ANALYSIS AND DESIGN OF PRE-ENGINEERED BUILDING

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Abstract - The project is **ANALYSIS AND DESIGN OF PRE-ENGINEERED BUILDING.** The pre-engineered building system construction has great advantages to the single storey buildings, the system representing one central model within multiple disciplines. Pre-engineered building concept involves pre-designed and prefabricated steel building system. The current construction approach calls for the best architectural look, high quality and quick construction, cost-effective & creative touch. One has to think of alternative building systems such as pre-engineered steel buildings. The implementation of the Pre-Engineered Building (PEB) is a modern-day concept in which utilizing the steel structure and optimizing the design by ensuring economical integrity. The main objective of this project is to understand the concepts of PEB and to minimize the usage of cost and time. Pre-engineered building creates and maintains in real time multidimensional, data rich views through a project support is currently being implemented by staad pro software packages for design and engineering.

1. INTRODUCTION

Advancements in technology have been greatly improved over the years thereby contributing tremendously to improving the living standards through various new products and services. Pre-engineered buildings (PEB) are one such revolution. The use a set stock of raw materials that have been tested over time to meet a wide range of specifications for structural and architectural design.

1.1 Needs of pre-engineered building

In almost all parts of the world, the steel industry is growing rapidly. The use of steel structures at a time when there is a risk of global warming is not only economical but also environmentally friendly. If we go for standard steel structures, the time frame will be longer, and the cost will be higher as well, and both together, i.e. time and cost, will make it inexpensive. Therefore, the complete construction is performed in the factory in pre-engineered structures, and according to the design, members are prefabricated and then transported to the site where they are erected in less than 6 to 8 weeks.

Technological improvement over the year has contributed immensely to the enhancement of quality of life through various new products and services. One such revolution was the pre-engineered buildings. Through its origin can be traced back to 1960's its potential has been felt only during the recent years. This was mainly due to the development in technology, which helped in computerizing the design.

1.2 History of PEB

The use of pre-engineered buildings has been limited to North America and the Middle East for the most period until 1990. The use of pre-engineered buildings has since spread throughout Asia and Africa, where the concept of PEB architecture has now been widely accepted and lauded. The principle of pre-engineered steel building is known as the most flexible and economical building.

2.3 Applications of PEB

Almost every conceivable building use has been achieved with the most common applications are industrial, institutional and commercial. In India, pre-engineered building systems find application primarily in the construction of warehouses, industrial sheds and buildings. The recent focus has also shifted to cover rural as well as urban, individual and mass housing projects, farmhouse, slum re-organization projects and rehabilitation projects, amenity structures like health centers, kiosks, primary schools, etc. The pharmaceutical industries and exhibition centers, functional requirements like offices, seminar halls, call centers, supermarkets, showrooms etc. have also attracted PEB. Earthquake-resistant buildings are the recent applications of PEB with wide and immediate acceptance.

3. Types of PEB

There are two types of systems associated with PEB-primary and secondary The former system involves rafters and columns, whereas the latter involved C and Z purlin for keeping the structure together. Using purlins helps in cost reduction by 50% in comparison to conventional beams, channels and angles. Available in various dimensions and thickness, purlins ensure no fabrication cost and wastage. Purlins are easy to install, low maintenance, corrosion-resistant, light weight and durable. Therefore, these have become more and more popular these days.

3.1 OBJECTIVES

Presently, large column free area is the utmost requirement for any type of industry and with the advent of computer software's it is now easily possible with the improvement in technology, computer software's have contributed immensely to the enhancement of quality of life through new researches. Pre-engineered building is one of such revolution. Pre-engineered buildings are fully fabricated in the factory after designing, then transported to the site in completely knocked down (CKD) condition and all components are assembled and erected with nut-bolts, thereby reducing the time of completion.

4 COMPONENTS OF PRE-ENGINEERED BUILDING 4.1.1 Primary members Primary members in a PEB are the primary load bearing membranes and usually consist of the main rigid frame. Vertical members are called as columns and horizontals members are called as rafters. These are generally built up members made with hot rolled plates.

4.1.2 Secondary members Cold-formed members such as roof purlins, wall grits, eave strut, etc are the secondary members in the PEB process. These are called cold-formed members as there is no involvement of processes like cutting, welding and grinding. Cold-formed members are made with a pressing machine where in MS steel coil will be pressed by the machine into the required shape.

4.2 Miscellaneous

4.2.1 Sag rod To provide lateral support to purlin and grit sag rods are provided. Purlin or grits top flanges is expected to be completely secured by the roof or wall panels, but it is resumed that the bottom flanges is braced by sag rods. The spacing of the sag rod depends on purlins or grit, span loads and their tributary area.

6.2.2 Flange brace

To provide lateral support and stability, the flange brace is an angle member extending between grits or purlin to the inner flange of the column or rafter.

