2.68

2.68 The massless, 4-ft-wide gate shown in Fig. P2.68 pivots about the frictionless hinge O. It is held in place by the 2000 lb counterweight, *W*. Determine the water depth, *h*.

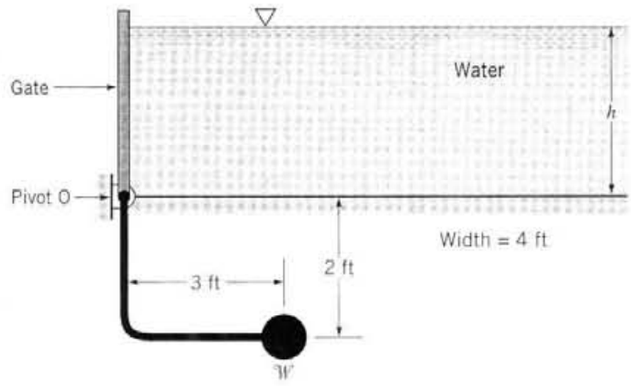


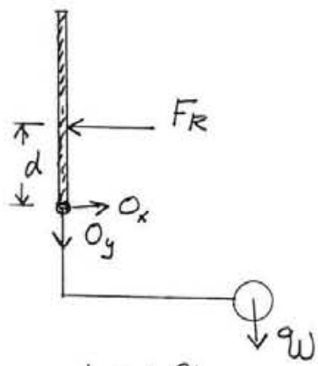
FIGURE P2.68

$F_R = \gamma h_c A$ where $h_c = \frac{h}{2}$

Thus,

$$F_R = \gamma_{H_2O} \frac{h}{2} (h \times b)$$

$$= \gamma_{H_2O} \frac{h^2}{2} (4\,ft)$$



$b = 4\,ft$

To locate F_R,

$$y_R = \frac{I_{xc}}{y_c A} + y_c = \frac{\frac{1}{12}(4\,ft)(h^3)}{\frac{h}{2}(4\,ft \times h)} + \frac{h}{2}$$

$$= \frac{2}{3} h$$

For equilibrium,

$$\Sigma M_O = 0$$

$$F_R d = W (3\,ft) \quad \text{where} \quad d = h - y_R = \frac{h}{3}$$

so that

$$\frac{h}{3} = \frac{(2000\,lb)(3\,ft)}{(\gamma_{H_2O})(\frac{h^2}{2})(4\,ft)}$$

Thus,

$$h^3 = \frac{(3)(2000\,lb)(3\,ft)}{(62.4\,\frac{lb}{ft^3})(\frac{1}{2})(4\,ft)}$$

$$h = \underline{\underline{5.24\,ft}}$$