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Study on Optimization and Analysis of Pre Engineering Building with Conventional Steel sections

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ABSTRACT: The experimental study is conducted to optimization and analyzes the effect of different parameters on pre-engineered buildings and comparison of pre engineered building with conventional steel sections of building Pre Engineered Buildings (PEB) fulfills this requirement along with reduced time and cost as compared to conventional structures. The present work involves the comparative study and optimization and analysis of Pre Engineered Buildings (PEB) and Conventional steel sections. Analysis of the structure is being done in Staad Pro software and the same is then compared with conventional type, in terms of weight which in turn reduces the cost. Four sections have been taken for the study. Comparison of Pre Engineered Buildings (PEB) and Conventional steel section is done, Pre Engineered Building structure with increased bay space is taken for the study. In the present work, Pre Engineered Buildings (PEB) and Conventional steel section structure is designed for wind forces. Wind analysis has been done manually as per IS 875 (Part III) – 1987.

KEYWORDS: Pre-engineered building, conventional building, steel consumption, Staad Pro software.

I. INTRODUCTION

Steel industry is growing rapidly in almost all the parts of the world. The use of steel structures is not only economical but also eco friendly at the time when there is a threat of global warming. Here, “economical” word is stated considering time and cost. Time being the most important aspect, steel structures (Pre fabricated) is built in very short period and one such example is Pre Engineered Buildings (PEB). Pre engineered buildings are nothing but steel buildings in which excess steel is avoided by tapering the sections as per the bending moment’s requirement. One may think about its possibility, but it’s a fact many people are not aware about Pre Engineered Buildings. If we go for regular steel structures, time frame will be more, and also cost will be more, and both together i.e. time and cost, makes it uneconomical. Thus in pre engineered buildings, the total design is done in the factory, and as per the design, members are pre fabricated and then transported to the site where they are erected in a time less than 6 to 8 weeks. The structural performance of these buildings is well understood and, for the most part, adequate code provisions are currently in place to ensure satisfactory behavior in high winds. Steel structures also have much better strength-to-weight ratios than RCC and they also can be easily dismantled. Pre Engineered Buildings have bolted connections and hence can also be reused after dismantling. Thus, pre engineered buildings can be shifted and/or expanded as per the requirements in future. In this paper we will discuss the various advantages of pre engineered buildings and also, with the help of three examples, a comparison will be made between pre engineered buildings and conventional steel structures.

II. METHODOLOGY

The first stage of this study is to model a PEB structure by using a commercial software. The further methodology is to take the modelled structure and try to optimize it by varying the following parameters:

1. Dimensions of structures – the optimum dimension is then chosen from 4 models of the structure.
2. Height of the structure – most optimum graded dimension for bay spacing and roof angle is then taken and the study is carried further. The most economic structure will be chosen by carrying out all the above-mentioned parameters and further compared with a conventional steel structure.

III. MODELLING

Building Dimension - 30m x 18m

Spacing of bay – 6m

Clear eave height - 5m

Maximum eave height - 6.35m

Roof slope - 5.71°

Weight of sheet and purlins - 15Kg/m^2

Live load of roof - 75Kg/m^2

Basic wind speed - 47 m/sec

Seismic zone (Z) - Zone IV

The analysis is performed using STAAD PRO V8i. In accordance with IS 875, load combinations are considered, which consist of static, temporary, wind and earthquakes. The parameters above are roof slope (θ), span (B) and column height (h). Also, a traditional truss model has been prepared for comparison.

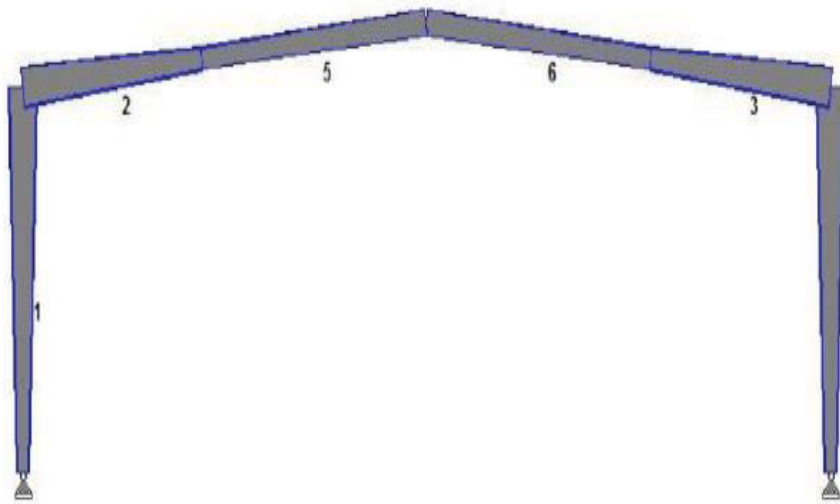


Fig -1: PEB Model

IV. MODELLING

REACTIONS

The reactions that were obtained for different model are expressed in form of following graph

