GOVT. POLYTECHNIC KANDHAMAL, PHULBANI

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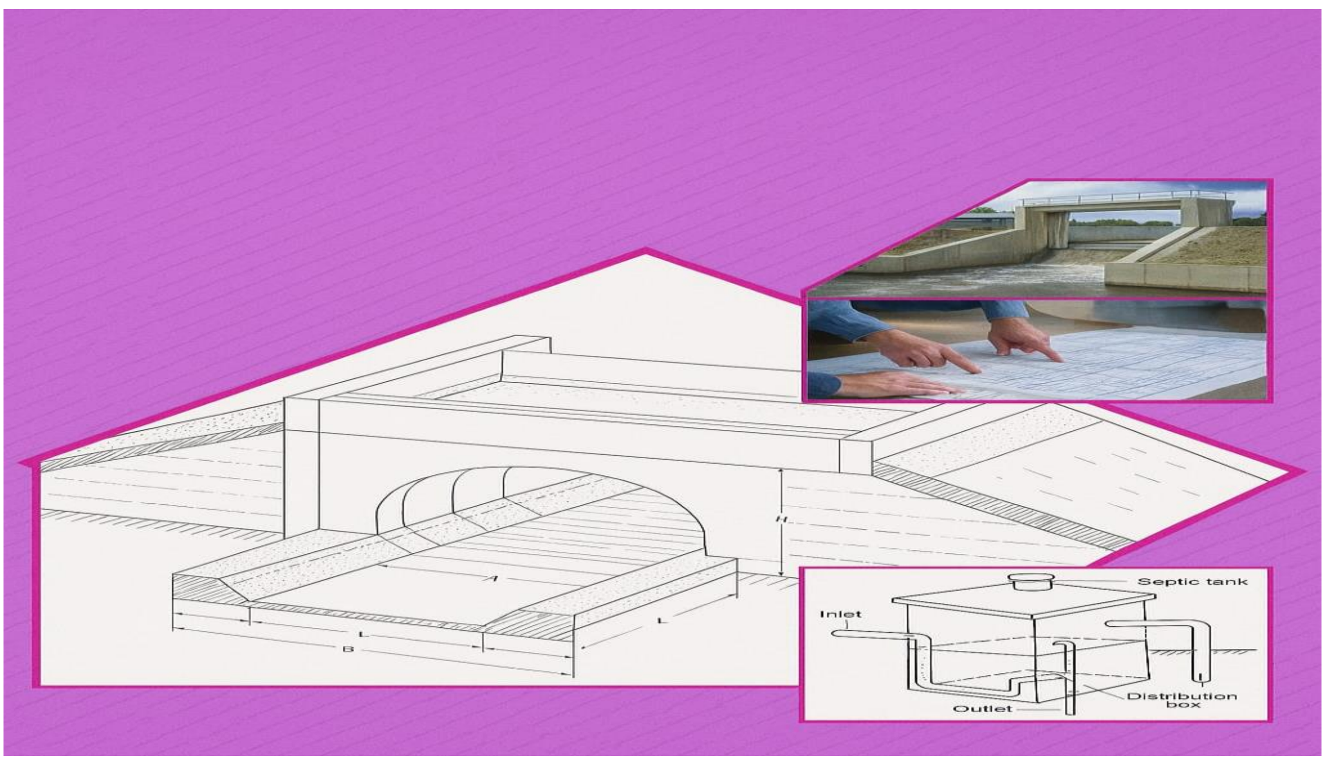
(Dept. of S D & T E, Odisha, Bhubaneswar, Under Directorate of Technical Edn&Trng, Odisha)

LAB MANUAL

CIVIL ENGINEEERING DRAWING –II

4TH , SEMESTER , CIVIL ENGINEERING



Prepared by

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Pr2. CIVIL ENGINEERING DRAWING – II

Name of the Course: Diploma in Civil Engineering			
Course code:		Semester	4th
Total Period:	90	Examination	3 hrs
Lab. periods:	6 P/week	Term Work/Sessional	50
Maximum marks:	150	End Semester Examination:	100

A. RATIONALE

The course aims to prepare the students to use modern engineering tools to prepare drawings of essential structures that include culverts, irrigation structures, sanitation components.

B. COURSE OBJECTIVES

After completion of the course, students will be able to use AutoCAD or CAD softwares to

–Prepare RCC slab culvert drawings

–Prepare Hume pipe culvert drawings

–Prepare detailed drawings including plan, elevation and section views of irrigation structures

–Prepare detailed drawings of drainage siphons

–Generate drawings of plumbing and sanitary connections in two room buildings

–Generate detailed drawing of septic tanks

C. TOPIC WISE DISTRIBUTION OF PERIODS

Chapter	Name of topics	Hours
1	Detailed drawing of culvert	25
2	Irrigation Structures	35
3	Plumbing and Sanitary connections	10
4	septic tank up to 50 users with soak pit	20

CI. COURSE CONTENT:

(ALL THE DRAWINGS TO BE DONE USING AUTO CAD SOFTWARE ONLY)

1.0 Detailed drawing of culvert

Half foundation plan and half top plan, cross sectional elevation and longitudinal section of

ii) RCC Slab culvert with right angled wing wall

ii) Hume pipe culvert with splayed wing wall

2.0 Irrigation Structures

1.2 Detail drawing of a vertical drop type fall (Sarada Type) from given specifications

2.2 Drawing of a Drainage siphon from given specifications

3.0 Plumbing and Sanitary connections and fittings of a two roomed building

4.0 Detailed drawing of septic tank up to 50 users with soak pit and necessary connection from the water closet.

A. RECOMMENDED BOOKS:

1. Civil Engg. Drawing -M.Chakrobarty.
2. Civil Engineering Drawing & House Planning -B.P.Verma.
3. A Course in Civil Engg Drawing -VB Sikka
3. Engineering graphics and design - K. Kumar, A.K. Ray & C. Ranjan- Vikas Pbln.
4. Auto Cad -Omura
5. AutoCAD (Architecture) 2011 -William G. Wyatt

1.0 Detailed drawing of culvert

Experiment -1

Aim of the Experiment – To prepare detailed Drawing of RCC Slab Culvert with right Angled Wing Wall.

