

PROB. 3,58

$|\vec{T}_{EG}| = 54 \text{ LB}$ , FIND  $\vec{M}_{AD}$

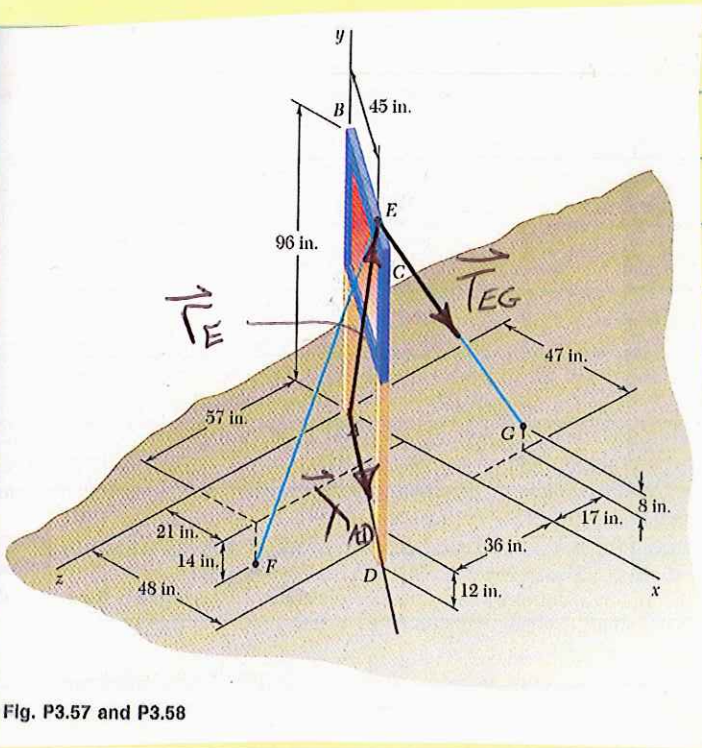
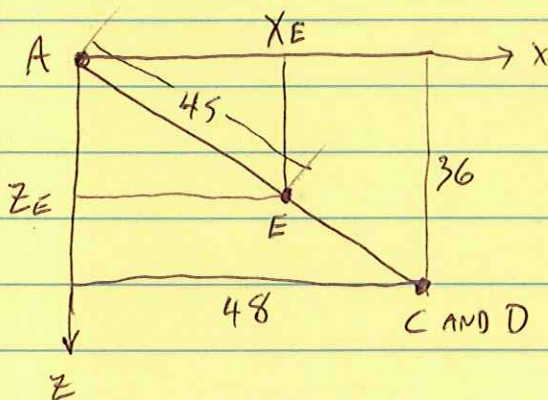


Fig. P3.57 and P3.58

LOCATE POINTS:  $G(47, +8, -17)^{IN}$

POINT E:  $Y_E = 96^{IN}$

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



$X_E = 45 \cdot \cos 36.9^\circ = 36^{IN}$

$Z_E = 45 \cdot \sin 36.9^\circ = 27^{IN}$

$E(36, 96, 27)^{IN}$

$D(48, -12, 36)^{IN}$

PROB. 3.58 CONT.

(2)

$$\vec{T}_{EG}: dx = X_G - X_E = 47 - 36 = 11^{\text{in}}$$

$$dy = Y_G - Y_E = 8 - 96 = -88^{\text{in}}$$

$$dz = Z_G - Z_E = -17 - 27 = -44^{\text{in}}$$

$$d = \sqrt{11^2 + 88^2 + 44^2} = 99^{\text{in}}$$

$$F_x = F \frac{dx}{d} = (54^{\text{LB}}) \left( \frac{11}{99} \right) = 6^{\text{LB}}$$

$$F_y = F \frac{dy}{d} = (54) \left( \frac{-88}{99} \right) = -48^{\text{LB}}$$

$$F_z = F \frac{dz}{d} = (54) \left( \frac{-44}{99} \right) = -24^{\text{LB}}$$

$$\vec{T}_{EG} = (6) \hat{i} + (-48) \hat{j} + (-24) \hat{k}^{\text{LB}}$$

$$\vec{r} = (36) \hat{i} + (96) \hat{j} + (27) \hat{k}^{\text{LB}}$$

$$\vec{\Delta}_{AD}: dx = X_D - X_A = 48^{\text{in}}, dy = -12^{\text{in}}, dz = 36^{\text{in}}$$

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

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

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

PROB. 3.58 CONT.

(3)

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

$$\vec{M}_A = \vec{r}_E \times \vec{T}_{EG} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 36 & 96 & 27 \\ 6 & -48 & -24 \end{vmatrix}$$

$$\vec{M}_A = [(96)(-24) - (27)(-48)]\hat{i}$$

$$- [(36)(-24) - (27)(6)]\hat{j}$$

$$+ [(36)(-48) - (96)(6)]\hat{k}$$

$$\vec{M}_A = (-1008)\hat{i} + (1026)\hat{j} + (-2304)\hat{k} \text{ IN}\cdot\text{LB}$$

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

$$M_{AD} = (0.784)(-1008) + (-0.196)(1026) + (0.588)(-2304)$$

$$M_{AD} = -2346 \text{ IN}\cdot\text{LB}$$

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

$$\vec{M}_{AD} = (-2346)[(0.784)\hat{i} + (-0.196)\hat{j} + (0.588)\hat{k}]$$

$$\vec{M}_{AD} = (-1839)\hat{i} + (459.8)\hat{j} + (1379)\hat{k} \text{ IN}\cdot\text{LB}$$