Course Title: AutoCAD 3D

Covered Course: Civil Engineering Drawing-II Sessional

COURSE CODE: CE 0731-2100 **CREDIT: 01**

CIE MARKS: 30

SEE MARKS: 20

CLO 01 **Explain** about AutoCAD 3D Max, Sketchup.

CLO 02 **Solve** practical problems of visual building plan.

CLO 03 **Examine** different attractive views of building.

CLO 04 **Plan** effectively to work on a field.

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Sl.	Course Contents	Hours	CLOs
1	Create 2D floor plan, File import & Controlling Views, Solid object create with Thickness and Elevation.	30	CLO 1, CLO 2
2	Wall making, Visualizing the Model, Z Coordinates, User Coordinate System, Window & Door Making by 3D Orbit Commands.	20	CLO 3
3	Thickness and Elevation, Typical Floor Copy, Colour Creation.	15	CLO 3
4	Background & Light, Camera setup, Rendering.	15	CLO 4

Reference

AutoCAD 3D Hand Note:- Kristen Kurland

Week	Topic	Teaching Learning Strategy	Assessment Strategy	CLOs	Page
1-3	Create 2D floor plan, File import & Controlling Views.	Lecture, Discussion	Lab Test, Quiz and Report	CLO 1	3-17
4-6	Solid object create with Thickness and Elevation.	Lecture, Discussion	Lab Test, Quiz and Report	CLO 2	17-28
7-8	Wall making, Visualizing the Model, Z Coordinates, User Coordinate System.	Lecture, Discussion	Lab Test, Quiz and Report	CLO 3	28-67
9	Window & Door Making by 3D Orbit Commands,	Lecture, Discussion	Lab Test, Quiz and Report	CLO 3	68-152
10	Thickness and Elevation.	Lecture, Discussion	Lab Test, Quiz and Report	CLO 3	153-179
11	Typical Floor Copy.	Lecture, Discussion	Lab Test, Quiz and Report	CLO 3	179-199
12-13	Colour Creation.	Lecture, Discussion	Lab Test, Quiz and Report	CLO 3	200-269
14	Background & Light.	Lecture, Discussion	Lab Test, Quiz and Report	CLO 4	269-299
15	Camera setup.	Lecture, Discussion	Lab Test, Quiz and Report	CLO 4	300-306
16	Rendering.	Lecture, Discussion	Lab Test, Quiz and Report	CLO 4	306-323

Assessment Strategy

CIE- Continuous Internal Evaluation (60 Marks) (Should be converted in 30 marks)

Bloom's Category Marks (out of 60)	Lab Final (30)	Lab Report (10)	Continuous lab performance (10)	Presentation & Viva (10)	External Participation in Curricular/Co-Curricular Activities (10)
Remember	05			02	Attendance 10
Understand	05	05	02	03	
Apply	05		02		
Analyze	05		02		
Evaluate	05	05	02		
Create	05		02	05	

SEE- Semester End Examination (40 Marks) (Should be converted in 20 marks)

Bloom's Category	Tests
Remember	05
Understand	05
Apply	10
Analyze	05
Evaluate	05
Create	10

AutoCAD 3D Training Manual

1st – 3rd Week

Create 2D floor plan, File import & Controlling Views

Chapter 1
Controlling Views

Viewports 1.1

-Vports Command

1. **Type** -VPORTS at the command prompt.

   Command: **-vports**

   Enter an option [Save/Restore/Delete/Join/SIngle/?/2/3/4] <3>: **enter**

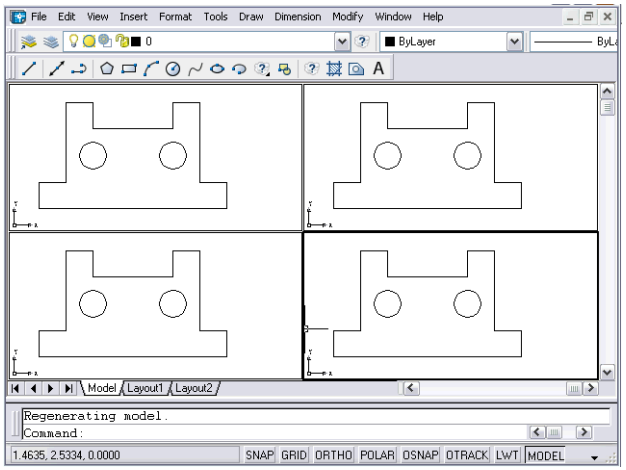
   Enter a configuration option [Horizontal/Vertical/Above/ Below/Left/Right] <Right>: **enter**

   Regenerating model.

2. **Click** once in each vport to make it active.
3. **Type** a ZOOM option in each viewport.

   NOTE: AutoCAD plots only the current vport.

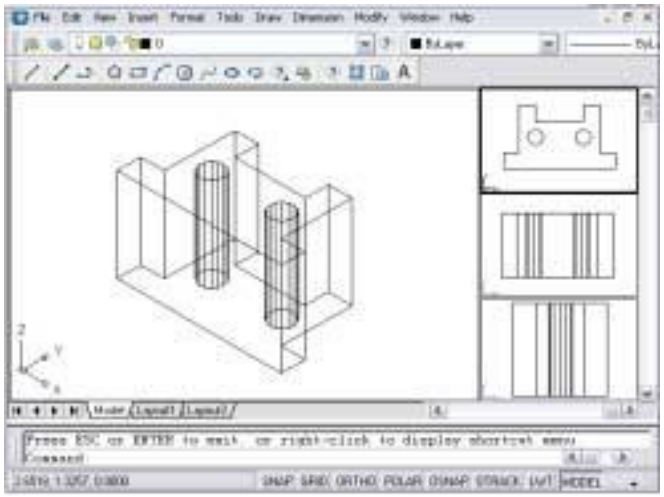
Screen divided into three tiled viewports



3D Viewports 1.2

1. **Choose** View, Viewports, New Viewports
2. **Click** the dropdown option for Setup and click 3D.
3. **Click** OK.

New Viewports tab of the Viewports dialog



Preset Views 1.3

1. **Choose** View, Named Views
2. **Click** **Orthographic & Isometric Views** tab of the View dialog.
3. **Click** One of the following view options:

   Top

   Bottom

   Front

   Back

   Left

   Right

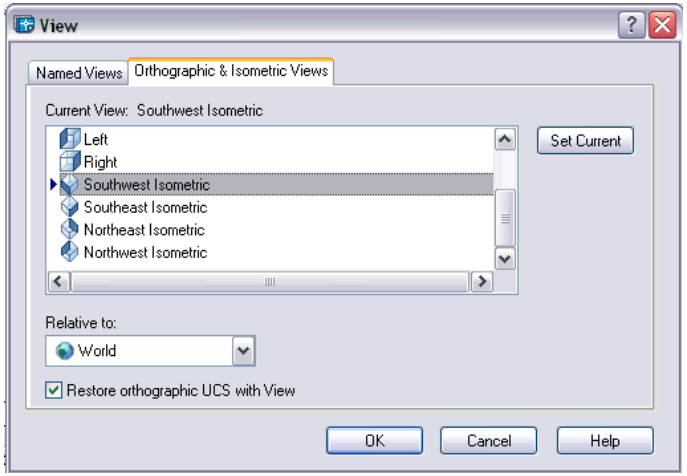
   Southwest Isometric

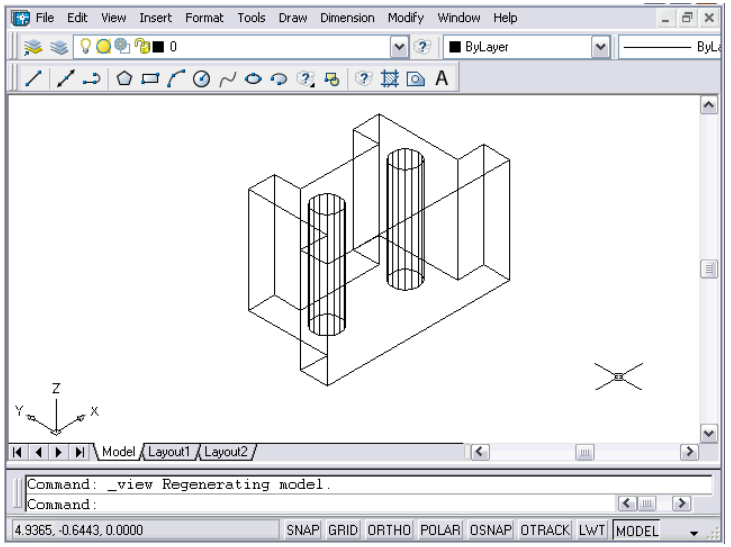
   Southeast Isometric

   Northeast Isometric

   Northwest Isometric

4. **Click** the **Set Current** button
5. **Click** the **OK** button





Vpoint Command (Tripod) 1.4

Displays a compass and tripod for defining a view rotation. The compass represents a two dimensional globe.

1. **Choose** View, 3D Views, Vpoint

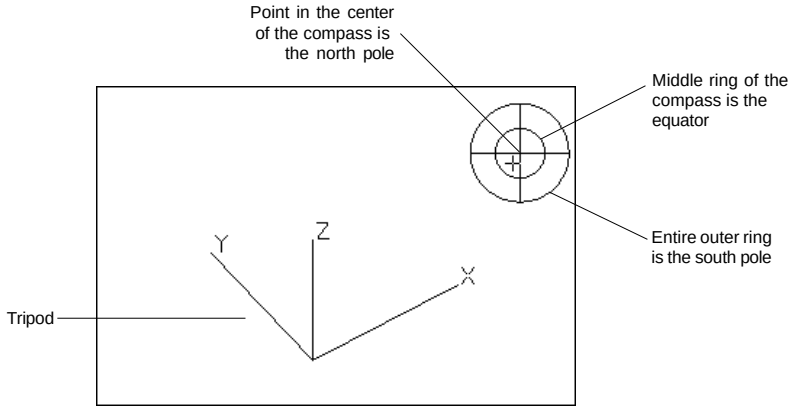
   or

2. **Type** VPOINT at the command prompt.

   Command: **vpoint**

   Rotate/<View point> <-0.614,-0.614,0.500>: **(enter)**

3. **Click** a point on the compass to define the viewing angle.



Vpoint Command (Rotate) 1.5

Enters a rotation angle at the viewpoint prompt.

1. **Choose** View, 3D Views, Vpoint

   or

2. **Type** VPOINT at the command prompt.

   Command: **vpoint**

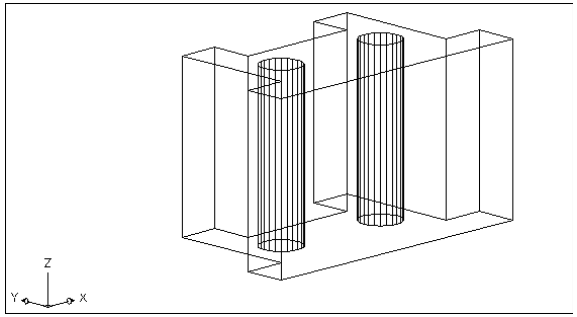
   Rotate/<View point> <-0.614,-0.614,0.500>: **R (enter)**

   Enter angle in XY plane from X axis <225>: **225 (enter)**

   Enter angle from XY plane <30>: **15 (enter)**

   Regenerating drawing.

Resultant viewport with new 3D view



DDVpoint Command 1.6

1. **Choose** View, 3D Views, Viewpoint Preset

   or

2. **Type** DDVPOINT at the command prompt.

   Command: **ddvpoint**

3. **Set** a viewing angle by typing the From X axis and XY Plane angle.

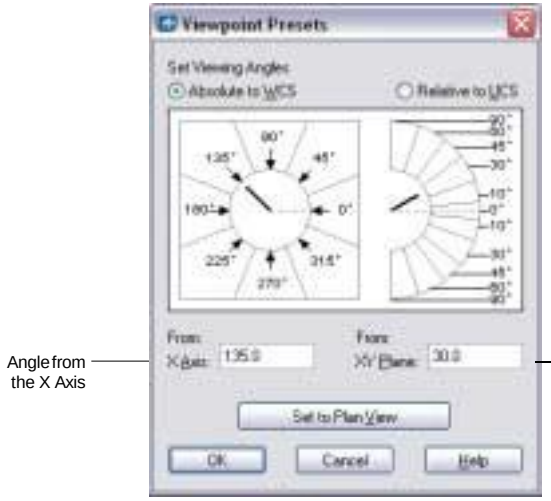
   or

4. **Pick** a viewing angle in the 2 graphics

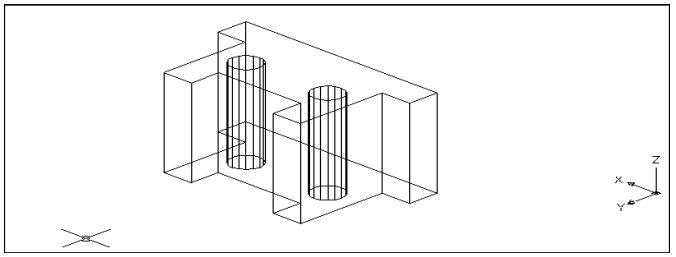
   Left graphic = From X Axis

   Right graphic = In XY Plane

5. **Click** OK.



Resultant viewport with new 3D view



Vpoint Command (Vector Option) 1.7

Enters coordinates at the viewpoint prompt.

1. **Choose** View, 3D Views, Vpoint

   or

2. **Type** VPOINT at the command prompt.

   Command: **vpoint**

   Rotate/<View point> <-1.690,-1.981,2.995>: **-1,-1,1**

   Regenerating drawing.

Other Preset Viewpoints 1.8

1. **Choose** View, 3D Views, and one of the following viewpoint options:

   Top, Bottom,

   Left, Right,

   Front, Back

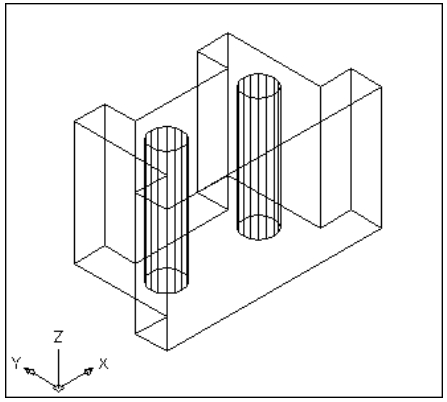
   SW Isometric

   SE Isometric

   NW Isometric

   NE Isometric

Resultant viewport with entered coordinates -1,-1,1



Plan View 1.9

1. **Choose** View, 3D Views, Plan View the one of the following:

   Current UCS, World UCS, Named UCS

   or

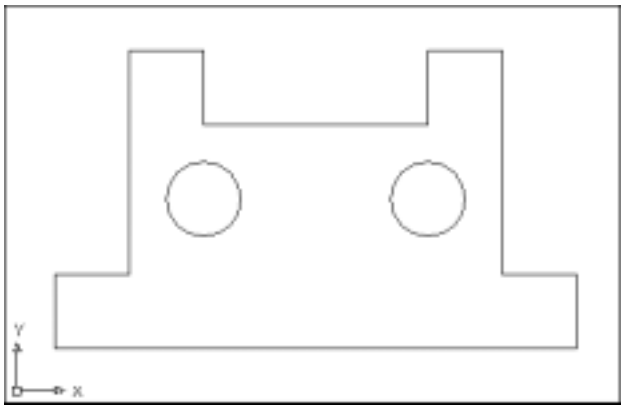
2. **Type** PLAN at the command prompt.

   Command: **plan**

   Enter an option [Current ucs/Ucs/World] <Current>:

   Regenerating model.

Current ucs	Goes to the plan view of the current UCS.
Ucs	At the command line type in a name of a previously named Coordinate System.
World	Goes to the plan view of the World Coordinate System.



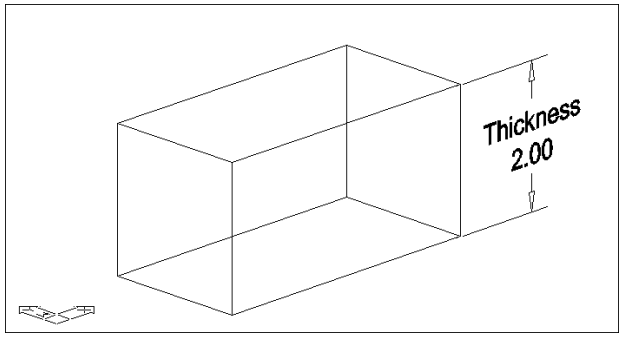
(4^{th} - 6^{th}) Week
Solid Object Creation with Thickness and Elevation

Chapter 2
Thickness and Elevation

Thickness Command 2.1

Sets the current 3D solid thickness.

1. **Type** THICKNESS at the command prompt.
   Command: **thickness**
   Enter new value for THICKNESS <0.0000>: **2.00**



Changing the Current Thickness 2.2

Changing the current properties of an object changes its thickness.

1. **Choose** Modify, Properties...

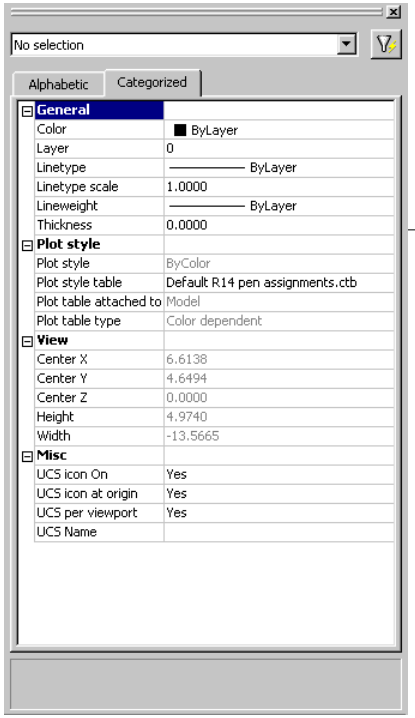
   or

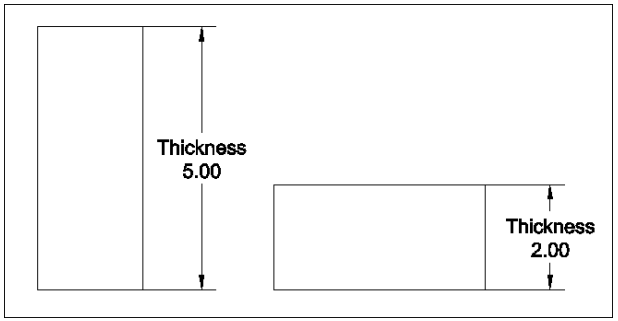
2. **Type** DDMODIFY or DDCHPROP at the command prompt.

   Command: **ddmodify** or **ddchprop**

   or

3. **Choose**  from the Standard Toolbar





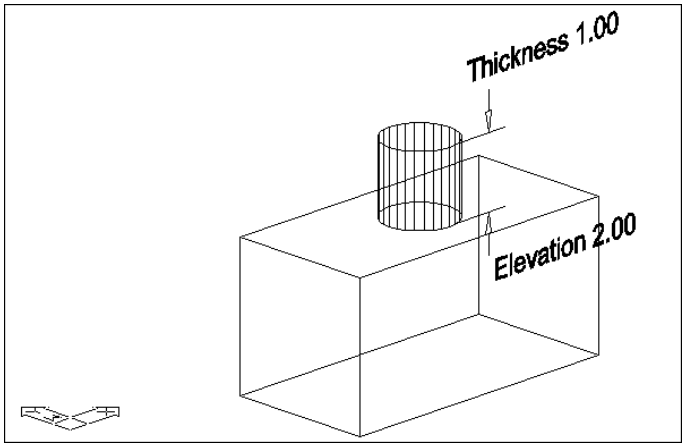
Elevation Command 2.3

Stores the current elevation relative to the current UCS for the current space.

1. **Type** ELEVATION at the command prompt.

   Command: **elevation**

   Enter new value for ELEVATION <0.0000>: **2.00**



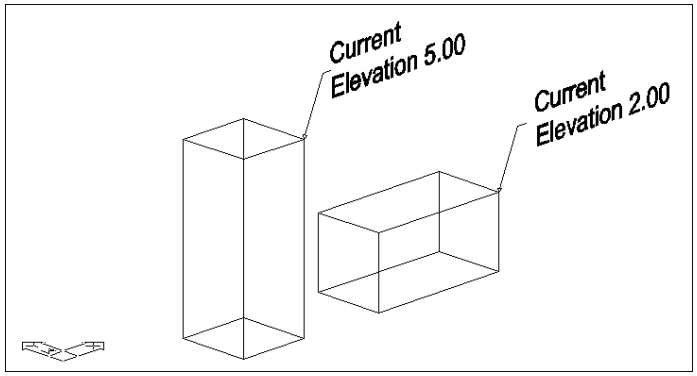
Shortcut to Elevation & Thickness Commands 2.4

1. **Type** ELEV at the command prompt.

   Command: **elev**

   Specify new default elevation: <2.0000>:

   Specify new default thickness: <3.0000>:



(7^{th} – 8^{th}) Week

Wall making, Visualizing the Model, Z Coordinates, User Coordinate System

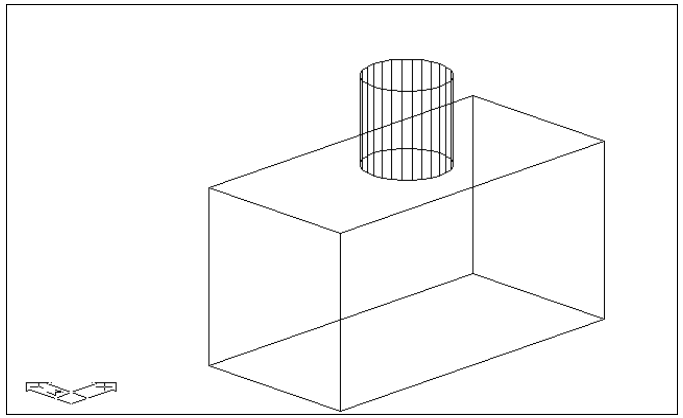
Chapter 3
Visualizing the Model

Hide Command 3.1

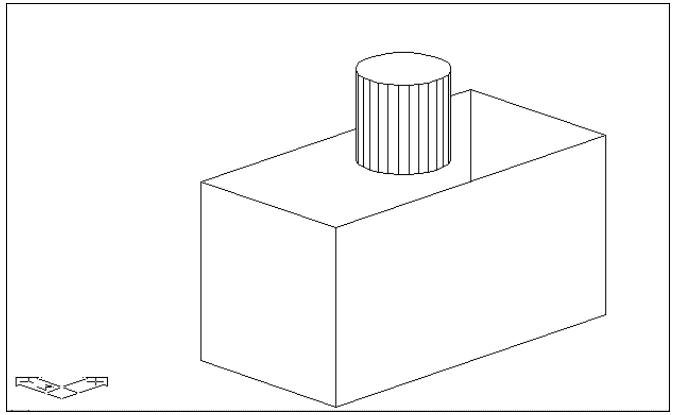
Regenerates a three-dimensional model with hidden lines suppressed.

1. **Type** HIDE at the command prompt.
   Command: **hide**
   Regenerating Model.
   OR
2. **Choose** View, Hide.

Objects Before Hidden Line Removal



Objects After Hidden Line Removal



Shade Command 3.2

Displays a flat-shaded image of the drawing in the current viewport while performing a hidden line removal.

1. **Type** SHADE at the command prompt.

   Command: **shade**

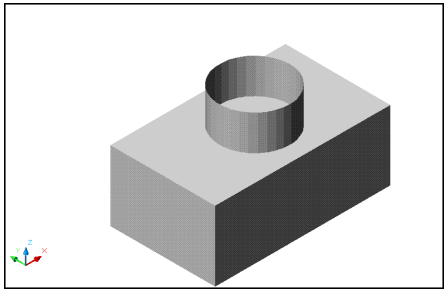
   Regenerating Drawing.

   OR

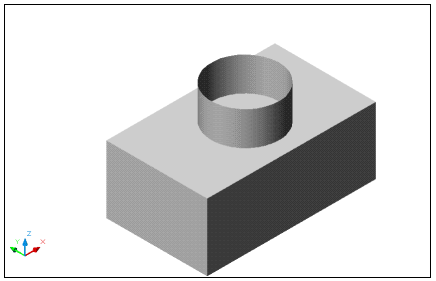
2. **Choose** View, Shade.

The following are various shade options:

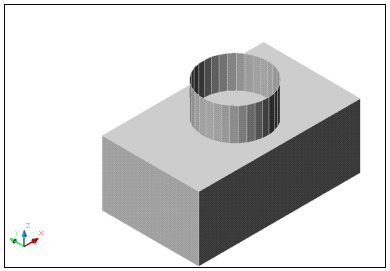
Flat Shaded



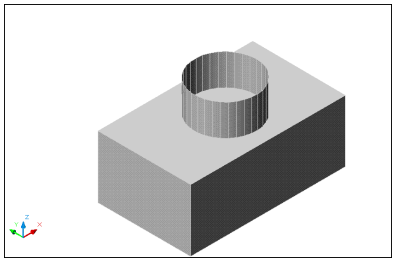
Gourand Shaded (Smoother)



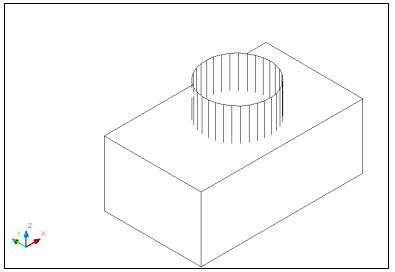
Flat Shaded (edges on)



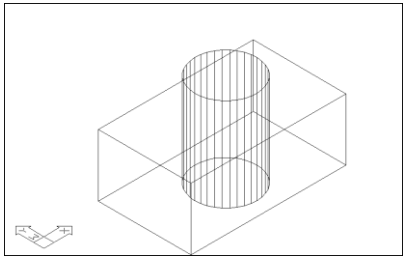
Gourand Shaded (edges on)



Gourand Shaded (edges on)



3D Wireframe



Shadedge Variable 3.3

Controls shading of edges in rendering.

1. **Type** SHADEDGE at the command prompt.

   Command: **shadedge**

   Enter new value for SHADEDGE <3>: **(enter)**

   0 Faces shaded, edges not highlighted

   1 Faces shaded, edges drawn in background color

   2 Faces not filled, edges in object color

   3 Faces in object color, edges in background color

Shadif Variable 3.4

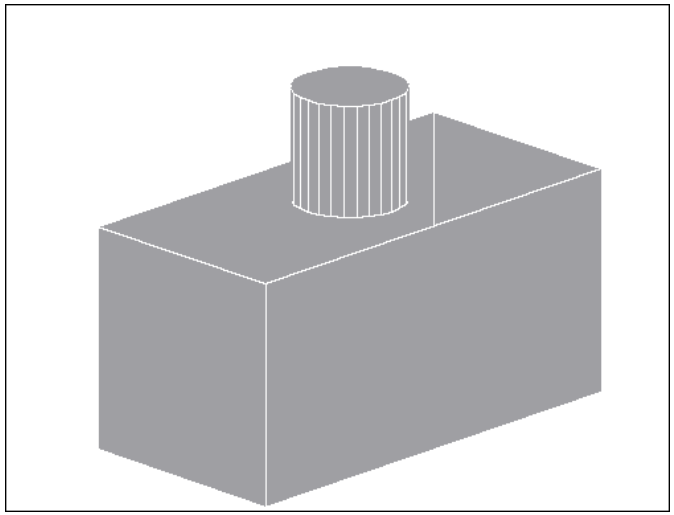
Sets the ratio of diffuse reflective light to ambient light (in percentage of diffuse reflective light).

1. **Type** SHADEDIF at the command prompt.

   Command: **shadedif**

   Enter new value for SHADEDIF <70>:**20**

Shaded Object



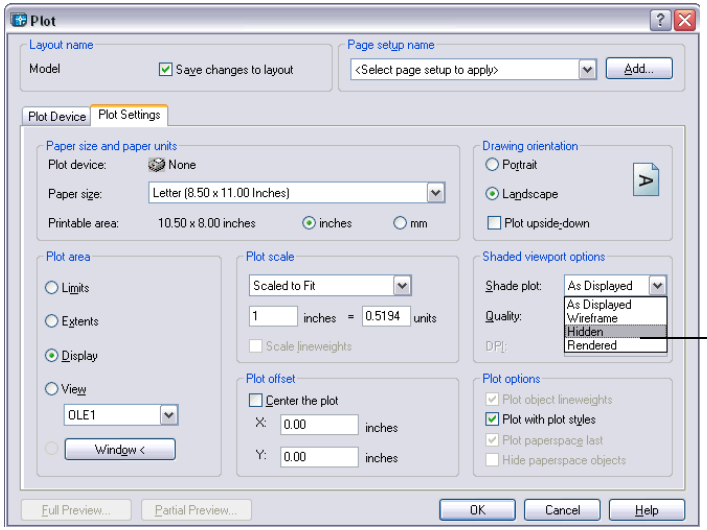
Hidden Line Removal and Shade for Plots 3.5

If your drawing contains 3D faces, meshes, extruded objects, sur faces, or solids, you can direct AutoCAD to remove hidden lines or shade from specific viewports when you plot the paper space view.

1. **Type** PLOT at the command prompt.

   Command: **plot**

2. **Choose** the check box beside the option to remove hidden lines.



Hidden Line Removal in Mviews (Paper Space) 3.6

1. **Type** MVIEW at the command prompt.

   Command: **mview**

   Specify corner of viewport or

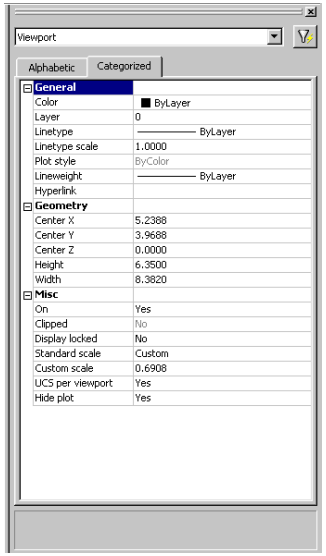
   [ON/OFF/Fit/Shadeplot/Lock/Object/Polygonal/Restore/2/3/4] <Fit>: **s**

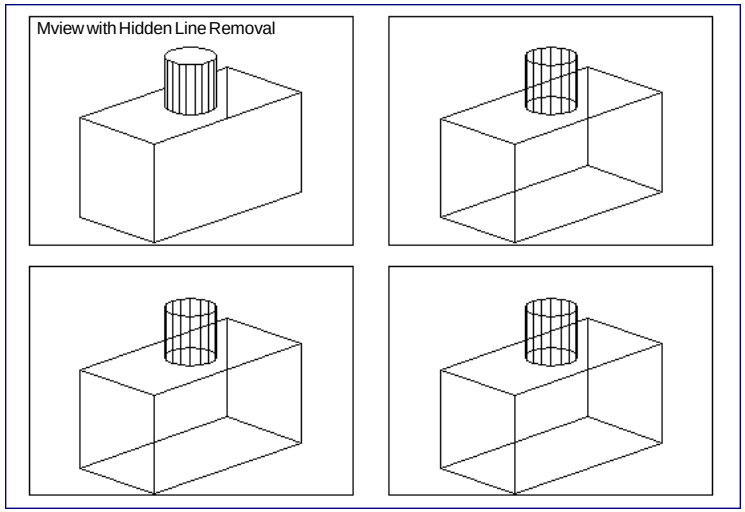
   Shade plot? [As displayed/Wireframe/Hidden/Rendered] <As displayed>: **h**

   Select objects: **pick mview in paperspace.**

   Select objects: **enter**

   NOTE: You do not see t,he effect of this command until you plot the drawing.





