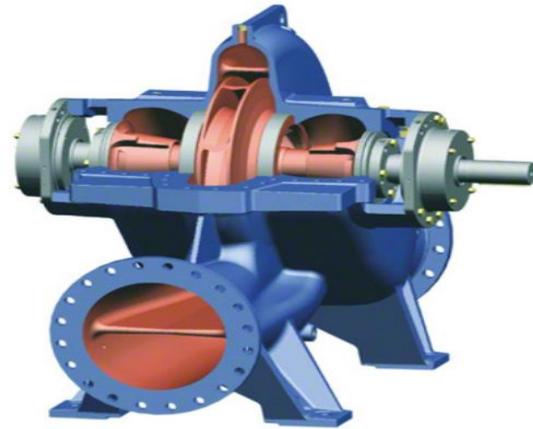


# Textbook of Plumbing and Solar Water Heating System-I Matric Tech Grade-X



National Vocational & Technical Training Commission (NAVTTC)

**Textbook of**  
**Plumbing and Solar Water Heating System-I**  
**Grade - X**



**National Vocational and Technical Training Commission**  
**(NAVTTC), ISLAMABAD**

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**Management:** National Vocational and Technical Training Commission H-9, Islamabad.

**Edition:** Test Edition,

**ISBN**-----

**Printer:** Gul Awan Printers

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## **PREFACE**

Any building however costly, without proper plumbing system, is only a skeleton. Proper plumbing alone adds life to the building and the inhabitants. Hence proper plumbing system as per the code of practices with the correct specifications of materials like pipes and fixtures should be used to make buildings sustainable.

This book has been written to meet the requirements to train the students of Matric Tech in plumbing. Matric Tech in plumbing has been introduced first time in the history of Pakistan. This textbook is the first national effort to describe the topics related to plumbing and solar water heating system in one book. The content is equally helpful for the students of various plumbing systems.

A key attempt has been made to make the book interesting and useful. All the chapters cover the basic details understandable to the students of secondary school level. All chapters include plumbing relevant activities and also assessments in form of MCQs, short questions and long questions.

Suggestion from the teachers/ instructors as well as students from the different institutions for the improvement of this book would be acknowledged and welcomed with thanks.

**Executive Director  
National Vocational & Technical Training Commission  
(NAVTTTC)**

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## CHAPTER -01

### INTRODUCTION TO GI PIPE & FITTINGS



**After Studying this unit you will be able to:**

- identify G.I pipes
- identify different classes of G.I pipes.
- observe the basic principle of G.I Pipes.
- know about fitting and their names.
- demonstrate fittings male and female parts.
- learn purpose of fittings.
- learn uses of all G.I fittings.
- learn uses of male and female types of fitting.

## 1.1. Introduction to G.I pipes

### GI Pipes and Tubes

GI stands for “galvanized iron.” Thus, GI pipes are galvanized iron pipes or called coated iron pipes in old terminology. GI carbon steel pipes are immersed in a galvanic (zinc) bath. These pipes are cheaper, of lightweight and easy to handle.

### GP Pipes and Tubes

GP stands for “galvanized pipe.” GP Pipes are made of thin sheets of carbon steel electroplated with zinc and then rolled into pipes. GP pipes are superior to GI pipes in terms of finish. Galvanized pipes are dipped in a protective zinc coating to prevent corrosion and rust. This piping was commonly installed in homes built before 1960. When the galvanized pipe was invented, it became an alternative to lead pipe for water supply lines.

#### 1.1.1. Identification of G.I pipes

Galvanised Iron (GI) Pipes are manufactured using mild steel strips of Low Carbon Steel Coils. The strips are passed through a series of fin rolls to give them a circular shape. The slit ends of the strips are then welded together by continuously passing high frequency electric current across the edges. The welded steel pipes are then passed through sizing sections where any dimensional deviations are corrected. The pipes are then cut into desired lengths by automatic cutting machines. The tubes are then pressure tested for any leaks randomly. The galvanization and varnishing of pipes are done as per specific requirements.

The GI Pipes are generally used for distribution of treated or raw water in rural or urban areas. These pipes are cheaper, light weight and easy to handle.

G.I pipes are made of mild steel sheet. Its length-wise joint is Welded Seam Type. G.I pipe is used to supply gas, water, or any other liquid within the building.

These types of pipes are prepared from 12 mm to 150 mm in diameter. They can be found in 6 meters length. The thickness of the wall of its sheet is different based on their diameters. After preparing this pipe, it's dipped in a zinc solution.

This action is called Galvanizing. In this way, the pipe is saved from rusting. The average age of this pipe is ten years.

They may be joined easily, threading, cutting, and bending them is also an easy task. They are joined with the help of a socket. These pipes are light-weighted and cheap. Acidic and alkaline waters affect these pipes badly.

#### 1.1.2. Identification of different classes of G.I pipes.

GI (Galvanized Iron) Pipes are classified into 3 Grades based on their weight per meter and inner diameter thickness. The more the thickness, better the performance and durability. According to



the codes each pipe shall bear a colour strip across the circumference for identifying the “class” of the GI pipes.

#### **Class A - Light**

These are light gauge pipes which bear a yellow colour strip for identification. They are cheaper than other classes of GI Pipes.

#### **Class B - Medium**

These are medium gauge pipes which bear a blue colour strip for identification. They are Costlier than Class A and Cheaper than class C.

#### **Class C - Heavy**

These are heavy gauge pipes which bear a red colour strip for identification. They are Costlier than other classes of the GI Pipes.

### **1.1.3. Basic Principles of G.I Pipes.**

GI (galvanised iron) pipes in the internal work of a building are laid either on the surface or concealed in the wall. For fixing on the surface, the pipes should be kept 1.5 cm apart from the wall and should be laid perfectly vertical or horizontal.

GI pipes should not come in contact with lime or lime-mortar. They should be treated with anti-corrosive paints

Whenever a pipe passes through a wall, provision of expansion should be made. Under the floors, the pipes must be placed in the layer of sand to allow expansion.

#### **Activity 1.1: Demonstrate G.I pipes as job per requirements.**

The teacher/ instructor is required to demonstrate different types of G.I pipes as job per requirements. with examples. Students are required to ask each other through cross questions different types of GI pipes.

#### **Activity 1.2: Classification of Pipes according to its function as per job requirements.**

The teacher/ instructor is required to demonstrate classification of pipes according to their function as per job requirements. Students are required to ask each other through cross questions different types of pipes according to their function.

## **1.2. Introduction to G.I pipe fitting**

Pipes are required to be jointed for different purposes. The components which are used to join pipes are known as fittings.

### **1.2.1. Fitting and Their Names.**

Different pipe fittings and their functions are explained below.

Elbow	Bend	Reducer	Tee type
Cross type	Coupling	Unions	Adaptors
Olet	Plug	Bush	Cap
Flange	Barb	Nipple	Socket
Cross over	Check nut	Mechanical Sleeve	Valve

**Elbow**

Elbows are used to change the direction of flow between two pipes. Elbows are generally available with an angle of 22.5°, 45° and 90°. The change of direction is sharp. If pipes are of same diameter, then normal elbows are used otherwise Reducer elbows are used. Elbows are made of different materials. These are generally coming with female threads and we can fix them by butt or socket welding also.

**Bend**

Bends are used to change the direction of flow between two pipes. Bends are generally available with an angle of 90°. The change of direction is with curve. Long radius pipe bends are used in fluid transportation pipelines requiring pigging. Such pipe fittings have very less pressure drop and smooth flow due to their long radius and smooth direction change. Common long radius pipe bends are 3D and 5D Pipe bends where D is the pipe size.

**Reducer**

Reducer is a pipe fitting component which reduces the flow size from larger to smaller by reducing size of pipe. Usually there are two types of reducers are available. One is concentric reducer which is like cone shaped with gradual decreasing around the pipe but in this case accumulation of air may possible and it results in cavitation. Other one is eccentric reducer which is having one edge parallel to connecting pipe due to which air accumulation is not possible.

*Bend (M/F)**Concentric Reducer**Eccentric Reducer***Tee**

Tee type fitting is a component of plumbing system which is in T-shape. It is having one inlet and two outlets; outlets are arranged at 90° to the main line connection (inlet). It can also be used to combine the flow from two inlets to one outlet. They are also available in different materials and different sizes. If the 3 sides of T-fitting are similar in size then it is called as Equal tee otherwise it is called as Unequal tee.

*Tee**Equal Tee**Reducer Tee***Cross**

Cross type fittings contain 4 opening in 4 directions. These are connected when there are 4 pipes are meeting at a point. These fittings generate more amount of stress on pipe as the temperature changes, because they are located at the centre of four connection points. Cross fittings are generally used for fire sprinkler systems.

**Coupling**

A coupling is used to connect the pipes of same diameter. Coupling is also useful if the pipe is broken or leakage occurs. Generally, two types of couplings are available. Compression coupling and slip coupling. Compression coupling is regular coupling which is connected between two pipes and it prevents leakage by the arrangement of gaskets or rubber seals on both sides, otherwise glue is provided. Slip coupling is easier to install and it contains two pipes which are arranged as one into other, inner pipe can slide up to some length. So, we can fix long length damaged pipe by slip coupling.

**Unions**

Union is a type of fitting, which functions as similar to coupling. But coupling cannot be removed after fixing but in this case, we can remove the union whenever is needed. Unions consists nut, male and female ended threads. So, this is also useful for maintaining purpose of pipe.

*Cross***Coupling***Union***Adaptors**

If the pipes are not having special ends or plain ends then adaptors make them threaded either male or female whichever is needed. Adaptors are generally used for copper and PVC pipes. Male

adapters contain male threads and female adapters contains female threads. One end of adapter is plain which is glued or welded or soldered to the plain pipe end.



*Male Adapter*



*Female Adapter*

### Olet

Olets are used where standard sizes of fittings are not suitable for our requirement. Sometimes the inlet pipe size is larger compared to outlet pipes in t-sections then also Olets are used. There are many types of olets available. Some important types of olets are given as under:

- Butt-Weldolet
- Socket weld Olet
- Threaded olet
- Elbow olet
- Nipple olet
- Lateral olet
- Sweepolet
- Flange olet



*Butt Weld Olet*



*Socket Weld Olet*



*Threaded Olet*



*Elbow Olet*



*Nipolet*



*Lateral Olet*



*Sweep Olet*



*Flange Olet*

### Plug

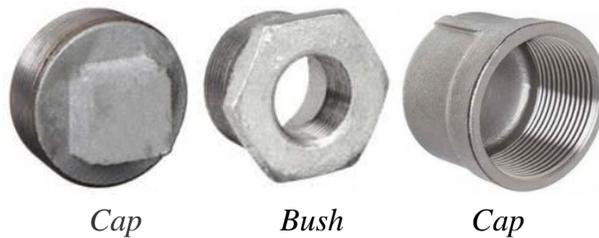
Plug is a component of plumbing which is generally used to close pipe opening during inspections and repairs. Plug generally contains male threads.

### Bush or Bushing

Bush is a component of plumbing which is generally used to change pipe size. It has male and female threads. Male end is fixed with fitting having female threads of larger diameter and the female end with pipe or fixture having male threads of larger diameter.

## Cap

Cap is a type of pipe fitting; function is same as plug but the only difference is plug contain male threads and cap contain female threads which is screws on the male thread of pipe. These are available in different materials like rubber, copper, steel, plastic etc.



Cap

Bush

Cap

## Flanges:

A pipe flange is a circular disc-shaped piping component that attaches to a pipe for blocking or connecting other components like valves, nozzles, special items, etc. After welding, piping flanges are the most popular joining methods. These are of different types

**Weld neck flanges** have a long-tapered hub between the flange ring & weld joint; Hence, these flanges are referred to as high hub flanges.

**Slip-on pipe flanges** are shorter in length than the weld neck flange so can be used where there is space constraint. The inside diameter of slip-on flanges is slightly larger than the pipe outer diameter (OD) and so it can slide over the pipe. They are secured to the pipe using two fillet welds from inside and outside.

### Lap Joint Flange

A lap joint flange is basically a two-component flange assembly. It has a stub end and a backing lap-joint ring flange. A pipe is butt-welded to the Stub End and the Lap Joint is free to rotate around the stub end.

### Blind Flange

A blind flange is a solid flange and without the central hole used to seal or block off a section of pipe or a nozzle on equipment that is not used.

**Socket weld flanges** use only one fillet weld on the outer side of the flange. In a socket weld flange connection, the pipe is inserted in the socket at first until it reaches the flange bottom and then it is lifted by 1.6 mm and finally fillet welded.

### Threaded or Screwed Flange

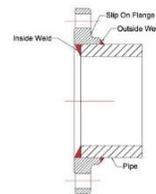
Threaded flanges are joined to pipes by screwing the pipe are used on piping systems that prohibit direct welding on the pipe. Usually, threaded flanges are used for Galvanized Piping.

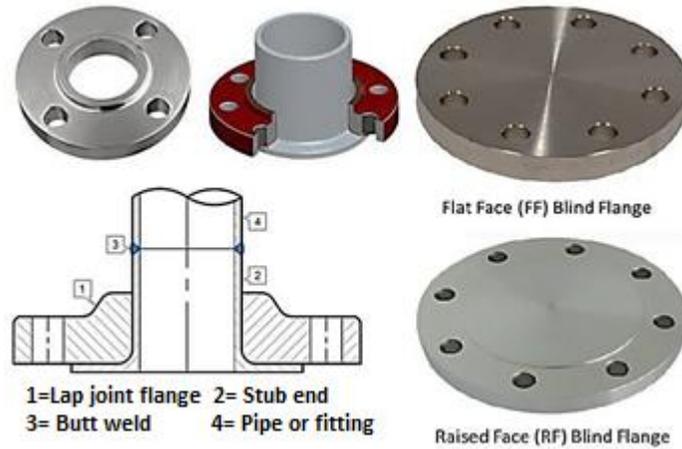


Weld Neck Flange

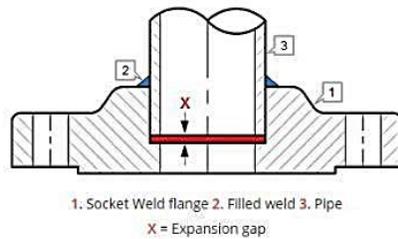


Slip on flange





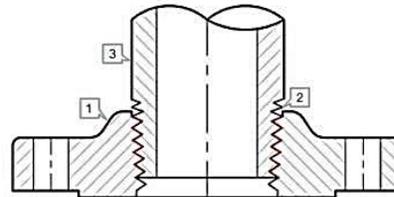
**Socket Weld Flange**



**Threaded Flange**



**Socket Weld Flange**



**1. Threaded flange 2. Thread 3. Pipe or Fitting**

**Barb**

A barb is a fitting whose one end is fitted with pipe or other fitting or fixture and the other end is used to connect hose pipe (flexible plastic pipe). These are of different shapes and of different materials. Threading can be male or female.



*Barb elbow brass*



*Barb with swivel joint*



*Barb brass male threads*

**Nipple:**

A nipple is a straight fitting casted or made from pipe having male threads on both ends. Casted nipple is called barrel nipple and the nipple made from piece of pipe is pipe nipple. Barrel nipple has usually an hexagonal part in between two ends. If it is not provided then the nipple is called full or close nipple.



*GI Tank Nipple*

*Hex Nipple*



Barrel Nipple

Close Nipple

Hose Nipple

Hex Nipple

Welding Nipple

**Socket**

A socket is a straight fitting which usually have female thread. Sockets also have male and female threads on different ends.



*Socket with female threads only*



*Socket with male and female threads*

**Cross Over, Check Nut**

A cross over is a fitting to cross a line without intersection. Check nut is used to tighten tank nipple or other fittings.

**Mechanical Sleeve:**

Mechanical Sleeve connects two pipes through the use of a screw or other device. This makes the fitting easy to install. The mechanical sleeve or coupling is usually made of rubber that is inserted inside a metal jacket (stainless steel clamp).



*Cross over*



*Check nut*



*Mechanical Sleeve*

## Valves

Valves are components of plumbing system which are used to stop or regulate flow of fluid in its path. Different types of valves are available depending up on their applications. Some important types of valves and its applications are listed below.

- Gate valve, plug valve and Ball valve - used for isolation only
- Globe valve - used for throttling
- Check valve - used for preventing reverse flow (non-return)
- Butterfly valve - used for isolation as well as throttling
- Diaphragm valve - used for isolation as well as throttling



### 1.2.2. Fittings Male and Female Parts.

#### Male Fitting:

A fitting is called a male fitting if the threads on fitting are on outside. Examples are barrel nipple, hex nipple etc.

#### Female Fitting

A fitting is called a female fitting if the threads on fitting are on inside. Examples are normal sockets, elbow, union, tee etc.

### Activity 1.3. Demonstration of all fittings.

Teacher/ instructor is required to demonstrate use of all fittings. Students are required to write down the name of all fittings.

### Activity 1.4. Recognized fittings by their names

The teacher/ instructor is required to direct the students for recognition of different GI fittings in the school building in various rooms. The students have to prepare the list of fittings room wise.

### Activity 1.5. Make sketches of all fittings.

The teacher/ instructor is required to direct the students to draw sketches of fittings in their note books.

## 1.3. Purpose and uses of G.I pipe fitting

The fittings in the network are for lengthening a pipe line, turn a pipe line and extend another branch pipeline.

### 1.3.1. Purpose of Fittings.

The fittings are used for different purposes. The purposes with lists of relevant fittings are detailed here under:

**Lengthen a Pipeline**

For long distances you have to use more than one pipe. So, you have to join pipes. To lengthen a pipe line, the fittings are socket, flanges, reducer socket, bush, union, adopter, coupling etc.

**Turn/ change direction the Pipeline**

You have to change the direction of pipeline. The fittings used may be: elbow, bend, reducer elbow.

**Provision of Branch Pipeline**

To form the pipe network, you have to extend the branch pipelines. The fittings used may be Tee, cross, reducer tee etc.

**Provide Service Point/ Fix fixtures**

To provide the facility of water, you have to install various fixtures/ appliances. The fittings used for the purpose are socket, elbow, reducer socket, reducer elbow, socket M/F etc.

**Terminate the Pipeline**

You have to terminate the pipeline if farther away is not require. The fittings may be cap, plug with socket etc.

**1.3.2. Use of all G.I fittings.**

- To lengthen a pipeline, sockets are used.
- Flanges can be used after some interval so as to ease for replacing damaged pipe along with lengthen the pipeline.
- Mechanical sleeves are also used along the length of pipeline for jointing.
- Elbows and bends are used for changing the direction of pipe line.
- Reducer socket or bush are used to change the diameter of pipeline.
- Coupling can be used to lengthen, remove damaged part of pipeline.
- Tee is used to extend branch pipeline. Reducer Tee is used to extend smaller diameter pipeline. Wye “Y” is used to convert one pipelines into two lines.
- Cross is used to extend branch pipeline on both sides.
- Union and flanges provide the facility of opening pipeline in between to prevent removing of all pipe network or part.
- Barb is used to attach plastic flexible pipe with metallic pipeline.
- Adopter is used to join two different diameter pipelines.

**1.3.3. Use of Male and Female Types of Fitting.**

Any threaded joint requires two types of threading, i.e., male threading and female threading. Pipes usually have male threading. All types of nipples have male threading. When it is required to install fixture having male threading, then fitting must have female threading. Sink mixer has compression nuts, hence fitting will have male threads. Shower mixer has compression nuts; hence fitting will have male threads. General faucets have male threads; hence fitting will have female threads.

**Activity 1.6. Demonstrate Purpose of fittings.**

Teacher/ instructor is required to demonstrate purposes of all fittings. Students are required to write down the name with purpose of all fittings.

**Activity 1.7. Practice on uses of all G.I fittings.**

The teacher/ instructor is required to demonstrate to the students for jointing of different water supply different GI fittings. The students have to prepare the list of fittings along with use of each wise.

**What I have learnt**

- GI carbon steel pipes are immersed in a galvanic (zinc) bath.
- GI (Galvanized Iron) Pipes are classified into 3 grades based on their weight per meter and inner diameter thickness.
- GP Pipes are made of thin sheets of carbon steel electroplated with zinc and then rolled into pipes.
- The GI pipes are mostly jointed by threaded joint.
- Class A GI Pipes light gauge pipes which bear a yellow colour strip for identification. They are cheaper than other classes of GI Pipes.
- Class B GI Pipes are medium gauge pipes which bear a blue colour strip for identification. They are Costlier than Class A and Cheaper than class C.
- Class C GI Pipes are heavy gauge pipes which bear a red colour strip for identification. They are Costlier than other classes of the GI Pipes.
- GI pipes should be placed with expansion allowance when laid under floor, through wall and should not come in contact with lime or lime mortar.
- A coupling is used to connect the pipes of same diameter. Coupling is also useful if the pipe is broken or leakage occurs. Generally, couplings types are Compression coupling and slip coupling.
- Plug is a component of plumbing which is generally used to close pipe opening during inspections and repairs.
- A pipe flange is a circular disc-shaped piping component that attaches to a pipe for blocking or connecting other components like valves, nozzles, special items, etc. After welding, piping flanges are the most popular joining methods.

- Mechanical Sleeve connects two pipes through the use of a screw or other device. This makes the fitting easy to install. The mechanical sleeve or coupling is usually made of rubber that is inserted inside a metal jacket (stainless steel clamp).
- A fitting is called a female fitting if the threads on fitting are on inside. Examples are normal sockets, elbow, union, tee etc.
- The different purposes of fittings are: lengthen pipeline, change direction, extend branch pipeline, provide service point and terminate pipeline etc.
- Barb is used to attach plastic flexible pipe with metallic pipeline.
- Adopter is used to join two different diameter pipelines.
- Olets are used where standard sizes of fittings are not suitable for our requirement.

### EXERCISE

#### Q-1. Tick ( ✓ ) the correct option for the following MCQs.

- i- GI carbon steel pipes are immersed in a galvanic bath of.
- (A) Zinc (B) Copper  
(C) Cobalt (D) Gold
- ii- Instant water heaters are:
- (A) Appliances (B) Fixture  
(C) Fitting (D) Appurtenances
- iii. The GI pipes are mostly jointed with this type of joint:
- (A) welded joint (B) threaded joint  
(C) flanged joint (D) solder joint.
- iv- These GI Pipes are light gauge pipes which bear a yellow colour strip for identification
- (A) Class A (B) Class B  
(C) Class C (D) Class D
- v- Bard in pipe fittings is used to join this:
- (A) pipe of flushing cistern (B) Hand shower  
(C) Hose pipe (D) All of these
- vi- A fitting that can be made from GI pipe:

- (A) tank Nipple (B) Hex Nipple  
(C) Barrel nipple (D) All of these
- vii- A fitting used to prevent intersection of pipes:  
(A) Union (B) Cross over  
(C) cap (D) plug
- viii- Fitting used where standard sizes of fittings are not suitable for our requirement.  
(A) Cap (B) Cross over  
(C) Olet (D) plug
- ix- A fitting used to do not prevent intersection of pipes:  
(A) Reducer tee (B) Cross  
(C) cap (D) plug
- x- GI pipes should not come in contact with this binding material:  
(A) Cement (B) mud  
(C) bitumen (D) lime

**Answer the following questions briefly.**

- i- Enlist classes of GI pipes.
- ii- Enlist all types of reducers.
- iii- What principles are observed while classifying GI pipes.
- iv- What is the use of adopters?
- v- Enlist the situations where plugs are used.
- vi- Why flanges are used in pipelines.
- vii- What is the use of mechanical sleeve?
- viii- Write down the situations where nipples are used with type.
- ix- Write down the use of barbs.

**Answer the following questions in detail**

- i- Explain the various classes of GI pipes. Also write down the principles of use of GI pipes.
- ii- Explain the following GI pipes' fittings with sketches
  - a) Flanges
  - b) Nipples
  - c) Barbs
- iii- Explain the different types of fittings having one end male threading and on the other end female threading.
- iv- Explain the purposes of pipe fittings.
- v- Explain the uses of GI pipe fittings.

## CHAPTER -02

### JOINTING OF GI PIPE & FITTINGS



#### After Studying this unit, you will be able to:

- know about joint types and their uses such as socket joint, union joint, threaded joint, coupling joint, long thread joint, flange joints and welded joint.
- know uses of joint according to materials of pipes and nature of material flowing in pipes
- know about jointing with thread long thread, socket and coupling joints
- know about joint gaskets, packing material and jointing materials.
- know about jointing with union and importance of union joint.
- know about joining pressure line with flange plates.
- know about joining house service line with main water supply line.
- know about joining socket clamp, gasket, ferrule valve and main line fittings.
- know the importance of joints and damages caused by leakage.
- know the procedure of detection of leakage in joints.

## Introduction.

The Plumbing system is network of pipes duly jointed & also jointed with subsystems, fixtures and parts. Galvanized Iron (GI) pipes have been in use for supply of fresh water upto 1960s. These are also used now a days. These pipes have usually threaded end. The network of GI pipes is prepared by jointing pipes in various form, screwed, grooved, welded and flanged type. Screwed joints can be socket joint, union joint, coupling joint, long thread joint.

## 2.1: Types of Joints and Their Uses

Pipe joints are integral to any piping system as the length of the pipe is limited. So, to have a continuous piping network pipe joints must be used. Also, these pipe joints are usually the weak sections of a piping network. So, depending on the durability of the technique used to form the joint, the actual working of the piping or plumbing system varies. The design and selection of a proper type of pipe joints can have a major impact on the initial installed cost. Also, the long-term operating and maintenance cost, and the performance of the piping system is dependent on piping joints. There are various factors that must be considered in the pipe joint selection like

- material cost,
- installation labour cost,
- degree of leakage integrity required,
- periodic maintenance requirements, and
- specific performance requirements.

### 2.1.1: Types of Joints.

GI pipes are jointed in different ways e.g., screwed type, welded type, flanged type and grooved type. The most common practice in domestic plumbing is screwed type. In this type of joint, both the parts have threads, one part has male threading and the other has female threading.

**Male Threading:** If the threading is done on outer periphery of the component, then it is call male threading. The threading on pipes is usually male threading.

**Female Threading:** If the threading is done on inner periphery of the component, then it is call female threading. The threading of fitting is usually female threading.

Different types of pipe joints used in plumbing system are as follows.

1. Threaded joint
2. Brazed joint
3. Soldered joint
4. Welded joint (butt welded)
5. Welded joint (socket welded)
6. Flanged joint
7. Compression joint
8. Grooved joint

### 1. Threaded Joint

Threaded joint means, pipes are connected by screwing with the help of threads provided for each pipe. One pipe having internal threads and the other one having threads externally. Cast iron pipes, copper pipes, PVC and G.I pipes are available with threads.



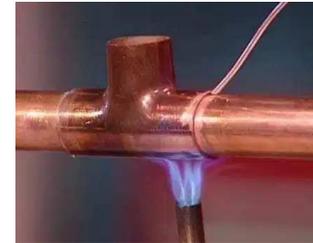
Brazed Joint in Pipe

### 2. Brazed Joint

Brazing is the process of jointing pipes using molten filler material at above  $840^{\circ}\text{C}$ . The melting point of parent metal should be higher than filler metal. Mechanical strength of brazed joint is low compared to other joints.

### 3. Soldered Joint

Soldering is also similar to brazing but the only difference is in case of soldering the filler metal melts at below  $840^{\circ}\text{C}$ . Before proceeding to soldering flux called paste is applied to pipes and fittings to prevent them from oxidation from flame. Here also we require skilled workers for installation.

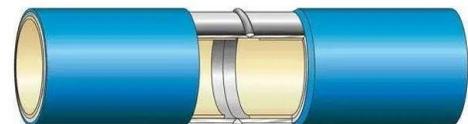


Soldered Joint

### 4. Butt Welded Joint

When the pipes are of same diameter butt welding is to done to join the pipes. It is the most common type of welding. Skilled workers are required to install the joint. Butt weld joints are expensive, to make it economical sometimes internal weld backing rings are used, which joins the pipe with less amount of filler material. But these rings may fail under heavy stress and cracks are developed.

The joints are fixed and not opened for maintenance purposes. External smoothing of welded portion will give good appearance to the piping system.

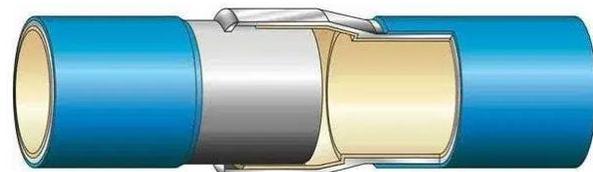


Butt Welded Joint in Pipe

### 5. Socket Welded Joint

Pipes are connected as putting one into other as shown below and welded around the joint. Pipes having different diameters are suitable for this type of joint.

If pipes having similar diameter, then required fittings are used. Welding cost is generally lower than butt welding. Fatigue resistance is lower for socket welded joints when compared to butt weld joints. However, socket welded joint give good results when compared with other mechanical joints.



## 6. Flanged Joint

Two flange components are connected by bolts at the pipe joint to prevent leakage. Generally, these are made of cast iron, steel etc. these are having good strength and do not fail against high pressure.



Compression Joint

## 7. Compression Joint in Pipe

When the pipes have plain ends, they are joined by installing some fittings at their ends then that type of joint is called compression joint. The pipe ends will be fitted with a threaded fittings or couplings hence they are connected.

## 8. Grooved Joint in Pipe

In case of grooved joint, the pipe ends consist grooved edges which are connected by elastomer seal and then ductile iron made grooved couplings are used as lock for elastomer seal. These grooved couplings are connected by bolts. These joints are easy to install and economical.



Grooved Joint

## 2.1.2 Uses of joints according to materials of pipes & material Flowing

### 1. Use of Threaded Joint

Threaded joints are available from 6mm diameter to 300mm diameter pipes. They are preferable for low temperature areas and low-pressure flows. In the areas of high temperature, the joints may expand and leaked due to thermal expansion. Installation of threaded joint is easy but good maintenance required.

### 2. Use of Brazed Joint

Brazing is generally used for joining copper pipes or copper alloy pipes. The filler material majorly consist tin which has great affinity towards copper. But because of its weak property tin is added to other materials like nickel, bismuth, silver and copper.

This type of joint is suitable in moderate range of temperature areas.

### 3. Use of Soldered Joint

Soldering also used to joint copper and copper alloy pipes. Soldered joints are suitable for low temperature areas. These are having low mechanical strength as brazed joints.

### 4. Use of Butt Welded Joint

These joints are generally used for large commercials and industrial piping systems.

Butt weld provides good strength for the joint and it can resist high pressure because of smooth and continuous surface inside the joint.

### 5. Use of Socket Welded Joint

Socket welded joints are used wherever there is a high chance of leakage in joints. If pipes having similar diameter, then required fittings are used.

### 6. Use of Flanged Joint

Flanged joints are used for high pressure flows and for large diameter pipes. Against high temperatures the bolts may fail under creep lost their grip so, fixing of bolts should be done properly while installing. They are also useful for repairing pipelines and maintenance purposes.

### 7. Use of Compression Joint

We can connect pipes of different materials and different sizes. But the joints should be properly fitted to resist flow pressure otherwise they may fail and leakage occurs. Compression fittings are available in different materials and selection of fittings may depend upon our requirement.

### 8. Use of Grooved Joint

Grooved joints will give good resistance against pressure and allows moderate axial movement due to thermal expansion. But, in high temperature Areas elastomer seal may lost its strength and torsional failure occurs. So, these are permitted to moderate temperature areas. Grooved joints are easily removable so, for maintenance purposes of pipes these joints are preferable.

#### Activity 2.1: Practice on all types of joints.

The teacher/ instructor is required to demonstrate the students for practice on brazed, soldered, compression and grooved joints.

#### Activity 2.2: Practice on making joints of G.I Pipe such as socket, union, thread, coupling, long thread, Flange and welding joints

The teacher/ instructor is required to demonstrate the students on making joints of G.I Pipe such as socket, union, thread, coupling, long thread, Flange and welding joints

## 2.2 G.I. Pipe Joint with Threading, Socket Long Thread and Coupling Joints.

GI pipes of smaller diameter are generally threaded for jointing purpose. Various types of fittings are used having male or female threads as per site requirements. Socket and coupling are mostly used for the purpose.

### 2.2.1 jointing with thread long thread, socket and coupling joints

A threaded coupling (or coupler) (used in piping or plumbing) is a **very short length of pipe or tube**, with threads at both ends that allows two pipes or tubes to be joined together.

#### Coupling Joints:

A Pipe Coupling, used in piping or plumbing, is a very short length of pipe or tube with either socket or female pipe threads at one or both ends that allows two pipes or tubes of equal or different sizes to be joined together. Couplings are pipe fittings that help to extend or terminate pipe runs. These fittings are also used to change pipe size. It's also used to repair a broken or leaking pipe.

## Categories of Pipe Couplings

Couplings under the scope of pipe fittings can be divided into two main categories.

- Permanent Coupling
- Removable Coupling

### Permanent Coupling

Permanent pipe couplings generally make use of soldering or brazing in the case of steel or copper pipes or adhesives in the case of PVC pipes. These permanent joints, if correctly installed, offer excellent rigidity and sealing characteristics where no future changes in the piping are foreseen.

### Removable Coupling

Removable pipe couplings are most often of a threaded design which allows them to be screwed onto the pipes to be joined. The simplest of these is a basic pipe section slightly larger than the pipes to be joined and cut with an internal thread. The ends of the pipes are also threaded, and the coupling is simply sealed with hemp or sealing tape and screwed onto both pipes.

## Types of Pipe Couplings

1. Full Coupling
2. Half Coupling
3. Reducing Coupling
4. Compression Coupling
5. Slip Coupling / Repair Coupling

### 1. Full Coupling

Full Coupling is used for connecting small bore pipes. It used to connect pipe to pipe or pipe to swage or nipple. It can be threaded or socket ends types.

A **socket weld full coupling** is used to join small bore plain end pipes where the pipe spec requirement is socket weld. A **threaded full coupling** is used to join small bore pipes with threaded ends. If the two ends of a coupling are different (e.g. one BSP threaded and one NPT threaded), then it is usually referred to as an **adapter**.



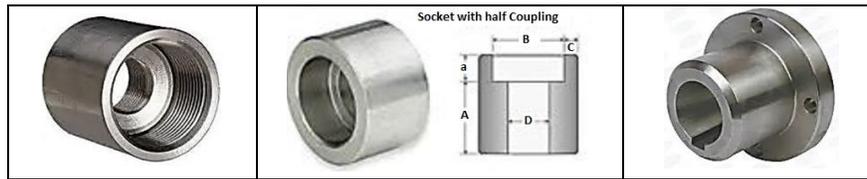
*Typical Images of Full Coupling*

### 2. Half Coupling

Half Coupling is used for small bore branching from a vessel or large bore pipe. It can be threaded or socket type. It has a socket or thread end on only one side.

A **socket weld half coupling** can be directly welded to large bore pipe, to make a branch connection. It is used to take a small bore pipe branch-off from a large bore pipe where the pipe spec requirement is socket weld in small bore size. A **threaded half coupling** only has one thread

end and another end of the coupling should be butt welding end with either a plain end or a bevel end.



*Typical Images of Half Coupling*

### 3. Reducing Coupling

Reducing coupling is used to connect pipes of dissimilar diameters. A reducing coupling has two different sizes of threads on each side. Reducing couplings are typically used where small process feeder lines are joined into large supply circuits or where small diameter fittings are installed. Reducing couplings will normally feature a simple, stepped down profile and screw onto the two lengths of pipe in the same way a standard pipe joint does. Welded reducing coupling designs are similar to threaded design but feature no threads.

### 4. Compression Coupling

A compression coupling connects two perfectly aligned pipes in which a slotted tapered sleeve is placed over the junction and two flanges are drawn over the sleeve so that they automatically centre the pipes and provide sufficient contact pressure.

### 5. Slip Coupling / Repair Coupling

A **slip coupling** (sometimes also called a **repair coupling**) includes two pipes, one of which slides out of the other pipe to a various length. Slip coupling is deliberately made without any internal stop, to allow it to be slipped into place in tight locations, such as the repair of a pipe that has a small leak due to corrosion or freeze bursting, or which had to be cut temporarily for some reason. Since the alignment stop is missing, it is up to the installer to carefully measure the final location of the slip coupling to ensure that it is located correctly.



*Various Types of Couplings*

## 2.2.2: Joint Gaskets, Packing Material and Jointing Materials.

### Gasket

In piping, a Gasket is **sealing material placed between connecting flanges to create a static seal**. This will maintain the leakage proof sealing in all operating conditions. Different types of gaskets are used to achieve the leak proof sealing between the pipe flange.

