MET 330	HW 2.1	John Butler

Chapter

2) Given $P = 14.4\ psig$, $d = 30 in$

cross section $A = \frac{\pi}{4} d^2 = \frac{\pi}{4} 30^2 = 706.86\ in$

$F = P \times A = 14.4\ psig \times 706.86\ in$

$F = 10,18\ lb$ @ $+14.4\ psig$

10) Given

Height of tank $= h_T = 1.8\ M$

Cylindrical tank $= 500\ mm$

Valve $= 75\ mm$

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

Find "A" value: $A = \frac{\pi}{4} d^2 = \frac{\pi}{4} \times (75\ mm)$

$A = 4.418E3\ mm = 4.418\ E{-3}\ m$

FBD (a)

Pressure at Bottom (a)

$P_a = \gamma_{water} h_T = 9.81 \times 1.8 M$

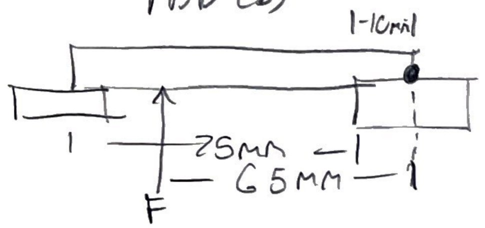
$P_a = 17.658\ kN/m^2$

$F = P_a A$

$F_a = 17.658\ kN/m^2 \times 4.417E{-3}\ m$

$F_a = 0.0779\ kN$

FBD (b)



Force to open valve

$\Sigma M_O = 0$

$F_a \times \frac{0.075m}{2} - F_{valve} \times 0.065 m = 0$

$F_{valve} = 0.045\ kN$ to open valve *

Chapter 4:

17) Given

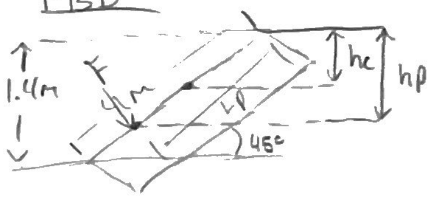
$\theta = 45°$

$Sg_{oil} = 0.86$

$h = 1.4\,m$

$l = 4$

FBD



Calculate Area $A = L \times l$

$\sin\theta = \frac{h}{L} = \frac{1.4\,m}{\sin 45} = 1.645\,m$

Area $= 1.645\,M \times 4\,M = \underline{6.581\,m^2}$

Find Resultant Force $(F_R) = \gamma_o h_c A$

$\gamma_o = Sg(oil) \times \gamma_w = 0.86 \times 9.81$

$\gamma_o = 8.436$

$\gamma_w = 62.4$

$h_c = \frac{h}{2} = \frac{1.4}{2} = 0.7\,m$

$F_R = 8.436 \times 0.7\,m \times 6.581\,m^2$

$\boxed{F_R = 38.862\,kN}$

center of Pressure $(L_p) = L - L/3$

$L_p = 1.645\,m - 0.548 = \boxed{1.097\,m} = L_p$

Solve for $(h_p) = h - h/3$

$h_p = 1.4 - 0.466 = \boxed{0.934\,m} = h_p$

54) Given

$Sg(Alcohol) = 0.79$ $\gamma_A = 0.79 \times 9.81 = 7.75$

$L = 60\,in$

Horizontal Force

$F_H = \gamma_A A h$ $h = (48 + \frac{36}{2}) = 66\,in = 1.676\,m$

$F_H = 7.75 \times (54.864\,m) \times (1.676\,M)$

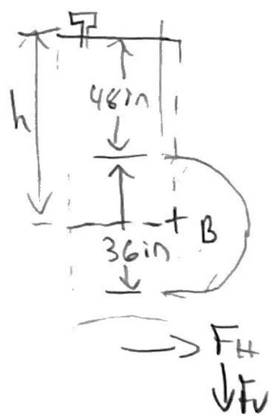
$F_H = 712.628\,lb/m^2$

$F_V = \gamma_A \times$ volume of B section $= 7.75 \times [\pi/4 (0.9144)^2 \times 1.524]$

$F_V = 7.756\,lb/m^2$

$F_R = \sqrt{F_H^2 + F_V^2} = \underline{712.67\,lb/m^2}$

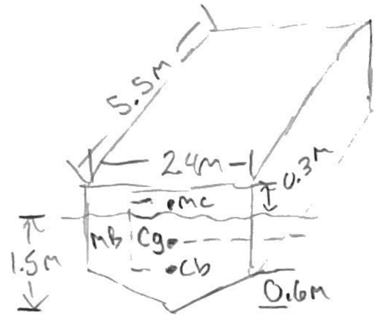
FBD



MET 330	HW 2.1	John Butler

Chapter 5:

(1) FBD



$$L_{cb} = \frac{1.5m}{2} = 0.75m$$

$$L_{cg} = \frac{1.8m}{2} = 0.9m$$

$$MB = \frac{I}{V_d} - (0.9m - 0.75m)$$

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

$$V_d = 1.5m \times 5.5m \times 2.4m = 19.8m^3$$

Now we can solve for $MB = \frac{I}{V_d} - (0.9 - 0.75m)$

$$MB = \frac{6.336m}{19.8m} - (0.9m - 0.75m)$$

$$MB = 0.17M$$

MB < 0.3m therefore, the MB is above the water, hence the boat is stable

5.8

5.8 Figure 5.19 shows a pump partially submerged in oil (sg = 0.90) and supported by springs. If the total weight of the pump is 14.6 lb and the submerged volume is 40 in^3, calculate the supporting force exerted by the springs.

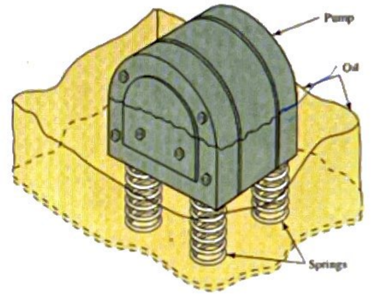
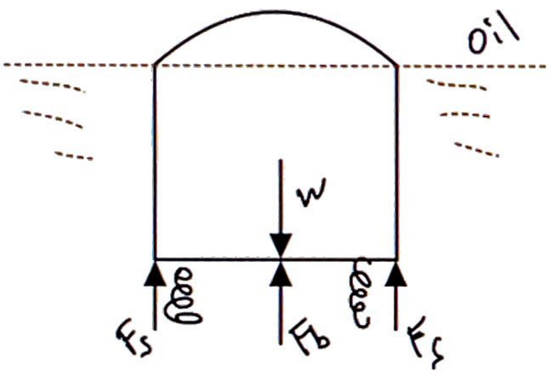


FIGURE 5.19 Problem 5.8.

$Sg_{oil} = 0.90$ $\quad W = 14.6\text{ lb}$

$V_d = 40\text{ in}^3$ $\quad S_{water} = 62.2\ \frac{\text{lb}}{\text{ft}^3}$ @ 80 °F



$F_b = \gamma_f V_d$

$V_d = 40\text{ in}^3 \cdot \frac{1\text{ ft}}{12\text{ in}} \cdot \frac{1\text{ ft}}{12\text{ in}} \cdot \frac{1\text{ ft}}{12\text{ in}}$

$V_d = 0.02314\text{ ft}^2$

$Sg = \frac{\gamma_f}{\gamma_w}$ ⇒ 62.2° @ 80°F (back of book)

$\gamma_f = Sg \cdot \gamma_w$

$\gamma_f = 0.9 \cdot 62.2\text{ lb/ft}^3$

$\gamma_f = 55.98\text{ lb/ft}^3$

$F_b = \gamma_F \cdot V_d$

$= 55.98\ \frac{\text{lb}}{\text{ft}^3} \cdot 0.02314\text{ ft}^3$

$F_b = 1.296\text{ lb}$

$\Sigma F = 0$

$F_b - W + F_s = 0$

$F_s = -F_b + W$

$F_s = W - F_b$

$= 14.6\text{ lb} - 1.296\text{ lb}$

$\boxed{F_s = 13.304\text{ lb}}$

↑ weight supported by springs

5.24

5.24 A brass weight is to be attached to the bottom of the cylinder described in Problems 5.22 and 5.23, so that the cylinder will be completely submerged and neutrally buoyant in water at 95°C. The brass is to be a cylinder with the same diameter as the original cylinder shown in Fig. 5.24. What is the required thickness of the brass?

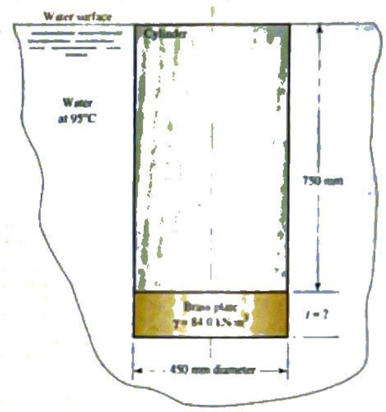


FIGURE 5.24 Problems 5.24 and 5.25.

