ANALYSIS OF COMPOSITE STEEL TUBE INFILLED WITH LEIGHT WEIGHT CONCRETE AND SELF COMPACTING CONCRETE USING ANSYS-14.0

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Abstract

To know the clear knowledge about self compacting concrete and light weight concrete when Infilled with composite steel tube and behavior take place after loading on both the Infilled concrete using non linear method by ansys software. The results, that obtained the difference in self compacting and light weight concrete says M20, M30, M40 are testing for ultimate of load capacity is published in this paper. Steel tube is comparing of different dimension of cross section of diameter, thickness' and length. This is the paper focused on the Infilled concrete filled with steel tube.

Keywords: *CFST, Light Weight Concrete, Self Compacting Concrete ,Hollow Steel Tube, Ansys-14*

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1. INTRODUCTION

Concrete Infilled steel tube column members utilized the both the concrete and steel . They are comprised of a hollow steel section of the circular Infilled with a plain concrete of mixture. This are broadly using in a large-rises building or tall structure as beam-column and columns, and as beams in small-rise building where an efficient structural systems is a required for better. There is many different advantageous relations to the such a structural system in both wise of structural performed and the constructions context. The local buckling problems related to thinned-wall structure of steel tubes are restricted due to the appearing of the core of concrete. Further, they performed when there is concrete in-filled is improvised due to confined effectively exerting by steel member. The distributions of the material in cross sections make the systems very efficiently in the term of which its structurally performed. Then steel lying in the circumstance of concrete material where it performed most effectively in tensile and flexure.

2. CLASSIFICATION OF CFT MEMBERS

There are several or different types of column Infilled steel tube as shown in figure:

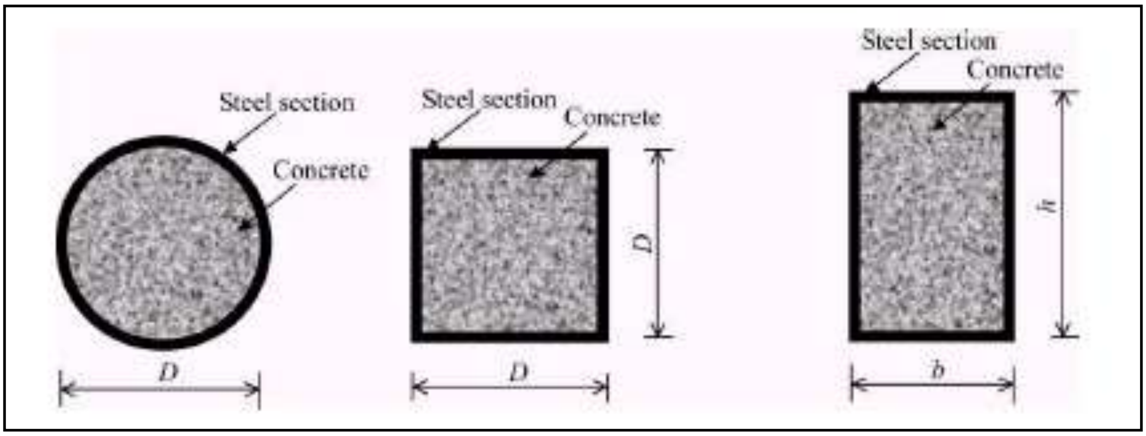

Fig 1 a) circular b) square c) rectangular

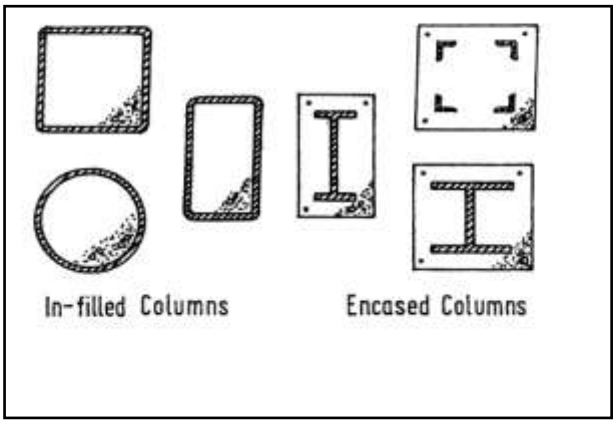

Fig 2 a) Infilled columns b) Encased columns

3. ADVANTAGES OF CFT USING ENCASED COLUMNS

Composite columns combined the advantage of the both a concrete & steels, such as the speed of strength, construction, & light weight steel, & mass, damping, stiffness, & economic of concrete. The steel column served as a straight frame to complete the constructions of remaining of the structures. Thus for ductility improving. Prolong concluding that concrete Infilled delayed the global buckling of steel tubes. However, not increased in material strength of concrete due to the confined of steel tubes was taken in to account.

