Draw Commands: Using the Draw Menu

Unit: 2D Computer-Aided Design and Drafting

Problem Area: Geometry Creation

Lesson: Draw Commands: Using the Draw Menu

Student Learning Objectives.

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

1. **Use draw commands to create 2D shapes.**
2. **Use object snap tools.**

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.

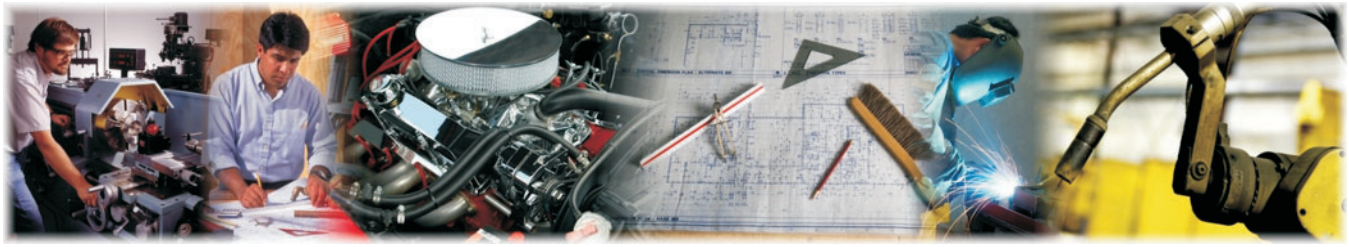
"AutoCAD–Line (Command)," *Autodesk Knowledge Network*. Accessed Sept. 28, 2018. https://knowledge.autodesk.com/support/autocad/learn-explore/caas/CloudHelp/cloudhelp/2018/ENU/AutoCAD-Core/files/GUID-E8C1190C-A26C-484C-ADDD-DDF81666F69F-htm.html.

"AutoCAD–Running Object Snap Tools," *Smith YouTube Channel.* Accessed Sept. 28, 2018. https://www.youtube.com/watch?v=wRqfrr0O91w.

"AutoCAD Student Shape Worksheet Drawing Arc Command," *Smith YouTube Channel.* Accessed Sept. 28, 2018. https://www.youtube.com/watch?v=_LN1gtuFjNQ&t=18s.

"AutoCAD Student Shape Worksheet Drawing Rectangle Command," *Smith YouTube Channel.* Accessed Sept. 28, 2018. https://www.youtube.com/watch?v=SHU8qwXJ7jM&t=5s.

"AutoCAD Student Shape Worksheet Drawing Donut Command," *Smith YouTube Channel.* Accessed Sept. 28, 2018. https://www.youtube.com/watch?v=YQsnz73MjAc.



"AutoCAD Student Shape Worksheet Drawing Ellipse Command," *Smith YouTube Channel.* Accessed Sept. 28, 2018. https://www.youtube.com/watch?v=rongZe4Q3iU&t=13s.

"AutoCAD Student Shape Worksheet Drawing Polygon Command," *Smith YouTube Channel.* Accessed Sept. 28, 2018. https://www.youtube.com/watch?v=mv7QG5HclYE&t=1s.

"AutoCAD Student Shape Worksheet Polyline Command," *Smith YouTube Channel.* Accessed Sept. 28, 2018. https://www.youtube.com/watch?v=Slfbt47-H3I&t=12s.

"AutoCAD Student Shape Worksheet Drawing Spline Tangency Command," *Smith YouTube Channel.* Accessed Sept. 28, 2018. https://www.youtube.com/watch?v=OQiunSEeWLw&t=2s.

"AutoCAD–To Draw A Multiline," *Autodesk Knowledge Network*. Accessed Sept. 28, 2018. https://knowledge.autodesk.com/support/autocad/learn-explore/caas/CloudHelp/cloudhelp/2018/ENU/AutoCAD-Core/files/GUID-FA4E9834-041E-4C5A-960D-1A28DDA3864B-htm.html.

"AutoCAD–To Draw Lines," *Autodesk Knowledge Network*. Accessed Sept. 28, 2018. https://knowledge.autodesk.com/support/autocad/learn-explore/caas/CloudHelp/cloudhelp/2018/ENU/AutoCAD-Core/files/GUID-57CDDB6C-B12B-46CE-B9C5-22EFC17258FF-htm.html.

"AutoCAD–To Draw Polylines," *Autodesk Knowledge Network*. Accessed Sept. 28, 2018. https://knowledge.autodesk.com/support/autocad/learn-explore/caas/CloudHelp/cloudhelp/2018/ENU/AutoCAD-Core/files/GUID-ACC319C8-34EA-4D9D-981E-B69B7B187400-htm.html.

"Glossary of AutoCAD Terms," *Autodesk Knowledge Network*. Accessed Sept. 28, 2018. https://knowledge.autodesk.com/support/autocad/learn-explore/caas/CloudHelp/cloudhelp/2016/ENU/AutoCAD-Core/files/GUID-C4325DCB-3648-4463-8135-629EA7F72AB0-htm.html.

Shumaker, Terence M., David A. Madsen, and David P. Madsen. *AutoCAD and Its Applications Basics 2018*, 25th ed., *Goodheart-Willcox*.

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):

- apparent intersection
- arc
- center
- circle
- draw commands
- ellipse
- endpoint
- extension
- from
- geometric center
- insert
- intersection
- line
- mid between two points
- midpoint
- nearest
- node
- object snap
- parallel
- perpendicular
- polygon
- polyline
- quadrant
- rectangle
- running object snaps
- spline
- tangent
- temporary track point

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

> *Unlike drawing shapes with a pencil and paper, AutoCAD enables the user to draw shapes in the electronic environment. CADD system tools speed up the process of drawing geometric shapes: lines, circles, rectangles, arcs, splines, polygons, etc. Mastering the basic CAD 2D shapes draw commands and object snap tools is essential to becoming a CADD operator.*

CONTENT SUMMARY AND TEACHING STRATEGIES

Objective 1: Use draw commands to create 2D shapes.

Anticipated Problem: What are draw commands? What are the basic 2D draw commands? How is 2D drawing commands and tools accessed?

I. ***Draw commands*** are strings of text linked together to create a larger string of graphical instructions delivered to provide limits to CAD's dynamic texture drawing functions. Most drawings are created using basic draw commands. Draw commands create new objects and most technical drawings are produced from the basic draw commands: lines, circles, polylines, etc. To be efficient working in AutoCAD, operators need a strong understanding of draw commands. AutoCAD's 2D drawing tools are located on the draw menu of the home tab on the ribbon.

