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Design of Various Types of Industrial Buildings and Their Comparison

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ABSTRACT :- 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-engineering Buildings of same dimension. Design is based on IS 800-2007 (LSM)
Load considered in modeling are Dead load, Live Load, Wind load along with the 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
Keywords: -IS Code, Stadd Pro

I. INTRODUCTION

1.1 General

Any building structure used by industry to store raw materials or for manufacturing products of industry is known as an Industrial Building. These buildings are used for workshop, warehouse etc. Steel is extensively used in the construction of industrial building of larger spans where concrete construction is not feasible or when construction tome is critical. The important elements of industrial buildings are purlins, rafters, roof truss, wind bracing and columns. In India conventional steel constructions are most popular because of their ease in construction, low cost, availability of manpower for erection & fabrication and availability of standard specifications 7 codes of practice. For industrial building, the economy of the structure plays an important role. For longer spans the design is optimized in order to minimize the use of materials, costs, and installation efforts. Buildings are designed to reduce energy costs and to achieve a high degree of sustainability. To reduce the costs, manufacturer adopted the Pre-Engineering Building concept. Pre-engineering Buildings is a metal building that consist of light gauge metal standing seam roof an steel purlins spanning between rigid frames with light gauge metal wall cladding.

II. DESIGN OF TRUSSES

2.1 Mathematical model I - The mathematical model under consideration is shown in figure (2.1) for the truss having area of 14 m×31.50 m, having purling spacing of 1.489 m having bay spacing of 5.25 m and building height is 6m. The column base is taken as Pinned support.

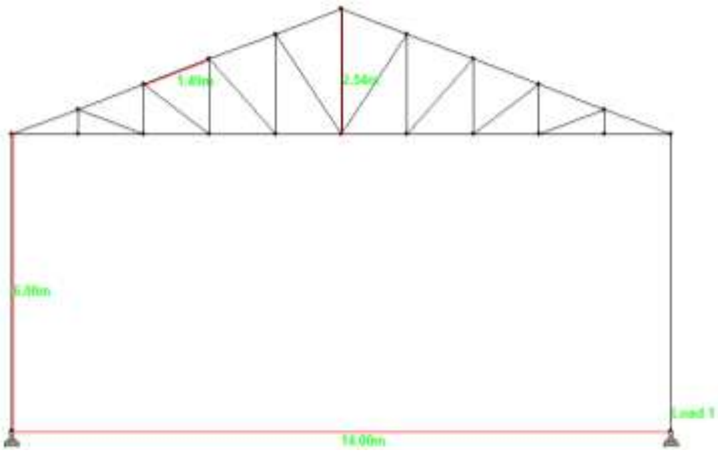


Figure 2.1: Mathematical Model of Industrial Building (Pinned support)

2.2 Loading Calculations

For the truss the dead load, live load, and wind load was considered. All of these were taken in accordance with is IS 875:1987

1.2.1 Dead load

a) Roofing material – GI sheeting with unit weight of 150 N/m^2.
b) Purlins – Assuming unit weight of purlin is 100 N/m^2.
c) Total dead load =150+100=250 N/m^2 of plan area
= 0.250 kN/m^2 of plan area

Dead load on plan area = load x spacing of purlin in plan x bay spacing
= 0.25 x1.489×cos (20) ×5.25
= 1.84 kN at each node
= 1.84/2 at end node
= 0.92 kN

1.2.2 Live load (As per IS 875:1987 part II)

As per IS 875:1987 part II when slope is greater than $\geq 10^0$then imposed load on purlin is 750 N/m^2 less 20 N/m^2 for every degree increase in slope in excess of 10^0 but not less than 400 N/m^2.

Live load =750 - 20× (20-10) =550 N/m^2

In case of sloping roofs with sloping greater than 10^0, members supporting the roof purlins, such as trusses, beams, girders, etc. may be designed for two – thirds of the imposed load on purlins or roofing sheeting.

$2/3^{rd}$ load = 2/3×550
= 366.67 N/m^2.

Live load on plan area = load x spacing of purlin in plan x bay spacing
= 366.67×1.489×cos (20) ×5.25
= 2.70 kN at each node
= 2.70/2 at end node
= 1.35 kN

2.2.3 Wind load (As per IS 875:1987 part III)

Basic wind speed for Amravati region (V_b) = 39 m/s.
Risk coefficient (k_1) = 1
Terrain height & Structure size factor (k_2) = 0.98
Topography factor (k_3) = 1
Design wind speed (V_z) = $V_b \times k_1 \times k_2 \times k_3$
Design wind pressure (P_z) = 0.6 Vz^2
Design wind pressure (P_z) = 38.22^2

Design wind pressure (P_z) = 876.46 N/m^2.
Internal pressure coefficient (P_i) = ±0.5
External pressure coefficient (P_e) – fig 3.2 shows the value of external pressure
Coefficient for wind angle (θ) = 20^0
$\frac{h}{w}$ = 0.42
$\frac{l}{w}$ = 2.25
Roof angle (θ) = 20^0

