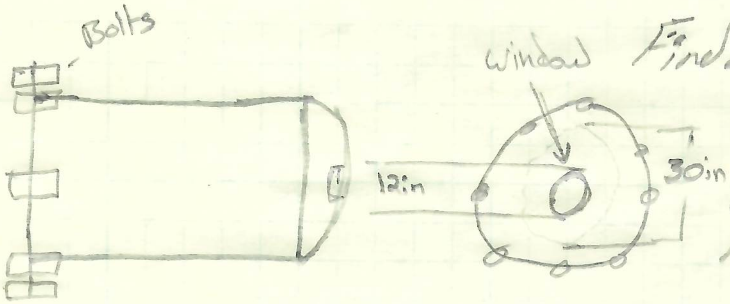
2.



Find: Calculate the total Force that must be resisted by the bolts in the flange.

Given: Inside diameter 30in = D
Internal pressure +14.4 psig = p

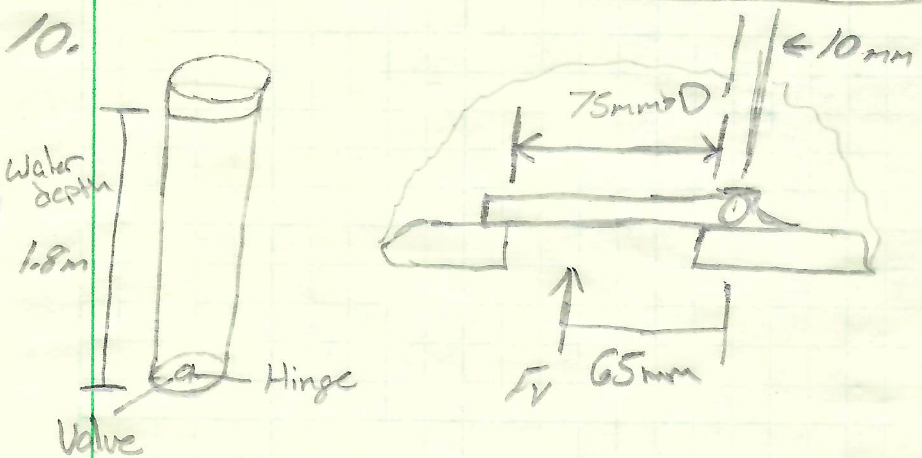
$P = \gamma h \rightarrow F$ $\quad P = \frac{F}{A}$

$F_R = \gamma h_c A$

$A = \frac{\pi D^2}{4} \Rightarrow \frac{\pi (30in)^2}{4} = 706.858 in^2$

$F_{Bolt} = PA \Rightarrow 14.4 \frac{lb}{in^2} \cdot 706.858 in^2 = \boxed{10178.755 lb}$

10.



Find: How much force is required to open the valve?

$\gamma_w = 9.81 kN/m^3$

$P = \gamma h \rightarrow F$

$F_R = \gamma h_c A$

$P = \frac{F}{A} \rightarrow F = PA$

Given: Cylindrical tank 500mm in = D
1.8m = h
Flapper valve opening 75mm = D

$D = 10mm + 75mm + 10mm = \frac{95mm}{1000mm} = .095m$

Flapper valve

$A = \frac{\pi D^2}{4} = \frac{\pi (.095m)^2}{4} = 7.088 \times 10^{-3} m^2$

$P = (9.81 kN/m^3)(1.8m) = 17.658 kN/m^2$

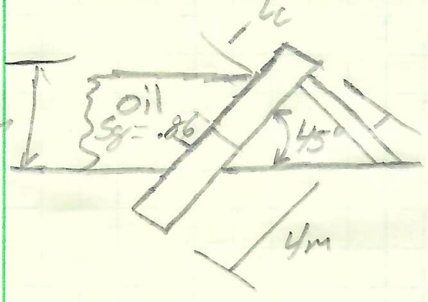
$F = (17.658 kN/m^2)(7.088 \times 10^{-3} m^2) = .1256 kN \rightarrow 125.6N$

10. Moment about hinge

$$\Sigma M_{hinge}=0 \rightarrow (125.6N)\left(\frac{95mm}{2}\right)-F_V(65mm)=0$$

$$\frac{5966N\cdot mm = F_V(65mm)}{65mm} \Rightarrow \boxed{F_V = 91.785N}$$

17.



