Draft Study Material

PLUMBER GENERAL

(Qualification Pack: Ref. Id. PSC/Q0104)

Sector: Plumbing

(Grade XI)

PSS CENTRAL INSTITUTE OF VOCATIONAL EDUCATION
(a constituent unit of NCERT, under Ministry of Education, Government of India)
Shyamla Hills, Bhopal- 462 002, M.P., India
http://www.psscive.ac.in

Preface

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

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

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

Deepak Paliwal
(Joint Director)
PSSCIVE, Bhopal

Date: 20 June 2024

STUDY MATERIAL DEVELOPMENT COMMITTEE

Members

- Abhay Kumar Jha, *Head*, Civil Engineering Department, LNCTS, Bhopal
- Aslam Nadaf, *Vocational Instructor–Construction*, Govt. High School, Pernem, Goa
- Avinash Singh, Ex-Consultant, PSSCIVE Bhopal, Madhya Pradesh, India
- Hemant Wadikar, Lecturer, Building Maintenance, Swami Vivekanand Jr. College (HSC Vocational) Sindhi Society, Chembur, Mumbai-400071, Maharashtra, India
- Tapas Singh, Assistant Professor, Civil Engineering Department, TITE, Bhopal
- Dr. Satyendra Thakur, Assistant Professor, PSSCIVE Bhopal Madhya Pradesh, India
- Neeraj Bhandari, Assistant Professor, PSSCIVE Bhopal Madhya Pradesh, India

Member- Coordinator

Saurabh Prakash, *Professor*, Department of Engineering and Technology, PSS Central Institute of Vocational Education, Bhopal, Shyamla Hills, Madhya Pradesh, India

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Module 1	INTRODUCTION TO PLUMBING SECTOR

Module Overview

This module introduces the plumbing sector, emphasizing its role in water management and sanitation. It explains the contribution of the Water Management Plumbing Skill Council in enhancing skills and standards in the field. The module highlights job opportunities in the plumbing sector, details the duties and responsibilities of a Plumber General, and describes common plumbing systems used in commercial and residential setups.

Learning Outcomes

After completing this module, you will be able to:

- Understand the significance of plumbing in water management and sanitation.
- Explain the role of the Water Management Plumbing Skill Council.
- Identify various job opportunities in the plumbing sector.
- Describe the duties and responsibilities of a Plumber General.
- Recognize common plumbing systems used in commercial and residential setups.

Module Structure

1.1 Role of Water Management Plumbing Skill Council
1.2 Job Opportunities in the field of Plumbing sector
1.3 Duties and responsibilities of Plumber General
1.4 Common Plumbing system used in commercial and residential setups

Plumbing is a skill which helps in the installation of bathroom and kitchen fittings, laying of new pipelines in buildings and identifying the defects in pipeline. The plumbing system includes two main systems— the water supply and the drainage system. Why is the plumbing system necessary for every construction project?

Whether a small or big construction, proper planning and designing of the plumbing system helps in maintaining the hygiene requirements of the occupants and acts as a safeguard against illness.

Fig 1.1 Plumber

It has been reported that 8 per cent of the total construction cost of the building is marked for plumbing and sanitary work.

The plumbing sector in India is an essential component of the country's infrastructure and construction industry. With a rapidly growing population and urbanization, the demand for plumbing services has increased significantly. Plumbers in India are responsible for a wide range of tasks, including the installation of water supply systems, drainage systems, and sewage systems in residential, commercial, and industrial buildings.

The plumbing sector in India faces several challenges. One of the main challenges is the lack of standardized regulations and licensing requirements across different states and regions. However, efforts are being made to streamline and regulate the industry to ensure the safety and quality of plumbing work. In recent years, there has been a growing awareness of water conservation and sustainable practices in India. This has led to an increased demand for water-efficient plumbing fixtures and systems. Plumbers are now expected to have knowledge of eco-friendly practices and technologies to meet the evolving needs of clients.

Moreover, the Indian government's initiatives such as Swachh Bharat Abhiyan (Clean India Mission) and AMRUT (Atal Mission for Rejuvenation and Urban Transformation) have emphasized the importance of sanitation and proper wastewater management. These initiatives have created opportunities for plumbers to contribute to the development of clean and healthy communities.

1.1 ROLE OF WATER MANAGEMENT AND PLUMBING SKILL COUNCIL (WMPSC)

Fig 1.2 Water management and plumbing Skill Council Logo

Water Management & Plumbing Skill Council - WMPSC (formerly Indian Plumbing Skills Council - IPSC) is the apex Sector Skill Council for the Water & Plumbing Industry, operating under the aegis of National Council for Vocational Education & Training (NCVET) & National Skills Development Corporation (NSDC), initiative of the Government of India, Ministry of Skill Development and Entrepreneurship (MoSDE) to transform India as a hub for skilled manpower. It is a not-for-profit organization that acts as an accreditation and a certifying body, working towards minimizing the gap between the skilled and the unskilled plumbing workforce in India. IPSC endeavours to address these issues and bring the skill levels in our country to world standards.

The purpose of establishing the Water Management & Plumbing Skill Council - WMPSC is to ensure that skilled & certified manpower in adequate numbers is provided across industries and to raise plumbing standards in India to global levels. It will maintain a dynamic LMIS (Labour Management Information System) to keep track of the Labour Market Skill gaps, frame Occupational Standards, facilitate development of practical and high-quality training content, ensure adequate availability of faculty through Training of Trainer initiatives, build Accreditation and Certification mechanisms and encourage capacity building through private sector participation.

1.2 JOB OPPORTUNITIES IN THE FIELD OF PLUMBING SECTOR

Plumbers have a wide range of job opportunities available to them. Here are some potential avenues for employment as a plumber:

1. **Plumbing Companies:** Many plumbers work for plumbing companies that provide various plumbing services to residential, commercial, and industrial clients. These companies often have a team of plumbers who collaborate on projects and assignments.
2. **Construction and Contracting Firms**: The construction industry relies heavily on skilled plumbers for installing plumbing systems in new buildings and infrastructure projects. Construction and contracting firms often employ plumbers as part of their workforce.
3. **Maintenance Departments**: Large organizations, such as hospitals, hotels, universities, and government institutions, have maintenance departments that employ plumbers to handle ongoing plumbing repairs, maintenance, and upgrades.
4. **Self-Employment**: Plumbers have the option to start their own plumbing businesses and work as independent contractors. This allows for flexibility, autonomy, and the opportunity to grow a client base and establish a reputation in the industry.

5. **Facilities Management Companies**: Facilities management companies oversee the maintenance and operation of various properties. Plumbers are often employed by these companies to handle plumbing-related tasks for multiple client sites.
6. **Municipalities and Government Agencies**: Local governments and public works departments hire plumbers to maintain and repair plumbing systems in public buildings, schools, parks, water treatment facilities, and other infrastructure.
7. **Energy and Utility Companies**: Energy and utility companies, particularly those involved in water supply and wastewater management, employ plumbers to ensure the efficient functioning of their plumbing infrastructure.
8. **Plumbing Supply and Equipment Companies**: Plumbers may find employment with plumbing supply and equipment companies, where they can utilize their expertise to provide technical support, product sales, or even work in research and development roles.
9. **Specialized Industries**: Certain industries, such as marine or oil and gas, require plumbers with specialized knowledge and skills to handle unique plumbing challenges in their respective sectors.

Plumbers with specialized skills, such as experience in green plumbing or knowledge of advanced technologies, may also find additional job prospects in emerging fields.

1.3 DUTIES AND RESPONSIBILTIES OF PLUMBER GENERAL

The duties and responsibilities of a Plumber General can vary depending on the specific job and work environment. However, here are some common tasks and responsibilities associated with the role of a general plumber:

1. **Installation of Plumbing Systems**: General plumbers are responsible for installing various plumbing systems, including water supply lines, drainage systems, fixtures, valves, and appliances.
2. **Repair and Maintenance**: Plumbers are often called upon to repair plumbing issues such as leaks, clogs, or damaged pipes. They diagnose the problem, identify the cause, and implement appropriate solutions to restore proper functionality.
3. **Pipefitting and Assembly**: General plumbers work with different types of pipes and fittings, cutting and fitting them together to create a functional plumbing system.
4. **Fixture Installation**: Plumbers install a variety of fixtures, such as sinks, faucets, toilets, showers, and water heaters. They ensure proper connections, sealing, and alignment to ensure reliable and efficient operation.
5. **Testing and Inspections**: Plumbers perform tests and inspections to ensure that plumbing systems meet safety and code requirements.

6. **Compliance with Codes and Regulations**: Plumbers must have a thorough understanding of local plumbing codes and regulations and ensure that all work complies with these standards.
7. **Customer Service**: General plumbers often interact with clients, homeowners, or project managers. They need good communication skills to understand client needs, provide advice or recommendations, and address any questions or concerns. Excellent customer service is important to maintain client satisfaction and build a positive reputation.

These are general duties and responsibilities of a plumber, but specific job requirements may vary depending on the employer, industry sector, and project scope.

1.4 COMMON PLUMBING SYSTEMS USED IN RESIDENTIAL AND COMMERCIAL SETUPS

The residential buildings are made as per requirements of people. The residential setups may be single floor independent house as well as multi-storey apartments. Water is supplied to a house or a building from a storage tanks through pipes. Similarly, the waste water from kitchen and washrooms is drained out with the help of pipes.

Common types of plumbing systems for water supply are as:

- Lifting of water from storage tank to overhead water tank.
- Distribution of water from overhead tank to different outlets at like washroom, kitchen etc.

Most common types of plumbing systems are as follows:

1. **Single stack system**: In this system, there is a single vertical pipe that carries all the wastewater and sewage from all the floors of the building. The pipes from the toilets, sinks, and other fixtures all connect to the single stack, which then leads to the main sewer line. This system is common in high-rise buildings and requires careful design to ensure proper drainage and venting.

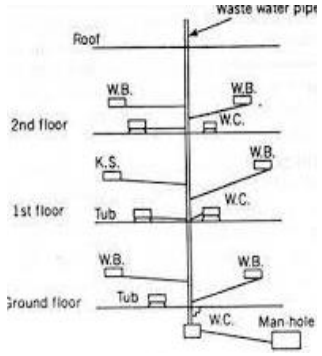


Fig 1.3 Single stack system

2. **Partially vented single stack system**: This system is similar to the single stack system, but it has additional vent pipes connected to the stack at certain points. The vent pipes help to release trapped air and prevent water from siphoning out of traps. This system is more complex than the single stack system and requires careful design to ensure proper venting.

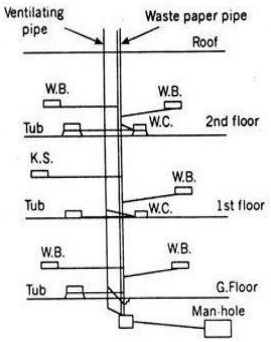


Fig 1.4 Partially vented Single stack system

3. **One-pipe system:** In this system, there is a single pipe that carries both hot and cold water to all the fixtures in the building. The hot water is usually produced by a central heating system and distributed through the same pipe as the cold water. This system is not very common in residential setups as it can lead to temperature fluctuations and is not very efficient.

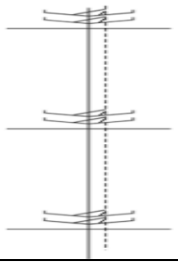


Fig 1.5 One-pipe system

4. **Two-pipe system:** This system consists of two separate pipes, one for hot water and one for cold water. Each pipe is connected to a separate source of water, and the hot water is usually produced by a hot water heater or boiler. This system is commonly used in modern residential setups as it ensures a consistent supply of hot and cold water and is more efficient than the one-pipe system.

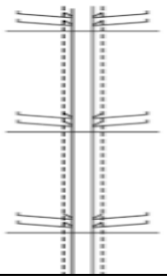


Fig 1.6 Two -pipe system

Another commonly used plumbing system on the basis of the water supply system network:

1. **Direct Water Supply System:** All water outlets of a house receive water directly from the mains. Potable water is available at all faucets. This is possible where water source delivers water 24 x 7 with high water pressure, sufficient enough to deliver water at an adequate pressure at all faucets (taps).

2. **Indirect Water Supply System:** Water from mains is conveyed to storage water tanks. Water is then delivered to house from water storage tank. This system is adopted where water supply from mains is not available throughout the day. It is also used when water pressure in mains is not sufficient enough to deliver water at all faucets with adequate pressure.

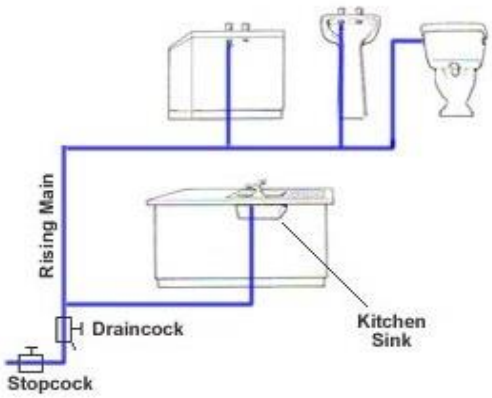


Fig 1.7 Direct Water supply system

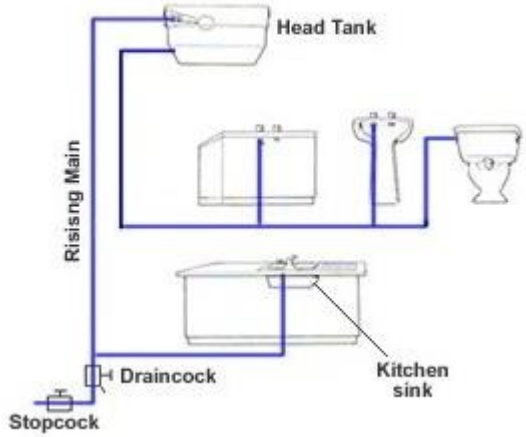


Fig 1.8 Indirect Water supply system

ACTIVITIES

Activity: Enlist different sections of the school where plumbing work is being carried out and note down the accessories and tools used over there.

Materials required:

1. Notebook
2. Pen

Procedure:

1. Under the guidance of the school teacher, visit different sections of the school where plumbing work is done.
2. Enlist the tools used at various places such as toilets, washrooms etc.
3. Note the type of plumbing system used in that area.

CHECK YOUR PROGRESS

A. Answer the following

1. Explain meaning of plumbing.
2. State the importance of plumbing industry.
3. Name the common types of plumbing system for water supply.
4. List the responsibilities of Plumber General.
5. Differentiate between direct and indirect water supply system.

B. Fill in the blanks

1. In …….. pipe system, there is a single pipe that carries both hot and cold water to all the fixtures in the building.
2. Water from mains is conveyed to storage water tanks in …….. water system.
3. ……..system is similar to the single stack system, but it has additional vent pipes connected to the stack at certain points.
4. The full form of WMPSC is ……

Module 2	BASICS OF PLUMBING

Module Overview

This module introduces key concepts and standards in plumbing. It explains important plumbing terminologies and symbols and highlights the Indian Standards for pipe installation. The module covers maintaining accuracy in measurements, the types of pipes and fittings, and tools used in plumbing. It also emphasizes the importance of understanding water properties, pressure, and flow rate, along with the principles of capillary action and thermal expansion relevant to plumbing systems.

Learning Outcomes

After completing this module, you will be able to:

- Understand key plumbing terminologies and interpret plumbing symbols.
- Identify different types of pipes, fittings, and tools used in plumbing.

- Explain the significance of water properties, pressure, flow rate, capillary action, and thermal expansion in plumbing systems.

Module Structure

2.1 Terminologies used in Plumbing
2.2 Plumbing Symbols
2.3 Indian Standards applicable to Pipe Installation
2.4 Maintaining accuracy in measurement and calculation of plumbing work
2.5 Pipe and Pipe Fittings
2.6 Different Types of Tools used in Plumbing
2.7 Importance of Water properties, Pressure and Flow rate
2.8 Capillary action and thermal expansion in plumbing

Plumbing refers to the system of pipes, valves, fixtures, tanks, and other equipment used to transport various fluids for a wide range of applications. While plumbing is commonly used for purposes such as heating and cooling (HVAC), waste removal, and delivery of clean water, its applications are not limited to these areas. Plumbers are technicians who handle various aspects of installing and maintaining plumbing systems. The scope of their work ranges from water supply and heating to sanitation and drainage.

2.1 TERMINOLOGIES USED IN PLUMBING

Air gap - The distance between the lowest point of a water inlet or pipe to a tank and the overflowing level of the tank

AC pipes Asbestos - Cement pipe used in water distribution systems

Appliance - a container or apparatus, in which water is heated, treated or measured, or in which it is utilised before passing to waste

Auger - A tool having a rotating helical screw blade used for drilling a hole

Available head - The head of water available at the point of consideration due to main's pressure or overhead tank or any other source of pressure

B

Backflow - It is an unwanted flow of water in the reverse direction. It leads to wastage of water and it is due to leakage or defect in the system.

Backflow prevention device - This device is fitted in such a way that allows water to flow in one direction but never in the opposite direction. Its sole job is to prevent drinking water from being contaminated due to backflow.

Back siphonage - The flowing back of used contaminated or polluted water from a plumbing fixture or vessel into a water supply pipe due to a reduced pressure in such a pipe.

Bathroom vanity - It can be defined as the combination of the bathroom sink or basin and the storage that surrounds it.

Bidet - It is a special plumbing fixture that allows a person to use water to wash their genitals, anus, and inner buttocks after using the bathroom. These fixtures are very popular with both men and women in developed countries.

Branch - Any part of the piping system other than a main pipe is known as branch

Branch soil pipe (BSP) - A pipe connecting one or more soil appliances to the main soil pipe

Branch soil waste pipe (BSWP) - A pipe connecting one or more soil and/or waste appliances to the main soil waste pipe (one-pipe system)

Branch ventilating pipe (BVP) - A pipe, one end of which is connected to the system adjacent to the trap of an appliance and the other to a main ventilating pipe or a drain-ventilating pipe. It is fitted to prevent loss of water seal from a trap, owing to partial vacuum back pressure, or surging caused by air movement within the pipe system. It also provides ventilation for the branch waste pipe.

Branch waste pipe (BWP) - A pipe connecting one or more waste appliances to the main waste pipe

Building drain - The building (house) drain is the part of the lowest horizontal piping of a drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building. It carries the discharge to the building (house) sewer beginning one metre outside the building wall.

Building sewer - The building (house) sewer is the part of the horizontal piping of a drainage system which extends from the end of the building drain and which receives the discharge of the building drain and carries it to a public sewer, private sewer, individual sewage-disposal system, or other point of disposal.

Burr - It is a raised edge or a small piece of material remaining attached to a work piece after a modification process. It is usually an unwanted piece of material and is removed with a de-burring tool in a process called deburring.

C

Cistern - A tank for storing water, especially one supplying taps or as part of a flushing toilet Cleaning eye When removable plug is fitted with removable cover into the pipe fitting as eye

opening and clearing of obstructions is done through this opening, it is called access eye or cleaning eye.

Couplers - When we connect two pieces of uniform or varying diameter pipe, a piece of pipe knows as coupler is used for joining these pipes. One end of a coupler may be of a higher or lower diameter size as per requirement.

Crown of trap - The top-most point of the inside of a trap outlet.

D

Diameter - Unless specifically stated, the nominal diameter of pipe fittings

Direct tap - Notes A tap or faucet, which is connected to a supply pipe and subject to pressure from the water main

Domestic purposes - All purposes incidental to the occupation of a dwelling

Down take tap or faucet - A tap or faucet connected to a system of piping, not subject to water pressure from the water main

Drain water outlet - Any pipe which conveys discharges from sanitary appliances in a drainage system.

