

# **BUILDING SERVICES II**

## **(LIGHTING & ELECTRICAL SERVICES)**

# What is electrical services in buildings ?

- Electrical services are a vital component in any building, so it is necessary for construction professionals to understand the basic principle of services design.
- Electrical Services for Buildings provides a methods of wiring, schemes of distribution and protection for lighting and power installations.

**TRANSFORMERS**

**HT PANELS**

**BUS DUCTS**

**EXTERNAL CABLING**

**SOLAR SYSTEM**

**LIGHTING  
ARRESTORS**

**DG SETS**

**EARTHING**

**ELECTRICAL SYSTEM**

**EXTERNAL**

**INTERNAL**

**LT PANELS**

**DISTRIBUTION BOARD**

**CABLE CONTAINMENT**

**LT CABLING**

**POWER WIRING**

**LIGHTING WIRING**

**ELECTRIC OUTLET**

**LUMINARIES**

# Commonly used terminology

- **Current (I):** The flow of an electric charge through a conductor. An electric current can be compared to the flow of water in a pipe. Measured in amperes.
- **Voltage (V):** is the difference in electric potential between two points, which (in a static electric field) is defined as the work needed per unit of charge to move a test charge between the two points.

- **Resistance (R):** is a measure of the opposition to current flow in an electrical circuit.
- **Circuit Breaker:** This is the modern equivalent of a fuse. This device will automatically cut the flow of electricity through a circuit when there is an excess amount of electricity flowing through the circuit. Fuses need to be replaced, where the circuit breaker just needs to be switched back on.

- **Conduit:** This is a term to describe the casing that electrical wires are concealed in. They provide additional protection against damage to the wires or shock to people near them.
- **Short Circuit:** When one part of an electric circuit comes in contact with another part of the same circuit, diverting the flow of current from its desired path.

- **Capacitor bank:** It is merely a grouping of several capacitors of the same rating. Capacitor banks may be connected in series or parallel, depending upon the desired rating. As with an individual capacitor, banks of capacitors are used to store electrical energy and condition the flow of that energy.

# Standard Electrical Units of Measure

Electrical Parameter	Measuring Unit
Voltage (V)	Volt (V)
Current (I)	Ampere (A)
Resistance (R)	Ohm ( $\Omega$ )
Power (P)	Watts (W)
Capacitance (C)	Farad (F)
Frequency (f)	Hertz (Hz)
Conductance (G)	Siemen (S)
Charge (Q)	Coulomb (C)
Inductance (L)	Henry (H)
Energy (E)	Joule (J)



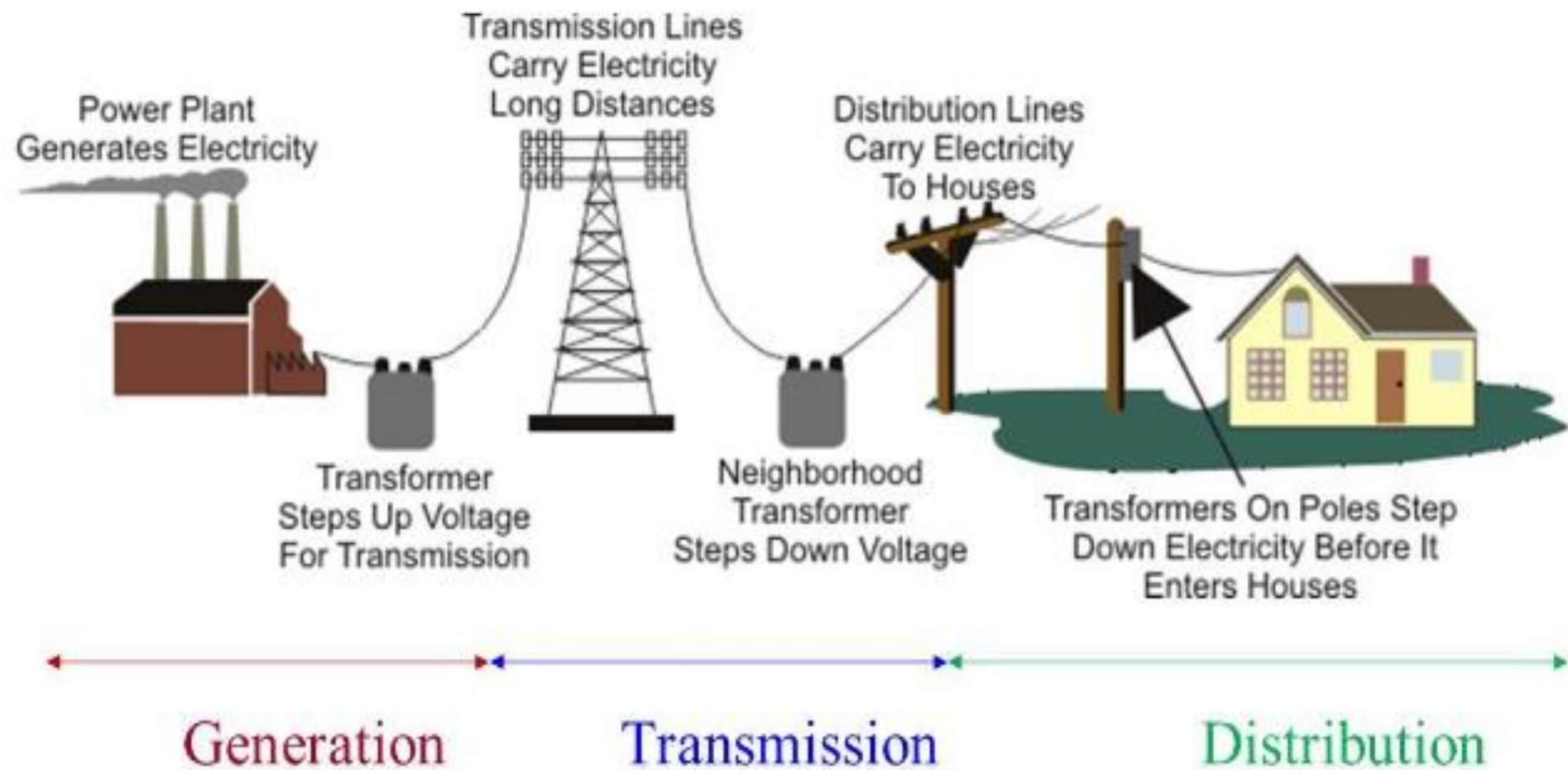
# How we get current to building ?

There is three main process:

1.Generation.

2.Transmission.

3.Distribution.



# SIMPLE ALGORITHM FOR ELECTRICAL POWER SYSTEM

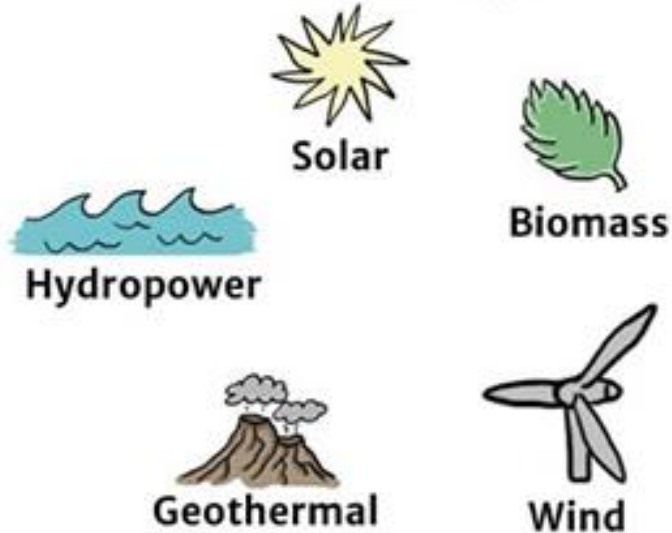
1. GENERATION
2. SUB STATION
3. FEEDER TRANSFORMER
4. ENERGY METER
5. DISTRIBUTION BOARD
6. LIGHT POINT

