

## CIVE 717 - RIVER MECHANICS

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### Homework #2 - Chapters 4 and 5 due March 10, 2009

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#### Problem #1 (60%) At-a-station Hydraulic Geometry

Consider the cross-section of the Missouri River on Figure P4.6.1, p. 120. Assume that the slope and Manning  $n$  remain constant at any flow depth. To answer the following questions, plot the data nicely, analyze the results and provide regression equations whenever appropriate:

- a. Stage – discharge relationship;
- b. Velocity - discharge
- c. Area - discharge;
- d. Determine the floodwave celerity relationship with discharge from the area-discharge equation and compare with the celerity obtained from the velocity ( $c = \beta V$ ) relationship;
- e. From Eqs 4.10 and 4.11 determine  $a$  and  $m$  of the power relationship at the 10-year discharge and plot the power relationship with  $a$  and  $m$  on Fig. 4.11;
- f. Plot the measured resistance factor for the 10-year discharge on Fig. 4.11;

For the following questions, consider the nearby gauging station on the Missouri River at Omaha, NE.

<http://waterdata.usgs.gov/>

Focus on the flood of 1993, and determine the largest daily increase in discharge.

- g. Determine the daily change in stage at that cross-section;
- h. Assuming similar cross sections over a 10 km reach, use the continuity equation to determine the percentage of decrease in discharge in the downstream direction; and
- i. During the day of maximum increase in discharge, evaluate all the terms of the Saint-Venant equation;
- j. Determine which approximation of the Saint-Venant equation would be appropriate.

#### Problem #2 Flow duration curves (40%)

Consider a long continuous record (about 25 years) of water discharge for the Missouri River at Omaha, NE.

Determine the following:

- a. Flow duration curve and mean daily discharge;
  - b. Plot the exceedence probability curve (e.g. Case Study 5.1 p. 151.);
  - c. Graphically determine the transform parameters  $\hat{a}$  and  $\hat{b}$ ;
  - d. Discharge exceeded one day per year, 10 year and 100 years.
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