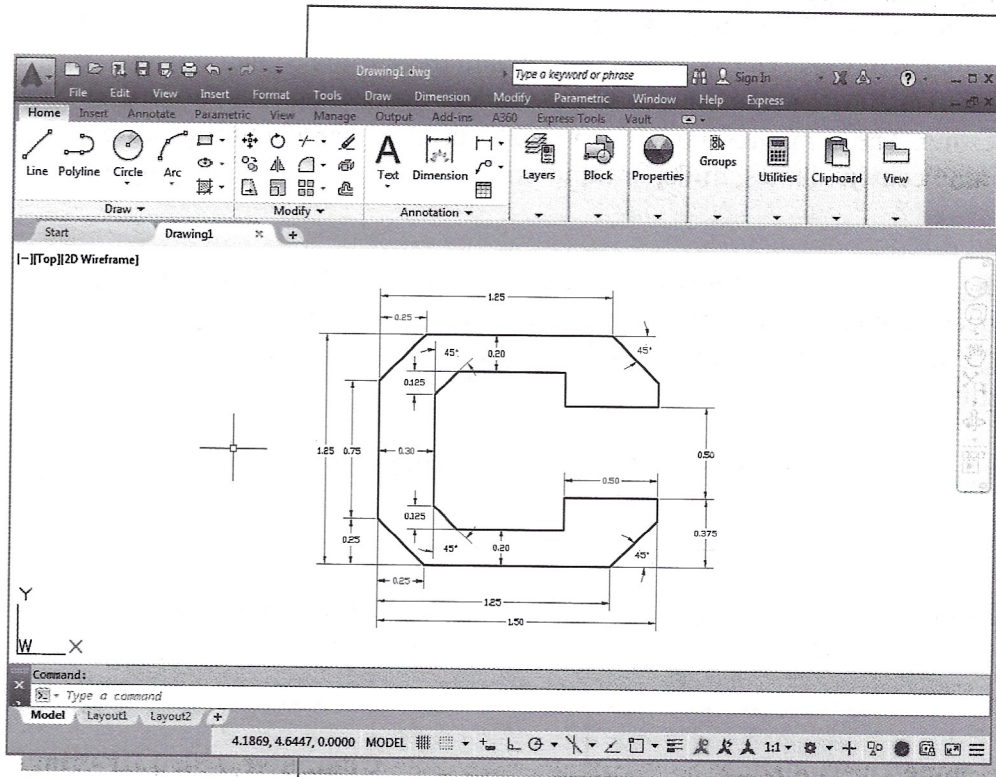


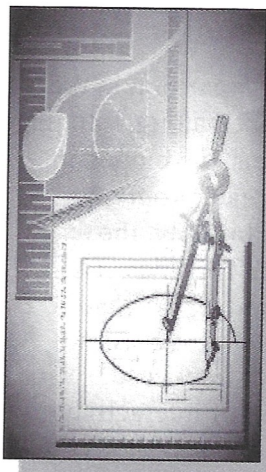
Introduction

Getting Started



Learning Objectives

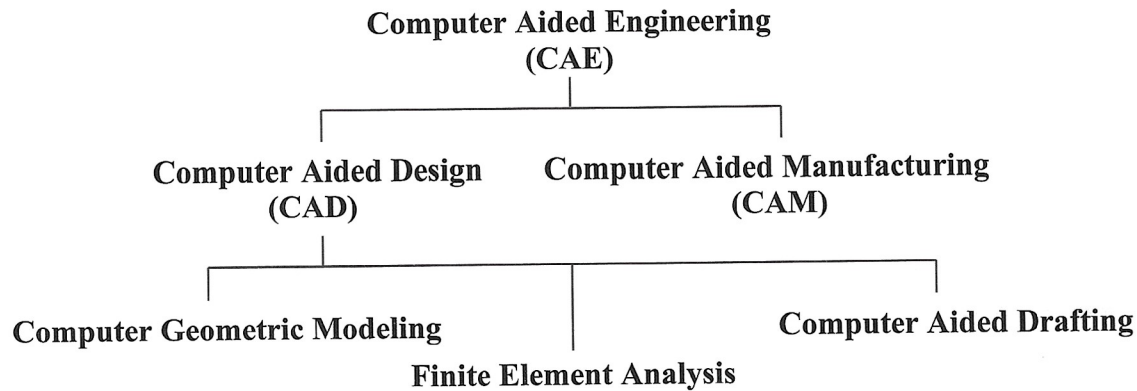
- ◆ Development of Computer Aided Design
- ◆ Why use AutoCAD 2021?
- ◆ Getting Started with AutoCAD 2021
- ◆ The AutoCAD Startup Dialog Box and Units Setup
- ◆ AutoCAD 2021 Screen Layout
- ◆ Mouse Buttons



Introduction

Computer Aided Design (CAD) is the process of doing designs with the aid of computers. This includes the generation of computer models, analysis of design data, and the creation of drawings. **AutoCAD 2021** is a computer-aided-design (CAD) software developed by *Autodesk Inc.* The **AutoCAD 2021** software is a tool that can be used for design and drafting activities. The two-dimensional and three-dimensional models created in **AutoCAD 2021** can be transferred to other computer programs for further analysis and testing. The computer models can also be used in manufacturing equipment such as machining centers, lathes, mills, or rapid prototyping machines to manufacture the product.

The rapid changes in the field of **computer aided engineering (CAE)** have brought exciting advances in industry. Recent advances have made the long-sought goal of reducing design time, producing prototypes faster, and achieving higher product quality closer to a reality.



