Hatching: Boundary and No Boundary

Unit: 2D Computer-Aided Design and Drafting

Problem Area: Hatching

Lesson: Hatching: Boundary and No Boundary

Student Learning Objectives.

Instruction in this lesson should result in students achieving the following objectives:

1. **Deploy boundary hatching.**
2. **Deploy no boundary hatching.**

Resources.

The following resources may be useful in teaching this lesson:

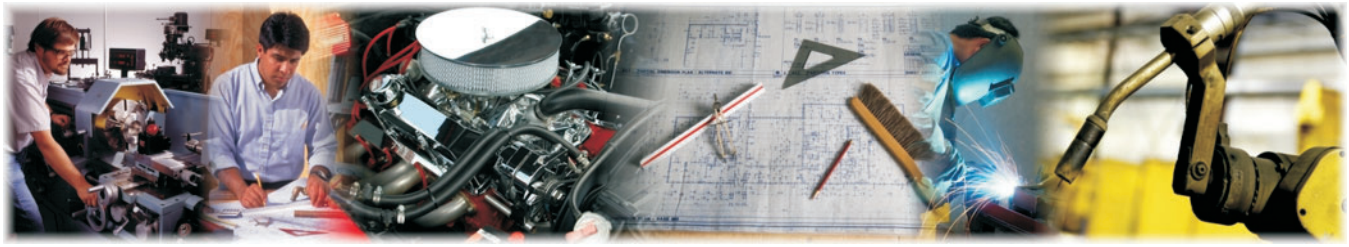
E-unit(s) corresponding to this lesson plan. *CAERT, Inc*. http://www.mycaert.com.

"ANSI Hatch Pattern Reference for AutoCAD," *AutoCAD Training*. Accessed May 4, 2019. http://www.ccadinc.com/autocad-tutorials-hatch-patterns.html.

"Boundary & No Boundary Hatching," *Smith YouTube Network*. Accessed May 4, 2019 https://www.youtube.com/watch?v=xRhgGbnsDLc.

"CAD Glossary," Pearson Education. Accessed May 4, 2019. http://wps.prenhall.com/chet_autocad_supersite_2/0,11165,2577613-,00.html.

"Hatch Command," *Autodesk Knowledge Network*. Accessed May 4, 2019. https://knowledge.autodesk.com/support/autocad/learn-explore/caas/CloudHelp/cloudhelp/2018/ENU/AutoCAD-Core/files/GUID-27C104F2-B687-4025-B50B-A58E37329832-htm.html.



Equipment, Tools, Supplies, and Facilities

- ✓ Overhead or PowerPoint projector
- ✓ Visual(s) from accompanying master(s)
- ✓ Copies of sample test, lab sheet(s), and/or other items designed for duplication
- ✓ Materials listed on duplicated items
- ✓ Computers with printers and Internet access
- ✓ Classroom resource and reference materials
- ✓ Computer, keyboard, and mouse
- ✓ SchoolVue or comparable software that broadcasts the teacher computer to student computers

Key Terms. The following terms are presented in this lesson (shown in bold italics):

- 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

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situation. A possible approach is included here.

> *The deployment of hatching is an important skill. Hatch patterns are used to indicate the types of materials drawn for a device, building, or property. Hatching is also used to indicate that a section cut through a part has a particular material or attribute and can show specific surface finishes. Hatch patterns can include or exclude an area on a site plan that includes surrounding information for context or to differentiate code compliance.*

CONTENT SUMMARY AND TEACHING STRATEGIES

Objective 1: Deploy boundary hatching.

Anticipated Problem: What is hatching? What is boundary hatching? How is boundary hatching deployed?

I. ***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.

A. 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.

1. 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:

a. The ***ANSI 131 hatch*** is AutoCAD's default pattern and the most commonly used hatch. [See VM–A.]
b. A ***solid hatch*** is composed of one color that fills the area or boundary. [See VM–B.]
c. A ***gradient hatch*** is composed of a transition between one to two colors that fills the area or boundary. [See VM–C.]
d. A ***boundary pattern*** is a hatch design that follows a boundary. [See VM–D.]

2. 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. [See VM–E.]
   a. First, AutoCAD asks the CAD operator/drafter to pick an internal point of an object on the screen. Then, AutoCAD gives the CAD operator/drafter the option of: selecting objects or 'Undo,' or settings options.
   b. 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).
   c. 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:
      (1) Boundaries
      (2) Pattern
      (3) Properties
      (4) Origin
      (5) Options
      (6) Close
3. The six areas of the hatch creation menu ribbon are:
   a. The ***boundaries menu*** determines how the hatch pattern interacts with the boundaries formed by geometry. [See VM–F.] The boundaries options are:
      (1) The pick-points category determines a hatch boundary by selecting a point within an enclosed area formed by one or more objects.
      (2) The select boundary objects category determines a hatch pattern boundary from selected objects that form an enclosed area.
      (3) The remove boundary objects category removes from the boundary definition any of the objects that were added previously.
      (4) The recreate boundary category creates a polyline or region around the selected hatch and optionally associates the hatch object with it.
   b. The ***pattern menu*** contains all of AutoCAD's premade hatch patterns. [See VM–G.]

c. The ***properties menu*** contains all of the areas that can change the way a preexisting hatch pattern looks. [See VM–H.] The properties options are:
   (1) The hatch type category specifies whether to create a predefined hatch or fill, or a user defined hatch.
   (2) The hatch color category overrides the current with a color specified for solid fills and hatch patterns.
   (3) The background color category specifies the background color for the hatch pattern.
   (4) The hatch transparency category displays the current hatch transparency value, or accepts a value for the hatch transparency override.
   (5) 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.
   (6) The hatch pattern scale category expands or contracts a predetermined or custom hatch pattern.

4. The ***specify new origin menu*** shifts the hatch pattern to align with the specified origin point. [See VM–I.]
5. The ***options menu*** controls several commonly used hatch or fill options. [See VM–J.] The options menu choices are:
   a. The ***associative boundaries menu*** controls whether the hatch automatically updates when its boundaries are modified. This option should be selected to ensure the hatch maintains its associative properties. It turns blue when selected.
   b. The ***annotative scale menu*** specifies that the ratio of the hatch pattern automatically adjust to the viewport scale.
   c. 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.
6. The ***close hatch editor menu*** exits hatch creation and shuts down the contextual hatch ribbon. [See VM–K.] 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.

B. BRICK PAVER DRIVEWAY EXERCISE: To guide the AutoCAD Brick Paver Driveway Exercise, the following student steps are useful.

1. STEP 1: Download the Brick Paver Driveway Exercise drawing at https://drive.google.com/file/d/19Uno2ILM3NoJwClrsV0n5dobeWE7Wvn9/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.]

