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A REVIEW ON COMPARATIVE STUDY OF PRE-ENGINEERED AND CONVENTIONAL STEEL BUILDING BY HOT ROLLED AND COLD FORMED SECTIONS

[1]Mansi Pandit Fulzele, [2]Prof. Ganesh Mahalle
[1] Research Scholar, [2] Professor,
[1] Department of Civil Engineering,
[1] Gondwana University, Gadchiroli.
Ballarpur Institute of Technology, Ballarpur, India

Abstract : The Pre-Engineering Structure (PEB) is a system in structural engineering that delivers cost-effective and time-efficient building design and construction. We have been optimising the structure design over the last few years by using PEB design. When the span is greater and a column-free design is required, PEB is the best choice. PEB construction takes less time and money than conventional steel building (CSB). Because of its higher quality control, lighter members, and cost-effective design, this system is used all over the world. The primary goal of this study is to discuss the advantages of the PEB system over the CSB system. A comparison of PEB and CSB execution is presented in this work.

***IndexTerms* - Pre-Engineered Building, Conventional Steel Building, Tapered Section, Hot rolled section, Cold formed sections.**

I. INTRODUCTION

Construction industries in India contribute significantly to the development of the Indian economy. The construction industries are critical to the development of the Indian economy. Structure engineering developed the PEB idea for rapid growth. Instead of many suppliers, PEB has a single supplier who provides the entire component package, including the steel framework, cladding, and roofing. All components are built on the job site utilising bolted connections, as specified. Software is used to design PEBs. To put it another way, we believe that PEB will be the future of the construction industry. Furthermore, many businesses prefer PEB to CSB. Structure engineers construct the structure based on the client's requirements, employing primary and secondary members made of built-up, hot roll, and cold-formed material. We employed a built-up tapered section instead of the hot roll I section. PEB is made up of several components such as an intermediary floor known as a mezzanine, canopies, trims, clips, sag rods, flange bracing, grits, purlins, and fascias, among others. The PEB concept is currently widely used over the world, and it has an attractive appearance and a distinct design style. In comparison to CSB, PEB offers a more cost-effective design for low-rise and wider-span structures. In other words, there is no other building concept that compares to PEB in terms of speed and cost from foundation to completion.

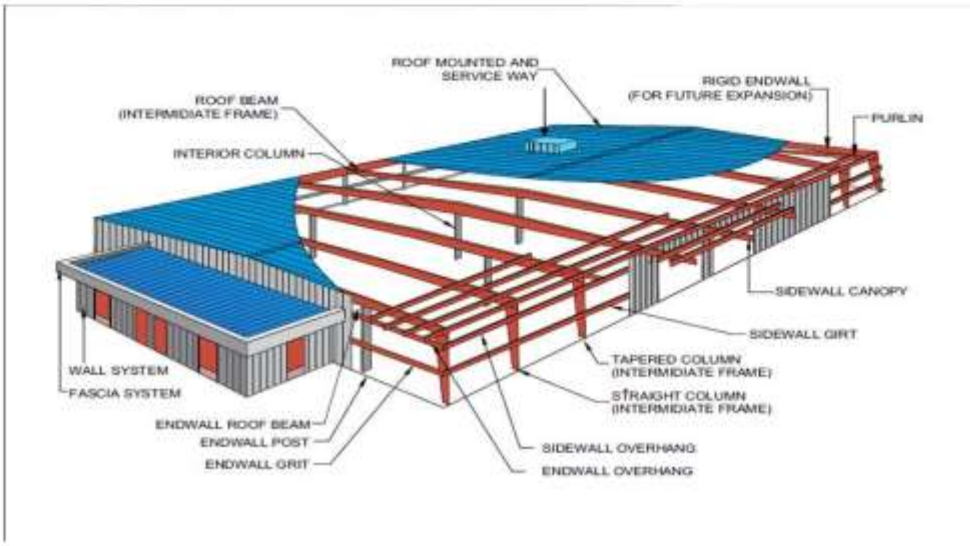

Figure 1: Pre-Engineered Building Components.

II. PRE-ENGINEERED BUILDING COMPONENTS

Following are the components of Pre-Engineered Building:

I. Primary Members:-

Main Frame:- The mainframe houses the most significant structural members of the building, which are built-up tapering columns and rafters. Welding the webs to the flanges creates these built-up tapered pieces. Splice plates are utilised as a connection after manufacture at the ends of tapering members. Bolted connections are commonly employed in the production of PEB. For the column, either a tapered section or a built-up I section is employed. The continuous welding is used to join the webs to the flanges.

