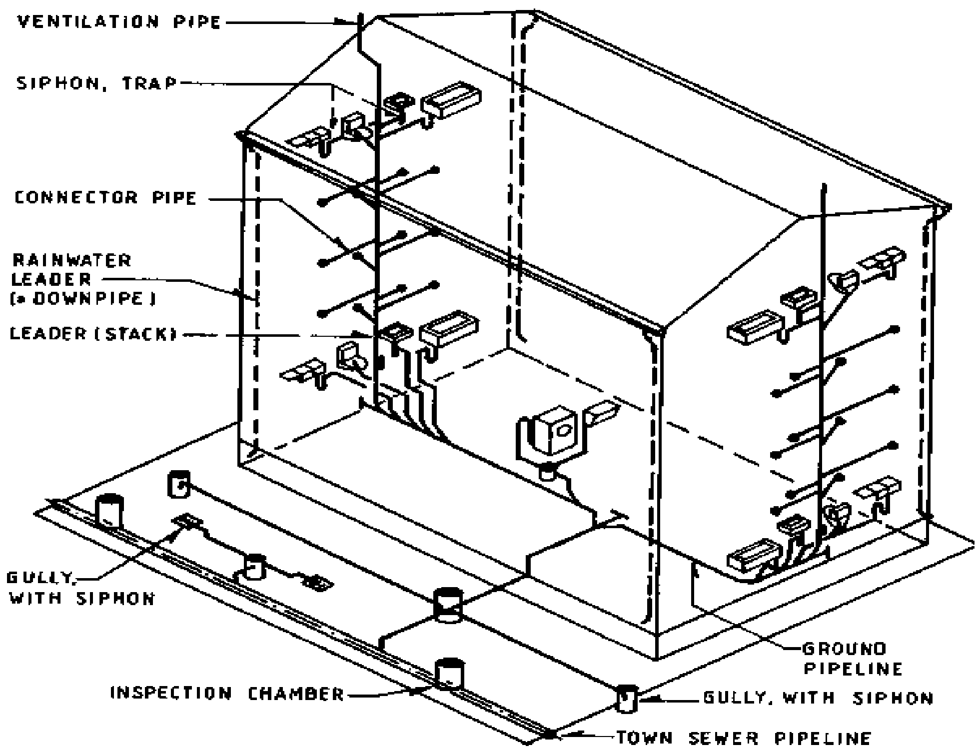
Plumbing Installation

Level-IV

Based on October 2023, Curriculum Version 2



Module Title: - Designing and sizing sanitary plumbing systems

Module code: EIS PLI4 M02 1023

Nominal duration: 100 Hour

Prepared by: Ministry of Labor and Skills

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Acronym

VOCs -------------------------------volatile organic compounds

MSDS ------------------------------Material Safety Data Sheets

PVC --------------------------------(polyvinyl chloride),

ABS --------------------------------(acrylonitrile butadiene styrene)

Gpm---------------------------------gallons per minute

Introduction to the Module

The Designing and sizing sanitary plumbing systems helps to know the prepare for planning, Identify system requirements, plan system layout in plumbing installation work filed.

This module is designed to meet the industry requirement under the plumbing installation work occupational standard, particularly for the unit of competency designing and sizing sanitary plumbing systems

This module covers the units:

- Preparation of planning.
- Identifying system requirements.
- system layout.

Learning Objective of the Module

- Prepare for planning.
- Identify system requirements.
- Plan system layout.

Module Instruction

For effective use this modules trainees are expected to follow the following module instruction:

1. Read the information written in each unit
2. Accomplish the Self-checks at the end of each unit
3. Perform Operation Sheets which were provided at the end of units
4. Do the "LAP test" giver at the end of each unit and
5. Read the identified reference book for Examples and exercise

Unit one: Preparing for planning

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- Concept of designing and sizing sanitary plumbing systems
- Nature and scope of planning task.
- Safety (OHS) and environmental requirements.
- Organizing and sequencing work.
- Tools and equipment.
- Prepare work area

Work area Preparation This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Understanding of designing and sizing sanitary plumbing systems
- Identify and confirm nature and scope of planning task.
- Adhere Safety (OHS) and environmental requirements.
- Organize and sequence work.
- Select tools and equipment.
- Prepare work area

1.1. Concept of Designing and sizing sanitary plumbing systems

Designing and sizing sanitary plumbing systems involves determining the appropriate layout, pipe sizes, and fixture requirements to ensure proper drainage and waste disposal in a building.

The purpose of the sanitary drainage system is to remove effluent discharged from plumbing fixtures and other equipment to an approved point of disposal. A sanitary drainage system generally consists of horizontal branches, vertical stacks, a building drain inside the building, and a building sewer from the building wall to the point of disposal. To economically design a sanitary drainage system, the designer should use the smallest pipes possible according to the applicable code that can rapidly carry away the soiled water from individual fixtures without clogging the pipes, leaving solids in the piping, generating excessive pneumatic pressures at points where the fixture drains connect to the stack (which might cause the reduction of trap water seals and force sewer gases back through inhabitable areas), and creating undue noise.

- **key steps and considerations in process:**

  A. **Understand the Building Codes and Regulations:** Familiarize yourself with the relevant building codes, regulations, and plumbing standards specific to your location. These guidelines will dictate the minimum requirements for sanitary plumbing systems, including pipe sizes, slopes, venting, and fixture counts.

  B. **Determine Fixture Requirements:** Identify the number and type of plumbing fixtures that will be connected to the system. This includes toilets, sinks, showers, bathtubs, urinals, and any other fixtures that generate wastewater.

  C. **Calculate Fixture Unit (FU) Load:** Assign a fixture unit (FU) value to each plumbing fixture based on its flow rate and drainage characteristics. Fixture unit values can be obtained from plumbing codes and guidelines. Add up the FUs for all fixtures to determine the total FU load on the system.

  D. **Size the Main Drainage Pipe:** Based on the total FU load and the slope of the pipe, determine the appropriate diameter for the main drainage pipe. The slope should be sufficient to maintain a self-cleaning velocity and prevent clogs. Refer to plumbing codes or engineering handbooks for pipe sizing charts and guidelines.

E. **Plan the Branch Lines:** Design the branch lines that connect the fixtures to the main drainage pipe. Consider the total FU load for each branch line and determine the appropriate pipe diameter based on the anticipated flow rates and slopes.

F. **Venting:** Proper venting is essential for sanitary plumbing systems to prevent siphoning, trap seal loss, and the buildup of harmful gases. Design vent pipes to allow for adequate air circulation and pressure equalization. Vent pipes should be sized according to code requirements.

G. **Consider Water Supply:** Ensure that the water supply system is designed to provide adequate water flow and pressure to all fixtures. Coordinate with the plumbing engineer and consider factors such as peak demand, pipe sizing, pressure regulators, and water storage if necessary.

H. **Accessibility and Maintenance:** Plan for accessibility and ease of maintenance by incorporating cleanouts, inspection points, and access panels as required by code. Ensure that the system design allows for future repairs, upgrades, and modifications.

I. **Use Plumbing Design Software:** Consider using plumbing design software or calculators to assist in sizing pipes, calculating flow rates, and generating detailed layouts. These tools can help streamline the design process and ensure accurate calculations.

Designing and sizing sanitary plumbing systems requires a thorough understanding of local codes, regulations, and industry standards. It's essential to follow best practices and consult with professionals to ensure a safe and efficient plumbing system.

1.2. Nature and scope of planning task

Plumbing the art and technique of installing pipes, fixtures, and other apparatuses in buildings for bringing in the supply of liquids, substances and/or ingredients and removing them; and such water, liquid and other carried-wastes hazardous to health, sanitation, life and property pipes and fixtures after installation .

The planning task for designing and sizing sanitary plumbing systems involves various considerations and activities to ensure the effective and efficient functioning of the plumbing system.

- **Plumbing system**

Plumbing System includes all potable water supply and distribution pipes, all plumbing fixtures and traps; all sanitary and storm drainage systems; vent pipes, roof drains, leaders and downspouts; and all building drains and sewers, including their respective joints and connections; devices, receptacles, and appurtenances within the property; water lines in the premises; potable, tap, hot and chilled water piping; potable water treating or using equipment; fuel gas piping; water heaters and vents for same

A Plumbing system, reduced to its simplest terms, consists of a supply pipe leading to a fixture and a drainpipe taking the used water away from this fixture.

- **key aspects including:**

1. **Regulatory Compliance:** The planning process begins with understanding and complying with local building codes, regulations, and standards related to sanitary plumbing systems. This includes requirements for fixture counts, pipe sizing, venting, drainage, and accessibility.
2. **System Layout and Design:** The planner needs to develop a comprehensive layout and design for the plumbing system based on the specific requirements of the building or facility. This includes determining the location and type of fixtures (such as toilets, sinks, showers, and drains) and establishing the routing of supply and waste pipes.
3. **Fixture Selection:** The planner must select appropriate fixtures that meet the functional and aesthetic needs of the building occupants while considering factors such as water efficiency, durability, and maintenance requirements.
4. **Sizing of Pipes:** Proper sizing of pipes is crucial to ensure adequate water supply and efficient drainage. The planner needs to calculate the pipe sizes based on factors such as fixture flow rates, pipe material, pressure requirements, and the length and elevation changes of the plumbing lines.

5. **Ventilation and Airflow:** Adequate ventilation and airflow within the plumbing system are essential for preventing the build-up of sewer gases, maintaining proper drainage, and preventing water trap seal loss. The planner must design an effective venting system that complies with regulatory requirements.
6. **Water Supply and Distribution:** The planner needs to determine the water supply source, calculate the demand for water within the building, and design the distribution system accordingly. This involves considering factors such as water pressure requirements, pipe sizing, and the incorporation of devices like pressure regulators and backflow preventers.
7. **Drainage and Waste Disposal:** The planner must design an efficient drainage system that ensures proper disposal of wastewater and prevents the occurrence of blockages or sewer backups. This involves determining the appropriate slope for drainpipes, selecting the right pipe materials, and incorporating features such as traps, cleanouts, and grease interceptors.
8. **Accessibility and Safety:** The planner should consider accessibility requirements, particularly for public buildings, to ensure that the plumbing system is usable and safe for all individuals, including those with disabilities. This includes provisions for wheelchair accessibility, grab bars, and appropriate clearances.
9. **Maintenance and Longevity:** The planner should consider the ease of maintenance and longevity of the plumbing system. This involves selecting durable materials, incorporating access points for inspections and repairs, and considering the potential for future expansions or modifications.

Overall, the nature and scope of the planning task for designing and sizing sanitary plumbing systems require a thorough understanding of plumbing principles, local regulations, and building requirements. It involves a holistic approach that considers functionality, safety, efficiency, and compliance to ensure the successful implementation of the plumbing system.

1.3. Safety and environmental requirements

The goal of occupational safety and health programs is to foster a safe and healthy work environment. OSH may also protect co-workers, family members, employers, customers, and many others who might be affected by the workplace environment.

The OHS Act gives the government authority to make regulations and codes (or rules) about health and safety in the workplace. Under the legislative framework, the OHS Act prescribes basic duties and obligations of employers and workers.

The OHS Regulation addresses requirements related to general administrative matters and health and safety rules and regulations. The OHS Code specifies detailed technical standards and safety rules that employers and workers must comply with to fulfill their obligations. Technical requirements cover areas such as equipment safety, noise, chemical hazards and first aid, to name a few.

Designing and sizing sanitary plumbing systems, it is important to consider safety, occupational health, and environmental requirements.

- **key considerations:**
  1. **Compliance with Regulations:** Familiarize yourself with local, regional, and national regulations governing plumbing systems, including Occupational Health and Safety (OHS) regulations and environmental protection guidelines. Ensure your design adheres to all applicable codes and standards.
  2. **Risk Assessment:** Conduct a thorough risk assessment to identify potential hazards associated with the plumbing system. Consider factors such as water supply contamination, cross-connections, pipe material selection, and potential for leaks or bursts. Mitigate risks through appropriate design measures.
  3. **Material Selection:** Choose plumbing materials that are safe, durable, and environmentally friendly. Avoid materials containing harmful substances such as lead or other toxic chemicals. Opt for materials that are resistant to corrosion and degradation, ensuring a longer lifespan for the system.
  4. **Proper Ventilation:** Adequate ventilation is crucial to prevent the buildup of harmful gases, such as sewer gases and volatile organic compounds (VOCs). Install ventilation

systems that effectively remove odors and maintain good indoor air quality. Follow local building codes and guidelines for ventilation requirements.

5. **Accessibility:** Design the plumbing system to be accessible for maintenance, repairs, and cleaning. Ensure that components such as cleanouts, shut-off valves, and fixtures are easily reachable and operable. Consider accessibility requirements for people with disabilities as per relevant accessibility standards.
6. **Backflow Prevention:** Install appropriate backflow prevention devices to prevent the reversal of wastewater into the potable water supply. This helps protect against contamination and ensures the safety of the water supply.
7. **Adequate Drainage and Slope:** Design the system to provide efficient drainage and prevent the buildup of stagnant water. Ensure proper slope and sizing of pipes to facilitate the flow of wastewater and minimize the risk of blockages.
8. **Proper Waste Disposal:** Follow guidelines for the proper disposal of wastewater and sewage. Design the system to connect to approved and properly managed sewage treatment facilities or septic systems, depending on local requirements.
9. **Water Hammer Prevention:** Water hammer is a hydraulic shock that occurs when there is a sudden change in the flow of water. It can cause damage to the plumbing system and create noise. Install water hammer arrestors or other mitigation measures to prevent water hammer and associated hazards.
10. **Adequate Fixture Supports:** Properly support and secure plumbing fixtures to prevent accidents, such as fixtures falling or becoming dislodged. Ensure that the fixtures are securely anchored to the building structure.
11. **Accessibility and Safety:** Design the plumbing system with accessibility in mind, particularly for people with disabilities. Install safety features such as grab bars, non-slip surfaces, and proper lighting in areas where potential hazards, such as wet areas or steps, are present.
12. **Maintenance and Inspection:** Include provisions in the design for regular maintenance and inspection of the plumbing system. This helps identify and address potential issues before they escalate, ensuring the ongoing safety and performance of the system.

