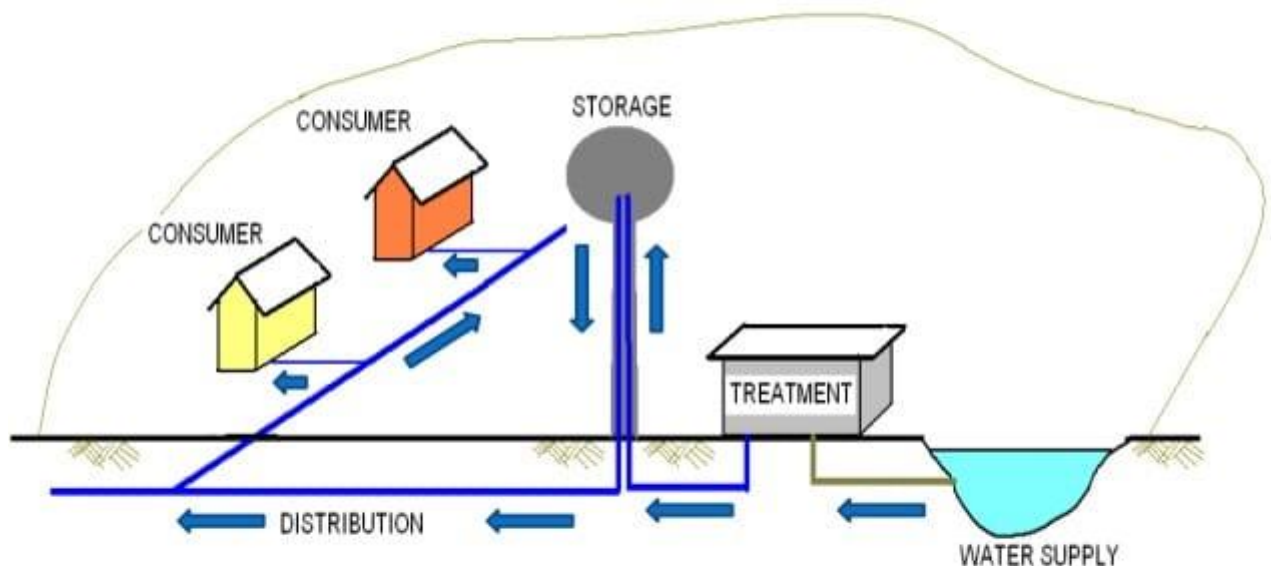


1. **Water Supply:** Water supply rule to deliver water to consumer with suitable quality, quantity and pressure by public utilities, commercial organizations, community efforts or by individuals, usually through a system of pumps and pipes.



## WATER SUPPLY



---

### 1.1

**(A) Water as a natural resource:** The water sources on the surface of the earth get their supplies from precipitation which may falls on the earth's surface in various forms such as rain, snow ,hail ,dew ,etc. The major part of all the supplies being rain.

Water resources are natural resources of water that are potentially useful. Uses of water include agricultural, industrial, household, recreational and environmental activities. All living things require water to grow and reproduce. 97% of the water on the Earth is salt water and only three percent is fresh water.

**(B) Public health significance of water quality:** Water has a profound influence on human health. At a very basic level, a minimum amount of water is required for consumption on a daily basis for survival and therefore access to some form of water is essential for life. However, water has much broader

influences on health and well-being and issues such as the quantity and quality of the water supplied are important in determining the health of individuals and whole communities.

The quality of water does, however, have a great influence on public health; in particular the microbiological quality of water is important in preventing ill-health. Poor microbiological quality is likely to lead to outbreaks of infectious water-related diseases and may cause serious epidemics to occur.

Microbiological drinking-water quality and human health: The microbiological quality of drinking-water has been implicated in the spread of important infectious and parasitic diseases such as cholera, typhoid.

**(C) Demand of water for domestic use:** It includes that water required for drinking, cooking, bathing, washing, sanitary purposes and other household purposes. In India, it is recommended as 135 liters per capita per day as per IS 1172-1971.

**(D) Industrial and commercial purposes:** It includes that water required for factories, hotels, offices, stores, mills, etc. In this case, the percentage of water required varies from 20 to 25 liters of the total water requirements.

**(E) Public use:** In this case water is needed for hostels, schools, colleges, cinemas, restaurants, cities, halls, etc. The percentage of water requirements for public use amounts to about 10% of total water requirements.

**(F) Per capita demand:** Generally, it means the average amount of water each person in a particular area uses on a daily basis, expressed as "gallons per capita per day." Water is used for various purposes in a community. If  $P$  is population, and  $Q$  is total quantity of water used in a year, then per capita demand is expressed as,

**Per Capita Demand ( $q$ ) =  $Q/P \times 365$  (Gallons or Liters per day)**

**$q$  = per capita demand**

**$Q$  = total water used in a year in liters**

**$P$  = population**

It indicates the average value but does not indicate the actual value.

**(G) Leakage and wastage of water:** Leaks can waste water, damage your home, and encourage unwanted organic growth. Unfortunately, because you cannot see most of the pipe work in your home, you may not always know that

a leak has formed. One of the best ways to protect your home from the future leaks is to understand and look for common situations that cause leaks to develop.

### **Preventive measures of leakage and wastage of water:**

- 1. Joint leakages**
- 2. Pressure in the supply system**
- 3. Method of supplying water**
- 4. Method of changing water supplies**
- 5. Illegal connections**

- 1.) Joint leakages:** The best time to fix a plumbing leak is before it happens, by properly connecting water supply and waste line fittings.
- 2.) Pressure in the supply system:** Pressure management is one of the most influential and cost-effective activities of reducing leakage. It can be defined as the practice of managing water distribution system pressures to the optimum levels of service ensuring sufficient and efficient supply to consumers.
- 3.) Method of supplying water:** Water supply either by intermittent system or continuous system.
- 4.) Method of changing water supplies:** When the water supplies are changed losses are reduced, because people use water economically.
- 5.) Illegal connections:** Illegal connections must be detected & the defaulter must be punished in order to reduce such losses.

#### **1.2) System of water supply:**

**A) Continuous system:** When water is supplied to the consumers for all the 24 hours, the system is known as continuous system. This system is possible where adequate quantity of water is available for supply. This is the best system and should be adopted where practicable. This produces a sense of confidence among consumers.

Water is available for firefighting. Due to continuous circulation water always remains fresh. There is less wastage if all building connections are metered & actual quantity of water consumed is charged for.

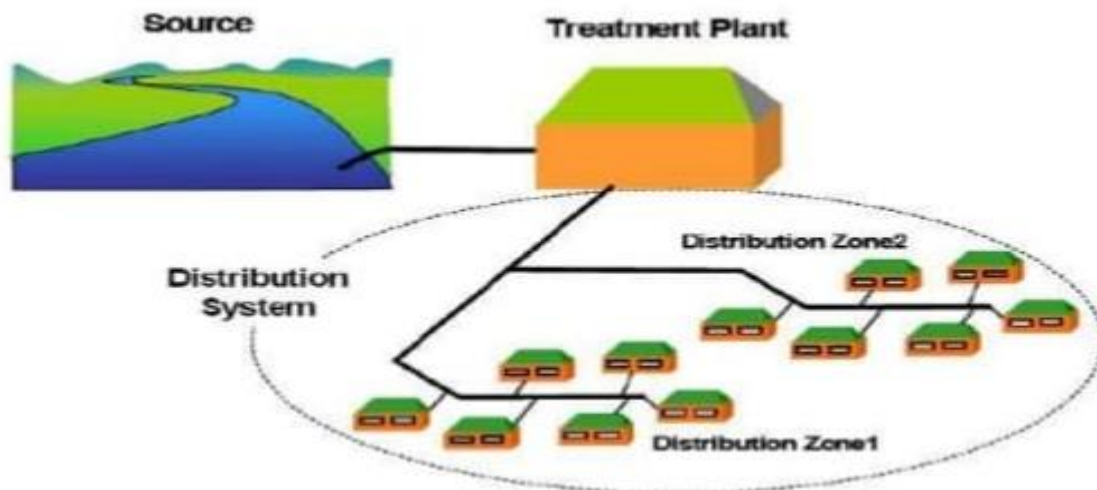
#### **Advantages:**

- In this system water is not stagnant in pipe at any instant and hence fresh water is always available.
- Lesser pipe sizes are required.
- Fire hazards can be met within time.

#### **Disadvantages:**

- If there are some minor leakages etc. in the system, great volume of water is wasted because of long duration of flow.
- More water is required at the source which is difficult in tropical countries like India, which get rains only during a particular season.
- More wastage of water due to lack of civic sense.

**B) Intermittent system:** If plenty of water is not available the supply of water is divided into zones and each zone is supplied with water for the fixed hours in a day maintaining good working pressure. As the supply is not continuous, it is called intermittent system. Repair to pipes can be carried out during non-supply hours.



**Advantages:**

- Reduced pressure also helps lowering leakage.
- Time is available for repair and maintenance out of supply hours.
- For older distribution systems having weaker joints and more leakage, restrained supply hours can limit leakage.

**Disadvantages:**

- Consumers need to store water between supplies and tend to throw away remnant store. This causes water wastage and storage costs.
- Frequent wear and tear on valves, water meters malfunction.
- More manpower and infrastructures needs.

**1.3 Storage and distribution of water :** Water storage is a broad term referring to storage of both potable water for consumption, and non potable water for use in agriculture. In both developing countries and some developed countries found in tropical climates, there is a need to store potable drinking water during the dry season.

**(A) Method of distribution of water:** The distribution of water supplies should be efficient. Water should reach the consumer with the desired rate of flow, the method of distribution depends:

- 1) On the level of water source.
- 2) On the level of city.
- 3) On the topography of the area.

**(B) System of conveyance of water:**

1) **By gravity system:** In this case, water is distributed from the higher level to lower level. This system is much suitable, if the source of supply is at higher level. This system is designed in such a way as to leave only minimum permissible (allowable) head to consume in losses. It minimizes the leakages.

2) **By pumping system:** In this case, treated water is not stored. It is pumped directly into the pipes. As the demand of water is not constant always. Therefore, high pumps will be required in this system.

In this system, the pumps are operated at a constant speed, which increase their efficiency and reduces wear and tear. The advantages of this system are many and disadvantages are that supply if power fails.

3) **By combined gravity and pumping system:** This system is also called dual system. In this case, the pump is connected to the reservoirs. Water is stored into the reservoir from where it is supplied its consumer by gravity, sometime water is pumped into the reservoirs. The system has been found to be cheap, efficiency and reliable.

**(C) Water distribution by boosting:**

- 1) To ensure constant pressure, tall commercial buildings face two major challenges.
- 2) First, pre-pressure in water mains is rarely high enough to cover the whole building.
- 3) Second, water demand changes constantly.
- 4) This means a booster system must not only be reliable but also have the intelligence to maintain the right pressure regardless of consumption.

**Systems for boosting water pressure :**

Pressure-boosting systems can be of several different types:

- pumping from a ground level or basement gravity tank to a gravity roof

- pumping from a gravity storage tank or public water main into a hydro-pneumatic pressure tank that uses captive air pressure to provide adequate drinking-water supply pressure.

#### **1.4 Hot water supply for buildings including solar water heating :**

-Water heated by the use of solar energy.

-Composed of:-

- 1) Solar thermal collectors
- 2) A water storage tank
- 3) Interconnecting pipes and
- 4) A fluid system to move the heat from the collector to the tank
- 5) Solar collector typically 3-6m<sup>2</sup> in area
- 6) Standard package with appliances.

#### ***Advantages:***

-Safety –No gas leak, no dangerous explosion, no electricity occurrence.

-Savings –No electric bills, no gas bills

– The product pays for itself.

-Convenient –Rain or shine. Enjoy a hot shower any time of the day.

#### **Types of Hot Water System**

##### **1. Electrical heating system**

**2. Solar heating system :** Solar water heating (SWH) is the conversion of sunlight into heat for water heating using a solar thermal collector .SWHs are widely used for residential and some industrial applications . A sun-facing collector heats a working fluid that passes into a storage system for later use. SWH are active and passive. They use water only, or both water and a working fluid.



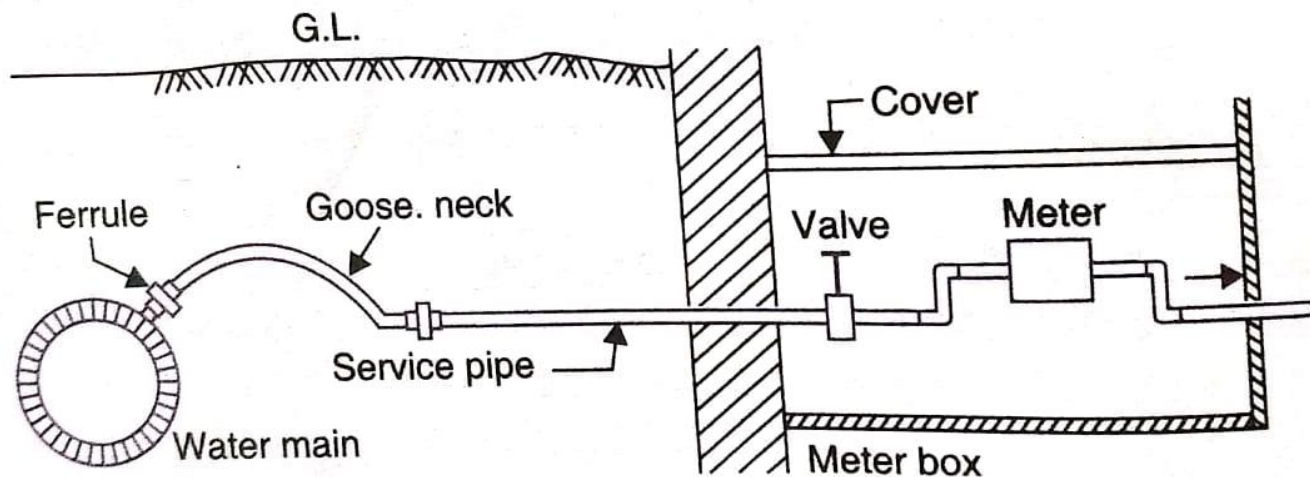
**1.5 Service connection :** It is a primarily connection from the distribution system to the consumers . The arrangement of giving connection of water from street to the consumer's house is known as tapping of water or house connection or service connection .This connection is given to the street main.

A domestic service includes the following components:

- 1) **Drilling of hole**: It is made in the main either by hand or by machine. If possible it should at night when there is no pressure in the main. The hole in the main should be drilled in the upper portion.
- 2) **Ferrule**: It is a small pipe of brass which is screw down in the hole, drilled in the main, to take water to the brass pipe. The size of ferrule depends upon the size of brass pipe but preferably, should not be more than 5 cm because it is weak.
- 3) **Goose neck**: A short length of lead pipe is placed between ferrule and service pipe, whose extra length is curved in the desired shape, is known as gooseneck. This consists of a 40 to 50 cm long, curved piece of flexible pipe. The gooseneck prevents the breaking of the main service pipe due to the movement that takes place between the water main and the service pipe, thus provide, flexibility of the junction.
- 4) **Service pipe**: The G.I. pipe placed at the end of lead pipe for the supply of water in the house is known as service pipe.
- 5) **Stop cock**: It is installed in the suitable chamber with cover, to close down the supply for repairs of the plumbing system.
- 6) **Water meter**: The meter is provided on the service pipe after the stop cock. It is also installed in suitable chamber with cover. It measures the quantity of water used by consumer. A water meter should possess the following characteristics :
  - 1) It should be easy to maintain and repair. Spare parts should be readily available.
  - 2) It should be capable of working at all pressures efficiently.



- 3) It should be durable. Its parts should not be affected by chemicals used for purification and the impurities in water.
- 4) It should have low cost.



**Figure 30.1. Service Connection**

**Sizes of service pipe:** The sizes of service pipes are determined on the basis of the following:

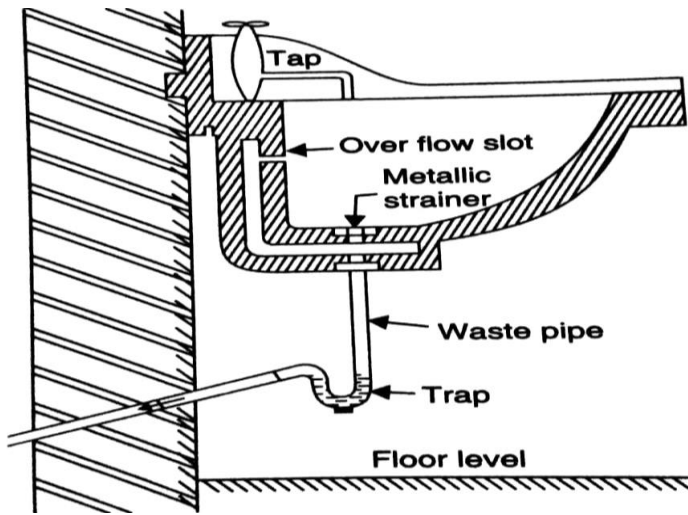
- 1) The minimum pressure in the distribution main at the proposed point of connection
- 2) Length of the service pipe required.
- 3) Elevation of the highest point of delivery above the distribution mains.
- 4) No. and types of plumbing fixtures in the building.
- 5) Maximum rate of flow required.

