

AutoCAD 3D

Module 18

Solid Modeling - Part 2

Learning Outcomes:

When you have completed this module, you will be able to:

1. Describe and apply the EXTRUDE and REVOLVE commands to draw solid models.

Solid Modeling Without Using Solid Primitives

Constructing all solid models using solid primitives would be too difficult and slow. It is much faster and simpler to construct most solid models using the EXTRUDE and/or the REVOLVE commands.

Extruding

Extruding involves drawing a closed object and then projecting it in the Z direction at a given distance using the EXTRUDE command. See Figure 18-1. The closed object can be a 2D polygon, a circle or an ellipse. Extruded solids can then be joined with the UNION command or subtracted using the SUBTRACT command to form the complete model.

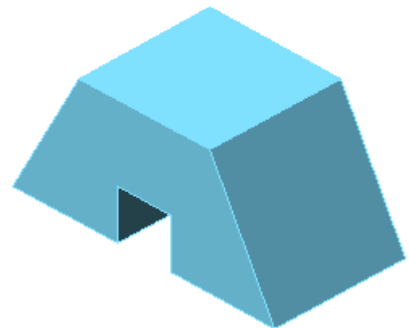
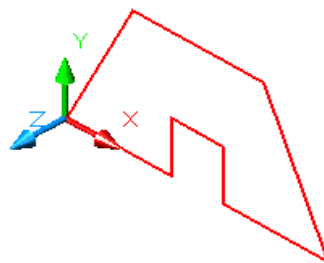


Figure 18-1
Extruding a Solid Model

Revolving

Not all solid models can be extruded. A solid model that is symmetrical can be created by revolving a closed object. See Figure 18-2. The closed 2D object can be a polygon, a circle or an ellipse. It is then revolved around an axis. The contour of the object will create the solid as it is revolved around the axis. It can be revolved around any angle from 1 degree to 360 degrees.

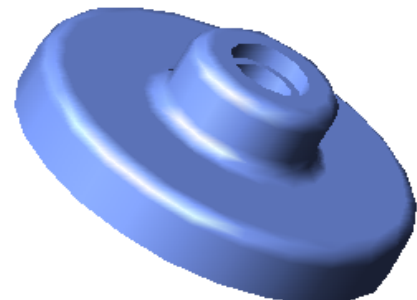
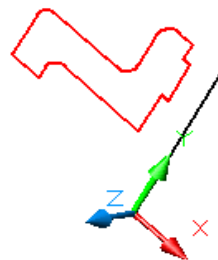


Figure 18-2
Revolving a Solid Model

AutoCAD System Variable: **DELOBJ**

The DELOBJ system variable controls whether the EXTRUDE or REVOLVE command deletes or retains the closed object when the command is executed.

Command: **DELOBJ**

Enter new value for DELOBJ <0>:

Command:

Set to:

0 - Will retain the closed polygon

1 - Will delete the closed polygon

AutoCAD Command: **EXTRUDE**

The EXTRUDE command is used to create a solid by projecting a closed 2D object in the Z direction.

Shortcut: **EXT**

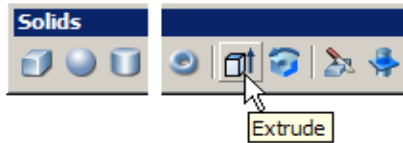


Extrude
Creates unique solid primitives by extruding

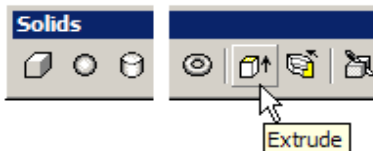
2009-2010



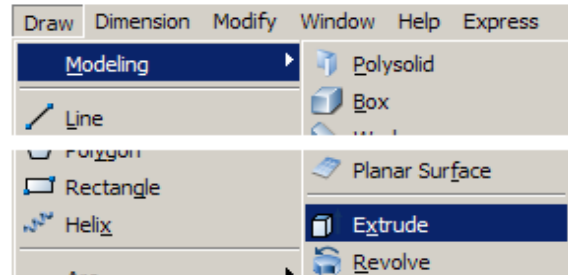
2007-2008



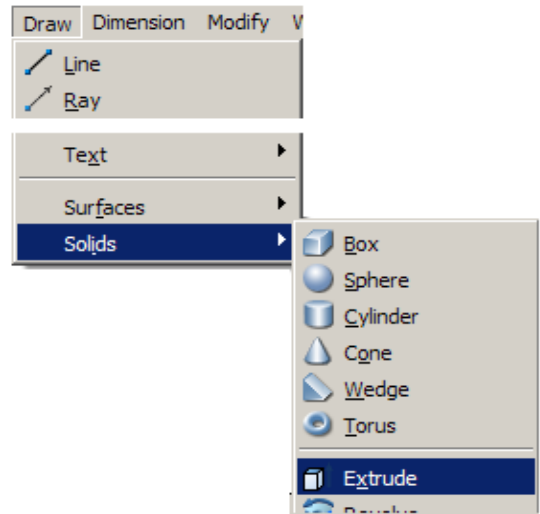
2004-2006



2000-2002



2007-2010



2000 - 2006

**WORK
ALONG**

Using the EXTRUDE Command

Step 1 Using the NEW command, start a new drawing using template Module Template 3D English.

