

LEARNING OBJECTIVES

After completing this lesson, you will be able to:

1. Construct 7 Solid model Primitives:
Box, Sphere, Cylinder, Cone, Wedge, Torus and Pyramid

LESSON 15

Drawing Basic Geometric Shapes

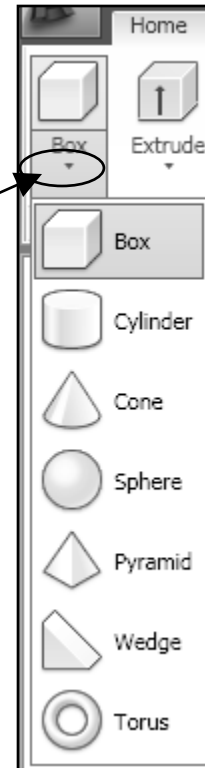
In this lesson you will learn the required steps to construct each of AutoCAD's basic geometric shapes. Each one requires different input information and some have multiple methods of construction.

AutoCAD has 7 Solid shapes.

Box, Cylinder, Cone, Sphere, Pyramid, Wedge and Torus.

To select a solid primitive use one of the following:

Ribbon = Home tab / Modeling panel / ▼
or
Keyboard = Type the name such as: Box



3D input direction

When drawing in 3D and prompted for Length, Width or Height, each input corresponds to an axis direction as follows:

Length = X Axis
Width = Y Axis
Height = Z Axis

I always write this on a little post-it and stick it to my monitor. It comes in handy as a reminder.

For example, if you are prompted for the Length the dimension that you enter will be drawn on the X axis. So keep your eye on the Origin icon in order to draw the objects in the correct orientation. Although it should be easy to visualize because you will actually see the shape constructed as you draw.

Consider starting the primitives on the Origin. It is useful to know where the primitive is located so it can be moved or manipulated easily.

In Lesson 16 you will learn more about moving the UCS around to fit your construction needs. But just relax and let's take it one step at a time.

BOX

There are 4 methods to draw a **Solid Box**. Which one you will use will depend on what information you know. For example, if you know where the corners of the base are located and the height, then you could use method 1 or 2.

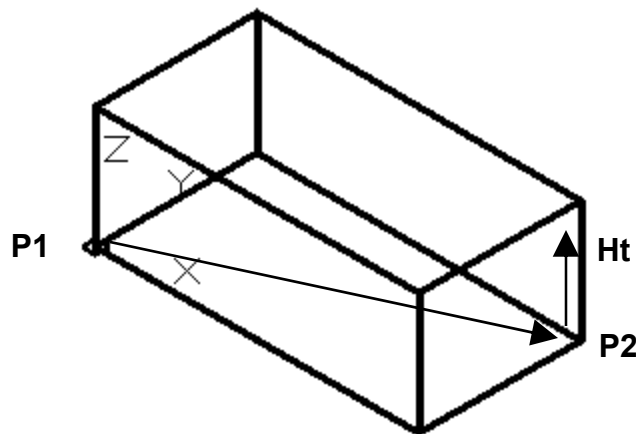
Start a new file and select Acad3d.dwt

Method 1

(You will enter the location for: base corner, diagonal corner and height)

1. Select the **SE Isometric** view (14-10) and **Parallel**. (14-7)
2. Select the **Box** command. (See page 15-2)
3. Specify first corner [Center]: *type coordinates or pick location with cursor (P1)*.
4. Specify other corner or [Cube/Length]: *type coordinates for the diagonal corner or pick location with the cursor (P2)*.
5. Specify height or [2Point]: *type or use cursor*.

Note: This model is displayed as Wireframe for clarity



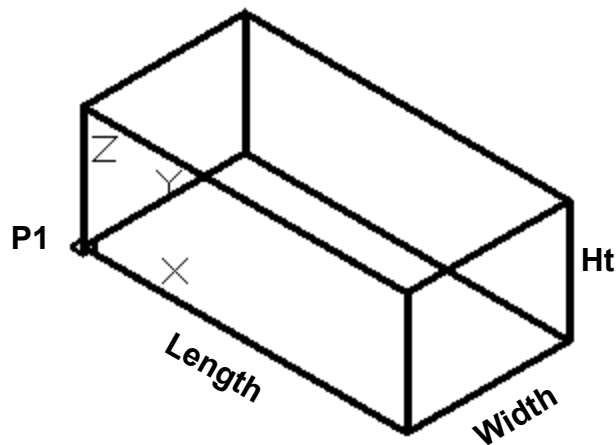
BOX....continued

Method 2

(You will enter the dimension for L, W, and Ht)

1. Select the **SE Isometric** view (14-10) and **Parallel** (14-7).
 2. Select the **Box** command.
 3. Specify first corner or [Center]: **type coordinates or pick location with cursor. (P1)**
 4. Specify other corner or [Cube/Length]: **type "L" <enter>**.
- (Note: when entering L, W and H Ortho should be "ON".)**
5. Specify length: **enter the Length (X axis).**
 6. Specify width: **enter the Width (Y axis).**
 7. Specify height: **enter the Height (Z axis).**

Note: This model is displayed as Wireframe for clarity



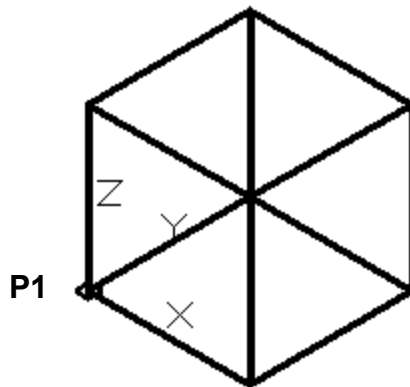
BOX....continued

Method 3

(If Length, Width & Height have the same dimension)

1. Select the **SE Isometric** view (14-10) and **Parallel** (14-7).
2. Select the **Box** command.
3. Specify first corner or [Center] : *type coordinates or pick location with cursor. (P1)*
4. Specify corner or [Cube/Length]: *type "C" <enter>*.
5. Specify length: *enter the dimension.*

Note: This model is displayed as Wireframe for clarity



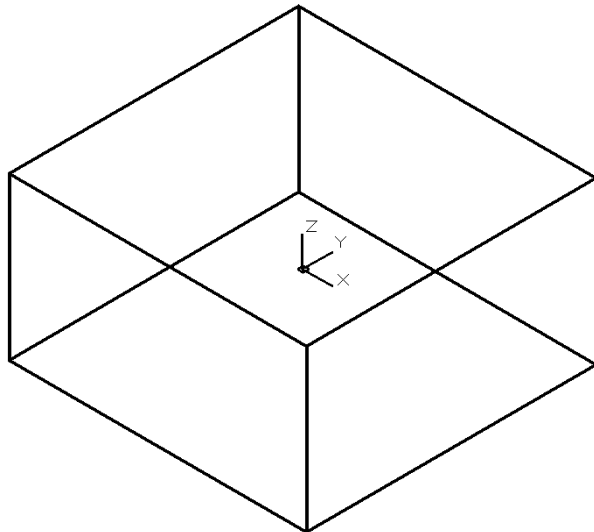
BOX....continued

Method 4

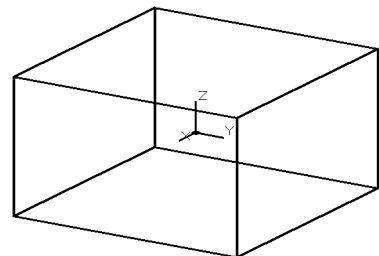
(You will enter the location for the center, a corner and the height)

1. Select the **SE Isometric** view (14-10) and **Parallel** (14-7).
2. Select the **Box** command.
3. Specify corner of box or [Center] : **type "C"<enter>**.
4. Specify center of box : **type coordinates or pick location with cursor. (P1)**
5. Specify corner or [Cube/Length]: **type coordinates for a corner or pick location with the cursor. (P2)**
6. Specify height: **type the height.**

Note: This model is displayed as Wireframe for clarity



(Note: The total Length, Width and Height straddles the centerpoint.
Use Orbit to view)



CYLINDER

Cylinder creates a cylindrical solid. You will define the center location for the base, define the radius or diameter and then the height or location for the other end.

