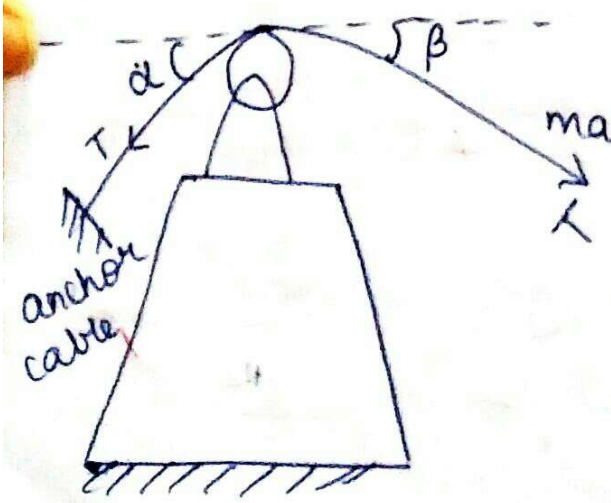
FORCES ON ANCHOR CABLES AND TOWE

Cable passed over guide pulley at the support

In this case the cable at the support is passed over a guide pulley provided at the top of the supporting pier and is anchored on the other side of pier. The anchor cable is just the continuation of the suspension cable itself.

The tension in both the cables will be same that is

$$T = \sqrt{V^2 + H^2}$$



If β is the angle of the suspension cable at the support with the horizontal

$$\tan\beta = \frac{V}{H}$$

Let α be the inclination of the anchor cable with the horizontal

$\therefore$ Total vertical load transmitted to the tower $= T \sin\alpha + T \sin\beta$.

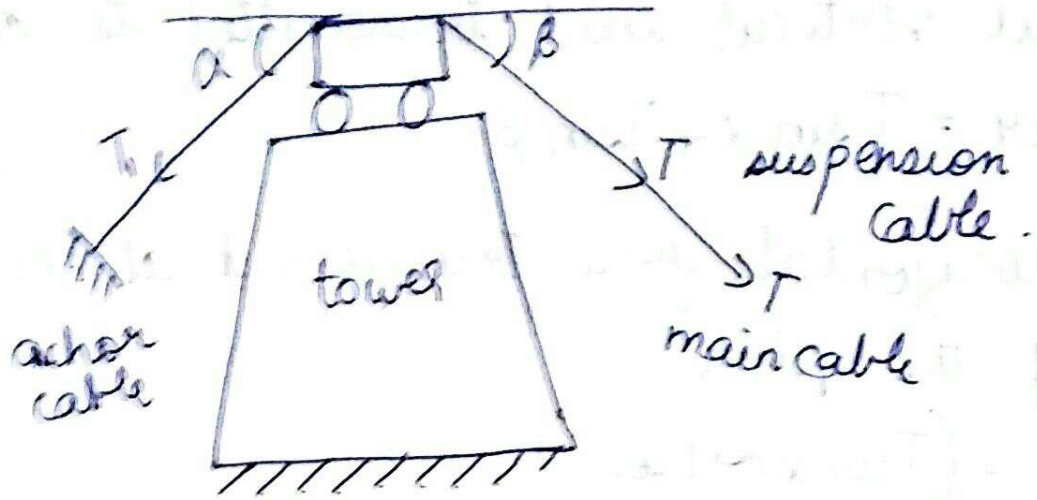
Net horizontal force transferred at the top of the pier

$= (T\cos\alpha \sim T\cos\beta)$ ...

Max. BM of the pier = Net horizontal force x height of pier

Cable clamped to saddle carried on smooth rollers on the top of a pier

In this case, the suspension cables and anchor cables are connected to a saddle resting on a tower. In this arrangement the two cables ~~have~~ do not have the same tension as the cables are different. Let T be the tension in the suspension cable and T_1 be the tension in the anchor cable.



