

UCS = User Co-ordinate System

CAD = Computer Aided Design

Introduction:

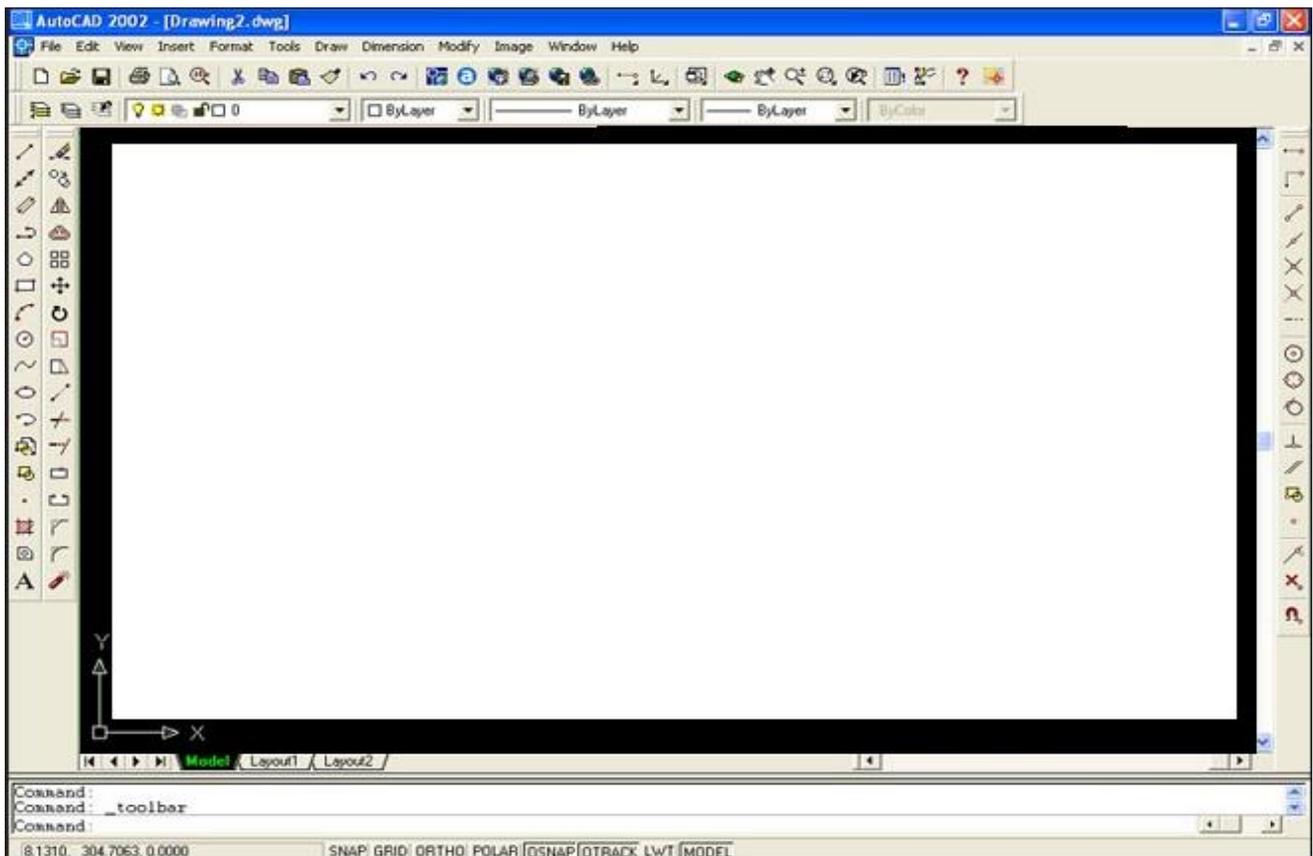
AutoCAD is a software application for computer-aided design (CAD) and drafting. The software supports both 2D and 3D formats.