# GENERATION

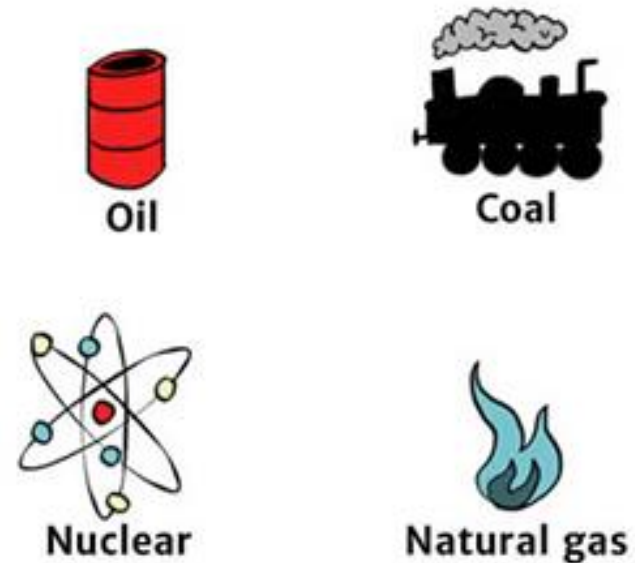
Electricity generation is the process of generating electric power from sources of primary energy. For utilities in the electric power industry, it is the stage prior to its delivery to end users or its storage. Electricity is not freely available in nature, so it must be produced.

# Renewable and Non-Renewable Energy Sources

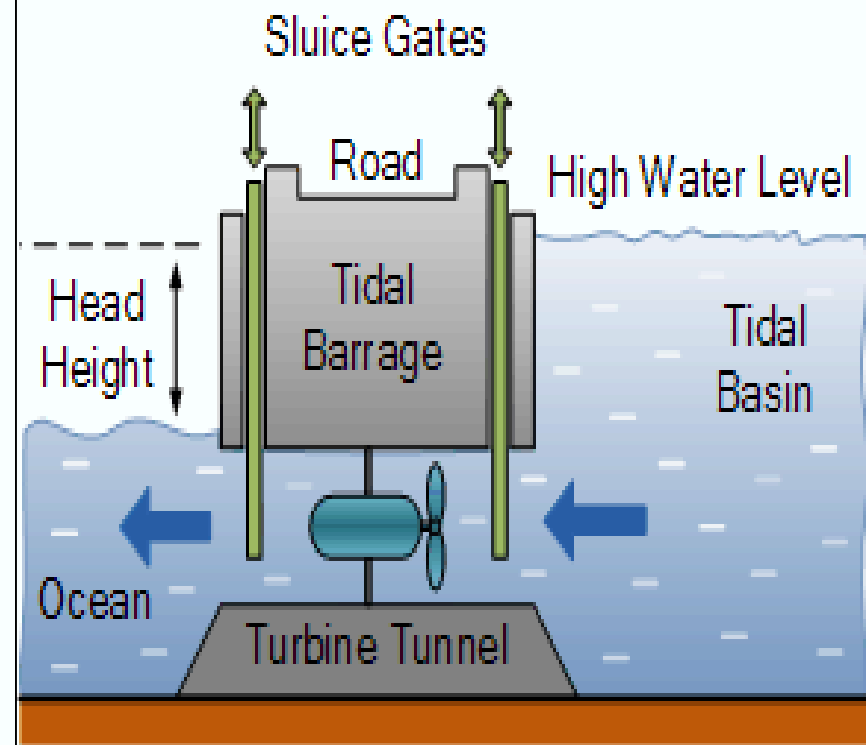
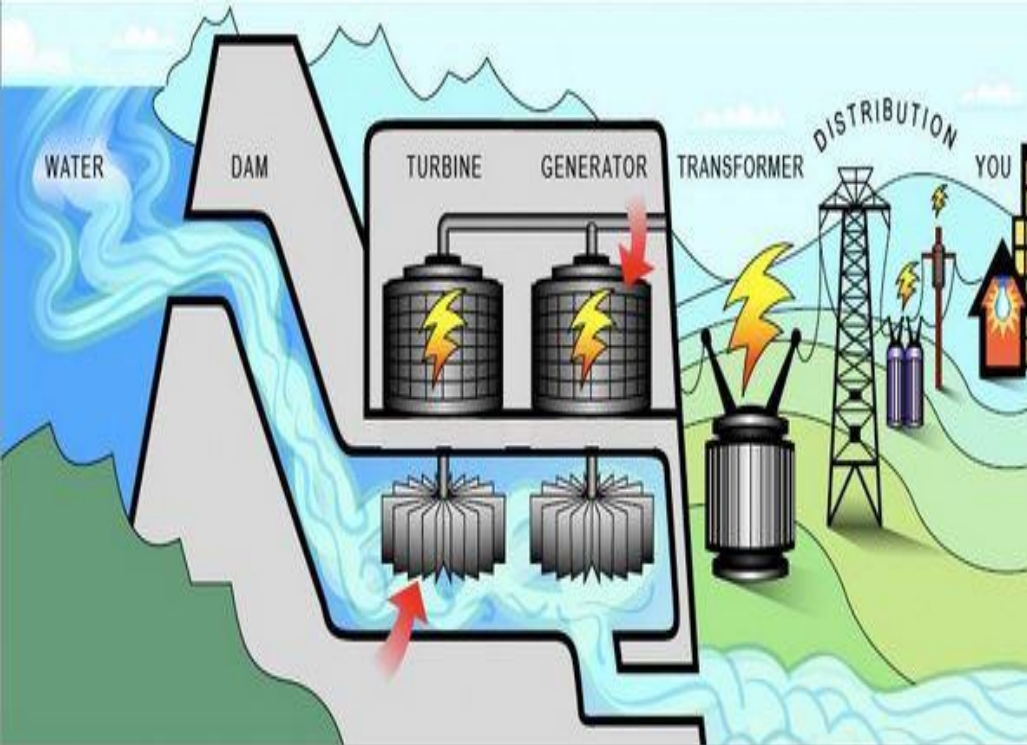
## Renewable energy

