Important Laminar Flow of Fluid in an Open Channel Formulas PDF

Formulas Examples with Units

List of 23

Important Laminar Flow of Fluid in an Open Channel Formulas

1) Bed Shear Stress Formula

Evaluate Formula

Formula

$$\tau = \gamma_f \cdot s \cdot d_{section}$$

Example with Units

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

2) Bed Slope given Bed Shear Stress Formula

Evaluate Formula

Formula

$$s = \frac{\tau}{d_{section} \cdot \gamma_f}$$

Example with Units

$$0.01 = \frac{490.5\,\text{Pa}}{5\,\text{m} \cdot 9.81\,\text{kN/m}^3}$$

3) Diameter of Section given Bed Shear Stress Formula

Evaluate Formula

Formula

$$d_{section} = \frac{\tau}{s \cdot \gamma_f}$$

Example with Units

$$5\,\text{m} = \frac{490.5\,\text{Pa}}{0.01 \cdot 9.81\,\text{kN/m}^3}$$

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

Evaluate Formula

Formula

$$d_{section} = \left(\frac{3 \cdot \mu \cdot \nu}{s \cdot \gamma_f}\right)^{\frac{1}{3}}$$

Example with Units

$$4.9969\,\text{m} = \left(\frac{3 \cdot 10.2\,\text{P} \cdot 4\,\text{m}^2/\text{s}}{0.01 \cdot 9.81\,\text{kN/m}^3}\right)^{\frac{1}{3}}$$

5) Diameter of Section given Mean Velocity of Flow Formula

Evaluate Formula

Formula

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

Example with Units

$$11.3046\,\text{m} = \frac{\left(1.01\,\text{m}^2 + \left(10.2\,\text{P} \cdot 10\,\text{m/s} \cdot \frac{10}{9.81\,\text{kN/m}^3}\right)\right)}{1.01\,\text{m}}$$

6) Diameter of Section given Potential Head Drop Formula

Evaluate Formula

Formula

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

Example with Units

$$4.9624\,\text{m} = \sqrt{\frac{3 \cdot 10.2\,\text{P} \cdot 10\,\text{m/s} \cdot 15\,\text{m}}{9.81\,\text{kN/m}^3 \cdot 1.9\,\text{m}}}$$

7) Diameter of Section given Slope of Channel Formula

Evaluate Formula

Formula

$$d_{section} = \left(\frac{\tau}{s \cdot \gamma_f}\right) + R$$

Example with Units

$$6.01\,\text{m} = \left(\frac{490.5\,\text{Pa}}{0.01 \cdot 9.81\,\text{kN/m}^3}\right) + 1.01\,\text{m}$$

8) Discharge per unit channel width Formula

Evaluate Formula

Formula

$$\nu = \frac{\gamma_f \cdot s \cdot d_{section}^3}{3 \cdot \mu}$$

Example with Units

$$4.0074\,\text{m}^2/\text{s} = \frac{9.81\,\text{kN/m}^3 \cdot 0.01 \cdot 5\,\text{m}^3}{3 \cdot 10.2\,\text{P}}$$

9) Dynamic Viscosity given Discharge per Unit Channel Width Formula

Evaluate Formula

Formula

$$\mu = \frac{\gamma_f \cdot s \cdot d_{section}^3}{3 \cdot \nu}$$

Example with Units

$$10.2188\,\text{P} = \frac{9.81\,\text{kN/m}^3 \cdot 0.01 \cdot 5\,\text{m}^3}{3 \cdot 4\,\text{m}^2/\text{s}}$$

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

Evaluate Formula

Formula

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

Example with Units

$$10.2115\,\text{P} = \frac{9.81\,\text{kN/m}^3 \cdot 0.2583 \cdot \left(5\,\text{m} \cdot 1.01\,\text{m} - 1.01\,\text{m}^2\right)}{10\,\text{m/s}}$$

11) Length of Pipe given Potential Head Drop Formula

Evaluate Formula

Formula

$$L = \frac{h_L \cdot \gamma_f \cdot \left(d_{section}^2\right)}{3 \cdot \mu \cdot V_{mean}}$$

Example with Units

$$15.2279\,\text{m} = \frac{1.9\,\text{m} \cdot 9.81\,\text{kN/m}^3 \cdot \left(5\,\text{m}^2\right)}{3 \cdot 10.2\,\text{P} \cdot 10\,\text{m/s}}$$

12) Mean Velocity of Flow in Section Formula

Evaluate Formula

Formula

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

Example with Units

$$10.0112\,\mathrm{m/s} = \frac{9.81\,\mathrm{kN/m^3} \cdot 0.2583 \cdot \left(5\,\mathrm{m} \cdot 1.01\,\mathrm{m} - 1.01\,\mathrm{m}^2\right)}{10.2\,\mathrm{P}}$$

13) Potential Head Drop Formula

Evaluate Formula

Formula

$$h_L = \frac{3 \cdot \mu \cdot V_{mean} \cdot L}{\gamma_f \cdot d_{section}^2}$$

Example with Units

$$1.8716\,\mathrm{m} = \frac{3 \cdot 10.2\,\mathrm{P} \cdot 10\,\mathrm{m/s} \cdot 15\,\mathrm{m}}{9.81\,\mathrm{kN/m^3} \cdot 5\,\mathrm{m}^2}$$

