Experimental Investigation CFST Column Infilled with Light Weight Concrete at Different Temperature under Compression

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***Abstract* : An experimental and analytical investigation of concrete-filled steel tubular (CFST) columns is presented. composite circular steel tubes- with light weight concrete as infill for three different grades of light weight concrete say M20,M30 and M40 are tested for ultimate load capacity and axial shortening , under cyclic loading. steel tubes are compared for different lengths, cross sections and constant thickness. From this research study it is expected that ,regression models which were developed with minimum number of experiments based on taguchi's method predicted the axial load carrying capacity very well and reasonably well at ultimate point. Cross sectional area of steel tube has most significant effect on ultimate load carrying capacity also it is observed that, as length of steel tube increased- load carrying capacitydecreased.**

Keywords : Composite Columns, Hallow Steel Tubes, Light Weight Concrete Filled Steel Tubes, light weight concrete

1. INTRODUCTION

As the light weight concrete has lesser density (300kg/m3-1850kg/m3) than conventional concrete density (2200kg/m3-2600kg/m3) it will have ease of handling, transporting & reduced dead load in case of High rise building. Also its cellular structural arrangement helps in good insulation from heat & sound. In order to reveal the performance of CFT columns, specimens will be designed for Axial compression Cyclic loading. The Concrete that will be considered is Light weight concrete for infill in steel tubes. Based on these factors, failure patterns & influence of Light weight concrete slenderness ratio to Ultimate load ratio, Energy absorption capacity, & Modulus of resilience are analyzed. Practical importance of this study is in the application of this system to "seismic resistance structures prone toearthquakes

1.1 CFST (Concrete Filled SteelTube)

Composite Steel Concrete construction has been widely used in many Structures such as Building and Bridge .The concrete encased composite column is one of the common composite structural elements. At the same time, due to the traditional separation of structural Steel and Reinforced Concrete Design and Construction, this type of Column has not received the same level of attention as Steel or Reinforced Concrete Column. Composite Structures from Concrete Steel section show considerable larger stiffness, stability and load carrying capacity in comparison with steel construction .An increase of corrosion and fire resisting is an addition advantage of concrete element. The use of steel- concrete composite columns, such as concrete-encased steel (CES) and concrete-filled steel tube (CFT) columns, has increased in the construction of high-rise buildings and long-spanstructures.

1.2 Light WeightAggregates

1.3 Light weight aggregates are the aggregates which possess a very light density which makes it advantageous over conventional aggregates since it Materials Used and Mix Proportions

1.3.1 Materials Used

Steel

Material: TATA steel

Young'smodules

E=310000Mpa

Poison ratio v= 0.3

Density p=7850kg/m3

Concrete

Light Weight Concrete

Grade of concrete =M20,M30,M40
E=22360.70000Mpa(M20),27386.12(M30),and 31622.78(M40).

Poison ratio v= 0.2 Density p=1850kg/m3

Fine Aggregates

The aggregate which is passing through 2.36 mm sieve is known as fine aggregate. Locally available river sand which is free from organic impurities is used sand passing through 2.36mm sieve and retained on 150 micron IS sieve is used in this investigation. The physical properties of fine aggregate like specific gravity, bulk density, gradation and fineness modulus is tested in accordance with IS: 2386-1975.

provides better block work and faster work

Light Weight Coarse Aggregates

The LW coarse aggregate of 12mm sieve 10 mm retained rounded obtained from the local crushing plant; (BANGALORE, Karnataka) is used in the present study. The physical properties of coarse aggregate like specific gravity, bulk density, gradation and fineness modulus are tested in accordance withACI211.2-98

Cement

Ordinary Portland cement of 53 grade was used and tested for physical and chemical properties and found to be conforming to various specifications as per

IS: 12269-1987. Specific gravity= 3.10

Normalconsistency =30%

Initial setting time =38min

Compressive strength (i) for 7 days=36N/mm^2 (ii) for

14 days=43 N/mm^2 (iii) for 28 days=53 N/mm^2

Water

As per IS 456:2000, water used for both mixing and curing should be free from injurious amount of deleterious materials. Portable water (tap water) is generally considered satisfactory for mixing and curing concrete

