

[3.2절]

3.55 S; $CD = 23 \text{ cm}$, $AB = 50 \text{ cm}$, $P = 235 \text{ N}$,

$$M_{AB} = ?$$

⇒ 축 AB 에 관한 모멘트

$$M_{AB} = \lambda_{AB} \square \mathbf{r}_{G/B} \times \mathbf{P}]$$

A; ① 위치벡터 $\mathbf{r}_{G/A}$ 또는 $\mathbf{r}_{G/B}$

$$\begin{aligned} \mathbf{r}_{G/B} &= [(16+21)-32]\mathbf{i} + (0)\mathbf{j} + (12+18)\mathbf{k} \text{ (cm)} \\ &= 5 \mathbf{i} + 30 \mathbf{k} \text{ (cm)} = 0.05 \mathbf{i} + 0.3 \mathbf{k} \text{ (m)} \end{aligned}$$

② 힘벡터

$$DG = \sqrt{21^2 + (-23-15)^2 + 18^2} \text{ cm} = 47.0 \text{ cm}$$

$$\lambda_{DG} = \frac{1}{47.0} (21 \mathbf{i} - 38 \mathbf{j} + 18 \mathbf{k})$$

$$\begin{aligned} \mathbf{P} &= P \lambda_{DG} \\ &= \frac{235 \text{ N}}{47.0} (21 \mathbf{i} - 38 \mathbf{j} + 18 \mathbf{k}) \\ &= 105 \mathbf{i} - 190 \mathbf{j} + 90 \mathbf{k} \text{ (N)} \end{aligned}$$

①② $\mathbf{M}_B = \mathbf{r}_{G/B} \times \mathbf{P}$

$$\begin{aligned} &= [0.05 \mathbf{i} + 0.3 \mathbf{k} \text{ (m)}] \times [105 \mathbf{i} - 190 \mathbf{j} + 90 \mathbf{k} \text{ (N)}] \\ &= [0 - (-0.3)(-190)]\mathbf{i} + [(0.3)(105) - (0.05)(90)]\mathbf{j} + [(0.05)(-190) - 0]\mathbf{k} \text{ (Nm)} \\ &= 57 \mathbf{i} + 27 \mathbf{j} - 9.5 \mathbf{k} \text{ (Nm)} \end{aligned}$$

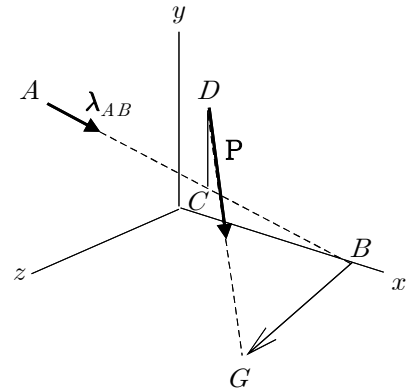
③ $AB = \sqrt{(32 \text{ cm})^2 + (-30 \text{ cm})^2 + (-24 \text{ cm})^2} = 50 \text{ cm}$

$$\lambda_{AB} = \frac{(32 \text{ cm})\mathbf{i} + (-30 \text{ cm})\mathbf{j} + (-24 \text{ cm})\mathbf{k}}{50 \text{ cm}} = 0.64 \mathbf{i} - 0.60 \mathbf{j} - 0.48 \mathbf{k}$$

④ $M_{AB} = \lambda_{AB} \square \mathbf{M}_B = \lambda_{AB} \square \mathbf{r}_{G/B} \times \mathbf{P}$

$$\begin{aligned} &= (0.64 \mathbf{i} - 0.60 \mathbf{j} - 0.48 \mathbf{k}) \square [57 \mathbf{i} + 27 \mathbf{j} - 9.5 \mathbf{k} \text{ (Nm)}] \\ &= (0.64)(57) + (-0.60)(27) + (-0.48)(-9.5) = 24.84 \text{ (Nm)} \end{aligned}$$

M; 자유물체도(F.B.D.)



R(과정의 타당성) : (가령 \mathbf{M}_B 계산에 사용될 수 있는 위치벡터 $\mathbf{r}_{G/A}$, $\mathbf{r}_{D/A}$, $\mathbf{r}_{G/B}$, $\mathbf{r}_{D/B}$, $\mathbf{r}_{G/C}$, $\mathbf{r}_{D/C}$)

T(결과의 의미) ; (가령, $M_{AB} > 0$, 선 AB 에 관한 모멘트의 방향)

$$\Rightarrow M_{AB} = 24.8 \text{ Nm}$$