International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 8 Aug 2021, pp: 567-571 www.ijaem.net ISSN: 2395-5252

Experimental Investigation of Unsymmeterical I-beam under Flexure

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Submitted: 01-08-2021 Revised: 10-08-2021 Accepted: 13-08-2021

ABSTRACT

The Cold Formed Steel Section (CFSS) has been popular in the engineering field recently than Hot Rolled Steel Section (HRSS) which are also widely used in various fields. Hot rolled section have heavy weight compared to cold formed steel section (CFSS). From the literatures we came to know that all studies happened on channel sections only. In the present study, an experimental investigation of flexural strength in cold formed steel with unsymmetrical I section is carried out. Four various dimensions of cold formed steel unsymmetrical I section were considered from the numerical studies. These are also carried out by Experimental Analysis also. The Results of both the studies are to be considered. The Maximum load obtained by the sections and the deflectionoccurred by the sections are considered and plotted by a Graph. The Ultimate load obtained by the sections are taken and the suitable section will be the one to be carried out.

Keywords: Cold formed steel section, Unsymmetrical, Flexural strength.

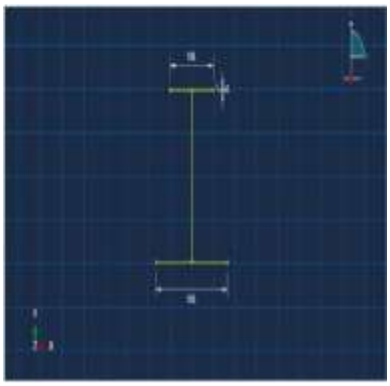
I. INTRODUCTION

Cold-formed steel is widely used in buildings, automobiles, equipment, home and office furniture, utility poles, storage racks, grain bins, highway products, drainage facilities, and bridges etc., Its popularity can be attributed to ease of mass production and prefabrication, uniform quality, lightweight designs, economy in transportation and handling, and quick and simple erection or installation.

In building construction, cold-formed steel products can be classified into three categories: members, panels, and prefabricated assemblies [1]. Typical cold-formed steel members such as studs, track, purlins, girts and angles are mainly used for carrying loads while panels and decks constitute useful surfaces such as floors, roofs and walls, in addition to resisting in-plane and out-of-plane surface loads [2-4]. Prefabricated cold-formed steel assemblies include roof trusses, panellized walls or floors, and other prefabricated structural assemblies [5-7]. The cold- formed structural members are defined as those cold formed to shapes in rolls or press brakes from carbon or low alloy steel sheets .

II. MATERIALS USED AND ITS PROPERTIES

A. Specimen Setup



(a) Specimen 1 (100*165mm)

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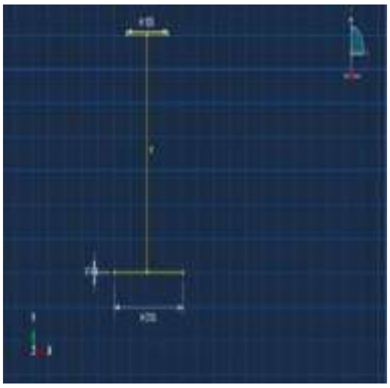
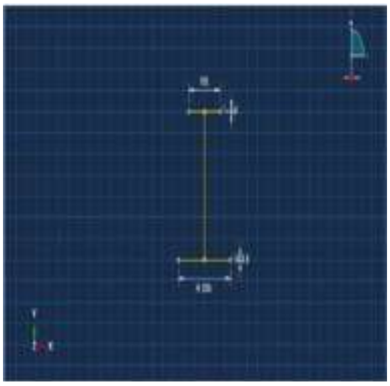
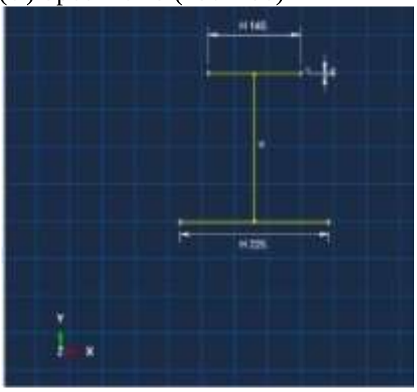


(b) Specimen 2 (125*210)



(c) Specimen 3 (150*250)



(d) Specimen 4 (140*210)

B. Numerical Analysis

The Finite Element Method (FEM) is a numerical analysis for obtaining approximate solutions to a wide variety of engineering problems. The finite element method is now well accepted as the most powerful general technique for the numerical solution of a variety of engineering problems. Applications range from the stress analysis of solids to the solution of acoustical phenomena, neutron physics, heat transfer problems etc.

