ANALYSIS AND COMPARATIVE STUDY ON CONVENTIONAL STEEL BUILDING AND PRE ENGINEERED BUILDING USING STAAD.PRO

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ABSTRACT

Cost of steel is increasing day by day and use of steel has increase in the construction industry. Hence to achieve economical sustainability it is necessary to use steel to its optimum quantity. Long span, Column free structures like complex industrial facilities, warehouses and distribution centers, stock house, shopping malls, resort, motor court, office, cabin, service complex, aircraft-hanger, athletics and fun stadium, study places, temples, hospitals, and any types of industrial structures are the most essential in any type. Hence in steel structures which type of structure is well efficient in less time consuming, cost and strength. Use Pre Engineered Buildings (PEB) and Conventional structure, which type of structure fulfill our requirement. These structures are analyzing in seismic and wind loads with the help of STAAD.pro software. This methodology is versatile not only due to its quality pre designing and prefabrication, but also due to its light weight and economical construction. In this thesis an attempt has been to present relative study of conventional and PEB steel building with the help of finite element based software STAAD.pro. The results were found from analysis indicate which one type of structure is having good load bearing capacity with optimum use of steel.

Keywords: Pre Engineered Building, Conventional Steel Building, STAAD.Pro, Wind Analysis, Industrial Structure.

I. INTRODUCTION

In today era steel industrial growth are catching day to day and use of steel structure is eco-friendly and economical. Hence economical word connected considering cost and time is most necessary aspects. Prefabricated steel building requires less consumption of time to be construct. Example Pre engineered building and conventional steel building. Complicated steel building, complete designed done on factory and it is based on according to design, sections are pre fabricated then it is transferred to the site, where it is taking 6 to 9 weeks to be prepare or for installing. Performance of these structure is well understood in the most part of codal provisions are currently in place to assure for serviceable behavior in high windy and seismic waves. Steel structures have much good strength to weight ratio than reinforces cement structure and they also can be dismantled or reused easily in another place. Pre engineered Buildings has welded and bolted connection and hence they were reused after dismantling from the structure. Thus, PEB structure can be transferred or shifted as per requirement in future. It has been noticed that steel has reserve strength in its characteristic. The conventional steel structure is stable. Mainly hot-rolled sectional members are in used. The changes are possible done during the erection process by welding and cutting. Generally trusses are used in system. Theyre productions are done in the plant itself according to the requirement. According to the demand of client the manufacturing of the members is done or carry. The sectional components manufactures is completely prefabricated condition for shifting. The pre-engineered structure is erected for resort, motor, office, complex, aircraft-hanger, stadium, temples, hospitals, ware houses, industries, cold store etc. Due to the necessary characteristics of steel structure like ductility, malleability, flexionless etc. steel has mostly used in the interface of construction industry. It is bending on the application of heavy load while undergoing crumbling and crushing. Due to their strength, low rate, stability, recyclability or flexibility it makes a very good option forising.
Components of steel building as:

- Main framing
- Columns
- Gables
- Bracings
- Purlins and Girts
- Eave Struts
- Sheeting or Cladding
II. METHODOLOGY

In this thesis work concluded the design of an Industrial shed of structure located at Zone-Ⅱ. The structure with length 35m and width 20m it has 7 spans of 20 meters width, eave height of structure is 8 meters, distance between gables is 5m. In this work pre engineered or conventional steel structure having span is taken into and the design is carried out or done by considering dead load, live load wind load and earthquake load.

Table 1: Specification of structure(CSB and PEB)

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>35m</td>
</tr>
<tr>
<td>Width</td>
<td>20m</td>
</tr>
<tr>
<td>Height</td>
<td>8m</td>
</tr>
<tr>
<td>Seismic zone</td>
<td>Ⅱ</td>
</tr>
<tr>
<td>Wind terrain category</td>
<td>2</td>
</tr>
<tr>
<td>Slope of roof</td>
<td>1/10</td>
</tr>
<tr>
<td>Soil type</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Section properties

The design of steel structure member is governed by cross sectional area and section modulus. General analysis regarding steel sections some sections are more capable of compression some in tension, some common structural members in building like purlins, bracings, beams (which is used to connect gables or rafters).

