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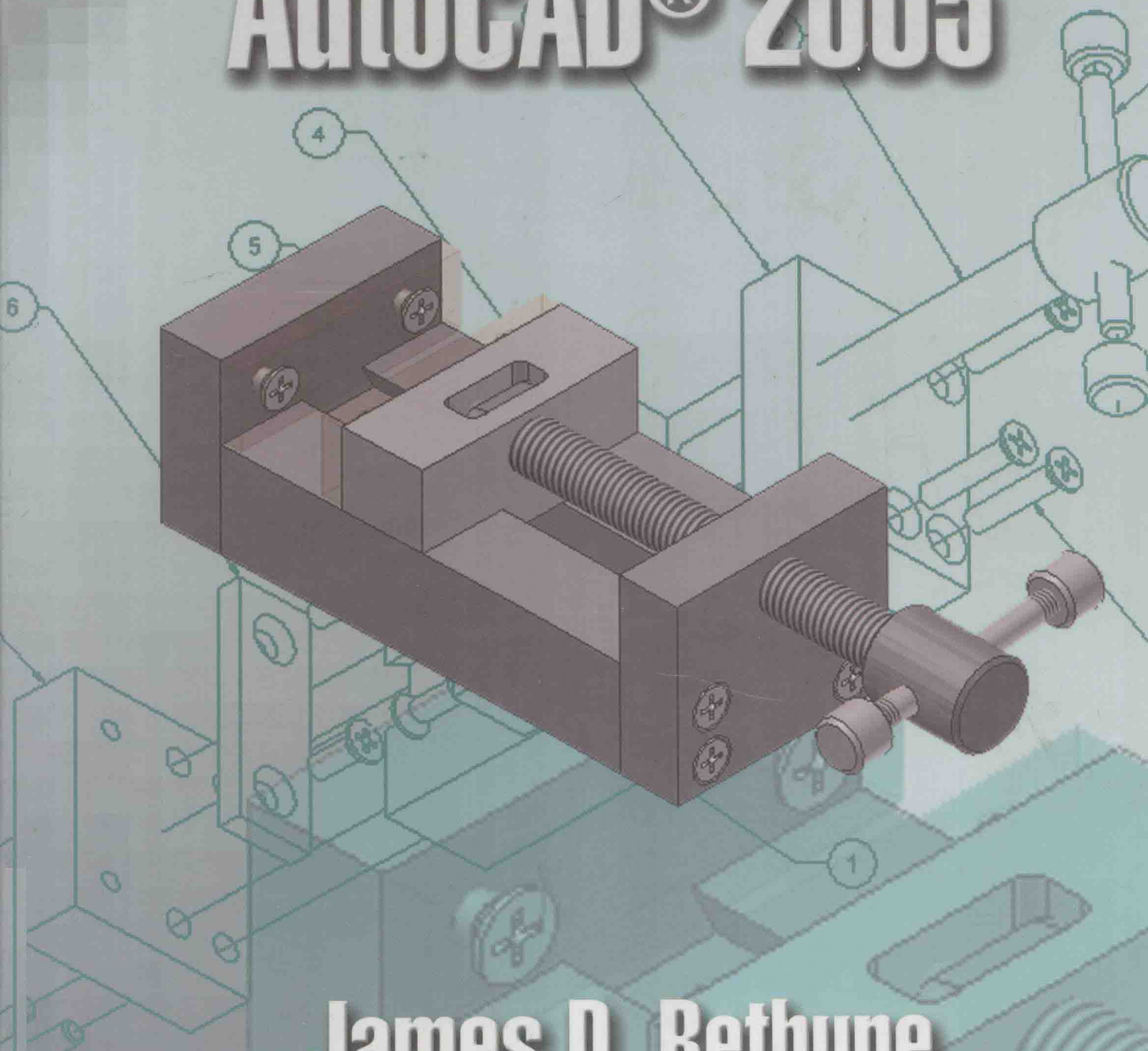
Engineering Graphics with AutoCAD® 2005



James D. Bethune

Engineering Graphics with AutoCAD® 2005

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Preface

This book teaches technical drawing and uses AutoCAD® as its drawing instrument. This book, an update of *Engineering Graphics with AutoCAD® 2004,* for AutoCAD® 2005, follows the general format of many technical drawing texts and presents much of the same material about drawing conventions and practices, with emphasis on creating accurate, clear drawings. For example, the book shows how to locate dimensions on a drawing so that they completely define the object in accordance with current national standards, but the presentation centers on the Dimension toolbar and its associated tools and options. The standards and conventions are presented and their applications are shown using AutoCAD® 2005. This integrated teaching concept is followed throughout the book.

