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Handbook for lean to roof type steel truss based on IS 800:2007 and IS 875(part 3):2015

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Abstract - *The analysis and design tables provided in SP 38(S&T):1987; Handbook for typified designs for structures with steel roof trusses, were based on IS 800: 1984 and IS 875: 1964. Later on the codes IS 800: 1984 and IS 875: 1964 were revised and thus it is necessary to have a hand book based upon the revised codes IS 800:2007 and IS 875(part 3):2015. The revised handbook will be helpful in analysis and design of trusses considering revised factors. In this study, "lean to roof" type truss configuration has been adopted for development of design tables. The designs for span 9 m slope of 1 in 3, considering wind speed 33 m have been provided.*

Key Words: Truss, K_4 factor, lean to roof

1. INTRODUCTION

A standard truss is a series of triangles - a stable geometric shape that is difficult to distort under loads. Regardless of its overall size and shape, all the chords and webs of a truss form triangles. These triangles combine to distribute the load across each of the other members.

Trusses are provided to support roof covering. The weight of roof covering through purlins is transferred at joints along the rafters. These joint loads cause axial forces – tensile or compressive – in all the members of a truss since all the joints of a truss are assumed to be hinged. Finally all loads including self-weight are transferred to the supports through the joints at supports. The trusses may be constructed of wood or of steel.

Wooden trusses may be used for smaller moderate span; whereas steel trusses may be provided for smaller to larger spans as steel is stronger than wood. Trussed roof covering is economical proposition for warehouses, assembly halls, hangers, etc. Steel trusses are economical, lighter in weight, more durable, more fire-resistant and easier to fabricate.

In this study, Analysis and Design of lean to roof type steel trusses have been carried out considering following parameters:

- Span of Trusses : 9m.
- Spacing of Trusses : 4.5m
- Roof slopes : 1 in 3.
- Permeability : High.
- Basic wind speeds (m/s): 33
- Column height : 4.5m.

2. LOAD CALCULATIONS:

1) DEAD LOAD CALCULATION:

The self-weight of roof truss is calculated by formula: ((span/3) +5)*10 N/m^2.

Weight of roofing sheet (AC, GI sheet) is taken 131 N/sq m. (as per IS – 875 (part 1): 1987.

2) LIVE LOAD CALCULATION:

The design of live load should be done by IS: 875 (part 2): 1987.

$$\text{Live load} = 2/3 * (750\text{-}20(\alpha\text{-}10)) \quad \text{.... [1]}$$

3) Wind load calculations are as per IS 875 : 2015 (part 3)

$$V_z = V_b \times K_1 \times K_2 \times K_3 \times K_4 \quad \text{.... [2]}$$

Where,
V_z = design wind speed at any height z in m/s
V_b is the basic wind speed for the zone.
K_1= probability factor/risk coefficient,
K_2=Terrain roughness (Category2) and height Factor varies according to the height of a structure,
K_3= topography factor and
K_4 = Importance factor for cyclonic region are adopted.

After finding the design wind speed, the pressure due to wind at that point is found out by the Eq

$$P_z = 0.6 \times Vz^2 \quad \text{... [3]}$$

Here, P_z is the wind pressure at a height "z", in N/sq.m.

Then the design wind pressure (Pd) is computed with the Eq (3).

$$P_d = K_d \times K_a \times K_c \times P_z \quad \text{...[4]}$$

Where, P_d is the design wind pressure at a height "z", in N/m^2.
K_d =wind directionality factor

K_a = area averaging factor,
K_c = combination factor

Then the Force F is calculated

$F= (Cpe-Cpi) xA x P_d$ .....[5]
Where,
Cpe=external pressure coefficient.
Cpi=Internal pressure coefficient.
A= Area on which the lateral wind force acts.