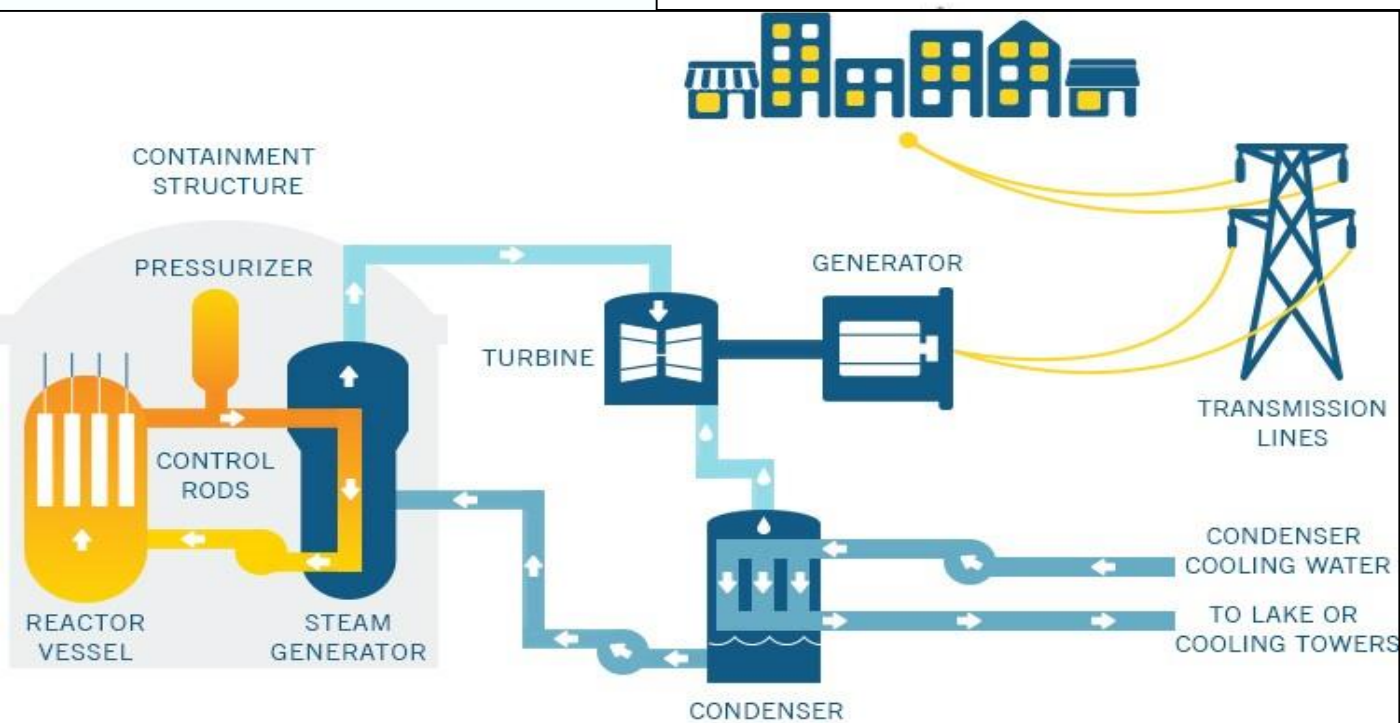
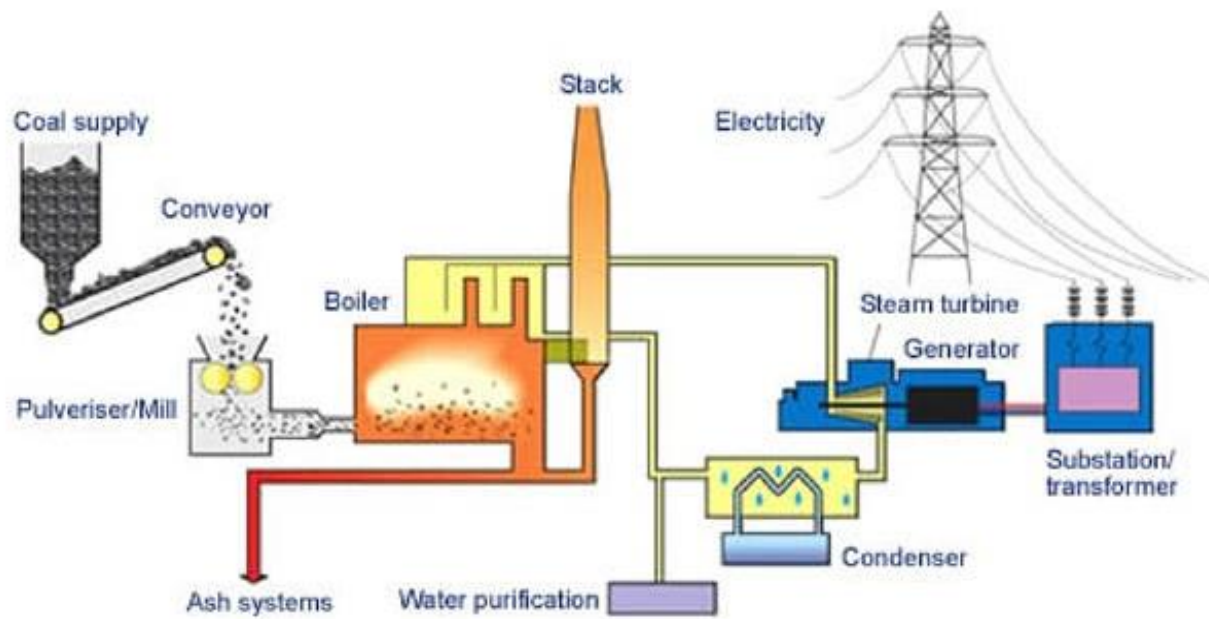


## Non-renewable energy









# Electrical Substation

- A substation is a part of an electrical generation, transmission, and distribution system. Substations transform voltage from high to low, or the reverse, or perform any of several other important functions.
- The purpose of a substation is to 'step down' high voltage electricity from the transmission system to lower voltage electricity so it can be easily supplied to homes and businesses in the area through lower voltage distribution lines.



SI No	Voltage	No of Substations	Line length in Circuit kms
1	400 kV	1+5*	947.96
2	220 kV	22	2910.98
3	110 kV	162	4803.28
4	66 kV	70	2100.64
5	33 kV	158	2082.69

# TRANSMISSION

Electrical transmission is the process of delivering generated electricity usually over long distances to the distribution grid located in populated areas.

An important part of this process includes transformers which are used to increase voltage levels to make long distance transmission feasible. The interconnected lines which facilitate this movement are known as a transmission network.



# TRANSFORMER

A Transformer is a static electrical machine which transfers AC electrical power from one circuit to the other circuit at the constant frequency, but the voltage level can be altered that means voltage can be increased or decreased according to the requirement.

# Types of Transformers Used in Transmission and Distribution.

1. Step-up Transformer.
2. Step-down Transformer.
3. Distribution Transformer.
4. Current Transformer (CT)
5. Potential Transformer (PT)

# Step-Up Transformer

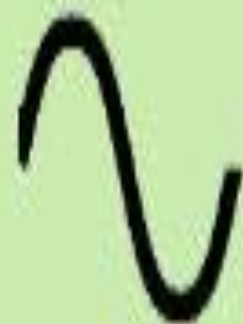
- As the name states that, the secondary voltage is stepped up with a ratio compared to primary voltage.
- This can be achieved by increasing the number of windings in the secondary than the primary windings.
- In power plant, this transformer is used as connecting transformer of the generator to the grid.



# Step-up Transformer

Iron Core

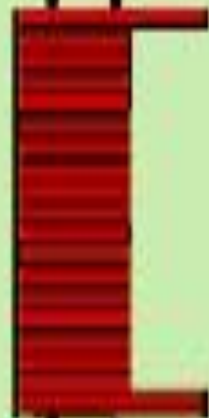
Input  
Voltage



Primary  
Coil  
(Input)



Secondary  
Coil  
(Output)



