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A DETAILED STUDY ON CONTRAST LINKAGES BETWEEN CONVENTIONAL AND PRE-ENGINEERING 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.

Many projects in India in recent years have been facing problems of both cost overruns and scheduling delays. Both of these problems can be controlled by following the concept of pre-engineered buildings. Pre-engineered structures have many advantages such as optimized design, easy construction, longer duration, less weight, less waste, increased productivity, better quality than traditional buildings, less time and cost. This study compared costs between traditional and pre-engineered buildings by selecting two projects. The literature review was done and the facts related to this concept were provided. A detailed cost analysis is done between the two buildings and it is concluded that pre-engineered buildings are more economical than traditional 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 traditional steel buildings for low-rise buildings.

I. INTRODUCTION

India has the second largest growing economy in the world and most of it, is attributed to its construction industry, which comes after agriculture in its economic benefaction to the nation. In its continuous evolution, the construction sector has invented, discovered and developed many of technologies, products and systems, one of special concept, which is PEBs (Pre-Engineered Buildings). In contrast to on-site manufacturing, PEB is delivered from one supplier to the site as a product which is completely finished, comprising of an essential structural steel framework joined with factory finished components of roofing and cladding. By bolting various components of building, the structure is erected on the site as per the specifications. PEBs can be developed using various potential design softwares. Technological advances in launching 3D modeling and proposed architecture and coordination details revolutionized traditional construction. Pre-Engineered Buildings (PEBs) are like the future of India. Many Indian business community are beginning to realize the benefits of PEB. Where you have been building with concrete for a long time, it is difficult to replace it until someone remembers. However, the most progressive companies in India are acquiring the advantages of PEB.

The steel industry is growing rapidly in almost all over the world. The usage of steel structures is not only economical, but also environmentally friendly when there is a threat of

global warming. Here, the term "economical" takes into account of cost and time. Since the time is very important ingredient, steel structures (Pre fabricated) are built in very short period of time and one such example is Pre Engineered Buildings (PEBs).

Although PEBs are widely used in industrial and most of other non-residential structures all over the world, this is relatively a new methodology in India. Several multinational corporations recently introduced these concepts to the Indian market with the launch of the economy in the late 1990s and the setting up of their own projects.

Pre-engineered buildings are usually low-rise buildings and the max eave height can be upto 25 to 30 meters. Low-rise buildings are best possible for houses, Offices, shop fronts, showrooms, etc. Applying the concept of pre-engineered buildings to low-rise buildings can be very economical and fast. Buildings are usually built in less than half the time, especially when affiliated with other engineering subsystems. PEB building cost 30% less than CSB construction cost.

A major portion of the India's economy is provided by the construction sector. The researcher not only tries to make the structure economical but also environmentally friendly. Steel is most expensive material compared to other materials of construction. With the help of paint the steel can be made rustproof. Recently, modern technology has been introduced in PEB steel construction.

Pre-engineered building systems in steel structure design are modern technology that provides economical, Sustainable and environmental friendly structures. On contrary, before the introduction of the PEB system in the construction of steel structures, conventional steel building systems were used which are of time-consuming and of expensive design. Pre-engineering building is expensive due to the high consumption of steel as a uniform cross-section of the hot-rolled section, which is used across the member length. Nonetheless, based on the loading effect in section used in PEB and only bolted connections are supplied at the construction site.

CATEGORIES OF BUILDING

The last decade has seen healthy growth and increased demand in the construction of residential buildings, institutional buildings, commercial buildings and the infrastructure sector. The structures of antiquity are very simple and barbaric compared to the structures of modern times. The major change seen in today's structures is that they are loftier, taller and thinner than vintage structures. Concrete, steel and other materials saw a continuous economic competition in the construction of structures.

The different categories of buildings are as follows:

1. Reinforced Concrete Structures

2. Conventional Steel Structures:

3. Pre-Engineered Buildings [PEB]

1. Reinforced Concrete Structures:

These are structures that use steel bars to improve the properties of concrete. In recent years, it has been used in various forms as a cost-effective material of construction. It is possible to build these structures with the help of local labors and with materials like fine aggregates, cement; coarse aggregates, water etc., which are available widely.

