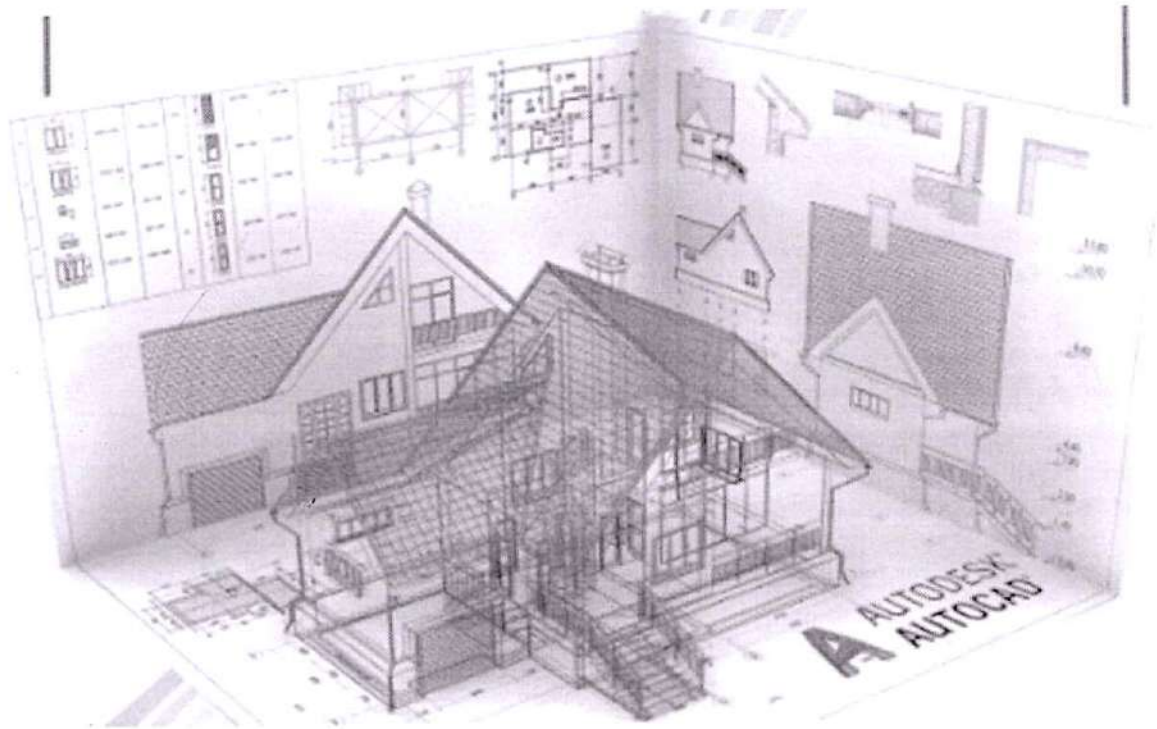




Unit- II

Computer Aided Drawing

Module



Fundamentals of Computer Aided Drawing

Computer Aided Drawing (CAD) is the use of computers and software to create, modify, analyze, and optimize engineering drawings and designs. CAD replaces manual drafting with accurate and faster digital drawing methods.

AUTO-CAD is widely used in:

- Civil Engineering
- Mechanical Engineering
- Architecture
- Electrical Engineering
- Interior Design
- Manufacturing industries

Software	Main Application	Features
AutoCAD	2D drafting and detailing	Widely used for plans, elevations, sections, and layouts
AutoCAD Civil 3D	Road and land development	Surface modeling, alignment design, contouring
STAAD.Pro	Structural analysis and design	Analysis of beams, trusses, frames, and buildings
Revit	Building Information Modeling (BIM)	3D building modeling and coordination
ETABS	Multi-storey building analysis	Earthquake and wind load analysis
SAP2000	Structural modeling and analysis	Advanced structural design
MS Excel	Engineering calculations	Quantity estimation and data analysis
Primavera P6	Construction project management	Scheduling and resource planning
Microsoft Project	Project scheduling	Time planning and tracking
SketchUp	3D architectural visualization	Simple modeling and presentation
QGIS	GIS and mapping	Free mapping and spatial data management

System Requirements for Drawing Software

Drawing software used in civil engineering and CAD applications requires suitable computer hardware and software for smooth performance.

Component	Minimum Requirement	Recommended Requirement
Processor (CPU)	Intel Core i3 / AMD Ryzen 3	Intel Core i5/i7 / Ryzen 5/7
RAM	4 GB	8 GB – 16 GB
Hard Disk	10 GB free space	SSD with 256 GB or more
Graphics Card	Integrated graphics	Dedicated graphics card (2 GB or more)
Monitor	1366 × 768 resolution	Full HD (1920 × 1080)
Operating System	Windows 10	Windows 11 (64-bit)
Input Devices	Keyboard and Mouse	Mouse with scroll wheel / digitizer
Internet Connection	Required for activation	High-speed internet

Advantages of CAD

1. High Accuracy

CAD drawings are highly accurate and reduce human errors in dimensions and calculations.

2. Faster Drafting

Drawings can be prepared much faster than manual drawing methods.

3. Easy Modification

Changes and corrections can be made quickly without redrawing the entire figure.

4. Better Presentation

CAD provides clean, neat, and professional-quality drawings.

5. Easy Storage

Thousands of drawings can be stored digitally in computers or cloud storage.

6. Zooming Facility

Users can zoom in and zoom out for detailed work and better visibility.

7. Improved Productivity

Engineers and draftsmen can complete more work in less time.

8. Simple Dimensioning

Automatic dimensioning and scaling save drafting effort.

9. Easy Sharing

Digital drawings can be easily shared through email or networks.

10. 3D Visualization

CAD software allows 3D modeling and realistic visualization of structures and objects.