- **Use of firefighting equipment and first aid equipment**

- **Fire Fighting Equipment:**
  - ✓ **Fire Extinguishers:** Determine the appropriate locations for fire extinguishers throughout the building, considering factors such as fire hazard areas, travel distances, and accessibility. Follow local fire safety codes and regulations regarding the type, quantity, and placement of fire extinguishers.
  - ✓ **Fire Hose Reels:** Identify areas where fire hose reels may be required, such as large open spaces or areas with higher fire risks. Consider the water supply requirements, pressure, and positioning of the hose reels.
  - ✓ **Fire Sprinkler Systems:** Evaluate whether fire sprinkler systems are necessary based on the building occupancy, size, and local fire codes. Design the sprinkler system layout, pipe sizes, and water supply to provide adequate coverage and flow rates in case of a fire emergency.
- **First Aid Equipment:**
  - ✓ **First Aid Kits:** Determine the number and location of first aid kits throughout the building, considering factors such as the number of occupants, the size of the facility, and the level of risk. Follow local regulations and guidelines for the contents of the first aid kits.
  - ✓ **Eye Wash Stations:** Identify areas where eye wash stations may be required, such as laboratories or areas with chemical hazards. Ensure the eye wash stations are easily accessible, properly plumbed, and meet the required standards.
  - ✓ **Emergency Showers:** Evaluate whether emergency showers are necessary based on the nature of the activities or chemicals used in the building. Design the emergency showers to provide an adequate flow rate, temperature control, and proper drainage.

Fire fighting and first aid equipment into the design of sanitary plumbing systems, it is essential to consult local building codes, regulations, and standards. Consider engaging the services of a professional engineer or consultant with expertise in fire protection and first aid to ensure compliance with the applicable requirements and to provide a safe environment for building occupants.

- **Workplace environment and safety**

Workplace environment and safety for designing and sizing sanitary plumbing systems, there are several considerations to keep in mind. Two important aspects are clean-up protection and storm water protection. Clean-up protection refers to measures taken to ensure that the workplace remains clean and free from potential hazards during the installation, maintenance, and repair of sanitary plumbing systems.

- **key points to consider**
  1. **Personal Protective Equipment (PPE):** Workers should be provided with appropriate PPE such as gloves, protective eyewear, and masks to protect against potential contaminants, chemicals, or hazardous materials encountered during plumbing activities.
  2. **Containment and Waste Disposal:** Proper containment and disposal of waste materials, debris, and leftover plumbing components should be implemented to maintain a clean and organized workspace. This helps prevent slips, trips, and falls, as well as reduces the risk of exposure to harmful substances.
  3. **Spill Response:** Adequate spill response procedures and materials should be in place to handle accidental spills or leaks of hazardous substances. This includes having absorbent materials, spill kits, and clear instructions on how to respond to and clean up spills safely.
  4. **Ventilation:** Sufficient ventilation should be provided in enclosed spaces to prevent the accumulation of harmful gases, fumes, or odors that may result from plumbing activities. Proper ventilation helps maintain good air quality and protects the health of workers.
  5. **Storm water Protection:** Storm water protection involves preventing the contamination of storm water systems and natural water bodies during the design and installation of sanitary plumbing systems. Here are some considerations:
  6. **Drainage Design:** Proper drainage design should be implemented to ensure that storm water and sanitary wastewater systems are separate and do not mix. This

prevents the contamination of storm water with potentially harmful substances or pollutants.

7. **Best Management Practices (BMPs):** Implementing BMPs, such as the use of sediment traps, oil-water separators, and filtration systems, can help remove pollutants from storm water runoff before it enters the drainage system or natural water bodies.
8. **Spill Prevention and Response:** Adequate measures should be in place to prevent spills or leaks of hazardous substances into storm water systems. This can include proper storage and handling of chemicals, regular inspections of plumbing fixtures and connections, and prompt response to any spills or leaks that do occur.
9. **Education and Training:** Workers involved in designing and sizing sanitary plumbing systems should receive appropriate education and training on storm water protection measures. This ensures they understand the importance of preventing pollution and are equipped with the knowledge and skills to implement best practices.

Overall, maintaining a clean and safe workplace environment when designing and sizing sanitary plumbing systems involves implementing proper clean-up protection measures and taking steps to prevent storm water contamination. By prioritizing these aspects, you can help protect the health and well-being of workers and contribute to environmental sustainability.

Safe operating procedures are essential for maintaining a secure work environment. Guidelines for recognizing and preventing hazards associated with various elements:

A. Electricity:

- Ensure that all electrical equipment is properly installed, grounded, and maintained.
- Use appropriate personal protective equipment (PPE), such as insulated gloves and safety glasses, when working with electrical equipment.
- Avoid overloading electrical circuits and use circuit breakers or fuses as required.
- Follow lockout/tag out procedures when working on electrical systems to prevent accidental energization.

B. Hazardous materials and substances:

- Identify and label hazardous materials properly, including using safety data sheets (SDS) to understand their properties and potential risks.

- Use appropriate PPE, such as gloves, goggles, and respirators, when handling hazardous materials.
- Store and handle hazardous substances according to manufacturer instructions and relevant regulations.
- Implement proper ventilation and control measures to minimize exposure to hazardous substances.
- Establish protocols for spills, leaks, and emergency situations involving hazardous materials.

C. Other machines:

- Follow manufacturer guidelines for operating machinery and equipment.
- Conduct regular inspections and maintenance to ensure machines are in good working condition.
- Provide appropriate training for operators and ensure they understand the safety features and potential risks associated with the machines.
- Use machine guards and safety interlocks to prevent accidental contact with moving parts.
- Establish clear communication protocols and signals when working near or with other machines.

D. Surrounding structure and facilities:

- Conduct regular inspections of the work site to identify potential hazards, such as structural weaknesses, uneven surfaces, or falling objects.
- Maintain clear and unobstructed pathways and emergency exits.
- Secure heavy objects and materials to prevent them from falling or causing accidents.
- Follow proper procedures for working around fragile structures or areas prone to collapse.

E. Trip hazards:

- Keep work areas clean and free of clutter, debris, and obstacles.
- Ensure that cables, wires, and hoses are properly secured and do not pose tripping hazards.

- Use appropriate signage and barriers to highlight potential tripping hazards and redirect foot traffic.

F. Underground services:

- Before digging or excavating, identify and mark the location of underground services, such as gas lines, water pipes, or electrical cables.
- Use appropriate tools and techniques, such as hand digging or vacuum excavation, to prevent damage to underground services.
- Follow local regulations and guidelines when working near or around underground services.
- Use of tools and equipment:
- Provide proper training on the correct use of tools and equipment.
- Inspect tools and equipment before use to ensure they are in good working condition.
- Use appropriate PPE when operating tools or equipment, such as safety glasses, gloves, or ear protection.
- Follow manufacturer instructions for maintenance, storage, and transportation of tools and equipment.

G. Work site visitors and the public:

- Establish clear guidelines for visitors and the public regarding safety protocols and restricted areas.
- Provide appropriate orientation and supervision to visitors.
- Implement signage and barriers to prevent unauthorized access to hazardous areas.
- Communicate potential risks to visitors and ensure they follow safety procedures.

H. Working at heights:

- Follow proper fall protection measures, such as using guardrails, safety harnesses, and safety nets.
- Ensure that ladders, scaffolds, and elevated work platforms are in good condition and used correctly.
- Provide appropriate training on working at heights and the use of fall protection equipment.
- Working in confined spaces:
- Identify and assess confined spaces to determine potential hazards, such as limited ventilation, toxic gases, or engulfment risks.
- Develop and implement confined space entry procedures, including atmospheric testing, proper ventilation, and communication protocols.
- Provide specialized training for working in confined spaces and ensure that workers have the necessary PPE and rescue equipment.

I. Working in proximity to others:

- Establish clear communication protocols and signals when working in close proximity to others.
- Use barriers or physical distancing measures to maintain a safe distance when necessary.
- Coordinate tasks and schedules to minimize the risk of accidents or interference with other workers.

1.4.Organizing and sequencing work.

Organizing and sequencing work for designing and sizing sanitary plumbing systems, it's important to follow a systematic approach to ensure accuracy and efficiency.

a) **Gather project information:** Start by collecting all relevant information about the project, including architectural plans, specifications, and any specific requirements or regulations that apply to the plumbing system design.
b) **Understand the design requirements:** Review the project requirements and objectives to gain a clear understanding of the scope. Identify the intended use of the building or facility, occupancy levels, fixture types, and any other factors that may impact the design.
c) **Conduct a site survey:** Visit the project site to assess the existing conditions. This includes examining the building layout, identifying potential constraints or challenges, and determining the locations of existing plumbing connections or utility access points.
d) **Determine fixture requirements:** Based on the project requirements, calculate the estimated demand for each type of plumbing fixture, such as toilets, sinks, showers, and urinals. Consider factors like peak usage, water efficiency standards, and any specific regulations that may apply.
e) **Size the sanitary plumbing system:** Use the fixture demand data to size the pipes, drains, and vents required for the plumbing system. Consider factors such as pipe material, slope requirements, and hydraulic calculations to ensure proper flow and drainage.
f) **Develop a preliminary design:** Create a preliminary design layout that illustrates the proposed plumbing system. This includes positioning of fixtures, pipe routing, and connection points, and venting arrangements. Ensure compliance with local plumbing codes and standards.
g) **Coordinate with other disciplines:** Collaborate with other design disciplines, such as architecture, structural engineering, and mechanical engineering, to coordinate the plumbing system design with the overall building design. Address any conflicts or coordination issues that may arise.

h) **Perform a hydraulic analysis:** Conduct a hydraulic analysis to verify that the proposed plumbing system can accommodate the anticipated flow rates and pressures. This analysis helps ensure that the system will function properly and meet the required performance standards.

i) **Finalize the design:** Incorporate any necessary revisions based on the hydraulic analysis and coordination with other disciplines. Prepare final drawings, specifications, and documentation that accurately represent the design intent.

j) **Obtain approvals and permits:** Submit the final design documentation to the relevant authorities for review and approval. Obtain any necessary permits or certifications required for construction or installation.

- **Ethiopian Standards Agency (ESA)**

Ethiopian Standards Agency (ESA) has established several plumbing standards and codes of practice applicable to sanitary plumbing systems in Ethiopia.

a) **Ethiopian Building Code Standard (EBCS 11):** This code provides guidelines for the design and construction of buildings in Ethiopia, including plumbing systems. It covers various aspects of plumbing, such as water supply, drainage, and sanitation.

b) **Ethiopian Building Code Standard (EBCS 07):** This standard focuses specifically on plumbing installations in buildings. It provides requirements and recommendations for the design, installation, and maintenance of plumbing systems, including sanitary plumbing.

c) **Ethiopian Building Code Standard (EBCS 09):** This standard addresses the water supply and distribution systems in buildings. It specifies requirements for the design, installation, and operation of water supply systems, including plumbing fixtures and fittings.

d) **Ethiopian Building Code Standard (EBCS 10):** This standard deals with the drainage and sewerage systems in buildings. It outlines requirements for the design, installation, and maintenance of drainage systems, including sanitary plumbing elements.

1.5. Tools and equipment.

Designing and sizing sanitary plumbing systems require a variety of tools and equipment to ensure accurate calculations and proper installation.

Tools and equipment commonly used in process:

a) **Plumbing Design Software:** There are several specialized software programs available that assist in designing and sizing sanitary plumbing systems. These software tools provide features such as **2D** and **3D** modeling, pipe sizing calculators, hydraulic calculations, and material quantity estimation.

- **AutoCAD:** widely used **CAD** software for creating precise 2D and 3D drawings.
- **Revit MEP:** Specifically designed for building systems design, including plumbing.
- **Sketch Up:** Allows you to create 3D models of plumbing systems.
- **SolidWorks:** Offers advanced 3D modeling capabilities for plumbing system design.
- **BIM (Building Information Modeling) software:** Enables integrated design and collaboration among different disciplines.

b) **Drawing Instruments:**

- **Scale ruler:** A ruler with different scales for accurately measuring and drawing to scale.
- **T-square:** A drawing tool used to draw straight lines and right angles.
- **Compass:** Used for drawing circles and arcs.
- **Drafting triangles**: 30-60-90 and 45-45-90 triangles for drawing angles and perpendicular lines.
- **Pencils and erasers:** For sketching and making changes to drawings.

c) **Building Plans and Specifications:** Detailed building plans and specifications are necessary for understanding the layout, dimensions, and requirements of the plumbing system. These documents typically include architectural drawings, plumbing fixture schedules, and any relevant codes or regulations.

d) **Pipe Sizing Charts and Tables:** Pipe sizing charts and tables provide guidelines for determining the appropriate pipe sizes based on the anticipated flow rates, pressure losses, and fixture unit values. These references help in selecting the correct diameter and material for various plumbing components.

e) **Measuring and Marking Tools:** Accurate measurements are crucial during the design and installation process. Common measuring and marking tools include

- **Tape measure:** Used for measuring distances, lengths, and heights.
- **Spirit level:** Ensures that pipes and fixtures are installed horizontally or vertically.
- **Plumb bob:** Helps establish vertical alignments.
- **Pipe and diameter gauges:** Used for measuring pipe sizes and diameters.
- **Angle finder:** Measures angles accurately

These tools ensure precise placement of fixtures, pipes, and other plumbing components.

1.6. Work area Preparation

Preparing and conducting the work area for designing and sizing sanitary plumbing systems involves several important steps.

