Important Cable System, Sag and Drainage on Bridges Formulas PDF

Formulas
Examples
with Units

List of 17
Important Cable System, Sag and Drainage on Bridges Formulas

1) Cable Systems Formulas

1.1) Cable Tension using Natural Frequency of Each Cable Formula

Evaluate Formula

Formula

$$T = \left(\left(\omega_n \cdot \frac{L_{span}}{n} \cdot \pi \right)^2 \right) \cdot \frac{q}{[g]}$$

Example with Units

$$600.9406\,\text{kN} = \left(\left(5.1\,\text{Hz} \cdot \frac{15\,\text{m}}{9.9} \cdot 3.1416 \right)^2 \right) \cdot \frac{10.0\,\text{kN/m}}{9.8066\,\text{m/s}^2}$$

1.2) Fundamental Vibration Mode given Natural Frequency of Each Cable Formula

Evaluate Formula

Formula

$$n = \frac{\omega_n \cdot \pi \cdot L_{span}}{\sqrt{T}} \cdot \sqrt{\frac{q}{[g]}}$$

Example with Units

$$9.9078 = \frac{5.1\,\text{Hz} \cdot 3.1416 \cdot 15\,\text{m}}{\sqrt{600\,\text{kN}}} \cdot \sqrt{\frac{10.0\,\text{kN/m}}{9.8066\,\text{m/s}^2}}$$

1.3) Natural Frequency of Each Cable Formula

Evaluate Formula

Formula

$$\omega_n = \left(\frac{n}{\pi \cdot L_{span}} \right) \cdot \sqrt{T \cdot \frac{[g]}{q}}$$

Example with Units

$$5.096\,\text{Hz} = \left(\frac{9.9}{3.1416 \cdot 15\,\text{m}} \right) \cdot \sqrt{600\,\text{kN} \cdot \frac{9.8066\,\text{m/s}^2}{10.0\,\text{kN/m}}}$$

1.4) Span of Cable given Natural Frequency of Each Cable Formula

Evaluate Formula

Formula

$$L_{span} = \left(\frac{n}{\pi \cdot \omega_n}\right) \cdot \sqrt{T \cdot \left(\frac{[g]}{q}\right)}$$

Example with Units

$$14.9883\,\text{m} = \left(\frac{9.9}{3.1416 \cdot 5.1\,\text{Hz}}\right) \cdot \sqrt{600\,\text{kN} \cdot \left(\frac{9.8066\,\text{m/s}^2}{10.0\,\text{kN/m}}\right)}$$

2) Catenary Cable Sag and Distance between Supports Formulas

2.1) Catenary Parameter for UDL on Catenary Parabolic Cable Formula

Evaluate Formula

Formula

$$c = \left(\frac{T_s}{q}\right) - d$$

Example with Units

$$19.56\,\text{m} = \left(\frac{210\,\text{kN}}{10.0\,\text{kN/m}}\right) - 1.44\,\text{m}$$

2.2) Maximum Sag given Catenary Parameter for UDL on Catenary Parabolic Cable Formula

Evaluate Formula

Formula

$$d = (-c) + \left(\frac{T_s}{q}\right)$$

Example with Units

$$1.44\,\text{m} = (-19.56\,\text{m}) + \left(\frac{210\,\text{kN}}{10.0\,\text{kN/m}}\right)$$

2.3) Span of Cable given Catenary Parameter for UDL on Catenary Parabolic Cable Formula

Evaluate Formula

Formula

$$L_{span} = 2 \cdot c$$

Example with Units

$$39.12\,\text{m} = 2 \cdot 19.56\,\text{m}$$

2.4) Tension at Supports given Catenary Parameter for UDL on Catenary Parabolic Cable Formula

Evaluate Formula

Formula

$$T_s = (d + c) \cdot q$$

Example with Units

$$210\,\text{kN} = (1.44\,\text{m} + 19.56\,\text{m}) \cdot 10.0\,\text{kN/m}$$

2.5) Total Sag given Catenary Parameter for UDL on Catenary Parabolic Cable Formula

Evaluate Formula

Formula

$$f_{cable} = d + c$$

Example with Units

$$21\,\text{m} = 1.44\,\text{m} + 19.56\,\text{m}$$

2.6) UDL given Catenary Parameter for UDL on Catenary Parabolic Cable Formula

Evaluate Formula

Formula

$$q = \frac{T_s}{d + c}$$

Example with Units

$$10\,\text{kN/m} = \frac{210\,\text{kN}}{1.44\,\text{m} + 19.56\,\text{m}}$$

3) Rainwater Accumulation and Drainage on Bridges Formulas

3.1) Average Rainfall Intensity given Runoff Rate of Rainwater from Bridge during Rainstorm Formula

