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ANALYTICAL STUDY ON BEHAVIOUR OF ZED PURLINS SUBJECTED TO PURE BENDING

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ABSTRACT:
The economic growth of both developed and developing country is largely dependent on steel developement and growth.In construction industry, at present there are two types of steel structures - Hot rolled and cold rolled sections. Hot rolled sections are manufactured above recrystallization temperature (1700^{0}C), while the cold formed sections are manufactured below recrystallization temperature. Hot rolled sections are heavy and difficult to handle and use, also has low tolerance value. To overcome this disadvantages, cold formed sections, also known as thin walled sections are preferred. Thin walled structures comprise an important and growing proportion of engineering construction. Thus, this analytical study mainly hub on the intention of increasing the moment carrying capacity of thin walled sections. The moment carrying capacity can be revamped by increasing the thickness, moment of inertia, area of cross section etc. In accordance with this idea, we endeavor to attain the maximum load carrying capacity in zed purlins using stiffeners. Cold formed structures has the aptness to provide good corrosion resistance through the use of previously coated material, it also aggrandize high ratios of load bearing resistance to structural weight. To determine the load carrying capacity, these sections are analyzed using software CUFSUM 4.0 and ABAQUS 6.10 and their buckling strength are determined .This proceeding also encompasses the analysis of different instability modes.

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1.1 GENERAL

Globally, thin walled sections have been extensively employed as prime-load bearing members, such as wall studs, floor joints, columns and beams, in low rise buildings such as offices, flat blocks and houses. In spite of the accessibility of steel sections, there are still vital barriers that restrain its recognition and execution in the construction industry. It can be found that the behaviour of thin walled steel sections, including local buckling, distortional buckling, global buckling and shear buckling have been well understood and appropriate design methods existed. Demands to create smaller, lighter parts have made thin walled section most popular. These days thin walled is generally defined by portable electronics parts having a wall thickness less than 1mm.For large automotive part thin may mean 2mm.In any case, thinner wall sections bring changes in processing requirements: higher pressure and speeds, faster cooling times, light weight, easy to erect etc.

So, we preferred thin walled section over hot rolled section in purlins.

1.2 THIN WALLED SECTION

Light gauge section is also called Cold Formed Steel (CFS) makes the steel shapes differently than the hot rolled structural steel. The cold forming process passes steel sheets between large rollers to deform the steel but at a room temperature than hot rolling. Cold-worked steel products, such as bar stock and sheet, are commonly used in all areas of manufacturing of durable goods, such as appliances or automobiles, but the phrase cold formed steel is most prevalently used to describe construction materials. The use of cold formed steel construction materials has become more and more popular since its initial introduction of codified standards in 1964. In the construction industry both structural and non-structural elements are created from thin gauges of sheet steel. Cold formed steel construction materials are differ from other steel construction materials which is known as hot rolled steel. The manufacturing of cold formed steel products occurs at room temperature using rolling or pressing. The strength of elements used for design is usually governed by buckling. The construction practices are more similar to timber framing using screws to assemble stud frames.

Cold formed steel members have been used in buildings, bridges, storage racks, grain bins, railway coaches, car bodies, highway products, transmission towers etc. The material thickness for such thin walled steel members usually ranges from 0.373mm to 6.35mm.

1.3 .ADVANTAGES OF COLD FORMED SECTION OVER HOT ROLLED SECTION

• 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.

• Pre-galvanized or pre-coated metals can be formed, so that high resistance to corrosion, besides an attractive surface finish, can be achieved.

• All conventional jointing methods, (i.e. riveting, bolting, welding and adhesives) can be employed.

• High strength to weight ratio is achieved in cold-rolled products.

• They are usually light making it easy to transport and erect.

2.1 LITERATURE REVIEW

Dong, et al (2015) reported to Study on distortional buckling performance of cold-formed thin-walled flexural members with stiffeners in the flange. "This paper presents a finite strip program CUFSUM 4.03 used to calculate and analyse the elastic distortional buckling of cold-formed thin-walled steel flexural members with stiffeners in the flange, which has different sectional geometric parameters. According to the classical buckling stress formula, the distortional

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buckling coefficient of the flange can be calculated so as to analyse the influence of changed sectional geometric parameters on it .On the basis, this study provides simplified formula of distortional buckling stress to calculate 40 members with different sections which are selected from the Technical Code of Cold-Formed Thin Walled steel structures. Compared with the analysis result of CUFSUM, it shows that the two simplified formulas have quite high accuracy and wide applicability for general members provided by the specification. So it is suggested that they can be used for engineering design and standard revision.

