International Journal of Multidisciplinary Academic Studies and Research (IJMASR)
Registered with MSME, Govt. of India: UDYAM-MH-20-0329275
Available at www.ijmasr.org *Volume-1, Issue-3, March 2026, Page- 168-174.*

To Cite This Article
Mr. Adarsh Perge, Prof. Pallavi Bhende, & Prof. Gaurav Hingwe. (2026). Comparative Analysis of Shed-Type Structures - A Review. International Journal of Multidisciplinary Academic Studies and Research (IJMASR), 1(3), 168-174.
https://doi.org/10.5281/zenodo.19683985

Article Info
Received: 23rd March 2026, Accepted: 25th March 2026, Published: 26th March 2026.

Comparative Analysis of Shed-Type Structures - A Review

Mr. Adarsh Perge[1], Prof. Pallavi Bhende [2], Prof. Gaurav Hingwe[3]

[1]Research Scholar (M.Tech in Computer Aided Structural Engineering (CASE), Civil Engineering Department, Wainganga College of Engineering & Management, Nagpur

[2]Assistant Professor & Head of Department, Civil Engineering Department, Wainganga College of Engineering & Management, Nagpur

[3] Assistant Professor, Civil Engineering Department, Wainganga College of Engineering & Management, Nagpur

Abstract: This paper presents a detailed review of previous research studies related to shed-type structures, including Pre-Engineered Buildings (PEB), Conventional Steel Buildings (CSB), alternative reinforcement materials such as bamboo, and various structural components like bracing systems and steel sections. The review focuses on analyzing structural performance, cost efficiency, and material optimization based on past studies. Furthermore, the study identifies critical research gaps in existing literature, including lack of uniform comparison, limited integration of cost and performance analysis, and insufficient focus on sustainability and practical implementation. The paper highlights the need for comprehensive and standardized studies to improve the design and efficiency of industrial shed structures.

Keywords: PEB, CSB, Industrial Shed, Bamboo Reinforcement, Structural Analysis.

I. INTRODUCTION

Industrial shed structures are one of the most important components of modern civil engineering infrastructure. These structures are widely used for industrial purposes such as warehouses, factories, workshops, aircraft hangars, railway sheds, storage units, and manufacturing plants. The main requirement of such structures is to provide large column-free spaces, adequate structural strength, durability, and cost-effectiveness. Due to rapid industrialization and urban development, the demand for efficient and economical shed-type structures has increased significantly in recent years. Traditionally, industrial sheds were constructed using conventional methods such as Reinforced Cement Concrete (RCC) structures and Conventional Steel Buildings (CSB). These structures generally consist of beams, columns, trusses, purlins, and bracing systems fabricated and assembled at the construction site. Although conventional construction methods provide flexibility in design and are suitable for customized applications, they often result in higher construction time, increased labor requirements, and excessive material consumption. In addition, the use of standard rolled steel sections in CSB leads to increased self-weight of the structure, which ultimately increases foundation cost and overall project expenditure. With the advancement in construction technology, the concept of Pre-Engineered Buildings (PEB) has emerged as a modern and efficient alternative to conventional construction methods. PEB structures are designed using advanced software tools and fabricated in factory-controlled environments before being transported to the site for assembly. These structures utilize optimized built-up sections, which are designed according to bending moment requirements, resulting in efficient use of material. The components of PEB structures are connected using bolted connections, which reduces construction time significantly and improves quality control. Due to these advantages, PEB systems are increasingly being adopted in industrial construction projects across the world. Another important aspect of shed-type structures is the selection of suitable construction materials. Steel is the most commonly used material due to its high strength-to-weight ratio, durability, and recyclability. However, the rising cost of steel and environmental concerns have led researchers to explore alternative materials such as bamboo, rattan, glass fiber, and other composite materials. Among these, bamboo has gained considerable attention due to its low cost, high availability, and eco-friendly nature. Bamboo is a renewable material with good tensile strength, making it a potential substitute for steel in low-cost and sustainable construction.