2. 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.
3. 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.
4. STEP 4: Repeat steps 2 and 3 to create the 'sand hatch pattern' for the long thin rectangle. Use a scale of .25.
5. 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.

Teaching Strategy: *Many techniques can be used to help students master this objective. Lead a discussion about deploying or creating hatch patterns in AutoCAD. Provide examples of standard hatch patterns and how to change them. Use VM–A through VM–L to reinforce how hatch patterns are deployed. Show and demonstrate deploying hatch patterns using SchoolVue or a comparable software. [NOTE: The base method is to use a program like SchoolVue to broadcast from the teacher's computer out to the student computers. This allows you to demonstrate directly to each student's computer. This lesson was prepared assuming the use of the Autodesk product AutoCAD.]*

Objective 2: Deploy no boundary hatching.

Anticipated Problem: What is a no boundary hatch? How is no boundary hatching deployed?

II. NO BOUNDARY HATCH: 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.

A. 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.

1. BRICK PAVER DRIVEWAY EXERCISE: To guide the AutoCAD Brick Paver Driveway Exercise, the following student steps are useful.
   a. STEP 1: Download the Brick Paver Driveway Exercise drawing at https://drive.google.com/file/d/19Uno2ILM3NoJwClrsV0n5dobeWE7Wvn9/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 purposes 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.]

b. 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.
c. 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.
d. 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.
e. 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.
f. 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.

Teaching Strategy: *Many techniques can be used to help students master this objective. Consider walking around the room and interacting with students as they deploy boundary hatch patterns and no boundary hatch patterns. Assign LS–A.*

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at the ends of chapters in the textbook may also be used in the review/summary.

Application. Use the included visual masters and lab sheet to apply the information presented in the lesson.

Evaluation. Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is provided.

Answers to Sample Test:

Part One: Matching

1. f
2. e
3. a
4. d
5. c
6. b

Part Two: Completion

1. boundaries
2. premade
3. preexisting
4. shifts
5. exits
6. default

Part Three: Short Answer

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. 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.

Sample Test

Name _____

Hatching: Boundary and No Boundary

Part One: Matching

Instructions: **Match the term with the correct definition.**

a. solid hatch
b. no boundary hatch
c. boundary pattern
d. gradient hatch
e. -bhatch
f. hatch command

_____1. The original order that creates fill patterns in an enclosed boundary or selected object including solid, gradient, and boundary types

_____2. A command that allows the CAD operator/drafter to deploy the no boundary hatch option

_____3. Composed of one color that fills the area or boundary

_____4. Composed of a transition between one to two colors that fills the area or boundary

_____5. A hatch design that follows a boundary

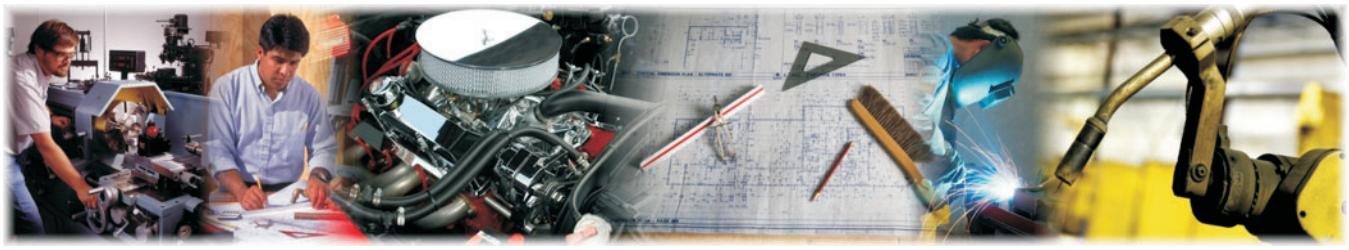
_____6. A repeating pattern without a perimeter or closed geometry that would typically contain the hatch

Part Two: Completion

Instructions: **Provide the word or words to complete the following statements.**

1. To determine how the hatch pattern interacts with the boundaries formed by geometry, the CAD drafter/operator uses the _____ menu.

2. The pattern menu contains all of the _____ hatch patterns available in AutoCAD.



3. The properties menu contains all of the areas that can change the way a/an _____ hatch pattern appears.

4. The specify new origin menu _____ the hatch pattern to align with the specified origin point.

5. The close hatch editor menu _____ hatch creation and closes the contextual hatch ribbon.

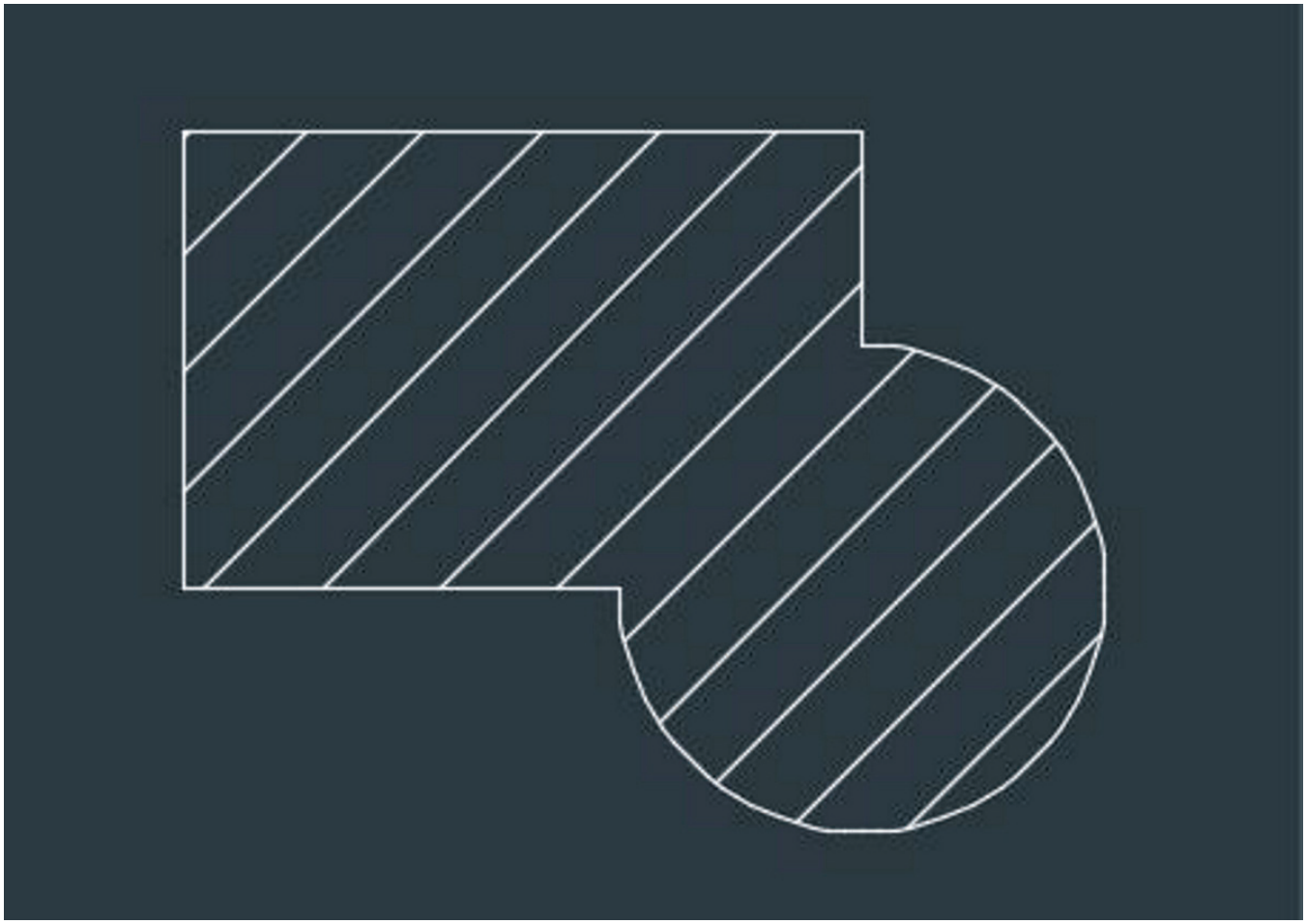
6. ANSI 131 is the _____ hatch pattern in AutoCAD.

