

“A Review Study of Warehouse Structure in Pre Engineered Building with Conventional Steel Building”

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ABSTRACT

In present years, the concept of Pre-Engineered Building in creation format of structures has helped into optimizing a design. Steel industry sector is developing more hastily in almost throughout elements of the world. In a hazard of global warming the usage of steel structures is not only efficient but also sustainable at the time. In Pre-Engineered Buildings (PEB) steel structures (Pre-fabricated) time is being the maximum significant aspect is built in very short duration period. In any type of Industrial structures and Pre-Engineered Buildings (PEB) Maximum Span, Column free suitable structures are the most vital in fulfills this requirement at the aspect of decreased time and price in comparison to conventional structures. Here this is study is achieved by planning 3D frame of an Industrial Warehouse constructing the use of the thoughts and studying the frames using appropriate assessment and design software after due validation. In this research, an industrial structure warehouse is analyzed and designed according to the Indian standards (IS 800-2007) and additionally through referring American Standard (AISC LRFD). The various loads like dead, live, wind, seismic and snow loads according as per IS codes are considered for the present work for relative study of Pre-Engineered Buildings (PEB) and Conventional Steel Building (CSB). To compare the consequences of the numerous parametric studies to perform the variations in terms of shear force, support reaction, weight correlation and cost evaluation.

Keywords— Pre-Engineered Building, Conventional Steel Building, Ware House, Tapered Section, STAAD Pro V8i

I. INTRODUCTION

Buildings & companies are one of the primeval creation activities of people. The present modern concept of house buildings the technology of creation has progressive since the established order from simple construction. India has emerged as one of the key worldwide markets for pre-engineered buildings steel structures. A plenty of growth has been given to do with the way how recognition towards steel buildings had been changing to developed a country. Today's the scene is such that PEB's are expected to about 25% to 30% of marketplace share within the creation industry sector. The most recent improving technology was continuously increasing the maximum clear-span competencies of steel structures. In India the industry has fast development of steel building makes for exciting analyzing and it can have commenced all with the on location fabrication model. With the opening up of the economy during the 1990s but, such things started to change. In the might of the PEB enterprise this became the cause for predominantly “manufacturing plant constructed” structures and to achieve economy growth. In PEB technology steel is one of the world's most reused material and toward the finish of any steel product's life, practically 100% of it tends to be reused without losing its engineering properties, preferred and ecological construction methods. The tropical nation like in India to give great protection impact and would be highly suitable for a PEB structures. PEBs is an ideal construction sector for in remote & hilly areas. A recently survey through the Metal Building Associations (MBMA) shows that nearby 50% to 60% of the non-residential near to the ground rises constructing in USA are pre-engineered buildings. This flexibility would seem to with ease provide itself to optimization of member cross-section shapes. In Industrial building systems, the partitions can be formed of steel columns with cladding which may be of profiled or plain sheets, Galvanized Iron sheets, roofing, precast concrete, or masonry work. The wall must be effectively in strong to resist the lateral pressure because of wind or seismic activity resistance. As the PEBs offers fastest technique to construct the warehouses structures as compared to conventional methods and its

demand for a broad range activities of construction will growth over the afterward four years. A growing range of distinguished International contractors and designers, who formerly certain conventional steel structural buildings entirely, have recently converted to the PEB approach.

II. FRAMING SYSYTEM

A. Concept of Conventional Steel Building

Conventional steel buildings (CSB) are small rise steel buildings with roofing structures of truss with roof coverings. The criterion selection process of roof truss also includes the gradient of the roof, pitch of the roof, fabrication and transport techniques, aesthetics, climatic conditions, etc. In a Conventional steel building design uses selected hot rolled "T" type steel sections that are regular in period but need to be reduce, punched, and bolted on site. The necessity of materials is delivered or produced in the plant and are placed to the site. The need for further economy of creation region and the design of the conventional industrial buildings is governed through beneficial necessities. The Structural members are very hot rolled and are utilized in conventional buildings. Steel roof trusses are normally used for industrial buildings, work shop buildings, packaging areas, warehouses and even for residential buildings, faculty buildings, places of work whereas the construction work is to be completed in a short length of time. In high winds the structural performance of these buildings is well agreed and for the maximum part, suitable code provisions are presently in area to that that make certain excellent behavior. In a roof truss the entire section of every member is subjected to uniform stress and consequently the strength of every member is wholly utilized. A roof truss is essentially frame structure formed through connecting various members at their ends to form a system of triangle, organized in pre-determined pattern depending upon the distance, type of loading and functional requirements.