2.3 Loading diagram:

2.3.1. Dead Load:

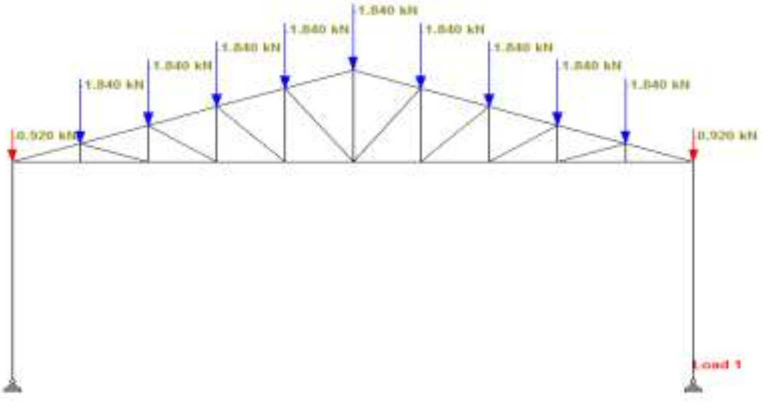


Figure 2.3.1: Dead Load on Truss

2.3.2 Live Load:

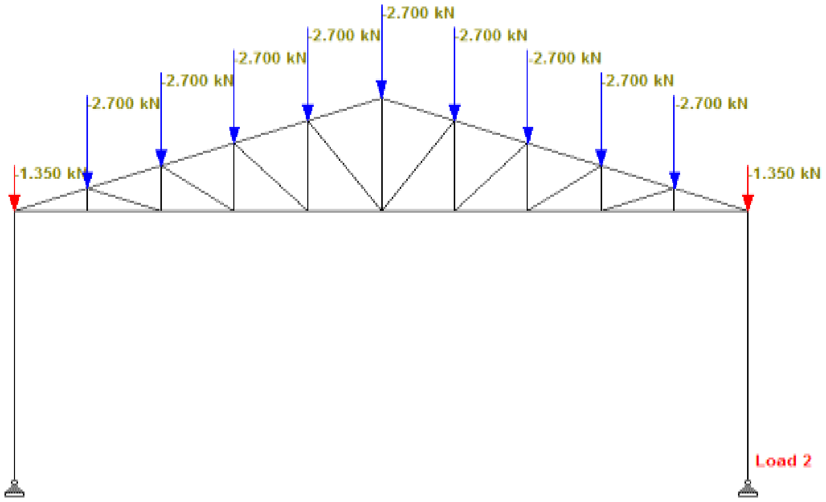


Figure 2.3.2: Live Load on Truss

2.3.3 Wind Load:

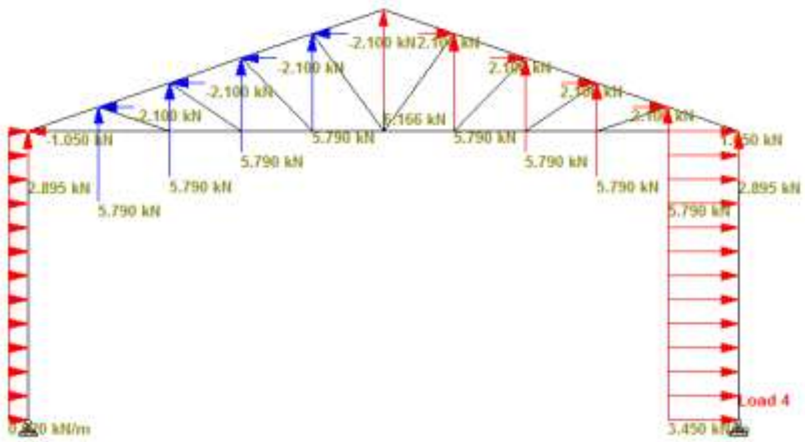


Figure 2.3.3: Wind Load on Truss& Columns

2.4 Design of Purlin (ISMC):

Span 5.25 m.

Spacing of purlin	= 1.489 m.	
Dead load on plan area	= 0.25×1.40	= 0.35kN/m.
Live load on plan area	= 0.55×1.40	= 0.77 kN/m.
Wind load acting on roof area	= -0.9×0.876×1.489	
	= -1.174kN/m	

2.4.1 Loads normal to slope

Dead load Wdz	= 0.35×cos (20) =	0.33 kN/m.
Live load Wlz	= 0.77×cos (20)	= 0.723 kN/m.
DL + LL	= 0.33+0.723	= 1.053 kN/m.

2.4.2 Loads parallel to slope

Dead load W_{dy} = 0.35 x sin (20) = 0.12 kN/m.

Live load W_{ly} = 0.77 x sin (20) = 0.26 kN/m.

2.4.3 Factored load combination

(Z direction)

WL + DL + LL = (1.2 x -1.173) + (1.2 x 0.33) + (1.2x 0.33)
= -0.144 kN/m.

DL + LL = (1.5 x 0.33) + (1.5 x 0.723)
=1.5795 kN/m

WL + DL = (1.2 x -1.173) + (1.2 x 0.33)
= -1.0116 kN/m.

(Y direction)

DL + LL = (1.5 x 0.12) + (1.5 x 0.26)
= 0.57 kN/m.

2.4.4 Bending moment and shear force calculations

$M_z = 1.5795 \times 5.25^2/8 = 5.503$ kN-m

Since sag rod is introduced at 1/3rd of span so Y-Direction moment will be very less

$M_y = 0.57 \times 5.25^2/90$
$= 0.17$ kN-m
$F_z = 1.5795 \times 5.25/2 = 4.146$ kN.
$F_y = 0.57 \times 5.25/2 = 1.496$ kN.

TRY ISMC 125

Section classification

i. d/t_w = 125- 2(8.1 + 9.5)/5.0
= 17.6 < 42

ii. b/t_f = 65/8.1
= 8.02 < 9.4 (section is plastic)

Check for shear calculations:

Z direction

$V_d = \frac{fy}{\gamma mo \times \sqrt{3}} \times h \times t_w = \frac{250}{1.1 \times \sqrt{3}} \times 125 \times 5.0$
= 82.009 kN.

$0.6V_d$ = 49.205 > 4.146 kN. Ok.

Y direction

Shear capacity = $\frac{250}{11.1 \times \sqrt{3}} \times x \times 2 \times 65 \times 8.1/10^3$
= 13.69 > 1.496 kN. Ok.

Design capacity of the section

$M_{dz} = \frac{Zpz \times fy}{\gamma mo} = \frac{73.92 \ x \ 103x \ 250}{1.1 \times 10^6}$
=17.25 KN-m $\leq 1.2 \times Zez \times fy/\gamma_{mo}$
≤ 18.16 kN-m **ok**

$M_{dy} = \frac{Zpy \times fy}{\gamma mo}$ = $14.93 \times 10^3 \times 250/1.1 \times 10^6$
= 3.39 KN-m. $\leq \gamma_f \times Zey \times fy / \gamma_{mo}$
$\leq 1.5 \times 13.1 \times 10^3 \times 250 / 1.1 \times 10^6 \leq 4.46$ kN-m **ok**

Interaction equation:

$\frac{Mz}{Mdz} + \frac{My}{Mdy} \leq 1.0$

$\frac{5.50}{17.25} + \frac{0.17}{3.39} \leq 1.0$

0.368 < 1.0 **ok.**

Hence overall member strength is satisfactory

Check for deflection

$\delta = \frac{5wl4}{384EI} = \frac{5 \times 0.723 \times 5250\,4}{384 \times 2 \times 105 \times 416.104}$
= 8.58 mm.

Allowable deflection = $\frac{l}{180} = \frac{5250}{180}$
= 29.16 mm. Ok.

Check for wind suction

Factored wind load W_z = 0.9 DL -1.5 WL
= 0.9×0.33 -1.51.173
= -1.4445 kN/m.
W_y = -0.9×1.173 x sin (20)
= -0.36 kN/m.

Buckling resistance of the section

Equivalent length = 5.25 m.

Moment $M_z = wl^2/8$
$= 1.4445 \times 5.25^2/8$

= 4.976 kN-m

$M_y = wl^2/90$

= 0.11 kN-m.

$M_{cr} = \sqrt{\frac{\pi 2EIy}{(KL)2} * \left(GIt + \frac{\pi 2EIw}{(KL)2} \right)}$

$G = \frac{E}{2(1+\mu)}$

$= \frac{2*105}{2(1+0.3)}$

$= 76.923 \times 10^3$

$I_t = \sum \frac{bi*ti3}{3}$

$= [\frac{2*65*8.1^3}{3} + \frac{(125-8.1)*5^3}{3}]$

$= 27899.94\ mm^4$

$I_w = (1- Bf) \times Bf \times Iy \times hf^2$

$h_f = 125-8.1$

= 116.9 mm.

$B_f = \frac{Ifc}{Ifc+Ift}$

= 0.5

$I_w = (1-0.5) \times 0.5 \times 59.9 \times 0^4 \times 16.9^2$

$= 2.04 \times 10^9\ mm^6$.