Development of Computer Geometric Modeling

Computer Aided Design is a relatively new technology, and its rapid expansion in the last fifty years is truly amazing. Computer modeling technology advanced along with the development of computer hardware. The first-generation CAD programs, developed in the 1950s, were mostly non-interactive; CAD users were required to create program codes to generate the desired two-dimensional (2D) geometric shapes. Initially, the development of CAD technology occurred mostly in academic research facilities. The Massachusetts Institute of Technology, Carnegie-Mellon University, and Cambridge University were the lead pioneers at that time. The interest in CAD technology spread quickly and several major industry companies, such as General Motors, Lockheed, McDonnell, IBM, and Ford Motor Co., participated in the development of interactive CAD programs in the 1960s. Usage of CAD systems was primarily in the automotive industry, aerospace industry, and government agencies that developed their own programs for their specific needs. The 1960s also marked the beginning of the development of finite element analysis methods for computer stress analysis and computer aided manufacturing for generating machine tool paths.

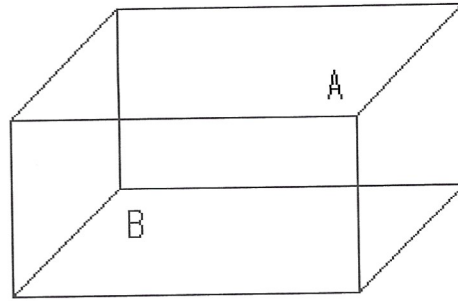
The 1970s are generally viewed as the years of the most significant progress in the development of computer hardware, namely the invention and development of **microprocessors**. With the improvement in computing power, new types of 3D CAD programs that were user-friendly and interactive became reality. CAD technology quickly expanded from very simple **computer aided drafting** to very complex **computer aided design**. The use of 2D and 3D wireframe modelers was accepted as the leading-edge technology that could increase productivity in industry. The developments of surface modeling and solid modeling technology were taking shape by the late 1970s, but the high cost of computer hardware and programming slowed the development of such technology. During this time period, the available CAD systems all required extremely expensive room-sized mainframe computers.

In the 1980s, improvements in computer hardware brought the power of mainframes to the desktop at less cost and with more accessibility to the general public. By the mid-1980s, CAD technology had become the main focus of a variety of manufacturing industries and was very competitive with traditional design/drafting methods. It was during this period of time that 3D solid modeling technology had major advancements, which boosted the usage of CAE technology in industry.

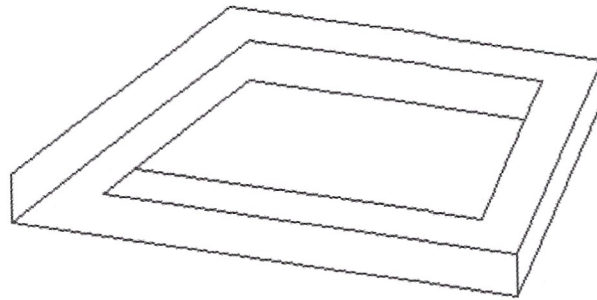
In the 1990s, CAD programs evolved into powerful design/manufacturing/management tools. CAD technology has come a long way, and during these years of development, modeling schemes progressed from two-dimensional (2D) wireframe to three-dimensional (3D) wireframe, to surface modeling, to solid modeling and, finally, to feature-based parametric solid modeling.

The first-generation CAD packages were simply 2D **Computer Aided Drafting** programs, basically the electronic equivalents of the drafting board. For typical models, the use of this type of program would require that several to many views of the objects be created individually as they would be on the drafting board. The 3D designs remained in the designer's mind, not in the computer database. The mental translation of 3D objects to 2D views is required throughout the use of the packages. Although such systems have some advantages over traditional board drafting, they are still tedious and labor intensive. The need for the development of 3D modelers came quite naturally, given the limitations of the 2D drafting packages.

The development of the 3D wireframe modeler was a major leap in the area of computer modeling. The computer database in the 3D wireframe modeler contains the locations of all the points in space coordinates, and it is sufficient to create just one model rather than multiple models. This single 3D model can then be viewed from any direction as needed. The 3D wireframe modelers require the least computer power and achieve reasonably good representation of 3D models. But because surface definition is not part of a wireframe model, all wireframe images have the inherent problem of ambiguity.



Wireframe Ambiguity: Which corner is in front, A or B?



A non-realizable object: Wireframe models contain no surface definitions.

Surface modeling is the logical development in computer geometry modeling to follow the 3D wireframe modeling scheme by organizing and grouping edges that define polygonal surfaces. Surface modeling describes the part's surfaces but not its interiors. Designers are still required to interactively examine surface models to ensure that the various surfaces on a model are contiguous throughout. Many of the concepts used in 3D wireframe and surface modelers are incorporated in the solid modeling scheme, but it is solid modeling that offers the most advantages as a design tool.

In the solid modeling presentation scheme, the solid definitions include nodes, edges, and surfaces, and it is a complete and unambiguous mathematical representation of a precisely enclosed and filled volume. Unlike the surface modeling method, solid modelers start with a solid or use topology rules to guarantee that all of the surfaces are stitched together properly. Two predominant methods for representing solid models are **constructive solid geometry (CSG)** representation and **boundary representation (B-rep)**.

The CSG representation method can be defined as the combination of 3D solid primitives. What constitutes a “primitive” varies somewhat with the software but typically includes a rectangular prism, a cylinder, a cone, a wedge, and a sphere. Most solid modelers allow the user to define additional primitives, which can be very complex.

