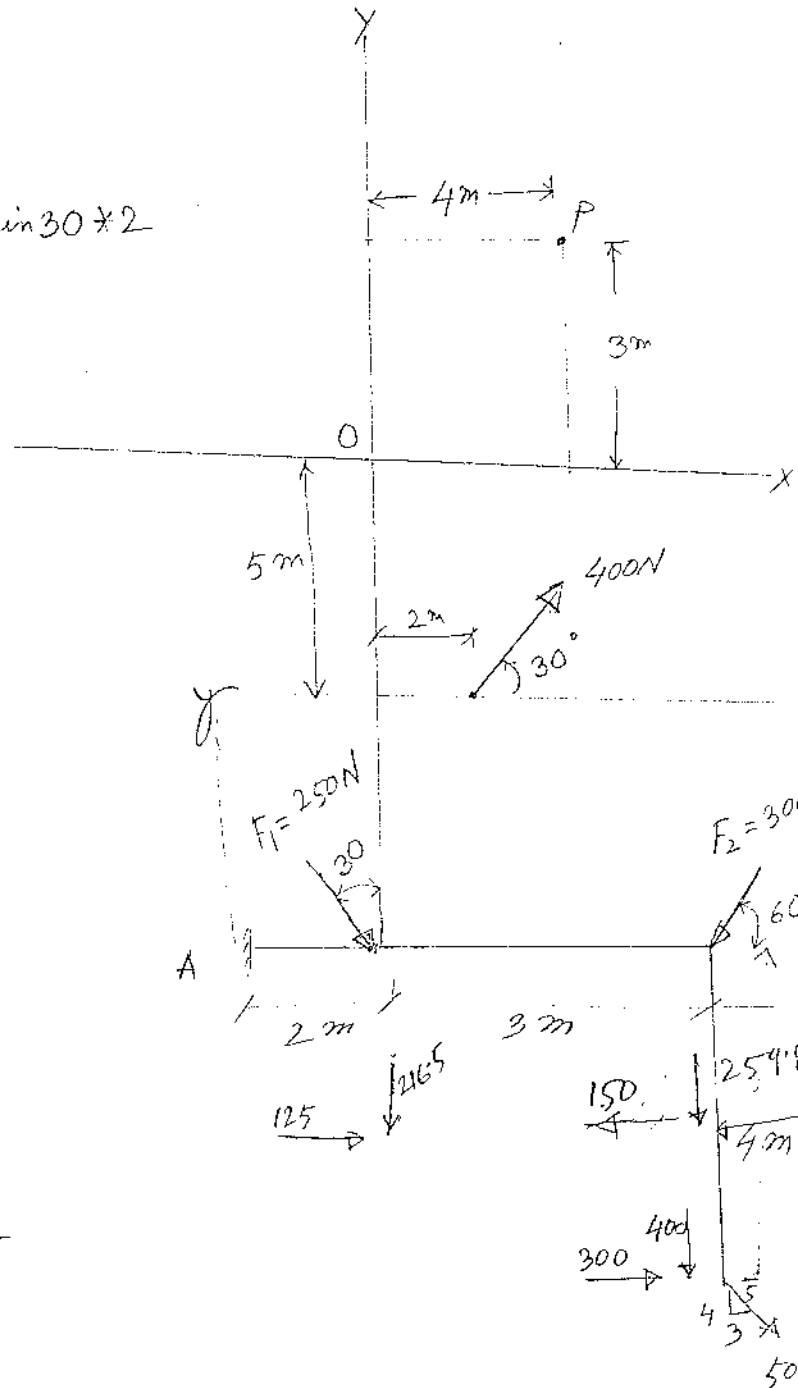


04-04-04

HW-044.5

$$\begin{aligned}
 (+\curvearrowright) M_P &= 400 \cos 30^\circ \times 8 - 400 \sin 30^\circ \times 2 \\
 &= 2371.28 \text{ N-M} \\
 &= 2.37 \text{ kN-M}
 \end{aligned}$$

