Journal of Advances in Science and Technology
Vol. 20, Issue No. 1, March-2023, ISSN 2230-9659

Impact Prefabrication Technology (Pre Engineering) and Equipments on Profitability in Construction Industry: A Review

Mr. Mithil Bokefode[1]*, Dr. A. F. Shaikh[2]

[1] Student, JSPM's Imperial College of Engineering

Email: mithilbokefode@gmail.com

[2] Associate Professor, JSPM's Imperial College of Engineering

Email: afshaikh_civil@jspmicoer.edu.in

Abstract - The strength, predetermined thermal properties, dynamic stability, and immutability of the geometric dimensions of the prefabricated elements are provided by prefabricated buildings and structures that are mounted from uniform prefabricated three-dimensional units under challenging and unique circumstances. Regarding its effect on environmental preservation, prefabrication has long been recognised as a sustainable building technique. Prefabrication's impact on reducing construction waste and the accompanying waste handling processes, such as waste sorting, reuse, recycling, and disposal, are essential aspects of this viewpoint. Improvement ideas for the sector and a cost-effectiveness analysis of precast concrete construction. This research focuses on the barriers to pre-engineered building technologies faced by newly emerging Indian enterprises and the key success criteria associated with these systems. Also, the contribution of pre-engineered building systems in India in the economic growth of country through various applications is stated briefly which is stated in different journals

Keywords - Prefabricated buildings ,Structure, Elements

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INTRODUCTION

A) Pre Engineered Buildings (PEB)

The facility itself produces or manufactures pre-engineered steel buildings. Structural members are produced in accordance with client specifications. Because members are made with regard to design characteristics, the detailed structural members are each numbered and specifically built for their particular locations. For transporting, these parts are produced in a modular or entirely knocked condition. These components are delivered to the customer's location, where they are put up. At the customer's location, no welding or cutting is done. On-site production is not done for customers.

B) History of PEB

Because of the enormous advantages that pre-engineered structures have to offer, they have become quite popular. It is simple to assemble, affordable, and demountable for recycling. Pre-engineered structures may also withstand fires in addition to this. The earliest instance of metals being used in building construction, according to the evidence available, dates to the late 18th century. Fire outbreaks in British cotton mills were renowned for resulting in severe damage. As a result, at the end of the eighteenth century, metal, primarily cast iron, was used to make the framework and columns of mill buildings.

Standardised engineering building designs were originally sold as PEBs in the 1960s. The main frame component of a pre-engineered building has traditionally been an assemblage of I-shaped members, sometimes known as I-beams.

C) Need of PEB in India :

The PEB structure is currently popular worldwide due to its many benefits. In the upcoming years, the PEB market in India is anticipated to expand. Pre-fabricated construction is presently one of the most popular technologies since it has several benefits. Cost-effectiveness, speedy construction, sustainability, toughness, recyclability, and design adaptability are a few of these.
The cost and time efficiency of prefabricated structural components results in long-term financial

savings. Furthermore, technological improvements have made labour incredibly simple for Indian construction organisations. Indian PEB building firms employ technology that directly benefits clients. Construction is seeing a surge as a result of the ease and rising popularity of PEBs in order to meet consumer demand.

Traditional building is a time-consuming procedure in comparison to PEB structure. To finish a typical structure, a lot of money is needed, not to mention a lot of manpower. All of this is surpassed by PEB construction, which makes the job of PEB building producers simple.

Obviously, a PEB construction is the most economical option. But it is also prized for its potential to be recycled. Practically any material may be recycled. It is simple to disassemble the prefabricated building if you need to for whatever reason. There won't be much waste in it.

Building a PEB structure is simple. The building frame is essentially created from scratch at the factory, and it is then put together on the construction site. Due to this, PEB is the best option and helps the business to expand.

Pre-engineered structures can be swiftly built, making them the preferred construction technique for the government's infrastructure push. The PEB technology is the best option since it is simple and produces results quickly. As a result, demand is increasing in both the public and private sectors. This comprises cold storage, multi-story buildings, industrial sheds, and storage facilities.

The need for homes is always rising as the population grows. PEB saves the day since it is a quick building method and provides design flexibility. Pre-fabricated structures are becoming more and more popular all around the world, and India is no exception. In the following years, the pre-fab sector is expected to change the market.

Pre-engineered structures are favoured in earthquake-prone areas since they are comparatively earthquake resistant and extremely durable. PEB structures were only utilised in a few industries, but today they are appearing everywhere..