The two methods below are the most commonly used.

Method 1

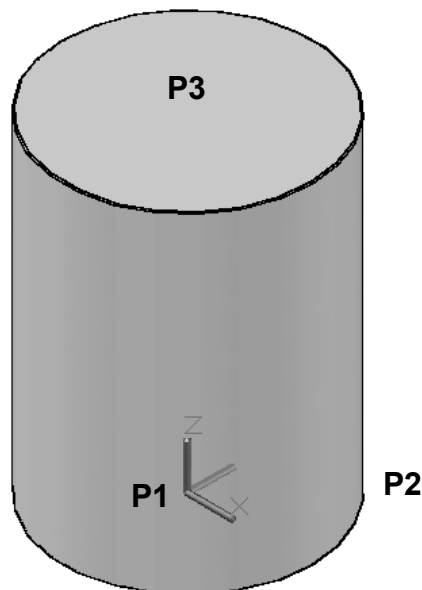
The default orientation of the cylinder locates the base on the X,Y plane and the height is in the Z direction. When you enter the height, the cylinder grows in the Z axis direction. You may enter a positive or negative number. It depends upon which direction you want the cylinder to grow. The Z-axis origin icon line points to the positive direction. So remember, keep an eye on the 3D Origin icon.

1. Select the **SE Isometric** view (14-10) and **Parallel** (14-7).
2. Select the **Cylinder** command.
3. Specify center point for base or [3P/2P/Ttr/Elliptical] : ***type coordinates or pick location with cursor (P1)***

(This base will be located on the X,Y plane)

4. Specify radius for base of cylinder or [Diameter]: ***enter radius or D. (P2)***
5. Specify height of cylinder or [Center of other end]: ***enter the height (Ht). (P3)***

Note: This model is displayed as Shades of Gray



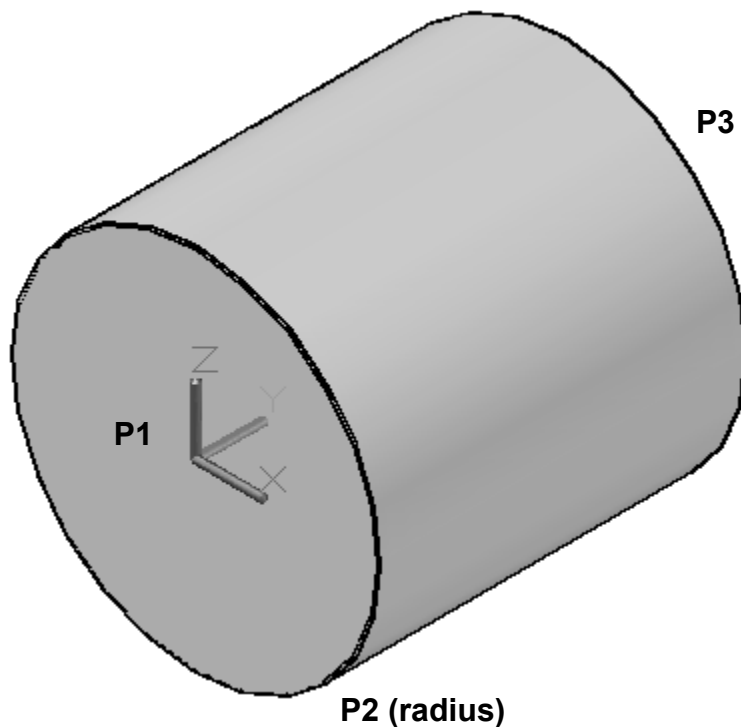
CYLINDER....continued

Method 2

The orientation of the Cylinder base depends on the placement of the Center of the other End. This method allows you to tilt the cylinder. Define the center of the base and radius then select the "Axis Endpoint" option. Define the "Axis Endpoint" entering relative coordinates or snapping to an object. (Soon you will learn how to rotate the Origin)

1. Select the **SE Isometric** view (14-10) and **Parallel** (14-7).
2. Select the **Cylinder** command.
3. Specify center point of base or [3P/2P/Ttr/Elliptical] <0,0,0>: **type coordinates or pick location with cursor (P1)**.
4. Specify base radius or [Diameter]: **enter radius or D. (P2)**
5. Specify height or [2 point/Axis endpoint]: **A <enter>**.
- 6 Specify axis endpoint: **type coordinates or snap to an object. (P3)**

In the example below the radius is 3" and the "center of the other end" is 0,6,0 (P3) This means the "center of the other end" was placed on the same axes as X and Z but 6" in the Y axis.



