Chapter 5
Orthographic Views in Multiview Drawings

Learning Objectives

- Create 2D orthographic views using AutoCAD
- Using the CONSTRUCTION LINE command to draw
- Using Running Object Snaps
- Use AutoCAD’s AutoSnap and AutoTrack features
- Create a Miter line to transfer dimensions
- Using Projection lines between orthographic views
- Use the POLAR Tracking option
AutoCAD Certified User Examination Objectives Coverage

This table shows the pages on which the objectives of the Certified User Examination are covered in Chapter 5.

Section 2: Creating Basic Drawings
- Construction Line ............................................................. 5-6
- Running Object Snaps ...................................................... 5-8
- Object Snap Tracking ...................................................... 5-12
- Snap From ........................................................................ 5-15
- Miter line Method ........................................................... 5-18

Section 3: Manipulating Objects
- Trim .................................................................................. 5-11

Section 4: Drawing Organization and Inquiry Commands
- Layers Properties ............................................................ 5-5
- List Command ................................................................. 5-25
- Properties Command ....................................................... 5-26

Section 5: Altering Objects
- Offset Command .............................................................. 5-6
Introduction

Most drawings produced and used in industry are multiview drawings. Multiview drawings are used to provide accurate three-dimensional object information on two-dimensional media, a means of communicating all of the information necessary to transform an idea or concept into reality. The standards and conventions of multiview drawings have been developed over many years, which equip us with a universally understood method of communication. The age of computers has greatly altered the design process, and several CAD methods are now available to help generate multiview drawings using CAD systems.

Multiview drawings usually require several orthographic views to define the shape of a three-dimensional object. Each orthographic view is a two-dimensional drawing showing only two of the three dimensions of the three-dimensional object. Consequently, no individual view contains sufficient information to completely define the shape of the three-dimensional object. All orthographic views must be looked at together to comprehend the shape of the three-dimensional object. The arrangement and relationship between the views are therefore very important in multiview drawings. In this chapter, the common methods of creating two-dimensional orthographic views with AutoCAD are examined.

The Locator Design
The *Locator Part*

Before going through the tutorial, make a rough sketch of a multiview drawing of the part. How many 2D views will be necessary to fully describe the part? Based on your knowledge of AutoCAD 2015 so far, how would you arrange and construct these 2D views? Take a few minutes to consider these questions and do preliminary planning by sketching on a piece of paper. You are also encouraged to construct the orthographic views on your own prior to following through the tutorial.

**Starting Up AutoCAD 2015**

1. Select the *AutoCAD 2015* option on the *Program* menu or select the *AutoCAD 2015* icon on the *Desktop*.

2. In the *Startup* dialog box, select the *Start from Scratch* option with a single click of the left-mouse-button.

3. In the *Default Settings* section, pick *Imperial* as the drawing units.

4. On your own, open up the *Drafting Settings* dialog box, and select the *SNAP and GRID* tab.

5. Change *Grid Spacing* to *0.5* for both X and Y directions.

6. Also adjust the *Snap Spacing* to *0.5* for both X and Y directions.
Layers Setup

1. Pick **Layer Properties Manager** in the **Layers** toolbar.

2. Click on the **New** icon to create new layers.

3. Create two **new** layers with the following settings:

<table>
<thead>
<tr>
<th>Layer</th>
<th>Color</th>
<th>Linetype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>White</td>
<td>Continuous</td>
</tr>
<tr>
<td>Object</td>
<td>Blue</td>
<td>Continuous</td>
</tr>
</tbody>
</table>

4. Highlight the layer **Construction** in the list of layers.

5. Click on the **Current** button to set layer **Construction** as the **Current Layer**.

6. Click on the **Close** button to accept the settings and exit the **Layer Properties Manager** dialog box.

7. In the **Status Bar** area, reset the option buttons so that only **SNAP Mode** and **GRID Display** are switched **ON**.

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_Snip of the dialog box showing layer settings._
Drawing Construction Lines

- Construction lines are lines that extend to infinity. Construction lines are usually used as references for creating other objects. We will also place the construction lines on the Construction layer so that the layer can later be frozen or turned off.

1. Select the Construction Line icon in the Draw toolbar. In the command prompt area, the message "_xline Specify a point or [Hor/Ver/Ang/Bisect/Offset]:" is displayed.
   - To orient construction lines, we generally specify two points. Note that other orientation options are also available.

