

AUTOCAD

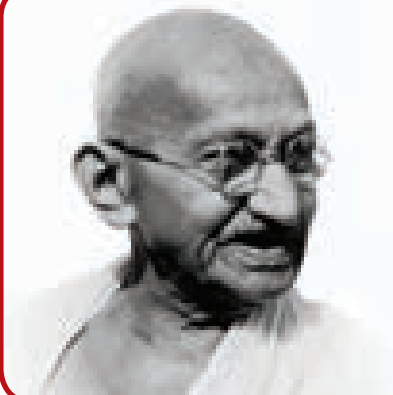
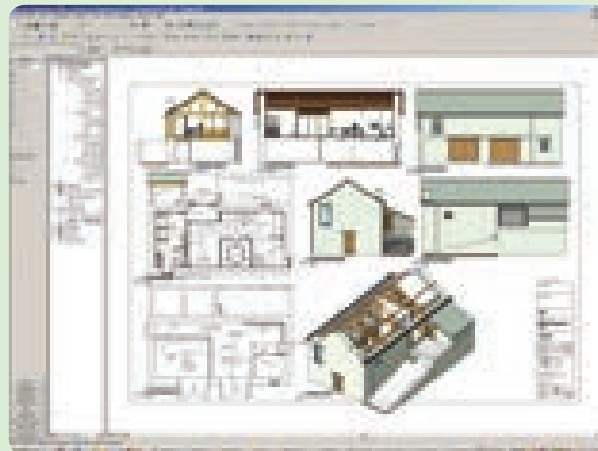


Unit - 2 Basic Civil Engineering

2.1 AUTOCAD SOFTWARE



2.2 AUTOCAD BASICS



The future depends
on what we do in
the present.



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2.2 AutoCAD Basics

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2.1

AUTOCAD SOFTWARE



Learning Objectives

At the end of this lesson you shall be able to

- State the AUTOCAD software and its uses.
- Understand the other softwares in civil engineering.

2.1.1 Introduction

In modern world, the use of computers are increasing in almost all the sectors. The computers play an important role in the field of Civil Engineering too. Various softwares are used to save time, energy and simplify the tedious work like building drawing, design, analysis, etc. In this chapter we learn about the softwares used in civil engineering.



Who invented CAD?

An American Ivan Sutherland invented CAD in 1961.





Who discovered AutoCAD?

In 1982, John Walker and 12 other programmers began to work on several computers application. The first to be completed was auto CAD, a software application for computer aided design (CAD) and drafting.



Search Link: [http://en.m.wikipedia.org>wiki>autodesk](http://en.m.wikipedia.org/wiki>autodesk)

2.1.2 Softwares Used in Civil Engineering:

1. AUTOCAD
2. STAAD PRO
3. QE PRO
4. ESR, GSR
5. GEO
6. AQUA++
7. KANAL ++
8. MX ROADS
9. ECOTECT
10. SAFE
11. SACS

2.1.2.1 AUTOCAD: AutoCAD software is prepared by an American company called Auto Desk. This software is highly used for the preparation of drawings. This software is used in branches like civil,

mechanical, electrical and electronics engineering. Drawing using this software is simple, speed and errorless.

The softwares like Archi CAD, REVIT, SKETCHUP and PHOTO SHOP are also used for drawing.



2.1.2.2. STAAD PRO : This software is used to designing and analysis of a structure.

The softwares SAP, NISA, ANSYS are also used for design and analysis of structure.



2.1.2.3 QE PRO: This software is used for fast and accurate quantity computation from building plans.



2.1.2.4 ESR, GSR: It is a unique software used for structural analysis, design and detailing of overhead water tanks.



2.1.2.5 GEO: This software is used to show the route map, topography of the land, etc.



2.1.2.6 AQUA ++: Aqua ++ software is used for water distribution and water management.



2.1.2.7 KANAL ++: Kanal ++ software is used for storm water distribution and waste water management.

2.1.2.8 MX ROADS: This software is useful to highway designing and 3D modeling, pavement design, etc. The softwares HDM, AUTO PLOTTER, HEADS are also used for highway modeling.

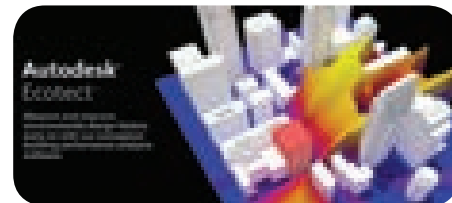


Which organisation developed AutoCAD?

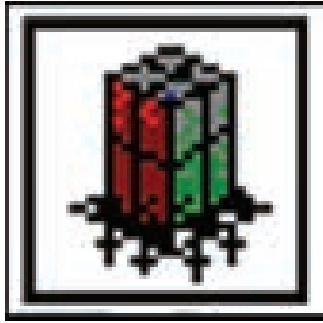
- Auto CAD developed and marketed by Auto Desk.
- Auto CAD was first released in December 1982.
- It releases auto CAD 2018(release 32) in March 2017



2.1.2.9 ECOTECT: This is an environmental analysis tool software. The softwares ENERGY +, IES are also used for pollution free building designs.



2.1.2.10 SAFE/STAAD FOUNDATION: This software is used for the design of foundations. STAAD FOUNDATION software also used for basic and complex foundation designs.



2.1.2.11 SACS: SACS software is useful for offshore structural analysis and design.



2.1.3 CAD – AutoCAD:

CAD – Computer Aided Design

Before constructing a building the preparation of drawing such as plan, sectional view and elevation is necessary. We



Photoshop

- Photoshop was developed in 1987 by the American brothers ‘Thomas’ and ‘John Knoll’.
- In 1988 he sold the distribution license to the adobe systems.



can draw the drawing with utmost care, clarity and fast by using the AutoCAD software.

2.1.4 Advantages of Using AUTOCAD Software in Computer

1. If a drawing is prepared by using AutoCAD, it will be beautiful and clear. This is a good type of drawing compared with manual preparation of drawing.
2. It will take much time while using varieties of lines, colours in manual drawing. But all these are done within a short time in AutoCAD.
3. It is very tough to edit or correct a manual drawing. But corrections can be easily done in AutoCAD.
4. We can show the original appearance of the building with the three dimensional drawings using AutoCAD.
5. According to the desire of building owner, the needs of a house can be shown through AutoCAD drawing which is impossible in manual drawing.
6. We can make some changes in the drawing as per our requirements and several copies may be taken at a time. It is not possible in manual drawing.
7. By joining two drawings, we can make it as a single drawing. It cannot be done in manual drawing.

Thus drawing by using AutoCAD software is more useful than manual drawing.

2.1.5 Units

1. Selection of unit is to be done before drawing a sketch. Eg. decimal, engineering, architectural, fractional or scientific.

2. Selection of Unit format. Eg. millimeter, centimetre, Feet, inches, etc.
3. Selection of unit for angle. Eg. Degree, min., sec., radians, etc.
4. Drawing area limits should be decided.

2.1.6 Functional Keys:

ESC: 'ESC' key is used to come out from any command.

F1 : This F1 key helps to know about the AutoCAD perfectly. This function key is a help window for AutoCAD.

F2 : This is an AutoCAD text window. This function key is used to open the file and thus it is used to know the commands we used.

F3 : OSNAP function: When a command is under progress, Symbols of midpoint, centre point, perpendicular, etc., of

a drawing can be shown by using this OSNAP function.

F7 : SNAP ON / SNAP OFF : Snap is used to control the cursor movement in a drawing. Isometric views can be drawn by using this key.

F8 : ORTHO ON (OR) ORTHO OFF :

ORTHO ON: In this position, 0° and 90° lines are drawn from one point to another point.

ORTHO OFF: In this position, we can draw the line according to our required angle from one point to another point.

F9 : GRID ON (OR) GRID OFF :

GRID ON: When grid is on, the points of X axis and Y axis, like graph sheet are seen in the window of AutoCAD. But it is not visible in print out. Grid on position is used to draw straight line. Also we can know how far we are selecting the limits of drawing.

GRID OFF: In this grid off position, we cannot see the graph on the window.

F10 : POLAR ON (OR) POLAR OFF :

POLAR ON: In polar on position, when lines are drawn from a point to another point by using line command, the distance of line and angle of line can be known. It can be used to draw the line with required angle.

POLAR OFF: In polar off position, the distance and angle of line are not visible in the window.

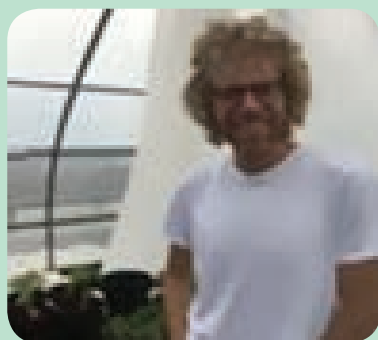
2.1.7 File Management:

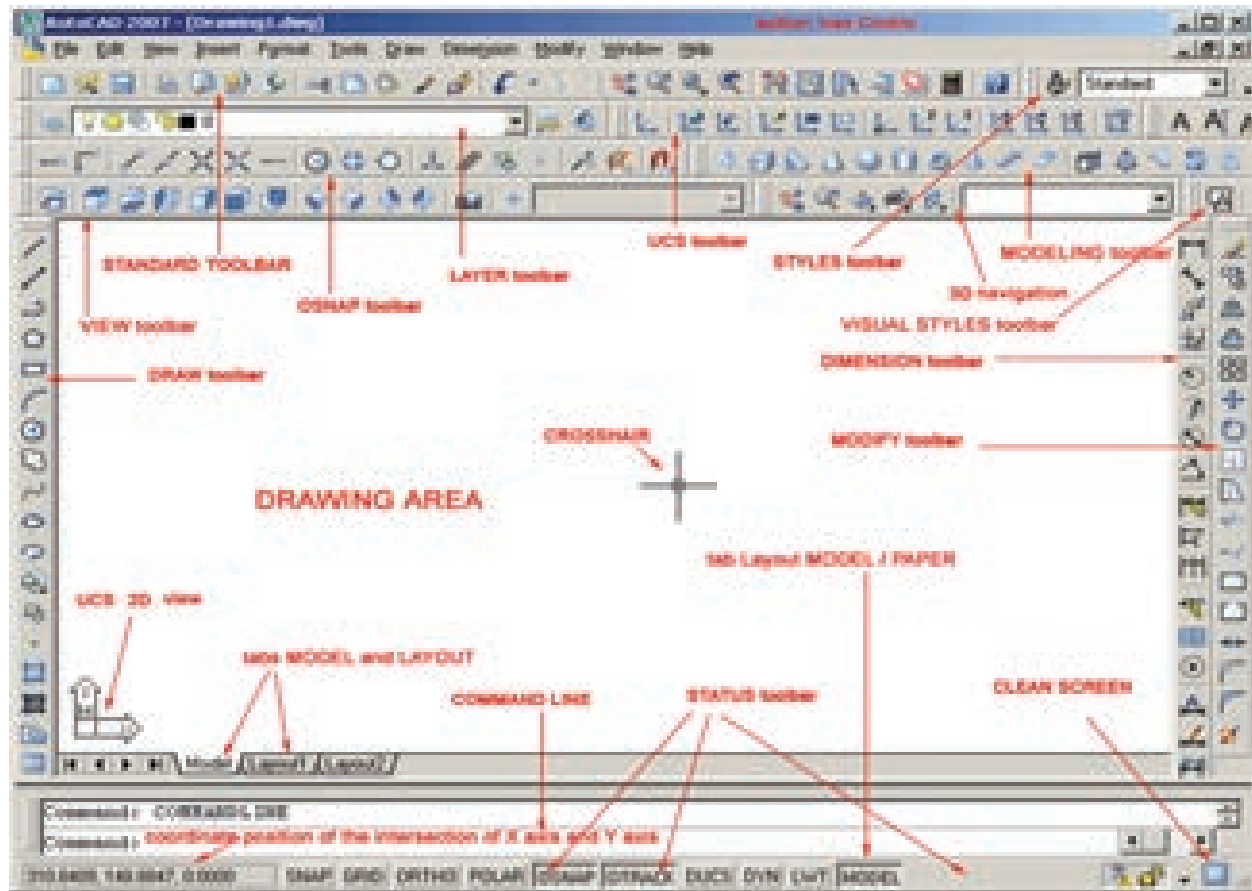
New: This command is used to draw a new drawing in AutoCAD.



