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General Relation for Suspension Cables Formulas

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List of 17 General Relation for Suspension Cables Formulas

General Relation for Suspension Cables

Catenary

1) Catenary Length given Tension at any Point of Simple Cable with UDL

Open Calculator

fx $$L_{span} = \sqrt{\frac{\left(T_s^2\right) - \left(T_m^2\right)}{q^2}}$$

ex $$20.99619\text{m} = \sqrt{\frac{\left((210\text{kN})^2\right) - \left((4\text{kN})^2\right)}{(10.0\text{kN/m})^2}}$$

2) Horizontal Component given Tension at any Point of Simple Cable with UDL

Open Calculator

fx $$H = \sqrt{\left(T^2\right) - \left(\left(W' \cdot s\right)^2\right)}$$

ex $$520.3062\text{kN} = \sqrt{\left((600\text{kN})^2\right) - \left((6.0\text{kN/m} \cdot 49.8\text{m})^2\right)}$$

3) Tension at any Point given Catenary Length of Simple Cable with UDL

Open Calculator

fx $$T_s = \sqrt{\left(T_m^2\right) + \left(q \cdot L_{span}\right)^2}$$

ex $$150.0533\text{kN} = \sqrt{\left((4\text{kN})^2\right) + \left(10.0\text{kN/m} \cdot 15\text{m}\right)^2}$$

4) UDL given Tension at any Point of Simple Cable with UDL

Open Calculator

fx $$q = \sqrt{\frac{\left(T_s^2\right) - \left(T_m^2\right)}{L_{span}^2}}$$

ex $$13.99746\text{kN/m} = \sqrt{\frac{\left((210\text{kN})^2\right) - \left((4\text{kN})^2\right)}{(15\text{m})^2}}$$

Parabola

5) Tension at Midspan given Parabolic Equation for Cable Slope

Open Calculator

fx $$T_{mid} = \frac{q \cdot x^2}{2 \cdot y}$$

ex $$196\text{kN} = \frac{10.0\text{kN/m} \cdot (7\text{m})^2}{2 \cdot 1.25}$$

6) UDL given Parabolic Equation for Cable Slope

Open Calculator

$$q = \frac{y \cdot 2 \cdot T_{mid}}{(x)^2}$$

$$10\text{kN/m} = \frac{1.25 \cdot 2 \cdot 196\text{kN}}{(7\text{m})^2}$$

7) UDL given Tension at Midspan for UDL on Parabolic Cable

Open Calculator

$$q = 8 \cdot T_{mid} \cdot \frac{d}{L_{span}^2}$$

$$10.0352\text{kN/m} = 8 \cdot 196\text{kN} \cdot \frac{1.44\text{m}}{(15\text{m})^2}$$

Supports at Same Level

8) Horizontal Component of Cable Tension for UDL

Open Calculator

$$T_{cable\ udl} = q \cdot \frac{L_{span}^2}{8 \cdot f}$$

$$56.25\text{kN} = 10.0\text{kN/m} \cdot \frac{(15\text{m})^2}{8 \cdot 5\text{m}}$$

9) Maximum Reactions at Supports

Open Calculator

fx $$T_{max} = \left(q \cdot \frac{L_{span}}{2}\right) \cdot \sqrt{1 + \left(\frac{L_{span}^2}{16 \cdot f^2}\right)}$$

ex $$93.75\text{kN} = \left(10.0\text{kN/m} \cdot \frac{15\text{m}}{2}\right) \cdot \sqrt{1 + \left(\frac{(15\text{m})^2}{16 \cdot (5\text{m})^2}\right)}$$

10) Sag of Cable at Midway between supports given Horizontal Component of Cable Tension for UDL

Open Calculator

fx $$f = q \cdot \frac{L_{span}^2}{8 \cdot T_{cable\ udl}}$$

ex $$5\text{m} = 10.0\text{kN/m} \cdot \frac{(15\text{m})^2}{8 \cdot 56.25\text{kN}}$$

