IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Impact Factor 6.252
Volume 2, Issue 1, July 2022

# Comparative Structural Analysis of Pre-Engineered Building: A Review

**Mr. Ravindra S. Ingole[1] and Prof. Bharati Changhode[2]**
PG Scholar, Department of Civil Engineering[1]
Assistant Professor, Department of Civil Engineering[2]
G H Raisoni University, Amravati, Amravati, Maharashtra, India

**Abstract:** The concept of pre-engineering construction provides systems of steel buildings that are pre-designed and prefabricated. As the name suggests, this concept involves preliminary engineering of structural elements, using a predetermined register of building materials and manufacturing technologies that can skillfully meet a wide range of structural and aesthetic design requirements. The basis of the PEB concept is to provide a site only in accordance with the requirement at that location. The sections can vary along the entire length according to the bending moment diagram.

**Keywords:** Pre-engineered building, steel, building, pitch and analysis.

## I. INTRODUCTION

Pre-engineering buildings ( PEB ) is the future for India. Most Indian business communities have just begun to realize the benefits of PEB. India is the most progressive company that sees the benefits of PEB.

- PEB needs a huge initial investment.
- Indian education focuses most on RCC buildings in the course curriculum, and therefore progress in sustainable construction is ignored.
- IS codes need to be changed because the selected sections are mostly heavier.

The pre-designed building has a broad future in India, as they are still not desirable.

## II. COMPONENTS OF PEB

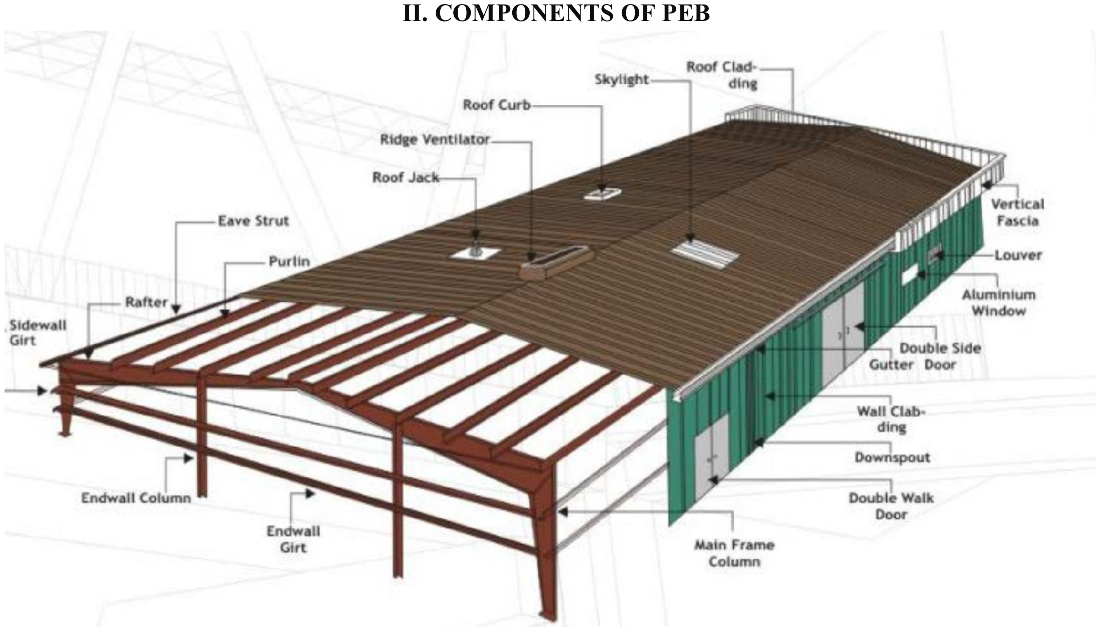


**Figure 1:** Components of PEB
(Source:- https://civildigital.com/wp-content/uploads/2017/01/peb-2-220x134.png)

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There are following major components in a pre-engineered building:

1. Primary or Main frame
2. Secondary frame or purlins,girts etc.
3. Roof & Wall Sheeting
4. Bracing system
5. Crane system
6. Mezzanine system
7. Insulations
8. Attachments like canopies, fascia etc.
9. Doors, Windows, Ventilators
10. Accessories like Turbo vents, Ridge Vents, Skylights etc.

