

# ELECTRICAL INSTALLATION ESTIMATING & COSTING

## **Topics covered in this PPT**

- 1) Types of load
- 2) Load assessment
- 3) Electrical supply systems
- 4) Wiring systems
- 5) Permissible voltage drops and conductor size calculations
- 6) Estimating and costing for residential and commercial service connections (single phase and three phase)

# Types of Load

- An electrical load is any electrical device or component that consumes electrical energy and converts that energy into another form.
- As part of any electrical circuit, the component transforms current into something useful, commonly motion, light or heat.
- An electric lamp, resistor, or even a motor are simple examples.
- Broadly speaking, the electrical load can refer to: the equipment that uses electrical energy; the power required from a given circuit; the current (or power) passing through the line.

# The Different Types of Electrical Load

- Basically We have 3 types of load which is more theoretical & less practical.

1. **Resistive Load**
2. **Inductive Load**
3. **Capacitive Load**

- And we have also some loads which is more practically use applications.

1. **Domestic (Residential) Load**
2. **Commercial Load**
3. **Industrial Load**
4. **Municipal Load**

# Resistive Load

- Any load that consists of a heating element is generally referred to as a resistive load.
- A resistive load obstructs the flow of energy in the circuit, converting it to thermal energy.
- See incandescent lamps and electric heaters.
- Importantly, resistive loads draw electrical power in a way that keeps the current and voltage waves in phase.
- The power factor for a resistive load is unity.

# Inductive Load

- An inductive load is quite different and will use a magnetic field to do all of the work.
- In this case, the load could be a transformer, generator, or, more commonly, a motor.
- An inductive load has a coil that stores magnetic energy when current passes through it.
- This means that the current wave trail behind the voltage wave.
- Therefore, the power factor of an inductive load is lagging.

# Capacitive Load

- And, as you've already guessed, the current wave leads the voltage wave in a capacitive load.
- The current wave reaches a maximum before the voltage wave, and that means that the power factor is leading.
- Interestingly, there are no standalone capacitive loads – no one load is capacitive, such as a lightbulb or a motor.
- Capacitors are used in large power circuits to control power usage.
- In fact, the majority of modern power circuits will use a combination of resistive, inductive, and capacitive loads.
- For example, you'll almost always find a capacitor (capacitive load) being used to help control a motor (inductive load) during start-up or while it's running.

# Domestic (Residential) Load

- A domestic load is the total energy that's consumed by the electrical appliances in a domestic – or household – setting.
- Naturally, this varies between household, and varies significantly between different countries.
- Lights, refrigerators, heaters, air conditioners, are just a few of the domestic appliances that will create a total domestic load.
- Many of these are only connected for a few hours of each day, and consume a modest amount of power.



# Commercial Load

- Turn your attention to the high street.
- A commercial load consists of shop lighting, office appliances, restaurant appliances, or any other electrical loads that are used commercially.
- These appliances are typically connected for longer hours than domestic loads.

# Industrial Load

- Industrial load is next, and is made up of the load demand across various different industries.
- This is a coverall load, all the way from small-scale industries to heavy industries.
- The load will generally consist of heavy machinery and other systems that involve induction motors.
- They're likely to be connected at all times.
- Cottage industries < 5 KW
- Small scale industries 5-25 KW
- Medium scale industries 25-100 KW
- Large scale industries 100-500 KW
- Heavy scale industries >500 KW

# Municipal Load

- Municipal load is the final type of electrical load in power systems that we'll look at.
- Drainage systems, sewer systems, and traffic lights will all create the municipal load.
- Some of these systems operate at night, like street lighting, or pumps that replenish overhead storage tanks.
- Agriculture loads, irrigation loads, and traction loads are other less common types of load.

# Load assessment

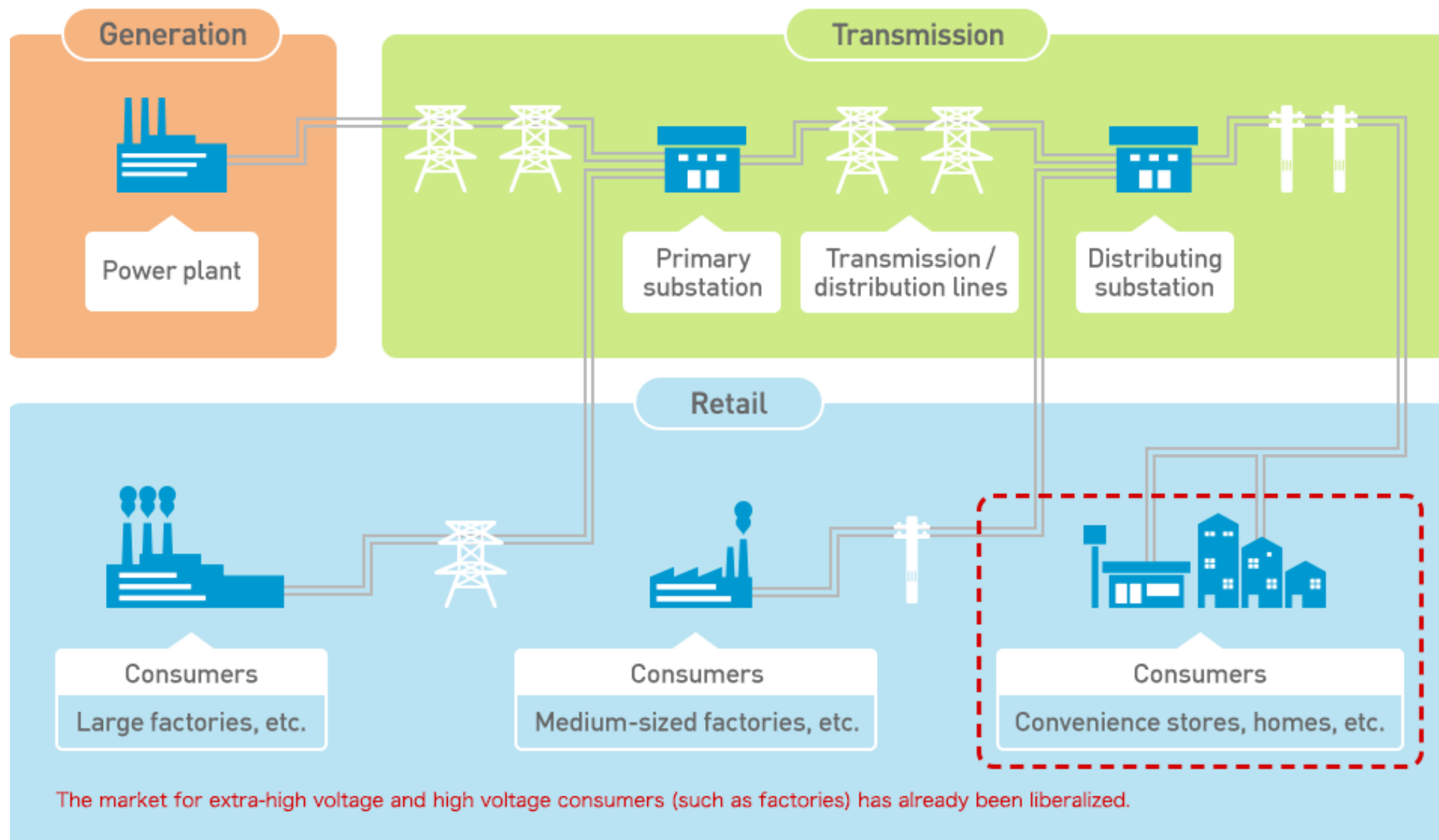
- What is load assessment?
- Load assessment consist in listing the appliances that will be connected and, record on the load assessment worksheet the quantity of each type of appliances, its wattage and the hours it will be in use every day. It is necessary to repeat the operation both for AC and DC loads.