4.22

$$\begin{aligned}
 (+\curvearrowright) M_{1A} &= 250 \cos 30^\circ \times 2 \\
 &= 433 \text{ k-M}
 \end{aligned}$$

$$\begin{aligned}
 (+\curvearrowright) M_{2A} &= 300 \sin 60^\circ \times 5 \\
 &= 1300 \text{ k-M}
 \end{aligned}$$

$$\begin{aligned}
 (+\curvearrowright) M_{3A} &= \frac{500}{5} \times 4 \times 5 - \frac{500}{5} \times 3 \times 4 \\
 &= 800
 \end{aligned}$$

Using moment principle

$P_1(2,0)$, $P_2(5,0)$ & $P_3(5,-4)$

$$\begin{aligned}
 M_{1A} &= \begin{vmatrix} i & j & k \\ 2 & 0 & 0 \\ 125 & -216.5 & 0 \end{vmatrix} = 433.1 \\
 M_{2A} &= \begin{vmatrix} i & j & k \\ 5 & 0 & 0 \\ -150 & -259.8 & 0 \end{vmatrix} = 1259.1 \\
 M_{3A} &= \begin{vmatrix} i & j & k \\ 5 & -4 & 0 \\ 300 & -400 & 0 \end{vmatrix} = 800 \hat{k}
 \end{aligned}$$

82

$$\sum \tau_A = 0$$

$$300 \cos 30^\circ \times d - 300 \sin 30^\circ \times 0.2 - P \times 2 = 0 \quad \text{--- ①}$$

$$259.8d - 30 - 2P = 0 \quad \text{--- ①}$$

$$\sum F_y = 0$$

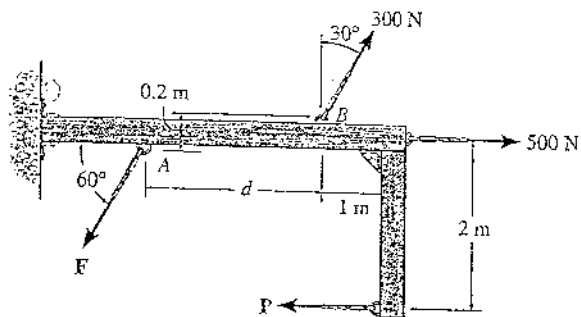
$$F \sin 60^\circ + 300 \cos 30^\circ = 0$$

$$F = 300$$

$$\sum F_x = 0 \Rightarrow 300 \cos 60^\circ - P + 500 + 300 \sin 30^\circ = 0 \quad \therefore P = 500$$

$$\text{From eqn ①} \Rightarrow 259.8d - 30 - 2 \times 500 = 0$$

$$\Rightarrow d = 3.96 \text{ m}$$



Prob. 4-82

4-60

$$A(0,0,0), B(4,3,-2)$$

$$C(4,3,0)$$

$$r_{AC} = 4i + 3j$$

$$|r_{AC}| = \sqrt{4^2 + 3^2} = 5$$

$$u_{AC} = \frac{4}{5}i + \frac{3}{5}j \quad / \quad F = 4i + 12j - 3k \quad / \quad r_{BC} = 0i + 0j - 2k$$

$$M_{AC} = \begin{vmatrix} u_x & u_y & u_z \\ r_x & r_y & r_z \\ F_x & F_y & F_z \end{vmatrix} = \begin{bmatrix} 4/5 & 3/5 & 0 \\ 0 & 0 & -2 \\ 4 & 12 & -3 \end{bmatrix} = 14.4 \text{ lb-ft}$$