Assuming saddle to have friction-less roller

$$T_1 \cos\alpha = T \cos\beta$$

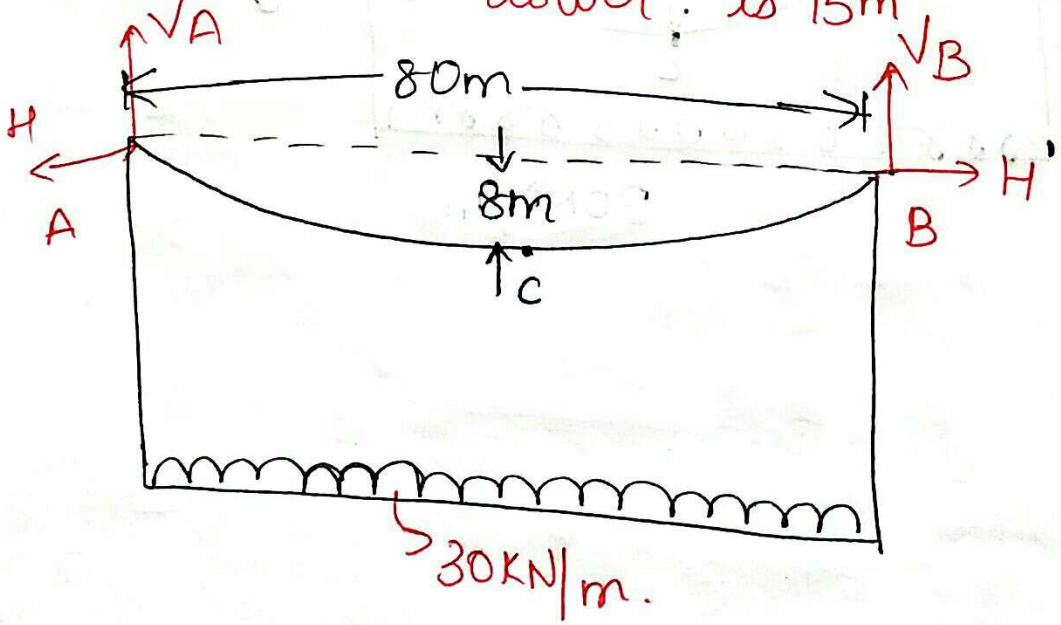
Since the saddle is friction less, there is no horizontal force and hence no bending moment on tower.

∴ Vertical force on the tower

$$= T_1 \sin\alpha + T \sin\beta$$

Problems on roller support and pulley support.

1) A bridge cable is suspended from towers 80m apart and carries a load of 30kN/m on the entire span. If the maximum sag is 8m. Calculate the maximum tension in cable. If the cable is supported by saddles which are stayed by wires inclined at 30° to the horizontal. Determine the forces acting on the towers. If the same inclination of back stay passes over pulley, determine the forces on the tower, max bending moment if the height of tower is 15m



