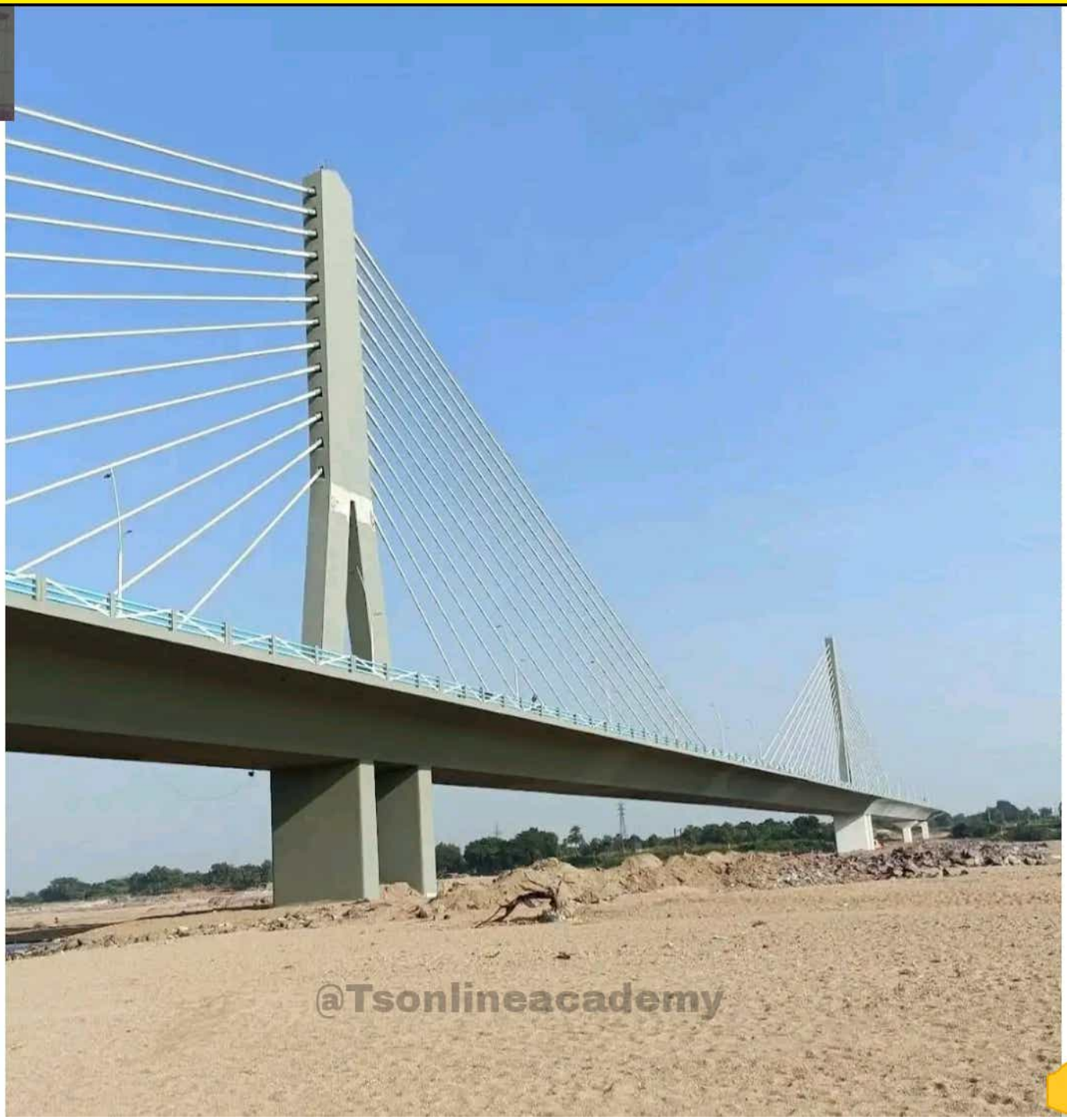
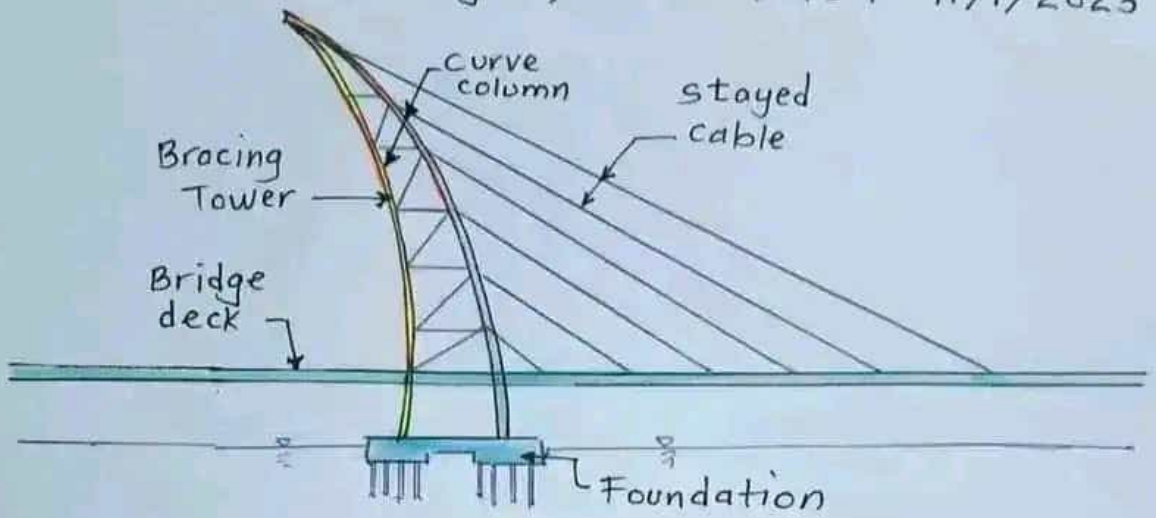
Cable bridge



