CABLE ANALYSIS

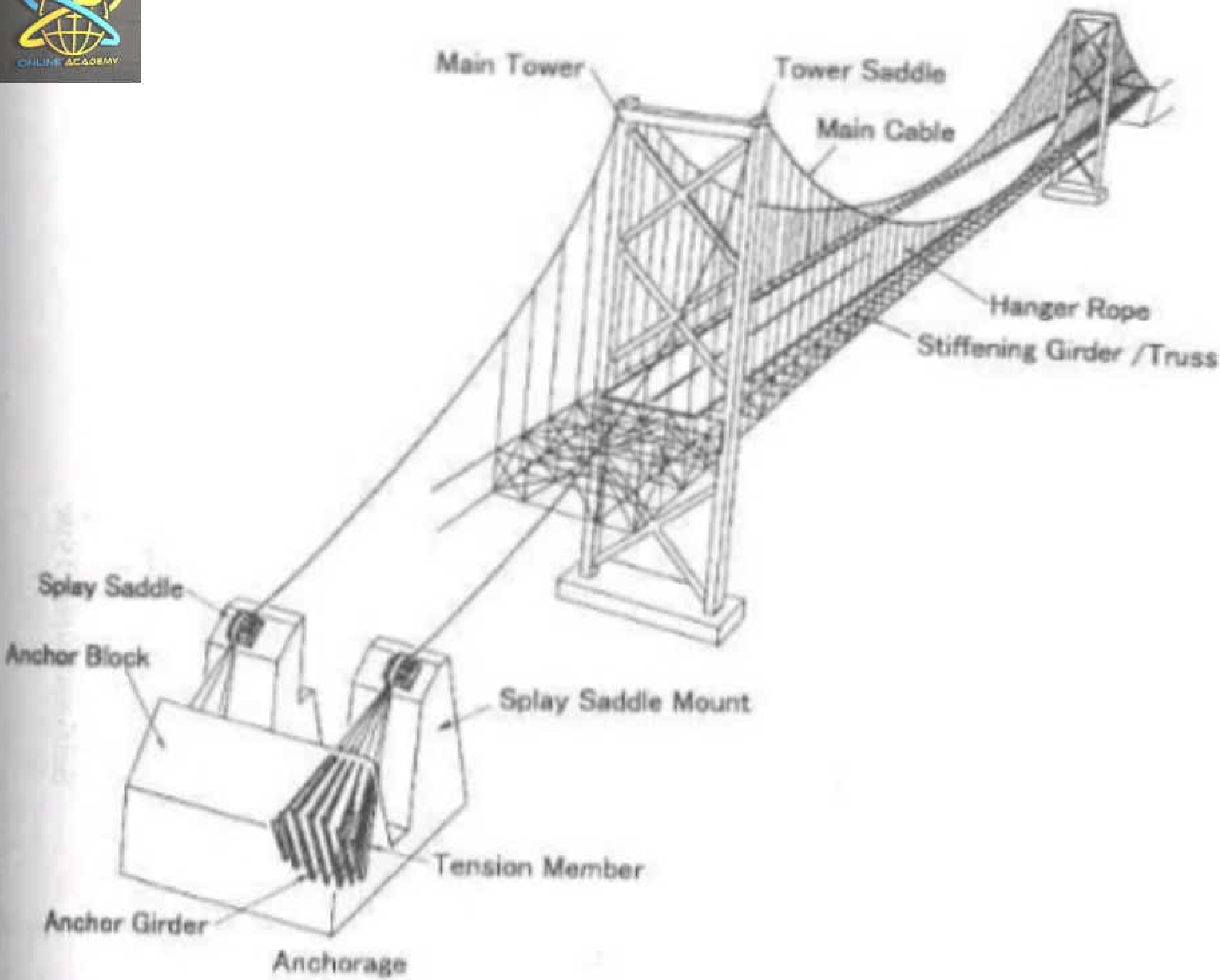
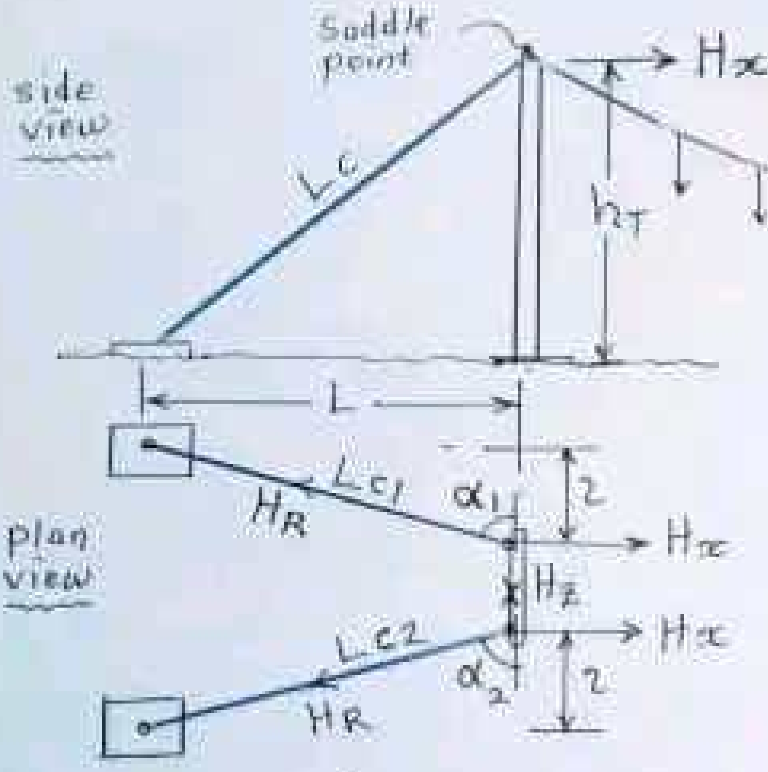


