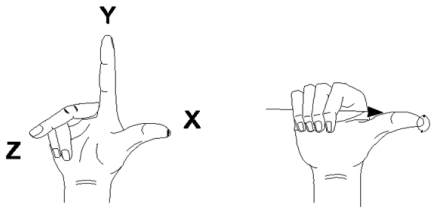
Control the Workplane



This tutorial outlines the procedures to understand and control the user coordinate system (UCS). You can realign and reorient the UCS to create and modify 3D objects on 2D workplanes and rotate objects in 3D.

Audience: Users new to 3D modeling in AutoCAD 2011

Prerequisites: Working knowledge of 2D drafting

Time to complete: 15 minutes

Objectives

- Understand the use of coordinates in 3D
- Reorient the UCS to rotate objects
- Work with the dynamic UCS

Tutorial Files

All necessary files for this tutorial are located at *http://www.autodesk.com/autocad-tutorials*.

Recommended: Before starting the tutorials

1 Download the *control_workplane.zip* from *http://www.autodesk.com/autocad-tutorials*.

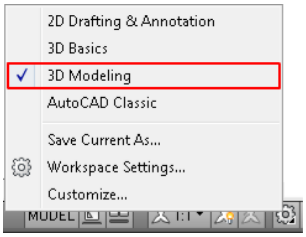
2 Unzip *control_workplane.zip* to *C:\My Documents\Tutorials*.

Before Starting This Tutorial

To switch to a 3D Modeling workspace

1 On the status bar, at the bottom of the drawing area, click the Workspace Switching button.

2 On the Workspace menu, click 3D Modeling.



The 3D Modeling workspace is displayed. The Workspaces icon in the status bar indicates that you are now in the 3D Modeling workspace. In this workspace, you can access the various commands and tools needed for creating 3D drawings.

NOTE For more information about switching workspaces, see the *AutoCAD User's Guide* or refer to the AutoCAD 2009 tutorial: *Switching Workspaces in AutoCAD 2009*.

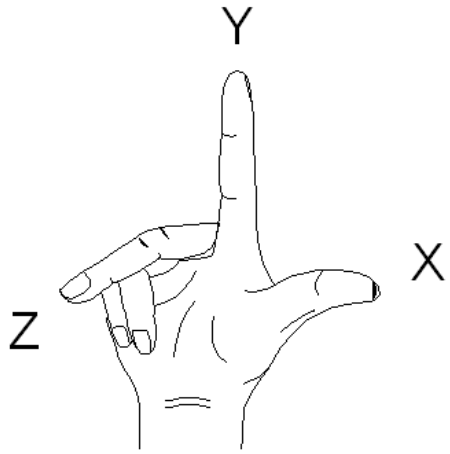
Lesson 1: Work with Coordinates

The coordinates of the world coordinate system(WCS) define the location of all objects and the standard views of AutoCAD drawings. However, WCS are permanent and invisible. It cannot be moved or rotated.

AutoCAD provides a movable coordinate system called the user coordinate system(UCS). The XY plane of the UCS is called the workplane. In a drawing,

by default WCS and UCS have the same orientation. When you create and modify objects in a 3D environment, you can move and reorient the UCS in 3D modeling view.

Use the right-hand rule to determine the positive axis direction of the Z axis. By rotating your hand, see how the X, Y, and Z axes rotate as you change the UCS.

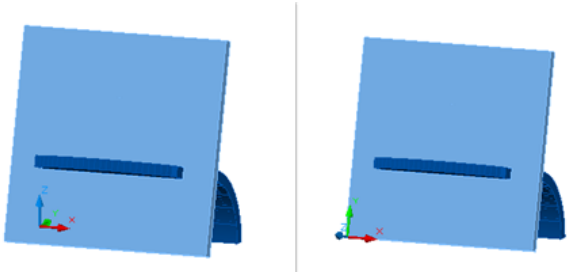


In this lesson, you will learn how to:

- Align the workplane with the face of an object
- Create and modify objects on the workplane of the current UCS

File Name: *41 Stand.dwg*

To align the workplane with the face of a 3D object



The left image shows the user coordinate system not aligned to the face plate of the 3D object and the right image shows

the user coordinate system aligned to the face plate of the 3D object.

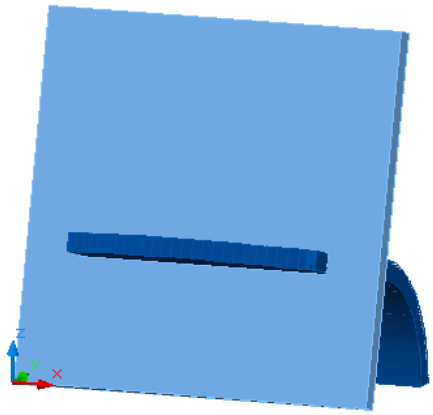
To construct objects on the face of the desk stand in the sample file, align the XY plane (workplane) of the UCS with the face of the desk stand.

