

BUILDING SERVICES

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10.1 INTRODUCTION TO BUILDING SERVICES

Buildings are not only four super structural components, but also provide the environment to make people using the building comfortable, functional, efficient, safe, and livable by protecting the inmates from cold and heat, wind, rain, and sun. So everything in the building that contributes to efficient sustainability and function is called a building service. Building services might include:

- i. **Safety:**
 - Daylight and artificial lighting
 - Escalators and lifts
 - Ventilation and refrigeration
 - Security and alarm systems
 - Fire detection and protection
- ii. **Efficiency**
 - Reducing carbon emissions and environmental impact
 - Energy supply and use
 - Communications networks

- Façade engineering

iii. Comfort

- Heating and ventilating
- Water, drainage, and plumbing
- Air conditioning and refrigeration

10.2 PLUMBING AND DRAINAGE SYSTEM

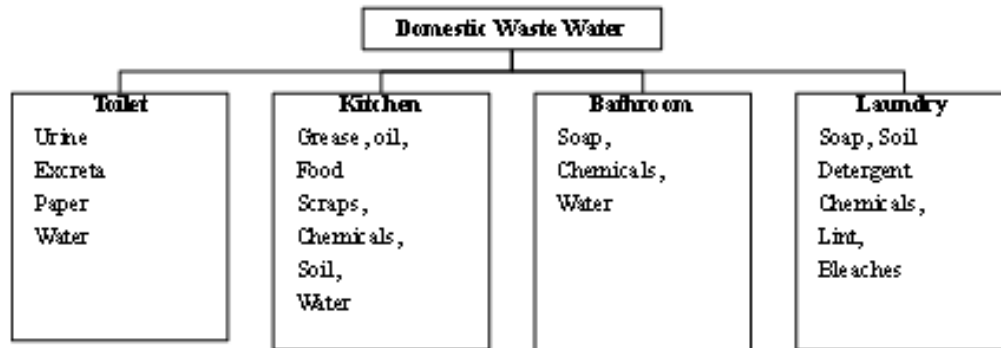


Fig. 10.1: Domestic Waste Water

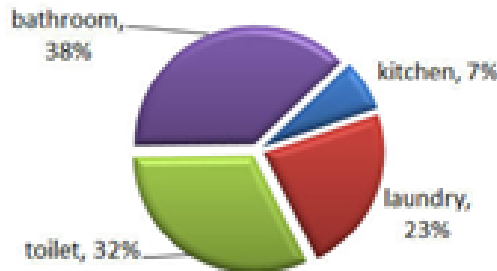


Fig. 10.2: Content of Waste Water from Houses

Plumbing uses pipes, valves, plumbing fixtures, tanks, and other apparatuses to convey fluids. The three types of plumbing systems are potable water, sanitary, and stormwater systems. The flow of water through well-defined channels arranged to remove liquid away from where it is not required for disposal in an appropriate location is known as 'drainage' and the network of such channels is called a 'drainage system.'

10.2.1 Sanitary Drainage

Domestic wastewater is defined as used water that is generated from human activities and comes from the Kitchen, toilets, sinks, showers, and washing machines called sewage.

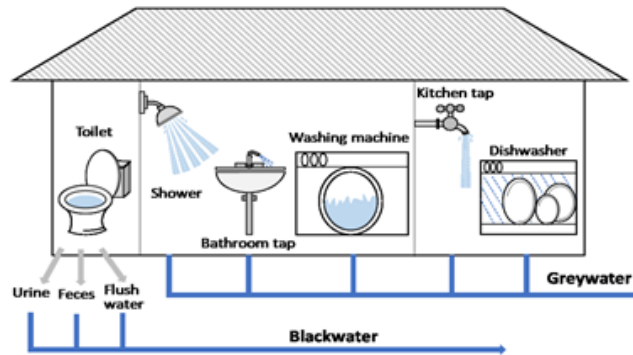


Fig. 10.3: Areas of Waste Water Generation

The strength and composition of the domestic wastewater varies based on the time of the day, activities, and season. The waste depends upon the living style of the inmates, the quantity of water consumption, eating habits, and the standard of living. The waste water called grey water is categorized with a musty smell and content of solid matter. The solid matter is a mixture of grease, oil, food remains, soaps, salts, feces, detergents, metals, sand, and grit. The solid may be suspended or dissolved consisting of chemical and biological processes. The suspended solid can lead to sludge formation which can get deposited leading to anaerobic conditions in the sewage chamber.

10.2.2 Waste Water Removal

Removing waste water safely from the house and surrounding living area, and treating and managing to dispose of the wastewater safely at a community level, is required for people's health. This section discusses essential items of waste water, and health hardware in the house and surrounding living area.

Essential household waste water disposal system includes the following components:

- i. Drains from baths, showers, hand basins, kitchen sinks, and laundry tubs – the floors in all these areas should also have a floor drain and a grate to prevent objects from going down the drains and blocking the pipes
- ii. On each drain, there should be a water trap or seal, which is a water-filled bend in the pipe under the drain to prevent bad smells from spreading from the drain back into the house.
- iii. Drainage pipes that connect and fall to a main house drain located in the yard, which flows into a system for treating and disposing of the waste water.
- iv. Inspection openings in the drainage pipes and house drain, for maintenance and removing blockages.
- v. Vent pipes that discharge above the roof to remove bad-smelling and volatile gases from the drain pipes.
- vi. An overflow relief gully for waste water to discharge into the yard and prevent overflow into the house if there is a blockage in the drain pipes.

