# CHAPTER 5

# Line Standards and Layers

## Learning Objectives

*After completing this chapter, you will be able to:*

✓ Describe basic line conventions.
✓ Explain the concept of layers in a CADD drawing.
✓ Describe how drawing layers are used in various drafting fields.
✓ Create and manage layers.
✓ Use **DesignCenter** to copy layers and linetypes between drawings.

AutoCAD has a layer system that allows you to organize and assign several properties to objects. *Layers* help you conform to drawing standards and conventions and create various displays, views, and sheets. This chapter introduces line conventions and the AutoCAD layer system. It also introduces **DesignCenter** as a tool for reusing drawing content.

**layers:** Components of the AutoCAD overlay system that allow you to separate objects into logical groups for formatting and display purposes.

## Line Standards

Drafting is a graphic language that uses lines, symbols, and text to describe how to manufacture or construct a product. *Line conventions* provide a way to classify the content of a drawing to enhance readability. Layers allow you to apply line conventions while drawing with AutoCAD. Use line conventions as a guide to develop layers.
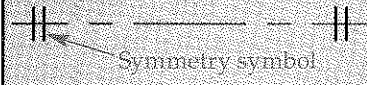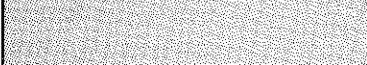
**line conventions:** Standards related to line thickness, type, and purpose.

The ASME Y14.2 standard, *Line Conventions and Lettering*, recommends two line thicknesses to establish contrasting lines: lines are thick or thin. Thick lines are twice as thick as thin lines. The recommended thicknesses are 0.6 mm for thick lines and 0.3 mm for thin lines. Figure 5-1 describes common linetypes. Figure 5-2 shows an example of a drawing with several common linetypes.

The US National CAD Standard (NCS) recommends specific line thicknesses and characteristics for architectural and similar drawings. Thicknesses range from *extra fine* at 0.13 mm to *4X* at 2 mm. Use the range of NCS-recommended line thicknesses to provide accents to drawings as needed. A common practice is to select a few of the line thicknesses that correlate best to specific applications. See Figure 5-3.

Figure 5-1.
Line conventions adapted from ASME Y14.2, *Line Conventions and Lettering*. Line characteristics and spacing are measured at full scale. Specifications vary according to drawing size.

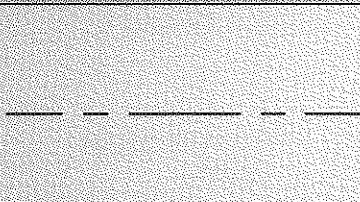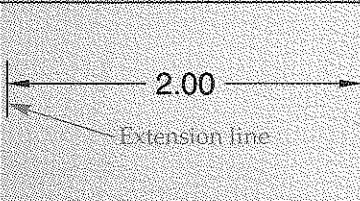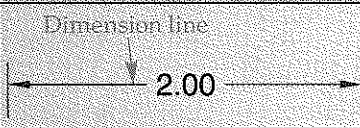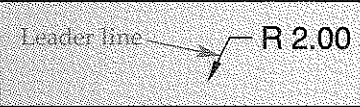| Line Conventions | | | |
|---|---|---|---|
| **Appearance** | **Purpose** | **Characteristics** | **AutoCAD Linetype** |
| **Object line** | | | |
| | Show the visible contour or outline of objects. | Thick (0.6 mm), solid. | Continuous |
| **Hidden line** | | | |
| | Represent features hidden in a view. | Thin (0.3 mm), dashed. Dashes are .125″ (3 mm) long and are spaced .06″ (1.5 mm) apart. | HIDDEN or DASHED |
| **Centerline** | | | |
| | Identify centers and axes of circular features and lines of symmetry for symmetrical objects. | Thin (0.3 mm). Consists of one .125″ (3 mm) dash alternating with one .75″ to 1.5″ (19 mm to 38 mm) dash. A .06″ (1.5 mm) space separates dashes. Extends .125″ to .25″ (3 mm to 6 mm) past objects. See Chapter 18. | CENTER |
| **Symmetry line** | | | |
| Symmetry symbol | Identify lines of symmetry for symmetrical objects. | Thin (0.3 mm) centerline with thick (0.6 mm) symmetry symbol. Symbol lines are 1.5 times longer than and spaced half the height of dimension text. | CENTER for line of symmetry and Continuous for symmetry symbol |
| **Section line** | | | |
| | In a section view, show where material has been cut away. | Thin (0.3 mm), usually drawn in a pattern. Different types of lines and patterns can be used to indicate specific materials or components. See Chapter 23. | Continuous |
| **Phantom line** | | | |
| | Identify repetitive details, show alternate positions of moving parts, and locate adjacent positions of related parts. | Thin (0.3 mm). Two .125″ (3 mm) dashes alternating with one .75″ to 1.5″ (19 mm to 38 mm) dash. Spaces between dashes are .06″ (1.5 mm). | PHANTOM |

*(Cont.)*
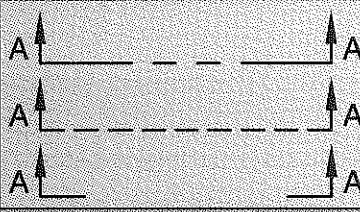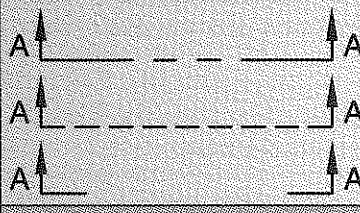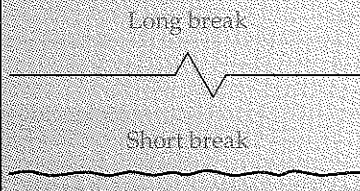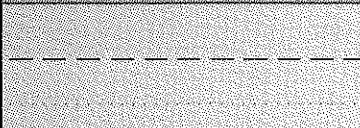
| Line Conventions (Cont.) | | | |
|---|---|---|---|
| **Appearance** | **Purpose** | **Characteristics** | **AutoCAD Linetype** |
| **Chain line** | | | |
| | Indicate special features or unique treatment for a surface. | Thick (0.6 mm). Consists of one .125″ (3 mm) dash alternating with one .75″ to 1.5″ (19 mm to 38 mm) dash. A .06″ (1.5 mm) space separates the dashes. | CENTER |
| **Extension line** | | | |
| ⊢——— 2.00 ———⊣   ~Extension line | Show the extent of a dimension. | Thin (0.3 mm), usually solid. Begins .06″ (1.5 mm) from an object and extends .125″ (3 mm) beyond the last dimension line. See Chapter 16. | Continuous |
| **Dimension line** | | | |
| Dimension line   ⊢——— 2.00 ———⊣ | Show the distance being measured. | Thin (0.3 mm), usually solid. See Chapter 16. | Continuous |
| **Leader line** | | | |
| Leader line ——⟋ R 2.00 | Connect a specific note to a feature on a drawing. | Thin (0.3 mm), solid. See Chapter 16. | Continuous |
| **Cutting-plane line** | | | |
| A⌐ _ _ _ ⌐A  A⌐ _ _ _ _ ⌐A  A⌐ _ _ ⌐A | Identify the location and viewing direction of a section view. | Thick (0.6 mm). See Chapter 23. | PHANTOM, Continuous, or DASHED |
| **Viewing-plane line** | | | |
| A⌐ _ _ _ ⌐A  A⌐ _ _ _ _ ⌐A  A⌐ _ _ ⌐A | Identify the location and viewing direction of a removed view. | Thick (0.6 mm). See Chapter 8. | PHANTOM, Continuous, or DASHED |
| **Break line** | | | |
| Long break  ——⋀——  Short break  ∼∼∼∼∼∼ | Show where a portion of an object has been removed for clarity or convenience. | Thin (0.3 mm) for long break lines and thick (0.6 mm) for short break lines, solid. Break representation is based on object or material being broken. | Continuous |
| **Stitch line** | | | |
| — — — — — — — | Identify the location of a stitching or sewing process. | Thin (0.3 mm), dashed or .01″ (0.3 mm) diameter dots. | HIDDEN, DASHED, or DOT |

**Figure 5-2.**
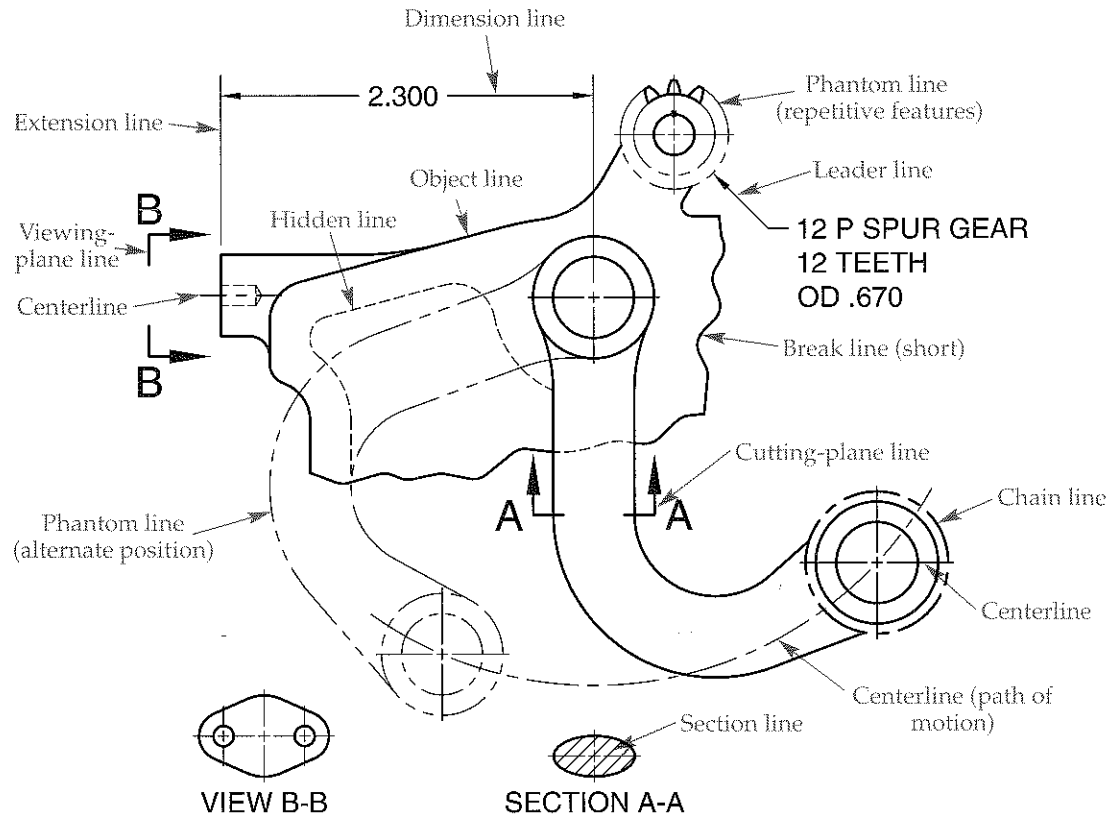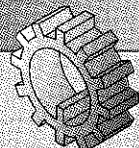An example of a mechanical assembly drawing with several common types of lines.