FIGURE 18.1 Suspension bridge components.

Backstay cable w/ inclined to side



Given anchor block position from saddle point:

h_T, L & Z

Length of Backstay cable:-

$$L_{c1} = \sqrt{L^2 + h_T^2 + Z^2}$$

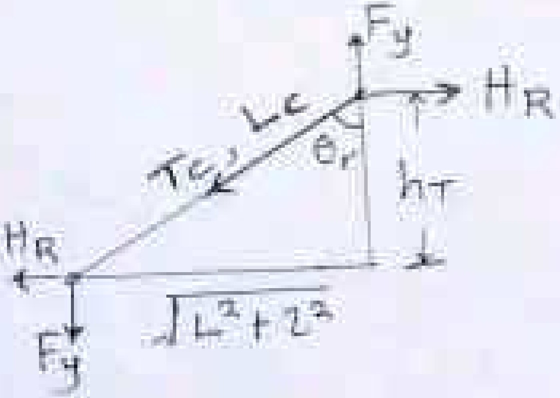
$$L_{c2} = \sqrt{L^2 + h_T^2 + Z^2}$$

$$\alpha_1 = \alpha_2 = \tan^{-1}\left(\frac{L}{Z}\right)$$

$$L_{c1} = L_{c2}$$

$$H_z = \frac{H_x \cdot \sin(90^\circ + \alpha)}{\sin(180^\circ - \alpha)}$$

$$H_R = \frac{H_x \cdot \sin 90^\circ}{\sin(180^\circ - \alpha)}$$

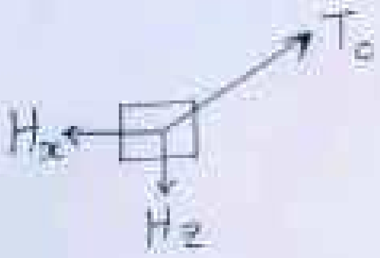


So, Tensile Force to backstay cable:-

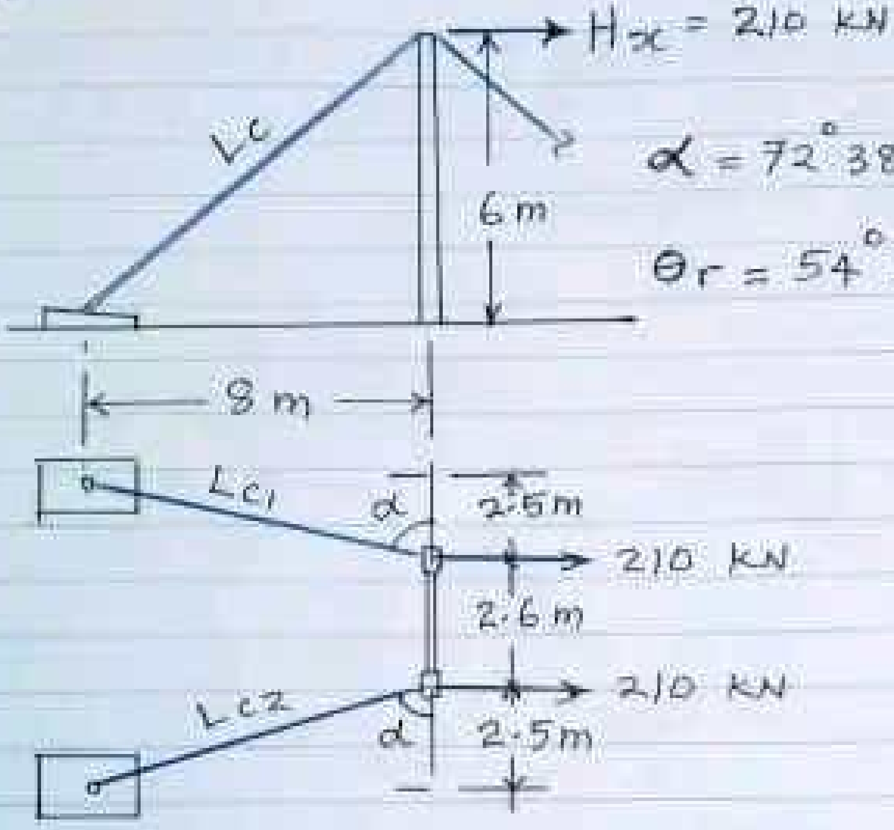
