Hazen–Williams Head Loss in Water Pipes

Friction head loss and pressure drop for water in a full pipe by the Hazen–Williams formula, from flow, diameter, length and the C factor.

Method: Hazen–Williams formula (SI, k = 0.849)

Input parameters

Unit system: SI

Parameter	Value	Unit
Water flow	50.000	L/s
Pipe inside diameter	200.00	mm
Pipe length	1,000.0	m
Hazen–Williams C factor From your design standard for the pipe material and age; smooth plastic pipes are around 140–150, older steel and cast iron much lower.	120.00	
Water density (for the pressure drop)	998.00	kg/m³

Calculated results

Parameter	Value	Unit
Head loss	14.891	m
Pressure drop	145.74	kPa
Hydraulic gradient (m per 1000 m)	14.891	
Velocity	1.5915	m/s

Notes for this case

- Hazen–Williams applies to water near room temperature in turbulent flow; use Darcy–Weisbach for other liquids or hot water.

Formula and method

$$v = \frac{Q}{\pi D^2/4} \qquad S = \left(\frac{v}{0.849\,C\,R^{0.63}}\right)^{1/0.54},\ R = \frac{D}{4} \qquad h_f = S\,L \qquad \Delta p = \rho g h_f$$

Variables

Q	flow	m³/s
D	inside diameter	m
L	length	m
C	Hazen–Williams factor	–
ρ	water density	kg/m³
h_f	head loss	m
Δp	pressure drop	Pa
S	hydraulic gradient, in m per 1000 m	-
v	velocity	m/s
R	hydraulic radius	m
g	standard gravity	m/s²

Method and standards

Hazen–Williams velocity formula in SI units (k = 0.849), solved for the slope.

Assumptions and limits

- Water near room temperature; full pipe; turbulent flow.

References

- Hazen–Williams formula (SI, k = 0.849)

Report details

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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/hazen-williams-head-loss

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.