HW 2.1

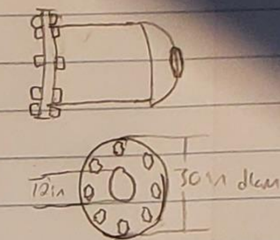
Watching and reviewing the online recording gave me the knowledge for calculating forces due to static friction. Within the recording it talked about the weight of static fluids resting on top of one another. Mentioning that even in different containers the way to solve for the values won't change and remain constant. Although using inclined walls the formulas to follow and ways to solve for values change slightly. Finding the average pressure utilizes the centroid of the slanted wall and is used to find forces typically applied at the $\frac{1}{3}$ the height on the wall. Along with using the moment of inertia to help find the properties of a rectangle with respect to an axis.

In class we were taught about drag and lift and the applications you can find these forces enacting upon an object. The Drag and drag coefficients are use when the velocity and pressure are going against an object pushing past on either side causing vortices to form behind an object. These vortices can change through oscillations or locations of an object in relative distance to flow. For lift it showcased the differences in flow over the object compared to drag formulating it's own calculations and formation of forces. As the velocity increased and flowed over creating low pressure, air flowed back under in a low velocity but high pressure causing a spinning motion of the object creating lift. Noting that in both they have similar formulas to use relying on velocity and finding the missing values.

Chp. 4 HW

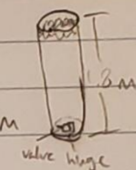
Pressure = 14.4 pound per square inch

4.2) $P = F/A$ $\quad F = P \cdot A$ $\quad$ Area of tank = 30 in



$F = 14.4 \text{ psig} \left(\left(\frac{\pi}{4}\right)(30 \text{ in})^2 \right)$ $\quad F = 10,178.76$ pounds ✓

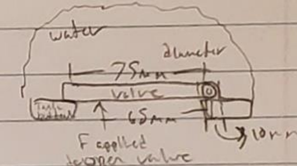
4.10) $F = \rho g h_c A$



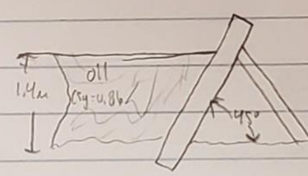
$\rho = 1,000 \text{ kg/m}^3 \quad g = 9.81 \text{ m/s}^2 \quad h_c = (1.8 - 0.75/2) = 1.7625 \text{ m}$

$F = 1,000 \text{ kg/m}^3 (9.81 \text{ m/s}^2)(1.7625 \text{ m})$

$F = 17.29 \text{ kg m/s}^2 \approx 17.29 \text{ kN}$ ✓

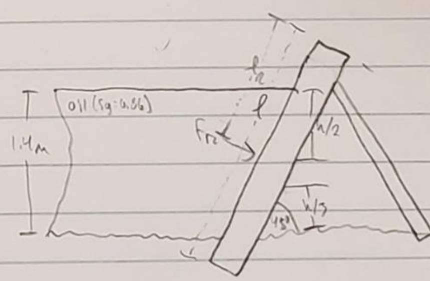


4.17)



$L = 4 \text{ m} \quad h = 1.4 \text{ m}$

$\sin 45° = \frac{1.4}{l} \Rightarrow 4(1.98) = 7.92 \text{ m}^2$



$\gamma = \rho g \quad \rho = SG(\rho_{water}) = 0.86(1000) = 860 \text{ kg/m}^3$

$\gamma = 860 \text{ kg/m}^3 (9.81 \text{ m/s}^2) = 8436.6 \text{ N/m}^3$

$F_R = P_{avg}(A)$

$F_R = 8436.6 \left(\frac{1.4}{2}\right)(7.92)$

$F_R = 46,772.5 \text{ N}$

$F_R = 46.77 \text{ kN}$

Center of pressure acting vertical distance

$\frac{h}{3} = \frac{1.4}{3} = 0.466 \text{ m}$

Location of pressure $L_p = \frac{2(1.98)}{3}$ $\quad L_p = 1.32 \text{ m}$

Measured along the face

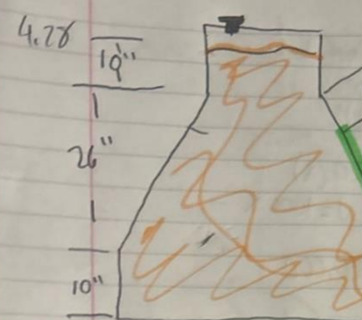
$\frac{l}{3} = \frac{1.98}{3} = 0.659 \text{ m}$

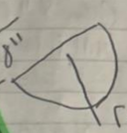
Vertical Depth from free surface to center of pressure

$h_p = h - h/3 \Rightarrow \frac{2(1.4)}{3} \quad h_p = 0.933 \text{ m}$

Container - 8.57
Water - Free
Duct tape - 7.95
30 Ping Pong balls - 14.99
Legs.

