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Overview of Pre- Engineering Building- A Construction Techniques

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Abstract — ***In our construction sector Pre-Engineering building is the new concept in India. It has many advantages including economical solutions, easier fabrication and speedy installation which reduced time and cost.***

This technology is adaptable due to its quality of pre-designing, pre-planning and pre-fabrication but also due to its light weight and economical construction.

This concept generally used to build industrial building, Metro stations, Warehouse, etc. This technology structure designed by using frame CADD, stadd- pro & Etab and its planning done by using primavera and MS Project.

This process briefly describes the material unloading, lifting, placing the material into better position and then assemble them as an entire member by bolting.

Installation cost varies around 10-12% of the whole project price which is mainly dependant on the speed of installation of the building project.

Result shows that this technology is economic, reduced construction cost & time, energy efficient and flexibility of expansion if the project build with proper planning.

Keywords— ***Pre-Engineering Building, Steel building, Erection, Planning & Management, Cost & Time, Eco-friendly Construction, Stadd Pro.***

1. INTRODUCTION

As the latest trend in construction technology, Pre- Engineering Building is a metal building which is design and fabricate in manufacturing plant by peb supplier. Pre-engineering are nothing but steel building in which excess of steel is avoided by tampering the section as per the bending moment's requirement.

The adoptability of PEB is the place of conventional steel building, Design Concept resulted in many advantages including economy & easier fabrication. It can be lighter than the conventional steel building by upto 30%.

These building were pre-designed or pre- engineered into standard sizes, span, bays and heights and use standard fixing cladding, roofing, gutters, flashing, windows, doors etc.

It is consist of light gauge metal standing seam roof panel on steel purlins spanning between rigid frames with light gauge metal wall cladding.

PEBs can be delivered to a site in just 5 to 8 weeks - conventional steel structure take as much as 20 to 25 weeks to complete. The unique techniques employed during fabrication help PEBs be up-to 30% lighter than regular steel products. No welding or fabrication is required at the construction site, resulting in greater speed and efficiency.

The structural performance of these buildings is well understood and, for the most part, adequate code provisions are currently in place to ensure satisfactory behavior in high winds. Steel structures also have much better strength-to-weight ratios than RCC and they also can be easily dismantled.

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Thus, Pre-engineering building can be shifted and/or expanded as per the requirements in future.

2. COMPONENTS OF PEB-

Pre Engineered Buildings consist different steel structural member which are as follows-

2.1 **Primary Frame:-** Primary Frame of Peb is an assembly of builtup I- shaped steel members & that framing consist trusses or castellated beam etc.

2.2 **Secondary Structural elements:-** It is actually cold frame members which can be in diff. shapes like- "Z", "C", etc known's as Purlins.

2.3 **Roof & Wall Panels:-** Tin Shades & curtains wall made of glass & Roll-formed steel sheets usually comes in this category, S.

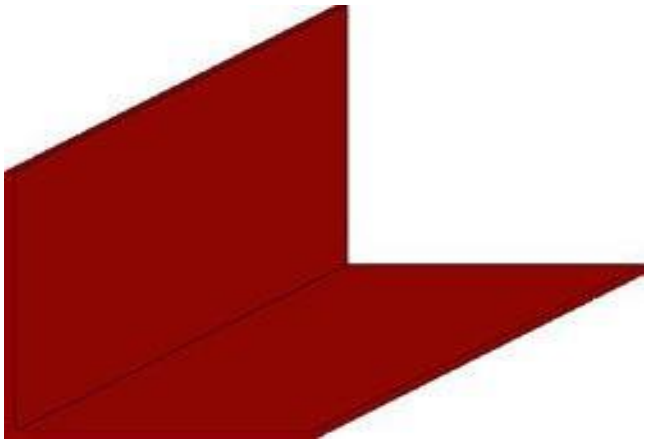

Fig. 1. Angle

2.4 **Sandwich Panels:-** This is made of three layers in which a non- aluminium core is inserted between two aluminium sheets.

2.5 **Other Accessories:-** Mezzanine floors, Bolts, Insulations, etc.