$$T_c = \frac{H_R}{\sin\theta_r} = H_R \cdot \frac{L_c}{\sqrt{L^2 + Z^2}} \qquad \theta_r = \tan^{-1}\left(\frac{\sqrt{Z^2+L^2}}{h_T}\right)$$

at anchorage block :-

$$F_y = \frac{H_R \cdot \sin(90^\circ + \theta_r)}{\sin(180^\circ - \theta_r)}$$



Example



$\alpha = 72^\circ 38' 45.51''$

$\theta_r = 54^\circ 24' 9.51''$

Length of Backstay cable: $L_{c1} = L_{c2} = \sqrt{6^2 + 8^2 + 2.5^2}$

$$L_c = 10.3078 \text{ m}$$

$$H_z = \frac{210 \times \sin(90^\circ + 72^\circ 38' 45.51'')}{\sin(180^\circ - 72' 38' 45.51'')}$$

$$H_z = 65.6250 \text{ kN}$$

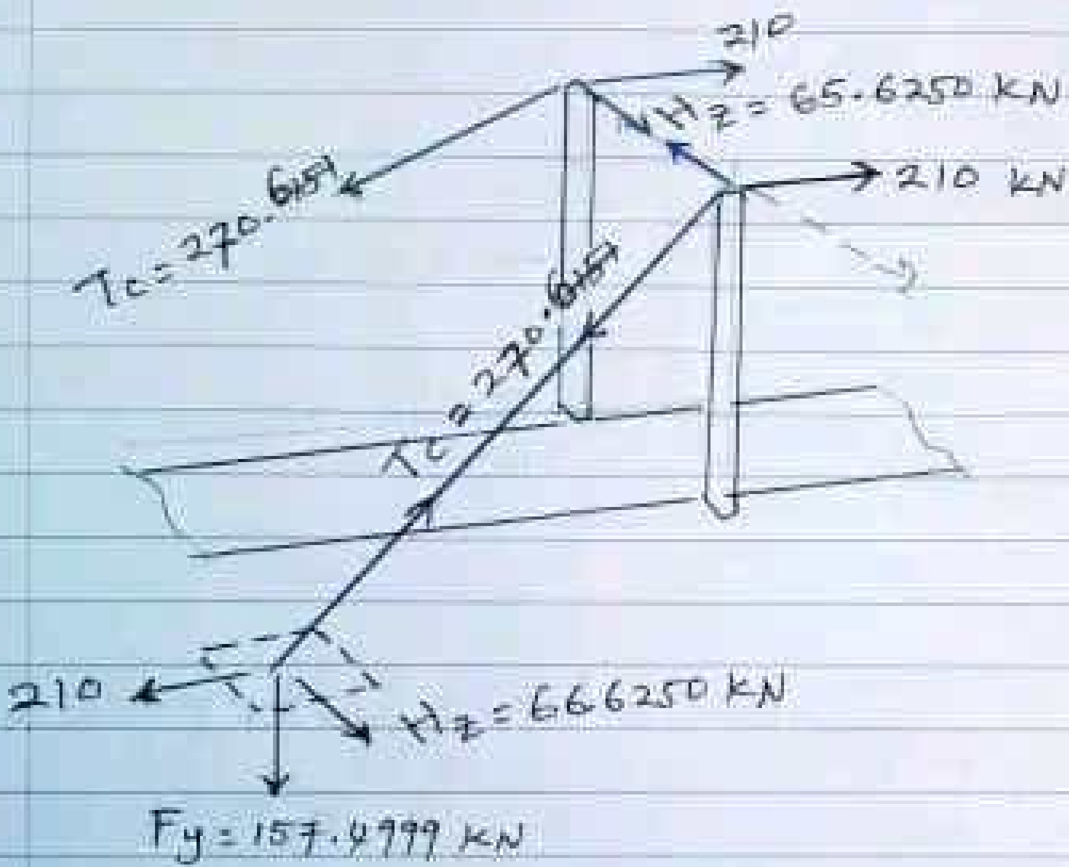
$$H_R = \frac{210 \times \sin 90^\circ}{\sin(180^\circ - 72^\circ 38'' 45.51'')}$$