Required Software and Materials

- **AutoCAD Software** (Any version such as AutoCAD 2023 or earlier)
- **Computer with necessary system requirements for AutoCAD**
- **Ruler, scale, compass** (for initial manual sketches, optional)
- **Drafting and drawing tools in AutoCAD**: Lines, polylines, hatches, layers, text, and dimensions.

Theory

1. RCC Slab Culvert Components

A RCC slab culvert consists of several components that need to be depicted in the drawings:

- **Deck Slab**: Horizontal slab that forms the top cover of the culvert.
- **Side Walls**: Vertical walls that support the deck slab and control the water flow.
- **Base Slab**: The bottom of the culvert, which supports the flow and the load from above.
- **Reinforcement**: Steel reinforcement bars placed within the concrete to provide strength against bending, shear, and torsion.
- **Inlet and Outlet**: Openings at both ends that allow water to flow through.

2. Key Drawings

- **Half Foundation Plan**: Shows one-half of the foundation, including the base slab and side walls.
- **Half Top Plan**: A top-down view showing the deck slab and the overall outline of the culvert.
- **Cross-Sectional Elevation**: A vertical cut showing the structural details of the culvert, including dimensions and reinforcement.
- **Longitudinal Section**: A view along the length of the culvert that shows the alignment and depth variations.

Lab Exercises/ *Procedure*

Exercise 1: Half Foundation Plan

Objective: To create the half-foundation plan of an RCC slab culvert in AutoCAD.

Procedure:

1. **Open AutoCAD**: Start a new project using an appropriate template or start from scratch.
2. **Set Units**: Type UNITS and set the drawing units to meters or millimeters depending on the required scale.
3. **Draw the Base Slab**: Use the RECTANGLE command to draw the base slab. Define the dimensions of the slab based on the design.
4. **Draw the Side Walls**: Use the LINE or RECTANGLE tool to draw the side walls of the culvert. Set the height and thickness according to the specifications.
5. **Add Dimensions**: Use the DIMLINEAR and DIMALIGNED tools to add dimensions for lengths, widths, and thicknesses of the base slab and side walls.
6. **Insert Reinforcement Details**: Use HATCH to represent the reinforcement (rebar) areas in the base slab and side walls. You can use dashed lines or patterns to represent rebars.
7. **Label Components**: Use the TEXT tool to label the components like "Base Slab", "Side Walls", "Reinforcement", etc.

AutoCAD Commands: RECTANGLE, LINE, DIMLINEAR, DIMALIGNED, HATCH, TEXT

Results:

Exercise 2: Half Top Plan

Objective: To create the half-top plan of the RCC slab culvert in AutoCAD.

Procedure:

1. **Start a New Drawing**: Open a new drawing file in AutoCAD.
2. **Draw the Deck Slab**: Using the RECTANGLE or LINE command, draw the outline of the culvert's deck slab.
3. **Create the Inlet and Outlet**: Use the CIRCLE or POLYGON command to represent the inlet and outlet openings of the culvert.
4. **Draw the Culvert Alignment**: Use the POLYLINE tool to show the centerline of the culvert.
5. **Add Dimensions**: Add the dimensions of the deck slab, inlet, outlet, and overall alignment using DIMLINEAR and DIMRADIAL for circular components.
6. **Insert Reinforcement Details**: For showing reinforcement in the deck slab, use the HATCH tool with a specific pattern representing rebar.
7. **Label Components**: Add appropriate labels for the components of the culvert using the TEXT tool.

AutoCAD Commands: RECTANGLE, CIRCLE, POLYLINE, DIMLINEAR, DIMRADIAL, HATCH, TEXT

Exercise 3: Cross-Sectional Elevation

Objective: To create the cross-sectional elevation of the RCC slab culvert in AutoCAD.

Procedure:

1. **Start a New Drawing**: Open a new AutoCAD drawing file for the cross-sectional elevation.
2. **Draw the Section**: Use the LINE tool to draw the outline of the section cut through the culvert. Include the deck slab, base slab, and side walls.
3. **Indicate Reinforcement**: Use the HATCH tool to represent reinforcement in the base slab, deck slab, and side walls. Use dashed lines for reinforcement bars.
4. **Add Elevation Dimensions**: Use DIMLINEAR and DIMALIGNED to show vertical dimensions, including the thickness of the slabs and the height of the walls.
5. **Label Components**: Use the TEXT tool to label the components, such as "Deck Slab", "Side Wall", "Base Slab", etc.
6. **Detail Reinforcement**: Include the details of the reinforcement bars' size, number, and placement using the TEXT tool to describe the reinforcement layout.

AutoCAD Commands: LINE, HATCH, DIMLINEAR, DIMALIGNED, TEXT

Exercise 4: Longitudinal Section

Objective: To create the longitudinal section of the RCC slab culvert in AutoCAD.

Procedure:

1. **Start a New Drawing**: Open a new AutoCAD drawing file for the longitudinal section.
2. **Draw the Longitudinal Cut**: Use the LINE tool to draw the longitudinal profile of the culvert. This section shows the alignment and depth variations along the length of the culvert.
3. **Draw Components**: Include the deck slab, side walls, and base slab in the longitudinal section.
4. **Add Dimensions**: Use DIMLINEAR to add horizontal and vertical dimensions for the length, width, and height of the components.
5. **Insert Reinforcement Details**: Represent the reinforcement within the slabs using HATCH and annotate with TEXT.
6. **Label Components**: Label the parts of the culvert using the TEXT tool, such as "Deck Slab", "Base Slab", "Side Walls", etc.

AutoCAD Commands: LINE, DIMLINEAR, TEXT, HATCH

Conclusion

By completing the lab exercises i will become proficient in using AutoCAD to create detailed engineering drawings of RCC slab culverts. These drawings, including the half-foundation plan, half-top plan, cross-sectional elevation, and longitudinal section.

Experiment – 02 DRAWING A HUME PIPE CULVERT USING AUTOCAD

Aim of the Experiment –

To create a detailed *Hume Pipe Culvert* drawing using AutoCAD software by following the standard engineering drawing principles.

Required Software and Materials

- AutoCAD (Any version from 2010 onwards)
- Basic knowledge of AutoCAD commands

Theory

What are Hume Pipe Culverts?