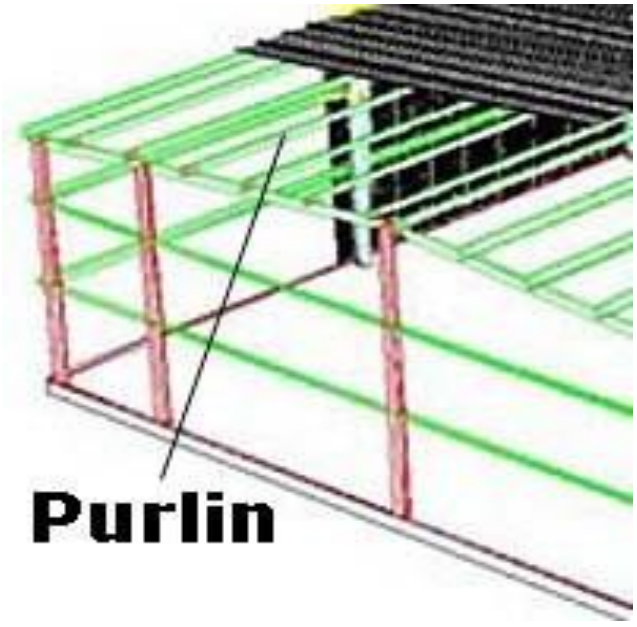

Fig. 2. Purlin

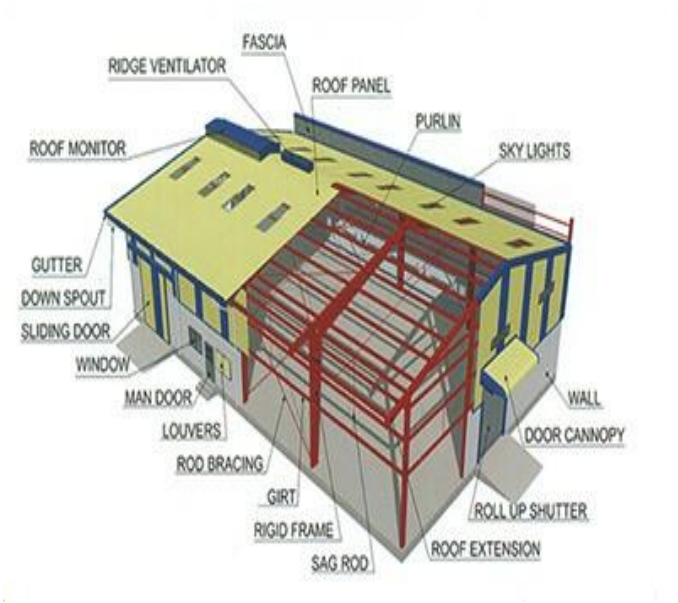

Fig 3. Pre- Engineering Building

3. ADVANTAGES OF PEB

There are many advantages of Pre-engineering building:-

3.1 **Quality Control:-** As building are manufactured completely in the factory under controlled the quality is assured.

3.2 **Lower Cost:-** Due to saving in design , manufacturing and on site erection.

3.3 **Flexibility of Expansion:-** Building can be easily expanded in length by adding additional bays. Also expansion in width and height is possible by pre-designing for future expansion.

3.4 **Low Maintenance:-** The use of standard quality of paints over steel members, which increase the ability to withstand & finally the maintenance cost will be low as compare to conventional steel building.

3.5 **Quick Erection:-** All the members are Pre- manufactured & skilled labour is used for connections of different components.

3.6 **Reduced Construction Cost:-** PEB will reduce total construction time of the project by at least 50%. Thus also allow faster occupancy and earlier realization of revenue.

4. DESIGN METHODOLOGY

4.1 **Method Used:-** Stiffness Matrix Method.

4.2 **Standard Code Used:-**

- AISC
- ASCE
- IS:800

4.3 **Software Used:**

- Stadd Pro v8i
- Etabs
- RAM Steel
- Framecadd

4.4 **Load Calculations:-** Loads considered in the PEB design are same as for general building structure. These are as follows,

4.4.1 Dead Load: It includes Self Wt. of Purlins, Roof & Wall Sheeting, insulation material & other structural component.

4.4.2 Live /Imposed Load:- It should be Considered as per given in IS 875 (Part 2) for diff. type of structure.

4.4.3 Wind Load Calculation:- Consider the Basic wind Speed as per Area of that particular structure. Design wind Pressure is calculated as per IS 875 (Part 3). Wind Load on Roof can be UDL & calculation for this can be done as per IS875 (Part 3).

A building built with heavy masonry, timber tiled roof may not be affected by the wind load.

4.4.4 Seismic Load Calculations:- Earthquake Loads affect the design of structure in areas of great seismic activity. The seismic load can be calculated as per IS 1893-2002 (Part 1).

4.4.5 Other Loads:- It can be Moving EOT Crane load or Mono Rail etc.

5. ERECTION PROCEDURES

When all the pre-erection work is completed, inspected, and passed by Quality Control, and your inventory is completed, you are ready to start erecting the PEB. To give you a general guide to follow, this phase of the discussion will introduce you to the basic PEB erection procedures. However, keep in mind that the drawings provided by the manufacturer must be followed in all cases, even where they might differ from information in this training manual. The manufacturer's standard practice is to pack an erection manual and a set of drawings in the small parts box (Box 1) shipped with each building.

5.1 Bolting Rigid Frames:- Before bolting up the rigid-frame assembly, clean all the dirt and debris from the top of the foundation, and then lay out and bolt the base shoes firmly to the concrete. Use appropriate washers between the shoes and nuts. Lay out an assembled column and roof beam at each pair of base shoes, using one bolt on each side of each base shoe to act as pivots in raising the frame (Figure 4). Use drift pins if needed to line up the holes.