STAYED - CABLE BRIDGE W/ BRACING TOWER

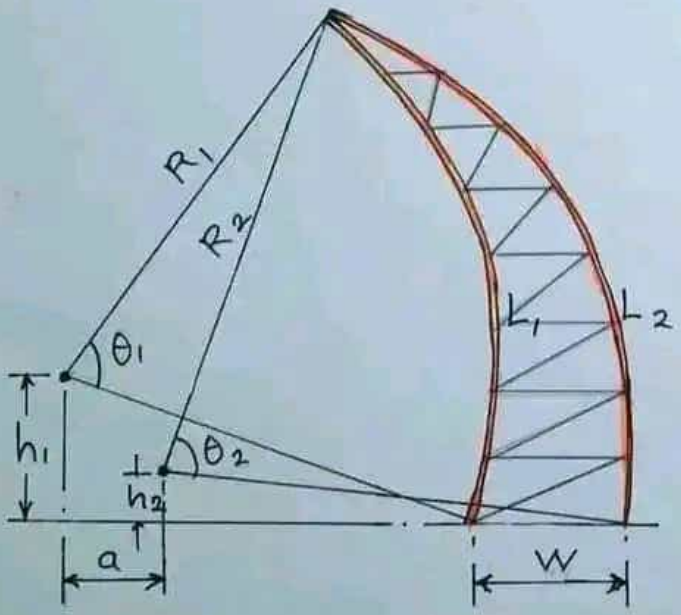
Prepared by: Shah Rizan Mahran
(Sarawak, Malaysia)

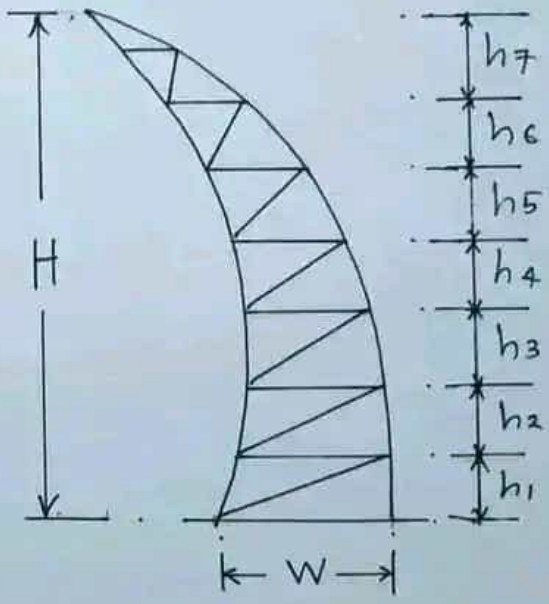
Civil & Structural knowledge
Date : 11/1/2023



GEOMETRY OF TOWER

1. circular column





$$a = \sqrt{R_1^2 - h_1^2} + W - \sqrt{R_2^2 - h_2^2}$$

Length of curve column.