However, challenges such as durability, bonding with concrete, and variability in properties need to be addressed before its widespread application in structural engineering. In addition to material selection, the structural performance of shed-type structures depends on various factors such as type of steel sections, bracing systems, roofing systems, and loading conditions. Bracing systems play a crucial role in maintaining the stability of the structure by resisting lateral loads such as wind and earthquake forces. Different types of bracing systems, including X-bracing, diagonal bracing, and V-bracing, are used to improve stiffness and reduce displacement. Similarly, the selection of steel sections, such as hot-rolled sections, cold-formed sections, and tubular sections, significantly influences the structural efficiency and cost of the building. Modern research has shown that tubular sections and cold-formed steel provide better performance due to their high strength-to-weight ratio and improved load distribution. Another important development in shed structures is the introduction of innovative roofing systems such as truss-less roofing. These systems eliminate the need for intermediate structural members like trusses and purlins, thereby reducing material consumption and construction time. Such advancements highlight the continuous evolution of structural design practices aimed at achieving efficiency and economy. The design of industrial shed structures must also consider various loading conditions such as dead load, live load, wind load, seismic load, and sometimes crane load. The combined effect of these loads plays a critical role in determining the safety and performance of the structure. Modern design approaches such as the Limit State Method (LSM) provide a more realistic and economical design by considering ultimate load conditions and safety factors. However, some older studies still use the Working Stress Method (WSM), leading to inconsistencies in design results.

II. LITERATURE REVIEW

2.2.1 Nayak et al. (2013)
Studied replacement of steel with bamboo in RC elements. Bamboo showed good cost and environmental benefits but lower tensile strength compared to steel. It is suitable for low-load structures only. Concluded bamboo can be used for affordable housing.

2.2.2 Naidu et al. (2014)
Compared Pre-Engineered Buildings (PEB) and conventional steel structures. PEB showed reduced weight, faster construction, and better cost efficiency. Use of tapered sections optimized material usage. Concluded PEB is more suitable for industrial structures.

2.2.3 Ogunbiyi et al. (2015)
Conducted tensile strength comparison of bamboo and steel. Steel showed much higher strength than bamboo. Bamboo has limited load-carrying capacity. Suitable only for non-structural or temporary works.

2.2.4 Adewuyi et al. (2015)
Compared bamboo, rattan, and steel reinforcement in concrete beams. Steel performed best in strength and stiffness. Bamboo showed moderate performance but lower than steel. Suitable for lightweight structures.

2.2.5 Deshpande & Shirsath (2016)
Studied bamboo mesh in ferrocement panels. Strength increased with more bamboo layers but remained lower than steel. Bamboo is economical and eco-friendly. Suitable for low-cost construction.

2.2.6 Shah et al. (2017)
Compared hot-rolled and cold-formed steel sections. Cold-formed sections reduced structural weight and cost. Easier to fabricate and transport. Suitable for modern lightweight structures.

2.2.7 Dange & Pataskar (2017)
Analyzed cost and design of bamboo vs steel reinforcement. Bamboo significantly reduced cost with acceptable strength. Suitable for low-rise buildings. Promotes sustainable construction.

2.2.8 Quazi et al. (2018)
Compared CSB, PEB, and tubular structures. Tubular sections showed better strength-to-weight ratio. PEB provided optimized material usage. Concluded PEB and tubular systems are more efficient.

2.2.9 Motghare (2018)
Studied steel shed designs using different codes. PEB showed better economy and faster construction. Reduced steel usage due to tapered sections. Suitable for medium to large spans.

2.2.10 Bajpai et al. (2020)
Compared warehouse structures using PEB and CSB. PEB showed better structural performance and cost efficiency. Reduced weight and improved design optimization. Suitable for large-span structures.

2.2.11 Hemanthkumar et al. (2020)
Studied steel warehouse design using STAAD Pro. Emphasized optimization of steel sections for cost efficiency. Bracing improved structural stability. Concluded proper design leads to economical structures.

2.2.12 Gilbile & Mane (2020)
Compared PEB and CSB using different models. PEB showed reduced weight and cost. Faster construction due to prefabrication. CSB offers flexibility but higher material usage.

2.2.13 Shameem et al. (2021)
Compared truss and truss-less roofing systems. Truss-less systems reduced cost and construction time. Eliminated intermediate members. Suitable for medium-span industrial sheds.

2.2.14 Dhanush et al. (2021)
Studied bamboo as reinforcement in multistory buildings. Bamboo is lightweight, economical, and eco-friendly. Requires proper treatment for durability. Suitable for sustainable construction.

2.2.15 Patil et al. (2021)
Compared PEB and CSB under seismic and wind loads. PEB performed better in extreme conditions. More economical and efficient. Suitable for high-risk zones.

2.2.16 Gulve et al. (2021)
Reviewed PEB and CSB performance. PEB showed reduced steel consumption and faster construction. Better material optimization. Recommended for industrial applications.

2.2.17 Benichetage & Patil (2021)
Studied different bracing systems. Bracing improved stability and reduced displacement. Some patterns performed better than others. Essential for resisting lateral loads.

2.2.18 Nikhil (2021)
Analyzed bamboo reinforcement in beams. Bamboo showed good tensile strength but lower than steel. Suitable for low-cost structures. Needs proper treatment.

