

A Review on Dynamic Analysis of PEB Over CSB Industrial Structure

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Abstract—The concept of Pre-Engineered Building in creation format of structures has helped into optimizing a design of steel structure. Steel industry sector is developing more hastily in almost throughout elements of the world. In a hazard of global warming the usage of steel structures is not only efficient but also sustainable at the time. In Pre-Engineered Buildings (PEB) steel structures (pre-fabricated) time is being the maximum significant aspect is built in very short duration period. In any type of Industrial structures and Pre-Engineered Buildings (PEB) Maximum Span, Column free suitable structures are the most vital in fulfills this requirement at the aspect of decreased time and price in comparison to conventional structures. In this research, an industrial structure warehouse is analyzed for dynamic forces according to the Indian standards (IS 800-2007) and additionally through referring American Standard (AISC LRFD). The various loads like dead, live, wind, seismic according as per IS codes are considered for the present work for relative study of Pre-Engineered Buildings (PEB) and Conventional Steel Building (CSB).

Index Terms—Steel Building, Pre-Engineered Buildings, Staadpro.

I. INTRODUCTION

Buildings & companies are one of the primeval creation activities of people. The present modern concept of house buildings the technology of creation has progressive since the established order from simple construction. India has emerged as one of the key worldwide markets for pre-engineered buildings steel structures. A plenty of growth has been given to do with the way how recognition towards steel buildings had been changing to develop a country. The most recent improving technology was continuously increasing the maximum clear-span competencies of steel structures. In India the industry has fast development of steel building makes for exciting analyzing and it can have commenced all with

the on-location fabrication model. With the opening up of the economy during the 1990s but, such things started to change. In the might of the PEB enterprise this became the cause for predominantly “manufacturing plant constructed” structures and to achieve economy growth. In PEB technology steel is one of the world’s most reused material and toward the finish of any steel product’s life, practically 100% of it tends to be reused without losing its engineering properties, preferred and ecological construction methods. The tropical nation like in India to give great protection impact and would be highly suitable for a PEB structures. PEBs is an ideal construction sector for in remote & hilly areas.

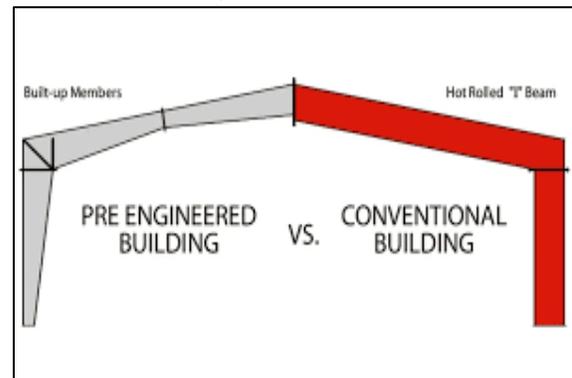


Fig 1 Difference Between Conventional and PEB Building

A. Concept of Conventional Steel Building

Conventional steel buildings (CSB) are small rise steel buildings with roofing structures of truss with roof coverings. The criterion selection process of roof truss also includes the gradient of the roof, pitch of the roof, fabrication and transport techniques, aesthetics, climatic conditions, etc. In a Conventional steel building design uses selected hot rolled "T" type steel sections that are regular in period but need to be reduce, punched, and bolted on site. The necessity of materials is delivered or produced in the plant and are placed to the site. The need for further economy of

creation region and the design of the conventional industrial buildings is governed through beneficial necessities.

B. Concept of Pre-Engineered Building

Pre-Engineered steel structures are fabricated or created necessity in the plant itself. The production of structural members is done on customer requirements. The buildings were pre-engineered due to the fact they actually depend on general engineering designs for the limited number of configurations. A pre-engineered building (PEB) is designed by the producer to be fabricated using a predetermined inventory of raw materials and production techniques that may be efficiently satisfy a wide variety of a structural and aesthetic view of design requirements within a few geographic manufacturing sectors these buildings are also called as Pre-Engineered Steel Buildings. Generally, a PEB is an inflexible jointed plane frame from hot-rolled or cold-rolled sections, helping the roofing and side cladding through hot-rolled or cold-formed sections purlins and sheeting rails. Z and C-shaped cold formed steel members may be used as secondary structural elements to fasten and support to the outside cladding.

