1

MET330
HW 2.1
4.2, 4.42, 5.41
Kevin Smith
Group 2

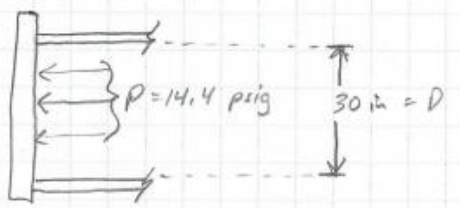
4.2 Given

Diameter = 30 in
Pressure = 14.4 psig

Find

Find the total force that must be resisted by the bolts in the flange.

Drawings



Solution

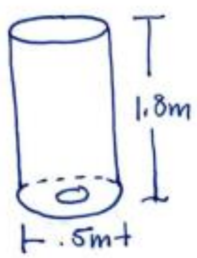
$A = \pi r^2$
$A = \pi 15^2$
$A = 706.85 \text{ in}^2$

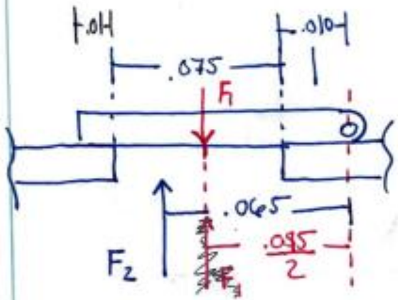
$F = PA$
$F = \frac{14.4 \text{ lb}}{\cancel{\text{in}^2}} \cdot 706 \cancel{\text{in}^2}$

$\boxed{F = 10,166 \text{ lb}}$

HWK 2.1 | Met 330 | Carroll, Shaunmark

4.10) A simple Shower for remote locations is designed with a cylindrical tower (.5m diameter, 1.8m high). water flows through flapper valve at bottom, through a (.075 diameter) opening. Flapper is pushed forward how much force is required.





diameter = (.01 + .075 + .01) ⇒ .095

$A = \frac{\pi}{4}(.095^2) \Rightarrow A = .0071\,m^2$

$P = F/A \rightarrow F = PA$

$P = \gamma h \Rightarrow 9.81\frac{KN}{m^3}(1.8\,m)$

$P = 17.658\ \frac{KN}{m^2}$

$F_1 = 17.658\ \frac{KN}{m^2}\ (.0071\,m^2)$

$F_1 = .125\ KN$ or $125\ N$

ΣM @ hinge $\circlearrowright +$

$F_1\left(\frac{.095}{2}\right) - F_2(.065) = 0$

$125N(.0475) - F_2(.065) = 0$

$F_2 = \frac{125(.0475)}{.065}$

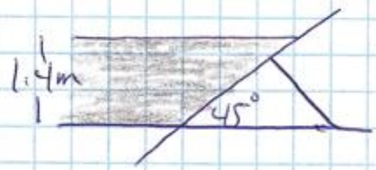
$F_2 = 91.35\ N$

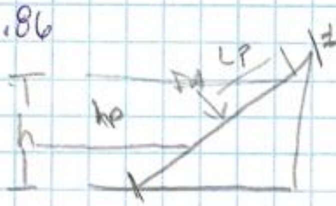
4.17

John Vazquez
MET330
Hw 2.1

- Calculate total force on wall due to oil pressure.
- Determine location of Center of pressure & show resultant force on wall

S.G = .86

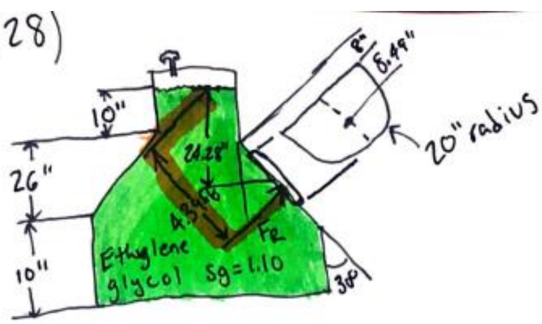




$L = \frac{1.4}{\sin 45°} = \boxed{1.98m}$

- $h_p = \frac{2}{3}h = \frac{2}{3}(1.4) = \boxed{.933m}$
- $L_p = \frac{2L}{3} = \frac{2}{3}(1.98) = \boxed{1.32m}$
- $F_R = \gamma_o\left(\frac{h}{2}\right)A$
$= (.86)\left(9.81\frac{kN}{m^3}\right)(1.98_m)(4_m)(.7_m)$
$\boxed{= 46.77kN}$

4.28)



