Chapter: 05

Mechanical Features and Design of Overhead Transmission Line:

Lecture : 21

TOPIC:

1. Sag in overhead lines
2. Calculation of sag
3. Examples.

Chapter: 05
Mechanical Features and Design of Overhead Transmission Line:

1. Main components of overhead lines
2. Conductor materials
3. Line supports
4. Insulators, Types of insulators
5. String efficiency, Methods of improving string efficiency
6. Examples
7. Sag in overhead lines, Calculation of sag
8. Examples.

1. Sag in overhead lines

The difference in level between points of supports and the lowest point on the conductor is called **sag.**

2. Calculation of sag

I. **Supports are at equal levels and**

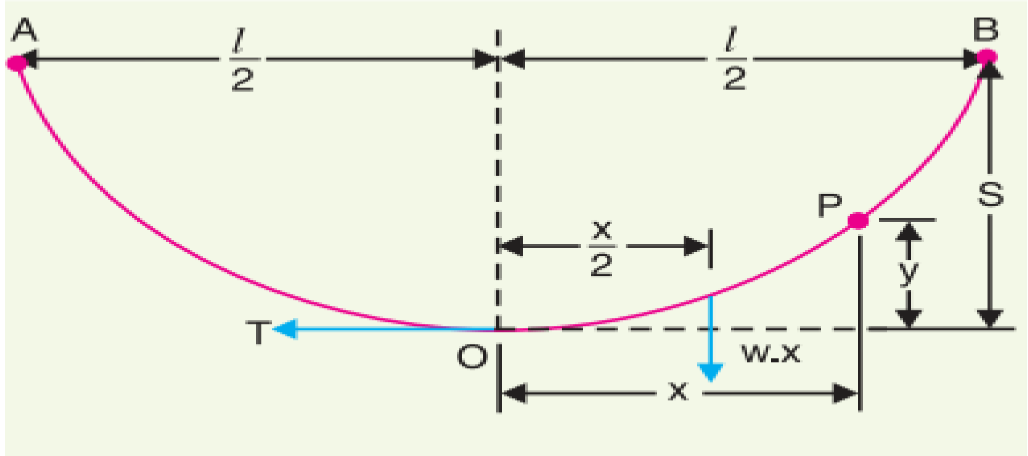


Fig. 8.24

II. **Supports are at unequal levels.**

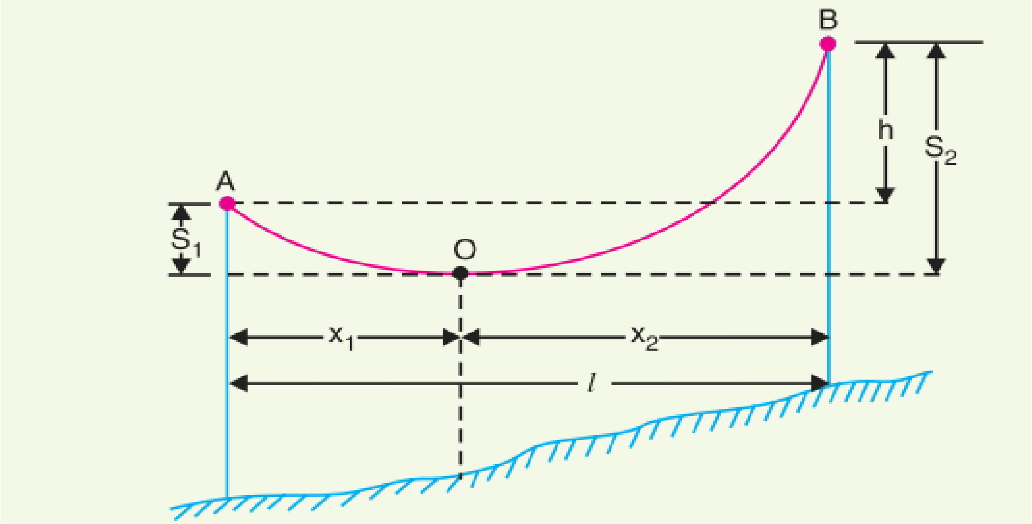


Fig. 8.25

Supports are at equal levels

Let

l = Length of span

w = Weight per unit length of conductor

T = Tension in the conductor.