2. Conventional steel structures:

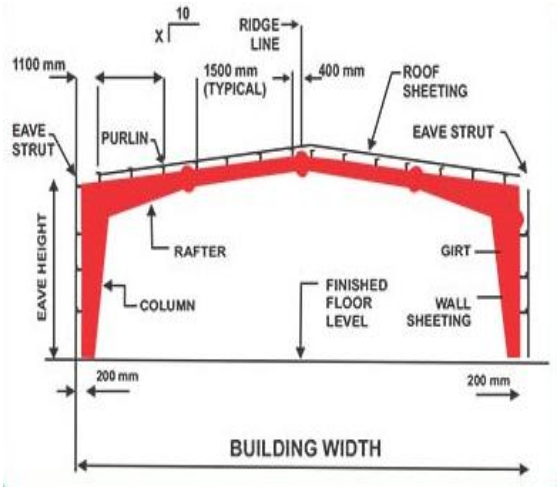
In today's world, steel is bringing elegance, imaginativeness, artistry and is functioning in unlimited ways contributing to new answers for the construction of formidable structures, which were once even inconceivable. Steel provides speedy construction right from the beginning. Due to its important properties like flexibility, durability, ductility, etc, steel is been extensively used in the construction sector. It bends under the application of heavy loads instead of crumbling and crushing. Due to its strength, less rate, stability, flexibility and recyclability, it is a best option to use the steel in construction. It can also be observed that steel has some reserve strength in them. The conventional steel buildings are stable. Hot rolled structural members are commonly used in these buildings. Here the members are manufactured in factories and then shipped to the site. The changes can be made during the erection by welding and cutting process. Usually trusses are used in this system.

3. Pre-Engineered Buildings [PEB]:

These are produced at the plant, itself. Here the members are manufactured according to the need of the customer. The components are made in completely ready state for shipment. These are then sent to the site and then the erection process begins. The manufacturing process does not take place on the site. Pre-engineered buildings are commonly constructed for shop fronts, office, warehouses etc. Here the additional amount of steel is avoided because the sections are tapered according to the bending moment diagram.

BASIC PARAMETERS OF A PRE-ENGINEERED BUILDING

The basic parameters that define a pre-engineered buildings are:



i. Width of the building

Regardless of which primary framing system is used, the building width is elucidated as the distance from the outside of the eave strut of one sidewall to outside of eave strut of the other sidewall. The width of the building does not include width of roof extensions or Lean buildings.

ii. Length of the building

The distance between the outside flanges of the two end wall columns in is the length of the building. It is a combination of several bay lengths.

iii. Height of the building

Height of the building is the eave height, which is usually the distance from the bottom of the main frame column base plate to the outer point at the top of the eve strut. When columns are lowered or raised from finished floor, eave height is the distance from finished floor level to top of eave strut.

iv. Roof Slope

This is the inclination or angle of the roof relative to the horizontal. The most common roof slopes are 0.5/10 and 1/10. Any practical roof slope is conceivable.

v. The length of the end bay

The distance from centreline of the first interior rime column to outside of the outer flange of end wall columns.

vi. The length of the inner bay

The distance between the center lines of two adjacent inner mainframe columns. The most common lengths of the inner bay are 6 m, 7.5 m and 9 m.

vii. Design Loads

PEBs are designed for the following minimum loads:

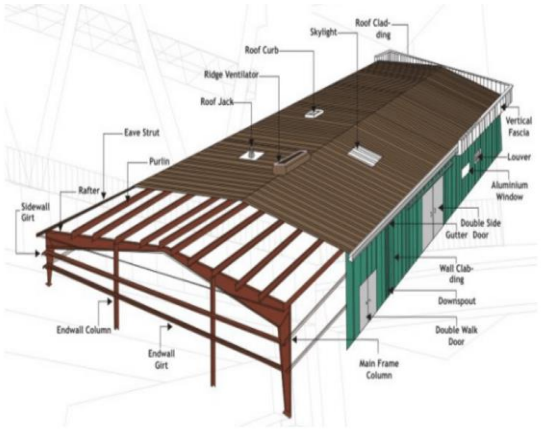
Roof Live Load: 0.57 kN/m^2

Design Wind Speed: 110 km/h

Design for collateral load, crane load, snow load, earth quake load, or any other loading condition, if required must be specified at the time of request for quotation.