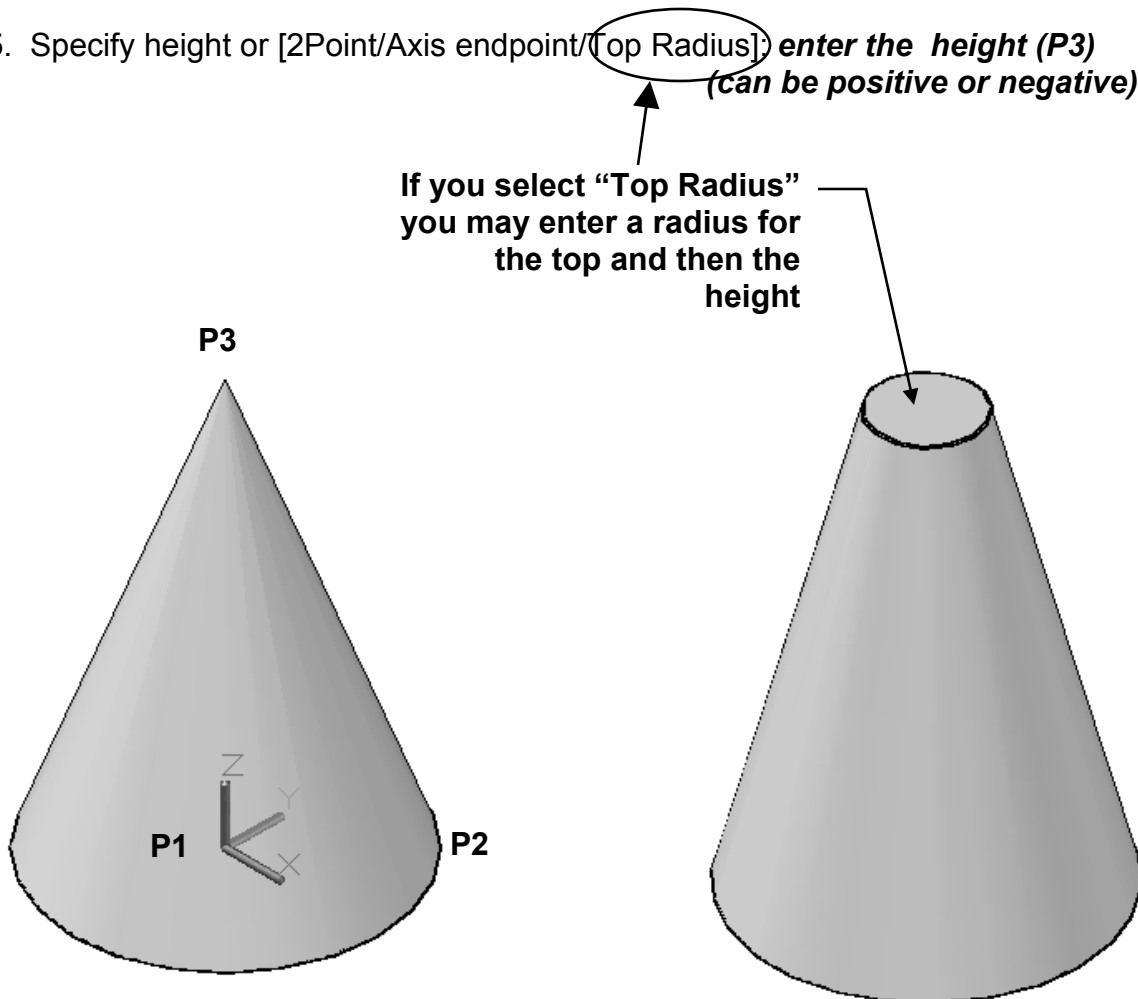
CONE

Cone command creates a Conical solid. There are 2 methods to create a Cone. You will define the center location, radius or Diameter for the base and then define the height or location for the apex.

Method 1

When using this method the default orientation for the base is on the X, Y plane and the height is perpendicular to the X, Y plane in the Z direction.

1. Select the **SE Isometric** view (14-10) and **Parallel** (14-7).
2. Select the **Cone** command. (15-2)
3. Specify center point of base [3P/2P/Ttr/Elliptical]: **type coordinates or pick location with cursor (P1)**
4. Specify base radius or [Diameter]: **enter radius or D. (P2)**
5. Specify height or [2Point/Axis endpoint/Top Radius]: **enter the height (P3)**
(can be positive or negative).

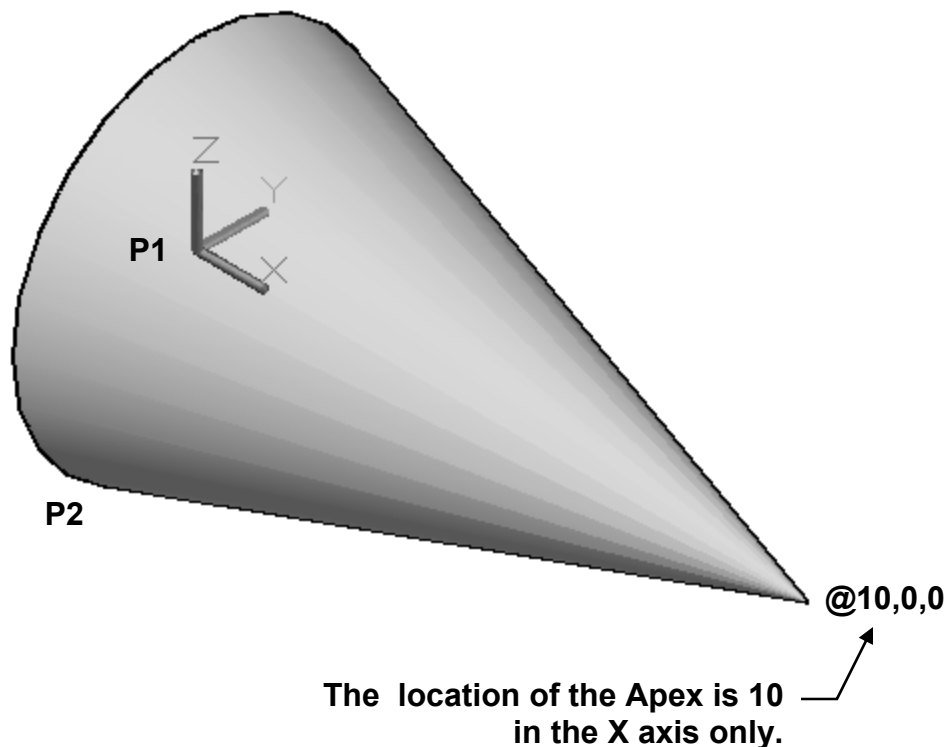


CONE....continued

Method 2

When using this method the orientation of the Cone depends on the placement of the Apex. Define the center of the base and radius then select the “Apex” option. Define the “Apex” location using coordinates or snapping to an object.

1. Select the **SE Isometric** view (14-10) and **Parallel** (14-7).
2. Select the **Cone** command. (15-2)
3. Specify center point of base or [Elliptical]: **type coordinates or pick location with cursor (P1)**
4. Specify base radius or [Diameter]: **enter radius or D. (P2)**
5. Specify height or [2Point/Axis endpoint/Top radius]: **type “A” <enter>**
6. Specify axis endpoint: **type coordinates or snap to an object. (P3)**

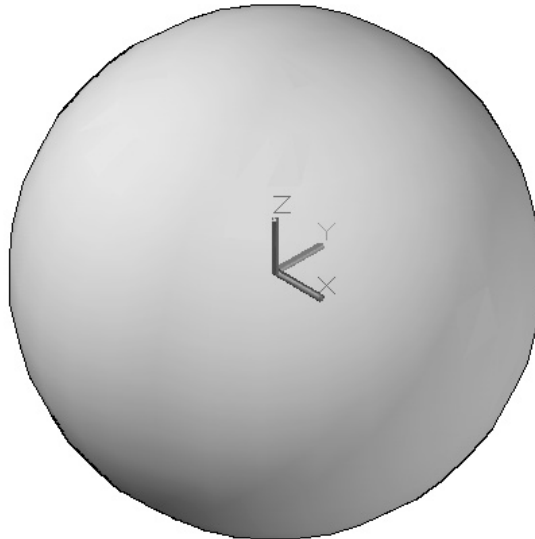


SPHERE

Sphere creates a spherical solid. You define the center point and then define the size by entering either the radius or the diameter.

1. **Start a new file and select Acad3d.dwt.**
2. Select the **Sphere** command. (See page 14-2)
3. Specify center point or [3P/2P/Ttr]: ***type coordinates or pick location with cursor.***
4. Specify radius of sphere or [Diameter]: ***enter radius or D.***

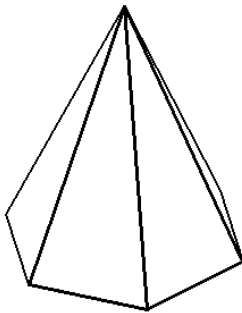
You may enjoy experimenting with Visual Styles.