$$T = \frac{\text{Ultimate strength}}{\text{Safety factor}}$$

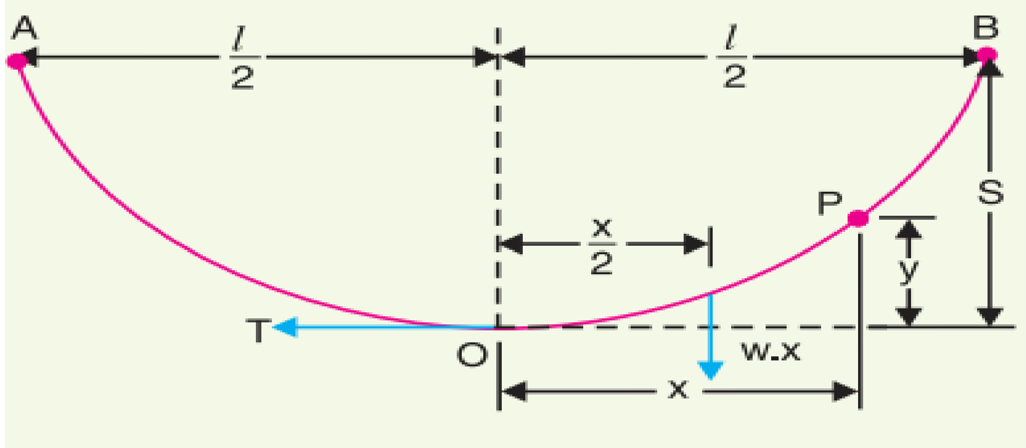


Fig. 8.24

$$\text{Sag,} \quad S = \frac{w\,l^2}{8\,T}$$

Example 8.17. *A 132 kV transmission line has the following data :*

Wt. of conductor = 680 kg/km	;	*Length of span = 260 m*
Ultimate strength = 3100 kg	;	*Safety factor = 2*

Calculate the height above ground at which the conductor should be supported. Ground clearance required is 10 metres.

$$T = \frac{\text{Ultimate strength}}{\text{Safety factor}}$$

Supports are at unequal levels.

l = Span length
h = Difference in levels between two supports
x_1 = Distance of support at lower level (*i.e.*, *A*) from *O*
x_2 = Distance of support at higher level (*i.e.* *B*) from *O*
T = Tension in the conductor

