Important Transition Curves Surveying Formulas PDF

Formulas
Examples
with Units

List of 21
Important Transition Curves Surveying Formulas

1) Length of Transition Curve Formulas

1.1) Hands-Off Velocity Formula

Evaluate Formula

Formula

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

Example with Units

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

1.2) Length given Angle of Super Elevation Formula

Evaluate Formula

Formula

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

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

Evaluate Formula

Formula

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

Example with Units

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

1.4) Length of Transition Curve given Time Rate Formula

Evaluate Formula

Formula

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

Example with Units

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

1.5) Length when Comfort Condition Holds Good for Highways Formula

Evaluate Formula

Formula

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

Example with Units

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

1.6) Length when Comfort Condition Holds Good for Railways Formula

Evaluate Formula

Formula

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

Example with Units

$$63.9225\,\text{m} = 4.52 \cdot \sqrt{200\,\text{m}}$$

1.7) Rate of Change of Radial Acceleration Formula

Evaluate Formula

Formula

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

Example with Units

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

1.8) Shift of Curve Formula

Evaluate Formula

Formula

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

Example with Units

$$4.3802\,\text{m} = \frac{145\,\text{m}^2}{24 \cdot 200\,\text{m}}$$

1.9) Time Rate given Length of Transition Curve Formula

Evaluate Formula

Formula

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

Example with Units

$$45.0387\,\text{cm/s} = 0.90\,\text{m} \cdot \frac{80\,\text{km/h}^3}{145\,\text{m} \cdot 9.8\,\text{m/s}^2 \cdot 200\,\text{m}}$$

1.10) Time Taken given Radial Acceleration Formula

Evaluate Formula

Formula

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

Example with Units

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

2) Centrifugal Ratio Formulas

2.1) Centrifugal Force Acting on Vehicle Formula

Evaluate Formula

Formula

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

Example with Units

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

2.2) Centrifugal Ratio Formula

Evaluate Formula

Formula

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

Example with Units

$$3.2653 = \frac{80\,\text{km/h}^2}{200\,\text{m} \cdot 9.8\,\text{m/s}^2}$$

2.3) Design Speed of Highway Formula

Evaluate Formula

Formula

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

Example with Units

$$22.1359\,\text{km/h} = \sqrt{\frac{200\,\text{m} \cdot 9.8\,\text{m/s}^2}{4}}$$

2.4) Design Speed of Railway Formula

Evaluate Formula

Formula

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

Example with Units

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

2.5) Radius of Curve given Centrifugal Force Formula

Evaluate Formula

Formula

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

Example with Units

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

2.6) Speed of Vehicle given Centrifugal Force Formula

Evaluate Formula

Formula

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

Example with Units

$$79.1474\,\text{km/h} = \sqrt{163\,\text{N} \cdot 9.8\,\text{m/s}^2 \cdot \frac{200\,\text{m}}{51\,\text{kg}}}$$

3) Superelevation Formulas

3.1) Cant given Width of Pavement Formula

Evaluate Formula

Formula

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

Example with Units

$$90.1224\,\text{cm} = 6.9\,\text{m} \cdot \frac{80\,\text{km/h}^2}{50\,\text{m} \cdot 9.8\,\text{m/s}^2}$$

3.2) Gauge Width of Track given Cant Formula

Evaluate Formula

Formula

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

Example with Units

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

3.3) Pavement Width given Cant Formula

Evaluate Formula

Formula

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

Example with Units

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

3.4) Radius of Curve given Cant for Road Formula

Evaluate Formula

Formula

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

Example with Units

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

3.5) Railway Cant Formula

Evaluate Formula

Formula

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

Example with Units

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

Variables used in list of Transition Curves Surveying Formulas above

- **B** Pavement Width *(Meter)*
- F_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 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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