#### Important Transition Curves Surveying Formulas PDF



**Formulas Examples** with Units

#### List of 21

**Important Transition Curves Surveying Formulas** 

Evaluate Formula

Evaluate Formula

Evaluate Formula

Evaluate Formula C

Evaluate Formula

#### 1) Length of Transition Curve Formulas (

1.1) Hands-Off Velocity Formula 🕝



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

Example with Units

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

#### 1.2) Length given Angle of Super Elevation Formula C

Formula

$$L_{a} = \left(g \cdot tan\left(\theta_{e}\right)\right)^{1.5} \cdot \frac{\sqrt{R_{Curve}}}{\alpha}$$

**Example with Units** 

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

#### 1.3) Length of Transition Curve given Shift Formula 🕝

$$L_{a} = \sqrt{S \cdot 24 \cdot R_{Curve}}$$

Example with Units

$$L_{a} = \sqrt{S \cdot 24 \cdot R_{Curve}} \qquad 120 \, \text{m} = \sqrt{3 \, \text{m} \cdot 24 \cdot 200 \, \text{m}}$$

#### 1.4) Length of Transition Curve given Time Rate Formula 🗗

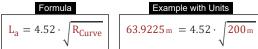
$$L_a = G \cdot \frac{V^3}{x \cdot g \cdot R_{Curve}}$$

$$L_a = G \cdot \frac{V^3}{x \cdot g \cdot R_{Curve}} \qquad \boxed{ 108.8435 \, \text{m} \, = \, 0.90 \, \text{m} \, \cdot \frac{80 \, \text{km/h}^3}{60 \, \text{cm/s} \, \cdot \, 9.8 \, \text{m/s}^2 \, \cdot \, 200 \, \text{m} } }$$

#### 1.5) Length when Comfort Condition Holds Good for Highways Formula C



#### 1.6) Length when Comfort Condition Holds Good for Railways Formula 🗂



Example with Units

Evaluate Formula (

1.7) Rate of Change of Radial Acceleration Formula 🕝

## Formula

$$\alpha = \left(\frac{V^2}{R_{Curve} \cdot t}\right) \qquad \boxed{ \begin{array}{c} \text{Example with Units} \\ \\ 10\,\text{m/s}^2 \end{array} = \left(\frac{80\,\text{km/h}}{200\,\text{m}\,\cdot 3.2\,\text{s}}\right) }$$

Evaluate Formula [

1.8) Shift of Curve Formula C

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

Formula Example with Units 
$$S = \frac{L_a^2}{24 \cdot R_{Correc}}$$
 
$$4.3802 \text{ m} = \frac{145 \text{ m}^2}{24 \cdot 200 \text{ m}}$$

1.9) Time Rate given Length of Transition Curve Formula

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

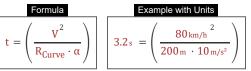
$$x = G \cdot \frac{V^{3}}{L_{a} \cdot g \cdot R_{Curve}} \qquad 45.0387 \, cm/s = 0.90 \, m \cdot \frac{80 \, km/h}{145 \, m \cdot 9.8 \, m/s^{2} \cdot 200 \, m}$$

Evaluate Formula (

Evaluate Formula [

1.10) Time Taken given Radial Acceleration Formula

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



Evaluate Formula

#### 2) Centrifugal Ratio Formulas 🕝

2.1) Centrifugal Force Acting on Vehicle Formula 🗂

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

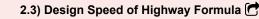
Formula Example with Units 
$$F_{c} = \frac{W \cdot V^{2}}{g \cdot R_{Curve}} \qquad \boxed{166.5306 \, \text{N} \, = \, \frac{51 \, \text{kg} \cdot 80 \, \text{km/h}^{\, 2}}{9.8 \, \text{m/s}^{\, 2} \cdot 200 \, \text{m}}}$$

Evaluate Formula [

2.2) Centrifugal Ratio Formula C

Formula Example with Units  $PW_{ratio} = \frac{V^2}{R_{Curve} \cdot g} \quad 3.2653 = \frac{80 \, \text{km/h}^2}{200 \, \text{m} \cdot 9.8 \, \text{m/e}^2}$ 