Most chapters include design problems. The problems are varied in scope and are open-ended, which means that there are several correct solutions. This is intended to encourage student creativity and increase their problem-solving abilities.

This edition does not include a disk with exercise problems from Chapter 8. The exercise problems for Chapter 8 are now presented on grids so that the dimensions can be easily derived.

Chapters 1 through 3 cover AutoCAD's Draw and Modify toolbars and other commands needed to set up and start drawings. The text starts with simple Line commands and proceeds through geometric constructions. The final sections of Chapter 3 describe how to bisect a line and how to draw a hyperbola, a parabola, a helix, and an ogee curve. These constructions are included in most on-the-board technical drawing books because they help students develop accuracy and an understanding of how to use their equipment. The same type of learning experience also occurs when the constructions are done using AutoCAD. Redrawing many of the classic geometric shapes will help students learn how to use the Draw and Modify toolbars, along with other associated commands, with accuracy and creativity.

Chapter 4 presents freehand sketching. Simply stated, there is still an important place for sketching in technical drawing. Many design ideas start as freehand sketches and are then developed on the computer. This chapter now includes extensive exercise problems associated with object orientation.

Chapter 5 presents orthographic views. Students are shown how to draw three views of an object using AutoCAD. The discussion includes projection theory, hidden lines, compound lines, oblique surfaces, rounded surfaces, holes, irregular surfaces, castings, and thin-walled objects. The chapter ends with several intersection problems. These problems serve as a good way to pull together orthographic views and projection theory.

Chapter 6 presents sectional views and introduces the Hatch command. The chapter includes multiple, broken-out, and partial sectional views and shows how to draw an S-break for a hollow cylinder.

Chapter 7 covers auxiliary views and shows how to use the Snap, Rotate command to create axes aligned with

slanted surfaces. Secondary auxiliary views are also discussed. Solid modeling greatly simplifies the determination of the true shape of a line or plane, but a few examples of secondary auxiliary views help students refine their understanding of orthographic views and eventually the application of UCSs.

Chapter 8 shows how to dimension both two-dimensional shapes and orthographic views. The Dimension command and its associated commands are demonstrated, including how to use the Dimension Styles tool. The commands are presented as needed to create required dimensions. The conventions demonstrated are in compliance with ANSI Y32. The exercise problems for Chapter 8 have been extensively revised and are all presented on grids so that the dimensions can be easily derived.

Chapter 9 introduces tolerances. First, the chapter shows how to draw dimensions and tolerances using the Dimension and Tolerance commands, among others. The chapter ends with an explanation of fits and shows how to use the tables included in the appendix to determine the maximum and minimum tolerances for matching holes and shafts.

Chapter 10 continues the discussion of tolerancing using geometric tolerances and explains how AutoCAD® 2005 can be used to create geometric tolerance symbols directly from dialog boxes. Both profile and positional tolerances are explained. The overall intent of the chapter is to teach students how to make parts fit together. Fixed and floating fastener applications are discussed, and design examples are given for both conditions.

Chapter 11 covers how to draw and design using standard fasteners, including bolts, nuts, machine screws, washers, hexagon heads, square heads, set screws, rivets, and springs. Students are shown how to create wblocks of the individual thread representations and how to use them for different size requirements.

Chapter 12 discusses assembly drawings, detail drawings, and parts lists. Instructions for drawing title blocks, tolerance blocks, release blocks, and revision blocks, and for inserting drawing notes are also included to give students better preparation for industrial practices. Several new exercise problems have been added to the chapter.

Chapter 13 presents gears, cams, and bearings. The intent of the chapter is to teach how to design using gears selected from a manufacturer's catalog. The chapter shows how to select bearings to support gear shafts and how to tolerance holes in support plates to maintain the desired center distances of meshing gears. The chapter also shows how to create a displacement diagram and then draw the appropriate cam profile.

Chapter 14 introduces AutoCAD®'s 3-D capabilities. It teaches students about AutoCAD®'s 3-D commands and coordinate system definition before introducing them to surface and solid models. Both WCS and UCS are explained and demonstrated along with Preset and View commands. 3-D primitives are introduced and used to create simple shapes. The chapter concludes by showing how to create orthographic views from the drawn 3-D shapes.

Chapter 15 extends the discussion of Chapter 14 to cover surface modeling. The basic geometric shapes of the Surfaces toolbar are presented as well as the Revsurf, Tabsurf, Rulesurf, 3D Face, and 3D Mesh commands. All the surface commands are demonstrated and used to create 3-D shapes.

