Scope Of Pre-engineered Building in India

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ABSTRACT

In recent years, the introduction of Pre Engineered Building (PEB) concept in the design of structures has helped in optimizing design. The adoptability of PEB in the place of Conventional Steel Building (CSB) design concept resulted in many advantages, including economy and easier fabrication. In this study an industrial structure (Ware House) is analyzed and designed.
Pre Engineering building means steel building system which is predesigned and prefabricated. In this study, know the Cost effective tool which helps to utilize the optimum cross-sections of steel. In this study we will study about the efficiency between Pre-engineered building and conventional steel building.

Keywords
PEB, CSB.

1. INTRODUCTION

In civil engineering, a pre-engineered building (PEB) is designed by a PEB supplier or PEB manufacturer, to be fabricated using best suited inventory of raw materials available from all sources and manufacturing methods that can efficiently satisfy a wide range of structural and aesthetic design requirements. Within some geographic industry sectors these buildings are also called pre-engineered metal buildings (PEMB) or, as is becoming increasingly common due to the reduced amount of pre-engineering involved in custom computer-aided designs, simply engineered metal buildings (EMB).During the 1960s, standardized engineering designs for buildings were first marketed as PEBs. Historically, the primary framing structure of a pre-engineered building is an assembly of I-shaped members, often referred to as I-beams. In pre-engineered buildings, the I beams used are usually formed by welding together steel plates to form the I section. The I beams are then field-assembled (e.g. bolted connections) to form the entire frame of the pre-engineered building. Some manufacturers taper the framing members (varying in web depth) according to the local loading effects. Larger plate dimensions are used in areas of higher load effects. Other forms of primary framing can include trusses, mill sections rather than three-plate welded, castellated beams, etc. The choice of economic form can vary depending on factors such as local capabilities (e.g. manufacturing, transportation, construction) and variations in material vs. labor costs.

Typically, primary frames are 2D type frames (i.e. may be analyzed using two-dimensional techniques). Advances in computer-aided design technology, materials and manufacturing capabilities have assisted a growth in alternate forms of pre-engineered building such as the tension fabric building and more sophisticated analysis (e.g. three-dimensional) as is required by some building codes.

While pre-engineered buildings can be adapted to suit a wide variety of structural applications, the greatest economy will be realized when utilizing standard details. An efficiently designed pre-engineered building can be lighter than the conventional steel buildings by up to 30%. Lighter weight equates to less steel and a potential price savings in structural framework.

Pre-Engineered buildings are being preferred over conventional buildings for industrial construction due to its fast construction. Following is the comparison between Pre-Engineered building and Conventional Buildings for steel structures, which shows advantages of pre-engineered buildings over conventional buildings..

2. NEED OF STUDY OF PEB IN INDIA.

India has the second fastest growing economy in the world and a lot of it, is attributed to its construction industry which figures just next to agriculture in its economic contribution to the nation. In its steadfast development, the construction industry has discovered, invented and developed a number of technologies, systems and products; one of them being the concept of Pre-engineered Buildings (PEBs). As opposed to being on-site fabricated, PEBs are delivered as a complete finished product to the site from a single supplier with a basic structural steel framework with attached factory finished cladding and roofing components. The structure is erected on the site by bolting the various building components together as per specifications. PEBs are developed using potential design software. The onset of technological advancement enabling 3d-modelling and detailing of the proposed structure and coordination has revolutionised conventional building construction.

PEBs have hit the construction market in a major way owing to the many benefits they possess. They exemplify the rising global construction, technology and while they oppose the practice of conventional building construction they simultaneously have taken it to a higher level too. Worldwide, they are a much used concept with studies revealing that 60% of the non-residential low-rise building in USA are pre-engineered; for India the concept has been gaining momentum and the scope of growth is guaranteed looking at India's huge infrastructural requirements. Studies already validate that India has the fastest growing market in the PEB construction segment. The scope of using PEBs ranges from showrooms, low height commercial complexes, industrial building and workshops, stadiums, schools, bridges, fuel stations to aircraft hangers, exhibition centres, railway stations and metro applications. While we are still to see PEBs being used in residences in India, one can see their optimal use in warehouses, industrial sheds, sports facilities etc. The Delhi Airport and the metro projects of Delhi, Bangalore and Mumbai are also examples of PEB applications. The PEB industry has evolved over the years. What started as a role limited to design and manufacturing PEBs, has widened today to making firms responsible for the erection of structure too.

