Uniform Flow in Channels Formulas

List of 32 Uniform Flow in Channels Formulas

Uniform Flow in Channels

Average Velocity in Uniform Flow in Channels

1) Average Velocity in Channel

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

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

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

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

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

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Chezy Constant in Uniform Flow

10) Average Velocity in Channel given Chezy Constant

Open Calculator

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

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

11) Chezy Constant given Average Velocity in Channel

Open Calculator

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

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

12) Chezy Constant through Ganguillet-Kutter Formula

Open Calculator

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

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

13) Chezy Constant using Basin Formula

Open Calculator

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

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

14) Chezy Constant using Manning's Formula

Open Calculator

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

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

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

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

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

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

Open Calculator

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

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

18) Manning's Formula for Average Velocity

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

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

Open Calculator

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

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

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

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

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

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

32) Mean Velocity of flow in Smooth Channels

fx Open Calculator

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

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

Variables Used

- **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)*
- γ_l Liquid Specific Weight *(Kilonewton per Cubic Meter)*
- ζ_0 Shear Stress of Wall *(Pascal)*
- v_{Tur} Kinematic Viscosity of Turbulent Flow *(Stokes)*

Constants, Functions, Measurements used

- Constant: **[g]**, 9.80665 Meter/Second²
  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/m³)
  Specific Weight Unit Conversion

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- Impact of Free Jets Formulas
- Impulse Momentum Equation And Its Applications Formulas
- Liquids in Relative Equilibrium Formulas
- Most Economical or Most Efficient Section of Channel Formulas
- Non-uniform Flow in Channels Formulas
- Properties of Fluid Formulas
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