HW 2.1 CHP 4

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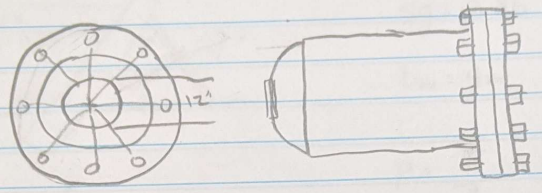

$D = 30\ in$

$p = 14.4\ psig$

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

$F = pA$

$A = \frac{\pi D^3}{4} = \frac{\pi(30)^2}{4} = 706.86\ in^2$

$F = (14.4)(706.86)$

$\boxed{F = 10{,}178.78\ lbs}$

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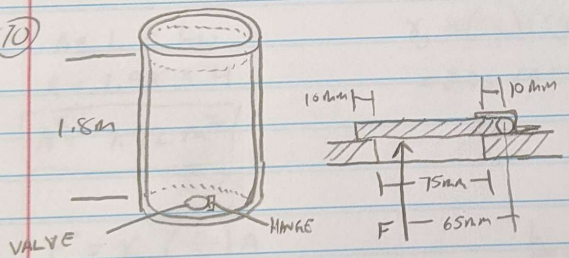

$D_c = 500\ mm$

$h = 1.8\ m$

$D_o = 75\ mm$

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

$F = pA$

$\gamma_w = 9.81\ kN/m^3$

$p = \gamma_w h$

$p = (9.81)(1.8) = 17.658\ kN/m^2$

$D_T = 10 + 10 + 75$

$D_T = 95\ mm = 0.095\ m$

$A = \frac{\pi (0.095)^2}{4} = 7.088 \times 10^{-3}\ m^2$

$F = pA$

$F = (17.658)(7.058 \times 10^{-3})$

$F = 0.125\ kN$

$F = 125\ N$

$\Sigma M = F(D_T/2) - F_o(65) = 0$

$125(95/2) - F_o(65) = 0$

$5937.5 - F_o(65) = 0$

$F_o(65) = \frac{5937.5}{65}$

$\boxed{F_o = 91.35\ N}$

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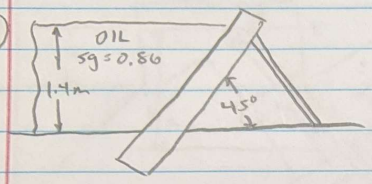
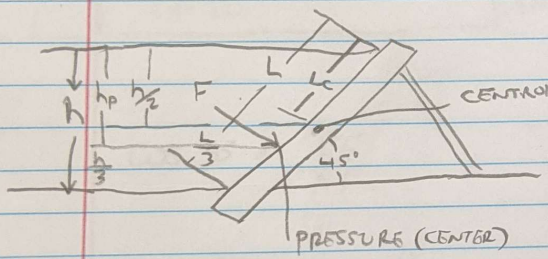


$sg = 0.86$ $\quad h = 1.4m$

$L_W = 4m$ $\quad \theta = 45°$

$P = \frac{F}{A}$ $\quad F = pA$ $\quad p = \gamma_0 h_c$



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

$L = \frac{h}{\sin\theta} = \frac{1.4}{\sin 45}$

$L = 1.98m$

$A = L \times L_W$

$A = 1.98 \times 4$

$A = 7.92 m^2$

$\gamma_0 = (sg_0)(sg_w)$

$= 0.86\ (9.81)$

$\gamma_0 = 8.437\ KN/m^3$

$F = \gamma_0 \left(\frac{h}{2}\right) A$

$F = (8.437)\left(\frac{1.4}{2}\right)(7.92)$

$F = 46.77\ KN$

$\frac{h}{3} = \frac{1.4}{3} = 0.466m$ $\quad \frac{L}{3} = \frac{1.98}{3} = 0.66m$

$L_{PRESSURE} = L - \frac{L}{3}$

$1.98 - 0.66$

$L_{PRESSURE} = 1.32m$

$h_{PRESSURE} = h - \frac{h}{3}$

$= 1.4 - 0.466$

$h_{PRESSURE} = 0.934m$

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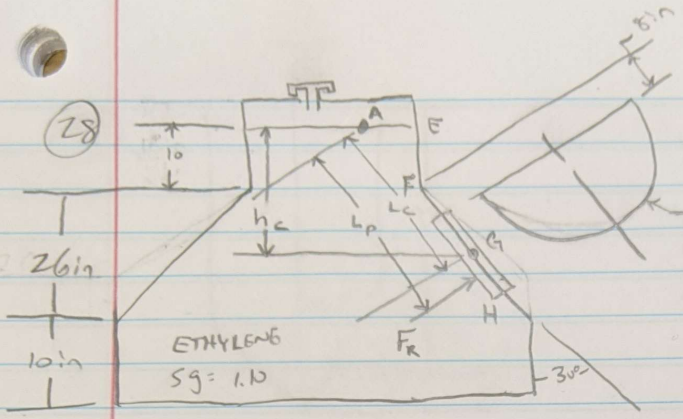