### Different Types of Pipe Gaskets

The most commonly used gaskets in piping are standard flange gaskets in rubber or fibre, or spiral wounds. For particularly large pipes, gaskets can be manufactured in segments of rubber and joined together.

Pipe gaskets can be manufactured from many different gasket materials. The right material to use depends upon the application and the environment in which the gasket will be used. The contents of the pipe, including the range of temperatures and pressures under which it is expected to operate will dictate material selection. Material specification should also take into account the flange being used. If you are in doubt about which material you need, please contact us for technical support.

A non-asbestos fibre or graphite material can be specified for steam applications. For diesel or other fuels, a non-asbestos fibre or quality nitrile rubber (BS 2751) should be used. Because of the extra additives in modern fuels, lower grade nitrile can be affected and break down. This is mistakenly blamed on the fuel itself when in reality it is caused by the corrosive nature of the additive.

### Thickness for Pipe Gaskets

The thickness of a pipe gasket is governed by several requirements. The condition of the surface of the flange face has an important part to play. A thicker gasket may be required for a poor-quality surface, as it will flow into and takes up the deformities on the face ensuring a good seal. With a clean and smooth flange face, a thinner gasket can be considered.

Pressure and media are other factors that can decide the thickness of gasket required. Putting too thick a gasket into a flange joint will increase the surface area that the system pressure can work against. For this reason, as a general rule: the thinner the gasket the better. Common thicknesses of gasket material for pipe flanges are 1.5mm and 3mm.

### Full-Face or IBC Gaskets

Pipe gaskets can be either full-faced or inner bolt circle (IBC). Full faced gaskets have bolt holes in them and cover a large part of the face of the flange. IBC gaskets, otherwise known as ring-type or raised-faced joints, sit inside the bolts fastening the pipe flanges.

### Packing Material

Packing materials are about 10mm to 20mm thick and are normally made of plywood, fibreboard or other materials. In case packing materials are absent in pipe joints for pipe jacking, then any deflection in the joints reduces the contact area of the concrete and it leads to spalling of joints due to high stresses induced. With the insertion of packing material inside the pipe joints, the allowable deflection without damaging the joint during the pipe jacking process can be increased.

## GI Pipe Jointing Materials

Jointing materials for GI are the fittings, joints and connectors. Other materials are jointing compounds and sealing tapes, Teflon tape, gasket, seals, silicone caulk, rubber strand/ bands, cotton thread, epoxy, silicone tape. List of fittings is given as under:

Galvanized (GI) Pipe Elbow	Galvanized (GI) Street Elbow
Galvanized (GI) 45 Degree Equal Elbow	Galvanized (GI) Pipe T Fittings
Galvanized (GI) Pipe Cross Tee	Galvanized (GI) Coupling / Socket
Galvanized (GI) Socket M & F	Galvanized (GI) Short Bend
Galvanized (GI) Long Bend	Galvanized (GI) Pipe Plug
Galvanized (GI) Pipe Nipples Fitting	Galvanized (GI) Lock Nut
Galvanized (GI) Flange Fitting	Galvanized (GI) Pipe Cap
Galvanized (GI) Pipe Union	Galvanized (GI) Pipe Reducer Tee
Galvanized (GI) Pipe Reducer Socket	Galvanized (GI) Pipe Reducer Nipple
Galvanized (GI) Bushing	

## Practical/ Activities

### Activity 2.3 Practice on all joints types such as socket joint long threading and coupling joint.

The teacher/ instructor is required to demonstrate the students on making joints of G.I Pipe such as socket long threading and coupling joints.

### Activity 2.4 Practice with wrapping tape, threading and packing material for leak proof joint.

The teacher/ instructor is required to demonstrate the students on making joints of G.I Pipe by wrapping tape and packing for leak proof joint.

## 2.3: G.I. Pipe Joint with Union and Flange Plates.

### 2.3.1: Union Joint and its Importance.

Union fittings allow two pipes to be connected in a manner that can be quickly disassembled for maintenance or replacement. Two sides of the pipe are set into union fittings, which are then joined together to finish the connection. Unlike copper pipes, which require soldering, galvanized steel pipe is connected using pipe threads that screw into each other. This makes connecting a galvanized union fast and relatively straightforward. Once installed, a galvanized union connection can be removed using two wrenches and elbow grease.

**Step 1:** Place a 1/4-inch bead of liquid pipe dope around the center of the pipe threads on one side of a galvanized steel pipe.

**Step 2:** Place the end of the pipe into the top of the galvanized steel union fitting and turn the fitting clockwise until tight.

**Step 3:** Place a pipe wrench around the fitting and turn it clockwise until very tight.

**Step 4:** Place a 1/4-inch bead of liquid pipe dope around the center of the pipe threads on the pipe that you want to join with.

**Step 5:** Place the end of the pipe into the bottom of the galvanized steel union fitting and turn the fitting clockwise until tight. Finish tightening the connection with the pipe wrench.

**Step 6:** Remove the connection for maintenance or repair by placing a pipe wrench around the centre of the union fitting, not the nuts around the pipes, and turning the fitting counter clockwise. The pipes will pull apart but still have one half of the union on either side for quick re-assembly.

### Tip

Dielectric unions can also be used to connect galvanized steel to copper pipes. These unions contain a non-conductive barrier that separates the copper from the steel, but holds together the same way.

### Warning

Only use galvanized steel fittings with galvanized steel pipes as mixing materials may cause a slight electrical current that will corrode your plumbing system over time.

## 2.3.2: Flange Plates Joints

In all modern piping and pipeline systems, flanged connections are extensively used due to their ease of assembly and disassembly. But they are costly due to the high cost of the flanges themselves and the labour costs for attaching the flanges to the pipe using bolting. Flanged joints are used for all high-pressure and temperature applications. But they have a tendency to leak. Dissimilar pipe materials can be easily joined using flanged pipe joints. A gasket is inserted between two flanges to prevent leakage.

## Practical/ Activities

### Activity 2.5 Practice on G.I pipe with union fitting.

The teacher/ instructor is required to demonstrate the students on making joint of union with free G.I Pipes. The students have to perform the same.

### Activity 2.6 Practice union fitting on fixed line.

The teacher/ instructor is required to demonstrate the students on making joint of union with G.I Pipes which have been fixed on wall. The students have to perform the same.

### Activity 2.7 Practice with flange joint and gasket.

The teacher/ instructor is required to demonstrate the students on making joints of G.I Pipes by use of flanges and gasket. The students have to perform the same.

## 2.4 Provision of Domestic Connection.

### 2.4.1 Joining House Service Line with Main Water Supply Line.

Installing a new water line to your house is a project that will take some time, but is not difficult. You should wear protective clothing. Collect Clamp duly welded with socket of correct size, gasket, Teflon tape, ferrule valve, socket or other fitting in case of PVC pipe along with jointing solution.

#### Locate Your Water Supply

Call your local water company to find out where the main water supply is located. If you are near a main water valve, you will see it sticking out of the ground. A private water supply, such as a dug well, will have a well cover sticking out of the ground.

#### Dig Trench

Your water pipes need to be buried to protect them from freezing temperatures or other problems that could damage them. Dig a trench from the water source to your basement, garage or other building where you want the water.

#### Collect Correct Pipes

Once you have the hole dug you will have to make the connections for your pipes. You will need to what type of connections you need. In most cases, it is a threaded fitting and PVC piping.

#### Measure Pipe

Chances are you will not get a long enough pipe to go from your water source to the home. Measure off the PVC/ GI pipe and cut to size with a hack saw. Use PVC glue to connect each pipe where you need to. In case of GI pipe cut the threads and fix in the relevant fitting with pipe wrench.

### 2.4.2 Joining socket clamp, gasket, ferrule valve and main line fittings.

When you are ready, you should get clamp with properly welded socket. Open the nut bolts of clamp and place around the main supply. Place the requisite gasket with its hole under the socket. Now insert and tighten the nut bolts of the clamp. When you secured that properly, take the drill machine and drill a hole in the main line through the socket. Water will flow out.

Now fix the ferrule valve with Teflon tape wrapped on its threads. The ferrule valve should be closed before fixing it. Now join the service line pipe with socket fixed with ferrule valve. You can use PVC couplings to connect to the threaded end of the water supply and into your home. Check for any leaks and then bury your pipe.

## Practical/ Activities

### Activity 2.8 Practice of joining service line with main water supply line.

The teacher/ instructor is required to demonstrate the students how to locate water main supply, dig a trench, collect requisite pipes, measure & cut pipes and join those in correct manners. The students have to perform the same.

### Activity 2.9 Practice of fitting socket clamp its gasket, ferrule valve and required fittings of service line.

The teacher/ instructor is required to demonstrate the students how to fix flanges & gasket on supply line, drill hole, fix ferrule valve and join service line with fittings. The students have to perform the same.

## 2.5 Importance and Detection of Leakage in G.I. Pipe Line

Joints in a plumbing system are integral. These are of great importance. Due to some reasons joints are damaged. The water can leak from the damaged joints.

### 2.5.1 Importance of Joints and Damages Caused by Leakage.

#### Importance of Joints

Pipes are connected with the help of joints. A variety of joints are used in an assembly of pipes. Connecting two or more pipes together is called a fitting. Various types of joints could be used in a pipe as per the requirement. Long pipes are not available. Hence, they are required to be joint. As joints are provided at specified interval. They provide the strength by reducing the deflection due to short span.

Joints are also used for multiple pipe connections and are an important component of the plumbing system. Generally, the pipe joint fitted can easily sustain the pressure created in the pipe.

#### Damage Caused by Leakage of Pipes

If you ignore leaking pipes long enough, they can cause destruction in your entire home. Poor water quality, warped and stained walls, invasive black mold, and flooding are some of the ways leaky pipes damage your whole house and end up costing a fortune.

If you see a warped or stained wall in your home, it is most likely from leaky pipes. This damage, unchecked, can lower the value of your home, costing you greatly in the future if you plan to sell it. Having to replace a wall and the plumbing behind it can be costly as well.

Extra moisture in your home can lead to mold growth. Mold typically grows in bathrooms, but it can also be found under any sink and behind any wall. Mold from leaking pipes causes serious health problems and must be addressed promptly. The longer it is ignored the worse the damage will be, costing you even more.

The worst possible thing that could happen with unaddressed leaks is, of course, flooding. All it takes is one pipe to burst and a deluge of water will come through your home. It can be costly and

timely to fix water damage from flooding. It's much more affordable to keep it from becoming a problem in the first place

Noticing and taking care of water leaks on time is very important because if left unattended they can lead to some greater damages, whether to your property or to your health. Here are some of the main hidden dangers that leaks can cause:

### **1. Mold and Mildew Issues**

Mold and mildew are probably the most serious problems that can develop due to a water leak. Mold and mildew are prone to appear, grow, and develop in damp places, on wet areas and areas that build-up moisture easily. Even a few drops of water a day can lead to creating damp spots where mold is very likely to appear. It can spread to very different areas of your home, including the HVAC system, walls, floors, wood framing, furniture, carpets, and even clothing. Mold can be toxic and it is difficult and costly to remove it.

### **2. Health Effects**

Mold and mildew are not only harmful to the structural components of your home, but they can also pose some serious health risks, especially for those who have respiratory issues and asthma. Mold spores are known to cause allergic reactions, skin irritations, nose and throat inflammation and soreness, coughing, sneezing, itchy and red eyes, and similar.

### **3. Household Water Contamination**

If your leak is coming from a burst or broken pipe that carries drinking water to your household, that water is at risk of contamination as different contaminants can enter the pipe when there is a sudden change or drop in the pressure and the velocity in the pipe. The pipes may suck in some external water in that case, and, with it, some particles that can lower the quality of your drinking water.

### **4. Increased Utility Bills**

As you water continues leaking, you will see a higher water bill, but also higher utility bills and energy consumption. This can happen due to damages that water causes to your insulation as well. As the leak makes its way through the roof, attic, or ceiling, it will also saturate and damage all the insulation it comes across. This, in turn, results in more warm or cold air loss and more energy spent on heating and cooling.

### **5. Attic and Ceiling Damage**

If you have an attic, then leaks coming from your roof can damage the attic and things you have stored there, and if you don't have one, then the damage will be on your ceiling. This damage can then spread and affect the integrity of your walls, and even damage your lights and fans mounted on the ceiling.

### **6. Structural Damage**

Apart from the attic and ceiling, both roof and plumbing leaks can cause significant structural damage to the rafters, wall framing, ceiling joists, wood deterioration, damages to the framing, walls where the pipes are located etc. All of this can lead to costly and extensive repairs, so it is important to detect the leaks when they are still small and the damage salvageable.

### **7. Fire hazard**

One of the most unexpected dangers of water leaks is actually fire hazard. When a leak is near or reaches the areas with electrical wiring you are at risk of short circuits and shorted wires which can result in electrical fires and therefore serious damages. When the leak is near electrical wiring it is always recommended to turn off the electricity and have a professional deal with it.

### **8. Financial damage**

Finally, water leaks can lead to some significant blows to your budget. The potential dangers described previously, such as compromised structural integrity, damages to the ceiling, attics, walls, as well as the appearance of mold and mildew, are all issues that can be complex and costly to resolve.

## **2.5.2 Detection of Leakage in Joints**

In a water distribution system, a considerable amount of water gets wasted and lost either due to leakage or unauthorized water connections. These losses can amount to 15% of the total consumption even in a well-managed distribution system, and in case of faulty systems, the losses can be as high as 40%. This wastage will directly increase the per-unit cost of pure water. Thus, for effective management of the system, it becomes essential to detect the points where water is being wasted. Proactive steps should be taken to rectify the faulty pipes and stop the wastage.

Leaks can sometimes be very visible and noticeable, especially if your pipes suddenly burst and create a significant mess in your home, such as water flooding your floors or obviously leaking or bursting from a pipe. On the other hand, these leaks can be very low-key, with smaller warning signs that can often go unnoticed.

These warning signs can come in the form of lower water pressure coming from your faucets, water damage or stains on your walls, and higher utility and water bills. If you notice any of these signs you should act quickly and try to locate the source of the leak and repair it before it progresses and causes some greater or even irreparable damage.

Some water leaks can be caused by minor problems that are very easily fixed and that you can repair on your own. For example, some of the most common problems are found in joint fittings of your pipes and in the middle of your pipes. If the joints are the source of a minor leak, for example behind the washing machine or the tap, you can easily replace them on your own. Methods to detect leakage are given here under:

### **1- Direct Observation**

This method mainly involves carrying out practical observations on wet spots on unpaved grounds, or the rise of spring at odd places, or luscious green growth at a specific spot. These types of leakages are easier to trace on clayey soils in comparison to sandy soils. However, the exact location of the preliminary indications has to be confirmed using sounding rods, waste detection meters, etc.

## 2- Using Sounding Rods

In this method, a sharp pointed metal rod is forced into the ground along the pipeline and then pulled up for inspection. Just by observing, one can identify the moist and muddy spot that indicates the presence of leakage. The sound of the leaking water can be heard clearly when one places their ear on top of the inserted rod, thus confirming the leakage point.

Another way to magnify the sound of leakage is by the use of an instrument called sonoscope or aquaphone. The sound of the leakage is amplified to a greater extent than the rod. To increase the effectiveness of the instruments, these experiments must be carried out at night when there is comparatively lesser noise.



*Detection of leakage by sounding rod method*

## 3- Plotting the Hydraulic Gradient Line

In this method, the pressure at multiple points is measured along the suspected line and then the hydraulic gradient is plotted. In case there is a kink or fluctuation in the slope of the hydraulic gradient line, it will indicate the presence of leak in the pipeline. The graph will also help in detecting the location of the leakage.

## 4- Using Waste Detection Meter

Although the devices are named as ‘waste detection meters’, they do not actually measure the quantity of water that has been wasted. These meters measure any unusually high flow of water through a water main when the consumption of water is low i.e., in the nights or early mornings.

The unnaturally excess flow from a particular portion of the pipe depicts a leakage through that particular section, provided that there is no unusual high consumption in that specific vicinity.



*Waste water detection meter*

First, the suspected locality is isolated and all the supplies, except the head of the chosen locality, are shut down. The waste detection meter is then fixed at the head of the main supply pipe and the water is allowed to flow to the locality after getting recorded by the meter. After this, the other laterals and branches in the locality are shut down progressively.

Thus, the flow recorded in the meter will drop down at each shut-off. If the shut-off indicates a disproportionately large drop in the listed flow, that shows that the pipe is leaking. The defect can then be corrected.

One of the widely used instruments is Deacon's wastewater detection meter, which is very accurate and sensitive. When the water passes through such a meter, it forces down a brass disc which is otherwise balanced by a counterweight.

This movement of the disc is conveyed by a rod to a pencil point. The pencil then moves up and down vertically on a graph paper with respect to time. The meter is designed in such a way that it automatically records the quantity of water that flows through it.

This method of detecting wastage is quite useful and scientific. However, it is expensive as a crew is required for operating it and many valves have to be installed in the pipeline.

## Practical/ Activities

### Activity 2.10 Detection of leakage in joints.

The teacher/ instructor is required to demonstrate the student's leakage of joints is detected by different methods stated above. The students have to perform the same.

## What I have learnt

- Factors that must be considered in the pipe joint selection are material cost, installation labour cost, degree of leakage integrity required, periodic maintenance requirements, and specific performance requirements.
- Male Threading: If the threading is done on outer periphery of the component, then it is called male threading. The threading on pipes is usually male threading.
- Female Threading: If the threading is done on inner periphery of the component, then it is called female threading. The threading of fitting is usually female threading.
- Different types of pipe joints used in plumbing system are Threaded joint, brazed joint, soldered joint, welded joint (butt welded), Welded joint (socket welded), Flanged joint, Compression joint and Grooved joint
- When the pipes have plain ends, they are joined by installing some fittings at their ends then that type of joint is called compression joint. The pipe ends will be fitted with a threaded fittings or couplings hence they are connected.
- In flanged joint, two flange components are connected by bolts at the pipe joint to prevent leakage. Generally, these are made of cast iron, steel etc. these are having good strength and do not fail against high pressure.
- Threaded joints are available from 6mm diameter to 300mm diameter pipes. They are preferable for low temperature areas and low-pressure flows.
- Butt weld provides good strength for the joint and it can resist high pressure because of smooth and continuous surface inside the joint.



- (A) GI Pipe (B) GP Pipe  
(C) copper pipe (D) stainless steel pipe
- vii- Socket welded joints are used wherever the chance of leakage is.:
- (A) high (B) low  
(C) very low (D) None of these
- viii- What is the percentage loss of water caused due to leakage in faulty water distribution system?
- (A) 20% (B) 30%  
(C) 40% (D) 50%
- ix- To join small plain end pipe, the full coupling used is:
- (A) socket welded (B) threaded  
(C) flanged (D) None of these
- x- Ferrule valve is used for:
- (A) basin (B) sink  
(C) service connection (D) bath tub

**Give short answer to the following questions.**

- i- What are the methods for detecting leakages?  
ii- State the situation in which fire hazard can occur due to leakage of pipes.  
iii- Enlist the types of joints for GI Pipe.  
iv- Enlist the types of gaskets  
v- Enlist the damages which can result due to leakage of pipe joints.  
vi- Why union pipe is provided in plumbing system of GI pipes.  
vii- Describe long thread joint.  
viii- What is the use of ferrule valve?  
ix- Enlist jointing materials for GI pipes.  
x- What is the importance of union joint?

**Answer the following Questions in detail.**

- i- Describe the damages caused by leaking of joints?  
ii- Describe the procedure of joining house service line with main water supply line.  
iii- Describe the procedure of joining Pressure line with flange plates.  
iv- Explain the different types of coupling with sketches.  
v- State uses of joint according to materials of pipes and nature of material flowing in pipes.

## CHAPTER -03

### INSTALLATION OF WATER SUPPLY FIXTURES AND APPLIANCES



#### **After Studying this unit you will be able to:**

- state about meanings for installation of appliances.
- understand the importance of appliances
- manage to change appliances
- understand the working procedures of different appliances
- know about scope of appliances at industry (hotels, accommodations).
- explore importance of appliances
- know about different types of water supply appliances.
- know about different types of sanitary appliances.
- familiarize with the house appliances specially.
- classify appliances by type, location and price.
- isolate services.
- carry out electric safety check (if required)
- loose unions
- disconnect and remove pump from foundation
- reconnect pump to existing services.

- check for leakage.
- check level of pump at foundation
- check gas pressure
- understand specification
- uninstall existing gas meter
- install new gas meter
- identify tank
- check water pressure
- shut down valve
- locate position for installation
- replace pipe with fittings
- identify geyser
- check water pressure
- shut down valve
- locate position for installation
- fix union for inlet and out let pipes
- fix pipes connection for hot and cold water
- identify water cooler or dispenser
- check water pressure
- shut down valve
- locate position for installation
- fix union for inlet and out let pipes
- check drain pipes
- clear the work area.
- dispose extra materials in accordance with state and territory legislation and workplace policies and procedures.

### 3.1: Introduction to Water Supply and Sanitary Appliances

The devices which perform specific functions in plumbing system are called plumbing appliances. Mainly two systems are considered in plumbing i.e., water supply and sanitary. The appliances which are related to water supply are called water supply appliances. water meter, hot water heater, etc. The term 'sanitary appliance' means a WC, urinal, bath, shower, washbasin, sink, bidet and drinking fountain. It also includes appliances those are not connected to a water supply (e.g., composting toilet) supply or drain (e.g., waterless urinal). These appliances collect and remove waste matter. They are generally grouped into two categories i.e., soil appliances and waste water appliances.

#### 3.1.1: Meanings for Installation of Appliances.

The fixing of appliances is known as installation of appliances. These installations may be on walls, on roof or on floor. For example, installation of water tank on roof, installation of geyser on wall etc.

#### 3.1.2: Importance of Appliances

For the efficient working as per guidelines for plumbing system, appliances are of great importance. As fresh water without contamination must be available for drinking. Disposal of used water is necessary to prevent growth of dangerous germs in the dwelling units. To achieve these purposes, we need the specific water supply and sanitary appliances. So, installation of specific appliances is very important for humans, and other living creatures. These are also important in maintaining better environment.

#### 3.1.3: Manage to Change Appliances

Every appliance has some utility period. Due to continuous usage, these appliances do not work as per requirements due to wear and tear. An efficient maintenance of appliance will enhance the life span of appliance. Hence continuous inspection for working status of appliances is necessary. When these are not working properly, there comes a stage when the maintenance cost exceeds then change of appliances is required. Thus, change/ replacement of appliances should be managed as and when required.

#### 3.1.4: Working Procedures of Different Appliances

**Soil sanitary appliances** – For the reception and discharge of excretory matters. Examples are: WC, urinal and bidet.

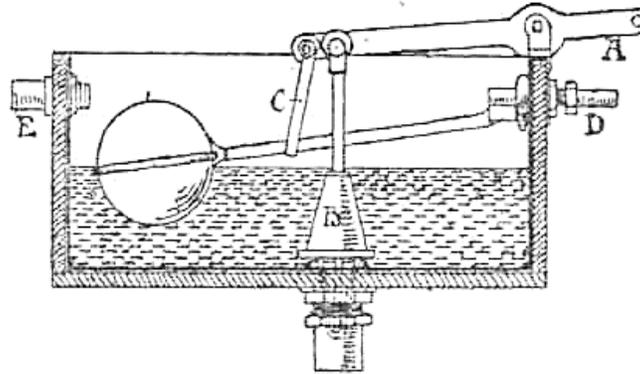
Soil sanitary appliances should have at least one trap with a water seal of not less than 50mm before connecting to a separate branch drain-line to an inspection chamber at level 1 or to a discharge pipe on upper storey level.

**Waste sanitary appliances** – For the reception and discharge of water for cleaning or culinary purposes. Examples are: Sink, basin, bath and shower.

#### **Flushing Cisterns**

Water-closet flushing cisterns are of three main types-the valve, the siphon, and the tipper. A fourth kind, which may be called the pneumatic, may be used with high-pressure supplies.

**1. Valve Cisterns:** The simplest form of cistern contains a single valve. Figure shows a wooden cistern of this kind lined with lead. When the lever at A is depressed, the valve B is raised from its seating, and the water continues to flow down the flush-pipe as long as the lever is depressed or until the cistern is empty.



**2. Siphon Cisterns:** The water in these is discharged by siphonic action, and the principal difference between the various kinds lies in the method of starting this action. Four methods are in general use—the valve, the dome, the plunger, and the displacer.

### **Mechanical water meters**

Mechanical water meters are very common. When water passes through the water meter, it causes an impeller to rotate. Each water meter is calibrated to determine the flow rate based on this rotation. Mechanical water meters are highly accurate (though less accurate than other types of meters, like ultrasonic), but they degrade over time due to impurities in the water wearing down the moving parts of the meter.

### **Domestic water supply storage and water transfer tanks:**

1. Both are installed with ball float valves and water sensor electrodes for high rise building. The ball float valve is to control the amount of water entering the tank to prevent water from overflowing from the overflow outlet.
2. The water sensor electrodes which are installed in the water tank and are connected via the cables to the float relays are used to activate the domestic transfer pump when water level falls below the set level and cut off the pump when the water level rises to the required level.
3. The water sensor electrodes and relays are also used to cut off the pump when the water level is below the low or above the high set level points to prevent the pump from running dry and water from overflowing from the overflowing outlet.

### **Showers**

Showers are fundamentally a very simple appliance designed to contain water for a person or two and to drain spent water into the sewer system.

## Practical/ Activities

### Activity 3.1: Presentations About Concept of Different Appliances Used in Water Supply and Sanitation.

The teacher/ instructor is required to give presentation to the students for usage of different water supply and sanitary appliances. The students have to prepare the list of appliances and write in their note books.

### Activity 3.2: Groups' Discussion / Exercises About Water Supply and Sanitation Appliances

The teacher/ instructor is required to direct the students for group discussion about usage of water supply and sanitary appliances.

### Activity 3.3: Differentiate Between Appliances Used in Different Places.

The teacher/ instructor is required to direct the students to visit in the school building in various rooms. The students have to prepare the list of appliances category wise.

## 3.2: Scope and Classification of Appliances

The devices which perform specific functions in plumbing system are called appliances. Mainly two systems are considered in plumbing i.e., water supply and sanitary. The appliances which are related to water supply are called water supply appliances. water meter, hot water heater, etc. The term 'sanitary appliance' means a WC, urinal, bath, shower, washbasin, sink, bidet and drinking fountain. It also includes appliances those are not connected to a water supply (e.g., composting toilet) supply or drain (e.g., waterless urinal). These appliances collect and remove waste matter. They are generally grouped into two categories i.e., soil appliances and waste water appliances.

### 3.2.1: Scope of Appliances at Industry (Hotels, Accommodations).

Both water supply and sanitary appliances are used in hotels and accommodations. In hotels specific appliances other than domestic plumbing appliances are installed, for example, sensor-based faucets, air hand driers, etc.

### 3.2.2: Importance of Appliances

For the efficient working as per guidelines for plumbing system, appliances are of great importance. As fresh water without contamination must be available for drinking. Disposal of used water is necessary to prevent growth of dangerous germs in the dwelling units. To achieve these purposes, we need the specific water supply and sanitary appliances. So, installation of specific appliances is very important for humans, and other living creatures. These are also important in maintaining better environment.

### 3.2.3: Types of Water Supply Appliances

#### Water Heater appliances

The appliances which are used to heat water are called water heater appliances.

**i- Storage Water Heaters (Tank type)**

In household and commercial usage, most water heaters are the tank type, also called *storage water heaters*. These consist of a cylindrical vessel or container that keeps water continuously hot and ready to use.

**ii- Central Water Heaters**

Centralized water heaters are Storage water heater tank type. In building a central water is install to supply hot water in all components of building. These are more traditional, and are still a good choice for small buildings.

**iii- Point of Use Water Heater**

Tiny *point-of-use* (POU) electric storage water heaters with capacities ranging from 8–32 L (2–6 gallons) are made for installation in kitchen and bath cabinets or on the wall above a sink. A similar wood-fired appliance was known as the chip heater.

**iv- Tankless Water Heaters**

Tankless water heaters—also called *instantaneous, continuous flow, inline, flash, on-demand, or instant-on* water heaters—are gaining in popularity. These high-power water heaters instantly heat water as it flows through the device, and do not retain any water internally except for what is in the heat exchanger coil.

**v- Electric Shower Heads**

An electric shower head has an electric heating element which heats water as it passes through. These self-heating shower heads are specialized point-of-use (POU) tankless water heaters, and are widely used in some countries.

**vi- Solar Water Heater**

Increasingly, solar powered water heaters are being used. Their solar collectors are installed outside dwellings, typically on the roof or walls or nearby, and the potable hot water storage tank is typically a pre-existing or new conventional water heater, or a water heater specifically designed for solar thermal. The most basic solar thermal models are the direct-gain type, in which the potable water is directly sent into the collector. By contrast, *indirect* or *closed-loop* systems do not allow potable water through the panels, but rather pump a heat transfer fluid (either water or a water/antifreeze mix) through the panels. After collecting heat in the panels, the heat transfer fluid flows through a heat exchanger, transferring its heat to the potable hot water.

#### Water filtration Systems

Water filtration is a huge niche with a vast array of different treatment methods available.



**Whole-house filtration** gives you anywhere from 5 to 10 years of use. Filters need swapping every 6 months or so. These all-encompassing systems give you flow rates from 15 gallons per minute (GPM) to 20 GPM and up. The filters are capable of screening particles to a size of 5 microns.

If you don't want the expense or installation issues of a comprehensive system, there are many less intrusive options including:

- Counter Top
- Inline
- Refrigerator
- Under-Sink

**Reverse-osmosis filters** can be used to purify all types of water to a high standard but it's relatively wasteful with up to 5 gallons of wastewater for every 1 gallon that's filtered. With this type of RO system, regular household water pressure is used to channel water through a membrane then through a series of supplementary filters.

**Water softeners** can be salt-based using a method of **ion-exchange** to remove minerals from hard water while you can also find **salt-free water conditioners**.

### **Bath Room Faucets**

Bathroom faucets are simple products that vary dramatically in price depending on functionality and materials.

You have 3 broad choices with bathroom faucet style:

1. **Centre-set:** 1 spout and 2 handles in a single unit
2. **Spread-fit:** 1 spout and 2 handles as 3 separate components. These work well for corner sinks and small bathrooms
3. **Single-hole:** All-in-one unit with a single handle for both hot and cold water. Ideal for motion-sensor faucets

Faucets can be mounted over the surface of your sink or set into the wall.

Whether you want a design-driven statement piece, a water-conserving faucet or a smart tap with motion sensors to make your life easier, you'll soon find choosing the right fixture is a little more complex than you first thought.

Water filtration is a huge niche with a vast array of different treatment methods available.

**Water softeners** can be salt-based using a method of **ion-exchange** to remove minerals from hard water while you can also find **salt-free water conditioners**.

#### **Water Meters**

These are used to measure discharge of Water flowing through pipelines.

#### **Water Pumps:**

Used to supply water at elevated levels. The pumps are centrifugal type, reciprocating type. Also, pumps are Auto type having and attachment of pressure cylinder.

### **3.2.4: Types of Sanitary Appliances.**

They are generally grouped into two categories i.e., soil appliances and waste water appliances

#### **Soil Sanitary Appliances**

These are used for the reception and discharge of excretory matters. Examples are: WC, urinal and bidet.

Soil sanitary appliances should have at least one trap with a water seal of not less than 50mm before connecting to a separate branch drain-line to an inspection chamber at level 1 or to a discharge pipe on upper story level.

#### **Waste Sanitary Appliances**

For the reception and discharge of water for cleaning or culinary purposes. Examples are: Sink, basin, bath and shower.

#### **Sanitary Appliances without water use**

It includes appliances those are not connected to a water supply (e.g., composting toilet) supply or drain (e.g., waterless urinal). These appliances collect and remove waste matter.

### **3.2.5: House Appliances**

Structure of Water supply home appliances is explained at section 3.2.3.

The sanitary appliances used in the drainage system of houses and buildings include: 1. Wash Basins 2. Sinks 3. Bath Tubs 4. Water Closets 5. Urinals 6. Flushing Cisterns.

#### **1. Wash Basins:**

Wash basins are the plumbing fixtures provided for washing hands and face and brushing teeth in a standing position. These are usually made of glazed earthenware or vitreous china. Sometimes these are also made of enamelled iron, stainless steel or plastic, especially where the number of users is more. The wash basins may be of either flat back pattern for fixing on walls, or angle back pattern for fixing at the junction of two walls.

The standard sizes of these wash basins are as indicated below:

- (a) Flat Back Pattern – 630 x 450 mm, 550 x 400 mm, and 450 x 300 mm
- (b) Angle Back Pattern – 600 x 480 mm and 400 x 400 mm

A wash basin is an oval shaped bowl of one-piece construction including a combined overflow. The overflow is usually of slot type with overflow slot of minimum area 5 cm<sup>2</sup> provided at 40 to 45 mm below the top of the basin. The wash basin is provided with double or single tap holes suitable for fixing pillar taps.

It is also provided with a circular waste hole at the bottom for draining the basin. The waste hole is provided with a metallic waste fitting also called waste coupling having a strainer and a clear opening of about 40 mm diameter. A waste pipe with a trap at its bottom is fixed to the waste fitting.

Sometimes the waste pipe is not provided with any trap but it is made to discharge into a floor trap or nahni trap. For holding water in the basin for its cleaning a rubber plug attached to a chain secured by a stay is provided. The chain stay hole is of 10 mm diameter and it is located slightly above the overflow slot.

The wash basin also has an integral soap holder recess or recesses which drain into the bowl. The wash basin may be supported either on brackets fixed in the wall or on a pedestal rising from the floor.

## **2. Sinks:**

Sinks are the plumbing fixtures provided in kitchens for cleaning utensils. These are also provided in laboratories for cleaning laboratory ware. Sinks are usually of rectangular shape and are made of glazed earthen ware or vitreous china, cement concrete with or without terrazzo finish, marble, stainless steel and enamelled iron.

The usual sizes of the kitchen sinks are as indicated below:

600 x 450 x 150 mm

600 x 450 x 250 mm

750 x 450 x 250 mm

The sinks are of one-piece construction with or without rim. These are provided with a circular waste hole at the bottom for draining. The waste hole is provided with a metallic waste fitting also called waste coupling having a strainer and a clear opening of about 40 mm diameter.

A waste pipe is fixed to the waste fitting which discharge into a floor trap or nahni trap. The kitchen sinks are usually provided with an overflow arrangement which is in the form of a circular outlet of minimum diameter 25 mm provided at 30 mm below the top edge of the sink.

The laboratory sinks may be with or without overflow arrangement. The overflow if provided for laboratory sinks is of slot type which is included in the one piece construction of the sink with overflow slot of minimum area 5 cm<sup>2</sup> provided at 30 mm below the top edge of the sink. The kitchen sinks are usually provided with a draining board which is fixed on the right side of the user.

## **3. Bath Tubs:**

Bath tubs are the plumbing fixtures provided in the bath rooms for taking bath. These are usually made of glazed earthenware or vitreous china, cement concrete finished with terrazzo or glazed porcelain tiles or marble titles and enamelled iron. The bath tubs are provided with a circular waste hole at the bottom for draining.

The waste hole is provided with a metallic waste fitting also called waste coupling having a strainer and a clear opening of about 40 to 50 mm diameter. A waste pipe with a trap is fixed to the waste fitting. The bath tub is provided with tap/shower and an overflow pipe of diameter 40 mm located at 40 to 50 mm below the top edge of the tub.

For holding water in the tub, a rubber plug attached to a chain secured by a stay is provided. The chain stay hole is of 10 mm diameter and it is located slightly above the overflow pipe. The usual dimensions of a bath tub are: length 1.8 m, width 0.75 m and depth 0.45 m. The overall height of the tub including feet is about 0.6 m.

#### **4. Water Closets (W.C.):**

A water closet is a pan like water flushed plumbing fixture designed to receive human excreta directly from the user. It is made of vitreous china or porcelain and is connected to the soil pipe by means of a trap. The inside surface of the water closet and the trap is made smooth by glazing in order to ensure an efficient flush.

The water closet has an integral flushing rim with adequate number of holes to spread the flushing water. The water closet also has an inlet or supply horn for connecting a flushing cistern or a flushing pipe fitted with regulating valve, to flush the water closet and discharge the human excreta to the soil pipe.