11. Reduced Paper Work

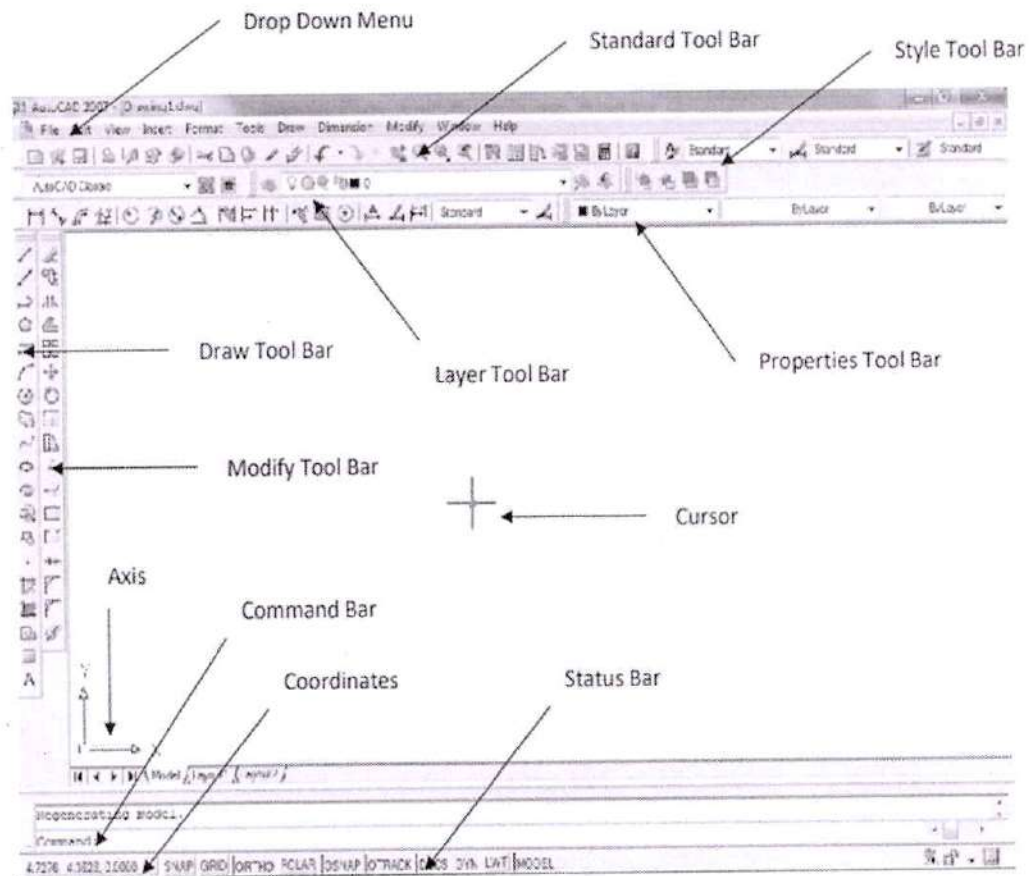
Most drawings are maintained digitally, reducing paper usage.

Basics

Computer Aided Drawing (CAD)

- The use of computer technology for the process of design documentation (i.e. drafting). CAD may be used to draft in 2D or 3D space.

2D User Interface



DRAW TOOL COMMANDS

It consists of a set of commands that can be used to create new objects like line, arc, rectangle, polygon, circle, ellipse, polyline, hatch, etc.

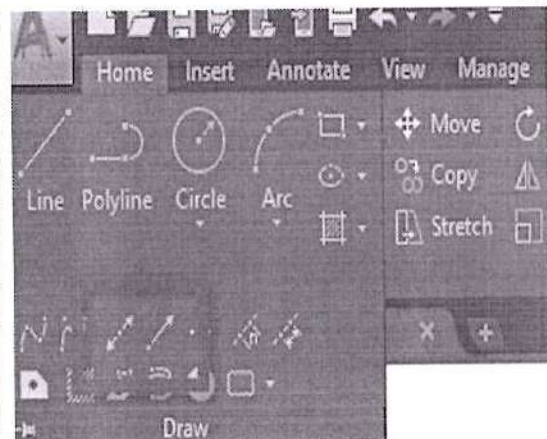
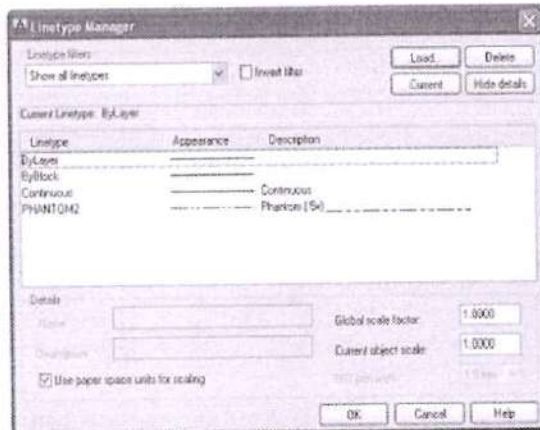
LINE-

Draw menu: Line

Command line: line

Short cut key: L

Line command creates one or series of straight-line segments; here each line segment is a separate object. There are various methods of giving inputs for creating a line.



CIRCLE-

Draw menu: Circle

Command line: circle

Short cut key: C

It creates a circle. The default method is to specify the centre point and the radius. In addition

POLYLINE-

Draw menu: P

line Command line: p

line Shortcut key: pl

Polyline is a series of connected line and are segments created as one object, width of the object can also be controlled.

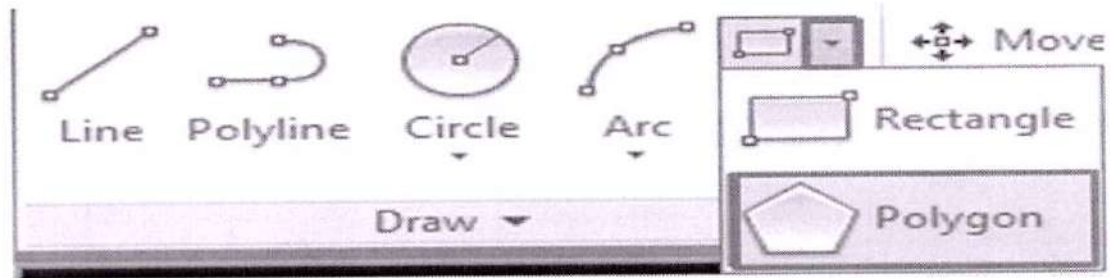
RECTANGLE-

Draw menu: Rectangle

Command line: rectangle

Shortcut key: rec

It creates a rectangle and it acts as one entity. It can be drawn by picking two opposite corners or by giving areas and dimensions



POLYGON-

Draw menu: Polygon

Command line: polygon

Shortcut key: pol

It creates a regular polygon with the given number of sides and side length.

ARC-

Draw menu: Arc

Command line: arc

Short cut key: A

It creates an arc and is used to add curved segments to the drawing.