Chapter 4
Z Coordinates

Entering 3D Coordinates 4.1

3D Coordinates

Entering 3D Cartesian coordinates (X,Y,Z) is similar to entering 2D coordinates (X,Y). In addition to specifying X and Y values, you specify a Z value.

3D Polyline

1. **Type** Any command asking for a "point" at the command prompt.

   Command: **3DPOLY**

   Specify start point of polyline: **1,1,0**

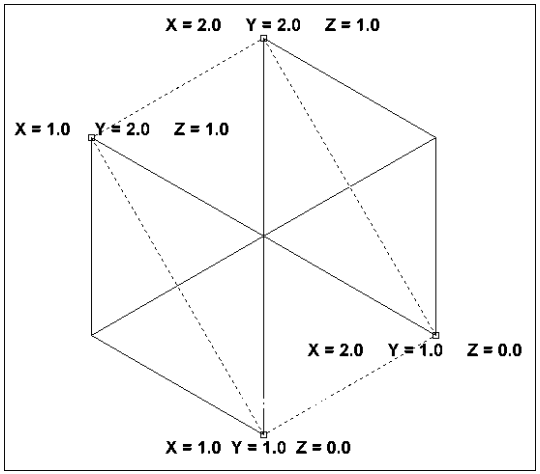
   Specify endpoint of line or [Undo]: **1,2,1**

   Specify endpoint of line or [Undo]: **2,2,1**

   Specify endpoint of line or [Close/Undo]: **2,1,0**

   Specify endpoint of line or [Close/Undo]: **1,1,0**

3D Polyline Drawn with 3D Coordinates



Moving in the Z Direction 4.2

Move Command

To move an object in the Z direction, use the move command.

1. **Type** MOVE at the command prompt.

   Command: **move**

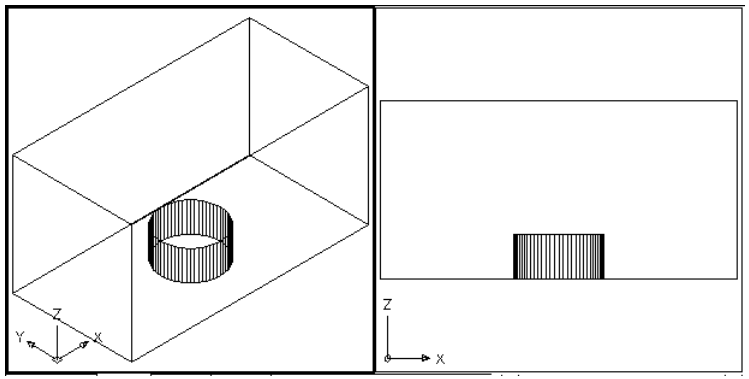
   Select objects: **(pick object)** 1 found

   Select objects: hit enter

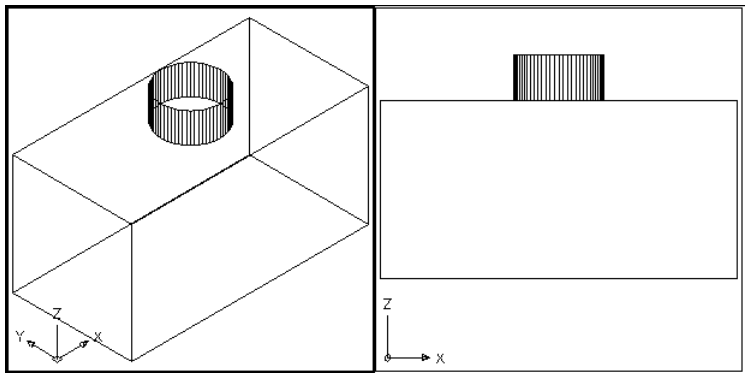
   Specify base point or displacement: **0,0,0**

   Specify second point of displacement or
   <use first point as displacement>: **0,0,1**

Original Circle Draw at Elevation Zero



Circle Moved -2 Units in the Z Direction



3D Point Filters 4.3

To place a point 1 inch above the back left corner of the rectangle, you can use point filters. Before issuing the point filter command, use DDPTYPE and choose a visible point style.

1. **Type** Any command asking for a “point” at the command prompt.

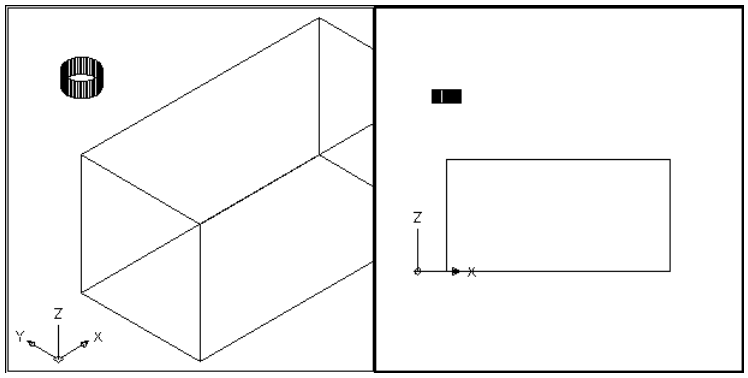
   Command: **point**

   Point: **.xy**

   of end **P1**

   of (need Z): **2**

3D Point Filters

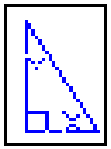


Chapter 5
User Coordinate System

UCSICON 5.1

The UCS icon represents the orientation of the UCS axes and the location of the current UCS origin. It also represents the current viewing direction relative to the UCS XY plane.

Mspace UCSICON *Pspace UCSICON*



1. **Choose** View, Display, UCS Icon, On/Off.

   or

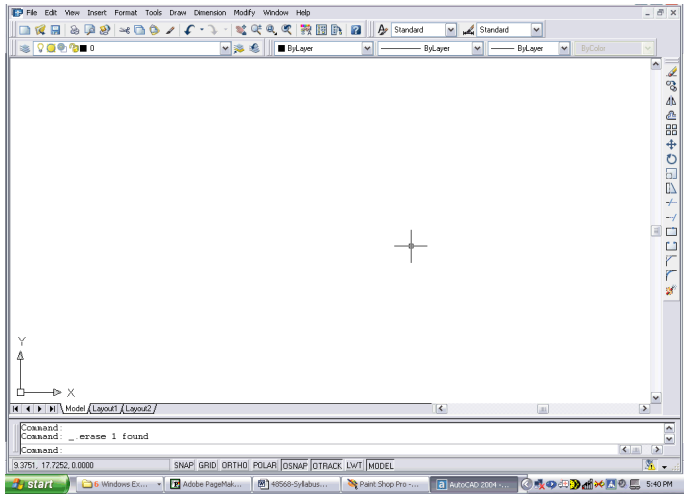
2. **Type** UCSICON at the command prompt.

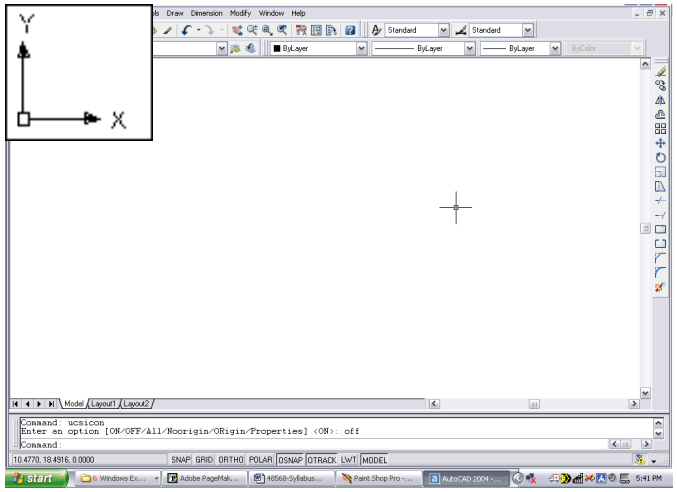
   Command: **ucsicon**

   Enter an option [ON/OFF/All/Noorigin/ORigin] <ON>:

ON	Displays the UCS icon.
OFF	Turns off the display of the UCSICON.
All	Affects the display of the UCSICON in all viewports.
Noorigin	Always displays the UCS at the lower left corner.
ORigin	Shows the UCS at the 0,0,0 origin of the current UCS.

UCS icon turned ON





UCS Overview 5.2

Manages user coordinate systems. The user coordinate system provides an alternate movable coordinate system for coordinate entry, planes of operation, and viewing. Most AutoCAD geometric editing commands are dependent on the location and orientation of the UCS.

1. **Type** UCS at the command prompt.

   Command: **ucs**

   Enter an option [New/Move/orthoGraphic/Prev/Restore/ Save/Del/Apply/?/World] <World>:

2. **Choose** One of the following UCS options:

   New Defines a new coordinate system by one of six methods: **Origin, Z Axis, 3 Point, Object, Face, View X, Y, Z**

   Origin Defines a new UCS by shifting the origin of the current UCS, leaving the direction of the X,Y, and Z axes unchanged.

   ZAxis Allows you to define a new origin.

   3 Point Specifies a UCS by its origin and a point on the positive X and Y axes.

   Object Lets you define a new coordinate s ystem by pointing at an entity (except a 3D polyline, polygon mesh, or viewport entity).

   Face Aligns the UCS to the selected face of a solid object.

   View Establishes a new coordinate system whose XY plane is perpen dicular to your viewing direction (i.e. parallel to your screen).

   X/Y/Z Rotates the ucs around a specified axis

Move Redefines a UCS by shifting the origin or changing the Z-depth of the current UCS, leaving the orientation of its XY plane un changed.

OrthoGraphic Specifies one of the six orthographic UCSs provided with AutoCAD. These UCS settings are typically used when viewing & editing 3D models **[Top/Bottom/Front/Back/Left/Right]**

Previous Restores the previously saved UCS.

Restore Restores a saved UCS.

Save Names and saves a UCS.

Delete Removes a saved UCS definition.

World Restores the World Coordinate System.

? Lists the defined UCSs in the current drawing.

UCS Toolbar

UCSII Toolbar

World UCS 5.3

1. **Type** UCS at the command prompt.

   Command: **ucs**

   Current ucs name: *NO NAME*

   Enter an option [New/Move/orthoGraphic/Prev/Restore/ Save/Del/Apply/?/World] <World> **(press enter)**

   World Returns the UCS back to the original World UCS.

   NOTE: This is the UCS you should use when creating Wblocks and inserting Wblocks. It is the only UCS guaranteed to be the same in all AutoCAD drawings.

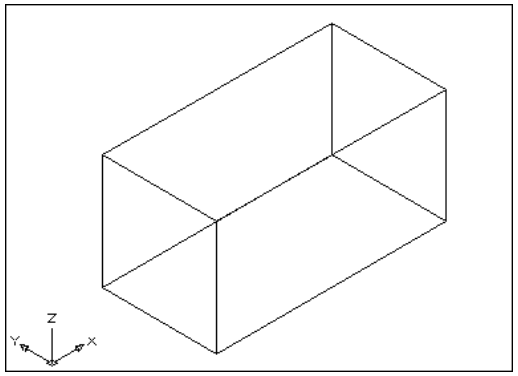
Tip: To enter coordinates relative to the WCS

- Precede coordinate values with an asterisk (*).

  Entering @*2,0,0 specifies a point two units in the X direction of the last point entered relative to the WCS.

  Entering @2,0,0 specifies a point two units in the X direction of the last point entered relative to the UCS.

  In practice, most coordinates are entered relative to the UCS rather than the WCS.



3 Point UCS 5.4

1. **Type** UCS at the command prompt.

   Command: **ucs**

   Enter an option [New/Move/orthoGraphic/Prev/Restore/ Save/Del/Apply/?/World] <World>: **n**

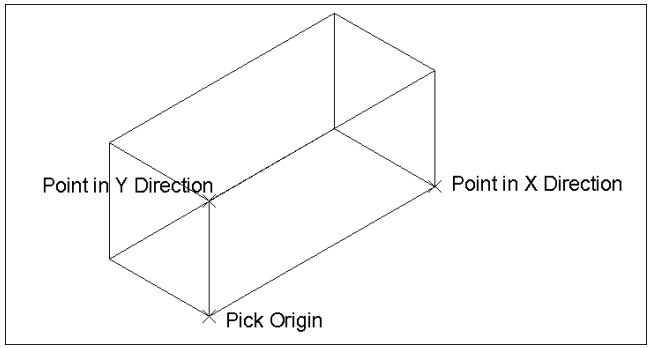
   Specify origin of new UCS or [ZAxis/3point/OBject/ Face/View/X/Y/Z] <0,0,0>: **3**

   Specify new origin point <0,0,0>: **pick origin**

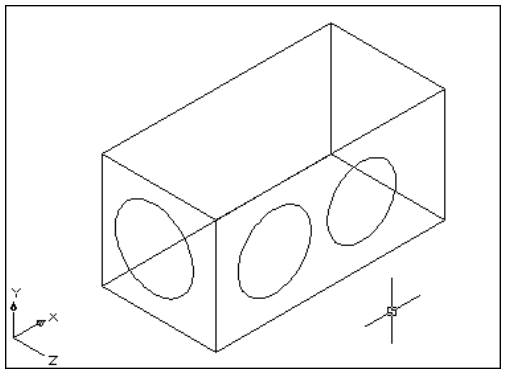
   Specify point on positive portion of X-axis <3.53,7.73,0.00>:

   Specify point on positive-Y portion of the UCS XY plane <2.53,8.73,0.00>:

Setting the UCS with the 3 Point Method



UCS modified



Plan View and UCS 5.5

1. **Type** PLAN at the command prompt.

   Command: **plan**

UCS View 5.6

1. **Type** UCS at the command prompt.

   Command: **ucs**

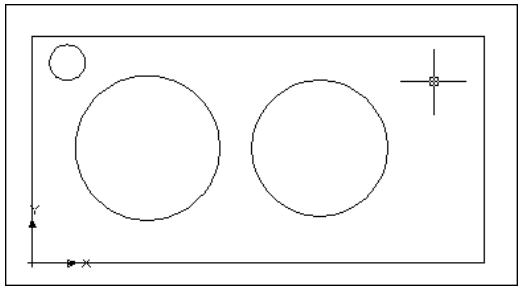
   Current ucs name: *NO NAME*

   Enter an option [New/Move/orthoGraphic/Prev/Restore/ Save/Del/Apply/?/World] <World>: **n**

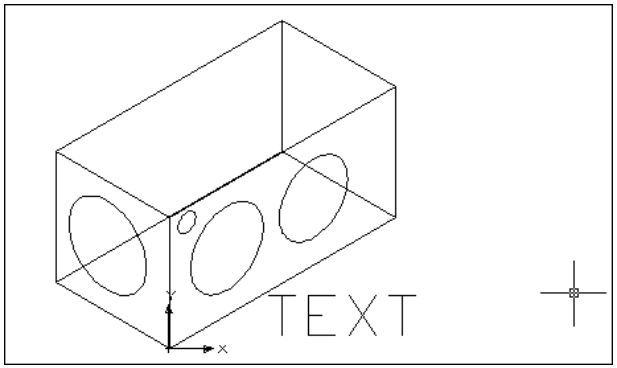
   Specify origin of new UCS or [ZAxis/3point/OBject/ Face/View/X/Y/Z] <0,0,0>: vOrigin/ZAxis/3point/ OBject/View/X/Y/Z/Prev/Restore/Save/Del/?/<World>:**V**

   View Establishes a new coordinate system whose XY plane is perpendicular to your viewing direction (i.e. parallel to your screen).

Plan View of Current UCS



UCS parallel to the View Instead of the Object



UCS Object 5.7

1. **Type** UCS at the command prompt.

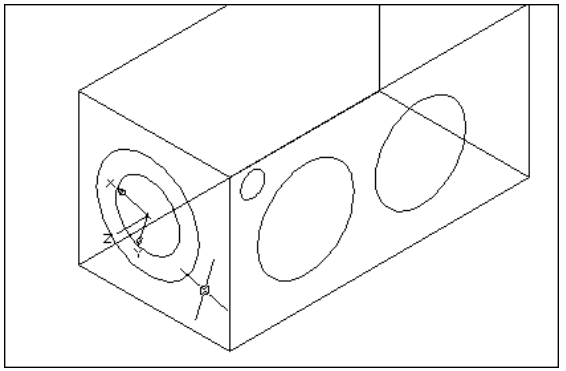
   Command: **ucs**

   Current ucs name: *NO NAME*

   Enter an option [New/Move/orthoGraphic/Prev/Restore/ Save/Del/Apply/?/World] <World>: **n**

   Specify origin of new UCS or [ZAxis/3point/OBject/ Face/View/X/Y/Z] <0,0,0>: vOrigin/ZAxis/3point/ OBject/View/X/Y/Z/Prev/Restore/Save/Del/?/ <World>:**OB**

   Object Defines a new coordinate system based on a selected 3D object. The new UCS has the same extrusion direction (positive Z axis) as that of the selected object.



Other New UCS Options 5.8

1. **Type** UCS at the command prompt.

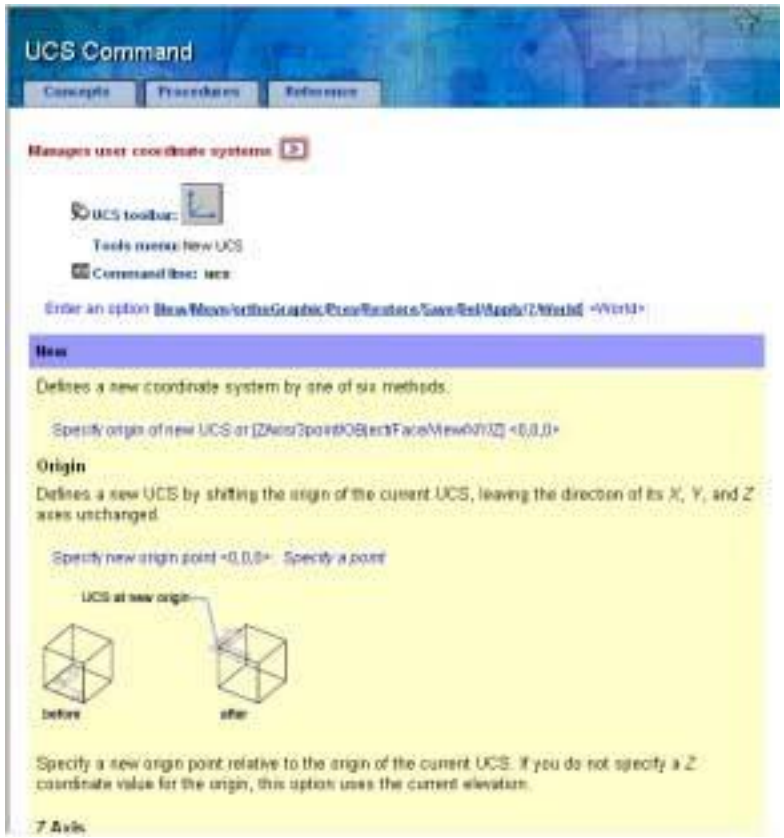
   Command: **ucs**

   Current ucs name: *NO NAME*

   Enter an option [New/Move/orthoGraphic/Prev/Restore/ Save/Del/Apply/?/World] <World>: **n**

   Specify origin of new UCS or [ZAxis/3point/OBject/ Face/View/X/Y/Z] <0,0,0>: vOrigin/ZAxis/3point/ OBject/View/X/Y/Z/Prev/Restore/Save/Del/?/ <World>:

AutoCAD Help Topics for New UCS



Saving the UCS 5.9

1. **Type** UCS at the command prompt.

   Command: **ucs**

   Current ucs name: *NO NAME*

   Enter an option [New/Move/orthoGraphic/Prev/Restore/ Save/Del/Apply/?/World] <World>: **s**

   Enter name to save current UCS or [?]:

Restoring the UCS 5.10

1. **Type** UCS at the command prompt.

   Command: **ucs**

   Current ucs name: *NO NAME*

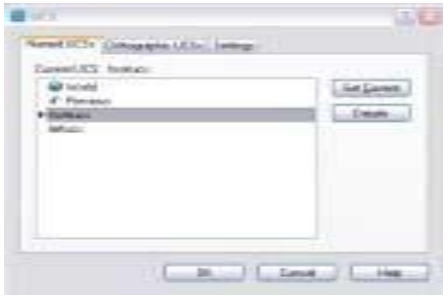
   Enter an option [New/Move/orthoGraphic/Prev/Re store/Save/Del/Apply/?/World] <World>: **r**

   Enter name of UCS to restore or [?]: 1

UCS Dialog Box 5.11

1. **Type** DDUCS at the command prompt.
   Command: **dducs**

UCS Dialog Box (DDUCS)



9th Week

Window & Door Making by 3D Orbit Commands,

1. Dynamic View – Perspective,
2. 3D Model Objects

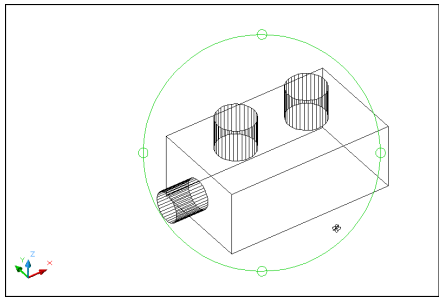
Chapter 6
3D Orbit Commands

Introduction to 3D Orbit Command 6.1

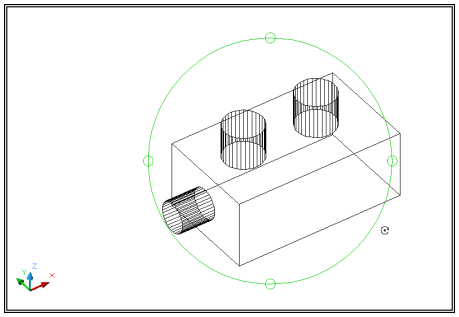
Controls Interactive 3D Viewing

1. **Type** 3DORBIT at the command prompt.
   Command: **3dorbit**
   OR
2. **Choose** View, 3D Orbit.
   The 3D Orbit Arcball appears.
3. **Click** on one of the 3D Orbit arcball locations.

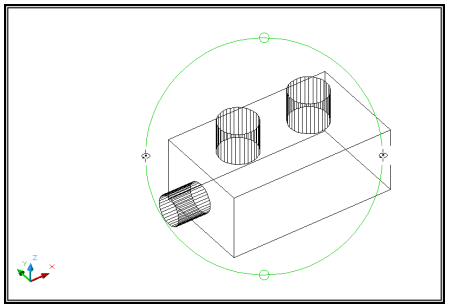
Inside the Arcball - Allows movement in any direction



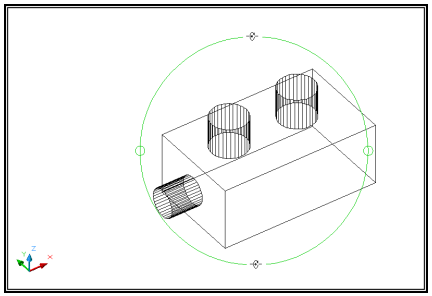
Outside the Arcball - Moves View about an axis that extends through the center (acts like twist)



Inside one of the small circles to the left/right - Rotates around the "Y" axis through the center.

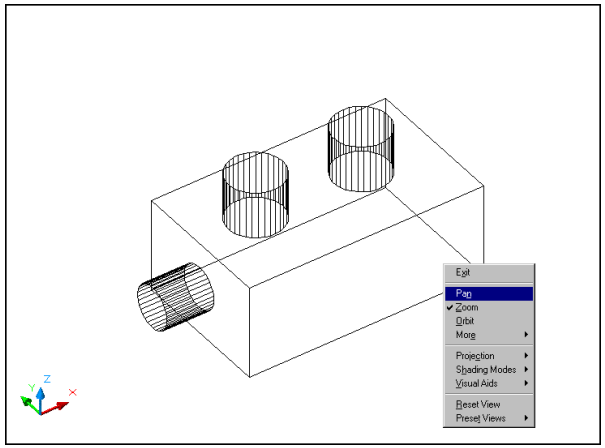


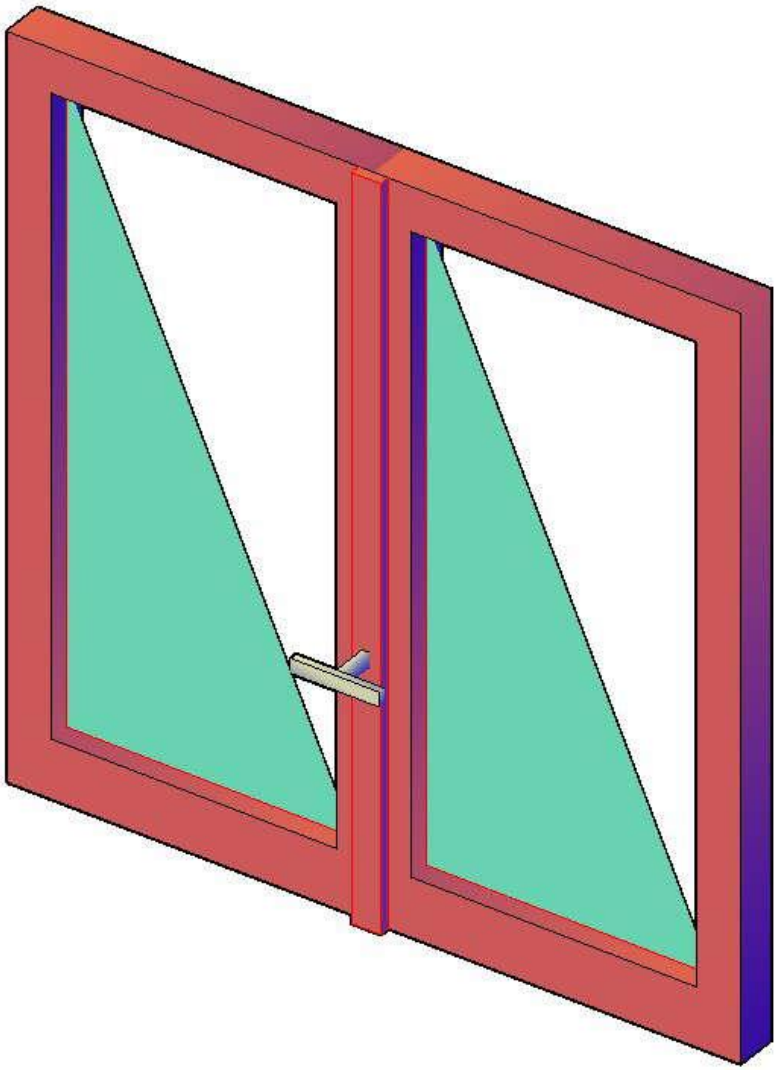
Inside one of the small circles to the top/bottom - Rotates around the "X" axis through the center.



Pan and Zoom in 3D Orbit 6.2

1. **Click** with the right mouse button while in the 3D Orbit command.
2. **Choose** PAN or ZOOM from the pop-up menu.





Projection Mode 6.3

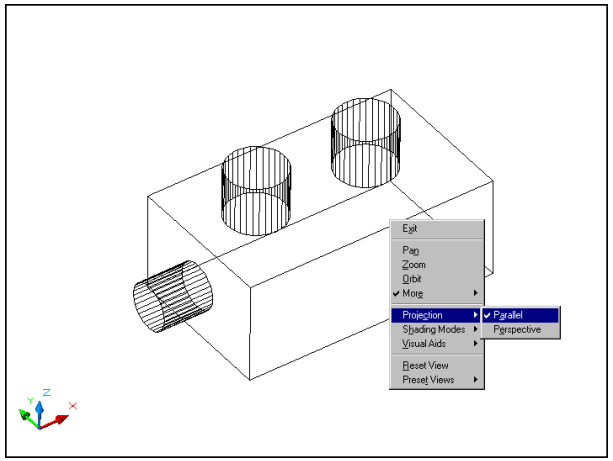
1. **Click** with the right mouse button while in the 3D Orbit command.
2. **Choose** Projection.
3. **Choose** Parallel or Perspective.

Parallel

Displays objects so that two parallel lines in a drawing never con verge at a single point. The shapes in your drawing always remain the same and do not appear distorted when they are closer.

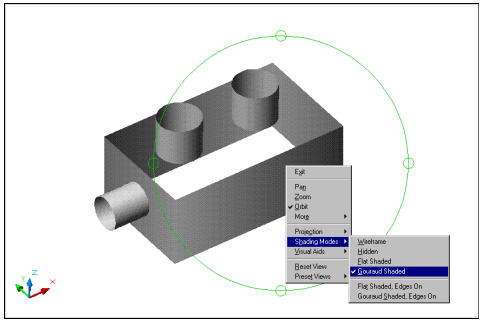
Perspective

Displays objects in perspective so that all parallel lines converge at one point. Objects appear to recede into the distance, and parts of the objects appear larger and closer to you. The shapes are some what distorted when the object is very close. This view correlates more closely to what your eye sees.



Shading 6.4

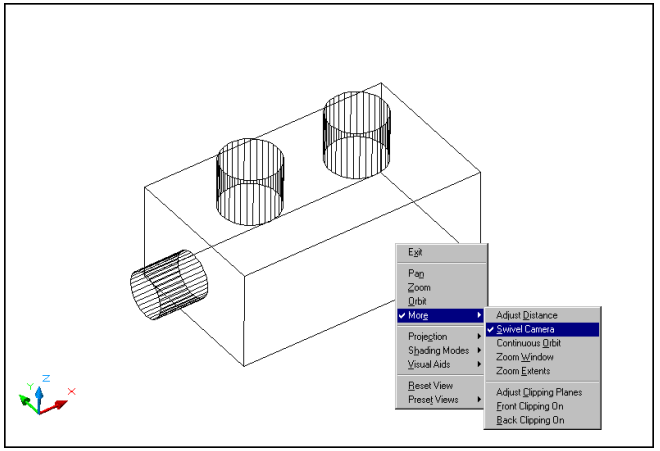
1. **Click** with the right mouse button while in the 3D Orbit command.
2. **Choose** Shading.
3. **Choose** one of the shade options.



