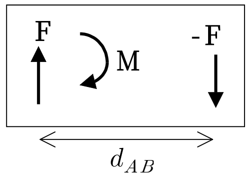
<3.12~3.16절>

3.69 [우력의 모멘트]

M =12 N·m , $M = F\,d$

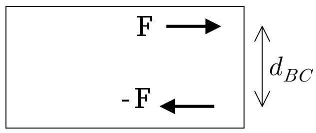
(a) d_{AB} = 0.45 m



$F = \dfrac{M}{d_{AB}}$

$= \dfrac{12\ \text{N}\cdot\text{m}}{0.45\ \text{m}}$ = 26.7 N

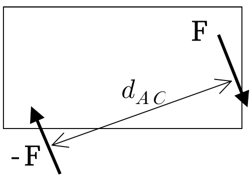
(b) d_{BC} = 0.24 m



$F = \dfrac{M}{d_{BC}}$

$= \dfrac{12\ \text{N}\cdot\text{m}}{0.24\ \text{m}}$ = 50.0 N

(c) $d_{AC} = \sqrt{(0.45\ \text{m})^2 + (0.24\ \text{m})^2}$ = 0.51 m



$F = \dfrac{M}{d_{AC}}$

$= \dfrac{12\ \text{N}\cdot\text{m}}{0.51\ \text{m}}$ = = 23.5 N

3.71 [우력의 모멘트]

r = 1.2 cm, F = 2.5 N, d_x = 15.2 cm, d_y = 11.4 cm

(a) T = 9 N

$M = T(d_y + 2r)$ - $F\,d_x$

= (9 N) [(11.4 cm) + 2 (1.2 cm)] - (2.5 N) (15.2 cm)

= 86.2 N·cm = 0.862 N·m ⇒ M = 0.862 N·m ⟩

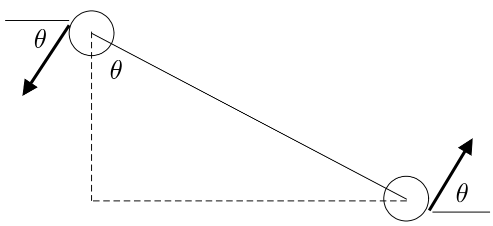
(b) minimum T ⇒ maximum d = d_{AC} + 2r ⇒ perpendicular T

$\tan\theta = \dfrac{15.2\ \text{cm}}{11.4\ \text{cm}}$ = 1.333

⇒ $\theta = \tan^{-1}1.333 = 53.1°$

T_A 의 방향 ↙53.1°

T_C 의 방향 ↗53.1°



(c) $d_{max} = d_{AC} + 2\ r$

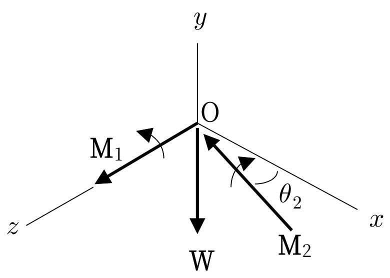
$= \sqrt{(15.2\ \text{cm})^2 + (11.4\ \text{cm})^2}$ + 2 (1.2 cm) = 21.4 cm

$T_{min} = \dfrac{M}{d_{max}} = \dfrac{86.2\ \text{N}\cdot\text{cm}}{21.4\ \text{cm}}$ = 4.03 N

3.96 [우력의 합성, 수직한 힘과 우력 벡터 합성]

W = 2.4 N, M_1 = 0.068 N·m, M_2 = 0.065 N·m, θ_2 = 25°

(a) $\mathbf{W} = -W\,\mathbf{j}$



$\mathbf{M} = \mathbf{M}_1 + \mathbf{M}_2$

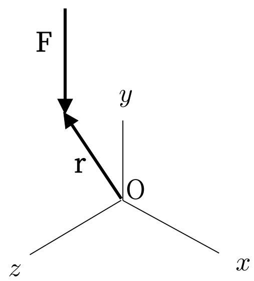
$= M_1\,\mathbf{k} + M_2\,(-\cos\theta_2\,\mathbf{i} - \sin\theta_2\,\mathbf{k})$

$= -M_2\cos\theta_2\,\mathbf{i} + (M_1 - M_2\sin\theta_2)\,\mathbf{k}$

$\mathbf{W} \perp \mathbf{M}$ 이므로, 등가 힘 $\mathbf{F}$로 대치

$\mathbf{F} = \mathbf{W} = -W\,\mathbf{j} = -(2.40\ \text{N})\,\mathbf{j}$

(b) $\mathbf{r} = x\,\mathbf{i} + z\,\mathbf{k}$



$\mathbf{r} \times \mathbf{F} = (x\,\mathbf{i} + z\,\mathbf{k}) \times (-W\,\mathbf{j}) = (-W)\,x\,\mathbf{k} - (-W)\,z\,\mathbf{i}$

$\mathbf{M} = \mathbf{r} \times \mathbf{F}$

$-M_2\cos\theta_2\,\mathbf{i} + (M_1 - M_2\sin\theta_2)\,\mathbf{k} = W\,z\,\mathbf{i} - W\,x\,\mathbf{k}$

$-M_2\cos\theta_2 = W\,z$

$$\Rightarrow\quad z = -\frac{M_2\cos\theta_2}{W} = -\frac{(0.065\ \text{N}\cdot\text{m})\cos 25^\circ}{2.4\ \text{N}} = -0.0245\ \text{m} = -24.5\ \text{mm}$$

$M_1 - M_2\sin\theta_2 = -W\,x$

$$\Rightarrow\quad x = -\frac{M_1 - M_2\sin\theta_2}{W} = -\frac{(0.068\ \text{N}\cdot\text{m}) - (0.065\ \text{N}\cdot\text{m})\sin 25^\circ}{2.4\ \text{N}}$$

$$= -0.01689\ \text{m} = -16.89\ \text{mm}$$