IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 7.105 ⁜ Vol. 9, Issue 4, April 2022

DOI: 10.17148/IARJSET.2022.9439

Comparative Study & Analysis of Pre-Engineering Building with Respect to Normal Construction

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Abstract: Pre-Engineered building (PEB) is a new concept for the construction of single storey industrial building. The concept is versatile not only due to its quality pre-designing and prefabrication but also due to its time efficiency and light weight. The concept of Pre-Engineered Building includes the technique of providing the best possible section according to the optimum requirements. This concept has many advantages over Conventional Steel Structure (CSB). And Pre-Engineered Building is efficient alternative to Conventional Steel Building. In this paper main frame of Pre-Engineered Structure of 12 m, 14m, 16m, 18m, 20m width & 6m Eave height have been analysed and designed by Staad pro to understand behaviour of PEB. The design is done by IS 800:2007, "Code of practice for General Construction in Steel Structures" as well as IS 875:1987(Part 1,2 &3), "Indian Standard code of practice for loads on buildings and structures". Load case considered in modelling are Dead load, imposed load & Wind load with the various combinations as specified in IS.

Keywords: Pre-Engineered building (PEB), Staad pro, Industrial building, Loads on structure, Indian codes.

I. INTRODUCTION

India is the second fastest growing economy in the world and a lot of it is attributed to its construction industry which figures just next to agriculture in its economic contribution to the nation. In its steadfast development, the construction industry has discovered, invented and developed a number of technologies, systems and products; one of them being the concept of Pre-engineered Buildings (PEB). As opposed to being on-site fabricated, PEBs are delivered as a complete finished product to the site from a single supplier with a basic structural steel framework with attached factory finished cladding and roofing components. The structure is erected on the site by bolting the various building components together as per specifications. PEBs are developed using potential design software. The onset of technological advancement enabling 3D modelling and detailing of the proposed structure and coordination has revolutionized conventional building construction. PEBs have hit the construction market in a major way owing to the many benefits they possess. They exemplify the rising global construction, technology and while they oppose the practice of conventional building construction they simultaneously have taken it to a higher level too. Worldwide, they are a much used concept with studies revealing that 60% of the non-residential low-rise buildings in USA are pre-engineered; for India the concept has been gaining momentum and the scope of growth is guaranteed looking at India's huge infrastructural requirements. Studies already validate that India has the fastest growing market in the PEB construction segment. The scope of using PEBs ranges from showrooms, low height commercial complexes, industrial building and workshops, stadia, schools, bridges, fuel stations to aircraft hangars, exhibition centeres, railway stations and metro applications.

II. AIM & OBJECTIVE OF STUDY

Aim- To Study, Analyse & Compare Pre Engineered Building [PEB] Management with Respect to Conventional steel building and RCC Building.

Objectives of study-

Objectives identified for the present study have listed as follows.

- To compare the steel take-off of the conventional steel building and Pre-Engineered building.
- To Analyze Building with all design criteria and Comparison of Pre-Engineered building with respect to Normal Construction.
- To compare advantages of Pre-Engineered building over Conventional steel building and RCC Building.

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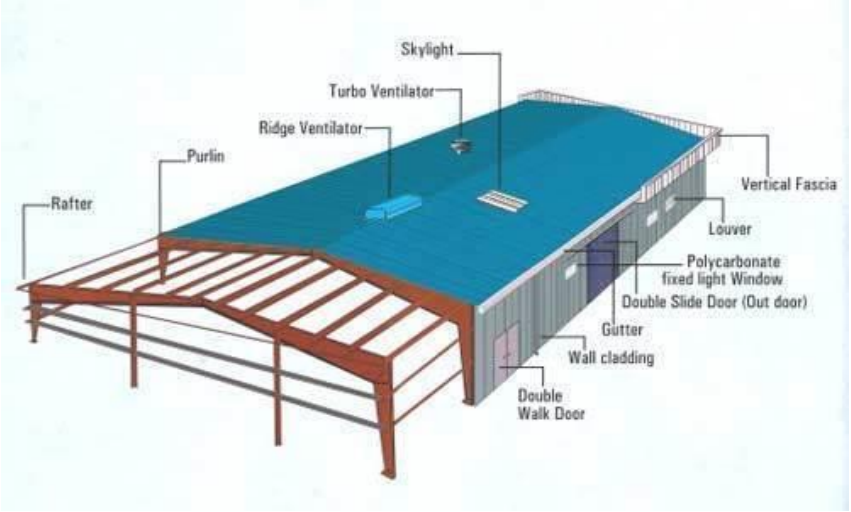
III. METHODOLOGY