2.2.19 Anunciação Jr et al. (2021)
Compared different bracing systems in steel sheds. Bracing reduced displacement and improved stiffness. Inverted V-bracing performed best. Important for structural safety.

2.2.20 Saif & Franklin (2021)
Compared steel and RCC structures under seismic loads. Steel structures were lighter and more flexible. RCC showed higher stiffness. Steel is better for dynamic performance.

2.2.21 Gour et al. (2022)
Compared steel, bamboo, and glass fiber reinforcement. Steel showed highest strength. Bamboo had lowest but acceptable performance. Suitable for non-load-bearing structures.

2.2.22 Naathan (2022)
Studied PEB vs conventional buildings. PEB reduced construction time and material usage. Provided better efficiency. Suitable for long-span structures.

2.2.23 Pati et al. (2022)
Analyzed industrial shed structures using PEB and CSB. PEB reduced weight by up to 27%. Improved performance and reduced displacement. Suitable for large spans.

2.2.24 Rathod et al. (2022)
Compared bamboo and steel reinforcement. Bamboo showed good strength and sustainability. Steel performed better overall. Bamboo suitable for low-cost housing.

2.2.25 Maghrabi et al. (2022)
Compared WSM and LSM design methods. LSM provided better safety and economy. Improved material utilization. Recommended for modern design.

2.2.26 Sharan et al. (2023)
Reviewed long-span PEB structures. PEB reduced weight by 25–50%. Faster construction and better quality. Suitable for industrial applications.

2.2.27 Kaaria (2023)
Compared steel and RCC structures for sustainability. RCC was more economical and eco-friendly. Steel offered faster construction. Both have advantages.

2.2.28 Chakravarthy et al. (2023)
Analyzed different steel sections in sheds. Performance varied with section type. Some sections reduced weight and improved efficiency. Important for design optimization.

2.2.29 Bhandarkar et al. (2023)
Studied conventional steel shed design. Trusses and bracing ensured stability. Flexible design but longer construction time. Suitable for customized structures.

2.2.30 Chen et al. (2023)
Studied bamboo fiber in concrete beams. Improved crack resistance and stiffness. Slight reduction in strength. Suitable for sustainable design.

2.2.31 Rathod & Vaidya (2024)
Compared bamboo and steel reinforcement. Steel performed better in durability. Bamboo showed good strength for limited use. Suitable for eco-friendly construction.

2.2.32 Sisode & Mate (2024)
Studied bamboo structures using STAAD Pro. Bamboo showed good strength and flexibility. Suitable for light structures. Needs proper design standards.

2.2.33 Kumar & Dudhe (2025)
Compared treated bamboo and steel reinforcement. Bamboo achieved up to 72% strength of steel. Treatment improved durability. Suitable for low-cost housing.

2.2.34 Ugemuge et al. (2025)
Compared different shed systems. PEB showed better efficiency and reduced cost. Conventional systems still useful. Selection depends on requirement.

2.2.35 Gattani et al. (2025)
Studied PEB with tubular sections. Improved stiffness and reduced deflection. Better performance than conventional systems. Suitable for long-span sheds.

2.2.36 Abdulkarim et al. (2025)
Compared tensile strength of bamboo and steel. Bamboo showed moderate strength. Suitable for small-scale structures. Eco-friendly alternative.

2.2.37 Gajghate et al. (2025)
Studied hybrid bamboo-steel beams. Hybrid system improved strength and sustainability. Balanced cost and performance. Promising for future construction.

