

<3.9~3.11절>

3.40 [스칼라 곱 응용 : 각, 투영]

$$T_{AC} = 1.26 \text{ kN}$$

(a) $\mathbf{r}_{B/A} = -2.4 \mathbf{i} - 1.8 \mathbf{j} \text{ (m)}$

$$r_{B/A} = \sqrt{(-2.4)^2 + (-1.8)^2 + 0^2} \text{ (m)} = 3.0 \text{ (m)}$$

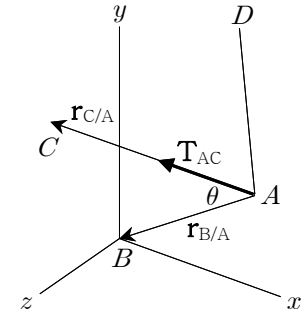
$$\begin{aligned} \mathbf{r}_{C/A} &= -2.4 \mathbf{i} + (2.6-1.8) \mathbf{j} + 1.2 \mathbf{k} \text{ (m)} \\ &= -2.4 \mathbf{i} + 0.8 \mathbf{j} + 1.2 \mathbf{k} \text{ (m)} \end{aligned}$$

$$r_{C/A} = \sqrt{(-2.4)^2 + (0.8)^2 + (1.2)^2} \text{ (m)} = 2.8 \text{ (m)}$$

$$\begin{aligned} \mathbf{r}_{B/A} \cdot \mathbf{r}_{C/A} &= (-2.4 \mathbf{i} - 1.8 \mathbf{j}) \cdot (-2.4 \mathbf{i} + 0.8 \mathbf{j} + 1.2 \mathbf{k}) \text{ (m}^2\text{)} \\ &= (-2.4)^2 + (-1.8)(0.8) + 0 = 4.32 \end{aligned}$$

$$\cos \theta = \frac{\mathbf{r}_{B/A} \cdot \mathbf{r}_{C/A}}{r_{B/A} r_{C/A}} = \frac{4.32}{(3.0)(2.8)} = 0.5143$$

$$\theta = \cos^{-1}(0.5143) = 59.04^\circ \Rightarrow \theta = 59.0^\circ$$



(b) $\mathbf{T}_{AC} \cdot \boldsymbol{\lambda}_{AB} = T_{AC} \cos \theta = (1.26 \text{ kN}) (0.5143) = 0.648 \text{ kN} = 648 \text{ N}$

3.46 [좌표 축 z에 대한 모멘트 $M_z = \mathbf{k} \cdot (\mathbf{r} \times \mathbf{F})$]

$$T = 66 \text{ N}$$

$$d_z = \sqrt{(0.61 \text{ m})^2 - (0.11 \text{ m})^2} = 0.600 \text{ m}$$

$$\begin{aligned} \mathbf{r}_{E/D} &= 0.30 \mathbf{i} + (0.71-0.11) \mathbf{j} - 0.600 \mathbf{k} \text{ (m)} \\ &= 0.30 \mathbf{i} + 0.60 \mathbf{j} - 0.600 \mathbf{k} \text{ (m)} \end{aligned}$$

$$r_{E/D} = \sqrt{0.30^2 + 0.60^2 + (-0.60)^2} \text{ (m)} = 0.90 \text{ m}$$

$$\boldsymbol{\lambda}_{DE} = \frac{\mathbf{r}_{E/D}}{r_{E/D}} = \frac{1}{0.90 \text{ m}} [0.30 \mathbf{i} + 0.60 \mathbf{j} - 0.600 \mathbf{k} \text{ (m)}]$$

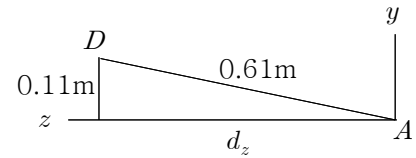
$$= \frac{1}{3} (1 \mathbf{i} + 2 \mathbf{j} - 2 \mathbf{k})$$

$$\mathbf{T}_{DE} = T \boldsymbol{\lambda}_{DE} = \frac{66 \text{ N}}{3} (1 \mathbf{i} + 2 \mathbf{j} - 2 \mathbf{k}) = (22 \text{ N}) (1 \mathbf{i} + 2 \mathbf{j} - 2 \mathbf{k})$$

