# Important Circular Sewer Section Running Full Formulas PDF

Formulas
Examples
with Units

## List of 37
### Important Circular Sewer Section Running Full Formulas

### 1) Area of Cross-Section given Discharge Formula

Evaluate Formula

Formula

$$A = \frac{Q}{V}$$

Example with Units

$$5.4077\,\text{m}^2 = \frac{32.5\,\text{m}^3/\text{s}}{6.01\,\text{m/s}}$$

### 2) Diameter of pipe given Area of Cross-section Formula

Evaluate Formula

Formula

$$D_{pipe} = \left( \frac{a}{\left(\frac{\pi}{4}\right) \cdot \left( \left( \frac{\angle_{central}}{360 \cdot \frac{\pi}{180}} \right) - \left( \frac{\sin\left(\angle_{central}\right)}{2 \cdot \pi} \right) \right)} \right)^{\frac{1}{2}}$$

Example with Units

$$4.9748\,\text{m} = \left( \frac{3.8\,\text{m}^2}{\left(\frac{3.1416}{4}\right) \cdot \left( \left( \frac{120^\circ}{360 \cdot \frac{3.1416}{180}} \right) - \left( \frac{\sin\left(120^\circ\right)}{2 \cdot 3.1416} \right) \right)} \right)^{\frac{1}{2}}$$

### 3) Diameter of Pipe using Hydraulic Mean Depth Formula

Evaluate Formula

Formula

$$D_{pipe} = \frac{r_{pf}}{\left(\frac{1}{4}\right) \cdot \left( 1 - \left( \frac{\left(360 \cdot \frac{\pi}{180}\right) \cdot \sin\left(\angle_{central}\right)}{2 \cdot \pi \cdot \angle_{central}} \right) \right)}$$

Example with Units

$$21.8243\,\text{m} = \frac{3.2\,\text{m}}{\left(\frac{1}{4}\right) \cdot \left( 1 - \left( \frac{\left(360 \cdot \frac{3.1416}{180}\right) \cdot \sin\left(120^\circ\right)}{2 \cdot 3.1416 \cdot 120^\circ} \right) \right)}$$

### 4) Discharge when Pipe is Running Full Formula

Evaluate Formula

Formula

$$Q = V \cdot A$$

Example with Units

$$32.454\,\text{m}^3/\text{s} = 6.01\,\text{m/s} \cdot 5.4\,\text{m}^2$$

### 5) Hydraulic Mean Depth using Central Angle Formula

Evaluate Formula

Formula

$$r_{pf} = \left(\frac{D_{pipe}}{4}\right) \cdot \left(1 - \left(\frac{\left(360 \cdot \frac{\pi}{180}\right) \cdot \sin\left(\angle_{central}\right)}{2 \cdot \pi \cdot \angle_{central}}\right)\right)$$

Example with Units

$$0.3871\,\text{m} = \left(\frac{2.64\,\text{m}}{4}\right) \cdot \left(1 - \left(\frac{\left(360 \cdot \frac{3.1416}{180}\right) \cdot \sin\left(120°\right)}{2 \cdot 3.1416 \cdot 120°}\right)\right)$$

### 6) Velocity while Running Full given Discharge Formula

Evaluate Formula

Formula

$$V = \frac{Q}{A}$$

Example with Units

$$6.0185\,\text{m/s} = \frac{32.5\,\text{m}^3/\text{s}}{5.4\,\text{m}^2}$$

## 7) Proportionate Area Formulas

### 7.1) Area of Cross-section given Proportionate Area Formula

Evaluate Formula

Formula

$$A = \frac{a}{P_a}$$

Example with Units

$$5.4054\,\text{m}^2 = \frac{3.8\,\text{m}^2}{0.703}$$

### 7.2) Proportionate Area given Area of Cross-section Formula

Evaluate Formula

Formula

$$P_a = \frac{a}{A}$$

Example with Units

$$0.7037 = \frac{3.8\,\text{m}^2}{5.4\,\text{m}^2}$$

### 7.3) Proportionate Area given Central Angle Formula

Evaluate Formula

Formula

$$P_a = \left(\left(\frac{\angle_{central}}{360 \cdot \frac{\pi}{180}}\right) - \left(\frac{\sin\left(\angle_{central}\right)}{2 \cdot \pi}\right)\right)$$

