Chapter 13

Hatching Drawings

Learning Objectives

After completing this chapter, you will be able to:

- *Use the **HATCH** command to hatch an area using various patterns.*
- *Use the boundary hatch with predefined, user-defined, and custom hatch patterns as options.*
- *Specify pattern properties.*
- *Preview and apply hatching.*
- *Use advanced hatching options and Ray Casting.*
- *Edit associative hatch and hatch boundary using **HATCHEDIT** command, **PROPERTIES** palette, and Grips.*
- *Hatch inserted blocks.*
- *Align hatch lines in adjacent hatch areas.*
- *Hatch by using the **-HATCH** command at the Command prompt.*

HATCHING

In many drawings, such as sections of solids, the sectioned area needs to be filled with some pattern. Different filling patterns make it possible to distinguish between different parts or components of an object. Also, the material of which an object is made, can be indicated by the filling pattern. You can also use these filling patterns in graphics for rendering architectural elevations of buildings, or indicating the different levels in terrain and contour maps. Filling objects with a pattern is known as hatching (Figure 13-1). This hatching process can be accomplished by using the **HATCH** command or the **TOOL PALETTES** window.

Figure 13-1 *Illustration of hatching*

Before using the **HATCH** command, you need to understand some terms that are used when hatching. The following subsection describes some of the terms.

Hatch Patterns

AutoCAD LT supports a variety of hatch patterns (Figure 13-2). Every hatch pattern is composed of one or more hatch lines or a solid fill. The lines are placed at specified angles and spacing. You can change the angle and the spacing between the hatch lines. These lines may be broken into dots and dashes, or may be continuous, as required. The hatch pattern is trimmed or repeated, as required, to fill exactly the specified area. The lines comprising the hatch are drawn in the current drawing plane. The basic mechanism behind hatching is that the line objects of the pattern you have specified are generated and incorporated in the desired area in the drawing. Although a hatch can contain many lines, AutoCAD LT normally groups them together into an internally generated object and treats them as such for all practical purposes. For example, if you want to perform an editing operation, such as erasing the hatch, all you need to do is select any point on the hatch and press ENTER; the entire pattern gets deleted. If you want to break a pattern into individual lines to edit them, you can use AutoCAD LT's **EXPLODE** command.

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Figure 13-2 *Some hatch patterns*

Hatch Boundary

Hatching can be used on parts of a drawing enclosed by a boundary. This boundary may be lines, circles, arcs, polylines, 3D faces, or other objects, and at least part of each bounding object must be displayed within the active viewport.

HATCHING DRAWINGS USING THE HATCH DIALOG BOX

Toolbar:	Draw > Hatch
Menu:	Draw > Hatch
Command:	HATCH or BHATCH

The **HATCH** command allows you to hatch a region enclosed within a boundary (closed area) by selecting a point inside the boundary or by selecting the objects to be hatched. This command automatically designates a boundary and ignores any other objects (whole or partial) that may not be a part of this boundary. When you invoke the **HATCH** command, the **Hatch** dialog box is displayed, as shown in Figure 13-3. You can also enter **HATCH** at the pointer input to invoke the **Hatch** dialog box. The default appearance of the **Hatch** dialog box is a little different from the one shown in Figure 13-3. That is because options like **Islands**, **Boundary Retention** are not visible by default. To make these options visible select the **More Options button** available in the lower right hand corner. You can perform the hatching operation using this dialog box.

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Figure 13-3 *The* ***Hatch*** *dialog box*

Example 1 — *General*

In this example, you will hatch a circle using the default hatch settings. Later, in the chapter you will learn how to change the settings to get a desired hatch pattern.

1. Invoke the **Hatch** dialog box by choosing the **Hatch** button on the **Draw** toolbar.

2. Choose the **Pick Points** button in the **Hatch** dialog box. The dialog box temporarily closes.

3. Select a point inside the circle (P1) (Figure 13-4) and press ENTER. The **Hatch** dialog box is displayed again. You can now preview the hatching by choosing the **Preview** button. After specifying an internal point, you can also right-click to display a shortcut menu and select the **Preview** option.

4. After checking the preview, press ESC to complete the point specification; the dialog box reappears. You can also right-click to apply the hatch without invoking the dialog box.

5. Choose **OK** to apply the hatch to the selected object, Figure 13-5.

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Figure 13-4 Specifying a point to hatch the circle

Figure 13-5 Drawing after hatching

Tip

*The **FILLMODE** system variable is set to On by default (value of the variable is 1) and hence the hatch patterns are displayed. In case of large hatching areas, you can set the **FILLMODE** to Off (value of the variable is 0), so that the hatch pattern is not displayed and the regeneration time is saved.*

You can also hatch a selected face of a solid model. However, to hatch a face of the solid model, you need to align the UCS at that face. You will learn more about this in later chapters.

HATCH DIALOG BOX OPTIONS

The **Hatch** dialog box has several options that let you control the various aspects of hatching, such as pattern type, scale, angle, boundary parameters, associativity, and so on. The following is a description of these options.

Type and pattern Area

This area contains the options that allows you to choose the type of pattern and preview the chosen pattern type.

Type. The **Type** drop-down list (Figure 13-6) displays the types of patterns that can be used for hatching drawing objects. This list lets you choose the type of hatch pattern you want. The three types of hatch patterns available are **Predefined**, **User defined**, and **Custom**. The predefined type of patterns come with AutoCAD LT and are stored in the *acad.pat* and *acadiso.pat* files. The predefined type of hatch pattern is the default type. When you select **User defined** from the **Type** drop-down list a pattern of lines that is based on the current linetype is created. You can set the angle of the lines in the pattern and also the spacing between them. When you select **Custom** from the **Type** drop-down list, you can select a pattern that has been defined in a custom PAT file.

*Figure 13-6 The **Type** drop-down list displaying hatch pattern types*

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Note
*When using the patterns defined in the custom PAT files, make sure that their search path has been added in the **Files** tab of the **Options** dialog box.*

Pattern. The **Pattern** drop-down list displays the names of all the predefined patterns available in AutoCAD LT. You can select any pattern from this list and the selected pattern is displayed in the **Swatch** box. The selected pattern is stored in the **HPNAME** system variable. ANSI31 is the default pattern in the **HPNAME** system variable. The **Pattern** drop-down list is available only if you have selected **Predefined** from the **Type** drop-down list.

To select a particular hatch pattern, you can also choose the [**...**] button that displays the **Hatch Pattern Palette** dialog box (Figure 13-7). This dialog box shows the images and names of the available hatch patterns. This dialog box is also displayed by clicking on the pattern displayed in the **Swatch** box. The **Hatch Pattern Palette** dialog box has four tabs. They are described next.

Figure 13-7 *The **Hatch Pattern Palette** dialog box (**ANSI** tab)*

ANSI. This tab displays all the ANSI (American National Standards Institute)-defined hatch patterns that come with AutoCAD LT. ANSI31 is the default pattern.

ISO. This tab displays all the ISO (International Standard Organization)-defined hatch patterns that come with AutoCAD LT.

Other Predefined. This tab displays all the predefined hatch patterns other than ANSI- or ISO-defined patterns.

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Custom. This tab displays all the custom patterns described in any custom *PAT* file that is added in the search path of AutoCAD LT 2006.

Tip
*Using the **Hatch Pattern Palette** dialog box for selecting a hatch pattern is more convenient since you can view all the pattern names and the corresponding patterns simultaneously.*

Swatch. This box displays the selected pattern. When you click in the **Swatch** box, the **Hatch Pattern Palette** dialog box is displayed.

Custom Pattern. This drop-down list is available only if you have selected **Custom** from the **Type** drop-down list. It displays all the available custom hatch patterns defined in the custom PAT files that have been added to the AutoCAD LT search path. The recently used custom hatch patterns in a current drawing session appear in the list. The selected pattern is stored in the **HPNAME** system variable. You can also choose the **[...]** button; the **Hatch Pattern Palette** dialog box (**Custom** tab) appears. This tab displays the custom pattern paths.

Angle and scale Area

The options in the Angle and Scale area are discussed next.

