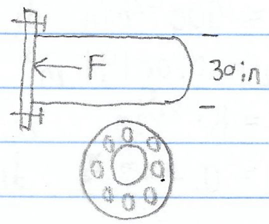
MET 330 Chapter 4 HW

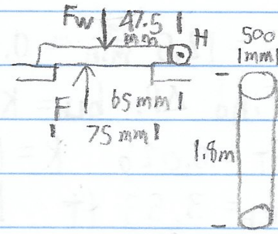
2. $P = 14.4$ Psig   ID = 30 in   Find force on all bolts, F.



$n = 8$ $A = \pi \cdot 15^2 = 706.86\ in^2$ $F = P \cdot A$

$F = 10178.76$ lb $F/n = 1272\ \frac{lb}{bolt}$

10. $d_T = 0.5$ m $d_V = 0.075$ m $h = 1.8$ m $\gamma_w = 9.81\ \frac{KN}{m^3}$

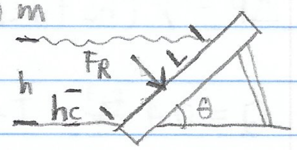


$P_w = 9.81 \cdot 1.8 = 17.66$ KPa $\Sigma M_H = 0 = 65 \cdot F - 47.5 \cdot F_w$

$65 F = 47.5 F_w$ $F_w = P_w \cdot A_T = 17.66 \cdot \pi \cdot 0.25^2$

$F_w = 3.47$ KN $F = 47.5 \cdot 3.47 / 65 = 2.53$ KN

17. $d = 4$ m $h = 1.4$ m   s.g. $= 0.86$ $\theta = 45°$ Find resultant force and center of pressure. $\sin\theta = h/L$ $L = h/\sin\theta = 1.98$ m



$A = 4 \cdot 1.98 = 7.92\ m^2$ $F_R = s.g. \cdot \gamma_w \cdot \frac{h}{2} \cdot A$

$F_R = 46.77$ KN $h_c = \frac{h}{3} = 0.47$ m

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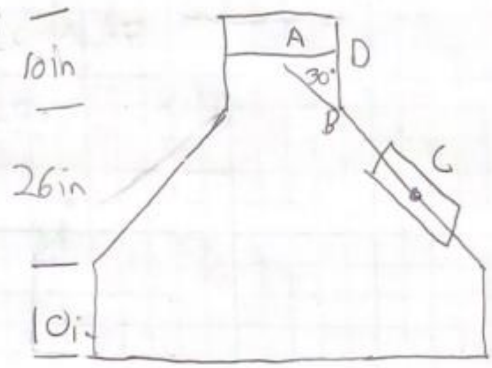