Loads are applied as per the recent American codes, guidelines and standards applicable to PEBs unless otherwise requested at the time of request for quotation.

COMPONENTS OF PRE-ENGINEERED STEEL BUILDING



Generally, the major components of steel PEB are as follows

I. Main frame or vertical columns

II. Purlins, Girts And Eave Struts

III. Panels And Insulation

IV. Paints And Finishes

V. Windows And Doors

VI. False Ceiling

VII. Partition Walls

VIII. Flooring

ADVANTAGES OF PRE ENGINEERED BUILDINGS (PEB)

Advantages of PEB

a. Initial cost is low due to

• Tapered built-up structural members (columns & rafters)

• Z shaped secondary members (purlins & girts) that allow overlapping

• Foundations are less and it is very lighter

b. Greater product quality

• Design quality is newest and consistent as per international codes

• Welding is professionally done

• Fabrication is as per quality

c. Speedy construction of project

• Anchor bolts are on site before the building

• Fabrication and delivery is faster due to standardization

• Since all members are field bolted erection takes place faster

d. Functional Versatility

• Modular construction before the building

• Larger clear spans up to 100 m

• Longer bay spacing upto 13 m without jack beams

• Buildings are expandable in future easily

e. Architectural Flexibility

• Aesthetic features such as fascias, etc improve the panels

• Flashing and Trims come in various shapes and colors

• A wide range of wall and roof sheeting is available

f. Low maintaining and operating costs

• Virtually no maintenance for panels

• Eave gutters are washed annually

• Roofs are watertight

Disadvantages of PEB

The disadvantages of PSBs (pre-engineered buildings) are as follows

• Lead distance

• Handling

• Assembling

• Connections

• Demounting

• Proper structural analysis

• Material, equipment, and technique used

ADVANTAGES OF COST OF PRE- ENGINEERED BUILDINGS OVER CONVENTIONAL BUILDINGS

i. Accurate Estimates:

Computer production technologies and material design provide better estimates. Pre-engineered components are seamlessly assembled to prevent expensive construction surprises.

ii. Cheaper to Build:

Construction cost is very low. No welding or fabrication on site and no waste. The material is cheap. Computer aided design saves material and cost in pre-engineering manufacturing.

iii. Only One Structural Component Supplier:

One company does the architectural design work and provides the material components. This simplifies record keeping and eliminates waiting for supplies from various vendors.

iv. Good Energy Efficiency:

Components fit snugly without gaps. Metal panels have insulation.

v. Less Maintenance:

Metal roof finishes are very durable and last 15-20 years longer than traditional roofs. Finished metal panels are easy to clean and do not corrode or lose their color. No construction maintenance is required in practice.

vi. Cheaper Insurance:

Metal construction reduces fire risk — insurance companies sometimes lowers their rates.

vii. Less Time to Build:

A typical pre-engineered metal building takes less time to build and reduces financing costs.

viii. Attractive Appearance:

Masonry trim can be added to the exterior to give it a traditional look. Panels are available in a wide selection of baked colors for decoration selection.

ix. Safety:

The metal-frame structure is internally safe and can withstand extreme weather conditions.

II LITERATURE REVIEW

• Vivek Thakre and Mr. Laxmikant Vairagade showed that prefabricated buildings with one storey have many advantages, especially in terms of economy and ease of construction. Here he analyzed and developed the industrial structure in accordance with IS Code 800-1984, IS 800-2007 and MBMA-96 and AISC-89. He later made a comparison of the economy in terms of weights between the IS code and the US code. From their research they concluded that the structures they designed earlier were created by simple procedures related to IS codes. They also found that pre-engineered structures had different advantages over traditional steel-structures in terms of price, weight, erection etc.

