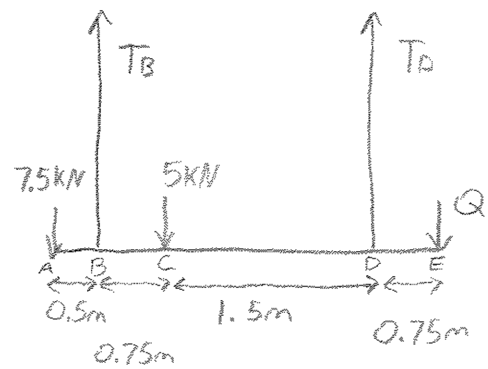
MAE 206 HW 3 #4.11

4.11



$\sum M_D = 0 \quad (7.5\,kN)(2.75\,m) - T_B(2.25\,m) + (5\,kN)(1.5\,m) - Q(0.75\,m) = 0$

$Q = 37.5\,kN - 3T_B$

$\sum M_B = 0 \quad (7.5\,kN)(0.5\,m) - (5\,kN)(0.75\,m) + T_D(2.25\,m) - Q(3\,m) = 0$

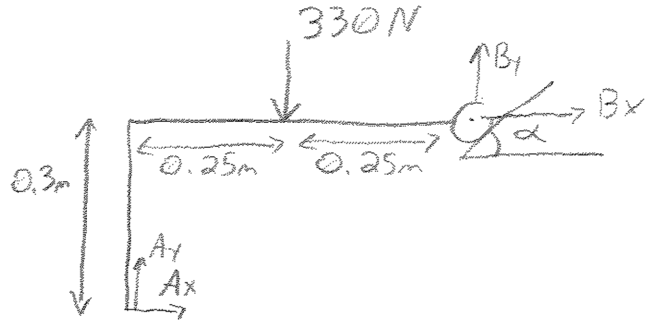
$0 \le T_B \le 12\,kN \qquad 1.5\,kN \le Q \le 37.5\,kN$

$0 \le T_D \le 12\,kN \qquad 0\,kN \le Q \le 9.0\,kN$

To be safe cables must not be slack and tension must not exceed 12kN

$1.50\,kN \le Q \le 9.00\,kN$

4.17



a) $\sum M_A = 0 = -330N(0.25m) + B_y(0.5m)$

$B_y = 165\ N$

$\sum M_B = 0 = 330N(0.25m) - A_y(0.5m)$ $\quad A_y = 165N$

when $\alpha = 0$

$\vec{A} = 165N$ @ $90°$
$\vec{B} = 165N$ @ $90°$

b) $\sum M_A = 0 = -330N(0.25m) - B_x(0.3m)$

$B_x = -275N$

$\sum F_x = 0 = -275N + A_x$ $\quad A_x = 275N$

$\sum M_B = 0 = 330N(0.25m) + 275N(0.3m) + A_y(0.5m)$

$A_y = 330N$

$\sqrt{(275N)^2 + (330N)^2} = 430N$

$\tan^{-1}\left(\frac{330N}{275N}\right) = 50.2°$

$\vec{A} = 430N$ @ $50.2°$
$\vec{B} = 275N$ @ $180°$

4.17 cont

c) $\sum M_A = 0: -330N(0.25N) + B\cos 30°(0.5m) + B\sin 30°(0.3m)$

$B = 142N$ @ $120°$

$B_x = 142N \cos 120° = -70.8N$

$B_y = 142N \sin 120° = 123N$

$\sum F_x = -70.8 + A_x \qquad A_x = 70.1N$

$\sum F_y = -330N + 123N + A_y \qquad A_y = 207N$

$\sqrt{(70.1N)^2 + (207N)^2} = 219N$

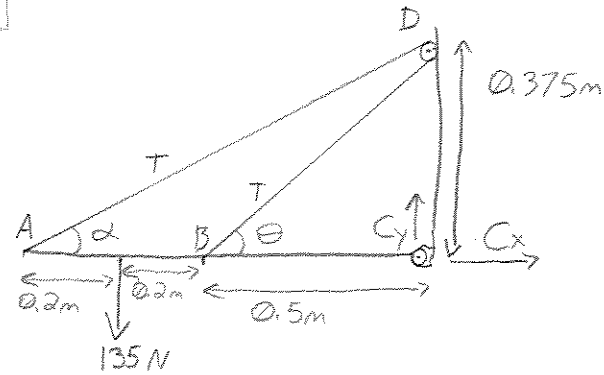
$\theta = \tan^{-1}\left(\frac{207N}{70.1N}\right) = 71.2°$

