Chapter 31

Creating Linetypes and Hatch Patterns

Learning Objectives

After completing this chapter, you will be able to:
Create Linetypes:
- *Write linetype definitions.*
- *Create different linetypes.*
- *Create linetype files.*
- *Determine* ***LTSCALE*** *for plotting the drawing to given specifications.*
- *Define alternate linetypes and modify existing linetypes.*
- *Create string and shape complex linetypes.*

Create Hatch Patterns:
- *Understand hatch pattern definition.*
- *Create new hatch patterns.*
- *Determine the effect of angle and scale factor on hatch.*
- *Create hatch patterns with multiple descriptors.*
- *Save hatch patterns in a separate file.*
- *Define custom hatch pattern file.*

STANDARD LINETYPES

The AutoCAD software package comes with a library of standard linetypes that has 38 different standard linetypes and 7 complex linetypes, including ISO linetypes. These linetypes are saved in the **ACAD.LIN** file. You can modify existing linetypes or create new ones.

LINETYPE DEFINITION

All linetype definitions consist of two parts: **header line and pattern line**.

Header Line

The **header line** consists of an asterisk (*) followed by the name of the linetype and the linetype description. The name and the linetype description should be separated by a comma. If there is no description, the comma that separates the linetype name and the description is not required.

The format of the header line is:

*** Linetype Name, Description**

Example
***HIDDENS,___ ___ ___ ___ ___ ___**

Where ***** -------------------- Asterisk sign
HIDDENS ------ Linetype name
, --------------------- Comma
__ __ __ __ ------ Linetype description

All linetype definitions require a linetype name. When you want to load a linetype or assign a linetype to an object, AutoCAD recognizes the linetype by the name you have assigned to the linetype definition. The names of the linetype definition should be selected to help the user recognize the linetype by its name. For example, the linetype name LINEFCX does not give the user any idea about the type of line. However, a linetype name like DASHDOT gives a better idea about the type of line that a user can expect.

The linetype description is a textual representation of the line. This representation can be generated by using dashes, dots, and spaces at the keyboard. The graphic is used by AutoCAD when you want to display the linetypes on the screen by using the AutoCAD **LINETYPE** command with the ? option or by using the dialog box. The linetype description cannot exceed 47 characters.

Pattern Line

The **pattern line** contains the definition of the line pattern. The definition of the line pattern consists of the alignment field specification and the linetype specification. The alignment field specification and the linetype specification are separated by a comma.

The format of the pattern line is:

Alignment Field Specification, Linetype Specification

Example
A,.75,-.25,.75

Where **A** -------------------- Alignment field specification
, --------------------- Comma
.75,-.25,.75 ----- Linetype specification

The letter used for alignment field specification is A. This is the only alignment field supported by AutoCAD; therefore, the pattern line will always start with the letter A. The linetype specification defines the configuration of the dash-dot pattern to generate a line. The maximum number for dash length specification in the linetype is 12, provided the linetype pattern definition fits on one 80-character line.

ELEMENTS OF LINETYPE SPECIFICATION

All linetypes are created by combining the basic elements in a desired configuration. There are three basic elements that can be used to define a linetype specification.

Dash (Pen down)
Dot (Pen down, 0 length)
Space (Pen up)

Example

_______ . _______ . _______ . _______

Where **.** --------------------- Dot (pen down with 0 length)
Blank space ----------------- Space (pen up)
_______ --------------------- Dash (pen down with specified length)

The dashes are generated by defining a positive number. For example, .5 will generate a dash 0.5 units long. Similarly, spaces are generated by defining a negative number. For example, -.2 will generate a space 0.2 units long. The dot is generated by defining a 0 length.

Example
A,.5,-.2,0,-.2,.5
Where **0** -------------------- Dot (zero length)
-.2 ------------------ Length of space (pen up)
.5 ------------------- Length of dash (pen down)

CREATING LINETYPES

Before creating a linetype, you need to decide the type of line you want to generate. Draw the line on a piece of paper and measure the length of each element that constitutes the line. You need to define only one segment of the line, because the pattern is repeated when you draw a line. Linetypes can be created or modified by any one of the following methods:

Using a text editor like Notepad
A**dding a new linetype in the ACAD.LIN file**
Using the AutoCAD LINETYPE command

The following example, Example 3, explains how to create a new linetype by using a text editor, adding a linetype to the **ACAD.LIN** file, and using the AutoCAD **LINETYPE** command.

Example 1

Create linetype DASH3DOT (Figure 31-1) with the following specifications:

Length of the first dash 0.5
Blank space 0.125
Dot
Blank space 0.125
Dot
Blank space 0.125
Dot
Blank space 0.125

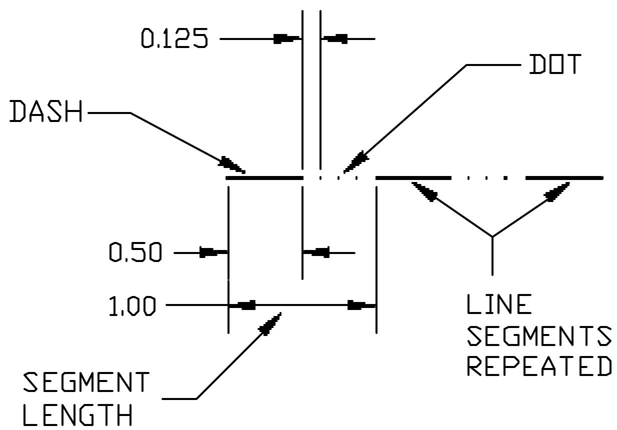

Figure 31-1 *Linetype specifications of DASH3DOT*

Using a Text Editor

Step 1: Writing definition of linetype

You can start a new linetype file and then add the line definitions to this file. Use any text editor like Notepad to start a new file (NEWLT.LIN) and then add the following two lines to the file to define the DASH3DOT linetype. The name and the description must be separated by a comma (,). The description is optional. If you decide not to give one, omit the comma after the linetype name DASH3DOT.

```
*DASH3DOT,____ . . . ____ . . . ____
A,.5,-.125,0,-.125,0,-.125,0,-.125
```

Save it as NEWLT.LIN in AutoCAD's Support directory.

Step 2: Loading the linetype

To load this linetype, choose **Linetype** from the **Format** menu to display the **Linetype Manager** dialog box as shown in Figure 31-2. Choose the **Load** button in the **Linetype Manager** dialog box to display the **Load or Reload Linetypes** dialog box. Choose the **File** button in the **Load or Reload Linetypes** dialog box to display the **Select Linetype File** dialog box. Choose the **NEWLT.LIN** file in the **Select Lintype File** dialog box and then choose **Open**. Again the **Load or Reload Linetypes** dialog box is displayed. Choose the **DASH3DOT** linetype in the **Available Linetypes** area and then choose **OK**. Again, the **Linetype Manager** dialog box is displayed. Choose the **DASH3DOT** linetype and then choose the **Current** button to make the selected linetype current. Then choose **OK**.

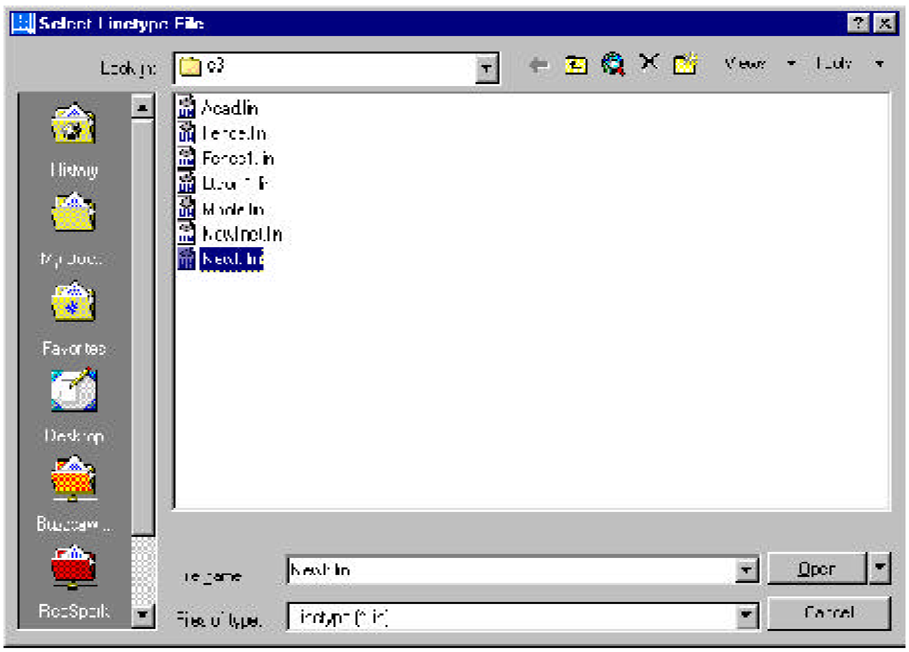

Figure 31-2 Select Linetype dialog box

Adding a New Linetype in the ACAD.LIN File

Step 1: Adding a new linetype in the ACAD.LIN

You can also use a text editor (like Notepad) to create a new linetype. Using the text editor, load the file and insert the lines that define the new linetype. The following file is a partial listing of the **ACAD.LIN** file after adding a new linetype to the file:

```
*BORDER,__ __ . __ __ . __ __ . __ __ . __ __ . __ __ .
A,.5,-.25,.5,-.25,0,-.25
*BORDER2,__.__.__.__.__.__.__.__.__.__.__.__.__.__.__.
A,.25,-.125,.25,-.125,0,-.125
*BORDERX2,____ ____ . ____ ____ . ____ ____ .
A,1.0,-.5,1.0,-.5,0,-.5
```

```
*CENTERX2,________ __ ________ __ ________ __ __
A,2.5,-.5,.5,-.5
*DASHDOT,__ . __ . __ . __ . __ . __ . __ . __ . __ .
A,.5,-.25,0,-.25
*DOTX2,. . . . . . . . . . . . . . . .
A,.25,-.125
*HIDDEN2,_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
A,.125,-.0625
*HIDDENX2,____ ____ ____ ____ ____ ____ ____ ____ ____
A,.5,-.25
*PHANTOM,______ __ __ ______ __ __ ______ __ __
A,1.25,-.25,.25,-.25,.25,-.25
*PHANTOMX2,____________ ____ ____ ____________
|

*GAS_LINE,Gas line ----GAS----GAS----GAS----GAS----GAS----GAS--
A,.5,-.2,["GAS",STANDARD,S=.1,R=0.0,X=-0.1,Y=-.05],-.25
*ZIGZAG,Zig zag /\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/
A,.0001,-.2,[ZIG,ltypeshp.shx,x=-.2,s=.2],-.4,[ZIG,ltypeshp.shx,r=180,x=.2,s=.2],-.2
*DASH3DOT,____ . . . ____ . . . ____
A,.5,-.125,0,-.125,0,-.125,0,-.125
```

The last two lines of this file define the new linetype, DASH3DOT. The first line contains the name DASH3DOT and the description of the line (___ . . .___). The second line contains the alignment and the pattern definition.

Step 2: Loading the linetype

Save the file and then load the linetype using the AutoCAD **LINETYPE** command. The procedure of loading the linetype is the same as described earlier in this example. The lines and polylines that this linetype will generate are shown in Figure 31-3.

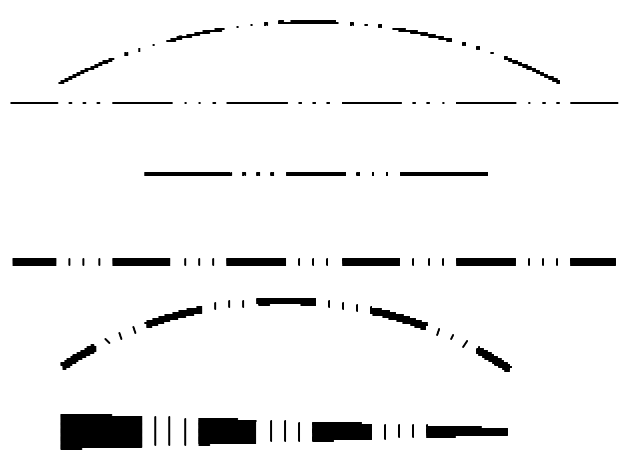

Figure 31-3 Lines created by linetype DASH3DOT

Note
If you change the LTSCALE factor, all lines in the drawing are affected by the new ratio.