Find: Calculate the total force on the wall due to pressure. Determine location of center of pressure & show resultant force on wall.

Given: wall length $L = 4m$

oil sg = 0.86

height = 1.4m

angle = 45°

$$P=\gamma h \rightarrow F$$

$$F_R=\gamma h_c A$$

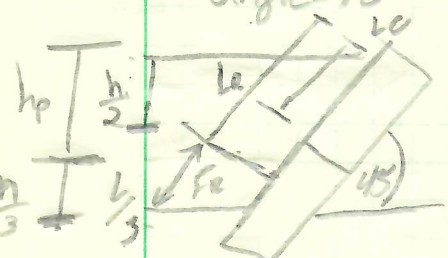
$$L_p = L_c + \frac{I_c}{L_c A}$$

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

$$\gamma_{water} = 9.81 kN/m^3$$

$$L_p = L - \frac{L}{3}$$

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



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

$$\sin\theta = \frac{h}{L} \Rightarrow L = \frac{h}{\sin\theta} \Rightarrow \frac{1.4m}{\sin 45} = 1.979m$$

$$A = L \times l \Rightarrow 1.979m \cdot (4m) = 7.916m^2$$

$$\gamma_{oil} = .86 \times 9.81 kN/m^3 = 8.4366 kN/m^3$$

$$F_R = (8.4366 kN/m^3)\left(\frac{1.4m}{2}\right)(7.916m^2) = \boxed{46.749kN = F_R}$$

$$\frac{h}{3} = \frac{1.4m}{3} = .467m$$

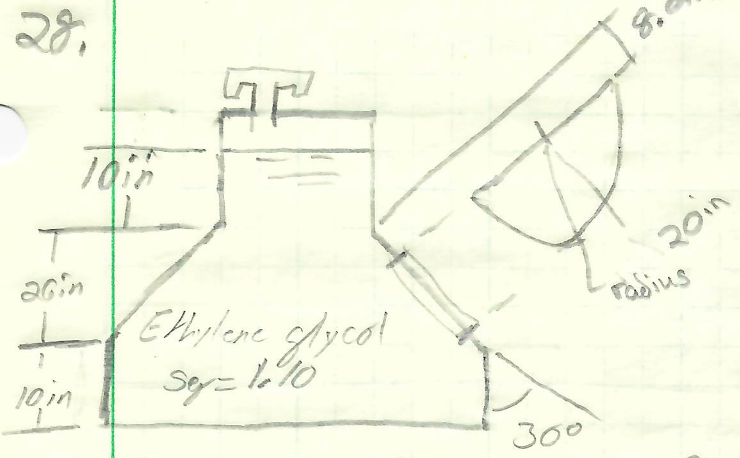
$$\frac{L}{3} = \frac{1.979m}{3} = .659m$$

$$L_p = 1.979m - .659m$$

$\boxed{L_p = 1.32m}$ center of pressure

$h_p = 1.4m - .467m = \boxed{h_p = .933m}$ vertical depth center pressure

28.



Find: Magnitude of Resultant force on indicated Area & location of center of pressure.

Given: Radius 20in → 1.67ft
angle 30°
Ethylene glycol Sg = 1.10

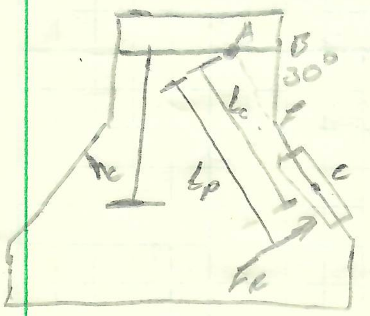
$P = \gamma h \to F$

$F_R = \gamma h_c A$

$L_p = L - \frac{L}{3}$

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

$\gamma_{water} = 62.4\ lb/ft^3$



$\bar{Y} = \frac{4R}{3\pi} = \frac{4(20in)}{3\pi} = 8.49in$

Centroid $= 8.0in + \bar{Y} \Rightarrow 8.0in + 8.49in = 16.49in$

$\cos\theta = \frac{FB}{FA} \Rightarrow FA = \frac{FB}{\cos\theta} \Rightarrow \frac{10}{\cos 30°} = 11.55in$

$L_c = FA +$ Centroid $\Rightarrow 11.55in + 16.49in = 28.04in$

$h_c = L_c \cos 30° \Rightarrow 28.04in(\cos 30) = 24.28in \left| \frac{1ft}{12in} \right. = 2.023ft$