All types of structures, including low rise, medium rise, and skyscrapers, are currently constructed using PEB. The advantages of prefabricated constructions are displacing those of conventional construction.

For steel constructions, PEB technology offers the crucial design freedom. This is significant since no other building style offers this amount of benefit.

PREVIOUS RESEARCH

Roshani Ramkrishna (2021) Due of the benefits Teel provides over RCC, including its malleability, reusability, fire resistance, and other features, it is becoming much more popular. A form of construction system known as a pre-engineered building uses built-up sections for the structural components, which are designed and created in factories and assembled on site. Time is saved and there is superior quality control as a consequence. The effectiveness of pre-engineered building systems for smaller and bigger span structures is not well studied, and the majority of comparative study works done in the past have been between PEB and conventional steel buildings. Three plan dimensions—15 x 30 m, 40 x 80 m, and 90 x 180 m—for an industrial pitched roof structure are taken into consideration for the research job. Each is examined for a PEB and truss arrangement building configuration, and a thorough comparative analysis is conducted. An examination of the deformations, analysis findings, and material take-off is compared, and the efficacy of pre-engineered buildings for a building of a specific span and size is then examined.

Dipali K. Chhajed, Dr Sachin B. Mula (2020) The steel industry is expanding quickly in practically every region of the world. In the face of the threat posed by global warming, using steel constructions is not only cost-effective but also environmentally benign. Pre-engineered Buildings (PEB) meet this criteria along with decreased time and cost as compared to traditional structures, and long Span, Column Free buildings are the most important in any form of industrial structures. The task at hand entails a thorough examination and planning of connections in Pre-Engineered Buildings (PEB). With the aid of the Indian Standard Code and International Codes, the work is mostly dependent on the load combination and design specifications of the structure. Pre-Engineered building analysis and design must be completed manually as well as using STAAD Pro software. The difference between two alternative codes by total tonnage and deflection criterion is seen in the result.

Ryan E.Smith & Shilpa Narayanmurthy.(2019) The function of prefabrication in India is discussed in this article. The article talks about the current state of building in India in terms of things like transportation, human rights, timetable, precision, and climate, among other things. The essay focuses on the introduction of prefabricated iconography into India and discusses how it has affected the country's administration, economics, and culture. Because it is a production technology or knowledge-based rather than a consumption technology or product-based, fabrication technology has not transferred as readily as other technologies.

M. D. Gawade, U. P. Waghe (2018) In the steel construction sector, a pre-engineered steel building (PEB) is now one of the most effective and straightforward building types. In the Indian civil sector, PEB has a wide range of applications. One of the fundamental characteristics of PEB is the use of tapered elements for columns and rafters. The PEB operates more effectively when web-tapered members are used. The usage of these members is created in the industry whose design is based on the American design, although there are restrictions for the design of tapered members by Indian code. In this study, we conducted a review of certain literature that is based on the idea and layout of

PEB. We have also investigated the code provisions and conducted a quick analysis of PEB.

Buildin Momin Afrin Imatiyaj, Mote Prajakta (2018) Pre-engineered buildings is a word that sounds academic and dates back to the 1960s. Pre-engineered steel building systems are a practical and cost-effective alternative to traditional buildings that have several benefits over single-story structures. It aids in lowering the amount of steel used and raises the atheistic viewpoint of the construction.

C.M.Meera, (2015) In this essay, the conventional steel building (CSB) idea and the PEB concept are compared. The structural analysis and design programme Stand Pro is used to conduct the comparison research. at a commercial warehouse. This essay explains the multiple benefits of the PEB idea over the CSB concept in terms of cost efficiency, quality assurance, construction speed, and ease of erection.

Kavya.Rao.M.N, K.N.Vishwanath(2014) The quality of our everyday lives has significantly improved as a result of technical advancements over time. Pre-engineered structures are just one illustration of this shift. Although it is believed to have its roots in the 1960s, it has just recently become extensively used. A brand-new idea in industrial building construction for single stories is the pre-engineered building (PEB). It covers the method of offering the best segment in accordance with the most pressing need. This essay compares and contrasts the concepts of conventional steel buildings (CSB) and re-engineered buildings (PEB). By applying the concepts to construct an industrial building and the structural analysis and design programme Staad pro to analyse them, the study is accomplished. PEB and CSB are built to withstand dynamic forces, including wind forces, in order to do this. The study's findings demonstrate that pre-engineered buildings have advantages over traditional steel structures.

