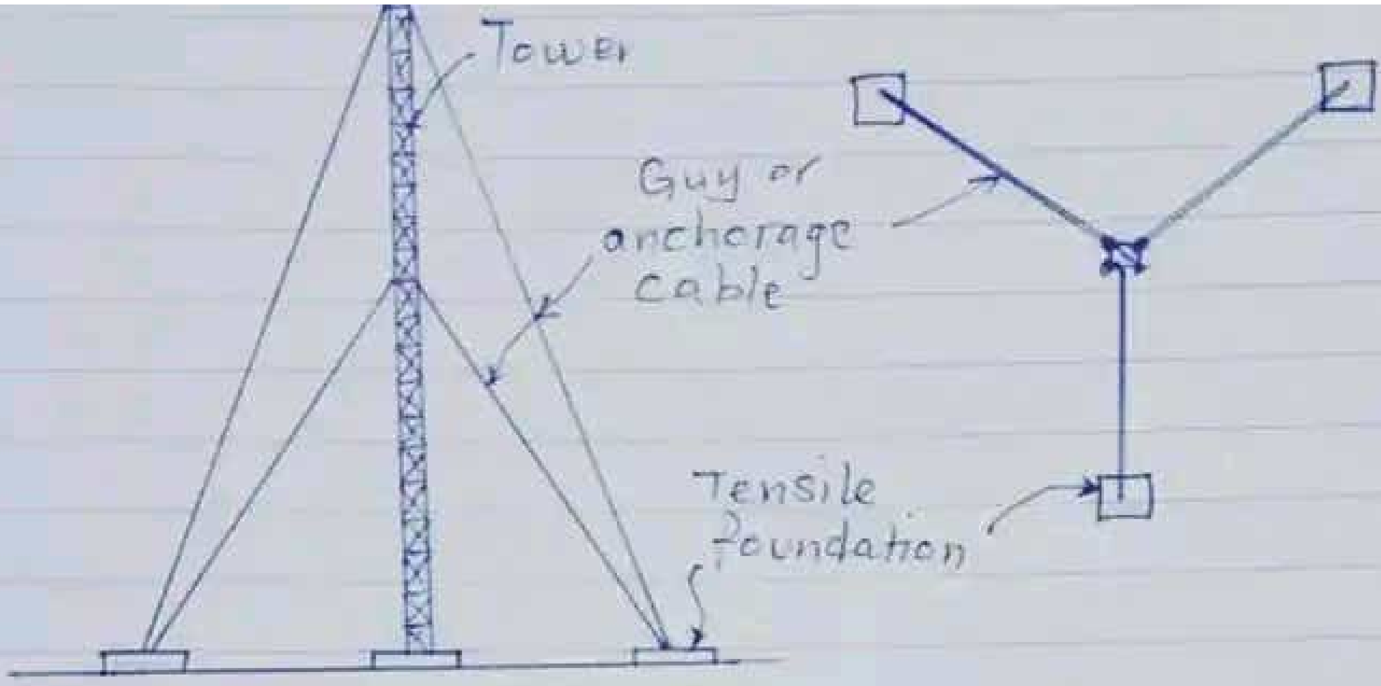
