Homework #1.6

Ch 4 Forces due to Static Fluids

Ch 5 Buoyancy and Stability

MET 330 Virginia Beach Distance Learning WC2 and

Nathanael Yapnayon - Aaron Jackson - Zach Hollifield

Due Date: 10/10Campus

Nathanael Yapman
10/10/19
HW 1.6

1)

We are thinking about the phenomenon of a problem instead of thinking about the equation of a problem. Friction is parallel when we are discussing about the problem of a pipe. Besides friction, pressure is involved in this problem when we are talking about forces. The pipe is reacting to force of a fluid. When you see a change of velocity or magnitude, there must be force involved. We are finding the reaction forces in some pipe problems. Equations might have to be modified to change based on how the object interfers. When we solve the problem, think about the problem first then find the equations. Think about the phenomenom of the problem first, Friction should be less than a reaction force.

CH 5: 8 27, 41, 61

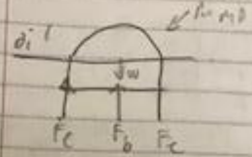
Nathaniel Yapraayon
10/10/17

1

Problem 8

Given $Sg = 0.98$
Weight of pump $W = 14.6$ lb
submerged vol $V_d = 40 in^3$

Figure 5.19 shows a pump submersed



$F_b = \gamma_f V_d$

specific weight

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

$\gamma_f = (0.9)(62.4\ lb/ft^3)$

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

$$V_d = 40 in^3 \times \left(\frac{0.00058 ft^3}{1 in^3}\right) = 0.0232\ ft^3$$

$F_b = \gamma_f V_d = (56.16)(0.0232)$

$= 1.3029$ lb

Given

$\Sigma F_v = 0$

$F_b - W + F_e = 0$

Find F_e

$F_e = W - F_b = 14.6 - 1.3029$

$\boxed{F_e = 13.297\ lb}$

Problem 24

What is the required thickness

Water surface cylinder

Diameter $D = 450\ mm = 0.45\ m$

Height $h = 750\ mm = 0.75\ m$

Fresh water temp $T = 95°C$

Fresh water weight $\gamma_f = 9.44\ kN/m^3$ @ 95°C

Cylinder sg = $\gamma_c = 6.45\ kN/m^3$, in 95°C fresh water

weight of cube

$W = \gamma_c V$

Volume of the cylinder

$V_c = \frac{\pi}{4} D^2 h$

Brass plate

$V_b = \frac{\pi}{4} D^2 (h)$

$= \frac{\pi}{4} (0.45m)(t\ m)$

$V_c = \frac{\pi}{4} (0.45)^2 (0.75)$

$= 0.1193\ m^3$

Brass

$V_b = 0.1556\ m^3$

Total vol $V = V_c + V_b = 0.1193 + 0.159t =$

Sum of forces $F_y = 0 = F_b - W_c - W_b$

Find F_b

$F_b = W_c + W_b$

$\gamma_f V = \gamma_c V_c + \gamma_b V_b$

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

Find t

$t = \frac{0.3567}{11.855} = 0.03m$

$t = 0.03m = 30mm$ thickness of brass plate

Problem 41

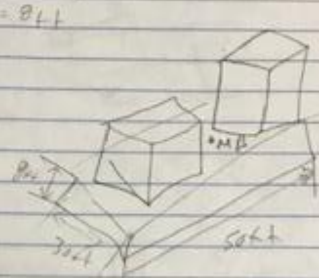
Will the platform be stable in seawater

Total weight $W = 45600$ lb

Height of platform $H = 8$ ft

Width $B = 20$ ft

Length $= 50$ ft



$\Sigma F_y = 0 = F_b - W = 0$

$F_b - W$

$V_d = LBH$

$V_d = (50)(20)(x)$

$V_d = 1000(x)$

buoyancy force

$F_b = \gamma_f V_d = 64(1000)(x) = 64000(x)$ lb

$F_b = W \quad 64000(x) = 450000$

$x = \frac{450000}{64000} = 7.03$ ft (displaced distance)

$y_{cb} = \frac{x}{2} = \frac{7.03}{2} = 3.515$ ft

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

$F_b = 64000(7.03)$

$F_b = 449920$ lb

Find V_d

$V_d = (1000)(7.03) = 7030$ ft^3

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

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

$MB = 4.742$ ft

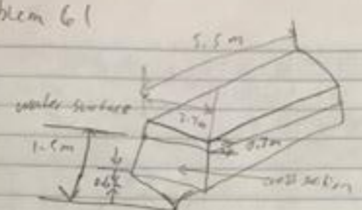
$y_{mc} = y_{cb} + MB$

$= 3.515 + 4.742$ ft

$y_{mc} = 8.257$ ft

Meta center distance is above center of gravity.