**Figure 5-3.**
Common US National CAD Standard line thicknesses.

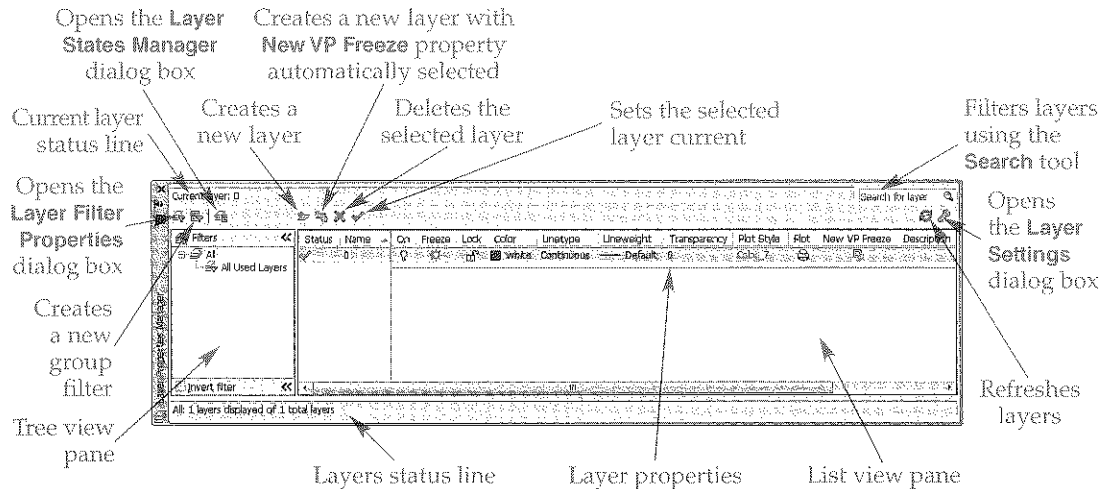| Thickness | Application |
|---|---|
| Thin, 0.25 mm | Dimension elements, phantom lines, hidden lines, centerlines, long break lines, schedule grid lines, and background objects. |
| Medium, 0.35 mm | Object lines, text for dimension values, notes and schedules, terminator marks, door and window elevations, and schedule grid accent lines. |
| Wide, 0.5 mm | Major object lines at elevation edges, cutting-plane lines, short break lines, title text, minor title underlines, and border lines. |
| Extra wide, 0.7 mm | Major title underlines, schedule outlines, large titles, special emphasis object lines, elevation and section grade lines, property lines, sheet borders, and schedule borders. |

**NOTE**

Many AutoCAD tools simplify and automate the process of applying correct line standards. You will learn applications and techniques for drawing specific types of lines in this textbook.

Figure 5-4.
The **Layer Properties Manager**. Layer 0 is the default layer. Pick an icon to change the corresponding layer setting.



The default 0 layer is the only required layer in an AutoCAD drawing. You cannot delete, rename, or *purge* the 0 layer. However, the 0 layer is primarily reserved for drawing blocks, as described later in this textbook. Draw each object on a layer specific to the object. For example, draw object lines on an Object layer, draw floor plan walls on an A-WALL layer, and draw construction lines on a Construction or A-ANNO-NPLT layer. Make a conscious effort to assign appropriate layers to objects.

**purge:** To remove unused items, such as block definitions and layers, from the drawing.

## Adding Layers

Add layers to a drawing to meet the needs of the drawing project. Use the **Layer Properties Manager** to add a new layer. Select an existing layer with properties similar to those you want to assign to the new layer. Reference the 0 layer to create the first new layer using a default template. Then pick the **New Layer** button, right-click in the list view and select **New Layer**, or press [Alt]+[N]. A new layer appears, using a default name. The layer name is highlighted, allowing you to type a new name. See Figure 5-5. Pick away from the layer in the list or press [Enter] to accept the layer.

### Layer Names

Name layers to reflect drawing content. Layer names can include letters, numbers, and certain other characters, including spaces. Layer names are usually set according to specific industry or company standards. Figure 5-6 provides examples of typical mechanical, architectural, civil, and electronic drafting layer names.

Figure 5-5.
AutoCAD names a new layer Layer*n* by default and provides the opportunity for you to change the name immediately.



Edit layer name
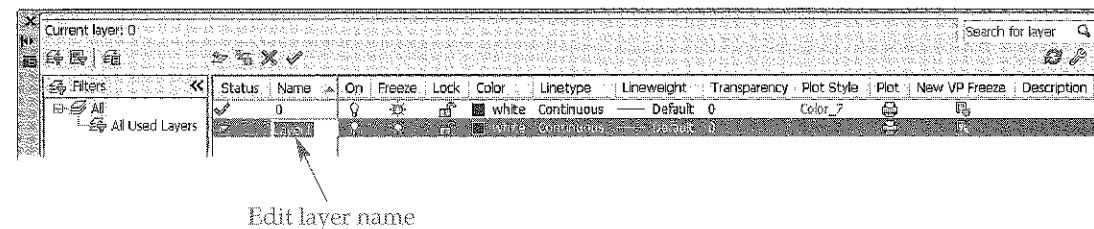
# Introduction to Layers

In AutoCAD, you can use an *overlay system* of layers to separate different objects and elements of a drawing. For example, you might choose to draw all visible object lines on an Object layer and all dimension objects on a Dimension layer. You can display both layers to show the complete drawing with dimensions or hide the Dimension layer to show only the visible objects. The following is a list of ways you can use layers to increase productivity and add value to a drawing:

- Assign each layer a different color, linetype, and lineweight to correspond to line conventions and to help improve clarity.
- Make changes to layer properties to update all objects drawn on the layer.
- Turn off or freeze selected layers to decrease the amount of information displayed on-screen or to speed up screen regeneration.
- Plot each layer in a different color, linetype, or lineweight, or set a layer not to plot.
- Use separate layers to group specific information. For example, draw a floor plan using floor plan layers, an electrical plan using electrical layers, and a plumbing plan using plumbing layers.
- Create several sheets from the same drawing file by controlling layer visibility to separate or combine drawing information. For example, use layers to display a floor plan and electrical plan together to send to an electrical contractor or to display a floor plan and plumbing plan together to send to a plumbing contractor.

**overlay system:** A system of separating drawing components by layer.

# Layers Used in Drafting Fields

The type of drawing typically determines the function of each layer. In mechanical drafting, you usually assign a specific layer to each different type of line or object. For example, draw object lines on an Object layer that is black in color, has a solid (Continuous) linetype, and is 0.6 mm wide. Draw hidden lines on a green Hidden layer that uses a 0.3 mm hidden (HIDDEN or DASHED) linetype.

Architectural and civil drawings may require hundreds of layers, each used to produce a specific item. For example, draw full-height floor plan walls on a black A-WALL-FULL layer that has a 0.5 mm solid (Continuous) linetype. Add plumbing fixtures to a floor plan on a blue P-FLOR-FIXT layer that has a 0.35 mm solid (Continuous) linetype.

You can create layers for any type of drawing: detail parts, assemblies, floor plans, foundation plans, partition layouts, plumbing systems, electrical systems, structural systems, roof drainage systems, reflected ceiling systems, HVAC systems, site plans, profiles, topographic maps, and details. Interior designers may use floor plan, interior partition, and furniture layers. Electronics drafters may draw each level of a circuit on its own layer.

# Creating and Using Layers

Use the **LAYER** command to open the **Layer Properties Manager**, where you can create and control layers. See Figure 5-4. The columns in the list view pane on the right side of the **Layer Properties Manager** list layers and provide layer property controls. Properties in each column appear as an icon or as an icon and a name. Pick a property to change the corresponding layer setting. The tree view pane on the left side of the **Layer Properties Manager** displays filters for limiting the number of layers displayed in the list view pane.
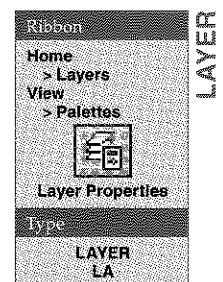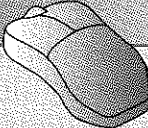
Ribbon
Home
> Layers
View
> Palettes

Layer Properties

Type
LAYER
LA

Figure 5-6.
Examples of typical layer names in common drafting fields.

| Mechanical | Architectural | Civil | Electronic |
|---|---|---|---|
| Object | A-WALL-FULL | G-BLDG | Capacitor |
| Hidden | A-GLAZ | C-WATR | Coil |
| Center | A-DOOR | C-TOPO | Resistor |
| Dimension | E-LITE | C-PROP | Diode |
| Construction | P-FLOR-FIXT | C-NGAS | Transistor |
| Section | S-FNDN | C-SSWR | Notation |
| Border | M-HVAC | C-ELEV | Coupling |

However, simple or generic drawings may use a more basic naming system. For example, the name Continuous-White indicates a layer assigned a continuous linetype and white color. The name Object-7 identifies a layer for drawing object lines, assigned color 7. Another option is to assign the linetype a numerical value. For example, name object lines 1, hidden lines 2, and centerlines 3. If you use this method, keep a written record of the numbering system for reference.

More complex layer names are appropriate for some applications, and may include items such as drawing number, color code, and layer content. For example, the name Dwg100-2-Dimen refers to drawing DWG100, color 2, for use when adding dimensions. The American Institute of Architects (AIA) *CAD Layer Guidelines*, associated with the US National CAD Standard, specifies a layer naming system for architectural and related drawings. The system uses a highly detailed layer naming process that assigns each layer a discipline designator and major group and, if necessary, one or two minor groups and a status field. The AIA system allows complete identification of drawing content.

Layer names are listed alphanumerically as you create new layers. See Figure 5-7. Pick any column heading in the list view to sort layer names in ascending or descending order according to that column. The **Layer Properties Manager** is a palette, so new layers and changes made to existing layers are immediately applied to the drawing. There is no need to "apply" changes or close the palette to see the effects of the layer changes in the drawing.

