

Comparative Economic Evaluation of Conventional and Pre-Engineered Steel Building Systems

Arewale M.A¹, Prof. Pawar D.S², Prof. A. Y. Kankuntala³

¹P. G. Student at Civil Engineering Department, N. K. Orchid College of Engineering & Technology, Solapur, India

² Assistant Professor at, Civil Engineering Department, N. K. Orchid College of Engineering & Technology, Solapur, India

³ Assistant Professor at, Civil Engineering Department, N. K. Orchid College of Engineering & Technology, Solapur, India

Abstract - In current years, introduction of Pre Engineered Building (PEB) in the design steel of structures has facilitated in enhancing design. Application of PEB in place of Conventional Steel Building (CSB) resulted in many advantages, including economy and simple fabrication. Long Span, column free structures are the greatest crucial requirements in any type of industrial structures and Pre Engineered Buildings (PEB) satisfies these requirement along with reduced time and cost in comparison with conventional structures. The PEB methodology is advantageous not just because of its high-quality pre-design and prefabrication, but also due to its lightweight nature and cost-effective construction. This study includes analysis and design of industrial structure in accordance with the Indian standard. The economy of structure is conferred in terms of its weight comparison, between Indian code. The proposed study is to analyze frames of industrial shed for different loadings by using PEB sections. Comparison between Conventional and PEB structures is also performed. Analysis of industrial shed is done for various Loading conditions by Conventional Steel Building & by PEB structure. The B.M., Shear Forces and Stresses have been compared for Conventional Steel Building and PEB structures and required section are designed.

Key Words: Conventional steel Buildings, Pre Engineered Steel Buildings, Steel Take-off, Staad Pro V8i, CSB, PEB etc.

1. INTRODUCTION

This Steel is widely recognized for its superior structural integrity and strength in the field of construction. Its durability and robustness outperform other materials such as wood or concrete. In fact, steel is given the top priority for construction due to its several advantages. When building steel structures, different frames such as clear span, modular, and single slope are commonly used. The ease and efficiency of constructing with steel have made it the most sought-after method in modern building practices. Structural steel is clearly the favored option for building projects because of the numerous advantages it offers. Structural steel is a crucial component in the construction industry, known for its strength and durability. Despite the challenges of corrosion it is proven to be a favourable material for tall

buildings that withstand various adversities. With the increasing usage of steel in construction, it is poised to dominate the industry in the future. Tall buildings constructed with steel have proven to be resilient against, showcasing the material's strength and durability. Steel remains a preferred choice for architects and engineers. Steel will play in shaping the future of the construction industry and building projects As the construction industry continues to evolve, structural steel remains a reliable and durable material for building tall structures. Implementing corrosion prevention measures is crucial to ensure the longevity and integrity of steel buildings. Steel's dominance in the construction industry is set to grow, offering endless possibilities for innovative and sustainable building design. Structural steel offers various advantages, including durability and flexibility. One of the main reasons why structural steel is preferred in building construction is its efficiency. Buildings composed of steel require various structural frames that are made from precise cross sections. In addition, constructing with steel takes much less time compared to traditional building materials, making it for many construction projects. Variety of Structural steel comes in a variety of shapes and sizes to suit different construction needs. Some of the common shapes include L-beams, Z-shapes, HSS shapes, and L-angles). These shapes are designed for mechanical properties and chemical composition, ensuring the life of the building. Its durability and strength, making it a reliable choice for building construction. Steel structures are able to withstand extreme weather conditions, earthquakes, and other external forces, providing long-lasting support for the building.

1.1 Conventional Steel Structure

Conventional steel structures involve custom design and on-site fabrication using standard steel components such as I-beams, channels, and plates. These structures are highly versatile and can be adapted to a wide range of architectural designs and load requirements. However, they often require significant labour and material costs due to the complexity and customization involved.

1.2 Pre-Engineered Buildings (PEBs)

PEBs are factory-fabricated buildings designed using standardized components. The primary structure consists of

rigid frames fabricated from high-strength steel, with secondary members such as purlins and girts. These components are pre-cut, pre-drilled, and pre-welded, allowing for quick on-site assembly. PEBs offer significant advantages in terms of construction speed, cost efficiency, and material optimization.