No. of occupants	4	8	24	60
Diameter of pipe (in mm)	12.5 mm	20 mm	25 mm	30 mm

**Water supply fixtures:**

- 1) **Wash basin:** A wash basin is used for washing hands, face etc. Normally, a wash basin is provided with two taps – one for hot water and the other one for cold water mounted at the top. It has oval shaped bowl, with an overflow slot at the top. They are made of burnt fireclay, ceramic, enamel over steel, marble, glass, etc.

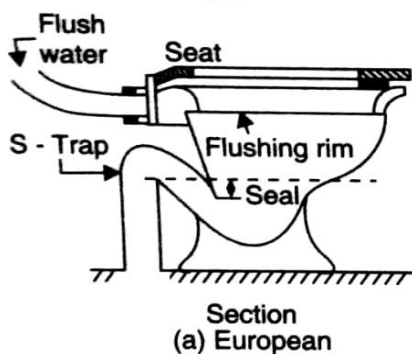
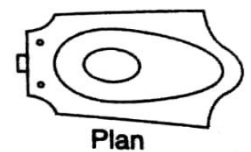
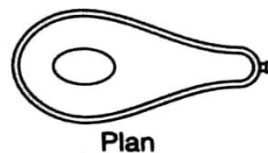
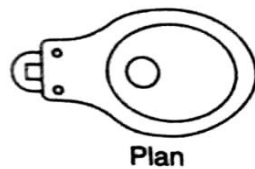




**2) Sinks:** while a wash basin is used for washing hands and face etc., a sink is used in kitchen or laboratory. These may be made of glazed fire clay, stainless steel, and metal, pressed steel. They are manufactured in various size and shape. A rectangle shape is quite common in kitchens. The out let pipe, provided with a grating of brass, may discharge over a floor trap.

**3) Water closets [W.C.]:** Water closet is designed to receive and discharge human excreta directly from the person using it. The appliance is connected to the soil pipe. it is usually connected to a flushing cistern to flush the closet and discharge the human excreta to the soil pipe .Water closets are of three types:

- 1) Indian-type
- 2) European-type
- 3) Anglo-type



**Figure 30.14. Wate Closets**

**4) Urinals:** urinals are usually of two types :

- 1) Bowl type
- 2) Stall type

The former type is used in residential building while the later type is used in public building. A stall urinal normally has more than one unit, with a centre to center spacing of 0.6 to 0.7 m. The best types of urinal are made of salt glazed stoneware, marble, slate and in cement. Urinals are collected and discharged into soil pipe through floor trap.

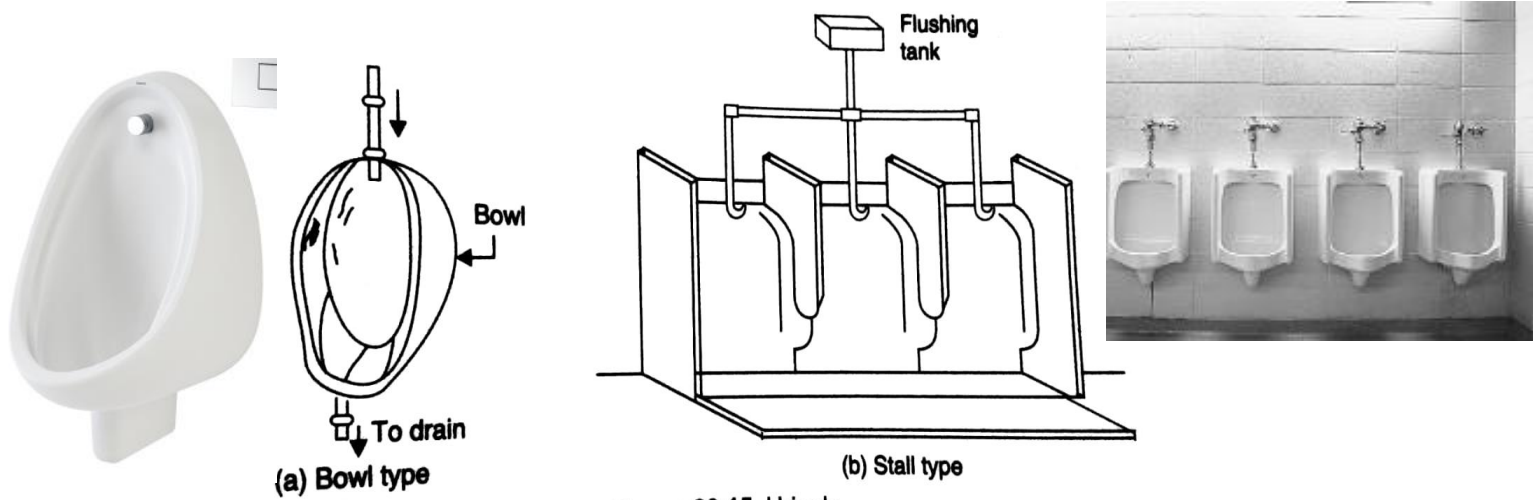


Figure 30.15. Urinals

**5) Bath tubs:** Bath tubs, are usually made of iron or steel coated with enamel, enameled porcelain or of plastic material. They may also be made of cast-marble chips or terrazzo. It has length varying from 1.7 to 1.85 m, width between 0.7 to 0.75 m and depth near waste pipe varying from 0.43 to 0.45 m. The overall height may vary between 0.58 to 0.6 m. It is provided with outlet and overflow pipes, usually of 40 mm diameter. A trap with proper water seal is used at the outlet.

**6) Flushing cisterns:** These are used for flushing out water closets and urinals. These are made of either cast iron or porcelain. For Indian type W.C., cast iron flushing cistern is normally used, fixed at about 2 m above the floor level. For European type and Anglo-Indian type closets, porcelain cisterns, made of porcelain, are decent in look, and operate very easily by simple turning a

handle. Flushing cisterns are of two types:

- 1) Valves symphonic type.
- 2) Valve fitted symphonic type.

**7) Faucet:** It is a device that controls the flow of liquid, especially water, from a pipe. It is also called a water tap. It is available in a bathroom, kitchen or sink, as per use.

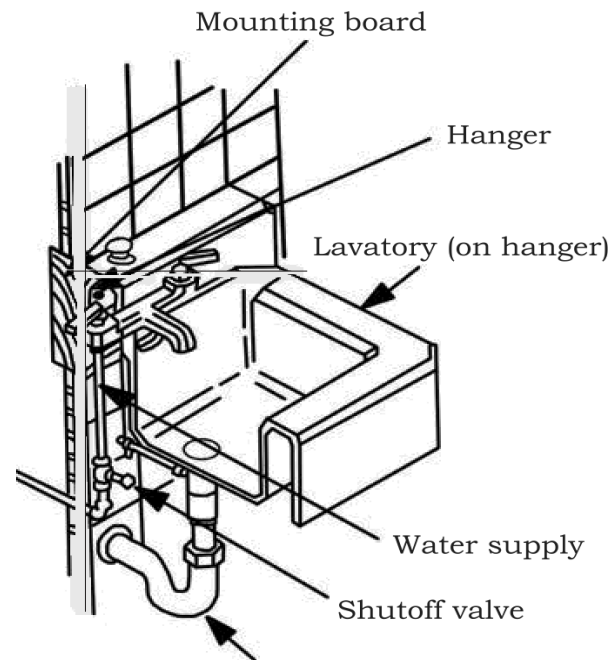
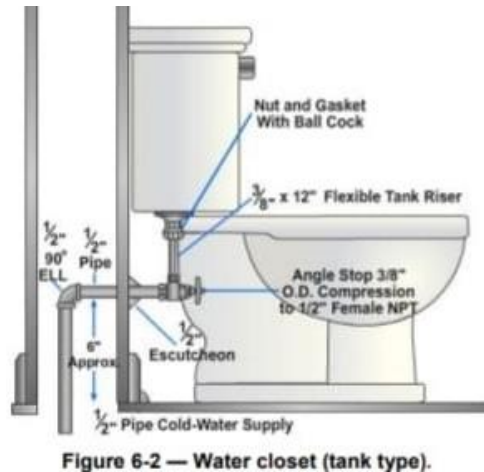
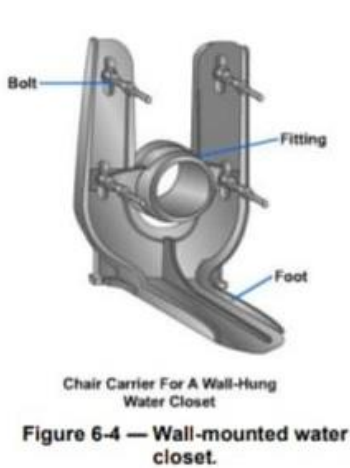
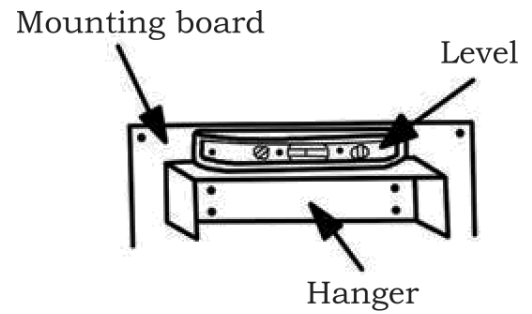


## **Installation:** of a wall hung fixture

Step 1. Install the mounting board between the studs at the proper height, using the same method as for a wall-hung flush tank.

Step 2. Attach a hanger bracket on the finished wall using the proper length of wood screws at the recommended height. The metal bracket must be level.

Step 3. Place the lavatory on the bracket and push down. Make sure the lavatory is level.



## **1.6 Concept of Rain Water Harvesting:**

Rain water harvesting is a technique of collection and storage of rain water in to natural reservoirs or tanks.

One method of rain water harvesting is rooftop rain water harvesting, which water is quite clean and free from impurities like cow-dung, leaves, pebbles, etc. can be used for the household purposes for the years. This is a high quality of drinking water and year round storage can be done.

### **Uses:**

- Drinking and cooking.
- Bathing and laundry.
- Flushing toilets.
- Watering lawns, gardens and house plants.
- Water for wild life, pets or livestock.
- Outdoor ponds and water features.
- Rinsing vegetables.

### **Advantages:**

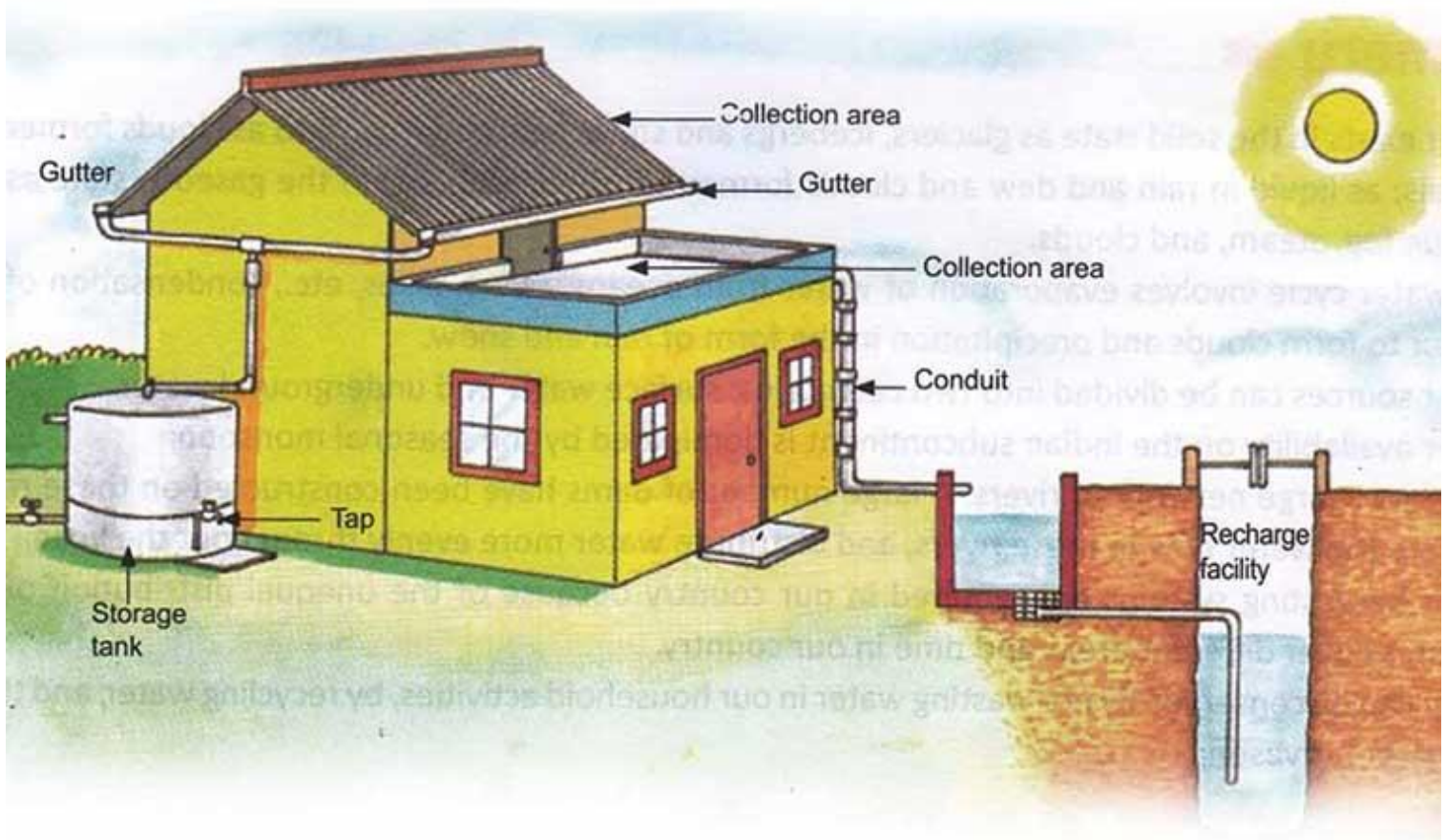
- Rain water harvesting will improve water supply and food production,



- Rain water is free from chemicals and bacteria's, hence no need of treatment.
- It is the only state source where canals or river water is not available like in some areas of Rajasthan.
- People use water economically.
- No heavy plumbing work is required.

**Disadvantages:**

- Sufficient arrangement is required for storing water.
- Rain is not assured.
- Storage is cleaned only when they are empty.
- Sometimes this water may cause breeding mosquitoes.



## **DRAINAGE**

Drainage is the natural or artificial removal of a surface's water and sub-surface water from an area with excess of water.

The arrangement provided in a house or building, for collecting and conveying waste water through drain pipes, by gravity, to join either a public sewer or a domestic septic tank, is termed as house drainage or building drainage.

### **Aims of house/building drainage**

House drainage is provided

- i. To maintain healthy conditions in the building.
- ii. To dispose off waste water as early and quickly as possible.
- iii. To avoid the entry of foul gases from the sewer or the septic tank.
- iv. To facilitate quick removal of foul matter (e.g. human excreta).
- v. To collect and remove waste matters systematically.

### **Principles of house/building drainage**

The following principles are adopted for the efficient drainage system:

1. The lavatory blocks should be so located that the length of drainage line is minimum. In the case of multistoreyed building they should be located one above the other. At least one wall of the lavatory block should be an outside wall, to facilitate the fixing of soil and vent pipes.
2. The drainage pipes should be laid by the side of the building rather than below the building.
3. All the drains should be aligned straight between successive inspection chambers. All sharp bends and junctions should be avoided except through chambers.
4. The slope of the drains should be sufficient to develop self cleansing velocity.
5. The size of drain should be sufficient, so that flooding of the drain does not take place while handling the maximum discharge.
6. The drainage system should contain enough number of traps at suitable locations.
7. The house drain should be disconnected to the public sewer by the provision of an intercepting trap. This will avoid the entry of foul gases

from entering the house drainage system. It should be seen that the public sewer is deeper than the house drain.

8. Rain water pipes should drain out rain water directly into the street gutters from where it is carried to the storm water drain.
9. All the connections should be water tight.
10. The entire drainage system should be properly ventilated from the starting point to the final point of disposal. It should permit free circulation of air.
11. All the materials and fittings of the drainage system should be hard, strong and resistant to corrosive action. They should be non-absorbent type.
12. The entire system should be so designed that the possibilities of formation of air locks, siphonage, under deposits etc. are minimized.

**Surface Drainage:** is the diversion or orderly removal of excess water from the surface of land by means of improved natural channels or constructed drains, supplemented when necessary by shaping and grading of land surface to such drains.