- **A general guide to process:**

a) **Gather information:** Start by gathering all the necessary information about the project. This may include architectural plans, building codes and regulations, client requirements, and any specific design considerations.

b) **Assess the site:** Visit the site or review the architectural plans to assess the available space for plumbing systems. Take note of the location of existing plumbing connections, fixtures, and other relevant infrastructure.

c) **Identify fixtures and appliances:** Determine the types and quantities of plumbing fixtures and appliances that will be installed. This may include sinks, toilets, showers, bathtubs, dishwashers, and washing machines. Consider their intended use and water demand.

d) **Determine the system type:** Based on the project requirements, decide on the type of sanitary plumbing system to be used. Common types include the one-pipe, two-pipe, or single-stack systems. Consider factors such as building height, drainage flow rates, and venting requirements.

e) **Calculate load and demand:** Calculate the water demand and load requirements for the plumbing system. This involves estimating the peak flow rates, fixture unit values (based on fixtures and appliances), and the number of occupants or users. Consider local plumbing codes and standards for guidance.

f) **Size pipes and connectors:** Use plumbing design tables or software to size the pipes and connectors based on the calculated load and demand. Consider factors such as pipe material, pressure requirements, and flow characteristics. Ensure that the pipe sizing meets the minimum requirements for adequate water supply and drainage.

g) **Plan the layout:** Create a plumbing layout plan that indicates the positioning of fixtures, pipes, vents, and other components. Ensure that the design complies with building codes and regulations, including proper slopes for drainage and adequate venting.

h) **Consider accessibility and maintenance:** Design the plumbing system with accessibility and maintenance in mind. Ensure that shut-off valves, cleanouts, and other serviceable components are easily accessible for repairs and maintenance tasks.

i) **Document the design:** Prepare detailed drawings and specifications documenting the plumbing system design. Include all relevant information, such as pipe sizes, fixture locations, venting details, and any special considerations.

j) **Coordinate with other disciplines:** Collaborate with other professionals involved in the project, such as architects, structural engineers, and mechanical engineers. Ensure that the plumbing system design integrates seamlessly with other building systems.

Self-cheek 1.1

PART- I choose the correct answer

1. Which of the following best describes the nature of planning tasks?
   A. The allocation of resources to achieve organizational goals.
   B. The execution of day-to-day operational activities.
   C. The assessment of employee performance.
   D. The management of conflict within a team.
2. What is the primary purpose of planning tasks?
   A. To ensure compliance with safety regulations.
   B. To identify potential risks and develop strategies to mitigate them.
   C. To allocate budgets and resources effectively.
   D. To supervise and monitor employee performance.
3. Why is it important to comply with environmental requirements?
   A. To minimize the impact on the environment and prevent pollution.
   B. To ensure employee safety and well-being.
   C. To streamline organizational processes and increase efficiency.
   D. To meet customer demands and expectations.
4. What does organizing work involve?
   A. Allocating resources and responsibilities to achieve objectives.
   B. Managing conflicts and resolving disputes among team members.
   C. Developing marketing strategies to promote a product.
   D. Monitoring and evaluating employee performance.
5. What is the purpose of sequencing work?
   A. To prioritize tasks and determine their order of execution.
   B. To assess employee skills and competencies.
   C. To allocate budgets and resources effectively.
   D. To develop contingency plans for potential risks.
6. What is the purpose of sizing sanitary plumbing systems?
   A. To determine the appropriate dimensions for pipes and fittings.

B. To estimate the cost of materials and labor.
C. To evaluate the environmental impact of the plumbing system.
D. To ensure compliance with safety regulations.

PART- II gives short answer

1. What is the purpose of planning in the context of sanitary plumbing systems?
2. What are the key elements to consider when developing a plumbing system plan?
3. What are the primary safety considerations when working with sanitary plumbing systems?
4. Why is it important to consider the environmental impact of plumbing systems?
5. How can you effectively organize plumbing tasks to optimize efficiency?
6. What are some modern technologies or software used in plumbing system design and sizing?

Unit tow: Identifying system requirements

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- Information and specifications system .
- Regulations and Ethiopian standards.
- Quantity, location and fixtures.
- Fixture unit loading.
- System size.

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Obtain Information and specifications system.
- Apply Regulations and Ethiopian standards.
- Determine Quantity, location and fixtures.
- Determine Fixture unit loading.
- System size.

1.2. Information and specifications system

Designing and sizing sanitary plumbing systems, various sources of information and specifications are essential.

- **SPECIFICATION**

  This specification is intended to cover design, engineering, manufacture, test and inspection of works, delivery to site, properly packed for transportation, erection, testing, commissioning, performance demonstration at site and handing over to client/consultant/ purchaser of plumbing and sanitary system as indicated in the schedule of requirement and scope of work as required for reliable and effective plumbing and sanitary system for project. This specification also includes complete earthwork i.e., excavation and back filling for the entire buried piping for plumbing & sewerage system.

- **Key elements that should be considered:**

1. **Charts and Hand Drawings:** These visual aids provide information on pipe sizes, flow rates, system layouts, and connections. They help in understanding the overall design and dimensions of the plumbing system.
2. **Diagrams or Sketches:** These visual representations illustrate the layout and connections of the plumbing system. They assist in visualizing the flow of water, fixture locations, and pipe routing.
3. **Instructions Issued by Authorized Organizational or External Personnel:** These instructions may come from experienced plumbers, engineers, or regulatory bodies. They provide guidance on best practices, codes, and standards to be followed during the design and sizing process.
4. **Job Drawings, Manufacturer Specifications, and Instructions:** These documents provide specific details about the fixtures, equipment, and materials to be used in the plumbing system. They include information on installation requirements, dimensions, and performance specifications.
5. **Material Safety Data Sheets (MSDS):** MSDS provides information about the safe handling, storage, and disposal of plumbing materials and chemicals. They contain details

about potential hazards, recommended protective measures, and emergency response procedures.

6. **Memos:** Internal communications within the organization or project team may include memos that convey important information related to the design and sizing of the plumbing system. These memos may address specific requirements, changes in plans, or updates on regulations.
7. **Organization Work Specifications and Requirements:** These documents outline the specific standards, procedures, and quality requirements set by the organization or project. They ensure consistency and compliance with internal guidelines.
8. **Regulatory and Legislative Requirements:** Compliance with building codes, occupational health and safety (OHS) regulations, plumbing regulations, and environmental requirements is crucial. These regulations establish the minimum standards and guidelines for sanitary plumbing systems. Safe work procedures relating to planning, sizing, and documenting the layout of sanitary pipe work and fixtures may include:
9. **Signage:** Proper signage indicating safety precautions, pipe contents, and directions can help ensure a safe work environment.
10. **Verbal, Written, and Graphical Instructions:** Clear instructions, either communicated verbally, in writing, or through graphical representations, guide workers on how to plan, size, and document the layout of sanitary pipe work and fixtures.
11. **Work Bulletins:** Work bulletins provide updates, instructions, and specific requirements related to the planning and sizing of plumbing systems. They may include changes in design, material specifications, or installation methods.

2.2. Regulations and Ethiopian standard

Regulations and standards for designing and sizing sanitary plumbing systems in Ethiopia are primarily governed by the Ethiopian Building Code Standards (EBCS) and the Ethiopian Ministry of Water, Irrigation, and Energy. However, please note that regulations and standards can be updated over time, so it's essential to refer to the latest versions and consult with local authorities or professionals for the most up-to-date information.

General guidelines that were in place at the time:

Ethiopian Building Code Standards (EBCS): The EBCS provides guidelines for the design and construction of buildings in Ethiopia. Part 5 of the EBCS specifically addresses plumbing and sanitation systems, including sanitary plumbing systems. It covers various aspects such as water supply, drainage, venting, and fixture requirements.

Drainage requirements for buildings Performance: Discharge pipe systems should comprise the minimum of pipe work necessary to carry away the discharges from sanitary fixtures In the building quickly, quietly and with freedom from nuisance or risk of injury to health. In the design of any drainage system, the performance criteria which shall be followed are:

- Requirements for discharge rates from fixtures,
- Exclusion of foul air,
- limitation of noise,
- Containment of leakage of discharge,
- Prevention of risk of blockage,
- Durability of material,
- Ease of replacement of materials, and
- Access for testing and' maintenance.

Where it is necessary to pump effluent from below the building drain level, the method of discharge to the building drainage system should be such that the rate of flow and the location of the discharge will not cause pressure fluctuations which might adversely affect the performance of the gravity system.

Sanitary Drainage System: The EBCS for the design and installation of sanitary drainage systems. It covers the sizing and slope of drainage pipes, venting requirements, and the proper disposal of wastewater.

Table 2.1 Fixture unit rating

Fixture	Size of trap outlet and fixture discharge pipe	Fixture unit rating	Max. Length of unvented fixture discharge pipe [m]
(a) Autopsy table	DN50	3	2.5
(b) Bain-marie	DN40	1	2.5
(c) Bath (with or without shower)	DN40	4	2.5
(d) Bed pan washer	DN80	6	6
(e) Bidet	DN40	1	2.5
(f) Clothes washing machine:			
(i) domestic	DN40	5	2.5
(ii) commercial	DN50	acc. to flow	2.5
(g) Dishes washing machine:			
(i) domestic	DN40	3	2.5
(ii) commercial	DN50	acc. to flow	2.5
(h) Drinking fountain	DN40	1	2.5
(i) Floor waste gully			
(i) without fixture	DN50	3	2.5
(ii) with fixture	up to DN100	as per fixture rating	
(j) Shower (i) single	DN40 or DN50	2	2.5
(ii) multiple	DN50(min)	2 per shower head	2.5
(k) sink (i) domestic	DN40	1	2.5
(ii) commercial	DN50	3	2.5
(l) Sink cleaner	DN50	1	2.5

Fixture	Size of trap outlet and fixture discharge pipe	Fixture unit rating	Max. Length of unvented fixture discharge pipe [m]
(k) sink (i) domestic (ii) commercial	DN40 DN50	1 3	2.5 2.5
(l) Sink cleaner	DN50	1	2.5
(m) Sink laboratory	DN50	1	2.5
(n) Trough (i) ablution (ii) laundry	DN40 or DN50 DN40 or DN50	3 5	2.5 2.5
(o) Urinal (i) wall hung (ii) Stall or trough	DN50 to DN65 DN65 to DN80	1 1	2.5 6.0
(p) Wash basin	DN40	1	2.5
(q) Water closet pan	DN100	7	6.0
(r) Bathroom group in a single room (wash basin, bath, shower, water closet).		7	

Table 1 Minimum sizes of tubular traps

Type of Appliance	Size of trap [mm]	Type of Appliance	Size of trap [mm]
(a) Wash basin	40	(i) Urinal (bowl)	40
(b) Bidet	40	(j) Urinal (stall, 1 to 6*)	65
(c) Sink (domestic)	40	(k) Food-waste disposal unit (industrial type)	50
(d) Bath	40	(l) Sanitary towel macerator	50
(e) Shower bath tray	40	(m) Drinking fountain	40
(f) Wash tub	50	(n) Kitchen sink (domestic)	40
(g) Food-waste disposal unit (domestic)	40	(o) Turkish type WC	80
(h) Channel urinal (1 to 6%)*	65		

- **Branch discharge pipes Sizing**

  the sizing of branch discharge pipes shall be table 2.3 as appropriate.

  - **Gradients**

    a) The gradient of a branch discharge pipe should be uniform and adequate to drain the pipe efficiently.

    b) Minimum gradients shall comply with those indicated in Table 2.3. Self-cleansing, in very flat gradients could be attained with high flow rates (e.g., not less than *2.5S/ls* for diameter 150.0mm or above pipes with a gradient of 1%) and workmanship of a high standard.

Table 2.3 Minimum gradients of discharge pipes

Size of graded section of pipe	Minimum gradient [%]
(a) DN40	2.50
(b) DN50	2.50
(c) DN65	2.50
(d) DN80	1.65
(e) DN100	1.65
(f) DN125	1.25
(g) DN150	1.00

Table2. 2 Maximum loadings of stacks in fixture units

Size of stack	Max. loading per floor level	Max. loading per stack
DN40	2	6
DN50	5	15
DN65	6	18
DN80	13	40
DN100	65	195
DN125	150	450
DN150	250	750
DN225	950	3850

Fixture Requirements: The EBCS provides specifications for various plumbing fixtures, including toilets, sinks, showers, and urinals. It covers the type, size, and installation requirements for these fixtures.

Material Standards: The EBCS may refer to relevant Ethiopian and international standards for plumbing materials, such as pipes, fittings, valves, and fixtures. These standards ensure the quality and durability of the materials used in sanitary plumbing systems.

2.3. Quantity, location and fixtures.

Designing and sizing sanitary plumbing systems involves considering various factors such as the quantity of fixtures, their locations, and the required fixtures for a particular building or facility.

- **key considerations:**

1. **Quantity of Fixtures:** The first step is to determine the number of fixtures that will be connected to the plumbing system. This includes fixtures such as toilets, sinks, showers, bathtubs, urinals, and any other water outlets. The quantity of fixtures will depend on the type of building or facility, its occupancy, and local plumbing codes and regulations.
2. **Fixture Location:** The location of fixtures is crucial for designing the plumbing system. Each fixture should be strategically placed to ensure efficient water supply and drainage. Consider factors such as proximity to main water supply lines, ease of access for maintenance, and functional requirements. Plumbing fixtures should also comply with local building codes and regulations regarding spacing and accessibility.
3. **Fixture Selection:** The choice of fixtures depends on the specific requirements of the building or facility. Factors to consider include water efficiency, durability, aesthetics, and functionality. There are various types of fixtures available, ranging from standard models to low-flow or water-saving fixtures. Make sure to select fixtures that meet the desired standards and regulations.
4. **Pipe Sizing:** Once the quantity and location of fixtures are determined, the next step is to size the plumbing pipes. Pipe sizing involves calculating the appropriate diameter of the pipes to ensure sufficient water flow and pressure throughout the system. Factors such as fixture flow rates, pipe length, and the number of fixtures connected to a particular

branch should be considered. Plumbing codes and standards provide guidelines and formulas for pipe sizing calculations.

5. **Ventilation:** Proper ventilation is essential for sanitary plumbing systems. Vent pipes allow air to enter the plumbing system, preventing siphoning and maintaining proper drainage flow. Ventilation pipes should be sized and located correctly to avoid issues such as trap siphon age, sewer gas buildup, and inadequate air circulation.
6. **Drainage System:** The design of the drainage system is crucial for effective waste disposal. Gravity is typically used to ensure the flow of wastewater from fixtures to the main sewer line. Proper slope and pipe size should be considered to prevent clogs and backups. Local plumbing codes and regulations provide guidelines for drainage system design.

Fixture unit loading

Fixture unit loading, also known as fixture unit calculation, is a method used in plumbing design to determine the water supply and drainage requirements for a building or a specific area within it. The fixture unit is a measure of the flow rate and drainage load of a particular plumbing fixture or group of fixtures.

Each plumbing fixture is assigned a fixture unit value based on its anticipated water consumption or drainage load. The fixture unit values are typically provided by plumbing codes or standards and can vary depending on the specific fixture and its intended use. These values are then used to calculate the total demand on the water supply system and the drainage capacity required for the plumbing system.

