STEPS INVOLVED IN THE ANALYSIS AND DESIGN OF ROOF TRUSS

1. Load calculations & Load combinations
2. Analysis
Manual analysis - Method of sections or Method of joints
Analysis using computers – Truss as a truss or Truss as a plane frame

3. Design
Load calculations and Load combinations
Normally trusses are analysed for Dead load, Live load, Wind load, Snow load, Seismic load and for different load combinations. All trusses in a roof structure are designed for the worst possible combination of dead, live and wind loads. The individual truss members are designed to restrain the corresponding forces i.e.., tension or compression, or a combination of bending with either the tension or compression force.

Analysis
The truss was analysed using STAAD pro software as plane frame and care is taken to do the proper analysis for Member release and Member truss options. All the loads are calculated and applied as UDL.

Design.
Design can be done either by manual or using software. The design is done using STAAD pro software and the results are tabulated.

ROOF TRUSS – LOAD CALCULATION
DATA

Plan area (a/c sheet)	=	23.32 × 11.37 m
Span of truss	=	11.42 m c/c
Spacing of truss	=	4.632 m
Wt. of A.C. sheet roofing	=	0.17kN/m^2
(Including extra weight due to Overlaps & fasteners)		
Location of building	=	
Purlins (assuming ISMC 125)	=	0.127 kN/m

(1) DEAD LOAD:

Length of sloping roof =
Weight of A/C sheet = 0.17×4.632 = 0.79kN/m
No of purlins on each slope = 6 Nos.
Total weight of purlins per slope = 6 × 0.127 × 4.632
= 3.53kN
Weight of purlins distributed
as UDL on rafter = 3.53/6.08
=0.58 kN/m
Total D.L (excluding wt of truss) =0.79 + 0.58
= 1.37 kN/m
Say =1.40 kN/m

(2) LIVE LOAD (Ref IS: 875 – Part II)

Slope of the Truss =
Live Load = 0.75 – 0.02(20.2 – 10)
= 0.55 kN/m²
Actual Live Load =2/3 × 0.55 = 0.37 kN/m²
(For truss & Columns except purlin)
Live load per m run on Rafter = 0.37 × 4.632
= 1.71 kN/m
Say =1.80 kN/m

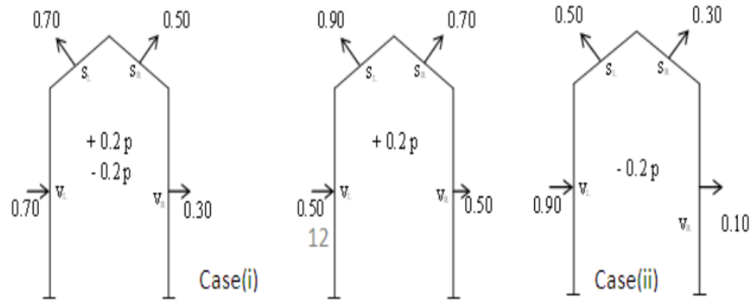
(3) WIND LOAD (Ref IS: 875 – Part III)

Design Wind Speed =Vz = K1×K2 ×K3. Vb
Where, Vb = Basic Wind Speed =50 m/s (For Chidambaram)
K1 = Risk Coefficient = 1.00
K2 = Terrain Factor = 0.98
(Assumed for category 2 & class B)
(Total Height of Building = 9.70m)
(Length of Building = 11.37m)
K3 = Topography Factor = 1.00
(Plain Ground)
Design Wind Speed Vz = 1×1.0×0.98×50 = 49 m/s
Design Wind Pressure = 0.60 Vz^2 = 0.6 × 49^2
= 1441N/m² = 1.44kN/m²
Say = 1.50 kN/m²

DETERMINATION OF WIND COEFFICIETNS:
PITCHED ROOF (REF TABLE 5/IS 875 – P16)
h = 9.70m w =11.37 m h/w = 9.70/11.37 = 0.85
(This is the case of ½< h/w<3/2)
Referring to Table 5 / IS: 875 – P16,
External coefficients are found and marked in the sketches
WIND LOAD ON COLUMNS (REF TABLE, 4/IS 875 – P14)
CONDITION (i)
h/w = 9.70/11.37 = 0.85 (i.e., ½<h/w<3/2)
CONDITION (ii)
l = 30.5 m w = 24.4 m
l/w = 23.32 / 11.37 = 2.05 (i.e.,3/2 < h/w < 4)
External coefficients are found and marked in the sketches

INTERNAL PRESSURE COEFFICIENT:

(REF P27 / IS – 875 Cl: 6.2.3)
Assume low permeability
Cpi = ± 0.2
WIND COEFFICIENTS Wind angle 0º



