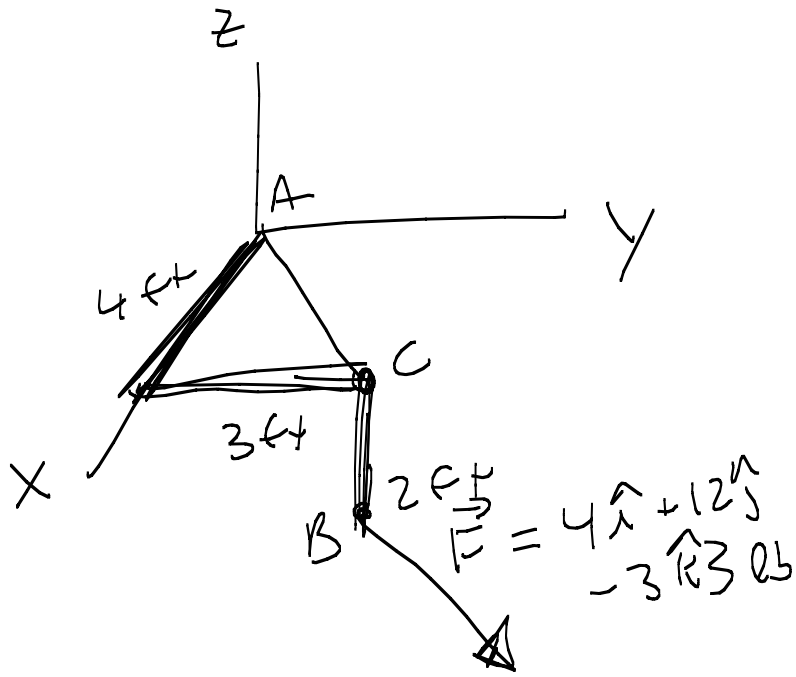
4.55



$$\vec{M}_C = \vec{r}_{CB} \times \vec{F}$$

$$\vec{r}_{CB} = \{0\hat{i} + 0\hat{j} - 2\hat{k}\}\ ft$$

$$\vec{M}_C = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & -2 \\ 4 & 12 & -3 \end{vmatrix}$$

$$\vec{M}_C = [(0)(-3) - (-2)(12)]\hat{i} - [(0)(-3) - (-2)(4)]\hat{j} + 0\hat{k}$$

$$\vec{M}_C = \{24\hat{i} - 8\hat{j} + 0\hat{k}\}\ lb \cdot ft$$

$$\vec{r}_{AC} = \{4\hat{i} + 3\hat{j} + 0\hat{k}\}\ ft$$

$$\cos\theta = \frac{\vec{r}_{AC} \cdot \vec{M}_C}{r_{AC} M_C}$$

$$r_{AC} = \sqrt{(4)^2 + (3)^2} = 5 \text{ ft}$$

$$M_C = \sqrt{(24)^2 + (-8)^2} = 25.3 \text{ lb} \cdot \text{ft}$$

$$\cos\theta = \frac{\{4\hat{i} + 3\hat{j}\} \cdot \{24\hat{i} - 8\hat{j}\}}{(5)(25.3)} = \frac{(4)(24) + (3)(-8)}{(5)(25.3}$$

$$\cos\theta = 0.57 \qquad \theta = 55.3^\circ$$

$$M_{AC} = (25.3 \text{ lb} \cdot \text{ft}) \cos 55.3^\circ = 14.4 \text{ lb} \cdot \text{ft}$$

$$\vec{M}_{AC} = M_{AC}\,\vec{u}_{AC} \qquad \vec{u}_{AC} = \frac{\{4\hat{i} + 3\hat{j} + 0\hat{k}\} \text{ ft}}{5 \text{ ft}}$$