In the B-rep representation method, objects are represented in terms of their spatial boundaries. This method defines the points, edges, and surfaces of a volume, and/or issues commands that sweep or rotate a defined face into a third dimension to form a solid. The object is then made up of the unions of these surfaces that completely and precisely enclose a volume.

By the 1990s, a new paradigm called *concurrent engineering* had emerged. With concurrent engineering, designers, design engineers, analysts, manufacturing engineers, and management engineers all work closely right from the initial stages of the design. In this way, all aspects of the design can be evaluated, and any potential problems can be identified right from the start and throughout the design process. Using the principles of concurrent engineering, a new type of computer modeling technique appeared. The technique is known as the *feature-based parametric modeling technique*. The key advantage of the *feature-based parametric modeling technique* is its capability to produce very flexible designs. Changes can be made easily, and design alternatives can be evaluated with minimum effort. Various software packages offer different approaches to feature-based parametric modeling, yet the end result is a flexible design defined by its design variables and parametric features.

In this text, we will concentrate on creating designs using two-dimensional geometric construction techniques. The fundamental concepts and use of different **AutoCAD 2021** commands are presented using step-by-step tutorials. We will begin with creating simple geometric entities and then move toward creating detailed working drawings and assembly drawings. The techniques presented in this text will also serve as the foundation for entering the world of three-dimensional solid modeling using packages such as **AutoCAD Mechanical Desktop**, **AutoCAD Architecture** and **Autodesk Inventor**.

Why use AutoCAD 2021?

AutoCAD was first introduced to the public in late 1982 and was one of the first CAD software products that were available for personal computers. Since 1984, **AutoCAD** has established a reputation for being the most widely used PC-based CAD software around the world. By 2015, it was estimated that there were over 6 million **AutoCAD** users in more than 150 countries worldwide. **AutoCAD 2021** is the thirty-fifth release, with many added features and enhancements, of the original **AutoCAD** software produced by *Autodesk Inc.*

CAD provides us with a wide range of benefits; in most cases, the result of using CAD is increased accuracy and productivity. First of all, the computer offers much higher accuracy than the traditional methods of drafting and design. Traditionally, drafting and detailing are the most expensive cost elements in a project and the biggest bottleneck.

With CAD systems, such as **AutoCAD 2021**, the tedious drafting and detailing tasks are simplified through the use of many of the CAD geometric construction tools, such as *grids*, *snap*, *trim*, and *auto-dimensioning*. Dimensions and notes are always legible in CAD drawings, and in most cases, CAD systems can produce higher quality prints compared to traditional hand drawings.

CAD also offers much-needed flexibility in design and drafting. A CAD model generated on a computer consists of numeric data that describe the geometry of the object. This allows the designers and clients to see something tangible and to interpret the ramifications of the design. In many cases, it is also possible to simulate operating conditions on the computer and observe the results. Any kind of geometric shape stored in the database can be easily duplicated. For large and complex designs and drawings, particularly those involving similar shapes and repetitive operations, CAD approaches are very efficient and effective. Because computer designs and models can be altered easily, a multitude of design options can be examined and presented to a client before any construction or manufacturing actually takes place. Making changes to a CAD model is generally much faster than making changes to a traditional hand drawing. Only the affected components of the design need to be modified and the drawings can be plotted again. In addition, the greatest benefit is that, once the CAD model is created, it can be used over and over again. The CAD models can also be transferred into manufacturing equipment such as machining centers, lathes, mills, or rapid prototyping machines to manufacture the product directly.

CAD, however, does not replace every design activity. CAD may help, but it does not replace the designer's experience with geometry and graphical conventions and standards for the specific field. CAD is a powerful tool, but the use of this tool does not guarantee correct results; the designer is still responsible for using good design practice and applying good judgment. CAD will supplement these skills to ensure that the best design is obtained.

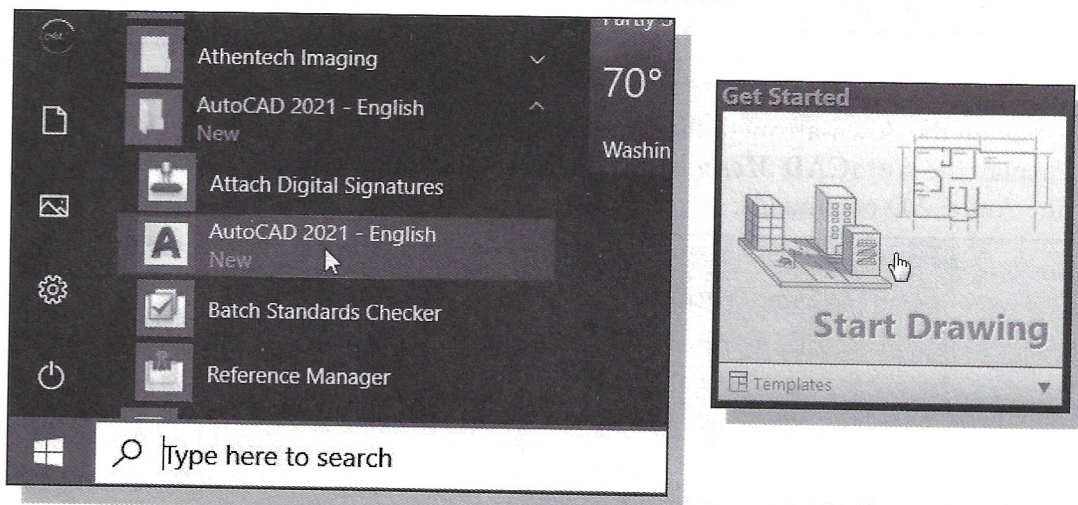
CAD designs and drawings are stored in binary form, usually as CAD files, to magnetic devices such as diskettes and hard disks. The information stored in CAD files usually requires much less physical space in comparison to traditional hand drawings. However, the information stored inside the computer is not indestructible. On the contrary, the electronic format of information is very fragile and sensitive to the environment. Heat or cold can damage the information stored on magnetic storage devices. A power failure while you are creating a design could wipe out the many hours you spent working in front of the computer monitor. It is a good habit to save your work periodically, just in case something might go wrong while you are working on your design. In general, one should save one's work onto a storage device at an interval of every 15 to 20 minutes. You should also save your work before you make any major modifications to the design. It is also a good habit to periodically make backup copies of your work and put them in a safe place.

