Experimental Research on Seismic Behavior of New CFT column-CFT beam Frame Structure

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1. Introduction

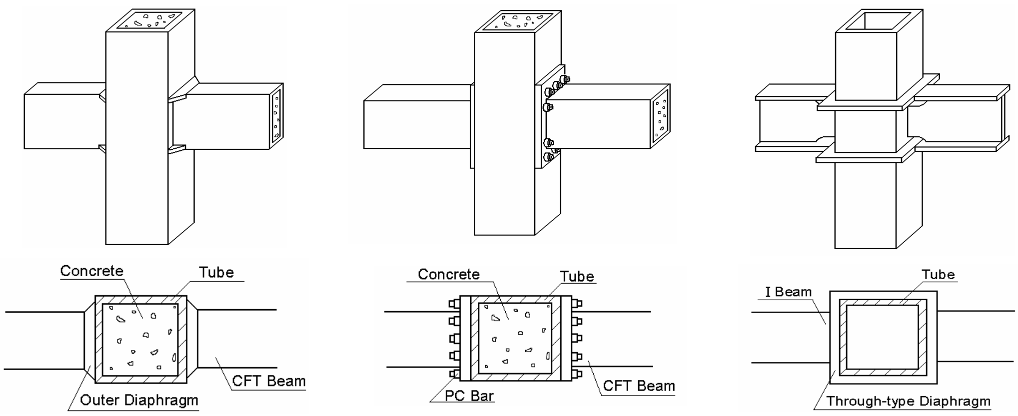
A concrete filled steel tube (CFT) structure has the merits of the high tensile strength and ductility of steel in addition to the high compressive strength and stiffness of concrete. Although many researches have been done on CFT column systems during the past several decades, almost all of them were limited to CFT column-steel beam systems. No information on CFT column-CFT beam systems is available until now. Conventional concrete can be introduced to CFT column; however, it impossible to be introduced to CFT beam due to need of vibrating compaction work. Self-compacting concrete (SCC) can be compacted into every corner of a formwork purely by means of its own weight without need of vibrating compaction. The character of SCC makes it possible to be applied to CFT beam.

In this research program, CFT column-CFT beam joint specimens were designed and tested aimed to investigate the seismic behaviour of the new CFT structure. A pure steel specimen made up of hollow tube column and I beam was design and tested as well in order to make comparison with the new CFT structure.This paper presents design details and cyclic loading experimental results of these specimens.

2. Joint Detail and Test Procedure

Three specimens including two CFT specimens and one steel specimen were tested in the experimental work. Outer diaphragm and PC bar joint details were employed in two CFT specimens respectively. Through-type diaphragm was employed in steel specimen. The joint details are shown in Fig1.Dimensions of the connection specimens were chosen basing on a real 10-story steel prototype building. 56% scale connection specimens were employed. Column dimension of specimen is 250× 250× 6 for CFT, and 250× 250× 12 for steel. Beam dimension of specimen is 250× 150× 9 for CFT, and 294× 200× 8 for steel. Yield strength of steel is 245MPa; compressive strength of concrete is 80MPa. In order to avoid air entrapment occurs at each corner of the connected regions, four 4mm holes were drilled on each side of beam to drain off the inner air of the specimen.

A typical test setup is shown in Fig2. 1000 KN axial load was applied to the columns first. This value was remained constant during the whole period of test. Equal and opposite vertical loads were then cyclically applied to the end of



(a) CFT-1 (b) CFT-2 (c) Steel

Fig1. Joint Details

Keywords : CFT Column-CFT beam joint, seismic behavior, self-compacting concrete
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beam. The cyclic load history is shown in Fig3. Table1 shows mix-proportioning of SCC.

3. Test Results and Discussion

Load-drift angle responses were used to compare the performance of each specimen. The drift angle of the specimen was calculated as the ratio of the total relative vertical displacement between the two ends of the beam to the distance between the two ends. Fig4 shows the load-drift angle relationship of each specimen. Failures of all CFT connection specimens were due to fracture of the weld that attached the beam flange to tube or PC bar flange, as shown in Fig5. CFT-1 was not able to develop plastic capacity of beam due to precocious weld fracture. Specimen CFT-2 was not able to develop full plastic capacities of the beam due to the brittle weld fracture. The substantial deformation capacity expected was obtained in Specimen CFT-2. No failure occurred in steel specimen until end of test. The hysteresis loops of CFT specimens were plumper than that of steel specimen, which indicated a higher energy dissipation capability of CFT structure.

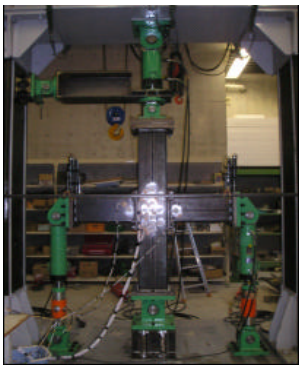


Fig2. Typical Test Setup

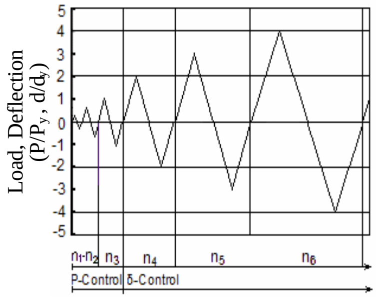
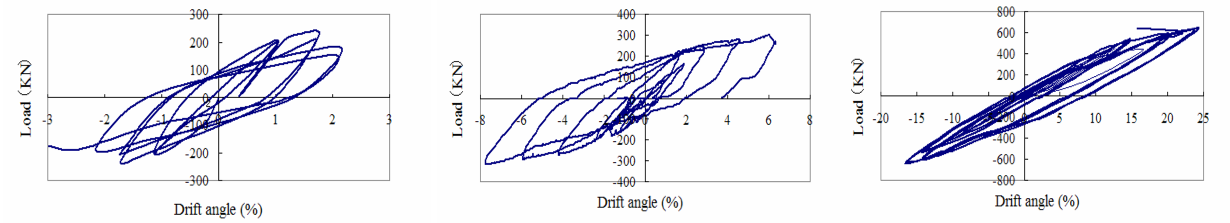


Fig3. Load History

Table1. Mix-proportioning of SCC (kg/m^3)

W/C	C	W	Fly Ash	S	G	Ad
34.5	492	170	170	851	772	9.6



(a) CFT-1 (b) CFT-2 (c) Steel

Fig4. Load-drift Angle Responses of Each Specimen

4. Conclusions

1) The experiment result shows that self-compacting concrete (SCC) can be successfully compacted into beam tube, which indicates that CFT column-CFT beam frame can be made using SCC.

2) Substantial deformation capacity expected was obtained in PC bar jointed CFT column-CFT beam joint specimens. Insufficient thickness of PC bar flange led to a little larger deformation of PC bar flange.

CFT-1 CFT-2

Fig5. Weld fracture in CFT specimens

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