$$= \{0.8\hat{i} + 0.6\hat{j} + 0\hat{k}\}$$

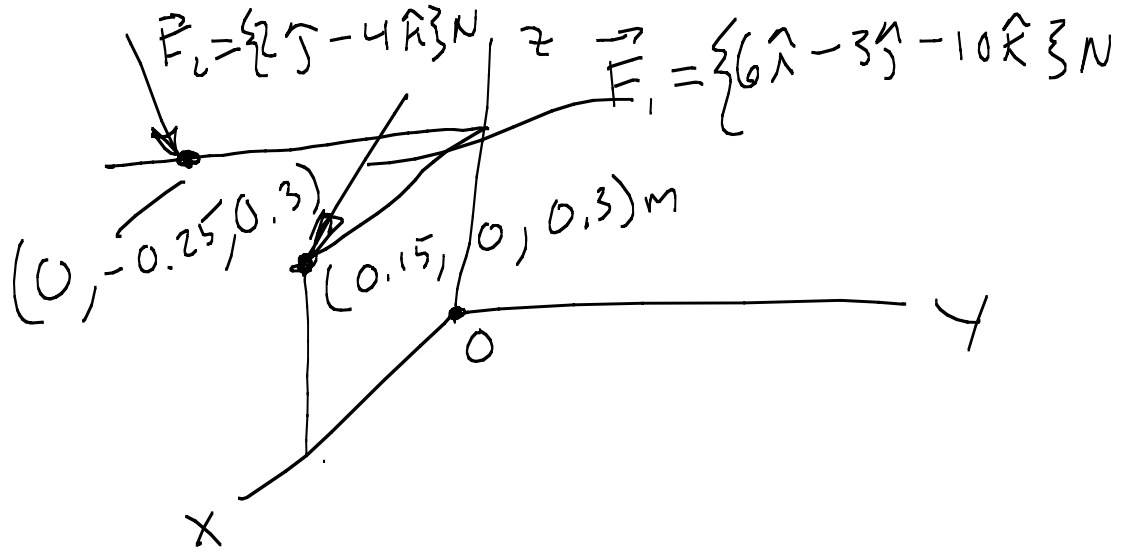
$$\vec{M}_{AC} = (14.4 \text{ lb} \cdot \text{ft}) \{0.8\hat{i} + 0.6\hat{j} + 0\hat{k}\}$$

$$\boxed{\vec{M}_{AC} = \{11.5\hat{i} + 8.64\hat{j} + 0\hat{k}\} \text{ lb} \cdot \text{ft}}$$

4.115

$$\vec{F}_R = \{2\hat{j} - 4\hat{k}\}\,N + \{6\hat{i} - 3\hat{j} - 10\hat{k}\}\,N$$

$$\boxed{\vec{F}_R = \{6\hat{i} - 1\hat{j} - 14\hat{k}\}\,N}$$



$$\Sigma \vec{M}_{RO} = (\vec{r}_1 \times \vec{F}_1) + (\vec{r}_2 \times \vec{F}_2)$$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0.15 & 0 & 0.3 \\ 6 & -3 & -10 \end{vmatrix} = [(0)(-10) - (0.3)(-3)]\hat{i} - [(0.15)(-10) - (0.3)(6)]\hat{j} + [(0.15)(-3) - 0]\hat{k}$$

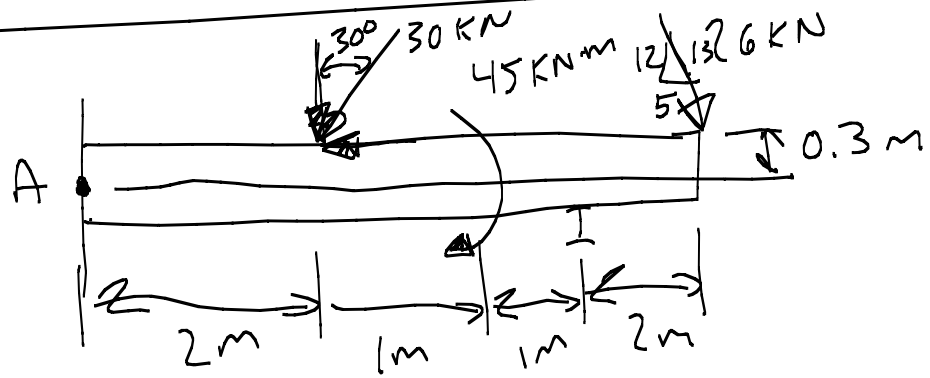
$$= \{0.9\hat{i} + 3.3\hat{j} - 0.45\hat{k}\}\,N\cdot m$$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & -0.25 & 0.3 \\ 0 & 2 & -4 \end{vmatrix} = \left[(-0.25)(-4) - (0.3)(2)\right]\hat{i} - \left[0\right]\hat{j} + 0\hat{k}$$

$$= 0.4\hat{i}\ \text{N}\cdot\text{m}$$

$$\vec{M}_{RO} = \{1.3\hat{i} + 3.3\hat{j} - 0.45\hat{k}\}\ \text{N}\cdot\text{m}$$

