

Factors influence the Cost effectiveness in PEB & Conventional Buildings

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Abstract: *The current construction method for buildings requires the best aesthetic form, high quality and fast construction, cost effective and innovative touches. As India is a developing country, large scale buildings are being constructed in different parts of the country. In recent years, many projects in India have been facing problems of both costs and schedule delays. Since 30% of the Indian population lives in towns and cities, construction is high in urban areas. Therefore alternative construction systems such as prefabricated steel buildings should be considered. Pre engineered building is a steel building system that is prefabricated and prefabricated. Pre-engineered structures have many advantages such as optimized design, easy construction, longevity, light weight, low waste, increased productivity, better quality and reduced time and cost compared to traditional buildings. The concept of a pre engineered building consists of a complete design in the factory and parts of the building are brought to the site in a knock down position. These parts are fixed / attached on site and lifted with the help of cranes. Pre-engineered buildings are very fast construction and call for good aesthetics and quality construction of buildings. This study compared costs between conventional and pre-engineered buildings by selecting projects. A detailed cost analysis is done between the buildings and it is concluded that pre-engineered buildings are more economical than conventional buildings based on factors such as better planning, distance from the construction unit, proper operation and type of buildings. This also concludes that pre-engineered buildings are much more economical than conventional steel buildings for low-rise buildings*

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I. INTRODUCTION

As industrialization becomes the need of the hour, there continues to be an ever increasing demand for construction and site infrastructure. Business entities wanting to have new manufacturing, design and warehouse units, do invest in large amounts of resources. However, building large concrete structures requires both time and cost. One of the best solutions to these problems is pre-engineered buildings. The construction is much more cost effective. The installation also requires lesser manpower.

Pre Engineered buildings can be cost effective in many different ways. The process of construction takes much lesser time as assembled parts are put together. The conventional brick and mortar construction requires humongous amount of resources, budget and manpower. Also needed is large space for storing construction material as bricks, stones, sand, cement, etc.

Pre-engineered buildings are constructed by assembling the building components like door head, supporting pillars and column for doors. During the process of building, no welding work is required. This also cuts down on the cost of electricity consumption. These buildings can be erected within the stipulated deadline. As a result, multiple projects can be executed. It takes a long time in construction of a conventional building and thus, these are not suitable for any urgent projects. Prefabricated metal buildings are extremely durable as it is made using metal components. These buildings are lightweight and can withstand extreme weather conditions.

Below are few reasons as to how steel and metal building projects save costs in the long run.

II. LITERATURE REVIEW

1 **Jinsha M S and Linda Ann Mathew (2016)** stated that, A 25-meter wide and 6-meter elevated Engineered Building, according to has been examined and planned using STAAD Pro.2007 to determine how well the Pre-Engineered Structure needs to perform but whether or not shifting the cove dispersing to 6m, 8m, 10m, and 12m will meet the financial system's steel amount requirements. Pre-Engineered Buildings answer the major need in modern technology for a long-span, column-free structure, while also saving money and time as compared to conventional constructions. PEB stands for Pre-Engineering Buildings (PEB), which are now being used for wind generation. In compliance with IS 875 (Part III) – 1987, a physical wind investigation was conducted. The outcomes of this inquiry influenced the following results: As the Bay Spacing increases up to a specific dividing point, weight decreases and also increases as a result of the increased Bay Spacing. The most cautious option is a pre-designed structure with narrows that scatter 8 metres. Steel production is largely depending on the amount of key staff and purlins. As bay spacing grows, primary member steel consumption decreases, while secondary member steel consumption increases.