$\gamma_w = 62.4\ lb/ft^3$

CENTROID SEMI CIRCLE

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

$\bar{y} = \frac{4(20)}{3\pi}$

$\bar{y} = 8.49\ in$

$FG = 8 + \bar{y}$

$= 8 + 8.49$

$FG = 16.49$

$\cos 30° = \frac{FE}{AF}$

$AF = \frac{FE}{\cos 30} = \frac{10}{\cos 30}$

$AF = 11.55\ in$

$L_c = AF + FG = 11.55 + 16.49$

$\boxed{L_c = 28.04\ in}$

$h_c = L_c \cos 30°$

$= 28.04 \cos 30$

$\boxed{h_c = 24.28\ in}$

$\gamma = SG_E \times \gamma_w$

$\gamma = 1.1 \times 62.4$

$\boxed{\gamma = 68.64\ lb/ft^3}$

$F_R = pA$

$(\gamma)(h_c)\left(\frac{\pi R^2}{2}\right)$ 2.78

$F_R = (68.64)\left(\frac{24.28}{12}\right)\left(\frac{\pi (20/12)^2}{2}\right)$

2.023

$\boxed{F_R = 606.4\ lb}$

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

$= \left(\frac{\pi}{8} - \frac{8}{9\pi}\right)(20)^4$

$\boxed{I_c = 17561.4\ in^4}$

$L_p = L_c + \frac{I_c}{L_c A} = 28.04 + \frac{17561.4}{(28.04)(628.32)}$

$L_p = 29.04\ in$

$L_p - L_c = 29.04 - 28.04$

$\boxed{= 1\ in}$

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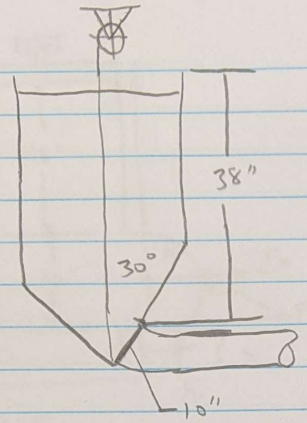

$$y = \frac{D}{2}\cos\theta = \frac{10}{2}\cos 30$$

$$y = 5\cos 30$$

$$y = 4.33 \text{ in}$$

$$h_c = 38 + 4.33 = 42.33$$

$$L_c = \frac{h_c}{\cos\theta} = \frac{42.33}{\cos 30}$$

$$\boxed{L_c = 48.88 \text{ in}}$$

$$A = \frac{\pi D^3}{4} = \frac{\pi 10^2}{4}$$

$$\boxed{A = 78.54 \text{ in}^2}$$

$$F_R = \gamma h_c A \qquad \gamma_w = 62.4 \text{ lb/ft}^3$$

$$F_R = (62.4)\left(\frac{42.33}{12}\right)\left(\frac{78.54}{144}\right)$$

$$\boxed{F_R = 120.05 \text{ lb}}$$

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

$$\boxed{I_c = 490.87 \text{ in}^4}$$

$$L_p - L_c = \frac{I_c}{L_c A} = \frac{490.87}{(48.88)(78.54)}$$

$$L_p - L_c = 0.128 \text{ in}$$

$$\sum m = F_R\left[D/2 + (L_p - L_c)\right] - (F_c \times D/2) = 0$$

$$120.05\left[10/2 + (0.128)\right] - (F_c \times 10/2) = 0$$

$$615.36 - F_c \times 5 = 0$$

$$F_c 5 = 615.36$$

$$\boxed{F_c = 123.07 \text{ lb}}$$

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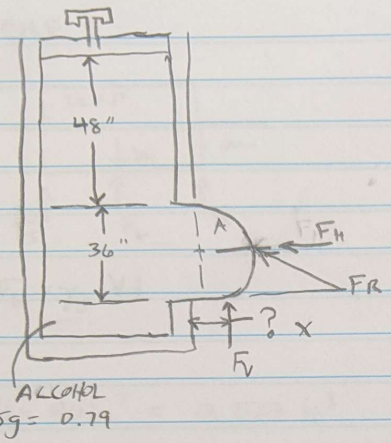

