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Experimental Study on Flexural Behaviour of Cold Formed Steel Section

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Abstract:
Cold-formed steel has been widely used in construction industry. In this paper, an attempt has been made in order to investigate the property of cold-formed steel by flexural behaviour of a channel section connected back to back. The flexural behaviour is evaluated both theoretically and experimentally and the results are compared in this study. In the experimental work, sections with nominal dimension 200 x 80 mm and 1.5 m length were loaded vertically while the lateral deflection were unrestrained to allow flexural buckling. The main objective of this study is to check the flexural strength of the specimen. Cold-formed steel (CFS) section under this study is the popular and emerging in the past decades. The property of the cold-formed steel makes it economic and feasible. The study of structural behaviour of cold-formed steel can make it easier to know its property and usage.

***Keywords**: Flexural buckling, cold formed steel theoretically and experimentally*

1. Introduction

Cold formed steel sections are light-weight material suitable for any kind of building. The type used in this study is steel fabricated by cold forming process: stamping rolling or pressing. This process helps getting the specimen to desired size. Experimental and research work was said that it’s have more advantage than hot-rolled steel and economical.

Typical Cold-Formed Steel members such as studs, track, purlins, grits mainly used for carrying loads while panels and decks constitute useful surface such as floor, roof and walls. In addition to resisting in-plane and out-of-plane surface load. Cold-Formed Steel research and products, including codes and standards developments that are spear headed by the American Iron and Steel Institute (AISI)

The thickness typically ranges from 1.2mm to 3.5mm The typically design strength for cold formed steel section are 350N/mm^2 450 N/mm^2 550 N/mm^2 .Cold formed steel sections are generally applied in the construction on both primary and secondary structural members.

The variety of size and thickness of CFS profiles provides high flexibility in design. In addition, the CFS structural systems are characterized by high productivity, especially when innovative connection technology as press-joining, clinching are used. These peculiarities, together with the high and uniform quality of products, make the CFS system a structural typology particularly suitable for factory prefabrication.

The cold-formed steel sections are manufactured from steel sheets. By cutting and bending into desired shapes. In the same way, the specimen chosen here is a channel lipped section connected back to back with bolts. The cold-formed sheet is also known as Light gauge steel because of its minimum thickness when compared to hot rolled section

The aims of this paper are to present an overview of the experimental investigation and found to be in coincidence with the theoretical calculation.

2. Methodology

The methodology adopted in the study is shown in Fig. 1.