Example with Units

$$0.1955 = \left(\left(\frac{120°}{360 \cdot \frac{3.1416}{180}}\right) - \left(\frac{\sin\left(120°\right)}{2 \cdot 3.1416}\right)\right)$$

## 8) Proportionate Depth Formulas

### 8.1) Depth of Partial Flow given Proportionate Depth Formula

Evaluate Formula

Formula

$$d = P_d \cdot D_{pipe}$$

Example with Units

$$2.1991\,\text{m} = 0.833 \cdot 2.64\,\text{m}$$

### 8.2) Diameter of Pipe given Proportionate Depth Formula

Evaluate Formula

Formula

$$D_{pipe} = \frac{d}{P_d}$$

Example with Units

$$2.6411\,\text{m} = \frac{2.2\,\text{m}}{0.833}$$

### 8.3) Proportionate Depth given Central Angle Formula

Evaluate Formula

Formula

$$P_d = \left(\frac{1}{2}\right) \cdot \left(1 - \cos\left(\frac{\angle_{central}}{2}\right)\right)$$

Example with Units

$$0.25 = \left(\frac{1}{2}\right) \cdot \left(1 - \cos\left(\frac{120°}{2}\right)\right)$$

### 8.4) Proportionate Depth given Diameter of Pipe Formula

Evaluate Formula

Formula

$$P_d = \frac{d}{D_{pipe}}$$

Example with Units

$$0.8333 = \frac{2.2\,\text{m}}{2.64\,\text{m}}$$

## 9) Proportionate Discharge Formulas

### 9.1) Area of Cross-section while Running Full given Proportionate Discharge Formula

Evaluate Formula

Formula

$$A = \frac{a \cdot V_s}{V \cdot P_q}$$

Example with Units

$$5.4061\,\text{m}^2 = \frac{3.8\,\text{m}^2 \cdot 4.6\,\text{m/s}}{6.01\,\text{m/s} \cdot 0.538}$$

### 9.2) Discharge when Pipe is Running Full using Proportionate Discharge Formula

Evaluate Formula

Formula

$$Q = \left(\frac{q}{P_q}\right)$$

Example with Units

$$32.4907\,\text{m}^3/\text{s} = \left(\frac{17.48\,\text{m}^3/\text{s}}{0.538}\right)$$

### 9.3) Proportionate Discharge given Area of Cross-Section Formula

Evaluate Formula

Formula

$$P_q = \frac{V_s \cdot a}{V \cdot A}$$

Example with Units

$$0.5386 = \frac{4.6\,\text{m/s} \cdot 3.8\,\text{m}^2}{6.01\,\text{m/s} \cdot 5.4\,\text{m}^2}$$

### 9.4) Proportionate Discharge given Central Angle Formula

Evaluate Formula

Formula

$$P_q = \left(\left(\frac{\angle_{central}}{360 \cdot \frac{\pi}{180}}\right) - \left(\frac{\sin\left(\angle_{central}\right)}{2 \cdot \pi}\right)\right) \cdot \left(1 - \frac{\left(360 \cdot \frac{\pi}{180}\right) \cdot \sin\left(\angle_{central}\right)}{2 \cdot \pi \cdot \angle_{central}}\right)$$

Example with Units

$$0.1147 = \left(\left(\frac{120°}{360 \cdot \frac{3.1416}{180}}\right) - \left(\frac{\sin\left(120°\right)}{2 \cdot 3.1416}\right)\right) \cdot \left(1 - \frac{\left(360 \cdot \frac{3.1416}{180}\right) \cdot \sin\left(120°\right)}{2 \cdot 3.1416 \cdot 120°}\right)$$

### 9.5) Proportionate Discharge using Discharge when Pipe Running Full Formula

Evaluate Formula

Formula

$$P_q = \frac{q}{Q}$$

Example with Units

$$0.5378 = \frac{17.48\,\text{m}^3/\text{s}}{32.5\,\text{m}^3/\text{s}}$$

### 9.6) Velocity while Running Full given Proportionate Discharge Formula

Evaluate Formula

Formula

$$V = \frac{V_s \cdot a}{P_q \cdot A}$$

Example with Units

$$6.0168\,\text{m/s} = \frac{4.6\,\text{m/s} \cdot 3.8\,\text{m}^2}{0.538 \cdot 5.4\,\text{m}^2}$$