$h_1 = 48\text{ in}$ $D = 36\text{ in} = 3\text{ ft}$

$sg = 0.79$ $w = 60\text{ in} = 5\text{ ft}$

$V = Aw$ $W = \gamma V$

$F_V = W$ $F_H = \gamma D w h_c$

$F_R = \sqrt{F_V^2 + F_H^2}$ $A = \frac{\pi D^2}{8} = \frac{\pi (36)^2}{8} = \boxed{508.94\text{ in}^2}$

$V = Aw = (508.94)(60)$

$V = 30536.4\text{ in}^3 = \boxed{17.67\text{ ft}^3}$

$\gamma_{ALCOHOL} = (0.79)(62.4)$

$\boxed{\gamma_A = 49.296\text{ lb/ft}^3}$

$W = \gamma_A V = (49.296)(17.67)$

$W = 871.06\text{ lb}$

CENTROID SEMICIRCLE

$= (0.212)(36)$

$x = 7.632\text{ in}$

$\boxed{F_V = 871.06}$

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

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

$\boxed{h_c = 66\text{ in}} \approx 5.5\text{ ft}$

$F_H = \gamma D w h_c = (49.296)(3)(5)(5.5)$

$\boxed{F_H = 4066.92\text{ lb}}$

$F_R = \sqrt{F_V^2 + F_H^2} = \sqrt{871.06^2 + 4066.92^2}$

$\boxed{F_R = 4159.2\text{ lb}}$

$h_p = h_c + \frac{D^2}{12 h_c}$ $\boxed{h_p = 5.64\text{ ft}}$

$5.5 + \frac{3^2}{12(5.5)}$

$\text{TAN}^{-1}(871.06/4066.92) = \boxed{12.1^\circ}$

CHP 5

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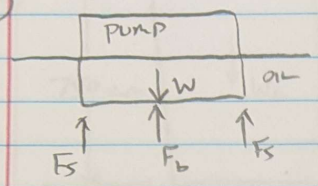

$sg = 0.90$ $\quad W = 14.6$ lb

$V_d = 40$ in^3

$F_b = \gamma_o V_d$

$\gamma_o = sg_o \, sg_w = \gamma_o = (0.9)(62.4)$

$\gamma_o = 56.16$ lb/ft^3

$V_d = 40 \text{ in}^3 = 0.023 \text{ ft}^3$

$F_b = (56.16)(0.023)$

$F_b = 1.3$ lb

$\sum F_N = F_b - w + F_s = 0$

$F_s = w - F_b$

$F_s = 14.6 - 1.3$

$\boxed{F_s = 13.3 \text{ lb}}$

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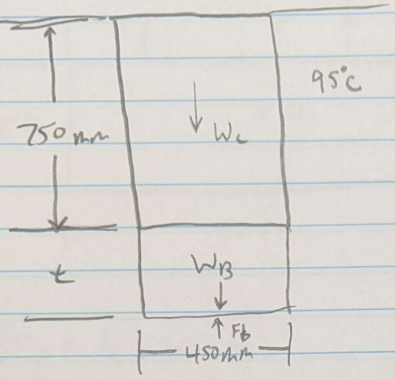

$D = 450\ mm = 0.45\ m$

$h = 750\ mm = 0.75\ m$

$T = 95°C$

$\gamma_f = 9.44\ kN/m^3$ @ 95°C

$\gamma_B = 84.0\ kN/m^3$

$\gamma_c = 6.45\ kN/m^3$

$F_b = \gamma_f V_d \qquad W = \gamma_c V_c \qquad V_c = \frac{\pi}{4} D^2 h = \frac{\pi}{4}(0.45)^2(0.75)$

$$\boxed{V_c = 0.1193\ m^3}$$

$V = V_c + V_B$

$V_B = \frac{\pi}{4}(0.45)^2 t$

$$\boxed{V_B = 0.159t\ m^3}$$

$V = (0.1193) + (0.159t)$

$\sum F_V = F_b - W_c - W_B = 0$

$F_b = W_c + W_B$

$\gamma_f V_d = \gamma_c V_c + \gamma_B V_B = 0$

$(9.44)(0.1193 + 0.159t) = (6.45 \times 0.1193) + (84 \times 0.159t)$

$(1.126) + 1.500t = 0.769 +$

$t = \frac{0.357}{11.86} = 0.03\ m$

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

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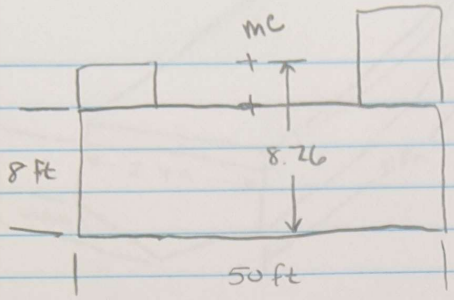