Evaluate Formula C



Example with Units

Evaluate Formula (

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

 $V_1 = \sqrt{\frac{R_{Curve} \cdot g}{4}}$  | 22.1359 km/h =  $\sqrt{\frac{200 \text{ m} \cdot 9.8 \text{ m/s}^2}{4}}$ 

#### 2.4) Design Speed of Railway Formula C

 $v_2 = \sqrt{R_{Curve} \cdot \frac{g}{8}}$   $4.3479 \,\text{m/s} = \sqrt{200 \,\text{m} \cdot \frac{9.8 \,\text{m/s}^2}{8}}$ 

Evaluate Formula (

#### 2.5) Radius of Curve given Centrifugal Force Formula

Evaluate Formula [

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

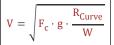
 $R_{Curve} = \frac{W \cdot V^2}{g \cdot F_c} \left| \quad 204.332 \,\text{m} \right| = \frac{51 \,\text{kg} \cdot 80 \,\text{km/h}^2}{9.8 \,\text{m/s}^2 \cdot 163 \,\text{N}}$ 

#### 2.6) Speed of Vehicle given Centrifugal Force Formula

Formula

Example with Units

Evaluate Formula (



 $V = \sqrt{F_c \cdot g \cdot \frac{R_{Curve}}{W}} \hspace{0.2cm} \left| \hspace{0.2cm} 79.1474 \, \text{km/h} \hspace{0.2cm} = \sqrt{163 \, \text{N} \, \cdot 9.8 \, \text{m/s}^2 \, \cdot \frac{200 \, \text{m}}{51 \, \text{kg}}} \right|$ 

#### 3) Superelevation Formulas (?

3.1) Cant given Width of Pavement Formula 🕝

Formula

Example with Unit

Evaluate Formula C



 $h = B \cdot \frac{V^2}{R \cdot g} \qquad 90.1224_{cm} = 6.9_{m} \cdot \frac{80_{km/h}^2}{50_{m} \cdot 9.8_{m/s^2}}$ 

#### 3.2) Gauge Width of Track given Cant Formula 🕝

Example with Units

Evaluate Formula 🕝



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

$$0.9071_{m} = \frac{91.42_{cm} \cdot 1.27 \cdot 50_{m}}{80_{km/h}^{2}}$$

#### 3.3) Pavement Width given Cant Formula 🕝

Formula

Evaluate Formula (



$$B = h \cdot \frac{R \cdot g}{V^2}$$
 6.9993 m = 91.42 cm \cdot \frac{50 \text{ m} \cdot 9.8 \text{ m/s}^2}{80 \text{ km/h}^2}

#### 3.4) Radius of Curve given Cant for Road Formula

#### Formula

Example with Units

Evaluate Formula 🕝

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

$$49.2903\,\mathrm{m} \; = \; 6.9\,\mathrm{m} \; \cdot \frac{80\,\mathrm{km/h}^{\;\;2}}{91.42\,\mathrm{cm} \; \cdot 9.8\,\mathrm{m/s^2}}$$

#### 3.5) Railway Cant Formula 🗂

#### Formula

Example with Units

Evaluate Formula 🕝

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

$$90.7087_{\text{cm}} = 0.90_{\text{m}} \cdot \frac{80_{\text{km/h}}^2}{1.27 \cdot 50_{\text{m}}}$$

### Variables used in list of Transition Curves Surveying Formulas above

- **B** Pavement Width (Meter)
- F<sub>c</sub> Centrifugal Force (Newton)
- g Acceleration due to Gravity (Meter per Square Second)
- **G** Railway Gauge (Meter)
- h Cant (Centimeter)
- La Transition Curve Length (Meter)
- PW<sub>ratio</sub> Centrifugal Ratio
- R Radius of Curve (Meter)
- R<sub>Curve</sub> 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<sub>1</sub> Design Speed on Highways (Kilometer per Hour)
- V<sub>2</sub> 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)
- **0** Angle of Super Elevation (Degree)
- θ<sub>a</sub> Super Elevation Angle

# Constants, Functions, Measurements used in list of Transition Curves Surveying Formulas above

- 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.
- Functions: 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), 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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