Sketch up

- Sketch up was introduced by @last software, a tech company, co-founded in 1999 by Brad Schell release date august 2000.
- Sketch up developed as a 3D modelling tool for architects, designers and film makers.





AUTOCAD Window

Open: This command is used to open the saved drawing which is already drawn and saved in the file.

Save: It is used to save the drawing we have already drawn in AutoCAD Window.

Save As: This command is used to change the title of the drawing which is already saved and to save it in another file. It is also used to take the print out of duplicate copy.

Quit: This command is used to come out from AutoCAD.

Plot: This command is used to print the drawing of AutoCAD.

Export: This is used to change or bring the drawing file from AutoCAD file to another file.

Exit: This command is used to come out from AutoCAD to desktop.

2.1.8 Drawing Limits

Before drawing a sketch in AutoCAD, we have to know the limits of the drawing. For this purpose like manual drawing sheets, we have to select the limits such as A1, A2, A3 and A4 size. This measurements should be given in X and Y direction.

Model Questions

PART I (1 Mark)

Choose the correct answer

1. Auto CAD software is developed by an Company.
a) Italian
b) Egyptian
c) American
d) Australian
2. Software is used for water distribution and water management.
a) GEO b) AQUA++
c) ENERGY+ d) STAD PRO
3. Inposition, 0° and 90° lines are drawn from one point to another point.
a) Snap on
b) Grid on
c) Polar on
d) Ortho on
4. command is used to print the auto CAD drawing
a) EXPORT b) NEW
c) PLOT d) QUIT
5. Thefunctional key is a help window for Auto CAD.
a) F1 b) F2 c) F3 d) F4



PART II (3 Marks)

Answer in one or two sentences

6. What is Auto CAD?
7. State any three softwares used in civil engineering.
8. What is the difference between 'Ortho on' and 'Ortho off'?

PART III (5 Marks)

Answer shortly

9. Write short notes on any three functional keys.
10. Explain about 'UNITS' in Auto CAD.

PART IV (10 Marks)

Answer in detail

11. What are the advantages of using AutoCAD to draw drawing?

Part – I Answers
1. (c) 2. (b) 3. (d) 4. (c) 5. (a)

2.2

AUTOCAD BASICS



Learning Objectives

At the end of this lesson you shall be able to

- State the draw commands, modify, text & dimension commands, layer & editing commands and its uses.
- Draw the engineering drawing using commands.



2.2.1 Introduction

To draw a drawing using AutoCAD software so many commands are required. For this, there was a necessity of compulsory typing in the command box. But, in the latest or modified software of Auto CAD 2000, 2002, 2004, 2007, 2010 the highly used commands are given in toolbar or icon. Let us know the required commands to draw a building drawing.

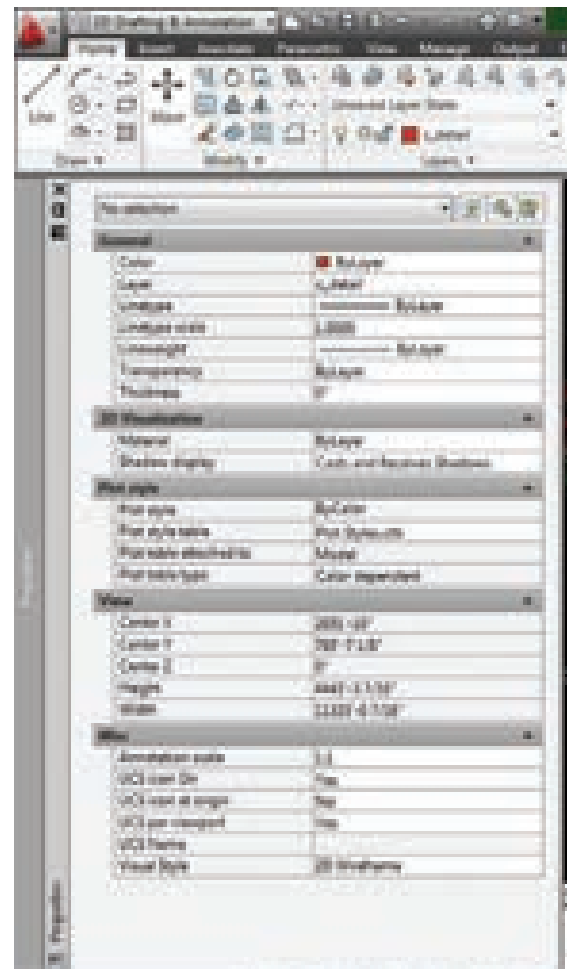
Lines are drawn using line command. The line toolbar is used to draw the line (or) type 'line' and enter (or) type 'l' and enter. Instead of giving enter, we can also click the right button in the mouse.

2.2.2 Draw Commands



Polyline line Polygon Arc Spline Ellipse arc
Construction line Rectangle Circle Ellipse
DRAW TOOL BAR

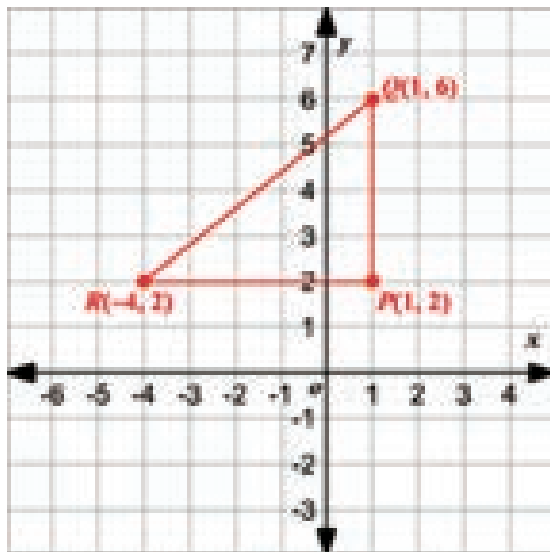
2.2.2.1 Line



Lines are Drawn in Three Methods.

1. Absolute co-ordinate method.
2. Relative co-ordinate method.
3. Polar co-ordinate method.

1. **Absolute Co-Ordinate Method:** In this method, we have to give the statement of points from origin.

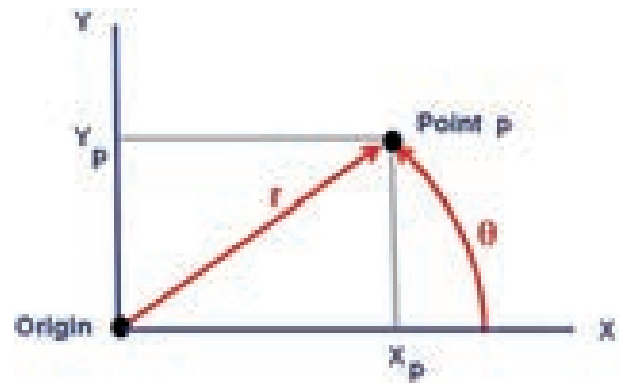


2. **Relative Co-Ordinate Method:** In this method, we have to give the co-ordinates of the starting point towards X-axis and Y-axis or distance of Y axis from the point.

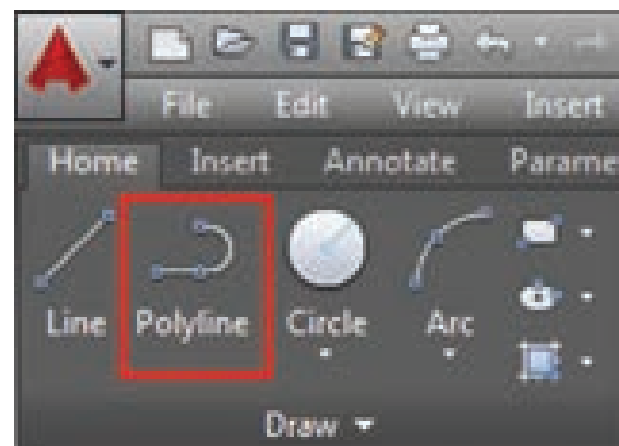


3. **Polar Co-Ordinate Method:** In this method, sketch is drawn by giving the

angle of direction and distance from starting point to the next point.



2.2.2.2 Polyline



Polyline means many characteristics of a line. It can be drawn by using the polyline toolbar or by typing PL and pressing ENTER key.

Special Charecteristics of Polylines:

1. Polyline has a single characteristic feature.
2. We can enlarge the size and thickness of line.
3. With polyline, we can draw different shaped drawings with a single characteristic feature.

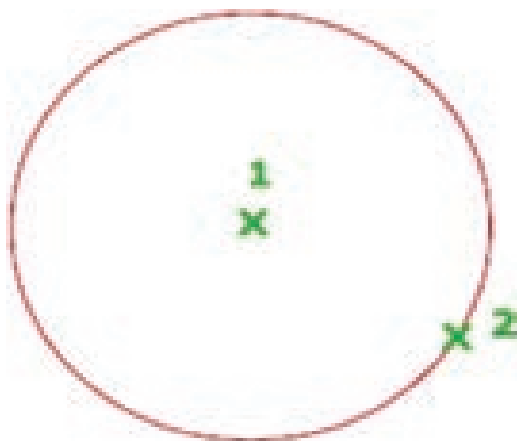
4. The line drawn by polyline can be easily changed.
5. One line can be joined with another line with (straight line + curved line) a single characteristics.
6. Structure of several lines drawn with a polyline is called an object. This command is highly useful to draw circumference and hatching.

2.2.2.3 Circle

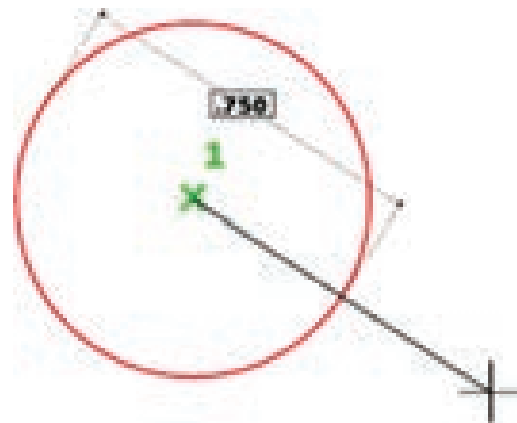


Generally, if there is a centre and radius, we can draw a circle. There are five methods to draw a circle.