2 **D. Rakesh, V. Sanjay Gokul and G. Amar 2016** appeared in the lead roles. Pre-engineered fabrication and steel structures are becoming increasingly important in mechanical constructions, where safety and reliability are key considerations. The normal steel building and Pre-Engineered fabricating idea is another kind of single-story mechanical structure construction. Because of its carefree and effective development as well as its thorough pre-planning and construction, this is a strategy that can adapt to any situation. An essential part of the concept is the strategy of delivering the best possible segment to meet the customer's most pressing needs. Conventional building methods are used to build the industrial facility's surrounding structures, using steel and prefabrication ideas. Building a structure with traditional steel construction and Pre-Engineered Fabrication requires speedy construction with high aesthetic and quality standards. The use of pre-engineered and standardized steel structures in the mechanical and private construction industries is widespread. The eminent structure can be used in a variety of ways (4-6 stories). There is currently a standard support system and pre-designed structure used for steel removal and amount.

3 **T D Mythili (2017)**, steel has become increasingly more expensive, making its use in construction, and specifically industrial structures, an inevitable need. As a result, in order to maintain long-term economic viability, Steel must be used to its maximum capacity possible. PEBs are ideal for long-span, column-free industrial structures because they save time and money compared to traditional constructions. If you need a high-quality repair or if you're prefabricating, this approach is the best option. In a study effort, a truss with a 30-meter span holding a crane of 10tonne, 15tonne, and 20tonne was compared to a typical steel structure. Material use has decreased significantly during the past few years. Steel usage may be reduced by using PEB instead of CSB. When the amount of steel is reduced, there is a significant reduction in the dead load. Due to a decrease in Dead load, the foundation is smaller. The structure's visual attractiveness is enhanced with the use of PEB.

4 **ApurvRajendraThorat and Santosh K. Patil 2017** according to, this study used the Kirby Technical Specification based on ASCE-07 to design and examine pre-engineered structures. Two instances were selected for this investigation. Bracings and PEBs without bracing systems are compared using two instances. El-Centro will use the ground movement reported by PEB to conduct dynamic load analysis. Various loading actions on PEB are studied utilising Time Event Investigation in this article. Even without bracing, two PEB mathematical models with a total span of 21 metres may be constructed

5 **Muhammad UmairSaleem and Hisham Jahangir Qureshi (2018)** declared that In general, scientists have emphasised the need of building a sustainable foundation, Steel segment forms and profiles may now be dealt with more efficiently thanks to the use of new innovation in the steel fabricating business. Through pre-built structure development innovation, steel building prices have been lowered significantly over the past few decades. Traditional steel structures (CSB) use hot-working components and homogenous cross-segment over the length of the assembly to create their structures. Instead of pre-designed steel structures (PEB), utilize steel segments that are custom-fitted and profiled depending on the needed stacking forces. PEB Steel Exhibition now outlines the optimum use of steel areas and their link to conventional steel structures in great detail. Steel outlines of PEB and CSB may be seen developing in different stacking conditions. As part of the American Foundation for Steel Development's structural details, a limited component-based inspection device was used to inspect casings. Several aspects of the casings have been studied in detail, including edge loads, parallel relocation (influence), and vertical removals (avoidance).

III. METHODOLOGY

PEB system is highly efficient in design due to synergy between building components. Primary members are made of tapered built-up sections and roof/wall secondary members from cold rolled sections designed as continuous beams. Tapered built up sections allows for custom designing the member as required. High strength steel is used and all structural elements are fully optimized by computerized design program. This leads to significant reduction in dead load reactions to foundations and reduction in overall weight of steel used. Site erection is fast and simple - just bolting together the various building components as per the erection drawings provided. No site fabrication or welding is involved. Due to this, quality is far more superior and a large chunk of time is saved in comparison to conventional steel construction methods.

✓ **What is the percentage of saving in steel structure using PEB systems compared to conventional steel buildings?**

On average the estimated savings is between 20-40%. It depends on design code considered and building dimensions. PEB's are lighter through efficient use of steel. Primary framing members are tapered (varying depths) built-up sections with large depths in the areas of highest stress. Secondary members are light gage (light weight) roll-formed (lower labor cost) Z or C shaped members. Primary steel members are selected from standard hot rolled "I" sections which are in many segments of the members, heavier than what is actually required by design. Members have constant cross sections regardless of the varying magnitude of the local internal stresses along the member length. Secondary members are selected from standard hot rolled I or C sections, which are heavier.

