

PROB. 3.57

$|\vec{T}_{EF}| = 46 \text{ lb}$, FIND \vec{M}_{AD}

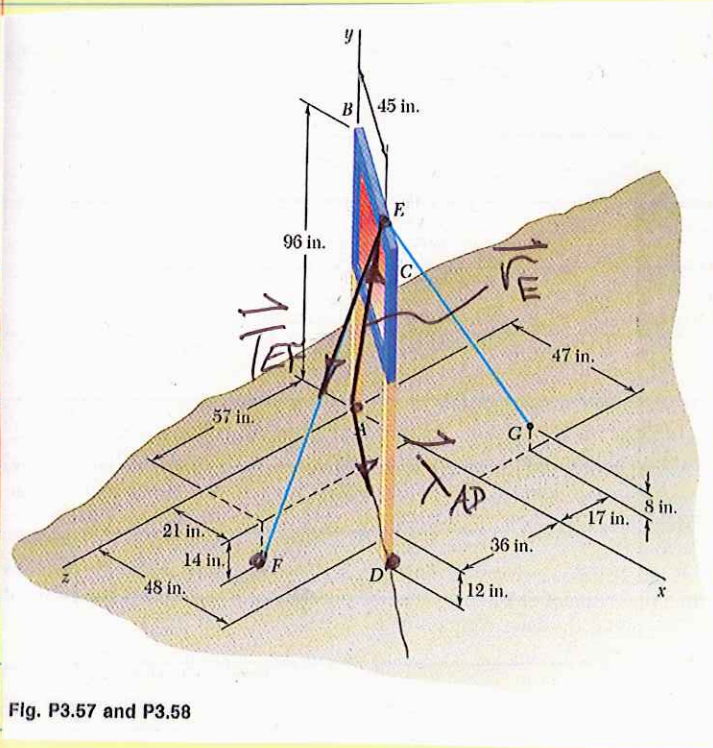
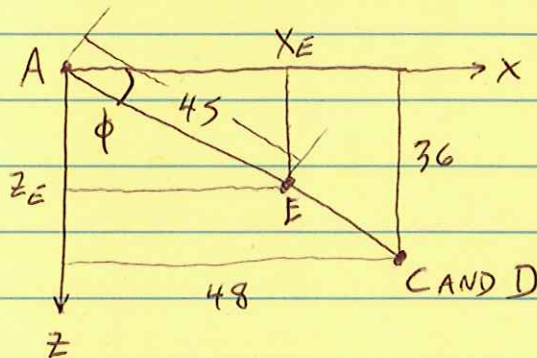


Fig. P3.57 and P3.58

LOCATE POINTS: $D(48, -12, 36) \text{ in}$

POINT E: $y_E = 96 \text{ in}$

$\phi = \text{TAN}^{-1}\left(\frac{36}{48}\right) = 36.9^\circ$



$x_E = 45 \cdot \cos 36.9^\circ = 36 \text{ in}$

$z_E = 45 \cdot \sin 36.9^\circ = 27 \text{ in}$

$E(36, 96, 27), F(21, -14, 57) \text{ in}$

PROB, 3.57 CONT.

(2)

$$\vec{T}_{EF}: dx = x_F - x_E = 21 - 36 = -15^{\text{IN}}$$

$$dy = y_F - y_E = -14 - 96 = -110^{\text{IN}}$$

$$dz = z_F - z_E = 57 - 27 = 30^{\text{IN}}$$

$$\cancel{dx} \quad d = \sqrt{15^2 + 110^2 + 30^2} = 115^{\text{IN}}$$

$$F_x = F \frac{dx}{d} = (46^{\text{LB}}) \left(\frac{-15}{115} \right) = -6^{\text{LB}}$$

$$F_y = F \frac{dy}{d} = (46) \left(\frac{-110}{115} \right) = -44^{\text{LB}}$$

$$F_z = F \frac{dz}{d} = (46) \left(\frac{30}{115} \right) = 12^{\text{LB}}$$

$$\vec{T}_{EF} = (-6)\hat{i} + (-44)\hat{j} + (12)\hat{k}^{\text{LB}}$$

$$\cancel{dx} \quad \vec{r} = (36)\hat{i} + (96)\hat{j} + (27)\hat{k}^{\text{IN}}$$

$$\vec{\lambda}_{AD}: dx = x_D - x_A = 48^{\text{IN}}, dy = -12^{\text{IN}}, dz = 36^{\text{IN}}$$

$$d = \sqrt{48^2 + 12^2 + 36^2} = 61.2^{\text{IN}}$$

$$\vec{\lambda}_{AD} = \left(\frac{dx}{d} \right) \hat{i} + \left(\frac{dy}{d} \right) \hat{j} + \left(\frac{dz}{d} \right) \hat{k}$$

$$\vec{\lambda}_{AD} = \left(\frac{48}{61.2} \right) \hat{i} + \left(\frac{-12}{61.2} \right) \hat{j} + \left(\frac{36}{61.2} \right) \hat{k}$$

$$\vec{\lambda}_{AD} = (0.784)\hat{i} + (-0.196)\hat{j} + (0.588)\hat{k}$$

$$\vec{M}_A = \vec{r}_{E} \times \vec{T}_{EF} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 36 & 96 & 27 \\ -6 & -44 & 12 \end{vmatrix}$$

$$\vec{M}_A = [(96)(12) - (27)(-44)]\hat{i}$$

$$- [(36)(12) - (27)(-6)]\hat{j}$$

$$+ [(36)(-44) - (96)(-6)]\hat{k}$$

$$\vec{M}_A = (2340)\hat{i} + (-594)\hat{j} + (-1008)\hat{k} \quad \text{IN}\cdot\text{LB}$$

$$M_{AD} = \vec{\lambda}_{AD} \cdot \vec{M}_A$$

$$M_{AD} = (0.784)(2340) + (-0.196)(-594) + (0.588)(-1008)$$

$$M_{AD} = 1358 \quad \text{IN}\cdot\text{LB}$$

$$\vec{M}_{AD} = M_{AD} \cdot \vec{\lambda}_{AD}$$

$$\vec{M}_{AD} = (1358) [(0.784)\hat{i} + (-0.196)\hat{j} + (0.588)\hat{k}]$$

$$\vec{M}_{AD} = (1065)\hat{i} + (-266)\hat{j} + (798)\hat{k} \quad \text{IN}\cdot\text{LB}$$