

{2.12~14절}

2.71 [공간에서 힘의 직각성분]

$$F = 900 \text{ N}, \quad \alpha = 65^\circ, \quad \beta = 20^\circ$$

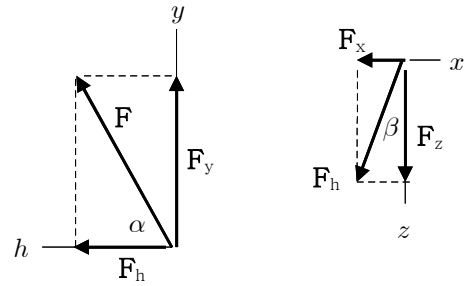
$$(a) \quad F_y = F \sin \alpha = (900 \text{ N}) \sin 65^\circ \\ = 815.6 \text{ N}$$

$$F_h = F \cos \alpha$$

$$F_x = -F_h \sin \beta = -F \cos \alpha \sin \beta \\ = -(900 \text{ N}) \cos 65^\circ \sin 20^\circ \\ = -130.08 \text{ N}$$

$$F_z = F_h \cos \beta = F \cos \alpha \cos \beta \\ = (900 \text{ N}) \cos 65^\circ \cos 20^\circ = 357.4 \text{ N}$$

$$\Rightarrow \quad \mathbf{F}_x = -130.1 \text{ N } \mathbf{i}, \quad \mathbf{F}_y = 816 \text{ N } \mathbf{j}, \quad \mathbf{F}_z = 357 \text{ N } \mathbf{k}$$



$$(b) \quad \cos \theta_x = \frac{F_x}{F} = \frac{-130.08 \text{ N}}{900 \text{ N}} = -0.1445 \quad \Rightarrow \quad \theta_x = \cos^{-1}(-0.1445) = 98.3^\circ$$

$$\cos \theta_y = \frac{F_y}{F} = \frac{815.6 \text{ N}}{900 \text{ N}} = 0.9062 \quad \Rightarrow \quad \theta_y = \cos^{-1}(0.9062) = 25.0^\circ$$

$$\cos \theta_z = \frac{F_z}{F} = \frac{357.4 \text{ N}}{900 \text{ N}} = 0.3971 \quad \Rightarrow \quad \theta_z = \cos^{-1}(0.3971) = 66.6^\circ$$

2.89 [힘의 작용선 상의 두 점과 힘 크기에 의해 정의되는 힘]

$$T = 385 \text{ N}$$

$$(d_{DB})_x = 480 \text{ mm}, \quad (d_{DB})_y = -510 \text{ mm}, \quad (d_{DB})_z = (6000 - 280) \text{ mm} = 320 \text{ mm}$$

$$d_{DB} = \sqrt{(d_{DB})_x^2 + (d_{DB})_y^2 + (d_{DB})_z^2} \\ = \sqrt{(480 \text{ mm})^2 + (-510 \text{ mm})^2 + (320 \text{ mm})^2} \\ = 770 \text{ mm}$$

$$\lambda_{DB} = \frac{1}{d_{DB}} [(d_{DB})_x \mathbf{i} + (d_{DB})_y \mathbf{j} + (d_{DB})_z \mathbf{k}]$$

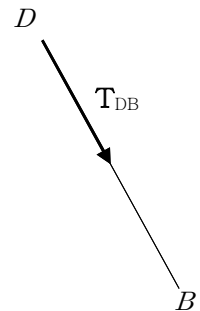
$$= \frac{1}{770} (480 \mathbf{i} - 510 \mathbf{j} + 320 \mathbf{k})$$

$$= \frac{1}{77} (48 \mathbf{i} - 51 \mathbf{j} + 32 \mathbf{k})$$

$$\mathbf{T}_{DB} = T \lambda_{DB} = (385 \text{ N}) \frac{1}{77} (48 \mathbf{i} - 51 \mathbf{j} + 32 \mathbf{k})$$

$$= 240 \mathbf{i} - 255 \mathbf{j} + 160 \mathbf{k} \text{ (N)}$$

$$\Rightarrow \quad (\mathbf{T}_{DB})_x = 240 \text{ N } \mathbf{i}, \quad (\mathbf{T}_{DB})_y = -255 \text{ N } \mathbf{j}, \quad (\mathbf{T}_{DB})_z = 160.0 \text{ N } \mathbf{k}$$