$M_{cr} = \sqrt{\frac{\pi^2*2*10^5*59.9*10^4}{(5250)2} * \left(76.923*10^3*27899.9 + \frac{\pi^2*2*10^5*2.04*10^9}{(5250)2}\right)}$

= 9.91 kN-m

$\lambda_{LT} = \sqrt{\frac{\beta bxZpxfy}{Mcr}}$

$= \sqrt{\frac{1.0*75.92*10^3*250}{5.44}}$

=1.38

$\phi 2_{LT} = 0.5\times [1+ \alpha_{LT}*(\lambda_{LT}-0.2) + \lambda^2_{LT}]$

$= 0.5\times [1 + 0.21\times (1.38-0.2+ 1.38^2]$

=1.576

$\chi_{LT} = \frac{1}{\phi LT+[\phi 2LT-\lambda 2LT]^{0.5}} \leq 1.0$

$= \frac{1}{1.576+[1.5762-1.382]0.5} \leq 1.0$

$= 0.427 < 1.0$

$F_{bd} = \frac{\chi LT*fy}{\gamma mo}$

$= \frac{0.427\times 250}{1.1}$

$=97.04\ N/mm^2$

$M_{dz} = Z_p \times F_{bd}$

$= 75.93\times 10^3 \times 97.04$

= 7.36 kN-m > 4.976 kN-m.

The buckling resistance Mdy of the section need not be found out , because the purlins is restrained by cladding in the Z plane and hence instability is not considered for a moment about the minor axis.

Overall strength of the member

$\frac{Mz}{Mdz} + \frac{My}{Mdy} \leq 1.0$

$\frac{4.976}{7.36} + \frac{0.11}{3.39} \leq 1.0$

$0.708 \leq 1.0$

2.5 Design of Purlin (Truss Purlin) for 5.25m span

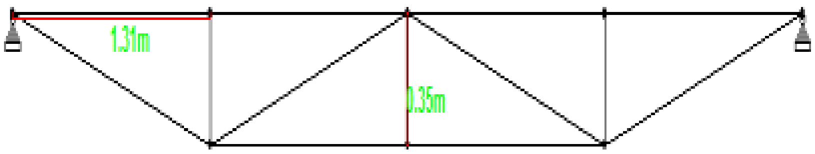


Figure 4.19: Elevation of Truss Purlin

2.5.1 Loading Calculation:

Span 5.25 m.

Spacing of purlin	= 1.489 m.	
Dead load on plan area	= 0.25×1.40	= 0.35 kN/m.
Live load on plan area	= 0.55×1.40	= 0.77 kN/m.
Wind load acting on roof area	= -0.9×0.876×1.489	
	= -1.174 kN/m	

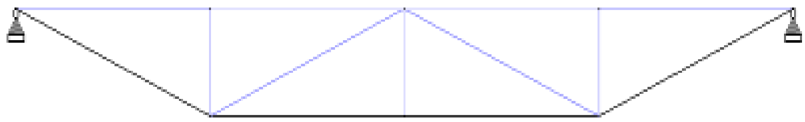


Figure 4.23: Member showing Tension and Compression

Black Color Represents – TENSION
Blue color represents – Compression

Result From STADD:

Profile	Length (Meter)	Weight (kN)
ST Pipe33.70 mm	5.25	0.152
ST Pipe21.30 mm	3.77	0.035
ST Pipe33.70 mm	5.34	0.106
	Total =	0.293

III. DESIGN OF PRE-ENGINEERING BUILDING

3.1 Introduction

In this section the design of various component of PEB has been considered.

The component include:-

i. Purlins
ii. Girt Rods
iii. Main frame
iv. Bracings

The Purlins have been designed as per IS 801:1975 which deals with cold formed steel sections. The results of cold formed purlins are then compared with the results of channel purlins.For the design of main frame, built up I sections have been used of which the web depth has been tapered section. The design of main frame has been done as per IS 800:2007(LSM)Bracings are essentially made up of angle sections, pipe sections. The design of Bracing is done in 3-D model and the results are then computed.

3.2 Mathematical model I - The mathematical model under consideration is shown in figure (3.1) for the Pre-engineered building having area of 14 m x 31.50 m,purling spacing of 1.489 m and bay spacing of 5.25 m and building height is taken as 6m. The column base is taken as Pinned support.

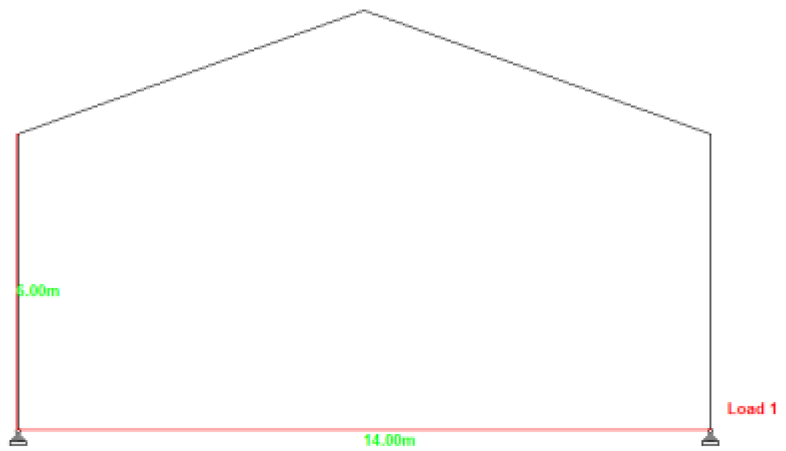


Figure 3.1: Mathematical model of an Industrial Building (Pinned Support)

3.3 Loading calculations

3.3.1 Dead load

d)Roofing material –GI sheeting with unit weight of 150 N/m^2.
e) Purlin – Assuming unit weight of purlin is 100 N/m^2.
f) Total dead load = 150+100 = 250 N/m^2 of plan area
= 0.250 kN/m^2 of plan area
Dead load on plan area = load x bay spacing
= 0.25 x 5.25
=1.3125 kN/m

3.3.2 Live load (As per IS 875:1987 part II)

As per IS 875 part II when slope is greater than > 10^0then imposed load on purlin is 750 N/m^2 less 20 N/m^2 for every degree increase in slope in excess of 10^0 but not less than 400 N/m^2.
Live load =750 – 20 x (20-10)
=550 N/m^2
In case of sloping roofs with sloping greater than 10^0, members supporting the roof purlins, such as trusses, beams, girders, etc. may be designed for two – thirds of the imposed load on purlins or roofing sheeting.
2/3rd load = 2/3 x 550
=366.67 N/m^2.
= 0.366kN/m^2
Live load on plan area = load x bay spacing
= 0.366 x5.25
= 1.9215kN/m

3.3.3 Wind load (As per IS 875:1987 part III)

Basic wind speed for Amravati region (V_b) =39 m/s.
Risk coefficient (k_1) = 1
Terrain height & Structure size factor (k_2) = 0.98
Topography factor (k_3) = 1
Design wind speed (Vz) = V_b x k_1 x k_2 x k_3
Design wind pressure (Pz) = 0.6 Vz^2
Design wind pressure (Pz) = 38.22^2

Design wind pressure (Pz) = 876.46 N/m^2.
Internal pressure coefficient (P_i) = + _ 0.5
External pressure coefficient (P_e) – fig 3.2 shows the value of external pressure coefficient for wind angle (0) = 0^0
$\frac{h}{w} \leq 0.5$

$\frac{l}{w}$= 2.25
Roof angle (θ) = 20^0.

