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A REVIEW ON A COMPARATIVE STUDY OF AN INDUSTRIAL PRE-ENGINEERED BUILDING AND A CONVENTIONAL STEEL BUILDING

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Abstract —*The development of Pre-Engineered Building (PEB) design of buildings in recent years has aided in design optimization. The use of the PEB design concept instead of the conventional steel building design concept resulted in various advantages since the members are constructed according to the bending moment diagram, lowering the material need. This approach is adaptable not only because of its high-quality pre-designing and prefabrication, but also because of its light weight and low-cost construction. This approach offers numerous benefits over the traditional steel building with roof trusses concept. Several types of industrial PEB buildings are evaluated and constructed in this work in accordance with Indian norms. The models are believed to have varied geometries, and a parametric analysis is conducted to determine the performance of the models in terms of self-weight, cost of construction, and construction time.*

Keywords-*Pre-engineered Building (PEB), Conventional Steel Building (CSB), STAAD PRO, Optimizing Weight, Geometries, Economical*

I. INTRODUCTION

Advancements in technology during the last year have made a significant contribution to the improvement of quality of life either through the development of several innovative products. Steel constructions are not only cost-effective, but also environmentally acceptable at a time when global warming is a concern. Pre-engineered buildings are simply steel structures in which excessive steel is minimized by tapering the sections to the required bending force. Although it is possible, many people are unfamiliar with the concept of Pre-Engineered Buildings. If we go with normal steel buildings, the time period will be longer, as will the expense, and both will be more, i.e. Thus, with pre-engineered structures, the entire design is completed in the factory, and members are prefabricated and delivered to the site where they are constructed in less than 6 to 8 weeks. Pre-engineered structures are those that are entirely fabricated in the factory following design, sent to site in CKD (completely knocked down) condition, and all components are assembled and erected at site with nut-bolts, minimising completion time against precise instructions. These structures were predesigned or 'pre-engineered' into typical sizes, spans, bays, and heights, and also use standard features for cladding, roofing, and gutters, flashing, windows, doors etc.

II. CONCEPT

A. Pre-Engineered Building

The steel building systems that are predesigned and prefabricated are included in the pre-engineered building idea. As the name implies, this approach entails the pre-engineering of structural elements via a specified registry of building materials and manufacturing techniques suitable of addressing a wide range of structural and aesthetic design criteria. The PEB concept is based on providing the section at a specific location based on need of that location. According to the bending moment diagram, the sections might vary in length. This necessitates the use of non-prismatic stiff frameworks with skinny parts. To accomplish this configuration, tapered I sections made of built-up thin plates are adopted. Along with the tapered sections, standard hot-rolled sections, cold-formed sections, profiled roofing sheets, and so on are used. The adoption of the optimum least section results in efficient steel saving and cost savings. The structure's typical PEB frame was shown in the figure.

