2.67

2.67 A gate having the cross section shown in Fig. P2.67 closes an opening 5 ft wide and 4 ft high in a water reservoir. The gate weighs 500 lb and its center of gravity is 1 ft to the left of AC and 2 ft above BC. Determine the horizontal reaction that is developed on the gate at C.

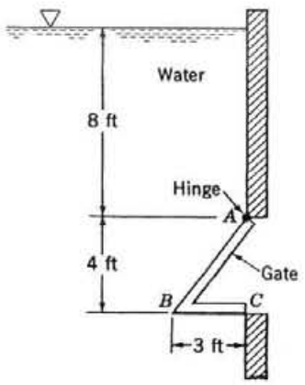


FIGURE P2.67

$F_1 = \gamma h_{c1} A_1$ where $h_{c1} = 8\,ft + 2\,ft$

Thus,

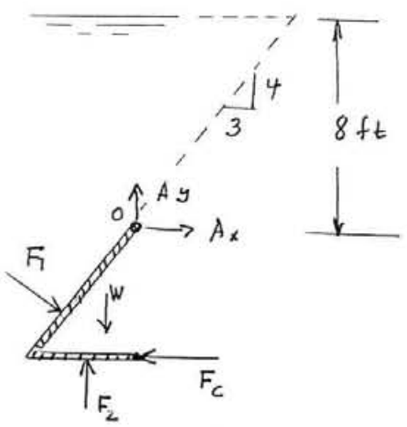
$F_1 = (62.4\ \frac{lb}{ft^3})(10\,ft)(5\,ft \times 5\,ft)$

$= 15,600\ lb$

To locate F_1,

$y_1 = \frac{I_{xc}}{y_{c1} A_1} + y_{c1}$

where $y_{c1} = \frac{8\,ft}{\frac{4}{5}} + 2.5\,ft = 12.5\,ft$



So that

$y_1 = \frac{\frac{1}{12}(5\,ft)(5\,ft)^3}{(12.5\,ft)(5\,ft \times 5\,ft)} + 12.5\,ft = 12.67\,ft$

Also,

$F_2 = p_2 A_2$ where $p_2 = \gamma_{H_2O}(8\,ft + 4\,ft)$

so that

$F_2 = \gamma_{H_2O}(12\,ft)(A_2) = (62.4\ \frac{lb}{ft^3})(12\,ft)(3\,ft \times 5\,ft) = 11,230\ lb$

For equilibrium,

$\Sigma M_O = 0$

and $F_1\left(y_1 - \frac{8\,ft}{\frac{4}{5}}\right) + W(1\,ft) - F_2\left(\frac{1}{2}\right)(3\,ft) - F_C(4\,ft)$

so that

$F_C = \frac{(15,600\ lb)(12.67\,ft - 10\,ft) + (500\ lb)(1\,ft) - (11,230\ lb)(\frac{3}{2}\,ft)}{4\,ft} = 6330\ lb$