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EXPERIMENTAL STUDY ON BUCKLING BEHAVIOUR OF COLD-FORMED STEEL SECTIONS

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Abstract- *Cold-formed steel is also called as light gauge steel sections. CFS section is 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-section. 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 having high strength-to-weight ratio. This paper presents a study of compressive behavior of cold formed steel (CFS) 1.Back to back lipped channel section without gap, 2.Face to face lipped channel section with gap. The length of the column is kept constant for 1m. Experimental setup will be made to find the load versus deflection and load versus strain behavior under compression. Research project aims to provide which section is economical, more load carrying capacity and lesser deflection.*

Key words: cold-formed steel, buckling behavior, compression, load carrying capacity.

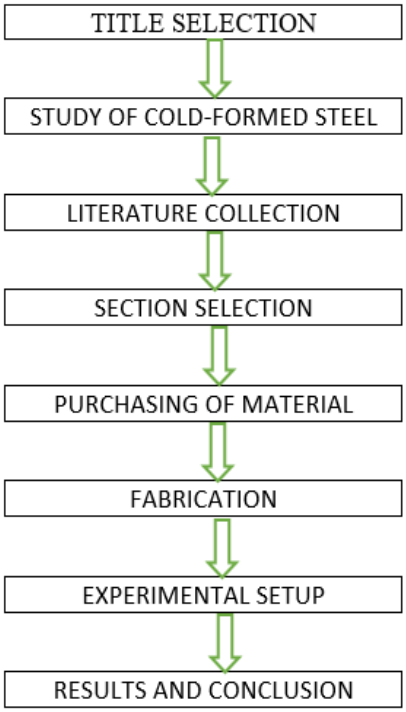
1. INTRODUCTION

Cold-formed steel (CFS) or light gauge is a type of steel created by cold forming process. Cold-formed steel goods are bring into existence by the working of sheets steel using stamping, rolling or presses to deform the sheets into a usable product. The thickness of the sheet used is generally between 1 mm to 8 mm. Even though cold-formed steel sections finds its application in transmission poles, transmission towers, grain bins, storage racks, car bodies, railway coaches and various types of equipment , 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 such as purlins, grits, roof trusses, complete framing of one and two storey residential, commercial and industrial structure subjected to moderate load, for which cold-formed steel members may be agreeable. Cold-formed sections such as zee section, channel section, I-sections, angles, Hat sections, T-section, and tubular members are commonly used.

The yield strength of steel sheets is at least 280 N/mm2, which is used in cold-formed steel sections. Although there is a trend to use steels of higher strengths and sometimes as low as 230 N/mm2. The ratio of tensile strength to yield strength for light gauge steel commonly ranges from 1.2 to 1.8.

Cold-formed steel are available for use as basic building elements for assembly at site or as prefabricated frames or panels. These thin steel sections are cold-formed, i.e. their building process incorporates into steel sections in a cold state (i.e. without supply of heat) from steel sheets of uniform thickness. Sometimes they are also called light gauge steel sections or cold rolled steel sections. Cold-formed steel sections are normally manufactured by either roll forming or press braking. The process used is largely dependent on the complexity of the section geometry, and the volume of the particular section required. Past research investigated on compressive behavior of build-up cold formed steel sections and found out that the compression capacity was more than the single cold formed steel section. Hence cold formed built up sections were used in these research.

2. METHODOLOGY



3. SPECIMEN DETAILS

3.1 BACK TO BACK CHANNEL SECTION

A.CROSS-SECTION OF THE SPECIMEN:

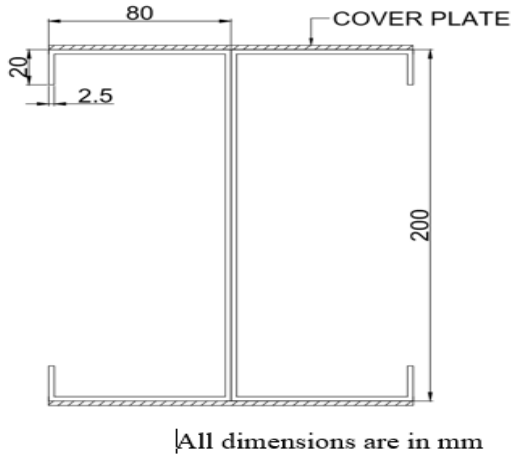


TABLE 1: DETAILS OF THE SPECIMEN (BACK TO BACK)

Column section	L*B*D*LIPS
Depth, d (mm)	200
Width, b (mm)	80
Lips, (mm)	20
Thickness of cover plate	2.5
Length of column (mm)	1000