**PROFESSIONAL TIP**

To accelerate the process of creating multiple layers, press the comma key [,] after typing each layer name to create another new layer.

Figure 5-7.
Layer names are automatically listed in alphanumeric order when you create new layers or change layer names.



Layer names sort automatically
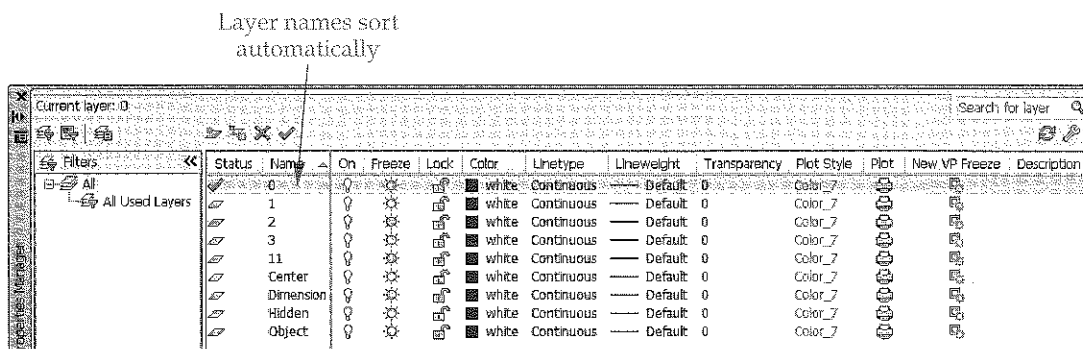
### Renaming Layers

To change a layer name using the **Layer Properties Manager**, slowly double-click on the existing name in the **Name** column to highlight it. Type the new name and press [Enter] or pick outside of the text box. You can also rename a layer by picking the name once to highlight it and then pressing [F2], or by right-clicking and selecting **Rename Layer**. You cannot rename layer 0 or layers associated with an external reference.

---

### Exercise 5-1

Complete the exercise on the companion website.
www.g-wlearning.com/CAD

---

## Selecting Multiple Layers

Select multiple layers to speed the process of deleting or applying the same properties to several layers. Use standard selection practices or the shortcut menu to select multiple layers. Hold [Shift] to select several consecutive layers, or hold [Ctrl] to select several nonconsecutive layers. You can also use a window to select all the layers that contact the window. The following selection options are available when you right-click in the list view:

- **Select All.** Selects all layers.
- **Clear All.** Deselects all layers.
- **Select All but Current.** Selects all layers except the current layer.
- **Invert Selection.** Deselects all selected layers and selects all deselected layers.

---

### Exercise 5-2

Complete the exercise on the companion website.
www.g-wlearning.com/CAD

---

## Layer Status

Current

Not in Use

In Use

The icon in the **Status** column describes the status, or use, of a layer. A green check mark indicates the *current layer*. The status line at the top of the **Layer Properties Manager** also identifies the current layer.

A gray sheet of paper, or **Not In Use** icon, in the **Status** column indicates a non-current layer that is not used by the drawing. A blue sheet of paper, or **In Use** icon, in the **Status** column means the layer is assigned to objects, but the layer is not current. The **In Use** icon also means that you cannot delete or purge the layer, even if no objects are assigned to the layer.

**current layer:**
The active layer. Whatever you draw is placed on the current layer.
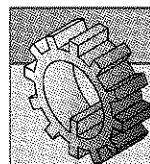
> **NOTE**
>
> If the **Layer Properties Manager** does not indicate layers in use, pick the **Settings** button in the upper-right corner to display the **Layer Settings** dialog box and select the **Indicate layers in use** check box.
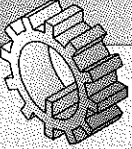
## Setting the Current Layer

To set a layer current using the **Layer Properties Manager**, double-click the layer name, pick the layer name and select the **Set Current** button, or right-click on the layer and choose **Set current**. You can also make a layer current without using the **Layer Properties Manager** by picking the layer name from the **Layer Control** drop-down list

in the **Layers** panel of the **Home** ribbon tab. See Figure 5-8. Use the vertical scroll bar to move up and down through a long list. The **Layer Control** drop-down list is a very effective way to activate and manage layers while drawing.

Command line content search offers another way to find a layer and make a layer current without using the **Layer Properties Manager**. Begin typing the letters in a layer name on the command line. Layers that match the letters you enter appear in the suggestion list as you type. Figure 5-9 shows the results of typing LITE at the command line to locate layers used to draw lighting symbols in an architectural drawing. You may need to search through the content category in the suggestion list to find the desired layer. Select a layer from the suggestion list to set current.
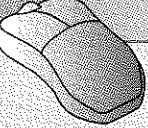
**NOTE**

You can use the **Layer Properties Manager** or the **Layer Control** drop-down list to change the current layer or layer properties while a command is active. For example, draw a line segment using the current layer, and then, without exiting the **LINE** command, make a different layer current to draw the next line segment on a different layer.

**PROFESSIONAL TIP**

To assign a different layer to existing objects, select the objects and then choose the layer using the **Layer Properties Manager** or the **Layer Control** drop-down list.

Figure 5-8.
The **Layer Control** drop-down list allows you to change the current layer and adjust specific layer properties.
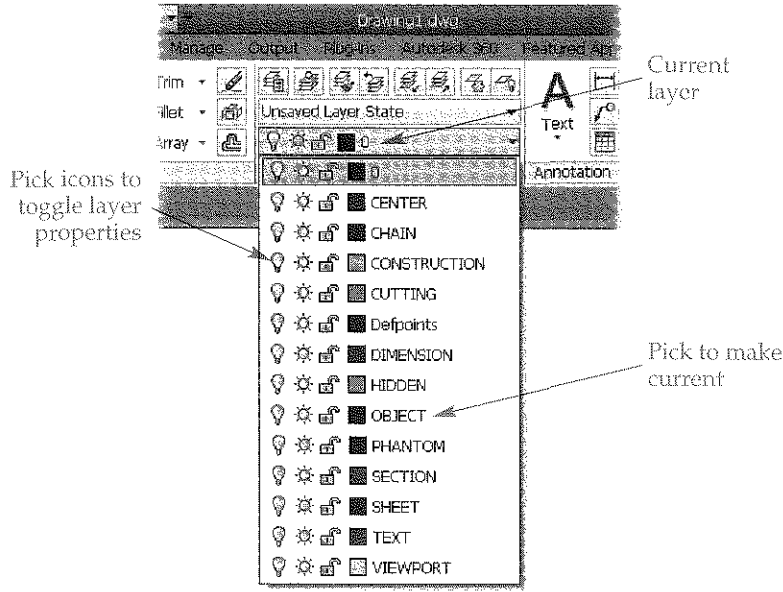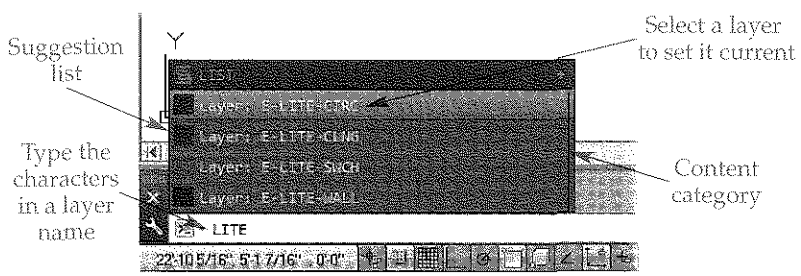


Figure 5-9.
Using command line content search to locate layers and set a specific layer current.

## Setting Layer Color

You can assign a unique color to each layer to help distinguish objects on-screen. You can also use layer colors to plot a drawing in color or to control object properties. Although plotting in color and controlling object properties using color are not common, assigning colors to layers is very important for on-screen drawing clarity, organization, workability, and format. Layer colors should highlight important features and symbols and not cause eyestrain.

Use the **Color** column of the **Layer Properties Manager** to assign a color to each layer. Pick the existing color swatch to change the color using the **Select Color** dialog box. See Figure 5-10. The **Select Color** dialog box includes an **Index Color** tab, a **True Color** tab, and a **Color Books** tab. Each tab provides a different method for color selection.

The default **Index Color** tab provides enough color options for most 2D drawings. The **Index Color** tab includes 255 color swatches, each numerically coded according to the AutoCAD Color Index (ACI). The first seven colors in the ACI have both a number and a name: 1 = red, 2 = yellow, 3 = green, 4 = cyan, 5 = blue, 6 = magenta, and 7 = white. The color white (number 7) appears white on the default dark-gray model space background. It appears black on the default white layout background.
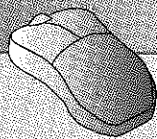
Hover over a color swatch to display the code in the **Index color:** field and the mix of red, green, and blue (RGB) used to create the color in the **Red, Green, Blue:** field. Pick a color swatch to select and display the color in the **Color:** text box, or type the color name or ACI number in the **Color:** text box. A preview of the color selection and a sample of the previously assigned color appear in the lower-right corner of the dialog box.

After you select a color, pick the **OK** button to assign the color to the specified layer. The layer color swatch indicates the color. By default, all objects are displayed in the selected layer color, or ByLayer.

---
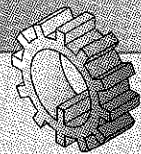
**NOTE**

Your graphics card and monitor affect color display characteristics and sometimes the number of available colors.