1 Click ➤ Open.

2 In the Select File dialog box, browse to *C:\My Documents\Tutorials* and select *41 Stand.dwg*.

3 Click Open.

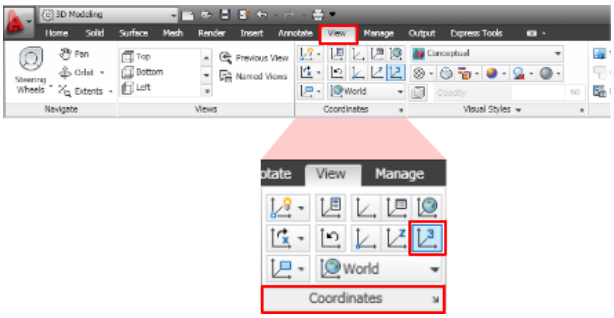
The UCS icon is displayed at the origin (0,0,0) of the current coordinate system.



By convention, the X axis is red, the Y axis is green, and the Z axis is blue. The crosshairs use the same colors to represent the directions of the axes.

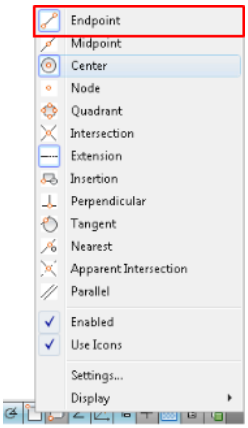
4 On the status bar, click the Dynamic UCS button to turn it off.

5 On the ribbon, click View tab ➤ Coordinates panel ➤ 3-Point.

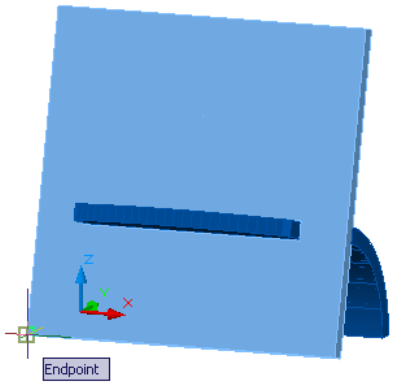


6 On the left half of the status bar, click Object Snap button to enable object snap mode.

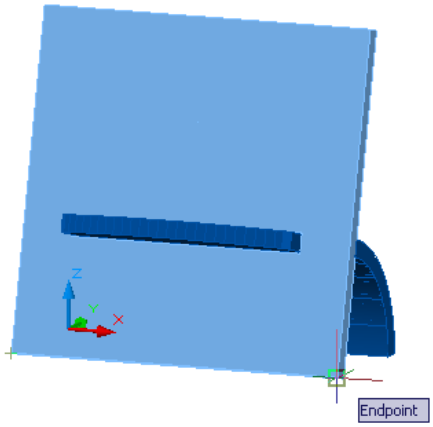
7 Right-click the object snap button and click Endpoint to turn it on. The Endpoint option should now have a box around its icon which indicates that the object snap is enabled.



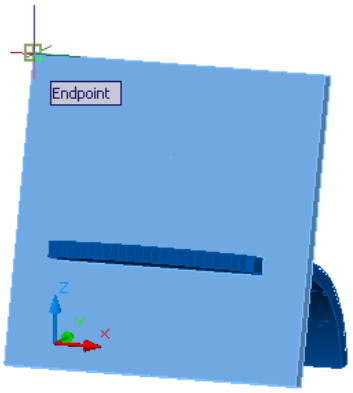
8 At the prompt, specify the endpoint of the lower-left corner of the face plate as the new origin point.



9 At the prompt, specify the lower-right corner of the face plate.

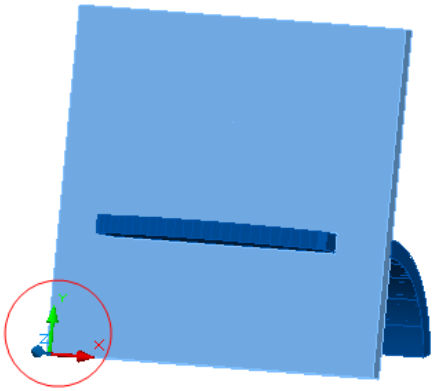


10 At the prompt, specify the endpoint of the upper-left corner of the face plate.



TIP You can use Zoom on the SteeringWheels tool to magnify the edges of the model that are in close proximity to each other. For more information on SteeringWheels, see the *AutoCAD User's Guide*. Refer to the AutoCAD 2009 tutorial: *Navigating a Model with Steering Wheels*.

