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Optimization of Industrial Structure using Light Gauge Steel Section

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Abstract - *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. In recent decades the interest of the building sector is tending towards the lightweight construction so as to overcome the faults of the last decades. Though there are several advantages of the light gauge steel section they are partially obtained due to the unawareness of the designer about the behaviour of the section. Therefore it is necessary to study the behaviour of the light gauge section under loading which will help in achieving the good performance of the structure.*

Key Words: Light weight, satisfy, analysis, performance, necessary.

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.

Light gauge steel products are found in all aspects of modern life; in the home, the shop, the factory, the office, the car, the petrol station, the restaurant, and indeed in almost any imaginable location. Nowadays, a multiplicity of widely different products, with a tremendous diversity of shapes, sizes, and applications are produces in steel using the cold forming process. Light gauge steel products sections have been commonly used in the metal building construction industry for more than 40 years.

2. METHODOLOGY

2.1. 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.

2.1 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.

2.2 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

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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.

2.3 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.

3. RESULTS AND DISCUSSION

3.1 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)

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

$$= 0.075 - 0.02(11.3 - 10)$$

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

Live load on purlin $= 0.724x1.5$

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

- Wind load ……(As per 875 Part-III)

Basic wind speed = 44 m/s

Designed wind speed =$V_b \ XK_1XK_2XK_3$

$$= 44X1X1.09X1$$

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

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

$$= 0.6X\ 47.96^2$$

$$= 1380\ N/m2$$

$$= 1.380\ KN/m2$$

3.2 Analytical results of Reaction of Model.

Table No 3.1: Reaction of Model

Sr. No	Light Gauge Steel Section	Reaction
1	40 X20	1788.164
2	40 X40	1791.74
3	60 X30	1806.777
4	80 X40	1817.817

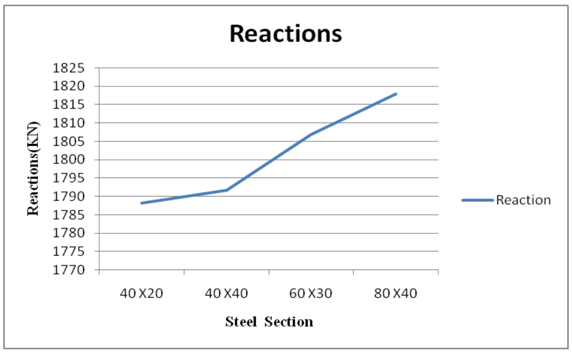

Figure No. 3.1: Reaction

3.3 Analytical results for Compression of models

Table No 3.2: **Maximum Compression**

Sr. No	Light Gauge Steel Section	Maximum Compression
1	40 X20	5.78E+05
2	40 X40	1.60E+05
3	60 X30	1.58E+05
4	80 X40	96598.744

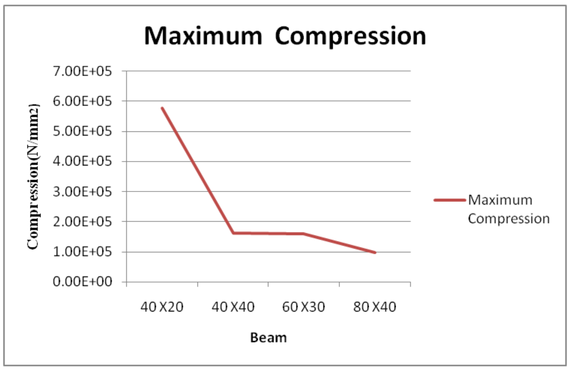

Figure No. 3.2: **Maximum Compression**

3.4 Analytical results for Tension of models

Table No 3.3: **Maximum Tension**

Sr. No	Light Gauge Steel Section	Maximum Tension
1	40 X20	375472.13
2	40 X40	153030.58
3	60 X30	101543.27
4	80 X40	50776.592

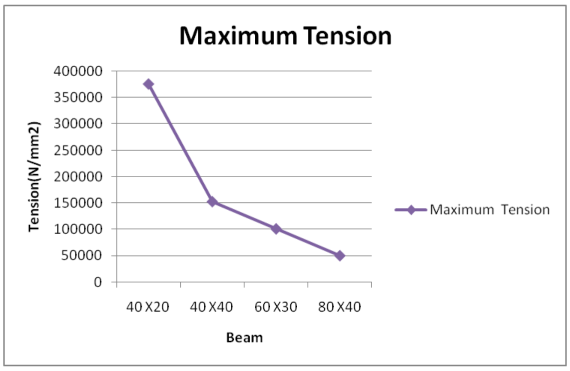

Figure No. 3.3: **Maximum Tension**

3.5 Analytical results for Beam Force

Table No 3.4: **Beam Force**

Sr. No	Light Gauge Steel Section	Beam Force
1	40 X20	4924.502
2	40 X40	4925.86
3	60 X30	4998.842
4	80 X40	5035.572

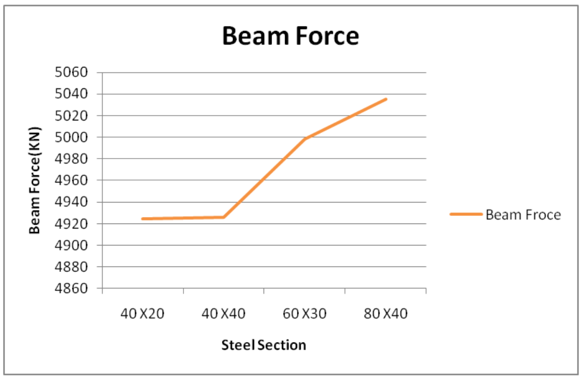

Figure No. 3.4: **Beam Force**

4. CONCLUSIONS

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 easy to change or modify this construction at any point in its lifespan.
- It is able to shape itself to any form, and can be clad and insulated with a wide range of materials.
- 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 1.63% and minimum is 0.6% differs shows in the analysis results.
- It is determined in this study that light gauge steel is better ion resisting load, and unbalanced forces.
- It is determined that stress and support reaction of light gauge steel is comparatively less than the steel.

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