**Storm Water:** The discharge due to rain fall on roof, courtyard open area etc. is called storm water.

### **System of sewer drainage:**

There are three system of sewer drainage:

1. Combined system
2. Separate system
3. Partially separate system

**1. Combined system:** A drain which carries both sanitary sewage as well as storm water simultaneously through it to treatment plant and ultimately to a final disposal place is known as combined system .

### **Advantage:**

1. It require only one sewer.
2. Size becomes large, so easy to clean .
3. House plumbing work reduced.
4. Easy to lay.

### **Disadvantage:**

1. Load on treatment plant increases.
2. Storm water also get polluted.
3. Plumbing and lifting sewage becomes costly.
- 2. Separate system:** In separate system, two independent drain pipes are required, one for sanitary sewage and other for storm water. Only sanitary sewage needs treatment and storm water discharged in to a natural drain directly. It is suitable where rain fall is more.

### **Advantage:**

1. Sizes of drain is very small.
2. Storm water is not polluted.
3. Load on treatment plant is less.

### **Disadvantage:**

1. System is costly.
2. Drain pipe of small sizes, so cleansing is difficult.
3. More plumbing work is required.
- 3. Partially separate system:** The sanitary sewers are designed to carry rain water up to a certain limit and extra heavy storm water is carried through the open drain is called partially separate system.

### **Advantage:**

1. It consists the merits of the above two system.
2. This system is good , upto certain limit of storm water .
3. House plumbing work reduced .

### **Disadvantage:**

1. Mixed quantity of storm water increases load on treatment plant .
2. Dry weather and self cleansing velocity will not developed and sewage deposit in pipes.

**TRAPS:** A vertical bend or depression as fitting at the end of soil pipes of waste pipes to prevent foul gases coming out of the soil pipe / waste pipe.

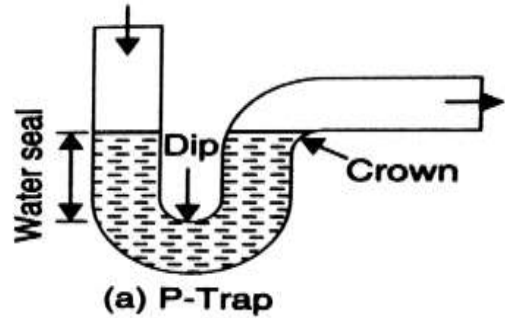


## Classification of Traps

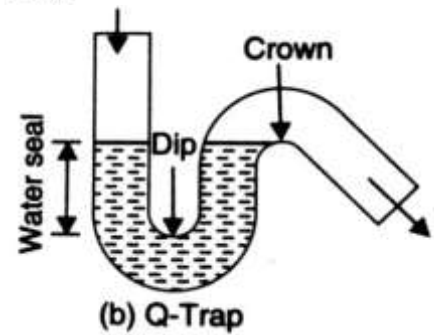
a. According to the shapes:

1. P- trap
2. Q- trap
3. S- trap

1. **P – Trap:** The trap hearing the shape of letter “P” shown in figure is called as P – trap. In this case , the legs of the traps at right angle to each other.



2. **Q – Trap:** The trap of having the shape letter “Q” showing in figure is called Q- Trap.



3. **S – Trap:** The trap having the shape of letter “s” shown in figure is called S – Trap. In this case, the legs of trap are parallel.

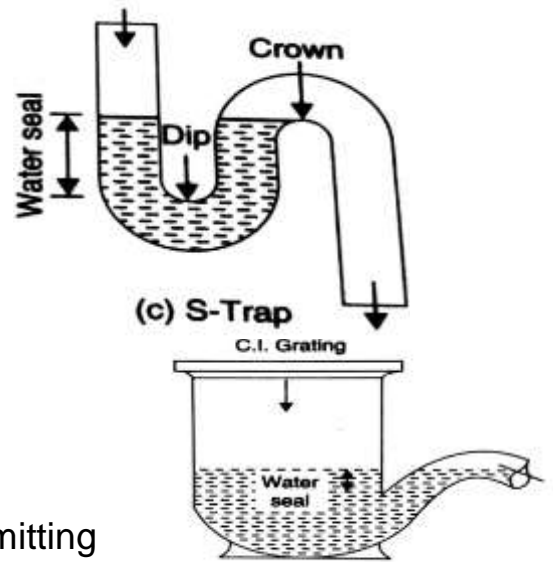


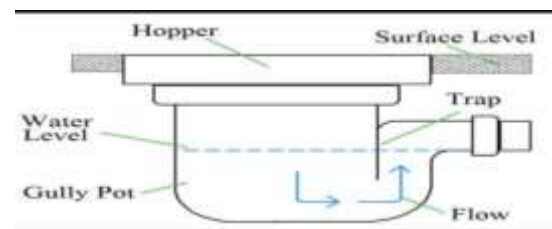
Figure 30.7. Floor Trap

b. According to the particular use of trap :

1. Floor trap
2. Gully trap
3. Intercepting trap
4. Grease trap

1. **Floor Trap:** The traps which are used for admitting surface wash or waste floor of bath and kitchen are called floor trap.

2. **Gully Trap:** The trap which is used to receive waste water from sink, bath, wash basin and rain water is called gully trap.



3. **Intercepting Trap:** The trap is provided at the function of house s drain a sewer is called intercepting trap .

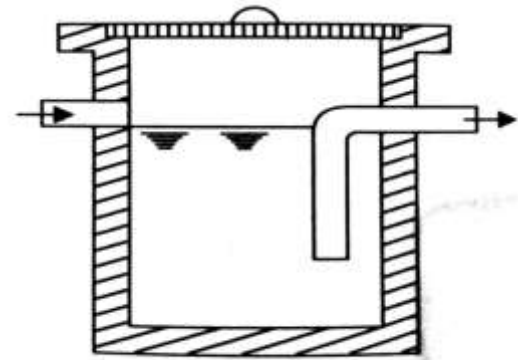


(a) Intercepting trap

**4. Grease trap:** The trap is provided in the plumbing system for remaining grease oil and gcesoline are called grease trap.

**Function of trap:**

1. It is only way traffic arrangement and controls the movement of sewer gases only.
2. It allows sewage to enter into municipal sewers.
3. It does not allow the passage of sewer gases towards the buildings as the trap remain full of water.



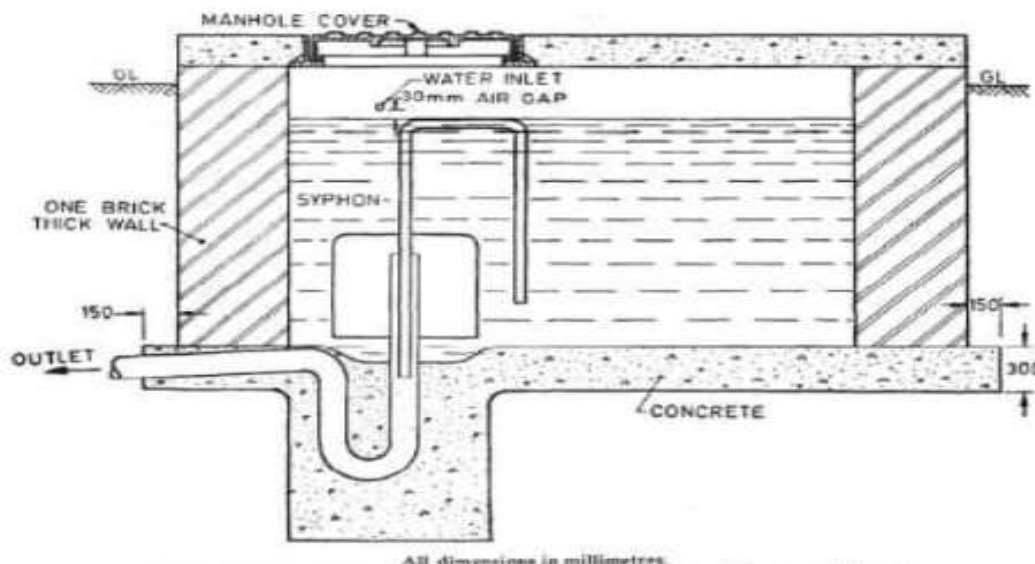
**Figure 30.10. Grease Trap**

**Requirement of good traps:**

1. Construction of trap should be simple .
2. It should easily to cleaned .
3. It should easily to fix in position .
4. It should have smooth surface from inside .
5. Water seal depth should remain full with water all time .
6. It should provide self cleansing velocity .

**INSPECTION CHAMBER**

Inspection chamber is an access fillings. In drainage term an inspection chamber is usually a small acess to underground services. It is with room to acess by hand from the ground surface where as a man hole is a bigger acess. Drain pipes from two or many sides enters in inspection chamber . Where their blockage can be inspection and cleaned.



**Size of inspection chamber:** Size of inspection chamber is two, 450 mm and 320 mm, made up of brick masonry in cement mortar. The big inspection chamber called man hole is constructed on sewer line for inspection chamber . It is minimum 15m deep .

**Ventilation of house drainage :**

Some important terms :

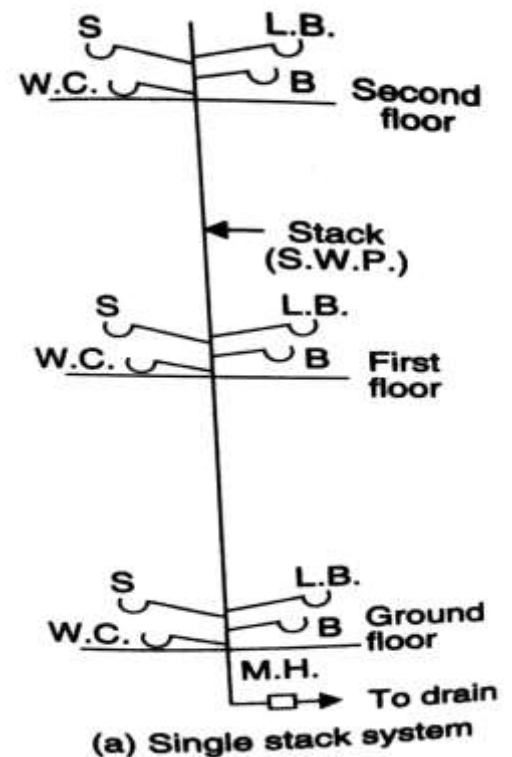
1. **Soil pipe:** A soil pipe is a pipe through which human excreta flows. The size of soil pipe is 100mm dia.
2. **Waste pipe :** It is a pipe carries only the liquid waste . It does not carry human excreta . The size is 30mm to 50mm dia. In the horizontal and 75mm in vertical.
3. **Vent pipe:** It is a pipe which is provided for the purpose of ventilation of the system. A vent pipe is open at the top and bottom, to exit the foul gases. It is at least 1m Higher from roof. Its size is 50mm dia.
4. **Anti – siphonage pipe:** It is a pipe which is insulated in the house, drainage to preserve the water seal of trap. It size:
  - a. Connecting soil pipe : 50 mm
  - b. Connecting waste pipe : 40mm
5. **Rain water pipe:** It is pipe which carries only the rain water. Its size is 75mm dia.

**STACK:** It is a generally term and used for any vertical line of drainage pipe may be fixed in horizontal, vertical or inclined system.

System of plumbing:

There are four system of plumbing but two are, main system which are mainly used:

1. **Single stack system:** This is the simplest system, in which the waste matter from baths, sinks, etc. as well as foul matter from the W.C. are discharged in one single pipe, called the soil and waste pipe. The vent pipe at the top, and no separate vent pipe is provided.



The single stack system is effective only if the traps are filled with water seal of depth not less than 75mm.

2. **Double stack [two pipe system]:** In this system separate soil pipe and waste pipe are provided. The discharge from W.C. is connected to the soil pipe while the discharged from bath, sink, etc. are connected to the waste pipe. All the trap are completely ventilation by providing separate ventilation pipe. This system is costly due to the more number of pipes.

**Sanitary fitting:**

The following fitting are commonly used in building, for efficient collection and removal of waste water to the house drain:

1. **Wash basin:** A wash basin is used for washing hands, face etc. Normally, a wash basin is provided with two taps – one for hot water and the other one for cold water mounted at the top. It has oval shaped bowl, with an overflow slot at the top. They are made of cast iron, pressed steel or plastic, especially where number of user are more.

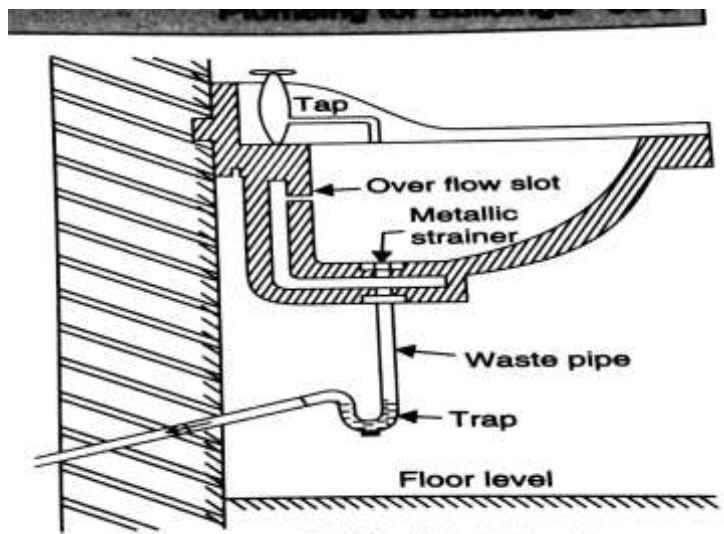
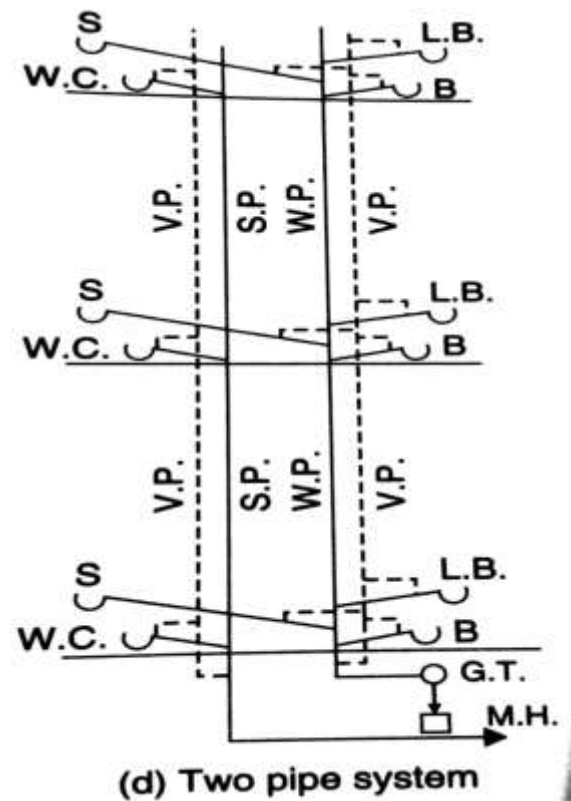


Figure 30.12. Wash Basin

2. **Sinks:** while a wash basin is used for washing hands and face etc., a sink is used in kitchen or laboratory. These may be made of glazed fire clay, stainless steel, and metal, pressed steel. They are manufactured in various size and shape. A rectangle shape is quite common in kitchens. The out let pipe, provided with a grating of brass, may discharge over a floor trap.



**3. Water closets [W.C.]:** water closet are designed to receive and discharge human excreta directly from the person using it. The appliance is connected to the soil pipe. It is usually connected to a flushing cistern to flush the closet and discharge the human excreta to the soil pipe. Water closets are three types:

1. Indian – type
2. European –type
3. Anglo –type

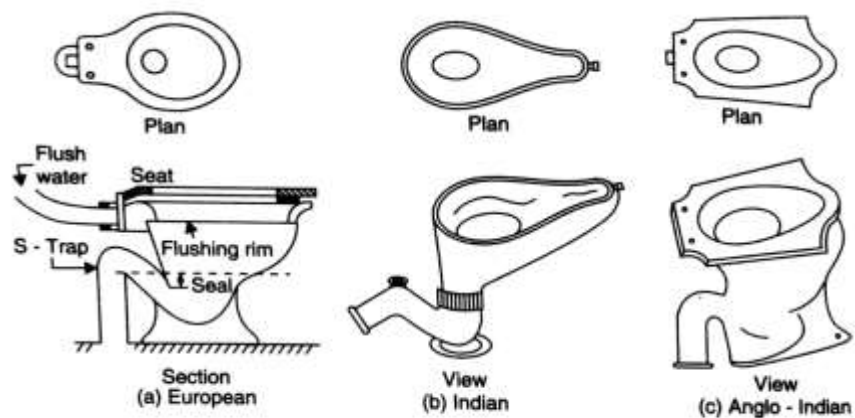


Figure 30.14. Water Closets

**4. Urinals:** urinals are usually of two types:

1. Bowl type
2. Stall type

The former type is used in residential building while the later type is used in public building. A stall urinal normally has more than one unit, with a centre to centre spacing of 0.6 to 0.7 m. The best types of urinal are made of salt glazed stoneware, marble, slate and in cement. Urinals are collected and discharged into soil pipe through floor trap.