10.2.3 House Drainage System

The inmates of the house use water in the course of daily activities like cooking, bathing, washing, and restroom activities. The components for performing these activities are Sinks, wash basins, bathrooms, and Water closets. The water coming out of these components is called waste water containing impurities which should be disposed of into the municipal sewage system or pit latrines. The process of disposal of the waste water through proper channels is called a house drainage system.

10.2.4 Terms Used

- **Waste water:** General term for used water from houses/commercial premises containing physical, chemical, and biological impurities.
- **Sewage:** Waste water coming from Water Closets containing human excreta is known as sewage.
- **Sullage:** The used water coming from bathrooms, wash basins, washing machines, and kitchens that do not contain fecal matter is known as sullage.
- **Plumbing System:** It is the complete pipeline for providing fresh water supply to the building and/or pipelines for disposal of used water from the building.
- **Sewer:** A pipeline used for carrying sewage/ wastewater is called a sewer.
- **Soil Pipe:** It is a pipeline system carrying sewage from Water Closets.
- **Waste Pipe:** Pipelines carrying sullage from bathrooms, kitchens, sinks, wash basins, etc.
- **Sewerage System:** A system of sewers of various types and sizes in a city collecting wastewater from the households/commercial buildings of the town and carrying it to the wastewater treatment plant.
- **Manhole:** These are Reinforced cement concrete/ Masonry chambers constructed at suitable intervals along sewer lines called the manholes.
- **Traps:** Traps are defined as devices fitted at the end of waste pipes to avoid the backward flow of foul gases sewage chamber.

10.2.5 Aims of House Drainage

- i. To maintain hygienic conditions in the house.
- ii. To collect waste systematically.
- iii. To dispose of wastewater scientifically.
- iv. To avoid the backward flow of foul gases.

10.2.6 Principles of House Drainage

- i. For ease in maintenance and repair of the sewage lines without much damage to the house property, the household drainage lines are laid on one side of the property
- ii. Sewer joints should be leakage-proof to avoid foulodour problems and unwanted collection of waste water in the undergrounds around the house.
- iii. Gravity force should be used for the disposal of used water from the houses into the sewage chamber.
- iv. The house sewer should always be laid in a straight line.

- v. The complete sewage lines laid should be well-ventilated at regular intervals to avoid pressure build-up.
- vi. To avoid the backward flow of foul gases from the chamber, the household manhole should be located at a higher level when connecting to the community chamber.
- vii. Inspection chambers should be placed at regular intervals to check for any problem in the flow /blockage of waste water.
- viii. House sewer should not be used to drain off rainwater from the rooftops or courtyards of the building premises.
- ix. Siphonage action can never be permitted and therefore adequate ventilation systems should be installed.

10.2.7 Main Components of House Drainage System

A. Pipes: The pipes used in the drainage system are labeled based on the function:

- i. **Soil Pipe:** A pipe that conveys sewage or wastewater reliably, either from the toilet or sink to a soil drain or sewer.
- ii. **Waste Pipe:** It is a pipe that carries waste water from sinks, showers, and other appliances that use water away from your home and not human excreta.
- iii. **Vent Pipe:** This is a pipe provided to prevent sewer gases from entering the home and allows wastewater gases and odors to escape through the plumbing vent stack on the roof of your home.
- iv. **Rainwater Pipe:** A rainwater downpipe is a pipe that is used to direct rainwater away from a building, typically from roof guttering to a drainage system. It is sometimes also referred to as a downspout, drain spout, roof drain pipe, or leader.
- v. **Anti- Siphonage Pipe:** An additional pipe fitted to the outlets of toilet seats of all the floors, the other end of which is exposed to the atmosphere. The cause of the provision of the pipe is to sustain the water seal so that foul gases of the sewer line/ soil pipe/ toilet pipe do not enter the toilet and bathrooms.

Sizes of Pipes used in House Drainage

- Soil pipe: 100mm
- Waste pipe: 30 to 50 mm horizontal pipe, 75mm vertical pipe
- Rainwater pipe: 75mm
- Vent pipe: 50mm
- Anti-siphonage pipe: 50mm connecting soil pipe, 40mm connecting waste pipe.

B. Traps: In plumbing terminology, a **trap** is a U-shaped portion of pipe designed to trap liquid or gas to prevent unwanted flow; most notably sewer gases from entering buildings while allowing waste materials to pass through. The traps are placed below or within a plumbing fixture and help in retaining a small quantity of water. The retaining water creates a water seal to avoid foul gases going back to the building through drain pipes. Therefore, all plumbing fixtures such as sinks, washbasins, bathtubs, washing machines, water closets, etc. are fitted with traps.

Characteristics of a Trap

- i. It may be manufactured as an integral trap with the appliance as in some models of European WC, or it may be a separate fitting called an attached trap, which is connected to the waste or foul water outlet of appliances.
- ii. The traps should be of a self-cleansing pattern.
- iii. Traps for use in domestic waste should be convenient for cleaning.
- iv. A good trap should maintain an efficient water seal under all conditions of flow.

