**Analysis & Design of Pre-Engineered & Conventional Industrial Building: A REVIEW**

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**ABSTARCT:**

The fundamental knowledge gained from a thorough literature assessment on traditional steel structures and pre-engineered buildings (PEBs) is summarized in this research abstract. Examining the development, design philosophies, and technological improvements of these structural techniques over time, the literature review provides a comprehensive picture of their evolution. The review of previous studies offers a thorough understanding of the structural characteristics, design issues, and real-world applications related to PEBs and conventional steel structures. In addition to theoretical viewpoints, the review delves into practical research and case studies, providing insight into how these building systems actually function in various real-world scenarios.

**Keywords**: Pre-Engineered Buildings, traditional steel structures, structural engineering, literature review and historical evolution

**1. Introduction**

The continuous growth of structural engineering procedures is shown in the comparative comparison between pre-engineered buildings (PEBs) and traditional steel structures, which has developed as a crucial topic of study in the construction industry. Pre-engineered buildings are a tribute to innovative construction methods because of their prefabricated components and quick installation. Their time and money savings have drawn attention to their streamlined design and excellent building procedure. On the other hand, classic steel structures have served as the foundation for many famous buildings all over the world due to their lengthy history, strength, and versatility. With a focus on the finer points that distinguish PEB performance from that of traditional steel structures, this study aims to conduct a thorough comparative structural analysis. It seeks to add significant insights to the continuing discussion on modern structural engineering and construction techniques by offering a sophisticated knowledge of the structural, economic, and temporal ramifications of selecting one approach over the other.
The aim of this research is to significantly advance the field of structural engineering and construction by providing insights into the relative structural performance of PEBs and conventional steel structures. The study's conclusions may help professionals in the field choose the right construction techniques for a given project by providing them with relevant information. Moreover, the wider consequences of the study are consistent with the current discussion on sustainable building methods, providing information on how various structural arrangements complement the main objectives of environmental responsibility and resource economy.

The upcoming portions of this research will undertake a comprehensive and in-depth investigation, closely examining and contrasting the structural characteristics, design factors, and pragmatic consequences that are inherent in pre-engineered buildings and conventional steel structures. The aim is to provide a thorough and sophisticated analysis of the relative advantages of these two structural systems in the context of modern construction environments. Through an exploration of nuances including material efficiency, construction speed, cost-effectiveness, and adaptability, the research aims to uncover important information that will help decision-makers, engineers, and industry professionals choose the best structural solutions for a range of construction projects. With this comprehensive analysis, the study seeks to further the current conversation in structural engineering.

**2. REVIEW OF LITERATURE:**

**2.1 General**:

The literature research lays the groundwork for a thorough comparison analysis by providing an in-depth understanding of the complex relationship between traditional steel structures and pre-engineered buildings (PEBs). The development of these two building approaches and their progression have been extensively researched within the field of structural engineering. In order to set the scene, historical viewpoints that trace the development of PEBs and conventional steel structures from their conception to the present will be examined. The objective of this exploration of extant academic literature is to document the development of design theories, innovations in technology, and the fundamental ideas that have influenced these structural frameworks.

**2.2 Literature Review**

**Gilbile, M. J., et al [1]** This article examines and designs an industrial structure (PEB & CSB Frames) in compliance with Indian norms. For PEB and CSB, three models with varying widths are taken into consideration, and a parametric analysis is done to examine the models' performance in terms of weight comparison, cost comparison, and time comparison. An industrial structure (a factory truss) is examined and designed in this study in compliance with Indian standards IS 800-2007 and IS 800--1984.

**Zende, A. A., et al [2]** In the current work for the comparative research of Pre-Engineered Buildings (PEB) and Conventional Steel Buildings (CSB), the different loads such as dead, live, wind, seismic, and snow loads according to IS standards are taken into consideration. In order to execute the modifications in terms of shear force, support reaction, weight correlation, and cost evaluation, it is necessary to compare the results of several parametric experiments.

