e-ISSN: 2250-0758 | p-ISSN: 2394-6962
Volume-11, Issue-3 (June 2021)
https://doi.org/10.31033/ijemr.11.3.35

Investigation on Behaviour of Cold Formed Deep Joist Channel Section

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ABSTRACT

The application of cold formed steel elements in construction is becoming very popular due to several advantages like Speedy construction, higher strength to weight ratio, dimensional stability and recycled material. Nowadays, CFS is proposed to use as building components as beams, columns, Joists, wall panels etc. The load carrying capacity of cold-formed steel (CFS) joists can be enhanced by employing optimization techniques. Recent research studies have mainly focused on optimizing the bending capacity of conventional channel with and without lips that are used as joists. The objective of the study is to examine the flexural strength, failure mode and load-deflection of the cold formed steel double furred channel section with and without web openings under flexure.

Keywords— Cold-Formed Section, Flexural Behavior, Furred Section, Joist Beam

I. INTRODUCTION

The built up members are formed by connecting two or more cold-formed steel members together, such as I section member. Member built-up by connecting two channel sections back to back. Cold-formed steel (CFS) cross-sections are used extensively in the construction industry as secondary load-carrying members, such as roof purlins and wall girts [2]. Various shapes are also available for wall, floor and roof diaphragms and coverings. Open sections, closed sections and built up sections; C,Z, double channel I sections, hat, and angle sections are open sections while box sections and pipes are closed sections. The advantages are cross sectional shapes are formed to close tolerances and these can be consistently repeated for as long as required. Cold rolling can be employed to produce almost any desired shape to any desired length. Shear failure is critical in short spans while web crippling failure occurs when CFS beams subjected to concentrated loads [3]. A theoretical study on the optimization of lipped channel beams under uniformly distributed transverse load was presented to maintain the local, distortional, and global buckling strength as well as yielding, in combination with allowable deflection limits [1]. Manufacturers of cold formed steel sections purchase steel coils of 1.0 to 1.25 m width, slit them longitudinally to the correct width appropriate to the section required and then feed them into a series of roll forms. These rolls, containing male and female dies, are arranged in pairs, moving in opposite direction so that as the sheet is fed through them its shape is gradually altered to the required profile. In order to compensate some of the lost capacity, edge and intermediate stiffeners are fabricated into the web which complicates the characteristics and buckling mode [5].

II. MATERIAL TEST

In this study, coupon tests are performed to determine material properties. The shape and size of the test specimens were in accordance with IS 1608-2005-Part-1. All physical dimensions of the coupons were measured at salient locations and the gauge length is marked and test is done. From that Young’s modulus of the material and Poisson’s ratio is found. The test results were used in the numerical study. The stress-strain behaviour is obtained from the in-built facilities of the machine.

Figure 1: Coupon test

III. EXPERIMENTAL STUDY

This chapter describes the experimental investigation carried out on deflection and load carrying capacity of simply supported furred channel section. Experimental study was carried out on beams having

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different profile in order to obtain results. Cross sections of the profiles and dimensions adopted referring code provisions [6]. As the investigation is aimed at obtaining best profile, span of 1200 mm and same depth of 150mm was chosen for all the beams. The results of the cross section are presented below. The web of the beams was altered by producing as furred section on symmetrical and unsymmetrical order. Proving ring and deflect meters are used for load deflection measurements. The boundary condition of the beam is simply supported at the ends and load was applied as single point loading at center of the beam [4].

Figure 2: Loading

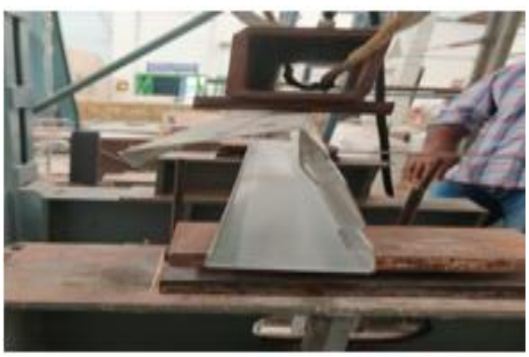

Figure 3: Failure mode

IV. ANALYTICAL STUDY

Cold formed steel sections have thickness which is extremely small compared to the other two dimensions which are modeled as plate-shell elements. The commercial non-linear finite element analysis software ANSYS 21.0 is used to predict load versus deflection behavior, failure loads and failure modes of the furred channel section. The program has static, stability and non-linear analysis capabilities, which are used in this study. The various steps involved in the finite element analysis, are discussed in detail in this chapter. The analytical simulation is performed in three stages. In three stages. In the first stage a linear analysis is performed on a perfect geometry and secondly a buckling analysis to incorporate the initial imperfections is performed with the same geometry to establish probable buckling modes. In the third stage, a non-linear analysis is performed incorporating material and nonlinearities to obtain the ultimate load and failure modes of the cold furred channel section. In the finite element model, the measured cross-section dimensions of the tested specimens and their material properties are modeled.