3.4 Loading Diagram:

3.4.1 Dead load-

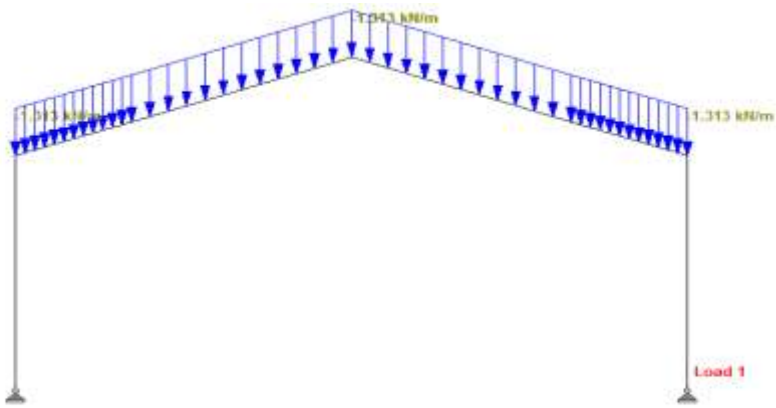


Figure 3.4.1: Dead Load on PEB

3.4.2 Live load –

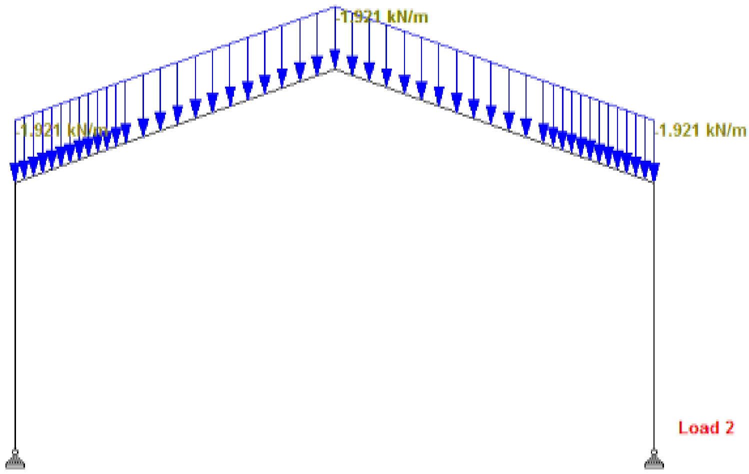


Figure 3.4.2: Live Load on Truss

3.4.3 Wind load –

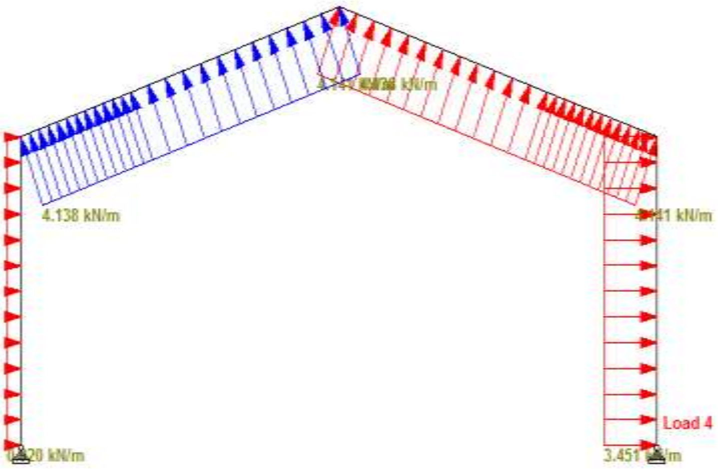


Figure 3.4.3: Wind Load on Truss & Columns

3.5 Design of Z - Purlin :(14m x 31.50m)
Span = 5.25m
Spacing of purlin = 1.489 m.
$\theta = 20^0$

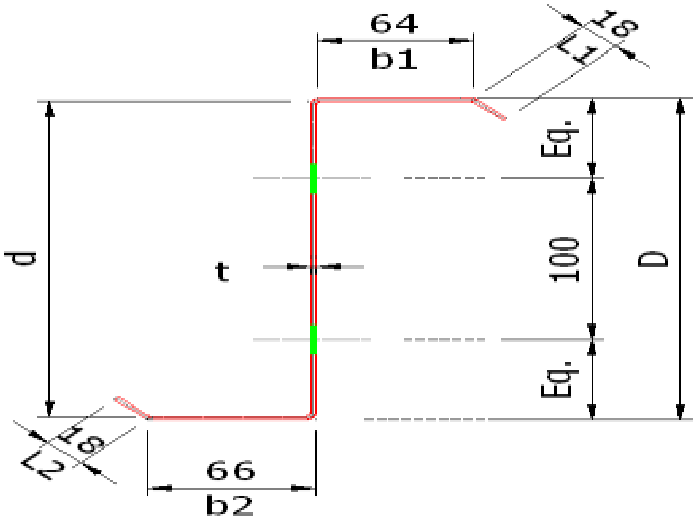


Figure 5.20: Cross Section of Z Purlin

Z purlin – (150 x 2.5):

Table 5.2: Sectional Properties of Z- Purlin

Parameter	Abbreviation	Value	Unit
Flange Width	b1	6.4	Cm
	b2	6.6	Cm
Overall Depth	D	15	Cm
Depth of Lip	L1	1.8	Cm
	L2	1.8	Cm
Thickness	T	0.2	Cm
Centre of Gravity	Y	7.51	Cm
Moment of Inertia	Ixx	210.69	cm^4
Sectional Modulus	Zxxtop	28.06	cm^3
Sectional Modulus	Zxxbot	28.12	cm^3
Centre of Gravity	X	5.90	Cm
Moment of Inertia	Iyy	49.14	cm^4
Sectional Modulus	Zyyleft	8.33	cm^3
Sectional Modulus	Zyyright	8.30	cm^3
Cross Sectional Area	A	6.16	cm^2
Weight/m		4.84	Kg

3.5.2 Loading calculations
Dead load = 0.25 kN/m^2.
Live load = 0.55 kN/m^2.
Wind load = 876.46 kN/m^2.
Major loads in vertical plane
a) DL + LL = [(DL+LL) x cos (20^0)] x spacing of purlin
= [(25+55) x 0.94] x 1.489
= 111.97 kg/m.
b) DL + WL = [(DL x cos(20^0)) + (WL x Net coefficient pressure)] x spacing of purlin
= [(25 x 0.94) + (87.6 x (-0.9)] x 1.489
= -82.40 kg/m.
Minor loads in inclined plane
a) DL + LL = [(DL+LL) x sin(20^0)] x spacing of purlin
= [(25 + 55) x 0.342] x 1.489
= 40.73 kg/m.