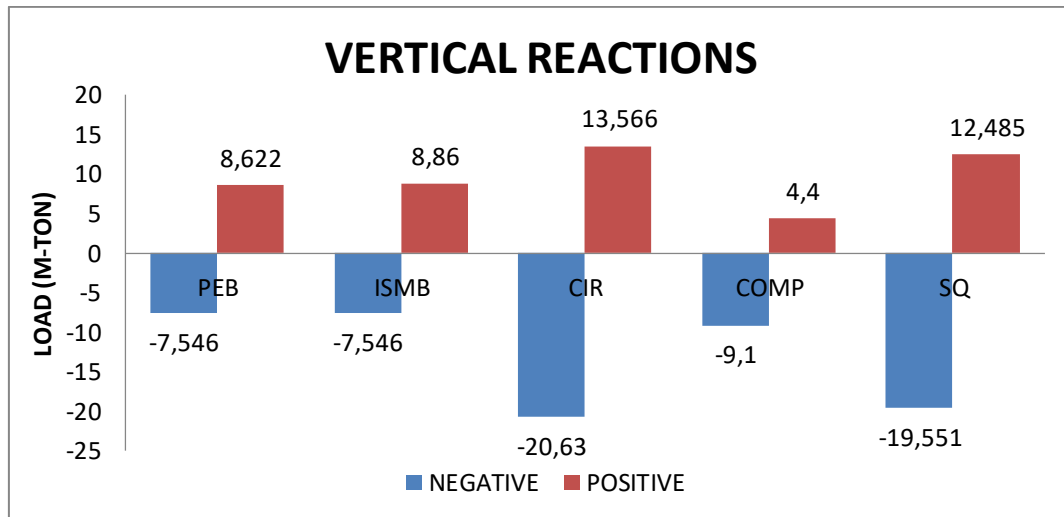


Fig -2: Vertical reaction Chart

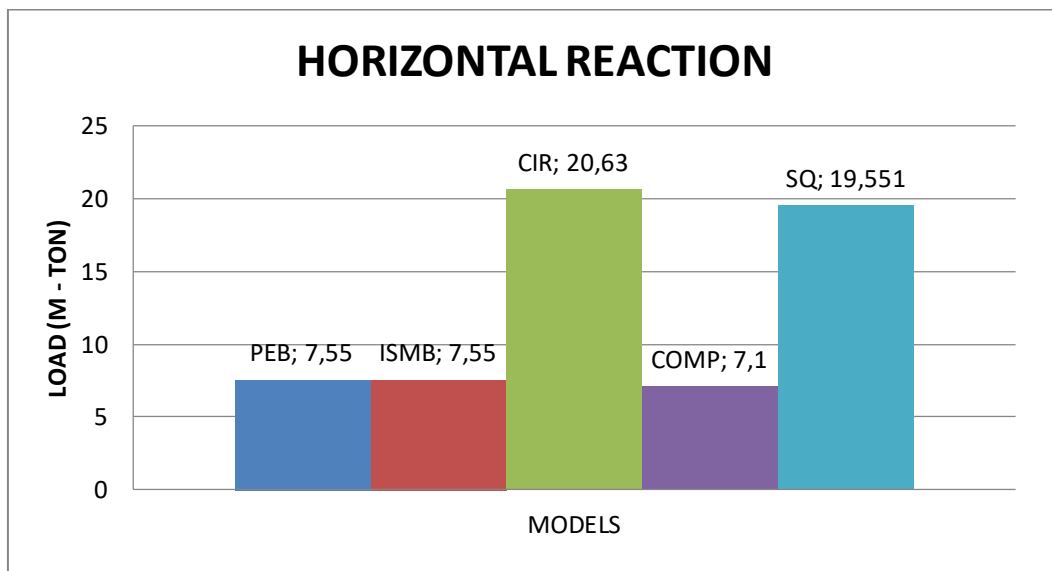


Fig -3: Horizontal reaction Chart

As obtained from above graph it is observed that maximum positive and negative vertical reactions are obtained when circular hollow section is used in conventional steel building. When we are use rectangular and square hollow section in conventional steel building it offers more vertical and horizontal (positive & negative reactions) as compared to PEB.