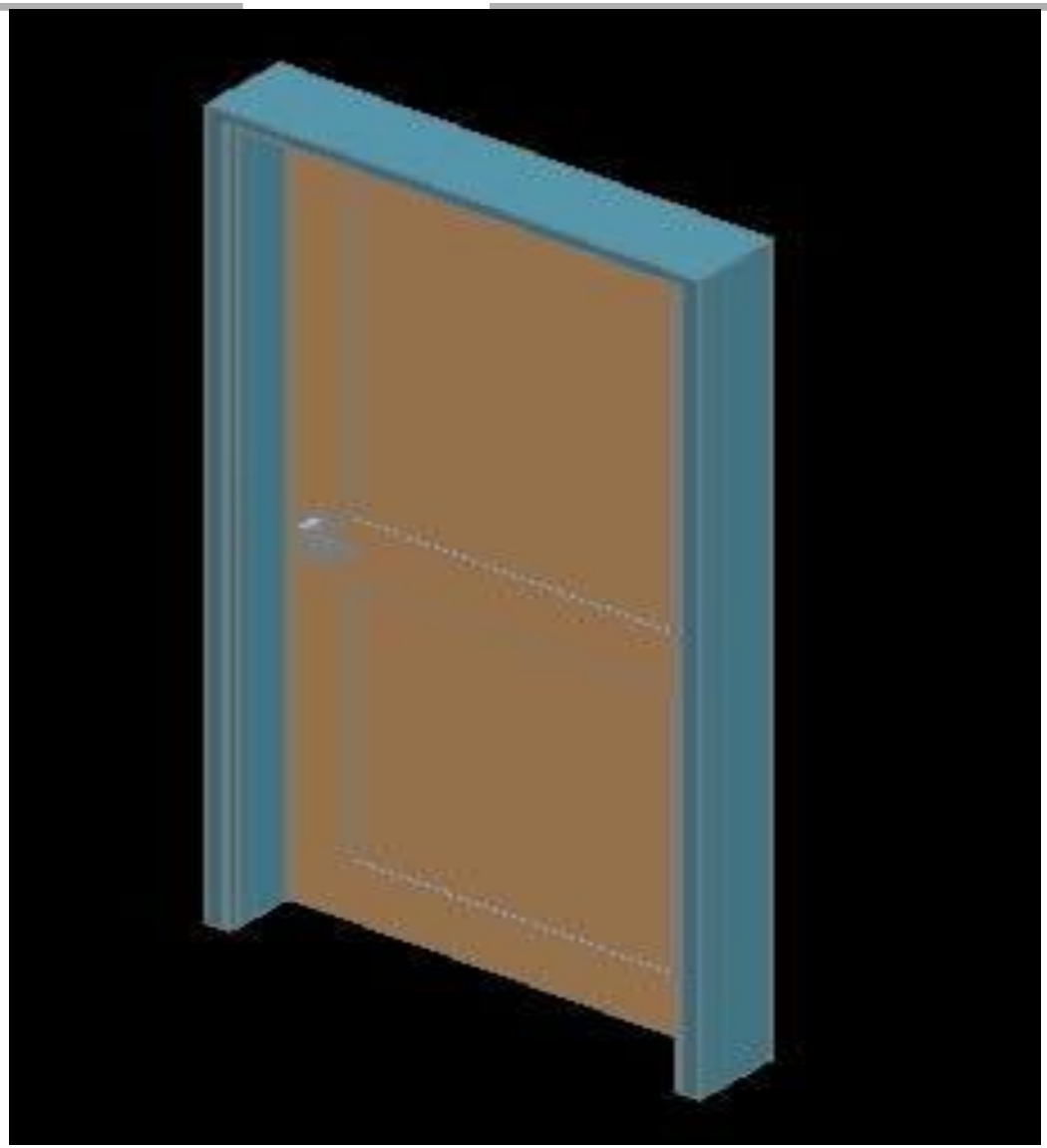
Camer Swivel and Distancea 6.5

Simulates the effect of turning the camera. Changes the target of the view.

1. **Click** with the right mouse button while in the 3D Orbit command.
2. **Choose** More.
3. **Choose** Swivel Camera.
4. **Choose** a location in the view to change the camera.



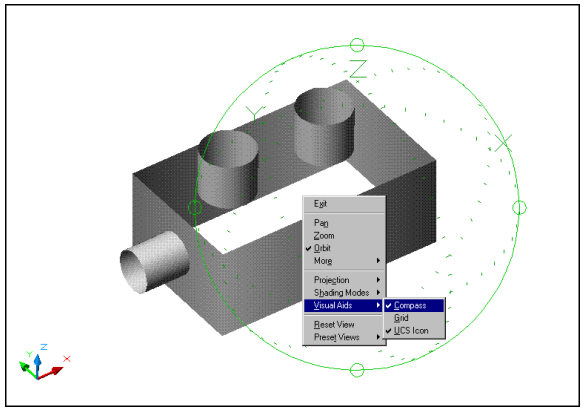
Adjusting Camera



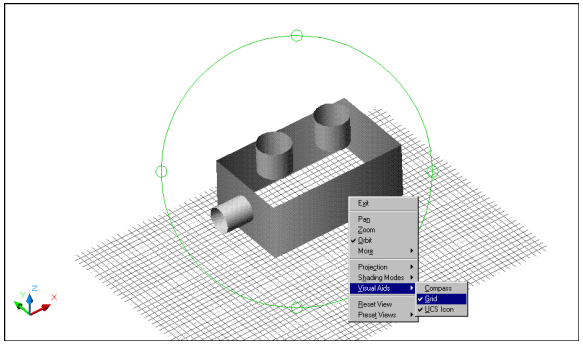
Visual Aids 6.6

1. **Click** with the right mouse button while in the 3D Orbit command.
2. **Choose** Visual Aids.
3. **Choose** one of the visual aids options.

Compass Option

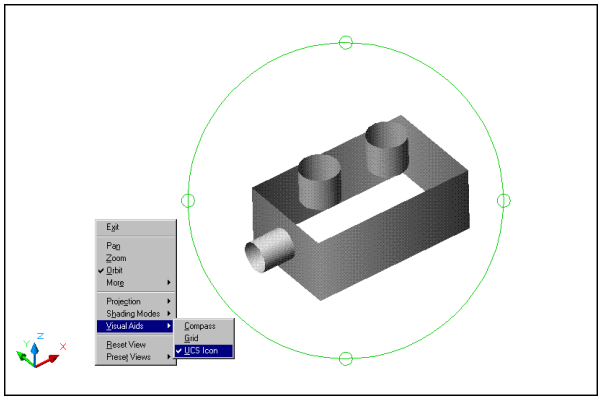


3D Grid Option



TIP: Use GRIDUNIT to change the spacing of the grid units.

UCS Icon

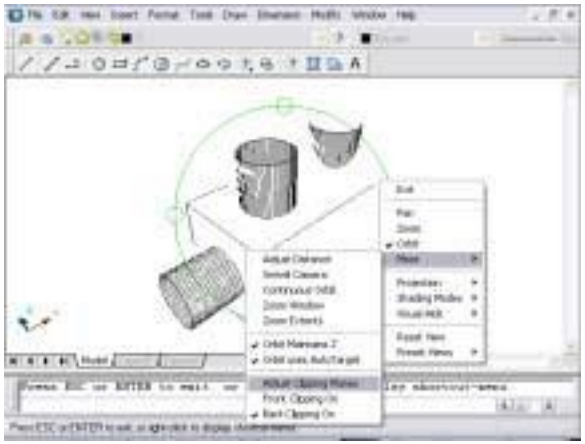


Clipping Planes 6.7

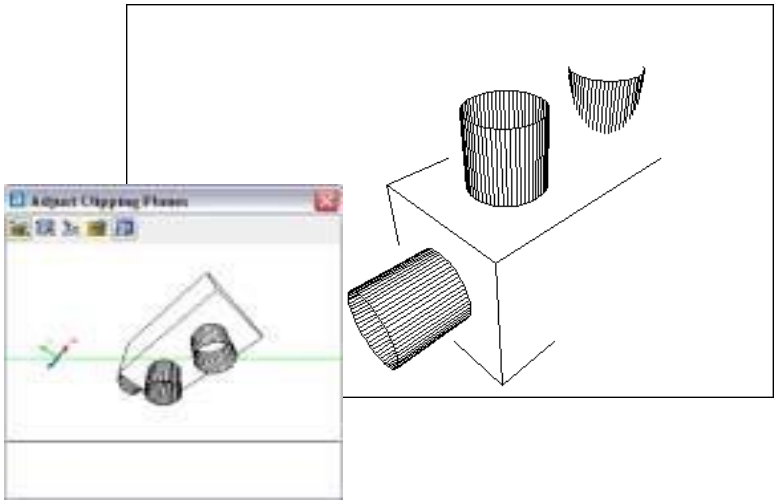
1. **Click** with the right mouse button while in the 3D Orbit command.
2. **Choose** More.
3. **Choose** one of the clipping planes options.

NOTE: If you have clipping planes ON when you exit the 3D Orbit command, they will remain ON.

Clipping Plane Options



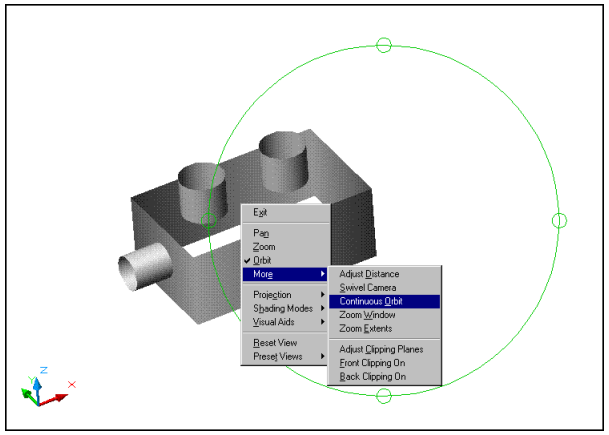
Adjusting Clipping Planes in the Clipping Plane Window



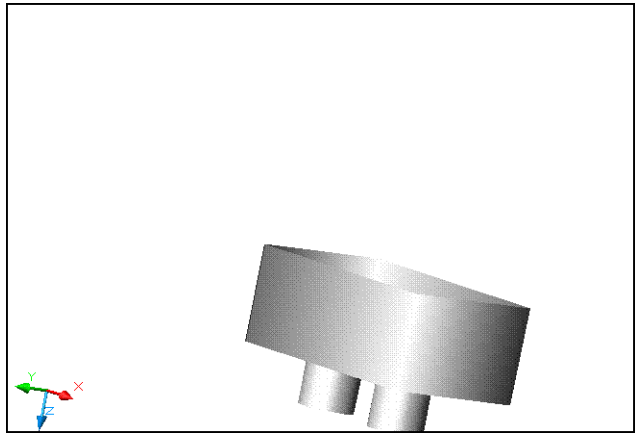
Continuous Orbit 6.8

1. **Click** with the right mouse button while in the 3D Orbit command.
2. **Choose** More.
3. **Choose** Continuous Orbit.
4. **Click** and drag to start the continuous 3D Motion.

   This movement controls the direction and speed of the orbit.



Continuous Motion (Rt Click to change options)



Chapter 7
Dynamic View - Perspective

DView Camera Option 7.1

1. **Choose** View, 3D Orbit

   or

2. **Type** DVIEW at the command prompt.

   Command: **dview**

   Select objects or <use DVIEWBLOCK>:

   pick objects

   Enter option

   [CAmera/TArget/Distance/POints/PAn/Zoom/TWist/CLip/Hide/Off/Undo]: **ca**

   Specify camera location, or enter angle from XY plane, or [Toggle (angle in)] <90.0000>: **30**

   Specify camera location, or enter angle in XY plane from X axis, or [Toggle (angle from)] <90.00000>: **45**

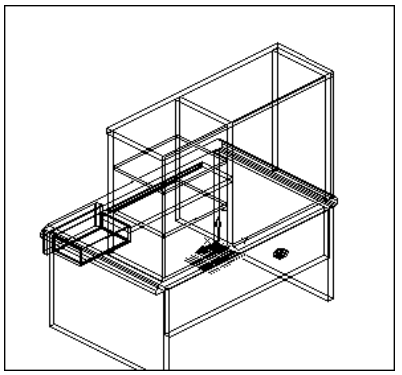
   Enter option

   [CAmera/TArget/Distance/POints/PAn/Zoom/TWist/CLip/Hide/Off/Undo]:

   Regenerating model.

   Note: You can also twist and pick a camera location.

Setting a Camera Location



DView Target Option 7.2

1. **Choose** View, 3D Orbit

   or

2. **Type** DVIEW at the command prompt.

   Command: **dview**

   Select objects or <use DVIEWBLOCK> **pick objects**:

   Select objects: **enter**

   Enter option

   [CAmera/TArget/Distance/POints/PAn/Zoom/TWist/ CLip/Hide/Off/Undo]: **TA**

   Specify camera location, or enter angle from XY plane,

   or [Toggle (angle in)] <35.2644>: **pick a target location**

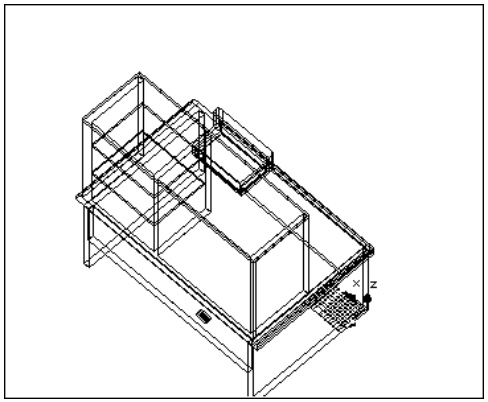
   Enter option

   [CAmera/TArget/Distance/POints/PAn/Zoom/TWist/ CLip/Hide/Off/Undo]: **enter**

   Regenerating model.

   Note: You can also type a target location.

Setting a Target Location



Setting Camera Target with Points 7.3

Moves the camera in or out along the line of sight relative to the target. Once a perspective view is set, zooming is not allowed. Zoom functions must be done in the DVIEW command.

1. **Choose** View, 3D Dynamic View.

   or

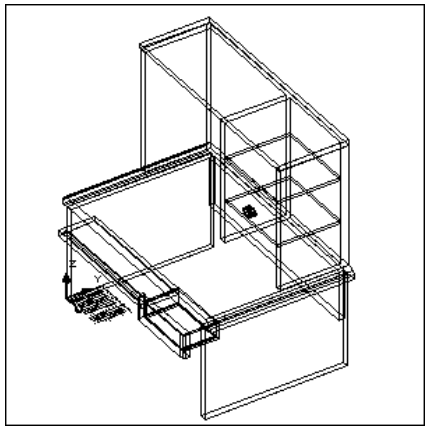
2. **Type** DVIEW at the command prompt.

   Command: **dview**

   Select objects: **pick objects**

   Select objects: **enter**

   CAmera/TArget/Distance/POints/PAn/Zoom/ TWist/CLip/Hide/Off/Undo/<eXit>: **PO**



Setting Perspective Distance 7.4

Moves the camera in or out along the line of sight relative to the target. Once a perspective view is set, zooming is not allowed. Zoom functions must be done in the DVIEW command.

1. **Choose** View, 3D Dynamic View.

   or

2. **Type** DVIEW at the command prompt.

   Command: **dview**

   Select objects: **pick objects**

   Select objects: **enter**

   CAmera/TArget/Distance/POints/PAn/Zoom/TWist/CLip/Hide/Off/Undo/<eXit>: **D**

   New camera/target distance <1.7321>: **pick**

Turning Perspective Off 7.5

1. **Choose** View, 3D Dynamic View.

   or

2. **Type** DVIEW at the command prompt.

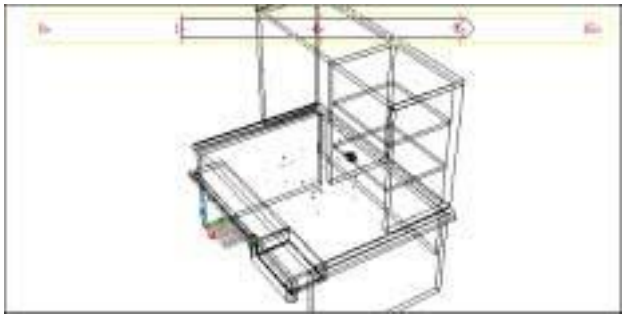
   Command: **dview**

   Select objects: **pick objects**

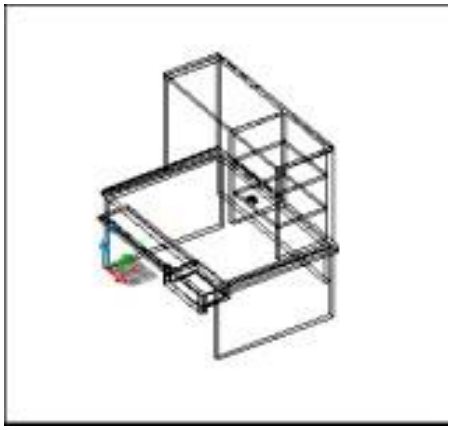
   Select objects: **enter**

   CAmera/TArget/Distance/POints/PAn/Zoom/TWist/CLip/Hide/Off/Undo/<eXit>: **OFF**

Zoom to a Perspective



Resultant Perspective View



Zooming in Dview 7.6

1. **Choose** View, 3D Dynamic View.

   or

2. **Type** DVIEW at the command prompt.

   Command: **dview**

   Select objects: **pick objects**

   Select objects: **enter**

   CAmera/TArget/Distance/POints/PAn/Zoom/TWist/ CLip/Hide/Off/Undo/<eXit>: **Z**

   Adjust lens length <9.666mm>: **pick**

Panning in Dview 7.7

1. **Choose** View, 3D Dynamic View.

   or

2. **Type** DVIEW at the command prompt.

   Command: **dview**

   Select objects: **pick objects**

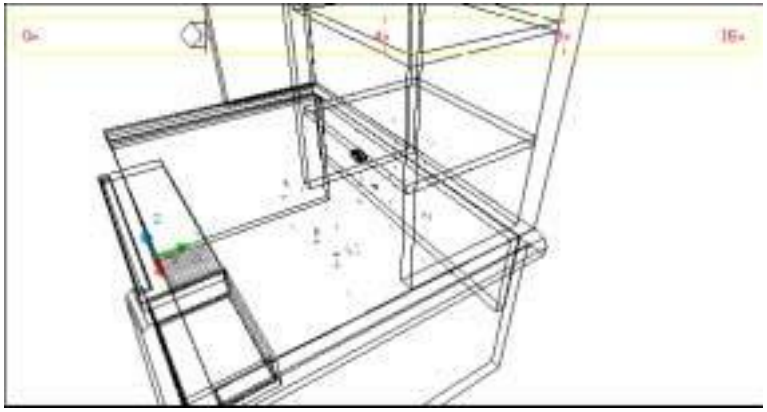
   Select objects: **enter**

   CAmera/TArget/Distance/POints/PAn/Zoom/TWist/ CLip/Hide/Off/Undo/<eXit>:**PA**

   Displacement base point: **pick**

   Second point: **pick**

Resultant View of Zoomed and Panned



Clipping Objects 7.8

1. **Choose** View, 3D Dynamic View.

   or

2. **Type** DVIEW at the command prompt.

   Command: **dview**

   Select objects: **pick objects**

   Select objects: **enter**

   CAmera/TArget/Distance/POints/PAn/Zoom/TWist/
   CLip/Hide/Off/Undo/<eXit>: **CL**

   Back/Front/<Off>: **F**

   Eye/<Distance from target> <4.4721>: **pick**

*T*wisting Objects 7.9

1. **Choose** View, 3D Dynamic View.

   or

2. **Type** DVIEW at the command prompt.

   Command: **dview**

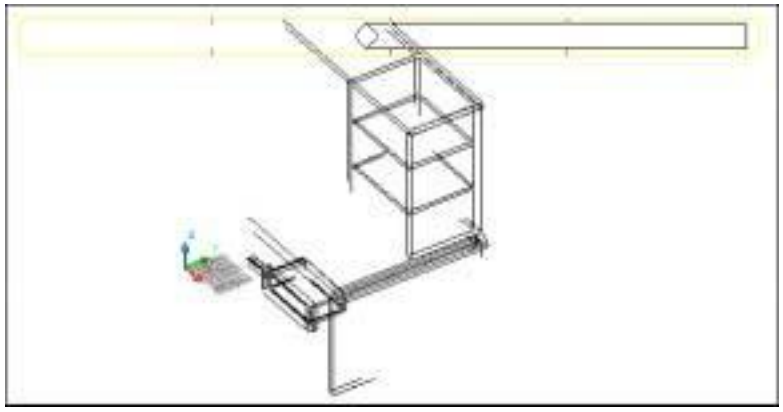
   Select objects: **pick objects**

   Select objects: **enter**

   CAmera/TArget/Distance/POints/PAn/Zoom/TWist/
   CLip/Hide/Off/Undo/<eXit>: **TW**

   New view twist <0.00>: **pick**

Resultant View of Clipped Objects



Hidden Line Removal 7.10

1. **Choose** View, 3D Dynamic View.

   or

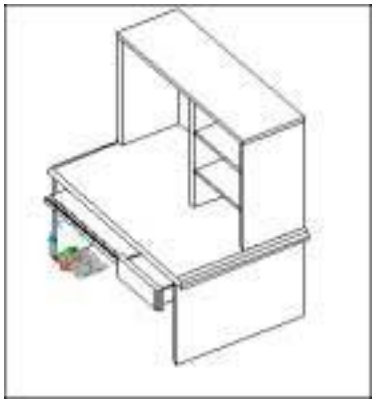
2. **Type** DVIEW at the command prompt.

   Command: **dview**

   Select objects: **pick objects**

   Select objects: **enter**

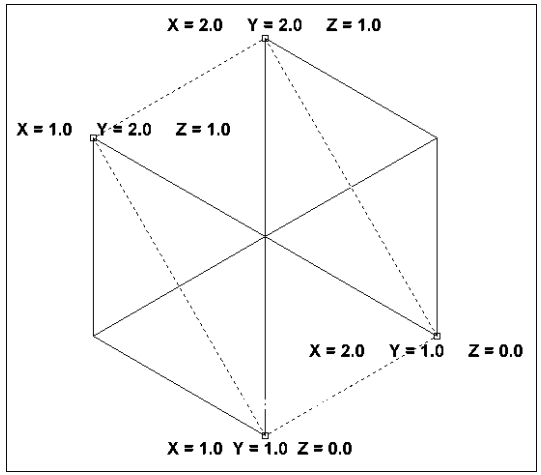
   CAmera/TArget/Distance/POints/PAn/Zoom/TWist/
   CLip/Hide/Off/Undo/<eXit>: **H**



Chapter 8
3D Model Objects

Wireframes 8.1

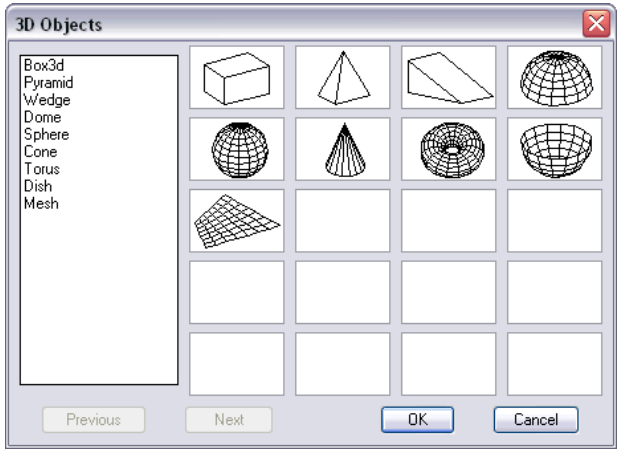
A wireframe model is a skeletal description of a 3D object. There are no surfaces in a wireframe model; it consists only of points, lines, and curves that describe the edges of the object. With AutoCAD you can create wireframe models by positioning 2D (planar) objects anywhere in 3D space. AutoCAD also provides some 3D wireframe objects, such as 3D polylines (that can only have a CONTINUOUS linetype) and splines. Because each object that makes up a wireframe model must be independently drawn and positioned, this type of modeling can be the most time-consuming.



Surfaces 8.2

Surface modeling is more sophisticated than wireframe modeling in that it defines not only the edges of a 3D object, but also its surfaces. The AutoCAD surface modeler defines faceted surfaces using a polygonal mesh. Because the faces of the mesh are planar, the mesh can only approximate curved surfaces. With Mechanical Desktop, you can create true curved surfaces. To differentiate these two types of surfaces, AutoCAD calls faceted surfaces, meshes.

1. **Choose** Draw, Surfaces.

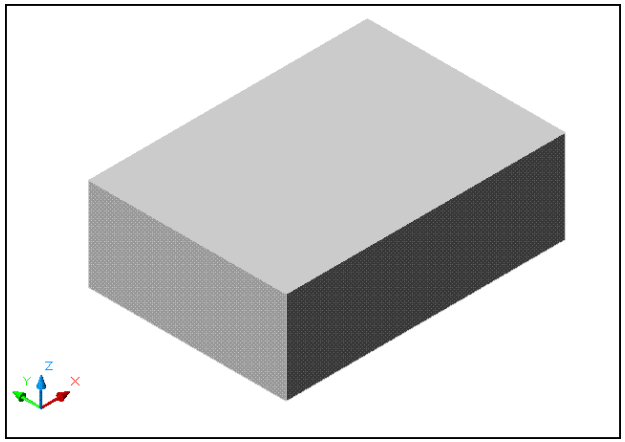


Solids 8.3

Solid modeling is the easiest type of 3D modeling to use. With the AutoCAD solid modeler, you can make 3D objects by creating basic 3D shapes: boxes, cones, cylinders, spheres, wedges, and tori (donuts). You can then combine these shapes to create more complex solids by joining or subtracting them or finding their intersecting (overlapping) volume. You can also create solids by sweeping a 2D object along a path or revolving it about an axis.

NOTE: Because each modeling type uses a different method for constructing 3D models and editing methods vary in their effect on the different model types, it is recommended that you not mix modeling methods.

1. **Choose** Draw, Solids.



Chapter 9
2D Solids and 3D Faces

2D Solid 9.1

1. **Choose** Draw, Solids, 2D Solid.

   or

2. **Type** SOLID at the command prompt.

   Command: **solid**

   First point: **P1**

   Second point: **P2**

   Third point: **P3**

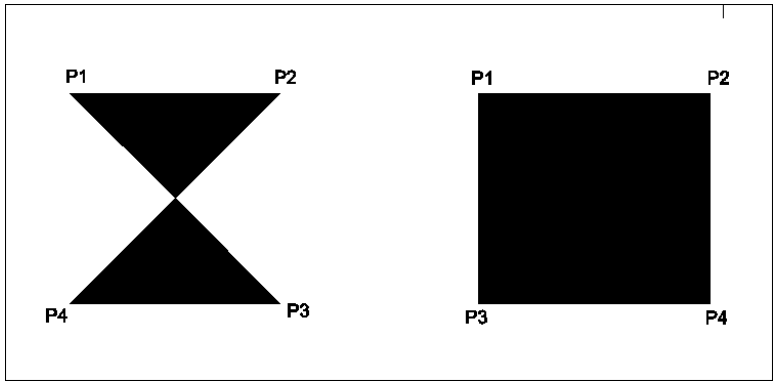
   Fourth point: **P4**

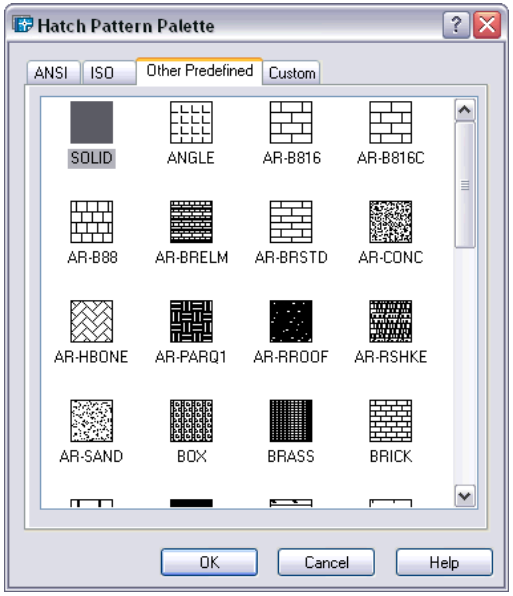
   Third point: **enter**

2D Hatch 9.2

1. **Choose** Draw, Hatch...
2. **Choose** the Other Predefined tab.
3. **Choose** Solid.

NOTE: 2D Solids and Hatches cannot be rendered or shaded.





3D Face 9.3

3DFACE creates a three- or four-sided surface anywhere in 3D space. You can specify different Z coordinates for each corner point of a 3D face. 3DFACE differs from SOLID, which creates a three- or four-sided surface that is parallel to the current UCS and can be extruded.

With 3DFACE, you control which edges of a 3D face are visible, allowing accurate modeling of objects with holes. Entering i or invisible before the first point of an edge makes the edge invisible.

1. **Choose** Draw, Surfaces, 3D Face.

   or

2. **Type** 3DFACE at the command prompt.

   Command: **3dface**

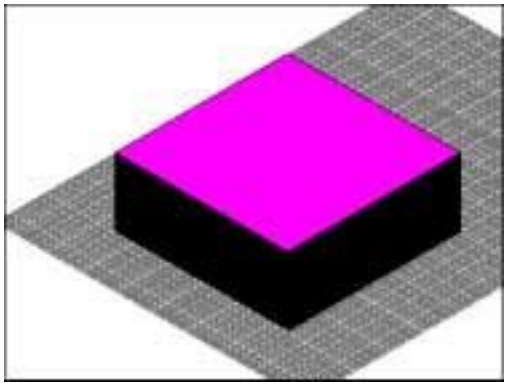
   First point: **pick**

   Second point: **pick**

   Third point: **pick**

   Fourth point: **pick**

   Third point: **enter**



Edge 9.4

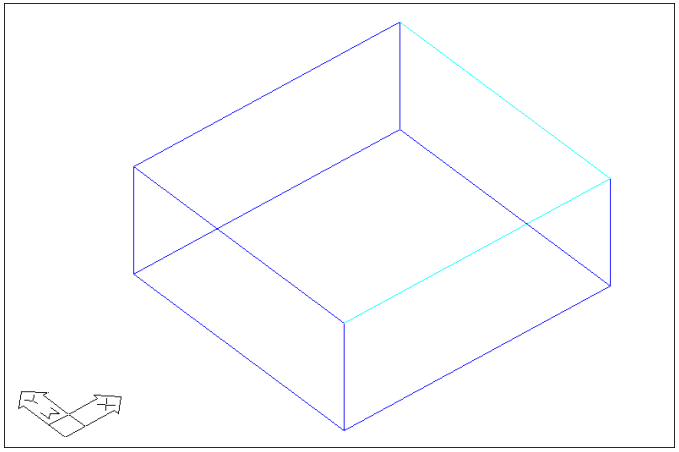
1. **Choose** Draw, Surfaces, Edge.

   or

2. **Type** EDGE at the command prompt.

   Command: **edge**

   Display/<Select edge>: pick a 3D edge



3D Invisible Edge 9.5

1. **Choose** Draw, Solids, 3D Face.

   or

2. **Type** 3DFACE at the command prompt.

