



Highway Geometric Design Formulas

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List of 32 Highway Geometric Design Formulas

Highway Geometric Design 🗷

Gradients

1) Camber given Gradient

$${
m H_c}=rac{{
m h_{Elevation}}}{2}$$

Open Calculator 🗗

$$\boxed{1.5\mathrm{m} = \frac{3\mathrm{m}}{2}}$$

2) Distance from Center of Camber given Height for Parabolic Shape Camber

$$X = \left(rac{ ext{H}_{ ext{c}}\cdot(ext{h}_{ ext{Elevation}}\cdot ext{B})}{2}
ight)^{0.5}$$

Open Calculator 🗗

$$= \left(\frac{1.5 \text{m} \cdot (3 \text{m} \cdot 6.9 \text{m})}{2}\right)^{0.5}$$



3) Grade Compensation formula 1

fx $m s = rac{30 + R_c}{R_c}$

Open Calculator

 $= 1.230769 = \frac{30 + 130 \mathrm{m}}{130 \mathrm{m}}$

4) Grade Compensation formula 2

fx $m s = rac{75}{R_c}$

Open Calculator 🖸

5) Gradient given Camber

 $ag{h_{
m Elevation}} = 2 \cdot {
m H_c}$

Open Calculator 🚰

 $3 ext{m} = 2 \cdot 1.5 ext{m}$

6) Gradient given Height for Parabolic Shape Camber

 $\mathbf{f_{\mathbf{x}}}\mathbf{h}_{\mathrm{Elevation}} = rac{2\cdot\left(\mathbf{X}^{2}
ight)}{\mathbf{H}_{\mathrm{c}}\cdot\mathbf{B}}$

Open Calculator

 $= 2.93913 \text{m} = \frac{2 \cdot \left((3.9 \text{m})^2 \right)}{1.5 \text{m} \cdot 6.9 \text{m}}$





7) Height for Parabolic Shape Camber

 $\mathbf{H}_{\mathrm{c}} = rac{2 \cdot \left(\mathrm{X}^2
ight)}{\mathrm{h}_{\mathrm{Elevation}} \cdot \mathrm{B}}$

Open Calculator

 $oxed{ex} 1.469565 \mathrm{m} = rac{2 \cdot \left(\left(3.9 \mathrm{m}
ight)^2
ight)}{3 \mathrm{m} \cdot 6.9 \mathrm{m}}$

8) Height for Straight Line Camber

fx $m H_c = rac{B}{h_{
m Elevation} \cdot 2}$

Open Calculator

 $= 1.15 \text{m} = \frac{6.9 \text{m}}{3 \text{m} \cdot 2}$

9) Radius of Road given Grade Compensation formula 1

 $\left| {
m R_c}
ight| {
m R_c} = rac{30}{{
m s}-1}$

Open Calculator 🖸

 $= \frac{30}{1.23 - 1}$

10) Radius of Road given Grade Compensation formula 2 🛂

 $R_{\rm c}=rac{75}{
m s}$

Open Calculator







11) Width of Road given Height for Parabolic Shape Camber 🖸

 $\mathbf{E} = rac{2 \cdot \left(\mathrm{X}^2
ight)}{\mathrm{H_c} \cdot \mathrm{h_{Elevation}}}$

Open Calculator

 $= 2 \cdot \left(\left(3.9 \text{m} \right)^2 \right)$ $= \frac{2 \cdot \left(\left(3.9 \text{m} \right)^2 \right)}{1.5 \text{m} \cdot 3 \text{m}}$

12) Width of Road given Height for Straight Line Camber

 $oldsymbol{ iny B} = H_{
m c} \cdot (h_{
m Elevation} \cdot 2)$

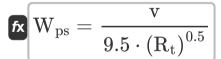
Open Calculator

 $\boxed{9m = 1.5m \cdot (3m \cdot 2)}$

Horizontal Curves

Extra Widening on Horizontal Curves

13) Psychological Widening on Horizontal Curves



 $oxed{ex} 0.303869 \mathrm{m} = rac{50 \mathrm{km/h}}{9.5 \cdot \left(300 \mathrm{m}
ight)^{0.5}}$