4.2. Nodal Deflection

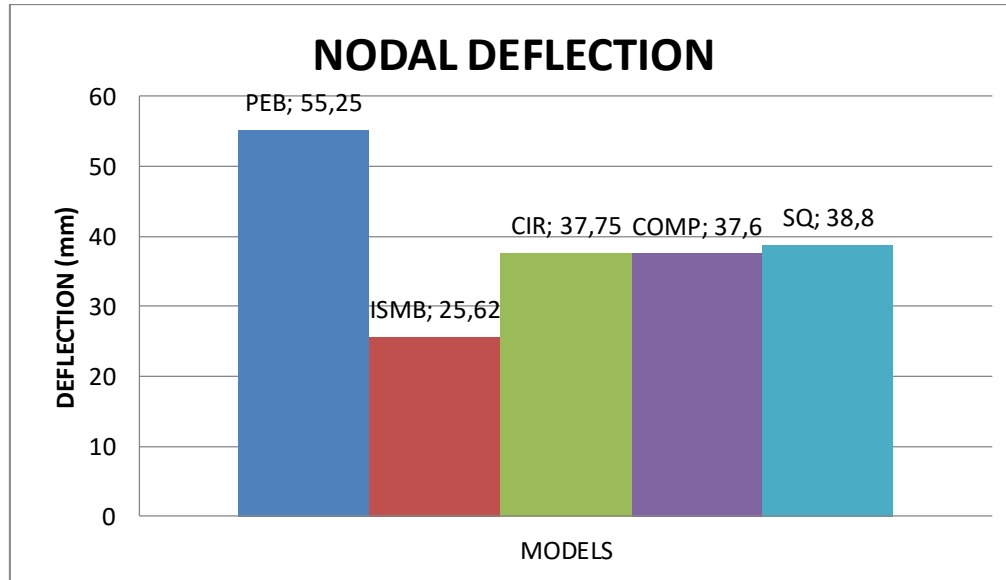


Fig -4: Nodal deflection Chart

It is observed that maximum deflection is in PEB as compared to CSB and minimum deflection occurs in ISMB CSB as compared to other section in CSB and PEB.

4.3 Weight of Portal

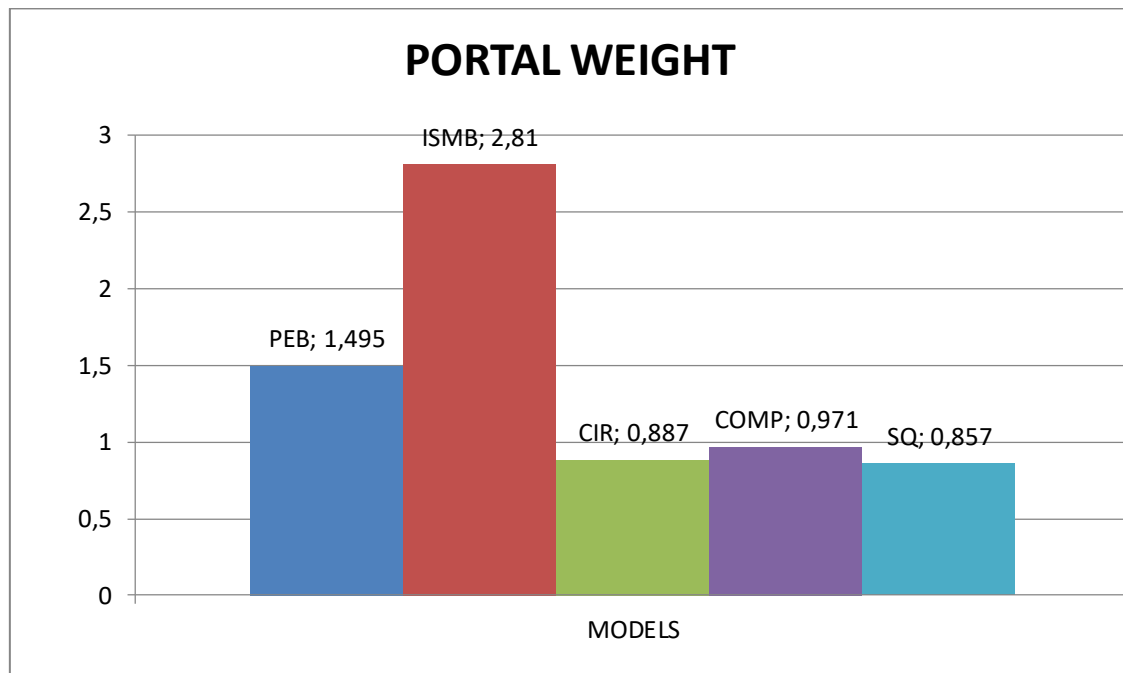


Fig -4: Designed Portal weight Chart

Weight of Portal is becomes maximum when CSB is designed by using ISMB section. Weight of PEB is less than ISMB CSB but it is more than all CSB of circular hollow section, compound ISMC, and rectangular hollow section and square hollow section.



V. CONCLUSION

- After economic and technical analysis of the PEB and CBS with span 18m and bay spacing 6m.
- It's been recommended that more than PEB, truss bracing gives the best suited result based on the economical possibility and structural safety.
- When for a project if PEB is the preferred design then it is found that bracing system comes out to be the best suitable when both economical and technical analysis is considered together.
- The overall economic analysis shows that, PEB comes out to be economically less than CSB with standard hot rolled section but truss system in conventional building is the most economical.
- Using the hollow tubes in truss system reduced the steel quantity when compare to PEB, However, PEB instead of CSB reduces the steel quantity.
- Reduction in steel quantity definitely reducing the dead load.

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