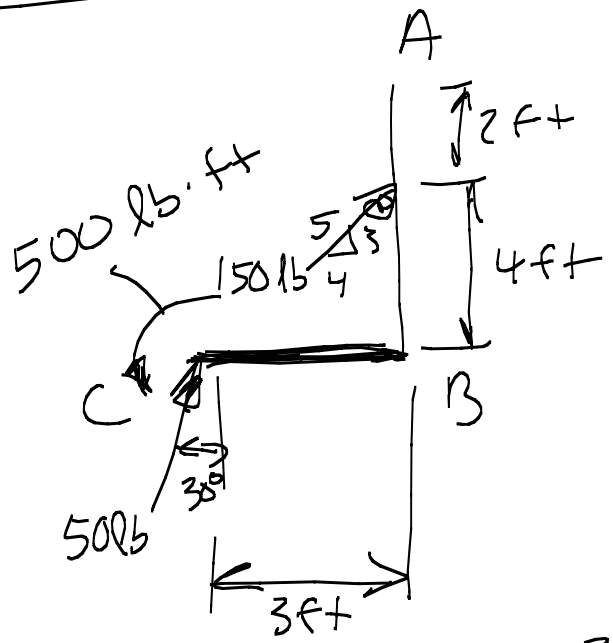
4.110



$$+\circlearrowright \sum M_A = M_{RA} = (30\text{kN})(\sin 30^\circ)(0.3\text{m}) - (30\text{kN})(\cos 30^\circ)(2\text{m}) - 45\text{kN}\cdot\text{m}$$
$$-(26\text{kN})\left(\tfrac{5}{13}\right)(0.3\text{m}) - (26\text{kN})\left(\tfrac{12}{13}\right)(6\text{m})$$

$$M_{RA} = -239.46\ \text{KN}\cdot\text{m}$$

4.123

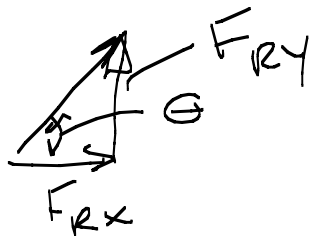


$\vec{F}_R$

$$\overset{+}{\rightarrow}\Sigma F_x = F_{Rx} = 50\sin 30^\circ + 150\left(\frac{4}{5}\right)$$

$$F_{Rx} = 145\ \text{lb}$$

$$+\uparrow \Sigma F_y = F_{Ry} = 50\cos 30^\circ + 150\left(\frac{3}{5}\right) = 133.3\ \text{lb}$$

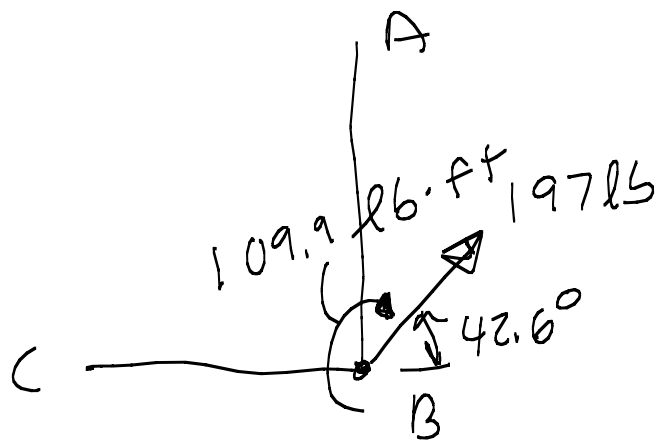


$$F_R = \sqrt{(145)^2 + (133.3)^2} = 197\ \text{lb}$$

$$\tan\theta = \frac{133.3}{145} \Rightarrow \theta = 42.6^\circ$$

$$\overset{+}{\circlearrowleft}\Sigma M_{RB} = M_{RB} = -(150\text{lb})\left(\frac{4}{5}\right)(4\text{ft}) - (50\text{lb})(\cos 30^\circ)(3\text{ft}) + 500\text{lb·ft}$$