$W = 450{,}000$ lb

$H = 8$ ft

$B = 20$ ft

$L = 50$ ft

$y_{cg} = 8$ ft

$\gamma_{sw} = 60 \text{ lb/ft}^3$

$\sum F_V = F_b - W = 0$

$F_b = W$

$F_b = \gamma_f V_d$

$V_d = LBH$

$V_d = (50)(20)H$

$V_d = 1000x$

$F_b = (64)(1000x)$

$F_b = 64000x = 45000$

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

$x = 7.03$ ft

$F_b = 64{,}000(7.03)$

$\boxed{F_b = 449{,}920 \text{ lb}}$

$V_d = (1000)(7.03)$

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

CENTER OF BUOYANCY

$y_{CB} = \frac{x}{2} = \frac{7}{2}$

$\boxed{y_{CB} = 3.52 \text{ ft}}$

$I = \frac{LB^3}{12} = \frac{(50)(20)^3}{12} = 33.33 \times 10^3 \text{ ft}^4$

$MB = \frac{I}{V_d} = \frac{33.33 \times 10^3}{7030}$

$\boxed{MB = 4.74 \text{ ft}}$

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

$= 3.52 + 4.74$

$\boxed{y_{mc} = 8.26 \text{ ft}}$

$y_{mc} > y_{cg}$

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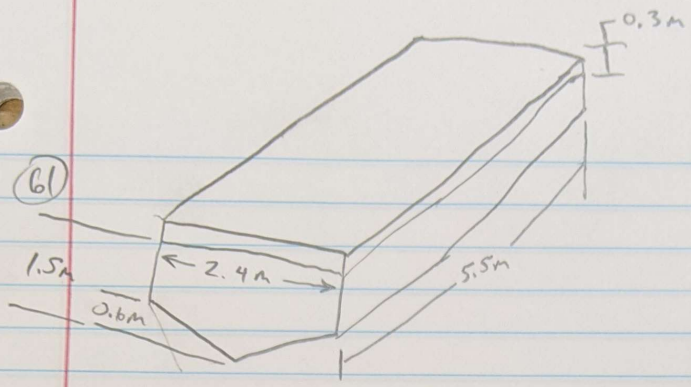

$h = 1.8\,m$

$w = 2.4\,m$

$L = 5.5\,m$

$h_d = 1.5\,m$

$A_T = A_{REC} + A_{TRI}$

$A_T = (1.2 \times 2.4)(\frac{1}{2} \times 2.4 \times 0.6)$

$\boxed{A_T = 3.6\,m^2}$

$A_{SUB} = A_{REC} + A_{TRI}$

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

$\boxed{A_{SUB} = 2.88\,m^2}$

$A_{TRI_T} = 0.75$

$A_{REC_T} = 2.88$

$A_{TRI_S} = 0.72$

$A_{REC_S} = 2.16$

$$Y_{cg_T} = \frac{(A_{TRI_T})(\frac{2h}{3}) + (A_{REC_T})(0.6 + \frac{1.2}{2})}{A_T}$$

$$Y_{cg_T} = \frac{(0.75)(\frac{2(0.6)}{3}) + (2.88)(1.2)}{3.6}$$

$\boxed{Y_{cg_T} = 1.04\,m}$

$$Y_{cg_S} = \frac{(A_{TRI_S})(.4) + (T_{REC_S})(0.6 + \frac{0.9}{2})}{A_{SUB}}$$

$$Y_{cg_S} = \frac{(0.72)(.4) + (2.16)(1.05)}{2.88}$$

$\boxed{Y_{cg_S} = 0.8875\,m}$

$V_d = A_{SUB} \times L$

$V_d = 2.88 \times 5.5$

$\boxed{V_d = 15.84\,m^3}$

$$I = \frac{LH^3}{12} = \frac{5.5(2.4)^3}{12}$$

$\boxed{I = 6.336\,m^4}$

$$MB = \frac{I}{V_d} = \frac{6.336}{15.84}$$

$MB = 0.4\,m$

$Y_{MC} = Y_{cg_S} + MB$

$Y_{MC} = (0.8875) + 0.4$

$\boxed{Y_{MC} = 1.29\,m}$