

Analysis and Design of Light Gauge Steel Structures for Commercial Building

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Abstract - Light gauge steel frame is increasingly used in residential and commercial buildings as load bearing and non-load bearing elements. The purpose of this paper is to analysis and design light gauge steel structures as per Indian standard codes. After some time, better materials and strategies for development have been produced for the home structure industry, bringing about as good as ever fabricating systems.

Construction materials and building techniques have improved to help advance the development of homes, making homes more vitality proficient, strong, safer, affordable, and earth amicable. Light Gauge Steel Frame (LSF) divider frameworks are generally utilized in residential, commercial

land modern structures as both burden bearing and non-load bearing components

Key Words: Light gauge steel Structures, Cold formed steel, Stud, Joist, Track, finite element analysis, Dynamic analysis,

1. INTRODUCTION

Sometimes it's best to take a step back and analyse the situation, if that means understanding how specific items are made or even what they are exactly. Over the years, steel has experienced many improvements in technology but also significant changes in how it is manufactured. Steel bars with pre-formed shapes are now cold-formed using either hydraulic presses or continuous casting machines. Cold-formed steel is produced by shaping the metal before it reaches its final temperature. One of the biggest benefits of cold-forming is it allows for more precise shapes than casting, which also allows for steel to be formed into complex shapes. This process allows cold-formed steel's design to follow more established industry standards than what could be achieved by casting. The forming process uses a hydraulic press to compress the steel platen in order to fold it. This technology allows for the metal to be shaped very quickly, but it also creates a seam in the metal where the two sides are joined together. The machines are able to bend parts in about 20 seconds, whereas casting takes about 10 minutes. Cold-rolled steel is often used in areas where heat treatment would cause problems with each piece's final quality. Cold-rolled steel can be used in places that casted steel would normally be a bad decision, such as around the water supply system of a building. Although it may seem a bit more wasteful, cold-formed steel does not require any

investment into time or cost to produce due to how it is made. This common material can easily replace other options that take longer and cost more money to make.

1.1 Technical terms

C-Shape - A cold-formed steel shape used for structural and non-structural framing members consisting of a web, two (2) flanges and two (2) lips (edge stiffeners).

Flange - The portion of the C-shape framing member or track that is perpendicular to the web.

Floor Joist - A horizontal structural framing member that supports floor loads and superimposed vertical loads.

In-Line Framing - A framing method where all vertical and horizontal load-carrying members are aligned.

Track - Frame member consist of only a web and two (2) flanges. Track depth measurements are taken to the inside of the flanges.

1.2 General Procedure

- 1) The wall layout is marked on the floor using straight lines.
- 2) Squareness is checked by accurately measuring diagonals in large areas of the house first, then individual rooms.
- 3) Internal wall frames are stacked inside the boundaries and external walls around the foundations, with the first frame on top.
- 4) External frames are placed around the perimeter with their bottom plates adjacent to their final positions.
- 5) Starting at any convenient external corner stand and plumb a wall frame panel in its exact position.
- 6) Stand and plumb the adjoining frame to make a self-supporting corner.
- 7) Clamp the frames together and check again that both frames are in their exact locations and standing vertical.
- 8) Connect the frames using the manufacturers recommended method -generally nails, screws or rivets.

9) Proceed with the erection of the frames around the house, standing internal and external frames as they occur.

10) Provide adequate temporary bracing during wall frame erection. The line of top plates in a run of walling should be checked with a string.

2. LITERATURE SURVEY

2.1. OPENING REMARK

Review of related literature helps the researcher to understand the topic better. The researcher can collect the all the relevant information on the research topic. The review is always helpful in finding out what were their methods used, what were suggestions given for further research. The review of related literature certainly makes new researcher well equipped with previous background of the topic and area of research. It makes researcher more critical and provides sound foundation and deep insight into the problem.