$\gamma = 1.10 \times 62.4\ lb/ft^3 = 68.64\ lb/ft^3$

$F_R = \gamma h_c A \Rightarrow 68.64\ lb/ft^3 \cdot 2.023ft \cdot \left(\frac{\pi}{2}(1.67ft)^2\right) = \boxed{608.311\ lb}$

$I_c = \left(\frac{\pi}{8} - \frac{8}{9\pi}\right)(20)^4 = 17561.11in^4$

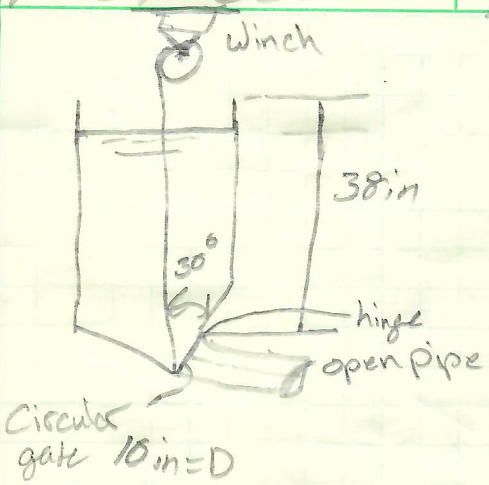
$L_p = L_c + \frac{I_c}{L_c A} \Rightarrow 28.04in + \frac{17561.11in^4}{(28.04in)(628.32in^2)} = \boxed{29.037in}$

from surface to center

$L_p - L_c = 29.037in - 28.04in$

$L_p - L_c = \boxed{1.997in}$ Distance between L_p & L_c

42.



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

Given: $h = 38in$, $D = 10in$, angle $= 30°$

$P = \gamma h \rightarrow F$

$F_R = \gamma h_c A$

$L_p = L_c + \frac{I_c}{L_c A}$

$\gamma_{water} = 62.4\ lb/ft^3$

$h_c = 38in + Y$

$$Y = \frac{D}{2}\cos\theta \Rightarrow \frac{10in}{2}\cos 30° = 4.33in$$

$$L_c = \frac{h_c}{\cos\theta} \Rightarrow \frac{42.33in}{\cos 30°} \Rightarrow 48.88in$$

$$A = \frac{\pi}{4}D^2 \Rightarrow \frac{\pi}{4}(10in)^2 \Rightarrow 78.54in^2$$

$$F_R = \gamma h_c A \Rightarrow 62.4lb/ft^3\left(\frac{42.33in}{12in}\right)\left(\frac{78.54in^2}{144in^2}\right) \Rightarrow \boxed{120.055lb}$$

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

$$L_p - L_c = \frac{I_c}{L_c A} \Rightarrow \frac{490.87in^4}{(48.88in)(78.54in^2)} = .128in$$

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

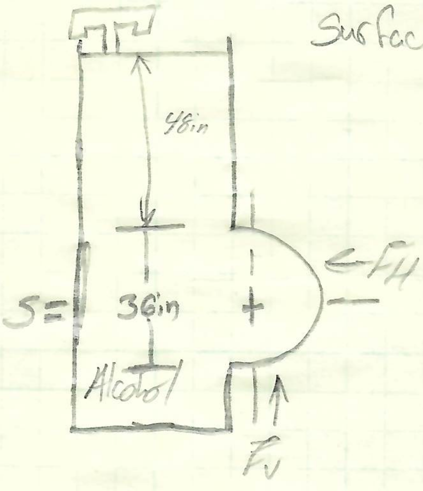
$$F_R \times \left[\frac{D}{2} + (L_p - L_c)\right] - F_{cable}\left(\frac{D}{2}\right) = 0$$

$$120.055lb \times \left[\frac{10in}{2} + .128in\right] - F_{cable}\left(\frac{10in}{2}\right) = 0$$

$$\frac{615.64 = F_{cable}(5)}{5} \Rightarrow \boxed{F_c = 123.128lb}$$

MET 330 | HW 2.1 | FRIAS-GARCIA

54.



