

<3.9~3.11 >

3.37 []

$$\mathbf{r}_{B/A} = (0.56 \text{ m}) \mathbf{i} + (0.9 \text{ m}) \mathbf{j}$$

$$\mathbf{r}_{D/A} = (-0.52 \text{ m}) \mathbf{i} + (0.9 \text{ m}) \mathbf{j} + (0.36 \text{ m}) \mathbf{k}$$

$$\begin{aligned} \mathbf{r}_{B/A} \cdot \mathbf{r}_{D/A} &= [(0.56 \text{ m}) \mathbf{i} + (0.9 \text{ m}) \mathbf{j}] \cdot [(-0.52 \text{ m}) \mathbf{i} + (0.9 \text{ m}) \mathbf{j} + (0.36 \text{ m}) \mathbf{k}] \\ &= (0.56 \text{ m})(-0.52 \text{ m}) + (0.9 \text{ m})(0.9 \text{ m}) = 0.5188 \text{ m}^2 \end{aligned}$$

$$r_{B/A} = \sqrt{(0.56 \text{ m})^2 + (0.9 \text{ m})^2} = 1.06 \text{ m}$$

$$r_{D/A} = \sqrt{(-0.52 \text{ m})^2 + (0.9 \text{ m})^2 + (0.36 \text{ m})^2} = 1.10 \text{ m}$$

$$\mathbf{r}_{B/A} \cdot \mathbf{r}_{D/A} = r_{B/A} r_{D/A} \cos \theta$$

$$\cos \theta = \frac{\mathbf{r}_{B/A} \cdot \mathbf{r}_{D/A}}{r_{B/A} r_{D/A}} = \frac{0.5188 \text{ m}^2}{(1.06 \text{ m})(1.10 \text{ m})} = 0.4449$$

$$\theta = \cos^{-1} 0.4449 = 63.6^\circ$$

3.46 [$\mathbf{M}_O = \mathbf{r} \times \mathbf{F}$,]

$$T_{DE} = 1349 \text{ N}$$

$$\mathbf{r}_{D/O} = (0.90 \text{ m} + 2.30 \text{ m}) \mathbf{i} + (2.25 \text{ m}) \mathbf{k} = (3.20 \text{ m}) \mathbf{i} + (2.25 \text{ m}) \mathbf{k}$$

$$d_{DE} = \sqrt{(-2.30 \text{ m})^2 + (1.50 \text{ m})^2 + (-2.25 \text{ m})^2} = 3.550 \text{ m}$$

$$\begin{aligned} \lambda_{DE} &= \frac{(-2.30 \text{ m}) \mathbf{i} + (1.50 \text{ m}) \mathbf{j} + (-2.25 \text{ m}) \mathbf{j}}{3.550 \text{ m}} \\ &= -0.6479 \mathbf{i} + 0.4225 \mathbf{j} - 0.6338 \mathbf{k} \end{aligned}$$

$$\mathbf{T}_{DE} = T_{DE} \lambda_{DE}$$

$$= (1349 \text{ N}) (-0.6479 \mathbf{i} + 0.4225 \mathbf{j} - 0.6338 \mathbf{k})$$

$$= (-874.0 \text{ N}) \mathbf{i} + (569.9 \text{ N}) \mathbf{j} + (-855.0 \text{ N}) \mathbf{k}$$

$$\mathbf{M}_O = \mathbf{r}_{D/O} \times \mathbf{T}_{DE}$$

$$= [(3.20 \text{ m}) \mathbf{i} + (2.25 \text{ m}) \mathbf{k}] \times [(-874.0 \text{ N}) \mathbf{i} + (569.9 \text{ N}) \mathbf{j} + (-855.0 \text{ N}) \mathbf{k}]$$

$$= [-(2.25 \text{ m})(569.9 \text{ N})] \mathbf{i}$$

$$+ [(2.25 \text{ m})(-874.0 \text{ N}) - (3.20 \text{ m})(-855.0 \text{ N})] \mathbf{j}$$

