Important Proportionate Hydraulic Elements for Circular Sewers Formulas PDF

Formulas
Examples
with Units

List of 27
Important Proportionate Hydraulic Elements for Circular Sewers Formulas

1) Area of Cross Section of Circular Sewer Formulas

1.1) Area of Cross-section for Full Flow given Discharge Ratio Formula

Evaluate Formula

Formula

$$A = \frac{a}{\frac{qsQ_{ratio}}{\left(\frac{N}{n_p}\right)\cdot\left(\frac{r_{pf}}{R_{rf}}\right)^{\frac{1}{6}}}}$$

Example with Units

$$5.4165\,\text{m}^2 = \frac{3.8\,\text{m}^2}{\frac{0.532}{\left(\frac{0.74}{0.9}\right)\cdot\left(\frac{3.2\,\text{m}}{5.2\,\text{m}}\right)^{\frac{1}{6}}}}$$

1.2) Area of Cross-section for Full Flow given Hydraulic Mean Depth and Discharge Ratio Formula

Evaluate Formula

Formula

$$A = \frac{a}{\frac{qsQ_{ratio}}{\left(\frac{N}{n_p}\right)\cdot\left(R\right)^{\frac{1}{6}}}}$$

Example with Units

$$5.4086\,\text{m}^2 = \frac{3.8\,\text{m}^2}{\frac{0.532}{\left(\frac{0.74}{0.9}\right)\cdot\left(0.61\right)^{\frac{1}{6}}}}$$

1.3) Area of Cross-Section for Full Flow given Hydraulic Mean Depth Ratio Formula

Evaluate Formula

Formula

$$A = \frac{a}{\frac{\frac{q}{Q}}{\left(\frac{N}{n_p}\right)\cdot\left(R\right)^{\frac{1}{6}}}}$$

Example with Units

$$5.3498\,\text{m}^2 = \frac{3.8\,\text{m}^2}{\frac{\frac{17.48\,\text{m}^3/\text{s}}{32.5\,\text{m}^3/\text{s}}}{\left(\frac{0.74}{0.9}\right)\cdot\left(0.61\right)^{\frac{1}{6}}}}$$

1.4) Area of Cross-Section for Partial Flow given Discharge Ratio Formula

Evaluate Formula

Formula

$$a = A\cdot\left(\frac{qsQ_{ratio}}{\left(\frac{N}{n_p}\right)\cdot\left(\frac{r_{pf}}{R_{rf}}\right)^{\frac{1}{6}}}\right)$$

Example with Units

$$3.7884\,\text{m}^2 = 5.4\,\text{m}^2\cdot\left(\frac{0.532}{\left(\frac{0.74}{0.9}\right)\cdot\left(\frac{3.2\,\text{m}}{5.2\,\text{m}}\right)^{\frac{1}{6}}}\right)$$

1.5) Area of Cross-section for Partial Flow given Hydraulic Mean Depth and Discharge Ratio Formula

Evaluate Formula

Formula

$$a = A \cdot \left(\frac{qsQ_{ratio}}{\left(\frac{N}{n_p} \right) \cdot \left(R \right)^{\frac{1}{6}}} \right)$$

Example with Units

$$3.794\,\text{m}^2 = 5.4\,\text{m}^2 \cdot \left(\frac{0.532}{\left(\frac{0.74}{0.9} \right) \cdot \left(0.61 \right)^{\frac{1}{6}}} \right)$$

1.6) Area of Cross-Section for Partial Flow given Hydraulic Mean Depth Ratio Formula

Evaluate Formula

Formula

$$a = A \cdot \left(\frac{\frac{q}{Q}}{\left(\frac{N}{n_p} \right) \cdot \left(R \right)^{\frac{1}{6}}} \right)$$

Example with Units

$$3.8357\,\text{m}^2 = 5.4\,\text{m}^2 \cdot \left(\frac{\frac{17.48\,\text{m}^3/\text{s}}{32.5\,\text{m}^3/\text{s}}}{\left(\frac{0.74}{0.9} \right) \cdot \left(0.61 \right)^{\frac{1}{6}}} \right)$$

