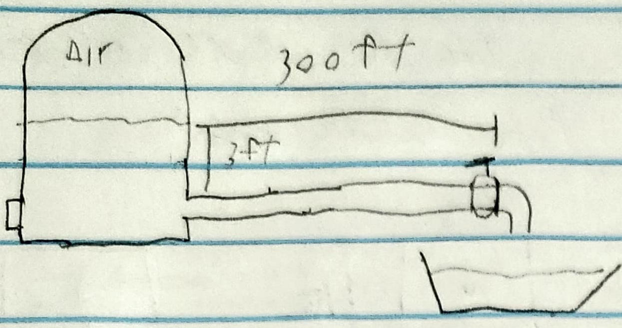
Test 2 Robert morris



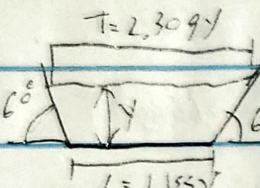
$T_{water} = 60^{\circ} F$ rate = 75 gpm

Pipe: $1\frac{1}{2}$ in sch 40 steel pipe

elasticity of steel = 200 GPa

Density hickory = 830 kg/m^3

a. what is y?



$S = 0.1 \qquad n = 0.017$

$75\text{ gpm} = \left(\frac{1.49}{0.017}\right) A R^{2/3} \cdot 0.1^{1/2}$

$75 = (82.647) \cdot (1.73y^2) \cdot \left(\frac{y}{2}\right)^{2/3} \cdot (0.215)$

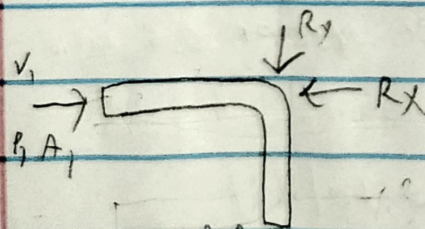
$75 = 32.6\, (y^2)\left(\frac{y}{2}\right)^{2/3}$

$421875 = \frac{34645.976\, y^8}{4} \cdot \sqrt[8]{48.707} = 1.625$

$\boxed{y = 1.625 \text{ ft}}$

b. calculate horizontal and vertical force on elbow

$Q = 75 \text{ gpm} = 10.026 \text{ ft}^3/\text{m} \qquad v = 10.026 / 0.01227 = 817.115 \text{ ft/m}$



$\gamma_{water} = 62.4$

$P = 62.4 \cdot 3 = 187.2 \text{ lb/ft}^2$

$F_x = 187.2 \cdot (10.026/60)(817.115/60)$

$= 426.005 \text{ lb}^f/s^2$

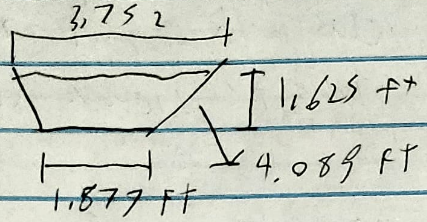
$P_1 \cdot A_1 = 187.2 \cdot 0.01227 = 2.297$

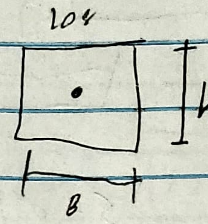
$426.005 + 2.297 = 428.302 \text{ lb}\cdot f/s^2$

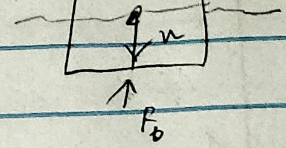
$\boxed{R_x = R_y = 428.302 \text{ lb}\cdot f/s^2}$

C. Largest hickory log   log has square cross section

$\rho_{log} = 830\ kg/m^3$ $\rho_{water} = 1000\ kg/m^3$

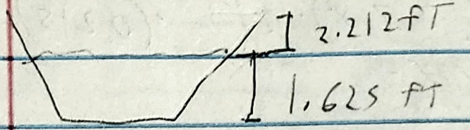






$4.089 - 1.877\ ft = 2.212\ ft$ $\rho_{log} = 1.61\ slug/ft$

$\rho_{water} = 1.94\ slug/ft$



$F_b = 62.4 \cdot V_d$

$F_b = W$ $62.4 \cdot V_1 = 1.61 \cdot 32.2 = 51.842\ lb$

$V_B \approx 1.204\ ft$ max: $\boxed{1.6 \times 1.6 \times 8.243\ ft}$

Density of water is higher than density of log so it would float and be stable

D. Pressure drop across nozzle diameter here of 0.5 ratio

$$Re = \frac{1.94\ slug/ft^3 \cdot 13.61\ ft/s \cdot 0.0268\ ft}{2.35 \cdot 10^{-5}\ lb\text{-}s/ft^3} = 301.111$$

$$C = 0.9976 - 6.53\sqrt{0.5/301.111} = 0.732$$

$$13.618\ ft/s = 0.732\sqrt{\frac{2(32.2)(P_1 - P_2)/62.4}{\left(\frac{0.01414}{0.00707}\right)^2 - 1}}$$

$$(P_1 - P_2) = 1006.209$$

e Pressure increment after sudden shut

$E = 200\ GPA$

$$C = \frac{\sqrt{(326000 \cdot 60) / 1.94}}{\sqrt{1 + \frac{(326000 \cdot 60) \cdot \frac{1.9}{60}}{200 \cdot \ \cdot \frac{0.145}{60}}}} = 2.805$$

$= 2,$

$$\Delta P = 1.94 \cdot 2.805 \cdot 13.619 = 74.111\ lb/ft^2$$

shutting suddenly will affect the cavitation as alot of water will come to a sudden stop.

f find maximum drag force

max size: $1.6 \times 1.6 \times 82.432$ ft

$A = 1.6 \cdot 41.216 = 65.946$ $\qquad \frac{1}{2}$ size $= 1.6 \times 1.6 \times 41.216$ ft

$w = 1.6 \cdot 1.6 \cdot 4.216 \cdot 1.61 = 169.876\ lb$

$N_R = \frac{(1.6 \cdot 41.216)}{1.21 \cdot 10^{-5}} = 5450049.587$ $\qquad C_D \approx 2$

$F_D = 2(1.94) \cdot 13.619 \cdot 65.946 \approx \boxed{3484.7\ lb}$

g Pressure of blind flange $D_F = 1.9$ in $\quad A_F = \frac{\pi (1.9)^2}{4} = 2.835$ in

$P_F = 1.94 \cdot 32.2 \cdot \frac{2.835}{12} \cdot 3 \approx 44.274\ lbs/f^2$