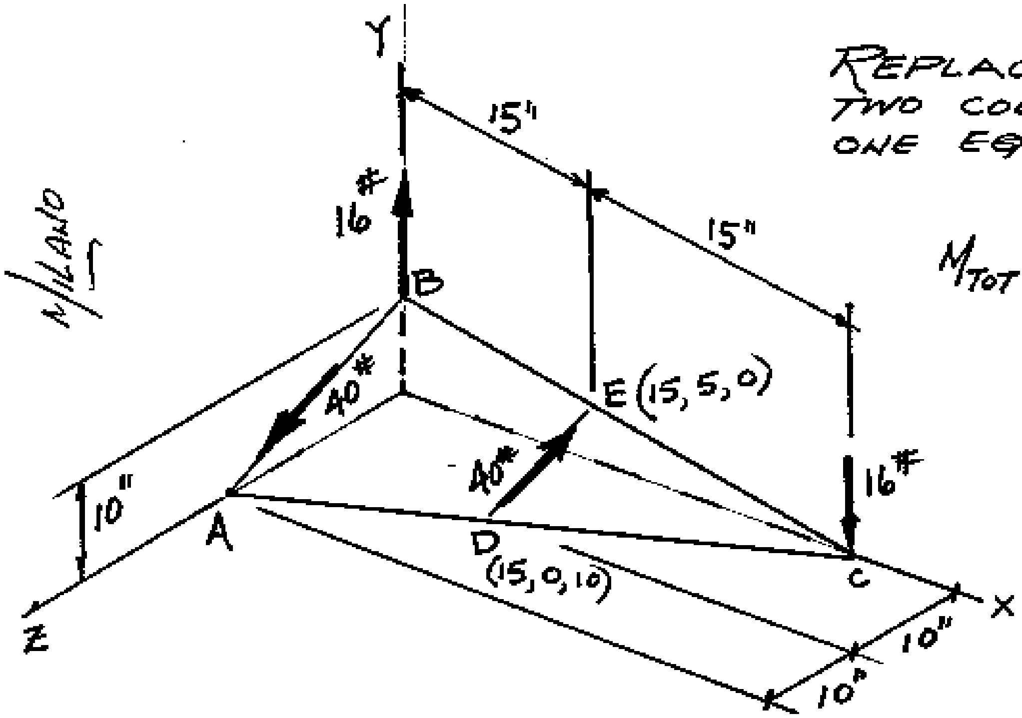
MECH 234 + 235

PROB. 3.77




REPLACE THESE TWO COUPLES WITH ONE EQUIVALENT ONE.

$M_{TOT} = M_{16\#} + M_{40\#}$

16# FORCES ARE VERTICAL $\therefore \perp d$ IS HORIZ. = 30"

$16\hat{j}$ 30" $-16\hat{j}$

$M_{16\#} = (16\#)(30") = 480 \text{ in lb} (-k)$

OR $(+30\hat{i}) \times (-16\hat{j}) = (-30\hat{i}) \times (+16\hat{j})$

$= -480\hat{k}$ in. lb.

40# FORCES LIE IN AN OBLIQUE PLANE: $\hat{i}, \hat{j}, \hat{k}$

$$M_{40\#} = \underbrace{\left(\vec{r}_{AD} \times \vec{F}_{DE}\right)} = \left(\vec{r}_{BE} \times \vec{F}_{DE}\right) = \left(\vec{r}_{DA} \times \vec{F}_{BA}\right) = \left(\vec{r}_{EB} \times \vec{F}_{BA}\right)$$

$\vec{r}_{AD} = 15\hat{i} - 10\hat{k}$

$\vec{F}_{DE} = 40\# \lambda_{DE}$ $\quad \overline{DE} = +5\hat{j} - 10\hat{k}$, $\sqrt{5^2 + 10^2} = 11.18"$

$$= 40\left[+\frac{5}{11.18}\hat{j} - \frac{10}{11.18}\hat{k}\right] = 17.89\hat{j} - 35.78\hat{k}$$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 15 & 0 & -10 \\ 0 & 17.89 & -35.78 \end{vmatrix} = \hat{i}\left[0 - (-10)(17.89)\right] - \hat{j}\left[(15)(-35.78) - 0\right] + \hat{k}\left[(15)(17.89) - 0\right]$$

$M_{40\#} = 178.9\hat{i} + 536.7\hat{j} + 268.35\hat{k}$ in lb

$$M_{TOT} = \underbrace{178.9\hat{i}}_{\cos\theta_x} \underbrace{+ 536.7\hat{j}}_{\cos\theta_y} \underbrace{- 211.65\hat{k}}_{\cos\theta_z} \text{ in. lb.}$$

$M_{TOT} = \sqrt{179^2 + 537^2 + 212^2} = \underline{604 \text{ in.lb.}}$

$\theta_x = \cos^{-1}\frac{178.9}{604} = 72.8°$

$\theta_y = 27.3°$

$\theta_z = 110.5°$