Chapter 16 introduces solid modeling and includes the Solids Editing commands. The Solid and Solids Editing toolbars are demonstrated and used with the Union and Subtract commands to create 3-D shapes. Orthographic views are then created from the solid shapes. More complex shapes are created using the Extrude, Section, and Slice commands. The chapter concludes with several exercise problems that demonstrate a solid modeling approach to intersection problems as originally introduced at the end of Chapter 5. The chapter also includes several design exercise problems.

Chapter 17 presents a solid modeling approach to descriptive geometry. For example, a plane is drawn as a solid that is 0.00001 inch thick. AutoCAD®'s solid modeling and other commands are then used to manipulate the plane. The true lengths of lines and shapes of planes, point and plane locations, and properties between lines and planes are discussed. Piercing points and line visibility are also covered.

I would like to thank the following reviewers. Their comments and suggestions were most helpful in creating this and previous editions: Anthony Duva, Wentworth Institute of Technology; Dale M. Gerstenecker, St. Louis Community College at Florissant; John Loebach, Spoon River College; N. S. Malladi, Ph.D., University of South Alabama; and Jack Zhou, Drexel University.

Thanks to Debbie Yarnell and Judy Casillo, the managing editor who pulled it all together; to Lisa Garboski; and to David, Maria, Randy, Lisa, Hannah, Wil, Madison, Jack, Lake, and Cheryl for their continued support.

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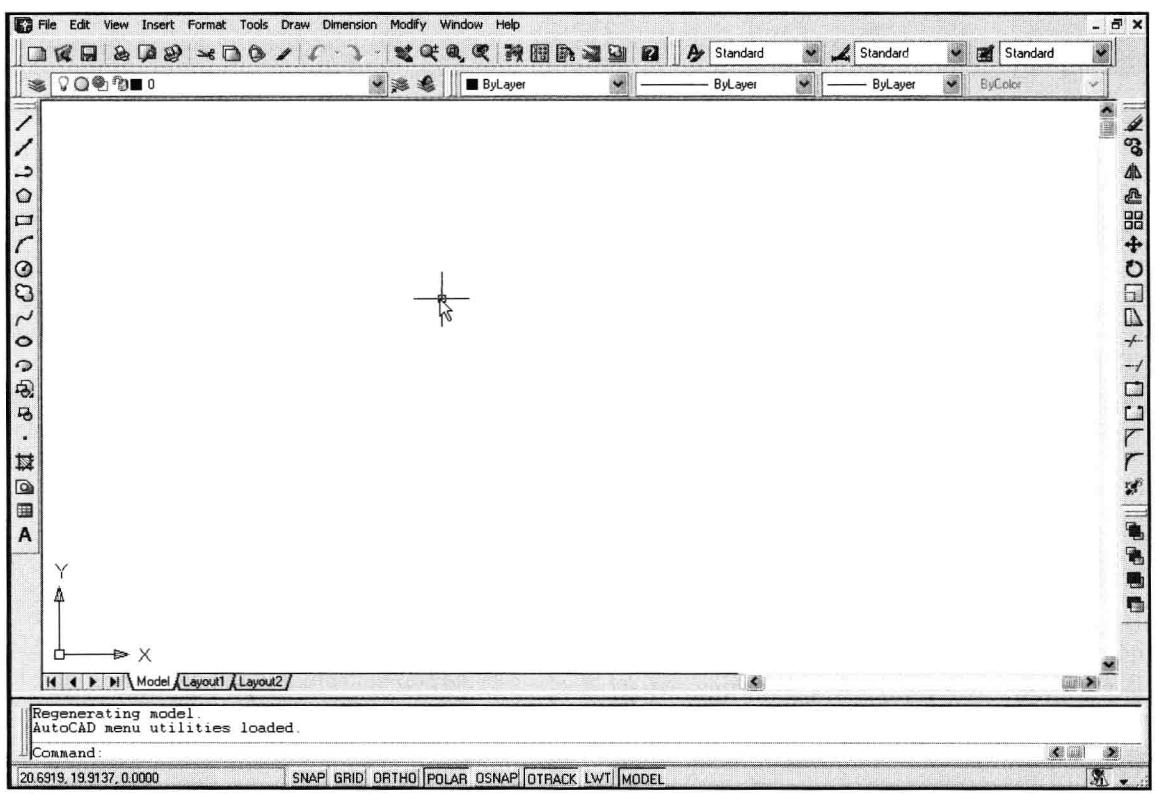
CHAPTER 1