Getting Started with AutoCAD 2021



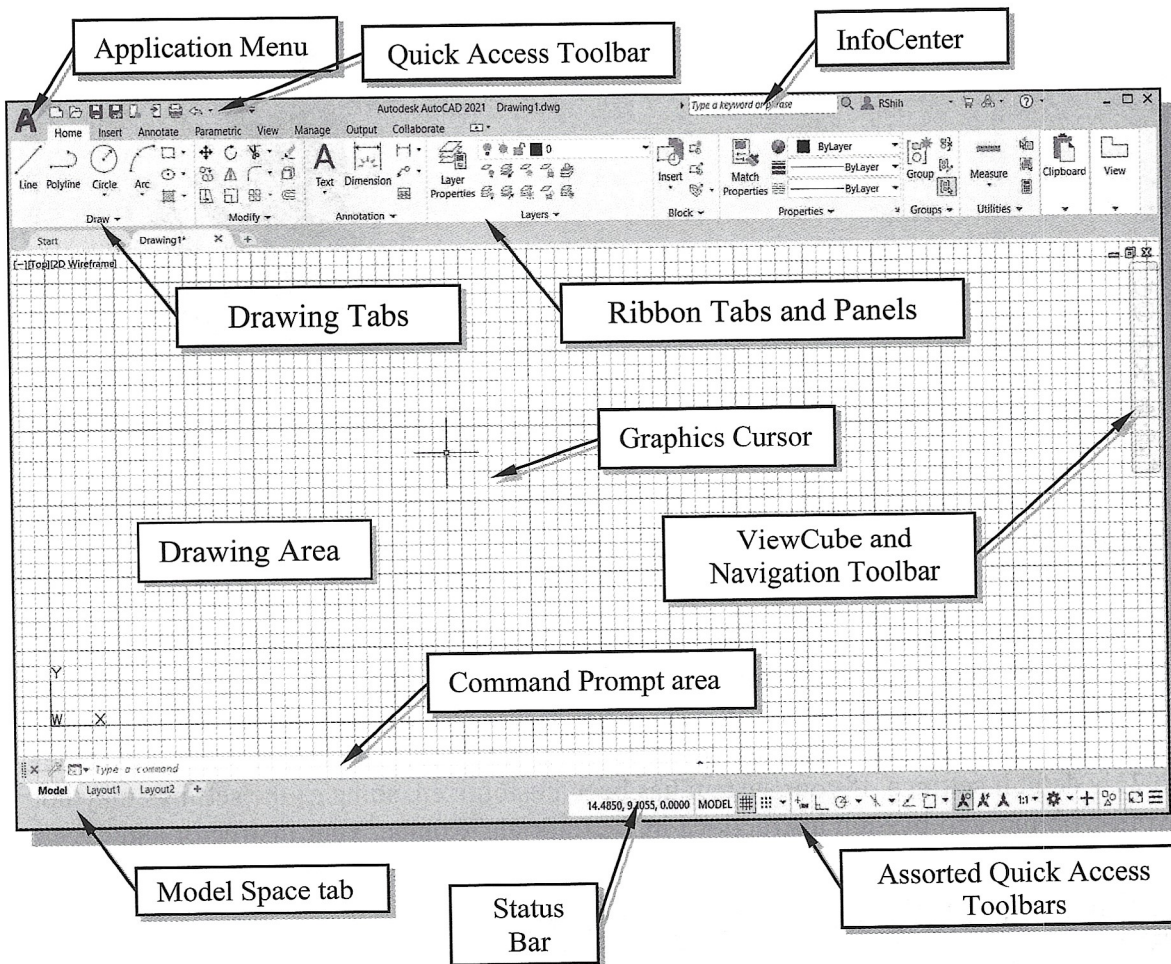
How to start **AutoCAD 2021** depends on the type of workstation and the particular software configuration you are using. With most *Windows* systems, you may select the **AutoCAD 2021** option on the *Start* menu or select the **AutoCAD 2021** icon on the *Desktop*. Consult with your instructor or technical support personnel if you have difficulty starting the software.

The program takes a while to load, so be patient. Eventually the **AutoCAD 2021** main *drawing screen* will appear on the screen. Click **Start Drawing** as shown in the below figure. The tutorials in this text are based on the assumption that you are using **AutoCAD 2021**'s default settings. If your system has been customized, some of the settings may not work with the step-by-step instructions in the tutorials. Contact your instructor and technical support to restore the default software configuration.

