

**LEARNING OBJECTIVES**

1. To get introduced to AutoCAD software
2. To know different menus, tools, commands and its uses
3. Able to make basic 2D drawing and mechanical engineering drawing using AutoCAD software
4. Able to modify 2D Mechanical Drawing
5. Able to read the mechanical engineering drawing and to obtain the technical information

**TABLE OF CONTENT**

- 3.1. Introduction
- 3.2. Understanding the AutoCAD software
- 3.3. Important Functions
- 3.4. Important commands
- 3.5. Shortcut Keys in AutoCAD
- 3.6. Setup Commands
- 3.7. Absolute and Incremental coordinate references
- 3.8. Using the AutoCAD Commands
- 3.9. Layers in AutoCAD
- 3.10. Dimensioning in AutoCAD
- 3.11. Exporting DWG file to PDF

3.1 INTRODUCTION

- AutoCAD was released in 1982 by Autodesk, Inc., which was a small company at that time. It was designed to be used for PCs only. Since then AutoCAD has enjoyed the biggest user base in the world in the CAD business. Users can use AutoCAD for both 2D and 3D drafting and designing. AutoCAD can be used for architectural, structural, mechanical, electrical, environmental, and manufacturing drawings and for road and highway designs. Though the focus these days is BIM (Building Information Modelling), AutoCAD is still the most profitable software for Autodesk, Inc. due to its ease of use and comprehensiveness, which address all user needs. Another version of AutoCAD, called AutoCAD LT, is used for 2D drafting only.

To start AutoCAD 2016, double-click the shortcut on your desktop that was created in the installation process. AutoCAD will show the Welcome window, which looks like the following screen:

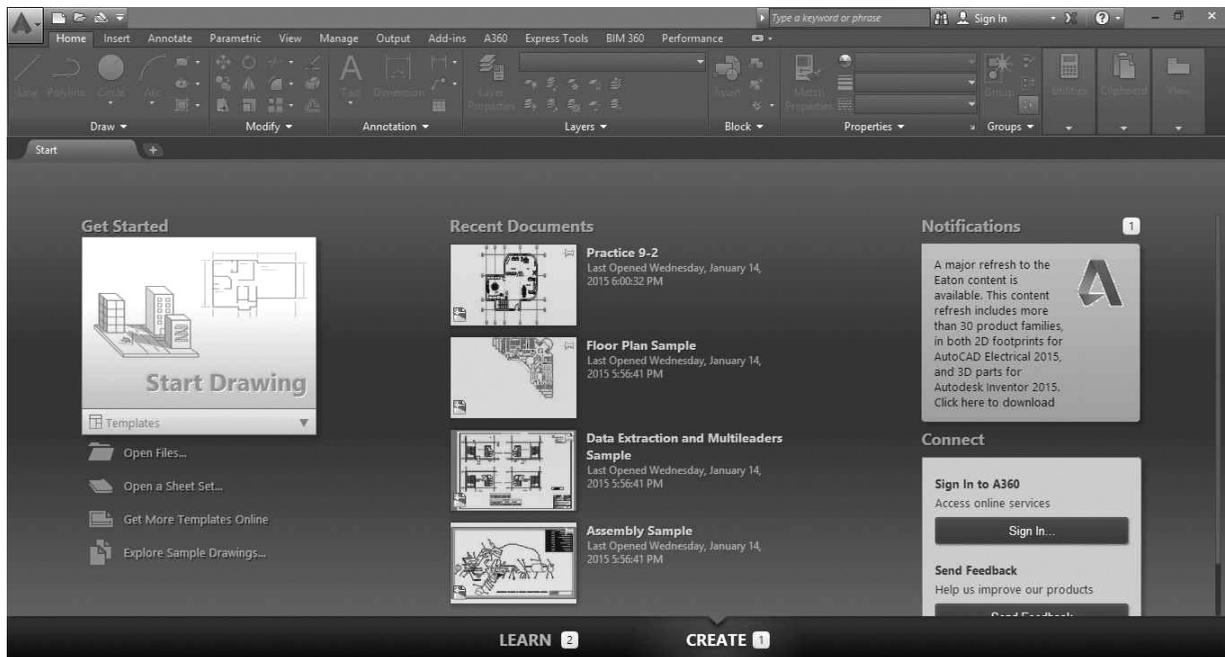


Figure 1 Start Screen

As you can see at the bottom, there are two choices: CREATE and LEARN. In the current figure you are seeing the CREATE part. While you are in this part you can:

