

LEARNING OBJECTIVES

After completing this lesson, you will be able to:

1. Understand the concept of 3D
2. Enter the 3D Workspace
3. Manipulate and rotate the 3D Model
4. Understand the difference between:
Wireframe, Surface and Solid Modeling

*The following lessons are an introduction to 3D.
These lessons will give you a good understanding
of the basics of AutoCAD's 3D program.*

LESSON 14

INTRODUCTION TO 3D

We live in a three-dimensional world, yet most of our drawings represent only two dimensions. In Lesson 6 you made an isometric drawing that appeared three-dimensional. In reality, it was merely two-dimensional lines drawn on angles to give the appearance of depth.

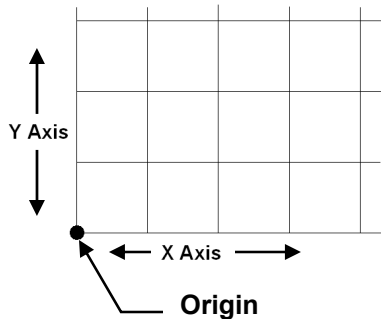
In the following lessons you will be presented with a basic introduction to AutoCAD's 3D techniques for constructing and manipulating objects. These lessons are designed to give you a good start into the environment of 3D and encourage you to continue your education in the world of CAD.

DIFFERENCES BETWEEN 2D AND 3D

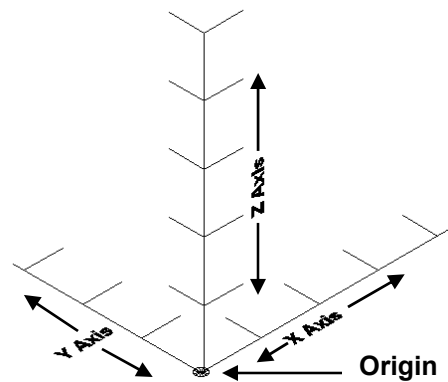
Axes

In 2D drawings you see only one plane. This plane has two axes, X for horizontal and Y for vertical. In 3D drawings an additional plane is added. This third plane is defined by an additional axis named Z. The direction of the positive Z-axis basically comes out of the screen toward you and gives the object height. To draw a 3D object you must input all three, X, Y and Z axes coordinates.

A simple way to visualize these axes is to consider the X and Y axes as the ground and the Z axis as a Tree growing up (positive Z) from the ground or the roots growing down (negative Z) into the ground.



2D Coordinate System



3D Axes Coordinate System

BASIC TYPES OF 3D MODELS

There are 3 basic types of 3D models.

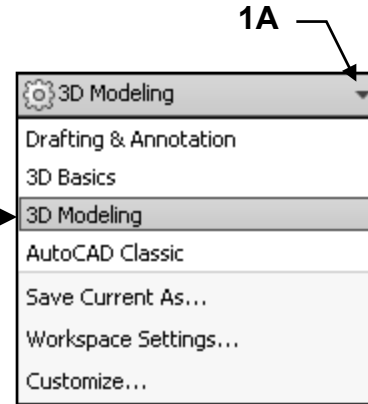
1. Wireframe models
2. Surface models
3. Solid models

A description of each starts on page 14-14.

