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Pre Engineering Building as a Modern Era: A Review

Mr. Vaibhav Thorat[1], Mr. Samyak Parekar[2]
[1]*Student M-tech Structural Engineering, Dept. of Civil Engineering G H Raisoni University Saikheda (MP)*
[2]*Assistant Professor, Dept. of Civil Engineering G H Raisoni University Saikheda (M.P)*

Abstract: ***Now A Days the cost and time of construction is in more priority for the client with the large working area for various uses. For the economically and minimum loss of material, pre-engineered building system (PEBs) has many advantage, because it gives more column free space at low cost. Pre-engineered metal buildings are more reliable for various uses like complex industrial facilities, warehouses and distribution centres, stock-house, shopping malls, resort, motor court, office, cabin, service complex, aircraft-hanger, athletics and fun stadium, study places, temples, hospitals, and any types of industrial structures. In the pre-engineered metal building system, the rigid frame consists of slab.The performance of the models in terms of weight comparison, cost comparison and time comparison. In this study, an industrial structure (factory truss) is analysed and designed according to the Indian standards, IS 800-1984, IS 800-2007. 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 sheer force, support reaction, weight correlation and cost evaluation. Pre Engineered Buildings (PEB) without bracings is done in two examples. Later Pre Engineered Buildings (PEB) is analysed for Dynamic loads using El-Centro specified ground motion. STAAD Pro in accordance to British standards (BS 5950-1:2000) and Euro codes (EC3 EN-1993-1) with wind and seismic analysis. In order to achieve the above aim of the project, two models of the car showroom were created namely British Standard (BS) model and Euro code (EC) model using STAAD Pro.***

Keyword: Pre-engineered building (PEB), Conventional steel Building (CSB), Dynamic load, conventional structure, STAAD.pro software, Time History Analysis.

I. INTRODUCTION

The industry is growing speedily in the majority thee elements of the globe. The employment of steel structures isn't solely economical however conjointly eco-friendly at the time once there's a danger of world warming. Here, "Economical "word suggests that considering time and Price. Time is that the most vital side, steel structures (Pre-fabricated) square measure inbuilt terribly short amount and one such example is Pre-Engineered Buildings (PEB). Pre-engineered buildings square measure nothing however steel buildings within which additional steel is avoided by tapering the sections as per the bending moment's demand. One might imagine regarding its risk, however it's a truth many folks don't seem to be better-known regarding Pre built Buildings. If we have a tendency to opt for regular steel structures, time span are a lot of, and conjointly value are a lot of, and each along i.e. time and price, makes it uneconomical.

Steel is the material of choice for design because it is ductile and flexible. Steel members have high strength per unit weight and the properties of the steel members mostly do not change with time. In recent years, the introduction of Pre Engineered Building (PEB) design of structures has helped in optimized design. The construction of PEB in the place of Conventional Steel Building (CSB) design concept resulted in many advantages as the members are design as per bending moment diagram and thus reducing the material requirement. This methodology is versatile not only due to its quality predesigning and prefabrication, but also due to its light weight and economical construction. 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. This concept has many advantages over the Conventional Steel Building (CSB) concept of buildings with roof truss. In this paper, a comparison will be made between Pre Engineered buildings and conventional steel structures.

The efficient and economic construction over conventional method of building construction Pre-engineered building (PEB) system were induced. The concept of pre-engineered steel metal building system made over all structural component like, beam, column, purlin, rafter as well as roof wall sheeting, primary members, secondary members, connected with each other and different structural components.