The buildings are planned as a combination of columns and beam, slab system. After preliminary sizing of various structural members, a computer model of the structural frame of the building will be generated for carrying out computer analysis for the effects of vertical and lateral load that are likely to be imposed on the structure. The building structure will be analyzed using the STAAD PRO software. Geometrical dimensions, member properties and member-node connectivity, including eccentricities will be modeled in the analysis problem. The seismic analysis would be carried out for static loading in accordance with the relevant code of Practice. The computer analysis will evaluate individual internal member forces, reactions at foundation level and deflection pattern of the entire structures and in the individual members. This data will then be used to verify adequacy of the member sizes adopted and after further iterations arrive at the. Most appropriate design of the structural members. Some re-runs of the analysis program might be required for arriving at the optimum structural space frame characteristics that satisfy the strength and stability criteria in all respects.



IV. LITERATURE REVIEW

1. Shrunkhal V.Bhagatkar& Farman Iqbal Shaikh Observes that Pre-engineered building are steel building where in the framing members and other components are fully fabricated in the factory after designing and brought to the site for assembly, mainly by nut-bolts, thereby resulting into a steel structure of high quality and precision. In conventional steel construction, we have site welding involved, which is not the case in P.E.B using nut-bolt mechanism. These structures use hot rolled tapered sections for primary framing and cold rolled sections for secondary framing as per the internal stress requirements, thus reducing wastage of steel and the self- weight of the structure and hence lighter foundations. International codes are referred in their design as per the MBMA (Metal Building Manufacturers Association) standards which are more flexible allowing the use of built - up sections of minimum 3.5 mm thickness against 6 mm as minimum criteria in conventional steel sections .There is use of steel of high strength (345MPa) which prominently speaks about greater strength with judicious use of steel as a result of tapered profile. The tapered section concept was first adopted in U.S.A keeping in mind the bending moment diagram. At locations of high bending moment values, greater depth is used while less moment encouraged the use of lesser depths. Further unlike the conventional steel sections, where Moment of inertia (I) remains constant, it is not so in case of P.E.B due to varying depths.

2. Anil V. Bandre, Girish Joshi In this paper Industrial Steel truss Building of 14m x 31.50m, 20m x 50m, 28m x 70m and bay spacing of 5.25m, 6.25m and 7m respectively having column height of 6m is compared with Pre-engineered Building of same dimension. Design is done using on IS 800-2007 (LSM) Load considered in modelling are Dead load, Live Load, Wind load along with combinations as specified in IS. Analysis results are observed for column base as hinge base. Results of Industrial steel truss buildings are compared with the same dimensions of Pre-Engineering Building. The design of roof purlin of Steel Truss building and PreEngineering Building (PEB) is carried out. Various configurations of roof purlins using rolled channel sections, angle truss section and cold formed Z section purlin are considered. The most economical section for weight is Cold formed section but considering the cost effect, angle truss section is economical. Again the same shed with dimensions is analysed for the truss frame. With the usage of Pipe section in truss and purlin, Truss Building is found economical compared with PEB. Also the design using angle section for Truss and channel section for purlins, Steel Truss Building using pipe section and PEB is found to be economical compared to Steel Truss Building using angle section. Concluding all above the configuration of Steel truss purlin using angles, roof truss using pipe sections is economical as compared to PEB portal and cold formed or channel purlins.

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3. Syed Firoz, Sarath Chandra Kumar B Observed that, The pre-engineered steel building system construction has great advantages to the single storey buildings, practical and efficient alternative to conventional buildings, the System representing one central model within multiple disciplines. 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. Choosing steel to design a Pre-engineered steel structures building is to choose a material which 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. It also means choosing reliable industrial products which come in a huge range of shapes and colours; it means rapid site installation and less energy consumption. It means choosing to commit to the principles of sustainability. Infinitely recyclable, steel is the material that reflects the imperatives of sustainable development management system, that ready to accomplish the improved potency of project management and to cute back reduce the waste of materials within the construction sites. To Conclude Pre-Engineered Building Construction gives the end users a much more economical and better solution for long span structures where large column free areas are needed.

