A REVIEW PAPER ON MANAGING PERFORMANCE OF INNOVATIVE CFS COLUMN SECTION

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Abstract

Use of CFS column members in different areas to creates innovative sections. The performance of these sections are affected by generic disabilities such as local and distortion. Present study is focused on selecting series of innovative sections having same perimeter, thickness and yield strength irrespective of local and distortion interaction, three different lengths are selected which is equal to perimeter, twice and thrice of perimeter. Selection of 12 different innovative shapes of CFS section will be selected. Strength and buckling loads will be calculated to find the appropriate shape.

Keyword: *cold- formed steel, hot -rolled steel, distorsion, Constrained and Unconstraine.*

I. INTRODUCTION

Cold-formed steel are made by bending a flat sheet of steel at room temperature into a shape that will support more load than the flat sheet itself. Thin sheet steel products are extensively used in building industry, and range from purlins to roof sheeting and floor decking. Generally these are 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 4 mm. These sections are cold-formed from carbon or low alloy steel sheet, strip, plate, or flat bar. The CFS has a very high strength to weight ratio compared to hot-rolled sections. CFS does'ot shrink or split, won't absorb moisture. Quality of CFS is very eminent. Dead load of building is reduced. CFS has high resistance to corrosion, low construction cycle time. The effect of cold working on Structural steel are increase yield strength and ultimate tensile strength, decrease ductility of steel, restore or partially restore the shape yielding characteristic.

II. PROBLEM STATEMENT

Currently cold formed steel is used in various applications such as highway railings, building steel structures, bridges, railway platforms, industrial buildings, etc. But due to its geometrical imperfections as well as instability due to low strength for long length structures, it can easily buckle and is unable to withstand loads falling on it. As cold formed is very cost effective compared to hot-rolled steel, if we design cold formed steel with all its innovative shapes in perfect manner, we can get its long durability in very effective cost reduction way. The cost is cheap for cold formed steel as compared to hot-rolled steel.

III. OBJECTIVES

1. To study the behavior of innovative CFS sections under axial compression.
2. To evaluate the buckling strength under axial compression.
3. To find the most optimized shape for the selected perimeter, thickness, and yield stress.
4. Finding optimized design which will be cost efficient than traditional material for various applications such as highway railings, industrial sheds.

IV. LITURATURE SURVEY

The cold formed steel which can be module to any shape in room temperature is nowadays dominating over the use of hot rolled steel structures which need very high temperature to change its shape. Cold formed steel is majorly used in highway railings which reduce the costing as compared to hot formed steel railings. Also as every nation is emerging nation, industrial area is developing so fast across the globe. Industrial shed structures are completely made up steel structures. As a cheaper substitute over hot rolled steel structures which need tremendous temperature and energy to get properly fitted, cold formed materials is proving very economical and consisting of good strength and durability. While working on CFS research, we have referred many research papers which gives appropriate amount of knowledge about its shapes and strengths and its durability. Abu-Hamd et.al., (2018) [1], experimented numerical procedure with finite element analysis for the calculation of axial strength of CFS built up I-section composed of two back to back 26 channels or stiffened web sigma, these sections are generally fabricated as single C, Z, hat and sigma sections. B.W. Schafer et.al. (1998) [2] & (2006) [3], explained the use of the imperfection spectrum for modal imperfections and generalized imperfections. Later focused on elastic buckling of member and interaction of buckling behavior. Ben Young et.al.,(2008) [4] & (2008) [5], summarized research work on CFS columns performed CFS members are cold-rolled braked-pressed into structural shape. Later on, determined on cold-formed steel columns performed CFS members are either cold-rolled braked-pressed into structural shape. Dr. G. Beulah et.al.,(2014) [6], performed both the analytical and theoretical investigations on ultimate load carrying capacity & behavior of CFS unlipped channels with their ends fixed subjected to axial compression. G. Aruna et.al.,(2015) [7], conducted a series of experiment on cold-formed built-up square sections (BSS) with intermediate flange and web stiffeners under axial compression with hinged end conditions. Hancock et.al., (2002), (2007) [8], Hancock reviewed different 50 papers and summarized development of North American Specification for the Design of Cold-Formed Steel Structural Members. Explained Direct Strength Method being developed by the American Iron and Steel Institute Specification Committee. Hashmi et.al.,(2017) [9], estimated the effects of local geometric imperfections on the buckling capacity (Pn) of a lipped channel CFS column. Helen chen et.al. (2007) [10], discussed the Direct Strength Method (DSM) predicts the strength of a cold formed steel member buckling in local, distortional and global buckling under given loading conditions, and also optimized the cross-section properties. J.M. Davies et.al.,(1998) [11], in this paper performed design for distortional buckling and also CFS sections may be subject to one of three generic types of buckling; namely local, global or distortional. Jyrki Kesti et.al.,(1999) [12], assessed the applicability of European code 3 (EC3) to the prediction of compression capacity of short fixed-ended columns with different cross-sections. M. Anbarasu et.al.,(2014) [13], performed theoretical and numerical investigation concerning the behavior of pinned end CFS lipped channel columns affected by local, distortional and global buckling mode interaction. Mohamed Salah Al-Din Soliman et.al. (2012) [14], investigated on web crippling and interaction between bending and web crippling are performed considering the material and geometric nonlinearities. Nadia Baldassino et.al.,(2019) [15], focused on isolated thin-walled cold-formed beam-columns. Nguyen Huu Thanh et.al.,(2009) [16], investigated the buckling & post-buckling behavior of thin-walled composite columns subjected to compressive loading, columns consist of hat sections and lipped-channel sections with web stiffener. P. Manikandan et.al.,(2018) [17], investigated the distortional buckling behavior of intermediate cold-formed lipped channel section under pinned end condition subjected to axial compression. S. Narayanan et.al.,(2003) [18], analyzed distortional buckling behavior of compression members with complex geometries of CFS Sections. S.S.E. Lamet.al.,(2006) [19], focused on the load carrying capacities of lipped C-section sub columns with the initial geometric imperfections caused by the process of cutting.

