

## 1. Unit 1. Introduction

### 1.1. Loading AutoCAD, Screen organization

Computer-aided design (CAD) is the use of computers to aid in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing.

There are various types of drawings in different fields of engineering and sciences. In the fields of mechanical or aeronautical engineering, the drawings of machine components and the layouts of them are prepared. In the field of civil engineering, plans and layouts of the buildings are prepared. In the field of electrical engineering, the layouts of power distribution system are prepared. In all fields of engineering use of computer is made for drawing and drafting.

The use of CAD process provides enhanced graphics capabilities which allows any designer to

- Conceptualize his ideas
- Modify the design very easily
- Perform animation
- Make design calculations
- Use colors, fonts and other aesthetic features

### REASONS FOR IMPLEMENTING A CAD SYSTEM

1. **Increases the productivity of the designer:** CAD improves the productivity of the designer to visualize the product and its component, parts and reduces the time required in Synthesizing, analyzing and documenting the design
2. **Improves the quality of the design:** CAD system improves the quality of the design. A CAD system permits a more detailed engineering analysis and a larger number of design alternatives can be investigated. The design errors are also reduced because of the greater accuracy provided by the system
3. **Improves communication:** It improves the communication in design. The use of a CAD system provides better engineering drawings, more standardization in the drawing, and better documentation of the design, few drawing errors and legibility.
4. **Create data base for manufacturing:** In the process of creating the documentation for these products, much of the required data base to manufacture the products is also created.
5. **Improves the efficiency of the design:** It improves the efficiency of the design process and the wastage at the design stage can be reduced.

### BENEFITS OF CAD:

The implementation of the CAD system provides variety of benefits to the industries in design and production as given below:

1. Improved productivity in drafting
2. Shorter preparation time for drawing
3. Reduced man power requirement

4. Customer modifications in drawing are easier
5. More efficient operation in drafting
6. Low wastage in drafting
7. Minimized transcription errors in drawing
8. Improved accuracy of drawing
9. Assistance in preparation of documentation
10. Better designs can be evolved
11. Revisions are possible
12. Colors can be used to customize the product
13. Production of orthographic projections with dimensions and tolerances
14. Hatching of all sections with different filling patterns
15. Preparation of assembly or sub assembly drawings
16. Preparation of part list
17. Machining and tolerance symbols at the required surfaces
18. Hydraulic and pneumatic circuit diagrams with symbols
19. Printing can be done to any scale

## Loading AutoCAD

**Starting AutoCAD**

**3 ways to start AutoCAD:**

- Double-Click **AutoCAD 2012 English** icon on your desktop.
- Use the Start Menu –  
**Start > All Programs > Autodesk > AutoCAD 2012-English > AutoCAD 2012-English**
- Double-Click an AutoCAD **.dwg** file in Windows Explorer.

AutoCAD drawings are identified by a .dwg extension. When you save a drawing a .dwg extension is applied. However, when you start a new drawing, AutoCAD loads a template file with a .dwt extension.

**Template:**

Standardized file formats with preset internal variables. Provided by AutoCAD or created by user with predefined:

- Limits (drawing length & width)
- Text Height
- Dimension Scale
- Linetype Scale

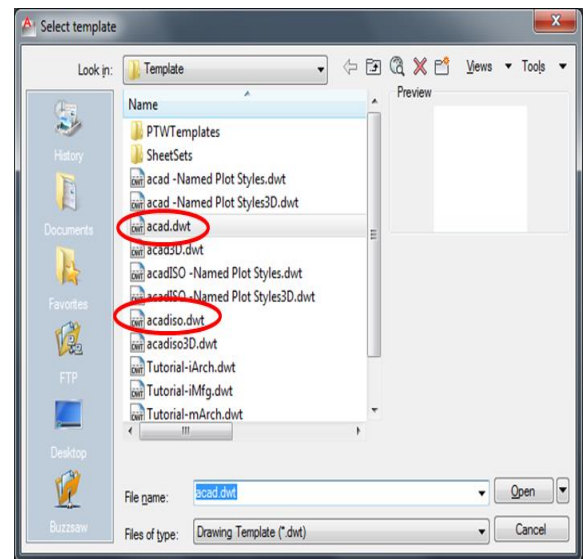
You can start a drawing using a standard AutoCAD template or a user defined template that you create. Your Drawing settings will match the defined template properties.