$sg = 1.10$

$\gamma_{Eg} = 1.10(62.4) = 68.64 \text{ lb/ft}^3$

Robert Knupp
MET 330
HW 2.1
Group 2

$\text{Centroid} = \frac{4r}{3\pi} = \frac{4(20)}{3\pi} = 8.49 \text{ in}$

$A = \frac{\pi r^2}{2} = \frac{\pi 20^2}{2} = 628.32 \text{ in}^2 = 4.36 \text{ ft}^2$

$\therefore h_c = 10 + (8 + 8.49)\cos 30$

$h_c = 24.28 \text{ in} = 2.02 \text{ ft}$

$F_R = \gamma_{Eg} h_c A = 68.64(2.02)(4.36) = \boxed{604.53 \text{ lb}}$

$\therefore L_c = \frac{h_c}{\sin 30}$

$I_c = \frac{\pi r^4}{4} = \frac{\pi 20^4}{4} = 125{,}663.71 \text{ in}^4 = 6.06 \text{ ft}^4$

$L_c = 48.56 \text{ in} = 4.05 \text{ ft}$

$\therefore L_p = L_c + \frac{I_c}{L_c A} = 4.05 + \frac{6.06}{(4.05)(4.36)} = \boxed{4.39 \text{ ft}}$

$= \boxed{52.72 \text{ in}}$

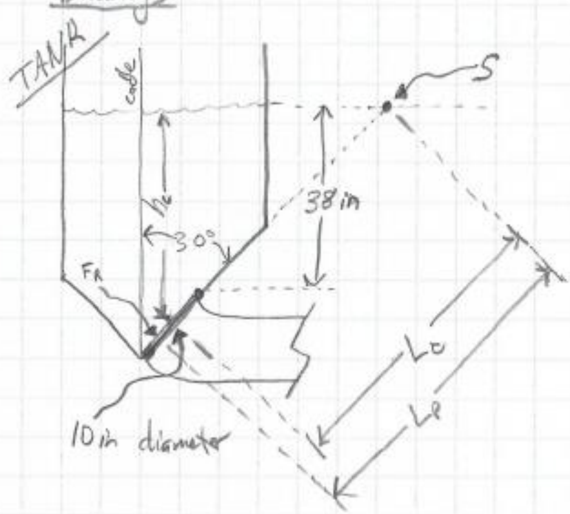
4.42 Given

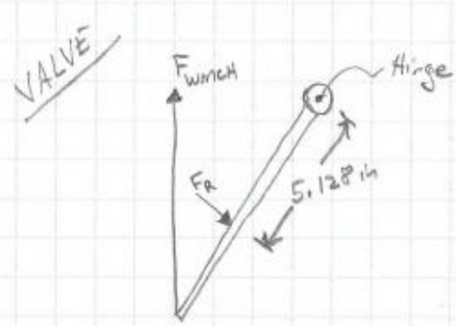
Circular gate = 10 in diameter at 30° angle
fluid is water
distance to hinge is 38 in deep

Find

Compute the amount of force that the winch cable must exert to open the gate.

Drawings





Solution

F_R = 120 lb
θ = 30°
h_c = 42.33 in
L_c = 48.88 in
L_p = 49 in
h_p =
B = 10 in diameter
H = 10 in diameter
A = 78.54 in^2
Assume... H_2O temp = 50°F
γ = 62.4 lb/ft^3 or 0.0361 lb/in^3
I_c = 490 in^4

Centroid $= \frac{1}{2} D = \frac{1}{2} 10 = 5$ in

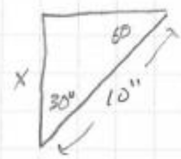
$A = \pi r^2$
$A = \pi 5^2$

For $\gamma = 62.4 \frac{lb}{ft^3} \cdot \frac{ft^3}{1748 \, in^3} = 0.0361$ lb/in^3

3

$h_c = 38\text{ in} + \frac{8.66}{2}$

$h_c = 42.33\text{ in}$



SOHCAHTOA

$\sin 60 = \frac{x}{10\text{ in}}$

$0.866 = \frac{x}{10\text{ in}}$

$8.66 = x$

$h_c = L_c \sin\theta$

$42.33\text{ in} = L_c \sin 60°$

$48.88\text{ in} = L_c$

$F_R = \gamma h_c A$

$F_R = \frac{0.0361\text{ lb}}{\text{in}^3} \cdot 42.33\text{ in} \cdot 78.54\text{ in}^2$