Bending moment calculations
Maximum spn moment, M_{span} = 111.97 x 5.25^2/8
= 385.77 kg-m
Maximum Span Moment over Sag Rod, Msag = 0.1071 x 40.73 x $(5.25/3+1)^2$
= 7.52 kg-m
Maximum moment capacity of Section, Mmax = 0.6 x f_y x $z_{xx\ min}$
= 0.6 x 345 x 28.06 x 10^3
= 580.8 kg-m
Allowable stress in web of purlin (As per clause 6.4 of IS 801:1975)
Shear stresses in Web: h/t = 146/2 = 73 Not greater than $\frac{4590}{\sqrt{345 \text{ x } 10}}$ = 78.14

Fv = $\frac{1275 \text{ x } \sqrt{fy}}{(h/t)}$ with a maximum of 0.40 fy
= 1025 < 1380 kg/cm^2.
Developed shear stress:
Fv = P x L/ Aw
= 111.97 x 525/ (146 x 2)
= 201.22 kg/cm^2 **Safe**

Bending Stress in Web:
Maximum Bending stress, F_{bw} = 0.6 fy
= 2070 kg/cm^2
Developed Bending Stress Vertical Plane, Mspan / Zxmin = 386/28.06 x 100
= 1375.62 kg/cm^2 **Safe**
Developed Bending Stress Inclined Plane, Msag / Zymin = 7.52 /8.30 x 100
= 90.60 kg/cm^2 **Safe**
Total Bending stress, f_{bw} = 1375.62 + 90.60
= 1465.6 kg/cm^2 < 2070 kg/ cm^2 **Safe**

Combined Bending and Shear Stress in Web: (AS PER CLAUSE 6.4.3 OF IS 801-1975)

$$\sqrt{\frac{fbw^2}{Fbw^2} + \frac{fv^2}{Fv^2}} \leq 1.0$$

$$\sqrt{\frac{1465.6^2}{2070^2} + \frac{201.22^2}{1025^2}} \leq 1.0$$

0.73 ≤ 1.0 **Safe**

Deflection Check: (As per table 6 In IS 800:2007)
Permissible Deflection, Span/180 = 5250/180
= 29.16 mm.

For DL + LL = $\frac{5wl^4}{384 \text{ EI}}$
= 25.01 mm.
For DL + WL = $\frac{5wl^4}{384 \text{ EI}}$
= 18.4 mm.

IV. COMPARISON AND DISCUSSION

Table 4.1: Weight for 14m x 31.50m Steel Building Pinned Support at base using Channel purlin & Angle Section Truss			
1	Weight of truss and column	55.083	kN
2	Weight of purlin ISMC 125	47.088	kN
3	Tie Runner pipe 80x80x6	19.503	kN
4	Top Bracing LD 60x60x6	22.462	kN
5	Bottom Bracing LD 50x50x6	18.693	kN
6	Column Bracing LD 50x50x6	19.871	kN
	Total	183.45	kN
Table 4.2:Weight for 14m x 31.50m PEB pinned supports at Base using Z purlins			
1	Weight of PEB	56.042	kN
2	Weight of Z- Purlin	17.94	kN
3	Top Bracing LD 60x60x6	22.462	kN
4	Column Bracing LD 50x50x6	19.871	kN

	Total	116.315	kN

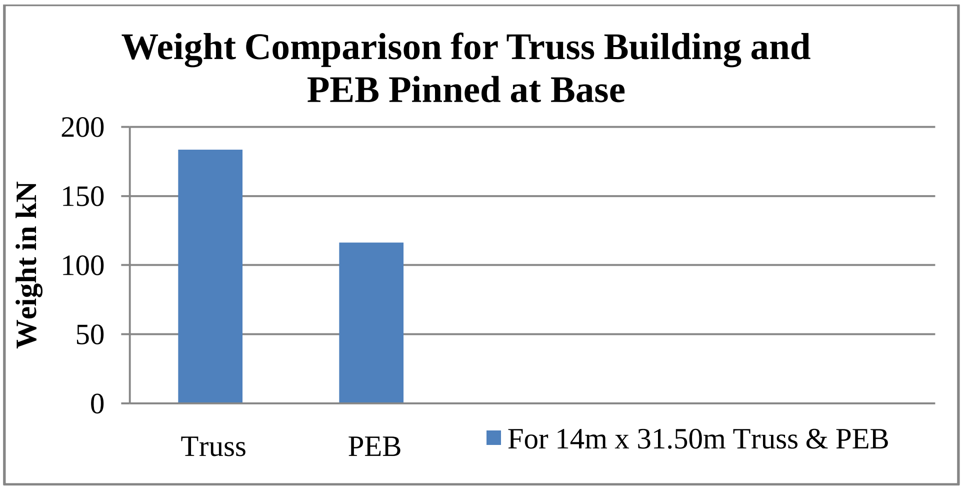
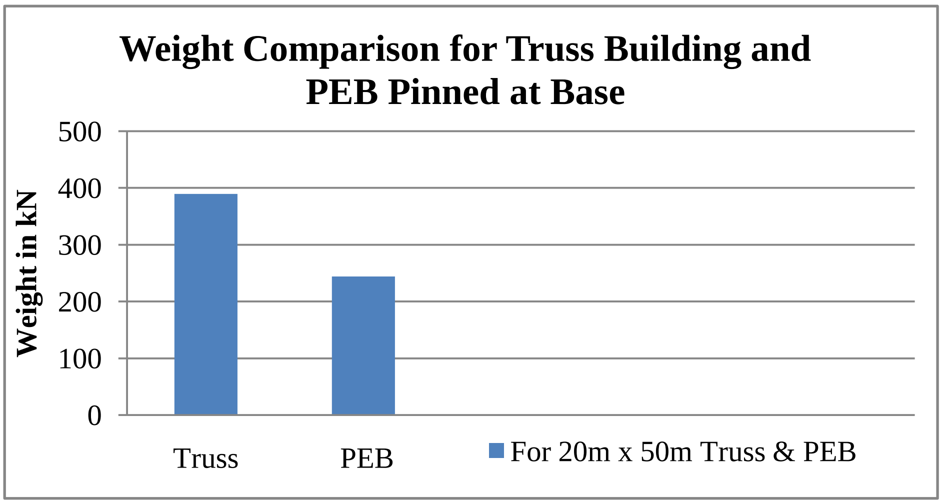


Figure 4.1: Weight Comparison for Truss Building and PEB Pinned at Base for14m x 31.50m

Table 4.3: Weight for 20m x 50m Steel Building Pinned Support at Base using Channel purlin & Angle Section Truss			
1	Weight of truss and column	111.546	kN
2	Weight of purlin ISMC 150	144.08	kN
3	Tie Runner pipe 90x90x6	28.151	kN
4	Top Bracing LD 65x65x6	39.834	kN
5	Bottom Bracing LD 55x55x6	36.256	kN
6	Column Bracing LD 55x55x6	29.85	kN
	Total	389.717	kN
Table 4.4: Weight for 20m x 50m PEB Pinned supports at Base using Z purlins			
1	Weight of PEB	118.836	kN
2	Weight of Z- Purlin 200x2.5	55.552	kN
3	Top Bracing LD 65x65x6	39.834	kN
4	Column Bracing LD 55x55x6	29.85	kN
	Total	244.072	kN



