A Numerical Investigation of Conventional Column, Duplex Steel And Conventional Steel Column Using Ansys

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Abstract- *Use of stainless steel in construction industry is increasing day by day. High prices of stainless steel are mainly due to presence of nickel about 10-15%. But recently developed grade of stainless steel called as Duplex steel which contains low nickel as compare to stainless steel. Duplex steel have nickel less than 5 – 8 %. Despite of very low percentage of nickel lean duplex steel possess high strength than common stainless steel also have better corrosion resistance, weld ability, fire resistance, etc. Concrete filled steel tube(CFST) with conventional steel is mostly used composite structure in construction field. Nowadays use of duplex steel in CFST is been carried out on large scale due to its high advantages over stainless steel. This paper includes study of comparison of duplex steel and conventional steel in tapered and straight tapered straight (STS) CFST section using ANSYS (WORK BENCH) software. Relations between stress vs. strain curve and deformation vs. load are studied.*

Keywords- Duplex steel, conventional steel, CFST, ANSYS, tapered column, Straight Tapered Straight (STS).

I. INTRODUCTION

GENERAL

Concrete filled steel tube is a composite material which is currently being increasingly used in the construction of buildings. The use of concrete-filled steel tubular beams in high rise buildings has become popular in recent years. Concrete filled steel tube beams can provide excellent seismic resistant structural properties such as high strength, high ductility and large energy absorption capacity.

In the present era, creation of infrastructure facilities for the development of a country is the most important task of Civil Engineers. A multistoried building plays a vital role in the development of infrastructure facilities. In the light of construction of high rise buildings concrete filled steel tubes is one of such an innovative new building material, which can sustain worst combination of loads, with high stiffness and facilitating speeder construction and maintaining economy

The concrete-filled steel tube (CFT) column system has many advantages compared with the ordinary steel or the reinforced concrete system. One of the main advantages is the interaction between the steel tube and concrete: local buckling of the steel tube is delayed by the restraint of the concrete, and the strength of concrete is increased by the confining effect of the steel tube. Extensive research work has been done in Japan in the last 15 years, including the “New Urban Housing Project” and the “US-Japan Cooperative Earthquake Research Program,” in addition to the work done by individual universities and industries that presented at the annual meeting of the Architectural Institute of Japan (AIJ). This paper introduces the structural system and discusses advantages, research findings, and recent construction trends of the CFT column system in Japan. The paper also describes design recommendations for the design of compression members, beam-columns, and beam-to-column connections in the CFT column system

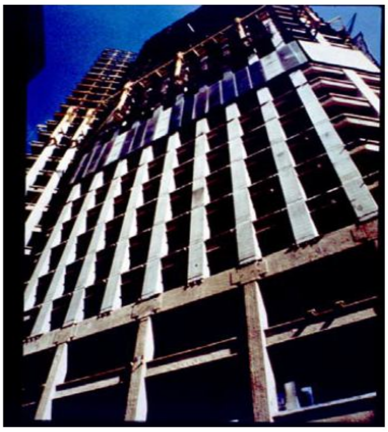


Fig.1 Composite column tube 3 Houston center Texax

1.2 STRUCTURAL SYSTEM

Figure 2 and Figure 3 shows typical connections between a CFT column and H-shaped beams often used in Japan. The connection is fabricated by shop welding, and the beams are bolted to the brackets on-site. In the case of connections using inner and through-type diaphragms, the diaphragm plates are located inside the tube, and a hole is opened for concrete casting. A cast steel ring stiffener is used for a circular CFT column. In the case of a ring stiffener and an outer diaphragm, there is no object inside the tube to interfere with the smooth casting of the concrete. Concrete casting is usually done by Tremie tube or the pump-up method. High strength and ductility can be obtained in the CFT column system because of the advantages mentioned below. However, difficulty in properly compacting the concrete may create a weak point in the system, especially in the case of inner and through-type diaphragms where bleeding of the concrete beneath the diaphragm may produce a gap between the concrete and steel. There is currently no way to ensure compactness or to repair this deficiency. To compensate, high-quality concrete with a low water-content and a superplasticizer for enhanced workability is used in construction.

1.3 ADVANTAGES OF CFT COLUMN

1.3.1 Advantages of Concrete Filled Steel Tube (Cfst) Applied In Resident Buildings

1. **The frame-tube system is adopted**
   The RC elevators can be used as structure to resist the lateral loads. For official buildings the frame-shear structure system can be used also. In which the shear-walls or braces are set on the symmetrical positions of plan.

2. **Large span of columns (column's net) can be adopted**
   the span of columns includes two rooms even more. Then, the inside space can be arranged wantonly. The foundations are reduced with the reduction of columns, hence, the economic benefit will be more. Owing to the large span of columns, the vertical loads acting on columns are increased and the compressive bearing capacity of CFST columns can be bring into play sufficiently.

3. **The span of frame beam is large**

The span of frame beam reaches 7~8m even more. Hence, steel beams should be used, but it should toke welding I-beam for save steel and construction cost. The SRC beams can be adopted also.

4. **Story structure system**

As mentioned above, the span of story beams is 7~8m always, even reaches to 10m. Hence, the story structure system may be as following kinds.

a. Composite steel story system as shown in Fig. 5.

b. Steel beam with pre-stressed RC plate the pre-stressed RC plate is set on the steel beam, and then pours RC deck with ~110mm thickness on it.

c. Two direction dense ribs story structure As shown in Fig. 6. SRC beams are used for two direction beams, hence, this type of story structure system is conveniently for construction and the cost can be cheaper.

d.) Pre-stressed RC story structures system This story structure system is composed of pre-stressed RC beams without adhesion and RC plate. This type of story structure system is more complexly.

e. The dimension of CFST column is nearly with the outline dimension of steel column. Hence, the space occupied by CFST column does not more than that of steel column. As everyone knows, the volume of core concrete of CFST column is about 10% of total volume of column. And the density of concrete is one third of the density of steel. Then, the weight of CFST column does not more than that of steel column.

f. The seismic, corrosion and fire resistant behaviors of CFST column are better than that of steel column.