$F_R = 120\text{ lb}$

$I_c = \frac{1}{4}\pi r^4$

$I_c = \frac{1}{4}\pi 5^4_{\text{in}}$

$I_c = 490\text{ in}^4$

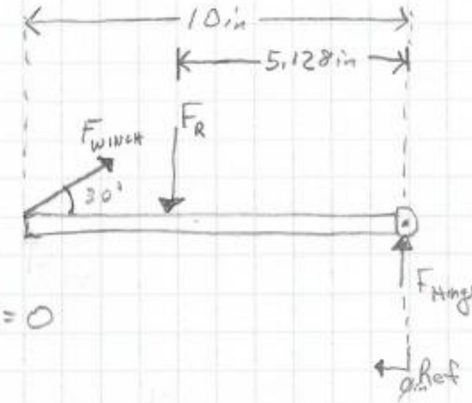
$L_p = L_c + \frac{I_c}{L_c A} = 48.88\text{ in} + \frac{490\text{ in}^4}{48.88\text{ in} \cdot 78.54\text{ in}^2}$

$L_p = 48.88\text{ in} + 0.128\text{ in}$

$L_p = 49\text{ in}$

$L_p - L_c = 49\text{ in} - 48.88\text{ in} = 0.128''$

4



$F_R = 120\ lb$

$\Sigma F_y = 0$

$0 = -F_R$

$0 = -120\ lb + F_{HINGE} + F_w \sin 30°$

$5.128 in \cdot 120\ lb = F_w \sin 30 + F_{HINGE}$

$5.128 in \cdot 120\ lb - F_w \sin 30 = F_{HINGE}$

$615.36 lb - 123\ lb/in \sin 30 = F_{Hinge}$

$615.36 - 61.5 = F_{Hinge}$

$553.86\ lb = F_{Hinge}$

$\Sigma M = 0$

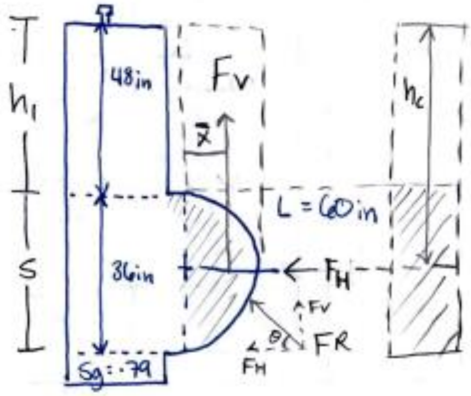
$0 = -120\ lb \cdot 5.128 in + F_w \sin 30 \cdot 10 in$

$\frac{615.36\ lb/in}{10_{in} \sin 30} = F_w$

$\boxed{123\ lb/in = F_w}$

Hwk 2.1 | Met 330 | Carroll, Shaunmark

4.54) Compute the magnitude of the horizontal component of the force and compute the vertical component of the force exerted by the fluid on that surface. Then compute the magnitude of the resultant force and its direction. Show resultant force acting on curved surface.



$V = AL$ ← length curved surface

$V = 508.938\,(60) \rightarrow 30536.28\ in^3 \left(\frac{1ft^3}{12^3 in^3}\right)$
$\rightarrow 17.67\ ft^3$

$F_V = V\gamma \rightarrow 17.67\,ft^3\left(49.296\,\frac{lb}{ft^3}\right)$

$F_V = 871.06\ lb$

$F_H = \gamma S L h_c \rightarrow 49.296\,\frac{lb}{ft^3}\left(\frac{36}{12}\right)\left(\frac{60}{12}\right)\left(\frac{66}{12}\right)$

$F_H = 4066.92\ lb$

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

$= \sqrt{871.06^2 + 4066.92^2}$

$= 4159.16\ lb$

$\theta = \tan^{-1}\left(\frac{871.06}{4066.92}\right)$

$\theta = 12.08°$

$A = \frac{\pi}{8}(d^2)$

$A = \frac{\pi}{8}(36)^2 \rightarrow A = 508.938\ in$

$\gamma = .79(62.4) \rightarrow \gamma = 49.296\,\frac{lb}{ft^3}$

$\bar{X} = 0.212\,D$
$0.212(36)$

$\bar{X} = 7.632\ in$

$h_c = h_1 + \frac{S}{2}$

$= 48 + \frac{36}{2}$

$h_c = 66in$

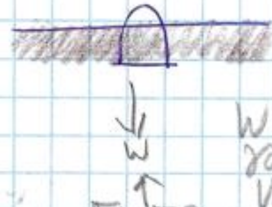
$h_p = h_c + \frac{S^2}{12h_c} \rightarrow \frac{66}{12} + \frac{\left(\frac{36}{12}\right)^2}{12\left(\frac{66}{12}\right)}$

