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A Comparative Study on Pre-Engineered Building and Conventional Steel Structures

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Abstract
This paper aims to provide comparative analyzed study between two outstanding structural construction methods i.e. Pre-Engineered Buildings and Conventional Steel Buildings. In recent years, introduction of Pre Engineered Building in the design steel of structures has helped in enhancingthe design. Adoptability ofPre Engineered Buildings in place of Conventional Steel Building resulted in many advantages, including long span, column free structures, economy and easier fabrication, are the most essential requirements in any type of industrial structures. Pre Engineered Buildings fulfills all structural requirement along with reduced time and cost as compared to conventional structures. Pre-Engineered Buildingsmethodology 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 a detailed comparative study between Pre Engineered Building & Conventional Steel Structure is carried out. Discussed on Design, Structure Weight, Delivery, Foundations, Construction cost, performance, Resistance, Architecture, Responsibility and Future expansion of both are Pre Engineered Building & Conventional Steel Structure. Through the comparative study it is observed that the Pre-engineered Building structures are more economical than Conventional Steel Building structures.

Key Words: Conventional Structure, Pre Engineered Building, Steel Structure

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I. Introduction

In this Dynamic construction world selecting the right building structure method is essential for achieving cost effectiveness, durability and efficient. Over the years two prominent approaches have emerged as popular choices for industrial and commercial construction Pre-Engineered Building (PEB's) and Conventional Steel Building (CSB's). In recent years, introduction of Pre Engineered Building in the design steel of structures has helped in optimizing the design. Adoptability of Pre Engineered Buildings in place of Conventional Steel Building resulted in many advantages, including economy and easier fabrication, long span, column free structures are the most essential requirements in any type of industrial structures. Pre Engineered Buildings fulfills these requirement along with reduced time and cost as compared to conventional structures. Pre-Engineered Buildings 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 a detailed comparative study between Pre Engineered Building & Conventional Steel Structure is carried out. Discussed on Design, Structure Weight, Delivery, Foundations, Construction cost, performance, Resistance, Architecture, Responsibility and Future

expansion of both are Pre Engineered Building & Conventional Steel Structure. Through the comparative study it is observed that the Pre-engineered Building structures are more economical than Conventional Steel Building structures [1].

Pre-Engineered Buildings (PEBs) is the one of the latest trend in India. A PEB is a metal building that consists of light gauge metal standing seam roof panels on steel purlins spanning between rigid frames with light gauge metal wall cladding. They drastically reduce construction time. Maintenance is also extremely low. PEBs optimally utilize resources, and leverage technology to the maximum.

Fig. 1 Pre-Engineered Building Structure

PEBsare commonused at industrial (warehouse and sheds) constructions, institutional and commercial buildings constructions. In India the recent focus shifted to cover rural as well as urban, individual and mass housing projects, farmhouses, slum re-organization projects and rehabilitation projects, amenity structures like health centers, kiosks, primary schools, panchayat and many more with the help of PEB structure. The PEB used not only restricted to above but also to the exhibition centers, pharmaceutical industries, offices, seminar halls, call centers, supermarkets, showrooms etc. The earthquake and water resistant buildings are the recent applications of PEB with wide and immediate acceptance.

Tubular Steel Buildings

Tubular steel sections are the best replacements to the conventional ones with their useful and comparatively better properties. It is obvious that due to the cross sectional properties of the tube section, dead weight is likely to be reduced for many structural members which derives overall economy. TSBs are used for dynamic loads,as they have higher frequency of vibration than any other rolled section.These are also used because of their high torsional rigidity and compressive strength.

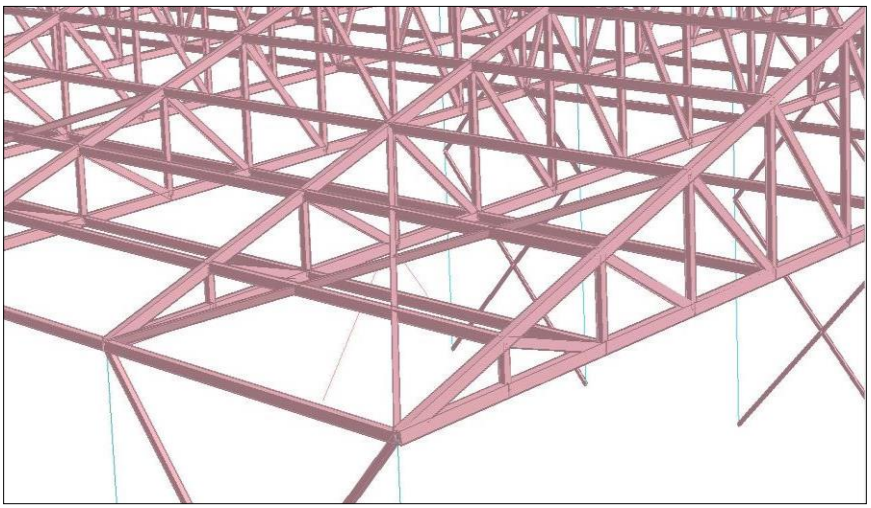

Fig 2 Conventional Tubular Structure 3D View

The findings of this study will aid architects, engineers, and construction professionals in making informed decisions when selecting the most suitable building method for specific projects, taking into consideration factors such as complexity, budget, timeline, and long-term sustainability

Ii. Literature Review

This literature review of pre-engineered building and conventional structures, tubular and is carried out from various books, reference, journals, and professional and educational websites.