Water closets are of the following three types:

- (i) Indian type or Squatting type;
- (ii) European type of Pedestal type; and
- (iii) Anglo-Indian type

Requirements of a Good Water Closet:

The following are the requirements of a good water closet:

- (1) It should be convenient for use by persons of all age from a child to an old person.
- (2) The size of the closet pan should be such that the urine as well as the faecal matter does not fall outside the pan.
- (3) The trap should be such that water in the trap does not splash when the excreta fall in the trap.
- (4) Urine should not splash outside the closet pan.
- (5) The surface of the closet pan should be smooth so that the faecal matter may flow easily into the trap without sticking to the closet pan.
- (6) The closet pan should be such that flushing may be achieved effectively with the use of small quantity of water.
- (7) The trap should have an effective and air tight seal.
- (8) The closet pan should be so designed that the faecal matter is not too plainly visible before flushing.
- (9) The closet pan should be of durable material so that it does not crack with the passage of time.

#### **5. Urinals:**

Urinals are the plumbing fixtures provided for the purpose of urinating.

These are usually made of glazed earthenware or vitreous china and are of the following four types:

- (i) Bowl type (see Figs. 20.16 and 20.17)

- (ii) Slab type (see Fig. 20.18)
- (iii) Stall type (see Fig. 20.19)
- (iv) Squatting plate type (see Fig. 20.20)

The bowl type urinal is of one-piece construction. It may be of either flat back pattern for fixing on a wall or angle back pattern for fixing at the junction of two walls.

The standard sizes of these urinals are as indicated below:

- (a) Flat Back Pattern- 430 mm Min. x 260 mm Min. x 350 mm Min
- (b) Angle Back Pattern- 340 x 430 x 265 mm

For fixing the urinal on the wall it is provided with at least two holes on each side having a minimum diameter of 6.5 mm. At the bottom of the urinal an outlet horn is provided to which an outlet pipe is fixed which is connected to a floor trap or nahni trap. The inside surface of the urinal is made smooth to ensure efficient flushing. The bottom of the urinal bowl has sufficient slope from the front towards the outlet so that there is efficient draining of the urinal.

The slab type urinal consists of a smooth glazed batter slab fixed on the wall with two end slabs one on either side of the batter slab fixed projecting from the wall.

The standard size of the slab type urinal is as indicated below:

- Batter slab- 450 x 1000 mm or 600 x 1000 mm
- End slab- 360×1000 mm

About 50 mm portion of the end wall is inserted into the wall for support and the remaining 310 mm portion remains projecting from the wall. Besides the slabs of glazed earthenware or vitreous china, the slabs of cement concrete, slate or marble are also used for the slab type urinals. At the bottom a half-round channel drain is provided along the wall in which urine flows and discharged into a floor trap or nahni trap to which the drain is connected.

The stall type urinal is similar to slab type urinal in which the batter slab and the two end slabs are made of one-piece construction. The standard size of the stall type urinal is 1140 x 460 x 400 mm. At the bottom of the urinal an outlet is provided which is connected to a floor trap or nahni trap.

The squatting plate type urinal is also of one-piece construction including a drain pipe. The standard sizes of the squatting plate type urinals are 600 x 350 mm and 450 x 350 mm.

The bowl type, slab type and stall type urinals may be used for urinating in standing position while the squatting plate type urinals may be used for urinating in sitting or squatting position. The urinals are usually flushed with siphonic type flushing cisterns which operate automatically at regular interval of 10 to 15 minutes. The urinals may be installed either as single unit or as multiple units placed side by side.

### **6. Flushing Cisterns:**

Flushing cisterns are the plumbing fixtures provided for flushing out water closets and urinals. These are made of cast iron, glazed earthenware or vitreous china, or plastic. For Indian type water closets normally cast-iron flushing cisterns are used which are fixed with their bottom at a height of 1.25 m above the top of the closet pans and these are known as high level flushing cisterns.

For European type and Anglo- Indian type water closets usually flushing cisterns of vitreous china or plastic are used which are fixed with their bottom at a height of 0.3 m above the top of the closet pans and these are known as low level flushing cisterns.

**Flushing cisterns are of two types:**

- (i) Valveless siphonic type, and
- (ii) Valve fitted siphonic type.

The valve less siphonic type flushing cisterns are preferred and are largely used in practice. Bell type flushing cistern is a typical example of the valveless siphonic type flushing cisterns. A bell type flushing cistern is provided with a central outlet stand-pipe with its upper end projecting a little above the maximum water level in the cistern and its lower end connected to a flush pipe which is connected to the closet pan or urinal.

The stand-pipe is provided with a bell-shaped cover called bell which is closed at the top and open at the bottom. The bell is connected to a chain through a lever arm so that on pulling the chain the bell is lifted up and on releasing it the bell is lowered to its original position.

The cistern is filled with water through an inlet controlled by a float valve or ball valve which closes the inlet when the cistern is filled upto the maximum water level and opens the inlet when the cistern is empty thus permitting the entry of water. An overflow pipe is provided to drain out excess incoming water if the float valve ceases to function and thus avoid spilling of water from the cistern in the toilet.

When the chain is pulled the bell is lifted up which splashes the water and a portion of it flows down the stand-pipe. The water flowing down the stand-pipe takes away some air with it which causes a partial vacuum in the upper portion of the bell, thus siphonic action starts and the entire quantity of water in the cistern is sucked rapidly through the large opening at the base of the bell, and the cistern is emptied.

The emptying action takes only a few seconds, causing powerful flush in the water closet or urinal below. When the cistern is emptied the float is lowered which results in opening of the inlet and allowing water to enter the cistern. It may be noted that the chain should be released immediately after being pulled; otherwise, the partial vacuum developed may be destroyed by the entry of air from the flush pipe.

The bell type flushing cisterns are usually of 5, 10 and 15 litres capacity.

**3.2.6: Classify Appliances by Type, Location and Price.**

The plumbing appliances can be classified Type, Location and price.

There are three classes of plumbing appliance according to usage type.

- water supply Appliances
- soil sanitary Appliances
- Waste sanitary appliances
- Appliances which do not use water.

Classification of appliances according to location. That is in which building components plumbing appliances are installed

- Bath room appliances

- Kitchen appliances
- Heating appliances
- Water storage tanks
- Meters (gas & water).

According to price the appliances classified as under:

- Low price appliances
- Medium price appliances
- High price appliances

### **Activity 3.4: Presentation About Scope and Importance of Different Appliances with its Working**

The teacher/ instructor is required to demonstrate to the students the scope and importance of different appliances along with their working. The students have to note the same in their note books.

### **Activity 3.5: Group Presentation on Different Appliances.**

The teacher/ instructor is required to direct the students for get prepared for having demonstration on plumbing appliance. The students have to give presentation on plumbing appliances.

### **Activity 3.6: Understanding About City Center, Motels, Suburban Hotels, Airport Hotels, Resort Hotels, Floating Hotels, and Specific Clientele.**

The teacher/ instructor is required to demonstrate to the students about various appliances in above buildings and state the purpose of each.

### **Activity 3.7: Group Presentation on Hotel Classification with Examples.**

The teacher/ instructor is required to direct the students for group presentation on hotel classification with examples.

## **3.3: Install Centrifugal Pump with Supply Pipes**

Centrifugal pump is used to provide fresh water in tanks placed at higher level in a domestic plumbing system. It works on the principle of centrifugal force which forces water to move in discharge pipe. The steps for installation are as under:

### **3.3.1: Isolate Services.**

- Collect the electric tools.
- Wear safety equipment to prevent form electric shock.
- Use insulated tools and electric current tester to check current/ electric pressure.

- Shut off breaker and remove the plug from the socket.

### **3.3.2: Carry Out Electric Safety Check**

- Check the pump with for current for satisfaction.
- Ensure there is no current in the pump.

### **3.3.3: Loose Unions**

- Collect the plumbing tools from the laboratory.
- Select suitable size pipe wrench as per size of unions.
- Open the unions to pick out the pump from the system.

### **3.3.4: Disconnect and Remove Pump from Foundation**

- Select the suitable size spanner or proper screw wrench to open the nuts used for fixing of pump with foundation bracket.
- Use the lubricating oil or joint cleaner to clean the corrosion if it is with nuts.
- Open the foundation nuts fully to free the pump.
- Remove the pump from the system.

### **3.3.5: Reconnect Pump to Existing Services.**

- Fix the unions and other necessary fittings with the repaired one or with new pump.
- Check the gasket condition. Replace with new one if is damaged one.
- Lubricate the threads of fittings and use Teflon tape to ensure prevention of corrosion with the joint.
- Place the pump on the foundation with proper alignment and level.
- Join the unions and also turn on nuts with bolts for fixing the pump with foundation.
- Re-examine the alignment and level of pump and tighten the nuts with foundation.
- Properly fix and tighten the unions with the service and suction pipe.

### **3.3.6: Check for Leakage.**

- For the purpose of priming the pump, on the nut to pour water in the pump body.
- Apply gas pressure or any other proper means to examine the pump for leakage.
- Insert the plug in the socket and switch on for electric power of the pump.
- Re-examine the leakage of the pump.

## Practical

### Activity 3.8: Identified Services Workplace, Replace the centrifugal pump as per standards.

The teacher/ instructor is required to demonstrate to the students the replacement of centrifugal pump observing the manufacturer instructions, work health & safety requirements. Also check the environmental requirements during and after replacement. The students have to perform the same as per instructions of the teacher/ instructor.

### 3.4: Install Gas Sub-Meter

Gas meter are generally mechanical based. Now a days digital meters are being installed. The procedure is very simple. But must observe safety precautions to prevent from any type of incident. When planning for the location of your new natural gas meter, please note meter set assemblies must be a minimum of 3 feet away from:

- Venting Heating systems
- Dryers' Central vacuums
- Direct vent appliances
- Intakes (10 feet from forced air intakes)
- Windows (including basement windows)
- Doors (including bulkheads)
- Sources of Ignition
- Electrical outlets
- Electrical meters
- Central A/C compressors
- Window air conditioners
- Source of heat (which could damage meter)

#### 3.4.1: Check Gas Pressure

- Prepare the necessary material list for installing the gas meter.
- Collect the necessary materials, tools and PPEs to perform the installation process.
- Wear the necessary personal protective equipments.
- Close the valve of the existing meter pipeline.
- Fix the pressure gauge available.
- Open the valve of pipeline.
- Note the pressure of gas.

#### Note:

Locked off gas in a downstream section of a high-pressure system could damage a meter with a Reverse Stop if the outlet valve from the meter is opened first.

#### 3.4.2: Understand Specification

- Note the specification of existing gas meter.

- Check the specifications of new gas meter to be installed.
- Match the specifications of new gas meter to be installed.
- Get ready if the specifications of new meters are as per requirements.

### 3.4.3: Uninstall Existing Gas Meter

- Close the valve of the line providing gas to the existing gas meter.
- Loosen the compression nuts of the existing gas meter.
- Hold securely the meter and open fully the compression nuts.
- Separate the meter from the pipeline.

Avoidance of an inadvertent and dangerous gas stream to atmosphere is well worth the checking time. Avoid high differential pressure across the meter

### 3.4.4: Install New Gas Meter

- Clean the threads of existing pipeline thoroughly.
- Check the condition of existing threads.
- Use the Teflon tape or suitable sealing material on the cleaned threads.
- Hold the meter up with proper location for fixing.
- Tighten the compression nuts and ensure the level of the meter.
- Securely tight the compression nuts.
- Check for leakage with soap slurry.
- Always be conscious for gas leakage smell for health and safety and avoidance of environmental pollution.

## Practical / Activities

### Activity 3.9: Uninstall and Re-install Gas sub-meter observing standard procedure, code of practices.

The teacher/ instructor is required to demonstrate to the students the Uninstalling and Re-installing Gas sub-meter starting with preparation of materials list, tools list, PPEs list, test and purge installation, checking working of gas meter observing the manufacturer instructions, work health & safety requirements. Also check the leakage with proper metho. The students have to perform the same as per instructions of the teacher/ instructor.

## 3.5: Install Storage Tank

Storage tanks are used for supply of water offline. Different types of water storage tanks are used with respect to material and purpose of the tank. Storage tanks may of RCC tanks, Fibre reinforced concrete, plastic, Fibre reinforced polymers etc.

### 3.5.1: Identify Tank

The installation process will differ depending on the application of the water storage tank. Reverse osmosis tanks are very simple to install, requiring only a piece of plastic tubing and a couple of plastic quick-connect fittings to connect your tank's control valve to the air gap faucet.

Though installing a well storage tank system is more involved than an RO (Reverse Osmosis) storage tank, it is not overly difficult or time-consuming task. A well tank installation will require several parts to ensure the system runs smoothly:

### **3.5.2: Connect the tank to a water inlet from the well.**

You'll need to make sure the pressure tank is connected to the water line running to the well. The well pump should be pumping water directly into the tank. Install fittings to route the plumbing from the well directly to the storage tank.

### **3.5.3: Make sure a check valve is in place.**

Check valves allow water to flow in only one direction. A check valve will let the well pump push water into the tank, and prevent it from flowing back out of the tank and down into the well once the pump has turned off.

### **3.5.4: Install a pressure relief valve.**

Pressure relief valves are designed to open when a specified pressure is reached and allow water to flow through until the pressure drops to the desired level. These prevent excessive pressure build-up that could cause the storage tanks to exceed their design limits

### **3.5.5: Ensure the tank is connected to a boiler drain.**

In the event that you need to drain the entire tank, a boiler drain will allow you to quickly and efficiently do so. Rather than turning off the well pump and running your faucet until the tank empties out, boiler drains will release all the water with the turn of a knob.

### **3.5.6: Attach a pressure switch.**

Pressure switches tell the well pump when to turn on and off based on the pressure building within the tank. Without this, the pump will not know when to stop delivering water to the tank. For example, a 40/60 pressure switch will allow water to drain out of the tank until the internal pressure reaches 40psi. This then tells the well pump to activate and start pumping water. The well pump will continue to fill the tank until the tank reaches 60psi, at which point the pump will turn off until the next pressure drops.

## **Practical Activity**

### **Activity 3.10: Install the storage tank**

The teacher/ instructor is required to demonstrate to the students the installation of water storage tanks in steps comprising of

- Create required material list
- Select size of tank as per number of users
- Select direction of tank
- Fixed with unions
- Test pipe pressure.
- Test joint leakage
- Check for working

The students have to perform the same as per requirements.

### 3.6: Install Geyser (Electric & Gas)

Geysers are sometimes known as hot water heater are of different types according to fuel being consumed in these, water storage capacity, central water heater, point on use heaters, Continuous or instant. Location of geyser on wall or on roof etc.

Fuel operated geysers should not be installed inside the room. These emit carbon mono oxide gas which is dangerous to health and can cause death of living things. These are called silent killers.

#### 3.6.1: Identify Geyser

- Open the packing of geyser
- Identify the type of geyser according to source of energy required for heating.
- Prepare list of materials required for installation.
- Prepare list of tools and equipments required for installation and collect the same from the laboratory.

#### 3.6.2: Check Water Pressure

- Open the dead plugs of cold-water supply line and hot water distribution lines.
- Fix requisite sized the unions with cold water supply line and hot water distribution lines.
- Mark the location of pipelines required to be installed/ laid.
- Prepare the new plumbing lines with the help of sandpaper cloths.
- Rub the sandpaper on the ends until they shine.
- Install pipe network as per requirements for both cold water and hot water line.
- Fix the T-Stop cock of requisite size at ends of supply of line and delivery line.
- Fix the pressure gauge to check the water pressure.
- Open the vales and T-stop cock and measure water pressure.

#### 3.6.3: Shut Down Valve, Locate Position and Install Geyser

- Close the T-stop cock.
- Close the main supply line valve providing water supply from water distribution tank.
- Read the drawing provided by manufacturer.
- Use the steel tape for measuring length.
- Use the spirit level for horizontal alignment.
- Use the plum bob for vertical alignment.
- Use the chalk line for marking horizontal and vertical lines.
- Use the permanent markers to mark the position of fixtures on wall for installation. You can also use Centre punch for marking location of fixture.
- Mark the point on wall for drilling holes to fix steel rowel bolts.
- Drill the holes and insert and tighten rowel bolts.
- Unscrew the bolt to fix the geyser.
- Fix the new geyser on the wall.

### 3.6.4: Waterline Connection and Operation of Geyser

- Fix the non-return valve to the cold-water side.
- Fix T&P (safety) valve to prevent blast due excessive pressure of steam with geyser.
- The geyser inlet-outlet connection now comes into consideration. Connect the cold-water supply and hot water supply with the respective inlets. Using flexible hoses for this connection will be a good idea.
- Make use of dielectric connectors to attach the flexible hoses to the trap nipples (cold and hot). You will also need to line the threads with plumber's tape.
- Tie up the flexible hose to one end of the connector body.
- Slide the compression nut into the pipe. Then press the pipe into the connector and tighten the compression nut.
- Turn on the hot water tap and check for leaks.
- Fill the water heater tank and connect with the electrical wirings. Or fix the flexible gas pipe with both the gas supply valve and with the geyser
- Then connect the green ground wires to the screws and twist the wires with the connectors.
- Turn on the circuit breaker at the main power. Or open the gas as per type of geyser.

## Practical

### Activity 3.11: Install the Geyser as per Requirements

The teacher/ instructor is required to demonstrate to the students the installation of water storage tanks in steps comprising of

- Create required material list
- Fix the bolt kits
- Fix cocks at entire height.
- Fix coupling for shower
- Check for leakage
- Check for fixing level
- Check for working

The students have to perform the same as per requirements.

## 3.7: Install Water Cooler or Dispenser

A water dispenser, known as water cooler (if used for cooling only), is a machine that cools or heats up and dispenses water with a refrigeration unit. It is commonly located near the restroom due to closer **access to plumbing**. Water cooler may also refer to a primitive device for keeping water cool.

### 3.7.1: Identify Water Cooler or Dispenser

First of all, open the packing of cooler/ dispenser.

Read the installation drawing. Let the cooler is wall type.

Read the manufacturer's instruction for unpacking cooler.

Verify that the electrical receptacle, water supply/valve, and drain locations are all in accordance with the installation drawing.

### 3.7.2: Check Water Pressure

Clean the line inlet pipe.

Attach the pressure gauge with inlet pipe.

Open the valve and check /note water pressure.

Ensure that water cooler can bear the maximum pressure coming from the water column as per site.

Close the valve and detach the pressure gauge.

### 3.7.3: Locate Position for Installation and Fix cooler with Wall

- Remove the hanger bracket from the back of the cooler by removing screw.
  - Place the bracket vertically on the wall and mark the location of hole points for the fixing the bracket.
  - Also mark the position of drain pipe.
  - Drill the Mount the hanger bracket on the wall using (4) 1/4” structural screws.
- a. NOTE: The screws must engage into structural material such as concrete, metal backing, wood blocking, etc.  
DO NOT use drywall anchors.
- b. NOTE: The hanger bracket has a notch indicating the centerline of the water cooler, as well as a second notch off-center indicating the ideal drain line location at the wall. If the centerline of the drain does not align with the second notch, consider moving the bracket location to accommodate.
- With the cooler laying on its back, remove the screws holding the skirt to the bottom of the frame. Then remove the skirt by sliding the skirt away from the cooler.
  - Hang the cooler onto the hanger bracket.

Do you know?

- a. NOTE: The hanger bracket must go through the holes in the cooler frame that are shaped like a sideways letter “P”.
- b. NOTE: The bracket allows for some lateral adjustment of the cooler location. Slide the cooler laterally as needed at this time.
- Secure both the lower right and lower left ends of the cooler to the wall using at least (2) 1/4” or 3/8” structural screws. These screws should go through the holes which are approximately 5” from the bottom of the cooler. Washers may be required.

- a. NOTE: The screws must engage into structural material such as concrete, metal backing, wood blocking, etc. DO NOT use drywall anchors.

### 3.7.5: Fix Union for Inlet and Outlet Pipes

- Connect the water inlet line (attached to either the strainer or filter, as applicable), to the water stop by following the steps below.
  - a. Cut the inlet line square and clean to the appropriate length, if needed.
  - b. Install the compression nut (included with your supply valve), followed by the plastic ferrule (supplied), and the brass tube support (supplied) onto the inlet line. Do not use the brass ferrule included with your supply valve.
  - c. Insert the inlet line into the supply valve until it bottoms out. Thread the nut down onto the supply valve until finger tight. Put a line on the nut using a marker. Tighten exactly one additional full (360 degrees) turn with a wrench, using the line to count turns.
- If the unit has a filter, install the filter now. Take care not to damage the circuit board which is near the filter head.
- Note that the thermostat is factory set at 50°F (±5°F) under normal conditions. The minimum thermostat set point varies with altitude. Adjust 1/16th turn counter clockwise (warmer) from cold position for every 1500 ft above sea level to prevent freezing of water.

### 3.7.6: Check Drain Pipes

- Install the P-trap. If necessary, trim the water cooler's drain tailpiece in place so it interfaces properly with the P-trap inlet. Pliers may be required to tighten the nuts to a leak-tight condition.

## Practical

### Activity 3.12: Install a water cooler from Drill in Wall at Measured Hight for Electric Panel

The teacher/ instructor is required to demonstrate the students for installation of water cooler starting from  
drilling in wall for bracket fixing  
Fix Cock at Entire Hight for Inlet Pipe  
fixing coupling.  
Checking leakage.  
Checking level of pump.  
The students have to perform under the supervision of instructor/ teacher.

### 3.8: Clean Up

#### 3.8.1: Clear the Work Area

- Clear the work area
- Dispose off the materials those are not reusable or recycle able at proper place.
- Store the materials those are reusable in storage bins.
- Place the materials at recycling station those are recycle able.
- Clean tools and equipment
- Check for serviceability of tools and equipment.
- Report any damage tools and equipment
- Store and secure tools and equipment in cabinets.

#### 3.8.2: Dispose Extra Materials in Accordance with State and Territory

##### Legislation and Workplace Policies and Procedures.

Collect the materials those are not used are have been wasted. For temporary storage of waste materials use the relevant bins with covers as per category of waste. Dispose off the waste materials as per guidance and rules of environmental protection authority. Reusable materials should be stacked in the store observing all safety precautionary measures. The following points should be observed during waste disposal.

- All waste should be segregated correctly.
- When handling waste, appropriate personal protective equipment (PPE) should be worn, and hands cleaned after removing each item of PPE, e.g. pair of gloves, apron.
- All waste bags should be no more than 3/4 full and no more than 4 kg in weight. This allows enough space for the bag to be tied using a suitable plastic zip tie or secure knot.
- Waste bags should be labelled with the address and date prior to collection by the waste contractor (some waste contractors may undertake this) to ensure traceability if an incident occurs.
- When handling tied waste bags, only hold the bag by the neck and keep at arm's length to reduce the risk of injury in case a sharp item has been inappropriately disposed of in the bag.
- If a waste bag awaiting collection is torn or contaminated, the bag and contents should be placed inside a new waste bag.

##### Activity/ Practical

##### Activity 3.13: Perform workplace cleaning activity.

Students are required to perform cleaning of work area and housekeeping of tools and equipment after installation of centrifugal pump.

Students are required to perform cleaning of work area and housekeeping of tools and equipment after installation of gas sub-meter.

Students are required to perform cleaning of work area and housekeeping of tools and equipment after installation of storage tank and geyser.

Students are required to perform cleaning of work area and housekeeping of tools and equipment after installation of water cooler.

## What I have learnt

- The devices which perform specific functions in plumbing system are called plumbing appliances.
- The fixing of appliances is known as installation of appliances. These installations may be on walls, on roof or on floor.
- Water-closet flushing cisterns are of three main types-the valve, the siphon, and the tipper. A fourth kind, which may be called the pneumatic, may be used with high-pressure supplies.
- The water sensor electrodes which are installed in the water tank and are connected via the cables to the float relays are used to activate the domestic transfer pump when water level falls below the set level and cut off the pump when the water level rises to the required level
- Soil sanitary appliances – For the reception and discharge of excretory matters. Examples are: WC, urinal and bidet.
- Waste sanitary appliances – For the reception and discharge of water for cleaning or culinary purposes. Examples are: Sink, basin, bath and shower.
- Showers are fundamentally a very simple appliance designed to contain water for a person or two and to drain spent water into the sewer system.
- Water supply appliances are water heating appliances, water tanks, water filtration systems, bathroom & other faucets, water meter, water pumps, geysers, coolers.
- Flushing cisterns are the plumbing fixtures provided for flushing out water closets and urinals.
- Geysers are sometimes known as hot water heater. These are of different types according to fuel being consumed in these, water storage capacity, central water heater, point on use heaters, Continuous or instant.
- T&P Valve means Temperature and Pressure Relief Valve.
- The main consideration during plumbing is that two systems run side-by-side but do not intersect each other.
- Before cutting or drilling into a wall, ceiling, or floor cavity, make sure you know what's behind the surface.
- Personal protective equipment, hazard identification, and emergency preparation are essential safety elements at the installation site.
- Dispose-off the materials those are not reusable or recycle able at proper place.
- Check for serviceability of tools and equipment after every installation/ job.

**EXERCISE****Q-1. Tick ( ✓ ) the correct option for the following MCQs.**

- i. The devices which perform specific functions in plumbing system are called
  - (A) fittings
  - (B) appliances
  - (C) valves
  - (D) none of these
- ii. This is a type of flushing cistern:
  - (A) valve types
  - (B) siphon type
  - (C) tipper type
  - (D) All of these
- iii. This is a type of soil sanitary appliance:
  - (A) Water closet
  - (B) bidet
  - (C) Urinal
  - (D) All of these
- iv. This is a type of waste sanitary appliance.
  - (A) Urinal
  - (B) Bidet
  - (C) Sink
  - (D) faucet
- v. Filters need swapping after every:
  - (A) 3 months
  - (B) 6 months
  - (C) 9 months
  - (D) 12 months
- vi. The P-trap is required for installation of:
  - (A) Water Dispenser
  - (B) Water Cooler
  - (C) water closet
  - (D) all of these
- vii. The instant geyser is of this type:
  - (A) continuous type
  - (B) point on use heater
  - (C) water storage type
  - (D) all of these
- viii. T & P valve is used for installation of:
  - (A) geyser
  - (B) storage tank
  - (C) water pump
  - (D) all of these
- ix. RO is abbreviation for in plumbing:
  - (A) Reverse Osmosis
  - (B) Riding Over
  - (C) Ray over
  - (D) all of these
- x. The distance of gas meter from source of ignition should be:
  - (A) 8 ft
  - (B) 10 ft
  - (C) 12 ft
  - (D) 14 ft

**Give short answer to the following question.**

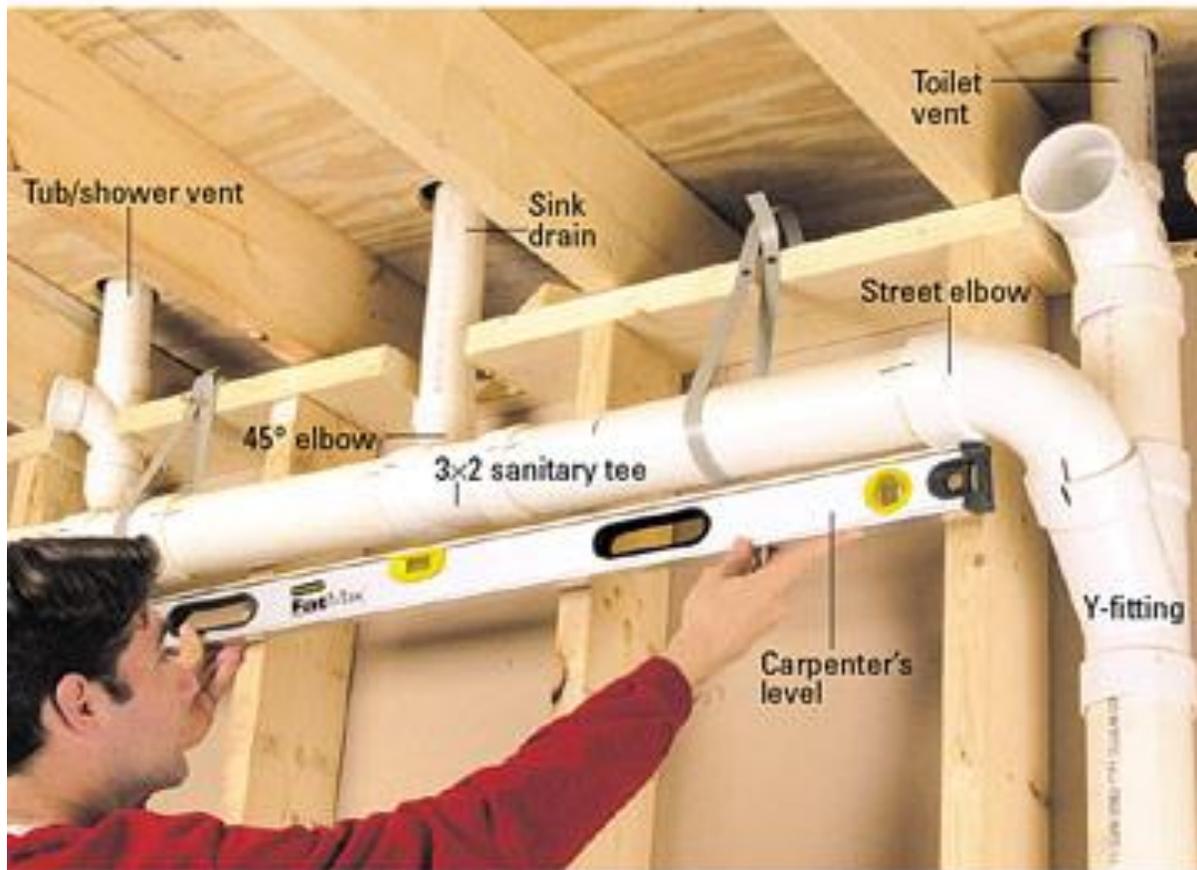
- i. What is the difference between continuous type geyser and the instant geyser?
- ii. Enlist types of waste sanitary appliances.
- iii. What is meant by priming of water pump?
- iv. Why it is necessary to dispose-off extra materials?
- v. What is the difference between electric water cooler and water dispenser?
- vi. Enlist the different types of water heaters.
- vii. Enlist the types of Geysers.
- viii. Define a plumbing appliance.
- ix. What points are considered while adjusting thermostat of water cooler.
- x. Describe the location of gas meter for installation.

**Answer the following questions in detail.**

- i. Write down the procedure for installation of gas meter.
- ii. Write a detailed note on classifications of plumbing appliance.
- iii. Write down the procedure for installation of gas Geyser.
- iv. Explain the working procedure of different types of flushing cisterns.
- v. Explain the installation procedure of water storage tank.

## CHAPTER -04

# SANITARY PIPES AND FITTINGS



### After Studying this unit, you will be able to:

- state about meanings for installation of pipes.
- state about meanings for installation of fittings.
- understand the importance of pipes
- manage to change fittings
- understand the working procedures of different fittings
- know about scope of pipes at industry (hotels, accommodations).
- explore importance of sanitary fittings
- know about different Type of sanitary pipes (concrete, cast iron, PVC etc.).
- know about different Types of sanitary fittings.
- classify pipes by type, location and price.
- classify fittings by type, location and price.

- 
- identify vent pipe.
  - carry out joint with waste pipe
  - check nuisance
  - connect with clamp
  - check leakage at joint.
  - check level of vent pipe
  - understand specification
  - check gas pressure
  - understand specification
  - excavate ground at level and width according to diameter of pipe
  - compact the excavated ground
  - lay pipe and check gradient
  - jointing the pipes
  - identify Y-fitting
  - identify waste pipe
  - check water pressure
  - shut down valve
  - locate position for installation
  - check joint position
  - identify Y-fitting
  - check gas
  - locate position for installation
  - fix Y with clamps
  - fix pipes with Y-Fitting
  - identify socket
  - check waste water pressure
  - locate position for fixing socket
  - fix appropriate joint
  - identify hockey pipe
  - check waste water pressure
  - locate position for fixing pipe
  - fix appropriate joint
  - check proper working
  - clear the work area.
  - dispose extra materials in accordance with state and territory legislation and workplace policies and procedures.

## 4.1: Introduction to Sanitary Pipes and Fittings

Sanitary plumbing system is a network of pipes to dispose-of used/ waste water. The pipes used to convey used water are known as sanitary pipes. The components which are used to join pipes with each other are known as sanitary fittings. Other components which provide specific service/ function are called appliances. Pipes are also connected with fixtures and appurtenances.

Sanitary Fittings are cleanable tubing connections installed in systems of process piping to ensure sterility and cleanliness. Like regular fittings, sanitary fittings connect sections of piping systems to regulate the flow of fluid, but sanitary fittings are specially designed and made to prevent the entrapment, formation, and spread of bacteria in the piping system.

### 4.1.1: Meanings for Installation of Pipes.

The jointing of pipes is known as installation of pipes. These installations may be on walls, or under floor/ underground. For example, installation vent pipe with wall, installation of soil pipe with water closet underground etc.

### 4.1.2: Meanings for Installation of Fittings.

The components which are used to join pipes with each other are known as sanitary fittings. The jointing of fittings with pipes is known as installation of fittings.

### 4.1.3: Importance of Sanitary Pipes

Most of the killer diseases, especially in third world countries, are caused by poor sanitation. Diseases such as cholera, typhoid, and many others are as a result of water contamination. Pipes provides the means of conveying used water by minimum polluting the environment. Prevent the stacking of water in the residential/ public areas. Hence sanitary pipes are important for the health, maintaining clean environment.

### 4.1.4: Manage to change fittings

Every fitting has some utility period. Due to continuous usage, these fittings do not work as per requirements due to wear and tear. An efficient maintenance of fitting will enhance the life span of fitting. Hence continuous inspection for working status of fitting is necessary. When these are not working properly, there comes a stage when the maintenance cost exceeds then change of fitting is required. Thus, change/ replacement of fittings should be managed as and when required.

### 4.1.5: Working Procedures of Different Fittings

#### External piping - Sewerage & Storm water

- Mark pipe lines in ground according to working drawings.
- Excavate trenches to required depths with proper barricading.
- Prepare base for laying pipes.
- Lay pipes according to specified gradient.

- Perform hydraulic/smoke test and obtain certification form client's representative.
- Provide encasement with concrete / sand/ granular material, as specified.
- Backfill trenches in layers including compaction.

#### **Sanitary fixtures & CP fittings**

- Flush the installed pipework (water supply and drainage) to remove debris or blockages, if any.
- Install sanitary fixtures, faucets and washroom accessories. Use screws with nylon washers to fix vitreous chinaware and PTPE tape for installation of faucets to pipework.
- Check CP fittings for leaks and firmness. Refit them if necessary. Ensure that proper tools are used. They must not make scratches or any other kind of damages on the chrome plated fixtures.
- Commission the toilets in the presence of the client's engineer.
- Handover the toilets formally using the forms provided for the purpose.
- Disinfection
- The water distribution system should be thoroughly disinfected before being put to use.

### **Practical /Activities**

#### **Activity 4.1: Presentation about concept of different pipes and fittings.**

The teacher/ instructor is required to give presentation to the students for usage of different sanitary pipes and fittings. The students have to prepare the list of fittings and write in their note books.

#### **Activity 4.2: Groups' discussion about wastewater pipes fittings**

The teacher/ instructor is required to give presentation to the students for usage of different sanitary fittings. The students have to prepare the list of fittings and write in their note books.

#### **Activity 4.3: Differentiate between sanitary pipes and sanitary fittings.**

The teacher/ instructor is required to give demonstrate difference between sanitary pipes and sanitary fittings. The students have to recognize different pipes and fittings.

### **4.2: Scope and classification of sanitary pipes and fittings**

Various types of sanitary pipes and fitting are used to lay sanitary pipelines. The most commonly used pipes are concrete pipes, PVC pipes and cast-iron pipes. For turning, lengthening and other purposes different components are used. These are called fittings.

### 4.2.1: Scope of Pipes at Industry (Hotels, Accommodations).

Pipes are used in many fields for conveying liquids and gases. The different fields using the pipes including hotels and accommodations are:

Supply of fresh water.

Disposal of waste water

Disposal of foul gases.

For irrigation purposes.

For conveyance of petroleum products.

For conveyance of different types of gases including fuel gases.

### 4.2.2: Explore importance of sanitary fittings

The important part of the pipeline is its joint. Joint requires different types of fitting for different purposes. If the strength of fittings is not able to bear different stresses, the cracks may develop, leading to the leakage of joints. Diseases such as cholera, typhoid, and many others are as a result of water contamination resulting from leakage mostly. Fittings provides the means of easy and durable jointing. Prevent the stacking of water in the residential/ public areas. Hence sanitary pipes are important for the health, maintaining clean environment.

