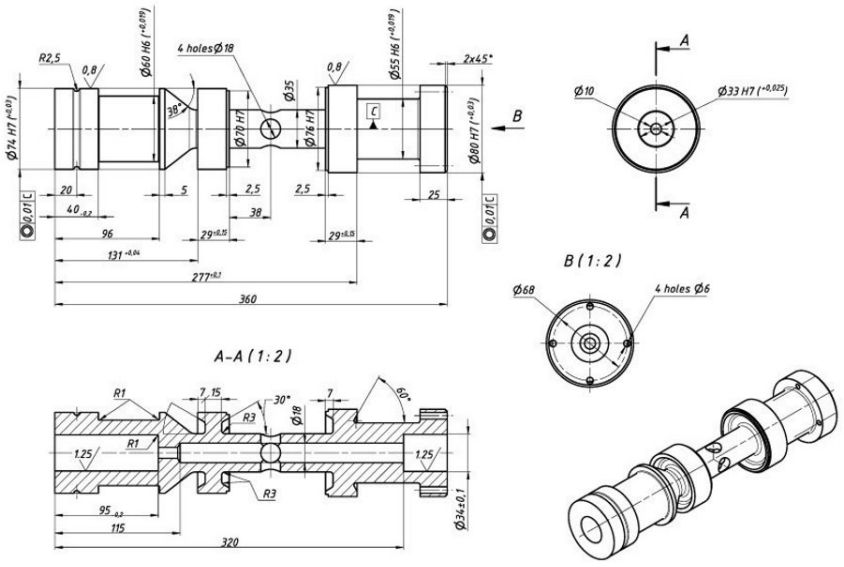
Hatching: Boundary and No Boundary

HATCH PATTERNS are used to indicate the types of materials in a device, building, or property being drawn by the CAD operator/drafter. Hatching can be used to indicate that a section cut through a part has a particular material or attribute. Hatching can also show surface finishes. These pattern designs can include or exclude an area on a site plan that includes surrounding information for context or to differentiate code compliance. The deployment of hatching is an important skill. Which areas of this technical drawing have been hatched?



Objective:

Deploy boundary and no boundary hatching.

Key Terms:

annotative scale menu
ANSI 131 hatch
associative boundaries menu
bhatch
-bhatch
boundaries menu
boundary
boundary hatch
boundary pattern
close hatch editor menu
gradient hatch
hatch
hatch creation menu ribbon
hatching
hatch command
hatch pattern
match properties menu
no boundary hatch
options menu
pattern menu
properties menu
solid hatch
specify new origin menu
UCS

Deploy Boundary and No Boundary Hatching

Hatching is a "regular pattern of line segments covering an area bounded by lines and/or curves." (Source: Pearson Education CAD Glossary at http://wps.prenhall.com/chet_autocad_supersite_2/0,11165,2577613-,00.html) A **hatch** is composed of repeating lines, dots, and shapes in varying combinations and angles. A **hatch pattern** can be abstract graphic designs of lines and dots. The **hatch command** is the original order that creates fill patterns in an enclosed boundary or selected object including solid, gradient, and boundary types. Boundaries must be well defined to prevent the hatch "leaking out" unpredictably to other locations. AutoCAD software provides a standard library of hatch patterns although the patterns can be used as is, modified, or the CAD operator can create new patterns. Hatch patterns stored in the AutoCAD software are contained in two different library files: acad.pst and acadiso.pat.

BOUNDARY HATCHING

A **boundary** is the limits (bounds) of an area or geometry. A **boundary hatch** is a perimeter or closed geometry that contains the hatch pattern. Architectural and mechanical drawings use hatch patterns extensively as a way to designate materials used, show surface qualities, or add realism to a drawing. The hatch patterns are abstract patterns of lines and dots.

bhatch

A **bhatch** is a command that supports boundary hatching, allowing the CAD operator to pick a point that is adjacent to the boundary. Then, AutoCAD search for the nearest entity and creates a closed boundary by tracing in a counterclockwise fashion to look for intersection points as well as connecting lines or arcs. There are four types of hatch patterns:

- The **ANSI 131 hatch** is AutoCAD's default pattern and the most commonly used hatch.
- A **solid hatch** is composed of one color that fills the area or boundary.
- A **gradient hatch** is composed of a transition between one to two colors that fills the area or boundary.
- A **boundary pattern** is a hatch design that follows a boundary.

