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Experimental Investigation On Buckling Behavior Of Cold Formed Sigma Section

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Abstract - *Cold formed steel sections are the widely used structural elements in India. One of the great advantages of cold-formed steel (CFS) is the immense flexibility that the material affords in forming cross-sections. Whereas, the low strength-to-weight ratio of hot rolled steel members leads to increase in overall load on structure as compared with cold-formed steel sections which is having high strength-to-weight ratio. This paper presents a study on buckling behavior of cold formed steel (CFS) sigma section with and without lip. This study involves in examination of experimental and analytical investigations of specimens in series. Overall six specimens in which three specimens with lip and three specimens without lip of same dimensions were designed and compared for ultimate load carrying capacity and ultimate deflection at these sections. The experimental results are verified using ANSYS software. Research project aims to provide which section is economical, more load carrying capacity and lesser deflection.*

***Key Words*: Cold Formed Steel, Sigma Section, Buckling Behavior, ANSYS, Ultimate Load Carrying Capacity.**

1.INTRODUCTION

Cold Formed Steel (CFS) is a type of steel fabricated by cold forming process and Cold-formed steel goods are created by the working of sheet steel using stamping, rolling or presses to deform the sheet into a usable product. The thickness of the sheet used is generally between 1mm and 8mm. Although cold-formed steel sections are used in car bodies, railway coaches, various types of equipment, storage racks, grain bins, transmission towers, transmission poles etc. but in building construction it has limited advancement. The use of hot rolled steel sections becomes uneconomical for the steel structures subjected to light and moderate loads. The structural members like purlins, girts, roof trusses, complete framing of one and two storey residential, commercial and industrial structures subjected to moderate load, for which cold formed steel Members may be sufficient. Cold formed sections like Channel, Zee sections, I-sections, angles, T-sections, hat sections, and tubular members are commonly used.

In the previous researches, buckling behaviour of cold formed steel sigma section with and without lip have not been performed and compared experimentally and analytically. The aim of this paper is to investigate the behavior of cold formed sigma section under buckling. In this study six specimen in which three with lip and three without lip.

2. EXPERIMENTAL INVESTIGATION

The specimens are fabricated by locally available cold formed sheets. The CFS sheet of 1.6mm is used for section. The yield strength of the cold formed steel used is 250 Mpa

3. TEST SET UP

The testing was carried out in a loading frame of 400kN capacity. All the specimens were tested for compressive strength. The specimens were arranged with an effective span of 1.0 m. Compressive loads were applied at a uniform rate till the ultimate failure of the specimens occurred . Strain gauges are fixed at top , bottom and at the centre of the column . The strain gauges were connected to a data logger from which the readings were noted at every load interval until failure of the column occurred. The experimental set-up for the test specimens are shown in fig 1 and the failure patterns are shown in fig 2 and 3.

Fig 1: Experimental Set up

Fig 2: Without lip

Fig 3: With lip

4. RESULT AND DISCUSSION:

4.1. Load versus Deflection Curves.

The specimen without lip failed at an average ultimate load of 98 kN with a central deflection of 3.3 mm. The specimen with lip failed at an average ultimate load of 108.2 kN with a central deflection of 1.7 mm.

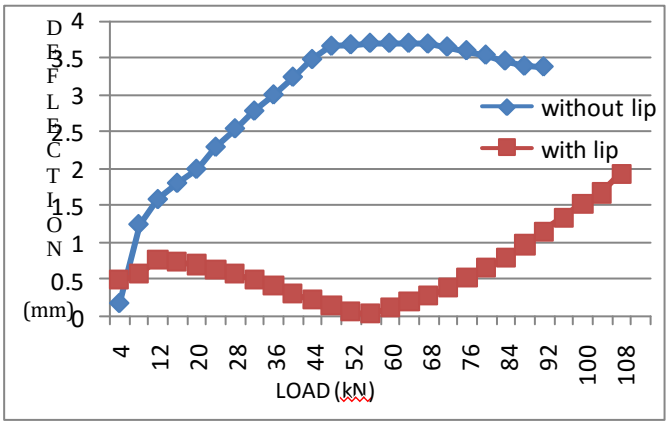

CHART 1: Load vs deflection curve

4.2. Load versus Strain curves

Strain gauge having 120 ohms capacity & 10 mm grid are used. Straingauges are fixed at the top and bottom plates at the centre of the beam. The figure 5 and 6 shows the load vs strain curve for the beam without and with lip.

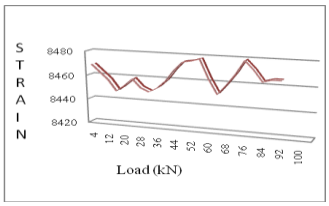

CHART 2: Load vs strain for without lip

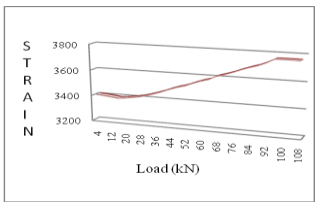

CHART 3: Load vs strain for with lip

5. NUMERICAL INVESTIGATION

Numerical analyses have been carried out using ANSYS software. The compressive strength of the cold formed steel without lip was 92.2 kN, 92.5 kN and 91.3 kN and that of the column with lip was 108.5 kN, 107.3 kN and 108.8 kN.

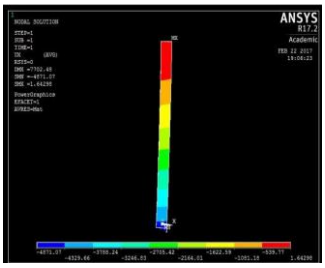

FIG 4: Deflection for with lip

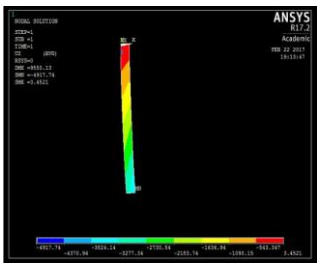

FIG 5: Deflection for without lip

6. COMPARISON OF LOADS

The experimental and analytical results were compared and the results are well within the permissible limits. The average experimental load carrying capacity of the column without lip was 92 kN and deflection found by FEM analysis was 3.4mm . The experimental load carrying capacity of the beam with lip was 108.2 kN and deflection found by FEM analysis was 1.64 mm

7. CONCLUSIONS

Experimental investigations were carried out to make a comparative study on the buckling behaviour of cold – formed steel sigma section without lip, cold –formed steel sigma section with lip and following conclusions were drawn.

1) The ultimate load carrying capacity of cold- formed steel sigma section without lip was 18% higher than that of cold-formed steel sigma section with lip.

2) The ultimate deflection of the cold- formed steel sigma section without lip was 3.66 mm and the ultimate deflection of cold formed steel sigma section with lip was 1.7mm.

3) The analytical results are in good agreement with the experimental results. The average load found out using analysis was 92 kN for column without lip and 108.2 kN for column with lip.

4) T he observed failure pattern of both the sections are local buckling.

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