### 4.2.3: Type of sanitary pipes. (Concrete, cast iron, PVC etc.)

Pipes are used for carrying gas, cold and hot water, and other liquids from one place to another safely. Different types of pipes are used in different circumstances. Pipes used in sanitary plumbing system are known as sanitary pipes. Pipes types are selected on the basis of work and suitability, and their prices are also taken into account. Here under are some commonly used sanitary pipes for internal sanitary system.

#### 1. Cast Iron Pipe

Cast iron pipe is made from pig iron. Such pipes are normally made from 5 cm to 120 cm in diameter. Cast Iron pipe is widely used because of its high resistance to corrosion and consequent long life. It is used as vent pipe, vent shaft and soil pipe. These are jointed with lead caulked joint- molten lead is poured in jointing location. These are also jointed with cement caulked joint- cement mortar 1:2 is filled/ applied for the joint.

The usual length of a pipe section is 12 ft, but lengths up to 20 ft can be obtained.

Cast iron pipe is made in several thickness classes for various pressures up to a maximum of 350 psi. Cast-iron pipes are usually dipped in a bituminous compound for protection against corrosion and to improve their hydraulic qualities; larger sizes may be provided with a lining of cement mortar. Different fittings are used for various purposes.

A common joint for cast iron pipe is the bell and spigot. A few strands of jute are wrapped around the



spigot before it is inserted into the bell, and then more jute is packed into the joint. Finally, the space between the bell and spigot is filled with a molten lead, which is tightly caulked into the joint after cooling. Patented compounds of sulphur and other materials and neat cement mortar are also used for joints. These materials are cheaper than lead, but the joints are usually less flexible. Under normal conditions, a cast iron pipe can be expected to last 100 years.

## 2. Concrete Pipe.

The Pre-cast Concrete pipe is available in sizes up to 72 inches diameter, and sizes up to 180 inches have been made on special order.

Precast Concrete pipes are reinforced except in sizes under 24 inches diameter. The reinforcement may take the form of spirally wound wire or elliptical boom.

In large pipes, the reinforcement usually consists of two cylindrical cages. The precast concrete pipe is usually made by rotating the form rapidly about the pipe axis.

The centrifugal force presses the mortar tightly against the forms and results in high-density watertight concrete.



The concrete pipe is usually joined with a mortar caulked bell-and-spigot joint

Because of the need to move plant and forms over long distances, cast-in-place pipe is relatively expensive and is normally used only for pipe sizes not available in precast form or where transportation difficulties make use of precast pipe impossible.

For gravity flow, the no-joint concrete pipe has been developed. This pipe has been constructed in sizes 24 to 72 inches. A special pipe-laying machine with a slip form is used. A concrete pipe should last at least 35 to 50 years under average conditions. Alkaline water may cause rapid deterioration of thin concrete sections.

Concrete pipes carrying wastewater may be subject to sulphide corrosion and may be short-lived unless proper precautions are taken.

Concrete Pipes are generally used these days. They are used even in low as well as high pressure. Plain concrete pipes are made for low pressure, and R. C. C. (Reinforced Cement Concrete) pipes are made for high pressure. Less expenditure is required for their maintenance. Rust does not affect these pipes, and they can be made at will. Such pipes are heavy. So, their transportation is difficult. It is also difficult to repair them.

## 3. PVC Pipes:

Polyvinyl Chloride (P. V. C.) pipes are joined using a thread joint or socket is joined with a solution. Such pipes are not rusted. They are light in weight. Cutting, bending, and jointing are easy for these pipes. These types of pipes have good resistance against electric current. They become



useless on increasing temperature. They also become useless on being tempered by nail, etc. These pipes are being used increasingly these days for supply of cold water as well as disposal of sewage and foul gases in external and internal plumbing work.

#### 4. Asbestos Cement Pipe.

The asbestos pipe is made from asbestos, silica, and cement converted under pressure to a dense, homogeneous material possessing considerable strength. The asbestos fiber is thoroughly mixed with the cement and serves as reinforcement. This type of pipe is available in diameters of from 4 to 36 inches in 13-ft lengths. The pipe is made in various grades, the strongest being intended for internal pressures up to 200 psi.



The asbestos pipe is assembled by means of a special coupling which consists of a pipe sleeve and two rubber rings which are compressed between the pipe and the interior of the sleeve.

The joint is as resistant to corrosion as the pipe itself and is flexible enough to permit as much as 12° deflection in laying pipe around curves.

An asbestos-cement pipe is light in weight and can be assembled without skilled labor. It can be joined to cast-iron pipe with lead or sulfur-base compounds.

It is easily cut and can be tapped and threaded for service connections. The hydraulic efficiency of an asbestos pipe is high.

However, the rubber-joint seals may deteriorate if exposed to gasoline or other petroleum products. The pipe is easily damaged by excavating tools and does not have much strength in bending. They are used to carry water under low pressure.

These pipes are soft from the inside. That is why their performance is better. They are not rusted and are cheap as well.

#### 5. Vitrified Clay Pipe (VCP)

Vitrified clay pipe is pipe made from a blend of clay and shale that has been subjected to high temperature (1100°C=2000°F) to achieve vitrification, which results in a hard, inert ceramic. Vitrified Clay Pipe is not often used as pressure pipe, but is widely used in sewerage and drainage for flow at partial depth. The main advantage of vitrified clay



pipe is that it is virtually corrosion-free, has a long life, and its smooth surface provides high hydraulic efficiency.

Use of vitrified clay pipe under pressure is usually prevented by its low strength in tension and the difficulty of securing watertight joints.

The most common joint for vitrified clay pipe is the bell-and-spigot flexible compression joint in which precision mated surfaces are in tight contact with one another.

Rubber-sleeve couplings held in place with corrosion-resistant steel bands are occasionally used with a plain-end clay pipe, but more often the joints of this type of pipe are left open to permit passage of water either into or out of the pipe.

Vitrified Clay pipe is most commonly made of 3-ft lengths, but 2, 2.5, and 4-ft lengths can be obtained. Inside diameters vary by 2 inches increments from 4 to 12 inches and by 3 inches increments above 12 inches. Clay pipe in diameters greater than 36 inches is rarely used. Because of the dimension changes, while the pipe is in the kiln, liberal tolerances in all dimensions are necessary.

**4.2.4: Types of sanitary fittings.**

Here under are the different sanitary fittings.

		
3 IN. X 2 IN. PVC DWV Flush Bushing	1 1/2 INCH PVC P-Trap with Cleanout Mueller	1-1/2 HUB PVC DWV 90 Degree Elbow Mueller
		
1-1/2 IN. Chrome Center Outlet Waste Elbow	1-1/2 IN. PVC DWV 90-Degree Vent Elbow	1-1/2 IN. X 12 IN. PVC Flange Sink Tailpiece
		

<p>1-1/2 IN. X 12 IN. PVC TAILPIECE EXTENSION</p>	<p>1-1/2 INCH FLEXIBLE PVC COUPLING</p>	<p>1.5 x 1.25in PVC Double Tee</p>
		
<p>1-1/2 X 1-1/4 IN TRAP ADOPTER</p>	<p>1-1/2 X 12-INCH PVC EXTENSION TUBE</p>	<p>1-1/2 X 6 IN. PVC SINK TAILPIECE`</p>
		
<p>1-1/2 X 6 IN. PVC SLIP-JOINT EXTENSION TUBE</p>	<p>1-1/2-IN X 1-1/4-IN DIA BUSHING</p>	<p>1-1/2IN - PVC P-TRAP W/UNION</p>
		
<p>1-1/2IN - P-TRAP PVC W/ADAPTER</p>	<p>1-1/2IN SANITARY TEE</p>	<p>P-TRAP 2 PIESE</p>
		
<p>1-1/2IN - PVC WYE45</p>	<p>1-1/2IN - SCHEDULE 40 MALE ADAPTER USE</p>	<p>FEMALE TRAP ADAPTER</p>
		

		
1-1/2IN - S-TRAP	1-1/2IN X 20FT DWV PVC PIPE	End-Cap
		
1/2 IN. X 12 IN. PVC Flange Sink Tailpiece	1/4 IN Straight Connector For P-Trap Toilets	2 IN. PVC DWV Sanitary Tee
		
3 Inch DWV Vent Cap Active Ventilation AV-3-PVC-BL	3-1/2 Inch Kitchen Sink Strainer with Basket-And Water Stopper	3-1/2 INCH PVC Sink Waste Strainer

**4.2.5: Classify pipes by type, location and price.**

**Classification of pipes according to materials types**

Cast iron Pipe.	G.I Pipe.	Wrought Iron Pipe.
Steel Pipe.	Copper Pipe.	Plastic Pipe.
Asbestos Cement Pipe	Concrete Pipe.	Vitrified Clay Pipe.

**1) Asbestos Cement Sewer**

These are manufactured from a mixture of cement and asbestos fibres. These pipes are normally available in sizes from 5 cm to 90 cm in diameter and 4 in length. These pipes are suitable for domestic sanitary fittings.

**2) Brick Sewer (Masonry Sewer)**

Bricks are used for constructing large size sewers. These sewers are plastered outside and lined inside with stoneware or ceramic blocks. These sewers are used at places where the sewers are

required to be constructed at the site. They are also preferred for constructing large-sized combined sewer or for the stormwater drain. The sewer section is always rectangular in section.

### **3) Cast Iron Sewer**

The Cast iron sewer possesses high strength and durability. These are highly resistant to corrosion and have a long life. But these are very heavy and difficult to handle. These sewers are used under the following condition:

1. When the sewage is conveyed under high pressure.
2. When the sewer line is to be laid in an exposed position or in suspension.
3. When sewers are to be laid below heavy traffic loads.

### **4) Cement Concrete Sewer**

These pipes are manufactured using cement concrete with or without reinforcement. They may be pre-cast or cast-in-situ. The pre-cast R.C.C pipes are known as Hume pipes. The diameter of plain cement concrete pipes may be up to 60 cm. The Hume pipes are available up to 250 cm in diameter. The length of the pipe varies from 1 to 3 m. These pipes are most suitable for combined sewer and stormwater Sewer.

### **5) Plastic Sewer**

The plastic pipes are used for carrying industrial sewage and in domestic sanitary fittings. These are highly resistant to corrosion and light in weight. These pipes may be available in diameter varying from 5 cm to 15 cm and of longer length.

### **6) Stoneware Sewer**

These pipes are manufactured from vitrified clay by moulding and burning. The diameter of these pipes varies from 10 to 90 cm. These pipes are joined by bell and spigot joint. These pipes offer high resistant to sulphide corrosion. Their interiors are very smooth and they are hydraulically very efficient. These pipes are widely used in domestic sanitary fittings and for laterals.

#### **Classification of pipes according to location**

- 1- Vent pipe- used for disposal of foul gases
- 2- Soil pipe- used to convey human excreta up to first intercepting chamber.
- 3- Sullage pipe- carries water from bath, wash basin and kitchen.
- 4- Vent shaft- used for disposal of foul gases at distant turning points.
- 5- Waste pipe- used to carry water of sink, basin, dishwasher to floor trap.
- 6- Flush pipe- used to flush water from flushing cisterns.
- 7- Rainwater pipe- used to carry rain water from roofs to ground.
- 8- Anti- Siphonage pipe- A pipe which is installed for the purpose of preserving the water seal of traps in drainage system is called anti siphonage pipe

**Classification of pipes according to price**

- 1- Low-cost pipe
- 2- Medium cost pipe
- 3- High-cost pipes

**1) External Sewer pipes According to the Place of Use**

According to the place of use, the sewer is classified as follows:

Main Sewer.	Branch or sub-main Sewer.	Lateral Sewer.
Combined Sewer.	Depressed Sewer.	Intercepting Sewer.
Outfall Sewer.	Trunk Sewer.	Relief or Overflow Sewer.

**1) Main Sewer**

The sewer which obtains its discharge from a few branch or sub-main sewers is termed as the main sewer.

**2) Branch or sub-main Sewer**

The sewer which obtains its discharge from a few laterals and delivers it to the main sewer is termed as a branch or sub-main sewer.

**3) Lateral Sewer**

The sewer which obtains its discharge directly from buildings is known as a lateral sewer.

**4) Combined Sewer**

The sewer which carries sewage and stormwater is known as combined sewer

**5) Depressed Sewer**

When an obstruction is met, the sewer is constructed lower than the adjacent sections to overcome the obstruction. Such a section of the sewer is termed as a depressed sewer.

**6) Intercepting Sewer**

The sewer which obtains the discharge from a number of main or outfall sewer and carries the same to the point of treatment and disposal is termed as intercepting sewer.

**7) Outfall Sewer**

The length of main or trunk sewer between the connection of the lowest branch and final point of disposal is termed as outfall sewer.

**8) Trunk Sewer**

The sewer which obtains its discharge from two or more main sewers is known as trunk sewer.

**9) Relief or Overflow Sewer**

The sewer which carries the excess discharge from an existing sewer is known as relief or overflow sewer.

**4.2.6: Classify fittings by type of materials.**

Sanitary fittings according to material of sanitary pipes are:

PVC Fittings- Fittings made from PVC (polyvinyl chloride).

Cast iron Fittings- Fittings made from cast iron.

Concrete Fittings- Fittings made from concrete

## Practical/ Activities

### Activity 4.4: Presentation about scope and importance of different sanitary pipes and fittings

The teacher/ instructor is required to give demonstrate about scope and importance of sanitary pipes and sanitary fittings. The students have to give presentation about different pipes and fittings.

### Activity 4.5: Group Presentation on different sanitary pipes.

The teacher/ instructor is required to give demonstrate difference between sanitary pipes. The students have to give presentation about different pipes.

### Activity 4.6: Group Presentation on different sanitary fittings

The teacher/ instructor is required to give demonstrate sanitary fittings. The students have to give presentation about different fittings.

## 4.3: Install Vent pipes

Vent pipes are required to be installed to escape foul gases. These are usually installed for every water closet for the escape of said gases.

### 4.3.1: Identify vent pipe.

Read the drawing relevant to vent pipe. Note the specifications of the vent pipe required to be installed. Collect the vent pipe of required material, size, relevant fittings and materials from the shop / lab store.

### 4.3.2: Jointing Waste Pipe

1- Collect the required tool from the lab. Vent pipe is usually of 2” internal diameter. There may be one of the three situations for installation of vent pipe.

- i- If the toilet drain does not connect directly to a vent, you must find another way to vent it. If the drain line runs away from the wall where you want the vent, use a reducing Y and a 45-degree street elbow to point the vent line toward the wall. The horizontal vent pipe runs right next to the closet bend.
- ii- If the vent wall is parallel to the drain pipe, install a 45-degree reducing Y and a street elbow to point toward the wall. You might need another elbow (of any degree) to position the vertical vent where you want it.

**iii-** If the vent wall is opposite the drain line, use a reducing Y and a street elbow. The fittings can be pointed straight at the wall or at an angle, as needed.

**2-** Align the main soil pipe line. Start with a length of 3-inch pipe long enough to reach the basement or crawlspace. You might be able to cut it to the exact length after it has been installed. Dry-fit a Y-fitting, a length of pipe, and a low-heel vent fitting as shown, aligning them precisely.

**3-** After fixing this secure the low-heel vent fitting to the framing with pipe strap. Secure the pipe from below as well.

**4-** Assemble the fittings in sequential order. Measure, mark and cut the vent pipe pieces for all the fixtures to be connected by suitable tools. Firstly, dry fit all pipes and fittings with waste pipes/traps of all fixtures. Make sure the horizontal pipe slopes at a rate of 1/8 to 1/4 inch per running foot.

**5-** Lay down horizontal pipes with fittings and join with suitable jointing materials. For example, use bonding solution for PVC fitting and vent pipe, cement mortar or lead for cast iron pipe. Install the wall vent pipe and fix top cover (cowl) with jointing materials. Height of vent pipe should be 2m above living level.

### 4.3.3: Check Nuisance

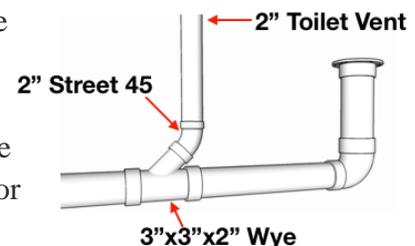
Check any variance or hassles against the code of practice with spirit level, plumb bob and other relevant tools. Any hassle if observed shall be removed.

### 4.3.4: Connect with clamp

After making sure the correct horizontal and vertical alignment, anchor the vent pipe with suitable clamps. Clamps may be fixed by drilling suitable diameter holes in the wall, inserting rowel plug/rowel bolts in the holes. And then tightening the bolts or screws as per requirements.

### 4.3.5: Check leakage at joint.

Run the new vent line over to the tee fitting. The pipes should slope gently away from the existing vent pipe so water can travel downward. Once the drain system is assembled and cemented, plug the drainpipe at the lower end. Pour water into it until all the drain and vent pipes are filled with water. Allow the water to sit for a day to make sure there are no leaks.



## Practical/ Activities

### Activity 4.7: Identified services workplace

The teacher/ instructor is required to demonstrate to the students how to identify the need of vent service for different fixtures. The students have to perform the same as per instructions of the teacher/ instructor.

**Activity 4.8: Create required material list**

The teacher/ instructor is required to demonstrate to the students how to prepare list of required materials with the help of drawings and specifications. The students have to prepare the list as per instructions of the teacher/ instructor.

**Activity 4.9: Fix the vent pipe by adopting standard procedures and observing work health and safety requirements.**

The teacher/ instructor is required to demonstrate to the students the how to fix the vent pipe by adopting standard procedures and observing work health and safety requirements. The students have to perform the same as per instructions of the teacher/ instructor.

**Activity 4.10: Check environmental requirements.**

The teacher/ instructor is required to demonstrate to the students how to check environmental requirements of installed vent pipes. The students have to perform the same as per instructions of the teacher/ instructor.

**4.4: Install / Lay waste pipe for sink / wash hand basin**

We need fresh water for drinking, take bath, washing clothes, utensils, and for other

**4.4.1: Understand specification**

Make sure you unpack and inspect your basin waste as soon as it's delivered. Always turn off your water at the mains before attempting any installation in the bathroom.

**4.4.2: Trench preparation as per requirements:**

- Excavate ground at level and width according to diameter of pipe.
- Dress the sides of the trench.
- Compact the loos soil.
- Check the gradient of trench. Comply with gradient if not up to the mark.
- Compact the be

**4.4.3: Lay pipe and check gradient**

- Lower the waste pipes to be laid and jointed in the trench.
- Provide necessary supports nearby to the jointing location.
- Check the gradient of pipes with spirit level.
- Join the pipes in the trench.

**4.4.4: Jointing the pipes**

1: Disassemble your waste coupling ready for fitting.

2: Apply a bead of silicone sealant around the opening of the plug hole to create a watertight seal inside your basin.

3: Fit the waste coupling into the hole, making sure any slots are pointed towards the overflow (if your waste and basin has these).

4: Apply a second bead of silicone around the thread before adding a washer.

5: Screw on the hexagonal nut and wipe away any excess silicone with a cloth.

6: Now fit the basin with wall and/ or bracket.

7: Now fit the waste pipe and the trap and check for any leaks.



## Practical/ Activities

### Activity 4.11: Create required material list and tools

The teacher/ instructor is required to demonstrate to the students how to prepare list of required materials with the help of drawings and specifications and tools. The students have to prepare the list as per instructions of the teacher/ instructor.

### Activity 4.12: Install Waste pipe with basin and sink and check for leakage.

The teacher/ instructor is required to demonstrate to the students how to install waste pipe with sink and basin, check the slope of pip. The students have to prepare the list as per instructions of the teacher/ instructor.

## 4.5: Install “Y” in waste pipe

### 4.5.1: Identify Y-fitting and Waste

Select the suitable size wye (“Y”) fitting as per requirement considering the size of main waste pipe and the purpose for which wye is to be installed. Let the Wye to be connected is to for branch waste pipe. The wye can be 2”x2” i.e., 2” for waste pipe coming from upper floor and 2” for branch pipeline of this floor wash basin. The wye should have the capacity to bear pressure. Check the pressure of water approaching the wye. Always turn off your water at the mains before attempting any installation in the bathroom.

### 4.5.2: Locate position and prepare for install

Use the measuring tape to mark the location of wye. Also measure the lengths of pieces of pipes to be attached. Check the requirements of other fittings required as per site requirements. Cut the piece of pipes.

### 4.5.3: Join and Check joint

- Firstly, assemble the components without joining material.
- Check the correctness of the alignment and correctness of the lengths of pipe in the form of loose assembly.
- Now start joining from ground floor. Let you have the alignment of top floor nearest to wall and ground pipe is somewhat away from wall, use two bends inversely to have the alignment with wall. Join the two bends with ground pipe.
- Now join 10” piece of pipe with bend and join the wye above it to have branch connection from basin of ground floor with main.
- Then join pipe upto required location of basin P-trap.
- Plug the ends and fill the assembled network with water.
- Wait and check for leakage.



## Practical/ Activities

### Activity 4.13: Install a “Y” with waste pipe and check for leakage and working of assembly.

The teacher/ instructor is required to demonstrate to the students how to select size of pipe, decide direction of pipe, check gradient, join the “Y”, test for leakage and check working of the assembly. The students have to perform the same as per instructions of the teacher/ instructor.

## 4.6: Install “Y” in vent pipe

### 4.6.1: Identify Y-fitting and check foul gas

Select the suitable size of wye (“Y”) fitting as per requirement considering the size of existing vent pipe and the size of vent to be attached with main vent. Let Wye to be connected is 2”x2”. The wye should have the capacity to accommodate the foul gas to be disposed of through vent pipe. Check the pressure of foul gas approaching the wye.

### 4.6.2: Locate position for installation

Use the measuring tape to mark the location of wye. Also measure the lengths of pieces of pipes to be attached. Check the requirements of other fittings required as per site requirements. Cut the piece of pipes.

### 4.6.3: Join the Assembly with Y and fix with clamps

- Firstly, assemble the components without joining material.
- After you have checked the correctness of the alignment and correctness of the lengths of pipe in the form of loose assembly.
- Now start joining from ground floor vent pipe of WC. Let you have the alignment of top floor and ground floor pipe is somewhat different, use the bends inversely to have the same alignment. Join the two bends with first floor vent pipe.
- At first floor join 10” piece of pipe with bend and join the wye connecting the both vent pipes of Ground floor and first floor.
- Then join pipe upto required location i.e., 2m above living level.
- Fix the clamps to the vent pipe with the wall.
- Plug the ends and fill with coloured gas in assembled network.
- Wait and check for leakage by exit of any gas at joints.



## Practical

### Activity 4.14: Install a “Y” in vent pipe, clamp and test for leakage.

The teacher/ instructor is required to demonstrate to the students how to select size of pipe, decide direction of pipe, clamp the vent pipes with wall, join the “Y”, test for leakage and check working of the assembly. The students have to perform the same as per instructions of the teacher/ instructor.

## 4.7: Install Socket with Waste Pipe

### 4.7.1: Identify socket

Select the suitable size socket fitting as per requirement considering the size of existing pipe and the size of another pipe to be attached. Let the socket to be connected is 4”x2” according to size of pipes. The socket should have the capacity to bear the external pressure.

### 4.7.3: Locate position for fixing socket

Use the measuring tape to mark the location of socket. Also measure the lengths of pieces of pipes to be attached. Cut the piece of pipes with suitable cutting tool.

#### 4.7.4: Fix appropriate joint

Clean the socket and pipe ends. Remove the burr if any. Apply the jointing solution on inner side of socket of 2" end and on outer side of the pipe of 2" i/d pipe. Press the pipe into the socket. Retain it for some time and then release the pressure. Similarly apply jointing solution to other end of socket and second 4" i/d pipe. Now the joint is ready. Plug the one end. Fill the jointed pipe with water and check for leakage. Now lay the pipe in excavated trench. Check the level difference of ends of pipe. It should be 1/8" to 1/4" per foot run.



### Practical/ Activities

#### Activity 4.15: Install socket with waste pipe with PVC reducing socket.

The teacher/ instructor is required to demonstrate to the students how to select size of socket according to sizes of pipes, fix the socket and check for leakage and gradient of pipe. The students have to perform the same as per instructions of the teacher/ instructor.

#### 4.8: Install Flush (Hockey) pipe with Flushing Cistern

Let the flush pipe (hockey pipe) is jointed with the water closet. Top end of flush pipe is required to be fitted with the low-level flushing cistern.

##### 4.8.1: Identify Flush Pipe (hockey pipe) and flushing cistern

- Physically observe the flush pipe.
- Note the material of flush pipe, e.g., PVC of one inch dia.
- Measure the diameter of piece of pipe with coupling of the flushing cistern.
- Unclamp coupling of the flushing cistern.
- Check if the coupling pipe fits in the flush pipe.

##### 4.8.2: Join Flush Pipe (hockey pipe) with coupling pipe.

- If it not fits then heat the flush pipe
- Push the coupling pipe in to the flush pipe or join these with a PVC socket.
- Apply the jointing solution, press pipe in to the socket and hold for some time.

##### 4.8.3: Install Flushing Cistern and Thread join Coupling.

- Fix the coupling with flushing cistern and mark location of drilling for rowel plug for installation of hanger of flushing cistern.
- Drill into the wall and insert the rowel plug.
- Fix the hangers on wall with screws and also hang the flushing cistern on these.
- Join the plastic connection of Flushing cistern with tee stop cock.
- Fix the coupling with the flushing cistern.

- Check the level of flushing cistern.

#### 4.8.4: Check the joints for Leakage.

- Open the T-stop cock and fill the flushing cistern with water.
- Press or pull the knob of flushing cistern as the case may be for flushing.
- Check the joints for leakage.

### Practical/ Activities

#### Activity 4.16: Install flush pipe with Flushing cistern.

The teacher/ instructor is required to demonstrate to the students how identify task points for jointing flush pipe with flushing cistern, join flush pipe, fix the flushing cistern, check level of flushing cistern and check for leakage. The students have to perform the same as per instructions of the teacher/ instructor.

### 4.9: Clean Up

As given on chapter 3 for clean-up section 3.8.

### Practical/ Activities

#### Activity 3.17: Perform workplace cleaning activity including observing hygiene standards, cleaning tools and housekeeping.

Students are required to perform cleaning of work area and housekeeping of tools and equipment after installation of vent pipe

Students are required to perform cleaning of work area and housekeeping of tools and equipment after installation of waste pipe of basin and sink.

Students are required to perform cleaning of work area and housekeeping of tools and equipment after installation of “Y” in vent pipe & waste pipe, socket with waste pipe and hockey pipe with flushing cistern.

Students are required to perform cleaning of work area and housekeeping of tools and equipment after installation of water cooler.

### What I have learnt

- The pipes used to convey used water are known as sanitary pipes.
- The components which are used to join pipes with each other are known as sanitary fittings. The jointing of fittings with pipes is known as installation of fittings.
- Most of the killer diseases, especially in third world countries, are caused by poor sanitation. Diseases such as cholera, typhoid, and many others are as a result of water contamination.
- Pipes types are selected on the basis of work and suitability, and their prices are also taken into account

- Cast iron pipe is made in several thickness classes for various pressures up to a maximum of 350 psi. Under normal conditions, a cast iron pipe can be expected to last 100 years.
- The Pre-cast Concrete pipe is available in sizes 24” to 72 inches diameter, and sizes up to 180 inches have been made on special order.
- The asbestos fiber is thoroughly mixed with the cement and serves as reinforcement. This type of pipe is available in diameters of from 4 to 36 inches in 13-ft lengths. These can bear internal pressure up to 200 psi.
- Vitriified Clay Pipe also known as stone ware pipe is not often used as pressure pipe, but is widely used in sewerage and drainage for flow at partial depth.
- A pipe which is installed for the purpose of preserving the water seal of traps in drainage system is called anti siphonage pipe
- Make sure the horizontal pipe slopes at a rate of 1/8 to 1/4 inch per running foot.
- Firstly, assemble the components without joining materials to ascertain the correctness of lengths and alignment.
- Always clean the joining surfaces before apply jointing materials.
- When handling waste, appropriate personal protective equipment (PPE) should be worn, and hands cleaned after removing each item of PPE, e.g. pair of gloves, apron.
- When handling tied waste bags, only hold the bag by the neck and keep at arms length to reduce the risk of injury in case a sharp item has been inappropriately disposed of in the bag.

## EXERCISE

### Q-1. Tick ( ✓ ) the correct option of the following MCQs.

- i- The pipes used to convey used water are known as:
 

(A) waste pipe	(B) soil pipe
(C) sanitary pipe	(D) potable water pipe
- ii- The most commonly used sanitary pipe for domestic purpose is:
 

(A) Cast iron	(B) PVC
(C) concrete	(D) stoneware
- iii- The fixing of WC, basin etc. is known as:
 

(A) jointing	(B) fitting
(C) installation	(D) fabricating
- iv- This disease is mostly as a result of water contamination.
 

(A) Cholera	(B) typhoid
(C) malaria	(D) all of these
- v- This pipe can bear pressure of 350 psi:
 

(A) PVC	(B) Asbestos
(C) Cast Iron	(D) all of these
- vi- Vitriified clay pipe is also called as:
 

(A) mud pipe	(B) stoneware pipe
(C) pre-cast pipe	(D) all of these

- vii- This horizontal slope is provided for gravitational flow in sanitary pipes:  
(A) 1" per foot (B) 1/2" per foot  
(C) 1/4" per foot (D) 1/16" per foot
- viii- P-trap is used with:  
(A) Indian water closet (B) Sink  
(C) Wash basin (D) all of these
- ix- This is used to prevent backflow in rooms of foul gases:  
(A) trap (B) tee  
(C) Wye (D) bend
- x- This pipe carries water from bath, wash basin and kitchen:  
(A) soil pipe (B) waste pipe  
(C) sullage pipe (D) all of these

**Give short answer to the following questions.**

- i- Enlist 6 types of sanitary pipes according to material.
- ii- Enlist 12 sanitary fixtures.
- iii- Write down the scope of sanitary pipes.
- iv- Write importance of sanitary fittings.
- v- Write down the uses of PVC pipes in sanitary.
- vi- Write the difference between elbow and bend.
- vii- Write types of sanitary pipe according to material conveyed.
- viii- What is the use of vent pipe?
- ix- Enlist the fixture for which vent pipe is installed.
- x- Why work area is cleared?

**Answer the following questions in detail**

- i- Write down the procedure of installing vent pipe?
- ii- How flush pipe (hockey pipe) is installed with flushing cistern?
- iii- Write the note on cast iron pipes.
- iv- Explain the PVC pipes.
- v- How waste pipe is installed with basin.

## CHAPTER -05

### WASTE WATER FITTINGS



#### After Studying this unit, you will be able to:

- know about meanings for waste water sanitary fittings.
- understand the importance of fittings
- manage to change the fittings
- understand the working procedures of different fittings
- know about scope of fittings at industry (residence and hotels accommodations).
- explore importance of waste water fittings
- know about different types of waste water fittings.
- know about different types of fittings as price.
- familiarize with the house fittings specially.
- classify appliances by type and location.
- identify coupling
- identify sockets
- check waste pressure

- understand specification
- uninstall existing socket
- install new fitting (socket)between
- differentiate between coupling and sockets
- identify tee & elbow
- check pressure
- shut down valve for water supply
- uninstall existing fittings
- replace fittings with new one
- adopt proper method
- use work health and safety (WHS) and environmental requirements.
- identify y & cross
- check waste water pressure
- shut down valve of water supply
- locate position for installation
- replace pipe with fittings
- identify workplace
- differentiate between “y” and cross
- select procedures,
- use work health and safety (WHS) and environmental requirements.
- identify waste pipe
- identify workplace
- check waste pressure
- locate position for installation
- replace pipe with fittings
- fix new pipe with proper joint and fittings
- check for proper working (waste flow)
- check depth for waste pipe
- calculate earth work
- locate position for waste pipe
- clear the work area.
- dispose extra materials in accordance with state and territory legislation and workplace policies and procedures.

## 5.1: Introduction to Waste Water Fittings

It is necessary for safety of human and other living beings, to dispose of hazardous matters in a manner so that during conveyance of these matters, environment cannot be polluted. Pipes are the sources for conveying these matters without polluting the environment. The pipes used to convey used water and other contaminated liquids are required to be jointed. These pipes are called sanitary pipes or sewer pipes.

### 5.1.1: Meaning of Waste Water Sanitary Fittings

Fittings which are used to join sanitary pipes, being used for conveyance of used/ waste water, are generally known as waste water sanitary fittings.

### 5.1.2: Understand the Importance of Fittings

Fittings are very important from various points of views. We have to create a network of pipes for various purposes. We need these to lengthen the pipeline and change the direction of flow. We have to extend or join a branch pipeline. We need these fitting for joining fixtures and appliances. Joint is considered the weakest point of pipeline. A good fitting being properly jointed can overcome this by providing a leak-proof and stable joint. So, fittings are very important to achieve the above-mentioned targets. As a leak proof joint prevents the pollution of environment and ultimately safeguards the health of living creatures.

### 5.1.3: Manage to Change the Fittings

Every fitting has some utility period. Due to continuous usage, these fittings do not work as per requirements due to wear and tear. An efficient maintenance of fitting will enhance the life span of fitting. Hence continuous inspection for working status of fitting is necessary. When fittings are not working properly or are damaged, there comes a stage when the maintenance cost exceeds, then change of fitting is required. Thus, change/ replacement of fittings should be managed as and when required.

### 5.1.4: Working Procedures of Different Fittings

- To lengthen a pipeline, sockets are used.
- Flanges can be used after some interval so as to ease for replacing damaged pipe along with lengthen the pipeline.
- Mechanical sleeves are also used along the length of pipeline for jointing.
- Elbows and bends are used for changing the direction of pipe line.
- Reducer socket or bush are used to change the diameter of pipeline.
- Tee is used to extend branch pipeline. Reducer Tee is used to extend smaller diameter pipeline. Wye “Y” is used to convert one pipelines into two lines.
- Cross is used to extend branch pipeline on both sides.
- Traps are used to provide water seal to prevent back flow of foul gases.

## Practical/ Activities

### Activity 5.1: Presentations about concept of different waste water fittings

The teacher/ instructor is required to give presentation to the students for usage of different sanitary fittings according to purpose of fittings. The students have to prepare the list of fittings and write in their note books.

### Activity 5.2: Groups' exercises about waste water fittings

The teacher/ instructor is required to organize group discussions for push fit fittings, solvent weld fittings, universal compression fittings, and jointing material filled Fittings to the students for usage of different sanitary fittings. The students have to prepare the list of fittings and write in their note books.

### Activity 5.3: Differentiate between fittings used in different places.

The teacher/ instructor is required to give demonstrate difference between sanitary fittings used in different places. The students have to conduct cross questions.

## 5.2: Scope and classification of Waste Water fittings

### 5.2.1: Scope of fittings at Industry

You cannot get real bathroom facilities without accurate sanitary fittings. It also represents your bathroom in a good look. But many people, especially the buyer, can understand what types of sanitary fittings they need. Mostly, there are different types of fitting for the bathroom. The fittings as per requirements may be of PVC, cast iron or other plastics. Some are of good quality, and some are of less quality. When you decide to buy bathroom fittings, try to find out what type is convenient for you for your residence or hotel as the case may be.

### 5.2.2: Importance of Waste Water Fittings

The important part of the pipeline is its joint. Joint requires different types of fitting for different purposes. If the strength of fittings is not able to bear different stresses, the cracks may develop, leading to the leakage of joints. Diseases such as cholera, typhoid, and many others are as a result of water contamination resulting from leakage mostly. Fittings provides the means of easy and durable jointing. Prevent the stacking of water in the residential/ public areas. Hence sanitary pipes are important for the health, maintaining clean environment.

### 5.2.3: Different Types of Waste Water Fittings.

The sanitary fittings are classified according to different factors. These may be materials, method of jointing, type of jointing materials.

### Types of Fitting

The types of sanitary fittings according to have been shown in chapter 4 under heading types of fittings. The list is given as under:

Flush Bushing	P-Trap with Cleanout Mueller
90 Degree Elbow Mueller	Chrome Center Outlet Waste Elbow
90-Degree Vent Elbow	Flange Sink Tailpiece
Tailpiece Extension	Flexible PVC Coupling
Double Tee	Trap Adopter
Extension Tube	Sink Tailpiece`
Slip-Joint Extension Tube	Bushing
P-Trap W/Union	Male Adapter Use
Female Trap Adapter	Vent Cap Active Ventilation
Kitchen Sink Strainer with Basket-And Water Stopper	Sink waste strainer
Cowl	End cap

### Material of Fitting

- **Plastic pipe fitting-** These fittings are made from different types of plastics, e.g., of PVC, HDPE, CPVC etc.
- **Cast Iron Fittings-** These fittings are made from cast iron.
- **RCC fitting-** These fittings are made from Concrete for example collar.
- **Asbestos Fittings-** These fittings are made from asbestos.