C. Steps In Finite Element Analysis

The following are the steps involved in the application of finite element analysis:

1. Modelling.
2. Discretization
3. Selection of proper field model
4. Derivation of element characteristics
5. Assemblage of elemental equations to obtain overall equilibrium equations
6. Solution of unknown nodal displacements / field variable.

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7. Computation of results / elemental strains.

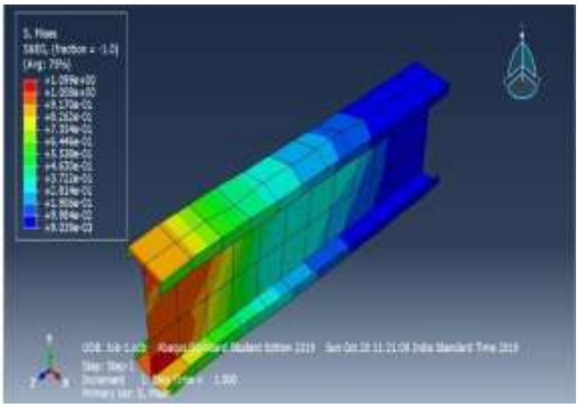

Fig. 1 Specimen 1

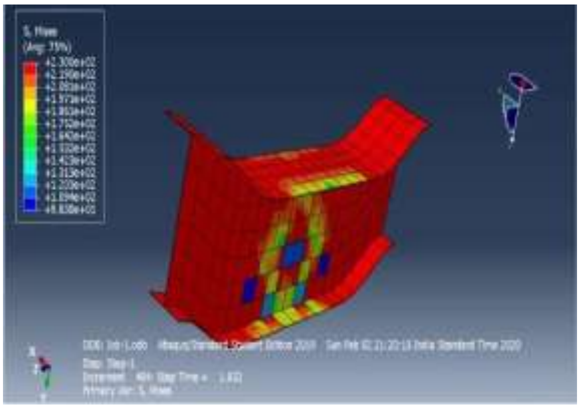

Fig. 2 Specimen 3

D. Test Set Up

Connection will made by welded connection. All the specimen will be tested by flexural strength under two-point loading by using reaction type loading frame. The specimens will be arranged with simply supported end conditions, centered over bearing blocks adjusted for an effective span of 1600mm. Load will be applied to the specimen by two points loading at a distance of 500mm from each support i.e. 1/3rd distance from the support and applied without shock, increased at a uniform rate till the ultimate rate till the ultimate failure of specimen.

III. RESULTS AND DISCUSSION

B. Specimen Details

Here the Cold formed steel Unsymmetrical I-section with different geometry was studied. The geometrical behaviour of Unsymmetrical I-section is not clear yet. So a study involving wide ranges of sections helps to investigate this new open cross section. Four specimens will be selected. Thickness of the section is 1.6 mm and 1.2mm for flange and web respectively. Depth of the section is 250mm.

Fig. 3 Fabricated Mono symmetrical and Unsymmetrical I-Section

As the specimen will be Unsymmetrical I-section it will be fabricated by bending the 1.6 mm and 1.2mm thick sheets. Mig welding will be used to assemble the components.

C. Load and Boundary Conditions

1. Load applied on the Beam is uniformly distributed pressure load.
2. Support conditions given to the loading system is act as like simply supported beam.
3. Hinged support end conditions.
4. Arresting the all horizontal translation in hinged support.
5. Translation at both the end of the I-section is constrained in all three (X, Y and Z-directions) directions.
6. Both the ends are allowed to rotate in all the directions.
7. The typical view of the composite deck slab model with boundary conditions and loading.