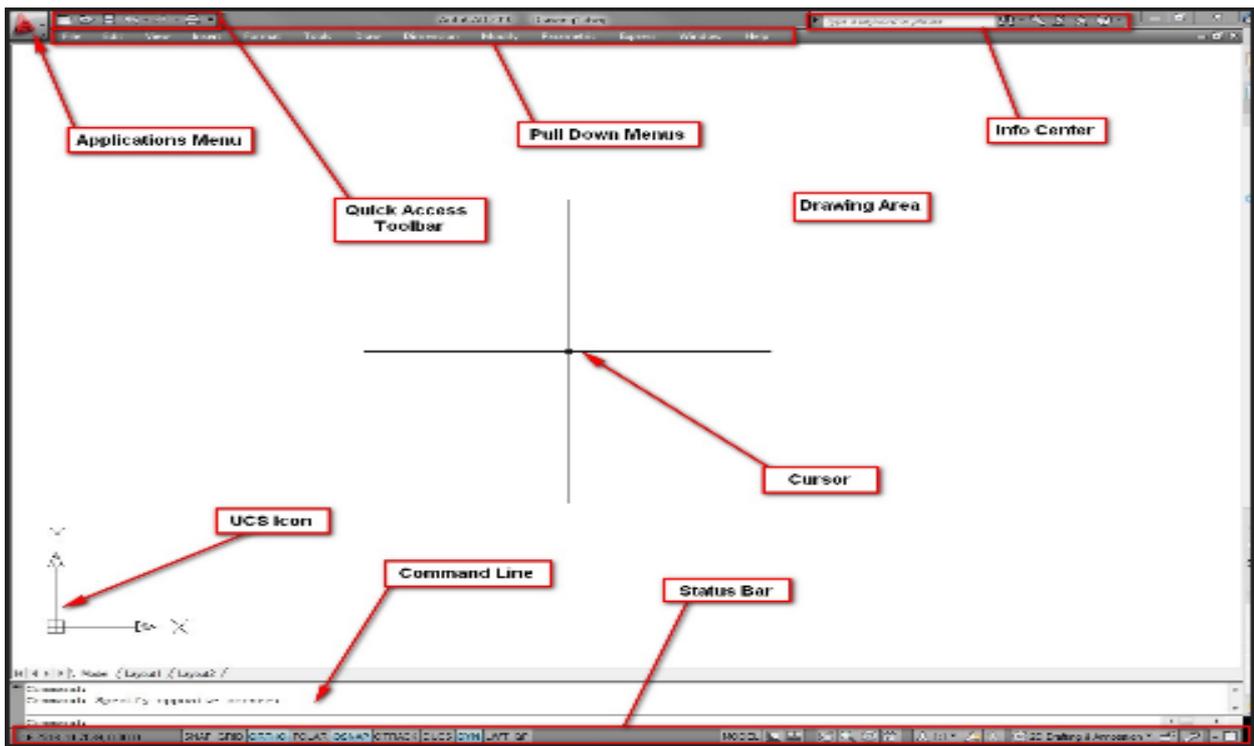
[IN DETAIL]- AutoCAD is a Computer Aided Design (CAD) program used by just about every Engineering and Design office in the world. It is a software application for 2D and 3D design and drafting. It was developed and sold by Autodesk, Inc.

First released in December 1982, AutoCAD was one of the first CAD programs to run on personal computers, notably the IBM PC. At that time, most other CAD programs ran on mainframe computers or mini-computers which were connected to a graphics computer terminal for each user.

There have been several versions of Autocad over the years, with each new version introducing new and more powerful features than its predecessor. The latest version of AutoCAD (at the time of writing) is Autocad 2014.

The AutoCAD screen normally looks like this-





Origin: AutoCAD was derived from a program called Interact, which was written in a proprietary language (SPL) and ran on the Marinchip Systems 9900 computer (Marinchip was owned by Autodesk co-founders John Walker and Dan Drake.)

Toolbars

There are many toolbars available in AutoCAD. Go to **View > Toolbars** from the drop down menu to see them all. For now make sure that the following toolbars are checked:

Draw - Contains AutoCAD's most common drawing tools

Modify - Contains all of the common editing commands such as erase, copy etc.

Object Properties - Contains 'layer' information as well as object colours and line style options.

Standard Toolbar - Contains open & save options as well as zoom & pan options.

Object Snap - AutoCAD's intelligent drawing aid - joins lines at specific points.

