Write a paragraph or two on what you learned.

4.2 - **Ethan E**
4.10 - **Ethan K**
4.17 - **Gershon**
4.28 - **Kayla**
4.42-**Josiah**
4.54-**Josiah**

5.8 - **Kayla**
5.24 - **Ethan K**
5.41- **Gershon**
5.61 - **Ethan E**

Present an initial drawing (if CAD drawing, better!) of the learning/demonstration kit the elementary school kids, or at least show me at least 4 ideas you might have found online. Remember, your device is centered around an idea from water parks.

1. The effect of viscosity on the properties of pancake batter
2. The effect of temperature and pressure on the viscosity of ice cream
3. The effect of viscosity on the flow of liquids
4. The effect of pressure on the molecules of a viscous liquid

In this homework assignment we learned about the forces created by static fluids exerting pressure on their containers. We also learned about buoyant forces created by the force of a fluid pushing up on an object that is either partially or fully submerged. The weight of the object is compared to the buoyant force in order to determine whether it will be fully submerged, partially submerged, neutrally buoyant, or not buoyant. Another thing we learned and solved was the effects of a fluid being exerted on a curved surface instead of a straight and flat one. We used the formula developed in class for this purpose to assist us in the calculations and to present complete and correct answers.

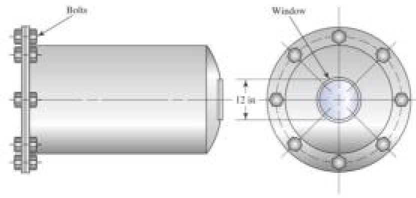
4.2

4.2 The flat left end of the tank shown in Fig. 4.21 is secured with a bolted flange. If the inside diameter of the tank is 30 in and the internal pressure is raised to +**23.6** psig, calculate the total force that must be resisted by the bolts in the flange.

$$F = PA = \left(\frac{23.6\,lb}{in^2}\right)\left(\frac{\pi(30\,in)^2}{4}\right)$$

$$F = 16681.86\,lb$$

FIGURE 4.21 Tank for Problems 4.1 and 4.2.

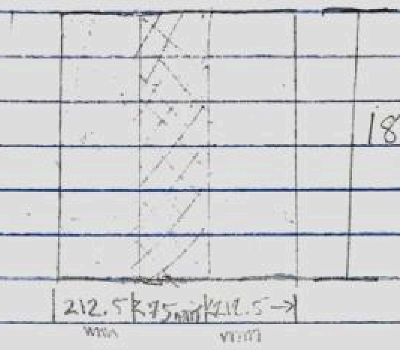


Ettrich

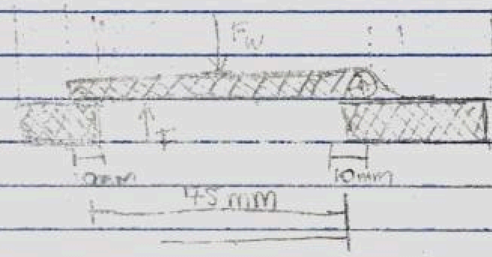
4.10

Tank

water on valve
water



Valve

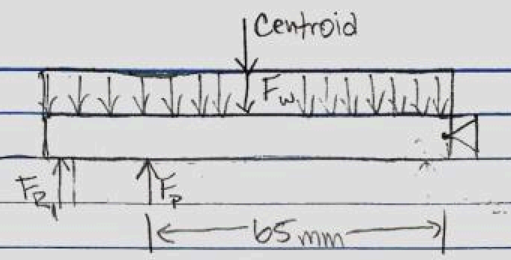


Considerations
- Fluid is water
- Incompressible
- Isothermal

Procedure

1. I will calculate the Forces to sum them.
2. I will calculate the moments to sum them.
3. The Force required to open it is any force larger than the force holding it, so this is what I will solve for.

Calculations



$\Sigma F = 0 \rightarrow F_P - F_w + F_R = 0$

$\Sigma M = 0 \rightarrow F_P \cdot 65mm - F_w \cdot 47.5mm + F_R \cdot 75mm = 0$

$P = \frac{F}{A} \rightarrow F = p \cdot A \rightarrow p = \rho g h = 1000 \frac{kg}{m^3} \cdot 9.81 m/s^2 \cdot 1.8m$

$p = 17658 \ kg/m \cdot s^2$

$= 17.658 \ kg/mm \cdot s^2$

$F_w = 17.658 \ kg/mm \cdot s^2 \cdot A \rightarrow A = \pi \cdot 37.5^2 = 4417.9 \ mm^2$

