

## Assessment & maintenance of pre-engineered buildings

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### Abstract

Steel industry is growing rapidly in almost all the parts of the world. The use of steel structures is not only economical but also Eco-friendly at the time when there is a threat of global warming. Here, “economical” word is stated considering time and cost. Time being the most important aspect, steel structures (Pre-fabricated) is built in very short period and one such example is Pre Engineered Buildings (PEB). Pre-engineered buildings are nothing but steel buildings in which excess steel is avoided by tapering the sections as per the bending moment’s requirement. One may think about its possibility, but it’s a fact many people are not aware about Pre Engineered Buildings. If we go for regular steel structures, time frame will be more, and also cost will be more, and both together i.e. time and cost, makes it uneconomical. Thus in pre-engineered buildings, the total design is done in the factory, and as per the design, members are pre-fabricated and then transported to the site where they are erected in a time less than 6 to 8 weeks.

**Keywords:** pre-engineered building, assessment of PEB, maintenance of PEB

### 1. Introduction

India has the fastest growing market in the PEB construction segment. Infrastructure development and the increasing popularity of PEB systems in the industrial sector have led to a robust growth of Indian PEB market. PEBs have hit the construction market in a major way owing to the many benefits they possess. The PEB concept has been gaining momentum, and the scope of growth is increasing due to India’s huge infrastructural requirements. The scope of using PEBs ranges from showrooms, low height commercial complexes, industrial building and workshops, stadiums, schools, bridges, fuel stations, aircraft hangers, exhibition centers, railway stations and metro applications. Durability of any structure is mainly depends on its component parts and its regular maintenance work.

### 2. Durability Factors

Following are the factors on which durability of PEB structure in depend:-

- 1) The grade of steel used for PEB.
- 2) The joints of components of PEB.
- 3) Regular maintenance of PEB.
- 4) The accurate cutting and sizes of components of PEB.
- 5) The material used to avoid environmental effects on PEB structure.
- 6) The design must be proper as per the loads.
- 7) Load calculation should be exact as per the present situation.
- 8) Type of sheeting or cladding provided in the structure.

### 2.1 Suggestions for increasing durability of PEB

**Table 1:** Suggestions for increasing durability

S. No.	Factors Affecting Durability	Suggested	Remark
1.	Grade of bolts	Greater than 8.8 Like 9.8 or 10.9 or 12.9	To increase the strength at joints
2.	Joints		Joints must be made by using torque fixing machine. So there will not be chances of loosening of screws or nuts.
3.	Regular Maintenance	Maintenance should be done after regular interval of time as per the location of structure.	Generally regular maintenance is not required for PEB as per the suggestion of manufacturer. But to increase durability it will be helpful.
4.	Accurate cutting of components		The components must be cut properly and in perfect shape and size as per the design provided by designer.
5.	Environmental effect	To get better finish and also to avoid environment effect multi coat paint system should be adopted.	Multi coat paint system is costly than shop primer but it gives better finish.
6.	Design		It is most important factor on which durability is based. So design should be made properly by designer by considering all conditions and loads.
7.	Load Calculation		All loads should be considered by the designer according to use of building and also load calculation should be done properly and perfect.
8.	Cladding or sheeting	275 GSM with 2.3 mm thickness	To minimize corrosion effect

If all these points taken in to account that will be helpful for us to increase the durability of the same structure. Mainly durability of PEB structure is depends on grade of steel, welding and regular maintenance of building. These buildings are highly durable than conventional buildings and RCC structures. Because all the components are made up of purely steel. In some cases we can construct the same structure of PEB at another location. But the loading conditions and atmospheric conditions must be same. So, if atmospheric as well as loading conditions are same then we can construct the same structure on another place by using same components of steel.

To improve the durability of PEB maintenance is also important factor.

**3. Maintenance Period of PEB**

Periodic maintenance of PEB depends upon the environmental zone and pollution level in which the building is located. In PEB, the core maintenance is required for the steel roofing and cladding. In the humid areas, buildings should be taken much care as the moisture presents in the air breakdowns the paint.

**3.1 Maintenance Period of PEB**

Frequency of maintenance is dependent upon the environmental zone in which the building is located. Table 2 shows maintenance period for PEB in different locations.

**Table 2:** Maintenance period for PEB in different locations

Building Location	Maintenance
Within 5 km of the sea.	Every 3 months
High pollution industrial area.	Every 3 months
Medium pollution industrial area	Every 4 months
Areas of high humidity.	Every 4 months
Low pollution industrial area.	Every 6 months
Dry desert regions.	Every 6 months

**3.2 Maintenance Procedure**

A maintenance procedure varies from building to building and depends upon building design, material specifications and access provisions. It is also necessary to ensure that the leak-proof performance of the building is not compromised.

Preventive maintenance of PEBS begins immediately after a project is erected. Waste and small items such as screws, pop rivets, drill bits, or any ferrous objects are removed by sweeping with a soft nylon brush. Large items such as sheet metal cut-off are removed by hand to avoid damaging the surface of the roof panels. Sand and dust shall be removed by washing with clean potable water and a soft nylon brush. To remove saline deposits that become encrusted on the panels of buildings located in high pollution industrial areas, or close to marine environments should be washed with the mild detergent added to the initial washing water. Oil, grease, tar, wax, or similar substances can be removed with mineral spirits, followed by a detergent solution and a clean potable water rinse. Caustic or abrasive cleaners may damage the paint and zinc layers.

