

[3.1절]

3.25 $l_{AB} = 2 \text{ m}$, $T_{BC} = 30 \text{ N}$, $\alpha = 8^\circ$, $\beta = 30^\circ$, $\phi = 45^\circ$

S; given l_{AB} , T_{BC} , α , β , ϕ , required \mathbf{M}_A

⇒ 점에 관한 모멘트, 위치벡터와 힘벡터의 벡터곱

A; ① 위치벡터

$$\begin{aligned} \mathbf{r}_{AB} &= l_{AB} \sin\phi \mathbf{j} - l_{AB} \cos\phi \mathbf{k} \\ &= (2 \text{ m}) \sin 45^\circ \mathbf{j} - (2 \text{ m}) \cos 45^\circ \mathbf{k} \\ &= 1.4142 \mathbf{j} - 1.4142 \mathbf{k} \text{ (m)} \end{aligned}$$

② 힘벡터

$$T_y = -T_{BC} \sin\alpha = -(30 \text{ N}) \sin 8^\circ = -4.175 \text{ N}$$

$$T_h = T_{BC} \cos\alpha$$

$$T_x = T_h \sin\beta = T_{BC} \cos\alpha \sin\beta = (30 \text{ N}) \cos 8^\circ \sin 30^\circ = 14.854 \text{ N}$$

$$T_z = -T_h \cos\beta = -T_{BC} \cos\alpha \cos\beta = -(30 \text{ N}) \cos 8^\circ \cos 30^\circ = -25.73 \text{ N}$$

$$\mathbf{T}_{BC} = 14.854 \mathbf{i} - 4.175 \mathbf{j} - 25.73 \mathbf{k} \text{ (N)}$$

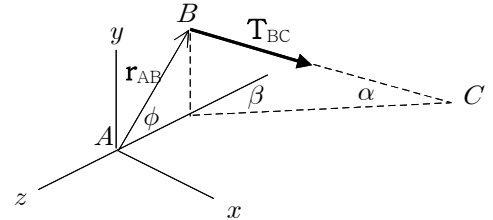
③ 벡터곱

$$\begin{aligned} \mathbf{M}_A &= \mathbf{r}_{AB} \times \mathbf{T}_{BC} \\ &= [1.4142 \mathbf{j} - 1.4142 \mathbf{k} \text{ (m)}] \times [14.854 \mathbf{i} - 4.175 \mathbf{j} - 25.73 \mathbf{k} \text{ (N)}] \\ &= [(1.4142)(-25.73) - (-1.4142)(-4.175)] \mathbf{i} + [(-1.4142)(14.854) - 0] \mathbf{j} \\ &\quad + [0 - (1.4142)(14.854)] \mathbf{k} \text{ (N} \cdot \text{m)} \\ &= -42.3 \mathbf{i} - 21.0 \mathbf{j} - 21.0 \mathbf{k} \text{ (N} \cdot \text{m)} \end{aligned}$$

R(과정의 타당성) : (가령 $T_x > 0$, $T_y < 0$, $T_z < 0$, 각 힘의 직각성분의 방향)

T(결과의 의미) ; (가령, $M_x < 0$, $M_y < 0$, $M_z < 0$, 각 좌표축에 관한 모멘트의 방향)

M; 자유물체도(F.B.D.)



3.30 $T_{BC} = 30 \text{ N}$, $\mathbf{M}_A = -42.3 \mathbf{i} - 21.0 \mathbf{j} - 21.0 \mathbf{k} \text{ (N} \cdot \text{m)}$

S; given T_{BC} , \mathbf{M}_A , required d

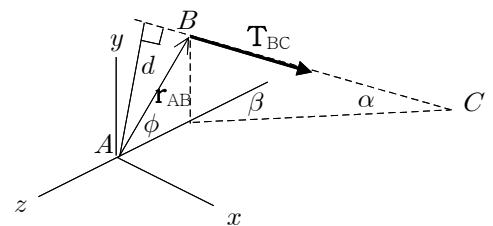
$$\Rightarrow M_A = T_{BC} d$$

$$\begin{aligned} \text{A; } M_A &= \sqrt{(-42.3)^2 + (-21.0)^2 + (-21.0)^2} \text{ N} \cdot \text{m} \\ &= 51.68 \text{ N} \cdot \text{m} \end{aligned}$$

$$d = \frac{M_A}{T_{BC}} = \frac{51.68 \text{ N} \cdot \text{m}}{30 \text{ N}} = 1.7228 \text{ m}$$

$$\Rightarrow d = 1.723 \text{ m}$$

M; 자유물체도(F.B.D.)



R; 모멘트 = 수직거리 \times 힘 크기

T; 수직거리 $d < r_{AB}$ ($r_{AB} = \sqrt{0 + (1.4142)^2 + (-1.4142)^2} \text{ m} = 2.00 \text{ m}$)