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A. Types of Building

1) Reinforced Concrete Structures:
2) Conventional Steel Structures:
3) Pre-Engineered Buildings [PEB]:

B. PEBs Structural Members Concept

Pre-engineered buildings use a prearranged supply of raw materials in lighter weight that has verified over time to satisfy a broad range of structural and unique esthetic design requirements. This flexibility allows PEBs to fulfill and almost unlimited range of building configurations, custom design, requirements and applications. The pre-engineered steel building is a building shell utilizing three distinct product categories as Built-up "I" shaped primary structural framing members(columns and rafters) Refer fig. 1 Cold-formed "Z" and "C" shaped secondary structural members (roof purlin, eave struts and wall grits)

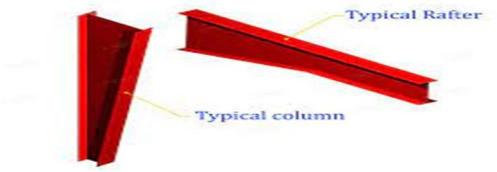


Fig:- Column and Rafter Of Steel Components

"Pre-engineered steel buildings" are those that are totally invented within the industrial plant once planning, shipped to site} in CKD (completely knocked down) condition; and all parts are assembled and erected at a site with nut-bolts, thereby reducing the time of completion. Pre-engineered means that, typically speaking, is any a part of a structure that's factory-made first off to its arrival on the building site.

C. Planning For Pre-Engineered Building for Industrial Purpose

The planning of an Industrial building is based on functional requirements i.e. on the operations to be performed inside the building. In the planning of an Industrial building, due consideration should be given to factors such as wide area of primary frames, large height, large doors and openings, large span of primary frames , consistent to give minimum weight of primary frames, purlins, girts , eave struts etc. and lighting and sanitary arrangement. The site for a proposed plant is in general, pre-selected before it comes for design. But it is better to discuss with the designer the preliminary plans in advance. This gives the designer an opportunity to choose a suitable site giving due consideration to future developments. Some of the factors governing the site selection are as listed below:

1) The site should be located on an arterial road.
2) Facilities like water, electricity, telephone, etc.
3) Topography and water drainage.
4) Soil condition with reference to foundation design.
5) Sufficient space should be available for storage of raw materials and finished products.
6) Sufficient space should be available for transportation facilities to deliver raw materials and collect the finished products.
7) Water disposal facilities.

II. LITERATURE REVIEW

A. D. Mahaarachi, M.Mahendran

The paper described an advance finite element model that accurately predicts the true behaviour of Crest-fixed steel claddings under Wind uplift. The results from the FEA and experiments agreed well for the trapezoidal steel claddings with wide pans used in this investigation. This demonstrates that non-linear finite element analysis can be used with confidence to carry out extensive parametric studies into the structural behaviour of profiled steel claddings, which undergo local pull-through failures associated with splitting or local dimpling failures. Once the use of finite element analysis to determine the most important pull-through failure load was validated using large scale two-span experiments, it was used to investigate the behaviour of trapezoidal steel claddings with varying geometry and material properties. Based on these FEA, improved design formulae have been developed for the local failures of trapezoidal steel claddings with wide pans. This paper has also discussed the disadvantages of using the Conventional one rib FEA model for multispan steel Cladding assemblies.

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B. Hemant Sharma

The Researcher have studied comparison and analysis of PEB & CSB staad Pro. In this case study comparison for industrial building is done for bending moments at different sections & the results are compared for economy and time saving in construction. After analysis and design the report is concluded with 37% material saving in case of PEB than that of CSB.

C. Abhyuday Titiksh, Abhinav Dewangan, Ankur Khandelwal , Akshay Sharma

This paper mainly focuses on the advantages of pre-engineered buildings over conventionally designed buildings. The different fields of comparison mainly constitute its cost effectiveness, time saving, future scope, subtleness and economy of pre-engineered buildings over conventionally engineered buildings and its importance in developing nations like India. This case study for Industrial Shed based on the review & studies which shows experimental and analytical studies carried out in this field. The result shows that these structures are economical, energy efficient and flexible in design

D. Swati Wakchaure and N.C.Dubey

have shown that by using preengineered-structure in construction, there are various advantages because according to the bending moment diagram, the designing of members is done. As a result, the steel is reduced. They have analyzed and studied according to IS 800-2007 and IS 800-1984 & the comparison of pre-engineered-structure with conventional steel-structure is done. They have also compared the weight of both the structures. From their studies they concluded that conventional steel-structure is 30% heavier than pre-engineered-structure and as a result the size of foundation is reduced of pre-engineered-structure.

