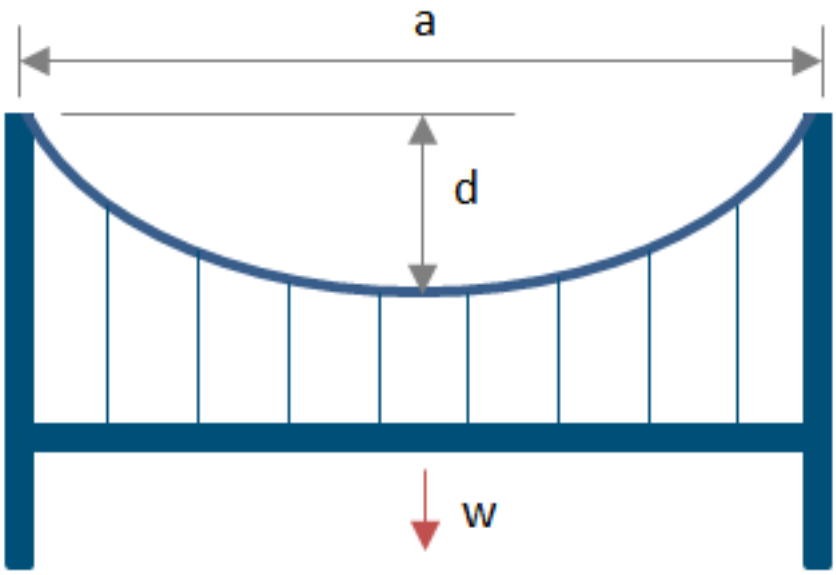
Parabolic Suspension Cable

Introduction

A cable is suspended between two supports.



- d is the sag
- w is the uniform weight per unit length
- a is the span
- L is the length of the cable

This application first derives a symbolic expression that describes the relationship between the cable length, span and sag.

Then, given values for the length and sag, this application will calculate the span.

Reference:
I.A. Karnovsky and O. Lebed, *Advanced Methods of Structural Analysis*, Springer, 2010.

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> restart :
  with( Units[ Simple ] ) :
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Derive Cable Length Equation

According to Karnovsky and Lebed (2010), the length of the cable is

> $cable\_length := L = \int_0^a \sqrt{1 + \left(\frac{4d}{a}\right)^2 \left(\frac{2x}{a} - 1\right)^2}\, dx$ **assuming** $a > 0, d > 0$

$$cable\_length := L = \frac{\operatorname{arcsinh}\left(\frac{4d}{a}\right) a^2 + 4\sqrt{a^2 + 16d^2}\, d}{8d} \tag{2.1}$$

Parameters

> $w := 0.01\ \text{lbf}\,\text{ft}^{-1}$:
$L := 100\ \text{ft}$:
$d := 2.738\ \text{ft}$:

Calculation

Hence the span is

> $fsolve(cable\_length, a = 100\,\text{ft})$

$$99.80004928\ \text{ft} \tag{4.1}$$