A careful review of the research journal, books, thesis and other source of information on the problem to be investigated is one of the important steps in planning of any research study.

2.2 REVIEW OF PREVIOUS RESEARCHERS:

1. Sareh Naji a, Oguz Cem C, elik b, U. Johnson Alengarama, Mohd Zamin Jumaat a, Shahaboddin Shamshirbandc (2014) This article presents the analysis of the structure, energy and cost efficiency of three lightweight structural systems – wood light frames (WLF), lightweight steel frames (LGSF) and 3D sandwich (3DSP) panels – during their useful life. This paper has focussed upon in this study that are commonly used in Eastern Europe with specific reference to Turkey. The structural analysis and design was carried out using ETABS while EnergyPlus was used in the analysis of the energy consumption of the buildings.

2. Sheppard, Jr. et al. (1986) This patent describes the light gauge steel truss building system of the present invention which includes inter alia, a number of truss members which are comprised of chords, compression members, and tension members. These chord members are arranged so that they intersect with one another while the compression members and the tension members overlap the chords, all of which eliminates the requirement for using numerous gussets as in other buildings. With respect to the invention, a wall system is provided which includes a number of steel sheets which are securely fastened to wall studs having a number of support spacers, or girts, which provide uniform spacing between the outside wall of the building and the wall studs, and also add structural strength to the walls. With addition to this, girts or purlins are provided where the roof sections meet the exterior wall, and also where the roof sections meet at the peak of the roof.

3. Damien Koen (2008) This paper investigates report of the down-aisle buckling load capacity of steel storage rack uprights. The effects of discrete torsional restraints provided by the frame bracing in the cross-aisle direction is considered in this report. Since current theoretical methods used to predict the buckling capacity of rack uprights appear to be over-conservative and complex, this research may provide engineers an alternative method of design using detailed finite element analysis.

4. Reynaud, Serrett (1998) This paper discusses the current state of lateral load design for light gauge steel framed shear wall structures, issues related to hysteretic behavior, deformation capacity, over-strength, gypsum wallboard, and sheathing both sides. Also it presents the design values are available for different systems. At the end, it is suggested that a more detailed approach, using energy methods, needs to be used to compare different systems.

5. De Quesada (1996) General object of this invention is to provide an improved prefabricated light gauge steel wall panel and associated related improved construction techniques in a high-rise building environment. The wall panel may be used in many different modes for easy inter-relationship with floor and roof panels and also with hot rolled steel-type construction for higher buildings, box-shaped unitized room construction etc.

3. Statement of problem

To design a safe, efficient, and functional design building to house the new marketing office Building for the GIGA CITY building project in hope of solving the problems that the staff currently face.

3.1 Software

i) STAAD-Pro

ii) STRAP

iii) Vertex BD

4. Scope of Work

The scope of works for this project are as follows:

Spatial Design of the building paying keen respect to the effect to wind. Using the Graphic

Standards as the main authority on spatial designs.

Provide complete set of drawings.

Analysis of the structural model under the influence of the following chosen loads:

1. Dead Loads according to IS875(Part-1)

2. Impose Loads according to IS875(Part-2)

3. Wind Loads according to according to IS875(Part-3)

4. Seismic Loads according to IS1893

Table -1: Sections used in projects

Sr. No.	Description	Section used	Depth (Web) in mm	Flange in mm	Lip in mm	Thk. in mm
1.	Bottom Track	CL100	100	50	13	1.2
2.	Stud	CL100	100	50	13	1.2
3.	Nogging	CL100	100	50	13	1.2
4.	Top Track	CL100	100	50	13	1.2
5.	Bottom Chord of Roof Truss	CL150	150	50	13	1.0
6.	Top Chord of Roof Truss	CL150	150	50	13	1.0
7.	Inclined Members of Roof Truss	CL150	150	50	13	1.0