Hatch centroid

$\bar{Y} = \frac{4R}{3\pi}$

$\bar{Y} = 8.49 in$

length AB

$AB = \frac{BD}{\cos 30°}$

$AB = \frac{10}{\cos 30}$

$AB = 11.5 in$

length BC

$BC = 8 + \bar{Y}$

$BC = 16.49 in$

Face length

$L_F = AB + BC$

$L_F = 28.04 in$

Distance surface to centroid

$L_C = L_F \cos 30$

$L_C = 24.28\ in$

Specific weight Ethylene

$\gamma_e = SG \cdot \gamma_w$

$\gamma_e = 68.64\ lb/ft^3$

Force resultant

$F = \gamma_e \cdot L_C \cdot \pi/2\, R^2$

$F = 605\ lb$

Inertia

$I = R^4 \left(\frac{\pi}{8} - \frac{8}{9\pi} \right)$

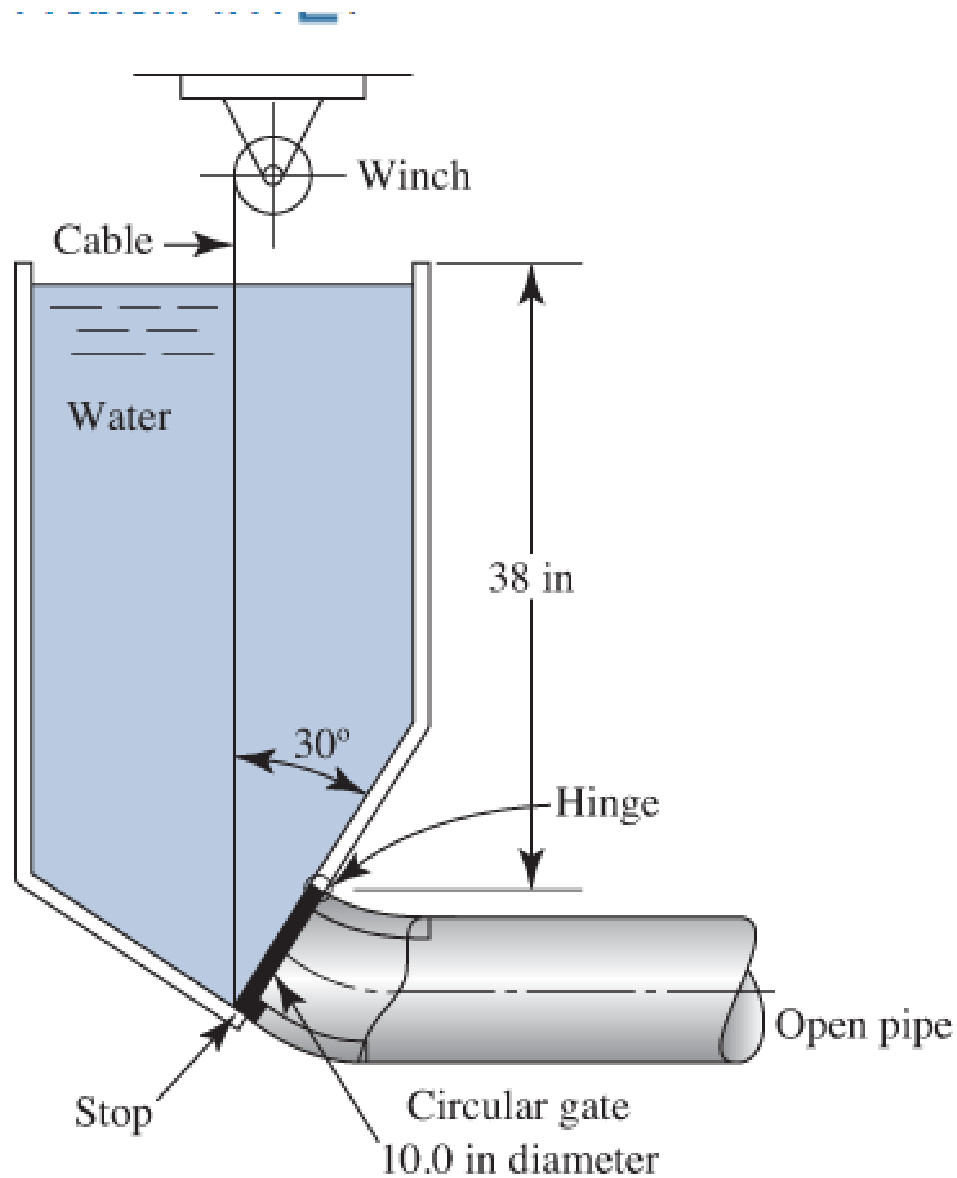
$I = 17561\ in^4$

Distance to center pressure

$L_P = L_C + \frac{I}{L_C (\pi/2 R^2)}$

$L_P = 29\ in$

Problem 42



Winch
Cable
Water
38 in
30°
Hinge
