River Mechanics – Dr. Abdul-Sahib T. Al-Madhhachi

HW Assignment #1
Assigned: October 26, 2019
Due: November 02, 2018

1. The critical shear stress required to initiate movement due to a flowing fluid is hypothesized to depend on the following variables: τ_o, shear stress on the bed, the quantity given by $(\gamma_s\text{-}\gamma)$; the average grain diameter, d_{50}; the friction velocity, u*, and the viscosity, ν. By dimensional analysis, derive the following relationship:

$$\frac{\tau_o}{(\gamma_s - \gamma)d} = f\left(\frac{u_* d}{\nu}\right)$$

2. A liquid is moving horizontally through a bed of sand. The sand grains have an average diameter D and the void fraction (volume of free space to the total volume) is α. It is assumed that the pressure drop through the bed is a function of the sand grain diameter, D, the void fraction, α, the fluid density, ρ, the fluid viscosity, μ, and the distance through the bed, Δs. By dimensional analysis, find the Π-groups for this problem.

3. Flow over a spillway has a given discharge coefficient C_D that can be defined as

$$q = C_D\sqrt{2g(y_o - H)^3}$$

in which q = flow rate per unit width. Use the Bernouilli and continuity equations to obtain an expression for y_1/y_o in terms of C_D and H/y_o. If y_o = 15 m, H = 10 m, and C_D = 0.5, calculate the depth, y_1, the velocity, V_1.