CEE 342 Laboratory Exercise: Momentum (Hydraulic Jump)

Apparatus and Procedure

The experiments will be performed in a rectangular, horizontal channel 31.43 cm (12.375 inches) wide. The flow meter in the water supply line has the calibration equation:

$$Q = 3.06\text{x}10^{-2}\left(0.0518M + 0.109\right)^{0.5}$$

where Q is in m^3/s and M is the reading of a millivolt meter connected to a differential pressure transducer, just like the meters used in Lab #2. The pressure transducer is connected to pressure taps on a Dall tube flow meter. Use one flow rate for all tests, with $25 < M < 30$. By adjusting the sluice gates at both ends of the flume, establish two separate, stationary hydraulic jumps. Record M, y_1 and y_2 (defined in Figure 1) for each jump.

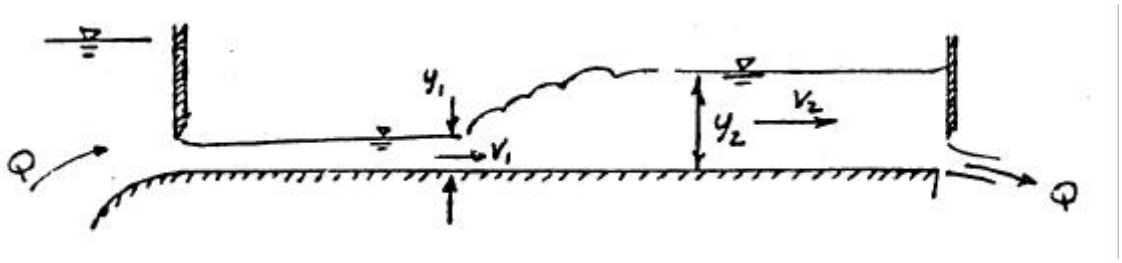

Figure 1. Longitudinal section of 12.375-inch wide flume, 106 Harris Hydraulics Laboratory

Report

Please include the following items in a brief report.

1. Schematic drawing of the experiment

2. Lab data sheet

3. Using the value of Q from the meter calibration equation in conjunction with the measured value of y_1, calculate for each jump the predicted y_2. Use the following equation, which can be derived by combining the continuity equation with the impulse-momentum equation:

$$\frac{y_2}{y_1} = \frac{1}{2}\left[-1+\sqrt{1+\frac{8q^2}{gy_1^3}}\right] = \frac{1}{2}\left[-1+\sqrt{1+\frac{8v_1^2}{gy_1}}\right]$$

Note that this equation is based on an assumption that gravity and the pressure forces are the only forces acting on the water upstream and downstream of the jump; as the water

goes through the jump, friction converts useful forms of energy to heat. The frictional force causes the water to lose momentum, and the magnitude of this force can be quantified based on the momentum equation. The equation given above is the result of such an analysis.

4. For the jump with the greater y_2, prepare a neat sketch showing the energy line (EL) and the hydraulic grade line (HGL) upstream and downstream of the jump. Draw the sketch to scale vertically. Label and show the numerical value for the head loss across the jump.

5. Compute the decline in total head associated with the jump for the other data set (the set not analyzed in item #4 above).

6. Comment on how well the measured and predicted y_2 values compare, and on the validity of the basic 1-D momentum equation to this situation. When comparing measurements with theory, it is instructive to use percent differences rather than absolute differences.

7. Please attach a copy of the lab grading sheet as a separate page at the end of your report.

CIVE 342 Lab 4 Grading Sheet

Report Section	Points Possible
1. Cover sheet	--
2. Table of Contents	--
3. Lab data sheet	--
4. Introduction	2
5. Schematic drawing	1
4. Calculation Results	
v_1 (ft/s)	2
y_2 (ft)	2
5. Grade lines	
a. EL	4
b. HGL	4
6. Energy Eqn. calcs.	5
7. Discussion	5
TOTAL	25