---

absolute value: In property settings, a value set directly instead of referenced by layer or by block. An absolute value overrides the corresponding layer settings.
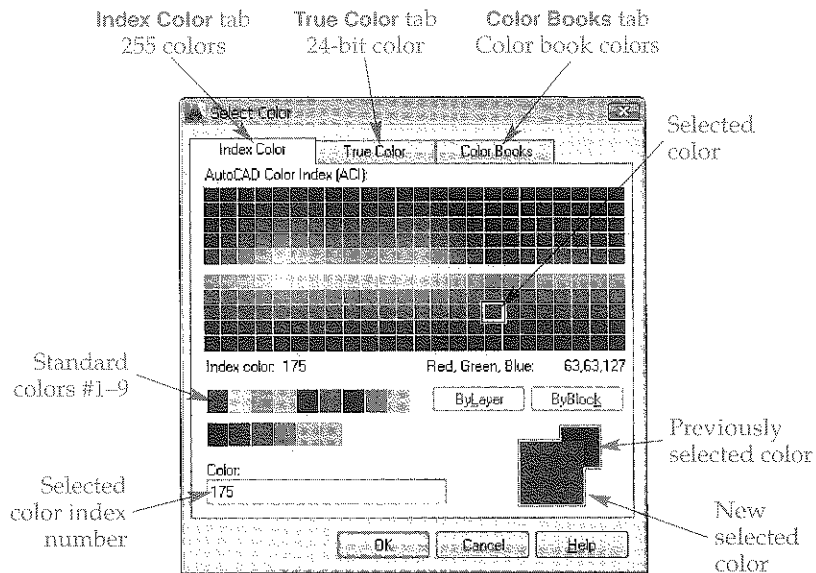
**PROFESSIONAL TIP**

Use the color swatch in the **Layer Control** drop-down list to change the color assigned to a layer without accessing the **Layer Properties Manager.**

---

COLOR

Type
COLOR
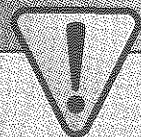
**CAUTION**

The **COLOR** command provides access to the **Select Color** dialog box, which you can use to set an *absolute value* for color. If you set the absolute color to red, for example, the red color overrides the colors assigned to layers, and all objects appear red. For most applications, set the color to the default ByLayer setting and use layers and the **Layer Properties Manager** to control object color.

---

Figure 5-10.
Use the **Select Color**
dialog box to assign
a color to a layer.

Index Color tab    True Color tab    Color Books tab
255 colors         24-bit color      Color book colors



Selected
color

Standard
colors #1–9

Index color: 175    Red, Green, Blue:    63,63,127

ByLayer    ByBlock

Previously
selected color

Selected
color index
number

Color:
175

New
selected
color

## Exercise 5-4

Complete the exercise on the companion website.
www.g-wlearning.com/CAD
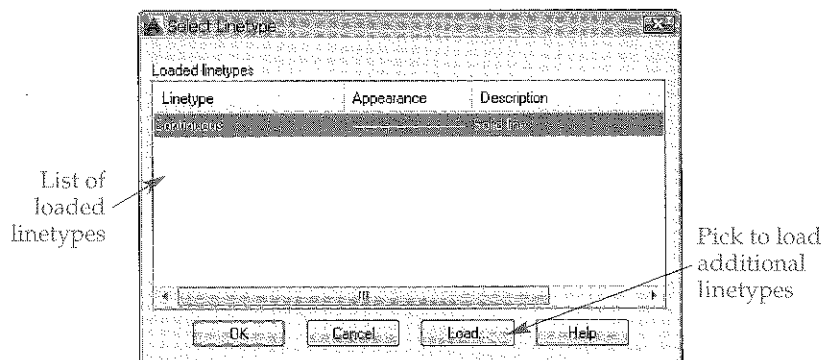
## Setting Layer Linetype

Appropriate linetypes and line thicknesses enhance the readability of a drawing.
You can apply standard line conventions to objects by assigning a linetype and thickness to each layer. AutoCAD provides standard linetypes that match or are similar to
ASME, ISO, NCS, and other standard linetypes. You can also create custom linetypes.
Assign lineweights to layers to achieve different line thicknesses.

Use the **Linetype** column of the **Layer Properties Manager** to assign a linetype to
each layer. Pick the existing linetype to change the linetype using the **Select Linetype**
dialog box. See Figure 5-11. By default, the Continuous linetype is the only linetype
in the **Loaded linetypes** list. Use the Continuous linetype to draw solid lines with no
breaks.

### Loading Linetypes

AutoCAD maintains linetypes in external linetype definition files. Before you
can apply a linetype other than Continuous to a layer, you must load the linetype into
the **Select Linetype** dialog box. Pick the **Load...** button to display the **Load or Reload**

Figure 5-11.
The **Select Linetype**
dialog box allows
you to load linetypes
for use in the current
drawing.



Loaded linetypes

| Linetype | Appearance | Description |
|----------|-----------|-------------|
| Continuous | | Solid line |

List of
loaded
linetypes

Pick to load
additional
linetypes

**Linetypes** dialog box. See Figure 5-12. The acad.lin or acadiso.lin file is active, depending on the template you use to begin the drawing. The acad.lin and acadiso.lin files are identical except that the acadiso.lin file applies a 25.4 scale factor to non-ISO linetypes to convert inches to millimeters for metric drawings. Pick the **File...** button and use the **Select Linetype File** dialog box to select a different linetype definition file.

The **Available Linetypes** list displays the name and a description and image of each linetype available from the active linetype definition file. Use the scroll bar to view all available linetypes, and use the image in the **Description** column to aid in selecting the appropriate linetypes to load. Choose a single linetype, or select multiple linetypes using standard selection practices or the shortcut menu. Pick the **OK** button to return to the **Select Linetype** dialog box, where the linetypes you selected now appear. See Figure 5-13. In the **Select Linetype** dialog box, pick the linetype to assign to the layer, and then pick the **OK** button. Figure 5-14 shows the HIDDEN linetype selected in Figure 5-13 assigned to the layer named Hidden.

---
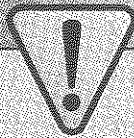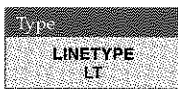
**CAUTION**

The **LINETYPE** command provides access to the **Linetype Manager,** which you can use to set an absolute value for linetype. If you set the absolute linetype to HIDDEN, for example, the HIDDEN linetype overrides the linetypes assigned to layers, and all objects appear in the HIDDEN linetype. For most applications, set linetype to ByLayer and use layers and the **Layer Properties Manager** to control object linetype.

---

Figure 5-12.
The **Load or Reload Linetypes** dialog box displays linetypes available for loading.

Select file where linetype definitions are stored

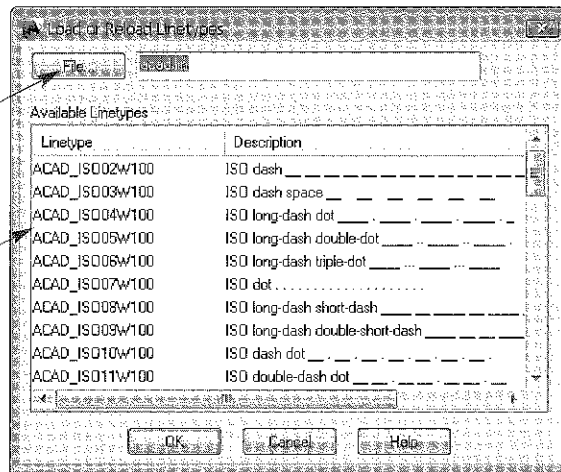Select linetypes to load into drawing



Figure 5-13.
Linetypes loaded into the drawing using the **Load or Reload Linetypes** dialog box appear in the **Loaded linetypes** list.
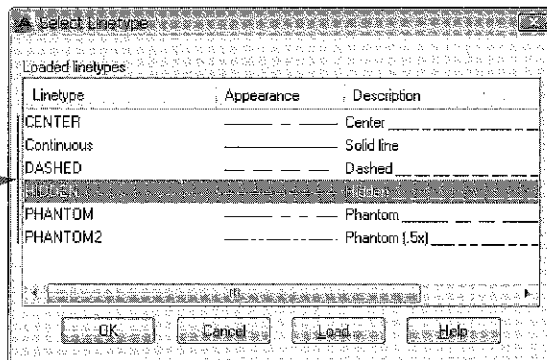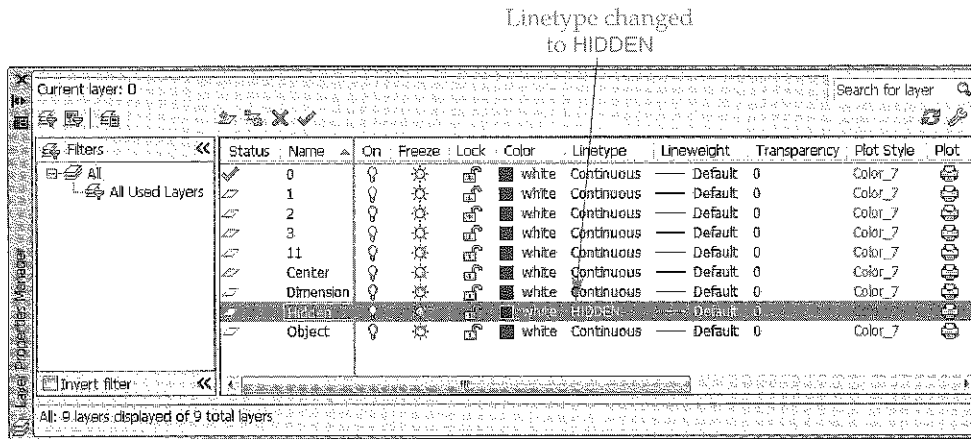
Loaded linetypes

Figure 5-14.
Objects drawn on the Hidden layer will have the HIDDEN linetype.

Linetype changed
to HIDDEN



## Exercise 5-5

Complete the exercise on the companion website.
www.g-wlearning.com/CAD

## Setting Linetype Scale

You can change the *linetype scale* to adjust the lengths of dashes and spaces in linetypes to make a drawing more closely match standard drafting practices. Changing the *global linetype scale* is the preferred method for adjusting linetype scale, but it is possible to change the linetype scale of specific objects.

Use the **LTSCALE** system variable to make a global change to the linetype scale. Enter LTS or LTSCALE at the keyboard and then enter a new value. The default global linetype scale factor is 1. A value less than 1 makes dashes and spaces smaller, and a value greater than 1 makes them larger. See Figure 5-15. After you enter a value and press [Enter], the drawing regenerates and the global linetype scale changes for all lines on the drawing. Experiment with different linetype scales until you achieve the desired results.

**linetype scale:** The lengths of dashes and spaces in linetypes.

**global linetype scale:** A linetype scale applied to every linetype in the current drawing.
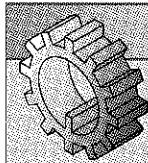
---
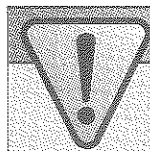
⚠ **CAUTION**

Be careful when changing linetype scales to avoid making your drawing look odd and not in accordance with drafting standards.