Classification of Traps

- i. Classification according to Shape
 - P-trap
 - Q-Trap
 - S-Trap
- ii. Classification according to Use
 - Nahni or Floor Trap
 - Gully Trap
 - Intercepting Trap

- C. P. Trap:** This trap is used with an Indian water closet (ORISSA Pattern). It is manufactured from unplasticized polyvinyl chloride (UPVC) sheets and cast iron. The water seal provided in the traps stops the foul gases from flowing back into the household.
- D. Q Trap:** This trap is used in toilets under the water closet. It is used in multi-storey buildings as well as in ground-floor sanitary lines. Also known as half-S-trap. This resembles the shape of the letter Q, in which two legs meet at an angle other than a right angle.
- E. S. Trap:** This trap is like a P trap and attached to the drainage pipes of water closets in toilets. The only difference between the P trap and S trap is the P trap is used for waste collectors through the wall whereas the S. trap is at ground floor level outlets.
- F. Floor Trap or Nahini Trap:** The trap is fitted at the floor level to collect waste water from the washbasin, shower, sink, and bathroom. These are available in cast iron or UPVC material and have removable grating (JALI) on the top of the trap. The minimum depth of the water seal should be 50 mm to trap gases correctly.



Fig. 10.4: P Trap

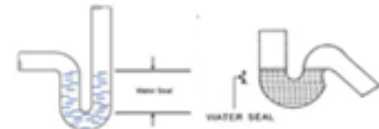


Fig. 10.5: Q Trap



Fig. 10.6: S Trap



Fig. 10.7: Nahini Trap

G. Gully Trap: Gully trap also has a water seal of a minimum of 50 mm to prevent backward follow of gases and also to avoid the entry of harmful insects and cockroaches from the sewer line into the households.



H. Intercepting Trap: This is the last trap provided at the intersection of the household sanitary line joining the manhole of building sewerage to prevent the entry of foul gases from a public sewer to the building sewer. It has a deep-water seal of 100 mm. It has an opening at the top for frequent cleaning, termed as cleaning eye or rodding arm.



Fig. 10.9: Intercepting Trap

I. Grease Trap: A device used to collect the oil/grease contents of waste water and which can be cleaned from the surface. This is generally used in food processing units.



Fig. 10.11: Bottle Trap

J. Bottle Trap: This trap is used below the washbasin and sinks to prevent entry of foul gases.



Fig. 10.10: Grease Trap

K. Venting of Pipes: A proper vent pipe has to be provided for the trap under fixtures or otherwise the water seal is liable to be siphoned off. The vent pipe also serves the purpose of letting the foul smell out of the house. All types of pipes, including wrought, cast, and galvanized iron, lead, brass, plastic, and copper, have been used for vents, depending on the pipe used in other parts of the system, the coat involved, and the type of sewage handled by the drainage system.

L. Sanitary Fittings: The sanitary fittings are used to collect and discharge used waste water from the kitchen, wash basins, bathtub, urinals, and solid waste from the water closet. The sanitary appliances are mostly manufactured from vitreous chinaware and glazed fire clay sanitary ware. It is grouped under two categories

1. Soil appliances
2. Wastewater appliances

Soil Appliances:

- Toilets or other types of water closets (such as squatting, composting, washdown, siphonic or universal).
- Bidets (either pedestal or wall hung).
- Urinals (bowl type, slab, stall, squatting, syphon jet, or waterless).
- Slop sinks (found in hospitals and used for emptying and washing bedpans and urine bottles).
- Bed pan sinks (again, found in hospitals).

Waste Water Appliances:

- Wash basins.
- Wash troughs.
- Sinks.
- Showers.
- Bathtub.
- Drinking fountains

M. Water Closet A soil appliance is classified as ordinary or wash-down type and the siphonic type is designed to receive human excreta directly from the user and is connected to the soil pipe using a trap. The following varieties of waterclosets are in common use.

N. Squatting or Indian Type: usually made of vitreous china clay is available in the market in patterns such as along pattern, Orissa pattern (preferred in a house), and integrated type where the squatting pan and trap are made integrally.

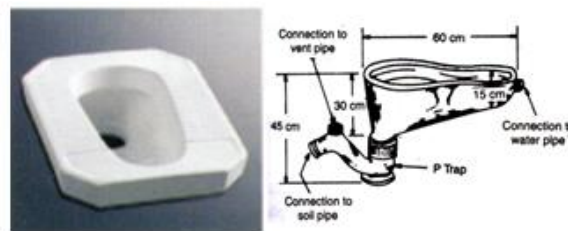


Fig. 10.12: Indian Type Water Closet

The pan is provided with an integral flushing rim of a suitable type. The inside of the bottom of the pan should have a sufficient slope towards the outlet for quick disposal during flushing. The pan is connected to the flushing cistern using a flushing pipe. The top of the trap is connected to the anti-siphon or vent pipe.

O. Wash Down or Western Type WC Seat: an alternative to the squatting pan, is most popular and commonly used in high-class buildings or luxury homes and quite convenient for aged persons. It is provided with a wide flushing rim and a trap normally available in one-piece construction with an inlet or supply horn for connecting to the flushing pipe. It may be provided with a P and S trap as desired.