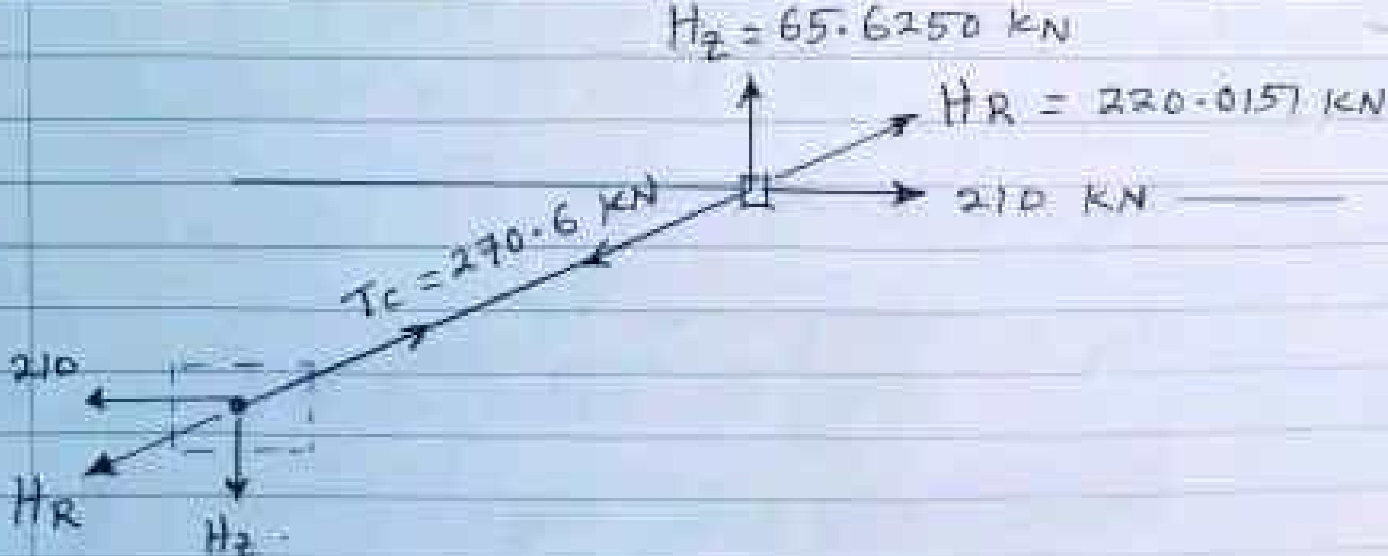
$$H_R = 220.0151 \text{ kN}$$

$$T_c = 220.0151 \times \frac{10.3078}{\sqrt{8^2 + 2.5^2}} = 270.5798 \text{ kN}$$

$$F_y = \frac{220.0151 \times \sin(90^\circ + 54^\circ 24' 9.51'')}{\sin(180^\circ - 54^\circ 24' 9.51'')}$$