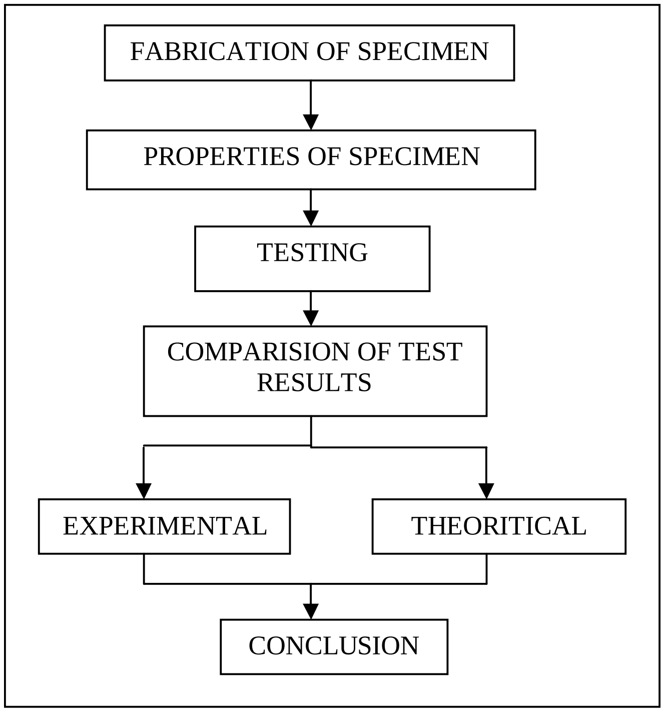

Figure 1

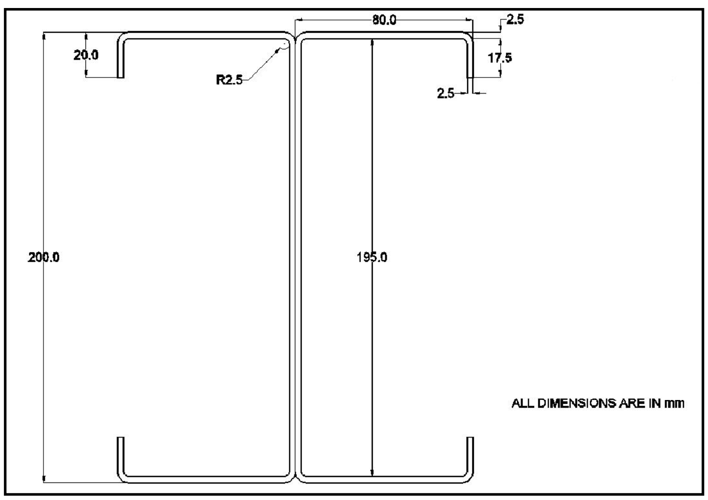

Figure 2: Section properties of channel section

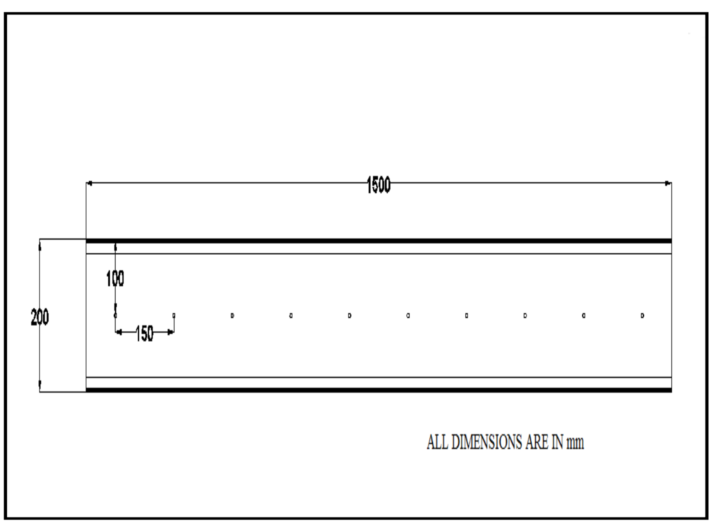

Figure 3: Bolt Connection Details

Beam section (mm)	Depth, d (mm)	Width, b (mm)	Lips (mm)
L*B*D* LIPS	200	80	20
Radius (r) (mm)	**Thickness (t) (mm)**	**Design strength (f_y) (N/mm^2)**	**Beam length(mm)**
8	2.5	350	1500

Table 1: Size of Channel Section Specimen

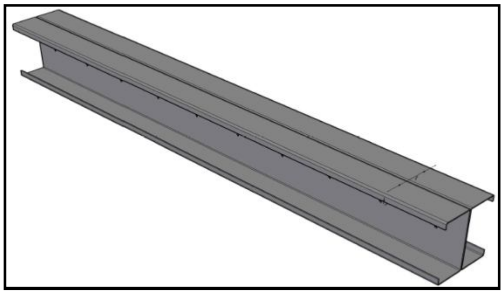

Figure 4: Cross View of Bolt Connection

Bolt (mm)	Specimen size
Diameter	6 mm
Diameter of bolt holes	8mm
Spacing of bolt	150mm
Thickness	2.5mm
Gauge length	100mm
End spacing	75mm
Pitch length	150mm