2. Select a location near the lower left corner of the Drawing Area. It is not necessary to align objects to the world coordinate origin. CAD systems provide us with many powerful tools to manipulate geometry. Our main goal is to use the CAD system as a flexible and powerful tool, and to be very efficient and effective with the systems.

3. Pick a location above the last point to create a vertical construction line.

4. Move the cursor toward the right of the first point and pick a location to create a horizontal construction line.

5. Inside the Drawing Area, right-mouse-click to end the Construction Line command.

6. In the Status Bar area, turn OFF the SNAP option.

Using the OFFSET Command

1. Select the Offset icon in the Modify toolbar. In the command prompt area, the message "Specify offset distance or [Through/Erase/Layer]:" is displayed.

2. In the command prompt area, enter: 5.0 [ENTER].

3. In the command prompt area, the message "Select object to offset or <exit>:" is displayed. Pick the vertical line on the screen.
4. AutoCAD next asks us to identify the direction of the offset. Pick a location that is to the **right** of the vertical line.

5. Inside the Drawing Area, **right-mouse-click** and choose **Enter** to end the **Offset** command.

6. In the command prompt area, click on the small **triangle icon** to access the list of recent commands.

7. Select **Offset** in the popup list, to repeat the **Offset** command.

8. In the command prompt area, enter: **2.5 [ENTER]**.

9. In the command prompt area, the message "**Select object to offset or <exit>:**" is displayed. Pick the **horizontal line** on the screen.

10. AutoCAD next asks us to identify the direction of the offset. Pick a location that is **above** the horizontal line.

11. Inside the Drawing Area, **right-mouse-click** to end the **Offset** command.

12. Repeat the **Offset** command and create the offset lines as shown.
Set Layer *Object* as the Current Layer

1. On the *Layers* toolbar panel, choose the *Layer Control* box with the left-mouse-button.

2. Move the cursor over the name of the layer *Object*. The tool tip "Object" appears.

3. Left-mouse-click once on the layer *Object* to set it as the *Current Layer*.

Using the Running Object Snaps

In *AutoCAD 2015*, while using geometry construction commands, the cursor can be placed to points on objects such as endpoints, midpoints, centers, and intersections. In *AutoCAD*, this tool is called the *Object Snap*.

Object snaps can be turned on in one of two ways:
- **Single Point (or override) Object Snaps**: Sets an object snap for one use.
- **Running Object Snaps**: Sets object snaps active until we turn them off.

The procedure we have used so far is the Single Point Object Snaps option, where we select the specific object snap from the Object Snap toolbar for one use only. The use of the Running Object Snaps option to assist the construction is illustrated next.

1. In the *Menu Bar*, select:

   ![Tools] → [Drafting Settings]
2. In the *Drafting Settings* dialog box select the **Object Snap** tab.

The *Running Object Snap* options can be turned on or off by clicking the different options listed. Notice the different symbols associated with the different *Object Snap* options.

3. Turn **ON** the *Running Object Snap* by clicking the **Object Snap On** box, or hit the [F3] key once.

4. Confirm the *Intersection, Endpoint* and *Extension* options are switched **ON** and click on the **OK** button to accept the settings and exit from the *Drafting Settings* dialog box.

   Notice in the *Status Bar* area the **OSNAP** button is switched **ON**. We can toggle the *Running Object Snap* option on or off by clicking the **OSNAP** button.

5. Press the [F3] key once and notice the **OSNAP** button is switched **OFF** in the *Status Bar* area.

6. Press the [F3] key again and notice the **OSNAP** button is now switched **ON** in the *Status Bar* area.

   ➤ *AutoCAD 2015* provides many input methods and shortcuts; you are encouraged to examine the different options and choose the option that best fits your own style.
Creating Object Lines

We will define the areas for the front view, top view and side view by adding object lines using the Running Object Snap option.

1. Select the Line command icon in the Draw toolbar. In the command prompt area, the message "_line Specify first point:" is displayed.

2. Move the cursor to the intersection of any two lines and notice the visual aid automatically displayed at the intersection.

3. Pick the four intersection points closest to the lower left corner to create the four sides of the area of the front view.

4. Inside the Drawing Area, right-mouse-click once to activate the option menu and select Enter with the left-mouse-button to end the Line command.

5. Repeat the Line command to define the top view and side view as shown.
Turn OFF the Construction Lines Layer

1. On the Object Properties toolbar, choose the Layer Control box with the left-mouse-button.

2. Move the cursor over the light-bulb icon for layer Construction. The tool tip “Turn a layer On or Off” appears.

3. Left-mouse-click once on the light-bulb icon and notice the icon color is changed to gray color, representing the layer (layer Construction) is turned OFF.

