

Name:- Dawood Shah Alam

I.D:- 16212

Section:- B

Department of Civil Engineering

2nd Semester

Subject Engineering Mechanics

Submitted To:- Sir M. Majid

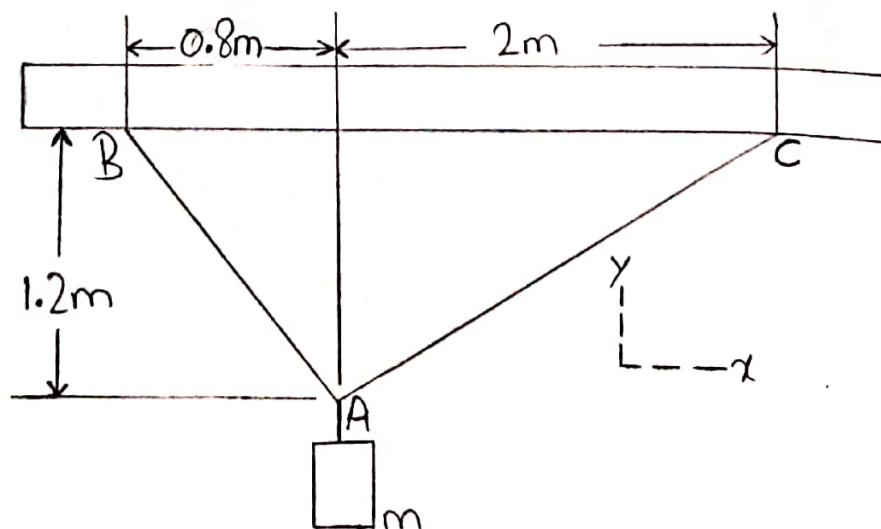
Naeem

QUESTION #1

Part (a)

Two high strength flexible steel cables AB and AC are fastened to a ceiling of a building through high carbon steel hooks at point B and C. These cables are knotted together to a third cable at point A which is holding a thick wall water tank weighing 400 pounds and is full of 3000 litres of water volume. What percentage of the whole weight is being held by cable AB alone? What amount of tensions must be there in both the cables to maintain the static equilibrium of the system?

Ans)



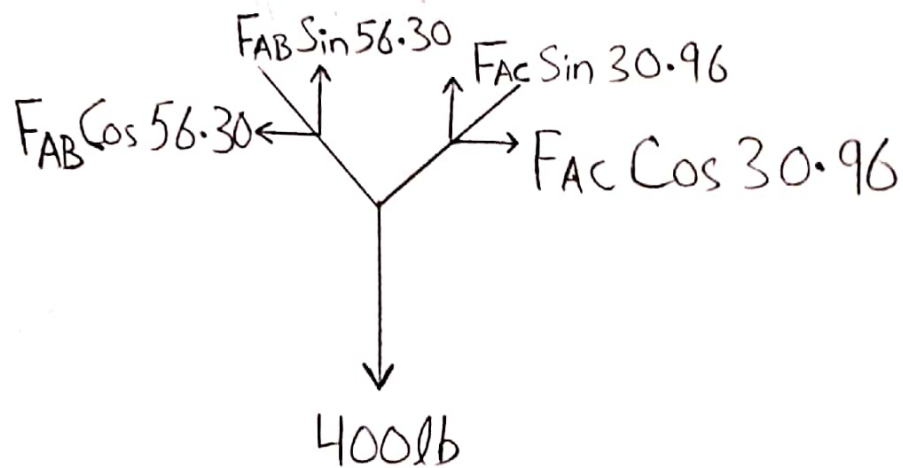
$$\tan \theta = P/B, \quad \tan \theta = P/B$$

$$\tan \theta = \frac{1.2}{0.8}, \quad \tan \theta = \frac{1.2}{2}$$

$$\tan \theta = 1.5, \quad \tan \theta = 0.6$$

$$\theta = \tan^{-1}(1.5), \quad \theta = \tan^{-1}(0.6)$$

$$\theta = 56.30, \quad \theta = 30.96$$



$$\sum F_x = 0 \quad \rightarrow, \leftarrow$$

$$-F_{AB} \cos 56.30 + F_{AC} \cos 30.96 = 0$$

$$\sum F_y = 0 \quad \uparrow, \downarrow$$

$$F_{AB} \sin 56.30 + F_{AC} \sin 30.96 - 400 = 0$$

$$F_{AB} \sin(56.30) + F_{AC} \sin(30.96) = 400$$

$$F_{AB} = 343.40 \text{ lb}, \quad F_{AC} = 222.13 \text{ lb}$$

$$\begin{aligned}\text{Total } T &= 343.40 + 222.13 \\ &= 565.53\end{aligned}$$

%age of whole weight

$$\begin{aligned}\text{held by AB alone} &= \frac{343.40}{565.53} \times 100 \\ &= 60.72 \%\end{aligned}$$

Part (b)

If the water tank weight and volume of water are increased 15% and 35% respectively what effects will occur on results of part(a).

