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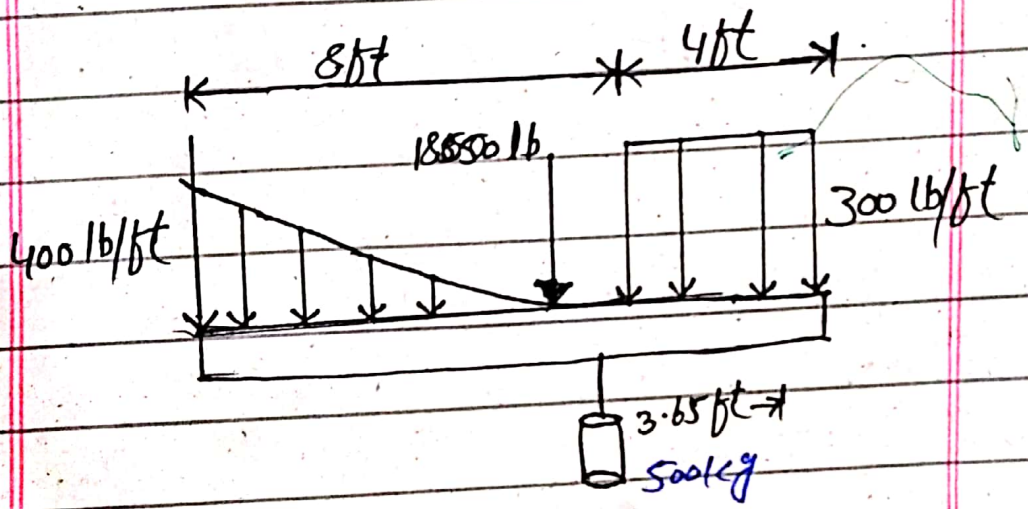
Section - B

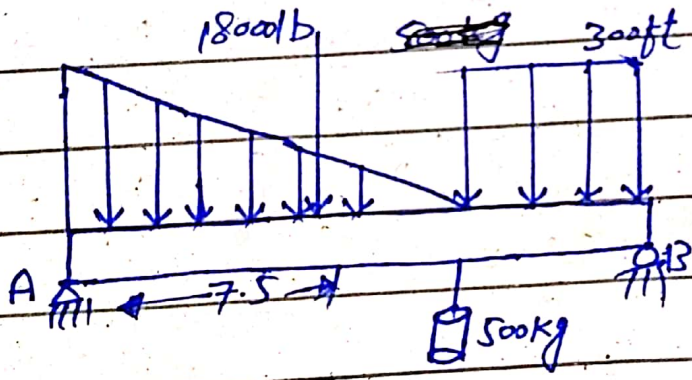
Department - BEE (Civil)

paper: Engineering mechanics

Q No 3 calculate the Reaction supports.