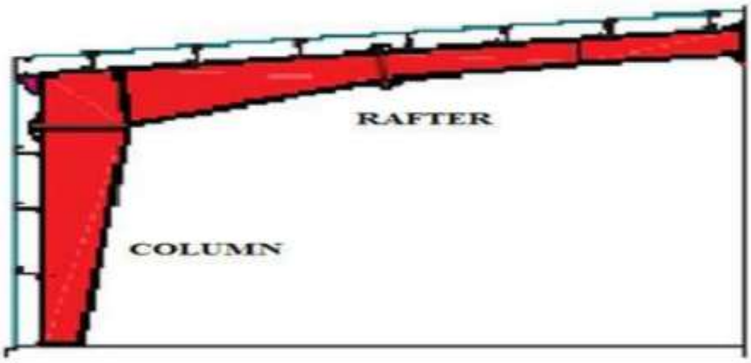

Figure 2: Main Frame.

Column:- The main purpose of the column is to distribute the load safely to the foundation. Columns are generally constructed by using „I' sections. I section are cheaper as compared to other sections. Depend on design the depth of the column goes increases from bottom to the top end. The flange and web of the column are connected by using welding.

Rafter:- Rafter act as a platform for purlins and roof sheeting. Its design to sustain the load of roofing and purlins

II. Secondary Members.

Secondary members are those that serve as a support system for the roof and wall sheeting. girt and purlin are two examples. Purlin is used to support the roof sheeting while girt is used to support the wall sheeting. The fundamental objective of the girt and purlin is to strengthen the frame by giving lateral stability to the flanges. Cold-formed steel is used for the secondary members.

Figure 3: Cold formed sections.

Figure 4: Hot Rolled sections.

III. ADVANTAGES OF PRE-ENGINEERED BUILDING OVER CONVENTIONAL STEEL BUILDING.

Below are some of the main advantages of Pre-engineered building structures over conventional steel building.

a. Manufacturing Time: - After the design and drawing have been approved, the structure may be built in 6 to 8 weeks. Whereas typical buildings took around 10 to 11 weeks to manufacture. PEB is cost-effective and affordable due to the reduced building time.
b. Cost: Because the section size is optimised, the PEB structure is less expensive than the CSB structure.
c. Weight: By optimising the section weight of PEB, the weight can be lowered by up to 20% when compared to CSB.
d. Foundation: Because the overall weight of the building is smaller than that of CSB, PEB requires a light and simple foundation.
e. Expansion: Where future growth is required, PEB is the ideal option. In most cases, structure enlargement is accomplished by increasing the number of bays.
f. Clear span: When a column-free structure is required, PEB has an advantage over CSB. A PEB structure can have a clear span of up to 90 metres.
b. Quality Control: Having more control over quality as a result of production in a plant is a component of PEB.

IV. LITERATURES REVIEW.

Following are the some of Pre-Engineered Building:

I. C.M. Meera:- The author of this paper compared PEB with CSB in terms of steel takeoff. The author conducted a comparative analysis and design of industrial warehouses utilising the Indian steel standard code I.S 800:2007. We learned from this paper. The CSB roof is 30% heavier than the PEB roof. The PEB frame is lightweight and flexible, but the CSB frame is heavyweight and unyielding. Because of the reasons stated above, PEB is more resistant to earthquakes. The PEB structure's overall takeoff is less than 30% of the CSB.

II. Aijaz Ahmad Zende:- The author of this paper compared PEB with CSB in terms of steel takeoff. The author conducted a comparative analysis and hotel design utilising the Indian standard code of steel I.S 800:2007. We discovered from this paper PEB is more cost-effective for longer spans and column-free area. PEB is more cost-effective for structures with a greater span and a modest rise height. After a certain point, increasing the number of bays spacing increases the weight of the structure.

III. Maria Subashini and Shamini Valentina:- The author of this research evaluated PEB with CSB in terms of steel takeoff of a building 44 m long and 20 m broad. STADD Pro is the design software used. The author conducted a comparative analysis and design utilising the Indian steel standard code I.S 800: 2007. We concluded from this study that the size of PEB members is lowered according to the bending moment and shear force diagram, resulting in a reduction in steel weight by utilising a tapered section. In this article, the author used a lightweight Z section as a supplementary member for girts and purlin in PEB rather than a hot roll section like in CSB. Because of the structure's low dead load, the author chose a lightweight foundation in PEB. We infer that the takeoff and cost of PEB are 30% cheaper than that of conventional steel construction based on the author's design.