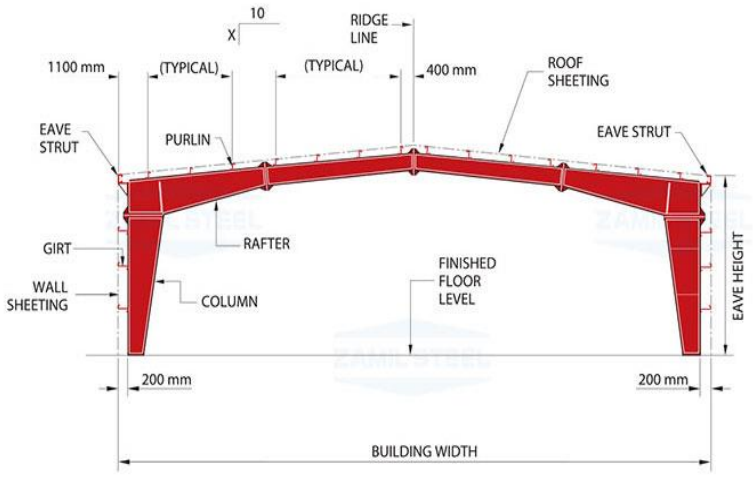

Figure.1. Single Frame Pre-Engineered Building Structure

B. Conventional Steel Buildings

Low-rise steel constructions with truss roofing systems and roof coverings are known as conventional steel buildings (CSB). Depending on the pitch of the truss, many types of roof trusses can be used for these buildings. Fink type truss may be utilised for large pitches, Pratt type truss for medium pitches, and Howe type truss for little pitches. A skylight can be added for additional daylighting, and a quadrangular type truss can be adopted. Roof truss selection criteria also include roof slope, fabrication and transportation techniques, aesthetics, climatic situations, and so on. Depending on the utility, several compounds and combination kinds of inexpensive roof trusses may be used. Standard hot-rolled sections, combined with gusset plates, are often utilised for truss components.

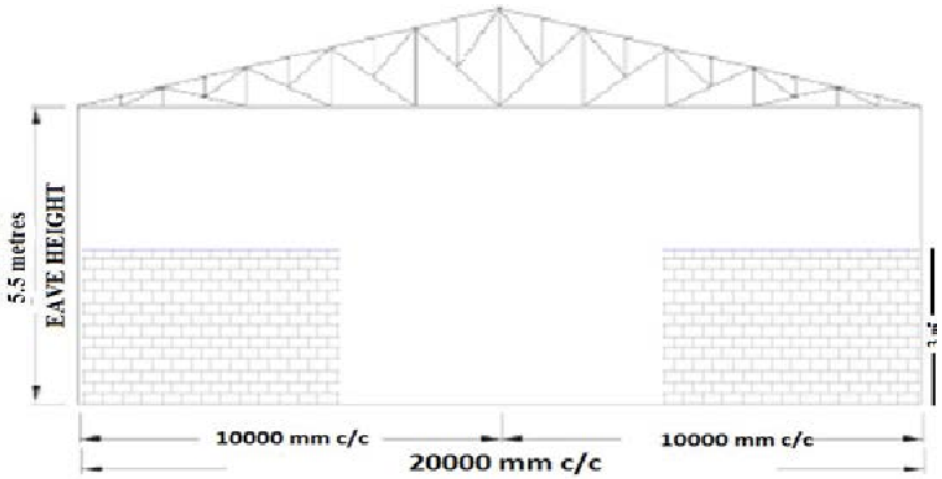

Figure.2. Single Frame Conventional Steel Structure

III. LITERATURE REVIEW

3.1 Santosh S. Patil, Sujay Deshpande "A Study on the Structural Analysis and Design of Pre-Engineered Buildings for Different Geometries"

The introduction of Pre-Engineered Building (PEB) design of buildings in recent years has aided in design optimization. Three types of PEB industrial structures are evaluated and designed according to Indian norms in this study. The models are thought to have diverse geometries, and parametric research is conducted to determine their performance in terms of self-weight, building cost, and construction time.

STAAD.Pro was used to model and analyze each of the three models, and MS-Excel sheets were used to create them. The Self-Weight of the models was investigated, and it was shown that for the same geometry, PEB structures have a lower

Self-Weight than typical steel structures. The loads and hence the forces on the PEB structures will be lower when the Self-Weight is reduced, reducing the effective sizes of the structural parts.
The cost of construction of the models was examined, and it was discovered that PEB structures are more cost-effective than traditional steel buildings for the same geometry. As a result, the amount of steel used for PEB constructions will be less than for traditional steel buildings.
Up to a certain ideal span, PEB structures are preferred for larger constructions. PEB technology has little effect on the overall performance and cost of smaller buildings. As a result, traditional steel construction technology may be used for smaller buildings, whereas PEB technology can be used for larger structures up to a particular span.
The time it took to build the models revealed that PEB structures can be built in a fraction of the time it takes to build traditional steel structures of the same shape. PEB buildings may be built in around 30% less time than traditional steel structures.

