# Important Uniform Flow in Channels Formulas PDF

**Formulas**
**Examples**
**with Units**

## List of 32
### Important Uniform Flow in Channels Formulas

## 1) Average Velocity in Uniform Flow in Channels Formulas

### 1.1) Average Velocity in Channel Formula

Evaluate Formula

Formula

$$V_{avg} = \sqrt{8 \cdot [g] \cdot R_H \cdot \frac{S}{f}}$$

Example with Units

$$0.3169\,\text{m/s} = \sqrt{8 \cdot 9.8066\,\text{m/s}^2 \cdot 1.6\,\text{m} \cdot \frac{0.0004}{0.5}}$$

### 1.2) Boundary Shear Stress Formula

Evaluate Formula

Formula

$$\zeta_0 = \gamma_l \cdot R_H \cdot S$$

Example with Units

$$6.2784\,\text{Pa} = 9.81\,\text{kN/m}^3 \cdot 1.6\,\text{m} \cdot 0.0004$$

### 1.3) Friction Factor given Average Velocity in Channel Formula

Evaluate Formula

Formula

$$f = \left(8 \cdot [g] \cdot R_H \cdot \frac{S}{V_{avg}^2}\right)$$

Example with Units

$$0.4903 = \left(8 \cdot 9.8066\,\text{m/s}^2 \cdot 1.6\,\text{m} \cdot \frac{0.0004}{0.32\,\text{m/s}^2}\right)$$

### 1.4) Hydraulic Radius given Average Velocity in Channel Formula

Evaluate Formula

Formula

$$R_H = \left(\frac{V_{avg}}{\sqrt{8 \cdot [g] \cdot \frac{S}{f}}}\right)^2$$

Example with Units

$$1.6315\,\text{m} = \left(\frac{0.32\,\text{m/s}}{\sqrt{8 \cdot 9.8066\,\text{m/s}^2 \cdot \frac{0.0004}{0.5}}}\right)^2$$

### 1.5) Hydraulic Radius given Boundary Shear Stress Formula

Evaluate Formula

Formula

$$R_H = \frac{\zeta_0}{\gamma_l \cdot S}$$

Example with Units

$$1.6055\,\text{m} = \frac{6.3\,\text{Pa}}{9.81\,\text{kN/m}^3 \cdot 0.0004}$$

### 1.6) Slope of Channel Bed given Average Velocity in Channel Formula

Evaluate Formula

Formula

$$S = \left( \frac{V_{avg}}{\sqrt{8 \cdot [g] \cdot \frac{R_H}{f}}} \right)^2$$

Example with Units

$$0.0004 = \left( \frac{0.32\,\text{m/s}}{\sqrt{8 \cdot 9.8066\,\text{m/s}^2 \cdot \frac{1.6\,\text{m}}{0.5}}} \right)^2$$