14) Shear Stress given Slope of Channel Formula

Evaluate Formula

Formula

$$\tau = \gamma_f \cdot s \cdot \left(d_{section} - R\right)$$

Example with Units

$$391.419\,\mathrm{Pa} = 9.81\,\mathrm{kN/m^3} \cdot 0.01 \cdot \left(5\,\mathrm{m} - 1.01\,\mathrm{m}\right)$$

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

Evaluate Formula

Formula

$$s = \frac{3 \cdot \mu \cdot \nu}{\gamma_f \cdot d_{section}^3}$$

Example with Units

$$0.01 = \frac{3 \cdot 10.2\,\mathrm{P} \cdot 4\,\mathrm{m^2/s}}{9.81\,\mathrm{kN/m^3} \cdot 5\,\mathrm{m}^3}$$

16) Slope of Channel given Mean Velocity of Flow Formula

Evaluate Formula

Formula

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

Example with Units

$$0.229 = \frac{10.2\,\mathrm{P} \cdot 10\,\mathrm{m/s}}{\left(5\,\mathrm{m} \cdot 1.01\,\mathrm{m} - \frac{1.01\,\mathrm{m}^2}{2}\right) \cdot 9.81\,\mathrm{kN/m^3}}$$

17) Slope of Channel given Shear Stress Formula

Evaluate Formula

Formula

$$s = \frac{\tau}{\gamma_f \cdot \left(d_{section} - R\right)}$$

Example with Units

$$0.0125 = \frac{490.5\,\mathrm{Pa}}{9.81\,\mathrm{kN/m^3} \cdot \left(5\,\mathrm{m} - 1.01\,\mathrm{m}\right)}$$

18) Laminar Flow Through Porous Media Formulas

18.1) Coefficient of Permeability given Velocity Formula

Evaluate Formula

Formula

$$k = \frac{V_{mean}}{H}$$

Example with Units

$$10\,\mathrm{cm/s} = \frac{10\,\mathrm{m/s}}{100}$$

18.2) Hydraulic Gradient given Velocity Formula

Evaluate Formula

Formula

$$H = \frac{V_{mean}}{k}$$

Example with Units

$$100 = \frac{10\,\mathrm{m/s}}{10\,\mathrm{cm/s}}$$

18.3) Mean Velocity using Darcy's Law Formula

Evaluate Formula

Formula

$$V_{mean} = k \cdot H$$

Example with Units

$$10\,\mathrm{m/s} = 10\,\mathrm{cm/s} \cdot 100$$

19) Lubrication Mechanics Slipper Bearing Formulas

19.1) Dynamic Viscosity given Pressure Gradient Formula

Evaluate Formula

Formula

$$\mu = dp|dr \cdot \frac{h^3}{12 \cdot \left(0.5 \cdot V_{mean} \cdot h - Q\right)}$$

Example with Units

$$10.4354\,\mathrm{P} = 17\,\mathrm{N/m^3} \cdot \frac{1.81\,\mathrm{m}^3}{12 \cdot \left(0.5 \cdot 10\,\mathrm{m/s} \cdot 1.81\,\mathrm{m} - 1.000001\,\mathrm{m^3/s}\right)}$$

19.2) Pressure Gradient Formula

Evaluate Formula

Formula

$$dp|dr = \left(12 \cdot \frac{\mu}{h^3}\right) \cdot \left(0.5 \cdot V_{mean} \cdot h - Q\right)$$

Example with Units

$$16.6166\,\mathrm{N/m^3} = \left(12 \cdot \frac{10.2\,\mathrm{P}}{1.81\,\mathrm{m}^3}\right) \cdot \left(0.5 \cdot 10\,\mathrm{m/s} \cdot 1.81\,\mathrm{m} - 1.000001\,\mathrm{m^3/s}\right)$$

19.3) Rate of Flow given Pressure Gradient Formula

Evaluate Formula

Formula

$$Q = 0.5 \cdot V_{mean} \cdot h - \left(dp|dr \cdot \frac{h^3}{12 \cdot \mu} \right)$$

Example with Units

$$0.8142\,\mathrm{m^3/s} = 0.5 \cdot 10\,\mathrm{m/s} \cdot 1.81\,\mathrm{m} - \left(17\,\mathrm{N/m^3} \cdot \frac{1.81\,\mathrm{m}^3}{12 \cdot 10.2\,\mathrm{P}} \right)$$

Variables used in list of Laminar Flow of Fluid in an Open Channel Formulas above

- $d_{section}$ 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_L 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_{mean} Mean Velocity *(Meter per Second)*
- γ_f Specific Weight of Liquid *(Kilonewton per Cubic Meter)*
- **μ** Dynamic Viscosity *(Poise)*
- **ν** Kinematic Viscosity *(Square Meter per Second)*
- τ Shear Stress *(Pascal)*

Constants, Functions, Measurements used in list of Laminar Flow of Fluid in an Open Channel Formulas above

- 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)
  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 (m^3/s)
  Volumetric Flow Rate Unit Conversion
- Measurement: **Dynamic Viscosity** in Poise (P)
  Dynamic Viscosity Unit Conversion
- Measurement: **Kinematic Viscosity** in Square Meter per Second (m^2/s)
  Kinematic Viscosity Unit Conversion
- Measurement: **Specific Weight** in Kilonewton per Cubic Meter (kN/m^3)
  Specific Weight Unit Conversion
- Measurement: **Pressure Gradient** in Newton per Cubic Meter (N/m^3)
  Pressure Gradient Unit Conversion
- Measurement: **Stress** in Pascal (Pa)
  Stress Unit Conversion

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