1.3 Advantages Pre-Engineered Buildings (PEBs)

1. **Cost Efficiency:** Reduced material and labor costs due to factory fabrication and standardized components.
2. **Faster Construction:** Quick assembly on-site reduces construction time significantly.
3. **Material Optimization:** Efficient use of materials minimizes waste and lowers costs.
4. **Scalability:** Easily scalable for various applications, from small warehouses to large industrial complexes

2. Applications of Pre-Engineered Buildings -PEBs

PEB technology has been widely adopted for industrial buildings due to its efficiency and cost-effectiveness. It provides a quick and efficient solution for constructing warehouses and industrial facilities. Institutional buildings such as schools, hospitals, and government facilities have also benefited systems. The speed of construction and flexibility in design make it a popular choice for projects. PEB technology is increasingly being used for commercial buildings such as malls, office complexes. PEB allows creative and customizable design of commercial projects. In addition to traditional uses, PEB systems are now being utilized for rural and urban housing projects, farmhouses, slum re-organization initiatives, and rehabilitation projects. In the realm of modern construction, earthquake utilizing Pre-Engineered Building (PEB) technology have emerged as a cutting-edge solution for storage facilities and logistics centers. This innovative approach not only prioritizes structural stability a diverse range of customization. By utilizing high-quality materials and innovative engineering techniques, these buildings are able to withstand seismic damage. From choice of roofing elements, weather-sheds, color variations in planning and massing, these buildings can be tailored to suit the unique requirements of any project. Pre-engineered building systems are commonly utilized in the construction of warehouses, Industrial Sheds and buildings. While PEB technology has traditionally been associated with urban construction projects, there is a growing trend towards in rural settings as well. The versatility and cost-effectiveness of PEB have made them a preferred choice for construction projects in recent years: The use of PEB in industrial settings such as factories, warehouses, and manufacturing industries is on the rise. The quick construction time and durability of PEB make them ideal for industrial applications. PEB has also gained popularity in commercial buildings, including shopping malls The flexibility in design and cost savings associated with PEB

have made them a popular choice for commercial construction projects. In the agricultural sector, PEB is used for barns, storage units, and greenhouses. The ease of construction and ability to withstand harsh weather conditions make PEB a practical choice for agricultural structures.

