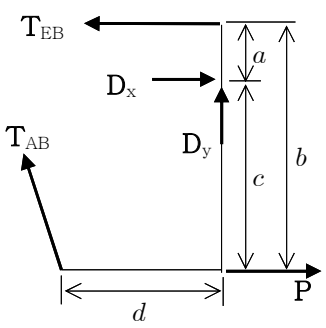
[4.1절]

4.33 S; known ; **P** = 90 N →, a = 3 cm, b = 12 cm, d = 7 cm
unknown ; T, **D**　　M; 자유물체도(F.B.D.)



⇒ 모멘트 평형, 힘의 평형, 반력 유형 1&2

A; $c = b - a = (12\text{ cm}) - (3\text{ cm}) = 9\text{ cm}$

$T_{EB} = T_{AB} = T,\quad T_{ABx} = \frac{5}{13}T,\quad T_{ABy} = \frac{12}{13}T$

(a) $+\circlearrowleft\Sigma M_D = 0$;

$$a\ T_{EB} + c\ P - c\ T_{ABx} - d\ T_{ABy} = 0$$

$$\Rightarrow\ a\ T + c\ P - c\ \frac{5}{13}T - d\ \frac{12}{13}T = 0$$

$$\Rightarrow\ T = \frac{c}{\frac{5}{13}c + \frac{12}{13}d - a}P = \frac{(9\text{ cm})}{\frac{5}{13}(9\text{ cm}) + \frac{12}{13}(7\text{ cm}) - (3\text{ cm})}\ (90\text{ N})$$

$= (1.3)\ (90\text{ N}) = 117.0\text{ N}$　　⇒　　$T = 117.0$ N

(b) $\rightarrow\Sigma F_x = 0$;

$$D_x + P - T_{EB} - T_{ABx} = 0$$

$$\Rightarrow\ D_x = T + \frac{5}{13}T - P = \frac{18}{13}(117.0\text{ N}) - (90\text{ N}) = 72.0\text{ N}$$

$\uparrow\Sigma F_y = 0$;

$$D_y + T_{ABy} = 0$$

$$\Rightarrow\ D_y = -\frac{12}{13}T = -\frac{12}{13}(117.0\text{ N}) = -108.0\text{ N}$$

$$D = \sqrt{D_x^2 + D_y^2} = \sqrt{(72.0\text{ N})^2 + (-108.0\text{ N})^2} = 129.80\text{ N}$$

$$\theta = \tan^{-1}\frac{D_y}{D_x} = \tan^{-1}\frac{-108.0\text{ N}}{72.0\text{ N}} = \tan^{-1}(-1.500) = -56.3°$$

⇒　　**D** = 129.8 N ↘56.3°

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?)

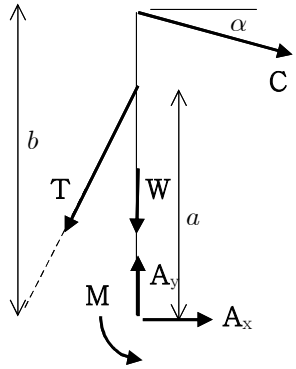
T; (예: 힌지 D의 역할)

4.45 m = 175 kg, C = 600 N, α = 15°, a = 3.6 m, b = 4.5 m, $M \le$ 500 N · m

S; 반력 유형 1&3(고정지지, 줄) M; 자유물체도(F.B.D.)

힘의 평형, 모멘트 평형,

$+\circlearrowleft \Sigma M_A = 0$



A; AD = 1.5 m, AB = 3.6 m

$BD = \sqrt{1.5^2 + 3.6^2}$ m = 3.90 m

$\frac{AD}{BD} = \frac{1.5 \text{ m}}{3.90 \text{ m}} = 0.3846$

M = $M\circlearrowleft$ 일 때, T_{max}

$+\circlearrowleft \Sigma M_A = 0$; $-M + a\ T_x - b\ C_x = 0$

$\Rightarrow \quad -M + a\ (\frac{AD}{BD}\ T) - b\ C\ \cos\alpha = 0$

$\Rightarrow \quad T = \frac{b\ C\cos\alpha + M}{a\ \frac{AD}{BD}} = \frac{(4.5 \text{ m})\,(600 \text{ N})\cos 15^\circ + (500 \text{ N} \cdot \text{m})}{(3.6 \text{ m})\,(0.3846)} = 2{,}244{,}7 \text{ N}$

M = $M\circlearrowright$ 일 때, T_{min}

$+\circlearrowleft \Sigma M_A = 0$; $M + a\ T_x - b\ C_x = 0$

$\Rightarrow \quad M + a\ (\frac{AD}{BD}\ T) - b\ C\ \cos\alpha = 0$

$\Rightarrow \quad T = \frac{b\ C\cos\alpha - M}{a\ \frac{AD}{BD}} = \frac{(4.5 \text{ m})\,(600 \text{ N})\cos 15^\circ - (500 \text{ N} \cdot \text{m})}{(3.6 \text{ m})\,(0.3846)} = 1{,}522.5 \text{ N}$

$\Rightarrow \quad T_{max}$ = 2,240 N, T_{min} = 1,522 N

R; (예: ΣF_x 또는 ΣF_y 의 용도는?)

T; (예: T가 $T_{min} < T < T_{max}$ 이면?)