Low Voltage Electrical Installation

MODULE 6
Chapter 3: Wiring System

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Module Description

- Expected Outcomes
  - Interpret rules and regulation for electrical wiring comprising of cable selection and load calculation.
  - Apply ethical principles and commit to professional ethics.

- Module Outline
  - ST Regulation of Electrical Wiring
  - Voltage Drop based on Suruhanjaya Tenaga (ST) (Table 4D1B)
  - Cable Sizing
  - Calculation of Cable's Voltage Drop
  - Cable Sizing Calculation
  - Cable Effect by The High Voltage Drop

ST Regulation of Electrical Wiring

FUSE/MCB (Amp)	CABLE SIZE (mm²)	LOAD LIMIT
6/10	1.5	Light/Fan 1000 W
16	2.5	1 x 13A s/s/o
20	2.5	2 x 13A s/s/o
32 (ring)	2.5	6 x 13A s/s/o
32 (radial)	4.0	4 X 13A s/s/o
32	4.0	1 x Electric Cooker
20	4.0	1 x Water Heater (Double Pole Switch)
20	4.0	1 x Air-Conditioner (Double Pole Switch)
40/63	16/25	Main Input Cable

Source: [1]

Voltage Drop based on ST (Table 4D1B)

Conductor cross-sectional area	2 cables d.c	2 cables, single-phase a.c			3 or 4 cables, three-phase a.c			
		Reference Method 3 & 4 (Enclosed in conduit etc. in or on a wall)	Reference Method 1 & 11 (clipped direct or on trays, touching)	Reference Method 12 (spaced*)	Reference Method 3 & 4 (Enclosed in conduit etc. in or on a wall)	Reference Method 1, 11 & 12 (in trefoil)	Reference Method 1 & 11 (flat and touching)	Reference Method 12 (spaced*)
1	2	3	4	5	6	7	8	9
(mm^2)	(mV/A/m)	(mV/A/m)	(mV/A/m)	(mV/A/m)	(mV/A/m)	(mV/A/m)	(mV/A/m)	(mV/A/m)
1	44	44	44	44	38	38	38	38
1.5	29	29	29	29	25	25	25	25
2.5	18	18	18	18	15	15	15	15
4	11	11	11	11	9.5	9.5	9.5	9.5
6	7.3	7.3	7.3	7.3	6.4	6.4	6.4	6.4
10	4.4	4.4	4.4	4.4	3.8	3.8	3.8	3.8
16	2.8	2.8	2.8	2.8	2.4	2.4	2.4	2.4

Source: [1]

Cable Sizing

- It is very important to do a proper sizing of cable in order to minimize the cost.
- Cable sizing must follow the IEE regulation.
- Voltage Drop (V_d) at the cable must not exceed than 4% of supplied power **[2]**. For instance;
  a) 240V x 4% = 9.6V
  b) 415V x 4% = 16.6V

Cable Sizing

- Formula Voltage drop (V_d) **[2];**

$$V_d = \frac{mV \times I_b \times L}{1000}$$

V_d = Voltage drop [V}

I_b = Full load current [A]

mV = [mV/A/m] - refer table 4D1B

l = length [m]

Calculation of Cable's Voltage Drop

Example..

- Calculate the voltage drop for an installation of 240V supplied system by a 40m-long single core of 16mm^2 PVC-insulated cable in conduit with the maximum load of 40 A.

Calculation of Cable's Voltage Drop

Solution..

- Find the value of the V_d for the cable size of 16 mm^2 by using the third column in table 4D1B.
- From table 4D1B, the obtained value is 2.8 mV/A/m

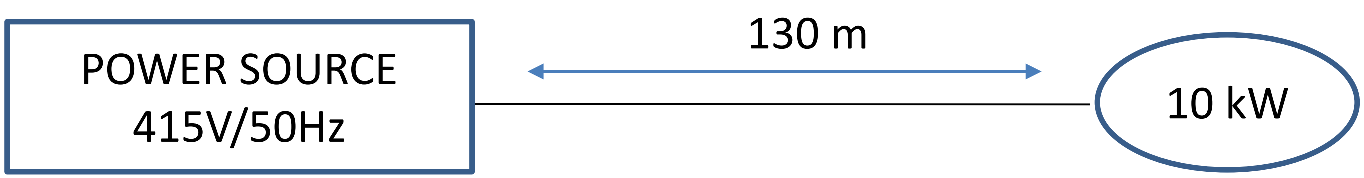
$$V_d = \frac{mV \times I_b \times L}{1000} = \frac{2.8 \times 40 \times 40}{1000} = 4.48\ V$$

- Since the V_d does not exceed 4% from power supply (9.6 V), based on IEE regulation [2], the cable of 16 mm^2 is permitted to be used in this installation.

Cable Sizing Calculation

Example…

- One small unit factory needs a main power supply of 415V/50Hz to support 10 kW of load. The nearest distance is quite far, which is around 130m. Even though the wiremen does not recommend this choice, the company owner insists to stick to this plan. Thus, please calculate the most suitable cable size based on the IEE regulation standard.



Cable Sizing Calculation

Solution :

Calculate the full load current,

$$I = \frac{V}{P} = \frac{10\ kW}{415\ V} = 24.096\ Amp$$

Choose the cable size 6.0 mm^2;

By referring table 4D1B - mV = 7.3 mV/A/m

$$V_d = \frac{mV \times I_b \times L}{1000}$$

$$V_d = \frac{24.096 \times 7.3 \times 130}{1000} = 22.89\ V$$

* The cable 6.0 mm^2 are not suitable – V_d more than 4% = 16.6 V

Choose the cable size 9.0 mm^2 ;

By referring table 4D1B - mV = 4.4 mV/A/m

$$V_d = \frac{mV \times I_b \times L}{1000}$$

$$V_d = \frac{24.096 \times 4.4 \times 130}{1000} = 13.78\ V$$

<u>* The cable 9.0 mm^2 are suitable.</u>

Cable Effect by The High Voltage Drop

1. Voltage value of the load drops significantly.
2. Efficiency of electrical equipment becomes low.
3. Power loss of the cable is high.
4. Cable insulation will break.

References

[1] Suruhanjaya Tenaga, *Guideline For Electrical Wiiring in Residential Buildings*, 2008.

[2] IEE, 16th IEE Wiring Regulations, 2001.

Thank you