Using the AutoCAD Linetype Command

Step 1: Creating a linetype

To create a linetype using the AutoCAD **LINETYPE** command, first make sure that you are in the drawing editor. Then enter the **-LINETYPE** command and select the Create option to create a linetype.

Command: **-LINETYPE**
Enter an option [?/Create/Load/Set]: **C**

Enter the name of the linetype and the name of the library file in which you want to store the definition of the new linetype.

Enter name of linetype to create: **DASH3DOT**

If **FILEDIA**=1, the **Create or Append Linetype File** dialog box (Figure 31-4) will appear on the screen. If **FILEDIA**=0, AutoCAD will prompt you to enter the name of the file.

Enter linetype file name for new linetype definition <default>: **Acad**

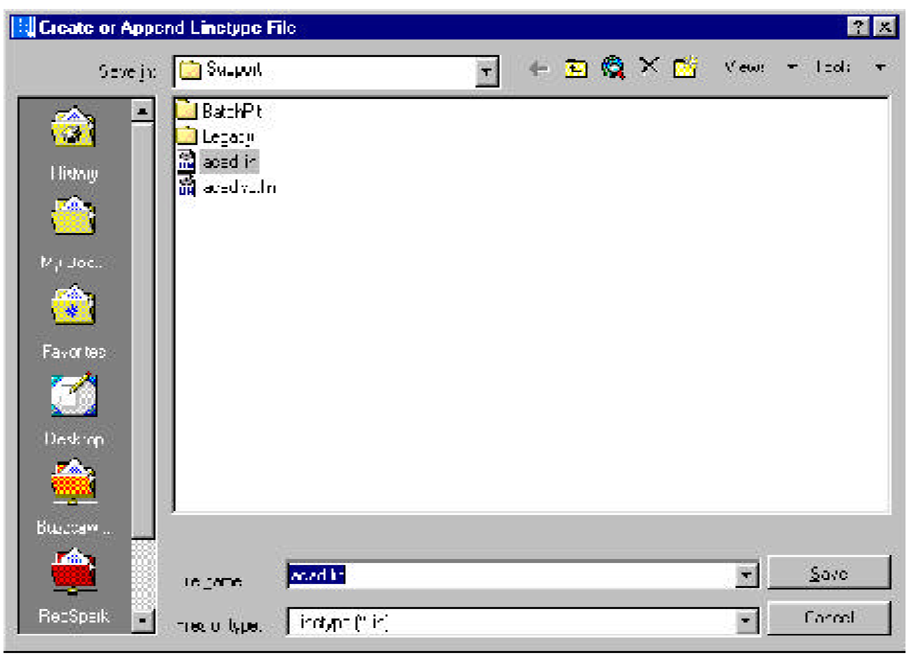

Figure 31-4 Create or Append Linetype File dialog box

If the linetype already exists, the following message will be displayed on the screen:

Wait, checking if linetype already defined...
"Linetype" already exists in this file. Current definition is:
alignment, dash-1, dash-2, _____.
Overwrite?<N>

If you want to redefine the existing line style, enter Y; otherwise, type N or press RETURN to choose the default value of N. You can then repeat the process with a different name of the linetype. After entering the name of the linetype and the library file name, AutoCAD will prompt you to enter the descriptive text and the pattern of the line.

Descriptive text: ***DASH3DOT,____ . . . ____ . . . ____**
Enter linetype pattern (on next line):
A,.5,-.125,0,-.125,0,-.125,0,-.125

Descriptive Text

***DASH3DOT,____ . . . ____ . . . ____**

For the descriptive text, you have to type an asterisk (*) followed by the name of the linetype. For Example 1, the name of the linetype is DASH3DOT. The name *DASH3DOT can be followed by the description of the linetype; the length of this description cannot exceed 47 characters. In this example, the description is dashes and dots ____ . . . ____. It could be any text or alphanumeric string. The description is displayed on the screen when you list the linetypes.

Pattern

A,.5,-.125,0,-.125,0,-.125,0,-.125

The line pattern should start with an alignment definition. Currently, AutoCAD supports only one type of alignment—A. Therefore, it is automatically displayed on the screen when you select the **LINETYPE** command with the Create option. After entering **A** for pattern alignment, you must define the pen position. A positive number (.5 or 0.5) indicates a “pen-down” position, and a negative number (-.25 or -0.25) indicates a “pen-up” position. The length of the dash or the space is designated by the magnitude of the number. For example, 0.5 will draw a dash 0.5 units long, and -0.25 will leave a blank space of 0.25 units. A dash length of 0 will draw a dot (.). Here are the pattern definition elements for Example 1:

.5	**pen down**	**0.5 units long dash**
-.125	**pen up**	**.125 units blank space**
0	**pen down**	**dot**
-.125	**pen up**	**.125 units blank space**
0	**pen down**	**dot**
-.125	**pen up**	**.125 units blank space**
0	**pen down**	**dot**
-.125	**pen up**	**.125 units blank space**

After you enter the pattern definition, the linetype (DASH3DOT) is automatically saved in the **ACAD.LIN** file

Step 2: Loading the linetype

You can use the LINETYPE command to load the linetype or choose Linetype in the Format pulldown menu. The linetype (DASH3DOT) can also be loaded using the AutoCAD **-LINETYPE** command and selecting the **Load** option.

ALIGNMENT SPECIFICATION

The alignment specifies the pattern alignment at the start and the end of the line, circle, or arc. In other words, the line would always start and end with the dash (___). The alignment definition “A” requires that the first element be a dash or dot (pen down), followed by a negative (pen up) segment. The minimum number of dash segments for alignment A is two. If there is not enough space for the line, AutoCAD will draw a continuous line.

For example, in the linetype DASH3DOT of Example 1, the length of each line segment is 1.0 (.5 + .125 + .125 + .125 + .125 = 1.0). If the length of the line drawn is less than 1.00, the line will be drawn as a continuous line (Figure 31-5). If the length of the line is 1.00 or greater, the line will be drawn according to DASH3DOT linetype. AutoCAD automatically adjusts the length of the dashes and the line will always start and end with a dash. The length of the starting and ending dashes will be at least half the length of the dash as specified in the file. If the length of the dash as specified in the file is 0.5, the length of the starting and ending dashes will be at least 0.25. To fit a line that starts and ends with a dash, the length of these dashes can also increase as shown in Figure 31-5.

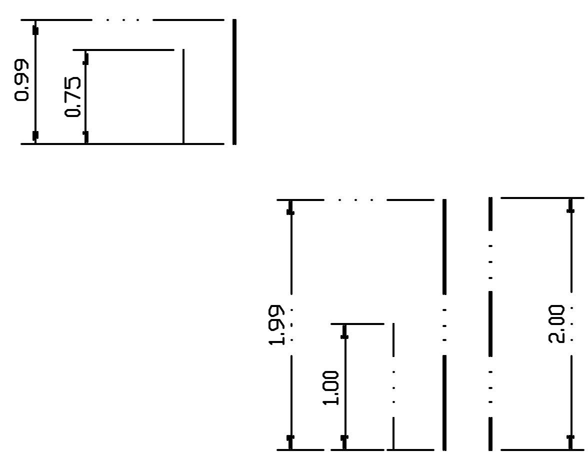

Figure 31-5 Alignment of linetype DASH3DOT

LTSCALE COMMAND

As we mentioned previously, the length of each line segment in the DASH3DOT linetype is 1.0 (.5 + .125 + .125 + .125 + .125 = 1.0). If you draw a line that is less than 1.0 units long, AutoCAD will draw a single dash that looks like a continuous line (Figure 31-6). This problem can be rectified by changing the linetype scale factor variable **LTSCALE** to a smaller value. This can be accomplished by using AutoCAD's **LTSCALE** command:

Command: **LTSCALE**
Enter new linetype scale factor <default>: *New value.*

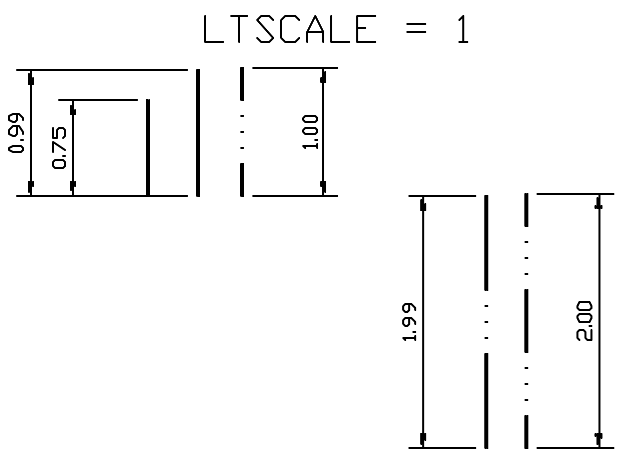

Figure 31-6 Alignment when Ltscale = 1

The default value of the **LTSCALE** variable is 1.0. If the LTSCALE is changed to 0.75, the length of each segment is reduced by 0.75 (1.0 x 0.75 = 0.75). Then, if you draw a line 0.75 units or longer, it will be drawn according to the definition of DASH3DOT (___ . . . ____) (Figures 3-7 and 3-8).

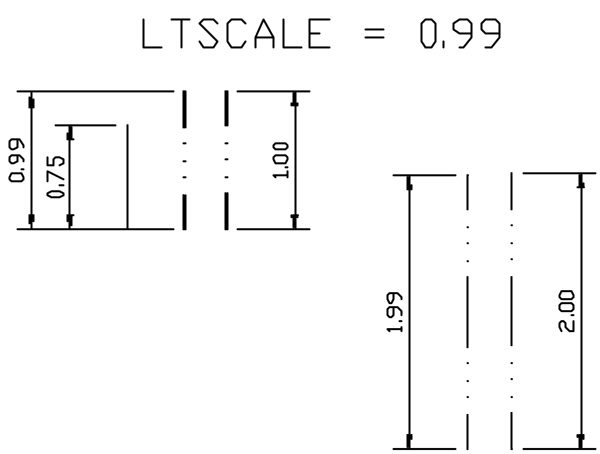

Figure 31-7 Alignment when Ltscale = 0.99

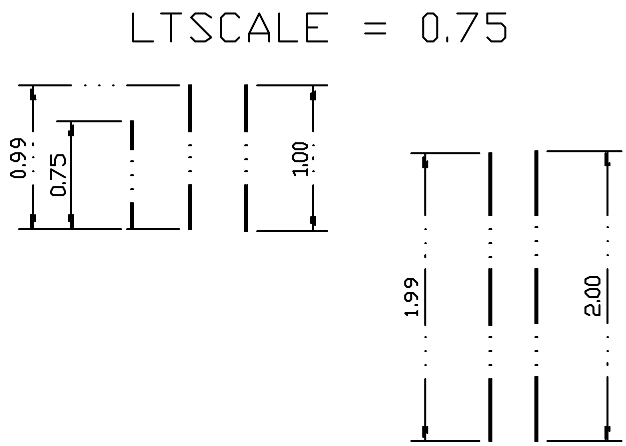

Figure 31-8 Alignment when Ltscale = 0.75

The appearance of the lines is also affected by the limits of the drawing. Most of the AutoCAD linetypes work fine for a drawing that has the limits 12,9. Figure 31-9 shows a line of linetype DASH3DOT that is four units long and the limits of the drawing are 12,9. If you increase the limits to 48,36 the lines will appear as continuous lines. If you want the line to appear the same as before **on the screen**, the LTSCALE should be changed. Since the limits of the drawing have increased four times, the LTSCALE should also increase by the same amount. If you change the scale factor to four, the line segments will also increase by a factor of four. As shown in Figure 31-9, the length of the starting and the ending dash has increased to one unit.