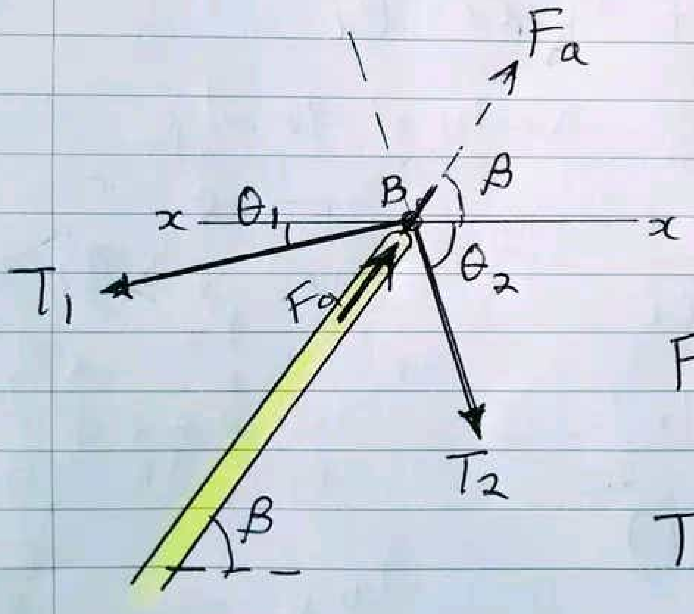
$$F_y = 157.4999 \text{ kN}$$





plan view

$$T_A = T_B = \sqrt{R^2 + H_x^2} \quad \ldots kN.$$

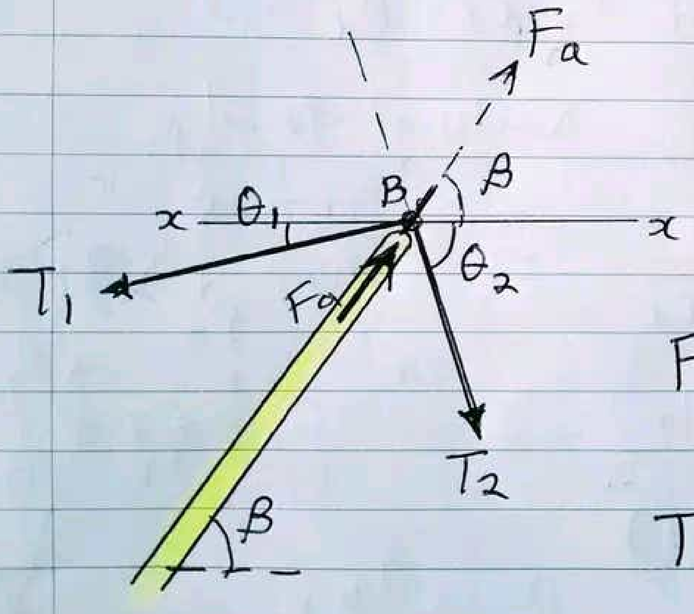


Given T_1, calculate F_a & T_2 to balance Force at joint B:

$$F_a = \frac{T_1 \cdot \sin(180^\circ - \theta_1 - \theta_2)}{\sin(\beta + \theta_2)}$$

$$T_2 = \frac{T_1 \cdot \sin(180^\circ + \theta_1 - \beta)}{\sin(\beta + \theta_2)}$$

