

2.58 A gate having the cross section shown in Fig. P2.58 closes an opening 5 ft wide and 4 ft high in a water reservoir. The gate weighs 500 lb and its center of gravity is 1 ft to the left of AC and 2 ft above BC. Determine the horizontal reaction that is developed on the gate at C.

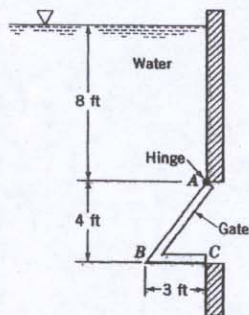


FIGURE P2.58

$$F_1 = \gamma h_{c1} A_1 \quad \text{where } h_{c1} = 8 \text{ ft} + 2 \text{ ft}$$

Thus,

$$F_1 = (62.4 \frac{\text{lb}}{\text{ft}^3}) (10 \text{ ft}) (5 \text{ ft} \times 5 \text{ ft})$$

$$= 15,600 \text{ lb}$$

To locate F_1 ,

$$y_{c1} = OD + \frac{1}{2} AB$$

$$y_1 = \frac{I_{xc}}{y_{c1} A_1} + y_{c1}$$

$$\text{where } y_{c1} = \frac{8 \text{ ft}}{\frac{4}{5}} + 2.5 \text{ ft} = 12.5 \text{ ft}$$

So that

$$y_1 = \frac{\frac{1}{12} (5 \text{ ft}) (5 \text{ ft})^3}{(12.5 \text{ ft}) (5 \text{ ft} \times 5 \text{ ft})} + 12.5 \text{ ft} = 12.67 \text{ ft}$$

Also,

$$F_2 = \rho_2 A_2 \quad \text{where } \rho_2 = \gamma_{H_2O} (8 \text{ ft} + 4 \text{ ft})$$

so that

$$F_2 = \gamma_{H_2O} (12 \text{ ft}) (A_2) = (62.4 \frac{\text{lb}}{\text{ft}^3}) (12 \text{ ft}) (3 \text{ ft} \times 5 \text{ ft}) = 11,230 \text{ lb}$$

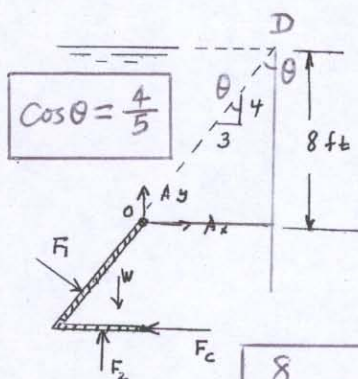
For equilibrium,

$$\sum M_O = 0$$

$$\text{and } F_1 (y_1 - \frac{8 \text{ ft}}{5}) + W (1 \text{ ft}) - F_2 (\frac{1}{2}) (3 \text{ ft}) - F_C (4 \text{ ft})$$

so that

$$F_C = \frac{(15,600 \text{ lb}) (12.67 \text{ ft} - 10 \text{ ft}) + (500 \text{ lb}) (1 \text{ ft}) - (11,230 \text{ lb}) (\frac{3}{2} \text{ ft})}{4 \text{ ft}} = \underline{\underline{6330 \text{ lb}}}$$



$$\frac{8}{OD} = \cos \theta$$

$$\cos \theta = \frac{4}{5}$$

$$OD = \frac{8}{4/5}$$