**AutoCAD Templates:**

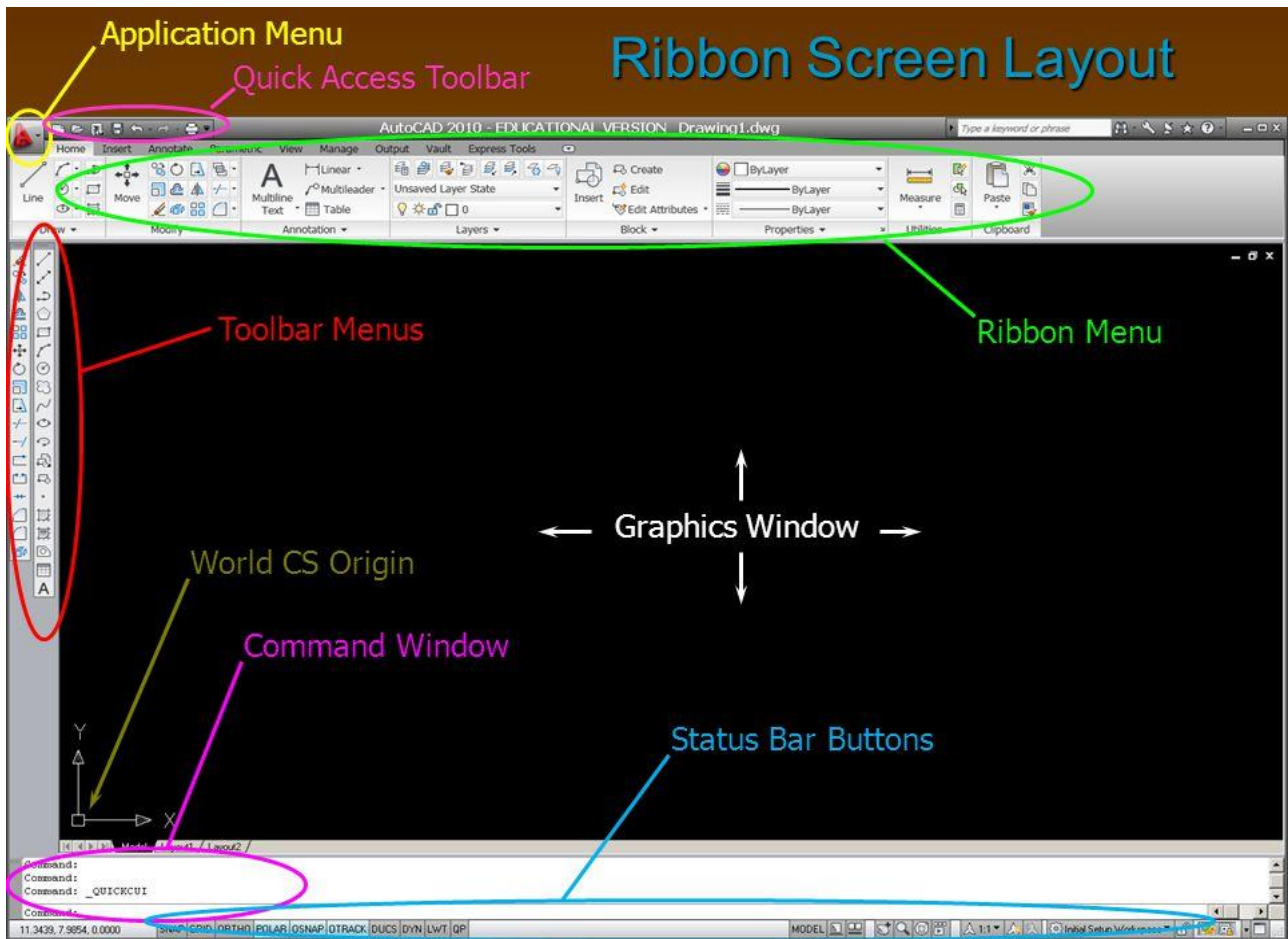
- Standardized formats provided with AutoCAD.
- Typically found in AutoCAD subfolder called Templates.

