International Journal of Latest Engineering and Management Research (IJLEMR)
ISSN: 2455-4847
www.ijlemr.com || Volume 03 - Issue 02(S) || PP.45-49

Flexibility Endurance of Cold Formed Industrial Structure under the Influence of Seismic Load Using Staad Pro Software

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Abstract: Cold formed steel members are extensively used in the building construction industry, especially in residential, commercial and industrial buildings. In recent times, the use ofcold- formed high strength steel members has rapidly increased. Cold-formed steel (CFS) cross-sections can be optimized to increase their load carrying capacity, leading to more efficient and economical structural systems. Buildings framed from cold-formed steel members are becoming increasingly common. Significant research has been conducted on individual cold-formed steel members, but little research has been done on full buildings framed from cold-formed steel. In the past, testing on individual components has been used to provide insights and create safe seismic designs for cold-formed steel buildings, but understanding and modeling of whole buildings have been out of reach. The research provides the necessary building blocks for developing efficient models of buildings framed from cold-formed steel. In addition, the experiments demonstrate the large difference between idealized engineering models of the seismic force-resisting system and the superior performance of the full building system.

Keywords: Cold formed steel, Seismic response, Earthquake engineering, Performance-based design.

I. Introduction

Cold-formed steel (CFS) is the common term for products made by rolling or pressing thin gauges of sheet steel. Cold formed steel goods are created by the working of sheet steel using stamping, rolling, or presses to deform the sheet into a usable product. Cold worked steel products are commonly used in all areas of manufacturing of durable goods like appliances or automobiles but the phrase cold form steel is most prevalently used to describe construction materials. The use of cold-formed steel construction materials has become more and more popular since the 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 (CFS) cross-sections are used extensively in the construction industry as secondary load-carrying members, such as roof purlins and wall girts. In recent years, however, CFS cross-sections are also increasingly being employed as primary structural elements. For example, CFS framing systems are used in low- to mid-rise multi-storey buildings and CFS portal frames are gaining popularity in single-storey industrial buildings with short to intermediate spans. In both cases, CFS members areemployed as the primary load-bearing members and consequently have to meet increased demands in terms of span length and load carrying capacity. Compared to hot-rolled members, CFS thinwalled members offer several advantages of economy and efficiency,including a high strength for a light weight, a relativelystraightforward manufacturing process and an ease of transportation and erection. Above all, CFS sectionsoffer flexibility andversatility in producing a variety of cross-sectional shapes, whichare obtained by bending relatively thin metal sheets using either acold-rolling or a press-braking process at room temperature.

The CFS structural systems are characterized by high productivity, especially when innovative connection technology as press-joining, clinching are used. The cold formed steel sections are manufactured from steel sheets. By cutting and bending into desired shapes. In the same way, the specimen chosen here is a channel lipped section connected back to back with bolts. The cold-formed sheet is also known as Light gauge steel because of its minimum thickness when compared to hot rolled section In Steel structures, two primary structural steel member types are used: hot-rolled steel members and cold-formed steelmembers. Hot-rolled steel members are formed at elevated temperatures, whereas cold-formed steel members are formed at room temperatures. Until recently, the hot-rolled steel members have been recognized as the most popular and are widely used steel group, but since then the use of cold-formed high strength steel structural members has rapidly increased.

II. Significance of the Project

- To assess the impact of seismic loads on the CFS structure.
- To study the flexural behaviour of cold formed steel structure.
- To reduce the dead weight of the structure.
- To increase the stability of the structure.

III. Criterias and Software Considered

3.1 Staad Pro v8i

STAAD or (STAAD.Pro) is a structural analysis and design computer program originally developed by Research Engineers International in Yorba Linda, CA. The commercial version STAAD.Pro is one of the most widely used structural analysis and design software. It supports several steel, concrete and timber design codes. It can make use of various forms of analysis from the traditional 1st order static analysis, 2nd order p-delta analysis, geometric non linear analysis or a buckling analysis. It can also make use of various forms of dynamic analysis from modal extraction to time history and response spectrum analysis.