2) Bed Slope of Circular Sewer Formulas

2.1) Bed Slope for Full Flow given Bed Slope for Partial Flow Formula

Evaluate Formula

Formula

$$s = \frac{s_s \cdot r_{pf}}{R_{rf}}$$

Example with Units

$$0.0011 = \frac{0.0018 \cdot 3.2\,\text{m}}{5.2\,\text{m}}$$

2.2) Bed Slope for Full Flow given Velocity Ratio Formula

Evaluate Formula

Formula

$$s = \frac{s_s}{\left(\frac{vsV_{ratio}}{\left(\frac{N}{n_p} \right) \cdot \left(\frac{r_{pf}}{R_{rf}} \right)^{\frac{2}{3}}} \right)^2}$$

Example with Units

$$0.0011 = \frac{0.0018}{\left(\frac{0.76}{\left(\frac{0.74}{0.9} \right) \cdot \left(\frac{3.2\,\text{m}}{5.2\,\text{m}} \right)^{\frac{2}{3}}} \right)^2}$$

2.3) Bed Slope for Partial Flow Formula

Evaluate Formula

Formula

$$s_s = \frac{R_{rf} \cdot s}{r_{pf}}$$

Example with Units

$$0.0016 = \frac{5.2\,\text{m} \cdot 0.001}{3.2\,\text{m}}$$

2.4) Bed Slope for Partial Flow given Velocity Ratio Formula

Evaluate Formula

Formula

$$s_s = s \cdot \left(\frac{vsV_{ratio}}{\left(\frac{N}{n_p}\right) \cdot \left(\frac{r_{pf}}{R_{rf}}\right)^{\frac{2}{3}}} \right)^2$$

Example with Units

$$0.0016 = 0.001 \cdot \left(\frac{0.76}{\left(\frac{0.74}{0.9}\right) \cdot \left(\frac{3.2\,m}{5.2\,m}\right)^{\frac{2}{3}}} \right)^2$$

2.5) Ratio of Bed Slope given Velocity Ratio Formula

Evaluate Formula

Formula

$$S = \left(\frac{vsV_{ratio}}{\left(\frac{N}{n_p}\right) \cdot \left(\frac{r_{pf}}{R_{rf}}\right)^{\frac{2}{3}}} \right)^2$$

Example with Units

$$1.6322 = \left(\frac{0.76}{\left(\frac{0.74}{0.9}\right) \cdot \left(\frac{3.2\,m}{5.2\,m}\right)^{\frac{2}{3}}} \right)^2$$

3) Discharge and Discharge Ratio through Circular Sewer Formulas

3.1) Discharge of Full Flow given Hydraulic Mean Depth for Partial flow Formula

Evaluate Formula

Formula

$$Q = \frac{q}{\left(\frac{N}{n_p}\right) \cdot \left(\frac{a}{A}\right) \cdot \left(\frac{r_{pf}}{R_{rf}}\right)^{\frac{1}{6}}}$$

Example with Units

$$32.757\,m^3/s = \frac{17.48\,m^3/s}{\left(\frac{0.74}{0.9}\right) \cdot \left(\frac{3.8\,m^2}{5.4\,m^2}\right) \cdot \left(\frac{3.2\,m}{5.2\,m}\right)^{\frac{1}{6}}}$$

3.2) Discharge of Full Flow given Hydraulic Mean Depth Ratio Formula

Evaluate Formula

Formula

$$Q = \frac{q}{\left(\frac{N}{n_p}\right) \cdot \left(\frac{a}{A}\right) \cdot (R)^{\frac{1}{6}}}$$

Example with Units

$$32.8051\,m^3/s = \frac{17.48\,m^3/s}{\left(\frac{0.74}{0.9}\right) \cdot \left(\frac{3.8\,m^2}{5.4\,m^2}\right) \cdot (0.61)^{\frac{1}{6}}}$$

3.3) Discharge Ratio given Hydraulic Mean Depth for Full Flow Formula

Evaluate Formula

Formula

$$qsQ_{ratio} = \left(\frac{N}{n_p}\right) \cdot \left(\frac{a}{A}\right) \cdot \left(\frac{r_{pf}}{R_{rf}}\right)^{\frac{1}{6}}$$

Example with Units

$$0.5336 = \left(\frac{0.74}{0.9}\right) \cdot \left(\frac{3.8\,m^2}{5.4\,m^2}\right) \cdot \left(\frac{3.2\,m}{5.2\,m}\right)^{\frac{1}{6}}$$

3.4) Discharge Ratio given Hydraulic Mean Depth Ratio Formula

Evaluate Formula

Formula

$$qsQ_{ratio} = \left(\frac{N}{n_p}\right) \cdot \left(\frac{a}{A}\right) \cdot (R)^{\frac{1}{6}}$$