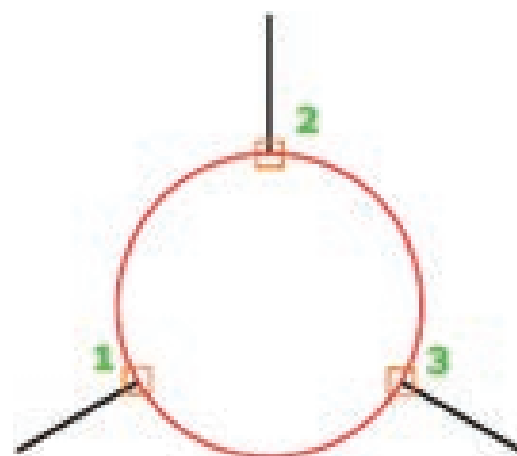
- **Centre Point Radius Method:** To draw a circle in this method, the centre point and radius should be given.



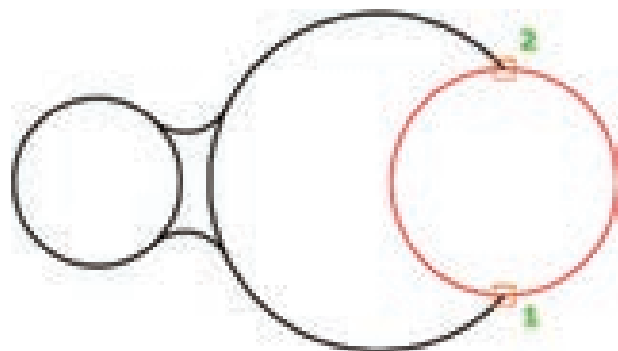
- **Centre Point Diameter Method:** In this method, the centre point and the diameter of the circle should be given to draw the circle.



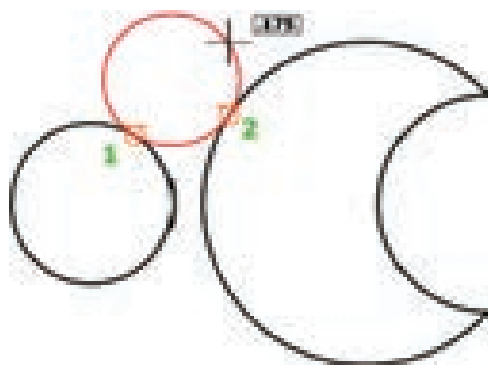
- **Three Point Method:** To draw a circle in this method, three points in the circumference of the circle should be given.



- **Two Point Method:** Two points in the circumference of the circle should be given to draw a circle in this method.

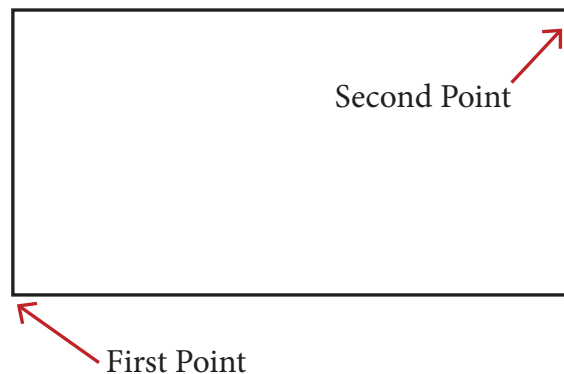


- **Tangent Radius Method:** To draw a circle in this method, the radius and the tangent position should be given.



ACTIVITY 1

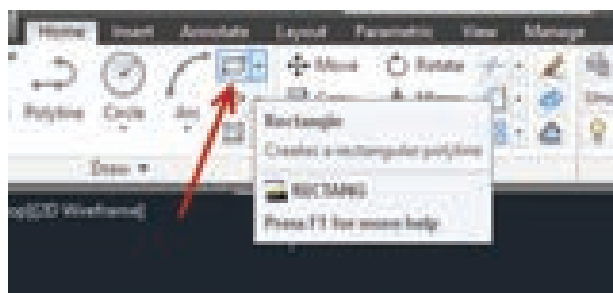
Draw some circles using circle command and take print outs.



ACTIVITY 2

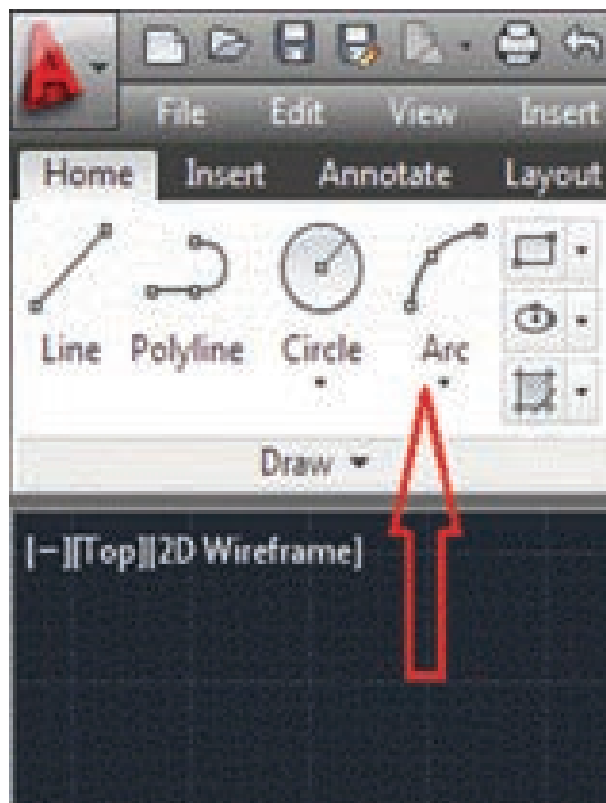
Draw some rectangles in various sizes and take print outs.

2.2.2.4 Rectangle

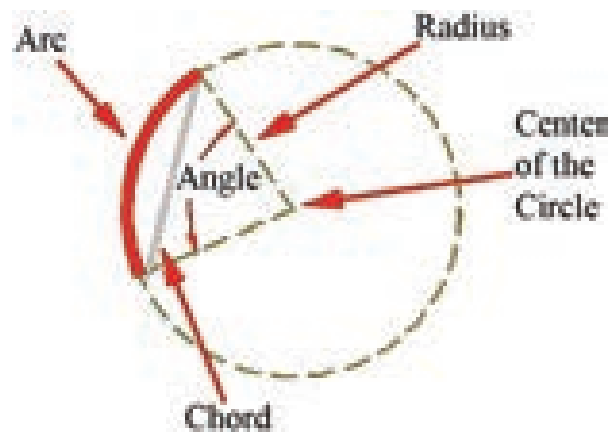


There are two dimensional measurements available for rectangle such as length and breadth (or) length and depth. When we are drawing by AutoCAD, we are not using these measurements. Instead of measurements, the rectangle is drawn with diagonal.

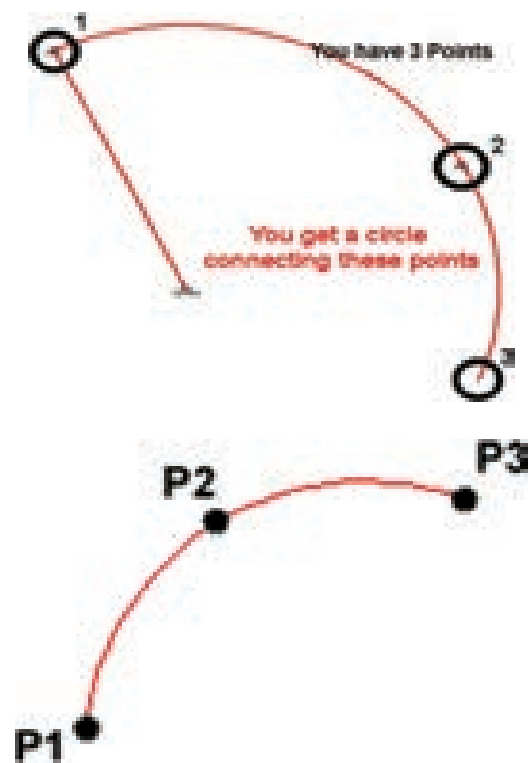
We have to give the values of lower edge of left side and opposite corner of the rectangle. Two corners are noted as first corner and other corner respectively.



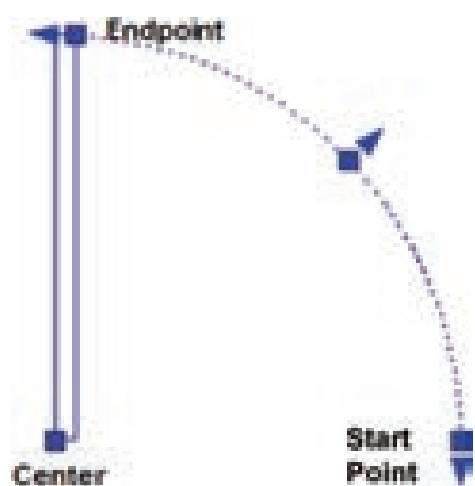
Part of a circumference of a circle is called as an arc. It is curved in shape. Three points are required to draw an arc. We can also draw the arc with the centre point of arc, angle of arc and radius of arc. There are six methods to draw an arc.



