Design of foundation of 40 M SRBT (Bhilai)

1. Calculation of wind load on tower: [IS 875 (Part 3)-1987]

Design wind speed is given by (Cl. 5.3)

$V_z = V_b k_1 k_2 k_3$

V_b = Basic wind speed, as per Fig. 1 of the Code, for Ernakulam region = 39 m/sec.

k_1 = 1.06 (Table 1)

k_2

Terrain category 2, class B (Table 2)

k_2 At base (up to 10m height) = 0.98

k_2 At top (40m) = 1.125

k_3 = 1.0 (for plain terrain topography) (5.3.3)

Design wind speed at base,

V_z = 39 × 1.06 × 0.98 × 1.0 = 40.51 m/sec

at top, V_z = 39 × 1.06 × 1.125 × 1.0 = 46.51 m/sec

Design wind pressure is given by $P_z = 0.6 V_z^2$ (5.4)

Design wind pressure at base = $0.6 \times 40.51^2 = 985$ N/m²

" at top = $0.6 \times 46.51^2 = 1298$ N/m²

Average value of P_z along the tower = $\frac{1298 + 985}{2} = 1142$ N/m²

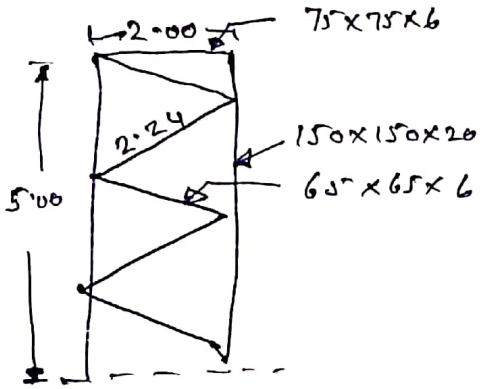
= 1.15 KN/m²

2. Calculation of Solidity Ratio of the tower:

The tower comprises of 8 panels of 5.00 m height

Bottom and top panels are considered:

a) Bottom panel



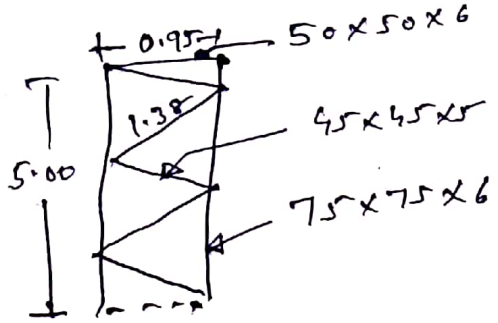
Solidity Ratio = $\frac{\text{Projected area of elements}}{\text{Total area}}$ (3.1.9)

Surface area of members on one face

$2 \times 5.00 \times 0.15$
+
$5 \times 2.24 \times 0.065$
+
$1 \times 2.00 \times 0.075$ $= 2.38\ m^2 + 10\%$ for gusset plates etc $= 2.62\ m^2$

Solidity ratio $= \frac{2.62}{5.00 \times 2.00} = 0.26$

b) Top panel



Surface area =

$2 \times 5.00 \times 0.075$
+
$5 \times 1.38 \times 0.045$
+
$1 \times 0.95 \times 0.05 = 1.11 \text{ m}^2$

$+10\% = 1.22 \text{ m}^2$

Solidity ratio = $\frac{1.22}{5.00 \times 0.95} = 0.26$.

Thus, it is seen that the tower has more or less the same solidity ratio throughout the height.

3. Force on tower:

From Table 30, Force Coefficient (C_f) for square tower composed of flat sided members, for solidity ratio of 0.26 = 3.0 (6.3.3.5)

The force acting on the face of tower is given by $F = C_f A_e P_d$ (6.3)

A_e = effective frontal area of any structure

= Solidity ratio × gross area.

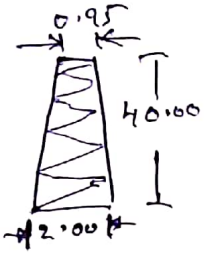
The total force on one face of the tower when wind is incident perpendicular that face,

$F = 3.0 \times (59.00 \times 0.26) \times 1.15$

= 52.92 kN + Add 20% for ladder, platform etc = 63.50 kN

As per 6.3.3.5 (b), the force when wind blows into a corner of the tower

= 63.50 × 1.2 = 76.20 kN



Area of face

$= \frac{40.00 \times (2.00 + 0.95)}{2}$

$= 59 \text{ m}^2$

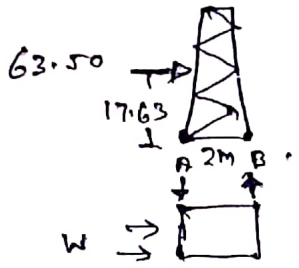
Distance to C.G. from base

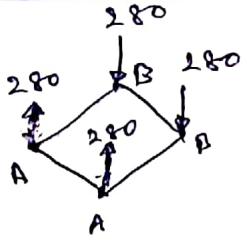
$= \frac{40.00}{3} \times \frac{(2 \times 0.95 + 2.00)}{(0.95 + 2.00)}$

$= 17.63 \text{ m}$

4. Force on legs

a) Wind blowing normal to the surface





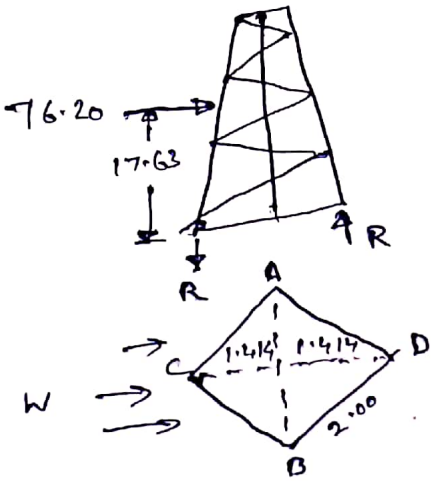
Taking moments about 'A',

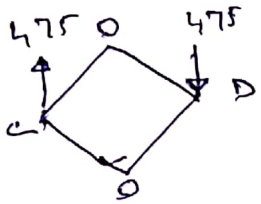
$63.50 \times 17.63 - 2.00 R_B = 0$

$R_B = 560$ KN (on 2 legs)

Force per leg = $560/2$ = **280 KN** on side B (compression) & **280 KN** (tension) each on side A

b) Wind blowing along diagonal:





Taking moments about line A-B,

$76.20 \times 17.63 - 1.414R - 1.414R = 0$

$R =$ **475 KN** (compression) at "D".

475 KN (tension) at "C".

0 at A & B