The XY plane (workplane) of the UCS is now aligned to the face of the desk stand with the origin point (0,0,0) located in the bottom-left corner.

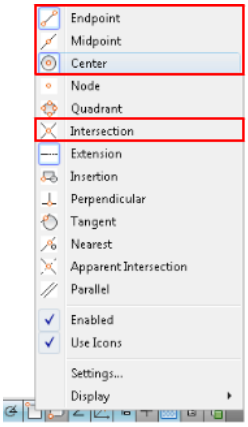


To create and modify objects when the workplane is aligned to the face of a 3D object

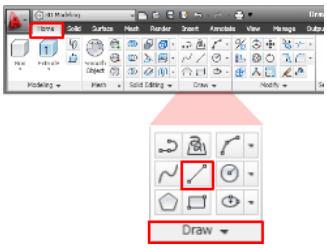
On the same drawing *41 Stand.dwg*. do the following:

1 On the left half of the status bar, click Ortho to turn it on.

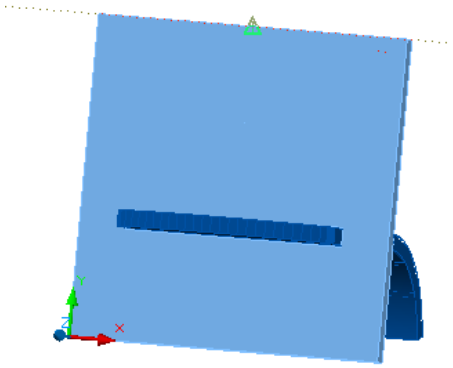
2 Right-click the Object Snap button and click Endpoint, Midpoint, Intersection, and Center to turn them on.



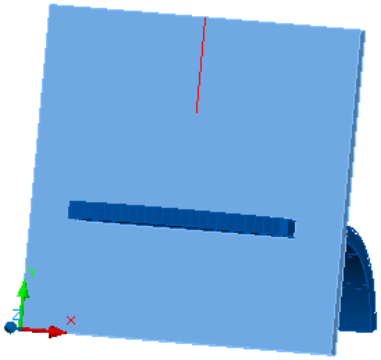
3 On the ribbon, click Home tab ➤ Draw panel ➤ Line.



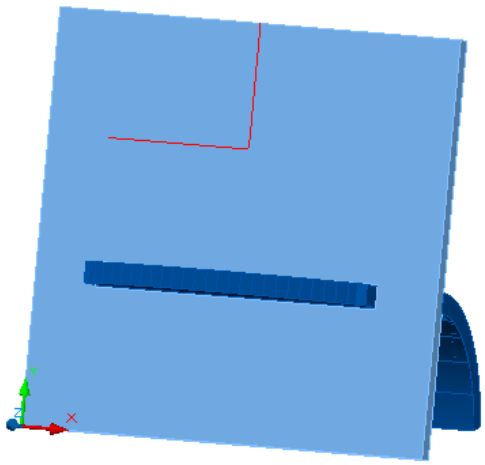
4 To specify first point, select the midpoint of the top edge of the face plate.



5 At the prompt, enter **@30<270** and press Enter.



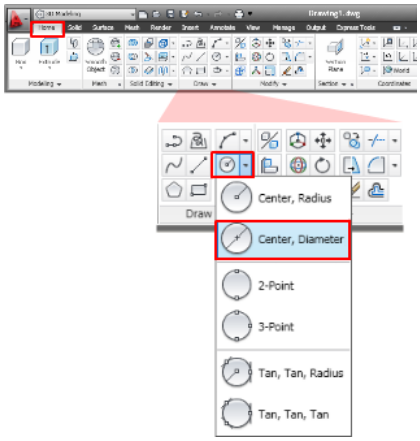
6 At the prompt, enter **@35<180 and** press Enter. This creates a 35 mm line that extends to the left at a 180-degree angle.



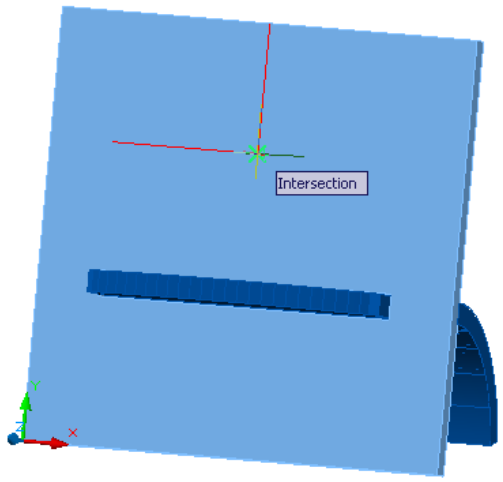
7 Press Enter to end the command.

