

Problem 1:

Given:

$$AB = 40 \text{ ft}$$

$$\text{Weight} = 2 \text{ kips}$$

$$AG = 20 \text{ ft}$$

fig A

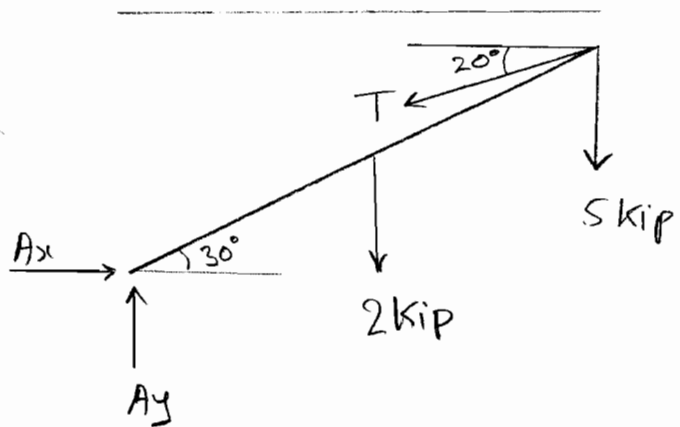


Fig A

Required:

Tension in cable BC & reaction at A.

Solution:-

$$\rightarrow \sum F_x = 0$$

$$A_x - T \cos 20 = 0$$

①

$$\uparrow \sum F_y = 0$$

$$A_y - 2 - 5 - T \sin 20 = 0$$

②

$$\uparrow \sum M_A = 0$$

$$-(2)(20 \cos 30) - (5)(40 \cos 30) + (T \cos 20)(40 \sin 20)$$

$$-(T \sin 20)(40 \cos 30) = 0$$

(2)

$$(18.794)T - (11.848)T = 207.846$$

$$6.946 T = 207.846$$

$$T = 29.923 \text{ kip}$$

$$\boxed{T \approx 30 \text{ kip.}}$$

Substituting at ①

$$A_x - T \cos 20 = 0$$

$$A_x = T \cos 20 = (29.923)(\cos 20) = 28.118 \text{ kip}$$

$$A_y = 2 + 5 + T \sin 20 = 7 + (29.923) \sin 20 = 17.234 \text{ kip}$$

$$\boxed{\begin{array}{l} A_x = 28.1 \text{ kip} \\ A_y = 17.2 \text{ kip} \end{array}}$$

(3)

Problem 2:

Given:

Fig P2.

 $T = 1950 \text{ N @ C}$

Required:

Reactions:

Solution:

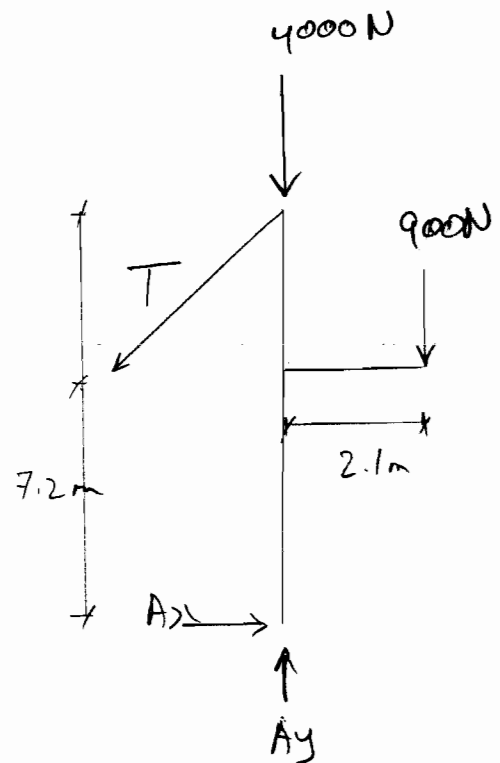


Fig P2 a.

