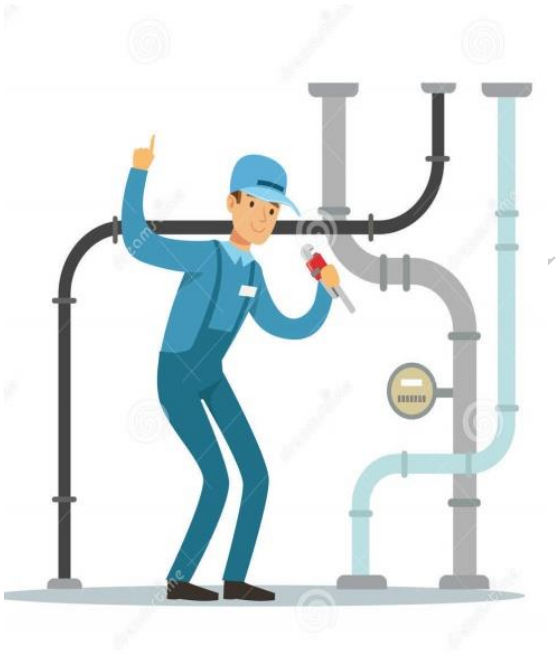
Draft Study Material



ASSISTANT PLUMBER GENERAL

(Qualification Pack: Ref. Id. PSC/Q0102)

Sector: Plumbing

(Grade X)

PSS CENTRAL INSTITUTE OF VOCATIONAL EDUCATION
(a constituent unit of NCERT, under Ministry of Education, Government of India)
Shyamla Hills, Bhopal- 462 002, M.P., India
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Preface

Vocational Education is a dynamic and evolving field, and ensuring that every student has access to quality learning materials is of paramount importance. The journey of the PSS Central Institute of Vocational Education (PSSCIVE) toward producing comprehensive and inclusive study material is rigorous and time-consuming, requiring thorough research, expert consultation, and publication by the National Council of Educational Research and Training (NCERT). However, the absence of finalized study material should not impede the educational progress of our students. In response to this necessity, we present the draft study material, a provisional yet comprehensive guide, designed to bridge the gap between teaching and learning, until the official version of the study material is made available by the NCERT. The draft study material provides a structured and accessible set of materials for teachers and students to utilize in the interim period. The content is aligned with the prescribed curriculum to ensure that students remain on track with their learning objectives.

The contents of the modules are curated to provide continuity in education and maintain the momentum of teaching-learning in vocational education. It encompasses essential concepts and skills aligned with the curriculum and educational standards. We extend our gratitude to the academicians, vocational educators, subject matter experts, industry experts, academic consultants, and all other people who contributed their expertise and insights to the creation of the draft study material.

Teachers are encouraged to use the draft modules of the study material as a guide and supplement their teaching with additional resources and activities that cater to their students' unique learning styles and needs. Collaboration and feedback are vital; therefore, we welcome suggestions for improvement, especially by the teachers, in improving upon the content of the study material.

Deepak Paliwal
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Date: 20 June 2024

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Module 1	BASIC BUILDING CONSTRUCTION

Module Overview

This module introduces the fundamental elements of a building and their importance in construction. It explains the process of making cuts or openings in structures for functional requirements. The module also covers basic masonry tools used in construction activities and provides guidance on preparing cement mortar, a key material in masonry work.

Learning Outcomes

After completing this module, you will be able to:

- Identify the key elements of a building and their functions.
- Understand the process of cutting or making openings in structures.
- Recognize and use basic masonry tools effectively.
- Prepare cement mortar with the correct proportions and technique.

Module Structure

1.1 Elements of a Building
1.2 Cutting or Opening in structures
1.3 Basic Masonry tools
1.4 Preparation of Cement mortar

Basic building construction involves the systematic process of creating a structure from the ground up. It typically begins with site preparation, including excavation and leveling of the ground. The foundation is then laid, providing a stable base for the structure. Next, the framework is constructed, consisting of walls, floors, and roof. This involves the installation of structural elements such as beams, columns, and trusses. Once the framework is complete, the building envelope, including exterior walls and windows, is installed to provide insulation and weather protection. Finally, interior finishes,

plumbing, electrical systems, and other components are added to make the building functional and aesthetically pleasing.

Throughout the construction process, adherence to building codes and regulations is essential to ensure safety and structural integrity.

Plumbing fittings and fixtures are installed at various places in the building structure. These include the bathroom, kitchen, washroom, roof, etc. As a plumber has to install these at the appropriatelocations, it is important that one is aware of the namesof the components of a building. This Unit will explain all the components in detail.

1.1 Elements of a Building

As you know that there are various elements in a building. These elements are foundation, structure, floors and ceiling, exterior walls, windows, roof, internal wall, etc.

Figure 3.1 represents the essential elements of a modern building.

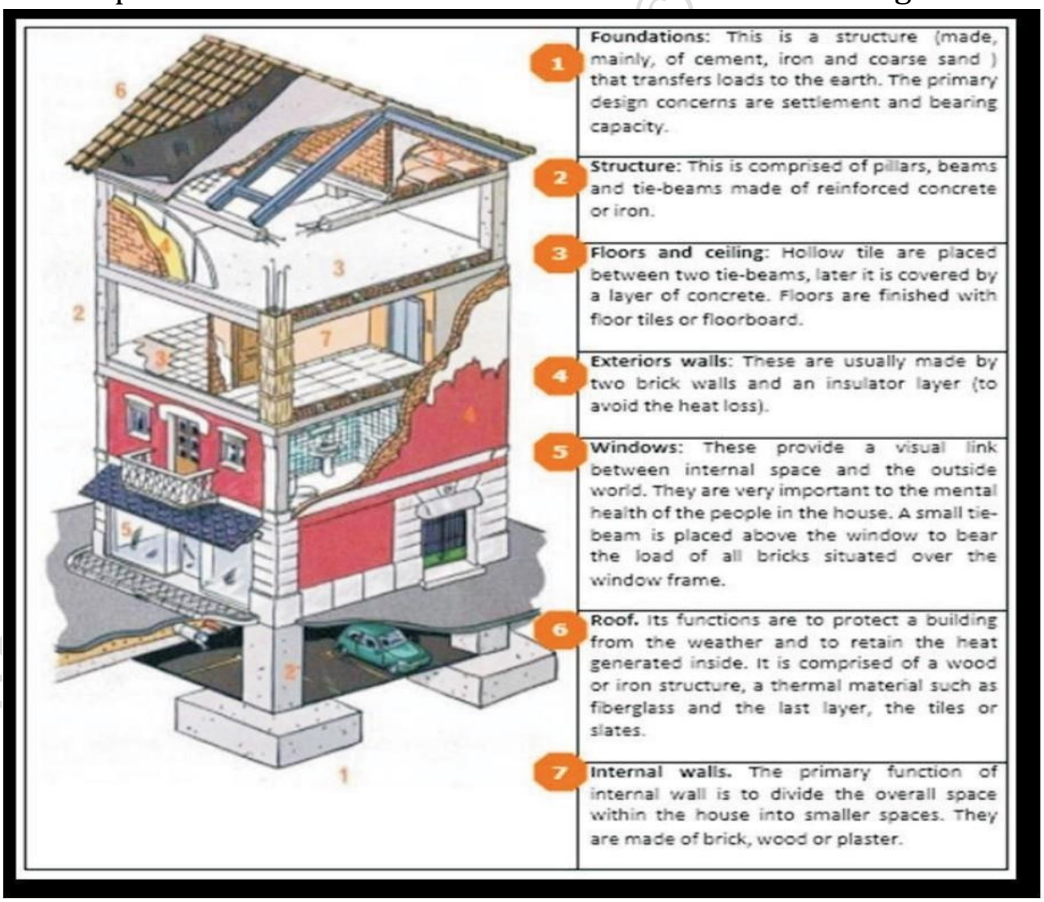

Fig 1.1 Elements of Modern Building

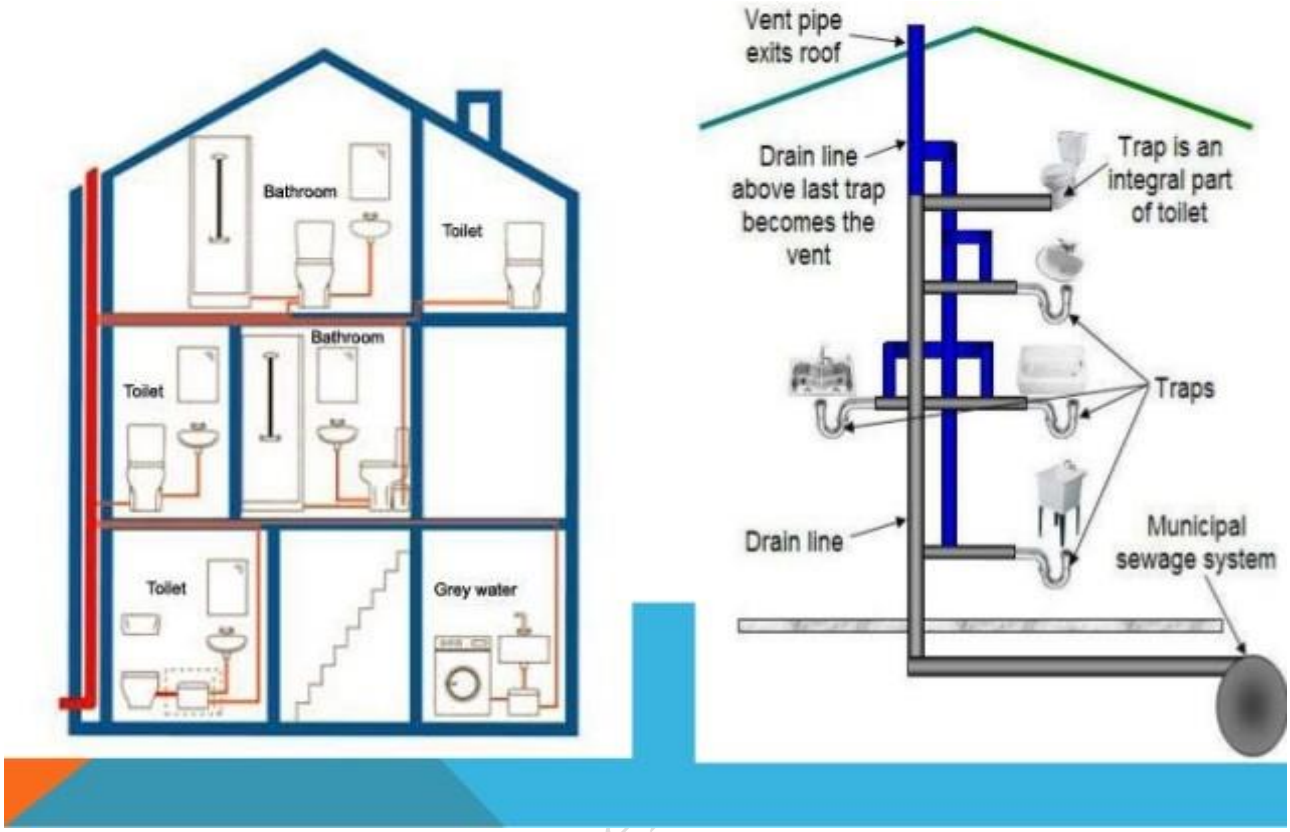

Fig 1.2 Sectional View of building with sanitary system

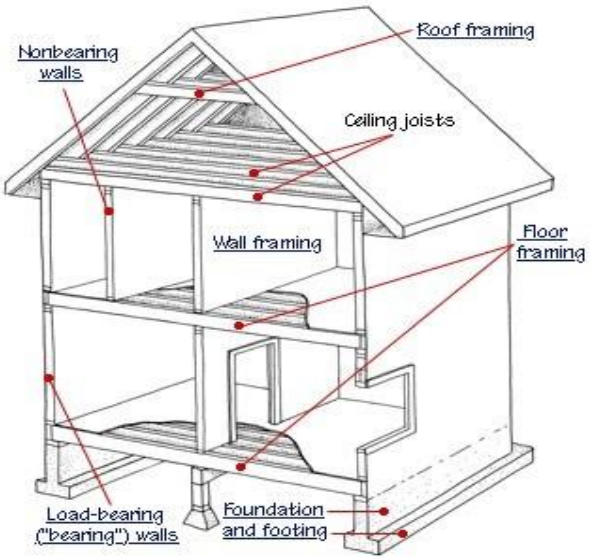

Fig 1.3 Basic elements of a building

1.2 Cutting or Opening in Structures

Drilling

Drills are very powerful and potentially dangerous tools. They can just as easily putholes in your walls or holes. However we have to be mindful of the following:

1. Always check for any electricity cables running through the wall before start drilling.
2. Catching a live cable when drilling is potentially fatal so it's worth taking the extratime to check.
3. Never wear loose clothing or dangling jewelry which could catch in the drill as onelean over it.
4. The drill bit will become hot with use so keep hands off it.
5. Make sure you use the correct drill bit for the type of wall you are drilling into.
6. If you are drilling into tiles use a specialist tile drill bit and stick a little piece ofmasking Tap/Faucet over the area to stop the drill from wandering.
7. If drilling into plasterboard, Tap/Faucet the wall to find where it is not hollow as this will be where the wooden joist is - aim to drill only into this.
8. Always use a proper purpose made extension cord if one needs a longer wire for drilland never pick the drill up by its flex.

