Transition Curves Surveying Formulas

List of 21 Transition Curves Surveying Formulas

Transition Curves Surveying

Length of Transition Curve

1) Hands-Off Velocity

Open Calculator

fx $$v = \sqrt{g \cdot R \cdot \tan(\theta)}$$

ex $$13.3546\text{m/s} = \sqrt{9.8\text{m/s}^2 \cdot 50\text{m} \cdot \tan(20^\circ)}$$

2) Length given Angle of Super Elevation

Open Calculator

fx $$L_a = (g \cdot \tan(\theta_e))^{1.5} \cdot \frac{\sqrt{R_{Curve}}}{\alpha}$$

ex $$146.2214\text{m} = (9.8\text{m/s}^2 \cdot \tan(95.4))^{1.5} \cdot \frac{\sqrt{200\text{m}}}{10\text{m/s}^2}$$

3) Length of Transition Curve given Shift

Open Calculator

fx $$L_a = \sqrt{S \cdot 24 \cdot R_{Curve}}$$

ex $$120\text{m} = \sqrt{3\text{m} \cdot 24 \cdot 200\text{m}}$$

4) Length of Transition Curve given Time Rate

Open Calculator

fx $$L_a = G \cdot \frac{V^3}{x \cdot g \cdot R_{Curve}}$$

ex $$108.8435\text{m} = 0.90\text{m} \cdot \frac{(80\text{km/h})^3}{60\text{cm/s} \cdot 9.8\text{m/s}^2 \cdot 200\text{m}}$$

5) Length when Comfort Condition Holds Good for Highways

Open Calculator

fx $$L_a = 12.80 \cdot \sqrt{R_{Curve}}$$

ex $$181.0193\text{m} = 12.80 \cdot \sqrt{200\text{m}}$$

6) Length when Comfort Condition Holds Good for Railways

Open Calculator

fx $$L_a = 4.52 \cdot \sqrt{R_{Curve}}$$

ex $$63.92245\text{m} = 4.52 \cdot \sqrt{200\text{m}}$$

7) Rate of Change of Radial Acceleration

Open Calculator

fx $$\alpha = \left(\frac{V^2}{R_{Curve} \cdot t}\right)$$

ex $$10\text{m/s}^2 = \left(\frac{(80\text{km/h})^2}{200\text{m} \cdot 3.2\text{s}}\right)$$

8) Shift of Curve

Open Calculator

$$S = \frac{L_a^2}{24 \cdot R_{Curve}}$$

$$4.380208\text{m} = \frac{(145\text{m})^2}{24 \cdot 200\text{m}}$$

9) Time Rate given Length of Transition Curve

Open Calculator

$$x = G \cdot \frac{V^3}{L_a \cdot g \cdot R_{Curve}}$$

$$45.03871\text{cm/s} = 0.90\text{m} \cdot \frac{(80\text{km/h})^3}{145\text{m} \cdot 9.8\text{m/s}^2 \cdot 200\text{m}}$$

10) Time Taken given Radial Acceleration

Open Calculator

$$t = \left(\frac{V^2}{R_{Curve} \cdot \alpha}\right)$$

$$3.2\text{s} = \left(\frac{(80\text{km/h})^2}{200\text{m} \cdot 10\text{m/s}^2}\right)$$

Centrifugal Ratio

11) Centrifugal Force Acting on Vehicle

Open Calculator

fx $$F_c = \frac{W \cdot V^2}{g \cdot R_{Curve}}$$

ex $$166.5306\text{N} = \frac{51\text{kg} \cdot (80\text{km/h})^2}{9.8\text{m/s}^2 \cdot 200\text{m}}$$