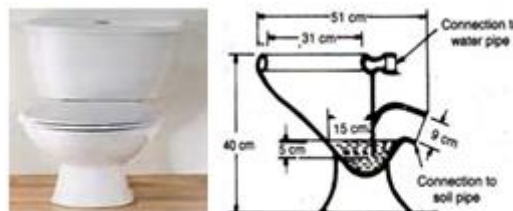


Fig. 10.13: Western Type Water Closet

These types of water closets require less space than the squatting pattern type and can be flushed by independent cisterns which may be installed either at high or low levels or be of a single unit having both the seat and the cistern.

- P. Wash Basin:** As the name suggests, these are provided in a house for casual washing of hands and face, etc., and also to carry out morning chores of brushing shaving, etc. These can be installed as an individual unit having a pipe to drain out the water or as a combined unit having both the basin and the pedestal. They are usually made of vitreous china and are commonly available in various designs and colours.
- Q. Kitchen Sink:** It is an essential feature of a house as it not only helps in the cleaning of utensils but also serves as part storage of the used utensils. The most commonly used sinks are of stainless steel, which is easy to install and can be cleaned easily.
- R. Bath Tub:** This can be provided in houses where there is sufficient area available in the bathrooms. Porcelain bathtubs, although perfectly non-absorbent, clean, and attractive are not much in use, being very expensive and heavy. can be made out of galvanized sheets, stainless steel or cast-iron stoneware, porcelain, PVC, etc.



Figure 10.14: Bath Tub

- i. It is provided with hot and cold water connection and inlet usually of 15 mm dia. each and outlet of 32 mm dia. connected to the waste pipe.
 - ii. The waste pipe is connected to the main vertical stack through a trap, to prevent the entry of foul gases in the bathtub.
 - iii. It is also provided with an overflow pipe to drain the excess water.
- S. Urinals:** are soil appliances connected to a soil pipe after a suitable trap. The urinals shall be of one of the following patterns:
- One-piece construction with integral flushing box rim with a minimum of 12 holes.
 - Should have a minimum of 6.5 mm of 2 fixing holes on either side of the urinal.
 - When installed there shall be no liquid left over in the bottom of the pan of the urinal after flushing.
- T. Squatting Plate:** Type Urinal is a one-piece construction generally used by women. It has an integral longitudinal flushing pipe of the suitable type which may be connected to the flush pipe. The integral flushing type shall be connected to the sump by three 13 mm diameter holes.

U. Flushing Cisterns: A Flushing cistern is used for storing water and flushing water closets and urinals after use. The flushing cisterns are provided with inlet/outlet pipes, overflow pipes, and automatic closing float ball valves. There are several varieties of cisterns. The bell type and flat bottom type are two types of cisterns that are in most common use. The flushing cisterns are also classified as low-level, high-level, close-coupled, automatic, and dual flushing types.

Precautions while Executing Layout of Pipe

- i. Pipe work and appliances should be arranged in such a way that allows close grouping of connections with the water closet near the main soil pipe.
- ii. The branch pipes should be kept short to reduce noise.
- iii. When the basin and bath are at some distance from the stack, it would be cheaper and simpler to combine the waste pipes into one.
- iv. Any bends in the waste pipe should be of a large radius.
- v. The pipework in branch connections should be arranged to allow free drainage for the system.
- vi. All connections to main or branch pipes should be arranged in such a way that prevents cross-flow from one appliance to another.
- vii. Branch connections should be of a large radius along the invert.
- viii. The minimum diameter of soil and waste stacks should be 100 mm and 75 mm respectively.
- ix. When the pipes are covered, and hard to find along the internal face of the walls, they should be cast iron.
- x. All pipes including those laid on the external face of the wall should be of cast iron on the ground floor.
- xi. Sufficient conditions should be made to access all pipe works and embedding of joints in the walls should be avoided.
- xii. All appliances connected directly to the stack should be trapped.
- xiii. The soil, waste, and building sewer pipes should not be reduced in diameter in the direction of flow.
- xiv. Cast iron fittings and branches for waste pipes should be of the same quality.

10.3 ELECTRICAL SYSTEM

An electrical system in a building is the network of conductors and equipment designed to carry, distribute, and convert electrical power safely from the point of generation to the various terminal points around the building that consume electricity.

10.3.1 Electric Power Connection

The power load or the estimated peak demand of the electricity depends on the number of electrical gadgets connected to the electrical connection. The electrical load calculation for each room is done at the planning stage only.

10.3.2 Alternating Current and Direct Current

Current electricity is a constant flow of electrons. There are two kinds of electricity: direct current (DC) and alternating current (AC). With direct current, electrons move in one direction. Batteries produce direct current. In

alternating current, electrons flow in both directions. Power plants produce AC electric current. In alternating current, the direction of the flow of the electric charge changes its direction periodically. AC is the most commonly used and preferred electric power for household equipment, offices, and buildings.

10.3.3 Direct Current (DC)

The direct current does not change the direction of the electric charge periodically. The current electricity flows in a single direction in a steady voltage. The main use of DC is to provide power to electrical devices and also to charge batteries. Examples: mobile phone batteries, flashlights, flat-screen televisions, and electric vehicles. DC has the combination of a plus and a minus sign, a dotted line, or a straight line. Everything that runs on a battery and uses an AC adapter while plugging into a wall or uses a USB cable for power relies on DC.