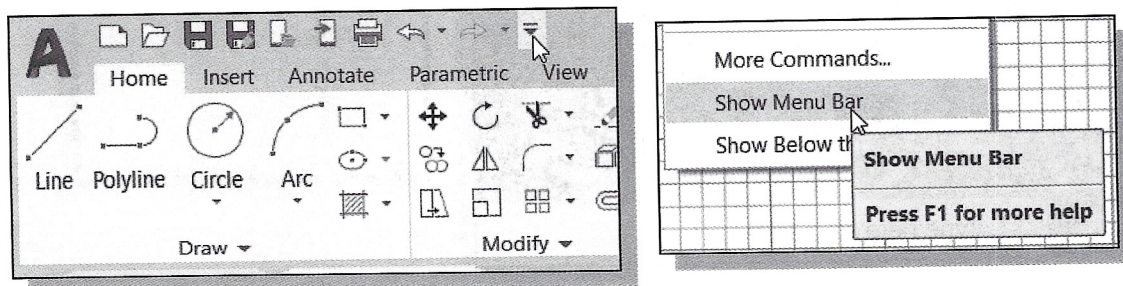


AutoCAD 2021 Screen Layout

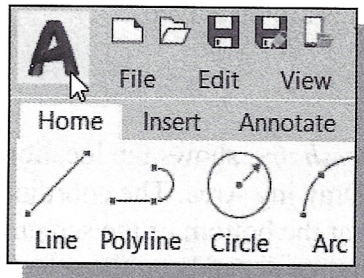
The default **AutoCAD 2021** drawing screen contains the *pull-down* menus, the *Standard* toolbar, the *InfoCenter* Help system, the *scrollbars*, the *command prompt* area, the *Status Bar*, and the *Ribbon Tabs and Panels* that contain several *control panels* such as the *Draw and Modify* panel and the *Annotation* panel. You may resize the **AutoCAD 2021** drawing window by clicking and dragging at the edges of the window, or relocate the window by clicking and dragging at the window title area.



- ❖ Click on the down-arrow in the *Quick Access* bar and select **Show Menu Bar** to display the **AutoCAD Menu** bar. Note that the menu bar provides access to all of the AutoCAD commands.



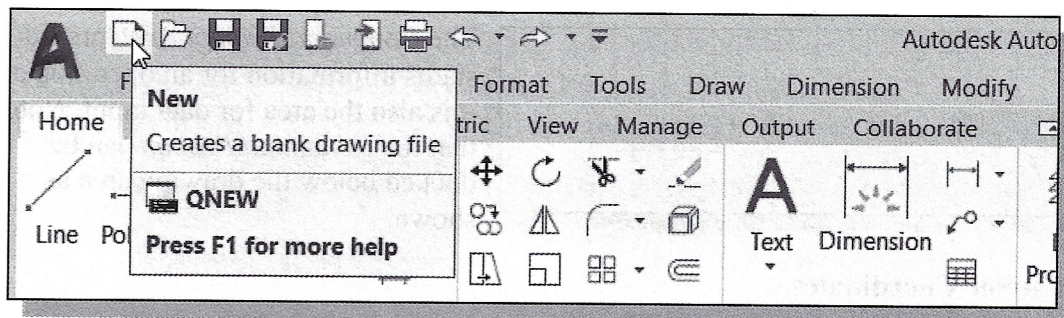
- **Application Menu**



The *Application Menu* at the top of the main window contains commonly used file operations.

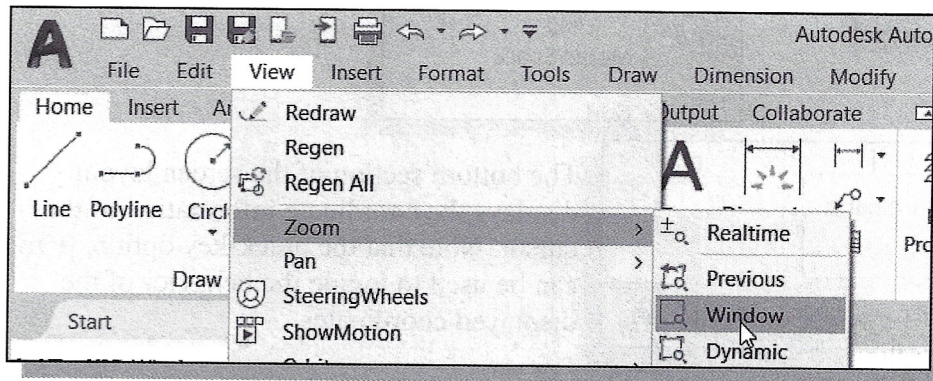
- **Quick Access Toolbar**

The *Quick Access* toolbar at the top of the *AutoCAD* window allows us quick access to frequently used commands, such as **Qnew**, **Open**, **Save** and also the **Undo** command. Note that we can customize the quick access toolbar by adding and removing sets of options or individual commands.

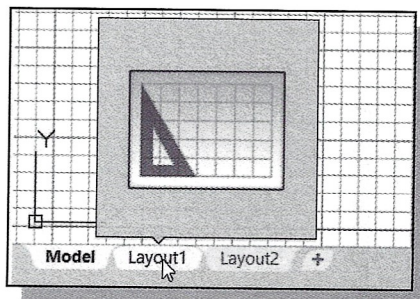


- **AutoCAD Menu Bar**

The *Menu* bar is the pull-down menu where all operations of AutoCAD can be accessed.



