CEE 342 Exercise: Pipe Friction and Head Loss

Apparatus and Procedure

In this lab, we will determine the head loss through straight sections of three different pipes for at least five steady flow rates of water. The pipes are part of a continuous flow system, so the flow rate (*Q*) is the same through all of them. Some geometric details are provided below.

Pipe #	Material	Diameter (in)	Tap #s	Length
1	Galvanized	$1\frac{7}{8}$	1-2	20' 8.5"
2	PVC	$1\frac{3}{4}$	3-4	10' 9.5"
3	PVC	$1\frac{15}{32}$	8-9	14' 8.0"

As indicated, the pipes have taps in them. These taps are connected to piezometer tubes that are aligned on a wall against a grid (gradations of 1/8 in.), which can be used to determine the height to which water rises in each. The flow in the pipes is tangent to the openings in the tubes, so the height of the water column corresponds to the piezometric head at that tap. The head loss between any two locations in a pipe refers to the loss of total energy head, but if the diameter of the pipe is the same at the two locations, the velocity head is also the same, so the loss of total head equals the loss of piezometric head.

The flow rate will be controlled by a gate valve at the upstream end of the system and will be measured by weighing the water collected over a short period (30 s - 1 min), as in the previous lab when the Venturi meter was calibrated. The Barco (venturi) meter can be used to adjust the flow rate to the desired range.

For readings on the Barco meter of approximately 0.3, 0.7, 1.5, 3.0, 4.5, and 6.0, record the water levels in the manometer tubes attached to the pipe at the beginning and end of each pipe section of interest. Also record the digital reading on the Barco meter, the water temperature, and the measurements needed to determine the flow rate (weight at beginning, weight at end, and collection time.

For each pipe and each flow rate, the head loss, pipe length and diameter, and velocity head are known, so the Reynolds number and Darcy-Weisbach friction factor can be computed. Determine these values, plot them on a photocopy of the Moody diagram, and estimate the values of e/d, and then e, for each pipe.

Report

Please include the following items in a brief report.

1. Lab data sheet
2. Sample calculation leading to determination of f and **R** for one run. For consistency, please carry out this sample calculation for the smaller PVC pipe at the largest flow rate tested.

3. Results from all runs, in tabular form, listing *Q*, *V*, **R**, h_L, and *f*.
4. Comparison of the *Q* vs. Barco meter reading in this lab with that in lab #2.
5. The photocopy of the Moody diagram, on which the computed values of *f* and **R** are shown.
6. Your estimates of ε/d and ε for each pipe section.
7. A discussion of the results, potential errors, etc.

Grading

1. Cover sheet (required)
2. Table of contents (required)
3. Lab data sheet (required)
4. Sample calculation of *f* and **R** at maximum *Q* (5)
5. Tabulated results (*Q*, **R**, h_L, *f*) (2)
6. Plot of *f* vs **R** for the three pipes on a single Moody diagram (4)
7. Estimate of ε/d and ε for each pipe (4)
8. Discussion (5)

TOTAL 20