$F_w = 78.01 \cdot 10^4 \ kg \cdot mm/s^2 = 78.01 \ [kg \cdot m/s^2]$

$F_P - 78.01 + F_R = 0$

$0.065m \cdot F_P + (78.01 \cdot 0.0475m) + F_R \cdot 0.095m = 0$

$\downarrow$

$F_P = -78.01 - F_R \rightarrow 0.065(-78.01 - F_R) + F_R \cdot 0.095m = 0$

$F_R = 169.022 \ N$ } plug and chug

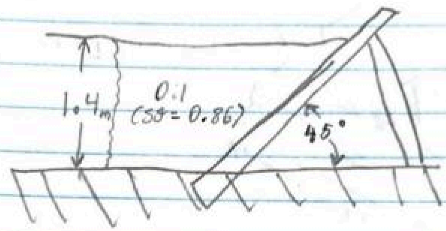
$\boxed{F_P = -247.032N}$

Any Force > 247.032 N will open the valve.

4.17) If the wall is 4m long, calculate the total force on the wall due to the oil pressure. Also determine the location of the center of pressure and show the resultant force on the wall.

$h = 1.4_m$

$\gamma = 8.44\ kN/m^3$



$F_R = \gamma (h/2) A$

$L = h/\sin\theta = 1.4_m / \sin(45°) = 1.98_m$

$A = L \cdot 4_m = 7.92 m^2$

$F_R = 8.44 \frac{KN}{m^3} \times \left(\frac{1.4m}{2}\right) \times 7.92 m^2$

$\boxed{F_R = 46.79\ kN}$

$h/3 = 1.4_m/3 = 0.467_m$

$L/3 = 1.98_m/3 = \boxed{0.66_m}$

$L_p = L - L/3$

$= 1.98_m - 0.66_m$

$L_p = 1.32_m$

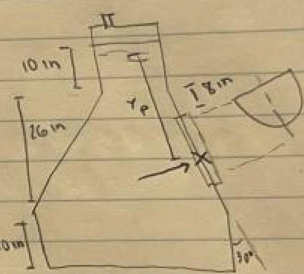
4.28

HW 2.1

4-28

compute the magnitude of the resultant force on the indicated area & the location on the center of pressure. show resultant force on A & its location

sg = 1.10   r = 20 in



$hb = 10 + 8\sin(60 \times \frac{\pi}{180}) + \frac{4 \times 20}{3 \times \pi}$

$hb = 0.018$

$yb = \frac{25.42}{\sin(60 \times \frac{\pi}{180})}$

$yb = 1390.9$

$I_s = 0.11 \times 20^4 = 17600 \text{ in}^4$

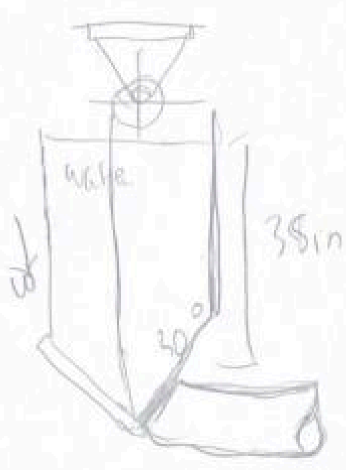
$y_p = 1390.9 + \frac{17600}{\pi \times 20^2 \times \frac{1390.9}{2}} = \boxed{1390 \text{ in}}$

resultant force:

$62.4 \times \frac{0.018}{12} \times \pi \times \left[\frac{(\frac{20}{12})^2}{2}\right] = \boxed{0.41 \text{ lb-f}}$

4.42

HW 4-42



D = 10 in

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

$F_R = \gamma h_c A$ $\quad A = \frac{\pi}{4} d^2 = \frac{\pi}{4}(10)^2 = 78.54\,in^2$

$h_c = 38 + d/2 \sin 30 = 38 + \frac{10}{2}\sin 30 = 42.33\,in$

$I_c = \frac{\pi D^4}{64} = \frac{\pi}{64}(10)^4 = 490.87\,in$

$F_R = \frac{62.4}{1000}(42.33)(78.54\,in) = 207.45$

$L_p - L_c = \frac{490.87}{(42.33)(78.54)} = .128\,in$

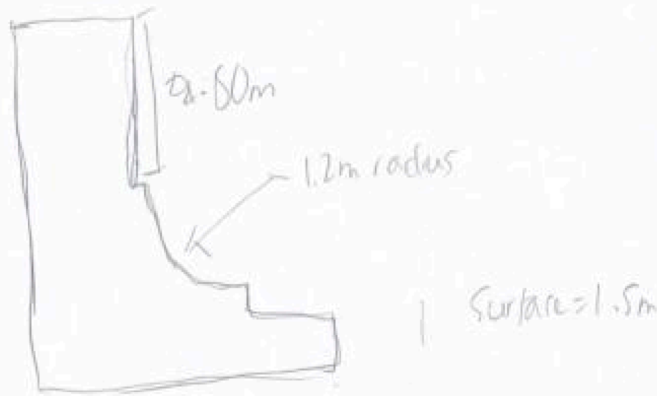
$F_R\left(\frac{D}{2} + (L_p - L_c)\right) - \left(F_c \times \frac{D}{2}\right) = 0$

$(207.45)(5 + .128) - (F_c \times 5) = 0$

$F_c = \frac{1063.1}{5} = 212.77\,lb$

4.54

HW 4.52



Compute the magnitude of the horizontal and vertical component, then comput the magnitude o the resultant force.

