ANALYSIS OF AN INDUSTRIAL STRUCTURE FOR WIND LOAD

Prof. Kavita.K.Ghogare[1], Vishakha.O.Dange[2]
[1]Asst. Prof, Department of Civil Engg, COET, Akola
[2]M.E.(Structure) Student IInd Year, Department of Civil Engg, COET, Akola

Abstract
Paper includes the comparison between various configurations of industrial shed. There are various type of industrial shed. But here we compare the various of industrial shed, such as hot rolled steel shed such as shed using Howe truss, A-truss, Portal truss etc. This paper will gives us the suitable configuration of industrial shed by making and comparing design and analysis of various configuration of industrial shed. This structure is proposed to design according to IS : 800 - 2007 and the dead, live and the wind load analysis is done according to IS :875 - 1987 (Part-I, Part-II, Part-III). Design of industrial shed by using STADD Pro-2007 which gives vary quickly and accurately. Comparison between various configurations of industrial shed using various types of truss type which gives us that which shed is suitable for the industrial shed and which is more effective in strength and economical point of view. This paper work compares the design of various configuration of industrial shed and concluded that which suitable & economical in all views. The comparison gives us suitable configuration which suitable strength point of view.
Keywords: Howe truss, STADD Pro-2007, Dead load, Live load, Wind load

1. Introduction:

Aim: The widely accepted aims of the seismic design of structural system are best defined by recalling the industrial structure that are to be satisfied.
Objectives:

- To study the industrial shed as per its drawing details, in Bentley Staad-Pro V8i.
- To study the structure as per code, with all the member sections as per the drawings.
- To design the structure against Dead Loads, Live Loads, Wind Loads.

Scope of the present study: To study how analysis is to be carried out in staad pro. It also includes the comparison of test result of various type of frame structure building during earthquake
Need:

- Good deformation control.
- Perform well in earthquake prone zone.
- Good durability during earthquake.
- Industries/ Factories are essential for nation's growth.
- The operations and physical circumstances change constantly unlike in the factories where the process, the method and the operations are generally respective.
- Timings and schedules vary considerably from place to place.

2. Methods:

Phase 1:
Introduction - Aim: Seismic analysis of an industrial structure for various seismic zone.
Objective: To design the industrial shed as per its drawing details, in Bentley STAAD-PRO V8i.
Scope: Modeling of the steel frame under the three analysis mentioned above using Staad Pro software is done and the results so obtained are compared.
Need: Good deformation control and Perform well in earthquake zone. Study of different papers as well as books.
Phase 2 :
Study of different IS Codes which are useful during calculations.

IS : 800 - 2007 the dead, live and the wind load analysis is done according to IS :875 - 1987 (Part-I, Part-II, Part-III).

Detailed study of Methods for analysis Problem consideration. Analysis of the structure manually.

Phase 3:

A major portion of the analysis is carried out in Bentley Staad. Pro V8i.Seismic Analysis by using Staad.Pro V8i. Results, Conclusion, Scope, References.

3. Experimental work:

Design a Howe Roof Truss for an industrial building for the following data:

1. Overall length of the building =20.90m 2.Overall width of the building=15.90m
3. Width(c/c of roof column)=15m 4.c/c spacing of trusses=7.5m
5. Rise of truss=1.5m 6.Self weight of purlins =318N/m 7.Height of column =6.38m
8. Roofing and side covering-Asbestos cement sheets (Dead weight=171N/m^2)

The building is located in industrial area MIDC, Akola. Both the ends of the truss are hinged. Use steel of grade Fe 410.