Fig 1.4 Precautions to be taken while using a drill

Nailing

It is done to fasten to a surface or to something else with a nail and ahammer as shown in Fig 1.5

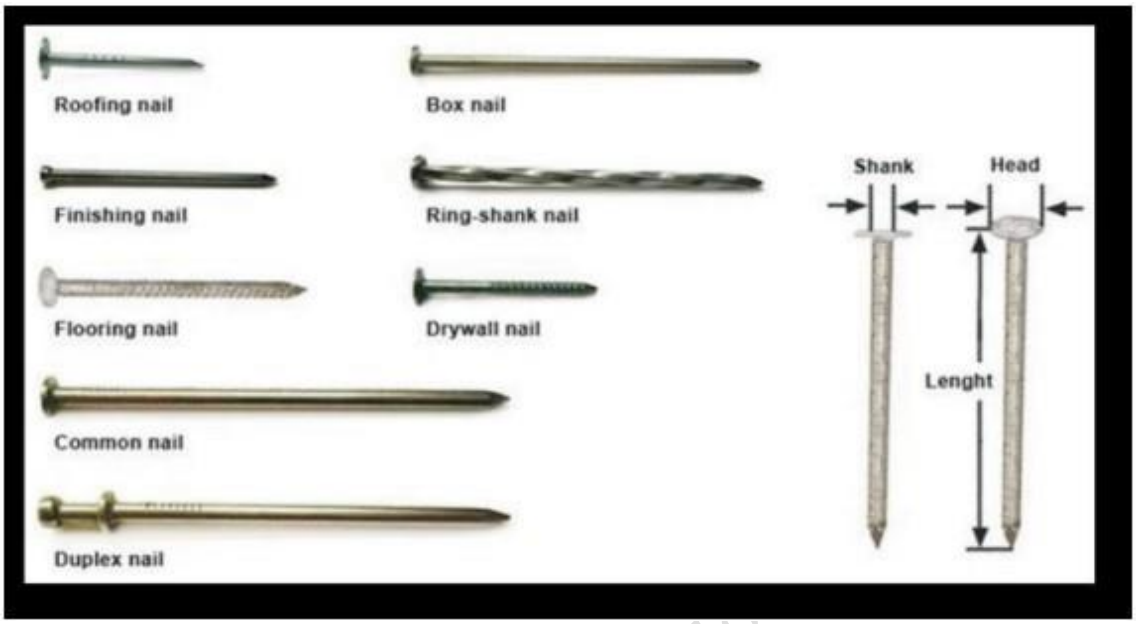

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Fig 1.5 Types of Nails

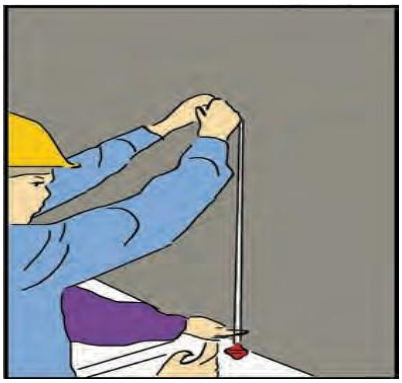
Core cutting

Chase or core is to bury (or, in builders' terms, chase) running cables or pipes up (or along) a masonry wall. When a space is created in a wall for keeping the plumbing pipes. It is called chase. Chase cut-outs should always be vertical or horizontal between start and finish on the wall. Core cutting machine is shown in Fig 1.6.

1. Never cut a chase at an angle between these two, nor step the channel.
2. While making vertical chase, care should be taken that the chase depth should not be more than one-third of the wall thickness.
3. Similarly, for horizontal chase, the width of the depth of cut should be more than the sixth of wall thickness.
4. Chases on opposite sides of a wall should not be in line, that is, 'back to back.
5. It should be noted, that if chasing in a cable, any new wiring circuit falls under Part P of the Building Regulations.

Fig 1.6 Core Cutting machine

General procedure to be followed for core cutting is shown in Fig 1.7.



Identifying the point of core cutting

Core Cutting Operation

Fig 1.7 Core Cutting Process

1.3 Basic Masonry Tools

(a) Trowels: Trowel is used in masonry work. It is used to pick up mortar from a board and to place and spread the mortar into a brick or set of bricks. It secures a brick into the mortar by tapping. Sizes of trowel vary and can reach up to 11 inches in length and 8 inches in width. Masons prefer using short and wide trowels since they do not put excessive stress on wrists.

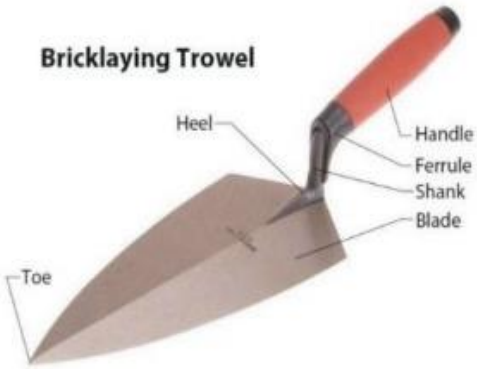


Fig 1.8 Trowel

(b) Chisels: A chisel is used to cut bricks into specific sizes as shown in Fig. 1.9. Chisel width ranges from 2 ½ to 4 ½ inches.

Fig 1.9 Chisel

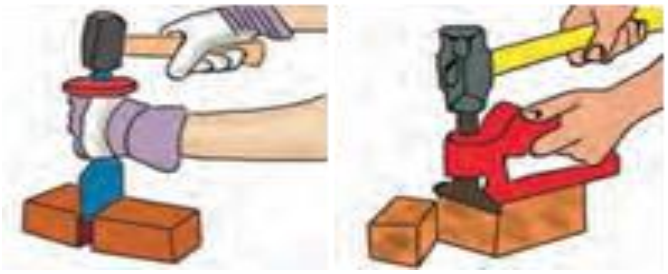


Fig 1.10 Cutting of bricks using chisel

(c) Hammer: A masonry hammer has a square face on one end for breaking as it has a sharp edge on the other for cutting as shown in Fig 1.9. They are used to split hard bricks.

Fig 1.9 Hammer

1.4 Preparation of Cement mortar

Before undestanding the process of preparation of cement mortar, we must know what it means? So, Mortar is a workable paste used to bind construction blocks and fill the gaps between them. Mortar may be used to bind masonry blocks of stone, brick, cinder blocks, etc.

Mortar becomes hard when it sets, resulting in a rigid aggregate structure. Modern mortars are typically made from a mixture of sand, a binder, such as cement or lime and water. Mortar can also be used to fix a masonry point when the original mortar has washed away. Mortar is mixed by hand in a mortar box. It should be as watertight as possible.

Method

1. Determining the type of cement will work best for the project.
2. Take fine sand and coarse sand. Take one-part cement, two parts sand and three parts coarse sand into the wheelbarrow.
3. Mix the ingredients thoroughly with a spade to ensure they are well blended. Pour a small amount of water and make a paste.

1.4.1 Mortar Filling

Filling mortars can be used for a variety of projects and repairs. Mortar is a necessary filling component to join some home-building components together, such as bricks. It can also be used to patch holes and cracks in basements and foundations, hold a patio together or secure fence posts and mailboxes. Most mortars, a mixture of concrete, lime and sand, are easy to mix and use, in small and large batches. Good mortar is necessary for good workmanship and good masonry service because it must bond the masonry units into a strong well-knit structure.

ACTIVITIES

Activity 1: Draw the components of a building.

Material required

1.Drawing copy

2.Rubber
3.Pencil
4.Scale
5.Drawing of building
Procedure
1. Select the drawing of a building.
2. Visit your school building.
3. Now, based on your knowledge of the components of a building, try to identify these components in your school building.
4. Draw the building drawing.
5. Level the components of building

Activity 2: Identify the parts of a hand-drill machine
Material required
1. Hand-drill machine
2. Drill bit
3. Chuck
4. Electrical Power switch
Procedure
1. Remove the power connection of the hand drill machine.
2. Identify the components of hand drill machine.
3. With the help of chuck open the holder of drill bit. Remove the drill bit.
4. Keep the drill bit back in the holder. Tighten the holder with the help of chuck.
5. Plug the wire into the electrical socket. Use the on–off switch of the drill machine and operate it.
6. Identify and make a list of all the components of this drill machine.

Activity 3: Practice the core cutting in a wall
Material required
1. Chisel
2. Hammer
3 Cleaning brush
4. Trowel
5. Scale
6. Old wall (unused)
7. PVC pipe
Procedure
1. Select the wall. Mark the wall.

2. Select horizontal length with the help of scale. Use the chisel and hammer and cut the grooves in the wall.
3. Fit the plumbing pipe in the wall. See the status of the pipe and whether the pipe inserted is loose or fit.
4. Clean the tool and keep the tool in proper place

CHECK YOUR PROGRESS

A. Short answer questions
1. List the components of a building.
2. Why is cutting made in the structure?
3. Why do we use a hand drill machine?

B. Multiple choice questions
1. Components of a building are _____.
(a) Road (b) playground (c) foundation (d) None of these
2. For cutting in the structure we do not use the tool _____.
(a) Drill machine (b) chisel (c) hammer (d) scale
3. Mortar is used for _____.
(a) binding masonry block (b) binding construction block (c) filling the gap between the blocks (d) All of these
4. Which is not a part of trowel?
(a) Toe (b) Handle (c) Ferule (d) Cone
5. Horizontal chase should not be deeper than the wall thickness _____.
(a) 1/3 (b) 1/4 (c) 1/5 (d) 1/6

C. Fill in the blanks
1. Mortar is made of mixture of sand, cement and _____.
2. Drill machine is used for making _____ in a wall.
3. Chisel is used for making _____ in the wall.
4. Nailing is done to _____ a surface.

Module 2	PIPES – CUTTING, THREADING, JOINING, AND TESTING OF PIPELINES

Module Overview
This module focuses on pipes and related operations such as cutting, threading etc. It covers the process of cutting pipes to the required size and threading them for

connections. The module also explains different methods of joining PVC pipes to create a secure plumbing system. Finally, it provides techniques for testing pipelines to ensure they are properly installed and free from leaks.

Learning Outcomes

After completing this module, you will be able to:

- Perform accurate cutting of PVC pipes for plumbing work.
- Understand and execute the process of threading PVC pipes.
- Apply various methods for securely joining PVC pipes.
- Conduct proper testing of pipelines to check for leaks and ensure functionality.

Module Structure

2.1 Cutting
2.2 Threading
2.3 Joining of PVC pipes
2.4 Method of testing Pipelines

For successful installation of any plumbing fittings or fixtures, various types of operations are carried out. These are cutting, threading, joining and testing.

2.1 Cutting

Cutting Pipe is one of the important materials in plumbing work. As per requirement, a pipe is cut into different sizes. A pipe is cut manually or with a machine. The length of a pipe to be cut should be marked on the pipe with a pencil.

Common tools used for pipe cutting are as given below.

(a) Plastic tubing cutters: It is used for thinner pipes andtubes, such as sprinkler pipe.

Fig 2.1 Plastic tubing cutter

(b) Wheel cutters: These are with a sharp wheel are used for thicker pipes. It has an adjustable jaw grip. It is used in areas where a complete turn is not possible. A wheel cutter is used by rotating itaround the pipe and repeatedly

tightening it untilit cuts all the way through. During the cutting process, a small burr is left in the pipe, which creates hurdles. The burr should be cleaned or reamed.

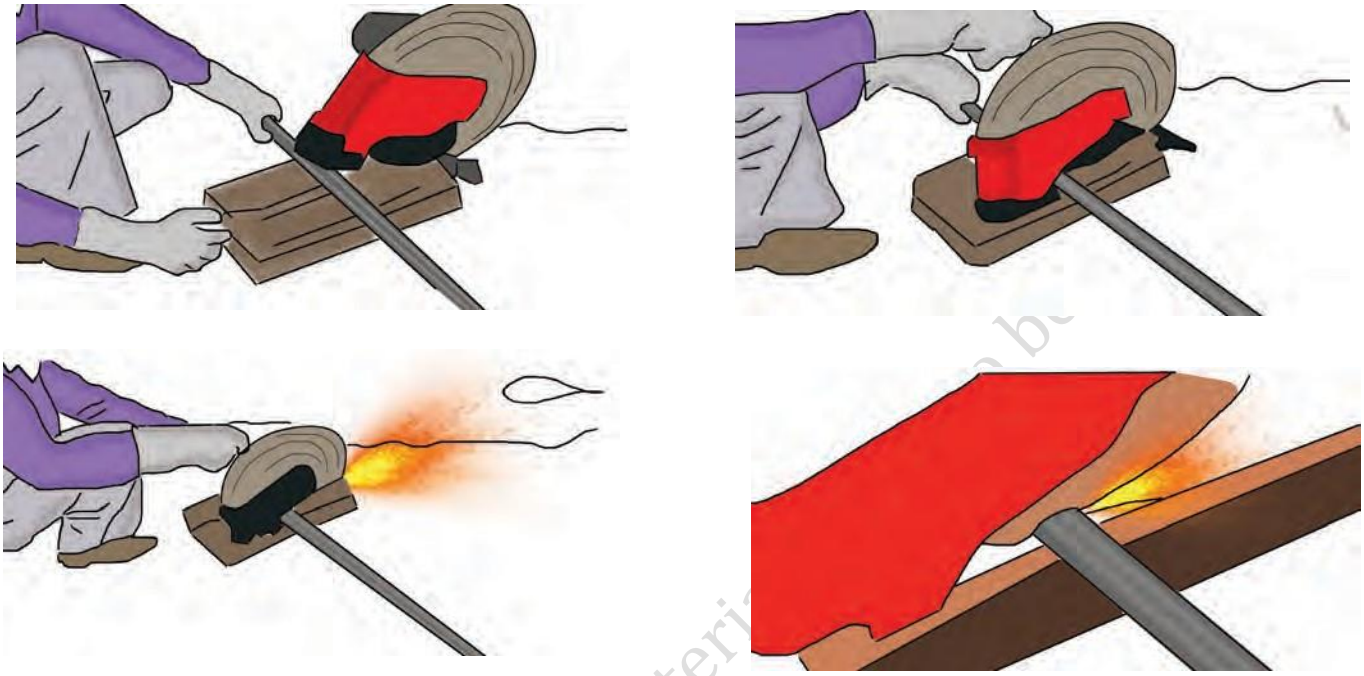


Fig 2.2 Wheel Cutter

(c) Hacksaws: Hacksaw is used for cutting pipe made out of metals and plastics. Mostly hacksaw is used for cutting the pipes. Hacksaw should be properly hold during cutting of pipe. Blade of hacksaw is changed when not working properly.

Fig 2.3 Cutting with a hacksaw

2.2 Threading

You already know that during installation of plumbing pipes and fixtures, joining is done with the help of screws and threads. The process of cutting threads using a tap or faucet is called tapping/faceting, whereas the process of using a die is called threading.

The purpose of threading is to create a screw thread. Threading is done with a tap or faucet and dies. Tap or faucet and dies are cutting tools used to create screw threads. Following are some facts about the threading:

- A tap or faucet is used to cut the internal portion of the bolt (for example, a nut).
- A die is used to cut the external portion of the bolt (for example, a screw).
- Both the tools can be used to clean up a thread, which is called chasing.
- A tap or faucet cuts a thread on the inside surface of a hole, creating a surface, which functions like a nut.
- The die cuts a thread on a preformed cylindrical rod, which creates a threaded piece that functions like a bolt.
- Unlike drill bits, hand tap or faucets do not automatically remove the chips they create.

2.2.1 Thread Cutting

Thread cutting is used when a full thread depth is required, the quantity is small and the blank is not accurate. A common method of threading is cutting with taps and dies. A hand tap cannot cut its threads in a single rotation because it creates long chips, which quickly jam the tap.

In manual thread cutting, normal wrench usage is to cut the threads 1/2 to 2/3 of a turn (180 to 240-degree rotation), then reverse the tap for about 1/6 of a turn (60 degrees) until the chips are broken by the back edges of the cutter. A threaded pipe is a pipe with screw-threaded ends for assembly. Threaded pipes used in some plumbing installations for the delivery of gases or liquids under pressure, have a tapered thread that is slightly conical.