- **Layout tabs**

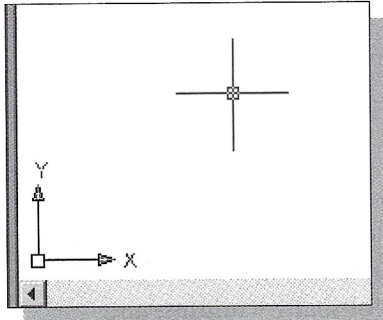


The Model/Layout tabs allow us to switch/create between different **model space** and **paper space**.

- **Drawing Area**

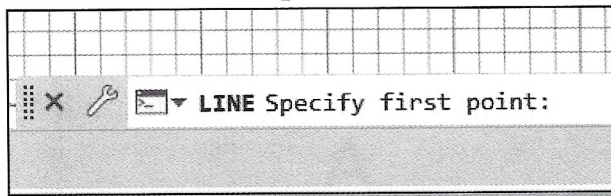
The *Drawing Area* is the area where models and drawings are displayed.

- **Graphics Cursor or Crosshairs**



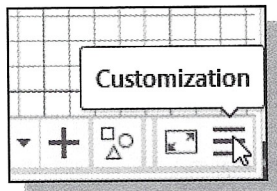
The *graphics cursor*, or *crosshairs*, shows the location of the pointing device in the Drawing Area. The coordinates of the cursor are displayed at the bottom of the screen layout. The cursor's appearance depends on the selected command or option.

- **Command Prompt Area**

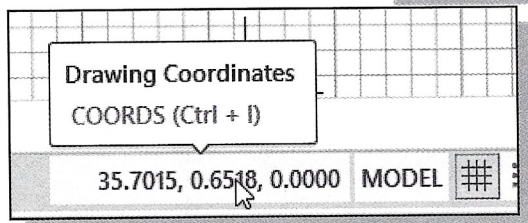
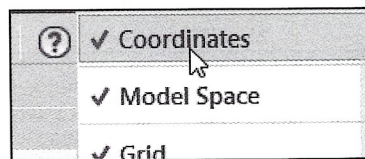


The *Command Prompt Area* provides status information for an operation and it is also the area for data input. Note that the *Command Prompt* can be docked below the drawing area as shown.

- **Cursor Coordinates**



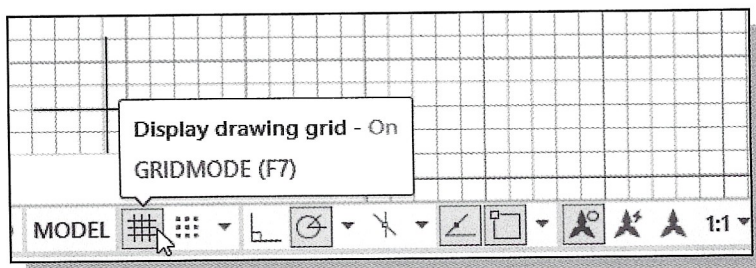
To switch on the **AutoCAD Coordinates Display**, use the *Customization option* at the bottom right corner.



The bottom section of the screen layout displays the coordinate information of the cursor. Note that the quick-key option, [Ctrl+I], can be used to toggle the behavior of the displayed coordinates.

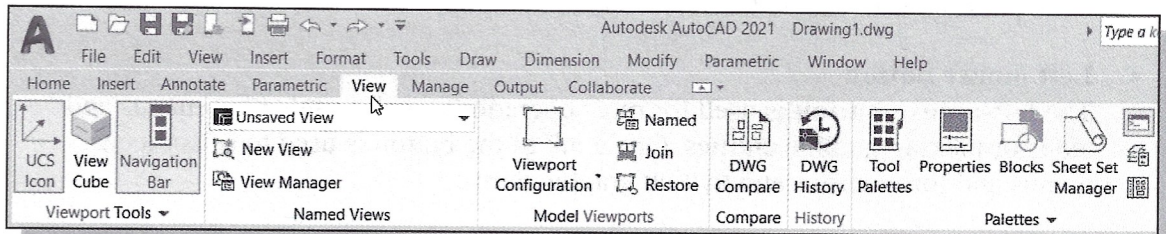
- **Status Toolbar**

Next to the cursor coordinate display is the *Status* toolbar, showing the status of many commonly used display and construction options.



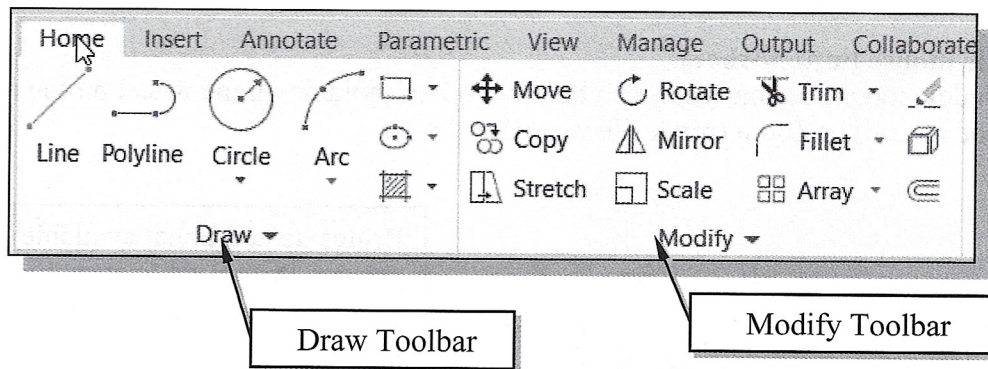
- **Ribbon Tabs and Panels**

The top section of the screen layout contains customizable icon panels, which contain groups of buttons that allow us to pick commands quickly, without searching through a menu structure. These panels allow us to quickly access the commonly used commands available in AutoCAD.

