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# Uniform Flow in Channels Formulas

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# List of 32 Uniform Flow in Channels Formulas

## Uniform Flow in Channels

## Average Velocity in Uniform Flow in Channels

### 1) Average Velocity in Channel

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

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2\_img.jpg\)](#)

$$\text{ex } 0.316891\text{m/s} = \sqrt{8 \cdot [g] \cdot 1.6\text{m} \cdot \frac{0.0004}{0.5}}$$

### 2) Boundary Shear Stress

$$\text{fx } \zeta_0 = \gamma_l \cdot R_H \cdot S$$

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa\_img.jpg\)](#)

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

### 3) Friction Factor given Average Velocity in Channel

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

[Open Calculator !\[\]\(f1c5da15572e3e09d343161be98f508d\_img.jpg\)](#)

$$\text{ex } 0.490332 = \left( 8 \cdot [g] \cdot 1.6\text{m} \cdot \frac{0.0004}{(0.32\text{m/s})^2} \right)$$



#### 4) Hydraulic Radius given Average Velocity in Channel

[Open Calculator !\[\]\(4729e517bc6a7cd81c8025b9646574fb\_img.jpg\)](#)

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

$$\text{ex } 1.631546\text{m} = \left( \frac{0.32\text{m/s}}{\sqrt{8 \cdot [g] \cdot \frac{0.0004}{0.5}}} \right)^2$$

#### 5) Hydraulic Radius given Boundary Shear Stress

[Open Calculator !\[\]\(e474458956c9a37fbf9586ddb60a7fa1\_img.jpg\)](#)

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

$$\text{ex } 1.605505\text{m} = \frac{6.3\text{Pa}}{9.81\text{kN/m}^3 \cdot 0.0004}$$

#### 6) Slope of Channel Bed given Average Velocity in Channel

[Open Calculator !\[\]\(4fe57c3593bf1b21d272ae7ac8dfaf77\_img.jpg\)](#)

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

$$\text{ex } 0.000408 = \left( \frac{0.32\text{m/s}}{\sqrt{8 \cdot [g] \cdot \frac{1.6\text{m}}{0.5}}} \right)^2$$



## 7) Slope of Channel Bottom given Boundary Shear Stress

$$\text{fx } S = \frac{\zeta_0}{\gamma_1 \cdot R_H}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95\_img.jpg\)](#)

$$\text{ex } 0.000401 = \frac{6.3\text{Pa}}{9.81\text{kN/m}^3 \cdot 1.6\text{m}}$$

## 8) Specific Weight of Liquid given Boundary Shear Stress

$$\text{fx } \gamma_1 = \frac{\zeta_0}{R_H \cdot S}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2\_img.jpg\)](#)

$$\text{ex } 9.84375\text{kN/m}^3 = \frac{6.3\text{Pa}}{1.6\text{m} \cdot 0.0004}$$

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

$$\text{fx } R_a = (21 \cdot n)^6$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7\_img.jpg\)](#)

$$\text{ex } 0.256096\text{mm} = (21 \cdot 0.012)^6$$

## Chezy Constant in Uniform Flow

## 10) Average Velocity in Channel given Chezy Constant

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

[Open Calculator !\[\]\(c1168d6a8b365d11e842ece304635fa7\_img.jpg\)](#)

$$\text{ex } 1.011929\text{m/s} = 40 \cdot \sqrt{1.6\text{m} \cdot 0.0004}$$



### 11) Chezy Constant given Average Velocity in Channel

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

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a\_img.jpg\)](#)

$$\text{ex } 12.64911 = \frac{0.32\text{m/s}}{\sqrt{1.6\text{m} \cdot 0.0004}}$$

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

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

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021\_img.jpg\)](#)

$$\text{ex } 92.90908 = \frac{23 + \left(\frac{0.00155}{0.0004}\right) + \left(\frac{1}{0.012}\right)}{1 + \left(23 + \left(\frac{0.00155}{0.0004}\right)\right) \cdot \left(\frac{0.012}{\sqrt{3\text{m}}}\right)}$$

### 13) Chezy Constant using Basin Formula

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

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd\_img.jpg\)](#)

$$\text{ex } 84.38028 = \frac{157.6}{1.81 + \left(\frac{0.10}{\sqrt{3\text{m}}}\right)}$$



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

[Open Calculator !\[\]\(eafc244b53721dd1ec133f0772f70fc7\_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(10f8862fc183b400327470ea85afe9ae\_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(35dc653d59570f8f891c312eeece91a2\_img.jpg\)](#)

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

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



## Manning's Formula in Uniform Flow

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

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

[Open Calculator !\[\]\(83f22ed94ec5517769dd76d702c6bfd8\_img.jpg\)](#)

$$\text{ex } 0.004762 = \frac{(0.001\text{m})^{\frac{1}{6}}}{21}$$

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

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

[Open Calculator !\[\]\(3cb60d42b10e53f9522bb0b392c1c4cd\_img.jpg\)](#)

$$\text{ex } 2.279968\text{m/s} = \left( \frac{1}{0.012} \right) \cdot \left( (1.6\text{m})^{\frac{2}{3}} \right) \cdot \left( (0.0004)^{\frac{1}{2}} \right)$$

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

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

[Open Calculator !\[\]\(0d7ca0919e6c47bbd874bfa0189fe22e\_img.jpg\)](#)

$$\text{ex } 0.034371 = \left( \frac{1}{0.796\text{m/s}} \right) \cdot \left( (0.0004)^{\frac{1}{2}} \right) \cdot \left( (1.6\text{m})^{\frac{2}{3}} \right)$$