STEP 1 :- Determine the vertical and horizontal reactions

$$\Sigma F_y = 0$$

$$V_A + V_B = 30 \times 80$$

$$V_A + V_B = 2400$$

Consider $\Sigma M_A = 0$

$$V_B \times 80 = 30 \times 80 \times \frac{80}{2}$$

$$V_B = 1200\,KN$$

$$V_A = 1200\,KN$$

Taking moment of forces about point C

$$\Sigma M_C = 0$$

Consider forces on the right side

$$(-V_B \times 40) + (H \times 8) + (30 \times 40 \times \frac{40}{2}) = 0$$

$$(-1200 \times 40) + (H \times 8) + (30 \times 40 \times 20) = 0$$

$$H \times 8 = 24{,}000$$

$$H = 3000\,KN$$

STEP 2:- Maximum tension in the cable

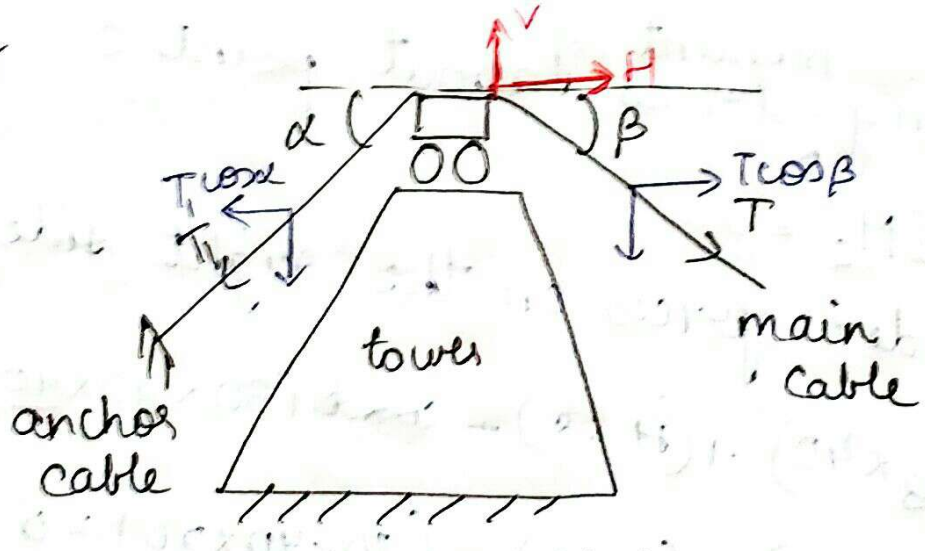
$$T_{max} = \sqrt{V^2 + H^2}$$

$$= \sqrt{1200^2 + 3000^2}$$

$$= 3231.1\ KN$$

STEP 3:-

(i) If the cable is supported by saddle the anchor cable tension, T_1 is given by



$$T_1 \cos\alpha = T_{max} \cos\beta$$

given $\alpha = 30^0$

$$\beta = T\cos\beta \quad \cos\beta = \frac{H}{T_{max}}$$

$$\cos\beta = \frac{3000}{3231.1}$$

$\therefore \beta = 21^\circ 47'$

NOW $T_1 \cos\alpha = T_{max} \cos\beta$

$T_1 \cos 30 = 3231.1 \cos 21^\circ 47'$

$T_1 = 3464.1\,KN$

There is no horizontal force on the tower.

$\therefore$ Vertical force on the tower

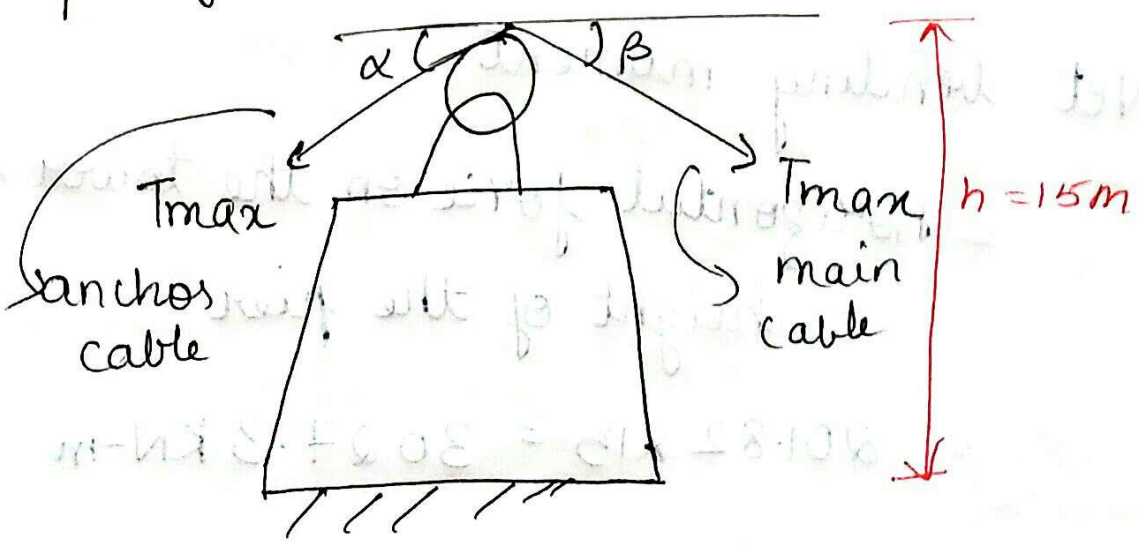
$= T_1 \sin\alpha + T_{max} \sin\beta$

$= 3464.1 \times \sin 30 + 3231 \sin 21^\circ 47'$

$= 2931.98\,KN$

STEP 4:-

i) If the cable is supported on a pulley.



$$\cos\beta = \frac{H}{T_{max}} = \frac{3000}{3231.1}$$

$$\therefore \beta = 21^\circ 47'$$

Vertical force on the tower is

$$= T_{max}(\sin\alpha + \sin\beta)$$

$$= T_{max}(\sin 30 + \sin 21^\circ 47')$$

$$= 3231.1(\sin 30 + \sin 21^\circ 47')$$

$$= 2815.48\ KN$$

Horizontal force on the tower is

$$= T_{max}(\cos\alpha - \cos\beta)$$

$$= 3231.1(\cos 30^\circ - \cos 21^\circ 47')$$

$$= 201.82\ KN$$

Net bending moment

= Horizontal force on the tower × height of the pier

$$= 201.82 \times 15 = 3027.3\ KN\text{-}m$$