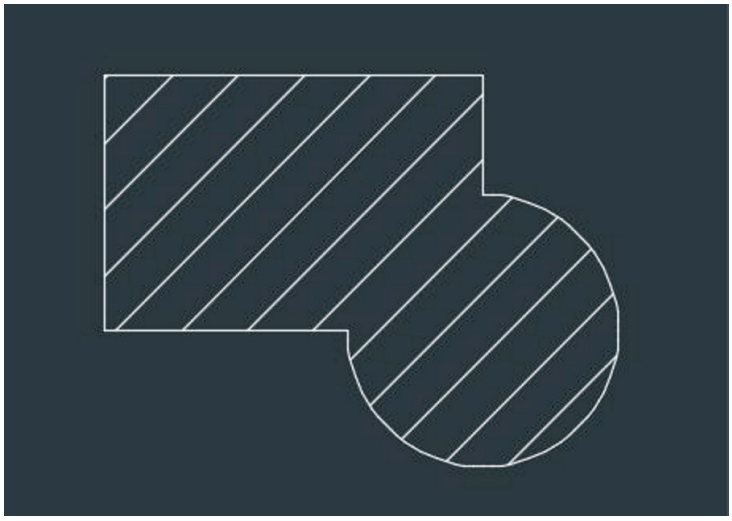


FIGURE 1. The ANSI 131 hatch pattern is AutoCAD's default hatch. (AutoCAD screen shot reprinted with the permission of Autodesk, Inc.)

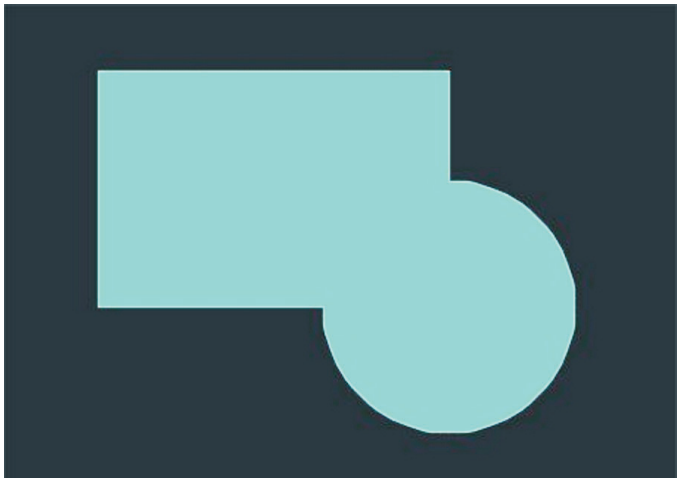


FIGURE 2. This image is an example of a solid hatch fill. (AutoCAD screen shot reprinted with the permission of Autodesk, Inc.)

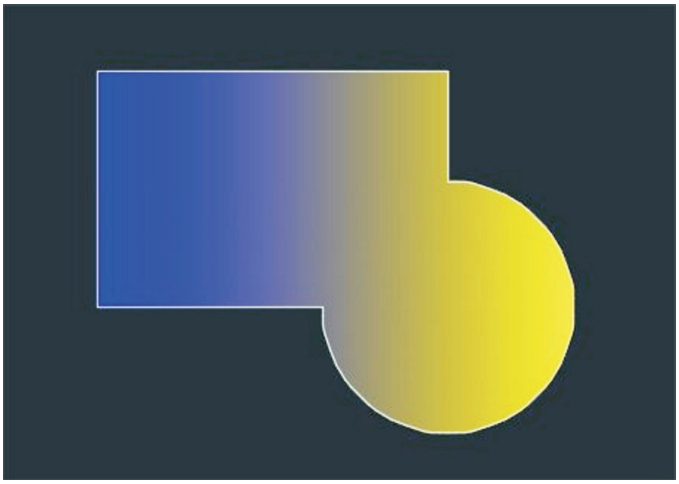


FIGURE 3. This is an example of a gradient hatch. (AutoCAD screen shot reprinted with the permission of Autodesk, Inc.)