2.2.2 Determine the Threads per Inch

Tapping is done when the threads are cut into a hole.A die set is used to cut threads onto a cylinder (bolt). To use a tap or a die, first determine the number of threads per inch (TPI) of the part to be fixed. A gauge system that has a number of different pins can be used. to calculate the TPI of a bolt or nut. After determiningthe TPI of a bolt, choose the die that corresponds to it.A tapered die will tell which side to begin using. The die fits into a special wrench that holds and guides it.

Fig 2.4 Measuring the thread per inch

2.2.3 Create new threads

To use the die to create new threads on a worn-out bolt,first place the bolt into a vise to hold it as the wrench isturned over it. Cutting metal with metal can create heat,so some cutting oil is used to lubricate the bolt. Place the die over the bolt and hold it horizontally. Turn the wrench. The die will catch the threads already cut into the bolt. Every couple of turns, reverse the wrench about half a turn to clear the threads so that the die cuts better. Also, re-apply cutting oil throughout the process. Turn the wrench until the bolt comes past the top of the die. As shown in Fig 2.5.

Fig 2.5 Creating a thread

Fig 2.6 Turning steel rod into bolt

Tap and die can also be used to turn the steel rod into bolts. A die set can also be usedto turn an ordinary steelrod into a bolt. To dothis, the rod must have abeveled end. If necessary,chamfer the end of arod on a grinder to get a bevel. The die will not workwell with a flat-ended rod.Lubricate the rod often,as when cutting intoa worn bolt. Maketurns slowly.

To use a tap, choose a size that is appropriatefor the size of the bolt or the hole you want to thread. Place the tap into the special wrench andtighten it. Then, place the cutting end of the tap over the hole and turn. Use cutting oil to lubricate the tap. As with the die, once the tap starts, make a slight reverse turn every now and then. Shown in Fig 2.7.

Fig 2.7 Tap and Die

2.2.4 Pipe Threader and Pipe threading machine

A pipe threader as shown in Fig 2.8 is used to cut grooves or threads in to the end of a metal pipe. These grooves are similar to thosefound on a conventional screw. The threads on the pipefit into a pattern of threads in the connector, allowing users to screw the two components together by hand.Before threading the pipe, plumbers use a pipe-cutting tool to cut the pipe to the desired length. The end ofthe pipe is then inserted into the pipe threader.

Special cutting tools or dies, within the threader can be used to create the proper thread profile and depth.

Pipe threading machine as shown in Fig 2.9 is used for making thread in pipe. Pipe is fixed in jaws of machine. As per pitch of thread, setting is made in die, die is rotated slowly slowly and thread is created.

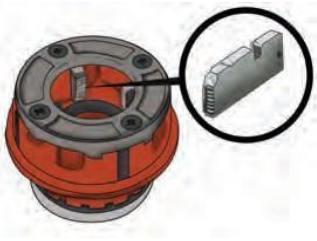
Fig 2.8 Pipe Therader

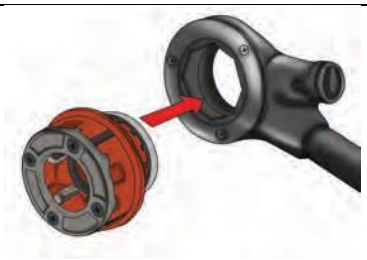
Fig 2.9 Pipe Threading using Pipe Threading machine

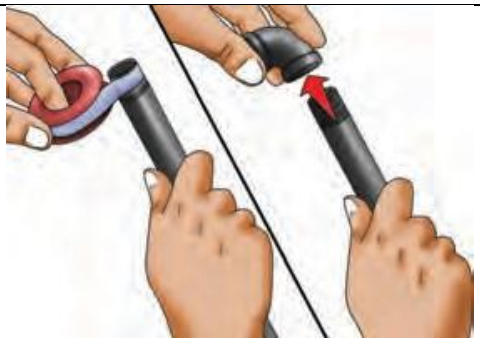
2.2.5 Process of Threading a Pipe

Before starting the threading process, all the tools to be used should be stored properly. Proper care should be taken during the process. The steps of threading are explained in Table 2.1.

Table 2.1: Steps of Threading a Pipe

Check and inspect the pipe threader before beginning. Worn out or damaged dies can result in poor thread quality.	
Mount your pipe firmly in the pipe vice tightly.	
Cut the end of the pipe smoothly and squarely by using a pipe cutter.	
Ream the cut end of the pipe to remove any burrs from the cut using a reamer. It is a cylindrical rotary cutting tool that you run smoothly across the freshly cut edges of the pipe to remove rough edges.	
Select your die head according to the size and type of pipe you are threading and the thread form you require. Die heads come in different shapes and sizes that include different threads for pipes that have different diameters.	

Place the die head over the pipe on the threader.	
Press steadily on the front of the die head, whilesimultaneously pushing the handle down to start the threader. Before putting too much pressure on the handle, check to be sure the ratchet pawl is engaged.	
Use your weight as leverage to apply pressure on the handle, while holding it firmly. Be sure to maintain a proper footingand balance for maximum control. Otherwise, this can be dangerous and could result in an injury.	
Reverse the ratchet mechanism and turn the die head in the opposite direction. Be careful to maintain control of the threader and move the piece smoothly as the dies are removed and the threads can get damaged	
Clean the pipe with a cloth, removing oil if any.Be careful as the threads are sharp. Seal the threading with Teflon tape or faucet or a pipe thread compound when attaching the pipe to the connector.	



2.3 Joining of PVC Pipes

Joining is the method of joining non-metallic, plastic pipes. It does not require threading of ends. Chlorinated Polyvinyl Chloride (CPVC) pipes are joined using a solvent cementing technique.

CPVC Solvent Cementing

The following points should be clearly understood as shown in Fig 2.10.

2. The joining surfaces must be softened and made semi fluid.
3. Sufficient cement must be applied to fill the gap between the pipe and the fitting.
4. The assembly of the pipe and fittings must be made while the surfaces are still wet and the cement is still fluid.
5. Joint strength develops as the cement dries. In the tight part of the joint the surfaces tend to fuse together. In the loose part, the cement will bond with both the surfaces. These areas must be softened and penetrated.

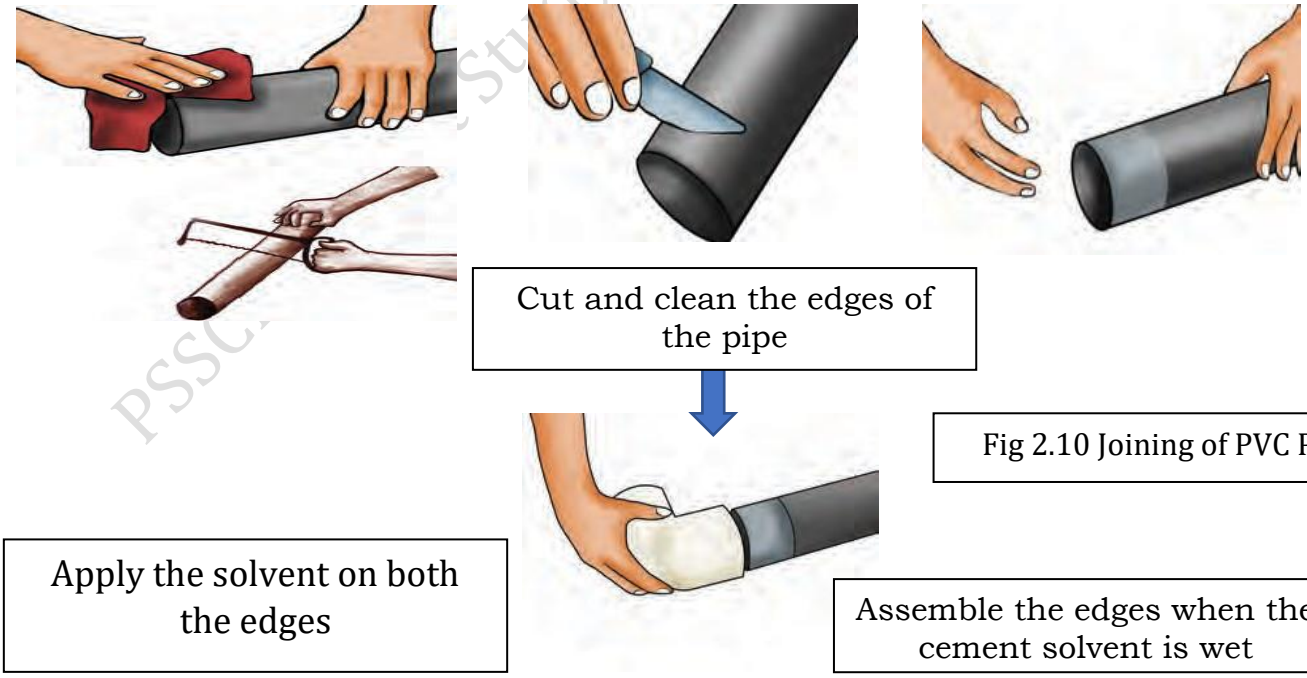


Fig 2.10 Joining of PVC Pipes

2.4 Methods of Testing Pipelines

Testing the pipeline is necessary after installation. There are four different testing methods of the pipeline, which are as follows.

1. **Smoke Test**

This test is done in the case of leakage in CI pipe.

2. Smoke is released from the bottom of the pipe.
3. Smoke can be detected from the leaked portion, if any.
4. Smoke testing refers to physical tests on closed systems of pipes to detect cracks or breaks.
5. In plumbing, a smoke test forces non-toxic, artificially created smoke through waste and drain pipes under a slight pressure to find leaks.
6. Plumes of smoke form where there are defects.
7. This test can be performed when the plumbing is brand new. More often it is used to find sewer gas leaks that may plague a building or an area.
8. Any sign of smoke escaping can be considered a possible site for sewer gas to escape.

Plumbing smoke tests are also used to find places where pipes will spill fluid, and to check sanitary sewer systems for places where groundwater and storm runoff can enter.

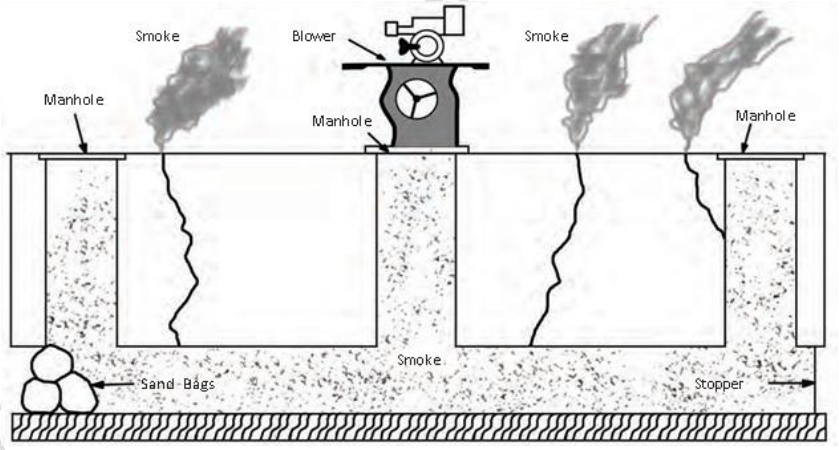


Fig 2.11 Smoke test

Pressure Hydraulic Test

This test is also done to detect leakage in the pipes.

1. For pressure test, open the ball valve on the pressure tester and then connect a garden hose to the tester.

2. Turn the hose on and allow the pressure in the pipes to reach 30 pounds per square inch (psi). This usually takes several minutes.
3. When it reaches 30 psi on the gauge, close the ball valve on the pressure tester assembly and then turn off the hose. You can now disconnect the hose from the pressure tester assembly.
4. The pressure should stay at 30 psi.
5. Leave the hose on at this pressure for several hours to make sure you do not have a small leak.
6. If the gauge does begin to drop slowly, check the plumbing for leaking water.

Fig 2.12 Pressure Hydraulic Test

ACTIVITIES

Activity 1: Cutting of the PVC Pipe

Material required

1. Cutting tool
3. Hacksaw
2. PVC pipe
4. Wheel cutter

Procedure

1. Select a PVC Pipe.
2. Mark with a pencil on the PVC pipe, where cutting is to be done.
3. Take a hacksaw and check whether the blade is fitted properly or not.
4. Keep the pipe on a table hold the pipe.
5. Cut the pipe with the help of hacksaw.
6. Fix the pipe in the wheel cutter and slowly cut the pipe.
7. Remove the burr around and inside the PVC pipe.

Activity 2: Threading in PVC pipe

Material required

1. PVC or metal pipe
2. Taper die
3. Bench vice
4. Pencil
5. Pipe threading machine
6. Tap

7. Teflon Tape

Procedure

1. Take a pipe.
2. Fix in a bench vice.
3. Identify and collect the die.
4. Fix the die in the tap.
5. Rotate the tap and die slowly.
6. Thread will be created on the pipe.
7. Pipe threader may be used for making grooves in the metal pipe.

Instructions 1. Clean the pipe with the help of a cloth and remove any oil.
2. Seal the thread with a Teflon tape.

Activity 3: Joining of PVC pipe using adhesive

Material required

1. PVC pipe
2. Brush
3. Adhesive

Procedure

1. Clean the end of the pipes with a cloth.
2. Fit one pipe into the other without adhesive.
3. Check that both the components are matching.
4. With the help of a brush apply the adhesive solution to the end of the pipe.
5. Hold the pipe material for a few minutes.
6. The pipes will join.

CHECK YOUR PROGRESS

A. Short answer questions

1. List the three cutting tools used for cutting pipes.
2. Explain how threads are made on a pipe.
3. Describe the different plumbing operations performed on a pipe.
4. How is pipe cutting done on site?

B. Multiple choice questions

1. Which of the following tools is used to cut the internal portion of the bolt?

(a) Tap (b) Die
(c) Cutter (d) Pipe threader

2. Chisel Threading machine is used to _____.

(a) make a hole in a pipe (b) make a thread in a pipe
(c) make a die in a pipe (d) None of the above

3. Which of the following methods is used for pipe cutting?
(a) Plastic tubing (b) Wheel cutters
(c) Hacksaw (d) All of the above

4. The process of cutting thread using a tap is called_____.
(a) tapping (b) threading
(c) cutting (d) bending

5. While conducting a pressure test, how much pressure should be retained in the pipes?
(a) 30psi (b) 40psi
(c) 55psi (d) 25psi

C. Fill in the blanks

1. Smoke is released from the _____ of the pipe_____.
2. _____ test is done in case of a leakage in CI pipe.
3. TPI stands for_____.
4. In manual thread cutting, normal wrench usage is to cut the threads _____ to _____ of a turn.

