COLLEGE OF ENGINEERING AND TECHNOLOGIES
ALMUSTAQBAL UNIVERSITY

# Power Engineering

## EET 305

## Lecture 6

## - Comparison of Conductor Materials in overhead systems I -

**(2025 - 2026)**

Dr. Zaidoon AL-Shammari

Lecturer / Researcher

zaidoon.waleed@mustaqbal-college.edu.iq

# Introduction



Overhead transmission and distribution systems use conductors to carry electrical energy across distances.

Selecting the appropriate conductor material is crucial for:

- Electrical efficiency.
- Mechanical strength.
- Cost optimization.
- Durability and reliability.

# Common Conductor Materials



| Type | Material Name | Typical Use |
|---|---|---|
| 1 | Copper (Cu) | Urban distribution, short spans |
| 2 | Aluminium (Al) | Transmission & distribution lines |
| 3 | ACSR (Aluminium Conductor Steel Reinforced) | Long spans & high-voltage lines |
| 4 | AAAC (All Aluminium Alloy Conductor) | Coastal and corrosive areas |


**Advantages:**

- **Excellent Conductivity:** Higher electrical conductivity than aluminum, allowing for smaller cross-sections.
- **Tensile Strength:** Stronger and more durable, which can reduce sag in wiring.
- **Lower Resistance:** Reduced power losses over long distances.


**Disadvantages:**

- **Heavy:** Heavier than aluminum, necessitating more robust support structures.
- **Cost:** Higher material costs compared to aluminum.
- **Corrosion Susceptibility:** Can corrode if exposed to certain environments, especially if not insulated properly.

## Advantages:

- **Lightweight:** Reduces tower loads and eases handling during installation.
- **Corrosion Resistance:** Typically resistant to corrosion due to the formation of a protective oxide layer.
- **Cost-Effective:** Generally less expensive than copper.
- **High Conductivity:** Good conductivity with lower thermal expansion.

**Disadvantages:**

- **Lower Strength:** Weaker than copper, needing larger diameters for the same current-carrying capacity.
- **Mechanical Handling:** Prone to mechanical damage if not handled properly.

## Advantages:

- **Hybrid Structure:** Combines aluminum and steel, providing the best of both worlds (low weight and high tensile strength).
- **Cost-Effectiveness:** Easier to install due to lower weight compared to copper.
- **Corrosion Resistance:** The aluminum outer layer protects against environmental factors.

**Disadvantages:**

- **Complexity in Design:** May require specific structural considerations due to the steel core.
- **Potential for Bimetallic Corrosion:** If not properly designed, connections can suffer from corrosion issues.

# AAAC (All Aluminum Alloy Conductor)



**Advantages:**

- **Enhanced Properties:** Designed to balance weight, strength, and conductivity.
- **High Thermal Resistance:** Can withstand higher temperatures without sagging.

# AAAC (All Aluminum Alloy Conductor)



- **Disadvantages:**
  - **Cost:** Often more expensive due to specialized manufacturing.
  - **Limited Availability:** May not be as readily available as traditional materials.

# Summary Table



| Material | Advantages | Disadvantages |
|---|---|---|
| Aluminum | Lightweight, corrosion-resistant, cost-effective | Lower strength, prone to mechanical damage |
| Copper | Excellent conductivity, tensile strength | Heavy, higher cost, susceptible to corrosion |
| ACSR | Combines strengths of aluminum and steel | Complex design, risk of bimetallic corrosion |
| Alloys | Enhanced properties, high thermal resistance | Higher cost, limited availability |

# Corrosion & Environmental Factors



- Copper: Excellent corrosion resistance.
- Aluminum: Forms protective oxide layer; less durable in coastal areas.
- AAAC: Best corrosion resistance among aluminum-based types.
- ACSR: Steel core may corrode; galvanization required.

# Conclusion



- Each conductor material has unique properties suited for specific applications in overhead power systems.
- Aluminum and ACSR are popular for their balance between weight and cost, while copper is chosen for its superior conductivity and strength.
- The choice depends on factors like installation conditions, environmental factors, and budget constraints.