1.3.2 MixProportions

Mix Proportion for M30 grade

Converting Into LWC Proportions:The normal concrete mix proportions are modified as per ACI specifications and different trail mixes and cast. By considering the fresh properties and harden properties of the mixes LWC mixed proportions are

Cement =401.85kg/m3

Fineaggregate =646.35 kg/m3

Coarse aggregate = 589.6 kg/m3

Water =217kg/m^3

The Mix Proportions Are:

Table-1 Mix proportions for M30 Grade

SL.NO	MATERIALS	MIX PROPORTION
1	CEMENT	1
2	FINE AGGREGATES	1.608
3	COARSE AGGREGATES	1.467
4	WATER	0.541

Concrete Mix Proportion for M20 grade

Cement = 332kg/m3

Fineaggregate =760.75 kg/m3

Coarse aggregate = 608 kg/m3

Water =186.09kg/m^3

The Mix Proportions Are:

Table- 2 Mix proportions for M20 Grade

SL.NO	MATERIALS	MIX PROPORTION
1	CEMENT	1
2	FINE AGGREGATES	1.76
3	COARSE AGGREGATES	1.78
4	WATER	0.6203

Concrete Mix Proportion: M40 Grade

Cement = 504kg/m3

Fineaggregate =544.2 kg/m3

Coarse aggregate =589.6 kg/m3

Water =217kg/m^3

The Mix Proportions Are :

Table-3 Mix proportions for M40 Grade

SL.NO	MATERIALS	MIX PROPORTION
1	CEMENT	1
2	FINE AGGREGATES	1.079
3	COARSE AGGREGATES	1.1698
4	WATER	0.430

1.3.3 RESULTS AND DISCUSSIONS

2.1 *Test for Compressive Strength*

The compressive strength of concrete is often considered the most important property of concrete, and is the most common measure used to evaluate the quality of hardened concrete.

Table- 2.1 Split Tensile Strength

Fig-2.2 Values of cubes after compression

In this investigation light weight concrete cubes of150mm150mm×150mm size were used for testing the compressive strength. The cubes were tested in a compression testing machine of capacity 2000KN.

Compressive strength is calculated by,

fc = P/A

where, fc = Cube compressive strength in N/mm2 P = Cube compressive failure in N A = Cross-sectional area of cube

Test for Split TensileStrength

The split tensile strength of concrete was obtained indirectly by subjecting concrete cylinders to the action of a compressive force along two opposite generators. In this investigation self compacting cylinder of 150mm dia×300mm length were used for testing the compressive strength The split tensile strength is calculated by using the formula

$$\sigma_{sp} = \frac{2P}{\pi DL}$$

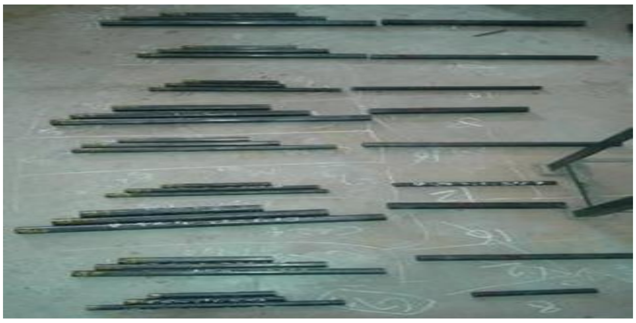

FIG- 2.3 Steel specimens used

Sl. No	Specimen	Specimen no	Age of Cube in Days	C/S Area of cube in mm2	Load in tons	Compressive strength in N/mm2	Average in N/mm2
1	M20	1	7	225	28	12.4	13.3
							1
		2			30	13.33	
		3			32	14.22	
2	M20	*1*	28	225	48	21.33	23.10
		2			55	24.44	
		3			53	23.55	
3	M30	*1*	7	225	45	20.00	19.84
		2			42	18.66	
		3			47	20.88	
4	M30	*1*	28	225	71	31.55	32.58
		2			74	32.88	
		3			75	33.33	
5	M40	*1*	7	225	65	28.88	29.03
		2			67	29.77	
		3			64	28.44	
6	M40	*1*	28	225	96	42.66	42.36
		2			94	41.77	
		3			96	42.66	