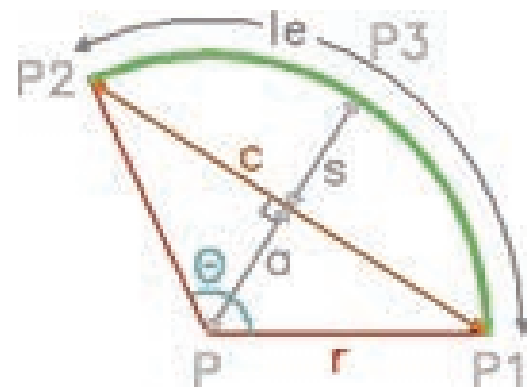
a) Three Points Method



b) Start, Centre and End Point Method



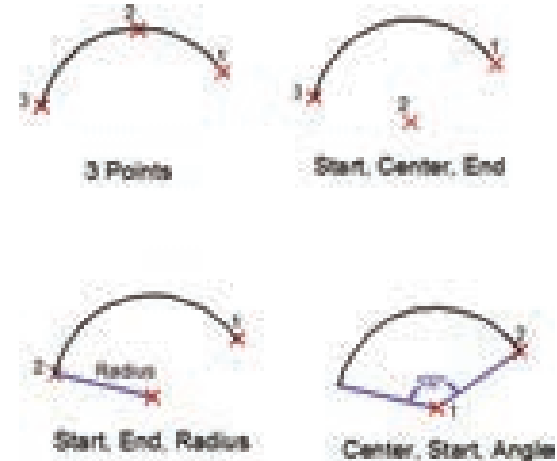
c) By Start, Centre and Included Angle



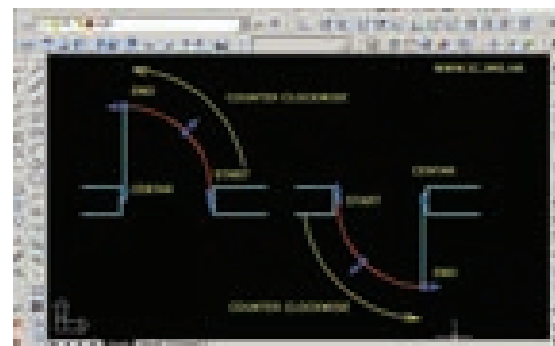
d) By Start, Centre and Length of Chord



e) By Start, End and Radius



f) By Start, End and Direction

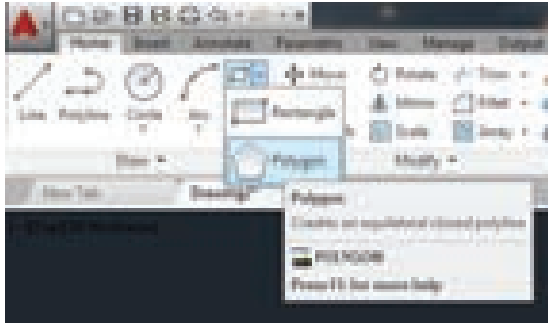




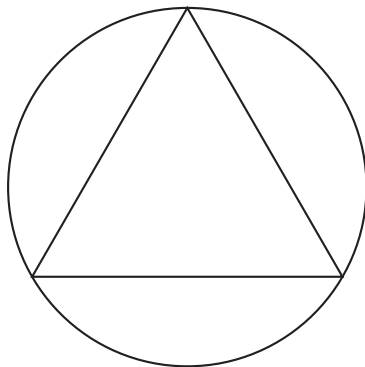
ACTIVITY 3

Draw some arcs by using any one method and take print outs.

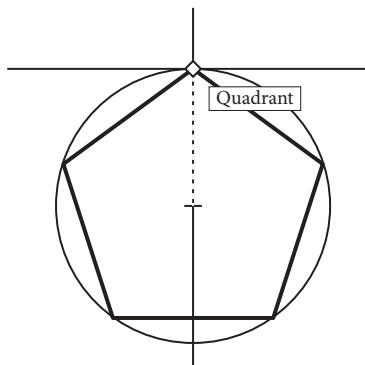
2.2.2.6 Polygon



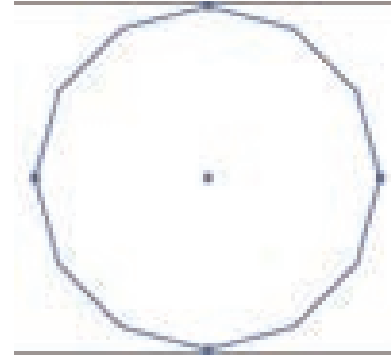
A closed drawing drawn with several angles (or) with several sides is called as polygon. In this, angle (or) sides should be equal in measurement. Polygons of 3 to 1024 sides can be drawn.



3 Sides Polygon (Triangle)



5 Sides Polygon (Pentagon)



Polygon With 12 Sides (Dodecagon)



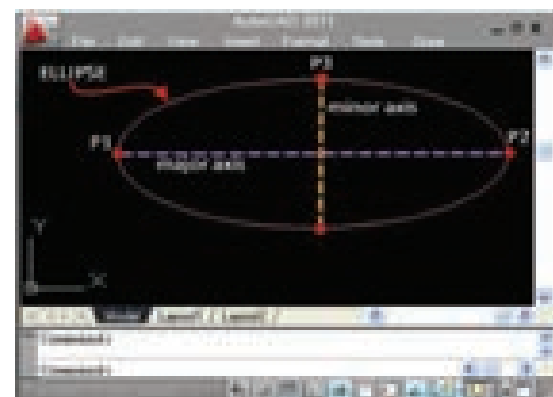
ACTIVITY 4

Draw some polygons of different number of sides and take print outs.

2.2.2.7 Ellipse



Ellipse is a closed curve drawn by two different axes. One axis is noted as major axis and another is noted as minor axis. It is noted that half of the distance of minor axis is axis distance. With this point, we can draw the ellipse in 4 methods.

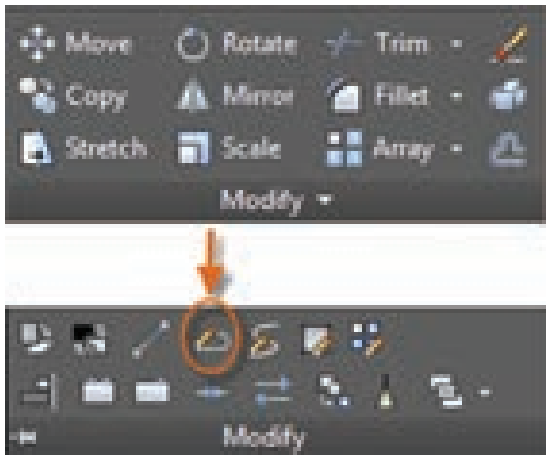




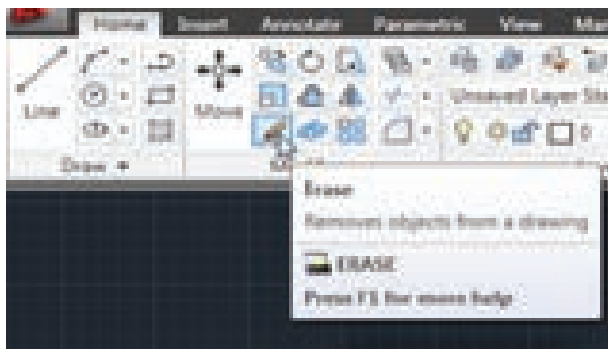
ACTIVITY 5

Draw an ellipse and take print out.

2.2.3 Modify Commands



2.2.3.1 Erase Commands



By using this command, objects of one (or) several lines are removed (or) erased.



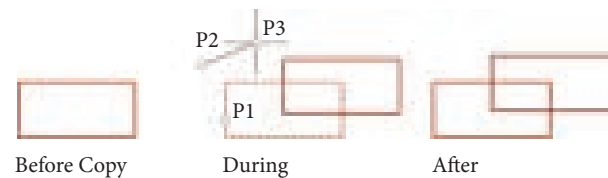
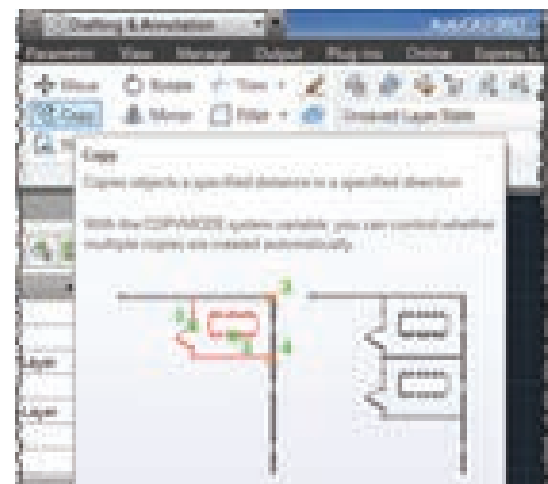
Before Erase

After Erase

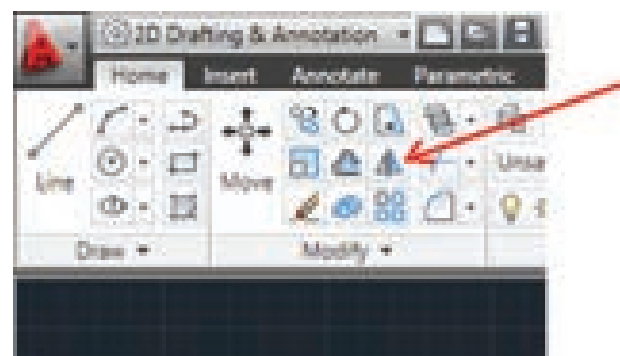
2.2.3.2 Copy



The object should be drawn before duplicating the object. Then the base point of the object is selected and the duplicate object is fixed at the displacement point.

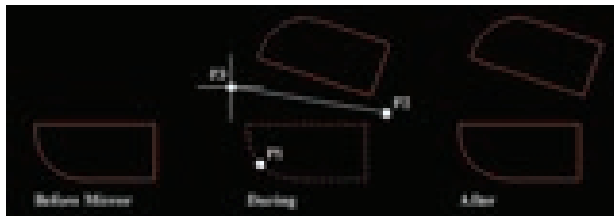
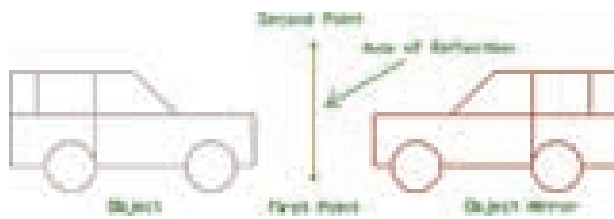


2.2.3.3 Mirror

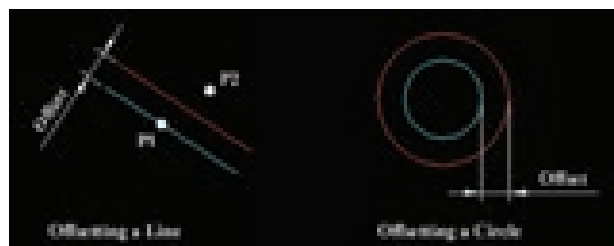
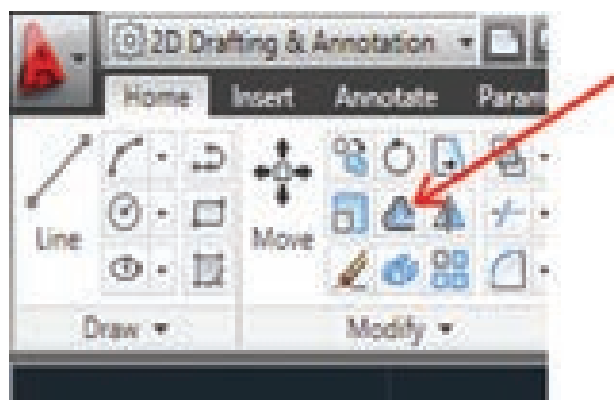


If an object is placed in front of a mirror, the object reflects in the mirror. Like this, if we draw mirror line at an object, the object will reflect in reverse direction.

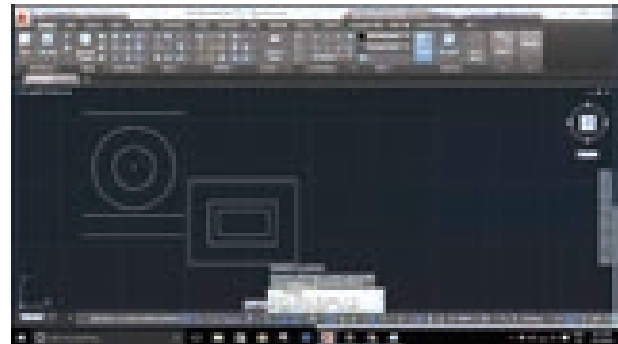
We can draw quickly the symmetrical figures by using this mirror command. Hence it reduces the time taken for drawing.