3.2 Design Criterias

- The components are designed based on the indian code IS 801.
- Seismic conditions are obtained as per the code IS 1893.
- The structure is considered under zone 5 category which comes under critical area.
- Wind load is not considered for the structure.
- The structure is considered to be constructed on a hard rock.
- Response Spectrum Analysis is carried out to determine the frequency at different levels
- Depth of foundation is considered as 3m.
- Response reduction factor is considered as 5.

3.3 Loading Conditions and sections

- Load of roofing sheets - 150Pa
- Loads on purlin - 2.35 KN/m
- Seismic loads acting on all 4 directions
- Triangular section are considered for purlin design.
- Angle sections are considered for the truss members.
- Channel section are considered for columns.

IV. Results and Discussions

The results of the software analysis follows.

A. Frequency and Period

Mode	**Frequency** (Hz)	**Period** (sec)
1	0.351	2.847
2	0.987	1.013
3	1.114	0.898
4	1.812	0.552
5	1.969	0.508
6	2.641	0.379

7	2.830	0.353
8	3.146	0.318
9	3.165	0.316
10	3.166	0.316

B. 3D Structure

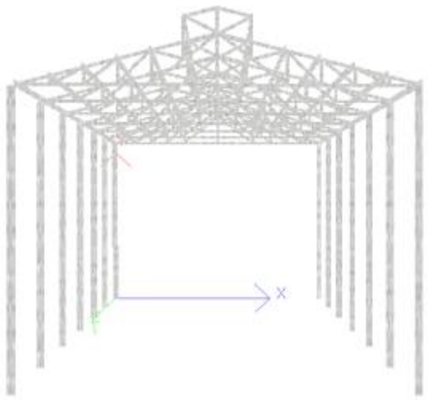
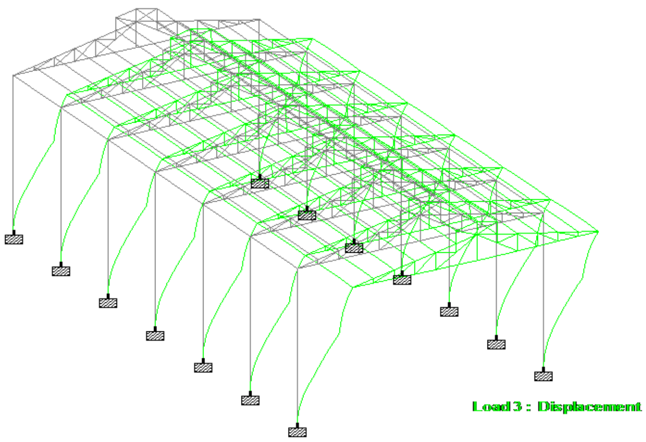


Fig 1. 3D Structure

C. Deflection Pattern



D. Mode Shape
The structure was analyzed for 10 mode shapes using response spectrum method.

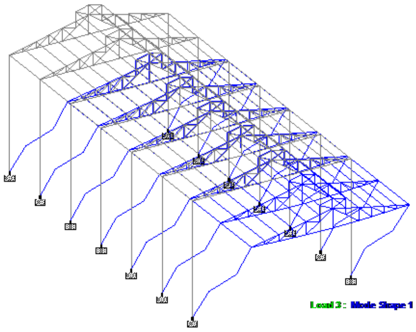


Fig 3 mode shape 1

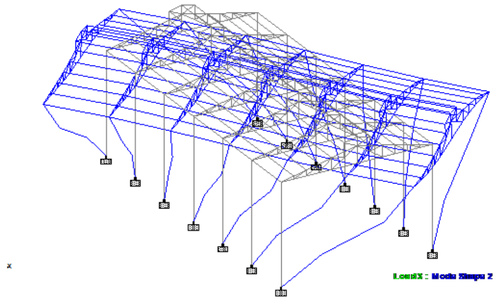


Fig 4 mode shape 2

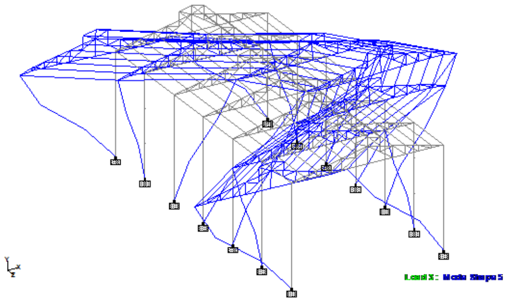


Fig 5 mode shape 3

E. Weight of structure

The structural weighs an overall frame weight of 102KN inclusive of connections.