- Start a new drawing.
- Open an existing file.
- Open a Sheet Set.
- Download more templates from online.
- Explore the sample files that come with the software
- See the recent files you opened
- Check if AutoCAD has a notification for you concerning your software/hardware
- Connect to Autodesk 360 (Autodesk Cloud)
- Send your feedback to Autodesk

At the bottom, click the LEARN option to see the following screen:

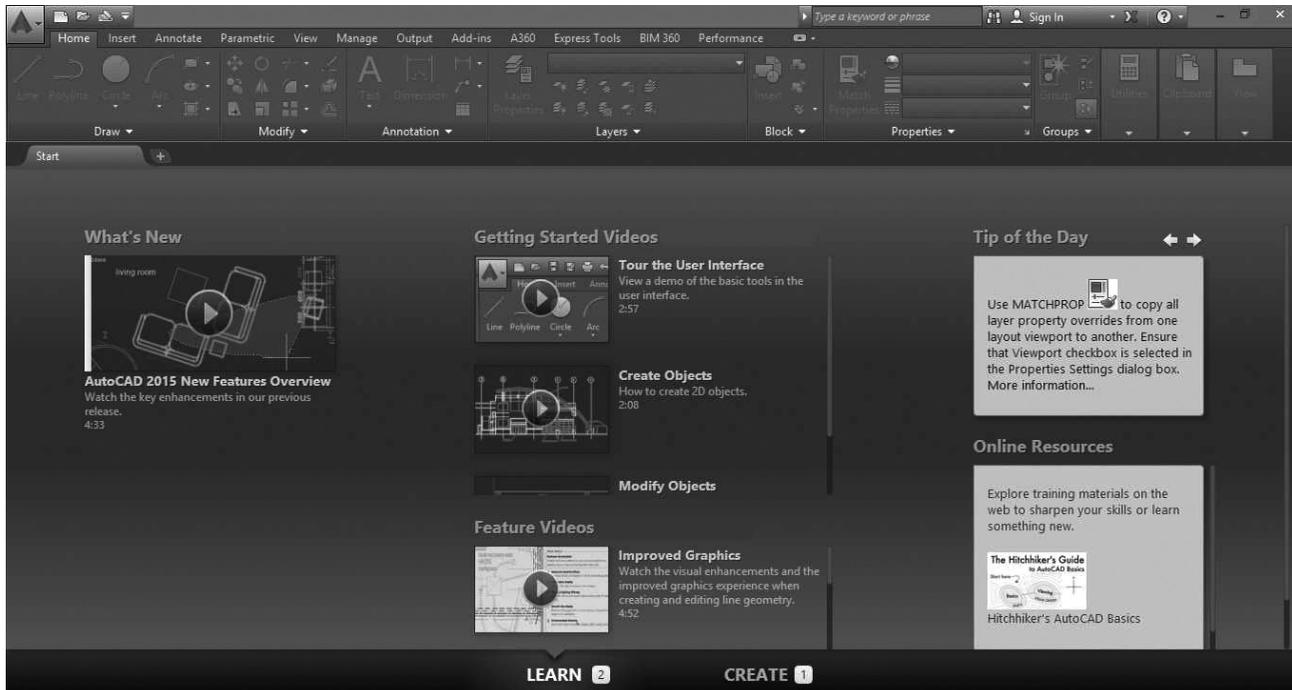


Figure 2 Learn Screen

You will see in this part the following:

- Videos of the new features of AutoCAD 2016
- Other videos discussing features of AutoCAD 2016, like how to use some modifying commands in AutoCAD
- Tips from Autodesk (normally you will see different tips every time you start AutoCAD)
- Some online sources to help and train you like Hitchhiker videos and Lynda.com

3.2. UNDERSTANDING THE AUTOCAD SOFTWARE

Starting a new file or opening an existing file will show you the interface of AutoCAD 2016, which will look like the following:

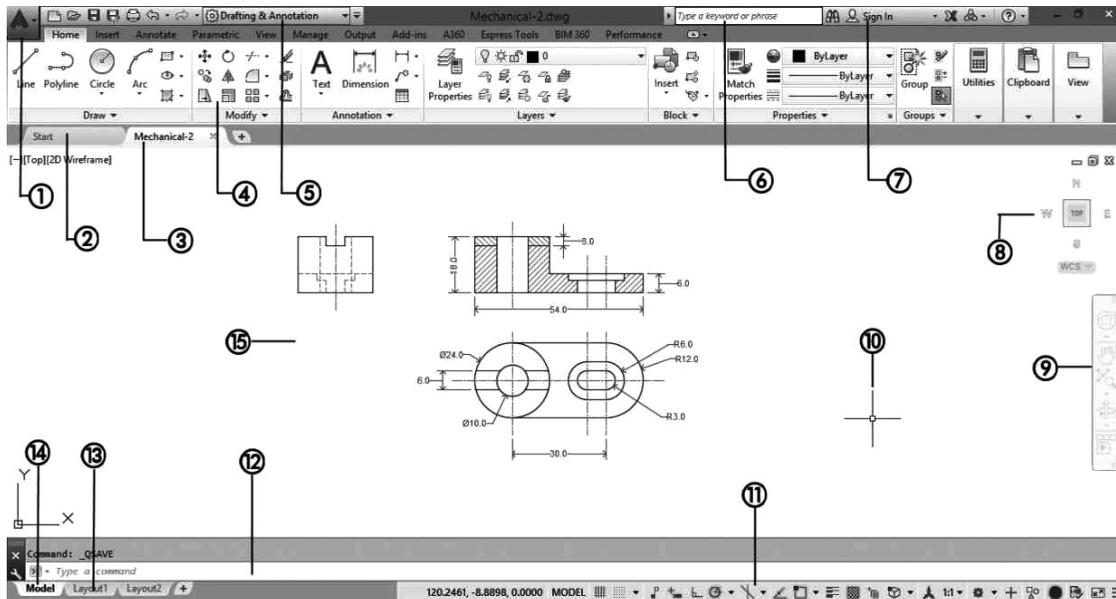


Figure 3 Work Screen

- 1. Application Menu:** It contains the file related commands: New, open, save, save as, export, publish, print, suite workflows, drawing utilities, close
- 2. Start Tab:** Where Create and Learn option will be there
- 3. File Tab:** After creating with specified filename, this tab can be accessed
- 4. Ribbon:** Where draw (line, polyline, circle, etc.), Modify (Move, Rotate, Trim, etc.), Annotation (Used to write texts), layers, blocks, etc. will be there.
- 5. Workspace:** The Workspace is the set of tabs (hence panels) which will appear together along with the palettes, menus, toolbars, and Quick Access toolbars. To create a new workspace, start CUI command, at the upper left part locate Workspaces, right-click, and select the New Workspace option.
- 6. Info Center:** Used to get information about the unknown data
- 7. Autodesk 360:** User can be signed in
- 8. View Cube:** Used to know the direction of drawing
- 9. Navigation Bar:** Used to scroll down and up
- 10. Cross Hairs:** Shows the location of cursor
- 11. Status Bar:** The status bar in AutoCAD contains coordinates along with important functions; some of them are for precise drafting in 2D, and some of them are for 3D.
- 12. Command Window:** Where commands are to be typed (Ex. M (short form) for MOVE (full form) – One can type either M or MOVE to use this command)
- 13. Layout Tab:** Layout is where you will plot your drawing. Each layout will be linked to a Page Setup, Objects (like a title block), text, dimensions, and finally Viewports
- 14. Model Tab:** Shows current window where modelling is done
- 15. Graphical Area:** The graphical area is your drafting area. This is where you will draw all your lines, arcs, and circles. It is a precise environment with an XYZ space for 3D and an XY plane for 2D. You can monitor coordinates in the left part of the status bar.

3.3. IMPORTANT FUNCTIONS

Ortho Function

Ortho function will force the lines to be at right angles (orthogonal) using the following angles: 0, 90, 180, and 270. In order to turn on/off the Ortho, press F8 button.

Object Snap

Object Snap, or OSNAP, is the most important accuracy tool to be used in AutoCAD for 2D and 3D as well. It is a way to specify points on objects precisely using the AutoCAD database stored in the drawing file. To activate running OSNAPs in the drawing, press F3.