## 10) Proportionate Hydraulic Mean Depth Formulas

### 10.1) Hydraulic Mean Depth while Running Full given Proportionate Hydraulic Mean Depth Formula

Evaluate Formula

Formula

$$R_{rf} = \left(\frac{r_{pf}}{P_{hmd}}\right)$$

Example with Units

$$5.2033\,\text{m} = \left(\frac{3.2\,\text{m}}{0.615}\right)$$

### 10.2) Proportionate Hydraulic Mean Depth given Central Angle Formula

Evaluate Formula

Formula

$$P_{hmd} = \left(1 - \frac{\left(360 \cdot \frac{\pi}{180}\right) \cdot \sin\left(\angle_{central}\right)}{2 \cdot \pi \cdot \angle_{central}}\right)$$

Example with Units

$$0.5865 = \left(1 - \frac{\left(360 \cdot \frac{3.1416}{180}\right) \cdot \sin\left(120°\right)}{2 \cdot 3.1416 \cdot 120°}\right)$$

### 10.3) Proportionate Hydraulic Mean Depth given Hydraulic Mean Depth while Running Partially Full Formula

Evaluate Formula

Formula

$$P_{hmd} = \frac{r_{pf}}{R_{rf}}$$

Example with Units

$$0.6154 = \frac{3.2\,\text{m}}{5.2\,\text{m}}$$

## 11) Proportionate Perimeter Formulas

### 11.1) Central Angle given Proportionate Perimeter Formula

Evaluate Formula

Formula

$$\angle_{central} = \left(P_p \cdot \left(360 \cdot \frac{\pi}{180}\right)\right)$$

Example with Units

$$187.2° = \left(0.520 \cdot \left(360 \cdot \frac{3.1416}{180}\right)\right)$$

### 11.2) Proportionate Perimeter given Central Angle Formula

Evaluate Formula

Formula

$$P_p = \left(\frac{\angle_{central}}{360 \cdot \frac{\pi}{180}}\right)$$

Example with Units

$$0.3333 = \left(\frac{120°}{360 \cdot \frac{3.1416}{180}}\right)$$

### 11.3) Proportionate Perimeter given Wetted Perimeter Formula

Evaluate Formula

Formula

$$P_p = \frac{P_w}{P}$$

Example with Units

$$0.5208 = \frac{6.25\,\text{m}}{12\,\text{m}}$$

# 12) Proportionate Velocity Formulas

## 12.1) Hydraulic Mean Depth while Running Full given Proportionate Velocity Formula

Evaluate Formula

Formula

$$R_{rf} = \left( \frac{\left( r_{pf} \right)^{\frac{2}{3}}}{P_v} \right)^{\frac{3}{2}}$$

Example with Units

$$4.7825\,\text{m} = \left( \frac{\left( 3.2\,\text{m} \right)^{\frac{2}{3}}}{0.765} \right)^{\frac{3}{2}}$$

## 12.2) Proportionate Velocity given Central Angle Formula

Evaluate Formula

Formula

$$P_v = \left( 1 - \frac{\left( 360 \cdot \frac{\pi}{180} \right) \cdot \sin\left( \angle_{central} \right)}{2 \cdot \pi \cdot \angle_{central}} \right)^{\frac{2}{3}}$$

Example with Units

$$0.7007 = \left( 1 - \frac{\left( 360 \cdot \frac{3.1416}{180} \right) \cdot \sin\left( 120° \right)}{2 \cdot 3.1416 \cdot 120°} \right)^{\frac{2}{3}}$$

## 12.3) Proportionate Velocity given Roughness Coefficient Formula

Evaluate Formula

Formula

$$P_v = \left( \frac{N}{n_p} \right) \cdot \left( \frac{r_{pf}}{r_{pf}} \right)^{\frac{2}{3}}$$

Example with Units

$$0.8222 = \left( \frac{0.74}{0.9} \right) \cdot \left( \frac{3.2\,\text{m}}{3.2\,\text{m}} \right)^{\frac{2}{3}}$$

