Important Area-Velocity and Ultrasonic Method of Streamflow Measurement Formulas PDF

Formulas
Examples
with Units

List of 27
Important Area-Velocity and Ultrasonic Method of Streamflow Measurement Formulas

1) Area-Velocity Method Formulas

1.1) Flow Velocity Formula

Evaluate Formula

Formula

$$V_f = V \cdot \sin(\theta)$$

Example with Units

$$7.6604\,\text{m/s} = 10\,\text{m/s} \cdot \sin(50°)$$

1.2) Moving Boat Velocity Formula

Evaluate Formula

Formula

$$v_b = V \cdot \cos(\theta)$$

Example with Units

$$6.4279\,\text{m/s} = 10\,\text{m/s} \cdot \cos(50°)$$

1.3) Moving Boat Velocity given Width between Two Verticals Formula

Evaluate Formula

Formula

$$v_b = \frac{W}{\Delta t}$$

Example with Units

$$6.383\,\text{m/s} = \frac{300\,\text{m}}{47\,\text{s}}$$

1.4) Partial Discharge in Sub-Area between Two Verticals given Flow Velocity Formula

Evaluate Formula

Formula

$$\Delta Q_i = \left(\frac{y_i + y_{i+1}}{2}\right) \cdot W + 1 \cdot V_f$$

Example with Units

$$1057.6\,\text{m}^3\text{/s} = \left(\frac{3\,\text{m} + 4\,\text{m}}{2}\right) \cdot 300\,\text{m} + 1 \cdot 7.6\,\text{m/s}$$

1.5) Partial Discharge in Sub-Area between Two Verticals given Resultant Velocity Formula

Evaluate Formula

Formula

$$\Delta Q_i = \left(\frac{y_i + y_{i+1}}{2}\right) \cdot V^2 \cdot \sin(\theta) \cdot \cos(\theta) \cdot \Delta t$$

Example with Units

$$135.0007\,\text{m}^3\text{/s} = \left(\frac{3\,\text{m} + 4\,\text{m}}{2}\right) \cdot 10\,\text{m/s}^2 \cdot \sin(50°) \cdot \cos(50°) \cdot 47\,\text{s}$$

1.6) Resultant Velocity given Flow Velocity Formula

Evaluate Formula

Formula

$$V = \frac{V_f}{\sin(\theta)}$$

Example with Units

$$9.9211\,\text{m/s} = \frac{7.6\,\text{m/s}}{\sin(50°)}$$

1.7) Resultant Velocity given Moving Boat Velocity Formula

Evaluate Formula

Formula

$$V = \frac{v_b}{\cos(\theta)}$$

Example with Units

$$9.9877\,\text{m/s} = \frac{6.42\,\text{m/s}}{\cos(50°)}$$

1.8) Time of Transit between two Verticals given Width between Verticals Formula

Evaluate Formula

Formula

$$\Delta t = \frac{W}{v_b}$$

Example with Units

$$46.729\,\text{s} = \frac{300\,\text{m}}{6.42\,\text{m/s}}$$

1.9) Width between Two Verticals Formula

Evaluate Formula

Formula

$$W = v_b \cdot \Delta t$$

Example with Units

$$5.029\,\text{m} = 6.42\,\text{m/s} \cdot 47\,\text{s}$$

2) Measurement of Velocity Formulas

2.1) Average Stream Velocity given Minimum Weight Formula

Evaluate Formula

Formula

$$v = \frac{N}{50 \cdot d}$$

Example with Units

$$20\,\text{m/s} = \frac{3300\,\text{N}}{50 \cdot 3.3\,\text{m}}$$

2.2) Average Velocity in Moderately Deep Streams Formula

Evaluate Formula

Formula

$$v = \frac{v_{0.2} + v_{0.8}}{2}$$

Example with Units

$$20\,\text{m/s} = \frac{26\,\text{m/s} + 14\,\text{m/s}}{2}$$

2.3) Average Velocity obtained by using Reduction Factor Formula

Evaluate Formula

Formula

$$v = K \cdot v_s$$

Example with Units

$$20.9\,\text{m/s} = 0.95 \cdot 22\,\text{m/s}$$

2.4) Depth of Flow at Vertical given Sounding Weights Formula

Evaluate Formula

Formula

$$d = \frac{N}{50 \cdot v}$$

Example with Units

$$3.3\,\text{m} = \frac{3300\,\text{N}}{50 \cdot 20\,\text{m/s}}$$

2.5) Distance Travelled given Surface Velocity Formula

Evaluate Formula

Formula

$$S = v_s \cdot t$$

Example with Units

$$110\,\text{m} = 22\,\text{m/s} \cdot 5\,\text{s}$$

2.6) Revolutions per Second of Horizontal Axis Meter given Stream Velocity Formula