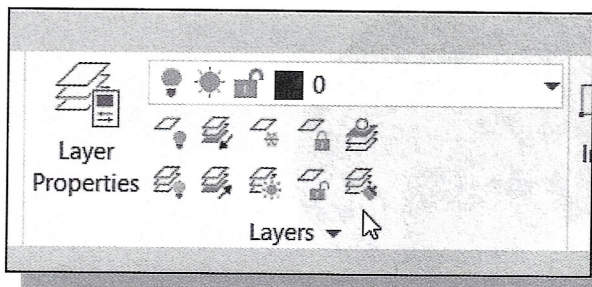


- **Draw and Modify Toolbar Panels**

The *Draw* and *Modify* toolbar panels are the two main panels for creating drawings; the toolbars contain icons for basic draw and modify commands.

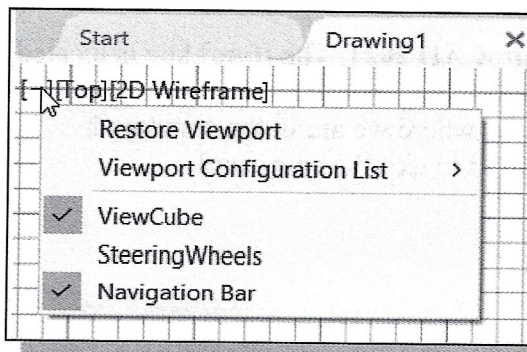


- **Layers Control Toolbar Panel**



The *Layers Control* toolbar panel contains tools to help manipulate the properties of graphical objects.

- **Viewport/View/Display Controls**



The *Viewport/View/Display controls* panel is located at the upper left corner of the graphics area and it can be used to quickly access viewing related commands, such as Viewport and Display style.

Mouse Buttons

AutoCAD 2021 utilizes the mouse buttons extensively. In learning **AutoCAD 2021**'s interactive environment, it is important to understand the basic functions of the mouse buttons. It is highly recommended that you use a mouse or a tablet with **AutoCAD 2021** since the package uses the buttons for various functions.

- **Left mouse button**

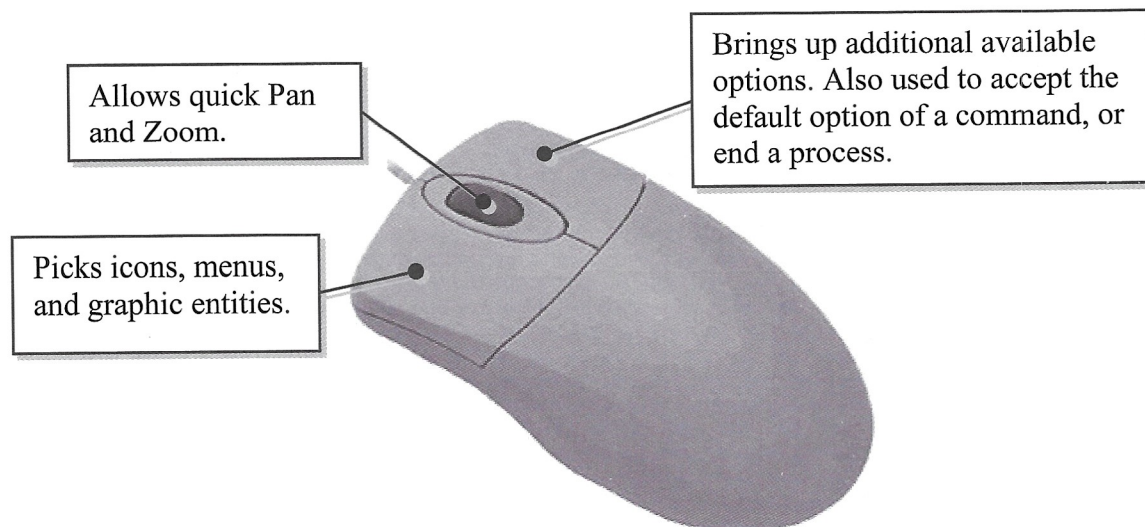
The **left-mouse-button** is used for most operations, such as selecting menus and icons or picking graphic entities. One click of the button is used to select icons, menus and form entries and to pick graphic items.

- **Right mouse button**

The **right-mouse-button** is used to bring up additional available options. The software also utilizes the **right-mouse-button** the same as the **ENTER** key and is often used to accept the default setting to a prompt or to end a process.

- **Middle mouse button/wheel**

The middle mouse button/wheel can be used to Pan (hold down the wheel button and drag the mouse) or Zoom (rotate the wheel) real time.



[Esc] – Canceling commands

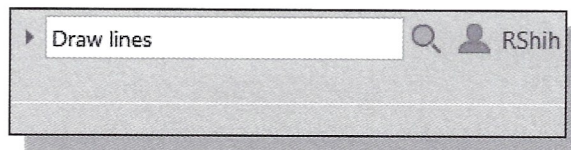
The **[Esc]** key is used to cancel a command in **AutoCAD 2021**. The **[Esc]** key is located near the top-left corner of the keyboard. Sometimes, it may be necessary to press the **[Esc]** key twice to cancel a command; it depends on where we are in the command sequence. For some commands, the **[Esc]** key is used to exit the command.