$F = \rho g h_c A$

$A = 1.2 \times 1.5 = 1.8\,m^2$

$h_c = (2.8 + 1.2/2) = 3.4\,m$

F_y For horizontal

$F_y = (1000)(9.81)(1.8)(3.4)$

↓

60037.21

or

60.0372 KN

F_x For vertical $F = \rho g V$

$F_x = (1000)(9.81)\left((2.8)(1.2) + \frac{\pi}{4}(1.2)^2\right)$

↓

66084.671

or

66.084671 KN

$F_R = \sqrt{F_x^2 + F_y^2}$

↓

$\sqrt{60037.2^2 + 66084.67^2} = 89284.09$

or

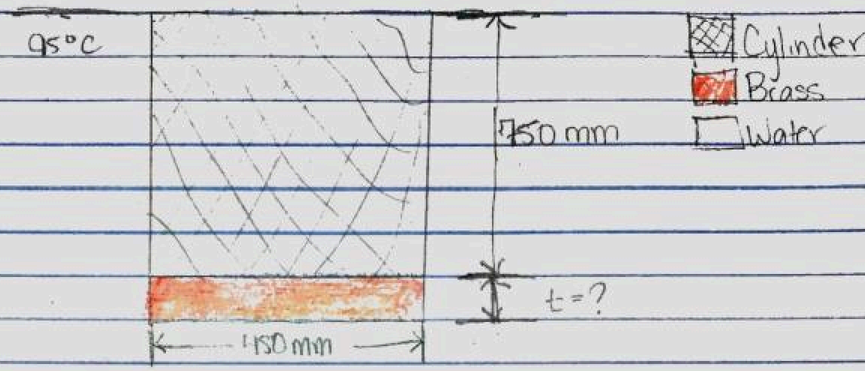
89.28409 KN

Direction: $\tan\theta = \frac{F_x}{F_y} = \frac{66084}{60037.2}$

→ 47.75°

5.24

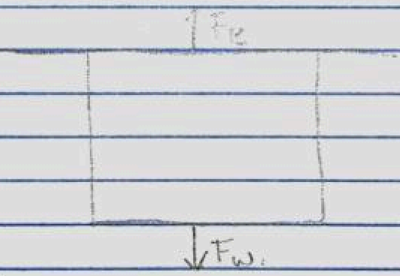
Diagram



Procedure

1. Free body diagram of the forces involved.
2. Find required thickness through statics.
3.

Free-Body Diagram



$F_B - F_w = 0$

$F_B = \gamma_w \cdot V_c \rightarrow \gamma_w = 9.4329\ kN/m^3$

$\gamma_w V_c - F_w = 0 \rightarrow V_c = \pi r^2 \cdot h \rightarrow h = 750 + t\ [mm]$, $r = 225\ [mm]$

$V_c = \pi \cdot 225^2 \cdot 750 + \pi \cdot 225^2 \cdot t$

$9.4329\ [kN/m^3] \cdot (225^2 \pi \cdot 750 + \pi \cdot 225^2 \cdot t) - F_w = 0$

$F_w = W_c + W_B \rightarrow W_B = \gamma_B \cdot \pi \cdot .225^2 \cdot t = 13.36t\ kN$

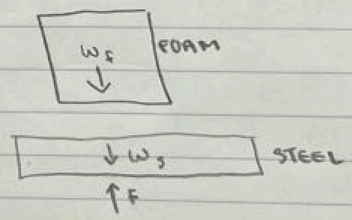
$= W_c + 13.36t$

$2.655t - W_c + 13.36t = 0 \rightarrow W_c - 16.015t = 0$

5-8

A steel cube 100 mm on a side weighs 80 N. We want to hold the cube in equilibrium under water by attaching a light foam bouy to it. If the foam weighs 470 N/m³, what is the minimum required V?