RCC Hume Pipe Culverts are structures designed to manage the flow of water beneath roads, railways, or other obstructions. They act as channels or conduits, allowing water to pass through, preventing erosion, and ensuring the integrity of the surrounding infrastructure. Culverts play a critical role in controlling water movement, minimizing the risk of flooding, and preserving the stability of transportation systems.

Advantages of Hume Pipe Culverts

Durable: RCC pipes are made of concrete and therefore offer high durability and resistance to environmental factors, ensuring a longer lifespan.

Ease of Installation: The precast nature of Hume pipes simplifies the installation process, saving time and labor costs.

Versatility: Cement Pipe Culverts are adaptable to various site conditions and are suitable for both rural and urban settings.

Lab Exercises/ *Procedure*

1. Setting Up the Drawing Environment

1. Open *AutoCAD* and create a new drawing file.

2. Set the units to *centimeters* (UNITS command) and choose *Decimal* format.
3. Set limits using the LIMITS command (e.g., 0,0 to 500,500) and enable GRID & SNAP.
4. Create separate *layers* (LAYER command) for:
    a. Foundation
    b. Walls
    c. Pipe
    d. Road
    e. Dimensions
    f. Hatching
5. Assign different colors to layers for clarity.

2. Creating the Foundation Plan

1. Use the LINE or POLYLINE command to draw the *foundation outline*.
2. Use the RECTANGLE and OFFSET commands to draw the *base slab* and *side walls*.
3. Hatch the foundation area using the HATCH command.

3. Drawing the Pipe

1. Use the CIRCLE command to draw a *60 cm diameter pipe*.
2. Use ARRAY (polar or rectangular) to create multiple pipes if needed.
3. Draw *collar joints* using OFFSET and ARC.
4. Use TRIM or FILLET to refine the edges.

4. Drawing the Road Profile and Wing Walls

1. Draw the *road surface* using LINE and OFFSET.
2. Use the PLINE command to create *parapet walls and kerb lines*.
3. Draw the *wing walls* using LINE with a *60° inclination*.
4. Apply HATCH to show materials like metalling and earth filling.

5. Adding Sections (Longitudinal and Cross Sections)

1. Create *longitudinal sections* by projecting key elements from the top plan.
2. Use SECTION views to show the pipe details.
3. Hatch different materials (e.g., GRAVEL, SAND, CONCRETE).

6. Dimensioning and Annotations

1. Use the DIMLINEAR and DIMALIGNED commands to add precise dimensions.
2. Use TEXT or MTEXT for annotations like *diameter, slope, and material details*.
3. Use LEADER to indicate notes.

7. Final Touches and Plotting

1. Set up the layout for printing (LAYOUT tab > Page Setup).
2. Choose an appropriate scale (e.g., *1:50* or *1:100*).
3. Use PLOT command to generate a *PDF or Print output*.

Conclusion

By doing this experiment i will learned how to draft a *Hume Pipe Culvert* with proper foundation, pipes, and road sections using AutoCAD, reinforcing key drafting skills required in civil engineering.

Assessment

- *Completeness*: All sections and details must be included.
- *Accuracy*: Dimensions must be precise as per the given drawing.
- *Presentation*: Proper use of layers, hatching, and annotations.

References

1. AutoCAD Civil Engineering Drafting Guide.
2. IRC Standards for Culverts.
3. Standard Engineering Drawing Practices.

2.0 Irrigation Structures

Experiment – 03 vertical drop type fall (Sarada Type) USING AUTOCAD

Aim of the Experiment –

To create a detailed engineering drawing of a Vertical Fall Irrigation Structure using AutoCAD, referring to the provided structural design.

Required Software and Materials

AutoCAD (any version supporting 2D drafting)

Prerequisites:

1. Basic knowledge of AutoCAD commands.
2. Understanding of engineering drawings and irrigation structures.

Materials Required:

- Reference drawing (attached image)
- Computer with AutoCAD software

Theory

The **Vertical Drop Type Fall** (commonly referred to as the **Sarada Type Fall**) is a specific type of **drainage system** designed to facilitate the rapid flow of water through a vertical drop. It is commonly used in areas where the elevation difference is sufficient to allow water to fall vertically and gather momentum to flow downstream effectively. This system is often employed in sewage or stormwater drainage systems to control the flow and minimize clogging or backflow.

The Sarada Type Fall is a variant of the vertical drop, featuring a distinctive design and working mechanism that makes it suitable for handling high volumes of wastewater, stormwater, or natural runoff, while promoting efficient flow dynamics.

Key Components of the Sarada Type Fall:

1. **Inlet Chamber:**
    a. This is the point where the water enters the fall system, often coming from an upstream sewer line or stormwater drainage pipe. The water enters the **vertical drop chamber** at a controlled flow rate.
2. **Vertical Drop Shaft:**
    a. The heart of the Sarada Type Fall is the **vertical drop shaft** or fall. The water is directed down this shaft, where it undergoes a rapid fall due to the significant difference in elevation between the inlet and the outlet.
3. **Outlet Chamber:**
    a. After the water falls through the vertical drop shaft, it reaches the **outlet chamber**, where the kinetic energy from the fall dissipates to some degree, allowing the water to exit the fall system. It then moves into the downstream drainage or treatment system.
4. **Energy Dissipation Mechanisms:**
    a. To avoid scouring, erosion, or excess turbulence at the bottom of the fall, energy-dissipating devices (such as **baffle plates** or **turbulent flow control systems**) are often installed. These help to reduce the water's velocity and promote a smooth transition to the next section of the drainage system.
5. **Safety and Maintenance Features:**
    a. The system often includes **inspection chambers**, **access hatches**, and **safety barriers** to prevent accidents during maintenance or operation.

Advantages of Sarada Type Fall:

1. **Efficient Flow Control:**
    a. The Sarada Type Fall is highly efficient at handling high-flow rates. By using gravity, it facilitates the easy movement of water without the need for energy-intensive pumps or additional power sources.
2. **Prevention of Clogging:**
    a. The rapid vertical drop minimizes the likelihood of debris or solids accumulating in the system, reducing the risk of blockages. The energy generated by the fall helps to flush out any sediments, promoting a self-cleaning effect.
3. **Energy Efficiency:**
    a. By harnessing the natural energy of falling water (gravity), the Sarada Type Fall does not require external power sources, making it an energy-efficient option for wastewater and stormwater management.
4. **Minimal Maintenance Requirements:**

   a. Since the system relies on gravity and natural flow, the need for constant maintenance is reduced. However, periodic checks for sediment buildup and structural integrity are necessary to ensure continued performance.