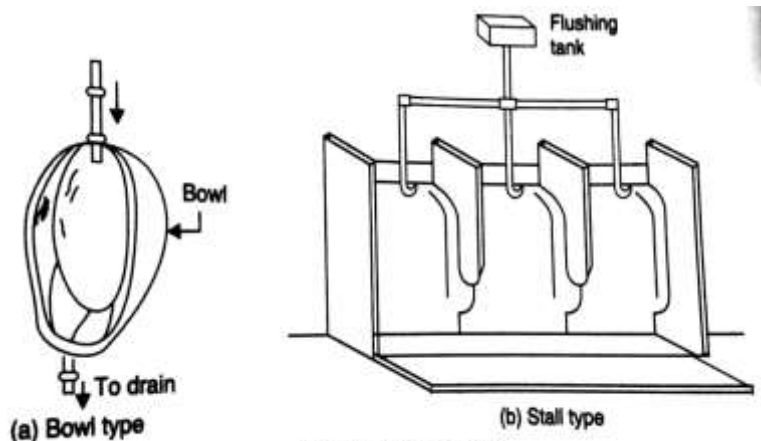


Figure 30.15. Urinals

**5. Bath tubs:** Bath tubs are usually made of iron or steel coated with enamel, or of plastic material. They also may be made of marble slabs properly jointed at the side. It has a length varying from 1.7 to 1.85m, width between 0.7 m to 0.75m and depth near waste pipe varying from 0.43 m to 0.45 m. The overall height

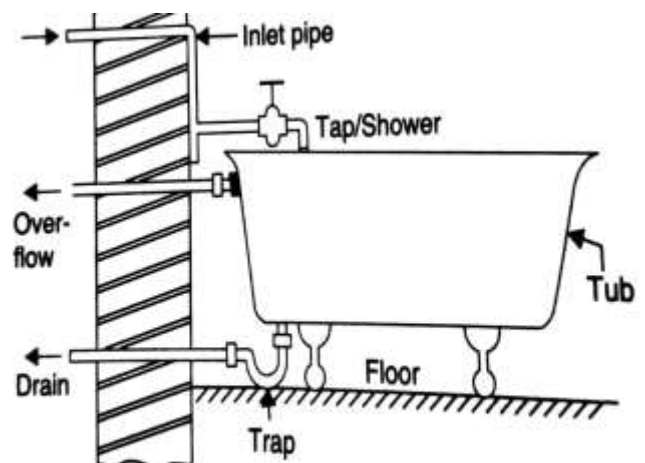


Figure 30.13. Bath Tub

may vary between 0.58 to 0.6m. It is provided with outlet and overflow pipes, usually of 40mm dia. A trap with proper water seal is used at the outlet.

**6. Flushing cisterns:** Flushing cisterns are used flushing out water closets and urinals. These are made of either cast iron. The low level flushing cisterns, made of porcelain, is decent in look, and operate very easily by simply turning a handle.

Flushing cisterns are two types:

- i. Valueless siphonic type.
- ii. Value filled siphonic type.

Bell type flushing cistern, commonly used with Indian type closets. Press the handle to flush the toilet and you operate a lever inside the cistern. Pressurized

water flow in, refilling the cistern. And pushing the float back up again. When the float reaches the correct level, the ball valve switches off the water supply and the toilet is ready to flush again.

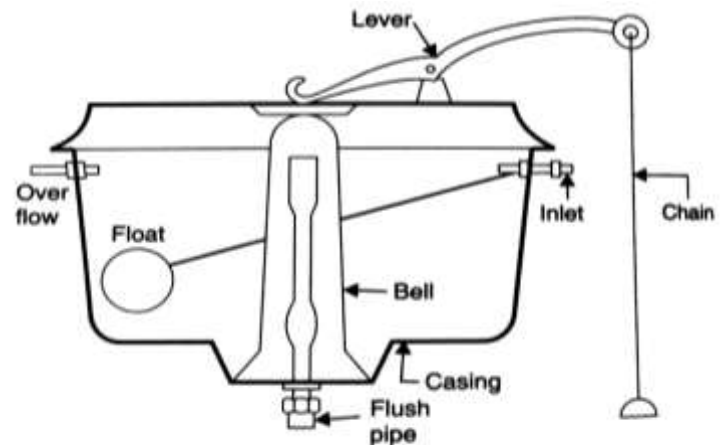


Figure 30.16. Bell Type Flushing Cistern

## METHOD OF SEWER CONSTRUCTION

Construction methodology of laying a sewerage pipe Laying involves setting the pipe into the ground, usually in a trench dug with a shovel. The sewerage pipe can be laid right on the earth. However, the trench must be dug on a slight angle to assist in the flow of liquids through the pipe. This is done by setting a grade into the trench line to match the layout of your pipe design, and they must be very straight. This improves the flow of water through the pipe. Many methods are used to lay sewerage pipe so it is straight, but one of the best ways is to use a "laser-assisted" device.

Set stakes into the ground to mark the route of your sewer line. Make sure they are straight by positioning a laser on the top of the first stake and pointing a laser on the top of the first stake and pointing it to the last stake. Reposition the stakes that fall out of line with the laser so they line up with the laser. Dig the trench using a shovel, following the stakes used to denote the straight line. Dig the trench at a 1 percent grade

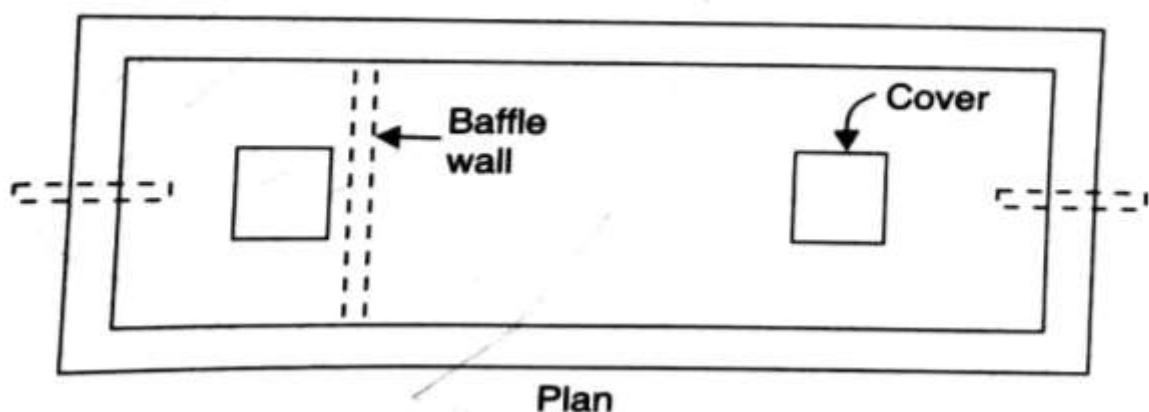
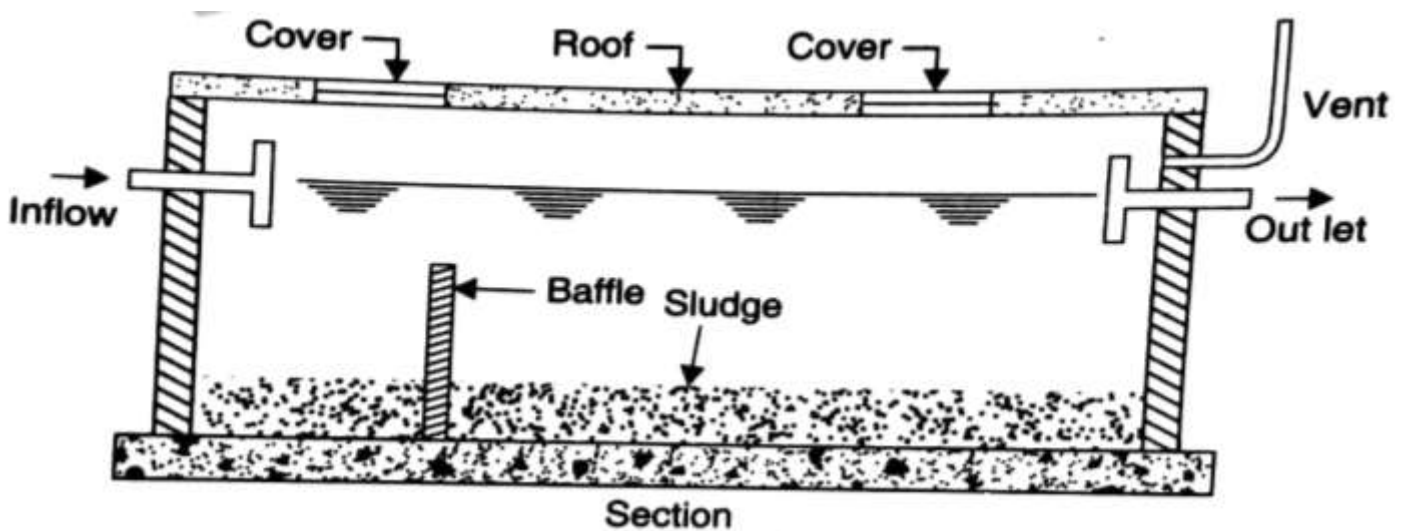
toward the end of the sewer line, at a depth of 6 feet or more, or as specified by your sewer line design. Place a batter board over the sewer pipe section. This is a 2-by-4 board that lays across the trench with two stakes in the ends. It is secured in place with a sledgehammer. The batter board also has a "batten" that is nailed dead center to the batter board.

Attach a laser to the first batten and line up each consecutive batten on each batter board down the line. This ensures they are all perfectly straight.

### Septic tank

It is a horizontal continuous flow sedimentation tank in which sewage move very slowly. A septic tank is an underground chamber made of concrete, fiberglass, or plastic through which domestic wastewater [sewage] flows for basic treatment. Settling and anaerobic processes reduce solids and organic, but the treatment efficiency is only moderate.

Septic tank system are type of simple onsite sewage facility. They can be used in areas that are not connected to a **sewerage** system, such as rural areas. The treated liquid effluent is commonly disposed in a septic tank field, which provides further treatment.





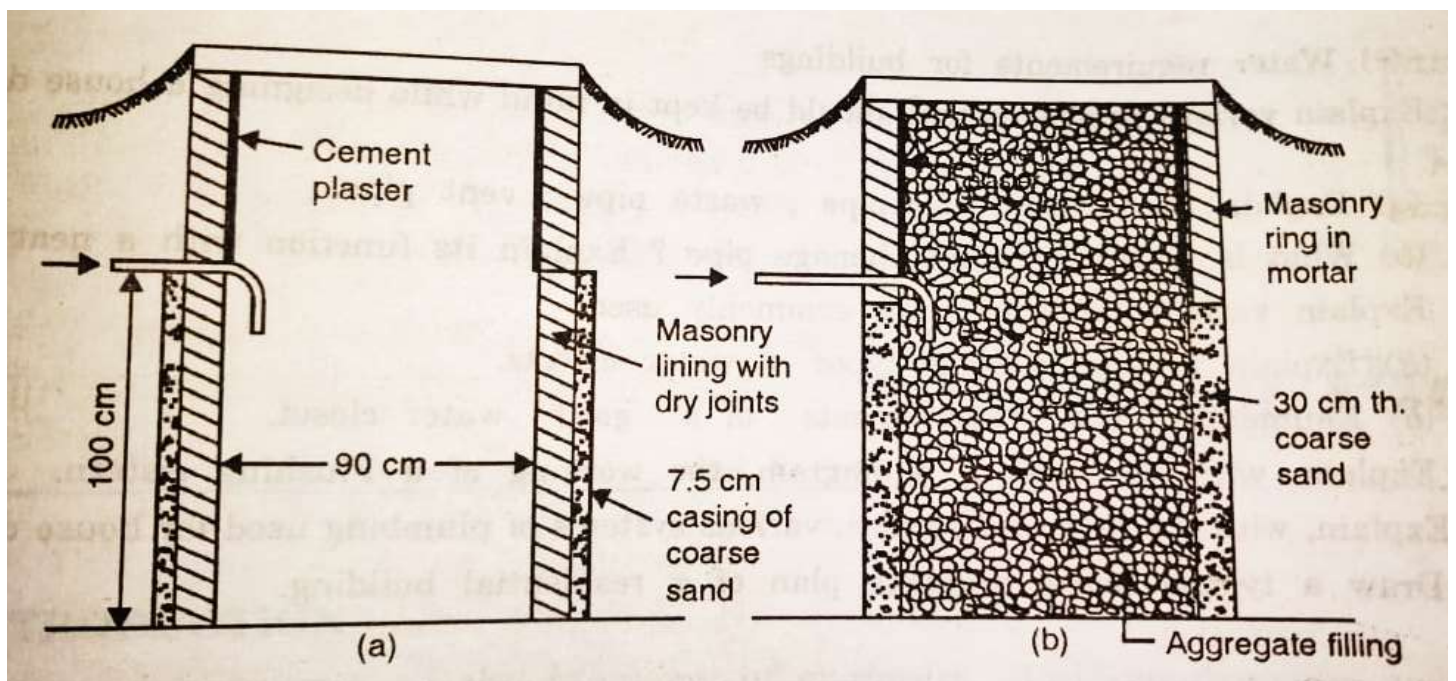
**CONSTRUCTION OF SEPTIC TANK:** It is so constructed that direct current between inlet and outlet is prevented. This is achieved by using pipe –tees at inlet and outlet. A baffle wall with openings is constructed at some distance away from the outlet.

**SIZE:** The outlet pipe is kept about 15cm lower than the inlet pipe. The sludge, which is deposited in the bottom is cleaned periodically, say once in 6 to 12 months. A vent pipe is provided for the escape of gases.

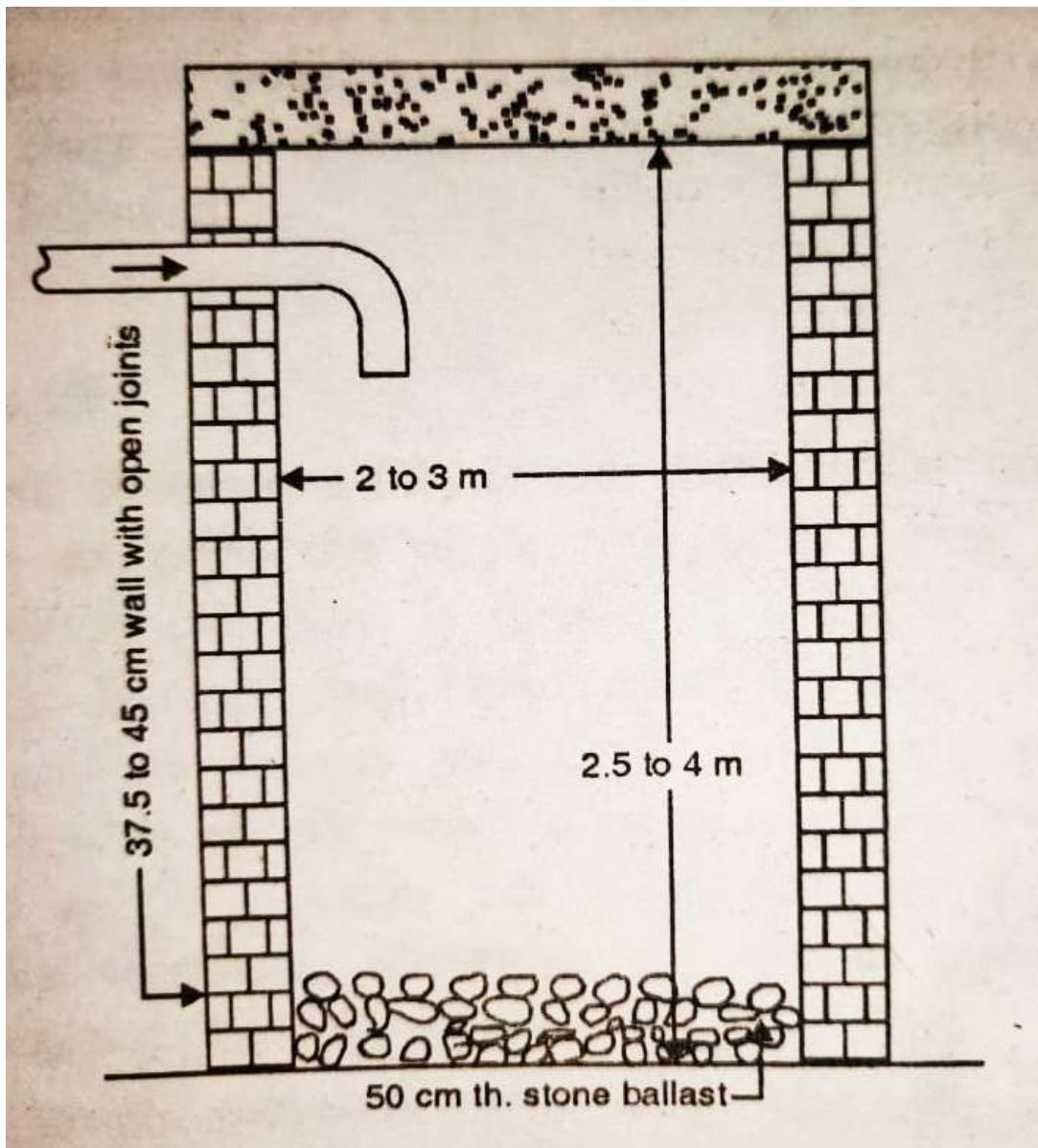
**SOAK PIT (SEEPAGE PIT):** A soak pit is a covered pit dug in the ground, in which effluent from the septic tank is discharged. It is generally dug in the pervious soil which can absorb the effluent. Two forms of soak pits are:

1. Lined
2. Unlined

Lined soak pits are used when the inner volume is kept empty. The lining may be of bricks, stone or concrete blocks, with dry open joints, and with at least 7.5 cm backing of coarse aggregate. However, if the inner volume is filled with stone and brick aggregates, no lining is required, except for the masonry ring provided at the top.