---

Figure 5-15.
The CENTER
linetype at different
linetype scales.

| Scale Factor | Line |
|--------------|------|
| 0.5 | — — — — — — — — — |
| 1.0 | — — — — — — — |
| 1.5 | — — — — — |

## Setting Layer Lineweight

**lineweight:** The assigned width of lines for display and plotting.

Assign a *lineweight* to a layer to manage the weight, or thickness, of objects. You can adjust the lineweight to match ASME, ISO, NCS, or other standards. Use the **Lineweight** column of the **Layer Properties Manager** to assign lineweight to each layer. Pick the existing lineweight to change the lineweight using the **Lineweight** dialog box. See Figure 5-16. The **Lineweight** dialog box displays fixed AutoCAD lineweights. Scroll through the **Lineweights:** list and select the lineweight to assign to the layer. Pick the **OK** button to apply the lineweight and return to the **Layer Properties Manager**.

### Lineweight Settings

LINEWEIGHT
=========

Type

LINEWEIGHT
LWEIGHT
LW

The **LINEWEIGHT** command provides access to the **Lineweight Settings** dialog box, shown in Figure 5-17. Use the **Units for Listing** area to set the lineweight thickness to **Millimeters (mm)** or **Inches (in)**. The units apply only to values in the **Lineweight** and **Lineweight Settings** dialog boxes, helping you to select lineweights based on a known unit of measurement.
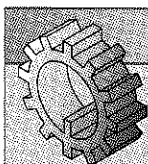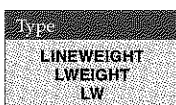
Check the **Display Lineweight** box to display object lineweight on-screen. Use the **Adjust Display Scale** slider to adjust the lineweight display scale to improve the appearance of lineweights when lineweight display is on. When lineweight display is off, all objects display a 0, or one-pixel, thickness regardless of the lineweight assigned to the layer. You can also toggle screen lineweight on and off using the **Show/Hide Lineweight** button on the status bar.

The **Default** drop-down list sets the value used when you assign the Default lineweight to a layer. The Default lineweight is an application setting and applies to any drawing you open. It is not template-specific and remains set until you change the value.

Figure 5-16.
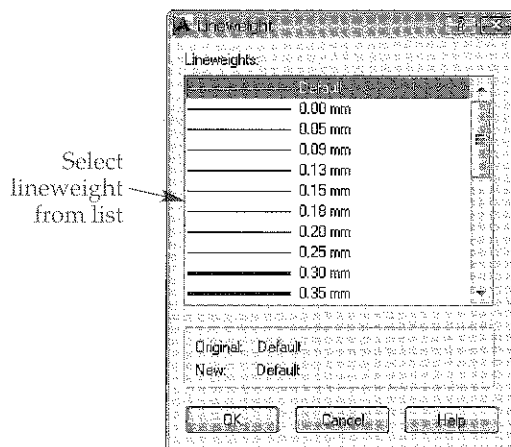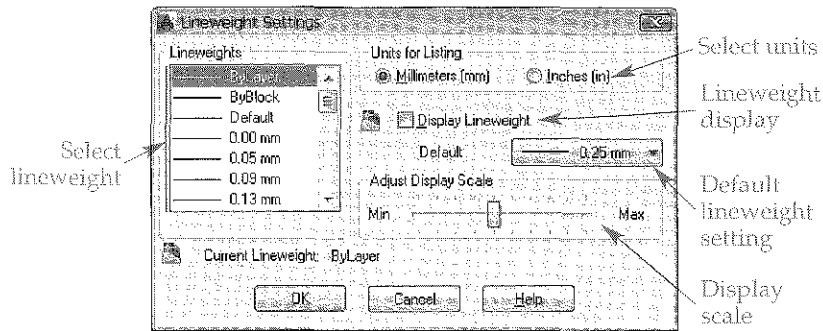Use the **Lineweight** dialog box to assign a lineweight to a layer.

Select lineweight from list

Lineweights:

Default
0.00 mm
0.05 mm
0.09 mm
0.13 mm
0.15 mm
0.18 mm
0.20 mm
0.25 mm
0.30 mm
0.35 mm

Original: Default
New: Default

OK    Cancel    Help

Figure 5-17.
The **Lineweight**
**Settings** dialog box.

Select units

Lineweight
display

Select
lineweight

Default
lineweight
setting

Display
scale

Do not assign the Default lineweight to layers if you anticipate using a different default lineweight for different drawing applications. Assign a specific lineweight, other than Default, to each layer to maintain flexibility and consistency between drawings.
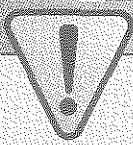
> **CAUTION**
>
> You can use the **Lineweights** list in the **Lineweight Settings** dialog box to set an absolute value for lineweight. If you set the absolute lineweight to 0.30 mm, for example, the 0.30 mm lineweight overrides the lineweights assigned to layers and all objects appear 0.30 mm thick. For most applications, set lineweight to ByLayer and use layers and the **Layer Properties Manager** to control object lineweight.

## Exercise 5-6

Complete the exercise on the companion website.
www.g-wlearning.com/CAD

## Layer Transparency

ASME standards recommend that all objects be opaque and dark for most applications. However, you can choose to draw transparent, or see-through, objects for specific drawing requirements, usually for architectural, civil, or technical illustration applications. For example, draw an existing building using transparent objects to highlight a proposed structure drawn using nontransparent objects.

### Setting Transparency

Use the **Transparency** column of the **Layer Properties Manager** to assign a level of transparency to each layer. Pick the existing transparency value to change the level of transparency using the **Layer Transparency** dialog box. See Figure 5-18. Type a value between 0 and 90 or select a value from the drop-down list.

Figure 5-18.
Use the **Layer Transparency** dialog box to assign a level of transparency to a layer.

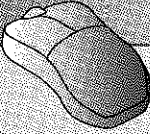Type a transparency value or select a value from the drop-down list
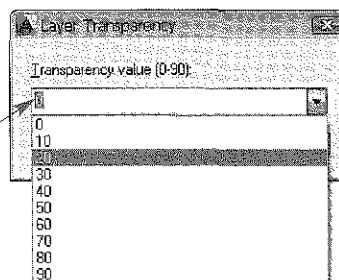
The default layer transparency value of 0 creates nontransparent objects, appropriate for most layers. A higher transparency value increases transparency. Any object drawn on a transparent layer appears transparent. One type of object that is commonly made transparent is a hatch, which fills an area with a pattern, solid, or gradient. See Figure 5-19. Chapter 23 explains creating hatch objects.

### Showing and Hiding Transparency

Show or hide transparency using the **Show/Hide Transparency** button on the status bar. Transparency is on by default, and all objects drawn using a transparent layer appear at their transparent level. Disabling transparency using the **Show/Hide Transparency** button makes all transparent objects appear nontransparent, but does not change the layer transparency property.

> **CAUTION**
> You can override layer transparency for specific objects, but for most applications, set transparency to ByLayer and use layers and the **Layer Properties Manager** to control object transparency.

> **PROFESSIONAL TIP**
> Layers should simplify and support drafting. Set color, linetype, lineweight, and transparency using layers and do not override these properties for individual objects. Also, once you establish layers, avoid resetting and mixing color, linetype, lineweight, and transparency, which can lead to confusion and disorder.

Figure 5-19.
An example of a portion of a storm water pollution control plan with transparent solid hatch objects that represent different impervious and non-impervious surfaces.
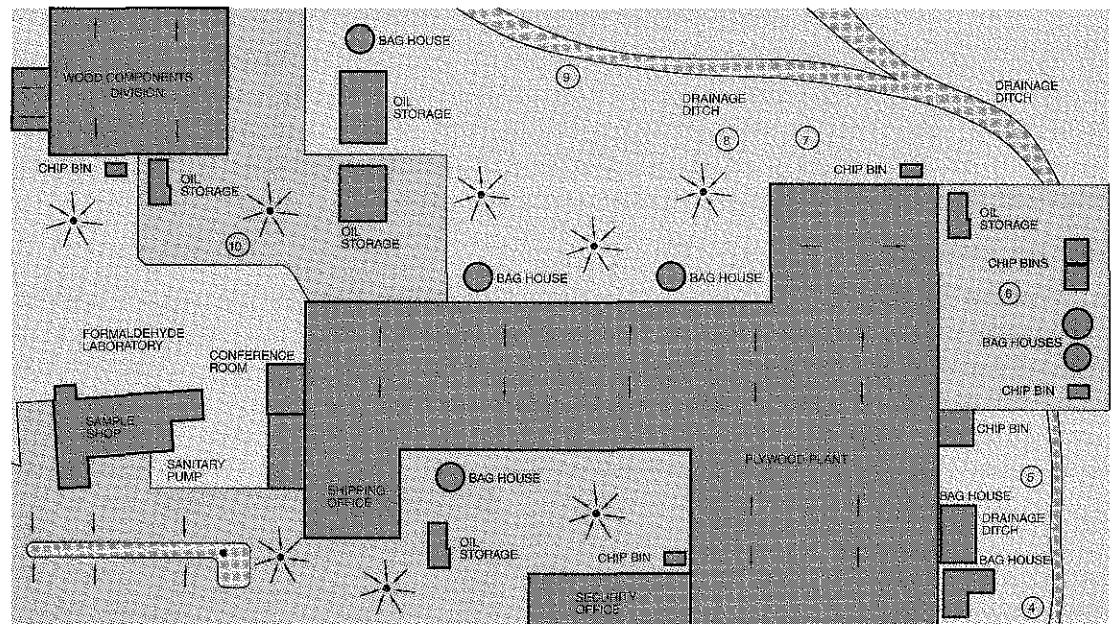
## Layer Plotting Properties

Use the **Plot Style** column of the **Layer Properties Manager** to assign a named plot style to each layer. AutoCAD uses color-dependent plot styles by default, so the plot style property is disabled. This textbook explains plot styles when appropriate.

Use the **Plot** column of the **Layer Properties Manager** to disable a layer from printing or plotting. Pick the printer, or **Plot**, icon to change it to the **No Plot** icon if the layer should not plot. The layer displays on-screen and is selectable, but does not plot.
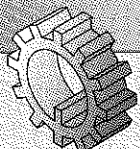
Plot   No Plot

## Adding a Layer Description

Use the **Description** column of the **Layer Properties Manager** to describe each layer. To add or change a description, slowly double-click on the blank area or existing description, type a description, and press [Enter] or pick outside of the **Description** text box. Another method is to right-click and select **Change Description**.

## Turning Layers On and Off

Use the **On** column of the **Layer Properties Manager** to turn a layer on or off. The lit light bulb, or **On** icon, indicates that the layer is turned on. Objects assigned to an "on" layer display on-screen and can be selected, regenerated, and plotted. Pick the lit light bulb to turn the layer off, indicated by the gray light bulb, or **Off** icon. Objects assigned to an "off" layer do not display on-screen and do not plot. You can select and edit objects that are off using advanced selection techniques. Objects that are off can also be regenerated.