Problem 61



Total height of the boat = 1.8m
Width of the boat = 2.4m
Length = 5.5m   displaced height = 1.5m

Total area: $A_{total} = A_{rec} + A_{triangle}$

$A_{total} = (1.2 \times 2.4) + \left(\frac{1}{2} \times 2.4 \times 0.6\right)$

$A_{total} = 3.6 m^2$

Submerged area: $A_{sub} = (0.9)(2.4) + \left(\frac{1}{2}(2.4)(0.6)\right)$

$= 2.88 m^2$

$$y_{cg} = \frac{A_1 y_1 + A_2 y_2}{A_{total}} = \frac{\left(\frac{1}{2}(2.4)(0.6)\right)\left(\frac{2(0.6)}{3}\right) + (1.2)(2.4)\left(0.6 + \frac{1.2}{2}\right)}{3.6 m}$$

$y_{cg} = 1.04 m$

both 4'

$$y_{cb} = \frac{A_1 y_1 + A_2 y_2}{A_{sub}} = \frac{\left(\frac{1}{2}(2.4)(0.6)\right)\left(\frac{2 \times 0.6}{3}\right) + (0.9)(2.4) \cdot \left(0.6 + \frac{0.9}{2}\right)}{2.88}$$

$y_{cb} = 0.8875 m$

Center buoyancy

$V_d = A_{sub} B = 2.88(5.5) = 15.84 m^3$

X-X axis: $I = \frac{BH^3}{12} = \frac{5.5(2.4^3)}{12} = 6.336 m^4$

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

$MB = 0.4 m$

Center distance: $y_{mc} = y_{cb} + MB = 0.8875 + 0.4 = 1.2875 m$

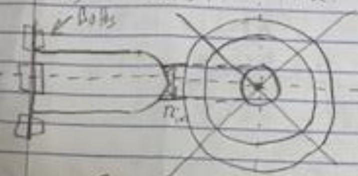
Center gravity: **$y_{mc} = 1.2875$**

CH 4 : 2, 10, 17, 28, 43, 54

Problem 2

5

Calculate the total force that must be resisted by the bolts in the flange.



Diameter of the tank
$D = 30 in$
Pressure in the tank
$p = 14.4$ psis

Area of the tank

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

$A = 706.858 \, in^2$

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

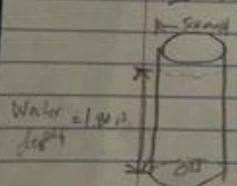
Force acting on bolts: $F = pA = (14.4 \text{ psis})(706.858)$

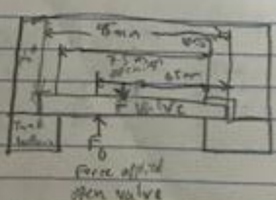
$F = 10178.755 \, lb$

Problem 10

The flapper must be pushed upward to open the valve. How much force is required to open the valve?

$D = 500 \, mm \quad h = 1.8 \, m \quad$ diameter opening $d = 75 \, mm$





Diameter of valve
$D = 10 + 75 + 10 = 95 \, mm$ or $0.095 \, m$

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

$A = 7.088 \times 10^{-3} \, m^2$ (open valve area)