$$L_1 = \pi \cdot R_1 \cdot \frac{\theta_1}{180^\circ} \qquad L_2 = \pi \cdot R_2 \cdot \frac{\theta_2}{180^\circ}$$

Weight of Tower;-

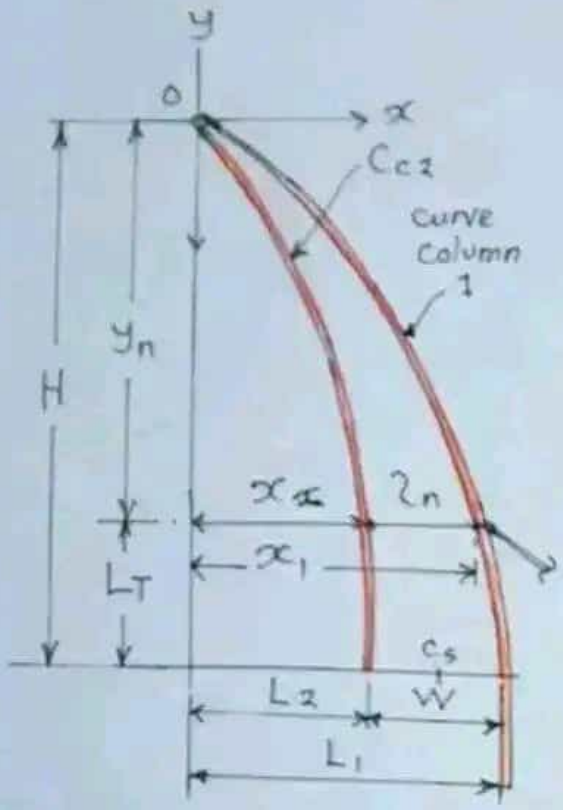
$W_T = \gamma_m \times$ Volume.

$W_T = \gamma_m (A_m \times L_m)$

A_m ~ cross-section Area.

L_m ~ length

2. Parabola column



Ordinate x_n when y_n.

$$x_1 = \frac{L_1}{H^2}(2H \cdot y_n - y_n^2)$$

$$x_2 = \frac{L_2}{H^2}(2H \cdot y_n - y_n^2)$$

Tie length:-

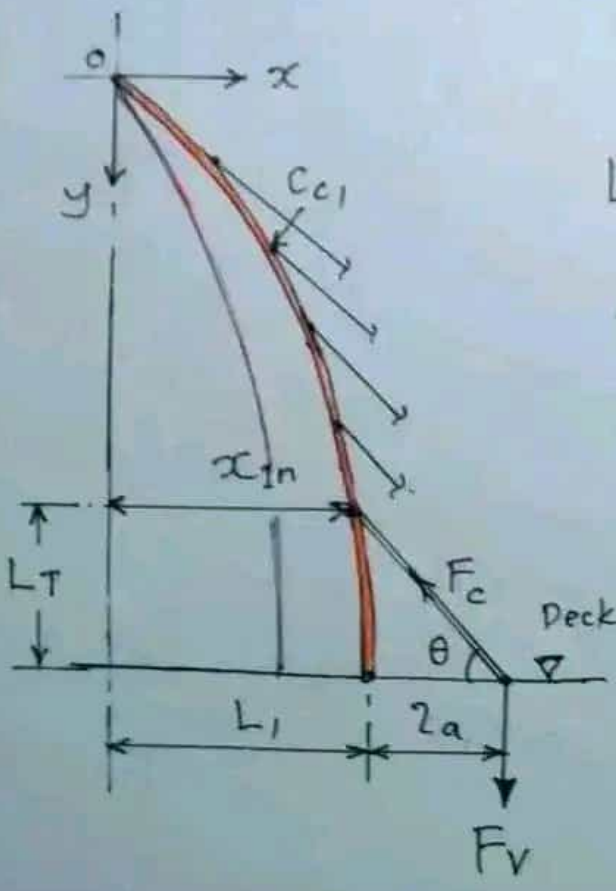
$$2_n = x_1 - x_2$$

$$L_T = H - y_n$$

$$W = L_1 - L_2$$

centroid support, $C_s \sim \bar{x} = \frac{W}{2}$

3. Stayed Cable Analysis



cable length:-

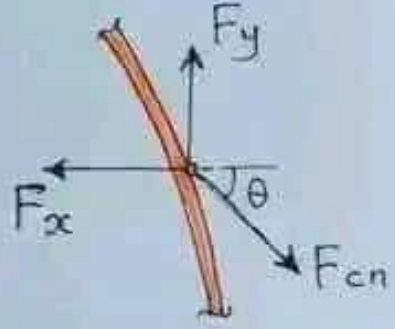
$$L_c = \sqrt{L_T^2 + (L_1 + 2a - x_{1n})^2}$$

Tensile Force to stayed cable:

$$F_c = \frac{F_V}{\sin\theta} = F_V\left(\frac{L_c}{L_T}\right) \ldots kN$$

where: $F_V \sim$ is Vertical Force from bridge deck.