The differences between Alternating Current and Direct Current

Alternating Current	Direct Current
AC is used to transfer current over long distances without loss.	DC loses power when transferred for long distances.
The change in the direction of electric flow is possible due to the rotation of the magnets.	The single-directional flow of electricity in DC is due to steady magnetism.
The frequency of AC is dependent upon the country. But, generally, the frequency is 50 Hz or 60 Hz.	DC has no frequency or zero frequency.
There is a periodical change in the direction of the current in AC.	It flows in a single direction steadily.
The change in the direction of electric flow in AC is due to a change in the direction of the electrons.	Electrons only move in one direction – forward.

Advantages of AC over DC

- AC is less expensive and easier to generate than DC.
- AC can be transmitted across long distances without much energy loss, unlike DC.
- The power loss during transmission in AC is less when compared to DC.

Use of AC voltage preferred over DC voltage

- The loss of energy during the transmission in AC voltage is less when compared with the DC voltage and this makes its installations easy when the transformers are at a distance.
- AC voltage has the advantage of stepping up and stepping down as per the requirement.

10.3.4 Types of Electrical Wiring Systems

The process of combining all the lights, fans, televisions, motors, and all gadgets used in the home or commercial building with wire and bringing it to the distribution board is known as electrical wiring. Wiring is a system in which we can easily operate all the appliances in the house from the meter through the distribution system.

Types of Internal Electrical Wiring Systems

i. **Lead Sheathed or Metal-Sheathed Wiring:** This type of wiring allows the conductor which be insulated with VIR. It has about 95% lead aluminum alloy in the outer casing, which protects the metal casing from moisture, mechanical damage, and atmospheric corrosion. The entire lead covering is electrically jointless and is fixed to the ground from the entry point to protect against electrolytic action due to leakage and to provide safety if the casing comes alive.



Fig. 10.18: Wooden Casing and Capping Wiring

ii. **Wooden Casing and Capping Wiring:** This wiring has been used extensively in the past, but since the introduction of concealed wiring, the demand for this has been reduced. The cables used in this system are VIR (Vulcanized Indian Rubber) or PVC (Polyvinyl chloride) wire.

Wooden or plastic casings are used to enclose the wires. The cover is made of wood strips or plastic. The parallel groove is cut in the direction of length so that the VIR cable can be easily accommodated.

iii. **Batten Wiring (TRS):** This type of wiring uses a single-core, double-core, or round, oval cable with a three-core tough rubber sheathed (T.R.S) cable. For this, a single-core cable is preferred. TRS cable is waterproof, chemical proof, and steamproof but can be affected by lubricating oil. The TRS cable is fixed to the strong teak wood with a thickness of at least 10 mm.



Fig. 10.19: Batten Wiring

iv. **Conduit Wiring:** There are two main types of Conduit Wiring which are as follows:

- Concealed Conduit Wiring.
- Surface Conduit Wiring.



Fig. 10.20: Concealed Conduit Wiring

v. **Concealed Conduit Wiring:** A plastic or metal pipe is concealed inside the plaster by drilling a hole in the wall under this wiring. This wiring is called Concealed Conduit Wiring.

In this wiring, the pipe that is pressed inside the plaster should be continuous, and there should be no puncture or block. If a steel or other metal pipe is used, it is necessary to give it some distance earthing. But especially when it comes to the house, most of the PVC pipe is used. Doing this wiring protects against rodents. So wire cutting can easily get rid of such a problem. That is why this wiring is more convenient and popular for homes or offices.



Fig. 10. 21: Surface Conduit Wiring

vi. **Surface Conduit Wiring:** This wiring is done on the outside of the wall. Such wiring is known as Surface Conduit Wiring. This is done by making a hole in the wall at equal distances and fixing it with the help of a GI clamp. By

pulling the wire through this pipe, it is given to the board and light, fan, or another consumer device.

10.3.5 Types of Electrical Wire Used in Homes

- i. Aluminum and copper are two commonly used wires. Copper has high tensile strength, and high conductivity, can be easily soldered, and is more ductile. Although silver is the best conductor, its use is limited because of its high cost.
- ii. Copper is more expensive than aluminum. Aluminum wire has about 60% of the conductivity of copper. It is used in high-voltage transmission lines and sometimes in domestic and industrial wiring. Its use has increased in recent years.

Wires

Wires are copper or tinned copper, the most common conductor in-home wiring with minimum resistance that comes for a reasonable cost. Wires are usually grouped by gauge number ranging from 00-40. The smaller the number thicker the wire. For residential/ home, wire gauges ranging from 10 to 20 are used.

- **Cable Wire:** Cable denotes a collection of 2 or more strands of wire. The cable has 3 wires running- phase, neutral, and grounding wire. Cables are categorized according to the number of wires running through them and their size/gauge.
- **Telephone Wire:** This type of wire is used for low-voltage control, especially for communication and alarm purposes. Braided, twisted, and plastic-jacketed are the most common types of thermostat wiring. Twisted cable wiring has no outer braid and is used for doorbells, burglar alarms, and telephone systems.
- **TV Wire:** Television lead-in wire connects the receiving set to the antenna that is installed on the society roof. Good quality 300-ohm wire is used for both VHF and UHF receivers.