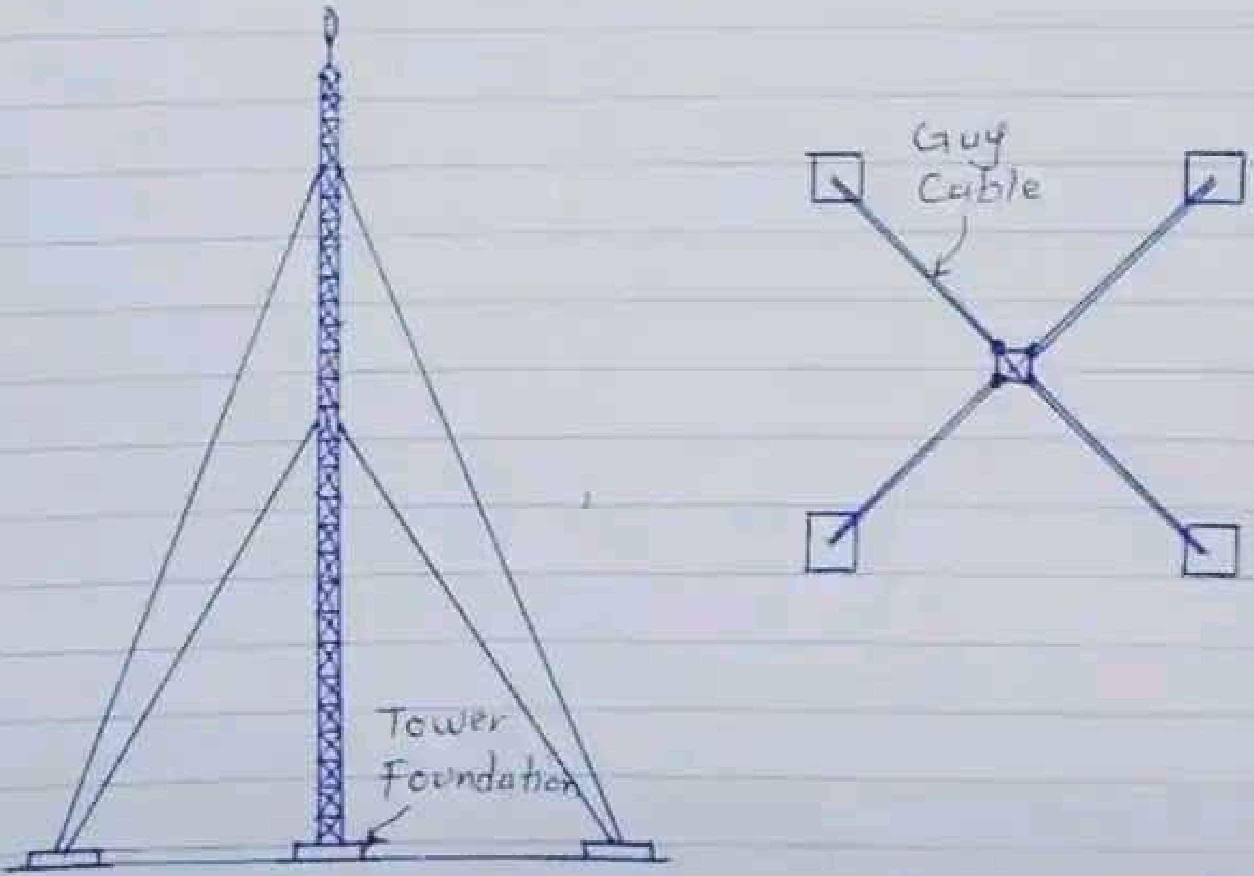
Calculation notebook for mast tower