A PEB system in totality consists of a structural system, sandwich panels, roofing, exterior facade and accessories. The PEB concept based on a proper design usually involves a thorough project information data including complete details like building parameters, grade of steel, secondary member details, paint coat on steel members, welding, anchor bolts steel grade, roof & wall liner / panel, insulation, sky light, gutters, mezzanine, ridge ventilation to name a few. Following this input, the drawings for general arrangement, Anchor Bolt & Template Fabrication & Erection are prepared.

3. HISTORY OF PEB

The origins of metal buildings date back nearly 150 years when British metal building companies developed this application. Walker Construction Company provided its original self-supporting barrel roof concept in 1832 and Morewood and Rogers provided warehouses to California during the gold rush in 18501. Similarly Hemming and Company supplied six churches to the diocese of Melbourne (Australia) in 1853. These church buildings weights about 50 tons when packaged and included a steel frame covered with galvanized corrugated sheets. An air gap was provided between the exterior steel and the interior wooden skin for air circulation.

During World War II, the need for "ready to erect" structures arose for use as barracks and maintenance facilities that could be containerized and shipped. Pre-engineered Steel buildings, which could be bolted together and required no welding at the site, were thus produced in significant quantities. By the end of the war, it was clear that the industry would not return to its pre-war product offerings. Metal buildings were here to stay. The post-war construction boom offered an ideal opportunity to mass produce buildings for a variety of non-residential industries. Metal building companies learned that partnerships with local contractors across a region, or even the entire country, were an effective way to deliver a building structure to the end customer. Buildings during this time were still prefabricated as the marketplace adapted to the limited, standard sizes that were available. However, the industry started offering several "standard sizes" to meet demand. The increase in standard sizes and the growing demand made prefabrication uneconomical and gave way for custom designed buildings. At this time, still well before the computer age, the process came to be known as the "pre-engineered".

The advent of the computer to analyze and design structural members has ultimately led to the current "made-to-order" process. Today, the metal building industry boasts a capability of producing buildings for virtually any low-rise, non-residential end use. These buildings are designs and quickly analyzed for structural integrity by engineers, who have vast knowledge of the applicable regional building codes. The custom design practice allows for economy in building design that makes metal buildings very attractive.

In order to accurately design a pre-engineered building, engineers consider the clear span between bearing points, bay spacing, roof slope, live loads, dead loads, collateral loads, wind uplift, deflection criteria, internal crane system and maximum practical size and weight of the fabricated members for efficient transportation and handling. Before the computer design era, PEB manufacturers had developed pre-calculated tables for different structural elements in order to allow designers to select the most efficient I-beams size for their projects. However, the computer-aided design software era has rendered the table selection procedure obsolete.

A pre-engineered building (PEB) is designed by a PEB supplier or manufacturer, using sophisticated design software which takes into account the strength and thickness of available steel, the building loading criteria like wind resistance, snow loading, seismic zone, and a host of other loads that the building may be subjected to. In addition to the design integrity, the corrosion resistance of the steel materials used is of great importance. The building components are manufactured to exacting standards so assembly at the site is not hampered. Today's PEBs can efficiently satisfy a wide range of structural and aesthetic design requirements. Ideally, the available material inventory is added to the software database and the software selects the appropriate materials for optimum design. It does include the flexibility to specify the preferred material thickness and mechanical properties.