On   Off

> **NOTE**
> Turn layers on or off using the **Layer Control** drop-down list in the **Layers** panel of the **Home** ribbon tab.
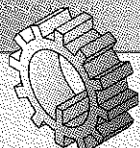
## Freezing and Thawing Layers

Use the **Freeze** column of the **Layer Properties Manager** to freeze or thaw a layer. The sun, or **Thaw** icon, indicates a thawed layer. Objects assigned to a thawed layer display on-screen and can be selected, regenerated, and plotted. Pick the sun to freeze the layer, indicated by the snowflake, or **Freeze** icon. Objects assigned to a frozen layer do not display on-screen, and cannot be plotted or regenerated. You cannot select or edit objects that are frozen. Freeze layers to hide objects and ensure that you do not accidentally modify the objects.

Freeze   Thaw

Use the **New VP Freeze** column to control thawing or freezing of layers when you create a new viewport. Additional layer functions also apply to layouts and viewports. This textbook explains layouts and viewports when appropriate.

VP Freeze

VP Thaw

> **NOTE**
> You can also freeze or thaw layers using the **Layer Control** drop-down list in the **Layers** panel of the **Home** ribbon tab. You cannot freeze the current layer or make a frozen layer current.
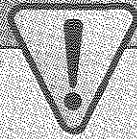
## Locking and Unlocking Layers

**Lock   Unlock**

Use the **Lock** column of the **Layer Properties Manager** to lock or unlock a layer. The unlocked padlock, or **Unlock** icon, indicates an unlocked layer. Pick the unlocked padlock to lock the layer, indicated by the locked padlock, or **Lock** icon. A **Lock** icon also appears next to the cursor when you hover over an object on a locked layer. Objects assigned to a locked layer display on-screen, and you can use a locked layer to draw new objects. However, you cannot select or edit locked objects. Lock layers to display objects but eliminate the possibility of selecting the objects.
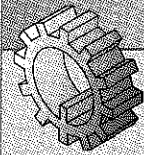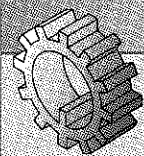
**NOTE**

You can also lock or unlock layers using the **Layer Control** drop-down list in the **Layers** panel of the **Home** ribbon tab.

### Locked Layer Fading

By default, all locked layers fade, allowing unlocked layers to stand out on-screen. The quickest way to control locked layer fading is to use the options available in the expanded **Layers** panel of the **Home** ribbon tab. See Figure 5-20. Pick the **Locked Layer Fading** button to allow or disable locked layer fading. Use the **Locked Layer Fading** slider to increase or decrease fading, or type a fading percentage between 0 and 90. The default fade value is 50%. A higher fade value increases fading. Figure 5-21 shows an example of using locked layer fading on an architectural drawing.

**NOTE**

Transparency is a layer property that makes objects transparent. Locked layer fading is a function of the lock state, intended for on-screen drawing purposes only. For example, you can plot transparent objects, but you cannot plot the display created by locked faded layers.

Figure 5-20.
Locked layers fade by default. Increase or decrease fading and enable or disable locked layer fading as needed.

Pick to enable or disable locked layer fading

Slide the bar to display a new fade value
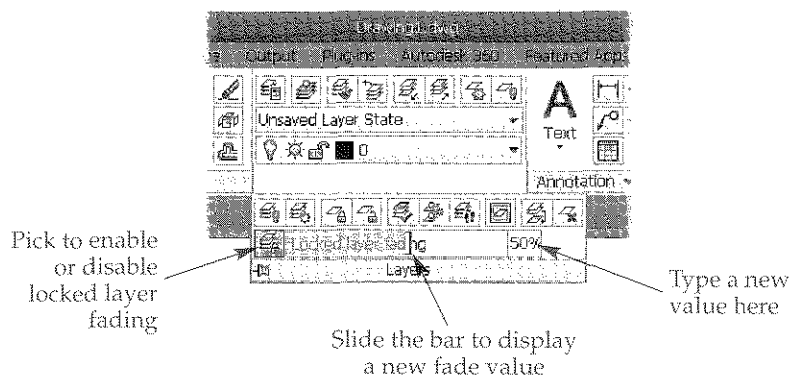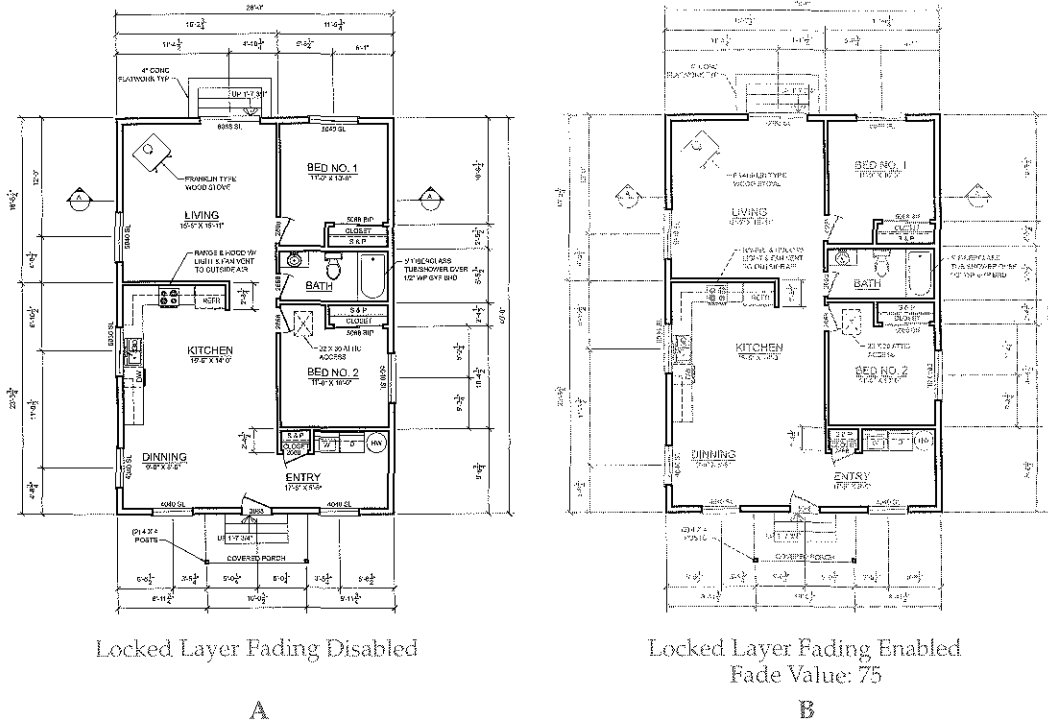
Type a new value here

Figure 5-21.
An example of a floor plan with all layers locked except the A-WALL-FULL layer, which contains the walls. A—Locked layer fading disabled. B—Locked layer fading enabled and set to a fade value of 75.



Locked Layer Fading Disabled

A

Locked Layer Fading Enabled
Fade Value: 75

B

## Deleting Layers

To delete a layer using the **Layer Properties Manager**, select the layer and pick the **Delete Layer** button, or right-click on the layer and choose **Delete Layer**. You cannot delete or purge the 0 layer, the current layer, layers containing objects, or layers associated with external references.

## Adjusting Property Columns

To resize a column in the **Layer Properties Manager**, move the cursor over the column edge to display the resize icon and drag the column width. Maximize column width to show the full heading or longest value in the column. To maximize the width of a specific column, double-click on the column edge, or right-click on the heading and select **Maximize column**. To maximize the width of all columns, right-click on any heading and select **Maximize all columns**.

Optimize column width to show the longest value in columns that list properties as text and reduce the width of columns that list properties as icons. To optimize the width of a specific column, right-click on the heading and select **Optimize column**. To optimize the width of all columns, right-click on any heading and select **Optimize all columns**.

By default, a vertical bar appears on the right side of the **Name** column. Any column to the left of the bar is "frozen" to remain in position when you move the scroll bar near the bottom of the **Layer Properties Manager**. Scroll columns to the right of the vertical bar using the horizontal scroll bar. To disable the column freeze function, right-click on a heading and select **Unfreeze column**. Right-click on a heading and select **Freeze column** to turn on the freeze function for the selected column and every column to its left.

To hide a column in the **Layer Properties Manager**, right-click on a heading and deselect the column name. Another option is to right-click on a heading and select **Customize...** to display the **Customize Layer Columns** dialog box. Deselect the check boxes corresponding to the columns to hide. To move a column left or right in the **Layer Properties Manager**, pick a column name and select the **Move Up** or **Move Down** button. Reset the display of all property columns to their default settings by right-clicking on a heading and selecting **Restore all columns to defaults**.

---

**Supplemental** *Additional Layer Commands*
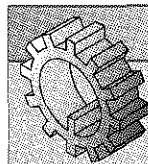
**Material** For information about additional layer commands, go to the companion website, navigate to this chapter in the **Contents** tab, and select **Additional Layer Commands**.
www.g-wlearning.com/CAD

---

## Introduction to Layer Filters

The filter tree view pane on the left side of the **Layer Properties Manager** controls *layer filters*. See Figure 5-22. Layer filters are appropriate when it becomes difficult to manage a very large number of layers. Filter a large list of layers to make it easier to work with only those layers needed for a specific drawing task.
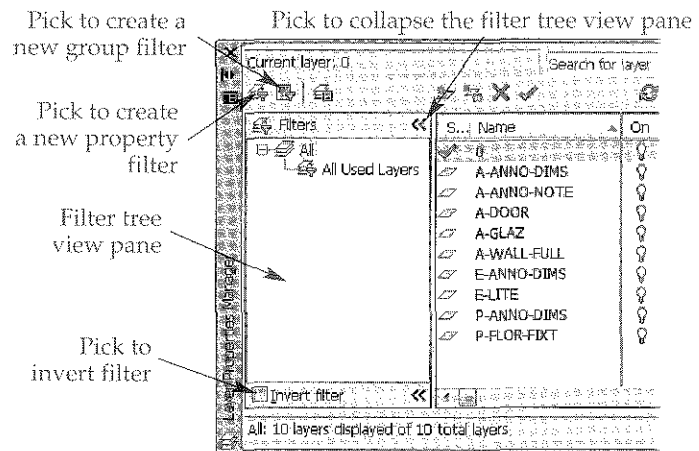
Layer filters are listed in alphabetical order inside the All node. Select the All node to display all layers in the drawing. Pick the **All Used Layers** filter to display only layers used to create objects in the drawing. When you insert external references and save the drawing, an Xref filter node appears, allowing you to filter the display of layers associated with external references. This textbook explains external references when appropriate. You can create custom filters as needed.