Figure

4.2: Weight Comparison for Truss Building and PEB Pinned at Base for 20m x 50m

Table 4.5: Weight for 28m x 70m Steel Building Pinned Support at Base using Channel purlin & Angle Section Truss			
1	Weight of truss and column	292.622	kN
2	Weight of purlin ISMC 200	333.78	kN
3	Tie Runner pipe 100x100x6	56.478	kN
4	Top Bracing LD 65x65x6	63.926	kN

5	Bottom Bracing LD 65x65x6	62.024	kN
6	Column Bracing LD 65x65x6	40.645	kN
	Total	849.475	kN

Table 4.6: Weight for 28m x 70m PEB Pinned supports at Base using Z purlins

1	Weight of PEB	302.478	kN
2	Weight of Z- Purlin 200x2.5	84.88	kN
3	Top Bracing LD 65x65x6	63.926	kN
4	Column Bracing LD 65x65x6	40.645	kN
	Total	491.929	kN

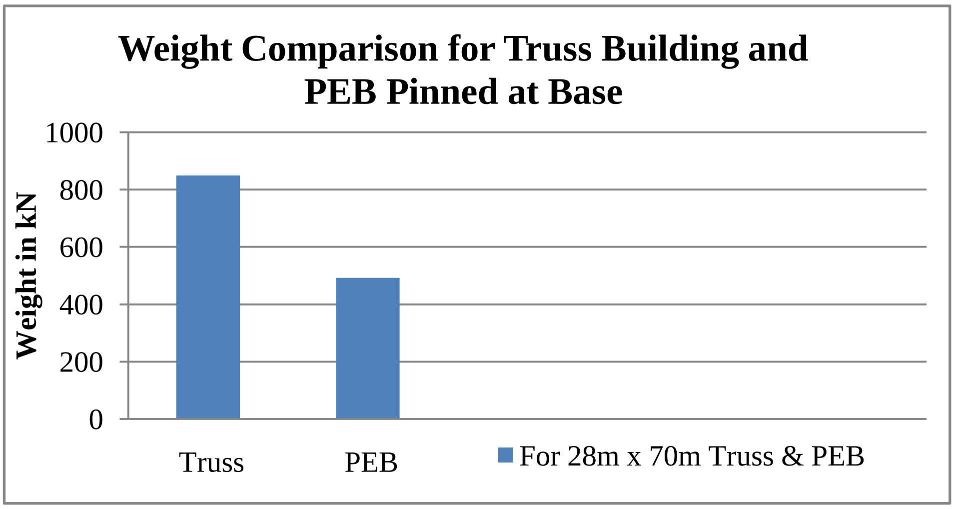


Figure 4.3: Weight Comparison for Truss Building and PEB Pinned at Base for 28m x 70m

Table 4.7: Weight for 14m x 31.50m Steel Building Pinned Support at Base using Channel purlin & Pipe section Truss

1	Weight of truss	47.544	kN
2	Weight of Purlin ISMC 125	47.088	kN
3	Tie Runner Pipe 42.40 mm	4.005	kN
4	Top Bracing Pipe 60.30 mm	6.798	kN
5	Bottom Bracing Pipe 60.30 mm	6.812	kN
6	Column Bracing Pipe 60.30 mm	4.615	kN
	Total	116.862	kN

Table 4.8: Weight for 14m x 31.50m PEB pinned supports at Base using Z purlins

1	Weight of PEB	56.042	kN
2	Weight of Purlin	17.94	kN
3	Top Bracing	6.798	kN
4	Column Bracing	4.615	kN
	Total	85.395	kN

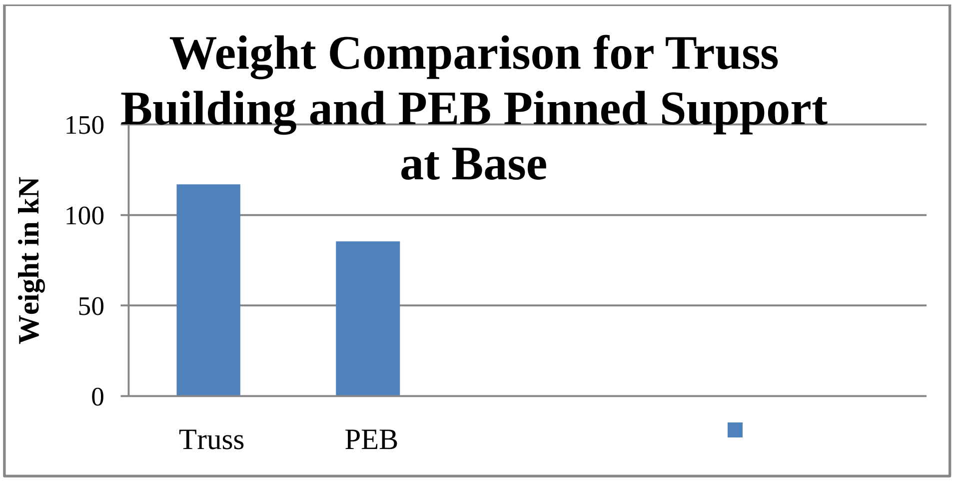


Figure 4.4: Weight Comparison for Truss Building and PEB Pinned at Base for 14m x 31.50m

Table 4.9: Weight for 20m x 50m Steel Building Pinned Support at Base usingChannel purlin & Pipe section Truss			
1	Weight of truss	97.371	kN
2	Weight of purlin ISMC 150	144.08	kN
3	Tie Runner Pipe 40.30mm	11.131	kN
4	Top Bracing Pipe 60.30 mm	11.083	kN
5	Bottom Bracing Pipe 60.30 mm	11.989	kN
6	Column Bracing Pipe 60.30 mm	5.291	kN
	Total	280.945	kN
Table 4.10: Weight for 20m x 50m PEB Pinned supports at Base using Z purlins			
1	Weight of PEB	118.836	kN
2	Weight of Purlin	55.552	kN
3	Top Bracing Pipe 60.30 mm	11.083	kN
4	Column Bracing Pipe 60.30 mm	5.291	kN
	Total	190.762	kN

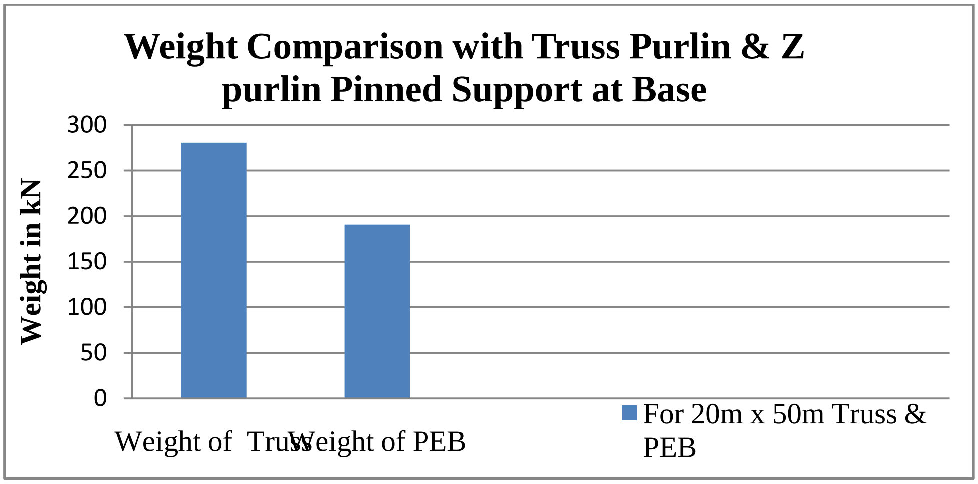


Figure 4.5: Weight Comparison for Truss Building and PEB Pinned at Base for20m x 50m

