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Study The Structural Performance of Cold Formed Steel Sigma Face-to-Face Concrete Column By Varying Its Screw Spacing

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Abstract - *To better understand the structural performance of sigma section built-up box-section columns associated with axial compression tests and screw spacing are conducted. When the screw spacing was reduced from 600 to 150 mm, the load-bearing capacity increased by about 14.6%–17.5%. A finite-element model was developed and calibrated against the test results. A series of parametric analyses was carried out to analysis the effects of the screw spacing and shear stiffness on the elastic buckling load and ultimate load-carrying strength. The structural performances of the sigma section built-up columns under axial compression screw spacing test was studied through the ANSYS software.*

***Key Words*: Sigma Section, Built-up section, Screw Spacing, Column**

1. INTRODUCTION

Cold-Formed Steel (CFS) members are made from structural quality steel sheet that are formed into C-sections and other shapes by roll forming the steel through series of rollers which doesn't required heat to form the shapes unlike hot-rolled steel, thus the cold formed steel. CFS members Fig.1.1 used in bridges, railway coaches, highway products, transmission towers etc., and these types of cold-formed from steel sheet, strip, plate etc., in roll forming machines by bending operations, pressing, stamping, which is in the form of thin gauge sheets commonly used in construction industry for structural or non-structural items such as column, beam, studs, built-up sections and other elements. The difference between hot and cold formed steel is how they are processed. Hot rolled steel has been rolled at high temperature while cold rolled steel is essentially hot rolled steel is further processed in cold reduction materials. Cold rolling produces steel with closer dimensional tolerances and a wider range of surfaces finishes than hot rolling and up-to 20% stronger than hot rolled through the use of strength hardening. When making more precise shapes, the process involves: (a) breakdown (b) semi-finishing (c) sizing (d) semi-roughing (e) roughing (d) furnishing. Cold rolled steel results in a productwith a better more finished surface with closer tolerance, also yield smoother surfaces which are oily to touch. It can be used harder and stronger than hot rolled steel and aesthetically pleasing finish with wider range of surfaces.

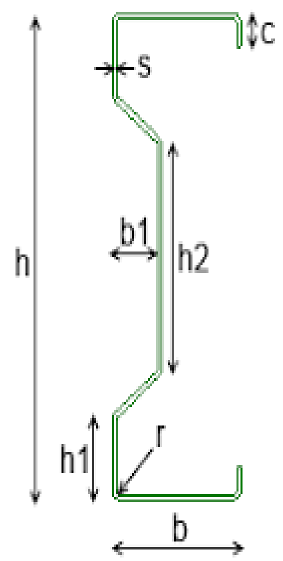


Fig.1.1 Sigma Face to Face Section

In this thesis, a structural performance of sigma face to face column is studied. Also, built-up column with different screw spacing is also analysed. The modelling and analysis is done using finite element software ANSYS 21.

1.1 CFS Sigma column

A cold formed steel with sigma shape is analyzed shown in Fig.1.2. The sigma sections with face to face column is analyzed by varying its screw spacing like 100mm, 150m and 200mm are used here. Material is used Q355 steel sheet along with these material provide ULCC1250 concrete. Quadruple is defined as a structure consisting of four parts or elements, four sections of CFS can be over-lap the column by using screws. The use of CFS built-up column to resist axial forces in CFS multistory buildings has gained high strength and lightweight structure.

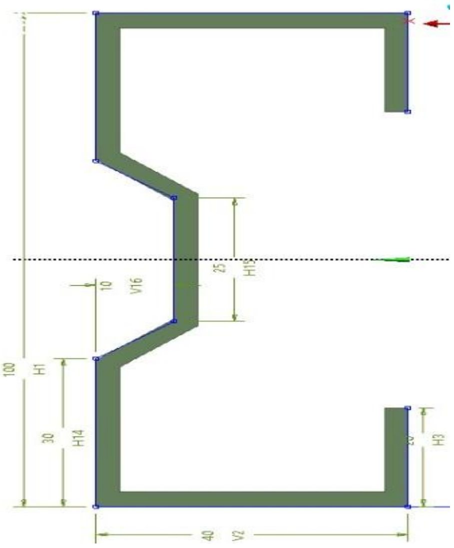


Fig.1.2: Sigma section

The dimensions of Sigma sections are shown in Fig.1.2 and along with these dimension provide a thickness as 3 mm. The proposed system can improve the capacity of built-up column.

1.2 Objective

To study the structural performance of sigma face to face concrete column by varying its screw spacing like 100mm,150mm and 200mm under axial loading.

2. ANALYSIS OF COLD FORMED STEEL COLUMN BY VARYING QUADRUPLE MEMBERS

It deals with the dimensional details, modelling details and analysis and results of sigma face to face concrete column by varying its screw spacing in ANSYS software.

2.1 Geometric Modelling

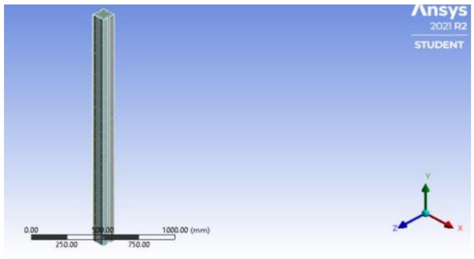
In order to determine the effective screw spacing for CFS sigma face to face concrete column. The end supporting condition was provided as both ends are hinged end condition. The Properties of concrete are shown in Table 1.