A. Basic draw commands are:

1. ***Line*** is a command used to draw a straight line starting at an exact point and ending at an exact point. The user can pick arbitrary point on the x- and y-axes or pick exact locations using coordinate entry methods. The line command is accessed by:
   a. Clicking on the line icon in the draw menu (See VM–A.)
   b. Typing LINE at the command prompt
2. ***Polyline*** is a command that is a connected sequence of line segments created as a single object. Polylines can be edited to change their shape and appearance. The polyline can be edited with the following options: arc, half-width, length, undo, and width. The polyline command can be accessed by:
   a. Clicking on the polyline icon in the draw menu (See VM–A.)
   b. Typing PLINE at the command prompt [NOTE: To view an example of the polyline command, watch the video tutorial, "AutoCAD Student Shape Worksheet Polyline Command," at https://www.youtube.com/watch?v=SIfbt47-H3I&t=12s.]
3. ***Circle*** is a command that draws a sphere based on a center point and a diameter, or a radius, of the circle. When accessing the circle command icon located in the draw menu, the user has the following circle command options: center-radius, center-diameter, 2-point, 3-point, tangent, tangent, radius, and tangent, tangent, tangent. When a user creates a circle using the command prompt, AutoCAD asks for the starting point and then defaults to asking for the radius of the circle. The circle command can be accessed by:
   a. Clicking on the circle command icon in the draw menu (See VM–B.)
   b. Typing CIRCLE at the command prompt

4. ***Arc*** is a command that creates a curve, major or minor, clockwise or counter-clockwise, beginning with a start point, ending at an endpoint. AutoCAD defaults to creating arc in the counterclockwise manner. When accessing the arc command via the draw menu, AutoCAD gives the user the following options: 3-point, start-center-end, start-center-angle, start-center-length, start-end-angle, start-end-direction, start-end-radius, center-start-end, center-start-angle, center-start-length, and continue. The user can also access the arc command by:
   a. Using the draw menu (See VM–C.)
   b. Typing ARC at the command prompt [NOTE: To view an example of the arc command, watch the video tutorial, "AutoCAD Student Shape Worksheet Drawing Arc Command," at https://www.youtube.com/watch?v=_LN1gtuFjNQ&t=18s.]
5. ***Rectangle*** is a command that creates an oblong polyline from the specified rectangle parameters (length, width, rotation) and type of corners (fillet, chamfer, square). The rectangle (and the polygon command) is found in the same area of the draw menu. (See VM–D.) By default, the rectangle command is displayed (and the polygon command only accessed) by:
   a. Clicking on the down arrow to the right of the rectangle icon
   b. Typing RECTANGLE at the command prompt [NOTE: Regardless of the way the user accesses the command, the next question AutoCAD asks is to specify the first corner, and be given access to the chamfer, elevation, fillet, thickness, and width options. The user can specify the first corner either by clicking on an arbitrary location or by entering specific x and y locations. Upon locating the first corner and hitting "enter," the user is asked to specify the second corner and is given the following options: area, dimensions, and rotation. To view an example of the rectangle command, watch the video tutorial, "AutoCAD Student Shape Worksheet Drawing Rectangle Command," at https://www.youtube.com/watch?v=SHU8qwXJ7jM&t=5s.]
6. ***Polygon*** is a command that creates an equilateral closed polyline. Once the polygon command is deployed, the user is asked to specify the number of sides. Then, the user is asked to specify the center of the polygon. Next, the user must specify the center by clicking on an arbitrary location or by entering specific x and y locations. Now, the user is asked to specify whether the polygon will be "inscribed (polygon is to the inside of the circle) or circumscribed (polygon is to the outside of the circle)." The user enters one or the other (inscribed or circumscribed) and then specifies the radius. The polygon command is accessed by:
   a. Using the draw menu (See VM–D.)
   b. Typing POLYGON at the command prompt [NOTE: To view an example of the polygon command, watch the video tutorial, "AutoCAD Student Shape Worksheet Drawing Polygon Command," at https://www.youtube.com/watch?v=mv7QG5HcIYE&t=1s.]

7. ***Ellipse*** is a command that creates a regular oval shape by locating two points for the location and length of the first axis and a third point that determines the distance between the center of the ellipse and the end point of the second axis. There are three ellipse commands in AutoCAD: center, axis-end, and elliptical arc. AutoCAD defaults to the ellipse-center command. Whether the user accesses the command via the ellipse command icon in the draw menu (See VM–E) or enters the ELLIPSE command at the command prompt, the user is asked to specify the center point, and then asked to specify the end-point of the axis. The user can specify the first point and second point either by clicking on an arbitrary location or by entering a specific x and y location. The three ellipse commands can be accessed by
   a. Using the ellipse command icon in the draw menu (See VM–E.)
   b. Typing ELLIPSE at the command prompt [NOTE: To view the ellipse command, watch the video tutorial, "AutoCAD Student Shape Worksheet Drawing Ellipse Command," at https://www.youtube.com/watch?v=rongZe4Q3iU&t=13s.]

Teaching Strategy: *Many techniques can be used to help students master this objective. Lead a discussion about AutoCAD draw commands. Provide examples of what draw commands look like and what they do. Help students set up their own drawing files and save it on the school network, thumb drive, or in the cloud. Use VM–A through VM–E to illustrate AutoCAD draw commands. Use the shape worksheet skill builder exercises to reinforce AutoCAD drawing commands. Have students view the tutorial videos as needed. [NOTE: Demonstrate the CAD tools using SchoolVue or a comparable software to broadcast from the teacher's computer out to the student computers. This allows you to demonstrate directly to each student. This lesson was prepared assuming the use of the Autodesk product AutoCAD.]*

Objective 2: Use object snap tools.

Anticipated Problem: What is an object snap? How are object snap tools used in a drawing?

II. Object snap tools

A. An ***object snap*** is a tool designed to lock the crosshairs onto a known, precise location. Since AutoCAD is accurate to the sixteenth decimal place (0.0000000000000001), a user is visually unable to rest the crosshairs at the endpoint or midpoint or any other point and expect to be accurate to any decimal place. Therefore, tools were developed to accurately snap to points. To access the object snap tools a user would:

1. METHOD 1: Hold down the shift key while selecting the right mouse button. This action provides the user access to a context sensitive list of snap tools (See VM–F) and to the entire list of object snap tools. This access method is

only available when using a drawing tool. [NOTE: 3D Osnap and none are not covered in this lesson.]

2. METHOD 2: Go to the object snap tools icon in the status bar (at the bottom right of the AutoCAD screen) and click the down arrow (to the right of the object snap icon). This action causes a menu to pop up with most of the object snap tools that allows the user to pick an object snap tool (See VM–F). [NOTE: This list is missing the temporary track point, from, mid between 2 points, and none.]
3. METHOD 3: Use 'running object snap mode.' ***Running object snaps*** are object snap modes that run in the background during all drawing and editing procedures. To turn on the object snap tools required for the drawing (e.g., tools that are activated or running in the background), the user left-clicks the down arrow (to the right of the object snap tool icon) (See VM–F) and selects 'object snap settings.' This action brings to the forefront the 'drafting settings dialog box' with the 'object snap tab' (See VM–G). [NOTE: When using the running object snap mode, a user does not check the nearest object snap tool. This action will override all of the other snap tools and make them difficult to use. Notice this list is missing the temporary track point, from, mid between two points, and none. To view an example of the running object snap, watch the video tutorial, "AutoCAD Running Object Snap Tools," at https://www.youtube.com/watch?v=wRqfrr0O91w.]
4. METHOD 4: With the object snap tools running in the background, the user temporarily suspends all the 'running object snaps' by right clicking and selecting an individual snap tool to use. This action suspends all other 'running object snap tools' until the user applies the selected object snap. Once used, all 'running object snap tools' are reactivated.

B. AutoCAD object snap tools that can be temporarily activated or be running in the background are:

1. ***Endpoint*** is an object snap that provides access to the closest endpoint of a geometric object.
2. ***Midpoint*** is an object snap that provides access to the closest center of a geometric object.
3. ***Center*** is an object snap that provides access to the closest middle of an arc, circle, ellipse, or elliptical arc.
4. ***Geometric center*** is an object snap that provides access to the centroid (mathematical center) of any closed polylines and splines. A ***spline*** is a curve that uses a series of control points and other math principles to describe the location and form of the curve.
5. ***Node*** is an object snap that finds the location of point objects, dimension definition points, and text origin points.
6. ***Quadrant*** is an object snap that provides access to the closest horizontal or vertical quarter of the point of an arc, ellipse, or elliptical arc.