**User defined templates:**

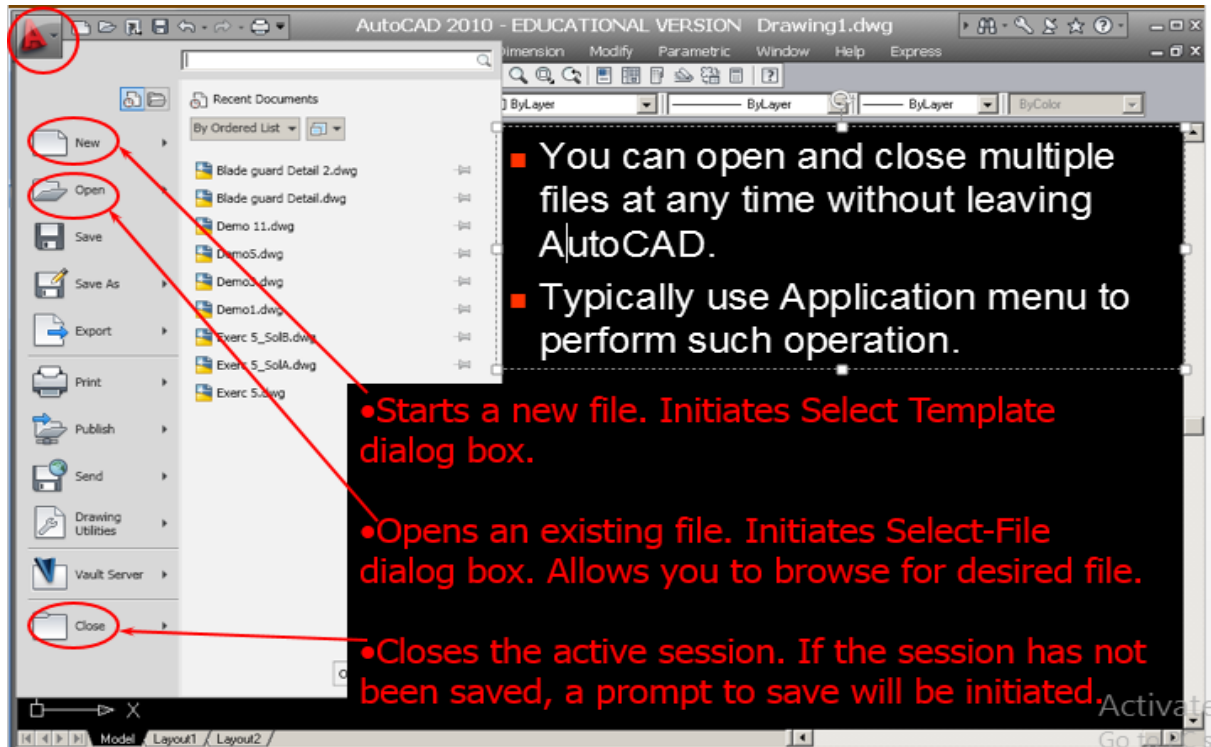
- Template file containing commonly used settings & objects.
- Use Browser to locate user template.



Screen organization:

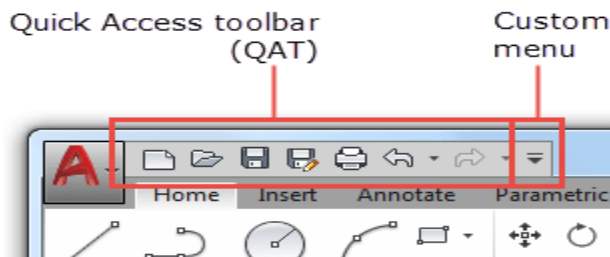


1. **Application menu:** it offers tools to help you manage your AutoCAD file. It is basically file pull down menu. The figure below shows the options available in application menu.



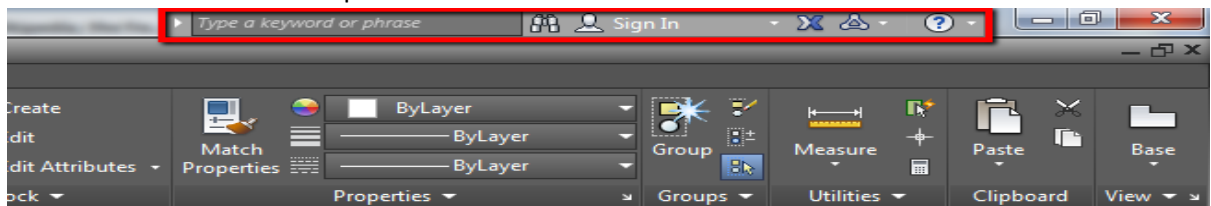
**2. Quick access toolbar:**

It helps for quick access to commands QNEW, OPEN, SAVE, PLOT and UNDO/REDO



**3. Info center:**

It is used for quickly search for a variety of information sources; access product updates and announcements and save topics with info center.

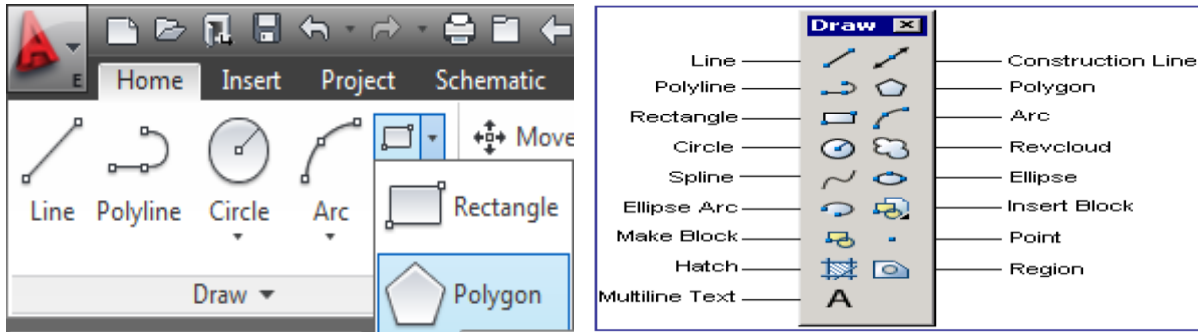


**4. Ribbon:**

The ribbon provides a single, compact placement for operations that are relevant to the current workspace. It eliminates the need to display multiple toolbar reducing clutter in the application. The ribbon maximizes the area available for work using a single compact interface.