5. **Adaptability:**
   a. This type of fall can be adapted to a variety of applications, from sewage treatment plants to stormwater systems, depending on the site-specific requirements. It is especially beneficial in regions with significant elevation differences.

Lab Exercises/ *Procedure*

Step 1: Setting Up the Drawing Environment

1. Open AutoCAD and create a new file.
2. Set units by typing UNITS in the command line and selecting *Metric (mm or meters)*.
3. Define layers for different elements like masonry, concrete, and dimensions using LAYER command.

Step 2: Creating the Basic Outline

1. Use the LINE and POLYLINE commands to draw the general outline of the structure.
2. For curved sections, use the ARC command.
3. Utilize OFFSET to create parallel lines for walls and other structural elements.

Step 3: Adding Structural Details

1. *Foundation and Apron Concrete:*
   a. Use HATCH with appropriate patterns to indicate concrete portions.
   b. Draw sections using RECTANGLE and LINE commands.
2. *Masonry Walls:*
   a. Use HATCH to apply brick patterns.
   b. Ensure proper wall thickness as per the drawing.
3. *Pointing & Pitching:*
   a. Use DASHED lines for mortar joints where needed.
   b. Implement brick pitching with suitable hatching.

Step 4: Dimensions and Annotations

1. Use DIMLINEAR, DIMANGULAR, and DIMRADIUS to add necessary dimensions.
2. Place text annotations using MTEXT for specifications.

3. Label different sections and components as per the reference drawing.

Step 5: Cross-Sections and Views

1. Use XLINE to mark construction lines for section views.
2. Generate sectional views with appropriate labels.

Step 6: Finalizing the Drawing

1. Apply line weights (LWEIGHT) for clarity.
2. Use PLOT or LAYOUT to set up the sheet for printing.
3. Save the drawing in .dwg format.

Expected Outcome:

A professional AutoCAD drawing of a Vertical Fall Irrigation Structure, including foundation details, masonry work, pointing, and pitching.

Conclusion:

This exercise helps in understanding the design of an irrigation structure and improves AutoCAD drafting skills for civil engineering applications.

Experiment – 04 Drawing of a Drainage siphon from given specifications

Aim of the Experiment –

To create a detailed engineering drawing of a drainage syphon using AutoCAD software, based on the given reference drawing.

Required Software and Materials

AutoCAD (Any version compatible with 2D drafting and annotation tools)

Tools Used:

1. *Line Tool* - To create basic structure lines
2. *Polyline Tool* - For continuous boundary lines
3. *Rectangle Tool* - For base and sectional views
4. *Circle Tool* - If any circular elements are needed
5. *Trim & Extend Tools* - To modify line lengths
6. *Offset Tool* - To maintain uniform distances
7. *Hatch Tool* - For sectional hatching
8. *Text & Dimension Tools* - For adding annotations and measurements
9. *Layer Management* - To differentiate elements such as construction lines, dimensions, and object lines

Theory

A **drainage siphon** is a plumbing device used to transport wastewater, stormwater, or other fluids from one location to another by utilizing the principles of atmospheric pressure and gravity. The siphon effect relies on creating a continuous flow path, enabling fluids to flow uphill and then downhill without the use of a pump. Drainage siphons are commonly used in drainage systems, including stormwater management, sewage systems, and irrigation.

The siphon system operates based on the fundamental principle that water will flow in a loop if it is connected at both ends by a pipe and there is a height difference between the inlet and the outlet. This phenomenon is called the **siphoning effect**, and it occurs due to the differences in pressure between the two ends of the siphon.

Advantages of Drainage Siphons:

1. **No Need for Pumps:**
   a. Siphons operate on the natural principle of gravity and atmospheric pressure, eliminating the need for mechanical pumps. This makes siphons highly energy-efficient and cost-effective for drainage systems.
2. **Effective Fluid Transport:**
   a. Siphons are particularly effective for transporting fluids over elevation changes or from areas with difficult access, where a pump or other mechanical systems may not be feasible or cost-effective.
3. **Maintenance-Free:**

   a. Once properly installed, siphons generally require very little maintenance. The siphoning effect is self-sustaining, which reduces the need for regular inspection and repair compared to pumps or other mechanical systems.

4. **Versatility:**
   a. Siphons can be used in a variety of applications, from small-scale residential drainage to large-scale stormwater or sewage management systems. They are also used in agricultural irrigation systems for fluid distribution.
5. **Prevents Blockages:**
   a. The continuous flow and high-speed movement of liquid through the siphon make it difficult for debris or other blockages to accumulate, promoting a self-cleaning action.

Lab Exercises/ ***Procedure***

Step 1: Setting Up the Drawing Environment

- Open AutoCAD and set the units to meters.
- Use "LIMITS" command to set drawing boundaries.
- Activate "GRID" and "SNAP" for precision.
- Set up appropriate layers for different elements (e.g., structure, dimensions, hatching).

Step 2: Creating the Base Plan (Half Top and Foundation Plan)

- Use the *Line Tool* and *Rectangle Tool* to outline the base dimensions as per the provided drawing.
- Ensure dimensions such as foundation width, syphon width, and alignment are maintained.
- Use the *Offset Tool* to maintain equal distances for walls and structural members.
- Apply *Hatch* to indicate different materials used.

Step 3: Drawing the Longitudinal Section

- Construct the main sectional view using the *Line Tool* based on the given sectional drawing.

- Indicate levels such as *Ground Level (G.L.)*, foundation levels, and RCC slab placement.
- Use the *Polyline Tool* for smooth curves, if necessary.
- Insert dimensions using the *Dimension Tool*.

Step 4: Creating the Cross Sections (A-A, B-B, and C-C)

- Use the *Line Tool* to draw vertical sections as indicated in the reference drawing.
- Apply *Hatching* to distinguish materials like RCC, PCC, and bricks.
- Label each section with appropriate naming conventions.
- Maintain symmetrical proportions based on the main plan and longitudinal section.