4. FINITE ELEMENT ANALYSIS (FEA)

FEA modeling is the analysis is conducted in ANSYS workbench modules [14.0], where material nonlinear is considered. Material modeling: Elastic–plastic model is utilized to describe a clear constitutive behavior of steels and multi-linear of the concrete & Bilinear properties for steel tube used. The modulus of elasticity of concrete is taken as √ 4700 according to the code IS 456:2000, where fck is compressive characteristic strength of concrete.

5. MATERIAL SPECIFICATIONS

The material properties are listed below.

STEEL
Material: - Steel Fe 310Mpa
Young's Modulus E=200×10^9pa
Poison ratio v=0.3
Density p=78KN/m3

CONCRETE
SELF COMPACTING CONCRETE (SCC)
Grade of Concrete: M20, M30, M40
Young's Modulus E=22360.7Mpa
Young's Modulus E =27386.12Mpa
Young's Modulus E= 31622.78Mpa
Poison's ratio v=0.16-0.3
Density p=2400kg/m

LIGHT WEIGHT CONCRETE (LWC)
Grade of concrete =M20, M30, M40
E=22360.70 Mpa
E=27386.12Mpa
E= 31622.78Mpa
Poison ratio v= 0.2
Density p=1850kg/m

6. BREIF DESCRIBE OF SOFTWARE'S USED

The following are the software's tools used below are;
- CATIAV 5
- HYPERMESH
- ANSYS 14.0

CATIA V5

CATIA software also used to design the geometry that is modeling this software gives more accurate 3-d modeling. Catia is the present software used for developmenting solution for all manufactured catiav5 using in the processing of the buildings the globe leading facilities for new research.

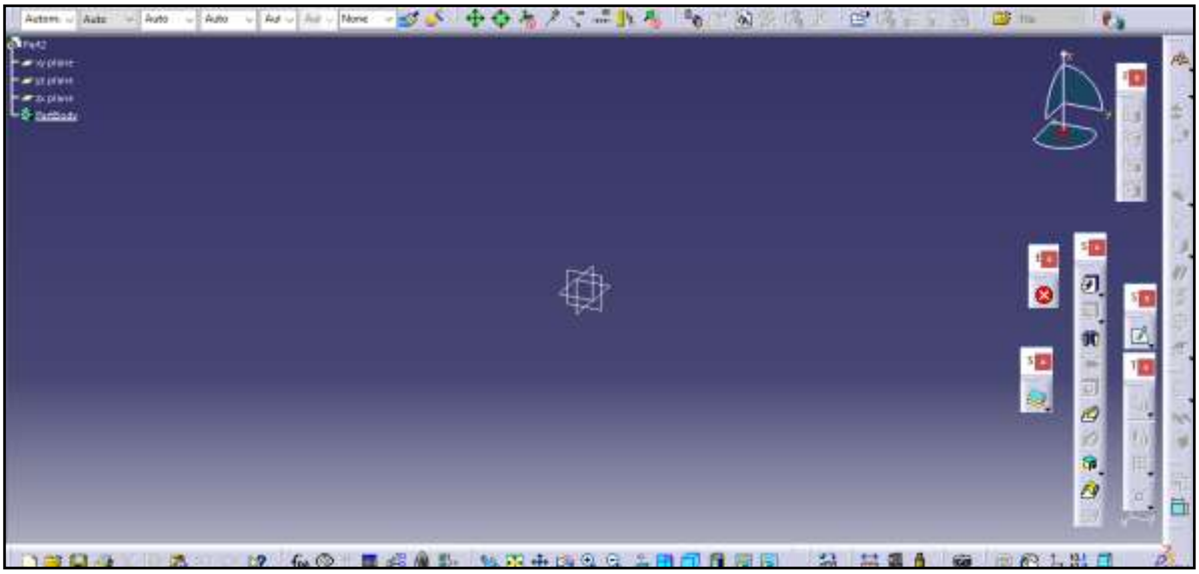

Fig 3 Main menus of CATIA V5

Hypermesh

HYPERMESH; - HY performance and therefore it is a performance finite element pre and post processer. Used for modeling the specimen and also for the purpose of analysis stands for high and per stands for performance and therefore it is a high