II. STATE OF DEVELOPMENT

Pratik M. Londhe et. al. (2024) “A Comparative Analysis of Conventional Steel Building and Pre-Engineered Building Systems: a case study Approach” India being a developed country, massive house building construction is taking place in various parts of the country. Since 30% of the Indian population lives in towns and cities, the frequency of construction is more in urban places. There is an enormous need for housing, but there will never be enough houses available because current masonry construction technology cannot keep up with the annual rise in demand. Hence, one has to think of alternative construction systems like pre-engineered steel buildings. India has an installed steel capacity of 35 to 40 million tonnes & apparent steel consumption is around 27 to 30 million tonnes. There is a surplus capacity of flat steel products available in India particularly of hot and cold rolled sheets. These steel components can be utilized in the construction of pre-engineered building components.

- PEBs need a huge initial investment in comparison to normal conventional buildings.
- Indian education has most of the focus on RCC buildings in course curriculum and hence advancement in steel construction is ignored.

Ranjith Raja P et. al. (2024) “Design of Pre-Engineered Building Using STAAD PRO”

To design and analyze the casting yard under the concept of Pre-Engineered Building (PEB) involves pre designed and pre-fabricated steel building system. Casting Yard is a confined place where all the concrete structures such as I-girder, beams and other structural members are casted and transported to the site. PEB are fabricated based on the requirements and functional aspects of the building.

- They also offer flexibility throughout the design phase. The building has a nice architectural viewpoint.
- PEB offers the least displacement under the load situation according to the investigation.
- PEB constructions are lighter and more wind-resistant. In the construction industry, among students and others, the understanding of PEB should be enhanced rather of concentrating on RCC

Shubham Dashore et. al. (2023) “Analysis And Design of Pre-Engineered Building Warehouse In Different Seismic Zones”

Construction of pre-engineered steel buildings is increasing very rapidly nowadays. The methodology used in PEB is not just because of high quality in pre-designing and pre-fabrication but also due to light weight and economical construction. From past studies it has been found that PEB has good strength, flexibility, recyclable nature, longer span, no limitation in size of components and has more seismic resistance capacity as compared with conventional buildings.

- Cold formed sections are taken which produced having low cross section area which leads to low unit weight of components and hence contributes less dead load to structure.
- As it is a review paper, the final results that should obtain due to same loading in different seismic zones in India and various stresses occurring due to load combinations will be discussed.

Payal J. Abhichandani et. al. (2022) “Analytical Study of Pre- Engineered Building”

Steel is the most common and smart choice for construction of industrial structure. This has resulted in use of Pre-Engineered Building in India as it has a number of benefits over conventional steel building. It is important to study the PEB using IS code and American code so as to understand the difference between the standards. This study focuses on the analytical study of PEB using Indian Codes (IS 800 and IS 875) and American Code (AISC 360 and AISC 7). A PEB having length 43.26 m, width 32.46 m, eave height 5.82 for Pune location was modeled in STAAD Pro software using IS code as well as American code and the comparison of results obtained was performed.

- The present work is related to effectiveness of PEB structure using IS code.
- The results reveal that shear force and bending moment values are higher using IS code.
- While the displacement values are higher using American code.

Akshay Gavandare et. al. (2022) “Analysis and Design of Steel Building and its Comparative Study with Conventional RCC Building”

This study reviews the analysis and design of steel members or sections to use in construction of apartment buildings, and its comparative study with conventional RCC structure. Nowadays the construction sector is exploring rapidly and it also involves new structural systems for fast and precise work on the field. During the recent decades, our society has been continuously experimenting with newer techniques and alternative materials. In a study it is found that the two major aspects for which all these alternatives get researched are Speed of Execution and Economy of Project. So we want to have a comparative study of steel apartment buildings with conventional RC structures. In the present work a G+5 story apartment building whose ground floor is considered as parking, which is situated in earthquake zone-II.

- Time required for construction of steel building is significantly less than that of rc building, during pandemic or any other emergency when erection needs to be quick steel building should be preferred.
- It is observed that the core material cost of steel structure is more than RC structure, but speedy erection may make steel structure economically

viable. Speedy construction facilitates quicker return on the invested capital and benefits.

Laishram Chandramani Singh et. al. (2021) “An Analytical Study on Pre-Engineered Building by Using Staad Pro”

With the development of science and technology in the field of structural engineering as well as in Civil engineering, the adaptation of pre-engineered building can be observed in industrial as well as residential building sectors. In the earlier days, even if Pre-Engineered Building ideas were there, it was quite a lengthy process to design and check whether the structure is acceptable or not. But in this modern-day world, with the coming of various softwares like Staad pro, it has become more convenient to adopt the practice of pre-engineered building than conventional steel building.