7. ***Intersection*** is an object snap that provides access to the closest physical junction (where objects cross each other) of any two geometric drawing objects.
8. ***Extension*** is an object snap that causes a temporary extension line or arc to be displayed when the user passes the cursor over the endpoint of objects, to specify points on the extension.
9. ***Insert*** is an object snap that provides access to the closest insertion point of objects such as an attribute, a block, or text.
10. ***Perpendicular*** is an object snap that provides access to the closest point that is located 90-degrees to the selected geometric object.
11. ***Tangent*** is an object snap that provides access to the closest location at which a line, circle, or arc meets another circle or arc at only one point. A line tangent to an arc or circle is perpendicular to that circle's radius line and parallel to a line passing through the center at the same angle.
12. ***Nearest*** is an object snap that provides access to any point on an arc, circle, ellipse, elliptical arc, line, point, polyline, ray, spline, or xline.
13. ***Apparent intersection*** is an object snap that provides access to the visual junction of two objects that do not cross over in 3D space, but may appear to cross over in the current view.
14. ***Parallel*** is an object snap that constrains (limits) a new line segment, polyline segment, ray, or xline to be similar (parallel) to an existing linear object. To create a parallel to one of the above-mentioned objects, the user hovers the cursor over it.
15. ***Temporary track point*** is an object snap that, for the moment, places a tracking point precisely on an object based on two different dimension (rather than first having to draw construction geometry).
16. ***From*** is an object snap that provides access to an area measured precisely from a temporary point selected on an object.
17. ***Mid between two points*** is an object snap that provides access to the middle area between two touched points. [See VM–H to review object snap tools running in the background.]

Teaching Strategy: *Many techniques can be used to help students master this objective. Use VM–F, VM–G, and VM–H to illustrate the use of object snap tools. Walk around the room and interact with the students as they use the tutorial videos and create any skill builder exercises. Assign LS–A to have students complete two skill builder exercises that reinforce drawing in AutoCAD using VM–I .dwg and VM–J .dwg files as directed. A list of video tutorials is provided in 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. c
2. a
3. f
4. b
5. e
6. d
7. g

Part Two: Completion

1. oval
2. axis-end
3. crosshairs
4. accurate
5. object snap tools
6. background
7. object snap

Part Three: Short Answer

Answers will vary and would be similar to the following. Draw commands are strings of text linked together to create a larger string of graphical instructions delivered to provide limits to CAD's dynamic texture drawing functions. Most drawings are created using basic draw commands. Draw commands create new objects and most technical drawings are produced from the basic draw commands: lines, circles, polylines, etc. To be efficient working in AutoCAD, operators need a strong understanding of draw commands. AutoCAD's 2D drawing tools are located on the draw menu of the home tab on the ribbon.

Sample Test

Name _____

Draw Commands: Using the Draw Menu

Part One: Matching

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

a. center
b. from
c. geometric center
d. intersection
e. midpoint
f. node
g. quadrant

_____1. An object snap that provides access to the centroid of any closed polylines and splines

_____2. An object snap that provides access to the closest middle of an arc, circle, ellipse, or elliptical arc

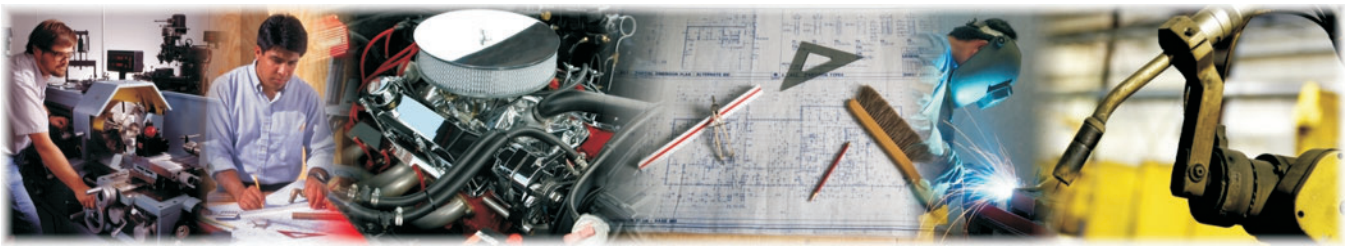
_____3. An object snap that finds the location of point objects, dimension definition points, and text origin points

_____4. An object snap that provides access to an area measured precisely from a temporary point selected on an object

_____5. An object snap that provides access to the closest center of a geometric object

_____6. An object snap that provides access to the closest physical junction (where objects cross each other) of any two geometric drawing objects

_____7. An object snap that provides access to the closest horizontal or vertical quarter of the point of an arc, ellipse, or elliptical arc



Part Two: Completion

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

1. The ellipse command creates a regular _____ shape by locating two points for the location and length of the first axis and a third point determines the distance between the center of the ellipse and the end point of the second axis.
2. There are three ellipse commands in AutoCAD: center, _____, and elliptical arc.
3. The object snap tool is a tool designed to lock the _____ onto a known precise location.
4. Since AutoCAD is accurate to the sixteenth decimal place, you are visually unable to rest the crosshairs at the endpoint or midpoint or any other point and expect to be _____ to any decimal place.
5. Holding down the shift key while selecting the right mouse button is one method to access the _____.
6. Running object snaps are object snap modes that run in the _____ during all drawing and editing procedures.
7. A tool designed to lock the crosshairs onto a known, precise location is a/an _____.

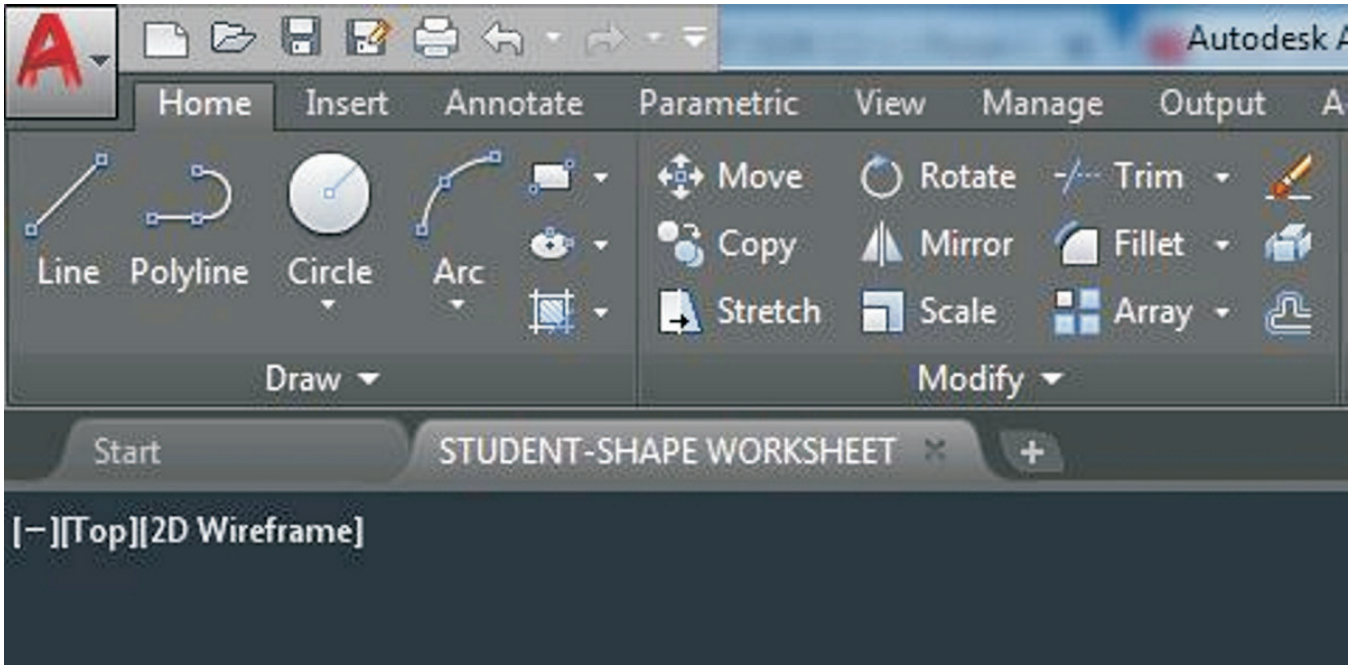
Part Three: Short Answer

Instructions: **Complete the following.**

Define and briefly describe AutoCAD's draw commands.