# Why load assessment is important prior to electrical installation?

- A load analysis **verifies whether electrical systems are safe and efficient, and that installations show no signs of overload.** It may also highlight potential problems with energy usage, harmonic interference or unexpected spikes that a visual inspection alone may not identify.

# Electrical supply systems

- As we see in figure ,electrical power is supplied to individual homes by the following route: Power plant → Transmission lines → Transformer substation → Distribution lines. The power supply system is broadly divided into 3 sectors: **(1) the power generation sector, (2) the power transmission and distribution sector, and (3) the retail sector.**



 The market for sales to the consumers indicated by the red box (low voltage consumers) will be liberalized in April 2016.

# (1) Power generation sector

- This sector operates hydroelectric, thermal, nuclear, solar, wind, geothermal, and other power plants and produces electricity.



## (2) Transmission and distribution sector

- This sector manages the power transmission network which includes the transmission lines and distribution lines that connect the power plants to the consumers (including individual households).
- This sector is responsible for physically delivering electricity to homes.
- It also is responsible for coordinating the power balance (frequency, etc.) of the entire network in order to prevent blackouts and ensure a stable supply of electricity.

## (3) Retail sector

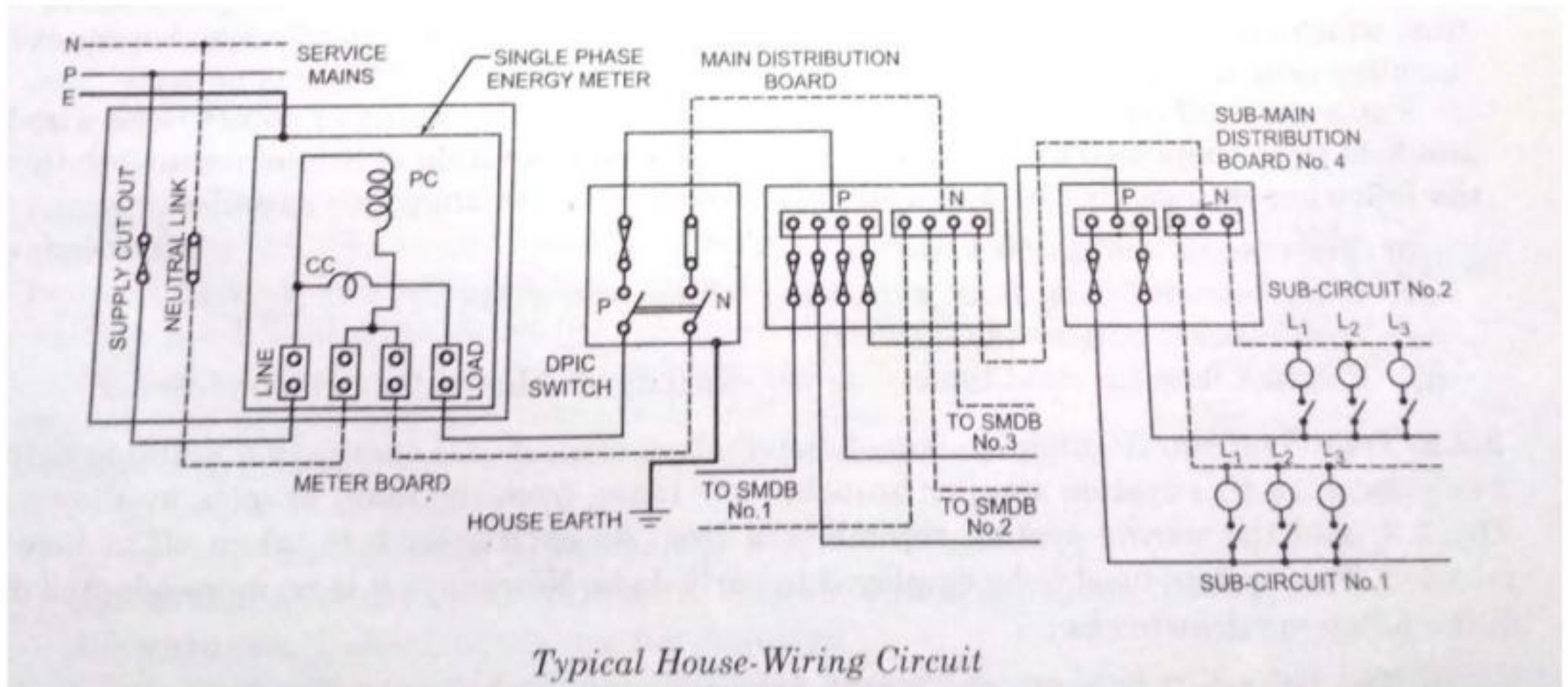
- This sector interacts directly with the consumers (including individual households), and performs a variety of services including the conclusion of power supply contracts.
- It also purchases the amount of power required by the consumers from the power generation sector.
- Full liberalization of the electricity market will allow new companies to freely enter the retail sector **(3)**.