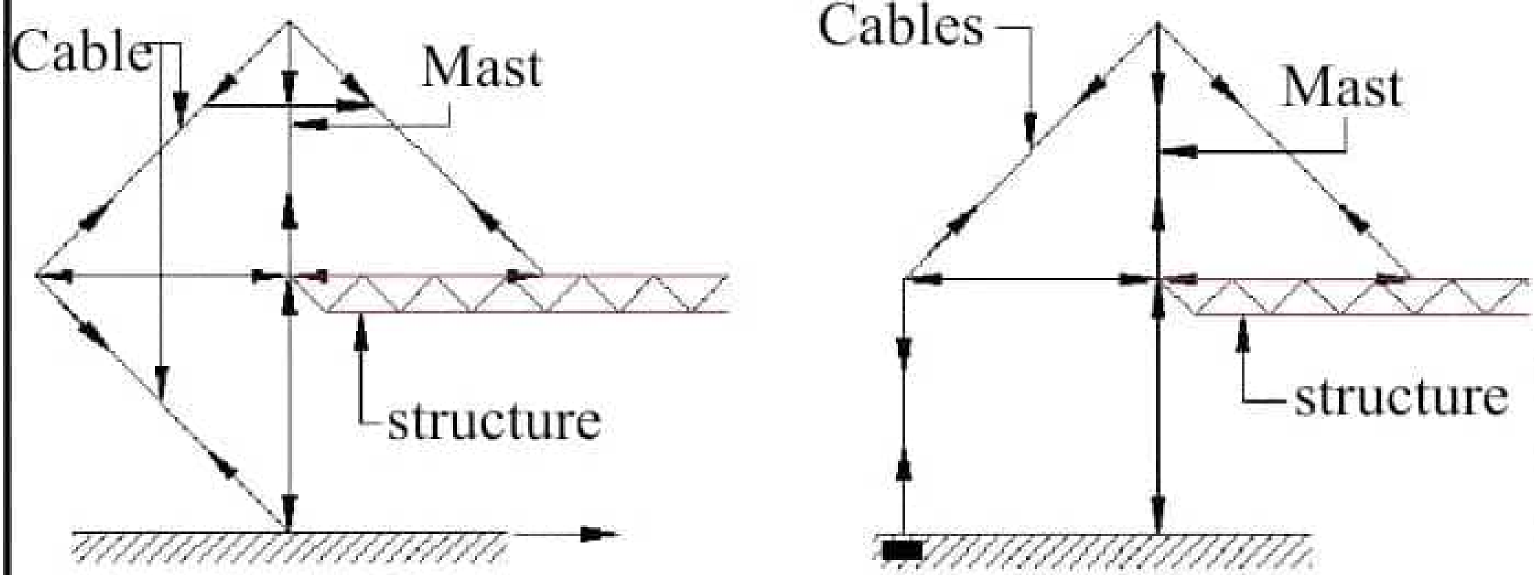
$$T_A = T_B = \sqrt{R^2 + H_x^2} \quad \ldots \text{kN.}$$



Given T_1, calculate F_a & T_2 to balance Force at joint B.

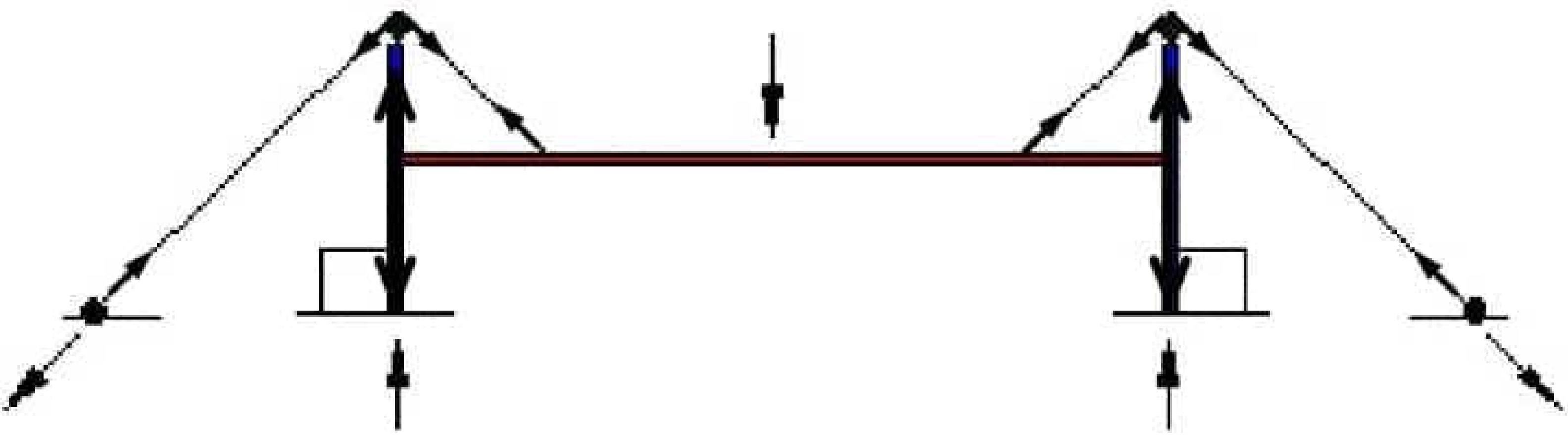
$$F_a = \frac{T_1 \cdot \sin(180^\circ - \theta_1 - \theta_2)}{\sin(\beta + \theta_2)}$$

