Pipes in Series and Parallel: Equivalent Pipe and Flow Split

Equivalent length of pipes in series (Dupuit) and the equivalent diameter and flow shares of the same pipes in parallel, for equal friction factors.

Method: Dupuit's equivalent pipe and parallel pipe relations with a common friction factor

Input parameters

Unit system: SI

Parameter	Value	Unit
Length, pipe 1	300.00	m
Diameter, pipe 1	300.00	mm
Length, pipe 2	200.00	m
Diameter, pipe 2	250.00	mm
Length, pipe 3 (0 = none)	0	m
Diameter, pipe 3	200.00	mm

Calculated results

Parameter	Value	Unit
Series: equivalent length of diameter D_1	797.66	m
Parallel: equivalent diameter of length L_1	377.52	mm
Parallel: share of flow in pipe 1	56.293	%
Parallel: share in pipe 2	43.707	%
Parallel: share in pipe 3	0	%

Notes for this case

• With the same friction factor, head loss is proportional to $L \cdot Q^2/D^5$. In series the flow is common and losses add, so the pipes equal one pipe of diameter D_1 and length $D_1^5 \cdot \Sigma L_i/D_i^5$ (Dupuit's equation). In parallel the head loss is common and flows add, each proportional to D^2.5/√L; the equivalent single pipe of length L_1 has diameter (√L_1·ΣD_i^2.5/√L_i)^0.4. Different roughness or Reynolds numbers change the friction factors; iterate with the Darcy–Weisbach calculator for accuracy.

Formula and method

$$L_e = D_1^5 \sum \frac{L_i}{D_i^5}, \quad \frac{q_i}{Q} = \frac{D_i^{2.5}/\sqrt{L_i}}{\sum D_j^{2.5}/\sqrt{L_j}}$$

Variables

L_1	Length, pipe 1	m
D_1	Diameter, pipe 1	m
L_2	Length, pipe 2	m
D_2	Diameter, pipe 2	m
L_3	Length, pipe 3 (0 = none)	m
D_3	Diameter, pipe 3	m
L_e	Series: equivalent length of diameter D_1	m
D_e	Parallel: equivalent diameter of length L_1	m
q_1/Q	Parallel: share of flow in pipe 1	-
q_2/Q	Parallel: share in pipe 2	-
q_3/Q	Parallel: share in pipe 3	-

Method and standards

Series and parallel pipes.

Assumptions and limits

- Equal friction factors; minor losses neglected.

References

Dupuit's equivalent pipe and parallel pipe relations with a common friction factor

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

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Reopens the calculator with the inputs of this report.