Satellite Coverage Footprint, Horizon and Slant Range

Coverage radius and area, Earth central angle, nadir angle and maximum slant range of a satellite at an altitude for a minimum elevation angle seen from the ground.

Method: Spherical-Earth viewing geometry

Input parameters

Unit system: SI

Parameter	Value	Unit
Satellite altitude	550.00	km
Minimum elevation angle at the ground station	25.000	°

Calculated results

Parameter	Value	Unit
Nadir angle to the edge of coverage	56.549	°
Earth central angle (coverage half-angle)	8.4508	°
Coverage radius along the surface	940.74	km
Coverage area	2,775,254	km²
Maximum slant range	1,123.4	km
Fraction of the Earth's surface covered	0.54288	%

Notes for this case

- Spherical Earth (WGS 84 equatorial radius). The footprint is a spherical cap of half-angle λ = 90° − ε − η; with ε = 0 it reaches the geometric horizon.

Formula and method

$$\sin\eta = \frac{R_E\cos\varepsilon}{R_E + h}, \quad \lambda = 90^\circ - \varepsilon - \eta, \quad D_{max} = \frac{R_E\sin\lambda}{\sin\eta}, \quad A_c = 2\pi R_E^2(1-\cos\lambda)$$

Variables

h	Satellite altitude	m
ε_{min}	Minimum elevation angle at the ground station	rad
η	Nadir angle to the edge of coverage	rad
λ	Earth central angle (coverage half-angle)	rad
r_c	Coverage radius along the surface	m
A_c	Coverage area	m²
D_{max}	Maximum slant range	m
A_c/A_{Earth}	Fraction of the Earth's surface covered	-

Method and standards

Satellite viewing geometry.

Assumptions and limits

- Spherical Earth, no terrain masking.

References

Spherical-Earth viewing geometry

Report details

Report reference	FCC-YSHM-A0SZ (the same inputs always give the same reference)
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Calculator	Satellite Coverage Footprint, Horizon and Slant Range
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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/mechanical/aerospace/satellite-coverage-footprint

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.