Important Levelling Formulas PDF

Formulas
Examples
with Units

List of 23
Important Levelling Formulas

1) Angle of Dip for Compass Surveying Formula

Evaluate Formula

Formula

$$\theta = \frac{D}{R} \cdot \left(\frac{180}{\pi} \right)$$

Example with Units

$$18.2951° = \frac{35.5\,\text{m}}{6370} \cdot \left(\frac{180}{3.1416} \right)$$

2) Back Sight given Height of Instrument Formula

Evaluate Formula

Formula

$$BS = HI - RL$$

Example with Units

$$36\,\text{m} = 65\,\text{m} - 29\,\text{m}$$

3) Combined Error Due to Curvature and Refraction Formula

Evaluate Formula

Formula

$$c\_r = 0.0673 \cdot D^2$$

Example with Units

$$84.8148\,\text{m} = 0.0673 \cdot 35.5\,\text{m}^2$$

4) Correction on Refraction Error Formula

Evaluate Formula

Formula

$$c_r = 0.0112 \cdot D^2$$

Example with Units

$$14.1148 = 0.0112 \cdot 35.5\,\text{m}^2$$

5) Difference in Elevation between Ground Points in short lines under Trigonometric levelling Formula

Evaluate Formula

Formula

$$\Delta h = D_p \cdot \sin(M) + h_i - h_t$$

Example with Units

$$50.6452\,\text{m} = 80\,\text{m} \cdot \sin(37°) + 22\,\text{m} - 19.5\,\text{m}$$

6) Difference in Elevation between Two Points using Barometric Levelling Formula

Evaluate Formula

Formula

$$D_p = 18336.6 \cdot \left(\log10(h_i) - \log10(h_t) \right) \cdot \left(1 + \frac{T_1 + T_2}{500} \right)$$

Example with Units

$$2058.2224\,\text{m} = 18336.6 \cdot \left(\log10(22\,\text{m}) - \log10(19.5\,\text{m}) \right) \cdot \left(1 + \frac{8°\text{C} + 17°\text{C}}{500} \right)$$

7) Distance between Two points under Curvature and Refraction Formula

Evaluate Formula

Formula

$$D = \left(2 \cdot R \cdot c + \left(c^2\right)\right)^{\frac{1}{2}}$$

Example with Units

$$35.4964\,\text{m} = \left(2 \cdot 6370 \cdot 0.0989 + \left(0.0989^2\right)\right)^{\frac{1}{2}}$$