Fig. no.4 Composite steel story system

Fig. no. 5 Two direction dense ribs story system

1.3.2 ADVANTAGE OF CFST COLUMN FOR BRIDGES

According to the experiences of these engineering, we have understood the advantages of CFST structures adopted in arch bridges as follows.

1. The load carrying capacity of compression is high and the seismic behavior is very good.
2. The empty steel tube forms arch rib at first, whose weight is light. Hence, the bridge can leap over a very large span.
3. Erection and construction are easy to perform. The cost of engineering is decreased.
4. The problem of concrete cracking does not exist.

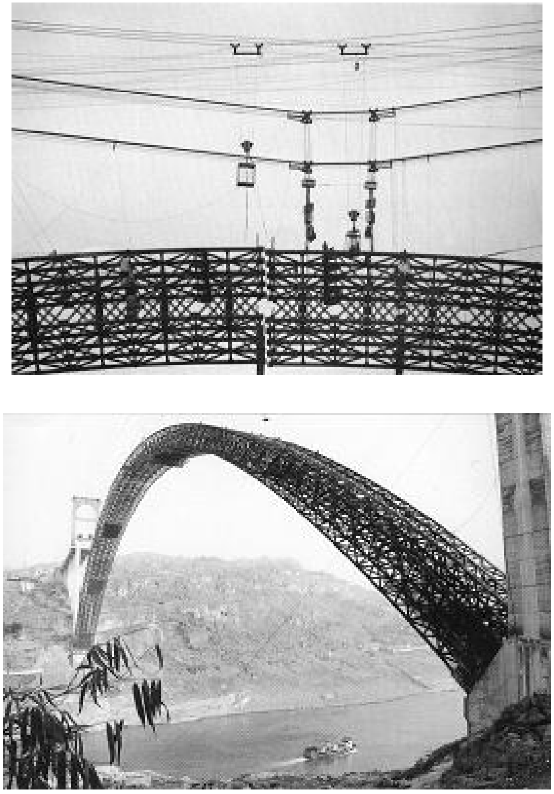


Fig.6 Arch rib being erected

1.4 LIMITATIONS OF CONCRETE-FILLED STEEL TUBES

A primary deterrent to widespread use of CFTs is the limited knowledge regarding their behavior. A number of factors complicate the analysis and design of concrete-filled steel tubes. A CFT member contains two materials with different stress-strain curves and distinctly different behavior. The interaction of the two materials poses a difficult problem in the determination of combined properties such as moment of inertia and modulus of elasticity. The failure mechanism depends largely on the shape, length, diameter, steel tube thickness, and concrete and steel strengths. Parameters such as bond, concrete confinement, residual stresses, creep, shrinkage, and type of loading also have an effect on the CFT's behavior. Axially loaded columns and, in more recent years, CFT beam-columns and connections, have been studied worldwide and to some extent many of the aforementioned issues have been reconciled for these types of members. However, researchers are still studying topics such as the effect of bond, confinement, local buckling, scale effect, and fire on CFT member strength, load transfer mechanisms and economical detailing strategies at beam-to-CFT column connections, and categorization of response in CFTs and their connections at all levels of loading so as to facilitate the development of performance-based seismic design provisions. It should also be noted that, despite a recent increase in the number of full-scale experiments, the majority of the tests to date have been conducted on relatively small specimens, often 6 inches in diameter or smaller. This is due to the load limits of the testing apparatus and the need to run the tests economically.

1.5APPLICATION OF CFST COLUMN

The first engineering adopted CFST is the No.1 subway of Beijing. The size of CFST column is smaller than that of RC column, which increases the usable area. Good economical effect was obtained. Then, all of the platform columns for Beijing No.2 subway adopted CFST columns.
According to incomplete statistics, in this stage, there are over 200 constructed engineering adopted CFST structures in China. Some typical engineering are introduced as follows.

1.The steel ingot work- shop of Benxi steel company, the span is 24m, interval of column is 6m, which the heavy cranes Q=20t/200t and 10t/50t are equipped. The length of column is 15.8m.

Four limbs column was used, steel is Q235 and concrete is C40. It was the first industry building adopted CFST columns. It completed in 1972.

2. The application of CFST in tall buildings, only partial columns of building adopted in early days, then greater part of columns adopted, then all of the columns adopted. This process was very short, only a little more than 10 years. The highest tall building adopted CFST is Shenzhen SEG Plaza building completed in 1999. It is the highest one in China and abroad. There is no staying area for construction. It made the construction rather difficult.

There are a lot of new technology and experiences in design, fabrication and construction of this building. It offers a good example of the adoption of CFST columns in super tall buildings. It also promotes the development of CFST structures in our country to a higher level.

Fig.7 SEG Plaza under construction

1. The concrete filled steel tube (CFST) is a composite material combined by the thin-walled steel tube and the concrete filled into the steel tube. On one hand, the concrete in the tube improves the stability of the thin-walled steel tube in compression; on the other hand, the steel tube confines the filled concrete and the filled concrete in turn is in compression in three directions. Therefore, the CFST has higher compression capacity and ductility. It is good for the application of arch bridge.

Figure 8 : First CFST Arch Bridge in China: Wangchang East River Bridge (Span 115 m)

1.6 PRACTICAL USE OF CFT COLUMN CONNECTIONS

The two CFT joint types constructed for different buildings are shown in Photos 1 and 2. In both cases, the wide-flange shape was continuous through the steel pipe column. Both buildings were two stories; with the first floor using a composite concrete slab on a steel girder framing system and the roof having a corrugated metal deck only. Both buildings also had an orthogonal layout for the lateral-load resisting frames, with most frames located along the perimeter. Circular CFTs were used for both buildings in lieu of the more traditional steel wide-flange columns because the preliminary cost estimates indicated that CFTs could be as much as 20% more economical.

