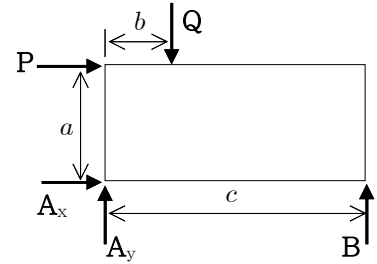


{4.1절}

4.23 $P = 40 \text{ N}$, $Q = 50 \text{ N}$
 $a = 0.10 \text{ m}$, $b = 0.04 \text{ m}$, $c = 0.20 \text{ m}$

(a) S; 모멘트 평형, 힘의 평형, 반력 유형 1&2
 $+\uparrow \Sigma M_A = 0$, $\rightarrow \Sigma F_x = 0$, $\uparrow \Sigma F_y = 0$

M; 자유물체도(F.B.D.)



$$A; +\uparrow \Sigma M_A = 0 ; c B - a P - b Q = 0$$

$$\Rightarrow B = \frac{a P + b Q}{c}$$

$$= \frac{(0.10 \text{ m})(40 \text{ N}) + (0.04 \text{ m})(50 \text{ N})}{0.20 \text{ m}} = 30.0 \text{ N}$$

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

$$\uparrow \Sigma F_y = 0 ; A_y + B - Q = 0$$

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

$$A = \sqrt{A_x^2 + A_y^2} = \sqrt{(-40.0 \text{ N})^2 + (20.0 \text{ N})^2} = 44.72 \text{ N}$$

$$\theta = \tan^{-1} \frac{A_y}{A_x} = \tan^{-1} \frac{20.0 \text{ N}}{-40.0 \text{ N}} = \tan^{-1}(-0.500) = -26.6^\circ$$

$$\Rightarrow A = 44.7 \text{ N } \searrow 26.6^\circ, \quad B = 30.0 \text{ N } \uparrow$$

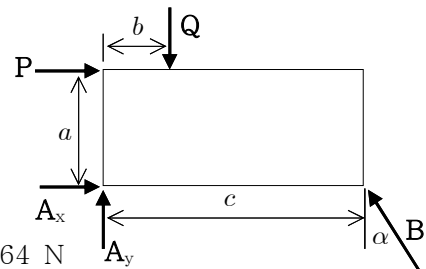
R; (예: $+\uparrow \Sigma M_B = 0$ 을 사용하면?)

T; (예: A_x 가 음수인 의미는?)

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

S; 모멘트 평형, 힘의 평형, 반력 유형 1&2
 $+\uparrow \Sigma M_A = 0$, $\rightarrow \Sigma F_x = 0$, $\uparrow \Sigma F_y = 0$

M; 자유물체도(F.B.D.)



$$A; +\uparrow \Sigma M_A = 0 ; c B \cos \alpha - a P - b Q = 0$$

$$\Rightarrow B = \frac{a P + b Q}{c \cos \alpha}$$

$$= \frac{(0.10 \text{ m})(40 \text{ N}) + (0.04 \text{ m})(50 \text{ N})}{(0.20 \text{ m}) \cos 30^\circ} = 34.64 \text{ N}$$

$$\rightarrow \Sigma F_x = 0 ; A_x + P - B \sin \alpha = 0$$

$$\Rightarrow A_x = -P + B \sin \alpha = -(40.0 \text{ N}) + (34.64 \text{ N}) \sin 30^\circ = -22.68 \text{ N}$$

$$\uparrow \Sigma F_y = 0 ; A_y + B \cos \alpha - Q = 0$$

$$\Rightarrow A_y = -B \cos \alpha + Q = -(34.64 \text{ N}) \cos 30^\circ + (50.0 \text{ N}) = 20.0 \text{ N}$$

$$A = \sqrt{A_x^2 + A_y^2} = \sqrt{(-22.68 \text{ N})^2 + (20.0 \text{ N})^2} = 30.24 \text{ N}$$

$$\theta = \tan^{-1} \frac{A_y}{A_x} = \tan^{-1} \frac{20.0 \text{ N}}{-22.68 \text{ N}} = \tan^{-1}(-0.882) = -41.4^\circ$$

$$\Rightarrow A = 30.2 \text{ N } \searrow 41.4^\circ, \quad B = 34.6 \text{ N } \swarrow 60.0^\circ$$

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

T; (예: A_x 가 음수인 의미는?)

4.46 $T = 1,300 \text{ N}$, $P = 750 \text{ N}$, $Q = 450 \text{ N}$
 $a = 0.5 \text{ m}$, $b = 0.4 \text{ m}$, $c = 0.15 \text{ m}$, $d = 0.25 \text{ m}$, $e = 0.6 \text{ m}$

S; 힘의 평형, 모멘트 평형, 반력 유형 1&3

$$\rightarrow \Sigma F_x = 0, \uparrow \Sigma F_y = 0, +\curvearrowright \Sigma M_C = 0,$$

