*Chézy, Manning and Darcy-Weissbach friction coefficients

The three most often used equation for calculating friction losses h_f (Eqs. 6-30) are the ones known as Chézy, Manning and Darcy-Weissbach equations.

$$h_f = \frac{1}{C^2}\frac{Lv^2}{R} \quad \text{Chézy}$$

$$h_f = n^2 \frac{Lv^2}{R^{4/3}} \quad \text{Manning}$$

$$h_f = f_{DW}\frac{L}{4R}\frac{v^2}{2g} \quad \text{Darcy} - \text{Weissbach} \tag{6-30}$$

where L is the length of the river section and R is hydraulic radius. C is the Chézy coefficient, $n = 1/k_{St}$ is the Manning coefficient (the inverse of n is K_{St} called the Strickler coefficient) and f_{DW} is the Darcy-Weissbach friction coefficient originally developed for pipe flow. Note the h_f is linearly related to f_{DW} but to C^2 and n^2.

There is the following connection between the different friction coefficients:

$$f_{DW} = 8gR^{-1/3}n^2 = 8gC^{-2} \tag{6-31}$$

The three different friction factors are used to calculate the average flow velocity v (m s^{-1}) in the river as follows:

$$v = C\sqrt{RS_f} \quad \text{Chézy}$$

$$v = \frac{1}{n}R^{2/3}\sqrt{S_f} \quad \text{Manning}$$

$$v = \sqrt{\frac{8g}{f_{DW}}RS_f} \quad \text{Darcy} - \text{Weissbach} \tag{6-32}$$

where S_f is the energy slope (friction slope) and in uniform flow S_f can be replaced by the bottom slope S_o.

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* extract from T. Karvonen "HYDRAULICS", Laboratory of Water Resources, Helsinki University of Technology