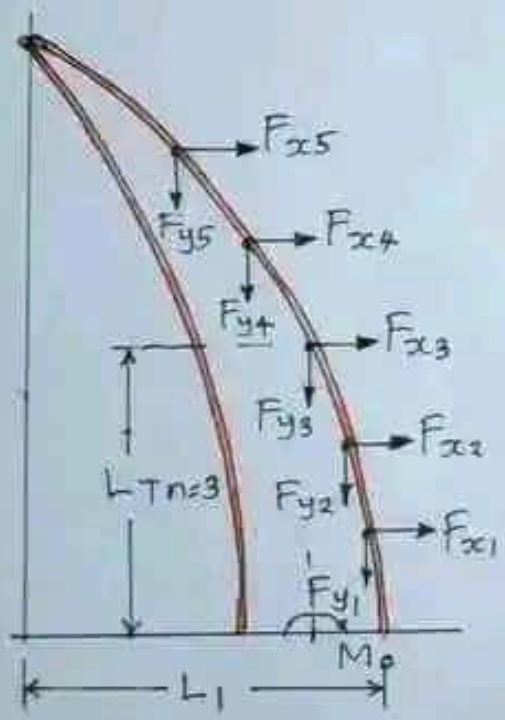
Reaction at joint :-



$$F_x = \frac{F_{cn} \cdot \sin(90^\circ + \theta)}{\sin 90^\circ}$$

$$F_y = \frac{F_{cn} \cdot \sin(180^\circ - \theta)}{\sin 90^\circ}$$

So, component of force at each joint:



overturning Moment:

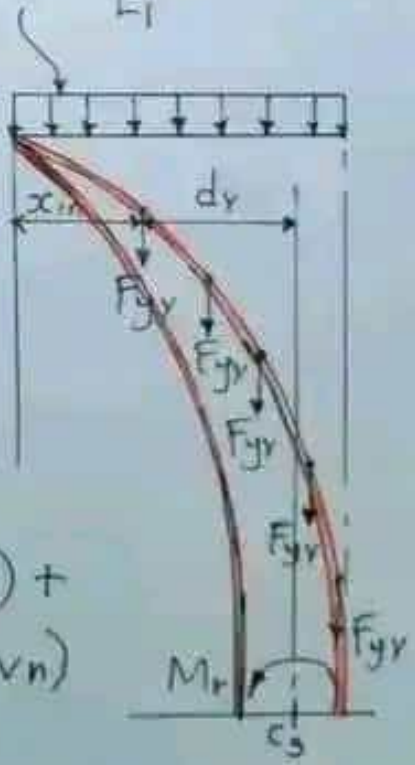
$$\overset{\curvearrowright}{M_o} = \Sigma [F_x \times L_T]$$

$$M_o = (F_{x1} \cdot L_{T1}) + (F_{x2} \cdot L_{T2}) + \cdots + (F_{xn} \cdot L_{Tn})$$

Service load from structure:

$$Q = 1.4 W_T$$

UDL; $\omega = \frac{Q}{L_1}$ ~ (KN/m)



Distance; $d_v = L_1 - x_{1n} - \frac{W}{2}$

Total Vertical load at joint:

$$F_{yv} = F_{y1} + \omega \cdot x_{1n}$$

Moment resistance; M_r

$$M_r = (F_{yv1} \cdot d_{v1}) + (F_{yv2} \cdot d_{v2}) + (F_{yv3} \cdot d_{v3}) + \cdots + (F_{yvn} \cdot d_{vn})$$