- In principle, new companies are already permitted to freely enter the power generation sector **(1)**.
- However because the transmission sector **(2)** is responsible for ensuring stable supply, this sector will continue to be operated by companies that are licensed by the government (regional power companies such as Tokyo Electric Power Company and Kansai Electric Power Company) after full liberalization of the electricity market.
- Therefore because power will be delivered using the same network of distribution lines as before, the quality and reliability (including the possibility of blackouts) will remain unchanged when a consumer concludes a contract with a new retail electricity provider, regardless of which company the consumer buys the electricity from.
- Due to the nature of electrical power, if demand (consumption) and supply (generation) are not balanced over the transmission/distribution network as a whole, the power supply across the network will become unstable.
- Therefore in the event that a new company in the retail sector is unable to purchase the amount of power that is required by the consumers it is contracted with, the transmission sector operator will make up the difference and ensure that power is properly delivered to the consumers.

# Wiring systems

- What is wiring system?
- A wiring system is a network of wires that connect various accessories for the distribution of electrical energy from the supplier meter board to a variety of electrical energy consuming devices such as lamps, fans, and other domestic appliances via regulating and safety devices.
- What is the importance of wiring system?
- Wiring devices **provide proper control and connections in your electrical devices and wiring**. Wiring devices are needed for efficient, reliable, and safe electrical wire connections in your home or business. They can protect circuits and prevent fire and shock hazards.

# A typical house wiring circuit



# Systems of distribution of electrical energy:

- Since as per recommendation of Indian Standards the maximum number of points of lights, fans and 5A socket outlet that can be connected in one circuit is 10 and the maximum load that can be connected in such a circuit is 800 W, in case more load or points are required to be connected to the supply, then it is to be done by having more than one circuit.

## **Distribution Board System:**

- In distribution board system, which is most commonly adopted for distribution of electrical in a building, the fuses of various circuits are grouped together on a distribution board, sometimes simply known as fuse board.
- Connections necessary for connecting two or more than two circuits, each consisting of 10 or less number of lamps is shown in fig.-2.
- The two copper strips known as bus bars fixed in a distribution board of hardwood or metal case are connected to the supply mains through a double pole iron clad (DPIC) switch so that the installation can be switched off.
- A fuse is inserted in the positive or phase pole of each circuit so that each circuit is connected up through its own particular fuse.
- The number of circuits and sub-circuits is decided as per number of points to be wired and load to be connected to the supply system