- CHS pipe section (beams and bracings in conventional and pre engineered structure).
- IM SECTION (I section for beams and columns in conventional structure).
- ISLB section (for rear and front side in conventional and pre engineered structure).
- Tapered section for rafter in pre engineered building.

Load Combinations

1) DL+LL
2) DL+EX
3) DL+EZ
4) DL+ (-EZ)
5) DL+0.8LL+0.8EZ
6) DL+0.8LL+0.8EX
7) DL+0.8LL+0.8EZ
8) DL+0.8LL+0.8EX
9) DL+0.8LL+0.8EZ
10) DL+WLLIS
11) DL+WLLIRS
12) DL+WLLIS
13) DL+WLLIRP
14) DL+WLLIS
15) DL+WLLIS
16) DL+WLLIRP
17) DL+WLLLS
18) DL+WLLLIS
19) DL+WLLLIS
20) DL+WLLLIS
21) DL+WLLLIS
22) DL+WLLLIS
III. MODELLING

In the modern study, STAAD.Pro software can be use in order to analyze and design of PEB and CSB structure or sections. The sectional property of channel section and angle section are present in the steel tables of STAAD.Pro, the C or I sections. In any case, for the design of PEB, there is one command as tapered sections. Optimum use of tapered section are one in which we can assemble the web, flange their thicknesses, and so on. STAAD.Pro is the structural engineering professional’s decision for steel, timber, concrete, cold formed, and aluminum steel design of practically any structure including of petrochemical plants, tunnels, bridges, culverts, piles, and substantially more through it is adaptable demanding condition. For drawing or prepare plans or breaking down any shape on STAAD.Pro we first need to create a model of it.

![3D model of PEB frame](image1)

**Figure 4: 3D model of PEB frame**

![3D model of CSB frame](image2)

**Figure 5: 3D model of CSB frame**

- Utilization ratio:

The critical value that indicates the ability of the member in front of load as per IS 875 (LSD). Normally, a value higher than 1.0 indicates extent to which the member is over-stressed, and a value below 1.0 tells us the represents capacity section. The critical conditions used where as to determine Pass/Fail criteria status or ratio in axial, slenderness limits and bending due to compression, axial and bending due to tension, maximum weight to load ratios and shear showing utilization ratio of members. The result file generated after further calculation which is done by software.
- **Steel takeoff:**

  Steel or quantity take-off refers to the estimation of material weight in buildings calculated by STAAD.

### Table 2: Steel used in conventional structure

<table>
<thead>
<tr>
<th>Member</th>
<th>Length (Meter)</th>
<th>Weight (kN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST ISHB400H</td>
<td>322.80</td>
<td>257.891</td>
</tr>
<tr>
<td>ST 165.1X5.4CHS</td>
<td>363.89</td>
<td>75.755</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>333.646</td>
</tr>
</tbody>
</table>

### Table 3: Steel used in preengineered structure

<table>
<thead>
<tr>
<th>Member</th>
<th>Length (Meter)</th>
<th>Weight (kN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tapered</td>
<td>288.80</td>
<td>176.151</td>
</tr>
<tr>
<td>ST 165.1X5.4CHS</td>
<td>363.89</td>
<td>75.755</td>
</tr>
<tr>
<td>ST ISHB300H</td>
<td>34.00</td>
<td>20.869</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>272.775</td>
</tr>
</tbody>
</table>
V. CONCLUSION

- Pre-engineered building the members used are built up members and are verified by the designer. Pre-engineered building is 18.244% more economical than conventional.
- Use of PEB structure building in place of CSB building shall be reducing quantity of steel.
- Reducing the quantity of steel definitely reducing the dead load of structure.
- PEB increase the Aesthetic view of steel structure.
- It is noticed that the weight of PEB structure depends upon spacing of the bay while with increase in bayspacing up to certain space, the weight reduces and further increase results the weight heavier.
- Nodal displacement check, results maximum displacement occurs in conventional structure. Hence the capacity to bear load and moments in pre-engineered structure is greater than conventional structure.
- The moments, forces bearing capacity in columns and beam depending upon the dimension of the structure due to the sizable nature of PEB, structure is more economical compared to conventional structure.

VI. REFERENCES


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