NOTE To change the line color, select the lines, right-click and click Properties. In the Properties palette, under General, select Color and change it to red.

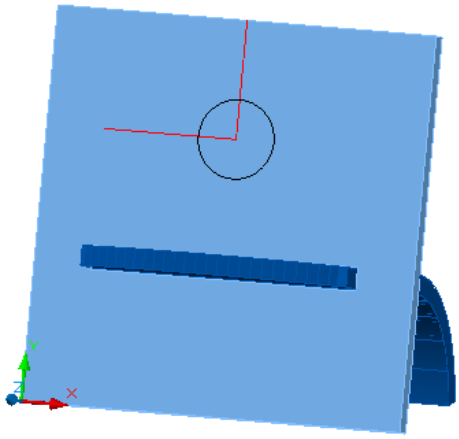
8 On the ribbon, click Home tab ➤ Draw panel ➤ Circle drop-down ➤ Center, Diameter.



9 Select the intersection between the two lines as the center point for circle.

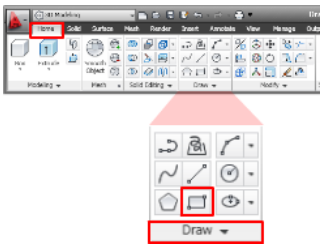


10 At the prompt, enter **20** as the diameter of circle and press Enter.

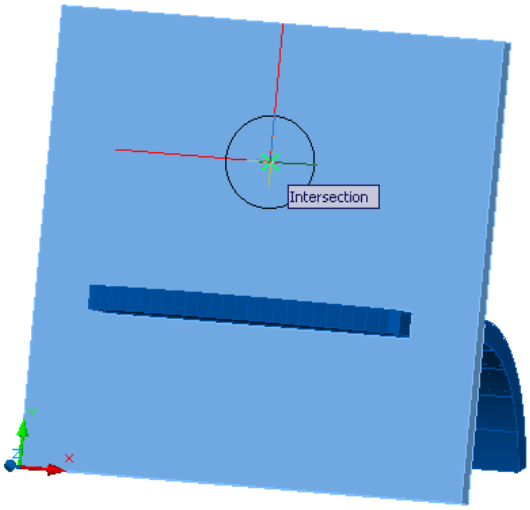


NOTE Coordinate values, such as those of the center of the circle, are measured from the new UCS origin.

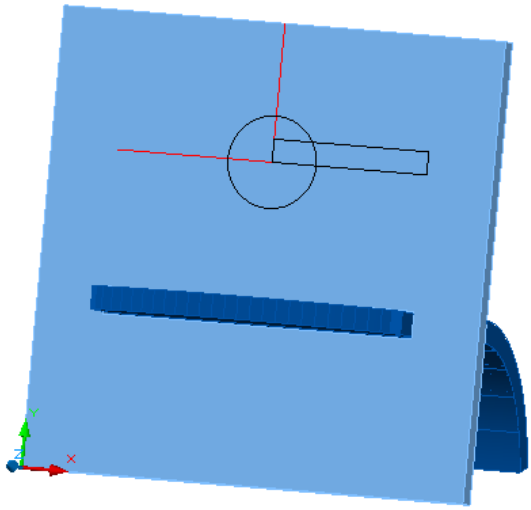
11 On the ribbon, click Home tab ➤ Draw panel ➤ Rectangle.



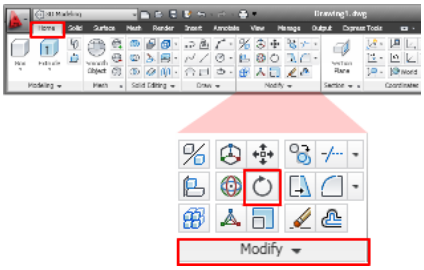
12 Select the center point of the circle as the first corner point.