Module 3	PLUMBING AND SANITARY FIXTURES

Module Overview
This module focuses on sanitary fixtures and their proper installation. It introduces different types of fixtures used in plumbing and their functions. The module explains the standard heights at which sanitary fixtures should be installed for usability and comfort. It also provides guidelines on the standard dimensions required for the correct installation of these fixtures in residential and commercial setups.

Learning Outcomes

After completing this module, you will be able to:

- Identify different types of sanitary fixtures and their purposes.
- Understand the standard heights for installing sanitary fixtures.
- Apply the correct dimensions and guidelines for proper installation of fixtures.

Module Structure

3.1 Fixtures
3.2 Standard height of sanitary fixtures
3.3 Standard dimensions for installation

You must have seen plumbing and sanitary fittings and fixtures installed in the kitchen, bathroom or toilets of your home, school or other buildings. Many people confuse the words plumbing fittings and plumbing fixtures. A fixture is a part that is connected to a plumbing system and carries water through a building. The most common plumbing fixtures are bathtubs, sinks, showers, tubs, toilets and faucets. While a fixture can be fixed into walls or the floor, a fitting is an item that can be hung by a hook, screw or nail.

3.1 Fixtures

1. Tap or Faucet

A tap or faucet is a valve used for controlling or release of liquids or gas. These taps are available in varieties for the simple act of turning a tap or faucet on or off as shown in Fig 3.1.

Fig 3.1 Tap or Faucet

- **Single Lever Mixer**

It is meant to control the water and temperature. A single lever handle tap or faucet is easy to grip and turn. These are available in many decorative styles as shown in Fig 3.4.

Fig 3.2 Single level mixer

- **Joystick**

It is similar to a lever handle tap or faucet, yet with a different look and different range of motion as shown in Fig 3.3

Fig 3.3 Joystick

- **Push Tap or Faucet**

It turns the water on with a push instead of turning a handle or knob. It is used for predetermined flow of water as shown in Fig 3.4.

Fig 3.4 Push Tap

- **Sensor Tap or Faucet**

It does not require handles or knobs at all. Most automatic taps or faucets are battery powered and incorporate a passive infrared sensor to detect hand motion. Automatic taps or faucets are common in public washrooms, particularly airports and hotels, where they help reduce water consumption and transmission of disease-causing microbes. (Fig 3.5)

Fig 3.5 Sensor Tap

2. Shower

The modern shower comes with configurable temperature and spray pressure settings, along with adjustable showerhead nozzle settings. (Fig 3.6)

Fig 3.6 Shower

3. Washbasin

A washbasin is a bowl-shaped fixture used for washing hands, dishwashing or other purposes. The most significant difference between major washbasin types is the manner in which they are installed.

- **Wall-mounted**

A wall-mounted washbasin shown in Fig 3.7 hangs directly from the wall, taking up little space and offering easy access to plumbing hook-ups. These are ideal options for half baths and small bathrooms.

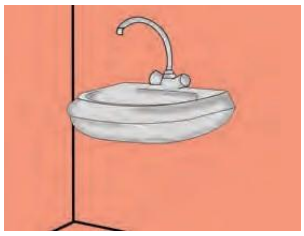


Fig 3.7 Wall mounted washbasin

- **Pedestal**

A pedestal washbasin is also wall-mounted washbasin that rests on a pedestal which may or may not provide actual support to the washbasin bowl. Usually, the pedestal conceals plumbing. The drawback of this type is the lack of storage space under the bowl.(Fig 3.8)

Fig 3.8 Pedestal Washbasin

- **Console**

A console washbasin as shown in Fig 3.9, is also wall-mounted that rests on legs. The legs support the front two corners while an apron often masks the plumbing hook-ups. A small storage space can be created underneath simply by placing a basket or a shelving unit.

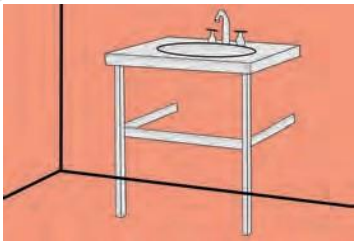


Fig 3.9 Console Washbasin

- **Self-rimming**

A self-rimming washbasin drops into a cut-out in the countertop and is usually secured with mounting clips from below. The rim overlaps the cut-out edges. (Fig 3.10)

Fig 3.10 Self-rimming Washbasin

- **Integral**

An integral washbasin is usually made of solid surface material like Corian (acrylic polymer and alumina trihydrate derived from bauxite ore) and acrylic. The bowl and the countertop are one piece and easy to clean and maintain.

4. Water Closets

A water closet (WC) is a fixture for the toilets used to carry out human excreta.

- **Indian**

An Indian water closet is commonly used in the eastern part of the world—India, Bangladesh including, Pakistan, Sri Lanka, Nepal and Bhutan. It is shaped in a way that one has to sit on one's haunches. Its basin has an inverted slope towards the back of the closet where a trap leads to the sewer pipe (drain) from it.

Fig 3.11 Indian Water Closet

- **Western**

A western water closet is very popular and commonly used in the western part of the world. It is shaped like a chair and is used in the same manner. It is sloped from the back and connects with the drain through a trap. There are two types of western water closets—a one-piece with a basin and the trap manufactured together; and a two piece in which, the basin and the trap are manufactured separately.

Fig 3.11 Western Water Closet

5. Flushing Cistern

A flushing cistern is used for storage and discharge of water for flushing out the excreta from a WC and urinals. A flushing cistern is also known as a water waste preventer. It is used to throw water with pressure after the use of the WC and urinals.

Fig 3.12 Flushing Cistern

- **Flush Tank**

This is a tank that holds fluid in reserve for flushing and is attached to a toilet. Today's toilets are typically a two-piece (tank and bowl) plumbing fixture made out of vitreous china. The mechanical components, which are located inside the tank, work together as a system to perform a gravity flush.

- **Bell Flushing Cistern**

A bell flushing cistern is only suitable when installed at a height. It is made of cast iron with a capacity of 5 to 15 litres. Now virtually outdated, it may still be found in old factories, schools and similar established buildings. It consists of a bell connected to a flushing chain through a lever. When the chain is pulled, the bell is lifted and the water in the tank rushes through the flushing pipe by a siphon action. The float valve allows the water from the inlet into the cistern. Once the water starts moving down the pipe, it starts a siphon effect. The rest of the water is drawn from the cistern and the emptying action takes only a few seconds causing a powerful flush in the WC below. The chain should be released immediately after being pulled to force the water out of the flush pipe. This cistern is supplied with water through a ball valve arrangement. The water inlet closes

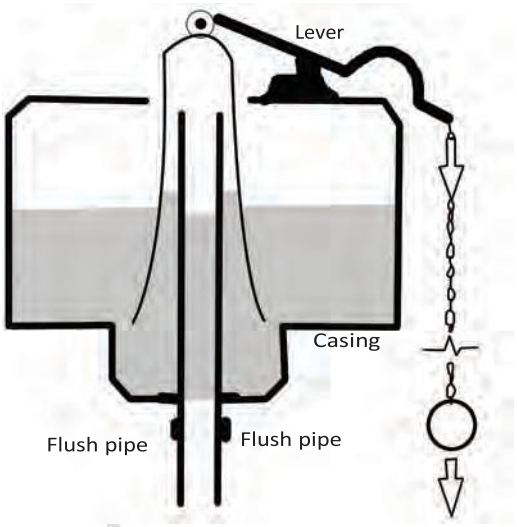


Fig 3.13 Bell Flushing Cistern

When the cistern is full and open when
it is empty, permitting entry of water. It also has an overflow pipe to drain out excess incoming water if the ballcock stops functioning to avoid overflow of water from the cistern into the toilet.

- **Flat-type Cistern**

This type of cistern is placed at a height of 3ft above the floor, are commonly used now. It is generally made of plastic and has a flat valve inside. It stops the water after the tank gets filled and starts after the tank becomes empty. Water flushes out at the press of a button.

Fig 3.14 Waterless urinals

- **Automatic Cistern**

This type of cistern is mainly used in urinals. A lot of water is used in these cisterns. These cisterns are mainly used in public places, for example, bus stands, railway stations, offices, etc.

6. Urinals

A device, usually attached to a wall into which men or boys can urinate. Urinal flushing is done by manual handles, time flush, automatic flush, waterless urinals.

- **Manual Handles**

Each urinal is equipped with a button or a short lever to activate the flush. Users are expected to operate it before they leave. Such a directly controlled system is the most efficient, provided the patrons remember to use it.

- **Timed Flush**

A constant drip-feed of water slowly fills the cistern, until a tipping point is reached. The valve opens (or a siphon begins to drain the cistern), and all the urinals in the group are flushed. Electronic controllers performing the same functions are also used.

- **Automatic Flush**

Electronic automatic flushes solve the problems of both previous approaches, and are common in new installations. Passive infrared sensors identify when the urinal has been used (or when someone has stood in front of it and moved away), and activate the flush. Thus, the urinal gets cleaned and water is not wasted when the toilet is not in use. With a manual flush it might not have been possible.

- **Waterless Urinals**

In this, a trap insert is filled with a sealant liquid instead of water. The lighter-than-water sealant floats on top of the urine collected in the U-bend, preventing odours from being released into the air. The cartridge and sealant must be periodically replaced.

7. Bidets

Bidets are primarily used to wash and clean. They may also be used to clean any other part of the body, such as the feet. Despite appearing similar to a toilet, it would be more accurate to compare it to the washbasin or a bathtub.

8. Bathtub

Installed in a bathroom, it is made of vitreous material, enamelled iron, plastic, marble, etc. Its length varies from 1.7 m to 1.85 m, the width is 70 cm × 75 cm and the depth varies from 43 cm to 45 cm to the outlet end. Cold and hot water taps are provided for filling the tank, and an overflow pipe is provided for excess water drainage. A waste coupling with a waste seal trap is provided at the drain with a rubber plug as in the washbasin.

Fig 3.15 Bathtub

9. Geyser

It is used for heating water. It is available in different capacities, up to 25 liters, as per requirement.

Fig 3.16 Geyser

3.2 Standard Height of Sanitary Fixtures

Wet room installations are largely standardized and sanitary ware is supplied in a range of fixed dimensions. In the figure shown below the graphic representation shows a typical height of the most common sanitary ware. The sanitary fixtures, height are in centimeters.