Some of the important Object Snaps are given below:

Endpoint: To catch the Endpoint of a line

Midpoint: To catch the Midpoint of an a line

Intersection: To catch the Intersection of two objects (any two objects)

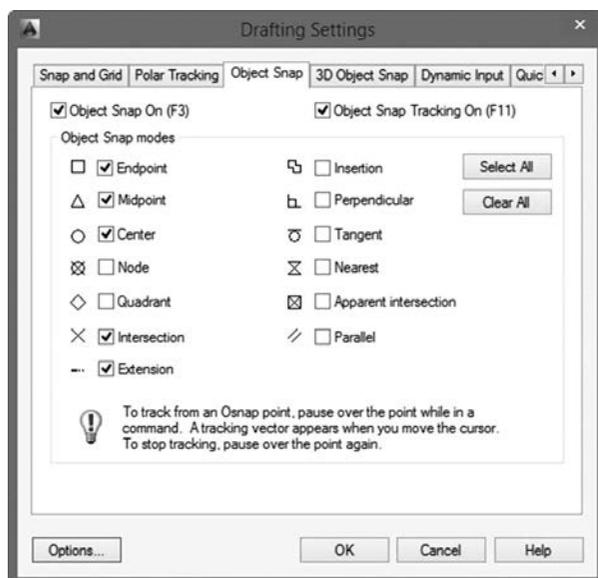
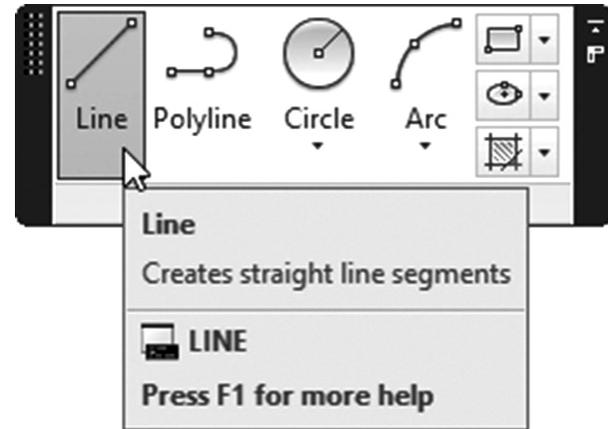


Figure 4 OSNAP Dialogue Box

Perpendicular: To catch the Perpendicular point on an object (any object)

Nearest: To catch a point on an object Nearest to your click point (any object)

F1: Pressing F1 will give more help along with the short notes available in each commands/ icon as shown below.



Arrow Up and Down: Arrow Up and Down button used to navigate to the previous commands. After selecting the suitable command and pressing 'Enter' will execute the selected command.

ESC: Pressing ESC button will exit from the present command which is running.

3.4. IMPORTANT COMMANDS

L: It can be used for making simple lines in the drawing.

C: It is the command used for making a circle in AutoCAD.

PL: This command can be used to make a Polyline in your drawing.

REC: This command will make a rectangle in AutoCAD.

POL: This command can be used to make a polygon with a minimum of 3 sides and a maximum of 1024 sides.

ARC: As the name suggests, this command can be used to make an arc in AutoCAD.



ELLIPSE: As the name suggests, this command can be used to make an ellipse with the major and minor axis.

CO: This command is used to copy the object(s) in AutoCAD.

ARRAY: Using this command you can make a Rectangular, polar, or Path array.

TR: This command is used for trimming geometry.

SC: This command is used to change the scale of an object.

B: This command is used for creating a block, the properties of the block can be defined using the block definition window.

I: This command can be used to insert an existing block or a drawing as a block in AutoCAD.

ST: Using this command, you can open a text style window that controls properties of the default AutoCAD text style.

X: This command can be used to explode objects like Polyline to simple lines, an array or a block to simple geometry, etc.

F: This command can be used to add rounded corners to the sharp edges of the geometry, these round corners are also called fillets.

DIMSTYLE: With the use of this command, one can change the style of dimension.

3.5. SHORTCUT KEYS IN AUTOCAD

Ctrl + N: You can use this shortcut to open a new drawing tab in AutoCAD.

Ctrl + S: You can use this keyboard shortcut to save a drawing file.

Ctrl + Shift + S: You can use this keyboard shortcut to save the drawing as a new file, in short, this is the hotkey for the “save as” command.

Ctrl + 0: Clears screen to show only the drawing area and hides palettes and tabs. Press it again to reset the default AutoCAD interface.

Ctrl + 1: Select an object and press Ctrl + 1 to open the properties palette which lists the properties of the object. You can use this palette to modify most of the properties of the object too. You can also use PR command to open the property palette.