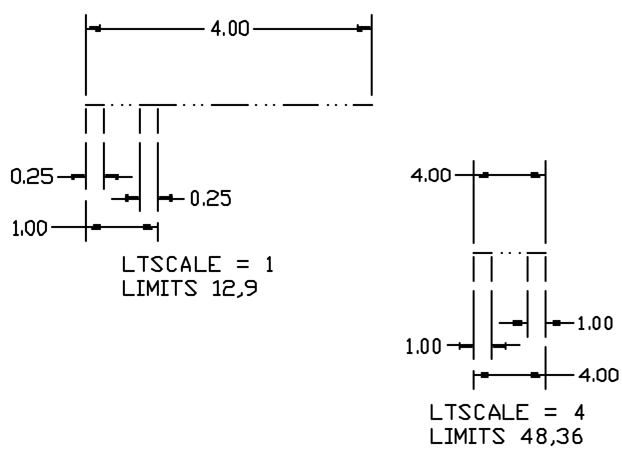

Figure 31-9 Linetype DASH3DOT before and after changing the LTSCALE

In general, the approximate LTSCALE factor for **screen display** can be obtained by dividing the X-limit of the drawing by the default X-limit (12.00). However, **it is recommended that the linetype scale must be set according to plot scale** discussed in the next section.

LTSCALE factor for SCREEN DISPLAY = X-limits of the drawing/12.00
Example

Drawing limits are 48,36
LTSCALE factor for screen display= 48/12 = 4

Drawing sheet size is 36,24 and scale is 1/4" = 1'
LTSCALE factor for screen display = 12 x 4 x (36 / 12) = 144

LTSCALE FACTOR FOR PLOTTING

The LTSCALE factor for plotting depends on the size of the sheet you are using to plot the drawing. For example, if the limits are 48 by 36, the drawing scale is 1:1, and you want to plot the drawing on a 48" by 36" size sheet, the LTSCALE factor is 1. If you check the specification of a hidden line in the ACAD.LIN file, the length of each dash is 0.25. Therefore, when you plot a drawing with 1:1 scale, the length of each dash in a hidden line is 0.25.

However, if the drawing scale is 1/8" = 1' and you want to plot the drawing on a 48" by 36" paper, the LTSCALE factor must be 96 (8 x 12 = 96). The length of each dash in the hidden line will increase by a factor of 96 because the LTSCALE factor is 96. Therefore, the length of each dash will be 24 units (0.25 x 96 = 24). At the time of plotting, the scale factor for plotting must be 1:96 to plot the 384' by 288' drawing on a 48" by 36" size paper. Each dash of the hidden line that was 24" long on the drawing will be 0.25 (24/96 = 0.25) inch long when plotted. Similarly, if the desired text size on the paper is 1/8", the text height in the drawing must be 12" (1/8 x 96 = 12").

Ltscale Factor for PLOTTING = Drawing Scale

Sometimes your plotter may not be able to plot a 48" by 36" drawing or you might like to decrease the size of the plot so that the drawing fits within a specified area. To get the correct dash lengths for hidden, center, or other lines, you must adjust the LTSCALE factor. For example, if you want to plot the previously mentioned drawing in a 45" by 34" area, the correction factor is:

Correction factor	= 48/45
	= 1.0666
New LTSCALE factor	= LTSCALE factor x Correction factor
	= 96 x 1.0666
	= 102.4

New Ltscale Factor for PLOTTING = Drawing Scale x Correction Factor

Note
If you change the LTSCALE factor, all lines in the drawing are affected by the new ratio.

ALTERNATE LINETYPES

One of the problems with the LTSCALE factor is that it affects all the lines in the drawing. As shown in Figure 31-10(a), the length of each segment in all DASH3DOT type lines is approximately equal, no matter how long the lines. You might want to have a small segment length if the lines are small and a longer segment length if the lines are long. You can accomplish this by using CELTSCALE (discussed later in this chapter) or by defining an alternate linetype with a different segment length. For example, you can define a linetype DASH3DOT and DASH3DOTX with different line pattern specifications.

```
*DASH3DOT,____ . . . ____ . . . ____ . . . ____
A,0.5,-.125,0,-.125,0,-.125,0,-.125
*DASH3DOTX,________ . . . __________
A,1.0,-.25,0,-.25,0,-.25,0,-.25
```

In DASH3DOT linetype the segment length is one unit, whereas in DASH3DOTX linetype the segment length is two units. You can have several alternate linetypes to produce the lines with different segment lengths. Figure 31-10(b) shows the lines generated by DASH3DOT and DASH3DOTX.

Note

Although you might have used different linetypes with different segment lengths, the lines will be affected equally when you change the LTSCALE factor. For example, if the LTSCALE factor is 0.5, the segment length of DASH3DOT line will be 0.5 and the segment length of DASH3DTX will be 1.0 units.

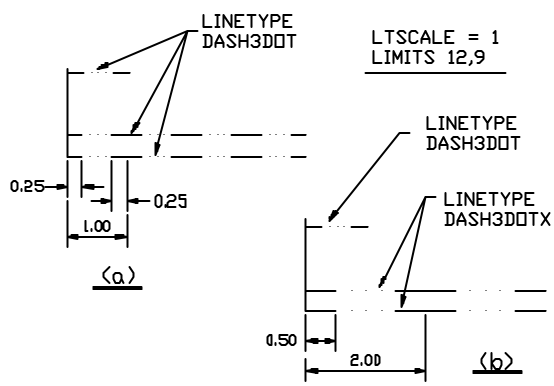

Figure 31-10 Linetypes generated by DASH3DOT and DASH3DOTX

MODIFYING LINETYPES

You can also modify the linetypes that are defined in the ACAD.LIN file. You must save a copy of the original ACAD.LIN file before making any changes to it. You need a text editor, such as Notepad, to modify the linetype. You can also use the EDIT function of DOS, or AutoCAD's **EDIT** command (provided the ACAD.PGP file is present and EDIT is defined in the file). For example, if you want to change the dash length of the border linetype from 0.5 to 0.75, load the file, then edit the pattern line of the border linetype. The following file is a partial listing of the ACAD.LIN file after changing the border and centerx2 linetypes.

;; AutoCAD Linetype Definition file, Version 2.0
;; Copyright 1991, 1992, 1993, 1994, 1996 by Autodesk, Inc.
;;
***BORDER,__ __ . __ __ . __ __ . __ __ . __ __ . __ __ . __ __ . __ __ .**
A,.75,-.25,.75,-.25,0,-.25
*BORDER2,Border (.5x) __.__.__.__.__.__.__.__.__.__.__.
A,.25,-.125,.25,-.125,0,-.125
*BORDERX2,Border (2x) ____ ____ . ____ ____ . ___
A,1.0,-.5,1.0,-.5,0,-.5

*CENTER,Center ____ _ ____ _ ____ _ ____ _ ____ _ ____
A,1.25,-.25,.25,-.25
*CENTER2,Center (.5x) ___ _ ___ _ ___ _ ___ _ ___ _ ___
A,.75,-.125,.125,-.125
***CENTERX2,Center (2x) ________ __ ________ __ _____**
A,3.5,-.5,.5,-.5

*DASHDOT,Dash dot __ . __ . __ . __ . __ . __ . __ . __
A,.5,-.25,0,-.25
*DASHDOT2,Dash dot (.5x) _._._._._._._._._._._._._._.
A,.25,-.125,0,-.125
*DASHDOTX2,Dash dot (2x) ____ . ____ . ____ . ___
A,1.0,-.5,0,-.5

*DASHED,Dashed __ __ __ __ __ __ __ __ __ __ __ __ __ _
A,.5,-.25
*DASHED2,Dashed (.5x) _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
A,.25,-.125
*DASHEDX2,Dashed (2x) ____ ____ ____ ____ ____ ___
A,1.0,-.5

*DIVIDE,Divide ____ . . ____ . . ____ . . ____ . . ____
A,.5,-.25,0,-.25,0,-.25
*DIVIDE2,Divide (.5x) __..__..__..__..__..__..__..__.._
A,.25,-.125,0,-.125,0,-.125
*DIVIDEX2,Divide (2x) ________ . . ________ . . _
A,1.0,-.5,0,-.5,0,-.5

*DOT,Dot . . . .
A,0,-.25
*DOT2,Dot (.5x) ....
A,0,-.125
*DOTX2,Dot (2x) . . . .
A,0,-.5

*HIDDEN,Hidden __ __ __ __ __ __ __ __ __ __ __ __ __ __
A,.25,-.125
*HIDDEN2,Hidden (.5x) _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

```
A,.125,-.0625
*HIDDENX2,Hidden (2x) ____ ____ ____ ____ ____ ____ ____
A,.5,-.25

*PHANTOM,Phantom ______ __ __ ______ __ __ ______
A,1.25,-.25,.25,-.25,.25,-.25
*PHANTOM2,Phantom (.5x) ___ _ _ ___ _ _ ___ _ _ ___ _ _
A,.625,-.125,.125,-.125,.125,-.125
*PHANTOMX2,Phantom (2x) ____________    ____    ____   _
A,2.5,-.5,.5,-.5,.5,-.5
;;  ISO 128 (ISO/DIS 12011) linetypes
;;  The size of the line segments for each defined ISO line, is
;;  defined for a usage with a pen width of 1 mm. To use them with
;;  the other ISO predefined pen widths, the line has to be scaled
;;  with the appropriate value (e.g. pen width 0,5 mm -> ltscale 0.5).
;;
*ACAD_ISO02W100,ISO dash __ __ __ __ __ __ __ __ __ __ __ __ __
A,12,-3
*ACAD_ISO04W100,ISO long-dash dot ____ . ____ . ____ . ____ . _
A,24,-3,.5,-3

*ACAD_ISO14W100,ISO dash triple-dot __ . . . __ . . . __ . . . _
A,12,-3,.5,-3,.5,-3,.5,-3
*ACAD_ISO15W100,ISO double-dash triple-dot __ __ . . . __ __ . .
A,12,-3,12,-3,.5,-3,.5,-3,.5,-3
;;  Complex linetypes

;;  Complex linetypes have been added to this file.
;;  These linetypes were defined in LTYPESHP.LIN in
;;  Release 13, and are incorporated in ACAD.LIN in Release 14

;;  These linetype definitions use LTYPESHP.SHX.
;;
*FENCELINE1,Fenceline circle ——0——0——0——0——0——0—
A,.25,-.1,[CIRC1,ltypeshp.shx,x=-.1,s=.1],-.1,1
*FENCELINE2,Fenceline square ——[]——[]——[]——[]——[]—-
A,.25,-.1,[BOX,ltypeshp.shx,x=-.1,s=.1],-.1,1
*TRACKS,Tracks -|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-
A,.15,[TRACK1,ltypeshp.shx,s=.25],.15
*BATTING,Batting SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
A,.0001,-.1,[BAT,ltypeshp.shx,x=-.1,s=.1],-.2,[BAT,ltypeshp.shx,r=180,x=.1,s=.1],-.1
*HOT_WATER_SUPPLY,Hot water supply —— HW —— HW —— HW ——
A,.5,-.2,["HW",STANDARD,S=.1,R=0.0,X=-0.1,Y=-.05],-.2
*GAS_LINE,Gas line ——GAS——GAS——GAS——GAS——GAS——GAS—
A,.5,-.2,["GAS",STANDARD,S=.1,R=0.0,X=-0.1,Y=-.05],-.25
*ZIGZAG,Zig zag /\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/
A,.0001,-.2,[ZIG,ltypeshp.shx,x=-.2,s=.2],-.4,[ZIG,ltypeshp.shx,r=180,x=.2,s=.2],-.2
```

Example 2

Create a new file, **NEWLINET.LIN**, and define a linetype, VARDASH, with the following specifications:

Length of first dash 1.0
Blank space 0.25
Length of second dash 0.75
Blank space 0.25
Length of third dash 0.5
Blank space 0.25
Dot
Blank space 0.25
Length of next dash 0.5
Blank space 0.25
Length of next dash 0.75

Step 1: Writing definition of linetype

Use a text editor and insert the following lines that define the new linetype **VARDASH**.

***VARDASH,———— —— — . — —— ————**
A,1,-.25,.75,-.25,.5,-.25,0,-.25,.5,-.25,.75,-.25

Step 2: Loading the linetype

You can use the **LINETYPE** command to load the linetype or choose Linetype in the **Format** pulldown menu. The type of lines that this linetype will generate are shown in Figure 31-11.