M. G. Kalyanshetti et.al [2] the structural members having larger span length can be designed with tubular sections which will be benefitted in overall economy. Through their study they advised that Tubular steel is the best possible alternatives to the conventional with their comparatively better specifications. They considered the economy is the main goal for their work which also including comparison of conventional structures with tubular structure. This study concluded that by using of Tubular section over conventional structure we can save up to 15 to 25% cost.

Yash Patel, et.al [3] they studied on the comparison of tubular steel and conventional structure. From their analysis it is found that tubular steel is the best possible alternatives to the conventional with their comparatively better specifications, dead weight is tending to be decreased for many structural members so it is clear that because of the tube section, it helps in reducing overall economy. They saved approx. Rs. 10729 per roof truss by using the Tubular section instead of conventional structure, it is almost 18% savings.

Abhyuday Titiksh, et.al [4] their study is mainly focused on advantages of PEBs over CSB designed buildings. It's a case study for Industrial Shed based on the review and various case studies which shows their experimental and analytical studies carried out in this field. They found that PEBs are more advantageous over conventionally designed buildings in terms of time saving, future scope, and cost effective. The result shows that PEBs structures are economical, energy efficient and flexible in design.

Deepti D. Katkar[5]they observed that the pre-engineered buildings are more advantageous over conventionally designed buildings in terms of cost effectiveness, time-saving, future scope, subtleness, and economy. This paper on a comparative study between conventional and pre-engineered buildings shows their experimental and analytical studies carried out in this field. The results show that steel structures are far more economical energy-efficient and flexible in design than other types of structures for industrial use.

Pradeep V et al. [5] this paper effectively conveys that PEB structures can be easily designed by simple design procedures by country standards. Low-weight flexible frames of PEB offer higher resistance to earthquake loads. PEB roof structure is almost 26% lighter than Conventional Steel Building. In secondary members, lightweight "Z" purlins are used for PEB structure, whereas heavier hot-rolled sections are used for CSB. Support reactions for PEB are lesser than CSB as per the analysis PEB building cost is 30% lesser than the cost of CSB structure. PEB offers low cost, strength, durability, design flexibility, adaptability, and recyclability

From the above Literature Review it is observed that, PEB offer rapid construction, cost effectiveness and standardized components, making them ideal for projects with tight timelines and budget constraints. They are designed and fabricated off site, allowing for quicker assembly on site. This comparative study aims to analyze the strength and weakness of each method.

Iii. Comparative Study Onpre Engineered Building & Conventional Steel Structure

The below table shows a detailed comparative study between Pre Engineered Building & Conventional Steel Structure which is based onDesign, Structure Weight, Delivery, Foundations, Construction cost, performance, Resistance, Architecture, Responsibility and Future expansionetc [6-11].

Table 1 Comparison between Pre Engineered Building & Conventional Steel Structure

Sr.No	Parameter	Pre Engineered BuildingStructure	Conventional Steel Structure
1	Structure Weight	Structural members used are reduce built-up sections and are 10 to 20% lighter than conventional buildings.	Primary steel members are selected hot rolled T sections & secondary members are selected from standard hot rolled sections which are much heavier.
2	Design	Design of PEB is well organized due to its integral framing system.	Design of conventional buildings takes more time and it offers fewer precision design aids.
3	Delivery	Pre Engineered building will fast delivery. It takes 5 to 7 weeks to construct 500 MT pre-engineered building after finalization of design.	It takes 20 to 26 weeks to construct 500 MT conventional building after finalization of design
4	Foundations	Since the structural weight is low, Lightweight foundation with very simple design is enough.	Heavy structural weight makes it very difficult to design the foundation. Foundation must be very heavy enough to carry the loads.
5	Construction cost	Price per square feet is 30% less than the cost of conventional building.	Price per square meter is very much higher.
6	Performance	Maximum efficiency can be achieved since all the components are designed specially to act together as a system.	Components are designed individually and hence there is no guarantee about the performance of the structure.
7	Seismic Resistance	These buildings offer excellent resistance against seismic actions or earth quack since it is made of Lightweight flexible members.	These cannot withstand against seismic forces because of their rigid heavy frames.
8	Architecture	Very impressive architectural options are available at low costs.	More research and time is needed. Cost also will increase.
9	Future Expansions	Easy to expand the pre-engineered building because of its simple connection design.	It needs a heavy budget and also difficult to expand the building.
10	Responsibility	Only one supplier took the responsibility of complete project which is good for minimizing construction risks.	Multiple suppliers took the responsibilities and issues like insufficient materials, different quality components etc. may arise.

IV Conclusion

PEBs have gained a global reputation for durability, water resistance and earthquake resistance. PEBs are tremendously versatile and they are easy to set-up, modify, expand, and transport to different locations. PEBs are environmental friendly and can be aesthetically designed with unique features. An estimated 20-30% can be saved on cost, as compared to conventional building methods.PEBs can be delivered to a site in just 5 to 6 weeks, whereas a conventional steel structures it take more than 20 to 22 weeks to complete it. The unique techniques employed during fabrication which helps PEBs be up to 30% lighter than regular steel products, also there is no requirement of welding or fabrication at a construction site, which resulting into a greater speed, efficiency and less CAPEX.

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