13 At the prompt, enter **@35,5** and press Enter.

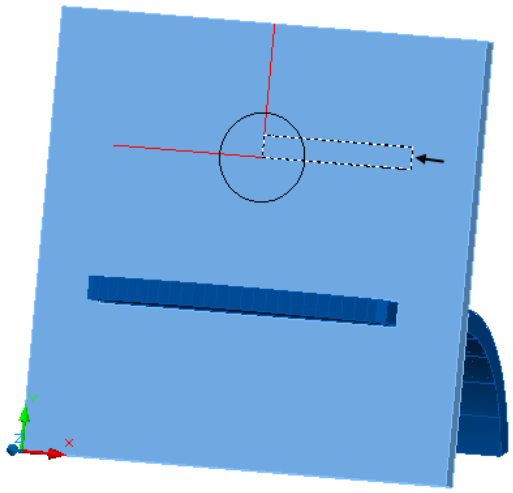


14 On the ribbon, click Home tab ➤ Modify panel ➤ Rotate.

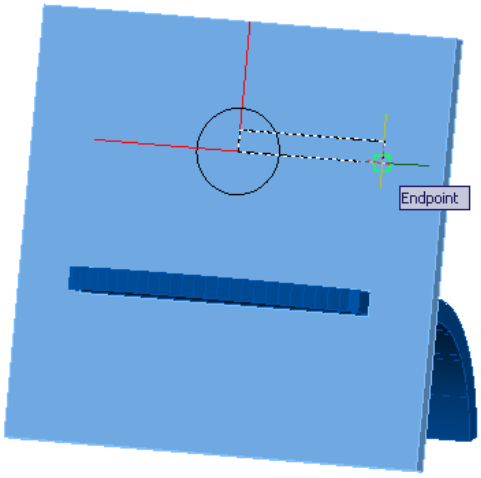


15 Select the rectangle and press Enter.

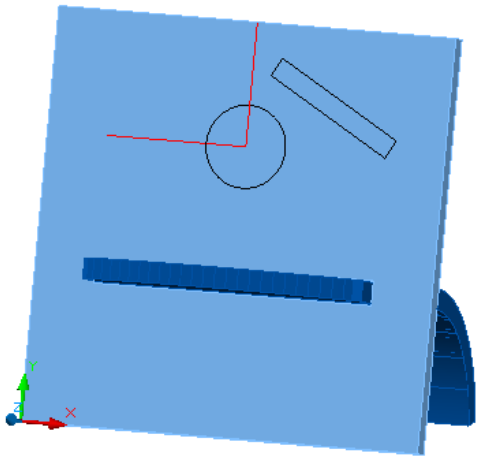
TIP If you cannot select the rectangle with the pickbox, enter **L** and press Enter to select the last object drawn.



16 Click the endpoint of the lower-right corner of the rectangle.

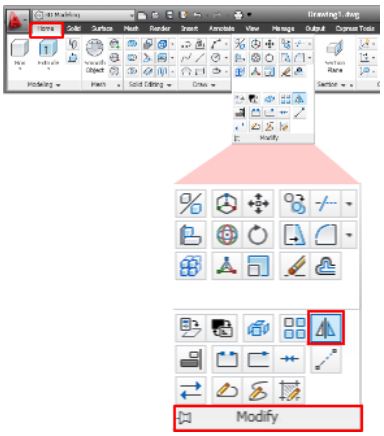


17 At the prompt, enter **-30** to specify the rotation angle and press Enter.

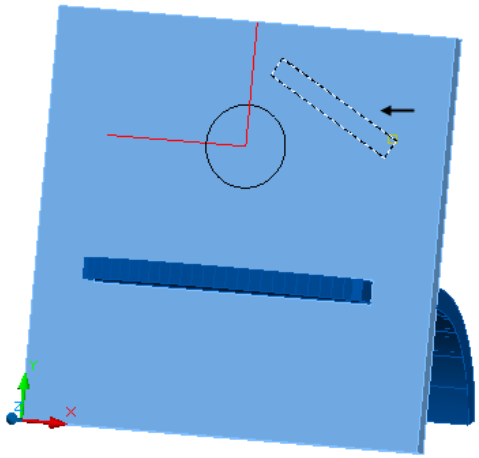


NOTE The rectangle was rotated on the workplane - the axis of rotation is always perpendicular to the Z axis of the UCS.

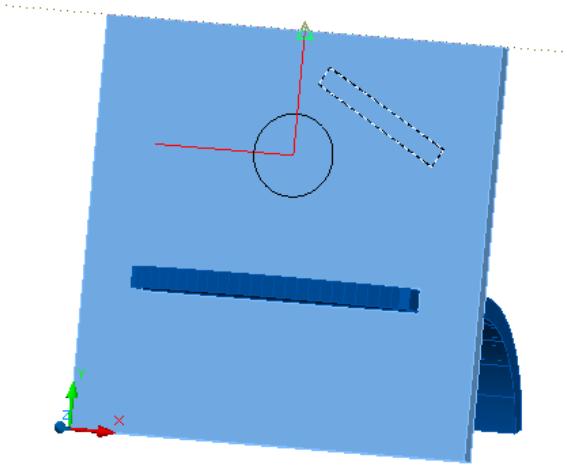
18 On the ribbon, click Home tab ➤ Modify panel ➤ ➤ Mirror.