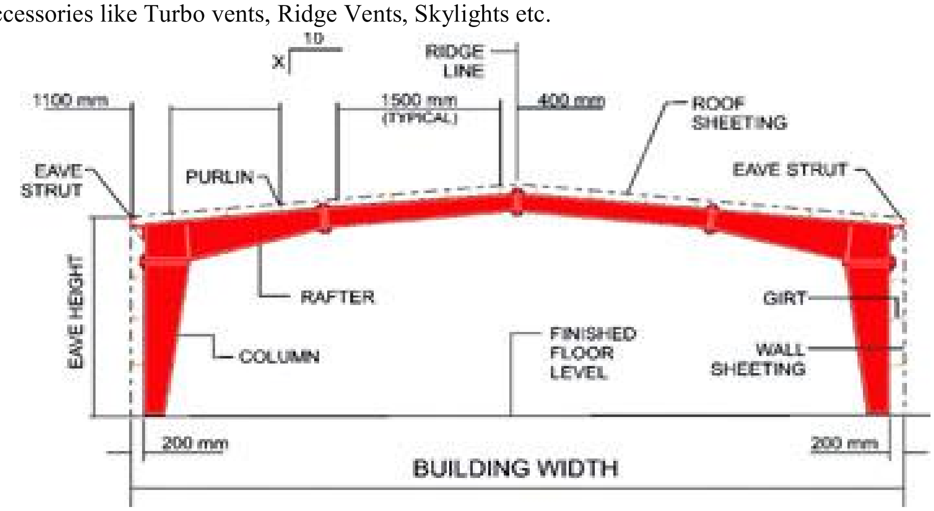


**Figure 2:** Typical Frame of PEB

(Source:- http://www.builtconstructions.in/OnlineMagazine/GlobalPageImages/BE-CF-PEB-Vol2-Iss4-April13.jpg)

**2.1 Primary or Main Frame**

The primary frame mainly includes rigid steel frames of buildings. The primary system consists of conical or parallel columns and conical beams, called rafters ( steel plates made of sections "I" or "H", called built-in elements ). ) The base of the columns can be fixed or fixed based on load requirements. The length of these members is usually limited to 12 m for comfortable transport. The joints are connected by bolts with high stretching. Vertical support for the whole building, as well as lateral stability for the building in its direction is provided by the main frame, while lateral stability in the other direction is usually achieved a mounting system.

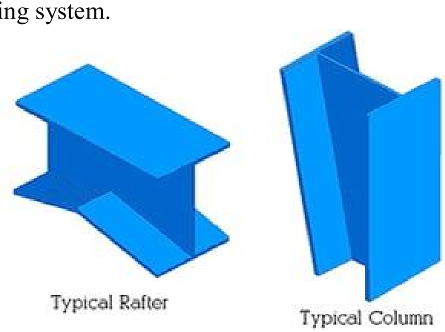


**Figure 3:** Typical Rafter and Column

(Source: - https://civildigital.com/wp-content/uploads/2017/01/peb-3.jpg)

### 2.2 Secondary Frame or Purlins, grits and Eave struts

Secondary structural elements used to support the walls and roof panels are purlins, shirts and tendrils. Purlins are used on the roof; Shirts are used on the walls, and Eave Struts are used at the intersection of the sidewall and roof. Flange stiffnesses that connect the unleashed flanges of the primary PEB structure to the secondary system are also included in the secondary system. The common secondary system is C or Z purlins, MS rods and trimmed corners. These are usually coldly formed sections corresponding to the IP:801 Two functions of the secondary frame, which they act as struts, help to resist the part of the longitudinal loads applied to the building, such as wind and earthquake loads, and they provide lateral attachment to the compression flanges of the main frame elements, thereby increasing the frame capacity.

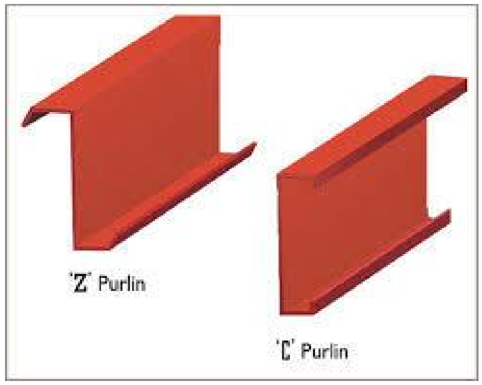


**Figure 4:** Z and C purlins
(Source:- https://www.alfapebltd.com/images/products/zandcpur.png)

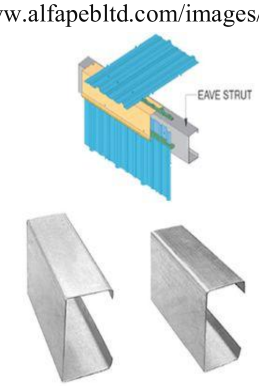


**Figure 5:** Eave strut
(Source: - https://cpimg.tistatic.com/04310402/b/4/Eave-Struts.jpg)

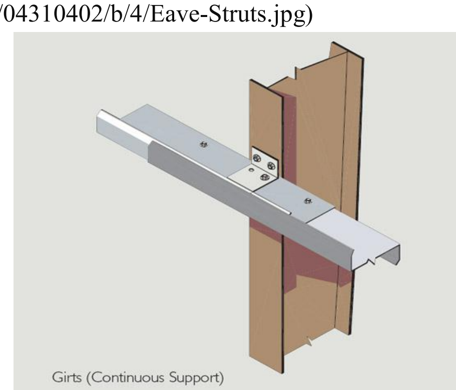


**Figure 6:** Girt
(Source: - https://4.imimg.com/data4/WM/OK/MY-2286138/jhjh-500x500.png)

## III. LITERATURE REVIEW

Pratik R. Atwal et al. ( 2017 ) analyzed and designed building G + 3 using IS 800-2007 and international standards, which are AISC-10, BS5950-2000 and Euro-03 Results show, that for the American reduction of the steel weight code is up to 24% compared to IS 800-2007. American codes generally prefer the design of steel buildings, although the weight of the structure is reduced to 28% by Euro-03 and up to 10% by BS5950-2000.