Ying-Lei Li et al presented paper mainly concerned with the in-plane behaviour of cold-formed steel beam-column with lipped channel section. The tested members are classified into three series by loading types, including: axial compression and major axis bending (X), axial compression and minor axis bending (lips in tension, Y1), and axial compression and minor axis bending (lips in compression, Y2). A numerical model is developed and verified by the experimental results. The elastic local buckling loads and second-order effects are discussed based on results of test, numerical analysis and design methods. Comparing with test results in this paper, numerical analysis overestimates the elastic local buckling loads and the actual second-order effect is more severe than the prediction by current design methods. Finally, the comparison between test strength and predicted strength obtained by AISI specification indicates that the interaction equation can provide conservative strength prediction for beam-column.

André Eduardo Martins Rua Pintoetal(2010) have done a study on local anddistortional buckling of cold-formed steel members. Laminar structures have a high post-buckling strength reserve. Cold-formed steel profiles can be taken as a set of thin plate elements. Therefore it is necessary to design this type of profiles taking into account that reserve of strength in post-local buckling modes of failure. The method normally used to design this type of structures is based on the Effective Width concept. Using the CUFSM software, a set of tables was created detailing the elastic buckling results (local and distortional) for a wide sample of commercially available

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profiles. Both Finite Strip Method (FSM) and Constrained Finite Strip Method (cFSM) were used. This design method uses the buckling loads (for the Local, Distortional and Global modes) gathered from a computer-based analysis and experimentally calibrated resistance curves to predict the strength of the profile.

3.1 CUFSM

CUFSM (Cornell University Finite Strip Method) is a semi-analytical finite strip method used to analyse thin walled sections.

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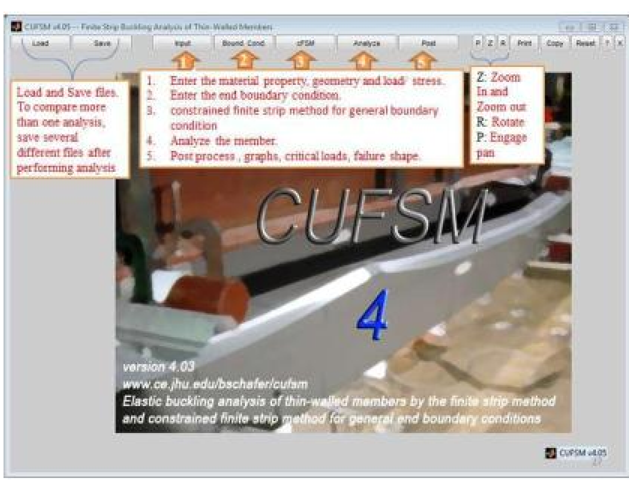

3.2 CUFSM RESULTS

S.NO	LIP	AREA mm²	LOAD FACTOR	MOMENT KNm	LOAD KN
1.	Zed with 0mm lip	480	316.85	7.6	22.8
2.	Simple 20mm lip	544	246.16	6.8	40.8
3.	Simple 40mm lip	608	312.10	9.17	55
4.	Simple 60mm lip	672	348.77	10.4	62.4
5.	Inclined 20mm lip	544	204.04	5.7	34.2
6.	Inclined 40mm lip	608	179.81	5.3	31.8
7.	Inclined 60mm lip	672	165.82	4.5	27

S.NO	LIP	AREA mm²	LOAD FACTOR	MOMENT	LOAD KN
1.	Zed with 0mm lip	480	316.85	7.6	45.6
2.	Simple 20mm lip	544	262.38	7.92	47.52
3.	Simple 40mm lip	608	359.92	14.26	85.56
4.	Simple 60mm lip	672	421.91	22.35	134.1
5.	Inclined 20mm lip	544	150.21	4.47	26.82
6.	Inclined 40mm lip	608	184.22	3.5	21
7.	Inclined 60mm lip	672	221.14	2.5	15

RESULTS

- The ZED sections provided with stiffeners in both inward and outward direction was analysed using CUFSM software.
- The load factor for each section was obtained from CUFSM ,

  From this load factor , the load carrying capacity was calculated.
- Thus,the maximum load carrying

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capacity is obtained,when stiffeners are provided with 60mm lip in outward direction.

CONCLUSION

- Analyzing the sections with the addition of the stiffeners, the buckling loads are obtained using CUFSM.
- Due to the addition of stiffeners in the channel sections, the buckling loads are increased significantly for the respective sections.
- Due to the addition of stiffeners, the failure occurs at the edge of the lipped sections and the major section remains unaffected. This implies that the percentage of the failure area reduces.

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3. Jun Ye, Iman HajirasIman, Hajirasouliha, Jurge Becque, Kypros Pilakoutas (2015)"Development of more efficient cold formed steel channel sections in bending".