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Flow Regime Formulas

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List of 17 Flow Regime Formulas

Flow Regime

1) Circumferential stress developed in pipe wall

Open Calculator

fx $$\sigma_c = \frac{p \cdot D}{2 \cdot t_p}$$

ex $$6.8E\hat{}7N/m^2 = \frac{1.7E\hat{}7N/m^2 \cdot 0.12m}{2 \cdot 0.015m}$$

2) Coefficient of contraction for sudden contraction

Open Calculator

fx $$C_c = \frac{V_2'}{(V_2') + \sqrt{h_c \cdot 2 \cdot [g]}}$$

ex $$0.599533 = \frac{2.89m/s}{2.89m/s + \sqrt{0.19m \cdot 2 \cdot [g]}}$$

3) Discharge in Equivalent Pipe

Open Calculator

fx $$Q = \sqrt{\frac{H_l \cdot (\pi^2) \cdot 2 \cdot \left(D_{eq}^5\right) \cdot [g]}{4 \cdot 16 \cdot \mu \cdot L}}$$

ex $$0.02483m^3/s = \sqrt{\frac{20m \cdot (\pi^2) \cdot 2 \cdot \left((0.165m)^5\right) \cdot [g]}{4 \cdot 16 \cdot 0.01 \cdot 1200m}}$$

4) Force required to accelerate water in pipe

Open Calculator

fx $F = M_w \cdot a_l$

ex $0.0925\text{N} = 0.05\text{kg} \cdot 1.85\text{m/s}^2$

5) Longitudinal Stress developed in Pipe wall

Open Calculator

fx $\sigma_l = \frac{p \cdot D}{4 \cdot t_p}$

ex $3.4\text{E}\hat{}7\text{N/m}^2 = \frac{1.7\text{E}\hat{}7\text{N/m}^2 \cdot 0.12\text{m}}{4 \cdot 0.015\text{m}}$

6) Retarding force for gradual closure of valves

Open Calculator

fx $F_r = \rho' \cdot A \cdot L \cdot \frac{V_f}{t_c}$

ex $319.889\text{N} = 1010\text{kg/m}^3 \cdot 0.0113\text{m}^2 \cdot 1200\text{m} \cdot \frac{12.5\text{m/s}}{535.17\text{s}}$

7) Time required to close Valve for Gradual Closure of Valves

Open Calculator

fx $t_c = \frac{\rho' \cdot L \cdot V_f}{I}$

ex $535.7143\text{s} = \frac{1010\text{kg/m}^3 \cdot 1200\text{m} \cdot 12.5\text{m/s}}{28280\text{N/m}^2}$

8) Time taken by pressure wave to travel

Open Calculator

fx $$t = 2 \cdot \frac{L}{C}$$

ex $$125.6545s = 2 \cdot \frac{1200m}{19.1m/s}$$

9) Velocity at Outlet for Head Loss at Exit of Pipe

Open Calculator

fx $$v = \sqrt{h_o \cdot 2 \cdot [g]}$$

ex $$12.49487m/s = \sqrt{7.96m \cdot 2 \cdot [g]}$$

10) Velocity at section 1-1 for sudden enlargement

Open Calculator

fx $$(V_1') = (V_2') + \sqrt{h_e \cdot 2 \cdot [g]}$$

ex $$4.605224m/s = 2.89m/s + \sqrt{0.15m \cdot 2 \cdot [g]}$$

11) Velocity at section 2-2 for sudden contraction

Open Calculator

fx $$(V_2') = \frac{\sqrt{h_c \cdot 2 \cdot [g]}}{\left(\frac{1}{C_c}\right) - 1}$$

ex $$2.895632m/s = \frac{\sqrt{0.19m \cdot 2 \cdot [g]}}{\left(\frac{1}{0.6}\right) - 1}$$

12) Velocity at section 2-2 for sudden enlargement

Open Calculator

$$(V_2') = (V_1') - \sqrt{h_e \cdot 2 \cdot [g]}$$

$$2.464776\text{m/s} = 4.18\text{m/s} - \sqrt{0.15\text{m} \cdot 2 \cdot [g]}$$

13) Velocity of Flow at Outlet of Nozzle

Open Calculator

$$V_f = \sqrt{2 \cdot [g] \cdot \frac{H_{bn}}{1 + \left(4 \cdot \mu \cdot L \cdot \frac{a_2^2}{D \cdot (A^2)}\right)}}$$

$$19.34473\text{m/s} = \sqrt{2 \cdot [g] \cdot \frac{28.5\text{m}}{1 + \left(4 \cdot 0.01 \cdot 1200\text{m} \cdot \frac{(3.97\text{E}\hat{}\text{-}4\text{m}^2)^2}{0.12\text{m} \cdot \left((0.0113\text{m}^2)^2\right)}\right)}}$$