IV. Milind Bhojkar and Milind Darade:- The author of this paper compared PEB with CSB in terms of steel takeoff. The author used the Indian standard code of steel I.S 800:2007 to conduct a comparative analysis and design of an aviation hangar. We learned from this paper. The time necessary for the erection of the PEB structure is approximately not more than 8 weeks. PEB is cost-effective for clear spans up to 30m long and eaves heights up to 30m. PEB lengths of up to 150 m may be allowed in the event of an aircraft hangar. Bracing of the structure was constructed for lateral stability. In the case of CSB, different types of trusses are employed depending on the span for huge span. For medium pitch prat, a Fink type truss is utilised.

V. G. Sai Kiran:- The author used the Indian standard code of steel I.S 800:2007, IS 800-1984, IS 800-2007, MBMA-96, and AISC-89 to conduct a comparative analysis and design of industrial warehouses. The structure's geometry was 187x40x8, where 187 m is the length, 40 m is the width, and 8 is the eave height. The building had a slope of 1:10. The author conducted a comparison of Indian and American codes.

VI. Swati Wakchaure, N.C Dubey: - The author of this paper compared PEB with CSB in terms of steel takeoff. The author conducted a comparison analysis and design utilising the Indian steel standard codes I.S 800:2007 and I.S 800-1984. We concluded from this study that the size of PEB members is lowered according to the bending moment and shear force diagram, resulting in a reduction in steel weight by utilising a tapered section.

VII. Vrushali Bahadure: - The authors compared numerous industrial constructions utilising various types of trusses. They created the design with STADD Pro software. They discovered that the sawtooth truss was more cost effective than the portal frame, A-type truss. The sawtooth shed is 66% more cost effective.

VIII. Navyashree P M, Sowjanya G V, Dr. T. V. Mallesh This paper summarizes the behavior of various cold formed or light gauge steel sections using nonlinear FEA (Finite element analysis). Based on the literature reviews we can investigate the analytical and theoretical behavior of CFS sections under the different loading conditions using the software package ABAQUS and ANSYS. In this paper the objective is to provide guidance for performance of cold formed steel in the construction industry field.

IX. D. Dubina , L. Fülöp , V. Ungurean , I. Szabo And Z. Nagy Cold-formed steel sections are used more and more as structural members. Compared with hot rolled ones, there are important technical advantages of these sections, but there are also some structural problems, mainly due to their slenderness, which impose limits of using such sections in heavy buildings and, particularly, in buildings located in seismic zones.

The present paper is based on the experience of the authors in designing four pilot cold formed steel buildings. The buildings are located in heavy snow and seismic zones and are fully made by cold-formed steel sections. They are also very different as destination, i.e.: a steel framed house; a steel framed single storey office building; a steel framed single storey industrial building; refurbishment of an existing old industrial building by addition of a supplementary storey.

X. V Venkatesan and R Ganesan In general, light gauge steel structural Cold-Formed Steel (CFS) members can lead to added economical design than Hot rolled Steel (HRS) members due to their high strength to weight ratio, ease of building, and fabrication. It is increased post-buckling strength and yield strength. Such members are vulnerable to local buckling at comparatively low compressive, shear, bearing stress, and bending. The utilization of light gauge steel structures has gotten progressively famous in various fields of building development. The Cold forms of hollow steel sections have a high compressive loading rate, and using infill material like Geopolymer concrete brings the best result in beams and columns joints. Sound Insulation and Head are done correctly according to the necessities of external and internal walls. Economical construction is source income for poor people.

XI. Athira V. V , Sruthy S Perforations are required in columns and purlins of a trussed building for making connections, for fixing electrical fixtures etc. An investigation was undertaken to study the effect of perforations in cold-formed C and Z sections used as columns and purlins. For this purpose, finite element model was developed using ANSYS software. Six different shapes of perforations were considered to investigate the shape that gives maximum buckling load. The perforation pattern which is optimum for the individual section was applied to frames and then to the building and optimum type of perforation is suggested. Buckling loads of frames and building with and without perforation was done separately and results were compared. By considering perforations with equal area, linear buckling analysis was done and stress pattern around perforation was studied. Even though the area reduction was equal, differently shaped perforations gave different buckling load.

