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Review Paper on Study and Analysis of Cold Formed Steel

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Abstract - *This review paper is prepared by studying previously published research papers on Cold Formed Steel. Selected papers covering area of study like sections, its manufacturing processes, advantages-disadvantages, various buckling modes along with analysis done by different methods and softwares viz. ABAQOUS, THINWALL, CUFSM etc. This paper also deals with the review of research papers showing properties of Basalt fiber in different area of its application. At the end, literature gap found in research paper is also been pointed out.*

Key Words: Cold Formed Steel, ABAQOUS, THINWALL, CUFSM, Basalt Fibre, Literature gap etc.

1.INTRODUCTION

Generally, these 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 manufacturing process involves forming steel sections in a cold state (i.e. without application of heat) from steel sheets of uniform thickness. These are given the generic title Cold Formed Steel Sections. Sometimes they are also called Light Gauge Steel Sections or Cold Rolled Steel Sections. The thickness of steel sheet used in cold formed construction is usually 1 to 3 mm and cam vary up to 8mm in particular cases. The method of manufacturing is important as it differentiates these products from hot rolled steel sections. Normally, the yield strength of steel sheets used in cold-formed sections is at least 280 N/mm2, although there is a trend to use steels of higher strengths, and sometimes as low as 230 N/mm2.

Commonly, cold formed steel (CFS) structural elements have traditionally been employed as secondary load-carrying members such as stud walls, roof purlins, wall girts and cladding. However, in a more recent trend, CFS members are also increasingly being employed as primary structural elements in low- to mid-rise multi-storey buildings and CFS portal frames with short to intermediate spans. Compared to hot-rolled members, CFS thin-walled members offer several advantages, such as a high strength for a lightweight, a relatively straightforward manufacturing process, a high flexibility in obtaining various cross-sectional shapes, and an ease of transportation and faster construction. However, as a result of the limitations of the manufacturing process, CFS components usually have 6–8 mm thickness, which makes them susceptible to local, distortional and global buckling, as well as their interactions.

2. LITERATURE REVIEW

Benjamin Schafer et.al. have proposed new definitions for different modes of buckling in their research paper. Those definitions were based on simple mechanical roofing assumptions which can easily be applied in the context of any numerical method. The proposed definitions were deeply explained with the applications of the Finite Strip Method. They have also mentioned the advantages and disadvantages of Cold Formed Steel.

Z. Li et.al. The author in his project have used the software CUFSM to determine the buckling modes of the columns. CUFSM is a freely available finite strip analysis software. They analyzed under general boundary conditions and concluded that, the conventional finite strip method combined with the constrained finite strip method, provides a powerful tool for exploring cross-section stability in cold formed steel members.

Vijayasimhan M et.al. As a result of the development of codal provisions, the design provisions developed in the various codes of practices have been reviewed and a comparative study has been carried out on design flexural strength of cold formed steel lipped channel sections in this paper. For this purpose, experimental results are collected from the literature. Based on the comparative study, direct strength method (DSM), which gives flexural strength closer to experimental results has been chosen for further parametric studies. Among several failure modes, distortional buckling is one such failure mode which affects the strength of the section. In order to assess the influence of distortional buckling, a study has been conducted by varying the lip depth, which is the influencing factor for distortional

buckling strength. This paper presents the details of the studies carried out and the conclusions arrived.

Prasham J Vora et.al. this research paper has done with the purpose to introduce a new material namely, "Basalt fiber" for structural retrofitting. Despite being regularly used in civil engineering industry for the new construction, conventional material like Lime, cement, Sand, steel will not always solve the purpose for building retrofitting and strengthening. Paper points that, there are many technics used for retrofitting purpose like jacketing, FRP wrapping etc. These technics cannot work with conventional material. Currently Carbon fibers, Glass fiber and Aramid fibers fabric are mainly used for building retrofitting and strengthening works. Basalt fiber is a new in market. So the main purpose of this paper is to introduce basalt fiber, properties of basalt fiber, benefits and limitation of basalt fiber and mainly its usefulness in structural retrofitting. The paper concluded that basalt is a good option for replacing Carbon and Glass. Due to its high rigidity and low elongation or extension or break. Its supreme tenacity value makes it as a useful reinforcing material in the present and in future as well.

S. A. Kakade et.al this paper provides an experimental investigation for the compressive strength of Cold –Formed light gauge steel plain (stiffened) tubular sections. In their project, the test specimens were brake pressed from high strength structural steel sheets and were designed by several different methods viz. Allowable Stress Design (ASD), Load and Resistance Factor-Design (LRFD), Working Stress Method (WSM) and Limit Stress Method (LSM). As the steel is tested for all types of tests viz, compressive, tensile test, shear test, torsion test, etc. In addition, they compared test strengths with the design strengths calculated using the Indian Standard and North American Specification for Cold – Formed steel structures.