### 1.7) Slope of Channel Bottom given Boundary Shear Stress Formula

Evaluate Formula

Formula

$$S = \frac{\zeta_0}{\gamma_l \cdot R_H}$$

Example with Units

$$0.0004 = \frac{6.3\,\text{Pa}}{9.81\,\text{kN/m}^3 \cdot 1.6\,\text{m}}$$

### 1.8) Specific Weight of Liquid given Boundary Shear Stress Formula

Evaluate Formula

Formula

$$\gamma_l = \frac{\zeta_0}{R_H \cdot S}$$

Example with Units

$$9.8437\,\text{kN/m}^3 = \frac{6.3\,\text{Pa}}{1.6\,\text{m} \cdot 0.0004}$$

### 1.9) Strickler Formula for Average Height of Roughness Protrusions Formula

Evaluate Formula

Formula

$$R_a = (21 \cdot n)^6$$

Example with Units

$$0.2561\,\text{mm} = (21 \cdot 0.012)^6$$

## 2) Chezy Constant in Uniform Flow Formulas

### 2.1) Average Velocity in Channel given Chezy Constant Formula

Evaluate Formula

Formula

$$V_{avg} = C \cdot \sqrt{R_H \cdot S}$$

Example with Units

$$1.0119\,\text{m/s} = 40 \cdot \sqrt{1.6\,\text{m} \cdot 0.0004}$$

### 2.2) Chezy Constant given Average Velocity in Channel Formula

Evaluate Formula

Formula

$$C = \frac{V_{avg}}{\sqrt{R_H \cdot S}}$$

Example with Units

$$12.6491 = \frac{0.32\,\text{m/s}}{\sqrt{1.6\,\text{m} \cdot 0.0004}}$$

## 2.3) Chezy Constant through Ganguillet-Kutter Formula Formula

Evaluate Formula

Formula

$$C = \frac{23 + \left(\frac{0.00155}{S}\right) + \left(\frac{1}{n}\right)}{1 + \left(23 + \left(\frac{0.00155}{S}\right)\right) \cdot \left(\frac{n}{\sqrt{D_{Hydraulic}}}\right)}$$

Example with Units

$$92.9091 = \frac{23 + \left(\frac{0.00155}{0.0004}\right) + \left(\frac{1}{0.012}\right)}{1 + \left(23 + \left(\frac{0.00155}{0.0004}\right)\right) \cdot \left(\frac{0.012}{\sqrt{3\,\mathrm{m}}}\right)}$$

## 2.4) Chezy Constant using Basin Formula Formula

Evaluate Formula

Formula

$$C = \frac{157.6}{1.81 + \left(\frac{K}{\sqrt{D_{Hydraulic}}}\right)}$$

Example with Units

$$84.3803 = \frac{157.6}{1.81 + \left(\frac{0.10}{\sqrt{3\,\mathrm{m}}}\right)}$$

## 2.5) Chezy Constant using Manning's Formula Formula

Evaluate Formula

Formula

$$C = \left(\frac{1}{n}\right) \cdot D_{Hydraulic}^{\frac{1}{6}}$$

Example with Units

$$100.0781 = \left(\frac{1}{0.012}\right) \cdot 3\,\mathrm{m}^{\frac{1}{6}}$$

## 2.6) Hydraulic Radius given Average Velocity in Channel with Chezy Constant Formula

Evaluate Formula

Formula

$$R_H = \frac{\left(\frac{V_{avg}}{C}\right)^2}{S}$$

Example with Units

$$0.16\,\mathrm{m} = \frac{\left(\frac{0.32\,\mathrm{m/s}}{40}\right)^2}{0.0004}$$

## 2.7) Slope of Channel Bed given Average Velocity in Channel with Chezy Constant Formula

Evaluate Formula

Formula

$$S = \frac{\left(\frac{V_{avg}}{C}\right)^2}{R_H}$$

Example with Units

$$4E\text{-}5 = \frac{\left(\frac{0.32\,\mathrm{m/s}}{40}\right)^2}{1.6\,\mathrm{m}}$$

## 3) Manning's Formula in Uniform Flow Formulas

### 3.1) Manning's Coefficient using Strickler Formula Formula

Evaluate Formula

Formula

$$n = \frac{R_a^{\frac{1}{6}}}{21}$$

Example with Units

$$0.0048 = \frac{0.001\,\text{mm}^{\frac{1}{6}}}{21}$$

### 3.2) Manning's Formula for Average Velocity Formula

Evaluate Formula

Formula

$$V_{avg(U)} = \left(\frac{1}{n}\right) \cdot \left(R_H^{\frac{2}{3}}\right) \cdot \left(S^{\frac{1}{2}}\right)$$

Example with Units

$$2.28\,\text{m/s} = \left(\frac{1}{0.012}\right) \cdot \left(1.6\,\text{m}^{\frac{2}{3}}\right) \cdot \left(0.0004^{\frac{1}{2}}\right)$$

### 3.3) Manning's Formula for Coefficient of Roughness given Average Velocity Formula

Evaluate Formula

Formula

$$n = \left(\frac{1}{V_{avg(U)}}\right) \cdot \left(S^{\frac{1}{2}}\right) \cdot \left(R_H^{\frac{2}{3}}\right)$$

Example with Units

$$0.0344 = \left(\frac{1}{0.796\,\text{m/s}}\right) \cdot \left(0.0004^{\frac{1}{2}}\right) \cdot \left(1.6\,\text{m}^{\frac{2}{3}}\right)$$