✓ **Why choose Pre-engineered Steel Buildings over concrete building when wide column spans is not an issue**

The global weight of steel buildings is lighter than a concrete building; therefore you can expect savings in foundation size and cost. Pre-Engineered Building Company is that it is both the designer and the fabricator of the building project. Therefore there is virtually no engineering service or process that can be identified as distinct from the fabricated product. In fact, a primary engineering objective is to make the fabrication process more efficient through design and detailing solutions which address economy of material and man-hours. At the same time, it addresses quality and time saving. Pre-engineering buildings are ideal to ensure structural integrity as engineering services or quality control on structural members and supervision, are not required on site.

IV. RESULT AND DISCUSSION

❖ **Cost saving factors in Pre-engineered buildings**

The ability to be pre-engineered or fabricated is one property of steel or metal buildings is another of the cost saving factors. These features attribute to multi-fold cost savings like:

✓ **Energy saving features**

Steel buildings are designed with energy efficiency in mind, during manufacturing process. Steel and metal components are made with high pre and post-consumer recycled materials. The building components themselves have also an energy saving capabilities. They also have recyclable properties which makes steel and metal buildings one of the preferred options in the market. Apart from cost savings, there are many reasons for the popularity of steel and metal buildings in the market. The durability and low-maintenance requirements are coupled with lifetime cost-effectiveness.

Cost and Durability Two factors that make Pre engineered Buildings the best choice for Warehouses. As a building material, steel supplies superior-top quality at an economical price, particularly when it involves big projects like the building of commercial warehouses.

Pre-engineering: Considering that the materials are pre-measured and cut, it permits a faster construct process from start to finish. Constructing a steel storage facility is a structured job due to the fact that the products are prepared in advance and delivered to the job site ready to be built. This can substantially reduce building and construction time which, in turn, causes a reduced task cost and obtains your procedure up and running faster.

Labour: The pre-fabrication of the building set helps to lower work prices substantially. Timelines can be reduced by as high as 50% contrasted to various other sorts of storehouse building. When it pertains to personal specialists, time is cash. When your structure's steel structure, wall surfaces, and also roof, are pre-measured and cut, this minimizes the quantity of time it will certainly take a crew to construct your building.

Upkeep: Not just do you need to look at the first prices for building, yet it's additionally crucial to note the recurring upkeep expenses of steel structures. A steel storehouse is low-maintenance, which means that you can prevent expensive costs in the future. Over the lifetime of your steel structure cost savings on maintenance can add up to tens, and even numerous hundreds of dollars.

Other cost savings, such as lowered insurance policy premiums thanks to the security and resistance to weather damages of steel, should also be made up. The same can be said for products or devices which are saved inside the warehouse; thanks to the durability and also security features associated with steel buildings, whatever you store in the stockroom will be risk-free and shielded from the elements.

When making an investment in something as expensive as a new commercial structure, the framework must be made of materials that will last for years to find. With appropriate construction and also maintenance, steel buildings can easily last 50 years or more.

Pre engineered buildings are resistant to many of the typical concerns that threaten the longevity and also longevity of structures. As an example, steel is a much more durable option if you are wanting to minimize the danger of all-natural risks, including fire, mold and mildew, rot, bugs, heavy snow, earthquakes, and solid winds. On the uncommon occasion that superstorms ravage an area, steel warehouses tend to be the last structures standing.

Long life is a top priority when investing a large amount of money right into building construction. Steel is a clear choice if you are trying to find something that will certainly hold up against the components as well as last for many years ahead.