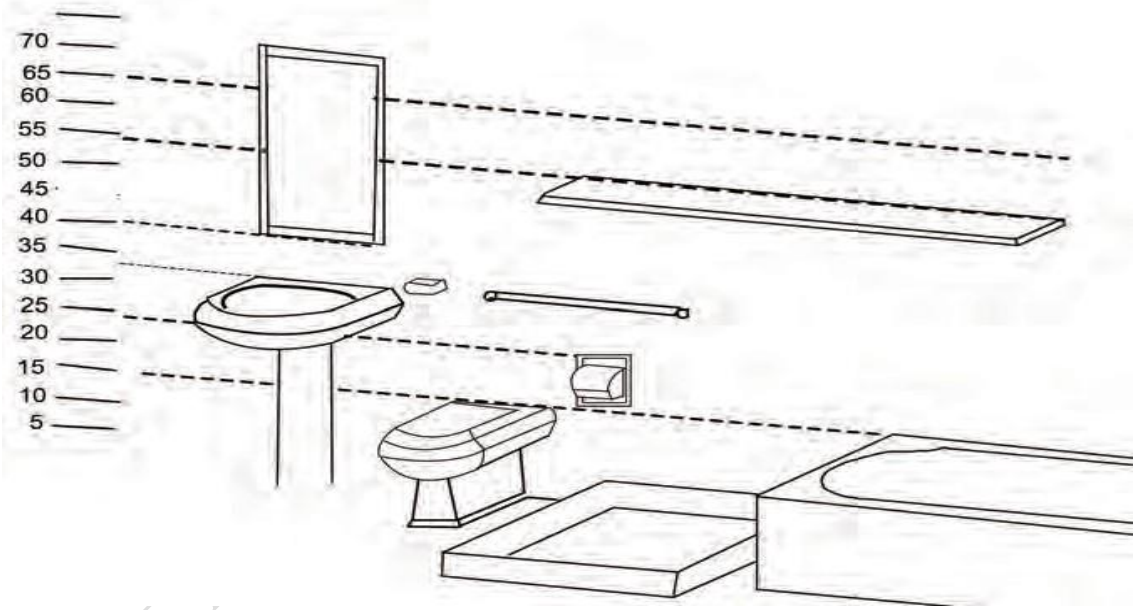


Fig 3.17 Standard height of sanitary fixtures (*Dimensions are in inches)*

3.3 Standard Dimensions for Installation

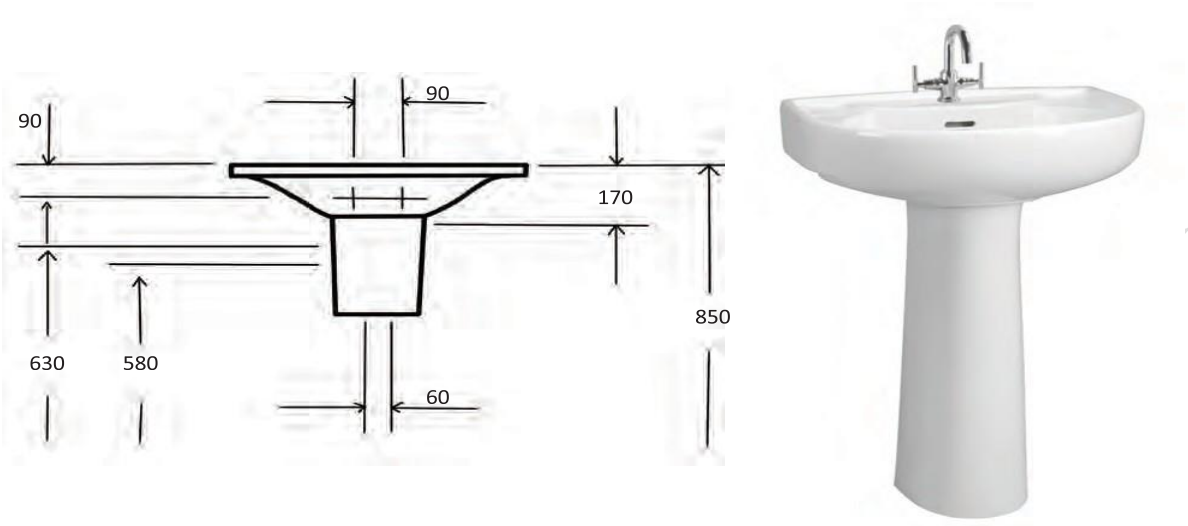


Fig 3.18 Installing a pedestal washbasin with a standard

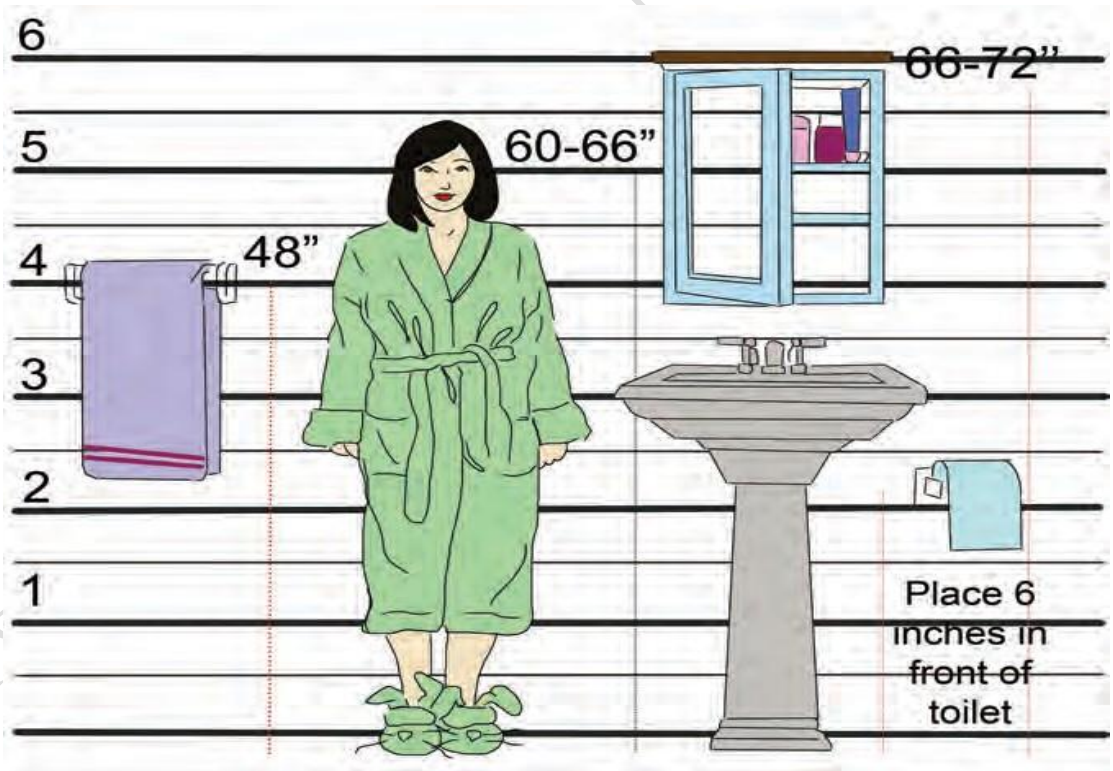


Fig 3.19 Standard height of fixtures in bathroom in inches

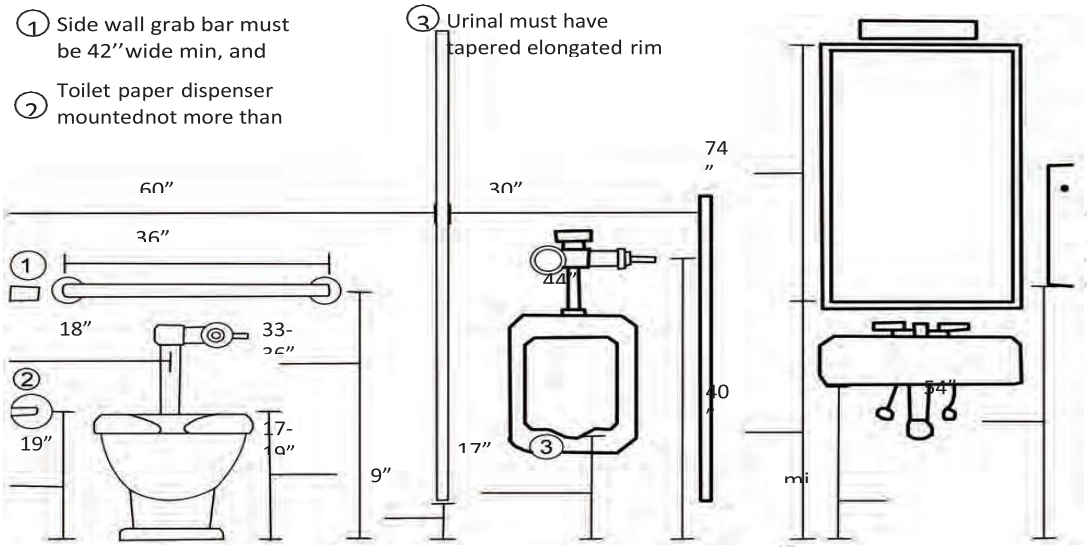


Fig 3.20 Standard toilet room specification in inches

ACTIVITIES

Activity 1: Make a list of plumbing fixtures fitted in your school

Material required

1. Drawing copy
2. Pencil

Procedure

1. Visit the school washroom.
2. Identify the different types of fixtures installed in the bathroom.
3. Note down the technical details of the fixtures in the bathroom.
4. Make a drawing for identifying the fixtures.

Activity 2: Sketch a washbasin

Material required

1. Pen
2. Drawing copy
3. Pencil

Procedure

1. Visit the bathroom at your home.
2. Identify the washbasin fitting.
3. Measure the dimensions.

4. Draw on your copy.

Activity 3: Measure the standard dimensions of installed of fixtures in the bathroom

Material required

1. Pen
2. Pencil
3. Copy

Procedure

1. Visit the bathroom at your home.
2. Identify the fitting fixtures in your bathroom.
3. Measure the dimensions with the help of a measuring tape.
4. Note down the dimensions in your notebook.
5. Discuss with the class teacher.

CHECK YOUR PROGRESS

A. Short answer questions

1. Name the various types of plumbing and sanitary fittings with neat sketches and describe any one of these.
2. Write short notes on (a) Washbasin (b) Bathtub (c) Types of sinks used
3. Give the general principle of design of sanitary fittings.
4. What are the sanitary provisions of a house?

B. Multiple choice questions

1. Which of the following is the average fixing height for a basin?

(a) 28–32 inches (b) 18–20 inches
(c) 22–25 inches (d) 35–40 inches

2. A flat-type WC must be fitted at a height of _____.

(a) 3ft (b) 2.5ft
(c) 1ft (d) 3.75ft

3. The fixture for the toilets used to carry out human excreta is _____.

(a) water closet (b) urinal
(c) tap (d) faucet

4. A bell flushing cistern is made up of _____.

(a) cast iron (b) metal
(c) wrought iron (d) chimney

C. Fill in the blanks

1. Washbasin is a _____ fixture used for washing hands.
2. A console washbasin is also wall-mounting that rests on _____.
3. A water closet (WC) is a fixture for the _____ used to carry out human excreta.
4. Timed flush is used to provide _____ at regular intervals.
5. Geyser is used for _____ water in bathroom.

Module 4	MAINTAINING A HEALTHY, SAFE AND SECURE WORK ENVIRONMENT

Module Overview

This module emphasizes safety measures for plumbers to ensure a secure working environment. It identifies common hazards faced by plumbers and the importance of safety checks to prevent accidents. The module introduces safety signs and symbols commonly seen on construction sites, their meanings, and their role in hazard communication. It also highlights the importance of Personal Protective Equipment (PPE) and provides guidelines for fire safety and precautions to manage fire-related risks effectively.

Learning Outcomes

After completing this module, you will be able to:

- Recognize common hazards faced by plumbers on-site.
- Perform safety checks to prevent accidents during plumbing work.
- Interpret safety signs and symbols used on construction sites.
- Use Personal Protective Equipment (PPE) effectively for workplace safety.
- Understand fire risks and implement necessary precautions to handle them.

Module Structure

4.1 Hazards to the Plumber
4.2 Safety check
4.3 Signs and Symbols on site
4.4 Personal Protection Equipment at work
4.5 Fire and its precautions

An accident can occur anywhere or everywhere if we do not follow or maintains a secure environment. Accidents occur due to improper handling of tools, machine or equipment. The fatal injury rate for the construction industry is higher than the national average in this category for all industries. “About 48,000 workers die in India due to occupational accidents, of which 38 fatal accidents take place every day in the construction sector. Construction industry contributes to 24.20% of occupation fatalities, the highest in the country annually,” the British Safety Council (BSC) has said. Construction sector is the number one sector employing maximum number of employees. It is important to that workers are oriented about hazards and their controlling them.

Within the plumbing industry, the plumber may be involved in a range of work activities, such as,

1. Installing hot water and gas services,
2. Replacing guttering and downpipes,
3. Laying and connecting water and sewage pipes and
4. Fixing washbasin or sewage blockage.

4.1 Hazards to the Plumber

Following are the hazards that may occur during the plumbing work**:**

1. Use of powered tools
2. Use of hand tools
3. Falls
4. Manual handling
5. Hazardous substances
6. Biological hazards
7. Electricity
8. Burns
9. Trenches and confined spaces
10. Sunburn and heat stress
11. Scaffolding

1. Use of Power Tools

Power tools are used to carry out everyday tasks in the plumbing industry. Power tools are operated by an additional power source, using electric motors, engines, compressed air, etc. These can present serious risks if not used and maintained correctly. The most common injury that can occur while using power tools is to the hands and fingers,

Fig 4.1 Using Power drill machine

which could get cut, broken or crushed. Eye injuries are often caused by pieces of material flying off while being cut or ground by power tools. Such injuries can lead to long periods away from work and sometimes result in permanent disability. Some commonly used power tools include air compressor, pneumatic wrench, power drill machine, etc.

2. Use of Hand Tools

These tools are manually operated and do not rely on a power source. Some commonly used hand tools include hammers, pliers, monkey wrenches, etc. These can also be dangerous if they are not used correctly. A common cause of accidents with hand tools is using the wrong tool for the job. For instance, if one uses a wrench for hammering work then it may hit one's fingers and cause injury. Thus, one should use hammer in place of a wrench.

Fig 4.2 Hand Tool

It is important for the plumber to wear the appropriate personal protective equipment (PPE) in order to protect oneself.

The personal protective equipment includes safety glasses or goggles, earplugs or earmuffs, protective gloves, overalls or other close-fitting clothing. Safety shoes or boots with reinforced toe-caps will protect one's feet if any heavy or sharp items are dropped.

3. Falls

Many plumbing tasks are carried out at varied heights and depths. These include plumbing work on roofs, installing or repairing gutters and downpipes, accessing roof cavities through manholes, etc. Safe work methods must be established before a worker is required to access the task. The options for work at height (in their preferred order) are as follows.

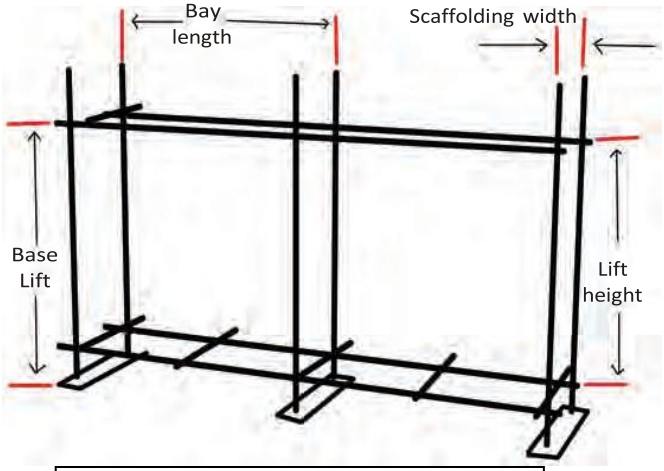


Fig 4.3 Fall

1. Use fall protection devices (such as temporary work platforms or scaffolding)
2. Use a work positioning system (such as a rope access system to position and support the worker for the duration of the task)

3. Use a fall injury prevention system (such as an industrial safety net or a safety harness)
4. Use a ladder, as long as it can be employed safely for the duration of the task. This will require procedures and training for the workers who will use it.

- **Protection from falls**

Each year, falls consistently account for the greatest number of fatalities in the construction industry. A number of factors are often involved in falls, including unstable working surfaces, misuse or failure to use fall protection equipment and human error. Using guardrails, fall arrest systems, safety nets, covers and restraint systems can prevent many deaths and injuries from falls.

Precautions

(i) Aerial lifts or elevated platforms should be considered to provide safer elevated working surfaces
(ii) Erect guardrail systems with toe boards and warning lines or install control line systems to protect workers near the edges of floors and roofs
(iii) Cover floor holes; and/or use safety net systems or personal fall arrest systems.

- **Ladders**

Ladders and stairways are another source of injuries and fatalities among construction workers. Injuries could occur due to bad quality ladder, loose ladder and narrow or steep, slippery stairways.

Precautions

(i) Use a ladder which is strong for the task.
(ii) Make sure that ladders are long enough to safely reach the work area.
(iii) Mark or tag ('Do Not Use') damaged or defective ladders for repair or replacement, or destroy them immediately.
(iv) Never load ladders beyond the maximum intended load or beyond the manufacturer's rated capacity. (v) Ensure that the load rating can support the weight of the user, including materials and tools.
(vi) Avoid using ladders with metallic components near electrical work and overhead power lines.

- **Stairways**

Slips, trips and falls on stairways are a major source of injuries and fatalities among the construction workers.

Precautions

(i) Stairway treads and walkways must be free of dangerous objects, debris and materials.

(ii) Slippery conditions on stairways and walkways must be corrected immediately.

(iii) Make sure that treads cover the entire step and landing The treads should be made enough wide so that there is no slipping. Stairways having four or more risers or rising more than 30 inches must have at least one handrail.

4. Manual Handling

A plumber's work often involves significant manual handling hazards. Handling heavy objects and moving them, often in uncomfortable postures because of lack of space to move freely, creates a risk of traumatic injury, such as a strained back. The need for continuous repetitive movements can lead to injuries due to exertion, affecting the neck, back, hand and arms over a period of time. Work should be arranged and monitored to minimise the risk of overuse injuries.

5. Hazardous Substances

Hazardous substances are chemicals used to carry out work, or present in the work environment. All of these may create hazards for plumbers if their use in the workplace is not managed withcare. These hazard substances may be Oxy-acetylene, Fluxes (solder), Lead, Hydrochloric acid, Degreasers and solvents, Adhesives or Caulking compounds.

