Mechanical Design of Overchead Lines

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SAG and Tension

SAG

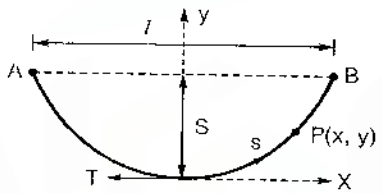
The vertical distance between the conductor at the mid point and the line joining the two adjacent level support is known as sag.

Catenary

A line conductor of uniform cross-section and material, perfectly flexible but stretched inelestic between 2 support hanging freely under its own weight is represented by a curve known as catenary.

Sag Calculation

1. Supports at Same Level



Sag, $S = \frac{Wl^2}{8T}$ m

where, l = Length of span, metres
S = Sag at mid span, metres
T = Conductor tension (assumed constant over the whole span), newtons
W = Conductor weight, N/m

Spacing Between Conductors (without sparking)

$$\text{Spacing} = \sqrt{S} + \frac{V}{150} \text{ metres}$$

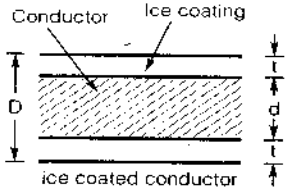
where, S = sag in metres
V = line voltage in kV

2. Effect of Ice and Wind

Weight of Ice Per Metre Length of Conductor

$$W_i = 2.8 \times 10^{-4} t(d + t) \text{ N/m}$$

where, d = diameter of conductor, metres
t = radial thickness of ice, metres



Wind load

$$F_W = P \times D \text{ N/m}$$

where, P = Wind pressure, Newton per square metre of projected area.

Total force acting on conductor per metre length

$$F_t = \sqrt{(W + W_i)^2 + F_W^2} \text{ N/m}$$

Sag under worst condition

$$S = \frac{F_t l^2}{8T} \text{ in new plane}$$

where, F_t = Total force per meter
T = Limiting tension

Vertical sag

$$\text{Vertical sag} = S \cos\gamma$$

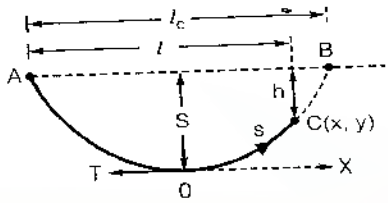
$$\tan\gamma = \frac{F_W}{W + W_i}$$

Total length of conductor

$$Z = l\left(\frac{F_t^2 l^2}{24T^2}\right)$$

where, Z = Total length of the conductor
F_t = Total force acting on conductor per metre length

3. Supports at different levels



$$S = \frac{Wl_c^2}{8T} \text{ and } l_c = l + \frac{2Th}{Wl}$$

where, l_c = Span of complete parabola

Remember:

The formulas are also valid if two supports A and C fall on the same side of origin $\left(\text{i.e. if } l < \frac{l_c}{2}\right)$.

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