To Study Optimization Industrial Structure Using Light Gauge Steel Section

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Abstract - Industrial structural analysis and design using software, which generally Staad software use for analysis and design, have been gaining popularity in the field of designing. The light weight and faster construction is the demand of the era. This has led to the increase in the use of the light weight steel structure as they satisfy the demand of the light weight and faster construction. The result generated is according to the values entered without the consideration of the feasibility. Moreover, optimization of structures has been a lesser used concept in day-to-day working and is independent of design and analysis of the structures. This paper provides a study of analysis of optimization of truss, complex or simple because truss is the most widely used and fundamental building block of any structure.

Key Words: Industrial, feasibility, light weight, satisfy , analysis.

1. 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 structural's, 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.

2. OBJECTIVES

i. Design of an industrial structure under wind loading using Staad with MYSD steel.

ii. Design of an industrial structure under wind loading replaces the member with light gauge section.

iii. Comparison of the both structure base on the performance.

3. LITERATURE REVIEW

1. S. Kravanja and T. Zula, (2010)

The paper presents the simultaneous cost, topology and standard cross-section optimization of single storey industrial steel building structures. The considered structures are consisted from main portal frames, which are mutually connected with purlins. The optimization is performed by the mixed-integer non-linear programming approach, MINLP. The MINLP superstructure of different structure/topology and standard cross-section alternatives has been generated and the MINLP optimization model of the structure has been developed. The defined cost objective function is subjected to the set of (in)equality constraints known from the structural analysis. Internal forces and deflections are calculated by the elastic first-order analysis constraints. The dimensioning constraints of steel members are defined in accordance with Eurocode 3. The modified outer-approximation/equality-relaxation (OA/ER) algorithm, a two-phase MINLP strategy and a special pre-screening procedure of discrete alternatives are used for the optimization.

2. Niraj P. Kareliya and Kaushik C. Koradia, (2016)

This in this paper, Genetic Algorithm based optimization presents for the design of portal frame according to Indian standard code. The design mainly consists of column element, Rafter element and hunched portion design. Pre engineering building have light gauge metal steel purlin,matel clading,and economic sections of column, rafter and haunched portion. In this project MAT-LAB Genetic Algorithm has been used to find the optimum design of portal frame according to "IS Code". This design aid can be used directly on structural design practice.

4. METHODOLOGY

4.1 Light Gauge Steel Section

Thin-walled, light gauge steel section are commonly used in the construction of modern industrial and residential buildings as sheeting and decking, purlins and sheeting rails, wall studs, storage racking and shelving. The most popular products are roof purlins and sheeting rails which account for a considerable proportion of light gauge steel usage in buildings. Light gauge roof purlins and sheeting rails are usually used as the intermediate members between the main structural frame and the corrugated roof or wall sheeting in buildings.

4.2 Advantages

- The light gauge steel section construction system presents great potential for recycling and reuse and several advantages when compared with other types of construction systems. The reduced steel debris in the construction phase and the steel removed during the demolition phase can be totally recycled and/or reused with evident sustainability advantages.
- Regarding economic issues, the use of modular light gauge steel section construction systems provides many benefits, given the increase of construction speed allied to the production in scale and to superior quality achieved by factory-based quality control. In comparison with traditional masonry construction,
- The recyclable potential of the materials used in light gauge steel section construction and its higher durability is also an economic advantage. In the particular case of steel, this material recyclability and reuse rate is often higher than 95%. In addition at demolition stage it is also a better solution, due to the possibility of applying screw connections, allowing for quick and easy dismantling.

4.3 Drawbacks

- One of the main drawbacks of light gauge steel section construction elements is the high thermal conductivity of the steel, which can create thermal bridges, whenever its design is not adequate, being important to use continuous thermal insulation (e.g., ETICS). Thermal bridges could penalize the thermal behaviour and energy efficiency of steel buildings, if not correctly addressed, increasing energy consumption and costs during the operational phase. Other related problems associated with thermal bridges, are the constructive pathologies and reduced levels of comfort and celebrity associated with the occurrence of condensation phenomena driven by localized temperature drop inside construction elements.
- This is particularly important in buildings where the relative humidity (RH) may be high and can greatly decrease the materials durability. Another potential drawback of Light gauge steel section construction system is the low thermal mass and consequent thermal inertia, leading to higher daily temperature fluctuations, originating higher discomfort to the occupants and higher energy consumption.

4.4 Applications of Light Gauge Steel Section

- Light gauge steel section are non organic and they resist the deficiencies of frame made of wood such as shrinking, warping and pest infestations. They are ideal for easy and quick assembly into steel wall, and roof panels.
- These panels are manufactured in quality controlled factories and transported to the construction site for fast erection. The frame members can be supplied in exact length, elimination labors work in onsite cutting . The pre punched holes aid to run pipes and electrical wires quickly.
- Large quantities are easily handles on the construction site since it weighs less than the traditional wood studs. The LSF system is non combustible and it can be designed to resist fire earthquakes and storm events. Unlike wood it does not required treatment for termites with harmful chemicals and it does not shrink to causes nail pops or squeaky floors. Due to this LSF system are widely accepted in residential industrial and commercial building construction.