**Sharma, L., et al [3]** The most important component of any kind of industrial building is a long span, column-free structure, which Pre Engineered Buildings (PEB) provide in addition to saving time and money when compared to traditional construction. The current project compares the design and static and dynamic analyses of conventional steel frames with pre-engineered buildings (PEBs). Staad Pro software is used to design the construction, and once that is finished, its weight is compared to that of the conventional form, which lowers the cost. For the study, three examples were selected.

**Wakchaure, S., et al [4]** Two examples compare conventional steel frames with Pre Engineered Buildings (PEBs), while a third example uses a longer span Pre Engineered Building construction for the study. The current study accounts for seismic and wind pressures in the design of conventional steel frame buildings and pre-engineered buildings (PEBs). Manual wind analysis was performed in accordance with IS 875 (Part III) – 1987, and seismic analysis was performed in accordance with IS 1893 – 2002.

**Bhadoria, S. S., et al [5]** Bentley STAAD PRO was the primary software utilized for all of the designing and analysis, and it was discovered that pre-engineered buildings produce more sustainable outcomes than traditional steel buildings. Additionally, it was discovered that using conventional construction methods would result in a more time- and money-consuming process overall. For this reason, it is recommended to use pre-engineered buildings, as their construction and maintenance costs are significantly lower than those of conventional steel buildings.

**Pattanshetti, S., et al [6]** An additional factor was considered: the materials utilized in the pre-engineered structures' construction were prefabricated and built in a way that made them recyclable and reusable for later use. In light of this, the structure and all of its structural elements can be molded and moved to any other location, which will satisfy a key requirement of sustainable building.

**Sai, V. V., et al [7]** Design optimization has benefited from the adoption of Pre Engineered Building (PEB) design of structures in recent years. There are numerous benefits to building PEBs instead of CSBs since the members are designed according to bending moment diagrams, which reduces the amount of steel needed for construction. An industrial structure, a PEB Frame and a CSB Frame, is examined and designed in this study in compliance with Indian standards, IS 800-1984 and IS 800-2007.

**Gilbile, M. J., et al [8]** Through the development of several new goods and services, technological growth over the past year has significantly improved people's quality of life. Pre-engineered buildings are one such breakthrough in the construction sector. Pre-engineered buildings are specially created to satisfy the needs of the client. The problem of excessive steel consumption and increased structure costs has long existed with conventional steel structures. In order to address these problems, PEBs are used in place of traditional steel structures in this paper.

**Naidu, G. D. R., et al [9]** PEB's concept and defining feature is that its members are designed based on the steel frame's bending moment diagram, which reduces the structure's cost and steel consumption. In this study, five models of conventional steel structures with spans identical to PEB spans—10, 20, 30, 40, and 50 meters—are compared with five different PEB span models. To determine which solution is more cost-effective, models of both are created using Staad Pro software and examined under dead, live, wind, and seismic loads.

**Jibhkate, M. H., et al [10]** Pre-engineered buildings have gained popularity in the construction sector during the last few decades. Pre-engineered structures are intended to replace traditional steel structures because their structural components are made in controlled environments, which tend to yield highly precise and high-quality products while reducing resource waste and budgetary constraints. The study, which compared preengineered and traditional steel structures, examined the economies of the two types of constructions in terms of material optimization and structural weight. Using the structural design program STAAD Pro, a 3D model of a pre-engineered building and a conventional steel structure is designed and analyzed in order to carry out the study.

**Siddarth Manoj, D., et al [11]** The quality of life has improved tremendously as a result of technological improvements thanks to a wide range of new goods and services. One example of a technology innovation in structural engineering is Pre Engineered Buildings (PEBs). The PEB idea offers the best possible design, an attractive appearance, quick construction, and a shorter erection time. PEB meets a wide range of applications and requests for unique design. This methodology's adaptability stems from its flexibility as well as its excellent pre-designing and prefabrication.