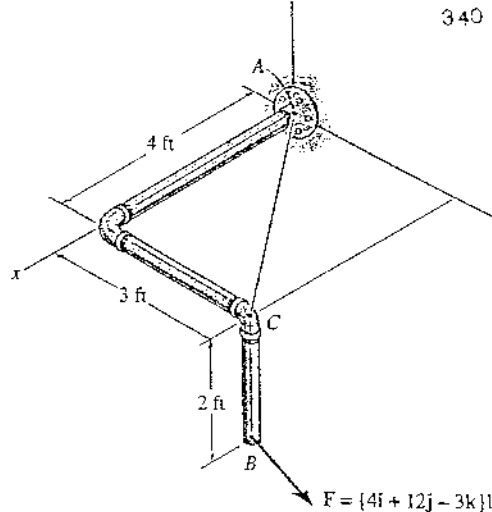
$$\vec{M}_{AC} = M_{AC} * u_{AC} = 11.5i + 8.64j$$

4-71

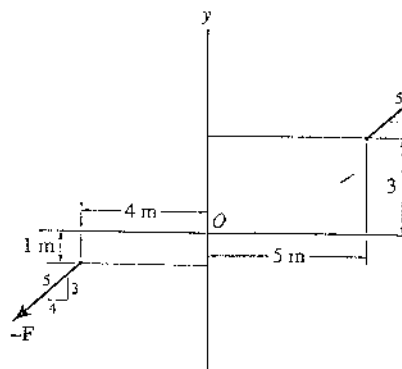
$$M = 8 * \frac{3}{5} * 9$$

$$- 8 * \frac{4}{5} * 4$$

$$= 17.6 \text{ kN-m}$$



Probs. 4-59/60



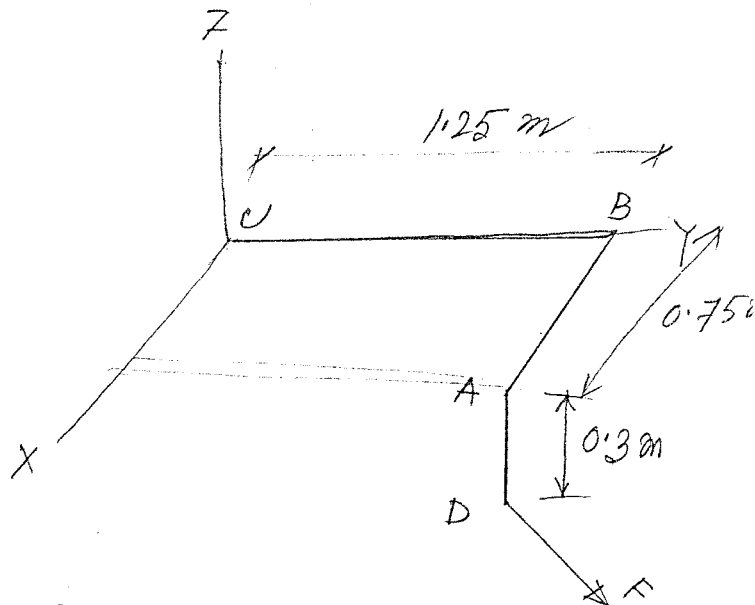
4-39

$$A(0.75, 1.25, 0)$$

$$B(0, 1.25, 0)$$

$$D(0.75, 1.25, -0.3)$$

$$C(0, 0, 0)$$



$$\vec{r}_{BD} = 0.75\hat{i} + 0\hat{j} + (-0.3)\hat{k} \quad \left| \quad \vec{F} = 50\hat{i} + 100\hat{j} - 50\hat{k} \right.$$

$$\vec{r}_{CD} = 0.75\hat{i} + 1.25\hat{j} - 0.3\hat{k}$$

$$M_B = \vec{F} \times \vec{r}_{BD} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0.75 & 0 & -0.3 \\ 50 & 100 & -50 \end{vmatrix} = 30\hat{i} + 22.5\hat{j} + 75\hat{k}$$

$$M_C = \vec{F} \times \vec{r}_{CD} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0.75 & 1.25 & -0.3 \\ 50 & 100 & -50 \end{vmatrix} \therefore M_C = -32.5\hat{i} + 22.5\hat{j} + 12.5\hat{k}$$