Step 2 Save and name the drawing AutoCAD 3D Workalong 18-1.

Step 3 Create layers Construction, Model and Solid as shown in Figure Step 3.

Status	Name	On	Freeze	Lock	Color	Linetype
✓	0	☑	☑	☑	white	Continuous
☐	Construction	☑	☑	☑	253	Continuous
☐	Defpoints	☑	☑	☑	white	Continuous
☐	Key	☑	☑	☑	magenta	Continuous
☐	Layout Titleblock	☑	☑	☑	white	Continuous
☐	Model	☑	☑	☑	red	Continuous
☐	Solid	☑	☑	☑	151	Continuous

Figure Step 3

Step 4 On layer Model, draw the top contour of the wireframe model only. Use the multiview drawing shown below for the dimensions. See Figure Step 4.

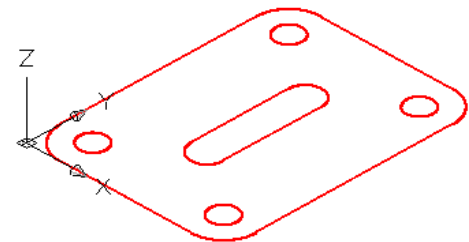
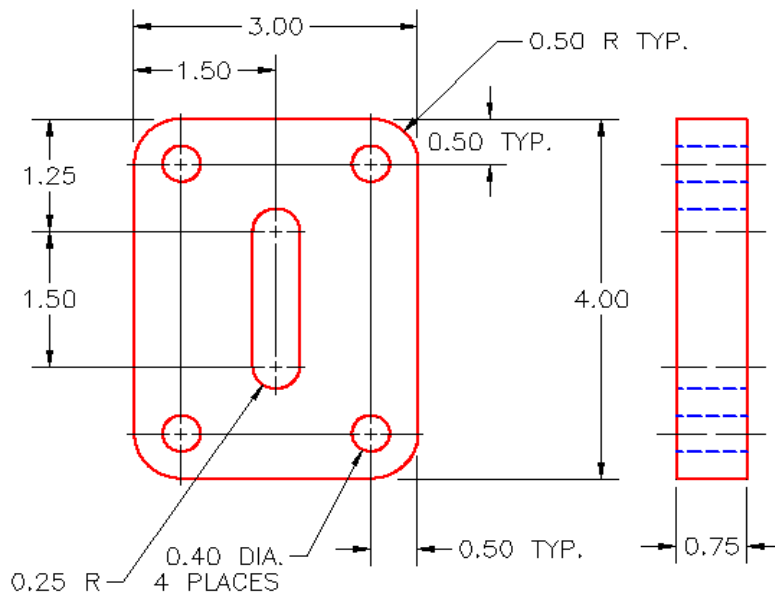


Figure Step 4



Multiview drawing

Step 5 Enter the DELOBJ system variable as shown below. Ensure it is set to 0.

Command: **DELOBJ**
 Enter new value for DELOBJ <1>: **0**
 Command:

Step 6 Set the UCS to Top and locate it on top of the model as shown in Figure Step 6.

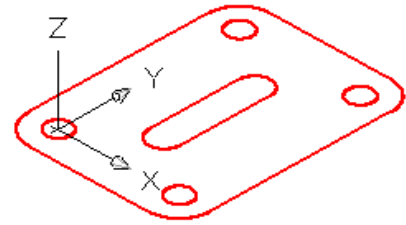


Figure Step 6

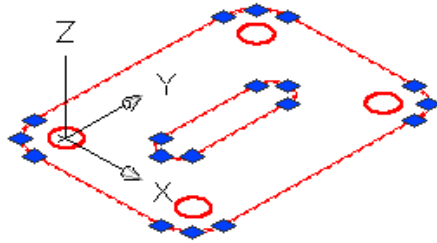


Figure Step 7

Step 7 Using what you learned earlier, use the PEDIT command to convert the lines and arcs to closed polylines. Check the objects with the Properties window to ensure they are closed polylines. See Figure Step 7.

Step 8 Set the system variable ISOLINES to 32 as shown below.

Command: **ISOLINES**

Enter new value for ISOLINES <4>: **32**

Command:

Step 9 Set layer Solid as the current layer and enter the EXTRUDE command as shown below to create the solid model.

Command: **EXTRUDE**

Current wire frame density: ISOLINES=32

Select objects: 6 found

(Select all of the objects in a window or pick them individually.)