Table 4.11: Weight for 28m x 70m Steel Building Pinned Support at Base usingISMC purlin & Pipe Section Truss			
1	Weight of truss	231.671	kN
2	Weight of purlin ISMC 200	333.78	kN
3	Tie Runner Pipe 60.30mm	20.036	kN
4	Top Bracing Pipe 60.30mm	16.418	kN
5	Bottom Bracing Pipe 60.30mm	17.257	kN
6	Column Bracing Pipe 60.30mm	5.813	kN
	Total	624.975	Kn
Table 4.12: Weight for 28m x 70m PEB Pinned supports at Base using Z purlins			
1	Weight of PEB	302.478	kN
2	Weight of Purlin	84.88	kN
3	Top Bracing Pipe 60.30mm	16.418	kN
4	Column Bracing Pipe 60.30mm	5.813	kN
	Total	409.589	kN

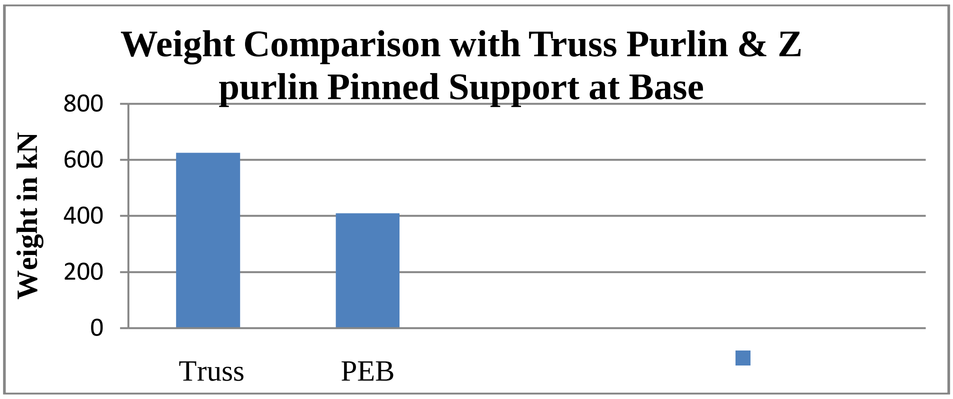


Figure 4.6: Weight Comparison for Truss Building and PEB Pinned at Base for 28m x 70m

Table 4.13: Weight f or 14m x 31.50m Steel Building Pinned Support at Base usingTruss Purlin & Pipe Section Truss			
1	Weight of truss and Column	47.544	kN
2	Weight of Truss Purlin	21.096	kN
3	Tie Runner Pipe 42.40mm	4.005	kN
4	Top Bracing Pipe 60.30mm	6.798	kN
5	Bottom Bracing Pipe 60.30mm	6.812	kN
6	Column Bracing Pipe 60.30mm	4.615	kN
	Total	90.87	kN
Table 4.14: Weight for 14m x 31.50m PEB Pinned supports at Base using Z purlins			
1	Weight of PEB	56.042	kN
2	Weight of Z Purlin	17.94	kN
3	Top Bracing Pipe 60.30mm	6.798	kN
4	Column Bracing Pipe 60.30mm	4.615	kN
	Total	85.395	kN

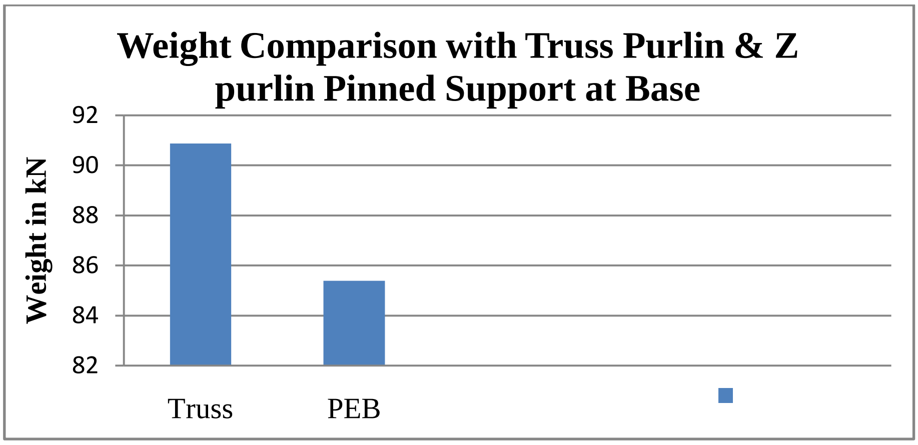


Figure 4.7: Weight Comparison for Truss Building and PEB Pinned at Base for14m x 31.50m

Table 4.15: Weight for 20m x 50m Steel Building Pinned Support at Base usingTruss Purlin & Pipe Section Truss			
1	Weight of truss and Column	97.371	kN
2	Weight of Truss Purlin	60.192	kN
3	Tie Runner Pipe 40.30mm	11.131	kN
4	Top Bracing Pipe 60.30mm	11.083	kN
5	Bottom Bracing Pipe 60.30mm	11.989	kN
6	Column Bracing Pipe 60.30mm	5.291	kN
	Total	197.057	kN
Table 4.16: Weight for 20m x 50m PEB Pinned supports at Base using Z purlins			
1	Weight of PEB	118.836	kN
2	Weight of Z Purlin	55.552	kN
3	Top Bracing Pipe 60.30mm	11.083	kN
4	Column Bracing Pipe 60.30mm	5.291	kN
	Total	190.762	kN

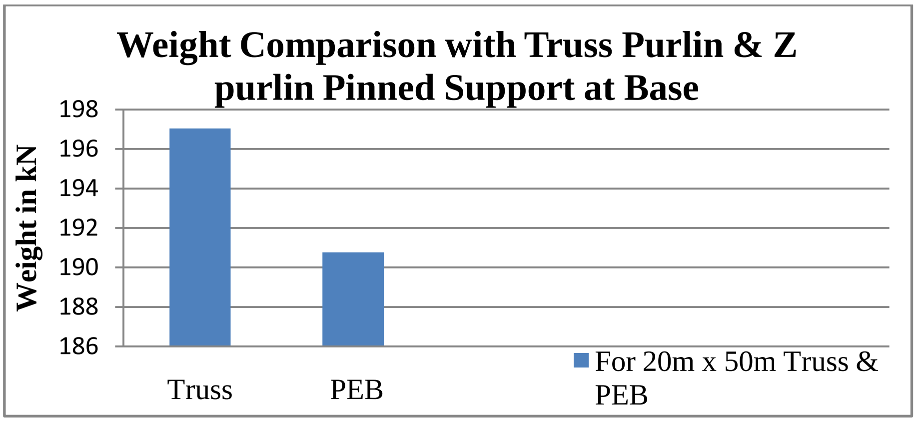


Figure 4.8: Weight Comparison for Truss Building and PEB Pinned at Base for20m x 50m