Drain ventilating pipe (DVP) - It is a pipe installed to provide flow of air to or from a drain to prevent undue concentration of foul air in the drain. The main soil pipe or main waste pipe may serve as drain ventilating pipe wherever its upper portions, which do not receive discharges, are extended to the roof level and let open to the air.

Dwelling - It is a building—used, constructed or adapted for use, wholly or principally for human habitation. It may include garages, other outhouses, etc.

E

Escutcheon -A flat piece of metal for protection and often ornamentation, around a keyhole, door handle, or light switch.

F

Fitting - It refers to the fixtures in the plumbing system to join straight pipes or any section of tubes. Examples include elbow, tee, socket, reducer, etc.

Fixture unit - A quantity, in terms of which the load producing effects on the plumbing system of different kind of plumbing fixtures are expressed on some randomly chosen scale

Flange - It is a plate or ring to form a rim at the end of a pipe when fastened to the pipe. A flange joint is a connection of pipes, where the connecting pieces have flanges by which the parts are bolted together.

Float operated valve - Ball valves or ball taps and equilibrium by valves operated by means of a float

Floor area of a building - The area of a horizontal section taken at the plinth or floor level of any storey of a building, inclusive of all projecting and overhanging parts of the external walls, and of such portions of the partition walls as belonging to the building
Flushing cistern - It is a cistern with a device for rapidly discharging the contained water. It is used in connection with a sanitary appliance for the purpose of cleansing the appliance and carrying away its contaminated contents into a drain.
Fracture - Due to heavy pressure or clogging, there is broken or cracked portion in plumbing pipes, fixture or fittings, due to which leakage takes place.

G
Gasket Mechanical seals, generally ring-shaped and fitted for sealing flange joints
General washing place A washing place provided with necessary sanitary arrangement and common to more than one tenement, that is a multi-occupancy building of any sort
H
Horizontal pipe - Any pipe or fitting which makes an angle of more than 45° with the vertical
I
Induced siphonage - The extraction of water from a trap by a siphonage set up by the reduction of pressure at the outlet of the trap.
Insanitary - Contrary to sanitary principles or injurious to health.

M
Main soil pipe (MSP) - A pipe connecting one or more branch waste pipes to the drain
Main soil waste pipe (MSWP) - A pipe connecting one more branch soil waste pipes to the drain
Main ventilating pipe (MVP) - A pipe which receives a number of branch ventilating pipes
Main waste pipe (MWP) - A pipe connecting one or more branch waste pipes to the drain.

N
Nipple - It is a piece of pipe having thread at both sides, and could be used for short extension of plumbing lines. It can also be used for connecting two fittings within a short distance.

O
O-ring - An O-shaped ring that is attached to the faucet to prevent water from oozing out of the spout.

P
Period of supply - The period of the day or night during which water supply is made available to the consumer

Pipe ears - Two wings cast integrally with the pipe socket provided with holes to take fixing nails or screws

Pipe systems - It is an assembly of various components put together with a method of joints, to transport water from the source to destination. The system to be adopted will depend on the type and planning of the building in which it is to be installed and will be one of the following:

- **One-pipe system**— The plumbing system in which the waste connection from washbasins, baths, and the soil pipe branches are all collected into one main pipe which is connected directly to the drainage system. Gully traps and waste pipes are completely dispensed with but all the traps of water closets, basin, etc., are completely ventilated to preserve water seal.
- **Two-pipe system—** It is a discharge pipe system comprising two independent discharge pipes, one of which conveys soil directly to the drain, the other conveying waste water to the drain through a trapped gully. The system may also require ventilating pipes.
- **Single stack system**— One-pipe system without trap ventilation pipework.

Pipework - Any installation of piping with its fitting.

Plinth - The portion of a structure between the surface of the surrounding ground and surface of the floor, immediately above the ground

Plumbing - It is the pipes, fixtures and other apparatus inside a building for bringing in the water supply and removing the liquid and water-borne wastes; It is the installation of the foregoing pipes, fixtures and other apparatus.

Plumbing system - It shall include the water supply and distribution pipes; plumbing fittings and traps; soil, waste, vent pipes and anti-siphonage pipes; building drains and building sewers including their respective connections, devices and appurtenances within the property lines of the premises and water-treating or water-using equipment.

Plunger - A tool for cleaning normal blockage in drain and pipe, washbasin, etc.

Potable water - Water which is satisfactory for drinking, cooking and domestic purposes and meets the requirements of the Bureau of Indian Standards (BIS)

Premises - It shall include passages, buildings and lands of any tenure, whether open or enclosed, whether built on or not, and whether public or private in respect of which, a water rate or charge is payable to a designated authority or for which an application is made for supply of water

Public building - A building used or intended to be used either ordinarily or occasionally as a church, temple, mosque or any place of public worship, dharamshala, college, school, theatre, cinema, public concert room, public hall, public bath, hospital, hotel, restaurant, lecture room or any other place of public assembly.

S

Sealing rings - It is a type of gasket used in connecting any fixture or joints to create leak proof condition.

Self-siphonage - The extraction of water from a trap by siphonage, setup by the momentum of the discharge from the sanitary appliance to which the trap is attached.
Service pipe - The pipe that runs between the distribution main in the street and the riser in case of a multi-storeyed building, or the water in case of an individual house, and is subjected to water pressure from such a main
Soil pipe (SP) - The pipe used to carry waste from the toilet and waste water
Spindle - It is a metal unit that provides the link between the handle and the stem washer.
Stack - The main vertical discharge or ventilating pipe
Stopcock - A cock fitting in a pipeline for controlling the flow of water Stop tap or faucet It includes stop cock, stop valve or any other devices for stopping the flow of water in a line or system of pipe at will.
Storage cistern - A cistern for storing water Stuffing box It is an assembly which is used to house a gland seal. It is used to prevent leakage of fluid, such as water or steam, between sliding or turning parts of machine elements.
Sullage - The waste water generated from bath and kitchen (but not the waste water from toilets known as excreta)
Supply pipe - The pipes which lead from the distribution main of water supply to the plumbing system of the house
Supports Devices for supporting and securing the pipe and fittings to the walls, ceilings, floors or any extra constructed unit

T

Trap -A fitting or device in a P-, U-, S- or J-shaped type. Traps are fitted near a plumbing fixture. The trap bend is fitted to prevent sewer gases from entering the building. It is so designed and constructed as to provide, when properly vented, a liquid seal which will prevent the back passage of air without materially affecting the flow of sewage or water through. If the gases are inserted back into home, then it could lead to people inhaling foul smell, which could cause illnesses. It could even explode.

V

Vertical pipe - Any pipe which is installed in a vertical position or which makes an angle of not more than 45° with the vertical.

W

Warning pipe - An overflow pipe so fixed that its outlet, whether inside or outside a building, is in a visible position where the discharge of any water from it can be readily seen.

Washout valve - A device located at the bottom of the tank for the purpose of draining a tank for cleaning, maintenance, etc.

Water line - A line marked inside a cistern to indicate the highest water level at which the supply valve should be adjusted to shut off.

Water main (street main) - It is a pipe laid by the water undertakers for the purpose of giving a general supply of water as distinct from a supply to individual consumers. It includes any apparatus used in connection with such a pipe.

Water outlet - As used in connection with the water distributing system, it is the discharge opening for the water

(1) To a fitting;

(2) To atmospheric pressure (except into an open tank which is part of the water supply); and

(3) To any water-operated device or equipment requiring water to operate.

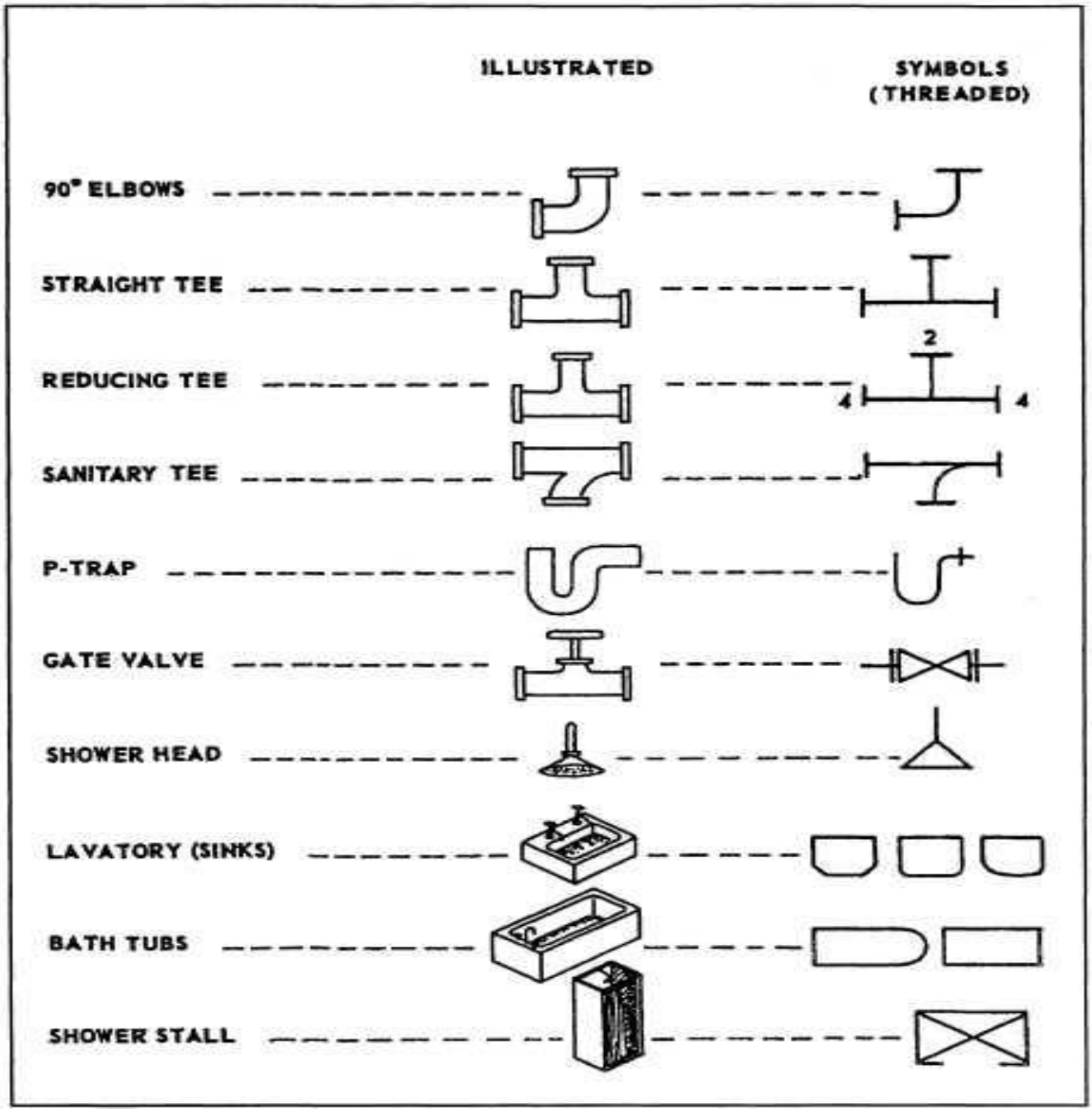
Water seal - The water in a trap which acts as a barrier to the passage of air through the trap Water supply system It consists of the water service pipe, the water distribution pipes, and the necessary connecting pipes, fittings, control valves, and all fixtures in or adjacent to the building or premises.

Water undertaker - The water service provider who owns the supply system and infrastructure and provides water to a defined geographic area.

Waterworks - It refers to an establishment for managing a water supply. Waterworks for public water supply include a lake, river, spring, well, pump with or without motor and accessories, reservoir, cistern, tank, duct whether covered or open, sluice, water main, pipe.

2.2 PLUMBING SYMBOLS

A well-trained plumber does the installation of the fittings and fixtures as per the drawing given in the assembly sheet of the plumbing fixtures in the manufacturer's catalogue. These drawings consist of symbols, assembly of fixture and installation method. Identification of the symbols given in the drawings of fixtures makes the installation work easy for the plumber. Plumbing symbols are given in this Unit. The students should identify and learn the symbols so that it will be helpful in future


ILLUSTRATED
SYMBOLS (THREADED)
90° ELBOWS
STRAIGHT TEE
REDUCING TEE
2
4
4
SANITARY TEE
P-TRAP
GATE VALVE
SHOWER HEAD
LAVATORY (SINKS)
BATH TUBS
SHOWER STALL

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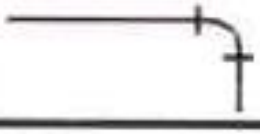
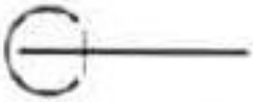
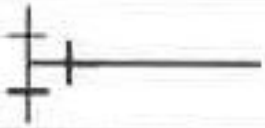
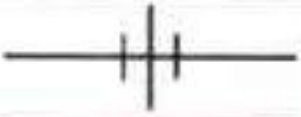
ITEM	SYMBOL	SAMPLE APPLICATION (S)	ILLUSTRATION
PIPE	SINGLE LINE IN SHAPE OF PIPE- USUALLY WITH NOMINAL SIZE NOTED		
JOINT- FLANGED	DOUBLE LINE		
SCREWED	SINGLE LINE		
BELL AND SPIGOT	CURVED LINE		
OUTLET TURNED UP	CIRCLE AND DOT		
OUTLET TURNED DOWN	SEMICIRCLE		
REDUCING OR ENLARGING FITTING	NORMAL SIZE NOTED AT JOINT		
REDUCER CONCENTRIC	TRIANGLE		
ECCENTRIC	TRIANGLE		
UNION SCREWED	LINE		
FLANGED	LINE		

 Water Meter	Cold Water
Hot Water	Vent Line
Sanitary Waste	 Gas Pipe
 Gate Valve	 Water Heater Shut Off
 Water Closet	 Lavatory
 Water Heater	 Dishwasher
 Clothes Washer	 Floor Drain
 Clean Out	 Vent Thru Roof
 90 degree Elbow	 Pipe Turns Up
 Pipe turns Down	 Tee
 Union	 Cap

2.3 INDIAN STANDARDS APPLICABLE TO PIPE INSTALLATION

ISI (Indian Standards Institute) or BIS (Bureau of Indian Standards) are applicable to piping installation in India. These standards define the specifications, requirements, and guidelines for various products and processes to ensure safety, quality, and performance. For piping installation, the relevant Indian standards include:

IS 1239: This standard covers the specifications for steel tubes used for water, gas, steam, and air lines. It includes requirements for dimensions, mechanical properties, and testing methods.

IS 3589: This standard specifies the requirements for electric resistance welded (ERW) steel pipes for water, gas, and sewage purposes. It includes provisions for dimensions, chemical composition, mechanical properties, and testing procedures.

IS 12371: This standard provides guidelines for the installation of underground gravity sanitary sewers using flexible (non-rigid) pipes. It covers aspects such as trenching, bedding, jointing, testing, and backfilling.

IS 15328: This standard deals with the installation of PVC (Polyvinyl Chloride) pressure pipes for water supply. It covers requirements for jointing methods, laying procedures, and testing.

IS 15337: This standard provides guidelines for the installation of polyethylene (PE) pipes for irrigation and water supply. It includes recommendations for jointing, trenching, bedding, and backfilling.

The above given are just few examples of Indian standards applicable to piping installation. It's important to consult the relevant standards and codes specific to your project to ensure compliance with the requirements set by ISI/BIS.

2.4 MAINTAINING ACCURACY IN MEASUREMENT AND CALCULATION OF PLUMBING WORK

Accuracy in measurement and calculation is of utmost important in plumbing work to ensure precise installation and efficient functioning of the plumbing system. Here are some techniques for achieving accuracy in measurement and calculation in plumbing work:

- **Use of Proper Tools**: Ensure that you have the right tools for measurement, such as a tape measure, spirit level, plumbing squares, and angle finders. Good-quality tools that are properly calibrated will help you achieve accurate measurements.
- **Take Multiple Measurements**: To minimize errors, take multiple measurements of the same dimension or distance. This helps identify any inconsistencies or outliers and allows you to take an average or most common value.
- **Verify Reference Points**: Use established reference points or benchmarks to ensure accuracy in measurement. For example, when installing pipes, you can use building corners, walls, or other fixed points as references to align and measure distances accurately.

- **Check and Recheck**: Double-check your measurements to ensure accuracy before making any cuts or installations. Rechecking will help identify any potential errors or inaccuracies before they cause problems in the plumbing system.
- **Consider Tolerances**: Understand the acceptable tolerances for different plumbing components and ensure your measurements and calculations fall within those limits. Tolerances may vary based on the type of material, system, and local codes.
- **Accurate Calculation of Pipe Lengths**: When calculating pipe lengths, consider factors like fittings, bends, and allowances for expansion and contraction. Consider the specific dimensions and types of fittings to ensure accurate pipe measurements and minimize material wastage.
- **Follow Standardized Formulas and Charts**: Use standardized formulas and reference charts provided by plumbing codes or industry standards for calculating flow rates, pipe sizes, pressure drops, and other important parameters. This helps ensure accuracy and consistency in your calculations.

By employing the above and paying attention to detail, one can enhance accuracy in measurement and calculation during plumbing work, leading to reliable and efficient plumbing installations.

2.5 PIPE AND PIPE FITTINGS

2.5.1 PIPES AND ITS TYPES

Plumbing is the system of pipes, drains fittings, valves, valve assemblies, and devices installed in a building for the distribution of water for drinking, heating and washing, and the removal of waterborne wastes.

There are various types of materials that are used for manufacturing pipes include:

1. Cast Iron Pipe
2. Ductile Iron Pipe
3. Galvanized Iron Pipe
4. CPVC Iron Pipe
5. PEX or XLPE Pipe
6. Polypropylene Pipe
7. Stone ware Pipe
8. Un-Plasticized Pipe
9. Copper Pipe
10. Stainless Steel Pipe

1. Cast Iron Pipe - Cast Iron Pipe is used as a pressure pipe for transmission of water, gas and sewage, and as a water drainage pipe. These are available with flanged ends or one end with socket & other with spigot.

Fig 2.1 Cast Iron Pipe

2. Ductile Iron Pipe - Ductile Iron Pipe is commonly used for potable water transmission and distribution. It is made of ductile iron. These pipes are improved version of Cast Iron Pipes.

Fig 2.2 Ductile Iron Pipe restraint

3. Galvanized Iron Pipe - Galvanized Iron Pipe is mainly used in water supply distribution. These pipes are made of different grade i.e. Light, Medium and Heavy depending upon the thickness of pipe used. These are colour coded for identification - light – yellow band, medium – blue band and heavy – red band. Pipes with diameters in size from 15 mm to 150 mm are used in distribution.

Fig 2.3 Galvanized Iron Pipe

4. CPVC Pipe - Chlorinated Polyvinyl Chloride (CPVC) Pipe is primarily used for supplying hot and cold potable water It is also used in industrial liquid applications. Chlorinated polyvinyl chloride is a thermoplastic pipe material.

Fig 2.4 CPVC Pipe

5. PEX or XLPE Pipe - PEX or XLPE is a form of polyethylene with cross-links, formed into tubing. PEX Pipe is primarily used in - building services, pipe work systems, domestic water piping, natural gas and offshore oil applications, chemical transportation and transportation of sewage
and slurries.

