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Finite Elemental Analysis of Industrial Structure Using Cold Formed Steel

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ABSTRACT

Increasing world population and natural resource limitations has led to a growing demand for more efficient structural systems to achieve a sustainable economy and society. Cold-formed steel CFS) Structural systems are increasingly adopted as primary or secondary structural members in modern building construction because of their light weight, speed of construction, recyclability, and sustainability. However, the inherently low buckling resistance of thin sections results in relatively low strength and ductility in CFS elements, which limits their performance in tall buildings and under extreme loading events. The pre-engineered steel building system construction has great advantages to the single storey buildings, practical and efficient alternative to conventional buildings, the System representing one central model within multiple disciplines. Pre-engineered building creates and maintains in real time multidimensional, data rich views through a project support is currently being implemented by Staad pro software packages for design and engineering.In this research work we will design Industry using analysis tool Staad.pro and use Novel cold formed steel structure and compare it with general steel available in Indian market. Here we will compare both in terms of strength and weight of structure with bolted and welded connections.

Keywords : Staad, C.F.S, Industrial frame,Analysis, Forces, Deflection, Cost.

I. INTRODUCTION

A large steel structures being built are only single storey buildings for industrial purpose. Secondary structural members span the distance between the primary building frames of metal building systems. They play a complex role that extends beyond supporting roof and wall covering and carrying exterior loads to main frames. Secondary structurals, as these members are sometimes called, may serve as flange bracing for primary framing and may function as a part of the building's lateral load–resisting system. Roof secondary members, known as purlins, often form an essential part of horizontal roof diaphragms; wall secondary members, known as girts, are frequently found in wall bracing assemblies. The majority of steel structures being built are only low-rise buildings, which are generally of one storey only. Industrial buildings, a sub-set of low-rise buildings are normally used for steel plants, automobile industries, light, utility and process industries, thermal power stations, warehouses, assembly plants, storage, garages, small scale industries, etc. These buildings require large column free areas. Hence interior columns, walls and partitions are often eliminated or kept to a minimum.

Cold formed steel is the common term for products made by rolling or pressing steel into semi-finished or finished goods at relatively low temperatures (cold working). Cold-formed steel goods are created by the working of steel billet, bar, or sheet using stamping, rolling (including roll forming), or presses to deform it into a usable product.

Fig 1. Steel Frame

The use of cold-formed steel construction materials has become more and more popular since its initial introduction of codified standards in 1946. In the construction industry both structural and non-structural elements are created from thin gauges of sheet steel. These building materials encompass columns, beams, joists, studs, floor decking, built-up sections and other components. Cold-formed steel construction materials differ from other steel construction materials known as hot-rolled steel (see structural 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.

Komara et. al. (2018) Review the current researches on Cold-formed steel (CFS) structures, particularly for screw connections, welded connections, bolted connections, and adhesive connections. The performance of different CFS connections is well discussed in order to capture the behavior of each type of connection. Based on the review assessment, the results highlighted that all types of connections except adhesive connections have shown the proper behavior that can trigger the change of any design codes. Otherwise, adhesive connections still have some gaps of knowledge that are needed to be filled with comprehensive future researches.

Kalyanshetti & Mirajkar (2017) this research involves the economy, load carrying capacity of all structural members and their corresponding safety measures. Economy was the main goal of this study involving comparison of conventional sectioned structures with tubular sectioned structure for given requirements. For study purpose superstructure-part of an industrial building is considered and comparison is made. Research reveals that, up to 40 to 50% saving in cost is achieved for square and rectangular tubular sections.

Gupta & Harma, (2014) the research involves various kinds of industrial roof trusses by using computer software. It also involves the knowledge regarding steel roof trusses and the design philosophies with worked examples. From the observations they concluded that, the sections designed using limit state methods are more economical than the sections using working stress method. It was observed that the tubular section designed by limit state method was the most economical among the three sections which were used.

II. METHODS AND MATERIAL

The main objective of this study is to justify the implementation of cold reformed steel in Indian continent buildings as an alternative for small buildings and industrial frames instead of R.C.C. and general steel sections.

Following are the objectives:

1. To determine the variation in strength of CFS and steel sections.
2. To determine the weight variation in both.
3. To determine its implementation on a live project using wind load.
4. To determine the technique of optimization of steel using softwares.
5. To determine the 3d analysis of steel structure using staad pro.

Following steps are followed as:

Step-1 selection of building geometry .

Step-2 Selection of different materials (CFS & STEEL) can be use.

Table 1 : Geometrical Data

Geometrical details	
Type of roof truss	Doublehowe
Section Size	Indian Standard Sections
Support Condition	Fixed Support
Length	36 metre
Bays in Z direction	10 spans
Width	12 metre
Bays in X direction	6 spans

Step-3 selection of wind zone (33, 39, 44, 47 and 55 m/s) as per IS- 875 (part-III):1987 for given location.

Step-4 Formation of load combination (8 load combinations in x & z-direction)

Step-5 Modeling of building frames using SAP2000 software.

