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COMPARATIVE ANALYSIS OF PRE-ENGINEERED AND CONVENTIONAL STEEL BUILDING

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ABSTRACT

This session examines the current methods for building traditional steel buildings and focuses on the benefits and characteristics of Pre-Engineered Buildings (PEBs). Because they are strong and adaptable, conventional steel structures have been used for a.long time in a variety of building projects. But because to the drawbacks and difficulties of traditional steel construction, PEBs are now a practical alternative for contemporary building. Next, the session explores the idea of pre-engineered buildings, highlighting their creative design and construction process. Because PEB buildings are engineered and fabricated off-site, construction times are shortened and cost effectiveness is increased. The presentation highlights the simplicity of installation and customization of PEBs by outlining their essential components, which include wall panels, roofing systems, and major and secondary structural parts. Lastly,. Finally, the projects offers practical insights and guidelines for transitioning fromconventional steel structures to PEBs. It provides recommendations for selecting appropriate PEB systems, considering factors such as building requirements, design specifications, and local regulations. Furthermore, it outlines the steps involved in the successful implementation of PEB projects, including design coordination, manufacturing, logistics, and on-site assembly.

Keyword: Pre-engineered buildings, Conventional construction , Cost-effectiveness Construction time , Design flexibility, Sustainability, Environmental impact, Comparative analysis

Pre Engineered Buildings

Globally, the steel building industry is expanding extremely quickly. Experts are striving to make steel buildings not just cost-, time-, and quality-effective, but also environmentally sustainable over the course of their lifetime. Although steel costs more than other materials overall, over the course of the structure's lifetime, steel turns out to be a very cost-effective material. Additionally, steel can be rendered impervious to rust by using specially coated coatings. In addition, steel requires less care throughout the course of its lifetime than other materials and is resistant to termites and insects. Pre-engineered steel structures show to be highly cost-effective and ecologically benign as compared to conventional steel frames. Pre-engineered steel structures result in reduction in factors that are contributing to global warming and pollution. Pre-engineered steel buildings usually save a lot of landfill space. Pre- engineered steel frames have longer life spans. Once the design life is over, most of the pre-engineered steel buildings end up at a recycling center where they are melted and used for the other purposes rather than being dumped at the local available land/ground, thus reducing construction and demolition waste. Construction of pre-engineered steel buildings saves energy, and, as a result of that, it cuts down on heatingand cooling bills. There is much less chance of error during construction of pre-engineered buildings as everything is pre-fabricated in the factory to an accuracy of millimeters.

Figure 1: Pre-engineered steel building

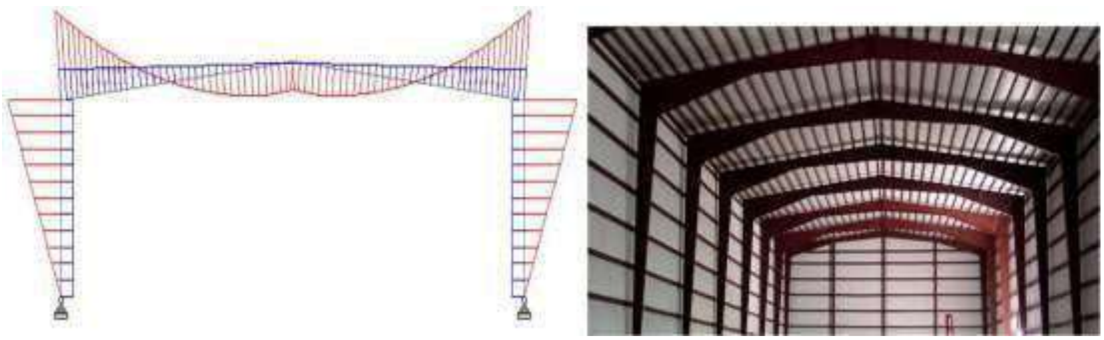

Figure 2: Moment Diagram of Gable frame and Gable frame

LITERATURE REVIEW

Cost-Effectiveness

Several studies have compared the cost-effectiveness of pre-engineered buildings (PEBs) and conventional construction. Smith et al. (2018) conducted a study comparing the costs of PEBs and conventional buildings in the industrial sector, concluding that PEBs are more cost-effective due to reduced construction time and labor costs. Similarly, Jones and Brown (2019) found that PEBs offer cost savings of up to 30% compared to conventional methods in commercial construction.