$$\mathbf{M}_A = \mathbf{r}_{D/A} \times \mathbf{T}_{DE}$$

$$\begin{aligned} &= [0\mathbf{i} + 0.11\mathbf{j} + 0.60\mathbf{k} \text{ (m)}] \times [(22 \text{ N}) (1 \mathbf{i} + 2 \mathbf{j} - 2 \mathbf{k})] \\ &= (22 \text{ N}\cdot\text{m}) [(0.11)(-2) - (0.60)(2)]\mathbf{i} + [(0.60)(1)]\mathbf{j} + [-(0.11)(1)]\mathbf{k} \\ &= (22 \text{ N}\cdot\text{m}) [(-1.42)\mathbf{i} + (0.60)\mathbf{j} + (-0.11)\mathbf{k}] \\ &= -31.24 \mathbf{i} + 13.20 \mathbf{j} - 2.42 \mathbf{k} \text{ (N}\cdot\text{m)} \end{aligned}$$

$$\mathbf{M}_x = (-31.2 \text{ N}\cdot\text{m}) \mathbf{i}, \quad \mathbf{M}_y = (13.20 \text{ N}\cdot\text{m}) \mathbf{j}, \quad \mathbf{M}_z = (-2.42 \text{ N}\cdot\text{m}) \mathbf{k}$$



3.56 [축 OL 에 대한 모멘트 $M_{OL} = \lambda_{OL} \cdot (\mathbf{r} \times \mathbf{F})$]

$$T_{AE} = 55 \text{ N}$$

$$\lambda_{DB} = \frac{(0.9+0.3 \text{ m})\mathbf{i} - (0.7-0.35 \text{ m})\mathbf{j}}{\sqrt{(1.2 \text{ m})^2 + (-0.35 \text{ m})^2}} = 0.96 \mathbf{i} - 0.28 \mathbf{j}$$

$$\begin{aligned} \mathbf{r}_{A/D} &= 0\mathbf{i} + (0.6 - 0.7)\mathbf{j} + (0.2)\mathbf{k} \text{ (m)} \\ &= -0.1 \mathbf{j} + 0.2 \mathbf{k} \text{ (m)} \end{aligned}$$

$$\begin{aligned} \mathbf{T}_{AE} &= T_{AE} \lambda_{AE} \\ &= (55 \text{ N}) \frac{(0.9 \text{ m})\mathbf{i} - (0.6 \text{ m})\mathbf{j} + (0.4 \text{ m} - 0.2 \text{ m})\mathbf{k}}{\sqrt{(0.9 \text{ m})^2 + (-0.6 \text{ m})^2 + (0.2 \text{ m})^2}} \\ &= \frac{55 \text{ N}}{1.1} (0.9\mathbf{i} - 0.6\mathbf{j} + 0.2\mathbf{k}) \\ &= 45.0 \mathbf{i} - 30.0 \mathbf{j} + 10.0 \mathbf{k} \text{ (N)} \end{aligned}$$

$$\begin{aligned} \mathbf{r}_{A/D} \times \mathbf{T}_{AE} &= [-0.1 \mathbf{j} + 0.2 \mathbf{k} \text{ (m)}] \times [45.0 \mathbf{i} - 30.0 \mathbf{j} + 10.0 \mathbf{k} \text{ (N)}] \\ &= [(-0.1) \times (+10.0) - (0.2) \times (-30.0)]\mathbf{i} + (0.2 \times 45.0)\mathbf{j} + [-(-0.1) \times 45.0]\mathbf{k} \text{ (N}\cdot\text{m)} \\ &= 5.0 \mathbf{i} + 9.0 \mathbf{j} + 4.5 \mathbf{k} \text{ (N}\cdot\text{m)} \end{aligned}$$

$$\begin{aligned} M_{DB} &= \lambda_{DB} \cdot \mathbf{M}_D = \lambda_{DB} \cdot (\mathbf{r}_{A/D} \times \mathbf{T}_{AE}) \\ &= (0.96 \mathbf{i} - 0.28 \mathbf{j}) \cdot [5.0 \mathbf{i} + 9.0 \mathbf{j} + 4.5 \mathbf{k} \text{ (N}\cdot\text{m)}] \\ &= (0.96)(5.0) + (-0.28)(9.0) + 0 = 2.28 \text{ (N}\cdot\text{m)} \end{aligned}$$

