

Comparative Study Of Pre Engineered And Conventional Steel Building

Humanaaz Arif Qureshi¹, Dr. Kuldeep R. Dabhekar², Amol Shahakar³

Department of Civil Engineering, G.H. Rasoni College of Engineering Nagpur, India

Abstract: In structural engineering, the Pre-Engineering Building (PEB) is a system that provides economical and less time-consuming design and construction of the building. From the past few years, by the use of PEB design, we get optimizing the design of the structure. When the span is more and column-free design required PEB is the best solution. As compared to conventional steel building (CSB), PEB requires less time and cost. This system is used worldwide due to its more quality control, less weighted member and economical design. The main objective of this paper is the advantages of the PEB system over the CSB system. In this paper a comparative study of PEB and CSB carryout.

Keywords: Pre-Engineered Building, Conventional Steel Building, Tapered Section.

I. Introduction

In India, construction industries contribute a large part to the development of the Indian economy. The construction industries play a very important role in the development of the Indian economy. For fast growth, structure engineering discovered the PEB concept. Instead of multiple suppliers, PEB has a single supplier which provide complete component including steel framework, cladding, and roofing component. According to specification, all components are erected on the site by using the bolted connection. PEB design is done by software. In other words, we say that PEB will be the future of construction industries. And many firms take advantage of PEB over CSB. Based on the client's requirement, structure engineers design the structure by using Primary and secondary members which are made up of built-up, hot roll and cold-formed material. Instead of using the hot roll I section we used a built-up tapered section. PEB is included with different component likes intermediate floor called mezzanine, canopies, trims, clip, sag rods, flange bracing, grits, purlin, and fascias, etc. PEB concept is worldwide adopted now a day and it's also achieved the aesthetic appearance and has a unique design style. As compare to CSB, PEB provides economical design for low rise and wider span structure. In another way, we say that there is no other building concept which matches PEB in term of speed and cost from foundation to finishing.

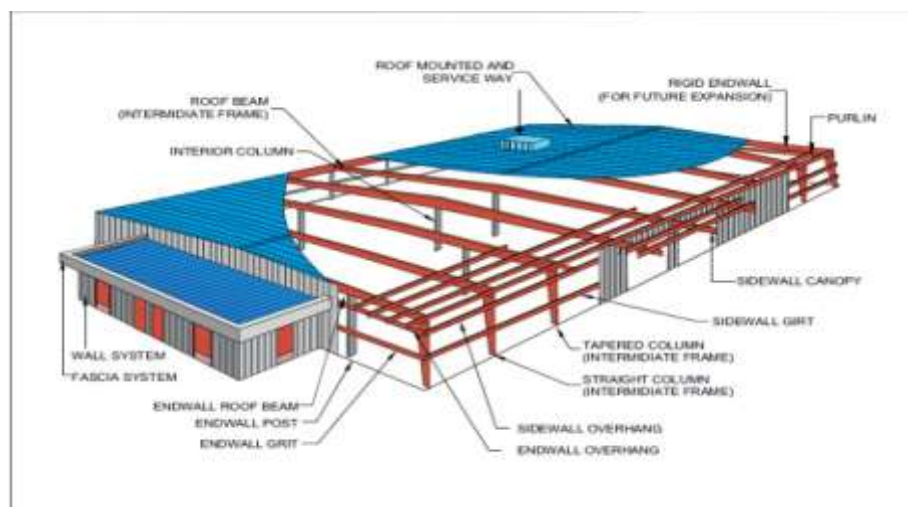


Figure 1: Pre-Engineered Building Components.

II. Pre-Engineered Building Components

Following are the components of Pre-Engineered Building:

I. Primary Members:-

Main Frame:-

The mainframe contains the most important member of the building i.e., Built-up tapered columns and rafters. In These Built-up tapered sections are manufactures by welding the webs to flanges. After manufacturing at the end of tapered members the splice plates are used as a connection. The bolted connection is generally used for the fabrication of PEB. Either tapered section or built-up I section used for the column. The continuous welding is done for the connection of webs to the flanges.

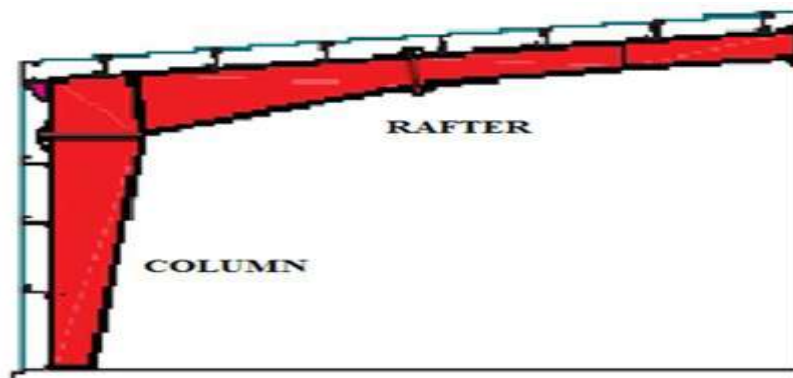


Figure 2: Main Frame.

Column:-

The main purpose of the column is to distribute the load safely to the foundation. Columns are generally constructed by using 'I' sections. I section are cheaper as compared to other sections. Depend on design the depth of the column goes increases from bottom to the top end. The flange and web of the column are connected by using welding.

Rafter:-

Rafter act as a platform for purlins and roof sheeting. Its design to sustain the load of roofing and purlins.