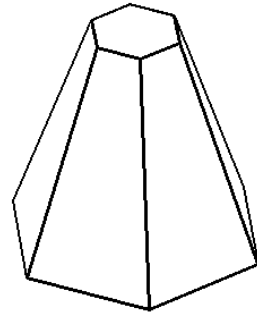
PYRAMID

The method for drawing a Pyramid is very similar to drawing a polygon for the base and a cone for the height. You specify the number of sides the base will need. It may have from 3 to 32 sides. Decide if the base radius is Inscribed or Circumscribed. Then define the height. If you select the Top radius option you can truncate it.

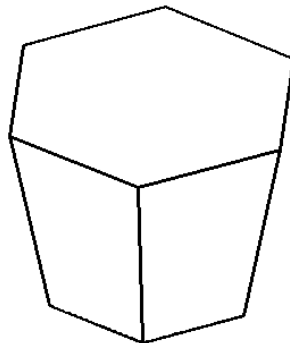
1. Select the **SE Isometric** view (14-10) and **Parallel** (14-7).
2. Select the **Pyramid** command.
3. Specify center point of base or [Edge/Sides]: **type "S"<enter>**
4. Enter number of sides <4>: **type number of sides <enter>**
5. Specify center point of base or [Edge/Sides]: **type coordinates or pick location with cursor for Center location**
6. Specify base radius or [Inscribed] <1.000>: **enter radius or D**
7. Specify height or [2Point/Axis endpoint/Top radius] <1.000>: **enter the height (can be positive or negative).**



**Pyramid with
6 sided base**



Truncated Pyramid
Use the "Top Radius"
option. Note: Top Radius
is smaller than base radius



Truncated Pyramid
Use the "Top Radius"
option. Note: Top Radius
is larger than base radius

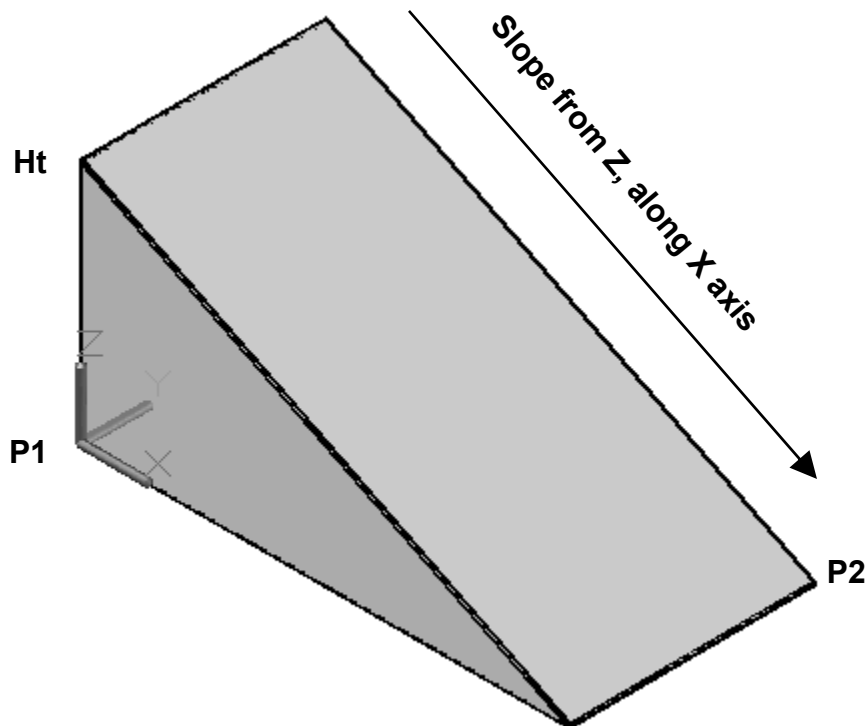
WEDGE

The Wedge command creates a wedge solid. There are 4 methods to create a Wedge. The base is always parallel with the XY plane and the height is always along the Z axis. The slope is always from the Z axis along the X axis.

Method 1

(Define the location for 2 corners of the Base and then the Height)

1. Select the **SE Isometric** view (14-10) and **Parallel** (14-7).
2. Select the **Wedge** command. (See page 15-2)
3. Specify first corner or [Center] <0,0,0>: ***type coordinates or pick location with cursor. (P1)***
4. Specify other corner or [Cube/Length]: ***type coordinates for the diagonal corner or pick location with the cursor. (P2)***
5. Specify height: ***type the height***

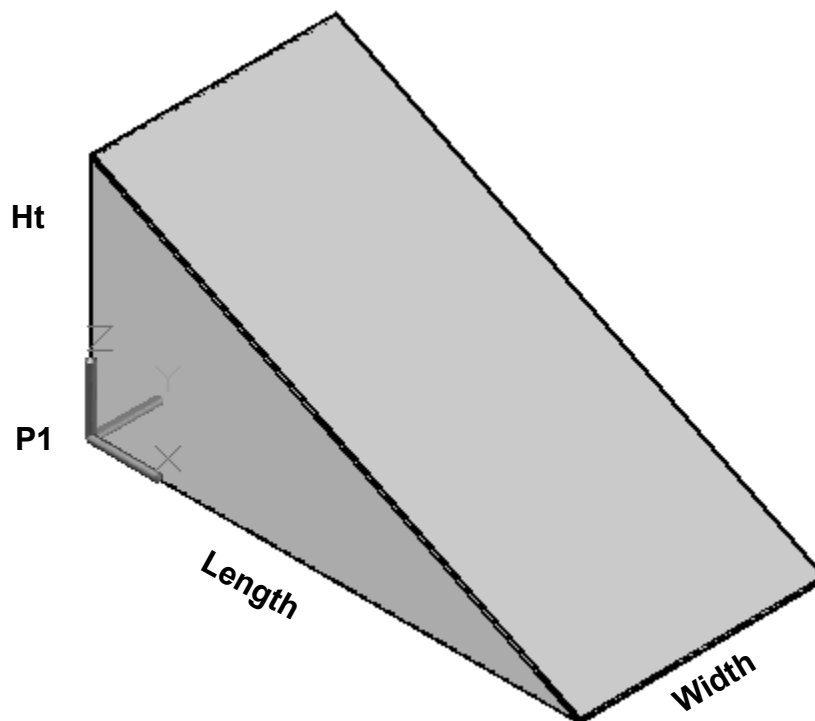


WEDGE....continued

Method 2

(Define the location for each: L, W and Ht)

1. Select the **SE Isometric** view (14-10) and **Parallel** (14-7).
2. Select the **Wedge** command. (See page 15-2)
3. Specify first corner or [Center]: *type coordinates or pick location with cursor. (P1)*
4. Specify other corner or [Cube/Length]: *type "L" <enter>.*
5. Specify length: *enter the Length (X axis).*
6. Specify width: *enter the Width (Y axis).*
7. Specify height: *enter the Height (Z axis).*