Pressure at bottom tank: $p = \gamma_w h = (9.81)(1.8) = 17.658 \, kN/m^2$

Force valve: $F = pA = (17.658)(7.088 \times 10^{-3})$

$F = 0.125 \, kN$

Moment at hinge

$$\Sigma M_{hinge} = 0 = (125)\left(\frac{95}{2}\right) - F_0 (65)$$

$$F_0 = \frac{(125)\left(\frac{95}{2}\right)}{65} = 91.35 \, N$$

$F = 91.35 \, N$

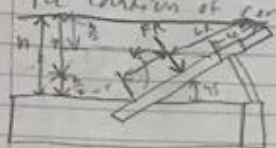
Problem 28

7

Problem 17

6

If the wall is 4m long, calculate the total force on the wall due to oil pressure. Also determine the location of center



sg of oil = 0.8

L of wall = 4m

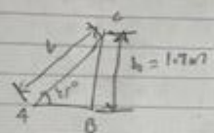
h = Height water = 1.4

$\theta = 45°$

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

$P = \frac{F_R}{A}$ $F_R = PA$ $P = \gamma_o h_c$

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



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

find L

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

$L = 1.979\ m$

Area of dam

$A = L \times I = (1.979)(4)$

$A = 7.919\ m^2$

specific weight of oil = $0.86 \times 9.81\ kN/m^3$

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

Resultant force

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

$\boxed{F_R = 46.76\ kN}$

$\frac{h}{3} = \frac{1.4}{3} = 0.466\ m$ $\frac{L}{3} = \frac{1.979}{3} = 0.659$

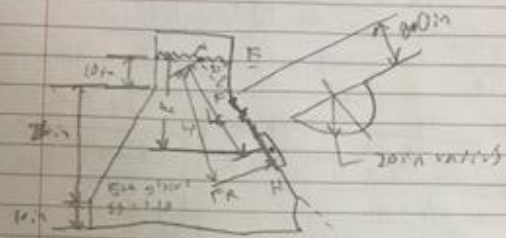
Center of pressure

$L_p = L - \frac{L}{3} = 1.979 - 0.659\ m$

$\boxed{L_p = 1.32\ m}$

Vertical depth $\boxed{h_p = 0.934\ m}$

Problem 28



Tank = Symmetrical

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

Length $FG = 8 + \bar{y} = 8 + 8.49\text{ in} = 16.49\text{ in}$

Length AF $\cos 30^\circ = \frac{FE}{AF}$

$AF = \frac{FE}{\cos 30^\circ} = \frac{10}{\cos 30^\circ} = 11.55\text{ in}$

$L_c = AF + FG = 11.55 + 16.49 = 28.04\text{ in}$

$h_c = L_c \cos 30^\circ = 24.28\text{ in}$

Specific weight $\gamma = (SG)(\gamma_{water}) = (1.1)(62.4) = 68.64\text{ lb/ft}^3$

Resultant force on hatch

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

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

$F_R = 605.9\text{ lb}$

inertia of Semicircle

$$I_c = \left(\frac{\pi}{8} - \frac{8}{9\pi}\right)R^4 = \left(\frac{\pi}{8} - \frac{8}{9\pi}\right)(20)^4$$
$$= 17561.1 \text{ in}^4$$

Center pressure

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

$$= L_c + \frac{I_c}{L_c(\pi/2 R^2)} = 28.04 + \frac{17561.1}{28.04\left(\frac{\pi}{2}\cdot 20^2\right)}$$

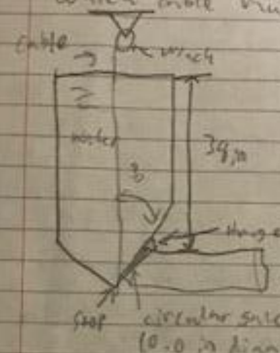
Surface to the center pressure

$$\boxed{L_p = 29.02 \text{ in}}$$

$$L_p - L_c = 29.02 - 28.04$$
$$= \boxed{0.98 \text{ in}}$$

Problem 42

Compute the amount of force that the which cable must exert to open the gate



Vertical height

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

$$= 4.33\text{ in}$$

Reference axis to centroid

$$L_c = \frac{h_c}{\cos\theta} = \frac{42.33}{\cos 30} = 48.87$$

Vertical height of tank

$$h_c = 38 + y$$

$$= 38 + 48.87$$

$$= 42.33\text{ in}$$

Area $A = \frac{\pi D^2}{4} = \frac{\pi\, 10^2}{4} = 78.54\text{ in}$

Resultant force $F_R = \gamma h_c A = (62.4\text{ lb/ft}^3)\left(\frac{42.33\text{ in}}{12}\right)\left(\frac{78.54}{12^2}\right)$

$$= 120.05\text{ lb}$$

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

Transfer theorem $L_p - L_c = \frac{I_c}{L_c A} = \frac{490.87}{(48.87 \cdot 78.54)} = 0.128\text{ in}$