Step 1.- Truss Configuration

Let ϴ be the inclination of the roof with the horizontaltan ϴ=1.5/7.5=1/5 ϴ=11º19'≈11.30º

Length of rafter=$\sqrt{(15/2)^2+1.5^2}$=7.64m

Length of each panel L_0U_1, U_1U_2, U_2U_3, U_3U_4, U_4U_5, U_5U_6, U_6U_7=7.64/7=1.091m

Panel length on plan=1.091xcos (11.19º)=1.070m

Area of plan =spacing x panel length on plan =7.5 x 1.070=8.025m^2

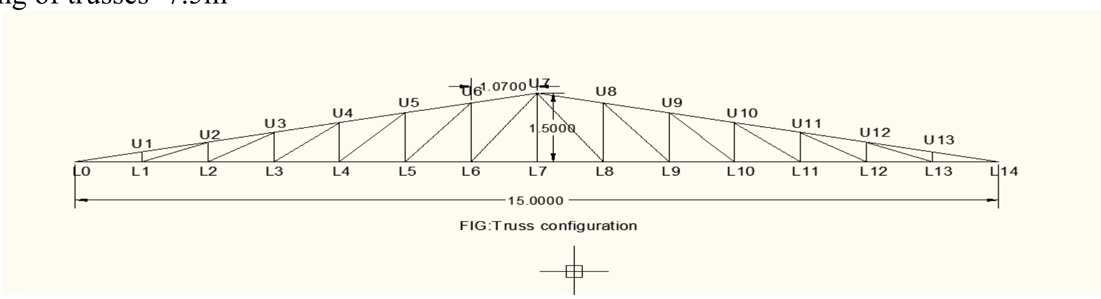


FIG:Truss configuration

STEP 2.-Dead Load Calculation

Self Weight of Truss= (Span/3+5)x10 =(15/3+5)x10 =100 N/m^2

Weight of Roofing Material=171 N/m^2

Assume Weight of Bracing=12 N/m^2

Total Load =288 N/m^2

Total Dead Load on each panel point=Total Load x Area=283 x 7.5 =3183N≈3.183KN/m^2

Dead Load Panel point due to the purlin= self wt. of purlin x spacing =318 x 7.5 =2385 N≈2.385KN/m^2

Dead load on intermediate panel point =3183+2385=5568N≈5.56KN

Dead load on end panel point =5.56/2=2.78KN

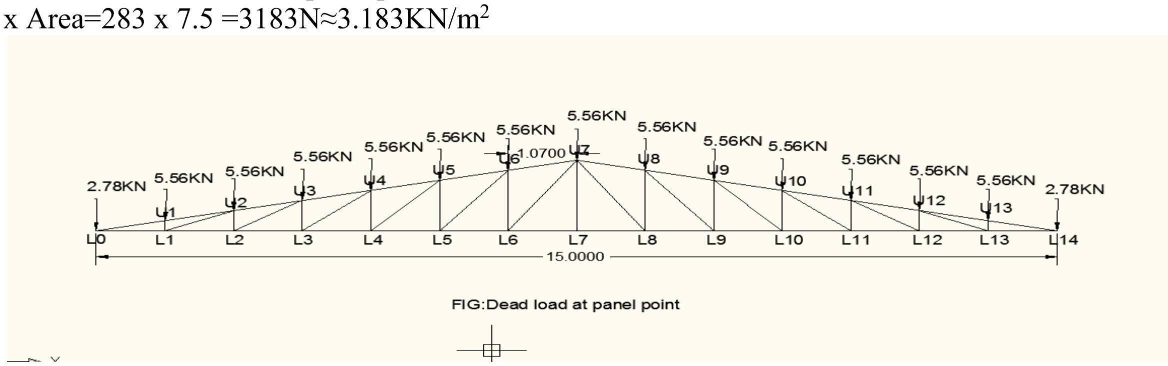


FIG:Dead load at panel point

STEP 3.- Live Load Calculation

ϴ=11.90

Let as assume that no access is provided to the roof. The live load is reduced by 20N/m^2 for each one degree above 10º slope ϴ > 10º

