# NOTES (15-Feb-2025)

**Overhead Line insulators:**

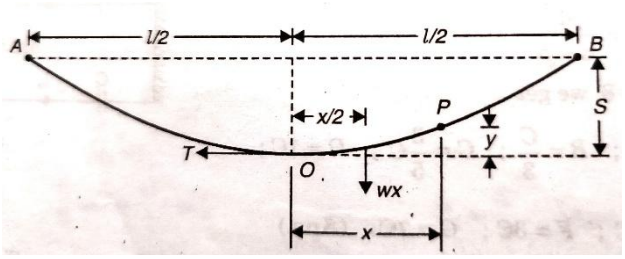
These insulators provide insulation of high voltage lines with the metal structure and also provide support to the power conductors.

- High mechanical strength
- High insulation resistance
- High relative permittivity (*High dielectric strength*)
- High ratio of rupture voltage to flashover voltage
- The insulation must be non-porous, free from internal impurities, cracks, dust, and also impervious to the atmosphere fluids/gases.
- Bearable to temperature fluctuations.

**Sag in Overhead Power Lines:** A sag is the difference between the points of support and the lowest point of the catenary formed by a power line.

**The following factors affect the sag,**

- Weight of a conductor
- Span length
- Working Tensile strength
- Temperature



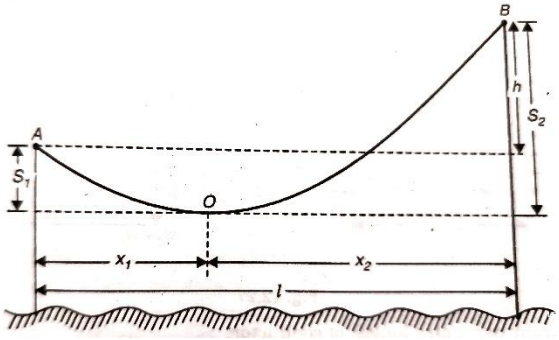

**Sag calculations for,**

1 For supports that are at equal levels

2 For supports that are at unequal levels

- **Supports are at equal levels,**
  - Sag, $S = w \times (l/2)^2/(2 \times T)$

  Where l is the span length, T is the tension in a conductor, and w is the weight per unit length of a conductor
- **Supports are at unequal levels,**
  - $S_1 = w \times (x_1)^2/(2 \times T)$ and $S_2 = w \times (x_2)^2/(2 \times T)$
  - $l = x_1 + x_2$
  - $h = \frac{w \times l}{2 \times T}(x_2 - x_1)$
  - $x_1 = \frac{l}{2} - \frac{T \times h}{w \times l}$ and $x_2 = \frac{l}{2} + \frac{T \times h}{w \times l}$



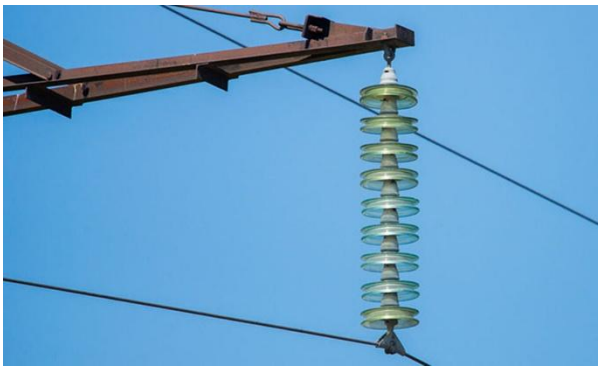

**Overhead Line Insulators**

- **Insulating Materials**
  - Porcelain
  - Glass
  - Steatite
  - Synthetic resins

**Causes of failure of Insulators**

- Mechanical stress
- Porosity of material
- Cracking of insulators
- Improper vitrification
- Short circuits
- Flash-over breakdown
- Puncture breakdown
- Dust deposition

- **Types of Insulators**
  - **Pin type** (11kV, 22kV, 66kV): *For low voltages, pin-type insulators which are made of glass are generally used. These types of insulators made of porcelain are designed for voltages up to 90kV but are seldom used on lines above 60kV.*
  - **Suspension type**: *Since the cost of pin-type insulators increases rapidly as the working voltage increases, this insulator is not economical beyond 33kV. So, for voltages beyond 33kV, it is usual practice to use suspension-type insulators.*

***(a) Pin Type (b) Suspension type***

  - **Strain type**: *Up to about 30kV pin-type insulators are satisfactory, but for higher voltages, the suspension type is generally used. These types of insulators are used on dead-end towers at bends or corners of transmission lines, or when making very long spans.*
  - **Shackle type**: *The shackle insulators were used as strain insulators but for low-voltage distribution lines.*


***(c) Shackle type (d) Strain type***