Overview of Shaped Steel - Concrete Columns

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Abstract

Shaped steel concrete special-shaped column is designed and constructed in various engineering fields due to its good seismic performance, convenient construction and large effective utilization space. In view of its various advantages, many domestic scholars and research institutions have carried out research on it, mainly studying the special shaped columns of steel-reinforced concrete (SRC) and concrete-filled steel tubular (CFST). This paper mainly reviews the studies of scholars on the basis of comprehensive arrangement.

Keywords

Steel-reinforced concrete, special-shaped column, concrete-filled steel tube.

1. The Introduction

The bearing capacity of reinforced concrete special-shaped column is not enough to meet the engineering requirements, and the traditional concrete column protrudes from the wall, which is not conducive to the interior decoration and furniture arrangement, so the shaped steel concrete emerges at the historic moment. With the use of light partition wall, so that the weight of the structure reduced, the earthquake effect is small, so that the cost of more economic. Moreover, the concrete wrapped around the steel tube skillfully avoids the direct contact between the steel tube and the air, playing the role of anti-corrosion and anti-rust. There are concrete supports inside and outside the section steel, which can delay the yield of the section steel and improve the stability of the section steel. Domestic scholars have studied the advantages of shaped steel concrete columns, and feedback to the community, applied in various engineering fields. In this paper, various types of steel - reinforced concrete are sorted out and reviewed.

2. Introduction of Shaped Steel Concrete Columns

Steel-reinforced concrete (SRC) is formed by filling concrete in SRC, which makes full use of the properties of SRC and concrete in the process of stress, makes up for their defects, gives full play to their advantages, and gives full play to the advantages of both, and becomes an important development direction of structural engineering discipline. The concrete pipe structure has the advantages of high bearing capacity, strong toughness and plasticity, superior fire resistance, short construction period, simple construction and remarkable economic benefits.

Compared with ordinary rectangular section, special-shaped column is a short form of cross-shaped section, including cross-shaped section, l-shaped section and t-shaped section, and the limb height to limb thickness ratio of the cross-section is no more than four column types. Compared with the brick-concrete structure, the self-weight of the structure is obviously reduced, which is suitable for high-rise buildings. In addition, compared with ordinary frame or frame-shear structure, it avoids the use of traditional rectangular column protruding from

the wall, affecting the appearance, and at the same time increases the building area. In addition, the wall is mostly made of heat preservation, heat insulation, lightweight and efficient materials, which conforms to the general direction of the contemporary construction industry. In the special shaped column of concrete-filled steel tube, the restraint effect of the steel tube wrapped on the outside makes the internal concrete in the lateral compression state, and the bearing capacity is greatly improved. Concrete makes up for the compressive properties of steel pipes, increases the stability of steel pipes, avoids local buckling, and significantly improves the ductility and energy dissipation characteristics of steel pipes. The common constraints of steel reinforced concrete (SRC) in engineering are steel-reinforced concrete (SRC) and concrete-filled steel tubular (CFST).