   Command: **3dface**

   First point: **P1**

   Second point: **P2**

   Third point: **i P3**

   Fourth point: **P4**

   Third point: **i P5**

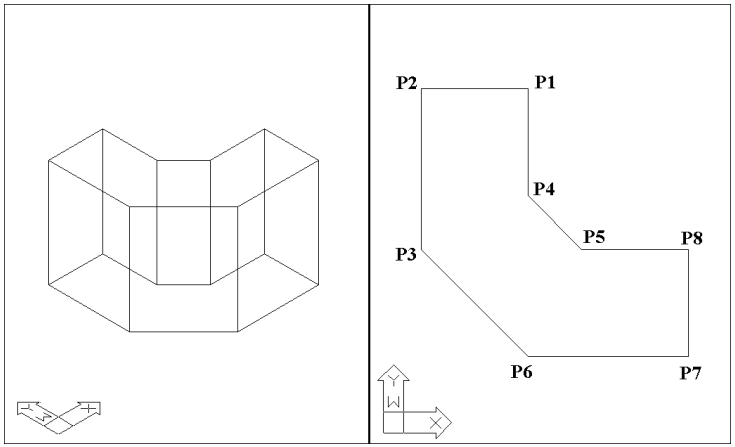
   Fourth point: **P6**

   Third point: **P7**

   Fourth point: **P8**

   Third point: **enter**

   NOTE: You must enter an "i" for invisible before the face is chosen.



Pface 9.7

1. **Type** PFACE at the command prompt.

Command: **pface**

Specify location for vertex 1-8: **P1 -P8**

Face 1, vertex 1:

Enter a vertex number or [Color/Layer]: **1**

Face 1, vertex 2:

Enter a vertex number or [Color/Layer] <next face>: **2**

Face 1, vertex 3:

Enter a vertex number or [Color/Layer] <next face>: **6**

Face 1, vertex 4:

Enter a vertex number or [Color/Layer] <next face>: **7**

Face 1, vertex 5: **enter**

Enter a vertex number or [Color/Layer] <next face>:

Face 2, vertex 1:

Enter a vertex number or [Color/Layer]: **2**

Face 2, vertex 2:

Enter a vertex number or [Color/Layer] <next face>: **3**

Face 2, vertex 3:

Enter a vertex number or [Color/Layer] <next face>: **4**

Face 2, vertex 4:

Enter a vertex number or [Color/Layer] <next face>: **6**

Face 2, vertex 5:

Enter a vertex number or [Color/Layer] <next face>:

Face 3, vertex 1:

Enter a vertex number or [Color/Layer]: **4**

Face 3, vertex 2:

Enter a vertex number or [Color/Layer] <next face>: **5**

Face 3, vertex 3:

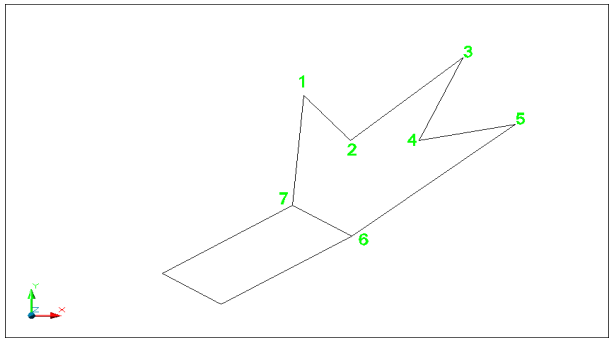
Enter a vertex number or [Color/Layer] <next face>: **6**

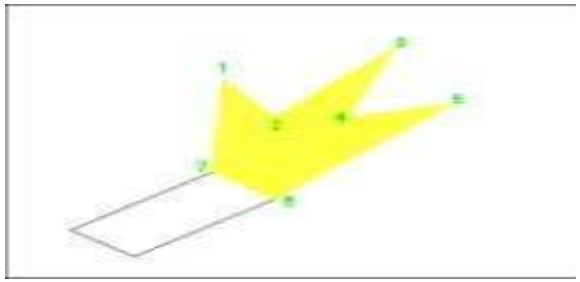
Face 3, vertex 4:

Enter a vertex number or [Color/Layer] <next face>:

Face 4, vertex 1:

Enter a vertex number or [Color/Layer]:





6th Week

Chapter 10
3D Surfaces

3DBox 10.1

1. **Choose** Draw, Surfaces, 3D Surfaces...
2. **Pick** the box from the dialog menu.

or

3. **Type** AI_BOX at the command prompt.

Command: **ai_box**

Initializing... 3D Objects loaded.

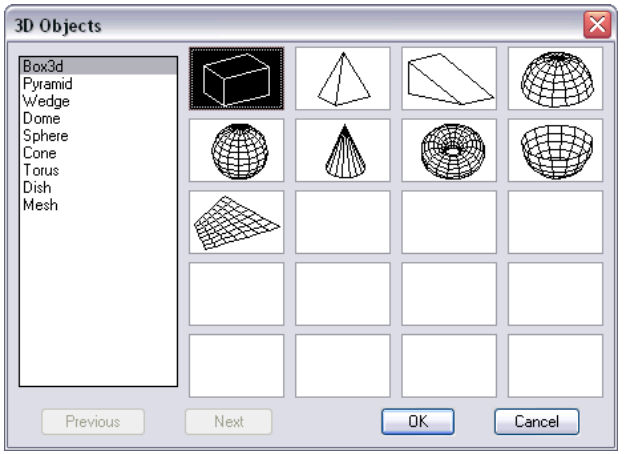
Corner of box: **pick**

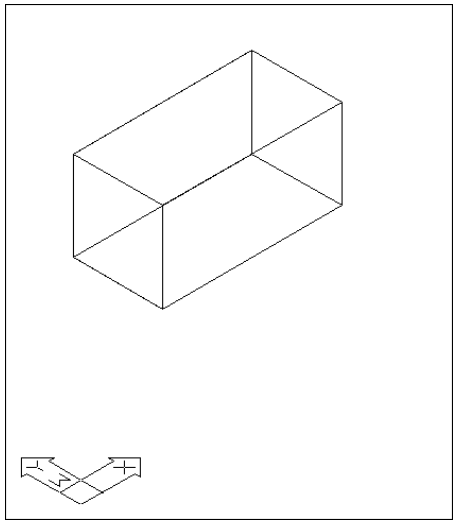
Specify length of box: **4**

Specify width of box or [Cube]: **2**

Specify height of box: **2**

Specify rotation angle of box about the Z axis or [Reference]: **0**





Pyramid 10.2

1. **Choose** Draw, Surfaces, 3D Surfaces...
2. **Pick** the pyramid from the dialog menu.

   or
3. **Type** AI_PYRAMID at the command prompt.

   Command: **ai_pyramid**

   Specify first corner point for base of pyramid: **pick**

   Specify second corner point for base of pyramid: <Ortho on> **4**

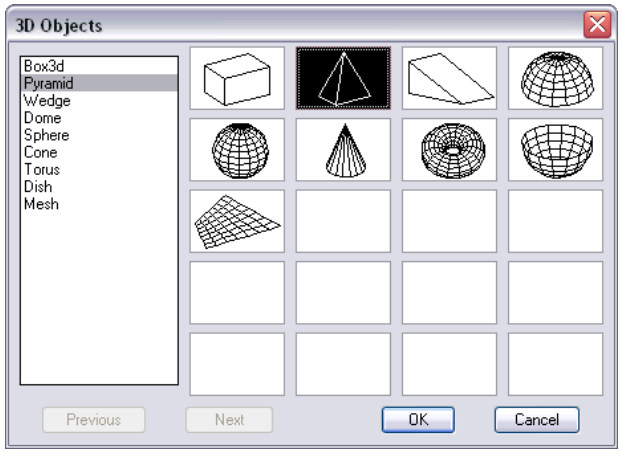
   Specify third corner point for base of pyramid: **4**

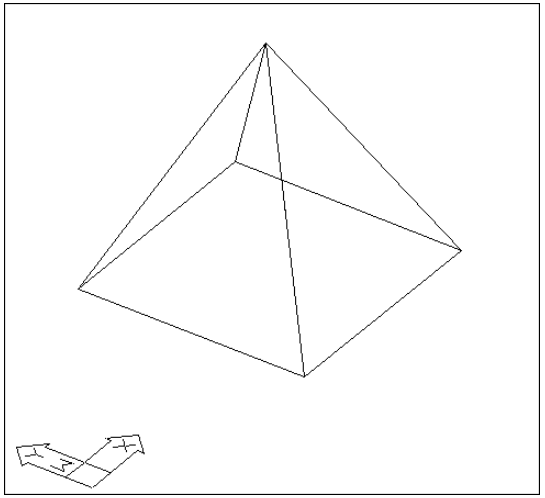
   Specify fourth corner point for base of pyramid or [Tetrahedron]: **4**

   Specify apex point of tetrahedron or [Top]: **.xy**

   of pick

   (need Z): **4**





Wedge 10.3

1. **Choose** Draw, Surfaces, 3D Surfaces...
2. **Pick** the wedge from the dialog menu.

   or

3. **Type** AI_WEDGE at the command prompt.

   Command: **ai_wedge**

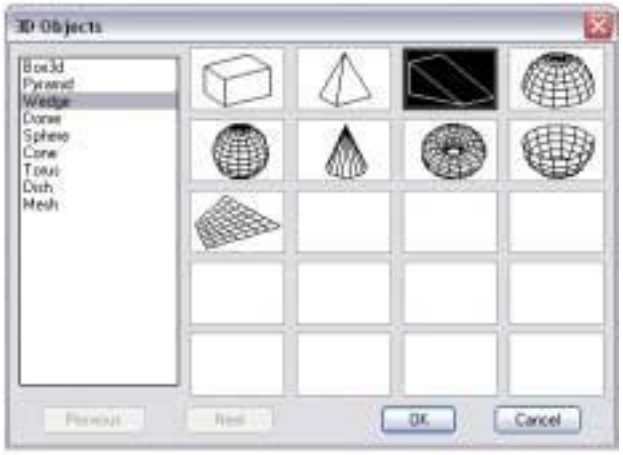
   Specify corner point of wedge: **pick**

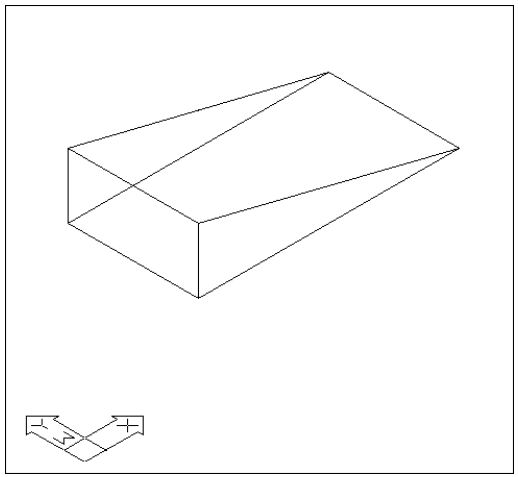
   Specify length of wedge: **4**

   Specify width of wedge: **2**

   Specify height of wedge: **1**

   Specify rotation angle of wedge about the Z axis: **0**





Dome 10.4

1. **Choose** Draw, Surfaces, 3D Surfaces...
2. **Pick** the dome from the dialog menu.

   or

3. **Type** AI_DOME at the command prompt.

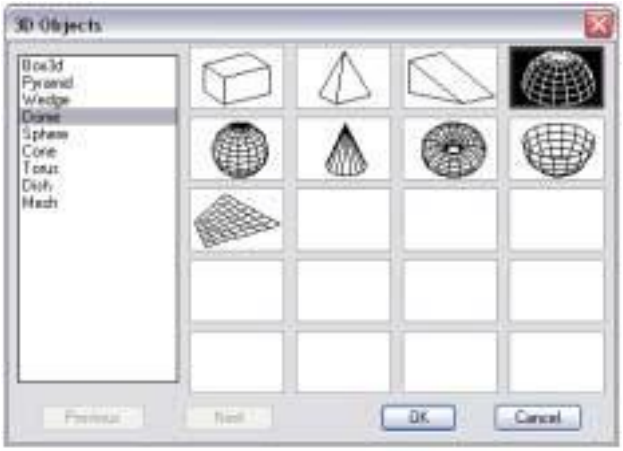
   Command: **ai_dome**

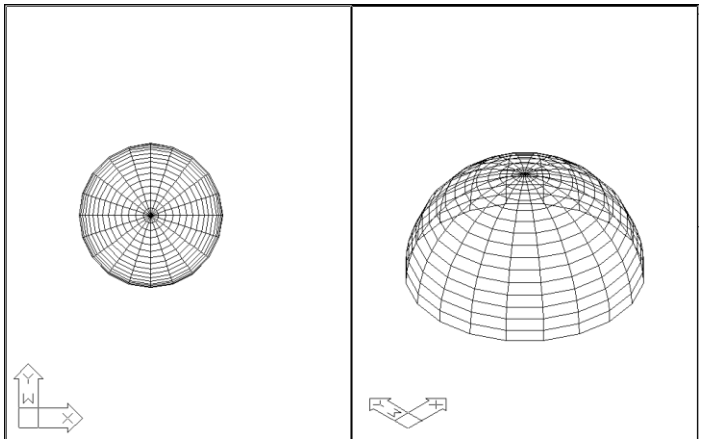
   Specify center point of dome: **pick**

   Specify radius of dome or [Diameter]: **3**

   Enter number of longitudinal segments for surface of dome <16>: **20**

   Enter number of latitudinal segments for surface of dome <8>: **10**





Sphere 10.5

1. **Choose** Draw, Surfaces, 3D Surfaces...
2. **Pick** the sphere from the dialog menu.

   or

3. **Type** AI_SPHERE at the command prompt.

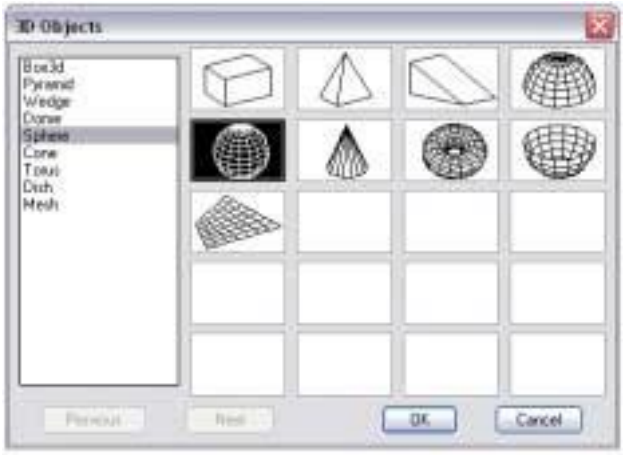
   Command: **ai_sphere**

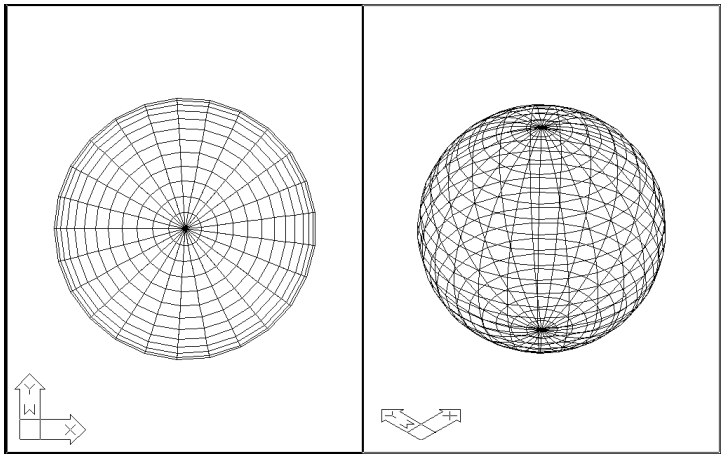
   Specify center point of sphere: **pick**

   Specify radius of sphere or [Diameter]: **3**

   Enter number of longitudinal segments for surface of sphere <16>: **25**

   Enter number of latitudinal segments for surface of sphere <16>: **25**





Cone 10.6

1. **Choose** Draw, Surfaces, 3D Surfaces...
2. **Pick** the cone from the dialog menu.

   or

3. **Type** AI_CONE at the command prompt.

   Command: **ai_cone**

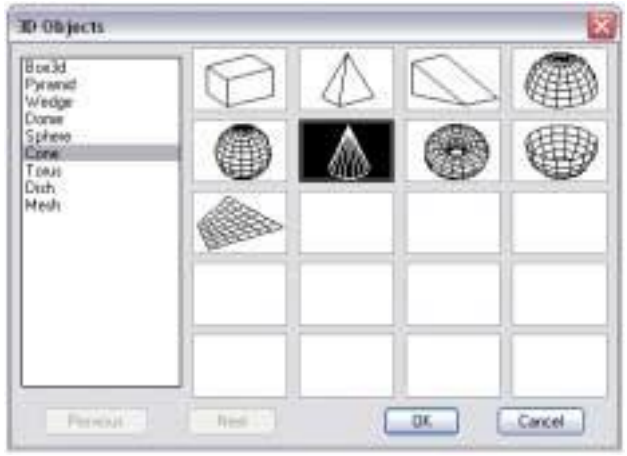
   Specify center point for base of cone: **pick**

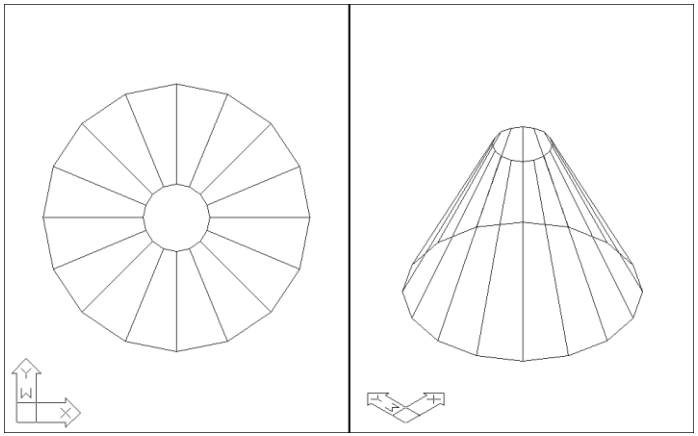
   Specify radius for base of cone or [Diameter]: **2**

   Specify radius for top of cone or [Diameter] <0>: **5**

   Specify height of cone: **3**

   Enter number of segments for surface of cone <16>: **enter**





Torus 10.7

1. **Choose** Draw, Surfaces, 3D Surfaces...
2. **Pick** the torus from the dialog menu.

   or

3. **Type** AI_TORUS at the command prompt.

   Command: **ai_torus**

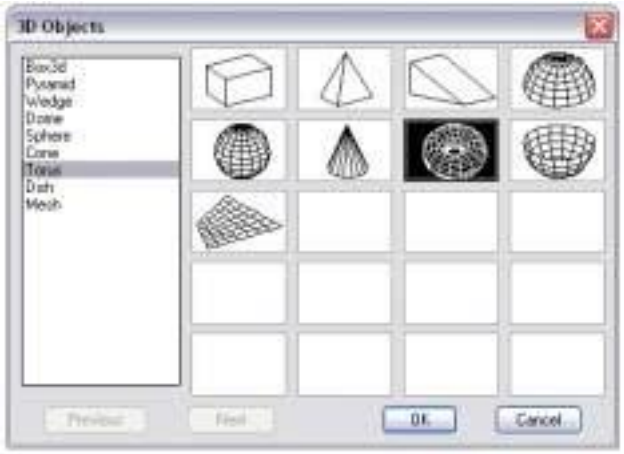
   Specify center point of torus: **pick**

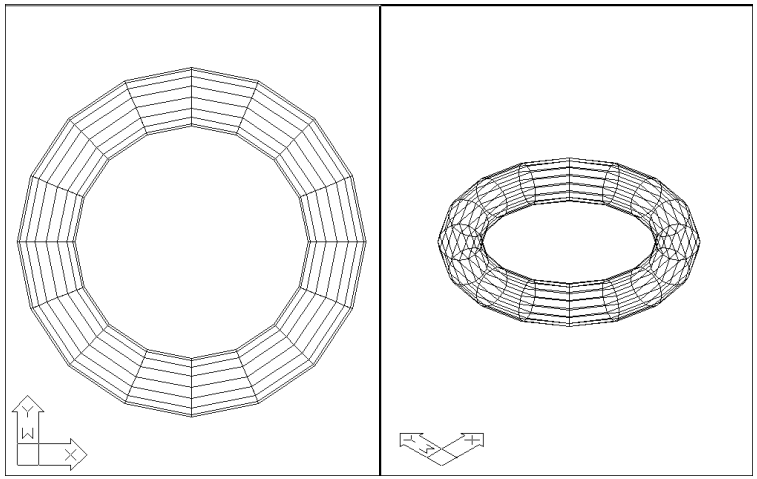
   Specify radius of torus or [Diameter]: **6**

   Specify radius of tube or [Diameter]: **1**

   Enter number of segments around tube circumference <16>: **enter**

   Enter number of segments around torus circumference <16>: **enter**





Dish 10.8

1. **Choose** Draw, Surfaces, 3D Surfaces...
2. **Pick** the dish from the dialog menu.

   or

3. **Type** AI_DISH at the command prompt.

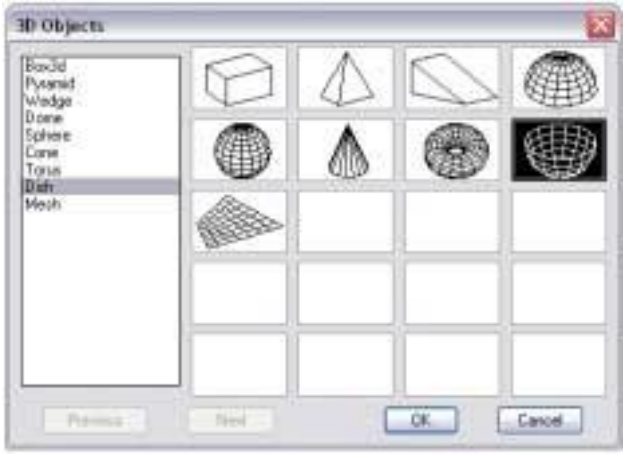
   Command: **ai_dish**

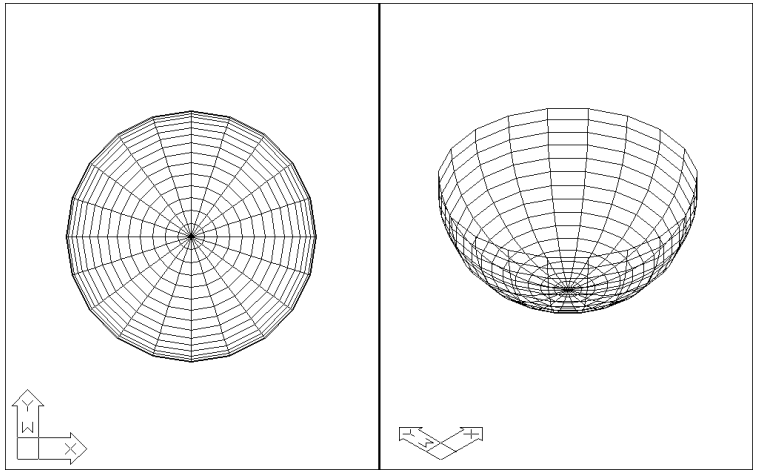
   Specify center point of dish: **pick**

   Specify radius of dish or [Diameter]: **3**

   Enter number of longitudinal segments for surface of dish <16>: **20**

   Enter number of latitudinal segments for surface of dish <8>: **15**





Mesh 10.9

Creates a planar mesh whose M and N sizes determine the number of lines drawn in each direction along the mesh.

1. **Type** ai_mesh at the command prompt.

   Command: **ai_mesh**

   Initializing... 3D Objects loaded.

   Specify first corner point of mesh: **1,1,1**

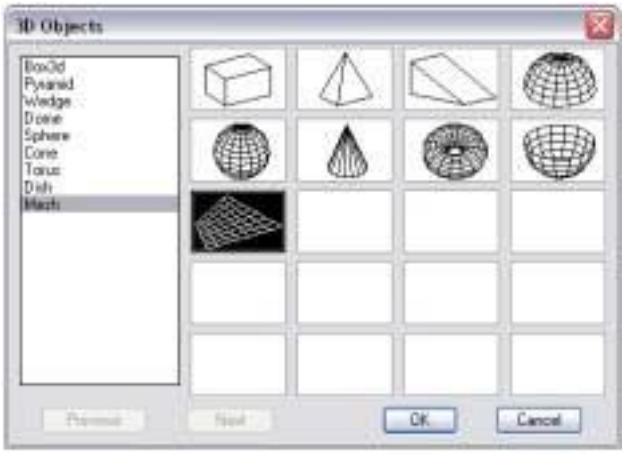
   Specify second corner point of mesh: **4,1,1**

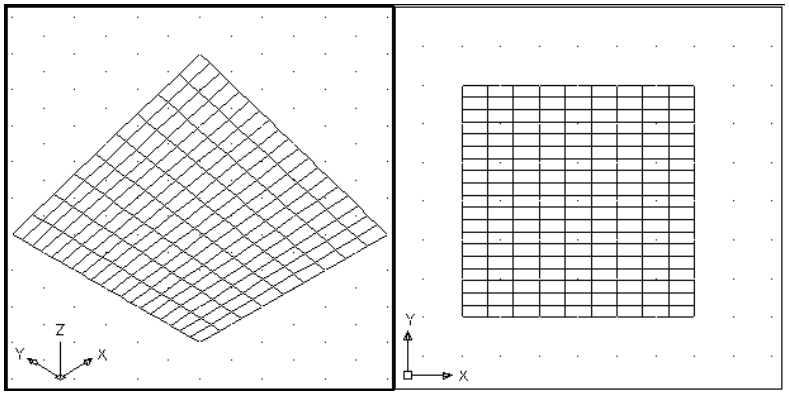
   Specify third corner point of mesh: **4,4,2**

   Specify fourth corner point of mesh: **1,4,1**

   Enter mesh size in the M direction: **20**

   Enter mesh size in the N direction: **10**





Chapter 11
Complex Surfaces

Revolved Surface 11.1

Creates a revolved surface about a selected axis.

1. **Choose** Draw, Surfaces, Revolved Surface...

   or

2. **Type** Revsurf at the command prompt.

   Command: **revsurf**

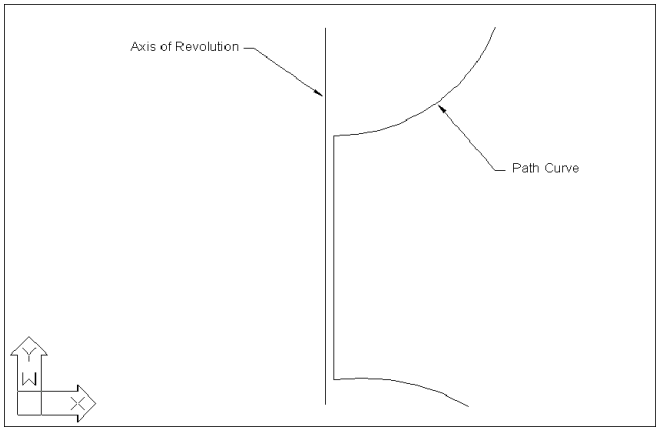
   Current wire frame density: SURFTAB1=6
   SURFTAB2=6

   Select object to revolve: **pick**

   Select object that defines the axis of revolution: **pick**

   Specify start angle <0>: **enter**

   Specify included angle (+=ccw, -=cw) <360> **enter**



Suftab1 and Surftab2 11.2

Sets the number of tabulations for both directions to be generated for RULESURF and TABSURF. Also sets the mesh density in ROTATE3D the M direction for REVSURF and EDGESURF commands.

1. **Type** Surftab1 at the command prompt.

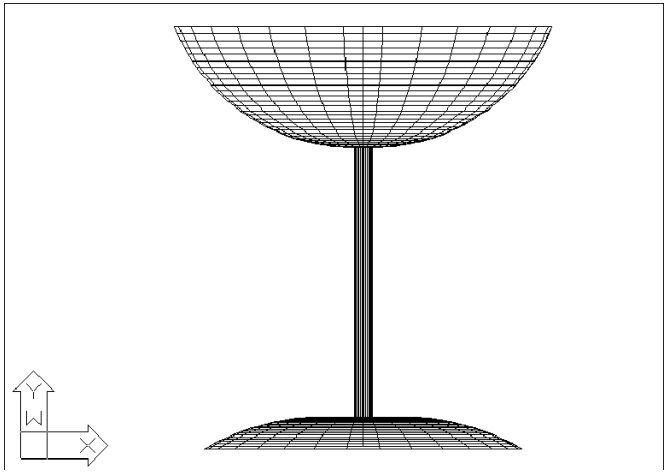
   Command: **surftab1**

   Enter new value for SURFTAB1 <6>: **30**

2. **Type** Surftab2 at the command prompt.

   Command: **surftab2**

   Enter new value for SURFTAB2 <6>: **30**



Tabulated Surfaces 11.3

Creates a tabulated surface from a path curve and a direction vector.

1. **Choose** Draw, Surfaces, Tabulated Surfaces

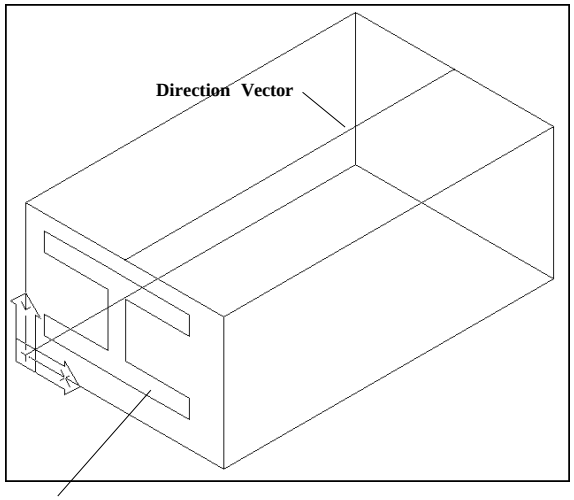
   or

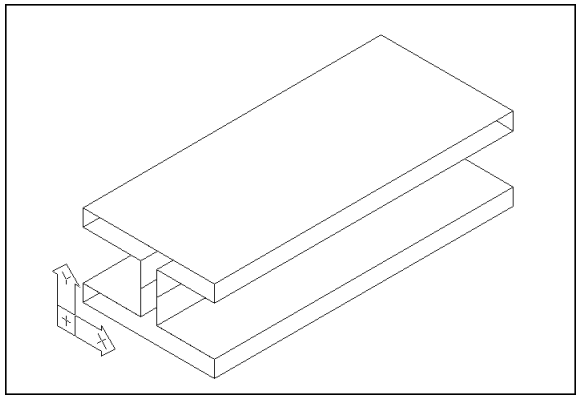
2. **Type** TABSURF at the command prompt.

   Command: **tabsurf**

   Select object for path curve:

   Select object for direction vector:





Ruled Surface 11.4

Creates a ruled surface between two curves.