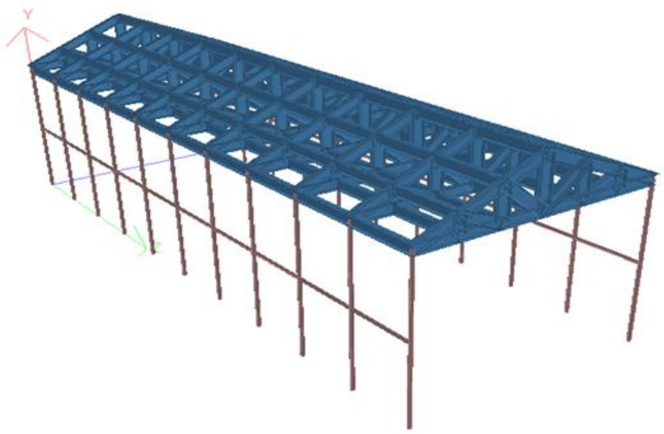

Fig 2. Modelling of industrial frame

Step-6 Analysis of truss considering same loading

Step-7 Comparative study of results as wind forces, Max bending moments,Maximum Axial force, Max displacements, story wise displacement, Maximum shear force , Maximum Axial force.

III. RESULTS AND DISCUSSION

Analysis Results:

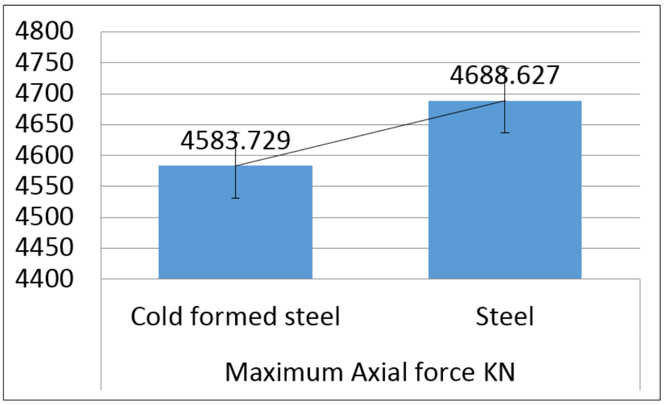

Fig 3. Axial force

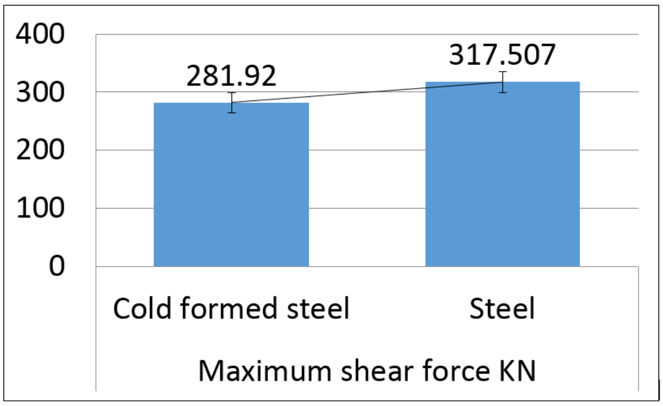

Fig 4. Shear force

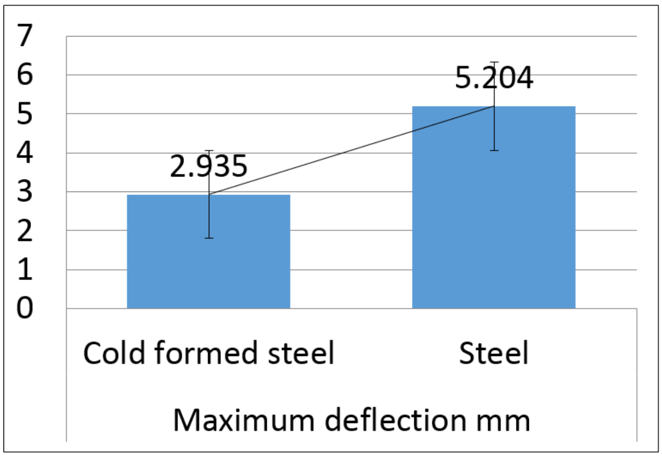

Fig 5. deflection

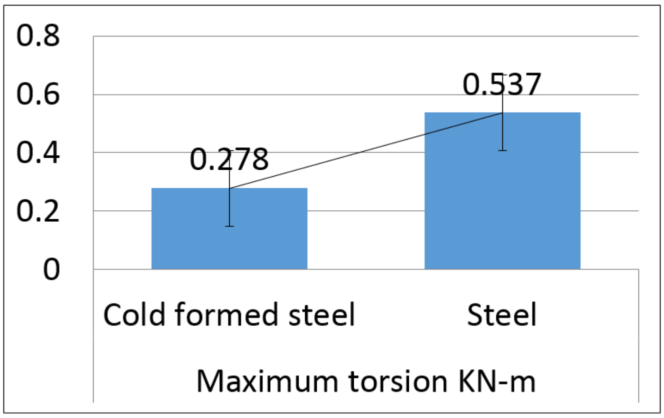

Fig 6. Torsion

IV.CONCLUSION

In present study comparative study is done on a 3-dimensional ware house for same loadings with different section to find out the best material either cold formed or general steel section which will be stable, good in stiffness, cost effective, economical and easily available.

- It is determined in this study that cold formed steel is better ion resisting load, and unbalanced forces.
- Here it is concluded that deflection in C.F.S. sections are relatively less.
- It can be determine that torsion and support reaction is comparatively less in C.F.S.

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