Selection of flow resistance formula in pipes & open channels

"In open channels, the Darcy equation is valid using the hydraulic diameter as equivalent pipe diameter. **It is the only sound method to estimate the energy loss**."

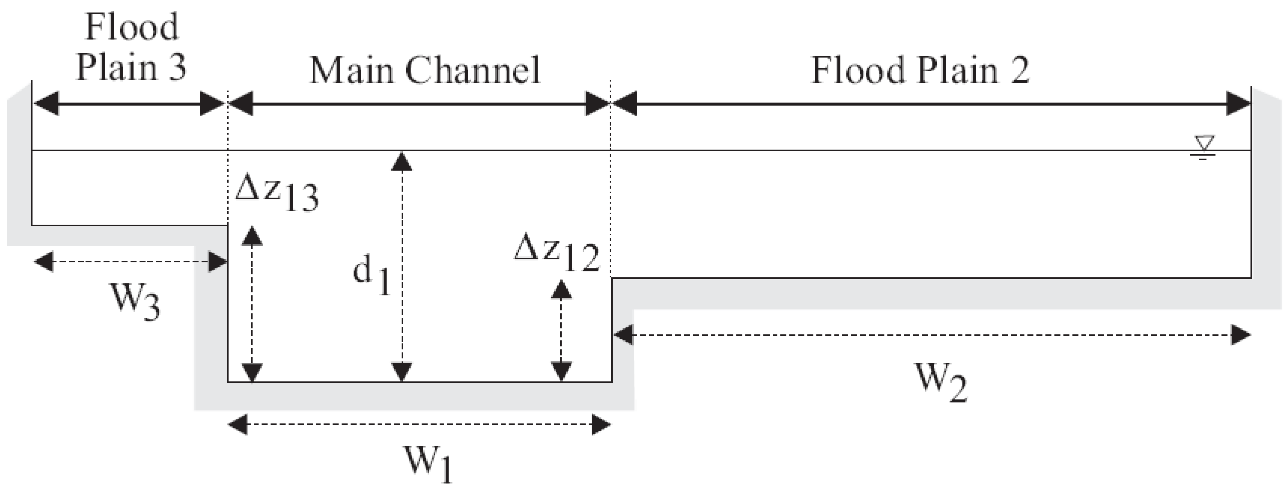
"For various reasons, empirical resistance coefficients (e.g. Chézy coefficient, Gauckler-Manning coefficient) were and are still used. Their use for man-made channels is highly inaccurate and improper."

"***The (Chézy and Gauckler-Manning) equations express our continuing ignorance of turbulent processes***" (LIGGETT 1975, p. 75)

"Several computer models of river flows using the unsteady flow equations are based on the Gauckler-Manning equation. Professionals (engineers, designers, managers) must not put too much confidence in the results of these models **as long as the resistance coefficients have not been checked and verified with experimental measurements**."

Application

Considering a river channel with a flood plain in each side, the cross-section characteristics are : W_1 = 5 m, W_2 = 14 m, Δz_{12} = 0.95 m, W_3 = 58 m, Δz_{13} = 1.35 m. The river channel is lined with finished concrete. The lowest flood plain (Flood plain No. 2) is liable to flooding and its bed consists of gravel (k_s = 20 mm). The left bank plain (Flood plain No. 2) is a grassed area (centipede grass, $n_{Manning}$ ~ 0.06 SI units).The longitudinal bed slope of the river is 3.2 m per km. In the main channel, the observed water depth is d_1 = 2.17 m. Compute : (a) the total discharge, (b) the flow rate in the main channel, and (c) the flow rate in the right flood plain.



Assume uniform equilibrium flow conditions.

Assume no friction (and no energy loss) at the interface between the river channel flow and the flood plain flows.

For man-made channels, do perform flow resistance calculations based upon the Darcy-Weisbach friction factor.

Solution:

Main channel: 58 m^3/s, Flood plain 2: 53 m^3/s, Flood plain 3: 39 m^3/s. Total: 149 m^3/s