Flow Chart of the FEM Process

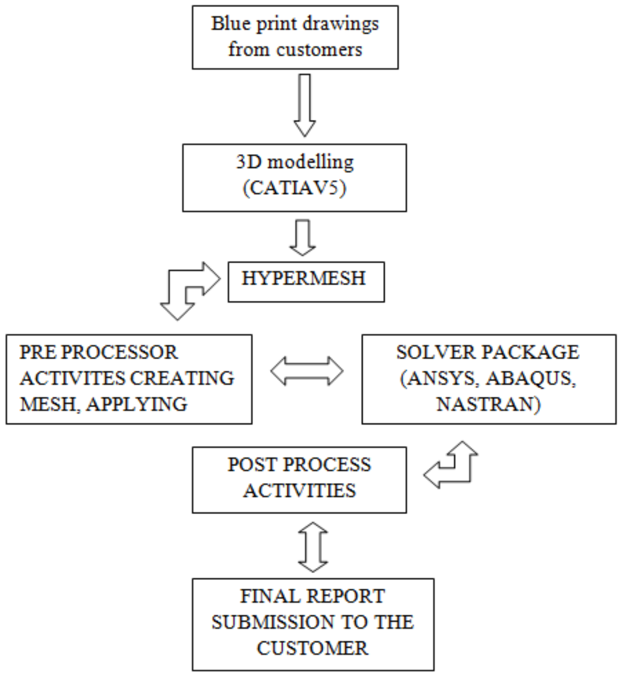

Fig 4 flowchart of hyper mesh

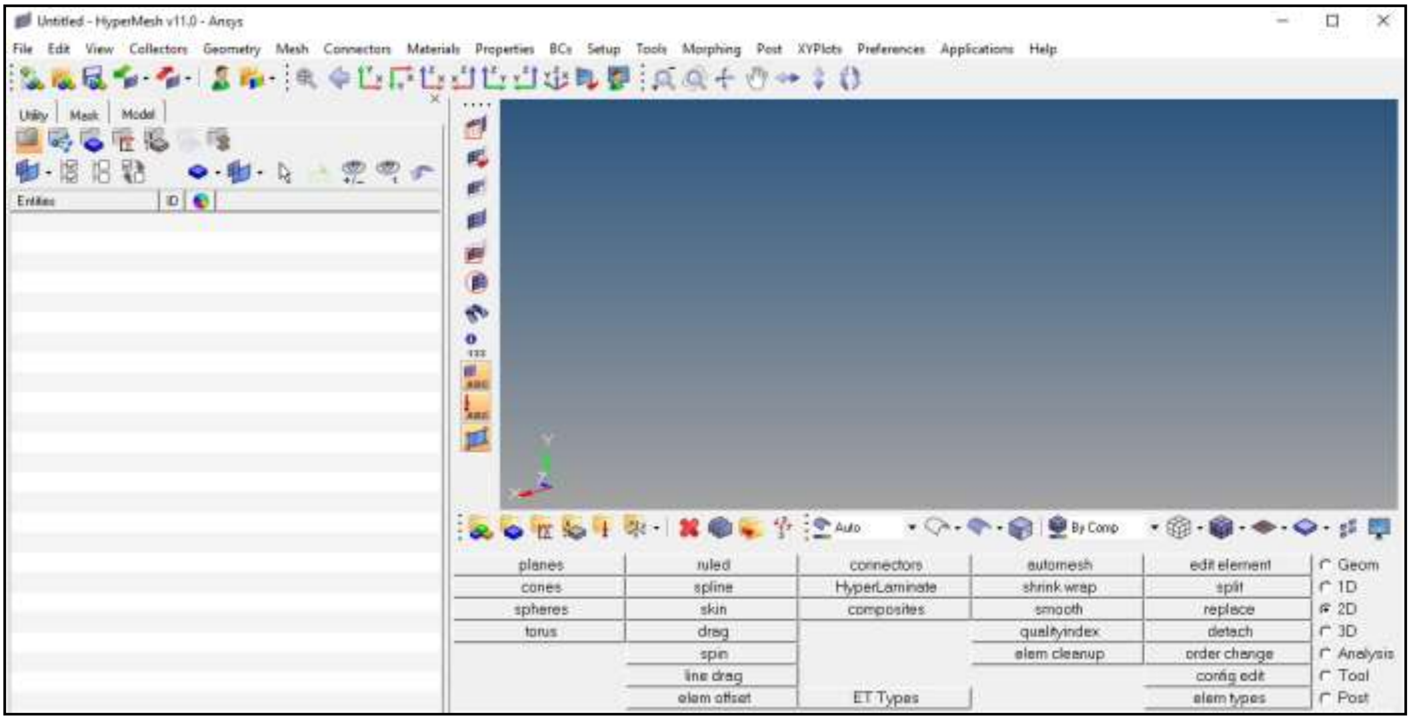

Fig 5 Main menu's of hyper mesh

Analysis

Finite Element Method

- For many of the technical engineering problem of analytical solution are not better suitable, because of the complexity of the material properties, grades, for different boundary conditions and the structure itself.
- Finite element method (FEM) is the represents of the structure by an assemblage of the subdivisions called finite element.

ANSYS

ANSYS is one of the commercial packages of FEM software having the capable of ranged from the simple, nonlinear, statical analysis to complex transient dynamic, nonlinear analysis. It will be available only in the module. Each modules is applicable for the specific problem. However, subsequently ansys: is the CFD package tool applicable for Fluid Flows. The advantages of the Ansys package comparing with different others competitive software is its available as bundle of software's of post Processor.