Fig 4.5 Inhalation hazard Sign

Fig 4.6 Hazardous Toxic Gas sign

Fig 4.4 Acid injury on hands

6. Biological Hazards

Health effects of exposure to sewage include tetanus (caused by a toxin produced by a bacteria common in soil and sewage), leptospirosis (caused by a parasitic worm), hepatitis A, and parasites, such as giardia and cryptosporum. The degree of harm that can result depends on the microbes present, and the extent and duration of exposure. Microbes in raw sewage can enter the body through the nose or mouth, particularly if a person drinks contaminated water or by hand-to-mouth transmission.

1. Assume anything touched by sewage as contaminated.
2. Do not eat or drink in any sewage handling area.
3. Wash hands well with soap and clean water, preferably hot, before eating or drinking, and after touching any surface or object that may be contaminated by sewage.
4. Immediately wash and disinfect any wound that comes in contact with sewage.
5. Change out of work clothes before leaving the work site (soiled work clothes should be bagged and laundered separately from other clothing).
6. Wear appropriate protection.

This includes rubber boots and gloves, overalls and eye protection (wear goggles if a hose is being used, as safety glasses will not protect against splashing).

7. Electricity

Electric leads must be kept away from water. Because plumbers use powered tools in proximity to water supply in all weather conditions, there is always the possibility of electrocution if work practices do not consider the presence of electrical hazard. Insulated hot water pipes with 240-volt heat trace cables are used to maintain water temperature in many modern apartments. If power to the heat trace cable is not isolated, there is potential for electrocution when a plumber unknowingly cuts through the insulated pipe. Simply turning off the water supply valve will not shut down the power to the cable but the power supply should also be shut down.

Fig 4.7 Electric Plug

8. Burns

Hot water services store water at high temperatures. Maintenance and repair work must be carried out carefully to avoid scalds and steam burns. The unexpected release of hot water or steam could result in serious injury and permanent disfigurement.

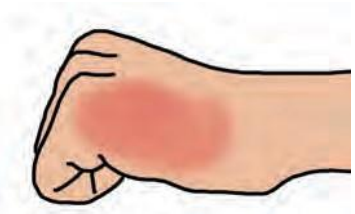


Fig 4.8 Burns

9. Trenches and Confined Spaces

Plumbers working in trenches, pits, tanks, beneath houses and in roof cavities must understand and plan for the significant hazards in confined spaces. In sewage systems, the release of toxic gases can cause the plumber to collapse, become unconscious and die. Before any worker begins a job in a confined space (such as a pit

or tunnel) where hazardous gases could be present or oxygen may be deficient, there must be a full assessment of the worksite and the safeguards required.

- **Trenching**

Trench collapses cause dozens of fatalities and hundreds of injuries each year.

Precautions

(i) Never enter an unprotected trench.

(ii) While entering a trench, proper support like ladder, ropes, oxygen cylinder, googles, etc., should be provided to the worker at a certain interval of depth.

(iii) Employ a registered professional engineer to design a protective system for trenches 20 feet deep or greater.

(iv) Always provide a way to exit a trench, such as a ladder, stairway or ramp—no more than 25 feet of lateral travel for employees in the trench.

(v) Keep soil at least two feet behind the edge of a trench.

(vi) Make sure that trenches are inspected by site engineer prior to entry and after any hazard increasing event, such as a rainstorm, vibrations or excessive surcharge loads.

10. Sunburn and Heat Stress

Workers who are exposed to extreme heat or work in hot environments may be at risk of heat stress. Heat stress can result in heat stroke, heat exhaustion, heat cramps, or heat rashes. Heat stress, sunburn and skin cancer can all result from prolonged exposure to ultraviolet radiation from the sun. The longer the skin is exposed, the greater the risk, regardless of tan or skin pigment.

Fig 4.9 Blisters due to sun

11. Scaffolding

A scaffold is a temporary structure made of bamboo or iron pipe to support workers to carry out the work. When scaffolds are not erected or used properly, fall hazards can occur.

Precautions

(i) Scaffold must be sound, rigid and sufficient to carry its own weight, plus four times the maximum intended load without settling or displacement. It must be erected on solid footing.

(ii) Unstable objects, such as barrels, boxes, loose bricks or concrete blocks must not be used to support scaffolds or planks.

(iii) The scaffold must not be erected, moved, dismantled or altered except under the supervision of person who supplies, installs and dismantles the scaffolding.
(iv) The scaffold must be equipped with guardrails, mid rails and toe boards.
(v) Scaffold accessories, such as braces, brackets, trusses, screw legs or ladders that are damaged or weakened must be immediately repaired or replaced.
(vi) Scaffold platforms must be tightly planked with scaffold plank grade material or equivalent. A plank is timber that is flat, elongated and rectangular with parallel faces that are high and long.
(vii) Synthetic and natural rope is used in suspension scaffolding, that is a hanging-type scaffolding. It must be protected from heat-producing sources.
(viii) The scaffold can be accessed by using ladders and stairwells.
(ix) The scaffolds must be at least 10 feet from electric power lines at all times.

4.2 Safety Check

For quality control of any work, a checklist for safety is prepared. A checklist is a list of items you need to verify, check or inspect. Checklists are used in every imaginable field—from building inspections to complex medical surgeries. Using a checklist allows you to ensure that you do not forget any important steps. These checklists are prepared for office work, construction site, handling of equipment, etc. These checklists are available with the user and agencies. This checklist should be followed in routine practice to maintain standard and quality. Adoption of these checklists will reduce accidents and hazards.

4.2.1 Precautions at Workplaces

For safe operation, following precautions should be ensured at the workplace.
(a) Precautions must be taken against a person falling from a working platform erected at various heights in a building.
(b) Protection against structural collapse (while work is taking place) i.e., the building falling down.
(c) Safeguards to be used when a person is working in excavations like well or mines.
(d) Care should be taken to prevent drowning (falling into water).
(e) Steps should be made for safe traffic routes (on sites) to avoid accidents.
(f) Prevention and control of emergencies services (site emergency evacuation procedures, etc.).
(g) Provision of welfare facilities—washroom, washing facilities, canteens/rest areas, shower facilities, (if required).
(h) Provision of site-wide issues—clean and tidy sites, adequate lighting, constant and fresh air supply, etc.

(i) Training, inspection and reports—training of staff, use of trained staff to do the work, supervision of staff and monitoring the work carried out to ensure it is carried out in a safe manner.

4.2.2 Reporting of Injuries, Diseases and Danger

For better working conditions in a factory or industry, it is necessary to record and report the injuries, diseases and danger that occur to a worker or employee. Special care should be taken to avoid dangerous occurrences like collapse of building, excavation, etc. It is always advisable to maintain an accident book document, where detail of all accidents is recorded, no matter how minor. Moreover, following points should be also checked.

1. Maintain a Material Safety Data Sheet (MSDS) for each chemical in the facility. Make this information accessible to employees at all times in a language or format that is clearly understood by all personnel.
2. Train employees on how to read and use the MSDS.
3. Follow the manufacturer's MSDS instructions for handling hazardous chemicals.
4. Train employees about the risks of each hazardous chemical being used.
5. Provide spill clean-up kits in areas where chemicals are stored.
6. Have a written spill control plan.
7. Train employees to clean up spills, protect themselves and properly dispose of used materials.
8. Provide proper personal protective equipment and enforce its use.
9. Store chemicals safely and securely.

4.3 Signs and Symbols on Site

Sign and symbols are used to inform and alert the people on all aspects. Some common safety symbols are discussed here.

- Circular red borders along with a cross bar and black symbols on a white background indicates what must not be done like 'No Smoking'
- White symbol on blue background indicates what must be done like 'Wear Eye Protection'
- Triangular yellow background with a black border and symbol inside warms of hazard or danger, for example, 'Danger Electric Shock Risk'.
- Square or rectangular white symbols on a green background indicates or gives information on safety provision like 'First Aid Facilities'.

Fig 4.10 Safety Symbols

4.4 Personal Protective Equipment at Work (PPE)

It is defined as any equipment (including clothing affording protection against the weather), which is intended to be worn or held by a person at work, and which protects them against one or more risks to their health. Following are included under PPE:

Fig 4.11 Eye Protection

(a) Eye protection: It comes in the form of

(i) Safety glasses—a typical application could be during lead welding

(ii) Safety goggles—these provide a higher level of protection than safety glasses, as they fit closely to the face.

(iii) Welding goggles—these include specialist coloured lenses.

(b) Hand protection: It is usually used in plumbing and includes the following.

(i) General-purpose gloves—these helps protect against cutting or puncture, wounds; an example of their use could be lifting concrete blocks or lifting steel tube.

(ii) Specialist gloves—these are typically used to deal with hazardous substances, such as dry ice used in pipe-freezing applications.

(iii) Rubber gloves—these helps protect against contact with waste systems and sanitary appliances. Gloves also provide protection against a disease known as dermatitis, which is caused by the hands coming in contact with materials classified as irritants.

Fig 4.12 Hand Protection

(c) Head Protection: Such injuries occur when we are not prepared to protect our head. Serious head injuries can get fatal. It is a mandatory requirement to wear a safety helmet when working on construction sites of multi-storey buildings or commercial housing, industrial building construction etc. In addition, a safety helmet needs to be worn while working at heights or in a trench. A safety helmet must:

(i) Be properly adjusted to fit.

Fig 4.12 Head Protection

(ii) Be replaced if it becomes defective or damaged.

(d) Foot protection: It is necessary to protect foot from injuries caused during plumbing installation work. It is necessary for workers to wear the standard safety boots.

Fig 4.13 Foot Protection

(e) Ear protection: It is used while working in noisy areas or with equipment that generate high levels of noise. Ear protection gear includes:
(i) Ear defenders
(ii) Ear plugs

(f) Respiratory protection: When there is dust at workplace, the efficiency of workers gets affected, hence, it is necessary to use respiratory protection system. Some important respiratory equipment is:
(i) Simple dust mask—this mask is used against normal pollution dust, etc.
(ii) Cartridge-type respirator—these masks can guard against a range of substances, such as high levels of dust or fumes; different disposable cartridges are required to protect against different types of substances.
(iii) Full breathing apparatus—usually used in specialist work in confined spaces, such as drains or sewers.

Fig 4.13 Respiratory Protection

4.5 Fire and its precautions

Fire is classified into groups according to the type of fuel
(i) Class A—fires involving solid materials, extinguished by water
(ii) Class B—fires involving flammable liquids, extinguished by foam or carbon dioxide
(iii) Class C—fires involving flammable gases, extinguished by dry powder
(iv) Class D—fires involving flammable metals, extinguished by dry powder

4.5.1 Fire-fighting Equipment

There is a variety of different types of firefighting equipment. In undertaking plumbing work you are more likely to come across the fire extinguisher as the main source of protection.

Type of extinguisher	Colour code	Main use
Water	Red	Wood paper or fabrics
Foam	Cream	Petrol oil, fats and paints
Carbon oxide	Black	Electrical equipment
Dry powder	Blue	Liquids, gases, electricalequipments

Following are the steps to use a fire extinguisher:

(i) An extinguisher should be kept in the immediate work area when not working

(ii) A fire extinguisher should only be used when it is safe to do so. Personal safety must come before attempts to contain a fire.

(iii) Fire extinguishers should only be used by those trained in their use

(iv) The following table shows the colour coding for extinguishers for dealing with the different types of fire.

4.5.2 Emergency Services and First Aid

During an emergency period, the following actions should be taken

(i) Find a telephone in a safe environment, well away from the emergency

(ii) Dial the emergency service number—Fire 102, Police 100, Ambulance 101

Summoning the Emergency Services

(a) Minimise the time taken for the emergency services to reach you

(b) Minimise the risk to operators, if there is an emergency

(c) Include environmental and other emergencies in your plan

(d) Employers and the self-employed need to assess the first aid requirements of their work

(e) Make sure there are enough trained first aiders and facilities to help casualties of illness or injury immediately, and that an ambulance or other professional help can be summoned without delay.

4.6 First Aid

It is necessary to have the following items in a first aid kit. These items help provide the patient immediate relief from pain or injury.

(a) Plasters
(b) Sterile dressings
(c) Triangular bandage
(d) Safety pins (sling)
(e) Disposable gloves
(f) Crepe bandages
(g) Scissors, tweezers
(h) Cotton wool tap/faucet
(i) Alcohol-free antiseptic wipes
(j) Sterile pads

Fig 4.14 First aid box

First aid assessment should consider:

(a) The nature of the work
(b) The history and consequences of injuries
(c) The nature and distribution of the workforce
(d) The remoteness of the site from the emergency services, including location, terrain and weather conditions (e) Working on shared or multi-occupied sites
(f) Holidays and other absences of first aiders
(g) The presence of trainees and the public
(h) The possibility of medical conditions or allergies

Safety Guidelines

Step 1 – Identify potential causes of workplace injury and illness

(i) Does the nature of the work being carried out pose a hazard to people's health and safety?
(ii) Have these hazards been identified in work that is being carried out?
(iii) Has incident and injury data been reviewed?
(iv) Has consultation with workers and their health and safety representatives occurred?
(v) Is specialist or external assistance required?

Step 2 – Assess the risk of workplace injury and illness

(i) How often does a hazard have the potential to cause harm?
(ii) What type of injuries would the hazard cause?
(iii) How serious are the injuries?

(iv) Does the number and composition of workers and other people affect how first aid should be provided?
(v) Could the size and location of the workplace affect how first aid is provided?

Step 3 – What first aid is required?
(a) First aiders
(i) How many first aid helpers are needed?
ii) What competencies do they require?
(iii) What training do they need?
(b) First aid kits and procedures
(i) What kits or modules are needed and where should they be located?
(ii) Is other first aid equipment needed?
(iii) Who is responsible for maintaining the kits?
(iv) What procedures are needed for my workplace?
(c) First aid facilities
(i) Is a first aid room or health centre required?

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ACTIVITIES

Activity 1 Visit to Fire Station

Material required

1. Copy
2. Pencil

Procedure

1. Fix an appointment with the Fire Station for a visit.
2. Reach the station as per schedule.
3. Discuss about all the safety tools, gadget and machines.
4. Do the handling and operating practice under the supervisor of fire station and teacher.

Activity 2 Drawing first aid equipment

Material required

1. First aid equipment
2. Tools
3. Drawing copy
4. Pencil
5. Rubber

Procedure

1. Select the fire safety equipment to be drawn.
2. Open the components with tools.
3. Draw the images of first aid equipment.

Activity 3 Draw the symbols and signs of safety at site

Material required

1. Pencil
2. Paper
3. Drawing sheet
4. Poster

Procedure

1. Identify the symbols and signs.
2. Draw the images.
3. Also write the uses of these symbols.
4. Display these posters in the classroom.