AUTOCAD'S DRAW MENU

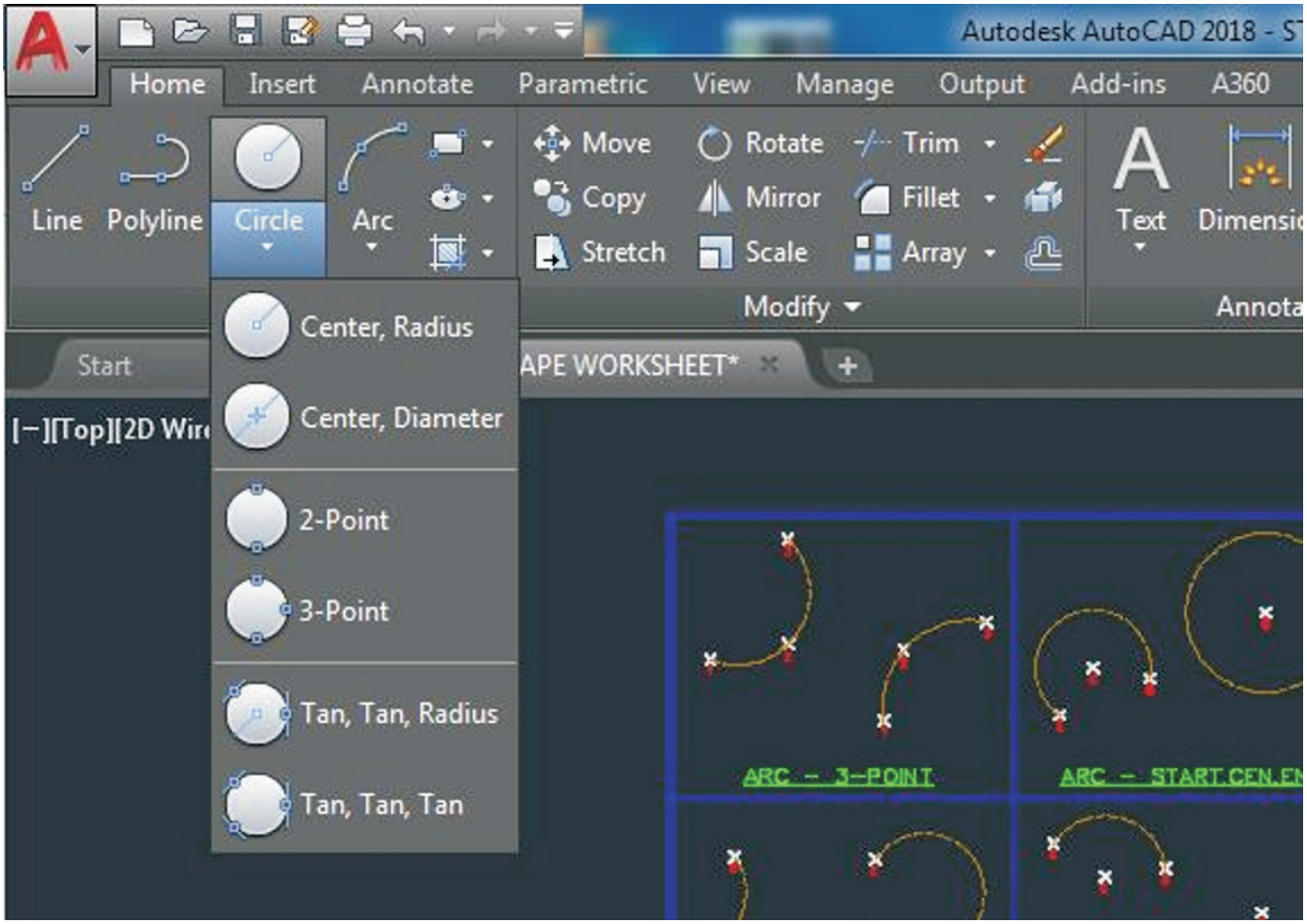
AutoCAD's draw menu is in located the home tab of the ribbon.



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

AUTOCAD CIRCLE COMMAND

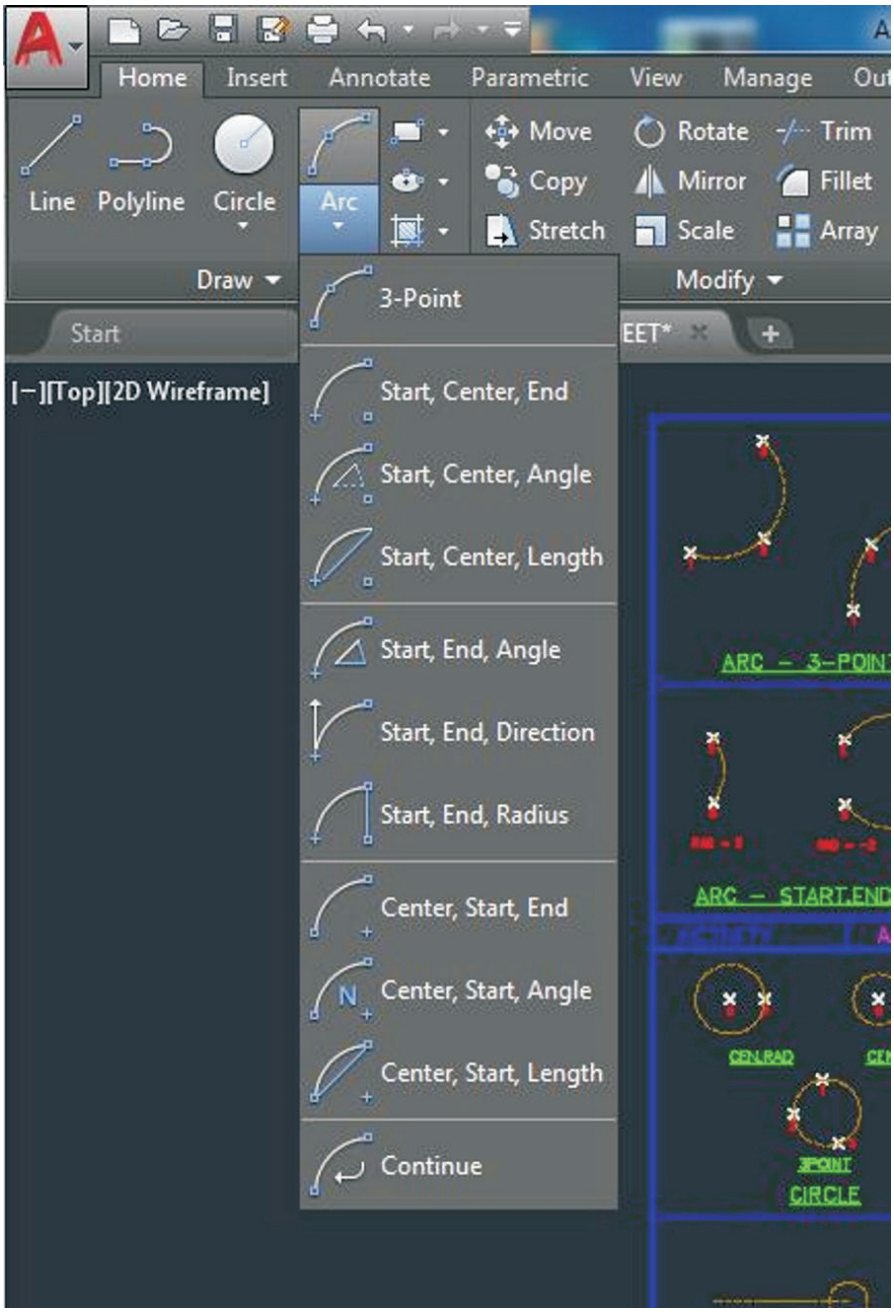
AutoCAD's circle command options are located in the draw menu in the home tab of the ribbon.