- It is also seen that the weight of PEB depends on the Bay Spacing, with the increase in Bay Spacing up to certain spacing, the weight reduces and further increase makes the weight heavier.
- To conclude, pre-engineered structures are more suitable for longer spans building as consumers prefers more space in a structure.

Mohd Atif Khan et. al. (2021) “A Review on the Optimization and Design of Pre-Engineered Building [PEB] with Conventional Steel Building”

An industrial structure (PEB & CSB Frames) is analyzed and designed according to the Indian standards. Three models each for PEB and CSB are considered having different widths and a parametric study is carried out to access the performance of the models in terms of weight comparison, cost comparison and time comparison. In this study, an industrial structure (factory truss) is analyzed and designed according to the Indian standards, IS 800-1984, IS 800-2007. The various loads like dead, live, wind, seismic and snow loads according as per IS codes are considered for the present work for relative study of Pre-Engineered Buildings (PEB) and Conventional Steel Building (CSB). To compare the consequences of the numerous parametric studies to perform the variations in terms of sheer force, support reaction, weight correlation and cost evaluation.

- From past studies the PEB structures are prove to be more economical and results in material saving. The implementation of PEB is increasing but use if PEB is less than expected. The

researches show that PEB structures are easy to design.

Bishbu Jacob et. al. (2020) “Design comparison of conventional steel structure with pre - engineered structure”

The pre- engineered buildings are the steel buildings which are pre-designed and prefabricated. For pre-engineered structure the member size is provided as per the requirement at the location and hence the members are tapered in nature. The study is on the design of the pre- engineered structure and its comparison with conventional structure. The objective of the study is to analyze and design a structure as a conventional steel structure and Pre-engineered structure and to compare the design of the structure in terms of structure weight. The use of cold-formed steel sections as secondary members reduces the self-weight of the pre- engineered structure. It was expected that the preengineered buildings will be more economical than conventional structure.

- A structure was designed as conventional portal frame structure and pre- engineered structure to study the design of both and to compare its design.
- The design needs to be compared in terms of total steel weight take off.

Kalesha Shaik et. al. (2020) “An analytical study on pre-engineered buildings using staad pro”

Pre-engineered building concept involves pre-designed and prefabricated steel building systems. The current construction approach calls for the best architectural look, high quality & quick construction, cost-effective & creative touch. One has to think of alternative building systems such as pre-engineered steel buildings. The implementation of the Pre-Engineered Building (PEB) is a modern-day concept in which utilizing the steel structure and optimizing the design by ensuring economical integrity.

- The amount of steel needed for PEB structures will, therefore, be smaller than that necessary for CSB structures. It was seen that cost savings for PEB is approximately 35 percent compared to CSB.

Muhammad Umair Saleem et. al. (2018) “Design Solutions for Sustainable Construction of Pre-Engineered Steel Buildings”

Sustainable construction of ecofriendly infrastructure has been the priority of worldwide researchers. The induction of modern technology in the steel manufacturing industry has enabled designers to get the desired control over the steel section shapes and profiles resulting in efficient use of construction material and manufacturing energy required to produce these materials. The current research study is focused on the optimization of steel building costs with the use of pre-engineered building construction technology. Construction of conventional steel buildings (CSB) incorporates the use of hot rolled sections, which have uniform cross-section throughout the length. However, pre-engineered steel buildings (PEB) utilize steel sections, which are tailored and profiled based on the required loading effects. In this research study, the performance of PEB steel frames in terms of optimum use of steel sections and its comparison with the conventional steel building is presented in detail. A series of PEB and CSB steel frames is selected and subjected to various loading conditions. Frames were analyzed using Finite Element Based analysis tool and design was performed using American Institute of Steel Construction design specifications. Comparison of the frames has been established in terms of frame weights, lateral displacements (sway) and vertical displacements (deflection) of the frames. The results have clearly indicated that PEB steel frames are not only the most economical solution due to lesser weight of construction but also have shown better performance compared to CSB frames.

- It is well known that many PEB manufacturers use sections with very thin webs in order to reduce the weight of the section and be economical/competitive in their commercial offers, and these thin webs do not satisfy the codal provisions of IS 800: 2007.

