2.87 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. P2.87. Water acts against the gate which is hinged at point *A*. Friction in the hinge is negligible. Determine the tension in the cable.
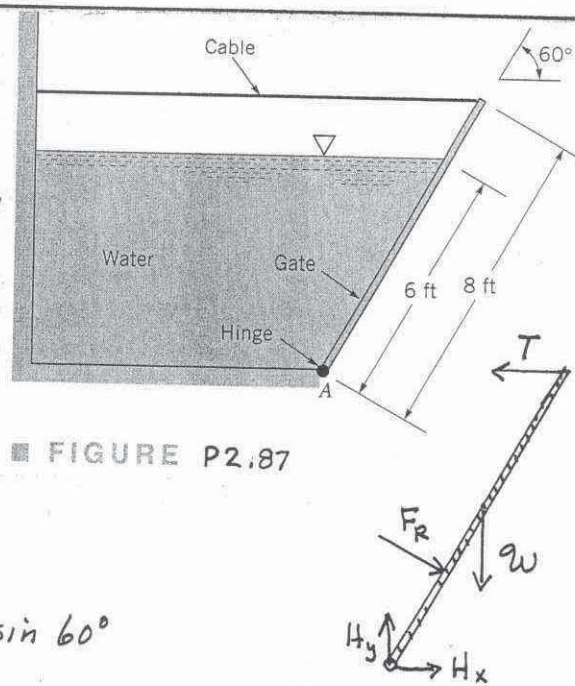

■ FIGURE P2.87

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

Thus,
$$F_R = \left(62.4 \frac{lb}{ft^3}\right)\left(\frac{6ft}{2}\right)(\sin 60°)(6ft \times 4ft)$$
$$= 3890 \ lb$$

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

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

For equilibrium,
$$\sum M_H = 0$$
and
$$T(8ft)(\sin 60°) = \mathcal{W}(4ft)(\cos 60°) + F_R(2ft)$$
$$T = \frac{(800 \ lb)(4ft)(\cos 60°) + (3890 \ lb)(2ft)}{(8ft)(\sin 60°)}$$
$$= \underline{1350 \ lb}$$