2.49

2.49 A rectangular gate having a width of 5 ft is located in the sloping side of a tank as shown in Fig. P2.49. The gate is hinged along its top edge and is held in position by the force P. Friction at the hinge and the weight of the gate can be neglected. Determine the required value of P.

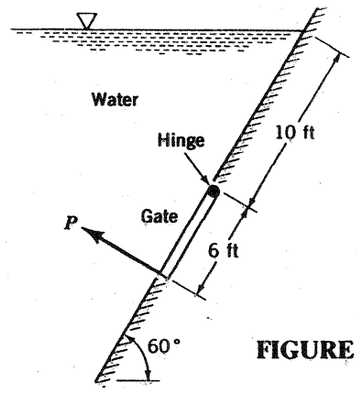


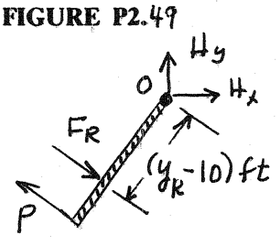
FIGURE P2.49

$F_R = \gamma h_c A$ where $h_c = (13\text{ ft}) \sin 60°$

Thus,

$$F_R = \left(62.4 \frac{\text{lb}}{\text{ft}^3}\right)(13\text{ ft}) \sin 60° (6\text{ ft} \times 5\text{ ft})$$

$$= 21{,}100\text{ lb}$$



Also, $y_R = \dfrac{I_{xc}}{y_c A} + y_c = \dfrac{\frac{1}{12}(5\text{ ft})(6\text{ ft})^3}{(13\text{ ft})(6\text{ ft} \times 5\text{ ft})} + 13\text{ ft} = 13.23\text{ ft}$

$\Sigma M_O = 0$

Thus, $F_R[(y_R - 10)\text{ ft}] = P(6\text{ ft})$

so that $P = \dfrac{(21{,}100\text{ lb})(13.23\text{ ft} - 10\text{ ft})}{6\text{ ft}} = \underline{\underline{11{,}400\text{ lb}}}$