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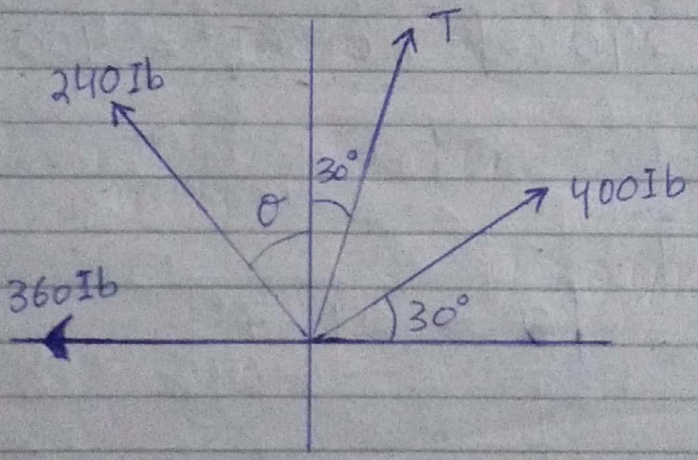
Section : B (civil eng)

Subject : Engineering Mechanics

Q2 Four forces are exerted ---------- determine the ~~the~~ value of T



Sol $\Sigma F_x = 0$

$$-360 - 240\sin\theta + T\sin 30^\circ + 400\cos 30^\circ = 0$$

$$-240\sin\theta + (0.5)T + 346.4 = 360$$

$$-240\sin\theta + 0.5T = 360 - 346.4$$

$$-240\sin\theta + 0.5T = 13.6 \rightarrow (i)$$

P.T.O

$$\Sigma F_y = 600$$

$$240\cos\theta + T\cos 30^\circ + 400\sin 30^\circ = 600$$

$$240\cos\theta + (0.866)T + 400(0.5) = 600$$

$$240\cos\theta + 0.866T + 200 = 600$$

$$240\cos\theta + 0.86T = 600 - 200$$

$$240\cos\theta + 0.86T = 400 \rightarrow (ii)$$

$$-240\sin\theta + 0.5T = 13.6 \rightarrow (i)$$

$$240\cos\theta + 0.86T = 400 \rightarrow (ii)$$

From the solution of eq (i) and (ii) we get as.