1. **Choose** Draw, Surfaces, Ruled Surface

   or

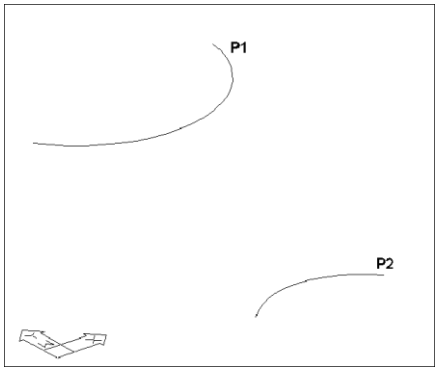
2. **Type** RULESURF at the command prompt.

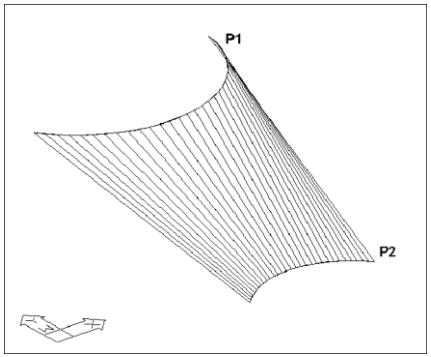
   Command: **rulesurf**

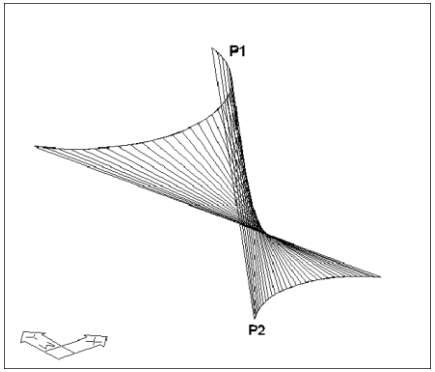
   Current wire frame density: SURFTAB1=6

   Select first defining curve: **P1**

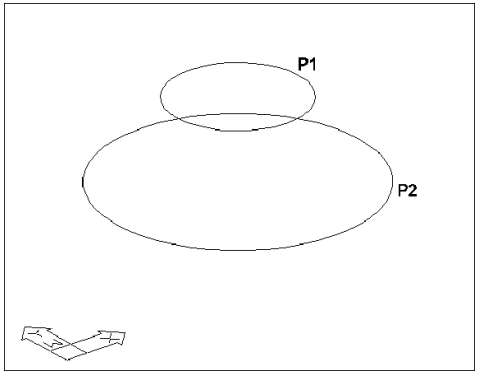
   Select second defining curve: **P2**

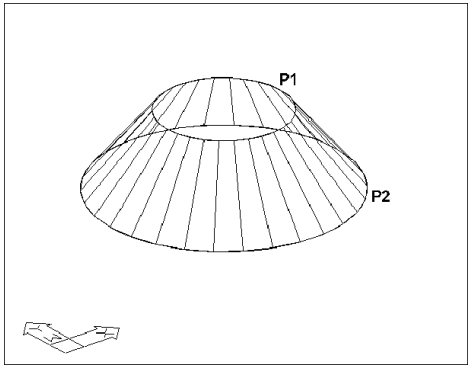


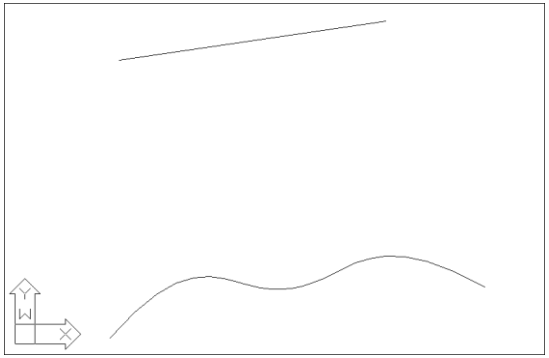


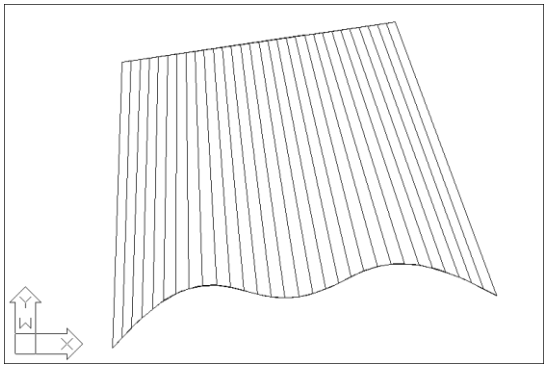


More Ruled Surface Examples 11.4









Edge Surface 11.5

Creates a three-dimensional polygon mesh

1. **Choose** Draw, Surfaces, Edge Surface

   or

2. **Type** EDGESURF at the command prompt.

   Command: **edgesurf**

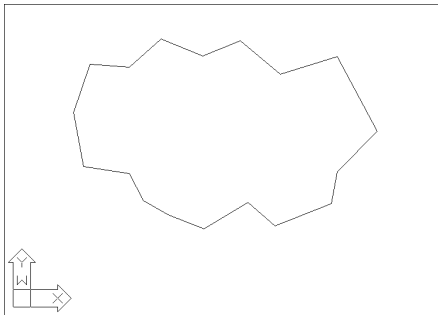
   Current wire frame density: SURFTAB1=6
   SURFTAB2=6

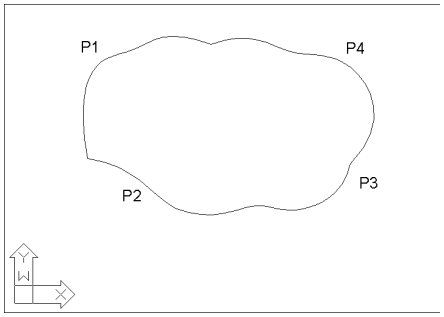
   Select object 1 for surface edge: **P1**

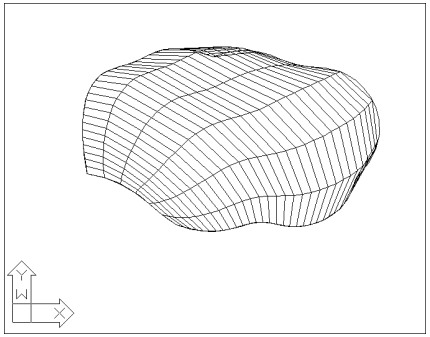
   Select object 2 for surface edge: **P2**

   Select object 3 for surface edge: **P3**

   Select object 4 for surface edge: **P4**







10th Week
Thickness and Elevation

Chapter 12
Solids

Extrude 12.1

Creates unique solid primitives by extruding existing two-dimensional objects. You can extrude multiple objects with EXTRUDE.

1. **Choose** Draw, Solids, Extrude.

   or

2. **Type** EXTRUDE at the command prompt.

   Command: **extrude**

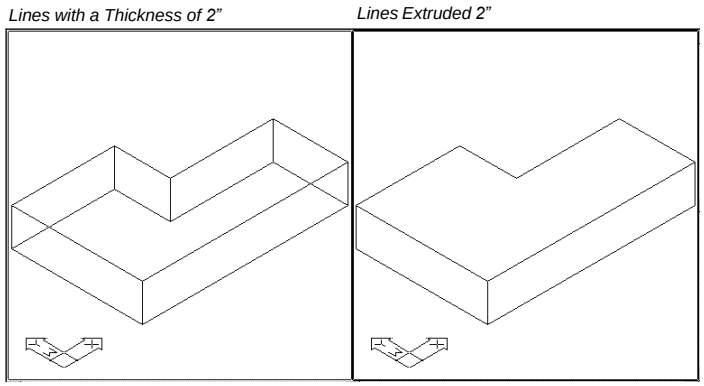
   Current wire frame density: ISOLINES=4

   Select objects: **pick objects**

   Select objects: **enter**

   Specify height of extrusion or [Path]: **4**

   Specify angle of taper for extrusion <0>: **enter**



Extrude with Taper 12.2

1. **Choose** Draw, Solids, Extrude.

   or

2. **Type** EXTRUDE at the command prompt.

   Command: **extrude**

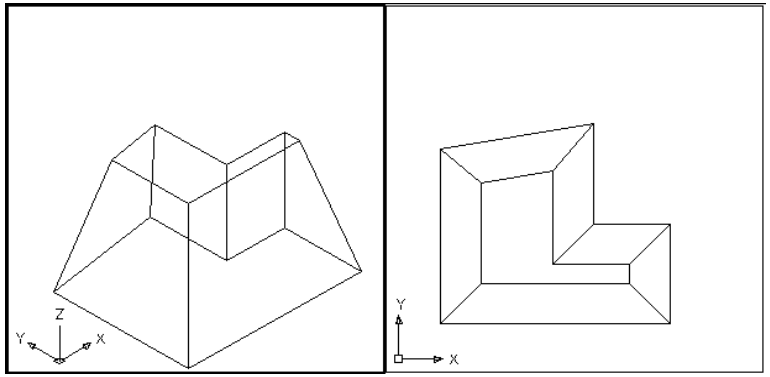
   Current wire frame density: ISOLINES=4

   Select objects: **pick objects**

   Select objects: **enter**

   Specify height of extrusion or [Path]: **3**

   Specify angle of taper for extrusion <0>: **15**



Extrude Curves 12.3

1. **Choose** Draw, Solids, Extrude.

   or

2. **Type** EXTRUDE at the command prompt.

   Command: **extrude**

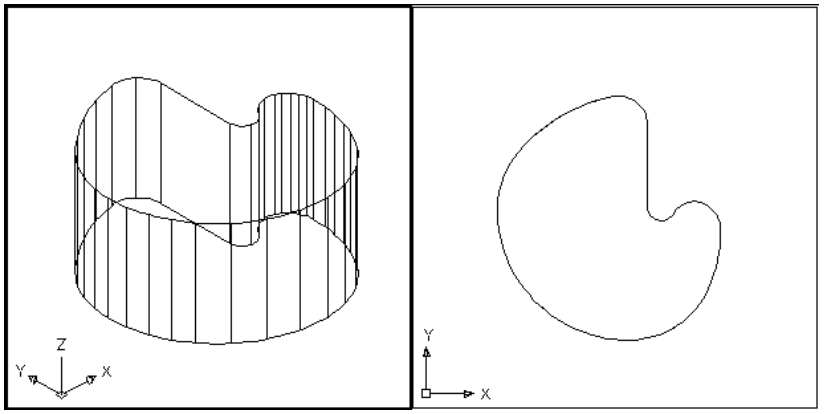
   Current wire frame density: ISOLINES=4

   Select objects: **pick curved pline**

   Select objects: **enter**

   Specify height of extrusion or [Path]: **3**

   Specify angle of taper for extrusion <0>: **0**



Extrude Along a Path 12.4

EXTRUDE also creates solids by extruding two-dimensional objects (profiles) along a specified path.

1. **Choose** Draw, Solids, Extrude.

   or

2. **Type** EXTRUDE at the command prompt.

   Command: **extrude**

   Current wire frame density: ISOLINES=4

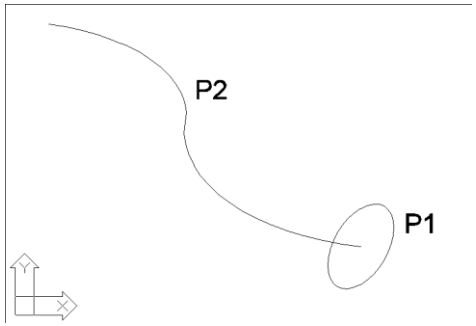
   Select objects: **P1**

   Select objects: **enter**

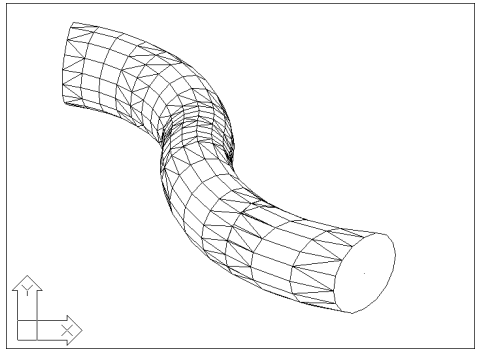
   Specify height of extrusion or [Path]: **p**

   Select extrusion path: **P2**

Circle Extruded Along a Path



Hidden Line Removal of Extruded Circle



Revolve 12.5

Creates a composite region or solid by addition.

1. **Choose** Draw, Solids, Revolve

   or

2. **Type** REVOLVE at the command prompt.

   Command: **revolve**

   Current wire frame density: ISOLINES=4

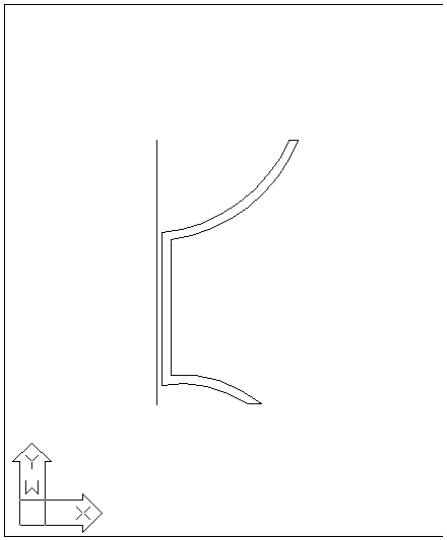
   Select objects: **pick profile**

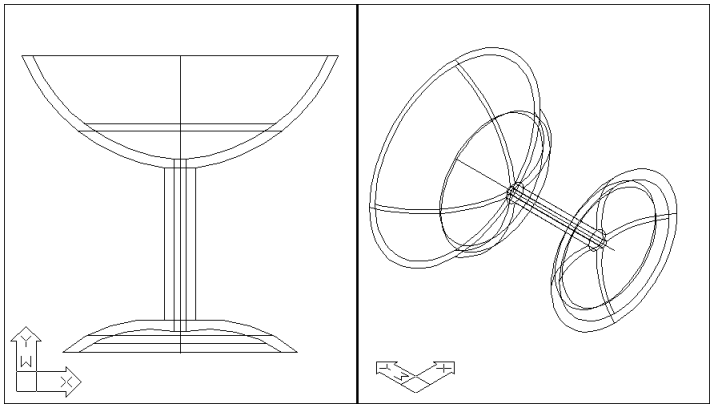
   Select objects: **enter**

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

   Select an object: **pick axis**

   Specify angle of revolution <360>: **enter**





Box Solid 12.6

Creates a three-dimensional solid box.

1. **Choose** Draw, Solids, Box.

   or

2. **Type** BOX at the command prompt

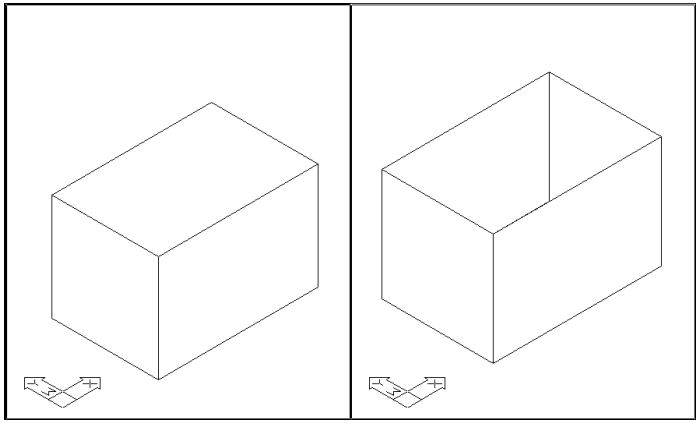
   Command: **box**

   Specify corner of box or [CEnter] <0,0,0>: **pick corner**

   Specify corner or [Cube/Length]: **pick opposite corner**

   Specify height: **2**

Solid Box *Lines with a Thickness*



Sphere 12.7

Creates a three-dimensional solid sphere.

1. **Choose** Draw, Solids, Sphere.

   or

2. **Type** SPHERE at the command prompt.

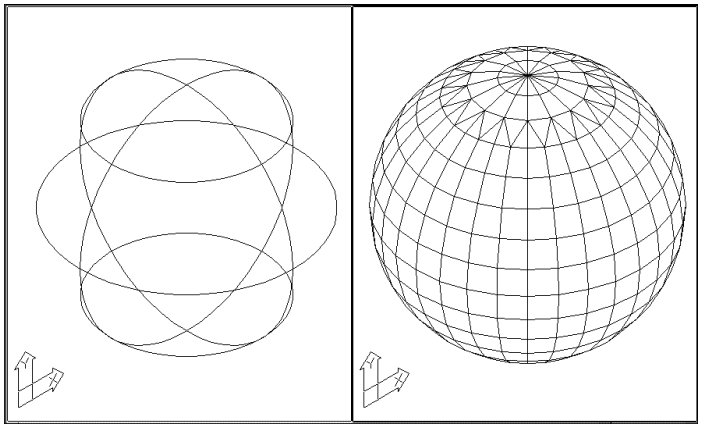
   Command: **sphere**

   Current wire frame density: ISOLINES=4

   Specify center of sphere <0,0,0>: **pick point**

   Specify radius of sphere or [Diameter]: **2**

Sphere *Sphere with Hidden Lines*



Isolines 12.8

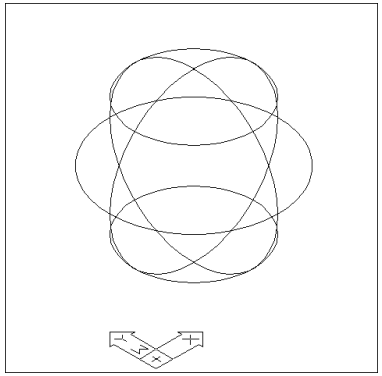
Specifies the number of isolines per surface on objects.
Valid integer values are from 0 to 2047.

1. **Type** ISOLINES at the command prompt.

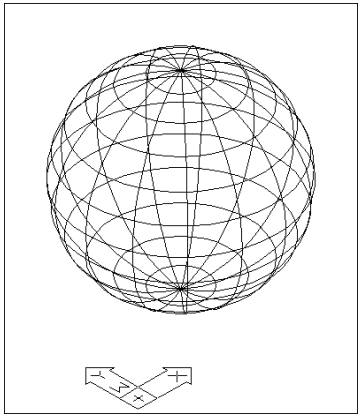
   Command: ISOLINES

   Enter new value for ISOLINES <4>: 15

sphere with 4 isolines



sphere with 15 isolines



Facetres 12.9

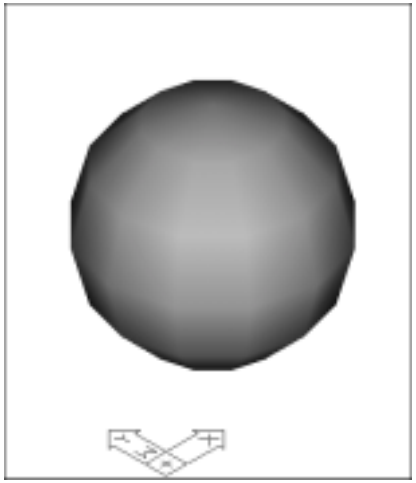
Adjusts the smoothness of shaded and rendered objects and objects with hidden lines removed. Valid values are from 0.01 to 10.0.

1. **Type** FACETRES at the command prompt.

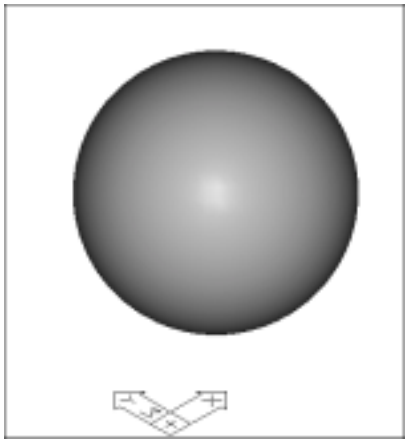
   Command: FACETRES

   Enter new value for FACETRES <.1000>: **5**

sphere with facetres 0.1



sphere with facetres 5



Cone 12.10

Creates a three-dimensional solid cone.

1. **Choose** Draw, Solids, Cone.

   or

2. **Type** CONE at the command prompt.

   Command: **cone**

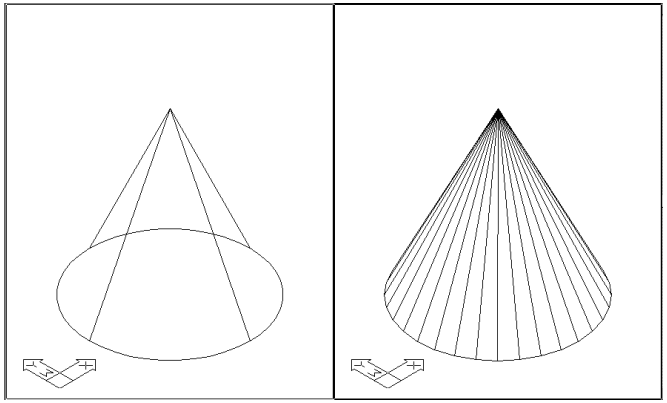
   Current wire frame density: ISOLINES=4

   Specify center point for base of cone or [Elliptical] <0,0,0>: **pick point**

   Specify radius for base of cone or [Diameter]: **2**

   Specify height of cone or [Apex]: **4**

Cone *Cone with Hidden Lines*



Wedge12.11

Creates a three-dimensional solid wedge.

1. **Choose** Draw, Solids, Wedge.

   or

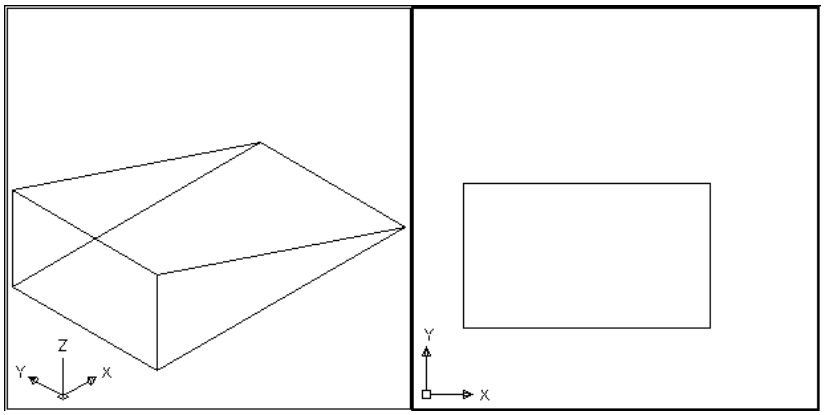
2. **Type** WEDGEat the command prompt.

   Command: **_wedge**

   Specify first corner of wedge or [CEnter] <0,0,0>: **pick**

   Specify corner or [Cube/Length]: **pick**

   Specify height: **2**



Torus 12.12

Creates a donut-shaped solid.

1. **Choose** Draw, Solids, Torus.

   or

2. **Type** TORUS at the command prompt.

   Command: **torus**

   Current wire frame density: ISOLINES=4

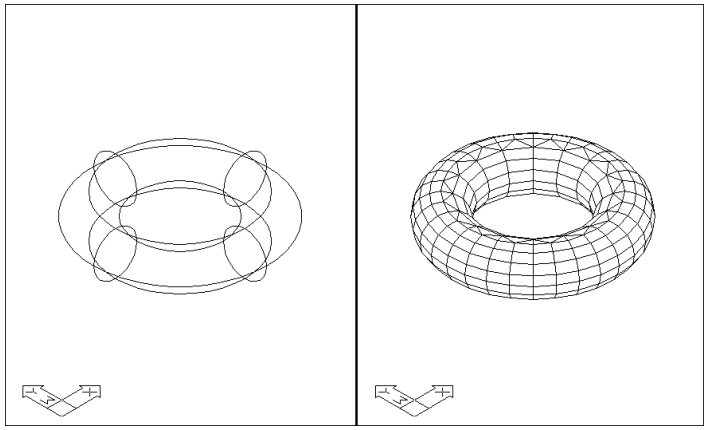
   Specify center of torus <0,0,0>: **pick point**

   Specify radius of torus or [Diameter]: **6**

   Specify radius of tube or [Diameter]: **2**

Torus

Torus with Hidden Lines



11th Week
Typical Floor Copy

Chapter 13
3D Edits

Rotate 3D 13.1

Rotates objects about a three-dimensional axis.

1. **Choose** Modify, 3D Operation, Rotate3D.

   or

2. **Type** ROTATE3D at the command prompt.

   Command: **rotate3D**

   Current positive angle: ANGDIR=counterclockwise ANGBASE=0

   Select objects: **pick**

   Select objects: **enter**

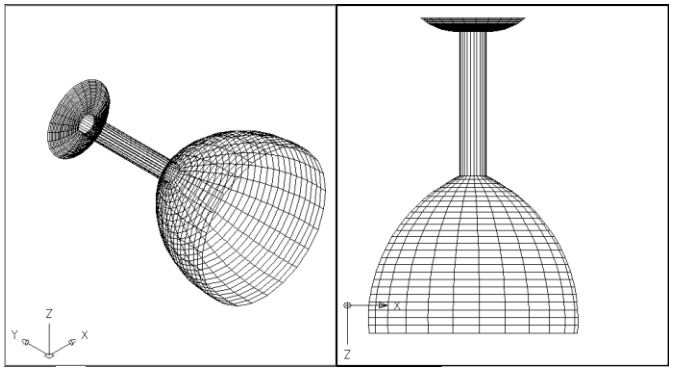
   Specify first point on axis or define axis by

   [Object/Last/View/Xaxis/Yaxis/Zaxis/2points]: **x**

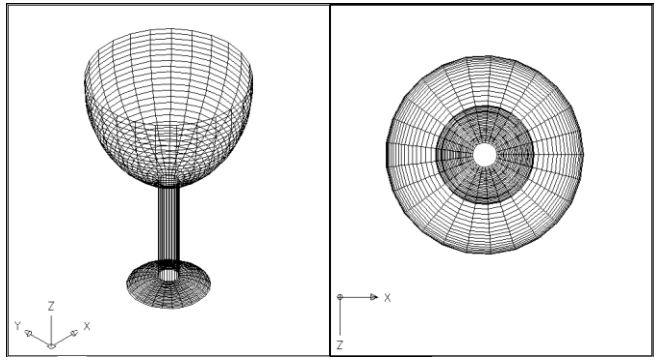
   Specify a point on the X axis <0,0,0>: **pick**

   Specify rotation angle or [Reference]: **90**

Object Before Rotation



Object Rotated 90 degrees around x-axis



Align 13.2

1. **Choose** Modify, 3D Operation, Align.

   or

2. **Type** ALIGN at the command prompt.

   Command: **align**

   Select objects: **pick the wedge**

   Select objects: **enter**

   Specify first source point: **P1**

   Specify first destination point: **P2**

   Specify second source point: **P3**

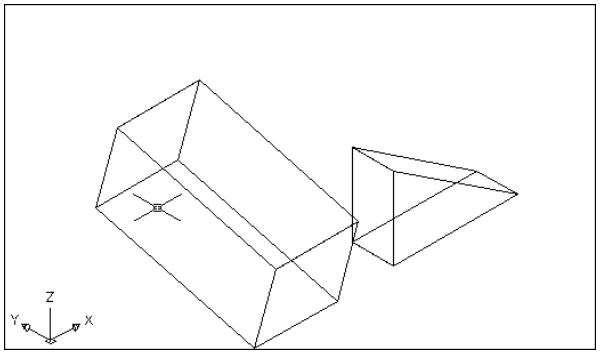
   Specify second destination point: **P4**

   Specify third source point or <continue>: **enter**

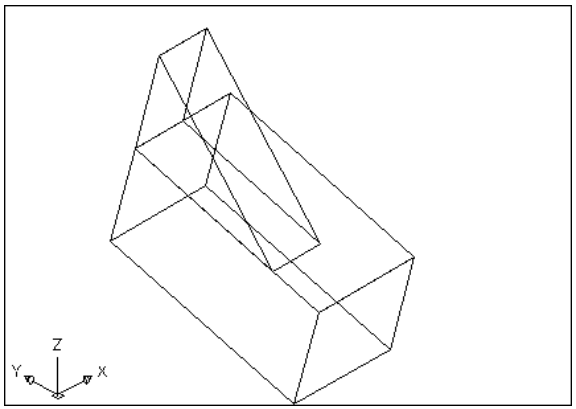
   Scale objects based on alignment points? [Yes/No] <N>:

   enter

Objects before align



Wedge Aligned to the Box (Not Scaled)



Mirror 3D 13.3

1. **Choose** Modify, 3D Operation, Mirror 3D.

   or

2. **Type** MIRROR3D at the command prompt.

   Command: **mirror3D**

   Select objects: **pick the circle**

   Select objects: **enter**

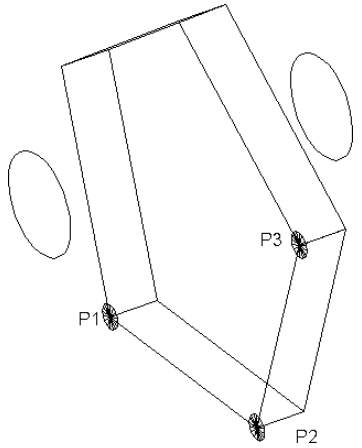
   Specify first point of mirror plane (3 points) or [Object/Last/Zaxis/View/XY/YZ/ZX/3points] <3points>: **P1**

   Specify second point on mirror plane: **P2**

   Specify third point on mirror plane: **P3**

   Delete source objects? [Yes/No] <N>: **enter**

Circle Mirrored around 3 Points



3D Array (Rectangular) 13.4

1. **Choose** Modify, 3D Operation, 3D Array.

   or

2. **Type** 3DARRAY at the command prompt.

   Command: **3darray**

   Select objects: **pick the cube**

   Select objects: **enter**

   Enter the type of array [Rectangular/Polar] <R>: **enter**

   Enter the number of rows (---) <1>: **3**

   Enter the number of columns (|||) <1>: **4**

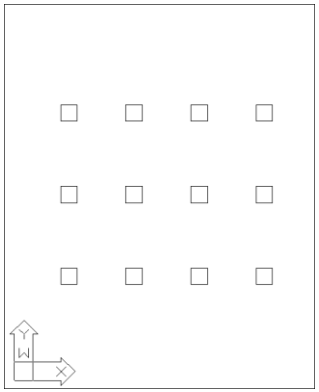
   Enter the number of levels (...) <1>: **2**

   Specify the distance between rows (---): **5**

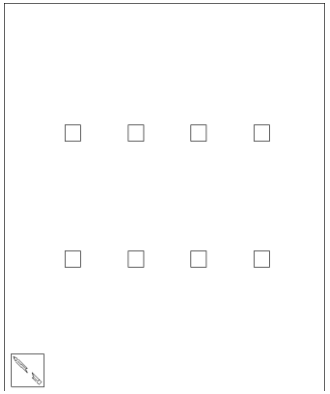
   Specify the distance between columns (|||): **4**

   Specify the distance between levels (...): **8**

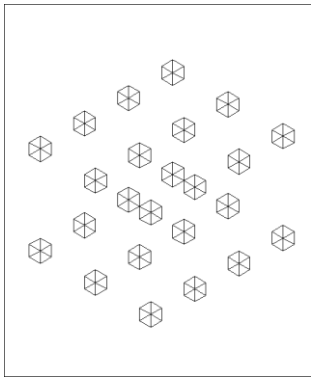
Arrayed Objects in Plan View



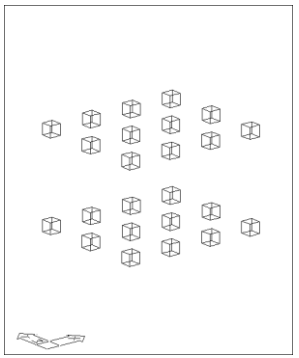
Arrayed Objects in Front View



Arrayed Objects in 3D Isometric



Arrayed Objects in 3D Viewpoint



3D Array (Polar) 13.5

1. **Choose** Modify, 3D Operation, 3D Array.

   or

2. **Type** 3DARRAY at the command prompt.

