

Study on axial compression ratio of Seismic Performance of Steel Tube Filled with Steel-reinforced Concrete Composite Column

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Abstract: With the rapid development of cities, the building becoming larger and higher. That means the weight of building will increase, the disaster will cause a greater loss. Bearing column is the main stress components of building, determining the safety of the building under earthquake. Steel Tube Filled with Steel-reinforced Concrete Composite Column (STFSC) has the advantages of concrete-filled steel tube column and steel reinforced concrete column. Therefore, this paper study on axial compression ratio of seismic performance of STFSC by ABAQUS finite element analysis software

Introduction

The tensile, compressive and bending performance of steel is good, but fireproof performance and corrosion resistance is poor, concrete has good compressive strength and refractory performance, but the bending performance is not good. The steel tube filled with concrete can enhance the stability of the steel pipe, avoiding the bearing capacity of steel pipe reducing after fire. Concrete compressed by more direction improves the concrete compressive strength, deformation capacity and component impact resistant ability, and improve the performance of fire resistance and corrosion. Besides steel tube can be used as the template to improve speed of construct. The present study as follows: (1) Guan Ping, Wang qing-xiang, Zhao da-zhou [1-3] study on the seismic performance of STFSC which built-in cross-shaped steel, studying its failure pattern, bearing capacity through the experiment. (2) Xu ya-feng, Zhao Jingyi [4-7] study the seismic performance of STFSC which steel bone outside and steel built-in, getting the hysteresis loop of different axial compression ratio and different gravel ratio. (3) Zhu Meichun jian-xin liu, qing-xiang wang [8] take intensity of concrete, axial compression ratio as the parameters, studying the square steel tube reinforced concrete composite column with built-in i-section and cross-shaped steel and the seismic performance of steel tests. Now there are little researchers study on seismic performance research of STFSC embedded I-section steel. Therefore, this article study on axial compression ratio of seismic performance of STFSC.

Related Parameters

Component parameters. This article will discuss the effect of axial compression ratio to the seismic performance of STFSC. The length of component are 1000 mm. Concrete compressive strength is 70 [MPa] .

Table 1 component parameters

| Number | D×t[mm] | f_{ck} [MPa] | f_{ty} [MPa] | f_{sy} [MPa] | Axial compression ratio |
|--------|---------|----------------|----------------|----------------|-------------------------|
| Z-1 | 220×3 | 70 | 235 | 235 | 0 |
| Z-2 | 220×3 | 70 | 235 | 235 | 0.4 |
| Z-3 | 220×3 | 70 | 235 | 235 | 0.8 |

D、 t- Steel pipe diameter and thickness; f_{ck} 、 f_{ty} 、 f_{sy} - compressive strength of concrete, steel bone and yield strength of steel pipe.

Loading system. Loading controlled by displacement to determine the components mechanical properties in different displacement condition .We should make sure the yield displacement values under horizontal load before applying cyclic loading. The yield displacement is about 4 mm through simulation. Loading controlled by level-to-level displacement before yield; Difference reduce to 0.5mm when close to the yield and increase to 1 mm after yield. Loading system is shown in figure 1.

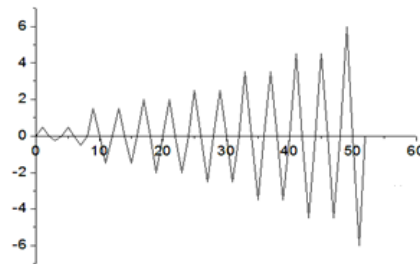


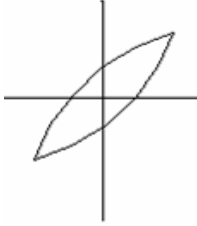
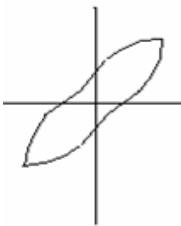
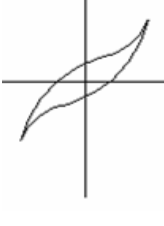
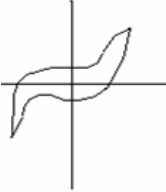
Fig 1 the loading system

Axial Compression Ratio Analysis

Hysteresis loop. Hysteresis loop is the relationship of displacement and load conducted by component under repeated loading. Hysteresis loop has four basic forms as shown in table 2:

For STFSC, concrete compressed from three direction, steel tube confined concrete development, the bone steel inhibit the concrete appear cracks and development. At the same time, the existence of the concrete enhance the stability of the whole component. Therefore, Hysteresis loop of STFSC likes spindle. The loop is full , indicating good seismic performance.

Table 2 the form of the hysteresis loop

| Name | Spindle type | Bow type | directing against S type | Z type type |
|-------------|--|---|--|---|
| Form |  |  |  |  |
| | Full | Central concave | Concave on both ends | Shape distortion |
| Introduce | No shear failure | Having "Pinch shrinkage" effect | Having "Pinch shrinkage" effect serious | Having a lot of slippage effect |
| Damage form | Components under compress without displacement, bending and shear without shear failure etc. | Components with stirrup under bending and shear or bias compress and shear etc. | The framework, framework with shear wall and joints of beam-column etc. | Components of small shear span and developed inclined cracks; Components with anchoring reinforcement and big displacement etc. |

Hysteresis loop in different axial compression ratio

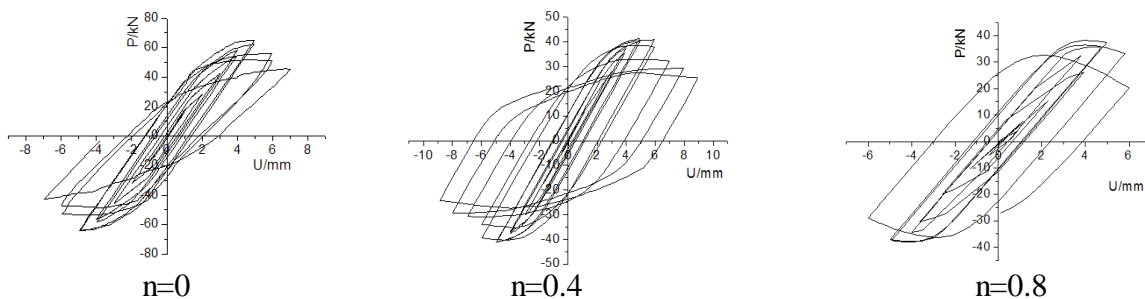


Fig 2 the hysteresis loop of different axial compression ratio

We can know from the hysteresis loop of different axial compression ratio, the hysteresis loop of the smallest Axial compression is most full, almost present standard spindle, that show the strongest energy consumption. The curve is more gentle after component reach maximum, that show good ductility. The hysteresis loop appear the trend of directing against S with the increase of axial compression ratio.

Under the repeated cyclic loading, the area of the hysteresis loop show components absorbed energy after repeated loading. We can found the area of Hysteresis loop is increasing in the hysteresis loop. This means that energy consumption capacity of components is increased. The energy consumption capacity of components is good.

Conclusion

This article selects axial compression ratio as the parameters, Study on axial compression ratio of STFSC:

- 1、The hysteresis loop of each component is full, no obvious pinch phenomenon, show a good ability of energy dissipation and plastic deformation. Axial compression ratio change will affect the shape of the hysteresis curve and carrying capacity.
- 2、The area of hysteresis loop show the ability of energy consumption. With axial compression ratio increasing, the capacity of the energy dissipation reduce.

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