14) Velocity of Flow at outlet of Nozzle for Efficiency and Head

Open Calculator

$$V_f = \sqrt{\eta_n \cdot 2 \cdot [g] \cdot H_{bn}}$$

$$21.14671\text{m/s} = \sqrt{0.8 \cdot 2 \cdot [g] \cdot 28.5\text{m}}$$

15) Velocity of Fluid for Head Loss due to Obstruction in Pipe

Open Calculator

$$V_f = \frac{\sqrt{H_o \cdot 2 \cdot [g]}}{\left(\frac{A}{C_c \cdot (A - A')}\right) - 1}$$

$$12.49186\text{m/s} = \frac{\sqrt{7.36\text{m} \cdot 2 \cdot [g]}}{\left(\frac{0.0113\text{m}^2}{0.6 \cdot (0.0113\text{m}^2 - 0.0017\text{m})}\right) - 1}$$

16) Velocity of fluid in pipe for head loss at entrance of pipe

Open Calculator

$$v = \sqrt{\frac{h_i \cdot 2 \cdot [g]}{0.5}}$$

$$12.49487\text{m/s} = \sqrt{\frac{3.98\text{m} \cdot 2 \cdot [g]}{0.5}}$$

17) Velocity of liquid at vena-contracta

Open Calculator

$$V_c = \frac{A \cdot V_f}{C_c \cdot (A - A')}$$

$$24.52257\text{m/s} = \frac{0.0113\text{m}^2 \cdot 12.5\text{m/s}}{0.6 \cdot (0.0113\text{m}^2 - 0.0017\text{m})}$$

Variables Used

- **A** Cross Sectional Area of Pipe *(Square Meter)*
- **A'** Maximum Area of Obstruction *(Meter)*
- a_2 Nozzle Area at Outlet *(Square Meter)*
- a_l Acceleration of Liquid *(Meter per Square Second)*
- **C** Velocity of Pressure Wave *(Meter per Second)*
- C_c Coefficient of Contraction in Pipe
- **D** Diameter of Pipe *(Meter)*
- D_{eq} Diameter of Equivalent Pipe *(Meter)*
- **F** Force *(Newton)*
- F_r Retarding Force on Liquid in Pipe *(Newton)*
- H_{bn} Head at Base of Nozzle *(Meter)*
- h_c Loss of Head Sudden Contraction *(Meter)*
- h_e Loss of Head Sudden Enlargement *(Meter)*
- h_i Head Loss at Pipe Entrance *(Meter)*
- H_l Loss of Head in Equivalent Pipe *(Meter)*
- h_o Head Loss at Pipe Exit *(Meter)*
- H_o Loss of Head Due to Obstruction in Pipe *(Meter)*
- **I** Intensity of Pressure of Wave *(Newton per Square Meter)*
- **L** Length of Pipe *(Meter)*
- M_w Mass of Water *(Kilogram)*
- **p** Pressure Rise at Valve *(Newton per Square Meter)*
- **Q** Discharge through Pipe *(Cubic Meter per Second)*

- **t** Time Taken to Travel *(Second)*
- t_c Time Required to Close Valve *(Second)*
- t_p Thickness of Liquid Carrying Pipe *(Meter)*
- **v** Velocity *(Meter per Second)*
- V_1' Velocity of Fluid at Section 1 *(Meter per Second)*
- V_2' Velocity of Fluid at Section 2 *(Meter per Second)*
- V_c Velocity of Liquid Vena Contracta *(Meter per Second)*
- V_f Flow Velocity through Pipe *(Meter per Second)*
- η_n Efficiency for Nozzle
- **μ** Coefficient of Friction of Pipe
- **ρ'** Density of Fluid Inside the Pipe *(Kilogram per Cubic Meter)*
- σ_c Circumferential Stress *(Newton per Square Meter)*
- σ_l Longitudinal Stress *(Newton per Square Meter)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- 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: **Weight** in Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Pressure** in Newton per Square Meter (N/m²)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Acceleration** in Meter per Square Second (m/s²)
  Acceleration Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m³/s)
  Volumetric Flow Rate Unit Conversion

- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion
- Measurement: **Stress** in Newton per Square Meter (N/m²)
  Stress Unit Conversion

Check other formula lists

- **Flow Regime Formulas**

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