   Command: **3darray**

   Select objects: **pick cube**

   Select objects: **enter**

   Enter the type of array [Rectangular/Polar] <R>: **p**

   Enter the number of items in the array: **5**

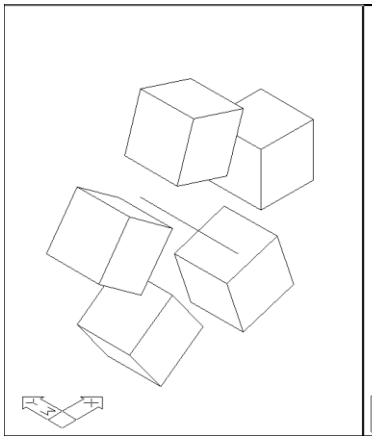
   Specify the angle to fill (+=ccw, -=cw) <360>: **enter**

   Rotate arrayed objects? [Yes/No] <Y>: **enter**

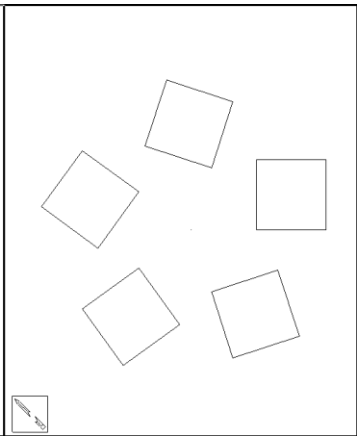
   Specify center point of array: **mid of axis line**

   Specify second point on axis of rotation: **pick**

Arrayed Objects Around a Line



Arrayed Objects in Plan View



Chapter 14
Solid Composites

Subtract 14.1

Creates a composite region or solid by subtraction.

1. **Choose** Modify, Solids Editing, Subtract.

   or

2. **Type** SUBTRACT at the command prompt.

   Command: **subtract**

   SUBTRACT Select solids and regions to subtract from...

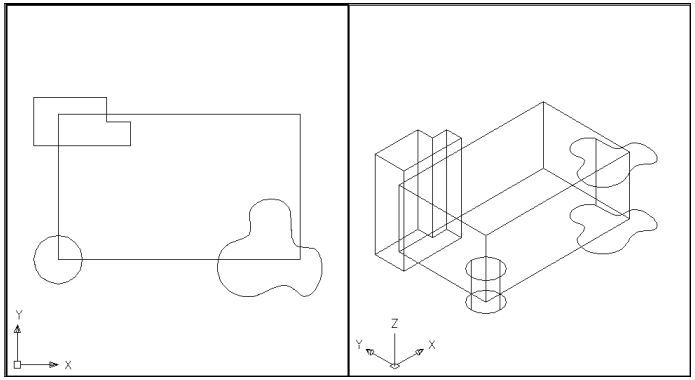
   Select objects: **pick the box**

   Select objects: **(press enter)**

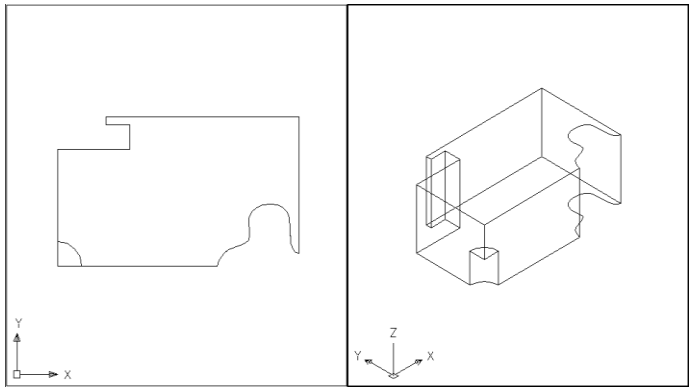
   Select solids and regions to subtract...

   Select objects: **pick the cylinder**

   Select objects: **enter**



Objects Subtracted from Box



Union 14.2

Creates a composite region or solid by addition.

1. **Choose** Modify, Solids Editing, Union.

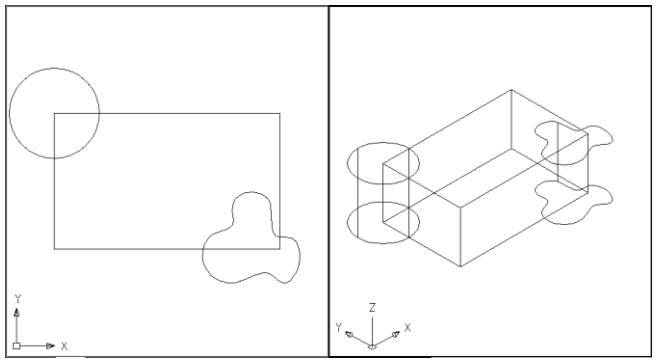
or

2. **Type** UNION at the command prompt.

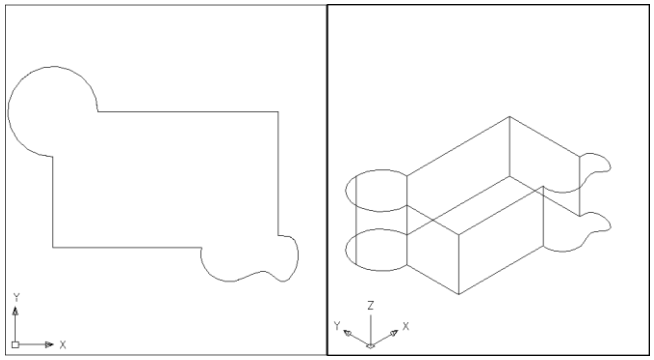
Command: **union**

Select objects: **pick cylinder & box**

Select objects: **enter**



Solid Objects Unioned Together



Intersect 14.3

Creates a solid based on the intersection of two existing solids.

1. **Choose** Modify, Solids Editing, Intersect

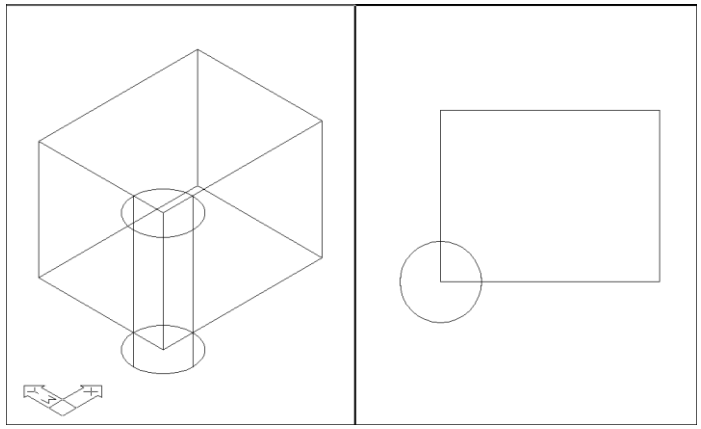
   or

2. **Type** INTERSECT at the command prompt.

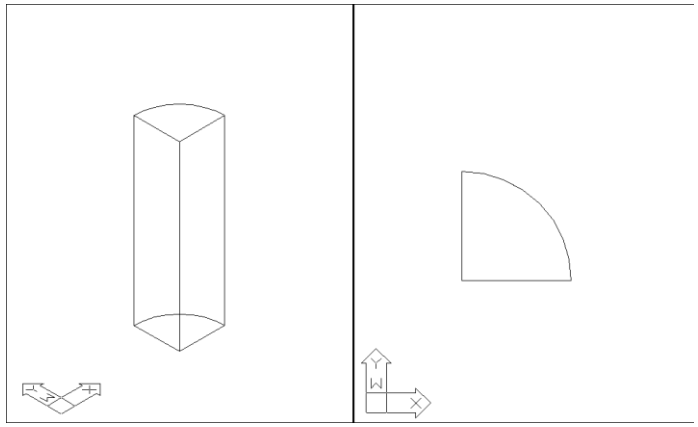
   Command: **intersect**

   Select objects: **pick cylinder and box**

   Select objects: **enter**



Intersection of Cylinder and Box



12th-13th Week
Color Creation

Chapter 15
Modifying Solid Objects

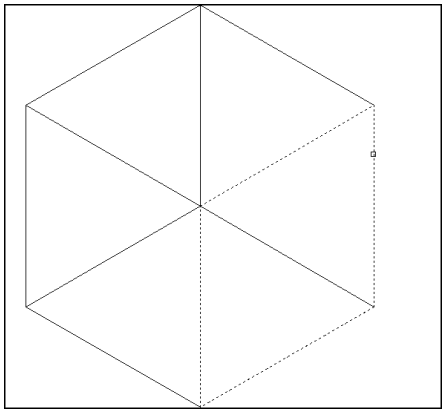
Extruding Faces 15.1

1. **Choose** Modify, Solids Editing, Extrude face

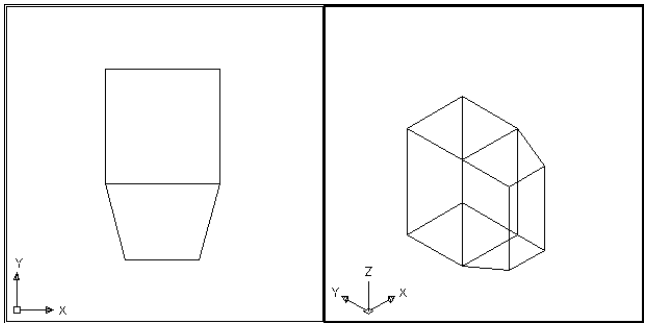
   NOTE: Must be a solid to extrude the face.

2. **Choose** a face to extrude. If you choose more than one face, hold the SHIFT key to deselect unwanted faces.
3. **Press** ENTER.
4. Specify height of extrusion or [Path]: **.25**
5. Specify angle of taper for extrusion <0>: **45**

Select Face



Extruded Face



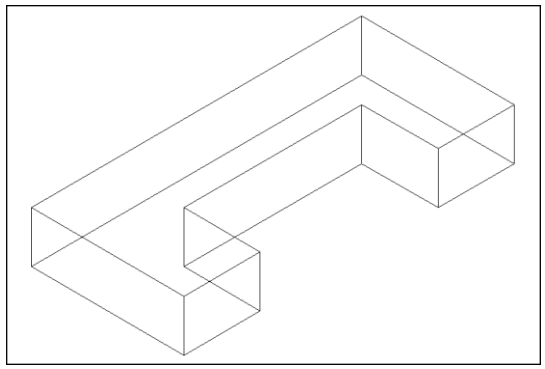
Tapered Faces 15.2

1. **Choose** Modify, Solids Editing, Taper face
2. **Choose** a face(s) to taper. If you choose more than one face, hold the SHIFT key to deselect unwanted faces.
3. **Press** ENTER.
4. **Specify** the base point: **pick the back left corner**
5. **Specify** another point along the axis of tapering: pick point
6. **Specify** the taper angle: **45**

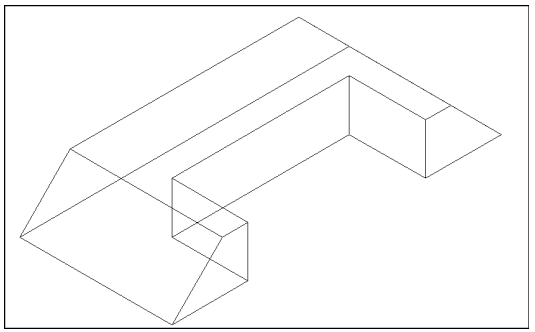
   Solid validation started.

   Solid validation completed.

Before Taper

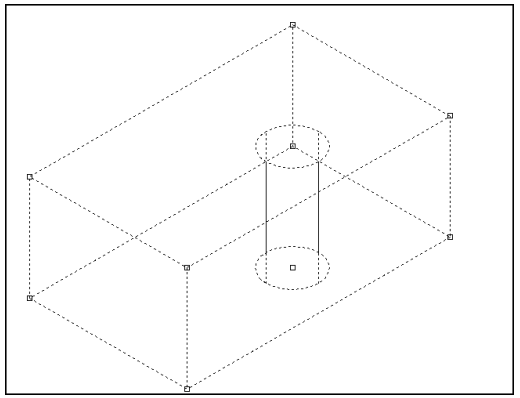


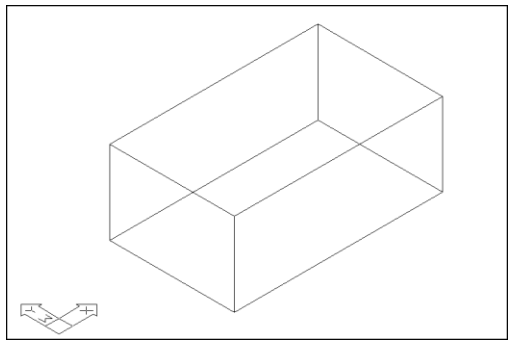
After Taper



Delete Faces 15.3

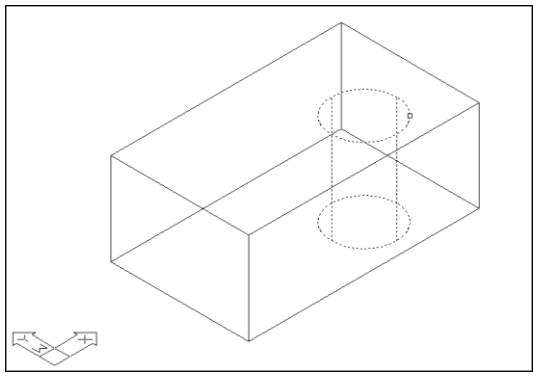
1. **Choose** Modify, Solids Editing, Delete face
2. **Choose** a face to delete. If you choose more than one face, hold the SHIFT key to deselect unwanted faces.
3. **Press** ENTER.
4. **Choose** the face to delete.

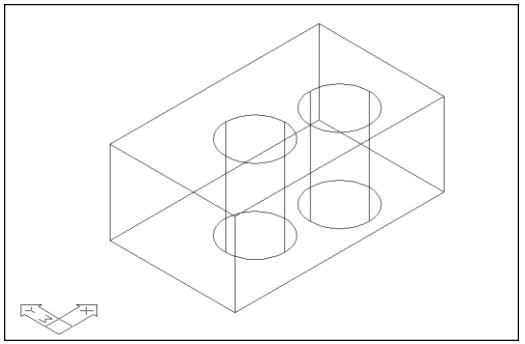




Copy Faces 15.4

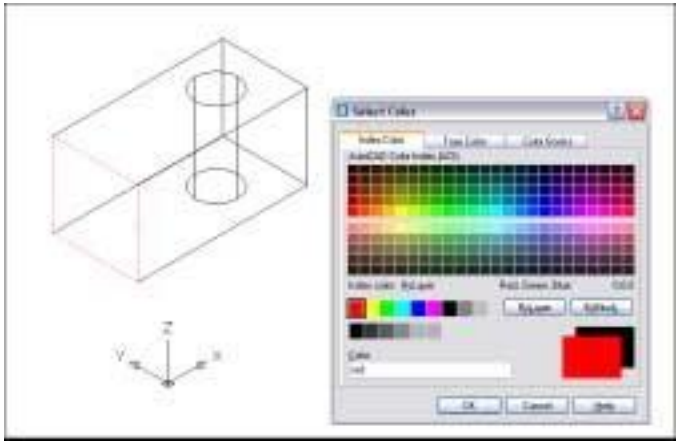
1. **Choose** Modify, Solids Editing, Copy face
2. **Choose** a face to copy . If you choose more than one face, hold the SHIFT key to deselect unwanted faces.
3. **Press** ENTER.
4. **Pick** the solid face to copy.
5. **Pick** a new location.





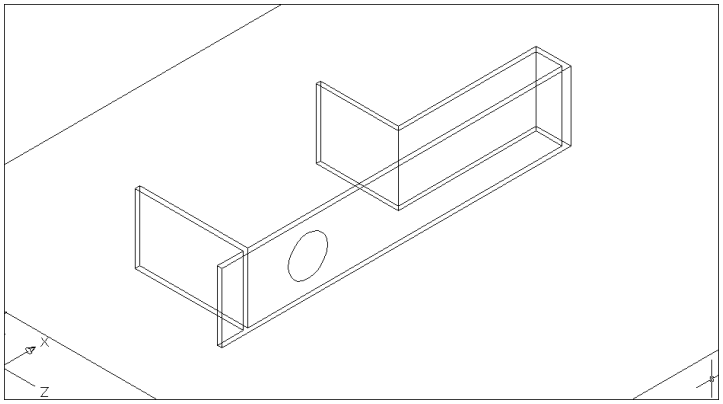
Color Face 15.5

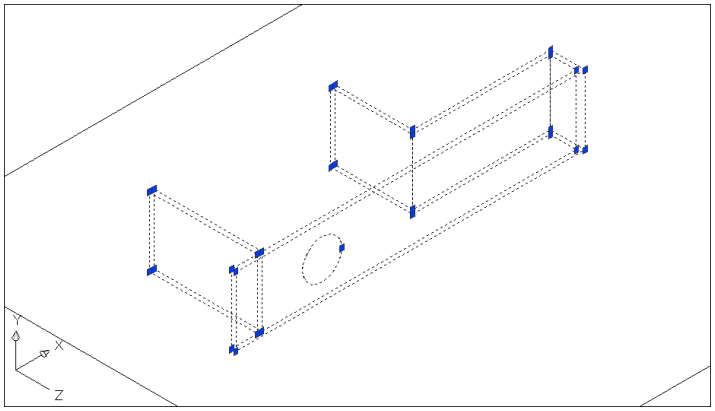
1. **Choose** Modify, Solids Editing, Color face
2. **Choose** a face to change the color of. If you choose more than one face, hold the SHIFT key to deselect unwanted faces.
3. **Press** ENTER.
4. **Choose** a color to change the face to.



Imprint 15.6

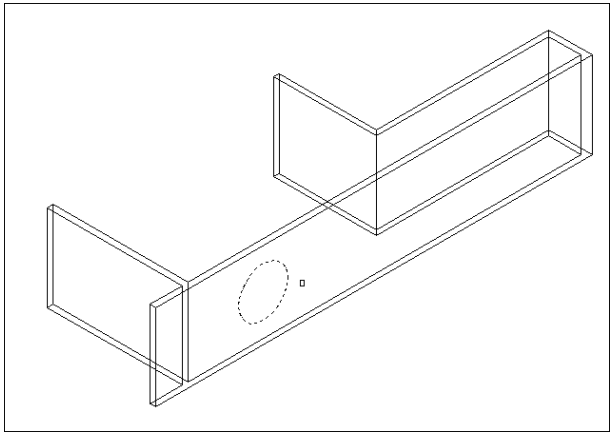
1. Extrude objects (i.e. walls) to create a solid object.
2. Change the UCS and draw an object on a face of one of the walls.
3. **Choose** Modify, Solids Editing, Imprint.
2. **Select** a 3D solid: **pick solid**
3. **Select** an object to imprint: **pick circle**
4. **Delete** the source object <N>: **y**

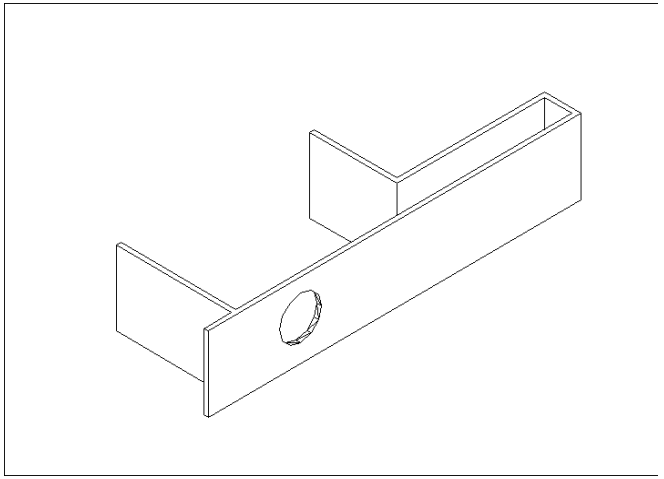




Extrude Imprint to Create Openings 15.7

1. **Choose** Modify, Solids Editing, Extrude Faces.
2. **Select** the circle that was imprinted.
3. **Deselect** any unwanted faces.
4. **Type** -8 as the height of extrusion (or desired height)

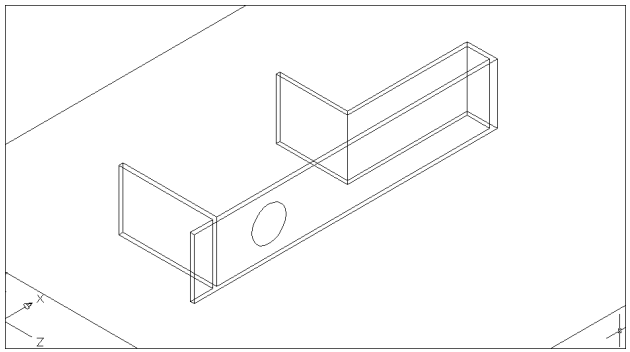




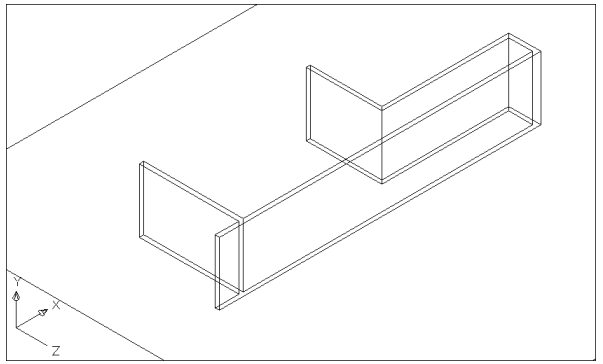
Clean 15.8

1. **Choose** Modify, Solids Editing, Clean.
2. **Select** a 3D solid: **pick imprinted circle.**

Before Clean



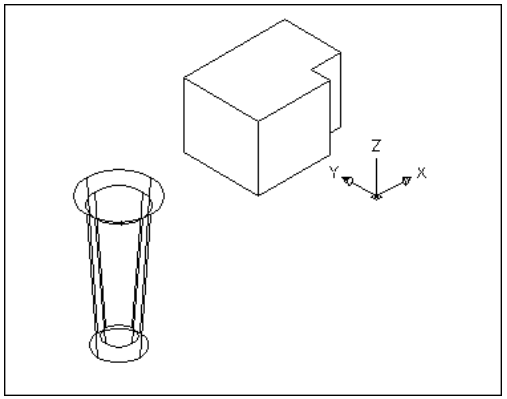
After Clean



Shell 15.9

You can create a shell or a hollow thin wall with a specified thickness from your 3D solid object. AutoCAD creates new faces by offsetting existing ones inside or outside their original positions. AutoCAD treats continuously tangent faces as single faces when offsetting.

1. **Choose** Modify, Solids Editing, Shell.
   Select a 3D solid: **pick**
   Remove faces or [Undo/Add/ALL]: **enter**
   Enter the shell offset distance: **.5**



Chapter 16
Enhancing the Drawing Process

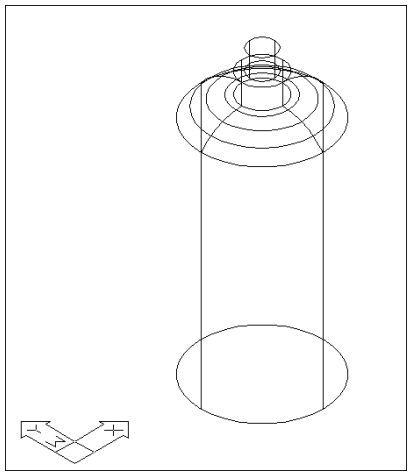
Creating Sections 16.1

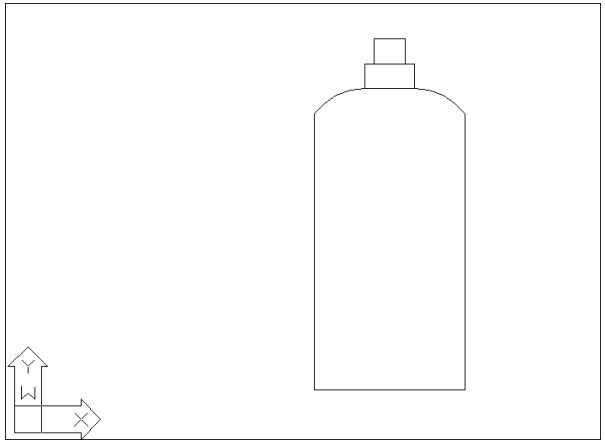
1. **Open** the drawing called 3DBottle.DWG
2. **Create** a layer called Section. Make it the current layer.
3. **Choose** Draw, Solids, Section.
4. **Choose** all 3 solids making up the bottle.

   Select objects:

   Specify first point on Section plane by [Object/ Zaxis/View/XY/YZ/ZX/3points]: **ZX**

   Specify a point on the ZX-plane <0,0,0>:**quad of bottle.**
5. **3DRotate** the section to a flat plane.





Slice 16.2

Slices a set of solids with a plane.

1. **Choose** Modify, Draw, Slice.

   or

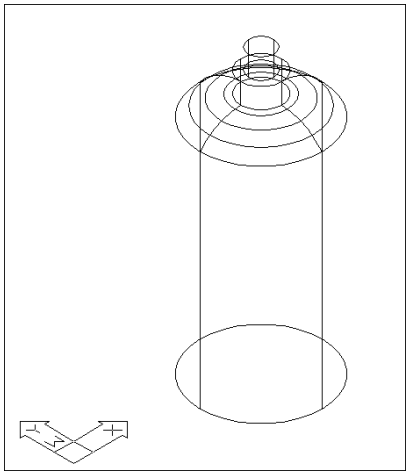
2. **Type** SLICE at the command prompt.

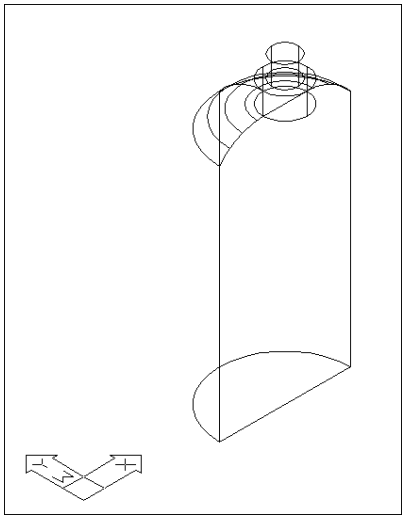
   Command: **slice**

   Slice plane by Object/Zaxis/View/XY/YZ/ZX/ <3points>: **ZX**

   Point on ZX plane <0,0,0>: **quad of bottle**

   Both sides/<Point on desired side of the plane>: pick the side of the bottle you want to keep.

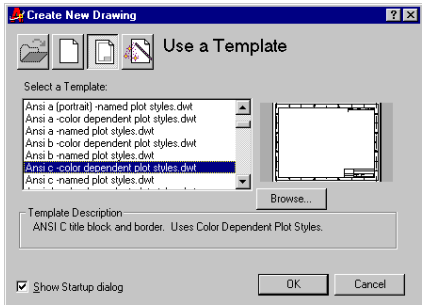




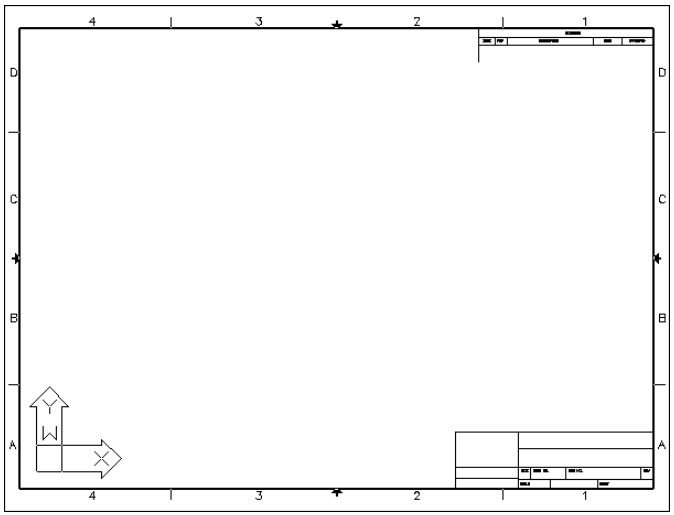
Create a SOLVIEW Viewport 16.3

1. **Choose** File, New...
2. **Choose** Use a Template from the startup dialog.
3. **Double Click** Ansi_c.dwt as the template file to start from.

   This create a new drawing with a border and one floating Model Space.
4. **Double Click** MODEL from the Status Bar. Note the change to Paper Space.
5. **Double Click** PAPER from the Status Bar to toggle back to Model Space.

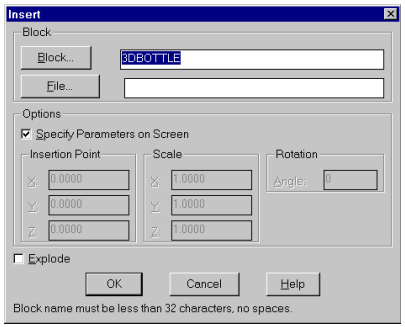


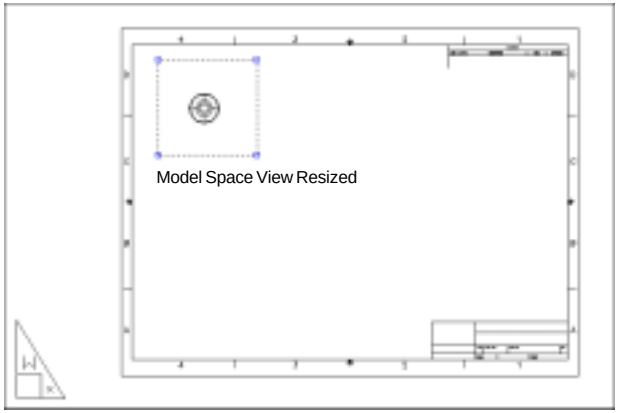
Drawing with a Model Space View

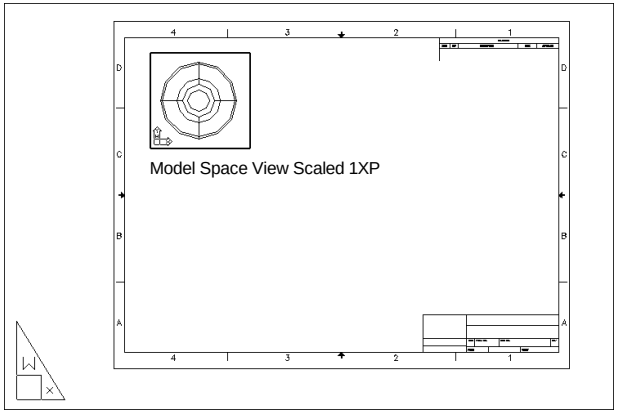


Insert a Drawing

1. **Choose** Insert, Block...
2. **Choose** the drawing called 3DBOTTLE.DWG to insert.
3. **Insert** the block anywhere in the Model Space view at a scale of 1 and rotation 0.
4. **Double Click** MODEL at the Status Bar and resize the Model Space view port in Paper Space.
5. **Double Click** PAPER at the Status Bar to return to Model Space.
6. **Type** ZOOM, 1XP at the command prompt.







