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Gradually Varied Flow in Channels Formulas

Calculators! Examples! Conversions!

List of 36 Gradually Varied Flow in Channels Formulas

Gradually Varied Flow in Channels

1) Area of Section given Energy Gradient

Open Calculator

fx $$S = \left(Q_{eg}^2 \cdot \frac{T}{\left(1 - \left(\frac{i}{m}\right)\right) \cdot ([g])}\right)^{\frac{1}{3}}$$

ex $$4.007819\text{m}^2 = \left((12.5\text{m}^3/\text{s})^2 \cdot \frac{2\text{m}}{\left(1 - \left(\frac{2.02}{4}\right)\right) \cdot ([g])}\right)^{\frac{1}{3}}$$

2) Area of Section given Froude Number

Open Calculator

fx $$S = \left(\left(Q_f^2 \cdot \frac{T}{[g] \cdot Fr^2}\right)\right)^{\frac{1}{3}}$$

ex $$3.997777\text{m}^2 = \left(\left((177\text{m}^3/\text{s})^2 \cdot \frac{2\text{m}}{[g] \cdot (10)^2}\right)\right)^{\frac{1}{3}}$$

3) Area of Section given Total Energy

Open Calculator

fx $$S = \left(\frac{Q_f^2}{2 \cdot [g] \cdot (E_t - d_f)}\right)^{0.5}$$

ex $$4.000068\text{m}^2 = \left(\frac{(177\text{m}^3/\text{s})^2}{2 \cdot [g] \cdot (103.13\text{J} - 3.3\text{m})}\right)^{0.5}$$

4) Bed Slope given Energy Slope of Rectangular channel

Open Calculator

fx $$S_0 = \frac{S_f}{\left(\frac{C}{d_f}\right)^{\frac{10}{3}}}$$

ex $$2.749304 = \frac{2.001}{\left(\frac{3\text{m}}{3.3\text{m}}\right)^{\frac{10}{3}}}$$

5) Bed Slope given Slope of Dynamic Equation of Gradually Varied Flow

Open Calculator

fx $$S_0 = S_f + \left(m \cdot \left(1 - \left(F_{r(d)}^2\right)\right)\right)$$

ex $$4.041 = 2.001 + \left(4 \cdot \left(1 - \left((0.7)^2\right)\right)\right)$$

6) Bottom Slope of Channel given Energy Gradient

Open Calculator

fx $$S_0 = i + S_f$$

ex $$4.021 = 2.02 + 2.001$$

7) Chezy Formula for Bed Slope given Energy Slope of Rectangular Channel

Open Calculator

fx $$S_0 = \frac{S_f}{\left(\frac{C}{d_f}\right)^3}$$

ex $$2.663331 = \frac{2.001}{\left(\frac{3\text{m}}{3.3\text{m}}\right)^3}$$

8) Chezy Formula for Depth of Flow given Energy Slope of Rectangular Channel

Open Calculator

fx $$d_f = \frac{C}{\left(\frac{S_f}{S_0}\right)^{\frac{1}{3}}}$$

ex $$3.779448\text{m} = \frac{3\text{m}}{\left(\frac{2.001}{4.001}\right)^{\frac{1}{3}}}$$

9) Chezy Formula for Normal Depth given Energy Slope of Rectangular Channel

Open Calculator

fx $$C = \left(\left(\frac{S_f}{S_0}\right)^{\frac{1}{3}}\right) \cdot d_f$$

ex $$2.61943\text{m} = \left(\left(\frac{2.001}{4.001}\right)^{\frac{1}{3}}\right) \cdot 3.3\text{m}$$

10) Depth of Flow given Energy Slope of Rectangular channel

Open Calculator

fx $$d_f = \frac{C}{\left(\frac{S_f}{S_0}\right)^{\frac{3}{10}}}$$

ex $$3.693156\text{m} = \frac{3\text{m}}{\left(\frac{2.001}{4.001}\right)^{\frac{3}{10}}}$$

11) Depth of Flow given Total Energy

Open Calculator

fx $$d_f = E_t - \left(\frac{Q_f^2}{2 \cdot [g] \cdot S^2}\right)$$

ex $$3.793897\text{m} = 103.13\text{J} - \left(\frac{(177\text{m}^3/\text{s})^2}{2 \cdot [g] \cdot (4.01\text{m}^2)^2}\right)$$