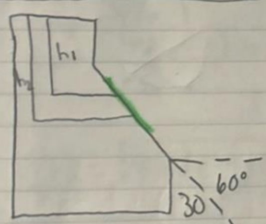
Mag RF

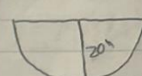




Sg = 1.10

Centroid = $\frac{4 \cdot 20}{3\pi} = 8.488''$





$I_c = \frac{\pi r^4}{8} - \left(\frac{\pi r^2}{2}\right)\left(\frac{4r}{3\pi}\right)^2$

$I_c = 17561.1\ in^4 \rightarrow m^4 = .00073$

$F = \rho_{eth} \cdot g \cdot A \cdot h_1$

$A = \frac{\pi(20)^2}{2} = 628.32\ in^2$
$.405\ m^2$

$\rho_{eth} = 1.10 \cdot 1000 = 1{,}100$

$h_1 = 10 + (8+c)\cos 30 = h = 24.28\ in \rightarrow .62\ m$

$F = 1{,}100 \cdot 9.81 (.405)(.62) = \boxed{2709.62\ N}$

$h_2 = h_1 + \frac{I_c \sin^2 60}{h_1 \cdot A} \therefore .62 + \frac{.00073 \cdot \sin^2 60}{.62 \cdot .405}$

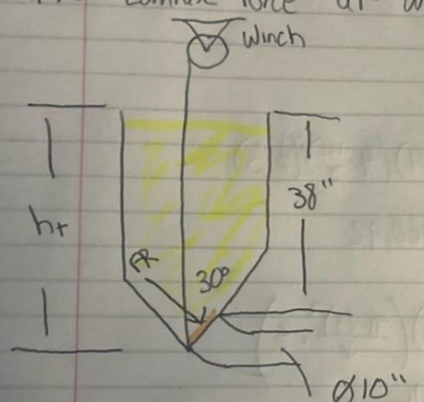
$.6222\ m$

$\boxed{= 24.50\ in}$

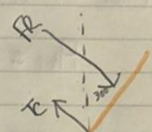
3-2" bendable Pipe/tube
Container - 8.57
Water - Free
Duct tape - 7.95
30 Ping Pong balls - 14.99
Legs.

42.54 5.41

4.42 Compute force at Winch Cable



$A_{gate} = \frac{\pi}{4} 10''^2 = 78.54''^2$



$h_t = 38 + 5\cos 30 = 42.33''$

$F_R = \gamma_{water} \cdot A \cdot h_t \therefore \frac{62.4\ lb/ft^3 (78.54) \cdot 42.33in}{1728}$

$F_R = 120.05 lb$

$gate \rightarrow top = h_t + \frac{I \cdot \sin 60^2}{78.54 \cdot 42.33} = 42.44$

$\boxed{T_c = 122.4 lb}$

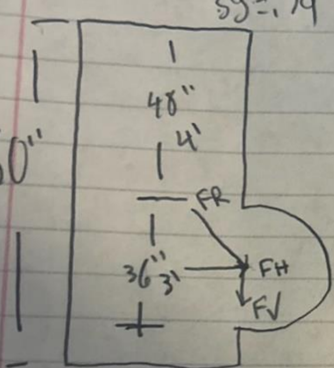
$(T_c \sin 30)(10) - 120.05 \cdot 5$ $T_c = \frac{120.05 \cdot 5.1}{\sin 30 \cdot 10}$

4.54 Compute Mag of horizontal/vertical

Mag of RF

$\gamma_w = 62.4$

sg = .79



$F_{Hor} = .79(62.4)(4+\frac{3}{2})(5 \cdot 3)$

$F_{Hor} = 4066.92$

$F_{vert} = .79(62.4)\left(\frac{\pi(3)^2}{4} \cdot 5\right)$

$F_{Vert} = 871.13\ lb$

$FR = \sqrt{4066.92^2 + 871.13^2} = \boxed{4159.17\ lb}$

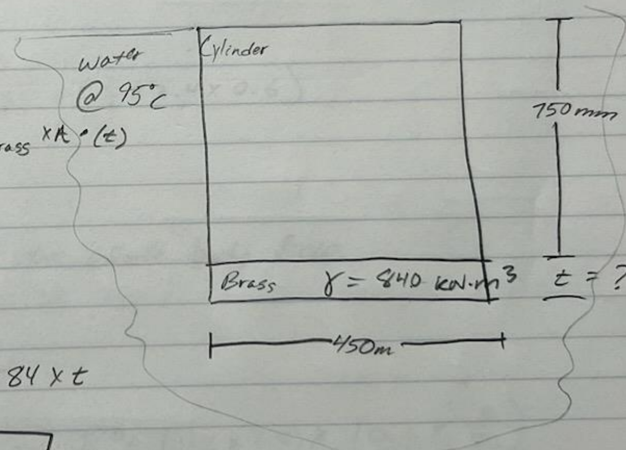
5-8 Density of oil = $0.9 \cdot 62.4 = 56.16\ lb/ft^3$