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

AUTOCAD ARC COMMAND

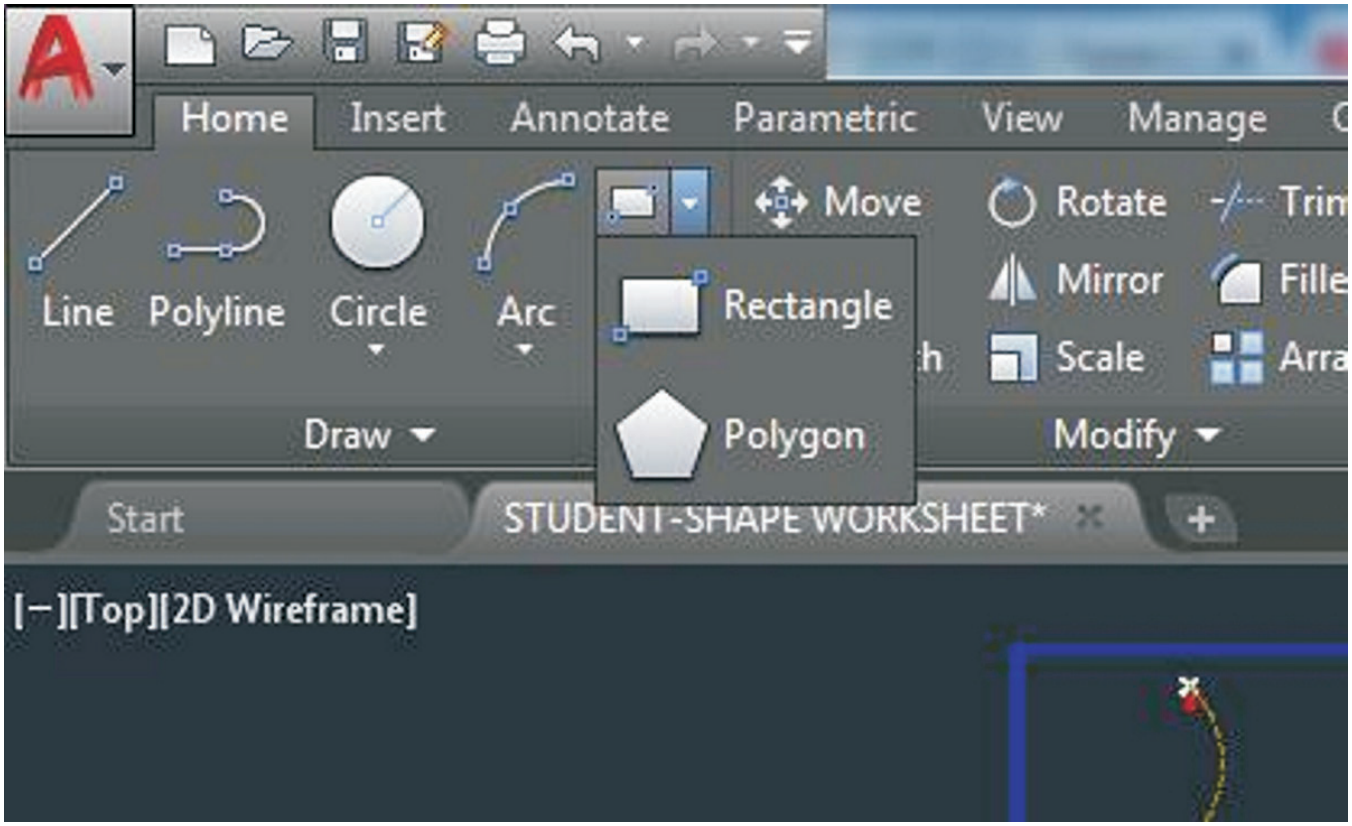
AutoCAD's arc command options are illustrated here.



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

AUTOCAD RECTANGLE AND POLYGON COMMANDS

AutoCAD's rectangle and polygon command icons are illustrated here.



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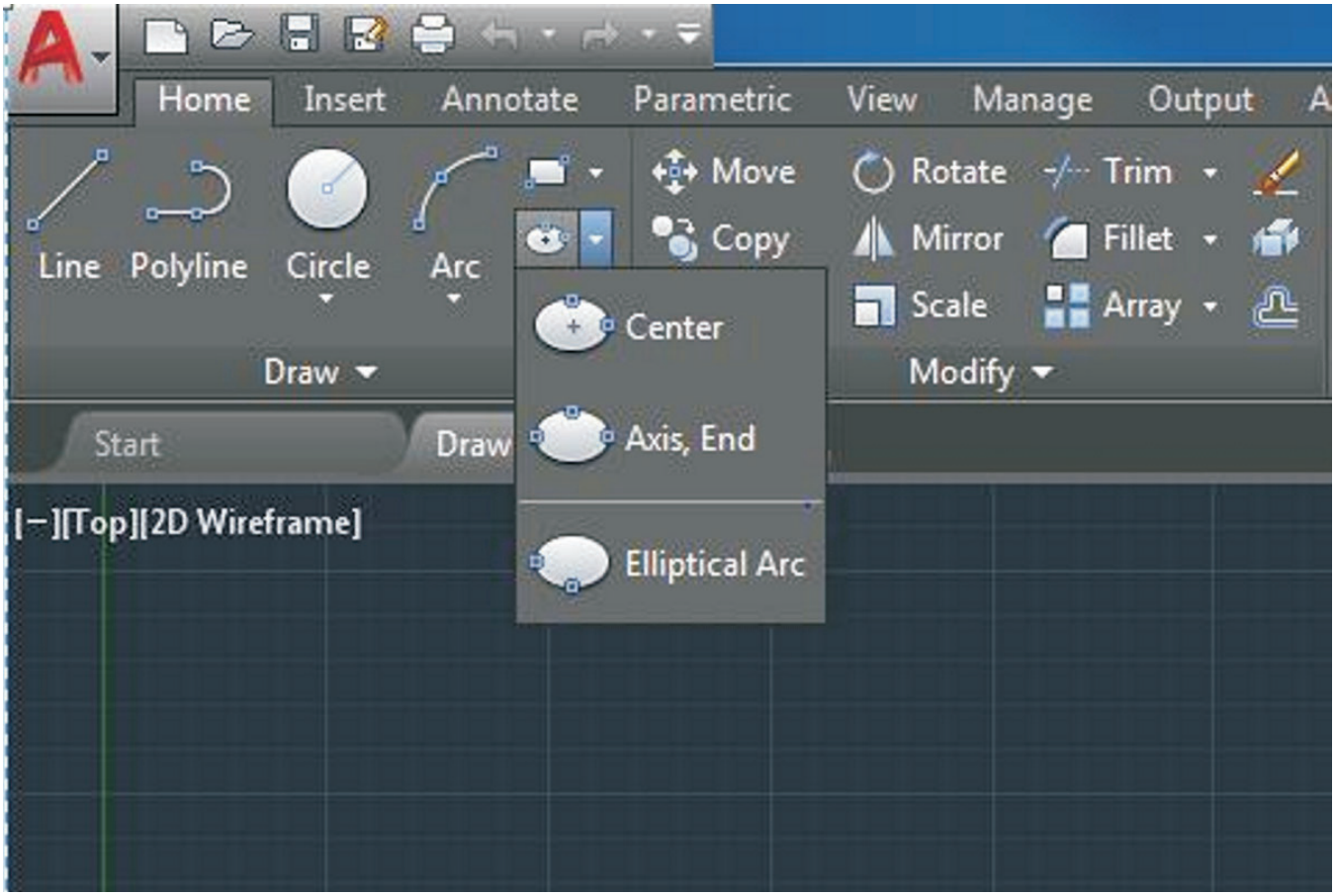
AUTOCAD ELLIPSE COMMAND OPTIONS

