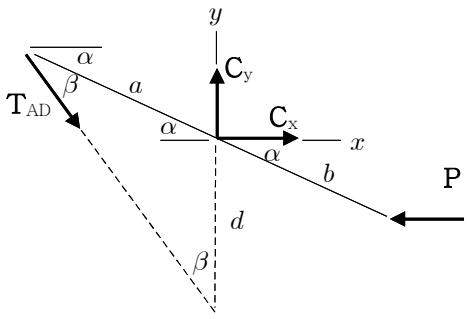
[4.1절]

4.22 S; known ; **P** = 500 N ←, a = 0.250 m, b = 0.200 m, d = 0.2 50 m, α = 30°
unknown ; T_{AD}, **C**
⇒ 모멘트 평형, 힘의 평형, 반력 유형 1&2

M; 자유물체도(F.B.D.)



A; (a) $AC = CD$ 이고, 각ACD = 120°
⇒ 각A = 각D = β = 30°
$+\circlearrowleft\Sigma M_C = 0$;

$$a\,(T_{AD}\sin\beta) - (b\sin\alpha)\,P = 0$$

$$\Rightarrow\ T_{AD} = \frac{b\sin\alpha}{a\sin\beta}P = \frac{(0.2\text{ m})\sin30^\circ}{(0.25\text{ m})\sin30^\circ}\ (500\text{ N})$$

$$= 400\text{ N}$$

⇒ T_{AD} = 400 N

(b) $\gamma = \alpha + \beta = 30^\circ + 30^\circ = 60^\circ$
$\rightarrow\Sigma F_x = 0$;

$$C_x + T_x - P = 0$$

$$\Rightarrow\ C_x = -T_{AD}\cos\gamma + P = -(400\text{ N})\cos60^\circ + (500\text{ N}) = 300\text{ N}$$

$\uparrow\Sigma F_y = 0$;

$$C_y - T_y = 0$$

$$\Rightarrow\ C_y = T_{AD}\sin\gamma = (400\text{ N})\sin60^\circ = 346.4\text{ N}$$

$$C = \sqrt{C_x^2 + C_y^2} = \sqrt{(300\text{ N})^2 + (346.4\text{ N})^2} = 458.2\text{ N}$$

$$\theta = \tan^{-1}\frac{C_y}{C_x} = \tan^{-1}\frac{346.4\text{ N}}{300\text{ N}} = \tan^{-1}(1.1547) = 49.1^\circ$$

⇒ **C** = 458 N ∠49.1°

R; (예: $+\circlearrowleft\Sigma M_A = 0$ 을 사용하면?
힘의 평형 방정식 ($\rightarrow\Sigma F_x = 0$, $\uparrow\Sigma F_y = 0$)을 먼저 사용하면?
x축을 막대 방향으로 설정하면?)

T; (예: 힌지 C의 역할)

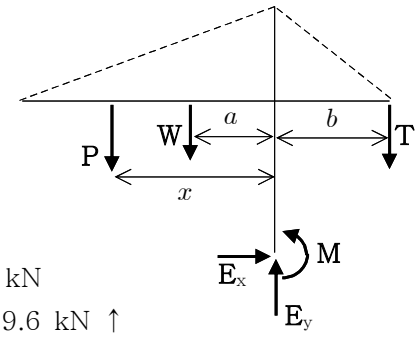
4.43 P = 16.2 kN, W = 5.4 kN, T = 18 kN, x = 4.8 m, a = 2.6 m, b = 1.5 m

S; 반력 유형 1&3(고정지지, 줄)

힘의 평형, 모멘트 평형,

$\rightarrow\Sigma F_x = 0$, $\uparrow\Sigma F_y = 0$, $+\circlearrowleft\Sigma M_E = 0$

(a) M; 자유물체도(F.B.D.)



A; $\rightarrow\Sigma F_x = 0$; $E_x = 0$

$\uparrow\Sigma F_y = 0$; $E_y - P - W - T = 0$

$\Rightarrow$ $E_y = P + W + T$

$= (16.2\ \text{kN}) + (5.4\ \text{kN}) + (18\ \text{kN}) = 39.6\ \text{kN}$

$\Rightarrow$ **E** = 39.6 kN ↑

$+\circlearrowleft\Sigma M_E = 0$; $M + x\ P + a\ W - b\ T = 0$

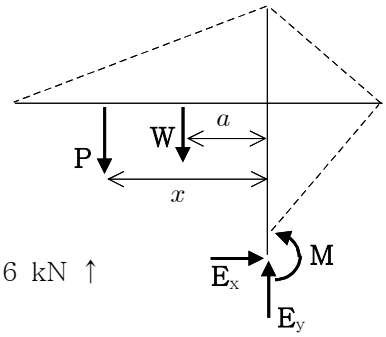
$\Rightarrow$ $M = -x\ P - a\ W + b\ T$

$= -(4.8\ \text{m})(16.2\ \text{kN}) - (2.6\ \text{m})(5.4\ \text{kN}) + (1.5\ \text{m})(18\ \text{kN})$

$= -64.8\ \text{kN·m}$

$\Rightarrow$ **M** = 64.8 kN·m ↺

(b) M; 자유물체도(F.B.D.)



A; $\rightarrow\Sigma F_x = 0$; $E_x = 0$

$\uparrow\Sigma F_y = 0$; $E_y - P - W = 0$

$\Rightarrow$ $E_y = P + W$

$= (16.2\ \text{kN}) + (5.4\ \text{kN}) = 21.6\ \text{kN}$

$\Rightarrow$ **E** = 21.6 kN ↑

$+\circlearrowleft\Sigma M_E = 0$; $M + x\ P + a\ W = 0$

$\Rightarrow$ $M = -x\ P - a\ W$

$= -(4.8\ \text{m})(16.2\ \text{kN}) - (2.6\ \text{m})(5.4\ \text{kN})$

$= -91.8\ \text{kN·m}$

$\Rightarrow$ **M** = 91.8 kN·m ↺

R; (예: ΣM_A 또는 ΣM_C 를 사용하는 경우)

T; (예: a와 b에서 반력 모멘트 방향이 다른 이유)