**Sludge Soak Pit:** A sludge soak pit is the one in which the sewage effluent from the house drain is directly discharged. The water in the accumulated sewage is soaked by adjoining pervious soil while the sludge is digested in the pit. Such soak pits are quite common in areas where subsoil is highly pervious. A typical section of such a soak pit is shown in the below diagram. It is lined with masonry with open joints. The top is covered with a rigid slab. The diameter of such a tank varies from 2 m to 3 m, while the depth varies from 2.5 m to 4 m. Each individual house has one such soak pit which has a life of about 20 years for a family of 6 persons. When the soak pit gets filled up, the top cover is removed and the tank is emptied.



## Electrical distribution-conduits for wiring:

An **electrical conduit** is a tube used to protect and route **electrical wiring** in a building or structure. **Electrical conduit** may be made of metal, plastic, fiber, or fired clay. Most **conduit** is rigid, but flexible **conduit** is used for some purposes. Conduit is generally installed by electricians at the site of installation of electrical equipment.

Electrical conduit provides very good protection to enclosed conductors from impact, moisture, and chemical vapors. Varying numbers, sizes, and types of conductors can be pulled into a conduit, which simplifies design and construction compared to multiple runs of cables or the expense of customized composite cable.

## Different Types of Electrical House Wiring Systems:

### 1. Cleat Wiring

- Very simple method and cheapest one.
- Single core PVC cables are used in this system.
- Cleats are held on walls and ceilings using porcelain cleats with grooves, wood or plastic.
- When wires are passed on to the walls or ceiling, they must be taken through conduit pipes.
- This system is not used in damp walls, ceilings.
- It is a temporary wiring system, therefore making it unsuitable for domestic premises. Moreover, cleat wiring system is rarely being used these days. Its life time is approximately 5 years.

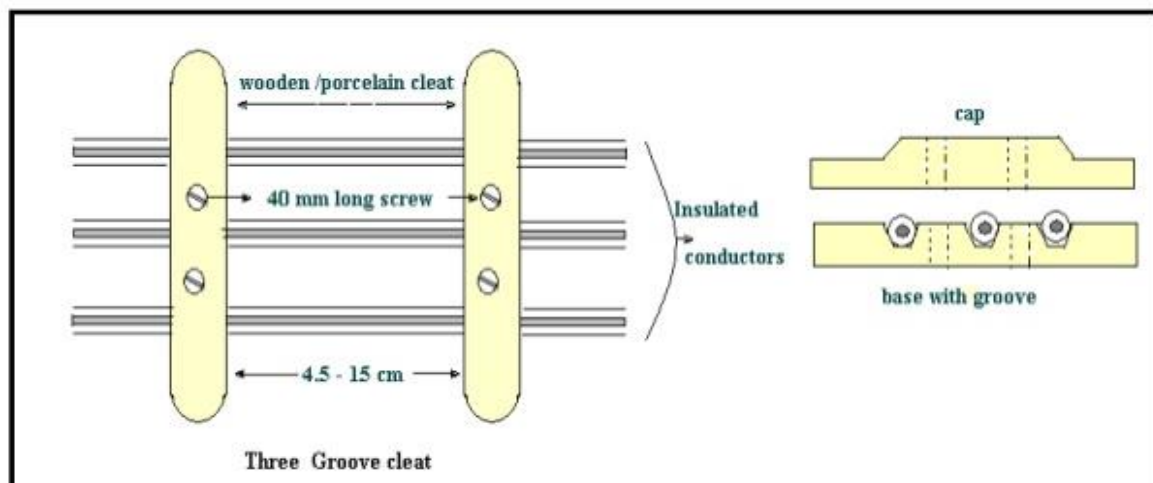


#### Advantages:

- ✓ Materials collected after removal installation can be used for further wiring
- ✓ Expansion of wiring is possible
- ✓ Fault can be easily identified

#### Disadvantages:

- ✓ Less safety
- ✓ Poor appearance
- ✓ Can't use for permanent installation





## 2. Casing and Capping Wiring

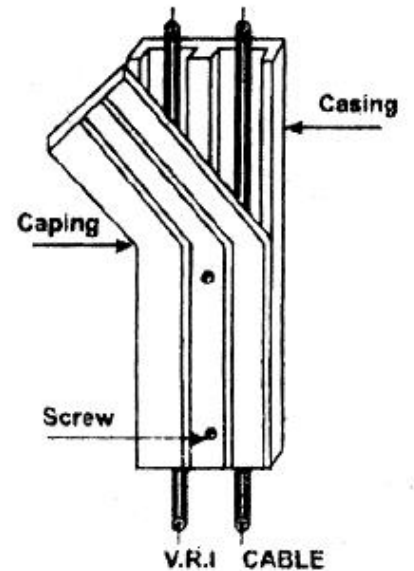
- Casing and Capping wiring system was famous wiring system in the past. The cables used in this kind of wiring were either VIR or PVC or any other approved insulated cables.
- The cables were carried through the wooden casing enclosures. The casing is made up of a strip of wood with parallel grooves cut length wise so as to accommodate VIR cables.
- The capping (also made of wood) used to cover the wires and cables installed and fitted in the casing.

### Advantages:

- It is cheap wiring system as compared to sheathed and conduit wiring systems.
- It is strong and long-lasting wiring system.
- Customization can be easily done in this wiring system.
- If Phase and Neutral wire is installed in separate slots, then repairing is easy.
- Stay for long time in the field due to strong insulation of capping and casing.
- It stays safe from oil, Steam, smoke and rain.
- No risk of electric shock due to covered wires and cables in casing & capping.

### Disadvantages:

- There is a high risk of fire in casing & capping wiring system.
- Not suitable in the acidic, alkalis and humidity conditions
- Costly repairing and need more material.



## Wooden Casing & Capping Wiring System



- Material can't be found easily in the contemporary
- White ants may damage the casing & capping of wood.

### 3. Lead Sheathed Wiring

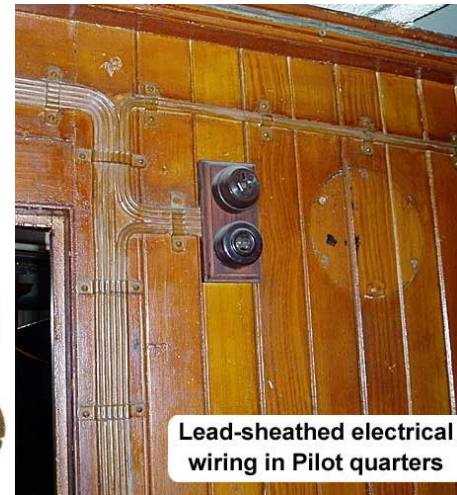
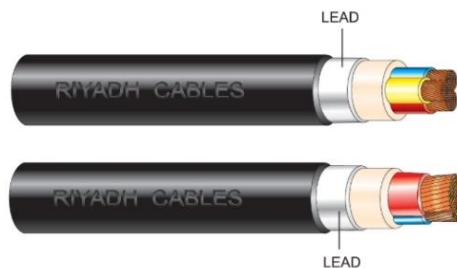
- This type of wiring used for low voltage installation.
- This system requires good earthing.
- Sharp bending of the cables should be avoided.

#### Advantages:

Protection from fire is good and mechanical protection is high

#### Disadvantages:

Not suited where fumes of acid are present.



### 4. Batten Wiring

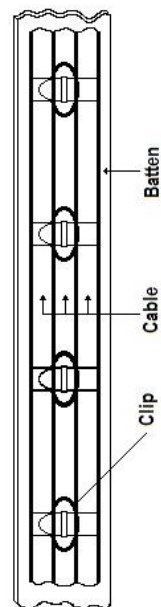
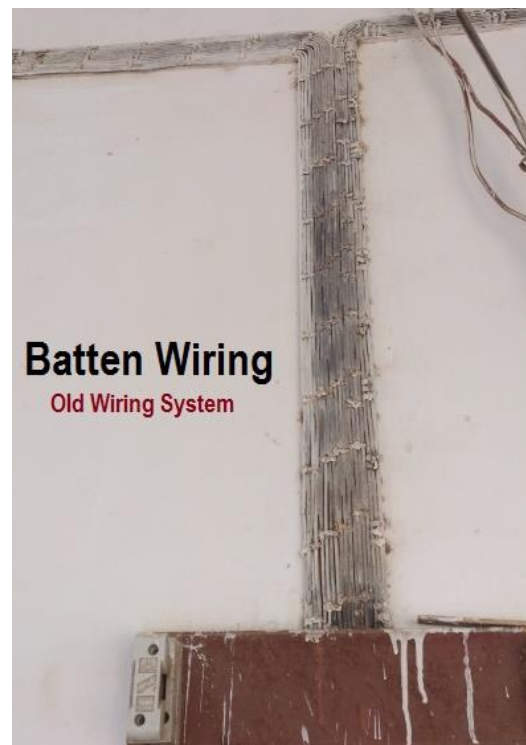
- This is when a single electrical wire or a group of wires are laid over a wooden batten.
- The wires are held to the batten using a brass clip and spaced at an interval of 10 cm for horizontal runs and 15 cm for vertical runs.
- This type of wiring is also used for house wiring and it's also quite cheap.
- Cab Tyre Sheathed (C.T.S) wire or Tough Rubber Sheathed (T.R.S) wire is normally used as conductor for this wiring.

#### Advantages:

- Wiring installation is simple and easy.
- Cheap as compared to other electrical wiring systems.
- Paraphrase is good and beautiful.
- Repairing is easy.
- Strong and long-lasting.
- Customization can be easily done in this wiring system.
- Less chance of leakage current in batten wiring system.

#### Disadvantages:

- Can't be install in the humidity, Chemical effects, open and outdoor areas.
- High risk of fire.
- Not safe from external wear & tear and weather effects (because, the wires are openly visible to heat, dust, steam and smoke).





- Heavy wires can't be used in batten wiring system.
- Only suitable below then 250V.
- Need more cables and wires.

## 5. Conduit Wiring

- An electrical conduit is a tube used to protect and route electrical wiring in a building or nonbuilding structure.
- Electrical conduit may be made of metal, plastic, fiber, or fired clay.

There are two additional types of conduit wiring according to pipe installation:

- Surface Conduit Wiring
- Concealed Conduit Wiring

- Surface Conduit Wiring-** If conduits installed on roof or wall. It is known as surface conduit wiring. In this wiring method, they make holes on the surface of wall on equal distances and conduit is installed then with the help of rawal plugs.
- Concealed Conduit Wiring-** If the conduits is hidden inside the wall slots with the help of plastering, it is called concealed conduit wiring. In other words, the electrical wiring system inside wall, roof or floor with the help of plastic or metallic piping is called concealed conduit wiring. Obviously, it is the most popular, beautiful, stronger and common electrical wiring system nowadays.



Types of Conduit:

Following conduits are used in the conduit wiring systems (both concealed and surface conduit wiring).

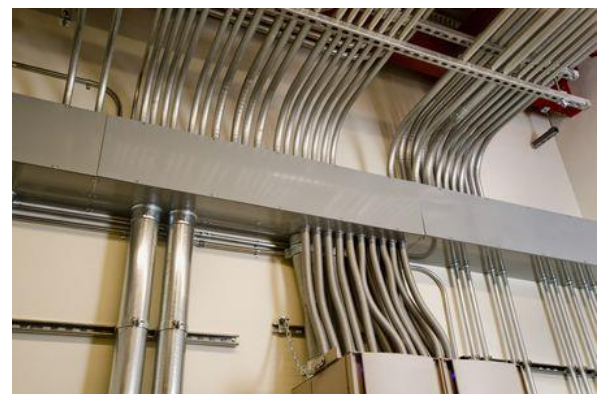
- Metallic Conduit
- Non-metallic conduit

- Metallic Conduit:** Metallic conduits are made of steel which are very strong but costly as well. There are two types of metallic conduits.

Class A Conduit: Low gauge conduit (Thin layer steel sheet conduit)

Class B Conduit: High gauge conduit (Thick sheet of steel conduit)

- Non-metallic Conduit:** A solid PVC conduit is used as non-metallic conduit now a days, which is flexible and easy to bend.



### Advantage:

- It is the safest wiring system (Concealed conduit wiring)
- Appearance is very beautiful (in case of concealed conduit wiring)
- No risk of mechanical wear & tear and fire in case of metallic pipes.
- Customization can be easily done according to the future needs.
- Repairing and maintenance is easy.
- There is no risk of damage the cables insulation.
- it is safe from corrosion (in case of PVC conduit) and risk of fire.
- It can be used even in humidity , chemical effect and smoky areas.
- No risk of electric shock (In case of proper earthing and grounding of metallic pipes).
- It is reliable and popular wiring system.
- sustainable and long-lasting wiring system.

### Disadvantages:

- It is expensive wiring system (Due to PVC and Metallic pipes, Additional earthing for metallic pipes Tee(s) and elbows etc.
- Very hard to find the defects in the wiring.
- installation is not easy and simple.
- Risk of Electric shock (In case of metallic pipes without proper earthing system)
- Very complicated to manage additional connection in the future.

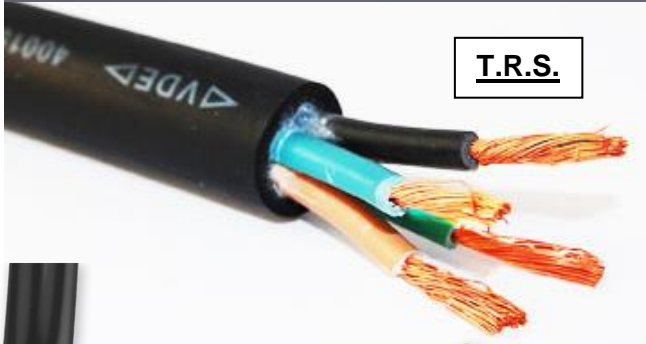
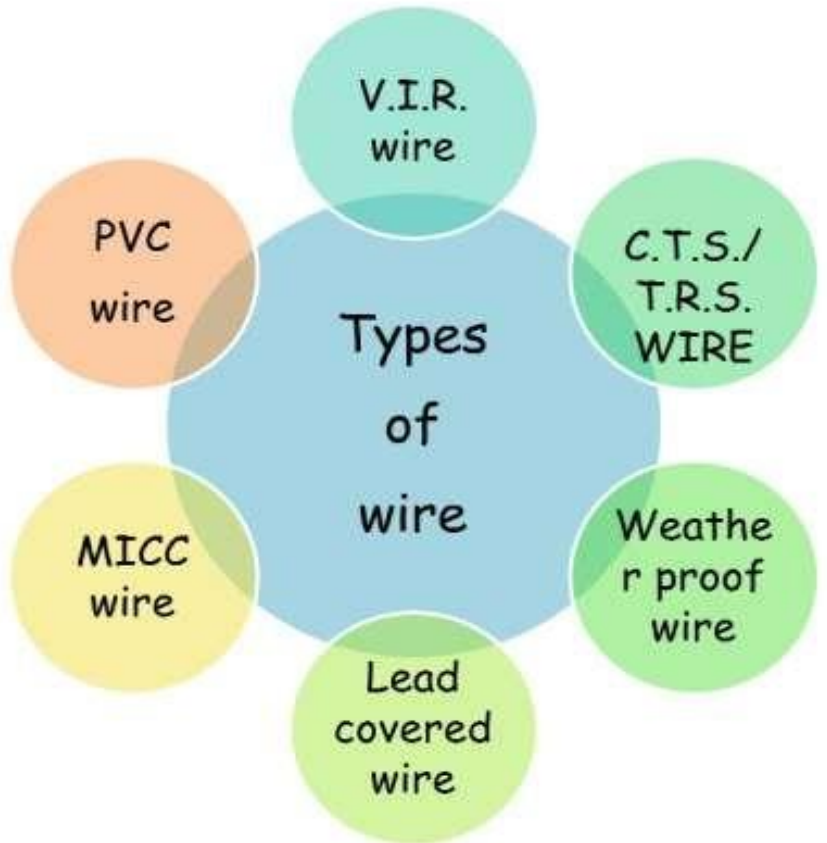
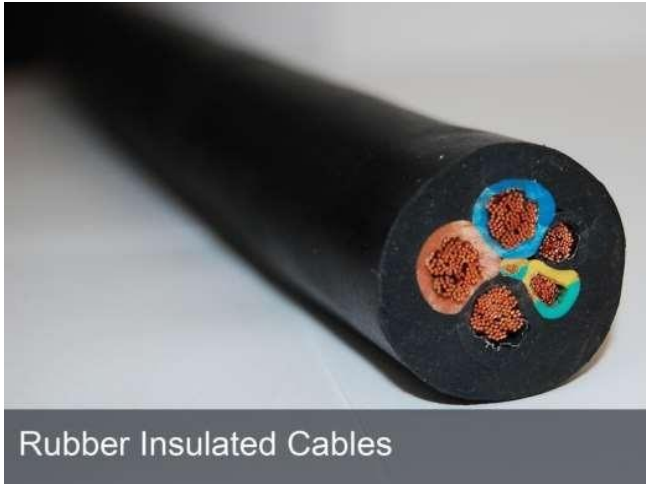
S.No	Particulars © www.electricaltechnology.org	Cleat Wiring	Casing Capping Wiring	Batten Wiring	Conduit Wiring
1	Life	Short	Fairly long	Long	Very long
2	Cost	Low	Medium	Medium	Highest
3	Mechanical Protection	None	Fair	None	Very good
4	Possibility of fire	Nil	Good	Good	Nil
5	Protection from dampness	None	Slight / a little	None	Good
6	Type of labor required	Semi-Skilled	Highly Skilled	Semi-skilled	Highly Skilled
7	Installation	Very Easy	Difficult	Easy	Difficult
8	Inspection	Easy	Easy	Easy	Difficult
9	Repair	Easy	Little bit difficult	Easy	Difficult
10	Popularity	Nil	Fair	Nil	Very High

## Comparison of Different Wiring Systems



# Types of wire used in wiring

**1. V.I.R. Wire-** (Vulcanized India Rubber) In this type of wire a tinned copper conductors or aluminum conductors are used.