Ctrl + 2: You can use it to open the design center palette which contains many AutoCAD blocks that can be used directly in your drawing.

Ctrl + 9: You can use this keyboard shortcut to toggle the visibility of the command line. If for some reason your command line is hidden from the drawing area, then use this keyboard shortcut to bring it back.

Ctrl + C: Select objects from the drawing area and press Ctrl + C to copy to objects to the clipboard.

Ctrl + V: To paste the copied objects of the clipboard in the drawing keeping their original properties, you can use this keyboard shortcut.

Ctrl + Shift + V: To paste the copied objects as a block you can use this keyboard shortcut, the block thus created will have a random set of characters as names. You can use this keyboard shortcut to make blocks quickly without going through the creative block window.





Ctrl + Z: This keyboard shortcut can be used to undo the last action in your drawing. You can press this shortcut key multiple times to undo many actions.

Ctrl + Y: This keyboard shortcut can be used to redo the last undo action which you have performed.

Ctrl + Tab: You can use this keyboard shortcut to cycle through all open drawing tabs in AutoCAD.

3.6. SETUP COMMANDS

UNITS: Choose the appropriate decimal points based on the required precision. Set specified units. (Ex. To mark the dimension of 2.75 mm, choose decimal 0.00 as it is precise to 2 decimal units and set units to millimetres)

LIMITS: This command fix the size of graphical area. Specifying lower and upper limits fixes the dimension of paper on which drafting is to be done. (Ex. (0, 0), (420, 297) will fix the paper size as A3)

ZOOM: Type this zoom command, select all and press enter.

UCS: The user coordinate system (UCS) establishes the location and orientation of a movable Cartesian coordinate system. By default, the origin is at (0, 0). All the pictures are drawn in I quadrant. Use the UCS command, Origin option to relocate the origin to one side of the shape so that the values in both X and Y will be correct. If you leave the origin to the current UCS origin, the values inserted may be wrong.

3.7. ABSOLUTE AND INCREMENTAL COORDINATE REFERENCES

AutoCAD user can choose, how the diagram is to be drawn with the use of coordinates.

Absolute Coordinate Reference: The positioning of points is done with reference to the origin (0, 0).

Ex.: Consider a line of 100mm with starting point $(x_1, y_1) = (20, 20)mm$ is to be drawn parallel to x – axis, then the second point with reference to the origin is to be positioned at $(x_2, y_2) = (20, 120) mm$. Here, the difference in Y coordinate provides the original length of line as $120 - 20 = 100 mm$.

Incremental Coordinate Reference: The positioning of the consecutive points (x_n, y_n) is done with reference to the position of previous point (x_{n-1}, y_{n-1}) .

Ex.: Consider a line of 100 mm with starting point $(x_1, y_1) = (20, 20) mm$ is to be drawn parallel to x – axis, then the second point with reference to the position of previous point is positioned at $(x_2, y_2) = (0, 100)mm$ which denotes no change in value of X, and 100 mm change in value of Y. Here, the value of Y provides the original length of line directly as 100 mm.

3.8. USING THE AUTOCAD COMMANDS

Step 1: Select required tool in ribbon (or) type the respective command in command window

Step 2: Choose the appropriate options available in each commands respective to the requirement

Step 3: Draw and finish the respective shape





Example:

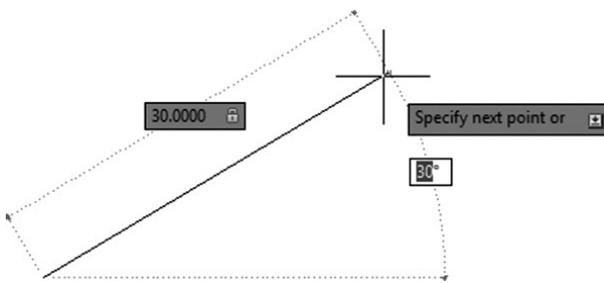
Drawing a line.

Step 1: Type the command 'LINE' in command window and press Enter.

Step 2: Specify first point (Can manually enter the co-ordinates or select a random point on screen by 'left click' on the mouse)



Step 3: Specify next point by moving the cursor and left click the cursor at the respective position or type the co-ordinate manually and press the Enter button.



(Think and check: Is it possible to draw the line as shown in the above figure with ORTHOMODE On?)