3. ANALYSIS AND DESIGN RESULTS

PROBLEM DESCRIPTION:

Span: 9m
Wind speed: 33 m/s
Roof slope: 1 in 3
Permeability: High
Spacing of truss: 4.5m

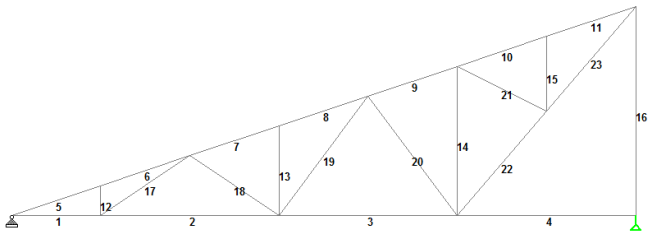

Fig. 1 Truss Configuration

The analysis and design tables are represented in tabular format:

Table 1: Analysis Table

Members	Tension (KN)	Compression (KN)	length of member
1	-69.19	224.90	1.286
2	-57.66	187.42	2.572
3	-34.60	112.45	2.572
4	0.00	0.00	2.572
5	-180.41	72.93	1.355
6	-189.12	72.93	1.355
7	-118.82	48.62	1.355
8	-127.53	48.62	1.355
9	-57.23	24.31	1.355
10	-81.81	29.19	1.355
11	-90.53	29.19	1.355
12	-24.97	7.68	0.428
13	-24.98	7.68	1.285
14	-37.51	11.54	2.142
15	-24.98	7.68	1.070
16	-87.41	26.89	2.999
17	-13.86	45.04	1.545
18	-45.04	13.86	1.545
19	-19.21	62.45	2.142
20	-62.45	19.21	2.142
21	-5.18	16.83	1.437
22	-35.44	115.19	1.976
23	-42.53	138.25	1.975

Table 2: Design Table

Members	No.	Sections	Dia of bolt	No. of Bolt	Edge Distance	Spacing of Bolts
TIE	1	DEA 55 X 55 X 10	20	5	35	50
TIE	2	DEA 50 X50 X 5	16	4	30	40
TIE	3	DEA 55 X 55 X 8	20	4	35	50
TIE	4	DEA 50 X50 X 5	16	4	30	40
RAFTER	5	DEA 50 X50 X 5	16	4	30	40
RAFTER	6	DEA 50 X 50 X 5	16	4	30	40
RAFTER	7	DEA 50 X50 X 5	16	4	30	40
RAFTER	8	DEA 50 X 50 X 5	16	4	30	40
RAFTER	9	DEA 50 X 50 X 5	16	4	30	40
RAFTER	10	DEA 50 X 50 X 5	16	4	30	40
RAFTER	11	DEA 50 X50 X 5	16	4	30	40
WEB	12	SEA 50 X 50 X 6	16	5	28	40
WEB	13	SEA 50 X 50 X 5	16	4	28	40
WEB	14	SEA 50 X 50 X 6	16	5	28	40
WEB	15	SEA 50 X 50 X 5	16	4	28	40
WEB	16	DEA 55 X 55 X 6	20	4	35	50
WEB	17	SEA 50 X 50 X 5	16	4	28	40
WEB	18	SEA 50 X 50 X 5	16	4	28	40
WEB	19	DEA 55 X 55 X 6	20	4	35	50
WEB	20	SEA 50 X 50 X 5	16	4	28	40
WEB	21	SEA 50 X 50 X 5	16	4	28	40
WEB	22	DEA 55 X 55 X 8	20	4	35	50
WEB	23	DEA 55 X 55 X 8	20	4	35	50

4. CONCLUSIONS

1) The handbook provides analysis and design tables of lean to roof type steel roof trusses for span 9m and 12m , pitch 1 in 3 , 1 in 4, and 1 in 5, considering all six wind zones according to IS 875 : 2015 (Part 3) and IS 800:2007 (LSM)

2) Single equal and unequal, double equal and unequal Angle sections with bolted connection are provided for truss members.

3) The compiled report will be helpful to the industry people for working out the designs.

5. REFERENCES

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