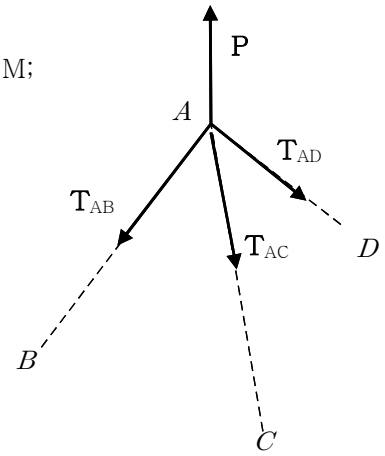
[2.5절]

2.109 T_{AC} = 60 N

S; known T_{AC}, 좌표들, unknown T_{AB}, T_{AD}, W M;

⇒ 공간에서 힘의 직각성분 (좌표 이용), 평형



A; $\mathbf{P} = -P\,\mathbf{j}$, $\mathbf{W} = W\,\mathbf{j}$

$\mathbf{P} + \mathbf{W} = 0 \quad \Rightarrow \quad -P\,\mathbf{j} + W\,\mathbf{j} = 0 \quad \Rightarrow \quad W = P$

$$d_{AB} = \sqrt{(-320\text{ mm})^2 + (-480\text{ mm})^2 + (360\text{ mm})^2}$$
$$= 680\text{ mm}$$
$$\boldsymbol{\lambda}_{AB} = \frac{1}{680}(-320\,\mathbf{i} - 480\,\mathbf{j} + 360\,\mathbf{k})$$
$$= -0.4706\,\mathbf{i} - 0.7059\,\mathbf{j} + 0.5294\,\mathbf{k}$$
$$\mathbf{T}_{AB} = T_{AB}\boldsymbol{\lambda}_{AB} = T_{AB}(-0.4706\,\mathbf{i} - 0.7059\,\mathbf{j} + 0.5294\,\mathbf{k})$$

$$d_{AC} = \sqrt{(450\text{ mm})^2 + (-480\text{ mm})^2 + (360\text{ mm})^2} = 750\text{ mm}$$
$$\boldsymbol{\lambda}_{AC} = \frac{1}{750}(450\,\mathbf{i} - 480\,\mathbf{j} + 360\,\mathbf{k}) = 0.6000\,\mathbf{i} - 0.6400\,\mathbf{j} + 0.4800\,\mathbf{k}$$
$$\mathbf{T}_{AC} = T_{AC}\boldsymbol{\lambda}_{AC} = (60\text{ N})(0.600\,\mathbf{i} - 0.6400\,\mathbf{j} + 0.4800\,\mathbf{k})$$
$$= (36.0\text{ N})\,\mathbf{i} - (38.4\text{ N})\,\mathbf{j} + (28.8\text{ N})\,\mathbf{k}$$

$$d_{AD} = \sqrt{(250\text{ mm})^2 + (-480\text{ mm})^2 + (-360\text{ mm})^2} = 650\text{ mm}$$
$$\boldsymbol{\lambda}_{AD} = \frac{1}{650}(250\,\mathbf{i} - 480\,\mathbf{j} - 360\,\mathbf{k}) = 0.3846\,\mathbf{i} - 0.7384\,\mathbf{j} - 0.5538\,\mathbf{k}$$
$$\mathbf{T}_{AD} = T_{AD}\boldsymbol{\lambda}_{AD} = T_{AD}(0.3846\,\mathbf{i} - 0.7384\,\mathbf{j} - 0.5538\,\mathbf{k})$$

$\Sigma\mathbf{F} = 0 \Rightarrow \quad \mathbf{T}_{AB} + \mathbf{T}_{AC} + \mathbf{T}_{AD} + \mathbf{P} = 0$

$\Sigma F_x = 0$; $-0.4706\,T_{AB} + (36.0\text{ N}) + 0.3846\,T_{AD} = 0$ … ①

$\Sigma F_y = 0$; $-0.7059\,T_{AB} - (38.4\text{ N}) - 0.7384\,T_{AD} + P = 0$ … ②

$\Sigma F_z = 0$; $0.5294\,T_{AB} + (28.8\text{ N}) - 0.5538\,T_{AD} = 0$ … ③

①×0.5538 + ③×0.3846

$$[(-0.4706)(0.5538) + (0.5294)(0.3846)]\,T_{AB} + [(36.0\text{ N})(0.5538) + (28.8\text{ N})(0.3846)] = 0$$

$$\Rightarrow \quad T_{AB} = 544.0\text{ N}$$

① ⇒ $T_{AD} = \frac{1}{0.3846}[(0.4706)(544.0\text{ N}) - (36.0\text{ N})] = 572.0\text{ N}$

② ⇒ $P = (0.7059)(544.0\text{ N}) + (38.4\text{ N}) + (0.7384)(572.0\text{ N}) = 844.4\text{ N}$

$$\Rightarrow \quad P = 844\text{ N}$$

R; 과정의 타당성 (가령, 공간에서 힘의 직각성분)

T; 결과 검토 (가령, 세 힘의 수평성분의 합)