

“Comparative Study on PEB Structure and Conventional Industrial Building”

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Abstract

This paper mainly focuses on the PEB concept and CSB concept. The Pre-Engineered Building (PEB) concept is a new conception of single-story industrial building construction. This methodology is versatile due to its lightweight and economical construction. Cost of steel is increasing day by day and use of steel has become inevitable in the construction industry in general and in industrial building in particular. Hence to achieve economic sustainability it is necessary to use steel to its optimum quantity. 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 paper an attempt has been to present comparative study of conventional and Pre-engineered steel structures which is a truss of span 30m carrying a crane of 10tonne, 15t and 20t. It has shown considerable reduction in the quantity of material. This methodology is versatile not only due to its quality pre-designing and prefabrication, but also due to its light weight and economical construction. The concept includes the technique of providing the best possible section according to the optimum requirement. The work presents the comparative study and design of conventional steel frames with Pre-Engineered Buildings (PEB). In this work, an industrial building of length 100m and width 30m with roofing system as conventional steel truss and pre-engineered steel frame is analysed and designed by using STAAD Pro V8

Keywords: Conventional Steel Building, Pre-Engineered Building

INTRODUCTION

India has the second fastest growing economy in the world. The construction industry has discovered, invented and developed a few technologies, systems and products, one of them being the concept of Pre-engineered Buildings (PEB). For the past few decades, pre-engineered buildings have become popular in the construction industry. Pre-Engineered building are the latest trend in India. Pre-engineered structure is an idea designed with a view to replace conventional steel structures as the structural components are manufactured under controlled environment conditions tend to produce products with high quality & precision, reduce resource wastages and decrease the budget considerably[1]. Pre-engineered buildings are those that are totally designed and manufactured in the factory and then shipped to the site for jointing /fixing. In pre-engineered building, usually I shaped members also called as I beams are used. In Indian manufactures trying to catch up [2] generally used for low rise buildings which are ideal for offices, houses, showrooms, steel plants, automobile industries, light, utility and process industries, thermal power stations, warehouses, assembly plants, storage, garages, small scale industries, etc. Presently, with the improvement in technology, computer software's are easily available for analysis and design of Pre-engineered building. [3]Due to their high strength to weight and stiffness-to-weight ratios, corrosion resistance, lightweight and potentially high durability

1.1 Conventional Industrial Building

Nowadays, steel used worldwide due to ductility and flexibility properties. Steel bend when it's subjected to heavy loading rather than crushing. Steel is recyclable flexible so that is also eco-friendly due to less wastage are generated. In CSB hot rolled steel section is used. Where members are manufactured in factories and later transported to the site. For connections of different members welding process are used. Steel offers speedy construction right from the start. Due to its important characteristics like ductility, flexibility etc, steel is been widely used in the construction industry.

1.2 Pre-Engineered Building Pre-Engineered Building

concept involves the steel building systems which are predesigned and prefabricated. As the name indicates, this concept involves pre-engineering of structural elements using a predetermined registry of building materials and manufacturing techniques that can be proficiently complied with a wide range of structural and aesthetic design requirements. The basis of the PEB concept lies in providing the section at a location only according to the requirement at that spot. The sections can be varying throughout the length according to the bending moment diagram. This leads to the utilization of non-prismatic rigid frames with slender elements. Tapered I section made with built-up thin plates are used to achieve this configuration. Standard hot-rolled sections, cold-formed sections, profiled roofing sheets, etc. is also used along with the tapered sections.

1.3 Advantages of Pre-Engineered Building over Conventional Steel Building

- **Faster construction:** The components of the Pre-engineered buildings are engineered beforehand and standardized. Use of standardized components results in reduction of engineering, manufacturing and erection time. Standard building delivery may take 6-8 weeks including engineering time
- **High strength to weight ratio:** Use of high strength materials lead to lighter construction.
- **Lower cost:** Owing to standardization and systematic approach, significant saving is possible in design, manufacturing and erection. From structural 10 design point of view the main frame section shape follows the stress diagram of the member, thereby causes weight reduction and less load on foundation.
- **Large clear spans:** Clear spans of up to 80 metres are possible.
- **Flexibility of expansion:** These buildings have the advantage of expansion in length by inclusion of additional bays in the future.
- **Quality control:** Availability of certified material from steel mills having guaranteed strength and welding of the entire building components facilities undisputed quality control.