Select objects:

Specify height of extrusion or [Path]: **-0.75**

(Use -0.75 since the extrusion is in the negative Z direction.)

Specify angle of taper for extrusion <0>:

(Press Enter to select the default.)

Command:

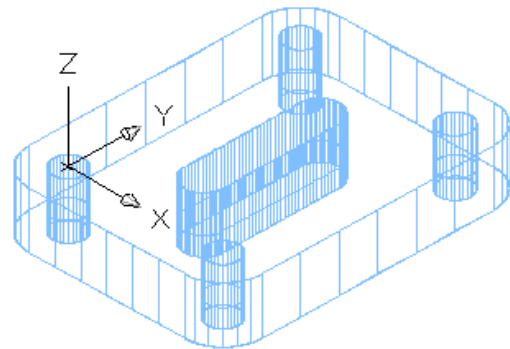


Figure Step 10

Step 10 Turn layer Model off and your model should appear as shown in Figure Step 10.

Step 11 Shade the model and it should appear as shown in Figure Step 11.

Author's Comments: You now have to subtract the inner solids from the overall solid to complete the model with its holes. To use the SUBTRACT command, you first select the solid(s) you want to subtract from (in this case only one) and then press Enter to change modes. Then select the solids you want to subtract. It is easiest to subtract solids when the shademode is 2D or 3D Wireframe. You may have to practice this a bit.

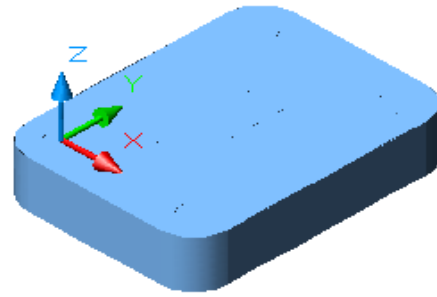


Figure Step 11

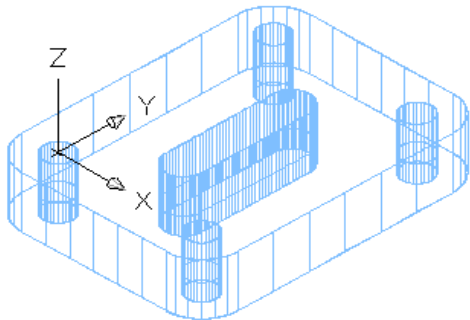


Figure Step 12

Step 12 Change the shademode to 2D Wireframe and then enter the SUBTRACT command to subtract the five inner solid from the larger solid. See Figure Step 12.

Step 13 Your model should now appear as shown in Figure Step 13A and 13B. Use 3D Orbit to check the complete model.

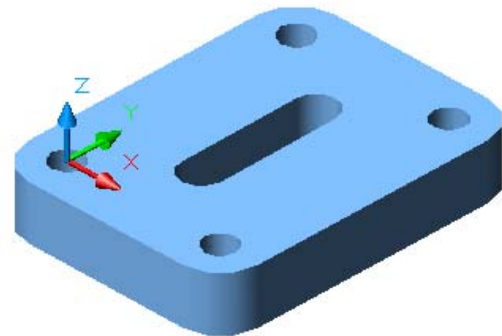


Figure Step 13A
SE Isometric View

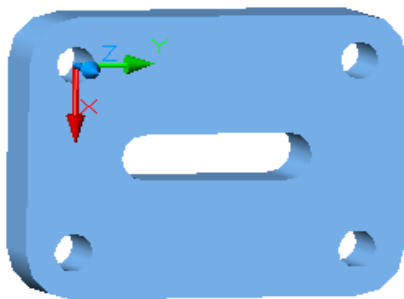


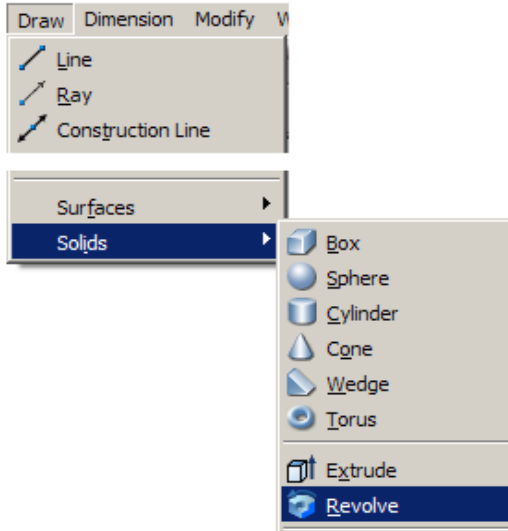
Figure Step 13B
Rotated View

Step 14 Save and close the drawing.