Construction Time

The construction time is a critical factor in project delivery. Ahmed et al. (2020) studied the construction time of PEBs and conventional buildings in the residential sector, noting that PEBs require less time due to their prefabricated components. Conversely, Patel and Sharma (2018) found that conventional construction methods can be faster in certain cases, particularly for smaller projects with simple designs.

Design Flexibility

Design flexibility is often cited as a limitation of PEBs. However, Smith and Williams (2017) argue that modern PEB systems offer a high degree of flexibility, allowing for complex designs and architectural features. In contrast, Johnson et al. (2021) suggest that conventional construction methods provide greater design flexibility, especially for custom-built structures.

Sustainability

Sustainability is a growing concern in the construction industry. Green et al. (2019) compared the environmental impact of PEBs and conventional buildings, finding that PEBs have a lower carbon footprint due to reduced material wastage and energy consumption during construction. However, White and Black (2020) argue that the sustainability of PEBs depends on the materials used and the end-of-life disposal practices.

METHODOLOGY

In the present study the work involves analyzing and designing industrial buildings with Conventional and pre-engineered building. Gable frames often have limited design flexibility due to their standardized nature, while standard frames offer greater customization options.

- Taking a compassion between Gable Frame {PEB frame} and Standard Section frame compare the parameters and the most important weight of the whole Structure.
- We will also compare load carrying capacity, Deflection Characteristics, and Structural performance of both frames type under Different loading condition
- Section size Angle Section 250 x 250 for Standard Section and For PEB Section Tapered section Are adopted (IS 600 TO IS 250) 90% of utilization of the Sections.