### Method of jointing employed

		
Push fit swept bend	Push fit+ screw socket	Compression multi-fit bend
		
Solvent weld tank connector	Compression elbow	Compression swivel elbow

- **Push fit Fitting-** These fitting have female socket end with gasket. Male end of pipe is pushed in for fitting.
- **Screwed fitting-** These fittings have male and/or female threads
- **Solvent Melt fittings-** these fittings have socket female ends and jointing solution is applied on outer side of pipe and inner side of fitting.
- **Compression fittings-** these fittings have threaded socket with gasket to have water tight joint. Waste pipe of sink is generally compression type.
- **Swivel fitting-** these fittings have threaded swivel socket with gasket to have water tight joint.
- **Flanged fitting-** these fittings have flanges and gasket is provided in between to have water tight joint.

#### Type of jointing material applied.

**Cement Mortar-** these fittings are plain socket type without threads. Socket and spigot type or collar type. Gasket/ rubber ring and cement mortar is used for jointing.

**Lead-** these fittings are plain socket type without threads. Gasket/ rubber ring and cement mortar is used for jointing. Cast iron pipes are jointed with cement mortar or with lead.

**Gasket-** Gasket and rubber rings/ seals are used for flanges, push fit, swivel and compression joint.

### 5.2.5: Familiarize with the House Fittings Specially.

In the house following fittings are used.

Flush Bushing	P-Trap	90 Degree Elbow Mueller
90-Degree Vent Elbow	Flange Sink Tailpiece	Tailpiece Extension
Flexible PVC Coupling	Double Tee	Trap Adopter
Extension Tube	Sink Tailpiece`	Bushing
P-Trap W/Union	Male Adapter Use	Female Trap Adapter
Vent Cap Active Ventilation	Kitchen Sink Strainer with Basket-And Water Stopper	Sink waste strainer
Cowl	End cap	

### 5.2.6: Classify Appliances by Type and Location.

#### Classes According to Types

Appliances are classified according to scope of plumbing. The scope of standard residential plumbing usually covers mains pressure, potable water, heated water (in conjunction with mechanical and/or electrical engineers), sewerage, storm water, natural gas, and sometimes rainwater collection and storage. In commercial environments, these distribution systems expand to accommodate many more users, as well as the addition of other plumbing services such as irrigation, fuels, oxygen, vacuum/compressed air, solids transfer, and more.

In this book, the classes of appliances are given for plumbing systems which generally an ordinary plumber installs in buildings, i.e., for potable water, heated water, internal sanitary, and natural gas systems. Hence appliances are:

1. Potable water appliances.
2. Heated water appliances.
3. Internal sanitation appliances
4. Natural gas appliances.

**1- Types of Potable water appliances.**

showers, water cooler, water meter, water pump, water tank, etc.

**2- Types of Heated water appliances.**

Geysers (hot water heaters)-Electric geyser, gas geyser, wooden fuel geyser, coal geyser, solar water heater.

**3- Internal sanitation appliances**

Water closet, wash hand basin, sink, urinal, dishwasher, bath tub, flushing cistern

**4- Natural gas appliances.**

Gas geyser, gas heater, gas meter, gas burner, gas lamp

### Classes According to Location

According to location the classes are:

**Bathroom appliances**

Water closet, wash hand basin, urinal, bath tub, flushing cistern, geyser, shower.

**Kitchen Appliances**

Sink, dishwasher, gas burner, gas lamp, gas heater

**Toilet Appliances**

Water closet, urinal, flushing cistern

**Miscellaneous Appliances (Courtyard, Roof and dining room appliances)**

Water pump, water tank, wash basin, water cooler, water meter.

### Practical / Activities

**Activity 5.4: Presentation about Scope and Importance of Different Fittings with its Working**

The teacher/ instructor is required to give presentation to the students about scope and importance of different fittings with its working. The students have to write in their note books and arrange quiz for that.

**Activity 5.5: Differentiate Between Waste Water and Fresh Water Fittings**

The teacher/ instructor is required to demonstrate to the students about waste water fittings and fresh water fittings. The students have to prepare the list of both fittings and write in their note books.

**Activity 5.6: Group Presentation on Different Waste Water Fittings.**

The teacher/ instructor is required to give presentation to the students for usage of different sanitary fittings according to purpose of fittings. The students have to prepare the list of fittings and write in their note books.

**Activity 5.7: Group Presentation on Fittings at Home**

The teacher/ instructor is required to give presentation to the students for usage of fittings at home. The students have to write in their note books.

**Activity 5.8: Group Discussion on Classification of Waste Water Fittings**

The teacher/ instructor is required to arrange group discussion after demonstration to the students on classification of fittings. The students have to prepare the list of fittings and write in their note books.

**5.3: Install Coupling at location of defective Socket****5.3.1: Identify Socket**

Check and measure the size defective socket in a pipeline. Let the socket connected is of 2" i.e., diameter of waste pipe is 2".

**5.3.2: Identify Coupling**

Select the suitable size coupling as per requirement considering the size of pipes. You should select the coupling of same size as of socket. The coupling should be 2" in this case, i.e., equal diameter of waste pipe is 2".

**5.3.3: Check Waste Pressure**

The coupling should have the capacity to bear pressure. Check the pressure of water approaching the socket. Always turn off your water at the mains before attempting any installation in the bathroom.

**5.3.4: Understand Specification**

By reading the specifications select the coupling of required material, and of other specifications.

**5.3.5: Uninstall Existing Socket**

Use the hacksaw/ chisel or other cutting tool to cut the socket. Care should be taken not to harm the waste pipe.

**5.3.6: Install Coupling Fitting in Place of Socket.**

Install the coupling and tight the screws of sleeve of coupling.

**5.3.7: Differentiate between coupling and sockets**

Socket is a fitting used to join two pipes during installation of pipe work. A coupling is a fitting which is installed in place of socket during repair work generally.

**Practical/ Activities****Activity 5.9: Create required material list & select coupling**

The teacher/ instructor is required to demonstrate to the students the materials require and coupling selection for replacement. The students have to prepare the materials list.

**Activity 5.10: Check pressure and replace socket with coupling and check for leakage**

The teacher/ instructor is required to demonstrate to the students how to check pressure, replace socket with coupling and checking of leakage. The students have to perform the same.

**5.4: Install Tee and Elbow****5.4.1: Identify Tee & Elbow**

Check and measure the size pipe with which you want to install tee & elbow. Identify the material of pipe and required tee & elbow. **Check** the material used for installation is approved, correct type & size. Make sure the installation as per approved shop drawing & material submittals. Decide upon the tee & elbow required are equal or unequal according to pipe sizes required to be connected. Let the Tee is required to join PVC pipes of 4” diameter for straight pipeline and branch pipe is vent pipe of 2” diameter. Let the elbow is required to join PVC pipes of 4” diameter and 2” diameter.

**5.4.2: Check pressure**

Plug/ cap the two ends of tee and connect third end to an air compressor hose and pressure gauge to the fitting.

Turn on the compressor and fill the Tee-fittings with air until the gauge reaches the test pressure reading. For water systems, this reading is usually around 80 psi. For drain systems, it's much lower □— about 5 psi.

Turn off the compressor and leave the system pressurized for 15 minutes. Any reduction in pressure during that time signifies the presence of a leak.

**Drain Plumbing System Requirements**

Minimum Flowing Pressure: 5 PSI Minimum

Flow Rate: 5

GPM Maximum Static Pressure: 16 PSI

**Water Plumbing System Requirements**

Minimum Flowing Pressure: 25 PSI

Minimum Flow Rate: 25

GPM Maximum Static Pressure: 80 PSI

Plug/ cap the one end of elbow and connect second end to an air compressor hose and pressure gauge to the fitting. Turn on the compressor and fill the elbow-fitting with air until the gauge

reaches the test pressure reading. For water systems, this reading is usually around 80 psi. For drain systems, it's much lower □— about 5 psi.

Turn off the compressor and leave the system pressurized for 15 minutes. Any reduction in pressure during that time signifies the presence of a leak.

### **5.4.3: Shut down valve for water supply**

If you are replacing the existing damaged tee or elbow then close the valve for water supply. Ensure that no water should enter in pipe with which you are fixing tee or elbow.

### **5.4.4: Uninstall existing fittings**

Use the hacksaw/ chisel or other cutting tool to cut the tee. Care should be taken not to harm the waste pipe. Similarly use the hacksaw/ chisel or other cutting tool to cut the elbow. Care should be taken not to harm the waste pipe.

### **5.4.5: Replace fittings with new one by proper method**

Install the new tee starting from main both sides. Fix the branch pipe. You should use the push fit tee fitting. Similarly fix the push fit elbow to both the pipes. Care should be taken that the pipes and fittings are cleaned to remove debris or other materials stuck with these.

### **5.4.6: Use work health and safety (WHS) and environmental requirements.**

Proper safety harness to be used and secured, if required.

All personal protective equipment shall be used as appropriate according to nature of the job. Housekeeping shall be of good standard and all cut materials and debris shall be removed.

## **Practical/ Activities**

### **Activity 5.11: Create required material list**

The teacher/ instructor is required to demonstrate to the students how to create materials list for specific job. The students have to perform the same.

### **Activity 5.12: Select pipe for replace**

The teacher/ instructor is required to demonstrate to the students how to select the pipe for replacement in sanitary pipe line and its jointing. The students have to perform the same.

### **Activity 5.13: Test pressure / discharge in pipe**

The teacher/ instructor is required to demonstrate to the students how to test pressure and discharge in pipes. The students have to perform the same.

### **Activity 5.14: Drilling / excavation for fixing pipe**

The teacher/ instructor is required to demonstrate to the students how to perform drilling and excavation for fixing pipes The students have to perform the same.

### **Activity 5.15: Check for working**

The teacher/ instructor is required to demonstrate to the students how to check pressure, replace socket with coupling and checking of leakage. The students have to perform the same.

## 5.5: Install “Y” and Cross

### 5.5.1: Identify Y & Cross

A- Select the suitable sizes of wye (“Y”) fitting as per requirement considering the size of the waste pipe of urinal to be attached with main disposal pipe. Let Wye to be connected is 2”x2”. The wye should have the capacity to accommodate the urinal waste to be disposed of. B- Select the suitable sizes of cross fitting considering the size of two branch vent pipes of 2” diameter to connect with 2” diameter main vent. Let cross to be connected is 2”x2”.

### 5.5.2: Check waste water pressure

Plug/ cap the two ends of wye and connect third end to an air compressor hose and pressure gauge to the fitting.

Turn on the compressor and fill the wye -fittings with air until the gauge reaches the test pressure reading. For drain systems, it's much lower □— about 5 psi.

Turn off the compressor and leave the system pressurized for 15 minutes. Any reduction in pressure during that time signifies the presence of a leak.

Plug/ cap the three ends of cross and connect fourth end to an air compressor hose and pressure gauge to the fitting.

Turn on the compressor and fill the cross-fitting with air until the gauge reaches the test pressure reading. For drain systems, it's much lower □— about 5 psi.

Turn off the compressor and leave the system pressurized for 15 minutes. Any reduction in pressure during that time signifies the presence of a leak.

### 5.5.3: Shut down valve of water supply

If you are replacing the existing damaged wye or cross then close the valve for water supply. Ensure that no water should enter in pipe with which you are fixing wye or cross.

### 5.5.4: Identify workplace and Locate position for installation

Mark the position of installation of wye. Use the hacksaw or other cutting tool to cut the pipe for fixing wye. Care should be taken not to harm the waste pipe.

Similarly, mark the position of installation of cross. Use the hacksaw or other cutting tool to cut the pipe to fix cross for other two vent pipes. Care should be taken not to harm the waste pipe.

### 5.5.5: Replace pipe with fittings

Install the new wye starting from main both sides. Fix the branch pipe. You should use the push fit tee fitting. Similarly fix the push fit cross to both the pipes. Fix the branch pipes. Care should be taken that the pipes and fittings are cleaned to remove debris or other materials stuck with these. Use the appropriate sleeve for jointing pipes. Now check line for leakage.

#### Step 1: Cap All Stub-Outs

Cap all the stub-outs connected to the system you're testing. For a DWV system, this usually means gluing a cap to each stub-out with plastic pipe cement. If you're testing a water system, you may have to glue or solder the caps, depending on the type of pipes in your system. You'll cut off the caps when the test is complete.

#### Step 2: Connect an Air Compressor Hose and Pressure Gauge

Install or find a fitting that allows you to connect an air compressor hose and pressure gauge to the system. In waste systems, you usually do this by screwing an adapter to a cleanout fitting and installing a tee. For water systems, it usually works to leave one stub-out uncapped and install a tee and adapter for the hose and gauge on that stub-out.

### Step 3: Turn on the Compressor

Turn on the compressor and fill the pipes with air until the gauge reaches the test pressure reading. For drain systems, it's much lower □— about 5 psi.

### Step 4: Turn the Compressor Off

Turn off the compressor and leave the system pressurized for 15 minutes. Any reduction in pressure during that time signifies the presence of a leak.

### 5.5.6: Differentiate between “Y” and Cross

A wye “Y” has three stub-outs two for main line and third at an angle of generally 45 degrees.

A cross has four stub-outs two for main line and third & fourth at an angle of generally 90 degrees.

	
2IN - PVC WYE45	2IN - PVC CROSS90

### 5.5.8: Select procedures

When a PVC pipe breaks, you have a few choices. You can either cut out or replace the broken section of pipe or you can use a PVC repair coupling to fix the break. There are different types of PVC repair couplings that you can choose, but one type requires no cutting and sets up fast. A snap-in-place style PVC repair coupling are fastened over the broken section of PVC pipe, eliminating the need for you to cut the PVC pipe and still creates a permanent repair on the broken PVC pipe. Sand the entire area of the PVC pipe. Clean the sanded area with the brush attached to the lid of the PVC primer to remove contaminants from the surface of the PVC pipe and the inside of both sides of the PVC wye and cross. Apply PVC glue to the entire repair area and both sides of the PVC wye and cross with the brush fixed to the lid of the PVC glue. Place one side of the PVC wye and cross onto the broken PVC pipe and then snap the other side of the PVC wye and cross to the first side. Wrap masking tape around the PVC wye and cross to hold it in place while the PVC glue dries. Remove the masking tape after the PVC glue has cured.



### 5.5.9: Use work health and safety (WHS) and environmental requirements.

Proper safety harness to be used and secured, if required.

All personal protective equipment shall be used as appropriate according to nature of the job.

Housekeeping shall be of good standard and all cut materials and debris shall be removed.

## Practical/ Activities

### Activity 5.16: Create required material list, select wye & cross

The teacher/ instructor is required to demonstrate to the students the materials required for replacement wye and cross in sanitary pipeline. The students have to prepare the materials list and select fitting as per job requirements.

### Activity 5.17: Select direction of fitting, fix with jointing materials, & test pipe pressure

The teacher/ instructor is required to demonstrate to the students how to install wye and cross in proper orientation, join with materials, and test pressure in pipes. The students have to perform the same.

### Activity 5.18: Test joint leakage & Check for working

The teacher/ instructor is required to demonstrate to the students how to check pressure, replace wye and cross and checking of leakage & working. The students have to perform the same.

## 5.6: Install Waste pipe

Before you can actually fit a fitting you will most probably need to cut a section of pipe to the correct length for your needs. There are really only a couple of ways that this can be done, considering the size of the pipes (e.g., 32mm and upwards):

- Using a hacksaw
- Using a pair of plastic pipe cutters

Steps for installing waste pipe are narrated below:

Step 1: Disassemble your waste ready for fitting.

Step 2: Apply a bead of silicone sealant around the opening of the plug hole to create a watertight seal inside your basin.

Step 3: Fit the waste into the hole, making sure any slots are pointed towards the overflow (if your waste and basin has these).

Step 4: Apply a second bead of silicone around the thread before adding a washer.

Step 5: Screw on the hexagonal nut and wipe away any excess silicone with a cloth.

Step 6: You can now fit your basin.

Step 7: Now, refit the trap and check for any leaks.

### 5.6.1: Identify waste pipe

Waste pipes for various fixtures are installed. For example, washbasin, sink, dish washer etc. The waste pipe may have P-trap or bottle trap in conjunction. Decide upon the waste pipe by carefully reading the working drawings. Also, select the appropriate material and size of waste pipe.

### 5.6.2: Identify workplace

As an example, we are going to be cutting a section of pipe to a given length and then fitting a 90° bend to run around a corner with waste pipe.

The first task is to measure and mark a point on your section of pipe where your cut needs to be made.

Using a tape measure, measure to the point of your cut and use a marker pen to mark that point (something like a Sharpie works well on PVC pipework).

### 5.6.3: Procedure

1. Turn off the water supply to the taps if you're worried about knocking the taps and soaking your leg. Make sure your new waste is the same depth as the old one to avoid altering the pipework configuration.
2. If taking out an old pop-up linkage waste (with the rod at the back of the tap) then get all that out of the way now. Use a screwdriver to get rid of the linkage. The new world is all about clicker wastes.
3. Undo the plastic nut on the trap to the waste. Be sure to loosen carefully and make sure the rubber seal is intact. If not, use an O-ring or similar seal and replace. It's easier to remove the trap completely from the waste pipe too. Most new wastes are the same length so you shouldn't have to do any pipework alterations.
4. Once the old trap is out of the way you can undo the large nut (plastic or brass). Sometimes you'll need a screwdriver to wedge in the top side of the waste to prevent it from spinning as you undo.
5. Remove the old waste and clean up the old sealant.
6. Insert your new waste. If there's an overflow then make a note of the direction of the overflow cut-out on your new waste. It's very important this line up with the porcelain hole at the end of the job.
7. Get some Plumbers Mait (a non-setting hand applied putty for sanitary joints) and roll it into a sausage shape in your hands. Wrap this sausage around the top of the thread. Press in with your fingers as best you can. Use the washer to push it right up inside the thread cavity.
8. Screw the new nut back on. Again, use a screwdriver to ensure the waste doesn't slip. Make sure the overflow holes are lined up. I cannot stress that enough!
9. Re-attach the trap to its waste and the bottom of your new clicker waste. Tighten and test for leaks.

## Practical/ Activities

### Activity 5.19: Create required material list

The teacher/ instructor is required to demonstrate to the students the materials required for replacement wye and cross in sanitary pipeline. The students have to prepare the materials list and select fitting as per job requirements.

### Activity 5.20: Select size and direction of pipe/ fitting, fix with jointing materials and tools, & test pipe pressure

The teacher/ instructor is required to demonstrate to the students how to install wye and cross in proper orientation, join with materials using appropriate tools, and test pressure in pipes. The students have to perform the same.

**Activity 5.21: Test pipe pressure and Test joint leakage**

The teacher/ instructor is required to demonstrate to the students how to check pressure, replace wye and cross and checking of leakage & working. The students have to perform the same.

**5.7: Clean Up**

As given on chapter 3 for clean-up section 3.8.

**Practical/ Activities****Activity 5.22: Perform workplace cleaning activity including observing hygiene standards, cleaning tools and housekeeping.**

Students are required to perform cleaning of work area and housekeeping of tools and equipment after replacement of socket with coupling.

Students are required to perform cleaning of work area and housekeeping of tools and equipment after installation of Tee & Elbow.

Students are required to perform cleaning of work area and housekeeping of tools and equipment after installation of Wye & Cross.

Students are required to perform cleaning of work area and housekeeping of tools and equipment after installation of waste pipe.

**What I have learnt**

- i- The pipes used to convey used water and other contaminated liquids are required to be jointed. These pipes are called sanitary pipes or sewer pipes.
- ii- Fittings which are used to join sanitary pipes, being used for conveyance of used/ waste water, are generally known as waste water sanitary fittings
- iii- The important part of the pipeline is its joint. Joint requires different types of fitting for different purposes.
- iv- Materials used to manufacture fittings are plastics, cast iron, Asbestos and concrete.
- v- Push fit Fitting- These fitting have female socket end with gasket. Male end of pipe is pushed in for fitting.
- vi- Screwed fitting- These fittings have male and/or female threads
- vii- Solvent Melt fittings- these fittings have socket female ends and jointing solution is applied on outer side of pipe and inner side of fitting.
- viii- Compression fittings- these fittings have threaded socket with gasket to have water tight joint. Waste pipe of sink is generally compression type.
- ix- Swivel fitting- these fittings have threaded swivel socket with gasket to have water tight joint.
- x- Flanged fitting- these fittings have flanges and gasket is provided in between to have water tight joint.
- xi- Jointing materials used for jointing fittings are cement mortar, lead, gasket, rubber rings, silicone sealant, masking tape, solvent solutions.
- xii- Gasket- Gasket and rubber rings/ seals are used for flanges, push fit, swivel and compression joint.

- xiii- Appliances are classified according to scope of plumbing. The scope of standard residential plumbing usually covers mains pressure, potable water, heated water (in conjunction with mechanical and/or electrical engineers), sewerage, stormwater, natural gas, and sometimes rainwater collection and storage.
- xiv- The classes of appliances are:
  - Potable water appliances.
  - Heated water appliances.
  - Internal sanitation appliances
  - Natural gas appliances.
- xv- Classes of appliances according to location are:
  - Bathroom appliances
  - Kitchen appliances
  - Toilet appliances
  - Miscellaneous appliances
- xvi- Socket is a fitting used to join two pipes during installation of pipe work. A coupling is a fitting which is installed in place of socket during repair work generally.
- xvii- Test water pressure for water system is usually around 80 psi and for drain system is around 5 psi.

## EXERCISE

### Q-1. Tick ( ✓ ) the correct option for the following MCQs.

- i- Fittings which are used to join sanitary pipes, being used for conveyance of used/ waste water, are generally known as waste water sanitary fittings
 

(A) soil sanitary fittings	(B) Waste water sanitary fittings
(C) potable sanitary fittings	(D) None of these
- ii- Materials used to manufacture fittings are plastics, cast iron, Asbestos and concrete.
 

(A) PVC	(B) Cast iron
(C) Asbestos	(D) All of these
- iii- These fitting have female socket end with gasket. Male end of pipe is pushed in for fitting.
 

(A) Screwed fitting	(B) Solvent Melt Fitting
(C) Push fit Fitting	(D) Compression fitting
- iv- These fittings have male and/or female threads
 

(A) Solvent Melt Fittings	(B) Screwed fittings
(C) Push fit Fittings	(D) Compression fittings
- v- These fittings have socket female ends and jointing solution is applied on outer side of pipe and inner side of fitting.
 

(A) Solvent Melt fittings	(B) Push fit Fittings
(C) Compression fittings	(D) Screwed fittings

- vi- These fittings have threaded socket with gasket to have water tight joint.  
(A) Compression fittings (B) Screwed fittings  
(C) Push fit Fittings (D) Solvent Melt Fittings
- vii- These fittings have threaded swivel socket with gasket to have water tight joint.  
(A) Push fit Fittings (B) Swivel fitting  
(C) Screwed fittings (D) Solvent Melt Fittings
- viii- These fittings have flanges and gasket is provided in between to have water tight joint.  
(A) Flanged fitting (B) Swivel fitting  
(C) Push fit Fittings (D) All of these
- ix- Test water pressure for drain system is around:  
(A) 15 psi (B) 12 psi  
(C) 10 psi (D) 5 psi
- x- Gasket- Gasket and rubber rings/ seals are used for this joint:  
(A) Compression joint (B) Push fit  
(C) Swivel (D) All of these

**Give Short answer to the following questions.**

- i- Enlist 8 sanitary fittings according to structure.
- ii- Enlist 8 sanitary fittings according to method of jointing.
- iii- What is a push fit fitting?
- iv- What is meant by compression fitting?
- v- Write down the use of gasket.
- vi- Write the difference between “Y” and cross.
- vii- Enlist steps for checking leakage in pipeline.
- viii- Define compression joint.
- ix- Define flange joint.
- x- Enlist steps to check waste water pressure.

**Answer the following questions in detail.**

- i- Explain the classifications of sanitary fittings?
- ii- Write the procedure for installation of “Y” and cross.
- iii- Write the procedure for installation of waste pipe with basin.
- iv- Explain the clean up after installation of wash basin.
- v- Explain the classifications of appliances by type and location.

## CHAPTER -06

### WASTE WATER FIXTURES



**After Studying this unit you will be able to:**

- introduction and installation of fixtures
- scope and classification of waste water fixtures
- install traps (floor & gully trap)
- install water closet (Indian & English)
- install sink.
- install wash hand basin
- install bath tub
- clean up.

## 6.1: Introduction and installation of fixtures

Plumbing fixtures and fittings are part of plumbing systems used to **drain and deliver water**. A receptacle or device that is connected to a water supply system or discharges to a drainage system or both. Such receptacles or devices require a supply of water; or discharge liquid waste or liquid-borne solid waste; or require a supply of water and discharge waste to a drainage system.

Examples of a plumbing fixture would be a sink, toilet, and bathtub.

### 6.1.1: Meanings for Installation of Sanitary Fittings and Fixtures.

The components which are used to join pipes with each other are known as sanitary fittings. The jointing of fittings with pipes is known as installation of fittings. Similarly, the jointing of fixtures with pipes and adjoining surface (wall, floor etc.) is known as installation of fixtures.

### 6.1.2: Importance of Appliances.

The appliances are the devices which perform specific function. Water-connected or drain-connected devices intended to perform a special function. These devices have their operation or control dependent on one or more energized components, such as motors, controls, or heating elements.

We want appliance for disposal of human excreta & urine excretion. You want to take a bath as well as wash your utensils. Prevent the stacking of water in the residential/ public areas. Hence sanitary appliances are important for the health, maintaining clean environment.

### 6.1.3: Manage to change fixtures.

Every fixture has some utility period. Due to continuous usage, these fixtures do not work as per requirements due to wear and tear. An efficient maintenance of fixtures will enhance the life span of these fixtures. Hence continuous inspection for working status of fixtures is necessary. When these are not working properly, there comes a stage when the maintenance cost exceeds then the change of the fixture is required. Thus, change/ replacement of fixtures should be managed as and when required.

### 6.1.4: Understand the working procedures of different fixtures

The working procedure of about the all fixtures is the same. Some waste is required to be disposed of. It can be waste of human excreta, urine, waste of washing utensils etc. Water is used to flow away the wastes through pipes. To prevent the back flow of foul gases, a water seal is created by jointing different types of traps. For example, P-trap is used with Indian type water closet, Specific P-trap of basins and sinks is attached with.

## Practical /Activities

### Activity 6.1: Presentations about concept of different fixtures used for sanitation.

The teacher/ instructor is required to give presentation to the students for usage of different sanitary fixtures. The students have to prepare the list of fixtures and write in their note books.

**Activity 6.2: Groups' discussion / exercises about sanitation fixtures**

The teacher/ instructor is required to give presentation to the students for usage of different sanitary fixtures. The students have to prepare the list of fixtures and write in their note books.

**Activity 6.3: Differentiate between appliances and fixtures.**

The teacher/ instructor is required to give demonstrate difference between sanitary appliances and fixtures. The students have to recognize different appliances and fixtures.

**6.2: Scope and Classification of Waste Water Fixtures**

The durability of a plumbing system is dependent on the quality of its component parts and the assembly skills of those who install it. No plumbing system, however well designed, can be expected to operate safely or hygienically if the products or materials used are unsatisfactory. The inverse is also true – if the best-quality products or materials are used but are installed incorrectly, the system will be a failure.

**6.2.1: Scope of Fixtures at Industry (Hotels and Accommodations).**

There is the need of waste water fixtures for disposal of sanitary wastes. Sanitary wastes come from bathrooms, kitchens, courtyards, toilets, dining rooms. Sanitary fixtures are required for collection and disposal sewage from these building compartments. These components of buildings are provided various types of buildings, i.e., houses, hostels, hotels, office buildings, hospitals, educational buildings, etc. In hotels and accommodations, we need, bathrooms, lavatory blocks, kitchen. So, fixture relevant to hotels of the grade and standards are required for bathrooms, lavatory blocks, kitchen.

**6.2.2: Explore Importance of Fixtures**

We need fixtures as per our requirement. We want fixtures for disposal of human excreta. Similarly, we want fixtures for urine excretion. You want to take a bath as well as wash your utensils. Water should be disposed of as soon as we use the fixtures. These fixtures should be leak proof. Diseases such as cholera, typhoid, and many others are as a result of water contamination resulting from leakage mostly. Good fixtures provide the means of easy and durable jointing. Prevent the stacking of water in the residential/ public areas. Hence sanitary fixtures are important for the health, maintaining clean environment.

**6.2.3: know about different Types of Fixtures**

**Sanitary fixtures** should be durable, smooth and impermeable to water. There should be no hidden surface that can become fouled or polluted. Both internal and exposed outside surfaces should be accessible for cleaning.

**Sanitary Fixtures used in Buildings**

Following are the commonly used sanitary fittings for buildings.

Hand wash basins, Sinks (glazed or stainless-steel sinks), Bath tubs, Water closets, Urinals, Flushing cisterns

**Types of Water Closets**

Water closets generally used are: Indian type, European type or pedestal types and Anglo-Indian type

**Types of Urinals**

Bowl type or lip type urinals and Stall type

**Types of Flushing Cisterns**

1. Low level 10 litres capacity
2. High level 10 litres capacity
3. Automatic flushing type for urinals

**6.2.4: Types of sanitary fixtures****Classification of Fixtures according to materials**

The most common and most economical **material** for domestic **fixtures** such as toilet bowls, urinals, and washbasins is vitreous china. For more durable day-to-day use in kitchen sinks and laundry tubs, stainless steel is recommended, but enamelled pressed steel and suitable plastic **materials** may be acceptable.

Plastics are commonly used for bathtubs, shower trays, laundry tubs, cisterns, washbasins and toilets and are often reinforced with fibreglass for extra strength and durability. Plastic materials, although generally durable in themselves, are readily prone to surface damage such as scratches and cuts. Stainless steel is a preferred material for plumbing fixtures where there is a risk of damage from users, such as in institutions and public amenities. Stainless steel is currently the only suitable choice in commercial or industrial food preparation areas.

1. Earthen ware (vitreous china) Fixtures.
2. Stainless Steel Fixtures.
3. Iron Nickle plate Fixtures.
4. Enamelled presses Steel Fixtures.
5. Plastic Fixtures.
6. Fibre Reinforced Plastics (FRP) fixtures.

**Classification of Fixtures according to Working/ Usage**

This article throws light upon the six main types of sanitary fixtures. The types are: 1. Washbasin 2. Sinks 3. Bath Tub 4. Flushing Cisterns 5. Water-Closet 6. Urinals.

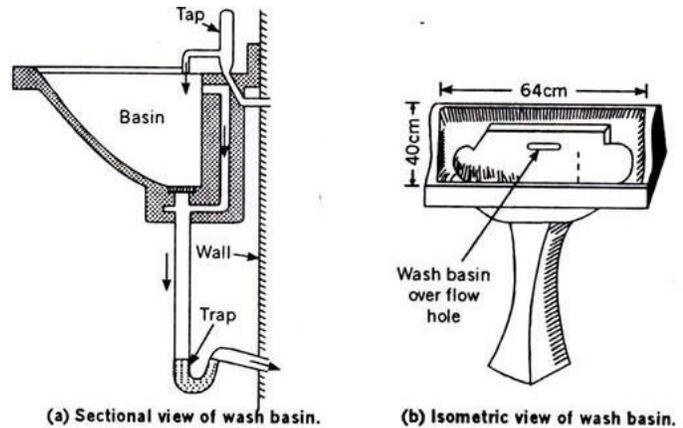
**1. Washbasin**

The wash basins are available in various patterns and sizes in the market. There are mostly two patterns:

- (a) Flat back for mounting on walls,
- (b) Angle back for fixing at the junction of two walls.

Flat back basins are provided with double or single tap holes. All the wash basins should be of one piece construction and should have slotted overflow hole. All the internal angles are designed so as to facilitate cleaning. The wash basins are provided with a circular waste hole in the bottom as shown in Figure 25.1. The basins are provided with an integral soap holder recess which drains

into the bowl. Wash basins are made of fire-clay, stoneware, earthenware or vitreous china. But nowadays steel, aluminium and plastic wash basins are also available in the market which are very popular. In plain the basins may have rectangular, square, circular, oblong, circular quadrant etc. shape depending on the choice. Again these may be supported on the brackets fixed on the wall or supported on the pedestals.



For holding water in the bowl these are provided with tapering rubber plugs, which can be fitted in the outlet. This plug is fixed to a chain secured by a stay.

The usual size of wash basins are:

Pattern	Size
Flat back	630 × 450 mm 550 × 400 mm
Angle back	600 × 480 mm 400 × 400 mm

There are multiple accessories found in the washing basin, such as:

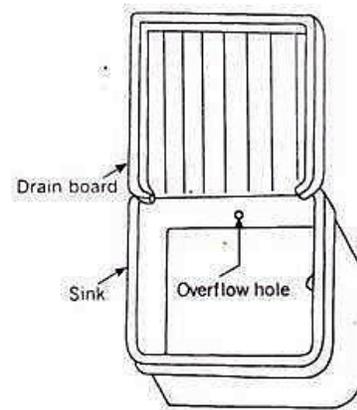
- **Faucet (TAP):** This type generally has taps (faucets). It can supply both hot and cold water along with providing spray facilities that use for faster rinsing. This feature might be fixed in the basin or sometimes may remain on the wall above on the pool.
- **Mirror:** You can't ignore the importance of mirrors at your bathroom. This is must-have stuff. However, generally, the mirror should be a minimum height of 1.6 inches above from the washing basin. The height should be fixed depending on the user's demand. Sometimes, those have children at their house; they can keep the mirror at an average position so that everyone can use it. You may also install it in front of a medicine cabinet.
- **Self:** A self is another essential stuff for a bathroom. You can put necessary tiny objects in it like a brush basket, hand wash, washing brush, etc.
- **Vanity unit:** It can be formed with a mirror door. It is suitable for the washbasin. You can use it instead of the medicine cabinet.
- **Soap dish:** The suitable position of soap dish is on the wall beside the basin. It is good to install at the height of 3'6'' inches from the floor. But you have the preferred option of yourself.
- **Electric receptacle:** The electric razor or hairdryer should have the right side of the basin.
- **Tumbler holder:** It can be placed on the wall on the side of the installed basin. The height is expectable as a wish or the plumber suggestion.
- **Towel bar or ring:** It should be placed at a minimum reachable position where you can take and keep towels easily. If you have children, then you may set the ring at a little lower height.

## 2. Sinks

These are rectangular shallow receptacles suitable for kitchens or laboratory. Figure shows a kitchen sink which is mostly used. It is of one-piece construction, provided with or without rim.

The floor of the sink is given a slope towards the waste outlet. The sinks are provided with circular waste hole. All the kitchen sinks are provided with a draining board which is fixed on the right of the user. Weir type overflow slots are also provided in some sinks. The usual dimensions of the sinks are:

The sinks are made of glazed earthenware or stoneware. The height of the top of the sink from the floor should be 90 cm.

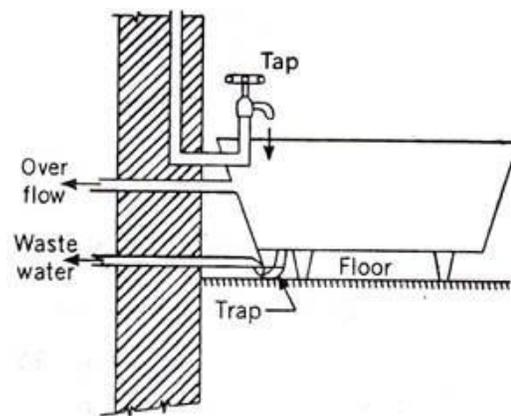


## 3. Bath Tub

Bath tubs may be made of various materials, such as enamelled iron, plastic, cast iron, porcelain enamelled, marble or fire clay etc. For high class residential buildings marble, plastic or enamelled iron or fibre glass baths are used. For public places glazed fire-clay or porcelain enamelled cast iron baths are used.

Vitreous enamelled pressed steel baths are also available in the market. Previously copper baths were used but nowadays they have become obsolete. In future aluminium alloy and fibre glass bath are coming which will replace old baths.