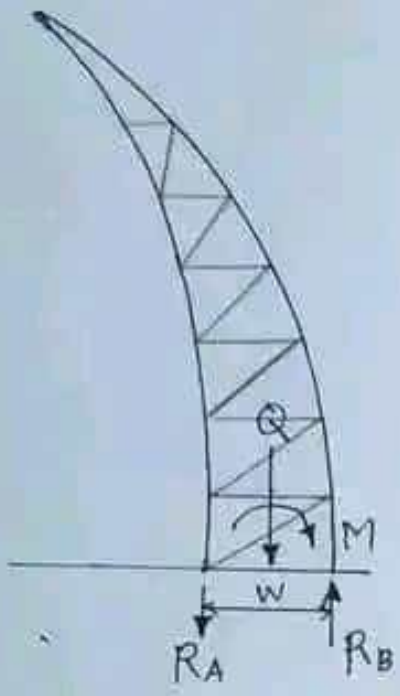
Bending Moment To tower:

$$M = M_o - M_r$$

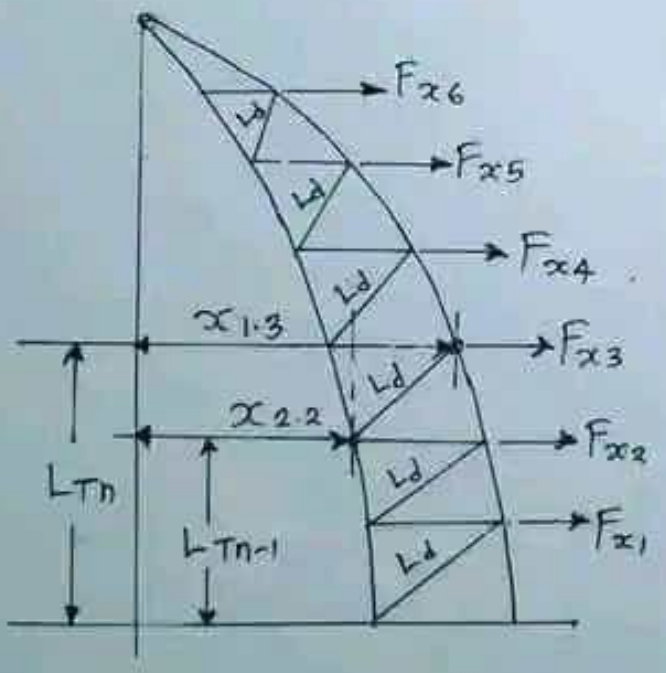
Reaction at leg:

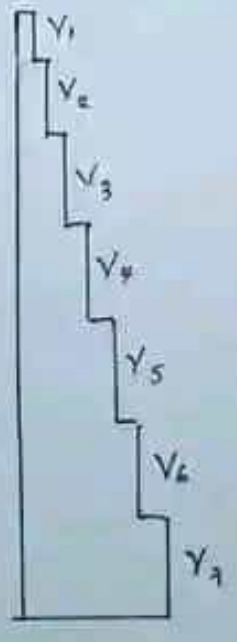
$$R_A = \frac{Q}{2} - \frac{M}{W} \quad \ldots \text{KN}$$

$$R_B = \frac{Q}{2} + \frac{M}{W} \quad \ldots \text{KN}$$

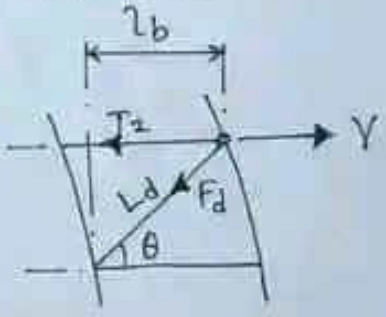


Analysis to diagonal bracing & Tie member:





SFD



Tensile Force to diagonal bracing & Tie ;-

$$F_d = \frac{V}{2.\cos\theta}$$

$$F_d = \frac{V}{2}\left(\frac{L_d}{2_b}\right) \quad \ldots \text{KN}$$

$$T_2 = \frac{V}{2} \quad \ldots \text{KN}$$

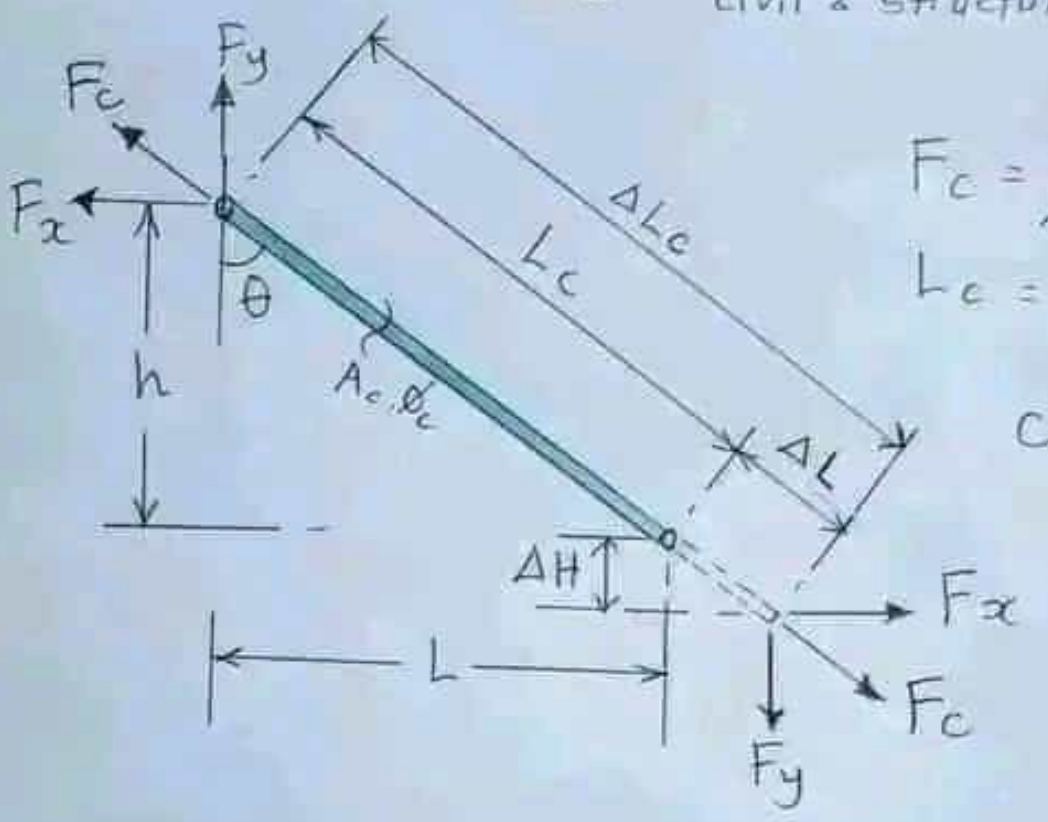
Diagonal length

$$L_d = \sqrt{(L_{Tn} - L_{Tn-1})^2 + 2_b^2}$$

$$2_b = x_{1.3} - x_{2.2}$$

ELONGATION & VERTICAL DISPLACEMENT

By: Shah Rizan Mahran
civil & Structural knowledge.



$$F_c = \sqrt{F_x^2 + F_y^2}$$

$$L_c = \sqrt{L^2 + h^2}$$

$$\cos\theta = \frac{h}{L_c}$$

Elongation of Cable:

$$\Delta L = \frac{F_c \cdot L_c}{A_c \cdot E} \quad \text{... mm}$$

Vertical Displacement (Deflection)

$$\Delta H = \frac{F_c \cdot L_c}{A_c \cdot E \cdot \cos\theta} = \frac{F_c \cdot L_c}{A_c \cdot E}\left(\frac{L_c}{h}\right)$$