There are many ways to give the data to draw arcs

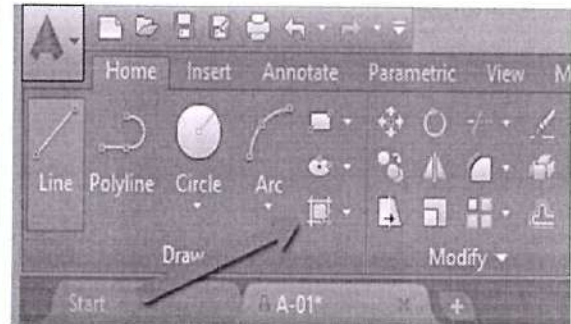
Hatch -

Draw menu: Hatch

Command line: hatch

Shortcut key: h

It fills an enclosed area with a pattern



MODIFY TOOL COMMANDS

It consists of set of commands that can be used to alter the existing objects.

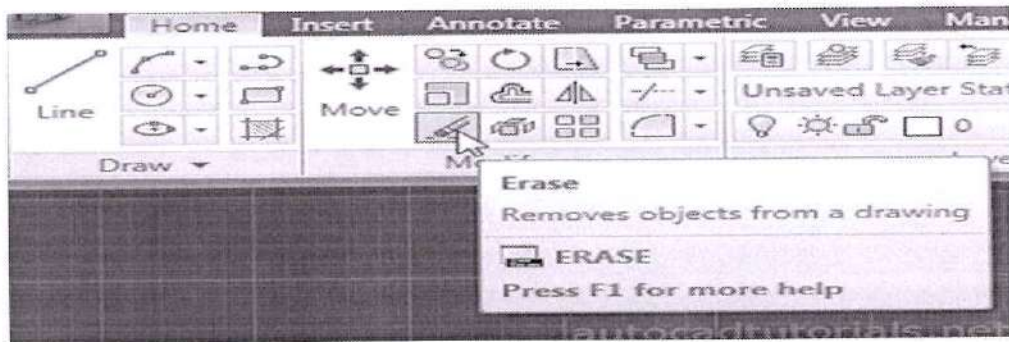
ERASE-

Modify menu: Erase

Command line: erase

Shortcut key: e

It deletes the selected objects from drawing.



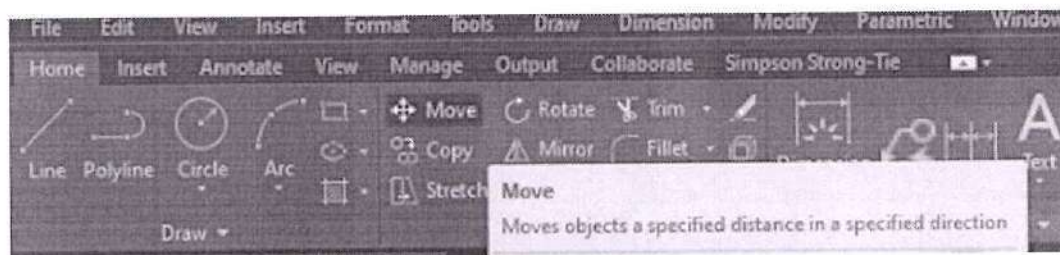
MOVE -

Modify menu: Move

Command line: move

Shortcut key: m

Objects can be shifted from one place to another place within the drawing area.



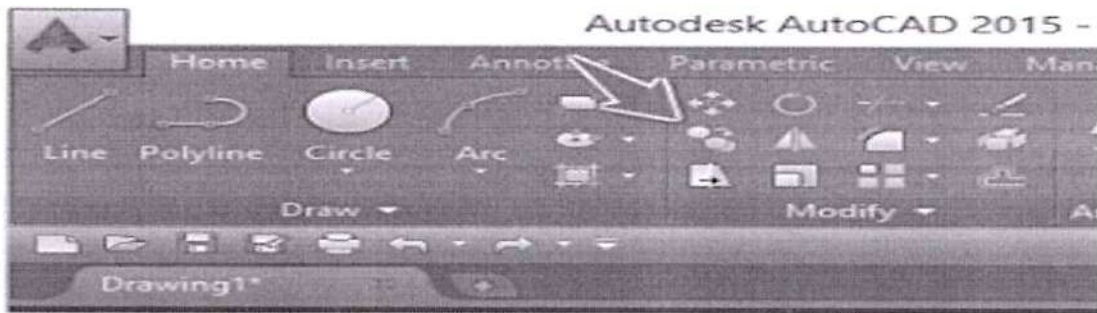
COPY -

Modify menu: Copy

Command line: copy

Shortcut key: co

It creates one or more number of copies of selected objects within the drawing.



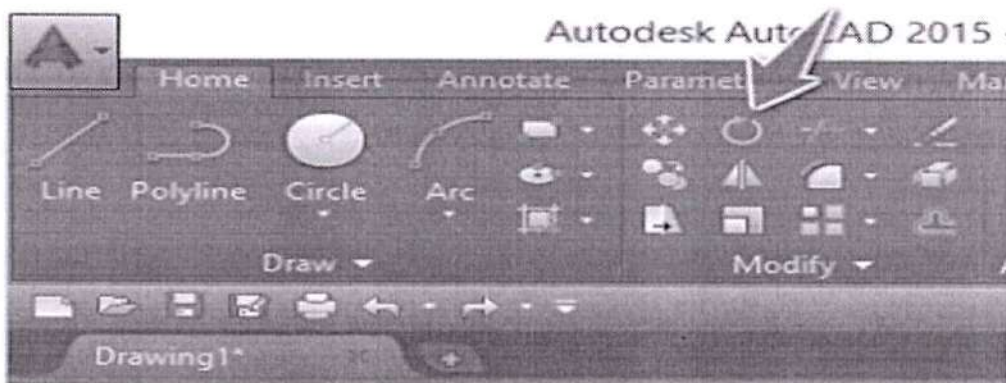
ROTATE-

Modify menu: Rotate

Command line: rotate

Shortcut key: ro

It rotates selected objects around given axis to the given angle or about a base point.



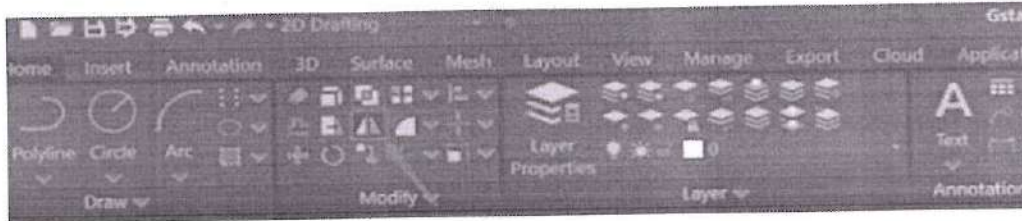
MIRROR -

Modify menu: Mirror

Command line: mirror

Shortcut key: MI

It creates mirror image of the selected object in selected direction. It helps to complete drawing faster if the object is symmetrical about any axis.