Output  
Voltage



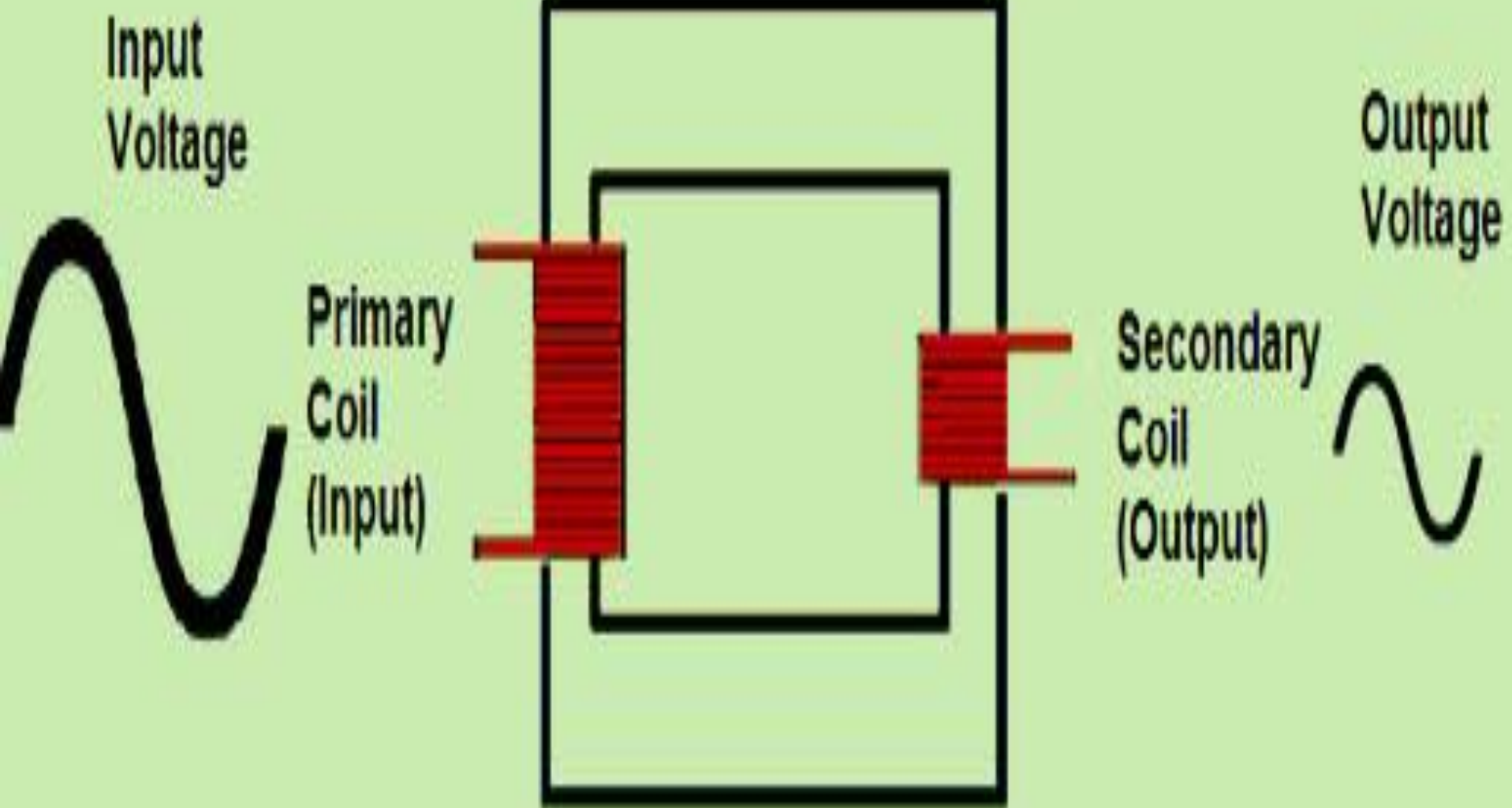
# Step-Down Transformer

- It used to step down the voltage level from lower to higher level at secondary side as shown below so that it is called as a step-down transformer.
- The winding turns more on the primary side than the secondary side.



# Step-Down Transformer

Iron Core



# Distribution Transformer

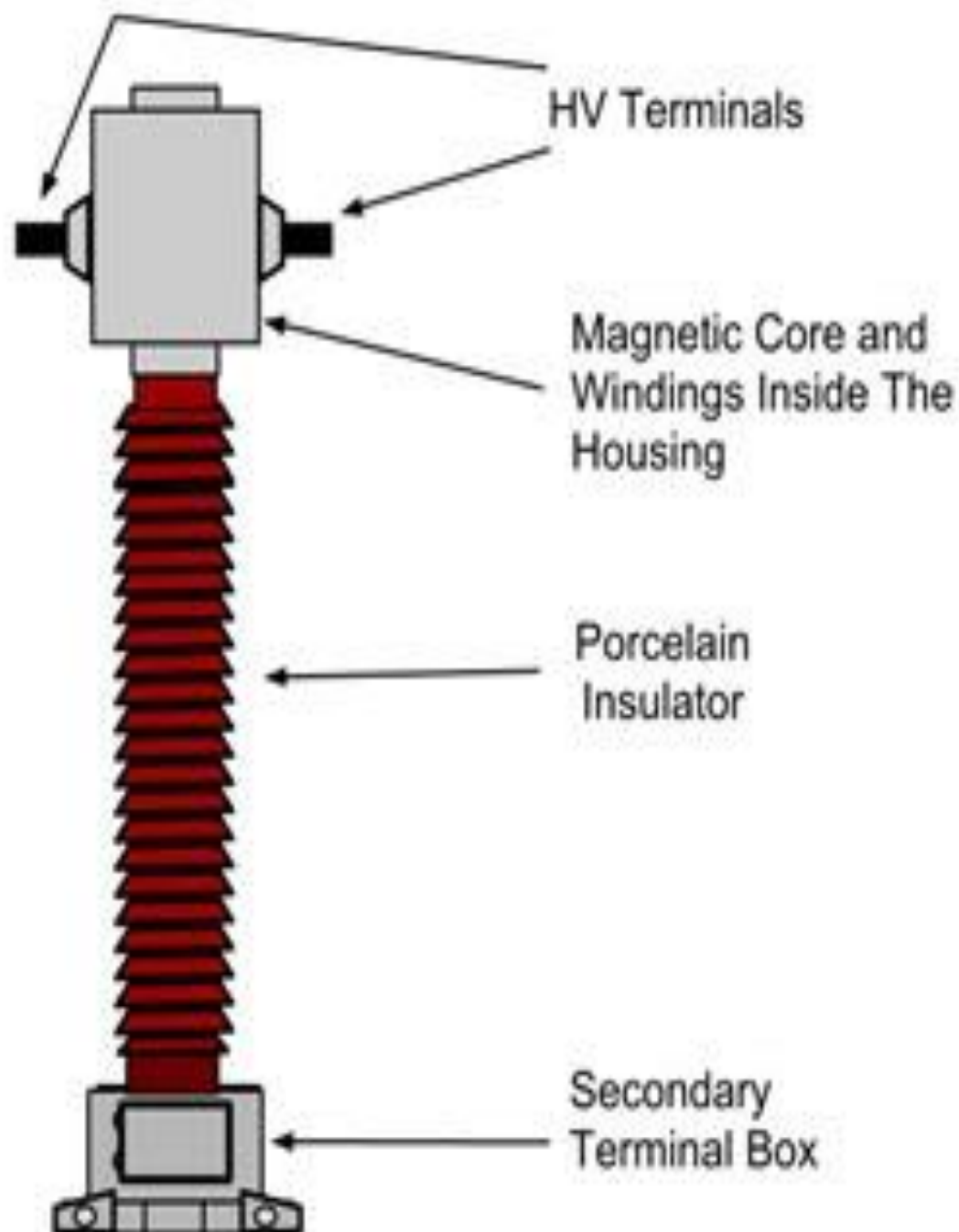
- In order to distribute the power generated from the power generation plant to remote locations, these transformers are used.
- The distribution transformer is used for the distribution of electrical energy at low voltage as less than 33KV in industrial purpose and 440v-220v in domestic purpose.





# Current Transformer

- A current transformer is a type of transformer that is used to measure alternating current (AC). It produces a current in its secondary which is proportional to the current in its primary.
- Current transformer converts the high value of current into low value.



# Potential Transformer

- The potential transformer may be defined as an instrument transformer used for the transformation of voltage from a higher value to the lower value. This transformer step down the voltage to a safe limit value which can be easily measured by the ordinary low voltage instrument like a voltmeter, wattmeter and watt-hour meters, etc.





# DISTRIBUTION

- Electric power distribution is the final stage in the delivery of electric power it carries electricity from the transmission system to individual consumers. Primary distribution lines carry this medium voltage power to distribution transformers located near the customer's premises.



- A distribution substation is located near or inside city / town / village / industrial area. It receives power from a transmission network. The high voltage from the transmission line is then stepped down by a step-down transformer to the primary distribution level voltage.

