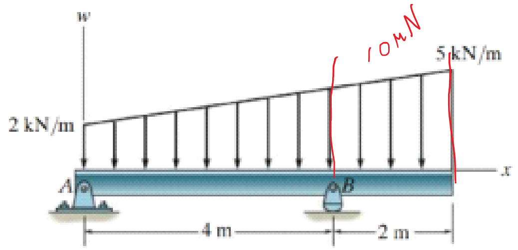
Homework 3

Monday, September 21, 2020 1:49 PM

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

- Alex Gaskins

**3–110.** Replace the loading by an equivalent resultant force and specify its location on the beam, measured from $A$.




$$F_c = \frac{1}{2}(5+2)(6)$$

$$F_c = 21 \text{ kN}$$

$$\frac{10+2}{3}\left(\frac{6}{5+2}\right) = 3.43 \text{ m.}$$

**4–7.** Determine the magnitude of force at the pin $A$ and in the cable $BC$ needed to support the 500-lb load. Neglect the weight of the boom $AB$.

$F_x = 0$

$F_x = -F_{BC}\cos(22) + A_x$

$A_x = 1687.8$ lbs

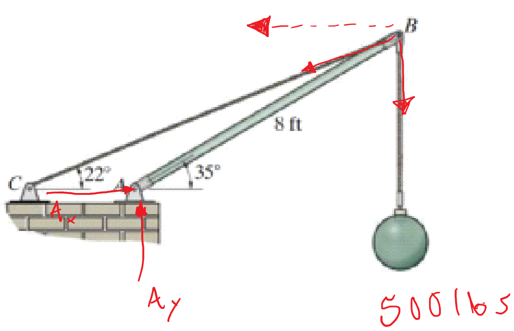
$F_y = 0$

$F_y = -F_{BC}\sin(22) - 500 + A_y$

$A_y = 1181.91$ lbs

$F_A = \sqrt{(1687.8)^2 + (1181.91)^2}$

$\boxed{F_A = 2060.47 \text{ lbs}}$




$M_A = 0$

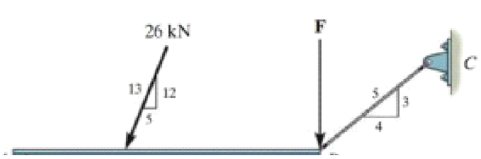
$M_A = F_{BC}\cos(22)(8\sin(35)) - 500(8\cos(35)) - F_{BC}\sin(22)(8\cos(35))$

$3276.61 = 1.8 F_{BC}$

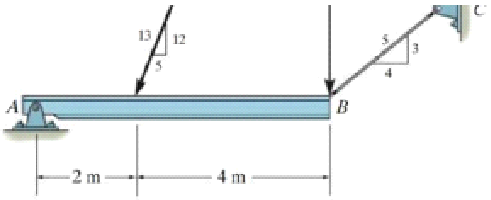
$\boxed{F_{BC} = 1820.34 \text{ lbs}}$

***4–16.** If rope $BC$ will fail when the tension becomes 50 kN, determine the greatest vertical load $F$ that can be applied to the beam at $B$. What is the magnitude of the reaction at $A$ for this loading? Neglect the thickness of the beam.

$F = \frac{3}{5} T$




$M_A = 0$




$M_A = 0$

$M_A = \frac{12}{13} 26(2) + 6F$

$-6F = \frac{12}{13}(26)(2)$

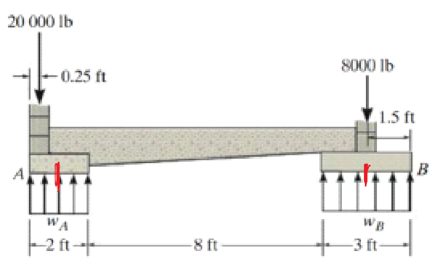
$F = -8$

$\frac{3}{5} T = -8$

$\frac{3}{5}(50) = -8$

$= \boxed{22 \text{ kN}}$

**4–19.** The cantilever footing is used to support a wall near its edge $A$ so that it causes a uniform soil pressure under the footing. Determine the uniform distribution loads, $w_A$ and $w_B$, measured in lb/ft at pads $A$ and $B$, necessary to support the wall forces of 8000 lb and 20 000 lb.




$M_A = 0$

$M_A = 20{,}000(.75) - 8000(10.5) + 31.5 W_B$

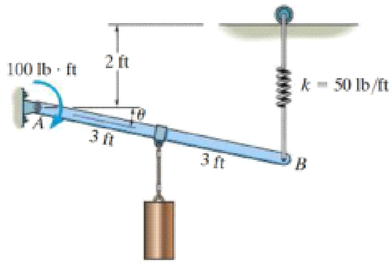
$\boxed{W_B = 2190.48 \text{ lb/ft}}$

$M_B = 0$

$M_B = 20{,}000(11.25) - 21 W_A$

$\boxed{W_A = 10{,}714.29 \text{ lb/ft}}$

**4–23.** The rod supports a weight of 200 lb and is pinned at its end $A$. If it is subjected to a couple moment of 100 lb · ft, determine the angle $\theta$ for equilibrium. The spring has an unstretched length of 2 ft and a stiffness of $k = 50$ lb/ft.




$M_A = 0$

$M_A = F_s(6\cos(\theta)) = 200(3\cos(\theta)) + 100$

$F_s = k(6\sin(\theta))$

$F_s = 50(6\sin(\theta))$

$F_s = 300\sin(\theta)$

$300\sin(\theta)(6\cos(\theta)) = 600\cos(\theta) + 100$

$1800\sin(\theta)\cos(\theta) = 600\cos(\theta) + 100$

$1800\sin(\theta)\cos(\theta) - 600\cos(\theta) = 100$

$\cos(\theta)[3\sin(\theta) - 1] = \frac{1}{6}$

$$\boxed{\begin{array}{ll} \cos(\theta) = \frac{1}{6} & \theta = 80.41^\circ \\ 3\sin(\theta) - 1 = \frac{1}{6} & \theta = 22.89^\circ \end{array}}$$