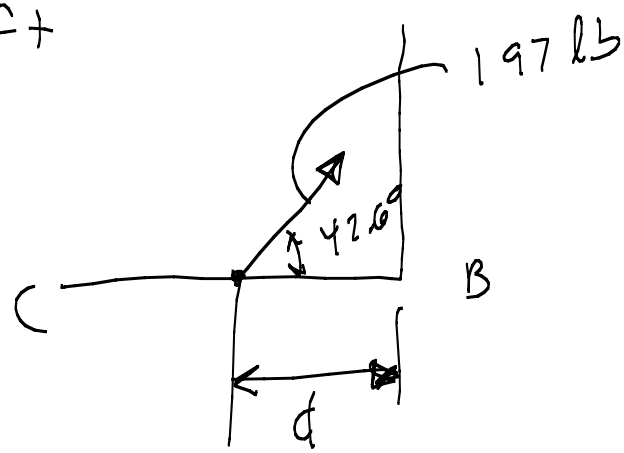
$M_{RB} = -109.9\ lb \cdot ft$



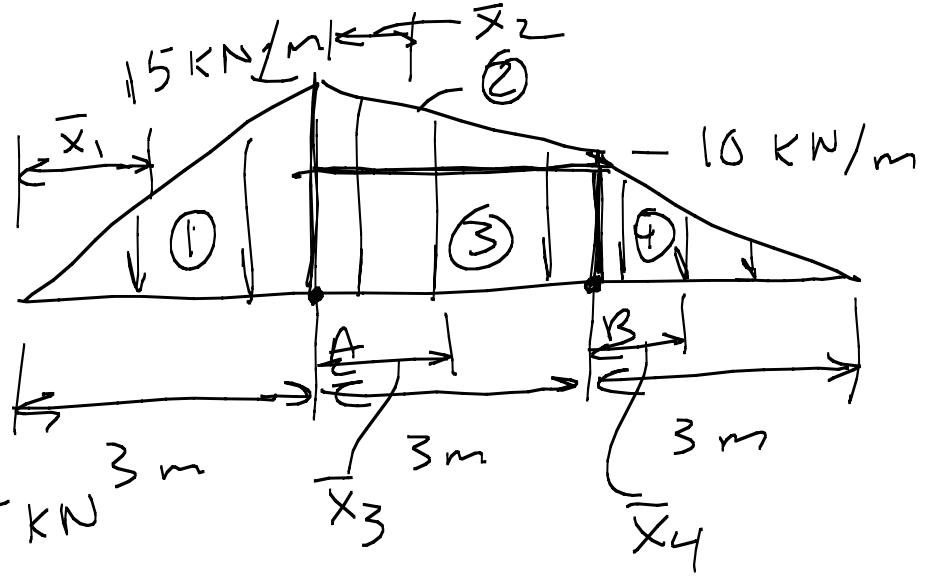
$197 \sin 42.6°$

$(133.3)\, d = 109.9\ lb \cdot ft$

$\boxed{d = 0.824\ ft}$



4,142



$F_1 = \frac{1}{2}(3m)(15\,KN/m)$

$= 22.5\,KN$

$\bar{x}_1 = \frac{2}{3}(3m) = 2m$

$F_2 = \frac{1}{2}(3)(5) = 7.5\,KN$

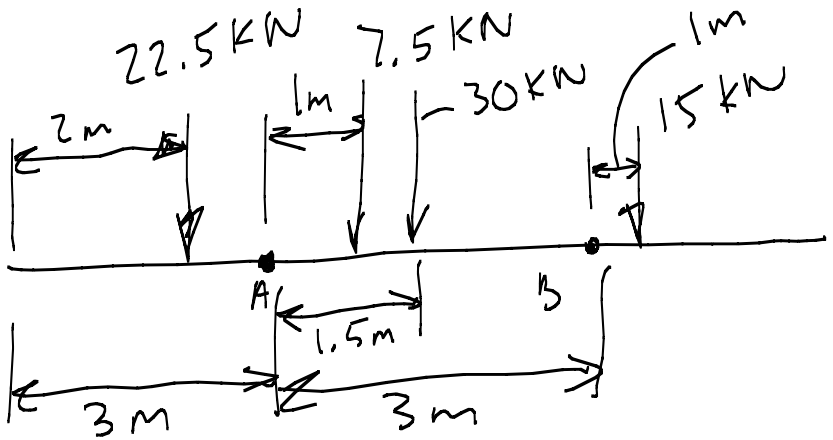
$\bar{x}_2 = \frac{1}{3}(3m) = 1m$

$F_3 = (3)(10) = 30KN$

$\bar{x}_3 = \frac{1}{2}(3) = 1.5m$

$F_4 = \frac{1}{2}(3)(10) = 15KN$

$\bar{x}_4 = \frac{1}{3}(3) = 1m$



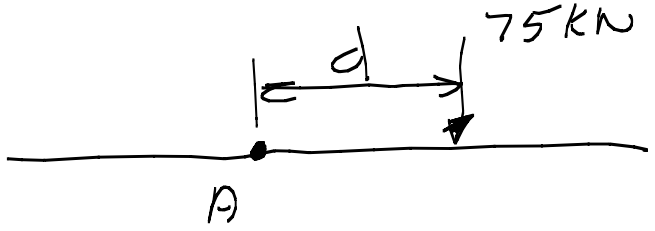
$+\uparrow \Sigma F_y \Rightarrow F_{Ry} = F_R = -22.5\,KN - 7.5\,KN - 30\,KN - 15\,KN$

$= -75\,KN$

$+\circlearrowleft \Sigma M_A = M_{RA} = (22.5\,KN)(1\,m) - (7.5\,KN)(1\,m) - (30\,KN)(1.5\,m)$

$-(15\,KN)(4\,m)$

$M_{RA} = -90\,KN \cdot m$



$(75\,kN)\,d = 90\,kN \cdot m$

$d = 1.2\,m$