- **Example to fixture unit loading:**
  - **Sample Problem:**

Determine the size of a sanitary house drain for a plumbing installation consisting of 6 water closets, 5 urinals, 5 shower bath, 6 wash basins, 4 floor drains and 3 combined fixtures.

Table2. 3 Sample Problem

No	Type fixtures	Fixtures unit
1	water closets	6
2	urinals	5
3	shower bat	2
4	wash basins	1
5	floor drains	1
6	combined fixtures	3
7	Kitchen sink	2

Solution:

Using Table -1 determine the Fixture Unit values of the following:

6 water closets x 6 fixture units - - - - - - - - - - 36 units

5 urinals x 5 fixture units - - - - - - - - - - - - - - - 25 units

5 shower bath x 2 fixture units- - - - - - - - - - - 10 units

6 wash basins x 1 fixture unit - - - - - - - - - - - - 6 units

4 floor drains x 1 fixture unit - - - - - - - - - - - - 4 units

3 combined fixtures x 3 fixture units - - - - - - 9 units

Total - - - - - - - - - - - - - - - - 90 fixture units

In this example, the fixture unit loading for the building is 90 fixture units. This value is used to determine the appropriate pipe sizes, water supply capacity, and drainage system requirements for the building.

It's important to note that fixture unit values can vary depending on local plumbing codes, standards, and the specific requirements of the building or project. Therefore, it's always recommended to consult the relevant plumbing regulations or work with a professional plumber or engineer to ensure accurate fixture unit loading calculations for a specific application.

2.4. System size

To design a plumbing system, several factors need to be considered, including the building's size, occupancy, water demand, and local plumbing codes. The minimum fixture drain size will be the minimum size of the fixture trap. Recommended minimum sizes of traps for various fixtures are given in Table2.3.

This section deals with the application of principles of hydraulics in sizing drainage piping so as to achieve the Performance required of plumbing fixtures, fixture drains, sanitary drainage stacks branches and building drains, storm drainage systems, and combined storm and sanitary building drains. The specific criteria used in each sizing application are presented in detailed discussion for each section of drainage piping systems. The criteria define the limits for adequacy of performance.

- **Fixture Drain Size**

The minimum fixture drain size will be the minimum size of the fixture trap.

Recommended minimum sizes of traps for various fixtures are given in Table1.1. The plumbing engineer is warned, however, that he/she must comply with the code requirements in the locality of the job.

Table2. 4 fixture unit per fixture group

Fixture Type	Fixture-unit value as load factors
1 bathroom group consisting of water closet, lavatory, and bathtub or shower stall:	
Tank water closet	6
Flush-valve water closet	8
Bathtub[1] (with or without overhead shower)	2
Bidet	3
Combination sink and tray	3
Combination sink and tray with food-disposal unit	4
Dental unit or cuspidor	1
Dental lavatory	1
Dishwasher, domestic	2
Drinking fountain	½
Floor drains[2]	1
Kitchen sink, domestic	2
Kitchen sink, domestic (with food-disposal unit)	3
Lavatory[3] small P.O.	1

Lavatory[3] large P.O.	2
Lavatory (barber, beauty parlor or surgeon)	2
Laundry tray (1 or 2 compartments)	2
Shower stall, domestic	2
Showers (group) per head	3
Sinks:	
Surgeon	3
Flushing rim (with flush valve)	8
Service (trap standard)	3
Service (P trap)	2
Pot, scullery, etc.	4
Urinal (pedestal, siphon jet, blowout)	8
Urinal, stall	4
Urinal, wall-hung	4
Urinal, trough (each 2-ft. section)	2
Wash sink (circular or multiple), each set of faucets	2
Water closet:	
Tank-operated	4
Valve-operated	6

1 A shower head over a bathtub does not increase the fixture unit value.
2 Size of floor drain shall be determined by the area of surface water to be drained.
3 Lavatories with 1 1/4.- or 1½-inch trap have the same load value: larger P.O plugs have greater flow rate.

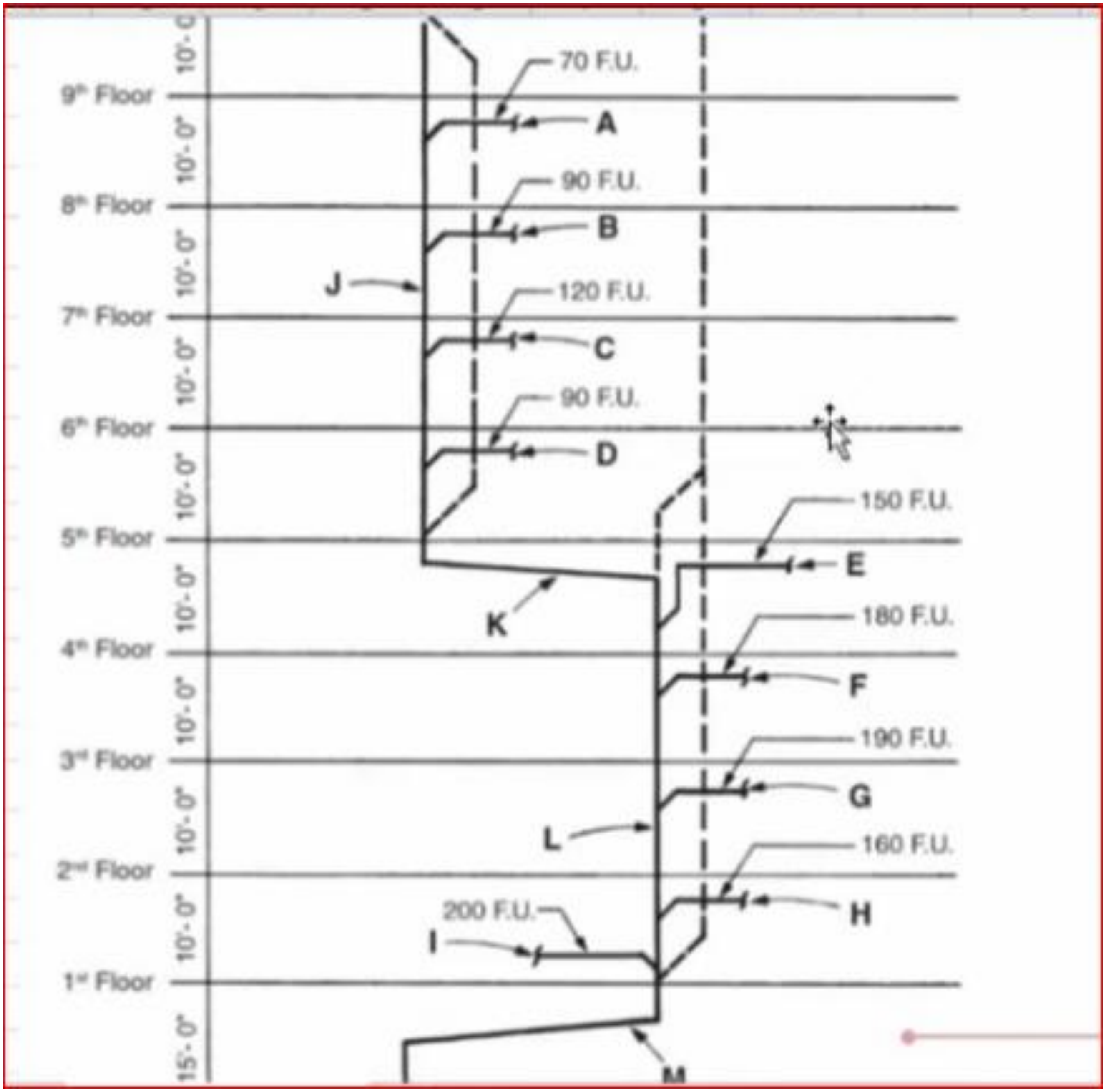


Figure 2.1 riser west water drawing

Table2. 5 calculation of fixtures unit

Branch	Fixture	Fixture Unit (DFU)	No of Fixtures	Total DFU	Total DFU in branch
A	Water Closet	6	5	30	70
	Urinal	4	2	8	
	Lavatory large P.O	2	2	4	
	Kitchen sink	2	3	6	
	Shower domestic	2	3	6	
	Bath tub	2	2	4	
	Laundry tray	2	3	6	
	Floor drain	1	3	3	
	bidet	3	1	3	
B	Water Closet	6			90
	Urinal	4	5	20	
	Lavatory large P.O	2	3	6	
	Kitchen sink	2	5	10	
	Shower domestic	2	4	8	
	Bath tub	2	8	16	
	Laundry tray	2	5	10	
	Floor drain	1	11	11	
	bidet	3	3	9	
C	Water Closet	6	6	36	120
	Urinal	4	5	20	
	Lavatory large P.O	2	5	10	
	Kitchen sink	2	5	10	
	Shower domestic	2	5	10	
	Bath tub	2	5	10	

	Laundry tray	2	5	10	
	Floor drain	1	5	5	
	bidet	3	3	9	
D	Water Closet	6	5	30	90
	Urinal	4	3	12	
	Lavatory large P.O	2	5	10	
	Kitchen sink	2	4	8	
	Shower domestic	2	4	8	
	Bath tub	2	4	8	
	Laundry tray	2	4	8	
	Floor drain	1	3	3	
	bidet	3	1	3	
E	Water Closet	6	6	36	150
	Urinal	4	6	24	
	Lavatory large P.O	2	8	16	
	Kitchen sink	2	6	12	
	Shower domestic	2	6	12	
	Bath tub	2	6	12	
	Laundry tray	2	6	12	
	Floor drain	1	8	8	
	bidet	3	6	18	
F	Water Closet	6	6	36	180
	Urinal	4	8	32	
	Lavatory large P.O	2	10	20	
	Kitchen sink	2	8	16	
	Shower domestic	2	6	12	
	Bath tub	2	6	12	
	Laundry tray	2	8	16	
	Floor drain	1	12	12	

	bidet	3	8	24	
G	Water Closet	6	8	48	190
	Urinal	4	10	40	
	Lavatory large P.O	2	5	10	
	Kitchen sink	2	3	6	
	Shower domestic	2	8	16	
	Bath tub	2	8	16	
	Laundry tray	2	8	16	
	Floor drain	1	14	14	
	bidet	3	8	24	
H	Water Closet	6	6	36	160
	Urinal	4	6	24	
	Lavatory large P.O	2	8	16	
	Kitchen sink	2	7	14	
	Shower domestic	2	7	14	
	Bath tub	2	7	14	
	Laundry tray	2	8	16	
	Floor drain	1	8	8	
	bidet	3	6	18	
I	Water Closet	6	6	36	200
	Urinal	4	8	32	
	Lavatory large P.O	2	10	20	
	Kitchen sink	2	9	18	
	Shower domestic	2	9	18	
	Bath tub	2	9	18	
	Laundry tray	2	9	18	
	Floor drain	1	16	16	
	bidet	3	8	24	

Table2. 6 Maximum permissible

F.U. loads for sanitary stacks			
Stack diameter, inches	**Stack three stories or less in height F.U**	**Stack more than three stories in height F.U**	**Total discharge into one branch interval F.U**
2	10	24	6
2 1/2	20	42	9
3	30	60	16
4	240	500	90
5	540	1100	200
6	960	1900	350
8	2200	3600	600
10	3800	5600	100
12	6000	8400	1500

Table2. 7 Maximum permissible

F.U. loads for sanitary branch	
Branch diameter inches	**Total load FU**
1 ½	3
2	6
2 ½	12
3	20
4	160
5	360
6	620
8	1400
12	6000

Table2. 8 Maximum permissible

F.U. loads for sanitary building drains and run outs from stacks			
Pipe diameter inches	**Building drain slope (inches per foot)**		
	1/8	¼	½
2		21	26
2 1/2		24	51
3	20	27	36
4	180	216	250
5	390	480	575
6	700	840	1000
8	1600	1920	2300
10	2900	3500	4200
12	4600	5600	6700
15	8300	10000	12000

Table2. 9

Horizontal branch	Pipe dia(in)	Vertical stack	Pipe dia (in)
A	4	J	5
B	4		
C	4		
D	4		
E	4	L	6
F	5		
G	5		
H	4		
I	5		

J = A + B + C + D

J= 70 + 90 + 120 + 90 = 370 F.U

L= E + F + G + H + I = 1250 FU

offset	pipe dia (in)
K	5
M	8

Value K= J =370FU

To decide pipe size look table 2.8

M= J + L =1250 FU

- **Size of the main vent**

The size of the main vent is determined by knowing the sum of the fixture units it will serve with the aid of Table 2.12.The usual practice is to continue the main vent full size from its base connection. However, installation of main vent for 3 floors or less allows a graduated size of the pipe from smaller to larger provided that such gradation follows the size recommended on Table 2.12. On how to use Table 2.12, following example is presented.

Table 2.12 MAXIMUM PERMISSIBLE LENGTH OF VENTS FOR SOIL AND WASTE STACKS IN METERS										
Size of Soil or Waste Stock		Number of fixture units	Diameter of the Vent Pipe (mm)							
mm (Ø)	inch (Ø)		32	38	50	63	75	100	125	150
32	1 1/4	1	13.50							
38	1 1/2	up to 8		18.00						
50	2	up to 18		15.00	27.00					
63	2 1/2	up to 36		13.50	22.50	31.50				
75	3	up to 12		10.20	36.00	54.00	63.60			
75	3	up to 18		5.40	21.00	54.00	63.60			
75	3	up to 24		3.60	15.00	39.00	63.60			
75	3	up to 36		2.40	10.50	28.00	63.60			
75	3	up to 48		2.10	9.60	24.00	63.60			
75	3	up to 72		1.80	7.50	19.50	63.60			
100	4	up to 24			7.50	33.00	60.00	90.00	102.00	
100	4	up to 48			4.70	19.50	34.50	90.00	102.00	
100	4	up to 96			3.60	13.50	25.20	90.00	102.00	
100	4	up to 144			2.70	10.80	21.60	90.00	102.00	
100	4	up to 192			2.40	9.00	19.20	84.60	102.00	
100	4	up to 264			2.10	6.00	16.80	73.50	102.00	
100	4	up to 384			1.50	5.40	14.10	61.80	102.00	
125	5	up to 72				12.00	19.50	75.00	117.00	132.00
125	5	up to 144				9.00	14.10	54.00	117.00	132.00
125	5	up to 288				6.00	9.60	37.20	117.00	132.00
125	5	up to 432				4.80	7.20	28.20	96.00	132.00
125	5	up to 721				3.00	4.80	21.00	67.50	132.00
125	5	up to 1020				2.40	3.90	17.40	54.00	132.00

Table 2.12 MAXIMUM PERMISSIBLE LENGTH OF VENTS FOR SOIL AND WASTE STACKS IN METERS										
Size of Soil or Waste Stock		Number of fixture units	Diameter of the Vent Pipe (mm)							
mm (Ø)	inch (Ø)		32	38	50	63	75	100	125	150
150	6	up to 144					8.10	32.40	102.00	153.00
150	6	up to 288					4.50	21.00	66.00	153.00
150	6	up to 576					3.00	12.90	45.00	127.50
150	6	up to 864					2.10	9.90	37.50	96.00
150	6	up to 1294					1.80	7.50	27.60	72.00
150	6	up to 2070					1.20	6.30	22.50	55.80
200	8	up to 350						12.60	43.50	120.00
200	8	up to 640						9.00	25.80	78.00
200	8	up to 960						6.60	18.00	58.80
200	8	up to 1600						4.80	12.00	36.00
200	8	up to 2500						3.60	8.40	27.00
200	8	up to 4160						2.10	6.60	18.60
200	8	up to 5400						1.50	5.10	15.60

- **Sample Problem 1.**

Determine the size of the main vent that will serve 30 fixture units.