### 3.4) Manning's Formula for Hydraulic Radius given Average Velocity Formula

Evaluate Formula

Formula

$$R_H = \left(V_{avg(U)} \cdot \frac{n}{\sqrt{S}}\right)^{\frac{3}{2}}$$

Example with Units

$$0.3301\,\text{m} = \left(0.796\,\text{m/s} \cdot \frac{0.012}{\sqrt{0.0004}}\right)^{\frac{3}{2}}$$

### 3.5) Manning's Formula for Hydraulic Radius given Chezy's Constant Formula

Evaluate Formula

Formula

$$R_H = \left(\frac{1}{S}\right) \cdot \left(\frac{V_{avg}}{C}\right)^2$$

Example with Units

$$0.16\,\text{m} = \left(\frac{1}{0.0004}\right) \cdot \left(\frac{0.32\,\text{m/s}}{40}\right)^2$$

### 3.6) Manning's Formula for Roughness Coefficient given Chezy's Constant Formula

Evaluate Formula

Formula

$$n = \left(\frac{1}{C}\right) \cdot D_{Hydraulic}^{\frac{1}{6}}$$

Example with Units

$$0.03 = \left(\frac{1}{40}\right) \cdot 3\,\text{m}^{\frac{1}{6}}$$

## 3.7) Manning's Formula for Slope of Channel Bed given Average Velocity Formula

Evaluate Formula

**Formula**

$$S = \left( V_{avg(U)} \cdot \frac{n}{R_H^{\frac{2}{3}}} \right)^2$$

**Example with Units**

$$4.9E\text{-}5 = \left( 0.796\,\text{m/s} \cdot \frac{0.012}{1.6\,\text{m}^{\frac{2}{3}}} \right)^2$$

# 4) Uniform Turbulent Flow Formulas

## 4.1) Average Height of Roughness Protrusions given Chezy Constant for Rough Channels Formula

Evaluate Formula

**Formula**

$$z_0 = 12.2 \cdot \frac{R_H}{10^{\frac{C}{18}}}$$

**Example with Units**

$$0.117\,\text{m} = 12.2 \cdot \frac{1.6\,\text{m}}{10^{\frac{40}{18}}}$$

## 4.2) Average Height of Roughness Protrusions given Mean Velocity of flow in Rough Channels Formula

Evaluate Formula

**Formula**

$$R_a = \frac{R_H}{10^{\frac{\left(\frac{V_{avg(Tur)}}{V_{shear}}\right) - 6.25}{5.75}}}$$

**Example with Units**

$$0.0009\,\text{mm} = \frac{1.6\,\text{m}}{10^{\frac{\left(\frac{380\,\text{m/s}}{9\,\text{m/s}}\right) - 6.25}{5.75}}}$$

## 4.3) Chezy Constant for Rough Channels Formula

Evaluate Formula

**Formula**

$$C = 18 \cdot \log10\left( 12.2 \cdot \frac{R_H}{R_a} \right)$$

**Example with Units**

$$131.2286 = 18 \cdot \log10\left( 12.2 \cdot \frac{1.6\,\text{m}}{0.001\,\text{mm}} \right)$$

## 4.4) Hydraulic Radius given Chezy Constant for Rough Channels Formula

Evaluate Formula

**Formula**

$$R_H = \frac{\left(10^{\frac{C}{18}}\right) \cdot R_a}{12.2}$$

**Example with Units**

$$1.4E\text{-}5\,\text{m} = \frac{\left(10^{\frac{40}{18}}\right) \cdot 0.001\,\text{mm}}{12.2}$$

## 4.5) Hydraulic Radius given Mean Velocity of flow in Rough Channels Formula

Evaluate Formula

**Formula**

$$R_H = \left( 10^{\frac{\left(\frac{V_{avg(Tur)}}{V_{shear}}\right) - 6.25}{5.75}} \right) \cdot R_a$$

**Example with Units**

$$1.8032\,\text{m} = \left( 10^{\frac{\left(\frac{380\,\text{m/s}}{9\,\text{m/s}}\right) - 6.25}{5.75}} \right) \cdot 0.001\,\text{mm}$$

## 4.6) Hydraulic Radius given Mean Velocity of flow in Smooth Channels Formula

Evaluate Formula

Formula

$$R_H = \left(10^{\frac{\left(\frac{V_{avg(Tur)}}{V_{shear}}\right) - 3.25}{5.75}}\right) \cdot \left(\frac{\nu_{Tur}}{V_{shear}}\right)$$

