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Comparative Study of Hot Rolled Steel Sections (CSB) and Cold Formed Steel Sections (PEB) for Industrial Building

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Abstract: Cold formed steel sections are extensively used in Industrial and many other non- industrial constructions in World wid. It is relatively a new concept in India. So, here in this research, an attempt is being to carry out the comparison between hot rolled and cold formed steel sections. The results shall be checked with the ultimate goal of reducing the tonnage. Structural analysis and design shall be carried out in STAAD.Pro.V8i SS6 by Bentley systems because of its strong analysis engine, easy graphic user interface and universal acceptability.

Index Terms **- Hot rolled sections, cold formed sections, Weight comparison, STADD-Pro, Tapered Section, pre-engineered, sustainable, conventional steel building**

I. INTRODUCTION

The principal objective of this research is to carry out the analysis and design of industrial sheds with 15m span using Hot rolled steel sections and cold formed steel sections. The results shall be achieved with the ultimate goal of reducing the tonnage. Structure analysis and design shall be carried out in STAAD Pro. V8i SS6 Software.

Cold formed steel is used in building construction, for wall coverings, floor decking etc. Cold formed steel is a basic component in construction of lightweight prefabricated structures like stud frame panels, trusses and portal frames. Cold formed steel sections can be made easily available at any place whereas hot rolled sections difficult to produce.

In the present work an attempt has been made to find the minimum weight for various steel sections such as hot rolled and cold formed on industrial shed under linear elastic method. The structure is modeled using constant parameters such as bracing systems, height, span with various load combination.