**Radake, N. D., et al [12]** The structural performance of multiple bay systems with various wind zones has been compared in the current study (Locations: Vijayawada and Hyderabad). Utilizing STAAD, analysis and design have been completed.professional software. Shear force (SF) and bending moment (BM) magnitudes have been used to evaluate the structural performance of pre-engineered buildings. based on the pre-engineered component output from SF and BM obtained via Staad. The pre-engineered portions' geometrical qualities have been determined through study. The weight of the construction in Vijayawada is 11.04% greater than the building in Hyderabad, according to the results.

**Patil, M. R., et al [13]** This article examines and designs an industrial structure (PEB & CSB Frames) in compliance with Indian norms. For PEB and CSB, three models with varying widths are taken into consideration, and a parametric analysis is done to examine the models' performance in terms of weight comparison, cost comparison, and time comparison. An industrial structure (a factory truss) is examined and designed in this study in compliance with Indian standards IS 800-2007 and IS 800--1984. In the current work for the comparative research of Pre-Engineered Buildings (PEB) and Conventional Steel Buildings (CSB), the different loads such as dead, live, wind, seismic, and snow loads according to IS standards are taken into consideration.

**Jacob, B., et al [14]** The most important component of any kind of industrial building is a long span, column-free structure, which Pre Engineered Buildings (PEB) provide in addition to saving time and money when compared to traditional construction. The current project compares the design and analysis of conventional steel frames with pre-engineered buildings (PEBs). Staad Pro software is used to design the construction, and once that is finished, its weight is compared to that of the conventional form, which lowers the cost.

**Sharma, H. [15]** For the study, three examples were selected. Two examples compare conventional steel frames with Pre Engineered Buildings (PEBs), while a third example uses a Pre Engineered Building structure with more bay area for the study. Pre Engineered Buildings (PEB) and conventional steel frame structures are developed for wind forces in the current job. Hand analysis of wind has been conducted in accordance with IS 875 (Part III) – 1987.

**Verma, R., et al [16]** Because a uniform hot-rolled section cross-section is used over the whole member length, the CSB is more costly because it uses more steel. On the other hand, depending on the loading effect built-up section used in PEB, only bolted connections are provided at the construction site. When a large span and a column-free space are required, PEB is preferred over CSB due to its lightweight construction and time-saving features. The facility designs and manufactures the structural members before they are delivered to the construction site and assembled.

**Valentina, L. M. S. S. [17]** The design of pre-engineered buildings (PEBs) has made steel construction more efficient and reduced its need. This method's adaptability stems from its low weight and economical nature as well as its excellent pre-designing and prefabrication. One of the guiding concepts is to give the best segment possible by prioritizing the most crucial requirements. I investigated, planned, and contrasted the pre-engineered structure in this case study with the conventional steel building (CSB). We've also considered a variety of pre-engineered building elements.

**Ramakrishnan, R. [18]** The PEB and CSB concepts are the primary subjects of this essay. A novel approach to the construction of single-story industrial buildings is the PreEngineered Building (PEB) idea. This methodology's inexpensive and lightweight design makes it adaptable. Compared to the conventional steel building (CSB) design, which calls for structures with roof trusses, this idea provides a number of advantages. This project is an industrial building that is 83 meters wide and 21 meters long. The roof truss slope is calculated to be 5.71 degrees.

**Bharmal, P. P., [19]** conducted an analysis and design comparison between pre-engineered buildings (PEB) and conventional steel trusses using STAAD Pro v8i software. The PEB design adhered to the American code AISC 360:10, while the conventional steel truss design followed the Indian code IS800:2007. Various loads including dead load, live load, and wind load were considered based on respective codes. The study location was in Savner, Nagpur district.

**Mythili, T. D. [20]** emphasized the indispensability of steel in construction, noting its versatility, strength, and sustainability due to its high recyclability. Steel buildings offer architectural flexibility and can accommodate evolving needs over time. Pre-engineered metal buildings are particularly suited for modern engineering requirements, providing design flexibility and cost-effectiveness.