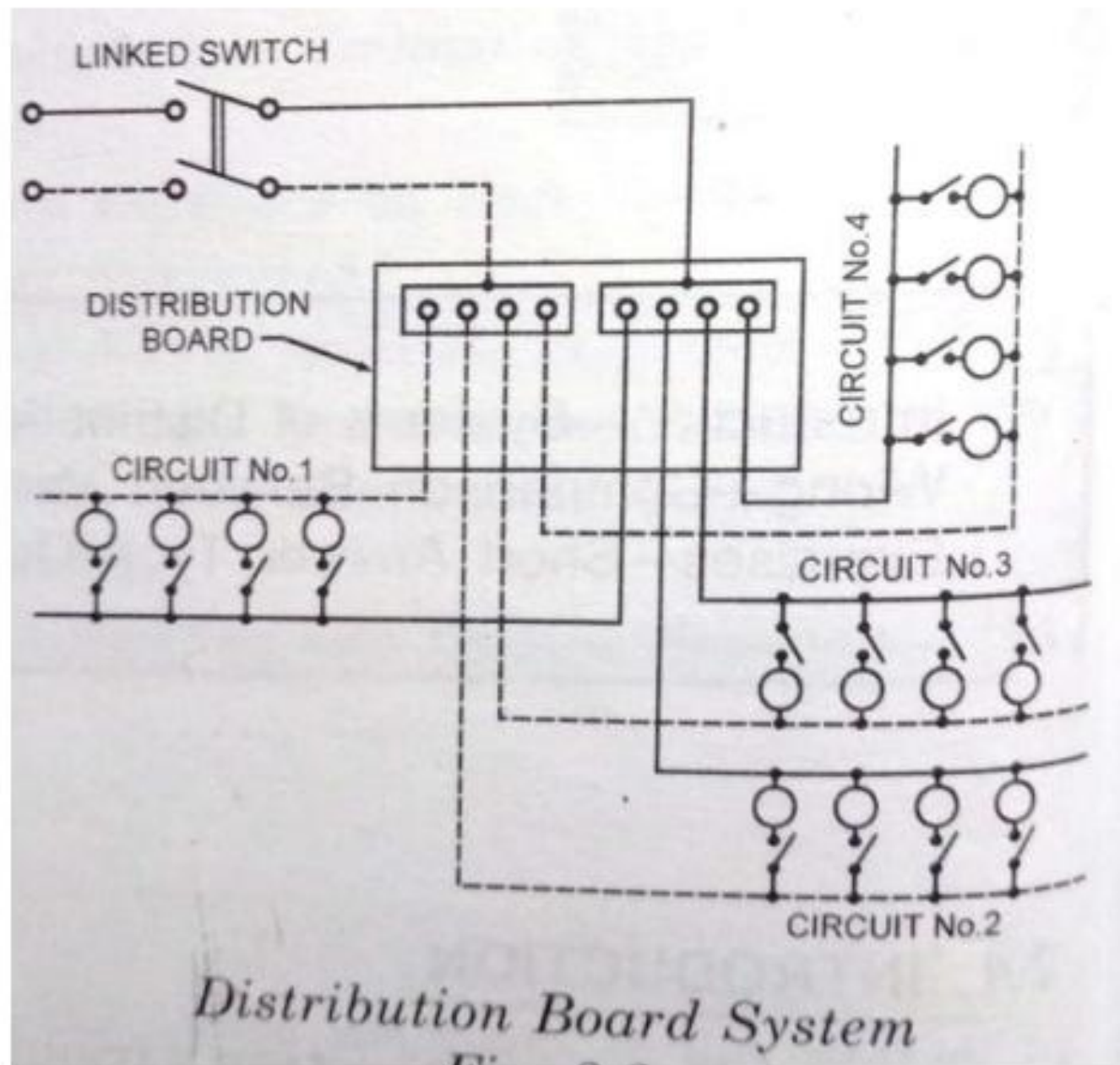


Fig.-2



## Tree system:

- Another system of distribution of electrical energy in a building is a tree system. In this system smaller branches are taken from the main branch as shown in fig.-3 and the wiring system resembles a tree.
- As each branch is taken off, a fuse is inserted. This system used to be employed in early days.
- Now a days it is no more adopted due to the following drawbacks.
  - (i) The voltage across all the lamps does not remain the same.
  - (ii) A number of joints are involved in every circuit.
  - (iii) Fuses are scattered.
  - (iv) In case of occurrence of faults all the joints have to be located.

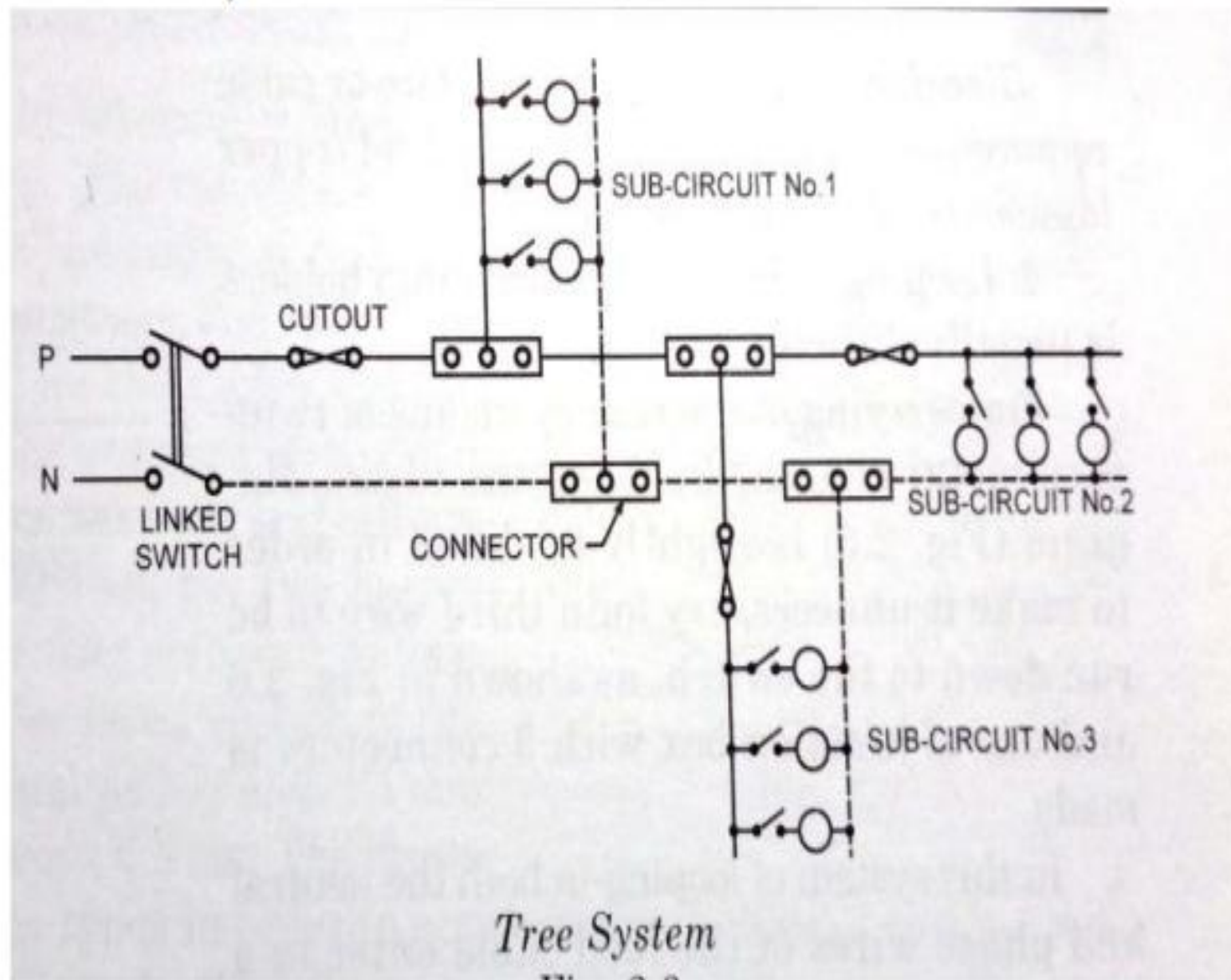


Fig.-3

# Methods of Wiring:

There are two methods of wiring known as

1. joint box system (or Tee system)
2. loop in system.

