Hazen-Williams Equation & C-Factors

Hazen-Williams Equation

The Hazen-Williams formula is an empirically derived equation for circular conduits flowing full in the turbulent flow regime.

The Hazen-Williams formula can be written as:

$$V = 1.318 \, C_{hw} \, R_H^{0.63} \, S^{0.51}$$

Where:

V = Average Velocity of Fluid (ft./sec.)

C_{hw} = Hazen-Williams Friction Factor (no units)

R_H = Hydraulic Radius (ft.)

Area Affected By Skin Friction = $\dfrac{\text{Area of Pipe}}{\text{Wetted Perimeter}}$

S = Slope of hydraulic grade line (no unit).

NOTES:

• For metric units, 1.318 is to be replaced with a factor of 0.845

• Hazen-Williams equation is valid for turbulent flow only.

• Equation and factors have been derived and are valid for water only. Properties for other fluids cannot be taken into account.

Values of Friction Factor C

Values of Friction Factor C to be used with the Hazen-Williams Formula.

TYPE OF PIPE	AGE	CONDITION/ SIZE	C
Vitrified Clay	In Good Condition		110
Concrete	Large Sizes, Good Workmanship, Steel Forms		140
	Large Sizes, Good Workmanship, Wooden Forms		120
	Centrifugally Spun		120
Wood Stave	All	All	120
Ductile Iron (cement lined)	New	All Sizes	145
	20 Years		140
	60 Years		130
Cast Iron	New	All Sizes	150
	5 Years	12"	120
		8"	119
		4"	118
	10 Years	24"	115
		12"	111
		4"	107
	20 Years	24"	100
		12"	100
		4"	100
	30 Years	30"	100
		16"	100
		4"	100
	40 Years	30"	100
		16"	100
		4"	100
		40"	100
		24"	100
		4"	100
Welded Steel	C the same as Cast Iron Pipe but 5 years older		
Riveted Steel	C the same as Cast Iron Pipe but 10 years older		

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