E. Nitin Vishwakarma, Hardik Taya

have studied Pre Engineered and Conventional Steel Building concept of Design for Industrial building of 18 m long span located in Palwal near New Delhi, India. A fully stressed design of Pre Engineered Building with members of varying thickness, Conventional Building with Conventional Steel members and Conventional Building with different hollow and compound section are discussed in paper. A total of five cases are studied. It concluded that more than PEB, truss bracing gives the best suited result based on the economical possibility and the structural safety. They have also concluded that the material cost is reduced by 40% to 42% from PEB portal, when only tube sections are adopted in portal with truss pattern.

F. Sagar Wankhade and Prof. Dr. P. S. Pajgade

have given importance of using pre-engineered-structure in construction, mainly for single storey building. They also have shown that conventional steel-structure has disadvantages compared to pre-engineered-structure. They have done comparative study of pre-engineeredbuilding with conventional steel-building. From their studies they have found that pre-engineered building can be designed using simple procedures. Also they concluded that pre-engineered-building has various advantages over conventional steel-building in terms of cost, speed of construction etc

G. Syed Firoz, Sarath Chandra Kumar B

Design Concept of Pre Engineered Building" Depicted that, picking steel to plan a Pre-built steel structures building is to pick a material which offers ease, quality, solidness, structure adaptability, flexibility and recyclability. Steel is the fundamental material that is utilized in the Materials that are utilized for Pre-designed steel building. It invalidates from territorial sources. It additionally implies picking solid modern items which arrive in an enormous scope of shapes and hues; it implies fast site establishment and less vitality utilization. It implies deciding to focus on the standards of supportability. Limitlessly recyclable, steel is the material that mirrors the objectives of economical turn of events. Correlation of Pre Engineered Buildings (PEB) and Conventional steel outlines is done in two models and in the third model, longer range Pre Engineered Building structure is taken for the investigation. In the current work, Pre Engineered Buildings (PEB) and Conventional steel outlines structure is intended for dynamic powers, which incorporates wind powers and seismic powers.

H. VrushaliBahadure, Prof. R.V.R.K.Prasad

Comparison Between Design And Analysis Of Various Configuration Of Industrial Sheds" Shows examination between different setups of mechanical shed. There are different kinds of mechanical sheds. However, here we look at the different setups of modern sheds, for example, hot moved steel shed, for example, shed utilizing Howe bracket, A-type, entrance support and so on. This paper will gives us the reasonable arrangement of modern shed by making and looking at structure and investigation of different designs of mechanical sheds. Plan of mechanical shed, by utilizing STAAD-Pro 2007 which gives results rapidly and precisely.

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I. Shrunkhal V. Bhagatka

has shown a study on Pre Engineered Building with review of various authors of papers on Pre Engineered Building. The paper aimed to assess from the past advancement, the use of PEB is implemented and continuously increasing, 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.

III. COMPONENTS OF PEB

1) Primary component
2) Secondary Component
3) Sheeting (or) cladding
4) Accessories

A. Main Framing

Main framing basically includes the rigid steel frames of the building. The PEB rigid frame comprises of tapered columns and tapered rafters (the fabricated tapered section are referred to as built-up members.) The tapered section are fabricated using the site of art technology wherein the flanges are welded to the web. Splices plates are welded to the ends of the tapered sections. The frame is erected by bolting the splice plates of connecting sections together. All rigid frames shall be welded built-up "I" section or hot-rolled section. The columns and the rafter may be either uniform depth or tapered. Flanges shall be connected to webs by means of a connection fillets weld on one side. All end wall roof beams and end wall columns shall be cold-formed "C" sections, mill-rolled section or built-up "I" section depending on design requirement. Plates Stiffeners, etc. All base plates splice plates, cap plates and stiffeners shall be factory welded into place on the structural member's. Built-up I section to build primary structural framing members (Columns and Rafters).