# Energy Meter

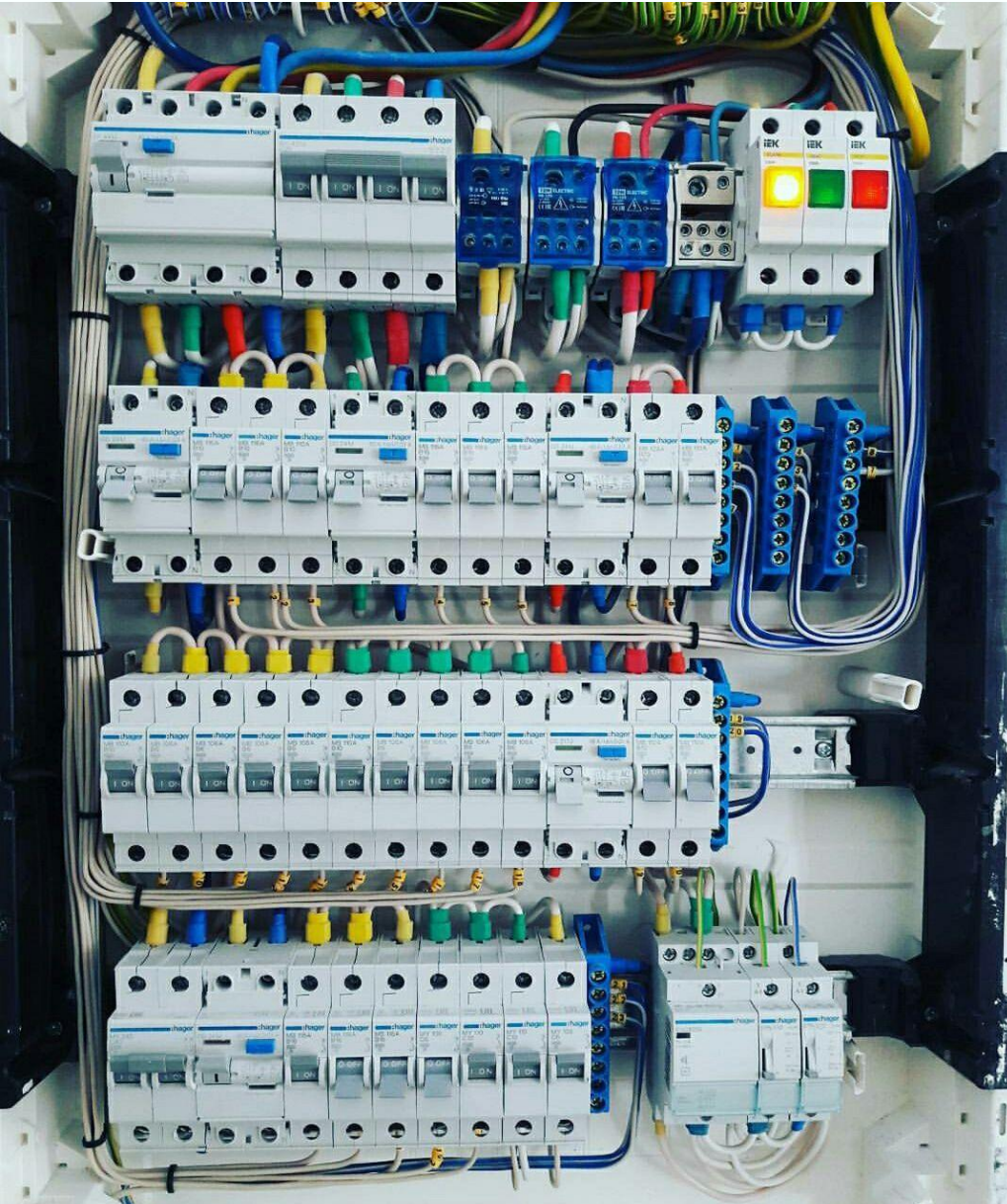
- An electricity meter, electric meter, electrical meter, or energy meter is a device that measures the amount of electric energy consumed by a residence, a business, or an electrically powered device. Electric utilities use electric meters installed at customers' premises for billing and monitoring purposes.

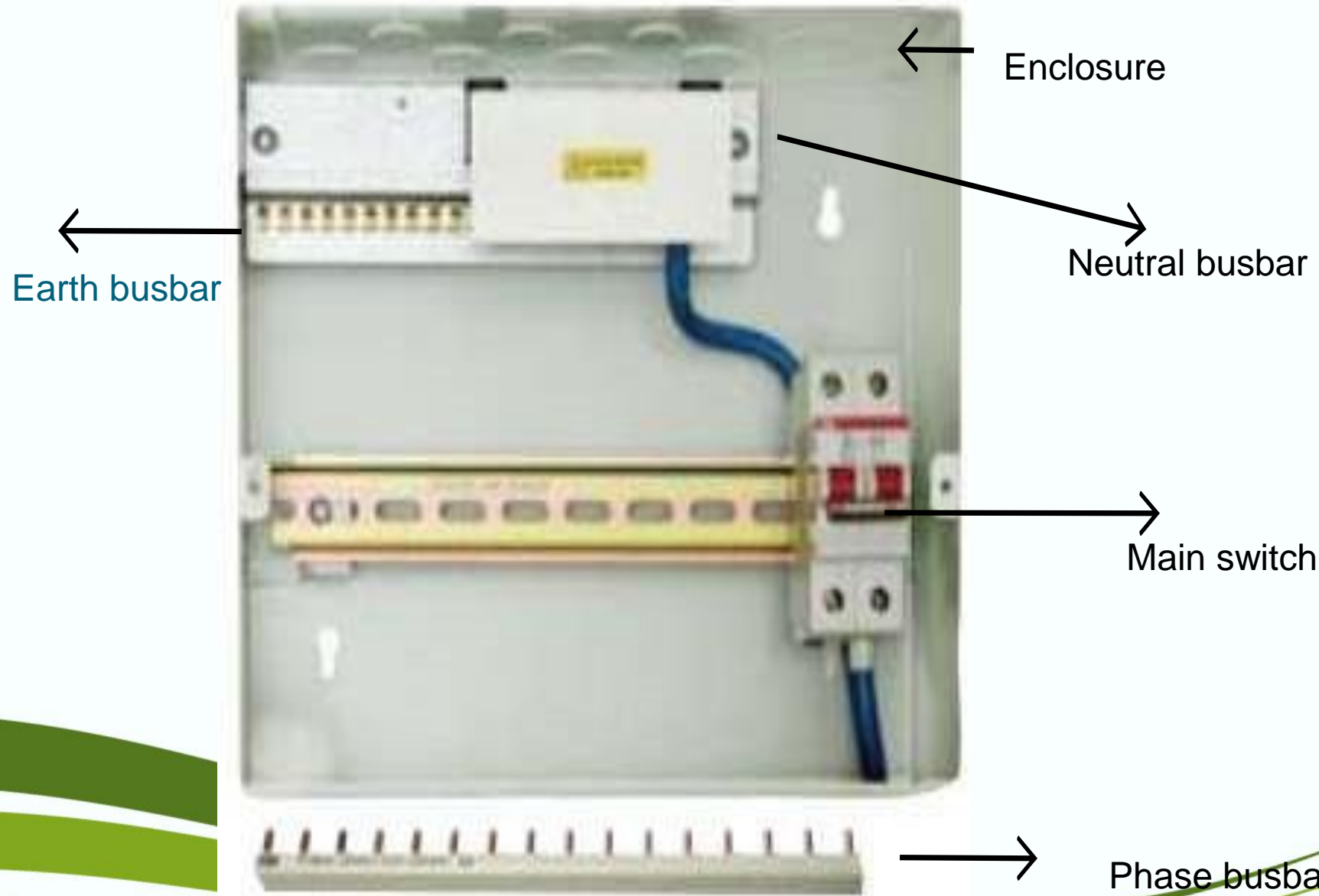


# DISTRIBUTION BOARD (DB)

- A distribution board (also known as panel board, breaker panel, or electric panel) is a component of an electricity supply system that divides an electrical power feed into subsidiary circuits, while providing a protective fuse or circuit breaker for each circuit in a common enclosure.







# Switchgear

In an electric power system, switchgear is composed of electrical disconnect switches, fuses or circuit breakers used to control, protect and isolate electrical equipment. Switchgear is used both to de-energize equipment to allow work to be done and to clear faults downstream.

# Miniature Circuit Breaker (MCB)

- An MCB is an automatically operated electrical switch. Miniature circuit breakers are intended to prevent damage to an electrical circuit as a result of excess current. They are designed to trip during an overload or short circuit to protect against electrical faults and equipment failure.
- Miniature circuit breaker (MCB)—rated current up to 125 A. Trip characteristics normally not adjustable. Thermal or thermal-magnetic operation.



# MCB

Type Number

Tripping curve

Rated Voltage

Standard

By G K Agrawal



# Moulded Case Circuit Breaker (MCCB)

- MCCBs (Moulded Case Circuit Breakers) are an electrically operated switch designed to protect an electrical circuit from damage caused by overcurrent, typically resulting from an overload or short circuit.
- The current rating of MCCB is up to 2500 amps. It is mainly used for high current applications.

# Residual Current Devices ( RCD)

- An **RCD**, or residual current device, is a life-saving device which is designed to prevent you from getting a fatal electric shock if you touch something live, such as a bare wire.
- RCDs offer a level of personal protection that ordinary fuses and circuit-breakers cannot provide.