CHECK YOUR PROGRESS

A. Answer the following

1. Why is it important to comply with health and safety on site?
2. What general hygiene practices must be adhered at the workplace?
3. Why should the correct clothing, footwear and headgear be worn at all times?
4. Why is it important to maintain good personal hygiene?
5. What are the possible causes of fire in the working environment?
6. What preventive actions can be taken to minimise the risk of fire?
7. What organisational procedures should be followed in the event of a fire?
8. Why should a fire never be approached unless it is safe to do so?
9. What is the basic first aid that should be applied in the event of an accident?
10. What action should be taken to ensure the safety of an injured and uninjured?
11. Why it is important to use the correct lifting techniques?
12. What are the employee's responsibilities in relation to health and safety regulations?

B. Multiple choice questions

1. Fall Hazard occurs when scaffoldings are erected _____.

(a) Improperly (b) properly (c) timely (d) None of these

2. Slips, trips and falls on stairways are a major source of injuries and fatalities among _____ workers.

(a) Construction (b) retail (c) automotive (d) None of these

3. Trench collapses cause dozens of fatalities and hundreds of injuries each _____

(a) Year (b) month (c) time (d) None of these

4. Head can be protected by wearing the _____.

(a) Helmet (b) safety cap (c) gloves (d) None of these

5. Eye injuries can be prevented during work by wearing the _____.

(a) Safety glass (b) safety glass with side shield

(c) cap (d) None of these

C. Fill in the blanks

1. Powered tools are used to _____ everyday tasks in the plumbing industry.
2. Hand tools can also be _____ if they are not used correctly.
3. Plumber work often involves significant _____ handling hazards.
4. Electric leads must be kept away from _____.
5. Heat stress, sunburn and skin cancer can all result from prolonged exposure to ultraviolet radiation from the _____

Module 5	OPTIMUM UTILIZATION OF RESOURCES

Module Overview

This module focuses on efficient plumbing practices, including water, material and energy conservation. It covers the basics of electricity, common electrical and thermal equipment used in plumbing, and energy-efficient devices. The module also addresses the identification of electrical issues, electricity conservation practices, and waste management, including the use of color-coded dustbins and the separation of recyclable and non-recyclable waste. It concludes with methods to minimize waste generated from plumbing activities, promoting sustainability and efficiency in the workplace.

Learning Outcomes

After completing this module, you will be able to:

- Understand basic electricity concepts and common electrical equipment in plumbing.
- Identify energy-efficient devices and apply practices for electricity conservation.
- Separate recyclable and non-recyclable waste, following proper waste management practices.
- Implement methods to minimize waste generated during plumbing activities.

Module Structure

5.1 Efficient utilization of water in plumbing process
5.2 Efficient ways of managing material in plumbing process
5.3 Basics of Electricity
5.4 Common electrical and thermal equipment used in a plumbing workplace
5.5 Energy Efficient Devices
5.6 Indicators of common electrical problems
5.7 Common Practices of Conserving Electricity
5.8 Different colours of Dustbins
5.9 Recyclable and Non-recyclable Waste

5.10 Efficient Waste Management Practices.
5.11 Common ways to minimize waste generated from plumbing activities

When buying a home, you may be interested in having a sustainable home, and one of the most important aspects that you should not overlook the plumbing systems. With water contamination getting more and more common lately, it's important to understand how plumbing systems work and their impact on the environment. Drinking water is carried through these pipes every day and when choosing plumbing materials we must consider ecological toxicity, air pollution, fossil fuel depletion, and global warming.
The environmental impacts from the deteriorated plumbing include holes in pipes formed through corrosion, which allow the influx of contaminants into drinking water systems, the loss of the water resource itself, and resultant property damage.
Water puts food on the table and money in the bank. According to the UN's Food and Agriculture Organization, roughly 60–80% of severely food-insecure people rely on agriculture for their livelihoods (and their own nutrition). This includes farming of crops and raising livestock, as well as fishing.

5.1 Efficient utilization of water in plumbing process

Water can be used effectively by using following systems:

1. **Meter/Measure/Manage**: Implementing a system to meter, measure, and manage water consumption is crucial for efficient water management. This involves installing water meters to track usage, collecting and analysing data on water consumption patterns, and implementing management strategies based on the findings. By monitoring and managing water usage, you can identify areas of high consumption and implement targeted conservation measures.
2. **Optimize Cooling Towers**: Cooling towers are commonly used in large buildings or industrial facilities to remove excess heat from processes or air conditioning systems. Optimizing cooling tower operations involves regularly maintaining and cleaning the towers, adjusting water flow rates and temperatures, and using efficient cooling tower fill materials. By optimizing cooling towers, you can reduce water waste through evaporation and improve overall cooling efficiency.
3. **Replace Restroom Fixtures**: Upgrading restroom fixtures is an effective way to conserve water. Replace older, inefficient fixtures with low-flow toilets, urinals, and faucets. Low-flow fixtures are designed to use less water while still providing adequate performance. They often include features like aerators, flow restrictors, or sensor-based controls to minimize water usage.
4. **Eliminate Single-Pass Cooling**: Single-pass cooling refers to a cooling system where water is used once and then discharged without any treatment or reuse.

This approach can be highly wasteful. Instead, consider implementing closed-loop or recirculating cooling systems, which treat and reuse water, reducing the overall water consumption and minimizing waste.

5. **Use Water-Smart Landscaping and Irrigation**: Landscaping and irrigation practices can have a significant impact on water consumption. Adopt water-smart landscaping techniques, such as choosing drought-resistant plants, grouping plants with similar water needs, and using mulch to retain moisture. Install efficient irrigation systems, such as drip irrigation or smart irrigation controllers, which adjust watering schedules based on weather conditions and plant water requirements.

6. **Reduce Steam Sterilizer Tempering Water Use**: Steam sterilizers, commonly used in healthcare facilities and laboratories, require tempering water to cool down the sterilized items after the process. By implementing water-saving techniques such as using recirculating tempering water systems or optimizing cooling processes, you can reduce the amount of water required for sterilization.
7. **Reuse Laboratory Culture Water**: Laboratories often use large amounts of water for research and testing purposes, particularly in growing cultures. Implement water treatment systems to recycle and reuse laboratory culture water wherever possible. This can involve filtration, disinfection, and monitoring processes to maintain water quality standards for reuse.
8. **Control Reverse Osmosis System Operation**: Reverse osmosis (RO) systems are commonly used to purify water for various applications. However, they can consume a significant amount of water during the purification process. By optimizing RO system operation, such as adjusting recovery rates, monitoring system performance, and implementing efficient membrane cleaning procedures, you can reduce water waste and improve overall system efficiency.

Implementing these strategies can help organizations and individuals effectively manage water usage, reduce waste, and contribute to sustainable water management practices

5.2 Efficient ways of managing material in plumbing process

Efficient management of materials in plumbing work is important for optimizing resources, reducing waste, and ensuring the smooth execution of plumbing projects. Here are some efficient ways to manage materials in plumbing work:

1. **Plan and Estimate Accurately**: Thoroughly plan and estimate the materials needed for each plumbing project. Take accurate measurements, consider the specific requirements of the project, and factor in potential contingencies. This

helps minimize unnecessary material purchases and reduces waste.

2. **Optimize Material Procurement**: Seek competitive bids from suppliers and choose reputable vendors that offer quality materials at reasonable prices. Consider bulk purchasing for commonly used items to take advantage of economies of scale. Additionally, maintain good relationships with suppliers to ensure timely delivery of materials when needed, avoiding project delays.

3. **Inventory Management**: Implement an organized inventory management system for plumbing materials. Regularly track and monitor the stock levels to avoid overstocking or understocking. This helps prevent unnecessary material purchases and ensures that required materials are readily available when needed.

4. **Proper Storage**: Store plumbing materials in a clean, dry, and well-organized manner. Protect them from exposure to moisture, extreme temperatures, or other damaging conditions. Proper storage extends the lifespan of materials, reducing the need for premature replacements and wastage.

5. **Waste Reduction and Recycling**: Minimize waste generation by accurately cutting and measuring materials during installation. Salvage and reuse leftover or excess materials where possible. Additionally, segregate and recycle materials such as plastic pipes, copper fittings, or scrap metals in compliance with local recycling regulations.

6. **Implement Lean Construction Practices**: Apply lean construction principles to plumbing work. This involves optimizing workflow, eliminating unnecessary steps, and minimizing material handling. By reducing waste and improving efficiency, lean practices contribute to more effective material management.
7. **Collaboration and Communication**: Foster effective communication and collaboration among plumbing teams, contractors, and suppliers. Ensure clear channels of communication to address material-related issues promptly. This helps prevent errors, miscommunications, or delays that could result in wasteful practices or material misuse.

8. **Quality Control and Inspections**: Conduct regular quality control checks and inspections during and after plumbing work. This ensures that materials are installed correctly, minimizing the risk of leaks, failures, or premature replacements. Proper installation extends the lifespan of materials and reduces waste.

9. **Training and Skill Development**: Invest in training and skill development programs for plumbing teams. Well-trained plumbers are more likely to handle materials efficiently, reducing errors, and avoiding unnecessary material waste due to mistakes or rework.

10. **Documentation and Record-Keeping**: Maintain accurate documentation and records of material usage, receipts, and warranties. This helps track material consumption, identify patterns, and make informed decisions for future projects. It also aids in warranty claims and facilitates effective maintenance and repairs.

5.3 Basics of Electricity

An electric current is the rate of flow of electric charges in a circuit**.** Electricity is a form of energy that can be easily changed to other forms.

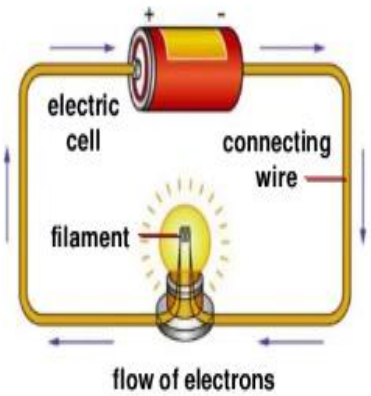

Fig 5.1 Flow of electricity

There are mainly two sources of electricity:

1. Electric cells (batteries)

- Supply a little electricity, portable, safe

Fig 5.2 Electric cells

2. Power stations

- Supply a lot of electricity, used in many electrical appliances

Fig 5.3 Power stations

To make an electrical appliance work, electricity must flow through it.The flow of electricity is called an **electric current**. The path along which the electric current moves is called the **electric circuit**.

5.3.1 Measurement of current

The SI unit for electric current is ampere (A). Smaller currents are measured in milliamperes (mA). Different electrical components and appliances require different sizes of current to turn them on.

1 A = 1000 mA
1 mA = 0.001 A

How does electricity flow?
The battery in a circuit gives energy to the electrons and pushes them around a circuit, from the negative's terminal of the cell, round the circuit and back to the positive terminal of the cell.

An ammeter is an instrument used for measuring electric current.

Fig 5.4 Ammeter

5.4 Common electrical and thermal equipment used in a plumbing workplace
Following are the electrical and thermal equipment used in a plumbing workplace:

1. **Drill machine:** An instrument with an edged or pointed end for making holes in hard substances by revolving or by a succession of blows. A drilling machine, also called a drill press, is a powerful tool used to cut a round hole into or through metal, plastic, wood, or other solid materials by turning and advancing rotary drill bits into a workpiece.

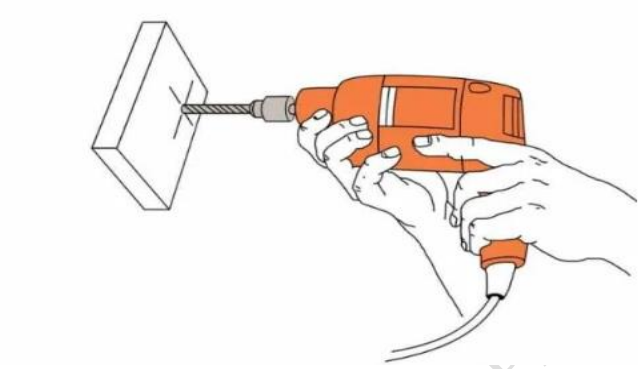

Fig 5.5 Drill Machine

- **Traditional drill:** A drill is a tool used for making round holes or driving fasteners. It is fitted with a bit, either a drill or driver chuck. with hand-operated types dramatically decreasing in popularity and cordless battery-powered ones proliferating.

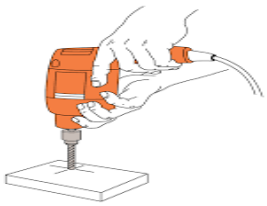

Fig 5.6 Traditional Drill

- **Hammer drill**: Hammer drills are used for drilling holes into concrete and masonry to install brackets to hold up water and waste pipes. A good quality, battery operated hammer drill is a must. When purchasing your hammer drill check the chuck size needed for the type of work you do onsite.

Fig 5.6 Hammer Drill

- **Cordless drill:** A cordless drill is an electric drill which uses rechargeable batteries. Drills are primarily used for drilling circular holes in material, or for inserting screws and other threaded fasteners into material. Drills are also available in the impact driver configuration, high-torque tools primarily used for driving screws and tightening nuts. Impact drivers can be especially useful when driving larger fasteners or driving into harder, more dense materials. Always use a spoil board under your work piece when using a handheld drill. Ref. Fig. 5.7

Fig 5.7 Cordless Drill

2. **Tester:** A test light, test lamp, voltage tester, or mains tester is a piece of electronic test equipment used to determine the presence of electricity in a piece of equipment under test. Ref. Fig. 5.8

Fig 5.8 Tester

3. **Chain saw:** Chainsaws are mechanical power tools that are commonly found everywhere – homes, construction sites, car shops, and machine shops. They are identified by their rotating teeth which are attached to a rotating chain on a guide bar. A cylinder engine with a battery pack or gasoline is essential to power the chainsaw. Ref. Fig. 5.9

Fig 5.9 Chain tester

4. **Air Testing U Gauge Kit:** Used to test drains and sewers in accordance with Building Regulations. Ref. Fig. 5.10

Fig 5.10 Air testing U Gauge kit

5. **Solder Capillary Lead-Free Wire:** Used to produce perfect joints quickly and effectively. Ref. Fig. 5.11

Fig 5.11 Solder Capillary Lead-Free Wire

6. **Super Fire 2 Torch**: Used for soldering and brazing. Ref. Fig. 5.12

Fig 5.12 Super Fire 2

7. **Propane torch:** A propane torch is a tool normally used for the application of flame or heat which uses propane, a hydrocarbon gas, for its fuel and ambient air as its combustion medium. Ref. Fig. 5.13

Fig 5.13 Propane Torch

8. **Snake Machine**: Used to dislodge clogs in plumbing. Ref. Fig. 5.14

Fig 5.14 Snake Machine

9. **Borescope:** Used to non-destructively inspect industrial systems and equipment for condition, manufactured parts for quality and security, and law enforcement for contraband, intelligence, and safety. Ref. Fig. 5.15

Fig 5.15 Borescope

10. **Heat Shields/Pads:** Used to protect objects from overheating. Ref. Fig. 5.16

Fig 5.16 Heat Shields/Pads

11. **Standard U-Gauge Manometer:** Used to measure the pressure that the difference in column heights is also a common unit. Ref. Fig. 5.17

Fig 5.17 Standard U Gauge Manometer

12. **Abrasive Mini Strips:** Used for roughing up, deburring, and removing paint and oxides from copper pipe and fittings prior to soldering. Ref. Fig. 5.18

Fig 5.18 Abrasive Mini Strips

13. **Fire resistant cloth:** Flame-resistant clothing refers to any garments that are specifically designed to protect the wearer from flames and thermal injury. It resists ignition and self-extinguishes once the source of the ignition is removed. Ref. Fig. 5.19

Fig 5.19 Fire resistant cloth

5.5 Energy Efficient Devices

Energy efficient appliances and equipment use technologies that are less energy intensive to reduce the amount of electricity used per product.