The primary objective of each joint-type shown in Photos 1 and 2 was to maintain continuity of the wide flange shape through the full depth of the CFT column. To make the joint more constructible a rectangular notch, matching the width of the wide-flange shape, was cut in the steel pipe. A bent plate welded to the girder web, spanning full depth between girder flanges, must be used as a closure plate for the joint. Closure plates, as shown in Photo 1b, are angle-shaped with the 90° bend extending toward the core of the concrete-filled tube. This provides some tolerance in the final location of the girder through the column and provides a surface on which to weld the tube to the girder. Because of the need to develop the flexural strength at the CFT joint, this vertical weld between the steel pipe and the girder web is critical. The steel tube wall may be welded either directly to the 90°-bend surface of the closure angle, or a filler plate may be welded between the steel tube and the closure plate. Closure plates may or may not be needed between the bottom girder flange and the tube; however, a closure will be needed above the top flange. Once welded, the joint is fully enclosed thereby ensuring complete confinement of the concrete core at the joint by the steel tube.

After the joint is complete, the steel pipe column is filled with concrete. To facilitate compaction of the concrete around the joint, holes in the girder flanges have been used to allow concrete consolidation around the girder flanges in the core of the steel tube. Several types of concrete mixes and delivery methods have been tried; however, it has been found that self-compacting concretes may be the most appropriate and, perhaps, economical considering the cost and labor involved in tube wall vibration. The design should also consider the ability to avoid long drop-lengths when placing concrete in the steel tube core.

II. LITERATURE REVIEW

2.1 BEHAVIOUR OF CONCRETE FILLED STEEL TUBE COLUMNS

2.1.1 Columns under Axial Compression

Some of the earliest research on concrete filled steel tubular columns subjected to concentric compression was carried out by Gardner and Jacobson (1967), Knowles and Park (1969) and Sen (1972). In the investigations into the behavior of concrete filled circular tubes, they found that the concrete containment results in an enhancement of the compressive strength, and also in the development of hoop stresses in the steel tube which causes a reduction in the effective yield strength of steel. Then, more experimental and theoretical studies were performed by other researchers found that the measured ultimate load of circular CFSTs is considerable larger than the nominal load, which is the sum of the two component strengths.

This is due to strain hardening of the steel and the confinement of the concrete. Although the confinement effect diminishes with increasing column length and is generally neglected for columns of practical length, it ensures that the column behaves in a ductile manner, a distinct advantage in seismic applications. Tests on approximately 270 stubs showed that axial load versus longitudinal strain relationships in a classification based on test parameters including cross-section shape, diameter to wall thickness ratio (D/f) and concrete and steel strength. For CFST slender column, stability rather than strength will govern the ultimate load capacity. Overall column buckling will precede strains of sufficient magnitude to allow large volumetric expansion of the concrete to occur. Hence, for overall buckling failures there is no confinement of the concrete and thus no additional strength gain. Many authors have agreed that a slenderness ratio {LID) equal to 15 generally marks an approximate boundary between short and long column behavior. Neogi, Sen. and Chapman originally proposed this value for eccentrically loaded columns. Chen and Chen Bridge and Prion and Boehme confirmed the LID value of 15. Knowles and Park proposed a KL/r (the ratio of effective length to radius of gyration), value of 44 (approximately equal to an LID of 12) above which confinement does not occur. However, Zhong et al. specified a lower value of LID equal to 5 above which confinement does not occur.

2.1.2 Concrete Filled Steel Tube Beam (Pure Bending)

For the derivation of ultimate moment capacity of the concrete-filled steel tubular sections, the reinforced concrete theory was considered by most of the researchers. In some of codes of practices [ACI 318, 1995; AS3600, 1994], concrete failure is considered at a limiting concrete strain of 0.3% and carries no strength in the tensile zone, and the tensile resistance of a CFST depends on the steel alone. Therefore, moment resistance is highly influenced by the steel tube. The only contribution of the concrete to moment resistance occurs due to the movement of the neutral axis of the cross section toward the compression face of the beam with the addition of concrete.

This effect can be enhanced by using thinner tubes or higher strength concrete. Tests by Bridge showed that concrete core only provides about 7.5% of the capacity in member under pure bending.

For the steel hollow section, most of the studies assumed the steel section is fully plastic at the time of failure for the simplification of the analysis. Except in some of the studies the stress in steel were derived from corresponding strain values obtained during experiments to compare test with the theory.

2.1.3 Combined axial load and Bending

The parameter influencing the behavior of beam – columns include

1. D/t ratio
2. Axial load ratio (N/Nc)
3. L/D ratio or the slenderness of the member

Firstly, the D/t ratio determines the point of local buckling and it affects the section's ductility. A smaller D/t ratio delays the onset of local buckling of the steel tube. Tubes with high D/t ratios will often exhibits local buckling even before yielding of the section occurs. A low D/t provides greater ductility, illustrated by the long plateau in the moment –curvature diagrams for such columns. The beam and column with low D/t ratio could sustain the maximum moment after local buckling. Beam column with high D/t ratio began to lose capacity as the curvature increased, although only under large axial loads did the capacity drop significantly.

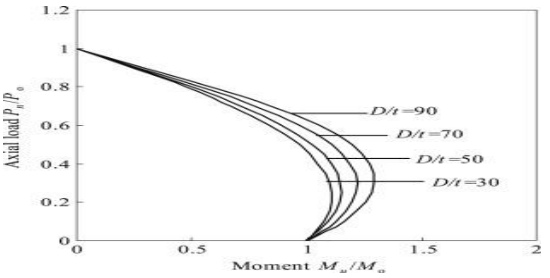


Fig.no.13

III. DESIGN PHILOSOPHIES IN CFT

For the design of steel-concrete composite columns subject to an eccentric load which causes uniaxial or biaxial bending, the first task is commonly to generate the axial force and moment strength interaction curves. Based on the section strength interaction diagram the member strength is obtained by considering the effect of member buckling. The strength checking is then made by comparing the applied load and member strength. Accurate numerical methods have long been proposed to calculate the section strength of a composite column. There are different variations of the theory, and all of these are based on the principle of classic mechanics.

