정방형 STRC 기둥의 자기이력현상 거동

Hysteretic Behavior of Reinforced Concrete Columns Confined By Square Steel Tubes.

왕소용* 장수메이** 이한승***

Xiaoyong Wang Sumei Zhang Lee, Han-Seoung

ABSTRACT

The reinforced concrete column confined by square steel tubes(RCST) is a reinforced column (RC) confined by thin steel tubes which cover over the full length of the column but terminates 15mm from the column's ends. The steel tube is in uniaxial tension stress state and won't buckle when the column sustains axial load. This will highly increase the bearing capacity and ductility of the columns. The hysteretic behavior of four square RCST columns and one square RC column were experimentally studied under constant axial load and lateral cyclic load. The wide-to-thickness (D/t) ratio of RCST columns employed in this research is 75. The main variables of the experiment were axial load ratio and compressive strength of the concrete. Based on the findings in this research, RCST columns exhibits high lateral strength, ductility, and energy dissipation ability.

1. INTRODUCTION

Because of the excellent mechanical performance, high strength concrete (HSC) is widely used in high-rise buildings. However, HSC is more brittle than conventional normal strength concrete, which restricts the use of HSC in seismic engineering. Concrete-filled steel tube (CFT) column may exhibit better ductility and can be used in seismic engineering. However, the steel tube of a CFT column is in a state of biaxial stress. As axially loaded in compression and laterally loaded in tension this will reduce the effective yield stress in the lateral direction. In RCST column the steel tube covers all length of column but terminates 15mm from the column's end. The steel tube only sustains lateraltension stress.Several researchers have done some experiments about seismic behavior of RCST columns. Tommi et al.(1987) investigated seismic behavior of square steel tube confined RC short columns. Aboutaha (1999) compared hysteretic behavior between the ordinary reinforced concrete columns and RCST columns and the axial load ratio in his experimen twas 0,0.12,and 0.14. Nevertheless, almost all previous researchers focused on short columns and lower axial load ratio. Medium length columns and columns with higher axial load ratio are frequently adopted in engineering. In this paper the seismic behavior of medium length columns with higher

* 정회원, 한양대학교 대학원 건축환경공학과, 박사과정

** 하얼빈 공과대학교 토목공학과 교수, 공학박사

*** 정회원, 한양대학교 공학대학 건축학부 조교수, 공학박사

axial load ratio was investigated.

2. TEST PROGRAM

2.1 detail of test columns

Fig. 1 shows a photo of a RCST column in the test frame. During the testing, a constant axial load was maintained by a manual pump whereas the lateral force was cycled based on force control before specimen yield strength and displacement control after specimen yield strength. A total of five columns were tested, including one square RC columns and four square RCST columns.

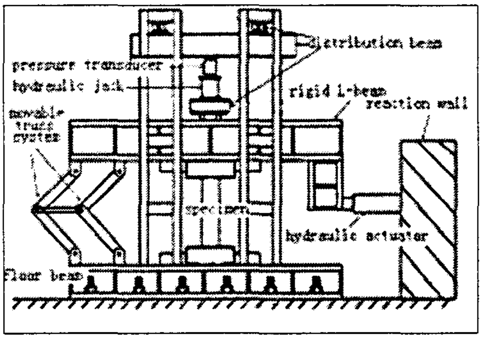
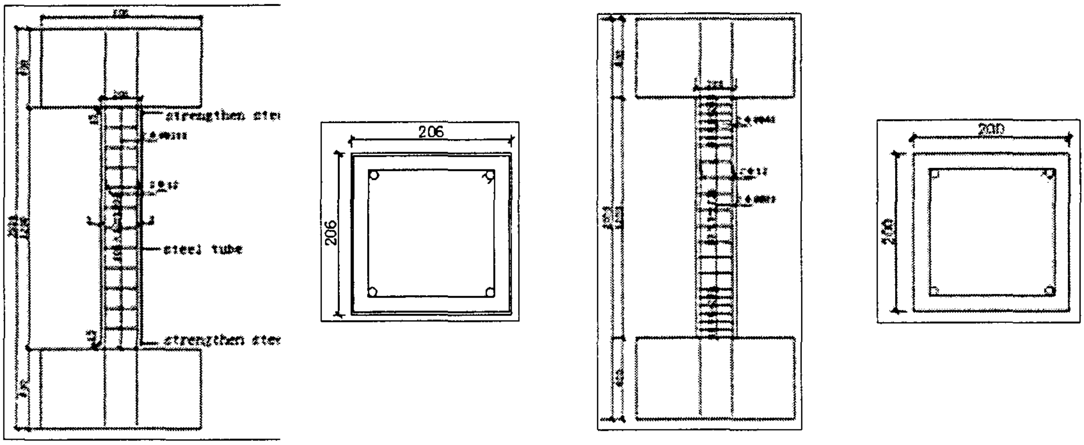


Fig.1 schematic of column test set-up

Fig.2 shows the details both the elevation view and the section view of test specimens.