Table 2: Details of Bolt Connection

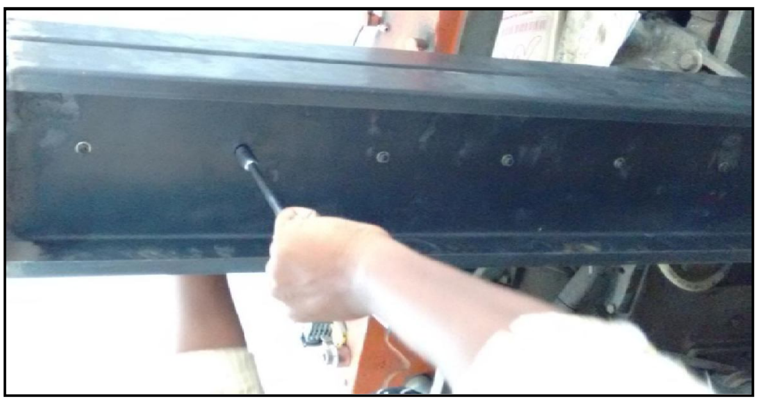

Figure 5: Back to Back Bolt Connection

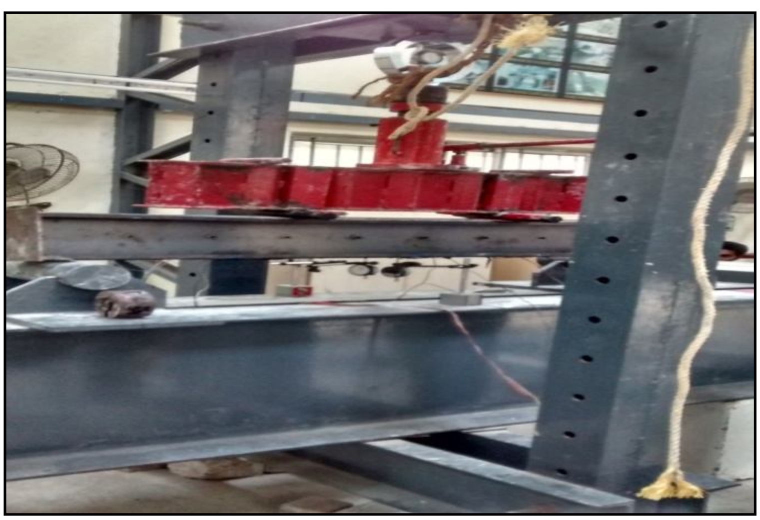

Figure 6: Before Testing of the Specimen

2.1. Test Procedure

The two point loading test configuration was set up for experimental investigation. The length of the beam was fixed to 1500mm for Depth of the channel 200mm.

The test specimen has been fixed in to the test setup as shown in fig. above, by the simply supported over hanging channel specimen fixed and completely avoiding the translation of the member.

Check the alignments and fix the LVDT (for testing the deflection) & Strain gauges (for measuring strain) at necessary locations.

The load cell is fixed between the Proving ring & the support and connected it in to the Data logger.

Apply axial Uniformly Distributed load, by the use of mechanical Screw Jack

Necessary readings are taken from Proving ring & from the Data Logger.

Calculations are made theoretical (as per codes & from Literatures) and Comparing with experimental results.

2.2. Experimental Investigation

The specimen is tested under the loading frame with the load applied manually. Various apparatus are equipped for the bending test and finally the load is checked on the proving ring and dialguage are noted from the deflection and the strain is noted from the strain indicator. Strain gauges are attached to the specimen at particular points using special glue. Hydraulic jack is the device used to apply load in the loading frame. The strain gauge resistance increases with the strain in the specimen and this is how the values are tabulated from the stain indicator to draw the Load vs. strain graph.