**5. Drawing toolbar:**

It contains the different draw shapes like line, circle, arc, polyline etc. as shown in the figure across which helps in easy selection of the type of the shape that has to be made.



## 6. UCS icons (user coordinate system icons)

The drawing area displays an icon representing the XY axis of a rectangular coordinate system called the user coordinate system, or UCS. You can select, move, and rotate the UCS icon to change the current UCS. The UCS is useful in 2D, and essential in 3D.

You can control whether the UCS icon is visible, and change its appearance, with the UCSICON command, Properties option.

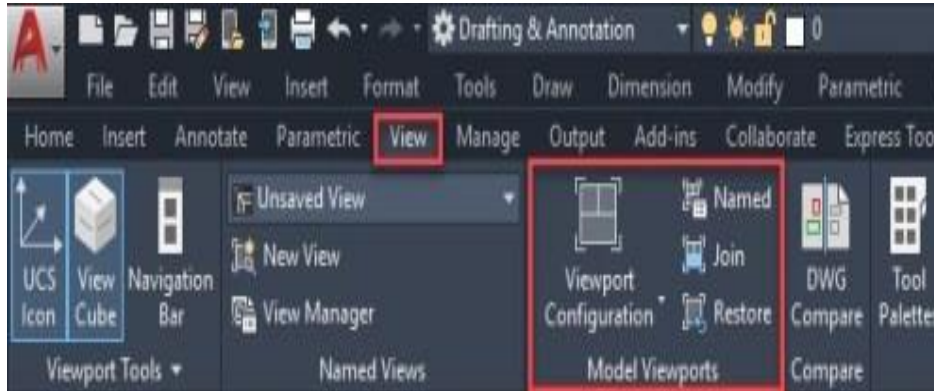
The point meeting the X and Y or X,Y and Z shows the origin of the drawing



## 7. Viewports controls

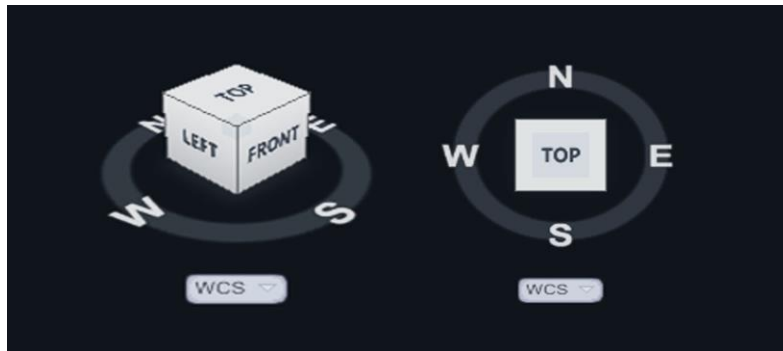


There are two types of viewports in AutoCAD. Model Space viewports and Layout space viewports. Viewports are areas that display different views of your drawing and/or model. Layout viewports are objects that you can scale to display the view of your drawing on a layout tab for publishing and production. In model space, you can split the drawing area into one or more rectangular areas called model space viewports. Viewports are areas that display different views of your model. In large or complex drawings, displaying different views reduces the time needed to zoom or pan in a single view. You can configure these viewports from the View tab on the Ribbon as shown.



#### 8. View cubes:

The ViewCube is a navigation tool that is displayed when you are working in 2D model space or 3D visual style. With ViewCube, you can switch between standard and isometric views. The ViewCube is a persistent, clickable and draggable interface that you use to switch between standard and isometric views of your model.



#### 9. Navigation bar:

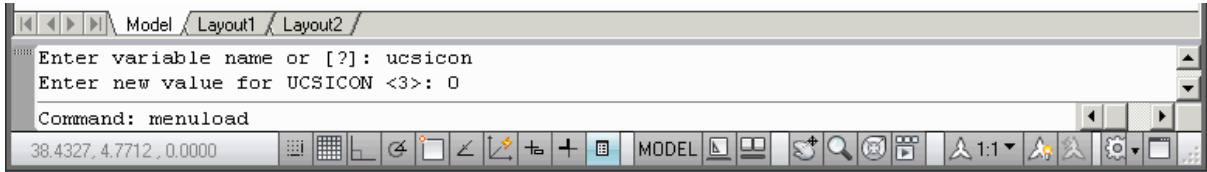
The navigation bar is a user interface element where you can access both unified and product-specific navigation tools. Unified navigation tools are those that can be found across many Autodesk products. Product-specific navigation tools are unique to a product. The navigation bar floats over and along one of the sides of the current drawing area.



You start navigation tools by clicking one of the buttons on the navigation bar or selecting one of the tools from a list that is displayed when you click the smaller portion of a split button.