Create an Orthogonal View

1. **Choose** Draw, Solids, Setup, View.

   or

2. **Type** SOLVIEW at the command prompt.

   Command: **solview**

   Ucs/Ortho/Auxiliary/Section/<eXit>: **O**

   Pick side of viewport to project: **P1**

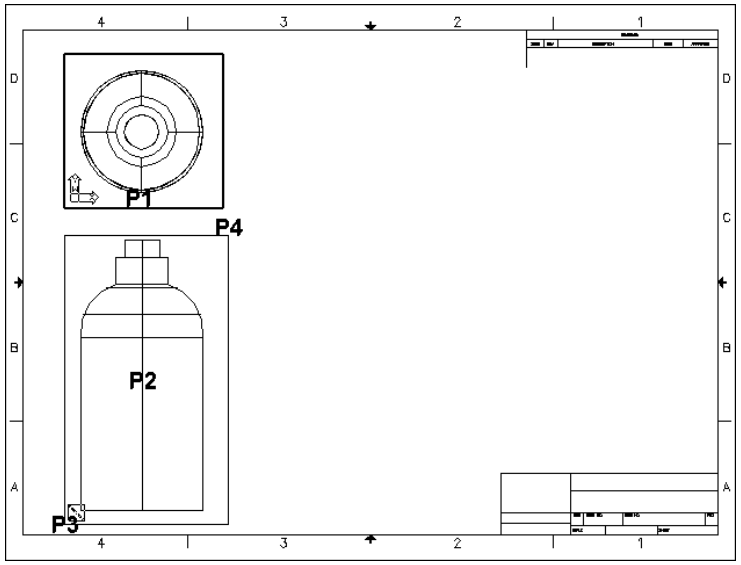
   View center: **P2**

   Clip first corner: **P3**

   Clip other corner: **P4**

   View name: **front**

   Ucs/Ortho/Auxiliary/Section/<eXit>:



Create a 2D Section with Soldraw 16.4

Generates profiles and sections in viewports created with SOLVIEW.

SOLDRAW can only prepare viewports that have been created with SOLVIEW.

1. **Choose** Draw, Solids, Setup, Drawing.

   or

2. **Type** Command: **soldraw**

   Select viewports to draw: **P1**

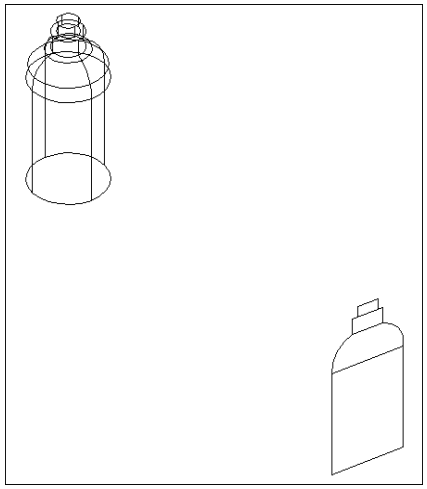
   Select objects: **1 found**

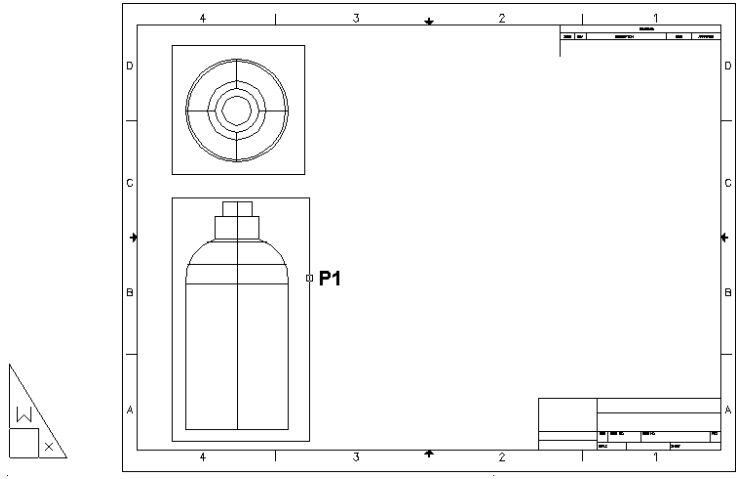
   Select objects: **enter**

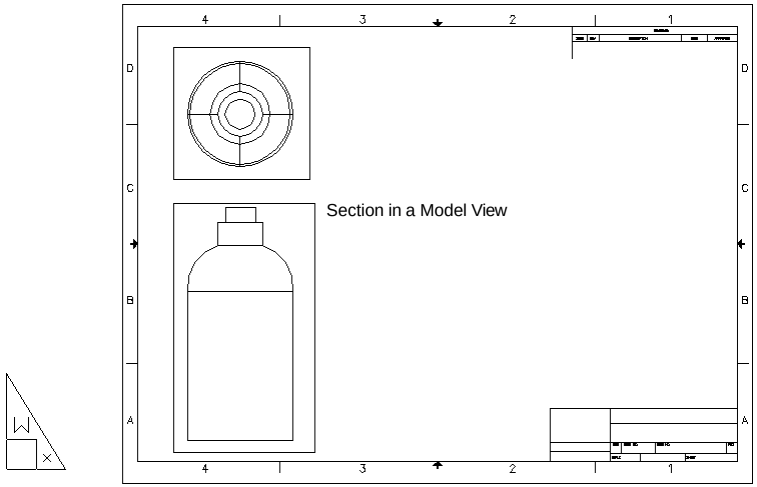
   3 solids selected.

   NOTE: If your object was an inserted block, you need to first explode it so it becomes a solid.

Resultant Section and Solid







Create a 3D View Using UCS 16.5

1. **Click** MSPACE and the plan view of the 3D Bottle.

2. **Choose** View, 3D Viewport, SW Isometric...

3. **Type** UCS at the command prompt.

   Command: **ucs**

   Origin/ZAxis/3point/OBject/View/X/Y/Z/
   Prev/Restore/Save/Del/?/<World>: **view**

   This sets the current UCS parallel to the screen. We now need to save this ucs.

4. **Type** UCS at the command prompt.

   Command: **ucs**

   Origin/ZAxis/3point/OBject/View/X/Y/Z/
   Prev/Restore/Save/Del/?/<World>: **save**

   ?/Desired UCS name: **3dview**

5. **Click** PSPACE at the command prompt.

6. **Choose** Draw, Solids, Setup, View

   Command: **solview**

   Ucs/Ortho/Auxiliary/Section/<eXit>: **u**

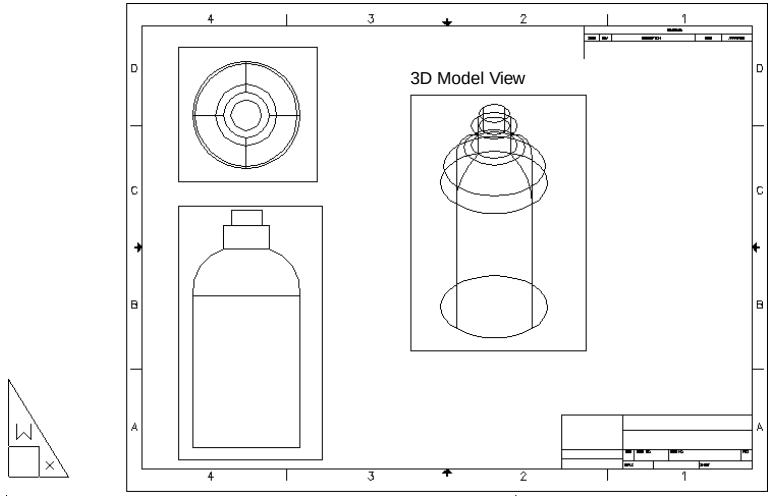
   Named/World/?/<Current>: **n**

   Name of UCS to restore: **3dview**

   Enter view scale<1.0000>: **enter**

   View center: **pick**

   View center: **pick**



Create a Hidden Line View 16.6

1. **Double Click** MODEL to return to Model Space.
2. **Choose** Draw, Solids, Setup, Profile.

   or

3. **Type** SOLPROF at the command prompt.

   Command: **solprof**

   Select objects: **pick solids**

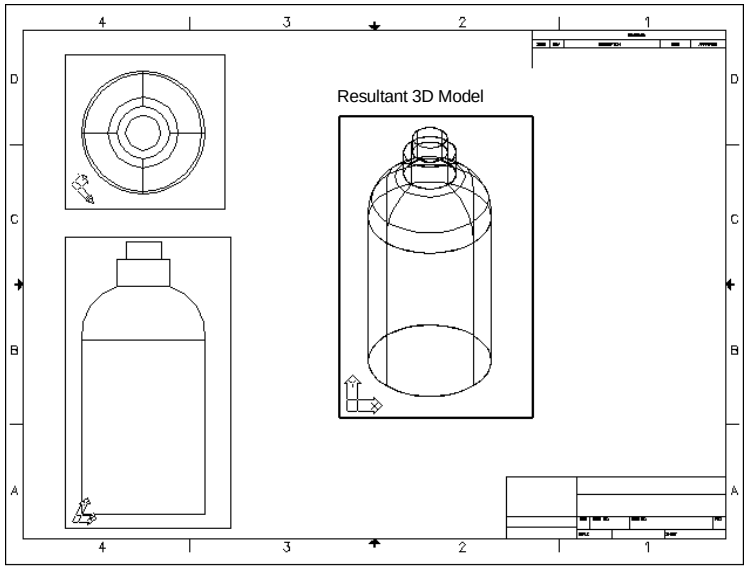
   Select objects: **enter**

   Display hidden profile lines on separate layer? <Y>: **enter**

   Project profile lines onto a plane? <Y>: **enter**

   Delete tangential edges? <Y>: **enter**

   3 solids selected.



Chapter 17
Rendering

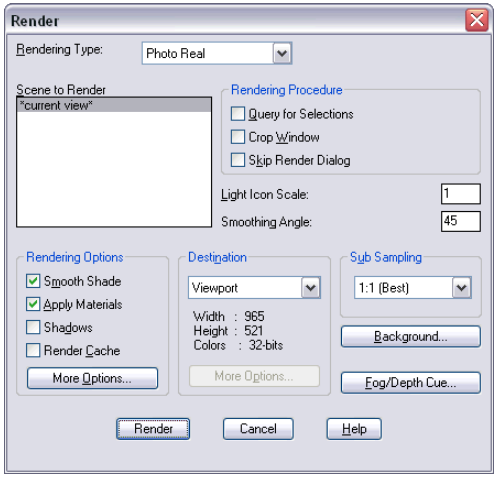
Render Command 17.1

Creates a photorealistic or realistically shaded image of a three-dimensional wireframe or solid model.

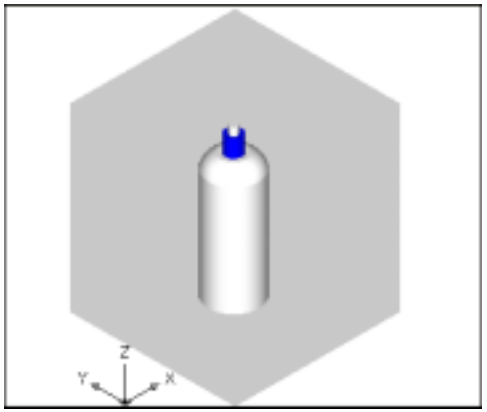
1. **Open** the AutoCAD drawing called 3DBOTTLE.DWG.
2. **Type** MSPACE to go to the model space view.
3. **Choose** View, Render, Render...

   or
4. **Type** RENDER at the command prompt.

   Command: **render**
5. **Click** the Render button.



Rendered Viewport



Render a Selection 17.2

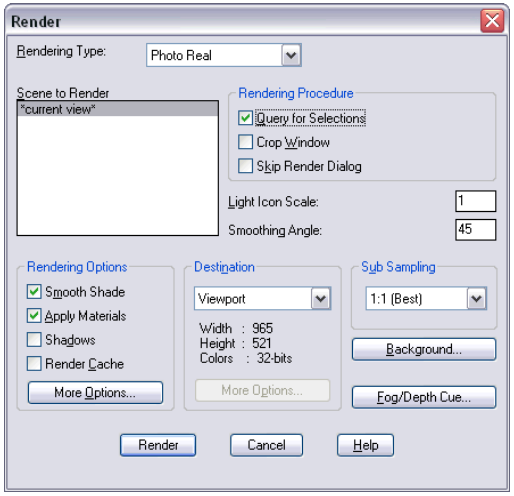
1. **Choose** View, Render, Render...

   or

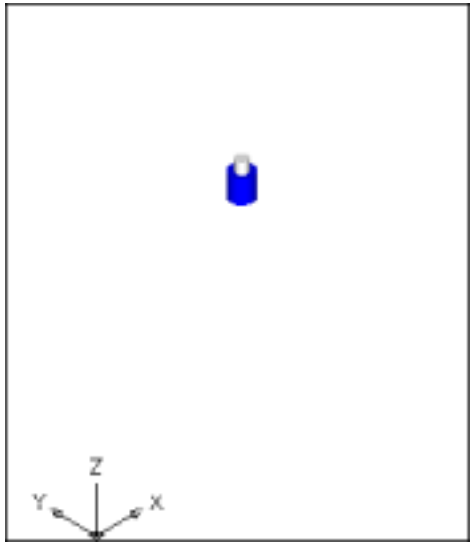
2. **Type** RENDER at the command prompt.

   Command: **render**

3. **Click** Query for Selection.
4. **Click** Render.
5. **Choose** the objects to render.



Rendered Selection



Render a Cropped Window 17.3

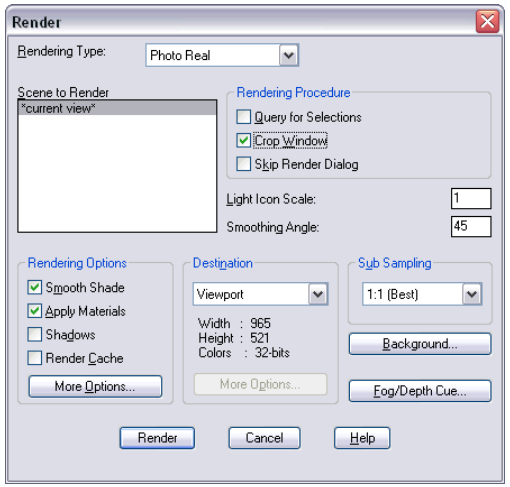
1. **Choose** View, Render, Render...

   or

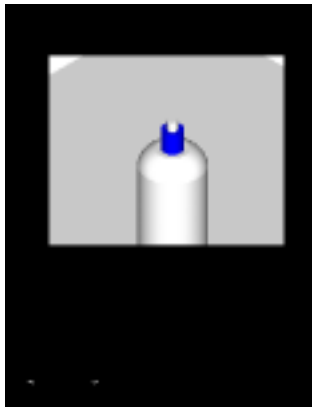
2. **Type** RENDER at the command prompt.

   Command: **render**

3. **Click** Crop Window.
4. **Click** Render.
5. **Choose** a window to render.



Cropped Rendered Window



Render without Dialog Box 17.4

1. **Choose** View, Render, Render...

   or

2. **Type** RENDER at the command prompt.

   Command: **render**

3. **Click** Skip Render Dialog.
4. **Click** Render.

Turn Render Dialog Box On with RPREF 17.5

1. **Type** RPREF at the command line.

   Command: **rpref**

3. **Click** Skip Render Dialog.

Render to File 17.6

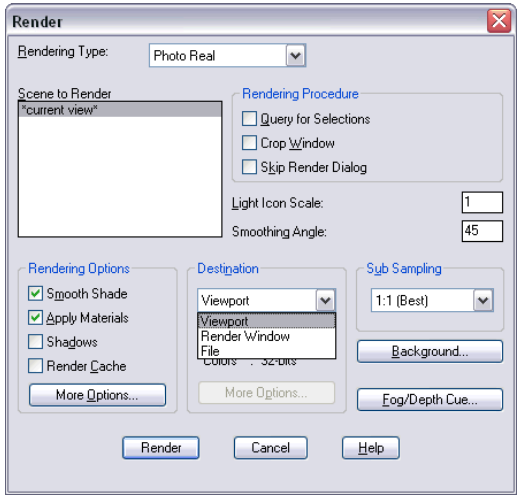
1. **Choose** View, Render, Render...

   or

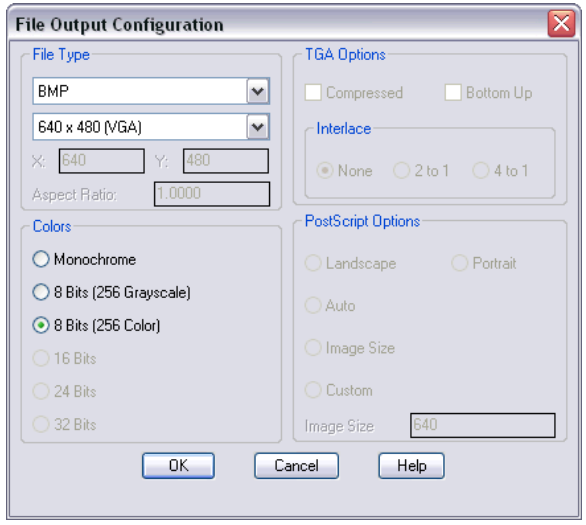
2. **Type** RENDER at the command prompt.

   Command: **render**

3. **Click** the dropdown list under Viewport.
4. **Choose** File as the destination options.



Render to a File Options



Render to Render Window 17.7

1. **Choose** View, Render, Render...

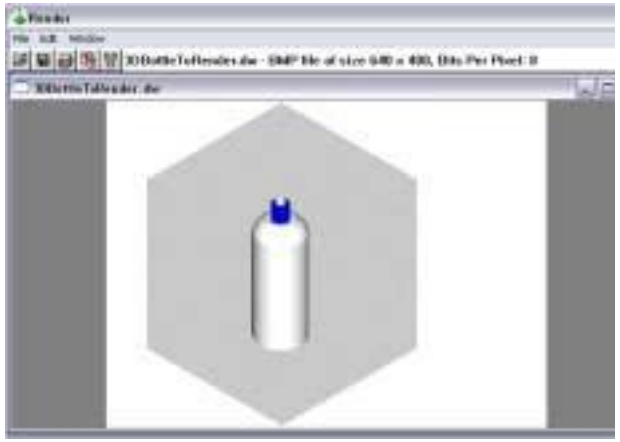
   or

2. **Type** RENDER at the command prompt.

   Command: **render**

3. **Click** the dropdown list under Viewport.
4. **Choose** Render Window as the destination option.

Render Window



Print Screen 17.8

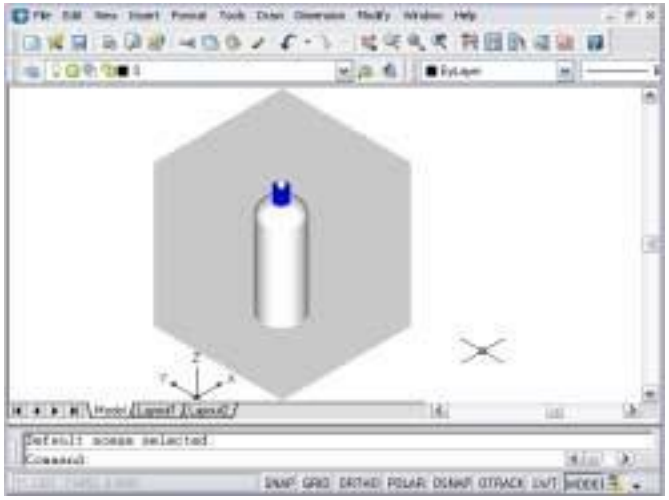
1. **Choose** View, Render, Render...

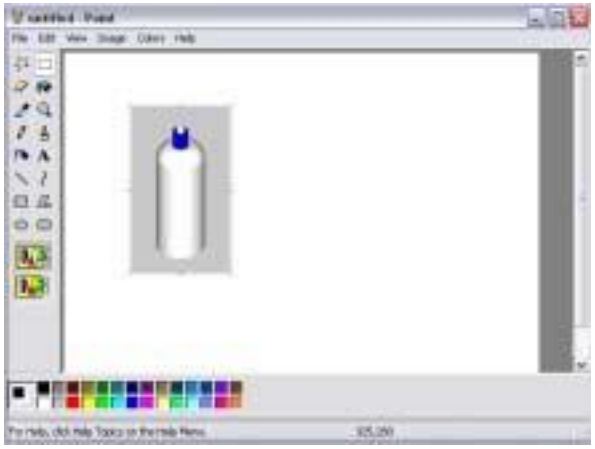
   or

2. **Type** RENDER at the command prompt.

   Command: **render**

3. **Press** PRINT SCREEN on the keyboard to copy your rendered image to the Window's clipboard.





Light Scale Icon and Smoothing Angle 17.9

1. **Choose** View, Render, Render...

   or

2. **Type** RENDER at the command prompt.

   Command: **render**

3. **Click** **Light Scale Icon** and **Smoothing** to change the values.

Light Icon Scale

Controls the size of the light blocks in the drawing. The value is the current scale factor (in drawing units) of rendering blocks in the drawing. Enter a real number to rescale the blocks.

The scale factor affects the following blocks: OVERHEAD, DIRECT, and SH_SPOT.

Smoothing Angle

Sets the angle at which AutoCAD interprets an edge. The default is 45 degrees. Angles greater than 45 degrees are considered edges. Angles less than 45 degrees are smoothed. To define an edge as less than 45 degrees, reduce the smoothing angle.

Chapter 18
Materials

Materials Command 18.1

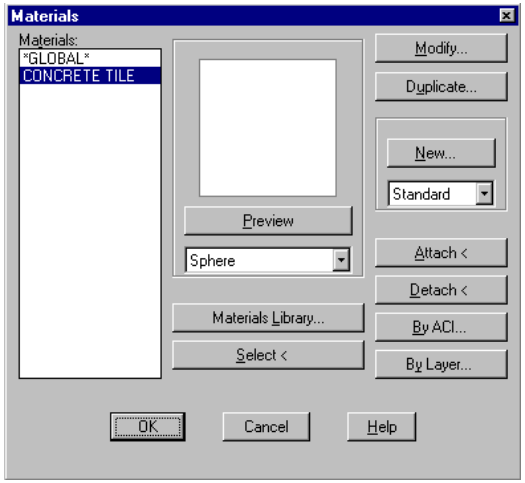
1. **Choose** View, Render, Materials...

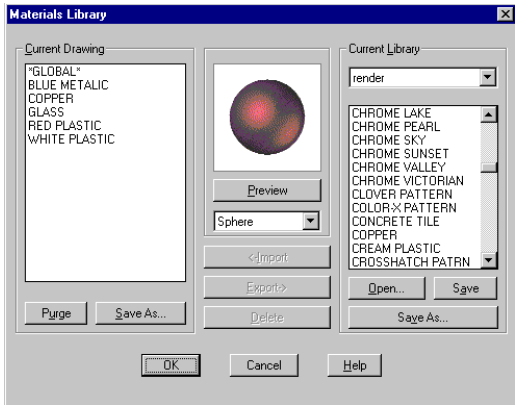
   or

2. **Type** RMAT at the command prompt.

   Command: **rmat**

3. **Click** the Materials Library...button.
4. **Pick** Concrete Tile as the material.
5. **Click** the Preview button.
6. **Click** the Import button.
7. **Click** OK.





Materials Library 18.2

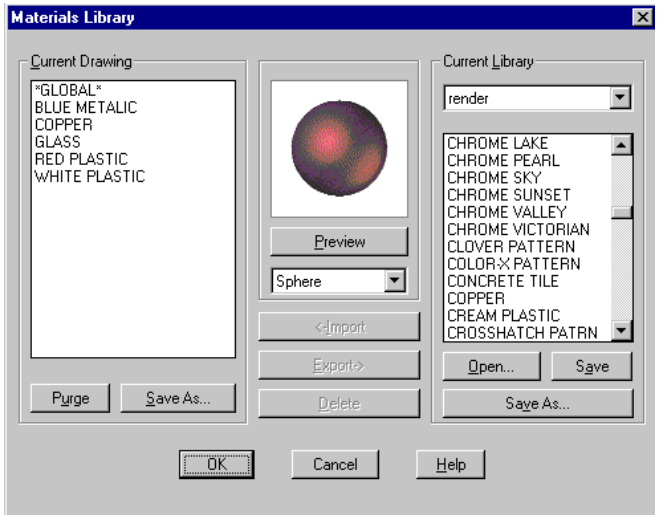
1. **Choose** View, Render, Materials Library.

   or

2. **Type** MATLIB at the command prompt.

   Command: **matlib**

3. **Pick** a material from the material list.
4. **Click** the Preview button and preview as a sphere or cube.



Applying Materials with Attach 18.3

1. **Choose** View, Render, Materials...

   or

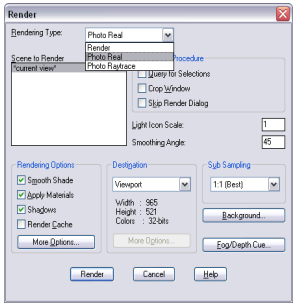
2. **Type** RMAT at the command prompt.

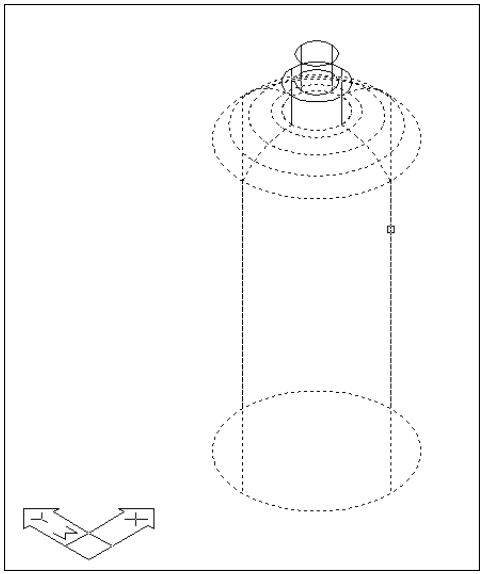
   Command: **rmat**

3. **Click** the Materials Library...button.
4. **Pick** Glass as the material.
5. **Click** the Preview button.
6. **Click** the Import button.
7. **Click** OK.
8. **Click** the Attach button.
9. **Pick** Objects to attach materials to.
10. **Exit** the materials menu and render the viewport.

NOTE: You need to set the rendering type to Photorealistic Rendering in order to see the materials

1. **Choose** View, Render, Render
2. **Choose** Photoreal as the render type.
3. **Render** the viewport.





Applying Materials by Layer 18.4

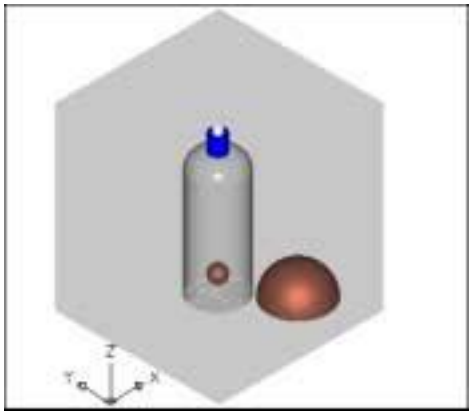
1. **Choose** View, Render, Materials...

   or

2. **Type** RMAT at the command prompt.

   Command: **rmat**

3. **Click** Click Copper as the material.
4. **Click** the By Layer button.
5. **Click** Ball as the layer to attach materials to.
6. **Exit** the materials menu and render the viewport.



Applying Materials by Color 18.5

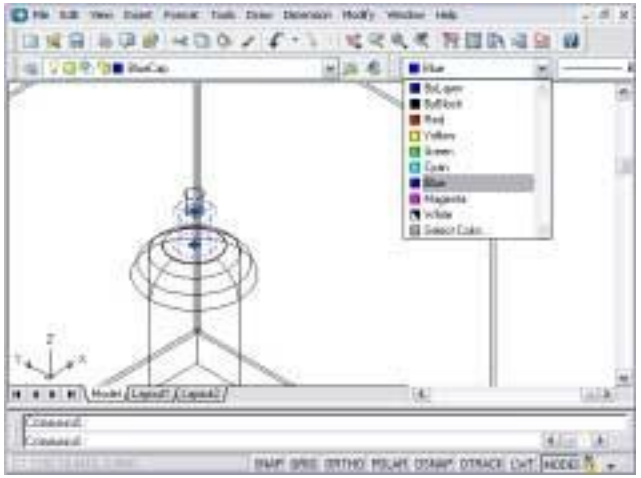
1. **Choose** View, Render, Materials...

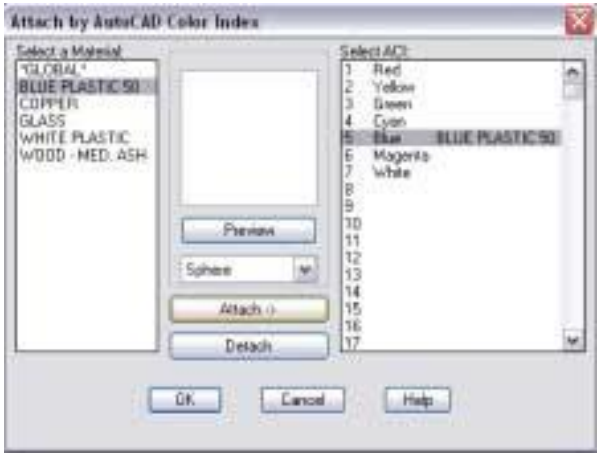
   or

2. **Type** RMAT at the command prompt.

   Command: **rmat**

3. **Click** Click Copper as the material.
4. **Click** the By Layer button.
5. **Click** Ball as the layer to attach materials to.
6. **Exit** the materials menu and render the viewport.





Complex Materials 18.6

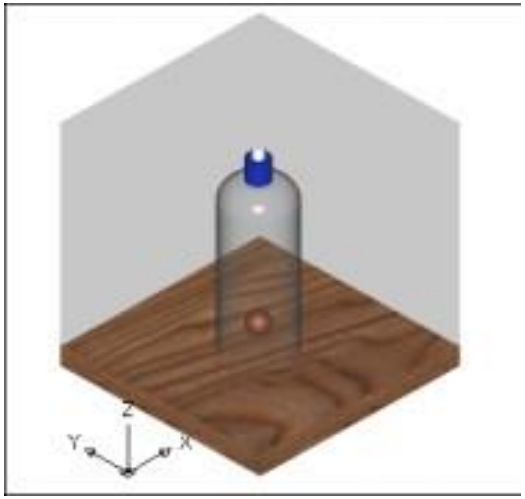
1. **Choose** View, Render, Materials...

   or

2. **Type** RMAT at the command prompt.

