Tutorial 9

1. For a trapezoidal channel flowing at normal depth with Q = 2 m^3/s, bottom width, b = 6 m, and 2H:1V side slopes, channel slope, S_0 =0.005 m/m, and Manning's roughness, n = 0.03, determine the median sediment particle size that will be on the verge of motion within the channel. Assume ν = 1.306 x 10^{-6} m^2/s, ρ_s = 2650 kg/m^3, ρ = 1000 kg/m^3.

2. For the trapezoidal channel and discharge specified in Example 1, determine the maximum shear stress on both the bed and side slopes of the channel. For these stress values, determine the median sediment particle sizes that would be on the verge of motion.

3. Design a stable channel of trapezoidal cross section with the following data:
   Discharge = 50 m^3/s
   Bed material: D = 2 cm, very rounded
   Bed slope: 5 x 10^{-4}
   ρ_s = 2650 kg/m^3, ρ = 1000 kg/m^3
   ν = 10^{-6} m^2/s
   Use the Strickler's formula to calculate the Manning's coefficient.

4. A circular culvert of length 26 m and diameter 75 cm, is installed on a slope of 2.5 percent. The Manning's coefficient is n = 0.014. The culvert is designed for flood conditions where the head water depth is 2.5 m and the tail water depth is 1.0 m. Local losses through the culvert include an entrance loss (k_L = 0.5) and an exit loss of one velocity head. Calculate the discharge capacity of the culvert. Assume C_d = 0.6.