Engineering Mechanics

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Section: A

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Signature

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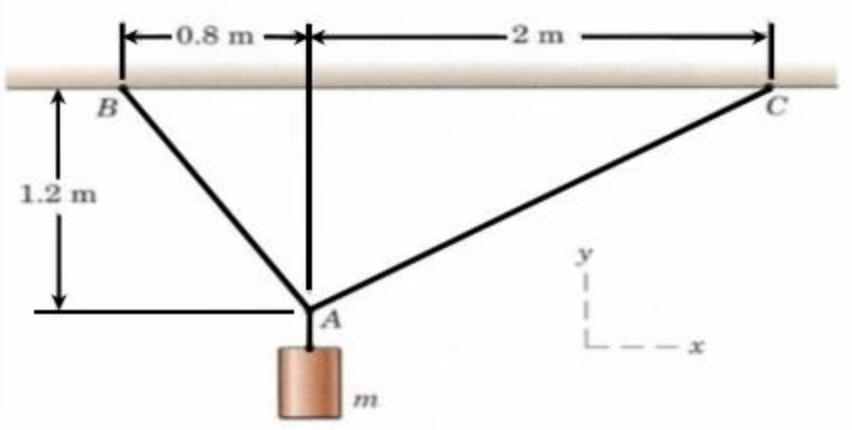
Q1: Part-(a)

Two high strength flexible steel cables AB and AC are fastened to the ceiling of a building through high carbon steel hooks at point B & C. These cables are knotted together to a 3rd cable 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 cable AB alone? What amount of tensions must be there in both the cables to maintain the static equilibrium of the system? (7)

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. (3)



Solution:

$$\boldsymbol{\alpha = \tan^{-1}\left(\frac{1.2}{0.8}\right) \quad = 56.3^0}$$

$$\boldsymbol{\beta = \tan^{-1}\left(\frac{1.2}{2}\right) \quad = 31.8^0}$$

Total mass = 400 + 6613.9

= 7013.9 lb

OR

= 3181.45 kg

The total weight is being held by cable AB is 85.8 %.

Part A

Tension in AB

$T_{AB} = T_{AB} \Lambda AB = 0.858(8181.45)(9.81) \{\cos 56.3i + \sin 56.3j\}$

$= 14857i + 22278j$ N

Now tension in AC

$T_{AC} = T_{AC} \Lambda AC = 0.555(3181.45)(9.81) \{\cos 31i + \sin 31j\}$

$=14857i + 8921j$ N

Part B

Increase weight by 15%

400 + 60 = 460 lb

Increase volume by 35%

3000 + 1050 =4050 lb OR 8928.722 kg

Total weight = 8928.7 + 450 by increasing 15%

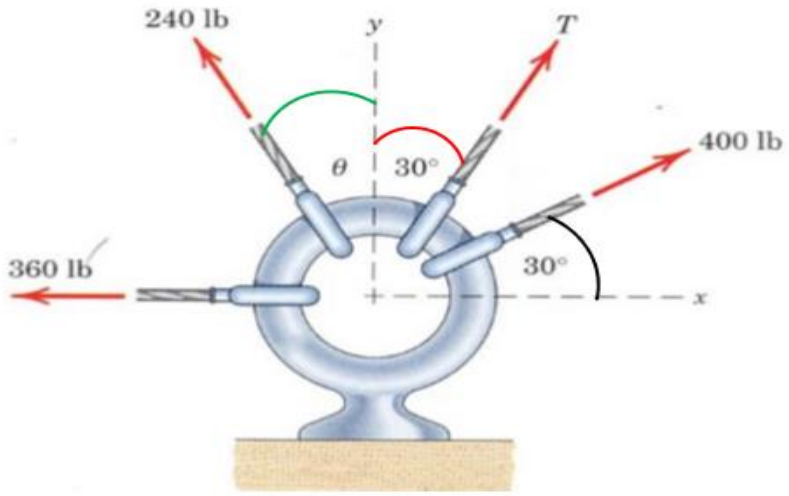
= 9378.7 lb

Tension in AB

$T_{AB} = T_{AB} \Lambda AC = 0.555(4258.7)(9.8) \{\cos 31i + \sin 31j\}$

$=1.9874i + 11942j$ N.

Q2: 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 values of T and Θ (Marks=10)



Required:

θ=?

T=?