$h_p = 5.6363\ ft$

5.8

• pump Submerged SG = .9 • Total weight = 14.6 lb • Volume = 40 in³

• Calculate Supporting forces



• $W - \gamma_0 \cdot V_d - F_{sp} = 0 = W - F_b - F_{sp}$

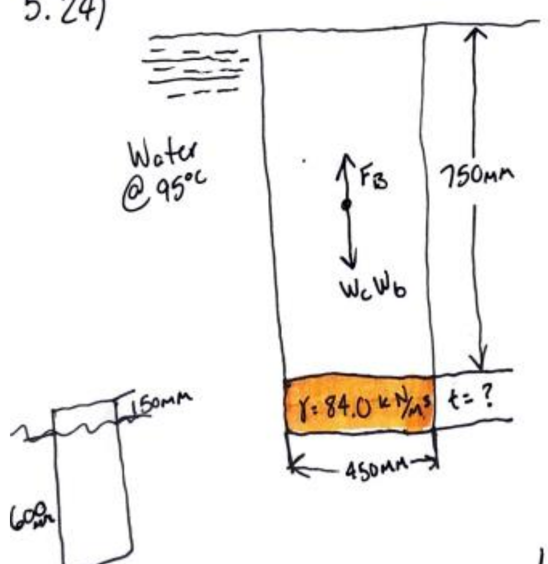
• $F_{sp} = W - \gamma_0 V_d =$

$= (14.6\,lb) - (.90)(62.4\,\frac{lb}{ft^3})(40\,in^3)(\frac{1\,ft^3}{1728\,in^3})$

$\boxed{= F_{sp} = 13.3\,lb}$

$W = 14.6\,lb$
$\gamma_0 = .90$
$V_d = 62.4\,lb/ft^3$
$V = 40\,in^3$

5.24)



$\gamma_w = 9.44\ kN/m^3$

$\rho_w = 962\ kN/m^3$

$\Sigma F = F_B - W_c - W_b$

$\therefore \gamma_F V_T = \gamma_c V_c + \gamma_b V_b$

$9.44\,kN/m^3(.119 + .159t) = 6.456(.119) + 84(.159t)$

$(1.12336 + 1.501t) = .768 + 13.356t$

$\therefore 11.855t = .35536$

$\therefore \boxed{t = 0.03\,m \text{ or } 30\,mm}$

$\gamma_{cylinder} = \gamma_{kero}\left(\frac{V_{kero}}{V_{cylinder}}\right) = 8.07\,kN/m^3\left(\frac{\frac{\pi(.45m)^2}{4} \times .6m}{\frac{\pi(0.45m)^2}{4} \times 0.75m}\right) = 6.456\ kN/m^3$

$V_{cylinder} = \frac{\pi(.225)^2}{} \times .75m = .119\,m^3$ $V_T = (.119 + .159t)$

$V_{brass} = \pi(.225)^2 \times t = .159t\,m^3$

5

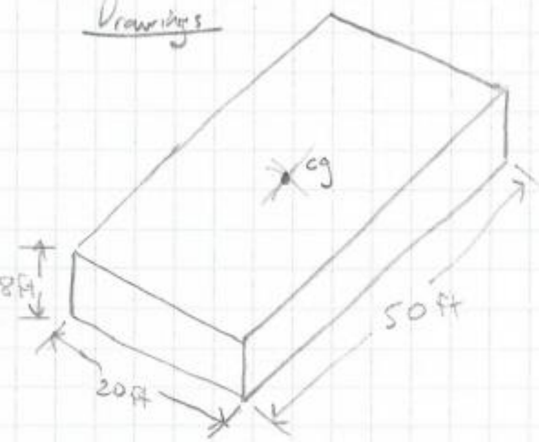
5.41 Given

$W = 450$ k lbs
CG = center with w + h
8 ft from bottom
Fluid is seawater

Find

Will the platform be stable in seawater in the position shown?

Drawings



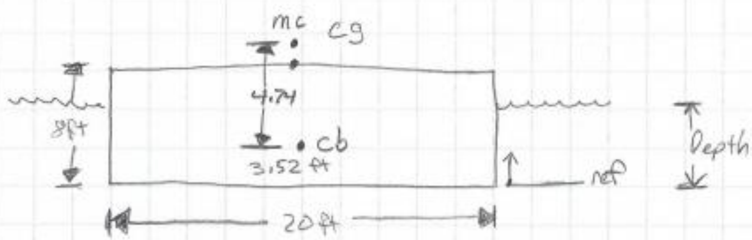
$W = 450{,}000$ lb
~~MG~~
$y_{mc} =$
~~y_{cg}~~
$F_b = 450000$ lb
$\gamma_f = 64$ lb/ft^3
$SG = 1.03$
$V_d = 7031$ ft^3
$\gamma_B = 56.25$ lb/ft^3
$y_{cb} = 3.52$ ft
$MB = 4.74$ ft