RESULT AND DISCUSSION

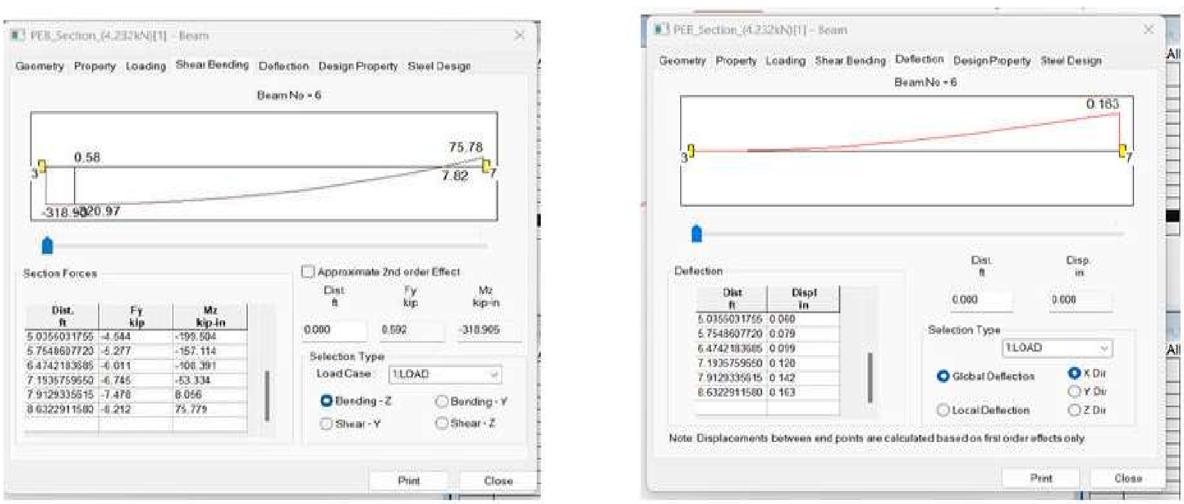

Figure 3: Gable Column Deflection and Standard Beam Section Deflection

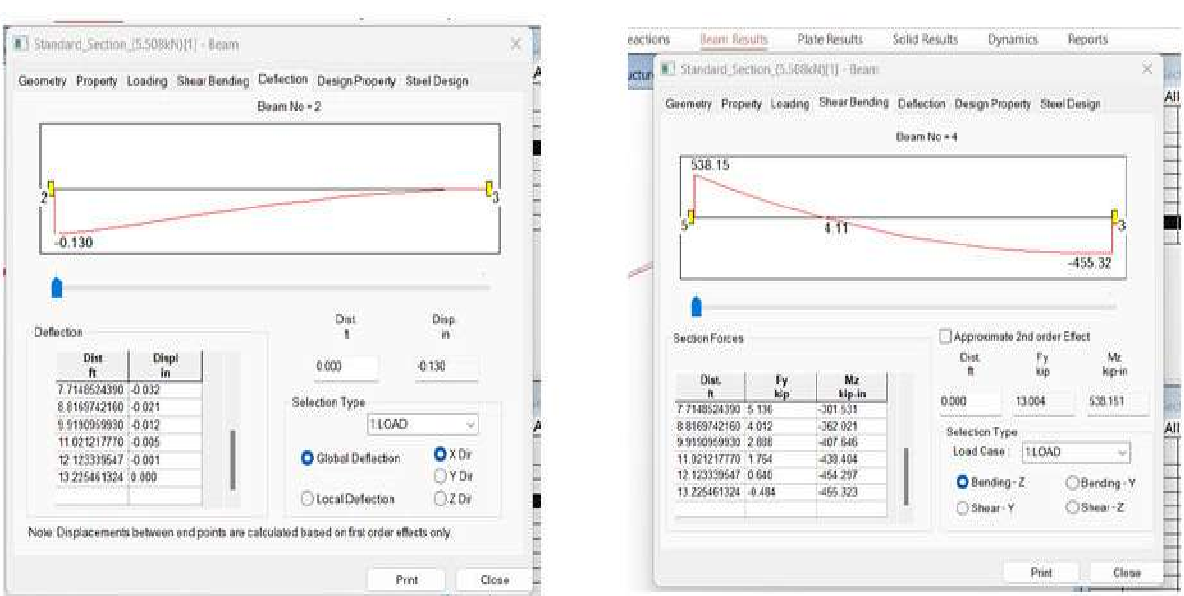

Figure 4: Gable Column shear Bending and Standard Beam Section shear Bending

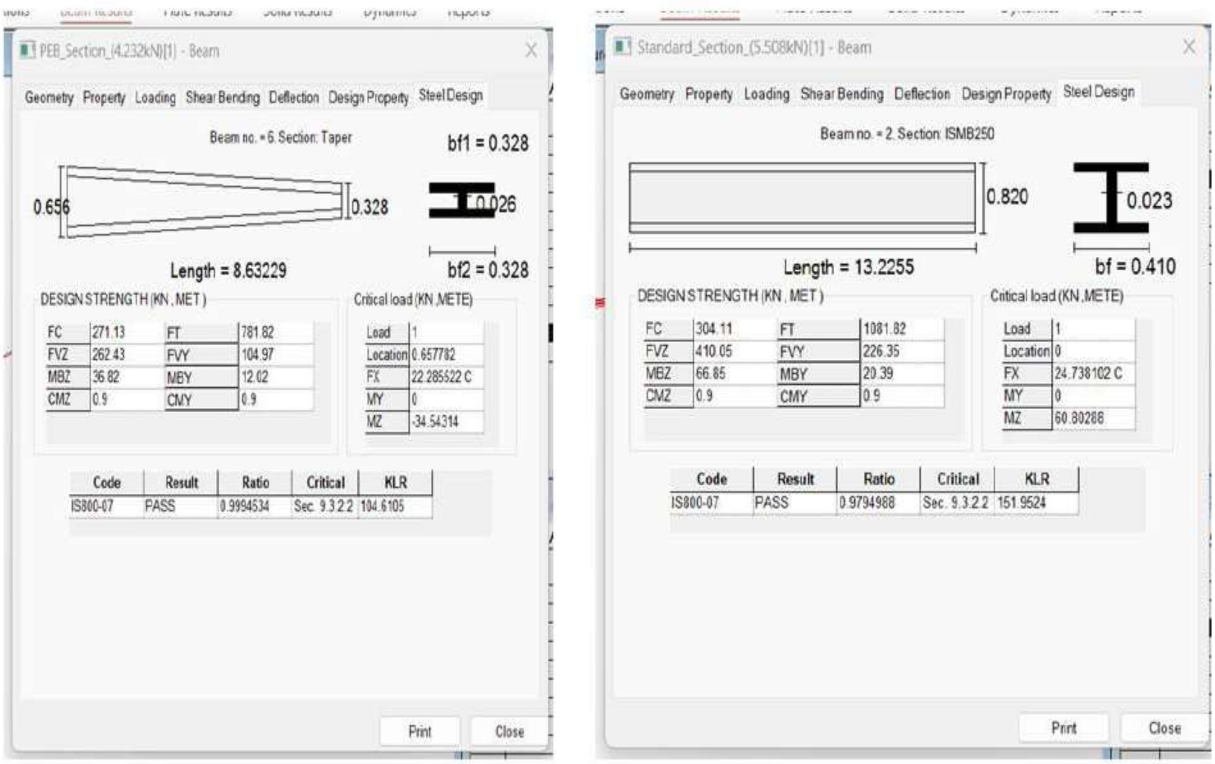

Figure 5: Tapered section (Gable Column) are pass and Standard Section Column are pass

WEIGHT COMPARISON

Gable Frame Weight

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STEEL TAKE-OFF
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  PROFILE                        LENGTH(METE)     WEIGHT(KN   )

Tapered    MembNo:       1            7.00            2.280
Tapered    MembNo:       2            2.80            0.723
Tapered    MembNo:       5            5.26            1.229
                                          ----------------
                                      TOTAL =         4.232


************ END OF DATA FROM INTERNAL STORAGE ************
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Standard Section Frame Weight

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STEEL TAKE-OFF
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   PROFILE                    LENGTH(METE)     WEIGHT(KN  )

ST   ISMB250                       15.06             5.508
                                          ----------------
                                   TOTAL =           5.508

************ END OF DATA FROM INTERNAL STORAGE ************
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Sr. No.	Description	PEB Frame	Hot Roll Steel section
i.		-0.444,	-0.258,
	column in deflection(mm)	-0.259	-0.13
ii.	Column in Shear	-657.52	538.15
		-318.90,	583.15,
iii.	Beam in Shear KN.m	75.78	-455.32
iv.	Beam deflection(mm)	0.103	-0.13
v.	Wight of the Gable Frame	431.33 Kg	584.33 kg

Comparison of Weight-