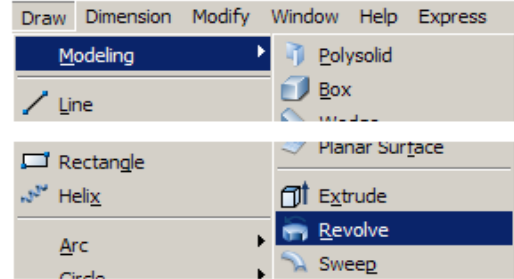
AutoCAD Command: **REVOLVE**

The REVOLVE command is used to create a solid model by revolving a 2D closed object around an axis.

Shortcut: **REV**



2000 - 2006



2007-2010



Revolve
Creates a solid by revolving a two-dimensional object about an axis:

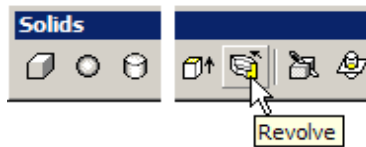
2009-2010



2007-2008



2004-2006



2000-2002

**WORK
ALONG**

Using the REVOLVE Command

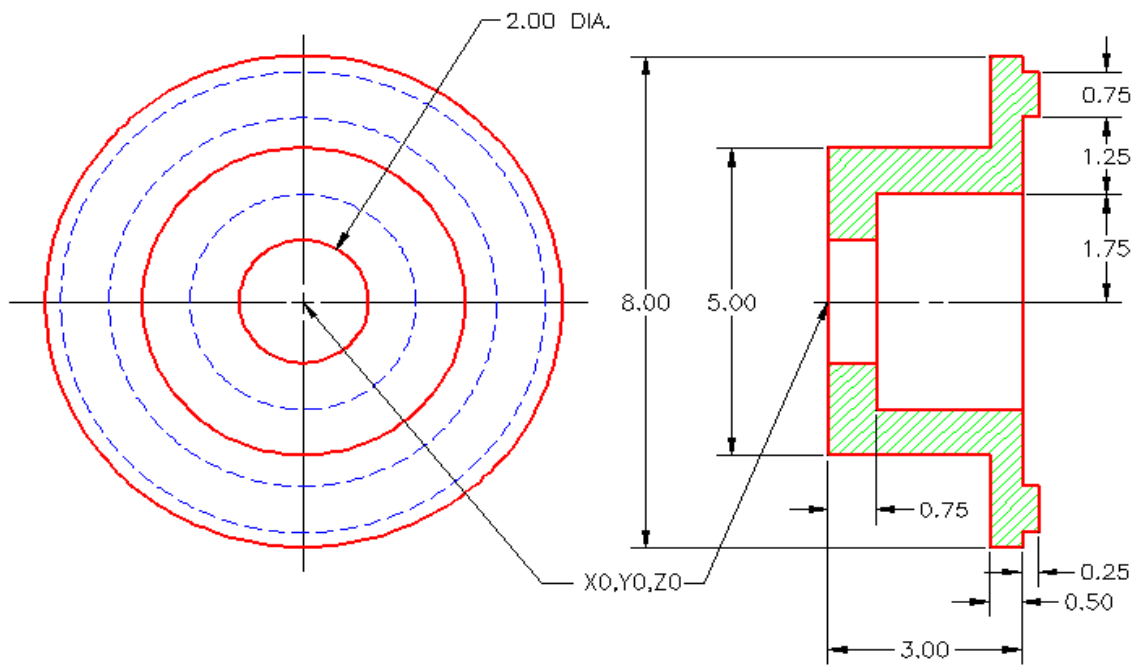
Step 1 Using the NEW command, start a new drawing using template Module Template 3D English.

Step 2 Save and name the drawing AutoCAD 3D Workalong 18-2.

Step 3 Create layers Construction, Model and Solid as shown in Figure Step 3.

Status	Name	On	Freeze	Lock	Color	Linetype
	0				white	Continuous
	Construction				253	Continuous
	Defpoints				white	Continuous
	Key				magenta	Continuous
	Layout Titleblock				white	Continuous
	Model				red	Continuous
	Solid				201	Continuous

Figure Step 3



Multiview Drawing

Step 4 Change the view to SE Isometric and the UCS to Right as shown in Figure Step 4.

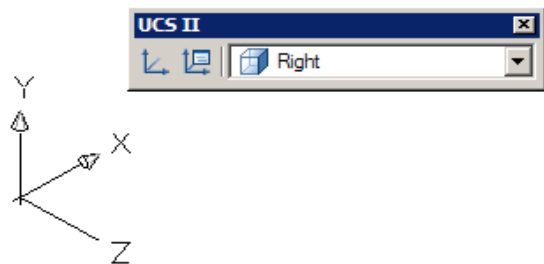


Figure Step 4

Step 5 On layer Model and using the dimensions shown in the multiview drawing, draw the right side cross section of the solid part of the object as shown in Figure Step 5.

Author's Comments: You will be revolving this cross section 360 degrees to create a solid as it revolves. Therefore, only one-half of the section view has to be drawn.