Example with Units

$$0.5328 = \left(\frac{0.74}{0.9}\right) \cdot \left(\frac{3.8\,m^2}{5.4\,m^2}\right) \cdot (0.61)^{\frac{1}{6}}$$

3.5) Self Cleansing Discharge given Hydraulic Mean Depth for Full Flow Formula

Evaluate Formula

Formula

$$q = Q \cdot \left(\left(\frac{N}{n_p} \right) \cdot \left(\frac{a}{A} \right) \cdot \left(\frac{r_{pf}}{R_{rf}} \right)^{\frac{1}{6}} \right)$$

Example with Units

$$17.3428\,\text{m}^3/\text{s} = 32.5\,\text{m}^3/\text{s} \cdot \left(\left(\frac{0.74}{0.9} \right) \cdot \left(\frac{3.8\,\text{m}^2}{5.4\,\text{m}^2} \right) \cdot \left(\frac{3.2\,\text{m}}{5.2\,\text{m}} \right)^{\frac{1}{6}} \right)$$

3.6) Self Cleansing Discharge given Hydraulic Mean Depth Ratio Formula

Evaluate Formula

Formula

$$q = Q \cdot \left(\left(\frac{N}{n_p} \right) \cdot \left(\frac{a}{A} \right) \cdot \left(R \right)^{\frac{1}{6}} \right)$$

Example with Units

$$17.3175\,\text{m}^3/\text{s} = 32.5\,\text{m}^3/\text{s} \cdot \left(\left(\frac{0.74}{0.9} \right) \cdot \left(\frac{3.8\,\text{m}^2}{5.4\,\text{m}^2} \right) \cdot \left(0.61 \right)^{\frac{1}{6}} \right)$$

4) Flow Velocity through Circular Sewer Formulas

4.1) Self Cleansing Velocity given Bed Slope for Partial Flow Formula

Evaluate Formula

Formula

$$V_s = V \cdot \left(\left(\frac{N}{n_p} \right) \cdot \left(\frac{r_{pf}}{R_{rf}} \right)^{\frac{2}{3}} \cdot \sqrt{\frac{s_s}{s}} \right)$$

Example with Units

$$4.7966\,\text{m/s} = 6.01\,\text{m/s} \cdot \left(\left(\frac{0.74}{0.9} \right) \cdot \left(\frac{3.2\,\text{m}}{5.2\,\text{m}} \right)^{\frac{2}{3}} \cdot \sqrt{\frac{0.0018}{0.001}} \right)$$

4.2) Self Cleansing Velocity given Hydraulic Mean Depth for Full Flow Formula

Evaluate Formula

Formula

$$V_s = V \cdot \left(\left(\frac{N}{n_p} \right) \cdot \left(\frac{r_{pf}}{R_{rf}} \right)^{\frac{1}{6}} \right)$$

Example with Units

$$4.5574\,\text{m/s} = 6.01\,\text{m/s} \cdot \left(\left(\frac{0.74}{0.9} \right) \cdot \left(\frac{3.2\,\text{m}}{5.2\,\text{m}} \right)^{\frac{1}{6}} \right)$$

4.3) Self Cleansing Velocity given Hydraulic Mean Depth Ratio Formula

Evaluate Formula

Formula

$$V_s = V \cdot \left(\frac{N}{n_p}\right) \cdot \left(R\right)^{\frac{1}{6}}$$

Example with Units

$$4.5508\,\text{m/s} = 6.01\,\text{m/s} \cdot \left(\frac{0.74}{0.9}\right) \cdot \left(0.61\right)^{\frac{1}{6}}$$

4.4) Self Cleansing Velocity using Ratio of Bed Slope Formula

Evaluate Formula

Formula

$$V_s = V \cdot \left(\left(\frac{N}{n_p}\right) \cdot \left(\frac{r_{pf}}{R_{rf}}\right)^{\frac{2}{3}} \cdot \sqrt{S}\right)$$

Example with Units

$$4.7966\,\text{m/s} = 6.01\,\text{m/s} \cdot \left(\left(\frac{0.74}{0.9}\right) \cdot \left(\frac{3.2\,\text{m}}{5.2\,\text{m}}\right)^{\frac{2}{3}} \cdot \sqrt{1.8}\right)$$

4.5) Velocity of Full Flow given Hydraulic Mean Depth for Full Flow Formula

Evaluate Formula

Formula

$$V = \frac{V_s}{\left(\frac{N}{n_p}\right) \cdot \left(\frac{r_{pf}}{R_{rf}}\right)^{\frac{1}{6}}}$$