The Command Line

The command line appears at the bottom of the AutoCAD screen (as shown above) and displays the commands entered. Commands can be entered into the command line in text format, or by using the icons or drop down menus. 'Old School' Cad users tend to type each command into the command line, as was required with older versions of AutoCAD. It is much quicker to familiarize yourself with the tool bars and drop down menus. There are times however when commands need to be typed into the command line, these will be covered later.

Drawing Technique - AutoCAD's Co-ordinate system

Just before we start drawing, one more important point. AutoCAD works on a co-ordinate system. When drawing, we can be very precise and specify an exact point in space where a line should begin or end. The 2D co-ordinates system is based on the horizontal and vertical axis named x and y. (This is shown in the bottom left of the AutoCAD drawing area, the X Y icon is called the UCS).

Drawing - Line Command

1) Select the **line** command from the draw menu  (alternatively select line from the 'draw' drop down menu).

2) AutoCAD asks you (in the command line area) to specify a start point. Simply pick an area central to the drawing area (left click of the mouse).

3) AutoCAD now asks for an end point. Select somewhere (left click) to the top right of the drawing area.

4) Now one line is drawn. AutoCAD keeps the line command open so that another line can be drawn beginning exactly where the previous finished. We want to end the command so simply right click to end (AutoCAD 2000 users and above - right click will open a small menu - simply choose 'enter' to end the command).

Drawing - Line Command - Specifying Points

Erase the line we just created. Select the **erase** command from the menu  or from the 'modify' drop down menu.

AutoCAD asks you to select an object, left click the line we drew. Right click to enter the command and delete the line.

Let's imagine we are looking down over a plot of land (plan view). We are going to draw the land boundary from some measurements taken. The land measures 25m x 40m.

1) Select the line command as before. This time for a start point we will specify some co-ordinates (simply an exact point in the drawing area.)

2) We will start our drawing at a point 50m horizontal and 50m vertical from the default UCS location of 0,0. AutoCAD is asking for a start point, type in the command line: **50,50** followed by hitting enter. Note - AutoCAD's normal co-ordinate system is always relative to the UCS icon position of 0,0.

```
Command:
Command: _line Specify first point: 50,50
Specify next point or [Undo]:
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3) For the next point we'll draw the bottom end of the plot of land. We want a line 25m horizontal from the start point. We can specify co-ordinates from a particular point by including the @ symbol in front of the co-ordinates. This informs AutoCAD that the co-ordinates we are specifying are relative to the last point specified and not to the UCS.

To enter a 25m length horizontal line from the start point the command would be **@25,0** (i.e go 25m along, go 0m up).