$$a) \sum F_x = 0$$

$$A_x - T(3/7.8) = 0 \quad \text{--- ①}$$

$$\uparrow \sum F_y = 0$$

$$A_y - 4000 - 900 - T(7.2/7.8) = 0 \quad \text{--- ②}$$

$$\uparrow \sum M_A = 0$$

$$-(2.1)(900) + (7.2)(T)(3/7.8) = 0$$

$$T = 682.5$$

$$\boxed{T \approx 683 \text{ N.}}$$

(4)

$$\therefore A_x = (682.5) \left(\frac{3}{7.8} \right) = 262.5 \text{ N}$$

$$A_y = 4000 + 900 + (682.5) \left(\frac{7.2}{7.8} \right) = 5530 \text{ N}$$

$$A = \sqrt{262.5^2 + 5530^2} = 5536.2 \text{ N}$$

$$\theta = \tan^{-1} \left(\frac{5530}{262.5} \right) = 87.28^\circ$$

$A = 5536 \text{ N}$ $\theta = 87.28^\circ$

b)

$$\rightarrow \sum F_x = 0$$

$$\uparrow \sum F_y = 0$$

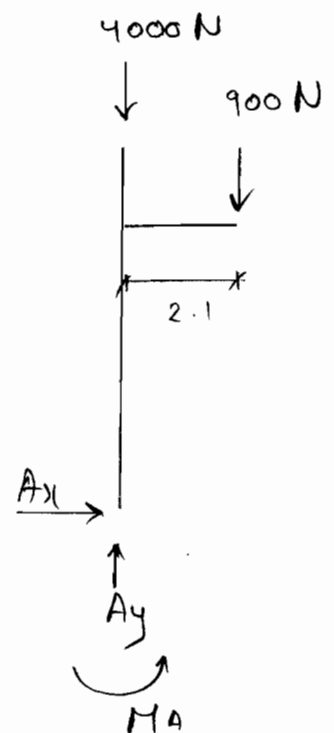
$$A_y - 4000 - 900 = 0$$

$$A_y = 4900 \text{ N}$$

$$\curvearrow \sum M_A = 0$$

$$M_A - (900)(2.1) = 0$$

$$M_A = 1890 \text{ N.m} \curvearrow$$



(5)

$$A = \sqrt{0^2 + 4900^2} = 4900 \text{ N}$$

$$A = 4900 \text{ N}$$

$$M_A = 1890 \text{ N}\cdot\text{m}$$

c)

$$\rightarrow \Sigma F_x = 0$$

$$A_x - 1950 \left(\frac{3}{7.8} \right) = 0$$

$$A_x = 750 \text{ N}$$

$$\uparrow \Sigma F_y = 0$$

$$A_y - 4000 - 900 - 1950 \left(\frac{7.2}{7.8} \right) = 0$$

$$A_y = 6700 \text{ N}$$

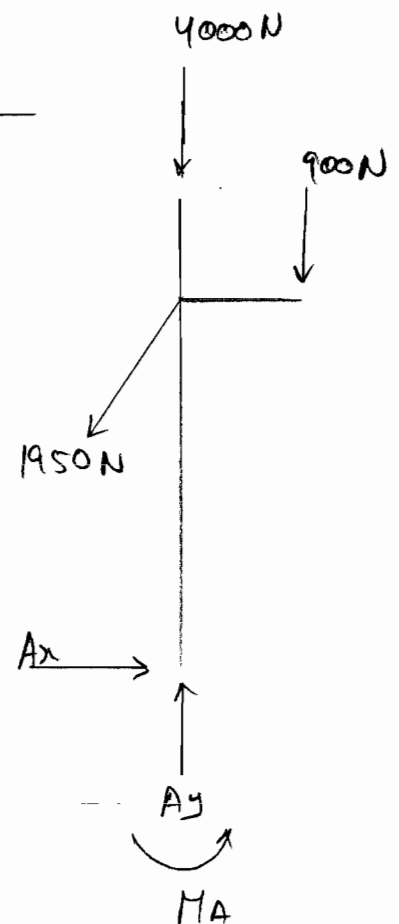
$$A = \sqrt{6700^2 + 750^2} = 6741.847 \text{ N}, \quad \boxed{A = 6741.8 \text{ N}}$$

$$\theta = \tan^{-1} \left(\frac{6700}{750} \right) = 83.61^\circ, \quad \boxed{\theta = 83.61^\circ}$$

$$\curvearrowright M_A = 0$$

$$M_A = (900)(2.1) - (1950) \left(\frac{3}{7.8} \right) (7.2) = 0$$

$$M_A = -3510 \text{ N}\cdot\text{m}, \quad \boxed{M_A = 3510 \text{ N}\cdot\text{m}}$$