Modelling

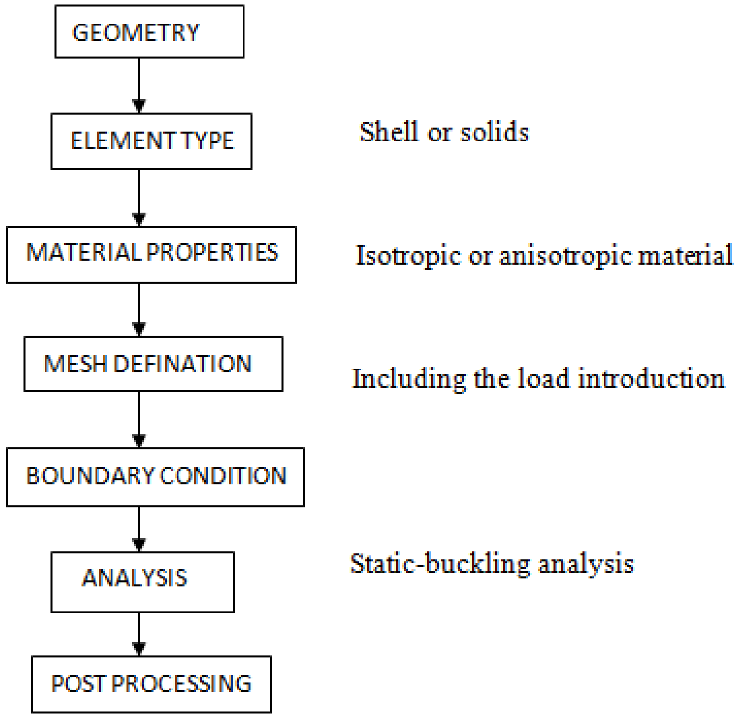

Fig 6 MODELLING PROCEURE

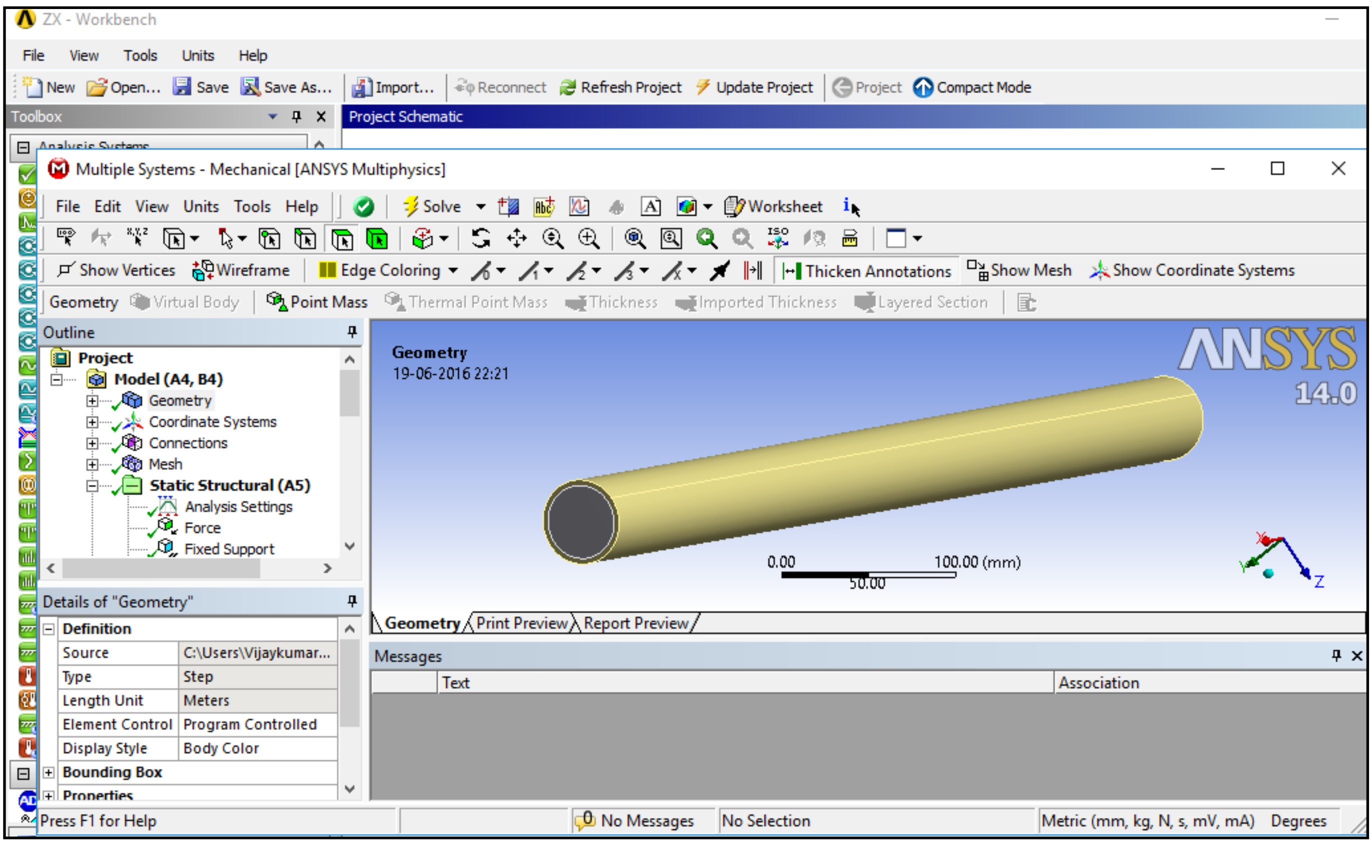

Fig 7 modeling in ansys

Ansys is used to selecting different types of various element. This will be providing one-Dimensional element (beam element) two-Dimensional element (shell element) and three-Dimensional element (solid elements) were found to be more efficiency in modeling of both concrete and steel tube structure because it gives good better masses.

7. DIMENSIONS OF CIRCULAR COLUMN AS PER L/D RATIO FOLLOWED.

Table 1:- DIMENSIONS OF CIRCULAR COLUMNS

(a) L/D ratio for 6, 12, 16

GRADE	DIAMETER (mm)	D/T (mm)	L/D	THICKNES (mm)	LENGTH (mm)
HOLLOW	33.7	10.5	6	3.2	202.2
			12	3.2	404.4
			16	3.2	539.2
	42.2	13.3	6	3.2	254.4
			12	3.2	508.8
			16	3.2	678.4
	48.8	15.1	6	3.2	289.8
			12	3.2	579.6
			16	3.2	772.8
M20	33.7	10.5	6	3.2	202.2
			12	3.2	404.4
			16	3.2	539.2
	42.2	13.3	6	3.2	254.4
			12	3.2	508.8
			16	3.2	678.4
	48.8	15.1	6	3.2	289.8
			12	3.2	579.6
			16	3.2	772.8
M30	33.7	10.5	6	3.2	202.2
			12	3.2	404.4
			16	3.2	539.2
	42.2	13.3	6	3.2	254.4
			12	3.2	508.8
			16	3.2	678.4
	48.8	15.1	6	3.2	289.8
			12	3.2	579.6
			16	3.2	772.8
M40	33.7	10.5	6	3.2	202.2
			12	3.2	404.4
			16	3.2	539.2
	42.2	13.3	6	3.2	254.4
			12	3.2	508.8
			16	3.2	678.4
	48.8	15.1	6	3.2	289.8