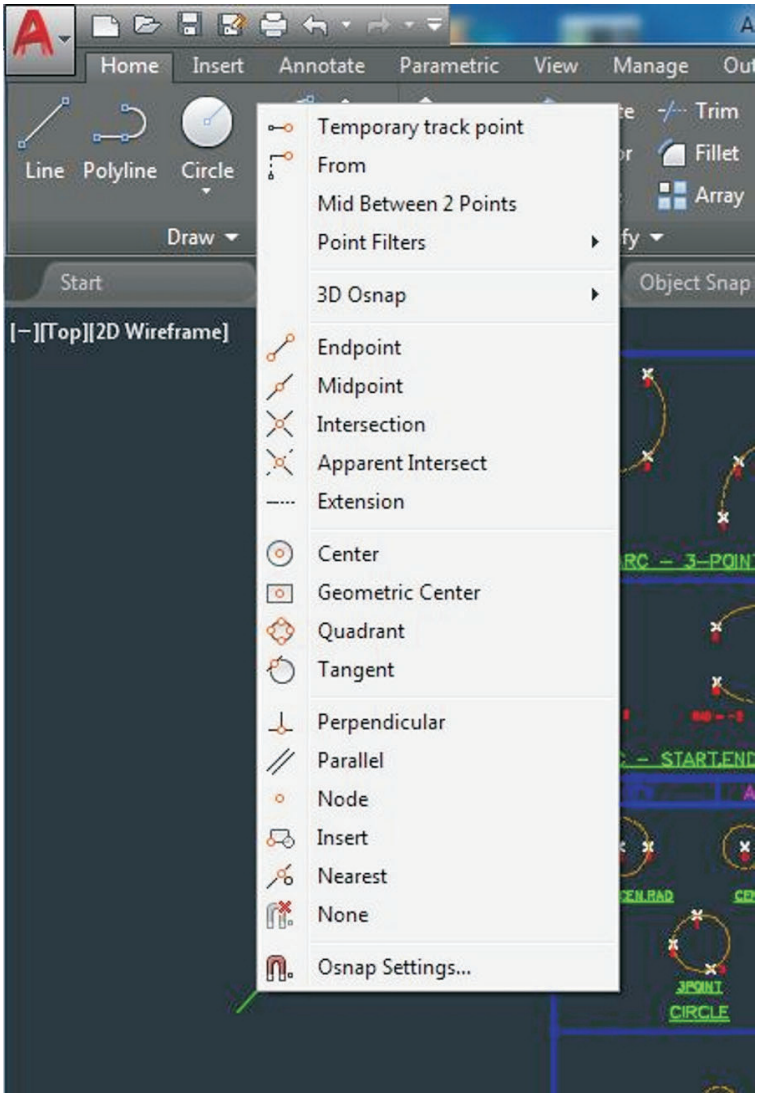
AutoCAD's ellipse command icons are highlighted here.



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

AUTOCAD SNAP TOOLS CONTEXT SENSITIVE POP-UP LIST

Holding down the shift key and selecting the right mouse button causes AutoCAD's context sensitive pop-up list of snap tools to appear.



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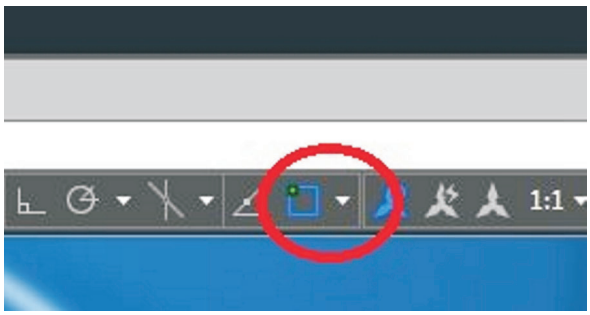
AUTOCAD SNAP TOOLS ICON POP-UP LIST

Note the down arrow to the right of the object snap tool icon and the pop-up list of snap tools that appear when you left-click on the down arrow.



