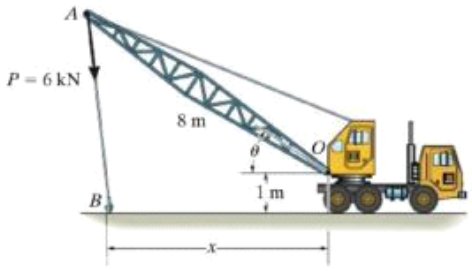
Homework 2

Monday, September 14, 2020 5:06 PM

"I pledge my honor I have abided by the Stevens Honor system."

- Alex Jaskins

***3–12.** The cable exerts a force of $P = 6$ kN at the end of the 8-m-long crane boom. If $x = 10$ m, explain why this force creates a maximum moment about point O when the angle of the boom is $\theta = 31.54°$. What is this moment?



$x = 8 \cos(31.54)$

$x = 6.82$ m.

$y = 8 \sin(31.54)$

$y = 4.18$ m.

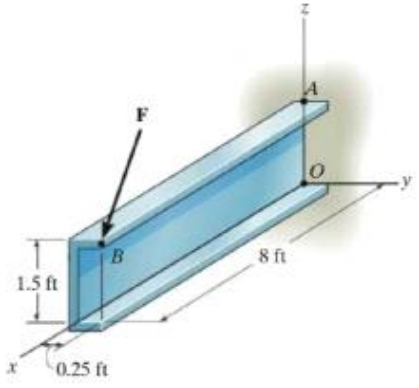
$\tan^{-1}\left((4.18+1)/(10-6.52)\right) = 58.46°$

$360° - 180° - 31.54° - 58.46° = 90°$

$M = 6(8)$

$M = 48$ kN·m

3–30. The force $\mathbf{F} = \{400\mathbf{i} - 100\mathbf{j} - 700\mathbf{k}\}$ lb acts at the end of the beam. Determine the moment of this force about point A.



$F = (400\hat{i} - 100\hat{j} - 700\hat{k})$

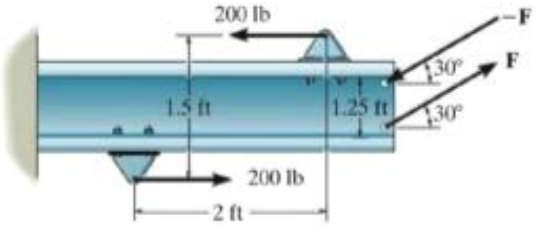
$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 8 & .25 & 0 \\ 400 & -100 & -700 \end{vmatrix}$$

$\langle .25(-700) - 0(-100)\rangle\hat{i} + \langle 8(700) - 0(-100)\rangle\hat{j} + \langle 8(-100) - .25(400)\rangle\hat{k}$

$M = -175\hat{i} + 5600\hat{j} - 900\hat{k}$

$M_A = -175\,i + 5600\,j - 900\,k$

3–58. Determine the magnitude of **F** so that the resultant couple moment is 450 lb · ft, counterclockwise. Where on the beam does the resultant couple moment act?

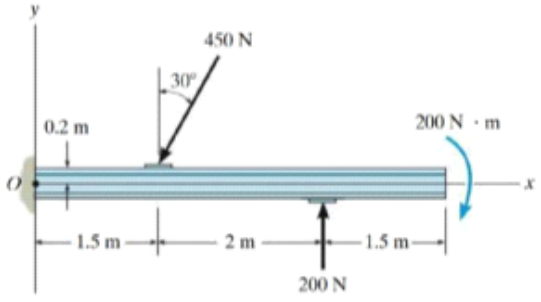


$M = 200(1.5) + F\cos(30)(1.25)$

$450 = 300 + F\cos(30)(1.25)$

$F = 138.56\ N$ across the entire beam.

3–75. Replace the loading acting on the beam by an equivalent resultant force and couple moment at point *O*.



$F_{Rx} = -450\sin(30)$

$F_{Rx} = -225\ N$

$F_{Ry} = 200 - 450\cos(30)$

$F_{Ry} = -189.71\ N$

$F_R = \sqrt{F_{Rx}^2 + F_{Ry}^2}$

$F_R = \sqrt{(-225)^2 + (-189.71)^2}$

$F_R = 294.3\ N$

$\tan(\theta) = \frac{189.71}{225}$

$\theta = \tan^{-1}\left(\frac{189.71}{225}\right)$

$\theta = 40.14°$

$\theta + 180° = 220.14°$

$M_O = 200(3.5) + 450\sin(30)(.2) - 450\cos(30)(1.5) - 200$

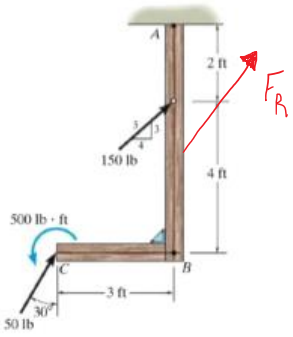
$M_O = -39.57\ N\cdot m$ or $M_O = -39.57\ N\cdot m$

$F_R = 294.3\ N$ @ $220.14°$

***3–100.** Replace the loading acting on the frame by an equivalent resultant force and specify where the resultant's line of action intersects member *BC*, measured from *B*.

$F_{Rx} = \frac{4}{5}150 + 50\sin(30)$

line of action intersects member BC, measured from B.



$$F_{Rx} = \frac{4}{5}150 + 50\sin(30^\circ)$$

$$F_{Rx} = 145\ N$$

$$F_{Ry} = \frac{3}{5}150 + 50\cos(30^\circ)$$

$$F_{Ry} = 133.3\ N$$

$$F_R = \sqrt{(145)^2 + (133.3)^2}$$

$$F_R = 197\ N \quad @\ 42.6^\circ$$

$$\tan(\theta) = \frac{133.3}{145}$$

$$\theta = \tan^{-1}\left(\frac{133.3}{145}\right)$$

$$\theta = 42.6^\circ$$

$$F_y(d) = 50\cos(30)(3) + 150\left(\frac{4}{5}\right)(4) - 500$$

$$d = .824\ ft.$$