EXPERIMENTAL INVESTIGATION ON MANUFACTURED SAND CONCRETE-FIILED STEEL TUBULAR COLUMNS

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Abstract
Steel members have the advantages of high ductility and tensile strength, while concrete members have the advantages of high compressive strength and fire resistance. Composite members made from steel and concrete, have the beneficial qualities of both materials. Concrete filled steel tube column is a recent concept. Concrete filled tube columns provide higher stiffness due to confined effect as compare to hollow steel tube column. Very few research works are conducted on concrete filled steel tube short columns. It is observed that this type column has more load carrying capacity. In this paper experimentation is carried out on three hollow specimens and nine specimens are concrete filled steel tube with variable ratio of diameter to wall thickness. All the composite column specimens tests are carried out under Universal Testing Machine.

Keywords: Composite column; concrete-filled steel tube column; Mild steel tube; Axial strain; Axial loading;

1. Introduction
Steel members have the advantages of high tensile strength and ductility, while concrete members have the advantages of high compressive strength and fire resistance. The enhancement of the concrete filled tube columns in structural properties can be reached because the steel tube provides confinement for the concrete, and the concrete core can prevent the inward buckling of the tube.

2. Experimental Program
Specimen preparation
As stated above, a total of 3 hollow and 9 CFST column specimens were prepared and tested under axial compression in the present study. The main parameters included the types of fine aggregates, i.e., manufactured sand (MS), the sectional steel ratio (defined as $\alpha = As/Ac$). Details of the test specimens are listed in Table1, where D is the outer diameter of the circular CFST specimens, t is the wall thickness of the steel tube, fcu is the measured compressive strength of standard concrete cubic samples under the same curing condition with the CFST specimens fy as the yield stress of the steel and fck as the characteristic compressive strength of the core concrete. For circular CFST specimens, three different tubular thicknesses (3.2, 4 and 4.8 mm) and height of each specimens is 600mm were designed to achieve the steel ratio α as 0.151, 0.208 and 0.257 respectively. The sectional diameter D of the circular steel tube is 88.7 mm.

Specimen labeling
1. The first letter of the label represents the cross-sectional shape: 'C' for circular cross section.
2. The first number of the label represents the nominal wall thickness of the steel tubes: for circular specimens, '3' for 3.2mm, '4' for 4mm, and '5' for 4.8mm.
3. The following two letters represents the type of fine aggregate of the core concrete: 'MS' for manufactured sand.
4. The last number, i.e., '1', '2' or '3', represents the serial number of the three reference specimens.

Table 1, Information of the CFST specimens.

NO.	Sectional profile	Specimen label	D (mm)	t (mm)	Types of fine aggregates	Fcu (MPa)	α
1		C-3-MS-1	88.7	3.2		30.8	0.151
2		C-3-MS-2	88.7	3.2		30.8	0.151
3		C-3-MS-3	88.7	3.2		30.8	0.151
4		C-4-MS-1	88.7	4		30.8	0.208
5	Circle	C-4-MS-2	88.7	4	Manufactured sand (MS)	30.8	0.208
6		C-4-MS-3	88.7	4		30.8	0.208

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7		C-5-MS-1	88.7	4.8		30.8	0.257
8		C-5-MS-2	88.7	4.8		30.8	0.257
9		C-5-MS-3	88.7	4.8		30.8	0.257

Experimental results

3.1. Typical failure modes of the tested CFSST specimens

The failure patterns of the circular CFST specimens after testing are displayed in Fig.3. The circular CFST specimens had obvious local buckling at the mid-height of the tube. The steel exhibited very good deformation ability, where no fracture was observed the tested specimens even under severe buckling conditions. The failure modes of all CFST specimens were outward buckling instead of inward buckling due to the inner support provided by the core concrete.