Table -1: Properties of concrete

Density	1250 kg/m^3
Poisson's ratio	0.2
Young's modulus	1.79X10^5 N/mm^2
Compressive strength	60 MPa

2.3 Modelling

The modelling of the three different size of screw spacing in sigma face to face concrete column is done by using CFS SOLID 186 / SCREWS BEAM 188 element type to determine the effective screw spacing. The models of different screw spacing is shown in Fig.2.1.



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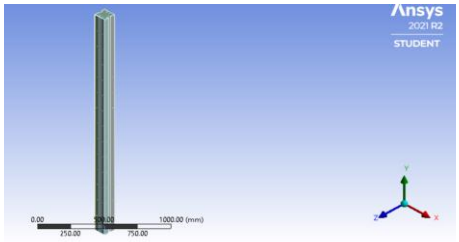

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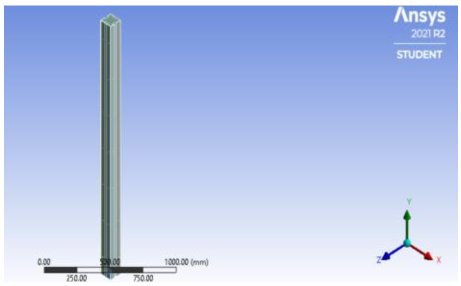


(c)

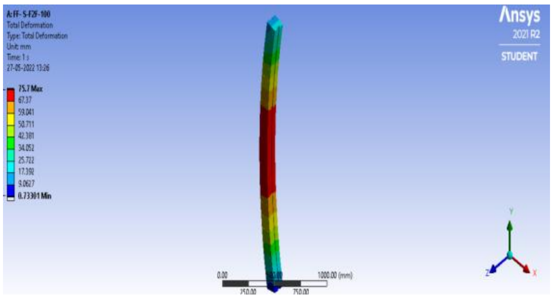
Fig-2.1: Solid model of sigma face to face concrete column (a) 100mm spacing (b) 150mm spacing(c) 200mm spacing.

2.4 Meshing and Loading

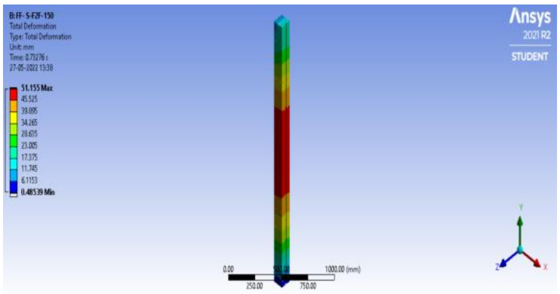
Here the element type used is CFS SOLID186. Element shape is of hexahedron. Element size provided for is 25mm Loading is done based on displacement convergence criteria with a value of 10mm and the corresponding ultimate value is noted.

2.5 Analysis

Non-linear static analysis is carried out in CFS sigma face to face concrete column and different size of screw spacing to find the maximum ultimate load corresponding to the buckling. The buckling of CFS sigma face to face column and different spacing of sections are shown in Fig. 2.2.



(a)



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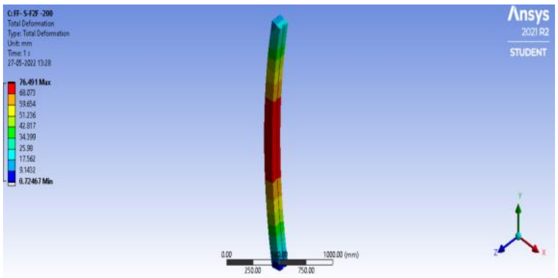

(c)

Fig-2.2: Buckling of sigma face to face concrete column (a) 100mm spacing (b) 150mm spacing (c) 200mm spacing.

2.6 Results and Discussions

The load- deflection graph of deformation of sigma face to face concrete column and different screw spacing of segment is shown in Chart-1.

Table -2: Comparison of results

Model	Deflection (mm)	Load (kN)
100mm spacing	37.798	1308.6
150mm spacing	37.946	1307.4
200mm spacing	37.93	1306.6

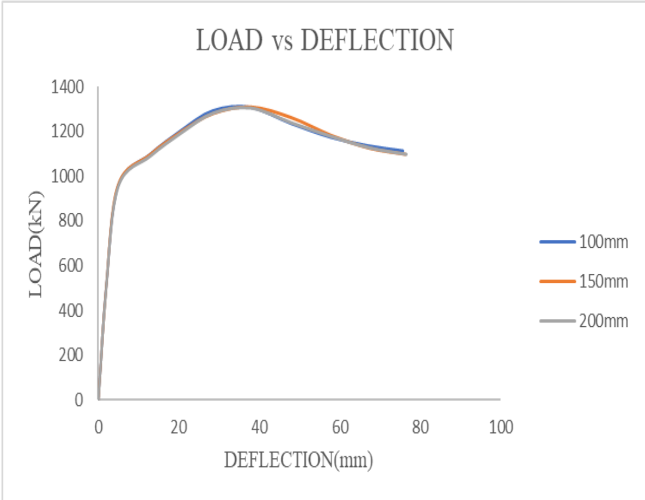

Chart-1: Comparison of load deflection graph

Here sigma-face to face concrete column with 100mm spacing has better ultimate load carrying capacity than the others. The percentage increase in load carrying capacity of 100mm spacing 0.0917% more load than further.

3. CONCLUSIONS

In this study, structural performance of sigma face to face concrete column is studied. To find the better spacing of section is analyzed. The conclusions obtained are:

- Sigma-face to face concrete column with 100mm spacing has better ultimate load carrying capacity than the others. The percentage increase in load carrying capacity of 100mm spacing 0.0917% more load than further.

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