



# Laminar Flow of Fluid in an Open Channel Formulas

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# List of 23 Laminar Flow of Fluid in an Open Channel Formulas

# Laminar Flow of Fluid in an Open Channel &

1) Bed Shear Stress

fx 
$$au = \gamma_{
m f} \cdot {
m s} \cdot {
m d}_{
m section}$$

Open Calculator

$$490.5 Pa = 9.81 kN/m^3 \cdot 0.01 \cdot 5m$$

2) Bed Slope given Bed Shear Stress

$$\mathbf{f}\mathbf{x} = rac{ au}{\mathrm{d_{section}} \cdot \gamma_{\mathrm{f}}}$$

Open Calculator 🖒

$$0.01 = rac{490.5 ext{Pa}}{5 ext{m} \cdot 9.81 ext{kN/m}^3}$$

3) Diameter of Section given Bed Shear Stress

$$ag{d}_{
m section} = rac{ au}{{
m s} \cdot {
m \gamma}_{
m f}}$$

$$=$$
  $\frac{490.5 Pa}{0.01 \cdot 9.81 kN/m^3}$ 



#### 4) Diameter of Section given Discharge per Unit Channel Width

 $\mathbf{f}$   $\mathbf{d}_{\mathrm{section}} = \left(rac{3 \cdot \mu \cdot 
u}{\mathbf{s} \cdot \gamma_{\mathrm{f}}}
ight)^{rac{1}{3}}$ 

Open Calculator

ex  $4.99694 \mathrm{m} = \left( \frac{3 \cdot 10.2 \mathrm{P} \cdot 4 \mathrm{m}^2 / \mathrm{s}}{0.01 \cdot 9.81 \mathrm{kN/m}^3} \right)^{\frac{1}{3}}$ 

# 5) Diameter of Section given Mean Velocity of Flow

 $\mathbf{K} d_{\mathrm{section}} = rac{\left(R^2 + \left(\mu \cdot V_{\mathrm{mean}} \cdot rac{S}{\gamma_{\mathrm{f}}}
ight)
ight)}{R}$ 

Open Calculator

 $= \frac{\left( \left( 1.01 \mathrm{m} \right)^2 + \left( 10.2 \mathrm{P} \cdot 10 \mathrm{m/s} \cdot \frac{10}{9.81 \mathrm{kN/m^3}} \right) \right)}{1.01 \mathrm{m}}$ 

# 6) Diameter of Section given Potential Head Drop

 $d_{section} = \sqrt{rac{3 \cdot \mu \cdot V_{mean} \cdot L}{\gamma_f \cdot h_L}}$ 

Open Calculator

 $oxed{4.962437 m} = \sqrt{rac{3 \cdot 10.2 P \cdot 10 m/s \cdot 15 m}{9.81 kN/m^3 \cdot 1.9 m}}$ 



# 7) Diameter of Section given Slope of Channel

 $\mathbf{K} \left| \mathrm{d}_{\mathrm{section}} = \left( rac{ au}{\mathrm{s} \cdot \mathrm{v}_c} 
ight) + \mathrm{R} \right|$ 

Open Calculator

 $oxed{6.01 ext{m} = \left(rac{490.5 ext{Pa}}{0.01 \cdot 9.81 ext{kN/m}^3}
ight) + 1.01 ext{m}}$ 

# 8) Discharge per unit channel width

 $onumber egin{aligned} \kappa \ arphi = rac{\gamma_{\mathrm{f}} \cdot \mathrm{s} \cdot \mathrm{d}_{\mathrm{section}}^3}{3 \cdot \mu} \end{aligned}$ 

Open Calculator 🖸

 $oxed{4.007353 ext{m}^2/ ext{s} = rac{9.81 ext{kN/m}^3 \cdot 0.01 \cdot \left(5 ext{m}
ight)^3}{3 \cdot 10.2 ext{P}}}$ 

# 9) Dynamic Viscosity given Discharge per Unit Channel Width 🚰

 $\mu = rac{\gamma_{
m f} \cdot {
m s} \cdot {
m d}_{
m section}^3}{3 \cdot {
m v}}$ 

Open Calculator

ex  $10.21875 ext{P} = rac{9.81 ext{kN/m}^3 \cdot 0.01 \cdot (5 ext{m})^3}{3 \cdot 4 ext{m}^2/ ext{s}}$ 