3.1 BASIC ASSUMPTIONS

In the study of CFST subjected to axial load and biaxial bending, the following assumptions have been made:

1. Plane section remains plane after loading;
2. Perfect bond exists between the concrete core and the steel shell at the material interface;
3. Monotonic loading;
4. Effect of creep and shrinkage is neglected; and
5. The shear deformation and torsional effect are all neglected.

fully plastic to the natural axis. But the writer believes that the reduction value appears too conservative for high bending moment and low axial force situation ,as discussed in the next section.

For a CFST column, the load –carrying capacity of the cross-section with the influence of imperfection can be represented by an N-M interaction diagram , as discussed already in Chapter 5, and the reduction due to imperfection is referred to in fig .6.2 as the strength line. At each stage of loading the internal force *N* in the section is equal to the external applied load P. if it is a pin-ended column with a load applied at a constant eccentricity. Eqn. now becomes

$$M = \frac{C_m}{1 - \frac{N}{N_{cr}}}(N e)$$

Equation expresses the relation between N and M, is therefore the equation of the loading for a particular column with known eccentricity. For the purpouse of calculation it is often convenient to arrange eqation.in the form [Warner et al.,1989]

$$\frac{1}{N} = \frac{C_m e}{M} + \frac{1}{N_{cr}}$$

In Fig. 6.2 the intersection "A" with the loading line from Eqn.6.22 and strength lines gives the memmber load capacity of a CFST column.

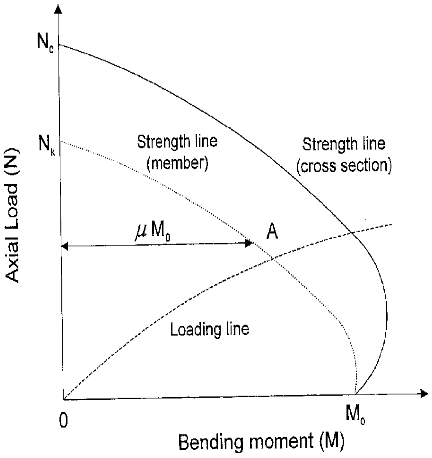


Fig.no.17

IV. OBJECTIVES OF STUDIES

1- Design of CFST columns using various codes to compute their compressive capacities. The codes are:

- Euro code "BS EN1994-1-1".
- American code "American Institute for Steel Construction (LRFD) AISC 360-05".

2- Comparison of Tapered Column tube section with mild steel and Duplex stainless stee

3- Prepare the geometry of CFST columns using SolidWorks and then linking them to ANSYS to perform the rest of the finite element analysis process.

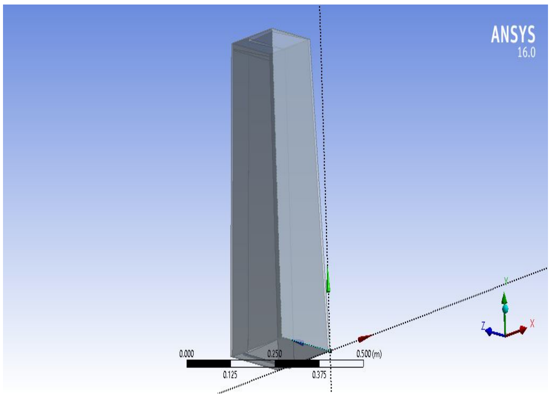
4- Verification and comparison of the results achieved in this study with those in the published literature(Auther-Schinder)

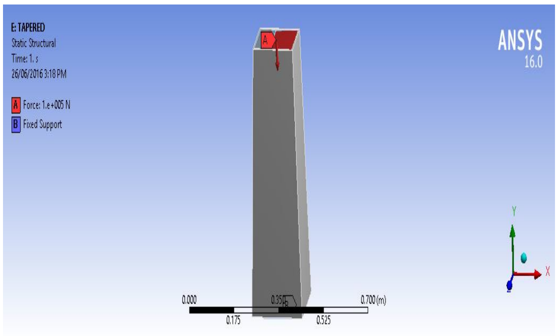
5-To compare shape factor of circular tube against L/D ratio 5 and L/D ratio 7.

6- To study natural frequency ,Mode shape and time period

V. PROBLEM STATEMENT

A short column of 5m is subjected to gradually increasing axial load of 1000Kn.Support conditions are one end fixed and one end free. Mechanical properties of duplex steel like Poissons ratio -0.31, Tensile strength – 530 MPa, Density 7.8 gm./cm3 are inserted

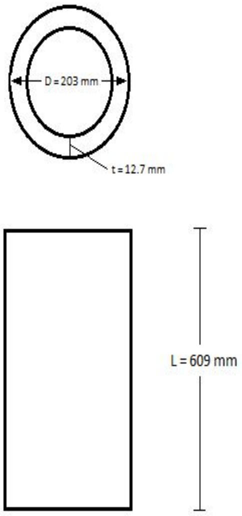


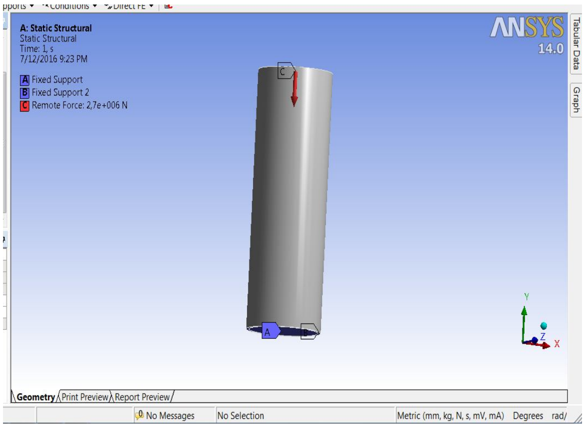


VI. VALIDATION OF MODEL

6.1 Verification of the results

In order to verify the results of the Finite Element analysis and the ones calculated using the three available codes (American, Australian and Euro), they are compared with those available in the published literature. One example was chosen to confirm the results.