Getting Started



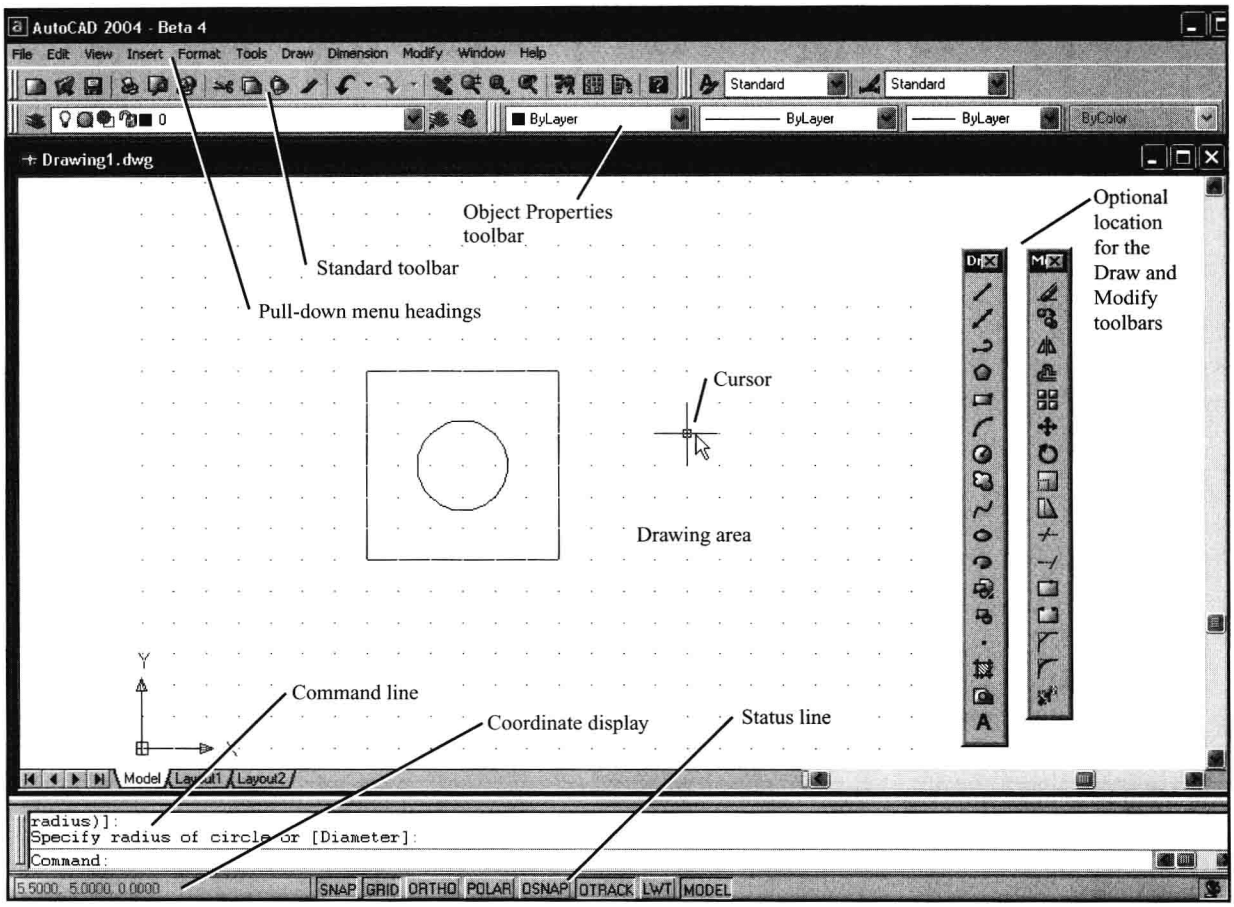


Figure 1-1

1-1 INTRODUCTION

This chapter explains the various aspects of the AutoCAD 2005 for Windows drawing screen and shows how they can be manipulated. Figure 1-1 shows a typical initial AutoCAD Windows screen. Your screen may look slightly different because of your selected screen resolution values.

The top line displays the Windows pull-down menus for exiting a program and changing a program. It is assumed that the reader is familiar with basic Windows operations.

The second line is the Standard toolbar and contains a group of the most commonly used commands.

The third line contains some command icons and an area that shows the current, or docked, object properties that are active.

The line below the drawing portion of the screen displays the name of the current drawing. Since no drawing has been named, the line reads "Drawing1.dwg". Once a drawing name has been defined, it will appear at the bottom of the screen.

The bottom left corner of the drawing screen shows the coordinate display position of the horizontal, vertical crosshairs in terms of an X,Y coordinate value, whose origin is the lower left corner of the drawing screen.

The commands listed on the bottom line (status line) are displayed in light gray when they are off, and in black when they are on.

The horizontal and vertical scroll bars can be used to move the drawing screen up, down, right, or left; they function as they do with other Windows applications.