Evaluate Formula

Formula

$$I = \frac{q_p}{1.00083 \cdot C_r \cdot A_{catchment}}$$

Example with Units

$$16.0003\,\text{mm/min} = \frac{1.256\,\text{m}^3/\text{s}}{1.00083 \cdot 0.5 \cdot 9412\,\text{m}^2}$$

3.2) Deck Width for Handling Rainwater Runoff to Drain Scuppers Formula

Evaluate Formula

Formula

$$w = S + \frac{t}{3}$$

Example with Units

$$4.5\,\text{m} = 2.5\,\text{m} + \frac{6}{3}$$

3.3) Drainage Area given Runoff Rate of Rainwater from Bridge during Rainstorm Formula

Evaluate Formula

Formula

$$A_{catchment} = \frac{q_p}{1.00083 \cdot C_r \cdot I}$$

Example with Units

$$9412.1879\,\text{m}^2 = \frac{1.256\,\text{m}^3/\text{s}}{1.00083 \cdot 0.5 \cdot 16\,\text{mm/min}}$$

3.4) Runoff Coefficient given Runoff Rate of Rainwater from Bridge during Rainstorm Formula

Evaluate Formula

Formula

$$C_r = \frac{q_p}{1.00083 \cdot I \cdot A_{catchment}}$$

Example with Units

$$0.5 = \frac{1.256\,\text{m}^3/\text{s}}{1.00083 \cdot 16\,\text{mm/min} \cdot 9412\,\text{m}^2}$$

3.5) Runoff Rate of Rainwater from Bridge during Rainstorm Formula

Evaluate Formula

Formula

$$q_p = 1.00083 \cdot C_r \cdot I \cdot A_{catchment}$$

Example with Units

$$1.256\,\text{m}^3/\text{s} = 1.00083 \cdot 0.5 \cdot 16\,\text{mm/min} \cdot 9412\,\text{m}^2$$

3.6) Shoulder Width for Deck Width of Rainwater Runoff to Drain Scuppers Formula

Evaluate Formula

Formula

$$S = w - \left(\frac{t}{3}\right)$$

Example with Units

$$2.5\,\text{m} = 4.5\,\text{m} - \left(\frac{6}{3}\right)$$

3.7) Traffic Lane given Deck Width for Handling Rainwater Runoff to Drain Scuppers Formula

Evaluate Formula

Formula

$$t = (w - S) \cdot 3$$

Example with Units

$$6 = (4.5\,\text{m} - 2.5\,\text{m}) \cdot 3$$

Variables used in list of Cable System, Sag and Drainage on Bridges Formulas above

- $A_{catchment}$ Catchment Area for Rainstorm *(Square Meter)*
- **c** Catenary Parameter *(Meter)*
- C_r Runoff Coefficient
- **d** Maximum Sag *(Meter)*
- f_{cable} Sag of Cable *(Meter)*
- **I** Intensity of Rainfall *(Millimeter per Minute)*
- L_{span} Cable Span *(Meter)*
- **n** Fundamental Vibration Mode
- **q** Uniformly Distributed Load *(Kilonewton per Meter)*
- q_p Peak Rate of Runoff *(Cubic Meter per Second)*
- **S** Shoulder Width *(Meter)*
- **t** Number of Traffic Lane
- **T** Cable Tension *(Kilonewton)*
- T_s Tension at Supports *(Kilonewton)*
- **w** Width of Deck *(Meter)*
- ω_n Natural Frequency *(Hertz)*

Constants, Functions, Measurements used in list of Cable System, Sag and Drainage on Bridges Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- constant(s): **[g]**, 9.80665 *Gravitational acceleration on Earth*
- 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.*
- Measurement: **Length** in Meter (m) *Length Unit Conversion*
- Measurement: **Area** in Square Meter (m²) *Area Unit Conversion*
- Measurement: **Speed** in Millimeter per Minute (mm/min) *Speed Unit Conversion*
- Measurement: **Force** in Kilonewton (kN) *Force Unit Conversion*
- Measurement: **Frequency** in Hertz (Hz) *Frequency Unit Conversion*
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m³/s) *Volumetric Flow Rate Unit Conversion*
- Measurement: **Surface Tension** in Kilonewton per Meter (kN/m) *Surface Tension Unit Conversion*

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