$$\Delta H = \frac{F_c \cdot L_c^2}{A_c \cdot E \cdot h}$$

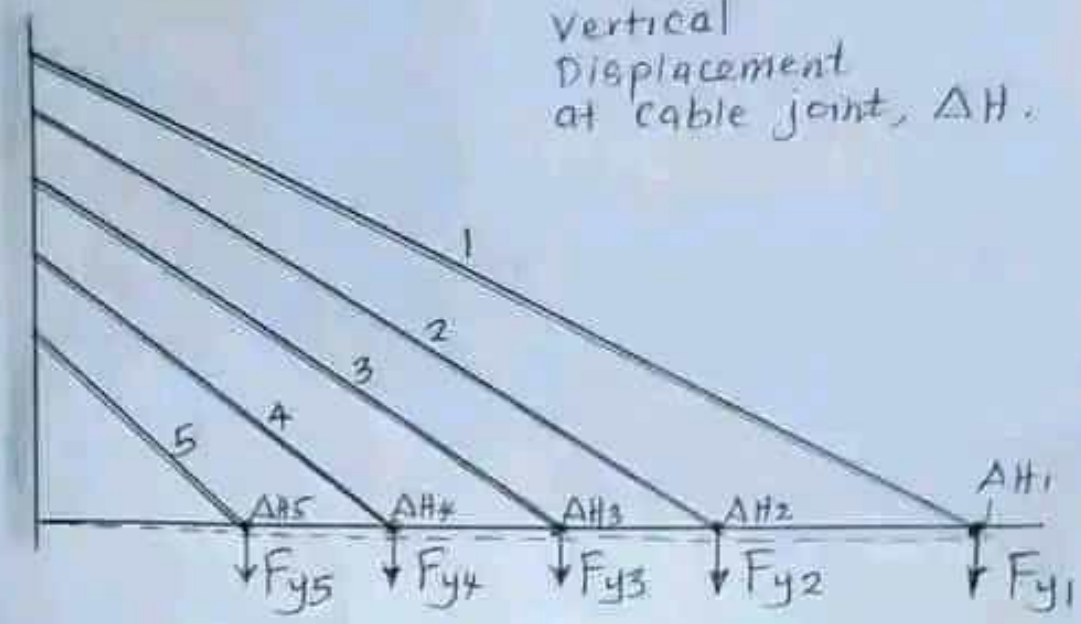


Table 1:

Data Input: Cable strength, f_{ut} = _____ N/mm²

Modulus Elasticity, E = _____

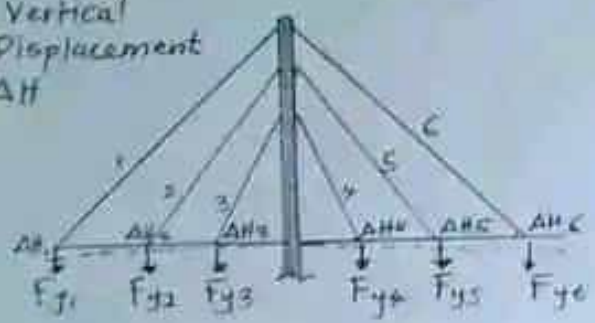
Cable Ref.	Dimension			F_y	F_x	F_c	ΔL	ΔH
	h	L	L_c					
1								
2								
3								
4								
5								

where:

$$A_c = \frac{F_c}{F_{uT}} \quad \ldots mm^2 \quad \& \quad \emptyset_{ccal} = \sqrt{\frac{4 \cdot A_c}{\pi L}}$$

(Diameter)

Vertical Displacement ΔH



Cable Diameter $\phi_{ccal} = \sqrt{\frac{4 \cdot F_c}{\pi \cdot f_{ut}}}$ (mm)

Table 2 :

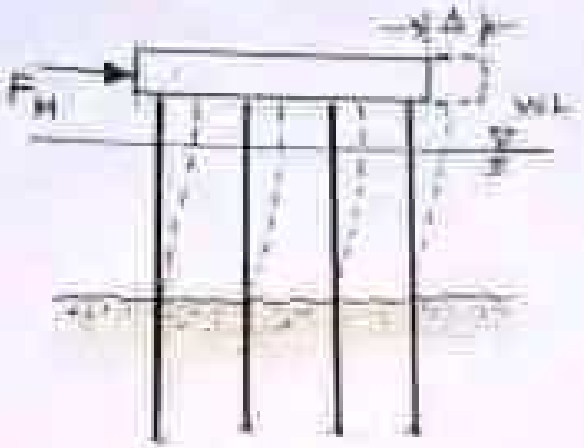
Input Data : f_{ut} = _____

E = _____

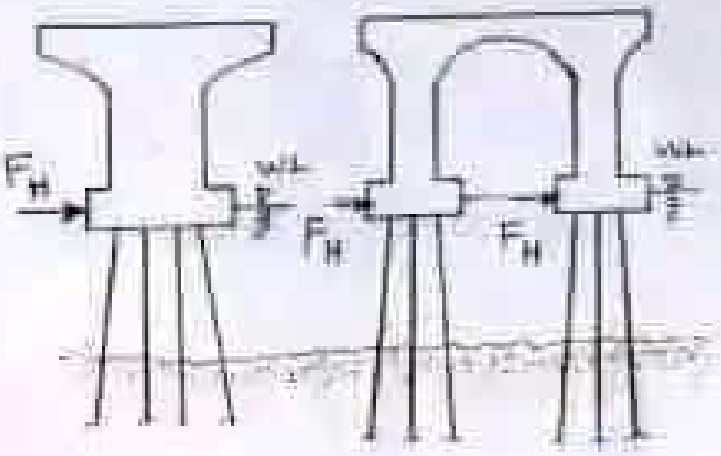
Cable Ref.	Dimension			F_y	F_x	F_c	Cable Size			ΔL	ΔH
	h	L	L_c				ϕ_{ccal}	ϕ_c	A_c		
1											
2											
3											
4											
5											
6											