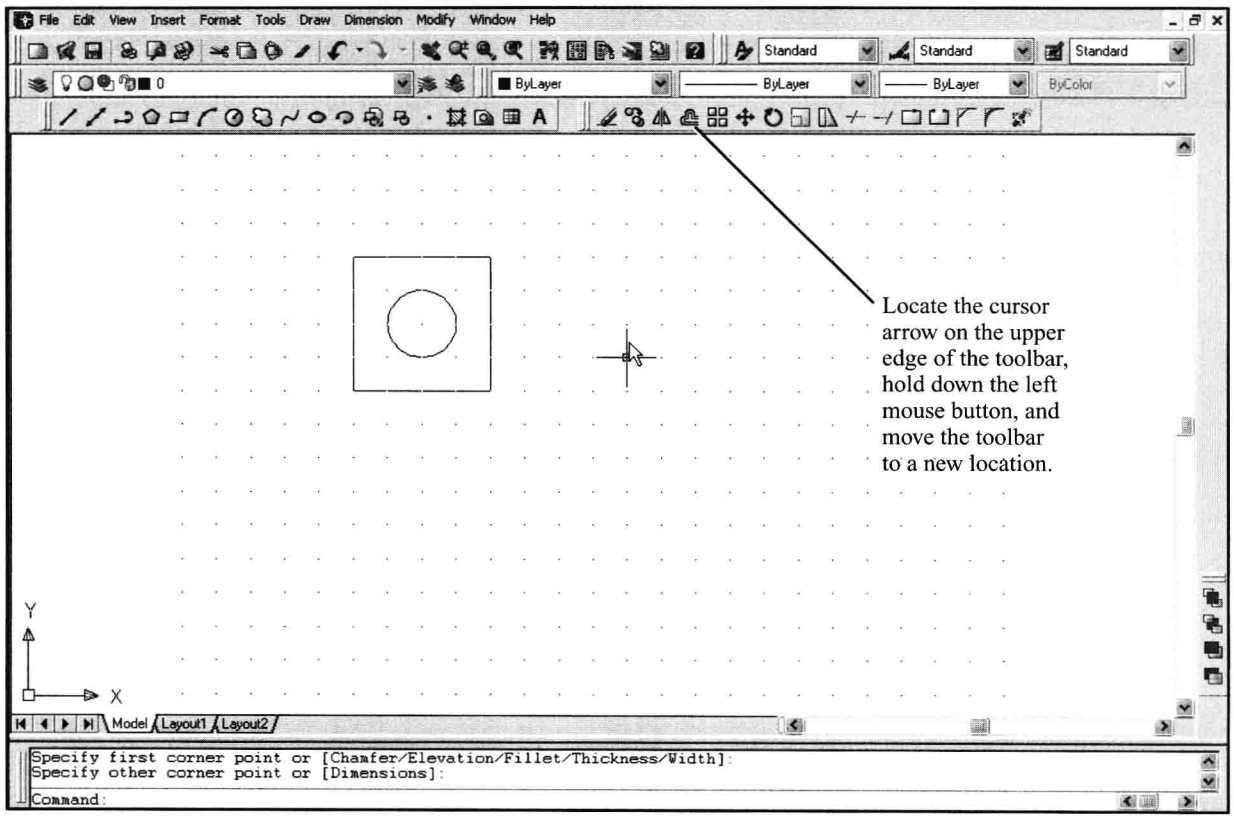


Figure 1-2

The large open area in the center of the screen is called the *drawing screen,* or *drawing editor.* The two rectangular boxes of command icons located along the left edge of the drawing screen are the Draw and Modify toolbars. They can be moved around the screen as shown in Figure 1-2.

1-2 TOOLBARS

An AutoCAD toolbar contains a group of command icons located under a common heading. The initial AutoCAD as screen, shown in Figure 1-1, contains six toolbars: Layers, Standard, Object Properties, Styles, Draw, and Modify. There are 24 additional predefined toolbars, and you can create your own user-specific toolbars as needed.

To move a toolbar

See Figure 1-2.

1. Locate the cursor arrow on the heading Modify.
2. Press and hold down the left mouse button.

A light gray broken-line box appears around the edge of the toolbar.

3. Still holding the left mouse button down, move the gray outline box to a new location on the screen.
4. Release the left button.

The toolbar will appear in the new location.