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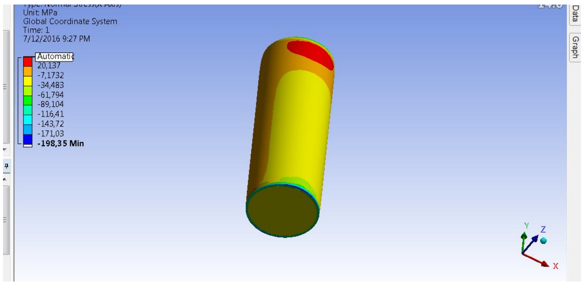
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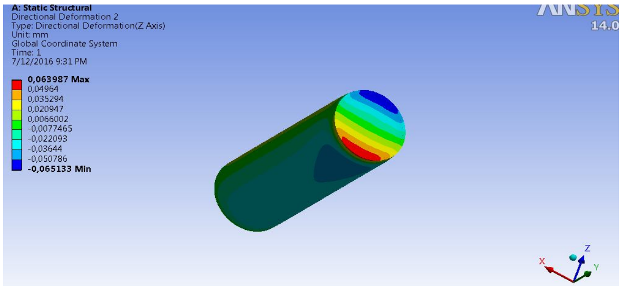
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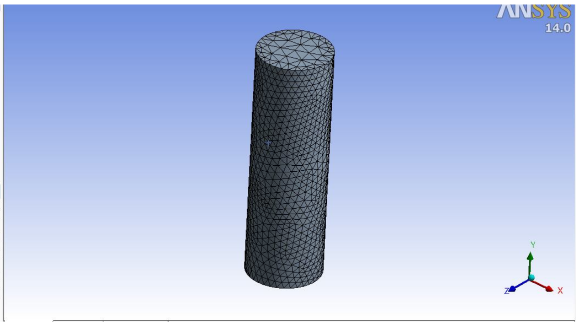


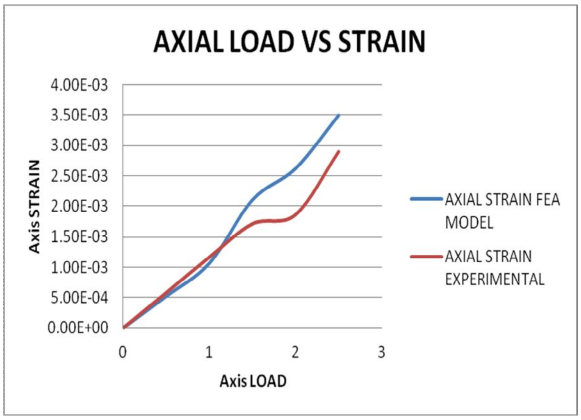
AXIAL LOAD(MN)	ANALYTICAL VALUE	FEA VALUE	%ERROR
0	0	0	0
0.5	0.5	0.429	8.58
1	1	0.868	8.68
1.5	1.5	1.243	8.286667
2	2	1.843	9.215

The difference between analytical value and FEA model is due to idealisation of model in ANSYS which is acceptable.

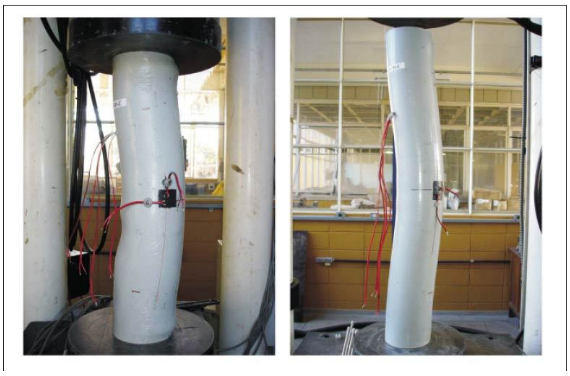
6.1.1 Verification of FEM results

The finite element results were verified by comparing them with those published by Shneider [28]. The same sample sizes were taken as that of the paper. The steel strength is Fy=317 MPa and the concrete strength is f'c=20 MPa. The samples had constant L/D ratio of 5. The comparison results are shown in Table.

Axial strain values of D/t=50 model is compared with Sheider experimental results



COMPARISON OF FEA MODEL WITH EXPERIMENTAL RESULTS



EXPERIMENTAL SETUP FOR COLUMN TUBE

The differences in the results are due to many reasons. The major reason is the type of mesh used. In this report, the automatic method of defining the mesh is used. Whereas, in the study by Shneider, two types of mesh were chosen, which are different for the steel and the concrete. The steel tube was modeled using an 8-node shell element, with five degrees of freedom at each node. The concrete core was modeled using 20-node brick elements, with three translational degrees of freedom at each node

Another reason is the software used in the analysis. Shneider used ABAQUS software, where as in this report, ANSYS software was used. The ABAQUS software used was quite old. It was released in 1994, whereas the ANSYS used was released in 2011. This 17 years difference may have resulted in a lot changes in the way softwares analyses structures.