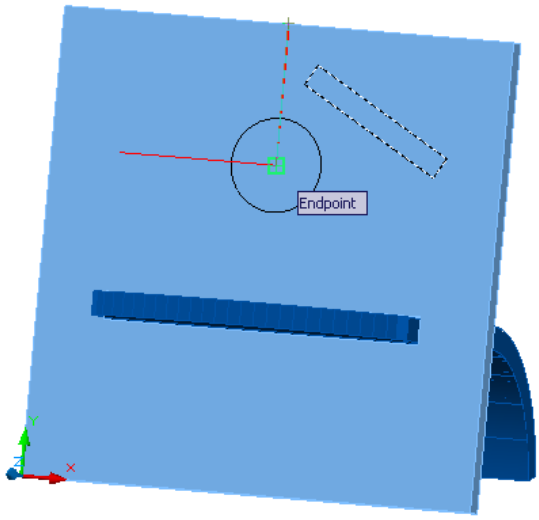
19 Select the rectangle and press Enter.



20 Select the top endpoint of the first line drawn to specify the first point of the mirror line.

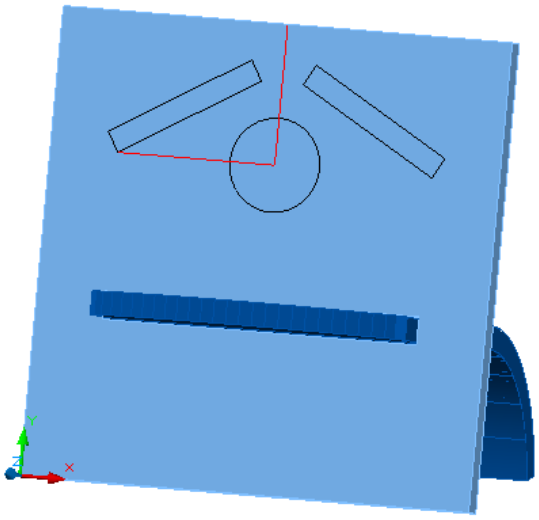


21 Select the bottom endpoint of the same line to specify the second point of the mirror line.



22 At the prompt, enter **n** (No) and press Enter.

A mirror image of the first rectangle is created and aligned to the face of the desk stand.



NOTE Objects created and modified on the face of the desk stand are automatically aligned to the workplane of the current UCS.

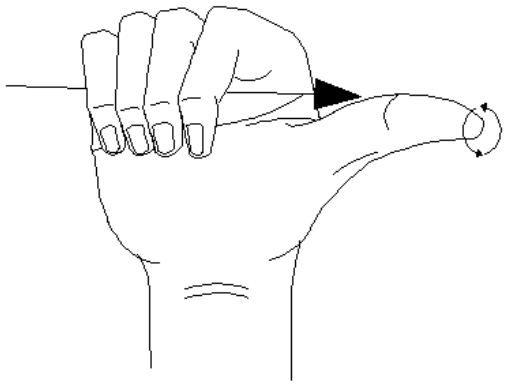
Summary: In this lesson, you learned how to

- Align the workplane of the UCS to the face of a 3D solid object
- Create and modify objects that are aligned to the face of the solid object you selected

Lesson 2: Reorient the UCS to Rotate Objects

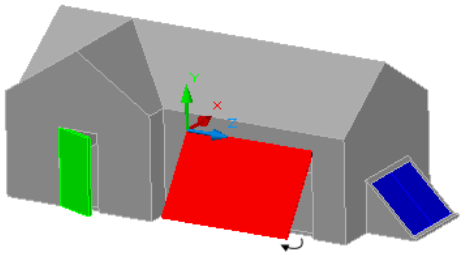
There are several methods to manipulate the UCS in 3D. You can move and reorient the UCS to rotate objects.

Point your right thumb in the positive direction of the UCS Z axis and curl your fingers. Your fingers indicate the positive rotation in a counter-clockwise direction.