V. Conclusions

- The structure weighs a weight of 102KN which is 26KN lesser than that of hot rolled sections.
- The increase in frequency can be determined from the increase of the 1st mode.
- Based on the deflection pattern it can be determined that the greater distortion occurs along the longer span of the structure
- From the mode shapes the various kinds of deformations that can occur in the structure like torsion, bending moment, etc., can be noticed.
- The effect of load of purlin had great impact on the load of the entire structure. As the weight of the purlin reduce, the weight of the entire structure reduced on a greater scale.

References

[1]. H. Estrada, J. Jimenez, F. Aguíñiga, Cost analysis in the design of open-web castellated beams, in: Proceedings of the 2006 *Architectural Engineering National Conference, 2006.*

[2]. K. Sivakumaran, Some studies on cold-formed steel sections with web openings, *9th International Specialty Conference on Cold-Formed Steel Structures, (1988) 513 - 527.*

[3]. M.-Y. Shan, R.A. LaBoube, W.-w. Yu, Behavior of web elements with openings subjected to bending, shear and the combination of bending and shear, in, Missouri S&T (formerly the University of Missouri-Rolla), 1994.

[4]. M. Kulatunga, M. Macdonald, Investigation of cold-formed steel structural members with perforations of different arrangements subjected to compression loading, *Thin-Walled Structures, 67 (2013) 78-87.*

[5]. T. Liu, K. Chung, Steel beams with large web openings of various shapes and sizes: finite element investigation, Journal of Constructional Steel Research, 59 (2003) 1159-1176.

[6]. K. Sivakumaran, M.Y. Ng, S.R. Fox, Flexural strength of cold-formed steel joists with reinforced web openings, Canadian Journal of Civil Engineering, 33 (2006) 1195-1208.

[7]. K. Tsavdaridis, C. D Mello, Finite element investigation of perforated steel beams with different web opening configurations, in: ICASS'09/IJSSD-Proceedings of Sixth International Conference on Advances in Steel Structures and Progress in Structural Stability and Dynamics, ICASS’09 Press, 2009, pp. 213-220.

[8]. K.D. Tsavdaridis, C. D’Mello, Vierendeel bending study of perforated steel beams with various novel web opening shapes through nonlinearfinite-element analyses, Journal of Structural Engineering, 138 (2012) 121 4-1230.

[9]. M. Kulatunga, M. Macdonald, J. Rhodes, D. Harrison, Load capacity of cold-formed column members of lipped channel cross-sectionwith perforations subjected to compression loading–Part I: FE simulation and test results, Thin-Walled Structures, 80 (2014) 1-12.

[10]. C.-C. Chen, C.-Y.Li, M.-C.Kuo, Experimental study of steel reinforced concrete beams with web openings, in, The 14th World Conferenceon Earthquake Engineering, Beijing, China, October 12-17, 2008.

[11]. N.D. Lagaros, L.D. Psarras, M. Papadrakakis, G. Panagiotou, Optimum design of steel structures with web openings, Engineering Structures,30 (2008) 2528-2537

[12]. H. Wang, Y. Zhang, Experimental and numerical investigation on cold-formed steel C-section flexural members, Journal of ConstructionalSteel Research, 65 (2009) 1225-1235.

[13]. L. Vieira, M. Malite, B. Schafer, Simplified models for cross-section stress demands on C-section purlins in uplift, Thin-walled structures,48 (2010) 33-41

[14]. L.-y. Li, Lateral–torsional buckling of cold-formed zed-purlins partial-laterally restrained by metal sheeting, Thin-walled structures, 42(2004) 995-1011

[15]. X.-t. Chu, R. Kettle, L.-y. Li, Lateral-torsion buckling analysis of partial-laterally restrained thin-walled channel-section beams, Journal ofConstructional Steel Research, 60 (2004) 1159-1175

[16]. N.D. Kankanamge, Structural behaviour and design of cold-formed steel beams at elevated temperatures, in, Queensland University of Technology, Brisbane, Australia, 2010.