4. ERECTION OF PEB

The construction of a pre-engineering building is a methodical step-by-step progression centred in design and function.
The construction of a pre-engineered building (PEB) commences with identifying the precise functions the structure will serve, so the loading of the building can be worked out and parameters influencing key structural components be charted and frozen.
Companies forming part of the PEB industry typically use meticulous design software facilitating 3D modeling and detailing of the proposed structure.
Many company has progressed from manually detailing engineering drawings to using sophisticated licensed CAD software for pre-engineered construction industry and, further, to using its in-house developed proprietary design software, including INTLEST (Intelligent Building Estimator), AGOSED (Automatic Generator of Shop and Erection Drawings), ASFAD (Advanced Structural Frame Analysis and Design) and Ez-Build. As a result, today, “100 per cent of engineering output is in digital format, facilitating the digital transportation of drawings to customers through FTP sites.
The foundation work entailed in constructing a PEB starts with the preparation of site, similar to the construction of conventional buildings. This involves two steps: civil foundation work, followed by the construction of the PEB superstructure on the foundation. Cites plain cement concrete (PCC) as providing a strong and stable base for the foundation as it avoids direct contact of the foundation with soil and provides a flat base (vis-à-vis an undulating base) for the upcoming foundation. To a certain extent, PCC also reduces the stresses on the soil and, as the grade of concrete used in PCC usually differs from that used in the foundation, it provides the substructure in a wholesome differential to reduce the impact of ground bacteria on the foundation.
The actual foundation differs depending on the kind of soil. “We chose a relatively shallow, isolated foundation for our project involving the construction of residential PEBs. However, the depth of the foundation would be significantly less than a conventional heavier structure. For instance, the construction of a ground-plus-two-storey brick and mortar housing structure would entail a 2.5 m pile foundation in a coastal region, whereas a PEB of the same height would only require a 1.25 m pile foundation. The steel frames of the PEB are anchored to bolts embedded into the pedestal at an appropriate depth depending on the load of the structure.”
As the unit weight of PEBs is considerably lower than conventional RCC buildings, similar functionality can be achieved with much smaller footings and foundations. This makes the structure economical by reducing the amounts of steel and concrete used for reinforcement. Anchor bolts are used to secure the steel structure to the foundation.
Steel at the core at the core of every PEB-whether it is a one-room kiosk or an expansive airport hangar, styled pillar-free warehouse or multi-storied building-is a steel frame manufactured to meet exacting specifications. However, the grade of steel used to make the frame differs depending on the type of structure. A modular PEB, limited to being a ground-plus-one-storey structure, requires a light gauge steel frame of a lesser thickness, typically 0.9 mm to 1.2 mm but with a higher tensile strength of 550 mpa. In comparison, the steel framing for a large, pillar-free structure is made of thicker steel, usually 4 mm to 50 mm, with a lower tensile strength of 345 Mpa.”
An integral component of a PEB, steel also finds expression in the roofing of single-storey and in the flooring and roofing of multi-storied PEBs. Contrary to laying an RCC slab supported by RCC columns and beams, in a traditional construction, a multi-storey PEB mandates steel columns and beams connected by nuts and bolts, to support a steel corrugated decking sheet that is typically 1 mm thick. The steel deck becomes a permanent part of the structure, unlike the supportive shuttering used in conventional construction that is removed after the concrete has matured. The method specifies minimum reinforcement for the concrete that is poured on the form,

that is, the steel deck, and which becomes the floor of the next storey.

The extensive range of wall finishes for a steel-framed building includes granite, stone cladding, fibre cement insulated panels, conventional brickwork, structural glazing, insulated steel panels, and aluminum composite panels. The choice usually depends on the client's preference and type of the building.

Nevertheless, the PEB industry seems given to using insulated steel panels in commercial establishments, because of their strength and ability to function as an effective weather barrier. For instance, for the construction of a chain of cash 'n' carry mega-sized Wal-Mart stores, Everest Industries is using 50-mm-thick insulated polyurethane foam puff steel panels. “The panels have twice the normal insulation and still the thickness of the walls does not exceed 2 inch, vis-à-vis a conventional 9-inch-thick brick wall “The roof of the stores also makes use of insulated steel panels to bring down the energy load of the structure.”

