PRACTICAL CABLE(HT/LT) SIZING CALCULATION:

Before going for cable sizing for both for HT/LT cable, we sequentially follow the following methods in steps.

- Step-1: Calculation of load current for 3 phase system

$$I=\frac{P}{\sqrt{3XVXpfX\eta}}$$

Where P=Load in KW or MW V=Line Voltage in V/KV, pf=Power factor and η=Efficiency.

- Step-2:**LT CABLE SIZING (upto 1KV)**
  a. **Current Carrying Capacity**

$$I_{cable} \geq I_{Load}$$
$$where\ I_{cable} = rated\ current\ of\ the\ cable$$
I_{Load} = Load current

Reference-Standard table (IS 3961 / IEC 60502)

  b. **Application of derating factors**

Derating factor due to ambient temperature =K_1
Derating factor due to grouping of cables =K_2
Derating factor due to soil resistivity (for buried cables) =K_3
Effective derating factor=$K_{effective}$=K_1X K_2X K_3
Effective Current= $I_{effective}$=$K_{1effective}$X I_{Rated}

  c. **Checking of voltage drop**:

$$\%\ VD=\frac{\sqrt{3}X\ I\ x(R cos\phi + X\ sine\phi)xL}{V}\ X100$$
$$\leq 3\%\ for\ lighting\ load$$
$$\leq 5\%\ for\ power\ load$$

  d. **Short circuit withstand**

$$A=\frac{I_{sc}\ X\sqrt{t}}{K}$$
Where A= cross sectional area in mm^2

I_{sc}= fault current
t =fault duration in s
K= material constant for the conductor, for copper=115

e. **Final Selection**:
Choose nearest standard size of conductors in mm^2

Let us a practical example of LT cable sizing-
Given Load=500, Voltage=415V.PF=0.9
Step-1: Load Current(I)
I=$\frac{500000}{\sqrt{3}X415X0.9}$=773A(approx..)
Step-2: Cable Selection
1 run 400 sqmm can carry 600A current, but not sufficient
2 runs 400 sqmm is sufficient to carry the above load current
Step-3:Voltage drop is checked and it is ensured that it is less than 5%.
Step-4: Short Circuit Checking: The withstand capacity of the cable is verified with 1s fault current

Step-3:.**HT CABLE SIZING (11KV,33KV etc.)**

- **Load current(I):**
  I=$\frac{S}{\sqrt{3}XV}$
  Where S is KVA or MVA
- **Current Capacity**:
  - ✓ Current is taken from manufacturer's data sheet or IEC standard
  - ✓ Installation method should be considered.
  - ✓ Soil thermal resistivity should also be considered
- .**Short Circuit Rating**:
  HT cables are mainly selected on the basis of fault current.
  Fault Level MVA=$\frac{Rated\ MVA\ X100}{\%\ Z}$
  Fault Current= I_{SC}=$\frac{Fault\ level(MVA)}{\sqrt{3}XV}$
  Then to check, A≥ $\frac{I_{SC}X\sqrt{t}}{K}$
- **Voltage Drop**: It is usually within limit due to high voltage.
- **Insulation level:** Chosen as per voltage level.

e.g for 11 KV 12/20 KV grade and 33 KV 19/33 KV grade

Practical Example HT Cable sizing:

Transformer: 10 MVA

Voltage: 11 kV

Load current, I= $\frac{10X\ 10^6}{\sqrt{3X11000}}$=525A

Then choose 240 sqmm or 300 sqmm XLPE HT Cable

Verify short circuit rating of of the cable with 25KA for 1 second

Key Practical Tips:

- Always **prefer multiple runs** instead of one huge cable
- Check **future load expansion (20–25%)**
- Use **Aluminium for cost**, Copper for space/critical loads
- For substations:
  LT → 3.5C or 4C cables
  HT → Single core (3 runs)

Final Practical Engineering Checklist

- ✓ Before finalizing cable:
- ✓ Load current
- ✓ Derating factors
- ✓ Voltage drop
- ✓ Short circuit capacity
- ✓ Installation method
- ✓ Future expansion