Example with Units

$$6.0661\,\text{m/s} = \frac{4.6\,\text{m/s}}{\left(\frac{0.74}{0.9}\right) \cdot \left(\frac{3.2\,\text{m}}{5.2\,\text{m}}\right)^{\frac{1}{6}}}$$

4.6) Velocity of Full Flow given Hydraulic Mean Depth Ratio Formula

Evaluate Formula

Formula

$$V = \frac{V_s}{\left(\frac{N}{n_p}\right) \cdot \left(R\right)^{\frac{1}{6}}}$$

Example with Units

$$6.075\,\text{m/s} = \frac{4.6\,\text{m/s}}{\left(\frac{0.74}{0.9}\right) \cdot \left(0.61\right)^{\frac{1}{6}}}$$

4.7) Velocity Ratio given Hydraulic Mean Depth Ratio Formula

Evaluate Formula

Formula

$$vsV_{ratio} = \left(\left(\frac{N}{n_p}\right) \cdot \left(R\right)^{\frac{1}{6}}\right)$$

Example

$$0.7572 = \left(\left(\frac{0.74}{0.9}\right) \cdot \left(0.61\right)^{\frac{1}{6}}\right)$$

4.8) Velocity Ratio given Ratio of Bed Slope Formula

Evaluate Formula

Formula

$$vsV_{ratio} = \left(\frac{N}{n_p}\right) \cdot \left(\frac{r_{pf}}{R_{rf}}\right)^{\frac{2}{3}} \cdot \sqrt{S}$$

Example with Units

$$0.7981 = \left(\frac{0.74}{0.9}\right) \cdot \left(\frac{3.2\,\text{m}}{5.2\,\text{m}}\right)^{\frac{2}{3}} \cdot \sqrt{1.8}$$

4.9) Velocity when Running Full using Bed Slope for Partial Flow Formula

Evaluate Formula

Formula

$$V = \frac{V_s}{\left(\frac{N}{n_p}\right) \cdot \left(\frac{r_{pf}}{R_{rf}}\right)^{\frac{2}{3}} \cdot \sqrt{\frac{s_s}{s}}}$$

Example with Units

$$5.7637\,\text{m/s} = \frac{4.6\,\text{m/s}}{\left(\frac{0.74}{0.9}\right) \cdot \left(\frac{3.2\,\text{m}}{5.2\,\text{m}}\right)^{\frac{2}{3}} \cdot \sqrt{\frac{0.0018}{0.001}}}$$

4.10) Velocity when Running Full using Ratio of Bed Slope Formula

Evaluate Formula

Formula

$$V = \frac{V_s}{\left(\frac{N}{n_p}\right) \cdot \left(\frac{r_{pf}}{R_{rf}}\right)^{\frac{2}{3}} \cdot \sqrt{S}}$$

Example with Units

$$5.7637\,\text{m/s} = \frac{4.6\,\text{m/s}}{\left(\frac{0.74}{0.9}\right) \cdot \left(\frac{3.2\,\text{m}}{5.2\,\text{m}}\right)^{\frac{2}{3}} \cdot \sqrt{1.8}}$$

Variables used in list of Proportionate Hydraulic Elements for Circular Sewers Formulas above

- **a** Area of Partially Full Sewers *(Square Meter)*
- **A** Area of Running Full Sewers *(Square Meter)*
- **N** Roughness Coefficient for Running Full
- n_p Roughness Coefficient Partially Full
- **q** Discharge when Pipe is Running Partially Full *(Cubic Meter per Second)*
- **Q** Discharge when Pipe is Running Full *(Cubic Meter per Second)*
- qsQ_{ratio} Discharge Ratio
- **R** Hydraulic Mean Depth Ratio
- r_{pf} Hydraulic Mean Depth for Partially Full *(Meter)*
- R_{rf} Hydraulic Mean Depth while Running Full *(Meter)*
- **s** Bed Slope of Channel
- **S** Bed Slope Ratio
- s_s Bed Slope of Partial Flow
- **V** Velocity While Running Full *(Meter per Second)*
- V_s Velocity in a Partially Running Sewer *(Meter per Second)*
- vsV_{ratio} Velocity Ratio

Constants, Functions, Measurements used in list of Proportionate Hydraulic Elements for Circular Sewers Formulas above

- 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: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m³/s)
  Volumetric Flow Rate Unit Conversion

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