```
Command: _line Specify first point: 50,50
Specify next point or [Undo]: @25,0
Specify next point or [Undo]:
```

Now we should have drawn a horizontal line 25m long.

Note - Do not right click to end the line command, this layout can be drawn leaving the command open.

4) We now need a 40m vertical line to represent the right side of the plot of land. This command would be **@0,40** (i.e go 0m along, go 40m up).

5) Now for the top of the land. We need to go back horizontally by 25m from the current end position of the vertical 40m line. The command would be @-25,0 (i.e go back 25m, go up 0m).

6) To finish off we need to draw the last line. we need to go 40m vertically down so the command is @0,-40 (i.e go 0m along, go 40m down).

7) Right click to end the draw command.

That's it! We've just drawn a scale drawing of the plot of land from the measurements given from a start point of 50,50 relevant to the UCS.

TIP- If your drawing is only taking up a small area of the screen, try zooming in with the various zoom commands. To quickly view your drawing close up choose zoom extents  to see the entire drawing.

Drawing - Rectangle Command

Erase the 4 lines we just drew. We will now try a command that would have drawn the above land layout in one simple command.

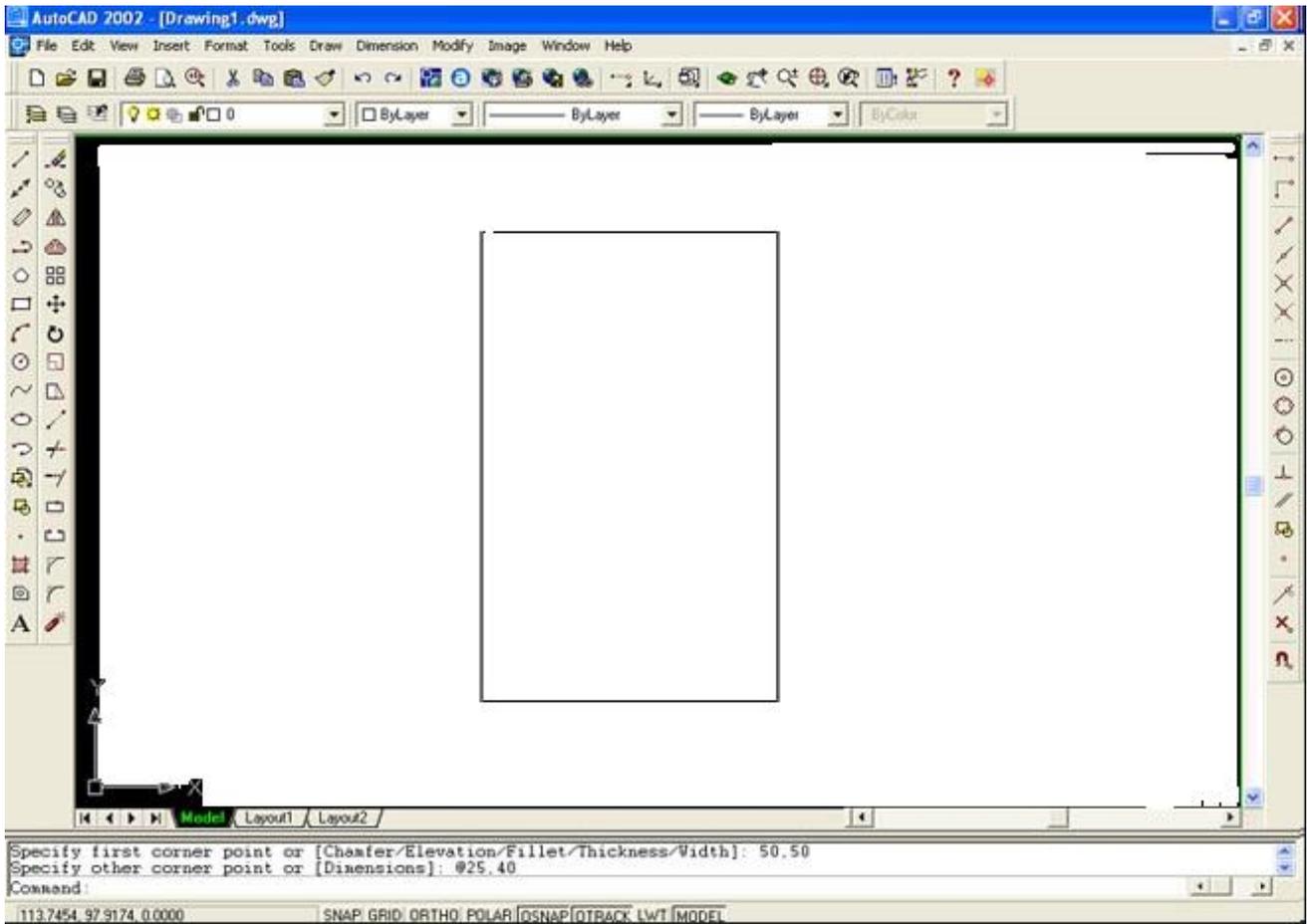
1) Choose the **rectangle** command  or select it from the draw drop down menu.

2) AutoCAD asks for the start point. As before, we want to begin 50m horizontally and 50m vertically from the UCS, so enter **50,50** then hit return.

3) AutoCAD now asks for the position of the top right corner of the rectangle we are going to draw. To draw the plot of land we need 25m along and 40m up from the start point, so the command is **@25,40**

Your drawing should be identical to the one we drew before, but was a lot simpler and quicker to draw.

Have a play around with the line and rectangle commands and familiarise yourself with how they operate.



SHORTCUT COMMANDS

A	ARC	Draw an arc
C	CIRCLE	Draw a circle
CO	COPY	Copy an object
L	LINE	Draw a line
REC	RECTANG	Draw a rectangle
RO	ROTATE	Rotate a selection
U	UNDO	Undo last command
W	WBLOCK	Write a block
Z	ZOOM	Zoom in display - A=All, E=EXTENTS, W=WINDOW

COORDINATE ENTRY

#X,Y Location measured by distance from 0,0 in current UCS

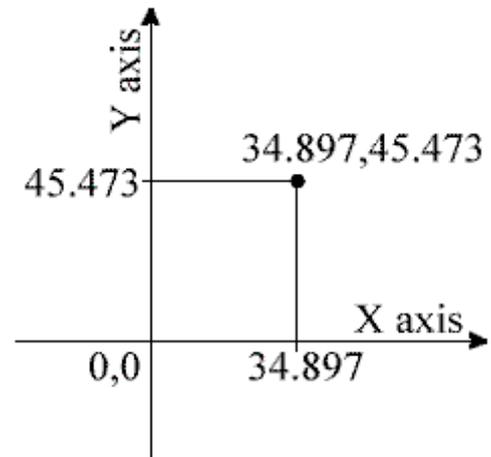
@X,Y Location measured by distance from last point

POL	POLYGON	Draw a regular polygon 3 to 1024 sides
BOX	BOX	Draw a cube
CYLINDER	CYLINDER	Draw a cylinder

Introduction

A good understanding of how co-ordinates work in AutoCAD is absolutely crucial if you are to make the best use of the program. If you are not familiar with co-ordinates and co-ordinate systems, take some time to familiarise yourself with the basic concepts.

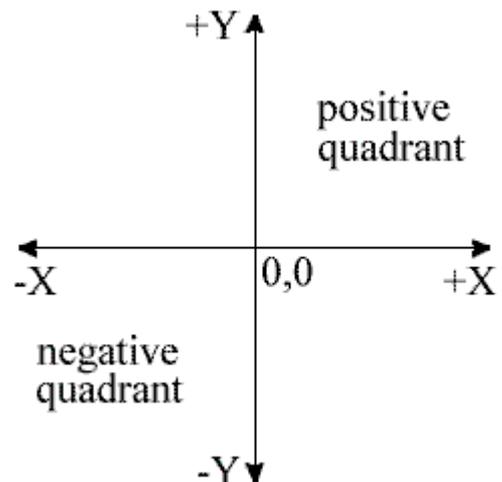
Co-ordinates fall into two types, namely Cartesian and Polar. A basic understanding of these co-ordinate types will help you to use AutoCAD to construct drawings more easily. In addition, these two co-ordinate types come in two distinct flavours. They can be either Absolute or Relative. Knowing just when and where to use the various types and flavours of co-ordinate is the key to efficient drawing with AutoCAD.



