Drip or Sprinkler Lateral Friction Loss (Christiansen Factor)

Friction loss along a drip or sprinkler lateral with many equally spaced outlets, from the full-flow Hazen–Williams loss and Christiansen's factor.

Input parameters

Unit system: SI

Parameter	Value	Unit
Lateral length	100.00	m
Outlet (emitter) spacing	0.60000	m
Flow per outlet (litres per hour)	2.0000	
Lateral inside diameter	13.800	mm
Hazen–Williams coefficient	150.00	
Operating pressure head at the inlet	10.000	m

Calculated results

Parameter	Value	Unit
Number of outlets	166.00	
Inlet flow	332.00	L/h
Christiansen factor	0.35365	
Friction loss along the lateral	1.3584	m
Loss as a share of the operating head	13.584	%

Notes for this case

• Flow in a lateral falls as each outlet takes its share, so friction is much less than if the full flow ran the whole length. Christiansen's factor F = 1/(m+1) + 1/(2N) + √(m−1)/(6N²), with m = 1.852 for Hazen–Williams, scales the full-flow loss; for many outlets it approaches 0.35. Keep the lateral loss within about 20 % of the operating head (10 % flow variation for typical emitters), or use a larger pipe or feed from the middle.

Formula and method

$$F = \frac{1}{m+1} + \frac{1}{2N} + \frac{\sqrt{m-1}}{6N^2}, \quad h_f = F\,\frac{10.67\,L\,Q^{1.852}}{C^{1.852}\,d^{4.87}}$$

Variables

L	Lateral length	m
s	Outlet (emitter) spacing	m
q	Flow per outlet (litres per hour)	-
d	Lateral inside diameter	m
C	Hazen–Williams coefficient	-
h	Operating pressure head at the inlet	m
N	Number of outlets	-
Q	Inlet flow	m³/s
F	Christiansen factor	-
h_f	Friction loss along the lateral	m
h_f/h	Loss as a share of the operating head	-

Method and standards

Christiansen factor.

Assumptions and limits

- Equal outlets, equal spacing, level lateral, first outlet one spacing from the inlet.

Report details

Report reference	FCC-FC6N-MZBX (the same inputs always give the same reference)
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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/irrigation-farm/drip-lateral-friction-christiansen

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.