$\vec{B} = 142N$ @ $120°$

$A = 219N$ @ $71.2°$

MAE 206 | HW3 | # 4.32

4.32



$\alpha = \tan^{-1}\left(\frac{0.375m}{0.9m}\right) = 22.6°$

$\theta = \tan^{-1}\left(\frac{0.375m}{0.5m}\right) = 36.9°$

$\Sigma F_x = 0 : T\cos\alpha + T\cos\theta + C_x$

$C_x = -T\cos\alpha - T\cos\theta$

$\Sigma F_y = 0 : T\sin\alpha + T\sin\theta - 135N + C_y$

$\Sigma M_c = 0 : 135N \cdot (0.7m) - T\sin\alpha(0.9m) - T\sin\theta(0.5m)$

$T = \frac{135N \cdot 0.7m}{\sin 22.6°(0.9m) + \sin 36.9°(0.5m)}$

$T = 146N$

$\vec{C} = (-T\cos\alpha - T\cos\theta)\hat{\imath} + (135N - T\sin\theta - T\sin B)\hat{\jmath}$

$\vec{C} = (-252\hat{\imath}, -9\hat{\jmath})N$

$|C| = \sqrt{(-252N)^2 + (-9N)^2} = 252.161\ N \approx 252N$

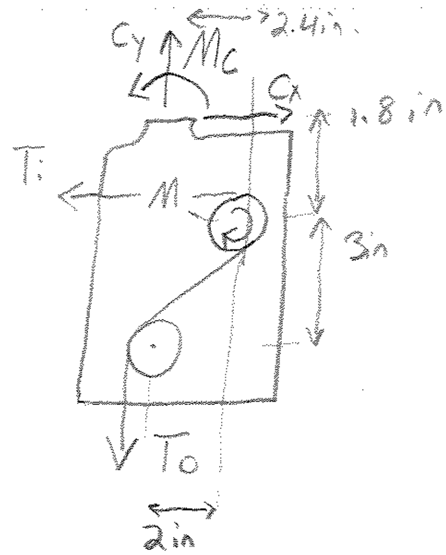
Almost all force is exerted in the $-x$ direction.

angle of $\vec{C}$: $\tan^{-1}\left(\frac{-9N}{-252N}\right) = 182°$

$T = 146N$ $\quad$ $\vec{C}$: $252N$ @ $182°$

MAE 206 | HW 3 | # 4.47

4.47



$T_i = 16$ lb

$T_o = 8$ lb

$M = 8$ lb·in

$\sum F_x = -T_i + C_x$

$C_x = 16$ lb

$\sum F_y = -T_o + C_y$

$C_y = 8$ lb

$\sum M_c = -T_i(1.8\text{in} - 1\text{in}) + T_o(2\text{in} + 1\text{in} - 2.4\text{in}) - 8\text{ lb}\cdot\text{in}$

$M_c = 16.0$ lb·in $|C| = \sqrt{(16\text{lb})^2 + (8\text{lb})^2}$

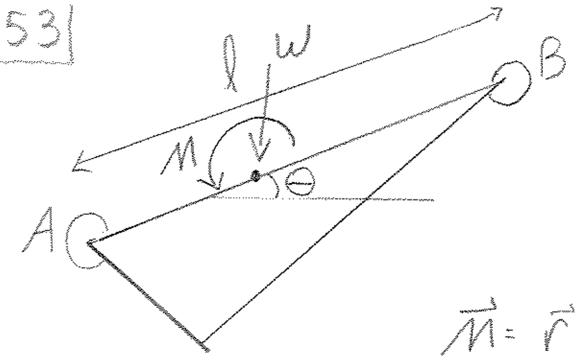
$|C| = 17.9$ lb

$\theta = \tan^{-1}\left(\frac{8\text{lb}}{16\text{lb}}\right) = 26.6°$

$M_c = 16.0$ lb·in $\vec{M} = 17.9$ lb @ 26.6°

MAE 206 HW 3 # 4.53

4.53



$w = m \cdot l$

$\vec{M} = \vec{r} \times \vec{F}$

$= \frac{l}{2} (mg) \sin\theta$

$\frac{2M}{mgl} = \sin\theta$

$\theta = \sin^{-1}\left(\frac{2M}{mgl}\right)$

$\theta = 20.1°$

For $M = 2.7$ N·m

$m = 2$ kg

$l = 0.8$ m