Important Metering Flumes and Momentum in Open Channel Flow Specific Force Formulas PDF

Formulas
Examples
with Units

List of 15
Important Metering Flumes and Momentum in Open Channel Flow Specific Force Formulas

1) Metering Flumes Formulas

1.1) Coefficient of Discharge through Flume given Discharge Flow through Channel Formula

Evaluate Formula

Formula

$$C_d = \left(\frac{Q}{A_i \cdot A_f} \cdot \left(\sqrt{\frac{\left(A_i^2\right) - \left(A_f^2\right)}{2 \cdot [g] \cdot \left(h_i - h_o\right)}} \right) \right)$$

Example with Units

$$0.7675 = \left(\frac{14\,\text{m}^3/\text{s}}{7.1\,\text{m}^2 \cdot 1.8\,\text{m}^2} \cdot \left(\sqrt{\frac{\left(7.1\,\text{m}^2\right)^2 - \left(1.8\,\text{m}^2\right)^2}{2 \cdot 9.8066\,\text{m/s}^2 \cdot \left(20\,\text{m} - 15.1\,\text{m}\right)}} \right) \right)$$

1.2) Coefficient of Discharge through Flume given Discharge Flow through Rectangular Channel Formula

Evaluate Formula

Formula

$$C_d = \left(\frac{Q}{A_i \cdot A_f} \cdot \left(\sqrt{\frac{\left(A_i^2\right) - \left(A_f^2\right)}{2 \cdot [g] \cdot \left(h_i - h_o\right)}} \right) \right)$$

Example with Units

$$0.7675 = \left(\frac{14\,\text{m}^3/\text{s}}{7.1\,\text{m}^2 \cdot 1.8\,\text{m}^2} \cdot \left(\sqrt{\frac{\left(7.1\,\text{m}^2\right)^2 - \left(1.8\,\text{m}^2\right)^2}{2 \cdot 9.8066\,\text{m/s}^2 \cdot \left(20\,\text{m} - 15.1\,\text{m}\right)}} \right) \right)$$

1.3) Depth of Flow given Discharge through Critical Depth Flume Formula

Evaluate Formula

Formula

$$d_f = \left(\frac{Q}{W_t \cdot C_d} \right)^{\frac{2}{3}}$$

Example with Units

$$3.3241\,\text{m} = \left(\frac{14\,\text{m}^3/\text{s}}{3.5\,\text{m} \cdot 0.66} \right)^{\frac{2}{3}}$$

1.4) Discharge Coefficient given Discharge through Critical Depth Flume Formula

Evaluate Formula

Formula

$$C_d = \frac{Q}{W_t \cdot \left(d_f^{1.5} \right)}$$

Example with Units

$$0.6673 = \frac{14\,\text{m}^3/\text{s}}{3.5\,\text{m} \cdot \left(3.3\,\text{m}^{1.5} \right)}$$

1.5) Discharge Flow through Channel Formula

Evaluate Formula

Formula

$$Q = \left(C_d \cdot A_i \cdot A_f \right) \cdot \left(\sqrt{2 \cdot [g] \cdot \frac{h_i - h_o}{\left(A_i^2 \right) - \left(A_f^2 \right)}} \right)$$

Example with Units

$$12.0397\,\text{m}^3/\text{s} = \left(0.66 \cdot 7.1\,\text{m}^2 \cdot 1.8\,\text{m}^2 \right) \cdot \left(\sqrt{2 \cdot 9.8066\,\text{m/s}^2 \cdot \frac{20\,\text{m} - 15.1\,\text{m}}{\left(7.1\,\text{m}^2{}^2 \right) - \left(1.8\,\text{m}^2{}^2 \right)}} \right)$$

1.6) Discharge Flow through Rectangular Channel Formula

Evaluate Formula

Formula

$$Q = \left(C_d \cdot A_i \cdot A_f \right) \cdot \left(\sqrt{2 \cdot [g] \cdot \frac{h_i - h_o}{\left(A_i^2 \right) - \left(A_f^2 \right)}} \right)$$

Example with Units

$$12.0397\,\text{m}^3/\text{s} = \left(0.66 \cdot 7.1\,\text{m}^2 \cdot 1.8\,\text{m}^2 \right) \cdot \left(\sqrt{2 \cdot 9.8066\,\text{m/s}^2 \cdot \frac{20\,\text{m} - 15.1\,\text{m}}{\left(7.1\,\text{m}^2{}^2 \right) - \left(1.8\,\text{m}^2{}^2 \right)}} \right)$$

1.7) Discharge through Critical Depth Flume Formula

Evaluate Formula

Formula

$$Q = C_d \cdot W_t \cdot \left(d_f^{1.5} \right)$$

Example with Units

$$13.8479\,\text{m}^3/\text{s} = 0.66 \cdot 3.5\,\text{m} \cdot \left(3.3\,\text{m}^{1.5} \right)$$

1.8) Head at Entrance given Discharge through Channel Formula

Evaluate Formula

Formula

$$h_i = \left(\frac{Q}{C_d \cdot A_i \cdot A_f \cdot \left(\sqrt{2 \cdot \frac{[g]}{A_i^2 - A_f^2}} \right)} \right)^2 + h_o$$