Fig 2.5 PEX/XLPE Pipe

6. Polypropylene Pipe - These are made of polypropylene "random copolymer". Polypropylene Pipe is primarily used for - inner hot water and cold-water supply conduits, industrial pipe-lines

Fig 2.6 Polypropylene Pipe

7. Stone Ware Pipe - Stone Ware Pipe are made of clay. They are s primarily used in - sewerage systems for underground drainage, industrial drainage, irrigation, chemical industry for transporting the highly corrosive
chemical etc.

Fig 2.7 Stoneware Pipe

8. Un-Plasticized Pipe - Un-plasticized Polyvinyl (UPVC) Pipe is primarily used in - ventilation pipe work, rain water applications, soil and waste water discharge system.

Fig 2.8 Un-Plasticized Pipe

9. Copper Pipe - Copper Pipe as the name suggests are made up of copper. It is most often used in - supply of hot and cold tap water, as refrigerant line in HVAC systems. Copper offers a high level of resistance to corrosion however, it is becoming very costly.

Fig 2.9 Copper Pipes

10. Stainless Steel Pipe -Stainless Steel Pipe is used in marine environments where salt water would erode other metal pipe. These pipes are strong and highly resistant to corrosion. However, even more expensive than copper pipes.

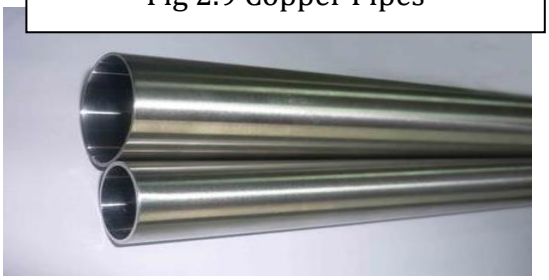


Fig 2.10 Stainless Steel Pipe

2.5.2 PIPE FITTINGS

Fitting is used in pipe plumbing systems to connect straight pipe or tubing sections, to adapt to different sizes or shapes, and for other purposes, such as regulating or measuring fluid flow.

Fig 2.11 Different fittings of pipe

Fitting are small component used in plumbing system. Fitting is used in pipe plumbing system to connect straight pipe or tubing section, to adapt to different sizes or shapes and for other purposes, such as regulating or measuring fluid flow. We can say that the water-supply fittings like elbow, tee, socket, reducer, etc., are used to change the direction of flow, distribute the water- supply from the main pipe to other pipes of equal size or lower size, etc. There are various types of fittings used in plumbing work.

Types of Fittings

1. Collar
2. Elbow
3. Gasket

4. Couplings
5. Union
6. Reducer
7. Tee
8. Nipple
9. Valve
10. Trap
11. Ferrule
12. Cross
13. Offset

1. **Collar:** A pipe fitting in the form of a sleeve for jointing the spigot ends of two pipes in the same alignment is known as collar.

Fig 2.12 Collar

2. **Elbow:** An elbow is a pipe fitting installed between two lengths of pipe or tubing to allow a change of direction, usually a 90° or 45° angle. The ends may be machined for butt welding, threaded (usually female), or socketed, etc. When the two ends differ in size, the fitting is called a reducing elbow or reducer elbow.

   Elbows are categorized based as below:

   Long Radius (LR) Elbows–radius is 1.5 times the pipe diameter

   Short Radius (LR) Elbows–radius is 1.o times the pipe diameter.

   90° Elbow–where change in direction required is 90°

   45° Elbow–where change in direction required is 45°

Fig 2.13 90° Elbow

Fig 2.14 45° Elbow

3. **Gasket:** Gaskets are mechanical seals, usually ring-shaped, which seal flange joints. Gaskets vary by construction, materials and features.
   Commonly used gaskets are non-metallic, spiral-wound and ring-joint.

Fig 2.15 Gasket

4. **Coupling:** A coupling connects two pipes to each other. If the size of the pipe is not the same, the fitting may be called a reducing coupling or reducer, or an adapter. A pipe piece with inside threads for connecting two pieces of pipes having screwed ends.

Fig 2.16 Coupling

5. **Union:** A pipe fitting used for joining two ends of pipes neither of which can be turned. A standard union pipe is made in three parts consisting of a nut, a female end, and a male end. When the female and male ends are joined, the nuts then provide the necessary pressure to seal the joint. Since the mating ends of the union are interchangeable, changing of a valve or other device can be achieved with a minimum loss of time.

Fig 2.17 Union

6. **Reducer:** A reducer is used for a change in pipe size to meet hydraulic flow requirements of the system.

Fig 2.18 Reducer

7. **Tee:** A tee, the most common pipe fitting, is used to combine (or divide) fluid flow. It is available with female thread sockets, solvent-weld sockets or opposed solvent-weld sockets and a female-threaded side outlet. Tees can connect pipes of different diameters or change the direction of a pipe run. Available in a variety of materials, sizes and finishes, they are used to transport two-fluid mixtures. Tees may be equal or unequal in size, with equal tees the most common.

Fig 2.19 Tee

8. **Nipple:** A nipple is a short stub of pipe, usually male-threaded steel, brass, chlorinated polyvinyl chloride (CPVC) or copper (occasionally bare copper), which connects two other fittings. A nipple with continuous uninterrupted threading is known as a "close nipple".
   Nipples are commonly used for plumbing and hose
   A tubular pipe with both the ends threaded and less than 300 mm length for connecting the pipe.

Fig 5.10 Nipple

9. **Valves:** For proper functioning of the pipe line, the valves are used in the water-supply mains. Valve is designed to stop or regulate flow of any fluid (liquid, gas, condensate, stem, slurry, etc.) in its path. Valves are categorized depending on their applications like isolation, throttling, and non-return.
   Various types of valves are available depending upon the type of construction as follows:
   (i) Sluice Valve: It is placed at an important place like any entry to a pipe. It may be the start of a new pipe from a tank or a number of branches from the tank or main the header. This valve isolates the water-supply as and when required. The sluice valve is specified by the nominal bore of the water-way. The standard sizes are 50 mm, 65 mm, 80 mm, 100 mm, 150 mm, 200 mm, 250 mm and 300 mm. The sluice valves are classified as Class 1 and Class 2. (Fig 5.11)

Class	**Test Pressure kg/cm^2**		**Max. working Pressure kg/cm^2**
	Body	Seat	
Class 1	20	10	10
Class 2	30	15	15

Table 2.1 - Test pressure in sluice valve

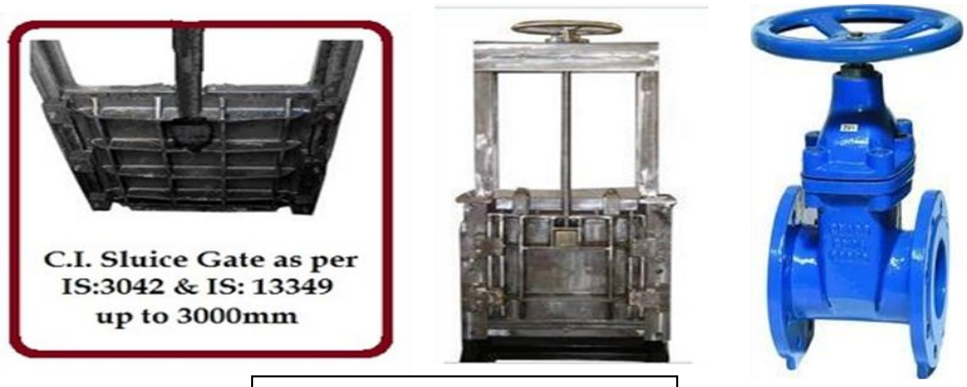


Fig 2.11 Sluice Valve

(ii) Scour Valve: This valve is provided at the lower level in a pipeline, so that such sections can be supplied and drained for maintenance purpose. The water is discharged into natural drains. It is basically a sluice valve and the very nature of its use has created the difference in name. (Fig 5.12)

Fig 2.12 Scour Valve

(iii) Air Valve: An air valve is fitted to release the air automatically when the pipe is filled with water. This valve also permits entry of air when the pipe is drained. This is a valve fixed at the end of a communication pipe and which controls or stops the supply of water. The valve is specified by the nominal bore of the socket or pipe outlet to which the valve is fitted. The standard sizes are 8 mm, 10 mm, 15 mm, 20 mm, 25 mm, 32 mm, 40 mm and 50 mm. (Fig 2.12)

Fig 2.13 Air Valve

The body components and washer plate are made of cast brass or leaded tin bronze. The spindle, glands, handle, etc. are made of a brass rod extruded or rolled. The washers are made of or fiber, leather, rubber or nylon. This valve is available in two types: internally threaded and externally threaded.

(iv) Gate Valve: It is a valve through which the flow of water (fluid) is controlled by a gate in the form of a wedge or disc between the body ends which are in line with each other. The gate is actuated by a spindle whose axis is at right angles to that of the body ends. In the gate valve, the water pressure acts on one side of the gate and there is no change in the direction of the flow.

Types of Gate valve

Gate valves have gates of wedge type, solid or split type, or gate of double disc or parallel type. The actuation of the gate shall be by the internal or external screw on the spindle. The spindle may be of the rising or non-rising type. See figure given below. (Fig 2.14)

Split taper non-rising gate valve

Rising spindle split wedge gate valve

Fig 2.14 Types of gate valve

Parallel slide valve

It is essentially a gate valve in which the gate consists of two discs without spreading mechanism except for a spring which slides between the two parallel body seats. The activation of the valve discs is by the internal and the external screw on the spindle and the spindle may be of the rising or non-rising type.

Fig 2.15 Parallel Slide valve

(v) Globe valve: It is a valve having generally a spherical body in which the body ends are in line with each other and in which the disc is lifted from, or lowered on to, the body seat by a spindle whose axis is at right angles to that of the body ends. In this valve, the pressure acts on the under-side of the valve disc and there is a change of the direction of the flow inside the valve body. (Fig 2.16)

Fig 2.16 Globe Valve

(vi) Angle valve: It is a valve generally having a spherical body in which the body ends are at right angles with each other and in which the disc is lifted from, or lowered on, the body seat by a spindle whose axis is in line with that of one body end. The valve is actuated by the internal or external screw on the spindle. The spindle may be of the rising or non-rising type. See Fig.2.17

Fig 2.17 Angle Valve

(vii) Check valve or non-return valve: It is a check valve which permits (fluid) water to flow in one direction but checks all returning flow. It is operated by pressure above, having no external means of control. (Fig 5.17)

Swing Check valve

Horizontal check valve

Vertical check

Fig 2.18 Check Valve

(viii) Foot Valve: A foot valve works as a one-way valve, that allows water to be sucked through the valve with a pump and when the water flow stops the seal stops the backflow of the water. The foot valve has a strainer on the outside which prevents obstructions and a check valve that closes when pump stops. See Fig 2.19.

Fig 2.19 Foot valve

(ix) Float valve: A float valve is a mechanism for filling water tanks as well as flush toilets. It avoids overflow and backflow. Float valve is fitted in roof water tank or other places. It is used for stopping the water when water tank or flush toilets is filled and it stops overflow. (Fig 2.20)

Fig 2.20 Float valve

(x) Trap: In plumbing, a trap is a P, U, S, or J-shaped pipe located below or within a plumbing fixture (Fig 2.21). The bend is used to prevent sewer gases from entering building. If the gases were allowed back into the home, not only would they smell, but they could cause illnesses and have even been known to explode.

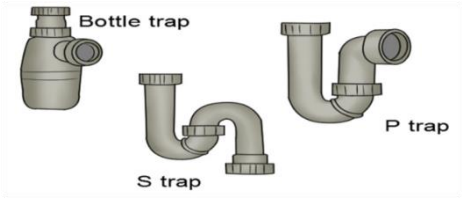


Fig 2.21 Trap

(xi) Ferrule: It is a pipe fitting for connecting a service pipe to the water main. It is usually made of non-ferrous metal and screwed to the main pipe.

Fig 5.22 Ferrule

(xii) Cross: A pipe fitting used for connecting four pipes crosses, also known as four-way fittings, cross branch lines. A cross has one inlet and three outlets (or vice versa), and often have solvent-welded socket or female-threaded ends. Cross fittings may stress pipes as temperatures change, because they are at the centre of four connection points. See in Fig 5.23.

Fig 5.23 Cross

(xiii) Offset: A combination of elbows, which bring the pipe out of line but parallel with it.

Fig 2.24 Offset

2.6 DIFFERENT TYPES OF TOOLS USED IN PLUMBING

The major tools used in plumbing are categorised as:

1. Holding tools

(a) Bench vice (b) Pipe vice

2. Fitting tools

(a) Wrenches (b) Water-pump pliers

(c) Spanners

3. Cutting tools

(a) Pipe cutter (b) Hacksaw

4. Pipe bending tools

(a) Pipe bending machine (b) Threading dies

5. Other tools

(a) Chisel (b) Hammer

(c) Chain wrench (d) Screw driver

(e) Trowel (f) File

(g) Plier (h) Caulking tools

(i) Drill machine (j) Drill bit

(k) Hanger (l) Measuring tape

(m) Plumb bob (n) Spirit level

(o) Spade
(p) Pickaxe
(q) Mortar pan
(r) Masons' square
(s) Water level tube

1. **Holding Tools**

These tools are designed to hold pipes, fittings, and other components in place while the plumber works on them. Holding tools are essential for maintaining the correct positioning of components during installation or repair work.

(a) **Bench vice:** A vice is a work-holding tool used for holding an item for various work like filing, chipping, sawing, threading, bending of various jobs, fitting, tapping etc. (Fig. 2.25). The bench vice has two jaws, one of which is fixed and other is moveable. These jaws are fitted with plates for gripping the job. The vice size depends on the width of jaw. Bench Vice is fixed through bolt to a table or bench (Fig. 2.26). Vice is opened and closed with the help of an attached handle to a spindle. In this way, a material is held tightly. Bench vices hold the objects and allow use of other tools to complete a task.

Fig 2.25 Bench Vice

Fig 2.26 Bench Vice fixed on table

(b) **Pipe vice:** A pipe vice is a tool used for holding a pipe for carrying out assembly, disassembly, threading, cutting, etc. (Fig. 2.27) This vice is of two kinds: (i) Open side pipe vice (ii) fixed side pipe vice.

The pipes vice sizes are known by the opened size of the jaws. Standard sizes of vices are from 80mm, 105 mm, 130 mm, 170 mm, etc.

Fig 2.27 Pipe Vice

2. Fitting tools

Fitting tools are a category of tools used in plumbing to install and remove plumbing fittings. These tools are designed to provide a secure grip on fittings, making it easier for the plumber to tighten or loosen them as needed.

a) Wrenches: The wrenches are hand tools used for tightening and loosening of the nuts and bolts. These tools hold slippery or small nuts and bolts for loosening or tightening it. Mostly two types of wrenches – adjustable and non-adjustable are used. These are useful particularly for loosening and tightening of odd size nuts and bolts. These tools hold a pipe and pipe fittings for screwing or unscrewing. This is a very common tool especially for small diameter pipes up to 50 mm. (Fig. 2.28)

Fig 2.28 Pipe Wrenches

(i) Adjustable wrench: This wrench is also used to loosening and tightening the bolts and nuts of any odd and regular sizes. This tool is used for tightening and untightening of valves, cocks, geysers, flexible pipes, etc. It is a good maintenance tool for repair of plumbing items like valves, cocks, pumps, etc. Chrome vanadium steel is used for making this wrench. (Fig.2.29)

Fig 2.29 Adjustable Wrench

It contains a fixed flat jaw with a handle and a square-toothed screw. The movable flat jaw slides in the body of the fixed jaw with the support of a screw. The gap between the flat jaws is used to grip the material to be twisted for screwing or unscrewing.

(b) Water-pump pliers: Chrome Vanadium steel is used for manufacturing. It is available in only one standard size of 250 mm length with 40 mm capacity. The maximum capacity between the two jaws varies up to 40 mm. (Fig. 2.30)

Fig 2.30 Water-Pump Pliers

(c) Spanner: This tool is used for nuts and bolts tightening and loosening. Standard nut and bolt sizes are mostly used. The standard spanners used are:

(i) Ring Spanners: These spanners have full circular closed ring at both ends. It is difficult to slip and cause damage. It is made of chrome vanadium by the forging process with burnished finish or chrome-plated. It is mostly available in two types:

- **Open-ended Spanners:** These types of spanners are open from both side and used for tightening and loosening nut and bolts (Fig. 2.31). (Spanner has open-ended jaws which slide through the nut or bolt with square or hexagonal heads. The bolts or nuts are turned with the required force to screw or to unscrew. The two jaws have two consecutive sizes like 6 mm and 7 mm or 1/4" and 5/16", etc. (Fig. 2.7).

Fig 2.31 Open ended Spanners

- **Combination Spanners:** These spanners are open at one end and closed at another end.

(ii) Bi-hexagonal ring spanner*:* It has a bi-hexagonal shape at the two ends to hold a nut or bolt the head of which is square or hexagonal. The sizes of the two ends are consecutive like 6 mm and 7 mm, 1/4" and 5/16", etc. (Fig. 2.32)

Fig 2.32 Bi hexagonal Ring spanner

3. Cutting tools:

Cutting tools are an essential category of tools used in plumbing for cutting pipes and tubes to the desired length. These tools come in various sizes and types, and each is designed for a specific type of pipe or tubing material.

(a) Pipe cutter: Pipe cutter is a manual tool to cut a pipe at the site, especially where it is difficult to use a hacksaw frame. This tool has a sharp, round cutting wheel which is pressed with to and for rotary motion ad it results in the cutting of a pipe. (Fig. 2.33).

Fig 2.33 Pipe Cutter

(b) Hacksaw: This tool is a generally used with the both hands. It cuts the material like plastic pipe, steel rod, angle iron, sheets, iron pipes etc. It can be also used for cutting the bolt heads and nuts when jammed nut and bolt do not open with a tool. Important parts of hacksaw are handling, frame, blade and adjusting wing nut.(Fig. 2.34).

A hand operated hacksaw is used for site work while a power hacksaw is used in a workshop for quick cutting of heavy pipes. (Fig. 2.35)

Fig 2.34 Hand hacksaw

Fig 2.35 Power hacksaw

4. Pipe bending tools:

Pipe bending tools are used in plumbing to create bends and curves in pipes, allowing them to be fitted into tight spaces or to follow the contours of a building. These tools come in various sizes and types, and each is designed for a specific type of pipe material and diameter.

(a) **Pipe bending machine:** This equipment is used to bend or turn a mild steel black or galvanized pipe. The size and strength of the machine depends upon the pipe diameter and the type of the pipe material to be bent. The mechanical or hand-operated pipe bending machines are available for 3/8" to 1" diameter pipes. For higher ranges, i.e. 1/2" to 2", 1/2" to 3", 1/2" to 4" and 2" to 6" hydraulic hand-operated Machines are used. (Fig. 2.36)

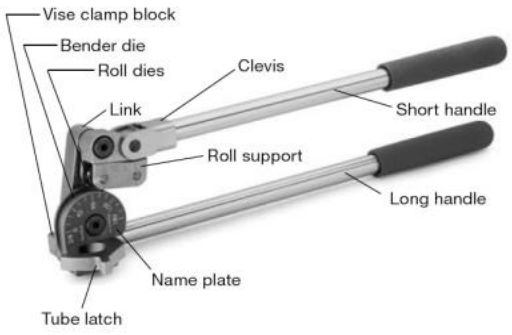


Fig 2.36 Pipe Bending machine

(b) **Threading dies:** Threading dies tool is used to cut threads on the pipes in the workshop. (Fig.2.13)

Fig 2.37 Threading dies

5. Other tools:

(a) Chisel: The chisels are mostly used in plumbing for cutting and jointing works. Chisels cut concrete surface. The diamond point chisels create grooves at a pointed bottom. (Fig. 2.38).
The different kinds of chisel are available which are used to cut through concrete. The diamond point chisel is used to give grooves appointed bottom.