Step 5: Adding Annotations and Dimensions

- Use the *Text Tool* to label sections, dimensions, and material details.
- Ensure proper font size and alignment for readability.
- Use *Leader Lines* for section descriptions and special instructions.

Step 6: Finalizing the Drawing

- Check for missing dimensions or errors.
- Assign proper line weights and print settings.
- Save the drawing in *.dwg* format for future modifications.
- Export to *PDF* if required for submission.

Outcome: Upon completing this lab, students will be able to:

- Create a drainage syphon drawing using AutoCAD.
- Understand sectional views, foundation plans, and dimensioning.
- Improve technical drafting skills required in civil engineering.

Assessment:

- Accuracy of dimensions and alignment.
- Proper use of layers and annotations.
- Neatness and clarity in drawing presentation.

References:

- AutoCAD User Manual
- Civil Engineering Drawing Standards

Instructor's Note: Students must adhere to engineering drawing standards and ensure accuracy in every section to make the drawing precise and professional.

Experiment – 05 Drawing of a Drainage siphon from given specifications

Aim of the Experiment –

Lab Manual: Creating Plumbing and Sanitary Connections and Fittings for a Two-Roomed Building Using AutoCAD

Objective:

The purpose of this lab is to guide students through the process of creating plumbing and sanitary connections and fittings for a two-roomed building using AutoCAD software. The goal is to develop a detailed plumbing layout that includes water supply, drainage, sanitary fittings, and proper connection placements.

Required Software and Materials

1. **AutoCAD Software** (version 2020 or later)
2. **Computer System** (with AutoCAD installed)
3. **Architectural Plans** (for reference)

4. **Basic Knowledge of Plumbing Systems** (e.g., water supply and drainage principles)
5. **Plumbing Symbol Library** (for AutoCAD, to insert plumbing symbols)
6. **Basic Tools for AutoCAD** (Line, Polyline, Hatch, Blocks, etc.)

Prerequisites:

- Basic knowledge of AutoCAD interface and tools.
- Familiarity with plumbing systems (water supply, drainage, vents, etc.).
- Understanding of the layout of a two-roomed building.

Lab Exercises/ *Procedure*

Part 1: Setting Up AutoCAD for Plumbing Design

1. **Start AutoCAD:**
    a. Open AutoCAD and create a new drawing by typing **"NEW"** in the command line or selecting the "New" option from the menu.
    b. Select the template for architectural design, such as "AECT.dwt" or any similar template that fits architectural planning.
2. **Set Drawing Units:**
    a. Type **"UNITS"** in the command line and press Enter.
    b. Set the unit type (e.g., architectural or decimal) based on the unit system for the project.
    c. Set precision to 0.00 for accuracy.
3. **Establish Drawing Limits:**
    a. Type **"LIMITS"** in the command line and set the drawing area limits according to the size of the building. For example, set the X and Y limits to match the dimensions of the two-room building.
4. **Set up Layers:**
    a. Go to the **Layer Properties Manager** (type **"LA"** in the command line).
    b. Create layers for plumbing components (e.g., **Water Supply, Drainage, Ventilation, Fixtures**).
    c. Assign different colors to each layer for clear identification.

Part 2: Drawing the Plumbing Layout

1. **Create the Building Layout:**
    a. Using architectural plans as a reference, draw the walls of the two-roomed building using the **Line** and **Polyline** tools.
    b. Ensure you represent the correct room sizes and wall placements.
2. **Place Fixtures:**

    a. Use the **Block** tool to insert symbols for fixtures (sinks, toilets, bathtubs, water heaters, etc.). You can either create your own symbols or use AutoCAD's library of plumbing symbols.
    b. Position fixtures according to the building layout (e.g., place the toilet, sink, and shower in their respective locations).
3. **Draw Water Supply Lines:**
    a. Draw water supply lines using the **Polyline** or **Line** tool. Water supply lines are typically represented as solid lines.
    b. Connect fixtures to a central water supply point (e.g., a water tank or distribution box). Use **Pipes** from the plumbing library if available.
4. **Draw Drainage Lines:**
    a. Use a dashed or different line style to represent drainage lines.
    b. Draw these lines from each fixture to the main drainage system (e.g., septic tank or sewer line). Include appropriate slope for drainage.
    c. Ensure that the drainage system follows local plumbing codes regarding pipe sizes and connections.
5. **Venting:**
    a. Draw vent pipes to ensure air circulation in the drainage system. Vents are typically represented by vertical dashed lines.
    b. Ensure vents are placed correctly, usually near the main drainage stack.
6. **Show Fixtures and Connections:**
    a. Insert all required plumbing fixtures (toilets, sinks, showers, etc.) and connect them with supply and drainage lines.
    b. Make sure you are adhering to recommended plumbing standards for pipe sizing and spacing between fixtures.
7. **Labeling and Dimensions:**
    a. Use the **Text** tool to label all fixtures and components in the drawing (e.g., "Sink", "Toilet", "Main Drain").
    b. Use the **Dimension** tool to add measurements for pipe lengths, fixture placements, and distances between plumbing components.
8. **Hatching:**
    a. Use **HATCH** to fill the plumbing and sanitary layout with patterns (e.g., for water supply and drainage areas) to visually separate sections of the plumbing system.

Part 3: Creating a Plumbing Isometric View

1. **Set Up Isometric View:**
    a. Type **"VIEW"** in the command line and select **"Isometric View"** to create a 3D perspective of your plumbing system.
    b. If you prefer a 2D view, skip this step.
2. **Draw Pipes in 3D (Optional):**
    a. Use the **3D Polyline** tool or **Extrude** function to represent pipes in three dimensions.

   b. You may create a 3D layout of pipes showing their depth, height, and positions relative to the building.

Part 4: Finalizing the Drawing

1. **Clean Up the Drawing:**
   a. Use the **Layer Properties** to turn off unnecessary layers (e.g., structural layers) and ensure only the plumbing layout is visible.
   b. Check for overlapping lines or errors in pipe connections.
2. **Final Dimensions and Labels:**
   a. Review the drawing and ensure that all dimensions are correct and all fixtures are properly labeled.
   b. Ensure compliance with local building codes for pipe sizing, fixture placement, and venting.
3. **Save the Drawing:**
   a. Save your AutoCAD drawing as both a DWG file for further editing and a PDF for submission or printing.