Subod S. Patil et al. ( 2017 ) conducted a comparative study and design of pre-engineered buildings ( PEB ) and conventional steel frames using software for full-time programs. Steel structures are designed for wind analysis, and manual analysis is performed in accordance with IS 875 ( Part III ) – 1987. They considered three examples. Frame 80 m long, 30 m wide and 6 m distance between the bay designed for both PEB and conventional, and comparisons were made in terms of steel weight. They found that PEB designs are lighter and the design is fast and efficient compared to the CSB design. PEB support reactions are much less than CSB, so a lightweight foundation has been adopted, and this has also reduced construction costs.

K. Prabin Kumar and D. Sunny Prakash ( 2018 ) presented a document on a complete analysis of the planning and design of an industrial barn using STAAD Pro software. They considered a hanger 50 m, a width of 15 m, an ear height of 10 m, and a slope of 10 degrees on the roof. The main goal is to achieve a plastic and stiffer hanger for this purpose, they provide fastening at different intervals, and the distance between the bays also ranges from 7.5 m and 7 m for the first and last bays and the other 5 bays, respectively. The calculation of the various loads acting on the structure was carried out by means of code provisions and the construction of the foundation was made. From the results, they concluded that the deviations receive less than the calculated allowable deflection.

Danush. J and others. ( 2018 ) conducted a parametric study of the structural model of a conventional hangar building for steel aircraft, a pre-designed aircraft hangar and an empty hangar in front of engineering aircraft. They considered a conventional hangar building for steel aircraft, a pre-designed aircraft hangar and a hollow pre-engineering hangar with a span of 60 m, and the analysis is performed using STAAD Pro. software. The main purpose of this project is to find out the most optimized structure, and this is clarified by comparing the angles of the section, the distance between the bays, the reactions of the support and the corners of the ridge. The result shows that the distance between the bay is 8.57 m and the angle of the ridge 1in10 reduces the use of steel. But the angle of the spine 1in10 was very effective in terms of BM and Steel takeoff. Also, a fixed-support frame is more efficient for deflection control, and a hollow pre-engineered building weighed 23.5% less than the PEB structure.

Suraj Tale and K.Vasugi ( 2019 ) analyzed the conventional and pre-engineering industrial structure to optimize mounting in different loading conditions using ETABS software. The building has a size of 25 m x 48 m, a height of 8 m, a roof slope of 1 by 3, and a distance of 6 m is analyzed for various reinforcements, such as X-braking, K-braking, diagonal mounting, alternative diagonal mounting, V-type and inverted V-pulling for both CSB and PEB. A variety of depths are used for the analysis of a conventional steel building ( CSB ) and a variety of depths are used for PEB Tapered I. The results show that the reduction in the time period before the engineering building is reduced than a conventional steel building. V-The type of fastening is most suitable for PBB, as the weight of steel decreases by 5.68% compared to CSB, and the time period is 0.32 sec, which is at least among all types of suspenders.

Balamuralikrishnan R. and Ibrahim Shabbir Mohamedali ( 2019 ) conducted a comparative study of a two-story car show using British standards and Eurocode. In this project, a model with a length of 50 m and a width of 45 m and a height of 8 m is prepared on STAAD Pro. and conducted wind and seismic analysis and design of the PEB two-storey car showroom, applying dead load, atmosphere load, wind load and seismic load. The results show that the total weight of the structure for the EC model is 7.9% heavier than the BS mode, but the deviations, bending moment, shear force and stress are within acceptable limits for both design codes. The results of the dynamic analysis show that the maximum volume for the British standard is 10.5 mm, and for the euro code - 8.83 mm, which is less than the British standard ( BS ). The amount of steel used for the BS model is reduced by 25.7% compared to the Euro model. Therefore, the BS model turned out to be economical.

## IV. CONCLUSION

From all the above works that I mentioned and mentioned above, there is a summary of the literature that will be useful for the further progress of my work.

1. With the help of pre-engineering, the economy is reached, and the time of construction of the structure is also reduced.
2. ii. Using a pre-engineering system, the cost of the structure is reduced to 35% compared to a conventional steel structure, thus saving the material.
3. iii. The distance between the bays affects the amount of steel used in a pre-engineering building. The distance between 6 m and 8 m is the most economical.
4. iv. The K and V type bracket is best suited for a pre-designed building, thus reducing the amount of steel by 6%
5. v. More than 70% of pre-engineered buildings are designed by American codes.

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