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Surveying Vertical Curves Formulas

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List of 19 Surveying Vertical Curves Formulas

Surveying Vertical Curves

1) Allowable Centrifugal Acceleration given Length

Open Calculator

fx $$f = ((g_1) - (g_2)) \cdot \frac{V^2}{100 \cdot L_c}$$

ex $$0.600649\text{m/s}^2 = ((2.2) - (-1.5)) \cdot \frac{(100\text{km/h})^2}{100 \cdot 616\text{m}}$$

2) Change of Grade given Length

Open Calculator

fx $$N = L \cdot P_N$$

ex $$1.4 = 20\text{m} \cdot 0.07$$

3) Downgrade given Length based on Centrifugal Ratio

Open Calculator

fx $$g_2 = g_1 - \left(L_c \cdot 100 \cdot \frac{f}{V^2} \right)$$

ex $$-1.496 = 2.2 - \left(616\text{m} \cdot 100 \cdot \frac{0.6\text{m/s}^2}{(100\text{km/h})^2} \right)$$

4) Length given S is Less than L and Change of Grade

Open Calculator

$$L_c = N \cdot \frac{SD^2}{800 \cdot h}$$

$$635.5588\text{m} = 3.6 \cdot \frac{(490\text{m})^2}{800 \cdot 1.7\text{m}}$$

5) Length of Curve Based on Centrifugal Ratio

Open Calculator

$$L_c = ((g_1) - (g_2)) \cdot \frac{V^2}{100 \cdot f}$$

$$616.6667\text{m} = ((2.2) - (-1.5)) \cdot \frac{(100\text{km/h})^2}{100 \cdot 0.6\text{m/s}^2}$$

6) Length of Curve given Change in Grade where S is more than L

Open Calculator

$$L_c = 2 \cdot SD - \left(800 \cdot \frac{h}{N}\right)$$

$$602.2222\text{m} = 2 \cdot 490\text{m} - \left(800 \cdot \frac{1.7\text{m}}{3.6}\right)$$

7) Length of Curve when Height of Observer and Object are Same

Open Calculator

$$L_c = 2 \cdot SD - \left(800 \cdot \frac{h}{(g_1) - (g_2)}\right)$$

$$612.4324\text{m} = 2 \cdot 490\text{m} - \left(800 \cdot \frac{1.7\text{m}}{(2.2) - (-1.5)}\right)$$

8) Length of Curve when S is Less than L

Open Calculator

fx $$L_c = SD^2 \cdot \frac{(g_1) - (g_2)}{200 \cdot \left(\sqrt{H} + \sqrt{h_2}\right)^2}$$

ex $$705.2362\text{m} = (490\text{m})^2 \cdot \frac{(2.2) - (-1.5)}{200 \cdot \left(\sqrt{1.2\text{m}} + \sqrt{2\text{m}}\right)^2}$$

9) Length of Curve when S is Less than L and h1 and h2 are same

Open Calculator

fx $$L_c = ((g_1) - (g_2)) \cdot \frac{SD^2}{800 \cdot h}$$

ex $$653.2132\text{m} = ((2.2) - (-1.5)) \cdot \frac{(490\text{m})^2}{800 \cdot 1.7\text{m}}$$

10) Length of Curve when Sight Distance is More

Open Calculator

fx $$L_c = 2 \cdot SD - \frac{200 \cdot \left(\sqrt{H} + \sqrt{h_2}\right)^2}{(g_1) - (g_2)}$$

ex $$639.5467\text{m} = 2 \cdot 490\text{m} - \frac{200 \cdot \left(\sqrt{1.2\text{m}} + \sqrt{2\text{m}}\right)^2}{(2.2) - (-1.5)}$$

11) Length of Vertical Curve

Open Calculator

fx $$L = \frac{N}{P_N}$$

ex $$51.42857\text{m} = \frac{3.6}{0.07}$$

12) Permissible Grade given Length

Open Calculator

fx $$P_N = \frac{N}{L}$$

ex $$0.18 = \frac{3.6}{20\text{m}}$$

13) Sight Distance when Length of Curve is Less

Open Calculator

fx $$SD = 0.5 \cdot L_c + \frac{100 \cdot \left(\sqrt{H} + \sqrt{h_2}\right)^2}{(g_1) - (g_2)}$$

ex $$478.2267\text{m} = 0.5 \cdot 616\text{m} + \frac{100 \cdot \left(\sqrt{1.2\text{m}} + \sqrt{2\text{m}}\right)^2}{(2.2) - (-1.5)}$$

14) Sight Distance when Length of Curve is Less and Both Height of Observer and Object is Same

Open Calculator

fx $$SD = \left(\frac{L_c}{2}\right) + \left(400 \cdot \frac{h}{(g_1) - (g_2)}\right)$$

ex $$491.7838\text{m} = \left(\frac{616\text{m}}{2}\right) + \left(400 \cdot \frac{1.7\text{m}}{(2.2) - (-1.5)}\right)$$

15) Sight Distance when S is Less than L

Open Calculator

fx $$S = \left(\frac{1}{c}\right) \cdot \left(\sqrt{H} + \sqrt{h_2}\right)$$

ex $$5.019317\text{m} = \left(\frac{1}{0.5}\right) \cdot \left(\sqrt{1.2\text{m}} + \sqrt{2\text{m}}\right)$$

16) Sight Distance when S is Less than L and h1 and h2 are same

Open Calculator

fx $$SD = \sqrt{\frac{800 \cdot h \cdot L_c}{(g_1) - (g_2)}}$$

ex $$475.8378\text{m} = \sqrt{\frac{800 \cdot 1.7\text{m} \cdot 616\text{m}}{(2.2) - (-1.5)}}$$

17) Tangential Correction

Open Calculator

fx $$c = \frac{g_1 - g_2}{4} \cdot n$$

ex $$0.41625 = \frac{2.2 - -1.5}{4} \cdot 0.45$$

18) Upgrade given Length based on Centrifugal Ratio

Open Calculator

fx $$g_1 = \left(L_c \cdot 100 \cdot \frac{f}{V^2} \right) + (g_2)$$

ex $$2.196 = \left(616\text{m} \cdot 100 \cdot \frac{0.6\text{m/s}^2}{(100\text{km/h})^2} \right) + (-1.5)$$

19) Velocity given Length

Open Calculator

fx $$V = \sqrt{\frac{L_c \cdot 100 \cdot f}{g_1 - (g_2)}}$$

ex $$99.94593\text{km/h} = \sqrt{\frac{616\text{m} \cdot 100 \cdot 0.6\text{m/s}^2}{2.2 - (-1.5)}}$$

Variables Used

- **c** Tangential Correction
- **f** Allowable Centrifugal Acceleration *(Meter per Square Second)*
- g_1 Upgrade
- g_2 Downgrade
- **h** Height of Vertical Curves *(Meter)*
- **H** Height of Observer *(Meter)*
- h_2 Height of Object *(Meter)*
- **L** Length of Vertical Curve *(Meter)*
- L_c Length of Curve *(Meter)*
- **n** Number of Chords
- **N** Change in Grade
- P_N Permissible Rate
- **S** Sight Distance *(Meter)*
- **SD** Sight Distance SSD *(Meter)*
- **V** Vehicle Velocity *(Kilometer per Hour)*

Constants, Functions, Measurements used

- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Speed** in Kilometer per Hour (km/h)
  Speed Unit Conversion
- Measurement: **Acceleration** in Meter per Square Second (m/s²)
  Acceleration Unit Conversion

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