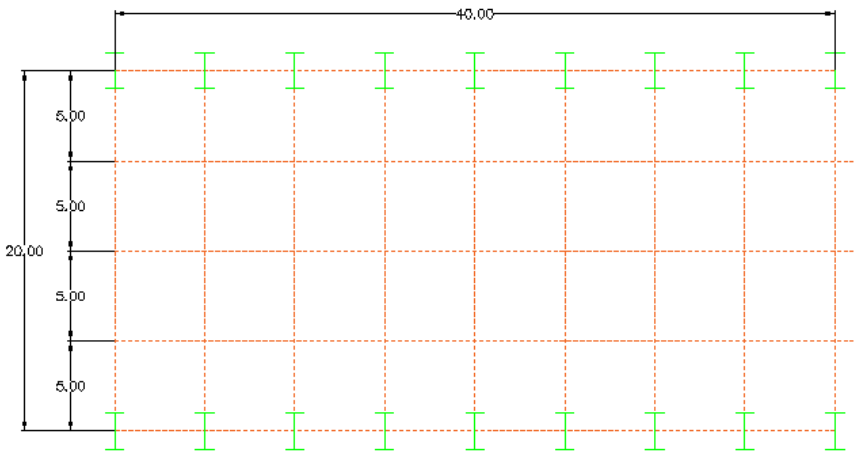


Figure 1. Column Layout Plan

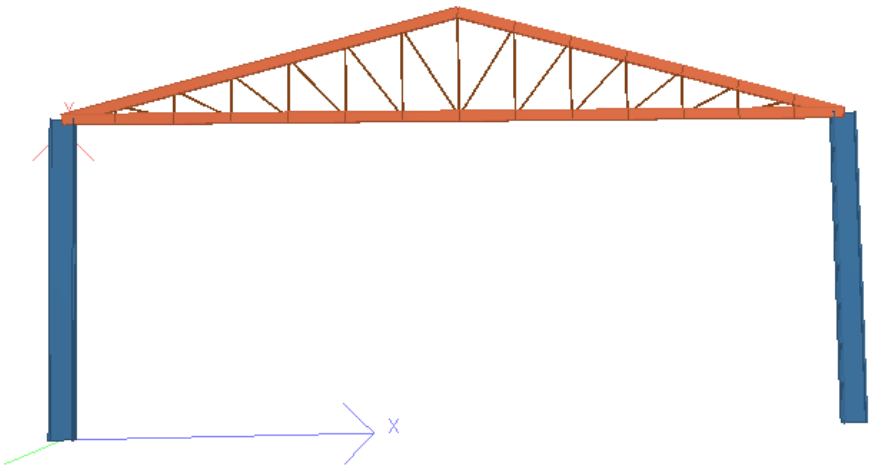


Figure 2. Conventional Steel Buildings (CSB) Section, Hot Rolled section

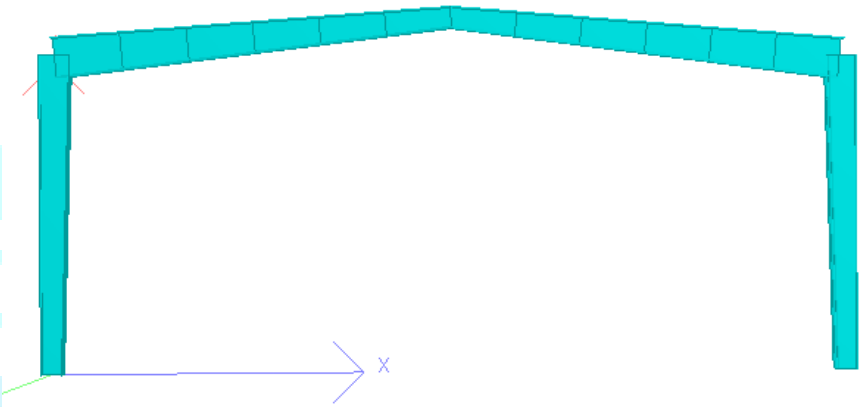


Figure 3. Pre-Engineered Buildings (PEB) Section

II. LOADING CALCULATION

2.1 Structural Parameters –

No. of Bays in X- Direction=9
No. of Bays in Z- Direction=5
Span of industrial shed =40m
Purlin distance=1.5m
Height of Industrial shed structure at edge=8m
Total Height of structure=10m
Support condition = Hinged

2.2. Loads –

1. DEAD LOAD
Selfweight of Structure:- 1.1
(Selfweight is inclusive of the weight of members and the connections like Bolted, welded and weight of Gusset plate.)
Weight of Roofing Material:- 10 kg/m2 = 0.1 kN/m

2. LIVE LOAD
Weight of an average Man:- 75 kg/m2 = 0.75 kg/m

3. WIND LOAD

❖ Wind loads calculation as per IS : 875 (Part 3) –2015

Basic wind speed (Vb) = 44 m/sec……for Nagpur (Table 1 of IS : 875 2015 (Part 3))

Design wind speed (Vz) = Vb x K1 x K2 x K3 x K4 ……(Clause 6.3)

where, K1 Probability factor = 1 …..….(Clause 6.3.1)

K2 Terrain Roughness and Height factor = 1.02 …..….(Table 2 of IS : 875 (Part 3))

K3 Topography factor =1 ……(Clause 6.3.3)

K4 Importance factor for cyclonic region =1 …….(Clause 6.3.4)

❖ Design wind speed Vz = Vb x K1 x K2 x K3xK4 ……(Clause 6.3)

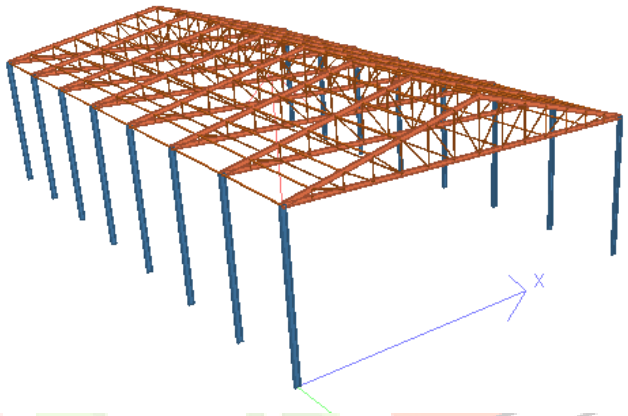
Vz = 44 x 1.0 x 1.02 x 1.0x1.0 Vz= 44.88 m/sec

❖ Design Wind Pressure Pz = 0.6 Vz2 ……(Clause 7.2)