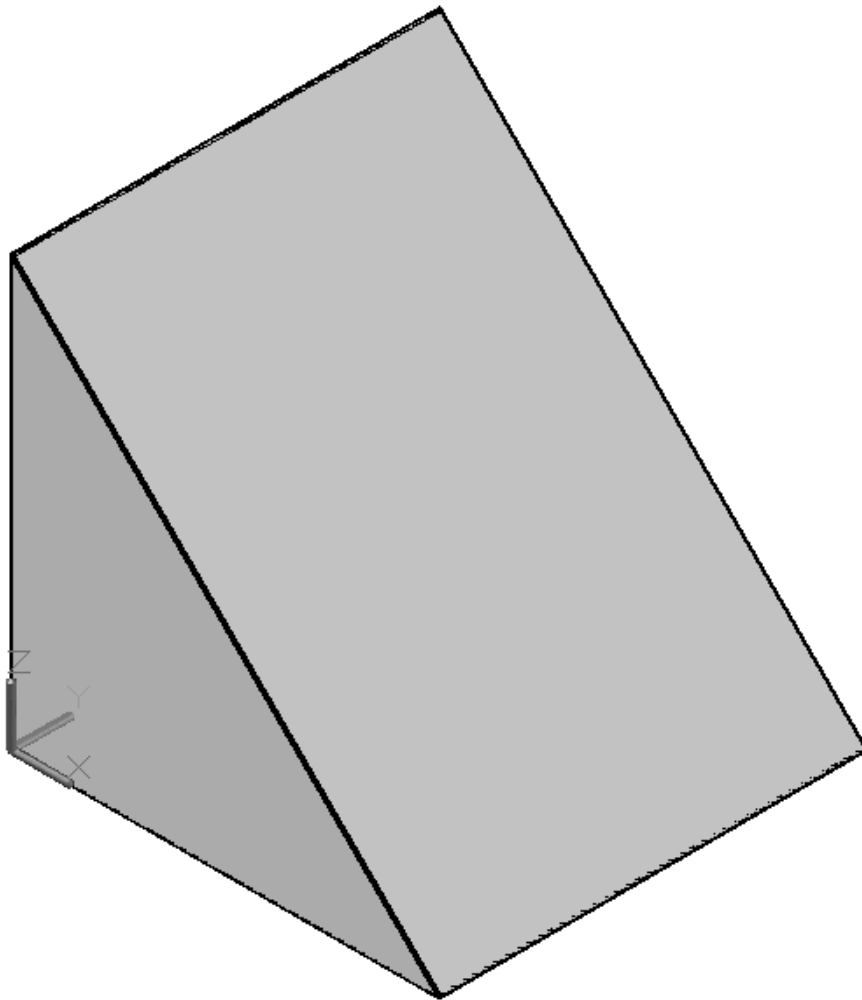


WEDGE....continued

Method 3

(Define the same dimension for Length, Width & Height)

1. Select the **SE Isometric** view (14-10) and **Parallel** (14-7).
2. Select the **Wedge** command.
3. Specify first corner or [Center] <0,0,0>: *type coordinates or pick location with cursor. (P1)*
4. Specify other corner or [Cube/Length]: *type "C" <enter.>*
5. Specify length: *enter the dimension.*

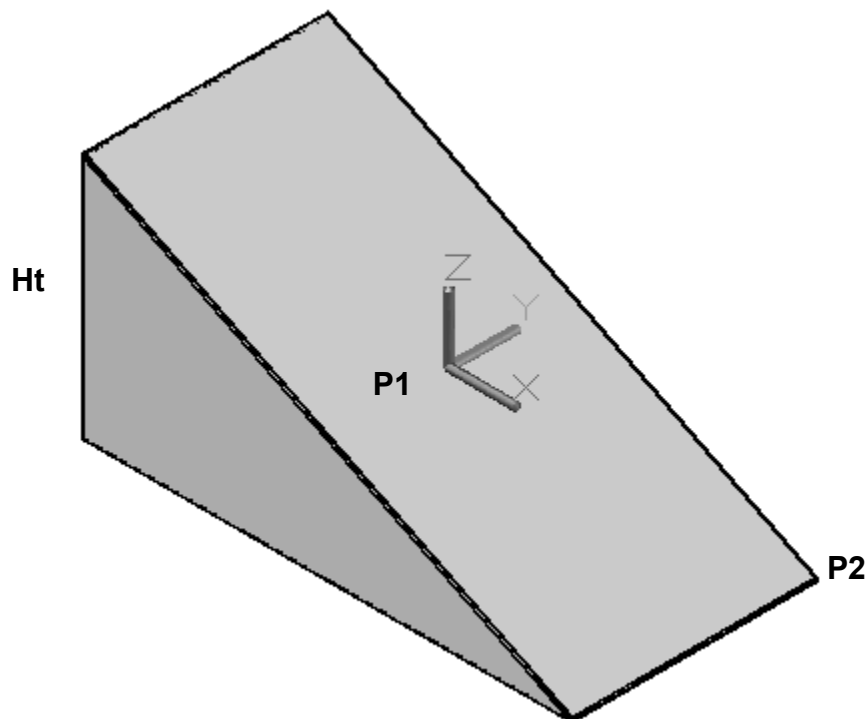


WEDGE....continued

Method 4

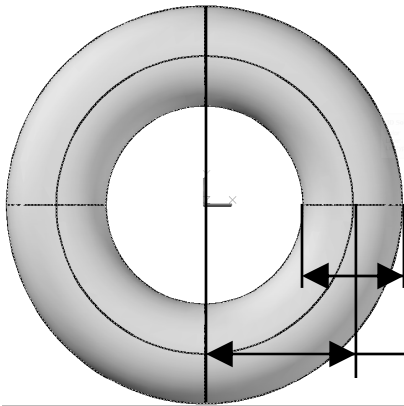
(Define the location for the Center and the Height)

1. Select the **SE Isometric** view (14-10) and **Parallel** (14-7).
2. Select the **Wedge** command.
3. Specify first corner or [Center] <0,0,0>: **type "C"<enter>**.
4. Specify center <0,0,0>: **type coordinates or pick location with cursor. (P1)**
5. Specify corner or [Cube/Length]: **type coordinates for a corner or pick location with the cursor. (P2)**
6. Specify height: **type the height.**



TORUS

The Torus command can be used to create 3 different solid shapes.

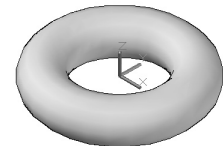


The 2 dimensions that are required are the radius or diameter of the **Torus** and the **Tube**.
(Pay close attention to what the Torus and Tube are defining. Example on the right)

Donut shaped

Note: the Torus radius must be greater than the Tube radius.

1. Select the **SE Isometric** view (14-10) and **Parallel** (14-7).
2. Select the **Torus** command. (See page 15-2)
3. Specify center point or [3P/2P/Ttr]: **type coordinates or pick location with cursor.**
4. Specify radius or [Diameter]: (**this dim. must be greater than the Tube radius**).
5. Specify tube radius or [2pt/Diameter]: (**this dim. must be less than the Torus radius**).