Home Networking and Modem Wires: Home networking wires include connecting multiple computers, audio systems, etc. The networking hub is a device where wiring from different locations comes together to meet.

Phase and Neutral: The electrical supply connection for the house is provided by the electrical distribution company has two types of wires. The first type of wire is called phase and the second type of wire is called neutral. Both phase and neutral are essential parts of any type of electrical connection either for the residential house or for commercial premises.

- i. **Phase Wire:** The term phase is used in the context of alternate current (AC). The electric power generated by the power plant is sent to the destination consumer through four cables. Out of the four cables, the three cables carry the electric current and are referred to as phase lines or live wires, and the fourth cable is called a neutral line. The three-pin socket is connected with a phase line, neutral line, and earthing wire. The three types of wires used in household circuits are Earth wire, Live wire, and



Fig. 10.22: Phase Wiring

Neutral wire.

- i. **Earthing Wire:** Earth wire is used as a safety measure, especially for those appliances that have a metallic body. The colour of insulation used for this wire is Green. All high-wattage electrical gadgets such as fridges, air conditioners (AC), water heaters, room heaters, centralized ACs, and other such devices are connected to the earthing wire as a measure of safety.
- ii. **Neutral Wire:** Neutral wire helps to complete the electric circuit. All electric home appliances need both phase and neutral connections to work. The live wire is a positive wire generally red in colour. The neutral wire is a negative wire generally black in colour. The electric power that we receive in our houses is from the main supply, commonly called mains. The meter board distributes these cables to various electric appliances throughout the house.



Fig. 10.23: Earthing Wiring

10.3.6 Electric Systems – Single-Phase and Three-Phase Connection

- i. **Single Phase Connection:** In single phase connection cable that connects home with the external electric pole will have only two wires. The first wire (Red) will be a phase wire that carries the electric current. The second wire (Black) is called a neutral wire that is necessary to complete the circuit. All high-wattage electric gadgets are also connected to the third wire called earthing or grounding line. The earthing is different from the neutral line.
- ii. **Three-Phase Connection:** Some residential houses and commercial properties demand high electricity. In such cases, the single-phase connection would not be sufficient and might overload the electric connection system. Such highly demanding customers recommended a three-phase connection. The three-phase connection cable that connects house with the external electric pole will have four wires. This includes the three-phase wires and one neutral line. The first three wires will be a phase wire that carries the electric current and the fourth wire is called a neutral wire that helps to complete the circuit.



Fig. 10.21: Single Phase Connection

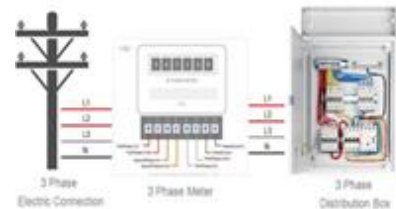


Fig. 10.22: 3- Phase Connection

10.3.7 Simple Electric Layout

The house's electrical wiring layout defines the electrical connections between the different rooms and the main electric power supply through a control panel. The electrical wiring layout is planned in such a way that the electrical wires can easily support the designated electrical load.

The house electrical wiring layout diagram is prepared which indicates the electrical connection between the electrical boards in all the rooms with the main electric control panel. The home electrical wiring layout defines how different rooms are connected to the main electrical power supply through a control panel.

Planning the electrical wiring layout

The entire house electrical work project can be grouped into two steps.

- A. Plan the electrical layout
- B. Execute the actual wiring work as per the layout.

The standard procedure to plan the house's electric wiring layout is as follows

- i. Identify the requirements for electrical points in each room.
- ii. Decide the rated capacity for each point in a room.
- iii. Calculate the electrical load for each room.
- iv. Mark the location of the electrical switchboards for each room.
- v. Divide the entire electric load into several circuits
- vi. Decide the rated capacity for the electrical wires.
- vii. Decide the size of the main electrical control panel.

Electrical Point: The electric point is a general term used to refer to one specific application of the electric supply. Each electric switch present on the board in a room is used to switch on or off a specific electric device such as a light or fan. This one single electric connection on the board is referred to as one single point. The electric board can have many such points.

10.4 LIGHTING FIXTURES – SELECTION, PLACEMENT, DESIGN

A lighting fixture is part of a light that is attached to the wall or ceiling where you put the light bulb or other lighting element, and which cannot be easily removed.

10.4.1 Factors to be Considered while Selecting A Lighting Fixture

- i. **Size of Lighting Fixtures:** Type of the lighting fixture size will be based on the clearance space between the ceiling and the floor, and room size.
- ii. **Cost:** The price of light fixtures can vary considerably. Selection of the lighting fixtures based on the budget of the family is a good choice.
- iii. **Function:** Based on the use of the light, whether for individual activities or group activities.
- iv. **Light Bulb Size:** Bulb size will depend on the amount of the range of space over which light is required. If the range of work is small, small bulbs can be selected. If the range of work is wide and big, either many small bulbs or one big light to illuminate the entire area can be chosen.

- v. **Light Bulb Style:** There are several choices and many styles available, including LED, CFL, and halogen. LEDs pay for themselves over time with lower energy use, brighter light, and longer life.
- vi. **Style:** The choice of the lighting fixtures style will be based on the personal taste of the inmates. Based on the home design and décor selection of the fixtures styles will widely vary.
- vii. **Maintenance:** On a long-term basis, ease of maintenance is an important factor to keep in mind. Changing bulbs or cleaning the blubs should be easy for the occupants of the house.