14) Total Extra Widening required on Horizontal Curves 🗗

Open Calculator 2

$$\mathbf{K} \mathbf{W}_{\mathrm{e}} = \left(rac{\mathrm{n}\cdot\left(\mathrm{l}^{2}
ight)}{2\cdot\mathrm{R}_{\mathrm{t}}}
ight) + \left(rac{\mathrm{v}}{9.5\cdot\left(\mathrm{R}_{\mathrm{t}}^{0.5}
ight)}
ight)$$

15) Total Extra Widening required on Horizontal Curves wrt Wm and Wps

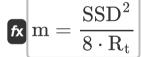
fx $W_e = (W_{ps} + W_m)$

Open Calculator

$$\boxed{0.89 \mathrm{m} = (0.52 \mathrm{m} + 0.37 \mathrm{m}) }$$

Set Back Distance and curve Resistance G

16) Set Back Distance by Approx Method (L is greater than S)



$$= 10.66667 \text{m} = \frac{(160 \text{m})^2}{8 \cdot 300 \text{m}}$$



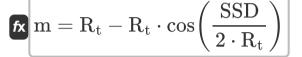
17) Set Back Distance by Approx Method (L is less than S)

 \mathbf{f} $\mathbf{m} = rac{\mathrm{L_c} \cdot (2 \cdot \mathrm{SSD} - \mathrm{L_c})}{8 \cdot \mathrm{R_t}}$

Open Calculator 🖸

$$=$$
 $10.5 \mathrm{m} = rac{140 \mathrm{m} \cdot (2 \cdot 160 \mathrm{m} - 140 \mathrm{m})}{8 \cdot 300 \mathrm{m}}$

18) Set Back Distance by Rational Method (L is greater than S) Single Lane



Open Calculator 🗗

ex
$$10.60361 \mathrm{m} = 300 \mathrm{m} - 300 \mathrm{m} \cdot \mathrm{cos} \left(\frac{160 \mathrm{m}}{2 \cdot 300 \mathrm{m}} \right)$$



Summit Curve

19) Length of Summit Curve for Stopping Sight Distance when Curve Length is less than SSD

Open Calculator 🛂

$$ext{L}_{ ext{Sc}} = 2 \cdot ext{SSD} - \left(rac{\left(\left(2 \cdot ext{H}
ight)^{0.5} + \left(2 \cdot ext{h}
ight)^{0.5}
ight)^2}{ ext{N}}
ight)$$

$$265.0368 \mathrm{m} = 2 \cdot 160 \mathrm{m} - \left(\frac{\left((2 \cdot 1.2 \mathrm{m})^{0.5} + (2 \cdot 0.15 \mathrm{m})^{0.5} \right)^2}{0.08} \right)$$

20) Length of Summit Curve for Stopping Sight Distance when Curve Length is more than SSD

$$extbf{L}_{ ext{Sc}} = rac{ ext{N} \cdot ext{SSD}^2}{\left(\left(2 \cdot ext{H}
ight)^{0.5} + \left(2 \cdot ext{h}
ight)^{0.5}
ight)^2}$$

Open Calculator

$$egin{aligned} extbf{ex} & 465.7662 ext{m} = rac{0.08 \cdot (160 ext{m})^2}{\left(\left(2 \cdot 1.2 ext{m}
ight)^{0.5} + \left(2 \cdot 0.15 ext{m}
ight)^{0.5}
ight)^2} \end{aligned}$$



21) Length of Summit Curve when Length of Curve is greater than OSD or ISD

 $\mathbf{L}_{\mathrm{Sc}} = rac{\mathrm{N} \cdot \left(\mathrm{SSD}^2
ight)}{8 \cdot \mathrm{H}}$