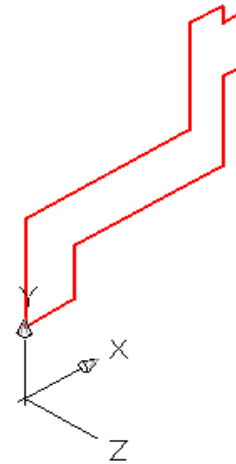


Figure Step 5

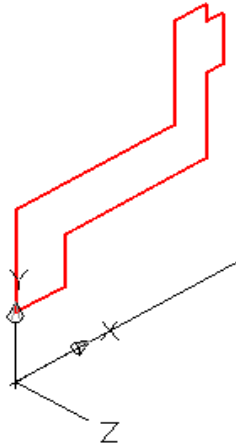


Figure Step 6

Step 6 On layer Construction, from 0,0,0 draw a line of any length along the X axis. If you use ortho mode, you can draw it quickly. This will be the axis for the revolution. See Figure Step 6.

Step 7 Using the PEDIT command, create a closed polygon from the lines. Ensure it is closed by checking it with the Properties windows. See Figure Step 7.

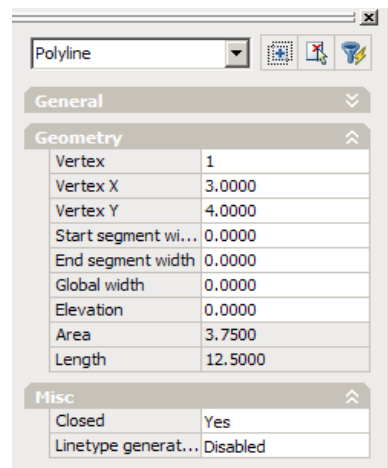
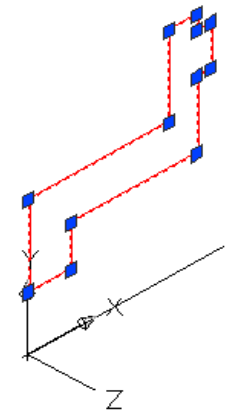


Figure Step 7



Step 8 Set the ISOLINES system variable to 48 as shown below.

Command: **ISOLINES**

Enter new value for ISOLINES <4>: **48**

Command:

Step 9 Change the current layer to Solid and enter the REVOLVE command as shown below. After you complete the command, your model should appear as shown in Figure Step 9.

Command: **REVOLVE**

Current wire frame density: ISOLINES=48

Select objects: 1 found

(Select the closed polyline.)

Select objects:

(Press Enter.)

Specify start point for axis of revolution or define axis by [Object/X (axis)/Y (axis)]: **O**

Select an object:

(Select the axis (the construction line).)

Specify angle of revolution <360>:

(Press Enter to select the default.)

Command:

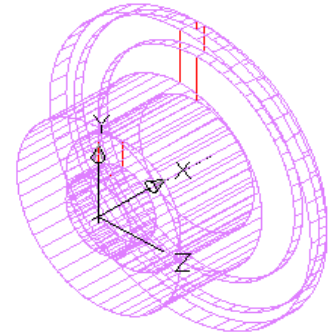


Figure Step 9

Step 10 Turn off layer Construction and Model and shade your model. Your model should now appear as shown in Figure Step 10.

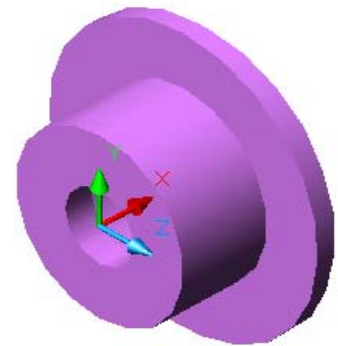


Figure Step 10
SE Isometric View

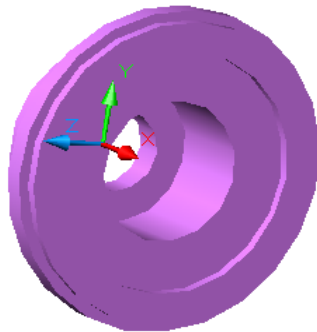


Figure Step 11
Rotated view

Step 11 Using 3D Orbit rotate the model as shown in Figure Step 11.

Step 12 Save and close the drawing.

The Key Principles in Module 18

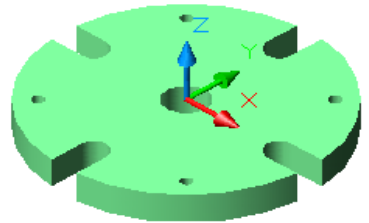
1. The object extruded or revolved with the EXTRUDE and REVOLVE commands must be closed polygon, a circle, or an ellipse.
2. Ensure you locate the UCS with the Z axis going in the direction of the extrude.