V. METHODOLOGY

5.1 Selection of innovative sections

Based on study, performance of innovative CFS columns is needed for selected innovative CFS column sections. Different types of innovative section having same perimeter, thickness and yield stress are selected. Direct strength method not provided interaction of local and distortion hence irrespective of local and distortion interaction, three different length (220,440 and 660) mm is selected which is equal to perimeter, twice and thrice of perimeter. Limitations of DSM for pre-qualified columns are followed while selecting the applicable sections according to AISI S100-2007.Following are the limitations given by DSM.

5.2 Elastic buckling analysis using CUFSM

Constrained and Unconstrained Finite Strip Method (CUFSM) provides the buckling behavior of CFS sections in local, distortional and global mode shapes or assess all buckling behavior in a CFS member under the uniform longitudinal stresses (axial, bending, warping torsion, or combinations).

5.3 Direct strength method (DSM)

A new design method developed by Schafer and Pekoz is called Direct Strength Method (DSM) and Hancock, Kwon and Bernard developed a design method for distortional buckling for thin-walled sections. DSM predicts the nominal strength (Pn) of CFS members when subjected to axial load considering elastic buckling behavior in local, distortional & global buckling. The signature curve of CUFSM software gives the slenderness ratio in the form of load factors; same is used to find out the buckling strength CFS column member.

5.4 Finite element analysis

It is numerical technique to understand the behaviour of structural members subject to different loading and boundary conditions. It is to predict strength without undergoing modelling of strength. To performed finite element analysis its necessary simulations, with mesh containing millions of small elements that together form the shape of a CFS structure, it's created. Calculations are needed for a every single element the combination of each of these individual solutions provides the result for the full CFS structure. To predict the strength using FEA two types of analysis is done.

5.4.1 Eigen value (linear value)

Eigenvalue analysis is a linear perturbation procedure analyze by ABAQUS, is normally used for linear elastic buckling analysis were determined to obtain the related buckling mode shapes.

5.4.2 Non-linear Analysis

Nonlinear analysis is done to find out ultimate buckling strength when subjected to axial compression. Apart from steps followed in linear analysis, following are few steps which is followed only in non-linear analysis.

5.5 Abaqus Validation

The validation was intended to verify the accuracy of the developed finite element model in terms of finite element type, mesh density, load and boundary conditions and the material model. The FE analysis of section L36_1000 was performed in abaqus. The FE analysis results are compared with the experimental results obtained from Young and Yan (2002)..

5.6 Cost Comparsion

Cost comparison between CFS columns and traditionally used hot rolled steel is important point of discussion as hot rolled steel is very much costlier as it need high temperature and huge amount of water for manufacturing. Cold formed steel can manufacture and molded at any temperature. So mostly in construction sites, it proves to be very cost efficient than hot rolled steels. We will conduct site analysis for highway railings and industrial shed for proper determination of cost effectiveness of CFS sections.

VI. CONCLUSION

Based on study, which is based on performance on innovative sections, some of following important conclusions is drawn

1. Size can effect the buckling strength of section of CFS.
2. After studying the details about raw materials and manufacturing process, CFS sections can be cost effective than hot rolled steel.
3. Strength of a section of CFS section can be totally dependent on shape for CFS sections.

VII. REFERECNES

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