LL=0.75-0.02 x (ϴ-10)=0.75-0.02 x (11.09-10)=0.726KN ≈726.2N/m^2 > 0.4KN

LL=2/3 x 0.726=0.484

LL on intermediate panel=0.484 x 7.5 x 1.5=5.44 KN

LL on end panel point=5.44/2=2.72KN

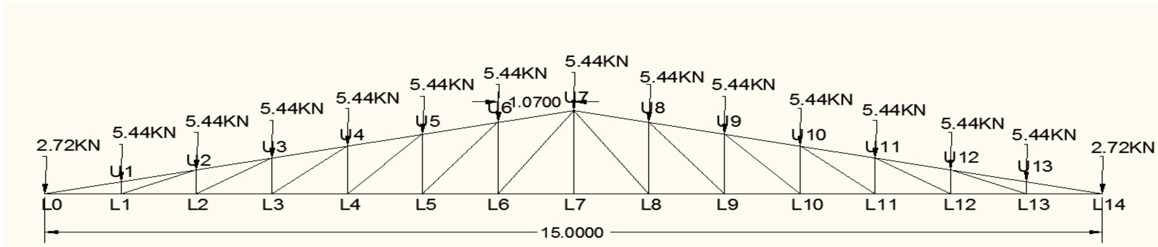


FIG: Live load at panel point

STEP 4.- Wind Load Calculation

Let as assume the life of the industrial building to be 50 year and the land to be plain and surrounded by small building.

K1=1.0 (for 50 year)

From Table 2; IS: 875 (part 3) – 1987

K2=0.89 (for torsion category 3, building height=6.38)

K3=1.0 (for plain land)

K4=39m/s (zone 2)

Design wind speed,(Vz) From Table 1; IS: 875 (part 3) – 1987

Vz = K1 x K2 x K3 x V_b=1 x 0.89 x 1 x 39=34.32m/s

Design wind pressure,(P_z)

P_z = 0.6 x $(V_z)^2$ =0.6 x $(34.32)^2$=706.71m/s

Height of building column above ground level=h= 6.38m

Width of building, W=15m

h/w=6.38/15=0.425

1/2 < h/w < 3/2

1/2 < 6.38/15 < 3/2

0.5 < 0.42 < 1.5

Θ=11.19, from (book s.k.duggal, page no.791 appendix XXII)

Let us assume the building ho have normal permeability.

The internal air pressure coefficient Cpi are ± 0.2 for both the windward and leeward sides.

Wind ward sides (C_{pe}),10 -> -0.8

11.19 -> Cpe

20 -> -0.8

C_{pe} = 0.8

Leeward sides (C_{pe}), 10 -> -0.6

11.19-> C_{pe}

20 -> -0.6

C_{pe}=0.6

Windward sides, F =(C_{pe} - C_{pi}) x Pd x A =(0.8-0.2) x 0.706 x 1.091 x 7.5 =-3.46KN

Wind load on each intermediate panel point=3.46

Wind load on each end panel point =3.46/2 =1.73KN

Leeward sides, F =(C_{pe} - C_{pi}) x Pd x A =(-0.6-0.2) x 0.706 x 1.091 x 7.5=-4.62KN

Wind load on each intermediate panel point = 4.62 KN

Wind load on each end panel point = 4.62/2 =2.31KN

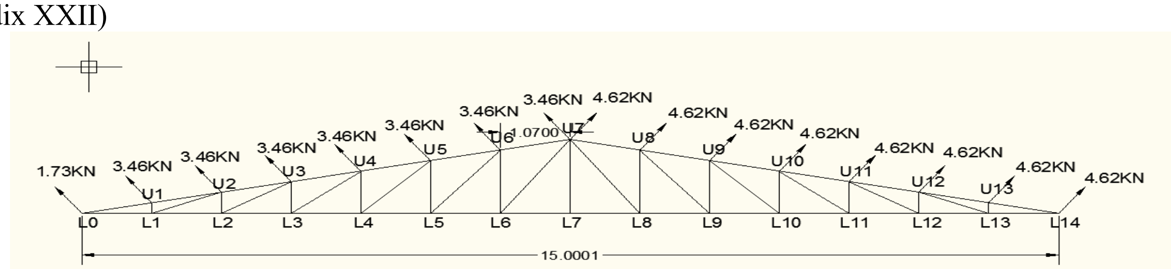


FIG: Wind load at panel point

By using STAAD PRO 2008 software details are-

Number of Nodes	210	Highest Node	210
Number of Elements	487	Highest Beam	487

Load cases and combination

Type	L/C	Name
Primary	3	DL
Primary	4	LL
Primary	5	WLX
Primary	6	WLZ
Combination	1	1.2(DL+LL+WLX)
Combination	2	1.2(DL+LL+WLZ)
Combination	7	1.7(DL+LL)
Combination	8	1.5(DL+WLX)
Combination	9	1.5(DL+WLZ)