ENTER AutoCAD 3D WORKSPACE

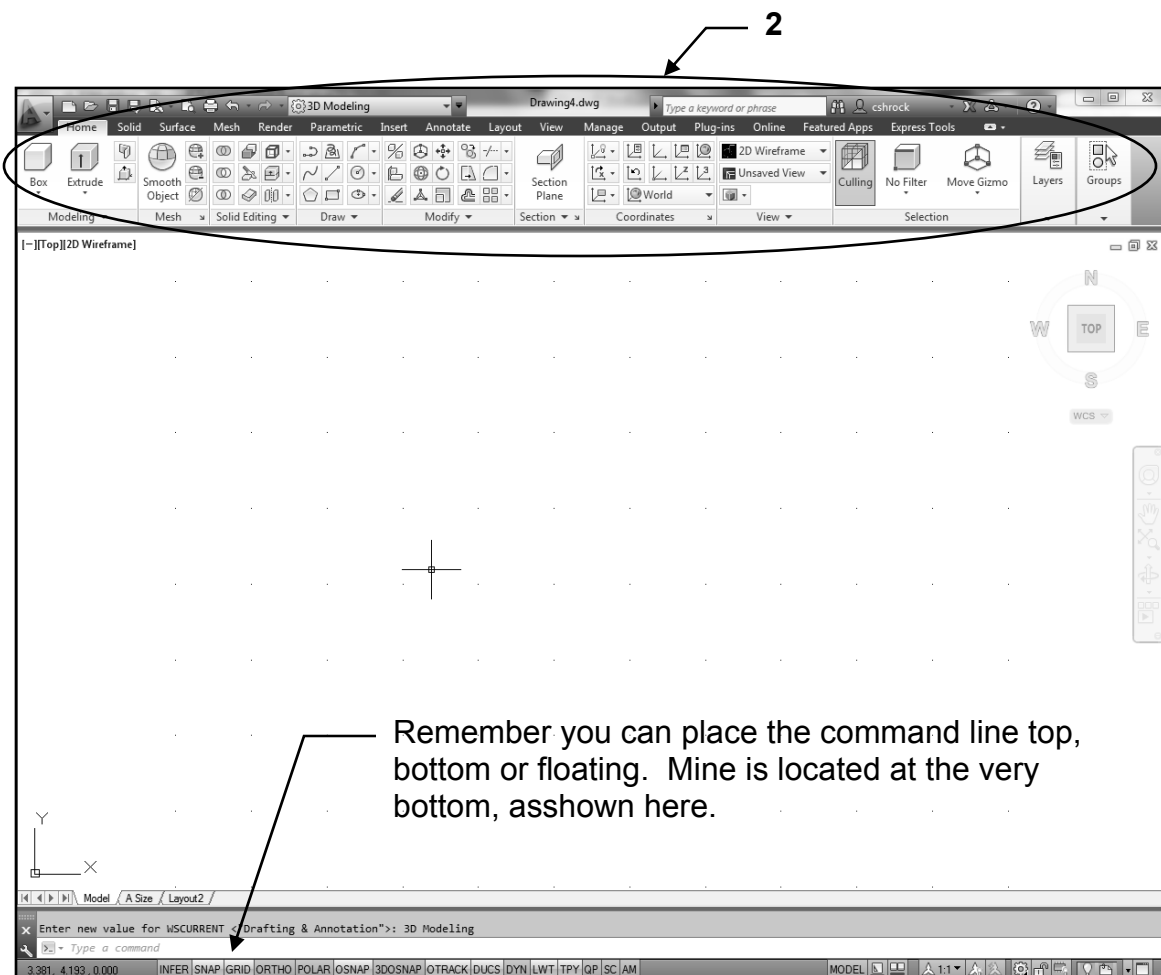
AutoCAD has two 3D workspaces, 3D Basics and 3D Modeling. The following Lessons will require the use of “3D Modeling” only.

1. Select the “3D Modeling” Workspace.
 - A. Select the Workspace tool ▼ located in the upper left corner.
 - B. Select the **3D Modeling** workspace.



2. The Ribbon tabs and panels have changed as shown below.

(Note: I have changed my background to white for clarity throughout the workbook.)



Continued on the next page...

ENTER AutoCAD 3D WORKSPACE....continued

4. Select **NEW** (to start a new file) and select one of the following **3D** templates from the list of templates:

acad3D.dwt (for Imperial units)