12) Discharge given Energy Gradient

Open Calculator

fx $$Q_{eg} = \left(\left(\left(1 - \left(\frac{i}{m}\right)\right) \cdot \frac{[g] \cdot S^3}{T}\right)\right)^{0.5}$$

ex $$12.51021\text{m}^3/\text{s} = \left(\left(\left(1 - \left(\frac{2.02}{4}\right)\right) \cdot \frac{[g] \cdot (4.01\text{m}^2)^3}{2\text{m}}\right)\right)^{0.5}$$

13) Discharge given Froude Number

Open Calculator

fx $$Q_f = \frac{Fr}{\sqrt{\frac{T}{[g] \cdot S^3}}}$$

ex $$177.8123\text{m}^3/\text{s} = \frac{10}{\sqrt{\frac{2\text{m}}{[g] \cdot (4.01\text{m}^2)^3}}}$$

14) Discharge given Total Energy

Open Calculator

fx $$Q_f = \left((E_t - d_f) \cdot 2 \cdot [g] \cdot S^2\right)^{0.5}$$

ex $$177.4395\text{m}^3/\text{s} = \left((103.13\text{J} - 3.3\text{m}) \cdot 2 \cdot [g] \cdot (4.01\text{m}^2)^2\right)^{0.5}$$

15) Energy Gradient given Bed Slope

Open Calculator

$$i = S_0 - S_f$$

ex $$2 = 4.001 - 2.001$$

16) Energy Gradient given Slope

Open Calculator

$$i = \left(1 - \left(Q_{eg}^2 \cdot \frac{T}{[g] \cdot S^3}\right)\right) \cdot m$$

ex $$2.02323 = \left(1 - \left((12.5\mathrm{m^3/s})^2 \cdot \frac{2\mathrm{m}}{[g] \cdot (4.01\mathrm{m^2})^3}\right)\right) \cdot 4$$

17) Froude Number given Slope of Dynamic Equation of Gradually Varied Flow

Open Calculator

$$F_{r(d)} = \sqrt{1 - \left(\frac{S_0 - S_f}{m}\right)}$$

ex $$0.707107 = \sqrt{1 - \left(\frac{4.001 - 2.001}{4}\right)}$$

18) Froude Number given Top Width

Open Calculator

$$Fr = \sqrt{Q_f^2 \cdot \frac{T}{[g] \cdot S^3}}$$

ex $$9.954315 = \sqrt{(177\mathrm{m^3/s})^2 \cdot \frac{2\mathrm{m}}{[g] \cdot (4.01\mathrm{m^2})^3}}$$

19) Normal Depth given Energy Slope of Rectangular channel

Open Calculator

fx $$C = \left(\left(\frac{S_f}{S_0}\right)^{\frac{3}{10}}\right) \cdot d_f$$

ex $$2.680634\text{m} = \left(\left(\frac{2.001}{4.001}\right)^{\frac{3}{10}}\right) \cdot 3.3\text{m}$$

20) Slope of Dynamic Equation of Gradually Varied Flow given Energy Gradient

Open Calculator

fx $$m = \frac{i}{1 - \left(Q_{eg}^2 \cdot \frac{T}{[g] \cdot S^3}\right)}$$

ex $$3.993615 = \frac{2.02}{1 - \left((12.5\text{m}^3/\text{s})^2 \cdot \frac{2\text{m}}{[g] \cdot (4.01\text{m}^2)^3}\right)}$$

21) Slope of Dynamic Equation of Gradually Varied Flows

Open Calculator

fx $$m = \frac{S_0 - S_f}{1 - \left(F_{r(d)}^2\right)}$$

ex $$3.921569 = \frac{4.001 - 2.001}{1 - \left((0.7)^2\right)}$$

22) Top Width given Energy Gradient

Open Calculator

fx $$T = \left(\left(1 - \left(\frac{i}{m}\right)\right) \cdot \frac{[g] \cdot S^3}{Q_{eg}^2}\right)$$

ex $$2.003268\text{m} = \left(\left(1 - \left(\frac{2.02}{4}\right)\right) \cdot \frac{[g] \cdot (4.01\text{m}^2)^3}{(12.5\text{m}^3/\text{s})^2}\right)$$