Find the moments

$$\Sigma M_H = 0$$

$$\left(F_R\left(\frac{D}{2} + (L_p - L_c)\right)\right) - \left(F_c\left(\frac{D}{2}\right)\right) = 0$$

$$\left(120.05\text{ lb}\right)\left(\frac{10}{2} + 0.128\right)\Big) - F_c\left(\frac{10}{2}\right) = 0$$

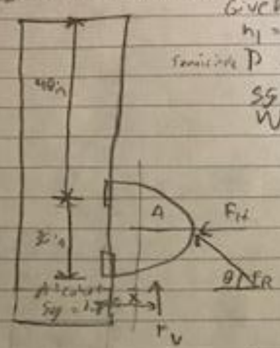
$$615.62 \qquad\qquad 5F_c$$

Find F_c $F_c = \frac{615.62}{5}$

$$\boxed{F_c = 123.12\text{ lb}}$$

Problem 59

Compute the magnitude of horizontal/vertical of force of liquid



Given

$h_1 = 48$ in

Semicircle $D = 36$ in

$sg = 0.79$

$W = 60$ in

Area semicircle

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

$A = 508.93 \text{ in}^2$

Volume $V = AW$

$V = (508.93)(60)$

1 in = 0.0833 ft $V = 30535.8 \text{ in}^3$

or 17.67 ft^3

Specific weight alcohol

$\gamma = (sg)\, 62.4 \text{ lb/ft}^3$

$= (0.79)(62.4) = 49.296 \text{ lb/ft}^3$

Weight: $W = \gamma V = (49.296)(17.67) = 871.06$ lb

Vertical comp: $F_V = 871.06$ lb

Location comp: $\bar{x} = 0.212\, D = (0.212)(36) = 7.632$ in

Depth vertical: $h_c = h_1 + \frac{s}{2} = 48 + \left(\frac{36}{2}\right) = 66$ in

Horizontal: $F_H = \gamma s w h_c = (49.296)(3)(5)(5.5) = 4066.92$ lb $F_H = 4066.92$ lb

Horizontal component: $h_p = h_c + \frac{s^2}{12 h_c} = 5.5 + \frac{3^2}{(12)(5.5)} = 5.63$ ft

Resultant: $F_R = \sqrt{F_V^2 + F_H^2} = \sqrt{(871.06)^2 + (4066.92)^2}$

$F_R = 4159.156$ lb

$\tan^{-1}\left(\frac{871.06}{4066.92}\right) = 12.1°$

Zach Hollifield

Homework 1.6

From the solved problems I learned about buoyancy, stability, and the forces due to static fluid. The center of gravity is located at the centroid of the object. The center of buoyancy is at the centroid of the displaced volume. If an object is floating, then the weight must be equal to the buoyancy force. If the weight is larger then it will sink. In forces due to static fluid, pressure at the bottom is uniformly distributed. Force is equal to pressure times area. The resultant force due to pressure depends directly on the height of fluid on the surface and geometry of the surface.

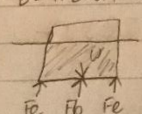
Chapter 5: 8, 24, 41, 61

8) A pump partially submerged in oil (sg 0.90) and support 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.

$F_b = \gamma_f V_d$ $\quad sg = \frac{\gamma_f}{62.4\ lb/ft^3} \rightarrow \gamma_f = 0.9 \times 62.4\ lb/ft^3 = 56.16\ lb/ft^3$

$F_b = (56.16\ lb/ft^3)\left[40\ in^3 \left(\frac{0.00058\ ft^3}{1\ in^3}\right)\right]$

$F_b = 1.3029\ lb$



$\Sigma F_y = 0$

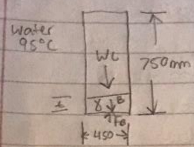
$F_b + F_e - w = 0$

$F_e = w - F_b \rightarrow 14.6\ lb - 1.3029\ lb =$

$\boxed{F_e = 13.3\ lb}$

Zach Hollifield

24) A brass weight is to be attached to the bottom of the cylinder described 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. What is the required thickness of the brass?