Solution:

$\Sigma Fx = 0$

$T\sin30^0 + 400\cos30^0 - 240\sin\theta - 360 = 0$ => eq 1

$\Sigma Fy = 600$

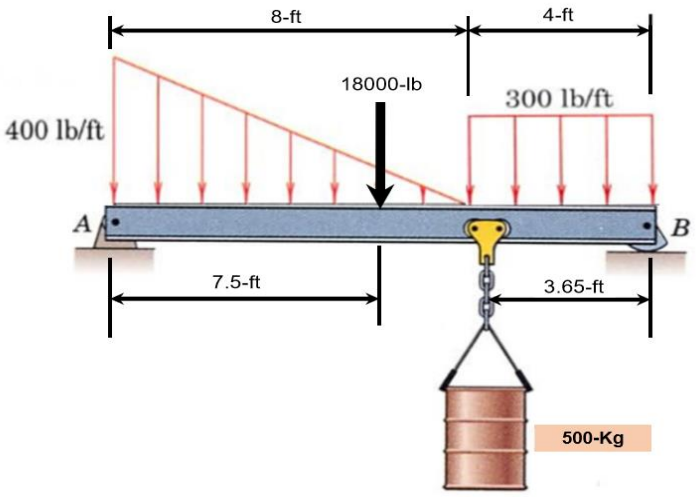
$T\cos30^0 + 240\cos\theta + 400\sin30^0 = 600$ => eq 2

Numerical solution of equation 1 & 2

θ= 21.7

T= 204 lb

Q3: Calculate the reactions at supports (Marks=10)



Required:

Ay= ?

By= ?

Solution:

⇨ UDL = convert to point load

300 * 4 = 1200 lb

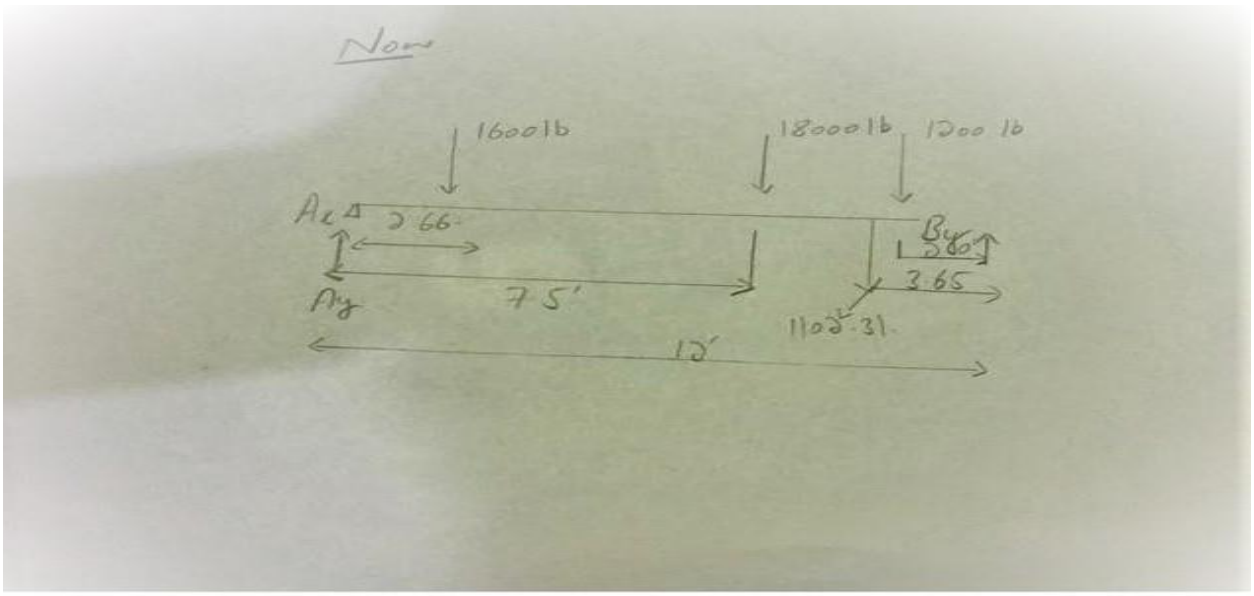
At point = $\frac{1}{2} * 4 = 2$ from B

⇨ UVL = $\frac{1}{2} * 400 * 8 = 1600\ lb$

At distance = $\frac{1}{3} * 8 = 2.66$ from A

⇨ One load in kg convert to lb

= 500 * 2.0204 = 1010.2 lb



Now

Ax= 0

Ay= 0

MA = -1600 * 2.66 -1800 * 7.5 – 1200 * 10 - 1102.31 * 8.35 + By * 12

= - 4256 – 135000 – 12000 – 9204.28 + By *12

= -160460.12 + By * 12

$By = \frac{160460.12}{12}$

By = 13371.69 lb

Ay = { Total load by }

Ay = 1200 + 1102.31 + 18000 + 1600 – 13371.69

Ay = 8530.31 lb

Ay = 8530.31 lb

By = 13371.69 lb