Prepared by : Shah Rizan Mahran

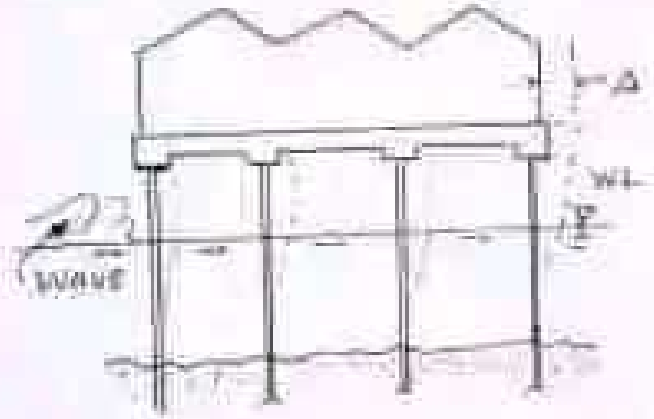
PILE FOUNDATION IN BENDING MOMENT & LATERAL HORIZONTAL FORCE (FH)



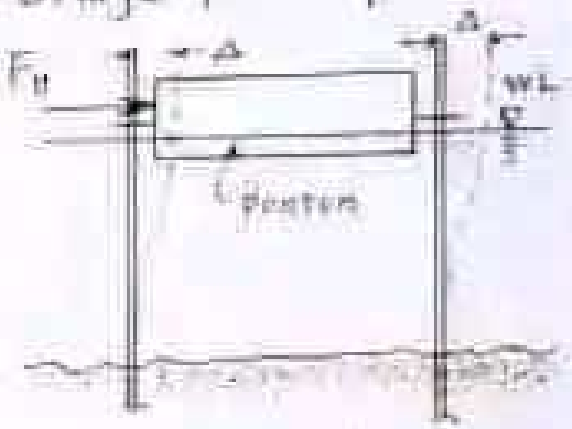
(a) Marine Structures



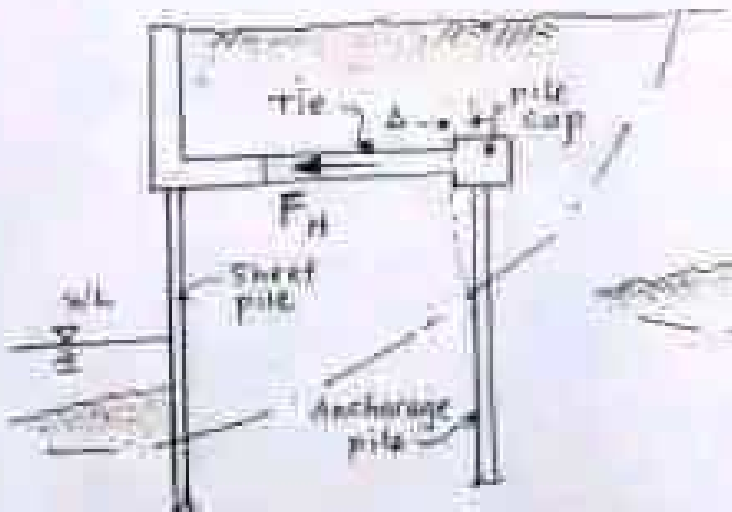
(b) Bridge pile cap



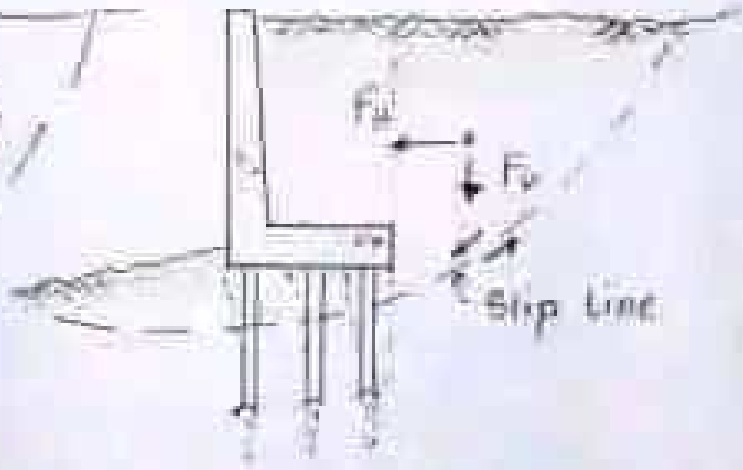
(c) Building top of pile cap



(d) Ponton Anchorage to pile



(e) Anchorage pile



(f) Retaining wall

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