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

$\gamma_c = 9.44\ kN/m^3$

$w = \gamma_c V \qquad V = \frac{\pi}{4} D^2 h$

$V = \frac{\pi}{4}(0.45^2)(0.75) = 0.1193 m^3$

$V = \frac{\pi}{4}(0.45^2)(t) = 0.159t\ m^3$

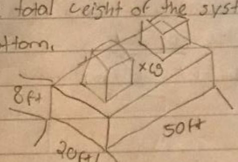
$V = V_c + V_b = 0.1193 + 0.159t$

$\Sigma F_y = 0 \qquad F_b - W_c - W_b = 0 \qquad F_b = W_c + W_B \qquad \gamma_f V = \gamma_c V_c + \gamma_b V_b$

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

$t = \frac{0.3567}{11.855} = 0.03m$ | Thickness of brass plate = 30 mm |

41) The large platform carries equipment and supplies to offshore installations. The total weight of the system is 450,000 lb, and its cg is even 8 ft from the bottom.



$cg = 8ft \qquad \gamma = 60 lb/ft^3$

$\Sigma F_y = 0 \qquad F_b - w = 0 \qquad F_b = w$

$F_b = \gamma_f V_d \qquad V_d = LBH = (50)(20)(H) = 1000x\ ft^3$

$F_b = (64)(1000x) = 64000x\ lb$

$F_b = w \qquad 64000x = 45000 \qquad x = 7.03 ft$

$y_{cb} = \frac{x}{2} = \frac{7.03}{2} = 3.515 ft$

$F_b = 64000(x) = 64000(7.03) = 449920 lb$

$MB = \frac{I}{V_d} \rightarrow V_d = (1000 ft^2)(7.03) = 7030 ft^3$

$I = \frac{LB^2}{12} = \frac{(50)(20)^3}{12} = 33.33 \times 10^3 ft^4$

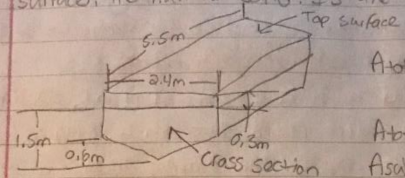
$MB = \frac{I}{V_d} = \frac{33.33 \times 10^3}{7030} = 4.742 ft$

$y_{mc} = y_{cb} + MB = 3.515 + 4.742 = $ | 8.3 ft |

$mc > cg$ so platform is stable in water

Zach Hollifield

6) A boat geometry at the water line is the same as the top surface. The hull is solid. Is the boat stable?



$A_{total} = A_{rectangle} + A_{triangle}$

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

$A_{total} = 3.6 m^2$

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

$= 2.88 m^2$

$$y_{cg} = \frac{A_1 y_1 + A_2 y_2}{A_{total}}$$

$$= \frac{(\frac{1}{2} \times 2.4 \times 0.6) \times \frac{2 \times 0.6}{6} + (1.2 \times 2.4) \times (0.6 + \frac{1.2}{2})}{3.6} = 1.04 m$$

$$y_{cb} = \frac{(\frac{1}{2} \times 2.4 \times 0.6) \times (\frac{2 \times 0.6}{3}) + (0.9 \times 2.4) \times 1.05}{2.88} = 0.8875 m$$

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

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

$mB = \frac{I}{V_d} = \frac{6.336}{15.84} = 0.4m$

$y_{mc} = y_{cb} + mB \rightarrow 0.8875 + 0.4 =$ **1.2875m center distance**

$y_{mc} > y_{cg}$ the boat is stable

Zach Hollifield

Chapter 4: 2, 10, 17, 28, 42, 54

2) The flat end of the tank secured. If the inside diameter of the tank is 30 in and the internal pressure is raised to 14.4 psig

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

$F = (14.4)(706.858) = \boxed{10178.8\ lb}$

10) A simple shower for remote locations is designed with a cylindrical tank 500mm in diameter and 1.800 m high as shown. The water flows through a flapper valve in the bottom through a 75-mm diameter opening. The flapper must be pushed upward to open the valve. How much for is required?