Open Calculator 🚰

ex $213.3333m = \frac{0.08 \cdot \left((160m)^2 \right)}{8 \cdot 1.2m}$

22) Length of Summit Curve when Length of Curve is less than OSD or ISD

 $\mathbf{L}_{\mathrm{Sc}} = 2 \cdot \mathrm{SSD} - \left(rac{8 \cdot \mathrm{H}}{\mathrm{N}}
ight)$

Open Calculator 🗗

 $oxed{ex} 200 \mathrm{m} = 2 \cdot 160 \mathrm{m} - \left(rac{8 \cdot 1.2 \mathrm{m}}{0.08}
ight)$

Transition Curve

23) Length of Transition Curve according to Rate of change of Centrifugal Acceleration

 $\mathbf{f}_{\mathbf{x}} \left[\mathrm{L_{s}} = rac{\mathrm{v}_{1}^{3}}{\mathrm{C} \cdot \mathrm{R}_{\cdot}}
ight]$

Open Calculator

$$oxed{ex} 36.39259 \mathrm{m} = rac{(17 \mathrm{m/s})^3}{0.45 \mathrm{m/s^3 \cdot 300 m}}$$





24) Length of Transition Curve according to Rate of Introduction of Superelevation

 $\mathbf{L}_{\mathrm{e}} = \left(rac{\mathrm{e}\cdot\mathrm{N}_{\mathrm{Rate}}}{2}
ight)\cdot\left(\mathrm{W}+\mathrm{W}_{\mathrm{ex}}
ight)$

Open Calculator 🗗

 $\boxed{ \mathbf{ex} } \ 562.1245 \mathrm{m} = \left(\frac{0.07 \cdot 150.1}{2} \right) \cdot \left(7 \mathrm{m} + 100 \mathrm{m} \right)$

25) Length of Transition Curve by Empirical Formula for Mountainous and Steep Terrains

 $\left| \mathrm{L_{Slope}} = rac{\mathrm{v}_1^2}{\mathrm{R_t}}
ight|$

Open Calculator

 $ext{ex} \left[0.963333 ext{m} = rac{\left(17 ext{m/s}
ight)^2}{300 ext{m}}
ight]$

26) Length of Transition Curve by Empirical Formula for Plain and Rrolling Terrain

 $\mathbf{L}_{\mathrm{Terrain}} = rac{2.7 \cdot (\mathrm{v}_1)^2}{\mathrm{R}_{\mathrm{t}}}$

Open Calculator 🗗

 $2.601 \mathrm{m} = rac{2.7 \cdot (17 \mathrm{m/s})^2}{300 \mathrm{m}}$



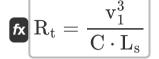
27) Length of Transition Curve if Pavement is Rotated about Inner Edge

fx $\left[\mathrm{L_{t}} = \mathrm{e} \cdot \mathrm{N_{Rate}} \cdot (\mathrm{W} + \mathrm{W_{ex}})
ight]$

Open Calculator 🗗

 $\texttt{ex} \ 1124.249 \texttt{m} = 0.07 \cdot 150.1 \cdot (7 \texttt{m} + 100 \texttt{m})$

28) Radius of Circular Curve given Length of Transition Curve



Open Calculator

= $300.0214 \mathrm{m} = rac{\left(17 \mathrm{m/s}
ight)^3}{0.45 \mathrm{m/s^3 \cdot 36.39 m}}$

Valley Curve

29) Length of Valley Curve for Head Light Sight Distance when Length is less than SSD

fx

Open Calculator 🗗

$$ext{L}_{ ext{Vc}} = 2 \cdot ext{SSD} - \left(rac{2 \cdot ext{h}_1 + 2 \cdot ext{SSD} \cdot ext{tan}(lpha)}{ ext{N}}
ight)$$

$$= 2 \cdot 160 \mathrm{m} - \left(\frac{2 \cdot 0.75 \mathrm{m} + 2 \cdot 160 \mathrm{m} \cdot \tan(2.1^\circ)}{0.08} \right)$$