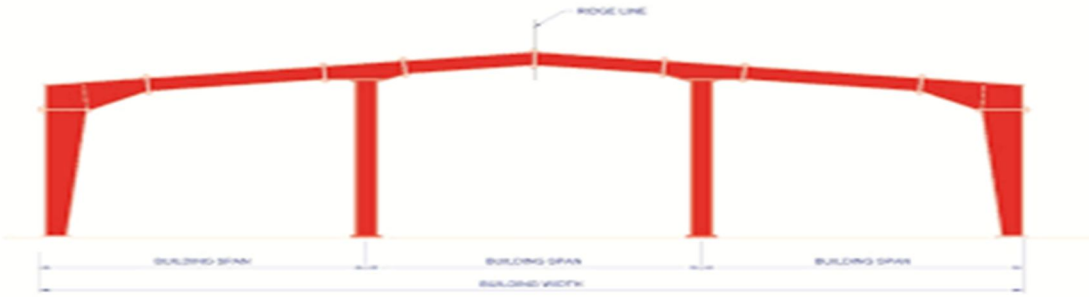


Fig Main Framing

B. Columns

The main purpose of the column is to transfer the vertical loads to the foundation. However apart of the horizontal actions (wind action) is also transferred through the column. Basically in pre-engineered building column are made up of I-section which are most economical than others. The width and breadth will, go on increasing from bottom to top of the column I section consists of flanges and web which are made from plates by welding.



Fig:- Columns Used in PEB

C. Sheeting and Cladding

The used in the construction of pre-engineered building are composed of the following. Base metal of either galvalume coated steel conforming to ASTM A 792M Grade 345B or aluminum conforming to ASTM B 209M. Galvalume coating is 55% Aluminium and about 45% Zinc by weight. An exterior surface coating on painted sheets of 25 microns of epoxy primer with a highly durable polyester finish. An interior surface coating on painted sheets of 12 microns of epoxy primer and modified polyester or foam. The sheeting material is cold-rolled steel, high tensile 550 MPA yield stress, with hot dip metallic coating of Galvalume sheet.

D. Load Combinations

All dead loads, live loads, wind load, accidental load will be confirming to IS: 875-1987. Earthquake loads will be confirming to IS: 1893-2002 part-IV Load combinations considered.

1) Self-Weight of structure
2) Weight of Purlins3.
3) Wind Force in X direction
4) Wind Force in Z direction
5) Negative Wind Pressure in X direction
6) Negative Wind Pressure in Z direction
7) Ground motion in X and Z direction

IV. ADVANTAGES OF PEB

PEB is a suitable Construction technique for developing countries for the following reasons:

1) Reduced construction time Building are typically delivered in just a few weeks after approval of drawings. Foundation and anchor bolts are cast parallel with finished, ready for site bolting. PEB will reduces total construction time of the project by at least 50%. This also allows faster occupancy and earlier realization of revenue.
2) Lower cost Due to the system approach, there is a significant saving in design, manufacturing and on site erection cost. The secondary members and cladding nest together reducing transportation cost. Steel buildings that are properly insulated save natural resources, energy and money.
3) Flexibility of expansion Building can be easily expanded in length by adding additional bays. Also expansion I width and height is possible by pre designing for future expansion.
4) Large clear spans Building can be supplied to around 80M clear spans. International Journal of Scientific Research and Review Volume 6, Issue 12, 2017 ISSN NO: 2279-543X 9