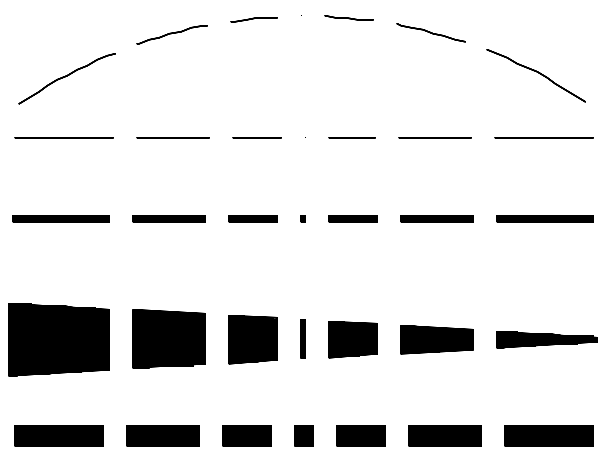

Figure 31-11 Lines generated by linetype VARDASH

CURRENT LINETYPE SCALING (CELTSCALE)

Like **LTSCALE**, the **CELTSCALE** system variable controls the linetype scaling. The difference is that **CELTSCALE** determines the current linetype scaling. For example, if you set the **CELTSCALE** to 0.5, all lines drawn after setting the new value for **CELTSCALE** will have the linetype scaling factor of 0.5. The value is retained in the **CELTSCALE** system variable. The first line (a) in Figure 31-12 is drawn with the **CELTSCALE** factor of 1 and the second line (b) is drawn with the **CELTSCALE** factor of 0.5. The length of the dashes is reduced by a factor of 0.5 when the **CELTSCALE** is 0.5.

The **LTSCALE** system variable controls the global scale factor. For example, if **LTSCALE** is set to 2, all lines in the drawing will be affected by a factor of 2. The net scale factor is equal to the product of **CELTSCALE** and **LTSCALE**. Figure 31-12(c) shows a line that is drawn with **LTSCALE** of 2 and **CELTSCALE** of 0.25. The net scale factor is = **LTSCALE** x **CELTSCALE** = 2 x 0.25 = 0.5.

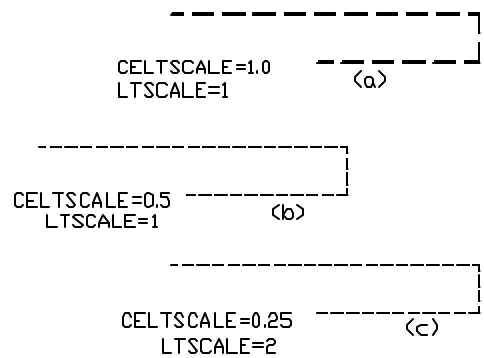

***Figure 31-12** Using CELTSCALE to control current linetype scaling*

Note
You can change the current linetype scale factor of a line by using the Properties *dialog box that can be invoked by choosing the* Properties *tool in the* Standard *toolbar. You can also use the CHANGE command and then select the* ltScale *option.*

COMPLEX LINETYPES

AutoCAD has provided a facility to create complex linetypes. The complex linetypes can be classified into two groups: string complex linetype and shape complex linetype. The difference between the two is that the string complex linetype has a text string inserted in the line, whereas the shape complex linetype has a shape inserted in the line. The facility of creating complex linetypes increases the functionality of lines. For example, if you want to draw a line around a building that indicates the fence line, you can do it by defining a complex linetype that will automatically give you the desired line with the text string (Fence). Similarly, you can define a complex linetype that will insert a shape (symbol) at predefined distances along the line.

Creating a String Complex Linetype

When writing the definition of a string complex linetype, the actual text and its attributes must be included in the linetype definition. The format of the string complex linetype is:

[“String”, Text Style, Text Height, Rotation, X-Offset, Y-Offset]

String. It is the actual text that you want to insert along the line. The text string must be enclosed in quotation marks (“ ”).

Text Style. This is the name of the text style file that you want to use for generating the text string. The text style must be predefined.

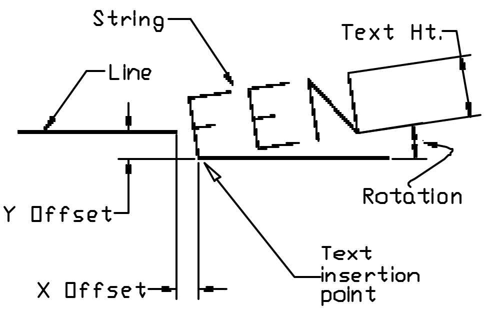

Figure 31-13 The attributes of a string complex line-

Text Height. This is the actual height of the text, if the text height defined in the text style is 0. Otherwise, it acts as a scale factor for the text height specified in the text style. In Figure 31-13, the height of the text is 0.1 units.

Rotation. The rotation can be specified as an absolute or relative angle. In absolute rotation the angle is always measured with respect to the positive X axis, no matter what AutoCAD's direction setting. The absolute angle is represented by letter "a".

In relative rotation the angle is always measured with respect to orientation of dashes in the linetype. The relative angle is represented by the letter "r". The angle can be specified in radians (r), grads (g), or degrees (d). The default is degrees.

X-Offset. This is the distance of the lower left corner of the text string from the endpoint of the line segment measured along the line. If the line is horizontal, then the X-Offset distance is measured along the X axis. In Figure 31-13, the X-Offset distance is 0.05.

Y-Offset. This is the distance of the lower left corner of the text string from the endpoint of the line segment measured perpendicular to the line. If the line is horizontal, then the Y-Offset distance is measured along the Y axis. In Figure 31-13, the Y-Offset distance is -0.05. The distance is negative because the start point of the text string is 0.05 units below the endpoint of the first line segment.

Example 3

In the following example, you will write the definition of a string complex linetype that consists of the text string "Fence" and line segments. The length of each line segment is 0.75. The height of the text string is 0.1 units, and the space between the end of the text string and the following line segment is 0.05 (Figure 31-14).

Step 1: Determining the line specifications

Before writing the definition of a new linetype, it is important to determine the line specification. One of the ways this can be done is to actually draw the lines and the text the way you want them to appear in the drawing. Once you have drawn the line and the text to your satisfaction, measure the distances needed to define the string complex linetype. In this example, the values are given as follows:

Text string =	Fence
Text style =	Standard
Text height =	0.1
Text rotation =	0
X-Offset =	0.05

Y-Offset=	-0.05
Length of the first line segment=	0.75
Distance between the line segments=	0.575

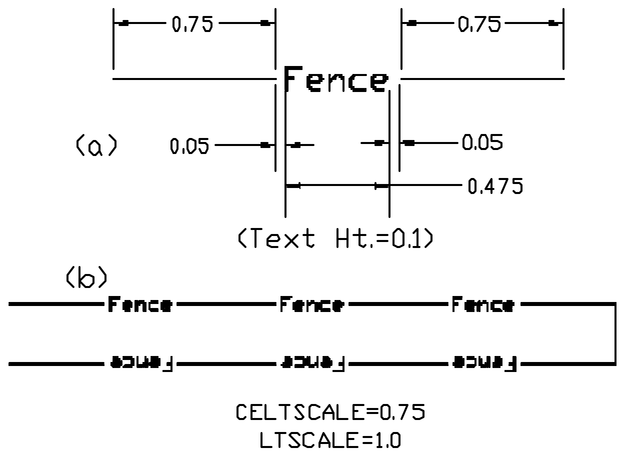

Figure 31-14 The attributes of a string complex linetype and line specifications for Example 3

Step 2: Writing the definition of string complex linetype

Use a text editor to write the definition of the string complex linetype. You can add the definition to the AutoCAD **ACAD.LIN** file or create a separate file. The extension of the file must be **.LIN**. The following file is the listing of the **FENCE.LIN** file for Example 3. The name of the linetype is NEWFence1.

```
*NEWFence1,New fence boundary line
A,0.75,["Fence",Standard,S=0.1,A=0,X=0.05,Y=-0.05],-0.575
or
A,0.75,-0.05,["Fence",Standard,S=0.1,A=0,X=0,Y=-0.05],-0.525
```

Step 3: Loading the linetype

You can use the **LINETYPE** command to load the linetype or choose Linetype in the **Format** pulldown menu. Draw a line or any object to check if the line is drawn to the given specifications as shown in the Figure 31-15. Notice that the text is always drawn along the X axis. Also, when you draw a line at an angle, polyline, circle, or spline, the text string does not align with the object (Figure 31-15).

Step 4: Aligning the text with the line

In the NEWFence linetype definition, the specified angle is 0 degrees (Absolute angle A = 0). Therefore, when you use the NEWFence linetype to draw a line, circle, polyline, or spline, the text string (Fence) will be at zero degrees. If you want the text string (Fence) to align with the polyline (Figure 31-16), spline, or circle, specify the angle as relative angle (R = 0) in the

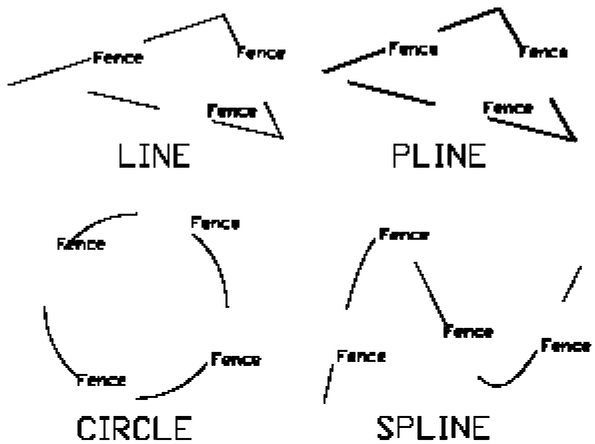

Figure 31-15 Using string complex linetype with angle A=0

NEWFence linetype definition. The following is the linetype definition for NEWFence line-type with relative angle R = 0:

```
*NEWFence2,New fence boundary line
A,0.75,["Fence",Standard,S=0.1,R=0,X=0.05,Y=-0.05],-0.575
```

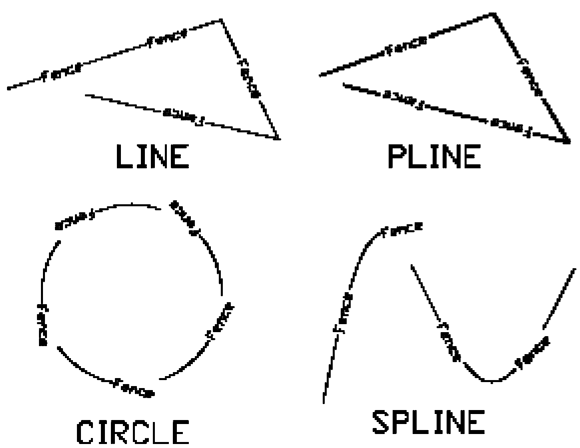

Figure 31-6 Using a string complex linetype with angle R = 0

Step 5: Aligning the midpoint of text with the line

In Figure 31-16, you might notice that the text string is not properly aligned with the circumference of the circle. This is because AutoCAD draws the text string in a direction that is tangent to the circle at the text insertion point. To resolve this problem, you must define the middle point of the text string as the insertion point. Also, the line specifications should be measured accordingly. Figure 31-17 gives the measurements of the NEWFence linetype with the middle point of the text as the insertion point.

The following is the linetype definition for NEWFence linetype:

```
*NEWFence3,New fence boundary line
A,0.75,-0.287,["FENCE",Standard,S=0.1,X=-0.237,Y=-0.05],-0.287
```

Note

If no angle is defined in the line definition, it defaults to angle R = 0. Also, the text does not automatically insert to its midpoint like the regular text with MID justification.