Part Three: Short Answer

Instructions: **Complete the following.**

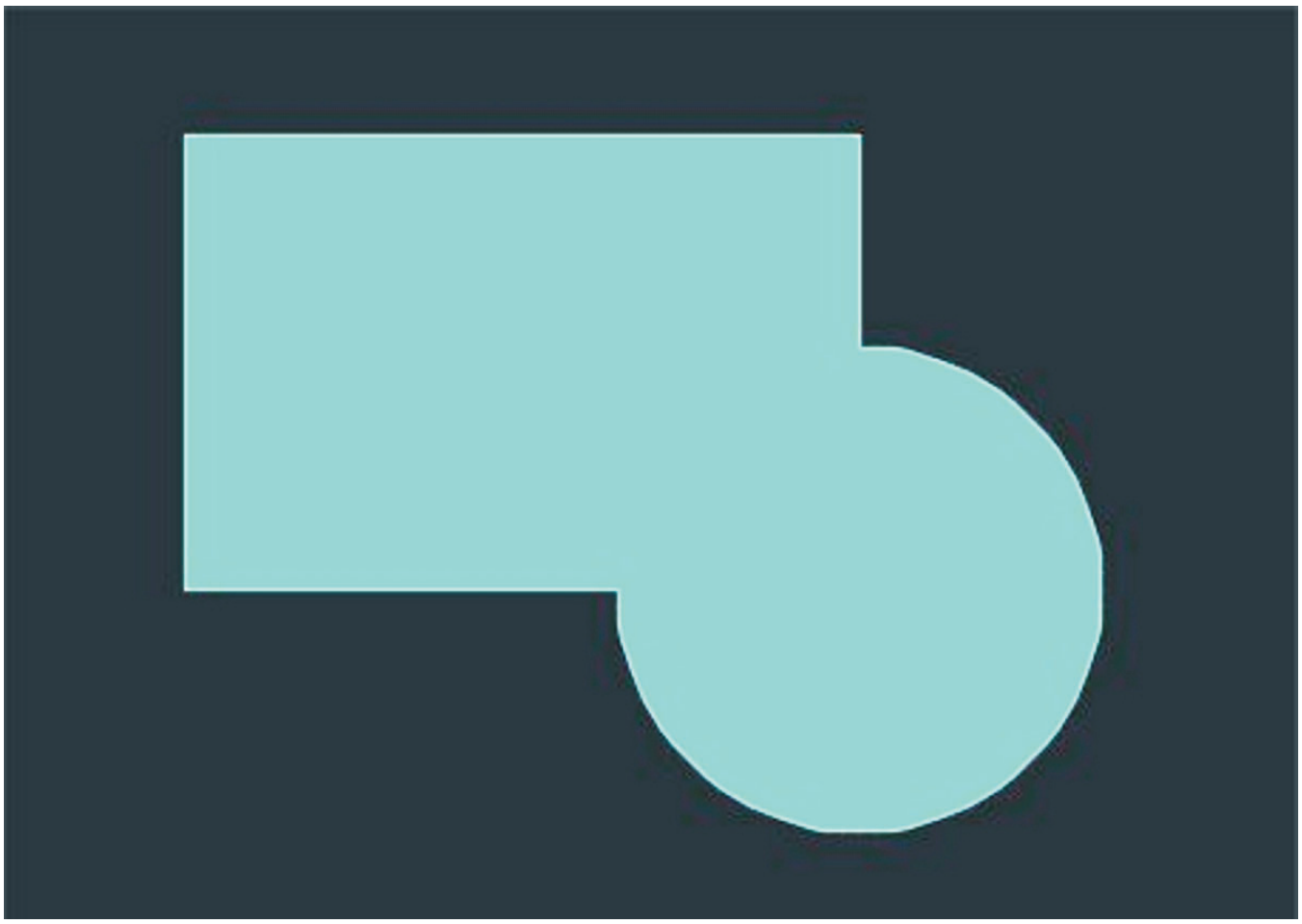
Differentiate between boundary hatching and no boundary hatching.

ANSI 131 HATCH PATTERN EXAMPLE



(AutoCAD screen shot reprinted with the permission of Autodesk, Inc.)

