# Reciprocal Levelling across a River or Valley

True height difference between two points across a wide gap and the combined collimation, curvature and refraction error, from readings taken from both banks.

**Method:** Reciprocal levelling

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Reading on A, level near A | 1.4850 | m |
| Reading on B, level near A | 2.3120 | m |
| Reading on A, level near B | 0.92600 | m |
| Reading on B, level near B | 1.7190 | m |
| Reduced level of A | 100.00 | m |
| Width of the gap | 400.00 | m |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| True fall from A to B | 0.81000 | m |
| Reduced level of B | 99.190 | m |
| Combined error in the long sight | 17.000 | mm |
| Expected curvature and refraction over D (0.0673 D² km) | 10.768 | mm |
| Remaining collimation error | 6.2320 | mm |

**Notes for this case**

- The mean of the two apparent differences cancels collimation, curvature and refraction, which affect the long sight equally from both banks (refraction assumed unchanged between the two sets). Read both sets close together in time.

## Formula and method

$$\Delta h = \frac{(b_1 - a_1) + (b_2 - a_2)}{2}, \quad e = \frac{(b_1 - a_1) - (b_2 - a_2)}{2}, \quad c_{cr} = 0.0673 D^2 \ (D \text{ in km, m})$$

### Variables

| | | |
|---|---|---|
| $a_1$ | Reading on A, level near A | m |
| $b_1$ | Reading on B, level near A | m |
| $a_2$ | Reading on A, level near B | m |
| $b_2$ | Reading on B, level near B | m |
| $RL_A$ | Reduced level of A | m |
| $D$ | Width of the gap | m |
| $\Delta h$ | True fall from A to B | m |
| $RL_B$ | Reduced level of B | m |
| $e$ | Combined error in the long sight | m |
| $c_{cr}$ | Expected curvature and refraction over D (0.0673 D² km) | m |
| $e - c_{cr}$ | Remaining collimation error | m |

### Method and standards

Reciprocal levelling.

### Assumptions and limits

- Same refraction for both sets; both instruments or one instrument used for both.

### References

Reciprocal levelling

## Report details

| | |
|---|---|
| Report reference | FCC-XMP2-0V53 (the same inputs always give the same reference) |
| Generated | 23 November 2026, 18:09 UTC |
| Calculator | Reciprocal Levelling across a River or Valley |
| Method last reviewed | 17 November 2026 |
| Software release | FireCAD Calc, release of 22 November 2026 |
| 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/civil/surveying/reciprocal-levelling

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.