File Name: *42 Toy House.dwg*

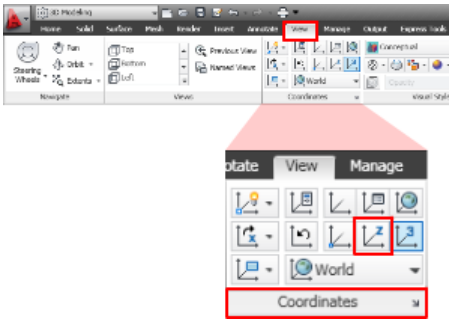
To align the Z axis of the UCS to rotate objects



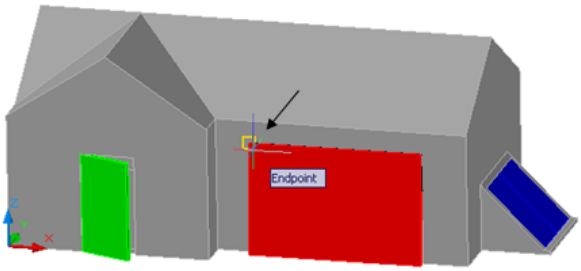
The positive Z axis of the UCS is aligned perpendicular to the plane in which the object was originally created.

The following steps explain how to align the Z axis of the UCS to rotate objects.

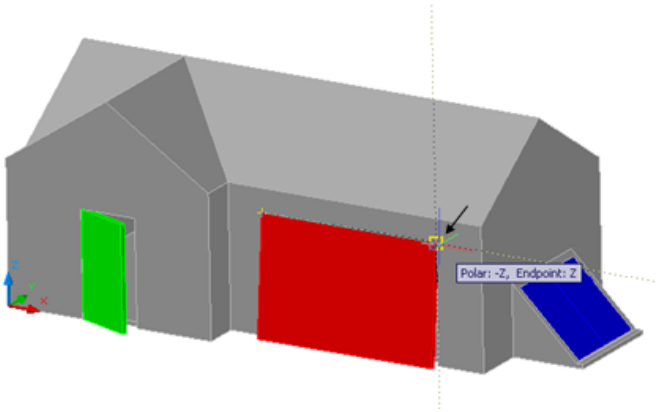
1. Click  ➤ Open.
2. In the Select File dialog box, browse to *C:\My Documents\Tutorials* and select *42 Toy House.dwg*.
3. Click Open.
4. On the ribbon, click View tab ➤ Coordinates panel ➤ Z-Axis Vector.



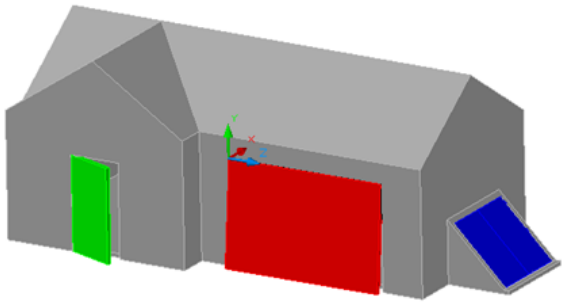
5. Click the endpoint on the top-left outside edge of the red door to specify the new origin point.



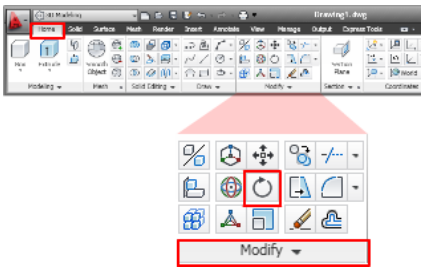
6 Click the endpoint on the top-right outside edge of the red door to specify point on positive portion of Z axis.



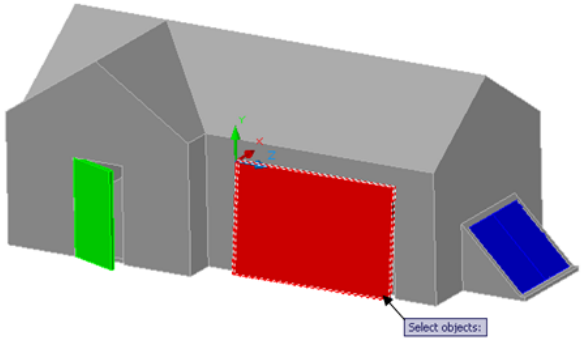
The UCS origin is moved to the first specified point and its positive Z-axis passes through the second specified point.



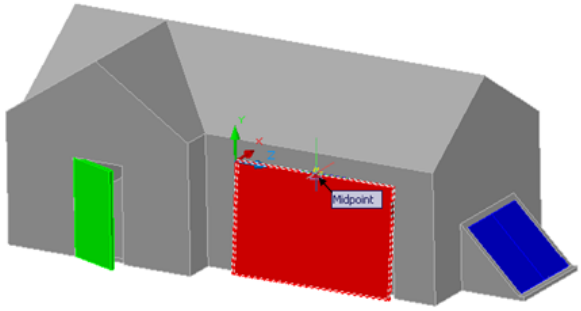
7 On the ribbon, click Home tab ➤ Modify panel ➤ Rotate.