A. Jayaraman et.al. their paper presents a study on behaviour and economical of cold formed steel (CFS) built up channel section using different codes. This paper provides an experimental investigation for the bending strength of Cold – Formed light gauge steel plain (stiffened) rectangular sections. The test strengths were compared with the design strengths calculated using the Indian Standard and Euro codes Specification for Cold –Formed steel structures. Flexural members are linear members in which axial forces act to cause elongation (stretch). The theoretical data were calculated using Indian Standard code IS 801-1975 and the section properties of the specimens were obtained using IS 811-1975. The specimens were designed under uniformly distributed loading with simply supported condition. They found that the theoretical investigations of limit state methods (SI method) have high bending strength, high load caring capacity, maximum deflection and minimum local buckling & distortional buckling compare to the other codes.
Vivek Dhand et.al. have given a short review on basalt fibers used as a reinforcement material for composites and discusses them as an alternative to the use of glass fibers. The paper also discusses the basics of basalt chemistry and its classification. Apart from this, we can say, an attempt to show the increasing trend in research publications and activity in the area of basalt fibers is also covered. Further sections discuss the improvement in mechanical, thermal and chemical resistant properties achieved for applications in specific industries. At the end, they marked that, Basalt fiber is cost-effective and offers exceptional properties over glass fibers.

Deenadhayalan S et.al. This paper focused on using cold formed steel as primary compression member. Paper study reveals that, Cold-formed steel sections usually formed in channel sections, Z-sections, hat sections, angle sections and other sections due to the manufacture process and are categorized as open sections. These sections can be also formed by connecting two or more sections together, for examples, I-section formed by connecting two channel sections back-to-back, and a box section formed by connecting two channel sections in the flanges. They have used same I-section as mentioned above for testing. Thickness of the section was 2.5mm and was 800mm in length. Further it says that as this kind of sections may fail by local buckling due to their short length, cold-formed steel sections can be strengthened by forming edge and web stiffeners in the I-shaped sections. Moreover, by providing spacing 25mm between two channels strength can be increased. Ultimate load was predicted from ABAQUS then it was compared with experimental result. They found maximum load carried by the specimen was 229 KN with spacing. In the discussion, it is clear that the load carrying capacity of the column has been increased by 21.8 % due to the provision of spacing.

R. Ganeshkumar et.al have used a back to back C-sections (Supacee) with lip. They have used it as compression member as well as flexural member and tested it under axial load. They compared their results with conventional built-up sections and gave suggestion that, improved cross sections i.e. cross sections other than traditional or made by connecting two traditional section to form a new one, can use as a primary compression member (although CFS sections are not much being used in construction as column) and as purlins, rafters in industrial building constructions.

S. Vallabhy et.al. in their project work, they altered channel section with provision of lip and compared their buckling modes under axial load using the software CUFSM. The buckling behaviour of the channel sections have effectively analysed using CUFSM. On study, one can say that this software uses finite strip method which is comparatively less precise than finite element method but provides acceptable results in a understandable format. Therefore, they have concluded that CUFSM is a reliable software that is available for free and with the help of it we can effectively analyse the buckling behaviour of columns. Their research paper also

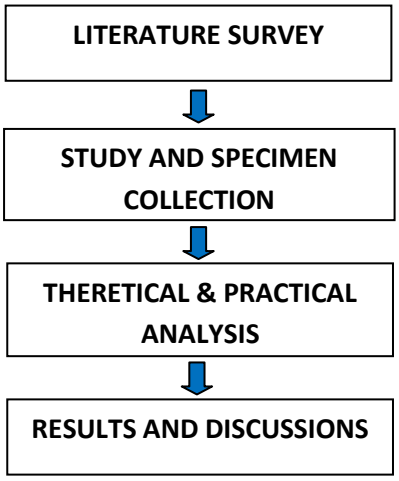
gives overview of manufacturing process in details along with different modes of buckling in brief. Sections having a inside-outside lip, without lip have used.

3. LITERETURE GAP

- We found that Cold Formed Steel sections are weak in Buckling. That's why there is a lot of scope to reduce or eliminate buckling problem of cold formed steel sections and consequently, to increase its strength.

4. METHODOLOGY

In our project, we will analyze a cold formed steel section theoretically as well as experimentally. Experimental analysis will carry out by applying basalt fiber on it. The following flowchart illustrates the methodology adopted to proceed towards completion of our project.



5. CONCLUSIONS

After studying the above research papers, we can conclude that

- There are several methods of design for Cold formed Steel e.g. Allowable Stress Design (ASD), Load and Resistance Factor-Design (LRFD), Working Stress Method (WSM) and Limit Stress Method (LSM). LSM gives better results.
- There are several applications are being used for analysis of the steel sections viz. ABAQOUS, THINWALL, CUFSM etc.
- Cold Formed Steel Sections should be strengthened against buckling so that preventive measures in the field of buckling can lead its more use in the construction.
- Basalt Fiber is emerged as replacement for Carbon and Glass as it is economical and can give better results due to its high tensile strength, so one can use it for strength increasing purpose.

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