# Residual Current Circuit Breaker (RCCB)

- A residual-current device, residual-current circuit breaker, or ground-fault circuit interrupter is a device that quickly breaks an electrical circuit to prevent serious harm from an ongoing electric shock.

# RCCB

Rated Residual current

Rated current

Rated AC Voltage





# Residual Current Circuit Breaker with Overcurrent Protection- RCBO

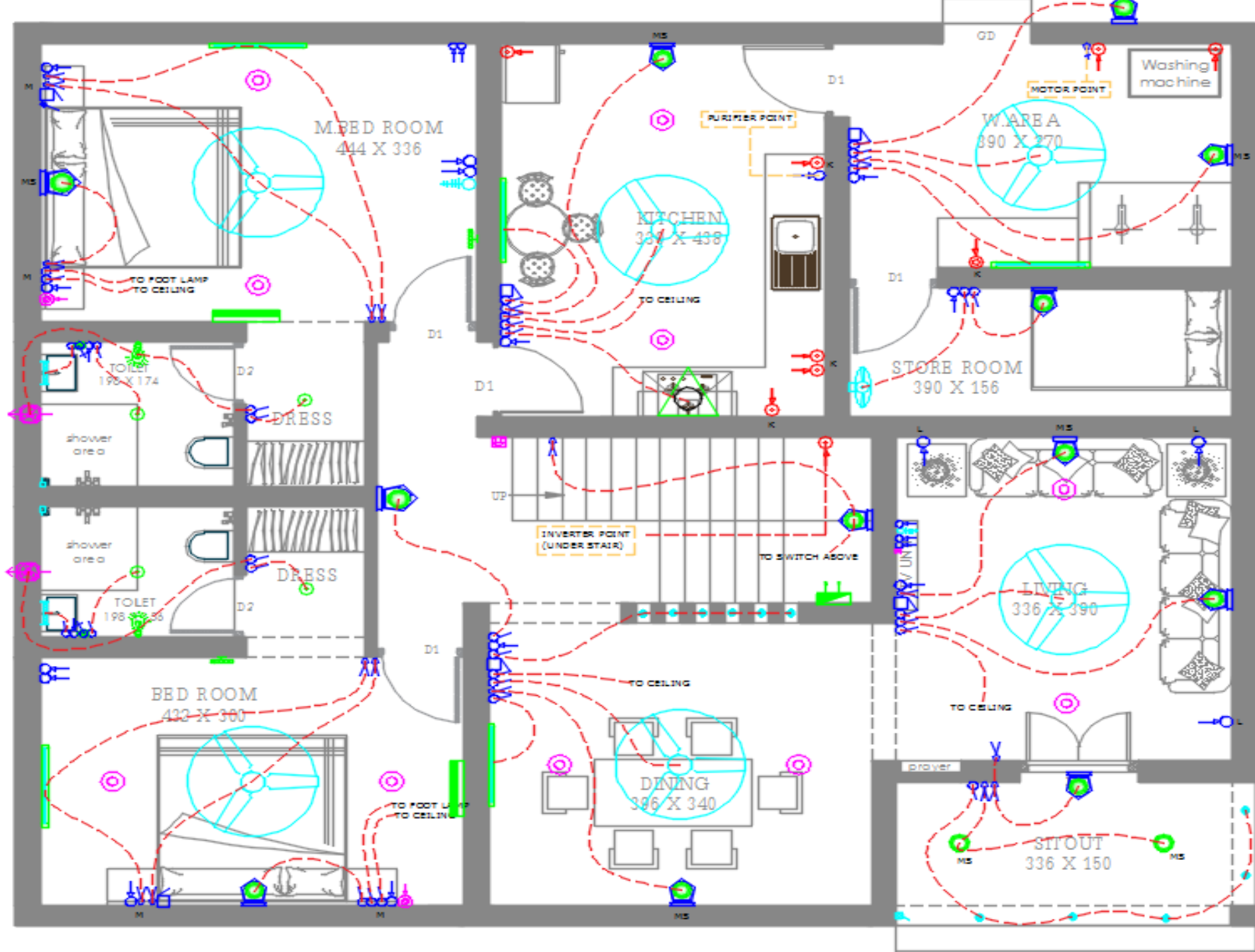
- An RCD device complete with overcurrent protection is called an RCBO, or residual current circuit breaker with overcurrent protection. The primary functions of RCBOs are to ensure protection against earth fault currents, overload, and short circuit currents.

# Earth Leakage Circuit Breaker (ELCB)

- An Earth-leakage circuit breaker is a safety device used in electrical installations with high Earth impedance to prevent shock.
- It detects small stray voltages on the metal enclosures of electrical equipment, and interrupts the circuit if a dangerous voltage is detected.



Electrical system design drawing,  
Load calculation and  
DB schedule.





# GROUND FLOOR

S.NO.	DESCRIPTION	LOCATION	PORCH+SITOUT+LIVING ROOM	DINING+STAIR+POOJA ROOM	BEDROOM 1+TOILET	BEDROOM 2+TOILET	KITCHEN+WORK AREA+STORE	T. QTY	T. LOAD
	<u>LIGHTING</u>	<u>LOAD(W)</u>							
1	4W LED LIGHT	4	3	0	0	0	0	3	12
2	6W LED LIGHT	6	2	1	2	2	4	11	66
3	9W LED LIGHT	9	1	1	1	1	1	5	45
4	CEILING FAN	60	1	1	1	1	2	6	360
5	WALL MOUNT LIGHT	18	4	4	2	2	5	17	306
6	WALL BRACKET	14	0	0	2	1	0	3	42
7	SPOT LIGHT	3	0	5	0	0	0	5	15
8	6A SOCKET	60	3	2	3	3	1	12	720
9	TUBE LIGHT	20	0	2	0	0	2	4	80
10	CHANDLEAR	20	0	1	0	0	0	1	20
11	EXHAUST FAN	60	0	1	1	1	1	4	240
12	MIRROR LIGHT	4	0	1	2	1	0	4	16
13	HOOD POINT	60	0	0	0	0	1	1	60
			345	406	393	375	463	1982	1.98
	<u>POWER</u>								
	TV	0	1	0	0	0	0	0	0
1	1.5 HP MOTOR	1118	0	0	0	0	1	1	1118
2	WATER HEATER	2000	0	0	1	1	0	2	4000
3	1.5T AC	1800	0	0	1	1	0	2	3600
4	16 A SOCKET	500	1	0	0	0	6	7	3500
			500	0	3800	3800	4118	500	12.2

**TOTAL WATTAGE=**

**14.2 KW**

# DB Schedule

<b>GF DB</b>	<b>VERTICAL TYPE, RECESSED. TPN 8 Way</b>
<b>ISOLATOR</b>	<b>63A TPN</b>
<b>RCCB</b>	<b>40A 4P WITH 30MA RS CURR.</b>
<b>MCBs</b>	<b>6A - 6 NOS</b>
	<b>16A - 6 NOS</b>
	<b>25A - 7 NOS</b>

<b>GROUND FLOOR DB LOCATION</b>	
<b>VERANDAH</b>	<b>6A MCB</b>
<b>FORMAL LIVING</b>	
<b>DINING</b>	
<b>FAMILY LIVING</b>	<b>6A MCB, 16A MCB</b>
<b>PRAYER ROOM</b>	
<b>KITCHEN</b>	<b>6A MCB, 16A MCB X5, 25A MCB</b>
<b>WORK AREA</b>	
<b>BEDROOM+TOILET</b>	<b>6A MCB, 25A MCB X2</b>
<b>BEDROOM+TOILET</b>	<b>6A MCB, 25A MCB X2</b>
<b>BEDROOM+TOILET</b>	<b>6A MCB, 25A MCB X2</b>

# PANELS (LT)

- LT Panel is an electrical distribution board that receives power from generator or transformer and distributes the same to various electronic devices and distribution boards.
- Such panels are used in industries both for internal and external use and, therefore, they are quite rugged to withstand different climatic conditions.