3. Experimental Observation for Flexural Testing

SI NO:	LOAD kN	SG 1	SG 2	SG 3	SG 4	SG 5
1	0	2275	2103	2765	2832	2207
2	2.5	2265	2085	2747	2822	2187
3	5.0	2256	2077	2759	2811	2184
4	7.5	2250	2068	2742	2805	2169
5	10	2239	2061	2730	2802	2161
6	12.5	2227	2052	2718	2781	2154
7	15	2219	2040	2709	2773	2140
8	17.5	2210	2026	2704	2767	2133
9	20	2204	2014	2691	2760	2115
10	22.5	2196	2002	2680	2743	2093
11	25	2188	1986	2665	2728	2087
12	27.5	2182	1977	2646	2716	2072
13	30	2169	1965	2634	2698	2082
14	32.5	2154	1960	2620	2690	2067
15	35	2129	1944	2599	2664	2045
16	37.5	2114	1936	2591	2654	2037
17	40	2072	1889	2572	2642	1997
18	42.5	2011	1828	2546	2610	1935
19	45	1982	1786	2487	2558	1894
20	47.5	1915	1735	2462	2526	1843
21	50	1803	1710	2401	2472	1804
22	52.5	1838	1672	2349	2412	1778
23	55	1786	1651	2329	2399	1749
24	57.5	1744	1570	2286	2356	1677
25	60	1710	1546	2268	2330	1655
26	62.5	1689	1519	2252	2322	1618
27	62.5	1678	1498	2238	2306	1605
28	60	1602	1465	2231	2301	1567
29	57.5	1519	1432	2219	2290	1531

Table 3:Load Applied Vs Strain Gauge Reading

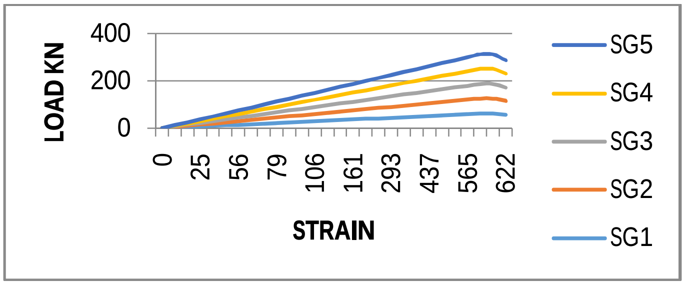

Figure 7: load vs. strain

SI NO:	LOAD kN	Dial gauge 1 (mm)	Dial gauge 2 (mm)
1	0	-	-
2	2.5	0.106	0.09
3	5.0	0.212	0.18
4	7.5	0.345	0.295
5	10	0.505	0.46
6	12.5	0.669	0.65
7	15	0.781	0.79
8	17.5	0.889	0.81
9	20	0.987	0.99
10	22.5	1.11	1.10
11	25	1.186	1.15
12	27.5	1.347	1.35
13	30	1.44	1.45
14	32.5	1.55	1.53
15	35	1.66	1.65
16	37.5	1.792	1.80
17	40	1.891	1.90
18	42.5	1.983	1.95
19	45	2.069	2.05
20	47.5	2.158	2.15
21	50	2.242	2.3
22	52.5	2.31	2.35
23	55	2.354	2.4
24	57.5	2.396	2.45
25	60	2.443	2.5
26	62.5	2.597	2.6
27	62.5	2.65	2.65
28	60	2.974	2.85
29	57.5	3.107	3.15

Table 4: Load VS Deflection Reading:

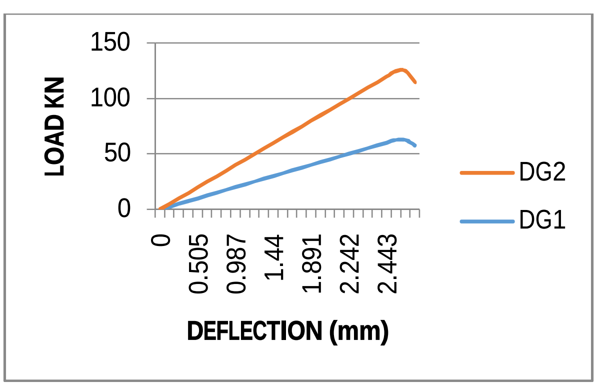

Figure 8: Load Vs Deflection

4. Theoretical Study

The theoretical study was carried out with reference to the IS: 811-1974. The obtained experimental results are compared with theoretical validation

