Sewer Self-Cleansing Velocity and Minimum Slope (Camp)

Velocity and slope that keep a grit particle moving in a sewer by Camp's critical shear relation, and the full-bore flow at that slope.

Method: Camp's self-cleansing velocity

Input parameters

Unit system: SI

Parameter	Value	Unit
Pipe diameter (running full or half full)	300.00	mm
Manning roughness	0.013000	
Dimensionless constant (0.04 start of motion to 0.8 scour)	0.060000	
Specific gravity of the particle	2.6500	
Particle diameter	1.0000	mm

Calculated results

Parameter	Value	Unit
Hydraulic radius D/4	75.000	mm
Self-cleansing velocity	0.49703	m/s
Minimum slope	0.001320	
Full-bore flow at that slope	35.133	L/s

Notes for this case

• A deposit stays moving while the bed shear stress ρgRS exceeds kρg(G_s − 1)d, so the self-cleansing slope is S = k(G_s − 1)d/R and, with Manning's equation, V = (1/n)R^(1/6)√[k(G_s − 1)d] (Camp, after Shields). k ≈ 0.04 starts motion of clean grit and 0.8 is needed to scour sticky deposits; 0.06 is commonly used for sanitary sewers. A circular pipe running full or half full has R = D/4, so the velocity is the same in both. Typical design minima are 0.6 m/s for sanitary and 0.9 m/s for storm sewers.

Formula and method

$$S = \frac{k(G_s - 1)d}{R}, \quad V_s = \frac{1}{n} R^{1/6} \sqrt{k(G_s - 1)d}$$

Variables

D	Pipe diameter (running full or half full)	m
n	Manning roughness	-
k	Dimensionless constant (0.04 start of motion to 0.8 scour)	-
G_s	Specific gravity of the particle	-
d	Particle diameter	m
R	Hydraulic radius D/4	m
V_s	Self-cleansing velocity	m/s
S_{min}	Minimum slope	-
Q	Full-bore flow at that slope	m³/s

Method and standards

Self-cleansing.

Assumptions and limits

- Uniform flow; circular pipe full or half full; non-cohesive particle.

References

Camp's self-cleansing velocity

Report details

Report reference	FCC-SN1F-049B (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/hydraulics/sewer-self-cleansing-velocity

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.