Evaluate Formula

Formula

$$Ns = \frac{v - b}{a}$$

Example with Units

$$32 = \frac{20\,\text{m/s} - 0.8}{0.6}$$

2.7) Sounding Weights Formula

Evaluate Formula

Formula

$$N = 50 \cdot v \cdot d$$

Example with Units

$$3300\,\text{N} = 50 \cdot 20\,\text{m/s} \cdot 3.3\,\text{m}$$

2.8) Stream Velocity at Instrument Location Formula

Evaluate Formula

Formula

$$v = a \cdot Ns + b$$

Example with Units

$$20.6\,\text{m/s} = 0.6 \cdot 33 + 0.8$$

2.9) Surface Velocity Formula

Evaluate Formula

Formula

$$v_s = \frac{S}{t}$$

Example with Units

$$22\,\text{m/s} = \frac{110\,\text{m}}{5\,\text{s}}$$

2.10) Surface Velocity given Average of Velocity Formula

Evaluate Formula

Formula

$$v_s = \frac{v}{K}$$

Example with Units

$$21.0526\,\text{m/s} = \frac{20\,\text{m/s}}{0.95}$$

2.11) Time of Distance Travelled given Surface Velocity Formula

Evaluate Formula

Formula

$$t = \frac{S}{v_s}$$

Example with Units

$$5\,\text{s} = \frac{110\,\text{m}}{22\,\text{m/s}}$$

2.12) Velocity Distribution in Rough Turbulent Flow Formula

Evaluate Formula

Formula

$$v = 5.75 \cdot v_{shear} \cdot \log10\left(30 \cdot \frac{y}{k_s}\right)$$

Example with Units

$$20.7711\,\text{m/s} = 5.75 \cdot 6\,\text{m/s} \cdot \log10\left(30 \cdot \frac{2\,\text{m}}{15}\right)$$

3) Ultrasonic Method Formulas

3.1) Average Velocity along Path AB at certain Height above Bed Formula

Evaluate Formula

Formula

$$v_{avg} = \left(\left(\frac{L}{2}\right) \cdot \cos(\theta)\right) \cdot \left(\left(\frac{1}{t_1}\right) - \left(\frac{1}{t_2}\right)\right)$$

Example with Units

$$2.3513\,\text{m/s} = \left(\left(\frac{3000\,\text{m}}{2}\right) \cdot \cos(50°)\right) \cdot \left(\left(\frac{1}{2.02\,\text{s}}\right) - \left(\frac{1}{2.03\,\text{s}}\right)\right)$$

3.2) Elapse Time of Ultrasonic Signal sent by A Formula

Evaluate Formula

Formula

$$t_1 = \frac{L}{C + v_p}$$

Example with Units

$$2.0202\,\text{s} = \frac{3000\,\text{m}}{1480\,\text{m/s} + 5.01\,\text{m/s}}$$

3.3) Elapse Time of Ultrasonic Signal sent by B Formula

Evaluate Formula

Formula

$$t_2 = \frac{L}{C - v_p}$$

Example with Units

$$2.0339\,\text{s} = \frac{3000\,\text{m}}{1480\,\text{m/s} - 5.01\,\text{m/s}}$$

3.4) Length of Path for Elapse Time of Ultrasonic Signal Formula

Evaluate Formula

Formula

$$L = t_1 \cdot (C + v_p)$$

Example with Units

$$2999.7202\,\text{m} = 2.02\,\text{s} \cdot (1480\,\text{m/s} + 5.01\,\text{m/s})$$

3.5) Length of Path given Elapse Time of Ultrasonic Signal Formula

Evaluate Formula

Formula

$$L = t_1 \cdot (C - v_p)$$

Example with Units

$$2979.4798\,\text{m} = 2.02\,\text{s} \cdot (1480\,\text{m/s} - 5.01\,\text{m/s})$$

3.6) Velocity of Sound in Water given Elapse Time of Ultrasonic Signal sent by A Formula

Evaluate Formula

Formula

$$C = \left(\frac{L}{t_1}\right) - v_p$$

Example with Units

$$1480.1385\,\text{m/s} = \left(\frac{3000\,\text{m}}{2.02\,\text{s}}\right) - 5.01\,\text{m/s}$$

Variables used in list of Area-Velocity and Ultrasonic Method of Streamflow Measurement Formulas above

- **a** Constant a
- **b** Constant b
- **C** Velocity of Sound in Water *(Meter per Second)*
- **d** Depth of Flow in Vertical *(Meter)*
- **K** Reduction Factor
- k_s Equivalent Sand-Grain Roughness
- **L** Length of Path from A to B *(Meter)*
- **N** Minimum Weight *(Newton)*
- **Ns** Revolutions per Second of Meter
- **S** Distance Travelled *(Meter)*
- **t** Time Taken to Travel *(Second)*
- t_1 Elapse Time t1 *(Second)*
- t_2 Elapse Time t2 *(Second)*
- **v** Average Velocity in Vertical *(Meter per Second)*
- **V** Resultant Velocity *(Meter per Second)*
- $v_{0.2}$ Velocity at 0.2 Times Depth of Flow *(Meter per Second)*
- $v_{0.8}$ Velocity at 0.8 Times Depth of Flow *(Meter per Second)*
- v_{avg} Average Velocity along Path *(Meter per Second)*
- v_b Boat Velocity *(Meter per Second)*
- V_f Flow Velocity *(Meter per Second)*
- v_p Component of Flow Velocity in Sound Path *(Meter per Second)*
- v_s Surface Velocity of River *(Meter per Second)*
- v_{shear} Shear Velocity *(Meter per Second)*
- **W** Width between Two Verticals *(Meter)*
- **y** Height above Bed *(Meter)*
- y_i Depth 'yi' of Flow in Sub-Area *(Meter)*
- y_{i+1} Depth 'i+1' of Flow in Sub-Area *(Meter)*
- ΔQ_i Partial Discharges *(Cubic Meter per Second)*

Constants, Functions, Measurements used in list of Area-Velocity and Ultrasonic Method of Streamflow Measurement Formulas above

- Functions: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Functions: **log10**, log10(Number)
  The common logarithm, also known as the base-10 logarithm or the decimal logarithm, is a mathematical function that is the inverse of the exponential function.
- Functions: **sin**, sin(Angle)
  Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m³/s)
  Volumetric Flow Rate Unit Conversion

- **Δt** Time of Transit between Two Verticals *(Second)*
- **θ** Angle *(Degree)*

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