• Sangale and Devalkar (2015) The Indian construction industry is changing rapidly, with new and inspired developments such as prefabricated parts, wooden round structures, steel limit structures, square work and shaped design etc. New advances will help assemble high-efficiency structures with less effort and time. Similarly, it expands capacity and limits work drive on site, minimizing material waste and minimizing impact on the ground. PEB was previously used more widely in India, but now conditions are developing adequately.

• Swati Wakchaure and N.C.Dubey showed that the use of pre-engineered structure in construction has various advantages as the members are designed according to the bending moment diagram. As a result, steel shrinks. They have been analyzed and studied according to IS 800-2007 and IS 800-1984 and the pre-engineering-construction has been compared to conventional steel-construction. He also compared the weight of the two structures. From their study they concluded that the traditional steel-structure was 30% heavier than the pre-engineered-structure and as a result the size of the foundation was reduced to pre-engineered-structure.

• Hemant Sharma studied the comparison and analysis of PEB and CSB Std Pro. In this case studies for industrial building are compared for bending moments in different sections and the results are compared for economy and time savings in construction. After analysis and design the report concludes with 37% material savings in PEB case as compared to CSB.

• G. Sai Kiran, A. Kailasa Rao, et al, (2014) "Examination of Design Procedures for Pre Engineering Buildings (PEB): A Case Study" - Refer to 1984, IS 800-2007 and further MBMA-96 and AISC-89. Currently, the structure, which is 187 m long, 40 m wide, 8 m high and has a clear height of 1:10, is being considered and planned for the 2D outline (end outline, 3 edge with outline and module without crane). Crane). The economy of construction is

talked about between Indian codes (IS800-1984, IS800-2007) and American codes (MBMA-96) and Indian codes (IS800-1984, IS800-2007).

• C. M. Meera, (2013) "Pre-Engineered Building Design of An Industrial Warehouse" The pre-engineered building (PEB) concept is another emergence of single story modern architectural development. This approach is suitable not only due to quality advance planning and construction, but also due to its light weight and traditional development. The idea captures the system that provides the most ideal area to meet the ideal needs. This idea has many more favorable conditions than the traditional steel building (CSB) idea of roof supported structures.

III METHODOLOGY

For accomplishing this project, following points will be considered. Collection of the information regarding conventional methods of building technologies and the limitations associated with it. Study various concepts of pre-engineered building and its various applications. Recent innovations and substitute techniques that are implemented for pre-engineered building will be highlighted. Cost-effectiveness of pre-engineered building over conventional buildings will be formulated. Following are the objectives of this study.

• Cost/Price comparison between pre-engineered building and conventional building.

• Quantitative estimation for all elements of an engineering block (Pre-engineered building)

• Quantitative estimates for all objects of a residential building (traditional building)

• Comparison between pre-engineered building and conventional building and highlighting construction cost and time difference.

IV RESULTS AND ANALYSIS

COMPARISION BETWEEN COST OF PRE-ENGINEERED BUILDING AND COST OF CONVENTIONAL BUILDING

Sl .No.	**Description**	**Pre-engineered building**	**Conventional building**
1.	Total cost of the building	Rs 3,01,21,050.30	Rs 24,74,490.58
2.	Plinth area in Square Meter	1984 Sq m	151 Sq m
3.	Plinth area in Square Meter	**Rs 15145.98 per Sq m**	**Rs 16333.27 per Sq m**

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.

INTERPRETATION

• Pre-engineered building construction is less costly than traditional building construction.

• The projects which have time constraint then we can go for the Pre-engineered buildings.

• The pre-engineered buildings will be used for the construction of temporary structures as these components can be reused.

V CONCLUSIONS

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.

Steel manufacturing has many advantages such as quality, economy, low cost, aesthetics and environmental friendliness. So steel pre-engineering should be given priority. Steel pre-engineered building has a huge range in India as it can meet the shortage of housing, educational, healthcare institutions, airports, railway stations, storage and industrial buildings etc.

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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