

# Detailed Bed Shear Equations

The TUFLOW Bed Shear Equations are given as:

**Metric Units:**

$$\tau_{bed(metric)} = \frac{\rho g v^2 n^2}{y^{1/3}}$$

where:

$\rho$  = Density

$g$  = Gravity

$v$  = Velocity

$n$  = Manning's n

$y$  = Depth

Units are in N/m<sup>2</sup>

**In US Customary Units, the total bed shear stress is given as:**

$$\tau_0 = \gamma R S$$

Where:

$\gamma$  = Specific weight of water

$R$  = Hydraulic Radius

$S$  = Energy Slope

**Manning's Energy Grade Line Slope in English Units is given as:**

$$S = \left[ \frac{vn}{1.486R^{2/3}} \right]^2$$

Where:

$\gamma$  = Specific weight of water

$R$  = Hydraulic Radius

$S$  = Energy Slope

**CME** = 1.486 in English units and 1.0 in SI units

$$\gamma = \rho g$$

Where:

$\rho$  = Density

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$g$  = Gravity

In channels where the width is 10 times greater than Depth ( $R$ ), then ( $R$ ) is taken as Depth ( $y$ ).

With substitution, we get:

$$\tau_0 = \frac{\rho g y^{\frac{3}{3}} v^2 n^2}{1.486^2 y^{\frac{4}{3}}}$$

With cancellation and roundup, we get:

$$\tau_{bed(English)} = \frac{\rho g v^2 n^2}{1.49^2 y^{\frac{1}{3}}}$$

Units are in **lb/ft<sup>2</sup>**