T.D. Mythili et. al. (2017) “An Overview of Pre-Engineered Building Systems”

Pre-Engineered Building concept involves the steel building systems which are pre-designed and prefabricated. The present construction methodology calls for the best aesthetic look, high quality & fast construction, cost effective & innovative touch. One has to think for alternative construction system like pre-engineered steel buildings. In recent years, the introduction of Pre-Engineered Building (PEB) concept in the design of structures has helped in

optimizing design. The adoptability of PEB in the place of Conventional Steel Building (CSB) design concept resulted in many advantages, including economy and easier fabrication. This review is focused on the obstructing issues in pre-engineered building technology by the new emerging companies in India and the critical success factors that are involved in these systems. Also, the contribution of pre-engineered building systems in India in the economic growth of country through various applications is stated briefly.

- Most attractive economy in civil engineering construction can be achieved by optimum use of steel of high grade and composite form of construction with improved materials
- Fire-fighting protocols in steel buildings have to improve as per the customer's concern.
- IS codes should be modified as the sections selected are found to be heavier mostly.

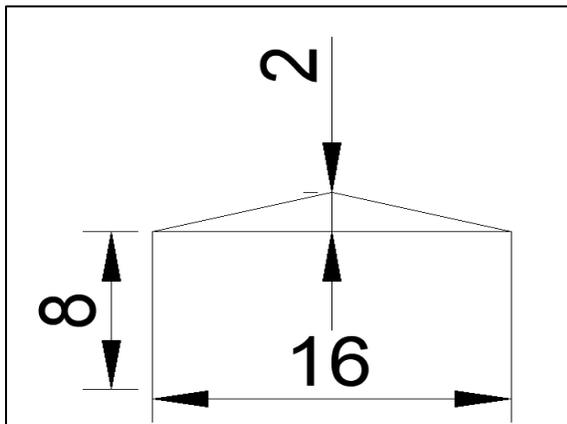
III. ANALYSIS OF THE STEEL FRAME WITH CSB AND PEB