Cartesian Co-ordinates

Despite the fancy title (named after the French philosopher and mathematician René Descartes 1596-1650), the Cartesian co-ordinate system is the standard co-ordinate system. The position of a point can be described by its distance from two axes, X and Y. This results in a simple point description using two numbers separated by a comma e.g. 34.897,45.473.

In the example on the right the point described lies 34.897 drawing units to the right of the Y axis and 45.473 drawing units above the X axis. The first value (34.897) is known as the X co-ordinate because it's value is measured along the X axis. The second value is known as the Y co-ordinate because it's value is measured along the Y axis.



The X and Y axes are two lines of infinite length which intersect at the origin point. The co-ordinate value of the origin point is always 0,0. When viewed in plan the X and Y axes are always perpendicular to one another with the X axis in a horizontal position and the Y axis in a vertical position (See illustration). X co-ordinate values become negative to the left of the Y axis and Y co-ordinate values become negative below the X axis. All co-ordinate values (both X and Y) are negative in the lower left hand quadrant and positive in the upper right hand quadrant. Normally we try to work in the positive quadrant. Although this is not essential for AutoCAD to operate, it does tend to make life easier because we don't need to worry about negative numbers.

AutoCAD allows you to use co-ordinates to draw objects rather than using pick points. For example you could draw a line like this:

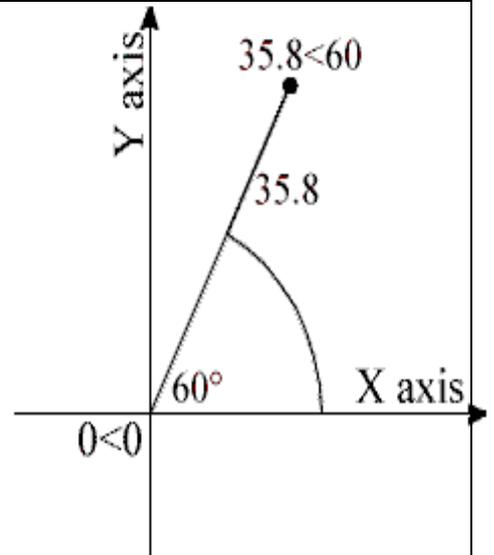
Command Sequence

Command: LINE
From point: 34.897,45.473
To point: 54.896,65.395
To point: ↵(to end)

This sequence draws a line between the two co-ordinate points specified. Note that if you enter a co-ordinate that is off the screen the line will still be drawn to the required point. You will then need to zoom out in order to see the whole line. You can also start the Line command by clicking  on the Draw toolbar or from the pull-down menu (Draw ► Line).

Polar Co-ordinates

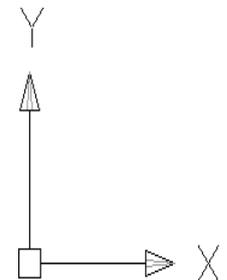
Polar co-ordinates achieve the same result i.e. the description of the position of a point. The main difference is that polar co-ordinates use one distance and one angle to describe the position of a point rather than the two distances in the Cartesian system. The distance and angle measurements are made relative to an origin. This results in a point description which looks like this 34.897<30 where the first figure is the distance (in drawing units) and the second is the angle. Notice that the separator in the case of polar co-ordinates is the "less than" mathematical symbol. If you look at your keyboard you will see that this symbol is typed by using Shift and comma.