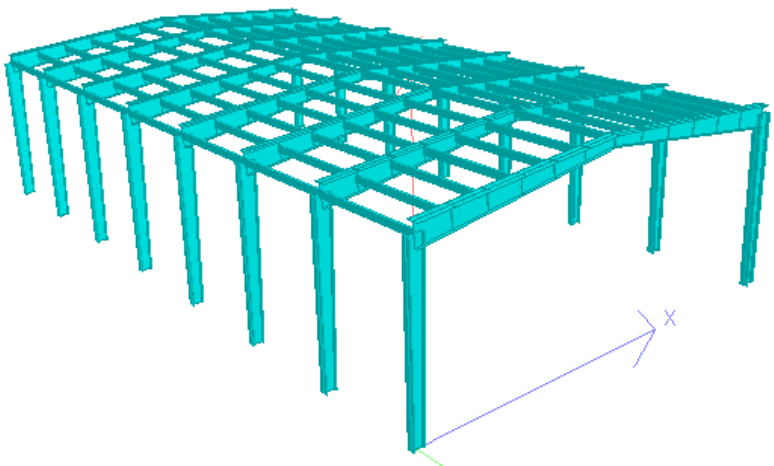
Pz = 0.6 (44.88)2 Pz = 1.2085 kN /m2

III. MODELLING APPROACH

The STAAD-Pro. V8i SS6 has been used for analysis and design. In this study industrial shed is modeled as a 3D model. In this study two industrial sheds are modelled with same geometric configuration. One industrial shed is modelled with using different beam sections and channel sections with use of hot rolled sections and other industrial shed is modelled by using channel section with use of cold formed sections. Wind load considered is acting in X and Z directions.



STAAD Model of HOT ROLLED SECTION BUILDING



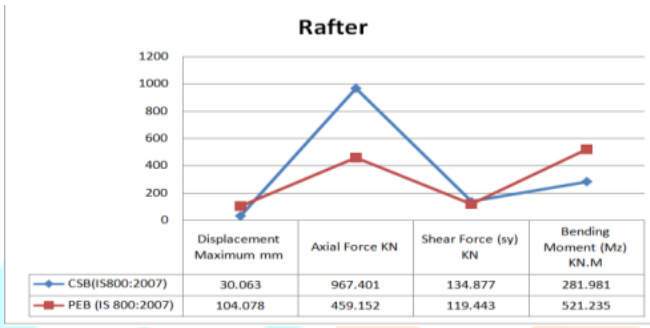
STAAD Model of COLD FORMED SECTION BUILDING

IV. RESULT

For design, analysis and modeling of structure STADD Pro. Software is used. This software support several country standards including Indian standard. In this Software, the Modeling of structure, properties, load and loading combination specification, applied analysis and design are carryout. The utilization ratio in the STADD Pro analysis shows the suitability of the component according to codes. If the value is greater than 1 its shows the component is overstressed, and if less than 1 indicates under stress and means it's suitable for design.

Table 5 Calculation for rafter

Sr. No.	Description	CSB (IS 800:2007)	PEB (IS 800:2007)
1	Length (m)	20	20
2	Displacement Maximum (mm)	30.063	104.078
3	Axial Force (kN)	967.401	459.152
4	Shear Force (kN)	134.877	119.443
5	Bending Moment (kN-m)	281.981	521.235
6	Steel Quantity (kN)	84.793	19.839



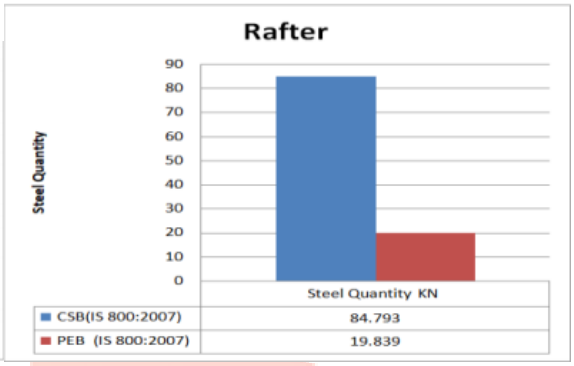
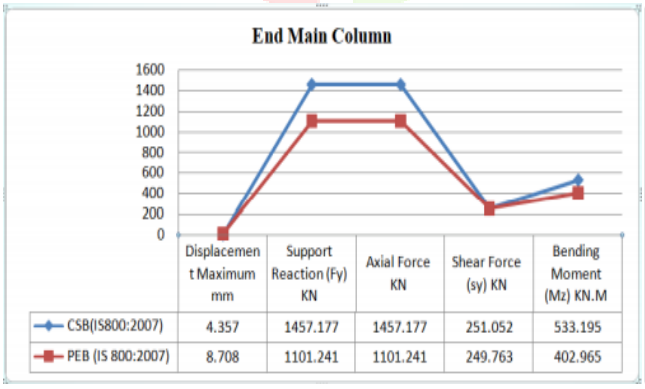


