[3.2절]

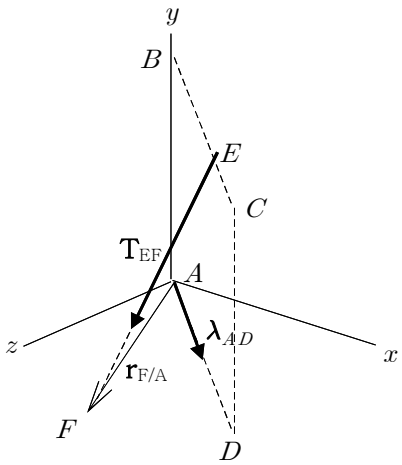
3.55 S; T_{EF} = 230 N,

M_{AD} = ?

⇒ 축 AD에 관한 모멘트

$M_{AD} = \boldsymbol{\lambda}_{AD} \cdot (\mathbf{r} \times \mathbf{T}_{EF})$]

M; 자유물체도(F.B.D.)



A; ① 위치벡터

$\mathbf{r}_{F/A}$ = (525) **i** + (−350) **j** + (1425) **k** (mm)

= 0.525 **i** − 0.350 **j** + 1.425 **k** (m)

② 힘벡터를 구하기 위해 E의 좌표 필요

$BC = \sqrt{1200^2 + 900^2}$ mm = 1500 mm

$\frac{BE}{BC} = \frac{1125}{1500} = 0.750$

x = 0.750(1,200 mm) = 900 mm, y = 2,400 mm, z = 0.750(900 mm) = 675 mm

$\mathbf{r}_{F/E}$ = (525 − 900) **i** + (−350 − 2,400) **j** + (1,425 − 675) **k** (mm)

= (−375) **i** + (−2,750) **j** + (750) **k** (mm)

$d_{EF} = \sqrt{(-375)^2 + (-2{,}750)^2 + (750)^2}$ mm = 2,875 mm

$\boldsymbol{\lambda}_{EF} = \frac{1}{2{,}875}$ (−375) **i** + (−2,750) **j** + (750) **k**

$\mathbf{T}_{EF} = T_{EF}\ \boldsymbol{\lambda}_{EF}$

$= \frac{230\ \text{N}}{2{,}875}$ [(−375) **i** + (−2,750) **j** + (750) **k**]

= −30.0 **i** − 220 **j** + 60.0 **k** (N)

①② $\mathbf{M}_A = \mathbf{r}_{F/A} \times \mathbf{T}_{EF}$

= [0.525 **i** − 0.350 **j** + 1.425 **k** (m)] × [−30.0 **i** − 220 **j** + 60.0 **k** (N)]

= [(−0.350)(60.0)−(1.425)(−220)] **i** + [(1.425)(−30.0)−(0.525)(60.0)] **j**

+ [(0.525)(−220)−(−0.350)(−30.0)] **k** (N · m)

= 292.5 **i** − 74.25 **j** − 126.0 **k** (N · m)

③ $AD = \sqrt{(1{,}200\,\text{mm})^2 + (-300\,\text{mm})^2 + (900\,\text{mm})^2}$ = 1,529.7 mm

$\boldsymbol{\lambda}_{AD} = \frac{(1{,}200\,\text{mm})\mathbf{i} + (-300\,\text{mm})\mathbf{j} + (900\,\text{mm})\mathbf{k}}{1{,}529.7\,\text{mm}}$ = 0.7844 **i** − 0.1961 **j** + 0.5884 **k**

④ $M_{AD} = \boldsymbol{\lambda}_{AD} \cdot \mathbf{M}_A = \boldsymbol{\lambda}_{AD} \cdot (\mathbf{r}_{F/A} \times \mathbf{T}_{EF})$

= (0.7844 **i** − 0.1961 **j** + 0.5884 **k**) · [292.5 **i** − 74.25 **j** − 126.0 **k** (N · m)]

= (0.7844)(292.5) + (−0.1961)(−74.25) + (0.5884)(−126.0) = 98.50 (N · m)

⇒ M_{AD} = 169.9 N · m

R(과정의 타당성) : (가령 $\mathbf{M}_A$ 계산에 사용될 수 있는 위치벡터 $\mathbf{r}_{F/A}$, $\mathbf{r}_{F/D}$, $\mathbf{r}_{E/A}$, $\mathbf{r}_{E/D}$ 중 선택)

T(결과의 의미) ; (가령, M_{AD}>0, 선 AD에 관한 모멘트의 방향)