Applied Hydraulics – Week 4 – Hydraulic Jump, Critical Flow

Reading Assignment: Chin, Ch. 3, pp. 120 – 124, sec. 3.3.3, pp. 133 – 136

Homework Problems: 3.26, 3.31, 3.41, 3.42, 3.43 (due in class, October 1)

Hands-on Assignment

In this experiment you will create four hydraulic jumps of varying Froude number, and observe the conditions upstream and downstream of the jump.

1. Set up the flume as described in experiment G of the Armfield manual.
2. Adjust the upstream and downstream depths, and the flume flow rate to create an undular jump ($1.0 < Fr < 1.7$, using the water depth upstream of the jump, see Chin, p. 135). Be sure to calculate the upstream Froude number to confirm that it is in the proper range. Carefully measure water depths at several known locations along the jump. Be sure to measure both the horizontal distance and the water depth for each measurement.
3. Now adjust conditions in the flume to get a steady jump ($4.5 < Fr < 9.0$), and repeat the measurements. Once again take measurements and make calculations to confirm you have the right upstream Froude number.
4. Repeat the process two more times at different Froude numbers. Try one case with a Froude number above the "steady jump" range, and one with a Froude number below the steady jump range. Repeat the measurements.

To Be Done Later (Bring to class September 24)

For each of the four cases, neatly summarize the data.

1. First give the type of jump, discharge rate (flow), upstream depth and upstream Froude number.
2. Then make a plot showing how the depth changed from upstream to down.
3. Then make a table showing at each location the water depth, velocity, Froude number, specific energy, and specific momentum (see Chin, p. 134).
4. Estimate the head loss using the equation from Chin. Compare this number to change in specific energy from upstream to downstream.
5. Point out any anything or unusual about your data (e.g. was the specific momentum constant, did all the Froude numbers look right, did the jump have the expected behavior, did the calculation in step 4 work out as expected).