> **layer filters:**
> Settings that screen out, or filter, layers you do not want to display in the list view pane of the **Layer Properties Manager**.

> **NOTE**
> Collapse the filter tree view of the **Layer Properties Manager** by picking the **Collapse Layer filter tree** button. To display all filters and layers in the list view, right-click in the layer list area and select **Show Filters in Layer List**.

---

Figure 5-22.
Create and restore layer filters using the filter tree view of the **Layer Properties Manager**.



Pick to create a new group filter

Pick to create a new property filter

Filter tree view pane

Pick to invert filter

Pick to collapse the filter tree view pane

## Layer States

Once you save a *layer state*, you can readjust layer settings to meet drawing tasks, with the option to restore a saved layer state when needed. For example, a basic architectural drawing might use the layers shown in Figure 5-22. You can use the drawing file to prepare a floor plan, a plumbing plan, and an electrical plan. Figure 5-23 shows the layer settings for each of the three plans.
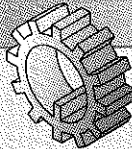
Save each of the three groups of settings as an individual layer state. Then restore a layer state to return the layer settings for a specific drawing. This method is easier than changing the settings for each layer individually.

Use the **Layer States Manager**, shown in Figure 5-24, to create a new layer state. Pick the **New...** button to display the **New Layer State to Save** dialog box. See Figure 5-25. Type a name in the **New layer state name:** text box and a description in the **Description** text box. Pick the **OK** button to save the new layer state. Once you create a layer state, you can adjust layer properties as needed. Figure 5-26 describes the areas, options, and buttons available in the **Layer States Manager**.

**layer state:** A saved setting, or state, of layer properties for all layers in the drawing.

**NOTE**

You can also access the **Layer States Manager** by picking the **Layer States Manager** button from the **Layer Properties Manager** or by right-clicking in the layer list view of the **Layer Properties Manager** and selecting **Restore Layer State....** To save a layer state outside the **Layer States Manager**, pick **New Layer State...** from the **Layer State** drop-down list in the **Layers** panel on the **Home** ribbon tab.

Figure 5-23.
A basic example of using layer states to manage the layers needed for several different architectural plans.

| Layer | Description | Floor Plan | Plumbing Plan | Electrical Plan |
|---|---|---|---|---|
| 0 | | Off | Off | Off |
| A-ANNO-DIMS | Floor Plan Dimensions | On | Frozen | Frozen |
| A-ANNO-NOTE | Floor Plan Notes | On | Frozen | Frozen |
| A-DOOR | Doors | On | Frozen | Locked |
| A-GLAZ | Windows | On | Frozen | Locked |
| A-WALL-FULL | Full Height Walls | On | Locked | Locked |
| E-ANNO-DIMS | Electrical Panel Dimensions | Frozen | Frozen | On |
| E-LITE | Electrical Plan Lights | Frozen | Frozen | On |
| P-ANNO-DIMS | Plumbing Plan Dimensions | Frozen | On | Frozen |
| P-FLOR-FIXT | Plumbing Plan Fixtures | Locked | On | Locked |

Figure 5-24.
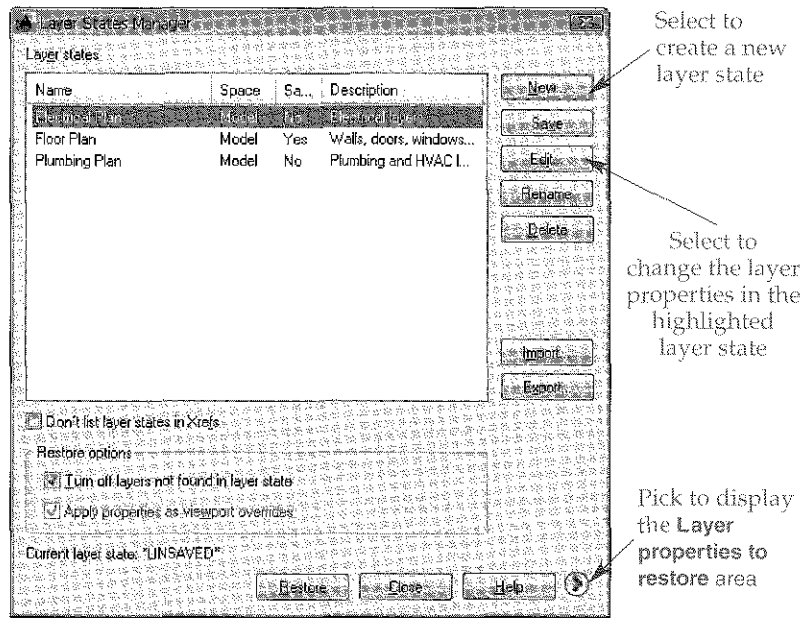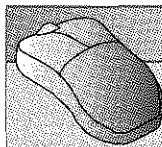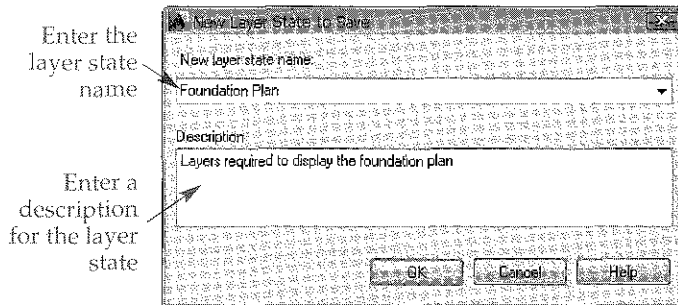The **Layer States Manager** allows you to save, restore, and manage layer settings.



Select to create a new layer state

Select to change the layer properties in the highlighted layer state

Pick to display the **Layer properties to restore** area

Figure 5-25.
Creating a new layer state.

Enter the layer state name

Enter a description for the layer state



**PROFESSIONAL TIP**

Importing a layer state file (.las file) to a drawing that does not contain any layers other than 0 adds the layers from the layer state file to the drawing.

After you create a layer state, you can restore layer properties to the settings saved in the layer state at any time. To activate a layer state using the ribbon, select it from the **Layer State** drop-down list in the **Layers** panel on the **Home** ribbon tab. You can also restore a layer state using the **Layer States Manager** by selecting the layer state from the list and picking the **Restore** button.

**Supplemental Material** *Layer Settings*

For information about options available in the **Layer Settings** dialog box, go to the companion website, navigate to this chapter in the **Contents** tab, and select **Layer Settings**.
www.g-wlearning.com/CAD

Figure 5-26.
Layer state options available in the **Layer States Manager.**

| Item | Description |
|------|-------------|
| **Layer states** | Displays saved layer states. The **Name** column provides the name of the layer state. The **Space** column indicates whether the layer state was saved in model space or paper space. The **Same as DWG** column indicates whether the layer state is the same as the current layer properties. The **Description** column lists the layer state description added when the layer state was saved. |
| **Save** | Pick to resave and override the selected layer state with the current layer properties. |
| **Edit...** | Opens the **Edit Layer State** dialog box, where you can adjust the properties of each layer state without exiting the **Layer States Manager.** |
| **Rename** | Activates a text box that allows you to rename the current layer state. |
| **Delete** | Deletes the selected layer state. |
| **Import...** | Opens the **Import layer state** dialog box, used to import an LAS file containing an existing layer state into the **Layer States Manager.** |
| **Export...** | Opens the **Export layer state** dialog box, used to save a layer state as an LAS file. The file can be imported into other drawings, allowing you to share layer states between drawings containing identical layers. |
| **Don't list layer states in Xrefs** | Hides layer states associated with external reference drawings. External references are described in Chapter 31. |
| **Restore options** | Check the **Turn off layers not found in layer state** check box to turn off new layers or layers removed from a layer state when the layer state is restored. Check **Apply properties as viewport overrides** to apply property overrides when you are adjusting layer states within a layout. |
| **Layer properties to restore** | Check the layer properties that you want to restore when the layer state is restored. Pick the **Select All** button to pick all properties. Pick the **Clear All** button to deselect all properties. |

# Reusing Drawing Content

In nearly every drafting discipline, many of the drawings created for a given project may share a number of common elements. All the drawings within a specific drafting project generally have the same set of standards. You often duplicate *drawing content*, such as layers, text and dimension characteristics, symbols, layouts, and details, in many different drawings. One of the fundamental advantages of CADD is the ease with which you can share content between files. Once you create a common drawing element, you can reuse the item as needed in any number of drawings.

**drawing content:**
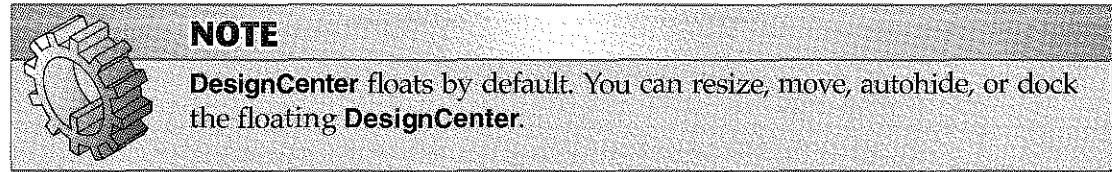All of the objects, settings, and other components that make up a drawing.

Drawing templates provide one way to reuse drawing content. Customized templates provide an effective way to start each new drawing using standard settings. Another way to reuse drawing content is to seek out data from existing files. This is a common requirement when you develop related drawings for a specific project or work on similar projects. Sharing drawing content is also common when revising drawings and when duplicating standards used by a consultant, vendor, or client. AutoCAD provides several ways to share drawing content, as described throughout this textbook. One of the most useful tools is **DesignCenter.**

# Introduction to DesignCenter
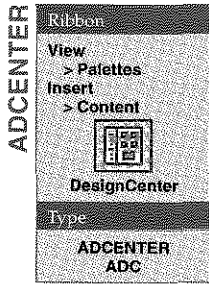
**DesignCenter** is a palette for managing drawing content between files. See Figure 5-27. You can use **DesignCenter** to locate and reuse a variety of drawing content you will use with this textbook, including layers, linetypes, text styles, dimension styles, multileader styles, table styles, blocks, and external references. **DesignCenter** allows you to load content from a file without actually opening the file.

> **NOTE**
>
> **DesignCenter** floats by default. You can resize, move, autohide, or dock the floating **DesignCenter**.