30) Length of Valley Curve for Head Light Sight Distance when Length is more than SSD

 $\mathbf{L}_{\mathrm{Vc}} = rac{\mathrm{N}\cdot\mathrm{SSD}^2}{2\cdot\mathrm{h}_1 + 2\cdot\mathrm{SSD}\cdot\mathrm{tan}(lpha)}$

Open Calculator

 $= \frac{0.08 \cdot (160 \text{m})^2}{2 \cdot 0.75 \text{m} + 2 \cdot 160 \text{m} \cdot \tan(2.1\degree)}$

31) Length of Valley Curve given Beam Angle and Height of Head Light

 $extbf{L}_{ ext{Vc}} = 2 \cdot ext{SSD} - \left(rac{1.5 + 0.035 \cdot ext{SSD}}{ ext{N}}
ight)$

Open Calculator

 $extbf{ex} 231.25 ext{m} = 2 \cdot 160 ext{m} - \left(rac{1.5 + 0.035 \cdot 160 ext{m}}{0.08}
ight)$

32) Length of Valley Curve given Height of Head Light and Beam Angle

 $extbf{L}_{ ext{Vc}} = ext{N} \cdot rac{ ext{SSD}^2}{1.5 + 0.035 \cdot ext{SSD}}$

Open Calculator 🚰

Variables Used

- **B** Pavement Width (Meter)
- C Rate of Change of Centrifugal Acceleration (Meter per Cubic Second)
- e Rate of Superelevation
- **h** Height of Subject above Pavement Surface (Meter)
- H Height of Eye Level of Driver above Roadway (Meter)
- **h**₁ Average Head Light Height (*Meter*)
- **H**_C Height of Camber (*Meter*)
- h_{Elevation} Elevation Difference (Meter)
- I Length of Wheel Base as per IRC (Meter)
- L_c Length of Curve (Meter)
- Le Transition Curve Length for Superelevation (Meter)
- L_s Length of Transition Curve (Meter)
- L_{Sc} Length of Parabolic Summit Curve (Meter)
- L_{Slope} Transition Curve Length for Slope (Meter)
- L_t Transition Curve Length (Meter)
- L_{Terrain} Transition Curve Length for Terrain (Meter)
- Lvc Length of Valley Curve (Meter)
- m Set Back Distance (Meter)
- n Number of Traffic Lanes
- N Deviation Angle
- N_{Rate} Allowable Rate of Change of Superelevation
- R_c Radius of Circular Curve (Meter)





- Rt Radius of Curve (Meter)
- S Percent Grade
- SSD Stopping Sight Distance (Meter)
- V Speed of Vehicle (Kilometer per Hour)
- V₁ Design Speed on Highways (Meter per Second)
- W Normal Pavement Width (Meter)
- **W**_e Total Extra Widening Required on Horizontal Curves (Meter)
- Wex Extra Widening of Pavement (Meter)
- W_m Mechanical Widening on Horizontal Curves (Meter)
- W_{ps} Psychological Widening on Horizontal Curves (Meter)
- X Distance from Center of Camber (Meter)
- α Beam Angle (Degree)





Constants, Functions, Measurements used

- Function: cos, cos(Angle)

 Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Function: tan, tan(Angle)

 The tangent of an angle is a trigonometric ratio of the length of the side opposite an angle to the length of the side adjacent to an angle in a right triangle.
- Measurement: Length in Meter (m)
 Length Unit Conversion
- Measurement: Speed in Kilometer per Hour (km/h), Meter per Second (m/s)
 - Speed Unit Conversion
- Measurement: Angle in Degree (°)
 Angle Unit Conversion
- Measurement: **Jerk** in Meter per Cubic Second (m/s³)

 Jerk Unit Conversion





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