Open pipe
Stop
Circular gate
10.0 in diameter

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Vertical height

$$y = \frac{D}{2} \cos 30$$

$$y = \frac{10}{2} \cos 30$$

$y = 4.3$ in

Surface to gate

$L_c = y + 38$

$L_c = 42.3$ in

Axis to centroid

$$L_A = \frac{L_c}{\cos 30}$$

$L_A = 48.87$ in

Area gate

$$A = \frac{\pi D^2}{4}$$

$A = 78.5 \text{ in}^2$

Force

$F = \gamma \cdot L_C \cdot A$

$F = 120$ lb

Inertia

$$I = \frac{\pi D^4}{64}$$

$$I = 490.9 \text{ in}^4$$

Transfer

$$L_P - L_A = \frac{I}{L_A \cdot A}$$

[illegible] $= 0.128$ in

Moment of Equilibrium at hinge

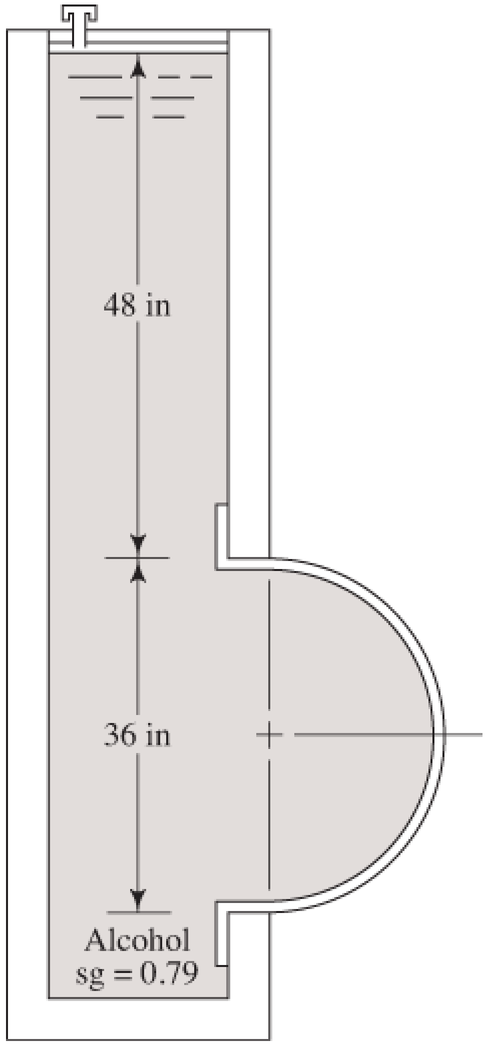
$$\Sigma M_H = 0$$

$$\left(F \cdot \frac{D}{2} + 0.128\right) - \left(F_C \cdot \frac{D}{2}\right) = 0$$