AutoCAD angles start at 3 o'clock (i.e. along the positive portion of the X axis) and increase in an anti-clockwise direction. You can specify negative angles if you need to define an angle in a clockwise direction although this is not really necessary because angles are circular, hence an angular value of -30 degrees will give the same result as an angular value of 330 degrees (there are 360 degrees in a full circle).

The UCS Icon

In the bottom left hand corner of the AutoCAD drawing window you will see a symbol like the one shown on the right. This is called the UCS (User Co-ordinate System) icon and it is there to remind you which is the X axis and which is the Y axis. The empty box at the intersection of the X and Y axes is there to remind you that you are using "World" co-ordinates and that the UCS icon is not positioned over the true origin of the current co-ordinate system, probably because it is off screen.



Absolute & Relative Co-ordinates

Both Cartesian and polar co-ordinates come in two flavours, absolute and relative. The distinction is quite simple, absolute co-ordinates relate to the X and Y axes and the origin of the current co-ordinate system, whilst relative co-ordinates relate to the current pick point. When you are specifying co-ordinates you need to tell AutoCAD which type you want. Absolute co-ordinates are typed exactly as in the examples above. To specify a relative co-ordinate you need to use the "at" symbol as a prefix. In the case of the two examples above a relative Cartesian co-ordinate looks like this @34.897,45.473 and a relative polar co-ordinate looks like this @34.897<30. Relative co-ordinates are very useful for drawing objects which you know the size of. For example, you could draw a square of 12 units with its lower left hand point at 30,40 as follows:

Command Sequence

Command: LINE

From point: 30,40 (an absolute Cartesian co-ordinate)

To point: @0,12 (a relative Cartesian co-ordinate)

To point: @12<0 (a relative polar co-ordinate)

To point: @0,-12 (another relative Cartesian co-ordinate)

To point: C (to close)

Try this sequence out and watch the square drawn as you enter each co-ordinate value. You can also use this method to quickly draw a rectangle of known size. Say you needed to draw a rectangle 20 drawing units wide and 10 drawing units high and you didn't mind where exactly the rectangle is drawn, you could do this:

Command Sequence

Command: RECTANGLE

Specify first corner point or [Chamfer/Elevation/Fillet/Thickness/Width]: (pick a point near the middle of the drawing area)

Specify other corner point or [Dimensions]: @20,10

Note that the relative X co-ordinate determines the rectangle width and the relative Y co-ordinate determines the rectangle height.

The Status Bar



The status bar at the bottom of the AutoCAD window always shows the current co-ordinate value at the cursor point. Watch the co-ordinate values change as the cursor moves across the drawing area. You can turn the dynamic co-ordinate display off and on using the F6 key on the keyboard.