III. RESEARCH GAP

The review of existing literature on industrial shed structures reveals that substantial research has been carried out in the areas of structural analysis, design optimization, cost comparison, and performance evaluation of steel structures. Numerous studies have compared Pre-Engineered Buildings (PEB) and Conventional Steel Buildings (CSB) and have highlighted the advantages of PEB systems in terms of reduced weight, cost efficiency, and faster construction. However, despite the availability of extensive research, several critical gaps and limitations still exist, which justify the need for further investigation. One of the major gaps identified in the literature is the lack of comprehensive comparative studies under uniform and standardized conditions. Many researchers have analyzed PEB and CSB systems separately or under varying assumptions related to geometry, loading, and design criteria. As a result, direct comparison between different structural systems becomes difficult. There is a need for a study where both PEB and CSB structures are analyzed using identical parameters such as span, height, loading conditions, and design codes, ensuring a fair and accurate comparison. Another important limitation is the insufficient integration of structural performance and economic analysis. Most studies focus either on structural parameters such as deflection, bending moment, and stress distribution or on cost comparison alone. However, in practical engineering applications, both structural performance and cost play an equally important role in decision-making. A detailed study that simultaneously evaluates structural behavior, material consumption, and overall project cost is required to identify the most efficient structural system. The literature also indicates a limited focus on medium-span industrial structures, as many studies are concentrated on either small-span or very large-span buildings. Medium-span sheds, which are commonly used in industrial applications, require detailed investigation to determine the most suitable structural system. The behavior of such structures under different loading conditions and design configurations is not adequately explored in existing research. Another gap identified is related to the use of updated design codes and standards. While some studies use older codes such as IS 800:1984, others use updated versions like IS 800:2007. However, there is a lack of consistency in the application of design standards across different studies. This creates discrepancies in results and conclusions. A study based on uniform application of the latest Indian Standard codes is necessary to ensure accuracy and relevance to current engineering practices. The role of advanced structural analysis software has been widely recognized, yet there is a need for more detailed and systematic modeling approaches. Many studies mention the use of software such as STAAD Pro, ETABS, or SAP2000, but do not provide sufficient details regarding modeling assumptions, boundary conditions, load combinations, and validation of results. This limits the reproducibility and practical applicability of the research. Therefore, a detailed methodology involving step-by-step modeling and analysis using STAAD Pro is required. Another significant gap is the limited consideration of combined loading conditions. Industrial structures are subjected to multiple types of loads, including dead load, live load, wind load, seismic load, and sometimes crane loads. While some studies consider individual loads, the combined effect of these loads is not extensively analyzed. A comprehensive study considering all relevant load combinations as per IS codes is essential to evaluate the real behavior of structures. The literature also shows that while bracing systems are recognized as critical components for structural stability, there is insufficient integration of bracing design in comparative studies of PEB and CSB systems. Most research focuses on bracing as an independent topic rather than analyzing its impact within the overall structural system. There is a need to evaluate how different bracing configurations influence the performance of both PEB and conventional structures.

CONCLUSION

The present review paper critically analyzed a wide range of previous research studies related to shed-type structures, including Pre-Engineered Buildings (PEB), Conventional Steel Buildings (CSB), alternative reinforcement materials such as bamboo, and various structural components like bracing systems, roofing systems, and steel sections. From the detailed literature review, it is evident that significant advancements have been made in the design, analysis, and construction of industrial shed structures over the years. The majority of studies clearly indicate that Pre-Engineered Buildings (PEB) offer considerable advantages over Conventional Steel Buildings (CSB) in terms of reduced structural weight, optimized material usage, faster construction time, and overall cost efficiency. The concept of using tapered sections designed according to bending moment requirements plays a crucial role in improving structural efficiency and minimizing unnecessary steel consumption.

Additionally, factory fabrication and bolted connections in PEB systems enhance construction quality and reduce project duration, making them highly suitable for modern industrial applications. At the same time, conventional steel structures continue to remain relevant due to their flexibility in design and suitability for customized and complex structural requirements. Although they may involve higher material consumption and longer construction time, their adaptability makes them useful in specific engineering conditions where standardization is not feasible. The review also highlights the growing interest in sustainable and eco-friendly construction materials such as bamboo. Many studies have demonstrated that bamboo possesses good tensile strength, low cost, and environmental benefits, making it a promising alternative to steel reinforcement in low-load and low-rise structures. However, limitations related to durability, bonding characteristics, and variability in material properties restrict its application in high-load structural elements. Hybrid systems combining bamboo and steel have shown potential in achieving a balance between strength, cost, and sustainability.

