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Performance of T-Shaped Steel Reinforced Concrete Column under High Temperature

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Abstract

With high strength and good seismic performance, T-shaped steel reinforced concrete column is widely used in high-rise building structure. Three T-shaped steel reinforced concrete columns were tested under high temperature and vertical load, to simulate fire effect. The test results indicate that failure characteristics, distribution of temperature field, vertical deformation characteristics and fire resistance were comparatively analyzed under different axial compression ratios and different eccentricity. The test also indicated that the cracks increased with the increase of axial compression ratio and eccentricity. The damages of web were severer than the flange. The cracks were mainly distributed on the eccentric side and mostly inclined cracks in specimen. The vertical expansion became more obvious as the eccentricity decreased. The fire resistance decreased as the axial compression ratio increased. Compared with, the fire resistance of large axial compression specimens (the axial compression ratio is 0.6) were decreased by 57% than small axial compression specimens (the axial compression ratio is 0.2). The fire resistance decreased by about 30min as eccentricity increased by 20mm.

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Keywords: Steel reinforced concrete columns; Fire resistance; Experimental Research; Axial compression ratio; Eccentricity

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Introduction

The steel reinforced concrete special-shaped column with high space utilization, flexible layout and good economic benefits is widely used in practical engineering [1]. Because of its high steel content , it is necessary to study the fire resistance of steel reinforced concrete special - shaped columns due to the decrease of the bearing capacity of steel - reinforced concrete special - shaped columns under high temperature.

The current research results are: Eurocode[2] carried on the research and analysis of the SRC column hinged at the ends of the beam .The results showed that the fire resistance limit was related to the column size, the thickness of the protective layer of the steel and the thickness of the protective layer of the steel, and it was independent of the slenderness ratio. The fire load ratio was determined by its cross section. Wu Bo and Xu Yuye[3~7] completed the fire resistance test of 11 full-sized reinforced concrete special-shaped columns under the standard heating process of ISO834. Axial deformation and fire resistance of reinforced concrete columns under high temperature were analyzed in the influences of load ratio, mode of fire and section form on the failure modes[8]. The influence of different parameters on the fire resistance of reinforced concrete columns was numerically analyzed and the method of calculating the fire resistance was deduced.

The test, four kinds of steel reinforced concrete T - pillar specimen in the high temperature fire and vertical load coupling under the fire resistance, was carried out. The damage morphology, temperature field distribution, vertical deformation and fire resistance of steel reinforced concrete T-type columns under different axial compression ratios and different eccentricity factors were analyzed and studied. The relevant conclusions will promote to further understand the fire behavior of steel reinforced concrete T - type columns under high temperature.

1 Test design

1.1 Specimen design

Considering the influence of axial compression ratio and eccentricity, four steel reinforced concrete T column specimens were designed and tested under the coupling action of high temperature fire and vertical grading loading. The size of T-shaped specimen cross-section was 300 × 200 × 100mm, and calculated length was 600mm. Q235 hot-rolled steel was built-in and specimen steel content was 6.9%. In order to avoid the local failure of the specimen during the loading process, the enlarged column of which the size was 300 × 200 × 200mm was set in the upper and lower ends of the specimen. The steel frame consisted of four longitudinal sections and a number of horizontal webs, with a horizontal web spacing of 200 mm. The horizontal webs were equipped with diagonal rods, and steels were set deep into stigma to ensure the strength of the stigma and the integrity of the column and the column[9]. Specimen specific parameters and refractory limit were shown in Table 1, the specimen cross-section were shown in Figure 1, and the specimen steel skeleton and reinforcement diagram were shown in Figure 2.

Table 1. Component design parameters and test results

Specimen number	Axial compression ratio	Design load /kN	Eccentricity /mm	fire resistance/min
TZ-1	0.2	225.6	0	787
TZ-2	0.6	676.8	0	338
TZ-3	0.6	676.8	20	304
TZ-4	0.6	676.8	40	279