**1. Joint Box or Tee System:** In joint box system the connections to the lamps are made through joints made in joint box by means of suitable connectors or joint cutouts.

- In this method though there is a saving in the quantity of wire or cable required but the same is offset by the extra cost of joint boxes.
- The other disadvantage is the number of 'T' connection made in wiring system results in weakness if not properly made.
- Now a days the use of this system is limited to temporary installations only as its cost is low.

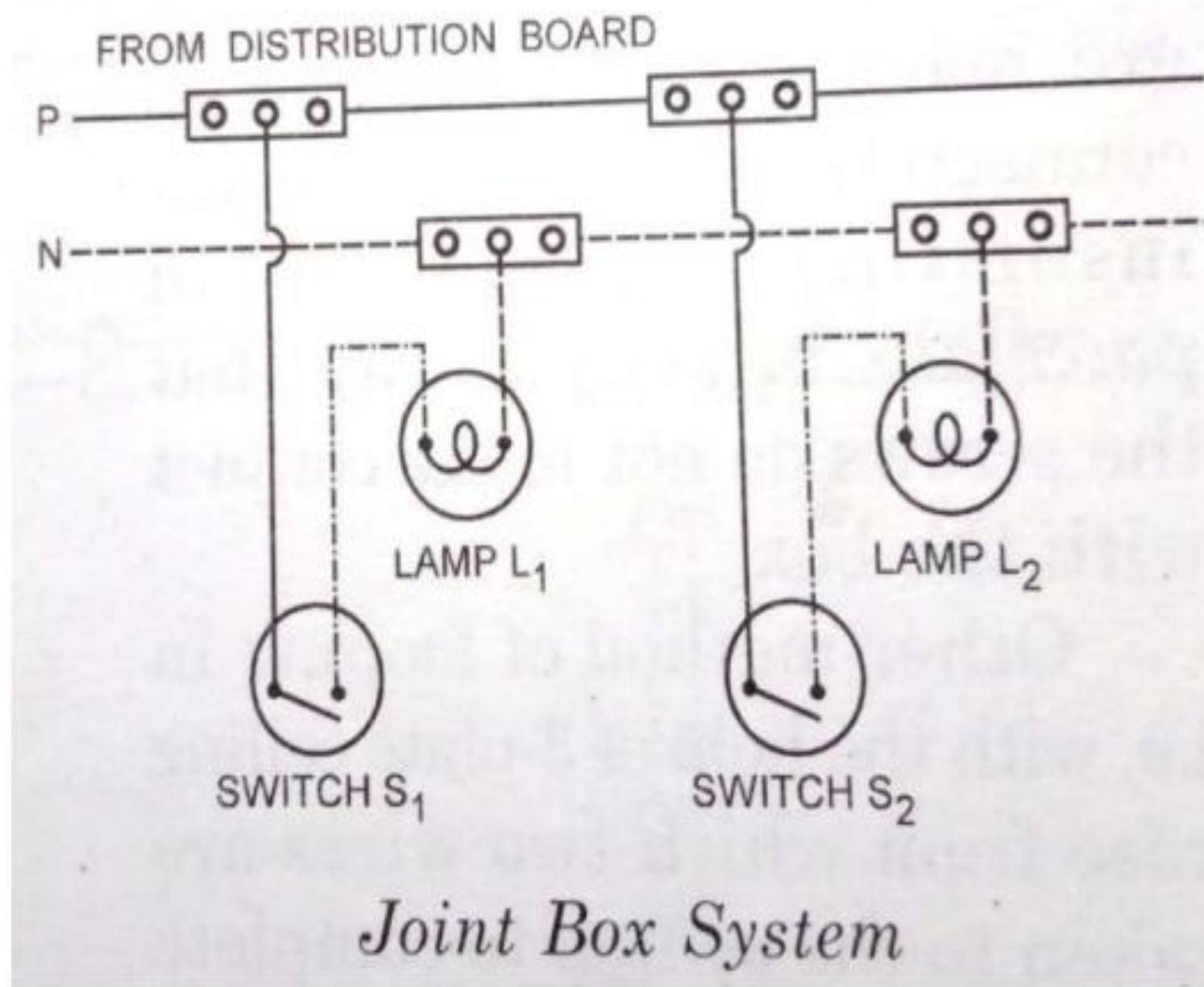


Fig.-4

## (2) Loop-in System:

- this system is universally used for connections of various lamps or other appliances in parallel.
- In this system when a connection is required at a light or switch, the feed conductor is looped in by bringing it direct to the terminal and then carrying it forward again to the next point to be fed as shown in fig.-4.
- The switch and light feeds are carried round the circuit in a series of loops from one point to another until the last point on the circuit is reached.
- The phase or line conductors are looped either in switch board or box and neutrals are looped either in switch board or from light or fan.
- Line or phase should never be looped from light or fan.