➢ **Solution:**

1. Referring to Table 2-9, it shows that a 63 mm Ø (2 ½") pipe could serve up to 36 fixture units.
2. Therefore specify a 63 mm Ø pipe for the main vent pipe.

- **Sample Problem 2.**

How large is the main vent diameter for various fixtures consisting of 4 water closets, 4 lavatories, 3 showers and 2 kitchen sink installed on the first floor of a two storey building 6.00 meters long?

➢ **Solution:**

1. Solve for the total fixture units using Table 3-1 of Learning Guide 3.

6 fixture units x 4 water closets - - - - - - - - - 24 units

1 fixture unit x 4 lavatories - - - - - - - - - - - -- 4 units

2 fixture units x 3 showers - - - - - - - - - - - -- 6 units

2 fixture units x 2 kitchen sink - - - - - - - - - - 4 units

Total - - - - - - - - - - - - - - - - - - - 38 units

2. Referring to Table 2-9 a 100 mm Ø (4”) soil or waste stack can accommodate to a maximum of 48 units.
3. Under the column “ Diameter of vent pipe “ a 63 mm Ø pipe could ventilate 48 fixture units as high as 19.50 meters.
4. Therefore: Specify a 63 mm Ø (2 ½ “) vent pipe.

- **Sample Problem 3.**

Determine the size of the main vent required for a drainage installation serving 90 fixture units installed on the ground floor of a 5 story building with a height of 19 meters.

- **Solution:**

1. Referring to Table 5-3, under column 1, a 100 mm Ø soil or waste stock could serve 96 fixture units.
2. Under column “ Diameter of Vent “ a 75 mm Ø (3”) pipe could ventilate 96 fixture units as high as 25.20 meters.
3. Therefore: Specify a 75 mm Ø (3”) main vent pipe.

- **Size of Storm Drain**

The size of Storm Drain could be determined under the following considerations:

1. Gauging the rainfall over a given period, whether it is constant or exceedingly heavy shower of short duration.
2. The varying roof area and its slope including the distance of water travel before it reaches the conductors or downspout of the roof.
3. Water drains faster on higher roof pitch. Thus, requires a larger drainage pipe than that of a flat roof.
4. The height of the building is a factor that contributes to the velocity of water in a vertical pipe conductor. It accelerates the flow of water entering the storm drain.
5. The use of short offsets and indiscriminate use of fittings will affect the flow of water and should be avoided.

- **Grade and Change Direction**

The storm drain pipe is installed providing a slope of not more than 2% per meter run. A combination of Y and 1/8 bend or a long radius fitting is appropriate for any change in direction.

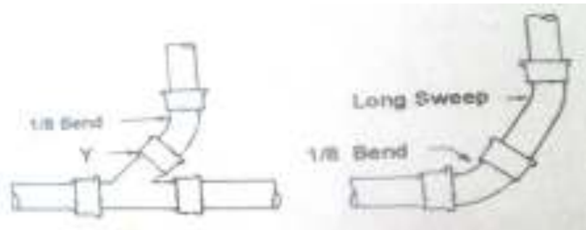


Figure 2.2 Grade and Change Direction

- **Roof Leader**

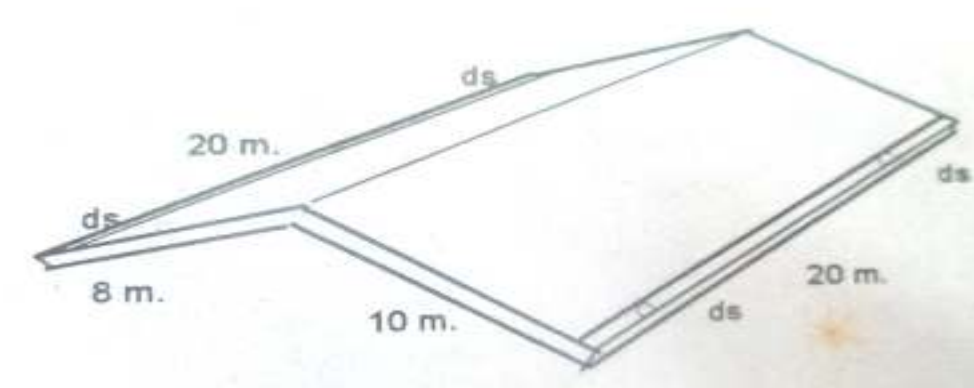


Figure 2.3 roof area

Roof Leader is popularly known as **Water Conductor or Downspout**. It connects the roof terminal to the storm drain. Roof leader is either exposed or concealed.

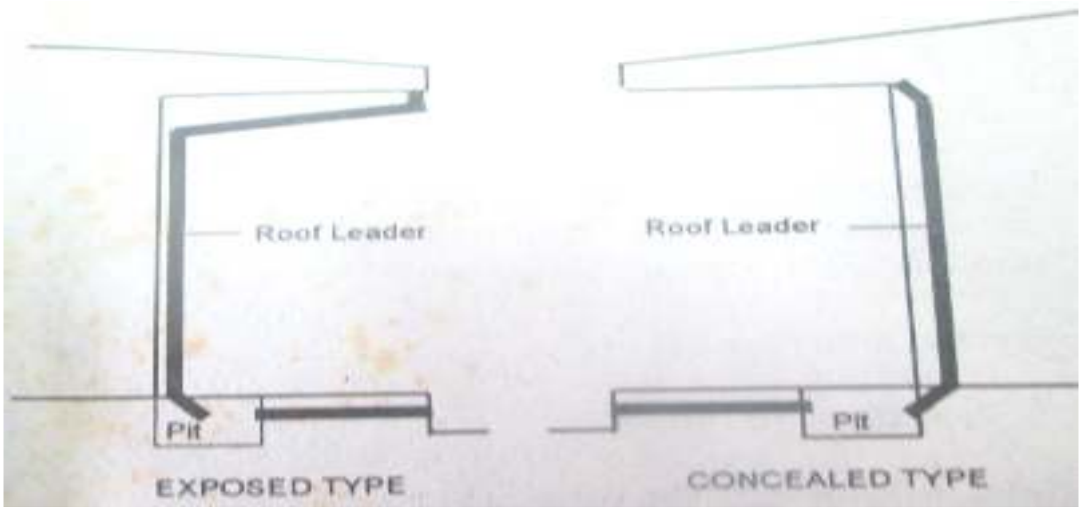


Figure 2.4 Roof leader

Table 2.13 Size of roof leader and gutter

Table 2.13 SIZE OF ROOF LEADER AND GUTTER		
Area of Roof (sq.m.)	Gutter Top Dimension (mm)	Downspout or Roof Leader Diameter (mm)
1 to 10	75	38
11 to 25	100	50
26 to 75	100	75
76 to 165	125	75
166 to 335	150	100
336 to 510	200	125
511 to 900	250	150

The size of the roof leader could be determine could be easily determine by using Table 2.13. And how to use the table we shall consider the given sample problem.

- **Sample Problem 1.**

How large is a downspout required to drain a roof with a general dimensions as shown in the figure.

➢ **Solution:**

1. Calculate the area of roof A.

   10 m x 20 m = 200 sq. meters
2. Using Table 4-1, under column 1, the 200 sq. m. roof are is within the limit of 166 to 335 sq. m. Thus, specify 100 mm Ø (4”) roof leader or downspout.
3. Calculate the area of Roof B.

   8 m x 20 m = 160 sq. meters
4. Using Table 4-1, under column 1, the value of 160 sq. m. requires a 75 mm Ø (3 ”) roof leader. Therefore specify a 75 mm Ø pipe.

In the given result of the above computation, it appears that the roof area A requires a one 100 mm Ø pipe while that of roof area B needs one 75 mm Ø pipe.

If only one roof leader is installed at each area considering the 20 meters length of the gutter, the rain water has to travel a long way before it reaches the roof terminal or the end where the roof leader is located. Under such condition, the gutter might be overloaded and overflow is likely to occur. More so, the terminal may be clogged up with dirt such leaves and others.

A good practice is to provide two or more terminals for roof leader to avoid clogging and overflow. The found size of the pipe if installed on two terminals would be oversized and expensive. Thus, it is necessary to select two small pipes that would serve the rain water.

- **Second Solution:**

1. Area of Roof A = 200 sq. m.
2. Divide by 2 terminals $= \frac{200 \text{ sq.m.}}{2}$ = 100 sq. m.
3. Referring to Table 4-1. The 100 sq. m. area is within 76 to 165 sq. m. Therefore specify 2 pieces of 75 mm Ø pipe.
4. For Roof B = 160 sq. m.
5. Divide by 2 terminals $= \frac{160 \text{ sq.m.}}{2}$ = 80 sq. m.
6. Referring again to Table 4-1, 80 sq. m. is within 76 to 165 sq. m. Use 2 pieces of 75 mm Ø roof leader.

Self-cheek 2.1

Part I: choose the best answer

1. Which of the following components should be considered when designing a sanitary plumbing system?
   A. Water supply pipes
   B. Drainage pipes
   C. Fixtures and appliances
   D. All of the above
2. Which organization in Ethiopia sets the regulations and standards for sanitary plumbing systems?
   A. Ethiopian Ministry of Health
   B. Ethiopian Standards Agency
   C. Ethiopian Water Works Construction Authority
   D. Ethiopian Public Health Institute
3. When determining the quantity and location of sanitary fixtures in a building, which factors should be considered?
   A. Number of occupants
   B. Building codes and regulations
   C. Accessibility requirements
   D. All of the above
4. How is the size of a sanitary plumbing system typically determined?
   A. Based on the number of fixtures in the building
   B. Based on the peak water demand of the building
   C. Based on the available budget for the project
   D. Based on the size of the building's water storage tank
5. Which of the following factors influence the design and size of sanitary plumbing pipes?
   A. Water pressure requirements
   B. Flow rate requirements
   C. Pipe material and diameter
   D. All of the above

Operation sheet 2.1

Operation Title: Fixture unit calculation

Purpose: To know the performance of size pipe calculation

Conditions or situations for the operations:

- Safe working area
- Properly operated tools and equipment

Equipment Tools and Materials:

- Drawing Instruments
- Building Plans and Specifications
- Pipe Sizing Charts and Tables
- Measuring and Marking Tools

Steps in doing the task

1. Identify the fixtures
2. Determine the fixture unit values
3. Assign fixture unit values
4. Calculate total fixture units
5. Determine size of system

Quality Criteria:

Assured performing of all the activities according to the procedures

Precautions:

- Detailed Scope of Work
- Accurate fixture quantity
- Accurate fixture unit value

Lap Tests

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks accordingly.

Task 1: quantity of fixture determine

Task 2: Calculate Fixture unit

Task 3: determine size of pipe

Unit Three: Planning system layout

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- Layout of sanitary pipe work and fixtures.
- Materials requiring.
- Recording plans.
- Sustainability principles and concepts.

This guide will also assist you to attain the unit stated in the cover age. Specifically, upon completion of this learning guide, you will be able to:

- Plan Layout of sanitary pipe work and fixtures.
- Specify and optimized Materials requiring.
- Record plans.
- Apply Sustainability principles and concepts.

3.1. Layout of sanitary pipe work and fixtures

The layout of sanitary pipe work and fixtures in a building depends on various factors such as the building's size, its purpose (residential, commercial, industrial), local plumbing codes and regulations, and the specific requirements of the project. general overview of how sanitary pipe work and fixtures are typically laid out in a building.

1. **Main Sewer Line:** The main sewer line, also known as the building sewer or house drain, is the primary pipe that carries wastewater from the building to the public sewer system or a private septic tank. It is usually located underground and connects to all the plumbing fixtures in the building.
2. **Branch Lines:** Branch lines are secondary pipes that connect individual fixtures to the main sewer line. The layout of branch lines depends on the location and number of fixtures in the building. For example, in a residential building, branch lines may connect toilets, sinks, showers, and bathtubs to the main sewer line.
3. **Vents:** Vents are pipes that allow air to enter the plumbing system and prevent the formation of vacuum or pressure. They also help to remove unpleasant odors from the system. Vents are typically connected to the branch lines and extend through the roof of the building. The layout and sizing of vents are crucial to ensure proper drainage and prevent the trap seals from being siphoned or blown out.
4. **Traps:** Traps are curved sections of pipe located below fixtures such as sinks, showers, and toilets. Their purpose is to create a water seal that prevents sewer gases from entering the building while still allowing wastewater to flow through. Traps are typically designed in a "U" or "P" shape and are an essential component of the sanitary plumbing system.
5. **Fixture Connections:** Each plumbing fixture in the building, such as toilets, sinks, showers, and bathtubs, will have its own connection to the branch line. The specific layout and configuration of these connections will depend on the fixture type and its location within the building.

It's important to note that the layout of sanitary pipe work and fixtures should be designed and installed by a licensed plumber or a qualified professional in accordance with local plumbing codes and regulations. These codes and regulations provide guidelines for pipe sizing, venting requirements, fixture distances, and other important considerations to ensure the proper functioning and safety of the plumbing system.

