

GEOL 652 Homework I

This exercise focuses on 5 channel units (2 riffles, 2 runs, 1 pool) along the North Fork Poudre River in Phantom Canyon.

Channel unit	Bed slope, S_b (m/m)	Channel width, w (m)	D_{50} , D_{84} (m)
Upstream riffle	0.027	11	0.13, 0.27
Upstream run	0.010	13	0.18, 0.31
Pool	0.001	19	0.01, 0.06
Downstream run	0.001	16	0.15, 0.29
Downstream riffle	0.009	16	0.12, 0.25

Using the data in the Excel file labeled Exercise 1 (sheet 1), calculate the Darcy-Weisbach friction factor, f for each channel unit at each of 24 discharges:

$$v = [(8gRS)/f]^{0.5} \quad (1)$$

where v is mean velocity (m/s), g is gravitational constant (9.8 m/s^2), R is hydraulic radius (m), and S is water-surface gradient (m/m).

Discuss how f varies in relation to Q , S_b , grain size (D_{50} , D_{84}), and w/R for the different channel units. (Discussion is most effective if based on visual and statistical assessment of trends in plots.)

Calculate k_s for each channel unit at each discharge using:

$$k_s = (12.2R)/10^{0.493x} \quad (2)$$

where x is $f^{-0.5}$

(This equation is modified from a formula used by Hey (1979, Flow resistance in gravel-bed rivers, ASCE J Hydraulic Engineering 105, 365-379; 1988, Bar form resistance in gravel-bed rivers, ASCE J Hydraulic Engineering 114 (12), 1498-1508)

Does $k_s = 3.5D_{84}$ for any of these channel units?

Plot velocity profiles for multiple discharges at the measurement point in each of the 5 channel units using the data in sheet 2. How does profile shape vary in relation to stage, S_b , and k_s ?

The measurement point in the pool was in the center of the pool tail. The measurement points in the riffles and runs were to one side of the thalweg and next to a very large clast, with no exceptionally large clast immediately upstream. At the downstream riffle, the measurement point was immediately below the metal bar shown in photos on the last page. Using the photos below, what can you infer about the general shape and specific zones of irregularity in each of the profiles?



Upstream view of pool (velocity profile in pool tail) at $10.25 \text{ m}^3/\text{s}$



Upstream view of upstream run at $0.45 \text{ m}^3/\text{s}$ (start of riffle in foreground; upstream riffle at top of photo; run is area of flat water between two riffles)



Upstream view of upstream riffle at $10.25 \text{ m}^3/\text{s}$; large boulder at right in photo above does not appear in this photo, but is nearly submerged



Upstream view of downstream riffle at approximately $2 \text{ m}^3/\text{s}$



Upstream view of downstream riffle at $10.25 \text{ m}^3/\text{s}$



Upstream view of downstream riffle at $19.07 \text{ m}^3/\text{s}$