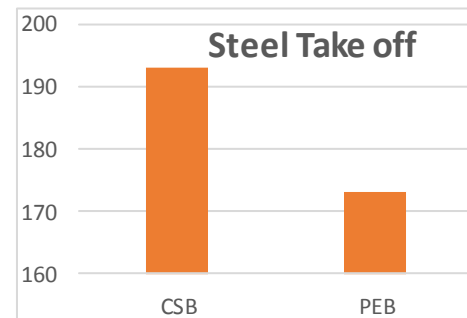


Chart -1 Steel takeoff for 20m span
CSB:193KN PEB:173KN

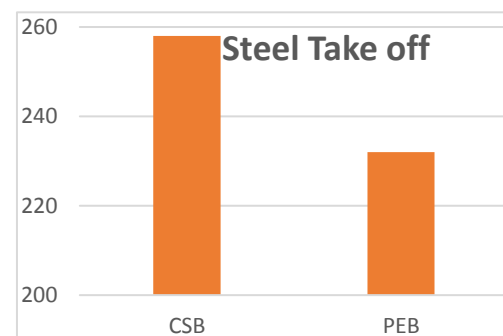


Chart -2 Steel takeoff for 23m span
CSB:258KN PEB:232KN

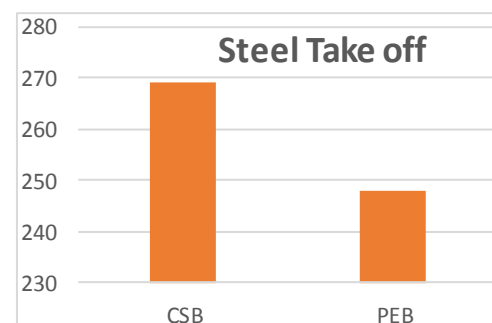


Chart -3 Steel takeoff for 26m span
CSB:269KN PEB:248KN

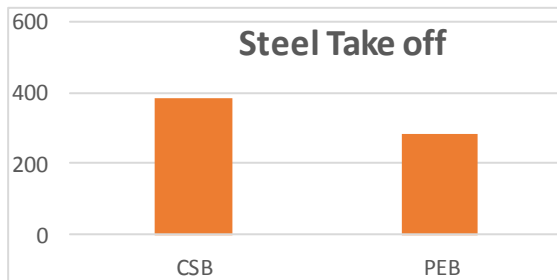


Chart -4 Steel takeoff for 29 m span
CSB:383KN PEB:282KN

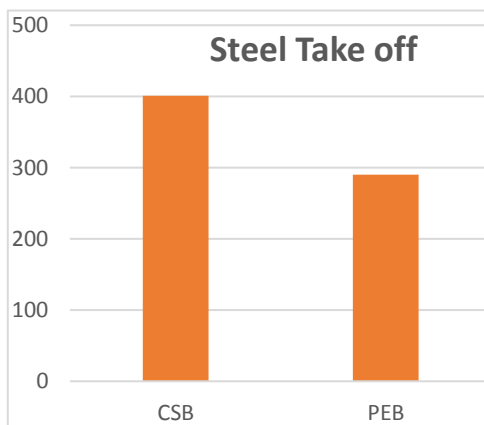


Chart -5 Steel takeoff for 32m span
CSB:401KN PEB:290KN

3. CONCLUSIONS

When it comes to construction projects, choosing between pre-engineered and conventional steel structures has significant impact on costs. One of the main benefits of PEBs is their standardized components and factory fabrication. This results in lower cost compared to conventional steel structures. Additionally, the construction time is reduced due to the components, leading to lower labour costs. PEBs are designed to optimize steel, making them more cost-effective than traditional. The efficient design of PEBs ensures that there is minimal wastage of steel, further reducing costs. While conventional steel structures highly customized and complex projects, whether it's for warehouses, industrial buildings, PEBs are cost-effective needs of various construction projects. With lower material and labor costs, reduced construction time, and optimized use of steel, PEBs are a professional choice for a wide. In addition to cost savings, PEB buildings are also lighter and faster to construct than traditional steel buildings. PEB roof structures are almost 30% lighter than conventional steel buildings, which not only saves its costs but also its foundation. This lightweight design can lead to additional savings. PEB construction is 30% to 40% faster than traditional steel building methods, allowing projects to be completed more quickly and efficiently. This can be especially beneficial for businesses with tight deadlines or

those looking to maximize their return on investment. In conclusion, PEB buildings offer a range of benefits over CSB structures, including cost savings, lightweight design, and faster constructions.

4. ACKNOWLEDGEMENT

With great sense of gratitude, I wish to acknowledge my indebtedness to Prof. D.S. Pawar of civil engineering department, N. K. Orchid College of Engineering & Technology, Solapur for his appreciation, encouragement & guidance throughout the course of the research. Special thanks to the technical friends and faculty for their assistance with the STAAD Pro software analysis and data collection.

5. REFERENCES

- [1] Kumar, S., & Gupta, R. (2018). Comparative study of pre-engineered and conventional steel buildings. *International Journal of Civil Engineering*, 16(4), 527-536
- [2] Smith, J., & Brown, P. (2019). Cost analysis of conventional and pre-engineered steel buildings. *Journal of Construction Engineering and Management*, 145(3), 04019015
- [3] Mehta, A., & Patel, K. (2020). Optimization of material and labor costs in steel construction. *Construction Economics and Building*, 20(2), 45-62
- [4] Ali, H., & Hussain, A. (2021). Maintenance cost analysis of steel structures: Conventional vs. pre-engineered. *Engineering Structures*, 230, 111704
- [5] IS 875 (Part I) – 1987 Code of practice for design loads (other than EQ load) for buildings and structures (Dead Load)
- [6] IS 875 (Part II) – 1987 Code of practice for design loads (other than EQ load) for buildings and structures (Imposed Load)
- [7]] IS 875 (Part I) – 1987 Code of practice for design loads (other than EQ load) for buildings and structures (Wind Load)
- [8] IS 800:2007 – Indian Standard general construction in steel – code of practice