Solution

$F_b = \gamma_f V_d$
$450{,}000 \text{ lb} = 64 \text{ lb/ft}^3 \, V_d$
$\frac{450000 \text{ lb}}{64 \text{ lb/ft}^3} = V_d$

$7031 \text{ ft}^3 = V_d$

for the barge:
$w = \gamma V$
$450 \text{ k} = \gamma \cdot 8\text{ft} \cdot 20\text{ft} \cdot 50\text{ft}$
$450 \text{ k} = \gamma \cdot 8000 \text{ ft}^3$
$\gamma = 56.25 \text{ lb/ft}^3$



$D = \frac{W}{\gamma_f \cdot A}$

$\text{Depth} = \frac{450{,}000}{64\ lb/ft^3 \cdot 20ft \cdot 50ft}$

$\text{Depth} = 7.03\ ft =$

$Y_{CB} = \frac{D}{2} = \frac{7.03\ ft}{2}$

$Y_{CB} = 3.52ft$

$\text{Inertia} = I = \frac{1}{12} bh^3$

$I = \frac{1}{12} \cdot 50ft \cdot 20ft^3$

$I = 33{,}333\ ft^4$

$MB = \frac{I}{V_d} = \frac{33{,}333\ ft^4}{7031\ ft^3}$

$MB = 4.74\ ft$

$Y_{mc} = Y_{cb} + MB = 3.52ft + 4.74ft$

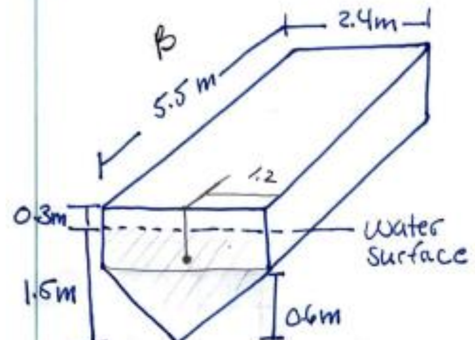
$Y_{mc} = 8.26\ ft$

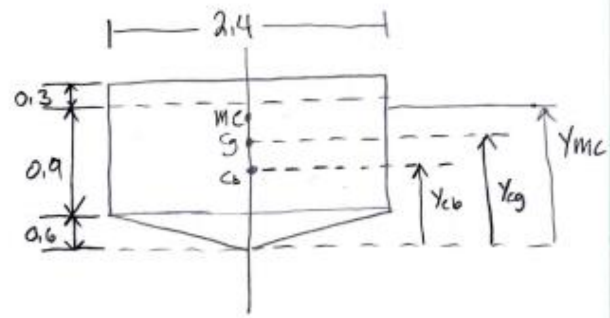
↓

8.26 ft > 8ft ∴ barge is stable

Hwk 2.1 | Met 330 | Carroll, Shaunmark

5.61) A boat is shown, its geometry at the water line is the same as the top surface, the hall is solid, Is the boat stable?





$A_T = \frac{1}{2}(0.6)(2.4) = .72$

$A_{sq} = 2.4(0.9+0.3) = 2.88$

$A_{sub_{sq}} = 2.4(0.9) = 2.16$

$Y_{mc} > Y_{cg}$

Stable !

$$Y_{cg} = \frac{A_1 Y_1 + A_2 Y_2}{A_T} \rightarrow \frac{(.72)(\frac{2}{3}(0.6)) + (2.88)(1.2)}{.72 + 2.88}$$

$Y_{cg} = 1.040$ m

$$Y_{cb} = \frac{A_1 Y_1 + A_2 Y_2}{A_{sub}} \rightarrow \frac{(.72)(\frac{2}{3}(0.6)) + (2.16)(0.6 + \frac{0.9}{2})}{(.72 + 2.16)}$$

$Y_{cb} = 0.8875$m

$V_d = A_{sub} \times B \rightarrow 2.88(5.5) \quad V_d = 15.84\ m^3$

$I = \frac{BH^3}{12} \rightarrow \frac{5.5(2.4)^3}{12} \rightarrow I = 6.336\ m^4$

$MB = \frac{I}{V_d} \rightarrow \frac{6.336}{15.84} \rightarrow MB = 0.4$ m

$Y_{mc} = Y_{CB} + M_B \rightarrow 0.8875 + 0.4 \rightarrow Y_{mc} = 1.2875$ m