2.2.3.4 Offset



By using this command, curves, circles, rectangles are drawn parallel to some distance.



2.2.3.5 Move



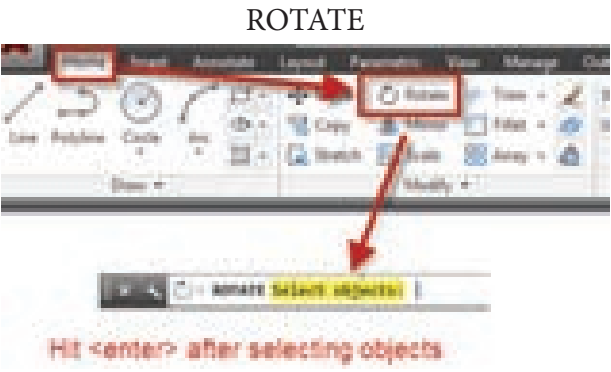
When an object is moved from one place to another place, it is called as moving. It is similar to copy command. The only difference is, old object and duplicate object will be in copy command. But, the old object will not be there in move command.



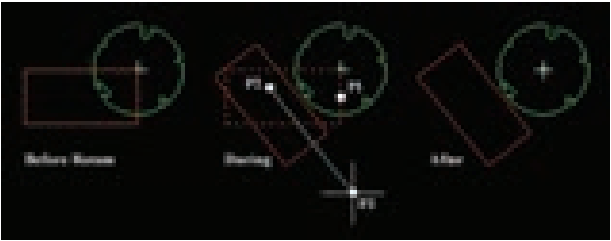
Before Move

After Move

2.2.3.6 Rotate

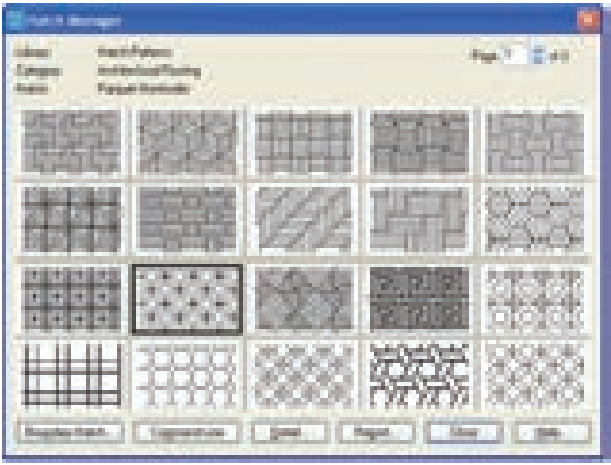


We have to use rotate command to rotate all the drawn objects or a single object. The object may be rotated from one position to another in a particular angle we need.



2.2.3.7 Hatching

This command is used to construct a sectional view of the drawing object and to show the inner parts of the objects in detail. Object will be filled by several patterns as shown in figure.

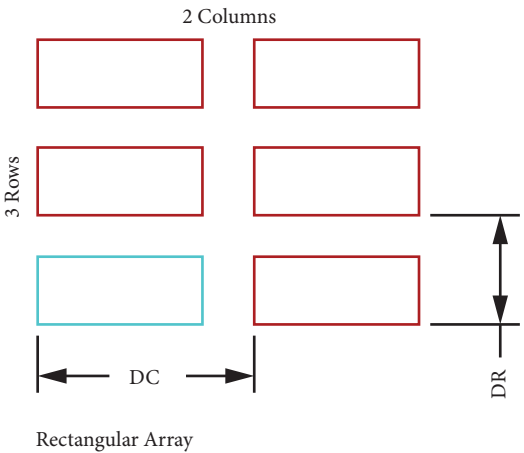


2.2.3.8 Array

Classifying an object in uniform order is called array command. This may be formed by square, rectangular (or) circular classification.



Array of square formation is called square array. Array of rectangular formation is called as rectangular array.





Array of circular formation is called circular array.

2.2.3.9 Stretch



This command is used to extend or reduce an object. Any form of an object can be extended or reduced in stretch command. We can stretch the objects of curve, polyline, solid by using this command

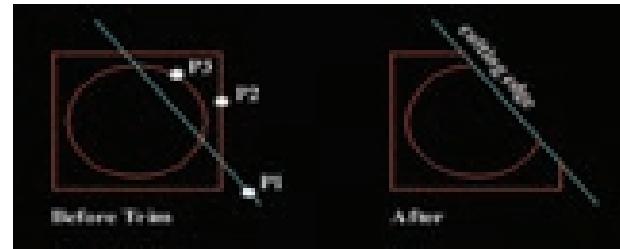


2.2.3.10 Trim

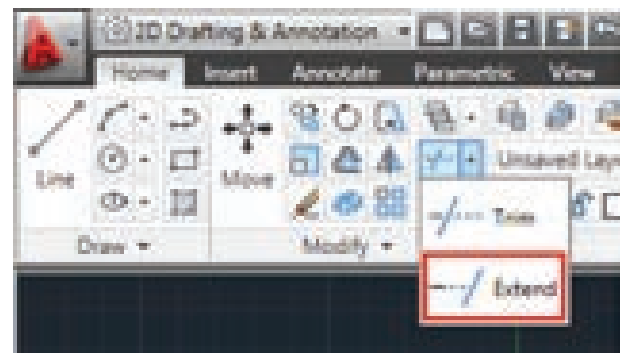


After drawing an object, the unnecessary lines are removed from the

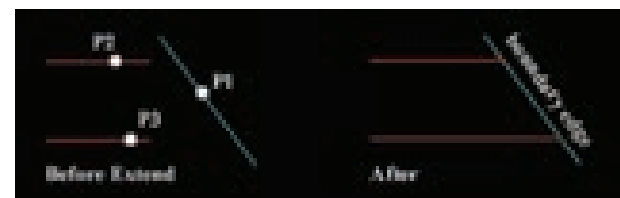
particular place by using this command. We can trim the form of circle, curve, polyline by using this command.



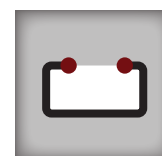
2.2.3.11 Extend



This command is used to extend a line. If we select the boundary edge, that line will be extended up to the selected boundary even though if there is any object in the centre.



2.2.3.12 Break



This break command is used to break the middle portion (or) edge of a line. By using this command we can break a line, circle, ellipse or polyline.



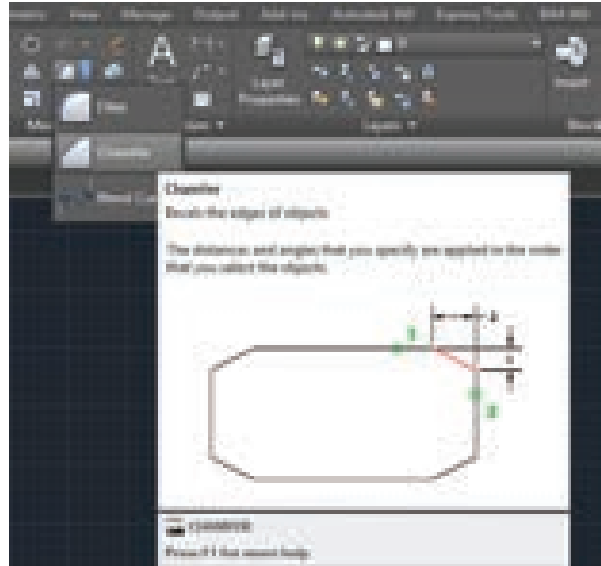
2.2.3.13 Fillet

Fillet helps to convert sharp edges of square, rectangle or polygons to round edges. The rounded edge of different radius can be drawn using this command.

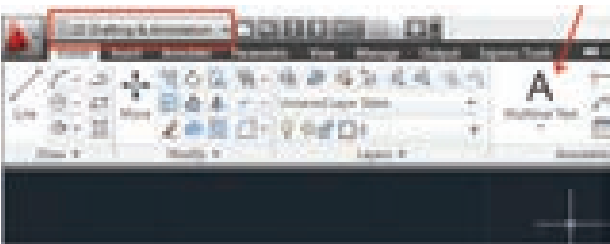


2.2.3.14 Chamfer

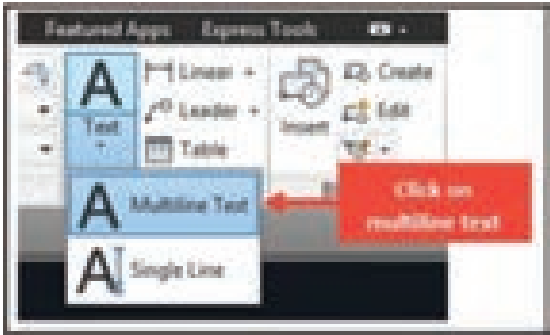
This command is used to bevel the edges of objects. The distances and angles are applied to the object in the specified order.



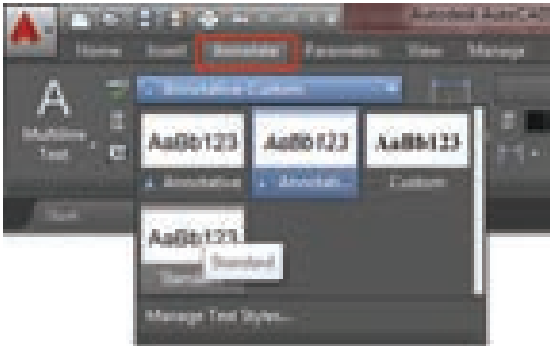
2.2.4 Text Command



By using this command, letters and numerals are typed by using the keyboard. Instead of this command, D text command is available. Dynamic Text is called D Text.



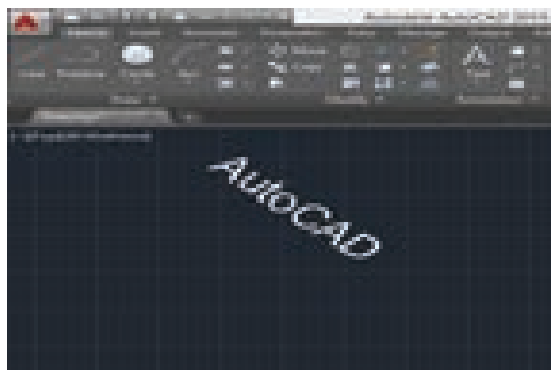
2.2.4.1 Text Style



This command is used to select the type of text. We can select standard text

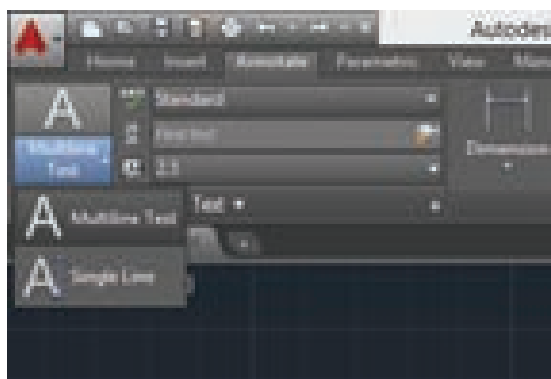
style (or) annotative text style from this command.