1.4 Application of Pre-Engineered Building

The most common applications of pre-engineered buildings are:

- **Industrial:** Factories, Workshops, Warehouses, Cold stores, Car parking sheds, Slaughter houses.
- **Commercial:** Showrooms, Distribution centres, Supermarkets, Fast food restaurants, Offices, Labour camps, Service station, Shopping centres.
- **Institutional:** Schools, Exhibition halls, Hospitals, Theatres/auditoriums, Sports halls.
- **Recreational:** Gymnasiums, swimming pool enclosures, Indoor tennis courts.
- **Aviation & Military:** Aircraft hangars, Administration buildings, Residential barracks.
- **Agricultural:** Poultry buildings, Dairy farms, Greenhouses, Grain storage, Animal

1.5 Load Calculations

- Dead load calculation as per IS875-part1-1987
- Live load calculation as per IS875-part2-1987
- Wind load calculation as per IS 875-part3-2015

Literature review

[1] Sagar Wankhade and Prof. Dr. P. S. Pajgade “Review Paper on Comparison of Conventional Steel Building & Pre-Engineering Building” have given importance of using pre-engineered structure in construction, mainly for single storey building. They also have shown that conventional steel-structure has disadvantages compared to pre-engineered-structure. They have done comparative study of pre-engineered building with conventional steel-building. From their studies they have found that pre-engineered building can be designed using simple procedures. Also, they concluded that pre-engineered-building has various advantages over conventional steel-building in terms of cost, speed of construction etc.

[2] Vivek Thakre and Mr. Laxmikant Vairagade (2016) “Analysis and Cost Comparative study of conventional Industrial building with PEB structure” have shown that there are many advantages of pre-engineered buildings having single storey especially including economy and ease of fabrication. Here they have analysed and designed an industrial structure according to IS codes 800-1984, IS 800-2007 and by MBMA-96 and AISC-89. Later they have also compared the economy which is in terms of comparison of weight between IS codes and American codes. From their research they have concluded that the design of pre-engineered structures is done by simple procedures with respect to IS codes. They have also found out that there are various advantages of pre-engineered structures over conventional steel-structures in terms of cost, weight, erection etc

[3] Swati Wakchaure and N.C.Dubey(2018) ‘Comparative Study of Design of Industrial Warehouse Using CSB, PEB and Tubular Sections’ have shown that by using pre-engineered structure in construction, there are various advantages because according to the bending moment diagram, the designing of members is done. As a result, the steel is reduced. They have analysed and studied according to IS 800-2007 and IS 800-1984 & the comparison of pre-engineered-structure with conventional steel-structure is done. They have also compared the weight of both the structures. From their studies they concluded that conventional steel-structure is 30% heavier than pre-engineered-structure and as a result the size of foundation is reduced of pre-engineered-structure.

[4] Jatin D. Thakar,2013 "Pre-Engineered Building Design of an Industrial Warehouse" explicit that Pre-Engineered product place of 25m, 30m, and 40m width and 6m eave height have been analysed &planned by utilizing STAAD Pro.2007 to comprehend the conduct of Pre-Engineered structure and to check in which case it accomplish the economy in steel amount by shifting narrows dividing as 4.5m, 5.5m, 6.5m, &7.5m. Design is done based on IS: 800. Yield stress of the steel is assumed as 540 Mpa in the PEB warehouse. The load case considered in modelling are dead load, live load, wind load and seismic load along with the various combinations as specified in the IS. Examination results are watched for base response, section minute, beam minute, dislodging at edge, removal at midrange. Analysis results also are compared for every bay spacing.

(5) Hemant Sharma,et.al(2017) ‘A Comparative Study on Analysis & Design of Pre-Engineered & Conventional Industrial Building’ have studied comparison and analysis of PEB & CSB Staad Pro. In this case study comparison for industrial building is done for bending moments at different sections & the results are compared for economy and time saving in construction. After analysis and design the report is concluded with 37% material saving in case of PEB than that of CSB.

CONCLUSIONS

It is observed that the weight of PEB is 26% less than conventional steel buildings. It is observed that the maximum support reaction of PEB is 15%less than Conventional steel building. It is noted that the maximum axial force of PEB is 30% less than Conventional steel building. Maximum bending moment will be high for PEB than for Conventional steel building. Maximum shear force will be high for PEB than for Conventional steel building. Pre-Engineered Building structures can be easily designed by simple procedures using IS code. In this study and analysis, it can be concluded that Pre-Engineered Building are more advantageous than Conventional Steel Building in terms of cost effectiveness, quality control, speed in construction and simplicity

in erection.

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