Curvature and Refraction Correction in Levelling

Curvature and refraction corrections to a levelling staff reading at a sight distance, the combined correction and the visible horizon.

Method: Curvature $D^2/2R$ and refraction $k{\cdot}D^2/2R$ (Punmia, Surveying, vol. 1–2 (Laxmi), vol. 1, ch. 8)

Input parameters

Unit system: SI

Parameter	Value	Unit
Sight distance	1.0000	km
Earth radius	6,370.0	km
Refraction as a fraction of curvature	0.14286	
Observer eye height (for horizon)	1.6000	m

Calculated results

Parameter	Value	Unit
Curvature correction (subtract)	78.493	mm
Refraction correction (add)	11.213	mm
Combined correction (subtract)	67.280	mm
Distance to the visible horizon	4.8766	km

Notes for this case

• With k = 1/7 and R = 6,370 km the combined correction is $0.0673D^2$ m (D in km). Equal fore and back sights cancel both corrections in ordinary levelling.

Formula and method

$$C_c = \frac{D^2}{2R}, \quad C_r = k\frac{D^2}{2R}, \quad C = (1-k)\frac{D^2}{2R} \approx 0.0673D^2 \text{ m } (D \text{ in km})$$

Variables

D	Sight distance	m
R	Earth radius	m
k	Refraction as a fraction of curvature	-
h	Observer eye height (for horizon)	m
C_c	Curvature correction (subtract)	m
C_r	Refraction correction (add)	m
C	Combined correction (subtract)	m
D_h	Distance to the visible horizon	m

Method and standards

Geometry of the earth's curve.

Assumptions and limits

- Spherical earth; standard refraction.

References

• Curvature $D^2/2R$ and refraction $k{\cdot}D^2/2R$ (Punmia, Surveying, vol. 1–2 (Laxmi), vol. 1, ch. 8)

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/curvature-refraction-correction

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.