Angle. The **Angle** drop-down list (Figure 13-8) displays the angles (at an increment of 15-degree) by which you can rotate the hatch pattern with respect to the *X* axis of the current UCS. You can select any angle from this drop-down list or you can also enter an angle of rotation of your choice in the **Angle** edit box. The angle value is stored in the **HPANG** system variable. The angle of hatch lines of a particular hatch pattern is governed by the values specified in the hatch definition. For example, in the **ANSI31** hatch pattern definition, the specified angle of hatch lines is 45-degree. If you select an angle of 0, the angle of hatch lines will be 45-degree. If you enter an angle of 45-degree, the angle of the hatch lines will be 90-degree.

Figure 13-8 *The **Angle** and **Scale** drop-down lists*

Scale. The **Scale** drop-down list (Figure 13-8) displays scale factors by which you can expand or contract the selected hatch pattern. The scale factors that are displayed range between 0.25 to 2 at increments of 0.25. You can also enter the scale factor of your choice in the **Scale** edit box. The **Scale** drop-down list is not available when you are using user-defined hatch patterns. The scale value is stored in the **HPSCALE** system variable. A value of 1 does not mean that the distance between the hatch lines is 1 unit. The distance between the hatch lines and other parameters of a hatch pattern is governed by the values specified in the hatch definition. For example, in the ANSI31 hatch pattern definition, the specified distance between the hatch lines is 0.125. If you select a scale factor of 1, the distance between the lines will be 0.125. If you enter a scale factor of 0.5, the distance between the hatch lines will be 0.5 X 0.125 = 0.0625.

Relative to Paper Space. If this check box is selected, then AutoCAD LT 2006 will automatically scale the hatched pattern relative to the paper space units. This option can be used to display

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the hatch pattern at a scale that is appropriate for your layout. This option is available only in a layout.

ISO Pen Width. The **ISO pen width** drop-down list is available only for ISO hatch patterns. You can select the desired pen width value from the **ISO pen width** drop-down list. The value selected specifies the ISO-related pattern scaling.

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User defined Hatch Patterns

To define a simple pattern, you can select **User defined** from the **Type** drop-down list. You will notice that the **Angle** and **Spacing** edit boxes and the **Double** check box are available in the dialog box. The **Scale** drop-down list is not available.

Angle

Just as with predefined patterns, you can specify in the **Angle** edit box an angle with respect to the *X* axis of the current UCS through which the hatch pattern is rotated. This value is stored in the **HPANG** system variable.

Double

This check box is available only for user-defined patterns. When you select this check box, AutoCAD LT doubles the original pattern by drawing a second set of lines at right angles to the original lines in the hatch pattern. For example, if you have a parallel set of lines as a user-defined pattern and if you select the **Double** check box, the resulting pattern has two sets of lines intersecting at 90-degree. You can notice the effect of selecting the **Double** check box in Figure 13-9. If the **Double** check box is selected, the **HPDOUBLE** system variable is set to 1.

Spacing

The **Spacing** edit box is available only when you have selected **User defined** from the **Type** drop-down list. The value you enter in the **Spacing** edit box sets the spacing between the lines in a user-defined hatch pattern. This spacing is stored in the **HPSPACE** system variable. The default spacing value is 1.0000.

Custom Hatch Patterns

When you select **Custom** from the **Type** drop-down list in the **Hatch** dialog box, you will notice that the **Custom pattern** drop-down list is available. The **Angle** and **Scale** drop-down lists are also available.

Custom pattern

In AutoCAD LT, hatch patterns are normally stored in the file named *acad.pat*. You can select a hatch pattern from an individual file by selecting **Custom** from the **Type** drop-down list. The **Custom pattern** drop-down list is available now. You can choose the [**...**] button to display the **Custom** tab of the **Hatch Pattern Palette** dialog box. Here, the list box on the left side of the dialog box displays the paths of the custom hatch patterns. When you select a path, the corresponding pattern is displayed in a preview window on the left. Choose **OK** to return to the

Figure 13-9 *Specifying angle and spacing for user-defined hatch patterns*

Hatch dialog box. The corresponding pattern is displayed in the **Swatch** window. You can also select a pattern from the **Custom pattern** drop-down list. You can also enter the name of the custom pattern in the field, if you know the name of the hatch pattern. The name is held in the **HPNAME** system variable. If AutoCAD LT does not locate the entered pattern in the *acad.pat* file, it searches for it in a file with the same name as the pattern. You can specify an angle and scale for the custom pattern using the **Angle** and **Scale** drop-down lists, as in the case of predefined patterns.

Tip

When you are hatching large areas, it is better to use a larger scale factor for the hatch pattern that will help you save time regenerating and plotting. Also, when using a larger scale factor for the hatch pattern, the drawing appears to be neater and not too cluttered.

Exercise 1 *Mechanical*

In this exercise, you will hatch the given drawing using the hatch pattern named STEEL. Set the scale and the angle to match the drawing shown in Figure 13-10.

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Figure 13-10 *Drawing for Exercise 1*

Selecting Hatch Boundary

The boundaries selection options in the **Hatch** dialog box allow you to define the hatch boundary. This is done by selecting a point inside a closed area to be hatched or by selecting the objects. There are other options also available here for removing islands, viewing the selection, using properties from an existing hatched object, and controlling associativity of the hatch pattern.

Boundaries Area

The options under **Boundaries Area** of **Hatch** dialog box are discussed next.

Add: Pick points. When you choose this button, AutoCAD LT automatically constructs a boundary from the objects that form a closed area. This is the easiest method to specify a region for hatching. When you choose the **Add: Pick Points** button, the dialog box disappears temporarily to allow you to select a point within the closed area to be hatched. Select a point inside the object and a boundary is defined around the selected point. The following prompts appear when you choose the **Add: Pick Points** button in the **Hatch** dialog box.

Pick internal point or [Select objects/remove Boundaries]: *Select a point inside the object to hatch.*
Selecting everything visible...
Analyzing the selected data...
Analyzing internal islands...
Pick internal point or [Select objects/remove Boundaries]: *Select another internal point or press ENTER to end selection.*

You can also select objects or remove boundaries from the existing selection to define the hatch boundary. To select objects enter **S** at the Pick internal point or [Select objects/remove Boundaries] prompt. Now, you can select the objects to define hatch boundary. The prompt sequence is given next.

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Pick internal point or [Select objects/remove Boundaries]: **S** Enter
Select objects or [picK internal point/remove Boundaries]: *Select the object to hatch.*
Select objects or [picK internal point/remove Boundaries]: *Select another object to hatch or press ENTER to end selection. .*

Enter **K** at the Select objects or [picK internal point/remove Boundaries] prompt to specify the hatch boundary by picking the internal point or enter **B** to remove the boundaries from the existing selection. The prompt sequence when you enter **B** is given next.

Select objects or [picK internal point/remove Boundaries]: **B** Enter
Select objects or [Add boundaries]: *Select objects to clear from selection*
Select objects or [Add boundaries/Undo]: *Select objects to clear from selection or press ENTER to end selection.*

To add the boundaries, enter **A** at the Select objects or [Add boundaries] prompt. As you enter **A** at the specified prompt, you will be routed back to the Pick internal point or [Select objects/remove Boundaries] prompt. To undo the last selection of boundaries, enter **U** at the Select objects or [Add boundaries/Undo] prompt.

Once the internal points have been selected, press ENTER or choose the ENTER **option from the shortcut menu** and the dialog box reappears. Choose **OK** to apply the hatch pattern to the region. If you want to hatch an object and leave another object contained in it without hatching, select a point inside the object you want to hatch. By default, when using the **HATCH** command, selecting a point creates multiple boundaries; a boundary of the internal object is also created, and the region between these two boundaries is selected for hatching. In Figure 13-11, the **Add: Pick points** button has been used to hatch the square but not the triangle simply by selecting the point inside the square but outside the triangle (using the default settings of the dialog box).

Figure 13-11 *Defining multiple hatch boundaries by selecting a point*

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Tip

*When you have selected a point within an area to hatch and you realize you have selected the wrong area, you can enter **U** or **UNDO** at the Command prompt to undo the last selection. You can also undo a hatch pattern you have already applied to an area by entering **UNDO** at the Command prompt.*

Boundary Definition Error. AutoCAD LT displays different types of **Boundary Definition Error** dialog boxes, depending on the kind of error occurred while selecting the boundary. For example, if you pick a point inside any boundary that is not closed, this dialog box informs you that boundary is not closed, see Figure 13-12. Choose the **Look at it** button and the system will again check the area with respect to the gap tolerance value specified in the **Tolerance** edit box of the **Hatch** tab of the **Hatch** dialog box. If you select the same boundary twice, this dialog box will inform you that the boundary duplicates an existing boundary.