Adding More Objects in the Front View

1. Use the Offset command and create the two parallel lines in the front view as shown.

2. Use the Trim command and modify the front view as shown.
AutoCAD’s *AutoSnap™* and *AutoTrack™* Features

AutoCAD’s *AutoSnap* and *AutoTrack* provide visual aids when the *Object Snap* options are switched *on*. The main advantages of *AutoSnap* and *AutoTrack* are as follows:

- **Symbols**: Automatically displays the *Object Snap* type at the object snap location.
- **Tooltips**: Automatically displays the *Object Snap* type below the cursor.
- **Magnet**: Locks the cursor onto a snap point when the cursor is near the point.

With *Object Snap Tracking*, the cursor can track along alignment paths based on other object snap points when specifying points in a command. To use *Object Snap Tracking*, one or more object snaps must be switched on. The basic rules of using the *Object Snap Tracking* option are as follows:

- To track from a *Running Object Snap* point, pause over the point while in a command.
- A tracking vector appears when we move the cursor.
- To stop tracking, pause over the point again.
- When multiple *Running Object Snaps* are on, press the `[TAB]` key to cycle through available snap points when the object snap aperture box is on an object.

1. In the *Status Bar* area, turn **ON** the *OTRACK/AUTOSNAP* option.

2. Select the **Line** command icon in the *Draw* toolbar. In the command prompt area, the message "*line Specify first point:*" is displayed.
3. Move the cursor near the top right corner of the vertical protrusion in the front view. Notice that AUTOSNAP automatically locks the cursor to the corner and displays the *Endpoint* symbol.

4. Move the cursor upward and notice that *Object Tracking* displays a dashed line, showing the alignment to the top right corner of the vertical protrusion in the front view. Move the cursor near the top horizontal line of the top view and notice that AUTOSNAP displays the intersection point.

5. Left-mouse-click to place the starting point of a line at the intersection.
6. Move the cursor to the top left corner of the front view to activate the tracking feature.

7. Create the line as shown in the above figure.

Adding More Objects in the Top View

1. Use the Offset command and create the two parallel lines in the top view as shown.

2. On your own, select [Tools] \(\rightarrow\) [Toolbars] \(\rightarrow\) [Object Snap] to display the Object Snap toolbar on the screen.
3. Select the **Line** command icon in the **Draw** toolbar. In the command prompt area, the message "*line Specify first point:*" is displayed.

4. In the **Object Snap** toolbar, pick **Snap From**. In the command prompt area, the message "*from Base point*" is displayed. AutoCAD now expects us to select a geometric entity on the screen.

➤ The **Single Point Object Snap** overrides the **Running Object Snap** option.

5. We will measure relative to the lower right corner. Pick the corner as shown.

6. In the command prompt area, enter @**0,0.25** [ENTER].

7. In the **Object Snap** toolbar, pick **Snap From**. Pick the lower right corner of the top view again.

8. In the command prompt area, enter @**-1.75,0** [ENTER].

9. Inside the Drawing Area, right-mouse-click to activate the option menu and select **Enter** with the left-mouse-button to end the **Line** command.
10. Repeat the procedure and create the line on the top right corner as shown.

11. Using the *Snap From* option, create the circle (diameter 1.0) as shown.

12. Select the **Trim** icon in the *Modify* toolbar. In the command prompt area, the message “*Select boundary edges... Select objects:*” is displayed.

13. Pick the following objects as boundary edges: the circle, and the lines that are near the circle.

14. Inside the *Drawing Area*, **right-mouse-click** to accept the selected objects.
15. Select the unwanted portions and modify the objects as shown.

16. On your own, use the **Offset** and **Trim** commands and modify the top view as shown.
Drawing Using the *Miter Line Method*

- The 45° *miter line* method is a simple and straightforward procedure to transfer measurements in between the top view and the side view.

1. On the *Layers* toolbar panel, choose the *Layer Control* box by clicking once with the left-mouse-button.

2. Move the cursor over the *light-bulb* icon for layer *Construction*. The tool tip “*Turn a layer On or Off*” appears.

3. **Left-mouse-click once** and notice the icon color is changed to a light color, representing the layer (layer *Construction*) is turned *ON*.

4. **Left-mouse-click once** over the name of the layer *Construction* to set it as the *Current Layer*.

5. Use the *Line* command and create the *miter line* by connecting the two intersections of the construction lines as shown.
6. Select the **Construction Line** command in the **Draw** toolbar as shown.