II. Secondary Members.

Secondary members are those members which act as a supporting system for roof and wall sheeting .i.e girt and purlin. For supporting the roof sheeting purlin are used and wall sheeting girt are used. The main purpose of providing the girt and purlin is to increase the strength of the frame by providing lateral stability to flanges. The secondary members are made up of cold-formed steel.



Figure 3: cold formed sections.

III. Advantages Of Pre-Engineered Building Over Conventional Steel Building.

Below are some of the main advantages of Pre-engineered building structures over conventional steel building.

- Manufacturing Time: - After approval of the design and drawing maximum of 6 to 8 weeks are required for the construction of the structure. Whereas the conventional Buildings required almost 10 to 11 weeks for manufacturing. Less consumption of construction time makes PEB cost-effective and economical.

- b. Cost: - Because of optimizing the section size the cost of the PEB structure is less as compared to CSB.
- c. Weight: - By optimizing the section weight of PEB is reduced up to 10 to 20 percent as compared to CSB.
- d. Foundation: - Overall weight of the structure is less as compared to CSB, therefore, PEB required light and simple foundation.
- e. Expansion: - Where future expansion is required PEB is the best solution. The expansion in the structure is generally done by increasing bays.
- f. Clear span: - Where the column-free structure required PEB is advantages over CSB. PEB structure can be constructed up to a 90 m clear span.
- g. Quality Control: - The component of PEB is having more control over quality due to manufacturing in a factory.

IV. Literatures Review.

Following are the some of Pre-Engineered Building:

I. C.M. Meera:-

In this paper author compared PEB and CSB in the aspect of steel takeoff. The author did comparative analysis and design of industrial warehouses by using the Indian standard code of steel I.S 800:2007. From this paper we observed.CSB roof is 30% heavy than the PEB roof. The PEB frame is light in weight and flexible whereas comparing to PEB, the CSB frame is heavyweights and rigid. Due to the above reason, PEB is more resistance to earthquakes. Overall Takeoff of the PEB structure is less than 30% the CSB.

II. Aijaz Ahmad Zende:-

In this paper author compared PEB and CSB in the aspect of steel takeoff. The author did comparative analysis and design of the hotel by using the Indian standard code of steel I.S 800:2007. From this paper we observed For longer span and column-free space, PEB is more economical.PEB is more economical for the wider span and low rise height structure. After a certain limit, with the increase of bays spacing the weight of the structure is also increases.

III. Maria Subashini and Shamini Valentina:-

In this paper author compared PEB and CSB in the aspect of steel takeoff of a building having 44 m length and 20 m wide. The software used for design is STADD Pro. The author has done comparative analysis and design by using the Indian standard code of steel I.S 800: 2007. From this paper, we concluded that in PEB member size are reduced according to bending moment and shear force diagram which results in reducing the weight of steel by using a tapered section. In this paper, the author used a lightweight Z section as a secondary member for girts and purlin in PEB instead of using the hot roll section which used in CSB. The author adopted a lightweight foundation in PEB due to a less dead load of the structure. According to the author's design, we conclude the takeoff and cost of PEB are 30% less than conventional steel building.

IV. Milind Bhojkar and Milind Darade:-

In this paper author compared PEB and CSB in the aspect of steel takeoff. The author did a comparative analysis and design of aircraft hanger by using the Indian standard code of steel I.S 800:2007. From this paper we observed. For the erection of the PEB structure is 50% less timing is required is approximately not more than 8 weeks.PEB is economical for clear span up to 30m long and eave height up to 30 m PEB is economical. In the case of an aircraft hanger, PEB length may be possible up to 150 m. For lateral stability bracing of the structure was provided. In the case of CSB, there is various type of trusses used according to span fir large span Fink type truss used, for medium pitch pratt type truss are generally used.

V. G. Sai Kiran:-

The author did comparative analysis and design of industrial warehouses by using the Indian standard code of steel I.S 800:2007, IS 800-1984, IS 800-2007, MBMA-96, and AISC-89. The geometry of structure was such that the 187x40x8 where 187 m is the length, 40 m is with and 8 is the eave height. The slope of the structure was 1;10. The author did a comparative analysis of Indian code and American code.

VI. Swati Wakchaure, N.C Dubey: -

In this paper author compared PEB and CSB in the aspect of steel takeoff. The author has done comparative analysis and design by using the Indian standard code of steel I.S 800:2007 and I.S 800-1984. From this paper, we concluded that in PEB member size are reduced according to bending moment and shear force diagram which results in reducing the weight of steel by using a tapered section.

VII. Vrushali Bahadure: -

The authors did a comparison of various industrial structures by using different types of truss. They have done design by using STADD Pro. Software. They observed that the sawtooth type truss was more economical than the portal frame, A-type truss. The sawtooth shed is 65% more economical.

VIII. Problem Identification.

In From the above research paper, we conclude that PEB is more economical for low rise structure up to 30 m eave height and wider clear span up to 60 m as compared to CSB. But in case of high rise and less span, PEB is not economical as compared to CSB. In such cases, CSB is more economical. There is a requirement of developing such a design and methodology which make the PEB economical for small span and high rise building.

IX. Future Scope

Following are the future scope which needs to research.

- a. The analysis of PEB & CSB building .by using software like MBS, E-TAB, SAP2005.
- b. Design the building with including the components like the crane, mezzanine on it.
- c. Design the PEB system for residential buildings.
- d. For different zone analysis and design of PEB structure.
- e. AISC like international codes is also used for the design of PEB.

X. Conclusion

This paper concludes that PEB design provides a design which offers cheap, flexible durable and economical design as compare to CSB design. In other words, we say that PEB is more economical, having great quality control. The erection of the PEB is simple and less time-consuming. When the span is more and column-free design required PEB is the best solution.

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