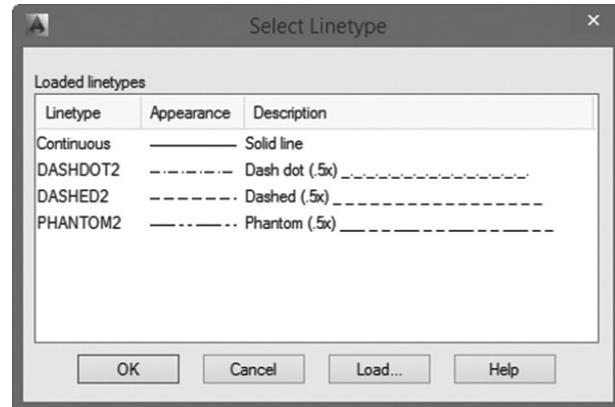
3.9. LAYERS IN AUTOCAD

Layers are a simulation of a transparent piece of paper in which you will draw part of the drawing using a certain color, linetype, and lineweight. This setting is called BYLAYER, which means we will control the drawing through controlling layers rather than controlling objects.

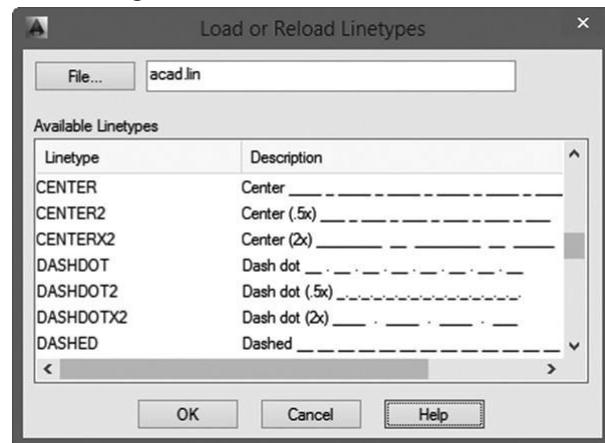
Ex.: Using layers to alter the type of line

- Using the Layer Properties Manager, select the desired layers

- Using the Linetype field, click the name of the linetype, and you will see the following dialog box:



- If the desired linetype is listed, then select it.
- If not, you need to load it. Click the Load button, and you will see the following dialog box:



- Browse for your desired linetype, select it to be loaded, then click OK. Now the linetype is loaded, you can select it and then click OK.

(Note: Similar to the above example, using layers we can set Lineweight, colors, etc.)

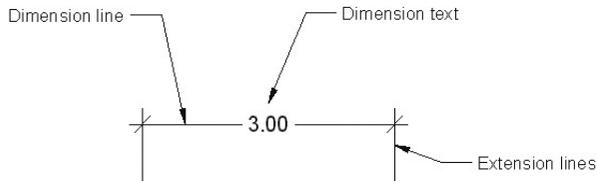
3.10. DIMENSIONING IN AUTOCAD

- Dimensioning contain following three components:



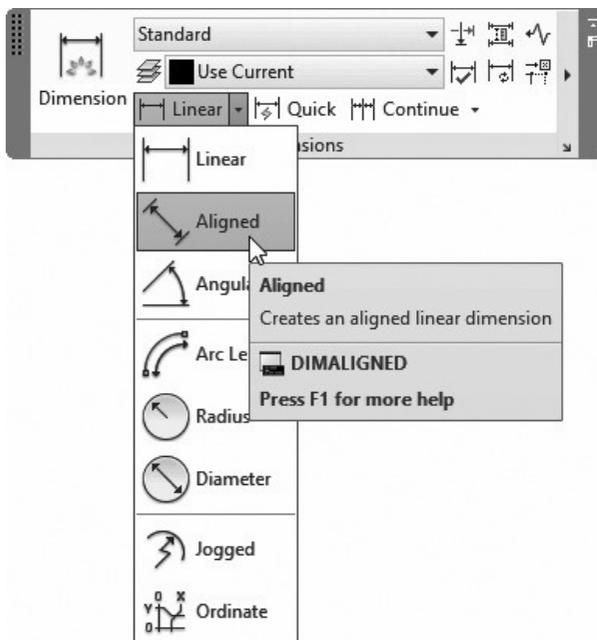


1. Dimension line
2. Dimension text
3. Extension line

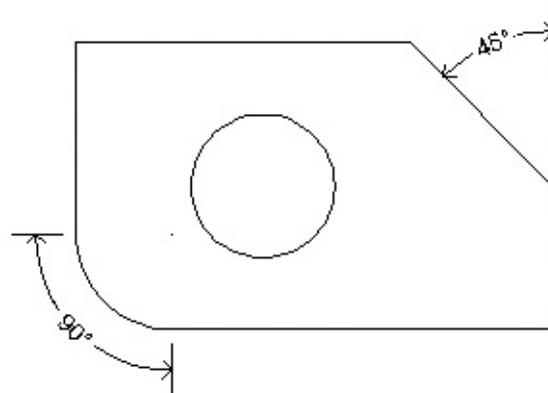


- Types of dimensions:
 1. Linear (Dimensioning the lines/ between two points along X, Y and Z axis)
 2. Aligned (Dimensioning the lines/ between two points along inclined directions)
 3. Arc length, Radius, Diameter (Arc and circles)
 4. Angular (Angle between lines)
- Inserting a dimension.

Ex.: Go to **Annotate** tab, locate the dimensions panel, and then select the **Angular** button



- Select the inclined line and move the cursor, the angular dimension with respect to any one of the axis can be marked.



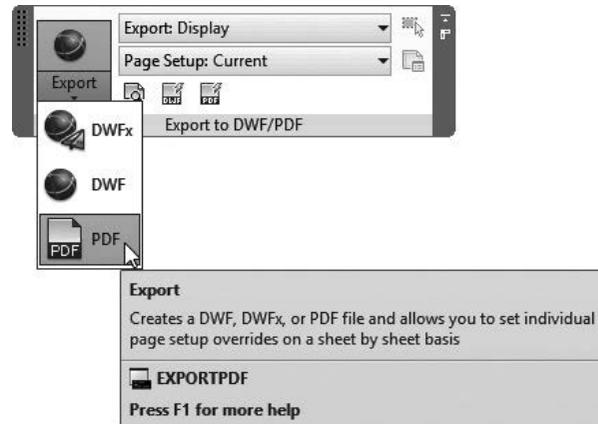
- AutoCAD may use one of the following methods based on the selected objects:
 1. If you select a circular arc, AutoCAD will measure the included angle
 2. If you select a circle, your selecting points will be the first point, the center of the circle will be the second point, and then the user will select the third point
 3. If you select a line, it will ask you to select a second line
 4. If you select a point, it will be considered as a center point, and AutoCAD will ask the user to specify two more points
- Using DIMSTYLE command, we can alter the style of texts (Font height, spacing, arrow size, tolerances etc.)
(Note: Under Annotation hatching can be done. Hatching is used to differentiate the normal plane and cutting plane. It is used to show the true shape of the object as well as the cut portion.)





3.11. EXPORTING DWG FILE TO PDF

After choosing proper Layout, Go to Output tab, locate the export to DWF/ PDF panel, then select Export button and click PDF.



QUESTIONS

PART A

I. Choose the correct option :

- Which function is used for getting help on unknown command?

- F1
- F8
- F3
- F5



- Which of the following is used to know the direction of drawing?

- Navigation Bar
- View Cube
- Cross Hairs
- Status Bar

- This function helps in aligning the lines by

- OSNAP
- RIGHTALIGN
- ORTHO
- XALIGN

- The command 'PL' is used to draw the _____.

- Simple Line
- Poly Line
- Polygon
- Perpendicular Line

- Which keyboard shortcut can be used to undo the last action in your drawing?

- Ctrl + Shift + V
- Ctrl + C
- Ctrl + G
- Ctrl + Z

PART B

II. Answer the following questions in one or two sentences:

- Compare OSNAP and ORTHOMODE function of AutoCAD.
- Write a note on the following:
 - View Cube
 - Navigation Bar





8. Differentiate: Graphical Area and Workspace.
9. Write down the functions of the following in AutoCAD:
 - a. Pressing ESC
 - b. Pressing ENTER
 - c. Arrow UP and Arrow DOWN
10. Brief on setup commands in AutoCAD.

PART C

III. Answer the following questions in about a page?

11. Explain any five Object snaps and its usage.
12. Compare and contrast the absolute and incremental coordinate references with suitable example.
13. Explain the importance of using layers in AutoCAD. How the linetype is defined using layers in AutoCAD?

PART D

IV. Answer the following questions in detail:

14. Describe about the various shortcut keys used in AutoCAD.
15. Describe the parts, types, and methods of dimensioning done in AutoCAD.