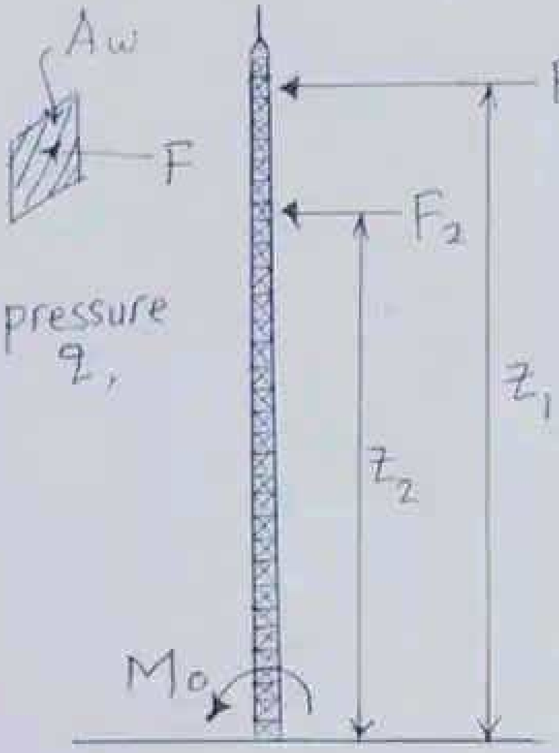


(a). Three Anchorage Cable



(b). Four Anchorage Cable

Overturning Moment, M_o



Lateral Force (wind Force):-

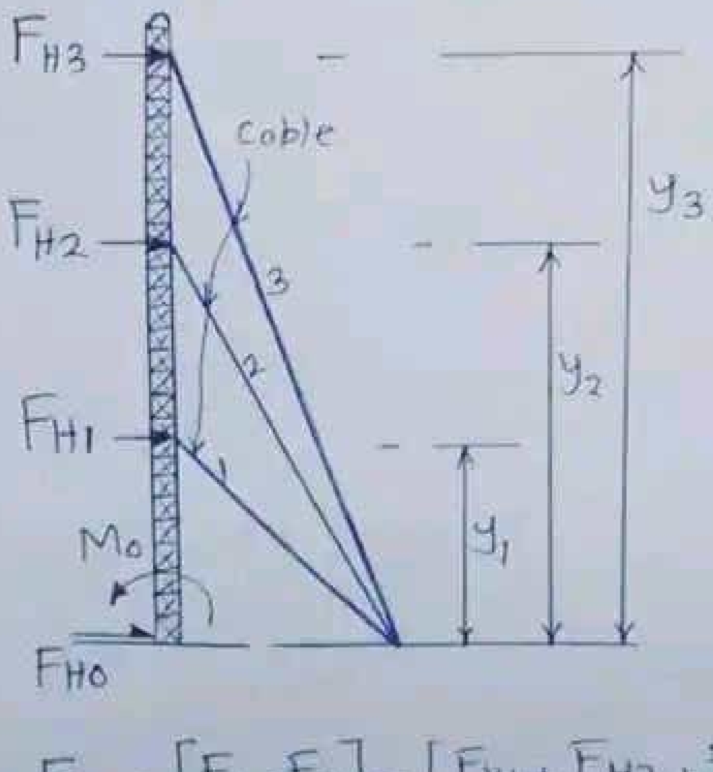
$$F_1 = q \cdot A_{w1} \quad kN$$

$$F_2 = q \cdot A_{w2} \quad \dots kN$$

overturning moment

$$M_o = F_1 \cdot Z_1 + F_2 \cdot Z_2$$

Horizontal Reaction each level



$$F_H = \frac{M_o \cdot y_n}{[y_1^2 + y_2^2 + y_3^2]}$$

so;

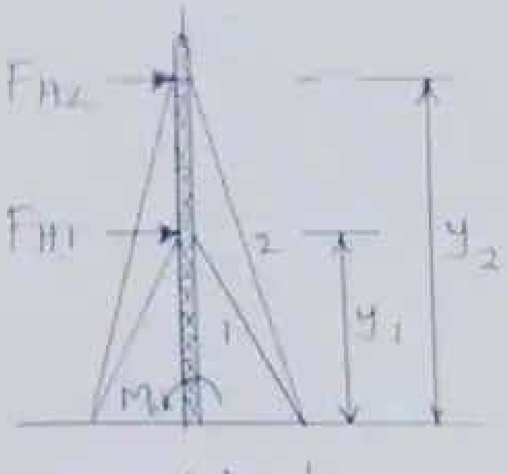
$$F_{H1} = \frac{M_o \cdot y_1}{[y_1^2 + y_2^2 + y_3^2]}$$

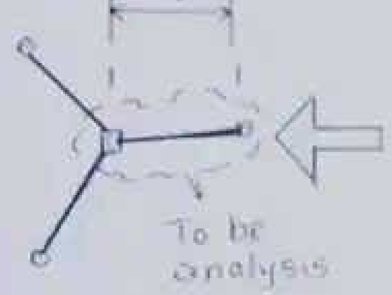
$$F_{H2} = \frac{M_o \cdot y_2}{[y_1^2 + y_2^2 + y_3^2]}$$

$$F_{H3} = \frac{M_o \cdot y_3}{[y_1^2 + y_2^2 + y_3^2]}$$

$$F_{H0} = [F_1 + F_2] - [F_{H1} + F_{H2} + F_{H3}]$$

case 1





Cable length:-

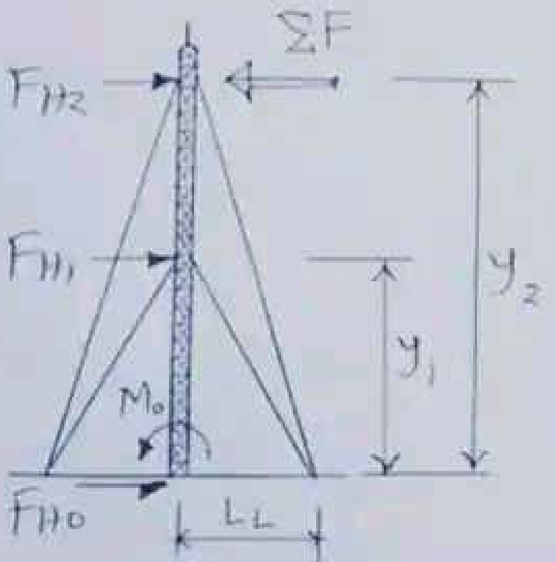
$$L_{c1} = \sqrt{L_L^2 + y_1^2} \quad \ldots m$$

