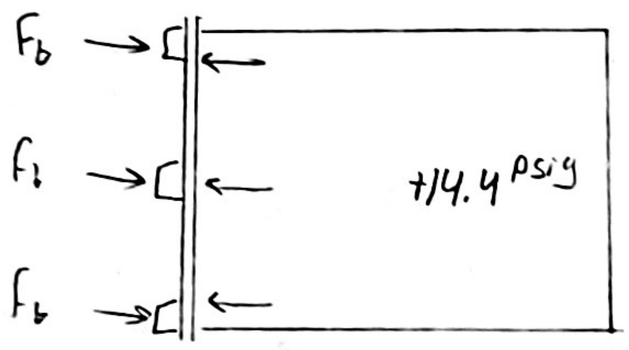
Problem 4.2

Given: flat end tank, with inside diameter of 30in, internal pressure is 14.4 psig

Find: force resisted by bolts

Solution:



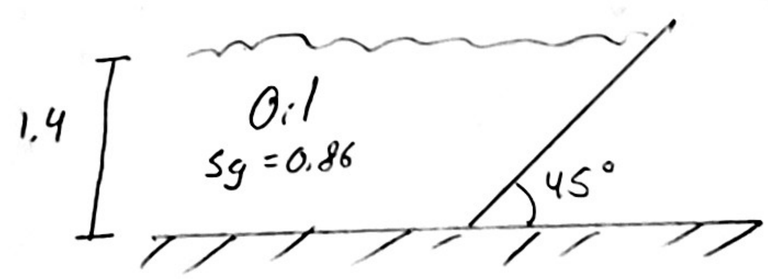
$$P = \frac{F}{A} \Rightarrow F = P \cdot A$$

$$A = \pi \cdot \left(\frac{D}{2}\right)^2 = \pi \left(\frac{30in}{2}\right)^2 = 706.8 in^2$$

$$F = 14.4 \frac{lb_f}{in^2} \cdot 706.8 in^2 = \underline{\underline{10177.92 lb}}$$

Problem 4.17

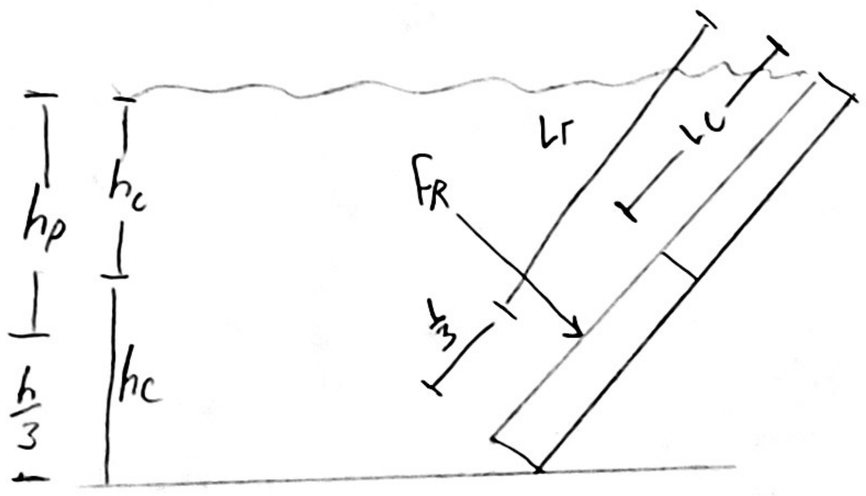
Given: figure



wall is 4m long

Find: total force on wall due to oil

Solution:



$$P = \frac{F_r}{A} \Rightarrow F_r = P \cdot A$$

$$P = \gamma_{oil} \cdot h_c =$$

$$A = l_{face} \cdot L$$

$$L_{face} = \frac{h}{\sin\theta} = \frac{1.4}{\sin 45°}$$

$$L_{face} = 1.97$$

$$A = 1.97 \cdot 4 = 7.919 m^2$$

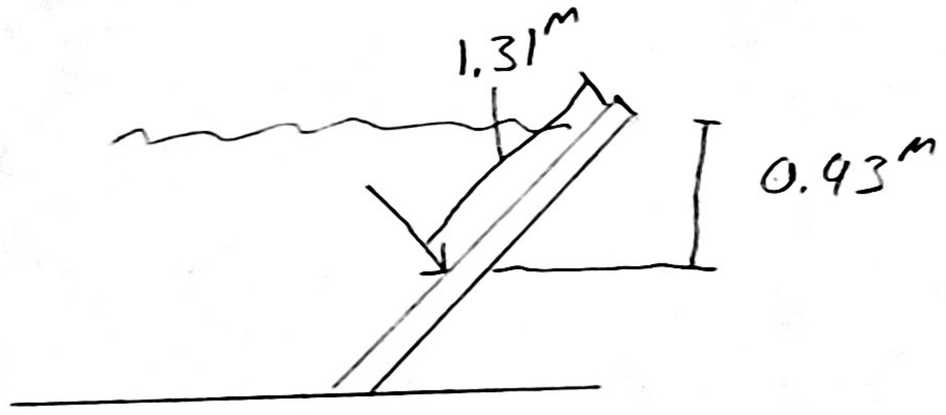
$$P = (0.86 \cdot 9.81) \cdot 0.7 = 5.90 \frac{kN}{m^2}$$

$$F_r = 5.9 \cdot 7.919 = \underline{46.72^{kN}}$$

location

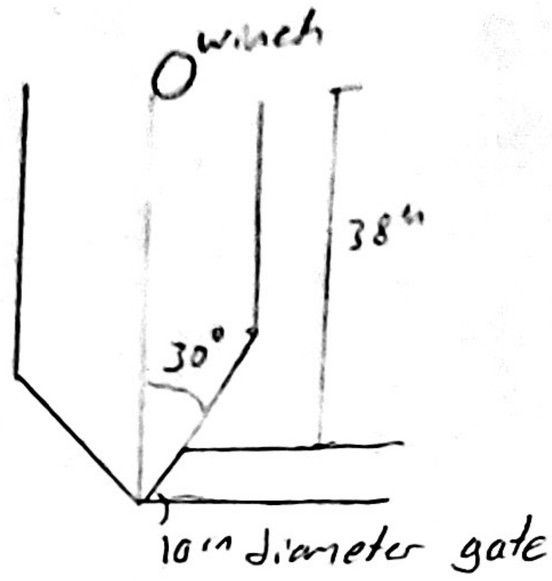
$$h_p = h - \frac{h}{3} = 1.4 - \frac{1.4}{3} = 0.93^m$$

$$L_r = l_{face} - \frac{L}{3} = \frac{1.4}{\sin 45} - \frac{\left(\frac{1.4}{\sin 45}\right)}{3} = 1.31^m$$



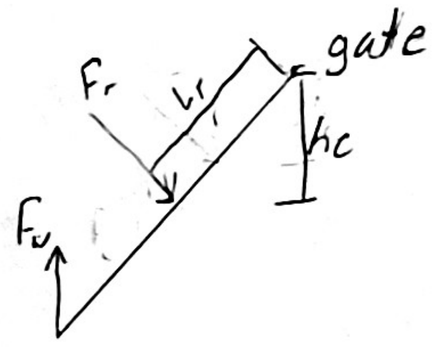
Problem 4.42

Given: Circular tank with winch operated gate at bottom.



Find: force required to open gate

Solution



$F_r = P \cdot A$

$P = \gamma_{water} \cdot (h + h_c)$

$h_c = 5^{in} \cdot \cos 30° = 4.33^{in}$

$P = 62.4 \cdot \left(\frac{38 + 4.33}{12}\right) = 220.1 \frac{lb}{ft^2}$

$A = \pi \left(\frac{10^{in}}{2}\right)^2 = 78.53^{in^2} = 0.54^{ft^2}$

$F_r = 220.1 \frac{lb}{ft^2} \cdot 0.54^{ft^2} = 119.95^{lb}$

Take moment at gate hinge

$L_{face} = \frac{10}{\cos 30} = 11.54$

$L_r = L_{face} - \frac{L}{3} = 7.69^{in}$

$\Sigma M_h = (F_r \cdot L_r) - (F_w \cdot D) = 0$

$(119.95^{lb} \cdot 7.69^{in}) = F_w \cdot 10^{in}$

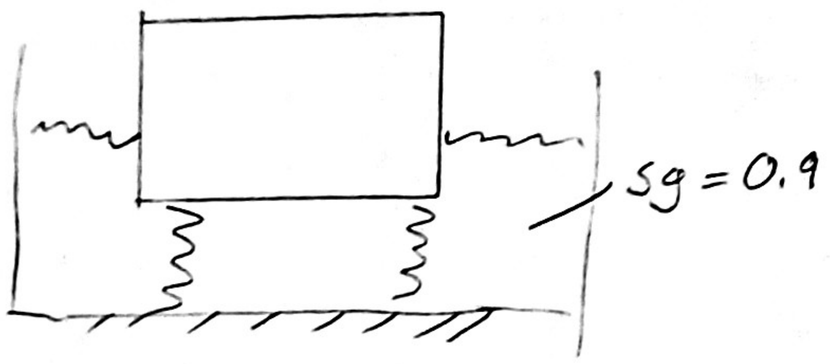
$F_w = \frac{922.41}{10} = \underline{92.24^{lb}}$