3.2 G. Durga Rama Naidu, K. Srinivasa Vengala Rao, V. Divya Sri, M. Navakanth, G.V. Rama Rao "Comparative Study of Analysis and Design of Pre-Engineered Buildings and Conventional Frames"

Long-span, column-free buildings are critical in any form of industrial construction, and Pre engineered Buildings (PEB) meet this need while saving time and money over traditional structures. Pre Engineered Buildings (PEB) and Conventional Steel Frames are being compared and designed in this project. Two examples are used to compare Pre Engineered Buildings (PEB) with conventional steel frames, and a third example is used to investigate a Pre Engineered Building structure with an enhanced bay area. In this study, wind forces are simulated using pre-engineered buildings (PEB) and traditional steel frame constructions. Steel is the most common material utilized in the construction of pre-engineered steel buildings.
PEB has a total steel take-off of 76 percent of a typical steel building with primary frame spacing of 6 m.
The total steel take-off for a PEB with primary frame spacing of 8 m is 74.4 percent of that of an atypical steel structure.
Steel take-off is higher for PEBs with 6 m main frame spacing than for PEBs with 8 m primary frame spacing.
The weight of PEB is also dependent on the Bay Spacing; as the Bay Spacing increases beyond a certain point, the weight decreases, and as the Bay Spacing increases further the weight increases. "Pre-engineered building construction provides end-users with a considerably more cost-effective and superior solution for long-span buildings needing significant column-free zones," according to the research.

3.3 Shivam prajapati, Chatan kambad, Varsha Yadav, Samruddha Raje "Comparative Study Of Various Peb Frame Type"

The use of the Pre-Engineered Building (PEB) concept in the design of buildings has aided in the optimization of the design in this work. PEB's potential to replace the conventional steel building (CSB) design idea resulted in several benefits, including cost savings and easier manufacturing. STAAD pro was used to analyse and create research of multiple frame types with varying factors such as width, height, bay spacing, and wind pressure. Understanding the behaviour of pre-engineered structures and determining in which cases they achieve steel cost savings.

3.4 Syed Firoz, Sarath Chandra Kumar B, S. Kankambara Rao, "Design concept of Pre Engineered Building"

The construction of a single-story pre-engineered steel building system offers several benefits over traditional buildings since it is a practical and efficient alternative to traditional structures, with the system reflecting a single core model across numerous disciplines. Pre-engineered structures are constructed and maintained in real-time. Staad Pro is presently implementing support. Steel is a low-cost, high-strength, long-lasting, design-flexibility, adaptability, and recyclability material that may be used to develop a Pre-designed steel structures building. Steel is the most common material utilized in the construction of pre-engineered steel buildings. A tall steel structure is not included in the overall number of tall steel structures developed worldwide For industrial purposes, huge steel buildings are only erected as single-story structures. Secondary structural components in metal building systems bridge the space between the principal building frames. Secondary structural members, as they are also known, can act as flange bracing for the primary frame and as part of the building's lateral load resisting system. Purlins, or supplementary roof members, are a common component of horizontal roof diaphragms. Low-rise steel buildings are commonly used for steel factories, car industries, light, utility, and process industries, thermal power stations, warehouses, assembly plants, storage, garages, and other small-scale enterprises. These structures necessitate huge column-free spaces. Most of these structures will likely need enough headroom to accommodate the usage of an overhead traveling crane. The eave strut, eave purlins, or eave girt, a third form of secondary framing, serves as part purlins and part girts top flange support roof panels, and its web portion siding. Because cold-formed steel is used to make the majority of secondary components in metal building systems, we'll start with some design considerations for cold-formed steel structures.