Lab Exercise 18-1 **Time Allowed: 45 Min.**

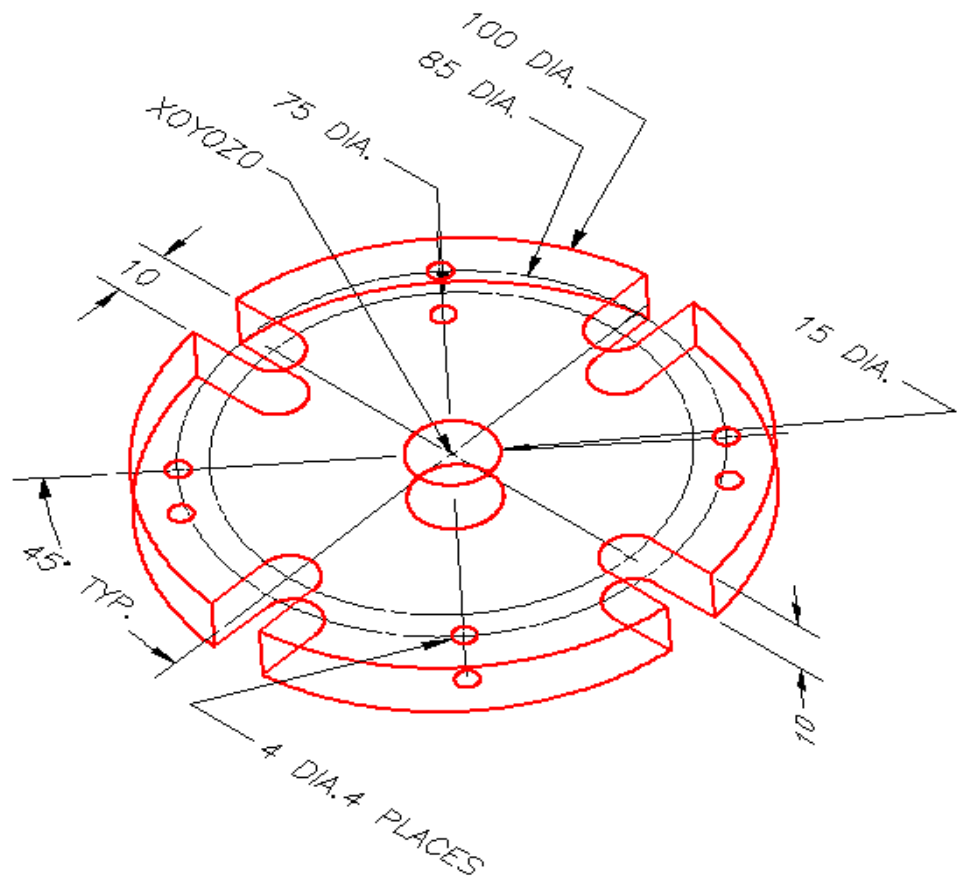
Name	Template	Units
AutoCAD 3D Lab 18-1	3D Layout Metric	Millimeters

Instructions:

- Step 1** Draw a solid model of the object shown below.
- Step 2** The completed solid model must be one object when complete.
- Step 3** Turn layers Construction and Model off and shade the model.
- Step 4** Use 3D Orbit to view all sides for completeness.



Completed Solid Model

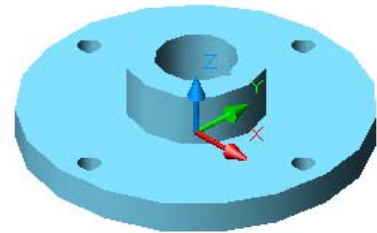


Lab Exercise 18-2**Time Allowed: 45 Min.**

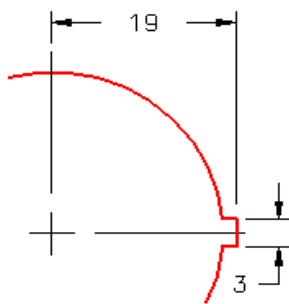
Name	Template	Units
AutoCAD 3D Lab 18-2	3D Layout Metric	Millimeters

Instructions:

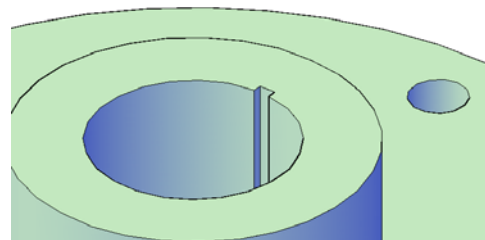
- Step 1** Draw a solid model of the object shown below.
- Step 2** The completed solid model must be one object when complete.
- Step 3** Turn layers Construction and Model off and shade the model.
- Step 4** Use 3D Orbit to view all sides for completeness.