4-52

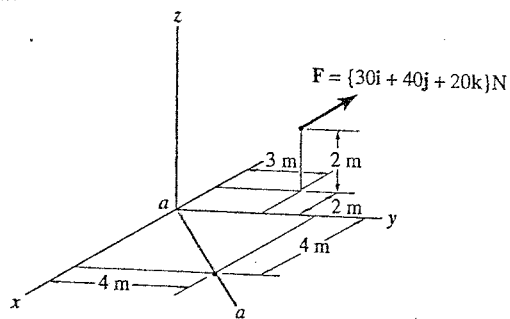
$$\vec{F} = 30\hat{i} + 40\hat{j} + 20\hat{k}$$

$$\vec{r}_F = -2\hat{i} + 3\hat{j} + 2\hat{k}$$

$$\vec{r}_{aa} = 4\hat{i} + 4\hat{j}$$

$$|\vec{r}_{aa}| = \sqrt{(4)^2 + (4)^2} = 5.66$$

$$\therefore U_{aa} = 0.71\hat{i} + 0.71\hat{j}$$



Prob. 4-52

$$M_{a-a} = \begin{vmatrix} U_x & U_y & U_z \\ r_x & r_y & r_z \\ F_x & F_y & F_z \end{vmatrix} = \begin{vmatrix} 0.71 & 0.71 & 0 \\ -2 & 3 & 2 \\ 30 & 40 & 20 \end{vmatrix} = 56.8 \text{ N-m}$$

$$\vec{M}_{a-a} = M_{a-a} \cdot U_{aa} = 40.33\hat{i} + 40.33\hat{j}$$

$$(0.35, 0, 0)$$

$$(0.35, -d \cos 30^\circ, d \sin 30^\circ)$$

$$\vec{r}_B = \{-d \cos 30^\circ \hat{j} + d \sin 30^\circ \hat{k}\}$$

$$\vec{M}_1 = \vec{r}_{AB} \times \vec{F}_1$$

$$= (-d \cos 30^\circ \hat{j} + d \sin 30^\circ \hat{k}) \times 35 \hat{k}$$

$$= -d \cos 30^\circ \hat{j} \times \hat{k} = -d \cos 30^\circ \hat{i}$$

$$= -30.31 d \hat{i}$$

Again

$$A(0.35, 0, 0)$$

$$C(0.6, -d \cos 30^\circ, d \sin 30^\circ)$$

$$\vec{r}_{AC} = \{0.25 \hat{i} - d \cos 30^\circ \hat{j} + d \sin 30^\circ \hat{k}\}$$

$$\vec{M}_2 = \vec{r}_{AC} \times \vec{F}_2$$

$$= \{0.25 \hat{i} - d \cos 30^\circ \hat{j} + d \sin 30^\circ \hat{k}\} \times 50 \hat{i}$$

$$= 43.3 d \hat{k} + 25 d \hat{j}$$

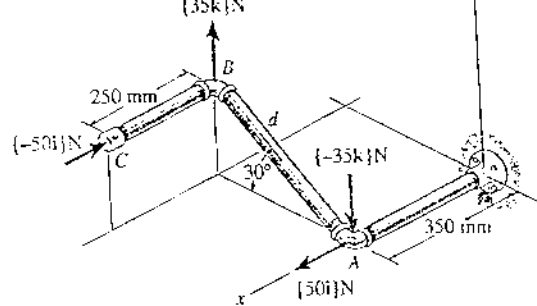
$$\vec{M}_R = \vec{M}_1 + \vec{M}_2$$

$$\Rightarrow 20 = \sqrt{(30.31 d)^2 + (25 d)^2 + (43.3)^2}$$

$$\Rightarrow 400 = 3418.6 d^2$$

$$\Rightarrow d = \sqrt{\frac{400}{3418.6}} = 0.342 \text{ m}$$

$$\therefore d = \underline{\underline{342 \text{ mm}}}$$



Probs. 4-96/97