Energy efficient plumbing can be a great investment for ease and convenience alone! These systems are by far easier to use than older units, as their technology is typically more functional and advanced. Because they conserve energy, these appliances can operate in less time, offering faster results and ultimately improving the quality of your home. They also tend to be more user-friendly and offer a greater degree of unique features for homeowners.

The beauty of energy efficient appliances is that they tend to have longer lifespans because they require less power and force to run properly. With reduced stress on the appliances' operations, there ends up being less wear and tear on the systems at large, resulting in better longevity and less repairs. As long as you have the systems installed by a reputable and experienced professional, you can rest assured they will have a longer lifespan.

Some common examples of Energy- Efficient Devices:

- Smart Thermostats.
- LED Lighting.
- Energy Management Systems.
- Energy Star Appliances.
- Charging Stations.
- Smart Power Strips

5.6 Indicators of common electrical problems

Here are some common electrical wiring problems and their solutions

1) Electrical surges: It can be occurred due to poor wiring in the house or lightning strikes or faulty appliances or damaged power lines. Surges are common and last for a microsecond but if you experience frequent surges lead to equipment damage that degrade life expectancy particularly.
Check the device that connects to the home grid or the wiring and try disconnecting the poor-quality power boards or devices from the outlet. If the surges don't occur again, your problem is solved. If it is not, you must call an electrician.

2) Overloading: Sometimes your light fixture has a bulb or other fitting with high watts than the designed fixture. This is a code violation and the risk level is quite high. The high

heat from the bulb can melt the socket and insulation present in wires of the fixture. This results in sparks from one wire to another and causes electrical fires. Even after the bulb is removed, the socket and wires will still be under damage.
It is always better to fit a bulb or any other fittings by staying within the wattage. If the fixtures are not marked with wattage, it is advisable to use a 60-watt bulb or even smaller ones.

3) Power sags and dips: Sags are dips usually occur when the power grip is faulty and electrical appliances are connected to it. It also occurs when the grid is made of low-quality materials. When this is the case, it draws more power when switched on.

4) A junction box that is uncovered: The junction box has lots of wires that are connected to each other. If it is not covered, a person gets a shock from damaged wire too. This is a code violation and the risk is minimal if the wires are not within the reach. Thus it is better to cover it with the screws provided.

5) Switches of light not working: You can easily point out if it bad workmanship or sub-standard products with dim switches that don't work on adjusting the lights properly. It can also be the fault of wiring or circuit or outlet. You can consult an electrician for this issue.

6) Flickering light: You might have experienced with your frayed wiring when it is windy outside that causes a short when the cables move. It is not a code violation but has a higher level of risk as it can suddenly start a fire. Immediately call the electrician to get Weather head replaced.

7) Tripping circuit breaker: When other high-power consuming items are used before you plug in microwave or hairdryers there is a chance to get it tripped. Tripping is actually a sign that your home is protected. Just check what causes tripping and try using a low setting and also users can be limited to a single circuit too.

8) Less outlets: Nowadays most of the houses have extension cords and power strips to rely heavily on them. If you don't use heavy load extension cords like 14-gauge or thicker the risk will be minimal.
Thus, it is advisable to use more outlets with the help of an electrician.

9) Electric shocks: When the electricity is not properly used, it results in electrical shocks with a nasty experience. The chances of such electrical problems in old homes were quite high because the circuits fitted during older days. An electric shock happens

when you switch on or off a device. The issue can either be with the appliance or the wiring. To check the issue, you can test with another device.

10) No RCCB (Residual Current Circuit Breaker): RCCB is also known as Earth Leakage Circuit Breaker (ELCB). This is used to disconnect the load from main supply when the circuit has residual current. By using RCCB you can ensure protection against direct and indirect contact, electric fire and protection of earthing against corrosion.

11) Frequent burning out of light bulbs: If your light bulbs burn out too often, check if your issue falls under this:

➤ High wattage

➤ Insulation is near to light

➤ Poor wiring on circuit and mains

➤ More wattage on a dimmer switch

12) Over circuited panel: It is a code violation to place tandem breakers in one slot rather than too many single-pole breakers. The difference between double-pole breakers and tandem breakers are that the latter one doesn't take up two slots in a single circuit. The danger level will be minimal. This problem can be resolved by adding a sub-panel with extra slots or replacing the existing panel with a bigger model.

13) High electric bill: You can reduce electric bills by:

- Repairing damaged circuits or wiring
- Unplugging electronic devices when not in use
- Relying on a cost-effective service provider
- Recognizing power surging devices

14) Aluminum wiring: It has a high danger level as aluminum was used as a cheap substitute for copper in earlier days and is no longer a safe option. This is because corrosion takes place when aluminum is in contact with copper and when the connections loosen, it leads to fires.

The solution for this issue is retrofitting a dielectric wire nut for an aluminum wire to copper connection in case of light fixtures. This helps in stopping corrosion due to the grease in the nuts.

15) Backstabbed wires: The pushed wires at the back can be loose for new switches than those anchored around screw terminals. This is not a code violation as it is allowed

for new constructions too. The risk occurs only when the loose wires are worst in case otherwise it stops the switch from working.

5.7 Common Practices of Conserving Electricity

Following are some basic practices which can help in conserving electricity:

6 Adjust your day-to-day behaviours
7 Replace your light bulbs
8 Use smart power strips
9 Install a programmable thermostat
10 Use energy efficient appliances
11 Reduce water heating expenses
12 Install energy efficient windows
13 Upgrade your HVAC system
14 Weatherize your home
15 Insulate your home
16 Wash your clothes in cold water
17 Replace your air filters
18 Use your microwave instead of your stove
19 Use natural light
20 Dress appropriately for the weather inside and outside.
21

Importance of checking if the equipment/machine is functioning normally before commencing work and ensuring is rectified.
Safety Inspections ensure that all equipment is safe before use. Of course, the primary purpose of safety is the well-being of employees, but there are also compelling business reasons for using equipment inspections to increase safety. Workplace injuries lower productivity due to lost work time.
The purpose of an inspection is to identify whether work equipment can be operated, adjusted and maintained safely, with any deterioration detected and remedied before it results in a health and safety risk.

5.8 Different colours of Dustbins.

There are the following colours of dustbins-

1. Green colour dustbin: Green-coloured dustbins are meant for wet and biodegradable wastes. For e.g.: kitchen wastes including vegetables and fruit skins.

Fig 5.19 Green Colour dustbin

2. **Blue colour dustbin:** It is meant for disposal of plastic wrappers and non-biodegradable wastes.

Fig 5.20 Blue Colour dustbin

3. **Yellow colour dustbin**: This dustbin is meant for paper and glass bottles.

Fig 5.21 Yellow Colour dustbin

4. **Red colour dustbin:** It is used for waste that is not biodegradable. It is also regarded as rejecting dustbins as these wastes cannot be recycled.

Fig 5.22 Red Colour dustbin

5. **Black colour dustbin:** Black bin, make up for the third category, which is used for domestic hazardous waste like sanitary napkins, diapers, blades, bandages, CFL, tube light, printer cartridges, broken thermometer, batteries, button cells, expired medicine etc.

Fig 5.23 Black Colour dustbin

a. **Grey colour dustbin**: grey bin is for the collection of materials that cannot be recycled. Some local retailers have introduced collections of soft plastics. You may be able to recycle more of your waste using these facilities

Fig 5.24 Grey Colour dustbin

5.9 Recyclable and Non-recyclable Waste

Recyclable resources: Recyclable resources are those substances that can be reused in any form again and again after use.

For example- one can turn a plastic bottle into a pen stand or can transform it into any other new item by recycling it.

Recycle materials- glass, paper, cardboard, metal, plastic, tires, textiles, batteries, and electronics

Non-recyclable substances: Non-recyclable substances include all those which cannot be used again and again. 90% of toys for example are made from plastics that are not recyclable.

For example- polythene bags, Garbage, Food waste, Food-tainted items (such as used paper plates or boxes, paper towels, or paper napkins), Ceramics and kitchenware, Windows and mirrors, Plastic wrap, Packing peanuts and bubble wrap, Wax boxes.

5.10 Efficient Waste Management Practices.

Waste management is important as it saves the environment from the toxic effects of inorganic and biodegradable element present in waste. Mismanagement of waste can cause water contamination, soil erosion and air contamination. Waste can be recycled if collected and managed efficiently. Some methods for waste management are -

1. Recover through Recycling.
2. Biological Reprocessing.
3. Dump in a Sanitary Landfill.
4. Waste to Energy (WtE)
5. Composting: Creating rich humus for your garden and lawn.
6. Bioremediation.

7. Thermal Treatment: Incineration.

5.11 Common ways to minimize waste generated from plumbing activities

The most desirable method of waste minimization is source reduction, which reduces the impact of chemical wastes on the environment to the greatest extent.

Simply put, waste causes pollution, contributes to climate change and squanders more money, energy and natural resources than most of us realize. Making small changes we make in our everyday lives can make a powerful difference to the health of all living things and the province and planet we call home.

There are a number of ways you can reduce waste and save money. You could:

- Work out your own ways of eliminating waste from your work, e.g. by using leftover materials from one job on the next one - this is usually cheaper than having to dispose of waste and is better for the environment. For example, you could reuse lengths of pipework during and between projects.
- Avoid over ordering, as this increases waste.
- Think about the types of waste you produce and whether they need to be dealt with as hazardous waste.
- Make sure you recycle any waste - this applies to many plumbing materials including copper, steel, lead, cast iron and aluminum.
- Reduce your packaging waste - e.g. some pipework does not require any packaging at all and can be unloaded directly off the delivery vehicle.
- Consider alternative, shorter routes for pipework.
- Purchase pre-fabricated pipework - this will reduce waste generated on site and also cut the cost of labour as installation is much quicker.\
- Speak to your suppliers to find out if they use returnable packaging - e.g. crates and pallets - for products, which can be returned for reuse.
- Keep stores secure, dry and organized - bad storage can cause considerable waste.
- Protect completed work so it is not damaged by others. 'Just-in-time' delivery for pre-fabricated pipework could increase available storage on site as well as reducing the likelihood of materials becoming damaged.
- Use materials with recycled content.
- Design pine-runs to use as few fittings as possible and save resources by fitting the minimum sizes of boiler, radiators and tanks.
- Use water-saving dual-flush systems and put hippo bags in existing cisterns to reduce water use.

- Insulate pipework to prevent heat loss and frost damage.
- Avoid flushing systems into surface water drains.
- Make sure customers know how best to use what you have installed - leave manuals and clear maintenance instructions.

ACTIVITIES

Activity 1: Enlist the thermal and electrical equipment used in plumbing system and mention the uses of each.

Material Required:

1. Electrical equipment used in plumbing system
2. Thermal Equipment used in plumbing system
3. Note book
4. Pen

Procedure:

1. With the help of class teacher collect all the thermal and electrical equipment.
2. Write one by one the name of each of the components leaving some space after each title.
3. Write the properties of each of the component.
4. Discuss the properties of every component.

CHECK YOUR PROGRESS

A. Answer the following

1. Explain the common indicators of electrical problems.
2. Define the term electricity?
3. Write the importance of report malfunctioning.
4. Discuss common sources of pollution and ways to minimize.
5. List the important plumbing tool with the power.
6. Name the method of waste management at site.
7. Define waste management.
8. Write the difference between recyclable and non-recyclable resource.
9. How does electricity flow?

B. Fill in the blanks

1. …… dustbin is used for waste that is not biodegradable.
2. …….. resources are those substances that can be used in any form again and again.

3. …….. Wiring is place of copper wiring is used which is not a safer option.
4. The path along which the electric current moves is called……..
5. 1 mA = …….. A.

ANSWER KEY

Unit 1: Basic Building Construction

B. Multiple choice questions

1. (c) 2. (e)
3. (d) 4. (d)
5. (d)

C. Fill in the blanks

1. Water 2. Hole
3. Groove 4. Fasten

Unit – 02 Pipes – Cutting, Threading, Joining, and Testing of pipelines

B. Multiple choice questions

1. (a) 2. (b)
3. (d) 4. (b)
5. (a)

C. Fill in the blanks

1. Bottom 2. Pressure
3. Thread per Inch 4. ½, 2/3

Unit -03 Plumbing and Sanitary Fixtures

B. Multiple choice questions

2. (c) 2. (a)
3. (a) 4. (a)

C. Fill in the blanks

1. Bowl Shaped 2. Legs
3. Toilets 4. Water
5. Heating

Unit-04 Maintaining a Healthy, Safe and Secure work Environment

B. Multiple choice questions

1. (a) 2. (a)
3. (a) 4. (b)
5. (a)

C. Fill in the blanks

1. Carry out 2. Dangerous
3. Manual 4. Water
5. Sun

Unit -05 Optimum utilization of resources

B. Fill in the blanks

1. Red
2. Recyclable
3. Aluminum
4. Electric current
5. 0.001

GLOSSARY

Guarded system: prevents the operator from having any part of their body in the danger zone during the operating cycle.

Landing: is the area of a floor near the top or bottom step of a stair. An intermediate landing is a small platform that is built as part of the stair between main floor levels and is typically used to allow stairs to change directions, or to allow the user a rest.

Risers: a vertical section between the treads of a staircase.

Scald: injury caused due to hot liquid or steam.

Shoring: is the construction of a temporary structure to support a temporarily unsafe structure. These support walls laterally.

Steps: stairs and steps share a single meaning. Both refer to a series of steps—those 'structures consisting of a riser and a tread.'

Toe board: is a long piece of wood nailed horizontally along a roof in various places. The purpose of a toe board is to safeguard tools, equipment and objects that fall from the edge or is being pushed down from the structure.

Tread: a stair tread is the horizontal portion of a set of stairs on which a person walks.

Trench: a long, narrow ditch.