Surface is 60in long $Sg = 0.79$

Diameter of circle 36in

$h_1 = 48in$

width of curved surface = 60in

$P = \gamma h \rightarrow F$

$F_R = \gamma h_c A$

$L_p = L_c + \frac{I_c}{L_c A}$

$V = Aw$

$W = \gamma V$

$F_V = W$

$\gamma_{water} = 62.4 lb/ft^3$

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

$F_H = \gamma s w h_c$

$A = \frac{\pi D^2}{8} \Rightarrow \frac{\pi}{8}(36in)^2 \Rightarrow 508.94in^2$

$V = Aw \Rightarrow (508.94in^2)(60in) = \frac{30536.28in^3}{1728in^3} = 17.67ft^3$

$\gamma_{Alcohol} = (.79)(62.4 lb/ft^3) = 49.296 lb/ft^3$

$W = \gamma V \Rightarrow (49.296 lb/ft^3)\cdot(17.67ft^3) = \boxed{871.06 lb = F_V}$

Location of centroid of semicircle $\bar{x} = .212D \Rightarrow .212(36in) = 7.632in$

Depth of centroid of projected area $h_c = h_1 + \frac{S}{2} \Rightarrow 48in + \frac{36in}{2} = 66in$

$F_H = \gamma s w h_c \Rightarrow (49.296 lb/ft^3)\left(\frac{36in}{12in}\right)\left(\frac{60in}{12in}\right)\left(\frac{66in}{12in}\right) = \boxed{4066.92 lb = F_H}$

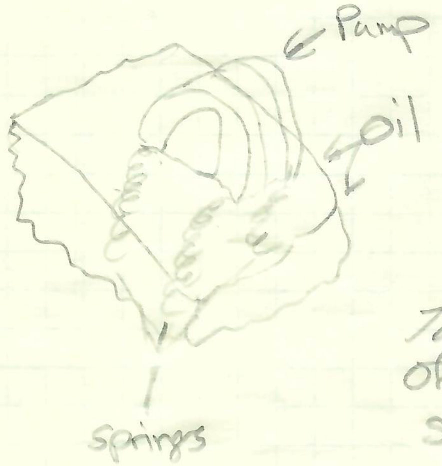
$h_p = h_c + \frac{s^2}{12h_c} \Rightarrow (5.5ft) + \frac{(3)^2}{(12)(5.5)} \Rightarrow \boxed{5.636in = h_p}$

$F_R = \sqrt{F_V^2 + F_H^2} \Rightarrow \sqrt{(871.06lb)^2 + (4066.92lb)^2} = \boxed{4159.16 lb = F_R}$

Angle of Inclination of Resultant Force relative to horizontal

$\phi = \tan^{-1}(F_V/F_H) \Rightarrow \tan^{-1}(871.06/4066.92) \Rightarrow \boxed{\phi = 12.089^\circ}$

8.

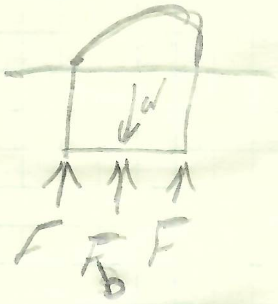


Find: calculate supporting force exerted by the springs.

Given: $Sg_{oil} = .90$ $\quad \gamma = 62.4\, lb/ft^3$

Total weight of pump $W = 14.6\, lb$

Submerged Volume: $V_1 = 40 in^3$



$F_b = \gamma V$

$V = 40 in^3 \times \frac{ft^3}{1728 in^3}$

$V = .0231\, ft^3$

$Sg = \frac{\gamma}{62.4\, lb/ft^3}$

$\gamma = Sg \times 62.4\, lb/ft^3$

$\gamma = (.90) \cdot (62.4\, lb/ft^3)$

$\gamma = 56.16\, lb/ft^3$

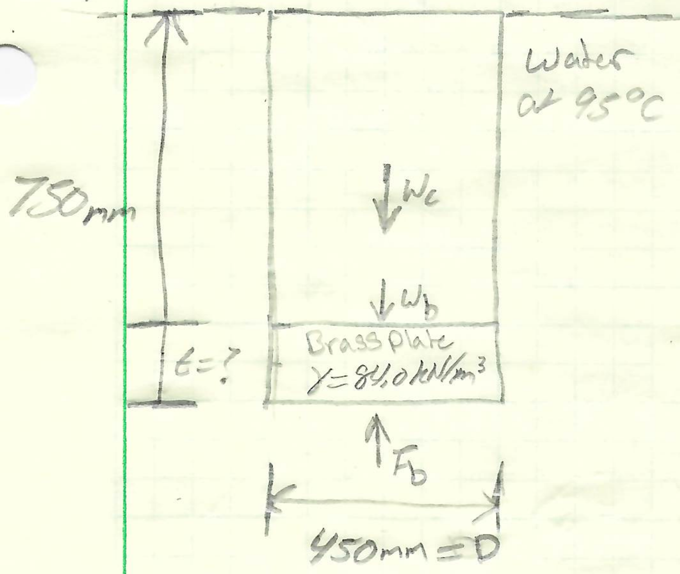
$F_b = \gamma V \Rightarrow 56.16\, lb/ft^3 \cdot (.0231\, ft^3)$