8) Distance for small errors under Curvature and Refraction Formula

Evaluate Formula

Formula

$$D = \sqrt{2 \cdot R \cdot c}$$

Example with Units

$$35.4963\,\text{m} = \sqrt{2 \cdot 6370 \cdot 0.0989}$$

9) Distance to Visible Horizon Formula

Evaluate Formula

Formula

$$D = \sqrt{\frac{h}{0.0673}}$$

Example with Units

$$35.5387\,\text{m} = \sqrt{\frac{85\,\text{m}}{0.0673}}$$

10) Error Due to Curvature Effect Formula

Evaluate Formula

Formula

$$c = \frac{D^2}{2 \cdot R}$$

Example with Units

$$0.0989 = \frac{35.5\,\text{m}^2}{2 \cdot 6370}$$

11) Height of Instrument Formula

Evaluate Formula

Formula

$$HI = RL + BS$$

Example with Units

$$49\,\text{m} = 29\,\text{m} + 20\,\text{m}$$

12) Height of Observer Formula

Evaluate Formula

Formula

$$h = 0.0673 \cdot D^2$$

Example with Units

$$84.8148\,\text{m} = 0.0673 \cdot 35.5\,\text{m}^2$$

13) Permissible Closing Error for Accurate Levelling Formula

Evaluate Formula

Formula

$$e = 12 \cdot \sqrt{D}$$

Example with Units

$$71.4983\,\text{m} = 12 \cdot \sqrt{35.5\,\text{m}}$$

14) Permissible Closing Error for Ordinary Levelling Formula

Evaluate Formula

Formula

$$e = 24 \cdot \sqrt{D}$$

Example with Units

$$142.9965\,\text{m} = 24 \cdot \sqrt{35.5\,\text{m}}$$

15) Permissible Closing Error for Precise Levelling Formula

Evaluate Formula

Formula

$$e = 4 \cdot \sqrt{D}$$

Example with Units

$$23.8328\,\text{m} = 4 \cdot \sqrt{35.5\,\text{m}}$$

16) Permissible Closing Error for Rough Levelling Formula

Evaluate Formula

Formula

$$e = 100 \cdot \sqrt{D}$$

Example with Units

$$595.8188\,\text{m} = 100 \cdot \sqrt{35.5\,\text{m}}$$

17) Reduced Level given Height of Instrument Formula

Evaluate Formula

Formula

$$RL = HI - BS$$

Example with Units

$$45\,\text{m} = 65\,\text{m} - 20\,\text{m}$$

18) Sensitiveness of Level Tube Formulas

18.1) Angle between Line of Sights given Radius of Curvature Formula

Evaluate Formula

Formula

$$\alpha = n \cdot \frac{l}{R_C}$$

Example with Units

$$0.0845\,\text{rad} = 9 \cdot \frac{2\,\text{mm}}{213\,\text{mm}}$$

18.2) Angle between Line of Sights in Radians Formula

Evaluate Formula

Formula

$$\alpha = \frac{s_i}{D}$$

Example with Units

$$0.0845\,\text{rad} = \frac{3\,\text{m}}{35.5\,\text{m}}$$

18.3) Distance from Instrument to Staff given Angle between LOS Formula

Evaluate Formula

Formula

$$D = \frac{s_i}{\alpha}$$

Example with Units

$$37.5\,\text{m} = \frac{3\,\text{m}}{0.08\,\text{rad}}$$

18.4) Number of Division where Bubble Moves given Staff Intercept Formula

Evaluate Formula

Formula

$$n = s_i \cdot \frac{R_C}{l \cdot D}$$

Example with Units

$$9 = 3\,\text{m} \cdot \frac{213\,\text{mm}}{2\,\text{mm} \cdot 35.5\,\text{m}}$$

18.5) Radius of Curvature of Tube Formula

Evaluate Formula

Formula

$$R_C = n \cdot l \cdot \frac{D}{s_i}$$

Example with Units

$$213\,\text{mm} = 9 \cdot 2\,\text{mm} \cdot \frac{35.5\,\text{m}}{3\,\text{m}}$$

18.6) Staff Intercept given Angle between LOS Formula

Evaluate Formula

Formula

$$s_i = \alpha \cdot D$$

Example with Units

$$2.84\,\text{m} = 0.08\,\text{rad} \cdot 35.5\,\text{m}$$

Variables used in list of Levelling Formulas above

- **BS** Back Sight *(Meter)*
- **c** Error due to Curvature
- **c_r** Refraction Correction
- **c_r** Combined Error *(Meter)*
- **D** Distance between Two Points *(Meter)*
- **D_p** Distance between Points *(Meter)*
- **e** Closing Error *(Meter)*
- **h** Height of Observer *(Meter)*
- **h_i** Height of point A *(Meter)*
- **h_t** Height of point B *(Meter)*
- **HI** Height of Instrument *(Meter)*
- **l** One Division Length *(Millimeter)*
- **M** Measured Angle *(Degree)*
- **n** Number of Division
- **R** Earth Radius in km
- **R_C** Radius of Curvature *(Millimeter)*
- **RL** Reduced Level *(Meter)*
- **s_i** Staff Intercept *(Meter)*
- **T_1** Temperature at Lower Ground Level *(Celsius)*
- **T_2** Temperature at Higher level *(Celsius)*
- **α** Angle between LOS *(Radian)*
- **Δh** Elevation Difference *(Meter)*
- **θ** Dip Angle *(Degree)*

Constants, Functions, Measurements used in list of Levelling Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **log10**, log10(Number) *The common logarithm, also known as the base-10 logarithm or the decimal logarithm, is a mathematical function that is the inverse of the exponential function.*
- Functions: **sin**, sin(Angle) *Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.*
- Functions: **sqrt**, sqrt(Number) *A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- Measurement: **Length** in Meter (m), Millimeter (mm) *Length Unit Conversion*
- Measurement: **Temperature** in Celsius (°C) *Temperature Unit Conversion*
- Measurement: **Angle** in Degree (°), Radian (rad) *Angle Unit Conversion*

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