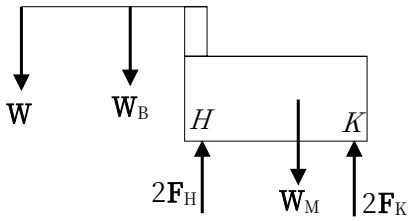
<4.1~4.5절>

4.3　[모멘트의 평형, 회전 중심을 미지의 힘의 위치에 설정하여 다른 미지의 힘을 구함]

W = 25 kN,　W_B = 3 kN,　W_M = 50 kN



(a) $\circlearrowleft \Sigma M_K = 0$;

W (2.0 + 0.9 + 2.0 + 0.5 m)
+ W_B (0.9 + 2.0 + 0.5 m) + W_M (0.5 m)
- 2 F_H (2.0 + 0.5 m) = 0

$$\Rightarrow \quad F_H = \frac{1}{5.0\ \text{m}} [(25\ \text{kN})(5.4\ \text{m}) + (3\ \text{kN})(3.4\ \text{m}) + (50\ \text{kN})(0.5\ \text{m})]$$

$$= 34.04\ \text{kN} \qquad \Rightarrow \qquad \mathbf{F}_H = 34.0\ \text{kN} \uparrow$$

(b) $\circlearrowleft \Sigma M_H = 0$;

W (2.0 + 0.9 m) + W_B (0.9 m) - W_M (2.0 m) + 2 F_K (2.0 + 0.5 m) = 0

$$\Rightarrow \quad F_K = \frac{1}{5.0\ \text{m}} [-(25\ \text{kN})(2.9\ \text{m}) - (3\ \text{kN})(0.9\ \text{m}) + (50\ \text{kN})(2.0\ \text{m})]$$

$$= 4.96\ \text{kN} \qquad \Rightarrow \qquad \mathbf{F}_K = 4.96\ \text{kN} \uparrow$$

(검산) $\uparrow \Sigma F_y = 0$;

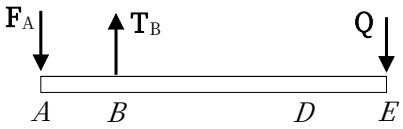
$$-W - W_B - W_M + 2F_H - 2F_K = -25 - 3 - 50 + 2(34.04) + 2(4.96) = 0$$

4.10　[모멘트의 평형, 회전 중심을 미지의 힘의 위치에 설정하여 다른 미지의 힘을 구함]

F_A = 7.5 kN,　$Q_{\min}$ = ?,　$Q_{\max}$ = ?

T_D = 0 일 때

$\circlearrowleft \Sigma M_B = 0$;

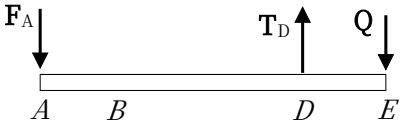


$$F_A\ (0.5\ \text{m}) - Q\ (0.75 + 1.5 + 0.75\ \text{m}) = 0$$

$$\Rightarrow \quad Q = \frac{1}{3.0\ \text{m}} (7.5\ \text{kN})(0.5\ \text{m}) = 1.25\ \text{kN}$$

T_B = 0 일 때

$\circlearrowleft \Sigma M_D = 0$;



$$F_A\ (0.5 + 0.75 + 1.5\ \text{m}) - Q\ (0.75\ \text{m}) = 0$$

$$\Rightarrow \quad Q = \frac{1}{0.75\ \text{m}} (7.5\ \text{kN})(0.5 + 0.75 + 1.5\ \text{m}) = 27.5\ \text{kN}$$

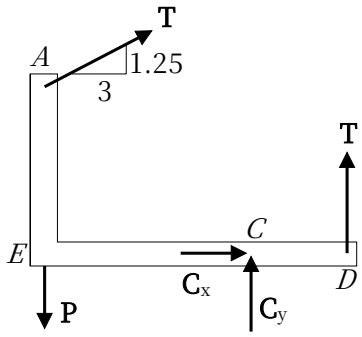
$$\Rightarrow \qquad 1.250\ \text{kN} \le Q \le 27.5\ \text{kN}$$

4.29 [hinge를 회전중심으로 하는 모멘트 평형, hinge이외의 미지의 힘을 구함 .
직각성분 힘의 평형, hinge에서 반력(reaction)을 구함]

P = 150 N

$\sqrt{3^2+1.25^2}$ = 3.25, $T_x = \frac{3}{3.25}T$, $T_y = \frac{1.25}{3.25}T$

d_{AE} = 0.175 m, d_{CE} = 0.225 m, d_{CD} = 0.075 m



$\circlearrowleft \Sigma M_C = 0$;

$-T_x\, d_{AE} - T_y\, d_{CE} + T\, d_{CD} + P\, d_{CE} = 0$

$$\Rightarrow \quad T\left[\frac{3}{3.25}d_{AE} + \frac{1.25}{3.25}d_{CE} - d_{CD}\right] = P\, d_{CE}$$

$$\Rightarrow \quad T = \frac{(150\text{ N})(0.225\text{ m})}{\frac{3}{3.25}(0.175\text{ m}) + \frac{1.25}{3.25}(0.225\text{ m}) - (0.075\text{ m})} = 195\text{ N} \quad \Rightarrow \quad T = 195.0\text{ N}$$

$\rightarrow \Sigma F_x = 0$;

$T_x + C_x = 0 \quad \Rightarrow \quad C_x = -\frac{3}{3.25}T = -\frac{3}{3.25}(195\text{ N}) = -180\text{ N}$

$\Rightarrow$ $\mathbf{C}_x$ = 180 N ←

$\uparrow \Sigma F_y = 0$;

$T_y + T - P + C_y = 0$

$\Rightarrow \quad C_y = -\frac{1.25}{3.25}T - T + P = -\frac{1.25}{3.25}(195\text{ N}) - (195\text{ N}) + (150\text{ N}) = -120\text{ N}$

$\Rightarrow$ $\mathbf{C}_y$ = 120 N ↓

$C = \sqrt{C_x^2 + C_y^2} = \sqrt{(-180\text{ N})^2 + (-120\text{ N})^2} = 216.3\text{ N}$

$\tan\theta = \frac{C_y}{C_x} = \frac{-120}{-180} = 0.6667 \quad \Rightarrow \quad \theta = \tan^{-1}0.6667 = 33.69°$

$\Rightarrow$ $\mathbf{C}$ = 216 N ↙33.7°