10.4.2 Types of Lighting

Lighting fixtures provide an aesthetic ambiance to the interiors.

The three main types of Lightings are

1. **Ambient Lighting:** Ambient lighting is also called mood lighting or general lighting. It is a soft, at times diffused lighting, and might mimic natural light. General lighting may be natural or come from light fixtures.
 - It is a gentle, relaxing type of lighting.
 - Ambient lighting “bounces” off walls to illuminate the maximum space possible.
 - There is no glare or spotlight. It does not call attention to any specific area.
 - It is ideal for general activity or quiet conversation.Good lighting fixtures for ambient lighting include chandeliers, LED downlights, wall scones, traditional recessed fixtures, and table & floor lamps.
2. **Accent Lighting:** Accent lighting creates visual interest and adds drama to a space. It is used to spotlight sculptures, houseplants, paintings, bookcases, wall textures, outdoor landscaping, and even drapery.
 - It is a very concentrated light meant to draw the eye to a focal point.
 - It needs at least three times as much light on a focal point as the ambient lighting around it.
 - Accent lighting for outdoor areas, including architecture and gardens, is called outdoor accent lighting. This is especially popular during holidays such as Christmas and Halloween.
 - It is often used in historical buildings, art shows, and museums.Types of accent lighting include sconces, picture lights, track lights, outdoor lighting, and under-cabinet lighting.
3. **Task Lighting:** As the name suggests, task lighting helps you to perform specific tasks such as sewing, balancing checkbooks, reading, writing, cooking, or gaming. Ideally, task lighting should be free of glare and shadows, while still bright enough to prevent eyestrain.
 - It provides additional, focused light for tasks in a space that may already have ambient or accent lighting.
 - It helps you see smaller objects, or objects with a low contrast.
 - Aids with accuracy in tasks.
 - Task lighting often has a swing arm or flexible neck.
 - They are often installed over or near a workspace and are an important part of commercial design.

Standard fixtures for task lighting include pendant lighting, recessed fixtures, desk or portable lamps, and under-cabinet lighting.

10.4.3 Types of Lighting Fixtures

- **Recessed.** Installed above the ceiling. The opening is flush with the ceiling. Insulation is required to ensure that condensation doesn't drip into a light fixture. Offers a narrow band of light in a single direction. Can be used for tasks, accents, or ambient lighting.
- **Under-cabinet.** Installed above the ceiling. The opening is flush with the ceiling. Insulation is required to ensure that condensation doesn't drip into a light fixture. Offers a narrow band of light in a single direction. Can be used for tasks, accents, or ambient lighting.
- **Track.** Suspended or mounted from the ceiling. Consists of a linear housing that has several heads, which can be positioned anywhere along the track. The direction of the heads is adjustable. Often used for accent or task lighting.
- **Wall Lighting & Sconces.** Work great for accent lighting. They come in a range of sizes and are ideal for showcasing architecture and art.
- **Desk, Floor & Table Lamps.** Extremely versatile and portable. Most are directed downward, except torchieres. Often used as a task or ambient light.
- **Ceiling Lights.** Installed directly into the ceiling. Lights a large room or only the area directly below the fixture. Most ceiling fixtures need to be installed directly into the electrical system and are controlled by wall-mounted switches.
- **Chandeliers.** Statement light fixtures are ideal for entertaining guests, either in a home or in a gathering space such as a large hall. The light emitted has a wide radius.
- **Pendant Lights.** These lights hang from the ceiling on a long chain, rod, or cord. Can be used for task lighting and are decorative and striking. Can range from simple to ornamental. The radius of light is usually smaller than that emitted by chandeliers.
- **Outdoor Wall Lights.** A good option if you don't have an overhead surface to install a ceiling light. Wall lanterns and barn lights are increasing in popularity for their warmth and stunning look.
- **Outdoor Landscape Lights.** Incorporate these in your landscaping design. These fixtures enhance and light up features of outdoor spaces, such as walkways, steps, patios, and decks. Characterized by location, such as pathway lights and deck lights.
- **Flush-Mount & Semi-Flush-Mount Lights.** Decorative, but more subtle than pendants or chandeliers. Installed into the ceiling, but do not hang too far down, if at all.

10.5 SMART HOME TECHNOLOGY

Smart home, home automation, smart home technology, and domotics are umbrella terms that all describe a home whose appliances (fridge, dishwasher, washing machine, etc.) and systems (HVAC, security, smart lighting, etc.) are connected through a network and controlled by remote devices (typically a phone, remote control, or tablet).

10.5.1 Smart Home System

A smart home system refers to the specific medium in which your network communicates. Smart home systems come in one of three categories, wired, wireless, or hybrid. Each of these systems uses specific protocols (languages) to communicate.

- **Wireless smart home systems:** These networks function over Wi-Fi, are easier to install, and are less expensive. However, they have weaker security and may require Wi-Fi extenders or additional access points if you have a larger home.
- **Hardwired smart home systems:** Wired systems are more expensive and challenging to implement, but they're more secure, reliable, and expandable.
- **Hybrid smart home systems:** Hybrid systems combine hardwired devices and wireless communication to create a diverse smart home system. Hybrid systems, while handy, can be complex to set up and may limit the type of devices you can connect.