5. RESULT AND DISCUSSION

5.1 Load calculation

Loading calculation for all configurations of

industrial sheds is as follows

- Dead load ……… (As per 875 Part- I)

Self weight of structure – Given by STADD)

Self weight of A.C Sheet = 0.138 KN/m^2

(IS 875 –I Table no 9)

=0.138 X 1.5

= 0.207 KN/m

- Live load ………(As per 875 Part-II)

On pitch roof = 0.75 KN/m^2

(As per 875 Part-II net live load)

$= 0.075 - 0.02(\emptyset - 10)$

$= 0.075 - 0.02(11.3 - 10)$

$= 0.724\ \mathrm{KN/m2}$

Live load on purlin $= 0.724x1.5$

$= 1.086\ \mathrm{KN/m}$

- Wind load ……(As per 875 Part-III)

Basic wind speed = 44 m/s

Designed wind speed $= V_b\ XK_1XK_2XK_3$

$= 44X1X1.09X1$

$= 47.96\ \mathrm{m/s}$

Designed wind Pressure = $0.6X\ {V_Z}^2$

$= 0.6X\ 47.96^2$

$= 1380\ N/m2$

$= 1.380\ KN/m2$

5.2 Analytical results of Reaction of Model.

Table No 5.1: Reaction of Model

Node	40 X 20	40 X 40	60 X 30	80 X 40
1	1050.483	1054.138	1064.143	1072.257
2	1050.483	1054.138	1064.143	1072.257
7	1787.535	1791.529	1805.909	1816.621
8	1787.535	1791.529	1805.909	1816.621
13	1772.482	1776.958	1791.265	1802.364
14	1772.482	1776.958	1791.265	1802.364
19	1774.591	1779.055	1793.353	1804.442
20	1774.591	1779.055	1793.353	1804.442
25	1774.284	1778.751	1793.055	1804.145
26	1774.284	1778.751	1793.055	1804.145
31	1774.331	1778.798	1793.103	1804.193
32	1774.331	1778.798	1793.103	1804.193
37	1774.284	1778.751	1793.055	1804.145
38	1774.284	1778.751	1793.055	1804.145
43	1774.591	1779.054	1793.353	1804.441
44	1774.591	1779.054	1793.353	1804.441
49	1772.482	1776.959	1791.266	1802.365
50	1772.482	1776.959	1791.266	1802.365
55	1787.535	1791.529	1805.909	1816.622
56	1787.535	1791.529	1805.909	1816.622
61	1050.483	1054.137	1064.143	1072.257
62	1050.483	1054.137	1064.143	1072.257

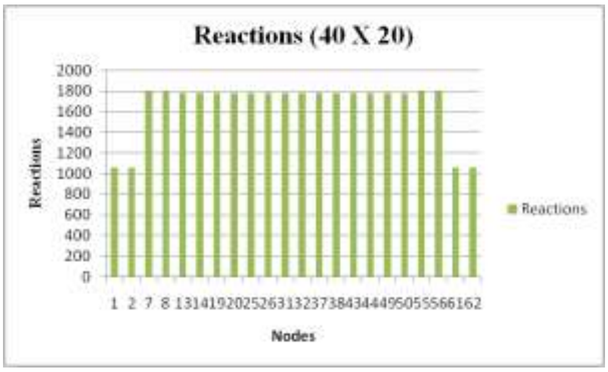

Figure No. 5.1: Reaction (40 X 20)

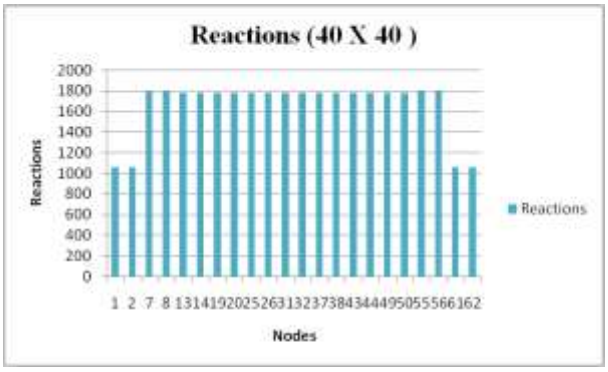

Figure No. 5.2: Reaction (40 X 40)

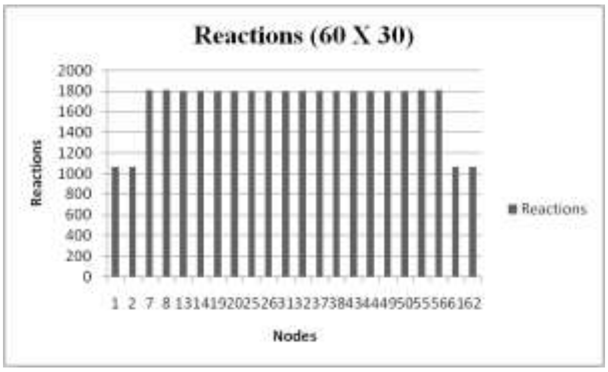

Figure No. 5.3: Reaction (60 X 30)