### 10. Command window:

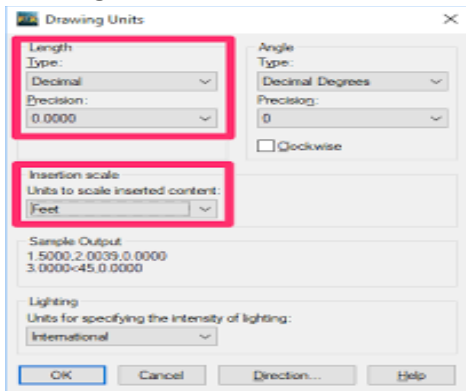
The Command window accepts command and system variable input and displays prompts that guide you through the command sequence. You can also press Ctrl+9 to toggle the display of the command window.



### 11. Status bar:

The status bar is the area below the command line. The status bar displays the cursor location, drawing tools, and tools that affect your drawing environment. The status bar provides quick access to some of the most commonly used drawing tools. You can toggle settings such as grid, snap, polar tracking, and object snap.

### 12. Drawing units:



## 1.2. Communicate with AutoCAD using keyboard

Most tasks in AutoCAD involve commands that are explicitly invoked by selecting an option from a menu.

- For example, you could pick Draw in the pulldown menu and then pick Line to invoke the Line command.

You should always keep an eye on the command line because this is where AutoCAD communicates with you.

- For example, when you invoke the Line command AutoCAD will prompt you to “Specify first point”.

In some cases you respond to prompts by selecting an object with your pick box.

- In other cases you must specify a point by left-clicking when your crosshairs are in the desired position.
- You might even type information (such as the length of a LINE or the diameter of a CIRCLE) at the keyboard.



Everything you type at the keyboard in response to command line prompts will appear on the command line as well.

Commands can often be invoked from more than one menu.

- For example, you can pick the Line button in the Draw toolbar to invoke the Line command (instead of using the pulldown menu).
- Hold your cursor over a toolbar button to see a tooltip near your crosshairs and a help string at the bottom of the screen.
- You see the same help string when you highlight a pulldown menu option (without picking it).

You will see command access tips throughout this manual when you first learn to use a particular command.

- These tips show you how to invoke the same command from different menus and list an alias if the command has one.
  - 1- LINE or L (alias) you could type "LINE" or "L" at the keyboard.
  - 2- Draw + Line you could pick draw then Line in the pulldowns.
  - 3- Draw you could pick this button in the Draw toolbar.

There may be more than one option for a command once a command is running and AutoCAD prompts for a response.

- Options are listed on the command line inside [square brackets] and you can select an option by typing keyword letters.
- You must type all capitalized letters of the desired option to use that option (most options have only one capital letter).

For example, when you invoke the Zoom command manually you will get the following prompts on the command line.

Command: ZOOM↵

Specify corner of window, enter a scale factor (nX or nXP), or [All/Center/Dynamic/Extents/Previous/Scale/Window] <real time>:

- At the last prompt above you could type the first (capital) letter of each option (i.e. A, C, D, E, P, S or W) to use that option.
- You must press <enter> after you type one of these letters.

When an option appears inside <angled brackets> you can invoke that option by pressing the <enter> key.

- For example, at the Zoom prompt shown above you could press <enter> to use the <real time> option of Zoom.

You can also select options listed inside [square brackets] from a shortcut menu (instead of typing keyword letters).

- Right-click in the drawing area to invoke a shortcut.

The following prompts are displayed.

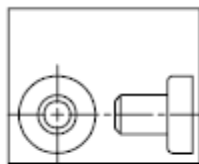
### Corner of window

Specify one corner of the area to be zoomed into.

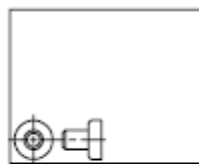
Opposite corner. Specify the opposite corner of the zoom area.

### All

Zooms to display all visible objects and visual aids. Adjusts the magnification of the drawing area to accommodate the extents of all visible objects in the drawing, or visual aids such as the grid limits (the LIMITS command), whichever is larger.



before ZOOM All

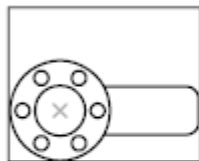


after ZOOM All

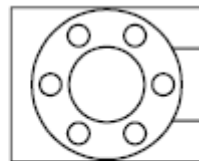
*In the illustration on the right, the grid limits are set to a larger area than the extents of the drawing.*

### Center

Zooms to display a view defined by a center point and a magnification value or a height. A smaller value for the height increases the magnification. A larger value decreases the magnification. Not available in perspective projection.



before ZOOM center



after ZOOM center,  
magnification increased

### Dynamic

Pans and zooms using a rectangular view box. The view box represents your view, which you can shrink or enlarge and move around the drawing. Positioning and sizing the view box pans or zooms to fill the viewport with the view inside the view box. Not available in perspective projection.



- To change the size of the view box, click, resize it, and click again to accept the new size of the view box.
- To pan with the view box, drag it to the location you want and press Enter.