Figure 13-12 *The* ***Boundary Definition Error*** *dialog box*

Note

*The default value of the gap tolerance is 0. As a result, the open area will not be selected for hatching. Instead, the **Boundary Definition Error** dialog box is displayed. This dialog box informs you that the hatch boundary is not closed.*

Add-Select objects. This option in the **Hatch** dialog box lets you select objects that form the boundary for hatching. It is useful when you have to hatch an object and disregard objects that lie inside it or intersect with it. When you select this option, AutoCAD LT will prompt you to select objects. You can select the objects individually or use other object selection methods. In Figure 13-13, the **Select Objects** button is used to select the triangle. This uses the triangle as the hatch boundary, and everything inside it. The text inside the triangle, in this case, also gets hatched. To avoid hatching of such internal objects, select them at the next **Select Objects** prompt. In Figure 13-14, the text is selected to exclude it from hatching. When using the **Pick Points** option, the text automatically gets selected to be excluded from the hatching.

Tip

If you have an area to be hatched that has many objects intersecting with it, it is easier to select the entire object to be hatched rather than choosing the internal points within each of the smaller regions created by the intersection.

You can also turn off layers that contain text or lines that make it difficult for you to select hatch boundaries.

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Figure 13-13 *Using the* ***Select Objects*** *button to specify the hatching boundary*

Figure 13-14 *Using the* ***Select Objects*** *button to exclude the text from hatching*

Remove boundaries. This option is used to exclude boundaries and islands from the hatching area. Boundaries inside another boundary are known as islands. If you choose the **Pick Points** button to hatch an area, the inside boundaries also known as islands are not hatched by default. But, if you want to hatch the islands, you can choose the **Remove Boundaries** button in the **Hatch** dialog box. This applies, for example, if you have a rectangle with circles within, as shown in Figure 13-15. You can use the **Pick Points** option to select a point inside the rectangle; AutoCAD LT will select both the circles and the rectangle. To remove the circles (islands), you can use the **Remove Islands** option. When you select this option, AutoCAD LT will prompt you to select the islands to be removed. Select the islands to be removed and press ENTER to return to the dialog box. Choose **OK** to apply the hatch. Similarly, you can remove boundaries.

Figure 13-15 *Using the* ***Remove Islands*** *option to remove islands from the hatch area*

Tip

It may be a good idea to use the ***Select Objects*** *option to select the object containing islands, if you want to remove the islands from the hatching area.*

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Recreate boundaries. This option is required while editing a hatch and is used to recreate boundaries from an existing hatch. On choosing this button, the dialog box is temporarily closed and you are prompted to specify whether you want to recreate boundaries as a region or as a polyline. You can also associate the hatch to the new boundary.

View Selections. This option lets you view the selected boundaries before you apply the hatch pattern. This option is not available when you have not selected any points or boundaries. When you choose the **View Selections** button, the dialog box closes temporarily and the selected boundaries in the drawing are displayed as highlighted.

Options Area

The options available in this area allow you to specify the draw order and composition of the hatch.

Associative

This radio button is selected by default, which implies that when you modify the boundary of the hatch object, the hatch patterns will be automatically updated to fill up the new area. One of the major advantages with the associative hatch feature is that you can edit the hatch pattern or edit the geometry that is hatched without having to modify the associated pattern or boundary separately. After editing, AutoCAD LT automatically regenerates the hatch and the hatch geometry to reflect the changes. The hatch pattern can be edited by using the **HATCHEDIT** command and the hatch geometry can be edited by using grips or AutoCAD LT editing commands.

Create separate hatches

While hatching multiple closed areas that are not nested together, selecting this check box ensures that a separate hatch is created for each closed area. If this check box is cleared, a single hatch is created for all the selected closed areas.

Draw order

The drop-down list is used to assign a draw order to the hatch. If you want to send the hatch behind all the entities, select the **Send to back** option. Similarly, if you want to place the hatch in front of all the entities, select the **Bring to front** option. If you want to place the hatch behind the hatch boundary, select **Send behind boundary**. Similarly, if you want to place the hatch in front of the boundary, select **Bring in front of boundary**. You can also select the **Do not assign** option, if you do not want to assign the draw order to the hatch.

Inherit Properties

The **Inherit properties** button is available below the **Options** area and is used to hatch the specified boundaries using the properties of an existing hatch. When you invoke the **HATCH** command and choose the **Inherit Properties** button, the following command sequence appears. Note that this prompt sequence does not appear when you specify the area to hatch first and then choose the **Inherit Properties** button.

Select hatch object: *Select the object from which you have to inherit the hatch pattern*.
Inherited Properties: Name <current>, Scale <current>, Angle <current>

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Pick internal point or [Select objects/remove Boundaries]: *Pick a point inside the object to hatch.*
Selecting everything visible...
Analyzing the selected data...
Pick internal point or [Select objects/remove Boundaries]: Enter

When you press ENTER, the **Hatch** dialog box reappears with the name of the inherited hatch pattern in the **Pattern** edit box. The inherited hatch pattern is also displayed in the **Swatch** box. The selected pattern now becomes the current hatch pattern. If you then want to adjust the hatch properties, such as the angle or scale of the pattern, you can do so.

Preview

This button is used to preview the hatching before it is actually applied. This option is available only after you have selected the area to be hatched. When you choose the **Preview** button, the dialog box is temporarily closed and the object selected for hatching is temporarily filled with the specified hatch pattern. You can also preview the drawing by right-clicking in the drawing area, after selecting the boundary and choosing **Preview** from the shortcut menu. After previewing the drawing, pick a point on the screen or press ESC to redisplay the **Hatch** dialog box so that you can make modifications in the hatching operation. You can also press ENTER or right-click after previewing the drawing to accept the hatching and apply it to the selected boundary. Note that because you accept the current hatch settings by pressing ENTER or by right-clicking; the **HATCH** command is completed and the **Hatch** dialog box is not displayed.

Exercise 2 *Mechanical*

In this exercise, you will hatch the front section view of the drawing in Figure 13-16 using the hatch pattern for brass. Two views, top, and front are shown. In the top view, the cutting plane line indicates how the section is cut and the front view shows the full section view of the object. The section lines must be drawn only where the material is actually cut.

Figure 13-16 *Drawing for Exercise 2*

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Hatch Origin Area

A hatch pattern is always drawn with reference to some specified origin. The options available in **Hatch Origin Area** allows you to specify origin for the hatch.

Use current origin

By default, the **Use current origin** radio button is selected. This implies that the origin of the hatch pattern to be created is the origin of the current drawing.

Specified origin

When you select the **Specified origin** radio button, other options available in **hatch Origin Area** are highlighted. Choose the **Click to set new origin** button and specify the origin point for the hatch pattern in the drawing area. Select the **Default to boundary extents** check box; the drop-down list is now available and you can select the options available in the drop-down list to specify the origin of hatch pattern. If you select the **Bottom left** option from the drop-down list, the origin of the hatch pattern will be at the bottom left corner of the boundary. The preview corresponding to the option chosen is displayed in the preview area at the right of the drop-down list. Selecting the **Store as default origin** check box stores the origin just selected as the default origin for all the hatch patterns.

MORE OPTIONS

When you choose the **More Options** button available on the right of the **Help** button in the **Hatch** dialog box, it expands and provides the following options.

Islands Area

The options in this area are used to specify the island detection method of creating the hatch. These options are discussed next.

Island detection

The options available under the **Island** area are available only if the **Island detection** check box is selected. When the checkbox is selected, the method of island detection is the **Flood** type. When the checkbox is cleared the island detection is the **Ray Casting** type. The two methods of island detection are discussed next.

Flood. This method of defining the hatch boundary includes the islands as the boundary objects. This is the default method of island detection.

Ray Casting. This method casts rays in all directions or a particular direction from the point specified to the nearest object and then traces the boundary in a counterclockwise direction, thus excluding islands as boundary objects. Ray casting is discussed later in detail.

Island display style

These options are used to select the style of the island detection during hatching (Figure 13-17). There are three styles available: **Normal**, **Outer**, and **Ignore**. To select a particular style, you can select the corresponding radio button. The effect of using the particular style is displayed in the

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form of an illustration in the image tile placed above the particular radio button and is also shown in Figure 13-18. You can also choose the image tiles to select a particular island detection style.