Aijaz Ahmad Zende, Prof. A. V. Kulkarni , Aslam Hutagia (2013) Pre Engineered Buildings (PEB) accomplish this need with less time and expense as compared to conventional structures, and long Span, Column Free buildings are the most important in any form of industrial structures. The current work compares static and dynamic analysis and design of conventional steel frames and pre-engineered buildings (PEB). Staad Pro software is used to design the construction, which is then compared to the conventional form in terms of weight. This lowers the cost. For the study, three cases were used. In two cases, pre-engineered buildings (PEB) and conventional steel frames are compared; in the third example, a pre-engineered building structure with a greater span is used for the analysis.

Jain D. Thakar, Prof.P.G.Patel,(2013) To understand the behaviour of PEB and determine when it achieves the economy in steel amount by varying bay spacing, PEB with various widths and eaves heights have been analysed and designed using Stadd-Pro. Base reaction, column moment, rafter moment, displacement at ridge, and displacement at mid span analysis findings are visible. After analysis, it was shown that the base response for various load scenarios grows as portal spacing grows. The increment of load is shown to decrease at bay spacings between 3.5 and 6.5 metres. It suggests that the base response is relatively reduced because of the 6.5m bay spacing. At the intersection of the beam and column, the increment of moment is observed to decrease between 5.5m and 6.5m by spacing and to increase between 6.5m and 7.5m by spacing. It shows that the moment caused by the dead load for 6.5m by spacing is significantly reduced.

Aijaz Ahmad Zende, Prof.A.V.Kulkarni, AslamHutagi (2013) In this essay, static and dynamic analysis and design of PEB and traditional steel frames are compared. Stadd Pro software is used to design the structures, and it is compared to the conventional kind. In the paper, greater span PEB structures are also studied. The cheap cost, strength, durability, design, flexibility, adaptability, and recyclability of PEB are all successfully communicated in this work. According to the report, the weight of steel may be lowered by 27%, resulting in a lower dead load and higher seismic resistance. Additionally, a comparison revealed that while PEB constructions have clear spans, their weight is 10% lower than that of conventional buildings.

Ms.Darshan P. Zood,"Evaluation (2012) This essay examines the IS-800 pre-engineering structure design standard and compares it to AISC. the main distinctions between the AISE and IS coding methodologies that were noted in this article. Live load (L.L) calculations made using the IS code (IS 875 Part II) are more accurate than those made using the Metal Building Manufacturers Association (MBMA), which leads to relatively expensive and hefty structures. Rolling shutters are taken into consideration when determining the percentage of opening in MBMA frames for opening doors even if they are not permanently open as per IS. When compared to IS code, MBMA greatly simplifies the calculation of the wind coefficient. The load determined by the IS code exceeds the MBMA's deflection limit. The IS code's deflection limit is greater than the MBMA's deflection limit. Compared to AISC, IS code provides a more traditional design for portal frames.

Dr.N.Subramanian (2008) The focus of this essay is on frame system selection as well as wall and roofing material choices. Industrial buildings can be categorised as braced or un-braced frames, with portal frames offering numerous benefits over braced frames, depending on the structural framing

method used. This portal structure is frequently prefabricated in a factory and assembled on site. It is also known as a metal building system. The kind of roof deck, the pipe of the purlin, spacing, deflections of secondary structural parts, roof pitch, and drainage needs are all impacted by the roofing option. In PEB, steel and aluminium decking and cladding are often employed. Steel decks come in a variety of thicknesses, depths, rib spacings, widths, lengths, and hues. The through fixed lapped seam roofing is simple, straightforward, and affordable to install, but since it is pierced by fasteners, it is prone to leaks. So, in modern projects, standing seam metal roof decks are employed. Each panel of a standing seam roof has two vertically oriented seams that are moulded or crimped together to seal the connection and prevent roofing material from penetrating.

Vaishali Turai (2017), The expansion of the Indian building industry would quicken in order to satisfy (meet) the demands of the next generation and to achieve advanced techniques. The article compares the construction times of precast and cast-in-place (or conventional) concrete. How using a precast concrete technology reduces construction time overall compared to using cast-in-place concrete. Any construction's duration directly varies with its expense. The amount of time needed for steel binding, shuttering, concreting, and subsequently curing will be as little as possible (7 days).Precast is produced in a factory (i.e., under controlled conditions) with the necessary quality, is simple to mix, and is cured until the needed quantity and strength are reached. Precast concrete is produced at a factory and delivered to the construction site. Precast concrete's strength is increased to a higher extent by employing a high-tech, regulated technique. Less labour is needed for precast building; workers are simply needed to join precast members. Precast members can reduce the amount of time required for rework as a result of defective work, flawed building techniques, inexperienced labour, poor material quality, and onsite environmental issues.