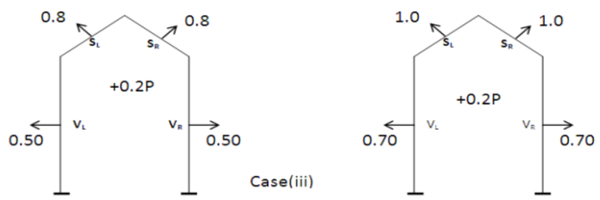


Fig .AN1

WIND LOADS:
Case (i) (WIND ANGLE = 0º, C_{pi} = + 0.2p)
$V_L = 0.5 \times 1.5 \times 4.632 = 3.51$ kN/m (→UNI GX)
$V_R = 0.5\times 1.5 \times 4.632 = 3.51$ kN/m (→UNI GX)
$S_L = 0.9 \times 1.5 \times 4.632 = 6.32$ kN/m (↑UNI Y)
$S_R = 0.7 \times 1.5 \times 4.632 = 4.91$ kN/m (↑UNI Y)

Case (ii) (WIND ANGLE = 0º, C_{pi} = - 0.2p)

$V_L = 0.9 \times 1.5 \times 4.632 = 6.32$ kN/m(→UNI GX)
$V_R = 0.10 \times 1.5 \times 4.632 = 0.70$ kN/m(→UNI GX)
$S_L = 0.5 \times 1.5 \times 4.632 = 3.51$ kN/m (↑UNI Y)
$S_R = 0.3 \times 1.5 \times 4.632 = 2.11$ kN/m (↑UNI Y)

Case (iii) (WIND ANGLE = 0º, C_{pi} = + 0.2p)

$V_L = 0.7 \times 1.5 \times 4.632 = 4.91$ kN/m (→UNI GX)
$V_R = 0.7 \times 1.5 \times 4.632 = 4.91$ kN/m (→UNI GX)
$S_L = 1.0 \times 1.5 \times 4.632 = 7.02$ kN/m (↑UNI Y)
$S_R = 1.0 \times 1.5 \times 4.632 = 7.02$ kN/m (↑UNI Y)

Case (ii) (WIND ANGLE = 0º, C_{pi} = - 0.2p)

$V_L = 0.9 \times 1.5 \times 4.632 = 6.32$ kN/m(→UNI GX)
$V_R = 0.10 \times 1.5 \times 4.632 = 0.70$ kN/m(→UNI GX)
$S_L = 0.5 \times 1.5 \times 4.632 = 3.51$ kN/m (↑UNI Y)
$S_R = 0.3 \times 1.5 \times 4.632 = 2.11$ kN/m (↑UNI Y)

Case (iii) (WIND ANGLE = 0º, C_{pi} = + 0.2p)

$V_L = 0.7 \times 1.5 \times 4.632 = 4.91$ kN/m (→UNI GX)
$V_R = 0.7 \times 1.5 \times 4.632 = 4.91$ kN/m (→UNI GX)
$S_L = 1.0 \times 1.5 \times 4.632 = 7.02$ kN/m (↑UNI Y)
$S_R = 1.0 \times 1.5 \times 4.632 = 7.02$ kN/m (↑UNI Y)

STAAD PLANE
START JOB INFORMATION
ENGINEER DATE 23-Oct-10
END JOB INFORMATION
INPUT WIDTH 79
UNIT METER KN
JOINT COORDINATES
1 0 -8.8 0; 2 0 0 0; 3 1.142 0 0; 4 1.142 0.42 0; 5 2.284
0.84 0; 6 3.426 0 0;7 3.426 1.26 0; 8 4.568 1.05 0; 9
4.568 1.68 0; 10 5.71 0 0; 11 5.71 2.1 0;12 6.852 1.68 0;
13 6.85201 1.05 0; 14 7.994 0 0; 15 7.994 1.26 0;16
9.136 0.84 0; 17 10.278 0 0; 18 10.278 0.42 0; 19 11.42 -
8.8 0;20 11.42 0 0;

```
MEMBER INCIDENCES
1 1 2; 2 2 3; 3 2 4; 4 4 3; 5 5 3; 6 4 5; 7 3 6; 8 5 6; 9 5 7;
10 7 6; 11 8 6;12 7 8; 13 7 9; 14 9 8; 15 10 6; 16 11 8; 17
9 11; 18 11 10; 19 12 11;20 11 13; 21 10 14; 22 12 13; 23
15 12; 24 13 14; 25 15 13; 26 15 14; 27 16 14;28 16 15;
29 17 14; 30 16 17; 31 18 16; 32 18 17; 33 20 17; 34 20
18; 35 19 20;
DEFINE MATERIAL START
ISOTROPIC CONCRETE
E 2.17185e+007
POISSON 0.17
DENSITY 23.5616
ALPHA 1e-005
DAMP 0.05


ISOTROPIC STEEL
E 2.05e+008
POISSON 0.3
DENSITY 76.8195
ALPHA 1.2e-005
DAMP 0.03
END DEFINE MATERIAL
MEMBER PROPERTY AMERICAN
1 35 PRIS YD 0.45 ZD 0.3
MEMBER PROPERTY INDIAN
2 3 6 7 9 13 15 17 19 21 23 28 29 31 33 34 TABLE SD ISA60X60X6
4 5 8 10 TO 12 14 16 18 20 22 24 TO 27 30 32 TABLE ST ISA60X60X6
CONSTANTS


MATERIAL CONCRETE MEMB 1 35
MATERIAL STEEL MEMB 2 TO 34
MEMBER RELEASE
3 34 START MX MY MZ
SUPPORTS
1 19 FIXED
LOAD 1 LOADTYPE Dead  TITLE DL
SELFWEIGHT Y -1.1
MEMBER LOAD
3 6 9 13 17 19 23 28 31 UNI GY -1.4
LOAD 2 LOADTYPE Live REDUCIBLE TITLE LL
MEMBER LOAD
3 6 9 13 17 19 23 28 31 UNI GY -1.8
```