3. Research Status of Steel Reinforced Concrete

Fan tai (2004) [1] carried out an experimental study on the seismic performance of three special-shaped steel reinforced concrete columns with 1/4 scale and one steel reinforced concrete circular column model. It is found that the steel reinforced concrete column has good seismic performance. Although the seismic performance of SRC special-shaped column is not as good as that of SRC circular column, it still has good seismic performance and can be used in practical engineering. Yang tao, zhang xide (2009) [2] et al. made a one-half scale single-span two-layer special-shaped column frame with t-shaped steel reinforced concrete, and studied the seismic performance by means of pseudo-static test load displacement loading method. With good energy dissipation capacity, the plastic hinge beam first and column after column are in line with the principle of strong column and weak beam, and the stiffness degradation is slow, in line with the seismic code, but the beam end cracking is serious, should be reasonable configuration of steel bone position, to strengthen the beam end bearing capacity. Tang chi hang Johnny to ping (2010) [3], the T section column node seismic performance, of 6 steel reinforced T cross section and two steel cross section are studied, it is divided into "3 + 1" type two experiments for single, two-way mixed loading dint - displacement loading way low cycle reciprocating motion, and to set up a second set of control variables, to study the axial compression ratio, measure the beam end node hysteretic curve and skeleton curve and the load and the displacement value at various stages. The results show that steel-reinforced concrete has full hysteretic curve and good seismic performance In addition, the steel skeleton inhibits the development of cracks, so that it has better ductility, and the shear stiffness of the envoy point is larger, which can effectively transfer the shear force. Li Yanyan, Zhang Weitian (2017) [4] et al. abstract: the low-cycle repeated loading test was carried out on five specimens with different axial compression ratios and steel configurations. The results show that the specimens with higher axial pressure have higher bearing capacity, but lower ductility and faster stiffness degradation rate. Compared with the ordinary reinforced concrete special-shaped column, the configuration of shaped steel in the special-shaped column can improve the hysteretic performance, enhance the stiffness, ductility, bearing capacity and energy dissipation performance, reduce the degree of damage, so as to improve the seismic performance. Xu hong Zhou, Zheng Zhou, Dan Gan (2018) [5], etc. Under the guidance of strong column weak beam, the design of five beam-column joints with the diaphragm, the other is encryption stirrup spacing, etc. 6 1/2 scale specimens, under axial compression and low cycle load in order to study the slenderness ratio, square steel tube thickness, axial compression and two damage forms (node and beam bending failure and shear failure bonding damage), by the experimental phenomena can be seen, first a beam plastic hinge and stirrup fracture, conforms to the concept of strong column weak beam; The experimental results show that the ductility and energy dissipation can be improved by increasing the wall thickness and axial horizontal bearing capacity, and the shear failure and bond failure of joints can be reduced. The diaphragm

ACTS as a restraint on the internal tension of the concrete and connects the steel plates, making the steel plates act as better restraints.

4. Research Status of Concrete-Filled Steel Tube

Wang Dan, Lu Xilin (2005) [6] et al. studied the influence of 6 l-type and 6 t-type on the ultimate bearing capacity, ductility and other seismic performance through axial compression ratio, pipe wall thickness and concrete strength. The axial compression ratio has little effect on the ultimate bearing capacity, but is inversely proportional to ductility. The wall thickness of the pipe is directly proportional to it. This is because the increase of the wall thickness of the pipe has a constraint effect on the concrete inside the pipe. The increase of concrete strength can improve its compressive strength, but the ductility has little impact. Ting Zhou, Zhihua Chen (2012) [7] The experimental concrete-filled steel tube (SCFST) is subjected to constant axial load and low cyclic load. The effects of axial compression rahtio and length-width ratio on the stiffness, strength, ductility and energy dissipation of CFST columns were studied. The results show that the concrete filled steel tube column has good coordination and seismic performance. With the increase of axial pressure ratio, stiffness increases and energy dissipation capacity, ductility and bearing capacity decrease. On the other hand, the increase of aspect ratio leads to the increase of energy dissipation capacity and ductility, and the decrease of stiffness and bearing capacity. Zhi - Liang Zuo, Jian Cai (2018) [8] investigates the axial compressive behaviors of T - shaped concrete - filled steel tube (CFST) stub columns with blinding bars. Under axial compression load, 11 specimens with bonded bars and 5 specimens without bonded bars were tested. The experimental results show that the local buckling failure mode can be changed, the local buckling can be delayed and the overall protrusion at the concave corner of the steel tube can be effectively restrained by setting the restraint bar.

5. Conclusion

The special-shaped steel reinforced concrete column has better seismic performance, higher ultimate bearing capacity, good ductility, convenient construction, large effective utilization space and wide application prospect compared with traditional reinforced concrete.

From the point of view of the existing research, the seismic performance, axial pressure, ductility and other aspects are mainly studied, but at the present stage, compared with the foreign countries, the research method is not mature and has not formed a system. In addition, there are few dynamic studies and finite element simulation, which are important directions for future research.

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