

Pratt Truss Roof design for industrial applications

Using the IS 800 Code & Limit State Procedure

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Abstract- Concrete Building required huge investment and vast time to construct making it difficult to finish in the desired time, thus to overcome this situation steel frame roof called Trusses can be installed. Truss is a framework consisting of steel frames and a bolt connected together. This paper discusses the study and construction of the 25 m span roof truss. Consideration Limit State Process (IS 800:2007) for study and architecture. For load Calculations on truss, IS 875:2000 (part 1, 2, 3) is used as the Reference Code to ease out the calculations. Fixed supported condition is consider here. Autodesk Robot and STAAD PRO v8i tools can assist in the design and study of the roof truss.

Keywords – Pratt truss , Wind Load (WL) ,Live Load (LL) , Dead load (DL) , AutoCAD 2017, STAAD PRO V6i , Robot Analysis Software ,IS 800:2007 , IS 875 (Part 1, 2,3).

I. INTRODUCTION

Truss is fixed frame, member's assembly such as stress member & tension member resulting in triangular assembly formulation. Formation of assemble act as the whole single unit which distributed the loads into entire span. Analysis of Trusses using conventional manual method is time taking and more complex as it consist of large number members. Thus Software plays its crucial role in the analysis of truss.

There are various types of trusses uses in construction such as king, queen, hoes frank, Pratt etc. Pratt truss is used for construction of roof structure in our study. Rolled Steel members used due to easily availability of steel in the fabrication.

II. PROBLEM

2.1 Statement –

We need to design the Pratt roof truss used for roof of industrial project with dimension of 25 metre (B) x 52 metre (L) with bay of 4 m each. Location of the proposed building in NCR zone. Permeability condition need to consider as medium. Colored Steel profile sheet is used for roofing cover.

2.2. Geometry calculation:--

Consider a pitch, $1/6$ of span.

Height of truss = $1/6 \times 25 = 4.166$ m.

Spacing of truss = $L/5 = 25/5 = 5$ m.

Slope of top Chord = $\tan^{-1} \left[\frac{4.166}{12.5} \right] = 18.43^\circ$

Pitched Length of top chord = $\sqrt{(12.5)^2 + (4.166)^2} = 13.175$ m.

Distance between Purlins = $13.175/4 = 3.29$ m.

Pitched Area = (pitched length x truss spacing) x 2 = $(13.175 \times 5) \times 2 = 131.75$ m²

Plan Area = $25 \times 5 = 125$ m²

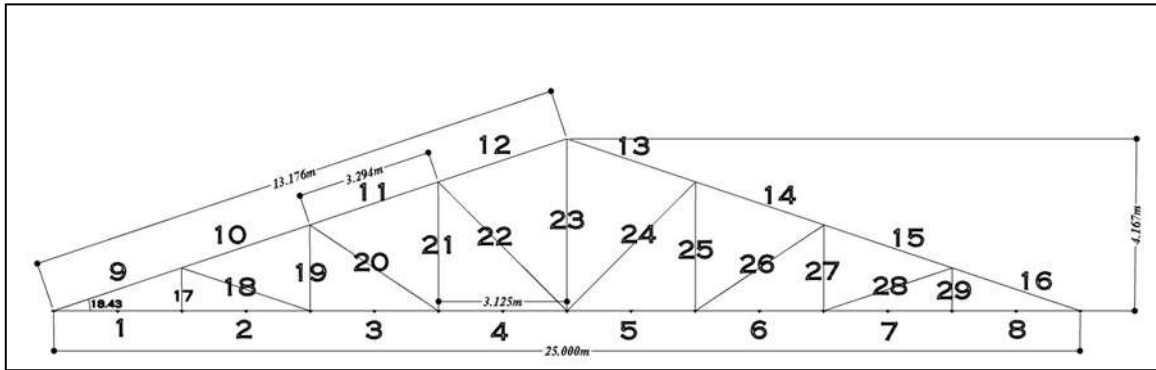


Figure 1. Geometry of truss

2.3. Different loading calculation -

2.3.1 Dead Load (DL)

Self-weight of CGI sheet = 150 N/m²

Self-weight of Purlin = 100 N/m²

a. Total self-weight of Purlin = $10 \times 5 \times 100 = 5000$ N

b. Total self-weight of truss on Plan Area = $133.33 \times 25 \times 5 = 16666.25$ N

c. Total self-weight of truss CGI sheet & Wind Bracing on Pitched Area = $(150+20) \times 131.75 = 22397.5$ N

Total D.L. = a.+ b.+c. = $5000 + 16666.25 + 22397.5 = 44063.75$ N

Dead loads at every Panel Node = $44063.75/8 = 5508$ N.