2.2.4.2 Single Line Text

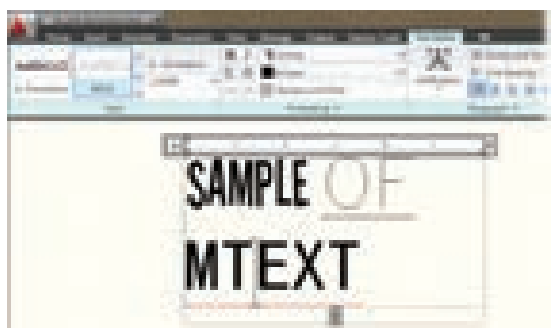


Single line text is used for small content and to write short words.

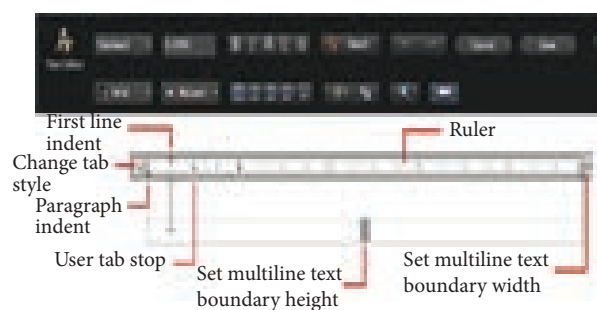
2.2.4.3 M Text



M text command is used to form the typed words into a sentence. This command will decide the text boundary. The typed sentences are included in the boundary. The lines are formed as a single object.

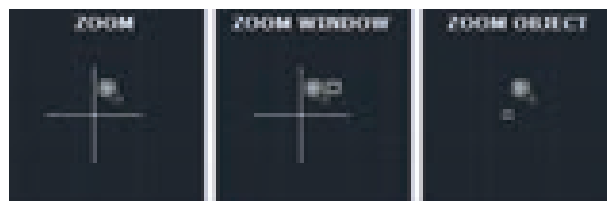
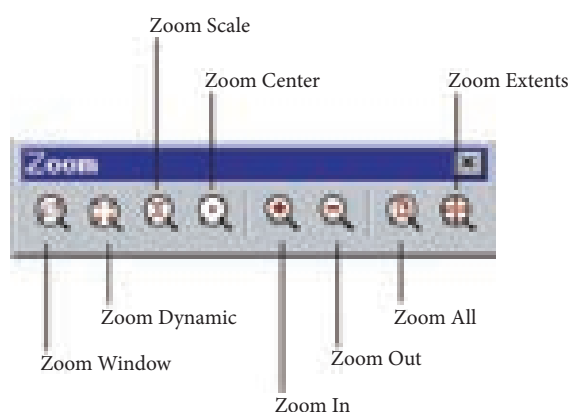


2.2.4.4 Editing Text



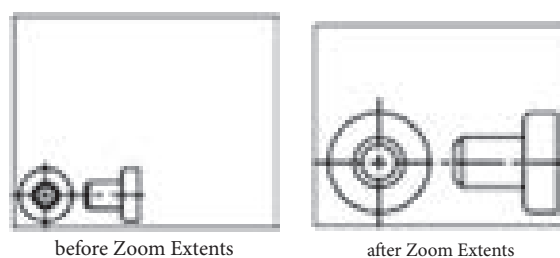
If there is any spelling mistake in the typing, it may be corrected by using this command.

2.2.5 Zoom Command



This command is used to see the object by magnifying (or) reducing it.

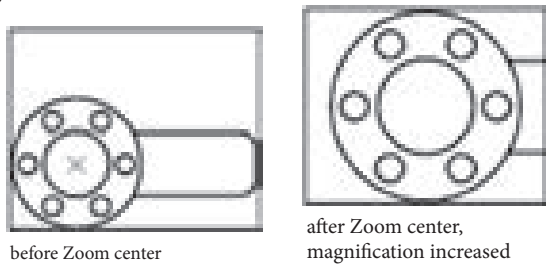
i) Zoom Extent



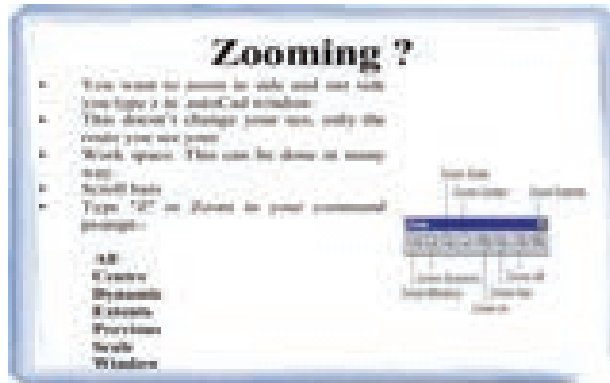
ii) Zoom Window

iii) Zoom Dynamic

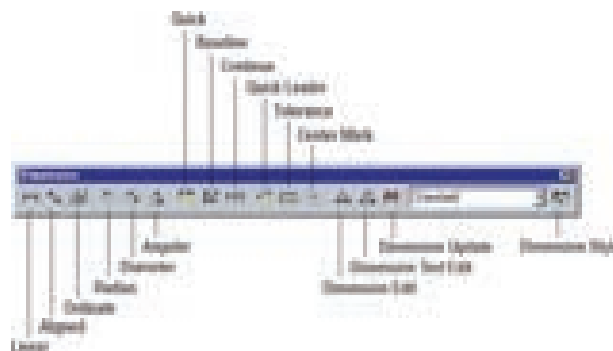
iv) Zoom Center



v) Zoom All



2.2.6 Dimension



This command is used to dimensioning an object. If an object is drawn without measurements, then the drawing will not attain

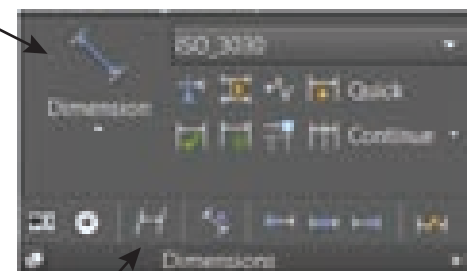
its fulfillment. If we furnish the details such as length, breadth, depth, angle, radius, diameter of the object, then the object gets nature of producing formation.

2.2.6.1 Methods of Dimensioning

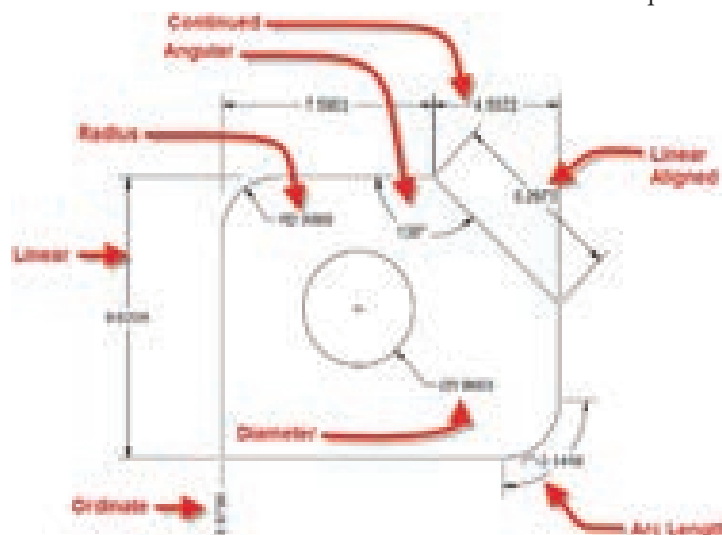
In the classification of dimensioning there are linear, angular, radius, diameter and co-ordinates are available. Some of the dimension variable used in dimensioning is shown in the figure below.

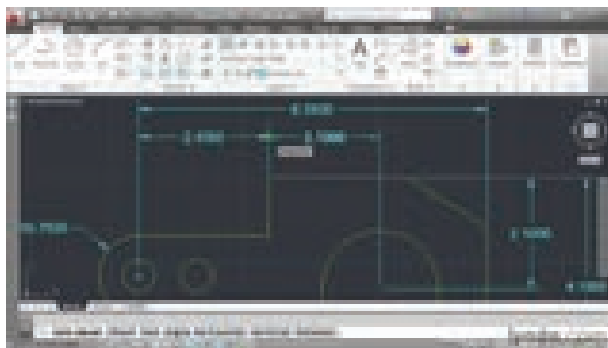
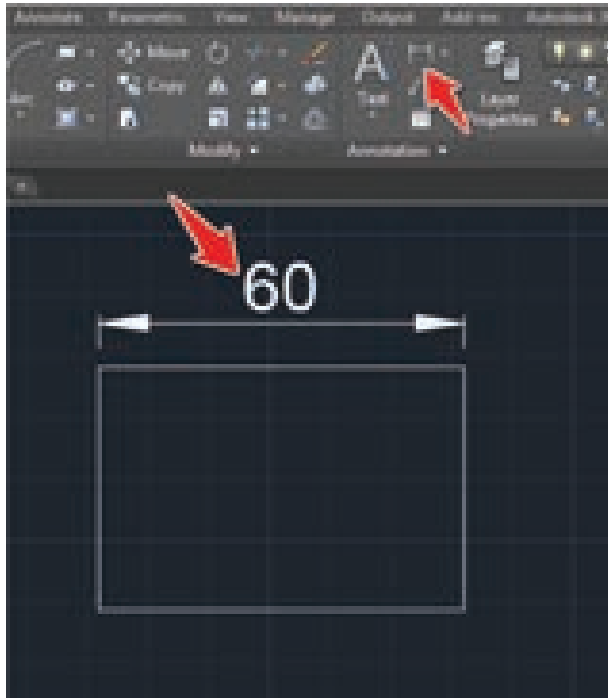


For best results use the Aligned Dimension style for Isometric Dims.