$$T_2 = \frac{T_1 \cdot \sin(180^\circ + \theta_1 - \beta)}{\sin(\beta + \theta_2)}$$



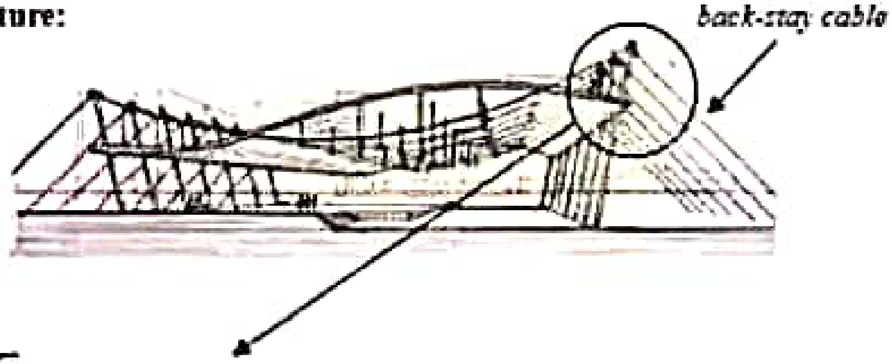
MASTS ARE SUPPORTING PIERS WHICH SUPPORTS THE CABLES AND TRANSFER REACTION OF CABLED TO GROUND

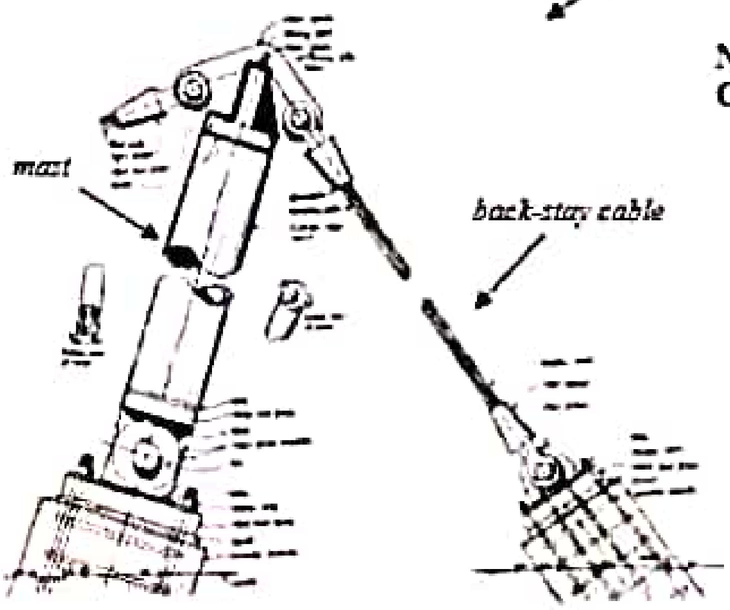
TYPES OF PERIMETER SUPPORT



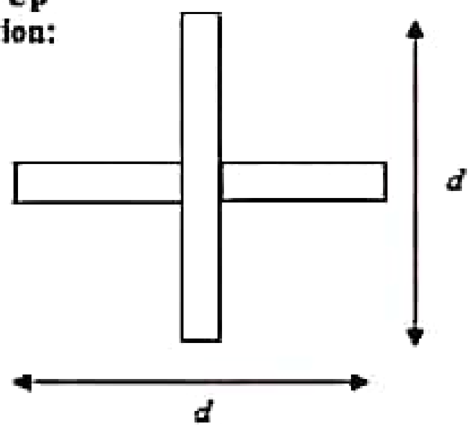
3. A steel back-stay cable in a suspended roof structure is 10-m long and supports a total factored tension force T_f of 1400 kN. (Note that the tensile strength of steel cables is typically more than 900 MPa). Without considering the connections, determine the minimum dimension d of a built-up cross section (see below) that would be required to replace the cable and be easy for erectors to handle. Which option would you recommend and why?

