OPTIMUM DESIGN OF AN INDUSTRIAL WAREHOUSE USING STAAD-PRO

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ABSTRACT

Long Span, Column free structures are the most essential in any type of industrial structures. Conventional structure with pipe and tube section concept are a new concept in the construction of single storey steel industrial building which fulfils this requirement along with reduced time and cost as compared to conventional structures. The objective of this paper is to do comparative study between Conventional Steel Building and Conventional Structure with Pipe & Tube Sections of Industrial Warehouse Using STAAD-Pro.

Keyword : - *Warehouse, CSB, Optimum, STAAD-Pro.*

1. INTRODUCTION

Warehouses are facilities that offer the adequate environment to store goods and materials that require proteaction from environmental factors and theft. When designing warehouses, many factors should be taken into account such as the capacity of storing the required materials, and lifting and delivery equipment as well as receiving, shipping and transferring operations and the related trucks and trailers, in addition to the needs of employees and workers, provided that lifting and delivery operations are carried out in the shortest time possible in order to achieve economic feasibility in the operation of warehouses.

2. DESIGN OF TYPES OF WAREHOUSE

Followings are design types of warehouse

2.1 Conventional Steel Building (CSB)

Building portions that are shop assembled prior to shipment to site are commonly referenced as prefabricated.. The smaller steel buildings tend to be prefabricated or simple enough to be constructed by anyone. Prefabrication offers the benefits of being less costly than traditional methods and is more environmentally friendly (since no waste is produced on-site). The larger steel buildings require skilled construction workers, such as ironworkers, to ensure proper and safe assembly. Fig 1 shows 3d view of conventional steel building.

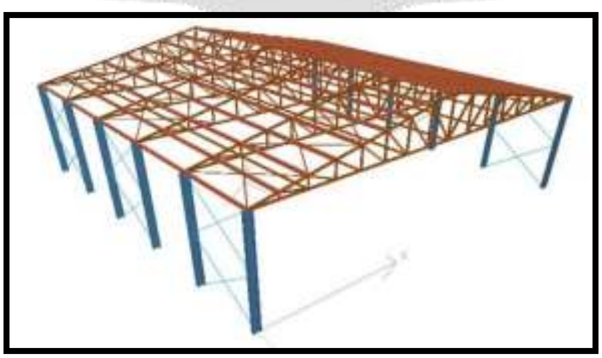

Fig-1: 3d view of conventional steel building

2.2 Conventional Structure with Pipe & Tube Sections

An economy of an industrial building depends on the configuration of structure, type of roof truss and portal frame utilized, forces acting on building and selection of steel sections needed as per force employed. Steel sections are categorized namely as conventional steel section (channel, angle, rolled etc.), and Hollow steel section (square hollow section, rectangular hollow section, circular hollow section). The Present work includes designing Roof truss components for an industrial building using conventional steel sections and tubular steel sections (circular hollow section) and selecting most suitable section according to its advantages and disadvantages. Fig 2 shows 3D View of Conventional Pipe structure and Fig 3shows 3D View of Conventional Tubular Structure.