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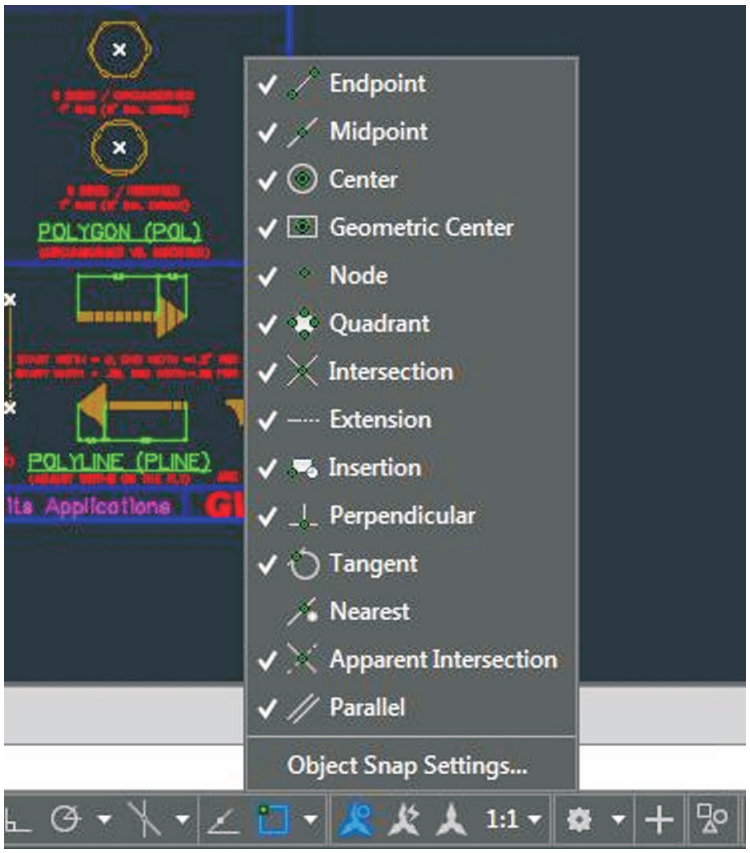
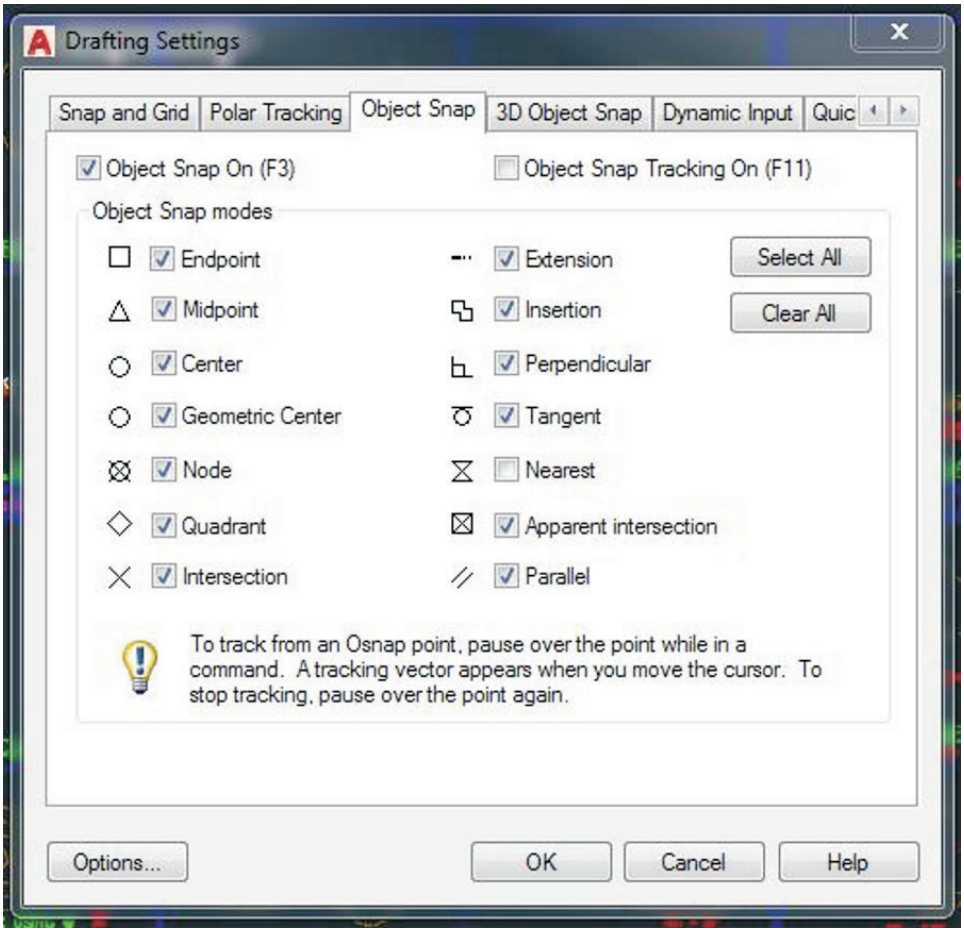


AUTOCAD DRAFTING SETTINGS DIALOG BOX DISPLAYING OBJECT SNAP TAB

This image shows the drafting settings dialog box with the object snap tab in the forefront and all the activated snap tools activated (those check marked) running in the background.



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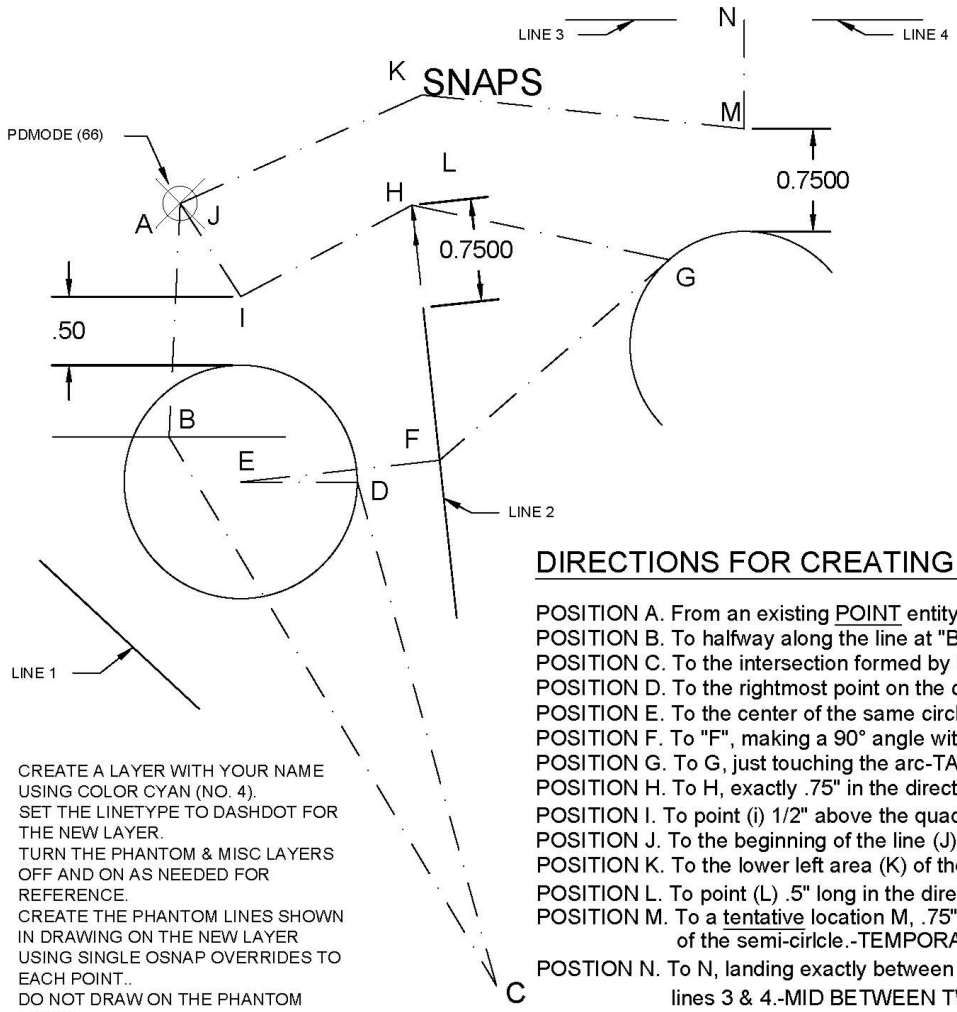
AUTOCAD SNAPS ILLUSTRATION