## 12.4) Proportionate Velocity given Velocity while Running Partially Full Formula

Evaluate Formula

Formula

$$P_v = \frac{V_s}{V}$$

Example with Units

$$0.7654 = \frac{4.6\,\text{m/s}}{6.01\,\text{m/s}}$$

## 12.5) Proportionate Velocity when Roughness Coefficient does not Vary with Depth Formula

Evaluate Formula

Formula

$$P_v = \left( \frac{r_{pf}}{R_{rf}} \right)^{\frac{2}{3}}$$

Example with Units

$$0.7235 = \left( \frac{3.2\,\text{m}}{5.2\,\text{m}} \right)^{\frac{2}{3}}$$

### 12.6) Roughness Coefficient while Running Full given Proportionate Velocity Formula

Evaluate Formula

Formula

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

Example with Units

$$0.9516 = \frac{0.765 \cdot 0.9}{\left(\frac{3.2\,\text{m}}{5.2\,\text{m}}\right)^{\frac{2}{3}}}$$

### 12.7) Velocity while Running Full given Proportionate Velocity Formula

Evaluate Formula

Formula

$$V = \frac{V_s}{P_v}$$

Example with Units

$$6.0131\,\text{m/s} = \frac{4.6\,\text{m/s}}{0.765}$$

## 13) Wetted Perimeter Formulas

### 13.1) Central Angle given Wetted Perimeter Formula

Evaluate Formula

Formula

$$\angle_{central} = \frac{P_w \cdot \left(360 \cdot \frac{\pi}{180}\right)}{\pi \cdot D_{pipe}}$$

Example with Units

$$271.2868° = \frac{6.25\,\text{m} \cdot \left(360 \cdot \frac{3.1416}{180}\right)}{3.1416 \cdot 2.64\,\text{m}}$$

### 13.2) Diameter of Pipe given Wetted Perimeter Formula

Evaluate Formula

Formula

$$D_{pipe} = \frac{P_w \cdot \left(360 \cdot \frac{\pi}{180}\right)}{\pi \cdot \angle_{central}}$$

Example with Units

$$5.9683\,\text{m} = \frac{6.25\,\text{m} \cdot \left(360 \cdot \frac{3.1416}{180}\right)}{3.1416 \cdot 120°}$$

### 13.3) Wetted Perimeter given Central Angle Formula

Evaluate Formula

Formula

$$P_w = \frac{\pi \cdot D_{pipe} \cdot \angle_{central}}{360 \cdot \frac{\pi}{180}}$$

Example with Units

$$2.7646\,\text{m} = \frac{3.1416 \cdot 2.64\,\text{m} \cdot 120°}{360 \cdot \frac{3.1416}{180}}$$

### 13.4) Wetted Perimeter given Proportionate Perimeter Formula

Evaluate Formula

Formula

$$P_w = P_p \cdot P$$

Example with Units

$$6.24\,\text{m} = 0.520 \cdot 12\,\text{m}$$

### 13.5) Wetted Perimeter while Running Full given Proportionate Perimeter Formula

Evaluate Formula

Formula

$$P = \frac{P_w}{P_p}$$

Example with Units

$$12.0192\,\text{m} = \frac{6.25\,\text{m}}{0.520}$$

## Variables used in list of Circular Sewer Section Running Full Formulas above

- $\angle_{central}$ Central Angle *(Degree)*
- **a** Area of Partially Full Sewers *(Square Meter)*
- **A** Area of Running Full Sewers *(Square Meter)*
- **d** Depth at Partial Flow *(Meter)*
- $D_{pipe}$ Diameter of Pipe *(Meter)*
- **N** Roughness Coefficient for Running Full
- $n_p$ Roughness Coefficient Partially Full
- **P** Wetted Perimeter *(Meter)*
- $P_a$ Proportionate Area
- $P_d$ Proportionate Depth
- $P_{hmd}$ Proportionate Hydraulic Mean Depth
- $P_p$ Proportionate perimeter
- $P_q$ Proportionate Discharge
- $P_v$ Proportionate Velocity
- $P_w$ Wetted Perimeter for Partial Flow *(Meter)*
- **q** Discharge when Pipe is Running Partially Full *(Cubic Meter per Second)*
- **Q** Discharge when Pipe is Running Full *(Cubic Meter per Second)*
- $r_{pf}$ Hydraulic Mean Depth for Partially Full *(Meter)*
- $R_{rf}$ Hydraulic Mean Depth while Running Full *(Meter)*
- **V** Velocity While Running Full *(Meter per Second)*
- $V_s$ Velocity in a Partially Running Sewer *(Meter per Second)*

## Constants, Functions, Measurements used in list of Circular Sewer Section Running Full Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- 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: **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: **Area** in Square Meter (m²) *Area Unit Conversion*
- Measurement: **Speed** in Meter per Second (m/s) *Speed 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*

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