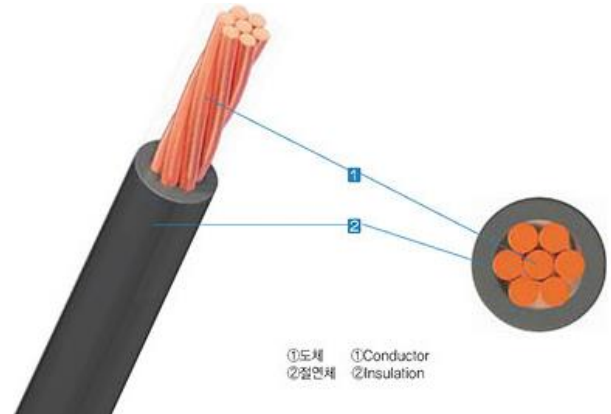
## **2. T.R.S. / C.T.S. WIRE-**

Tough Rubber Sheathed (T.R.S.) and Cab Tyre Sheathed (C.T.S.). Over the tinned copper or aluminum conductor a layer of pure rubber or rubber treated with Sulphur is used. As outer protective layer tough rubber sheath.

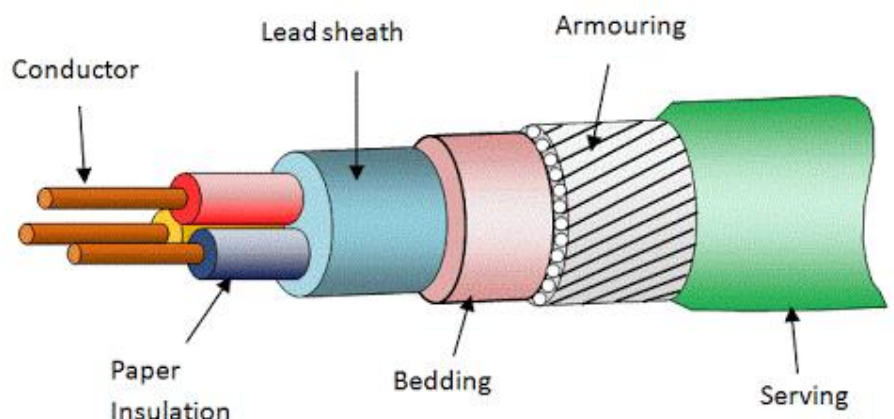


## **3. Weather proof wire-** It made waterproof by drooping it into

waterproof compound. It is useful for service connection.

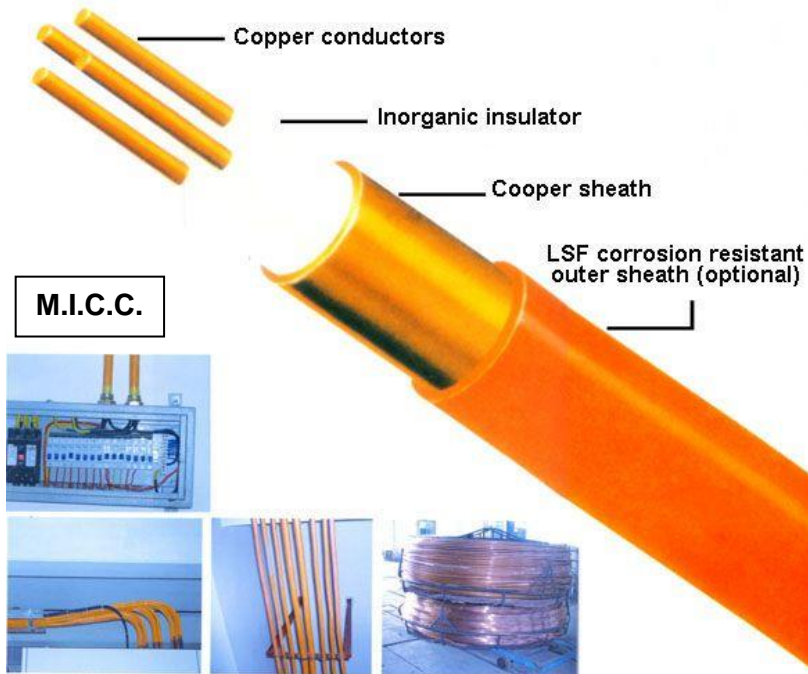


**4. Lead covered wire-** No effect of moisture on it. It used where there is moisture presence.



## 5. Mineral Insulated Copper

**Covered-** Less effect of temperature. Copper sheath is provided. It is used in mines, factory, refinery, furnace, boiler, rolling etc. Coating of magnesium oxide is provided.



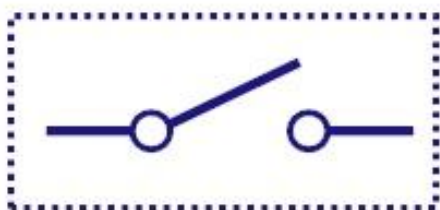
P.V.C.

**6. Poly Vinyl Chloride Wire-** Dielectric strength is more. Mechanical strength is more. Life is long. Protect against flame. Protect against oil, alkali. PVC wire is widely used

## TYPES OF SWITCHES:

### 1. Single Pole Switches / Single Pole Single Throw Switch (SPST):

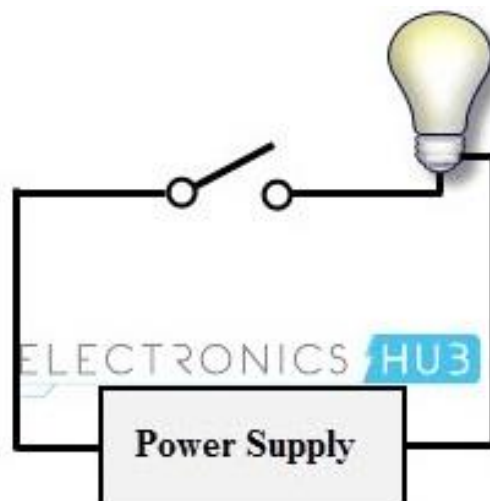
- They are used to control lights, fans, or other devices from a single location.
- This is the basic ON and OFF switch consisting of one input contact and one output contact.
- It switches a single circuit and it can either make (ON) or break (OFF) the load.
- The contacts of SPST can be either normally open or normally closed configurations.



Symbol



SPST Switch

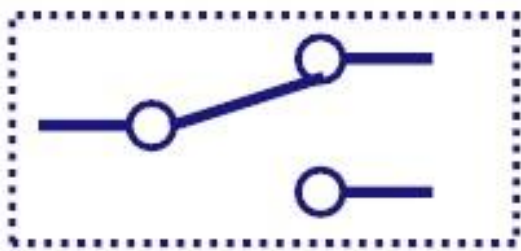


Power Supply



## 2. Double Pole Switch / Single Pole Double Throw Switch (SPDT):

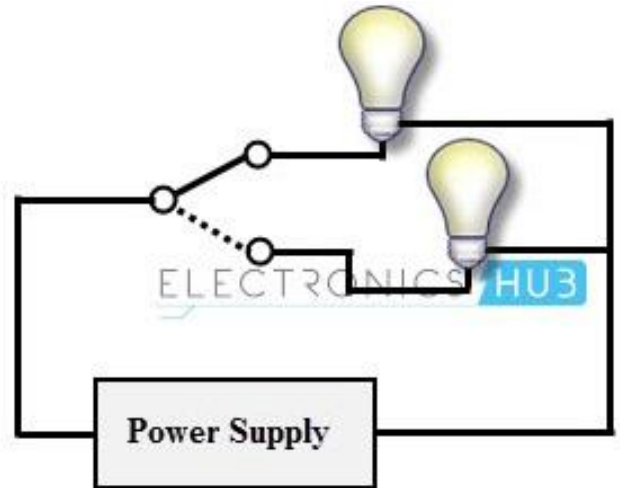
- This switch has three terminals, one is input contact and remaining two are output contacts.
- This means it consists of two ON positions and one-OFF position.
- In most of the circuits, these switches are used as changeover to connect the input between two choices of outputs.
- The contact which is connected to the input by default is referred to as normally closed contact and contact which will be connected during ON operation is a normally open contact.
- A two-way or double-pole electrical switch is generally used in industrial applications but can be found in some home wiring systems as well.



Symbol



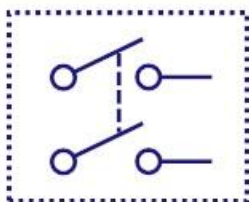
SPDT Switch



SPDT Switch Circuit

## 3. Three Ways Switch / Double Pole Single Throw Switch (DPST):

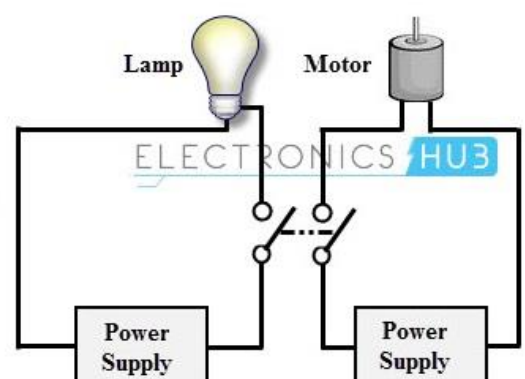
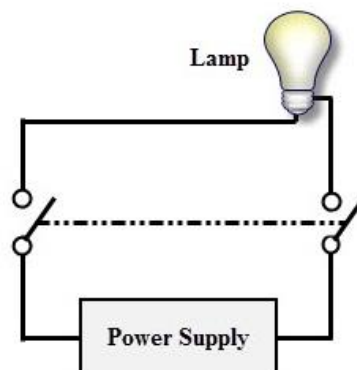
- This switch consists of four terminals, two input contacts and two output contacts.
- It behaves like two separate SPST configurations, operating at the same time.
- It has only one ON position, but it can actuate the two contacts simultaneously, such that each input contact will be connected to its corresponding output contact.
- In OFF position both switches are at open state.
- This type of switch is used for controlling two different circuits at a time.
- Also, the contacts of this switch may be either normally open or normally closed configurations.
- Three-way switches control the same electrical device from two different locations. They are mostly used in stairways, hallways, washrooms etc.



Symbol



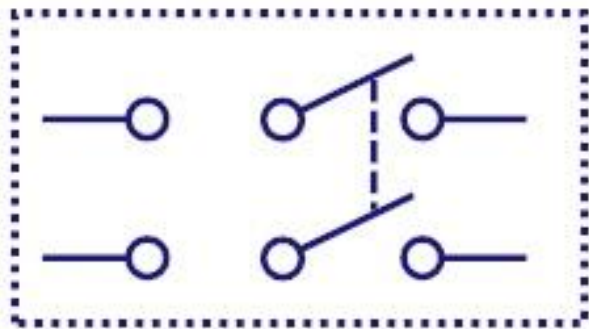
DPST Switch





#### 4. Four Ways Switch / Double Pole Double Throw Switch (DPDT):

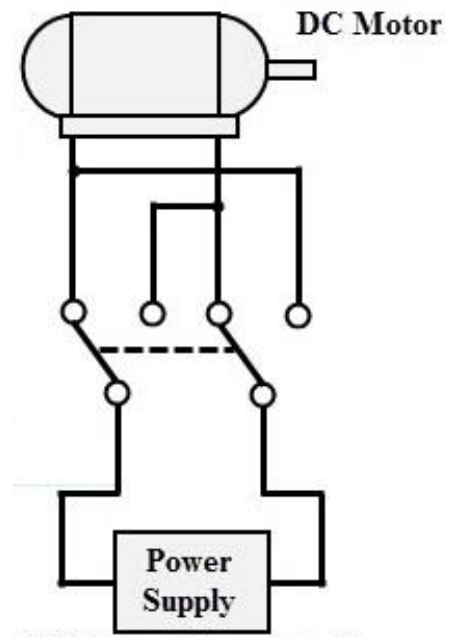
- These are used if you wish to control lighting from three or more locations.
- This is a dual ON/OFF switch consisting of two ON positions.
- It has six terminals, two are input contacts and remaining four are the output contacts.
- It behaves like a two separate SPDT configuration, operating at the same time.
- Two input contacts are connected to the one set of output contacts in one position and in another position, input contacts are connected to the other set of output contacts.



Symbol



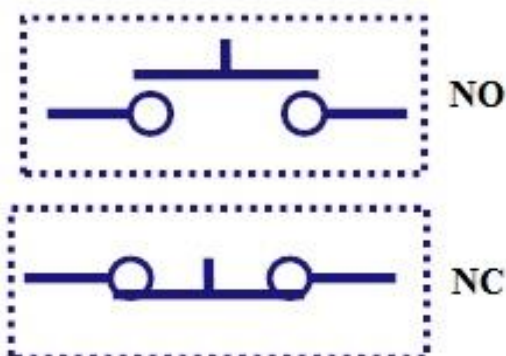
DPDT Switch



DPDT switch to control motor direction of rotation

#### 5. Bell Push Switch:

- A Bell Push switch is connected to a doorbell. So, when the switch is pushed, it rings the bell connected to it. It can be used at homes, offices or any other place wherever required.
- A Bell Push switch always maintains a broken circuit, unless the button is pressed.
- It is a momentary contact switch that makes or breaks connection as long as pressure is applied (or when the button is pushed).
- Generally, this pressure is supplied by a button pressed by someone's finger. This button returns its normal position, once the pressure is removed.



## 6. Toggle Switch:

- A toggle switch is manually actuated (or pushed up or down) by a mechanical handle, lever or rocking mechanism. These are commonly used as light control switches.
- Most of these switches come with two or more lever positions which are in the versions of SPDT, SPST, DPST and DPDT switch. These are used for switching high currents (as high as 10 A) and can also be used for switching small currents.
- These are available in different ratings, sizes and styles and are used for different type of applications. The ON condition can be any of their level positions, however, by convention the downward is the closed or ON position.



**LIGHT:** - That part of radiant energy from a hot body which produced visual sensation on human eye is called light / illuminate.

**Illuminate:** - When lights on a surface, it becomes visible, the phenomenon is called illumination. It is defined as luminous flux falling on a surface per unit area. It is denoted by **E** and measured in lumen per square meter or meter candle.

