Jacob Schwartz | MET330 | HW2.1 | 2-25-20

2) Given: $D = 30\text{in}$
$p = 14.4\ \text{psig}$

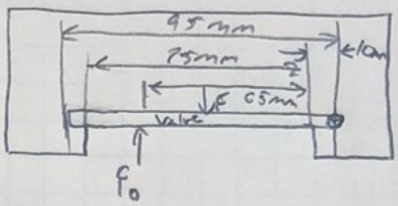
$$p = \frac{F}{A} \qquad A = \frac{\pi D^2}{4}$$

$$F = pA \qquad A = \frac{\pi (30)^2}{4}$$

$$F = (14.4)(706.858) \qquad A = 706.858\text{in}^2$$

$$\boxed{F = 10178.755\ \text{lb}}$$

10) Given: $D_{tank} = 500\text{mm}$
$h = 1.8\text{m}$
$d_{opening} = 75\text{mm}$



$$F = pA \rightarrow ①$$

$$D = 10 + 75 + 10$$

$$D = 95\ \text{mm or } 0.095\text{m}$$

$$A = \frac{\pi D^2}{4} \qquad p = \gamma_w h$$

$$= 9.81\ \text{kN/m}^3\ (1.8\text{m})$$

$$= \frac{\pi}{4}(0.095)^2$$

$$p = 17.658\ \text{kN/m}^2$$

$$A = 7.088 \times 10^{-3}\ \text{m}^2$$

$$F = (17.658\ \text{kN/m}^2)(7.088 \times 10^{-3}\ \text{m}^2)$$

$$F = 0.125\ \text{kN}$$

$$\Sigma M_{hinge} = 0$$

$$125\left(\frac{95}{2}\right) - F_o(65) = 0$$

$$\boxed{F_o = 91.35\text{N}}$$

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17) Given:
$S_g = 0.8$
$l = 4m$
$h = 1.4m$
$\theta = 45°$

$p = \frac{F_R}{A}$

$p = \gamma_o h_c$

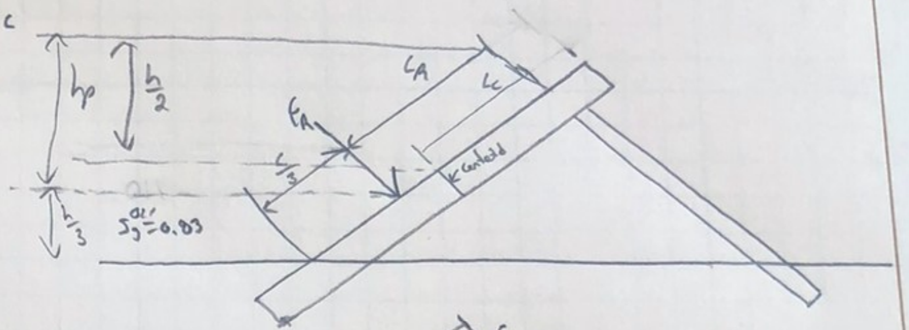
$h_c = \frac{h}{2}$

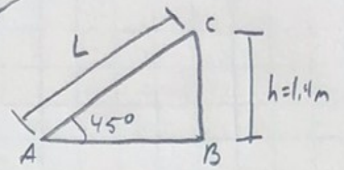
$F_R = pA$

$F_R = \gamma\left(\frac{h}{2}\right)A$

$F_R = (8.436)\left(\frac{1.4}{2}\right)(7.919)$

$\boxed{F_R = 46.76\ kN}$





$\frac{h}{3} = \frac{1.4}{3}$

$h/3 = 0.466m$

$\sin\theta = \frac{h}{L}$

$L = \frac{h}{\sin\theta}$

$L = \frac{1.4}{\sin 45°}$

$L = 1.979m$

$A = L(l)$

$A = 1.979(4)$

$A = 7.919m^2$

$\frac{L}{3} = \frac{1.979}{3}$

$\frac{L}{3} = 0.659m$

$\gamma = (0.86)(9.81)$

$\gamma = 8.436\ kN/m^3$

$L_p = L - L/3$

$L_p = 1.979 - 0.659$

$\boxed{L_p = 1.32m}$

$h_p = h - \frac{h}{3}$

$h_p = 1.4 - 0.466$

$\boxed{h_p = 0.934m}$

Homework Chapter 5

Problem 5.8

Given;

Specific gravity of oil = 0.90

Total weight of pump = 14.6 lb

Submerged volume = 40 in^3

$$F_b = \gamma_f V_d$$

$$S_g = \frac{\gamma_f}{62.4\ lb/ft^3}$$

$$\therefore \gamma_f = 0.90 \times 62.4\ lb/ft^3$$

$$\gamma_f = 56.16\ lb/ft^3$$

$$F_b = \gamma_f V_d$$

$$F_b = (56.16)(0.0232)$$

$$F_b = 1.3029\ lb$$

$$\Sigma F_v = 0$$

$$F_b - W + F_e = 0$$

$$F_e = W - F_b$$

$$F_e = 14.6 - 1.3029$$

$$F_e = 13.297\ lb$$

$\therefore$ exerted force, $F_e = \underline{13.297\ lb}$

Problem 5.24

Given:

$D = 450_{mm} = 0.45m$
$h = 750_{mm} = 0.75m$
$T = 95°c$

Specific weight of water $95°c$ is $\gamma_f = 9.44\ KN/m^3$
γ_c $6.45KN/m^3$ placed $95°c$

$$F_b = \gamma_f V_d$$
$$w = \gamma_c V$$

Volume. $V_c = \frac{\pi}{4} D^2 h = \pi/4 (0.45)^2 (0.75) = 0.1193 m^3$

$$V_b = \pi/4 D^2 h$$
$$= \pi/4 (0.45_m)^2 (t_m)$$
$$= 0.159 t m^2 \qquad V = 0.1193 + 0.159t$$

$$\Sigma f_y = 0$$
$$f_b - w_c - w_b = 0$$
$$f_b = w_c + w_b$$

$$9.44 \times (0.1193 + 0.159t) = [6.45 \times 0.1193] + (84.0 \times 0.159t)$$

$$t = \frac{0.3567}{11.855}$$
$$= 0.03m$$
$$\Rightarrow 30mm$$
$$\therefore t = \underline{30mm}$$

Problem 5.41

Given:

$w = 450000 \text{ lb}$

$H = 8 \text{ ft}$

$B = 20 \text{ ft}$

$L = 50 \text{ ft}$

Center of gravity $= 8 \text{ ft}$

$\gamma = 64 \text{ lb/ft}^3$

$F_b = \gamma_f V_d$

$V_d = LBH$

$= 50 \times 20 (x)$

$V_d = 1000(x)$

$\therefore V_d = 1000(x) \text{ ft}^3$

$F_b = \gamma_f V_d$

$F_b = 64 \times 1000 (x)$

$F_b = 64000(x) \text{ lb}$

$F_b = w$

$64000 (x) = 450000$

$x = \dfrac{450000}{64000}$

$x = 7.03 \text{ ft}$

$y_{cb} = \dfrac{x}{2}$

$= \dfrac{7.03}{2} = 3.515 \text{ ft}$

$F_b = 64000 (x)$

$= 64000 (7.03)$

$F_b = 450000 \text{ lb}.$

$V_d = (1000)(7.03)$

$V_d = 7030 \text{ ft}^3$

$I = \dfrac{LB^3}{12}$

$= \dfrac{(50)(20)^3}{12}$

$= 33.33 \times 10^3 \text{ ft}^4$

$MB = \dfrac{I}{V_d}$

$= \dfrac{33.33 \times 10^3}{7030}$

$MB = 4.742 \text{ ft}$

$y_{mc} = y_{cb} + MB$

$= 3.515 + 4.742 \text{ ft}$

$y_{mc} = 8.257 \text{ ft}$

$\therefore y_{mc} = \underline{\underline{8.257 \text{ ft}}}$

$\boxed{Q\ 5.61}$

Given

Boat width = $W_{Boat} = 2.4m$

Boat length = $L_B = 5.5m$

To Find:

Boat Stable = ?

Solutions:

Rectangulas Area of Boat = $B_{Rec} = (1.5 - 0.6 + 0.3) \times 2.4$

$= (1.2) \times 2.4 = 2.88\ m^2$

Triangulau Area of Boat = $B_{Tri} = \frac{1}{2} \times 2.4 \times 0.6$

$= 0.72\ m^2$

Total Area of Boat = $B_T = 2.88 + 0.72$

$= 3.6 m^2$

Sub maged Area $A_{sumerged} = A_{rect} + A_{tri}$

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

$A_{sub} = 2.16 + 0.72$

$= 2.88\ m^2$

As we know that

centroid of full Area $= Y_c = \dfrac{A_1 Y_1 + A_2 Y_2}{A\ \text{tatal}}$

$$= \frac{(1/2 \times 2.4 \times 0.6) \times \frac{2h}{3} + (1.2 \times 2.4)\left(0.6 + \frac{1.2}{2}\right)}{3.6}$$

$$= \frac{(0.72 \times 2 \times 0.6)/3 + (2.88 \times 1.2)}{3.6}$$

$$= \frac{0.288 + 3.456}{3.6} = 1.04\,m$$

Now Find
Centroid of Submaged Area

$$Y_c = \frac{A_1 Y_1 + A_2 Y_2}{A\ sub}$$

$$= \frac{\left(\frac{1}{2} \times 2.4 \times 0.6\right) \times \frac{2h}{3} + (0.9 \times 2.4)\left(0.6 + \frac{0.9}{2}\right)}{2.88}$$

$$= \frac{(0.72 \times 0.4) + (2.16)(1.05)}{2.88}$$

$$= \frac{0.288 + 2.268}{2.88} = 0.8875\ m$$

Now;
Total displaced volume

$$V_d = A_{sub} \times B$$
$$= 2.88 \times 5.5$$
$$V_d = 15.84\,m^3$$

Now;
Moment of inertia = ?