A. Model Dimensions for CSB

- Total Height -10m
- Height of column – 8m
- Total Span – 16m
- Location - Pune

A. Model Dimensions for PEB

- Total Height -10m
- Height of column – 8m
- Total Span – 16m
- Location - Pune



B. Section data For PEB

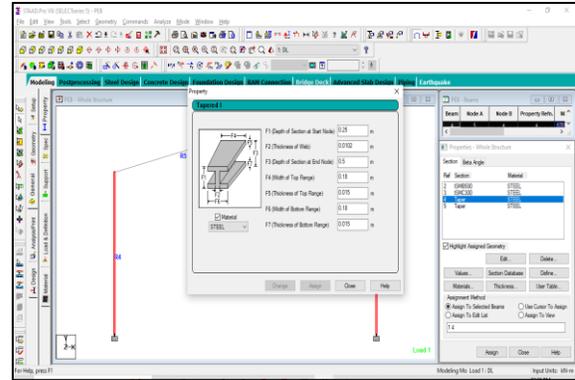


Fig 2 Tapered Section PEB Column

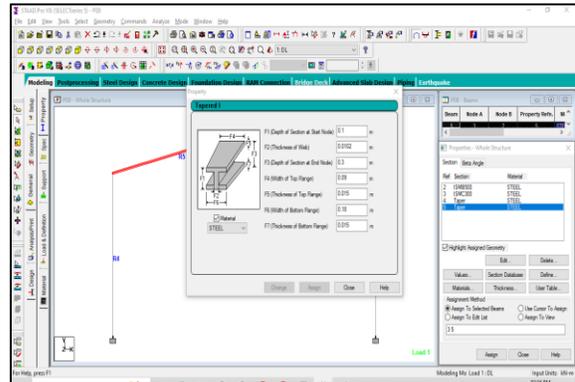


Fig 3 Tapered Section PEB Purlin

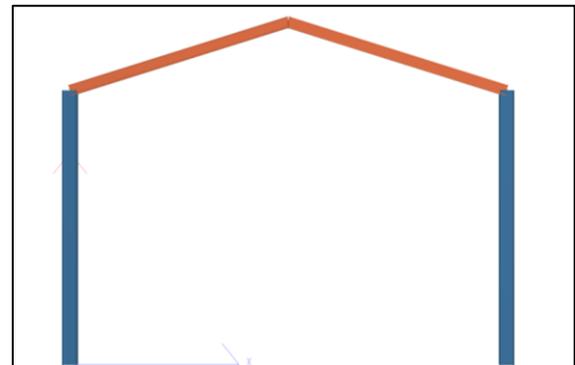


Fig 4. CSB Structure Render View

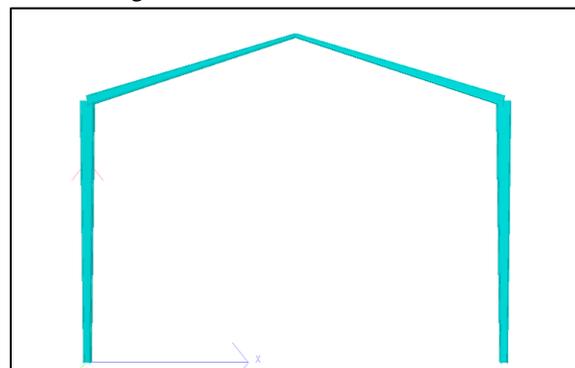


Fig 5. PEB Structure Render View

C. Results for displacement of CSB and PEB Structure

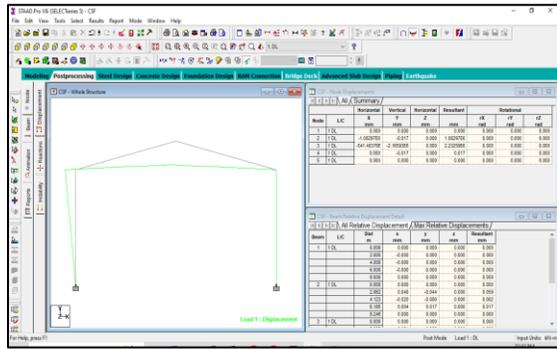


Fig 6 Displacement of CSB

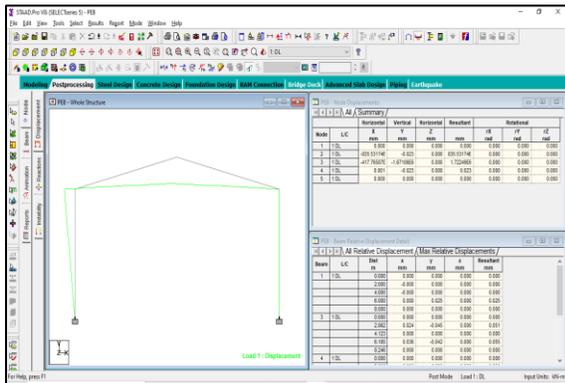
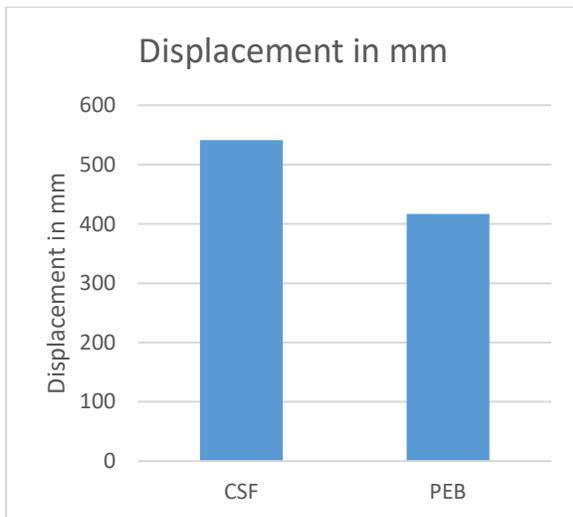


Fig 7 Displacement of PEB

Table 1 Displacement in mm

Displacement in mm	
CSF	PEB
541	417



Graph 1 Displacement in mm

IV. CONCLUSION

As it is a review chapter, it finds that PEB constructions are lighter and more wind-resistant. Pre-engineered structures are more suitable for longer spans building as consumers prefer more space in a structure. The design needs to compare in terms of total steel weight take off. IS codes should be modified as the sections selected are found to be heavier mostly Steel is the basic material that is used in the materials that are used for Pre-engineered steel building. Based on the analytical and design results thereon of conventional and pre-engineered steel buildings. The final results that should obtain due to same loading in different seismic zones in India. There are no one analyse PEB for the supported on RCC pedestal for effective results further study will analyse PEB and CSB structure comparatively and PEB on RCC pedestal on wind load by using gust method and higher seismic zone impact.

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