Additional Tips:

- **Use Blocks for Repetitive Items:** If you have multiple similar fixtures (e.g., sinks or toilets), create a block to simplify the drawing and reduce file size.
- **Check for Code Compliance:** Ensure that your plumbing system design follows local plumbing and sanitary codes (e.g., pipe slope, fixture clearances, etc.).
- **Use Xrefs for External References:** For larger projects, you may use Xrefs to manage the integration of multiple files (such as separate files for plumbing, electrical, and architectural layouts).

Conclusion:

Upon completing this excercise, i am able to create a detailed and accurate plumbing and sanitary layout for a two-roomed building using AutoCAD. I have gained hands-on experience in utilizing AutoCAD tools for drawing plumbing systems and ensuring code compliance.

Assessment:

- Accuracy of plumbing connections and fixtures.
- Correct application of AutoCAD drawing tools and techniques.
- Adherence to plumbing standards and codes.
- Presentation and clarity of the final drawing (including dimensions, labels, and layers).

Experiment – 05 Drawing of **Plumbing and Sanitary Connections and Fittings for a Two-Roomed Building**

Aim of the Experiment –

To Create Plumbing and Sanitary Connections and Fittings for a Two-Roomed Building Using AutoCAD

Required Software and Materials:

1. **AutoCAD Software** (version 2020 or later)
2. **Computer System** (with AutoCAD installed)
3. **Architectural Plans** (for reference)
4. **Basic Knowledge of Plumbing Systems** (e.g., water supply and drainage principles)
5. **Plumbing Symbol Library** (for AutoCAD, to insert plumbing symbols)
6. **Basic Tools for AutoCAD** (Line, Polyline, Hatch, Blocks, etc.)

Prerequisites:

- Basic knowledge of AutoCAD interface and tools.
- Familiarity with plumbing systems (water supply, drainage, vents, etc.).
- Understanding of the layout of a two-roomed building.

Theory

Plumbing and sanitary systems are critical for providing clean water and safely removing wastewater in a building. In a two-roomed building, efficient water supply and drainage are necessary for daily activities, hygiene, and comfort.

1. Water Supply System:

- **Main Water Pipe:** Brings water from the municipal supply or well to the building.
- **Distribution Pipes:** Deliver water to faucets, showers, and toilets. These pipes are typically **PVC**, **CPVC**, or **PPR**.
- **Shut-off Valves:** Control water flow to specific areas, useful during maintenance.
- **Fixtures:** Includes taps, showers, sinks, and toilets where water is used.

Fittings:

- **Elbows, tees, and couplings** are used to connect pipes and change directions.
- **Water heaters** are used for hot water supply.

2. Drainage System:

- **Wastewater Pipes:** Transport wastewater from sinks, toilets, and showers to the sewer or septic tank.
- **Soil Pipes:** Carry waste from toilets to the drainage system.
- **Vent Pipes:** Allow air to enter the system, preventing airlocks and maintaining proper flow.
- **Traps:** Prevent foul odors from entering the building by holding water in a sealed bend.

Fittings:

- **P-traps** are used for sinks and toilets.
- **Cleanouts** and **inspection chambers** allow maintenance of the drainage system.

3. Sanitary Fixtures and Fittings:

- **Toilets:** Connected to soil pipes with a **flange** and use water to flush waste.
- **Sinks and Wash Basins:** Connected to drainage via **P-traps**.

- **Showers/Bathtubs:** Connected to waste pipes with a floor drain.
- **Kitchen Sinks:** Connected to drainage and may have a **garbage disposal unit**.

4. Plumbing Layout:

A simple layout for a two-roomed building includes:

- **Main water supply** to kitchen and bathroom fixtures.
- **Drainage lines** leading to the sewer or septic system.
- **Vent pipes** for pressure balance.
- **Shut-off valves** for isolation.

Notes

- inspection chamber (also called a "manhole" or "access chamber") allows workers to inspect the condition of pipes, clean out blockages, and check for leaks. These chambers typically have a cover that can be removed to gain access to the interior.
- **inspection trap** (also called a **trap inspection chamber** or **inspection pit**) is a key component used to provide access for inspecting and maintaining traps or drainage systems. These are typically installed to allow plumbers or maintenance workers to check for blockages, clean, and perform repairs in the piping system.
- **gully trap** is a type of plumbing fixture used primarily in drainage systems to prevent the entry of foul gases and to trap debris before it enters the main sewer or drainage system. It is a crucial component of outdoor drainage systems, typically used in residential or commercial properties.
- **rainwater pipes** (also known as **rainwater downpipes**, **downspouts**, or **drainpipes**) are essential components of a building's stormwater drainage system. Their primary function is to collect and direct rainwater that falls on the roof or other surfaces of a building and channel it safely away from the structure, typically to a storm drain, a rainwater storage system, or the ground.
- **yard gully** is a type of drainage component used to collect and channel surface water from the yard or surrounding areas of a property. Yard gullies are typically installed in outdoor spaces like gardens, driveways, or yards to prevent water from pooling around the foundation of a building, which could cause water damage or flooding. These systems are crucial in managing stormwater runoff and maintaining proper drainage around the property.
- **sewage** refers to the waste water and other refuse, including solids, liquids, and gases, that are generated from residential, commercial, and industrial activities. Sewage typically consists of wastewater from toilets, sinks, showers, industrial processes, and rainwater runoff, and it is carried away through a network of pipes, drains, and treatment facilities.

Procedure:

Part 1: Setting Up AutoCAD for Plumbing Design

1. **Start AutoCAD:**

   a. Open AutoCAD and create a new drawing by typing **"NEW"** in the command line or selecting the “New” option from the menu.
   b. Select the template for architectural design, such as "AECT.dwt" or any similar template that fits architectural planning.
2. **Set Drawing Units:**
   a. Type **"UNITS"** in the command line and press Enter.
   b. Set the unit type (e.g., architectural or decimal) based on the unit system for the project.
   c. Set precision to 0.00 for accuracy.
3. **Establish Drawing Limits:**
   a. Type **"LIMITS"** in the command line and set the drawing area limits according to the size of the building. For example, set the X and Y limits to match the dimensions of the two-room building.
4. **Set up Layers:**
   a. Go to the **Layer Properties Manager** (type **"LA"** in the command line).
   b. Create layers for plumbing components (e.g., **Water Supply, Drainage, Ventilation, Fixtures**).
   c. Assign different colors to each layer for clear identification.

