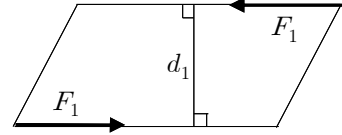


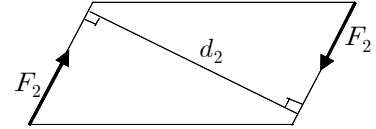
<3.12~3.16절>

3.70 [우력 모멘트, 우력 벡터 합성(2차원)]

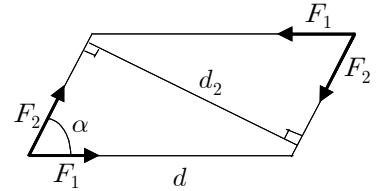
(a) $F_1 = 84 \text{ N}$, $d_1 = 0.16 \text{ m}$
 $M_1 = F_1 d_1 = (84 \text{ N})(0.16 \text{ m}) = 13.44 \text{ N}\cdot\text{m}$
 $\mathbf{M}_1 = 13.44 \text{ N}\cdot\text{m} \uparrow$



(b) $F_2 = 48 \text{ N}$, $M_2 = F_2 d_2$
 $\mathbf{M}_2 = M_2 \uparrow$
 $\mathbf{M}_1 + \mathbf{M}_2 = 0$; $M_1 - M_2 = 0$
 $\Rightarrow M_1 - F_2 d_2 = 0$
 $\Rightarrow d_2 = \frac{M_1}{F_2} = \frac{13.44 \text{ N}\cdot\text{m}}{48 \text{ N}} = 0.280 \text{ m}$



(c) $d = 0.42 \text{ m}$, $d_2 = d \sin \alpha$
 $\mathbf{M} = \mathbf{M}_1 + \mathbf{M}_2 = 2.88 \text{ N}\cdot\text{m} \uparrow$
 $\Rightarrow M_1 - F_2 d \sin \alpha = -M$
 $\Rightarrow \sin \alpha = \frac{M_1 + M}{F_2 d}$
 $= \frac{(13.44 \text{ N}\cdot\text{m}) + (2.88 \text{ N}\cdot\text{m})}{(48 \text{ N})(0.42 \text{ m})} = 0.8095$
 $\Rightarrow \alpha = \sin^{-1} 0.8095 = 54.0^\circ$



3.79 [우력 모멘트 벡터 합성(3차원)]

$M_A = 1600 \text{ N}\cdot\text{m}$, $M_B = 1200 \text{ N}\cdot\text{m}$, $M_C = 1120 \text{ N}\cdot\text{m}$
 $\theta_A = 20^\circ$, $\theta_B = 20^\circ$, $\theta_C = 0$

$\mathbf{M}_A = M_A (-\sin \theta_A \mathbf{j} + \cos \theta_A \mathbf{k})$

$\mathbf{M}_B = M_B (\sin \theta_B \mathbf{j} + \cos \theta_B \mathbf{k})$

$\mathbf{M}_C = M_C (-\mathbf{i})$

$\mathbf{M} = \mathbf{M}_A + \mathbf{M}_B + \mathbf{M}_C$

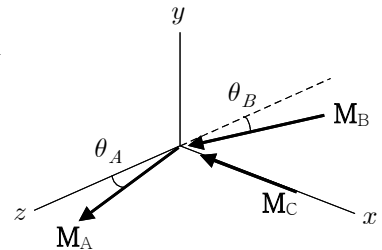
$= M_A (-\sin \theta_A \mathbf{j} + \cos \theta_A \mathbf{k}) + M_B (\sin \theta_B \mathbf{j} + \cos \theta_B \mathbf{k}) + M_C (-\mathbf{i})$
 $= -M_C \mathbf{i} + (-M_A \sin \theta_A + M_B \sin \theta_B) \mathbf{j} + (M_A \cos \theta_A + M_B \cos \theta_B) \mathbf{k}$
 $= -(1120 \text{ N}\cdot\text{m}) \mathbf{i} + [-(1600 \text{ N}\cdot\text{m}) \sin 20^\circ + (1200 \text{ N}\cdot\text{m}) \sin 20^\circ] \mathbf{j}$
 $\quad + [(1600 \text{ N}\cdot\text{m}) \cos 20^\circ + (1200 \text{ N}\cdot\text{m}) \cos 20^\circ] \mathbf{k}$
 $= (-1120 \text{ N}\cdot\text{m}) \mathbf{i} + (-136.81 \text{ N}\cdot\text{m}) \mathbf{j} + (2631.1 \text{ N}\cdot\text{m}) \mathbf{k}$

$M = \sqrt{M_x^2 + M_y^2 + M_z^2}$
 $= \sqrt{(-1120)^2 + (-136.81)^2 + (2631.1)^2} \text{ (N}\cdot\text{m)} = 2862.8 \text{ N}\cdot\text{m} \Rightarrow M = 2860 \text{ N}\cdot\text{m}$

$\cos \theta_x = \frac{M_x}{M} = \frac{-1120}{2862.8} = -0.3912 \Rightarrow \theta_x = \cos^{-1}(-0.3912) = 113.0^\circ$

$\cos \theta_y = \frac{M_y}{M} = \frac{-136.81}{2862.8} = -0.04779 \Rightarrow \theta_y = \cos^{-1}(-0.04779) = 92.7^\circ$

$\cos \theta_z = \frac{M_z}{M} = \frac{2631.1}{2862.8} = 0.9191 \Rightarrow \theta_z = \cos^{-1}(0.9191) = 23.2^\circ$



3.82 [등가 우력]

$$P = 80 \text{ N}, \quad \mathbf{P} = 80 \text{ N} \leftarrow$$

$$d_1 = 0.05 \text{ m}, \quad d_2 = 0.1 \text{ m}, \quad d_3 = 0.04 \text{ m}$$

(a) $\Sigma \mathbf{F}$; $\mathbf{F}_B = \mathbf{P} = 80 \text{ N} \leftarrow$

$$\Sigma \mathbf{M}_B ; M_B = P d_1 = (80 \text{ N})(0.05 \text{ m}) = 4.00 \text{ N}\cdot\text{m}$$

$$\Rightarrow \quad \mathbf{M}_B = 4.00 \text{ N}\cdot\text{m} \curvearrowright$$

(b) ΣF_y ; $F_D - F_C = 0 \quad \Rightarrow \quad F_C = F_D = F$

$$\Sigma M_B ; F d_3 = M_B$$

$$\Rightarrow \quad F = \frac{M_B}{d_3} = \frac{4.00 \text{ N}\cdot\text{m}}{0.04 \text{ m}} = 100.0 \text{ N}$$

$$\Rightarrow \quad \mathbf{F}_C = 100.0 \text{ N} \downarrow, \quad \mathbf{F}_D = 100.0 \text{ N} \uparrow$$