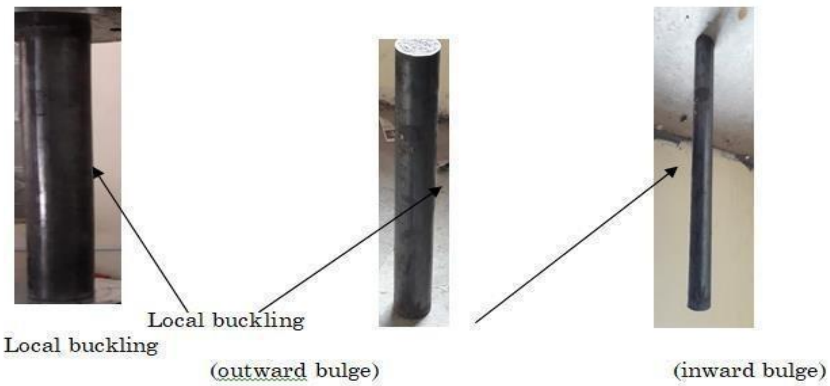

Fig.3 Buckling effect of circular column

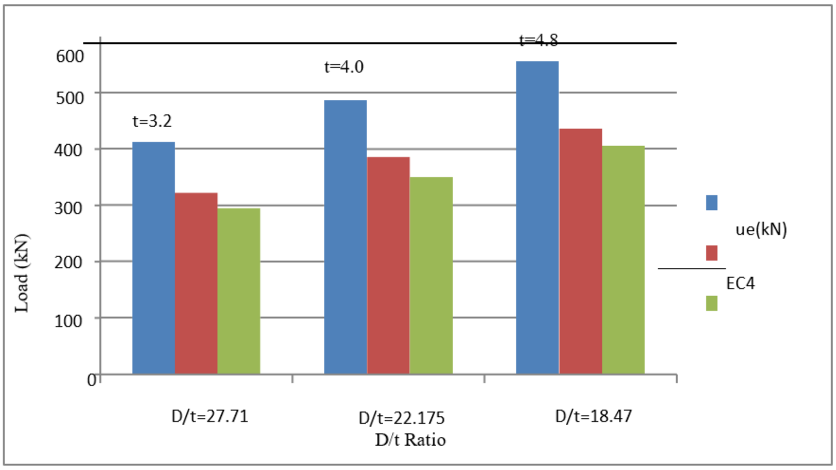

Fig.6 Comparison of the ultimate capacity of the tested CFST specimens

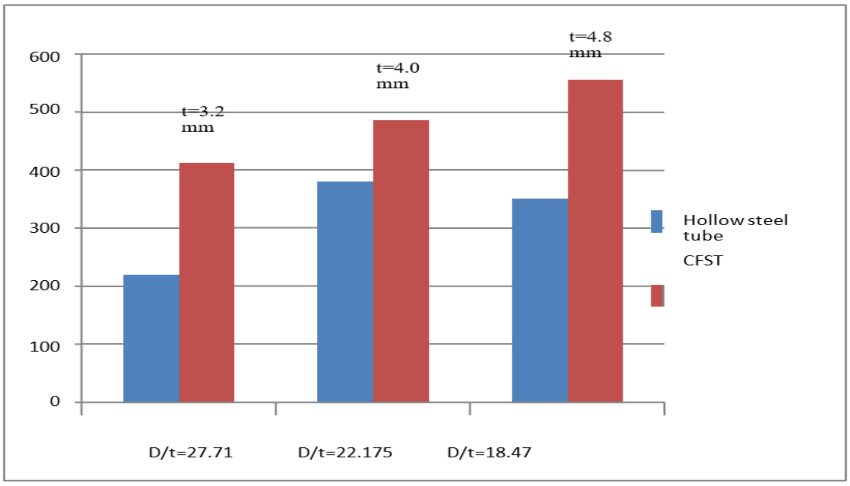

Fig.7 Comparision of the ultimate capacity of the hollow specimens and CFST specimens

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Conclusion

EC4 gives 27% to 15% lower strength than experimental strengths. ACI/AISC gives 30% to 10% lower strength than experimental strengths. Ultimate strength increases 1.87 times in concrete filled tube column than hollow steel tube. Generally, manufactured sand CFST specimens showed excellent ductility during the axial compression tests. The failure mode of such type of composite columns were outward buckling at mid height.

References

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