SOLID HATCH FILL EXAMPLE



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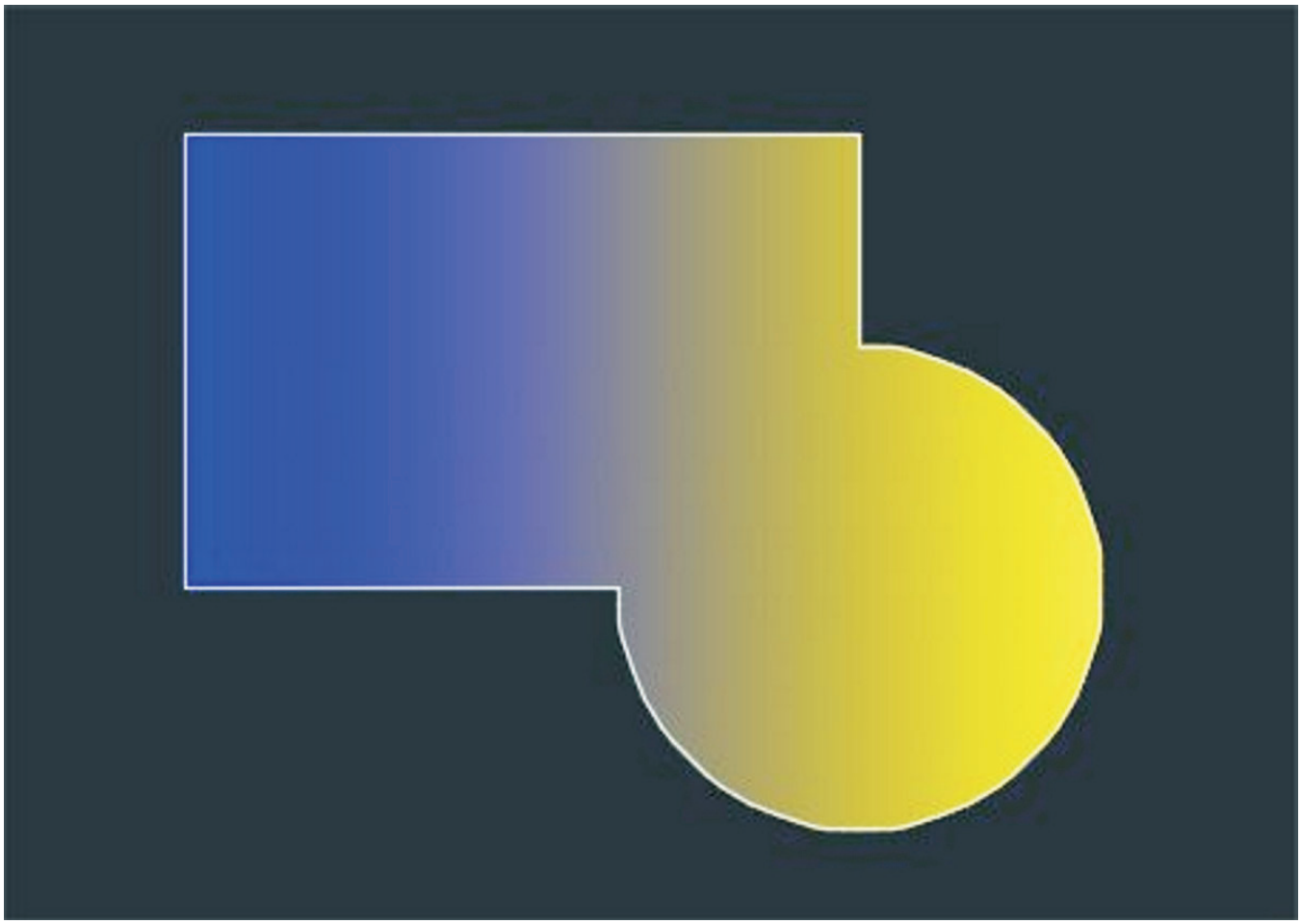
GRADIENT HATCH EXAMPLE



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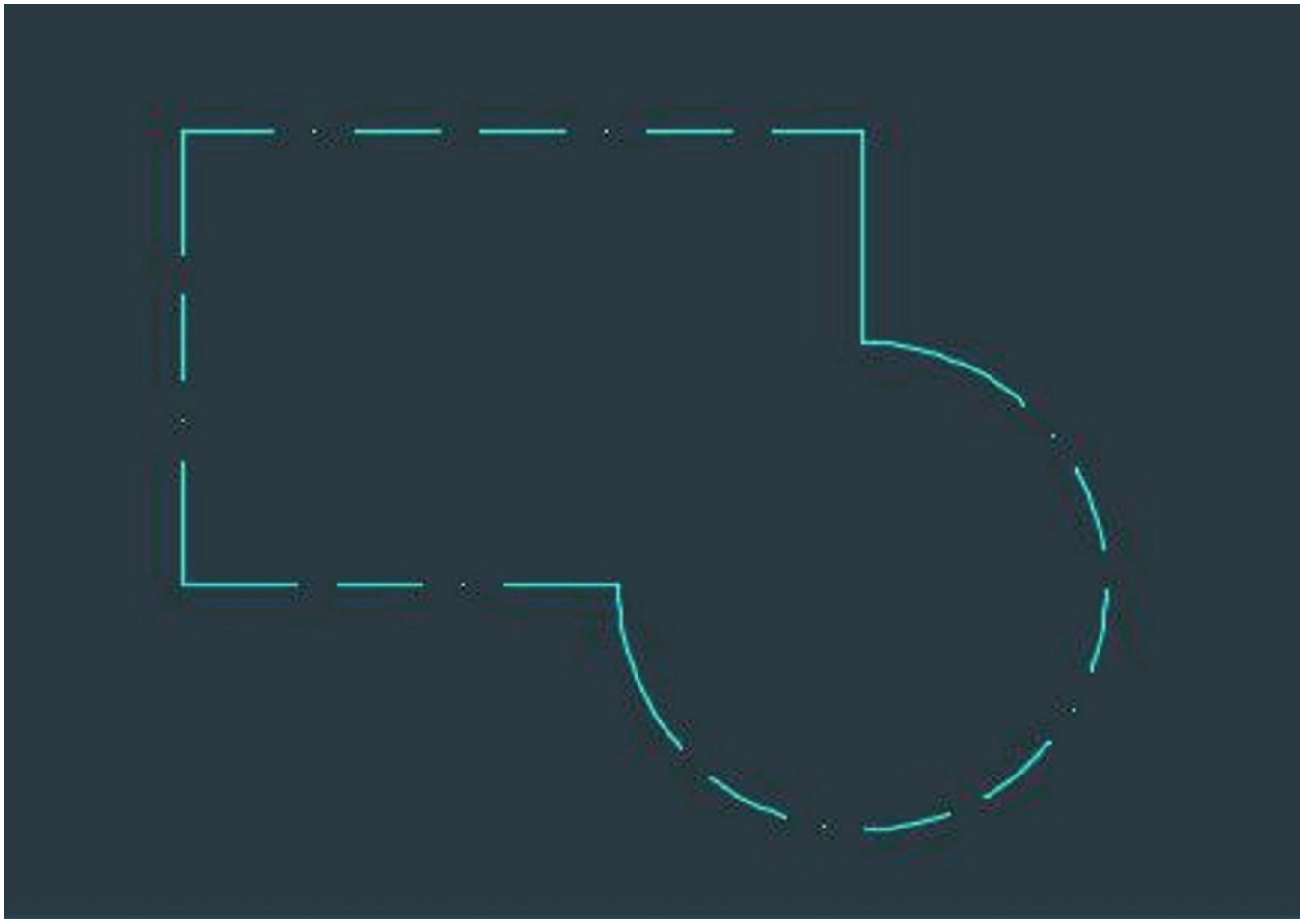
BOUNDARY PATTERN EXAMPLE