Figure shows the section through a bath. The bath may be parallel or taper, the latter type being more popular. It is provided with one outlet of 4 to 8 cm and one inlet pipe for filling it. In some cases, two taps are provided one for hot and another for cold water supply.



The bath should also be provided with one over-flow pipe to take excessive water. The waste pipe of bath is provided with a trap, to prevent the foul gases from entering in the bath room.

The usual dimensions of bath are: length 1.7 to 1.85 m width 70 to 75 cm, depth near waste pipe side 43 to 45 cm, overall height with feet 58 to 60 cm.

## 4. Flushing Cisterns

These are used for flushing water closets and urinals after use. There are several varieties of flushing cisterns. High-level cisterns are intended to operate with a minimum height of 125 cm between the top of the pan and the underside of the cistern.

Low-level cisterns are intended to operate at a height not more than 30 cm between the top of the pan and the underside of the cistern. Cistern may be of cast iron, glazed earthenware, glazed vitreous ware or pressed steel or any other impervious material. Now a days plastic cisterns are also available in the market. Following two types of cisterns are most common now a days:

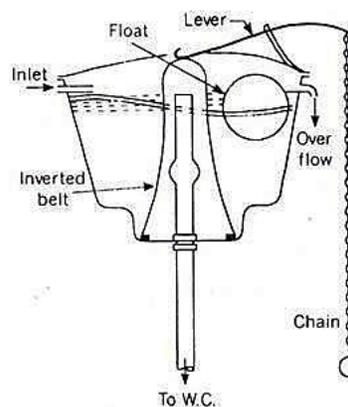
- (i) Bell type without valve.
- (ii) Flat bottom type fitted with valve.

Figure shows the bells type flushing cistern. The bell is kept over the outlet pipe, the inlet end of which is slightly above the water level. When the chain is pulled, the bell is lifted causing the water to spill over the outlet pipe and starting the siphonic action due to which the whole water rushes towards the outlet and flushes the W.C.

Due to shortage in the water supply, there was urgent demand to reduce the quantity of water consumption. All the flushing cisterns available and existing in the building fitting, discharge their full quantity of water even for small purposes or even when small quantity of water will sufficient for that purpose.

Central Building Research Institute (C.B.R.I.) Roorkee has developed dual flushing cistern, which allows fractional or full discharge of cistern at a time. All the existing cisterns can be converted into dual flushing cisterns by making arrangements to cut the vacuum seal at the fixed water level. To obtain the fractional discharge the chain is pulled and left, but for obtaining full discharge the chain is pulled and kept in position till full capacity is discharged.

For converting the existing cisterns to dual flushing cisterns, 6 mm dia., rubber tube is fixed in the bell of the cistern at the fixed height. The other end of the rubber tube is connected to a plastic pipe with a stop-cock at the end to control the entry of air. The cistern will give full discharge with the stop cock and fractional discharge with the stop cock open.



C.B.R.I. has also developed an automatic flushing cistern for the urinals. This cistern has eliminated the use of copper fittings which are presently provided with the public urinal's cisterns. The new developed fittings consist of a U-tube made of plastic pipe.

When the water level in the cistern reaches the level of the bend, the syphonic action takes place and the water present in the cistern rushes, to the urinals. This new automatic flushing cistern can be cheaply manufactured and easily fixed in the position. Table below gives the Flushing Storage Capacities.

S.No.	Classification of Building	Storage Capacity
1.	For tenements having common conveniences	900 litres net per W.C. seat,
2.	For residential premises other than tenement having common conveniences	270 litres net for one W.C. seat and 180 litres/additional W.C. seat in the same flat.
3.	For factories and workshops.	900 litres per W.C. seat and 180 litres per urinal seat.
4.	For cinema, public assembly hall etc.	900 litres per W.C. seat and 350 litres per urinal seat.

S.No.	No. of Floor	Storage Capacity	Remarks
<i>(For premises occupied as Tenements with common conveniences)</i>			
1.	Ground floor, 1st floor	Nil	Provide no down take fittings are installed
2.	Floor 2, 3, 4, 5 and upper	500 litres/tenements	---
<i>(For premises occupied as Flats or Blocks)</i>			
1.	Floor 1	Nil	Provide no down take fittings are installed
2.	Floor 2, 3, 4, 5 and upper floor	800 litre/tenements	---

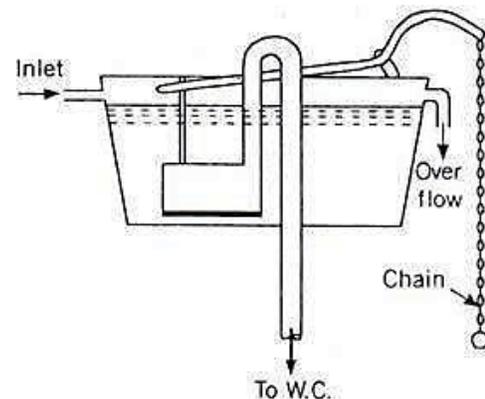
### Note

1. If the premises is situated at a place higher than the road level in front of the premises, storage at ground level should be provided on the same lines on floor 2.
2. The above storage may be permitted to be installed provided that the total domestic storage calculated on the above basis is not less than the storage calculated on the number of down take fittings according to the scales given below:

- (a) Down take taps – 70 litres each
- (b) Showers – 135 litres each
- (c) Bath tubs – 200 litres each

Figure 25.5. illustrates the flat bottom type flushing cistern provided with valve. When the chain is pulled, it lifts the disc which also suddenly lifts the water above it and starts the siphonic action. The valve allows the water to rush in the outlet pipe.

The flushing cisterns are provided with inlet pipe, over-flow pipe and automatic closing float ball valve.



## 5. Water-Closet

This is a sanitary appliance to receive the human excreta directly and is connected to the soil pipe by means of a trap.

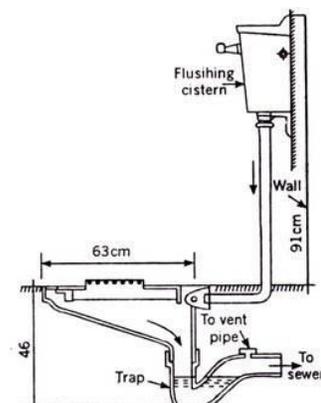
The water closets are classified as follows

### (A) Squatting type or Indian type

- (i) Long pan pattern (length 450,580,680 mm)
- (ii) Orissa pattern (length 580,630,680 mm)
- (iii) Rural pattern (length 425 mm)

### (B) Wash-down, Pedestal or European type

Figure shows the section through an Indian type water closet.



**This is manufactured in two different pieces**

- (a) Squatting pan, and
- (b) Trap.

The pan is provided with an integral flushing rim of suitable type. The inside of the bottom of the pan should have sufficient slope towards the outlet for quick disposal during flushing.

These are made of vitreous china clay. The inner portion is glazed to make it easy in cleaning. The pan is connected to the flushing cistern by means of flushing pipe. The top of the trap is connected to the anti-siphon or vent pipe.

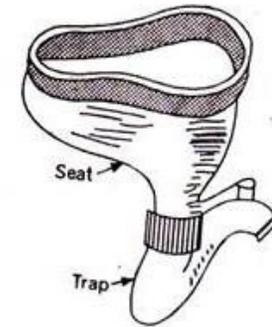
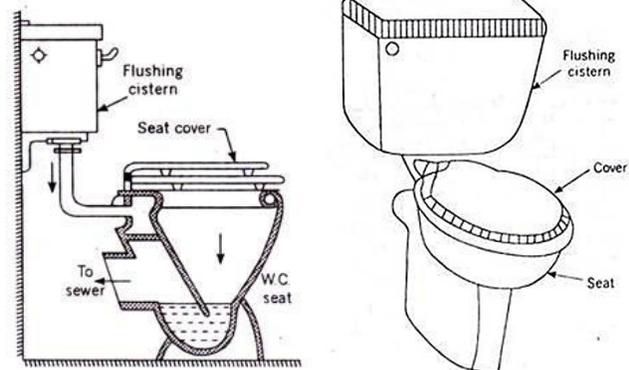


Figure below shows the section through a wash-down type water closet which is most commonly used in high class buildings. It is provided with a wide flushing rim and 5 cm trap. It is one piece construction in which the pan and trap are not separate. It is provided with an inlet or supply horn for connecting to the flushing pipe.

It may be provided with P and S trap as desired. These types of water closets require less space than squatting pattern type and can be flushed by low level cistern. Nowadays siphonic water closets are very popular. Figure shows the isometric view of such a water closet.



## 6. Urinals

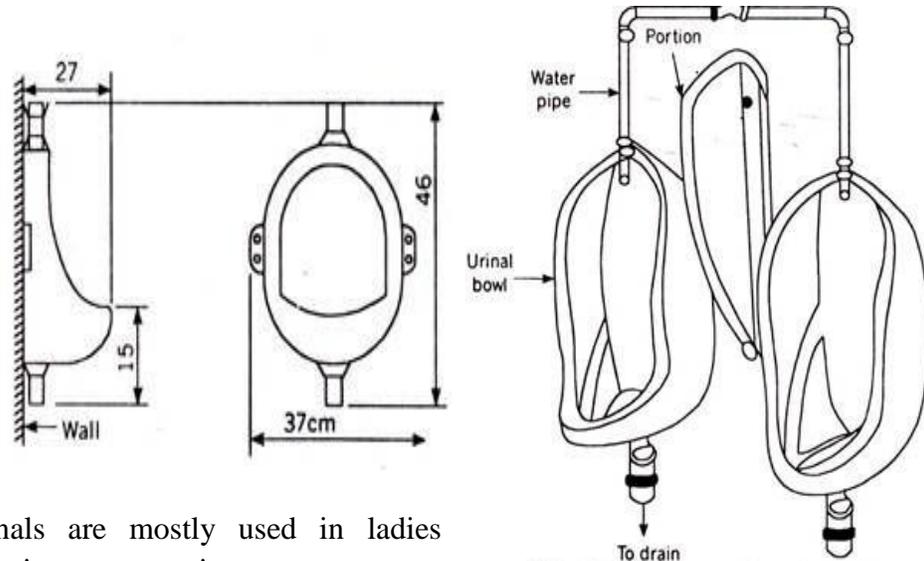
**Urinals can be made in any of the following patterns and sizes**

S.No.	Pattern	Sizes
1.	Bowl shape	430 mm Min × 260 mm Min
2.	(i) Flat back (ii) Angle back	× 350 mm Min 340 × 430 × 265
2.	Slab	Single 450 × 1000 mm 600 × 1000
3.	Stall	Single 1140 × 460 × 400 mm
4.	Squatting plate	600 × 350 mm and 450 × 350 mm

Bowl type urinals are of one-piece construction. Each urinal is provided with two fixing holes on the side for fixing it on the wall. At the bottom an outlet horn is provided for connecting it to the trap. The inside surface is regular and smooth for ensuring efficient flushing.

The bottom of the urinal is provided with sufficient slope from the front towards the outlet for efficient drainage of the urinal. Bowl type urinals are also provided with flushing rim which is connected by flushing pipe to the flushing cistern. Figure illustrates a bowl type urinal.

The slab and stall type urinals are manufactured either as a urinal or as a range of two or more and are used in public places such as cinema houses, restaurants, railway stations, offices, etc. The squatting plate urinals are mostly used in ladies lavatories and are on piece construction.



### Classification of Fixtures according to price

- 1- Low-cost fixtures
- 2- Medium cost fixture
- 3- High-cost fixtures

### Practical/ Activities

#### Activity 6.4: Presentation about scope and importance of fixtures

The teacher/ instructor is required to give presentation to the students on scope and importance of sanitary fixtures. The students have to present the same in groups. Portfolio will be prepared.

#### Activity 6.5: Group Presentation on different fixtures.

The teacher/ instructor is required to give presentation to the students about different types of sanitary fixtures according to materials, working and price. The students have to arrange group presentation on classifications/ types with examples

### 6.3: Install Traps (Floor & Gully Trap)

Trap is a bend in the pipe where the waste goes out of the toilet or other fixtures. It retains some water after flushing causing a seal and preventing sewer gases from entering the building. Protecting a building from water accumulation during heavy rainfalls is a very important matter. It is one of the most fundamental issues when it comes to home construction. It should be addressed at the stage of designing a house. Properly working sewage and gutter systems and their good connection is crucial. Gully trap is one of the most basic elements used in both those systems.

#### 6.3.1: Identify Traps

The types of traps are **S-Trap, P-trap, floor trap, gully trap, q-trap, bottle trap.**

P-trap is used with Indian water closet (W.C.), basin, sink etc. S-trap is used with European type WC. For wall type installation, P-trap pipe is designed to outlet through the wall whereas S-trap is designed to outlet through the floor. Therefore S-trap pipe is not suitable for wall mounted toilets. Floor trap is fixed in floor for to outlet through floor of the floor, sink, and basin. Gully trap is fixed just outside the bath or kitchen and also for the roof rain water

### 6.3.2: Identify workplace

For installing the traps of different types, you should observe the structure of fixture whether is required to be fixed on floor, or on the wall. It may be for the rain water down pipe or for basins, sinks and floor combined trap just outside the bath, kitchen or in the courtyard. Accordingly, you will decide the work place for installation of trap.

### 6.3.3: Adopt safety policies, Procedures as per work, health & Safety and environmental Requirements.

Always the policies and procedure of the local authority should be adopted. You should wear personal protective dresses and use PPEs as per workplace requirements. Adopt all the preventive measures for your and co-workers' safety. Necessary measures should be taken for the health at workplace. The safety rules and regulation as per instructions of the management and manufacturers should be followed.

### 6.3.10: Locate Position and Install the Traps

#### Types of gully traps

There are two solutions, most commonly chosen by homeowners. They are:

- **P-trap gully** - it removes water from the gutter and from the ground,
- **Gully trap with silt bucket or basket** protecting the sewage system from waste.

#### Installation of gully trap

Some homeowners might wonder how to connect underground drainage with pipes of various sizes. A gully trap has an outlet that can be fitted to any pipe, depending on the type of installation. The element won't work properly if it's not properly installed. Fortunately, the installation is easy and it can be performed by anyone.

1. The first step involves preparing the spot where you will install the gully trap. Underground drainage requires digging a hole in the ground. The upper part of the gully trap should remain at the ground level.
2. Stiffen the ground. To do it, you can use concrete.
3. Connect the sewage pipe to the gully trap.
4. Pour concrete over the trap.
5. Connect the gutter drain to the rainwater gully. Before you do that, adjust the outlet size.
6. Test for leakage of joints.

Note: Keep in mind that the gully trap needs to be cleaned regularly. If you own a rainwater gully with a basket, clean it thoroughly before winter.

### Installation of floor trap

1. The first step involves preparing the spot where you will install the floor trap. Underground drainage requires digging a hole in the ground. The upper part of the floor trap should remain at 5 to 10 cm down from the floor level.
2. Join the floor trap of cast iron or plastic with the sullage pipe. Use cement mortar for joining. When joint is ready join the vertical pipe reaching above the floor level.
3. Test for leakage of joints by filling water after setting of joints.
4. Place the concrete around this pipe to stiffen the trap.
5. Prepare the top surface for fixing of strainer.
6. After setting drill for inserting rowel plug for fixing of strainer.
7. Now firstly, place the strainer and check its level.
8. Fix the strainer with screws. Installation is complete

### Practical/ Activity

#### Activity 6.6: Practice for Installation of Floor Trap

The teacher/ instructor is required to demonstrate to the students how to calculate the materials required for fixing floor trap and installation of the same observing all health & safety requirements, policies and procedure of the authority. The students have to perform the same.

#### Activity 6.7: Practice for Installation of Gully Trap

The teacher/ instructor is required to demonstrate to the students how to calculate the materials required for fixing floor trap and installation of the same observing all health & safety requirements, policies and procedure of the authority. The students have to perform the same.

### 6.4: Install W.C. (Indian & English)

WC pans may connect directly to a drain or a discharge stack. When discharging to a drain, WC pans may be:

- vented by connection to a drain vent as long as the developed length does not exceed 1.5 m for an 80 mm diameter pipe, or 6 m for a 100 mm diameter pipe
- connected directly to a drain without venting if both the main drain and discharge pipe gradients are 1:60 or more, and the developed length does not exceed 1.5 m for an 80 mm diameter pipe, or 6 m for a 100 mm diameter pipe.

When discharging to a stack, WC pans must be vented.

**WARNING:** Any vitreous China can chip or break if the bolts or nuts are over-tightened or if mishandled.

#### 6.4.1: Identify W.C.

The most important thing to consider when purchasing a water closet is its size. Also, keep in mind the distance between the center of the floor drain and the wall. Water closets do not come in one size for all. It even depends on the height of the person for example, for a tall person, a small water closet won't do. Along with height, the shape of the water closet bowl should also be considered.

Not just the common elongated and round bowls but we present to you a never seen before square bowl.

### Types of Water closet

Smart Water closet	Wall Hung	One Piece
EWCS	Floor Mounted Coupled Closet	Extended Wall Hung
Anglo Indian WC	Squatting Pan	Urinals
Concealed Cisterns	Flush Valve	

#### 6.4.2: Apply workplace policies

For installing the water closets of different types, you should observe the structure of fixture whether is required to be fixed on floor, or on the wall. It may be European type o(commode) or Indian type. Accordingly, you will decide the work place for installation of water closet.

#### 6.4.3: Adopt procedures,

Always the policies and procedure of the local authority should be adopted. You should wear personal protective dresses and use PPEs as per workplace requirements. Adopt all the preventive measures for your and co-workers' safety. Necessary measures should be taken for the health at workplace. The safety rules and regulation as per instructions of the management and manufacturers should be followed.

**WARNING:** Any vitreous China can chip or break if the bolts or nuts are over-tightened or if mishandled.

#### 6.4.4: Isolate services.

Drainage and water supply pipe work should be inspected and tested prior to the installation of water closet.

- Turn off the water supply.
- Disconnect the flush valve.
- Remove the existing water closet.
- Using putty knife, completely remove old wax seal from floor and bottom of water closet.
- Lay water closet down on padded surface to help protect the vitreous china



#### 6.4.5: Locate place

Refer to the approved shop drawings. Use the measuring tape to locate the pace of installation in case of original installation. For replacing, existing location should be checked to house the water closet which is being installed

#### 6.4.6: Fix trap

P-trap is required for Indian type water closet. Locate the position of P-trap. Take the PVC pipe of size matching the size of P-trap. Prepare the surface with mortar placing of



P-trap. Now place the P-trap on it by jointing its discharge end with the soil pipe. Thoroughly support the P-trap.

#### 6.4.7: Fix W.C.

Water Closet extension piece, connectors, fittings, & accessories from main contractor should be as per manufacturer standards.

WC brackets & Cisterns from the main contractor should be properly installed and fixed prior to the closure of stud wall or shaft.

WC should be checked from any damage, scratched & defects prior to installation.

Install the floor mounted WC once the clearance & access already provided by the main contractor (stud wall, wall tiles or wall mirror already fixed) following the approved elevations & details.

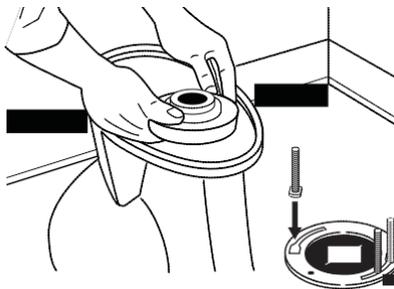
Secure all the fixing accessories like nuts, washers, gaskets from manufacturer, cover and seats.

Cover the WC with plastics or cartons and provided with cordons and signage till installation and commissioning

**WARNING:** Hazardous gases can escape through the closet flange if new water closet is not installed quickly. A temporary fix: place a large rag in the closet flange.

#### English Type Water Closet

- Check rough-in dimensions and install or relocate flush valve and outlet as indicated.
- Record model number for reference.
- Place and press in a new wax seal around the water closet bottom outlet.
- Install new 5/16 "T-bolts.
- Take out the temporary rag (if used) from the water closet flange hole.
- Carefully align and lower the water closet over the flange and T-bolts.



**IMPORTANT! Do not lift or rock the water closet after replacement. The watertight seal will have to be replaced if breakage occurs.**

- To seal, apply your full body weight around the water closet.
- Place the plastic cap base in the position indicated on cap as marked.

- The metal washers and nuts can now be placed on the bolt cap base and T-bolts.
- Tighten the nuts carefully.

**IMPORTANT! Do not overtighten the nuts, breakage and chipping of vitreous China can occur.**

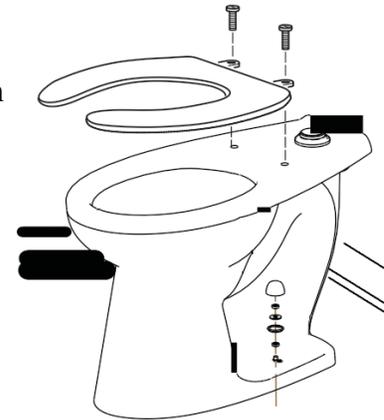
- • Cut 1/4" or more over the top of the nut.
- • Attach the bolt caps.

**IMPORTANT! Product damage can occur if using a saw blade to cut off the excess T-bolt length. Make sure vitreous china is protected and covered.**

### 3. COMPLETING THE INSTALLATION

• Flush valve should be installed to manufacturer's installation instructions.

- Turn on water supply valve.
- Install toilet seat (not included).
- Flush water closet a few times and check all connections for water seepage
- Check the leaks



### Installation of Indian Water Closet

First remove any large rocks or concrete lumps from the floor of your W.C room as these will make it hard for you to level the ground later. Then look at your blue print and place you W.C in it's appropriate place. This should be where the opening of your P trap is.

#### 6.4.8: Check Level

Put cement around the opening of the P trap and lower the W.C onto it. The W.C will need to be placed at floor level so bricks are required to raise and support the weight of the W.C. To ensure the W.C is at floor level you can use some thin tubing for levelling. You must also use a leveller to ensure that the W.C is not placed on a slant.



### 6.4.9: Pour concrete around W.C.

Concrete the W.C onto the bricks to keep it in place and fill the surrounding area with small rocks



### Practical/ Activity

#### Activity 6.8: Practice for Installation of W. Cs Indian type

The teacher/ instructor is required to demonstrate to the students how to calculate the materials required for fixing Indian type water closet and installation of the same observing all health & safety requirements, policies and procedure of the authority. The students have to perform the same.

#### Activity 6.9: Practice for Installation of W. Cs English type

The teacher/ instructor is required to demonstrate to the students how to calculate the materials required for fixing English type water closet and installation of the same observing all health & safety requirements, policies and procedure of the authority. The students have to perform the same.

### 6.5: Install Sink

The trickiest part of installing a new sink and faucet is connecting the sink's drain—the pieces between the sink's tailpiece and the waste line. Always start at the sink tailpiece and work down. This is where a swivel P-trap with a trap adapter earns its keep. It can swing side to side on two different axes and adjust up or down.

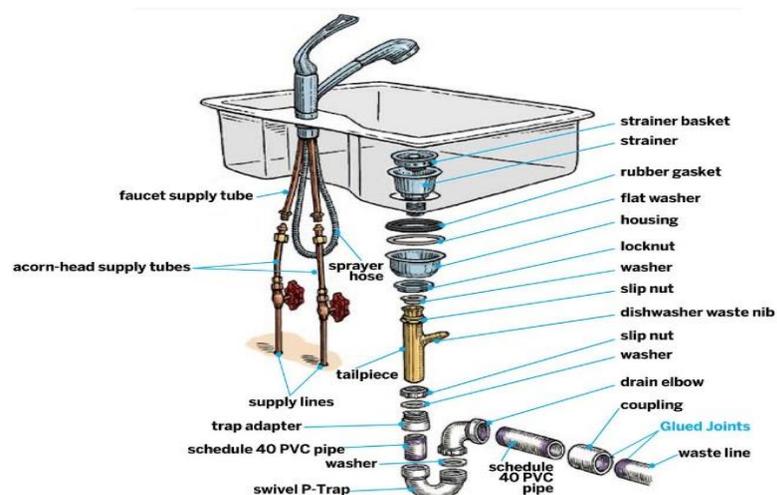
See the above drawing showing the illustration and checking the inside diameters of the tailpiece and waste line, usually 1 ½ inches. Then, instead of buying a kit, get only the pieces you need, including Schedule 40 PVC pipe to cut and fit as needed.

#### 6.5.1: Identify Sink

In today's market, there are several kitchen sinks that can be seen. According to installation types, there are three different types of kitchen sinks. These three sinks are installed in a different way and they are:

##### 1- Top mount sinks

A top mount sinks are also familiar as a drop-in sink. It is the most common type of



kitchen sink all over the world. This type of kitchen sink is installed by intromitting the sink into a pre-cut hole in the countertop.

There is a lip around the sink. The lip around the top mount sink props it on top of the countertop. It is also closed with silicone for a water-tight fit.

### 2- Under-mount sinks

It is easy to guess how an under-mount sink is installed. It is installed directly under the counter. It is attached to the underside of a countertop. There are special clips that ensure that the sink stays in plays. And the sink is supported from underneath.

The under-mount sink is versatile and works with most kitchen designs. This sink looks sleek, smooth, and easy to use for clean-up. As there is no lip or rim, the garbage can easily be pushed straight into the sink.

### 3- Flush mount sinks

There are two types of flush-mount kitchen sink. One sinks surface of the countertop flows seamlessly into the sink and there is nothing visible edges and changes in components. Another one is seen with tiled countertops, here the tiled has easily reached the edge of the sink.

But this type of installation is hard to see and less common.

### Others

Without these three kitchen sinks, there are another 10 best kitchens sinks that can be found in the market.

Farmhouse sink	Stainless steel sink	Bar sink
Corner sink	Granite composite sink	Cast iron sink
Kitchen Island Sink	Single bowl sink	Fireclay sink
Kitchen sink with drainboard		

## 6.5.2: Apply workplace policies, Adopt Procedures & Locate Place

For installation of sink following steps in order should be performed.

### 1. Measure and mark the kitchen sink's layout.

Mark the counter's back edge to center the sink within its cabinet. If sink has a template, align it with the mark on the counter. Place its back edge 1½ inches from and parallel to the counter. Trace around it; proceed to the next step.

If there's no template, use 2-inch tape to outline the sink location. Mark the center of the sink on its back lip. Lay the sink upside down on the counter. Align the mark on the sink with the one on the counter. Adjust the sink to leave 1½ inches between its back edge and the backsplash. Be sure sink is parallel with the counter's edge. Trace around the sink, then remove it. Measure the width of the sink lip, subtract 1/8 inch, and mark inside the sink outline by that much. To make the cut-out lines, connect all the marks with a straightedge.

### 2. Mark the cut line on to the counter

After using a straightedge to connect the marks, you'll end up with a rectangular outline of the sink's hole on the counter. Round off the corners by hand to approximate the radius of the sink's corners. Next, use a spade bit that's slightly wider than the jigsaw blade (½-inch bit is usually sufficient) and drill a hole inside the radius at each corner of the cut-out lines.

**3. Cut a sink opening with a jig saw**

Lower a jigsaw blade into a front hole and saw along the cut line to back hole. Repeat on the other side. Lay a scrap of wood a few inches longer than the cut-out across the sink area. Screw through the scrap and into the cut-out waste to prevent it from falling or binding the saw blade. Cut along the front and back cut lines. Remove the cut-out piece. Check the fit of the sink in countertop; trim the hole with the jigsaw, if necessary.

**4. Install sink faucet**

Set the sink upside down on a padded sawhorse or counter. Feed the faucet's supply tubing and tailpiece through the gasket that seals the faucet to the sink and then up through the hole (or holes) in sink. Screw the mounting nuts and washers to the underside of the sink deck. Make sure the faucet can swing in a full arc across the sink before tightening mounting nuts.

**5. Attach strainer over plumber's putty**

With the sink still upside down, pack a thick roll of plumber's putty under the strainer's lip and push it up through the sink's drain hole. Slip the gasket, washer, and housing (if your strainer has one) onto the strainer and against the underside of sink. Dab pipe-joint compound onto its exposed threads. Thread the locknut onto the strainer by hand, then tighten it with pliers while holding the strainer in place. Fit the gasket onto the sink-drain tailpiece and attach it to the strainer with its slip nut. Tighten the nut by hand while holding strainer.

**6.5.3: Fix stands, Fix the bolts and check Level****1. Set the sink and connect water supply**

Remove the tape, pulling toward centre of hole. With sink still upside down, squeeze a bead of silicone caulk around the underside of the sink's lip.

Fix the bolts in wall if stand is provided to install.

Turn the sink upright and set it into the countertop hole. Check that the front of the sink is parallel with the front edge of countertop. Adjust it, if necessary. Connect the faucet to shut-off valves using acorn-head supply tubes or braided stainless steel hoses. Attach the sprayer hose to the faucet's threaded tailpiece. In case of stand, fix the bolts with stand. Check the level of sink with spirit level

**2. Connect the waste pipe with waste coupling with the sink.**

Assemble the trap adapter onto the sink-drain tailpiece. Cut and dry-fit lengths of PVC pipe to connect the trap adapter to the trap and the drain elbow to the waste line. Swivel the trap or slide it on the tailpiece to fine-tune the pipes' lengths and alignment. Take the drain pieces apart. Clean off the cut ends with a utility knife. Coat them and their mating pieces with PVC primer. Let dry. Swab PVC cement on both ends being joined. Immediately push pieces together. Hold for 30 seconds. Reassemble and hand-tighten all threaded connections.

**3. Attach the dish washer drain.**

Attach the dishwasher drain line to the waste nib of the tailpiece. Tighten the hose clamp with a screwdriver. Remove excess putty from lip of strainer. Remove the aerator from the faucet and run the water full blast. Look for leaks at all connections along the supply and drain lines. In case of leaks, carefully tighten the nuts by one-eighth turns until the leak stops. Make sure the sink's front

edge is parallel to counter's edge. Fill the sink with water to weigh it down and hold it tight overnight as the caulk sets.

## Practical

### Activity 6.10: Practice for Installation of Sink

The teacher/ instructor is required to demonstrate to the students how to install a sink on counter & on brackets in a kitchen and installation of the same observing all health & safety requirements, policies and procedure of the authority. The students have to perform the same.

## 6.6: Install Wash Hand Basin

Wash basin is a sanitary fixture used for washing hands and mouth. These are of different types.

### 6.6.1: Identify wash hand basin

The type of washbasin (or sink) you choose will often dictate the choice of materials it is made from. Stand-alone pedestal and wall hung basins are invariably made from porcelain or vitreous china (ceramic), however those designed to be incorporated into a counter top can be made from almost any suitable material.

#### 1- Pedestal basins

The hollow pedestal provides a degree of support for the basin, but primarily hides the unsightly water supply and waste pipes.

#### 2- Wall hung basins

Modern basins are **supported on concealed mountings attached to the wall**, whereas older wall hung basins are supported on large screw fix brackets, similar to shelf brackets.

Mounting to a solid/external wall should present little or no problem, however depending on the size and weight of the washbasin, **it may be inadvisable to attach a wall hung basin directly to a timber frame stud wall**. In this case install a mounting board to the stud wall and attach the basin to this board.

#### 3- Corner basins

**Often used as a space saver**, making them ideal for use in a cloakroom or WC, corner basins can be mounted such that the pipework is easily concealed in an adjacent wall or by being boxed into the corner. Practicality, this means that corner basins are most frequently available in small sizes rather than full bathroom size.



#### 4- Recessed basins

The advantage to this type of basin is that **it can be recessed into a wall, on top of panelling or onto a vanity unit.** Primarily found in cloakrooms and small bathrooms, recessed basins are becoming increasingly popular as a feature in main bathrooms.

#### 5- Counter top basins

In a large bathroom space there is often enough room to mount a washbasin, or a pair of washbasins, into a counter top as a part of a **built-in vanity unit.**

This provides an **ideal storage scenario** as a variety of bathroom items can be stored below the washbasins. Aesthetically, counter top basins also allow the plumbing to be hidden away within the unit.



#### 6.6.2: Check water pressure

Drainage and water supply pipe work should be inspected and tested prior to the installation of wash basin. Check the water pressure and perform air test of pipe work installed. Wash basin extension piece, connectors, fittings, & accessories should be as per manufacturer standards. Wash basin should be checked from any damage, scratched & defects prior to installation.

#### 6.6.3: Shut down valve

Turn off the water supply. Disconnect the waste pipe. Drainage and water supply pipe work should be inspected and tested prior to the installation of water closet.

#### 6.6.4: Locate position for installation

Refer to the approved shop drawings. Use the measuring tape to locate the pace of installation in case of original installation. For replacing, existing location should be checked to house the wash basin which is being installed

#### 6.6.5: Identify workplace

For installing the wash basins of different types, you should observe the structure of fixture whether is required to be fixed in wall hung type, or in corner. It may be counter type or pedestal type and recessed type. It is required to be installed in bath, dining or in the courtyard. Accordingly, you will decide the work place for installation of wash basin.

#### 6.6.6: Adopt safety policies

For installing the wash basin of different types, you should observe the structure of fixture whether is required to be fixed on floor, or on the wall for adoption of safety policies.

#### 6.6.7: Select procedures, use proper tools as per Work Health Safety and environmental requirements

Always the policies and procedure of the local authority should be selected. You should wear personal protective dresses and use PPEs as per workplace requirements. Adopt all the preventive measures for your and co-workers' safety. Necessary measures should be taken for the health at

workplace. The safety rules and regulation as per instructions of the management and manufacturers should be followed.

Marble Counter for wash basin with steel support to be provided & installed by other trade following the requirement (opening & dimension) of the wash basin. Install the wash basin once the clearance & access already provided by the main contractor (counter with 20 mm plywood by others already fixed and hole for mixer already provided) following the approved elevations & details. Refer to the approved shop drawings.

Silicon sealant to be provided in between the wash basin's rim & the counter.

Secure all the fixing accessories like nuts, washers, gaskets from manufacturer, & single hole mixer. Wash basin to be secure by clamping the rim to the underside of the counter.

Install the hot & cold-water supply (escutcheons, angle valves & chrome plated tubes).

Install 32mm dia. Waste pipe to siphon bend with gasket flushed on the wall from bottle trap.

Cover the wash basin with plastics or cartons and provided with cordons and signage till installation and commissioning.

#### 6.6.10: Check manufacturer's specifications

Thoroughly read the manufacturer's specifications. Observe the work specification in true spirit. Location of wash basin and specific drilling and screwing points should match. Otherwise, China clay basins may be cracked.

### Practical Activity

#### Activity 6.11: Practice for Installation of wash hand basin

The teacher/ instructor is required to demonstrate to the students how to install a wash hand basin on counter & on brackets in a bathroom and installation of the same observing all health & safety requirements, policies and procedure of the authority. The students have to perform the same.

### 6.7: Install Bath Tub

These installation procedures for your shower tub should allow you to tie into your present drain, waste vent, and supply systems. Once all the roughing in has been completed, you're ready to assemble your shower and bathtub.

#### 6.7.1: Identify Bath tub & workplace

1. **Alcove bathtubs:** The most common type of bathtub is the alcove tub, which is often a built-in tub shower combo surrounded by three walls to save space in small bathrooms. The standard tub size for an alcove fixture is 60 inches long, 32 inches wide, and 18 inches deep. Small alcove tubs are available for smaller bathrooms, which are anywhere from 48 to 55 inches in length. Long alcove tubs are best suited for large bathrooms and can have nearly a full extra foot in length when compared with a standard alcove tub.
2. **Corner bathtubs:** A corner tub is a triangular bathtub that is inserted into the corner of your bathroom. They can take up a lot of floor space and are generally found in large master bathrooms. Corner bathtubs usually have two sides of the same length with a width ranging anywhere from 48 to 72 inches and a depth of 18 to 20 inches.