11) Sag of Cable at Midway between supports given Maximum Reactions at Supports

Open Calculator

fx $$f = \sqrt{\frac{\frac{L_{span}^2}{16}}{\left(\frac{2 \cdot T_{max}}{q \cdot L_{span}}\right)^2 - 1}}$$

ex $$5\text{m} = \sqrt{\frac{\frac{(15\text{m})^2}{16}}{\left(\frac{2 \cdot 93.75\text{kN}}{10.0\text{kN/m} \cdot 15\text{m}}\right)^2 - 1}}$$

12) Span Length given Horizontal Component of Cable Tension for UDL

Open Calculator

fx $$L_{span} = \sqrt{\frac{8 \cdot f \cdot T_{cable\ udl}}{q}}$$

ex $$15m = \sqrt{\frac{8 \cdot 5m \cdot 56.25kN}{10.0kN/m}}$$

13) Span Length given Vertical Reaction at Supports

Open Calculator

fx $$L_{span} = V_R \cdot \frac{2}{q}$$

ex $$15m = 75kN \cdot \frac{2}{10.0kN/m}$$

14) UDL given Maximum Reactions at Supports

Open Calculator

fx $$q = \frac{T_{max}}{\left(\frac{L_{span}}{2}\right) \cdot \sqrt{1 + \left(\frac{L_{span}^2}{16 \cdot f^2}\right)}}$$

ex $$10kN/m = \frac{93.75kN}{\left(\frac{15m}{2}\right) \cdot \sqrt{1 + \left(\frac{(15m)^2}{16 \cdot (5m)^2}\right)}}$$

15) UDL given Vertical Reaction at Supports

Open Calculator

fx $$q = 2 \cdot \frac{V_R}{L_{span}}$$

ex $$10\text{kN/m} = 2 \cdot \frac{75\text{kN}}{15\text{m}}$$

16) Uniformly distributed Load given Horizontal Component of Cable Tension for UDL

Open Calculator

fx $$q = \frac{T_{cable\ udl} \cdot 8 \cdot f}{(L_{span})^2}$$

ex $$10\text{kN/m} = \frac{56.25\text{kN} \cdot 8 \cdot 5\text{m}}{(15\text{m})^2}$$

17) Vertical Reaction at Supports

Open Calculator

fx $$V_R = q \cdot \frac{L_{span}}{2}$$

ex $$75\text{kN} = 10.0\text{kN/m} \cdot \frac{15\text{m}}{2}$$

Variables Used

- **d** Maximum Sag *(Meter)*
- **f** Sag of Cable at Midway between Supports *(Meter)*
- **H** Horizontal Tension *(Kilonewton)*
- L_{span} Cable Span *(Meter)*
- **q** Uniformly Distributed Load *(Kilonewton per Meter)*
- **s** Catenary Length *(Meter)*
- **T** Cable Tension *(Kilonewton)*
- $T_{cable\ udl}$ Cable Tension for UDL *(Kilonewton)*
- T_m Midspan Tension *(Kilonewton)*
- T_{max} Maximum Value of Tension *(Kilonewton)*
- T_{mid} Tension at Midspan *(Kilonewton)*
- T_s Tension at Supports *(Kilonewton)*
- V_R Vertical Reaction at Supports *(Kilonewton)*
- W' Total Load per Unit Length *(Kilonewton per Meter)*
- **x** Distance from Midpoint of Cable *(Meter)*
- **y** Parabolic Equation of Cable Slope

Constants, Functions, Measurements used

- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Force** in Kilonewton (kN)
  Force Unit Conversion
- Measurement: **Surface Tension** in Kilonewton per Meter (kN/m)
  Surface Tension Unit Conversion

Check other formula lists

- **Cable System, Sag and Drainage on Bridges Formulas**
- **General Relation for Suspension Cables Formulas**
- **Parabolic Cable Tension and Length Formulas**

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