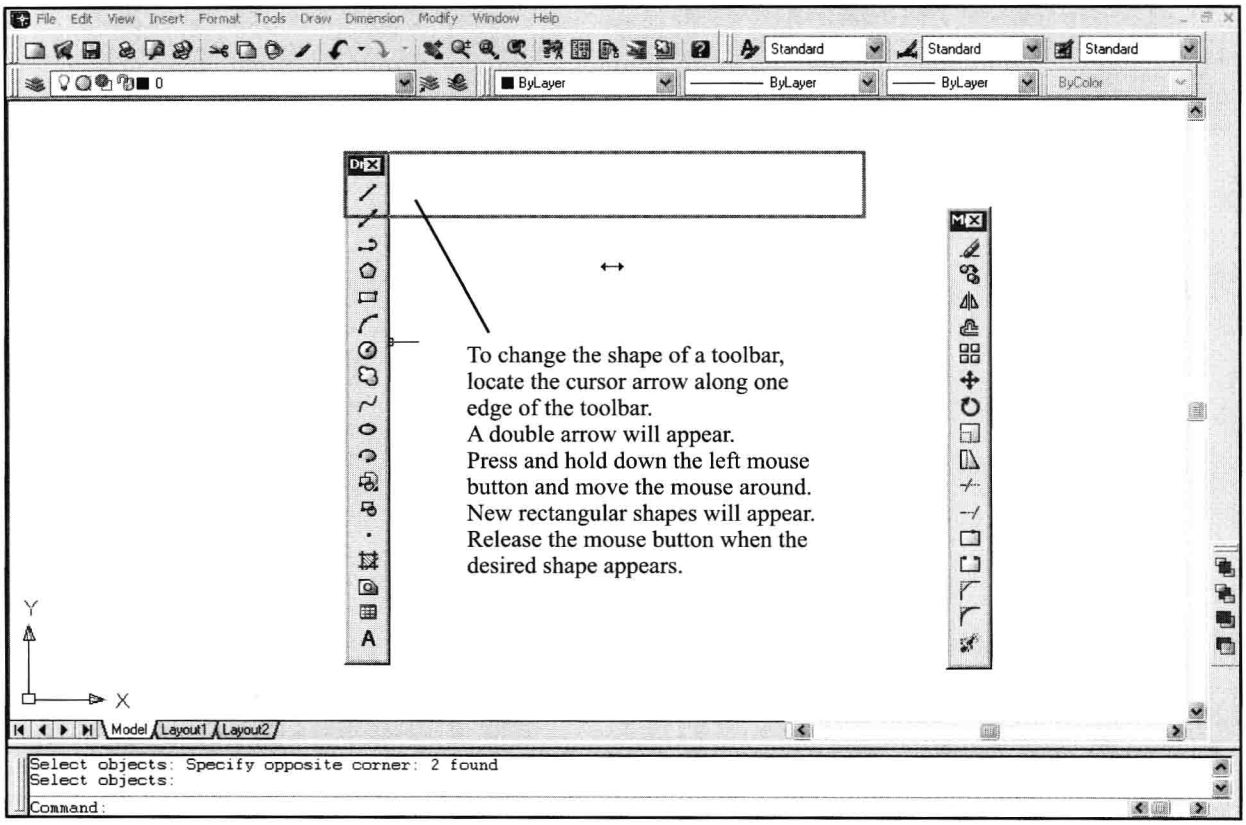


Figure 1-3

To change the shape of a toolbar

See Figure 1-3.

1. Locate the cursor arrow along the right edge of the Modify toolbox.

   A double arrow will appear.

2. Press and hold the left mouse button.

   A light gray broken-line box will appear around the outside of the toolbar.

3. Still holding the left mouse button down, move the mouse around and watch how the gray box changes shape.

4. When the gray toolbar shape is a long, vertical rectangle, release the left mouse button.

   A reshaped toolbar will appear.

To return the toolbar to its original location and shape

1. Locate the cursor arrow along the bottom or edge lines of the toolbar and return the toolbar to its original shape using the procedure outlined in Figure 1-3.
2. Move the reshaped toolbar to its original location along the left side of the drawing screen using the procedure outlined in Figure 1-2.