✓ **Insulation Properties help save cost**

Considering that prefabricated buildings are energy efficient since they have tremendous insulation properties to beat both heat and cold. The insulating capabilities of steel prevent heat from percolating in. This is of benefit during summers in areas with tropical climate. Apart from this, the roof on your steel building does reflect sun rays, which in turn reduces the cooling load on the steel building normally arising from use of ACs. This kind of energy-efficiency is one reason why a pre-engineered steel building will continue to offer you savings throughout the year.

✓ **PEBs need very little maintenance**

The other cost saving area in a pre engineered building is related to its low maintenance. A typical prefab steel building system, needs very little to no maintenance over a period of time. Metal surfaces are not difficult to keep tidy, and the modern metal finishes does allow the growth of mold, mildew or get discolored, which are common maintenance requiring areas in a typical brick and mortar alternative. Pre-engineered steel buildings neither decay nor decompose with the passage. Their columns don't disperse or attain damage caused by rodents or insects. So on the whole, a pre engineered steel building needs very little maintenance and therefore saves significant costs.

✓ **PEBs have fire resistive capabilities**

Other than accruing continuous savings due to energy-efficiency and low-maintenance factors, steel buildings do not inherently catch fire and have the ability to resist it. Many business owners don't realize that this fire resistive factor can save them immense cost on inventory and insurance premium during the life of pre engineered buildings.

To sum it up, with PEBs there is a broader scope to save on costs in the long run. When you compare different building types, it is recommended to have complete understanding of things that can give you an understanding of the total cost of setup as well as maintenance, labour costs, overheads etc. As a customer, one should consider the kind of value they associate with safety and environmental factors. While considering all the factors, we believe that your needle will swing towards Pre engineered buildings.

• **Estimation**

The data collection via the estimation, the raw data needed to be analyzed to meet the goal. For the convenience of comprehension, the following analysis is carried out under the same sections as the conventional building. From the above estimates it is clear that pre-engineered building costs lesser than conventional building and pre engineered building requires lesser time as compared to conventional building.

Table 1: Comparison between cost of PEB and Conventional Building

Description	PEB	Conventional building
Total cost of building	1472728	1782732
Plinth area in sq.m	760	760
Rate of plinth area in per sq.m	1937.8	2345.7
& Difference	-	17.38

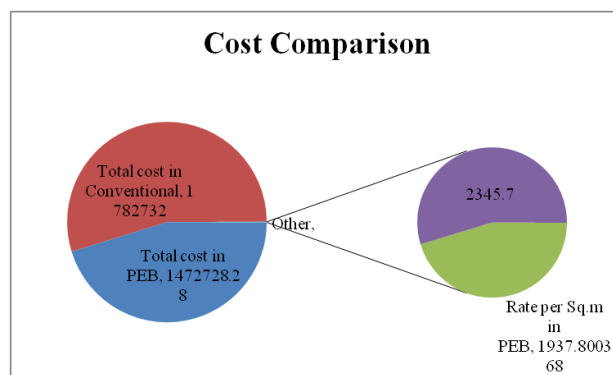


Figure1: Cost Comparison of PEB and Conventional Building

V. CONCLUSION

Pre-engineered buildings have proven to be lightweight structures and can be highly adopted to replace traditional steel structures. Effectively optimizing the cross section of construction components based on the minimum number of construction components involved in the design and the concentration of developed forces and stresses can help to achieve economy and consume less material resources.

The prefabricated metal fabrication concept creates a unique position in the construction industry, ideally suited to the needs of the modern engineering industry. It is the only solution for large industrial premises with thermal and acoustic properties. The main advantage of metal construction is the high speed of design and construction of buildings of different categories. Proper monitoring, maintenance, connections and a short lead distance can make a project more profitable. From previous studies, it has been proven that PEB structures are more economical and contribute to material savings. PEB implementation is increasing but is used lower than expected. Research suggests that PEB structures are easier to design. These designs provide efficient and fast construction. These structures are more reliable than CSB. Therefore more research is needed for more outputs to reduce design methods and materials in PEB structures

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