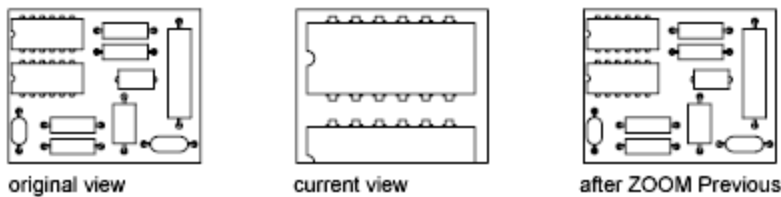
### Extents

Zooms to display the maximum extents of all objects. The extents of each object in the model are calculated and used to determine how the model should fill the window.



### Previous

Zooms to display the previous view. You can restore up to 10 previous views.



### Scale / Scale factor

Zooms to change the magnification of a view using a scale factor.

- Enter a value followed by x to specify the scale relative to the current view.
- Enter a value followed by xp to specify the scale relative to paper space units.

For example, entering .5x causes each object to be displayed at half its current size on the screen.



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Entering .5xp displays model space at half the scale of paper space units. You can create a layout with each viewport displaying objects at a different scale.

Enter a value to specify the scale relative to the grid limits of the drawing. (This option is rarely used.) For example, entering 2 displays objects at twice the size they would appear if you were zoomed to the limits of the drawing.



### Window

Zooms to display an area specified by a rectangular window.

With the cursor, you can define an area of the model to fill the entire window.



### Object

Zooms to display one or more selected objects as large as possible and in the center of the view. You can select objects before or after you start the ZOOM command.

### Real Time

Zooms interactively to change the magnification of the view.

The cursor changes to a magnifying glass with plus (+) and minus (-) signs. See Zoom Shortcut Menu for a description of the options that are available while zooming in real time.



Holding down the pick button at the midpoint of the window and moving vertically to the top of the window zooms in to 100%. Conversely, holding the pick button down at the midpoint of the window and moving vertically to the bottom of the window zooms out by 100%.

When you reach the zoom-in limit, the plus sign in the cursor disappears, indicating that you can no longer zoom in. When you reach the zoom-out limit, the minus sign in the cursor disappears, indicating that you can no longer zoom out.

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When you release the pick button, zooming stops. You can release the pick button, move the cursor to another location in the drawing, and then press the pick button again and continue to zoom the display from that location.

To exit zooming, press Enter or Esc.

### 1.3. AutoCAD system Variables:

System variables are the settings that AutoCAD checks before it decides how to do something. Most system variables are controlled by the Options command, but you can also change the value of a system variable by simply typing its name at the AutoCAD command prompt and pressing Enter. Some of the system variables are:

#### **APERTURE**

APERTURE controls how closely the crosshairs must be to an object before an object snap marker appears. You can set APERTURE from the command line between 0 and 50 pixels, or you can set it in the Options dialog box by adjusting the slider to a maximum of 20 pixels. The default value is 10.

#### **MENUBAR**

When MENUBAR is 1, AutoCAD displays its traditional classic menu bar below the application title bar. If MENUBAR is set to 0 (the default), the menu bar doesn't appear. MENUBAR is set automatically when you switch between the AutoCAD Classic and Drafting & Annotation workspaces.

#### **PICKBOX**

The pickbox is the little square box that the crosshairs turn into when AutoCAD prompts you to select an item. You control the pickbox size by setting a value in pixels for the PICKBOX variable. The initial setting of PICKBOX is 3, which is fine for a lower screen resolution, such as 1024 x 768. But, a higher setting might be useful for higher resolutions.

#### **ROLLOVERTIPS**

ROLLOVERTIPS controls the tooltip-like message boxes you see when you hover the mouse pointer over objects. When ROLLOVERTIPS is set to 1, pausing the cursor on an object opens a temporary panel showing the object type with its layer, color, and line type. If you find the panel intrusive, set its value to 0. ROLLOVERTIPS is stored in the Windows Registry.

### 1.4. Setting UNITS and DRAWING LIMITS

#### **SETTING UNITS**

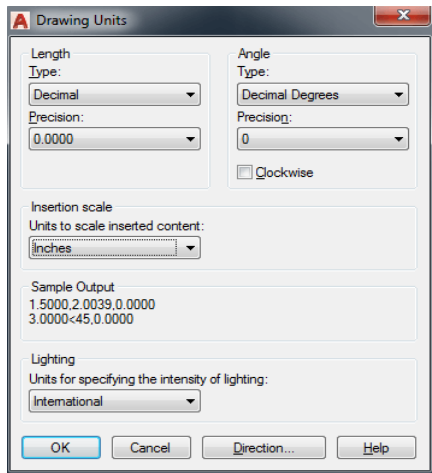
The Units setting (aka Drawing Units) makes it easy to set what you'll be drafting in your plan. The Drawing Units you set will be used in measurements of length and area in your drawing. It is important to know the units of your drawing while working on AutoCAD. AutoCAD units are most time what you should care about before starting any project. The default units is set to inches. It is possible to draw in AutoCAD using the following units:

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Inches, Feet, US Survey Feet, Miles, Millimeters, Centimeters, Meters, Kilometers, Micro inches, Mils, Yards, Angstroms, Nanometers, Microns, Decimeters, Decameters, Hectometers, Gig meters, Astronomical, Light years, Parsecs, Unit less

## How to change units in AutoCAD

To change the units in AutoCAD:

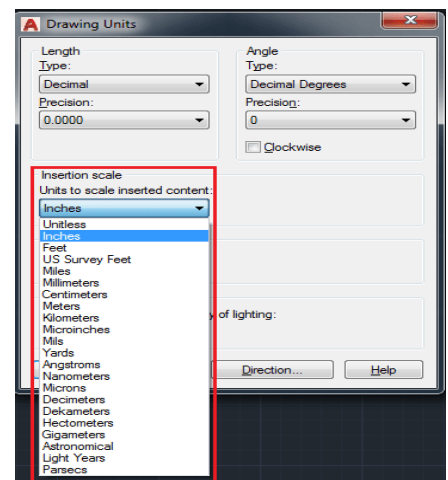


### Step 1

Type Units and Hit ENTER on your keyboard, the following window should pop up.

### Step 2

Click on the drop down menu under Insertion scale, select the appropriate unit and click on OK.



## Limits Command

The Limits command in AutoCAD is used to set an invisible rectangular boundary in the drawing area or viewport in which you are allowed to draw.

This is the area which will be displayed when you "zoom" "all." It is also the area in which the visible grid and snap grid are extended to.

They are preset by Autodesk as an area 12" wide and 9" high. This is too small to draw a large building in at full size, so you will need to change the limits to some reasonable number.

We are required to specify the coordinates of the opposite corners of the rectangular window. The opposite corners are named as Upper right and lower left corners.

## Why we need limits?



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Some dimensions in a drawing are represented in hundreds and thousands of meters. For example, bridge designing in AutoCAD, Architecture designing, etc.

The representation of such large dimensions is difficult in a regular drawing area. For such purposes, limits play a vital role in setting the boundary of the drawing area. We can specify the limits according to our requirements.

### **Limits Checking**

The two options under limits checking are:

**ON:** It turns ON the limit checking. It tests only the points we enter, so we cannot specify the points outside the grid limits. But portions of circles and other objects can extend outside the grid limits.

**OFF:** It turns OFF the limit checking. The current value of limits is maintained for the next time when we turn ON the limits.

### **Steps to set the limits**

The steps to set the limits are listed below:

- Type "LIMITS" on the command line or command prompt / pick "Format" then "Drawing Limits"
- Press Enter or spacebar.
- Write the coordinates of the lower-left corner. For example, (0,0). The coordinates for the lower-left are usually the coordinates of origin for better understanding. We can also modify the coordinates according to the requirements.
- Press Enter.
- Write the coordinates of the upper-right corner. For example, (200, 200).
- Press Enter.
- Write Z. Here Z signifies Zoom.
- Press Enter.
- Write E. Here, E signifies Extend.
- Press Enter.

The Z and E are mandatory to activate the limits. It is also called a regenerating mode of limits.

### **1.5. Coordinate system: entering distances and angles**

Use coordinate system in AutoCAD is the most. The major coordinate system used in AutoCAD are

1. Rectangular or Cartesian coordinate system
2. Polar coordinate system

These are further divided into absolute and relative.

### 1. Absolute Cartesian or rectangular coordinate system

Absolute Coordinates uses the Cartesian System to specify a position in the X, Y, and (if needed) Z axes to locate a point from the 0-X, 0-Y, and 0-Z (0,0,0) point. To locate a point using the Absolute Coordinate system, type the X-value, Y-value, and, if needed, the Z-value separated by commas (with no spaces).

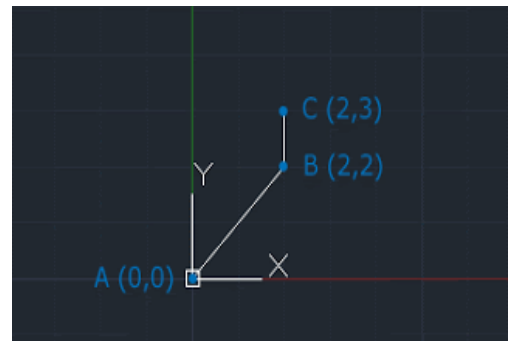
Command:

Enter LINE command: L [Enter]

Start line at point A: 0,0 [Enter]

End first line at point B: 2,2 [Enter]

End of second line at point C: 2,3 [Enter]



### 2. Relative Cartesian or rectangular coordinate system:

After first points entered, your next points can be entered by specifying the next coordinate compare/relative from the first points. The relative coordinate started with symbol "@" tell AutoCAD it was a relative coordinates. Using relative coordinate, points entered by typing @x,y [Enter].