Lastly, the assumptions on which the analysis is based may be different. In this report, loading plate and base plate were fixed at the top and bottom respectively. Schneider did not mention that plates were fixed in the FEM but in his experimental tests, plates were fixed. Also, the value of Modulus of Elasticity used was not mentioned

VII. RESULT AND CONCLUSION

1. Analytical study of CFST with conventional mild steel model and DUPLEX steel

To study finite element model of the tapered and Straight Tapered Straight (STS) CFST section with duplex steel and conventional mild steel model using ANSYS workbench 14.1 model created. Mechanical properties of duplex steel like Poissons ratio -0.31, Tensile strength – 530 MPa, Density 7.8 gm./cm3 are inserted. Boundary condition one end fixed other free support is used. In 9 steps 45000 axial load at Centre and with eccentricity is applied with 5000 each increment. For each load total deformation, stress (in MPa) strain are found. For that deformation vs. load and stress vs strain graph are found compered. Results obtained are as listed in table no 2 and table no. 3 under axial and eccentric loading

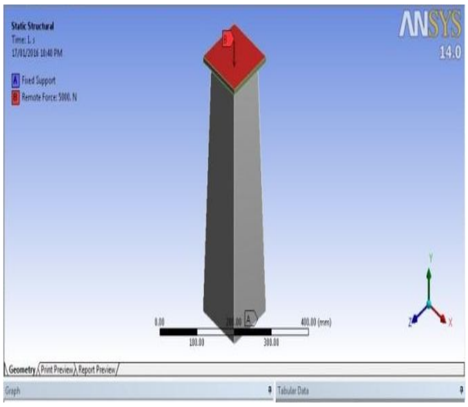


Fig 1 Model of tapered CFST tube

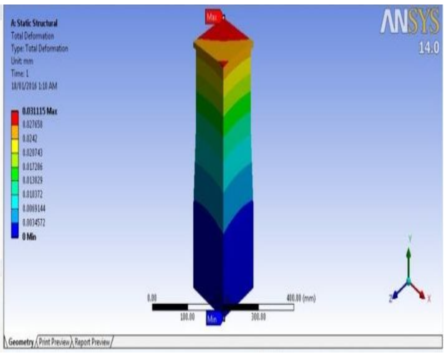


Fig 2 Deformation of tapered section under axial loading

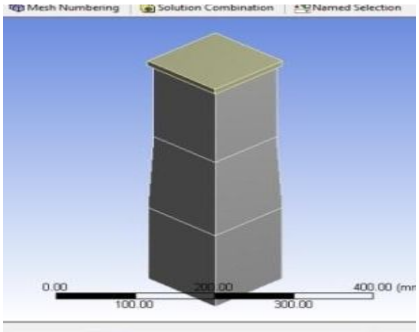


Fig 3 Model of STS CFST tube

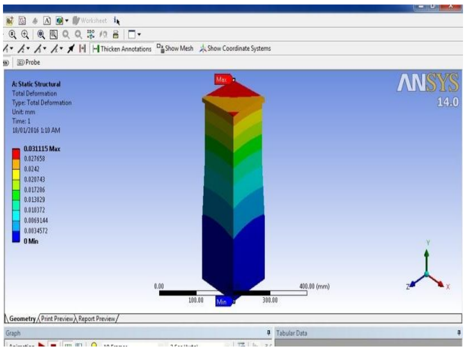


Fig 4 Deformation of STS section under axial loading

Table no. 2 deformation for various sections under axial loading

Load (N)	Deformation under axial loading in (MM)			
	Tapered section		Straight tapered section	
	Duplex steel	Conventional mild steel	Duplex steel	Conventional mild steel
5000	0.00663	0.007	0.0032	0.0042
10000	0.013	0.013	0.0062	0.0085
15000	0.02	0.02	0.0082	0.012
20000	0.026	0.031	0.0108	0.017
25000	0.033	0.041	0.0135	0.021
30000	0.041	0.046	0.017	0.025
35000	0.047	0.053	0.021	0.029
40000	0.053	0.061	0.0245	0.034
45000	0.06	0.071	0.029	0.038
5000	0.00663	0.007	0.0032	0.0042
10000	0.013	0.013	0.0062	0.0085

TABLE 3 Deformation under axial and eccentric axial loading for various sections.

Load (N)	Deformation under eccentric axial loading in (MM)			
	Tapered section		Straight tapered section	
	Duplex steel	Conventional mild steel	Duplex steel	Conventional mild steel
5000	0.046	0.046	0.031	0.031
10000	0.093	0.092	0.052	0.062
15000	0.16	0.13	0.06	0.093
20000	0.19	0.16	0.094	0.12
25000	0.24	0.22	0.12	0.15
30000	0.29	0.27	0.16	0.18
35000	0.38	0.32	0.19	0.031

This result can show graphically as below

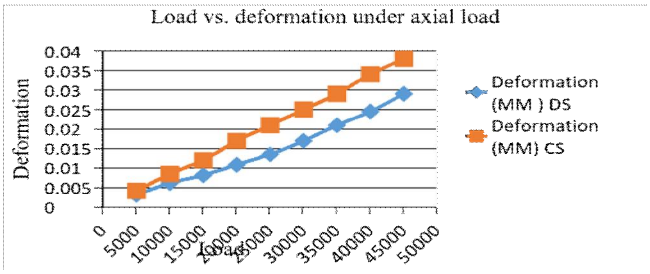


Fig 5Load vs. deformation variation under axial load of tapered CFST section

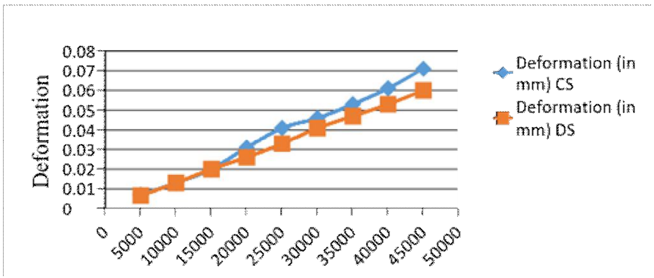


Fig 6Load Vs. deformation variation under axial load of tapered CFST section

After calculation stress strain graph plotted which are as below

Stress strain for tapered mild steel section under axial load and eccentric axial load are as below