Table 6 Calculation for Main column

Sr. No.	Description	CSB (IS 800:2007)	PEB (IS 800:2007)
1	Section Size	ISWB 600	Web 500~750 x 6mm Flange 240 x 12 mm
2	Length (m)	8	8
3	Displacement Maximum (mm)	4.357	8.708
4	Axial Force (kN)	1457.177	1101.241
5	Shear Force (kN)	251.052	249.763
6	Bending Moment (kN-m)	533.195	402.965
7	Steel Quantity (kN)	15.671	8.636



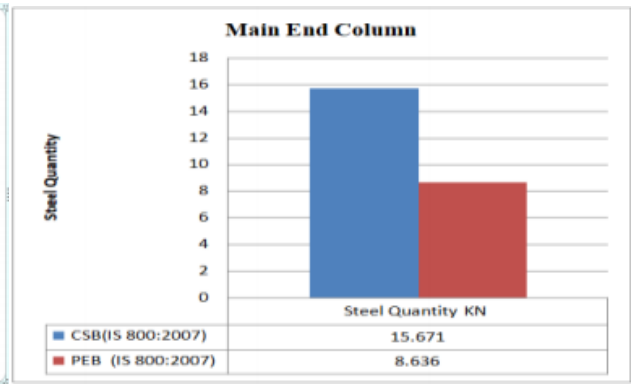
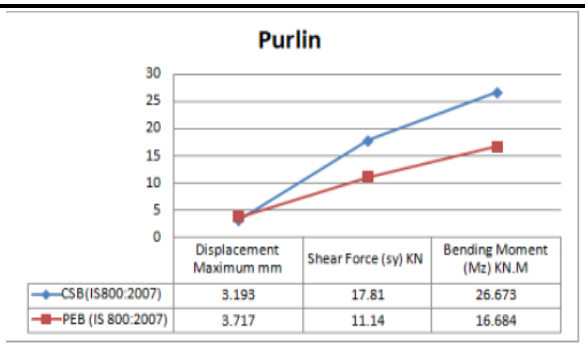
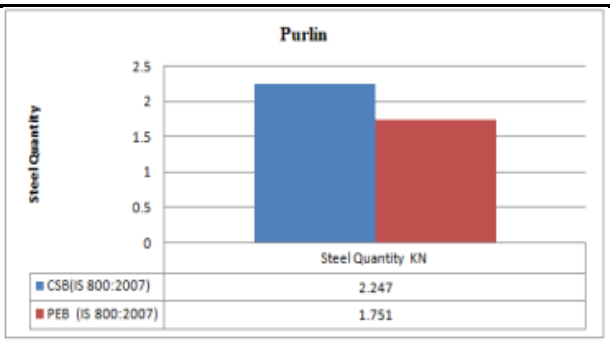


Table 10 Calculation for Purlin

Sr. No.	Description	CSB (IS 800:2007)	PEB (IS 800:2007)
1	Section Size	ISMC 250	Z300 X 75 X 3.15
2	Length (m)	5	5
3	Displacement Maximum (mm)	3.193	3.717
4	Shear Force (kN)	17.810	11.140
5	Bending Moment (kN-m)	26.673	16.684
6	Steel Quantity (kN)	2.247	1.751



	Displacement Maximum mm	Shear Force (sy) KN	Bending Moment (Mz) KN.M
CSB(IS800:2007)	3.193	17.81	26.673
PEB (IS 800:2007)	3.717	11.14	16.684



	Steel Quantity KN
CSB(IS 800:2007)	2.247
PEB (IS 800:2007)	1.751

V. Conclusion

The following are the different conclusions of the project.

- Displacement :-

The PEB structure model designed by IS 800:2007 has more displacement as compared to CSB structure due to less weight of the structure.

- Support Reaction :-

The PEB structure model designed by IS 800:2007 has less support reaction as compared to CSB structure due to less weight of the structure.

- Axial , shear Force and Bending Moment :-

The PEB structure model designed by IS 800:2007 has less axial, shear force and Bending Moment as compared to CSB structure.

- Steel Quantity:-

The PEB structure model designed by IS 800:2007 lightweight as compared to CSB structure. PEB structure is 64% lighter as compared to CSB Structure.

- Wind Resistance:-

The PEB structure model designed by IS 800:2007 higher resistance to wind as compared to CSB structure.

- Purlin:-

The cold formed purlin is 32.5% lighter as compared to Hot rolled Purlin.

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