Example with Units

$$21.7255\,\text{m} = \left(\frac{14\,\text{m}^3/\text{s}}{0.66 \cdot 7.1\,\text{m}^2 \cdot 1.8\,\text{m}^2 \cdot \left(\sqrt{2 \cdot \frac{9.8066\,\text{m/s}^2}{7.1\,\text{m}^2{}^2 - 1.8\,\text{m}^2{}^2}} \right)} \right)^2 + 15.1\,\text{m}$$

1.9) Head at Entrance of Section given Discharge Flow through Channel Formula

Evaluate Formula

Formula

$$h_o = h_i - \left(\frac{Q}{C_d \cdot A_i \cdot A_f \cdot \left(\sqrt{2 \cdot \frac{[g]}{A_i^2 - A_f^2}} \right)} \right)^2$$

Example with Units

$$13.3745\,\text{m} = 20\,\text{m} - \left(\frac{14\,\text{m}^3/\text{s}}{0.66 \cdot 7.1\,\text{m}^2 \cdot 1.8\,\text{m}^2 \cdot \left(\sqrt{2 \cdot \frac{9.8066\,\text{m/s}^2}{7.1\,\text{m}^2{}^2 - 1.8\,\text{m}^2{}^2}} \right)} \right)^2$$

1.10) Width of Throat given Discharge through Critical Depth Flume Formula

Evaluate Formula

Formula

$$W_t = \frac{Q}{C_d \cdot \left(d_f^{1.5} \right)}$$

Example with Units

$$3.5385\,\text{m} = \frac{14\,\text{m}^3/\text{s}}{0.66 \cdot \left(3.3\,\text{m}^{1.5} \right)}$$

2) Momentum in Open Channel Flow Specific Force Formulas

2.1) Specific Force Formula

Evaluate Formula

Formula

$$F = \left(Q \cdot \frac{Q}{A_{cs} \cdot [g]} \right) + A_{cs} \cdot Y_t$$

Example with Units

$$304.3324\,\text{m}^3 = \left(14\,\text{m}^3/\text{s} \cdot \frac{14\,\text{m}^3/\text{s}}{15\,\text{m}^2 \cdot 9.8066\,\text{m/s}^2} \right) + 15\,\text{m}^2 \cdot 20.2\,\text{m}$$

2.2) Specific Force given Top Width Formula

Evaluate Formula

Formula

$$F = \left(\frac{A_{cs}^2}{T} \right) + A_{cs} \cdot Y_t$$

Example with Units

$$410.1429\,\text{m}^3 = \left(\frac{15\,\text{m}^2}{2.1\,\text{m}}^2 \right) + 15\,\text{m}^2 \cdot 20.2\,\text{m}$$

2.3) Top Width given Specific Force Formula

Evaluate Formula

Formula

$$T = \frac{A_{cs}^2}{F - A_{cs} \cdot Y_t}$$

Example with Units

$$2.1028\,\text{m} = \frac{15\,\text{m}^2}{410\,\text{m}^3 - 15\,\text{m}^2 \cdot 20.2\,\text{m}}^2$$

2.4) Vertical Depth of Centroid of Area given Specific Force Formula

Evaluate Formula

Formula

$$Y_t = \frac{F - \left(Q \cdot \frac{Q}{A_{cs} \cdot [g]} \right)}{A_{cs}}$$

Example with Units

$$27.2445\,\text{m} = \frac{410\,\text{m}^3 - \left(14\,\text{m}^3/\text{s} \cdot \frac{14\,\text{m}^3/\text{s}}{15\,\text{m}^2 \cdot 9.8066\,\text{m/s}^2} \right)}{15\,\text{m}^2}$$

2.5) Vertical Depth of Centroid of Area given Specific Force with Top Width Formula

Evaluate Formula

Formula

$$Y_t = \frac{F - \left(\frac{A_{cs}^2}{T} \right)}{A_{cs}}$$

Example with Units

$$20.1905\,\text{m} = \frac{410\,\text{m}^3 - \left(\frac{15\,\text{m}^2}{2.1\,\text{m}}^2 \right)}{15\,\text{m}^2}$$

Variables used in list of Metering Flumes and Momentum in Open Channel Flow Specific Force Formulas above

- A_{cs} Cross-Sectional Area of Channel *(Square Meter)*
- A_f Cross Section Area 2 *(Square Meter)*
- A_i Cross Section Area 1 *(Square Meter)*
- C_d Coefficient of Discharge
- d_f Depth of Flow *(Meter)*
- F Specific Force in OCF *(Cubic Meter)*
- h_i Loss of Head at Entrance *(Meter)*
- h_o Loss of Head at Exit *(Meter)*
- Q Discharge of Channel *(Cubic Meter per Second)*
- T Top Width *(Meter)*
- W_t Width of Throat *(Meter)*
- Y_t Distance from Centroidal *(Meter)*

Constants, Functions, Measurements used in list of Metering Flumes and Momentum in Open Channel Flow Specific Force Formulas above

- constant(s): **[g]**, 9.80665
  Gravitational acceleration on Earth
- 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: **Volume** in Cubic Meter (m^3)
  Volume Unit Conversion
- Measurement: **Area** in Square Meter (m^2)
  Area Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m^3/s)
  Volumetric Flow Rate Unit Conversion

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