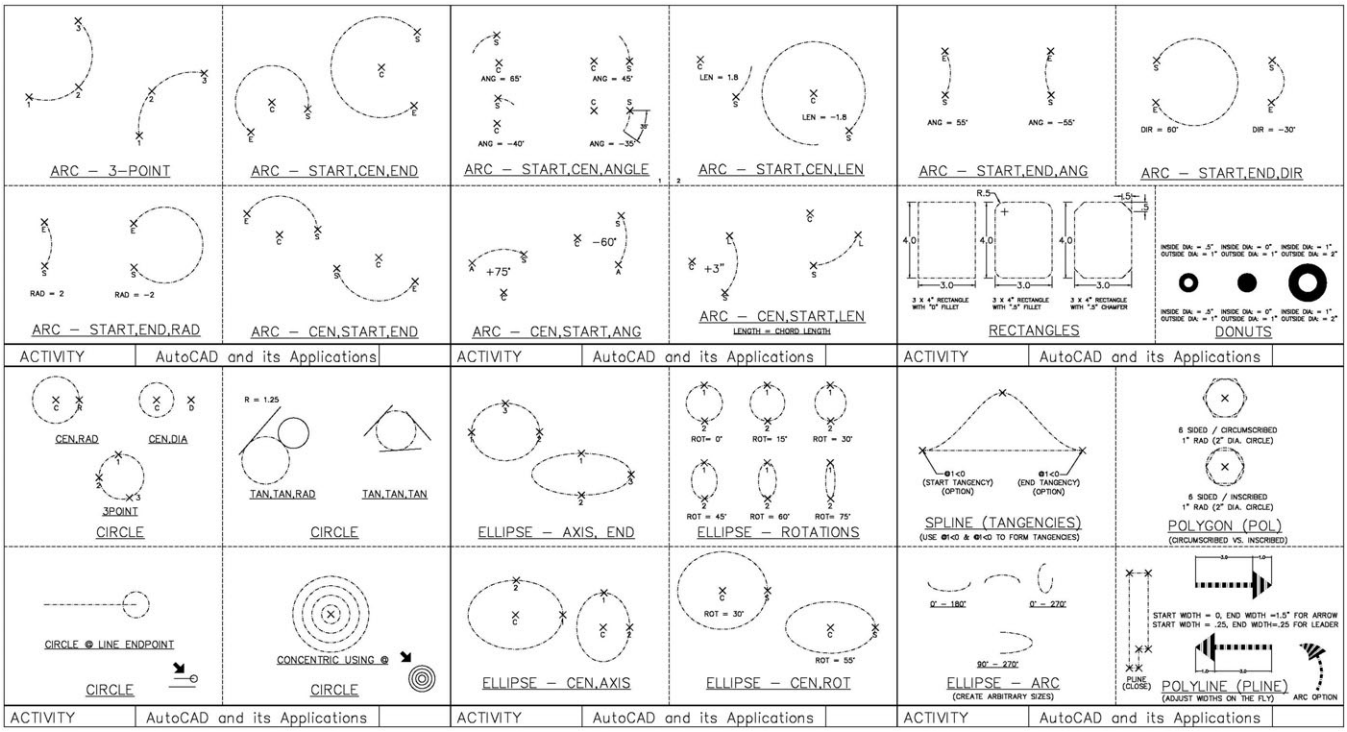


1. CREATE A LAYER WITH YOUR NAME USING COLOR CYAN (NO. 4).
2. SET THE LINETYPE TO DASHDOT FOR THE NEW LAYER.
5. TURN THE PHANTOM & MISC LAYERS OFF AND ON AS NEEDED FOR REFERENCE.
6. CREATE THE PHANTOM LINES SHOWN IN DRAWING ON THE NEW LAYER USING SINGLE OSNAP OVERRIDES TO EACH POINT..
7. DO NOT DRAW ON THE PHANTOM LAYER.

DIRECTIONS FOR CREATING THE PHANTOM LINE

POSITION A. From an existing POINT entity at "A"-NODE
POSITION B. To halfway along the line at "B"-MIDPOINT
POSITION C. To the intersection formed by lines 1 & 2 at "C"-APPARENT INTER
POSITION D. To the rightmost point on the circle at "D"-QUADRANT
POSITION E. To the center of the same circle at "E"-CENTER
POSITION F. To "F", making a 90° angle with line 2-PERPENDICULAR
POSITION G. To G, just touching the arc-TANGENT
POSITION H. To H, exactly .75" in the direction of line 2.-EXTENSION
POSITION I. To point (i) 1/2" above the quadrant of the circle-FROM
POSITION J. To the beginning of the line (J) you drew first-ENDPOINT
POSITION K. To the lower left area (K) of the letter "O" in Osnaps-INSERTION
POSITION L. To point (L) .5" long in the direction of line J-I-PARALLEL.
POSITION M. To a tentative location M, .75" above the quadrant of the semi-cirlcle.-TEMPORARY TRACKING POINT
POSTION N. To N, landing exactly between the endpoints of lines 3 & 4.-MID BETWEEN TWO POINTS

AUTOCAD SHAPES ILLUSTRATIONS



LS–A

Name _____

Use AutoCAD Drawing Commands and Object Snap Tools to Create Geometry

Purpose:

The purpose of this learning activity is to draw basic 2D shapes using AutoCAD's draw commands and object snap tools.

Objectives:

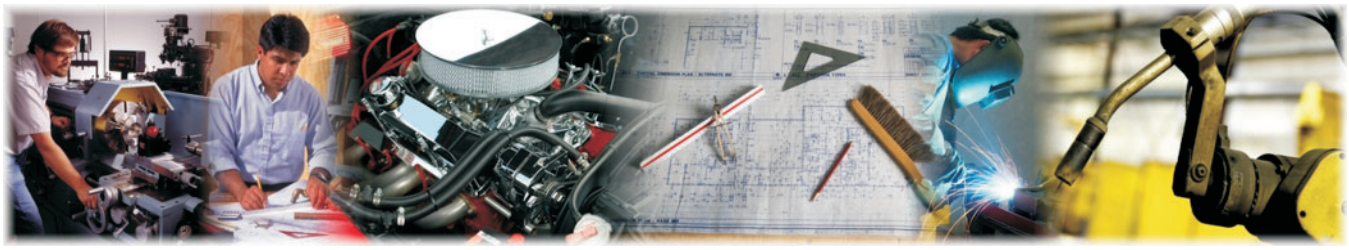
1. Use AutoCAD draw commands as needed to draw basic 2D shapes illustrated in two skill builder exercises.
2. Use AutoCAD object snap tools as needed to draw the basic 2D shapes illustrated in two skill builder exercises.

Materials:

- lab sheet
- computer with Internet access and the AutoCAD program
- VM–I.dwg worksheet
- VM–J.dwg worksheet

Procedure:

1. Open the skill builder exercises in AutoCAD: VM–I shape worksheet and VM–J object snap worksheets with .dwg extensions. Complete each drawing.



2. Use your notes and the following YouTube tutorial videos to aid in creating geometry using draw commands.

   a. "AutoCAD Student Shape Worksheet Drawing Arc Command," *Smith YouTube Channel* at https://www.youtube.com/watch?v=_LN1gtuFjNQ&t=18s.
   b. "AutoCAD Student Shape Worksheet Drawing Rectangle Command," *Smith YouTube Channel*, at https://www.youtube.com/watch?v=SHU8qwXJ7jM&t=5s.
   c. "AutoCAD Student Shape Worksheet Polyline Command," *Smith YouTube Channel,* at https://www.youtube.com/watch?v=SIfbt47-H3I&t=12s.
   d. "AutoCAD Student Shape Worksheet Drawing Polygon Command," *Smith YouTube Channel,* at https://www.youtube.com/watch?v=mv7QG5HcIYE&t=1s.
   e. "AutoCAD Student Shape Worksheet Drawing Spline Tangency Command," *Smith YouTube Channel*, at https://www.youtube.com/watch?v=OQiunSEeWLw&t=2s.
   f. "AutoCAD Shape Worksheet Drawing Ellipse Command," *Smith YouTube Channel*, at https://www.youtube.com/watch?v=rongZe4Q3iU&t=13s.

3. Use your notes and the following YouTube video tutorial to aid in using the object snap tools: "AutoCAD Running Object Snap Tools," *Smith YouTube Channel*, at https://www.youtube.com/watch?v=wRqfrr0O91w.

4. Turn your completed worksheets/drawings in to your instructor via your class method of submission.

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1. The VM–I and VM–J files, with a .dwg extension, are AutoCAD files that you may use to teach the lesson plan objectives. Students will need copies of the .dwg AutoCAD file to complete the LS–A tasks.
2. Project VM–I and VM–J to respond to initial student questions about the two drawing assignments.