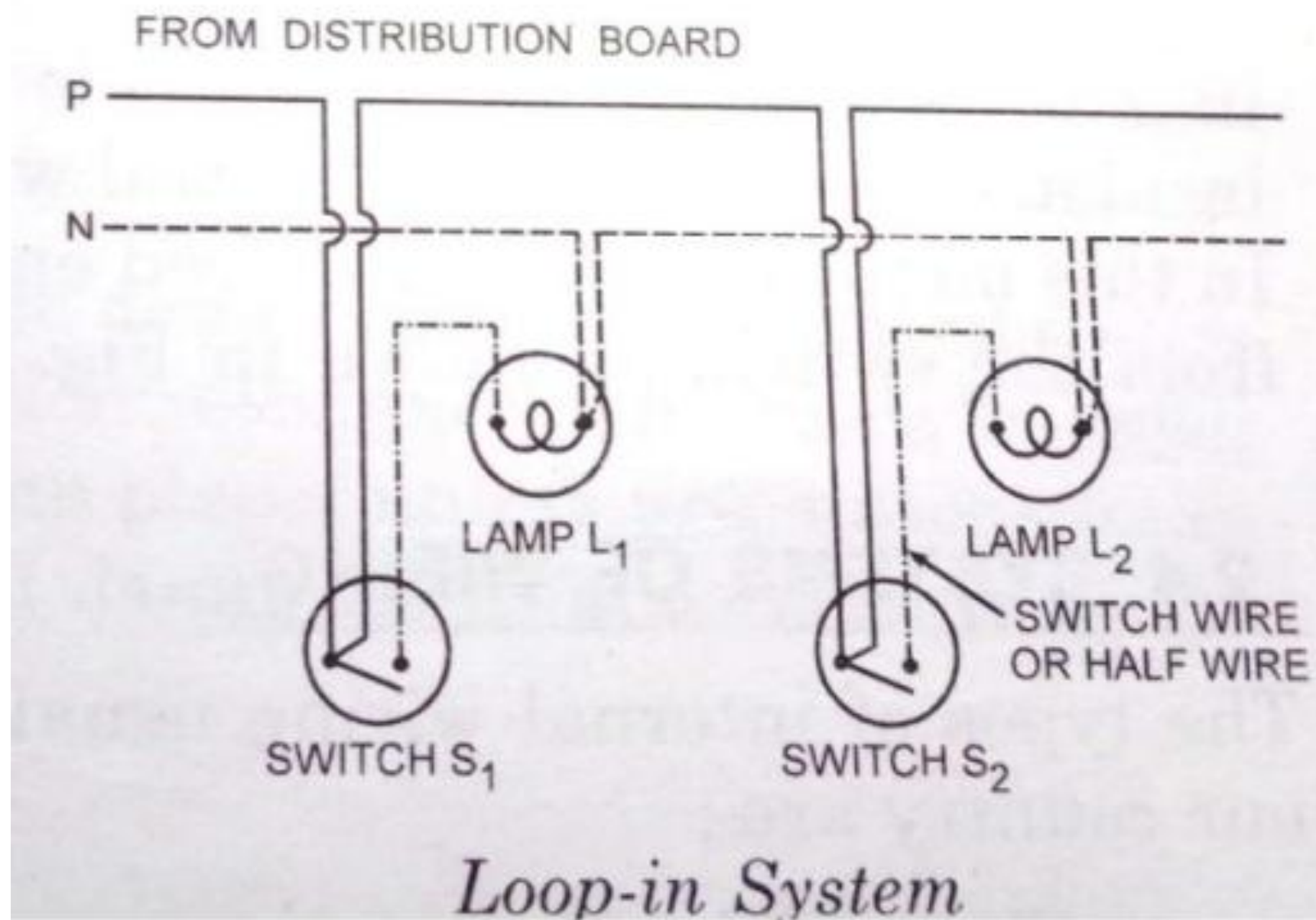


Fig.-5

# Selection or choice of wiring system:

- (i) Safety
- (ii) Durability
- (iii) Appearance
- (iv) Mechanical protection
- (v) Accessibility
- (vi) Low initial cost
- (vii) Low maintenance cost

