Area from Offsets: Trapezoidal and Simpson's Rules

Area between a survey line and an irregular boundary from equally spaced offsets by the trapezoidal rule and Simpson's one-third rule, with up to seven offsets.

Method: Offset area rules

Input parameters

Unit system: SI

Parameter	Value	Unit
Offset spacing	10.000	m
Number of offsets used (2–7)	7.0000	
Offset 1	0	m
Offset 2	2.6500	m
Offset 3	3.8000	m
Offset 4	3.7500	m
Offset 5	4.6500	m
Offset 6	3.6000	m
Offset 7	4.9500	m

Calculated results

Parameter	Value	Unit
Area, trapezoidal rule	209.25	m²
Area, Simpson's rule (trapezoid on a last odd strip)	206.17	m²
Area, average ordinate rule	200.57	m²
Length of the base line	60.000	m

Notes for this case

• Trapezoidal: A = d[(o₁ + o_n)/2 + o₂ + … + o_{n−1}], treating the boundary as straight between offsets. Simpson's one-third rule fits parabolic arcs over pairs of strips, A = (d/3)[o₁ + o_n + 4Σ(even) + 2Σ(odd)], and needs an even number of strips; with an odd number, the last strip is added by the trapezoidal rule. Simpson's rule is usually closer for curved boundaries. Average ordinate: mean offset × base length.

Formula and method

$$A_T = d\left[\frac{o_1 + o_n}{2} + \sum_{i=2}^{n-1} o_i\right], \quad A_S = \frac{d}{3}\left[o_1 + o_n + 4\sum o_{even} + 2\sum o_{odd}\right]$$

Variables

d	Offset spacing	m
n	Number of offsets used (2–7)	-
o_1	Offset 1	m
o_2	Offset 2	m
o_3	Offset 3	m
o_4	Offset 4	m
o_5	Offset 5	m
o_6	Offset 6	m
o_7	Offset 7	m
A_T	Area, trapezoidal rule	m²

A_S	Area, Simpson's rule (trapezoid on a last odd strip)	m²
A_O	Area, average ordinate rule	m²
L	Length of the base line	m

Method and standards

Offset areas.

Assumptions and limits

- Equal spacing; offsets perpendicular to the base line.

References

Offset area rules

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/surveying/area-by-offsets

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Reopens the calculator with the inputs of this report.