

[4.1절]

4.24 $P = 40 \text{ N}$, $Q = 50 \text{ N}$
 $a = 0.10 \text{ m}$, $b = 0.04 \text{ m}$, $c = 0.20 \text{ m}$

S; 모멘트 평형, 힘의 평형, 반력 유형 1&2

$$+\uparrow \Sigma M_B = 0, \rightarrow \Sigma F_x = 0, \uparrow \Sigma F_y = 0$$

(a) A;

$$+\uparrow \Sigma M_B = 0; -cA - aP + (c-b)Q = 0$$

$$\Rightarrow A = \frac{-aP + (c-b)Q}{c}$$

$$= \frac{-(0.10 \text{ m})(40 \text{ N}) + (0.20 - 0.04 \text{ m})(50 \text{ N})}{0.20 \text{ m}}$$

$$= 20.0 \text{ N}$$

$$\rightarrow \Sigma F_x = 0; B_x + P = 0 \Rightarrow B_x = -P = -40.0 \text{ N}$$

$$\uparrow \Sigma F_y = 0; B_y + A - Q = 0$$

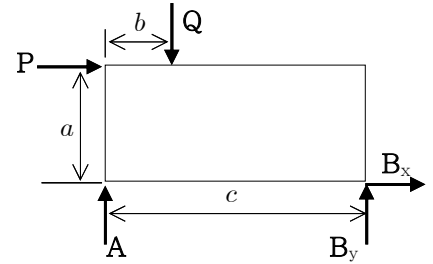
$$\Rightarrow B_y = -A + Q = -(20.0 \text{ N}) + (50.0 \text{ N}) = 30.0 \text{ N}$$

$$B = \sqrt{B_x^2 + B_y^2} = \sqrt{(-40.0 \text{ N})^2 + (30.0 \text{ N})^2} = 50.0 \text{ N}$$

$$\theta = \tan^{-1} \frac{B_y}{B_x} = \tan^{-1} \frac{30.0 \text{ N}}{-40.0 \text{ N}} = \tan^{-1}(-0.750) = -36.9^\circ$$

$$\Rightarrow \mathbf{A} = 20.0 \text{ N } \uparrow, \mathbf{B} = 50.0 \text{ N } \searrow 36.9^\circ,$$

M; 자유물체도(F.B.D.)



(b) $\alpha = 30^\circ$

$$A; +\uparrow \Sigma M_B = 0; -cA \cos \alpha - aP + (c-b)Q = 0$$

$$\Rightarrow A = \frac{-aP + (c-b)Q}{c \cos \alpha}$$

$$= \frac{-(0.10 \text{ m})(40 \text{ N}) + (0.20 - 0.04 \text{ m})(50 \text{ N})}{(0.20 \text{ m}) \cos 30^\circ}$$

$$= 23.09 \text{ N}$$

$$\rightarrow \Sigma F_x = 0; B_x + P + A \sin \alpha = 0$$

$$\Rightarrow B_x = -P - A \sin \alpha = -(40.0 \text{ N}) - (23.09 \text{ N}) \sin 30^\circ = -51.54 \text{ N}$$

$$\uparrow \Sigma F_y = 0; B_y + A \cos \alpha - Q = 0$$

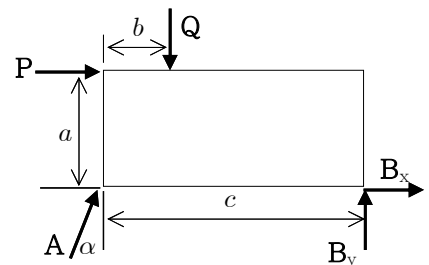
$$\Rightarrow B_y = -A \cos \alpha + Q = -(23.09 \text{ N}) \cos 30^\circ + (50.0 \text{ N}) = 30.0 \text{ N}$$

$$B = \sqrt{B_x^2 + B_y^2} = \sqrt{(-51.54 \text{ N})^2 + (30.0 \text{ N})^2} = 59.63 \text{ N}$$

$$\theta = \tan^{-1} \frac{B_y}{B_x} = \tan^{-1} \frac{30.0 \text{ N}}{-51.54 \text{ N}} = \tan^{-1}(-0.582) = -30.2^\circ$$

$$\Rightarrow \mathbf{A} = 23.1 \text{ N } \nearrow 60.0^\circ, \mathbf{B} = 59.6 \text{ N } \searrow 30.2^\circ$$

M; 자유물체도(F.B.D.)



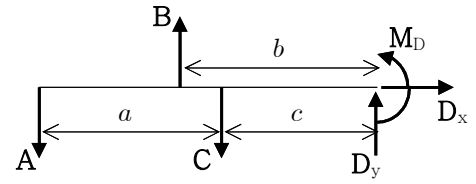
R; (예: $+\uparrow \Sigma M_A = 0$ 을 사용하면?)

T; (예: B_x 가 음수인 의미는?)

4.48 $A = 200 \text{ N}$, $C = 200 \text{ N}$, $B = W$
 $a = 4 \text{ m}$, $c = 4 \text{ m}$, $b = 5 \text{ m}$

S; 힘의 평형, 모멘트 평형, 반력 유형 1&3
 $\rightarrow \Sigma F_x = 0$, $\uparrow \Sigma F_y = 0$, $+\curvearrowright \Sigma M_D = 0$

M; 자유물체도(F.B.D.)



A; (a) $W = 500 \text{ N}$

$$\rightarrow \Sigma F_x = 0 ; D_x = 0$$

$$\uparrow \Sigma F_y = 0 ; D_y + B - A - C = 0$$

$$\Rightarrow D_y = -B + A + C = -(500 \text{ N}) + (200 \text{ N}) + (200 \text{ N}) = -100 \text{ N}$$

$$\Rightarrow \mathbf{D} = 100.0 \text{ N } \downarrow$$

$$+\curvearrowright \Sigma M_D = 0 ; M_D + (a+c)A + cC - bB = 0$$

$$\Rightarrow M_D = -(a+c)A - cC + bB$$

$$= -(4+4 \text{ m})(200 \text{ N}) - (4 \text{ m})(200 \text{ N}) + (5 \text{ m})(500 \text{ N}) = 100 \text{ N}\cdot\text{m}$$

$$\Rightarrow \mathbf{M}_D = 100.0 \text{ N}\cdot\text{m } \uparrow$$

(b) $W = 450 \text{ N}$

$$\rightarrow \Sigma F_x = 0 ; D_x = 0$$

$$\uparrow \Sigma F_y = 0 ; D_y + B - A - C = 0$$

$$\Rightarrow D_y = -B + A + C = -(450 \text{ N}) + (200 \text{ N}) + (200 \text{ N}) = -50 \text{ N}$$

$$\Rightarrow \mathbf{D} = 50.0 \text{ N } \downarrow$$

$$+\curvearrowright \Sigma M_D = 0 ; M_D + (a+c)A + cC - bB = 0$$

$$\Rightarrow M_D = -(a+c)A - cC + bB$$

$$= -(4+4 \text{ m})(200 \text{ N}) - (4 \text{ m})(200 \text{ N}) + (5 \text{ m})(450 \text{ N}) = -150 \text{ N}\cdot\text{m}$$

$$\Rightarrow \mathbf{M}_D = -150.0 \text{ N}\cdot\text{m } \uparrow$$

R; (예: ΣM_A 또는 ΣM_C 를 사용하는 경우)

T; (예: a와 b에서 반력 모멘트 방향이 다른 이유)