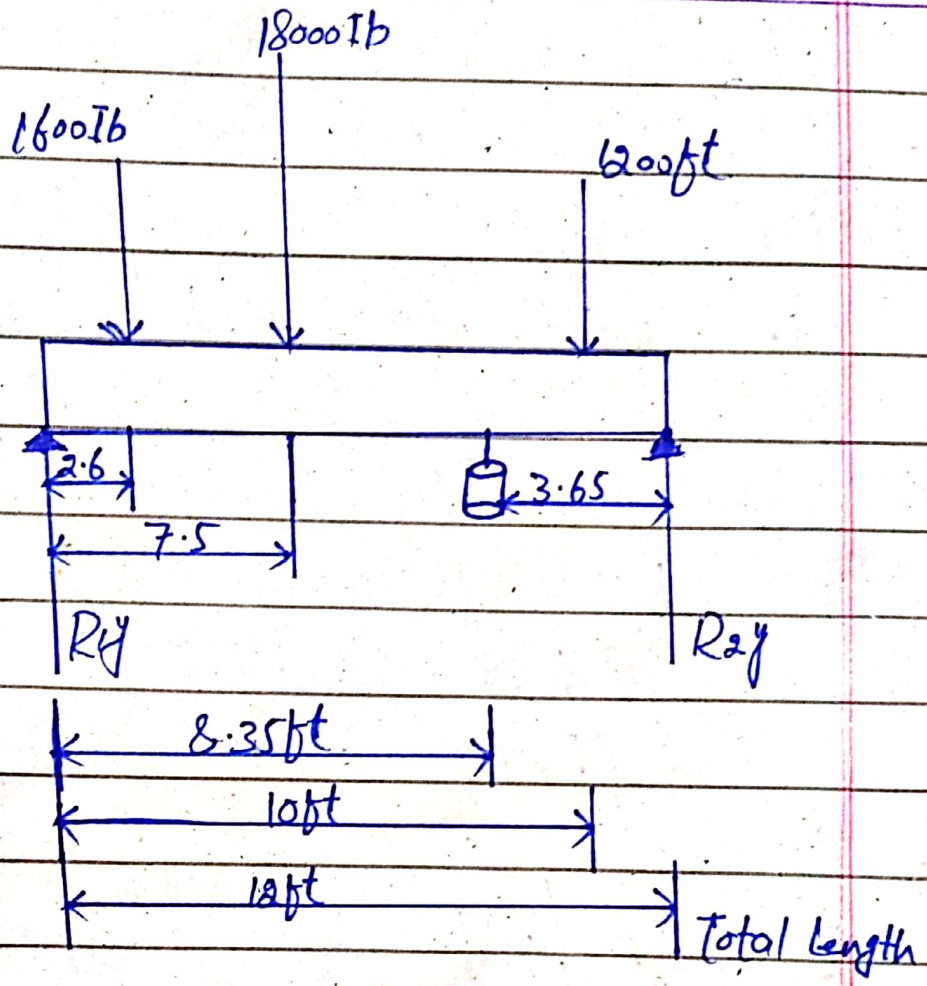
Sol



Resultant of UDL = 300 lb/ft × 4ft = 1200 lb

Resultant of UVL = $\frac{400 \text{ lb/ft} \times 4 \text{ ft}}{2}$

= 1600 lb



$\sum Fx = 0$ —(i)

$\sum Fy = 0$

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

$\sum M = 0$

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

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

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

$12 R_{2y} = 155310 =$

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

P.T.O

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

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

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

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

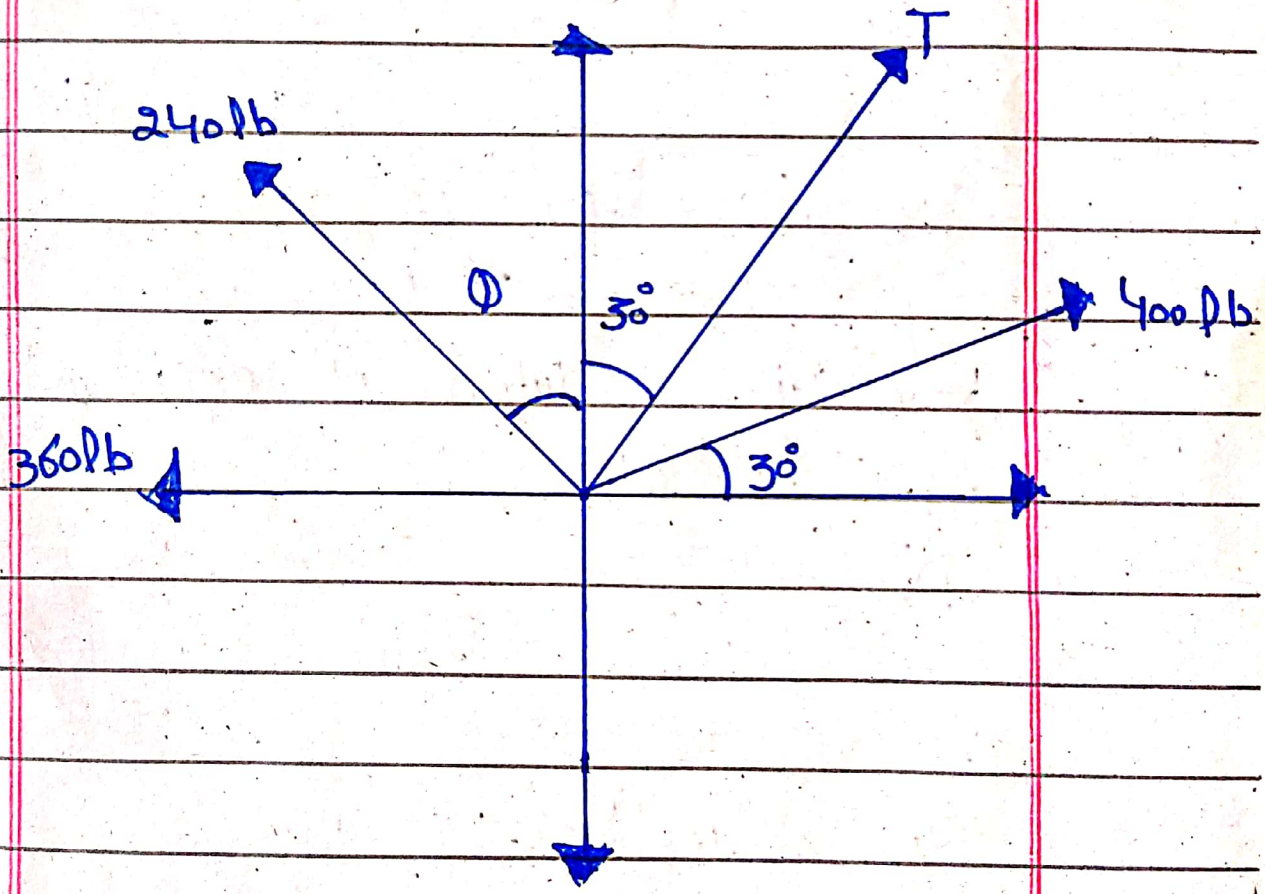
$$R_{1y} - 8357.5 = 0$$

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

$R_{1x} = 0$ $R_{1y} = 8357.5$ $R_{2y} = 12942.5$ lb

Ans.