$$\boxed{\theta = 21.7^\circ}$$

Put $\theta = 21.7^\circ$ in eq (i) we get

$$-240\sin(21.7^\circ) + 0.5T = 13.6$$

$$-88.7 + 0.5T = 13.6$$

$$0.5T = 13.6 + 88.7$$

$$0.5T = 102.3$$

$$T = \frac{102.3}{0.5}$$

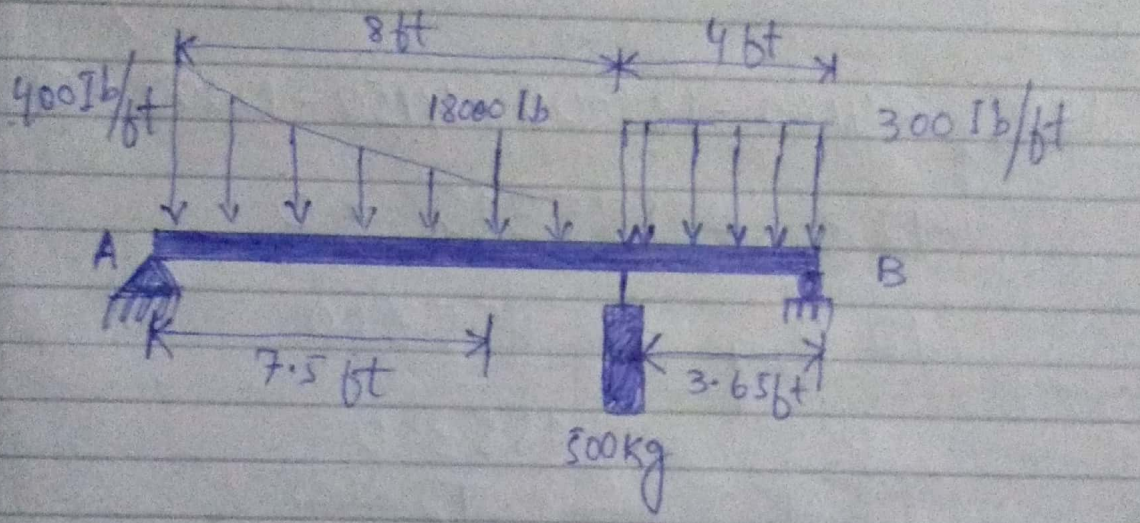
P.T.O

$$T = 204.6 \text{ lb}$$

So

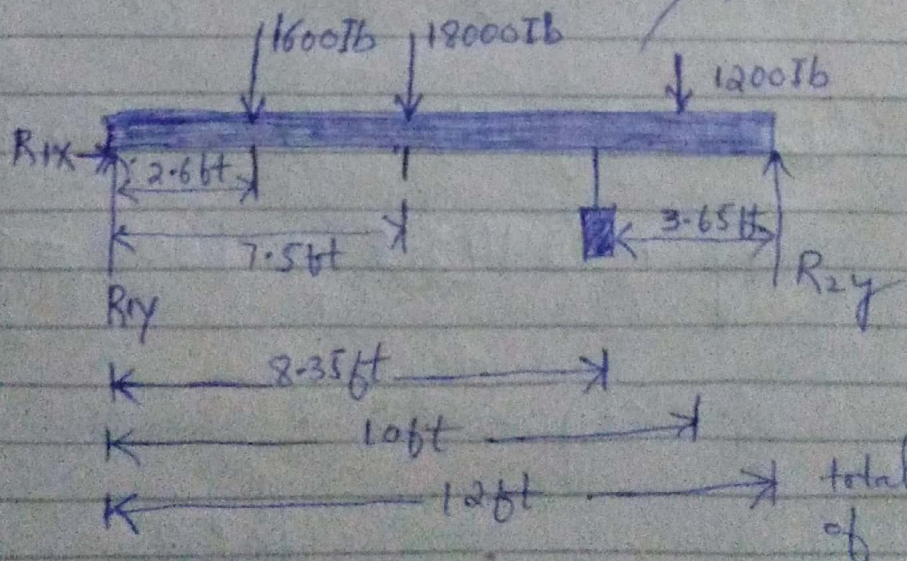
$$\boxed{\theta = 21.7^\circ} \quad , \quad \boxed{T = 204.6 \text{ lb}}$$

Q3 Calculate the reaction Supports



Resultant of UDL = 300 Ib/ft x 4ft = 1200 Ib

Resultant of UVL = $\frac{400 \text{ Ib/ft} \times 8 \text{ ft}}{2} = 1600 \text{ Ib}$



P.T.O

$$\Sigma Fx = 0 \longrightarrow (i)$$

$$R_{1y} + R_{2y} - 1600 - 18000 - 500 - 1200 = 0 \longrightarrow (ii)$$

$$\Sigma M = 0$$

$$(R_{2y} \times 12ft) - (1600 \times 2.6) - (18000 \times 7.5) - (500 \times 8.3) - (1200 \times 10) = 0$$

$$12R_{2y} - 4160 - 135000 - 4150 - 12000 = 0$$

$$12R_{2y} - 155310 = 0$$

$$12R_{2y} = 155310$$

$$R_{2y} = \frac{155310}{12}$$

$$\boxed{R_{2y} = 12942.5 \text{ lb}}$$

Put the value of R_{2y} in eq (ii) we get.