$F = PA$ $D = 10 + 75 + 10 \left(\frac{1m}{1000mm}\right) = 0.095\ m$

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

$P = \gamma_w h = (9.81)(1.8) = 17.658\ kN/m^2$

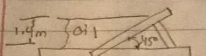
$F = (17.658)(7.088 \times 10^{-3}) = 0.125\ kN$

$125\left(\frac{95}{2}\right) - F_{open}(65) = 0$ $\boxed{F_{open} = 91.35\ N}$

17) If the wall is 4m long, calculate the total force on the water to the oil pressure.

$F_R = PA$

$P = \gamma_{oil} h_c$ $h_c = \frac{h}{2}$



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

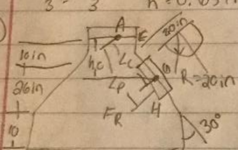
$\sin\theta = \frac{h}{L} \rightarrow L = \frac{1.4}{\sin 45} = 1.979\ m$

$A = 1.979 \times 4 = 7.919\ m^2$ $\gamma_o = (.86)(9.81) = 8.436\ kN/m^3$

$F_R = 8.436 \times \left(\frac{1.4}{2}\right) \times 7.919 = 46.76\ kN$

$\frac{h}{3} = \frac{1.979}{3}$ $h = 0.659\ m$ $L_p = 1.979 - 0.659 = \boxed{1.32\ m}$

28)



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

$F\bar{y} = 8 + \bar{y} \rightarrow 8 + 8.49 = 16.49\ in$

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

$L_c = 11.55 + 16.49 = 28.04\ in$

$h_c = 28.04 + \cos 30° = 24.28\ in$

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

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

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

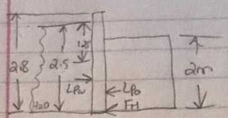
$\boxed{F_R = 606.0\ lb}$

$I_c = \left(\frac{\pi}{8} - \frac{8}{9\pi}\right) \times (20)^4 = 17561.1\ in^4$ $L_p = L_c + \frac{I_c}{L_c A} = 28.04 + \frac{17561.1}{28.04 \times \left(\frac{\pi}{2} \times 20\right)^2}$

$\boxed{L_p = 29.02\ in}$ $L_p - L_3 = 29.02 - 28.04 = \boxed{0.98\ in}$

Zaan Hollifield

42) The gate separates two fluids. Compute the net force on the gate due to the fluid on each side. Then compute the force on the hinge and on the support



$F_R = \gamma_w \left(\frac{h_w}{2}\right) A_w$

$A_w = 2.5 \times 0.6 = 1.5 m^2$

$= 9.81 \; kN/m^3 \times \left(\frac{2.5m}{2}\right) \times 1.5m^2 = 18.393 \; kN$

$LP_w = \frac{2}{3} h_w$

$= \frac{2}{3}(2.5m) = 1.667 m$

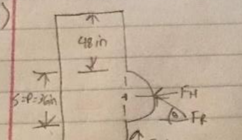
$A_w = 2 \times 0.6 = 1.2 m^2$

$= 9.81 \left(\frac{2m}{2}\right) \times 1.2 \times 0.9 = 10.6 \; kN$ $\quad = \frac{2}{3} \times 2 = 1.333 m$

$-F_{Rw} \times 1.967 + F_{Ro} \times 2.133 + F_H \times 2.8 = 0$

$F_H = \frac{(18.393 \times 1.967) - (10.6 \times 2.133)}{2.8} = \boxed{4.846 \; kN}$

59)



$A = \frac{\pi D^2}{8} = \frac{\pi (36^2)}{8} = 508.93 \; in^2$

$V = Aw = (508.93)(60) = 30535.8 \; in^3 \left(\frac{0.0833 \; ft}{1 in}\right) = 17.67 \; ft^3$

$\gamma = (0.79)(62.4) = 49.296 \; lb/ft^3$

$w = \gamma V = (49.296)(17.67) = \boxed{F_V = 871.06 \; lb}$

$\bar{x} = 0.212D = (0.212)(36) = \boxed{7.632 in}$

$h_c = h_1 + \frac{S}{2} = 48 + \left(\frac{36}{2}\right) = 66 in$

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

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

Hw 1.6 Chapter 5: 8, 24, 41, 61
Chapter 4: 2, 10, 17, 28, 42, 54

1 The pipe is reacting to the force of the fluid. When solving the problems, we are to think of the law behind the problem and what is actually happening, instead of trying to find an equation. When there is a change in velocity of a fluid there is a force involved. We learned to find the reaction forces in pipe problems and to modify the equation if necessary.