Q.No2 Four forces are exerted on the eyebolt as shown below. if the net effect on the bolt is directed Pull of 600 Pounds in the y-direction, determine the value of.



Sol

$$\Sigma F_x = 0$$

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

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

P.T.O

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

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

$\Sigma F_y = 600$

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

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

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

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

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

$-240\sin\theta + 0.5T = 13.6$ —— (i)

$240\cos\theta + 0.866T = 400$ —— (ii)

form the Solution of eq(i) and eq(ii) we get.

$\boxed{\theta = 21.7}$

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

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

$-88.7 + 0.5T = 13.6$

$0.5T = 13.6 + 88.7$

$0.5T = 102.3$

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

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

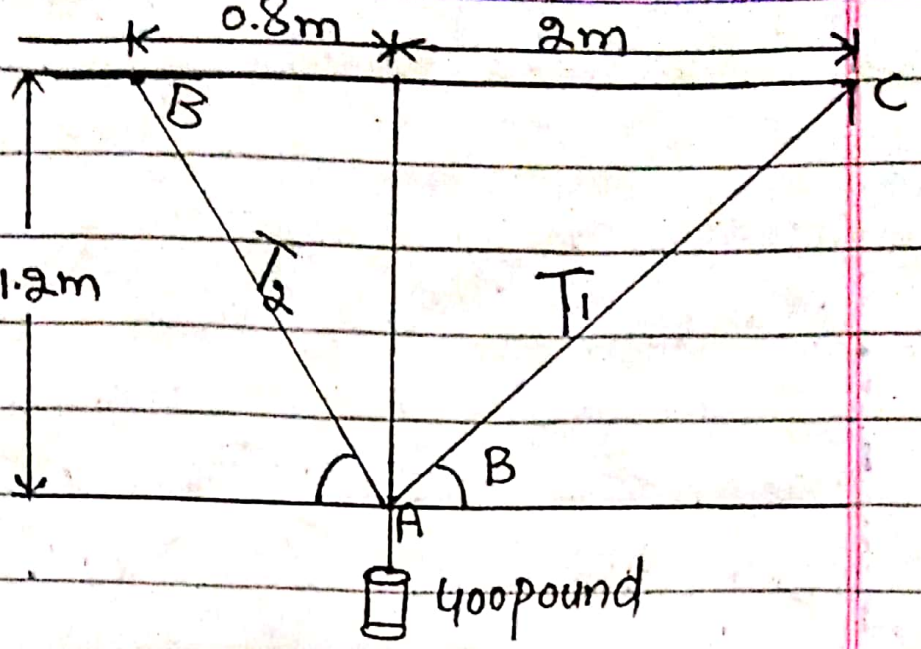
$\boxed{T = 204.6 \text{ lb}}$

Ans

Q No 1: Part - (a)

Two high strength flexible steel cables AB and AC are fastened to the ceiling of a building through high carbon steel hooks at point A which is holding a thick wall water tank weighting 400 Pounds and is full of 3000 liters of water volume. What percentage of the whole weight is being held by Alone? What amount of tension must be there in bolt the cables to maintain the Static equilibrium of the System?

(2)



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

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

$\Rightarrow \alpha = 56.3$

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

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

$\Rightarrow B = 31$

$W = 0i - 400j$

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

$T_1 = T_1 \sin 56° i + T_1 \cos 56 j$

$400 = T_2 \cos 31^\circ + T_1 \cos 56^\circ$ ——(x)

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

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

$T_2 (0.51) = T_1 (0.829)$

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

$$\boxed{T_1 = 0.62 T_2} \text{ ——(**)}$$

the value of T_1 put in eq(x) we get.

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

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

$400 = T_2 (0.55) + T_2 (0.341)$

$400 = T_2 (0.85 + 0.341)$

$400 = T_2 (1.19)$

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

$$T_2 = 336 \text{ lb}$$

the value of T_2 put in eq(**) we get.

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

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

$$T_1 = 208.31 \text{ lb}$$

% AB = ?

$$\% \text{ AB} = \frac{\text{Tension in AB}}{\text{Total Weight}} \times 100$$

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

$$= 0.84 \times 100$$

$$\text{TAB} = 84\%$$

Q No 1 Part "b"

Sol $W_t = W_{tank} + W_{water}$

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

$= 400 + Sg$

fixed Weight of Water

$m_W = \rho_W V_W$

$m_W = 1000 \times 3$

$= 3000\ kg$

Weight $W = M_W g$ $\quad g = 32.2$

$= 3000 \times 32.2$

$W_W = 96600\ lb$

$W_{total} = 400 + 96600$

$= \boxed{97000\ lb}$

$W_{tank} = 1.15 \times 400$

$\boxed{W_{tank} = 460\ lb}$

$W_{water} = 1.35 \times 96600$

$= \boxed{130410\ lb}$ Ans