SPECIMENSIZE(mm)	**Max shear stress (N/mm^2)**	**I_{XX} (mm^4)**	**SECTION MODULUS Z (mm^3)**
200*80*2.5	32.21	11028631.0	110286.31
Web Shear (N/mm^2)	**Permissible safe load(kN)**	**Allowable deflection (mm)**	**Maximum Deflection (mm)**
31.4	62.8	4.615	3.411

Table 5: Theoretical Calculation Value:

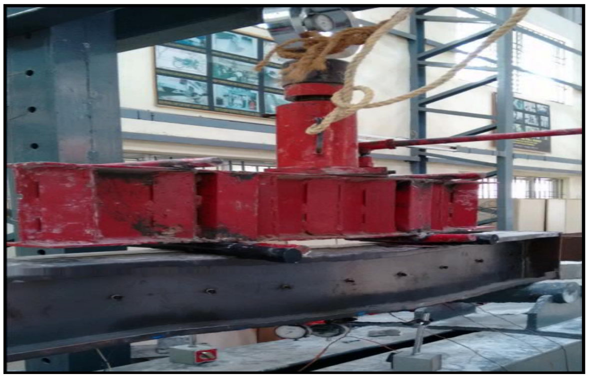

Figure 9: AFTER TESTING FAILURE

5. Discussion and Result

The specimen is expected to have an acceptable level of accuracy in experimental calculation and found to be in coincidence with the theoretical calculation. The following table shows the max load and deflection for the specimen and it is found to be valid as per the Indian code of practice.

Theoretical ultimate load (kN)	62.8
Theoretical max Deflection (mm)	3.411
Theoretical allowable deflection (mm)	4.615
Experimental ultimate load (kN)	62.5
Experimental max Deflection (mm)	3.2

Table 6: Load VS Max Deflection of the Specimen

6. Conclusion

This study deals with the flexural behavior of cold formed steel beams by connecting channel sections back to back.

- The deflection increases gradually till the local buckling of specimen.
- Most of the failures were found at 1/3 distance of steel beam from the support.
- The experimental deflection of cold formed steel channel section is found to be within the permissible limit and calculated form theoretical calculation.
- It is concluded that the beams made up of cold form steel channel section will give good flexural strength with less weight compared to hot rolled section.

7. References

i. Haiming wang,Yaochun zhang , Experimental and numerical investigation on cold formed steel C-section flexural members, journal of Thin-walled structures 65(2009);1225-1235.

ii. Wei-Xin Ren, Sheng-En Fang, Ben Analysis and design of cold –formed steel channels subjected to combined bending and web crippling,Thin-walled structures 44(2006);314-320.

iii. R.G.Beale, M.H.R.Godley, V.Enjily,A theoretical and experimental investigation into cold-formed channel sections in bending with the unstiffened flanges in compression. Computer and structures 79(2001);2403-2411

iv. Lee, Y. H, Y. L. Lee and C.S.Tan.2011.Analytical investigation of cold formed steel double channel beam section design between British standard and eurocode. sections in bending with the unstiffened flanges in compression. Computer and structures 79(2001);2403-2411

v. Mohamed salah Al-Din soliman,AnwarBadawy Abu-sena,,MoamedSaeedRefaeeSaleh, Resistance of cold formed steel to combined bending and web crippling Ain Shams Engineering journal 4(2013);435-453

vi. Luis Laim,joaopaulo C. Rodrigues,Luis Simoes da silva,Experimental and numerical analysis on the structural behavior of cold-formed steel beams, Thin-walled structures 72(2013);1-13