23) Top Width given Froude Number

Open Calculator

$$T = \frac{Fr^2 \cdot S^3 \cdot [g]}{Q_f^2}$$

$$2.0184m = \frac{(10)^2 \cdot (4.01m^2)^3 \cdot [g]}{(177m^3/s)^2}$$

24) Total Energy of Flow

Open Calculator

$$E_t = d_f + \frac{Q_f^2}{2 \cdot [g] \cdot S^2}$$

$$102.6361J = 3.3m + \frac{(177m^3/s)^2}{2 \cdot [g] \cdot (4.01m^2)^2}$$

Energy Slope

25) Chezy Formula for Energy Slope of Rectangular Channel

Open Calculator

$$S_f = S_0 \cdot \left(\frac{C}{d_f}\right)^3$$

$$3.006011 = 4.001 \cdot \left(\frac{3m}{3.3m}\right)^3$$

26) Energy Slope given Slope of Dynamic Equation of Gradually Varied Flow

Open Calculator

$$S_f = S_0 - \left(m \cdot \left(1 - \left(F_{r(d)}^2\right)\right)\right)$$

$$1.961 = 4.001 - \left(4 \cdot \left(1 - \left((0.7)^2\right)\right)\right)$$

27) Energy Slope of Channel given Energy Gradient

Open Calculator

$$S_f = S_0 - i$$

$$1.981 = 4.001 - 2.02$$

28) Energy Slope of Rectangular channel

Open Calculator

$$S_f = S_0 \cdot \left(\frac{C}{d_f}\right)^{\frac{10}{3}}$$

$$2.91201 = 4.001 \cdot \left(\frac{3m}{3.3m}\right)^{\frac{10}{3}}$$

Wide Rectangular Channel

29) Bed Slope of Channel given Slope of Dynamic Equation of Gradually Varied Flow

Open Calculator

$$S_0 = \frac{m}{\left(\frac{1-\left(\left(\frac{y}{d_f}\right)^{\frac{10}{3}}\right)}{1-\left(\left(\frac{h_c}{d_f}\right)^{3}\right)}\right)}$$

$$4.190987 = \frac{4}{\left(\frac{1-\left(\left(\frac{1.5m}{3.3m}\right)^{\frac{10}{3}}\right)}{1-\left(\left(\frac{1.001m}{3.3m}\right)^{3}\right)}\right)}$$

30) Bed Slope of Channel given Slope of Dynamic Equation of GVF through Chezy formula

Open Calculator

$$S_0 = \frac{m}{\left(\frac{1-\left(\left(\frac{y}{d_f}\right)^3\right)}{1-\left(\left(\left(\frac{h_c}{d_f}\right)^3\right)\right)}\right)}$$

$$4.291382 = \frac{4}{\left(\frac{1-\left(\left(\frac{1.5m}{3.3m}\right)^3\right)}{1-\left(\left(\left(\frac{1.001m}{3.3m}\right)^3\right)\right)}\right)}$$

31) Chezy Formula for Critical Depth of Channel given Slope of Dynamic Equation of GVF

Open Calculator

$$H_C = \left(\left(1-\left(\left(\frac{1-\left(\left(\frac{y}{d_f}\right)^3\right)}{\frac{m}{S_0}}\right)\right)\right)^{\frac{1}{3}}\right)\cdot d_f$$

$$0.106454m = \left(\left(1-\left(\left(\frac{1-\left(\left(\frac{1.5m}{3.3m}\right)^3\right)}{\frac{4}{4.001}}\right)\right)\right)^{\frac{1}{3}}\right)\cdot 3.3m$$

32) Chezy Formula for Normal Depth of Channel given Slope of Dynamic Equation of GVF

fx Open Calculator

$$y = \left(\left(1 - \left(\left(\frac{m}{S_0}\right) \cdot \left(\left(1 - \left(\left(\left(\frac{h_c}{d_f}\right)^3\right)\right)\right)\right)\right)\right)^{\frac{1}{3}}\right) \cdot d_f$$

ex

$$1.003896\text{m} = \left(\left(1 - \left(\left(\frac{4}{4.001}\right) \cdot \left(\left(1 - \left(\left(\left(\frac{1.001\text{m}}{3.3\text{m}}\right)^3\right)\right)\right)\right)\right)\right)^{\frac{1}{3}}\right) \cdot 3.3\text{m}$$