3.2 FACE TO FACE CHANNEL SECTION

B. CROSS SECTION OF THE SPECIMEN:

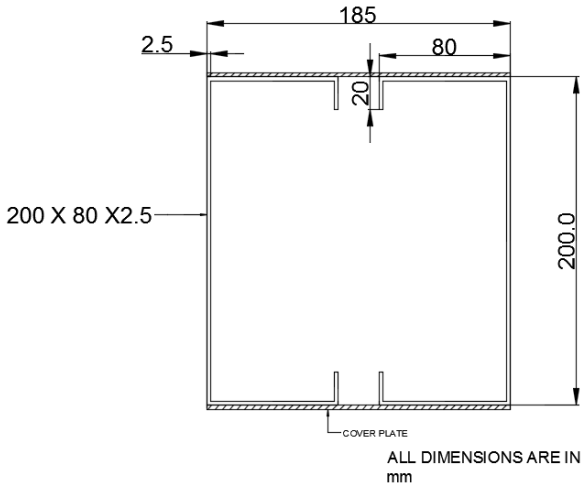


TABLE 2: DETAILS OF THE SPECIMEN (FACE TO FACE)

Column specimen	L*B*D*LIPS
Depth, d (mm)	200
Width, b (mm)	80
Lips, mm	20
Thickness of cover plate	2.5
Length of column (mm)	1000

4. EXPERIMENTAL INVESTIGATION

The specimens are fabricated by locally available cold-formed steel sheets. The CFS sheets of 2.5mm for channels and for connecting plates. The channels are connected by means of weld. The entire fabricated specimen of back to back and face to face are shown below.

FIG 1: FABRICATED BACK TO BACK SPECIMEN

FIG 2: FABRICATED FACE TO FACE SPECIMEN

5. EXPERIMENTAL SET-UP

Cold-formed build up channel sections of 1000 mm length and 200 mm depth is tested in a loading frame of capacity 400KN under axial loading condition for both back to back and face to face channel specimens. Fixed support is provided at the ends of specimen. LVDT and load cell are used for measuring deflection and load increment. All data were recorded in a data acquisition system .Strain gauge were fixed at the top flange and middle web portion and were connected to a data logger from which the readings were noted at every load interval until failure of the column. The experimental set-up for the test specimen were shown below.

FIG 3: EXPERIMENTAL SETUP FOR BACK TO BACK SPECIMEN

FIG 4: EXPERIMENTAL SET-UP FOR FACE TO FACE SPECIMEN

6. EXPERIMENTAL RESULTS

6.1 LOAD VERSUS DEFLECTION CURVE

The experimental load-deflection curves of the cold-formed steel column of specimen back to back and face to face is shown in fig 5&6. Back to back specimen failed at on ultimate load of 155KN with central deflection of 3.80mm face to face specimen failed at an ultimate load of 100KN with central deflection of 5.19mm.

FIG 5: GRAPH FOR LOAD VS DEFLECTION (BACK TO BACK SPECIMEN

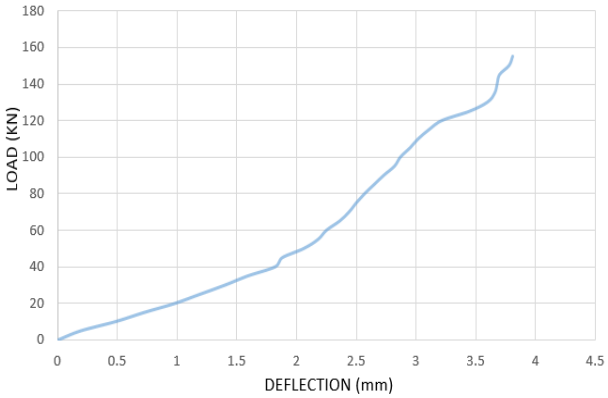


FIG 6: GRAPH FOR LOAD VS DEFLECTION (FACE TO FACE SPECIMEN)

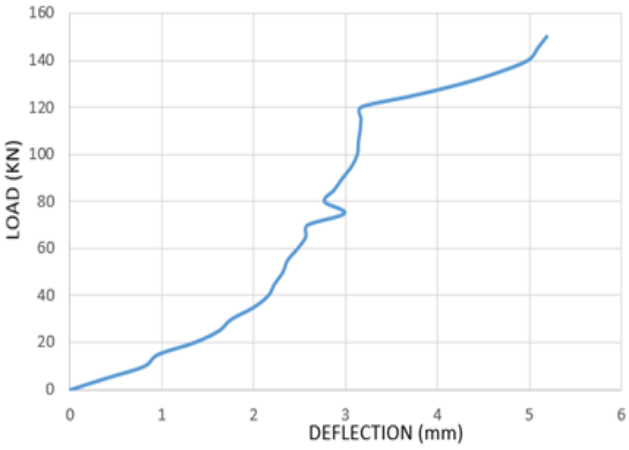


FIG 7: GRAPH FOR LOAD VS STRAIN (BACK TO BACK SPECIMEN)

6.2 LOADS VERSUS STRAIN CURVE

Strain gauge having 20 ohms capacity & 10mm grid are used strain gauges are fixed at top and center of the column fig 7&8 shows load vs strain curve for the column.