**Arote, A. A., et al [21]** focused on the design and comparison of pre-engineered structures with conventional steel structures. Pre-engineered buildings are prefabricated steel structures with tapered members, resulting in reduced self-weight. Cold-formed steel sections are utilized to further reduce weight.

**Iqbal, A., et al [22]** conducted a case study comparing pre-engineered industrial buildings with conventional buildings, analyzing bending moments and various components. Staad Pro v.8 and Indian standard codes were used for analysis, with a focus on economy and time-saving in construction.

**Kiran, G. S., et al [23]** highlighted the economic and time-saving advantages of pre-engineered building systems (PEBs), particularly for large working areas. PEBs offer column-free space at a lower cost and are suitable for various industrial and commercial applications.

**Melani, A., et al [24]** analyzed pre-engineered metal buildings with spans ranging from 15m to 60m using finite element-based software. The analysis revealed the economic and structural stability advantages of pre-engineered steel buildings compared to conventional steel buildings.

**Kumar, N., et al [25]** conducted a comparative study and design of conventional steel frames with concrete and steel columns, and pre-engineered buildings (PEB). The study focused on industrial buildings with long spans, demonstrating the versatility and cost-effectiveness of PEBs compared to conventional structures.

**2.3 Summary**

The literature review for this research conducts a thorough examination of existing studies and scholarly works concerning pre-engineered buildings (PEBs) and traditional steel structures. It initiates with an overview of the historical development and evolution of both structural systems, offering a contextual framework for comparison. Subsequent analysis delves into various studies exploring the structural characteristics, design approaches, and practical implications associated with PEBs and steel structures. These investigations shed light on the distinct advantages and limitations of each structural system, contributing to a comprehensive understanding of their comparative merits.

**3. Conclusions**

The methodology incorporates a critical examination of costs, recognizing their pivotal role in construction projects. By assessing expenses across the project lifecycle - spanning initial construction, maintenance, and potential operational costs - valuable insights into the economic viability and sustainability of structural systems are gained. Furthermore, the evaluation of bay spacing is undertaken to delve into spatial functionality and structural efficiency. This aspect influences the overall design and utility of buildings, offering crucial insights into how each structural approach accommodates varied spatial requirements and design considerations.