Hatch Creation Menu Ribbon

The bhatch command and the hatch command are deployed by entering 'bhatch' or 'hatch' at the command prompt or by selecting the hatch icon. The gradient and boundary options can also be accessed from within the 'bhatch' and 'hatch' options.

- First, AutoCAD asks the CAD operator/drafter to pick an internal point of an object on the screen. Then, AutoCAD

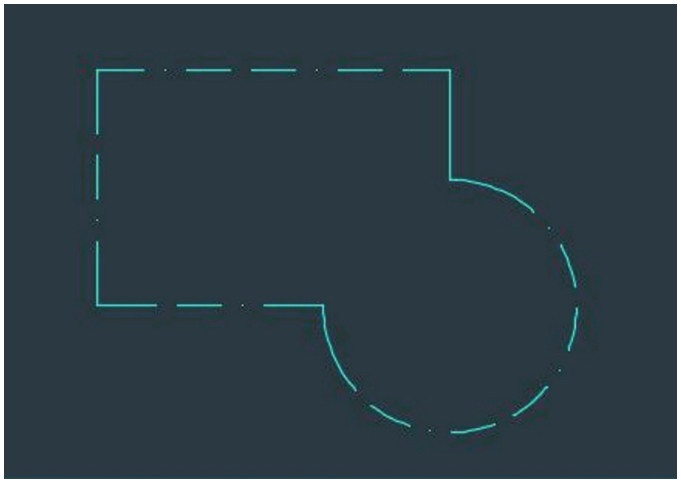


FIGURE 4. This is an example of a boundary pattern. (AutoCAD screen shot reprinted with the permission of Autodesk, Inc.)

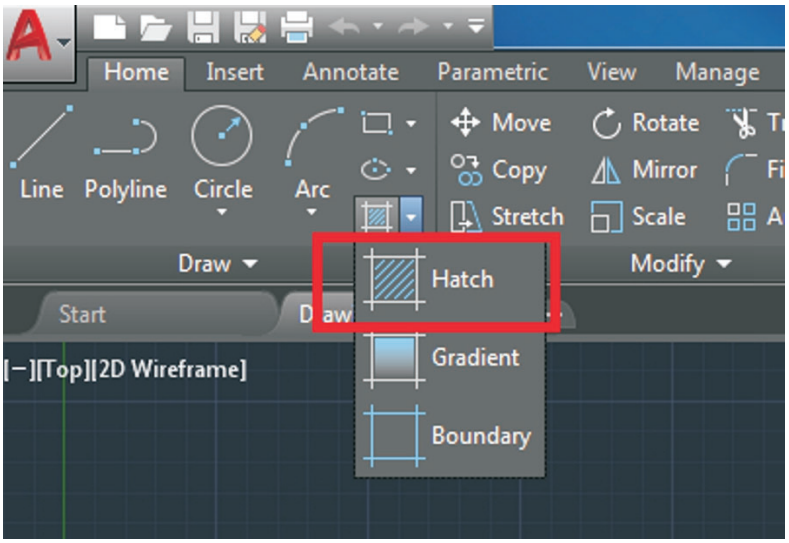


FIGURE 5. This is the location of AutoCAD's hatch command icon. (AutoCAD screen shot reprinted with the permission of Autodesk, Inc.)

gives the CAD operator/drafter the option of: selecting objects or 'Undo,' or settings options.

- Once the interior of a closed piece of geometry is picked, AutoCAD fills the closed geometry with the ANSI 131 hatch pattern (AutoCAD's default hatch pattern).
- Next, the hatch creation menu ribbon displays. The **hatch creation menu ribbon** is only visible when the hatch command is in use to give the CAD operator access to the following categories: Boundaries, Pattern, Properties, Origin, Options, and Close.