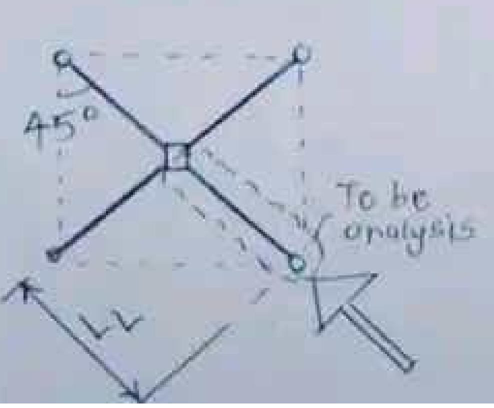
$$L_{c2} = \sqrt{L_L^2 + y_2^2} \quad \ldots m$$

Horizontal Reaction:-

$$F_{H1} = \frac{M_o \cdot y_1}{[y_1^2 + y_2^2]} \quad \ldots kN$$

$$F_{H2} = \frac{M_o \cdot y_2}{[y_1^2 + y_2^2]} \quad \ldots kN$$





Cable Length:-

$$L_{c1} = \sqrt{L_L^2 + y_1^2}$$

$$L_{c2} = \sqrt{L_L^2 + y_2^2}$$

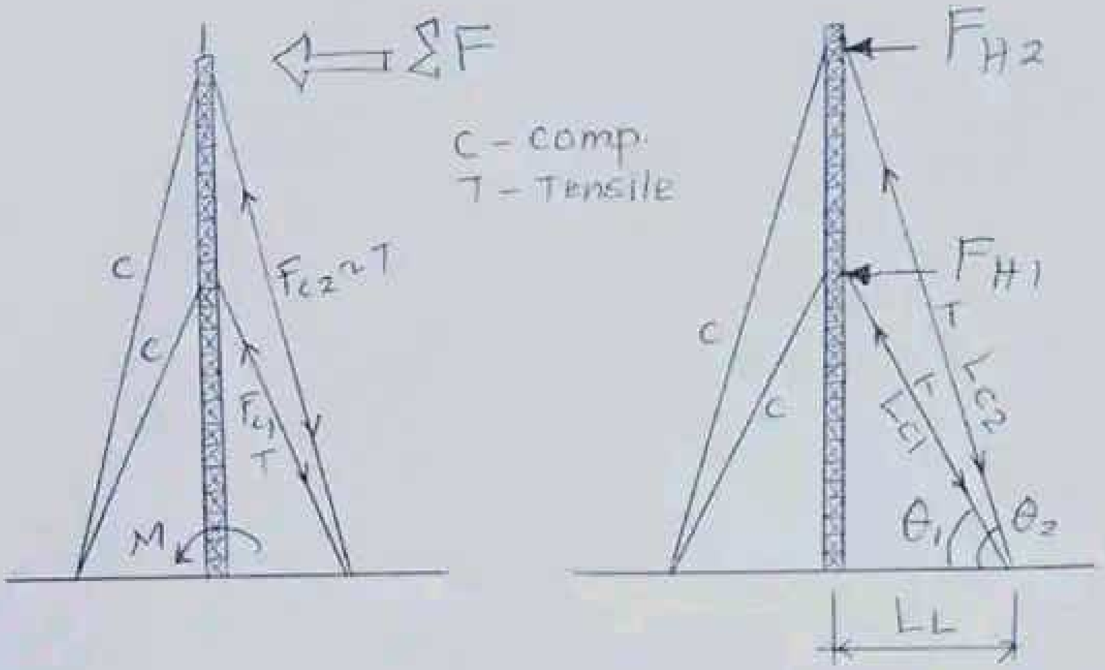
Horizontal Reaction

$$F_{H1} = \frac{M_o \cdot y_1}{[y_1^2 + y_2^2]} \quad kN$$

$$F_{H2} = \frac{M_o \cdot y_2}{[y_1^2 + y_2^2]}$$

$$F_{H0} = \Sigma F - (F_{H1} + F_{H2})$$

Tensile Force to Cable



Tensile Force to cable :-

$$F_{C1} = \frac{-F_{H1}}{\cos\theta_1} = -F_{H1}\left(\frac{L_{C1}}{L_L}\right) \quad \ldots \text{kN}$$

$$F_{C2} = \frac{-F_{H2}}{\cos\theta_2} = -F_{H2}\left(\frac{L_{C2}}{L_L}\right) \quad \ldots \text{kN}$$