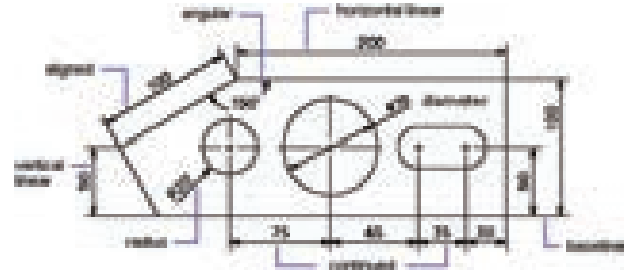
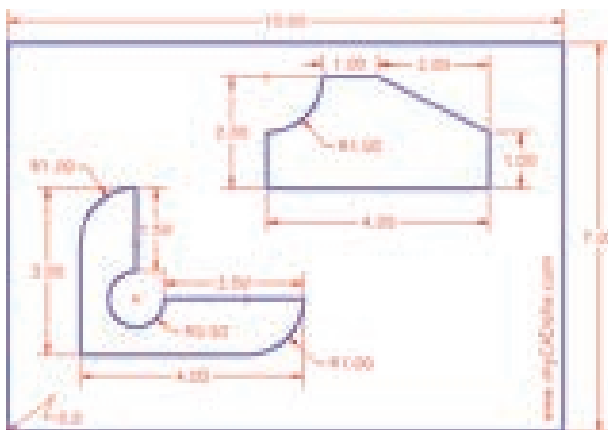


Oblique Dimension Button

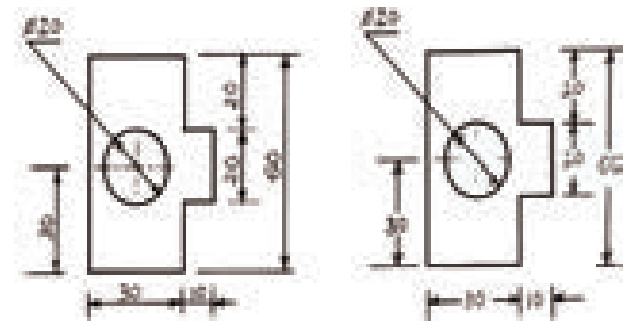




Dim Linear

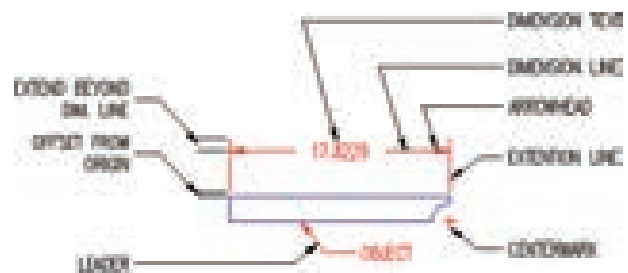


Dim Linear, Dim Angular, Dim Aligned, Dim Radius, Dim Diameter, Dim Baseline, Dim Continued.



Systems of Dimensioning

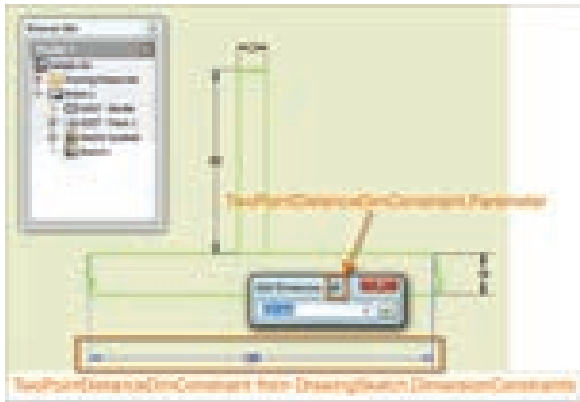
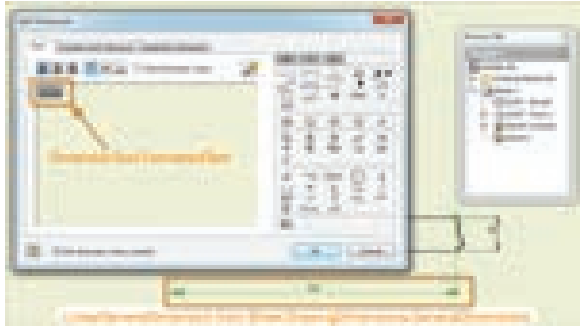
2.2.6.2 Dimension Line



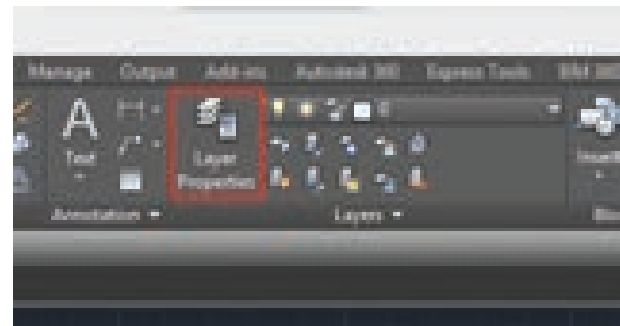
Dimension line is a single line. Side measurements of the objects are indicated with arrow mark from one end to another end. The vertical line from both end of the object is called extension line.

2.2.6.3 Dimension Text

Selection of actual size of the side of an object by AutoCAD is called dimension text.



It is very tough to understand a drawing, if we should show the full details of the object in the same drawing. When we prepare the manual drawing, we will give the details in several places of the object. If we want more information another drawing is to be drawn.



2.2.6.4 Dimension Style



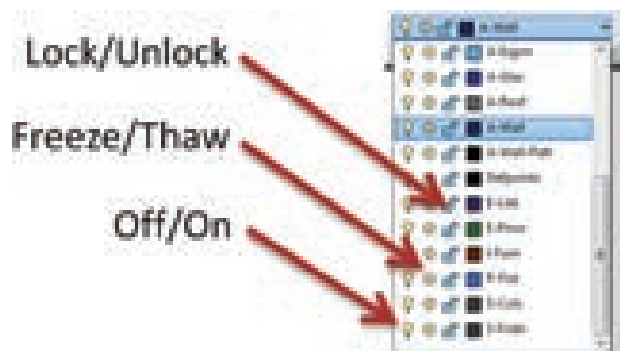
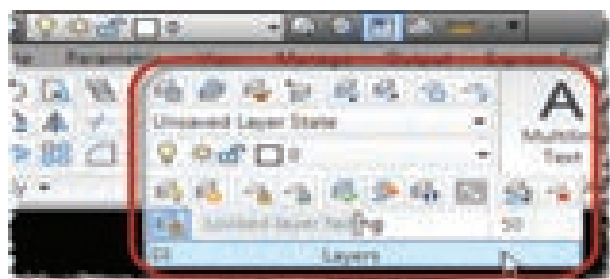
This command is used to select style for dimension.

To eliminate this problem, drawings are drawn in the layer method in AutoCAD. In this method, we can take print out of the object with required details.

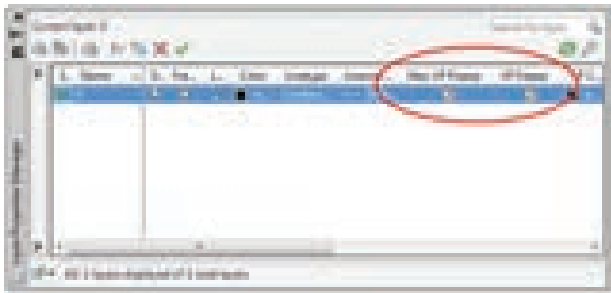
2.2.7.1 Layer On / Off

This characteristic is used to switch off the unnecessary layer. When we switch off the particular layer, the drawing drawn in that layer will not be visible to our eyes. Also that drawing cannot be printed or plotted. That layer may be switched on when required.

2.2.7 Layer



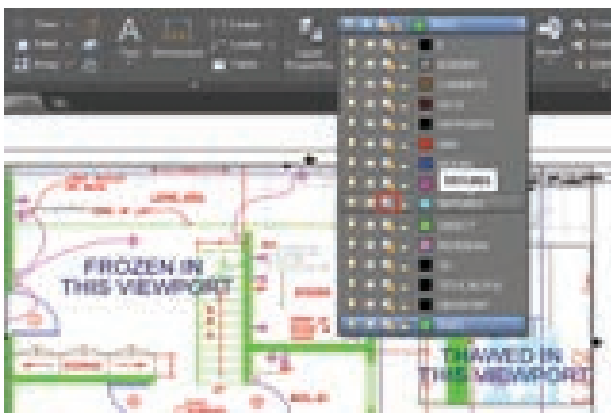
2.2.7.2 Freeze



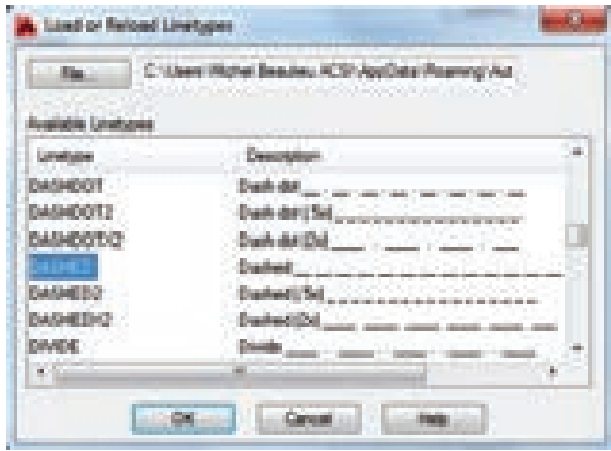
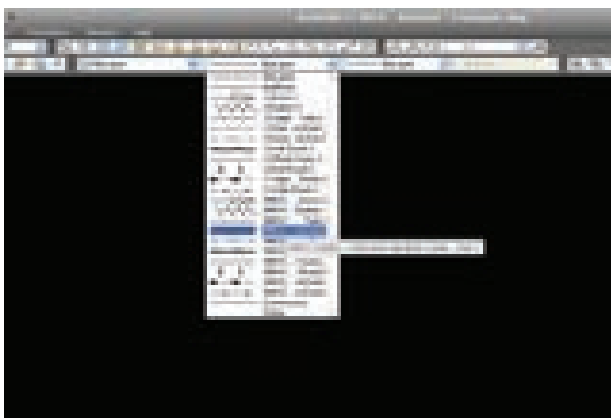
When we freeze a layer, the objects in that layer are hidden and printing is also not possible.

2.2.7.3 Thaw

Opposite form of freeze take is thaw take. To operate the freezed layer again, thaw is used.



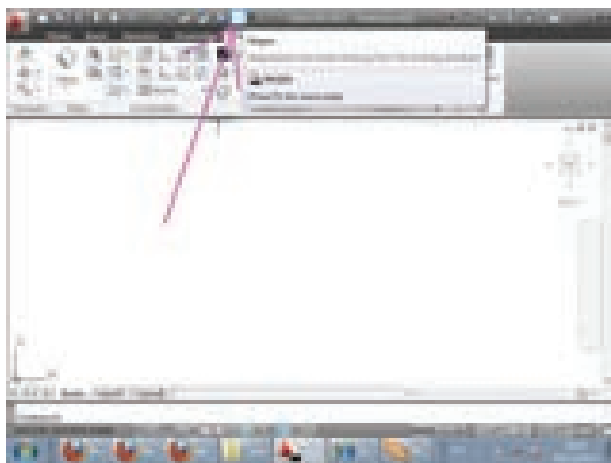
2.2.7.4 Line Type



If we press this (line type) option several types of lines will appear in model structure. We can select types of lines such as centre line, continuous line, hidden line and dashed line, etc.