The six areas of the hatch creation menu ribbon are:

- The **boundaries menu** determines how the hatch pattern interacts with the boundaries formed by geometry. The boundaries options are:
  - The pick-points category determines a hatch boundary by selecting a point within an enclosed area formed by one or more objects.
  - The select boundary objects category determines a hatch pattern boundary from selected objects that form an enclosed area.
  - The remove boundary objects category removes from the boundary definition any of the objects that were added previously.
  - The recreate boundary category creates a polyline or region around the selected hatch and optionally associates the hatch object with it.
- The **pattern menu** contains all of AutoCAD's premade hatch patterns.
- The **properties menu** contains all of the areas that can change the way a preexisting hatch pattern looks. The properties options are:
  - The hatch type category specifies whether to create a predefined hatch or fill, or a user defined hatch.

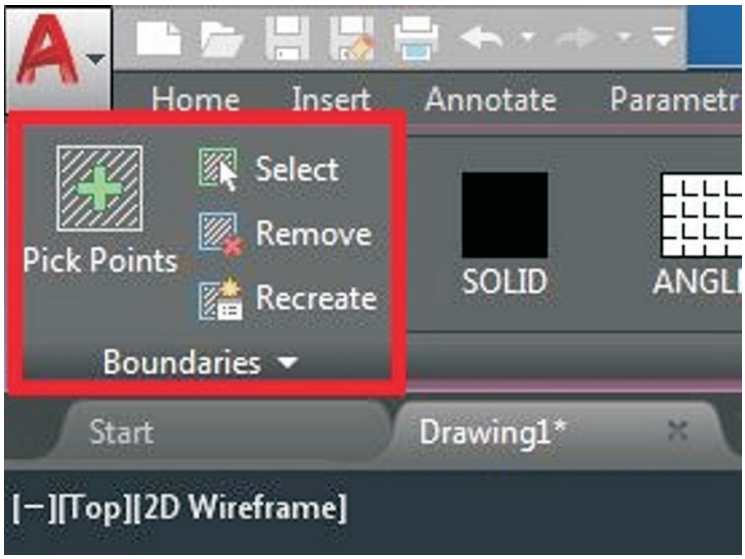


FIGURE 6. This is the location of AutoCAD's boundaries menu. (AutoCAD screen shot reprinted with the permission of Autodesk, Inc.)

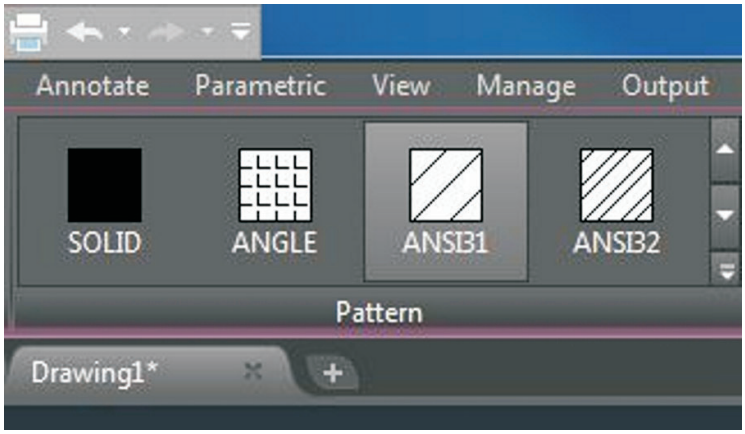


FIGURE 7. This is the location of AutoCAD's pattern menu. (AutoCAD screen shot reprinted with the permission of Autodesk, Inc.)