Conclusion:

Best used to support traffic signals is
as shown in b

(7)

Problem 3:

Given:-

$$a - T = 30 \text{ kip}$$

Fig P3

Required:-

a) Reaction at E

b) Moment at E = 0, find T

Solution

$$a) \rightarrow \sum F_x = 0$$

$$E_x + 30 \left(\frac{15}{25} \right) = 0$$

$$E_x = -18 \text{ kip}$$

$$\uparrow \sum F_y = 0$$

$$E_y - 5 - 5 - 5 - 5 - 30 \left(\frac{20}{25} \right) = 0$$

$$E_y = 44 \text{ kip}$$

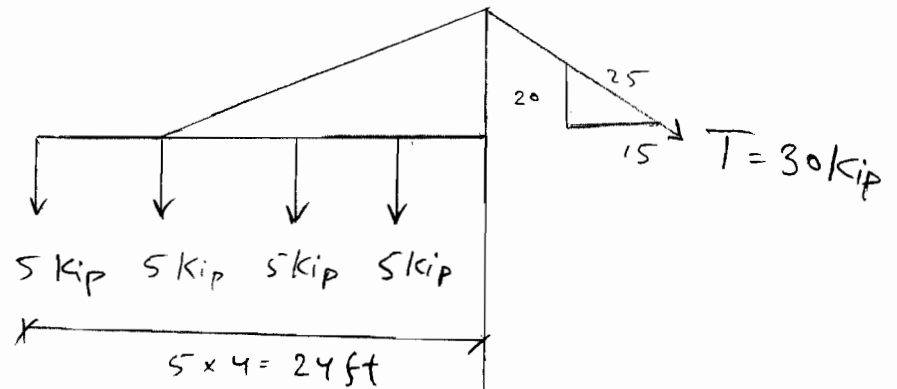


Fig P3

(8)

$$\sum M_E = 0$$

$$M_E - (30)(15/25)(20) + 5(24 + 18 + 12 + 6) = 0$$

$$M_E = 60 \text{ kip. ft.}$$

$$E = \sqrt{(-18)^2 + 44^2} = 47.539 \text{ kip}$$

$$\theta = \tan^{-1} \left(\frac{44}{-18} \right) = -67.75^\circ$$

$$E = 47.5 \text{ kips}$$

$$\theta = -67.75^\circ$$

b) $M_{E \text{ Right side}} = M_{E \text{ Left side}}$

$$M_{\text{Left side}} = 5(24 + 18 + 12 + 6)$$

$$= 300 \text{ kip. ft}$$

$$M_{\text{Right side}} = (T)(15/25)(20) = 12T$$

$$\therefore 300 = 12T$$

$$T = 25 \text{ kip}$$

(9)

Problem 4:

Given:-

Fig P4

Required:

Reactions at A & E.