Fig 2.38 Chisel (Chenni)

(b) Hammer: The hammers are general purpose workshop hand tools used for straightening of sections, riveting, striking of nails, inserting the component by striking, inserting keyways and fitting by striking. The hammer consists of head made from hard and tampered steel and wooden handle.
The head has a flat striking face and the other side is called pein.

Fig 2.39 Hammer

The peins are classified as per different shapes such as ball pein, cross pein and straight pein. The hammers made of hardened steel are known as engineer's hammers and are usually used for working with steel components. One-kilogram hammer is most commonly used. (Fig. 2.39)

(c) Chain wrench: The chain wrench is used to hold a pipe and pipe fittings for screwing or unscrewing during the screw joint. It consists of a toothed block, a handle and a chain. The chain is round, grooved and held on the toothed end of the block. The chain grips the pipe fitting and screws or unscrews. The chain wrench is available in 3", 4", 6", 8" and 12" and their length is 475 mm, 585 mm, 834 mm, 1100 mm and 1360 mm, respectively. These sizes are designated by the maximum diameter of the pipe it can hold. (Fig. 2.40)

Fig 2.40 Chain wrench

(d) Screw driver: Screw drivers are tools often used by plumbers to fit into screws. Screwdrivers have a sharp tip which can be easily fitted into various screws. Different types of screwdrivers are used for various type of screw. Various types of heads of screw driver such as the Flat-head, Phillips, Robertson and hex are all used by plumber. (Fig. 2.41)

Fig 2.41 Screw Driver

(e) Trowel: trowel is a hand tool that is commonly used in the construction and building trades, including in plumbing. It is a flat, pointed tool with a handle that is used for spreading and shaping various materials such as mortar, plaster, and cement. In plumbing, trowels are often used for applying mortar to secure pipes and fittings in place, as well as for finishing concrete or other surfaces around pipes. (Fig. 2.42)

Fig 2.42 Trowel

(f) Files: Files are hand tools used for variety of work like removing of sharp edges, metal removal, shaping of jobs, smoothening of surfaces, finishing, producing different shapes etc. The file has five parts: tang, heel, face, edge and point or tip. Various types of files of different shapes

Fig 2.43 Files

like hand round, pillar, square, three square, half round, flat, knife edge, needle file are used as per work. (Fig.2.43)

(g) Pliers: Pliers is an important used for holding small objects for tightening or loosening various parts. Several types of pliers are used by a mechanic during work. Pliers can be used for cutting purpose also. The slip joint pliers are used for flat work pieces and holding round work. Various shapes and sizes of pliers are available in the market. Pliers of different types are shown here. (Fig.2.44)

Fig 2.44 Pliers

(h) Caulking Tools: For filling the gaps in wall or bathroom, caulking tools are used. This tool helps in filling and removal of material in building.
(Fig. 2.45)

Fig 2.45 Caulking Tools

(i) Drill Machine: Drill machine is one of the important tools used for making a hole in metal or wood or concrete surfaces. Drill machine (Fig.2.46) is fitted with a cutting tool like a drill bit or a driver bit. The attachment is tightened
with a key.

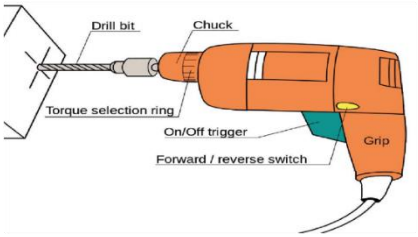


Fig 2.46 Drill Machine

(j) Drill bits: Drill bits are tools used to make cylindrical holes by cutting the material. Bits are fitted in a tool which rotates it and make the hole. For non-cylindrical-shaped holes specialized bits are used. (Fig. 2.47)

Fig 2.47 Drill Bits

Safety precautions:
Before installing the bit in drill machine, it should be sharpened. Key in the chuck should be removed after tightening.

(k) Hangers: Purpose of pipe hanger is to hold or support a pipe or group of pipes from a slab, beam, ceiling or other structural element. Common clamp and hangers like Clevis Hangers, Beam Clamps, C Clamps, Band Irons, Copper Clevis Hangers, Stud Brackets, Copper Straps, Galvanized Straps,
are also used. (Fig. 2.48)

Fig 2.48 Pipe Hangers

(l) Measuring tape: Measuring tape is used for measuring length of an item. Tape is made of flexible steel tape, cloth tape, and PVC tape. The length range available is 1 meter, 2 meters, 3 meters, 5 meters, 10 meters, 15 meters, etc. (Fig. 2.49)

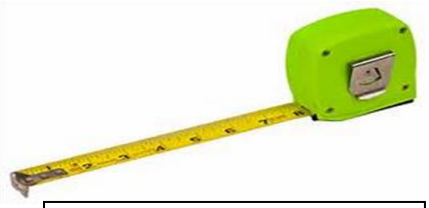


Fig 2.49 Measuring tape

(m) Plumb Bob: A plumb bob is a weight on a string that is used to establish a vertical line or plumb line. In plumbing, a plum b bob can be used to check that a pipe or other fixture is perfectly vertical, which is essential for proper drainage and water flow. The plumb bob is attached to the top of the pipe or fixture and the weight hangs down, indicating whether the object is perfectly vertical or not. (Fig. 2.50)

Fig 2.50 Plumb Bob

(n) Spirit Level: A spirit level, also known as a bubble level or plumb rule, is a commonly used tool in plumbing to ensure that pipes, fixtures, and other components are installed level. Plumbers use spirit levels to check whether a surface or pipe is perfectly horizontal or vertical, which is important for proper installation and water flow. The tool consists of a long, flat ruler with a bubble level

Fig 2.51 Spirit level

attached to it. The level is a small, liquid-filled tube with an air bubble in it. (Fig. 2.51).

(o) Spade: A spade, also known as a spade shovel or trenching shovel, is a tool commonly used in plumbing for digging trenches and excavating soil (Fig. 2.52). It has a flat, rectangular blade that is typically made of steel and a long handle for leverage. In plumbing, a spade is used to dig trenches for installing pipes, drain lines, and other plumbing components. The blade of the spade is sharp enough to cut through soil, but also flat enough to create a straight, even trench.

Fig 2.52 Spade

(p) Pickaxe: A pickaxe, also known as a pick or a mattock, is a tool that is sometimes used in plumbing for breaking up hard soil or rocks. In plumbing, a pickaxe may be used in situations where the soil is too hard to dig with a shovel or spade. (Fig. 2.53)

Fig 2.53 Pickaxe

(q) Mortar pan: A mortar pan, also known as a mixing tray or a mud pan, is a shallow, rectangular tray that is commonly used in plumbing for mixing cement, mortar, or other building materials. In plumbing, a mortar pan is used to mix small batches of cement or mortar for tasks such as setting toilet flanges or installing tile. The shallow shape of the pan allows for easy mixing and spreading of the material, and the sloping sides make it easy to scoop out the mixture with a trowel or other tool. (Fig. 2.54)

Fig 2.54 Mortar pan

(r) Manson's square: A Mason square, also known as a framing square, is a tool that is commonly used in plumbing for measuring and marking right angles and ensuring that pipes and other plumbing components are installed correctly. It consists of two arms that meet at a 90-degree angle and can be made of metal or plastic. (Fig. 2.55)

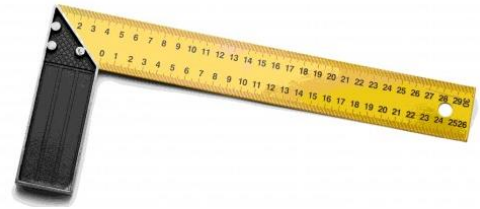


Fig 2.55 Mason's Square

(s) Water level tube: A water level tube, also known as a water level or water pipe level, is a simple and effective tool used in plumbing to measure the level of water between two points. It consists of a clear plastic tube filled with water and is typically between 25 and 50 feet in length. (Fig. 2.56)

Fig 2.56 Water Level tube

Using of water level tube:
In plumbing, a water level tube is used to determine the difference in elevation between two points or to determine if a surface is level. To use the tool, one end of the tube is placed at the s
starting point and the other end is moved to the end point. The tube is then held level, and the water will naturally settle to the same level in both ends of the tube. The difference in elevation between the two points can then be determined by measuring the distance from the water level in the tube to the ground at each point.
Water level tubes are useful in plumbing for tasks such as installing drainage pipes, ensuring that pipes are sloped correctly to promote proper water flow, and for determining the levelness of floors and other surfaces.

2.7 IMPORTANCE OF WATER PROPERTIES, PRESSURE AND FLOW RATE.

Water properties are important in plumbing systems as they impact the integrity, efficiency, and safety of the system. Water properties are crucial in plumbing systems for several reasons:

1. **Corrosion and Scaling**: The chemical composition and pH of water can greatly impact the plumbing system. Water with high mineral content or acidity levels can lead to corrosion of pipes, fittings, and fixtures over time.

2. Scaling and Blockages: Water hardness, determined by the concentration of dissolved minerals, can cause scaling and blockages in pipes and fixtures.

3. Bacterial Growth: Certain water properties, such as temperature, pH, and nutrient content, can influence the growth of bacteria in the plumbing system.

4. Pipe Sizing and Design: Water properties, specifically density and viscosity, play a role in determining the pipe sizing and design.

Plumbing and piping systems completely depend on the water flow and pressure. For example, if the water pressure is too high or too low in your plumbing system, it can damage equipment such as pipes and fixtures.

Flow rate is the amount of fluid that moves through an open channel or closed pipe, and the pressure is the internal pressure inside the pipe. The greater the differential pressure, the higher the flow rate is.

The general term “pressure” is the continuous physical force exerted against or on a contacted object. But, water pressure is the force exerted on the water to push it through a piping system or larger plumbing application.

There is a very close relationship between water flow and pressure, an increase in pressure also increases the flow rate. Therefore, changes in the pressure will directly change the flow rate.

Monitoring flow and pressure are essential in the following applications:

- Monitoring and controlling water in taps
- Dosing chemicals to water treatment systems
- Leakage detection and reduction
- Monitoring water consumption in commercial and residential buildings
- Monitoring discharge water and influent water quantity
- Monitoring the flow of water between reservoirs.

2.8 CAPILLARY ACTION AND THERMAL EXPNSION IN PLUMBING

Capillary action and thermal expansion are two important phenomena in plumbing that can have significant effects on the performance and integrity of plumbing systems.

2.8.1 Capillary Action

Capillary action is the ability of a liquid to flow against gravity in narrow spaces or capillary tubes. In the context of plumbing, capillary action plays a role in the movement of water within small gaps, cracks, or porous materials.

Importance in Plumbing:

- **Soldering**: Capillary action is utilized in soldering copper pipes. When heated, the solder melts and is drawn into the gap between the pipes through capillary action, creating a strong and leak-proof joint.
- **Water Leakage**: Capillary action can also contribute to water leakage in plumbing systems. If there are small cracks or gaps in pipe fittings or seals, water can be drawn into these spaces through capillary action, resulting in leaks. Proper sealing and maintenance are essential to prevent such issues.

2.8.2 Thermal Expansion

Thermal expansion refers to the increase in volume or size of a substance in response to an increase in temperature. In plumbing systems, thermal expansion occurs when water or other fluids heat up, causing the pipes and components to expand.

Importance in Plumbing:

- **Stress on Pipes**: Thermal expansion can exert significant stress on plumbing pipes, fittings, and fixtures. If the system is not designed to accommodate the expansion, it can lead to pipe failures, leaks, or damage to connections and joints. Therefore, proper measures must be taken to allow for thermal expansion.
- **Expansion Tanks**: In closed plumbing systems, where there is no outlet for the expanded water, an expansion tank is used. It provides a space for the increased volume of water, relieving pressure and preventing potential damage to the system.
- **Piping Design**: Plumbing systems should be designed to allow for thermal expansion by incorporating expansion joints or flexible connectors. These components accommodate the movement caused by thermal expansion, reducing the risk of pipe damage and improving the overall longevity of the system.

ACTIVITIES

Activity 1: Visit a local sanitary shop and identify various types of plumbing fixture.

Material required

1. Pen
2. Pencil
3. File

Procedure

1. Visit a sanitary store.
2. Identify various plumbing fixtures available there and make a list.
3. Ask for the price and technical details (size, capacity, make) of the fixtures and note down in your file. 4. Collect pamphlets of the same, if available.

Activity 2: Practice joining pipes using plumbing tools.

Material required

1. Joints
2. Pipe
3. Tools—hacksaw, cutter, brush, clamp
4. Adhesive

Procedure

1. Collect the pipe joints, pipes and tools—hacksaw, cutter, brush and clamp.
2. Identify the parts to be joined.
3. Collect the joints.
4. Join the pipe with help of a pipe jointing adhesive.

Activity 3: Identify the various fixtures and fittings used in the bathroom and toilet.

Material required

1. Pen
2. Pencil
3. File

Procedure

1. Go to your bathroom and toilet.
2. Identify the fixtures and fittings used there.
3. Make a list of these in your practical file.

CHECK YOUR PROGRESS

A. Answer the following:

1. Define the following:

a) Building Sewer
b) Escutcheon
c) Float operated valve
d) Nipple
e) Dwelling

2. Explain any two types of pipes with its uses.
3. Write the functions of the following:

a) Elbow
b) Gasket
c) Coupling
d) Valve

4. State air valves and its use.
5. Describe Parallel side valves with its importance in plumbing system.

B. Fill in the blanks

1. A pipe fitting used for joining two ends of pipe neither of which can be turned is known as ……..
2. …….. is used for change in pipe size for meeting hydraulic flow requirement.
3. …….. valve is placed at any entry of the pipe.
4. …….. is used as one-way valves allows water to be sucked through the valve with a pump and when water flow stops the backflow of water.
5. …….. are hand tools for tightening and loosening nuts and bolts.

C. Match the following

	Part A		Part B
1.	IS 1239	a	Specify the requirement s of electric resistance welded steel pipes.

2.	IS 3589	b	Guidelines for underground gravity sanitary sewers using flexible pipes.
3.	IS 12371	c	Installation of polyethylene pipes for irrigation and installation.
4.	IS 15337	d	Specification for steel tubes used for water, gas, steam and airline.

Module 3	**PREPARATION FOR PLUMBING INSTALLATION AND MAINTENANCE**

Module Overview

This module focuses on the essential aspects of planning, safety, and environmental considerations in plumbing work. It highlights the role of plumbing drawings in guiding installations and the importance of work schedule planning for efficiency. The module explains safe handling and storage of plumbing materials and discusses measures to prevent water contamination, erosion, and sedimentation. Additionally, it outlines the consequences of not following standard procedures and provides guidance on reporting and handling workplace hazards effectively.

Learning Outcomes

After completing this module, you will be able to:

- Understand the role of plumbing drawings in plumbing installations.
- Plan and schedule plumbing work efficiently.
- Implement measures to prevent water contamination, erosion, and sedimentation.
- Recognize the impact of not following standard procedures and report hazards in the workplace.

Module Structure

3.1 Role of Plumbing Drawing
3.2 Importance of the planning of work schedule
3.3 Safe handling and storage of plumbing materials

3.4 Measures to Avoid water contamination, erosion and sedimentation in plumbing work
3.5 Disadvantages and impact of not following defined procedures in plumbing work
3.6 Process of the reporting and handling hazards at the work place

The success of any plumbing installation or maintenance project depends heavily on thorough preparation. Adequate preparation ensures that the plumbing system is installed correctly, functions efficiently, and can be easily maintained in the long run. This chapter serves as a comprehensive introduction to the critical aspects of preparation required before undertaking plumbing installation and maintenance tasks.

Preparation for plumbing installation and maintenance also encompasses careful measurement and assessment of the site, including the identification of existing plumbing infrastructure, water supply sources, and potential challenges. Additionally, considerations such as pipe sizing, material selection, and fixture placement are vital in ensuring the proper functioning of the plumbing system.

3.1 ROLE OF PLUMBING DRAWINGS

A **plumbing drawing** is used to show clearly the location of fixtures, sanitary ware, pipework, valves and so on, and illustrates how fresh water is to be supplied into a building and waste water removed.
All plumbing system has their respective plans, riser diagram, installation details, legends, notes etc. In the drawing, marked are the pipe sizes. In a detailed drawing, the fixer units are also mentioned along with the pipe specifications.
In the case of shop drawings, the pipe details in the crossing areas must be specified and drawn.
The pipes for different purposes are displayed in different colours for easy understanding of the arrangement.

3.1.1 Types of Plumbing Drawings in Construction

The drawings that are included in plumbing drawings are:

1. Water Supply System Drawings
2. Irrigation System Drawings
3. Storm-water System Drawings
4. Drainage System Drawings

The set of all plumbing system mentioned above has their respective plans, riser diagram, installation details, legends, notes etc.

1. Water Supply System Drawings - The water supply system drawings include:

- Hot water piping
- Cold Water Piping

- Hot water returns piping system

In the water supply system drawings, the respective pump capacity and the number of pumps employed must be specified in the drawing file.

2. Drainage System Drawings - The drainage system drawings include:
Waste Piping, soil Piping and vent piping.
The drainage pipes are shown in figure with a slope. In drainage drawings, the manhole schedule must be shown. A manhole schedule consists of manhole name, invert level, the cover level, depth, which are clearly specified in the drawing.

3. Storm-Water System Drawings
Storm water system is a system that is constructed in order to manage the water coming from rainfall and runoff.

4. Irrigation System Drawings
Irrigation system is a method of artificially supplying water to conduct irrigation through canals, dams etc.

