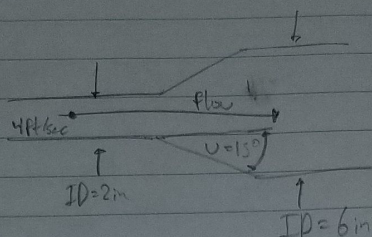


Foster Grubbs

HLV 2.3

10.5



$$\frac{P_1}{\gamma} + z_1 + \frac{V_1^2}{2g} = h_L = \frac{P_2}{\gamma} + z_2 + \frac{V_2^2}{2g} \quad h_L = K \left(\frac{V_1^2}{2g} \right)$$

Diameter of large pipe to small pipe

$$\frac{A_2}{D_1} = \frac{6m}{2m} = 3$$

From Figure 10.6 $K = 0.16$

$$h_L = 0.16 \left(\frac{4 \text{ ft/sec}^2}{2(32.2 \text{ ft/sec}^2)} \right)$$

$$h_L = 0.0397 \text{ ft}$$

Area for smaller pipe

$$A_1 = \frac{\pi \left(\frac{1}{2} \right)^2}{4} = 0.0818 \text{ ft}^2$$

$$Q = V_1 A_1$$

$$Q = (4 \text{ ft/sec}) (0.0818 \text{ ft}^2) = Q = A_2 V_2 \quad V_2 = \frac{Q}{A_2}$$

$$= 0.0818 \text{ ft}^3/\text{s}$$

$$V_2 = \frac{0.0818}{0.196}$$

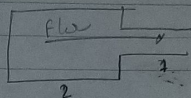
$$V_2 = 0.417 \text{ ft/sec}$$

Foster Gables

HW 2.3

10.22

$$ID_1 = 1.50 \text{ in} = 0.125 \text{ ft}$$



$$ID_2 = 3.826 \text{ in} = 0.3188 \text{ ft}$$

$$A_1 = 0.01227 \text{ ft}^2$$

$$A_2 = 0.07986 \text{ ft}^2$$

$$Q = 250 \text{ gal/min} = 250 (0.1337 \text{ ft}^3) \left(\frac{1}{60 \text{ s}} \right) = 0.557 \text{ ft}^3/\text{s}$$

$$V_2 = \frac{Q}{A_1} = \frac{0.557}{0.01227} = 45.39 \text{ ft/s}$$

$$\text{Diameter Ratio } \frac{D_2}{D_1} = \frac{0.3118}{0.125} = 2.55 \therefore K = 0.31$$

$$h_L = 0.51 \left(\frac{(45.39 \text{ ft/s})^2}{2(32.2)} \right) = 2.91 \text{ ft} \quad \text{Energy Loss}$$

Foster Gable

HW 2.3

$$P_1 - P_2 = \gamma \left[\cancel{z_2 - z_1} + \frac{(V_2^2 - V_1^2)}{2g} + h_L \right]$$

$$P_1 - P_2 = 62.4 \left[\frac{(0.449 \text{ ft/s})^2 - (4 \text{ ft/s})^2}{2(32.2 \text{ ft/s}^2)} + 0.0392 \text{ ft} \right]$$

the diff force is -0.089 lbf/in^2

VOLUNTARY CONSENT

By signing this form, you are saying several things. You are saying that you have read this form or have had it read to you, that you are satisfied that you understand this form, the research study, and its risks and benefits. The researchers should have answered any questions you may have had about the research. If you have any questions later on, then the researchers should be able to answer them: Dr. Stacie Ringleb at 757-683-5934 or sringleb@odu.edu. If at any time you feel pressured to participate, or if you have any questions about your rights or this form, then you should call Dr. Tancy Vandecar-Burdin, the current IRB chair, at 757-683-3802, or the Old Dominion University Office of Research, at 757-683-3460.

Please select one of the options below. By selecting yes, you are telling the researcher YES, that you agree to participate in this study.

 X yes, I would like my class assignments to be used in this research study.

 no, I would not like my class assignments to be used in the research study.

Please print and sign your name below, so the researchers know who to include or exclude in the study.

<i>Foster Grubbs</i> Subject's Printed Name & Signature	10/15/18 Date
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INVESTIGATOR'S STATEMENT

I certify that I have explained to this subject the nature and purpose of this research, including benefits, risks, costs, and any experimental procedures. I have described the rights and protections afforded to human subjects and have done nothing to pressure, coerce, or falsely entice this subject into participating. I am aware of my obligations under state and federal laws, and promise compliance. I have answered the subject's questions and have encouraged him/her to ask additional questions at any time during the course of this study. I have witnessed the above signature(s) on this consent form.

Stacie I Ringleb Investigator's Printed Name & Signature	<i>Stacie I. Ringleb</i> Date	9/20/18 Date
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