Experimental Investigation of Concrete Filled in Steel Tubular Columns

Princy
Dept of Civil Eng-
St.joseph's College Of Eng&Technology.

K. Sivasankari
Dept of Civil Eng-
St.joseph's College Of Eng&Technology.

T. Arul Jacob
Dept of Civil Eng-
St.joseph's College Of Eng&Technology.

Abstract:- **Concrete filled steel tubular columns are becoming widely used in engineering .The effects of change in length of the tube, diameter of the tube, strength of the infill concrete and percentage variation of concrete. CFT applications in buildings and the importance of bond stress are studied. The effect of concrete was also investigated. The bond carrying capacity is interrelated with slip between steel and concrete interface. From the experimental study it was found that the bond stress decreases with increasing in percentage of Concrete.**

Keywords: Bond Strength, Composite column, CFT, in filled tubes, Oyster shell, Push out test.

I. INTRODUCTION

Composite steel concrete columns have been widely used in recent decades. The use of concrete filled steel tubular columns (CFTs) in high rise buildings has become popular in recent years as they provide several advantages over reinforced concrete or pure steel columns. Two types of composite columns, those with steel sections encased in concrete and those with steel sections in-filled with concrete are commonly used in building (Shanmugam and Lakshmi 2001). Steel members have the advantages of high tensile strength and ductility, while concrete members have the advantages of high compressive strength and stiffness. (Ahmed Elremaily and Atorod Azizinamini, 2002) focused on the behaviour and strength of with the diameter-to-thickness ratio of 34 to 51, filled with the high-strength concrete of (34 to 103Mpa). The results of these tests exhibit very high levels of energy dissipation and ductility. Push out test is the common method to evaluate the bond carrying capacity of the CFT columns.Compression strength of the concrete core is one of the important parameter to affect the bond strength of CFT columns using expansive cement (Chang Xu, 2007). Though researches made push out test of CFTs have been carried out for many years. Those include the work of (Roader Charles and Cameron Brad, 1999). Experimentally (Dung and Tsong Yen, 2002) were studied rectangular CFT columns with high strength concrete of 29 to 54Mpa (Gengying, 2002). Strength of concrete filled steel tubular columns by the use of fly ash was studied (Gengying, 2005). From these researches bond strength and compressive strength of CFTs can be improved by adding fly ash. (Mouli and Khelafi. 2007) studied the strength of short composite rectangular

EXPERIMENTAL WORK

Push out test is emerging as an important experimental tool for characterizing the interfacial behavior of the steel tube and concrete in concrete filled steel tube columns. The main objective of this study is to improve the bond carrying capacity of the concrete filled steel tubular columns using the mineral admixture Oyster shell of materials (sand, aggregates and cement) and similar casting and curing procedures were adopted throughout the test program. For each mix standard cube tests were used to determine the compressive strength of the concrete. A total of 30 cubes were prepared by adding different percentage of Oyster shell in concrete and tested on a compression testing machine of 2000kN capacity after 7 days and 28 days of curing.

MATERIAL PROPERTIES

Concrete and steel are the two important materials used to carry out the experimental work.

CONCRETE

Concrete and steel are the two important materials used to carry out the whole experimental work. The mix design of concrete grade was carried out in accordance to the Indian standard code. In this paper the addition of Oyster shell was also studied. The chemical analysis of cement and Oyster shell are presented in table 1. The coarse aggregate was well graded with a maximum size of 12mm; the fine aggregate was river sand with a fineness modulus of 2.74. Mix proportion of cement, sand, aggregates of 1:2:4 and a water cement ratio of 0.4 are used in this paper. All specimens were cast from the same delivery.

All circular tubes were fabricated with high yield strength of Yst 310 according to the code of Indian standard 1161. Standard coupon test were conducted to carry out the properties of steel. Test coupons were cut from the steel tube section, and the testing was done based on ASTM – A370 procedure. Properties of steel tube are shown in table

2.3 COMPRESSIVE STRENGTH TEST

The compressive strength of concrete is one of the most important properties of concrete. Concrete specimens of 150 x 150 x 150 mm cubes were cast with different proportions of concrete. After 24 hours the specimens are moulded and subjected to curing, the cubes are then allowed to become dry for some hours, for each proportions triplicate specimens were cast. The cubes are tested in the compressive testing machine. The ultimate load at which the cube fails was taken. The mix proportion used was M20 Grade.

Chemical Constituents	Percentage	
	Cement	Oyster shell
SiO2	20.1	0.696
Al2O3	5.34	0.419
Fe2O3	2.4	_
CaO	60	95.994
MgO	2.08	0.649
SO3	3.2	0.724
Na2O	0.45	_
K2O	0.32	0.204
Tio2	0.34	-
C3S	49	-
C2S	20	-
C3A	9.7	-
C4AF	7.48	-

Thickness(mm)	4.85
Width(mm)	12.4
Cross Sectional area(mm2)	60.47
Yield Stress (N/mm2)	319
Yield Load (KN)	19.29
Tensile Load(KN)	27.96
Tensile Stress (N/mm2)	462.31
Initial gauge length(mm)	50.21
Final gauge length (mm)	61.02
% of Elongation	21.53

TABLE 2: COMPRESSIVE STRENGTH OF OYSTER SHELL CONCRETE

S.No	Descripti on	Strength N/mm^2		
		7days	21 days	28days
1	Cc	27.78	36.44	40.44
2	OS 5	28.00	36.67	40.89
3	OS 10	28.09	36.89	41.24
4	OS 15	28.22	37.07	41.47
5	OS 20	28.44	37.33	42.13
6	OS 25	27.87	36.49	40.49
7	OS 30	27.96	36.80	41.07
8	OS 35	28.13	37.16	41.64
9	OS 40	28.27	37.24	42.00

2. SPLIT TENSILE STRENGTH

The split tensile strength of concrete is one of the most important properties of concrete. Concrete specimens of 150mm height & 300mm diameter cylinders were cast with different proportions of concrete. After 24 hours the specimens are moulded and subjected to curing, the cubes are then allowed to become dry for some hours, for each proportions triplicate specimens were cast. The ultimate load at which the cube fails was taken. The mix proportion used was M20 Grade. Results are compared with the reference specimen.

Specimen Designation	Diameter(mm)	Length(mm)	Thickness(mm)	L/D ratio	Compression load Fu (KN)	Compression in strength Fc(KN)	Bond Stress fb(n/mm2)
CCFT1	150	300	5	2	231.651	53.4	1.338
CCFT2	150	300	5	2	225.697	54.2	1.296
CCFT3	150	300	5	2	218.990	53.1	1.349

TABLE 3: SPLIT TENSILE STRENGTH OF OYSTER SHELL CONCRETE

S.No	Description	Strength N/mm^2		
		7days	21 days	28days
1	Cc	2.42	3.11	3.52
2	OS 5	2.46	3.21	3.64
3	OS 10	2.52	3.31	3.73
4	OS 15	2.62	3.49	3.90
5	OS 20	2.65	3.59	4.06
6	OS 25	2.42	3.13	3.58
7	OS 30	2.51	3.18	3.71
8	OS 35	2.56	3.31	3.86
9	OS 40	2.61	3.47	3.95

CONCLUSION

An experimental study on circular concrete filled steel tubular columns. Parameters for this study included the length to diameter ratio of the steel tube, grade of concrete and the effect of conventional concrete.The influence of these parameters on the confinement of the concrete core, bond carrying capacity of the CFTs was investigated. Based on the results of these investigations, the following conclusion is obtained. The bond stress is high in the oyster shell.

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