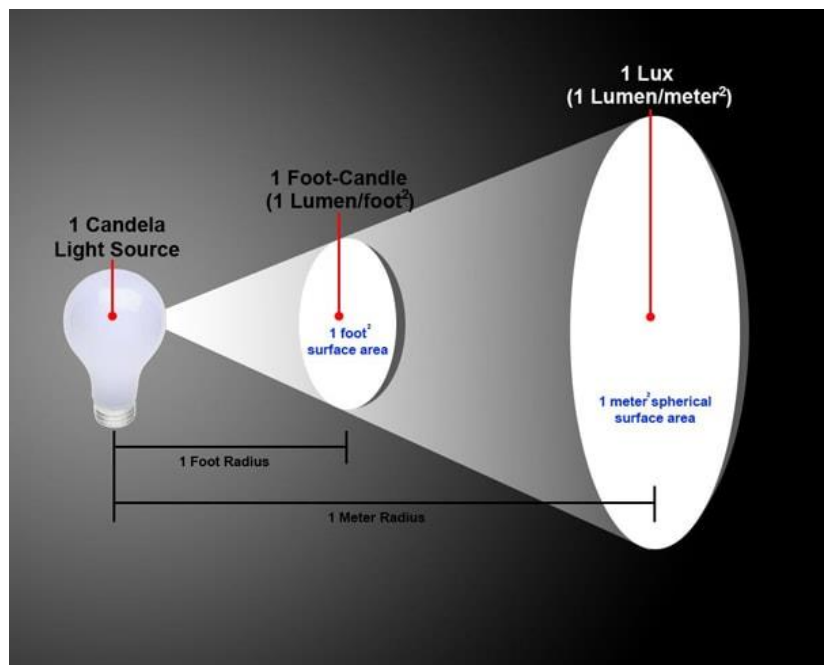
$$E = \Phi / A \text{ lux}$$

**Lux:** - One-meter candle or lux is defined as the illumination produced by a uniform source of one CP on the inner surface of a sphere of radius one meter.

**Candle Power:** - The light radiating capacity of a source is called its candle power. The number of lumens given out by a source per unit solid angle in a given direction is called its candle power. It is denoted by C.P.

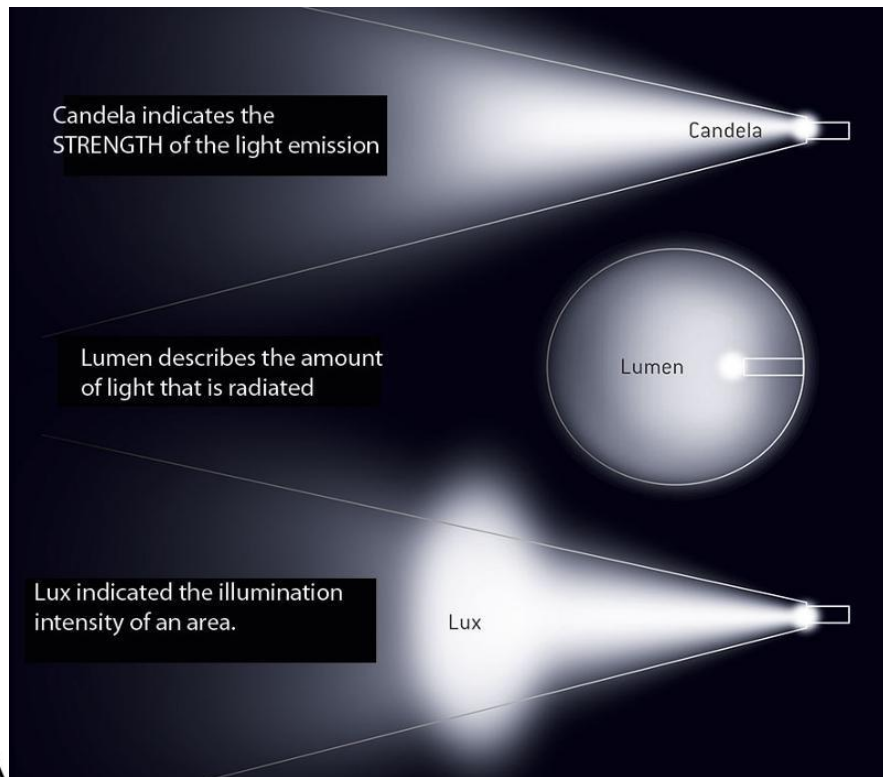
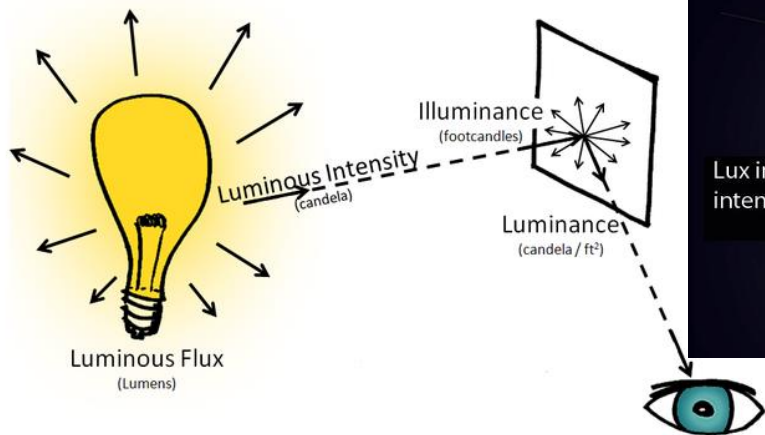
$$\begin{aligned} \text{Total flux emitted} &= \text{CP} \times \text{Solid angle} \\ &= 1 \times 4\pi = 4\pi \text{ lumens.} \end{aligned}$$

**Lumen:** - The SI unit of luminous flux, equal to the amount of light emitted per second in a unit solid angle of one steradian from a uniform source of one candela.



**LUMINOUS FLUX:** - The total quantity of radiant energy per second responsible for visual sensation from a luminous body is called luminous flux. Its measured in Lumens It is the unit of luminous flux.

### Lighting Units



### **Distribution Panel:** -

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.

**(MCB'S) Miniature Circuit Breaker:** - A small trip switch operated by an overload and used to protect an electric circuit, esp a domestic circuit as an alternative to a fuse.

A **Miniature Circuit Breaker (MCB)** is an automatically operated electrical switch used to protect low voltage electrical circuits from damage caused by excess current from an overload or short circuit.

**MCBs** are typically rated up to a current up to 125 A, do not have adjustable trip characteristics, and can be thermal or thermal-magnetic in operation.



**(ELCBS) Earth-leakage circuit breaker:** - An Earth-leakage circuit breaker (**ELCB**) 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.

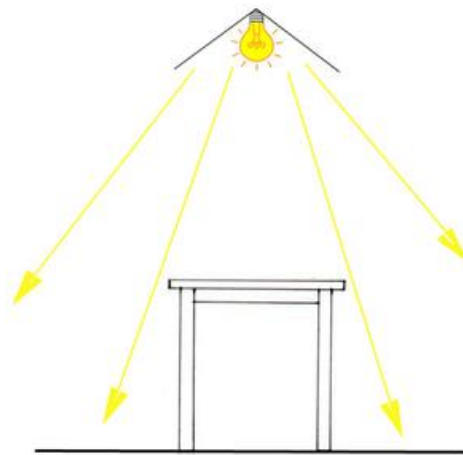


**Lighting methods:** - Proper lighting is critical to building operations, as well as the effectiveness and comfort of tenants. Lighting methods are classified according to lighting focus, or direction, and fixture arrangement. The light fixture, or luminaire, serves several functions. It must hold the bulb, protect the bulb, protect users from electric shock, and direct and diffuse the light.

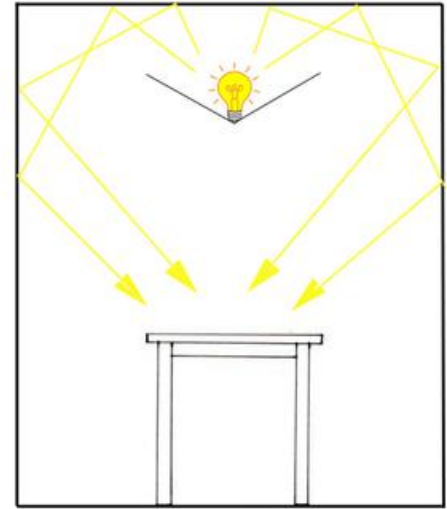
**Lighting Focus:** - A fixture can be designed to focus light in one of the following ways:

- Direct
- Semi-direct
- General (formerly called *diffused*)
- Semi-indirect
- Indirect

Direct

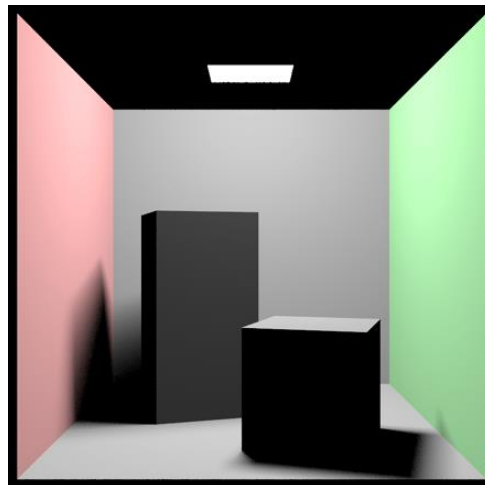


Indirect



i. **Direct Lighting:**

- In a direct lighting system, 90 to 100 percent of the light from the luminaire shines toward the work surface. This is the most common type of lighting and is used for many types of tasks. The area that is lit depends on the characteristics of the luminaire. For example, light shining downward may be



either concentrated in one small area or spread evenly over a wide surface. Sometimes, however, direct lighting creates glare and shadows. The placement of the fixture or brightness of the light can be adjusted to eliminate these problems.

- ii. **Semi-Direct Lighting:** - In a semi-direct lighting system, 60 to 90 percent of the light from the luminaire shines toward the working surface. The remaining light is reflected toward the ceiling and the upper portion of the walls. This lighting system softens shadows and produces even lighting. Semi-direct and direct lighting have many characteristics in common. As is true with a direct lighting system, unless the fixtures are properly arranged, reflected light or shadows can be a problem when using semi-direct lighting.





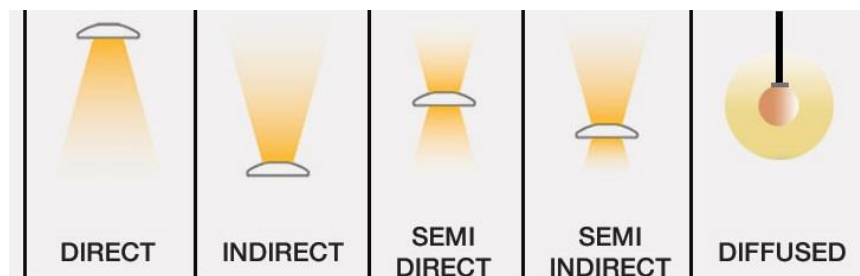
- iii. **General Lighting:** - In a general, or diffused, lighting system, light is distributed equally to both the upper and lower areas of a room—50 percent upward and 50 percent downward. While general lighting can be pleasing to the eye, it can seem harsh to some. Therefore, a more indirect method of lighting is often desirable.

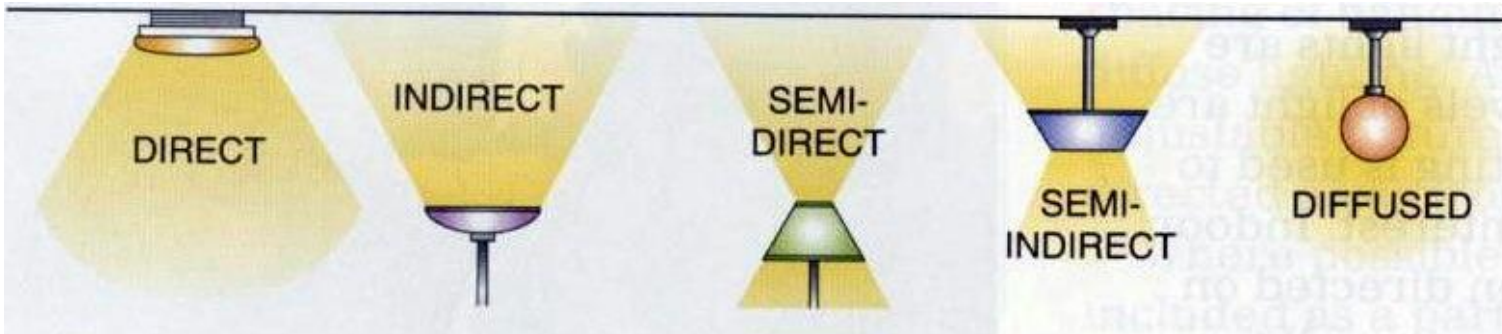


- iv. **Semi-Indirect Lighting:** - In a semi-indirect lighting system, 60 to 90 percent of the light from the luminaire reflects toward the ceiling. Highly reflective ceilings and room finishes are important, as is good surface maintenance. This method of lighting produces a very pleasing room ambience while also providing several good reading areas.



- v. **Indirect Lighting:** - In an indirect lighting system, 90 to 100 percent of the light from the luminaire shines upward and reflects off the ceiling. Indirect lighting should result in highly diffused, evenly distributed light. The ceiling is the main source of light in this type of system, so it should be completely and evenly lit. If the system is well designed, only a small amount of light will shine downward. Indirect lighting minimizes veiling reflections, shadows, and direct glare. Fixtures should be positioned far enough from the ceiling to prevent excessive brightness, and they should be placed low enough to distribute light evenly over the ceiling. Fixtures usually have a stem of at least 12 inches. Because both the ceiling and upper wall areas are illuminated, surface finishes in the room need to be light colored and highly reflective, and wall and ceiling surfaces must be maintained and kept clean. Poorly maintained surfaces can decrease the light level in the room.

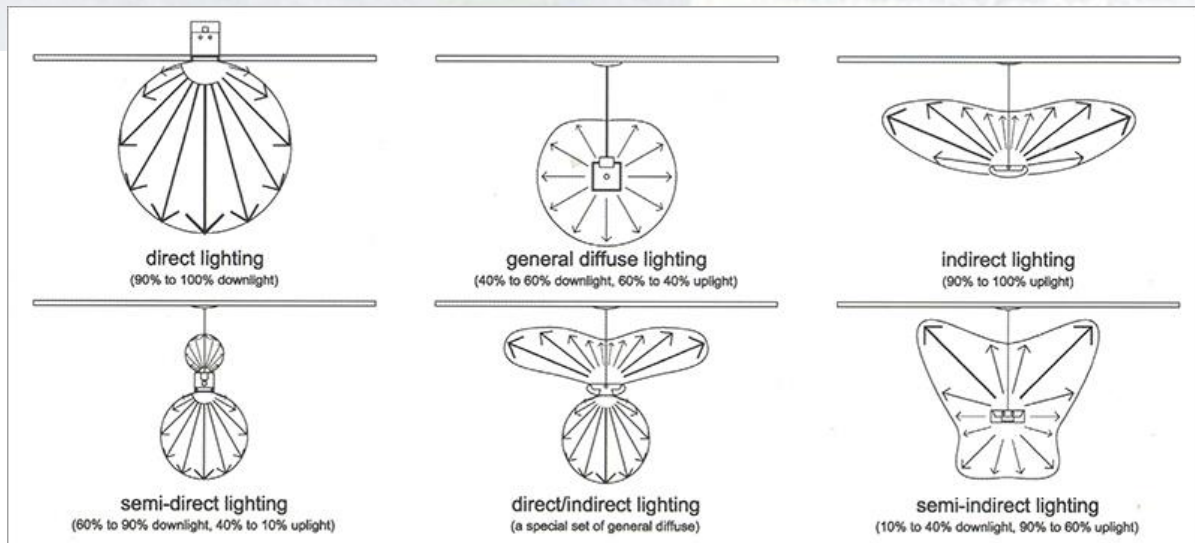




**Lighting Fixture Arrangement**

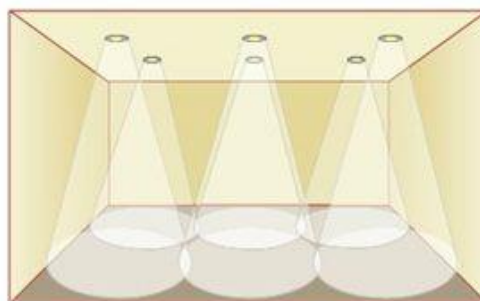
Lighting fixtures can be arranged in one of two ways:

- Uniform
- Non-uniform

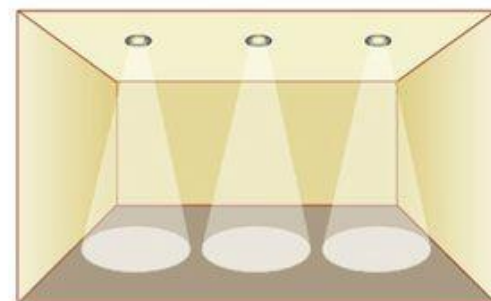


**Uniform Lighting: -**

Uniform lighting illuminates an entire area at about the same level, using any type of lighting focus. Fixtures are normally placed for maximum height and uniform spacing without regard for the location of desks or equipment within the room. This arrangement is useful for open furniture plans or in areas where a high level of churn (relocation of people, workstations, and equipment) is expected.