Sr. No.	Description	PEB Frame	Hot Road Steel section	percentage weight reduction
I.	Column	3.003	4.15	1.147
ii.	Beam	1.22	1.35	0.13
iii.	Total Weight	4.232	5.5	1.268
v.	**Wight of Frame in kg**	**431.33 Kg**	**584.33 kg**	**35.47%**

PERCENTAGE CALCULATION-

Gable Frame Weight

Standard Section Frame Weight

Difference of 431.33 and 584.33=35.47168061577%

CONCLUSION

- Due to reduction in size of member as per BM in secton, Reduces weight of frame, hence optimizes the whole structure, here in our project total weight of PEB is 35.47 % of total weight of CSB.
- By the reduction in the weight of structure, It reduces dead load on structure.

- As there is no moment at foundation in PEB structure size of foundation required is very less as compared to CSB structure. Hence overall quantity required (Steel) for PEB is very less as compared to PEB.
- Overall Economy is achieved.
- Pre-Engineering Buildings are found to be economical for long span structures than Conventional steel buildings especially for low rise buildings spanning up to 90.0 meters with eave height up to 30.0 meters. PEB structures are found to be costly as compared to conventional structures in case of smeller span structures.
- It is also seen that the weight of PEB depends on the Bay Spacing with the increase in Bay Spacing up to certain spacing the weight reduces and further increase makes the weight heavier
- Due to reduction in size of member in section, Reduces weight of frame, hence optimizes the whole structure, here in our project total weight of PEB is 35.47 % of total weight of CSB.
- As there is no moment at foundation in PEB structure size of foundation required is very less as compared to CSB structure. Hence overall quantity required (Steel) for PEB is very less as compared to PEB.

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