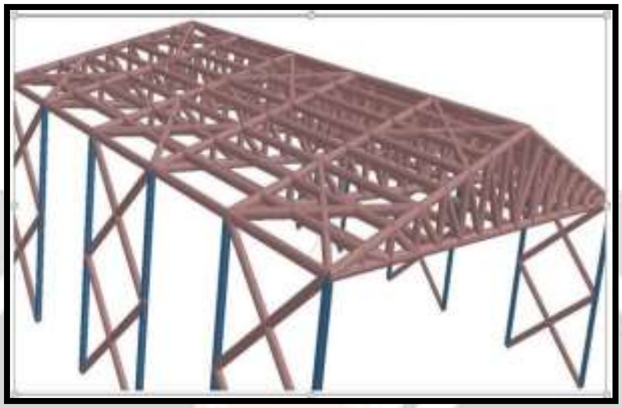

Fig-2: 3D View of Conventional Pipe structure

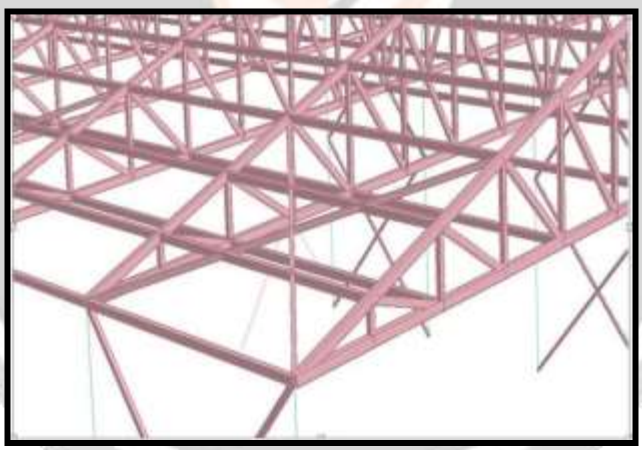

Fig-3: 3D View of Conventional Tubular Structure

3. LOADS AND LOAD COMBINATIONS

3.1 LOADS- Following Loads Are Consider For Analysis

3.1.1 Dead load

Dead load on the roof trusses in single storey industrial buildings consists of dead load of claddings and dead load of purlins, self-weight of the trusses in addition to the weight of bracings etc. Further, additional special dead loads such as truss supported hoist dead loads; special ducting and ventilator weight etc. could contribute to roof truss dead loads.

3.1.2 Live Load

The live load on roof trusses consist of the gravitational load due to erection and servicing as well as dust load etc. and the intensity is taken as per IS:875-1975. Additional special live loads such as snow loads in very cold climates, crane live loads in trusses supporting monorails may have to be considered.

3.1.3 Wind load

The wind load on the roof trusses, unless the roof slope is too high, would be usually uplift force perpendicular to the roof, due to suction effect of the wind blowing over the roof. Hence the wind load on roof truss usually acts opposite to the gravity load, and its magnitude can be larger than gravity loads, causing reversal of forces in truss members.

3.2 Load Combinations

Load combinations can be adopted according to IS: 800 – 2007. Twenty two different load combinations adopted for the analysis of the frame and some are listed as follows:

1) LOAD COMBINATION 1= 1.5 (DL + LL)

2) LOAD COMBINATION 2 = 1.2 (DL + LL + WIND 0 & -VE)

3) LOAD COMBINATION 3 = 1.2 (DL + LL + WIND 0 & +VE)

4) LOAD COMBINATION 4 = 1.2 (DL + LL + WIND 90 & +VE)

4. DESIGN OF CONVENTIONAL STEEL WAREHOUSE

The data used for the conventional type steel of ware house is as follows. The sections used for truss members are of angle sections.

- Type of truss = Howe truss
- span of truss = 25m
- Rise of truss = 3m
- Spacing between two columns = 5m
- Height of column = 8m
- Location of building = Solapur
- Type of roofing = G.I. sheets
- Number of frames = 6
- **Load Calculations-**

1. **Dead Load-**
   Weight of GI Sheet = 0.112kN/M^2
   Weight of fixings =0.025 kN/M^2
   Weight of bracing = 0.012kN/M^2
   Total Load = (weight of bracing + Weight of fixings + Weight of GI Sheet)
   = 0.0149 kN/M^2
   Dead load of purlin = 0.24 x 5= 1.20M
   Load on each intermediate panel point
   = (Total D.L. per M^2 x spacing x panel length) + D.L. of Purlin)
   = 0.149X 1.55x5 + 1.2
   Load on each panel point = 2.35 KN
   Load on each end panel point = 1.18 KN

5. RESULT-

Following table shows steel requirement and reaction etc. of various member of warehouse structures truss for 5M spacing between columns.

Table 5.1 -Results of 5m spacing between columns

PARAMETERS	CONVENTIONAL STRUCTURE WITH PIPE SECTIONS	CONVENTIONAL STRUCTURE WITH TUBE SECTIONS	CONVENTIONAL STRUCTURE
SUPPORT REACTION (KN)	128.529	130.25	135.978
MAXIMUM DISPLACEMENT (mm)	146.55	114.75	108.229
MAXIMUM MOMENT (kip. In.)	1677.894	1437.661	1252.33

Table 5.2-Total Steel Takeoff

SPACING BETWEEN TRUSS/COLUMN	CSB (TUBE)	CSB (PIPE)	CSB
5M	125.365 (KN)	130.577 (KN)	220.085(KN)

6. CONCLUSION

According to the results obtained from the analysis of these Structures in which optimum steel sections were assigned to the various warehouse models for every member following conclusion can be made.

- The support reactions are more for conventional building as compared to other structures trusses. Conventional structure with pipe sections gives lesser support reactions.
- Total steel takeoff is requiring more for CSB as compared to another structure truss.
- The total steel take-off for CSB (PIPE) with primary frame spacing of 5m is 41% less of the conventional steel building.

7. REFERENCES

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