Uniform Downlighting



Non-uniform Downlighting

**Non-uniform Lighting: -** In a non-uniform lighting system, the fixtures are placed high or close to the ceiling, but the spacing between them is irregular. The placement of the fixtures is determined by the location of workstations and machinery and the nature of

**Uniform VS Task lighting**

Figure 1 shows an office with several recessed ceiling lights providing uniform, ambient lighting. Figure 2 shows the same office with fewer ceiling lights and desk lamps providing focused task lighting on workstations.

Figure 1: Illustration of conventional general lighting system with luminaires arranged in regular layout to provide uniform lighting level to the whole office space

Figure 2: Illustration of a typical task lighting system with less ambient lighting together with additional luminaires at the task areas

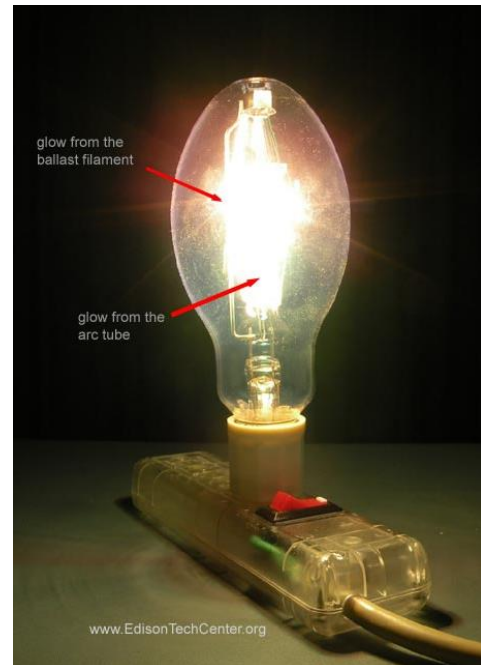
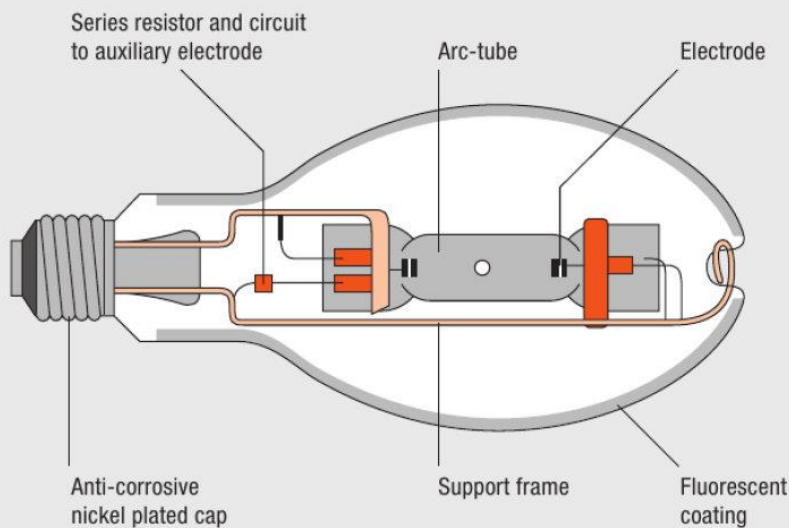
Lighting systems and their design



the task that will be performed in that area. Most offices have uniform lighting, because workers must be able to use the available lighting anywhere workstations can be set up. Yet, under certain conditions, adequate illumination can be provided by non-uniform lighting, saving up to half the operating cost of a uniform lighting system. For example, if workstations are not close together (that is, if they are generally more than 12 feet apart), and if workstations are rarely relocated, non-uniform lighting should be considered. In this case, large-area (usually fluorescent) fixtures should be used over the work surface or at the sides of the work surface. Fixtures located in front of the work surface may cause reflections, and fixtures located behind the worker can cause shadows.

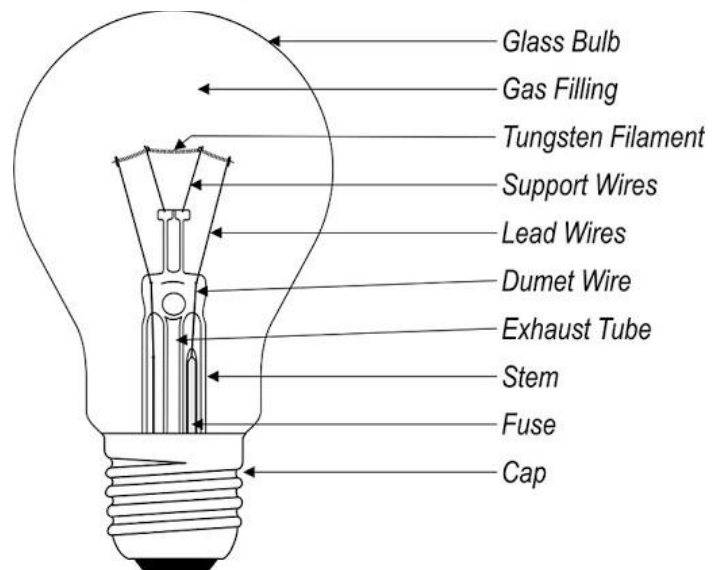
**Mercury Lamps:-** A mercury-vapor lamp is a gas-discharge lamp that uses an electric arc through vaporized mercury to produce light. When the supply is switched ON and full voltage is applied across main and starting electrodes. This voltage breaks down the gap and discharge through Argon Gas takes place. As the lamp warms up, mercury is vaporized, which increased the vapor pressure. this discharge takes the shape of Intense arc. After 5 minutes the lamp gives full light. It gives greenish blue color light. This lamp is always suspended vertically otherwise the inner glass tube may break due to excessive heat.

**MERCURY VAPOR LAMP**



**Incandescent Lamp: -**

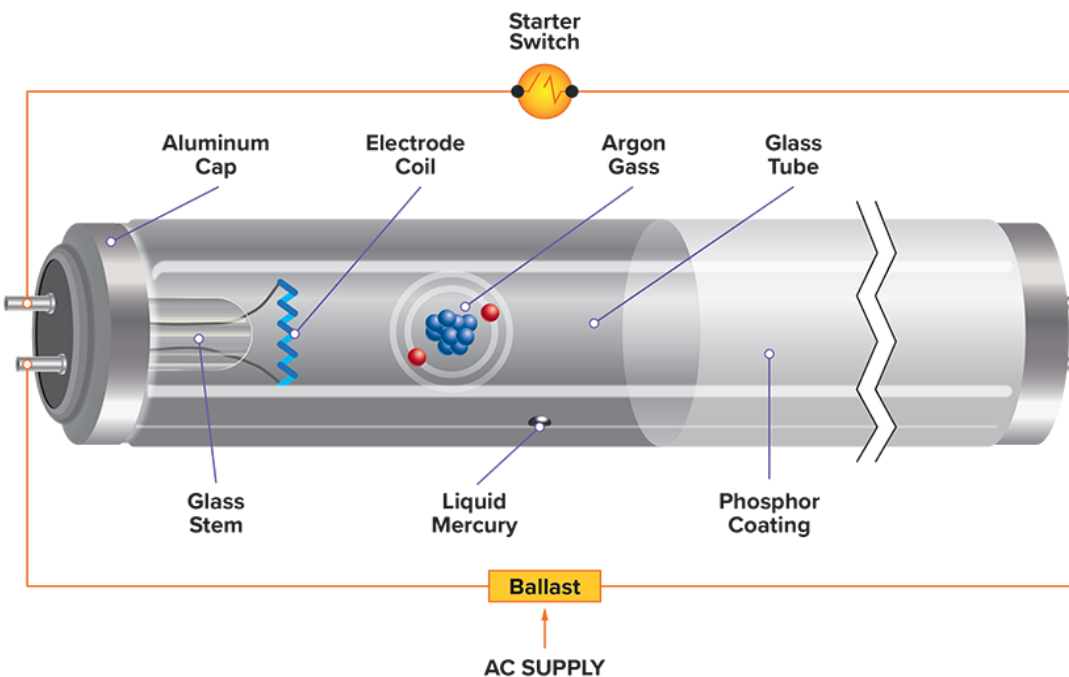
Incandescent light globe is an electric light which produces light with a filament wire heated to a high temperature by an electric current passing through it, until it glows. The hot filament is protected from oxidation with a glass or quartz bulb that is filled with inert gas or evacuated. The light bulb is supplied with electrical current by feed-through terminals or wires embedded in the glass. A tungsten



filament is enclosed in an evacuated glass bulb but to improve its performance some chemical like Argon or Nitrogen gas are filled.

### **Fluorescent Tubes: -**

It is a low-pressure mercury vapor Tube. The tube contains Argon gas at low pressure about 2.5mm of mercury. At the two ends, two electrodes coated with some electron emissive material are placed. An electric current in the gas excites mercury vapor which produces UV light that then causes a phosphor coating on the inside of the tube to fluoresce, producing visible light.

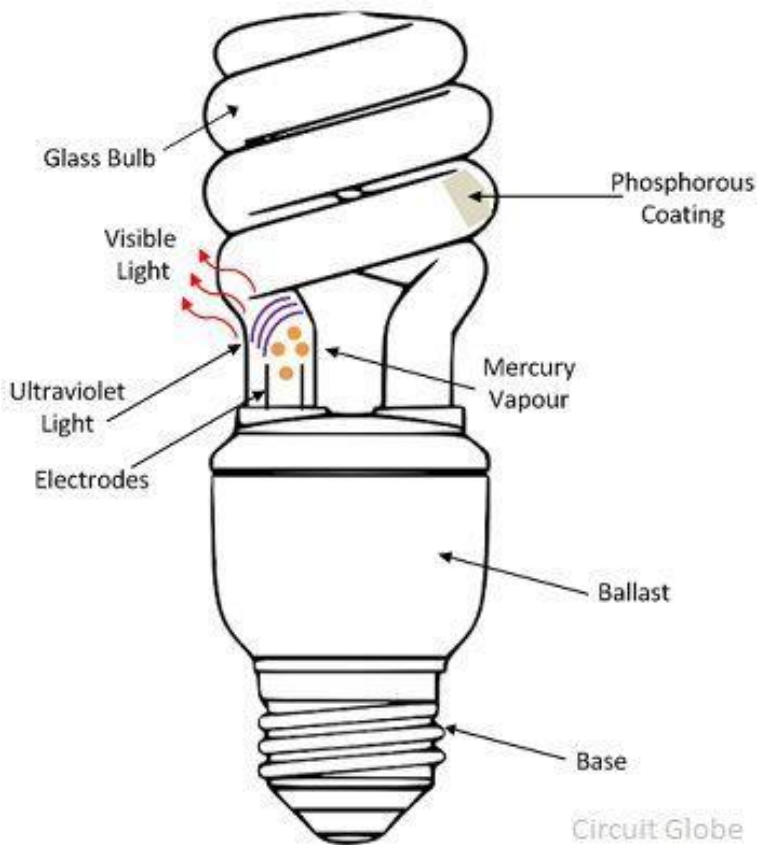


### **A Compact Fluorescent Lamp (CFL): -**

Also called compact fluorescent light, energy-saving light, and compact fluorescent tube, is a fluorescent lamp designed to replace an incandescent lamp; some types fit into light fixtures formerly used for incandescent lamps. The lamps use a tube which is curved or folded to fit into the space of an incandescent bulb, and a compact electronic ballast in the base of the lamp.



Compared to general-service incandescent lamps giving the same amount of visible light, CFLs use one-fifth to one-third the electric power, and last eight to fifteen times longer. A CFL has a higher purchase price than an incandescent lamp, but can save over five times its purchase price in electricity costs over the lamp's lifetime.



### **Calculation of Illumination: -**

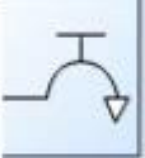







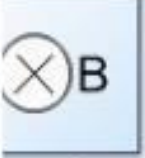

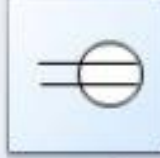


















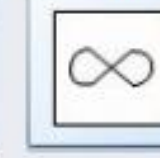








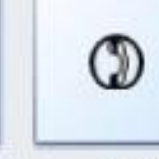




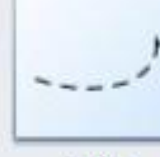
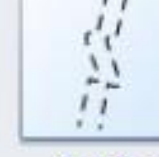

Watts per square meter method is based on the principle of “Rule of Thumb”. It is Very handy for rough calculation or checking. Illumination is based on assumption and consists in making of allowance of watts per square meter of area. It consists of making an allowance of watts/m<sup>2</sup> of area to be illuminated according to the illumination desired on the assumption of an average figure of overall efficiency of the system.

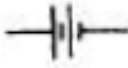

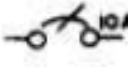

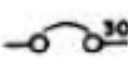



















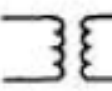








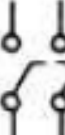
### **Precautions to avoid electrical accidents: -**

- Never touch anything electrical with wet hands or while standing in water. Wear rubber shoes in wet areas. If you get a tingle or shock when touching a sink, tub, or other wet area, turn off the power at the main panel (if it's safe) and immediately call an electrician.
- Don't use broken cords or plug in anything with a missing prong.
- Cover unused outlets. Keep metal objects such as silverware away from outlets.
- Don't overload sockets. Use a power board with a safety switch and only use one per wall outlet.
- When unplugging, don't yank! Pull by the plug, not the cord.
- Test safety switches each year.
- Don't fly kites near power lines. The kite or string can conduct electricity sending it right through you to the ground.
- Never touch a downed power line or climb a utility pole.
- If you are working on any receptacle at your home then always turn off the mains. It is also a good idea to put up a sign on the service panel so that nobody turns the main switch ON by accident.



- Always use insulated tools while working. Always use appropriate insulated rubber gloves and goggles while working on any branch circuit or any other electrical circuit.
- Electrical hazards include exposed energized parts and unguarded electrical equipment which may become energized unexpectedly. Such equipment always carries warning signs like “Shock Risk”. Always be observant of such signs and follow the safety rules established by the electrical code followed by the country you’re in.

							
Water tap	Lum. ceiling mount	Encl ceiling lum	Wall light	Circuit breaker	Multi-light bar	Light bar	Downlight
							
Outdoor lighting	Singleplex receptacle	Duplex receptacle	Fourplex receptacle	Batten fluores	Distribution box	Modular fluores	Office fluores
							
Pull-cord switch	Emerg. light	Emerg. sign	Switches	Dimmer switch	Socket outlet	Socket outlet 2	Telephone outlet
							
Stereo outlet	Ceiling fan	Ceiling fan 2	Combinati... fan	Service panels	Thermostat	Air conditioni...	Hold oper unit
							
Detector	Fire alarm	Monitor	Alarm	Doorbell	Smoke detector	Call	Tel
							
Main	Ground	Line	Wire	Cut line	Cut line 2		

	BATTERY, MULTICELLS		FIRE-ALARM BOX, WALL TYPE		S SINGLE-POLE SWITCH
	SWITCH BREAKER		LIGHTING PANEL		S <sub>2</sub> DOUBLE-POLE SWITCH
	AUTOMATIC RESET BREAKER		POWER PANEL		Ⓢ PULL SWITCH CEILING
	BUS		BRANCH CIRCUIT, CONCEALED IN CEILING OR WALL		Ⓢ PULL SWITCH WALL
	VOLTMETER		BRANCH CIRCUIT, CONCEALED IN FLOOR		Ⓢ FIXTURE, FLUORESCENT, CEILING
	TOGGLE SWITCH DPST		BRANCH CIRCUIT, EXPOSED		Ⓢ FIXTURE, FLUORESCENT, WALL
	TRANSFORMER, MAGNETIC CORE		FEEDERS		Ⓢ JUNCTION BOX, CEILING
	BELL		UNDERFLOOR DUCT AND JUNCTION BOX		Ⓢ JUNCTION BOX, WALL
	BUZZER, AC		MOTOR		Ⓢ LAMPHOLDER, CEILING
	Crossing not connected (not necessarily at a 90° angle)		CONTROLLER		Ⓢ LAMPHOLDER, WALL
	JUNCTION		STREET LIGHTING STANDARD		Ⓢ LAMPHOLDER WITH PULL SWITCH, CEILING
	TRANSFORMER, BASIC		OUTLET, FLOOR		Ⓢ LAMPHOLDER WITH PULL SWITCH, WALL
	GROUND		CONVENIENCE, DUPLEX		Ⓢ SPECIAL PURPOSE
	OUTLET, CEILING		FAN, WALL		Ⓢ TELEPHONE, SWITCHBOARD
	OUTLET, WALL		FAN, CEILING		Ⓢ THERMOSTAT
	FUSE		KNIFE SWITCH DISCONNECTED		Ⓢ PUSH BUTTON