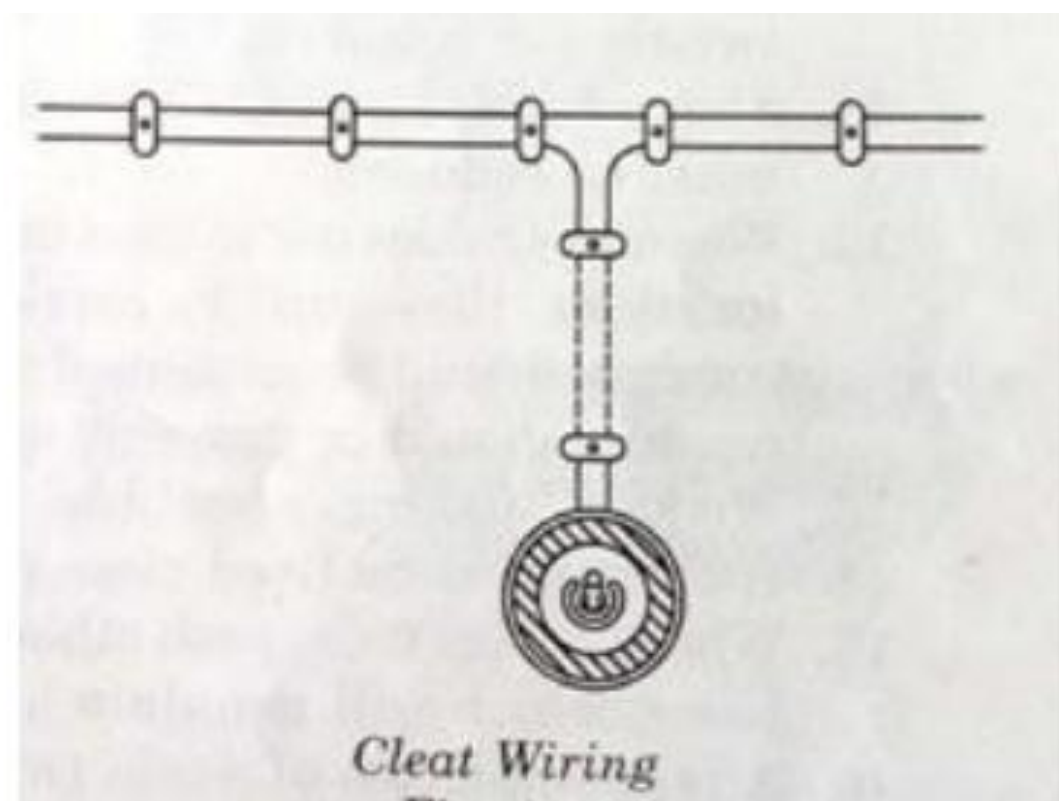
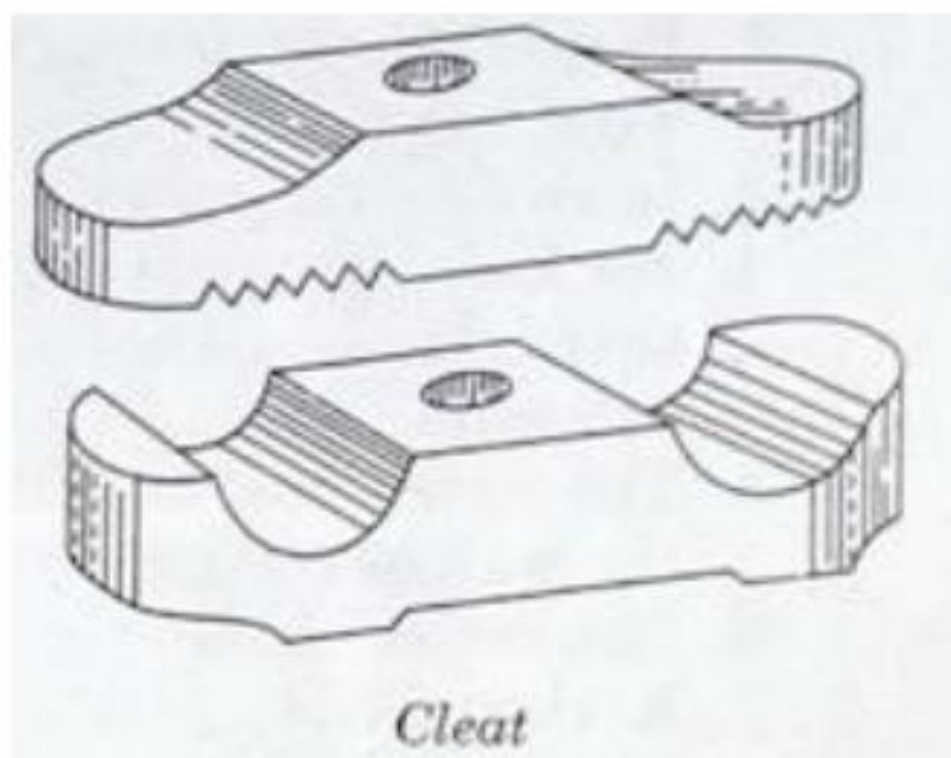
# **Types of Electrical wiring systems**

- (1) Cleat wiring system
- (2) TRS wiring system
- (3) Lead sheathed wiring system
- (4) Wooden batten wiring system
- (5) Plastic Casing-capping system
- (6) Conduit wiring system
  - (i) Conduit surface wiring
  - (ii) Concealed conduit wiring



# **1. Cleat wiring system:**

- In this system of internal wiring the cables used are either vulcanized Indian Rubber (VIR) or Polyvinyl chloride (PVC) type.
- The cables are held by porcelain cleats about 6 mm above the walls or ceiling. The cleats are made in two halves, one base and the other cap.
- The base is grooved to accommodate the cables and the cap is put over it and the whole of it is then screwed on the wooden plugs (gutties) previously cemented into the wall and ceiling.
- The cleats used are of different sizes and different types in order to accommodate cables of various sizes and different number of cables respectively.
- The cleats are of three types; one groove, two grooves and three grooves to accommodate one, two and three cables respectively.



## **Advantages:**

- (i) It is the cheapest system of internal wiring.
- (ii) Its installation and dismantlement is easy and quick.
- (iii) Material is recoverable after the dismantlement.
- (iv) Inspection, alterations and additions can be easily made.
- (v) Skilled labor required is little.

# **Disadvantages:**

- (i) It is not good looking.
- (ii) The wires are exposed to mechanical injury.
- (iii) Oil and smoke are injurious to VIR insulation.

## 2. **Casing-Capping wiring system:**

- This is one of the simplest form of electrical wiring system. This is little bit old/conventional wiring system.
- Now a days, we often use this wiring system.
- PVC insulated cables are placed in plastic casing and covered with cap. The casing is of rectangular cross section.
- The colour of casing channel and cap are normally white or grey.
- The casing channel and cap are normally made of plastic.
- The casing channels and caps are available in market in standard sizes.

# **Advantages:**

- (i) It is the cheapest wiring system as compared to concealed wiring system.
- (ii) It is strong and long lasting wiring system.
- (iii) Replacement and alteration of defective wire is easy.
- (iv) It provides protection against mechanical damage.
- (v) It is safe from oil, steam, smoke and rain.
- (vi) No risk of electric shock due to covered wires and cables in casing and capping.

# Disadvantages:

- (i) Since it requires better workmanship, the labour cost is high.
- (ii) This type of wiring can be used only on surface and cannot be concealed in plaster.
- (iii) Internal condensation of moisture may cause damage to the insulation.

### **3. Conduit wiring system:**

- In this system of wiring steel tubes or PVC pipes known as conduits are installed on the surface of wall by means of saddles or buried under plaster and VIR or PVC cables are drawn afterwards by means of GI wire.



# Advantages:

- (i) It provides protection against mechanical damage.
- (ii) It provides complete protection fire due to short circuit.
- (iii) The whole system is waterproof.
- (iv) Replacement and alteration of defective wiring is easy.
- (v) Its life is long.
- (vi) It is shocked proof also if earthing is properly done.

# Disadvantages:

- (i) It is very costly system of wiring.
- (ii) Its erection is not easy and required time.
- (iii) Experienced and highly skilled labour is required for carrying out the job.