4. Anisha T. Goswami , Shalaka Observes that Pre Engineered Building are nothing but steel building in which excess is avoided by tapering the section as per the bending moment's requirement. If we go for regular steel time frame will be more and also cost will be more, both together i.e. time cost makes it uneconomical. Thus in engineered building the total design is done in the factory, and as per the design members are erected and then transported to the site where they are erected in a time less than 6 to 8 weeks. In this study single storey pre-engineered building having 25m width, 0.6m Eave Height bay spacing as 6m, 8m, 10m & 12m and 60m length is selected for analysis. In this paper, Static load i.e., Dead loads and Live loads are considered as per IS 875 (Part I) – 1987 & IS 875 (Part II) – 1987 and Dynamics loads i.e. Wind loads are considered as per IS 875 (Part III) – 1987 respectively. It has seen in this paper that the weight of PEB depends upon the bay spacing, with the increase in bay spacing of 8m spacing, the weight reduces and further increase makes it heavier. The authors finally concluded that Steel quantity is primarily depending on primary and purlins. As bay spacing increased steel consumption is decreased for primary members & Steel consumption is increased for secondary member. 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 structure can be easily designed by simple design procedures in accordance with country standards, it is energy efficient, speedy in construction, saves cost, susutainable and most important its reliable as compared to conventional to conventional buildings. Thus PEB methodology mist be implemented and researched for mire outputs.

5. M. K. S. S. Krishna Chaitanya and M. K. M. V. Ratnam In this Research Paper building is assumed with medium openings between about 5 to 20 percent of wall area shall be examined for an internal pressure coefficient of +0.5 and later with an internal pressure coefficient of -0.5. In order to calculate the steel weight of conventional steel building the following member properties are used. Hot rolled "I" sections are assigned for columns. For the top chord, bottom chord and bracings Indian standard double angles are used. For purlins, girts and eave strut ISMC (Indian Standard Medium Channels) are used. Now using the above parameters the lengths and weights accordingly. For columns and rafters tapered "I" sections are assigned. For the purlins cold formed "Z" sections are used. For the girts cold formed "C" sections are used. For bracings Indian standard double angle sections are used. Now using the above parameters the lengths and weights are calculated accordingly. After analysing, the following are the conclusions of Pre-Engineered steel Building when compared with Conventional Steel Buildings . At ridge and haunch of the building Maximum bending moment for PEB is more than CSB by 6.19 % and 12.45 % this is due to the entire force will concentrated in PEB where as in CSB it is distributed. At ridge of the building axial force for CSB is more than PEB by 2.2 %, at haunch of the building PEB is more than CSB by 27% this is due to the entire force has to transfer at haunch like beam action in PEB where as in CSB it is like a truss arrangement. At ridge and haunch of the building shear force for PEB is more than CSB by 16.5 % and 22.53 % this is due to the entire force will concentrated in PEB where as in CSB it is distributed. At ridge the vertical displacement for PEB is 33mm where as for CSB it is 28mm. Both the displacements are within the allowable limit. At haunch the horizontal displacement for PEB and CSB is 8mm.Both the displacements are The total steel take-off for PEB is 16% of the conventional steel building. It is observed than maximum moment will be high for PEB than CSB .It is observed than maximum shear force will be high for PEB than CSB For PEB the axial force at haunch is higher than CSB . For CSB the axial force at ridge is higher than PEB.

V. CONCLUSION

As per all Research Papers, journals and study concluded that 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 structure can be easily designed by simple design procedures in accordance with country standards, it is energy efficient, speedy

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in construction, saves cost, susutainable and most important its reliable as compared to conventional to conventional buildings. Thus PEB methodology must be implemented and researched for mire outputs.

VI. ACKNOWLEDGEMENT

I take this opportunity to express my deep sense of gratitude and whole hearted thanks to my guide and Head of Department **Dr.M.M.Bais,** Prof. Ram Meghe College of Engineering & Management Badnera for his valuable guidance, motivation and valuable suggestions. I wish to express my sincere thanks to college for providing the required magazines, books and access to the Internet for collecting information related to the Project.

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