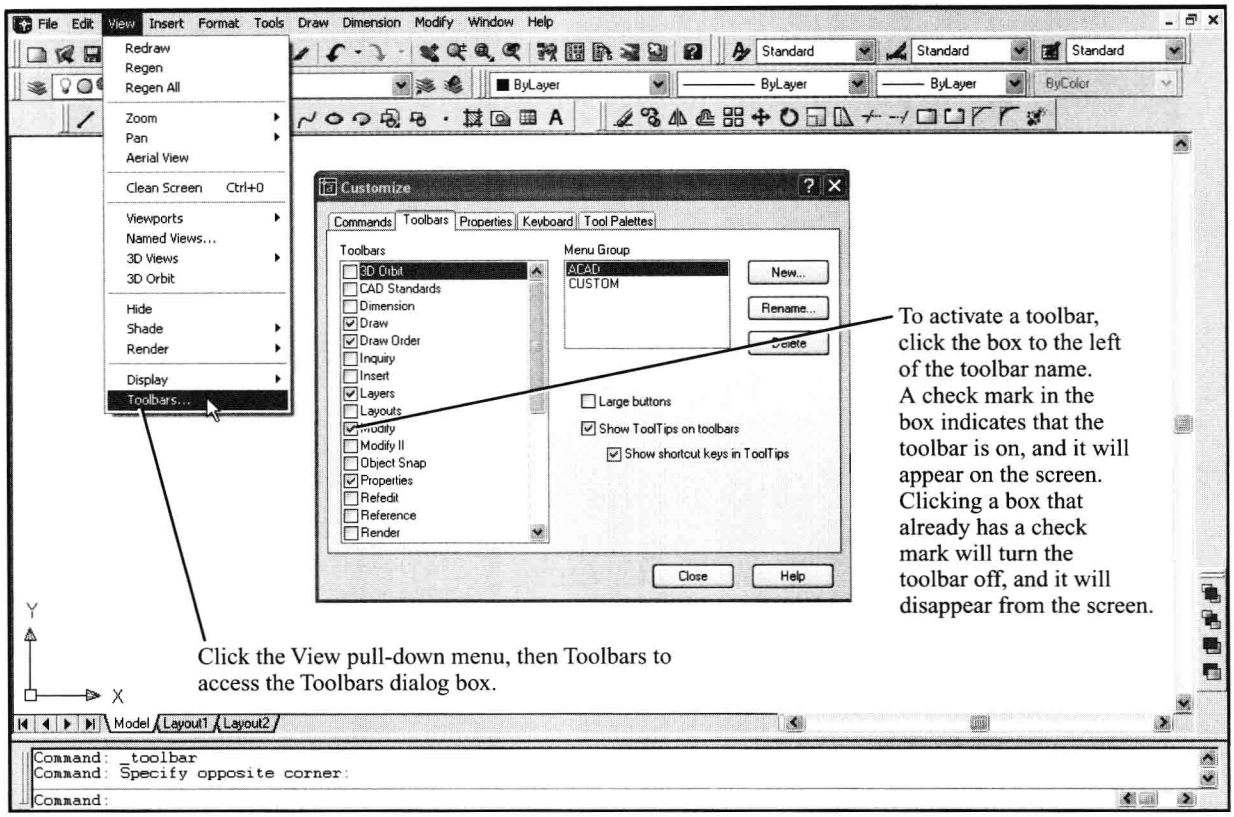


Figure 1-4

To add a new toolbar to the screen

See Figures 1-4 and 1-5.

1. Locate the cursor arrow on the View pull-down menu heading and press the left mouse button.
2. Select the item Toolbars (locate the cursor arrow on the word Toolbars and press the left mouse button).

The Toolbars dialog box will appear with a listing of all toolbars. See Figure 1-4.

3. Select Dimension.

The Dimension toolbar will appear. See Figure 1-5. Any toolbar can be moved or have its shape changed as described in Figures 1-2 and 1-3.

To remove a toolbar from the screen

1. Locate the cursor arrow on the check mark located in the upper right corner of the toolbar and press the left mouse button.

Figure 1-5 shows the Draw and Modify toolbars docked horizontally at the top of the drawing screen. The Dimension toolbar will initally appear within the drawing area of the screen, as will any other toolbar activated. Toolbars can then be moved to different locations as explained. If the toolbar is located close to either the top or sides of the drawing screen, it will blend into the area surrounding the drawing area and will no longer be within the drawing area.