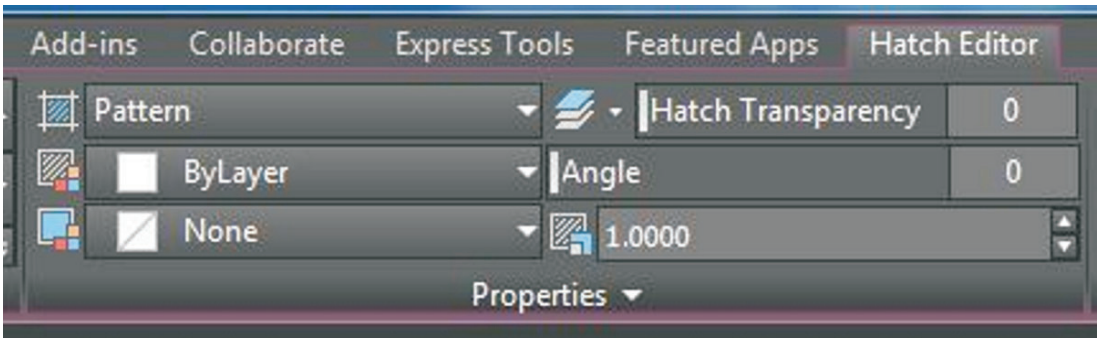


FIGURE 8. This is the location of AutoCAD's properties menu. (AutoCAD screen shot reprinted with the permission of Autodesk, Inc.)

- The hatch color category overrides the current with a color specified for solid fills and hatch patterns.
- The background color category specifies the background color for the hatch pattern.
- The hatch transparency category displays the current hatch transparency value, or accepts a value for the hatch transparency override.
- The hatch angle category specifies an angle for the hatch pattern relative to the X-axis of the current UCS. **UCS** is a moveable Cartesian coordinate system that establishes the X- and Y-work plane, horizontal and vertical directions, and axes of rotation.
- The hatch pattern scale category expands or contracts a predetermined or custom hatch pattern.

♦ The **specify new origin menu** shifts the hatch pattern to align with the specified origin point.

♦ The **options menu** controls several commonly used hatch or fill options. The options menu choices are:

- The **associative boundaries menu** controls whether the hatch automatically updates when its boundaries are

FIGURE 9. This is the location of AutoCAD's 'specify new origin menu.' (AutoCAD screen shot reprinted with the permission of Autodesk, Inc.)

FURTHER EXPLORATION...

ONLINE CONNECTION: Custom Hatch Patterns

The CAD operator/drafter can create custom hatch patterns. Go to the April 2019 SourceCAD website article, "Making Custom Hatch Pattern in AutoCAD," at https://thesourcecad.com/custom-hatch-autocad/. Watch the tutorial video demonstrating how to set up a unique, original hatch pattern.

modified. This option should be selected to ensure the hatch maintains its associative properties. It turns blue when selected.

- The **annotative scale menu** specifies that the ratio of the hatch pattern automatically adjust to the viewport scale.
- The **match properties menu** sets the properties of a hatch using the properties of a selected hatch object, by default, except the hatch origin. The CAD operator has the option of using the option that uses the hatch origin.

♦ The **close hatch editor menu** exits hatch creation and shuts down the contextual hatch ribbon. The CAD operator can also adjust the hatch pattern based on the needs of a drawing. By typing 'bhatch' or 'hatch' at the command prompt, and then selecting 'settings,' the settings dialog box opens. [See VM–L.] The hatch dialog box contains many of the same options as the hatch ribbon.

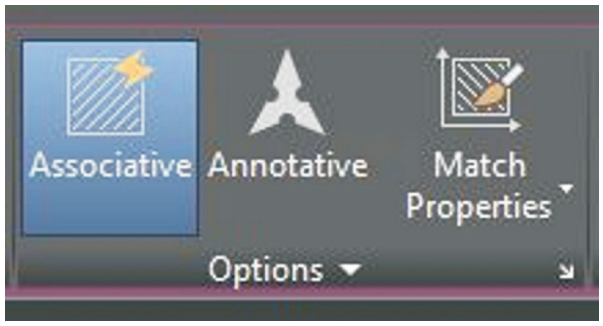


FIGURE 10. This is the location of AutoCAD's options menu. (AutoCAD screen shot reprinted with the permission of Autodesk, Inc.)

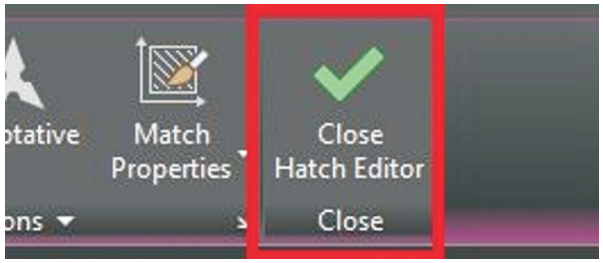


FIGURE 11. This is the location of AutoCAD's 'close hatch editor menu.' (AutoCAD screen shot reprinted with the permission of Autodesk, Inc.)

