Optimization in Industrial Steel Building by Using Different Section

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ABSTRACT- Buildings & houses are the oldest construction activities of human beings. The construction technology has advanced since the beginning of primitive construction technology to the present a concept of modern house buildings. The present construction methodology for buildings brought for the best aesthetic look, high quality & fast construction, cost effective & innovative appearance. Pre-Engineered Steel Buildings are manufactured or produced in the plant itself. The detailed structural members are designed for their respective location and are numbered, which cannot be altering because members are manufactured with respect to design features. An efficiently designed pre-engineered building can be lighter than the conventional steel buildings by till 30%. Lighter weight equates to less steel and potential cost savings in a structural framework.

This also covers the advantages of hollow sections in its effectiveness to reduce corrosion, minimizing the overall cost of the plant, and improvements in aesthetic value. The study involves the comparative analysis of industrial steel building using sections under the influence of usual loading values. It also covers a comparative study of sectional properties and its attributes and wide applications in architectural, industrial, infrastructural and general engineering.

KEYWORDS: IS1161, IS875, IS800-2007, IS806, IS2062

I. INTRODUCTION

How to meet the housing and infrastructural needs of society in a sustainable manner in unquestionably most important challenge confronting the steel industry today. This study about design components of the industrial building using open sections, tubular sections, and pre-engineering concept. These sections are designed by using most suitable cross sections according to dead load, live load, wind load, etc. As a result the structure will loss its weight up to 35% during the specified life span. In PEB construction is simple design easy to construct and light in weight both time and cost of erection are minimized. Outstanding architectural design can achieve at low cost using standard architectural features and interface details. In conventional steel building, special architectural design and features must be developed for each project which often required results and thus resulting in much higher cost. Future expansion would more difficult and more likely, costlier than tubular sections and open sections.

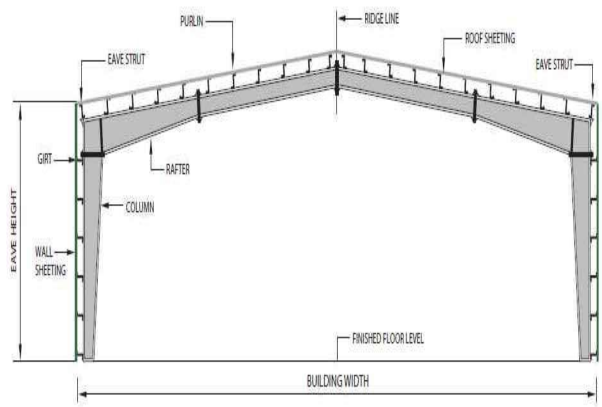
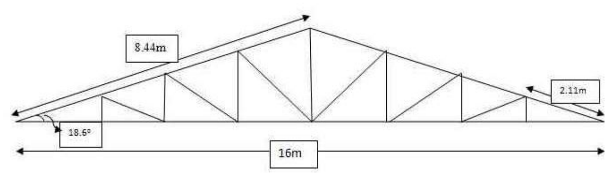


Fig.1 Typical Cross section of PEB

II. ANALYSIS AND DESIGN

Data required for analysis and design of Industrial Shed,
Plan Area= 640mm^2

Location= Pune; Roof Truss=Pratt



Geometry :- Span=16m ; Ø =18.6^0
8Panel point spacing of purlins=1.75m
Type of sheet= G.I.; Length of sheet=3.05m
Sloping length=8.44m
Spacing of truss=4m; No. of trusses= 8

OPEN SECTION

Design of members

Member (L_0U_1)
Force= 109.72 (C) KN
For grade of steel:
F_u = 410MPa
F_y=250MPa
Y_{mo}=1.1
Y_{mb}=1.25
Thickness of gusset plate= 12mm
Assume F_{cd}= 110 N/mm^2
Effective length of principle Rafter @z-z axis
=0.85L= 0.85x2.11=1.8m=1800mm
Cross sectional area required=$\frac{109.72}{110}$ x 10^3 = 997.45 mm^2
Let us try 2ISA 60x60x5@4.51Kg/m
A= 2 x 527 =1150mm^2
Y_{min}= 18.2mm
Effective slenderness ratio= $\frac{KL}{Y_{min}}$