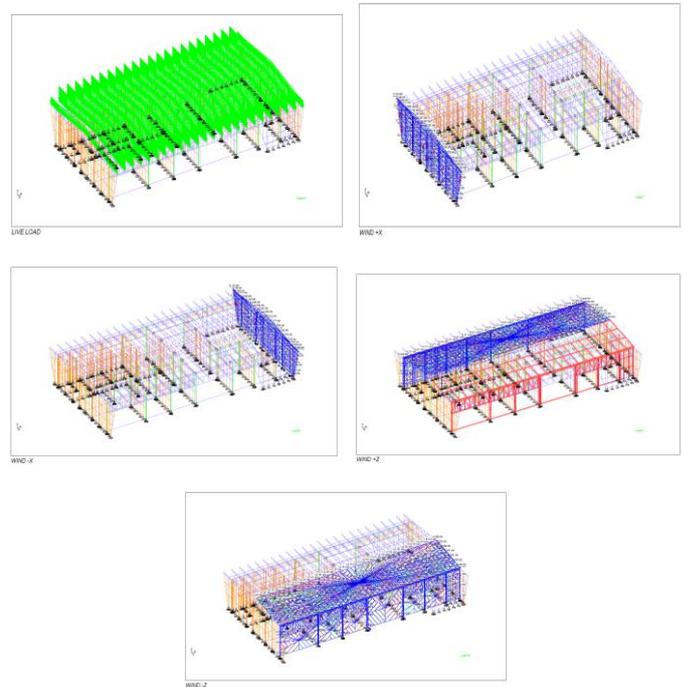


Fig -2: Loading on structural model

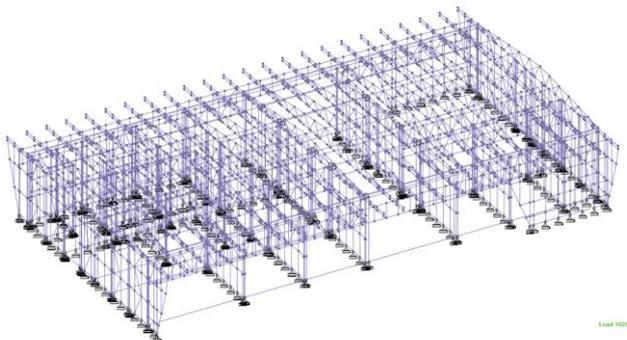


Fig -1: Structural Model

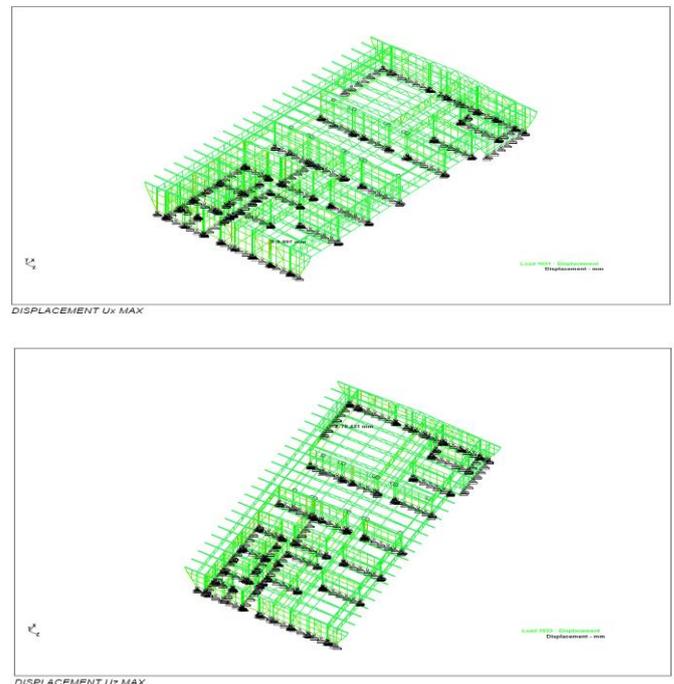
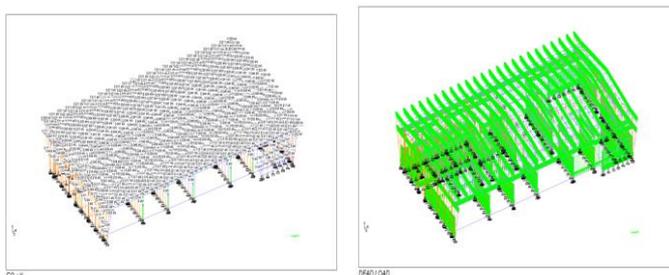