$$+ [(3.20 \text{ m})(569.9 \text{ N})] \mathbf{k} \quad (\text{N}\cdot\text{m})$$

$$= (-1282.3 \text{ N}\cdot\text{m}) \mathbf{i} + (769.5 \text{ N}\cdot\text{m}) \mathbf{j} + (1823.7 \text{ N}\cdot\text{m}) \mathbf{k}$$

$$M_x = -1282 \text{ N}\cdot\text{m}, \quad M_y = 770 \text{ N}\cdot\text{m}, \quad M_z = 1824 \text{ N}\cdot\text{m}$$

$$3.53 \quad [\quad OL \quad \quad \quad M_{OL} = \lambda_{OL} \cdot (\mathbf{r} \times \mathbf{F}) \quad]$$

$$T_{BH} = 1125 \text{ N}$$

$$\lambda_{AD} = \frac{(0.4 \text{ m} + 0.4 \text{ m})\mathbf{i} + (-0.6 \text{ m})\mathbf{k}}{\sqrt{(0.8 \text{ m})^2 + (-0.6 \text{ m})^2}} = \frac{1}{1.0 \text{ m}} [(0.8 \text{ m})\mathbf{i} + (-0.6 \text{ m})\mathbf{k}]$$

$$= 0.8 \mathbf{i} - 0.6 \mathbf{k}$$

$$\mathbf{r}_{B/A} = (0.4 \text{ m}) \mathbf{i}$$

$$BH ; \quad d_x = (0.7 - 0.4) \text{ (m)} = 0.3 \text{ (m)}, \quad d_y = 0.6 \text{ (m)}, \quad d_z = -0.6 \text{ (m)}$$

$$\lambda_{BH} = \frac{(0.3 \text{ m})\mathbf{i} + (0.6 \text{ m})\mathbf{j} + (-0.6 \text{ m})\mathbf{k}}{\sqrt{(0.3 \text{ m})^2 + (0.6 \text{ m})^2 + (-0.6 \text{ m})^2}} = \frac{1}{0.9} [(0.3)\mathbf{i} + (0.6)\mathbf{j} + (-0.6)\mathbf{k}]$$

$$\mathbf{T}_{BH} = T_{BH} \lambda_{BH} = (1125 \text{ N}) \frac{1}{0.9} [(0.3)\mathbf{i} + (0.6)\mathbf{j} + (-0.6)\mathbf{k}]$$

$$= (375 \text{ N}) \mathbf{i} + (750 \text{ N}) \mathbf{j} + (-750 \text{ N}) \mathbf{k}$$

$$\mathbf{r}_{B/A} \times \mathbf{T}_{BH} = [(0.4 \text{ m}) \mathbf{i}] \times [(375 \text{ N}) \mathbf{i} + (750 \text{ N}) \mathbf{j} + (-750 \text{ N}) \mathbf{k}]$$

$$= [0] \mathbf{i} + [0 - (0.4 \text{ m})(-750 \text{ N})] \mathbf{j} + [(0.4 \text{ m})(750 \text{ N}) - 0] \mathbf{k}$$

$$= 300 \mathbf{j} + 300 \mathbf{k} \quad (\text{N}\cdot\text{m})$$

$$M_{AD} = \lambda_{AD} \cdot (\mathbf{r}_{B/A} \times \mathbf{T}_{BH})$$

$$= [0.8 \mathbf{i} - 0.6 \mathbf{k}] \cdot [300 \mathbf{j} + 300 \mathbf{k}] \quad (\text{N}\cdot\text{m})$$

$$= 0 + 0 + (-0.6)(300) \quad (\text{N}\cdot\text{m})$$

$$= -180.0 \text{ (N}\cdot\text{m)} \quad \quad \quad M_{AD} = -180.0 \text{ N}\cdot\text{m}$$