3.5 Lovneesh Sharma, Nileshwar Taak, Pankaj Kumar Mishra "Comparative Study Between the Pre-engineered structures and conventional structures using STAADPRO"

The present study's major goal is to compare pre-engineered steel buildings to ordinary steel buildings in every way. Bentley STAAD PRO was the major program utilized for the whole designing and analysis phase, and it was discovered that pre-engineered structures provide more sustainable outcomes than traditional steel buildings.

It was also discovered that using traditional construction methods would take more time and money in every way, so pre-engineered buildings should be used instead, as the construction and maintenance costs of pre-engineered buildings are significantly lower than those of conventional steel buildings. As a result, the whole structural components, as well as the structure, maybe moulded and transported to any other site, achieving the primary part of sustainable building.

The current research compares pre-engineered buildings to existing conventional steel structures in every way. All of the configurations were chosen from actual conventional steel structures and then applied to the pre-engineered building using Bentley STAAD PRO, and conclusions were drawn based on the number of comparison variables.

In today's world, the primary goal of any sort of construction is cost reduction, and pre-engineered buildings outperform traditional steel buildings in every element of overall construction cost, maintenance cost, beginning cost, and the final cost of construction. When compared to a normal steel building, the construction of a pre-engineered building is far more cost-effective and environmentally friendly. The pre-engineered construction offers a higher output from the architectural factor of view because the pre-engineered construction may be melded in keeping with the requirement of the user. Also, the metal requirement is an awful lot lesser withinside the case of the pre-engineered construction compared to traditional metal construction.

3.6 Shaik Kalesha, B.S.S. Ratnamala Reddy, Durga Chaitanya Kumar Jagarapu "An analytical study on pre-engineered buildings using s STAAD PRO"

Pre-engineered steel building systems are pre-designed and prefabricated in the pre-engineered building idea. The contemporary building method necessitates the finest architectural appearance, high quality and speedy construction, cost-effectiveness, and creative touch. Alternative construction technologies, such as pre-engineered steel structures, must be considered. The Pre-Engineered Building (PEB) is a new idea that uses a steel framework to maximize the design while maintaining economic integrity. The major goal of this article is to grasp the PEB ideas and to reduce the amount of money and time spent on them. When compared to other construction methods, pre-engineered buildings are more environmentally friendly and come first. In comparison to PEB, if we go with normal steel construction, the time frame will be longer and the cost would be greater. This concept's materials are reusable, recyclable, and environmentally beneficial. Money is becoming more important in today's world in every area, including the building business. The world is lagging in terms of sustainability. When compared to other technologies, PEB comes out on top in all of these areas. Not only is the material used environment friendly, but it is also reusable. Steel is the primary component of pre-engineered steel structures. Completely recyclable steel fulfills the environmental necessity. The most acceptable civil construction economy may be obtained by combining modern materials with high-grade steel and composite building forms. PEB buildings are more cost-effective than CSB structures, according to the model building cost analysis. PEB is nearly half the weight of steel used in traditional steel buildings. As a result, the amount of steel required for PEB constructions will be less than for CSB buildings. When comparing PEB to CSB, it was shown that PEB saves about 35% on costs.

IV. CONCLUSION

A conclusion section is not required. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion.

Based on previous research Pre-engineered steel structure building has several advantages, including low cost, strength, durability, design flexibility, adaptability, and recyclability. Steel is the primary material utilized in the materials used in pre-engineered steel buildings. It varies from regional sources. Steel, which is completely recyclable, is the material that reflects the imperatives of sustainable development. The most attractive economy in civil engineering construction may be reached by optimal use of high-grade steel and composite form of building with better materials.

However, there are several issues that must be solved in the near future:

- PEBs need a significant initial expenditure.
- In Indian education, the majority of the concentration in course curriculum is on RCC structures, hence innovation in steel construction is disregarded.
- Fire-fighting methods in steel structures must be improved in response to consumer concerns.
- IS codes should be adjusted because the portions chosen are usually heavier.

As a conclusion, pre-engineered buildings have a promising future in India, despite the fact that they are still not appreciated today.

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