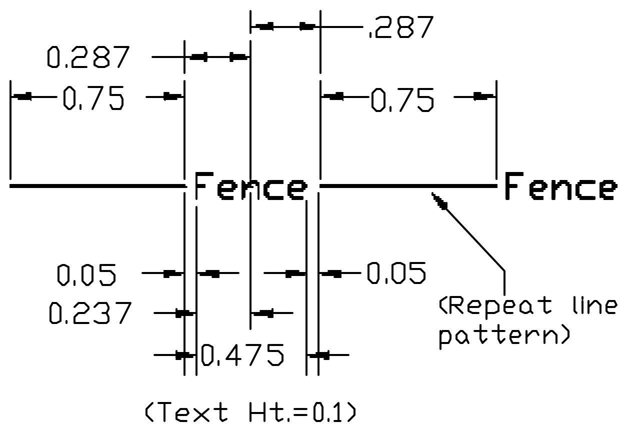

Figure 31-7 *Specifications of a string complex linetype with the middle point of the text string as the text insertion point*

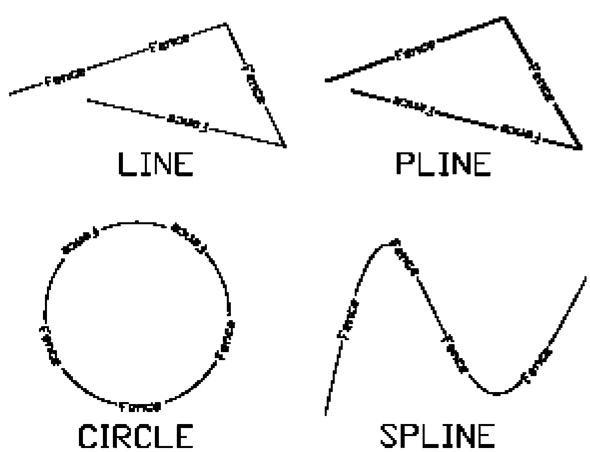

Figure 31-8 *Using a string complex linetype with the middle point of the text string as the text insertion point*

Creating a Shape Complex Linetype

As with the string complex linetype, when you write the definition of a shape complex line-type, the name of the shape, the name of the shape file, and other shape attributes, like rotation, scale, X-Offset, and Y-Offset, must be included in the linetype definition. The format of the shape complex linetype is:

[Shape Name, Shape File, Scale, Rotation, X-Offset, Y-Offset]

The following is the description of the attributes of Shape Complex Linetype (Figure 31-19).

Shape Name. This is the name of the shape that you want to insert along the line. The shape name must exist; otherwise, no shape will be generated along the line.

Shape File. This is the name of the compiled shape file (.SHX) that contains the definition of the shape being inserted in the line. The name of the subdirectory where the shape file is located must be in the ACAD search path. The shape files (.SHP) must be compiled before using the SHAPE command to load the shape.

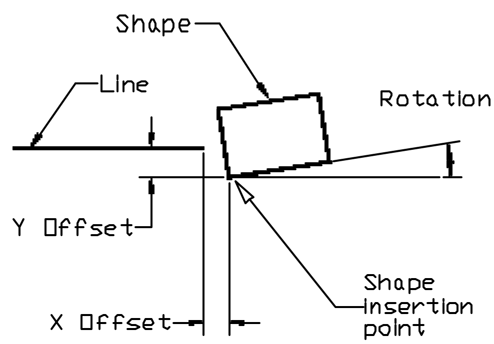

Figure 31-9 The attributes of a shape complex line-type

Scale. This is the scale factor by which the defined shape size is to be scaled. If the scale is 1, the size of the shape will be the same as defined in the shape definition (.SHP file).

Rotation. The rotation can be specified as an absolute or relative angle. In absolute rotation, the angle is always measured with respect to the positive X axis, no matter what AutoCAD's direction setting. The absolute angle is represented by letter "a." In relative rotation, the angle is always measured with respect to the orientation of dashes in the linetype. The relative angle is represented by the letter "r." The angle can be specified in radians (r), grads (g), or degrees (d). The default is degrees.

X-Offset. This is the distance of the shape insertion point from the endpoint of the line segment measured along the line. If the line is horizontal, then the X-Offset distance is measured along the X axis. In Figure 31-19, the X-Offset distance is 0.2.

Y-Offset. This is the distance of the shape insertion point from the endpoint of the line segment measured perpendicular to the line. If the line is horizontal, then the Y-Offset distance is measured along the Y axis. In Figure 31-19, the Y-Offset distance is 0.

Example 4

In the following example, you will write the definition of a shape complex linetype that consists of the shape (Manhole; the name of the shape is MH) and a line. The scale of the shape is 0.1, the length of each line segment is 0.75, and the space between line segments is 0.2.

Step 1: Determining the line specifications

Before writing the definition of a new linetype, it is important to determine the line specifications. One of the ways this can be done is to actually draw the lines and the shape the way you want them to appear in the drawing (Figure 31-20). Once you have drawn the line and the shape to your satisfaction, measure the distances needed to define the shape complex linetype. In this example, the values are as follows:

Shape name MH
Shape file name MHOLE.SHX (Name of the compiled shape file.)
Scale 0.1
Rotation 0
X-Offset 0.2
Y-Offset 0
Length of the first line segment = 0.75
Distance between the line segments = 0.2

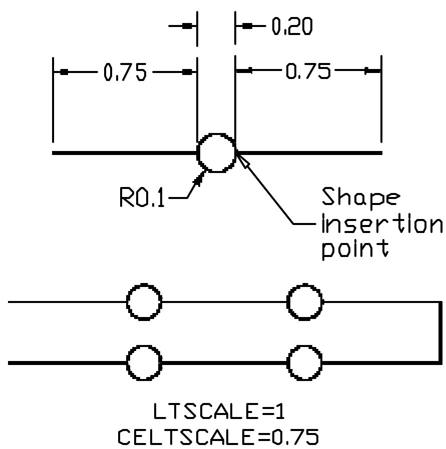

Figure 31-20 The attributes of the shape complex linetype and line specifications for Example 4

Step 2: Writing the definition of the shape

Use a text editor to write the definition of the shape file. The extension of the file must be **.SHP**. The following file is the listing of the **MHOLE.SHP** file for Example 4. The name of the shape is MH. (For details, see Chapter 11of Customizing AutoCAD.")

```
*215,9,MH
001,10,(1,007),
001,10,(1,071),0
```

Step 3: Compiling the shape

Use the **COMPILE** command to compile the shape file (**.SHP** file). When you use this command, AutoCAD will prompt you to enter the name of the shape file (Figure 31-21). For this example, the name is **MHOLE.SHP**. The following is the command sequence for compiling the shape file:

Command: **COMPILE**
Enter shape (.SHP) or PostScript font (.PFB) file name: **MHOLE**

You can also compile the shape from the command line by setting **FILEDIA**=0 and then using the **COMPILE** command. The .SHX files must be located in AutoCAD's search path.

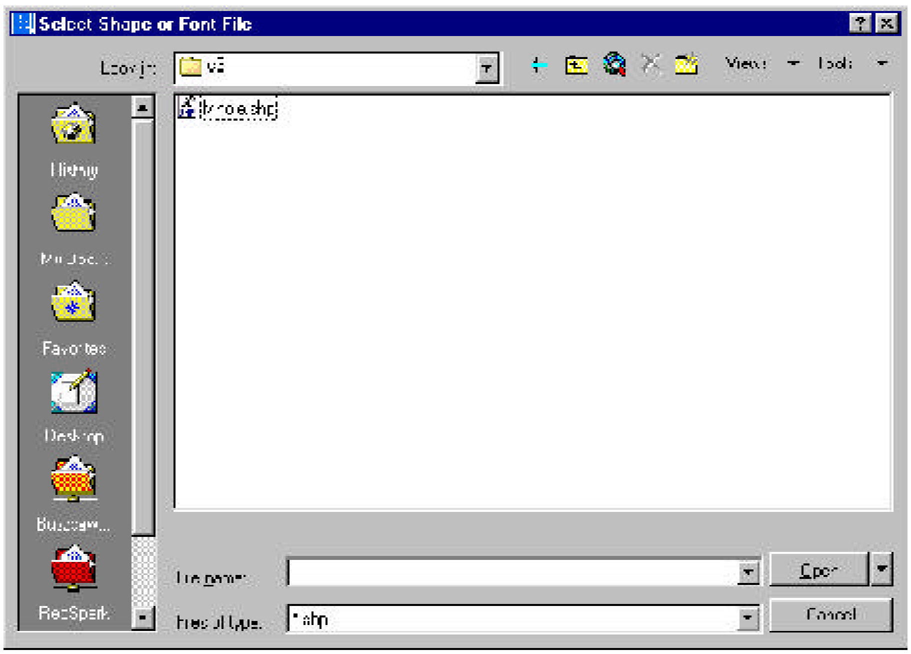

Figure 31-21 Select Shape or Font File dialog box

Step 4: Writing the definition of the shape complex linetype

Use a text editor to write the definition of the shape complex linetype. You can add the definition to the AutoCAD ACAD.LIN file or create a separate file. The extension of the file must be .LIN. The following file is the listing of the **MHOLE.LIN** file for Example 4. The name of the linetype is MHOLE.

```
*MHOLE,Line with Manholes
A,0.75,[MH,MHOLE.SHX,S=0.10,X=0.2,Y=0],-0.2
```

Step 5: Loading the linetype

To test the linetype, load the linetype using the **LINETYPE** command or choose Linetype in the **Format** pulldown menu. Assign the linetype to a layer. Draw a line or any object to check if the line is drawn to the given specifications. The shape is drawn upside down when you draw a line from right to left. Figure 31-22 shows the execution of the linetype **MHOLE.LIN** using line, pline, circle etc.

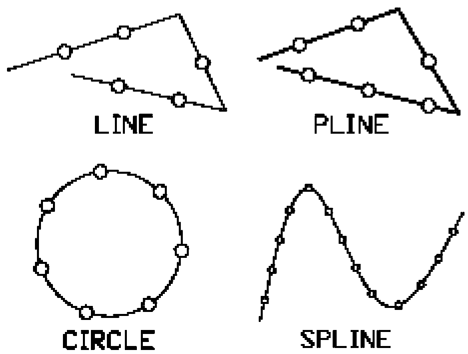

Figure 31-22 Using a shape complex linetype

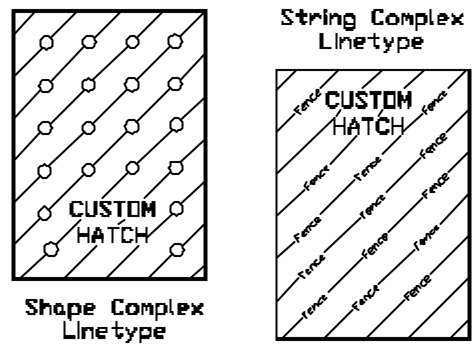

Figure 31-23 Using shape and string complex linetypes to create custom hatch

HATCH PATTERN DEFINITION

The AutoCAD software comes with a hatch pattern library file, **ACAD.PAT**, that contains 67 hatch patterns. These hatch patterns are sufficient for general drafting work. However, if you need a different hatch pattern, AutoCAD lets you create your own. There is no limit to the number of hatch patterns you can define.

The hatch patterns you define can be added to the hatch pattern library file, **ACAD.PAT**. You can also create a new hatch pattern library file, provided the file contains only one hatch pattern definition, and the name of the hatch is the same as the name of the file. The hatch pattern definition consists of the following two parts: **header line and hatch descriptors**.

Header Line

The **header line** consists of an asterisk (*) followed by the name of the hatch pattern. The hatch name is the name used in the hatch command to hatch an area. After the name, you can give the hatch description, which is separated from the hatch name by a comma (,). The general format of the header line is:

***HATCH Name [, Hatch Description]**

Where ***** -------------------------------- Asterisk
HATCH Name ------------ Name of hatch pattern
Hatch Description ------ Description of hatch pattern

The description can be any text that describes the hatch pattern. It can also be omitted, in which case, a comma should not follow the hatch pattern name.

Example
***DASH45, Dashed lines at 45 degrees**
Where **DASH45** --------- Hatch name
Dashed lines at 45 degrees ------ Hatch description

Hatch Descriptors

The **hatch descriptors** consist of one or more lines that contain the definition of the hatch lines. The general format of the hatch descriptor is:

Angle, X-origin, Y-origin, D1, D2 [,Dash Length.....]

Where **Angle** ------------- Angle of hatch lines
X-origin ---------- X coordinate of hatch line
Y-origin ---------- Y coordinate of hatch line
D1 ------------------ Displacement of second line (Delta-X)
D2 ------------------ Distance between hatch lines (Delta-Y)
Length ----------- Length of dashes and spaces (Pattern line definition)

Example

45,0,0,0,0.5,0.5,-0.125,0,-0.125

Where **45** ------------------ Angle of hatch line
0 -------------------- X-Origin
0 -------------------- Y-Origin
0 -------------------- Delta-X
0.5 ------------------ Delta-Y
0.5 ------------------ Dash (pen down)
-0.125 ------------- Space (pen up)
0 -------------------- Dot (pen down)
-0.125 ------------- Space (pen up)
0.5,-0.125,0,-0.125 Pattern line definition

Hatch Angle

X-origin and Y-origin. The hatch angle is the angle that the hatch lines make with the positive X axis. The angle is positive if measured counterclockwise (Figure 31-24), and negative if the angle is measured clockwise. When you draw a hatch pattern, the first hatch line starts from the point defined by X-origin and Y-origin. The remaining lines are generated by offsetting the first hatch line by a distance specified by delta-X and delta-Y. In Figure 31-25(a), the first hatch line starts from the point with the coordinates X = 0 and Y = 0. In Figure 31-25(b) the first line of hatch starts from a point with the coordinates X = 0 and Y = 0.25.

