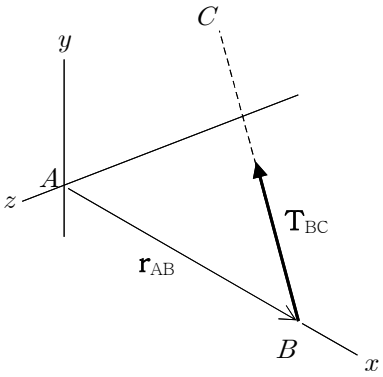
{3.1절}

3.22　T_{BC} = 2.5 kN

S; 점에 관한 모멘트, 위치벡터와 힘벡터의 벡터곱

M; 자유물체도(F.B.D.)



A; ① 위치벡터　$\mathbf{r}_{AB}$ = (6 m) $\mathbf{i}$

② 힘벡터

$(d_{BC})x$ = −6 m,　$(d_{BC})y$ = 2.4 m,　$(d_{BC})z$ = −4 m

$d_{BC} = \sqrt{(-6\text{ m})^2 + (2.4\text{ m})^2 + (-4\text{ m})^2} = 7.60$ m

$\boldsymbol{\lambda}_{BC} = \frac{1}{7.6}(-6\,\mathbf{i} + 2.4\,\mathbf{j} - 4\,\mathbf{k})$

$\mathbf{T}_{BC} = T_{BC}\,\boldsymbol{\lambda}_{BC}$

$= (2.5\text{ kN})\frac{1}{7.6}(-6\,\mathbf{i} + 2.4\,\mathbf{j} - 4\,\mathbf{k})$

$= -1.974\,\mathbf{i} + 0.789\,\mathbf{j} - 1.316\,\mathbf{k}$ (kN)

③ 벡터곱

$\mathbf{M}_A = \mathbf{r}_{AB} \times \mathbf{T}_{BC}$

$= [(6\text{ m})\,\mathbf{i}\,] \times [-1.9737\,\mathbf{i} + 0.7895\,\mathbf{j} - 1.3158\,\mathbf{k}\ (\text{kN})]$

$= -(6)(-1.3158)]\,\mathbf{j} + [(6)(0.7895)]\,\mathbf{k}$ (kN·m)

$= 7.89\,\mathbf{j} + 4.74\,\mathbf{k}$ (kN·m)

R; (과정의 타당성 검토)

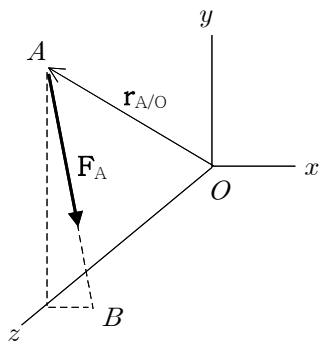
T; (결과의 의미 검토)

{3.2절}

3.47 d = 25 m, T_{AB} = 4 kN

S; 좌표축에 관한 모멘트,
좌표축 단위벡터와 위치벡터와 힘벡터의 삼중곱

M; 자유물체도(F.B.D.)



A; ① 위치벡터

d_x = 0, d_y = 15 m

$d_z = \sqrt{d^2 - d_y^2} = \sqrt{(25\text{ m})^2 - (15\text{ m})^2}$ = 20 m

$\mathbf{r}_{A/O}$ = 0 **i** + (15 m) **j** + (20 m) **k**

= 15 **j** + 20 **k** (m)

② 힘벡터

$(d_{AB})x$ = 2.5 m, $(d_{AB})y$ = −15 m, $(d_{AB})z$ = 0

$d_{AB} = \sqrt{(2.5\text{ m})^2 + (-15\text{ m})^2 + 0}$ = 15.207 m

$\boldsymbol{\lambda}_{AB} = \frac{1}{15.207}$ (2.5 **i** − 15 **j**) = 0.1644 **i** − 0.9864 **j**

$\mathbf{F}_A = T_{AB}\,\boldsymbol{\lambda}_{AB}$

= (4 kN) (0.1644 **i** − 0.9864 **j**)

= 0.6576 **i** − 3.946 **j** (kN)

③ 벡터곱

$\mathbf{M}_O = \mathbf{r}_{A/O} \times \mathbf{F}_A$

= [15 **j** + 20 **k** (m)] × [0.6576 **i** − 3.946 **j** (kN)]

= [−(20)(−3.946)] **i** + [(20)(0.6576)] **j** + [−(15)(0.6576)] **k** (kN·m)

= (78.92) **i** + (13.152) **j** + (−9.864) **k** (kN·m)

④ 삼중곱

⇒ $M_x = \mathbf{M}_O \cdot \mathbf{i}$ = [(78.92) **i** + (13.152) **j** + (−9.864) **k** (kN·m)] · **i** = 78.9 kN·m

$M_y = \mathbf{M}_O \cdot \mathbf{j}$ = [(78.92) **i** + (13.152) **j** + (−9.864) **k** (kN·m)] · **j** = 13.15 kN·m

$M_z = \mathbf{M}_O \cdot \mathbf{k}$ = [(78.92) **i** + (13.152) **j** + (−9.864) **k** (kN·m)] · **k** = −9.86 kN·m

R; (과정의 타당성 검토)

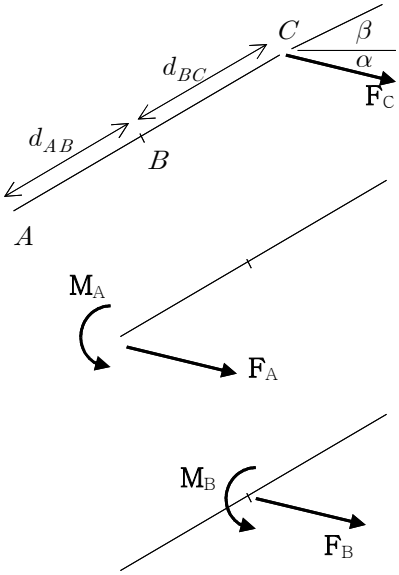
T; (결과의 의미 검토)

{3.3절}

3.82 T = 2.24 kN, α = 20°, β = 30°, d_{AB} = 2.4 m, d_{BC} = 3 m

S; 2차원 등가 힘-우력 계

M; 자유물체도(F.B.D.)



A; $\mathbf{F}_C = T \searrow \alpha$ = 2.24 kN $\searrow$20°

(a) $\Sigma\mathbf{F}$; $\mathbf{F}_A = \mathbf{F}_C$ = 2.24 kN $\searrow$20°

$\circlearrowleft\Sigma M_A$; $M_A = -(d_{AB} + d_{BC})\ [F_C \sin(\alpha+\beta)]$

= -(5.4 m) (2.24 kN) sin50°

= -9.267 kN·m

⇒ $\mathbf{F}_A$ = 2.24 kN $\searrow$20°, $\mathbf{M}_A$ = 9.27 kN·m $\circlearrowleft$

(b) $\Sigma\mathbf{F}$; $\mathbf{F}_B = \mathbf{F}_C$ = 2.24 kN $\searrow$20°

$\circlearrowleft\Sigma M_B$; $M_B = -d_{BC}\ [F_C \sin(\alpha+\beta)]$

= -(3 m) (2.24 kN) sin50°

= -5.148 kN·m

⇒ $\mathbf{F}_B$ = 2.24 kN $\searrow$20°, $\mathbf{M}_B$ = 5.15 kN·m $\circlearrowleft$

R; (과정의 타당성 검토)

T; (결과의 의미 검토)