33) Chezy Formula for Slope of Dynamic Equation of Gradually Varied Flow

fx Open Calculator

$$m = S_0 \cdot \left(\frac{1 - \left(\left(\frac{y}{d_f}\right)^3\right)}{1 - \left(\left(\left(\frac{h_c}{d_f}\right)^3\right)\right)}\right)$$

ex

$$3.729335 = 4.001 \cdot \left(\frac{1 - \left(\left(\frac{1.5\text{m}}{3.3\text{m}}\right)^3\right)}{1 - \left(\left(\left(\frac{1.001\text{m}}{3.3\text{m}}\right)^3\right)\right)}\right)$$

34) Critical Depth of Channel given Slope of Dynamic Equation of Gradually Varied Flow

Open Calculator

fx
$$H_C = \left(\left(1 - \left(\left(\frac{1 - \left(\left(\frac{y}{d_f}\right)^{\frac{10}{3}}\right)}{\frac{m}{S_0}}\right)\right)\right)^{\frac{1}{3}}\right) \cdot d_f$$

ex
$$0.081154\text{m} = \left(\left(1 - \left(\left(\frac{1 - \left(\left(\frac{1.5\text{m}}{3.3\text{m}}\right)^{\frac{10}{3}}\right)}{\frac{4}{4.001}}\right)\right)\right)^{\frac{1}{3}}\right) \cdot 3.3\text{m}$$

35) Normal Depth of Channel given Slope of Dynamic Equation of Gradually Varied Flow

fx

Open Calculator

$$y = \left(\left(1 - \left(\left(\frac{m}{S_0}\right) \cdot \left(\left(1 - \left(\left(\left(\frac{h_c}{d_f}\right)^{3}\right)\right)\right)\right)\right)\right)^{\frac{3}{10}}\right) \cdot d_f$$

ex
$$1.130762\text{m} = \left(\left(1 - \left(\left(\frac{4}{4.001}\right) \cdot \left(\left(1 - \left(\left(\left(\frac{1.001\text{m}}{3.3\text{m}}\right)^{3}\right)\right)\right)\right)\right)\right)^{\frac{3}{10}}\right) \cdot 3.3\text{m}$$

36) Slope of Dynamic Equations of Gradually Varied Flow

Open Calculator

$$m = S_0 \cdot \left(\frac{1 - \left(\left(\frac{y}{d_f} \right)^{\frac{10}{3}} \right)}{1 - \left(\left(\frac{h_c}{d_f} \right)^{3} \right)} \right)$$

$$3.818671 = 4.001 \cdot \left(\frac{1 - \left(\left(\frac{1.5m}{3.3m} \right)^{\frac{10}{3}} \right)}{1 - \left(\left(\frac{1.001m}{3.3m} \right)^{3} \right)} \right)$$

Variables Used

- **C** Critical Depth of Channel *(Meter)*
- **d_f** Depth of Flow *(Meter)*
- **E_t** Total Energy in Open Channel *(Joule)*
- **$F_{r(d)}$** Froude No by Dynamic Equation
- **Fr** Froude Number
- **h_c** Critical Depth of Weir *(Meter)*
- **H_C** Critical Depth of Channel GVF Flow *(Meter)*
- **i** Hydraulic Gradient to Head Loss
- **m** Slope of Line
- **Q_{eg}** Discharge by Energy Gradient *(Cubic Meter per Second)*
- **Q_f** Discharge for GVF Flow *(Cubic Meter per Second)*
- **S** Wetted Surface Area *(Square Meter)*
- **S_0** Bed Slope of Channel
- **S_f** Energy Slope
- **T** Top Width *(Meter)*
- **y** Normal Depth *(Meter)*

Constants, Functions, Measurements used

- Constant: **[g]**, 9.80665 Meter/Second²
  Gravitational acceleration on Earth
- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Energy** in Joule (J)
  Energy Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m³/s)
  Volumetric Flow Rate Unit Conversion

Check other formula lists

- **Gradually Varied Flow in Channels Formulas**

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