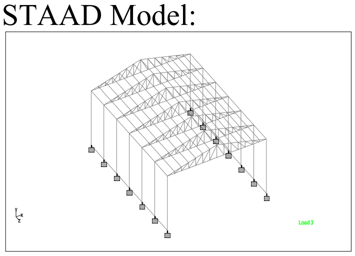
Section properties:

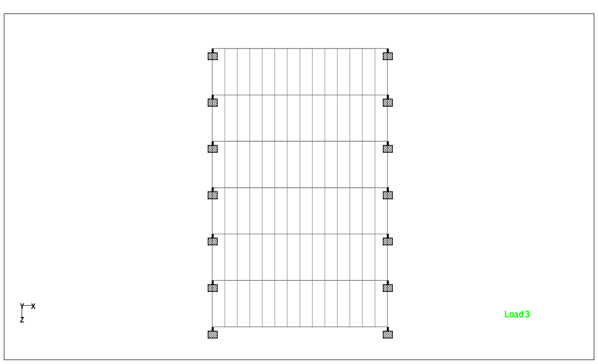
Prop	Section	Area (cm^2)	I_{yy} (cm^4)	I_{zz} (cm^4)	J (cm^4)	Material
1	ISA75X75X5 SD	14.540	141.378	79.656	1.229	STEEL

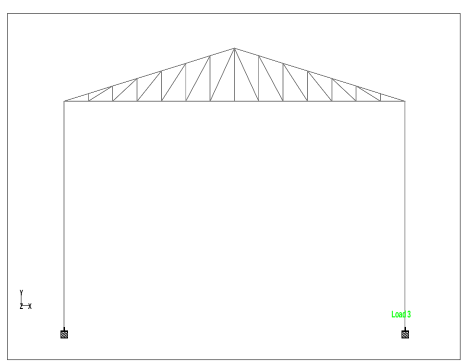
Load combination:

Comb.	Combination L/C Name	Primary	Primary L/C Name	Factor
1	1.2(DL+LL+WLX)	3	DL	1.20
		4	LL	1.20
		5	WLX	1.20
2	1.2(DL+LL+WLZ)	3	DL	1.20
		4	LL	1.20
		6	WLZ	1.20
7	1.7(DL+LL)	3	DL	1.70
		4	LL	1.70
8	1.5(DL+WLX)	3	DL	1.50
		5	WLX	1.50
9	1.5(DL+WLZ)	3	DL	1.50
		6	WLZ	1.50

STAAD Model:







4. Result:

	Beam	Node	L/C	Axial Fx (kN)
Max Fx	82	57	7:1.7(DL+LL)	**590.634**
Min Fx	69	44	7:1.7(DL+LL)	**-586.777**
Max Fy	206	118	1:1.2(DL+LL+WL	3.982
Min Fy	310	173	7:1.7(DL+LL)	8.821
Max Fz	330	166	9:1.5(DL+WLZ)	68.100
Min Fz	77	53	9:1.5(DL+WLZ)	274.771
Max Mx	1	1	9:1.5(DL+WLZ)	-250.297
Min Mx	15	15	9:1.5(DL+WLZ)	-250.290
Max My	330	180	9:1.5(DL+WLZ)	69.169
Min My	330	166	9:1.5(DL+WLZ)	68.100
Max Mz	220	106	8:1.5(DL+WLX)	69.116
Min Mz	220	120	8:1.5(DL+WLX)	70.184

5. Conclusion:

In this project the study is done for analysis of an industrial structure for wind load. In this project study mainly done for industrial structure which is in MIDC, AKOLA. Different loads are consider such as dead load, live load, wind load. In proposed work, the forces developed due to seismic action in X direction and Z direction, are considered. The results obtained from the above analysis are to be tabulated, compared and conclusions are drawn. By using software analysis result. Combination of axial force 1.7(DL+LL) & 1.5(DL+WLZ) in maximum value of 1.7(DL+LL)=590.634KN &1.5(DL+WLZ)=274.771KN

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