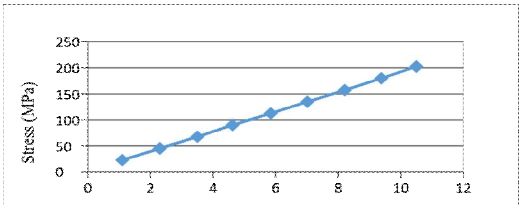


Fig 7 Stress vs Strain curve for tapered mild steel CFST section under axial loading

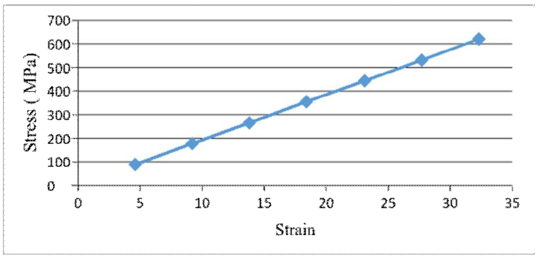


Fig 8 Stress Vs. Strain curve for tapered mild steel CFST section under eccentric axial loading

Stress strain for duplex steel tapered section under axial loading and eccentric axial loading as below

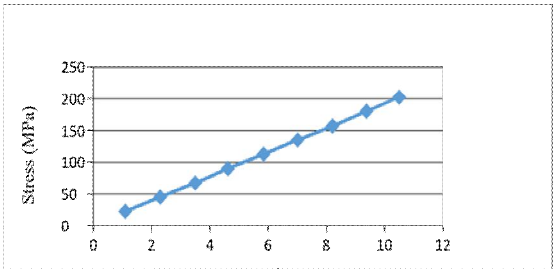


Fig 9 Stress vs Strain curve for tapered duplex steel CFST section under axial loading

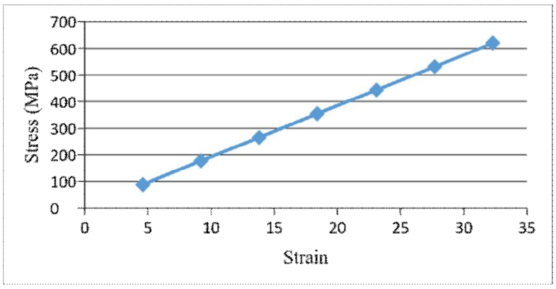


Fig 10 Stress vs Strain curve for tapered duplex steel CFST section under eccentric axial loading.

Stress strain for mild steel STS under axial loading and eccentric axial loading as below

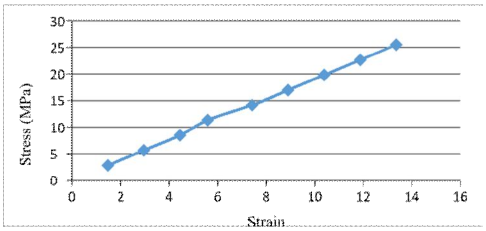


FIG 11 Stress Vs. Strain curve for STS mild steel CFST section under axial loading

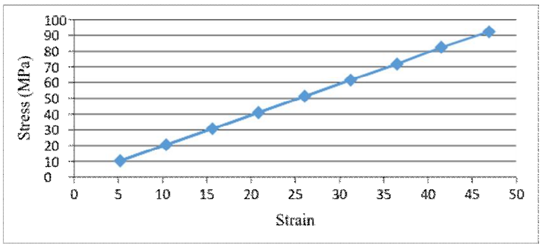


FIG 12 Stress vs. Strain curve for STS mild steel CFST section under eccentric axial loading

Stress strain for duplex steel STS section under axial loading and eccentric axial loading as below

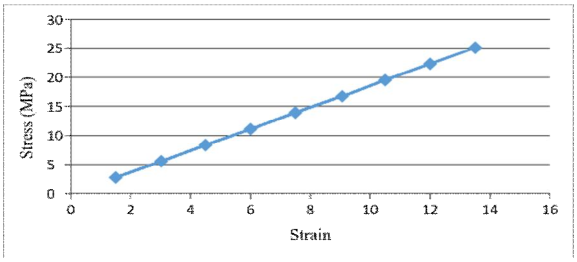


FIG 13 Stress vs. Strain curve for STS duplex steel CFST section under axial loading

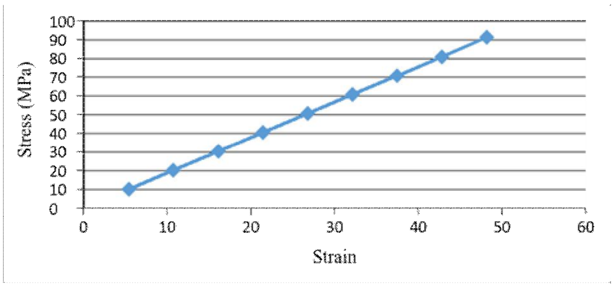
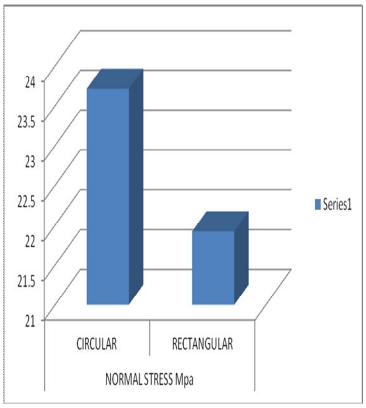
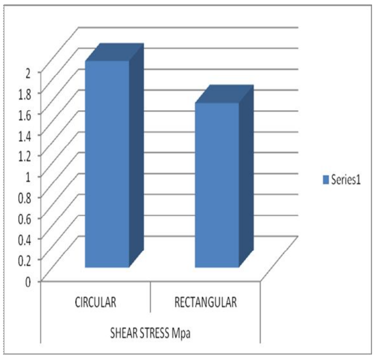