12) Centrifugal Ratio

Open Calculator

fx $$PW_{ratio} = \frac{V^2}{R_{Curve} \cdot g}$$

ex $$3.265306 = \frac{(80\text{km/h})^2}{200\text{m} \cdot 9.8\text{m/s}^2}$$

13) Design Speed of Highway

Open Calculator

fx $$V_1 = \sqrt{\frac{R_{Curve} \cdot g}{4}}$$

ex $$22.13594\text{km/h} = \sqrt{\frac{200\text{m} \cdot 9.8\text{m/s}^2}{4}}$$

14) Design Speed of Railway

Open Calculator

$$v_2 = \sqrt{R_{Curve} \cdot \frac{g}{8}}$$

$$4.34791\text{m/s} = \sqrt{200\text{m} \cdot \frac{9.8\text{m/s}^2}{8}}$$

15) Radius of Curve given Centrifugal Force

Open Calculator

$$R_{Curve} = \frac{W \cdot V^2}{g \cdot F_c}$$

$$204.332\text{m} = \frac{51\text{kg} \cdot (80\text{km/h})^2}{9.8\text{m/s}^2 \cdot 163\text{N}}$$

16) Speed of Vehicle given Centrifugal Force

Open Calculator

$$V = \sqrt{F_c \cdot g \cdot \frac{R_{Curve}}{W}}$$

$$79.14742\text{km/h} = \sqrt{163\text{N} \cdot 9.8\text{m/s}^2 \cdot \frac{200\text{m}}{51\text{kg}}}$$

Superelevation

17) Cant given Width of Pavement

Open Calculator

$$h = B \cdot \frac{V^2}{R \cdot g}$$

$$90.12245\text{cm} = 6.9\text{m} \cdot \frac{(80\text{km/h})^2}{50\text{m} \cdot 9.8\text{m/s}^2}$$

18) Gauge Width of Track given Cant

Open Calculator

$$G = \frac{h \cdot 1.27 \cdot R}{V^2}$$

$$0.907058\text{m} = \frac{91.42\text{cm} \cdot 1.27 \cdot 50\text{m}}{(80\text{km/h})^2}$$

19) Pavement Width given Cant

Open Calculator

$$B = h \cdot \frac{R \cdot g}{V^2}$$

$$6.999344\text{m} = 91.42\text{cm} \cdot \frac{50\text{m} \cdot 9.8\text{m/s}^2}{(80\text{km/h})^2}$$

20) Radius of Curve given Cant for Road

Open Calculator

$$R = B \cdot \frac{V^2}{h \cdot g}$$

$$49.29034\text{m} = 6.9\text{m} \cdot \frac{(80\text{km/h})^2}{91.42\text{cm} \cdot 9.8\text{m/s}^2}$$

21) Railway Cant

Open Calculator

$$h = G \cdot \frac{V^2}{1.27 \cdot R}$$

$$90.70866\text{cm} = 0.90\text{m} \cdot \frac{(80\text{km/h})^2}{1.27 \cdot 50\text{m}}$$

Variables Used

- **B** Pavement Width *(Meter)*
- **F_c** Centrifugal Force *(Newton)*
- **g** Acceleration due to Gravity *(Meter per Square Second)*
- **G** Railway Gauge *(Meter)*
- **h** Cant *(Centimeter)*
- **L_a** Transition Curve Length *(Meter)*
- **PW_{ratio}** Centrifugal Ratio
- **R** Radius of Curve *(Meter)*
- **R_{Curve}** Curve Radius *(Meter)*
- **S** Shift *(Meter)*
- **t** Time taken to Travel *(Second)*
- **v** Hands off Velocity *(Meter per Second)*
- **V** Vehicle Velocity *(Kilometer per Hour)*
- **V_1** Design Speed on Highways *(Kilometer per Hour)*
- **v_2** Design Speed on Railways *(Meter per Second)*
- **W** Weight of Vehicle *(Kilogram)*
- **x** Super Elevation Time Rate *(Centimeter per Second)*
- **α** Rate of Radial Acceleration *(Meter per Square Second)*
- **θ** Angle of Super Elevation *(Degree)*
- **θ_e** Super Elevation Angle

Constants, Functions, Measurements used

- Function: **sqrt**, sqrt(Number)
  Square root function
- Function: **tan**, tan(Angle)
  Trigonometric tangent function
- Measurement: **Length** in Meter (m), Centimeter (cm)
  Length Unit Conversion
- Measurement: **Weight** in Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s), Kilometer per Hour (km/h), Centimeter per Second (cm/s)
  Speed Unit Conversion
- Measurement: **Acceleration** in Meter per Square Second (m/s²)
  Acceleration Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion

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