Dead loads at Ends Nodes = $5508/2 = 2754$ N.

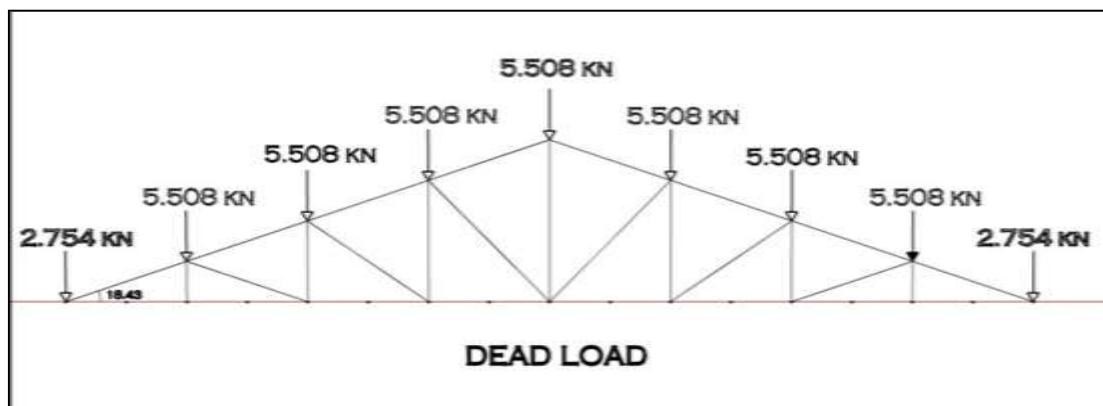


Figure 2. Dead load at each panel points.

2.3.2 Live Load (LL)-

Imposed load on truss = $750 - 20 \times (18.43 - 10) = 581.4$ N/m²

Live load on the truss = .66 x imposed load x plane area = .66 x 581.4 x 125 = 48450 N.

Live load on each panel points = (48450)/8 = 6056.25 N.

Live load on end panel points = 6056.25/2 = 3028 N.

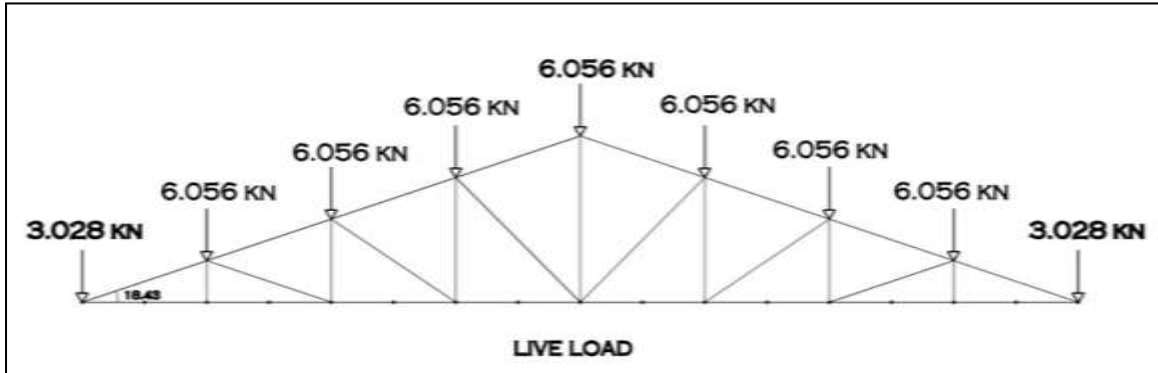


Figure 3. Live load at each panel points.

2.3.2 Wind Load (LL)-

Design wind Speed (V_z) = $V_b \times K1 \times K2 \times K3 \times K4$.

Where V_b = basic wind speed = 47 m/s.