<u>$F_C = 123$ lb</u>

Problem 54

4.54 Use Fig. 4.54. The surface is 60 in long.



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$D = 36in$

$Sg = 0.79$

$w = 60in$

$h_1 = 48in$

Area of semi circle

$$A = \frac{\pi D^2}{4}$$

$A = 508.9 in^2$

Volume

$V = Aw$

$V = 30535.8 in^3 \rightarrow 17.67 ft^3$

Weight of alcohol

$\gamma_a = 62.4 \cdot Sg$

$\gamma_a = 49.29 \ lb/ft^3$

Volume weight

$W_v = V \cdot \gamma_a$

$W_v = 871 lb$

Verticle force componet

$\underline{F_v = 871 \ lb}$

Centroid

$\bar{x} = 0.212 \cdot D$

$\bar{x} = 7.63 in$

Depth centroid

$H_c = 36/2 + 48$

$H_c = 66 in \rightarrow 5.5 ft$

Force horizontal

$F_H = 49.29 \cdot 3 \cdot 5 \cdot 5.5$

$F_H = 4066 lb$

Force

$F = \sqrt{F_V^2 + F_H^2}$

$F = 4159.15 lb$

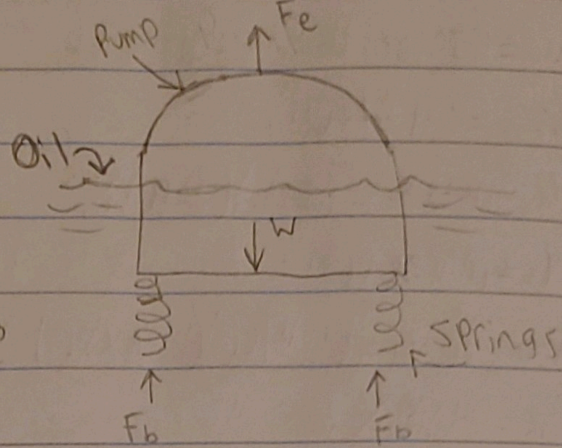
$\tan^{-1} F_V / F_H$

$\theta = 12°$ $F = 4159 Lb$ $F_H = 4066 lb$

$F_V = 871 Lb$

HW 2.1

Chapter 5



5.8 $sg_{oil} = 0.90$, $W = 14.6\,lb$

$V_d = 40\,in^3 = 0.0232\,ft^3$

$F_b = \gamma_f V_d$

$\gamma_f = sg \times 62.4\,lb/ft^3$

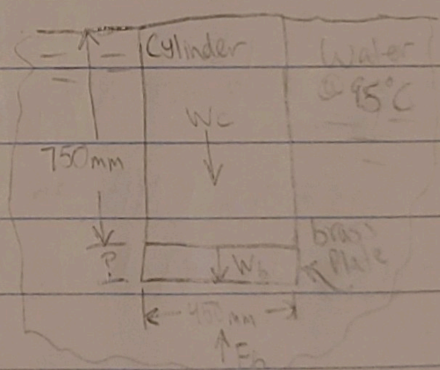
$\gamma_f = (0.90)(62.4\,lb/ft^3) = 56.16\,lb/ft^3$

$F_b = (56.16\,lb/ft^3)(0.0232\,ft^3)$

$F_b = 1.303\,lb$

$\Sigma F_v = 0 \rightarrow F_b + F_e - W = 0 \longrightarrow F_e = W - F_b$

$\hookrightarrow F_e = 14.6\,lb - 1.303\,lb = \boxed{13.30\,lb}$



5.24 $T_{water} = 95°C$, $\gamma_{brass} = 84.0\,kN/m^3$

$D = 0.45\,m$, $h = 0.75\,m$

$\gamma_{water} = 9.43\,kN/m^3$ $\quad \gamma_{cyl} = 6.45\,kN/m^3$

$V_{cyl} = \frac{\pi}{4}(0.45\,m)^2(0.75\,m) = 0.119\,m^3$

$V_{brass} = \frac{\pi}{4}(0.45\,m)^2\,t = 0.159\,t\,m^3$

$\Sigma F_v = 0 \rightarrow F_b - W_{cyl} - W_{brass} = 0$

$\hookrightarrow F_b = W_{cyl} + W_{brass}$

$F_b = \gamma_f V_d$, $W_{cyl} = \gamma_{cyl} V_{cyl}$, $W_{brass} = \gamma_{brass} V_{brass}$

$\hookrightarrow \gamma_f V = \gamma_{cyl} V_{cyl} + \gamma_{brass} V_{brass}$, $V = V_d = 0.119\,m^3 + 0.159\,t\,m^3$

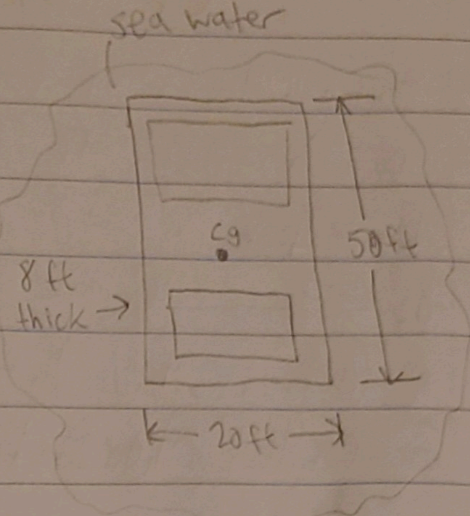
$9.43\,kN/m^3\,(0.119\,m^3 + 0.159\,t\,m^3) = (6.45\,kN/m^3)(0.119\,m^3) + (84.0\,kN/m^3)(0.159\,t\,m^3)$