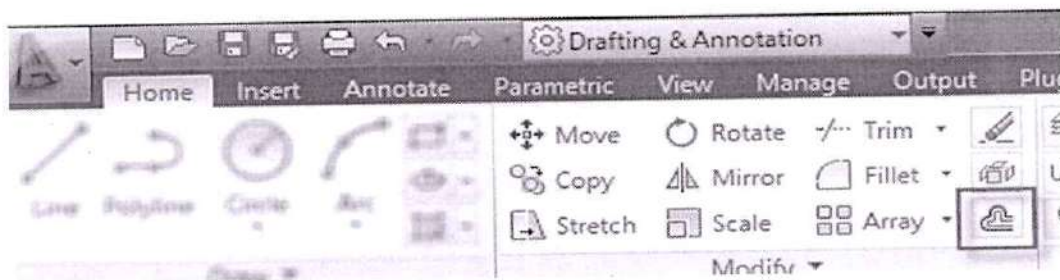
OFFSET -

Modify menu: Offset

Command line: offset

Shortcut key: O

It creates a new object that is similar to a selected object at a specified distance from the original object



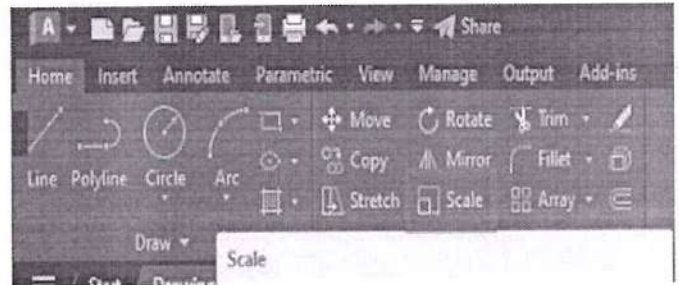
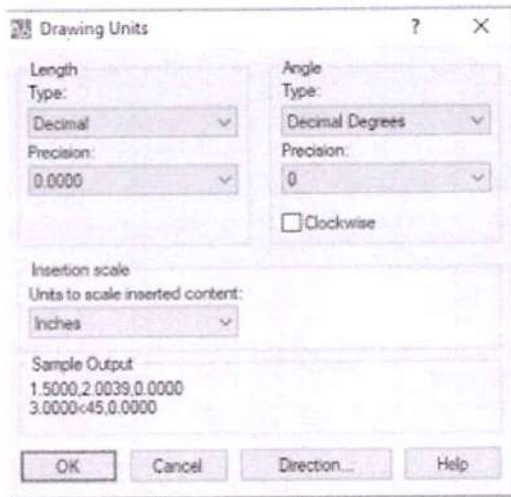
SCALE -

Modify menu: Scale

Command line: scale

Shortcut key: sc

It is used to enlarge / reduce the size of the objects equally in the x and y directions as per the scale factor given.



STRETCH -

Modify menu: Stretch

Command line: stretch

Shortcut key: str

It is used to change the snap and size of the object by pulling or pushing from one side and also to move objects from one place to another place.

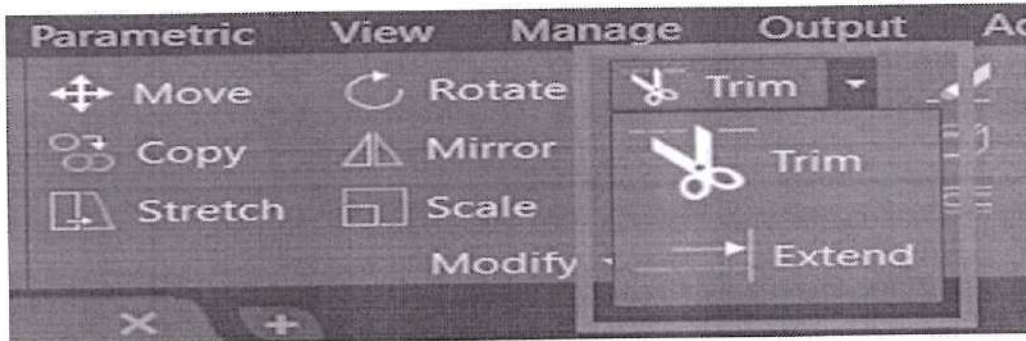
TRIM-

Modify menu: Trim

Command line: trim

Shortcut key: tr

It is used to cut off or erase an object or set of objects precisely at an edge defined by other objects. It can also be used to cut off part of the object in between two defined edges.



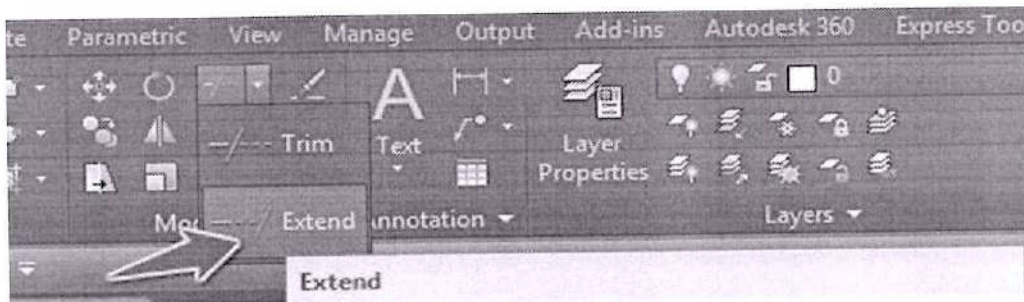
EXTEND -

Modify menu: Extend

Command line: extend

Shortcut key: ex

It extends an object to meet another object.



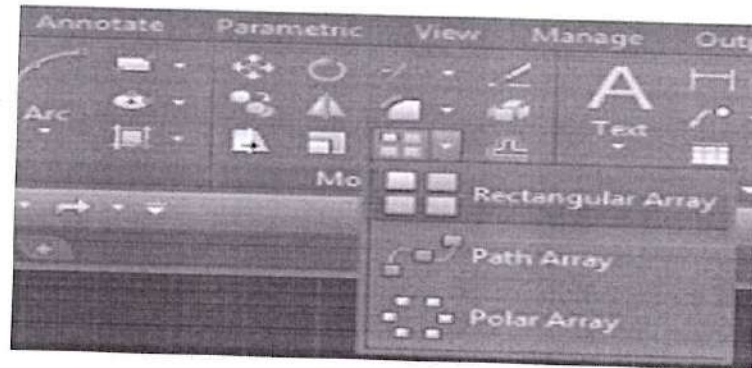
ARRAY-

Modify menu: Array

Command line: array

Shortcut key: ar

It creates multiple copies of object in given number of rows and columns or around an imaginary circle.