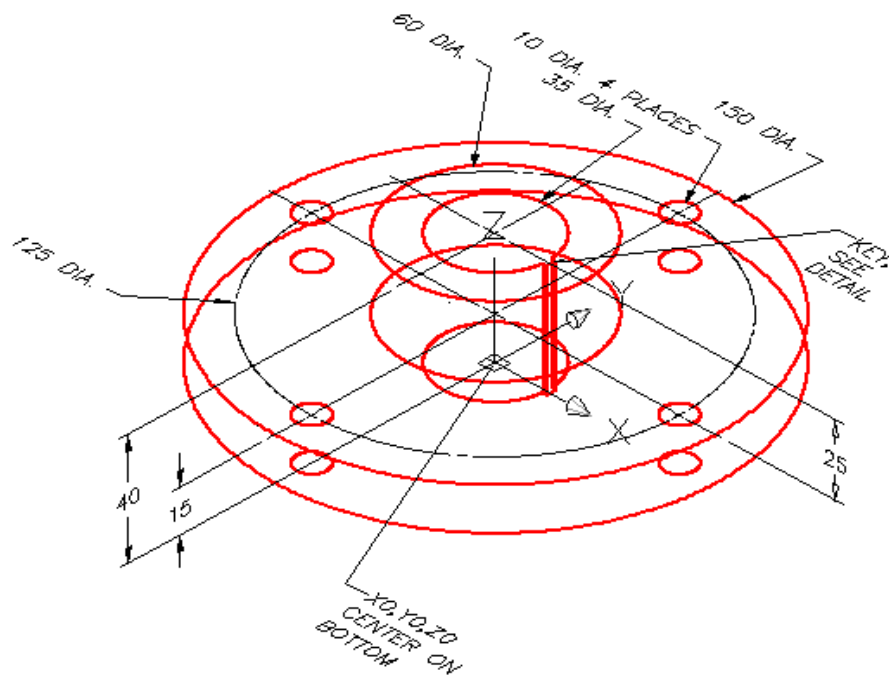
Completed Solid Model



Key Detail



View of Keyway - Rotated



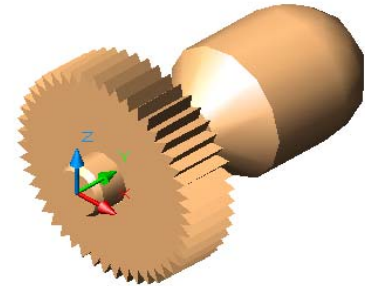
Lab Exercise 18-3

Time Allowed: 60 Min.

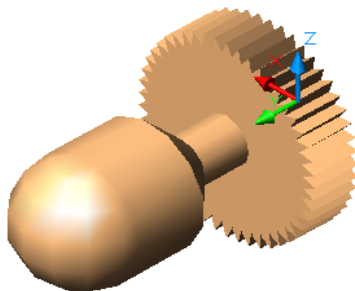
Name	Template	Units
AutoCAD 3D Lab 18-3	3D Layout English	Inches

Instructions:

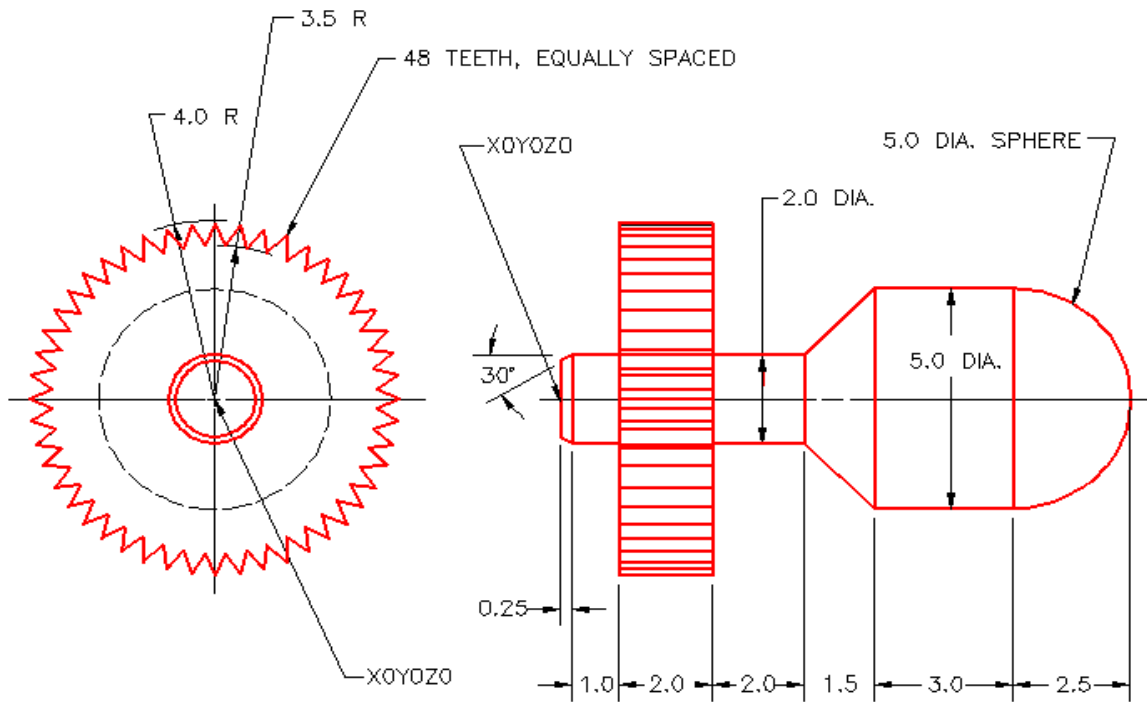
- Step 1** Draw a solid model of the object shown below.
- Step 2** The completed solid model must be one object when complete.
- Step 3** Turn layers Construction and Model off and shade the model.
- Step 4** Use 3D Orbit to view all sides for completeness.