			12	3.2	579.6
			16	3.2	772.8

(b) L/D ratio for 8, 10, 12

GRADE	DIAMETER	D/T	L/D	THICKNES	LENGTH
HOLLOW	33.7	10.5	8	3.2	269.6
			10	3.2	337
			14	3.2	471.8
	42.2	13.3	8	3.2	339.2
			10	3.2	424
			14	3.2	594.6
	48.8	15.1	8	3.2	386.4
			10	3.2	483
			14	3.2	676.2
M20	33.7	10.5	8	3.2	269.6
			10	3.2	337
			14	3.2	471.8
	42.2	13.3	8	3.2	339.2
			10	3.2	424
			14	3.2	594.6
	48.8	15.1	8	3.2	386.4
			10	3.2	483
			14	3.2	676.2
M30	33.7	10.5	8	3.2	269.6
			10	3.2	337
			14	3.2	471.8
	42.2	13.3	8	3.2	339.2
			10	3.2	424
			14	3.2	594.6
	48.8	15.1	8	3.2	386.4
			10	3.2	483
			14	3.2	676.2
M40	33.7	10.5	8	3.2	269.6
			10	3.2	337
			14	3.2	471.8
	42.2	13.3	8	3.2	339.2
			10	3.2	424
			14	3.2	594.6
	48.8	15.1	8	3.2	386.4
			10	3.2	483
			14	3.2	676.2

8. RESULTS OF FINITE ELEMENT MODELS USING ANSYS 14.0

To check the finite element model, a comparisons between the Euro code and analytical results and is carried out. The ultimate loads obtained from the analytical method and finite element analysts (FEA) have been investigated. Table 2 shows comparisons of the ultimate loads of the concrete filled steel tube (CFST) columns obtained analytical and numerically using the finite element model. It can be obtained that good agreements has been obtained b/w two sets of the result for most of the composite columns.