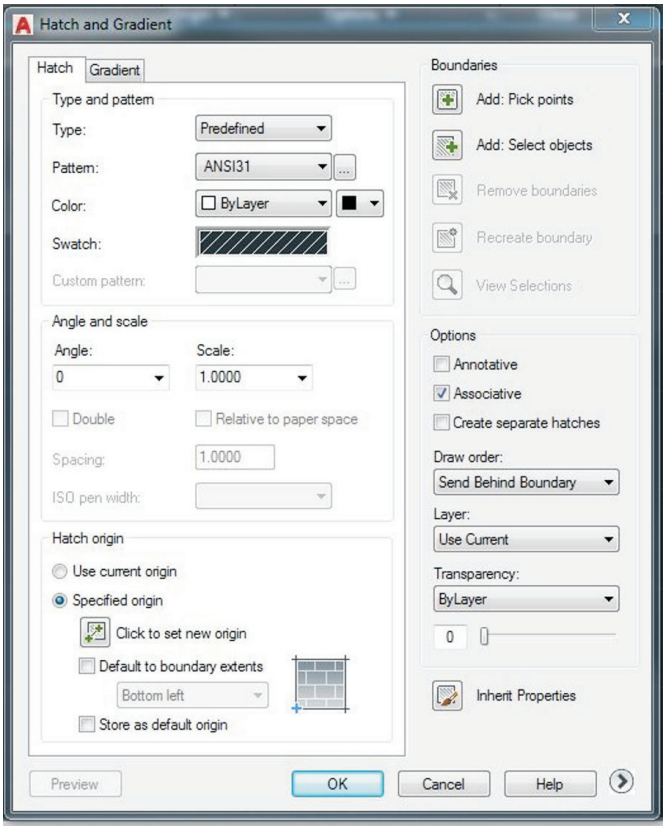


FIGURE 12. This is AutoCAD's 'hatch dialog box' menu. (AutoCAD screen shot reprinted with the permission of Autodesk, Inc.)

Brick Paver Driveway Exercise

STEP 1: Download the Brick Paver Driveway Exercise drawing at https://drive.google.com/file/d/19Uno2lLM3NoJwClrsV0n5dobeWE7Wvn9/view?ts=5cad6696 and open the drawing in AutoCAD. Open the Boundary & No Boundary Hatching tutorial video from the Smith YouTube Channel at https://www.youtube.com/watch?v=xRhgGbnsDLc. [NOTE: For the purposes of teaching the boundary hatching skill, the habit of drawing only in model space will be ignored. Click on the solution tab at the bottom left of the screen to see how the no boundary hatching will appear. Then, click on the challenge tab at the bottom left of the screen and double click inside the blue viewport to activate model space. This will allow one to draw in model space while remaining in the paper space layout tab.]

STEP 2: Type 'hatch' or 'bhatch' at the command prompt and select 'Select Objects' from the options list. Then, select 'Pick Internal Point.' Next, pick inside of the four horizontal pavers and the one vertical paver on the right.

STEP 3: While still in the 'hatch' or 'bhatch' command, go up to the hatch creation ribbon and enter the number 8 in the hatch pattern scale area; hit 'enter.' The hatch pattern created is ANSI 131.

STEP 4: Repeat steps 2 and 3 to create the 'sand hatch pattern' for the long thin rectangle. Use a scale of .25.

STEP 5: Repeat steps 2 and 3 to create the 'concrete hatch pattern' inside the long thick rectangle and the rectangle beneath the vertical paver. Use a scale of 1.

DEPLY NO BOUNDARY HATCHING

A **no boundary hatch** is a repeating pattern without a perimeter or closed geometry that would typically contain the hatch. It can be useful to show the material characteristics of an area without hatching the entire area: a topographical or architectural landscaping plan.