Figure 13-17 *Island detection styles*

Figure 13-18 *Using hatching styles*

Note

The selection of an island detection style carries meaning only if the objects to be hatched are nested (that is, one or more selected boundaries is within another boundary).

Normal. The Normal style is selected by default. This style hatches inward starting at the outermost boundary. If it encounters an internal boundary, it turns off the hatching. An internal boundary causes the hatching to turn off until another boundary is encountered. In this manner, alternate areas of the selected object are hatched, starting with the outermost area. Thus, areas separated from the outside of the hatched area by an odd number of boundaries are hatched, while those separated by an even number of boundaries are not.

Outer. This particular option also lets you hatch inward from an outermost boundary, but the hatching is turned off if an internal boundary is encountered. Unlike the previous case, it does not turn the hatching on again. The hatching process, in this case, starts from both ends of each hatch line; only the outermost level of the structure is hatched, hence, the name **Outer**.

Ignore. In this option, all areas bounded by the outermost boundary are hatched. The option ignores any hatch boundaries that are within the outer boundary. All islands are completely ignored and everything within the selected boundary is hatched.

Tip

It is also possible to set the pattern and the island detection style at the same time by using the ***HPNAME*** *system variable. AutoCAD LT stores the Normal style code by adding* ***N*** *to the pattern name. Similarly,* ***O*** *is added for the Outer style, and* ***I*** *for the Ignore style to the value of the* ***HPNAME*** *system variable. For example, if you want to apply the BOX pattern using the outer style of island detection, you should enter the* ***HPNAME*** *value to be* ***BOX, O****. Now, when you apply the hatch pattern, the BOX pattern is applied using the outer style of hatching.*

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Note

*The **Normal**, **Outer**, and **Ignore** options are also available in the shortcut menu when you select an internal point in the drawing object and right-click in the drawing area. The shortcut menu shall be discussed later.*

Boundary retention Area

When you select an internal point in a region to be hatched, a boundary is created around it. By default, these boundaries are removed as soon as the hatch pattern is applied. The **Boundary retention** area provides options that allow you to specify whether these boundaries are to be retained as objects or not. You can also specify the type of object it can be saved as.

Retain boundaries check box. The **Retain boundaries** check box is cleared by default, which implies that the hatch boundaries are not saved. If you select this check box, you can retain the defined boundary. When a hatching is successful and you want to keep the boundary as a polyline or region so that you can use it again, you can select the **Retain boundaries** check box. When you select this check box, the **Object type** drop-down list is available.

Object type drop-down list. The **Object type** drop-down list is available when you select the **Retain boundaries** check box. From this list, you can select the type of object AutoCAD LT will create when you define a boundary for hatching. It has two options: **Polyline** and **Region**. **Polyline** is selected by default and the boundary created around the hatch area is a polyline. Similarly, when you select **Region**, the boundary of the hatch area is a region. Regions are two-dimensional areas that can be created from closed shapes or loops.

Boundary set Area

When hatching takes place normally, AutoCAD LT evaluates the entire drawing visible on the screen to determine the boundary. For larger drawings, this may take a lot of time and therefore, slow down the process of hatching. The **Boundary set** area provides options that allow you to specify what is considered when hatching. You can either select an option from the drop-down list or you can create a new boundary set. The boundary set comprises the objects that the **HATCH** command uses when constructing the boundary. The default boundary set is **Current viewport**, which comprises everything that is visible in the current viewport. Boundary hatching is made faster by specifying a boundary set because, in this case, AutoCAD LT does not have to examine everything on screen.

This option allows you to define a boundary area so that only a specific portion of the drawing is considered for hatching. You use this option to create a new boundary set. When you choose the **New** button, the dialog box is temporarily cleared from the screen to allow the selection of objects to be included in the new boundary set. While constructing the boundary set, AutoCAD LT uses only those objects that you select and that are hatchable. If a boundary set already exists, it is replaced by the new one. If you do not select any hatchable objects, no new boundary set is created. AutoCAD LT retains the current set, if there is any. Once you have selected the objects to form the boundary set, press ENTER and the dialog box reappears on the screen. You will notice that **Existing Set** gets added to the drop-down list. When you invoke the **HATCH** command and you have not formed a boundary set, there is only one option, **Current Viewport**, available in the drop-down list. The benefit of creating a selection set is that when you select a point or

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select the objects to define the hatch boundary, AutoCAD LT will search only for the objects that are in the selection set. By confining the search to the objects in the selection set, the hatching process is faster. If you select an object that is not a part of the selection set, AutoCAD LT ignores it. When a boundary set is formed, it becomes the default for hatching until you exit the **HATCH** command or select the **Current Viewport** option from the drop-down list.

Tip

To improve the hatching speed in large drawings, you should zoom into the area to be hatched, so that defining the boundary to be hatched is easier. Also, since AutoCAD LT does not have to search the entire drawing to find hatch boundaries, the hatch process gets faster.

Gap Tolerance Area

The **Gap tolerance** edit box is used to set the value up to which the open area will be considered closed when selected for hatching, using the **Pick Points** method. The default value of the gap tolerance is 0. As a result, the open area will not be selected for hatching. You can set the value of the gap tolerance using the **Gap tolerance** edit box. If the gap in the open area is less than the value specified in this edit box, the area will be considered closed and will be selected for hatching.

Inherit Options Area

The options available in this area are used to set the hatch origin while working with the **Inherit Properties** tool. By default, the **Use current origin** radio button is selected because of which, the current origin will be taken as the hatch origin. If you select the **Use source hatch origin** radio button, the hatch pattern will accept the origin of the source hatch as the origin of the current hatch pattern.

RAY CASTING

You can use the **ray casting** technique to define a hatch boundary. In ray casting, AutoCAD LT casts an imaginary ray in all directions or in a particular specified direction and locates the object that is nearest to the point you have selected. After locating the object, it takes a left turn to trace the boundary and the boundary gets highlighted. If the point you have specified lies within the highlighted boundary, the islands within are ignored and the entire object is hatched. But, if the point lies outside the highlighted boundary, an error message is displayed and you are asked to select another point. Ray casting has five options: **Nearest**, **+X**, **-X**, **+Y**, and **-Y**, and **Angle**. All these options are available when you use the **-HATCH** command. But, when you are using the **HATCH** command, only the **Nearest** option can be used.

Ray Casting Using the HATCH Command

When you invoke the **HATCH** command, the **Hatch** dialog box is displayed. Clear the **Island detection** check box in **Islands** area. Choose the **Pick Points** button. The dialog box closes temporarily to allow you to specify a point for ray casting. In Figure 13-19, depending upon the location of the specified point, a boundary object is selected. If you select a point close to the outer circle, the circle gets highlighted as the hatching boundary. This is because imaginary rays are cast from the specified point and the circle is the nearest closed boundary available. When

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you press ENTER, the dialog box returns; choose the **Preview** button to see the preview of the hatching. You will notice that the entire circle is hatched and the inner objects (rectangle and triangle) have been ignored (Figure 13-20).

Figure 13-19 *Specifying a point closer to the outer circle during hatching using ray casting*

Figure 13-20 *The result of using the* ***Nearest*** *ray casting option*

Now, for the next time, select a point inside the circle but closer to the inner rectangle. The inner rectangle gets highlighted as it is nearest to the specified point and a **Boundary Definition Error** dialog box (Figure 13-21) is displayed suggesting the specified point is not within the highlighted boundary. The **Boundary Definition Error** dialog box has two buttons: **OK** and **Look at it**. If you choose **OK**, the dialog box is closed and you can select another point. If you choose **Look at it**, AutoCAD LT displays the highlighted boundary and the position of the specified point is shown marked with an (X) marker. An **AutoCAD LT Message** box is displayed with the message: **Press ENTER to continue**. You can press ENTER or choose **OK** to continue and specify another point.

Figure 13-21 *The* ***Boundary Definition Error*** *dialog box*

Using the -HATCH Command

You can also create hatch patterns from the command line using the **-HATCH** command. The **-HATCH** command is especially useful when you want to avoid boundary definition errors, by forcing the ray casting in a particular direction, or want to use other ray casting options that are not available through the dialog box. These options control the direction, in which AutoCAD LT casts the ray to form a hatch boundary. When using the **-HATCH** command, the dialog box is bypassed and the available options are **Nearest**, **+X**, **-X**, **+Y**, and **-Y**. The prompt sequence is given next.