B. Concept of Pre-Engineered Building

Pre-Engineered steel structures are fabricated or created necessity in the plant itself. The production of structural members is done on customer requirements. The buildings were pre-engineered due to the fact they actually depend on general engineering designs for the limited amount of configurations. A pre-engineered building (PEB) is designed by the producer to be fabricated using a pre-determined inventory of raw materials and production techniques that may be efficiently satisfy a wide variety of a structural and aesthetic view of design requirements within a few geographic manufacturing sectors these buildings are also called as Pre-Engineered Steel Buildings. Generally, a PEB is an inflexible jointed plane frame from hot-rolled or cold-rolled sections, helping the roofing and side cladding through hot-rolled or cold-formed sections purlins and sheeting rails. Z and C-shaped cold formed steel members may be used as secondary structural elements to fasten and support to the outside cladding. Steel building system usually a variety of wall materials, the unique creations and still the maximum popular being steel siding, supported by means of sidewall or end wall girts. In order to perfectly layout a pre-engineered building, engineers consider the clear span among the bearing factors, bay spacing, roof slope, dead loads, superimposed loads, collateral loads, wind uplift, deflection criteria, internal crane system and maximum realistic size and weight of the fabricated members. The use of an optimum least section leads to the equipped savings in steel and price reduction.



Fig. 1: Pre-Engineered Warehouse Structure

III LITERATURE REVIEW

Literature review and research paper provide good help in my dissertation work. Some of literature reviews are given below

- 1) **Pradeep & Rao (2014)** In this work effectively conveys that PEB structures can be easily designed by simple design procedures in accordance with country standards. Low weight flexible frames of PEB offer higher resistance to earthquake loads. PEB roof structure is almost 26% lighter than Conventional Steel Building. In secondary members, light weight “Z” purlins are used for PEB structure, whereas heavier hot-rolled sections are used for CSB. Support reactions for PEB are lesser than CSB as per analysis. Light weight foundation can be adopted for PEB which leads to simplicity in design and reduction in cost of construction of foundation. Heavy foundation will be required for CSB structure. PEB building cost is 30% lesser than the cost of CSB structure. PEB offers low cost, strength, durability, design flexibility, adaptability and recyclability. To conclude “Pre-Engineered Building construction gives end users a much more economical and better solution for long span structures where large column free areas are needed.
- 2) **Wankhade & Pajgade (2014)** In this work effectively conveys that PEB structures can be easily designed by simple design procedures in accordance with country standards. In light of the study, it can be concluded that PEB structures are more advantageous than CSB structures in terms of cost effectiveness, quality control speed in construction and simplicity in erection. The paper also imparts simple and economical ideas on preliminary design concepts of PEBs. The concept depicted is helpful in understanding the design procedure of PEB concept.
- 3) **Naidu & et. al. (2014)** In this work Long Span, Column free structures are the most essential in any type of industrial structures and Pre Engineered Buildings (PEB) fulfills this requirement along with reduced time and cost as compared to conventional structures. The present work involves the comparative study and design of Pre Engineered Buildings (PEB) and Conventional steel frames. Design of the structure is being done in Staad Pro software and the same is then compared with conventional type, in terms of weight which in turn reduces the cost. Three examples have been taken for the study. Comparison of Pre Engineered Buildings (PEB) and Conventional steel frames is done in two examples and in the third example, Pre Engineered Building structure with increased bay space is taken for the study. In the present work, Pre Engineered Buildings (PEB) and Conventional steel frames structure is designed for wind forces. Wind analysis has been done manually as per IS 875 (Part III) – 1987.
- 4) **Meena & et. al. (2015)** In this work effectively conveys that Pre-Engineered steel Buildings can be easily designed by simple design procedures in accordance Low weight flexible frames of Pre-Engineered steel Building offer higher resistance to earthquake loads. After analysing, the following are the conclusions of Pre-Engineered steel Building when compared with Conventional Steel Buildings.
- 5) **Lande & Kucheriya (2015)** In this work 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. Long Span, Column free structures are the most essential in any type of industrial structures and Pre Engineered Buildings (PEB) fulfils this requirement along with reduced time and cost as compared to conventional structures. PEB methodology is versatile not only due to its quality pre-designing and prefabrication, but also due to its light weight and economical construction. In this study, an industrial structure (Ware House) is analyzed and designed according to the Indian standard, IS 800-2007 and American code, MBMA-96 by using the structural analysis and design software STAAD-pro. The economy of the structure is discussed in terms of its weight comparison, between Indian code (IS800-2007) & American code (MBMA-96). A comparative study has also been carried out between cold formed sections as purlins with traditional used hot rolled sections for industrial structures.
- 6) **Subashini & Valentina (2015)** In this work effectively conveys that PEB structures can be easily designed by simple design procedures in accordance with country standards. Low weight flexible frames of PEB offer higher resistance to earthquake loads^{18,19}. PEB roof structure is almost 26% lighter than conventional Steel Building. In secondary members, lightweight “Z” purlins are used for PEB structure, whereas heavier hot-rolled sections are used for CSB. Support reactions for PEB are

lesser than CSB as per analysis. Lightweight foundation can be adopted for PEB which leads to simplicity in design and reduction in cost of construction of foundation. Heavy foundation will be required for CSB structure. PEB building cost is 30% lesser than the cost of CSB structure¹⁷. PEB offers low cost, strength, durability, design flexibility, adaptability and recyclability. To conclude “Pre-Engineered Building construction gives end users a much more economical and better solution for long span structures where large column free areas are needed.