Designing and sizing sanitary plumbing systems involves careful consideration of the layout of pipe work and fixtures.

Key factors

1. **Fixture Layout:** Start by determining the locations of all the plumbing fixtures, such as toilets, sinks, showers, and bathtubs, in the building. Consider the functionality, aesthetics, and accessibility of each fixture. Ensure that fixtures are evenly distributed throughout the building to minimize long pipe runs.
2. **Drainage System:** Design the drainage system to allow wastewater to flow efficiently from each fixture to the main sewer or septic tank. Use gravity to your advantage by ensuring that the pipes slope downward at a minimum slope of 1/4 inch per foot (2% slope) to facilitate proper drainage. Avoid excessive bends and use smooth, wide-radius bends where necessary.
3. **Ventilation:** Install vent pipes to prevent the buildup of sewer gases and to maintain a proper pressure balance in the system.

Fixtures

When designing and sizing sanitary plumbing systems, the layout of the sanitary pipe work and fixtures is an important consideration. Here is a general overview of the layout and fixtures commonly used in sanitary plumbing systems:

a) **Ablution Trough:** An ablution trough is a long, narrow fixture used in public restrooms or communal areas for multiple users to wash their hands simultaneously.

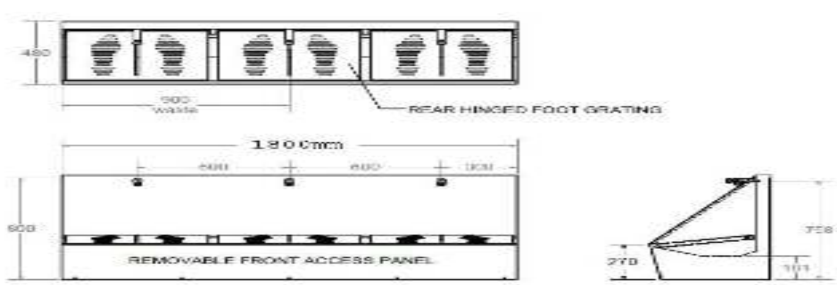
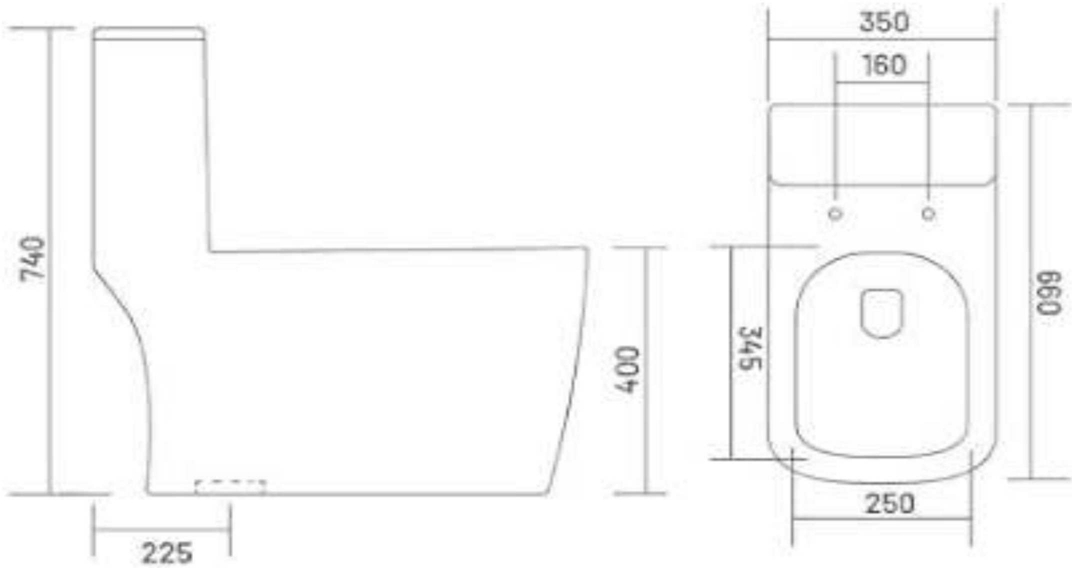


Figure 0.1 Ablution Trough

b) **Water Closet:** A water closet, commonly known as a toilet, is a fixture used for the disposal of human waste. It typically consists of a bowl with a water seal and a flushing mechanism.



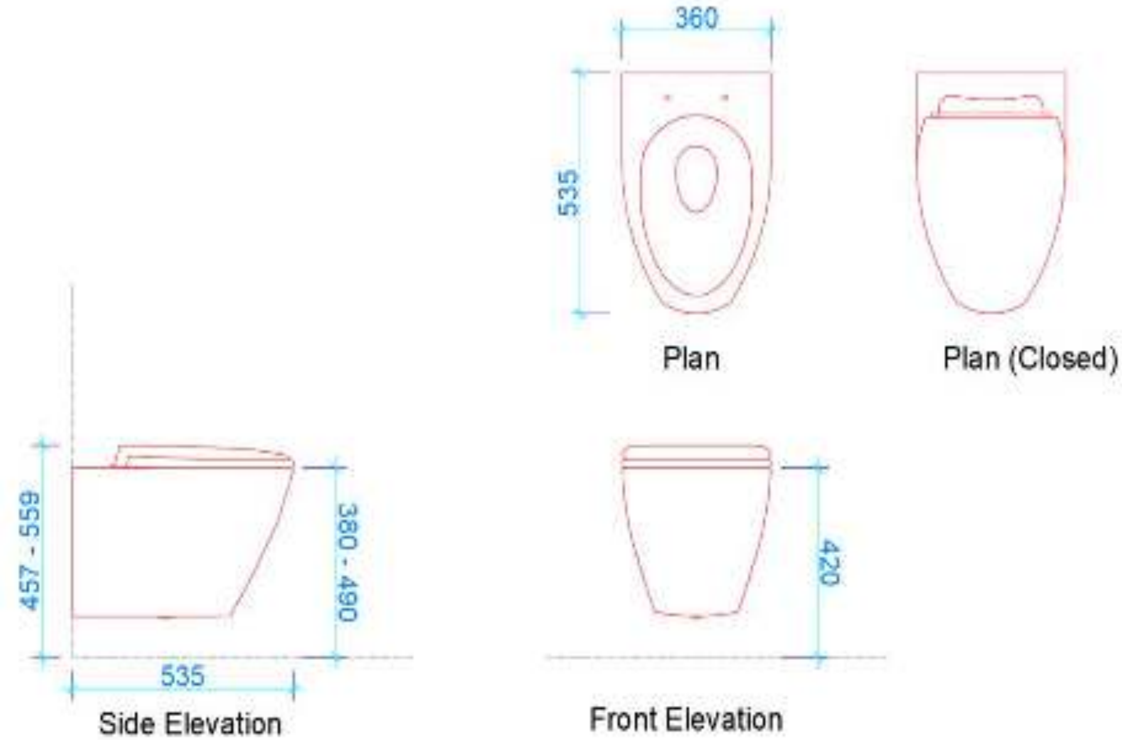


Figure 0.2 Water Closet (Commode)

WC FLOOR PAN

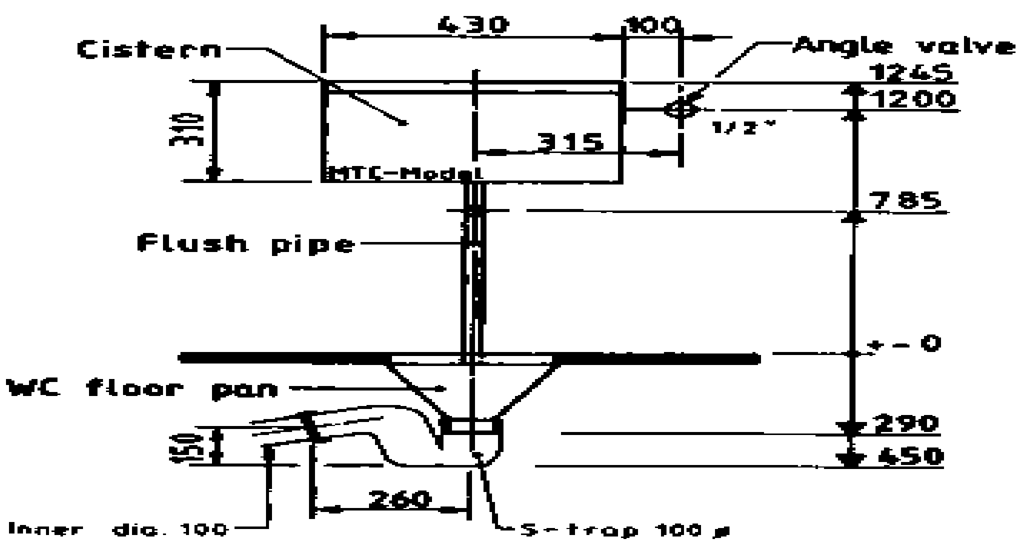


Figure 0.3 WC Eastern PAN

c) **Basin:** A basin, also known as a sink or lavatory, is a fixture used for hand washing and personal hygiene. It is typically used in bathrooms and kitchens.

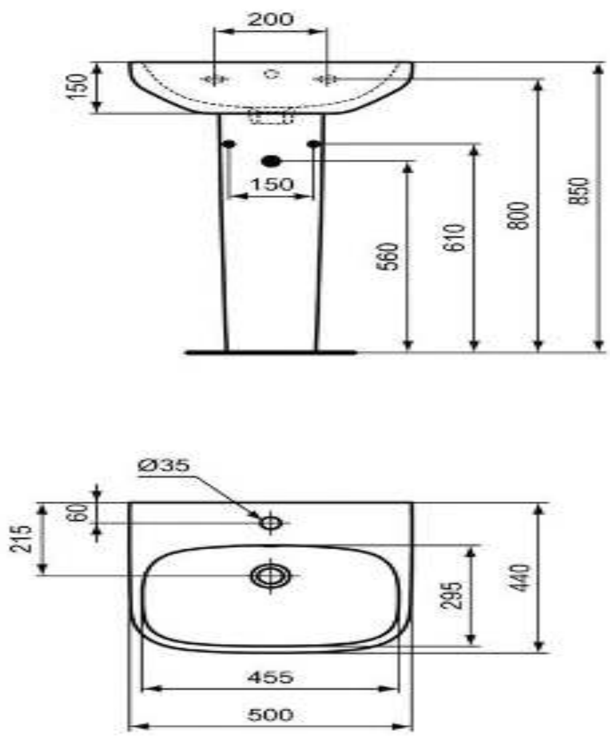


Figure 0.4 pedestal Hand Wash Basin

Figure 0.5 Coroner Hand Wash Basin

d) Bath: A bath, also known as a bathtub, is a fixture used for bathing. It is generally larger than a basin and allows users to immerse themselves in water.

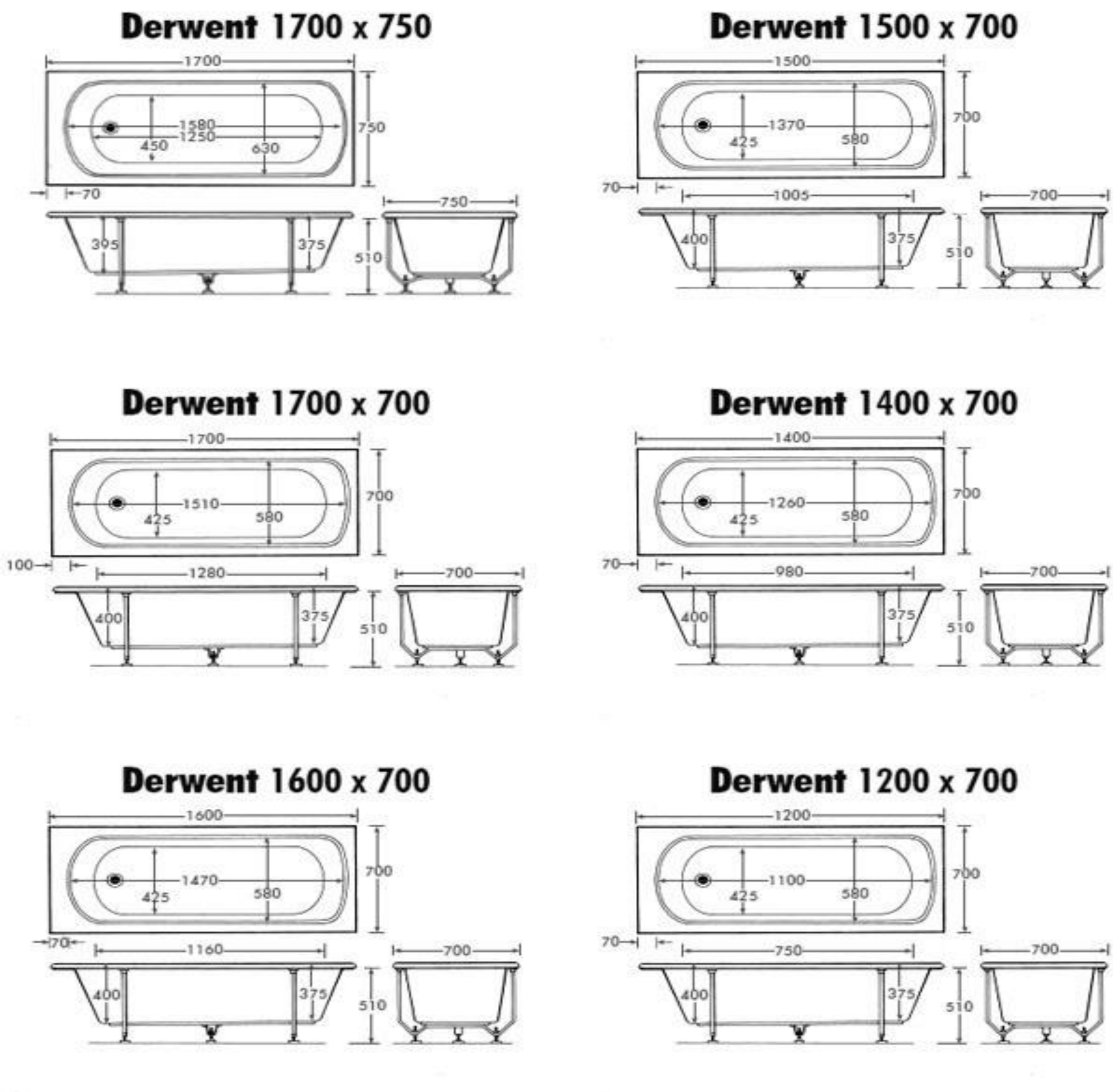


Figure 0. 0.6 Bathtub

e) Bidet: A bidet is a fixture used for personal hygiene after using the toilet. It typically includes a water spray or jet for cleansing.