   Command: **rmat**

3. **Click** Click Med. Ash Wood as the material.
4. **Click** the Attach button.
5. **Click** the base to attach materials to.
6. **Exit** the materials menu and render the viewport.



Adjusting Materials with Material Mapping 18.7

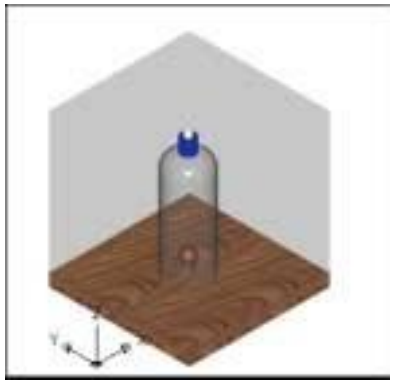
1. **Choose** View, Render, Mapping

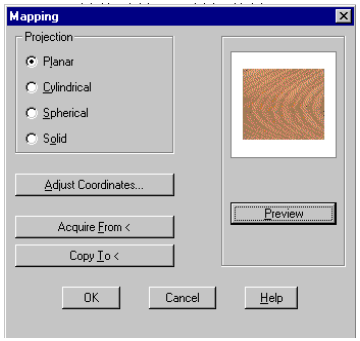
   or

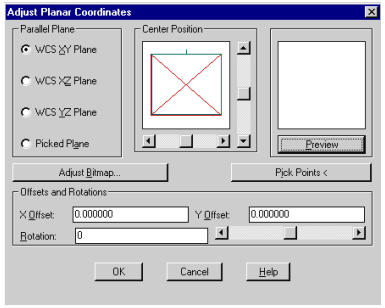
2. **Type** SETUV at the command prompt.

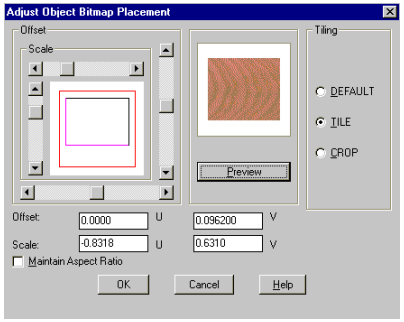
   Command: **setuv**

3. **Pick** objects to adjust (base).
4. **Press** enter when finished selecting.
5. **Pick** the type of projection to adjust.
6. **Click** the Adjust Coordinates... button.
7. **Adjust** the Planar coordinates as necessary.
8. **Click** OK.









New Materials 18.6

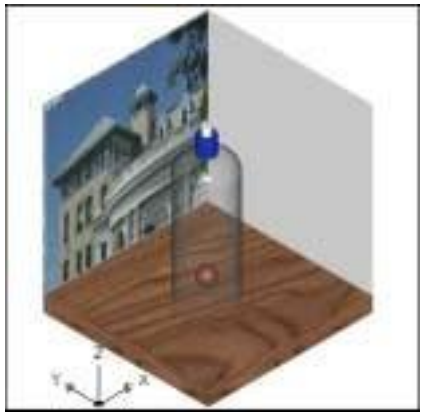
1. **Choose** View, Render, Materials...

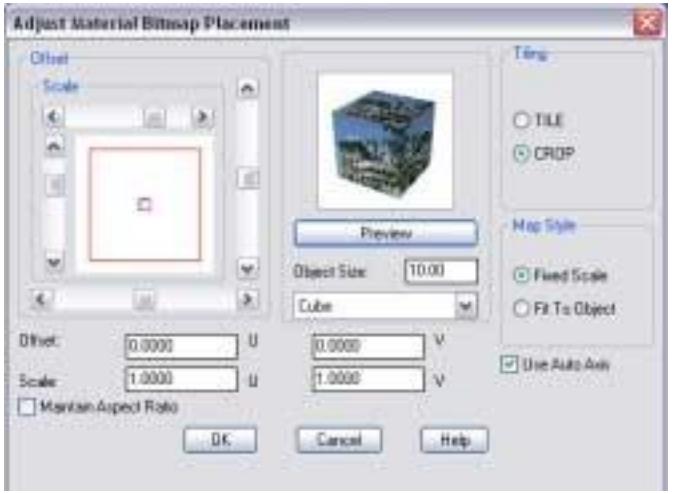
   or

2. **Type** RMAT at the command prompt.

   Command: **rmat**

3. **Choose** the New...button.
4. **Create** a new material.
5. **Apply** the material to an object.





Adjusting Material Appearances 18.7

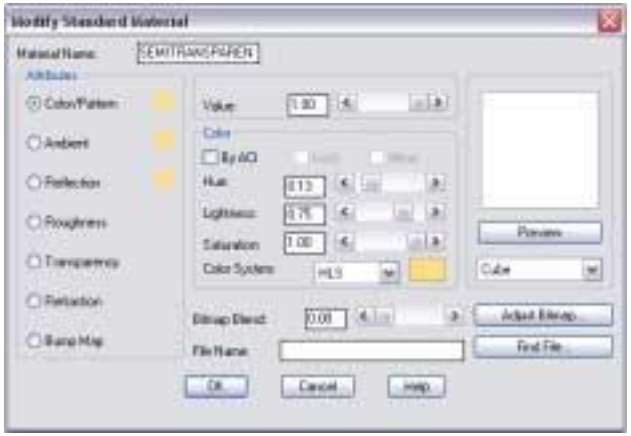
1. **Choose** View, Render, Materials...

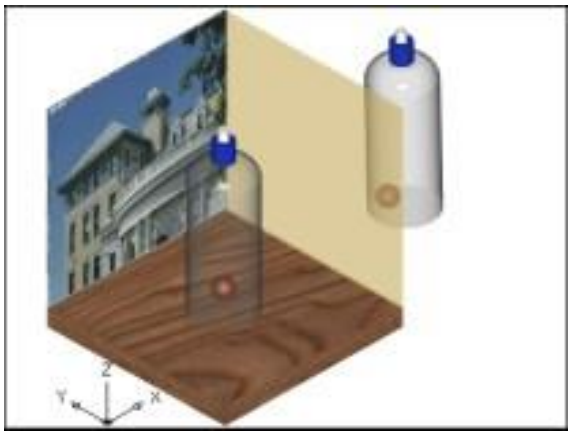
   or

2. **Type** RMAT at the command prompt.

   Command: **rmat**

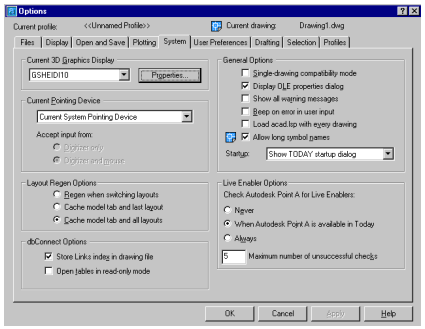
3. **Choose** the New...button.
4. **Create** a new material.
5. **Apply** the material to an object.

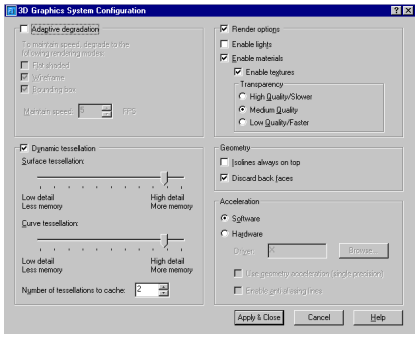




Advanced Material Options 18.10

1. **Choose** Tools, Options...
2. **Choose** the **Systems TAB**.
3. **Choose** the **Properties...**button under the Current 3D Graphics Display.
4. **Check** the **Enable Textures** and **Enable Materials** options.
5. **Apply** a textured material such as checkers.
6. **Shade** the drawing to see the material result.





14th Week
Background & Light

Chapter 19
Lights

Point Light 19.1

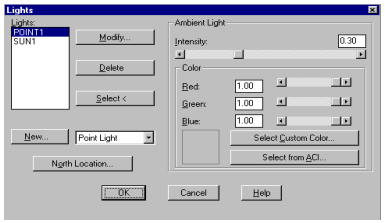
1. **Choose** View, Render, Light.

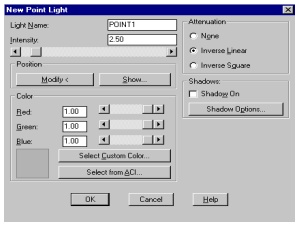
   or

2. **Type** LIGHT at the command prompt.

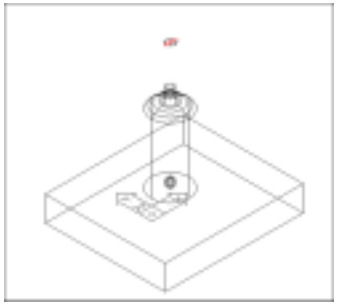
   Command: **light**

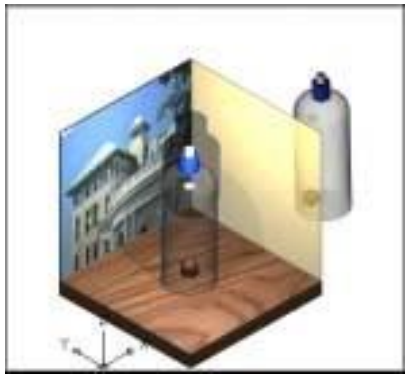
3. **Choose** Point as the light type.
4. **Click** the New... button.
5. **Type** POINT 1 as the new light name.
6. **Choose** Modify to place the light.
7. **Type** ‘ZOOM to zoom if necessary
8. **Pick** a location (Hint: use .xy filters)
9. **Exit** the light menu.
10. **Type** ZOOM PREVIOUS to zoom to the original view.
11. **Type** RENDER at the command prompt to render the viewport with the new lights.





Light Location





Spot Light 19.2

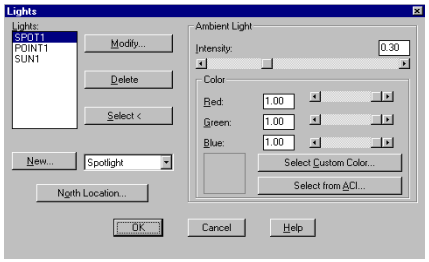
1. **Choose** View, Render, Light.

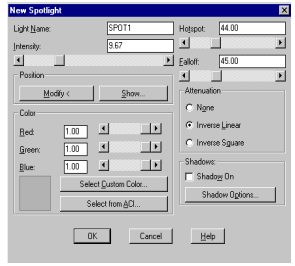
   or

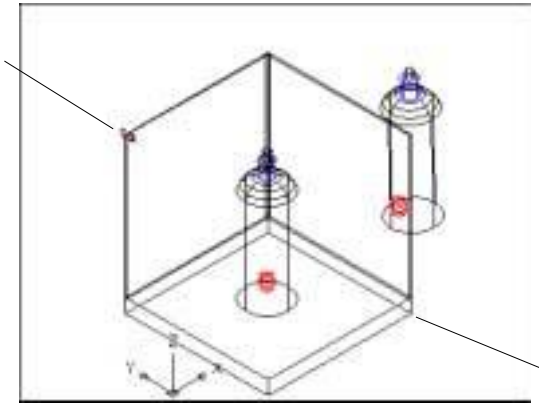
2. **Type** LIGHT at the command prompt.

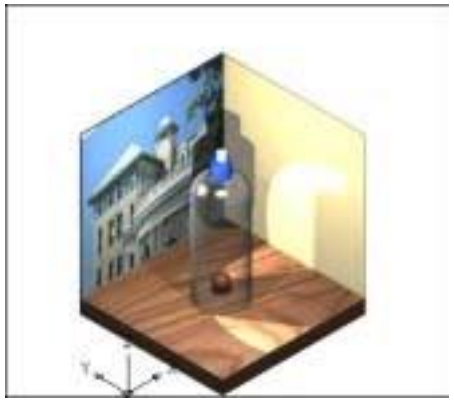
   Command: **light**

3. **Click** the dropdown box for point light and change it to spot light.
4. **Click** the New... button.
5. **Type** SPOT1 as the new light name.
6. **Click** Modify.
7. **Pick** The Target and Light Locations (Use Endpoint and Midpoint Object Snaps).
8. **Exit** the light menus.
9. **Type** RENDER at the command prompt to render the viewport with the new lights.









Setting the Shadow Options in the Light Command 19.3

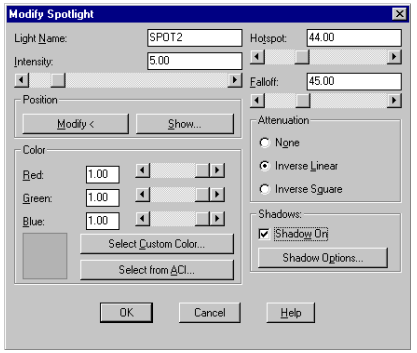
1. **Choose** View, Render, Light.

   or

2. **Type** LIGHT at the command prompt.

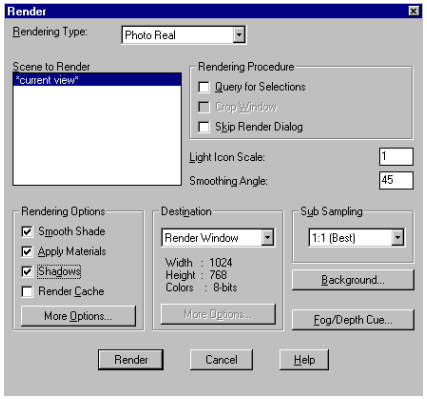
   Command: **light**

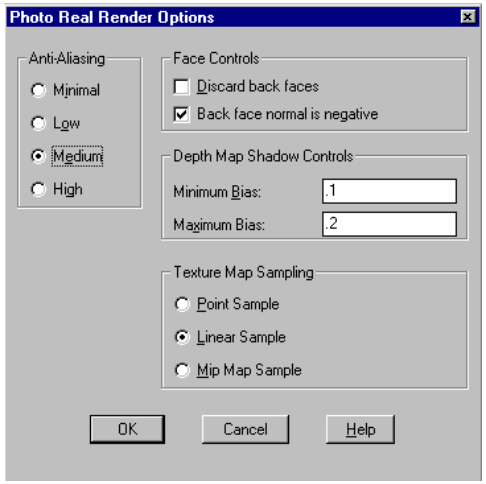
3. **Click** S1 and the Modify...button.
4. **Click** the box for Shadows On.
5. **Choose** Shadow Options and set the shadow Map Size to 512.
6. **Exit** the light menus.



Changing Shadow Options in Render Command 19.5

1. **Type** RENDER at the command prompt.
2. **Choose** More Options under the Rendering Options dialog.
3. **Change** the Minimum Bias to .1
4. **Change** the Maximum Bias to .2
5. **Choose** Medium as the Anti-Aliasing type.
6. **Click** Discard back faces to speed up the rendering processes by having AutoCAD eliminate the calculations for faces it doesn't need to render.





Preferences 19.5

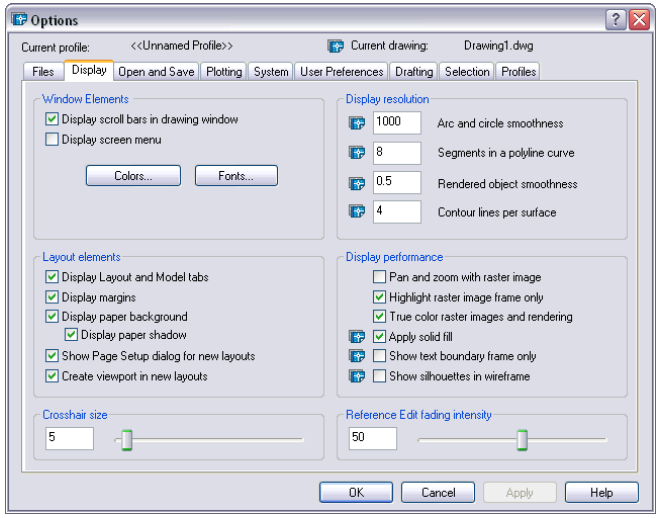
1. **Choose** Tools, Options...

   or

2. **Type** OPTIONS at the command prompt.

   Command: **options**

3. **Choose** the Display tab.
4. **Set** the Rendered object smoothness to 5.
5. **Render** the scene.



Distant Light 19.7

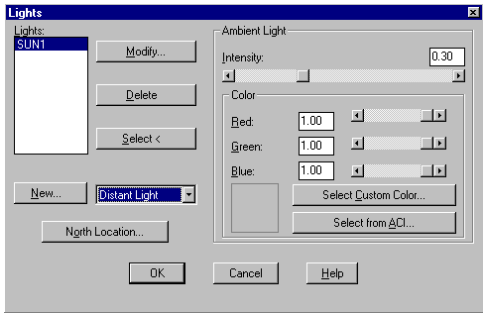
1. **Choose** View, Render, Light.

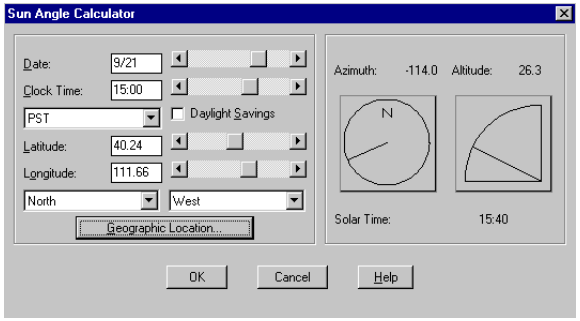
   or

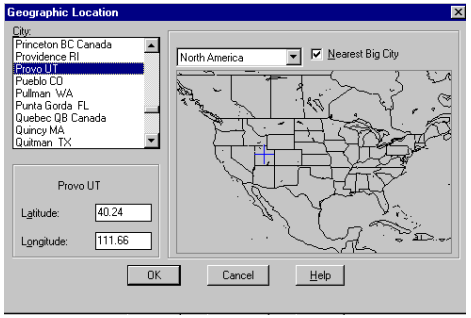
2. **Type** LIGHT at the command prompt.

   Command: **light**

3. **Click** the dropdown box for point light and change it to distant light.
4. **Click** the New... button.
5. **Type** PROVO as the new light name.
6. **Choose** the Sun Angle Calculator...button.
7. **Choose** the Geographic Location...button.
8. **Choose** Provo, UTAH as the nearest big city.
9. **Exit** the light menus.
10. **Type** RENDER at the command prompt to render the viewport with the new lights.







Chapter 20
Scenes

Scene Command 20.1

A scene represents a particular view of all or any portion of the drawing, with or without lights.

1. **Choose** View, Render, Scene.

   or

2. **Type** SCENE at the command prompt.

   Command: **scene**

3. **Choose** New.. to create a new scene.
4. **Type** POINT as the scene name.
5. **Choose** P1 as the light to include in the scene.
6. **Click** OK to exit the Scene dialog box.

Render a Scene

1. **Choose** View, Render, Render...

   or

2. **Type** RENDER at the command prompt.

   Command: **render**

3. **Choose** POINT as the scene to render.
4. **Click** Render.

Modify a Scene

1. **Choose** View, Render, Scene.

   or

2. **Type** SCENE at the command prompt.

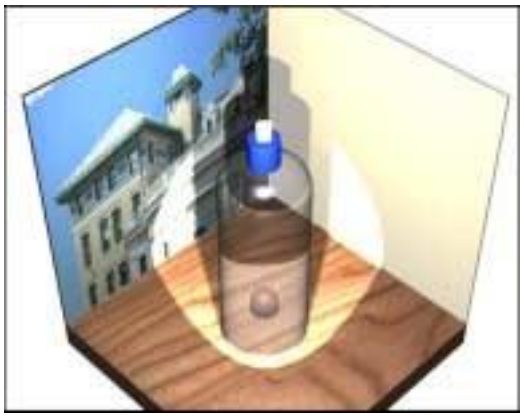
   Command: **scene**

3. **Choose** Modify...to change the lights and views in the scene.

Adding a View to a Scene 20.2

1. **Create** a perspective view with the DVIEW command.
2. **Type** DDVIEW at the command prompt . This will load a dialog box with predefined saved views.

   Command: **ddview**
2. **Choose** PERSPECTIVE as the saved view.
3. **Choose** Set Current
4. **Click** OK.



Chapter 21
Backgrounds

Solid Background 21.1

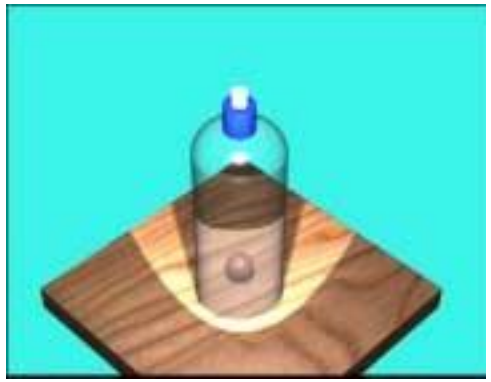
1. **Choose** View, Render, Background

   or

2. **Type** BACKGROUND at the command prompt.

   Command: **background**

3. **Click** Solid as the background type.
4. **Render** the viewport.



Gradient Background 21.2

1. **Choose** View, Render, Background

   or

2. **Type** BACKGROUND at the command prompt.

   Command: **background**

3. **Click** Gradient as the background type.
4. **Adjust** the colors as desired.
5. **Render** the viewport.

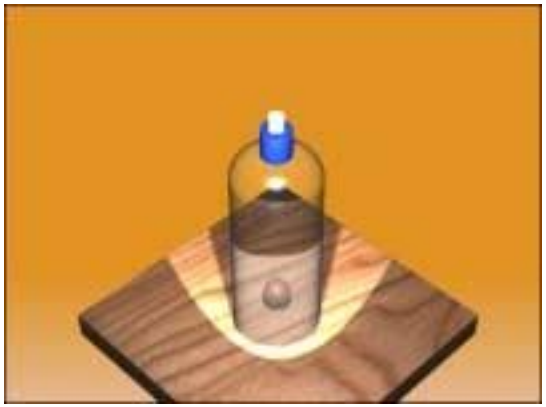


Image Background 21.3

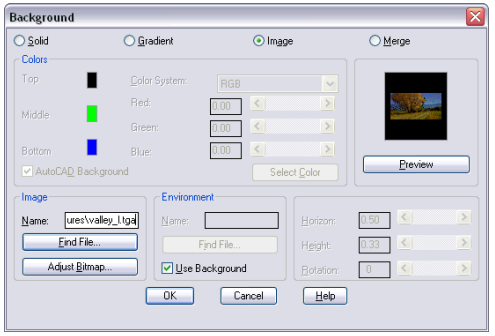
1. **Choose** View, Render, Background

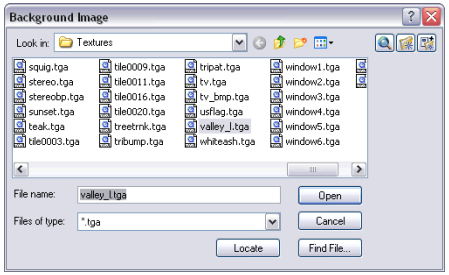
   or

2. **Type** BACKGROUND at the command prompt.

   Command: **background**

3. **Click** the Image radio button.
4. **Choose** Find File under the Image section.
5. **Choose** the C:\Program Files\ACAD2004\TEXTURES\valley_l.tga image file as the background.
6. **Click** OK.
7. **Render** the viewport.





Merge Background 21.4

1. **Choose** View, Render, Background

   or

2. **Type** BACKGROUND at the command prompt.

   Command: **background**

3. **Click** the Merge radio button.
4. **Render** the viewport.

15th Week
Camera setup

Chapter 22
Landscaping

Placing a New Landscape Object 22.1

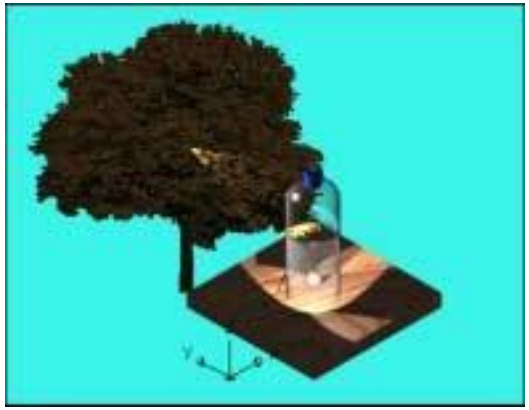
1. **Choose** View, Render, Landscape New...

   or

2. **Type** LSNEW at the command prompt.

   Command: **lsnew**

3. **Pick** Cactus as the landscape item.
4. **Click** the Position button.
5. **Pick** a new position for the Cactus.
6. **Exit** the Landscape dialog box.
7. **Type** Render at the command prompt.
8. **Choose** Photo Raytrace as the Rendering Type.



Editing an Existing Landscape Object 22.2

1. **Choose** View, Render, Landscape Edit...

   or

2. **Type** LSEDIT at the command prompt.

   Command: **lsedit**

3. **Pick** the Cactus as the landscape item to edit.
4. **Edit** the height of the Cactus.

Custom Landscape Library 22.3

1. **Create** an image and opacity image for desired object.
   NOTE: Youwill need to use an external paint program to do this.
2. **Choose** View, Render, Landscape Library...

   or
3. **Type** LSLIB at the command prompt.

   Command: **lslib**
4. **Click** New...to create a new landscape object.
5. **Edit** the other dialog options as desired.
6. **Click** OK and save the render library.
7. **Type** LSNEW at the command prompt to place the new image in your drawing.
8. **Render** the viewport.

16th Week

Rendering

Chapter 23
Misc. Render Commands

Raytracing 23.1

Introduction

Ray Tracing is a global illumination based rendering method. It traces rays of light from the eye back through the image plane into the scene. Then the rays are tested against all objects in the scene to determine if they intersect any objects. If the ray misses all objects, then that pixel is shaded the background color. Ray tracing handles shadows, multiple specular reflections, and texture mapping in a very easy straight-forward manner.

Note that ray tracing, like scan-line graphics, is a point sampling algorithm. We sample a continuous image in world coordinates by shooting one or more rays through each pixel. Like all point sampling algorithms, this leads to the potential problem of aliasing, which is manifested in computer graphics by jagged edges or other nasty visual artifacts.

In ray tracing, a ray of light is traced in a backwards direction. That is, we start from the eye or camera and trace the ray through a pixel in the image plane into the scene and determine what it hits. The pixel is then set to the color values returned by the ray.

www.siggraph.org/education/ materials/HyperGraph/raytrace/rtrace0.htm

1. **Choose** View, Render, Render...

   or

2. **Type** RENDER at the command prompt.

   Command: **render**

3. **Choose** PhotoRaytrace as the render type.

Set Antialiasing 23.2

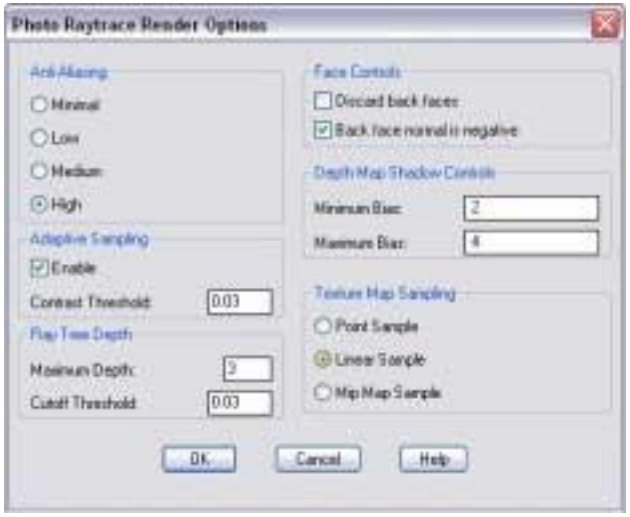
1. **Choose** View, Render, Render...

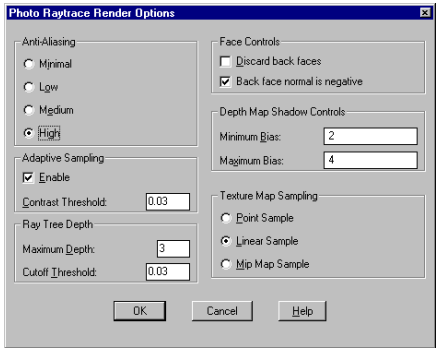
   or

2. **Type** RENDER at the command prompt.

   Command: **render**

3. **Choose** More Options...under Rendering Options.
4. **Choose** High as the Anti-Aliasing method.
5. **Click** OK.
6. **Render** the viewport.





Adaptive Sampling 23.3

1. **Choose** View, Render, Render...

   or

2. **Type** RENDER at the command prompt.

   Command: **render**

3. **Choose** More Options...under Rendering Options.

Ray Tree Depth 23.4

1. **Choose** View, Render, Render...

   or

2. **Type** RENDER at the command prompt.

   Command: **render**

3. **Choose** More Options...under Rendering Options.

Raytracing & Subsampling Options

Change Subsampling Options 23.5

1. **Choose** View, Render, Render...

   or

2. **Type** RENDER at the command prompt.

   Command: **render**

3. **Choose** the Sub-sampling dropdown list.
4. **Choose** 3:1
5. **Click** OK.
6. **Render** the viewport.

Rendered Bottle with Sub-Sampling 3:1

Fog 23.6

Provides visual cues for the apparent distance of objects.

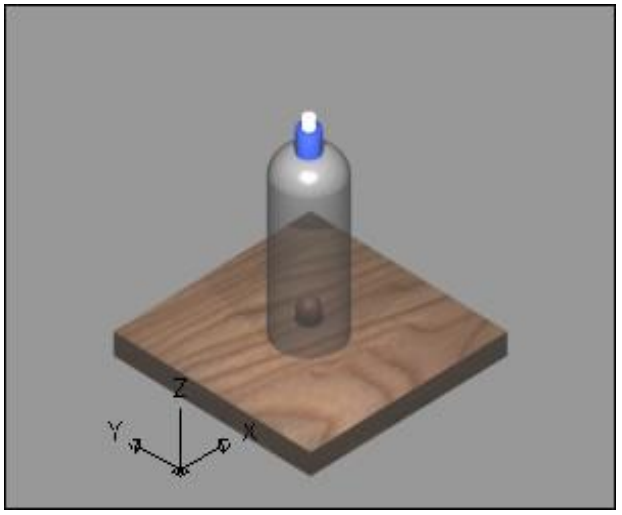
1. **Choose** View, Render, Fog

   or

2. **Type** FOG at the command prompt.

   Command: **fog**

3. **Click** Enable Fog to turn FOG on.
4. **Edit** the remaining dialog options as desired.



Render Statistics 23.6

Provides visual cues for the apparent distance of objects.

1. **Choose** View, Render, Statistics

   or

2. **Type** STATS at the command prompt.

   Command: **stats**

3. **Save** the statistics to a file or choose OK to exit.