Completed Solid Model - SE Isometric View



Completed Solid Model - Rotated View



Multiview Drawing

Lab Exercise 18-4		Time Allowed: 45 Min.
Name	Template	Units
AutoCAD 3D Lab 18-4	3D Layout Metric	Millimeters

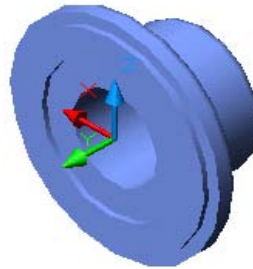
Instructions:

Step 1 Draw a solid model of the object shown below.

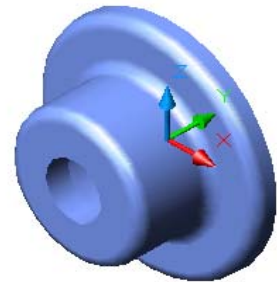
Step 2 The completed solid model must be one object when complete.

Step 3 Turn layers Construction and Model off and shade the model.

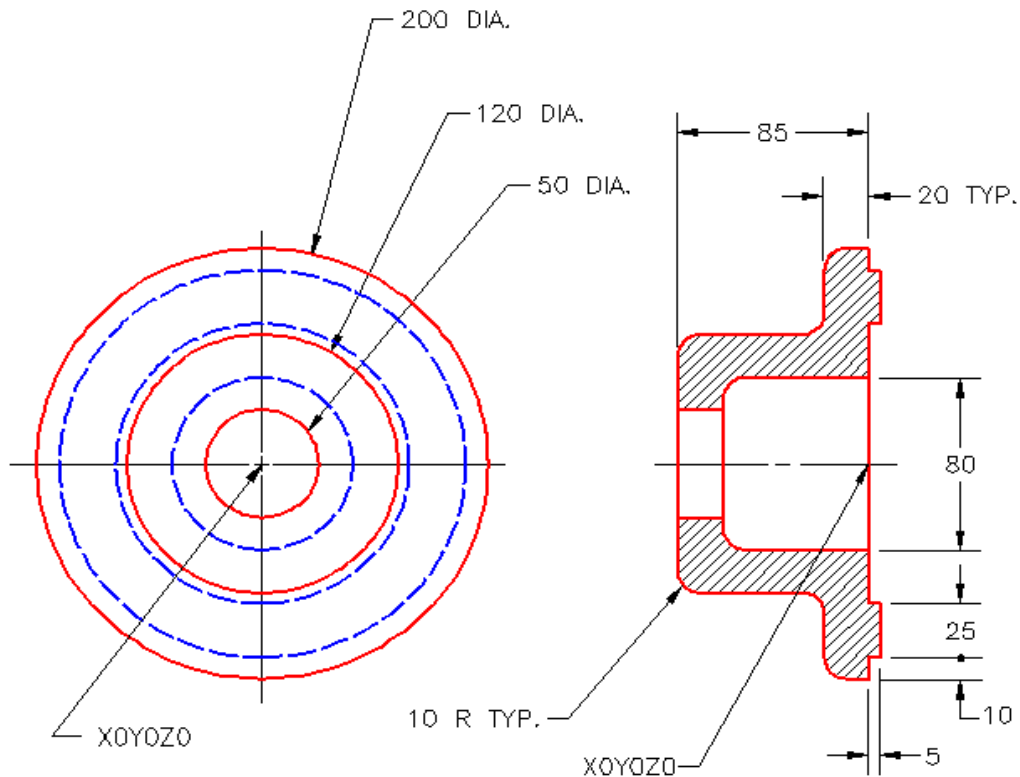
Step 4 Use 3D Orbit to view all sides for completeness.



Completed Solid Model
Rotated View



Completed Solid Model
SE Isometric View



Multiview Drawing