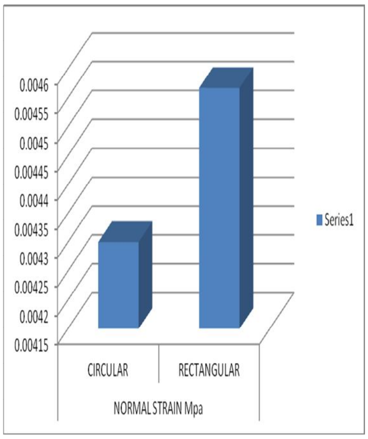
FIG 14 Stress vs. Strain curve for STS duplex steel CFST section under eccentric axial loading

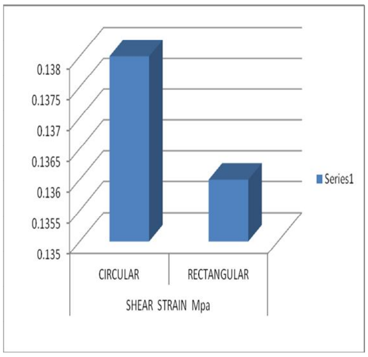
After comparison with different material like duplex steel and mild steel,shape effect and length effect of column tube is studied with reference to literature data the models are described below

Comparative Results of 600 mm Circular Column And Rectangular Column

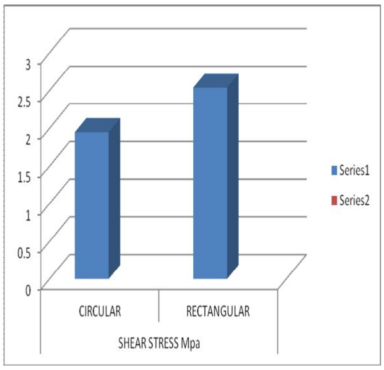


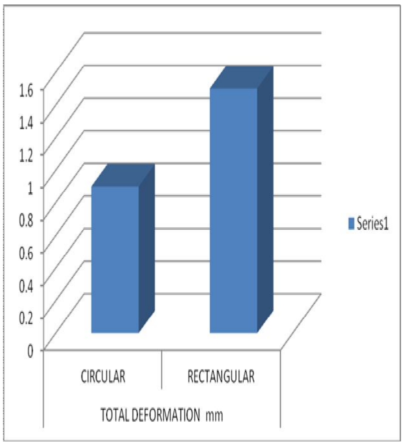


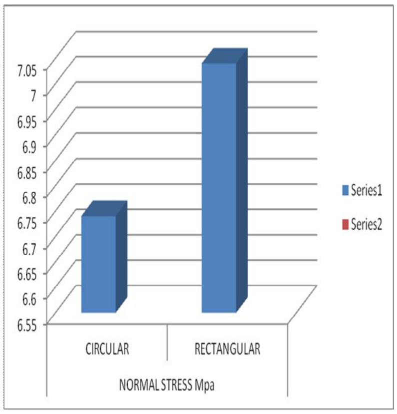




Comparative Results of 1800mm Circular Column And Rectangular Column







VIII. CONCLUSION

In this research, the compressive capacity of the Concrete Filled Steel Tubes (CFST) columns under axial compressive loads was investigated. Several codes of practices; the Euro Standard (BS-EN1994-1-1-2004) and the American Standard (AISC) are investigated to estimate the compressive capacity of CFST columns. The design according to standards is based on finding the capacity of short column subjected to axial force only (concentric loading). The steps used to design the column using the standards are explained in detail in separate chapters. A flow chart is drawn to summarize the design steps and to make it easier for the reader to understand the equations used. Additional provisions should be made in IS:806 regarding design of concrete filled steel tube for short as well as long column

In order to compare the results of the standards with actual results, finite element models were simulated. The models were generated using SolidWorks software [26] and were then analysed using ANSYS software [25]. An accurate finite element model for the analysis of normal concrete filled compact steel tube circular stub column has been created.

For verifying the results, the results of FE and American standard were compared with the results of Shneider [28],The comparison between the various codes and the comparison of FEM results with the codes were performed with respect to many factors. When comparing the FEM results with the codes, it has been observed that for a small thickness of the steel tube (small As/Atotal ratio), the FEM results are generally greater than the other standards. Which means that for the same section, FEM model shows that it can support greater axial load. This implies that the codes' results are conservative when it comes to small ratio of steel.

In later stage of investigation a tapered short column is studied by using Duplex stainless steel and Mild steel, it was observed that axial deformation ,normal elastic strain reduced up to 18%.

Further column tubes of circular section with L/D ratio5 and 12 is compared with rectangular and following conclusions can be drawn

- Normal stress decreases in rectangular short column by 9.2 % while 7.4% in long column

Indicates increase in axial strength of columns

- Shear stress decreases in rectangular short column by 8 % while 3.4 % in long column

Implies additional shear strength provision should be made for long columns

IX. FUTURE SCOPE

Followings can be extensions of CFST column study:

1. Design of CFST column subjected to both axial compression and bending moment.
2. Use more standards in the design, like British standard, Chinese standard, Canadian standard etc., for the sake of comparison.

3. Design other types of composite columns such as square hollow section, concrete encased sections, and partially encased concrete sections.
4. Include shear connectors in the design.
5. Include reinforcement in the design.
6. Design the mesh element separately instead of using the automatic method found in ANSYS.
7. Design of a slender composite columns (high length/diameter ratio)
8. Perform experimental results and compare the results with the codes and FEM analysis.
9. Perform cost study to find the most economical section for a given load by preparing a spreadsheet software.
10. Perform cost study to find the most economical type of column; composite column, steel column and reinforced concrete column.
11. Find the effects of different Poisson’s ratio for the concrete infill in FEM analysis.
12. Design CFST columns with pin connected ends using FEM analysis and compare them with fixed connections assumed in this study.
13. Compare the results in this study with the results of the load applied to the concrete core only

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