Torus=3 Tube=1

Football shaped

Note: the Torus radius must be negative and the Tube radius positive and greater than the Torus radius.

1. Select the **Torus** command.
2. Specify center point or [3P/2P/Ttr]: **type coordinates or pick location with cursor.**
3. Specify radius or [Diameter]: (**this dim. must be negative**).
4. Specify tube radius or [2pt/Diameter]: (**this dim. must be positive and greater than the Torus radius**).

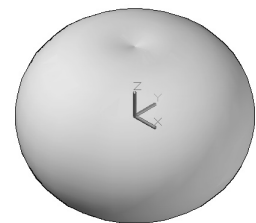


Torus=-2 Tube=3

Self-Intersecting

Note: the Torus radius must be less than the Tube radius.

1. Select the **Torus** command.
2. Specify center point or [3P/2P/Ttr]: **type coordinates or pick location with cursor.**
3. Specify radius or [Diameter]: (**this dim. must be less than the Tube radius**).
4. Specify tube radius or [2pt/Diameter]: (**this dim. must be greater than the Torus radius**).



Torus=1 Tube=3

EXERCISE 15A

Create 4 Solid Boxes

1. Start a **NEW** file using Acad3d.dwt
2. Select the **SE** Isometric view
3. **Create 4 solid boxes as shown below. You decide which method to use.**
(Refer to page 15-3 for instructions if necessary)
4. Save as **EX-15A**
5. **Do not Dimension** *Do not add the letters B, C or D. They are for reference only.*

BOX A

L = 14 W = 6 HT = -1

BOX B

L = 4 W = 3 HT = 2

BOX C

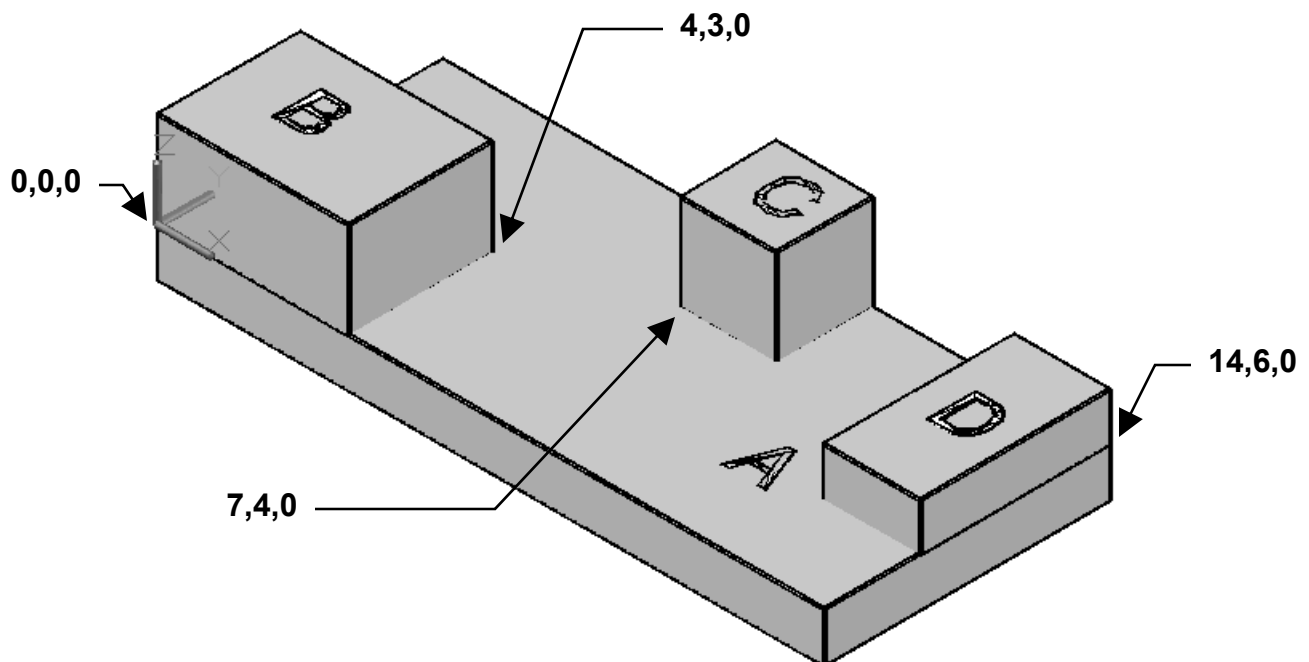
ALL SIDES 2"

BOX D

L = 2 W = 4 HT = 1 (Think, positive or negative)

Enter X, Y, Z coordinates for each point or Dynamic Input. If you use Dynamic Input make sure Ortho is ON for each point.

REMEMBER L = X AXIS W = Y AXIS HT = Z AXIS



EXERCISE 15B

Create 3 solid Cylinders

1. Open **EX-15A** (if not already open)
2. Add the 3 Cylinders as shown below.
Use Method 1 or 2 shown on page 15-7 and 15-8.
The method will depend on the information you are given below.

Read the command line prompts to make sure you are entering the correct information at the correct time.

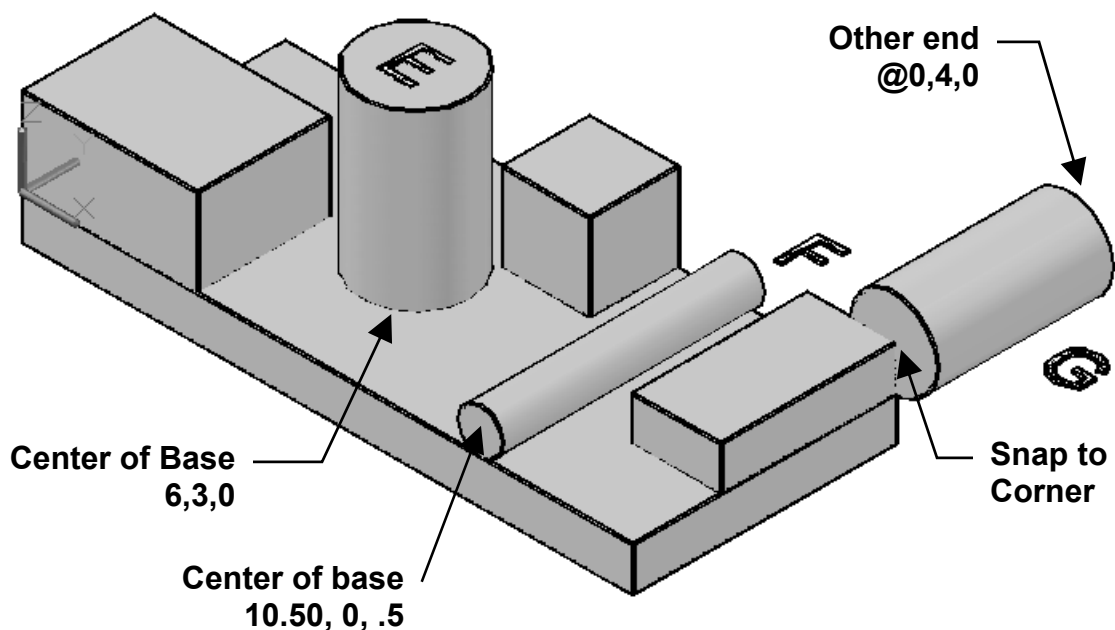
3. Select Orbit to confirm you have placed the objects in the correct location.
4. Save as **EX-15B**