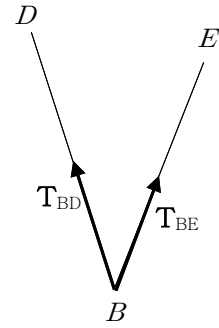
2.96 [공간에서 힘의 직각성분 합성]

$$T_{AB} = 1,425 \text{ N}$$

$$d_x = 900 \text{ mm}, \quad d_y = -600 \text{ mm}, \quad d_z = -360 \text{ mm}$$

$$\begin{aligned} d &= \sqrt{d_x^2 + d_y^2 + d_z^2} \\ &= \sqrt{(900 \text{ mm})^2 + (-600 \text{ mm})^2 + (-360 \text{ mm})^2} \\ &= 1,140 \text{ mm} \end{aligned}$$

$$\begin{aligned} \mathbf{T}_{AB} &= T_{AB} \lambda_{AB} \\ &= \frac{T_{AB}}{d} (d_x \mathbf{i} + d_y \mathbf{j} + d_z \mathbf{k}) \\ &= \frac{1,425 \text{ N}}{1,140 \text{ mm}} [(900 \text{ mm}) \mathbf{i} + (-600 \text{ mm}) \mathbf{j} + (-360 \text{ mm}) \mathbf{k}] \\ &= (1,125 \text{ N}) \mathbf{i} + (-750 \text{ N}) \mathbf{j} + (-450 \text{ N}) \mathbf{k} \end{aligned}$$



$$T_{AC} = 2,130 \text{ N}$$

$$d_x = 900 \text{ mm}, \quad d_y = -600 \text{ mm}, \quad d_z = 920 \text{ mm}$$

$$\begin{aligned} d &= \sqrt{d_x^2 + d_y^2 + d_z^2} \\ &= \sqrt{(900 \text{ mm})^2 + (-600 \text{ mm})^2 + (920 \text{ mm})^2} \\ &= 1,420 \text{ mm} \end{aligned}$$

$$\begin{aligned} \mathbf{T}_{AC} &= T_{AC} \lambda_{AC} \\ &= \frac{T_{AC}}{d} (d_x \mathbf{i} + d_y \mathbf{j} + d_z \mathbf{k}) \\ &= \frac{2,130 \text{ N}}{1,420 \text{ mm}} [(900 \text{ mm}) \mathbf{i} + (-600 \text{ mm}) \mathbf{j} + (920 \text{ mm}) \mathbf{k}] \\ &= (1,350 \text{ N}) \mathbf{i} + (-900 \text{ N}) \mathbf{j} + (1,380 \text{ N}) \mathbf{k} \end{aligned}$$

$$\begin{aligned} \mathbf{R} &= \mathbf{T}_{AB} + \mathbf{T}_{AC} \\ &= [1,125 \mathbf{i} - 750 \mathbf{j} - 450 \mathbf{k} \text{ (N)}] + [1,350 \mathbf{i} - 900 \mathbf{j} + 1,380 \mathbf{k} \text{ (N)}] \\ &= (2,475 \text{ N}) \mathbf{i} + (-1,650 \text{ N}) \mathbf{j} + (930 \text{ N}) \mathbf{k} \end{aligned}$$

$$\begin{aligned} R &= \sqrt{R_x^2 + R_y^2 + R_z^2} \\ &= \sqrt{(2,475 \text{ N})^2 + (-1,650 \text{ N})^2 + (930 \text{ N})^2} = 3,116 \text{ N} \quad \Rightarrow \quad R = 3,120 \text{ N} \end{aligned}$$

$$\cos \theta_x = \frac{R_x}{R} = \frac{2,475 \text{ N}}{3,116 \text{ N}} = 0.7941 \quad \Rightarrow \quad \theta_x = \cos^{-1}(0.7941) = 37.4^\circ$$

$$\cos \theta_y = \frac{R_y}{R} = \frac{-1,650 \text{ N}}{3,116 \text{ N}} = -0.5295 \quad \Rightarrow \quad \theta_y = \cos^{-1}(-0.5295) = 122.0^\circ$$

$$\cos \theta_z = \frac{R_z}{R} = \frac{930 \text{ N}}{3,116 \text{ N}} = 0.2984 \quad \Rightarrow \quad \theta_z = \cos^{-1}(0.2984) = 72.6^\circ$$