Table 2:-results of LWC &SCC both Ansys and Euro code

GRADE	L/D	ANSYS LOAD(KN)		EURO CODE EUC4(KN)	
		SCC	LWC	SCC	LWC
	6	465.37	358.31	418.7	322.47
	8	264.20	203.42	234.3	180.8
	10	169.0	130.13	148.7	114.4
	12	117.40	90.424	102.1	78.665
	14	79.74	61.364	68.54	52.76
	16	66.30	51.232	56.3	43.54
	6	641.80	494.21	577.6	444.78
	8	363.61	279.8	323.2	249.11
	10	233.51	163.40	205.4	143.6
	12	162.24	124.94	141.1	108.05
	14	118.91	91.55	103.4	79.64
	16	91.41	70.41	77.6	59.85
	6	768.0	591.31	691	532.17
	8	435.0	335.1	387.1	298.15
	10	279.3	214.81	245.5	189.02
	12	191.5	147.0	166	127.89
	14	142.80	109.98	122	94.514
M20	16	109.51	84.388	93.0	71.655
	6	473.82	364.87	426.4	328.32
	8	269.0	207.27	239.4	231.34
	10	172.41	132.17	151.3	116.24
	12	119.64	92.17	104.0	80.12
	14	88.11	67.88	75.7	58.351
	16	67.52	51.95	57.3	44.19
	6	657.8	506.58	592.0	455.85
	8	372.6	286.97	331.3	255.34
	10	239.11	184.17	210	161.92
	12	166.12	127.91	144.5	111.27
	14	121.8	93.77	104.7	80.58
	16	93.62	72.09	79.5	61.27
	6	790.41	608.5	711.3	547.74
	8	447.01	344.55	397.	306.33
	10	287.2	221.0	252.7	194.6
	12	199.8	153.87	175.8	133.8
	14	146.8	113.02	126.4	97.18
M30	16	112.6	86.712	95.71	73.7
	6	481.0	370.31	432.9	333.27
	8	273.07	210.33	242.	187.16
	10	174.97	134.67	153.9	118.4
	12	121.40	93.48	105.6	81.253
	14	89.51	68.76	76.9	59.058
	16	68.511	52.757	58.0	44.83
	6	671.57	516.78	604.3	465.03
	8	379.98	292.57	260.3	260.32
	10	243.95	187.84	214.6	165.26
	12	169.21	130.35	147.2	113.36
	14	124.24	95.663	106.8	82.26
	16	95.48	73.511	81.14	62.4
	6	809.12	622.92	728.1	560.61
	8	458.11	352.81	407.7	313.99
	10	293.32	225.87	258.11	198.70
	12	204.45	157.46	177.81	136.1
	14	150.28	115.71	133.62	111.0
M40	16	116.27	89.31	98.71	75.90

9. COMPARISIONS OF SCC AND LWC FOR GRADE OF CONCRETE ALONG WITH L/D RATIO

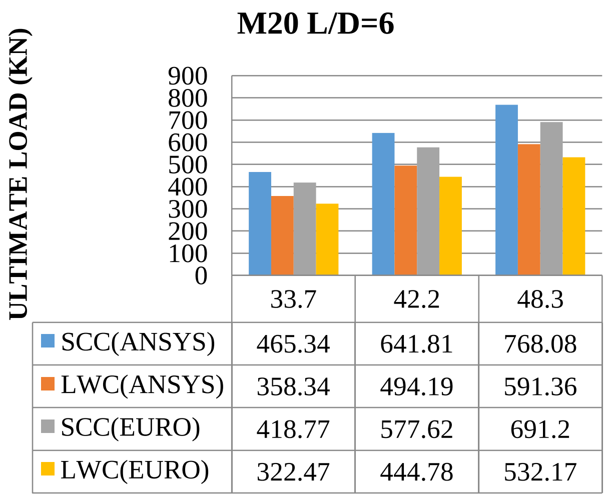

Chart-1 Grade of concrete M20 (l/d=6)

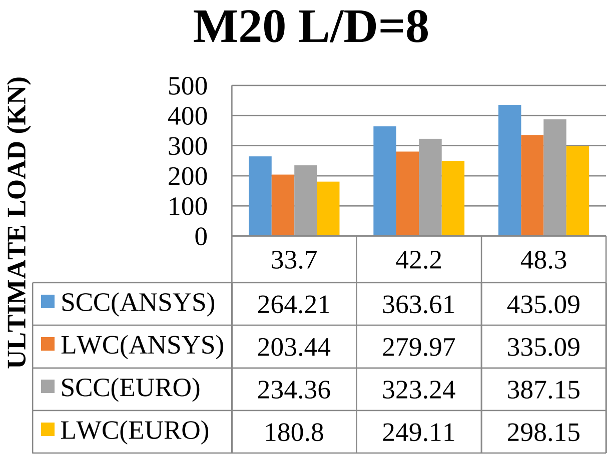

Chart-2: Grade of concrete M20 (l/d=8)

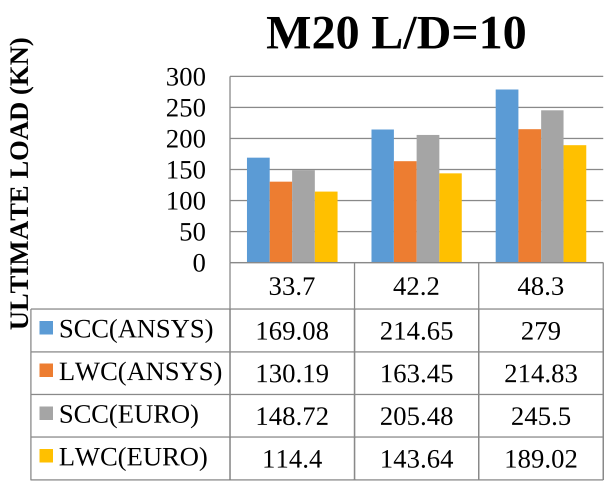

Chart-3 Grade of concrete M20 (l/d=10)