$F_b = 1.297\, lb$

$\Sigma F_v = 0 \Rightarrow F_b - W + F_{spring} = 0 \Rightarrow F_{spring} = W - F_b$

$F_{spring} = 14.6\, lb - 1.297\, lb = \boxed{13.303\, lb = F_{spring}}$

24.



Find: Required thickness of the brass

Given: $D = 450mm \rightarrow .450m$

height of cylinder $h = 750mm \rightarrow .750m$

$T = 95°C$ $\gamma_{water} = 9.44 kN/m^3$

$\gamma_{cylinder} = 6.45 kN/m^3$

$F_b = \gamma V$ $\quad V = \frac{\pi}{4} D^2 h$ $\quad w = \gamma V$

$V_c = \frac{\pi}{4} D^2 h \Rightarrow \frac{\pi}{4}(.450m)^2(.750m) = .1193 m^3$

$V_{brass} = \frac{\pi}{4} D^2 h \Rightarrow \frac{\pi}{4}(.450m)^2 \cdot t = .159 \cdot t\, m^3$

$V_{total} = V_C + V_B \Rightarrow .1193m^3 + .159t\, m^3$

$\Sigma F_v = 0 \Rightarrow F_b - w_c - w_b = 0$

$\gamma_{water} V = \gamma_c V_c + \gamma_b V_b \Rightarrow$

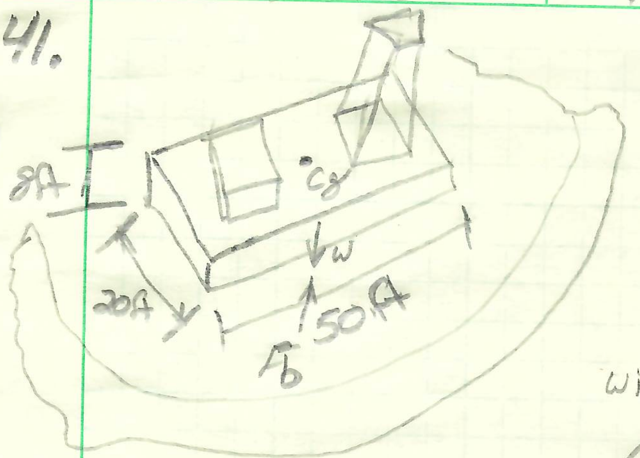
$(9.44 kN/m^3) \cdot (.1193m^3 + .159t\, m^3) = (6.45 kN/m^3) \cdot (.1193m^3) + (84. kN/m^3) \cdot (.159t\, m^3)$

$1.126 kN + 1.501 kN = .769 kN + 13.356\, t\, kN$

$\frac{.357 kN = 11.855\, t\, kN}{11.855} \Rightarrow t = .0301 m$

$\boxed{t = 30.1 mm}$

41.



Find: Platform be stable in Seawater in position shown

Given: Total weight $W = 450{,}000\,lb$

$H = 8\,ft$

width of Platfrom Breadth $= 20\,ft$

Length: $L = 50\,ft$

Center of gravity of system; $Y_{cg} = 8\,ft$

Specific weight of sea water $\gamma = 64\,lb/ft^3$

$\Sigma F_v = 0 \Rightarrow F_b - w = 0 \Rightarrow F_b = w$

$F_b = \gamma V \rightarrow V = LBH \Rightarrow (50\,ft)(20\,ft) \cdot h \Rightarrow V = 1000h\,ft^3$

$F_b = 64\,lb/ft^3 \cdot (1000h\,ft^3) = 64000\,h\,lb$

$F_b = w \Rightarrow \dfrac{64000\,h\,lb = 450{,}000\,lb}{64000\,lb} = h = 7.031\,ft$