Ans) Weight of water tank increased by 15% =

$$= 400 \times \frac{15}{100}$$

$$= 60$$

$$400 + 60 = 460 \text{ lb}$$

$$\text{Volume of water increased by } 35\% = 3000 \times \frac{35}{100}$$
$$= 1050$$

$$3000 + 1050 = 4050$$

litres

$$\sum F_x = 0$$

$$-F_{AB} \cos 56.30 + F_{AC} \cos 30.96 = 0$$

$$\sum F_y = 0$$

$$F_{AB} \sin 56.30 + F_{AC} \sin 30.96 = 460$$

$$F_{AB} = 394.91 \text{ lb}$$

$$F_{AC} = 255.452 \text{ lb}$$

$$\text{Total} = 650.362 \text{ lb}$$

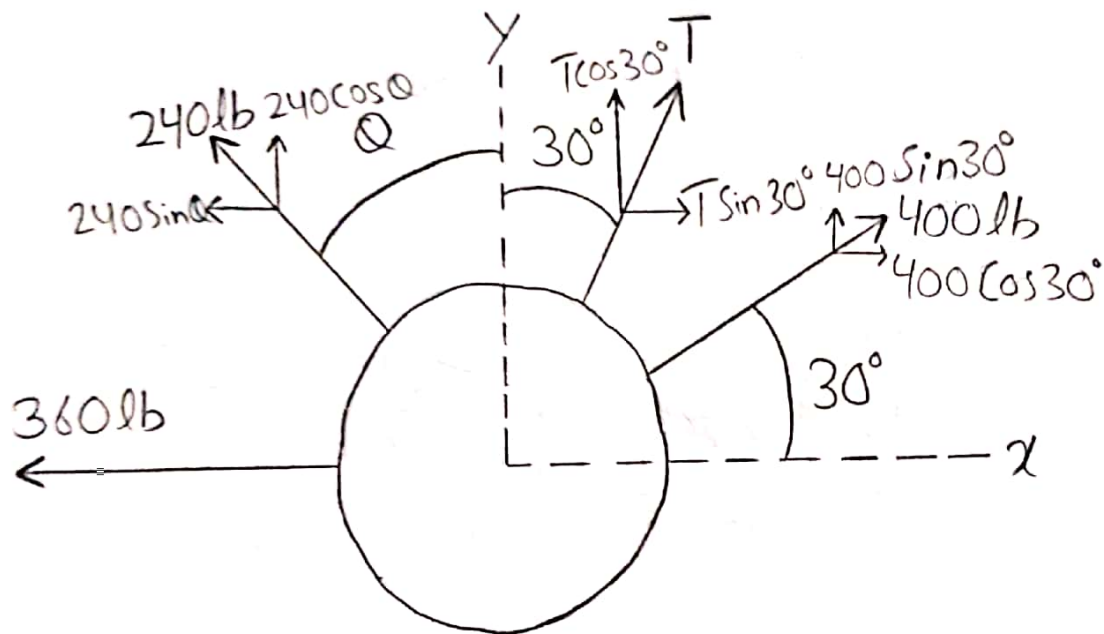
%age of whole weight

$$\text{held by AB alone} = \frac{394.91}{650.362} \times 100$$
$$= 60.72\%$$

QUESTION #2

Four forces are exerted on the eyebolt as shown below. If the net effect on the bolt is a direct pull of 600 pounds in the y-direction, determine the value of T and Q .

Ans)



$$\sum F_x = 0$$

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

$$\sum F_y = 600$$

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

$$-240 \sin Q + T \sin 30^\circ = 13.599 \rightarrow \textcircled{1}$$

$$240 \cos Q + T \cos 30^\circ = 400 \rightarrow \textcircled{2}$$

Put eq ① in eq ②, we get:

$$-240 \sin Q = 13.599 - T \sin 30$$

$$\sin Q = \frac{T \sin 30 - 13.599}{240}$$

$$Q = \sin^{-1} \left(\frac{T \sin 30 - 13.599}{240} \right)$$

$$-360 - 240 \sin Q + T \sin 30 + 400 \cos 30^\circ = 0 \rightarrow \textcircled{3}$$

$$240 \cos Q + T \cos 30^\circ + 400 \sin 30^\circ = 600 \rightarrow \textcircled{4}$$

Solution of eq ③ and ④ is:

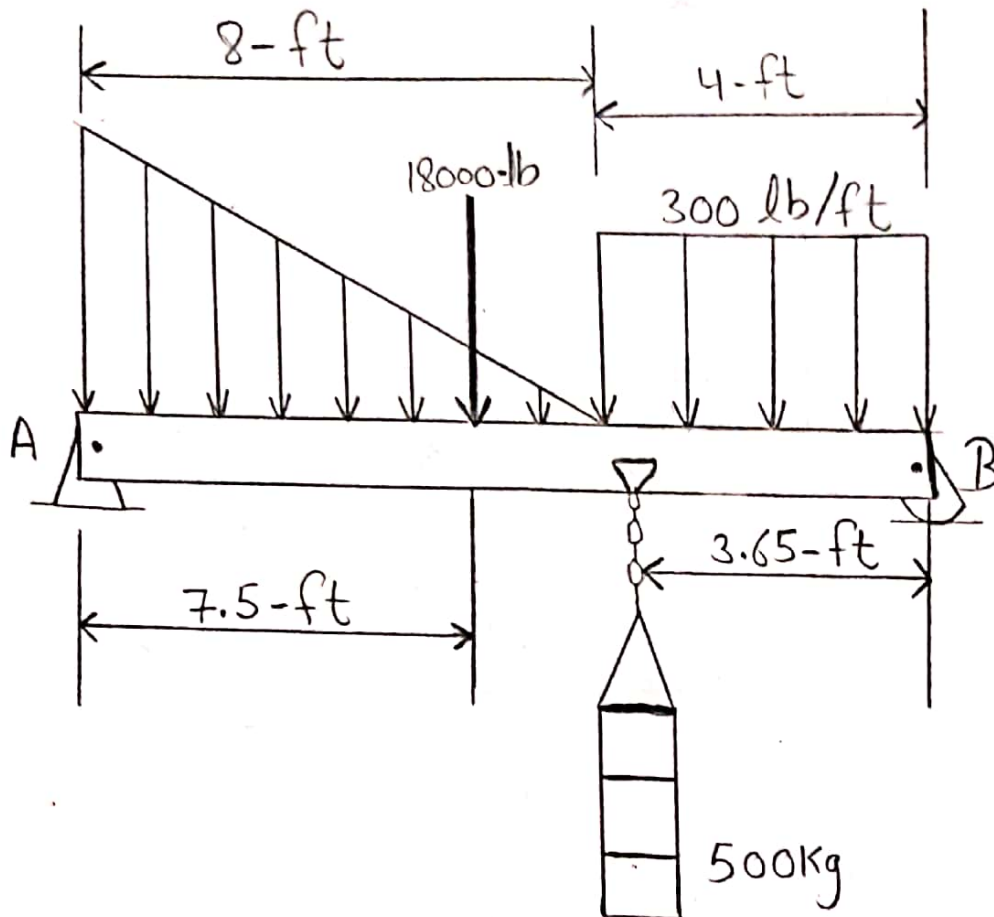
$$Q = 21.7$$

$$T = 204 \text{ lb}$$

QUESTION #3

Calculate the reactions at supports.

Ans)



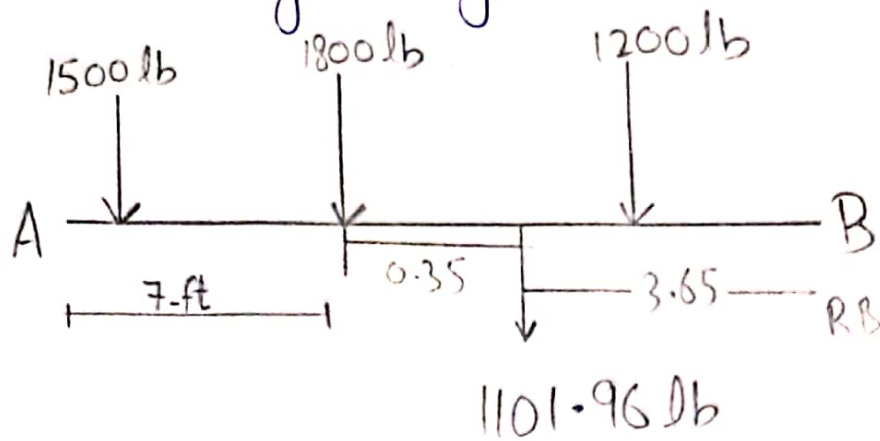
Statical determinacy

$$r - 3n = 0$$

$$3 - 3(1) = 0$$

$$0 = 0$$

Free body diagram



Sum of clockwise and anti-clockwise torque and forces are equal to zero.

$$\sum M_B = 0$$

$$1600 \times 2.67 + 1800 \times 7.5 + 1101.96 \times 8.35 + 1200 \times 10 - R_B \times 12 = 0$$

$$\Rightarrow 12 R_B = 160473.37$$

$$\Rightarrow \frac{12 R_B}{12} = \frac{160473.37}{12}$$

$$R_B = 13372.78 \text{ lb}$$

$$\sum MA = 0$$

$$RA \times 12 - 1600 \times 9.33 - 18000 \times 4.5 - 1101.96 \times 3.65 - 1200 \times 2 = 0$$

$$\Rightarrow 12RA = 102350.154$$

$$\Rightarrow \frac{12RA}{12} = \frac{102350.154}{12}$$

$$RA = 8529.1795$$

OR

$$RA = 8529.18$$