$K1$ = Probability factor

$K2$ = terrain/ height/ structure factor

$K3$ = Topography Factor , it is taken as unity.

$K4$ = Importance factor for cyclonic region.

$$V_z = 47 \times 1 \times 1 \times 1 \times 1.$$

$$V_z = 47 \text{ m/sec.}$$

Basic Wind Pressure = $0.6 (V_z)^2 = 0.6 \times (47)^2 = 1325.4 \text{ N/m}^2$

Wind Load (F) on Building = $F = P_z \times (C_{pe} \pm C_{pi})$

Assuming Wind Normal to Ridge

Calculation are given below:-

Net pressure calculation:-

For windward side slope:-

$$-526 + 0.2 \times 1325 = -261$$

$$-400 - 0.2 \times 1325 = -135$$

For leeward side slope:-

$$-526 - 0.2 \times 1325 = -791$$

$$-0.4 + 0.2 \times 1325 = -135$$

	Windward side	Leeward side
10	-1.2	-0.4
18.43	-0.526	-0.4
20	-0.4	-0.4

Assuming Wind parallel to Ridge

Calculation are given below:-

Net pressure calculation:-

For leeward side slope:-

$$-0.6 + 0.2 \times 1325 = -531$$

$$-0.715 - 0.2 \times 1325 = -1210$$

For windward side slope:-

	Windward side	Leeward side
10	-0.8	-0.6
18.43	-0.715	-0.6
20	-0.4	-0.6

$-0.6 - 0.2 \times 1.325 = -1060$
 $-0.715 + 0.2 \times 1.325 = -135$

Total wind force = Sloping Area x Intensity of load = $131.75 \text{ m}^2 \times 1210 = 159417.5 \text{ N}$

Wind load per panel points = $\frac{159417.5}{8} = 19927 \text{ N}$.

Wind load per end points = $\frac{19927}{2} = 9963.6 \text{ N}$.

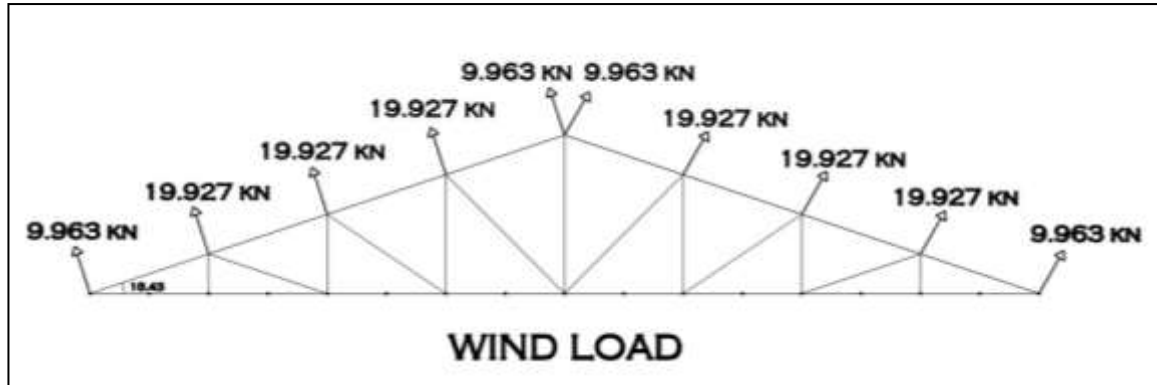


Figure 4. Wind Load on Each Panel Points.

III. EXPERIMENT AND RESULT

Various section details used in the structures are mention in given table 1:-

Table -1 Experiment Result

Sr. No	Types of Member	Member No.	Design section (Staad pro)
1	Main tie	1-8	ISWB600
2	Principal rafter	9-16	ISWB600
3	Vertical Ties	17,19,21,23,25,27,29	2 ISA 200 X 200 X 12
4	Inclined Ties	18,20,22,24,26,28	2 ISA 200 X 200 X12

Table 1 show the types of members used regarding to various member number with different design section described in staad pro software.

IV.CONCLUSION

The maximum deflection according to software is 0.004 mm .As the deflection is under permissible limit thus the structure model is safe. $L /25 = 25000/250 = 100 \text{ mm}$.

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