A; $T_x = \frac{5}{13} T = \frac{5}{13} (1,300 \text{ N}) = 500 \text{ N}$

$$T_y = \frac{12}{13} T = \frac{12}{13} (1,300 \text{ N}) = 1,200 \text{ N}$$

$$\rightarrow \Sigma F_x = 0; C_x - Q + T_x = 0$$

$$\Rightarrow C_x = Q - T_x = (450 \text{ N}) - (500 \text{ N}) = -50 \text{ N}$$

$$\uparrow \Sigma F_y = 0; C_y - P - T_y = 0$$

$$\Rightarrow C_y = P + T_y = (750 \text{ N}) + (1,200 \text{ N}) = 1,950 \text{ N}$$

$$C = \sqrt{C_x^2 + C_y^2} = \sqrt{(-50 \text{ N})^2 + (1,950 \text{ N})^2} = 1,951 \text{ N}$$

$$\theta = \tan^{-1} \frac{C_y}{C_x} = \tan^{-1} \frac{1,950 \text{ N}}{-50 \text{ N}} = \tan^{-1}(-39) = -88.5^\circ$$

$$\Rightarrow \mathbf{C} = 1,951 \text{ N } \searrow 88.5^\circ$$

$$+\curvearrowright \Sigma M_C = 0; M_C + aP + bQ - (c+d)T_y = 0$$

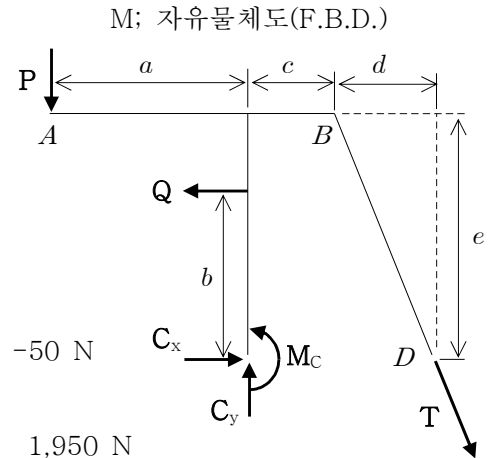
$$\Rightarrow M_C = -aP - bQ + (c+d)T_y$$

$$= -(0.5 \text{ m})(750 \text{ N}) - (0.4 \text{ m})(450 \text{ N}) + (0.4 \text{ m})(1,200 \text{ N}) = -7.50 \text{ N}\cdot\text{m}$$

$$\Rightarrow \mathbf{M}_C = 7.50 \text{ N}\cdot\text{m } \curvearrowleft$$

R; (예: 줄 BD의 장력에 의한 힘을 B에 작용하면?)

T; (예: M_C 가 음수인 의미는?)



{4.2절}

4.65 $P = 250 \text{ N}$, $a = 30 \text{ mm}$, $b = 60 \text{ mm}$, $c = 40 \text{ mm}$, $d = 100 \text{ mm}$, $e = 60 \text{ mm}$

S; 두 힘의 평형, 세 힘의 평형, 반력 유형2
세 힘의 작용선이 한 점에서 만남

M; 자유물체도(F.B.D.)

$$A: \tan \alpha = \frac{e}{d} = \frac{60 \text{ mm}}{100 \text{ mm}} = 0.6$$

$$\Rightarrow \alpha = \tan^{-1}(0.6) = 31.0^\circ$$

$$\tan \beta = \frac{b}{2e - a} = \frac{60 \text{ mm}}{90 \text{ mm}} = 0.667$$

$$\Rightarrow \beta = \tan^{-1}(0.667) = 33.7^\circ$$

$$\theta = 90^\circ - 33.7^\circ = 56.3^\circ$$

$$\gamma = 90^\circ + 31.0^\circ = 121.0^\circ$$

$$\phi = 180^\circ - \beta - \gamma = 180^\circ - 33.7^\circ - 121.0^\circ = 25.3^\circ$$

$$\frac{B}{\sin \gamma} = \frac{P}{\sin \phi}$$

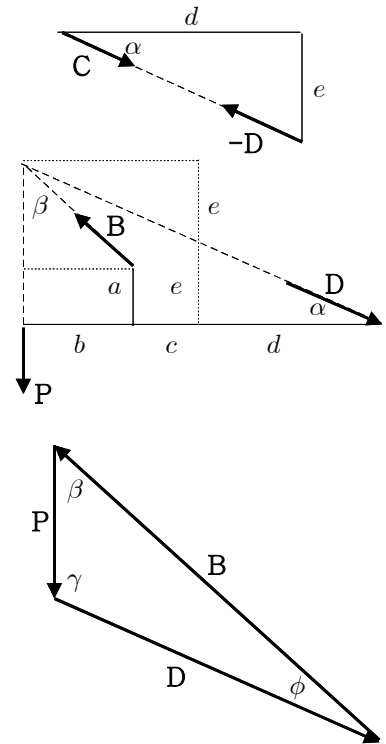
$$\Rightarrow B = P \frac{\sin \gamma}{\sin \phi} = (250 \text{ N}) \frac{\sin 121.0^\circ}{\sin 25.3^\circ} = 501.4 \text{ N}$$

$$\Rightarrow \mathbf{B} = 501 \text{ N } \nearrow 56.3^\circ$$

$$\frac{D}{\sin \beta} = \frac{P}{\sin \phi}$$

$$\Rightarrow D = P \frac{\sin \beta}{\sin \phi} = (250 \text{ N}) \frac{\sin 33.7^\circ}{\sin 25.3^\circ} = 324.6 \text{ N}$$

$$\Rightarrow \mathbf{D} = 325 \text{ N } \searrow 31.0^\circ$$



R; (예: 직각성분 방법으로 풀이 한다면?)

T; (예: B의 반력의 방향, C의 반력의 방향)