5.8 $sg = 0.90 = 56.16\ lb/ft^3$ $W = 14.6\ lb$ $V_d = 40\ in^3$

$F_s = W - F_b = 14.6 - 1.31 = 13.29\ lbs$

$F_b = V_d \cdot \gamma_f$

↓

$40\ in \cdot \frac{1\ ft^3}{12\ in}\ 56.16$

$= 1.31$

5.24 $D = 450\ mm$ $h_s = 600\ mm$ $h_1 = 750\ mm$

Kerosene $25° = 8.07$ $\gamma_k = 8.07\ kN/m^3$

$W = F_b$

$$\left(\frac{.45^2 \pi}{4}\ .75\right) \cdot \gamma_c = \left(\frac{.45^2 \pi}{4}\ .60\right)(8.07)$$

$.1193\gamma_c = 0.770$ → $\gamma_c = 6.45\ kN/m^3$

Water @ 95° C

$\gamma_W = 9.44\ kN/m^3$

$F_b = (0.1193 + .1590t)\,9.44$

$W = \left(\frac{0.45^2 \pi}{4} \cdot 0.75 \times 6.45\right) + \left(\frac{0.45^2 \pi}{4} t \cdot 84.0\right)$

$F_b = W$

$1.126 + 1.501t = 0.7695 + 13.3596t$

$11.8586t = 0.3565$

$= 0.030\ m \rightarrow 30\ mm$

5.41 $W = 45000\ lb$ $\quad V_d = LBH$

$H = 8\ ft$ $\quad V_d = 50 \cdot 120 \cdot x$

$W = 20\ ft$ $\quad V_d = 1000x$

Length $= 50\ ft$

$F_v = 0 = F_b -$ $\quad F_b = \gamma_f V_d = 64 \cdot 1000 = 64000\ lb$

$F_b = W \quad 64000x = 450000$

$x = \frac{45000}{64000} = 7.03\ ft$

$\frac{x}{2} = \frac{7.03}{2} = 3.515\ ft$

$F_b = 69000 \cdot 7.03^3 = 449990$

$V_d - 1000 \cdot 7.03 = 7030\ ft^3$

$I = \frac{LB^3}{12} = \frac{50 \cdot 20^3}{12} = 33.33 \cdot 10^3\ ft^4$

$MB = \frac{I}{V_d} = \frac{33.33 \times 10^3}{7030} = 4.74\ ft$

$MB = 4.742\ ft^2$

$C_b = \frac{WL}{2} = \frac{7.03}{2} = 3.52\ ft$

$4.74\ ft + 3.52\ ft = 8.26\ ft$ — stable

5.d $A_1 = (2.4 \times 1.2) + (0.5 \times 6 \times 2.4)$

$A_T = 3.6\ m^2$

$A_s = (2.4 \cdot 0.9) + (0.5 \times 0.6 \times 2.4)$

$A_s = 2.88\ m^2$

$C_y = \frac{A_1 y_1 + A_2 y_2}{A_T} = \frac{2.4 \cdot 1.2 \cdot (0.6 + 0.6) + 0.5 \cdot 0.6 \cdot 2.4 \cdot \frac{2}{3} \cdot 6}{3.6}$

$\frac{3.456 + 0.284}{3.6} = C_y = 1.04$

$$C_G = \frac{A_I y_I + A_{II} y_{II}}{A_T}$$

$$\frac{2.4 \cdot 1.2 \cdot (0.6 + 0.6) + 0.5 \cdot 0.6 \cdot 2.4 \cdot \frac{2}{3} \cdot 6}{3.6}$$

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

$$C_G = \frac{A_I y_I + A_2 y_{II}}{A_S}$$

$$\frac{2.4 \cdot 0.9 \cdot \left(0.6 + \frac{0.4}{2}\right) + 0.288}{2.88} \quad C_y = 0.89\ m$$