Part 2: Drawing the Plumbing Layout

1. **Create the Building Layout:**
   a. Using architectural plans as a reference, draw the walls of the two-roomed building using the **Line** and **Polyline** tools.
   b. Ensure you represent the correct room sizes and wall placements.
2. **Place Fixtures:**
   a. Use the **Block** tool to insert symbols for fixtures (sinks, toilets, bathtubs, water heaters, etc.). You can either create your own symbols or use AutoCAD’s library of plumbing symbols.
   b. Position fixtures according to the building layout (e.g., place the toilet, sink, and shower in their respective locations).
3. **Draw Water Supply Lines:**
   a. Draw water supply lines using the **Polyline** or **Line** tool. Water supply lines are typically represented as solid lines.
   b. Connect fixtures to a central water supply point (e.g., a water tank or distribution box). Use **Pipes** from the plumbing library if available.
4. **Draw Drainage Lines:**
   a. Use a dashed or different line style to represent drainage lines.
   b. Draw these lines from each fixture to the main drainage system (e.g., septic tank or sewer line). Include appropriate slope for drainage.
   c. Ensure that the drainage system follows local plumbing codes regarding pipe sizes and connections.
5. **Venting:**
   a. Draw vent pipes to ensure air circulation in the drainage system. Vents are typically represented by vertical dashed lines.
   b. Ensure vents are placed correctly, usually near the main drainage stack.

6. **Show Fixtures and Connections:**
    a. Insert all required plumbing fixtures (toilets, sinks, showers, etc.) and connect them with supply and drainage lines.
    b. Make sure you are adhering to recommended plumbing standards for pipe sizing and spacing between fixtures.
7. **Labeling and Dimensions:**
    a. Use the **Text** tool to label all fixtures and components in the drawing (e.g., "Sink", "Toilet", "Main Drain").
    b. Use the **Dimension** tool to add measurements for pipe lengths, fixture placements, and distances between plumbing components.
8. **Hatching:**
    a. Use **HATCH** to fill the plumbing and sanitary layout with patterns (e.g., for water supply and drainage areas) to visually separate sections of the plumbing system.

Part 3: Creating a Plumbing Isometric View

1. **Set Up Isometric View:**
    a. Type **"VIEW"** in the command line and select **"Isometric View"** to create a 3D perspective of your plumbing system.
    b. If you prefer a 2D view, skip this step.
2. **Draw Pipes in 3D (Optional):**
    a. Use the **3D Polyline** tool or **Extrude** function to represent pipes in three dimensions.
    b. You may create a 3D layout of pipes showing their depth, height, and positions relative to the building.

Part 4: Finalizing the Drawing

1. **Clean Up the Drawing:**
    a. Use the **Layer Properties** to turn off unnecessary layers (e.g., structural layers) and ensure only the plumbing layout is visible.
    b. Check for overlapping lines or errors in pipe connections.
2. **Final Dimensions and Labels:**
    a. Review the drawing and ensure that all dimensions are correct and all fixtures are properly labeled.
    b. Ensure compliance with local building codes for pipe sizing, fixture placement, and venting.
3. **Save the Drawing:**
    a. Save your AutoCAD drawing as both a DWG file for further editing and a PDF for submission or printing.

Additional Tips:

- **Use Blocks for Repetitive Items:** If you have multiple similar fixtures (e.g., sinks or toilets), create a block to simplify the drawing and reduce file size.
- **Check for Code Compliance:** Ensure that your plumbing system design follows local plumbing and sanitary codes (e.g., pipe slope, fixture clearances, etc.).

- **Use Xrefs for External References:** For larger projects, you may use Xrefs to manage the integration of multiple files (such as separate files for plumbing, electrical, and architectural layouts).

Conclusion:
Upon completing this excercise, I am able to create a detailed and accurate plumbing and sanitary layout for a two-roomed building using AutoCAD. I have gained hands-on experience in utilizing AutoCAD tools for drawing plumbing systems and ensuring code compliance.

Assessment:

- Accuracy of plumbing connections and fixtures.
- Correct application of AutoCAD drawing tools and techniques.
- Adherence to plumbing standards and codes.
- Presentation and clarity of the final drawing (including dimensions, labels, and layers).

Experiment – 05 Drawing of SEPTIC TANK

Aim of the Experiment –

To create a detailed AutoCAD drawing of a septic tank system, suitable for up to 25 users, complete with a soak pit and necessary connections from the water closet.

Required Software and Materials:

- Computer with AutoCAD software installed.
- Input data on the size and design parameters of the septic tank.
- Basic knowledge of plumbing systems, septic tanks, and soak pits.

Theory

Introduction:

A **septic tank** is an underground wastewater treatment system commonly used in areas without access to centralized sewer systems. It is designed to treat and dispose of household sewage and wastewater, such as from toilets, sinks, and showers. The septic tank operates by using natural biological processes to break down and treat the waste before it is released into the surrounding soil.

How a Septic Tank Works:

1. **Wastewater Entry:** Wastewater from the house (e.g., toilets, sinks, bathtubs) enters the septic tank through a sewer pipe. This wastewater typically contains solids, oils, and other organic materials.
2. **Separation of Waste:** Inside the septic tank, the wastewater is separated into three layers:
    a. **Solid waste (sludge):** Heavier solids settle to the bottom of the tank.
    b. **Liquid waste (effluent):** The liquid layer is lighter and floats above the sludge.
    c. **Scum:** Oils and grease float to the top, forming a scum layer.
3. **Biological Breakdown:** The bacteria and microorganisms in the septic tank break down the organic matter in the wastewater. This process converts solid waste into simpler substances, which reduces the volume of sludge over time.

4. **Effluent Disposal:** The treated liquid (effluent) flows from the septic tank into a **leach field** (also called a drain field). Here, the effluent is further filtered by the soil, which removes additional contaminants before it reaches groundwater or other water sources.