*(Defines a new point that is X units horizontally and Y units vertically away from the current point.)*

Command:

Enter LINE command: L [Enter]

Start line at point A: 0,0 [Enter]

End first line at point B: @2,2 [Enter]

End of second line at point C: @0,1 [Enter]



### 3. Relative Polar coordinate system:

Polar coordinates used when you need to draw the next points at specify angle. Polar coordinates system in AutoCAD specifies distance length at which angle. Using polar coordinate, points entered by typing @distance<angle [Enter].

*(Defines a new point that is the specified distance units away from the current point at the specified angle from the origin.)*

Command:

Enter LINE command: L [Enter]



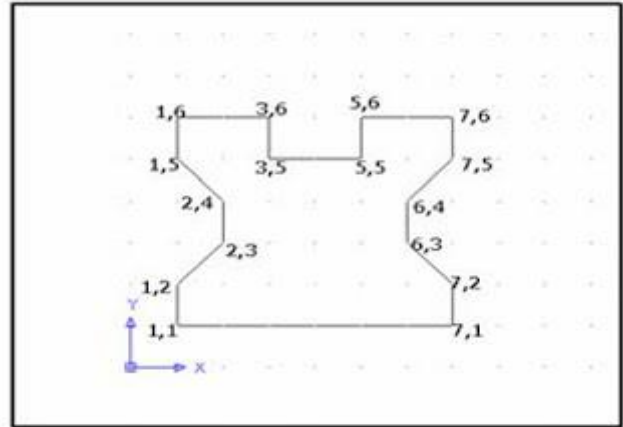
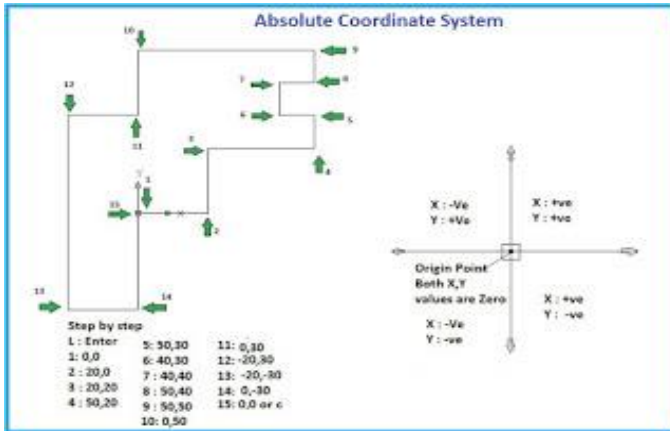
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Start line at point A: 0,0 [Enter]

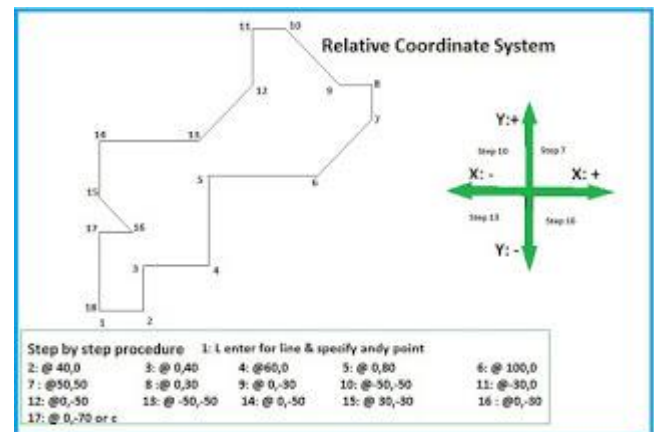
End first line at point B: @2.828<45 [Enter]

End of second line at point C: @1<90 [Enter]

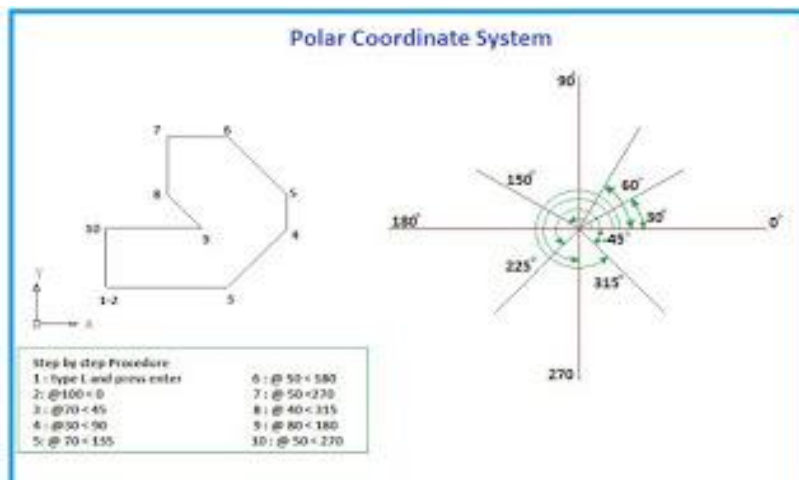
**Example1 for Absolute co-ordinate system**



**Example for Relative co-ordinate (Relative Rectangular co-ordinate) System**



**Example for Relative polar co-ordinate system**



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