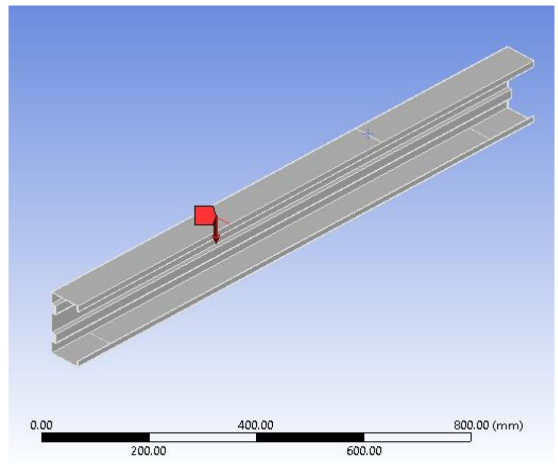

Figure 4: loading

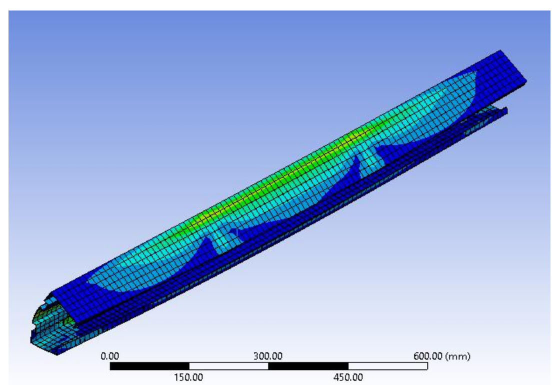

Figure 5: Stress Distribution

V. RESULTS

Table 1: Comparison of results

Specimen	Ultimate Load Capacity (KN)	Deflection (mm)	
		Exp.	ANSYS
75-150-1.2-1200	3.15	3.83	4.25

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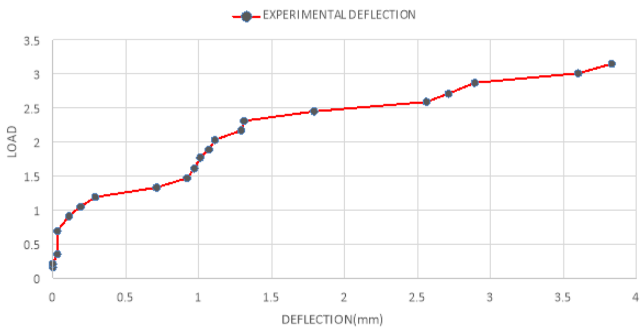

Figure 6: Load vs. deflection at midspan

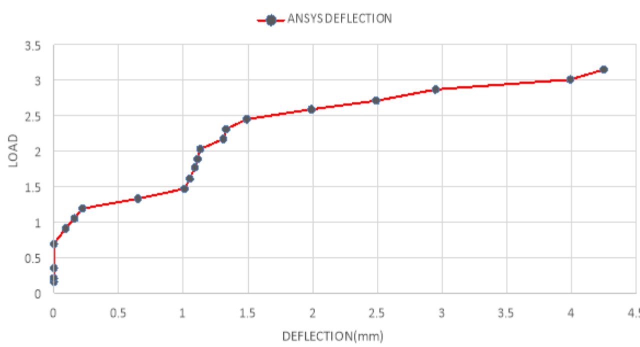

Figure 7: Load vs. deflection at Midspan

VI. CONCLUSION

Then experimental work is performed under two point loading to obtain the ultimate load capacity. In second phase, the finite element model is created and analysed. Through this load-deflection and buckling modes are observed. The experiments were carried out with specimens having same web depth, width of flange but varying cross-section profile.More investigation is required to obtain the most optimum section for the given dimensions of sample by varying the dimensions between the furring. As the sections are thin, the introduction of symmetrical stiffening will have a better resistance to buckle.

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