BREAK-

Modify menu: Break

Command line: break

Shortcut key: br

This method is used to cut an object into two parts at selected point or to remove part of the object in between two selected points.

EXPLODE -

Modify menu: Explode

Command line: explode

Shortcut key: x

It converts polyline, blocks and hatch objects into discrete objects.



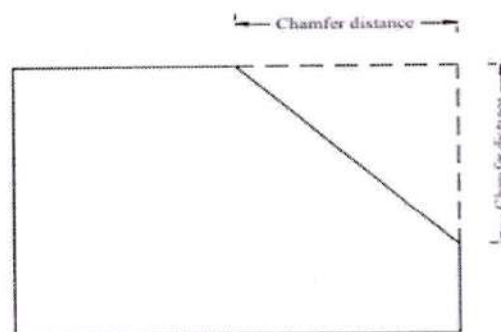
CHAMFER-

Modify menu: Chamfer

Command line: chamfer

Shortcut key: cha

It connects two non-parallel lines by extending them to intersect or to join with a bevelled line at specified distance from intersection.



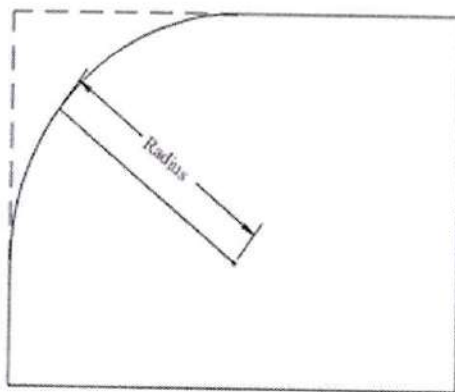
FILLET

Modify menu: Fillet

Command line: fillet

Shortcut key: f

It used for filleting connects the two objects with a round arc of a specified radius



The layer command-

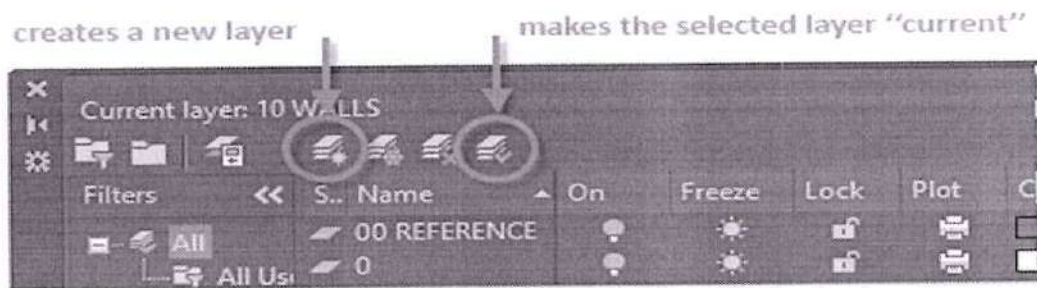
Creating a New Layer

LAYER (manages or LAYER and layer properties)

Command line: Type LA or LAYER(layer) and press enter.

Format menu: layer.....

Layers toolbar: pick Layer Properties Manager tool



- To create a new layer,
- click on in the layer toolbar,
- the Layer properties Manager dialogue box,
- illustrated below, appears.
- This is a tabbed dialogue box and can be used to control either layer properties depending upon which tab is selected.
- The layer tab is always selected by default.
- Now click on the 'New' button. A new layer called 'layer' is automatically created in the layer list below layer 0.

- As you can see from the illustration the layer name is automatically highlighted for you so that you can give the layer a more meaningful name.
- When you have entered an appropriate name, press key to complete the operation.
- You have now created a new layer and given it a name.
- Notice that by default it has been assigned the color white and the line type 'Continues'.

Dimension toolbar-

The Dimension toolbar contains commands to dimension elements of your symbol. You can activate the Dimension toolbar with the View > Toolbars command or by selecting Dimension command on the main toolbar.

- SmartDimension command
Places several different dimensions.
- Distance Between command
Places a linear dimension that measures the distance between elements or key points.
- Angle Between command
Places a dimension that measures the angle between elements or key points.
- Axis command
Sets a dimension axis for a drawing.
- Coordinate Dimension command

- Places a dimension that measures the distance from a common origin to one or more key points or elements.
- Symmetric Diameter command
Places a dimension that measures the distance between a center line and another element or key point.
 - Measure Distance command
Measures the distance between points in free space or between key points.
 - Measure Distance Along command
Measures the distance along an object based on two points.
 - Measure Area command
Displays the most recently selected area of the boundary in the current units.
 - Character Map command
Inserts a character into a text box using a different font.
 - Leader command
Adds a leader to an annotation or to another leader.
 - Balloon command
Places a balloon containing text.
 - Dimension Text command
Overrides a driven dimensional value with a text string.
 - Align Dimensions command
Aligns linear dimensions with a selected point.

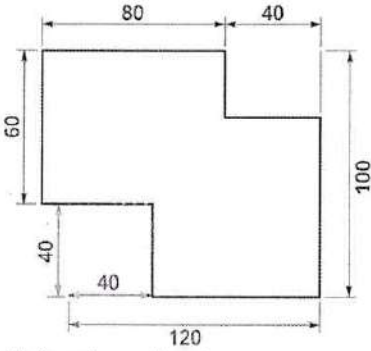
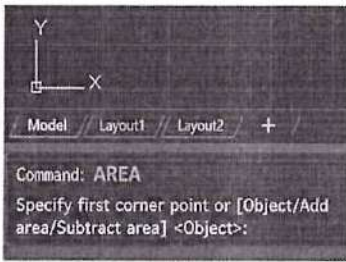
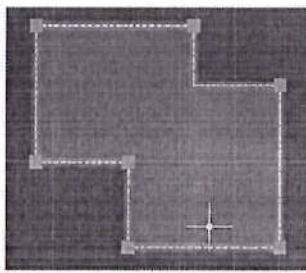
Compute area of the given drawing