Table 4.17: Weight for 28m x 70m Steel Building Pinned Support at Base usingTruss Purlin & Pipe Section Truss

1	Weight of truss and Column	231.671	kN
2	Weight of Truss Purlin	99.66	kN
3	Tie Runner Pipe 60.30mm	20.036	kN
4	Top Bracing Pipe 60.30mm	16.418	kN
5	Bottom Bracing Pipe 60.30mm	17.257	kN
6	Column Bracing Pipe 60.30mm	5.813	kN
	Total	390.855	kN

Table 4.18: Weight for 28m x 70m PEB Pinned support at Base using Z purlins

1	Weight of PEB	302.478	kN
2	Weight of Z Purlin	84.88	kN
3	Top Bracing Pipe 60.30mm	16.418	kN
4	Column Bracing Pipe 60.30mm	5.813	kN
	Total	409.589	kN

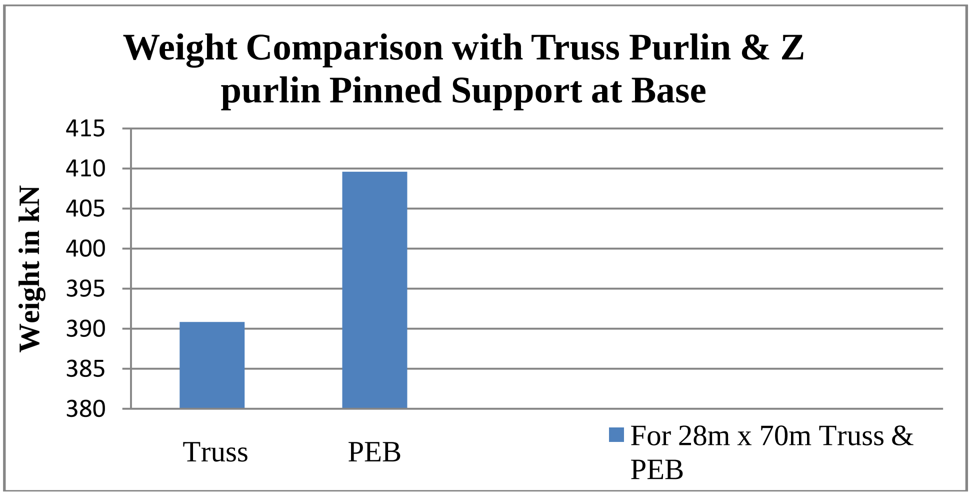


Figure 4.9: Weight Comparison for Truss Building and PEB Pinned at Base for 28m x 70m

V. DISCUSSION

From comparison between figures design of purlins following results are computed

1. Weight of Channel Purlinis very high as compared to Truss Purlin and Z Purlin
2. Weight of Truss Purlin is very less as compared to Channel Purlin but weight of Truss Purlin is Slightly high as compared to Z Purlin

From the discussion stated above Weight of Z Purlin is slightly less compared to Truss Purlin. Thought the weight of Truss Purlin is slightly higher compared to Z Purlin, Truss Purlins are cost effective because cost per kg for Z Purlin is 80 to 90 Rs per Kg and Truss Purlins are 70 to 75Rs per Kg.

VI. CONCLUSION

In this Dissertation, Numerical study was carried out. The design of Various Component of Steel Truss building and Pre-Engineering Building (PEB) is done and the following conclusions are drawn:-

i. From the design it is clear that 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. The Percentage saving in results are stated below in table

ii Also From comparison it is clear from the result that Weight of single Truss using Angle and Pipe both is less Compared to PEB but due to Weight of Channel Purlin, Weight of Steel Truss Building is on higher side.

Table 5.1: Showing the percentage saving in weight for PEB

	For 14m x 31.50m Pinned support	For 20m x 50m Pinned support	For 28m x 70m pinned support
% saving in Weight for PEB	36.59%	37.37%	42.19%
% saving in Weight for Steel Truss Building using Pipe section	50.47%	49.43%	53.98%

Weight of Truss = 183.457 kN
Weight of PEB = 116.315 kN
Difference in weight = Weight of Truss - Weight of PEB
= 67.142 kN
Percentage saving in weight = (67.142/183.45)×100
= 36.59%

ii. From the design it is clear that using Pipe section in Truss and channel section for purlins, PEB is found to be economical compared to Steel Truss Building. The Percentage saving in results are stated belowFrom comparison it is clear from the result that Weight of single Truss is less Compared to PEB but due to Weight of Channel Purlin, Weight of Steel Truss Building is on higher side

Table 7.2: Showing the percentage saving in weight for PEB

	For 14m x 31.50m Pinned support	For 20m x 50m Pinned support	For 28m x 70m pinned support
% saving in Weight for PEB	26.93%	32.09%	34.46%

iii. From the design it is clear that using Pipe section in truss and Truss purlin, Steel Truss Building is found to be economical compared to PEB. The results of saving in percentage are shown belowFrom Comparison it is clear that Weight of truss using Pipe section is less compared to PEB also Weight of Truss Purlin is not very high. So Weight of steel Truss Building is less as Compared to PEB

	or 14m x 31.50m Pinned support	'or 20m x 50m Pinned support	For 28m x 70m pinned support
% saving in Weight for Steel Truss Building	6.02%	3.19%	4.57%

Table 7.3: Showing the percentage saving in weight for Steel Truss Building

By using proper selection of material the Industrial Steel truss Building can be economical compared to PEB.

REFERENCES

Books

[1]. S. K. Duggal “Limit State Design of steel structure”
[2]. Prof. Dr. v. L. Shah and Prof. Mrs. Veena Gore (2013) “Limit State Design Of Steel
[3]. Structures”
[4]. N. Subramanian (2010) “Design of Steel Structures”

IS Codes

[5]. IS 800-2007 Indian standard code of practice for general construction in steel
[6]. IS 801-1975 Code of practice for use of Cold-formed light gauge steel structure member's in general building construction
[7]. IS 875(part 1) – 1987: Dead Loads
[8]. IS 875 (part 2) – 1987: Imposed Loads
[9]. IS 875 (part 3) – 1987: Wind Loads

Journals

[10]. Aijaz Ahmad Zende (2013) "Comparative Study of Analysis and Design of Pre-Engineered Buildings and Conventional frames" IOSR Journal of Mechanical and Civil Engineering (2013) 2278-1684
[11]. C. M. Meera (2013) "Pre-Engineered Building Design of an Industrial warehouse" International Journal of engineering sciences & Emerging Technologies (2013) 2231-6604
[12]. Jatin D. Thakar (2013) "Comparative Study of Pre-Engineered Steel Structure by Varying Width of structure" International Journal of Advanced Engineering Technology (2013) 0976-3945
[13]. Mr. Roshan S. Satpute (2012) " Building design Using Cold Formed Steel Structure" International Journal of Engineering and Science (2013) 2319-183X