5.2 Frame Erection:- To get the frame started be lifted by several people and proposed up as high as practical. Bolt an eave strut to each column. The eave strut allow to frame to be propped at every stage of the lifting.

You can use a crane or other suitable type of power equipment to hoist the frame into place where such equipment is amiable. When power equipment is used, use the following suggested procedure:-

- Raise the column, bolt then to the base shoes and brace them in place.
- Install all side wall girts to keep the column as rigid as possible.
- Bolts the roof beams together and install the gable posts and end wall header.
- Secure the guy lines and tag lines to the roof beams. Attached wire rope sling.
- Hoist the roof beam into position on top of column and built them in place.
- when the second rigid frame section is secured in position, install all the roof purlins, gable and lower angles.
- Install the brace rods and align the first buy.

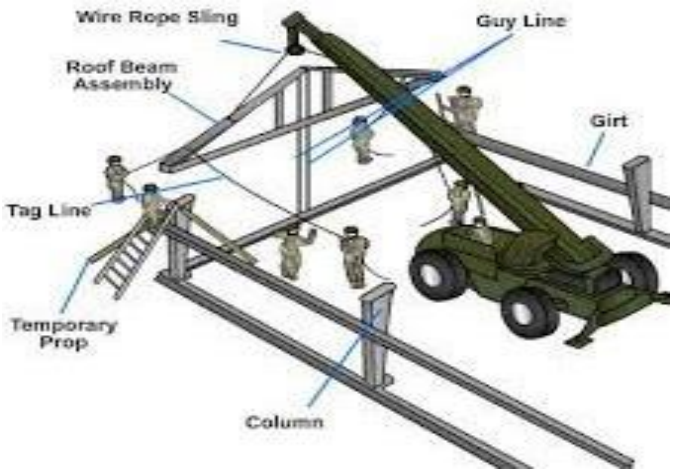

Fig. 4. Using Power equipment

5.3 Brace Rods: The length of the roof rods can be adjusted by tightening or loosening the turnbuckle. When the two diagonal measurements are the same, the end bay will be square. After the two frames have been plumbed and braced square with the diagonal rods, and the purlins, girts, and eave struts have been installed, the guy lines or props can be removed and the remaining frames of the building can be erected.

5.4 Sag Rods: Sag rods are used to hold the purlins and the girts in a straight line. First install the sag rods that connect the two purlins at the ridge of the building. Each rod must be attached from the top hole of one purlin through the bottom hole of the adjacent purlin. Use two nuts at each end of the sag rods, one on each side of each purlin. Adjust the nuts on these rods, so the purlins are held straight and rigid. Next, install the sag rods between the purlins below the ridge with the rod attached from the top hole of the upper purlin through the bottom hole of the lower purlin. Use two nuts on each end, one on each side of each purlin. Follow the same procedure with the sidewall sag rods.

5.5 Brace Angles and Base Angles:- After two or more bays have been erected, part of the erection crew can be assigned to install the diagonal brace angles. To install the brace angles, lay the notched portion against the frame flange and bend it into position (*Figure 17-8*). Diagonal brace angles are needed to support the inner flange of the frame. Be sure to install them so that they are taut.

5.6 End- Wall Framing/Door/Window:- Refer to the manufacturers' specifications for proper assembly and installation procedures for end-wall framing, doors (both sliding and roll-up), and windows, as these procedures will vary with available building options.

5.7 Sheeting:- Always start the sheeting, both sidewall and roof, at the end of the building toward which the prevailing winds blow.

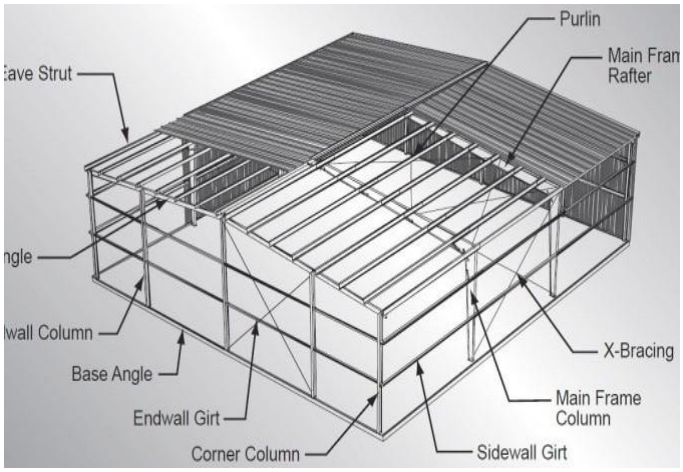

Fig 5. Section of Warehouse

6. CONCLUSION

This is reviewed that PEB structures can be easily designed by simple design procedures in accordance with country standards, it is energy efficient, speedy in construction, saves cost, sustainable and most important its reliable as compared to conventional buildings. Hence it is concluded that PEB has wide scope in India but they are still not preferred.

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