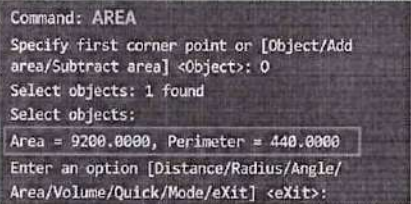
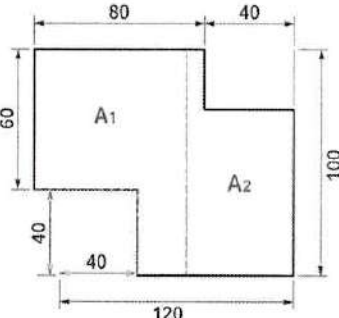
Properties Command-

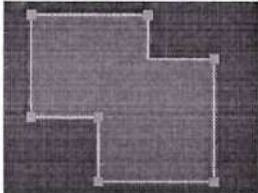
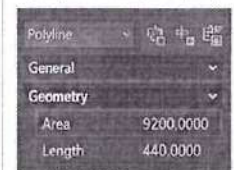
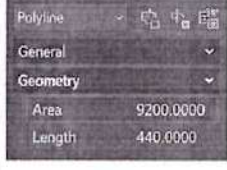
- Select the closed object
- Press **Ctrl + 1**
- Properties window opens
- Area value is displayed automatically

HOW TO COMPUTE AREA OF A GIVEN DRAWING IN CAD

Example : Compute the area of the given figure.

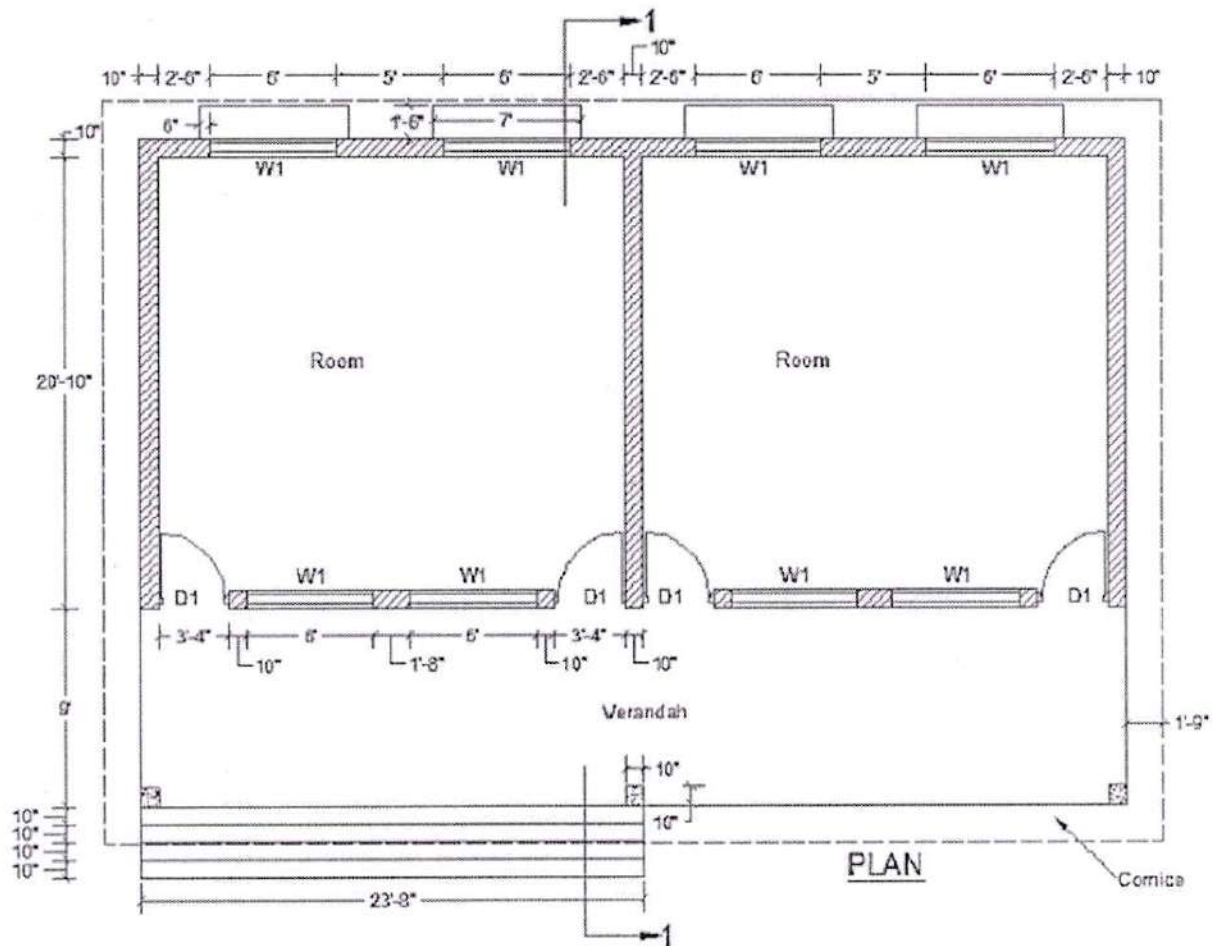
<p>1. Given Drawing (Closed Figure)</p>  <p>All dimensions are in meters.</p>	<p>2. Start AREA Command</p> <p>Type AREA in the command line and press Enter.</p> 	<p>3. Select the Method</p> <p>Type O (Object) and press Enter to select the closed object. Then click on the closed boundary.</p> 
------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

<p>4. Area Result</p> <p>After selecting the object, the area and perimeter are shown in the command line.</p>  <p>Area of the given figure = 9200.0000 sq. meters Perimeter of the figure = 440.0000 meters</p>	<p>5. Verify (Manual Calculation)</p>  <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Divide into two rectangles</p> <p>$A_1 = 80 \times 60 = 4800 \text{ m}^2$</p> <p>$A_2 = 40 \times 100 = 4000 \text{ m}^2$</p> <p>Total Area</p> <p>$= A_1 + A_2$</p> <p>$= 4800 + 4000$</p> <p>$= 9200 \text{ m}^2$</p> </div>
----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