5.2. Graphical representation of experimental result

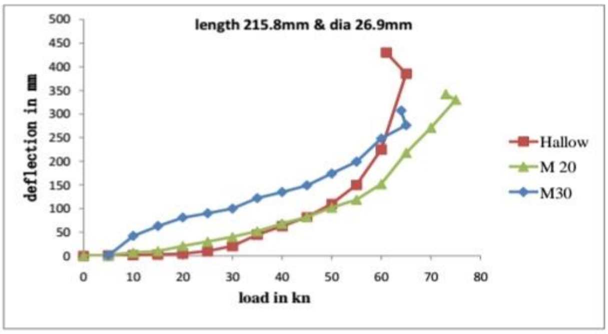

Fig.5.2.1: load v/s deformation comparison for same diameter of 26.9mm and same length 215.8mm for different grades of concrete.

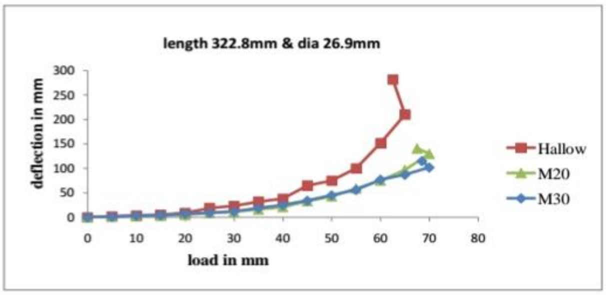

Fig.5.2.2: load v/s deformation comparison for same diameter of 26.9mm and same length 322.8mm for different grades of concrete.

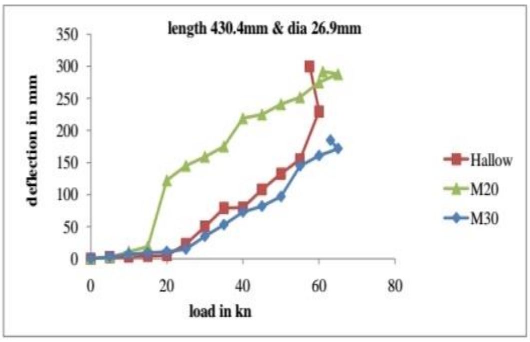

Fig.5.2.3: load v/s deformation comparison for same diameter of 26.9mm and same length 430.4mm for different grades of concrete..

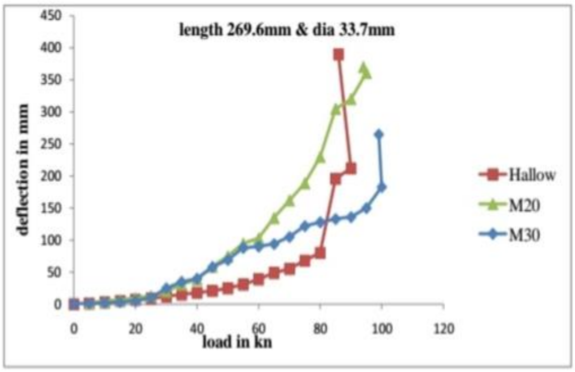

Fig.5.2.4: load v/s deformation comparison for same diameter of 33.7mm and same length 269.6mm for different grades of concrete.

3. CONCLUSIONS

The present study has shown that the use of LWC has a considerable increase in compressive, flexural and split tensile strength with reduced self weight in alternate to normal conventional concrete.

4. The compressive strength for M20, M30, and M40 grade of cement for 28days have given a satisfactory results as fallows 23.1 N/MM^2, 32.58 N/MM^2,

1) 42.36 N/MM^{2}.

1) 2.The LWC developed split tensile strengths ranging from 3.67 N/mm^2 , 4.14 N/mm^2 and 4.66
2) N/mm^{2}for M20

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