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Turbulent Flow Formulas

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List of 18 Turbulent Flow Formulas

Turbulent Flow

1) Average Height of Irregularities for Turbulent Flow in Pipes

Open Calculator

fx $$k = \frac{v' \cdot Re}{V,}$$

ex $$0.001208\text{m} = \frac{7.25\text{St} \cdot 10}{6\text{m/s}}$$

2) Blasius Equation

Open Calculator

fx $$f = \frac{0.316}{Re^{\frac{1}{4}}}$$

ex $$0.1777 = \frac{0.316}{(10)^{\frac{1}{4}}}$$

3) Boundary Layer Thickness of Laminar Sublayer

Open Calculator

fx $$\delta = \frac{11.6 \cdot v'}{V,}$$

ex $$0.001402\text{m} = \frac{11.6 \cdot 7.25\text{St}}{6\text{m/s}}$$

4) Centreline Velocity

Open Calculator

fx $$U_{max} = 1.43 \cdot V \cdot \sqrt{1 + f}$$

ex $$3.080314\text{m/s} = 1.43 \cdot 2\text{m/s} \cdot \sqrt{1 + 0.16}$$

5) Centreline Velocity given Shear and Mean Velocity

Open Calculator

fx $$U_{max} = 3.75 \cdot V_{'} + V$$

ex $$24.5\text{m/s} = 3.75 \cdot 6\text{m/s} + 2\text{m/s}$$

6) Discharge through Pipe given Head Loss in Turbulent Flow

Open Calculator

fx $$Q = \frac{P}{\rho_f \cdot [g] \cdot h_f}$$

ex $$3.004493\text{m}^3\text{/s} = \frac{170\text{W}}{1.225\text{kg/m}^3 \cdot [g] \cdot 4.71\text{m}}$$

7) Frictional Factor given Reynolds Number

Open Calculator

fx $$f = 0.0032 + \frac{0.221}{Re^{0.237}}$$

ex $$0.131254 = 0.0032 + \frac{0.221}{(10)^{0.237}}$$

8) Head Loss due to Friction given Power Required in Turbulent Flow

Open Calculator

fx $$h_f = \frac{P}{\rho_f \cdot [g] \cdot Q}$$

ex $$4.717055\text{m} = \frac{170\text{W}}{1.225\text{kg/m}^3 \cdot [g] \cdot 3\text{m}^3/\text{s}}$$

9) Mean Velocity given Centreline Velocity

Open Calculator

fx $$V = \frac{U_{max}}{1.43 \cdot \sqrt{1+f}}$$

ex $$1.869939\text{m/s} = \frac{2.88\text{m/s}}{1.43 \cdot \sqrt{1+0.16}}$$

10) Mean Velocity given Shear Velocity

Open Calculator

fx $$V = 3.75 \cdot V' - U_{max}$$

ex $$19.62\text{m/s} = 3.75 \cdot 6\text{m/s} - 2.88\text{m/s}$$

11) Power Required to Maintain Turbulent Flow

Open Calculator

fx $$P = \rho_f \cdot [g] \cdot Q \cdot h_f$$

ex $$169.7458\text{W} = 1.225\text{kg/m}^3 \cdot [g] \cdot 3\text{m}^3/\text{s} \cdot 4.71\text{m}$$

12) Roughness Reynold Number for Turbulent Flow in Pipes

Open Calculator

fx $$\mathrm{Re} = \frac{k \cdot V,}{v'}$$

ex $$6 = \frac{0.000725\mathrm{m} \cdot 6\mathrm{m/s}}{7.25\mathrm{St}}$$

13) Shear Stress Developed for Turbulent Flow in Pipes

Open Calculator

fx $$\tau = \rho_f \cdot V,^2$$

ex $$44.1\mathrm{Pa} = 1.225\mathrm{kg/m^3} \cdot (6\mathrm{m/s})^2$$

14) Shear Stress due to Viscosity

Open Calculator

fx $$\tau = \mu \cdot d_v$$

ex $$44\mathrm{Pa} = 22\mathrm{P} \cdot 20\mathrm{m/s}$$

15) Shear Stress in Turbulent Flow

Open Calculator

fx $$\tau = \frac{\rho_f \cdot f \cdot v^2}{2}$$

ex $$44.46162\mathrm{Pa} = \frac{1.225\mathrm{kg/m^3} \cdot 0.16 \cdot (21.3\mathrm{m/s})^2}{2}$$

16) Shear Velocity for Turbulent Flow in Pipes

Open Calculator

fx $$V_{'} = \sqrt{\frac{\tau}{\rho_f}}$$

ex $$5.993193\text{m/s} = \sqrt{\frac{44\text{Pa}}{1.225\text{kg/m}^3}}$$

17) Shear Velocity given Centreline Velocity

Open Calculator

fx $$V_s = \frac{U_{max} - V}{3.75}$$

ex $$0.234667\text{m/s} = \frac{2.88\text{m/s} - 2\text{m/s}}{3.75}$$

18) Shear Velocity given Mean Velocity

Open Calculator

fx $$V_s = V \cdot \sqrt{\frac{f}{8}}$$

ex $$0.282843\text{m/s} = 2\text{m/s} \cdot \sqrt{\frac{0.16}{8}}$$

Variables Used

- d_v Change in Velocity *(Meter per Second)*
- **f** Friction Factor
- h_f Head Loss Due to Friction *(Meter)*
- **k** Average Height Irregularities *(Meter)*
- **P** Power *(Watt)*
- **Q** Discharge *(Cubic Meter per Second)*
- **Re** Roughness Reynold Number
- U_{max} Centreline Velocity *(Meter per Second)*
- **v** Velocity *(Meter per Second)*
- **v'** Kinematic Viscosity *(Stokes)*
- **V** Mean Velocity *(Meter per Second)*
- V_* Shear Velocity *(Meter per Second)*
- V_s Shear Velocity 1 *(Meter per Second)*
- **δ** Boundary Layer Thickness *(Meter)*
- **μ** Viscosity *(Poise)*
- ρ_f Density of Fluid *(Kilogram per Cubic Meter)*
- τ Shear Stress *(Pascal)*

Constants, Functions, Measurements used

- Constant: **[g]**, 9.80665
  Gravitational acceleration on Earth
- 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)
  Speed Unit Conversion
- Measurement: **Power** in Watt (W)
  Power 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 Stokes (St)
  Kinematic Viscosity Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m^3)
  Density Unit Conversion
- Measurement: **Stress** in Pascal (Pa)
  Stress Unit Conversion

Check other formula lists

- **Turbulent Flow Formulas**

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