Do not Dimension, do not add text

CYLINDER E
Radius = 1.25
Ht = 4"

CYLINDER F
6" from end to end
Dia = 1 (notice "diameter")
Hint: Use Axis endpoint
@0,6,0

CYLINDER G
Radius = 1
Length = 4



EXERCISE 15C

Create 2 solid Cones

1. Open **EX-15B** (If not already open)
2. Add the 2 Cones as shown below.
(Refer to page 15-9 for instructions if necessary)
3. Save as **EX-15C**

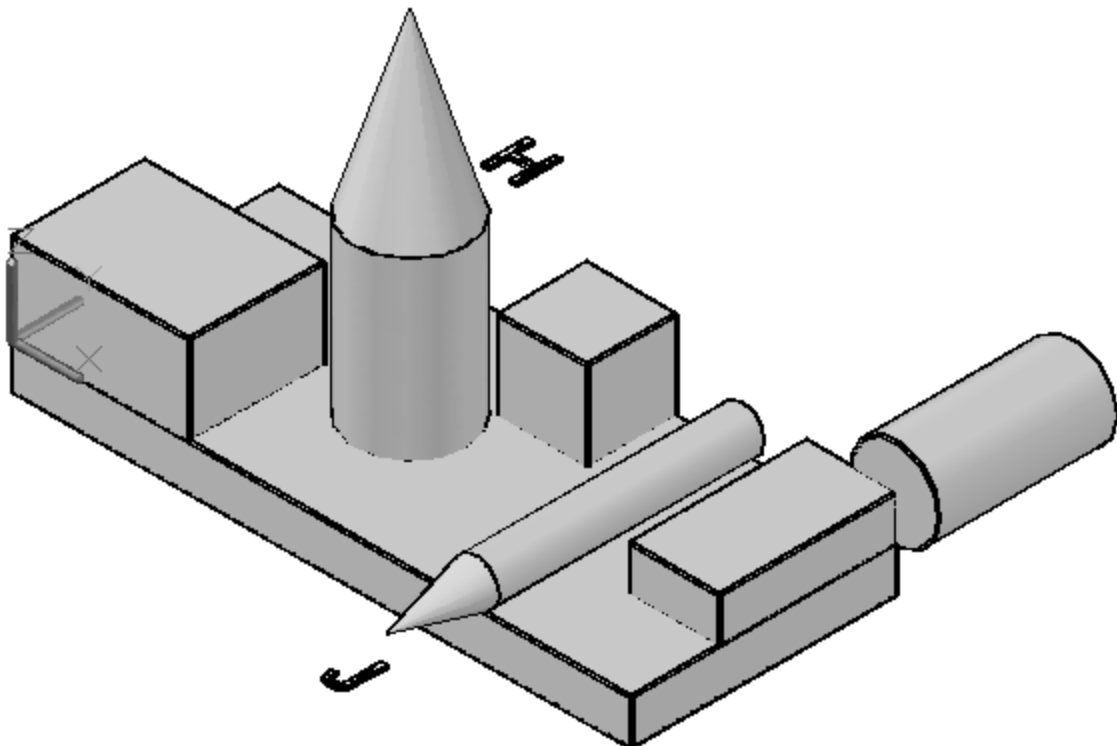
Do not Dimension

CONE H
Radius = 1.25
Ht = 4"

CONE J
Radius = .50
Ht = 2"

Note:

**Locate the Center location by snapping to the Center of the Cylinder.
Locate the Radius by snapping to the Quadrant of the Cylinder.
Remember, Ortho ON will help.**



EXERCISE 15D

Create 3 solid Wedges

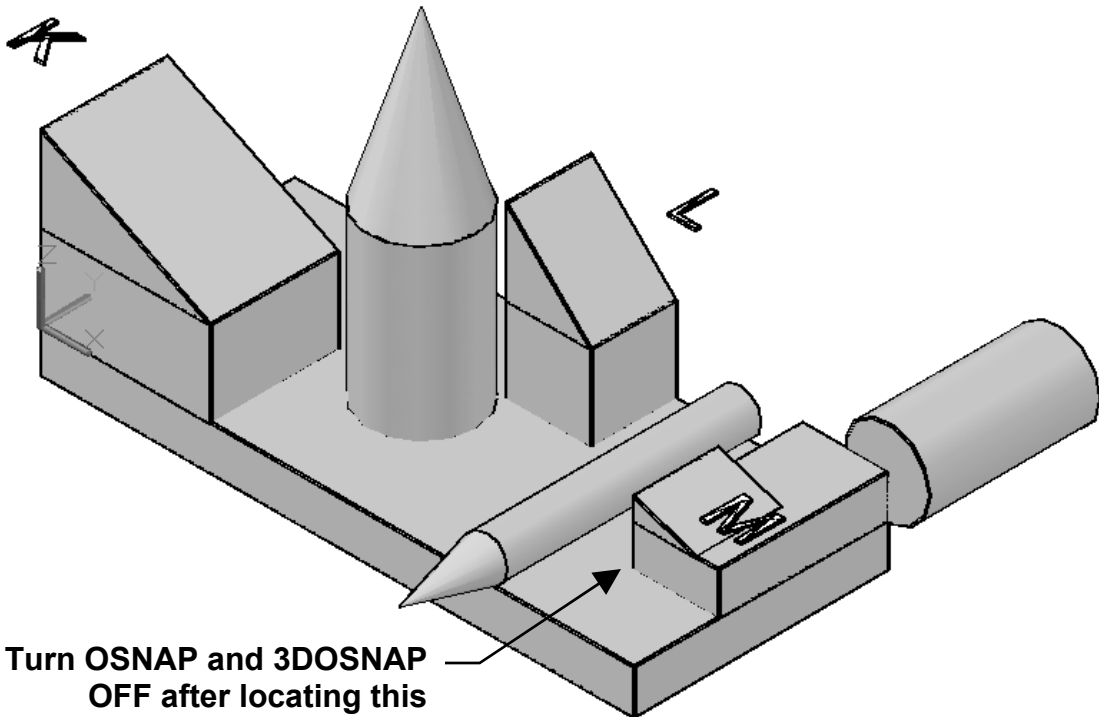
1. Open **EX-15C** (If not already open)
2. Add the 3 Wedges as shown below.
(Refer to page 15-13 for instructions if necessary)
3. Save as **EX-15D**

Do not Dimension

WEDGE K
Ht = 2"

WEDGE L
L, W & H = 2

WEDGE M
L = 1.5
W = 2
Ht = .5



Turn OSNAP and 3DOSNAP
OFF after locating this
corner. It may interfere with
placing the other corner.
Ortho should be ON.