XII. A. Rosana Begum, Dr. S. Evany Nithya It can be interpreted that the cold formed steel sections shows 5.74 % more load carrying capacity as compared to hot rolled sections below the span range upto 1.5m with fixed support conditions. At the same time if the span range exceeds above 1.5m the flexural capacity of cold formed section reduces compared to hot rolled sections. It also shows little variation in axial deflection of both cold formed steel section and hot rolled steel section. The stress distribution of hot rolled steel section is much uniform throughout the length, on the contrary cold formed steel section shows distinct variation in stress distribution. The finite element software ABAQUS gives results nearer to experimental results up to 13 % for load carrying capacity calculation. While comparing failure pattern, hot rolled steel member shows bending failure and cold formed steel shows distortional local buckling failure.

XIII. Salokhe S. A , Patil P. S It can be interpreted that the cold formed steel sections shows 17.37 % more load carrying capacity as compared to hot rolled sections and it gives 33% lesser lateral deformation as compared to hot rolled section. It also shows little variation in axial deflection of both cold formed steel section and hot rolled steel section.
The stress distribution of hot rolled steel section is much uniform throughout the length, on the contrary cold formed steel section shows distinct variation in stress distribution.
The finite element software ABAQUS gives results nearer to experimental results up to 0.6 % for load carrying capacity calculation. While comparing failure pattern, hot rolled steel member shows bending failure and cold formed steel shows distortional local buckling failure

XIV. A.Jayaraman , V.Senthilkumar , S.Athibaranan The final results the theoretical and investigations of channel section have high bending strength, high load caring capacity, minimum deflection and minimum local buckling & distortional buckling compare to the built up channel section by same cross sectional area. The numerical investigation of channel section is the maximum bending moment, torsional moment and deformation is higher than the built up channel section by same cross sectional area. But theoretical investigations are accuracy result. Channel section is the high moment of resistance , high load caring capacity and The slenderness ratio for flexural member as per IS Code provide 300 mm for compression flange of a beam against lateral torsional buckling ,so in this channel section (30 x60 x1.6) mm using construction up to 3m. Therefore channel section is most suitable and economical compare than the built up channel section.

XV. R.B. Kulkarni, Shweta B.Khidrapure In the construction industry both structural and non-structural elements are created from thin gauges of sheet steel. These building materials encompass columns, beams, joists, studs, floor decking, built-up sections and other components. Cold-formed steel construction materials differ from other steel construction materials known as hot-rolled steel (structural steel). The strength of elements used for design is usually governed by buckling.

The effect of cold working is thus to enhance the mean yield stress by 15% to 30%. In this dissertation, work on parametric study and comparison of flexural design strength of cold-formed light gauge steel section based on IS: 801-1975 (Indian standard) and BS 5950-5:1998 (British standard) codes has been carried out and presented.
The IS: 801-1975 code is based on working stress method and BS 5950-5:1978 code is based on limit state method. It was observed that both the design concepts give nearly the same strength.

V. CONCLUSION

This study finds that the PEB design offers a cheap, versatile, durable, and economical design when compared to the CSB design. In other words, PEB is more cost-effective and has better quality control. The PEB is easy to erect and takes little time. When the span is greater and a column-free design is required, PEB is the best choice.

- The Uses of Cold-formed Steel Structures For Residential And Non-residential Buildings
- Some Advances in the Application of Weathering and Cold-Formed Steel
- Investigation on the use of cold formed perforated steel sections as columns and purlins
- Comparative Study on Behaviour of Hot and Cold Formed Steel Sections Under Flexure
- Optimization of Industrial Structure using Light Gauge Steel Section
- Experimental Study on Flexural Behaviour of Cold Formed Steel Channel and I Sections Providing Angle Stiffener on the Web
- Comparative Study Of Behaviour Of Cold-formed Steel and Hot Rolled Steel Section Under Compressive Loading
- Study Of Various Design Methods For Cold – Formed Light Gauge Steel Sections For Compressive Strength
- Flexural Behaviour Of Light Gauge Cold Formed Steel Members : Comparison of IS Code And Euro Code
- Parametric study and comparison of Indian standard code with British standard code for the Design of Light gauge cold formed flexural members
- A Study on the Analysis and Design of the Steel Warehouse using STAAD.Pro
- It is provided guidance to Analysis of hot rolled steel and cold formed steel Structure

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