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

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

$$V_d = 2.88 \cdot 5.5 = 15.84$$

$$M_B = \frac{6.336}{15.84} = 0.4\ m$$

$$M_C = 0.89 + 0.4 = 1.29$$

4.2 $P = \frac{F}{A} = 14.4 = \frac{F}{\left(\frac{30^2 \pi}{4}\right)}$

$F = (14.4)(706.86)$

$= 10,179.16$

4.10 $h = 1.8\,m$

$P = \gamma h$

$D_V = 75 + 10 + 10 = 95\,mm$

$F = PA$

$P = 9.81 \cdot 1.8 = 17.658\ KN/m^2$

$F = PA = 17.658\ \frac{KN}{m^2} \cdot \left(\frac{0.095^2 \pi}{4}\right) m^2$

$F = 125\,N$

4.17 $L = 4\,m$

$sg = 0.86 = \gamma = 8.44$

$F_R = \gamma h_c A$

$A = 1.98 \cdot 4 = 7.92\,m^2$

$F_R = 8.44 \cdot 0.7 \cdot 7.92 = \boxed{46.79\ KN}$

$h_p = h_c + \frac{I \sin^2 \theta}{h_c A}$

$I = \frac{4 \cdot 1.98^3}{12} = 2.59$

$I = \frac{4 \cdot 1.98^3}{12} = 2.59\,m^4$

$h_p = 0.7 + \frac{2.59 \times 0.5}{0.7 \cdot 7.92} = 0.93\,m$

4.26 $\bar{y} = \frac{4R}{3\pi} = \frac{4 \cdot 20 in}{3\pi} = 8.49 in$

$FG = 8 + 8.49 = 16.49 in$

$\cos 30° = \frac{FR}{AF}$

$AF = \frac{FE}{\cos 30°} = \frac{10}{\cos 30°} = 11.53 in$

$Lc = AF + FG = 11.53 + 16.49 = 28.04 in$

$hc = Lc \cos 30° = 24.28$

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

$F_R = pA = \gamma h_c A = \gamma h_c \cdot \frac{\pi}{2} R^2$

$F_R = 68.64 \frac{lb}{ft^3} \cdot 24.28 in \frac{1 ft}{12} \cdot \frac{\pi}{2} \cdot 20 in \frac{1}{12}$

$F_R = 605.9 lb$

4.42 $\gamma_w = 62.4 \text{ lb/ft}^3$

$A_0 = \frac{\pi d^2}{4} = \frac{78.54 \text{ in}^2}{0.5454 \text{ ft}^2}$

$C_g = \frac{D}{2} = 5 \text{ in}$

$I = \frac{\pi D^4}{64} = 490.87 \text{ in}^4$

$F_R = \gamma h_c A$

$\cos 30 = \frac{x}{5}$

$x = 4.33 \text{ in}$

$h_c = 4.33 + 38 = 42.33 \text{ in}$

$F_R = 62.4 \cdot \frac{42.33}{12} \times 0.5454 = 120.05 \text{ lb}$

$h_p = \frac{490.87 \cdot \frac{1}{2}}{42.33 \cdot 78.54} + 42.33 = 42.37 \text{ in}$

$\cos 30 = \frac{4.37}{x}$

$x = 5.04$

$120.05 \cdot 5.04 - \frac{F_c}{\cos 60} \cdot 10 = 0$

$F_c = 121 \text{ lb}$

4.54 $S_s = 0.79$

$\gamma = 49.296 \frac{lb}{ft^3}$

$W = \gamma V$

$V = \frac{\pi D^2}{4} w = \frac{\frac{\pi 36^2}{4} \cdot 60}{1728} = 17.67 ft^3$

$F_V = 49.296 \cdot 17.67 = 871.06$

$A = \frac{\pi d}{2} \cdot w = \frac{\pi 3}{2} \cdot 5 = 23.56 ft^2$

$h_c = 4 + 1.5 = 5.5 ft$

$F_H = 49.296 \cdot 5.5 \cdot 23.56 = 6387.78$

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

$= \sqrt{871.06^2 + 6387.78^2}$

$= 6446.976$

$\tan^{-1} \frac{F_V}{F_H}$

$\tan^{-1} \frac{871.06}{6387.78}$

$= 6°$