High-density fibre cement boards are Minean Habitat's choice for external and internal layers of the walls of the multi-storied residential buildings it is constructing. While the external board is 12 mm thick, the internal board is 10 mm and the space between is occupied by electrical and plumbing conduits and mineral wool insulating panels. “We opted to use high-density fibre cement boards as we wanted the exterior appearance of the buildings to resemble that of conventionally constructed structures,” reveals Roy. “So the boards will be plastered by the EIFS system a composite wall and ceiling finish system consisting of base coat, reinforcing mesh and finish coat applied to cement board. The cement board is attached to framing over a code-approved, water-resistive barrier, and painted over.”

High-density fibre cement boards or gypsum drywalls are equally useful as internal partitions and, as experts point out, these materials have no adverse impact on the surrounding environment. In fact, PEBs are increasingly being cited as fulfilling the three key features of green buildings: being made of reusable or recyclable components; being energy-efficient (using natural ventilation and natural lighting systems); and being environment-friendly. After all, 98 per cent of a completely pre-engineered structure is composed of aluminum or steel. Both materials are recyclable and reusable, on an as-is basis with minimum loss. PEB buildings that are designed to have adequate ventilation and lighting using natural ridge ventilators and FG/FRP skylights are also energy-efficient. What's more, PEBs have a long life and entail minimal maintenance costs. Indeed, it wouldn't be surprising if PEBs emerge as the green buildings of the future!

The components are only required to be assembled at site, which ensures precise and faster erection of the structure. In contrast, RCC buildings require a considerably higher level of coordination at site between various building material suppliers. Conventional buildings also require curing time for the concrete and mortar used, whereas PEBs are ready to occupy as soon as the last bolt is in place.

Industry experts point out that a medium-sized PEB intended to be used for a manufacturing setup (size 300 m long × 180 m wide × 6 m high) would take only six months to construct, whereas it would take 12 to 14 months to construct a conventional structure of the same size.

5. ADVANTAGES OF PEB.

- Construction time: PEB reduces the total construction cost by the least 40% which leads to faster occupancy and early revenue.
- Lower cost: Saving is accomplished in design, manufacturing and erection cost.
- Large clear span: In PEB the buildings can be given up to 90m clear spans which is the important advantage of PEB with column free space.
- Flexibility of expansion: PEB can be easily expanded in length by adding additional bays.
- Quality control: PEB’s are manufactured under controlled conditions depending on the site and hence the quality is assured.
- Low maintenance: PEB’s have high quality paint systems for cladding which gives long durability and low maintenance costs.

6. DISADVANTAGES OF PEB.

- Susceptible to Corrosion: If not properly maintained the steel frames are susceptible to corrosion, thus special coatings becomes necessary to resist the corrosion of steel
- Low Thermal Resistivity: Steel being a metal is good at conducting heat, thus it reduces the thermal comfort in the building.
- Low Fire Resistance: During fire, this type of building becomes more susceptible to damage due its conductivity.

7. APPLICATION OF PEB

Some of the many application of PEB are:

- Factories, warehouses, workshop, offices.
- Gas stations.
- Showrooms.
- Aircraft hangers.
- Metro stations.
- Bridges, Railway platform shelters.
- Outdoor stadium canopies.
- School, Indoor stadium roofs.
- Vehicle parking sheds.

PEB are more advantageous than the conventional structures in economy, speed of construction and simple erection. As these structures have a wide scope, they must be preferred and utilized

8. CONCLUSION.

Choosing steel to design a Pre-engineered steel structures building is to choose a material which offers low cost, strength, durability, design flexibility, adaptability and recyclability. Steel is the basic material that is used in the Materials that are used for Pre-engineered steel building. It negates from regional sources. It also means choosing reliable industrial products which come in a huge range of shapes and colors; it means rapid site installation and less energy consumption.

And it can also save time and cost as compared to Conventional steel building.

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