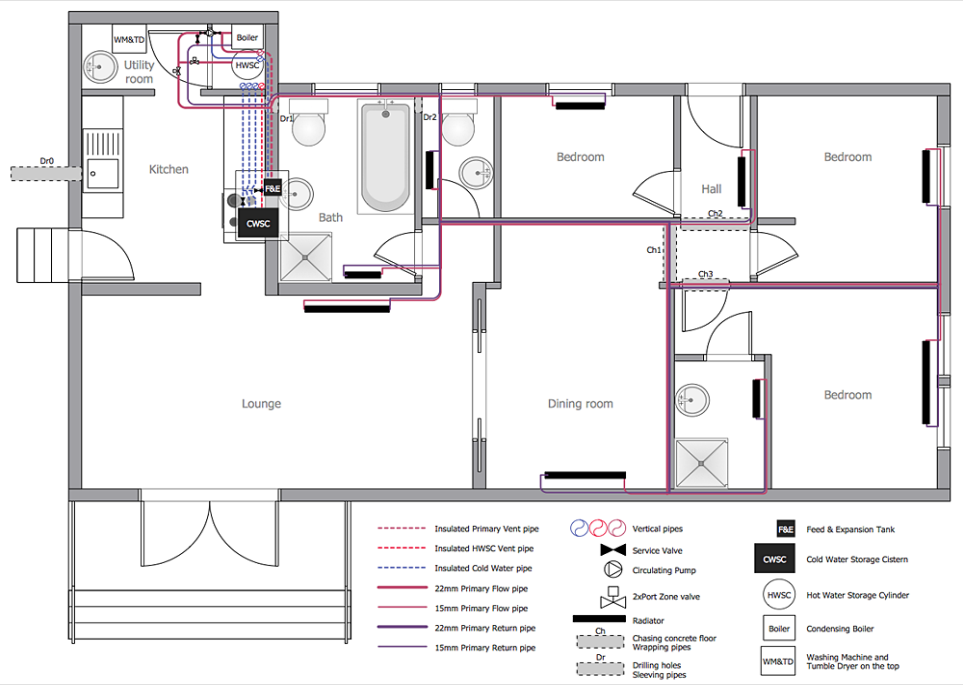


Fig 3.1 Plumbing Drawing of a residential house

3.2 IMPORTANCE OF THE PLANNING OF WORK SCHEDULE

In the plumbing sector, the planning of work schedules and work-related information is of paramount importance. Here's the reasons of the same:

1. **Timely Service Delivery**: Plumbing issues often require immediate attention, especially in cases of leaks, pipe bursts, or sewage problems. By planning work schedules, plumbers can prioritize emergency calls and allocate resources accordingly.
2. **Resource Management**: Planning work schedules allows plumbers to optimize the allocation of resources such as tools, equipment, and materials. By having a clear plan, they can ensure they have the necessary supplies readily available, reducing downtime and the need for multiple trips to the supplier.
3. **Coordination and Collaboration**: In plumbing projects that involve multiple plumbers or teams, planning becomes crucial for effective coordination and collaboration. By sharing work schedules and work-related information, plumbers can align their efforts, avoid overlaps or conflicts, and work together seamlessly. This coordination enhances productivity and streamlines project completion.
4. **Client Communication**: Planning work schedules allows plumbers to communicate with clients proactively.
5. **Safety and Compliance**: Plumbing work often involves handling hazardous materials, working with complex systems, and following specific regulations and codes.

3.3 SAFE HANDLING AND STORAGE OF PLUMBING MATERIALS

Proper care of plumbing tools and equipment properly can save a lot of time and money in the long run. It helps to ensure technician ability to do job in the best of his abilities. For proper usage and maintenance of plumbing resources, it is necessary to follow the key considerations:

- **Store your plumbing tools, equipment with care**

  It is necessary that each tool type has a separate compartment in toolbox, as this will help to stop them coming into contact with others that could damage them.

  Similarly, some tools which may even have their own special storage instructions — like torque wrenches, which need to be loosened at the spring to prevent weakening should be followed.

  If we are keeping tools and equipment in storage room, it must be ensured that there is no humidity in the room otherwise it may damage to plumbing tools and equipment. For better protection, keep dehumidifier, silica gel packs, or rust collectors and anti-rust liners.

- **Clean your plumbing tools after every use**

  For proper usage and maintenance of plumbing resources, it is necessary to clean plumbing tools and equipment after every use whereas other non-used tools should be properly wiped with cotton cloth. Hand tools which look dirty can be cleaned in a bowl of hot soapy water and wiped with dry cloth.

- **Inspect your plumbing tools, equipment frequently**

  Plumber technician must Inspect their tools regularly which help to prolong their life. Plumbers should be encouraged to check their tools for any signs of damage after every use to ensure so that their work is made easier, safer and of a high-standard. Caring properly for your tools increases the life of tools and equipment longer.

3.4 MEASURES TO AVOID AIR AND WATER CONTAMINATION, EROSION AND SEDIMENTATION IN PLUMBING WORK

To avoid air and water contamination, erosion, and sedimentation in plumbing work, it is important to implement several measures. Here are some key measures to consider:

1. **Proper Installation and Maintenance:** Ensure that all plumbing systems, including pipes, fittings, valves, and fixtures, are installed correctly and maintained regularly. This helps prevent leaks, which can lead to water contamination and erosion of surrounding soil.
2. **Backflow Prevention**: Install backflow prevention devices, such as backflow preventers and air gaps, in plumbing systems. These devices prevent the reverse flow of contaminated water into the potable water supply, thus avoiding water contamination.
3. **Cross-Connection Control**: Implement proper cross-connection control measures to prevent the mixing of potable and non-potable water sources. This includes using appropriate backflow prevention devices and ensuring separation of plumbing systems that carry different types of water.
4. **Proper Waste Disposal**: Establish proper waste disposal systems for plumbing work, including the disposal of debris, chemicals, and other waste materials. Ensure compliance with local regulations for the safe and environmentally friendly disposal of plumbing-related waste.
5. **Erosion and Sediment Control**: Implement erosion and sediment control measures during plumbing construction or repair projects. This may involve using erosion control blankets, sediment barriers, or silt fences to prevent soil erosion and sediment runoff into water bodies.

6. **Adequate Site Drainage**: Properly design and maintain site drainage systems to prevent water pooling, which can lead to erosion and sedimentation issues. Install drainage systems that effectively channel water away from sensitive areas and prevent water accumulation.
7. **Soil Stabilization**: Take measures to stabilize the soil around plumbing installations to prevent erosion. This may include using erosion control fabrics, hydroseeding, or vegetation to reinforce the soil structure and prevent erosion.
8. **Proper Chemical Handling**: Handle and store chemicals used in plumbing work safely and according to manufacturer instructions. This helps prevent accidental spills or leaks that can contaminate air or water sources.
9. **Compliance with Regulations**: Stay updated with local, regional, and national plumbing and environmental regulations. Ensure that all plumbing work adheres to these regulations to minimize the risk of contamination, erosion, and sedimentation.

3.5 DISADVANTAGES AND IMPACT OF NOT FOLLOWING DEFINED PROCEDURES IN PLUMBING WORK

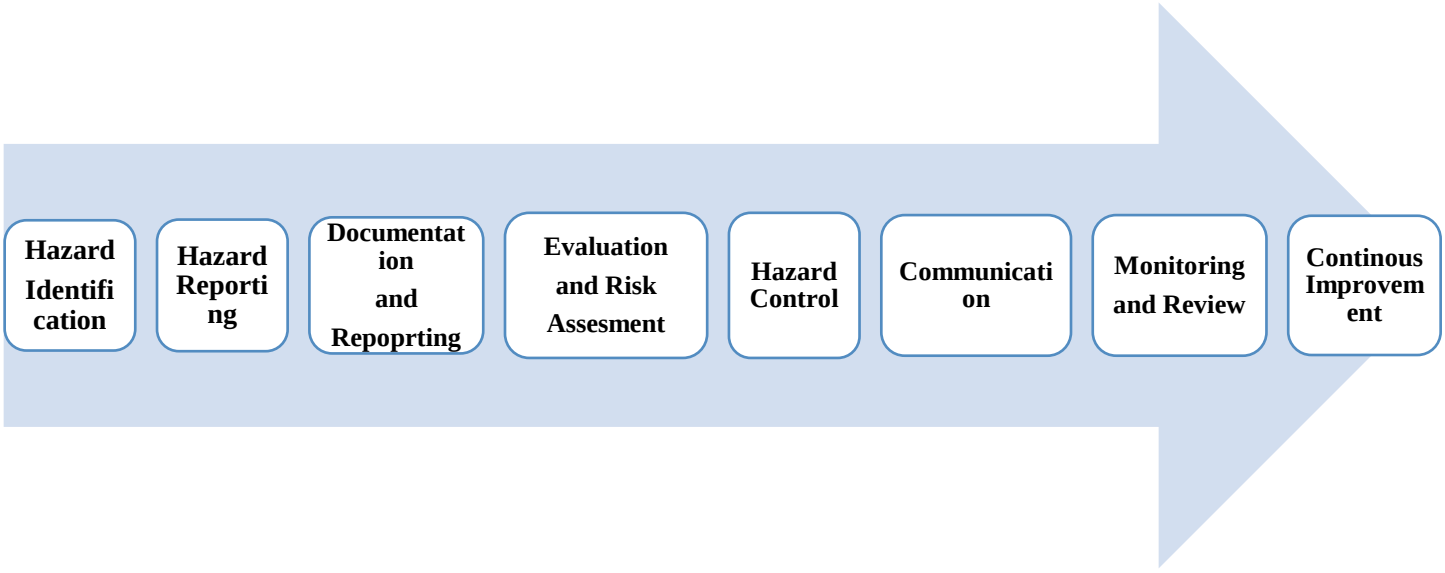
Not following defined procedures in the plumbing sector can have serious consequences. It can compromise safety, result in poor quality work, lead to legal and regulatory problems, damage reputation, increase costs, harm the environment, and result in customer dissatisfaction. Adhering to defined procedures is essential to ensure professionalism; safety, quality, and customer satisfaction in the plumbing industry. Here are some impact points:

- **Safety Risks**: Not following defined procedures increases the risk of accidents and injuries to both plumbers and occupants of the building. Improper handling of tools, equipment, and hazardous materials can lead to severe injuries or even fatalities.
- **Quality Issues**: Neglecting defined procedures can result in poor quality workmanship. This can lead to plumbing failures, leaks, water contamination, and other issues that may require costly repairs or replacements.
- **Legal and Regulatory Consequences**: Failure to adhere to defined procedures may result in legal and regulatory consequences. Plumbers and plumbing companies may face fines, penalties, or legal action if they are found to be in violation of building codes, environmental regulations, or safety standards.
- **Reputation Damage**: Poor workmanship, safety incidents, or violations of regulations can damage the reputation of plumbing professionals and companies. Negative word-of-mouth, customer complaints, and online reviews can harm business prospects and lead to a loss of trust from potential clients.
- **Increased Costs**: Not following defined procedures can lead to rework, additional repairs, and increased costs. Fixing mistakes, addressing customer complaints, or dealing with legal issues can significantly impact the profitability of plumbing projects.

- **Environmental Impact**: Negligence in plumbing work can result in environmental harm, such as water contamination or improper waste disposal. This can lead to ecological damage, harm to aquatic life, and contamination of water sources.
- **Customer Dissatisfaction**: When plumbing work is not performed according to defined procedures, customers may experience ongoing issues, disruptions, or inconveniences. This can lead to dissatisfaction, negative reviews, and a loss of repeat business.

3.6 PROCESS OF THE REPORTING AND HANDLING HAZARDS AT THE WORK PLACE

Reporting and handling hazards at the workplace is crucial for maintaining a safe and healthy working environment for employees. The process typically involves the following steps:



1. **Hazard Identification**:

Regular inspections: Conduct routine inspections of the workplace to identify potential hazards.
Employee input: Encourage employees to report any hazards they observe or experience during their work.

2. **Hazard Reporting**:

Reporting mechanism: Establish a clear procedure for reporting hazards, including designated individuals or departments responsible for receiving and documenting reports.
Reporting channels: Provide multiple channels for reporting hazards, such as a dedicated reporting system, email, or in-person reporting.

3. **Documentation and Recording**:

Incident reports: Require employees to complete incident reports detailing the nature of the hazard, its location, and any relevant details.
Photos or evidence: Encourage employees to provide visual documentation, such as photographs, if applicable.
Centralized database: Maintain a centralized database or system to record and track reported hazards for future reference.

4. Evaluation and Risk Assessment:

Assessing severity: Evaluate the severity of the reported hazard and its potential impact on employee safety and health.
Risk analysis: Conduct a thorough risk assessment to determine the likelihood and consequences of the hazard.
Prioritization: Prioritize hazards based on their severity and potential for harm.

5. **Hazard Control**:

Immediate action: Take immediate steps to control or mitigate the identified hazard to minimize the risk to employees.
Corrective measures: Implement appropriate measures to eliminate or reduce the hazard, such as engineering controls, administrative controls, or personal protective equipment (PPE).
Review and approval: Ensure that hazard control measures are reviewed and approved by relevant stakeholders, such as safety officers or management.

6. Communication:

Notify employees: Communicate the identified hazards and their control measures to employees, emphasizing their roles and responsibilities in maintaining a safe workplace.
Training and education: Provide necessary training and education programs to ensure employees are aware of hazards and know how to handle them safely.

7. Monitoring and Review:

Ongoing monitoring: Regularly monitor the workplace for any changes in hazards or the effectiveness of control measures.
Periodic reviews: Conduct periodic reviews of hazard reports, control measures, and incident data to identify trends or patterns and make necessary improvements.

8. Continuous Improvement:

Feedback and suggestions: Encourage employees to provide feedback and suggestions for improving hazard reporting and handling processes.
Learn from incidents: Analyse incidents and near-misses to identify underlying causes and implement preventive measures.

ACTIVITIES

Activity 1: The objective of this activity is to engage class 9 students in learning about safety procedures in a plumbing system through a relay-style game.

Materials Needed:

1. Printouts of plumbing system safety procedures (one for each team)
2. Stopwatch or timer
3. Whistle or bell
4. Whiteboard or large chart paper
5. Markers or coloured pens

Procedure:

1. Divide the students into teams of 4-5 members each. Ensure that each team has a mix of different abilities and strengths.
2. Introduce the activity by discussing the importance of safety in plumbing systems and the potential risks involved.
3. Provide each team with a printout of plumbing system safety procedures.
4. Explain that the activity will involve a relay-style game where teams will compete against each other to demonstrate their understanding and application of safety procedures.
5. Set up the relay course by marking four stations using the whiteboard or chart paper. Label each station as follows: Station 1 - "Identify the Hazard," Station 2 - "Select the Correct Safety Measure," Station 3 - "Demonstrate the Safety Measure," and Station 4 - "Explain the Safety Procedure."
6. Explain the tasks at each station:
   a. Station 1: Each team member must identify a potential hazard related to plumbing systems written on the whiteboard/chart paper.
   b. Station 2: Teams must select the correct safety measure from a set of options provided.
   c. Station 3: One team member must physically demonstrate the selected safety measure.
   d. Station 4: Another team member must explain the safety procedure in detail, including why it is essential.
7. Start the relay by blowing the whistle or ringing the bell.
8. The first member of each team moves to Station 1 and identifies a hazard as quickly as possible. Once done, they move to Station 2 and select the correct safety measure.
9. The second member then proceeds to Station 3, where they demonstrate the safety measure chosen by their teammate.
10. The third member moves to Station 4 and explains the safety procedure in detail.
11. After completing Station 4, the team returns to the starting point, and the next member starts the relay from Station 1.
12. The team that completes all stations correctly and in the shortest time wins the relay.
13. Conduct multiple rounds if time permits, allowing different team members to take on different roles.

After the activity, gather all teams and discuss the hazards, safety measures, and procedures covered during the relay. Encourage questions and clarify any doubts

CHECK YOUR PROGRESS

A. Answer the following

1. What are the impacts of not following the procedures in plumbing work?
2. Why planning of work schedule is important?
3. What are the measures to avoid air and water contamination in plumbing work?
4. Explain step by step process of reporting and handling hazards at the workplace?

B. Match the following

	Part A		Part B
1.	Hot and cold-water piping	a.	Drainage system drawing
2.	Waste, Soil and Vent Piping	b.	Water supply system drawing
3.	Water coming from rainfall/runoff	c.	Irrigation system drawing
4.	Water to conduct irrigation through canals	d.	Storm water system drawing

Module 4 INSTALLATION OF WATER SUPPLY SYSTEM

Module Overview

This module covers key aspects of water distribution systems and plumbing installations. In this module, various types of water distribution systems used in buildings and outlines various techniques for installing water piping have been discussed. The module also focuses on the use of supports, hangers, and restraints in plumbing systems. It explores the characteristics of metals used in plumbing and discusses the process of electrolysis and its associated problems when dissimilar metals are used together. Additionally, the module covers the processes of measuring, marking, fitting, and testing pipelines to ensure proper installation and functionality.

Learning Outcomes

After completing this module, you will be able to:

- Understand the process and types of water distribution systems in buildings.

- Apply various techniques for installing water piping systems.
- Identify the role of supports, hangers, and restraints in plumbing systems.
- Recognize the characteristics of metals used in plumbing and their applications.
- Understand the process of electrolysis and the issues related to using dissimilar metals.

Module Structure

Water supply installation involves a series of coordinated steps and careful planning to ensure the efficient flow and distribution of water from its source to the end users. It requires expertise in plumbing, hydraulic engineering, and adherence to safety and regulatory standards. A successful installation not only ensures the availability of water but also focuses on factors like water quality, pressure, conservation, and the longevity of the system.

4.1 PROCESS OF WATER DISTRIBUTION

Water distribution plays a crucial role in ensuring a reliable and safe water supply to different settings, including municipal areas, residential complexes, and private setups. The process of water distribution involves several steps and infrastructure to deliver water from its source to the end users. Let's explore the typical process of water distribution in each of these setups:

1. Municipal Water Distribution:

Source: The primary source of water for municipalities is usually rivers, lakes, reservoirs, or groundwater wells. Water is collected from these sources and undergoes various treatment processes to ensure its quality.

Treatment: Water is treated at water treatment plants to remove impurities, disinfect it, and make it safe for consumption.

Storage and pumping: Treated water is stored in reservoirs or water towers, which are elevated structures that provide water pressure for distribution. Whereas, pumping stations are used to push water through a network of pipes to ensure an adequate supply to all areas within the municipality.

Distribution Network: A system of pipes and valves carries water from the pumping stations to various neighbourhoods, streets, and individual households.

Metering: Water meters are installed at each residential or commercial property to measure the amount of water consumed for billing purposes.

2. Residential Water Distribution:

Connection: In residential setups, individual properties are connected to the municipal water supply network through service lines.

Pressure Regulation: Pressure regulators or pressure-reducing valves are installed to maintain an optimal and consistent water pressure within the property.

Internal Plumbing: Water is distributed within the residential property through a network of pipes, fixtures (such as faucets and showers), and fittings.

Hot Water Supply: In addition to cold water, residential setups often have a water heating system to provide hot water for various purposes. Hot water is typically supplied through a separate network of pipes connected to a water heater.

Water Storage: Some residential properties may have water storage tanks or cisterns to store water for backup or specific uses like irrigation.

4.2 TYPES OF WATER DISTRIBUTION NETWORK

A water distribution system is a collective system with components that are designed to carry water from the main water supply network to households. Different types of water distribution systems are used for supplying water.

The components such as pipes, pumps, fittings valves, storage tanks, etc. help in the water supply to meet the consumer needs. The main purpose of the water distribution system is to distribute quality water to the residents.

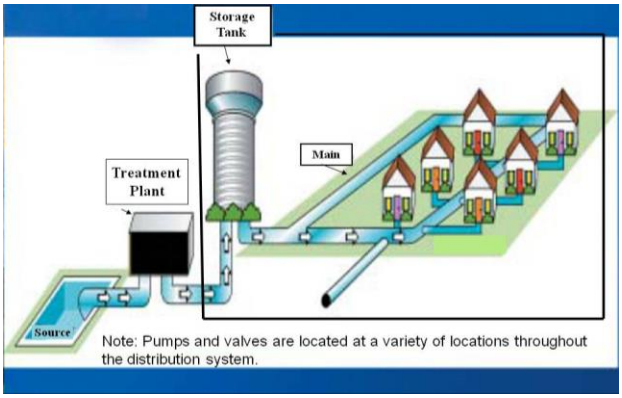


Fig 4.1 Water Distribution System

4.2.1 Design Principles of Water Distribution System

The distribution system must be:

- Capable of supplying water to all the water required areas with sufficient pressure heads.
- It should be designed in such a way; the water supply must not be disturbed while carrying out any repair or maintenance work in any section of the system.
- It must be capable of supplying the required amount of water during firefighting.
- The system must be water-tight to reduce leakage chances.
- The quality of water must not be compromised in the distribution pipes.
- The distribution pipe must be laid one meter away or above the sewer lines.
- Factors like water pressure, initial capital cost, and maintenance and operational cost must consider while designing.