# 10) Dynamic Viscosity given Mean Velocity of Flow in Section

 $\mu = rac{\gamma_{
m f} \cdot {
m dh} |{
m dx} \cdot \left({
m d}_{
m section} \cdot {
m R} - {
m R}^2
ight)}{{
m V}_{
m mean}}$ 

Open Calculator

 $= 10.21146 P = \frac{9.81 kN/m^3 \cdot 0.2583 \cdot \left(5m \cdot 1.01m - (1.01m)^2\right)}{10m/s}$ 







# 11) Length of Pipe given Potential Head Drop

 $ag{L} = rac{ ext{h}_{ ext{L}} \cdot ext{\gamma}_{ ext{f}} \cdot \left( ext{d}_{ ext{section}}^2
ight)}{3 \cdot \mu \cdot ext{V}_{ ext{mean}}}$ 

Open Calculator

 $= \frac{1.9 \text{m} \cdot 9.81 \text{kN/m}^3 \cdot \left( (5 \text{m})^2 \right)}{3 \cdot 10.2 \text{P} \cdot 10 \text{m/s} }$ 

# 12) Mean Velocity of Flow in Section

 $V_{
m mean} = rac{\gamma_{
m f} \cdot dh | dx \cdot \left( d_{
m section} \cdot R - R^2 
ight)}{\pi}$ 

Open Calculator

 $= \frac{9.81 \text{kN/m}^3 \cdot 0.2583 \cdot \left(5 \text{m} \cdot 1.01 \text{m} - \left(1.01 \text{m}\right)^2\right)}{10.2 \text{P} }$ 

# 13) Potential Head Drop

 $\mathbf{h}_{\mathrm{L}} = rac{3 \cdot \mu \cdot \mathrm{V}_{\mathrm{mean}} \cdot \mathrm{L}}{\gamma_{\mathrm{f}} \cdot \mathrm{d}_{\mathrm{section}}^2}$ 

Open Calculator 🖸

 $1.87156 \text{m} = \frac{3 \cdot 10.2 \text{P} \cdot 10 \text{m/s} \cdot 15 \text{m}}{9.81 \text{kN/m}^3 \cdot (5 \text{m})^2}$ 

# 14) Shear Stress given Slope of Channel

fx  $au = \gamma_{
m f} \cdot {
m s} \cdot ({
m d}_{
m section} - {
m R})$ 

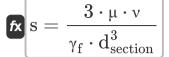
Open Calculator

 $= 391.419 Pa = 9.81 kN/m^3 \cdot 0.01 \cdot (5m - 1.01m)$ 





#### 15) Slope of Channel given Discharge per Unit Channel Width



Open Calculator

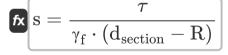
$$= \frac{3 \cdot 10.2 P \cdot 4 m^2 / s}{9.81 kN / m^3 \cdot (5m)^3}$$

#### 16) Slope of Channel given Mean Velocity of Flow

 $S = \frac{\mu \cdot V_{mean}}{\left(d_{section} \cdot R - \frac{R^2}{2}\right) \cdot \gamma_f}$ 

Open Calculator

# 17) Slope of Channel given Shear Stress



$$\mathbf{ex} = \frac{490.5 \mathrm{Pa}}{9.81 \mathrm{kN/m^3 \cdot (5m - 1.01m)}}$$



# Laminar Flow Through Porous Media

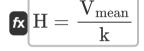
# 18) Coefficient of Permeability given Velocity



Open Calculator

$$\boxed{\text{ex}} \ 10 \text{cm/s} = \frac{10 \text{m/s}}{100}$$

#### 19) Hydraulic Gradient given Velocity



Open Calculator

$$\boxed{100 = \frac{10 \text{m/s}}{10 \text{cm/s}}}$$

#### 20) Mean Velocity using Darcy's Law



$$\texttt{ex} \ 10 \text{m/s} = 10 \text{cm/s} \cdot 100$$

# Lubrication Mechanics Slipper Bearing G

#### 21) Dynamic Viscosity given Pressure Gradient 🗗

Open Calculator

 $\mu = \mathrm{d} \mathrm{p} / \mathrm{d} \mathrm{r} \cdot rac{\mathrm{h}^3}{12 \cdot (0.5 \cdot \mathrm{V}_{\mathrm{mean}} \cdot \mathrm{h} - \mathrm{Q})}$ 