**4. References**

1. Gilbile, M. J., & Mane, S. S. (2020). A Review on Comparative Study on the Structural Analysis and Design of Pre-Engineered Building [PEB] with Conventional Steel Building [CSB]. *International Journal of Engineering Research & Technology (IJERT) ISSN*, 2278-0181.
2. Zende, A. A., Kulkarni, A. V., & Hutagi, A. (2013). Comparative study of analysis and design of pre-engineered-buildings and conventional frames. *IOSR Journal of Mechanical and Civil Engineering (2013)*, 2278-1684.
3. Sharma, L., Taak, N., & Mishra, P. K. (2021). A comparative study between the pre-engineered structures and conventional structures using STAADPRO. *Materials Today: Proceedings*, *45*, 3469-3475.
4. Wakchaure, S., & Dubey, N. C. (2016). Design and comparative study of pre-engineered building. *Int. J. Eng. Dev. Res*, *4*, 2108-2113.
5. Bhadoria, S. S., & Pathak, Y. (2017). Comparative study of Pre-Engineered building and conventional steel structures. *International Research Journal of Engineering and Technology (IRJET) ISSN*, 2395-0056.
6. Pattanshetti, S., & Kulkarni, S. M. (2017). Comparative study on the economy between pre-engineered and conventional steel buildings. *International Research Journal of Engineering and Technology (IRJET)*, *4*(7), 2708-2711.
7. Sai, V. V., Poluraju, P., & Rao, B. V. (2021, November). Structural Performance of Pre Engineered Building: A Comparative Study. In *IOP Conference Series: Materials Science and Engineering* (Vol. 1197, No. 1, p. 012086). IOP Publishing.
8. Gilbile, M. J., & Mane, S. S. (2020). A Review on Comparative Study on the Structural Analysis and Design of Pre-Engineered Building [PEB] with Conventional Steel [CSB] Building.
9. Naidu, G. D. R., Rao, K. S. V., Sri, V. D., Navakanth, M., & Rao, R. (2014). Comparative study of analysis and design of pre-engineered buildings and conventional frames. *Int. J. Eng. Res. Dev*, *10*, 33-41.
10. Jibhkate, M. H., & Budhlani, D. L. COMPARATIVE ANALYSIS OF PRE-ENGINEERED BUILDING AND CONVENTIONAL STEEL BUILDING BY STAAD PRO. *International Research Journal of Modernization in Engineering Technology and Science, vol*, *3*, 698-707.
11. Siddarth Manoj, D., Mol, J., & Eswaramoorthi, P. A COMPARATIVE STUDY OF PRE-ENGINEERED BUILDING, AND CONVENTIONAL STEEL STRUCTURE.
12. Radake, N. D., & Prasad, R. V. R. K. A Comparative Study between the Pre-Engineered Building and Conventional Steel Building’.
13. Patil, M. R., Patil, M. K., & Khadake, N. V. COMPARATIVE STUDY OF STRUCTURAL DESIGN OF PRE-ENGINEERED BUILDING WITH DESIGN OF CONVENTIONAL STEEL STRUTURE.
14. Jacob, B., & Althaf, M. (2020, November). Design comparison of conventional steel structure with pre-engineered structure. In *IOP Conference Series: Materials Science and Engineering* (Vol. 989, No. 1, p. 012008). IOP Publishing.
15. Sharma, H. (2017). A Comparative Study on Analysis & Design of Pre-Engineered & Conventional Industrial Building. *International Journal for Innovative Research in Science & Technology*, *3*(10), 91-99.
16. Verma, R., & Singh, R. (2020). Comparative Analysis Of Pre-Engineered Steel Building And Conventional Steel Building Using Etab-A Review. *International Research Journal of Modernization in Engineering Technology and Science*, *2*(02).
17. Valentina, L. M. S. S. (2015). Comparative study of pre-engineered and conventional industrial building. *Indian Journal of Science and Technology*, *8*, 32.
18. Ramakrishnan, R. (2022). *Comparitive Study of Pre-Engineered Building and Truss Arrangement Building for Varying Spans* (Doctoral dissertation, University of Mumbai).
19. Bharmal, P. P., Kumbhar, P. D., & Gumaste, K. S. (2023). Comparative study on the behaviour of conventional and pre-engineered buildings provided with different types of bracing. *Asian Journal of Civil Engineering*, 1-9.
20. Mythili, T. D. (2015). Analysis and comparative study of conventional steel structure with PEB structure. *International Journal of Science and Research (IJSR) ISSN (Online)*, 2319-7064.
21. Arote, A. A., Rathi, V. R., & Kolase, P. K. (2022). ADVANTAGES OF PRE-ENGINEERED BUILDING OVER CONVENTIONAL STEEL BUILDINGS.
22. Iqbal, A., & Shinde, B. H. COMPARATIVE STUDY BETWEEN PRE-ENGINEERED BUILDING AND CONVENTIONAL STEEL BUILDING.
23. Kiran, G. S., Rao, A. K., & Kumar, R. P. (2014). Comparison of design procedures for pre engineering buildings (PEB): a case study. *International Journal of Civil, Architectural, Structural &Construction Engineering (IJCASCE)*, *8*(4), 4.
24. Melani, A., Bhargava, R., Khare, R. K., & Jain, A. Comparative Study of Pre-Engineered Buildings Based on Codal Provisions and Design Practice.
25. Kumar, N., & Grover, K. S. A Comparative Study of Conventional Steel Building and Pre-Engineered Building Structure using Staad Pro.