$h_{cl} = 0.75\,m$ $\quad T_w = 95°C$ $\quad \gamma_B = 84.0\ kN/m^3$

$\phi_{cl} = 0.45\,m$ $\quad \gamma_w = 9.44\ kN/m^3$ $\quad \phi_B = 0.45$

Volume cyl

$V_{cl} = \pi \cdot r^2 \cdot h$

$= \pi \cdot \left(\frac{0.45m}{2}\right)^2 \cdot 0.75m$

$= 0.1193\ m^3$

Volume brass

$V_b = \pi \cdot \left(\frac{0.45m}{2}\right)^2 \cdot h_b$

$V_b = 0.159\,h_b\ m^3$

Volume System

$\therefore V = (0.1193 + 0.159\,h_b)\ m^3$

$\Sigma F = 0$

$0 = F_b - W_{cl} - W_b$

$F_b = W_{cl} + W_b$

$W = \gamma \cdot V$

so

$W_{cl} = \gamma_{cl} \cdot V_{cl}$ & $W_b = \gamma_b \cdot V_b$

$W_{cl} = \gamma_{cl} \cdot V_{cl}$

$= 6.456\ kN/m^3 \cdot 0.1193\ m^3$

From lecture slides

$W_{cl} = 0.7702$

$W_b = \gamma_b \cdot V_b$

$V_b = 0.159\,h_b{}^3$

$W_b = 84\ kN/m^3 \cdot 0.159\,h_b{}^3$

$F_b = \gamma_F \cdot V_d$

$F_b = W_{cl} + W_b$

$9.44\,(0.1193 + 0.159\,h_b) = 0.7702 + (84 \cdot 0.159\,h_b)$

$1.126 + 0.501\,h_b = 0.7702 + 13.356\,h_b$

$1.126 - 0.7702 = (13.353 - 1.501)\,h_b$

$11.852\,h_b = 0.3558$

$h_b = \frac{0.3558}{11.822} = 0.030$

$\frac{0.030\ m}{} \Big| \frac{1000\ mm}{1\ m} = 30.0\ mm$

Thickness of brass plate = 30.0 mm

5.41

5.41 The large platform shown in Fig. 5.29 carries equipment and supplies to offshore installations. The total weight of the system is 450 000 lb, and its center of gravity is even with the top of the platform, 8 ft from the bottom. Will the platform be stable in seawater in the position shown?

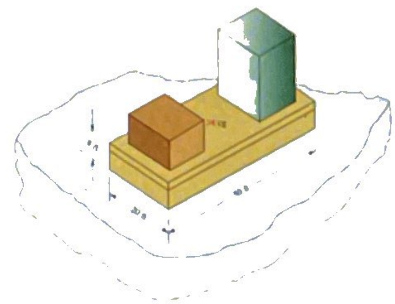
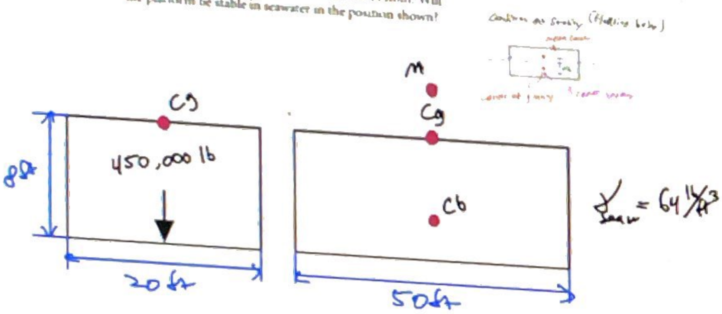


FIGURE 5.29 Problem 5.41



$$w = \gamma \cdot V$$

$$450{,}000\ \text{lb} = 64\ \frac{\text{lb}}{\text{ft}^3} \cdot (20\text{ft} \cdot 50\text{ft}\ h)$$

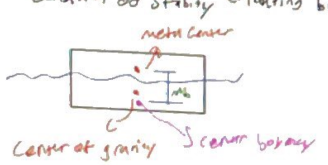
$$h = \frac{450\,000\ \text{lb}}{64\ \frac{\text{lb}}{\text{ft}^3} \cdot 1000\ \text{ft}^2} = \frac{450\,000\ \text{lb}}{64000\ \text{ft/lb}} - 7.031\ \text{ft}$$

$$V_d = 7.031\ \text{ft}$$

$$M_b = \frac{I}{V_d} = \frac{33{,}333.33}{(50 \cdot 20 \cdot 7.031)} = 4.741\ \text{ft}$$ Center of boyancy

$$I = \frac{1 \cdot b^3}{12} = \frac{50 \cdot 20^3}{12} = 33{,}333.33$$

Condition of Stabity (Flotting body)



$$= h_{cg} > h_{cb}$$

$$8\text{ft} > 4.741\ \text{ft}$$

there for the large platform is stable