Online Help

Several types of online help are available at any time during an **AutoCAD 2021** session. The **AutoCAD 2021** software provides many online help options:

- **Autodesk Exchange:**

Autodesk Exchange is a central portal in AutoCAD 2021; AutoCAD Exchange provides a user interface for Help, learning aids, tips and tricks, videos, and downloadable apps. By default, *Autodesk Exchange* is displayed at **startup**. This allows access to a dynamic selection of tools from the *Autodesk community*; note that an internet connection is required to use this option.



- To use *Autodesk Exchange*, simply type a question in the *input box* to search through the Autodesk's *Help* system as shown.

- A list of the search results appears in the *Autodesk Help* window, and we can also determine the level and type of searches of the associated information.

The screenshot shows the Autodesk AutoCAD 2021 - Help window. The search bar at the top contains the text "Draw lines". Below the search bar, the results are displayed under the heading "Showing 1-15 of 4242 results for Draw lines (0.48 seconds)".

REFINE BY

Knowledge Source	Count
Product Documentation	(4154)
YouTube	(87)
Screencast	(1)

Information Category	Count
Learn & Explore	(2752)
Developer's Documentation	(1459)
Getting Started	(431)
Have You Tried	(36)
Installation & Deployment	(18)
Troubleshooting	(18)

Product Feature	Count
Views and Viewports	(182)
Drawing Tools	(153)
Dimensioning	(152)
3D Modeling	(136)
Blocks	(99)
Annotation	(86)

To Draw Lines
Click Home tab > Draw panel > Line . Find Specify the start point and end point of the line segment by clicking in the drawing area.
Product Documentation | 2020-03-25

To Drop a Perpendicular Line From a 3D Point to the XY Plane
This location defines the first point of the line .
Product Documentation | 2020-03-25

About Lines
The simplest method to draw a line is to click two locations in the drawing area, however you will want your drawing to be much more precise.
Product Documentation | 2020-03-25

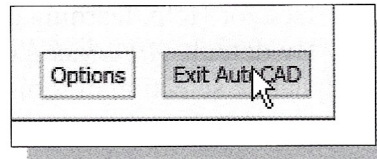
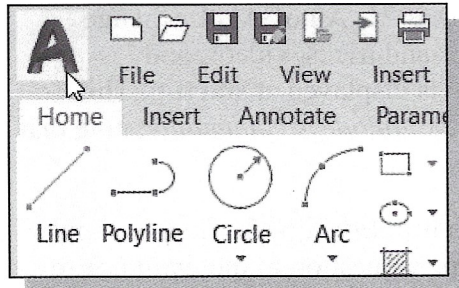
Drawing Lines Using Dynamic Input
Learn how to draw lines using dynamic input in AutoCAD 2018.
YouTube | 2016-03-03

About Linetypes
A line created with CELTSCALE = 2 in a drawing with LTSCALE set to 0.5 would appear the same as a line created with CELTSCALE = 1 in a drawing with LTSCALE = 1.
Product Documentation | 2020-03-25

About Saving Drawings to Previous Drawing File Formats
For example, if a line that was dimensioned is trimmed so that an interior portion of the line is removed, two line objects result and the associated dimension applies to only one of the line objects.
Product Documentation | 2020-03-25

Leaving AutoCAD 2021

To leave **AutoCAD 2021**, use the left-mouse-button and click the **Application Menu** button at the top left corner of the **AutoCAD 2021** screen window, then choose **Exit AutoCAD** from the pull-down menu or type **QUIT** in the command prompt area.

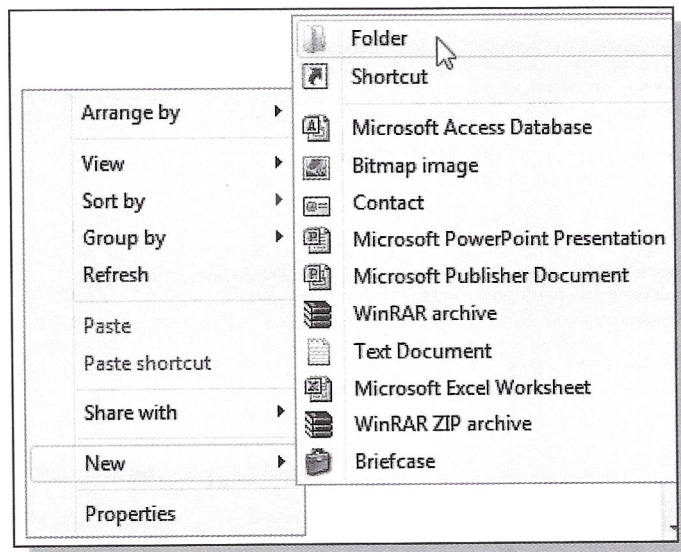


Creating a CAD File Folder

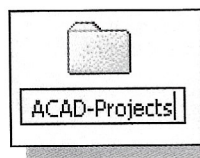
It is a good practice to create a separate folder to store your CAD files. You should not save your CAD files in the same folder where the **AutoCAD 2021** application is located. It is much easier to organize and back up your project files if they are in a separate folder. Making folders within this folder for different types of projects will help you organize your CAD files even further.

➤ To create a new folder in the *Microsoft Windows* environment:

1. On the *desktop* or under the *My Documents* folder in which you want to create a new folder.



2. Right-mouse-click once to bring up the option menu, then select **New** → **Folder**.



3. Type a name for the new folder, and then press **ENTER**.