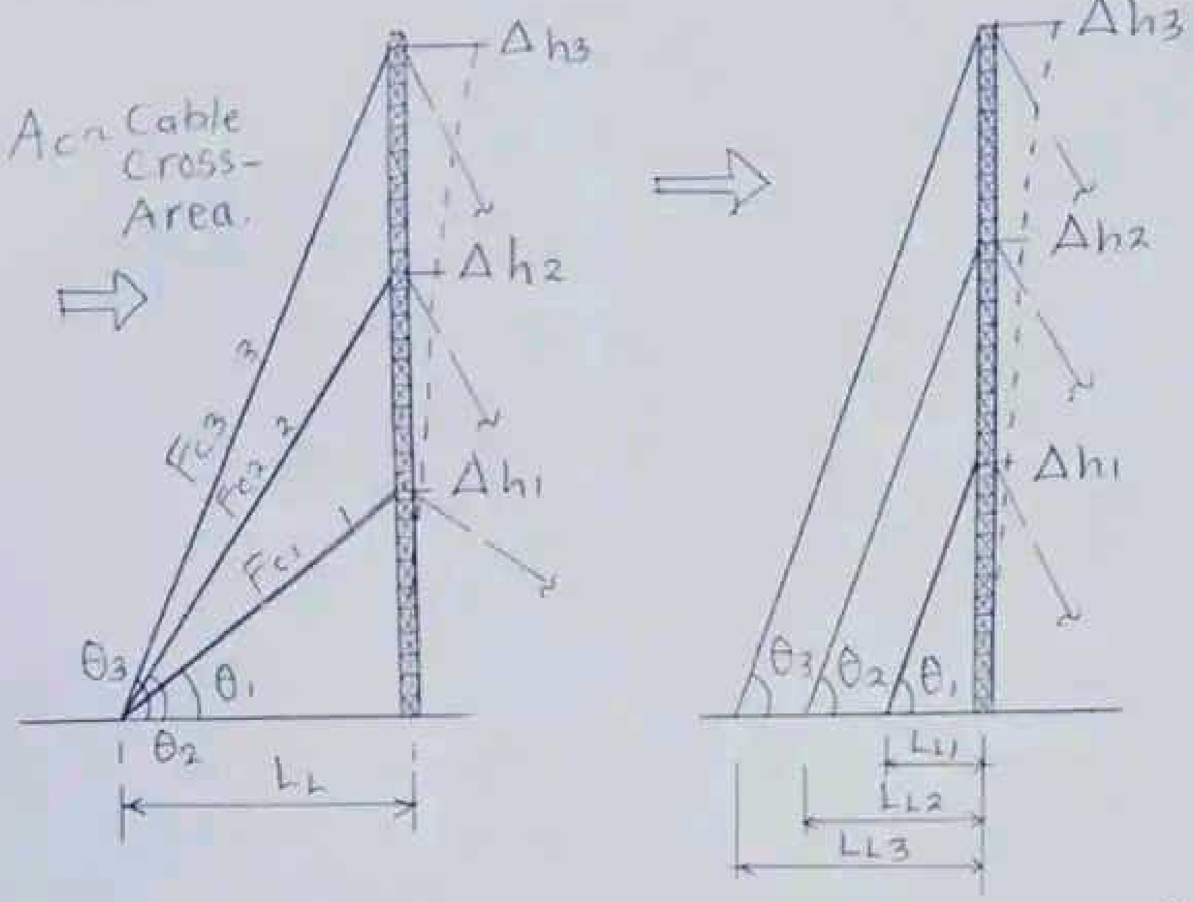
Given Cable strength, f_{TU} ... N/mm^2 from cable spesification. cable size.

$$A_{C1} = \frac{F_{C1}}{f_{TU}} \quad \& \text{ Diameter, } \phi_c = \sqrt{\frac{4A_{C1}}{\pi}}$$

$$A_{C2} = \frac{F_{C2}}{f_{TU}} \quad \& \text{ Diameter, } \phi_c = \sqrt{\frac{4A_{C2}}{\pi}}$$

selected proper size each cable.