REFERENCES

[1] Abdulkarim, A. A., Olaniyi, K. O., Oyeleke, M. O., Giwa, A., & Olahan, A. B. (2025). Comparative Study of the Tensile Strength of Bamboo and Steel Bars in Building Construction. Journal of Engineering Logic and Modelling Research, 7(3).
[2] Adewuyi, A. P., Otukoya, A. A., Olaniyi, O. A., & Olafusi, O. S. (2015). Comparative studies of steel, bamboo and rattan as reinforcing bars in concrete. Open Journal of Civil Engineering, 5(2), 228–238.
[3] Anunciação Jr, N. C., Souza, L. G. Q., Pereira, A. A., Ribeiro, C. B., & Barboza, M. D. S. (2021). Comparative Analysis of Bracing Systems in a Steel Structure Shed. WCCM & ECCOMAS Congress.
[4] Bajpai, R., & Patel, R. (2020). Comparative Study of Warehouse Structure in Pre-Engineered Building with Conventional Steel Building for Bhopal City. IJTRD.
[5] Benichetage, S., & Patil, S. (2021). Comparative Study of Different Bracing Pattern for Industrial Shed Structure at Different Location. Journal of Emerging Technologies and Innovative Research (JETIR), 8(5).
[6] Chakravarthy, N. L., Manju, R., & Hari Prasad, G. (2023). Comparison of inspection shed with different steel sections. IRJMETS, 5(7).
[7] Chen, W., Qin, G., Luo, F., Zhu, Y., Fu, G., Yao, S., & Ma, H. (2023). Experimental Study on Bamboo Fiber Reinforced Concrete Beams. Materials, 16, 3446.
[8] CPWD (2019). Manual on Bamboo Building Materials and Design.
[9] Dhanush, B. R., Hemanth Kumar, N. S., Bagur, A. G., Rajeev, A., & Sushma, C. K. (2021). Feasibility study on bamboo reinforcement. IRJMETS, 3(6).
[10] Gattani, S. A., & Shaikh, S. (2025). Structural Analysis and Design of Industrial Building Using PEB and Tube Section. IJNRD, 10(11).
[11] Gajghate, P., Iwarkar, S., Jadhavar, S., Jagtap, P., & Sabale, R. (2025). Comparative Study of Hybrid Bamboo Beam. IJIRT, 12(1).
[12] Gilbile, M. J., & Mane, S. S. (2020). Comparative Study on PEB and CSB. IJERT, 9(9).
[13] Gupta, A., Ugemuge, S., Zade, V., Zodape, P., Chahande, S., & Bahrainwala, M. (2025). Comparative Analysis & Design of Industrial Shed. SPARK Conference.
[14] Hemanthkumar, S. K., & Pradeep, A. R. (2020). Analysis and Design of Steel Warehouse. SSAHE Journal.
[15] IS 800:2007. General Construction in Steel – Code of Practice.
[16] IS 15912:2012. Bamboo Mat Corrugated Sheets – Specification.
[17] Kaaria, D. G. (2023). Comparative Analysis of Steel and RCC Construction. University of Nairobi.
[18] Komal, S. S., & Mate, N. U. (2024). Sustainable Bamboo Structure in Modern Construction. IJIRSET.
[19] Kumar, S., & Dudhe, N. (2025). Comparative analysis of bamboo and steel reinforcement. IJST.
[20] Maghrabi, J., Patil, S., Singala, N., Mundhe, S., & Shinde, S. (2022). Comparative Study of Industrial Shed by WSM and LSM. IRJET, 9(7).
[21] Motghare, Y. U. (2018). Comparative Design of Steel Sheds. IRJET, 5(6).
[22] Naathan, S. M. G., & Ramadevi, K. (2022). Comparative Study on PEB Structure and Conventional Building. IJARSCT, 2(6).
[23] Naidu, G. D. R., Vengala Rao, K. S., Divya Sri, V., Navakanth, M., & Rama Rao, G. V. (2014). Comparative Study of PEB and Conventional Frames. IJERD, 10(9).
[24] Nikhil, N. (2021). Replacement of Steel Reinforcement with Bamboo. IJIERT.
[25] Ogunbiyi, M. A., Olawale, S. O., Tudjegbe, O. E., & Akinola, S. R. (2015). Comparative analysis of tensile strength of bamboo and steel. IJSTR, 4(11).

[26] Patil, D., Sagar, Y., Thorat, M., Surushe, P., & Sakat, A. (2022). Study, Design, and Evaluation of Industrial Shed. IJSART, 8(5).
[27] Patil, V. S., & Choudhary, R. K. (2021). Cost Comparative Study of PEB and CSB. IRJET, 8(7).
[28] Rathod, S., Parab, A., Tamkhane, A., Neharkar, A., Patil, A., & Gayake, P. (2022). Comparative Study of Bamboo vs Steel Reinforcement. IJRASET, 10(6).
[29] Rathod, D. V., & Vaidya, M. R. (2024). Comparative Performance of Bamboo and Steel. IRJMETS, 6(1).
[30] Shah, F. A., Thakkar, K. R., & Nimodiya, P. N. (2017). Hot Rolled vs Cold Formed Steel Sections. IJERT, 6(4).
[31] Sharan, K., Eswaramoorthi, P., & Nandhakumar, P. (2023). Comparative Analysis of Long Span PEB Shed. IJRASET, 11(3).
[32] Shujat, Q. S., & Desai, R. (2018). Design of Industrial Warehouse Using CSB and PEB. IJERA, 8(5).
[33] Shameem, K. P., & Yadav, N. (2021). Comparative Study of Industrial Steel Structures. IRJET, 8(7).
[34] Gulve, P. R., Patil, S., & Pujari, A. (2021). Review on PEB and CSB Structures. IJCRT, 9(12).