4.2.2 Types of Water Distribution Systems

There are 4 different types of water distribution systems, as mentioned below:

1. Dead End System
2. Radial System
3. Grid Iron System
4. Ring System

1. Dead-End System

In this type of water distribution system, many sub-main pipelines are connected to a single main pipeline that runs along the centre of the building. Dead end water distribution system is also known as the Tree system.

The sub-main pipelines are further divided from both sides into branches that connect various service areas of the building. This system is most suitable for unsystematic areas like old towns and cities with definite patterns of roads.

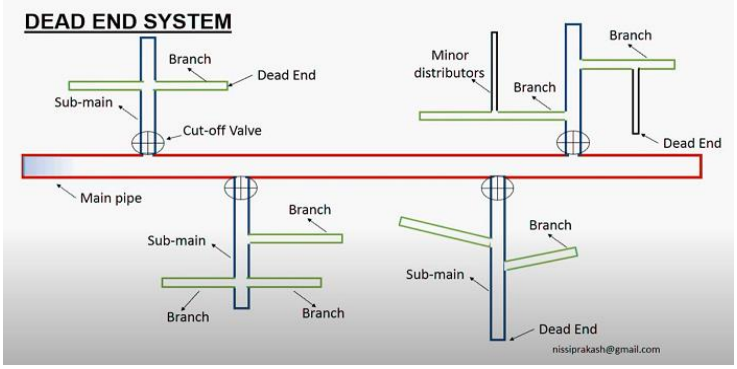


Fig 4.2 Dead End System

2. Radial System

In a radial system, the area is divided into various zones. The main water supply pipeline is connected to the distribution reservoir or storage tank which is kept in the middle of each zone.

Then supply pipes are laid radially (as shown in the figure) from the distribution reservoir to households.

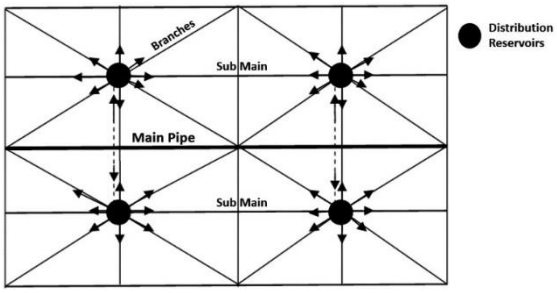
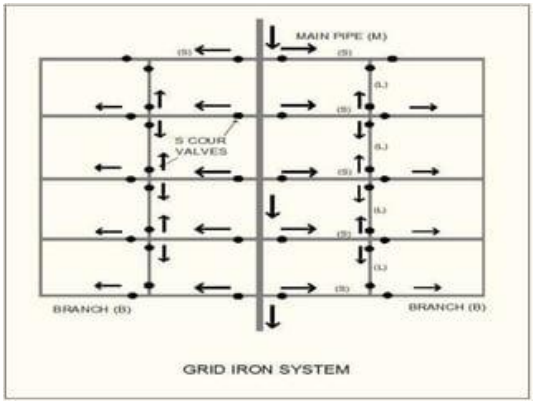


Fig 4.3 Radial System

3. Grid Iron System

In a grid-iron system, the main pipeline, sub main pipeline, and branch pipelines are interconnected to each other in the form of a grid system. A Grid-iron water distribution system is also known as an interlaced system or reticulation system. The requirement of the total length of the pipeline is more due to more connections and it helps to maintain water pressure evenly.



A Grid-iron water distribution system is best suited for modern well-planned cities as the water main pipeline and branches are laid in a rectangle layout.

Fig 4.4 Grid Iron System

4. Ring Distribution System

In this water distribution system, the whole system is enclosed by the main pipeline in a radial or rectangular shape. Smaller areas are enclosed by the sub-main pipeline. In case of any failure of one system, a very small area will be affected.

The area ahead of the affected area can get water from other system points. The ring distribution system requires a higher number of valves. In this system, water can be supplied to any point from two directions.

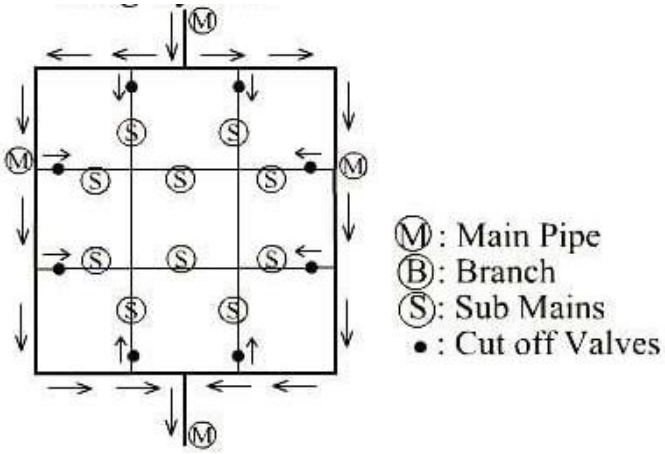


Fig 4.5 Ring Distribution System

4.3 VARIOUS TECHNIQUES OF INSTALLING THE WATER PIPING SYSTEM IN A BUILDING

There are various techniques used in installation of water piping system in a building such as:

1. Over-Ground Piping:

- Over ground piping refers to the installation of water pipes on the surface of walls, ceilings, or any visible area of the building

- This technique is commonly used in industrial setups, where the pipes are exposed and easily accessible for maintenance and repairs.
- Over ground piping is also used in certain residential or commercial buildings where aesthetics and architectural design considerations allow for visible piping.

Fig 4.6 Over-Ground Piping

1. Underground Piping:

- Underground piping involves the installation of water pipes beneath the ground surface.
- This technique is commonly used for water supply lines entering the building from the main water source, such as the municipal water supply line or well water supply.
- Underground piping protects the pipes from external elements and minimizes the risk of damage due to weather conditions or accidental impacts.
- It requires excavation and proper backfilling to ensure the stability and protection of the pipes.

Fig 4.7 Underground Piping

3. Piping Embedded in Concrete:

- Piping embedded in concrete refers to the installation of water pipes within the concrete structure of the building, such as the foundation, slabs, or walls.
- This technique is commonly used in construction projects where the water pipes need to be concealed within the structural elements of the building.
- It requires careful planning during the construction phase to ensure proper pipe routing and coordination with other building services.

Fig 4.8 Piping embedded in concrete

4. Concealed Piping:

- Concealed piping involves the installation of water pipes behind walls, ceilings, or within false ceilings.
- This technique is commonly used in residential and commercial buildings to achieve a clean and uncluttered aesthetic appearance.

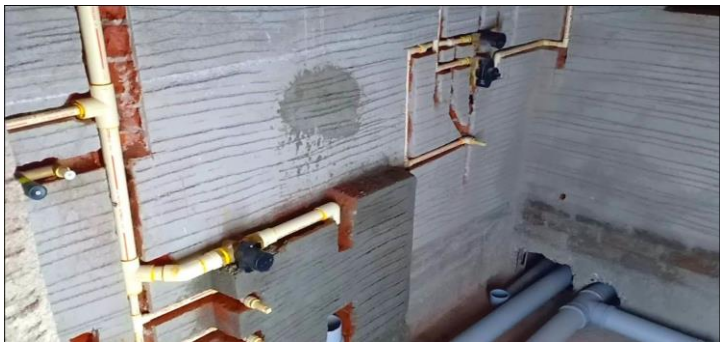


Fig 4.9 Concealed Piping

- Concealed piping requires proper coordination with other trades, such as electrical and HVAC, to avoid conflicts and ensure easy accessibility for maintenance and repairs.
- It may involve the use of access panels or removable sections for future maintenance needs.

5. Wall Mounted Piping:

- Wall-mounted piping refers to the installation of water pipes on the surface of walls, typically using brackets or hangers.
- This technique is commonly used in exposed areas or where accessibility and maintenance are important considerations.
- Wall-mounted piping is often seen in industrial buildings, utility rooms, or areas where aesthetics are not a primary concern.

4.4 SUPPORTS, HANGERS AND RESTRAINTS

Different types of supports, hangers, and restraints are used in water plumbing systems to ensure proper alignment, stability, and support for the pipes. These components help prevent excessive movement, vibration, sagging, or damage to the piping system.

Here are some properties and characteristics of commonly used supports, hangers, and restraints:

1. Pipe Supports:

- **Pipe Clamps:** These are u-shaped or round clamps that securely hold the pipe in place. They are often made of metal, such as steel or stainless steel, and provide stability and support.

Fig 4.10 Pipe Clamps

- **Pipe Saddles:** These are curved supports that cradle the bottom of the pipe to prevent excessive sagging or movement. They are typically used for horizontal piping runs.

Fig 4.11 Pipe Shoes

- **Pipe Shoes:** Pipe shoes are supports designed to bear the weight of the pipe at specific intervals, typically where the pipe is anchored or changes direction.

- **Pipe Rollers:** Pipe rollers are cylindrical rollers that allow for the smooth movement of the pipe, particularly in cases where thermal expansion and contraction occur.

2. Hangers:

- **Split Ring Hangers:** Split ring hangers consist of a metal ring that wraps around the pipe and is attached to a support structure. They provide vertical support and allow for easy installation or removal of the pipe.
- **Clevis Hangers:** Clevis hangers consist of a metal strap that holds the pipe and is connected to a supporting structure using a threaded rod. They provide vertical support and can be adjusted for pipe height.

Fig 4.12 Pipe Hangers

- **J-Hooks**: J-hooks are shaped like the letter "J" and provide support for horizontal piping runs. They are attached to a structural component, such as beams or joists.
- **Swivel Ring Hangers:** Swivel ring hangers allow for 360-degree rotation of the pipe, accommodating thermal expansion and contraction. They are often used in long piping runs.

2. Restraints:

- **Pipe Anchors:** Pipe anchors are used to prevent pipe movement in a specific direction. They are typically installed at points where the pipe changes direction or terminates.

Fig 4.13 Pipe Anchors

- **Pipe Guides:** Pipe guides help control the movement of the pipe along a specific path, preventing lateral displacement. They are often used in conjunction with anchors.

Fig 4.14 Pipe Guides

- **Expansion Joints:** Expansion joints provide flexibility in the piping system, allowing for thermal expansion and contraction. They absorb movements caused by temperature variations, reducing stress on the pipes and fittings.

Fig 4.15 Expansion Joints

Important properties and considerations for these supports, hangers, and restraints include:

- Material strength and durability to support the weight and pressure of the pipe.
- Adequate corrosion resistance, especially in environments with high moisture or chemical exposure.
- Compatibility with the pipe material to prevent galvanic corrosion or damage.
- Easy installation and adjustability to accommodate changes in the piping system.
- Compliance with relevant plumbing codes and standards to ensure safety and reliability.

4.5 CHARACTERSTICS OF METALS USED IN PLUMBING PIPES

Different metals are commonly used in plumbing materials, each with its own characteristics and properties.

Here are some of the key metals used in plumbing and their associated fabrication methods:

1. **Copper:**

   Characteristics: Copper is a widely used metal in plumbing due to its excellent corrosion resistance, durability, and malleability. It is known for its antimicrobial properties, making it suitable for potable water systems.

   Fabrication Methods: Copper can be fabricated using various methods, Including soldering, brazing, or compression fittings. Soldering is commonly used with copper pipes and fittings, where a filler metal (solder) is melted and used to join the copper parts.

2. Galvanized Steel:

Characteristics: Galvanized steel is steel that has been coated with a layer of zinc to protect against corrosion. It is strong, durable, and less expensive compared to other metals. However, it is susceptible to corrosion over time and may affect water quality.

Fabrication Methods: Galvanized steel pipes and fittings are typically joined using threaded connections. Pipe threads are cut, and fittings are screwed onto the pipe, creating a sealed connection. Welding can also be used for specific applications.

3. Stainless Steel:

Characteristics: Stainless steel is highly resistant to corrosion, making it suitable for plumbing systems exposed to harsh environments or corrosive fluids. It is strong, durable, and can withstand high temperatures and pressures.

Fabrication Methods: Stainless steel can be fabricated using welding techniques, such as TIG (Tungsten Inert Gas) or MIG (Metal Inert Gas) welding. These methods fuse the stainless-steel components together to form strong and leak-free connections. Press-fit or compression fittings are also commonly used with stainless steel pipes.

4.6 PROCESS OF ELECTROLYSIS AND PROBLEMS ASSOCIATED WITH THE USE OF DISSIMILAR METALS

Electrolysis refers to the process of chemical decomposition or corrosion of a metal caused by an electric current passing through an electrolyte solution. When dissimilar metals are in contact with each other in the presence of an electrolyte, such as water or moisture, electrolysis can occur. Here's an overview of the process of electrolysis and the problems associated with the use of dissimilar metals:

4.6.1 Process of Electrolysis:

Electrolyte: An electrolyte is a solution that contains ions and facilitates the flow of electric current. In the case of electrolysis in plumbing systems, water or moisture acts as the electrolyte.

Dissimilar Metals: When dissimilar metals, such as copper and steel, come into contact within the plumbing system, an electrochemical cell is formed.

Anode and Cathode: Within the electrochemical cell, one metal becomes the anode (where oxidation occurs), and the other metal becomes the cathode (where reduction occurs).

Electric Current: An electric current flow between the anode and cathode through the electrolyte, resulting in the transfer of metal ions from the anode to the cathode.

Metal Corrosion: The metal ions released from the anode cause corrosion or degradation of the anodic metal, leading to potential damage or failure of the plumbing system.

4.6.2 Problems Associated with the Use of Dissimilar Metals:

1. Galvanic Corrosion: One of the main problems associated with dissimilar metals is galvanic corrosion. When two dissimilar metals are in contact in the presence of an electrolyte, the more active (less noble) metal acts as the anode and corrodes more rapidly, while the less active (more noble) metal acts as the cathode and is protected.

2. Pipe Deterioration: Galvanic corrosion can cause deterioration of the metal pipes, leading to leaks, weakened structural integrity, and reduced lifespan of the plumbing system.

3. Water Quality Issues: The corrosion products and metal ions released during galvanic corrosion can contaminate the water supply, resulting in issues related to water quality, taste, and odour.

4. Electrolyte Imbalance: Electrolysis can alter the pH and chemical composition of the electrolyte solution, potentially causing further corrosion and damage to the plumbing system.

5. Increased Maintenance and Repair: The presence of dissimilar metals and galvanic corrosion may require more frequent maintenance and repairs, adding to the overall cost and inconvenience.

To mitigate the problems associated with dissimilar metals, several preventive measures can be taken, including:

1. Isolating dissimilar metals using insulating materials, such as dielectric unions or plastic sleeves.
2. Using sacrificial anodes, such as zinc or magnesium, to protect the more noble metal by attracting corrosion and sacrificially corroding themselves.
3. Employing proper plumbing design and material selection to minimize the contact between dissimilar metals.
4. Ensuring proper bonding and grounding techniques to reduce the potential for stray electrical currents that can exacerbate electrolysis.

4.7 MEASURING AND MARKING OUTPROCESSES FOR FABRICATION OF PIPES

Measuring and marking out processes are crucial in the fabrication of pipes to ensure accurate and precise cuts, fittings, and connections. Additionally, allowances need to be considered to accommodate the specific requirements of the pipe installation. Here's an overview of the measuring and marking out processes for pipe fabrication and the allowances to be considered:

Measuring and Marking Out Processes:

1. **Determine Pipe Length**: Measure the required length of the pipe by using a measuring tape or ruler. Ensure accurate measurements by aligning the measuring device with the end of the pipe.
2. **Marking for Cuts**: Mark the pipe at the desired cutting point using a marker or scribe. Make sure the marking is clear and visible to guide the cutting process.

3. **Transferring Measurements**: Transfer measurements from one pipe to another by aligning the two pipes and marking the desired measurement point on the second pipe.
4. **Marking for Fittings:** Identify the location of fittings, such as elbows or tees, and mark the pipe accordingly. This ensures proper alignment and fitting of the components during assembly.

4.7.1 Allowances to Consider in Measurement

- **Pipe End Preparation**: Allowances need to be considered for pipe end preparation, such as bevelling or threading. These preparations ensure proper fitting and connection with other pipe components.
- **Expansion and Contraction**: Allowances for expansion and contraction due to temperature variations should be considered, especially for materials like metal, which can expand or contract significantly.
- **Fitting Dimensions**: Consider the dimensions of fittings, such as elbows or tees, when measuring and marking the pipes. This ensures accurate positioning and alignment of the fittings during installation.
- **Overlap for Joining**: Allowances for overlap should be considered when marking pipes for joining or welding. This provides enough material for a strong and secure connection.

Standard Measuring Procedures

- **Centre-to-Centre**: In this method, measurements are taken from the centre of one pipe to the centre of the next pipe. This is commonly used for aligning pipes in parallel or for determining the spacing between pipes.
- **End-to-Centre**: This procedure involves measuring from the end of one pipe to the centre of the adjacent pipe. It is often used when connecting pipes to fittings or equipment.
- **End-to-End**: Measurements are taken from the end of one pipe to the end of another pipe. This is typically used when determining the overall length of a pipe run.

It's essential to follow standard measuring procedures and take accurate measurements to ensure proper fabrication and assembly of pipes. Using precise measuring tools, such as rulers, tapes, or callipers, can help achieve accurate measurements.

4.8 FIT- OFF PROCESS IN PLUMBING

Fit-off processes in plumbing refer to the final stages of installation where various components are connected, sealed, and secured to complete the plumbing system. Several principles underlie these fit-off processes, ensuring proper functioning, reliability, and longevity of the plumbing system.

Here are the key principles underlying various fit-off processes in plumbing:

1. **Leak-Free Connections**: One of the fundamental principles in plumbing fit-off processes is to achieve leak-free connections. This involves ensuring that pipes, fittings, valves, and other components are securely joined together to prevent any water or fluid leakage. Proper techniques, such as appropriate sealing methods or the use of suitable jointing materials, are employed to achieve tight and reliable connections.
2. **Proper Alignment and Positioning**: Fit-off processes emphasize the importance of proper alignment and positioning of plumbing components. This includes aligning pipes, fittings, and fixtures accurately to ensure smooth flow and efficient operation. Correct alignment and positioning also contribute to the overall aesthetics and functionality of the plumbing system.
3. **Adequate Support and Stability**: Plumbing fit-off processes incorporate the principle of providing adequate support and stability to the installed components. This involves using suitable supports, hangers, and restraints to secure the pipes, ensuring they are properly supported to prevent sagging, excessive movement, or damage. Proper support and stability help maintain the integrity and longevity of the plumbing system.
4. **Appropriate Sealing and Waterproofing**: Fit-off processes involve incorporating effective sealing and waterproofing measures to prevent water leakage and damage. This includes using appropriate sealants, gaskets, or O-rings at joints, connections, and penetrations to create watertight seals. Waterproofing measures are also implemented to protect surrounding areas from water damage, particularly in wet or moisture-prone locations.
5. **Compliance with Plumbing Codes and Standards**: Fit-off processes adhere to plumbing codes and standards set by relevant authorities. These codes ensure the proper installation, materials, and techniques are employed to meet safety, health, and performance requirements. Compliance with plumbing codes and standards is crucial in ensuring the plumbing system meets legal and regulatory obligations.
6. **Consideration of Thermal Expansion and Contraction**: Fit-off processes consider the thermal expansion and contraction of pipes and components due to temperature variations. Allowances are made to accommodate these movements, ensuring that the plumbing system can withstand thermal stresses without causing damage or leakage. Expansion joints or other techniques may be employed to allow for controlled movement and mitigate the effects of thermal expansion and contraction.