# Permissible voltage drops and conductor size calculations

- What is the permissible voltage drop value?
- The allowable voltage drop for low voltage installations supplied directly from a public low voltage distribution system is **3% for lighting and 5% for other uses.**

# What is the formula for voltage drop in a cable?

- By dividing the paired wire length by 100, we get the factor by which we need to **multiply voltage drop per 100 feet** to determine total voltage drop.
- Therefore, 350 feet divided by 100 equals 3.5.
- Multiply 3.5 by 1.27 volts drop per 100 feet to get your total voltage drop

# Voltage Drop Calculations

- For cables operating under dc conditions, the appropriate voltage drops may be calculated using the formula.  **$2 \times \text{route length} \times \text{current} \times \text{resistance} \times 10^{-3}$** . = 10.5 volts for 3 phase working or  $0.025 \times 240 = 6.0$  volts for single phase working.

# Estimating and costing for residential and commercial service connections (single phase and three phase)

- **Estimating**
- Estimating is an art by which we can get an approximation of the material, investment involved and the time to be taken for the completion of electrical project.
- Purpose of Estimating & Costing: It is necessary to know the necessary material and the cost to be incurred before starting the project.

- **REQUIREMENTS OF ESTIMATION AND COSTING**
- Estimate gives an idea of the cost of the work and hence its feasibility can be determined i.e. whether the project could be taken up with in the funds available or not.
- Estimate gives an idea of time required for the completion of the work. Estimate is required to invite the tenders and Quotations and to arrange contract.
- Estimate is also required to control the expenditure during the execution of work.
- Estimate decides whether the proposed plan matches the funds available or not.

# What are the purpose of estimation?

- The purpose of an estimate has a different meaning to different people involved in the process.
- To the owner, it **provides a reasonable, accurate idea of the costs.** This will help him or her decide whether the work can be undertaken as proposed, needs to be modified, or should be abandoned.



# What are three main components of estimate?

- In spite of the many types of cost estimates used at different stages of a project, cost estimates can best be classified into three major categories according to their functions.
- A construction cost estimate serves one of the three basic functions: **design, bid and control**.

# Types of estimating

- Preliminary Estimate.
- Detailed Estimate.
- Quantity Estimate.
- Bid Estimate.

# Principles Of Estimating

- Tender schedules.
- Non-Price Criteria & Priced Criteria.
- Direct Pricing & Indirect Pricing.
- Estimating (rating) methods including First Principles, Second Principles & Bench Marking.
- Cost Planning.

- A licensed [electrical estimator](#) will complete an inspection and then provide a drawing and written quotation.
- This quotation should include a breakdown of labor and materials costs. It is often suggested that one receive multiple quotes to ensure you are getting a fair price for a proper installation.
- In manufacturing, many electrical consultants will provide estimates of the total electrical demand, based on the current equipment and layout.
- They may be able to make adjustments or recommendations to reduce the total electrical expense through the use of load sharing or other techniques.

- **TYPES OF ESTIMATES**

1. Preliminary Estimate
2. Detailed estimate
3. Abstract
4. Revised Estimate

## **Preliminary Estimate:**

- The estimate is a rough estimate which is normally be estimated on approximate square feet rate.
- In this estimate the specifications and Area are only for the temporary purpose.
- Some times the cost may differ up to 50%.

## **Detailed Estimate:**

- The estimate which is in detail be provided with specifications of material, method of during the work, Details measurements and drawings.
- The quantities of the item of the works may vary up to 10%

# **Abstract:**

- The estimate which includes only the total quantities of the item of works, Rates either as per PWD schedule or market values and total cost of the project.

# **Revised Estimate:**

- The revised estimate is the estimate which includes revised quantities or specifications and Rates.
- The conditions for the preparation of Revised estimates are
  1. When the area or measurements of the approved plan changes
  2. When the specification of material or method of construction changes
  3. When the rates of the material, labour changes over and above 10%
  4. When the location of the work changes

# **DETAILED ESTIMATE:**

The preparation of detailed estimate consists of working out quantities of various items of work and then determines the cost of each item.

This is prepared in two stages.

## **I) DETAILS OF MEASUREMENTS AND CALCULATION OF QUANTITIES**

- The complete work is divided into various items of work such as earth work, concreting, brick work, R.C.C. Plastering etc.,
- The details of measurements are taken from drawings and entered in respective columns of prescribed preformed.
- The quantities are calculated by multiplying the values that are in numbers column to Depth column as shown.



Details of measurements form

Item No	Details of work	No	Measurements			Quantity	Unit	Remarks
			Length -L	Breadth-B	Height-H(D)			
			4	5	6			
1	2	3				7	8	9

# **Abstract of Estimated Cost :**

- The cost of each item of work is worked out from the quantities that already computed in the details measurement form at workable rate.
- But the total cost is worked out in the prescribed form is known as abstract of estimated form.
- 4% of estimated Cost is allowed for Petty Supervision, contingencies and Unforeseen items.

[illegible]

# DATA

- The process of working out the cost or rate per unit of each item is called as Data.
- In preparation of Data, the rates of materials and labor are obtained from current standard scheduled of rates and while the quantities of materials and labor required for one unit of item are taken from Standard Data Book.

# **FIXING OF RATE PER UNIT OF AN ITEM**

The rate per unit of an item includes the following:

## **Quantity of materials & cost:**

- The requirement of materials is taken strictly in accordance with standard data book(S.D.B).
- The cost of these includes first cost, freight, insurance and transportation charges.

## **Cost of labour:**

- The exact number of laborers required for unit of work and the multiplied by the wages/ day to get of labour for unit item work.

## **Cost of equipment (T&P):**

- Some works need special type of equipment, tools and plant.
- In such case, an amount of 1 to 2% of estimated costs provided.

## **Overhead charges:**

- To meet expenses of office rent, depreciation of equipment salaries of staff postage, lighting an amount of 4% of estimate cost is allocated.