International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 08 | August - 2023 SJIF Rating: 8.176 ISSN: 2582-3930

A REVIEW ON CONCRETE FILLED DOUBLE SKIN STEEL TUBULAR COLUMNS

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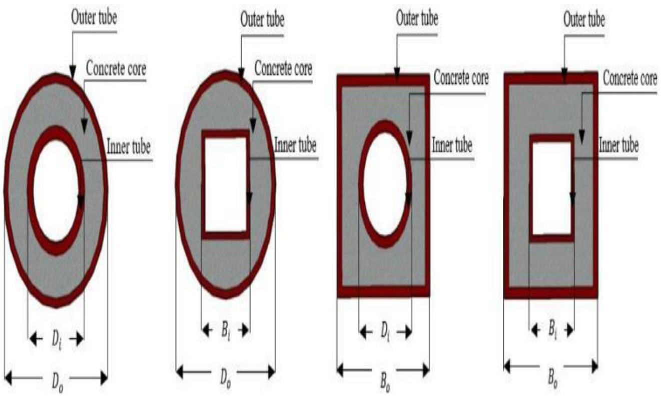
Abstract - *Concrete-filled double-skin steel tubular* ***(CFDST****) Columns considered as a new type of Concrete Filled Steel Tubular (****CFST****) Columns. It consists of an inner and outer steel tube with the annulus between the skins filled with concrete. The concrete is properly compacted and filled in between the steel surfaces. CFDST are high performance composite columns that are increasingly being used in* ***bridges*** *and* ***high-rise buildings*** *as well as to reinforce CFST columns. CFDST has many advantages over CFST such as improved stability, section modulus, lighter weight and better damping characteristics.* ***The inner tube increases their strength*** *and* ***ductility as compared to CFST.***

The ***hollow*** *steel tubes can be chosen with any type of cross section, commonly circular and square tubes are preferred.*

1.INTRODUCTION *(Size 11 , cambria font)*

A concrete filled double skin steel tube (CFDST) is a type of composite structure that is commonly used in modern construction. It is made up of an inner and outer steel tube, which are separated by a space or void that is filled with concrete. The inner and outer steel tubes provide the primary load-bearing structure of the CFDST, while the concrete filling provides additional strength and stiffness. The concrete filling also helps to protect the steel tubes from fire and corrosion. CFDST structures are often used in tall buildings and bridges because they are able to withstand high levels of compression, tension, and bending. They are also relatively lightweight compared to traditional reinforced concrete structures, which can help to reduce the overall weight of the building or bridge. CFDST structures can be designed in a variety of shapes and sizes, depending on the specific needs of the project. They can also be prefabricated off-site and assembled on-site, which can help to reduce construction time and costs. Overall, CFDST structures are a durable and efficient construction option that can provide a range of benefits for building and bridge projects.



2. Literature review:

Several research studies have investigated the behavior of CFDST structures, both experimentally and numerically. Here are some key findings from the literature:

1.Load-carrying capacity: CFDST structures are known for their high load-carrying capacity due to the combined strength of the steel and concrete. Experimental studies have shown that CFDST columns can withstand high axial loads, while numerical simulations have demonstrated their ability to resist lateral loads.

2.Ductility: CFDST structures have been shown to have high ductility, which is the ability to deform without fracturing. This is important for structures subjected to dynamic loading, such as earthquakes or wind. Experimental studies have shown that CFDST columns can undergo significant deformations before failing.

3.Fire resistance: CFDST structures have been shown to have good fire resistance due to the insulating properties of the concrete core. Experimental studies have shown that CFDST structures can maintain their load-carrying capacity for a longer period of time under fire conditions compared to other composite structures.

4.Construction and maintenance: CFDST structures are relatively easy to construct and maintain. They can be prefabricated and assembled on site, and the steel tubes provide protection against corrosion for the concrete core. Maintenance can be performed by accessing the inner steel tube through small openings.

Overall, the CFDST structures have several advantages over other composite structures, including high load-carrying capacity, ductility, fire resistance, and ease of construction and maintenance. However, further research is needed to fully understand their behavior under different loading conditions and to develop design guidelines for their use in practical applications.

3. Strength of cfdst column

The analytical test was conducted by using the ANSYS software. And the experimental tests were conducted on concrete filled double- skin steel tube (CFDST) under axially partial compression. the above tests were validated by the finite element method mentioned below.

- Euro code 4: According to EC4: Design of composite steel and concrete structures, the ultimate load carrying capacity o of concrete filled steel tubular columns is given by o Pu = Ac*Fc + As*Fs
- ACI 318: According to American concrete institute, the ultimate load carrying capacity of concrete filled steel tubular column is given by Pu = 0.85 Ac*Fc + As*Fs
- BS 400: According to British standard code, the ultimate load carrying capacity of concrete filled steel tubular column is given by Pu = 0.675 Ac*Fc + As*Fs
- Load & Resistance Factor Design Method (AISC 360 10 & ACI 318 14): According to American institute of steel construction, the theoretical load carrying capacity of CFST column is given by Pu= Po (0.685)^(po/pe)

A circular concrete-filled double steel tubular column (CFDST) with a square hollow section (SHS) as an inner tube filled with concrete that are axially loaded and tests that were conducted on the CFDST column ie. Compression test. Test are carried out on eight CFDST stub columns. For

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comparative analysis with CFDST columns, two circular CFST columns and one double-skin concrete-filled steel tubular (DCFST) column are added. Circular CFDST columns with the inner SHS have increased strength and also increase the ductility when compared with the conventional CFST column and DCFST column. The specimen consist of circular hollow section (CHS) outer and square hollow section (SHS) inner, with the space filled with concrete. And the inner tube of column is not filled with concrete. High nominal compressive strengths are in the parametric analysis, and steel tubes are cold-formed from various design yield strengths. Twenty columns were investigated and modelled in Abaqus to investigate the behavior of CFDST columns under axial compression.