7. In the **command prompt area**, select the **Horizontal** option as shown.

8. On your own, create horizontal projection lines through all the corners in the top view as shown.

9. Use the **Trim** command and trim the projection lines as shown in the figure below.

10. On your own, create additional Construction Lines (use the *vertical* option) through all the intersection points that are on the *miter line*. 
More Layers Setup

1. Pick Layer Properties Manager in the Layers toolbar panel as shown in the figure below.

![Layer Properties Manager](image)

2. Click on the New icon to create new layers.

3. Create two new layers with the following settings:

<table>
<thead>
<tr>
<th>Layer</th>
<th>Color</th>
<th>Linetype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hidden</td>
<td>Cyan</td>
<td>HIDDEN</td>
</tr>
<tr>
<td>Center</td>
<td>Red</td>
<td>CENTER</td>
</tr>
</tbody>
</table>

- The default linetype is Continuous. To use other linetypes, click on the Load button in the Select Linetype dialog box and select the desired linetypes.

![Select Linetype](image)

4. On your own, set the layer Object as the Current Layer.
Top View to Side View Projection

1. Using the Running Object Snaps, create the necessary object-lines in the side view.

2. Set layer Hidden as the Current Layer and create the two necessary hidden lines in the side view.

3. Set layer Center as the Current Layer and create the necessary centerlines in the side view.
4. In the Layer Control box, turn **OFF** the *construction lines*.

5. Set layer **Object** as the *Current Layer*.

6. Use the **Line** command and create the two 30° inclined lines as shown.

   (Hint: Relative coordinate entries of @2.0<-30 and @2.0<210.)

7. Use the Line command and create a horizontal line in the side view as shown.

8. On your own, use the **Trim** command and remove the unwanted portions in the side view. Refer to the image shown on the next page if necessary.
Completing the Front View

1. Select the **Line** command icon in the *Draw* toolbar. In the command prompt area, the message "_.line Specify first point:" is displayed.

2. Move the cursor to the top left corner in the side view and the bottom left corner in the top view to activate the *Object Tracking* option to both corners.

3. Left-mouse-click once when the cursor is aligned to both corners as shown.

4. Create the **horizontal line** as shown.
5. Repeat the procedure and create the lines in the front view as shown.

6. Add in any additional object lines that are necessary.

7. Set layer *Hidden* as the *Current Layer* and create the necessary hidden lines in the front view.

8. Set layer *Center* as the *Current Layer* and create the necessary centerlines in the top view and front view.
Object Information Using the LIST Command

- AutoCAD provides several tools that will allow us to get information about constructed geometric objects. The LIST command can be used to show detailed information about geometric objects.

1. Move the cursor to the side view and select the inclined line on the right, as shown in the figure.

2. In the Properties toolbar, click on the List icon to activate the command.

- Note the information regarding the selected object is displayed in the AutoCAD Text Window as shown.

3. Press the [F2] key once to close the AutoCAD Text Window.

4. Press the [Esc] key once to deselect the selected line.
Object Information Using the PROPERTIES Command

- AutoCAD also provides tools that allow us to display and change properties of constructed geometric objects. The Properties command not only provides the detailed information about geometric objects, modifications can also be done very quickly.

1. In the Ribbon tabs area, left-mouse-click once on the View tab as shown.

2. In the Palettes toolbar, click on the Properties icon to activate the command.

3. Note the Properties panel appears on the screen. The "No selection" on top of the panel indicates no object has been selected.

4. Move the cursor to the side view and select the inclined line on the right, as shown in the figure.

5. The geometry information is listed at the bottom section. Note the line length is 1.1547 and at the angle of 330 degrees.
Review Questions: (Time: 20 minutes)

1. Explain what an orthographic view is and why it is important to engineering graphics.

2. What does the Running Object Snaps option allow us to do?

3. Explain how a miter line can assist us in creating orthographic views.

4. Describe the AutoCAD AUTO SNAP and AutoTrack options.

5. List and describe two AutoCAD commands that can be used to get geometric information about constructed objects.

6. List and describe two options you could use to quickly create a 2-inch line attached to a 2-inch circle, as shown in the below figure.

7. What are the length and angle of the inclined line, highlighted in the figure below, in the top view of the Locator design?
Exercises: (Time: 120 minutes)
(Unless otherwise specified, dimensions are in inches.)

1. Saddle Bracket

2. Anchor Base
3. Bearing Base

4. Shaft Support (Dimensions are in Millimeters.)
5. Connecting Rod

6. Tube Hanger