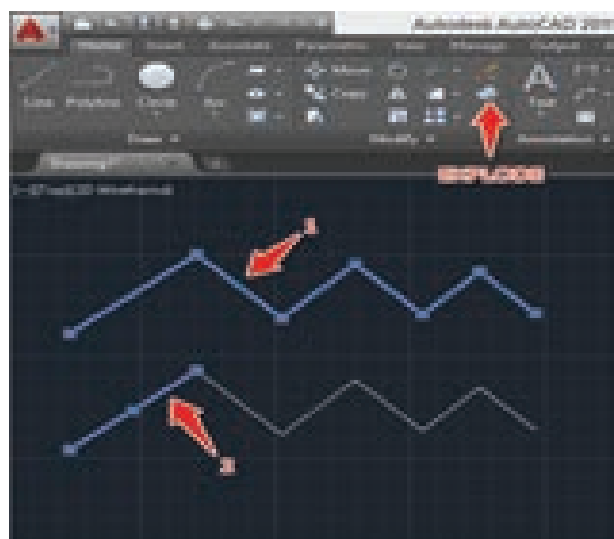
2.2.8 Editing Commands

2.2.8.1 Regen



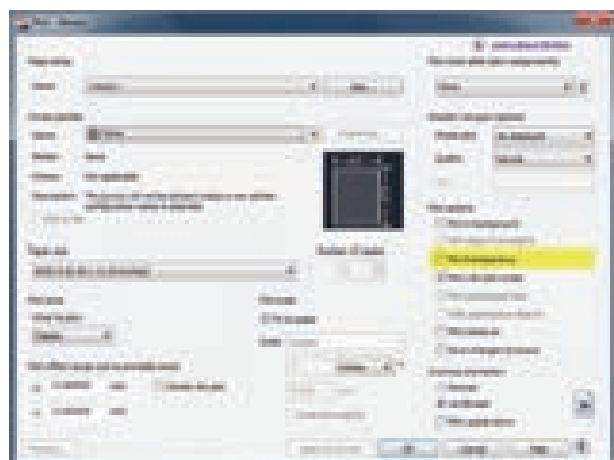
To renew a drawing which is already drawn, this command is used. Sometimes the drawn object can be seen flat, when we draw a circle or an arc. Regen command is used to remove this flat formation.

2.2.8.2 Explode



Objects of polyline, polygon can be changed into individual object by using this command.

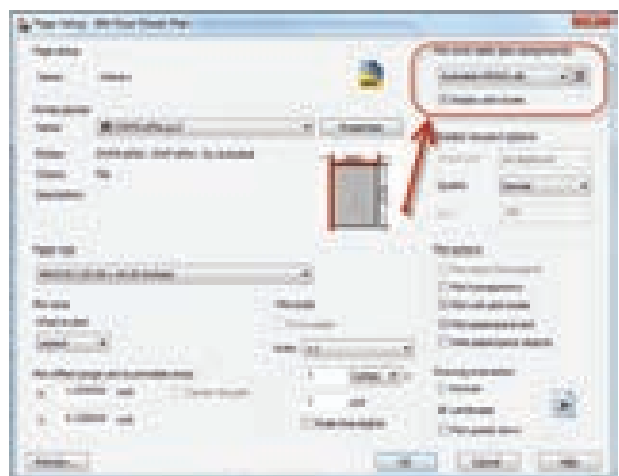
2.2.8.3 Print



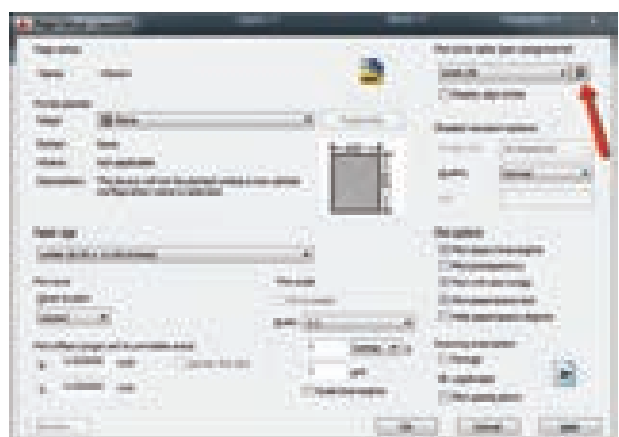
To copy the drawing we have drawn in ordinary sheet (or) tracing sheet, this command is used. There are two methods in copying such as printing and plotting. Printing is to take print by using dot matrix, inkjet and laser printer. With this normally we can take print out in A3 or A4 sheet.

2.2.8.4 Plot

Plot is nothing but taking tracing sheet print out using Indian ink by plotter instrument. These printouts taken in tracing sheets is used to make several copies by blue printing. Plotting can be made upto A0 size. Now-a-days photo print plotting can be carried out using color plotters.

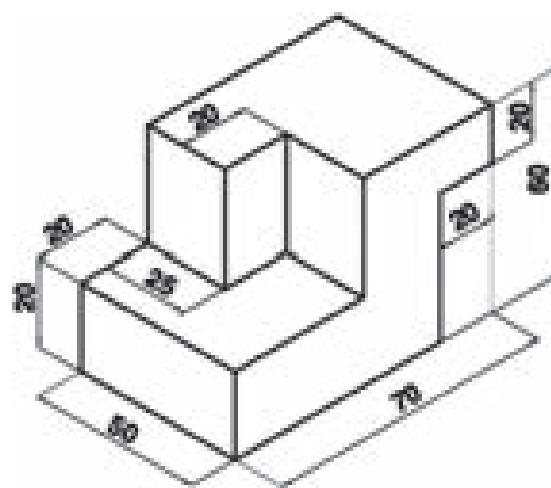


2.2.8.5 Paper Size and Orientation





Isometric view means equal sized view. That is we can see the views of the 3 axis of an object in 120° .



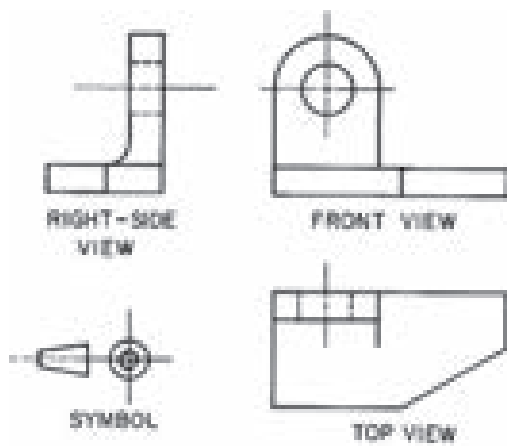
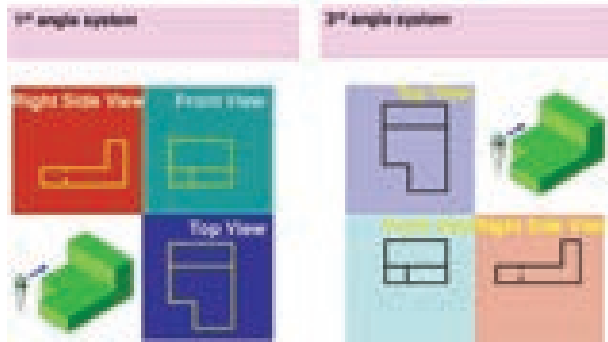
An isometric drawing of a mechanical part, likely a bracket or base. The part features a central cylindrical hole with a diameter of 40 mm and a height of 50 mm. The base is rectangular with a width of 100 mm and a depth of 60 mm. There are two vertical supports on the base, each with a width of 20 mm and a height of 30 mm. The part is shown with various dimension lines and arrows indicating measurements.



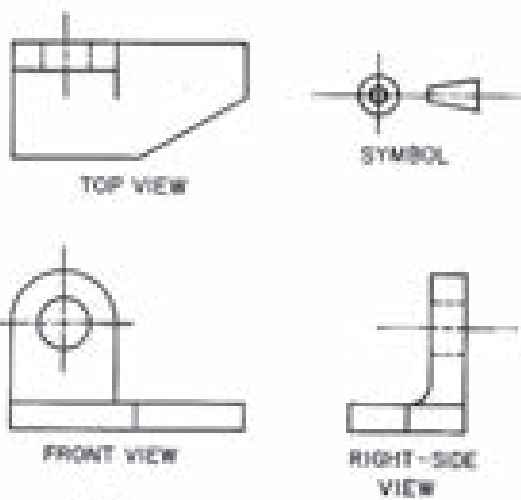
Draw isometric views of a square and a rectangle by using AutoCAD and take print out.

We have to change these three axes when we draw isometric drawing. That is, the cursor is moved to right axis and lines

ORTHOGRAPHIC VIEWS

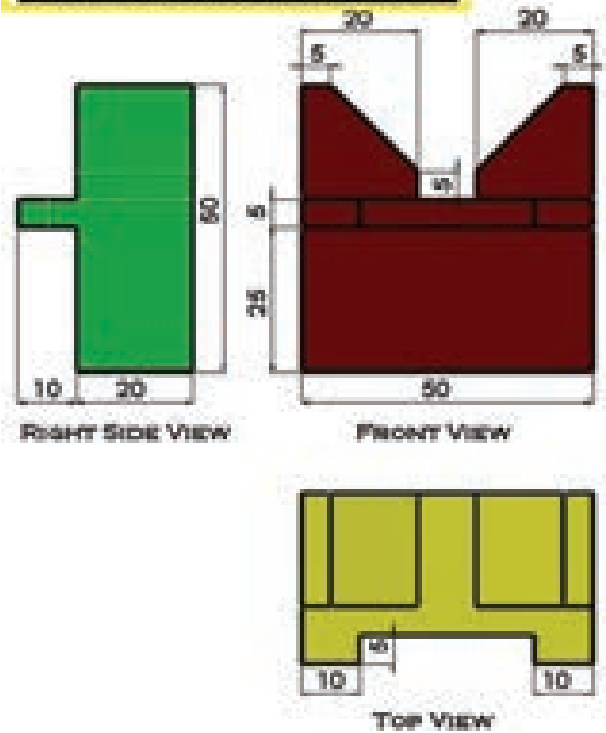


(a) FIRST-ANGLE PROJECTION



(b) THIRD-ANGLE PROJECTION

Orthographic Views



Model Questions

PART I (1 Mark)

Choose the correct answer

1. There are methods in Auto CAD to draw a circle.
 - a) Three
 - b) Four
 - c) Five
 - d) Six
2. Polygons of maximum sides can be drawn in Auto CAD.
 - a) 512
 - b) 624
 - c) 1024
 - d) 836
3. By using command parallel lines should be drawn.
 - a) MIRROR
 - b) OFFSET
 - c) ARRAY
 - d) STRETCH
4. To extend or reduce on object..... command is used.
 - a) STRETCH
 - b) TRIM
 - c) COPY
 - d) MOVE
5. Command is used to round the edges of square or rectangle.
 - a) Extend
 - b) Chamfer
 - c) Fillet
 - d) Dimension
6. The command is used to see the object by magnifying (or) reducing it.
 - a) ZOOM
 - b) ARRAY
 - c) DISTANCE
 - d) BREAK
7. Opposite form of freeze take is take.
 - a) Layer
 - b) Thaw
 - c) Export
 - d) Regen



PART II (3 Marks)

Answer in one or two sentences

8. What is meant by hatching command ?
9. Write notes on : ROTATE command.
10. What are the methods of drawing a line in Auto CAD?
11. List the isometric planes?
12. Write short notes on polygon command.

PART III (5 Marks)

Answer shortly

13. What are the methods of drawing circles in Auto CAD?
14. State the methods of drawing arc in Auto CAD?
15. What are the types of Zoom command?
16. List any five modifying commands.
17. What are the special characteristics of a polyline?

PART IV (10 Marks)

Answer in detail

18. Explain any five draw commands in detail.

19. Explain any five modifying commands.

20. Explain about isometric projections in Auto CAD.

Answers

1. (c) 2. (c) 3. (b) 4. (a) 5. (c) 6. (a) 7. (b)