Florida International University
Department of Civil and Environmental Engineering

CWR 3201 Fluid Mechanics
Fall 2018

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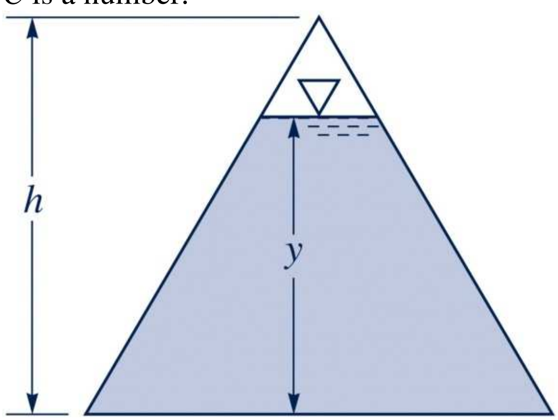
Homework Assignment 8

*Mechanics of Fluids (**Fifth edition**), by M.C. Potter, D.C. Wiggert and B.H. Ramadan.*

1. A trapezoidal channel is to be designed to carry a discharge of 75 m^3/s at **maximum hydraulic efficiency**. The side slopes of the channel are 2H:1V (2 Horizontal and 1 Vertical) and the Manning's roughness *n* is 0.030.
   a. If the maximum allowable velocity in the channel is 1.75*m/s*, what should be the dimensions of the channel (bottom width and height)?
   b. What should be the longitudinal slope of the channel if the flow is uniform?

2. Water flows in a channel with an equilateral triangle cross-section as shown in the figure below. For a given Manning coefficient, *n*, and bottom slope, determine the ratio "*y/h*"that gives the maximum flowrate.**Your answer should look something like this** : *y/h* = *C*, where *C* is a number.



3. 10.8 (same number in *Fourth edition*)
   A channel cross section, commonly called a *gutter*, forms at the side of a street next to a curb during rainfall conditions (Fig. P10.8). The slope along the roadway is $S_0 = 0.0005$, and the Manning roughness coefficient is $n = 0.015$. Assuming that uniform flow conditions occur:
   (a) Determine the discharge if the depth of flow is $y_0 = 12$ cm
   (b) If $Q = 80$ L/s, what is the flow depth y_0?

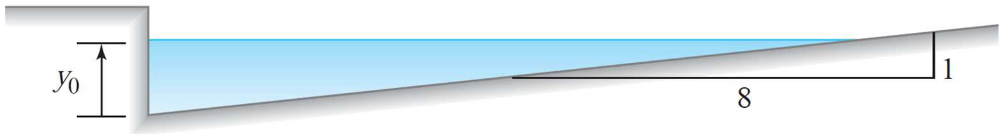


Fig. P10.8

4. 10.15 (same number in *Fourth edition*)

Water is flowing in a rectangular channel 2.0 m wide. At a transition section the channel bottom is lowered by $h = 0.1$ m for a short distance, and then is raised back to the original elevation (Fig. P10.15). If $y = 1.22$ m and $Q = 4.8$ m^3/s, then, with losses neglected:

(a) Find the change in channel width necessary to maintain a horizontal water surface through the transition.

(b) What change in width would cause critical flow to occur in the transition?

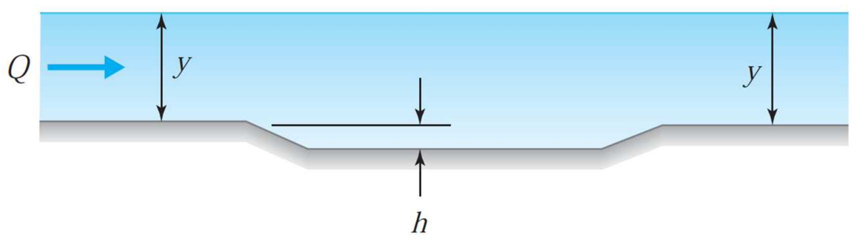


Fig. P10.15

5. 10.16 (same number in *Fourth edition*)

Water flows at a depth of 2.15 m and a unit discharge of 5.5 m^2/s in a rectangular channel. Energy losses can be neglected.

(a) What is the maximum height h of a raised bottom that will permit the flow to pass over it without increasing the upstream depth?

(b) Show the solution on an E–y diagram.

(c) Sketch the water surface and energy grade line.

(d) If the channel bottom is raised greater than h, discuss a type of change that may take place upstream of the transition.

6. 10.40 (same number in *Fourth edition*)

Water is flowing as shown in Fig. P10.40 under the sluice gate in a horizontal rectangular channel that is 5 m wide. The depths y_1 and y_2 are 2.5 m and 10 cm, respectively. The horizontal distances between locations 1, 2, and 3 are sufficiently short that rapidly varied flow conditions can be assumed to occur. Determine the following:

(a) The discharge

(b) The depth downstream of the jump at location 3

(c) The power lost in the hydraulic jump

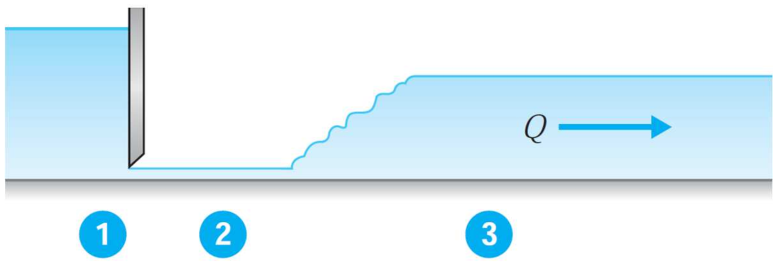


Fig. P10.40

7. 10.53 (same number in *Fourth edition*)

The partial water profile shown in Fig. P10.53 is for a rectangular channel of width $b = 3$ m, in which water is flowing at a discharge of $Q = 5\ \text{m}^3/\text{s}$.

(a) Does a hydraulic jump occur in the channel? If so, is it located upstream or downstream of location A?

(b) Sketch the water surface and energy grade line, and identify any known water surface profiles.

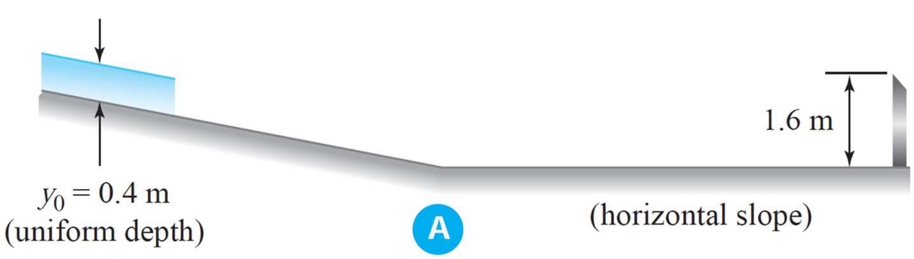


Fig. P10.53

8. Sketch the water surface profile for the open-channel system below (NDL = Normal depth, CDL = Critical depth)