= 98.90 < 180.....................................O.K.
Design Compressive Stresses(F_{cd})
For λ=98.90
Using table 9(c) IS 800-2007
By Interpolation, F_{cd} = 108.54 N/mm^2
Design Compressive Strength(P_d)
$P_d = A_c \times F_{cd}$ = 1156 x 108.54 = 124.82 KN
> P..Safe
Checks
Design of Tensile Strength = $\frac{F_y}{\gamma_{m0}}$ x A_g = $\frac{[illegible]}{1.1}$x1150
=261.36>88.30(T)
....Safe

TUBULAR SECTION

Design of members

Design of principal Rafter
L_0L_1 (2.11m)
Tension=88.305KN
Compression=-109.72KN
Tube of Grade Y_{st}210
F_y =210MPa F_u=330MPa
Assume Safe Stress F_c=100N/mm^2
Effective length=0.8L=0.8x2110=1688mm
Required Area=$\frac{Load}{Stress}$ = $\frac{109.72}{100}$ x 10^3= 1097.2mm^2
From Table 1 IS1161:2014
Choose light gauge tube
Nominal Diameter=90mm
Outside Diameter=101.6mm
Thickness=3.6mm
Mass=8.7Kg/m
Area of C/S = 1108mm^2
R = 34.7mm
$\frac{KL}{r}$ = $\frac{1688}{34.7}$ =48.64
From IS 1161
F_c =103.10 N/mm^2
Load Capacity = F_c x A
= 103.10 x 1108 x 10^{-3}
=114.24 KN > 109.72 KN...O.K

III. SUMMARY

Table 2: Summary of Sections in Structure

Sr. No.	Description	Open Section	Tubular Section
1	Principal Rafters	2 ISA 60x60x5	90mm N.D ; 101.6mm O.D of Light weight
2	Main Ties	2 ISA 50x50x6	
3	Struts	ISA 50x50x6	
4	Slings	ISA 50x50x6	
5	Purlins	ISMC125	50mm N.D
6	Columns	ISLB250	ISLB 250

IV.RESULTS AND DISCUSSION

Table 3: Comparison of Sections

	Open	Tubular	PEB
Weight of 10truss with column (MT)	14.362	9.018	11.038
Rate of truss (Rs.)	1196534.96	751318.072	919609.104

Fig. 1.Weight comparison between sections

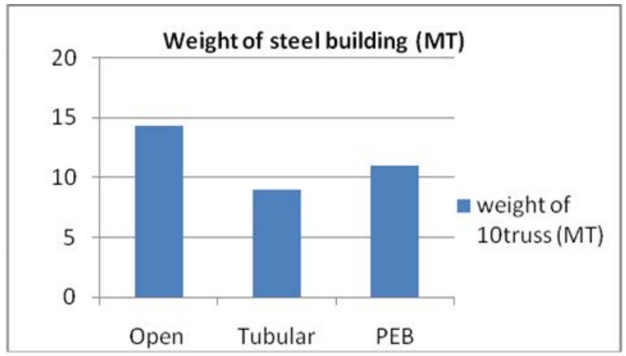
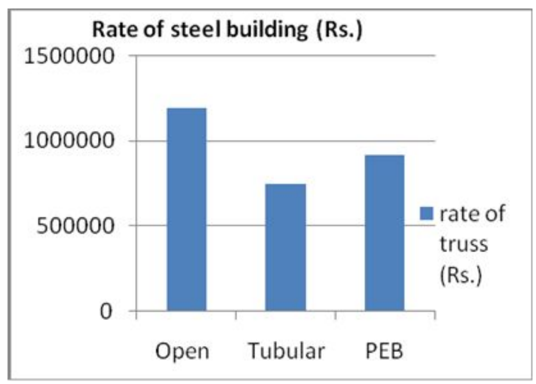


Fig.2. Rate Comparison with sections



V. CONCLUSION

From analysis and design, it is proved that steel requirement for erecting steel a structure using hollow section is very low as compared to structure constructed using conventional section. Though, the cost of erection of hollow section is more than a conventional section, the material requirement is tremendously reduced in the structure using hollow section.

Hollow sections have excellent mechanical, geometrical, tensile, compressive and bending characteristics for exposed conditions and aggressive environments. Thus from estimation, we came to the conclusion that cost of erection and manufacturing in the case of hollow section is reduced by half of that of a conventional section.

The pre-engineering building has cost and times of erection are minimized as compare to conventional and hollow sections. It was found that there is saving of 35 to 50 % in tubular sections and 35 to 45% in PEB in steel work and saving of cost in open sections and tubular sections are 30 to 50% and open sections and PEB 20 to 30%.

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