

2.52

2.52 A homogeneous, 4-ft-wide, 8-ft-long rectangular gate weighing 800 lb is held in place by a horizontal flexible cable as shown in Fig. P2.52. Water acts against the gate which is hinged at point A. Friction in the hinge is negligible. Determine the tension in the cable.

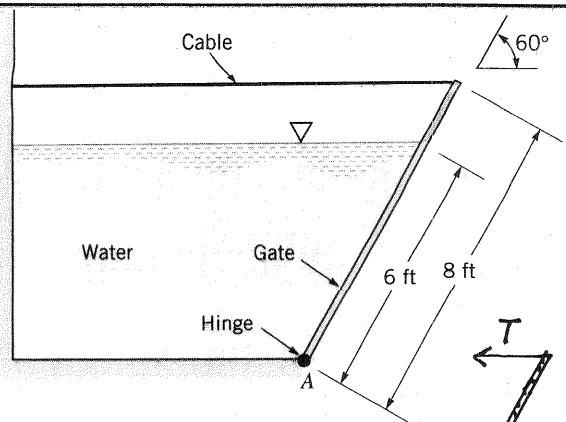


FIGURE P2.52

$$F_R = \gamma h_c A \quad \text{where } h_c = \left(\frac{6 \text{ ft}}{2}\right) \sin 60^\circ$$

Thus,

$$F_R = \left(62.4 \frac{\text{lb}}{\text{ft}^3}\right) \left(\frac{6 \text{ ft}}{2}\right) (\sin 60^\circ) (6 \text{ ft} \times 4 \text{ ft})$$

$$= 3890 \text{ lb}$$

To locate  $F_R$ ,

$$y_R = \frac{I_{xc}}{y_c A} + y_c \quad \text{where } y_c = 3 \text{ ft}$$

so that

$$y_R = \frac{\frac{1}{12} (4 \text{ ft})(6 \text{ ft})^3}{(3 \text{ ft})(6 \text{ ft} \times 4 \text{ ft})} + 3 \text{ ft} = 4.0 \text{ ft}$$

For equilibrium,

$$\sum M_H = 0$$

and

$$T (8 \text{ ft})(\sin 60^\circ) = w (4 \text{ ft})(\cos 60^\circ) + F_R (2 \text{ ft})$$

$$T = \frac{(800 \text{ lb})(4 \text{ ft})(\cos 60^\circ) + (3890 \text{ lb})(2 \text{ ft})}{(8 \text{ ft})(\sin 60^\circ)}$$

$$= \underline{\underline{1350 \text{ lb}}}$$