Earthwork Volume: Prismoidal and Average End Area

Volume of earthwork in cutting or filling between two cross sections by the prismoidal formula and the average end area method, with the loose volume after swell.

Method: Prismoidal formula (Simpson's rule) and average end area method (surveying practice)

Input parameters

Unit system: SI

Parameter	Value	Unit
Area of the first cross section	40.000	m²
Area of the section midway between them	55.000	m²
Area of the second cross section	75.000	m²
Distance between the first and second sections	30.000	m
Swell (bulking) on excavation	25.000	%

Calculated results

Parameter	Value	Unit
Volume, prismoidal formula	1,675.0	m³
Volume, average end area	1,725.0	m³
End-area minus prismoidal volume (positive: end area over-estimates)	50.000	m³
Loose volume to haul (prismoidal × swell)	2,093.8	m³

Notes for this case

• The middle area is measured at the middle section, not averaged from the ends. Add the sections of a long road or channel pair by pair.

Formula and method

$$V_p = \frac{L}{6}(A_1 + 4A_m + A_2)$$

$$V_e = \frac{L}{2}(A_1 + A_2), \quad V_l = V_p(1 + k_s)$$

Variables

A_1	Area of the first cross section	m²
A_m	Area of the section midway between them	m²
A_2	Area of the second cross section	m²
L	Distance between the first and second sections	m
k_s	Swell (bulking) on excavation	-
V_p	Volume, prismoidal formula	m³
V_e	Volume, average end area	m³
$V_e - V_p$	End-area minus prismoidal volume (positive: end area over-estimates)	m³
V_l	Loose volume to haul (prismoidal × swell)	m³

Method and standards

The prismoidal formula is Simpson's rule applied to the cross-section areas; the average end area method is the trapezoidal rule.

Assumptions and limits

- Sections measured square to the centre line.

- Swell factor from soil type.
- The end-area method usually over-estimates; when the middle area exceeds the mean of the end areas it under-estimates and V_e − V_p is negative.

References

- Prismoidal formula (Simpson's rule) and average end area method (surveying practice)

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/quantities/earthwork-prismoidal-volume

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.