Command: **-HATCH**
Current hatch Pattern: ANSI31
Specify internal point or [Properties/Select objects/draW boundary/removeBoundaries/Advanced/DRaw order/Origin]: **A** Enter
Enter an option [Boundary set/Retain boundary/Island detection/Style/Associativity/Gap tolerance/separate Hatches]: **I**

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Do you want island detection? [Yes/No] <Y>: **N**
Enter type of ray casting [Nearest/+X/-X/+Y/-Y/Angle] <Nearest>: *Specify an option.*
Enter an option [Boundary set/Retain boundary/Island detection/Style/Associativity/Gap tolerance/separate Hatches]: Enter
Current hatch pattern: ANSI31
Specify internal point or [Properties/Select objects/draW boundary/remove Boundaries/Advanced/DRaw order/Origin]: *Select a point.*

Nearest. The **Nearest** option is the default option. When this option is used, AutoCAD LT casts an imaginary ray from the specified point to the nearest hatchable object, then takes a turn to the left, and continues the tracing process in an effort to form a boundary around the internal point. To make this process work properly, the point you select inside the boundary should be closer to the boundary than any other object that is visible on the screen.

+X, -X, +Y, and -Y options. These options can be explained better by studying Figure 13-26. Figure 13-22(a) shows that the points that can be selected are those that are nearest to the right edge of the circumference of the circle because the ray casting takes place in the direction of the positive X. If you select a point on the left of the rectangle that is placed inside the circle, no valid boundary is detected. This is because when you have selected this point, rays are cast horizontally from it in the positive X direction and the rectangle is encountered, which is invalid, since this point is not within the highlighted boundary.

Figure 13-22(b) shows that the points that can be used for selection are those that are nearest to the left edge of the circle because the ray casting takes place in the negative X direction. Any point selected on the right of the rectangle casts rays toward the negative X direction and encounters the rectangle, which is again an invalid boundary for the selected point.

Figure 13-22 *Valid points for casting a ray in different directions to select the circle as boundary*

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In Figure 13-22(c), the ray casting takes place in the positive Y direction, and so the points that can be used for selection are the ones closest to the upper edge of the circle. If a point is selected below the rectangle, which is placed within the circle, rays are cast in the positive direction and a rectangle is encountered, which is an invalid boundary for the selected point.

In Figure 13-22(d), the ray casting takes place in the negative Y direction, and so the internal points that can be selected are the ones closest to the lower edge of the circle. When a point is selected above the rectangle, rays are cast in the negative Y direction and the rectangle is encountered, which is an invalid boundary for the selected point.

The valid areas for selecting points for the **+X**, **-X, +Y**, and **-Y** options of ray casting are shown in Figures 13-23 and 13-24 as shaded. Points selected within the unshaded portions result in boundary errors.

Figure 13-23 *Valid areas (shaded) for selecting points for the* ***-X*** *and* ***+X*** *options of ray casting*

Figure 13-24 *Valid areas (shaded) for selecting points for the* ***-Y*** *and* ***+Y*** *options of ray casting*

Note

The options of the ***-BHATCH*** *command are the same as those in the* ***-HATCH*** *command. From this release, the working of the* ***BHATCH*** *and* ***HATCH*** *commands have been made similar. You can use either of the commands.*

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The HATCH Shortcut Menu

After invoking the **HATCH** command and selecting a point that lies in the interior of the object to be hatched, or the object to be hatched itself, right-click to display the shortcut menu (Figure 13-25). This shortcut menu displays the options that are also available through the **Hatch** dialog box. If you choose **Preview**, you can preview the hatching before applying it. If you choose **Enter**, the dialog box reappears. Choosing **Clear All** removes all the previous selections made. You can also select another island detection mode and also change from one method of hatching to another. Choose the **Remove Boundaries** option to remove the boundaries from the selected hatching area. You can specify the hatch origin using the options available in the **Hatch Origin** cascading menu.

Figure 13-25 *The* ***HATCH*** *shortcut menu*

HATCHING THE DRAWINGS USING THE TOOL PALETTES

Toolbar:	Standard > Tool Palettes Window
Menu:	Tools > Tool Palettes Window
Command:	TOOLPALETTES

You can use the **TOOL PALETTES** window shown in Figure 13-26 to insert predefined hatch patterns and blocks in the drawings. By default, AutoCAD LT displays **TOOL PALETTES** as a window on the right of the drawing area. A number of tabs are available in this window, such as **Command Tools**, **Hatches**, **Civil/Structural, Electrical**, and so on. In this chapter, you will learn to insert Imperial and ISO hatches in the **Hatches** tab of the **TOOL PALETTES** window. The **Imperial Hatches** area provides the options to insert the hatch patterns that are created using the Imperial units. The **ISO Hatches** area provides the options to insert the hatch patterns that are created using the Metric units. You will notice that the hatch patterns provided in both these areas are similar. The basic difference between the two tabs is their scale factor.

Figure 13-26 *The* ***TOOL PALETTES*** *window*

Tip

The ***TOOL PALETTES*** *window can be turned on and off by pressing the CTRL+3 keys.*

AutoCAD LT provides two methods to insert the predefined hatch patterns from the **TOOL PALETTES** window: **Drag and Drop** method and **Select and Place** method. Both these methods are discussed next.

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Drag and Drop Method

To insert the predefined hatch pattern from the **TOOL PALETTES** using this method, move the cursor over the desired predefined pattern in the **TOOL PALETTES**. You will notice that as you move the cursor over the hatch pattern, the hatch icon gets converted into a 3D icon. Also, a tooltip is displayed that shows the name of the hatch pattern. Press and hold the left mouse button and drag the cursor within the area to be hatched. Release the left mouse button, and you will notice that the selected predefined hatch pattern is added to the drawing.

Select and Place Method

You can also add the predefined hatch patterns to the drawings using the **select and place** method. To add the hatch pattern, move the cursor over the desired pattern in the **TOOL PALETTE**. The pattern icon is changed to a 3D icon. Press the left mouse button; the selected hatch pattern is attached to the cursor and you are prompted to specify the insertion point of the hatch pattern. Move the cursor within the area to be hatched and press the left mouse button. The selected hatch pattern is inserted at the specified location.

Modifying the Properties of the Predefined Patterns Available in the TOOL PALETTES

To modify the properties of the predefined hatch patterns, move the cursor over the hatch pattern in the **TOOL PALETTES** and right-click on it to display the shortcut menu. Using the options available in this shortcut menu, you can cut or copy the desired hatch pattern available in one tab of **TOOL PALETTES** and paste it on the other tab. You can also delete and rename the selected hatch pattern using the **Delete Tool** and **Rename** options, respectively. To modify the properties of the selected hatch pattern, choose **Properties** from the shortcut menu, as shown in Figure 13-27. The **Tool Properties** dialog box is displayed, as shown in Figure 13-28.

Figure 13-27 *Choosing* ***Properties*** *from the shortcut menu*

In the **Tool Properties** dialog box, the name of the selected hatch pattern is displayed in the **Name** edit box. You can also rename the hatch pattern by entering the new name in the **Name** edit box. The **Image** area available on the left of the **Name** edit box displays the image of the selected hatch pattern. If you enter a description of the hatch pattern in the **Description** text box, it is stored with the hatch definition in the **TOOL PALETTES**. Now, when you move the cursor over the hatch pattern in **TOOL PALETTES** and pause for a second, the description of the hatch pattern appears along with its name in the tooltip. The **Tool Properties** dialog box displays the properties of the selected hatch pattern under the following categories.

Pattern

In this category, you can change the pattern type, pattern name, angle, and scale of the selected pattern. You can modify the spacing of the **User defined** patterns in the **Spacing** text box. Also, the ISO pen width of the ISO patterns can be redefined in the **ISO pen width** text box. The **Double** drop-down list is available only for the **User-defined** hatch patterns. You can select Yes

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Figure 13-28 *The* ***Tool Properties*** *dialog box*

or No from the **Double** drop-down list to determine the hatch pattern to be doubled at right angles to the original pattern or not. When you choose the [**...**] button in the **Type** property field, AutoCAD LT displays the **Hatch Pattern Type** dialog box. You can select the type of hatch pattern from the **Pattern Type** drop-down list. If the **Predefined** pattern type is selected, you can specify the pattern name by either selecting it from the **Pattern** drop-down list or from the **Hatch Pattern Palette** dialog box displayed on choosing the **Pattern** button. Similarly, if you select the **Custom** pattern type, you can enter the name of the custom pattern in the **Custom Pattern** edit box. If you select the **User defined** pattern type, both the **Pattern** drop-down list and the **Custom Pattern** edit box are not available.