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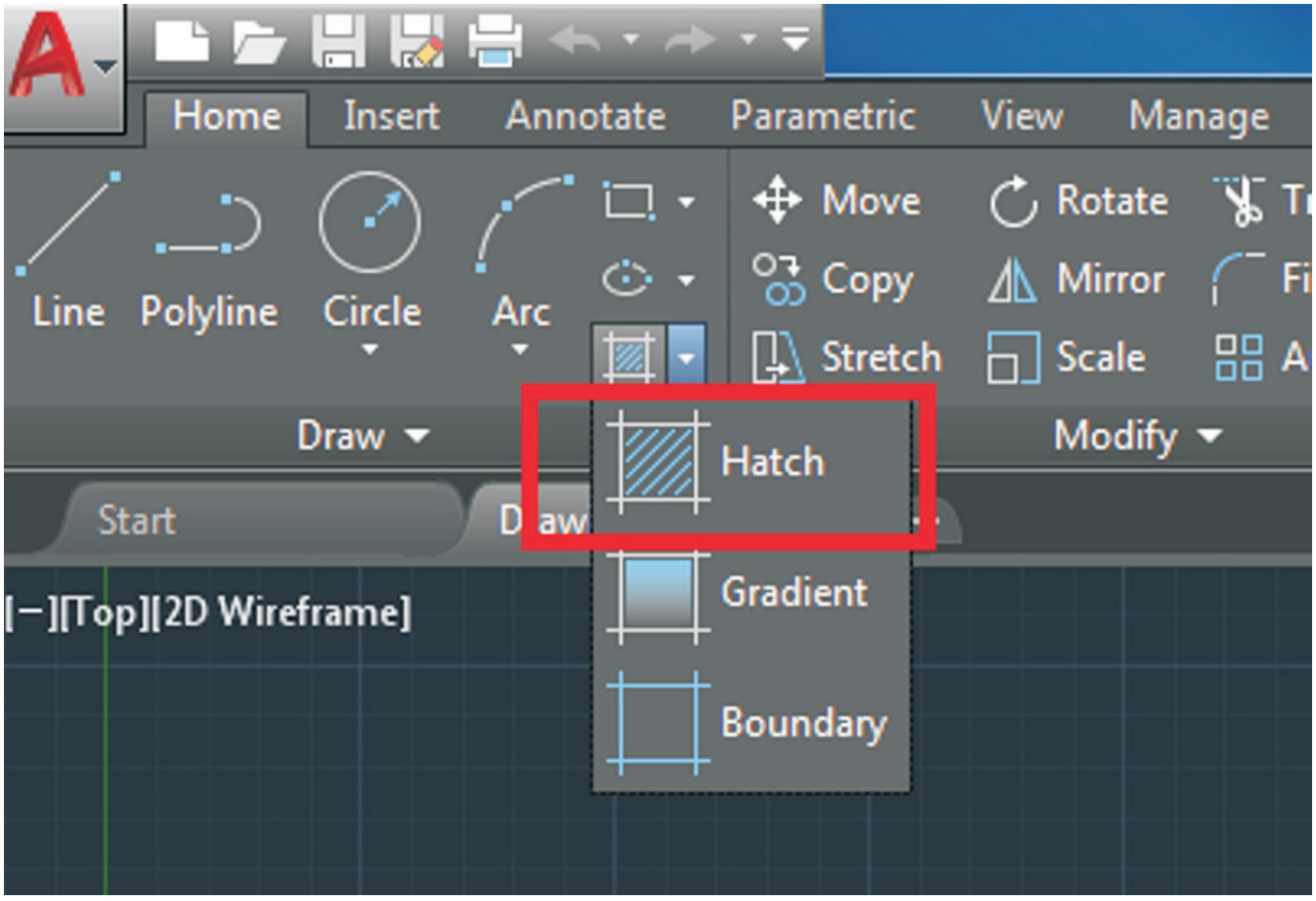
AUTOCAD'S HATCH COMMAND ICON LOCATION



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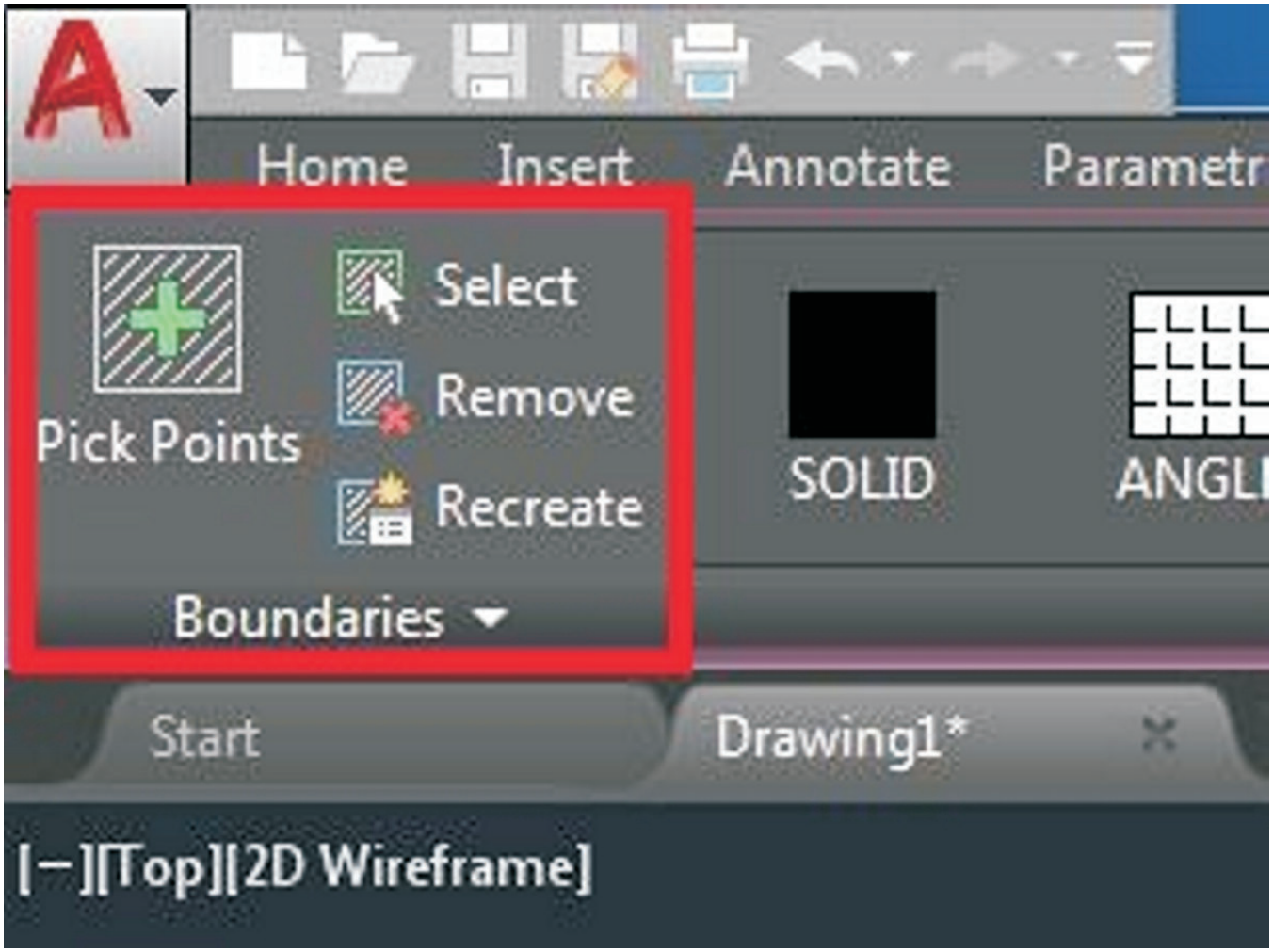
AUTOCAD'S BOUNDARIES MENU LOCATION