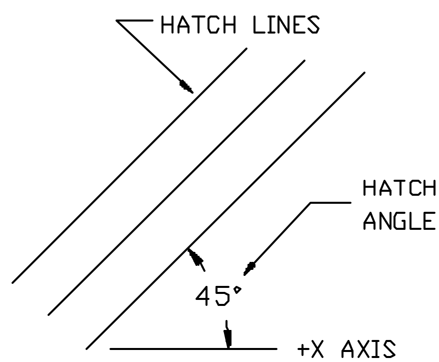

Figure 31-24 Hatch angle

Delta-X and Delta-Y. Delta-X is the displacement of the offset line in the direction in which the hatch lines are generated. For example, if the lines are drawn at a 0-degree angle and delta-X = 0.5, the offset line will be displaced by a distance delta-X (0.5) along the 0-angle direction. Similarly, if the hatch lines are drawn at a 45-degree angle, the offset line will be displaced by a distance delta-X (0.5) along a 45-degree direction (Figure 31-26). Delta-Y is the displacement of the offset lines measured perpendicular to the hatch lines. For example, if delta-Y = 1.0, the space between any two hatch lines will be 1.0 (Figure 31-26).

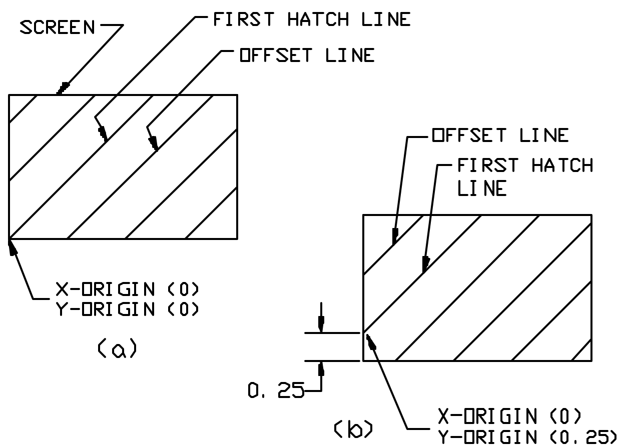

Figure 31-25 X-origin and Y-origin of hatch lines

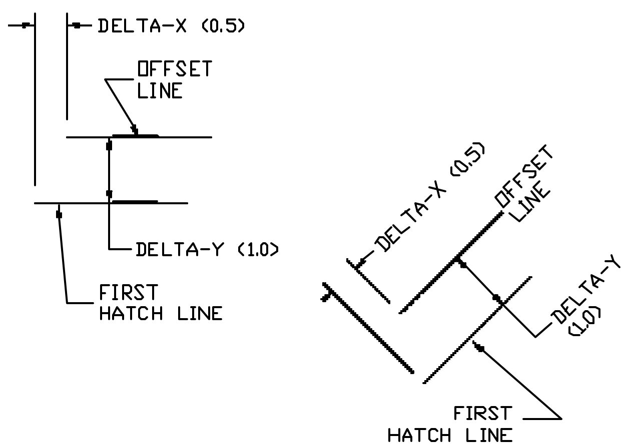

Figure 31-26 Delta-X and delta-Y of hatch lines

HOW HATCH WORKS

When you hatch an area, AutoCAD generates an infinite number of hatch lines of infinite length. The first hatch line always passes through the point specified by the X-origin and Y-origin. The remaining lines are generated by offsetting the first hatch line in both directions. The offset distance is determined by delta-X and delta-Y as shown in Figure 31-26. All selected entities that form the boundary of the hatch area are then checked for intersection with these lines. Any hatch lines found within the defined hatch boundaries are turned on, and the hatch lines outside the hatch boundary are turned off, as shown in Figure 31-27. Since the hatch lines are generated by offsetting, the hatch lines in different areas of the drawing are automatically aligned relative to the drawing's snap origin. Figure 31-27(a) shows the hatch lines as computed by AutoCAD. These lines are not drawn on the screen; they are shown here for illustration only. Figure 31-27(b) shows the hatch lines generated in the circle that was defined as the hatch boundary.

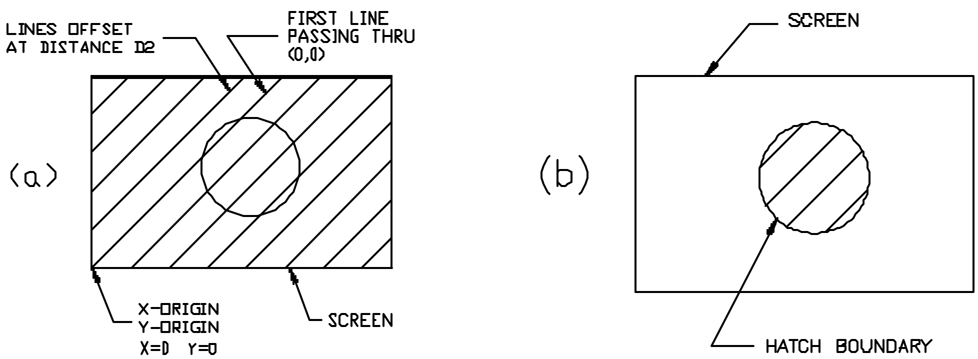

Figure 31-27 Hatch lines outside the hatch boundary are turned off

SIMPLE HATCH PATTERN

It is good practice to develop the hatch pattern specification before writing a hatch pattern definition. For simple hatch patterns it may not be that important, but for more complicated hatch patterns you should know the detailed specifications. Example 5 illustrates the procedure for developing a simple hatch pattern.

Example 5

Write a hatch pattern definition for the hatch pattern shown in Figure 31-28, with the following specifications:

Name of the hatch pattern =	HATCH1
X-Origin =	0
Y-Origin =	0
Distance between hatch lines =	0.5
Displacement of hatch lines =	0
Hatch line pattern =	Continuous

Step 1: Creating the hatch pattern file

This hatch pattern definition can be added to the existing **ACAD.PAT** hatch file. You can use any text editor (like Notepad) to write the file. Load the **ACAD.PAT** file that is located in **AutoCAD2002\SUPPORT** directory and insert the following two lines at the end of the file.

```
*HATCH1,Hatch Pattern for Example 5
45,0,0,0,.5
```

Where **45** ------------------ Hatch angle
0 -------------------- X-origin
0 -------------------- Y-origin
0 -------------------- Displacement of second hatch line
.5 ------------------- Distance between hatch lines

The first field of hatch descriptors contains the angle of the hatch lines. That angle is 45 degrees with respect to the positive X axis. The second and third fields describe the X and Y coordinates of the first hatch line origin. The first line of the hatch pattern will pass through this point. If the values of the X-origin and Y-origin were 0.5 and 1.0, respectively, then the first line would pass through the point with the X coordinate of 0.5 and the Y coordinate of 1.0, with respect to the drawing origin 0,0. The remaining lines are generated by offsetting the first line, as shown in Figure 31-28.

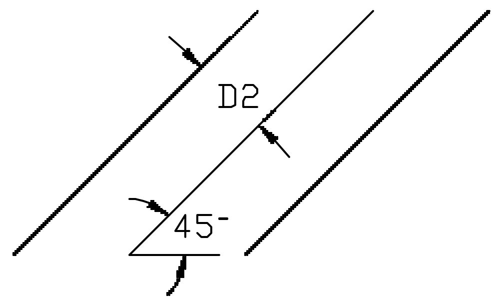

Figure 31-28 Hatch pattern angle and offset distance

Step 2: Loading the hatch pattern

Choose the **Hatch** button from the **Draw** toolbar or choose **Hatch** from the **Draw** menu to display the **Boundary Hatch** dialog box. Make sure Predefined is selected in the **Type:** edit box. Select the hatch pattern name from the drop-down list or choose the **[...]** button adjacent to the **Pattern:** drop-down list to display the **Hatch Pattern Palette** dialog box. Select the hatch pattern file displayed there. Then choose **OK** to display the **Boundary Hatch** dialog box again. Change the **Scale** and **Angle**, if needed, and then hatch an a circle to test the hatch pattern.

The **Boundary Hatch** dialog box can also be invoked by entering **BHATCH** at the Command prompt. Hatching can also be achieved by entering **-HATCH** at the Command prompt.

EFFECT OF ANGLE AND SCALE FACTOR ON HATCH

When you hatch an area, you can alter the angle and displacement of hatch lines you have specified in the hatch pattern definition to get a desired hatch spacing. You can do this by entering an appropriate value for angle and scale factor in the AutoCAD **HATCH** command.

To understand how the angle and the displacement can be changed, hatch an area with the hatch pattern HATCH1 in Example 5. You will notice that the hatch lines have been generated according to the definition of hatch pattern HATCH1. Notice the effect of hatch angle and scale factor on the hatch. Figure 31-29(a) shows a hatch with a 0-degree angle and a scale factor of 1.0. If the angle is 0, the hatch will be generated with the same angle as defined in the hatch pattern definition (45 degrees in Example 5). Similarly, if the scale factor is 1.0, the distance between the hatch lines will be the same as defined in the hatch pattern definition.

Figure 31-29(b) shows a hatch that is generated when the hatch scale factor is 0.5. If you measure the distance between the successive hatch lines, it will be 0.5 x 0.5 = 0.25. Figures 3-29(c) and (d) show the hatch when the angle is 45 degrees and the scale factors are 1.0 and 0.5, respectively.

Scale and Angle can also be set by entering **-HATCH** at the Command prompt.

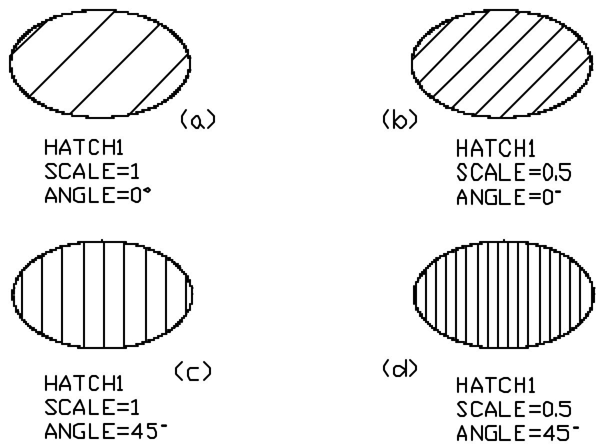

Figure 31-29 *Effect of angle and scale factor on hatch*

HATCH PATTERN WITH DASHES AND DOTS

The lines you can use in a hatch pattern definition are not restricted to continuous lines. You can define any line pattern to generate a hatch pattern. The lines can be a combination of dashes, dots, and spaces in any configuration. However, the maximum number of dashes you can specify in the line pattern definition of a hatch pattern is six. Example 6 uses a dash-dot line to create a hatch pattern.

Example 6

Write a hatch pattern definition for the hatch pattern shown in Figure 31-30, with the following specifications. Define a new path say C:\Program Files\Hatch1 and save the hatch pattern in that path.