Fig -3: Maximum displacement



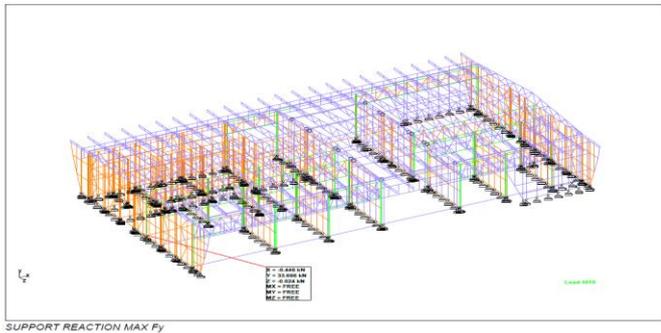


Fig -3: Maximum Reaction

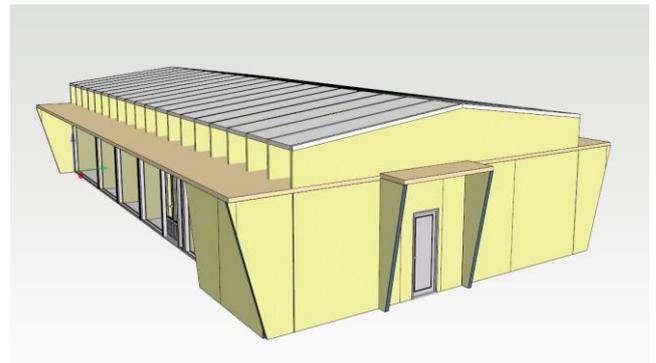


Fig -5: VERTEX BD Rendered Model

3. CONCLUSIONS

- i. LGSF is light weight and more reliable material which helps in rapid construction, less steel consumption, low cost in structural steel as well as in foundation, plinth height.
- ii. It is easy to modify the construction at any point of time during its lifespan.
- iii. It can be used to replace conventional steel section, RCC construction. Light gauge steel provides-High design flexibility, much lower tonnage, modular construction, highly stiff & strong, High vermin & pest resistance
- iv. Excellent thermal insulation, quality finishes are the specialties of this structure.
- v. Its having benefits like minimum pain to the citizens as they are well informed and know what to expect. Efficient working, time and cost saving for the authorities, Ease of doing business for authorized contractors.



Fig -6: Actual construction site picture

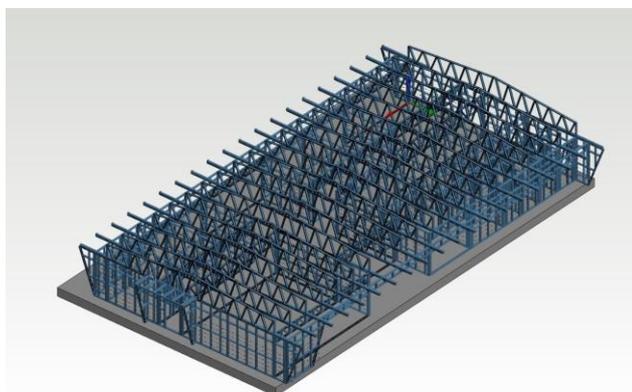


Fig -4: VERTEX BD Model for detailing & Generating NC file for production

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