Istanbul Technical University

Department of Civil Engineering

CIE 354 Hydraulic Engineering
Lab Tutorial 2:
Local Head Losses (Minor Losses) in Pipes

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1 Scope of the Work

In the scope of this lab assignment, you are asked to conduct an experiment about the local head losses in pipe and report your results in a proper engineering format. You will organize the obtained data and make relevant calculations to compare your results with the theoretical equations of local head losses in pipes.

2 Lab Preparation

1. Read this handout including the appendix.
2. Review our lecture notes and preferably make an additional search about the suject.
3. Read "the lab safety instructions" once again.
4. Bring your own meter, calculator and a lab notebook to take notes.

3 Experimental Apparatus

Experimental setup consists of the following elements:

1. A circulation pump with a control valve (Fig. 1);
2. A triangular weir to measure the flow rate (discharge) (Fig. 2);
3. A closed pipe system composed of a 90^o sharp elbow, contraction section and expansion section (Fig. 3 and Fig. 4);
4. A serious of piozometer tubes connected to different points on the closed pipe system (Fig. 5).

4 Experimental Procedure

Follow the below steps for the experimental procedure:

1. Note down the inne diameter (D_{outer}) of the pipe sections as written on the sketch of the setup.
2. Note down which piezometer tube corresponds to which point on the closed pipe system.

Figure 1: The control valve of the circulation pump.

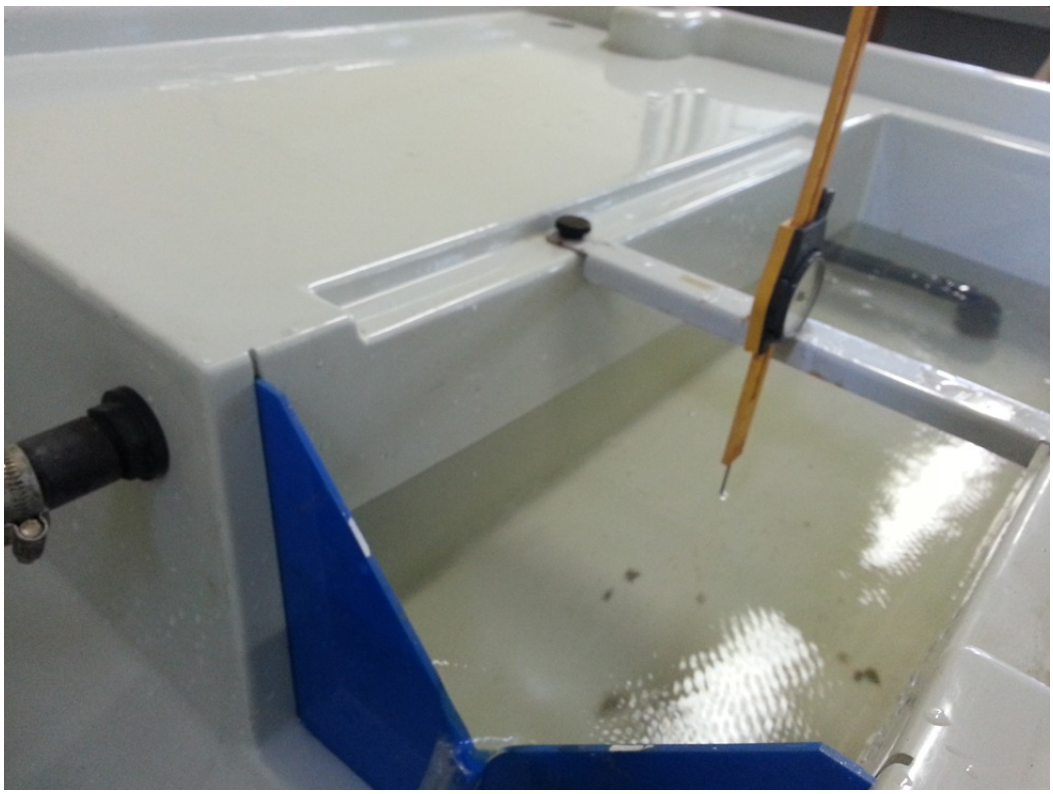

Figure 2: The triangular weir and the vernier.

Figure 3: The closed pipe system.