Name of the hatch pattern	HATCH2
Hatch angle =	0
X-origin =	0
Y-origin =	0
Displacement of lines (D1) =	0.25
Distance between lines (D2) =	0.25
Length of each dash =	0.5
Space between dashes and dots =	0.125
Space between dots =	0.125

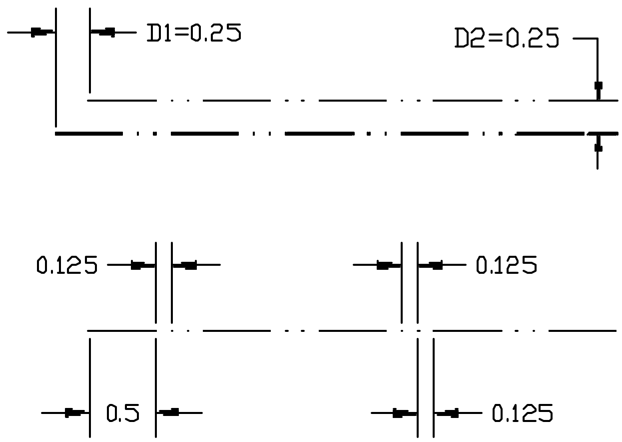

Figure 31-30 Hatch lines made of dashes and

Step 1: Writing the definition of a hatch pattern

You can use the AutoCAD **EDIT** command or any text editor (Notepad) to edit the **ACAD.PAT** file. The general format of the header line and the hatch descriptors is:

***HATCH NAME, Hatch Description**
Angle, X-Origin, Y-Origin, D1, D2 [,Dash Length.....]

Substitute the values from Example 6 in the corresponding fields of the header line and field descriptor:

*HATCH2,Hatch with dashes and dots
0,0,0,0.25,0.25,0.5,-0.125,0,-0.125,0,-0.125

Where **0** -------------------- Angle
0 -------------------- X-origin
0 -------------------- Y-origin
0.25 ---------------- Delta-X
0.25 ---------------- Delta-Y
0.5 ------------------ Length of dash
-0.125 ------------- Space (pen up)
0 -------------------- Dot (pen down)
-0.125 ------------- Space (pen up)
0 -------------------- Dot
-0.125 ------------- Space

Specifying a New Path for Hatch Pattern Files

When you enter a hatch pattern name for hatching, AutoCAD looks for that file name in the Support directory or the directory paths specified in AutoCAD. You can specify a new path and directory to store your hatch files.

Create a new folder **Hatch1** in C drive under the Program Files. Save the ACAD.PAT file with hatch pattern **HATCH2** definition in the same subdirectory, Hatch1. Right-click in the drawing area to activate the shortcut menu. Choose **Options** from the shortcut menu to display the **Options** dialog box as shown in Figure 31-31. The **Options** dialog box can also be invoked by choosing **Options** from the **Tools** menu or by directly entering **OPTIONS** at the Command prompt. Choose the **Files** tab in the **Options** dialog box to display the **Search paths, file names and file locations** area. Click on the **plus** sign of the **Support File Search Path** to display the different subdirectories of the **Support File Search Path**. Now choose the **Add** button to display the space to add a new subdirectory. Enter the location of the new subdirectory, C:\Program Files\Hatch1 or click on the **Browse** button to specify the path. Choose the **Apply** button and then choose **OK** to exit the dialog box. Now you have created a subdirectory and you have specified the search path for the hatch files.

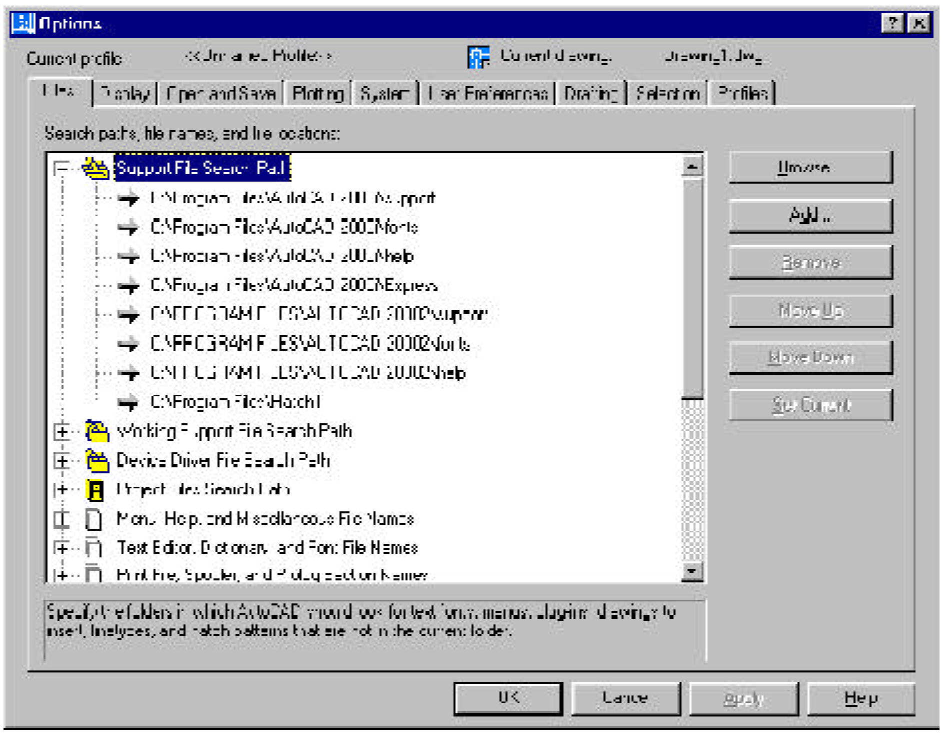

Figure 31-31 Options dialog box

Follow the procedure as described in Example 5 to activate the hatch pattern. The hatch that this hatch definition (Hatch2.pat) will generate is shown in Figure 31-32. Figure 31-32(a) shows the hatch with a 0-degree angle and a scale factor of 1.0. Figure 31-32(b) shows the hatch with a 45-degree angle and a scale factor of 0.5.

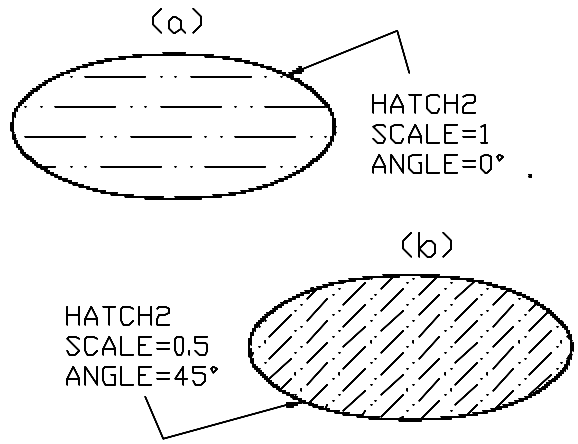

Figure 31-32 Hatch pattern at different angles and scales

HATCH WITH MULTIPLE DESCRIPTORS

Some hatch patterns require multiple lines to generate a shape. For example, if you want to create a hatch pattern of a brick wall, you need a hatch pattern that has four hatch descriptors to generate a rectangular shape. You can have any number of hatch descriptor lines in a hatch pattern definition. It is up to the user to combine them in any conceivable order. However, there are some shapes you cannot generate. A shape that has a nonlinear element, like an arc, cannot be generated by hatch pattern definition. However, you can simulate an arc by defining short line segments because you can use only straight lines to generate a hatch pattern. Example 7 uses three lines to define a triangular hatch pattern.

Example 7

Write a hatch pattern definition for the hatch pattern shown in Figure 31-33, with the following specifications:

Name of the hatch pattern =	HATCH3
Vertical height of the triangle =	0.5
Horizontal length of the triangle =	0.5
Vertical distance between the triangles =	0.5
Horizontal distance between the triangles =	0.5

Each triangle in this hatch pattern consists of the following three elements: a vertical line, a horizontal line, and a line inclined at 45 degrees.

Step 1: Defining specifications for vertical line

For the vertical line, the specifications are (Figure 31-34):

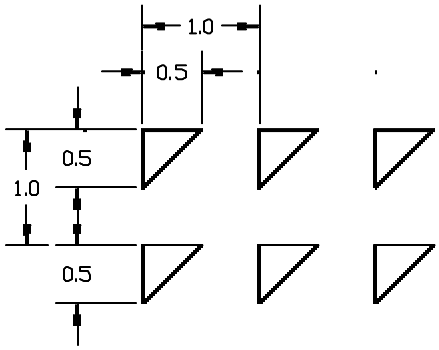

Figure 31-33 Triangle hatch pattern

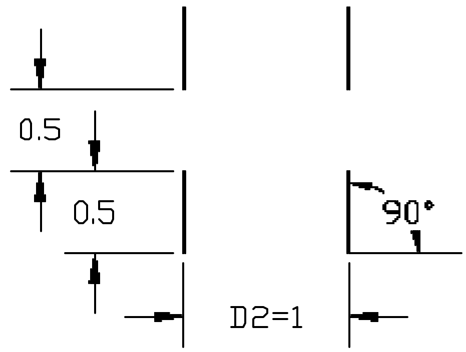

Figure 31-34 Vertical line

Hatch angle =	90 degrees
X-origin =	0
Y-origin =	0
Delta-X (D1) =	0
Delta-Y (D2) =	1.0
Dash length =	0.5
Space =	0.5

Substitute the values from the vertical line specification in various fields of the hatch descriptor to get the following line:

90,0,0,0,1,.5,-.5

Where **90** ------------------ Hatch angle
0 -------------------- X-origin
0 -------------------- Y-origin
0 -------------------- Delta-X
1 -------------------- Delta-Y
.5 ------------------- Dash (pen down)
-.5 ------------------ Space (pen up)

Step 2: Defining specifications of horizontal line

For the horizontal line (Figure 31-35), the specifications are:

Hatch angle =	0 degrees
X-origin =	0
Y-origin =	0.5
Delta-X (D1) =	0
Delta-Y (D2) =	1.0
Dash length =	0.5
Space =	0.5

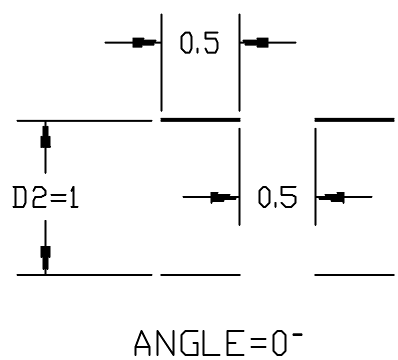

Figure 31-35 Horizontal line

The only difference between the vertical line and the horizontal line is the angle. For the horizontal line, the angle is 0 degrees, whereas for the vertical line, the angle is 90 degrees. Substitute the values from the vertical line specification to obtain the following line:

0,0,0.5,0,1,.5,-.5

Where **0** -------------------- Hatch angle
0 -------------------- X-origin
0.5 ------------------ Y-origin
0 -------------------- Delta-X
1 -------------------- Delta-Y
.5 ------------------- Dash (pen down)
-.5 ------------------ Space (pen up)

Step 3: Defining specifications of the inclined line

This line is at an angle; therefore, you need to calculate the distances delta-X (D1) and delta-Y (D2), the length of the dashed line, and the length of the blank space. Figure 31-36 shows the calculations to find these values.

Hatch angle =	45 degrees
X-Origin =	0
Y-Origin =	0
Delta-X (D1) =	0.7071
Delta-Y (D2) =	0.7071
Dash length =	0.7071
Space =	0.7071

After substituting the values in the general format of the hatch descriptor, you will obtain the following line:

45,0,0,.7071,.7071,.7071,-.7071

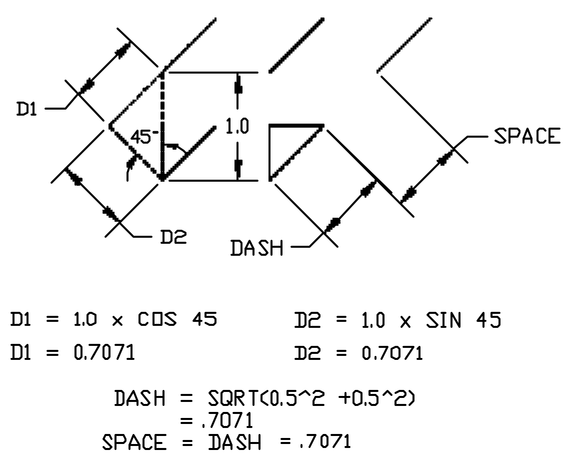

Figure 31-36 Line inclined at 45 degrees

Where **45** ------------------ Hatch angle
0 -------------------- X-origin
0 -------------------- Y-origin
.7071 -------------- Delta-X
.7071 -------------- Delta-Y
.7071 -------------- Dash (pen down)
-.7071 ------------- Space (pen up)

Step 4: Loading the hatch pattern

Now you can combine these three lines and insert them at the end of the **ACAD.PAT** file or you can enter the values in a separate hatch file and save it. You can also use the AutoCAD **EDIT** command to edit the file and insert the lines.