T.Subramani1, M. Muhammad Ansar (2013) The strength, predetermined thermal properties, dynamic stability, and immutability of the geometric dimensions of the prefabricated elements are provided by prefabricated buildings and structures that are mounted from uniform prefabricated three-dimensional units under challenging and unique circumstances. In terms of its effect on environmental protection, prefabrication has generally been viewed as a sustainable building process. The impact of prefabrication on the reduction of construction waste and the subsequent waste handling activities, such as waste sorting, reuse, recycle, and disposal suggestions for improving the industry and research on the cost-effectiveness of precast concrete construction, are important aspects of this perspective.. The prefabricated building process usually starts with assembling of the steel, concrete and wood, or pure concrete frames.

Radziszewska-Zielina (2014) A study conducted in Poland comparing the economic advantages of traditional construction techniques and prefabricated building systems found that the latter offered labour savings of up to 70% on the construction site while its total construction required savings of almost 50% when using prefabrication techniques in their entirety. These instances serve as illustrations of the enormous advantages of prefabrication, in addition to its ability to minimise energy use, waste production, greenhouse gas emissions, and other adverse environmental effects. The basis of this study is an evaluation of building systems, their features, and the difficulties they provide to the construction industry, particularly in metropolitan, fast-paced locations like the UAE.

Lu, W. and Yuan (2014) Prefabrication for the building industry is being promoted more and more as a way to reduce waste and the accompanying negative effects on the environment and society. Previous studies have discussed the potential for waste reduction via prefabrication adoption in many economies, including Hong Kong. These studies' ignoring of the prefabrication's upstream processes, such as component production and shipping, which also results in construction waste, is a serious flaw. How this amount of building debris is produced and measured is still a mystery as of this writing. This research offers perspectives on how to comprehend offshore prefabrication's ability to reduce construction waste from a comprehensive standpoint.

CONCLUDING REMARK

Traditional building methods employ shuttering or timber moulds for structural components such as roof spans. Due to the frequency of building during the peak seasons of spring and summer, these temporary timber structures have a short lifespan and are sometimes unavailable for larger, well-funded projects. Due to this, projects cannot be finished before the start of the colder or rainier seasons, which interferes with construction timelines. The absence of the right tools and materials does not, however, prevent work from continuing over the summer. Instead, adopting improvised techniques results in improper means and, as a result, poor construction quality in final structures. The problems of timber moulds and shuttering are eliminated by using the prefabricated alternative to roof construction. Indian housing prefabrication enhances homogeneity and The market for prefabricated houses has seen material advancements that have lessened material failures. Fly ash is added to concrete to improve thermal performance and make it easier to work with. Fly ash concrete block is also starting to take the place of conventional clay bricks since it doesn't include expanding soils that can cause walls and flooring to break when the temperature and humidity change. Fly ash is a byproduct of the coal burning process used to produce energy, and it is collected and

repurposed to create stronger, more stable construction materials in a manufacturing setting. Building more seismically resistant constructions is made possible by the more predictable material manufacture.

CONCLUSION

Pre-engineered steel buildings are affordable, strong, long-lasting, flexible in terms of design, adaptable, and recyclable. Pre-engineered steel buildings are made mostly of steel as its primary component. It contradicts local sources. Steel is the material that best embodies the requirements of sustainable development since it is infinitely recyclable. Pre-engineered steel buildings are more cost-effective and offer superior quality, strength, flexibility in terms of design, and recyclability. Steel is the primary component of the materials used in pre-engineered steel buildings. It cancels out from local sources. Steel is the material that symbolises the goals of practicable development since it is endlessly recyclable. The most attractive economy in the construction of respectful buildings may be achieved by making optimal use of tall review steel and a composite frame made of developed materials. However, there are a few views that must be addressed in the near future: 1. PEBs require a massive initial investment. 2. The majority of Indian teaching focuses on RCC buildings in its curricula, hence growth in steel development is neglected. 3. In response to consumer concerns, firefighting protocols for steel structures must advance. 4. As the portions chosen are typically heavier, IS codes should be changed.

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Corresponding Author

Mr. Mithil Bokefode*

Student, JSPM's Imperial College of Engineering