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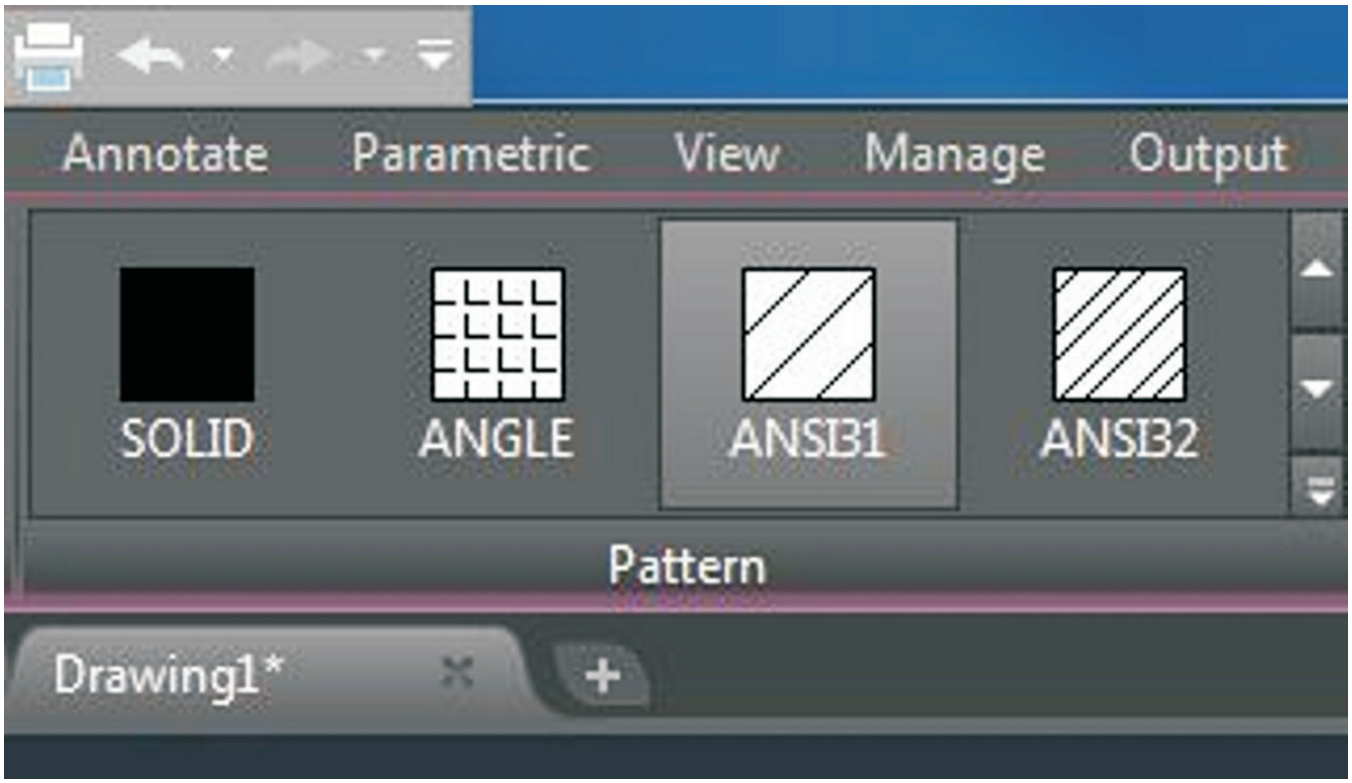
AUTOCAD'S PATTERN MENU LOCATION



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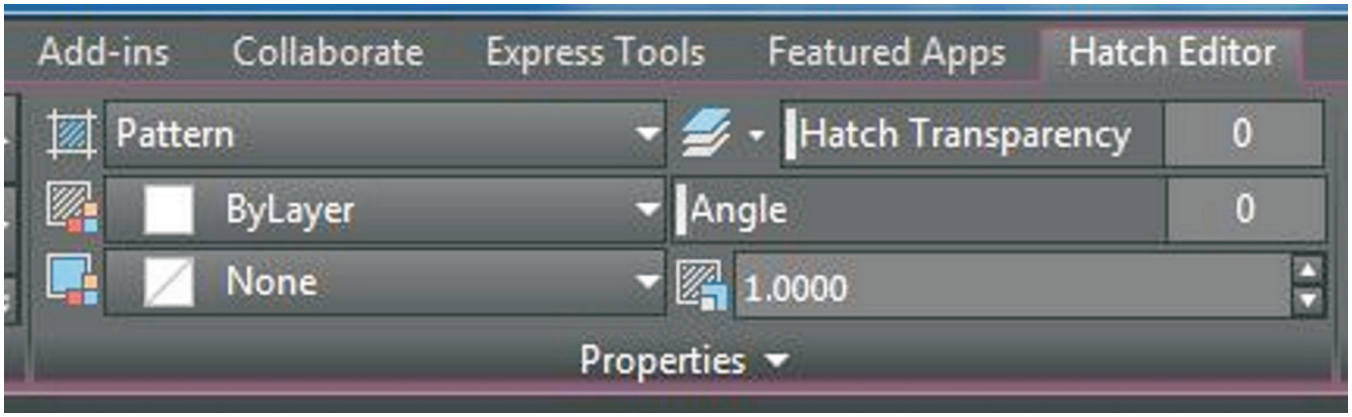
AUTOCAD'S PROPERTIES MENU