Sub Volume = $40\ in^3 = (40/12^3)\ ft^3$

$m \cdot g - \rho \cdot V \cdot g$

$14.6 \cdot 32.2 - 0.9 \times 62.4 \times (40/12^3) \cdot 32.2 = 428.26\ lb\text{-}ft/s^2$

5-24



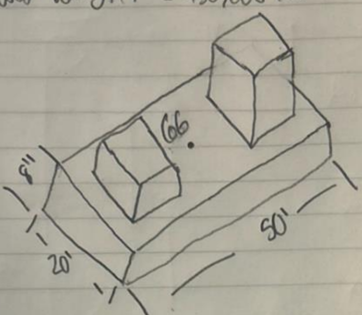
$\gamma_w \cdot A \cdot (H + t) = \gamma_{brass} \times A \cdot (t)$

$9.81 \times (750 + t) = 84 \times t$

$\boxed{t = 99.171\ mm}$

5.41. total Weight = 450,000 lb

CoG. 8" from bottom
Will platform be stable



$V = 50 \cdot 20\,(x)$

$V = 1000x$

$Bf = 450.000$

$B_F = 64{,}000\,(x)$

$450{,}000 = 64{,}000\,(x) \quad x = 7.03''$

$y_b = \frac{7.03}{2} = 3.515$

$B_F = 64000 \cdot 7.03 = 449920$

$M_oI = \frac{50(20)^3}{12} = 33333.33$

$M_c = \frac{33333.33}{7030} = 4741$

$Y_{mc} = 4.741 + 3.515$

$\boxed{= 8.256}$

$8.256 > 8 \therefore$

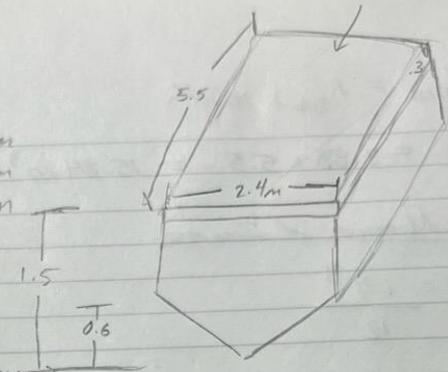
It will be Stable

5-6

$H_{total} = 1.8\,m$

$width = 2.4\,m$

$Length = 5.5\,m$



Total Area = $(1.2 \times 2.4) + (\frac{1}{2} \times 2.4 \times 0.6)$

$A_{total} = 3.6\,m^2$

$A_{sub} = (0.9 \times 2.4) + (\frac{1}{2} \times 2.4 \times 0.6)$

$A_{sub} = 2.88\,m^2$

find Centroid of the whole body Area

$$Y_1 = \frac{A_1 Y_1 + A_2 Y_2}{A_{total}}$$

$$Y_1 = \frac{(\frac{1}{2} \times 2.4 \times 0.6) \times \frac{2 \cdot 0.6}{3} + (1.2 \times 2.4) \times (0.6 + \frac{1.2}{2})}{3.6}$$

$Y_1 = 1.04\,m$

find Centroid of the area under water

$$Y_2 = \frac{(\frac{1}{2} \times 2.4 \times 0.6) \times \frac{2 \cdot 0.6}{3} + (1.2 \times 2.4) \times (0.6 + \frac{1.2}{2})}{2.88}$$

$Y_2 = 0.8875\,m$

$V_{total} = A_{sub} \times length$

$= 2.88 \times 5.5 = 15.84\ m^3$

→ ~~Moment of Inertia~~

$$I = \frac{LH^3}{12}$$

$$I = \frac{5.5 \cdot 2.4^3}{12} = \underline{6.336\ m^4}$$

$$MB = \frac{I}{V_{total}}$$

$$MB = \frac{6.336\ m^4}{15.84\ m^3} = \underline{0.4\ m}$$

<u>Find</u> Center distance from base of the boat

$$Y_{metacenter} = Y_2 + MB$$

$$= 0.8875 + 0.4 = \boxed{1.288\ m}$$

It is safe to say that the boat <u>is stable</u>