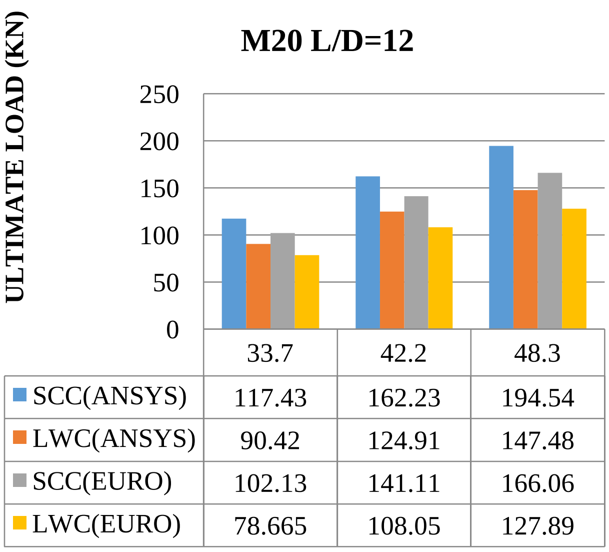

Chart-4: Grade of concrete M20 (l/d=12)

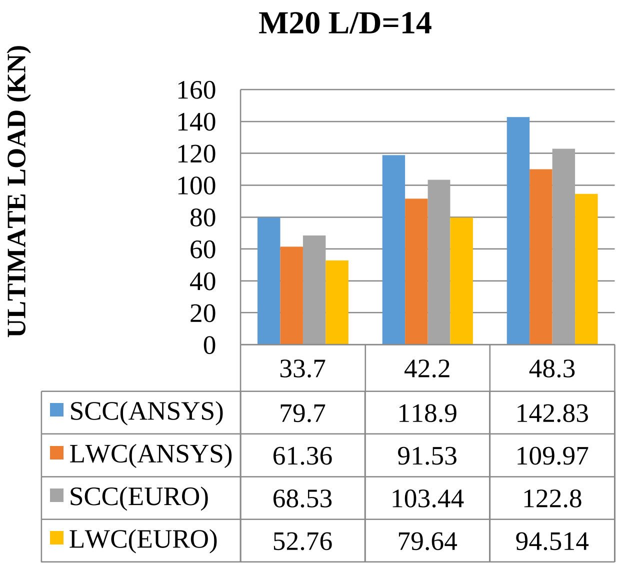

Chart-5: Grade of concrete M20 (l/d=14)

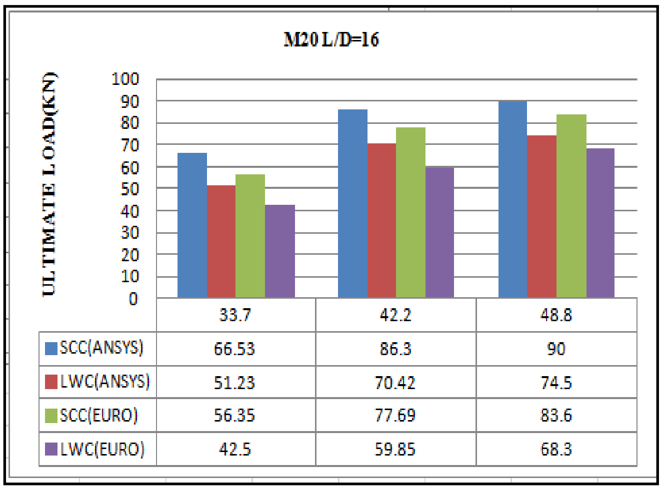

Chart-6 Grade of concrete M20 (l/d=16)

10. RESULTS TABULATED OF HOLLOW COLUMNS

Table 3; - Results of hollow column

GRADE	DIAMETER	D/T	L/D	THICKNESS	LENGTH	ANSYS LOAD(KN)
HOLLOW	33.7	10.5	6	3.2	202.20	425.0
			8	3.2	269.61	242.20
			10	3.2	337.0	155.42
			12	3.2	404.41	108.6
			14	3.2	471.81	73.267
			16	3.2	539.20	61.0
	42.4	13.3	6	3.2	254.41	591.7
			8	3.2	339.2	334.27
			10	3.2	424.0	214.60
			12	3.2	508.84	121.88
			14	3.2	594.64	109.37
			16	3.2	678.47	81.67
	48.3	15.1	6	3.2	289.8	662.97
			8	3.2	386.47	399.84
			10	3.2	483.0	256.44
			12	3.2	579.61	169.31
			14	3.2	676.22	131.30
			16	3.2	772.88	91.5