* 100 m = 0.1 m , $\rho = 1000 \frac{kg}{m^3}$



$V_s = 0.1^3 = 10^{-3}\ m^3$

$F_{B_s} = \rho_w g V_s = 1000 \times 9.8 \times 10^{-3} = 9.81\ N$

$W_f = \gamma V_f = 470\ V_f$

$F_{B_f} = \rho_w \times g \times V_f = 1000 \times 9.81 \times V_f = 9810\ V_f$

$\Sigma F_y = 0 = F_{B_f} + F_{B_s} - W_f - W_s$

$= 9810 V_f + 9.81 - 470 V_f - 80$

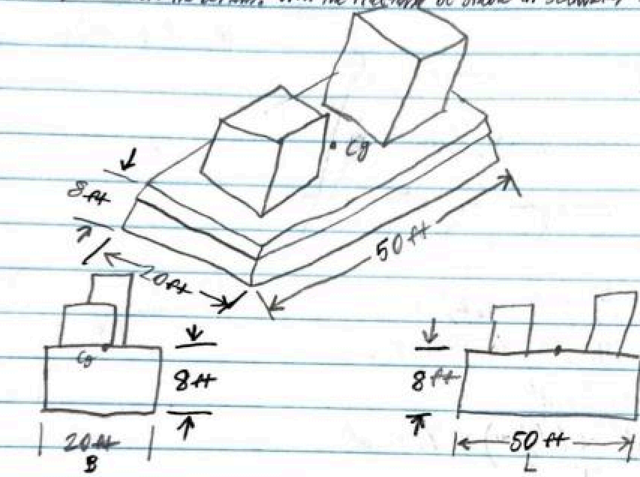
$\boxed{V_f = 7515E\text{-}3\ m^3}$

5.41

5.41) The large platform carries equipment and supplies to offshore installations. The total weight of the system is 45,000 lb, and its center of gravity is even with the top of the platform, 8ft from the bottom. Will the platform be stable in seawater in the position shown?

$B = 20ft = 240 in$

$L = 50ft = 600 in$



$X = \frac{W}{B \times L \times \gamma_f} = \frac{45{,}000 \text{ lb}}{(20ft)(50ft)} \times \frac{ft^3}{(32.174 \text{ lb})} = 1.4 ft$

$V_d = L \times B \times X = (50ft)(20ft)(1.4ft) = 1400 ft^3$

$I = \frac{LB^3}{12} = \frac{(50ft)(20ft)^3}{12} = 33333 ft^4$

$MB = I/V_d = 23.8 ft$

$y_{cb} = X/2 = 1.4/2 = 0.7ft$

$y_{mc} = y_{cb} + MB = 0.7ft + 23.8ft = 24.5ft$

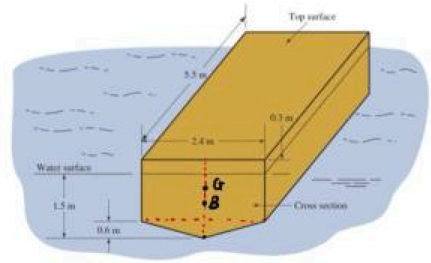
$y_{mc} > y_{cg}$; $24.5ft > 8ft$

The boat is stable

5.61

5.61 A boat is shown in Fig. 5.33. Its geometry at the water line is the same as the top surface. The hull is solid. Is the boat stable?

FIGURE 5.33 Problem 5.61.



$L = 5.5 m$
$W = 24 m$
$Draft = 1.5 m$
$Height = 1.8 m$

$CG = \frac{A_1 Y_1 + A_2 Y_2}{A_1 + A_2}$ $A_1 = \frac{1}{2}(2.4)(0.6) = 0.72 m^2$ $A_2 = \frac{1}{2}(1.2)(2.4) = 2.88 m^2$

$Y_1 = \frac{2}{3}(0.6) = 0.4 m$ $Y_2 = 0.6 + \frac{1.2}{2} = 1.2 m$

$= \frac{(0.72)(0.4) + (2.88)(1.2)}{0.72 + 2.88}$

$= 1.04$

$CB = \frac{A_3 Y_3 + A_4 Y_4}{A_3 + A_4}$ $A_3 = \frac{1}{2}(2.4)(0.6) = 0.72 m^2$ $A_4 = 0.9(2.4) = 2.16 m^2$

$y_3 = \frac{2}{3}(0.6) = 0.4 m$ $y_4 = 0.6 + \frac{0.9}{2} = 1.05 m$

$CB = \frac{(0.72)(0.4) + (2.16)(1.05)}{0.72 + 2.16}$

$= 0.8875$

$CG - GB = 1.04 - 0.8875 = 0.1525$

$BM = \frac{I}{V}$ $I = \frac{L h^3}{12} = \frac{(5.5)(2.4)^3}{12}$

$I = 6.34 m^4$

$V = (A_3 + A_4)(5.5)$

$= (0.72 + 2.16)(5.5)$

$V = 15.84 m^3$

$BM = \frac{6.34 m^4}{15.84 m^3}$

$= 0.4 m$

$GM = BM - BG$

$= 0.4 - 0.1525$

$= 0.2475$

Stable