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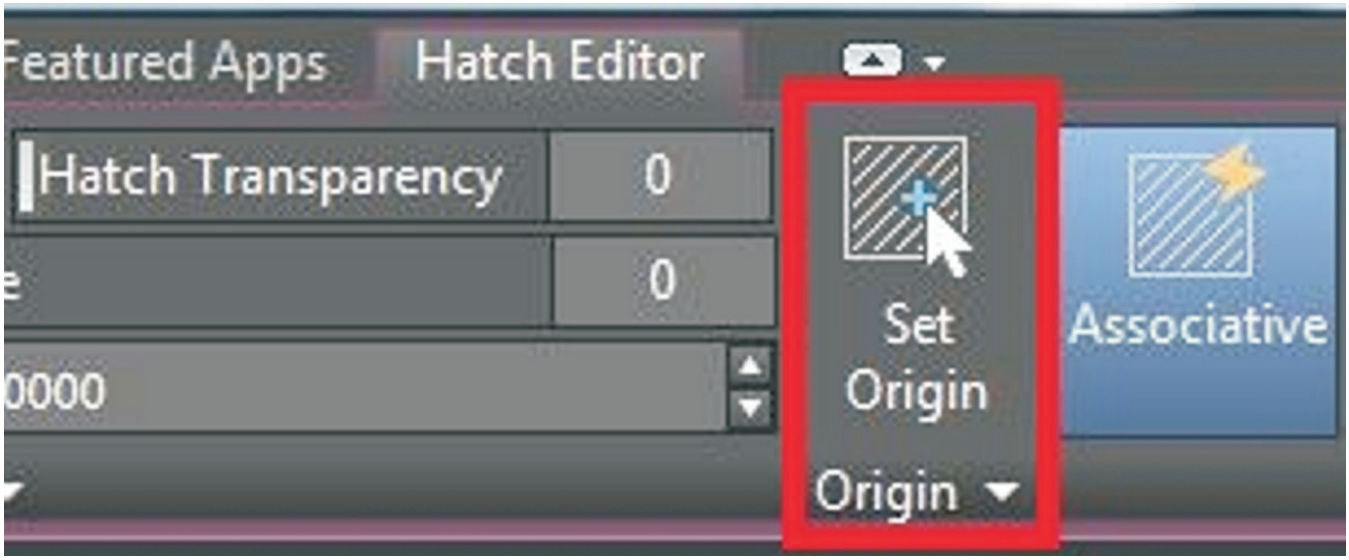
AUTOCAD'S SPECIFY NEW ORIGIN MENU



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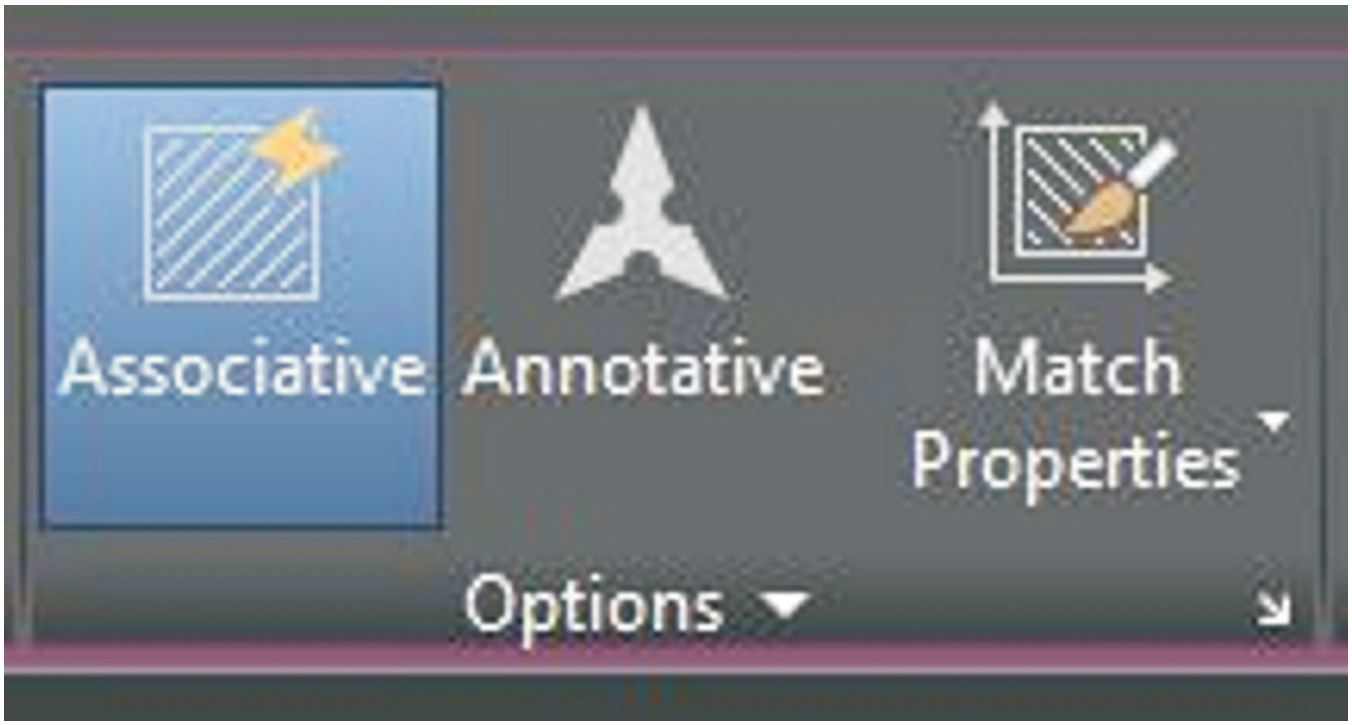
AUTOCAD'S OPTIONS MENU