# HT PANELS

- HT panels are compact outdoor type systems, which are broadly used in substations.
- Our product range is prepared from Circuit Breakers or switch fuse on HT side, which protects the equipment from sudden voltage fluctuations
- HT Panel is like LT Panel except that it is used for high tension cables.



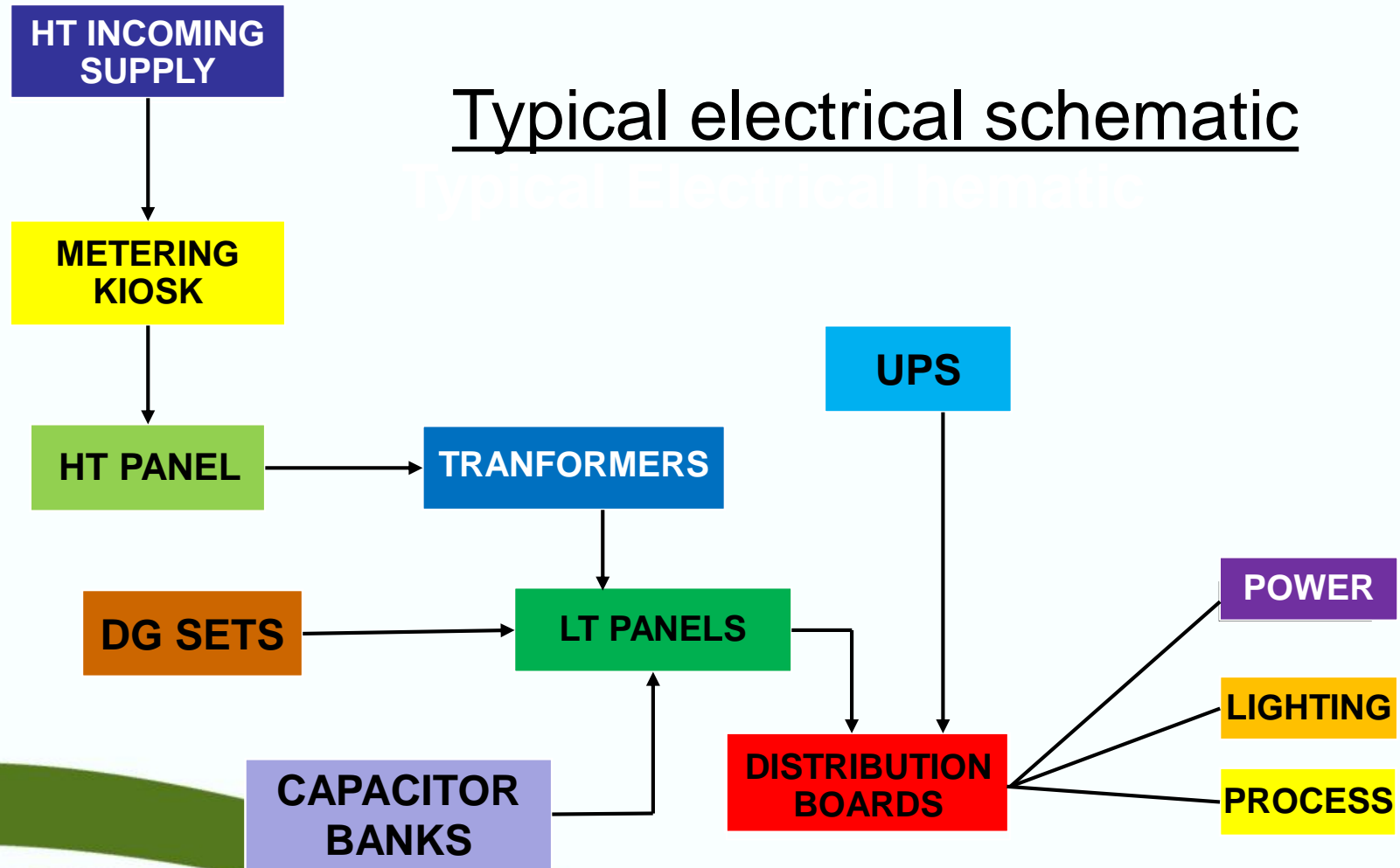


# Captive Power Plant

- A captive power plant, also called auto producer or embedded generation, is an electricity generation facility used and managed by an industrial or commercial energy user for their own energy consumption.

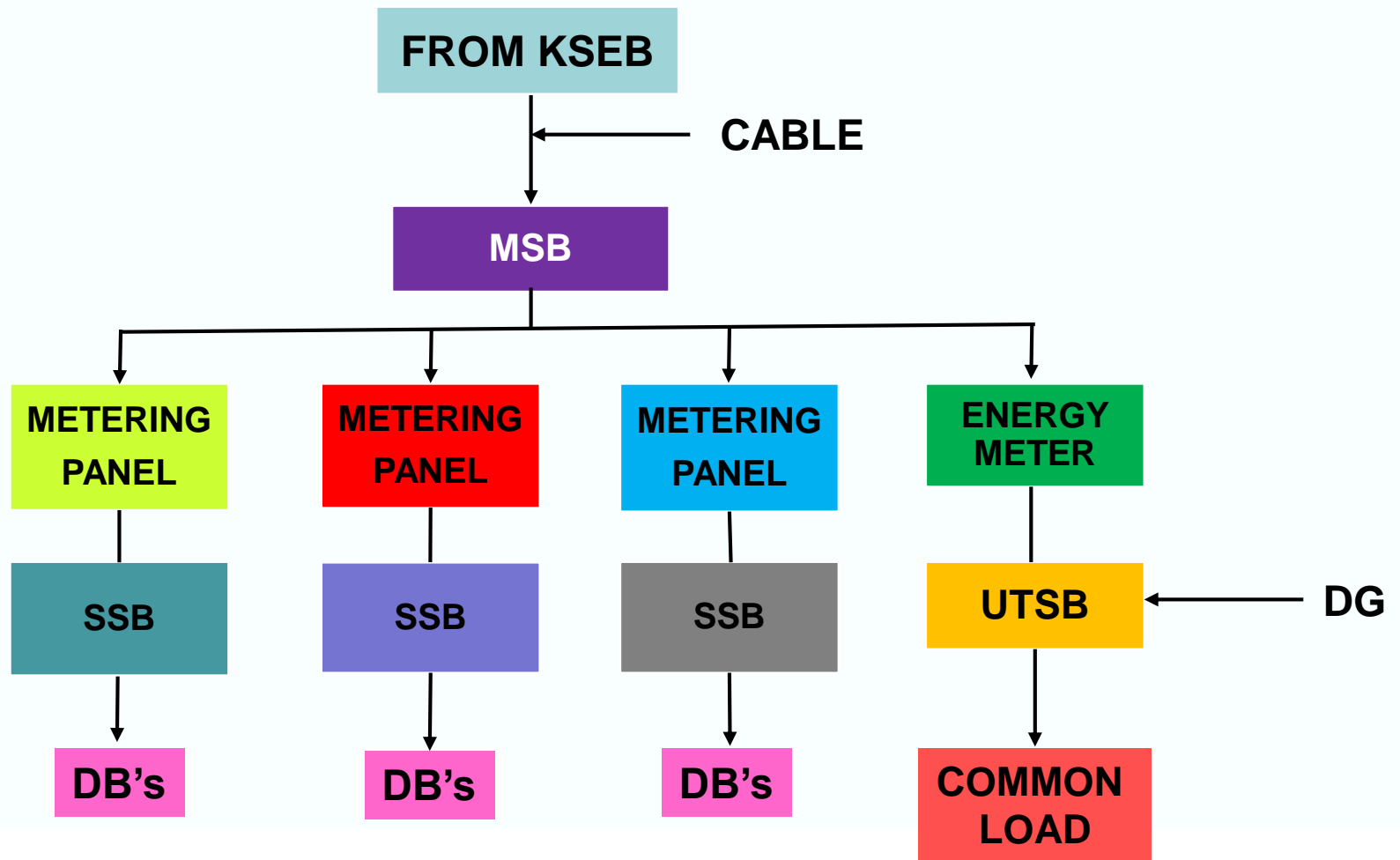
- A captive power plant is a facility that provides a localised source of power to an energy user. These are typically industrial facilities, large offices or data centres. The plants may operate in grid parallel mode with the ability to export surplus power to the local electricity distribution network.