Example with Units

$$1.9317\,\text{m} = \left(10^{\frac{\left(\frac{380\,\text{m/s}}{9\,\text{m/s}}\right) - 3.25}{5.75}}\right) \cdot \left(\frac{0.029\,\text{St}}{9\,\text{m/s}}\right)$$

## 4.7) Kinematic Viscosity given Mean Velocity of flow in Smooth Channels Formula

Evaluate Formula

Formula

$$\nu_{Tur} = \frac{R_H \cdot V_{shear}}{10^{\frac{\left(\frac{V_{avg(Tur)}}{V_{shear}}\right) - 3.25}{5.75}}}$$

Example with Units

$$0.024\,\text{St} = \frac{1.6\,\text{m} \cdot 9\,\text{m/s}}{10^{\frac{\left(\frac{380\,\text{m/s}}{9\,\text{m/s}}\right) - 3.25}{5.75}}}$$

## 4.8) Mean Velocity of flow in Rough Channels Formula

Evaluate Formula

Formula

$$V_{avg(Tur)} = V_{shear} \cdot \left(6.25 + 5.75 \cdot \log10\left(\frac{R_H}{R_a}\right)\right)$$

Example with Units

$$377.3132\,\text{m/s} = 9\,\text{m/s} \cdot \left(6.25 + 5.75 \cdot \log10\left(\frac{1.6\,\text{m}}{0.001\,\text{mm}}\right)\right)$$

## 4.9) Mean Velocity of flow in Smooth Channels Formula

Evaluate Formula

Formula

$$V_{avg(Tur)} = V_{shear} \cdot \left(3.25 + 5.75 \cdot \log10\left(R_H \cdot \frac{V_{shear}}{\nu_{Tur}}\right)\right)$$

Example with Units

$$375.7662\,\text{m/s} = 9\,\text{m/s} \cdot \left(3.25 + 5.75 \cdot \log10\left(1.6\,\text{m} \cdot \frac{9\,\text{m/s}}{0.029\,\text{St}}\right)\right)$$

## Variables used in list of Uniform Flow in Channels Formulas above

- **C** Chezy's Constant
- $D_{Hydraulic}$ Hydraulic Depth *(Meter)*
- **f** Darcy Friction Factor
- **K** Bazin's Constant
- **n** Manning's Roughness Coefficient
- $R_a$ Roughness Value *(Millimeter)*
- $R_H$ Hydraulic Radius of Channel *(Meter)*
- **S** Bed Slope
- $V_{avg}$ Average Velocity of Flow *(Meter per Second)*
- $V_{avg(Tur)}$ Average Velocity of Turbulent flow *(Meter per Second)*
- $V_{avg(U)}$ Average Velocity of Uniform Flow *(Meter per Second)*
- $V_{shear}$ Shear Velocity *(Meter per Second)*
- $z_0$ Roughness Height of Surface *(Meter)*
- $\gamma_l$ Liquid Specific Weight *(Kilonewton per Cubic Meter)*
- $\zeta_0$ Shear Stress of Wall *(Pascal)*
- $v_{Tur}$ Kinematic Viscosity of Turbulent Flow *(Stokes)*

## Constants, Functions, Measurements used in list of Uniform Flow in Channels Formulas above

- constant(s): **[g]**, 9.80665
  *Gravitational acceleration on Earth*
- Functions: **log10**, log10(Number)
  *The common logarithm, also known as the base-10 logarithm or the decimal logarithm, is a mathematical function that is the inverse of the exponential function.*
- Functions: **sqrt**, sqrt(Number)
  *A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- Measurement: **Length** in Meter (m), Millimeter (mm)
  *Length Unit Conversion*
- Measurement: **Pressure** in Pascal (Pa)
  *Pressure Unit Conversion*
- Measurement: **Speed** in Meter per Second (m/s)
  *Speed Unit Conversion*
- Measurement: **Kinematic Viscosity** in Stokes (St)
  *Kinematic Viscosity Unit Conversion*
- Measurement: **Specific Weight** in Kilonewton per Cubic Meter (kN/m³)
  *Specific Weight Unit Conversion*

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