Center of buoyancy $Y_{cb} = \dfrac{h}{2} \Rightarrow \dfrac{7.031\,ft}{2} = 3.516\,ft$

$F_b = 64000 \cdot (7.031) = \boxed{449984\,lb = F_b}$

Metacenter $MB = \dfrac{I}{V}$ $\quad V = 1000\,ft \cdot (7.031\,ft) = 7031\,ft^3$

$I = \dfrac{LB^3}{12} \Rightarrow \dfrac{(50\,ft)(20\,ft)^3}{12} = 33333.33\,ft^4$

$MB = \dfrac{33333.33\,ft^4}{7031\,ft^3} = \boxed{4.741\,ft = MB}$

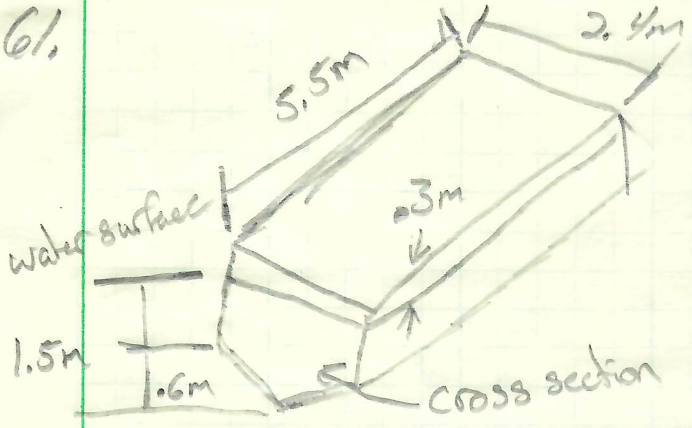
$Y_{mc} = Y_{cb} + MB \Rightarrow 3.516\,ft + 4.741\,ft = \boxed{8.257\,ft = Y_{mc}}$

$Y_{mc} > Y_{cg} \Rightarrow 8.257\,ft > 8\,ft$

Platform will be stable

Metacenter Distance from base

61.



Find: IS the boat stable

Given: Total height $h = 1.8m$
Width $B = 2.4m$
Length $L = 5.5m$
Displaced height $= 1.5m$

$A = L \times W \quad A = \frac{1}{2} bh$

$A_{total} = A_{rec} + A_{tri} \Rightarrow (1.2m \cdot 2.4m) + (\frac{1}{2} \cdot 2.4 \cdot 0.6) = 3.6m^2$

Submerged Area $= (.9 \cdot 2.4m) + (\frac{1}{2} \cdot 2.4 \cdot 0.6) = 2.88m^2$

Centroid of Whole Area: $Y_{cg} = \frac{A_1 Y_1 + A_2 Y_2}{A_{total}}$

$Y_{cg} = .72m^2 \cdot \frac{2(.6)}{3} + 2.88m^2 \cdot (.6 + \frac{1.2}{2})$

$Y_{cg} = \frac{.288m^3 + 3.456m^3}{3.6m^2} = \frac{3.744m^3}{3.6m^2} = \boxed{1.04m = Y_{cg}}$

Centroid of Submerged Area: $Y_{cg} = \frac{A_1 Y_1 + A_2 Y_2}{A_{sub}}$

$Y_{cg} = \frac{(.72m^2 \cdot 0.4m) + (2.16m^2 \cdot (.6 + \frac{0.9}{2})}{2.88m^2}$

$Y_{cg} = \frac{.288m^3 + 2.268m^3}{2.88m^2} = \frac{2.556m^3}{2.88m^2} = \boxed{.8875m = Y_{cg\,sub}}$

Displaced Volume: $V = A_{sub} \cdot L$

$V = 2.88m^2 \cdot 5.5m = 15.84m^3$

61. Moment of Inertia $I = \frac{BH^3}{12}$

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

Meta Center buoyancy $MB = \frac{I}{V} = \frac{6.336m^4}{15.84m^3} = \boxed{.4m = MB}$

$Y_{mc} = Y_{cg_{sub}} + MB \Rightarrow .8875m + .4m = \boxed{1.2875m = Y_{mc}}$

$Y_{cg} = 1.04m$ $\quad Y_{mc} > Y_{cg}$

$1.2875m > 1.04m$ Boat is stable