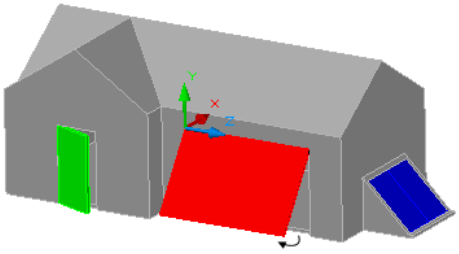
8 Click the red door and press Enter.



9 Click the midpoint on the outside edge at the top of the red door to specify the base point.



10 At the prompt, enter **-15** as the rotation angle and press Enter.



You have aligned and rotated the Z axis of the UCS to open the door.

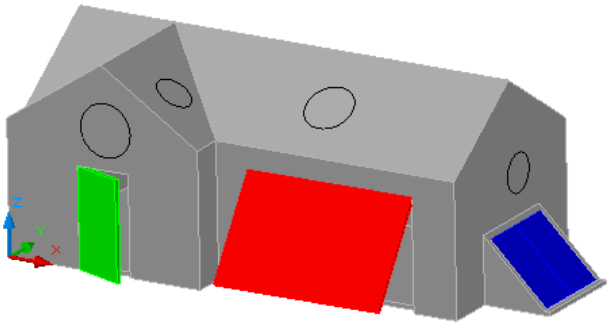
Summary: In this lesson, you learned how to align the axis of the UCS to rotate objects.

Lesson 3: Create an Object on the Face of a 3D Object with Dynamic UCS

To align objects on a 3D object, use the dynamic UCS feature to temporarily and automatically align the XY plane of the UCS with the face located under the crosshairs. After you finish the command, the UCS returns to its previous location and orientation.

File Name: *42 Toy House.dwg*

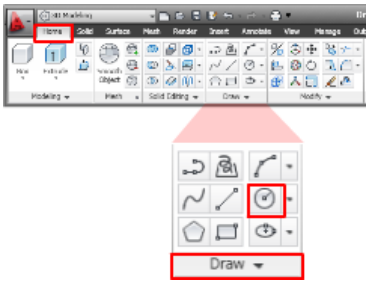
To align the XY plane with the dynamic UCS feature



The following steps explain how to use dynamic UCS to draw a circle to the face of a 3D solid object.

1. Click  ➤ Open.
2. In the Select File dialog box, navigate to *C:\My Documents\Tutorials* and select *42 Toy House.dwg.*
3. Click Open.
4. On the status bar, click the Dynamic UCS button to turn it on.

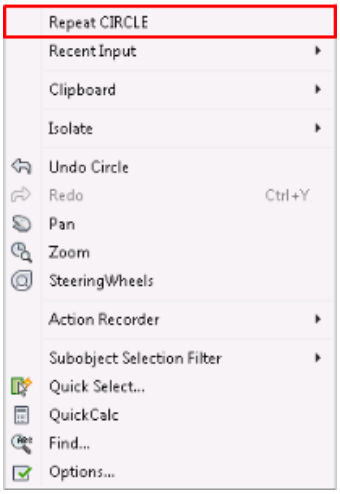
5. On the ribbon, click Home tab ➤ Draw panel ➤ Circle drop-down ➤ Center, Radius.



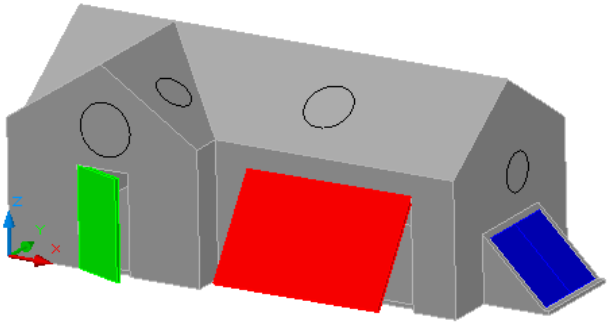
6. Click anywhere above the green door to specify the center point of the circle.
7. At the prompt, enter **0.6** as the radius of circle and press Enter.

NOTE The workplane aligns with each visible face as the crosshairs passes over it.

8. To create more circles as shown in the illustration, right-click the drawing and click Repeat CIRCLE.



9 Specify points anywhere on each plane to create more circles as shown in the illustration.



NOTE After you end the CIRCLE command, the UCS returns to its previous location and orientation automatically.

Summary: In this lesson, you learned how to align the UCS with the face of a 3D object using Dynamic UCS.

Congratulations! You have defined custom UCSs for use with 3D models.

For more information, see the *AutoCAD User's Guide*.