Components of a Septic Tank System:

1. **Septic Tank:**
    a. Typically made of concrete, fiberglass, or plastic, it holds the wastewater long enough for solids to settle and for some treatment to occur through bacterial action.
2. **Inlet and Outlet Pipes:**
    a. The **inlet pipe** brings wastewater into the tank, while the **outlet pipe** carries treated effluent to the leach field.
3. **Baffle or T-Shape Pipe:**
    a. The baffle (or T-shaped pipe) helps to control the flow of wastewater and keeps scum and solids from entering the outlet pipe.
4. **Leach Field (Drain Field):**
    a. This is a network of perforated pipes buried in gravel-filled trenches. It allows the effluent to gradually seep into the soil, where further filtration and treatment occur.
5. **Access Ports:**
    a. Access ports are provided for maintenance and inspection of the septic tank, allowing professionals to inspect the system, pump out sludge, and ensure it's functioning correctly.

Advantages of a Septic Tank:

1. **Independent Wastewater Treatment:**
    a. Septic tanks allow homes not connected to a municipal sewer system to safely manage wastewater.
2. **Cost-Effective:**
    a. Since septic tanks don't rely on municipal systems, they are often more affordable for rural or remote areas.
3. **Environmentally Friendly:**
    a. Properly functioning septic systems can treat wastewater without contaminating nearby water sources, as the effluent is naturally filtered through soil in the leach field.

Procedure:

Step 1: Understanding the Design Requirements

1. **Capacity Calculation:**

   A standard septic tank typically requires a volume of about 150 to 200 liters per person per day. For 25 users, calculate the required volume

   Required volume=Number of users × Volume per user

   For 25 users at 200 liters per user:

   Total volume= 25 × 200 = 5000 liters = 5 m3

2. **Tank Dimensions:**
   a. Typically, septic tanks are designed to be 1.5 to 2 times the daily flow volume. You will also need to account for baffles, inlets, and outlets in the design.
3. **Soak Pit Design:**
   a. The soak pit size is typically based on the water volume and soil percolation rate. For 25 users, a soak pit with adequate drainage area is necessary.
4. **Connection Details:**
   a. The system should include connections for:
      i. Water closet (WC) to the septic tank.
      ii. Outlet from the septic tank to the soak pit.
      iii. Inlet and outlet piping details.

Step 2: Setting Up AutoCAD for Drawing

1. **Open AutoCAD:**
   a. Launch AutoCAD and open a new drawing.
2. **Set Units:**
   a. Use Decimal units for the drawing (centimeter).

Command: UNITS

Set Unit Type: Decimal

Set Precision: 0.00

3. **Set Drawing Scale:**

    a. Choose an appropriate drawing scale to fit the septic tank and soak pit details onto your drawing sheet (e.g., 1:50 scale).

Step 3: Drawing the Septic Tank

1. **Draw the Tank Outline:**
    a. Begin by drawing the outline of the septic tank. Using the rectangle tool (REC), draw a rectangle representing the main body of the tank.
        i. Dimensions: For a 5000-liter septic tank, assume approximate dimensions of 2m x 2.5m (adjustable based on your requirements).
2. **Add Inlet and Outlet Pipes:**
    a. Draw the inlet and outlet pipes using the circle tool (CIRCLE).
    b. Typically, the inlet pipe is on one side of the tank and the outlet pipe on the other side.
    c. Inlet: 100mm diameter
    d. Outlet: 100mm diameter
3. **Draw Baffles Inside the Tank:**
    a. Use the line tool (LINE) to draw baffles. These are vertical partitions inside the tank that divide the tank into different chambers.
    b. Typically, the tank will have two chambers and a baffle between them.
4. **Add Access Ports:**
    a. Draw access ports at the top of the tank using the circle tool for maintenance purposes. These are typically located over each chamber.
5. **Label the Tank:**
    a. Add text labels using the TEXT or MTEXT tool to identify parts like "Inlet", "Outlet", "Baffle", "Access Port", etc.

Step 4: Drawing the Soak Pit

1. **Draw the Pit Outline:**
    a. Using the circle tool, draw the outline of the soak pit. The diameter can vary depending on the percolation rate and soil conditions, but typically a soak pit for 25 users might have a diameter of 3m.
    b. For a simple design, assume a cylindrical pit.
2. **Add Perforation Details:**
    a. For the soak pit, you may want to show small holes or perforations in the pit walls (use the circle tool to represent these).
3. **Connect the Septic Tank to the Soak Pit:**
    a. Draw a line from the septic tank’s outlet to the soak pit. This represents the drain pipe that leads effluent from the tank to the soak pit.

Step 5: Drawing the Plumbing Connections

1. **Draw WC to Septic Tank Connection:**
    a. Draw the pipe from the water closet (WC) to the septic tank. Use a line tool and indicate the connection diameter (usually 100mm).
    b. Label the water closet and its connection to the septic tank.
2. **Add Vent Pipes:**
    a. Add vertical vent pipes to allow gases to escape from the septic tank. These are typically drawn as small vertical pipes extending from the top of the tank.
3. **Drainage Details:**
    a. Add any additional drainage systems or connections that might be needed to ensure proper flow.

Step 6: Finalizing the Drawing

1. **Add Dimensions:**
    a. Use the DIMLINEAR tool to add dimensions to all relevant parts of the drawing, such as the tank size, pipe lengths, and soak pit dimensions.
2. **Add Layer and Color:**
    a. Use layers to differentiate between different components (e.g., septic tank, pipes, soak pit).
    b. Assign different colors to each layer to improve clarity.
3. **Label the Drawing:**
    a. Add a title block with the project details like "Septic Tank Design for 25 Users," date, and designer's name.
4. **Save the Drawing:**
    a. Save the drawing in a suitable format (e.g., .dwg, .pdf).

Step 7: Review and Print

- Review the drawing for accuracy.
- Print the final drawing at an appropriate scale, ensuring that all components are visible and clearly labeled.

Conclusion:

From this excercise, i have learned how to design and draw a septic tank system with a soak pit for up to 25 users using AutoCAD and also created detailed plans for the septic tank, soak pit, and plumbing connections, ensuring a functional and accurate system design.