6.2.3 Bracing

To provide stability against wind, seismic or other forces and to give lateral support to the structure longitudinal cross bracing are used. The bracing purpose is to move horizontal loads to the base from the frames.

Types of bracing :

- Cross bracing
- Rod bracing
- Angle bracing
- Pipe bracing
- Portal bracing

For buildings with less axial loads rod bracing are generally used and as the complexity of the building increase with crane or mezzanine in it creating high axial loads pipes and angle bracing are used. Portal bracing is used wherein the cross-bracing may obstruct the movement of humans or machinery.

6.2.4 Strut pipes

To carry compressive forces a compression member called strut pipe in used. These are the following places that normally use a strut pipe:

If column height is greater than 1.5 times the bay spacing then cross bracing is generally provided in two parts, and to transfer load from one portion to another strut pipe is provided in between.

- If eave strut is not enough to carry load, a strut pipe will be provided.

6.2.5 Cage ladders

In a building, ladders are provided for convenient and economical access to the tops of the roofs. If can be used to maintain the roof or other equipment on top of the roof platforms. Ladders are generally are two types:

- Plain ladders
  When the ladder height up to 3m plain ladders are used.

- Cage ladders

When the higher to be reached is more than 3m cage ladders are preferred.

6.2.6 Gratings Gratings are alternative flooring systems. These are more suitable for use in industrial mezzanines in shop floors, indoor or outdoor catwalks, roof platforms or flooring. The main advantages of using the gratings as flooring over checkered plates are that the gratings being galvanized, make it more appropriate for external use and as it is perforated it does not retain water, thus eliminating the need for the drainage system.

6.2.7 Checkered plates

Checkered plates can also be used instead of gratings in factories, warehouse and workshops and were the more common, but expensive and concrete floor finish is not needed. As these are solid and non-slippery these are ideal for floors that could collect a lot of dust and debris from materials handling, product processing, oil leaking from machinery that should be stopped from falling below.

6.3 Hardware

6.3.1 Anchor bolts

6.3.2 Primary connection bolts. To connect primary structural members or built-up members primary connection bolts or fasteners are used. Generally, these bolts are designed as bearing type bolts. Two types of connections are generally used they are:

- Moment connections
- Flexible or pinned connections

6.3.3 Secondary connection mobiles. Secondary fasteners are used to bind secondary members to primary members or other secondary members.

6.4Accessories 6.4.1 Skylight

To allow natural light into the building translucent panels are generally used. They are installed to the field using self-drilling screws. When these panels are installed in the roof they are called skylight and when they are called wall light. Generally two types of skylight panels are used which are given below:

- Polycarbonate sheets
- FRP sheets

6.4.2 Turbo vent

Turbo ventilator are powered by cost-free air, boosting the natural up-flow of hot and contaminated air. Suction and centrifugal forces generated by the vaccum creating head that is freely rotating. The vaccum is filled with warm air and released into the outside atmosphere.

6.4.3 Louvers

Standard fixed type louver and industrial louver are generally used when high ventilation is required industrial louvers are used and these are generally provided with bird mesh ate the bottom. Fixed louver are made of natural anodized steel with heavy-duty and are designed specifically for suitable wall panels.

3.2 Technical parameters PEB

Pre-engineered buildings are custom designed to meet client's requirements. PEB's are defined for definite measurements. The produced members fit to the designed dimensions. Measurements are taken accurately for the requirements. The basic parameters that can definite a PEB are Width or span of building

The centre to centre length from one end will column to the other end wall column of a frame is considered breadth or span of the building. The width between two column can be measured as span. The span length for different buildings varies. The design is done on span length given by customer. The basic span length starts from 10 to 150 meters or above with intermediate columns.

Length of building

The length of PEB is the total length extending from one front end to the rear end of the building. The length of PEB can be extendable in future.

Building height is the eave height which usually is the distance from the bottom of the main frame column base plate to the top outer point of the eave strut. When columns are elevated from finished floor, eave height is the distance from finished floor level to top of eave strut.

Roof slope

This is the angle of the roof with respect to the horizontal. The most common roof slopes are 1/10 and 1/20 for tropical countries like India. The roof slope in snow fall locations can go up to 1/30 to 1/60. Any practical roof slope is possible as per customer's requirement.

Design loads

Unless otherwise specified pre-engineered buildings are designed for the following minimum loads. The designed loads play a crucial role in case of PEB. The failure of the structures occurs if not properly designed for loads. The determination of the loads acting on a structure.

Dead load

The structure first of all carries the dead load, which includes its own weight, the weight of any permanent non-structural partitions, built-in cupboards, floor surfacing materials and other finishes. It can be worked out precisely from the known weights of the materials and the dimensions on the working drawings.

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4 RESULT AND CONCLUSION

PEB structure cost is 20.37% lesser than the cost of RCC structures.

PEB structures are preferable for large span structures up to a certain optimum span. For small span structures, use of PEB technology won't affect the overall performance.

In the present days situation time, money is gaining their importance in every sector including the construction of industry.

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