3. **Drop-in bathtubs:** A drop-in tub is built into a large frame that is set into an alcove. They often come with their own rim that is larger than the limited rims in alcove tubs. Unlike alcove tubs, drop-in tubs require a significant amount of space and are usually found in larger bathrooms. Drop-in tubs can be customizable in their size but they generally have a length of 60 inches, a width of 30 inches, and a depth of 16.
4. **Freestanding bathtubs:** A freestanding tub is a large stand-alone tub that is not built into the walls of a room. Freestanding tubs are usually found in large bathrooms and come in a variety of styles. A slipper tub is one popular style of freestanding tub featuring one end raised higher than the other to support a person's back while they lounge. Clawfoot tubs stand on top of four stylized feet, or "claws," and are another popular style of freestanding tub. Freestanding bathtubs are usually between 15 to 20 inches deep, 55 to 72 inches long, and 27 to 32 inches wide.
5. **Soaking bathtub:** A soaking tub is a kind of freestanding bathtub that you can place anywhere in your bathroom. Japanese soaking tubs are a popular choice for modern bathrooms, requiring the bather to sit upright rather than lounging at an angle. These tubs may have seats installed inside along their edges depending on the depth of the tub. Soaking tubs can come in a range of depths, usually at least 27 to 34 inches. Since they are made for soaking upright, they can have a diameter as small as 40 to 50 inches.
6. **Undermount bathtub:** An undermount tub is similar to a drop-in tub except that its rim is covered with tile or stone framing. An undermount tub is usually 60 inches long, 30 inches wide, and 16 inches deep.
7. **Walk-in bathtubs:** A walk-in tub has a door built along its side that lets you walk into the tub without having to step over the lip or climb in. Walk-in tubs are great for those who have restricted movement. Walk-in bathtubs come in a variety of sizes ranging from 48 to 60 inches long, 28 to 36 inches wide, and 38 inches deep.
8. **Whirlpool bathtub:** A whirlpool tub is an acrylic bathtub that takes up a similar amount of space as an alcove tub. A whirlpool tub uses air or water jet streams for a hydrotherapy effect that can keep your water warmer for longer amounts of time. Whirlpool bathtubs average about 60 inches in length, 32 to 36 inches in width, and 18 to 24 inches high.

You will decide the work place for installation of bath tub as per type of bath tubs. The types of wash basins are given above.

### 6.7.2: Installation procedure

#### Step 1 - Install Piping Before Tub

You will be using your existing drain and waste vent system, but pipes required include the hot and cold-water supply lines and a pipe leading to a shower head. A mixing valve and shower head are also needed. Air chambers may be required.

#### Step 2 - Position the Tub

Lower the tub into place so that the continuous flange fits against the wall studs and rests on 1'x4' or 2'x4' supports. Anchor the tub to the enclosure with nails or screws inserted through the flanges into the studs.

**NOTE:** Remember, bathtubs and shower stalls may require support framing. A bathtub filled with water is extremely heavy, so check building codes and framing support before installing the tub.

### **Step 3 - Assemble Drain Connections**

Assemble the bathtub drain connections by connecting the tub overflow with the tub drain above the trap, not beyond it. The trap will have a compression fitting that screws over the arm of the overflow assembly.

### **Step 4 - Place a Pipe for the Shower Head**

Locate a brass female threaded winged fitting and attach it to the framing support via a screw or a nail. Then run a pipe up the wall for the showerhead. Sweat or solder the other side of the brass fitting to the top of the pipe.

### **Step 5 - Attach Hot and Cold Water Lines**

Attach your water lines for both hot and cold by sweating these directly into the hot and cold ports of the mixing valve. The mixing valve will be how water enters the tub's system, not by the pipes themselves.

### **Step 6 - Install the Spout**

Extend a piece of 1/2 inch pipe, or whichever length is specified in the manufacturer's instructions, for the tub spout. Sweat on a male threaded fitting at the end of the pipe or use a brass nipple

**NOTE:** At this point you should have your rough-in plumbing work inspected before proceeding further.

### **Step 7 - Check for Leaks**

Restore the water pressure and check the drain connection and the supply pipes for any sign of leaking.

### **Step 8 - Restore the Bathroom Wall**

Replace the wall with moisture-resistant drywall as a base for your wall covering. Seal the joints between the wall and your new tub with silicone caulk as protection against water seepage.

### **Step 9 - Install the Shower and Tub Fixtures**

The spout, handles, and shower head are all easily attached at this stage. You can usually screw them on to structures you've already put in place. For example, the shower head screws onto the shower arm stub out.

### **Step 10 - Prevent Future Leaks**

Whether installing a new shower head or replacing an old one, always clean the pipe threads. Apply new pipe joint compound, PTFE tape, or both to prevent leaks.

## **Practical**

### **Activity 6.12: Practice for Installation of bath tub basin**

The teacher/ instructor is required to demonstrate to the students how to install a bath tub stand type & on floor in a bathroom and installation of the same observing all health & safety requirements, policies and procedure of the authority. The students have to perform the same.

## 6.8: Clean Up

### 6.8.1: Clear the work area,

- Clear the work area
- Dispose off the materials those are not reusable or recycle able at proper place.
- Store the materials those are reusable in storage bins.
- Place the materials at recycling station those are recycle able.
- Clean tools and equipment
- Check for serviceability of tools and equipment.
- Report any damage tools and equipment
- Store and secure tools and equipment in cabinets.

### 6.8.2: dispose extra materials in accordance with state and territory legislation and workplace policies and procedures.

Collect the materials those are not used or have been wasted. For temporary storage of waste materials use the relevant bins with covers as per category of waste. Dispose of the waste materials as per guidance and rules of environmental protection authority. Reusable materials should be stacked in the store observing all safety precautionary measures. The following points should be observed during waste disposal.

- All waste should be segregated correctly.
- When handling waste, appropriate personal protective equipment (PPE) should be worn, and hands cleaned after removing each item of PPE, e.g. pair of gloves, apron.
- All waste bags should be no more than 3/4 full and no more than 4 kg in weight. This allows enough space for the bag to be tied using a suitable plastic zip tie or secure knot.
- Waste bags should be labelled with the address and date prior to collection by the waste contractor (some waste contractors may undertake this) to ensure traceability if an incident occurs.
- When handling tied waste bags, only hold the bag by the neck and keep at arm's length to reduce the risk of injury in case a sharp item has been inappropriately disposed of in the bag.
- If a waste bag awaiting collection is torn or contaminated, the bag and contents should be placed inside a new waste bag.

## Practical

### Activity 6.13: Perform workplace cleaning activity including observing hygiene standards, cleaning tools and housekeeping.

Students are required to perform cleaning of work area and housekeeping of tools and equipment after installation of traps.

Students are required to perform cleaning of work area and housekeeping of tools and equipment after installation of Water Closets (Indian & English types).

Students are required to perform cleaning of work area and housekeeping of tools and equipment after installation of sink.

Students are required to perform cleaning of work area and housekeeping of tools and equipment after installation of wash hand basin.

Students are required to perform cleaning of work area and housekeeping of tools and equipment after installation of bath tub.

## What I have learnt

- A receptacle or device that is connected to a water supply system or discharges to a drainage system or both is called fixture.
- The fixtures in buildings are provided various types of buildings, i.e., houses, hostels, hotels, office buildings, hospitals, educational buildings, etc. In hotels and accommodations, we need, bathrooms, lavatory blocks, kitchen
- The most common and most economical **material** for domestic **fixtures** such as toilet bowls, urinals, and washbasins is vitreous china.
- For more durable day-to-day use in kitchen sinks and laundry tubs, stainless steel is recommended material.
- C.B.R.I. Roorkee has developed dual flushing cistern and also an automatic flushing cistern for the urinals.
- Trap is a bend in the pipe where the waste goes out of the toilet or other fixtures. It retains some water after flushing causing a seal and preventing sewer gases from entering the building.
- P-trap is used with Indian water closet (W.C.), basin, sink etc. S-trap is used with European type WC. For wall type installation, P-trap pipe is designed to outlet through the wall whereas S-trap is designed to outlet through the floor.
- The use of proper PPE for specific job safeguards the plumber from accident.
- The different types of basins are pedestal type, corner type, recessed type, wall hung type and counter top type.
- According to installation types, types of kitchen sinks are top mount type, under-mount type and flush mount type.
- Hazardous gases can escape through the closet flange if new water closet is not installed quickly. A temporary fix: place a large rag in the closet flange.
- Gully trap is fixed just outside the bath or kitchen and also for the roof rain water
- Floor trap is fixed in floor for to outlet through floor of the floor, sink, and basin.
- The most important thing to consider when purchasing a water closet is its size. Also, keep in mind the distance between the center of the floor drain and the wall.
- Do not lift or rock the water closet after replacement. The watertight seal will have to be replaced if breakage occurs.

**EXERCISE****Q-1. Tick (✓) the correct option for the following MCQs.**

- i- The most common and most economical material for domestic fixtures such as toilet bowls, urinals, and washbasin is:
- (A) vitreous china. (B) cast iron  
(C) asbestos (D) stainless steel
- ii- For more durable day-to-day use in kitchen sinks and laundry tubs, the recommended material is:
- (A) vitreous china. (B) PVC  
(C) asbestos (D) stainless steel
- iii- This is not a sanitary fixture:
- (A) wash basin (B) rose shower  
(C) water closet (D) urinal
- iv- This is not a type of flushing cistern:
- (A) bell type without valve (B) sustainable type  
(C) flat bottom type with valve (D) automatic type
- v- This is not a type of traps:
- (A) Q-trap (B) Gully trap  
(C) Floor trap (D) Z-trap
- vi- This is a type of sink according to installation:
- (A) Flush mount sink (B) Farmhouse sink  
(C) Bar Sink (D) Stainless steel sink
- vii- Prior to installation WC is checked for:
- (A) Damage (B) Scratches  
(C) Defects (D) All of these
- viii- This is a type of water closet:
- (A) English WC (B) Wall hung WC  
(C) Indian WC (D) All of these
- ix- The fixture which has not waste coupling as accessory:

- (A) Sink (B) Wash basin  
(C) water closet (D) none of these
- x- A temporary large rag is placed in the water closet to prevent from:  
(A) water flows back (B) Hazardous gases  
(C) to install trap (D) None of these

**Give Short answer to the following questions.**

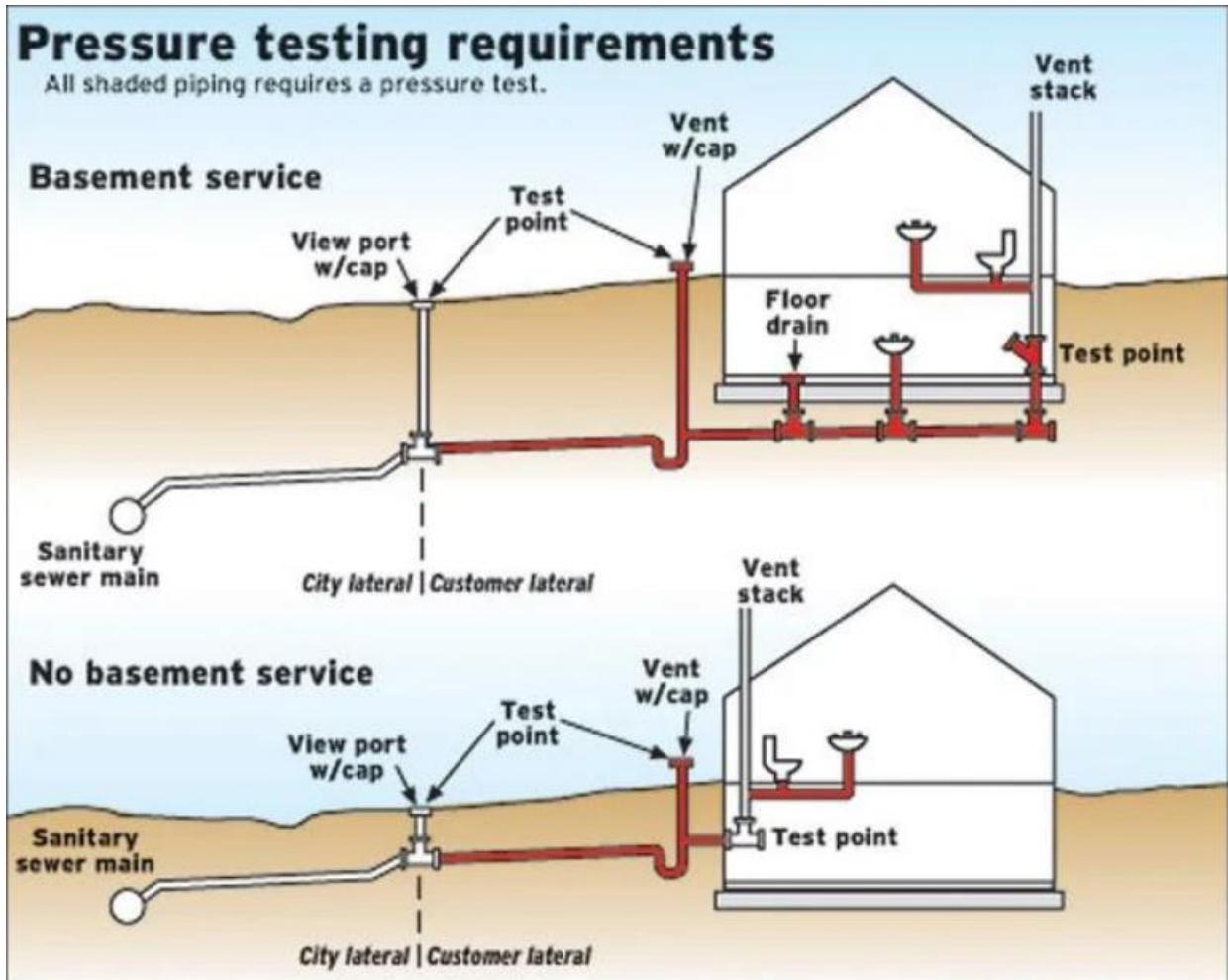
- i- State scope of fixture in industry.
- ii- What is importance of sanitary fixtures.
- iii- Enlist commonly used fixtures in buildings.
- iv- Enlist materials used for sanitary fixtures.
- v- Enlist types of traps.
- vi- How to identify work place for installation of wash basin.
- vii- Enlist components of sink.
- viii- What is meant by clean up?
- ix- Enlist the steps for installation of sink.
- x- Enlist the types of bath tubs.

**Answer the following questions in detail.**

- i- Explain the procedure for installation of wash basin.
- ii- Explain the different types of kitchen sinks.
- iii- Explain the types of bath tubs.
- iv- Explain the procedure of installation of sink.
- v- Explain the procedure for installation of English type water closet.

## CHAPTER -07

### TESTING OF SANITARY PIPES



**After Studying this unit. you will be able to:**

- access relevant job instructions from learning information management system (LIMS).
- prepare and workplace for task
- assemble / collect all required equipment and materials
- plan task / work sequences for optimum efficiency
- identify the specimen
- identify leakage testing machine
- detect the leakage of smoke.
- identify the specimen
- identify leakage testing machine
- evaluate the amount of leakage of water.

## 7.1: Carryout Initial Preparatory Activities

The leakage in the pipe joints or any other points is tested by water test, smoke test, or air test. Water test is carried out to find out the water tightness of the joints.

### 7.1.1: Access relevant job instructions from learning information management system (LIMS).

To test the leakage, one must have the knowledge of necessary instructions regarding operation and safety precautions. Sewer Test is carried out after giving sufficient time for the joints to set. In case of concrete and stoneware pipes with cement mortar joints, pipes should be tested three days after the cement mortar joints have been made. If it is necessary that the pipelines are filled with water for about a week before commencing the application of pressure to allow for the absorption by the pipe wall. The instructions of the manufacturer must be followed.

### 7.1.2: Prepare and workplace for task

One must recognize the task he is going to perform. The necessary instruction must be read first. Requisite personal protective equipments/ dresses must be used at the site of testing. The operator of machines must have the training to safely and efficiently use the machine. He should first make it clear that the machine is in working order.

### 7.1.3: Assemble / collect all required equipment and materials

You should first collect the requisite tools and machinery for the specific test you are going to perform. Assemble/ join the parts of machinery in correct order. Connect the necessary pipes or other electric cable connectors in proper manners/ order. Machines should be placed at site of work in sequence and in level position. These should be kept upright as per instructions of the manufacturer.

Collect the required materials to be used in the performance of test. Materials should be collected in the specific containers. These should be transported with care. At the site of testing these should be placed as per instructions of the manufacturer to prevent from any chemical reaction.

### 7.1.4: Plan task / work sequences for optimum efficiency

Read the instructions of manufacturer carefully. Arrange the machines in a sequence to be used. Use the relevant tool or machinery according to the testing job requirements. Never use out of order machine. Use the relevant tools for handling and mixing materials. Mix the materials as and when required without stoppage of work chain.

### Activity 7.1: Carry out initial preparatory activities.

The teacher/ instructor is required to demonstrate the initial preparatory activities for testing of sanitary pipes. Students are required to write a detailed note on the initial preparatory activities.

## 7.2: Leakage Detection Test by Smoke.

Fast and easy to do, smoke testing produces immediate results that can be acted on quickly - often at minimal expense to the municipality.

Hundreds of millions of feet of sanitary sewer mains have been smoke tested using Smoke Candles, Smoke Blowers, & Smoke Fluid, eliminating countless faults - and the SSO's that would result from them. Sanitary Sewer Overflows A properly designed, operated and maintained sanitary sewer system is meant to collect and convey all of the wastewater that flows into it to a wastewater treatment plant. However, occasional unintentional discharges from municipal sanitary sewers – called **sanitary sewer overflows (SSOs)** – can occur.

### 7.2.1: Identify the specimen

Sewer smoke testing is the most cost-effective method to find sources of surface water inflow & infiltration - the leading cause of wet weather SSO's. One must identify that the test is being performed for leakage, or to detect sanitary sewer overflows or of surface water inflow & infiltration.

### 7.2.2: Identify leakage testing machine

#### Smoke Candles, Smoke Blowers

**Smoke Candles** quickly and efficiently produce a dense white smoke ideal for sewer smoke testing. Disposable and simple to use, Smoke Candles require no external power or heat source. Due to its high visibility and excellent persistence, Smoke Candles provide the best results, allowing you to locate difficult leaks at greater distances when smoke testing. When smoke candle is paired with a genuine **Smoke Blower**, you have the best tools in the business to get the job done right!



#### Smoke Fluid Systems

Smoke Fluid systems are safe, inexpensive and easy to use. Smoke Fluid is a proprietary blend, specially formulated for optimum performance in Sewer Testing. Smoke Blowers are engineered to maximize dry smoke output, eliminating the wet smoke and mess typical of other liquid smoke systems. Smoke Fluid Systems use micro-control flow valves, custom-machined stainless steel injector nozzles, and custom-welded insulated heating chambers to generate the maximum volume of dry smoke.



## Sewer Pipe Plugs

Pipe Plugs and Pipe test plugs are ideal for blocking lines while Smoke Testing. Cherne Plugs have been the professional contractor's choice for over 50 years, and remain the most trusted in the industry. Pipe plugs are designed to work with a variety of systems from residential plumbing to municipal storm and sanitary sewer pipe.



### 7.3.3: Detect the leakage of smoke.

Smoke test is carried out for drainage pipes located in buildings and underground. Thus, smoke is produced by burning oil, waste, tar, paper etc. in the combustion chamber of the smoke machine. The pipes are approved gas-tight by the smoke test conducted under pressure of 25 mm of water. It is maintained for 15 minutes after all trap seals have been filled with water.



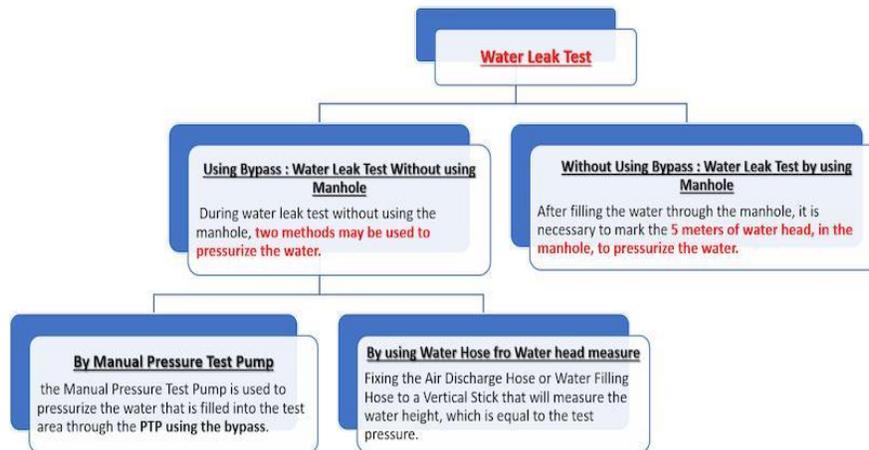
### Activity 7.2: Perform Leakage Detection Test by smoke.

The teacher/ instructor is required to demonstrate the leakage detection of sewer line by smoke/air test. Students are required to perform the same test.

## 7.3: Leakage Detection Test by water

### 7.3.1: Identify the specimen

Leakage detection by water can be applied with or without a manhole. As illustrated in the following chart. As per code, the pipe plugs must be inflated to the maximum permissible inflation pressure. then fill the test section with water up to 5 metres and monitor the water level; this means 0.5 bar because a water level of 5 metres is equal to 0.5 bar (50 kPa). Safety should be observed during performance of test. For instance, during a pressure test on a water pipe, the pipe plugs must be supported against sliding. Always brace the pipe plugs securely! Operators should be far away from the water lines.



### 7.3.2: Identify leakage testing machine

Manual pressure test Pump or water service line with hose pipe. Air Discharge Adaptor (ADA) escapes air from pipe during filling of water in test pipe. Plugs- pipe plug and pipe test plug. Pressure Gauge- to measure pressure. Stop Watch

### 7.3.3: Evaluate the amount of leakage of water.

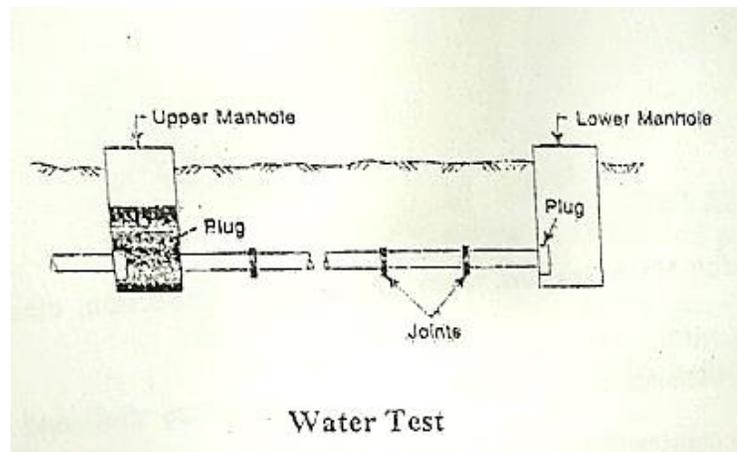
Water test is carried out to find out the water tightness of the joints. Sewer Test is carried out after giving sufficient time for the joints to set. In case of concrete and stoneware pipes with cement mortar joints, pipes should be tested three days after the cement mortar joints have been made. If is necessary that the pipelines are filled with water for about a week before commencing the application of pressure to allow for the absorption by the pipe wall.



The sewers are tested by plugging the upper end with a provision for an air outlet pipe with stop cock. The water is filled through a funnel connected at the lower end provided with a plug. Afterwards the air is expelled out, stop cock is closed and the water level in the funnel is raised to 2.5 m above the invert at the upper end. The water level in the funnel is noted after 30 minutes and the quantity of water required to restore the original water level in the funnel is determined.

The pipeline under pressure is then inspected while the funnel is still in position. There should not be any leaks in the pipe or the joints (small sweating on the pipe surface is permitted). Water shall not exceed 15 ml in the smaller dia. and 60 ml in the larger dia. of 100 mm. Any sewer or part there of that does not meet the test shall be emptied and repaired or re-laid as required and tested again.

The leakage or quantity of water to be supplied to maintain the test pressure during the period of 10 minutes shall not exceed 0.2 litres per mm diameter of pipes per kilometre length per day. For non-pressure pipes it is better to observe the leakage for a period of 24 hours if feasible. Exfiltration test for detection of leakage should be carried out at a time when the groundwater table is low.



For concrete, R.C.C., and asbestos cement pipes of more than 600 mm diameter the quantity of water inflow can be increased by 10% for each additional 100 mm of pipe diameter. For brick sewers regardless of their diameter the permissible leakage of water should not exceed 10 m<sup>3</sup> for 24 hours per kilometre length of sewer.

### STEPS FOR THE WATER LEAK TEST

**1st Step:** Connect the air Discharge adapter with the Pipe Test Plug.

**2nd step:** Place the Pipe Plug and the Pipe Test Plug, which is connected with the air discharge adapter, in the pipeline that should be tested

**3rd step:** Fill the water through the Bypass connection, and discharge the air by using the ADA (Air Discharge Adaptor); This air discharge adaptor has two ends, the first one is connected with the pipe plug and through it the compressed air is released. The second end provides connection with the water pipe, so that the water lines will be filled.

**4th step:** After receiving continuous flow water from the end of Air Discharge Adaptor the water hose can be connected to the manual pressure test pump. If you will make water leak test by using Water Hose.

**5th step:** Make sure that  $X$ ; the pressure created by the manual pressure test pump. plus,  $H/10$ ; the static pressure divided by 10, should be 0,5 bar;  $X+H/10=0,5$  bar.

**6th step:** Remove the manual pressure test pump and connect the pressure gauge to monitor the pressure drops. As per codes wait 30minutes to check if the test pressure is 0,5bar. If it is the case, the test is considered as successfully completed.

### Activity 7.3: Perform Leakage Detection Test by water.

The teacher/ instructor is required to demonstrate the leakage detection of sewer line by water test. Students are required to perform the same test.

### What I have learnt

- The leakage in the pipe joints or at any other points is tested by water test, smoke test, or air test.

- Sewer Test is carried out after giving sufficient time for the joints to set. In case of concrete and stoneware pipes with cement mortar joints, pipes should be tested three days after the cement mortar joints have been made.
- Pipelines are filled with water for about a week before commencing the application of pressure to allow for the absorption by the pipe wall.
- Smoke test for sanitary pipes can be done by use of Smoke Candles, Smoke Blowers, pipe plugs, pipe test plugs & Smoke Fluid for eliminating countless faults
- Sewer smoke testing is the most cost-effective method to find sources of surface water inflow & infiltration - the leading cause of wet weather SSO's.
- **Smoke Candles** quickly and efficiently produce a dense white smoke ideal for sewer smoke testing.
- Personal protective Equipments are necessary to prevent from accident of any type, safety from gases, noise and dust pollutions.
- Smoke Blowers are engineered to maximize dry smoke output, eliminating the wet smoke and mess typical of other liquid smoke systems.
- Smoke Fluid Systems use micro-control flow valves, custom-machined stainless steel injector nozzles, and custom-welded insulated heating chambers to generate the maximum volume of dry smoke.
- Smoke test is also carried out for drainage pipes located in buildings.
- In water test, make sure that  $X$ ; the pressure created by the manual pressure test pump, plus  $H/10$ ; the static pressure divided by 10, should be 0.5 bar;  $X+H/10=0.5$  bar.

## EXERCISE

### Q-1. Tick ( ✓ ) the correct option of the following MCQs.

- i- The leakage in the pipe joints or at any other points is tested by:
 

(A) water test	(B) smoke test
(C) air test	(D) all of these
- ii- In case of concrete and stoneware pipes with cement mortar joints, pipes should be tested after how much days of jointing for water test.
 

(A) 2 days	(B) 3 days
(C) 4 days	(D) 5 days
- iii- For absorption of water by wall, how much days before testing for water test, pipes should be filled with water.
 

(A) 5 days	(B) 6 days
(C) 7 days	(D) 8 days
- iv- Pipe plugs are used for this type of test.
 

(A) air test	(B) water test
(C) smoke test	(D) all of these
- v- Smoke testing of sewer is carried out for:
 

(A) water inflow	(B) infiltration
(C) leakage detection	(D) all of these

- vi- Smoke produced by smoke candles is of this colour:  
(A) White (B) yellow  
(C) red (D) green
- vii- This method of pipe testing is cost effective:  
(A) water test (B) air test  
(C) smoke test (D) all of these
- viii- This pipe testing system use micro-control flow valves:  
(A) smoke candle (B) water test  
(C) smoke blower (D) smoke fluid
- ix- The sum of pressure created by manual pressure test and static pressure in water test should be:  
(A) 0.4 bar (B) 0.5 bar  
(C) 0.6 bar (D) 0.7 bar
- x- PPEs are necessary for:  
(A) safety from gases (B) prevention from accident  
(C) safety from noise (D) all of these

**Give short answer to the following questions.**

- i- Why sanitary pipes' testing is performed?  
ii- What is the use of smoke candle?  
iii- What is the difference between pipe plug and pipe test plug?  
iv- What is a hose pipe?  
v- What are the uses of smoke blowers?  
vi- What is the function of smoke fluid?  
vii- What is the principle of water test?  
viii- SSOs stands for?  
ix- Why pipes jointed with cement mortar are tested late the jointing solution?  
x- How smoke fluids generate maximum dry smoke?

**Answer the following questions in detail.**

- i- Why water test is carried out. State steps for the water leak test.  
ii- Write the note on the followings?  
A- Smoke fluid B- Smoke Candle  
C- pipe plugs D- Use of gauges  
iii- Write the procedure of conducting smoke test for sewers.  
iv- Describe the initiative preparatory activities for testing of pipes.

## CHAPTER -08

# ENTREPRENEURSHIP



**After studying this unit, you will be able to:**

- define entrepreneurship
- know key concepts of entrepreneurship.
- understand main component of entrepreneurship.
- know how to identify business opportunity.
- know how to develop feasibility and business plan.
- prepare a business plan.
- learn about concept of marketing and marketing mix
- understand 6P's of marketing
- calculate costing and pricing

## 8.1: Introduction to Entrepreneurship

### 8.1.1- Entrepreneurship

The word 'entrepreneur' is derived from French word 'Entreprendre' which was used to designate an organizer of musical or other entertainments.

Later in 16th century it was used for army leaders. It was extended to cover civil engineering activities such as construction in 17th century. But it was Richard Cantillon, an Irishman living in France who first used the term entrepreneur to refer to economic activities.

According to Cantillon

“An entrepreneur is a person who buys factor services at certain prices with a view to selling its product at uncertain prices”.

Entrepreneur, according to Cantillon, an entrepreneur is a bearer of risk, which is non-insurable. Schumpeter gave a central position to the entrepreneur who believed that an entrepreneur was a dynamic agent of change; that an entrepreneur was a catalyst who transformed increasingly physical, natural and human resources into correspondingly production possibilities. Since then, the term entrepreneur is used in various ways and various views.

UNDP (2010) defined entrepreneurship as the process of using private initiative to transform a business concept into a new venture or to grow and diversify an existing venture or enterprise with high growth potential.

Entrepreneurs identify an innovation to seize an opportunity, mobilize money and management skills, and take calculated risks to open markets for new products, processes and services. It is observed that entrepreneurship is a derivative word from entrepreneur.

### 8.1.2- Concept of entrepreneurship

Entrepreneurship is an elusive concept. The concept of entrepreneurship has been a subject of much debate and is defined differently by different authors. Some of them view it as 'risk-bearing'; others call it as 'innovations', yet others consider it as 'thrill seeking'.

In a conference of entrepreneurship held in USA, it is defined, as

“Entrepreneurship is the attempt to create value through recognition of business opportunity, the management of risk taking appropriate to the opportunity and through the communicative and management skills to mobilize human, financial and material resources necessary to bring a project to fruition”.

A.H. Cole has defined entrepreneurship as

“The purposeful activity of an individual or group of associated individuals, undertaken to initiate, maintain or earn profit by production and distribution of economic goods and services”.

According to Heggins,

“Entrepreneurship is meant the function of seeking investment and production opportunity, organizing an enterprise to undertake a new production process, raising capital, hiring labour, arranging the supply of raw materials and selecting top managers of day-to-day operations”.

According to Joseph A Schumpeter,

“Entrepreneurship is essentially a creative activity. It consists of doing such things as are not generally done in ordinary course of business. An entrepreneur is one who innovates i.e., carries out new business”.

### **Basic Elements of Entrepreneurship**

#### **i- Innovation**

Innovation is doing something new or something different. Entrepreneurs constantly look out to do something different and unique to meet the changing requirements of the customers. Entrepreneurs need not be inventors of new products or new methods of production or service, but may possess the ability of making use of the inventions for their enterprises.

For example, in order to satisfy the changing needs of the customers, now-a-days fruit juice (mango, fruits etc.) in being served in tins, instead of bottles so that customers can carry it and throw away the containers after drinking the juice.

Hence entrepreneurship needs to apply inventions on a continuous basis to meet customers changing demands for products.

#### **ii- Risk bearing**

Giving birth to a new enterprise involves risk. Doing something new and different is also risky. The enterprise may earn profit or incur loss, which depends on various factors like changing customer preferences, increased competition, shortage or raw materials etc. An entrepreneur needs to be bold enough to assume the risk involved and hence an entrepreneur is a risk-bearer not risk-avoider. This risk-bearing ability keeps him to try on and on which ultimately makes him to succeed.

### **8.1.3- Main components of entrepreneurship**

While John Kunkel considered entrepreneurship as a function of social, political and economic structure, Max Weber treated it as a function of religious beliefs. The concept of entrepreneurship involves four key elements.

They are:

1. Organizing
2. Risk-bearing
3. Vision and
4. Innovating.

These four elements are interrelated and form a continuous process in business.

#### **1. Organizing**

Organizing involves mobilization of resources and utilization of them to initiate, maintain or enhance profit by the production or supply of goods or services. Entrepreneurs also mobilize other factors of production such as land, labour and capital.

#### **2. Risk-Bearing**

Starting a new enterprise always involves risk. The enterprise may earn profit or incur loss. The entrepreneurs should be bold enough to assume this risk.

### 3. Vision

Entrepreneurial vision encompasses the relentless pursuit of operational excellence, innovative technology and responsiveness to the needs of the market.

### 4. Innovation:

Innovation refers to introduction of something new in the economy, ex. a new product or a new method of production. According to Schumpeter, economic development can take place only through creative innovations and changes. The innovations may be related to new products, new technology, and new sources of raw material, new market or new organization.

To sum up, entrepreneurship is the practical ability to create and build up something new from nothingness. It is fundamentally an act of human creativity. The act of merely observing, analysing or interpreting a process is not entrepreneurship.

### Activity-8.1 Entrepreneur from hospitality

The teacher/ instructor is required to arrange an entrepreneur from hospitality sector for having a meeting with students.

## 8.2 Feasibility and Business Plan

### 8.2.1- Business opportunity

In general sense, the term opportunity implies a good chance or a favourable situation to do something offered by circumstances. In the same vein, business opportunity means a good or favourable change available to run a specific business in a given environment at a given point of time.

The term 'opportunity' also covers a product or project. Hence, the identification of an opportunity or a product or project is identical and, therefore, all these three terms are used as synonyms.

Opportunity identification and selection are like corner stones of business enterprise. Better the former, better is the latter. In a sense, identification and selection of a suitable business opportunity serves as the trite saying 'well begun is half done.' But it is like better said than done. Why? Because if we ask any intending entrepreneur what project or product he will select and start as an enterprise, the obvious answer he would give is one that having a good market and is profitable.

To mention the important ones, the entrepreneurs selected their products or projects based on:

- a. Their own or partners' past experience in that business line;
- b. The Government's promotional schemes and facilities offered to run some specific business enterprises;
- c. The high profitability of products;
- d. Which indicate increasing demand for them in the market?
- e. The availability of inputs like raw materials, labour, etc. at cheaper rates;
- f. The expansion or diversification plans of their own or any other ongoing business known to them;
- g. The products reserved for small-scale units or certain locations.

Now, having gained some idea on how the existing entrepreneurs selected products/projects, the intending entrepreneur can find a way out of the tangle of which opportunity/product/project to select to finally pursue as one's business enterprise.

**Idea Generation:****Sources of Ideas:**

The ideas about opportunities or products that the entrepreneur can consider for selecting the most promising one to be pursued by him/her as an enterprise, can be generated or discovered from various sources- both internal and external.

These may include:

- i. Knowledge of potential customer needs,
- ii. Watching emerging trends in demands for certain products,
- iii. Going through certain professional magazines catering to specific interests like electronics, computers, etc.,
- iv. Success stories of known entrepreneurs or friends or relatives,
- v. Making visits to trade fairs and exhibitions displaying new products and services,
- vi. Meeting with the Government agencies,
- vii. Ideas given by the knowledgeable persons,
- viii. A new product introduced by the competitor, and

In nutshell, a prospective entrepreneur can get ideas for establishing his/ her enterprise from various sources. These may include consumers, existing products and services presently on offer, distribution channels, the government officials, and research and development.

**i. Consumers:**

No business enterprise can be thought of without consumers. Consumers demand for products and services to satisfy their wants. Also, consumers' wants in terms of preferences, tastes and liking keep on changing. Hence, an entrepreneur needs to know what the consumers actually want so that he/she can offer the product or service accordingly.