- 7) **Bhagatkar & et. al. (2015)** In this work From the past advancement, the use of PEB is implemented and continuously increasing, but its usage is not throughout the construction industry. It 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. Thus PEB methodology must be implemented and researched for more outputs.
- 8) **Rakesh & et. al. (2016)** In this work Now a day there is a vital change in the steel industry, majorly in the industrial structures the usage of Conventional steel building and Pre-Engineered building is more. Conventional steel building and Pre-Engineered building concept is a new conception of single storey industrial building construction. This methodology is versatile not only due to its quality pre-designing and prefabrication, but also due to its light weight and economical construction. The concept includes the technique of providing the best possible section according to the optimum requirement. In Conventional steel building and Pre-Engineered building concept, the complete designing is done at the factory. The Conventional steel building and Pre-Engineered building calls for very fast construction of buildings and with good aesthetic looks and quality construction. Conventional steel building and Pre-Engineered building.
- 9) **Chavanke & Tolani (2017)** In this work Long span, Column free structures are the most essential in any type of industrial structures and Pre Engineered Buildings (PEB) fulfill this requirement along with reduced time and cost as compared to conventional structures. The present investigation aims at comparison of conventional steel building and pre-engineered building. In this investigation analysis of and design of pre-engineered building and conventional steel building will be carried out for spans like 15m, 20m, 25m, and 36 m using computer software STAAD Pro v8i.
- 10) **T.D. Mythili. (2017)** In this work Pre-Engineered Building concept involves the steel building systems which are pre-designed and prefabricated .The present construction methodology calls for the best aesthetic look, high quality & fast construction, cost effective & innovative touch. One has to think for alternative construction system like pre-engineered steel buildings. 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. This review is focused on the obstructing issues in pre-engineered building technology by the new emerging companies in India and the critical success factors that are involved in these systems. Also, the contribution of pre-engineered building systems in India in the economic growth of country through various applications is stated briefly.
- 11) **Bhadoria & Pathak (2017)** In this work Comparative study made on various models of Pre-Engineered building and Conventional steel structure shows that PEB is an economical option and it can be concluded that up to a certain value of clear span Pre-engineered building are most economical option and after a specific span steel quantity in PEB is almost same as that of conventional steel structure. Provision of tapered section in PEB makes it economical and tapering of section is done as per the bending moment diagram. From all the analysis made it can be concluded that steel consumption in PEB is on an average 30% lesser than conventional steel structure. PEB frames are light and more flexible than conventional steel frames and provide higher resistance to seismic forces.
- 12) **Prajapati & et. al. (2018)** In this work 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. A study of different frame types changing different parameters like width, height, bay spacing, and wind pressure have been analysed & designed by using STAAD pro. To understand the behaviour of Pre-Engineered structure & to check in which case it achieve the economy in steel

quantity by varying different parameters. Design is done based on IS: 800. Load case considered in modelling are Dead load, Live load, Wind load and seismic load along with the various combinations as specified in IS. Analysis results are observed for base reaction, column moment, rafter moment, displacement at ridge, displacement at mid span.

- 13) Katkar & Phadtare (2018)** In this work recent years, the introduction of Pre-Engineered Building (PEB) concept in the design of structures has helped in optimizing design. Long span, Column free structures are the most essential in any type of industrial structures and Pre Engineered Buildings (PEB) fulfil this requirement along with reduced time and cost as compared to conventional structures. This methodology is versatile not only due to its quality pre-designing and prefabrication, but also due to its light weight and economical construction. The present work presents the comparative study and design of conventional steel frames with concrete columns and steel columns and Pre Engineered Buildings (PEB). In this work, an industrial building of length 44m and width 20m with roofing system as conventional steel truss and pre-engineered steel truss is analyzed and designed by using STAAD Pro V8i.

IV. CONCLUSIONS

In our everyday existence steel is versatile material that each object we see used in steel immediately or circuitously. In Pre-engineered steel structures building 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. Infinitely recyclable, steel is the material that reflects the imperatives of sustainable development. Based on the analytical and design results thereon of conventional and pre-engineered steel buildings, the following conclusions are drawn. In our everyday existence steel is versatile material that each object we see used in steel immediately or circuitously. In the observe of self-weight of the models indicated that the self-weight for PEB is much less than that of CSB in the equivalent geometry.

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