$$I = \frac{BH^3}{12} = \frac{5.5 \times (2.4)^3}{12} = 6.335\,m^4$$

Central Height from Buoyancy center (3)

$$MB = \frac{I}{V_d}$$

$$MB = \frac{6.336}{15.84} \qquad MB = 0.4\,m$$

Now

Center distance from the Base of the Boat

$$Y_{mc} = Y_c + MB$$

$$= 0.8875 + 0.4$$

$$\boxed{Y_{mc} = 1.2875\,m}$$

Center of Gravity $Y_{cg} = 1.04\,m$

Now we can see

Metacenter is above the center of Gravity

$$Y_{mc} > Y_{cg}$$

Thus, The Boat is stable.

homework 28, 42, 54 ch4

28) $y = \frac{4R}{3\pi}$ $\quad y = \frac{4(20)}{3\pi} = 8.49\,in$

$F_y = 8 + \bar{y}$

$8 + 8.49 = 16.49\,in$

$\cos 30° = \frac{FE}{AF}$

$AF = \frac{10}{\cos 30°} = 11.55\,in$

$L_c = AF + FG$

$11.55 + 16.49 = 28.04\,in$

$h_c = L_c \cos 30 = 24.28\,in$

$\gamma = SG \times \gamma$

$\gamma = 1.1 \times 62.4 = 68.64\ lb/ft^3$

$F_R = PA$

$= \gamma h_c \times \left(\frac{\pi}{2} R^2\right)$

$F_R = 68.64 \frac{lb}{ft^3} \times \left(24.28\,in \times \frac{1}{12}\right) \times \frac{\pi}{2}\left(20 \cdot \frac{1}{12}\right)$

$\boxed{F_R = 605.916}$

$I_c = \left(\frac{\pi}{8} - \frac{8}{9\pi}\right) R^4 = 17561.1\,in^4$

$L_p = L_c + \frac{I_c}{L_c A}$ or $L_c + \frac{I_c}{L_c(\pi/2 \cdot 20^2)} = \boxed{L_p = 29.02\,in}$

$L_p - L_c = 29.02 - 28.04 = \boxed{.98\,in}$

42) $y = \frac{D}{2} \cos\theta$

$y = \frac{10}{2} \cos 30° = 4.33 in$

$L_c = \frac{h_c}{\cos\theta} = 48.87 in$

$h_c = 38 + y$

$h_y = 42.33 in$

$A = \frac{\pi \times 10^2}{4} = 78.54 in^2$

$F_R = \gamma h_c A \qquad F_R = 62.4 \times \left(\frac{42.33}{12}\right) \times \left(\frac{78.54}{12^2}\right) = 120.05 lb$

$I_c = \frac{\pi \times 10^4}{64} = 490.87 in^4$

$L_p - L_c = \frac{490.87}{(48.87 \times 78.54)} = .128 in$

$\Sigma M_H = 0 \qquad F_R \times \left[\frac{D}{2} + (L_p - L_c)\right] - \left(F_c \times \frac{d}{2}\right) = 0$

$120.05 \cdot \left(\frac{10}{2} + .126\right) - \left(F_c \times \frac{10}{2}\right) = 0$

$\boxed{F_c = 123.12 lb}$

54)

$h_1 = 48 in$

$D = 36 in$

$sg = .79$

$w = 60 in$

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

$A = 508.93 in^2$

$V = AW \quad 508.93 \cdot 60 = 30535.8 in^3$

$y = sg \cdot 62.4$

$y = (.79)(62.4) = 49.296\ lb/ft^3$

$w = yV \quad 49.296 \cdot 17.67$

$\boxed{F_V = 871.06\ lb}$

$x = .212 \cdot 36 = \boxed{\bar{x} = 7.632 in}$

$h_c = 48 + \frac{36}{2} \quad h_c = 66 in$

$F_H = y s w h_c \quad 49.296 \cdot 3 \cdot 5 \cdot 5.5 = \boxed{F_H = 4066.92 lb}$

$5.5 + \frac{(3)^2}{(12)(5.5)} = \boxed{h_p = 5.63 ft}$

$F_R = \sqrt{F_V^2 + F_H^2} \quad \sqrt{(871.06)^2 + (4066.92)^2} = \boxed{F_R = 4159.156 lb}$

$\phi = \tan^{-1}(F_V/F_H)$

$\tan^{-1}(871.06/4066.92) \quad \boxed{\phi = 12.09°}$

In class we started to look at the flow through a fitting. We learned you have weight to add to the equation. If we know one of the pressures on either side of the pipe we can still use Bernoullis equation to find the other. Also we looked at if the pipe was a straight pipe. In this case you have no weak points such as flanges. We learned you have a R_y and R_x to solve for but not a R_z, therefore the two sides of the pipe push in opposite direction so they cancel one another out. Simply whats going on in the middle has the exact same on the side of the pipe also.