# Typical electrical schematic

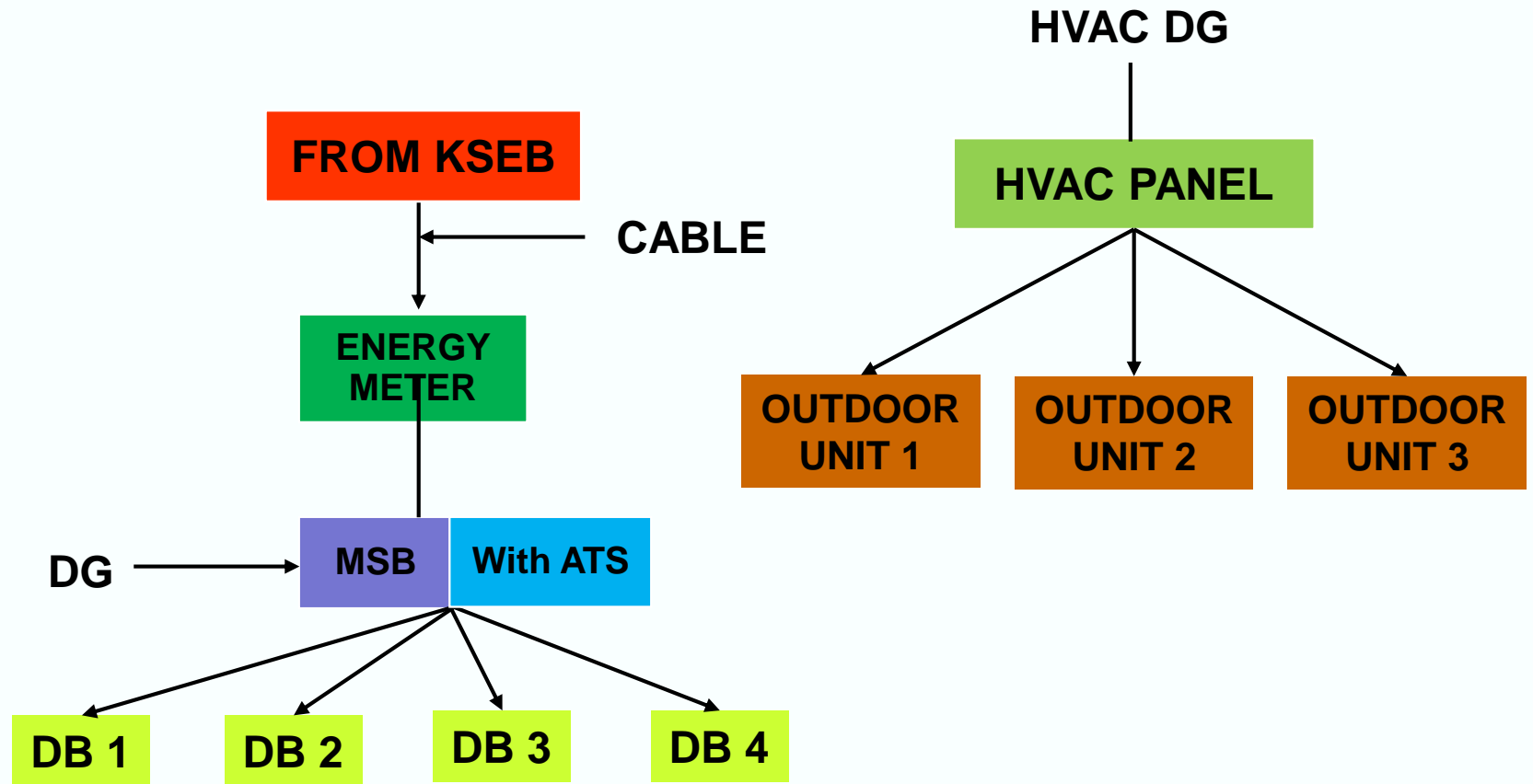


# Electrical System in Multi Storied Buildings

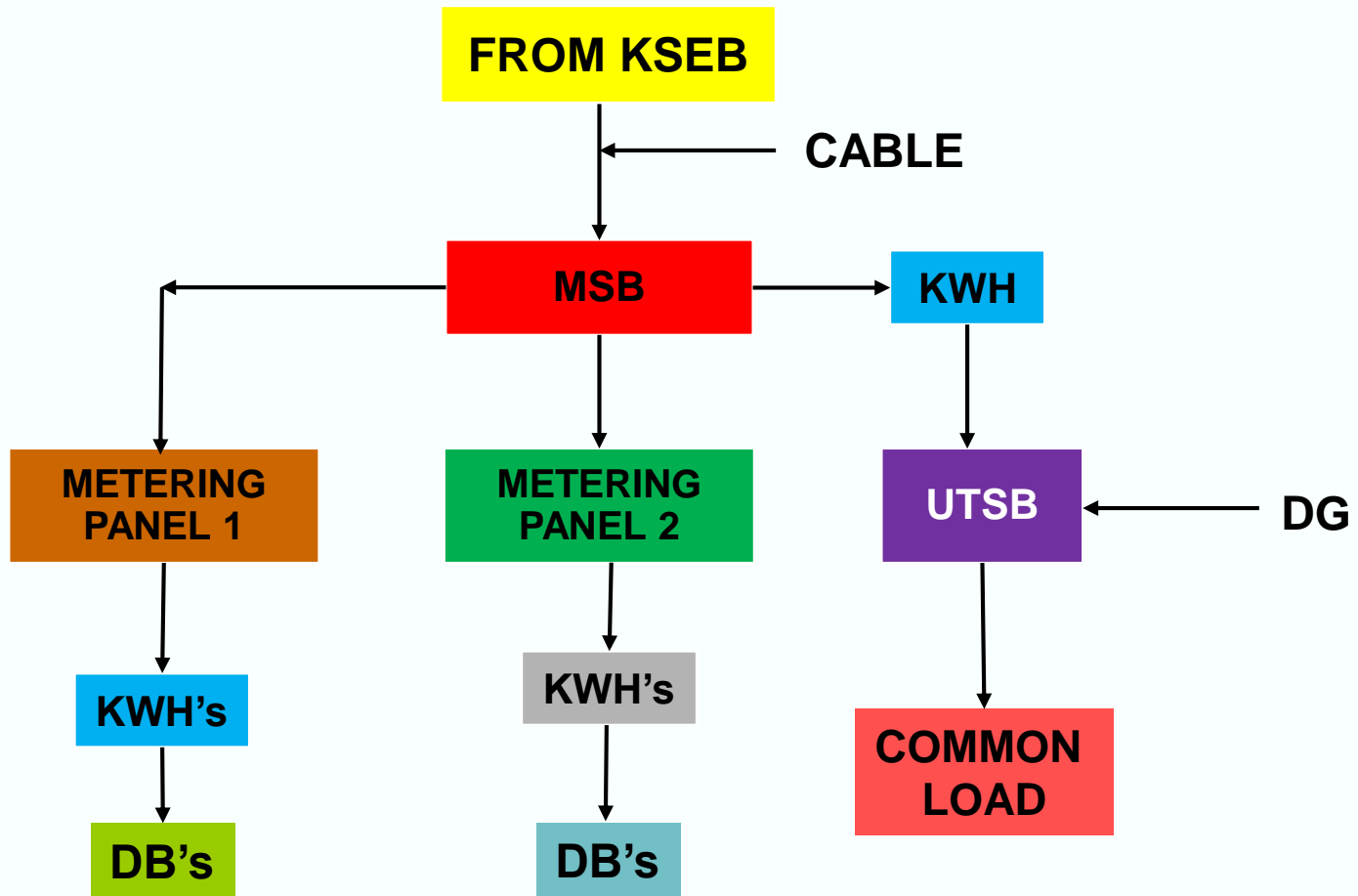




**COMMERCIAL**



**AUDITORIUM**



**APARTMENT**