**ii. Existing Products and Services:**

One way to have an enterprise idea may be to monitor the existing products and services already available in the market and make a competitive analysis of them to identify their shortcomings and then, based on it, decide what and how a better product and service can be offered to the consumers. Many enterprises are established mainly to offer better products and services over the existing ones.

**iii. Distribution Channels:**

Distribution channels called, market intermediaries, also serves as a very effective source for new ideas for entrepreneurs. The reason is that they ultimately deal with the ultimate consumers and, hence, better known the consumers' wants.

**iv. Government:**

At times, the Government can also be a source of new product ideas in various ways. For example, government from time-to-time issues regulations on product production and

consumption. Many a times, these regulations become excellent sources for new ideas for enterprise formation.

**v. Research and Development:**

The last but no means the least source of new ideas is research and development (R&D) activity. R&D can be carried out in-house or outside the organization. R&D activity suggests what and how a new or modified product can be produced to meet the customers' requirements.

**Methods of Generating Ideas:**

**Focus Groups:**

A group called 'focus group' consisting of 6-12 members belonging to various socio-economic backgrounds are formed to focus on some particular matter like new product idea. The focus group is facilitated by a moderator to have an open in-depth discussion. The mode of the discussion of the group can be in either a directive or a non-directive manner.

The comment from other members is supplied with an objective to stimulate group discussion and conceptualize and develop new product idea to meet the market requirement. While focusing on particular matter, the focus group not only generates new ideas, but screens the ideas also to come up with the most excellent idea to be pursued as a venture.

**Brainstorming:**

Brainstorming technique was originally adopted by Alex Osborn in 1938 in an American Company for encouraging creative thinking in groups of six to eight people. According to Osborn, brainstorming means using the brain to storm the issue/problem. Brainstorming ultimately boils down to generate a number of ideas to be considered for the dealing with the issue/problem.

However, brainstorming exercise to be effective needs to follow a modus operandi involving four basic guidelines:

- i. Generate as many ideas as possible.
- ii. Be creative, freewheeling, and imaginative.
- iii. Build upon piggyback, extend, or combine earlier ideas.
- iv. Withhold criticism of others' ideas.

**Following are some illustrative sources of generation of business ideas:**

- a. Realizing that especially service class people find it inconvenient to take milk pot with them to office that they need to buy milk while coming back from the office in the evening, to provide milk in sachets or tetra packs could be a new business idea.
- b. Having faced difficulty in finding out accommodation and transport facility while on visits to a new/tourist place may give one an idea to start a travel agency providing complete package of facilities to the visitors to a new / tourist place.
- c. Knowing that many people have hobby or even develop passion for gardening may give rise to an idea of setting up one's own nursery.
- d. Recognizing the increasing application of computers in offices as well as business organizations, irrespective of its size, may give an idea to set-up a computer-training centre.

Once ideas have been generated following the above process, the next step comes is identification of above generated ideas as opportunities.

### **Opportunity/Product Identification:**

After going through above process, one might have been able to generate some ideas that can be considered to be pursued as one's business enterprise.

### **Activity-8.2 Development of small business model**

The teacher/ instructor is required to demonstrate the students about developing a small business model.

### **8.2.2- Development of Feasibility:**

A feasibility study aims to objectively and rationally uncover the strengths and weaknesses of an existing business or proposed venture, opportunities and threats present in the environment, the resources required to carry through, and ultimately the prospects for success. In its simplest terms, the two criteria to judge feasibility are cost required and value to be attained.

Feasibility is an analysis and evaluation of a proposed project to determine if it is:

- a. Technically feasible
- b. Feasible within the estimated cost
- c. Profitable.

### **Objectives of Feasibility Analysis:**

Businesses undertake feasibility studies to determine if a proposed strategic action is operationally viable and will produce the desired results. The studies enable company leaders to understand both positive and negative impacts before making a change.

### **The main objectives of carrying out a feasibility analysis are:**

- i. To determine the outcome of the proposed action.
- ii. To ascertain whether it will work as anticipated and generate the projected revenue or anticipated cost savings.
- iii. To identify the customers in the current and potential market
- iv. To learn more about customers' current and future needs,
- v. To gauge interest of the customer in the product or service that is being offered.
- vi. To determine whether the primary customers will need the new product or service and how much they can and will pay.
- vii. To determine if the product will be satisfactory.
- viii. To ascertain company's strengths, weaknesses and position in the marketplace
- ix. To determine the financial benefits of the action vs. its costs.
- x. To gauge the competitor's strengths and weakness and take corrective actions while carrying out the feasibility analysis.

### **Four Tests for Feasibility:**

- a. Operational feasibility is a measure of how well the solution will fit in the organization. It is also a measure of how people feel about the system/project.

- b. Technical feasibility is a measure of the practicality of a specific technical solution and the availability of technical resources and expertise.
- c. Schedule feasibility is a measure of how reasonable the project timetable is.
- d. Economic feasibility is a measure of the cost effectiveness of a project or solution.

### **Contents of a Feasibility Report:**

The content of sample feasibility report is formatted and structured according to a range of requirements which may vary from organization to organization but there are common suggestions, which are listed below.

#### **i. Title Page or Front Matter:**

To begin with writing a sample feasibility report, first you need to create a title page that provides a descriptive yet concise title, containing the name of the writer, email, job position, and also the organization for which you are writing the report.

Next, you must include an itemized list of contents that provides headings and sub-headings sequenced the same way as they are structured in the report body. Also add a list of all material such as tables, figures, illustrations, annexes etc. which have been used within the document.

Keep in mind that the title page should not be numbered and that no more than 4-5 pages should be dedicated to the front matter.

#### **ii. Body of the Report:**

There are many different styles and requirements for formatting the body of feasibility study report, it may be difficult to select right format. However, there are several common suggestions which are as follows:

- a. Each page of the report body needs to include a descriptive header with an abbreviated title for the report, the author's name and page number
- b. Structure the report by headings and sub-headings and indicate this structure within the document content
- c. Make sure headings are properly formatted (i.e., flush left, indented, etc.) on each page
- d. Use the same style for headings throughout the entire report template
- a. e. Never use too larger or too small font (font should have a professional look)
- b. Use the same citation style (e.g., CBE, APA, etc.) for formatting sources used in your feasibility study.

#### **iii. Sections of the Report:**

The following list provides an outline of the key sections to be included in report content:

- a. **Executive Summary** – A description of the problem/opportunity highlighted in the study, the purpose of the report, and the importance of the research for your target audience
- b. **Background** – A more detailed description of the feasibility study, who it was carried out, and whether it was implemented elsewhere
- c. **Analysis** – An examination and evaluation method employed in the conducting your feasibility study

- d. **Alternatives and Options** – An overview of any alternative proposals or options and their features in comparison to the main proposal of the study
- e. **Cost-Benefit Evaluation** – A rigorous analysis method that was implemented to examine and evaluate the main proposal for cost-benefit effectiveness and to demonstrate the tech feasibility, economic practicality, social desirability, and eco soundness of the proposal.
- f. **Conclusion** – A summary of the work done and your own conclusions regarding your analysis
- g. **Recommendations & Suggestions** – A series of recommendations practices and follow-up actions based on your conclusions

**iv. Back or End Matter/Last Page:**

One last thing you need to consider when writing your feasibility study report is that the report should include a Reference page that lists all reference material such as articles, books, web pages, periodicals, reports, etc. cited in your document. This page should be styled appropriately. Additionally, you can create an Appendix page that provides detailed discussions of all criteria used in analysing feasibility and examples of each criterion. This page should also be styled appropriately.

### **8.2.3- Business Plan**

In simple words, business plan is a written statement of what an entrepreneur proposes to take up. It is a course of action what the entrepreneur hopes to achieve in his business and how is he going to achieve it. In other words, business plan serves like a kind of big road map to reach the destination determined by the entrepreneur.

Webster New 20th Century Dictionary defines a project as a scheme, design, a proposal of something intended or devised. Let some important definitions of business plan be presented.

Mar J. Dollinger has defined the business plan as

“The formal written expression of the entrepreneurial vision, describing the strategy and operations of the proposed venture.”

According to Jack M. Kaplan,

“The term business plan means the development of a written document that spells out like a roadmap where you are, where you want to be, and how you want to get there.”

Thus, a business plan or project report can best be defined as a well evolved course of action devised to achieve the specified objective, i.e., setting up a small business enterprise within a specified period of time. So, to say, business plan is initially an operating document.

The business plan is termed by different names by its different intended interest audience. For example, when presented to a bank, it may be called ‘loan proposal.’ a venture capital group might call it the ‘venture plan’ or ‘investment prospects’ and a common man may term it ‘project report.’ Let it be called by any name, its basic purpose is the same, i.e. to serve as a road-map in setting up a business enterprise.

#### **Significance of Business Plan:**

Arguments are made for and against writing a business plan. The argument advanced against writing business plan is that it involves costs especially when some outside consultant or

accountant or lawyer is hired to write the business plan. One of the reasons for not writing business plan is the fear of prematurely closing off the new venture.

The major argument made in favour of writing business plan is reducing tensions in running business enterprise. Writing business plan is especially useful for the entrepreneurs who require financial help from the outside sources like banks and financial institutions.

The business plan serves the two essential functions:

First and most important the business plan is like a road map. It describes the direction the enterprise is going in, what its goals are, where it wants to be, and how it is going to get there. It also enables an entrepreneur to know that he is proceeding in the right direction. Some hold the view that without well spelled out goals and operational methods/tactics, most businesses flounder on the rocks of hard times.

The second function of the business plan is to attract lenders and investors. Although, it is not mandatory for the small enterprises to prepare business plans, yet it is useful and beneficial for them to prepare the project reports for various reasons. The preparation of business plan is beneficial for those small enterprises which apply for financial assistance from the financial institutions and the commercial banks. It is on the basis of business plan or project report that the financial institutions make appraisal if the enterprise requires financial assistance or not.

The fact of the matter is that in today's highly uncertain and competitive business environment, only the most reluctant entrepreneur with the simplest business concept avoids writing a business plan. The very significance of business plan can be expressed as "if an entrepreneur fails to write business plan, he plans to fail in his/her business."

### Activity-8.3 Designing a business plan

The teacher/ instructor is required to demonstrate the students about designing a business plan keeping in view the skills of students.

## 8.3: Concept of marketing and marketing mix

### 8.3.1- Concept of marketing and marketing mix

A set up where two or more parties engage in exchange of goods, services and information is called a market. Ideally a market is a place where two or more parties are involved in buying and selling.

The two parties involved in a transaction are called seller and buyer. The seller sells goods and services to the buyer in exchange of money. There has to be more than one buyer and seller for the market to be competitive.

### Types of Markets

1. **Physical Markets** – Physical market is a set up where buyers can physically meet the sellers and purchases the desired merchandise from them in exchange of money. Shopping malls, department stores, retail stores are examples of physical markets.

2. **Non-Physical Markets/Virtual markets** - In such markets, buyers purchase goods and services through internet. In such a market the buyers and sellers do not meet or interact physically, instead the transaction is done through internet.
3. **Auction Market** - In an auction market the seller sells his goods to one who is the highest bidder.
4. **Market for Intermediate Goods** - Such markets sell raw materials (goods) required for the final production of other goods.
5. **Black Market** - A black market is a setup where illegal goods like drugs and weapons are sold.
6. **Knowledge Market** - Knowledge market is a setup which deals in the exchange of information and knowledge-based products.
7. **Financial Market** - Market dealing with the exchange of liquid assets (money) is called a financial market.

### Marketing Mix - Meaning and its Elements

Neil Borden in the year 1953 introduced the term Marketing mix, an extension of the work done by one of his associates James Culliton in 1948.

Marketing Mix - A mixture of several ideas and plans followed by a marketing representative to promote a particular product or brand is called marketing mix. Several concepts and ideas combined together to formulate final strategies helpful in making a brand popular amongst the masses form marketing mix.

#### 8.3.2- 7-P's of marketing:

The first four elements in the services marketing mix are the same as those in the traditional marketing mix. However, given the unique nature of services, the implications of these are slightly different in case of services.



**1. Product:**

In case of services, the 'product' is intangible, heterogeneous and perishable. Moreover, its production and consumption are inseparable. Decisions relating to the product include product designing, packaging and labeling, and varieties of the product.

**2. Pricing:**

Pricing of services is tougher than pricing of goods. While the latter can be priced easily by taking into account the raw material costs, in case of services attendant costs - such as labour and overhead costs - also need to be factored in. Thus, a restaurant not only has to charge for the cost of the food served but also has to calculate a price for the ambience provided. The final price for the service is then arrived at by including a markup for an adequate profit margin.

**3. Place:**

The third important element is place, which refers to decision regarding the market where products will be offered for sale.

**4. Promotion:**

Promotion involves decisions bearing on the ways and means of increasing sales. Different tools or methods may be adopted for this purpose. The relative importance to be attached to the various methods is decided while concentrating on the element of promotion in marketing mix.

**5. People:**

People are a defining factor in a service delivery process, since a service is inseparable from the person providing it. Thus, a restaurant is known as much for its food as for the service provided by its staff. The same is true of banks and department stores. Consequently, customer service training for staff has become a top priority for many organizations today.

**6. Process:**

The process of service delivery is crucial since it ensures that the same standard of service is repeatedly delivered to the customers. Therefore, most companies have a service blue print which provides the details of the service delivery process, often going down to even defining the service script and the greeting phrases to be used by the service staff.

**7. Physical Evidence:**

Since services are intangible in nature most service providers strive to incorporate certain tangible elements into their offering to enhance customer experience. Thus, there are hair salons that have well designed waiting areas often with magazines and plush sofas for patrons to read and relax while they await their turn.

**8.3.3- Costing and pricing**

Price goes by various names-freight, fare, license fee, tuition fee, professional charge, rent, interest, etc. But price in an enterprise/business system is seldom so simple. By definition, price is the money that customers must pay for a product or service. In other words, price is an offer to sell for a certain amount of currency.

Here, the word, offer indicates that price is subject to change if there are found insufficient number of customers at the original price of the product. That is why prices are always on trial. If

they are found to be wrong, either they must be immediately changed or the product itself must be withdrawn from the market.

Pricing of the product is something different from its price. In simple words, pricing is the art of translating into quantitative terms the value of a product to customers at a point of time. Someone has opined that, “The key to pricing is to build value into the product and price it accordingly.”

Pricing is one of the key elements of marketing mix.

**The salient ingredients of pricing are:**

- i. Pricing covers all marketing aspects like the item-goods or services-mode of payment, methods of distribution, currency used, etc.
- ii. Pricing may carry with it certain benefits to the customers like guarantee, free delivery, installation, free after-sale servicing and so on.
- iii. Pricing refers to different prices of a product for different customers and different prices for the same customer at different times.

Price stands for the amount of money customer have to pay to obtain the product. Price is the exchange value of the product. It revolves around two elements – utility and value.

Utility is the generic property to satisfy a need or want of a consumer. Value is the quantitative worth the consumer attaches to the product.

**Pricing Objectives:**

1. Profit maximization in the short term.
2. Profit optimization in the long term.
3. Maximum return on investment.
4. Maximum return on sales turnover.
5. Target market share.
6. Entering new markets.
7. Keeping parity with competitors.

### **Activity-8.4 Development of marketing strategy**

The teacher/ instructor is required to demonstrate the students about developing a marketing strategy for the business model already developed.

### **What I have learnt**

- The word ‘entrepreneur’ is derived from French word ‘Entreprendre’ which was used to designate an organizer of musical or other entertainments.
- According to Cantillon, “An entrepreneur is a person who buys factor services at certain prices with a view to selling its product at uncertain prices”.
- According to Mc Clelland, there are two characteristics of entrepreneur:
  - i. First is doing a thing in a new and better way,
  - ii. Second is decision making under uncertainty.

- Innovation is doing something new or something different. Entrepreneurs constantly look out to do something different and unique to meet the changing requirements of the customers.
- Giving birth to a new enterprise involves risk. An entrepreneur needs to be bold enough to assume the risk involved and hence an entrepreneur is a risk-bearer not risk-avoider.
- The concept of entrepreneurship involves four key elements. They are: Organizing, Risk-bearing, Vision and Innovating. These four elements are interrelated and form a continuous process in business.
- Business opportunity means a good or favourable change available to run a specific business in a given environment at a given point of time. The term 'opportunity' also covers a product or project. Hence, the identification of an opportunity or a product or project is identical and, therefore, all these three terms are used as synonyms.
- Brainstorming exercise to be effective needs to follow a modus operandi involving four basic guidelines:
  - i. Generate as many ideas as possible.
  - ii. Be creative, freewheeling, and imaginative.
  - iii. Build upon piggyback, extend, or combine earlier ideas.
  - iv. Withhold criticism of others' ideas.
- Feasibility is an analysis and evaluation of a proposed project to determine if it is technically feasible, Feasible within the estimated cost, and profitable.
- In simple words, business plan is a written statement of what an entrepreneur proposes to take up. It is a course of action what the entrepreneur hopes to achieve in his business and how is he going to achieve it. In other words, business plan serves like a kind of big road map to reach the destination determined by the entrepreneur.
- A set up where two or more parties engage in exchange of goods, services and information is called a market. Ideally a market is a place where two or more parties are involved in buying and selling.
- A mixture of several ideas and plans followed by a marketing representative to promote a particular product or brand is called marketing mix.
- The elements of marketing mix are often called the four P's of marketing, which are product, price, place and promotion.
- Goods manufactured by organizations for the end-users are called products. Products can be of two types - Tangible Product and Intangible Product (Services)
- The money which a buyer pays for a product is called as price of the product.
- Place refers to the location where the products are available and can be sold or purchased. Buyers can purchase products either from physical markets or from virtual markets.
- Promotion refers to the various strategies and ideas implemented by the marketers to make the end - users aware of their brand. Promotion includes various techniques employed to promote and make a brand popular amongst the masses.

## EXERCISE

**Q-1. Tick (✓) the correct option for the following MCQs.**

- i- The concept of 'entrepreneur' was first coined by.....
- (A) David, McClenand (B) Richard, Cantillon  
(C) David, Hisrich (D) Jean-Baptiste, Say
- ii- The one who creates a new enterprise in a risky and uncertain environment is referred to as a (an).....
- (A) Risk taker (B) Entrepreneur  
(C) Adventurist (D) Leader
- iii- The two disciplines where entrepreneurship originated were ..... / .....
- (A) French / English (B) Economics / History  
(C) Economics / Business (D) History / French
- iv- Which of the following is the final step of a comprehensive feasibility analysis?
- (A) Market research (B) Filing articles of association  
(C) Financial feasibility analysis (D) Market feasibility analysis
- v- A \_\_\_\_\_ is a document that thoroughly explains a business idea and how it will be carried out.
- (A) Marketing plan (B) Business plan  
(C) Promotion plan (D) Financial analysis
- vi- The \_\_\_\_\_ section of the business plan should be written last.
- (A) Financial statements (B) Appendices  
(C) Executive summary (D) Contact information
- vii- Marketing mix is suggested by\_\_\_\_\_.
- (A) Philip Kotler (B) Neil Borden  
(C) Peter Drucker (D) Neil Armstrong
- viii- Which of the following marketing mix activity is most closely associated with newsletters, catalogues and invitations to organization-sponsored events?
- (A) Pricing (B) Distribution  
(C) Promotion (D) Product

Advertising, Publicity, Personal selling, Sales promotion, these are also termed as four elements of a \_\_\_\_\_.

- (A) Promotion Mix (B) Marketing Mix  
(C) Place Mix (D) Sales Mix

ix- To which tool of marketing mix does 'Brand Name' relate?

- (A) Price (B) Promotion  
(C) Place (D) Product

**Give Short answer to the following questions.**

- i- Define entrepreneurship
- ii- Identify two basic elements of entrepreneurship.
- iii- Write down four key elements of entrepreneurship.
- iv- Define business opportunity.
- v- What is objective of feasibility analysis?
- vi- Define business plan.
- vii- Define promotion mix.
- viii- Enlist pricing objectives.

**Answer the following questions in detail.**

- i- Briefly explain different methods of gathering business ideas.
- ii- Explain 7 P's of marketing.
- iii- Briefly explain the contents of feasibility report.

## GLOSSARY

### **Anti-siphonage Pipe**

Anti- Siphonage pipe- A pipe which is installed for the purpose of preserving the water seal of traps in drainage system is called anti siphonage pipe

### **Asbestos Cement Pipe**

The asbestos pipe is made from asbestos, silica, and cement converted under pressure to a dense, homogeneous material possessing considerable strength.

### **Asbestos Cement Sewer**

These are manufactured from a mixture of cement and asbestos fibres. These pipes are normally available in sizes from 5 cm to 90 cm in diameter and 4 in length. These pipes are suitable for domestic sanitary fittings.

### **Barb**

A barb is a fitting whose one end is fitted with pipe or other fitting or fixture and the other end is used to connect hose pipe (flexible plastic pipe).

### **Bath Tubs**

Bath tubs are the plumbing fixtures provided in the bath rooms for taking bath.

### **Branch Sewer**

The sewer which obtains its discharge from a few laterals and delivers it to the main sewer is termed as a branch or sub-main sewer.

### **Brazed Joint**

Brazing is the process of jointing pipes using molten filler material at above 840°C

### **Brick/ Masonary Sewer**

Bricks are used for constructing large size sewers. These sewers are plastered outside and lined inside with stoneware or ceramic blocks.

### **Bush**

Bush is a component of plumbing which is generally used to change pipe size. It has male and female threads.

### **Butt Welded Joint**

Joint having welding of pipes of same diameter butting with each other

### **C.B.R.I.**

Central Building of Research Institute Roorkee developed dual flushing cistern and automatic flushing cistern for urinals.

### **Cap**

Cap is a type of pipe fitting; function is same as plug but the only difference is plug contain male threads and cap contain female threads which is screws on the male thread of pipe

### **Cast Iron Pipes**

Cast iron pipe is made from pig iron. Such pipes are normally made from 5 cm to 120 cm in diameter.

### **Central water heaters**

Centralized water heaters are Storage water heater tank type. In building a central water is install to supply hot water in all components of building.

### **Centrifugal Pump**

Centrifugal pump is used to provide fresh water in tanks placed at higher level in a domestic plumbing system. It works on the principle of centrifugal force which forces water to move in discharge pipe.

### **China clay**

The most common and most economical **material** for domestic **fixtures** such as toilet bowls, urinals, and washbasins are vitreous China.

### **Class A GI Pipes - Light**

These are light gauge pipes which bear a yellow colour strip for identification. They are cheaper than other classes of GI Pipes.

### **Class B GI Pipes - Medium**

These are medium gauge pipes which bear a blue colour strip for identification. They are Costlier than Class A and Cheaper than class C.

### **Class C GI Pipes- Heavy**

These are heavy gauge pipes which bear a red colour strip for identification. They are Costlier than other classes of the GI Pipes.

### **Combined**

The sewer which carries sewage and stormwater is known as combined sewer

### **Compression coupling**

Compression coupling is regular coupling which is connected between two pipes and it prevents leakage by the arrangement of gaskets or rubber seals on both sides, otherwise glue is provided.

**Compression fittings-** these fittings have threaded socket with gasket to have water tight joint. Waste pipe of sink is generally compression type.

### **Compression Joint**

When the pipes have plain ends, they are joined by installing some fittings at their ends then that type of joint is called compression joint.

### **Concrete Pipes**

Pipes manufactured from concrete are called concrete. These are pre-casted of PCC, RCC or PSC.

### **Coupling**

A coupling is used to connect the pipes of same diameter.

### **Cross over, Check nut**

A cross over is a fitting to cross a line without intersection. Check nut is used to tighten tank nipple or other fittings.

### **Depressed Sewer**

When an obstruction is met, the sewer is constructed lower than the adjacent sections to overcome the obstruction. Such a section of the sewer is termed as a depressed sewer.

### **Elbow**

The fitting used to change the direction sharply is called elbow

### **Electric shower heads**

An electric shower head has an electric heating element which heats water as it passes through. These self-heating shower heads are specialized point-of-use (POU) tankless water heaters, and are widely used in some countries.

### **Faucets**

Water discharging taps with one spout for both cold and hot water. These are of 03 types- Centre-set type, Spread fit types and Single hole type

### **Female Fitting**

A fitting is called a female fitting if the threads on fitting are on inside. Examples are normal sockets, elbow, union, tee etc.

**Fixture**

A receptacle or device that is connected to a water supply system or discharges to a drainage system or both is called fixture.

**Flange**

A pipe flange is a circular disc-shaped piping component that attaches to a pipe for blocking or connecting other components like valves, nozzles, special items, etc.

**Flanged fitting-** these fittings have flanges and gasket is provided in between to have water tight joint.

**Flanged Joint**

Two flange components with gasket are connected by bolts at the pipe joint to prevent leakage.

**Flush Pipe**

Flush pipe- used to flush water from flushing cisterns.

**Flushing Cistern**

A water tank used to flush water into a water closet or urinals for disposal of wastes.

**Full Coupling**

Full Coupling is used for connecting small bore pipes. It used to connect pipe to pipe or pipe to swage or nipple. It can be threaded or socket ends types.

**Full Faced Gasket**

Full faced gaskets have bolt holes in them and cover a large part of the face of the flange.

**Gasket**

Gasket is sealing material placed between connecting flanges to create a static seal.

**Gasket Use**

Gasket and rubber rings/ seals are used for flanges, push fit, swivel and compression joint.

**Geyser**

A geyser is an water supply appliance to provide hot water.

**GI pipes**

GI pipes are galvanized iron pipes or called coated iron pipes in old terminology. Carbon Steel pipes immersed in a galvanic (zinc) bath.

**GP pipes**

GP Pipes are made of thin sheets of carbon steel electroplated with zinc and then rolled into pipes

### **Grooved Joint**

The pipe ends consist of grooved edges which are connected by elastomer seal and then ductile iron made grooved couplings are used as lock for elastomer seal.

### **Half Coupling**

Half Coupling is used for small bore branching from a vessel or large bore pipe. It can be threaded or socket type. It has a socket or thread end on only one side.

### **IBC Gasket**

Inner Bolt Circle gaskets known as ring-type or raised-faced joints, sit inside the bolts fastening the pipe flanges.

### **Installation of pipes**

The jointing of pipes is known as installation of pipes.

### **Intercepting Sewer**

The sewer which obtains the discharge from a number of main or outfall sewer and carries the same to the point of treatment and disposal is termed as intercepting sewer.

### **Lateral Sewer**

The sewer which obtains its discharge directly from buildings is known as a lateral sewer.

### **Main Sewer**

The sewer which obtains its discharge from a few branch or sub-main sewers is termed as the main sewer.

### **Male Fitting**

A fitting is called a male fitting if the threads on fitting are on outside. Examples are barrel nipple, hex nipple etc.

### **Mechanical Water Meter**

Mechanical water meter is device, the impeller are rotated when water passes through it. Water meter is calibrated to determine the flow rate based on impeller rotation.

### **Nipple**

A nipple is a straight fitting casted or made from pipe having male threads on both ends. Casted nipple is called barrel nipple and the nipple made from piece of pipe is pipe nipple.

### **Olets**

Olets are used where standard sizes of fittings are not suitable for our requirement.

### **Outfall Sewer**

The length of main or trunk sewer between the connection of the lowest branch and final point of disposal is termed as outfall sewer.

### **Overflow Sewer**

The sewer which carries the excess discharge from an existing sewer is known as relief or overflow sewer.

### **Permanent Coupling**

Permanent pipe couplings generally make use of soldering or brazing in the case of steel or copper pipes or adhesives in the case of PVC pipes.

### **Pipe Fittings**

The components which are used to join pipes are known as pipe fittings.

### **Plug**

Plug is a component of plumbing having male threads which is generally used to close pipe opening during inspections and repairs.

### **Plumbing Appliance**

The devices which perform specific functions in plumbing system are called plumbing appliances.

### **Point of use water heater**

Tiny *point-of-use* (POU) electric storage water heaters with capacities ranging from 8–32 L (2–6 gallons) are made for installation in kitchen and bath cabinets or on the wall above a sink. A similar wood-fired appliance was known as the chip heater.

### **Push fit fitting**

**Push fit Fitting-** These fitting have female socket end with gasket. Male end of pipe is pushed in for fitting.

### **PVC Pipe**

Polyvinyl Chloride (P. V. C.) pipes are joined using a thread joint or socket is joined with a solution.

### **PVC Sewer**

The plastic pipes are used for carrying industrial sewage and in domestic sanitary fittings. These are highly resistant to corrosion and light in weight. These pipes may be available in diameter varying from 5 cm to 15 cm and of longer length.

## **Rain Water Pipe**

Rainwater pipe- used to carry rain water from roofs to ground.

## **Reducer**

Reducer is a pipe fitting component which reduces the flow size from larger to smaller by reducing size of pipe.

## **Reducing Coupling**

Reducing couplings are typically used where small process feeder lines are joined into large supply circuits or where small diameter fittings are installed

## **Removable Coupling**

Removable pipe couplings are most often of a threaded design which allows them to be screwed onto the pipes to be joined.

## **Sanitary Appliance**

These appliances collect and remove waste matter. WC, urinal, bath, shower, washbasin, sink, bidet and drinking fountain. It also includes appliances those are not connected to a water supply (e.g., composting toilet) supply or drain (e.g., waterless urinal).

## **Sanitary Fittings**

Fittings which are used to join sanitary pipes, being used for conveyance of used/ waste water, are generally known as waste water sanitary fittings

## **Sanitary Plumbing system**

Sanitary plumbing system is a network of pipes to dispose-of used/ waste water. The pipes used to convey used water are known as sanitary pipes. The components which are used to join pipes with each other are known as sanitary fittings. Other components which provide specific service/ function are called appliances. Pipes are also connected with fixtures and appurtenances.

## **Scope of Fixtures**

These components of buildings are provided various types of buildings, i.e., houses, hostels, hotels, office buildings, hospitals, educational buildings, etc. In hotels and accommodations, we need, bathrooms, lavatory blocks, kitchen

## **Screwed Fitting**

**Screwed fitting-** These fittings have male and/or female threads

**Showers**

Showers are fundamentally a very simple appliance designed to contain water for a person or two and to drain spent water into the sewer system.

**Sinks**

Sinks are the plumbing fixtures provided in kitchens for cleaning utensils. These are also provided in laboratories for cleaning laboratory ware.

**Siphon Cistern**

The water in these is discharged by siphonic action, and the principal difference between the various kinds lies in the method of starting this action.

**Slip coupling**

Slip coupling is easier to install and it contains two pipes which are arranged as one into other, inner pipe can slide up to some length. So, we can fix long length damaged pipe by slip coupling

**Smoke Candles**

Smoke Candles quickly and efficiently produce a dense white smoke ideal for sewer smoke testing.

**Smoke Test**

Smoke test is carried out for drainage pipes located in buildings and underground.

**Socket**

A socket is a straight fitting which usually have female thread. Sockets also have male and female threads on different ends.

**Socket Welded Joint**

Pipes of different diameter are connected as putting one into other and welded around the joint.

**Soil Pipe**

Soil pipe- used to convey human excreta up to first intercepting chamber.

**Soil Sanitary Appliances**

Soil sanitary appliances are used for the reception and discharge of excretory matters. These have at least one trap with a water seal of not less than 50 mm before connecting to a separate sewer line. Examples are: WC, urinal and bidet.

**Solar water heaters**

The solar powered water heaters have solar collectors installed outside dwelling house

### **Soldered Joint**

Soldering is also similar to brazing but the only difference is in case of soldering the filler metal melts at below 840°C.

### **Solvent Melt fittings**

**Solvent Melt fittings-** these fittings have socket female ends and jointing solution is applied on outer side of pipe and inner side of fitting.

### **Stone Ware Sewer**

These pipes are manufactured from vitrified clay by moulding and burning. The diameter of these pipes varies from 10 to 90 cm. These pipes are joined by bell and spigot joint.

### **Storage water heaters**

These consist of a cylindrical vessel or container that keeps water continuously hot and ready to use.

### **Sullage Pipe**

Sullage pipe- carries water from bath, wash basin and kitchen.

### **Swivel fitting have**

**Swivel fitting-** these fittings have threaded swivel socket with gasket to have water tight joint.

### **Tankless water heater**

Tankless water heaters—also called *instantaneous, continuous flow, inline, flash, on-demand,* or *instant-on* water heaters—are gaining in popularity. These high-power water heaters instantly heat water as it flows through the device, and do not retain any water internally except for what is in the heat exchanger coil.

### **Threaded Joint**

Threaded joint means, pipes are connected by screwing with the help of threads provided for each pipe.

### **Trap**

Trap is a bend in the pipe where the waste goes out of the toilet or other fixtures. It retains some water after flushing causing a seal and preventing sewer gases from entering the building.

### **Trunk Sewer**

The sewer which obtains its discharge from two or more main sewers is known as trunk sewer.

### **Types of basins**

The different types of basins are pedestal type, corner type, recessed type, wall hung type and counter top type.

### **Types of sinks**

According to installation types, types of kitchen sinks are top mount type, under-mount type and flush mount type.

### **Union**

A union is a fitting which can be opened/ removed from pipe network when needed.

### **Urinals**

Urinals are the plumbing fixtures provided for the purpose of urinating.

### **Valve Cistern**

The simplest form of cistern contains a single valve operated by lever for opening.

### **Vent Pipe**

used for disposal of foul gases

### **Vent Shaft**

Vent shaft- used for disposal of foul gases at distant turning points.

### **Vitrified Clay Pipe**

The pipes made from clay are called vitrified clay pipes. Vitrified clay pipe is pipe made from a blend of clay and shale that has been subjected to high temperature (1100°C=2000°F) to achieve vitrification, which results in a hard, inert ceramic.

### **Wash Basins**

Wash basins are the plumbing fixtures provided for washing hands and face and brushing teeth in a standing position.

### **Waste Pipe**

Waste pipe- used to carry water of sink, basin, dishwasher to floor trap.

### **Waste Sanitary Appliances**

Waste sanitary appliances are used for the reception and discharge of water for cleaning or culinary purposes. Examples are: Sink, basin, bath and shower.

### **Water Closets**

A water closet is a pan like water flushed plumbing fixture designed to receive human excreta directly from the user.

**Water Filters**

Water filters are used to have germs and solid free potable.

**Water Heater Appliances**

The appliances which are used to heat water are called water heater appliances.

**Water Pumps**

Water pumps are used to supply water at elevated levels. The pumps are centrifugal type, reciprocating type. Also, pumps are Auto type having an attachment of pressure cylinder.

**Water Softener**

Water softeners can be salt-based using a method of ion-exchange to remove minerals from hard water while you can also find salt-free water conditioners.

**Water Supply Appliance**

The appliances which are related to water supply are called water supply appliances. water meter, hot water heater, etc.

## Answers to the Multiple-choice Questions

### Book-I, Grade X

#### Chapter No. 1

1	A	2	A	3	B	4	A	5	C
6	C	7	B	8	C	9	B	10	D

#### Chapter No. 2

1	C	2	C	3	B	4	C	5	D
6	C	7	A	8	C	9	A	10	C

#### Chapter No. 3

1	B	2	D	3	D	4	C	5	B
6	D	7	B	8	A	9	A	10	B

#### Chapter No. 4

1	C	2	B	3	C	4	D	5	C
6	B	7	C	8	D	9	A	10	C

#### Chapter No. 5

1	B	2	D	3	C	4	B	5	A
6	A	7	B	8	A	9	D	10	D

#### Chapter No. 6

1	A	2	D	3	B	4	B	5	D
6	A	7	D	8	D	9	C	10	B

#### Chapter No. 7

1	D	2	B	3	C	4	D	5	C
6	A	7	C	8	D	9	B	10	D

#### Chapter No. 8

1	B	2	B	3	C	4	C	5	B
6	C	7	B	8	C	9	A	10	B

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### Acknowledgements

Special thanks to Engr. Azhar Iqbal Shad (Ex-General Manager P-TEVTA) for his guidance and help to write this book.

# قومی ترانہ

پاک سر زمین شاد باد! کشورِ حسین شاد باد!  
تو نشانِ عزمِ عالی شان ارضِ پاکستان  
مرکزِ یقینِ شاد باد!

پاک سر زمین کا نظام قوتِ اخوتِ عوام  
قوم، ملک، سلطنت پائندہ تابندہ باد!  
شاد باد منزلِ مراد!

پرچمِ ستارہ و ہلال رہبرِ ترقی و کمال  
ترجمانِ ماضی، شانِ حال جانِ استقبال  
سایہ خدائے ذوالجلال!



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