**3.3 Safety Measures during Maintenance**

A completed roof of a steel building is a safe surface, except near the edge and roof openings, or if it becomes slippery due to moisture.

The following steps should be maintained in maintenance:

- No walking on wet floors, gutters
- No stepping on skylights
- Availability of fire extinguishers.
- Use ladders that is 1 meter above the step-off
- Site safety procedure and emergency contacts.
- Use of personal protection equipment, contemporary tools and machineries are mandatory.
- Use of passive restraint mechanisms like sky web fall protection system significantly reduces risk during maintenance.
- Sufficient precautions should also be taken toward electrical safety and hazardous substances.

**4. Assessment of PEB**

Regular maintenance and assessment is an important factor to maximize the life of PEBs. Maintenance depends upon the locality of the building. Building areas with moisture and dry climate requires proper care than in mild and less populated industrial areas. Maintenance of the building can be taken by stagnation of unwanted materials and debris. Mostly, the vulnerable areas of the building like gutters, down spout, roof sheets and shelters areas under eaves and canopies covered with dirt, gutter and water should be washed off with clean water and soft brush. Less preference to maintenance will lead to short life of buildings.

The steel buildings also require attention to maintain their performance, appearance and value like any other investments. Steel buildings considerably have lower maintenance need than those of concrete structures. Nevertheless, maintenance contributes to the appreciably longer operational life of a steel building. Clean surfaces enhance the life of steel buildings as well as improve the thermal performance of steel buildings. Corrosion and physical damage are area for concern. Timely repair retains both functionality and aesthetics of the structure. A metal building or roof assembly should last 15 to 30 years before serious maintenance is required. Yet, due to various environmental and pollution related factors, many metal buildings and metal roofing assemblies require slight maintenance from time to time. “To achieve the desired life and functionality, maintenance of the building is also important just like other maintenance of machines and equipment.

Maintenance is preventive in nature. Activities include inspection and works necessary to fulfill the intended function or to sustain original standard of service. The maintenance of structure is done to meet the following objectives:-

- Prevention of damages due to natural agencies and to keep them in good appearance and working condition.
- Repair of the defects occurred in the structure and strengthen them, if necessary.

Following points are observed during assessment of PEB structure:-

1. Generally there is no requirement of regular maintenance for PEB structures.
2. After completion of erection work manufacturer provides 25 years guarantee certificate.
3. It is not possible to check the structure at very high level. If checking is done then it is at low i.e. foundation level.
4. For fixing nuts and bolts high tension torque fixing machines are used, so there is no problem regarding

loosening of nuts or screws.

5. For some cases to achieve economy rafters are manufactured on site and purlins are purchased from other manufacturer.
6. Generally PEBs are designed for particular zones only.
7. There is no problem of any ventilation or air circulation in the observed factory area as turbo ventilators and sky lights are provided.



**Fig 1:** Water leakage problem form ceiling



**Fig 2:** Water leakage problems on walls



**Fig 3:** Corrosion effect on members

Following solutions are taken for problems:-

1. The water leakage problem from roof is due to gap between lapping. So to overcome from this problem they provided adhesive sheets between the gaps. As the gaps are fully closed water leakage problem gets solved.
2. The problem of leakage is due to difference between profiles of sheets also. If sheets are purchased from two different manufacturers then there will be problem of leakage.
3. Due to improper drilling during fixing nuts and screws there may be problem of leakage. So drilling should be done properly and should be in perfect size to avoid such problems.
4. To avoid corrosion effect good painting should be provided. It will be good in look and also corrosion also avoided.
5. Components at higher level should be properly painted and then erected.
6. Generally maintenance work is done only for sheets and ventilators only.

### 5. Conclusions

Following points are concluded from this paper:-

- Pre engineered buildings have vast advantages over conventional buildings.
- PEB structures are lighter structures. As PEB is 30 % lighter than CSB structures.
- Generally PEB requires 6-8 weeks for its delivery. It requires maximum 15 to 25 days for its erection.
- PEB structures are higher resistance against earthquake loads.
- PEB structure cost is 25-30 % lesser than CSB structures.
- PEB manufacturers are able to stock large amount of elements and accessories which can be used in many types of PEB construction.
- PEB structures can be erected in other places, by using same components. But the main requirement is loads and environmental conditions must be same.
- There is no requirement of continuous maintenance work for PEB structures.
- There is 25 years of guarantee certificate is provided by manufacturer.
- We can erect same structure from at other place by using same material.
- No problem of loosening of nuts or bolts as they are fixed by toque machine.
- No problems regarding air circulation or ventilation.
- Minimum effect of atmosphere like high temperature or high rainfall or some amount of wind intensity.
- More cost requires in high wind intensity areas.
- All components of the PEB system are specially designed to act together as a system for highest efficiency. PEB designs are revised regularly with respect to the actual field conditions and in accordance with various country codes, which resulted in improved standardized designs leading to high performance of the structure.
- PEB systems have numerous advantages including cost effectiveness, quality control, speed in construction, ease in expansion, achievement of large span, long durability, exceptional architecture, standardization of materials, standardization of design, single sourcing and co-ordination, speed in delivery, etc.

## 6. References

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