General

In this category, you can specify the general properties of the hatch pattern such as color, layer, linetype, plot style, and line weight for the selected hatch pattern. The properties of a particular field can be modified from the drop-down list available on selecting that field.

When you select a particular field in the **Tool Properties** dialog box, its function is displayed in the display box available at the bottom of the dialog box. Choose **OK** to apply the changes and close the dialog box.

Tip

You can cut, copy, or rename the selected hatch pattern available on ***TOOL PALETTES*** *using the shortcut menu.*

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HATCHING AROUND TEXT, DIMENSIONS, AND ATTRIBUTES

When you select a point within a boundary to be hatched and if it contains text, dimensions, and attributes, the hatch lines do not pass through the text, dimensions, and attributes present in the object being hatched by default. AutoCAD LT places an imaginary box around these objects that does not allow the hatch lines to pass through it. Remember that if you are using the select objects option to select objects to hatch, you must select the text/attribute/shape along with the object in which it is placed when defining the hatch boundary. If multiple line text is to be written, the **MTEXT** command is used. You can also select both the boundary and the text when using the window selection method. Figure 13-29 shows you how hatching takes place around multiline text, attributes, and dimensions.

Figure 13-29 *Hatching around dimension, multiline text, and attributes*

EDITING HATCH PATTERNS

Using the HATCHEDIT Command

Toolbar:	Modify II > Hatch
Menu:	Modify > Object > Hatch
Command:	HATCHEDIT

The **HATCHEDIT** command (Figure 13-30) can be used to edit the hatch pattern. When you invoke this command and select the hatch for editing, the **Hatch Edit** dialog box (Figure 13-31) is displayed on the screen.

Figure 13-30 *Choosing* ***Edit Hatch*** *from the* ***Modify II*** *toolbar*

The **Hatch Edit** dialog box can also be invoked from the shortcut menu or by double-clicking on the hatch pattern. After selecting a hatched object, right-click in the drawing area, and choose **Hatch Edit** from the shortcut menu.

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Figure 13-31 *The* ***Hatch Edit*** *dialog box*

AutoCAD LT will display the **Hatch Edit** dialog box, where the hatch pattern can be changed or modified accordingly. This dialog box is the same as the **Hatch** dialog box, except that only the options that control the hatch pattern are available. These available options work in the same way as they do in the **Hatch** dialog box.

The **Hatch Edit** dialog box has one tab just like the **Hatch** dialog box. The **Hatch tab**. In this, you can redefine the type of hatch pattern by selecting another type from the **Type** drop-down list. If you are using the **Predefined** pattern, you can select a new hatch pattern name from the **Pattern** drop-down list. You can also change the scale or angle by entering new values in the **Scale** or **Angle** edit box. When using the **User defined** pattern, you can redefine the spacing between the lines in the hatch pattern by entering a new value in the **Spacing** edit box. If you are using the **Custom** pattern type, you can select another pattern from the **Custom pattern** drop-down list. You can also redefine the island detection style by selecting either of the **Normal**, **Outer**, or **Ignore** styles from the **Islands** area of the dialog box. If you want to copy the properties from an existing hatch pattern, choose the **Inherit Properties** button, and then select the hatch whose properties you want to be inherited. You can also change the draw order of the hatch patter using the options available in the **Draw Order** area. If the **Associative** radio button in the **Options** area of the dialog box is selected, the pattern is associative. This implies that whenever you modify the hatch boundary, the hatch pattern is automatically updated.

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Note

If a hatch pattern is associative, the hatch boundary can be edited using grips and editing commands and the associated pattern is modified accordingly. This is discussed later.

In Figure 13-32, the object is hatched using the ANSI31 hatch pattern. With the **HATCHEDIT** command, you can edit the hatch using the **Hatch Edit** dialog box to change the hatch to the one shown in Figure 13-33. You can also edit an existing hatch through the command line by entering **-HATCHEDIT** at the Command prompt.

Figure 13-32 *ANSI31 hatch pattern*

Figure 13-33 *Using the* ***HATCHEDIT*** *command to edit the hatch pattern*

IGNORING HATCH PATTERN ENTITIES WHILE SNAPPING

In the previous releases of AutoCAD LT, the hatch pattern elements were even considered, while trying to snap to a point close to them. This causes a problem in snapping to the exact point. AutoCAD LT 2006 allows you to set the option that ensures that the hatch pattern elements are not considered while snapping. This option is set using the **Ignore hatch objects** check box in the **Object Snap Options** area of the **Drafting** tab of the **Options** dialog box. This check box is selected by default.

Using the PROPERTIES Palette

Toolbar:	Standard > Properties
Menu:	Modify, Tools > Properties
Command:	PROPERTIES

You can also use the **PROPERTIES** command to edit the hatch pattern. When you select a hatch pattern for editing, and invoke the **PROPERTIES** command, AutoCAD LT displays the **PROPERTIES** palette for the hatch, see Figure 13-34. You can also invoke the **PROPERTIES** palette by selecting the hatch pattern and right-clicking to display a shortcut menu. Choose **Properties** here; the **PROPERTIES** palette is displayed. This palette displays the properties of the selected pattern under the following categories.

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General

In this category, you can change the general pattern properties like color, layer, linetype, linetype scale, lineweight, and so on. When you click on the field corresponding to a particular property, a drop-down list is displayed from where you can select an option or value. Whenever a drop-down list does not get displayed, you can enter a value in the field itself.

Figure 13-34 The ***PROPERTIES*** *palette (Hatch)*

Pattern

In this category, you can change the pattern type, pattern name, angle, scale, spacing, associativity, and island detection style properties of the pattern. In the case of ISO patterns, you can redefine the ISO pen width of the pattern and you can also modify the spacing of the **User defined** patterns. You can also determine whether you want to have a **User defined** pattern as double or not. When you choose the [**...**] button in the **Type** property field, AutoCAD LT displays the **Hatch Pattern Type** dialog box, see Figure 13-35. Here, you can select the type of hatch pattern from the **Pattern Type** drop-down list. If you have selected a **Predefined** pattern type, you can select a pattern name from the **Pattern** drop-down list or choose the **Pattern** button to display the **Hatch Pattern Palette** dialog box. You can then select a pattern here in one of the tabs and then choose **OK** to exit the dialog box. Now, choose **OK** in the **Hatch Pattern Type** dialog box to return to the **PROPERTIES** palette. You will notice that the pattern name you have selected is displayed in the **Pattern** name field. Similarly, if you select the **Custom** pattern type, you can enter the name of the custom pattern in the **Custom Pattern** edit box. If you select a **User defined** pattern type, both the **Pattern Type** drop-down list and the **Custom Pattern** edit box are not available. When you click in the **Pattern name** property field, the [**...**] button is displayed. When you choose the [**...**] button, the **Hatch Pattern Palette** dialog box is displayed with the ANSI31 pattern selected. The values of the angle, scale, and spacing properties can be entered in the corresponding fields. A value for the ISO pen width can be selected from the **ISO pen width** drop-down list. For user-defined hatch patterns, you can select **Yes** or **No** from the **Double** drop-down list to specify if you want the hatch pattern to double at right angles to the original pattern or not. You can also select **Yes** or **No** from the **Associative** drop-down list to determine if a pattern is associative or not. Similarly, you can select an island detection style from the **Island detection style** drop-down list.

Figure 13-35 The ***Hatch Pattern Type*** *dialog box*

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Tip

It is more convenient to choose the [...] button in the ***Pattern Type*** *edit box to display the* ***Hatch Pattern Type*** *dialog box and enter both the type and name of the pattern at the same time.*

Geometry

In this category, the elevation of the hatch pattern can be changed. A new value of elevation for the hatch pattern can be entered in the **Elevation** field. This category also displays the area and the cumulative area of the hatch.

