# Catenary Cable: Tension and Length from Span and Sag

Horizontal and maximum tension and the length of a cable hanging under its own weight between supports at the same level, by the exact catenary and the parabola.

**Method:** Equilibrium of a cable under its own weight (catenary)

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Span between supports | 100.00 | m |
| Sag at mid-span | 5.0000 | m |
| Weight per unit length | 15.000 | N/m |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Horizontal tension | 3.7624 | kN |
| Maximum tension (at the supports) | 3.8374 | kN |
| Cable length | 100.66 | m |
| Catenary parameter H/w | 250.83 | m |
| Horizontal tension by the parabola wS²/8d | 3.7500 | kN |
| Length by the parabola S + 8d²/3S | 100.67 | m |
| Cable angle at the support | 11.346 | ° |

**Notes for this case**

- Exact catenary y = c[cosh(x/c) − 1] with supports level; the parabola is within 1 % while the sag is below about a tenth of the span. Elastic stretch is not included.

## Formula and method

$$d = c\left[\cosh\frac{S}{2c} - 1\right], \quad H = wc, \quad T_{max} = w(c+d), \quad L_c = 2c\sinh\frac{S}{2c}$$

### Variables

| | | |
|---|---|---|
| $S$ | Span between supports | m |
| $d$ | Sag at mid-span | m |
| $w$ | Weight per unit length | N/m |
| $H$ | Horizontal tension | N |
| $T_{max}$ | Maximum tension (at the supports) | N |
| $L_c$ | Cable length | m |
| $c$ | Catenary parameter H/w | m |
| $H_{parab}$ | Horizontal tension by the parabola wS²/8d | N |
| $L_{parab}$ | Length by the parabola S + 8d²/3S | m |
| $\phi$ | Cable angle at the support | rad |

### Method and standards

Exact catenary for level supports.

### Assumptions and limits

- Inextensible, perfectly flexible cable; level supports; own weight only.

## References

Equilibrium of a cable under its own weight (catenary)

## Report details

| | |
|---|---|
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| Release checks | 3 reference cases of this calculator, computed independently, are checked on every release |

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

### This calculator online

https://calc.firecad.com/mechanical/statics-dynamics/catenary-cable

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.