4.9 INSPECTION AND TESTING OF PIPELINES

To ensure the proper functioning of pipework installed in a plumbing system, various test procedures are conducted. These tests help identify any issues, leaks, or deficiencies in the

installation and ensure that the system operates efficiently. Here are some common test procedures to check the proper functioning of pipework:

1. **Visual Inspection**: A visual inspection is the first step to assess the overall condition of the installed pipework. It involves visually examining the pipes, fittings, joints, and connections for any visible defects, such as cracks, misalignments, or improper supports. This inspection helps identify any obvious issues that may affect the proper functioning of the system.
2. **Pressure Test**: A pressure test is performed to verify the integrity and tightness of the installed pipework. This test involves pressurizing the system with water or air to a specific pressure level and monitoring for any pressure drops or leaks. The pressure is maintained for a specified duration to ensure the system can sustain the intended operating pressure without any significant loss.

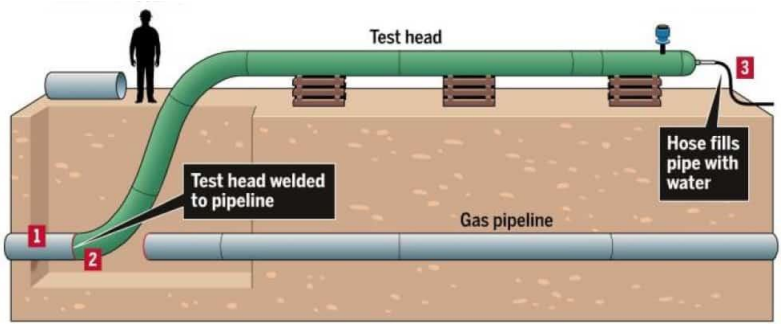


Fig 4.15 Pressure Test

3. **Flow Test:** A flow test measures the actual flow rate of water through the installed pipework. This test helps determine if the system is capable of delivering the desired flow and pressure to various fixtures and outlets. Flow tests are conducted at different points in the system to identify any restrictions, blockages, or imbalances in the flow.

4. **Leak Detection**: Leak detection tests are conducted to identify any hidden or small leaks in the pipework. This may involve visually inspecting joints, fittings, and connections for signs of water leakage, such as water stains, dampness, or puddles. Alternatively, specialized tools like leak detectors or infrared cameras may be used to identify leaks that are not easily visible.

5. **Functional Testing**: Functional tests are performed to ensure that all fixtures, valves, and controls connected to the pipework operate as intended. This includes checking the proper functioning of faucets, toilets, showers, and other plumbing fixtures for water flow, temperature control, and drainage. Valves and controls are tested to verify their operation and ensure they can effectively control the flow and shut off the water supply when required.

6. **Water Quality Testing**: Water quality testing may be conducted to assess the cleanliness and safety of the water flowing through the installed pipework. This involves sampling and analysing water samples for parameters such as pH, turbidity, microbial contamination, and chemical composition. Water quality tests help ensure that the water supplied through the system meets the required standards and is safe for use.

ACTIVITIES

Activity: To understand joint Assembly and undergo leak testing

Objective: To understand the process of assembling different types of plumbing joints and performing leak testing.

Materials needed:

1. Various plumbing fittings (elbows, couplings, tees, etc.)
2. Pipes of appropriate sizes
3. Plumber's tape or thread sealant
4. Pipe wrenches or adjustable wrenches
5. Bucket or container for water

Procedure:

1. Divide the students into small groups and provide them with the necessary materials.
2. Instruct each group to select a specific type of joint and demonstrate the assembly process step by step.
3. Guide the students through the proper techniques for preparing the pipe ends, applying sealants or flux, and tightening the joint.
4. Once the joints are assembled, instruct the students to perform a leak test. Fill a bucket or container with water and submerge the joint in water.
5. Observe if any bubbles appear, indicating a leak. Encourage the students to troubleshoot and make necessary adjustments to achieve a leak-free joint.
6. Discuss the importance of proper joint assembly and leak testing in plumbing systems, emphasizing the need for secure connections to prevent water leaks and ensure efficient operation.
7. Valve Operation and Flow Control: Objective: To explore the function and operation of different types of valves used in plumbing systems.

CHECK YOUR PROGRESS

A. Answer the following

1. State the process of water distribution in residential systems.
2. Write down the design principles of water distribution system.
3. What do you mean by concealed piping?
4. Write characteristics and fabrication method of stainless-steel piping.
5. What is fit off process in plumbing?

B. Fill in the blanks

1. Pipe …….. is U or round shaped that securely hold pipes in place.
2. Pipe …….. is curved supports that cradle at the bottom of the pipe to prevent excessive sagging or movement.
3. Pipe …….. is used to prevent pipe movement in specific direction.
4. …….. Joints allow the pipe for thermal expansion and contraction.
5. …….. Test is performed to test the integrity and tightness of installed pipeline.

C. Match the following

	Type of water distribution system		Description
1.	Radial System	a.	Many sub pipelines are connected to singles main pipeline that runs along centre
2.	Dead End system	b.	Main water supply pipeline is connected to the distribution
3.	Ring distribution system	c.	Main, sub main and branch pipeline are interconnected to each other in the form of grid
4	Grid Iron System	d.	Whole system is enclosed by main pipeline in radial or rectangular shape

Module 5	INSTALLATION OF DRAINAGE SYSTEM

Module Overview

This module covers the essential processes involved in the installation and maintenance of drainage systems in buildings. It discusses the wastewater drainage process, types of drainage systems, and the benefits of an effective drainage system. The module explores the components and materials used for sewer pipe installation and outlines the step-by-step process for installing residential sewer lines. This module also covers the use of traps and fittings in the drainage system, precautions to be taken during drainage work, and the basics of sewage treatment at home using a septic tank. Additionally, it addresses post-installation checks, tests, and the necessary signages to be put up after plumbing work is completed.

Learning Outcomes

After completing this module, you will be able to:

- Understand the process and types of wastewater drainage systems in buildings.
- Identify the components and benefits of an effective drainage system.
- Identify materials suitable for sewer pipe installation.
- Install residential sewer lines and drainage systems following a step-by-step process.
- Understand the use of traps and fittings in the drainage system.
- Explain the process of sewage treatment at home using a septic tank.
- Perform post-installation checks and tests to ensure proper system function.
- Identify the appropriate signages to display after completing plumbing work.

Module Structure

5.1 Process of waste water drainage in buildings
5.2 Type of Drainage system in buildings
5.3 Benefits of drainage system in buildings
5.4 Components of Drainage system
5.5 Materials efficient for sewer pipe installation
5.6 Process of installation of residential sewer line

5.7 Step by Step process of installation of drainage system in residential building
5.8 Fittings – Trap used in drainage system
5.9 Precautions for drainage work
5.10 Sewage Treatment at Home with septic tank
5.11 Post Installation and Pre-commissioning test and checks
5.12 Signages to be put after completion of plumbing work

The arrangement provided in a house or building for collecting and transporting waste water through drain pipes, by gravity, to join either a public sewer or a domestic septic tank, is termed house drainage or building drainage. Whether it's a residential building, commercial complex, or infrastructure development, effective drainage plays a vital role in maintaining the structural integrity and functionality of the site. A well-designed drainage system ensures the efficient removal of excess water, preventing water accumulation and potential damage to the property.

5.1 PROCESS OF WASTE WATER DRAINAGE IN BUILDINGS

The process of wastewater drainage in buildings involves a well-designed and implemented system that effectively collects and transports wastewater from various sources within the building to the municipal sewage system or a treatment facility. This process ensures the safe and hygienic removal of wastewater, preventing contamination and maintaining a clean and healthy environment. Here is an overview of the typical steps involved in the wastewater drainage process in buildings:

- **Collection Points**: Wastewater is generated from different sources in a building, such as sinks, toilets, showers, and washing machines. Each source is equipped with a drain or waste pipe that connects to the main drainage system.
- **Drainage System Design**: A proper drainage system design is crucial to ensure the efficient flow of wastewater. It includes determining the layout of the pipes, sizing them appropriately, and establishing the correct slope to allow gravity-driven flow.
- **Drainage Pipes**: The drainage system consists of different types of pipes, including soil pipes, waste pipes, and vent pipes. Soil pipes are larger in diameter and carry wastewater from toilets, while waste pipes handle wastewater from other sources. Vent pipes provide ventilation to the system, preventing the building of pressure and allowing for proper drainage.
- **Traps and Ventilation**: Traps are installed at each fixture to prevent foul odours, gases, and pests from entering the building. These traps retain a small amount of water, forming a barrier that blocks the passage of gases. Ventilation pipes, connected to the drainage system, allow the release of trapped gases and maintain equal pressure within the system.

- **Gravity Flow:** The drainage system is designed with a slight downward slope to facilitate the flow of wastewater through the pipes. Gravity aids in the movement of wastewater from higher floors to lower floors and eventually to the main sewage system or a treatment facility.
- **Building Connections**: The drainage system of a building is connected to the main sewage system or a local wastewater treatment facility. Proper connections and fittings, such as couplings and inspection chambers, are installed to ensure a secure and watertight connection.
- **Maintenance and Inspection**: Regular maintenance and inspection of the drainage system are essential to identify and address any blockages, leaks, or other issues. This includes periodic cleaning of traps, removal of debris, and clearing of any obstructions within the pipes.

Wastewaters coming from the kitchen sink, washbasins and urinals are not containing any solid matter. But sewage a solid material has to be treated such that it also could be converted as wastewater.

NEED FOR TREATMENT OF SEWAGE

Nearly 80% of the water supplied returns back in the form of wastewater. As there is a need for a water supply system, there is an equal necessity to dispose of the wastewater. The night- soil and urinary content of domestic sewage (originating from residential areas) consists of potentially most dangerous organisms. Such organisms are responsible for the occurrence and spread of water-borne diseases.

5.2 TYPE OF DRAINAGE SYSTEMS IN BUILDINGS

The drainage system comprises a well-arranged network of drainage pipes, and this system is used to get rid of human waste. Drainage systems pipes which are generally used are copper, CPVC, and HDPE pipes. These are made of plastic which makes them rust-free and lightweight. They have low maintenance and easy installations. These pipes are pocket friendly and economical.

1. **Surface Drainage System**: This system removes excess water from the surface of the land. This is important for the removal of extra water from the surface of the ground which is done with the help of improved natural channels or constructed drains. Surface systems are further classified into Regular Surface systems and Controlled Surface systems, the details of which are discussed below:

- A regular surface drainage system starts to function when there is excess rainfall or irrigation operated entirely by gravity.
- A controlled surface drainage system consists of check gates placed in the surroundings of flat basins like those in flatlands.

2. **Subsurface Drainage System:** This system lowers the water table and helps in the removal of excess water through open ditches. During wet times the water table gets lowered so as to keep the root zone unsaturated. This system can again be categorized into two types which are relief drains and interceptor drains. Relief drains are used to lower the water table for the purpose of serving vegetation and also for improving the surface water.

3. **Slope Drainage System**: It is built in such a way that it allows water to flow in a downward direction. This is done through fine quality pipes with a downward direction. The minimum slope that is required for the water to run off is 1%. The floor must be sloped to the drain at a tolerance of only 1% – 2% grade. On an excellent slope system, polymer concrete underlayment will be a cost-effective alternative.

4. **Downspout & Gutter Drainage System**: The gutter system consists of two parts:
   - Gutter channels that run horizontally along the roof edge.
   - A downspout that carries the collected water down to grade level.

   The Gutter downspout is a vertical pipe that is attached and helps the water to move out of the gutters away from the building, ensuring that all the waste is separated safely through the system. The downspout also redirects water and safely leads it away from the building toward the designated drainage area. If they are clear of clogs and properly installed, they will protect the building's foundation from water damage.

The type of drainage system also depends on the types of plumbing system adapted in the particular building such as single stack, double pipe etc.

5.3 BENEFITS OF DRAINAGE SYSTEM IN BUILDINGS

It prevents water accumulation which can cause flooding. It helps direct the water away from the building and helps to stop the accumulation of water, which can encourage mosquitos to breed. A good system in a building helps in the removal of access water in any area which is affected by floodwater or rainwater. It serves the purpose of removing wastewater effectively; this system is called a sewer system. The benefit of a drainage system can be seen when accumulated water is flushed out along with the waste in a systematic order and a strong network that helps to get rid of unwanted clogging, which results in maintaining a healthy condition in a building.

- Provides a better environment for plant growth.
- Helps to increase microbial decomposition.
- Improves the physical properties of the soil.
- Maintains proper soil temperature.

- Enhances better root system.
- It helps in the removal of toxic substances.
- May increase the life of the building.
- It helps to prevent water-borne diseases.

5.4 COMPONENTS OF DRAINAGE SYSTEM

A drainage system is designed to remove excess water or wastewater from an area efficiently and prevent flooding or water accumulation. Various components work together to achieve this purpose. Here are the functions of the main components of a typical drainage system:

- **Drainage Pipes**: Drainage pipes are the primary channels through which water flows. They are typically made of materials like PVC, concrete, or metal. The main function of drainage pipes is to collect and transport water away from the area. They are laid underground and connected to various fixtures and outlets.

Fig 5.1 PVC Drainage Pipes

- **Catch Basins**: Catch basins, also known as storm drains or gratings, are openings or grates located at ground level. They are connected to the drainage pipes and serve as collection points for surface water runoff. Catch basins prevent debris, leaves, and large objects from entering the drainage system, thus ensuring smooth water flow.

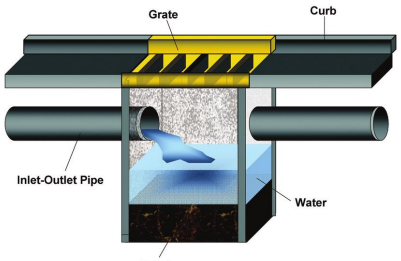


Fig 5.2 Catch Basin

- **Manholes**: Manholes are access points to the underground drainage system. They are typically round or rectangular covers that allow personnel to enter for inspection, maintenance, or repairs. Manholes provide access to the drainage pipes at specific intervals along their route.

Fig 5.3 Manholes

- **Storm water Inlets**: Storm water inlets are similar to catch basins but are designed to collect water specifically from roads and paved surfaces. They are strategically placed along the sides of roads to capture storm water runoff and prevent flooding on the streets.

- **Downspouts and Gutters**: Downspouts and gutters are components of the roof drainage system. They collect rainwater from rooftops and guide it away from the building's foundation. Gutters collect water and direct it to downspouts, which then discharge the water into the drainage system or a designated area.

Fig 5.4 Downspouts

- **Grading and Sloping**: Grading and sloping refer to the shaping of the land to promote proper water drainage. The land is graded in such a way that it slopes away from buildings and towards the drainage system. This allows gravity to assist in moving water away from the area efficiently.

- **Drainage Outfalls**: Drainage outfalls are the points where the collected water is discharged into natural water bodies such as rivers, lakes, or the ocean. These outfalls are usually equipped with structures or mechanisms to control the flow of water and prevent erosion.

Fig 5.5 Drainage outfall

- **Retention and Detention Basins**: Retention and detention basins are large, excavated areas designed to hold excess water temporarily. Retention basins store water permanently, while detention basins temporarily hold water during heavy rainfall events. These basins help control water flow, reduce the risk of flooding, and prevent downstream erosion.

- **Check Valves and Backwater Valves**: Check valves are one-way valves installed in drainage systems to allow water to flow in one direction only. They prevent backflow, which can occur during flooding or sewer backups. Backwater valves are specialized check valves that prevent wastewater from flowing back into the building's plumbing system.

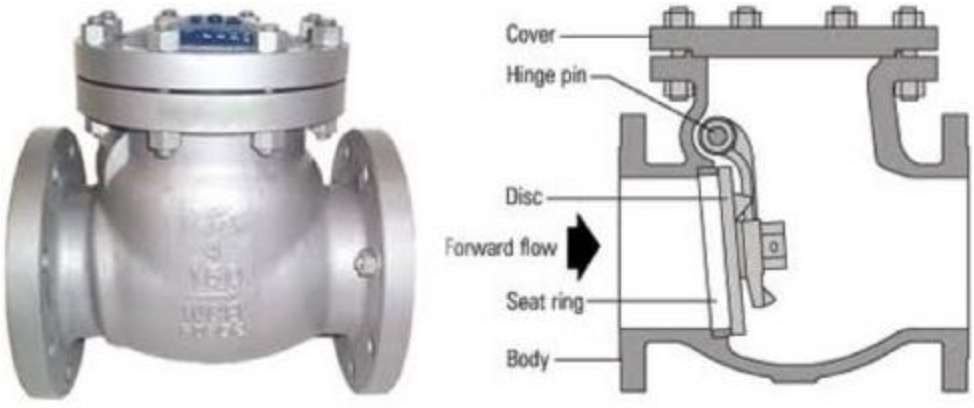


Fig 5.6 Check Valves

Each component of a drainage system plays a crucial role in managing water and preventing water-related issues. By working together, they ensure efficient water removal, reduce the risk of flooding, and protect the surrounding environment.

5.5 MATERIALS EFFICIENT FOR SEWER PIPES

The critical element to consider while scouting for the sewer line from house to street is lifespan. Moreover, the time frame of materials will determine their ability to withstand natural conditions. Here are some of the common materials used.

1. Concrete

Currently, most experts postulate concrete as the go-to choose, especially for buried infrastructure. Moreover, concrete is meant to last for long with minimal maintenance needed. Concrete is readily available, resistance to rot and can be used in any situation.

Furthermore, concrete is eco-friendly and usually lasts for long periods without degradation. However, concrete requires regular inspections, and they are susceptible to breakage during installation; hence they require proper care and handling.

2. Steel

Steel pipes are durable, strong and resistant but has being gradually becoming unpopular. Keep in mind steel pipes come in two types: galvanized iron and cast iron. Among the drawbacks of using steel, they are prone to rust which reduces their longevity. Rust then necessitate frequent repairs and replacements. Additionally, steel is costly from creating them to procurement and transportation.

3. Plastic:

Most contractors love to refer to them as the first option due to their ease of use. Moreover, they can be procured in different lengths, lightweight and last for long. Furthermore, experts recommend the use of plastics, especially in areas prone to earthquakes. Plastic pipes are currently gradually replacing cast iron pipes. Since they are few problems with pipeline maintenance, and the plastic pipes also feature convenient construction and high strength.

5.6 PROCESS OF INSTALLATION OF RESIDENTIAL SEWER LINE

The most challenging task is in the installation process, thus calling for expertise. Besides, the sewer pipe that links your house to the main sewer line or the municipal branch is known as a lateral. A lateral is a 4- inch pipe buried below the frost line in a sloped and well-prepared trench. The slope determines how the pipe will drain via the force of gravity.

Here are the procedures to follow when installing a new sewer line:

1. Determine the Pipe's Depth

Always begin by deciding the elevation of each pipe. Most residential installations start from the house' main drain usually exist on the foundation. The line then proceeds to join with the city's main branch at a connection point called a tap. You can use a GPS or laser level to determine the elevations.

2. Compute the Slope

The results gotten from the depth and the pipe's length provide the basis for slope computations.

The total drop in elevation= Ending Elevation – Starting Elevation.