Tower Displacement analysis



$$\cos\theta_1 = \frac{L_L}{L_{c1}} \; ; \quad \cos\theta_2 = \frac{L_L}{L_{c2}} \; ; \quad \cos\theta_3 = \frac{L_L}{L_{c3}}$$

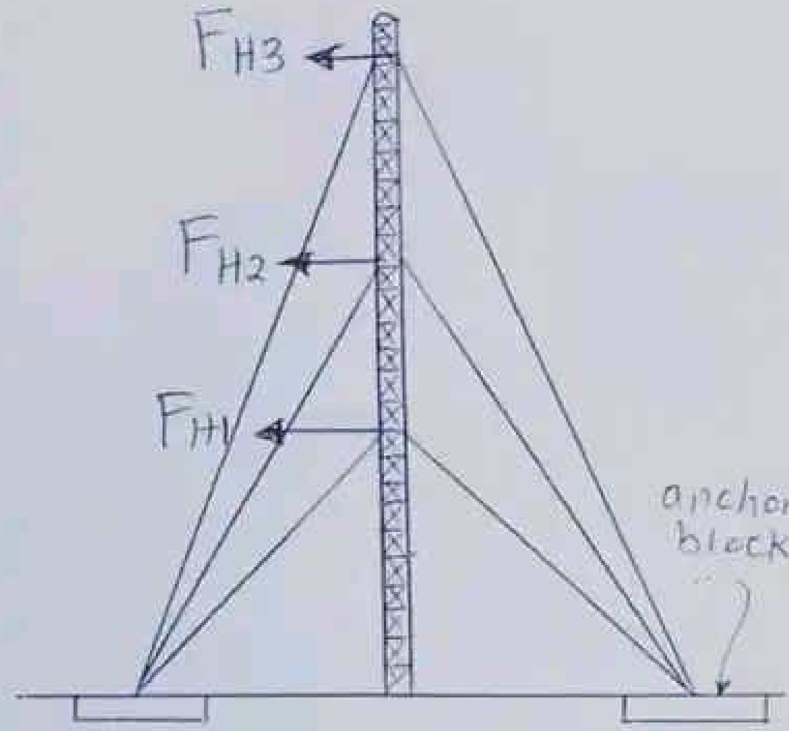
Displacement (Horizontal Deflection) each level :-

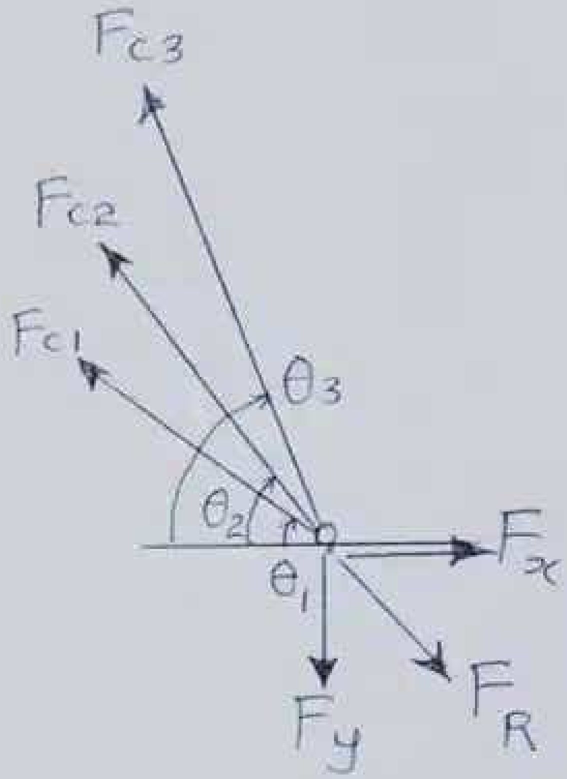
$$\Delta h_1 = \frac{F_{c1}.L_{c1}}{A_c.E.\cos\theta_1} = \frac{F_{c1}.L_{c1}}{A_c.E}\left(\frac{L_{c1}}{L_L}\right) \ldots \text{cm}$$

$$\Delta h_2 = \frac{F_{c2}.L_{c2}}{A_c.E.\cos\theta_2} = \frac{F_{c2}.L_{c2}^2}{A_c.E.L_L} \ldots \text{cm}$$

$$\Delta h_3 = \frac{F_{c3}.L_{c3}}{A_c.E.\cos\theta_3} = \frac{F_{c3}.L_{c3}^2}{A_c.E.L_L} \ldots \text{cm}$$