-bhatch

The **-bhatch** is a command that allows the CAD operator/drafter to deploy the no boundary hatch option. The -bhatch command keeps all of the command options available at the command prompt and no dialog box opens when deployed.

Brick Paver Driveway Exercise

STEP 1: Download the Brick Paver Driveway Exercise drawing at https://drive.google.com/file/d/19Uno2lLM3NoJwClrsV0n5dobeWE7Wvn9/view?ts=5cad6696 and open the drawing in AutoCAD. Open the Boundary & No Boundary Hatching tutorial video from the Smith YouTube Channel at https://www.youtube.com/watch?v=xRhgGbnsDLc. [NOTE: For pur-

poses of teaching the no boundary hatching skill, the habit of drawing only in model space will be ignored. Click on the solution tab at the bottom left of the screen to see what the no boundary hatching will look like. Then click on the challenge tab at the bottom left of the screen and double click inside of the blue viewport to activate model space. This will allow you to draw in model space while still in the paper space layout tab.]

STEP 2: Type –bhatch at the command prompt. AutoCAD then lists all of the hatching options. Only a few of the options are demonstrated in this lesson.

STEP 3: Select the draw boundary option and create a boundary around the geometry using lines and arcs. Next, AutoCAD asks the CAD operator/drafter if the polyline boundary should be retained; answer no.

STEP 4: Now, AutoCAD asks the CAD operator/drafter to specify the start point. Go to the status bar (lower left corner of the screen) and select the 'object snap icon.' The drafting settings dialog box opens to the 'object snap tab.' Click on the 'select all option' and uncheck the "nearest" snap tool. Then, click the OK button. Pick the endpoints of the outside corners of the paving stones and the concrete bed starting at the top left and continuing to the upper right corner. A total of 8 endpoints should be picked.

STEP 5: Go back to the command prompt and select the 'arc option.' Then, select the 'direction option' and pick somewhere to the right side of the pavers and a little lower than the pavers. The closer the picked point is to the pavers, the smaller the radius of the arc. The farther the picked point is from the pavers, the larger the radius of the arc. Pick the points needed to create a smooth spline looking boundary similar to what was viewed in the solution tab. Now, hit the 'enter key.' Hit 'enter' again to accept the boundary.

STEP 6: Select the properties option at the command prompt and type the hatch pattern name, EARTH. Then, type 8 for the scale factor and type 45 for the pattern angle. Hit 'enter' one last time. The hatch pattern now appears with no border.

Summary:

The use of hatching patterns is an important way CAD operators/drafters communicate specific ideas about the mechanical or architectural plans to the machinist or the builder. Straight lines and numbers can't illustrate everything. Understanding how to deploy and modify hatch patterns is an essential skill.

Checking Your Knowledge:

1. What is the name of the command that creates a pattern to fill an enclosed boundary or selected object?

2. What is the name of hatch patterns without a perimeter or closed geometry?
3. Name the hatch composed of a color that fills the area or boundary.
4. Name the hatch composed of a transition between one to two colors that fills the area or boundary.
5. Name the hatch pattern that follows a boundary.

Expanding Your Knowledge:

AutoCAD provides premade hatch patterns in the toolbox. Since hatch patterns exist inside of CAD program you can insert hatching into any drawings that require hatches. This is a great time saver. YouTube can be a great resource for AutoCAD tutorials. Go to YouTube and type in, "How to Hatch in AutoCAD." The search should result in numerous how-to videos on the subject.

Students can set up free accounts with Autodesk. Go to https://www.autodesk.com/education/free-software/featured to get a free account. They also have free software for students. After you set up a free account, Autodesk Knowledge Network is available for free. Go to https://knowledge.autodesk.com for additional tutorial videos.

Web Links:

ANSI Hatch Pattern Reference for AutoCAD
http://www.ccadinc.com/autocad-tutorials-hatch-patterns.html

Hatch Command
https://knowledge.autodesk.com/support/autocad/learn-explore/caas/CloudHelp/cloudhelp/2018/ENU/AutoCAD-Core/files/GUID-27C104F2-B687-4025-B50B-A58E37329832-htm.html

Using the Hatch Command
https://www.youtube.com/watch?v=9DradpLtACw