11. COMAPARISON OF HOLLOW STEEL TUBES

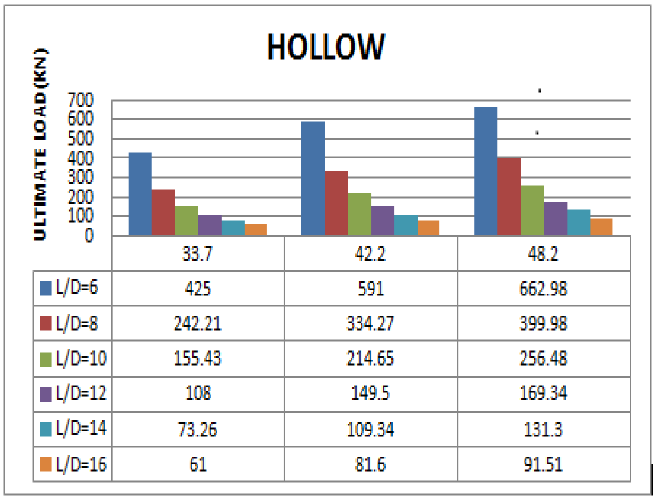

Chart-7: fundamental frequency of hollow steel tube

12. GLOBAL BULKING OF COLUMN

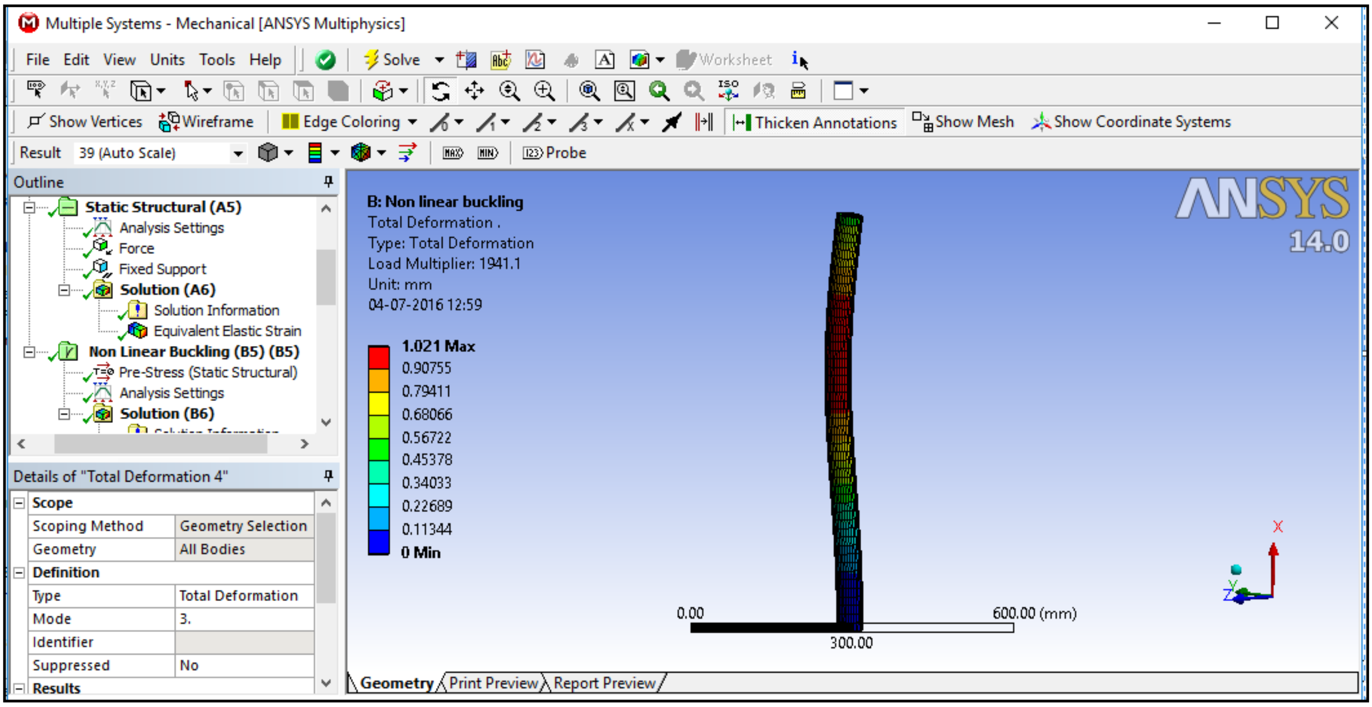

Fig 8 column bulked

12. CONCLUSION

“The Light weight concrete is low compressive strength than self compacting concrete, this will be cannot used for the constructions of structural parts or members, such as for a column, beam etc. But this can be effectively used in the constructions of floor slab, partition wall, ventilator, window, etc. The implementation of lieght [LWC] weight concrete more in the structural system lead to more economic. Therefore we can be concluded that”.

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