To get the Slope= (The total Drop) / (The entire run or length of the pipe)

The standard minimum slope for most laterals is usually 2 feet per every drop 100 feet of run or 2%. Even though the actual slope could be steeper than the target, the variation should be within the local code's requirements. Moreover, a steep slope will favor running of liquids more than solids leading to clogs. Subsequently, a shallow slope will not generate sufficient velocity for efficient drainage.

3. Dig the trench and Lay the Bleeding

Proceed to dig the trench with caution to minimize disturbance of the soil. Soil disturbance can be minimized by compacting. This can only be done by having sufficient knowledge of the pipe's termination point and digging a narrow trench. Moreover, ensure the canal is smooth, compacted and follows the desired slope. Use sand to slope the soil and fine-tune the area before laying the pipes.

4. Install the Pipe

Install each pipe starting with the lower end of the line and run towards the high elevation. The bell end of each pipe section should be installed facing up the hills to reduce leakages. At the house ends' use of at least two cleanouts for easier access of the pipe during cleaning with sewer auger or during scoping.

5. Back Fill the Trench

Once the installation is complete and has satisfied all inspection requirements, proceed to backfill the trench. Begin with a layer of sand to eliminate voids and protect the pipe. Finish with added layers of soil while compacting each layer to prevent future settling.

5.7 STEP BY STEP PROCESS OF INSTALLATION OF DRAINAGE SYSTEM IN RESIDENTIAL BUILDING

The installation process for a sewage drainage system in a residential building typically involves several steps. Here is a step-by-step guide to give you an overview of the process:

1. **Obtain Permits and Approvals**: Before starting any construction work, obtain the necessary permits and approvals from the local authorities. This ensures that the installation complies with building codes and regulations.
2. **Design the System**: Plan the layout of the sewage drainage system. Consider the location of fixtures such as toilets, sinks, showers, and washing machines, and determine the optimal routing for the sewer lines. Ensure that the system maintains the required slope for proper drainage.
3. **Excavation**: Excavate trenches to accommodate the sewer pipes. The depth and width of the trenches depend on the size of the pipes and the slope requirements. Follow local regulations regarding trench dimensions and safety measures.
4. **Install Main Sewer Line**: Begin by installing the main sewer line, which connects the building to the municipal sewer system or a septic tank. Lay the pipe in the trench, ensuring proper alignment and slope. Use appropriate fittings and couplings to connect sections of the pipe.
5. **Install Branch Lines**: From the main sewer line, install branch lines that connect the individual fixtures to the main line. Calculate the required slope for each branch line to ensure proper flow. Use fittings and couplings to connect the branch lines to the fixtures and the main line.
6. **Install Ventilation Pipes**: Install ventilation pipes to prevent the build-up of sewer gases and ensure proper airflow within the system. These pipes are typically connected to the main sewer line and extend vertically through the roof of the building.

7. **Install Traps and Cleanouts**: Install traps beneath each fixture to prevent sewer gases from entering the building. Traps also retain a small amount of water to form a seal that prevents sewer odours from escaping. Additionally, install cleanouts at strategic locations to provide access for maintenance and clearing blockages.
8. **Test the System**: Conduct a thorough testing process to ensure the integrity of the sewage drainage system. This typically includes water testing to check for leaks, proper flow, and the absence of blockages. It may also involve pressure testing to assess the system's ability to handle the expected load.
9. **Backfill the Trenches**: Once the system passes the testing phase, backfill the trenches carefully to cover the pipes. Use suitable backfill material, such as sand or gravel, and compact it in layers to prevent settling.
10. **Obtain Final Inspection and Approval**: Contact the local authorities for a final inspection of the installed sewage drainage system. Upon approval, you can proceed with connecting the system to the municipal sewer or septic tank.

5.8 FITTINGS- TRAP USED IN DRAINAGE SYSTEM

Traps are installed in the drainage system to collect the wastewater. . Entry of foul gases in the house, water seal is used to control the bad smell, in the sewage system. The traps are made of asbestos cement, cast iron, PVC, salt glazed stoneware, etc., which do not get corroded by the wastewater. The traps in common use are P-trap, Q-trap and S-trap. These traps are normally provided after every sanitary fixture as a separate piece or part of the fixture.

P-trap has a vertical inlet with a horizontal outlet which is lower than the inlet level. Between inlet and the outlet, there is an integral U-bend which retains some water forming the water seal. Thus, the waste water entering the inlet passing through the water seal area goes out from the outlet. Similarly, Q-trap has a vertical inlet but an inclined steeper outlet. S-trap has a vertical inlet and an outlet. The waste enters from the top and goes down.

The building drainage is also provided with some other types of traps, which are commonly known as:

(i) Gully trap
(ii) Intercepting trap
(iii) Anti-syphon trap
(iv) Floor trap
(v) Anti-D-trap

(i) **Gully Trap:** This trap is generally provided to collect the wastewater from the washbasins, sinks, baths, etc. The water seal is provided not to allow the foul smell of the sewer to enter the house. Grating or course screen is provided at the inlet to prevent the entry of bigger solid matter into the drainage system to prevent chocking.

Fig 5.7 Gully Trap

(i) Intercepting Trap: To stop foul gases (odour) coming out from the soil or waste pipe in pipe fittings, this trap is used and it is a part of drainage system. In such way, this trap is designed and developed to retain the small quantity of wastewater from the discharge of fittings that stop foul gases or air entering in the building, which is connected as a barrier.

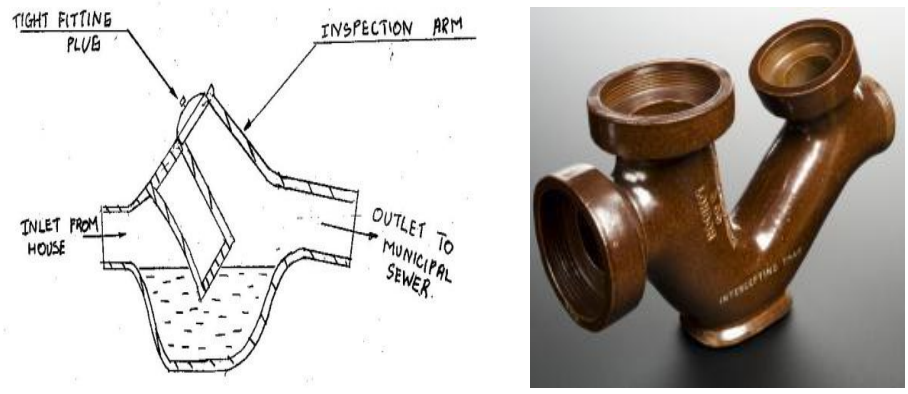


Fig 5.8 Intercepting Trap

(ii) **Anti-syphon Trap:** The anti-siphon trap is used to maintain the water seal, without the installation of trap ventilating or anti-siphon pipes. It is also known as resealing trap.

Fig 5.9 Anti-syphon Trap

(iii) **Floor Trap:** This trap is used to prevent the foul gases entering into the building by providing the water seal and it is known as Nahani Trap (Nahani means bathing place).

Fig 5.10 Floor Trap

(iv) **Anti-D-Trap:** P, Q, S trap are largely used for baths, sink and lavatories. They are made with large mouth so that waste in the pipe may be thoroughly flushed out. But in this trap full bore is not interfered with by the discharge.

Fig 5.11 Anti D -Trap

5.9 PRECAUTIONS FOR DRAINAGE WORK

Do's about Drainage work

- Proper and required slopes to all waste soil pipes and sewer pipes.
- Proper location of holes for outlets before external plaster.
- Curing of cement joints of vertical stacks and sewer pipes.
- Adjoining outlets of bath, W.C. and kitchen should be in one horizontal plane, remember water flows from higher level to lower and water finds its own level in connected pipe system.
- All vertical stacks should be truly vertical, spirit leveler and plumblines must be used to ensure.
- Sewer pipeline should be straight in line and have the required slope in one stretch.
- All traps to be covered with small pieces of gunny bag and plaster of Paris.
- All vertical stacks should be clamped (minimum two per pipe 2 m (6') long).
- All S.W.G. pipes should be laid having collar end in direction off low and the spigot opposite to the direction of the flow.
- Keep pipe drainage system according to building design and keep a copy of the same for records.

DONT's about Drainage work

- Do not fix the nahani trap after final coat of waterproofing treatment.
- Do not alter or change the position of sanitary units after waterproofing treatment.
- Do not start vertical stacks piping before actual marking on the wall.
- Do not neglect the quality of external finishing (plaster) of chamber/manhole.
- Do not forget/neglect to fix the screws/fasteners at the back of the wash hand basin.
- Do not forget to fix the grating for rain water pipe on terrace and spout in the balcony.
- Do not forget to put a cowlon ventilating pipe.

5.10 SEWAGE TREATMENT AT HOME WITH SEPTIC TANK

The sewage from the house flows through the sewerage pipes to the municipal sewerage treatment and disposal plants. Where such facility is not available, septic tanks are constructed. The sewage is directed into these tanks. The effluent come out from septic tank either in a biological fitter or on level or in a sub-surface disposal system. The surface and sub-surface water should not be allowed to go the septic tank. The wastewater may be allowed, only the tank capacity and the means of secondary disposal are able to cope with this quantity.

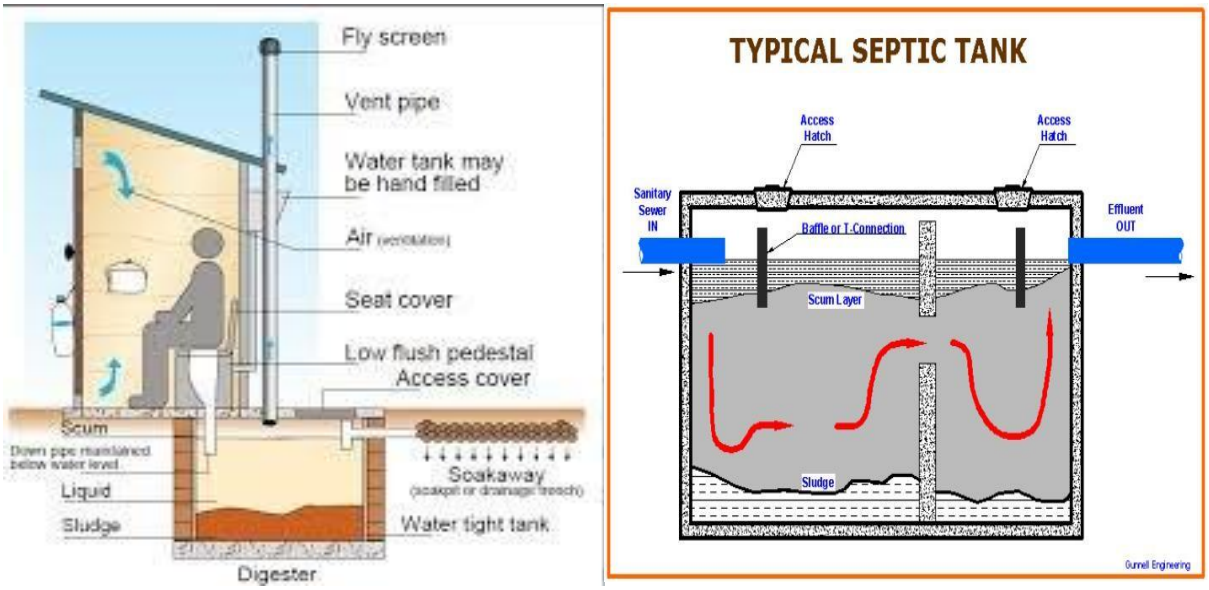


Fig 5.12 Septic Tank

A septic tank should have minimum width of 75 cms, minimum depth of one meter below the water level and minimum liquid capacity of one cubic meter. The length of the tank should be two to four times the width. The suitable sizes of septic tanks for colonies, hostels, boarding schools, etc.

Table5.1: Dimensions of Septic Tank

(a) Colonies

Number of Users	Length of septic tank (m)	Width of septic tank (m)	Depth of liquid level (m)
100	80	2.8	1.0
150	10.6	2.7	1.0
200	12.4	3.1	1.0
300	14.6	3.9	1.0

(b) Hostel and boarding schools

Number of users	Length of septic tank (m)	Width of septic tank (m)	Depth of liquid level (m)
50	5.0	1.6	1.3
100	5.7	2.1	1.4
150	7.7	2.4	1.4
200	8.9	2.7	1.4
250	10.7	3.3	1.4

5.11 POST INSTALLATION AND PRE-COMMISSIONING TESTS AND CHECKS

After the installation of a sewage drainage system in a residential building, several post-installation tests and checks are typically conducted to ensure the system's proper functioning and readiness for commissioning. Additionally, there are pre-commissioning tests that should be performed before the system is put into operation.

5.11.1 Post Installation Tests and Checks:

- **Leakage Test**: Conduct a leakage test to identify any potential leaks in the system. This can

involve visually inspecting all connections, joints, and fittings for signs of water seepage or dampness.

- **Visual Inspection**: Perform a comprehensive visual inspection of the entire sewage drainage system, including the pipes, fittings, cleanouts, traps, and ventilation pipes. Look for any signs of damage, misalignment, or improper installation.
- **Flow Test**: Test the flow of wastewater through the system by running water simultaneously from multiple fixtures. Observe if there are any blockages, slow drainage, or backup issues. This helps ensure that the pipes and the system can handle the expected flow rate.
- **Ventilation Test**: Check the ventilation pipes to ensure that they are clear of obstructions and allow for proper airflow within the system. Improper ventilation can lead to sewer gas buildup and odors.
- **Odor Test**: Check for any foul odors in and around the building, particularly near the fixtures and drain openings. This helps identify any issues with traps, ventilation, or vent pipe connections.
- **Backflow Prevention Test**: Verify that the backflow prevention devices, such as check valves or backwater valves, are properly installed and functioning correctly. This test ensures that wastewater cannot flow back into the building's plumbing system.

5.11.2 Pre-Commissioning Tests:

- **Pressure Test**: Conduct a pressure test to assess the system's ability to withstand the expected operating pressure. This involves pressurizing the system with air or water and checking for any pressure drop or leaks.
- **Water Test**: Fill the system with water and observe if there are any leaks or water seepage. This test helps ensure the integrity of the pipes and fittings.
- **Performance Test**: Test the system's performance by simulating a high flow rate to assess its capacity to handle peak wastewater loads. This test is particularly important for larger residential buildings or buildings with multiple fixtures.
- **Dye Test**: Add a colored dye to the system and flush it through to detect any leaks or cross-connections. This test helps identify any unexpected pathways or connections within the system.
- **Final Inspection**: Schedule a final inspection with the local authorities or building inspector to ensure compliance with relevant building codes and regulations.

5.12 Signages to be put up after the completion of plumbing work

After completing a plumbing task at a site, it is important to have appropriate signage in place to communicate important information and ensure safety. Here are some signages that can be put up:

1. **"Caution: Wet Floor":** If the plumbing task involved water or any liquid that could cause a slippery surface, it is important to place "Caution: Wet Floor" signs in the affected areas to alert people of the potential hazard and prevent slip and fall accidents.

Fig 5.13 Caution sign

2. "**Do Not Enter" or "No Access**": If certain areas need to be restricted due to ongoing plumbing work, potential hazards, or for safety reasons, "Do Not Enter" or "No Access" signs should be placed to clearly indicate that entry is prohibited.

Fig 5.14 Do not enter Sign

3. **"Work in Progress":** To inform people that plumbing work is still in progress, it is helpful to put up "Work in Progress" signs. These signs alert individuals to be cautious and avoid interfering with the ongoing work.

Fig 5.15 Work in Progress

4. **"Restricted Area":** If there are specific areas that are off-limits due to safety concerns or the presence of sensitive equipment or materials, "Restricted Area" signs can be displayed to clearly communicate that unauthorized entry is prohibited.

Fig 5.16 Restricted Area Sign

Remember to comply with any specific signage requirements or regulations set by local authorities and adhere to standard safety practices when selecting and placing signage at the site.

ACTIVITIES

Activity1: Visit to Sewage treatment plant

Material Required

1. Notebook or Copy
2. Pen

Procedure

1. Fix the appointment with sewage treatment plant to visit.
2. Reach the sewage treatment plant as per schedule.
3. Identify the different sewage systems being followed.
4. Identify the different components of sewage treatment plant.
5. Do the handling and operating practice under the supervisor of sewage treatment plant.
6. Draw and write the parts and safety tools.
7. Draw flow charts and give suitable reactions/processes taking place at each level of treatment.

Activity 2: Drawing of sanitary fittings and fixtures

Material Required:

1. Drawing copy
2. Pen and Pencil
3. Scale
4. Rubber/eraser

Procedure

1. Identify the sanitary fittings and fixtures.
2. Make a list the name of sanitary fittings and fixtures.
3. Draw figures of sanitary fittings and fixtures.
4. Label the different parts of the fittings and fixtures.

Activity 3: Write a report about what you learnt as a plumber in the visit of sewage treatment plant.

CHECK YOUR PROGRESS

A. Answer the following

1. Explain the process of waste water drainage in the buildings.
2. What is need of treating the sewage?
3. Define Downspout and Gutter drainage system.
4. State the benefits of providing drainage system in buildings.
5. Why drainage outfall is constructed?
6. State the materials used for construction of sewer pipes.
7. Write the precautions used for drainage work.

B. Fill in the blanks

1. …….. Drainage system removes excess water from the surface of the land.
2. …….. are access points to underground drainage system
3. Storm basin are also called as ……..
4. …….. valves are one-way valves installed in drainage system to allow water to flow in one direction only.
5. …….. traps are used to stop foul gases coming out from waste pipe in fittings.

ANSWER KEY

Unit 1: Introduction to Plumbing sector

B. Fill in the blanks

1. One
2. Indirect
3. Partially vented single stack system
4. Water Management and plumbing Skill Council

Unit – 2 Basics of Plumbing

B. Fill in the blanks

1. Union
2. Reducer
3. Sluice
4. Foot Valve
5. Wrench

C. Match the following

1-d
2-a
3-b
4-c

Unit -3 Preparation of Plumbing Installation and Maintenance

B. Match the following

1-b
2-a
3-d
4-c

Unit-4 Installation of Water Supply System

B. Fill in the blanks

1. Clamps
2. Saddles
3. Anchors
4. Expansion
5. Pressure test

C. Match the following

1-b
2-a
3-d
4-c

Unit -5 Installation of drainage system

B. Fill in the blanks

1. Surface
2. Manholes

3. Catch
4. Check
5. Intercepting

GLOSSARY

Accessory: a thing which can be added to something else in order to make it more useful, versatile, or attractive.

Backfill: to refill (an excavated hole) with the material dugout of it.

Bearing capacity: It is the capacity of soil to support the loads applied to the ground.

Catchment: an area where water is collected from the natural landscape.

Clogging: The process in which any hinder or obstruct that choke or block the flow of liquid.

Conflict: a serious disagreement or argument, typically a protracted one.

Crest: top of a mountain or hill.

Diaphragm: a thin sheet of material forming a partition.

Effluent: sewage or other liquid waste that is discharged into a body of water.

Flange: a flat surface sticking out from an object, used to fix it to something or to make it stronger.

Hydrants: It is an outlet from a fluid main often consisting of an upright pipe with a valve attached from which fluid (e.g. water or fuel) can be tapped.

Junction: a point where two or more things are joined.

Sedimentation: the process of settling or being deposited as a sediment.

Sewage: Sewage is a type of wastewater that is produced by a community or building of people.

Siphonic Action: The action in which atmospheric pressure pushes the liquid up and gravity pulls the liquid down.

Sullage: The wastewater from household sinks, showers, and baths.