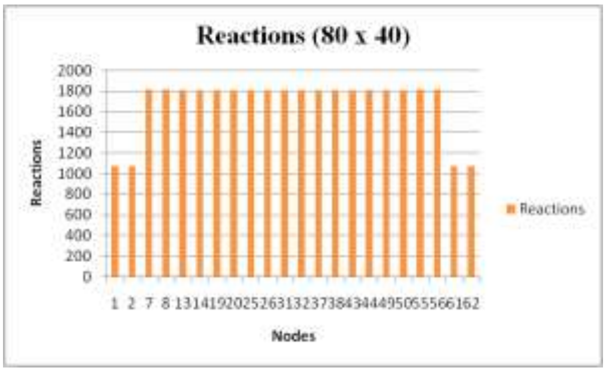

Figure No. 5.4: Reaction (80 X 40)

5.3 Analytical results for Displacement of models

The change displacements of model with respective change in the section are shows below graphs. The different sections are use 40 X20, 40 X 40, 60 X 30 and 80 X 40. The displacement is calculated are various node points. This shows the displacement goes decreases with respective node when the section is changes.

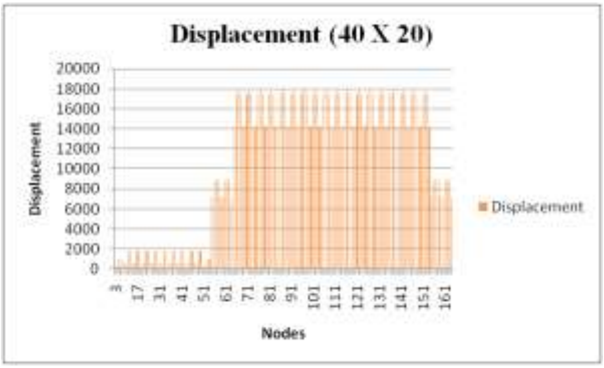

Figure No. 5.5: Displacement (40 X 20)

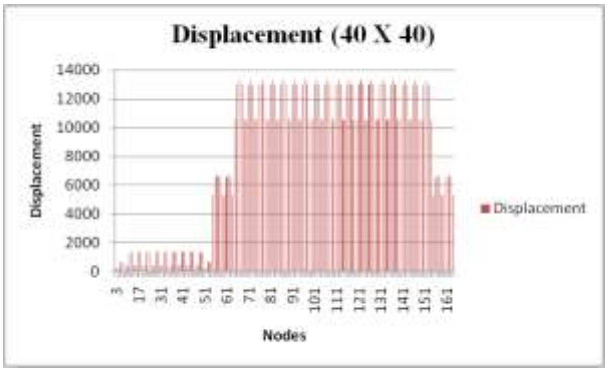

Figure No. 5.6: Displacement (40 X 20)

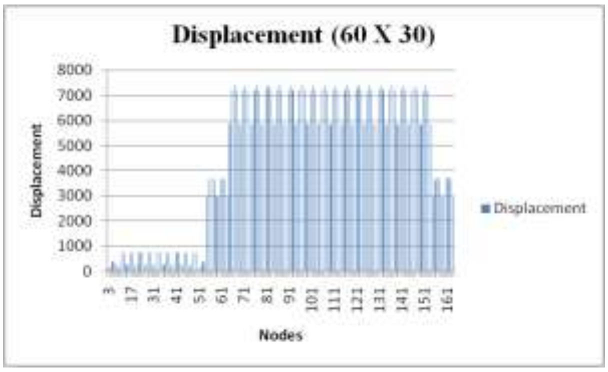

Figure No. 5.7: Displacement (60 X 30)

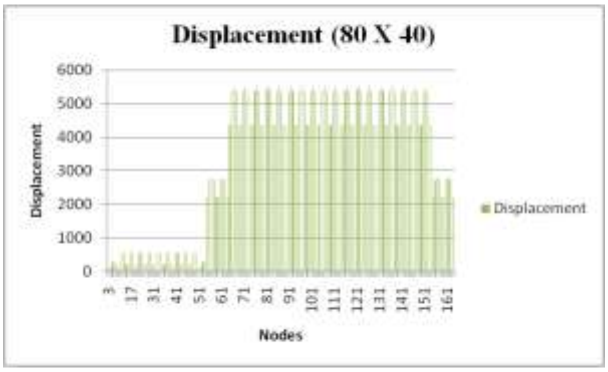

Figure No. 5.8: Displacement (60 X 30)

6. CONCLUSION

The optimization of industrial structure by maximum using light gauge steel sections in whole structure. In addition, the performance of the innovative optimized sections subject to shear and web crippling action were also investigated using analysis.

- It is able to shape itself to any form, and can be clad and insulated with a wide range of materials.
- It is easy to change or modify this construction at any point in its lifespan.

- There are a great range of systems and products catering to this type of construction.
- From the analysis the software models the section change, reaction and displacement also change its incensing with respective to node point.
- The maximum percent difference in the reaction of different models is 2.07% and minimum is 0.34% differs shows in the analysis results.

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