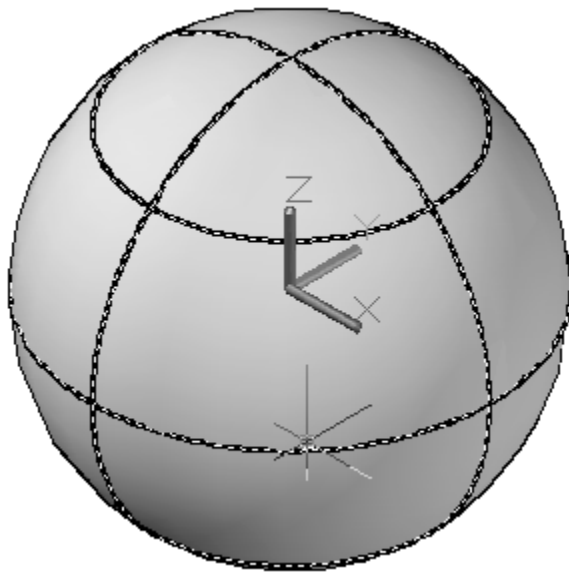
EXERCISE 15E

Create a solid Sphere

1. Start a **NEW** file using Acad3d.dwt
2. Select the **SE** Isometric view
3. Create the solid Sphere shown below.
(Refer to page 15-11 for instructions if necessary)
4. Experiment with Visual Styles.
5. Save as **EX-15E**

Do not Dimension

Center = 0, 0, 0
Radius = 4



EXERCISE 15F

Create 3 solid Torus'

1. Start a **NEW** file using Acad3d.dwt
2. Select the **SE** Isometric View.
3. Add the 3 Torus' as shown below.
(Refer to page 15-17 for instructions if necessary)
4. Save as **EX-15F** **Do not Dimension**

DONUT

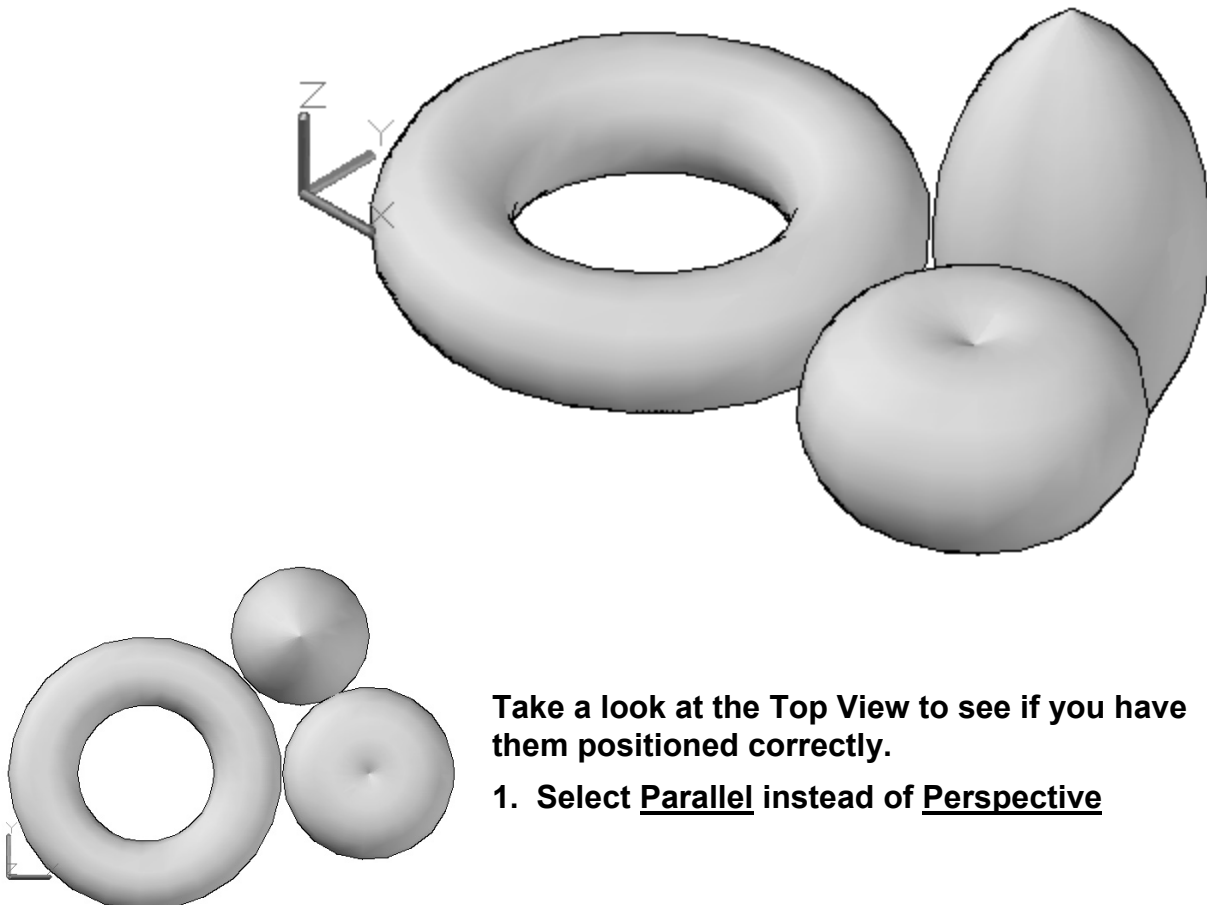
Center = 4, 3, 0
Torus Rad = 3
Tube Rad = 1

FOOTBALL

Center = 8.5, 7, 0
Torus Rad = -3
Tube Rad = 5

SELF-INTERSECTING

Center = 10.5, 3, 0
Torus Rad = 1
Tube Rad = 1.50



Take a look at the Top View to see if you have them positioned correctly.

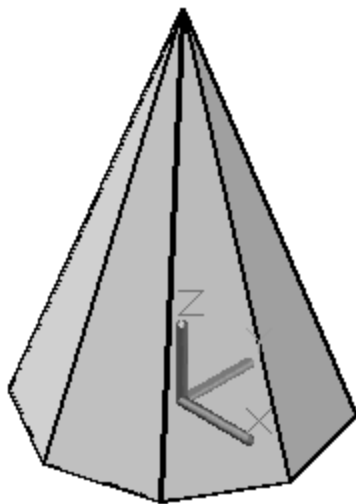
1. Select Parallel instead of Perspective

EXERCISE 15G

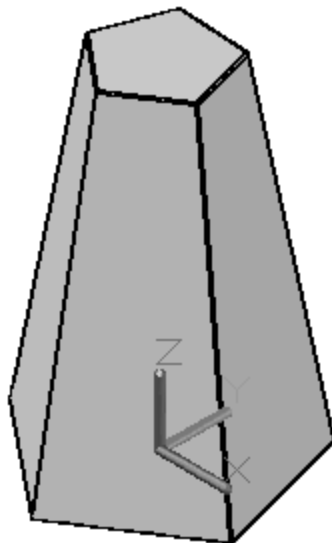
Create 2 Pyramids

1. Start a **NEW** file using Acad3d.dwt
2. Draw the 2 Pyramids (INSCRIBED) shown below.
(Refer to page 15-12 for instructions if necessary)
3. Save as **EX-15G**

Do not Dimension



Sides = 8
Base Radius = 2
Ht = 6



Sides = 5
Base Radius = 2
Top Radius = 1
Ht = 6

Note:

You may also create this pyramid by changing the pyramid above using "Properties".