$$R_{1y} + (12942.5) - 1600 - 18000 - 500 - 1200 = 0$$

$$R_{1y} + 12942.5 - 21300 = 0$$

$$R_{1y} - 8357.5 = 0$$

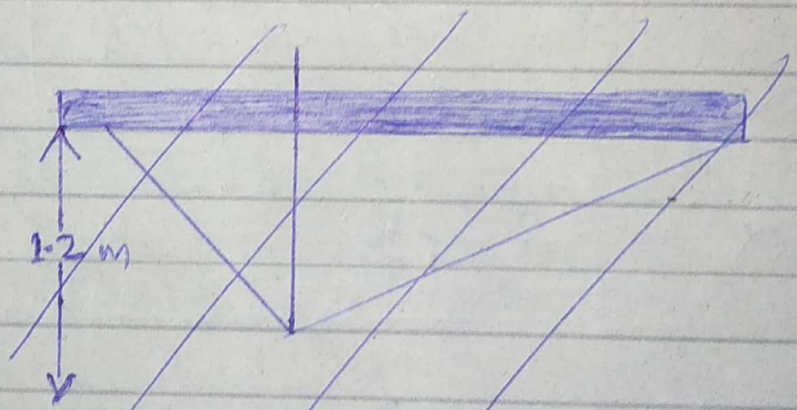
P.T.O

$$R_{1y} = 8357.5 \text{ lb}$$

$R_1x = 0$, $R_{1y} = 8357.5$ lb

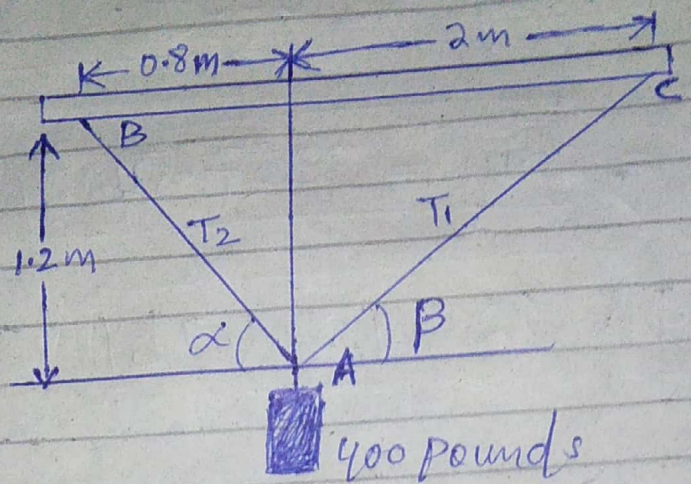
$$R_{2y} = 12942.5 \text{ lb}$$

Q 1 (a)



P.T.O.

Q 1 (a)



$$\tan\alpha = \frac{1.2}{0.8}$$

$$\alpha = \tan^{-1} 1.5$$

$$\boxed{\alpha = 56.3^\circ}$$

$$\tan\beta = \frac{P}{B} = \frac{1.2}{2}$$

$$\beta = \tan^{-1} 0.6$$

$$\boxed{\beta = 31^\circ}$$

$$W = 0i - 400j$$

$$T_2 = -T_2 \sin 31^\circ i + T_2 \cos 31^\circ j$$

$$T_1 = T_1 \sin 56^\circ i + T_1 \cos 56 j$$

$$400 = T_2 \cos 31^\circ + T_1 \cos 56^\circ \rightarrow (1)$$

P.T.O

$$0 = -T_2 \sin 31^\circ + T_1 \sin 56^\circ$$

$$T_2 \sin 31^\circ = T_1 \sin 56^\circ$$

$$T_2 (0.51) = T_1 (0.829)$$

$$T_1 = T_2 \left(\frac{0.51}{0.829} \right)$$

$$\boxed{T_1 = 0.62\, T_2} \rightarrow (ii)$$

The value of T_1 put in eq (i) we get

$$400 = T_2 (0.85) + T_1 (0.55)$$

$$400 = T_2 (0.85) + (0.62\, T_2)(0.55)$$

$$400 = T_2 (0.85) + T_2 (0.341)$$

$$400 = T_2 (0.85 + 0.341)$$

$$400 = T_2 (1.19)$$

$$T_2 = \frac{400}{1.19}$$

$$\boxed{T_2 = 336 \text{ pounds}}$$

put the value of T_2 in eq (ii) we get

$$T_1 = (0.62)\, T_2$$

$$T_1 = (0.62)(336)$$

P.T.O

$T_1 = 208.316$

Now find % AB = ?

$$\% AB = \frac{\text{Tension in AB}}{\text{total weight}} \times 100$$

$$= \frac{336}{400} \times 100$$

$$= 0.84 \times 100$$

$$T_{AB} = 84\ \%$$

(b)

$$wt = W_{tank} + W_{water}$$

$$= 400 + \frac{mg}{V}$$

$$= 400 + \rho g$$

Fixed weight of water is

$$m_w = \rho_w V_w$$

$$M_w = 1000 \times 3$$

$$= 3000\ kg$$

P.T.O

$$\text{Weight}_w = M_w g$$

$$= 3000 \times 32.2 \qquad g = 32.2$$

$$W_w = 96600 \text{ lb}$$

$$W_{total} = 400 + 96600$$

$$= 97000 \text{ lb}$$

$$W_{tank} = 1.15 \times 400$$

$$\boxed{\text{water}_{tank} = 460 \text{ lb}}$$

$$W_{water} = 1.35 \times 96600$$

$$\boxed{= 130410 \text{ lb}}$$

END