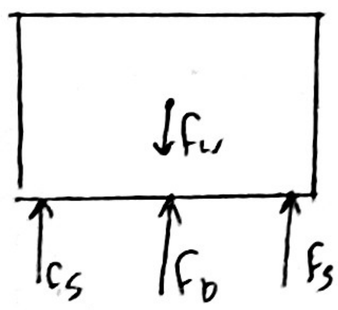
Problem 5.8

Given: pump partially submerged and supported by springs. total weight is 14.6^{lb}. Submerged volume is 40^{in^3}

Find: force supported by springs

Solution





$$F_b = \gamma_{0.1} \cdot V = (0.9 \cdot 62.4) \cdot \left(\frac{40}{12^3}\right)^{ft} = 1.3^{lb}$$

$$F_s = W - F_b = 14.6^{lb} - 1.3^{lb} = \underline{13.3^{lb}}$$

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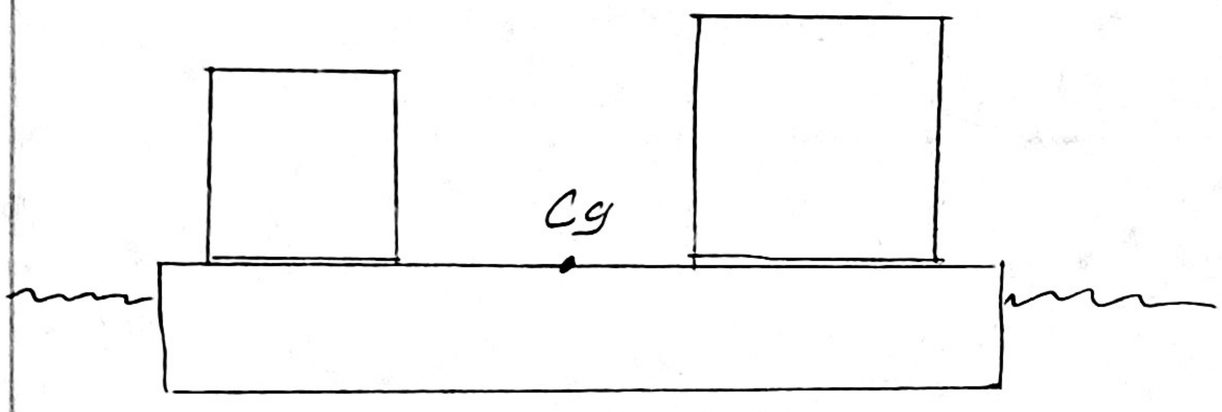
Problem 5.41

Given: Total weight of system is $450\,000^{lb}$
Center of gravity is 8^{ft} from bottom

Find: Will platform be stable

Solution:



for stability the metacenter must be higher than center of gravity.

$MC = \frac{I}{V}$ ← gives y above center of bouyancy

y_{cb} = half of displaced height

$F_b = W$ $\qquad F_b = \gamma_{water} \cdot V = \gamma_w \cdot L \cdot B \cdot D$

$450000^{lb} = (62.4\frac{lb}{ft^3})(20^{ft} \cdot 50^{ft} \cdot D)$

$D = \frac{450000}{62400} = 7.21^{ft}$

$y_{cb} = \frac{7.21}{2} = 3.6^{ft}$ from base

$MC = \frac{I}{V}$

$I = \frac{L \cdot B^3}{12} = \frac{50 \cdot 20^3}{12} = 33333.33^{ft^4}$

$V = L \cdot B \cdot D = 50 \cdot 20 \cdot 7.21 = 7210^{ft^3}$

$MC = 4.62^{ft}$

$y_{MC} = y_{cb} + MC = 3.6 + 4.62 = \underline{8.22}$

8.2278 ∴ platform is stable.