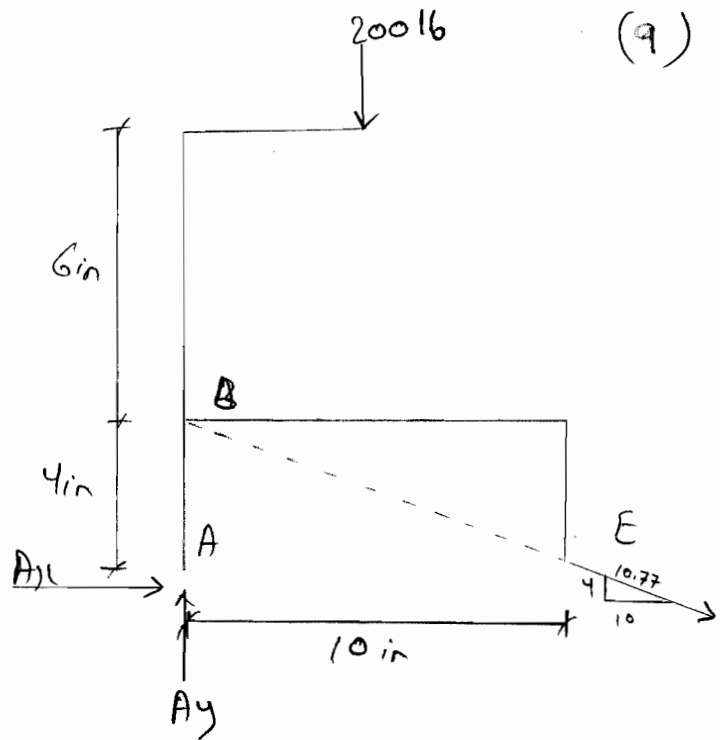


Fig P.4

Solution:-

$$\sum F_x = 0 \rightarrow^+$$

$$A_x + \sum (10 / 10.77) = 0 \quad \leftarrow \textcircled{1}$$

$$\sum F_y = 0 \uparrow^+$$

$$A_y - 200 - \sum (4 / 10.77) = 0 \quad \textcircled{2}$$

$$\sum M_A = 0 \uparrow^+$$

$$-(200)(5) - \sum (4 / 10.77)(10) = 0$$

$$E = -269.25 \text{ lb}$$

$$E = 269.25 \text{ lb} \quad \swarrow$$

$$\sum y = E (4 / 10.77) = +100 \text{ lb}$$

$$\sum x = E (10 / 10.77) = -250 \text{ lb}$$

$$\theta_E = \tan^{-1}(-100/250) = -21.8^\circ$$

(10)

$$\begin{aligned} E &= 269.25 \text{ lb} \leftarrow \\ \theta_E &= -21.8^\circ \end{aligned}$$

Substituting at ①

$$Ax + E(10/10.77) = 0$$

$$Ax - 269.25(10/10.77) = 0$$

$$Ax = 250 \text{ lb}$$

Substituting at ②

$$Ay - 200 - E(4/10.77) = 0$$

$$Ay - 200 + 100 = 0$$

$$Ay = 100 \text{ lb}$$

$$A = \sqrt{250^2 + 100^2} = 269.25 \text{ lb}$$

$$\theta = \tan^{-1}(100/250) = 21.8^\circ$$

$$\begin{aligned} A &= 269.25 \text{ lb} \\ \theta &= 21.8^\circ \end{aligned}$$

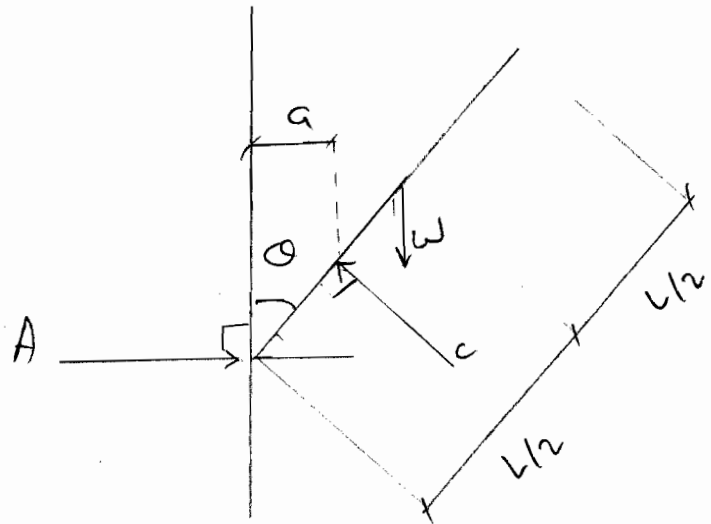
Problem 5:-

Given :-

Fig P5

Required :-

Angle θ

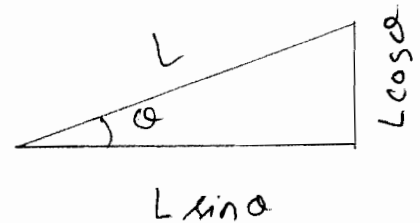


Solution

$$\uparrow \sum F_y = 0$$

$$c \sin \theta - W = 0$$

$$W = c \sin \theta$$



$$\downarrow \sum M_A = 0$$

$$- W \left(\frac{L}{2} \sin \theta \right) + c \left(\frac{a}{\sin \theta} \right) = 0$$

$$\frac{WL}{2} \sin \theta = c \frac{a}{\sin \theta}$$

$$\frac{cL}{2} \sin^2 \theta = c \frac{a}{\sin \theta}$$

$$\sin^3 \theta = \frac{2a}{L} \Rightarrow$$

$$\theta = \sin^{-1} \sqrt[3]{\frac{2a}{L}}$$