Suspended Roof Structure:

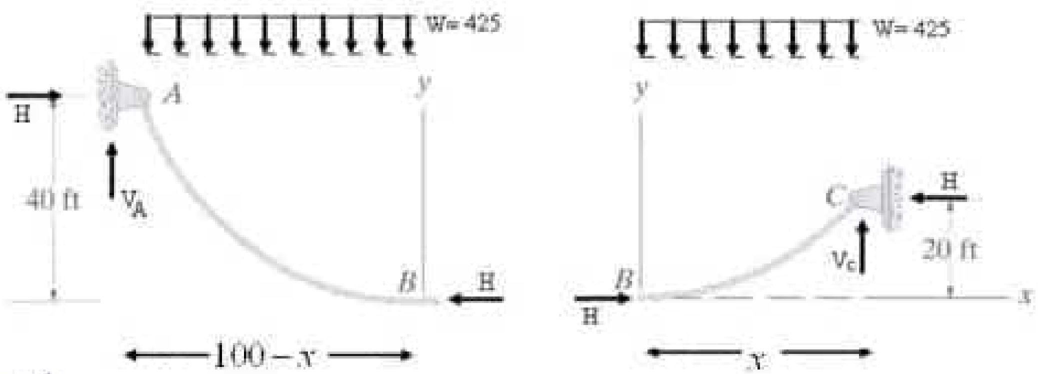




New Built-Up Cross Section:



All plates are 1-1/2" thick
350W steel



$from \mapsto 1$

$$20H = -425\frac{42.42^2}{2} = -36459.2lb = -36.46k$$

$also, from \ \sum f_{y\,(right\ part)} = 0 \Rightarrow V_C = Wx = 425(41.42) = 17.6k$

$from \ \sum f_{y\,(all)} = 0 \Rightarrow V_A = 100\,W - V_A$

$V_A = 425(100) - 17600 = 24900lb = 24.9k$

$T_A = \sqrt{36.46^2 + 24.9^2} = 61.7k$

$T_C = \sqrt{36.46^2 + 17.6^2} = 50.7k$

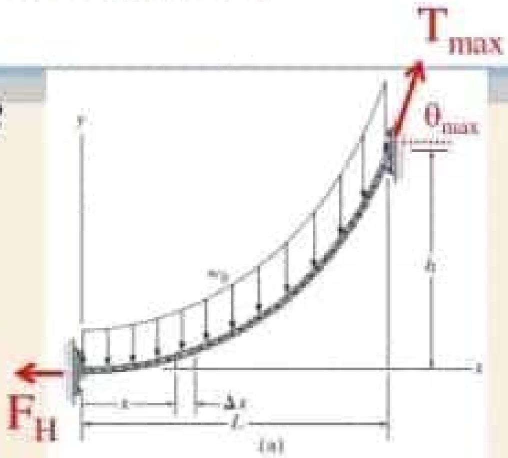
Cable subjected to a uniform distributed load

- Where and what is the max tension?

$$T\cos\theta = F_H \quad \text{eqn 4}$$

$$T\sin\theta = w_o x \quad \text{eqn 5}$$

$$T = \sqrt{F_H^{\,2} + (w_o x)^2}$$



- T is max when $x=L$

$$T_{max} = \sqrt{F_H^{\,2} + (w_o L)^2} \quad \text{eqn 10}$$

$$F_H = \frac{w_o L^2}{2h} \quad \text{eqn 8}$$

$$T_{max} = w_o L\sqrt{1 + (L/2h)^2} \quad \text{eqn 11}$$


LEARN
QUANTITY
SURVEYING COURSE
join us take online courses and
Achieve your Dream Job
ONLINE ACADEMY
Tsonlineacademy.in
UP TO 90% OFF
LIFETIME ACCESS
JOB ORIENTED COURSES
• ESTIMATION & COSTING
• BILL OF QUANTITY
• BAR BENDING SCHEDULES
• RATE ANALYSIS
• BILLING & BUDGET
• PROPERTY VALUATION
• TENDERING & CONTRACT
REGISTER NOW
+919559621157
Quantity
Surveying Course
₹999