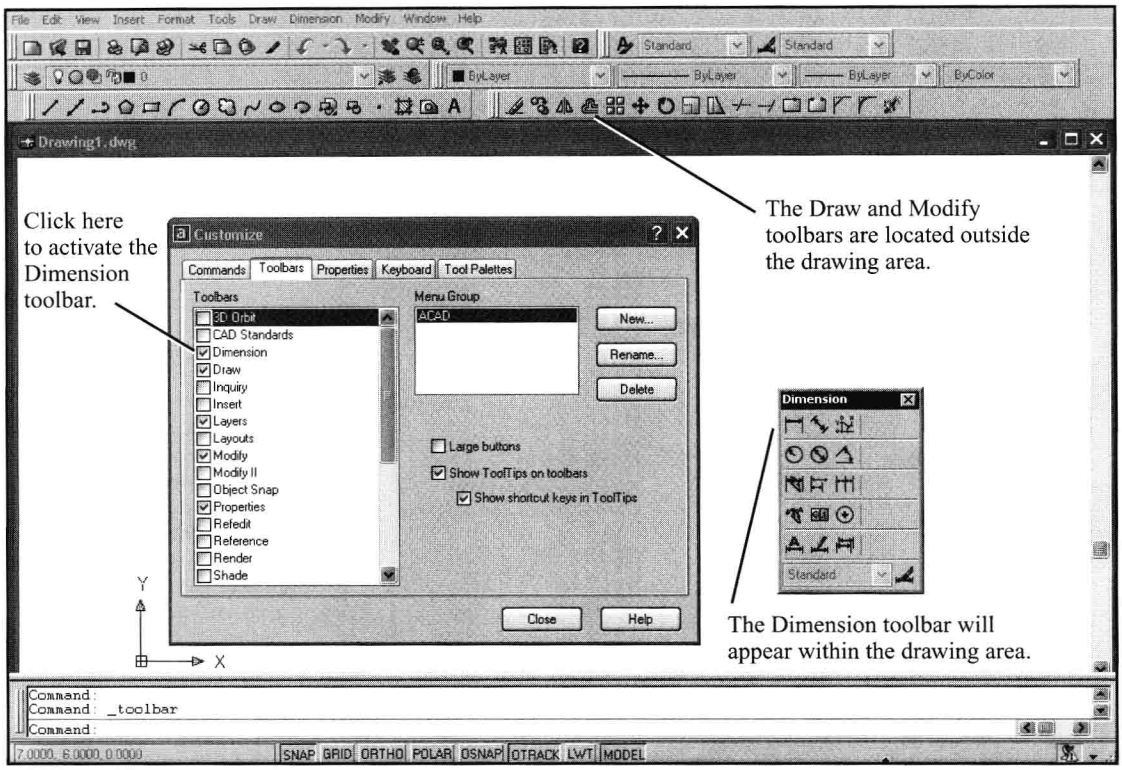


Figure 1-5

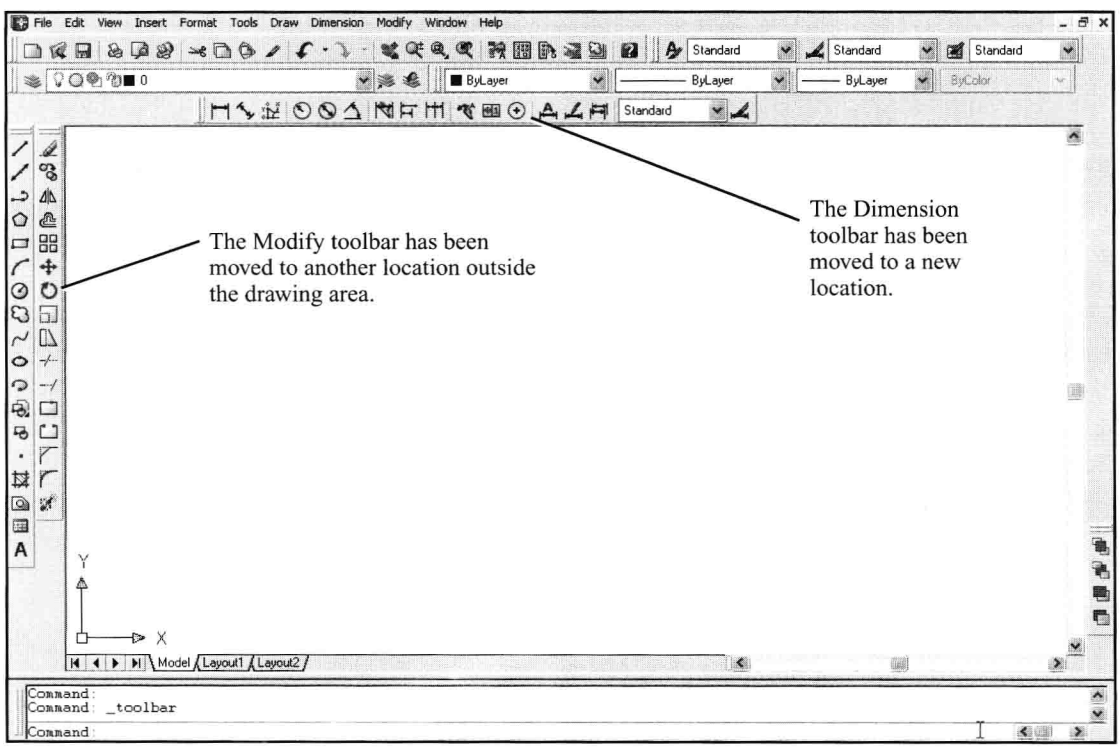


Figure 1-6

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