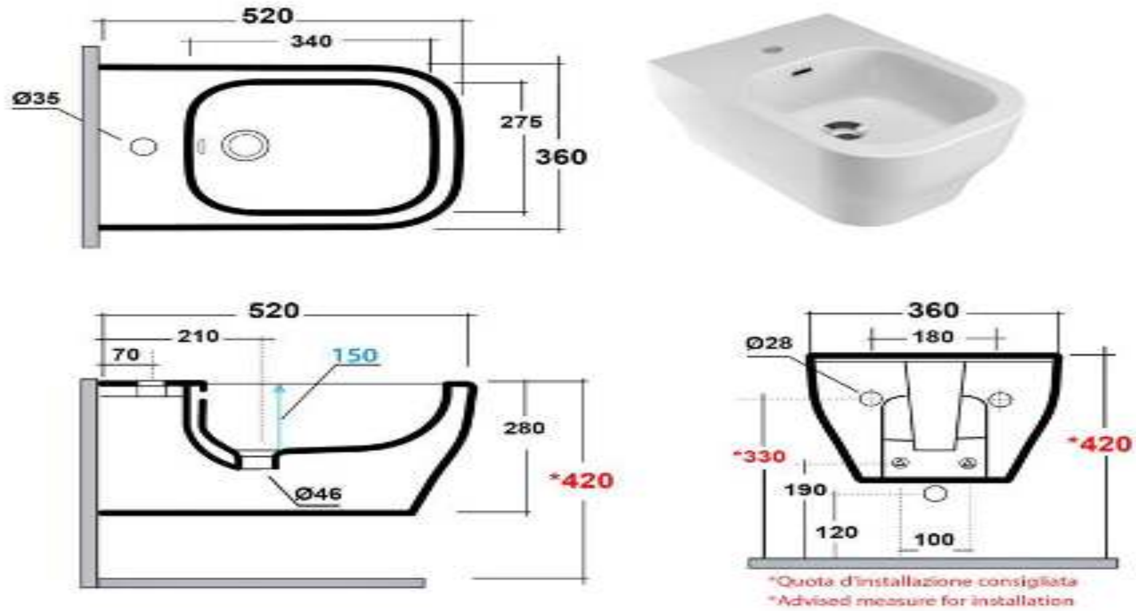


Figure 0.7 bidet

f) **Domestic and Commercial Clothes Washing Machine:** Clothes washing machines are fixtures used for washing clothes. In domestic settings, they are typically smaller and designed for home use. In commercial settings, larger and more robust machines are used.

Figure 0.8 Clothes Washing Machine

g) **Domestic and Commercial Dish Washing Machine:** Dishwashing machines, also known as dishwashers, are fixtures used for cleaning dishes and utensils. Similar to clothes washing machines, they can be designed for domestic or commercial use.

Figure 0.9 Dish Washing Machine

h) **Shower:** A shower is a fixture used for bathing, typically consisting of a spray nozzle or showerhead that delivers water from above.

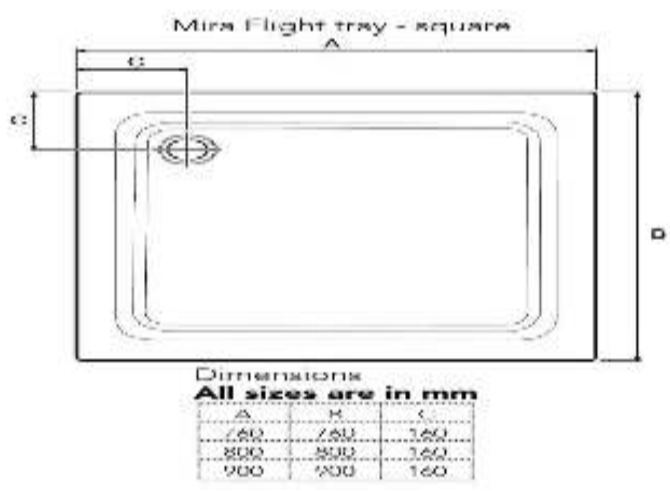
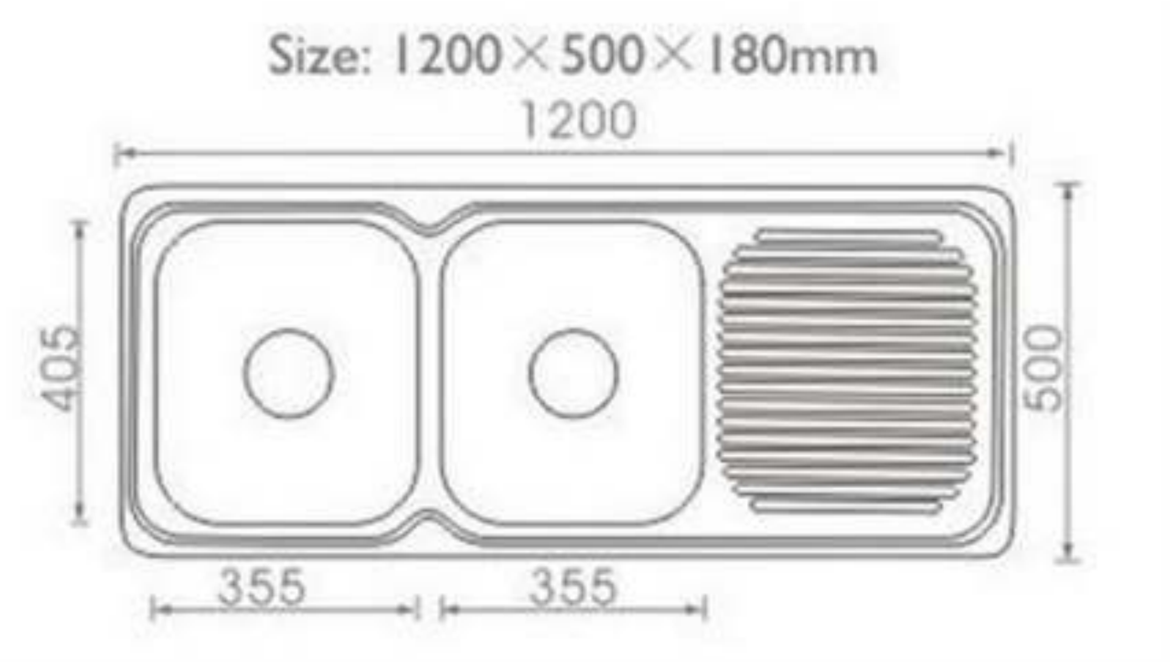


Figure 0.10 **Shower**

i) **Sink:** A sink is a fixture used for various purposes, such as hand washing, dishwashing, or food preparation. It can be found in kitchens, bathrooms, or utility areas.



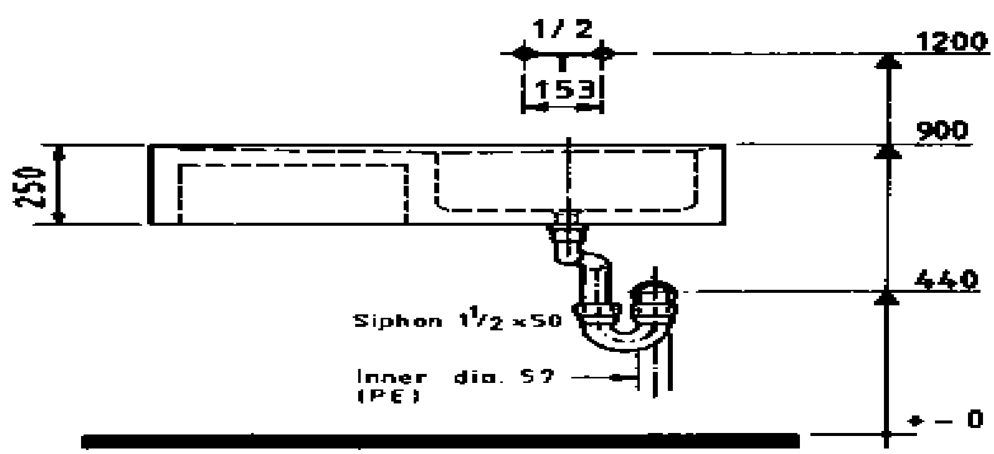


Figure 0.11 KITCHEN SINK

j) **Slop Hopper:** A slop hopper is a specialized fixture used in healthcare facilities or commercial settings for the disposal of liquid waste, such as vomit or other bodily fluids.

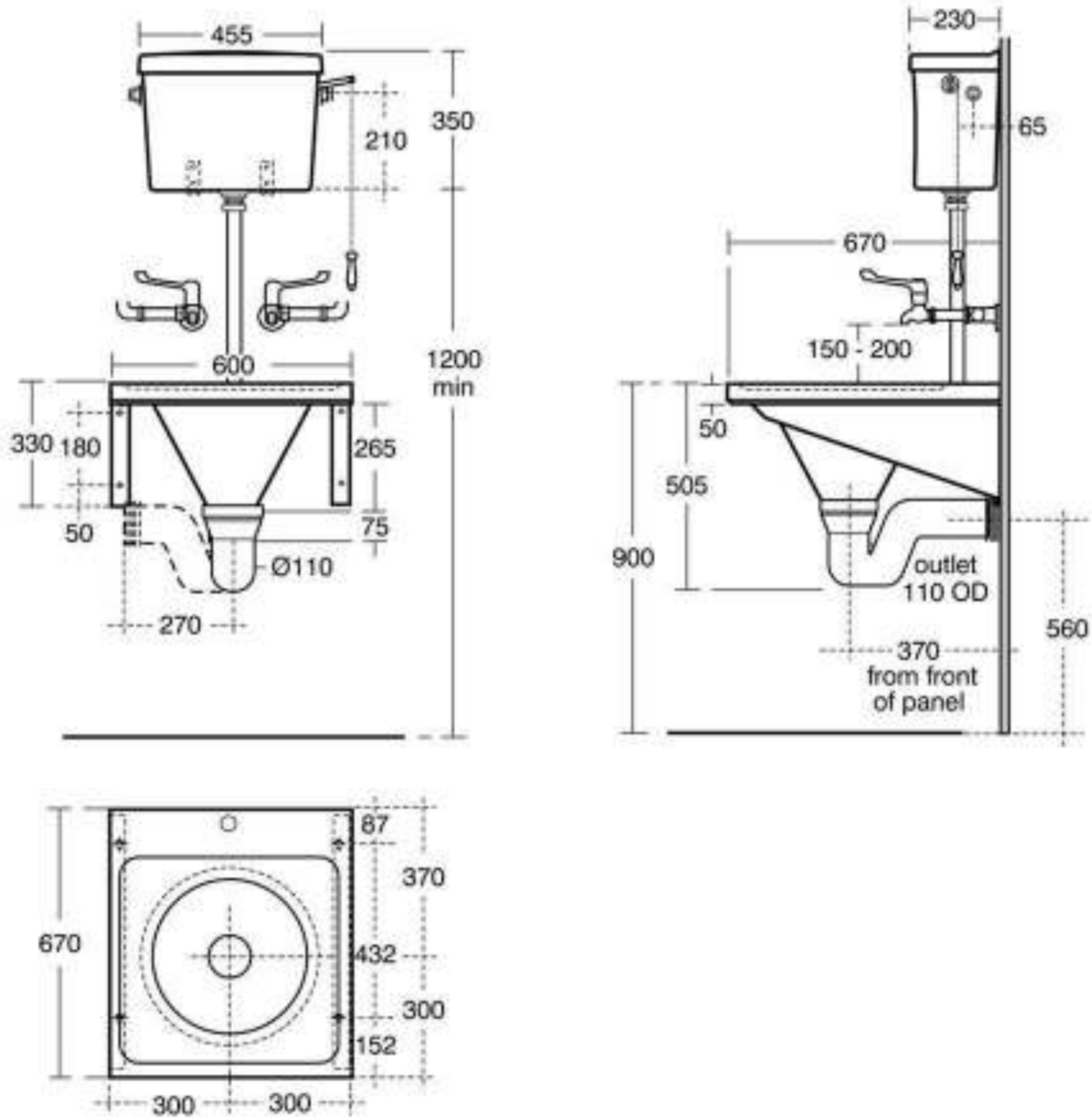


Figure 0.12 Slop Hopper

k) **Urinal:** Urinals are fixtures used for male urination. They are commonly found in public restrooms or commercial buildings and are designed to be water-efficient.

