Partly Full Circular Pipe: Area, Hydraulic Radius and Manning Flow

Flow area, wetted perimeter, hydraulic radius, Manning velocity and discharge of a circular pipe flowing partly full, with the ratios to the full-pipe values.

Method: Manning's equation for a part-full circular section

Input parameters

Unit system: SI

Parameter	Value	Unit
Pipe internal diameter	600.00	mm
Flow depth	360.00	mm
Pipe slope	0.40000	%
Manning roughness	0.013000	

Calculated results

Parameter	Value	Unit
Central angle subtended by the water surface	203.07	°
Flow area	0.17713	m²
Wetted perimeter	1.0633	m
Hydraulic radius	166.59	mm
Velocity	1.4729	m/s
Discharge	260.90	L/s
Discharge relative to full	67.184	%
Velocity relative to full	107.24	%

Notes for this case

- Manning's equation with the circular-segment geometry, constant n. The maximum discharge occurs at about 0.94D and the maximum velocity at about 0.81D, both slightly above full-pipe values.

Formula and method

$$\theta = 2\cos^{-1}\left(1-\frac{2y}{D}\right), \quad A = \frac{D^2}{8}(\theta - \sin\theta), \quad P = \frac{D\theta}{2}, \quad V = \frac{1}{n}R^{2/3}S^{1/2}$$

Variables

D	Pipe internal diameter	m
y	Flow depth	m
S	Pipe slope	-
n	Manning roughness	-
θ	Central angle subtended by the water surface	rad
A	Flow area	m²
P	Wetted perimeter	m
R	Hydraulic radius	m
V	Velocity	m/s
Q	Discharge	m³/s
Q/Q_{full}	Discharge relative to full	-

V/V_{full}	Velocity relative to full	-

Method and standards

Circular-segment geometry with Manning's equation.

Assumptions and limits

- Uniform flow, constant Manning n.

References

Manning's equation for a part-full circular section

Report details

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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/civil/hydraulics/partially-full-circular-pipe

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.