 $= 10.43536 P = 17 N/m^3 \cdot \frac{(1.81 m)^3}{12 \cdot (0.5 \cdot 10 m/s \cdot 1.81 m - 1.000001 m^3/s)}$ 

#### 22) Pressure Gradient

 $|\mathbf{dp}| \mathrm{dr} = \left(12 \cdot rac{\mu}{\mathrm{h}^3}
ight) \cdot (0.5 \cdot \mathrm{V_{mean}} \cdot \mathrm{h} - \mathrm{Q})$ 

Open Calculator

ex

 $16.61658 \mathrm{N/m^3} = \left(12 \cdot \frac{10.2 \mathrm{P}}{\left(1.81 \mathrm{m}\right)^3} \right) \cdot \left(0.5 \cdot 10 \mathrm{m/s} \cdot 1.81 \mathrm{m} - 1.000001 \mathrm{m^3/s}\right)$ 

# 23) Rate of Flow given Pressure Gradient

 $\mathbf{R} \left[ \mathbf{Q} = 0.5 \cdot \mathbf{V}_{\mathrm{mean}} \cdot \mathbf{h} - \left( \mathrm{dp} | \mathrm{dr} \cdot rac{\mathbf{h}^3}{12 \cdot \mathbf{u}} 
ight) 
ight]$ 

$$= 0.814249 \mathrm{m}^{_{3}}/\mathrm{s} = 0.5 \cdot 10 \mathrm{m/s} \cdot 1.81 \mathrm{m} - \left(17 \mathrm{N/m}^{_{3}} \cdot \frac{\left(1.81 \mathrm{m}\right)^{3}}{12 \cdot 10.2 \mathrm{P}}\right)$$



#### Variables Used

- d<sub>section</sub> Diameter of Section (Meter)
- dh|dx Piezometric Gradient
- dp|dr Pressure Gradient (Newton per Cubic Meter)
- **h** Height of Channel (Meter)
- H Hydraulic Gradient
- **h**<sub>I</sub> Head Loss due to Friction (*Meter*)
- **k** Coefficient of Permeability (Centimeter per Second)
- L Length of Pipe (Meter)
- Q Discharge in Pipe (Cubic Meter per Second)
- R Horizontal Distance (Meter)
- · S Slope of Bed
- S Slope of Surface of Constant Pressure
- V<sub>mean</sub> Mean Velocity (Meter per Second)
- γ<sub>f</sub> Specific Weight of Liquid (Kilonewton per Cubic Meter)
- µ Dynamic Viscosity (Poise)
- V Kinematic Viscosity (Square Meter per Second)
- τ Shear Stress (Pascal)





#### Constants, Functions, Measurements used

- Function: 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)
  Length Unit Conversion
- Measurement: Speed in Meter per Second (m/s), Centimeter per Second (cm/s)
   Speed Unit Conversion
- Measurement: Volumetric Flow Rate in Cubic Meter per Second (m³/s)

  Volumetric Flow Rate Unit Conversion
- Measurement: Dynamic Viscosity in Poise (P)
   Dynamic Viscosity Unit Conversion
- Measurement: Kinematic Viscosity in Square Meter per Second (m²/s) Kinematic Viscosity Unit Conversion
- Measurement: **Specific Weight** in Kilonewton per Cubic Meter (kN/m³) Specific Weight Unit Conversion
- Measurement: Pressure Gradient in Newton per Cubic Meter (N/m³)
   Pressure Gradient Unit Conversion
- Measurement: Stress in Pascal (Pa)
  Stress Unit Conversion





#### Check other formula lists

- Dash Pot Mechanism Formulas
- Laminar Flow around a Sphere Stokes' Law Formulas
- Laminar Flow between Parallel Flat Measurement of Viscosity Plates, one plate moving and other at rest, Couette Flow Formulas
- Laminar Flow between Parallel Plates, both Plates at Rest

- Formulas C
- Laminar Flow of Fluid in an Open Channel Formulas
  - Viscometers Formulas
- Steady Laminar Flow in Circular Pipes Formulas

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