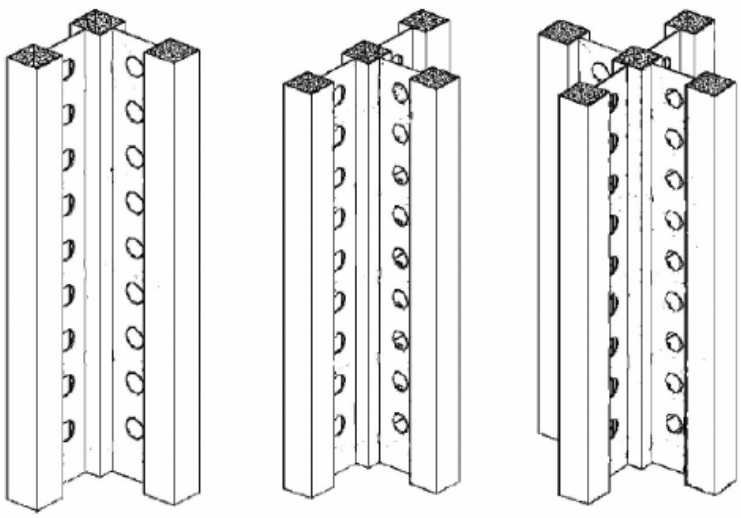

Fig.1 Special-shaped columns with square steel tubes

For square steel tube concrete shaped columns (as shown in Figure 1), Yao Yanan [1] tested the bending and bending properties of T-shaped square steel tube combined special-shaped columns, and obtained load-displacement, load-deflection and load-strain curves. The failure process of T-section square steel tube combined special-shaped column is studied. The research shows that the failure form of T-section square steel tube combined special-shaped column is the overall bending type instability failure, and the test piece has high bearing capacity and ductility.

Li Fengbin [2] tested the bending and bending properties of three L-shaped square steel tube combined special-shaped columns, and learned the force characteristics of L-shaped square steel tube combined special-shaped columns under different bending and bending loads, and analyzed the test data to obtain load-displacement. Deflection and load-strain relationship curves were carried out, and the finite element numerical simulation of the L-section square steel tube combined special-shaped column was carried out. The test results show the relationship between the one-way and two-way bending capacity, and the calculation formula of the biaxial compression bearing capacity of the L-shaped square steel tube combined special-shaped column is derived.

Sakino K[3-6] is used to enhance the stability and bearing capacity of the special-shaped column. The square steel tube concrete composite structure is used as the frame. Because there is filled concrete in the square steel tube, there is no obvious buckling phenomenon in the local part of the single-legged square steel pipe. It has good plastic deformation ability and good ductility under large axial pressure conditions.

3. Seismic behavior analysis of concrete-filled steel tubular frame columns

With the deepening of the research on special-shaped concrete-filled steel tubular columns, domestic and foreign scholars have carried out a lot of in-depth research on the special-shaped column frame joints. In the seismic fortification area, the joints of the special-shaped column frame are very complicated, which plays the role of transmitting and distributing internal forces. To ensure the integrity of the structure, the node is a key part of the frame structure and has an important impact on the overall seismic performance of the structure. At present, the research results of seismic performance of special-shaped column frame joints at home and abroad mainly include:

In 2013, Fengming Ren, Yun Zhou et al. [7] conducted a pseudo-static test on a three-story single-span, single-span, 1/4-scale round-tube concrete-column-steel frame, two of which were added with anti-buckling support. The test shows that the bearing capacity and deformation capacity of the frame are obviously improved after the buckling support is added, and the effect of the plastic hinge is delayed.

In order to study the failure characteristics and seismic performance of rectangular steel tubular concrete special-shaped column-steel beam frame joints, Xi'an University of Architecture and

Technology conducted low-cycle repeated loading tests of five middle nodes, two side nodes and two corner nodes. The results show that the concrete-filled steel tubular special-shaped columns and steel beam joints have strong bearing capacity, and the ductility can meet the requirements of elastoplastic ultimate deformation. The energy consumption of the core area of the joint is strong and the seismic capacity is good. Based on the existing test results of rectangular steel tube concrete-shaped column-steel beam frame joints, the general finite element software ABAQUS-6.12 was used to test the mechanical behavior of five cross-shaped rigidly connected rectangular steel tube concrete-shaped columns-steel beam joints. The nonlinear finite element analysis is compared with the experimental results, and the two agree well[8-11].

Tianjin University has carried out a comprehensive study on the seismic behavior of square-steel-concrete composite columns with different shapes. Firstly, the L-shaped steel plate-connected square steel tube concrete special-shaped columns have different slenderness ratios, different connecting steel plate thicknesses, different connecting steel plate widths, and different Axial compression test under eccentricity [12,13], followed by experimental study on the mechanical properties of a three-story two-story single-span square steel tubular concrete special-shaped column-H-shaped steel beam frame under constant axial pressure and reciprocating horizontal force . It is found that the square steel tubular concrete special-shaped column frame has good energy dissipation capacity and ductility, and the strength and stiffness degradation are not obvious, and it has good seismic performance, and the performance under the rare earthquake is better than the square steel tube concrete single column structure [14 , 15].

4. Conclusion

Since humans have recognized the dangers of earthquakes, they have been working tirelessly on the defense work and methods of earthquakes. Concrete-filled steel tube shaped column is a new type of structural system produced by the combination of concrete-filled steel tube structure and special-shaped column structure. Whether it is from the analysis of bending performance, shearing performance, axial compression performance, biasing performance and mechanical properties under repeated loading, or through the earthquake resistance test of experts and scholars, the seismic performance of concrete-filled steel tubular columns is Generally accepted. The structural form of the building not only has the advantages that the columnar column of the special-shaped column does not protrude indoors, occupies less space, and is beautiful and applicable, and the concrete-filled steel tube structure has high bearing capacity and good seismic performance. It is believed that this type of structure will receive universal attention in future buildings.

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