

<3.9~3.11절>

3.39 [스칼라 곱 응용 : 각도]

$$\mathbf{r}_{B/A} = 0.45 \mathbf{i} + 0.60 \mathbf{j} \quad (\text{m})$$

$$r_{B/A} = \sqrt{(0.45 \text{ m})^2 + (0.60 \text{ m})^2} = 0.75 \text{ m}$$

$$\mathbf{r}_{D/A} = -0.50 \mathbf{i} + 0.60 \mathbf{j} + 0.36 \mathbf{k} \quad (\text{m})$$

$$r_{D/A} = \sqrt{(-0.50 \text{ m})^2 + (0.60 \text{ m})^2 + (0.36 \text{ m})^2} = 0.86 \text{ m}$$

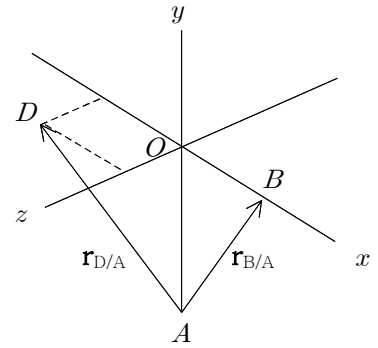
$$\mathbf{r}_{B/A} \cdot \mathbf{r}_{D/A}$$

$$= [0.45 \mathbf{i} + 0.60 \mathbf{j} \text{ (m)}] \cdot [-0.50 \mathbf{i} + 0.60 \mathbf{j} + 0.36 \mathbf{k} \text{ (m)}]$$

$$= (0.45)(-0.50) + (0.60)^2 + 0 \text{ (m}^2\text{)} = 0.135 \text{ (m}^2\text{)}$$

$$\cos \theta = \frac{\mathbf{r}_{B/A} \cdot \mathbf{r}_{D/A}}{r_{B/A} r_{D/A}} = \frac{0.135 \text{ m}^2}{(0.75 \text{ m})(0.86 \text{ m})} = 0.2093$$

$$\theta = \cos^{-1} 0.2093 = 77.9^\circ$$



3.41 [스칼라 곱 응용 : 각, 투영]

(a) EF; $d_x = 2 - \frac{32}{2} \text{ (m)} = -14 \text{ m}$

$$d_y = 0 - \frac{16.5 + 7.5}{2} \text{ (m)} = -12 \text{ m}$$

$$d_z = 0 - \frac{-24}{2} \text{ (m)} = 12 \text{ m}$$

$$\mathbf{r}_{F/E} = -14 \mathbf{i} - 12 \mathbf{j} + 12 \mathbf{k} \quad (\text{m})$$

$$r_{F/E} = \sqrt{(-14 \text{ m})^2 + (-12 \text{ m})^2 + (12 \text{ m})^2} = 22 \text{ m}$$

BC; $d_x = 32 \text{ m}$, $d_y = 7.5 - 16.5 \text{ (m)} = -9 \text{ m}$, $d_z = (-24) - 0 \text{ (m)} = -24 \text{ m}$

$$\mathbf{r}_{C/B} = 32 \mathbf{i} - 9 \mathbf{j} - 24 \mathbf{k} \quad (\text{m})$$

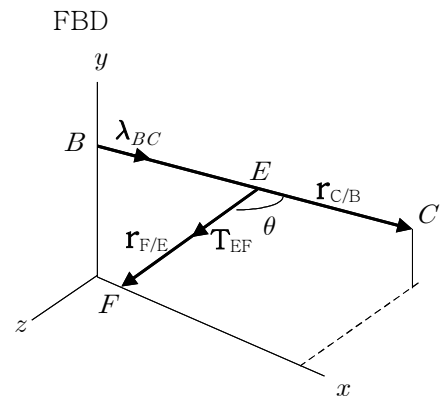
$$r_{C/B} = \sqrt{(32 \text{ m})^2 + (-9 \text{ m})^2 + (-24 \text{ m})^2} = 41 \text{ m}$$

$$\mathbf{r}_{F/E} \cdot \mathbf{r}_{C/B} = [-14 \mathbf{i} - 12 \mathbf{j} + 12 \mathbf{k} \text{ (m)}] \cdot [32 \mathbf{i} - 9 \mathbf{j} - 24 \mathbf{k} \text{ (m)}]$$

$$= (-14)(32) + (-12)(-9) + (12)(-24) \text{ (m}^2\text{)} = -628 \text{ (m}^2\text{)}$$

$$\cos \theta = \frac{\mathbf{r}_{F/E} \cdot \mathbf{r}_{C/B}}{r_{F/E} r_{C/B}} = \frac{(-628 \text{ m}^2)}{(22 \text{ m})(41 \text{ m})} = -0.6962$$

$$\theta = \cos^{-1}(-0.6962) = 134.12^\circ$$



$$\Rightarrow \theta = 134.1^\circ$$

(b) $\mathbf{T}_{EF} \cdot \lambda_{BC} = (T_{EF} \lambda_{EF}) \cdot \lambda_{BC}$

$$= T_{EF} (\lambda_{EF} \cdot \lambda_{BC}) = T_{EF} \cos \theta$$

$$= (110 \text{ N}) (-0.6962) = -76.585 \text{ N}$$

$$\Rightarrow \mathbf{T}_{EF} \cdot \lambda_{BC} = -76.6 \text{ N}$$

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

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

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

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

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

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

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