C.Load Deflection Behavior

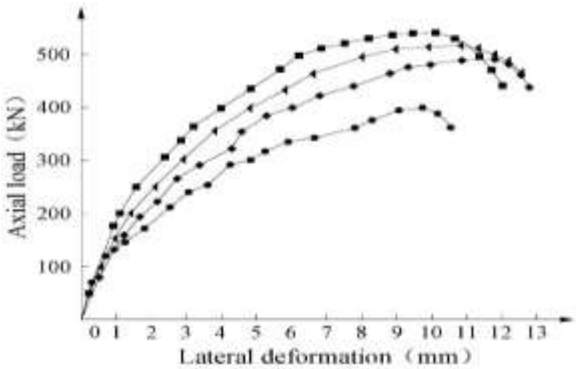

Fig. 4 Load Vs Deflection for Monosymmetrical cross section

Section	Ultimate Load (KN)	Deflection (mm)
1	320	11
2	410	13
3	410	12.5
4	405	12

Table. 1 Results

IV. CONCLUSION

The expansion of displacements of cold-formed thin-walled beams under increasing load results in local buckling that may appear together with global one. It is caused by the low-load capacity of such beams that depends on the dimensions and shape of the cross-section, boundary conditions (support) and the type of load. Beams that are loaded with a concentrated force at their middle lose stability quite quickly.The Ultimate load of specimen 2 is higher than specimen 1. It clearly shows that there is a need for search for new geometry of crosssections of cold-formed thin-walled beams.

Thin-walled members are used together if big strength and low weight of a structure is needed. The aim of the presented investigations is to find such a cross-section of a beam for which the load capacity is the biggest. The obtained results have been compared with a classical cold-formed thin-walled I-beam and I- beams with double flanges. It appears that unsymmetrical bends increase the load capacity, and in designing special attention need to be paid to their size. Eigen buckling and non-linear analysis has to be done using ABAQUS to determine the buckling load and failure modes. All the specimens are tested for flexural strength under two point loading. Flexural behaviour of beams and their modes of failure are studied based on the experimental results and numerical analysis of the beam. Feasibility of using direct strength method (DSM) to Unsymmetrical I-sections will be checked

REFERENCES

[1] S. Al-Mosawi, M.P. Saka (2000), "Optimum shape design of cold-formed thin-walled steel sections" , Journal of Advances in Engineering software, Vol. 31, pp. 851-862.

[2] Tuan Tran, Long-yuan L i(2006), "Global optimization of cold-formed steel channel sections" , Journal of Thin-Walled structures, Vol. 44, pp. 399-406.

[3] K. Magnucki, M. Rodak, J. Lewinski (2006), "Optimization of mono and unsymmetrical I-sections of cold-formed thin-walled beams", Journal of Thin- Walled structures, Vol. 44, pp. 832-836.

[4] R.J. Kasperska, K. Magnucki, M. Ostwald (2007), "Bicriteria optimization of cold-formed thin-walled beams with monosymmtrical open cross sections under pure bending", Journal of Thin-Walled structures, Vol. 45, pp. 563-572.

[5] K. Magnucki, P. Paczos (2009), "Theoretical shape optimization of cold-formed thin-walled channel beams with drop flanges in pure bending", Journal of constructional steel research, Vol. 65, pp. 1731-1737.

[6] Jurgen Becque, Kim J.R. Rasmussen (2009), "Experimental investigation of local-overall interaction buckling of stainless steel lipped channel column s" Journal of constructional steel research, Vol. 65, pp. 1677-1684.

[7] P. Paczos, P. Wasilewicz (2009), "Experimental investigations of buckling of lipped, cold-formed thin- walled beams with I-section", Journal of Thin-Walled structures, Vol. 47, pp. 1354-1362.

[8] Hong-Guang Luo, Yao-Jie Guo, Shi-Cheng Ma (2011), "Distortional buckling of thin-walled inclined lipped channel beams bending about the minor axis", Journal of constructional steel research, Vol. 67, pp. 1884- 1889.

[9] E. Magnucka-Blandzi, K. Magnucki (2011), "Buckling and optimal design of cold-formed thin-walled beams: Review of selected problems", Journal of Thin-Walled structures, Vol. 49, pp. 554-561.

[10] M. Ostwald, M. Rodak (2013), " Multicriteria optimization of cold-formed thin-walled beams with generalized open shape under different loads", Journal of Thin-Walled structures, Vol. 65, pp. 26-33.