BUCKLING ANALYSIS OF CONCRETE FILLED STEEL TUBE COLUMNS

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ABSTRACT
The use of CFST in building construction has increased significantly in the recent years mainly due to its simple construction sequence and superior structural performance. Therefore, it is necessary to understand their behavior as structural member. Extensive experimental studies about concrete filled steel tubes (CFSTS) have been conducted in past. However experimental results are not sufficient to support the engineering of these components. Advanced numerical techniques are required to simulate their behavior to extend the experimental research and develop predictive tools required for design and evaluation of structural systems. The objective of the present research work is to study the buckling of CFST column with different cross section. In the present research, the non-linear analysis of concrete filled steel tube (CFST) is done using ANSYS WORKBENCH 17 and SAP software. Circular cross sections are studied. It has been found that performance of circular cross section depends on L/D and D/t ratios.

KEYWORDS: CFST, ANSYS,SAP, Buckling etc.

I. INTRODUCTION

Concrete filled steel tubes (CFST) are composite structures consisting of a steel tube in-filled with concrete. An evaluation of available experimental studies shows that the main parameters influencing the behavior and strength of concrete filled steel tubular columns are slenderness, the diameter to wall thickness (D/t) ratio and the initial geometry of the column..

CFST columns having addition of silica with concrete in this way are known as high strength concrete filled steel tubular columns. For high strength concrete filled steel tubular columns, there is a composite action between these two essential elements which contributes the concrete to prevent inward buckling of wall of steel tube.

TYPES OF CFST

Concrete filled steel tubes are designed on the basis of their application. It may be square, hexagonal and circular depends upon design and use of their application. Concrete filled steel tubes are divided into two types according to the form of the concrete core. These two types are solid and hollow concrete core CFSTs. In Fig.1.1 some shapes of CFST are shown which indicates these both types. Solid concrete core is made by placing the plain concrete in the steel tube and compaction is done by vibration. Hollow concrete filled steel tubes are made by spinning method. The method of insertion of the wet concrete in the rotational mould is known as spinning method. Where wet concrete is compacted by vibration using centrifugation due to rotation of the mould.

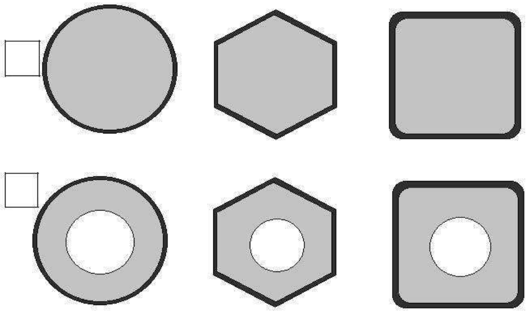

Fig.1.1 Cross-sections of solid and hollow CFST composite columns.

FINITE-ELEMENT-MODELLING

Composite properties of the concrete are mainly non- linear. The imperial formulae are the only tool available for the design of concrete filled steel tubular columns. With the Finite Element method it is possible to note the response of such systems. It is very helpful

Finite element method is the dominant discretization technique in structure analysis. The basic concept of the Finite Element Method is the subdivision of the mathematical model into disjoint (non-overlapping) components of simple geometry called finite elements or elements for short. The response of each element is expressed in terms of a finite number of degrees of freedom characterized as the value of an unknown function, or functions, at a set of nodal points. The method can be used to study the behavior of concrete filled steel tubular column structures including both force and stress redistribution. FEM is useful for obtaining the load deflection behavior and its crack patterns in various loading conditions.

BEHAVIOUR OF CFST

Many previous studies have shown that square concrete filled steel tubes is not as good compare to circular concrete filled steel tubes. This is due to the confining pressure acts in concrete core by square steel tube is less and that's why local buckling more likely to occur. The structural behavior of the concrete filled steel tube is affected by the Poisson's ratio of both steel and concrete. At the initial stage of loading, Poisson's ratio of the concrete is lower than that of steel. Hence the steel tube does not contribute confining effect to the concrete. When the longitudinal strain increases, lateral expansion of the concrete gradually becomes greater than the expansion of the steel tube. At this stage of loading, steel tube becomes biaxial stressed and concrete core becomes triaxially stressed. So due to the biaxial stress in the steel tube, the steel tube cannot sustain normal yield stress and hence transfer the load from tube to core. The load transfer mechanism is same for both circular and square concrete filled steel tubes.

OBJECTIVES OF THE STUDY

1. To examine abnormalities in structures dissect and plan of G+6 storied structure according to code (IS1893:2002) arrangement.
2. Investigate the structures in Etabs programming to complete the story avoidance, story float, story shear power and base shear of standard and sporadic structures utilizing reaction range examination and think about the aftereffects of various structure

II. METHOD OF ANALYSIS

Concrete filled steel tubular columns are clearly an intermediate between steel and reinforced concrete columns. However, the design philosophy for each of these two structural members is fundamentally different. Steel columns are treated as concentric in that they are loaded through their centroids, but with due allowances being made for residual stresses, initial out of straightness and slight eccentricities of the load. The basis of the design of steel column is instability or buckling, and any moments which act at the ends of the column are then incorporated by reducing the axial load by way of an interaction equation.