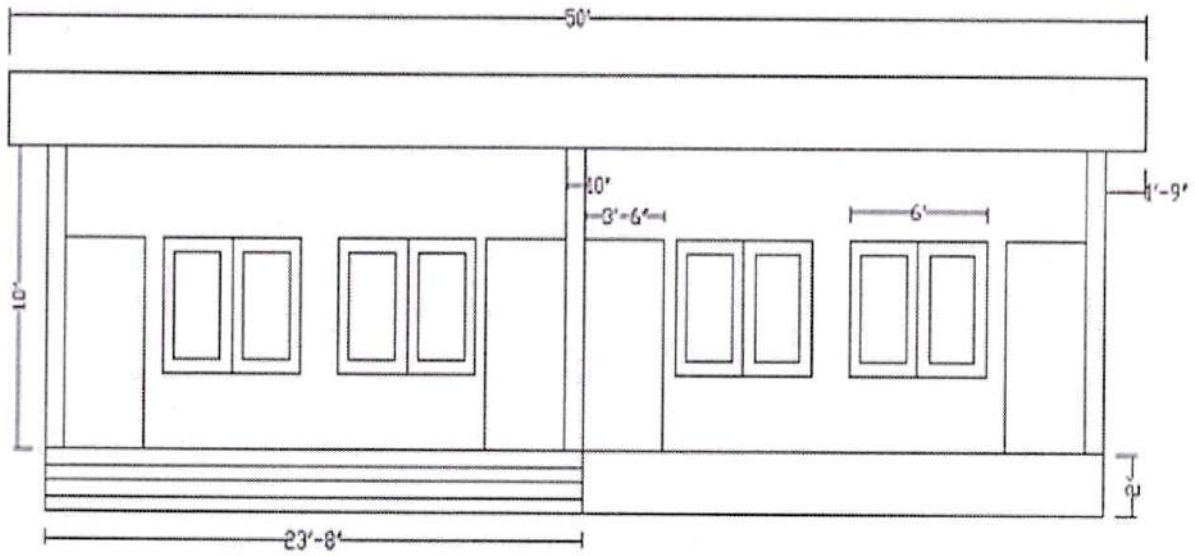
OTHER METHOD : Using Properties			<p>Important Notes</p> <ul style="list-style-type: none"> • The figure must be closed. • If the boundary is open, use JOIN or PEDIT to make it a closed polyline. • Units should be set correctly. • AREA command works with closed objects only.
<p>1. Select the closed object.</p> 	<p>2. Press Ctrl + 1 (Properties window opens)</p> 	<p>3. Area is shown in Properties.</p> 	