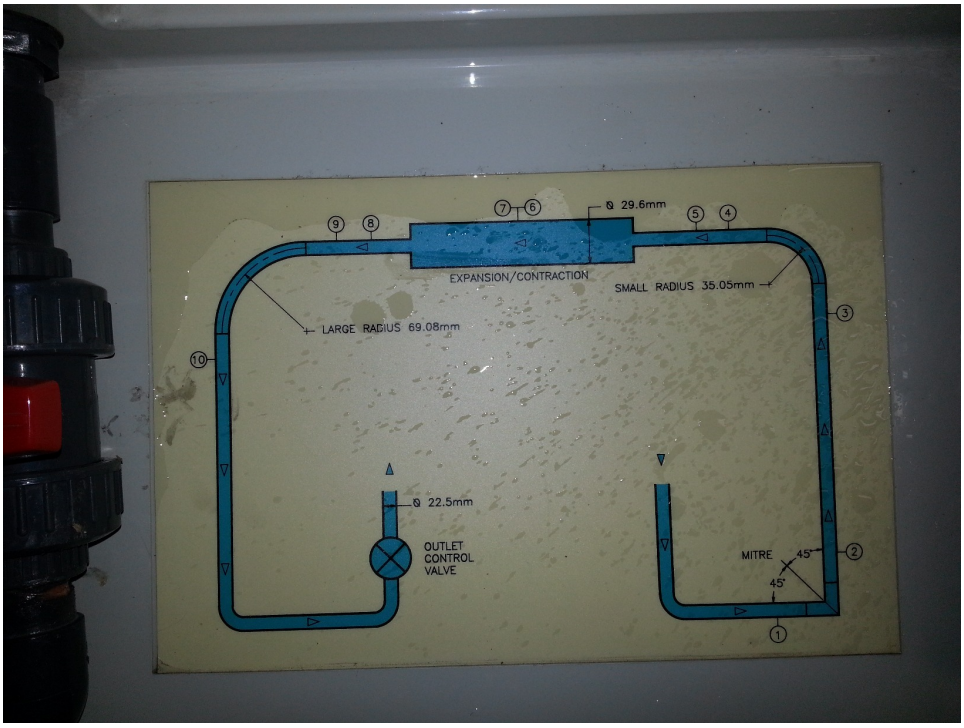

Figure 4: The sketch of the closed pipe system.

Figure 5: The piezometer tubes.

3. Start the pump and wait until the system becomes stable.

4. Adjust the valve if necessary. Do this in a mild and gradual fashion. DO NOT MAKE SUDDEN CHANGES WITH THE VALVE!

5. Wait until the system becomes stable again and make sure there are air bubbles in the closed pipe system.

6. Adjust the needle of the vernier to slightly touch the water level, read the gage of the vernier and record the value. You will use this value to calculate the discharge (Q).

7. Once the system is stable you can observe the changes in the pressure troughout the pipe system. Record the piezometric levels at all the points from 1 to 10.

8. Note down any leakage or malfunction in the system.

5 Calculation Procedure

Follow the below steps for the calculation procedure in your reports (Do not take these as "bible" and please feel free to modify these if you need to):

1. Calculate the cross-sectional area of the two (small and large) pipe segments (A_1, A_2).

2. Calculate the discharge (Q) using the gage value you read on the vernier (h_v). Note that the vernier reads 6.425 cm when the weir head is zero. use the below formula:

$$Q = \frac{8}{15} c_d \sqrt{2g} \tan\left(\frac{\theta}{2}\right) h^{2.5}$$

   where c_d is the discharge constant for the weir ($c_d = 0.578$ for the present setup), g is the gravitational acceleration, θ is the angle of the weir notch ($\theta = 90^o$ for the present setup) and h is the weir head ($h = h_v - 6.452\,\text{cm}$).

3. Calculate the mean sectional velocitis in bothe pipe segments ($V_1 = \frac{Q}{A_1}$, $V_2 = \frac{Q}{A_2}$).

4. Calculate the pressure heads ($z + \frac{p}{\gamma}$) and local head losses (h_{local}) in the system from your measurements on the piezometer tubes.

5. Note that a local head loss occurs by the constant C_l such that:

$$h_{local} = C_l \frac{V^2}{2g}$$

6. Find the relevant C_l coefficients (90^o sharp bend, sudden contraction, expansion, etc.) from the literature and compare with the values you found fro the experiment.

6 Remarks on Report Writing

Make sure that your report reflects the work you have conducted properly. It must be comprehensive but also brief. No handwriting is allowed. Before the deadline, a hardcopy should be submitted and a softcopy (pdf,doc, etc.) should be e-mailed to the instructor (kircave@itu.edu.tr).