The following file is a partial listing of the **ACAD.PAT** file, after adding the hatch pattern definitions from Examples 5, 6, and 7.

```
*SOLID, Solid fill
45, 0,0, 0,.125
*angle,Angle steel
0, 0,0, 0,.275, .2,-.075
90, 0,0, 0,.275, .2,-.075
*ansi31,ANSI Iron, Brick, Stone masonry
45, 0,0, 0,.125
*ansi32,ANSI Steel
45, 0,0, 0,.375
45, .176776695,0, 0,.375
*ansi33,ANSI Bronze, Brass, Copper
45, 0,0, 0,.25
45, .176776695,0, 0,.25, .125,-.0625
*ansi34,ANSI Plastic, Rubber
45, 0,0, 0,.75
45, .176776695,0, 0,.75
45, .353553391,0, 0,.75
45, .530330086,0, 0,.75
*ansi35,ANSI Fire brick, Refractory material
45, 0,0, 0,.25
45, .176776695,0, 0,.25, .3125,-.0625,0,-.0625
*ansi36,ANSI Marble, Slate, Glass
45, 0,0, .21875,.125, .3125,-.0625,0,-.0625
|
|
*swamp,Swampy area
0, 0,0, .5,.866025403, .125,-.875
90, .0625,0, .866025403,.5, .0625,-1.669550806
90, .078125,0, .866025403,.5, .05,-1.682050806
```

90, .046875,0, .866025403,.5, .05,-1.682050806

0, 0,0, .125,.125, .125,-.125
90, .125,0, .125,.125, .125,-.125
***HATCH1,Hatch at 45 Degree Angle**
45,0,0,0,.5
***HATCH2,Hatch with Dashes & Dots:**
0,0,0,.25,.25,0.5,-.125,0,-.125,0,-.125
***HATCH3,Triangle Hatch:**
90,0,0,0,1,.5,-.5
0,0,0.5,0,1,.5,-.5
45,0,0,.7071,.7071,.7071,-.7071

Load the hatch pattern as described in Example 5 (Hatch3.pat) and test the hatch. Figure 31-37 shows the hatch pattern that will be generated by this hatch pattern (HATCH3). In Figure 31-37(a) the hatch pattern is at a 0-degree angle and the scale factor is 0.5. In Figure 31-37(b) the hatch pattern is at a -45-degree angle and the scale factor is 0.5.

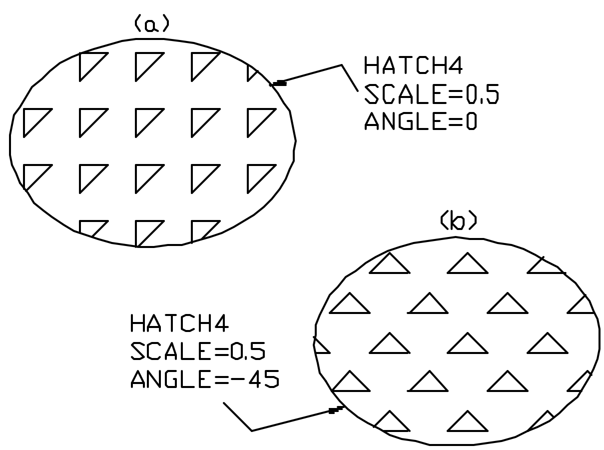

Figure 31-37 Hatch generated by HATCH3 pattern

SAVING HATCH PATTERNS IN A SEPARATE FILE

When you load a certain hatch pattern, AutoCAD looks for that definition in the ACAD.PAT file; therefore, the hatch pattern definitions must be in that file. However, you can add the new pattern definition to a different file and then copy that file to ACAD.PAT. Be sure to make a copy of the original ACAD.PAT file so that you can copy that file back when needed. Assume the name of the file that contains your custom hatch pattern definitions is CUSTOMH.PAT.

1. Copy ACAD.PAT file to ACADORG.PAT
2. Copy CUSTOMH.PAT to ACAD.PAT

If you want to use the original hatch pattern file, copy the ACADORG.PAT file to ACAD.PAT

CUSTOM HATCH PATTERN FILE

As mentioned earlier, you can add the new hatch pattern definitions to the **ACAD.PAT** file. There is no limit to the number of hatch pattern definitions you can add to this file. However, if you have only one hatch pattern definition, you can define a separate file. It has the following three requirements:

1. The name of the file has to be the same as the hatch pattern name.
2. The file can contain only one hatch pattern definition.
3. The hatch pattern name—and, therefore, the hatch file name—should be unique.
4. If you want to save the hatch pattern on the A drive, then the drive letter (A:) should precede the hatch name. For example, if the hatch name is HATCH3, the header line will be ***A:HATCH3, Triangle Hatch:** and the file name **HATCH3.PAT**.

```
*HATCH3,Triangle Hatch:
90,0,0,0,1,.5,-.5
0,0,0.5,0,1,.5,-.5
45,0,0,.7071,.7071,.7071,-.7071
```

Note

The hatch lines can be edited after exploding the hatch with the AutoCAD EXPLODE command. After exploding, each hatch line becomes a separate object.

It is good practice not to explode a hatch because it increases the size of the drawing database. For example, if a hatch consists of 100 lines, save it as a single object. However, after you explode the hatch, every line becomes a separate object and you have 99 additional objects in the drawing.

Keep the hatch lines in a separate layer to facilitate editing of the hatch lines.

Assign a unique color to hatch lines so that you can control the width of the hatch lines at the time of plotting.

Tip

1. *The file or the subdirectory in which hatch patterns have been saved must have been defined in the Support File Search Path in the File tab of the Options dialog box.*

2. *The hatch patterns that you create automatically get added to AutoCAD's slide library as an integral part of AutoCAD 2002 and the hatch patterns are displayed in the Preview Area in the Hatch Pattern Palette dialog box under the Boundary Hatch dialog box. Hence there is no need to create a slide library.*

Self -Evaluation Test

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

CREATING LINETYPES

1. The AutoCAD __________ command can be used to change the linetype scale factor.
2. The linetype description should not be more than __________ characters long.
3. A positive number denotes a pen __________ segment.
4. The segment length __________ generates a dot.
5. A negative number denotes a pen __________ segment.
6. The option__________ of linetype Command is used to generate a new linetype.
7. The description in the case of header line is __________ . (optional/necessary)
8. The standard linetypes are stored in the file__________ .
9. The__________ determines the current linetype scaling.

CREATING HATCH PATTERNS

10. The header line consists of an asterisk, the pattern name, and __________.
11. The **ACAD.PAT** file contains __________ number of hatch pattern definitions.
12. The standard hatch patterns are stored in the file __________ .
13. The first hatch line passes through a point whose coordinates are specified by __________ and __________.

Review Questions

CREATING LINETYPES

1. The AutoCAD __________ command can be used to create a new linetype.
2. The AutoCAD __________ command can be used to load a linetype.
3. In AutoCAD, the linetypes are saved in the __________ file.

4. AutoCAD supports only __________ alignment field specification.

5. A line pattern definition always starts with __________.

6. A header line definition always starts with __________.

CREATING HATCH PATTERNS

7. The perpendicular distance between the hatch lines in a hatch pattern definition is specified by __________.

8. The displacement of the second hatch line in a hatch pattern definition is specified by __________.

9. The maximum number of dash lengths that can be specified in the line pattern definition of a hatch pattern is __________.

10. The hatch lines in different areas of the drawing will automatically __________ since the hatch lines are generated by offsetting.

11. The hatch angle as defined in the hatch pattern definition can be changed further when you use the AutoCAD __________ command.

12. When you load a hatch pattern, AutoCAD looks for that hatch pattern in the __________ file.

13. The hatch lines can be edited after __________ the hatch by using the AutoCAD __________ command.

Exercises

CREATING LINETYPES

Exercise 1 *General*

Using the AutoCAD **LINETYPE** command, create a new linetype "DASH3DASH" with the following specifications:

Length of the first dash 0.75
Blank space 0.125
Dash length 0.25
Blank space 0.125
Dash length 0.25
Blank space 0.125
Dash length 0.25
Blank space 0.125

Exercise 2 *General*

Use a text editor to create a new file, **NEWLT2.LIN**, and a new linetype, DASH2DASH, with the following specifications:

Length of the first dash 0.5
Blank space 0.1
Dash length 0.2
Blank space 0.1
Dash length 0.2
Blank space 0.1

Exercise 3 *General*

a. Write the definition of a string complex linetype (hot water line) as shown in Figure 31-38(a). To determine the length of the HW text string, you should first draw the text (HW) using any text command and then measure its length.

b. Write the definition of a string complex linetype (gas line) as shown in Figure 31-38(b). Determine the length of the text string as mentioned in part *a*, above.

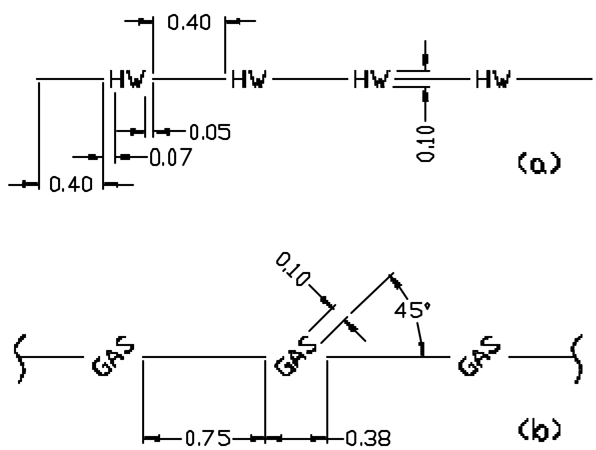

Figure 31-38 Specifications for string a complex linetype

Creating Hatch Patterns

Exercise 4 *General*

Determine the hatch pattern specifications and write a hatch pattern definition for the hatch pattern in Figure 31-39.

Exercise 5 *General*

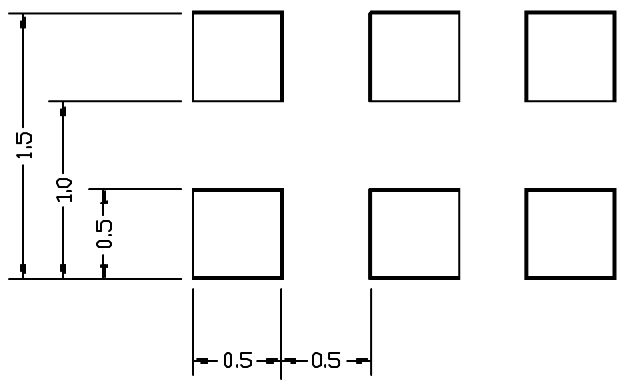

Figure 31-39 Drawing for Exercise 4

Exercise 5 *General*

Determine the hatch pattern specifications and write a hatch pattern definition for the hatch pattern in Figure 31-40.

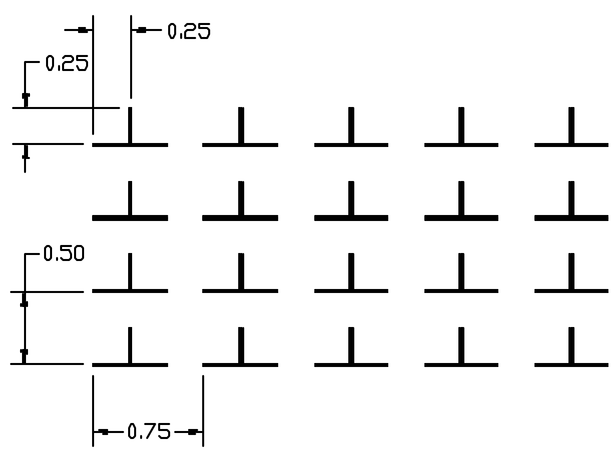

Figure 31-40 Hatch pattern for Exercise 5

Answers to self-evaluation test
1. LTSCALE, **2.** 47, **3.** down, **4.** zero, **5.** up, **6. Create**, **7.** optional, **8. ACAD.LIN**, **9. CELTSCALE**, **10.** Pattern Description, **11.** 67, **12. ACAD.PAT**, 1**3.** X-origin, Y-origin.