Assignments-

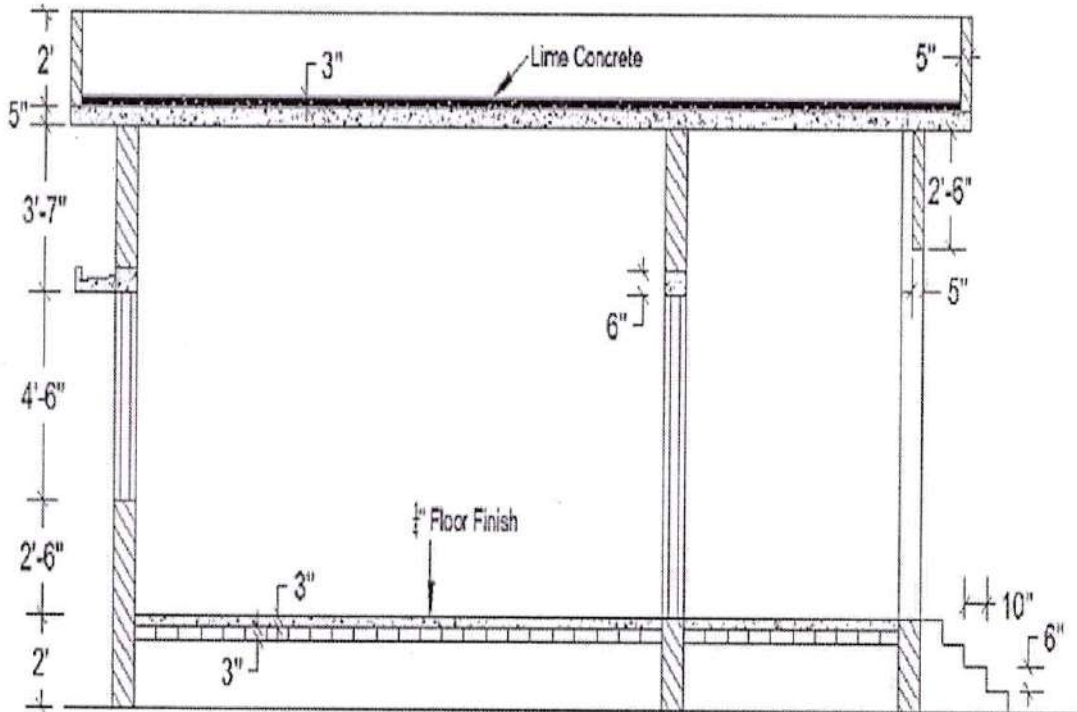
1. Draw a Developed plan



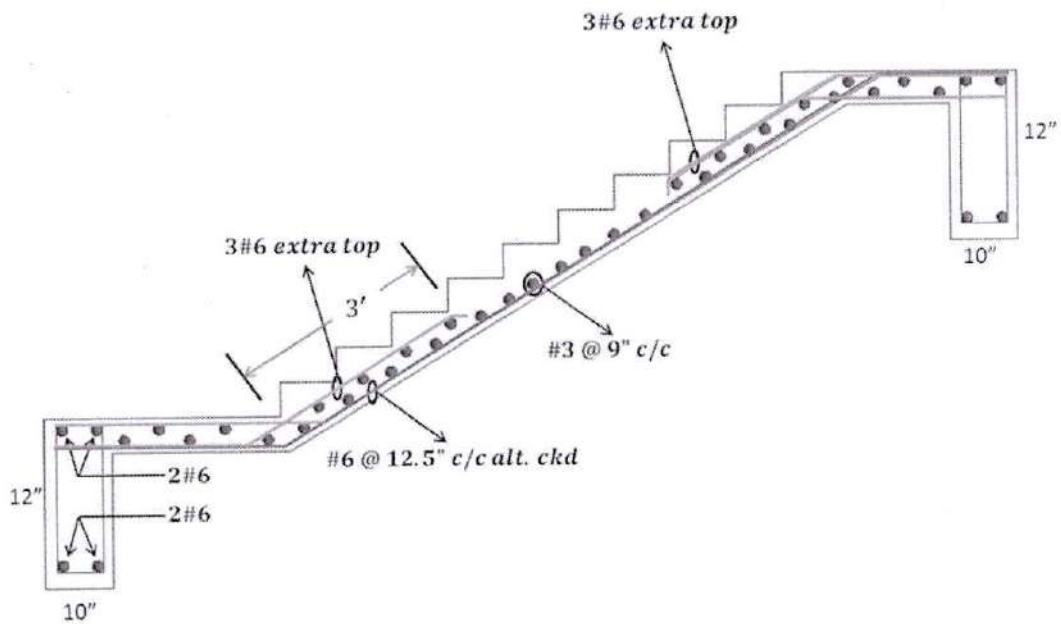
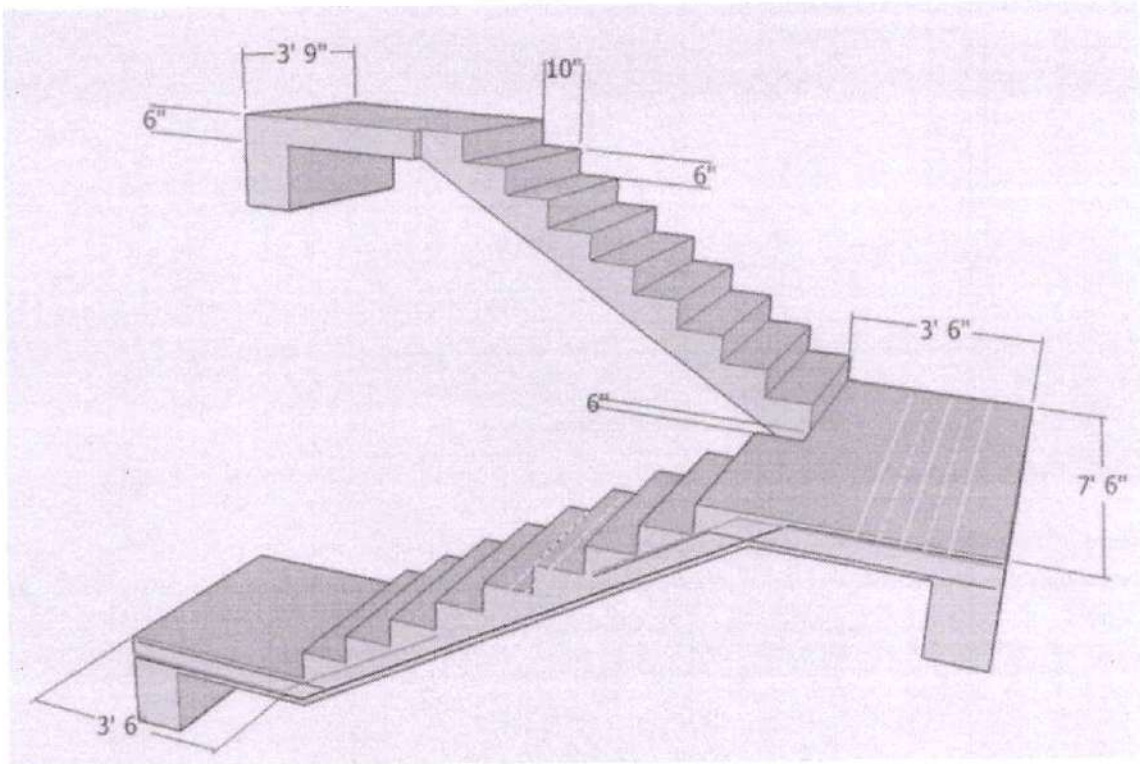
2. Draw Elevation of above Plan

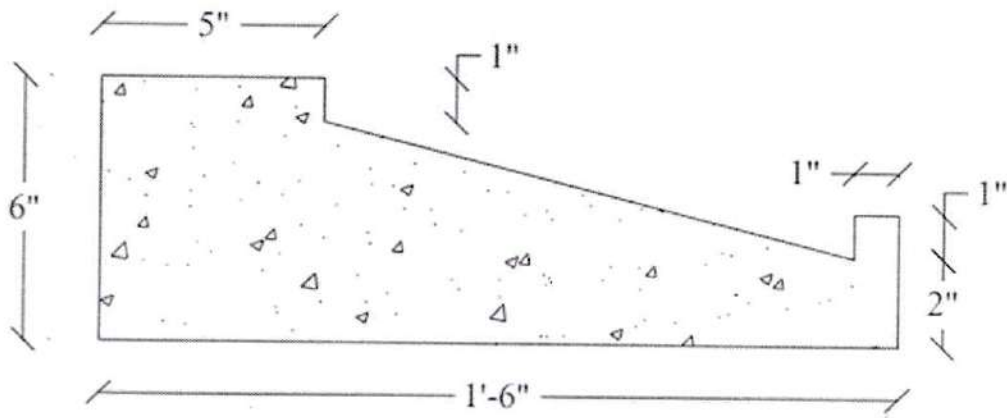


3. Draw Section of above Plan

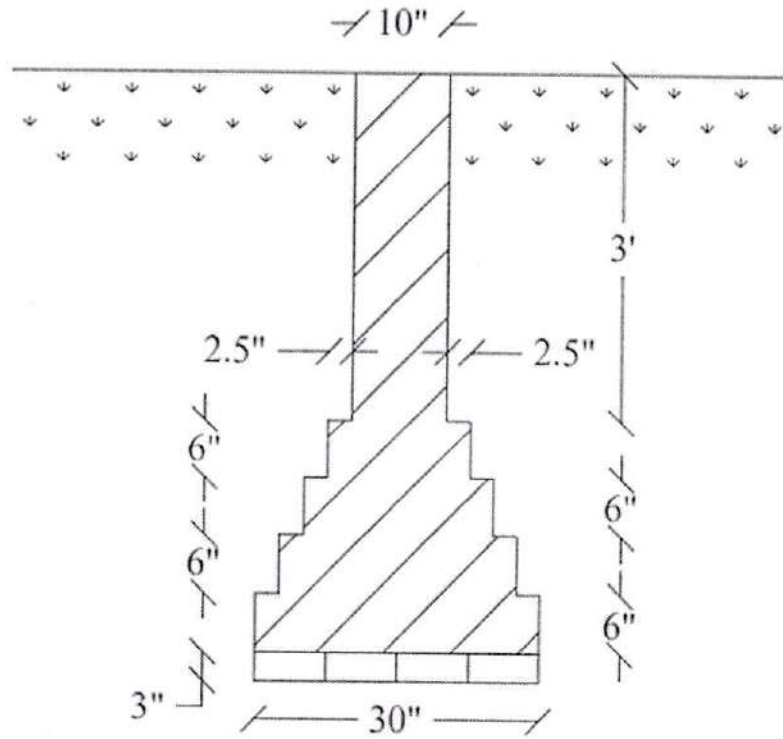


4. Draw plan and Sectional Elevation of dog-legged staircase





Use Hatch (Conc.)



Use Offset, Trim, Hatch (brick)

Handwritten signature and date:
 B.M.H.
 28/05/26