10.5.2 Advantages of Smart Home Technology

- i. Managing all of the home devices from one place.
- ii. Flexibility for new devices and appliances
- iii. Maximizing Home security
- iv. Remote control of home functions
- v. Increase energy efficiency
- vi. Improved appliance functionality
- vii. Home Management insights

10.5.3 Essential Smart Home Features

Smart Home appliances and devices work together to provide practicality, functionality, and security.

- Smart Lighting Installation.
- AI-controlled Entertainment Systems.
- Smart Home Appliances.
- Automated Home Utilities.
- Smart Home Security System.

10.5.4 Smart Home Devices

- Smart TV
- Smart Lighting systems
- Smart thermostats
- Smart door locks and garage doors
- Smart security cameras and systems
- Smart pet and lawn care
- Smart kitchen appliances
- Smart household monitors
- Smart plugs

10.6 LIGHTING AND VENTILATION

Importance of good lighting. Ventilation and thermal mechanism. Guidelines and design methodology using natural and artificial components. Understanding local climatic conditions and utilizing these factors efficiently.

10.6.1 Sources of Light

- i. **Daylight:** The quantity of daylight entering the interiors depends on the design of the building (dimension, location, and direction of the windows), the amount and path of sunlight, cloud cover, local topography, and the season. The quality of the window glass is important as well. The sum of daylight entering the workplace can be managed with tinted glass, window blinds, curtains, and awnings. Daylight is required in the workplace and should not cause glare or make the work area too bright.
- ii. **Electric Lighting:** The quantity of light, the colour of the light, and the colour of appearance of that object change with the type of artificial lighting. The lighting must match the workplace and the task. The following are common types of bulbs.
 - Incandescent
 - Compact Fluorescent bulb
 - LED
 - Fluorescent tubes

Importance of Good Lighting

- i. Make a space feel more inviting and comfortable.
- ii. Enhances the ambiance of the house.

- iii. Increases the appearance of the home by enhancing the best features of the home.
- iv. Lifts the mood of the inmates of the house.
- v. Increases the functional use of the various areas of the house.
- vi. Improve the lighting with the proper type of lights and fixtures.
- vii. Reduces eye strain and headaches.
- viii. Avoid house accidents and falls.

Importance of Ventilation

having good ventilation is essential for the comfort of the inmates of a house.

Some of the reasons for good ventilation are:

- i. Controls flow of air in the interiors.
- ii. Positive influence on the health and well-being of the occupants.
- iii. Regulates the indoor temperature.
- iv. Removes air impurities and smells.
- v. Reduces harm to health by mould formation.
- vi. It controls moisture.

Importance of Thermal Mechanism

A thermal environment is the satisfactory comfort felt by the occupants of a building. The factors affecting the thermal comfort of the inmates are:

- i. Indoor air temperature
- ii. Air speed.
- iii. The moisture content of the air
- iv. Clothing condition of the inmates
- v. Level of physical activity

10.6.1 Understanding Local Climatic Conditions and utilizing these Factors Efficiently

Lighting and ventilation are important aspects for the comfort, health, and efficiency of the energy of the building. The aspects for optimal use of natural light and ventilation are through cross ventilation and stack ventilation.

In the case of cross ventilation, airflow is possible due to the difference in the pressure conditions on either side of the building along which openings of windows are provided. In the case of stack ventilation airflow is possible due to variation in the upper and lower parts of the interiors of a building to create a vertical air flow. These natural

ventilation methods can be paired with artificial ventilation systems like fans, air-conditioners, and heat recovery units as backup for ventilation.

Lights for interiors using natural sources to illuminate the indoor spaces can be through Sunlight and the various modes of opening like doors, windows, skylights, clerestories, and reflective lighting through light pipes, light shelves, and reflective surfaces. It can be combined with artificial light through lighting fixtures and lamps to provide supplementary lights to interiors.

10.6.2 Design Considerations

- Orientate the building to take advantage of cooling breezes, and position landscaping and outbuildings to funnel breezes over, under, and through the building.
- Enhance night-time sleeping comfort by using low or no thermal mass in sleeping spaces to prevent radiant heat.
- Consider sleep-out spaces.
- Install ceiling fans in all rooms.
- Use passive cooling measures; ventilate roof spaces well with fans.
- Segregate heat-generating areas like the kitchen, and fridge placement away from the sleeping area to reduce radiation of heat.
- The plan covered outdoor living spaces.
- Plan water bodies like pools on the eastern side to heat the pool due to late evening sunlight.
- Apply cool and light colours in the interiors and on the eastern side of the house.
- Landscape around the house through plants.

End of Chapter Exercise

1. Discuss the sources of domestic waste water.
2. List the components essential for household waste disposal systems.
3. Discuss the principles of house drainage.
4. Name the components of the house drainage system.
5. Discuss about waste water appliances.
6. What are the precautions to be taken while laying sanitary pipes?
7. Bring out the difference between AC and DC.
8. What are the various types of wires used in electrical connections?

9. What is the role of earthing in electric connection?
10. State the factors to be considered while selecting lighting fixtures.
11. Name the types of bulbs used in lighting.
12. What are the smart gadgets used in the home?

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