NOVATEUR PUBLICATIONS
INTERNATIONAL JOURNAL OF INNOVATIONS IN ENGINEERING RESEARCH AND TECHNOLOGY [IJIERT]
ISSN: 2394-3696
VOLUME 5, ISSUE 2, Feb.-2018

It has been observed that the ultimate axial capacity of concrete filled tubular columns is larger than the sum of uncoupled steel and concrete at failure loads. The increase in failure load is caused by the confining effect of steel tube on the concrete. The structural behaviour of concrete filled tubular sections is considerably affected by the difference between the Poisson's ratios of the steel tube and concrete. In the initial stage of loading, the Poisson's ratio for the concrete is lower than that of steel. Thus the steel tube has no confining effect on the concrete. As the longitudinal strain increases, the lateral expansion of concrete gradually becomes greater than the expansion of the steel tube. At this stage the concrete becomes tri-axially stressed and the steel tube bi-axially stressed. The steel tube under a biaxial state of stress cannot sustain the normal yield stress, causing a transfer of load from the steel tube to the concrete. In the first stage of loading, the steel tube sustains most of the load until it yields. At this stage, there is a load transfer from the steel tube to the concrete. The steel tube exhibits a gradual decrease in load sharing until the concrete reaches its maximum compressive strength.

MODELLING IN SAP

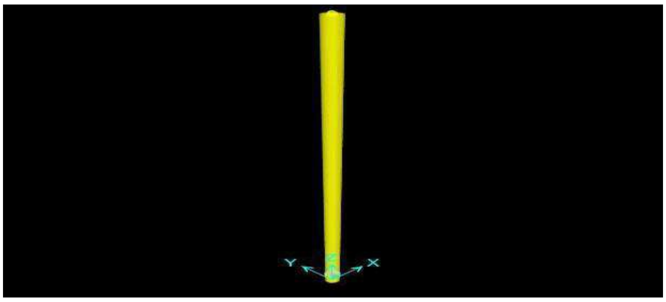

Fig 4.1 creating the solid model of circularCFST column

III. RESULTS AND ANALYSIS

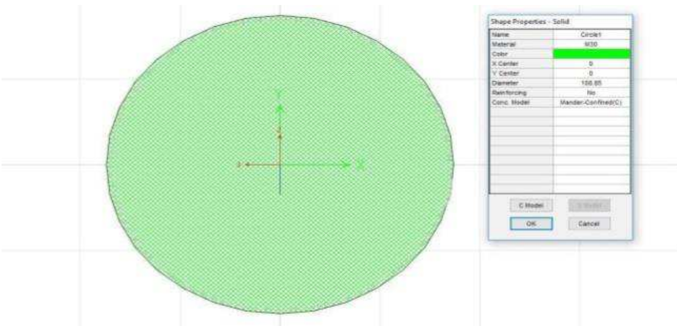

Fig 4.2 Core of the CFST column(concrete)

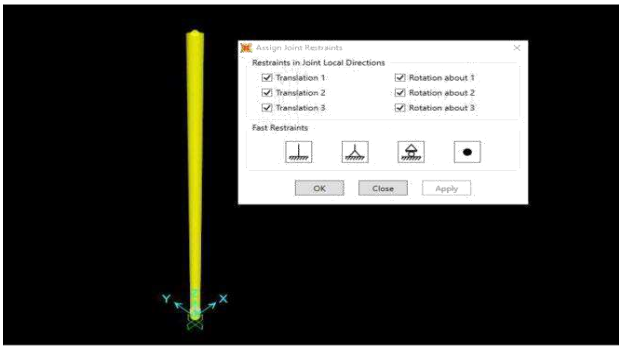

Fig 4.3 Supports of CFST column

RESULTS AND DISCUSSIONS

Table 5.1 Variation of crippling load for different L/D ratios

L/D	CRIPPLING LOAD(KN)
21.76	204.54
19.63	293.34
17.95	401.78
16.40	553.54
15.14	735.64
12.90	1390.36

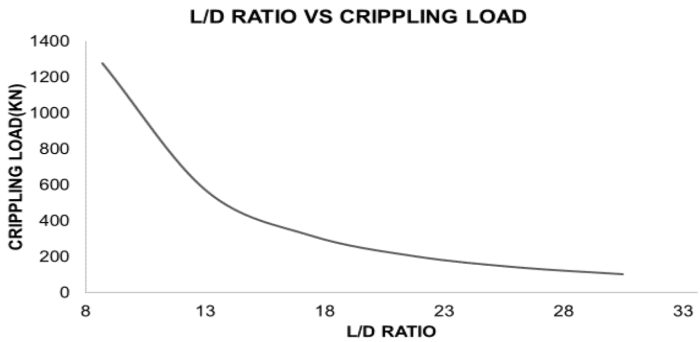

Fig 5.1 Graph showing variation of crippling load for different L/D ratios

From the above graph, as value of L/D ratio increases value of crippling load decreases gradually

Table 5.4 Comparison of crippling load, SAP and ANSYS for different L/D ratios

L/D	CRIPPLING LOAD(KN)	SAP(KN)	ANSYS(KN)
8.71	1278.43	1315.028	1325.9
13.06	568.19	586.75	590.59
17.41	319.60	330.50	332.66
21.76	204.54	211.65	213.09
26.12	142.048	147.049	149.9
30.42	104.361	108.05	111.02

CONCLUSIONS

Based on these extensive experimental and analytical

1. The slump flow varied between the ranges of 655-725 mm
2. Addition of fly ash nullified the stickiness observed in mixes without silica fumes and further, the mixes were highly cohesive.
3. Increase in percentage of fly ash content from 0% to 8 %, an increase in compressive strength was recorded.
4. At 6% replacement of fly ashby weight of cement the increase in compressive strength was 7% while the increase was about 9% when percentage replacement was 8% as compared with reference mix.
5. At 10% replacement of fly ash with cement there was slight decrease in compressive strength as compared to 4,6 and 8% replacement of silica fumes by weight of cement
6. The values of splitting tensile-strength range between 3 and 4 MPa.
7. The increase in split tensile strength is almost 10% at 2% replacement and 13% at 4% replacement of fly ash by weight of cement.

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