## Copying Layers and Linetypes

To copy content using **DesignCenter**, first pick a tab below the **DesignCenter** toolbar to locate a file with drawing content. Pick the **Folders** tab to explore the folders and files found on the hard drive and network, similar to using Windows Explorer. Pick the **Open Drawings** tab to list only drawings that are currently open. The **History** tab lists recently opened drawings and templates. Double-click on a recent file, or right-click on the file and choose **Explore**, to navigate to the file in the **Folders** tab.

The **Tree View** pane is displayed directly below the tabs by default. If the **Tree View** pane is not visible, toggle it on by picking the **Tree View Toggle** button from the **DesignCenter** toolbar. Use the **Tree View** pane with the **Folders** or **Open Drawings** tab to select a file with the content to reuse. Double-click the file or pick the plus sign (+) to view content categories. Pick **Layers** to load the **Content** pane with layers found in the selected drawing. See Figure 5-28.

Use a drag-and-drop operation to import content into the current drawing. Use standard selection practices to select multiple layers. Press and hold down the pick

---

Figure 5-27.
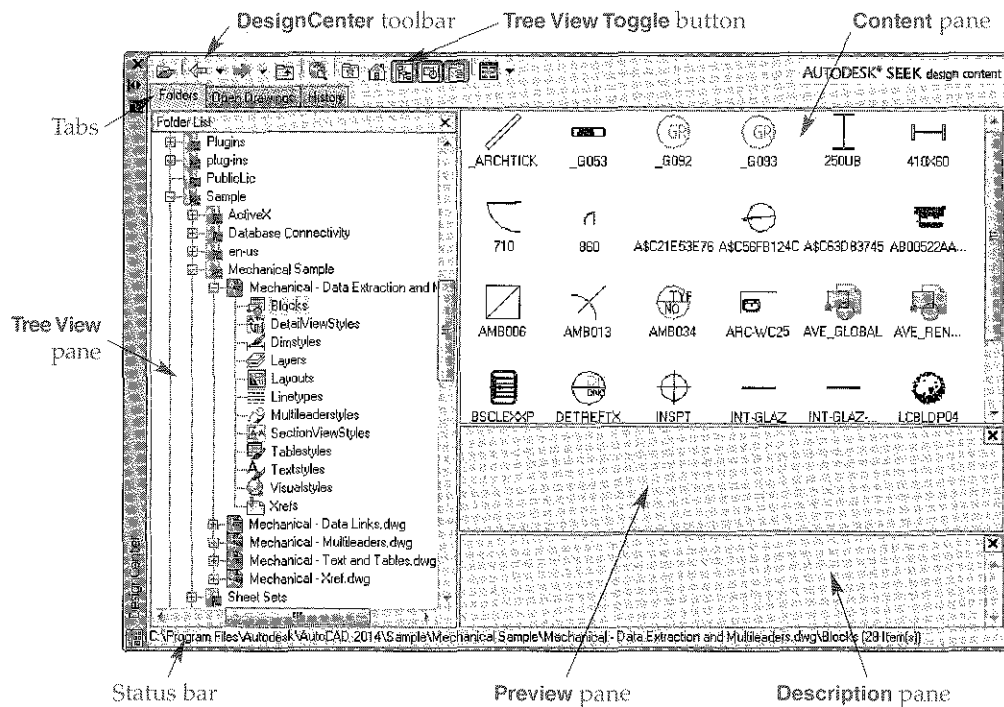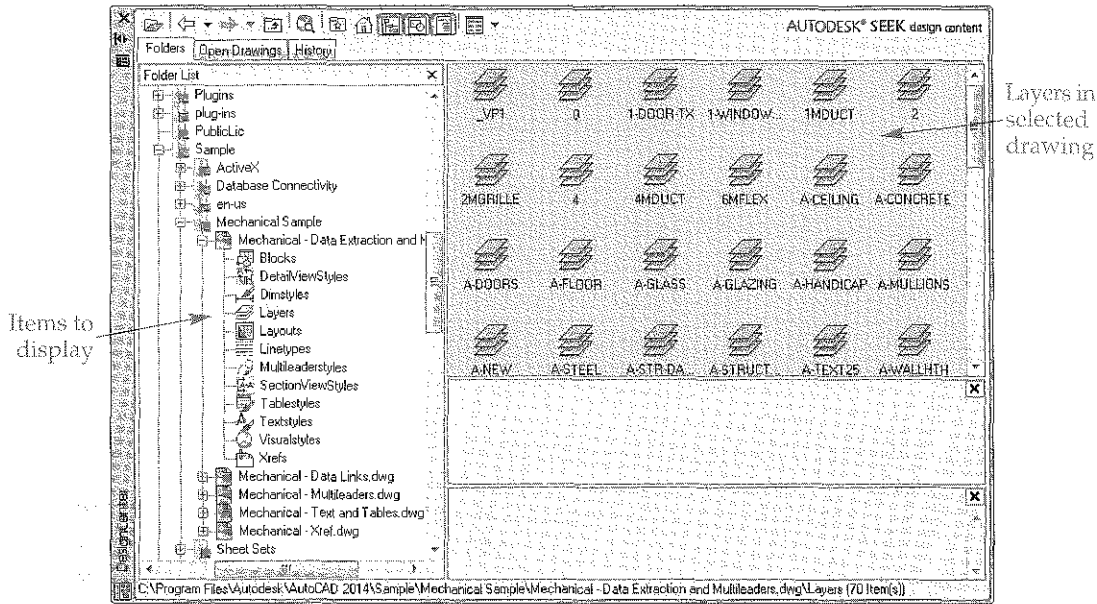Use **DesignCenter** to copy content from one drawing to another.



AutoCAD and Its Applications—Basics

Figure 5-28.
Using **DesignCenter** to display the layers found in a drawing.



Layers in
selected
drawing

Items to
display

button on the layers to import, and then drag the cursor to the drawing window. See Figure 5-29. Release the pick button to add the layers to the current file. An alternative is to right-click on the layers in the **Content** pane and pick **Add Layer(s)**.

Use **DesignCenter** to copy linetypes from one file to another using the same procedure as copying layers. In the **Tree View** pane, select and expand the file containing the linetypes to copy. Pick the **Linetypes** category to display the linetypes in the **Content** pane. Use drag-and-drop or the shortcut menu to add the linetypes to the current drawing. Figure 5-30 briefly describes several additional **DesignCenter** features.

Figure 5-29.
To copy layers shown in **DesignCenter** into the current drawing, drag and drop the layers into the drawing area.

Select layer(s) to copy



Cursor appearance during
drag-and-drop operation
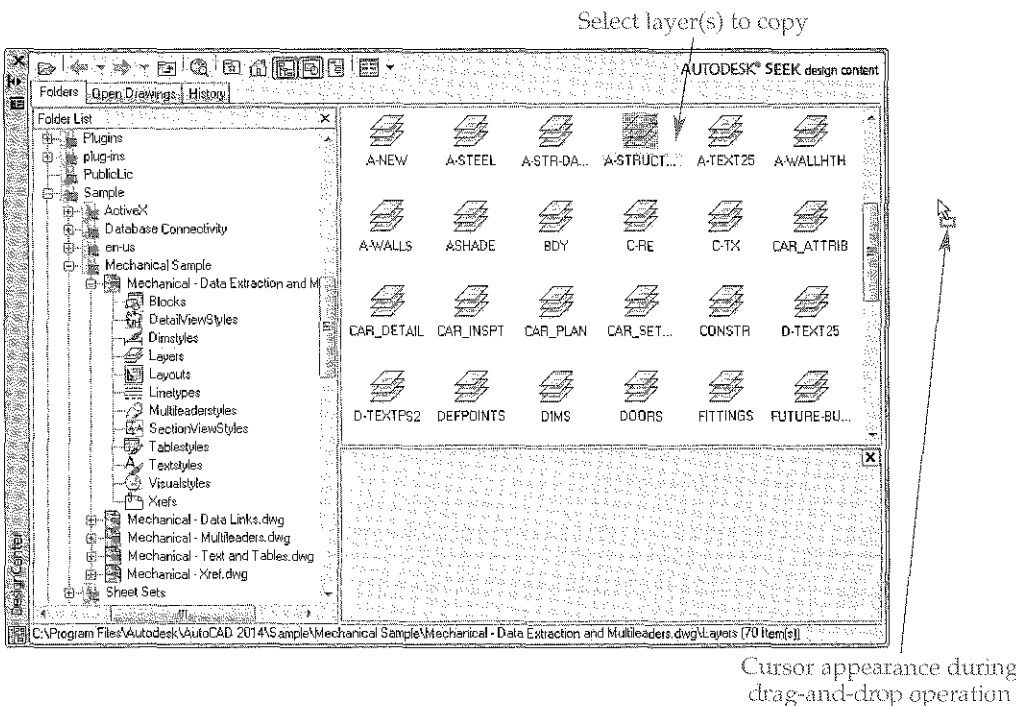
Figure 5-30.
Additional items available in **DesignCenter**.

| Item | Function |
|---|---|
| **Load** | Displays the **Load** dialog box, which you can use to select a file with drawing content or download online content to **DesignCenter**. |
| **Back** | Select to show the content of the last selected file, or choose the flyout to access a list of previously viewed content. |
| **Forward** | Pick after using the **Back** button to show the content of the last selected file, or choose the flyout to access a list of previously viewed content. |
| **Up** | Moves up one level in the **Folder List** tree to a file, folder, drive, My Computer, or the desktop. |
| **Search** | Displays the **Search** dialog box, which you can use to locate drawing content on any drive that meets search criteria and load the content to **DesignCenter**. |
| **Favorites** | Navigates to the Autodesk folder in your Favorites folder. To add commonly used content to the Favorites folder, right-click on an item in the **Folder List** area and select **Add to Favorites**. |
| **Home** | Navigates to the AutoCAD Sample folder. To change the "home" location, right-click on an item in the **Folder List** area and select **Set as Home**. |
| **Tree View Toggle** | Toggles the display of the **Tree View** pane. |
| **Preview** | Toggles the display of the **Preview** pane. |
| **Description** | Toggles the display of the **Description** pane. |
| **Views** | Allows you to show content in the **Content** pane using large icons, small icons, or a list or detail format. |
| **Preview** pane | Displays a saved image of the item selected in the **Content** pane, typically a block. |
| **Description** pane | Displays a saved description of the item selected in the **Content** pane. |
| **Autodesk Seek**<br>**Autodesk Seek** | Launches the Autodesk Seek website, where you can download content from contributing manufacturers and community members. |