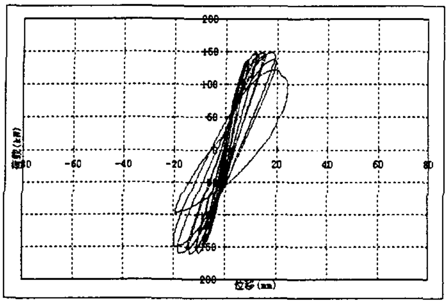
(a) RCST specimen

(b) reinforced concrete specimen

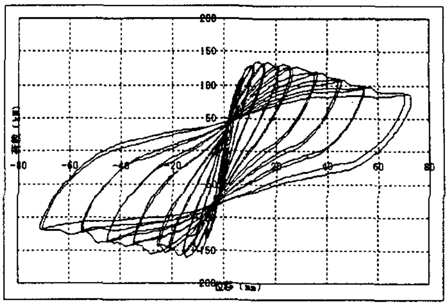
Fig.2 details of test specimen

2.2 test results of individual results and discussion of test results

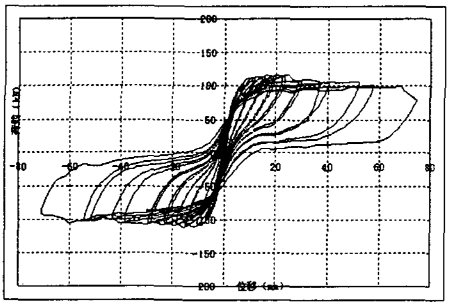
Fig. 3 shows the hysterestic response of test specimens and Fig 4 shows the failure mode of test specimens. Based on Fig. 3 and Fig. 4, some conclusions can be achieved as follows;
Firstly, columns RC-60-8 and RCST-60-8 were subjected to an identical axial compressive load and identical cyclic lateral load. Owing to the effective confinement of steel tube to core concrete, the ultimate strength of RCST-60-8 was 192.24kN while that



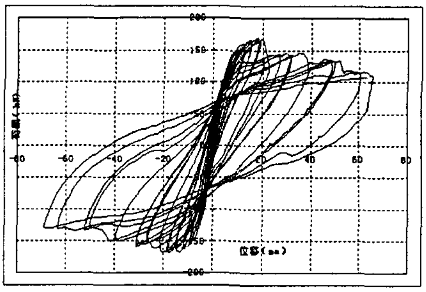
(a) RC-60-8



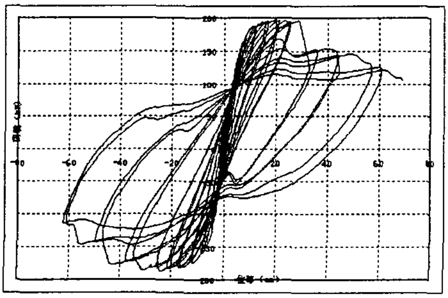
(b) RCST-30-8



(c) RCST-60-3

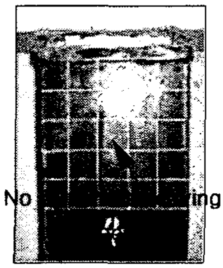


(d) RCST-60-6

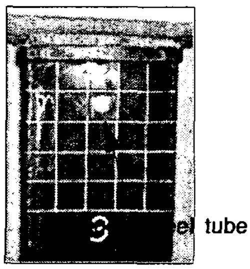


(e) RCST-60-8

Fig.3 response of test specimen



(a) RCST-60-3



(b) RCST-60-8

Fig4. failure mode of specimens

of RC-60-8 was 153.35kN, meanwhile RCST-60-8 had higher ductility, higher initial stiffness and stronger energy dissipation than RC-60-8. Secondly, columns RCST-30-8 and RCST-60-8 were subjected to approximately equal axial load ratio and identical cyclic lateral load, but concrete strength of RCST-60-8 was higher than RCST-30-8. The ultimate strength of RCST-60-8 was 192.24kN and that of RCST-30-8 was 146.97kN, and RCST-30-8 has higher ductility than RCST-60-8. As the concrete strength increased, the lateral strength and energy dissipation of the specimen increased but the specimen ductility decreased. Thirdly, columns RCST-60-3, RCST-60-6, RCST-60-8 were subjected to identical lateral load and their axial load ratio increased one by one. With axial load ratio increasing, the ultimate strength and energy dissipation of RCSTcolumns increased correspondingly while the ductility decreased.

3. CONCLUSIONS

An experimental investigation of seismic resistance of square RCST columns The following conclusions can be drawn from this investigation:

1. For the same column size and longitudinal reinforcing bars, RCST columns exhibit higher lateral strength, displacement ductility and greater energy dissipation than RC columns.
2. For the RCSTcolumns with the same concrete strength, as the axial load ratio increases, the lateral strength and energy dissipation increase, while the ductility decreases.
3. For the RCST columns with the same axial load ratio, as the concrete strength increases, the lateral strength and dissipation ability increases, while the ductility decreases.
4. The square tube with thewide-to-thickness (D/t) ratio used in this research may be used successfully to confine common strength or high strength RC columns to improve the column lateral strength and ductility.

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