V. CONCLUSIONS

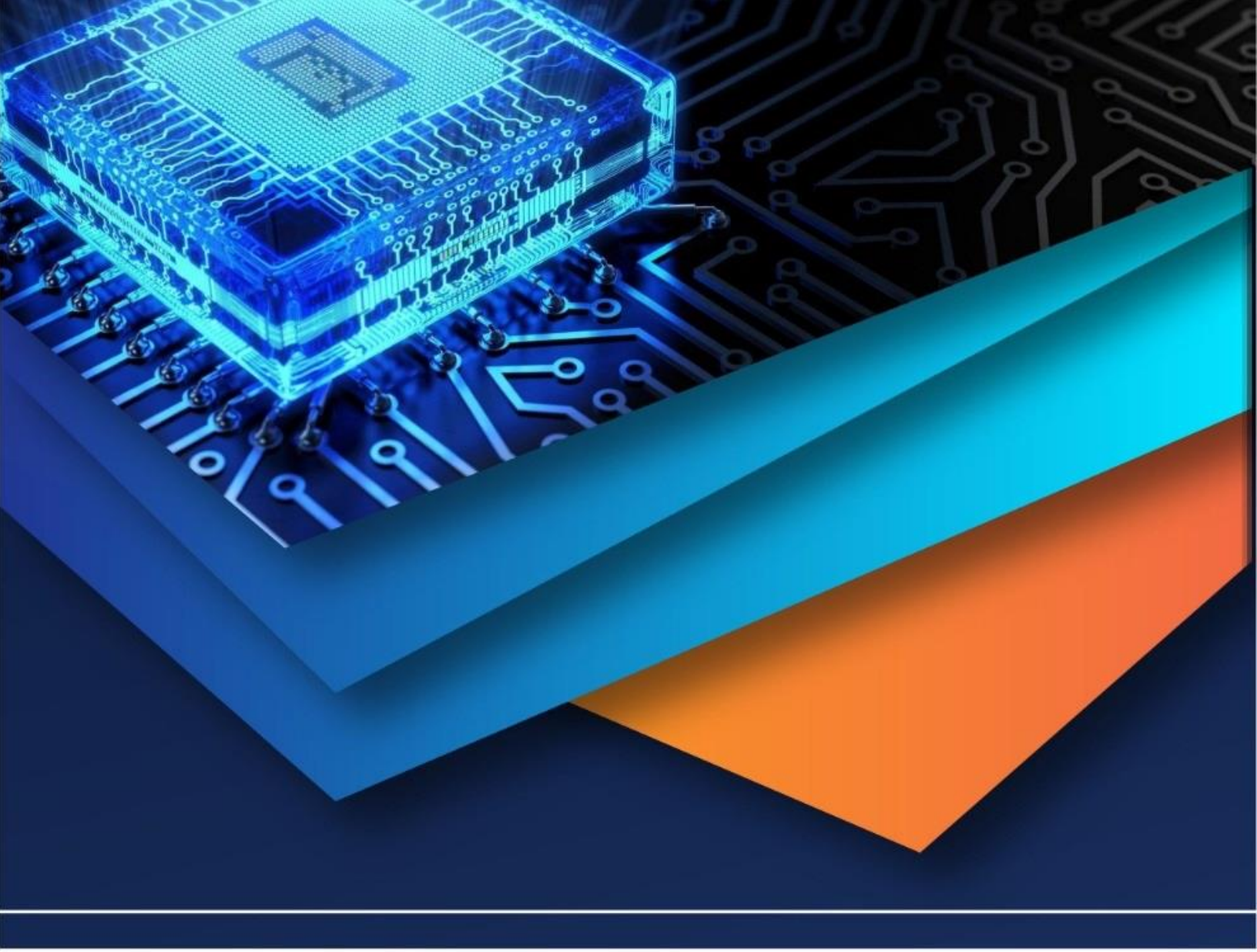
From past studies the PEB structures are prove to be more economical and results in material saving. The implementation of PEB is increasing but use if PEB is less than expected. The researches show that PEB structures are easy to design. These designs are efficient and results in speedy construction. These structures are more reliable than CSB. Hence the more research required for more outputs for design methods and reducing material in PEB structures.

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