CWR 5235 Open Channel Hydraulics
Homework 1, Spring 2021
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1. Water is flowing at a depth of 10 ft with a velocity of 10 ft/s in a channel of rectangular section. Find the depth and change in water surface elevation caused by a smooth upward step in the channel bottom of 1 ft. What is the maximum allowable step size so that choking is prevented? Neglect head losses.

2. Water is flowing at a depth of 10 ft with a velocity of 10 ft/s in a 10-ft wide rectangular channel. If there is a smooth contraction in width from 10 ft to 8 ft. How much should the channel bottom drop to maintain a constant water surface elevation through the transition? Neglect head losses.

3. We know that if you constrict a subcritical flow, the water depth will decrease. That is good news because, in most cases, river flows are subcritical and we do not need to worry about a constriction (bridge) raising the water surface and flooding over. However, during floods, water velocities go way up and we may have a supercritical approach flow to a constriction, such as a bridge. The q vs. y diagram tells us that constricting a supercritical flow will increase water depth, raising the risk of water flooding over the banks. Consider a flow with an upstream velocity of 6 m/s, depth of 1 m, and a width of 10 m. The flow is constricted to a width of 9 m (call this location 2). (a) Compute the initial (location 1) Froude number and specific energy. (b) Compute the minimum channel width to avoid choking the flow. (c) For the given constriction (b_2 = 9 m), compute the water depth and the Froude number in the throat of the constriction.

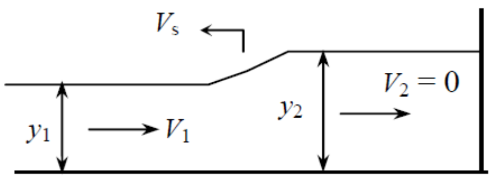
4. An open channel has a semicircular bottom and vertical, parallel walls. If the diameter, d, is 3 ft, calculate the critical depth and the minimum specific energy for two discharges, 10 cfs and 30 cfs.

5. A rectangular sharp-crested weir is used to measure the flowrate in a channel of width 10 ft. It is desired to have the channel flow depth be 6 ft when the flow rate is 50 cfs. Determine the height, P, of the weir plate.

6. Design a broad-crested weir for a laboratory flume with a width of 15 in. The discharge range is 0.1 to 1.0 cfs. The maximum approach flow depth ($H + P$) is 18 in. Determine the height of the weir (P) and the weir length in the flow direction. Plot the expected head-discharge relationship (H vs Q).

7. A rectangular channel carrying a supercritical flow is provided with a hydraulic jump dissipator. It is desired to have an energy loss of 5.0 m in the hydraulic jump when the inlet Froude number is 8.5. What are the sequent depths of this jump?

8. A steady flow is occurring in a rectangular channel, and a sluice gate controls it. The upstream depth is 1.0 m, and the upstream velocity is 3.0 m/sec. If the sluice gate is slammed shut abruptly, determine the depth and speed of the resulting surge.



9. The depths upstream and downstream of a sluice gate in a rectangular channel are 8 ft and 2 ft, respectively, for steady flow.
   a. What is the value of the flow rate per unit width q?
   b. If q in part (a) is reduced by 50% by the abrupt partial closure of the gate, what will be the height and speed of the surge upstream of the gate?

10. The main river channel **downstream** of a bridge (i.e., Section 4) can be approximated as a rectangular cross-section in which the flow depth y_4 is 2.0 m and the velocity V_4 is 3.0 m/s. The bridge has circular piers with a diameter of 1.0 m in the main channel. What pier spacing "*s*" would cause the **Type II** flow (e.g., critical depth at pier and hydraulic jump downstream of pier) and what would be the value of the backwater?.