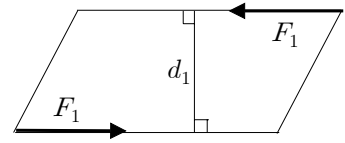


<3.12~3.16 >

3.68 (a)  $F_1 = 21 \text{ N}$ ,  $d_1 = 0.4 \text{ m}$

$$M_1 = F_1 d_1 = (21 \text{ N})(0.4 \text{ m}) = 8.4 \text{ N}\cdot\text{m}$$

$$\mathbf{M}_1 = 8.4 \text{ N}\cdot\text{m} \uparrow$$



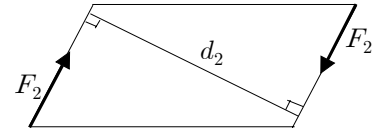
(b)  $F_2 = 12 \text{ N}$ ,  $M_2 = F_2 d_2$

$$\mathbf{M}_2 = M_2 \uparrow$$

$$\mathbf{M}_1 + \mathbf{M}_2 = 0 ; \quad M_1 - M_2 = 0$$

$$M_1 - F_2 d_2 = 0$$

$$d_2 = \frac{M_1}{F_2} = \frac{8.4 \text{ N}\cdot\text{m}}{12 \text{ N}} = 0.700 \text{ m}$$



(c)  $d = 1.05 \text{ m}$ ,  $d_2 = d \sin \alpha$

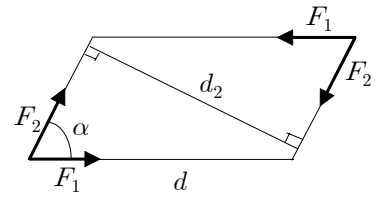
$$\mathbf{M} = \mathbf{M}_1 + \mathbf{M}_2 = 1.8 \text{ N}\cdot\text{m} \uparrow$$

$$M_1 - F_2 d \sin \alpha = -M$$

$$\sin \alpha = \frac{M_1 + M}{F_2 d}$$

$$= \frac{(8.4 \text{ N}\cdot\text{m}) + (1.80 \text{ N}\cdot\text{m})}{(12 \text{ N})(1.05 \text{ m})} = 0.8095$$

$$\alpha = \sin^{-1} 0.8095 = 54.0^\circ$$



3.85 (a)  $F_C = 800 \text{ N}$ ,  $F_D = 600 \text{ N}$ ,  $F_E = 600 \text{ N}$

$$F_y ; \quad F = -F_C + F_D - F_E$$

$$= -(800 \text{ N}) + (600 \text{ N}) - (600 \text{ N})$$

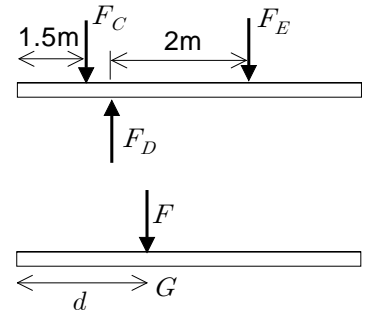
$$= -800 \text{ N}$$

$$\mathbf{F} = 800 \text{ N}$$

$$\uparrow M_G ; \quad F_C (d - 1.5 \text{ m}) - F_D (2 \text{ m}) = 0$$

$$d = \frac{F_C (1.5 \text{ m}) + F_D (2 \text{ m})}{F_C}$$

$$= \frac{(800 \text{ N})(1.5 \text{ m}) + (600 \text{ N})(2 \text{ m})}{(800 \text{ N})} = 3.00 \text{ m}$$



(b)  $F_y ; \quad F = -F_C - F_D + F_E$

$$= -(800 \text{ N}) - (600 \text{ N}) + (600 \text{ N})$$

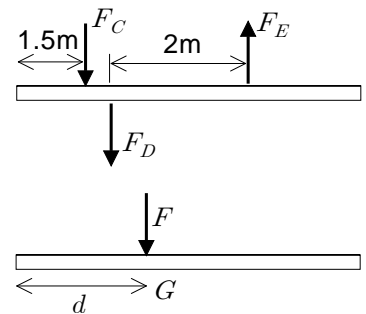
$$= -800 \text{ N}$$

$$\mathbf{F} = 800 \text{ N}$$

$$\uparrow M_G ; \quad F_C (d - 1.5 \text{ m}) + F_D (2 \text{ m}) = 0$$

$$d = \frac{F_C (1.5 \text{ m}) - F_D (2 \text{ m})}{F_C}$$

$$= \frac{(800 \text{ N})(1.5 \text{ m}) - (600 \text{ N})(2 \text{ m})}{(800 \text{ N})} = 0$$



$$3.93 \quad F_{AB} = 200 \text{ N}$$

$$d_x = -0.06 - (-0.11) \text{ m} = 0.05 \text{ m}$$

$$d_y = 0.95 \text{ m}, \quad d_z = -0.6 \text{ m}$$

$$d = \sqrt{(0.05 \text{ m})^2 + (0.95 \text{ m})^2 + (-0.6 \text{ m})^2} = 1.1247 \text{ m}$$

$$\lambda_{AB} = \frac{(0.05 \text{ m})\mathbf{i} + (0.95 \text{ m})\mathbf{j} + (-0.6 \text{ m})\mathbf{k}}{1.1247 \text{ m}}$$

$$= 0.04445 \mathbf{i} + 0.84465 \mathbf{j} - 0.53347 \mathbf{k}$$

$$\mathbf{F}_C = \mathbf{F}_{AB} = \lambda_{AB} F_{AB}$$

$$= (0.04445 \mathbf{i} + 0.84465 \mathbf{j} - 0.53347 \mathbf{k}) (200 \text{ N})$$

$$= 8.89 \mathbf{i} + 168.9 \mathbf{j} - 106.7 \mathbf{k} \text{ (N)}$$

$$\mathbf{r}_{B/C} = [(-0.06) - (-0.8)] \mathbf{i} + [0.95 - 1.8] \mathbf{j} + 0 \mathbf{k} \text{ (m)}$$

$$= 0.74 \mathbf{i} - 0.85 \mathbf{j} \text{ (m)}$$

$$\mathbf{M}_C = \mathbf{r}_{B/C} \times \mathbf{F}_{AB} = [0.74 \mathbf{i} - 0.85 \mathbf{j} \text{ (m)}] \times [8.89 \mathbf{i} + 168.9 \mathbf{j} - 106.7 \mathbf{k} \text{ (N)}]$$

$$= [(-0.85)(-106.7)]\mathbf{i} + [-(0.74)(-106.7)]\mathbf{j} + [(0.74)(168.9) - (-0.85)(8.89)]\mathbf{k} \text{ (N}\cdot\text{m)}$$

$$= 90.7 \mathbf{i} + 78.9 \mathbf{j} + 132.5 \mathbf{k} \text{ (N}\cdot\text{m)}$$

