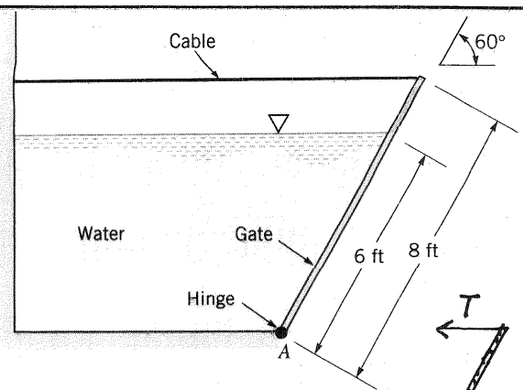
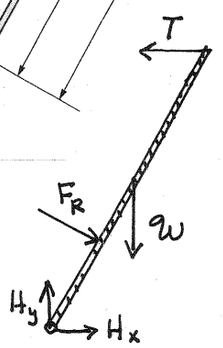
2.52

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



$F_R = \gamma h_c A$ where $h_c = (6\text{ft})\sin 60°$

Thus,

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

$$= 3890\text{ lb}$$

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,

$$\Sigma M_H = 0$$

and

$$T(8\text{ft})(\sin 60°) = W(4\text{ft})(\cos 60°) + F_R(2\text{ ft})$$

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

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