Reaction at anchorage block / FOUNdation





Horizontal Force:-

$$F_x = F_{H1} + F_{H2} + F_{H3} \quad \ldots \text{kN}$$

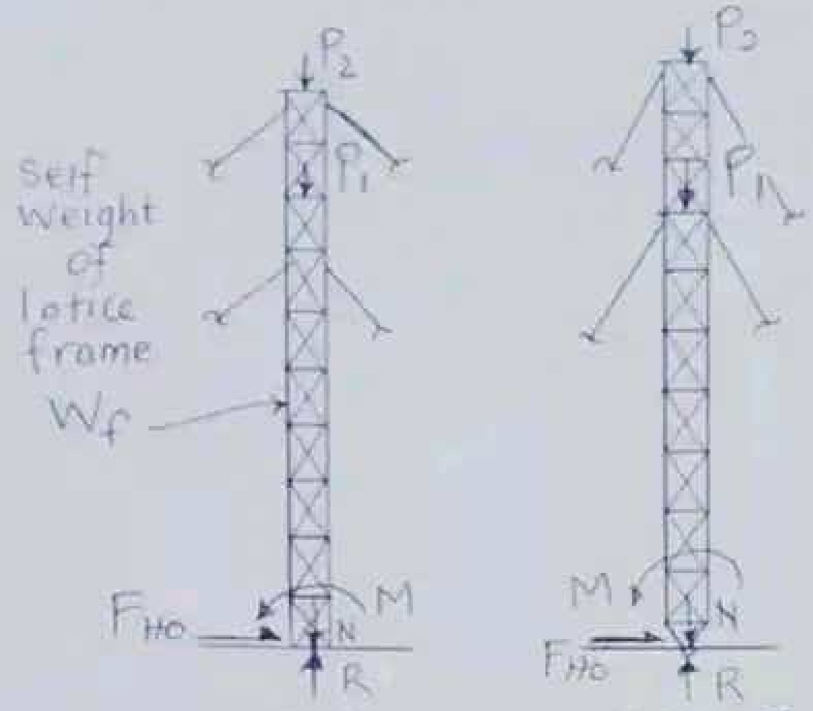
Vertical Reaction:

$$F_y = F_{c1} \cdot \sin\theta_1 + F_{c2} \cdot \sin\theta_2 + F_{c3} \cdot \sin\theta_3$$

Resultant Force:-

$$F_R = \sqrt{F_x^2 + F_y^2} \quad \ldots \text{kN}$$

Latice Frame Design



a) Rigid Base b) Hinge Base

axial load to base:

$N = P_1 + P_2 + W_f$

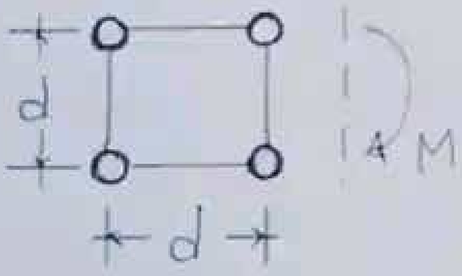
Vertical reaction

$R = N$

M ~ Moment at first column.