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

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

[Open Calculator !\[\]\(6605b201d6f14d9b3bcb8ab5f274d107\_img.jpg\)](#)

$$\text{ex } 0.330063\text{m} = \left( 0.796\text{m/s} \cdot \frac{0.012}{\sqrt{0.0004}} \right)^{\frac{3}{2}}$$

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

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

[Open Calculator !\[\]\(e8fb589d58dad1692debababa5e928b6\_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(4688aadfd656ded00cd6bdfae55089a9\_img.jpg\)](#)

$$\text{ex } 0.030023 = \left( \frac{1}{40} \right) \cdot (3\text{m})^{\frac{1}{6}}$$





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



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

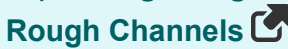
[Open Calculator](#)

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

## Uniform Turbulent Flow



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



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

[Open Calculator](#)

$$\text{ex } 0.117019\text{m} = 12.2 \cdot \frac{1.6\text{m}}{10^{\frac{40}{18}}}$$



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

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

[Open Calculator !\[\]\(0f848bbd71cef6b345273b16f905912a\_img.jpg\)](#)

$$\text{ex } 0.000887\text{mm} = \frac{1.6\text{m}}{10^{\frac{\left(\frac{380\text{m/s}}{9\text{m/s}}\right) - 6.25}{5.75}}}$$

## 26) Chezy Constant for Rough Channels

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

[Open Calculator !\[\]\(3211b5d1d968fc1665909b34f9f16010\_img.jpg\)](#)

$$\text{ex } 131.2286 = 18 \cdot \log 10 \left( 12.2 \cdot \frac{1.6\text{m}}{0.001\text{mm}} \right)$$

## 27) Hydraulic Radius given Chezy Constant for Rough Channels

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

[Open Calculator !\[\]\(9c2e8d1b5bd77cb5c9f83b7a9cff79fd\_img.jpg\)](#)

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



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

[Open Calculator !\[\]\(4729e517bc6a7cd81c8025b9646574fb\_img.jpg\)](#)

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

$$\text{ex } 1.803178\text{m} = \left( 10^{\frac{\left( \frac{380\text{m/s}}{9\text{m/s}} \right) - 6.25}{5.75}} \right) \cdot 0.001\text{mm}$$

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

[Open Calculator !\[\]\(e474458956c9a37fbf9586ddb60a7fa1\_img.jpg\)](#)

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

$$\text{ex } 1.931671\text{m} = \left( 10^{\frac{\left( \frac{380\text{m/s}}{9\text{m/s}} \right) - 3.25}{5.75}} \right) \cdot \left( \frac{0.029\text{St}}{9\text{m/s}} \right)$$

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


[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f\_img.jpg\)](#)

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

$$\text{ex } 0.024021\text{St} = \frac{1.6\text{m} \cdot 9\text{m/s}}{10^{\frac{\left( \frac{380\text{m/s}}{9\text{m/s}} \right) - 3.25}{5.75}}}$$



### 31) Mean Velocity of flow in Rough Channels

**fx**Open Calculator 

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

**ex**

$$377.3132 \text{m/s} = 9 \text{m/s} \cdot \left( 6.25 + 5.75 \cdot \log 10 \left( \frac{1.6 \text{m}}{0.001 \text{mm}} \right) \right)$$

### 32) Mean Velocity of flow in Smooth Channels

**fx**Open Calculator 

$$V_{avg(Tur)} = V_{shear} \cdot \left( 3.25 + 5.75 \cdot \log 10 \left( R_H \cdot \frac{V_{shear}}{v_{Tur}} \right) \right)$$

**ex**

$$375.7662 \text{m/s} = 9 \text{m/s} \cdot \left( 3.25 + 5.75 \cdot \log 10 \left( 1.6 \text{m} \cdot \frac{9 \text{m/s}}{0.029 \text{St}} \right) \right)$$








## Variables Used

- **C** Chezy's Constant
- **D<sub>Hydraulic</sub>** Hydraulic Depth (Meter)
- **f** Darcy Friction Factor
- **K** Bazin's Constant
- **n** Manning's Roughness Coefficient
- **R<sub>a</sub>** Roughness Value (Millimeter)
- **R<sub>H</sub>** Hydraulic Radius of Channel (Meter)
- **S** Bed Slope
- **V<sub>avg</sub>** Average Velocity of Flow (Meter per Second)
- **V<sub>avg(Tur)</sub>** Average Velocity of Turbulent flow (Meter per Second)
- **V<sub>avg(U)</sub>** Average Velocity of Uniform Flow (Meter per Second)
- **V<sub>shear</sub>** Shear Velocity (Meter per Second)
- **z<sub>0</sub>** Roughness Height of Surface (Meter)
- **Y<sub>l</sub>** Liquid Specific Weight (Kilonewton per Cubic Meter)
- **ζ<sub>0</sub>** Shear Stress of Wall (Pascal)
- **v<sub>Tur</sub>** Kinematic Viscosity of Turbulent Flow (Stokes)





















## Constants, Functions, Measurements used

- **Constant:** **[g]**, 9.80665 Meter/Second<sup>2</sup>  
*Gravitational acceleration on Earth*
- **Function:** **log10**, log10(Number)  
*Common logarithm function (base 10)*
- **Function:** **sqrt**, sqrt(Number)  
*Square root function*
- **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/m<sup>3</sup>)  
*Specific Weight Unit Conversion* 



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