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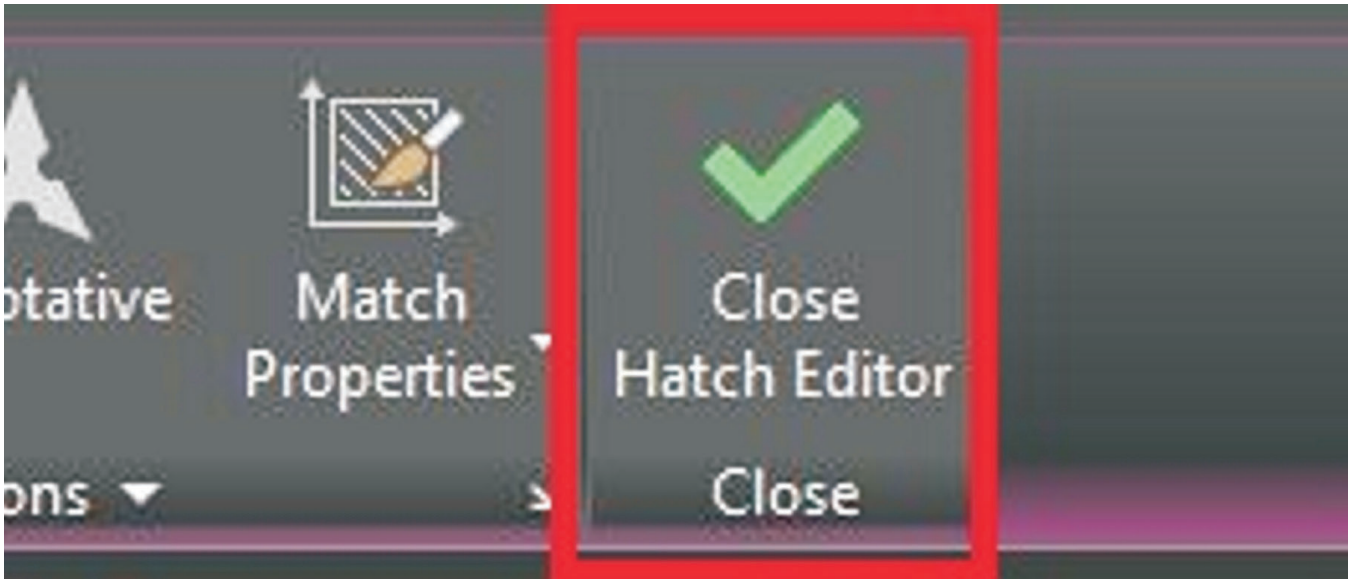
AUTOCAD'S CLOSE HATCH EDITOR MENU



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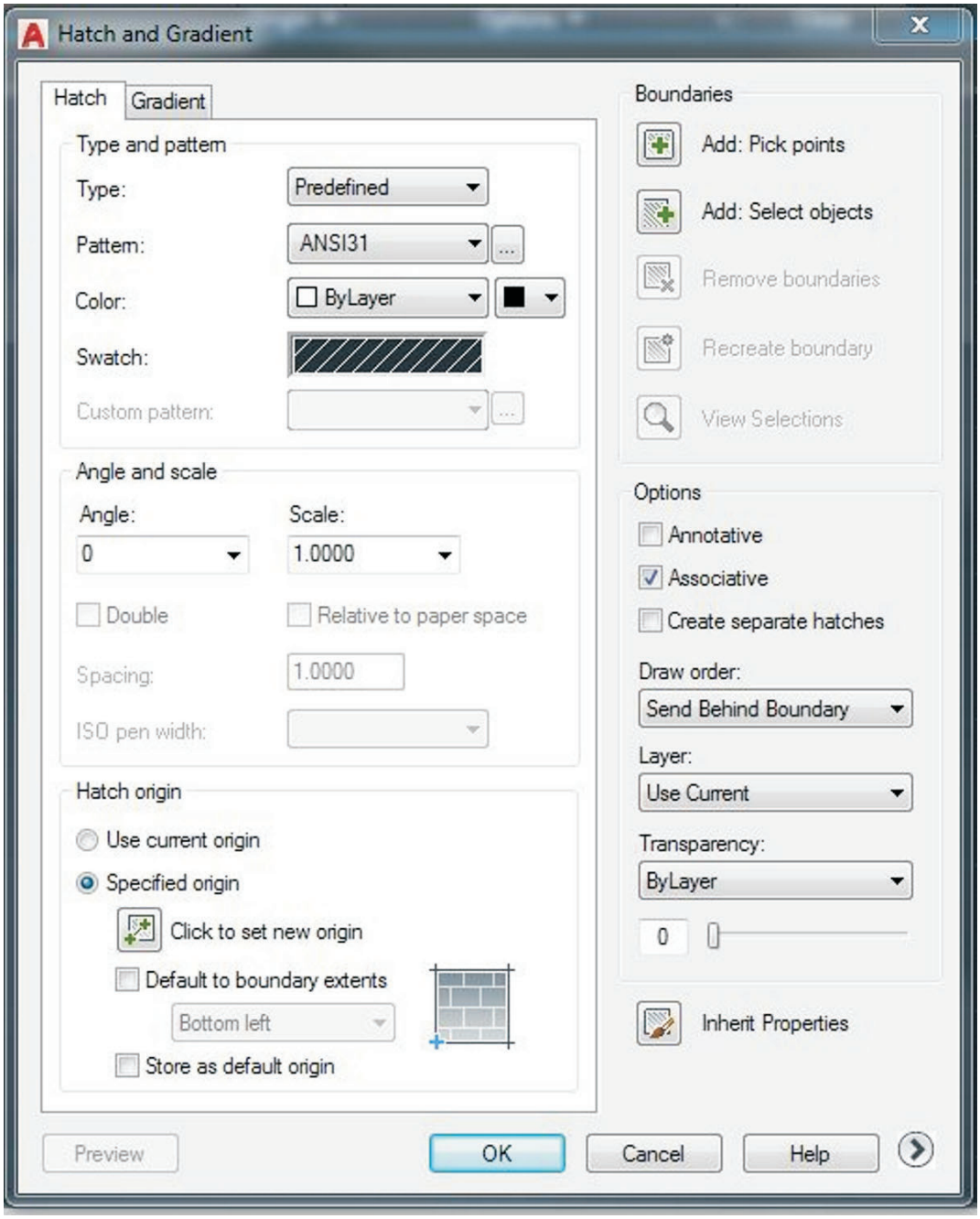
AUTOCAD'S HATCH SETTINGS DIALOG BOX



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LS–A

Name _____

Deploy Boundary and No Boundary Hatching

Purpose:

The purpose of this lab activity is to deploy boundary and no boundary hatching.

Objectives:

1. Demonstrate boundary and no boundary hatching.
2. Complete the "Brick Paver Driveway Exercise."

Materials:

- lab sheet
- computer with AutoCAD software
- class notes

Procedure

1. Download the "Brick Paver Driveway Exercise" drawing at https://drive.google.com/file/d/19Uno2ILM3NoJwClrsV0n5dobeWE7Wvn9/view?ts=5cad6696.
2. Open the "Brick Paver Driveway Exercise" drawing and use your notes and the tutorial video, "Boundary & No Boundary Hatching" at https://www.youtube.com/watch?v=xRhgGbnsDLc, to create boundary hatch patterns and no boundary hatch patterns.
3. Complete the "Brick Paver Driveway Exercise" drawings.
4. Turn your boundary and no boundary hatch drawings in to your instructor via the class method of submission.