EDITING HATCH BOUNDARY

Using Grips

One of the ways you can edit the hatch boundary is by using grips. You can select the hatch pattern or the hatch boundaries. If you select the hatch pattern, the hatch highlights and a grip is displayed at the centroid of the hatch. A centroid for a region that is coplanar with the *XY* plane is the center of that particular area. However, if you select an object that defines the hatch boundary, the object grips are displayed at the defining points of the selected object. Once you change the boundary definition, and if the hatch pattern is associative, AutoCAD LT will reevaluate the hatch boundary and then hatch the new area. When you edit the hatch boundary, make sure that there are no open spaces in it. AutoCAD LT will not create a hatch if the outer boundary is not closed. Figure 13-36 shows the result of moving the circle and text, and shortening the bottom edge of the hatch boundary of the object shown in Figure 13-33. The objects were edited by using grips and since the pattern is associative, when modifications are made to the boundary object, the pattern automatically fills up the new area. If you select the hatch pattern, AutoCAD LT will display the hatch object grip at the centroid of the hatch. You can select the grip to make it hot and then edit the hatch object. You can stretch, move, scale, mirror, or rotate the hatch pattern. Once an editing operation takes place on the hatch pattern, it may be moved, rotated, or scaled; then, the associativity is lost and AutoCAD LT displays the message: "**Hatch boundary associativity removed**."

Figure 13-36 *The result of using grips to edit the hatch boundary of the object shown in Figure 13-33*

The **Retain boundaries** check box in the **Hatch** dialog box is cleared when a hatch is created by default. Hence, all objects selected or found by the selection or point selection processes during hatch creation are associated with the hatch as boundary objects. Editing any of them may affect the hatch. If, however, the **Retain boundaries** check box was selected when the hatch was created, only the retained polyline boundary created by **HATCH** is associated with the hatch as its boundary object. Editing it will affect the hatch, and editing the objects selected or found by

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selection or point selection processes during the hatch created will have no effect on the hatch. You can, of course, select and simultaneously edit the objects selected or found by the selection or point selection processes, as well as the retained polyline boundary created by the **HATCH** command.

Trimming the Hatch Patterns

One of the recent additions in editing hatches is that you are now allowed to trim the hatch patterns using a cutting edge. For example, refer to Figure 13-37. This figure shows a drawing before trimming the hatch. In this drawing, the outer loop was selected as the object to be hatched. This is the reason the space between the two vertical lines on the right is also hatched. Figure 13-38 shows the same drawing after trimming the hatch using the vertical lines as the cutting edge. You will notice that even after trimming some of the portion of the hatch, it is a single entity.

Figure 13-37 *Before trimming the hatch*

Figure 13-38 *After trimming the hatch using the vertical lines as the cutting edge*

Using AutoCAD LT Editing Commands

When you use the editing commands such as **MOVE**, **ROTATE**, **SCALE**, and **STRETCH**, associativity is maintained, provided all objects that define the boundary are selected for editing. If any of the boundary-defining objects is missing, the associativity will be lost and AutoCAD LT will display the message **Hatch boundary associativity removed**. When you rotate or scale an associative hatch, the new rotation angle and the scale factor are saved with the hatch object data. This data is then used to update the hatch. When using the **ARRAY**, **COPY**, and **MIRROR** commands, you can array, copy, or mirror just the hatch boundary, without the hatch pattern. Similarly, you can erase just the hatch boundary, using the **ERASE** command and associativity is removed. If you explode an associative hatch pattern, the associativity between the hatch pattern and the defining boundary is removed. Also, when the hatch object is exploded, each line in the hatch pattern becomes a separate object.

When the original boundary objects are being edited, the associated hatch gets updated, but new boundary objects do not have any effect. For example, when you have a square island within a circular boundary and then you erase the square, the hatch pattern is updated to

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fill up the entire circle. But, once the island is removed, another island cannot be added, since it was not calculated as a part of the original set of boundary objects.

HATCHING BLOCKS AND XREF DRAWINGS

When you apply hatching to inserted blocks and xref drawings, their internal structure is treated as if the block or xref drawing were composed of independent objects. This means that if you have inserted a block that consists of a circle within a rectangle and you want the internal circle to be hatched, all you have to do is invoke the **Hatch** dialog box and then choose the **Pick Points** button to select a point within the circle to generate the desired hatch, see Figure 13-39. If you want to hatch a block using the **Select Objects** option, the objects inside the blocks should be parallel to the current UCS. If the block is composed of objects such as arcs, circles, or polyline arc segments, they need not be uniformly scaled for hatching, see Figure 13-39.

Figure 13-39 *Hatching inserted blocks*

When you xref a drawing, you can hatch any part of the drawing that is visible. Similarly, when you detach the xref drawing, the hatch pattern and its boundaries are not detached, although the hatch boundary associativity is removed.

PATTERN ALIGNMENT DURING HATCHING

Pattern alignment is an important feature of hatching, since on many occasions you need to hatch adjacent areas with similar or sometimes identical hatch patterns while keeping the adjacent hatch patterns properly aligned. Proper alignment of hatch patterns is taken care of automatically by generating all lines of every hatch pattern from the same reference point. The reference point is normally at the origin point (0,0). Figure 13-40 shows two adjacent hatch areas. The area on the right is hatched using the pattern ANSI32 at an angle of 0-degree and the area on the left is hatched using the same pattern at an angle of 90-degree. When you hatch these areas, the hatch lines may not be aligned, as shown in Figure 13-40(a). To align them, you can redefine the value of the **SNAPBASE** variable before you apply the hatch to the area on the left, so that the hatch lines are aligned, as

Figure 13-40 *Aligning hatch patterns using the* ***SNAPBASE*** *variable*

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shown in Figure 13-40(b). The reference point for hatching can be changed using the system variable **SNAPBASE**. The command prompt sequence is given next.

Command: **SNAPBASE**
Enter new value for SNAPBASE <0.0000, 0.0000>: *Enter the new reference point.*

In this case, the endpoint of the hatch in the area on the right is selected as the new reference point for hatching the area on the left. See Figure 13-40(b).

Note
*The value of the **SNAPBASE** variable can also be set using the **X base** and **Y base** edit boxes in the **Snap** area of the **Drafting Settings** dialog box (**Snap and Grid** tab).*

Tip
You should set the base point back to (0,0) when you are done with hatching the object; otherwise, the most recent value gets stored and is used the next time you apply a hatch pattern.

Exercise 3 *Mechanical*

In this exercise, you will hatch the given drawing using the hatch pattern ANSI31. Use the **SNAPBASE** variable to align the hatch lines shown in the drawing (Figure 13-41).

Figure 13-41 *Drawing for Exercise 3*

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CREATING A BOUNDARY USING CLOSED LOOPS

Menu:	Draw > Boundary
Command:	BOUNDARY

The **BOUNDARY** command is used for creating a polyline or region around a selected point within a closed area, in a manner similar to the one used for defining a hatch boundary. When this command is invoked, AutoCAD LT displays the **Boundary Creation** dialog box, as shown in Figure 13-42.

The options in the **Boundary Creation** dialog box are similar to those in the **Hatch** dialog box discussed earlier. Although, only the options related to boundary selections are available, the **Pick Points** button in the **Boundary Creation** dialog box is used to create a boundary by selecting a point inside the object, whose boundary you want to create.

When you choose the **Pick Points** button, the dialog box is cleared from the screen temporarily and you are prompted to select the internal point. Select a point that lies within the boundary of the object. Once you select an internal point, a polyline or a region is formed around the boundary (Figure 13-43). To end this process, press ENTER or right-click at the **Select internal point** prompt. Whether the boundary created is a polyline or region is determined by the option you have selected from the **Object type** drop-down list in the **Boundary retention** area. **Polyline** is the default option. You can edit the boundary that has been created with the editing commands. The boundary is selected by using the **Last** object selection option.

*Figure 13-42 The **Boundary Creation** dialog box*

*Figure 13-43 Using the **BOUNDARY** command to create a polyline boundary*

Similar to the **HATCH** command, you can also define a boundary set here by choosing the **New** button in the **Boundary set** area of the dialog box. The dialog box will temporarily close to allow you to select objects to be used to create a boundary. The default boundary set is **current viewport**, which means everything visible in the current viewport consists of the boundary set. As discussed earlier, the boundary set option is especially useful when you are working with large

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and complex drawings, where examining everything on the screen becomes a time-consuming process.