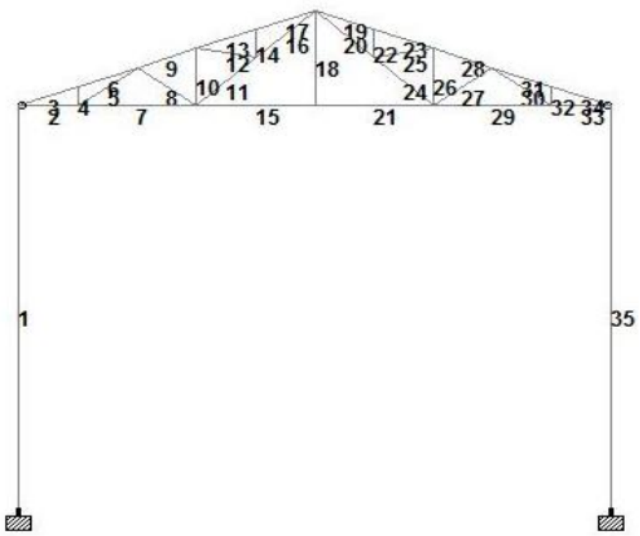
```
LOAD 3 LOADTYPE Wind  TITLE WL1
MEMBER LOAD
1 35 UNI GX 3.51
3 6 9 13 17 UNI Y 6.32
19 23 28 31 UNI Y 4.91
LOAD 4 LOADTYPE Wind  TITLE WL2
MEMBER LOAD
1 UNI GX 6.32
35 UNI GX 0.7
3 6 9 13 17 UNI Y 3.51
19 23 28 31 UNI Y 2.11
```

```
LOAD 5 LOADTYPE Wind  TITLE WL3
MEMBER LOAD
1 UNI GX -4.91
35 UNI GX 4.91
3 6 9 13 17 UNI Y 7.02
19 23 28 31 UNI Y 5.61
LOAD COMB 6 COMBINATION LOAD CASE 6
1 1.2 2 1.2
LOAD COMB 7 COMBINATION LOAD CASE 7
1 0.75 3 0.75
LOAD COMB 8 COMBINATION LOAD CASE 8
1 0.75 4 0.75
LOAD COMB 9 COMBINATION LOAD CASE 9
1 0.75 5 0.75
```

```
LOAD COMB 10 COMBINATION LOAD CASE 10
1 0.8 2 0.8 3 0.4
LOAD COMB 11 COMBINATION LOAD CASE 11
1 0.8 2 0.8 4 0.4
LOAD COMB 12 COMBINATION LOAD CASE 12
1 0.8 2 0.8 5 0.4
PERFORM ANALYSIS PRINT ALL
PRINT MEMBER FORCES ALL
PRINT SUPPORT REACTION ALL
UNIT MMS NEWTON
PARAMETER 1
CODE INDIAN
FYLD 250 MEMB 2 TO 34
RATIO 1 MEMB 2 TO 34
```

TRACK 2 MEMB 2 TO 34
CHECK CODE MEMB 2 TO 34
START CONCRETE DESIGN
CODE INDIAN
FC 20 MEMB 1 35
FYMAIN 415 MEMB 1 35
FYSEC 415 MEMB 1 35
MAXMAIN 25 MEMB 1 35
MINMAIN 20 MEMB 1 35
MINSEC 8 MEMB 1 35
RFACE 4 MEMB 1 35
DESIGN COLUMN 1 35
END CONCRETE DESIGN
PARAMETER 2

CODE INDIAN
STEEL MEMBER TAKE OFF LIST 2 TO 34
FINISH



Truss with Member numbers

Lecture 05

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