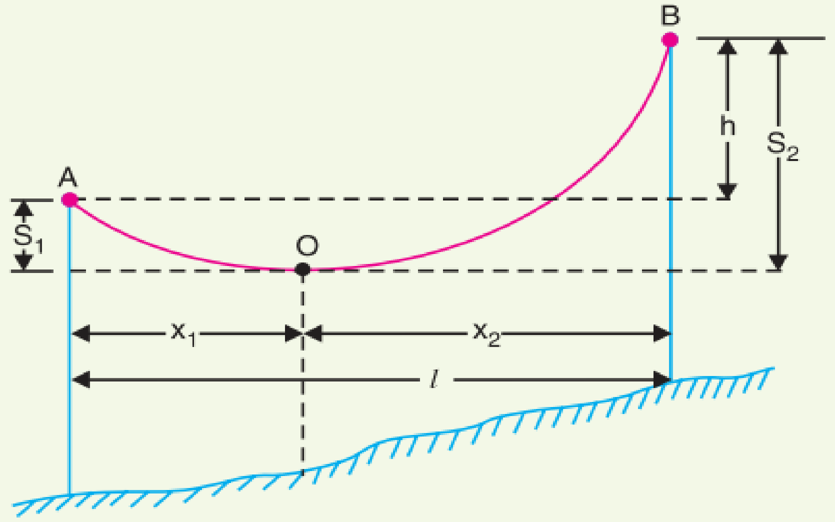


Fig. 8.25

$$x_1 = \frac{l}{2} - \frac{T\,h}{w\,l}$$

$$x_2 = \frac{l}{2} + \frac{T\,h}{w\,l}$$

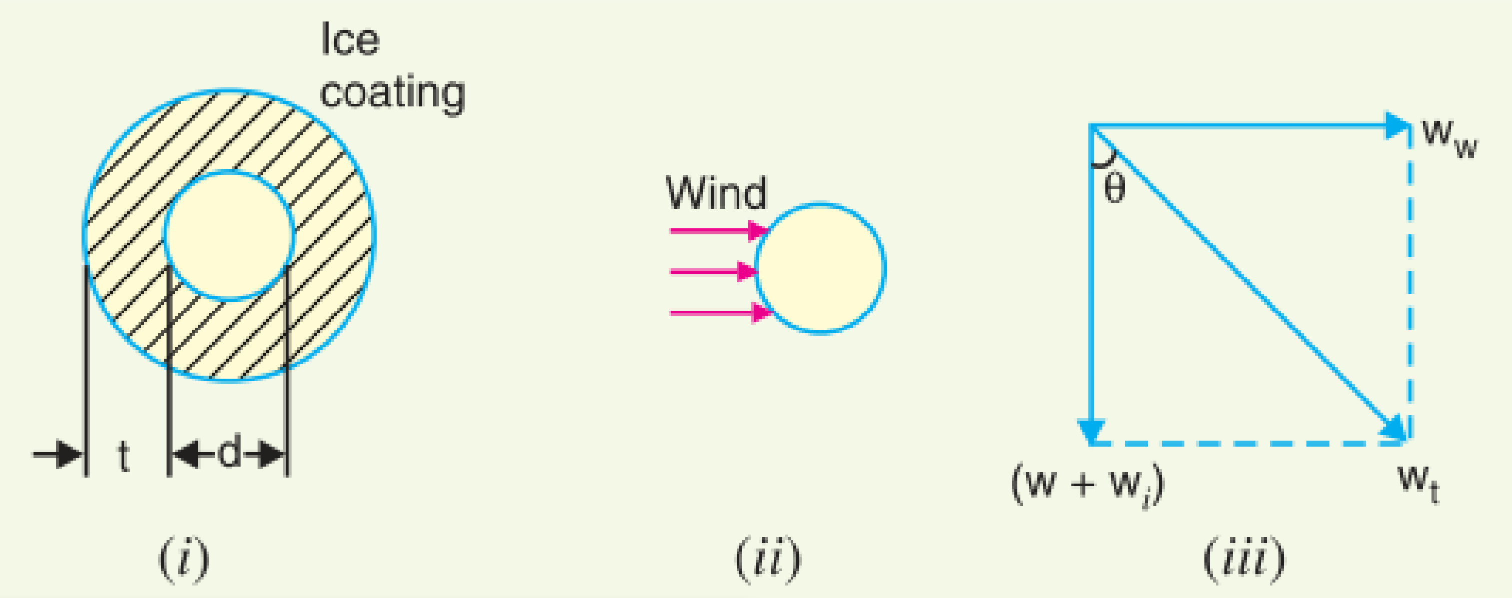
$$\text{Sag } S_1 = \frac{w\,x_1^{2*}}{2T}$$

and

$$\text{Sag } S_2 = \frac{w\,x_2^{2}}{2T}$$

$$x_1 + x_2 = l$$

Effect of wind and ice loading.



Total weight of conductor per unit length is

$$w_t = \sqrt{(w + w_i)^2 + (w_w)^2}$$

where w = weight of conductor per unit length

= conductor material density × volume per unit length

w_i = weight of ice per unit length

= density of ice × volume of ice per unit length

$= \text{density of ice} \times \frac{\pi}{4} [(d + 2t)^2 - d^2] \times 1$

$= \text{density of ice} \times \pi \; t\,(d + t)$*

w_w = wind force per unit length

= wind pressure per unit area × projected area per unit length

$= \text{wind pressure} \times [(d + 2t) \times 1]$

When the conductor has wind and ice loading also, the following points may be noted :

(*i*) The conductor sets itself in a plane at an angle θ to the vertical where

$$\tan\theta = \frac{w_w}{w + w_i}$$

(*ii*) The sag in the conductor is given by :

$$S = \frac{w_t\, l^2}{2T}$$

Hence S represents the slant sag in a direction making an angle θ to the vertical. *If no specific mention is made in the problem, then slant slag is calculated by using the above formula.*

(*iii*) The vertical sag $= S\cos\theta$

Example 8.18. *A transmission line has a span of 150 m between level supports. The conductor has a cross-sectional area of 2 cm^2. The tension in the conductor is 2000 kg. If the specific gravity of the conductor material is 9·9 gm/cm^3 and wind pressure is 1·5 kg/m length, calculate the sag. What is the vertical sag?*

Thank You