$1.122\,kN + 1.50\,t\,kN = 0.768\,kN + 13.356\,t\,kN$

$0.354 = 11.856\,t \longrightarrow t = 0.354/11.856 = 0.03\,m$

$\boxed{t = 30\,mm}$

5.41 $W = 450{,}000\ lb$, $y_{cg} = 8\ ft$



$\gamma_{sw} = 64\ lb/ft^3$

$V_d = BLX = (50ft)(20ft)X$

$V_d = 1000X\ ft^3$

$F_b = \gamma_f V_d = (64\ lb/ft^3)(1000X\ ft^3)$

$F_b = 64000X\ lb$

$\Sigma F_v = 0 \rightarrow F_b - W = 0 \rightarrow F_b = W$

$64000X\ lb = 450{,}000\ lb \rightarrow X = 450000/64{,}000 = 7.031\ ft$

$y_{cb} = X/2 = 7.031ft/2 = 3.516\ ft$

$F_b = 64000(7.031) = 44{,}9984\ lb$

$MB = I/V_d \rightarrow V_d = 1000(7.031) = 7031\ ft^3$

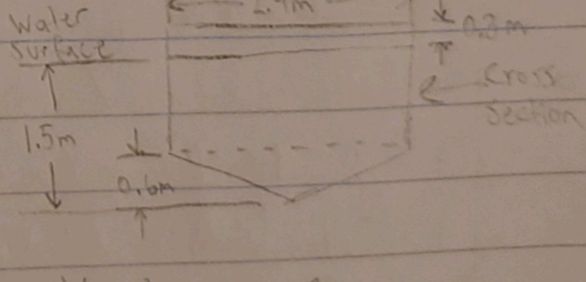
$I = LB^3/12 = (50ft)(20ft)^3/12 = 33{,}333.33\ ft^4$

$MB = 33{,}333.33ft^4/7031ft^3 = 4.741\ ft$

$y_{mc} = y_{cb} + MB \rightarrow y_{mc} = 3.516ft + 4.741ft = \boxed{8.257\ ft}$

→ yes the Platfor will be stable

5.61 $L = 5.5m$



$A_{rec} = (1.5 + 0.3 - 0.6)(2.4) = 2.88m^2$

$A_{tri} = \frac{1}{2}(2.4)(0.6) = 0.72m^2$

$A_{tot} = 2.88 + 0.72 = 3.6m^2$

Submerged Area, A_d . $A_{rec} = (1.5-0.6)(2.4) = 2.16m^2$

$A_d = 2.16 + 0.72 = 2.88m^2$

$$y_{cg} = \frac{(0.72m^2)\left(\frac{0.6m}{3}\right) + (2.88m^2)\left(0.6 + \frac{1.2}{2}\right)}{3.6m^2} = 1m$$

$$y_{cb} = \frac{(0.72m^2)\left(\frac{0.6m}{3}\right) + (2.16m^2)\left(0.6 + \frac{0.9}{2}\right)}{2.88m^2} = 0.8375m$$

$V_d = A_d X = 2.88 m^2 \times 5.5 m = 15.84 m^3$

$I = LB^3/12 = (5.5)(2.4)^3/12 = 6.336 m^4$

$MB = I/V_d = 6.336 m^4 / 15.84 m^3 = 0.40 m$

$y_{mc} = y_{cb} + MB = 0.8375 m + 0.40 m = \boxed{1.238 m}$

<u>Yes</u>, the boat is stable