Figure3.6**URINAL**

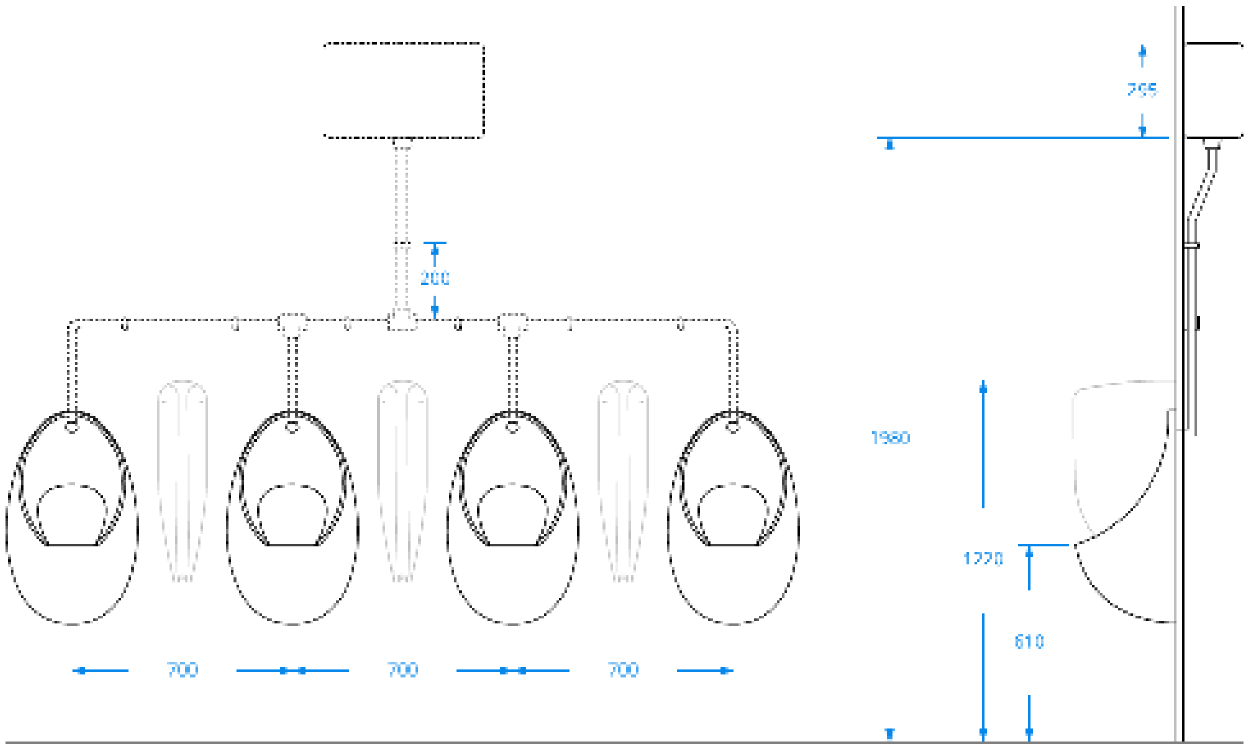


Figure 0.13 urinal

3.2. Materials requirement

When designing and sizing sanitary plumbing systems, several materials and resources are necessary. These include:

1. **Building Plans and Specifications:** These documents provide an overview of the building's layout, including the location and configuration of plumbing fixtures, such as toilets, sinks, showers, and drains. They also include information about the building's overall design, including its size, number of floors, and usage patterns.
2. **Drainage Plans:** These plans outline the network of drainage pipes and fixtures within the building. They indicate the location and size of main sewer lines, branch lines, vents, and traps. Drainage plans are crucial for understanding the flow of wastewater and designing an efficient plumbing system.

3. **Recording plans.**

When creating a plan for the layout of sanitary plumbing systems, there are several important factors to consider.

- **Step Create Plan:**

a) **Gather information:** Start by collecting all relevant information about the building or project. This includes architectural drawings, floor plans, and any specifications or regulations that need to be followed.

b) **Identify fixtures and requirements:** Determine the types and quantities of fixtures that will be connected to the plumbing system. This typically includes toilets, sinks, showers, bathtubs, and any other water-consuming appliances. Consider the intended use of the building and its occupancy to calculate the estimated water demand.

c) **Determine plumbing system type:** Decide on the type of plumbing system that will be used. The most common options are single-stack, two-pipe, and combined systems. The choice depends on factors such as building size, complexity, and local plumbing codes.

d) **Establish system layout:** Based on the architectural drawings and the chosen plumbing system type, create a preliminary layout of the plumbing system. Identify the main vertical stacks, horizontal branch lines, and fixture connections. Ensure that the layout allows for efficient water flow and minimizes the potential for clogs or backups.

e) **Consider venting requirements:** Plumbing systems require venting to prevent pressure imbalances and remove sewer gases. Determine the appropriate locations for vent pipes, which are typically connected to the main stack and extend above the roofline. Ensure that the vents are properly sized and positioned to meet code requirements.

f) **Plan drainage and waste disposal:** Determine the best routes for the drainage pipes to connect the fixtures to the main stack or sewer line. Consider the slope requirements for gravity-based drainage and incorporate the necessary fittings, such as P-traps and cleanouts, to ensure proper function and maintenance access.

g) **Plan water supply lines:** Determine the layout of the water supply lines that will deliver potable water to the fixtures. Identify the main supply line and its connection to the municipal water source or private well. Design the branch lines and choose appropriate pipe sizes based on anticipated water demand and pressure requirements.

h) **Consider accessibility and code compliance:** Ensure that the plumbing system layout meets accessibility requirements, such as providing adequate clearances and maneuvering space around fixtures. Additionally, ensure compliance with local plumbing codes and regulations regarding pipe sizing, slope, material selection, and fixture distances.

i) **Create detailed drawings:** Once the preliminary layout is established, create detailed drawings that illustrate the system design. Include dimensions, pipe sizes, fittings, fixture locations, and any other relevant information. These drawings will serve as a reference for the construction and installation process.

j) **Review and revise:** Review the plan for accuracy, functionality, and compliance. Seek input from plumbing professionals or consultants if needed. Revise the plan as necessary to address any issues or incorporate feedback.

Sustainability principles and concepts

Sustainability principles and concepts for sanitary plumbing systems involve designing and implementing practices that minimize water usage, reduce energy consumption, and promote efficient waste management.

Key principles and concepts:

1. **Water Efficiency:** Encouraging water conservation is crucial for sustainable plumbing systems. This can be achieved through the use of low-flow fixtures, such as low-flow toilets and aerated faucets, which reduce water consumption without compromising performance. Additionally, rainwater harvesting systems can be implemented to collect and reuse rainwater for non-potable purposes like irrigation or toilet flushing.
2. **Energy Efficiency:** Minimizing energy consumption in sanitary plumbing systems helps reduce greenhouse gas emissions. One way to achieve energy efficiency is by using energy-efficient water heaters, such as tank less or heat pump water heaters, which consume less energy compared to traditional storage tank water heaters. Insulating hot

water pipes and using timers or smart controls for hot water circulation pumps also contribute to energy savings.

3. **Grey water Systems:** Implementing grey water systems is an effective way to reduce freshwater usage. Grey water refers to gently used water from sources like sinks, showers, and washing machines. By treating and reusing grey water for non-potable purposes, such as toilet flushing or landscape irrigation, the demand for freshwater can be significantly reduced.
4. **Efficient Waste Management:** Proper waste management is essential for sustainable plumbing systems. Installing and maintaining efficient sewage systems, including sewer lines, septic tanks, or decentralized wastewater treatment systems, ensures effective collection and treatment of wastewater. Additionally, promoting responsible disposal practices, such as discouraging the flushing of non-biodegradable items, helps prevent clogging and reduces the strain on wastewater treatment facilities.
5. **Material Selection:** Choosing environmentally friendly materials is an important consideration for sustainable plumbing systems. Opting for products that are made from recycled or sustainable materials, such as low-lead or lead-free plumbing fixtures, helps minimize environmental impact. Additionally, selecting durable materials that require less frequent replacement reduces waste generation over time.
6. **Maintenance and Monitoring:** Regular maintenance and monitoring of plumbing systems are crucial for identifying and addressing issues promptly. Timely repairs of leaks, drips, or faulty fixtures help conserve water and prevent water damage. Implementing water metering and monitoring systems can provide insights into water usage patterns, facilitating better management and conservation efforts.
7. **Education and Awareness:** Promoting education and awareness about sustainable plumbing practices among building occupants, plumbers, and professionals is key to achieving long-term sustainability. Engaging in public outreach programs, providing educational materials, and incentivizing sustainable practices can encourage individuals to adopt water-saving habits and make informed choices about plumbing system upgrades.

Incorporating these sustainability principles and concepts into sanitary plumbing systems, it is possible to reduce water consumption, conserve energy, and minimize the environmental impact of plumbing infrastructure.

Sustainability principles and concepts can be applied to sanitary plumbing systems to minimize their environmental impact.

1. **Efficient Design Principles:** Optimize the design to minimize water and energy consumption. This can be achieved through the use of low-flow fixtures and appliances such as low-flow toilets, faucets, and showerheads.

   Design the plumbing system to reduce the length of pipe runs, as shorter pipes result in less water and energy waste due to reduced friction losses.

   Implement a well-designed layout that reduces the need for excessive piping, minimizing material usage and construction waste.
2. **Efficient Use of Materials:** Choose materials that are durable, long-lasting, and have allow environmental impact, such as recycled or reused materials. Incorporate materials that are easy to maintain and repair, reducing the need for replacements and minimizing waste.
3. **Recycling of Materials:** Promote the use of recycled materials in plumbing system components, such as fixtures, pipes, and fittings.

   Implement recycling programs during construction and renovation projects to ensure that waste materials are properly sorted and recycled.
4. **Efficient Energy and Water Use:** Install energy-efficient water heaters, such as tank less or heat pump systems, to minimize energy consumption.

   Incorporate water-saving technologies, such as dual-flush toilets, sensor-based faucets, and automatic shut-off valves, to reduce water usage.

   Design the plumbing system to include water reclamation and reuse systems, such as rainwater harvesting or gray water recycling, to minimize the demand for freshwater.
5. **Waste Disposal and Environmental Impact:** Implement proper waste management practices to ensure that waste materials, such as sewage, are treated and disposed of in an environmentally responsible manner.

Consider the use of advanced wastewater treatment technologies that can remove contaminants and reduce the environmental impact of discharged effluent.

Comply with local regulations and standards for waste disposal to ensure minimal environmental impact.

By incorporating these sustainability principles and concepts into the design and operation of sanitary plumbing systems, it is possible to achieve efficient water and energy use, minimize environmental impact, and contribute to a more sustainable built environment.

3.3. Restore work area

To restore the work area and refurbish tools and equipment, as well as ensure documentation and work backup for designing and sizing sanitary plumbing systems, you can follow these steps:

A. **Clean and organize the work area:** Remove any debris, dust, or clutter from the work area. Ensure that it is clean and ready for use.

B. **Inspect and refurbish tools and equipment:** Check all plumbing tools and equipment for any damage or wear. Repair or replace any faulty tools or equipment as needed. Clean and organize the tools for easy access.

C. **Review and update documentation:** Gather all relevant documentation related to designing and sizing sanitary plumbing systems. This may include building plans, plumbing codes and regulations, manufacturer specifications, and any previous designs or calculations. Review the documentation for accuracy and update it if necessary.

D. **Create a backup of previous work:** It's important to have a backup of your previous work for reference and to avoid any potential loss of data. Make digital copies of any design files, calculations, or reports related to the sanitary plumbing systems. Store these backups in a secure location, such as cloud storage or an external hard drive.

E. **Update software and tools:** If you are using any software or computer-based tools for designing and sizing sanitary plumbing systems, make sure they are up to date. Install any necessary updates or patches to ensure optimal functionality.

F. **Organize work materials:** Arrange all necessary materials such as drafting supplies, reference books, and software licenses in a systematic manner. This will help streamline your workflow and make it easier to access the resources you need.

G. **Establish a filing system:** Set up a filing system for organizing documents, such as design drawings, calculations, and reports. Use labels and folders to categorize and store the information in a logical manner. This will make it easier to retrieve specific documents when needed.

H. **Maintain regular backups:** Going forward, make it a habit to regularly back up your work to prevent data loss. Schedule automated backups or designate specific times to manually create backups of your design files, calculations, and other important documents.

Following these steps, you can effectively restore your work area, refurbish tools and equipment, update documentation, and ensure work backup for designing and sizing sanitary plumbing systems.

SELF CHEEK 3.1

Part –I Say True/False

1. The layout of sanitary pipe work and fixtures is determined solely by personal preference and does not need to follow any specific guidelines or regulations.
2. Recording plans of sanitary plumbing systems is not necessary and does not provide any benefits to the design and construction process.
3. Sustainability principles and concepts are not relevant to the design and sizing of sanitary plumbing systems as they do not have a significant impact on the environment.
4. The size of sanitary plumbing systems should be determined based on the maximum number of fixtures that will be connected to the system.

Part –II Choose the correct answer

1. Which material is commonly used for sanitary drainage pipes due to its durability and corrosion resistance?
   A. Copper
   B. PVC
   C. Galvanized steel
   D. Cast iron
2. Which material is typically used for water supply pipes due to its resistance to high pressure and temperature?
   A. PVC
   B. Copper
   C. HDPE
   D. PEX
3. What is the purpose of recording plans in sanitary plumbing system design?
   A. To estimate the cost of materials
   B. To ensure compliance with building codes
   C. To determine the ideal pipe diameter
   D. To calculate the required slope for drainage pipes
4. Which of the following information is typically included in recorded plans for sanitary plumbing systems?
   A. Fixture locations
   B. Material specifications
   C. Pipe sizes and slopes
   D. All of the above
5. Which of the following is a sustainable design principle for sanitary plumbing systems?
   A. Minimizing water usage
   B. Maximizing pipe diameter

C. Using non-recyclable materials

D. Ignoring energy efficiency

6. What is the purpose of sizing sanitary plumbing systems correctly in terms of sustainability?
   - A. To reduce water consumption and waste
   - B. To increase maintenance requirements
   - C. To maximize energy usage
   - D. To decrease the lifespan of the system

7. What is the first step to restore the work area and ensure the availability of tools, equipment, documentation, and work backups?
   - A. Clean and organize the work area
   - B. Verify the condition of tools and equipment
   - C. Collect and review relevant documentation
   - D. Create backup copies of design and sizing files

8. What should be included in the restoration process to ensure availability of documentation?
   - A. Conduct a thorough inventory of existing documentation
   - B. Digitize paper documents for easy access and backup
   - C. Update and organize design manuals and reference materials
   - D. Implement version control for design and sizing documents

9. What is the importance of creating work backups during the restoration process?
   - A. To protect against data loss and ensure project continuity
   - B. To comply with industry regulations and standards
   - C. To provide a reference for future plumbing system designs
   - D. To streamline collaboration with other design professionals

Operation sheet 3.1

Operation Title: Layout sanitary pipe work and fixtures

Purpose: To know the performance of lay out sanitary pipe work

Conditions or situations for the operations:

- Safe working area
- Properly operated tools and equipment

Equipment Tools and Materials:

- Drawing Instruments
- Building Plans and Specifications
- Pipe Sizing Charts and Tables
- Measuring and Marking Tools

Steps in doing the task

1. Identify size house dimension
2. Determine fixture
3. Assign fixture unit values
4. Calculate total fixture units
5. Determine size of system

Quality Criteria:

Assured performing of all the activities according to the procedures

Precautions:

- Detailed Scope of Work
- Accurate fixture quantity
- Accurate fixture unit value

Lap Tests

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks accordingly.

Task 1: quantity of fixture determine

Task 2: Calculate Fixture unit

Task 3: determine size of pipe

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