The **Boundary Creation** dialog box also provides you the option of determining the island detection method. The **Island detection** check box is available below the **Pick Points** button and is selected by default. As a result, the island detection method is **Flood** type and islands are included as boundary objects. If you clear this check box, the **Ray casting** method of island detection is enabled, where rays shall be cast from the selected internal point in all directions (by default, using the dialog box). The nearest closed object it encounters is used for boundary creation. If the selected point does not lie within the encountered boundary, a **Boundary Definition Error** dialog box is displayed and you have to select another internal point.

The **-BOUNDARY** command can be used if you want to bypass the dialog box and use the command line. When using the command line, all the options (**Nearest**, **+X**, **-X**, **+Y**, and **-Y**) of ray casting are available. When using the dialog box, only the **Nearest** option is available. The different options of ray casting have been described earlier in the chapter.

Note

*The **HPBOUND** system variable controls the type of boundary object created using the **BOUNDARY** command. Its default value of 1 creates a polyline and if the value is 0, the object created is a region.*

Exercise 4 *Mechanical*

Understand Figure 13-44 and then create the drawing shown in Figure 13-46 using the **BOUNDARY** command to create a hatch boundary. Copy the boundary from the drawing shown in Figure 13-45, and then hatch.

Figure 13-44 *Drawing for Exercise 4*

Figure 13-45 *Final drawing for Exercise 4*

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OTHER FEATURES OF HATCHING

1. In AutoCAD LT, the hatch patterns are separate objects. The objects store the information about the hatch pattern boundary with reference to the geometry that defines the pattern for each hatch object.

2. When you save a drawing, the hatch patterns are stored with the drawing. Therefore, the hatch patterns can be updated even if the hatch pattern file that contains the definitions of hatch patterns is not available.

3. If the system variable **FILLMODE** is 0 (Off), the hatch patterns are not displayed. To see the effect of a changed **FILLMODE** value, you must use the **REGEN** command to regenerate the drawing after the value has been changed.

4. You can edit the boundary of a hatch pattern even when the hatch pattern is not visible (**FILLMODE**=0).

5. The hatch patterns created with earlier releases are automatically converted to AutoCAD LT 2006 hatch objects when the hatch pattern is edited.

6. When you save an AutoCAD LT 2006 drawing in Release 2.0 format (DXF), the hatch objects are automatically converted to Release 2.0 hatch blocks.

7. You can use the **CONVERT** command to change the pre-Release 97 hatch patterns to AutoCAD LT 2006 objects. You can also use this command to change the pre-Release 97 polylines to AutoCAD LT 2006 optimized format to save memory and disk space.

Self-Evaluation Test

Answer the following questions, and then compare your answers to those given at the end of this chapter.

1. Different hatch patterns make it possible to distinguish between different parts or components of an object. (T/F)

2. If AutoCAD LT does not locate the entered pattern in the *acad.pat* file, it searches for it in a file with the same name as the pattern. (T/F)

3. When a boundary set is formed, it does not become the default for hatching. (T/F)

4. You can edit the hatch boundary and the associated hatch pattern by using grips. (T/F)

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5. The working of the _____ command and the _____ is made similar in this release of AutoCAD LT.

6. One of the ways to specify a hatch pattern from the group of stored hatch patterns is by selecting one from the _____ drop-down list.

7. The value you enter in the _____ edit box lets you rotate the hatch pattern with respect to the *X* axis of the current UCS.

8. The _____ option in the **Hatch** dialog box lets you select objects that form the boundary for hatching.

9. You can use the _____ option after you have selected the area to be hatched to see the hatching before it is actually applied.

10. The selection of a hatch style carries meaning only if the objects to be hatched are _____.

Review Questions

Answer the following questions.

1. The **HATCH** command does not allow you to hatch a region enclosed within a boundary (closed area) by selecting a point inside the boundary. (T/F)

2. A **Boundary Definition Error** dialog box is displayed if AutoCAD LT finds that the selected point is not inside the boundary or that the boundary is not closed. (T/F)

3. The **Gap tolerance** edit box is used to set the value up to which the open area will be considered closed when selected for hatching using the **Pick Points** method. (T/F)

4. When you use editing commands such as **MOVE**, **SCALE**, **STRETCH**, and **ROTATE**, associativity is lost, even if all the boundary objects are selected. (T/F)

5. The hatching procedure in AutoCAD LT does not work on inserted blocks. (T/F)

6. Patterns drawn using the **HATCH** command are associative. (T/F)

7. If the **Double** hatch box is selected, which system variable is set to 1?

   (a) **HPSPACE** (b) **HPDOUBLE**
   (c) **HPANG** (d) **HPSCALE**

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8. The **ISO Pen Width** drop-down list is available only for which hatch patterns?

   (a) **ANSI** (b) **Predefined**
   (c) **Custom** (d) **ISO**

9. If you want to have the same hatching pattern, style, and properties as that of an existing hatch on the screen, which button should you choose?

   (a) **Inherit Properties** (b) **Select Objects**
   (b) **Pick Points** (d) **Remove Islands**

10. Which variable can you use to align the hatches in adjacent hatch areas?

    (a) **SNAPBASE** (b) **FILLMODE**
    (c) **SNAPANG** (d) **HPANG**

11. The specified hatch spacing value is stored in which system variable?

    (a) **HPDOUBLE** (b) **HPANG**
    (c) **HPSCALE** (d) **HPSPACE**

12. One of the advantages of using the _____ command is that you don't have to select each object comprising the boundary of the area you want to hatch, as in the case of the _____ command.

13. To select a custom hatch pattern, first select **Custom** from the **Type** drop-down list and then select the name of a previously stored hatch pattern from the _____ drop-down list.

14. There are three hatching styles from which you can choose: _____, _____, and _____.

15. If you select the _____ style, all areas bounded by the outermost boundary are hatched, ignoring any hatch boundaries that lie within the outer boundary.

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Exercises

Exercise 5

Mechanical

Hatch the drawings in Figures 13-46 and 13-47 using the hatch pattern to match.

Figure 13-46 *Drawing for Exercise 5*

Figure 13-47 *Drawing for Exercise 5*

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Exercise 6

General

Hatch the drawing in Figure 13-48 using the hatch pattern ANSI31. Use the **SNAPBASE** variable to align the hatch lines, as shown in the drawing.

Figure 13-48 *Drawing for Exercise 6*

Exercise 7

Mechanical

Figure 13-49 shows the top and front views of an object. It also shows the cutting plane line. Based on the cutting plane line, hatch the front views in section. Use the hatch pattern of your choice.

Figure 13-49 *Drawing for Exercise 7*

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Exercise 8

Mechanical

Figure 13-50 shows the top and front views of an object. Hatch the front view in full section. Use the hatch pattern of your choice.

Figure 13-50 *Drawing for Exercise 8*

Exercise 9

Mechanical

Figure 13-51 shows the front and side views of an object. Hatch the side view in half section. Use the hatch pattern of your choice.

Figure 13-51 *Drawing for Exercise 9*

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Exercise 10

Mechanical

Figure 13-52 shows the front view with broken section and top views of an object. Hatch the front view as shown. Use the hatch pattern of your choice.

Figure 13-52 *Drawing for Exercise 10*

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Exercise 11

Mechanical

Figure 13-53 shows the front, top, and side views of an object. Hatch the side view in section using the hatch pattern of your choice.

Figure 13-53 *Drawing for Exercise 11*

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Problem Solving Exercise 1

Mechanical

Figure 13-54 shows an object with front and side views with aligned section. Hatch the side view using the hatch pattern of your choice.

Figure 13-54 *Drawing for Problem Solving Exercise 1*

Problem Solving Exercise 2

Mechanical

Figure 13-55 shows the front view, side view, and the detail "A" of an object. Hatch the side view and draw the detail drawing as shown.

Figure 13-55 *Drawing for Problem Solving Exercise 2*

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Problem Solving Exercise 3

Mechanical

Create the drawing shown in Figure 13-56. Assume the missing dimensions.

Figure 13-56 *Drawing for Problem Solving Exercise 3*

Problem Solving Exercise 4

Mechanical

Create the drawing shown in Figure 13-57. Assume the missing dimensions.

Figure 13-57 *Drawing for Problem Solving Exercise 4*

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Answers to Self-Evaluation Test

1 - T, **2** - T, **3** - F, **4** - T, **5** - **BHATCH**, **HATCH**, **6** - **Pattern**, **7** - **Angle**, **8** - **Select Objects**, **9** - **Preview**, **10** - nested

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