4. Material property

Steel

Modelling of the MS Steel tube is done as elastic-perfectly plastic with von mises yield criterion. As the steel tube is subjected to multiple stresses and hence the stress-strain curve crosses elastic limit and reaches in plastic region. The steel tube's nonlinear behavior is obtained from uniaxial tension test and used in steel modeling. Material = Structural steel Fe 210Mpa, 230Mpa, 240Mpa, 250Mpa & 310Mpa.

Young's modulus = 210Gpa

Poison's ratio = 0.3

Density = 7800kg/m3

Concrete

To understand the concrete behavior in the finite element model, a nonlinear stress-strain diagram for confined concrete should be established. This is used in proposed finite element model. The stress-strain curve is divided into 3 parts namely elastic part (Linear), Elasto-Plastic part and Perfectly Plastic part (nonlinear).

5. Effect of Hollow ratio

Hollow ratio (χ) is an important factor affecting the compressive behavior of CFDST. Investigated the Curves of average stress versus longitudinal strain, stress distributions of concrete and steel tubes and hollow ratio effect. The hollow ratios 0, 0.25, 0.5, 0.75 were defined. As hollow ratio χ increases, the location of maximum concrete stress moves from centre to the periphery of the cross-section. Commonly, hollow ratio on the concrete stresses with CHS outer is larger than SHS outer. It is important to control the inner tube thickness to prevent premature failure. The performance of CFDST columns of the inner tube diameter were investigated by using hollow ratio (χ). The hollow ratios of 0.1, 0.2, 0.3, 0.5, 0.7 and 0.8 were defined by changing the inner tube diameter and other properties remained unchanged. It was shown that the ultimate axial strength of CFDST short columns improves with increasing the concrete compressive strength or with decreasing the hollow ratio. The effect of hollow ration on the load axial were shown below.

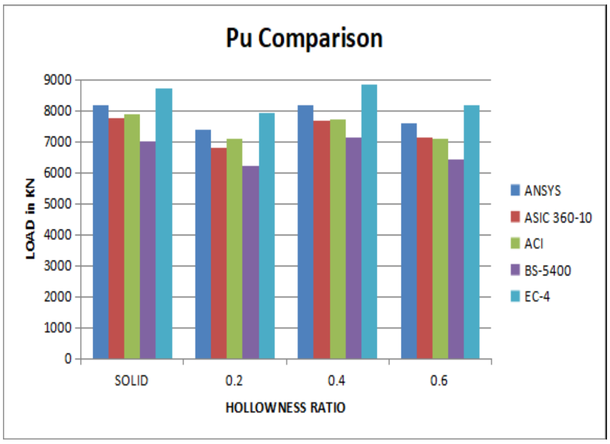

Chart 1: strength For circular tubular column outer and inner

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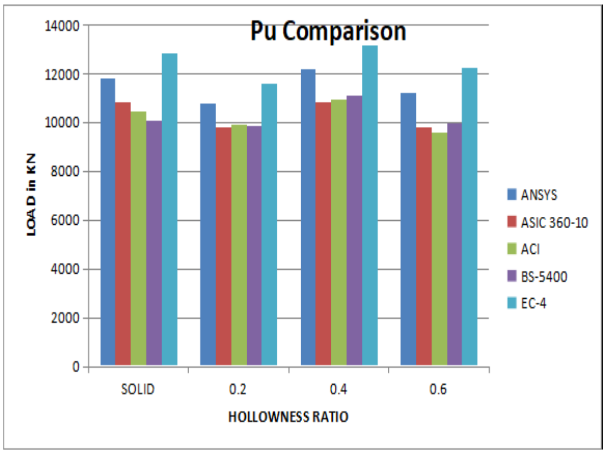

Chart 2: strength For circular and squar tubular column outer and inner respectively

6. Effect of stiffener

Investigates the behavior of stiffened CFDST members under axial compression and cyclic loading. In the tests all the specimens are behaved in a ductile manner. For stiffened CFDST, the outward buckling was found in the outer tube and the inward buckling was found in the inner tube.

7. Concluding the materials:

Take the concrete of M60 or M70 grade for filling. The outer tube of 175mm diameter and 62.5mm diameter for inner tube. It gives the hollowness of 0.316. Take above material for experimental study.

8. CONCLUSIONS

- From Time Series plot we observe that Ultimate Axial load carrying capacity of column can be well predicted.
- From this Research work parametric optimization and Factors like Thickness, length and Grade of concrete influencing the response can be well predicted.
- Results obtained from ANSYS software varied from 5% to 10% when compared with experimental results.
- Results obtained from EC4 code of practice varied from 2% to 15% when compared with experimental results.
- Results obtained from ACI code of practice varied from 6% to 25% when compared with experimental results.
- Results obtained from BS400 code of practice varied from 5% to 15% when compared with experimental results.
- Results obtained from AISC 360-10 code of practice varied from 5% to 15% when compared with experimental results.
- Minimizing the local buckling by increasing the outer tube thickness.
- Ultimate strength of CFDST column increase while increasing the strength of concrete.
- Elastic energy capacity absorption capacity of CFDST column increases while increasing the strength of concrete.
- Inner tube thickness must be controlled to prevent the premature failure.
- For Hollow CFST (constant diameter, constant thickness) for varying L/D ratio, the load carrying capacity decreased by 2% to 5%.
- It is observed that results obtained from ANSYS software almost coincides with experimental results than results obtained from EC4, ACI, BS400, AISC 360-10 Codes.

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