P_1 & P_3 ~ Point load from equipment

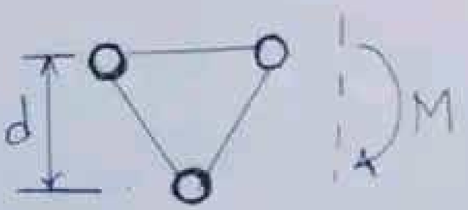
column arragement:-



axial Force to each column

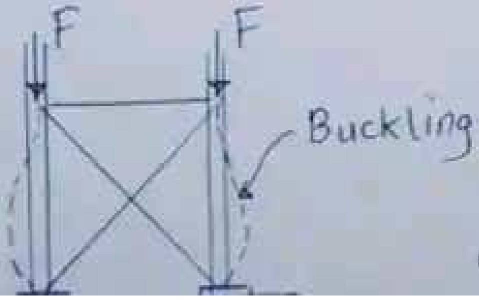
$$F = \frac{N}{4} + \frac{M}{2d}$$

axial Force to each column



$$F = \frac{N}{3} + \frac{M}{d}$$

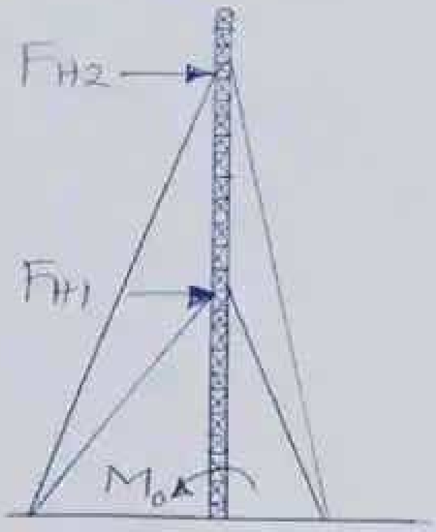
column size



$$A_{cs} = \frac{F_{max}}{P_y} \quad cm^2$$

check for buckling.

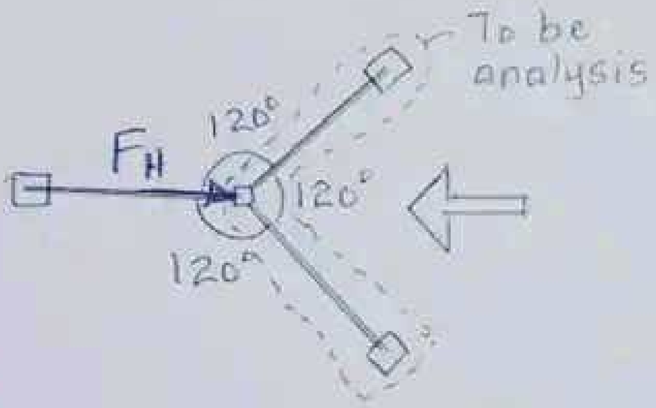
case 2

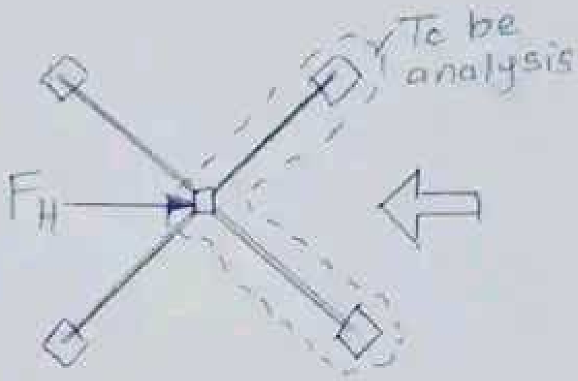


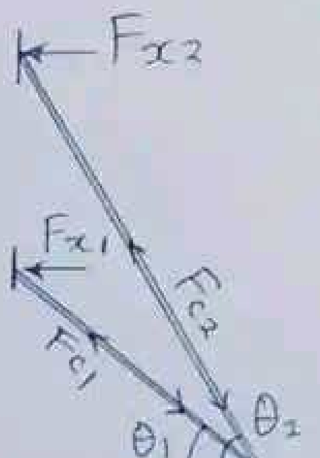
Horizontal Reaction:

$$F_{H1} = \frac{M_o \cdot y_1}{[y_1^2 + y_2^2]} \quad \ldots kN$$

$$F_{H2} = \frac{M_o \cdot y_2}{[y_1^2 + y_2^2]} \quad \ldots kN$$







Horizontal Force

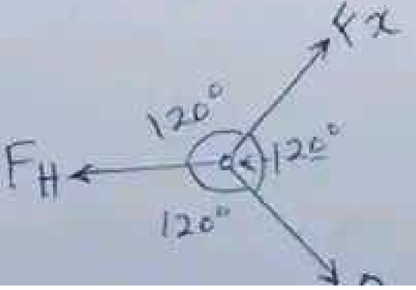
from lami's Theorem:

$$\frac{F_x}{\sin 120°} = \frac{F_H}{\sin 120°}$$

$$F_x = F_H\left(\frac{\sin 120°}{\sin 120°}\right)$$

Tensile Force to Cable:-

$$F_{c1} = \frac{-F_{x1}}{\cos\theta_1} = -F_{x1}\cdot\left(\frac{L_{c1}}{L_L}\right)$$



$$F_{c2} = \frac{-F_{x2}}{\cos\theta_2} = -F_{x2}\cdot\left(\frac{L_{c2}}{L_L}\right)$$

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