FIG 7. A) AT WEB (MIDDLE)

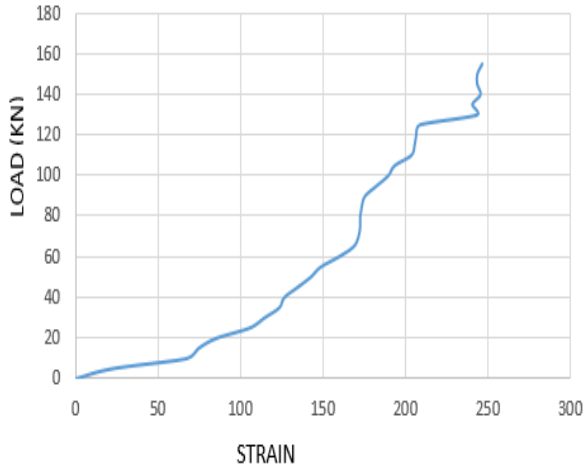


FIG 7. B). AT FLANGE (TOP)

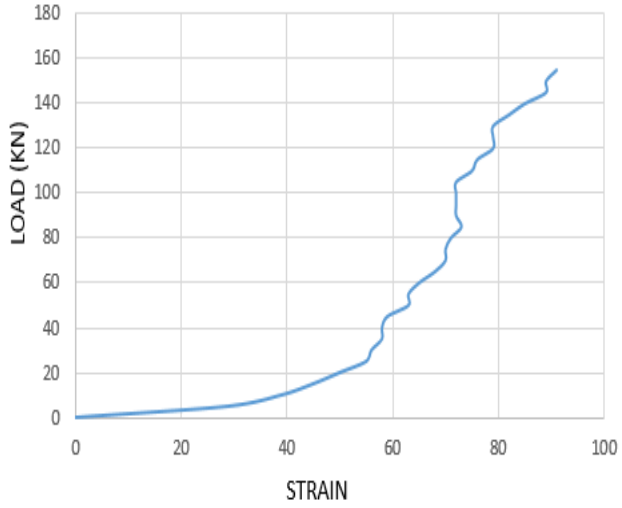


FIG 8: GRAPH FOR LOAD VS STRAIN (FACE TO FACE SPECIMEN)

FIG 8. A) AT WEB (MIDDLE)

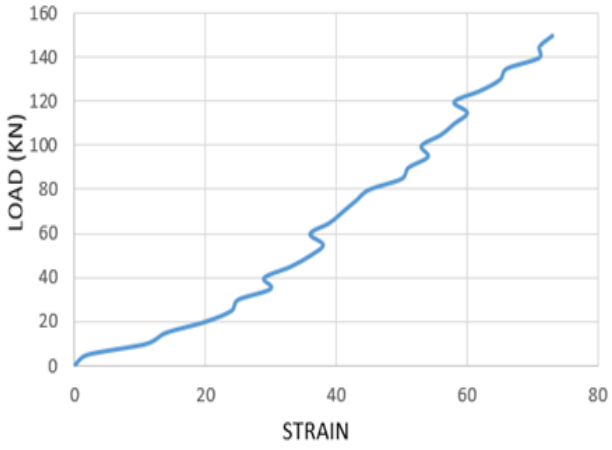
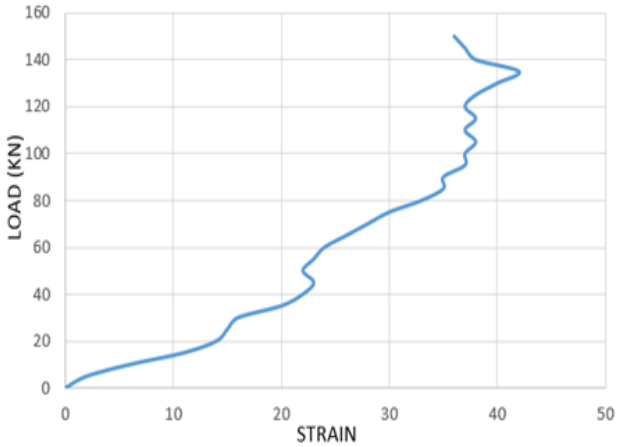


FIG 8. B) AT FLANGE (TOP)



6.3 FAILURE PATTERN

FIG 9: FAILURE OCCUR AT THE TOP OF BACK TO BACK SPECIMEN

FIG10: FAILURE OCCUR AT THE BOTTOM OF FACE TO FACE SPECIMEN

6.4 ANALYSIS OF SPECIMENS

Experimental analysis have been carried out between back to back lipped channel section and face to face lipped channel section

TABLE 3: EXPERIMENTAL ANALYSIS

SPECIMEN	BACK TO BACK	FACE TO FACE
\MAXIMUM LOAD (KN)	155	150
DEFLECTION (mm)	3.80	5.19
STRAIN	246.7	73

7. CONCLUSIONS

Experimental investigation were carried out to make a comparative study on the compressive behavior of back to back channel section with lip and face to face channel section without lip.

1. The cover plate at the specimen increases the load carrying capacity of the column.

2. The ultimate deflection of the cold-formed back to back section with lip was 3.80mm and for face to face section with lip was 5.19mm.

3. By comparing both the sections we came to know that the section with lip has high load carrying capacity

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