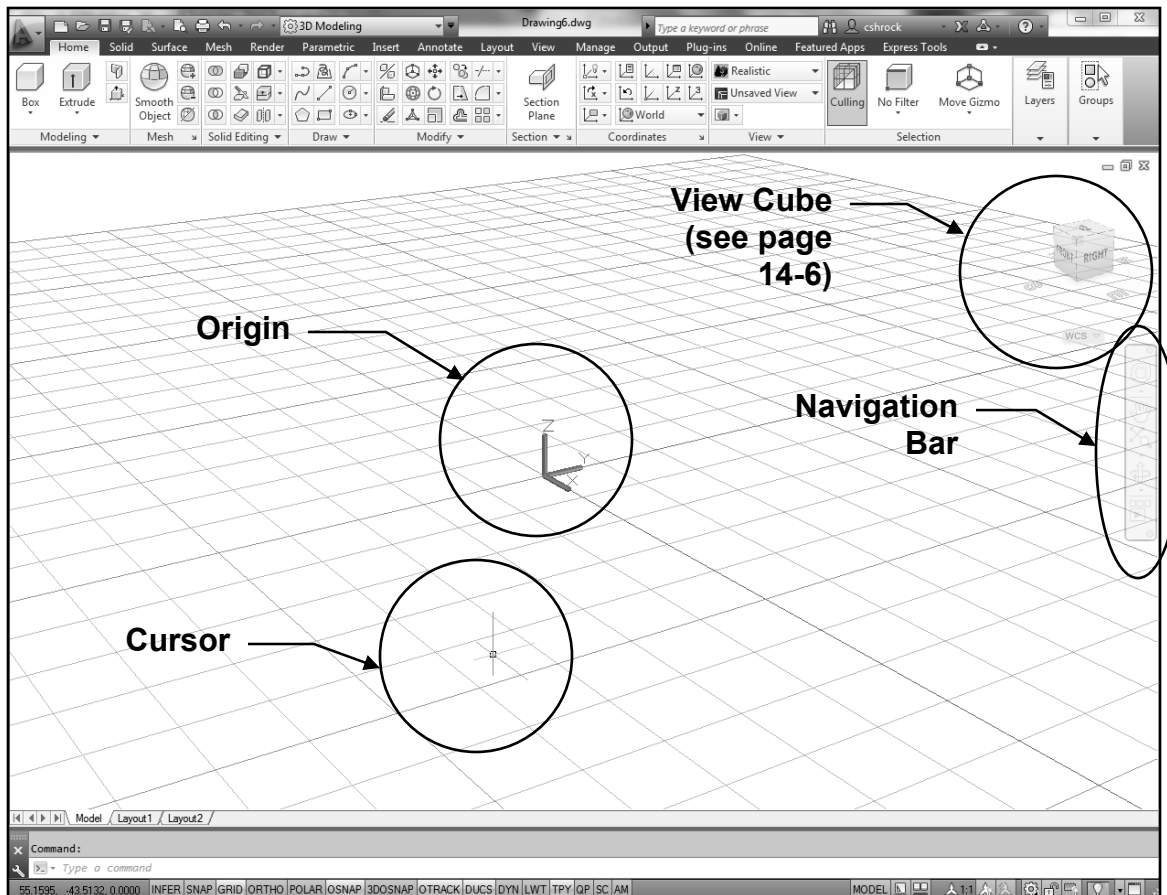
OR

Acadiso3D.dwt (for metric)

Now your screen should appear approximately as the shown below.

(Note: I have changed my background to white for clarity throughout the workbook.)

*Notice the appearance of the Origin and the Cursor have changed.
They now display the Z axis.*



Viewing a 3D Model

Viewpoint

It is very important for you to be able to control how you view the 3D Model.

The process of changing the view is called **selecting the Viewpoint**.

(Note: Viewpoint; not viewport.)

The **Viewpoint** is the location where “YOU” are standing. ***This is a very important concept to understand.*** The Model does not actually move; you move around the model. For example, if you want to look at the South East corner of your house, you need to walk to the South East corner of your lot and look at the corner of your house. Your house did not move, but you are seeing the South East corner of your house. If you want to see the Top or Plan View of your house, you would have to climb up on the roof and look down on the house. The house did not move, you did. So in other words, the Viewpoint is **your “Point of View”**.

Remember when you select a Viewpoint you are selecting where you are standing. The view that appears on the screen is what you would see when you move to the viewpoint and looked at the model.

How to change the Viewpoint

There are 3 methods to change the viewpoint of your model.

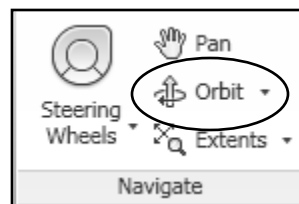
ViewCube, Orbit, 3D Views.

Each of these methods are described on the pages noted below.



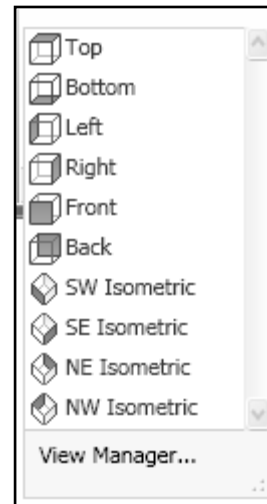
ViewCube

Page 14-6



Orbit

Page 14-9



3D Views

Page 14-10

ViewCube

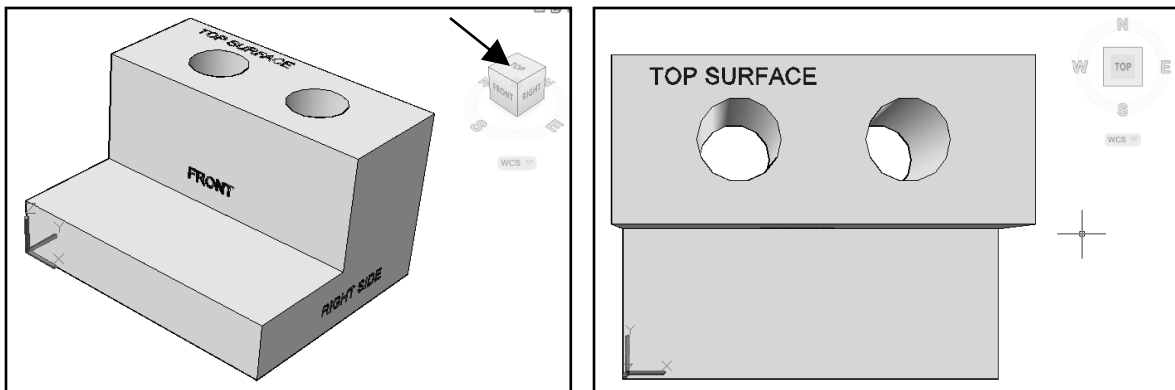
The following is a description of the ViewCube tool and how to use it to view your model. But the best way to understand the ViewCube is to use it. So I would like you to **OPEN the 2013-3D Demo.dwg** that you downloaded from our website. Refer to Intro-1 if you have not downloaded this file.

ViewCube Location

The ViewCube is located in the upper right corner of the drawing area. But you can change it's location. (Refer to ViewCube settings on page 14-8.)

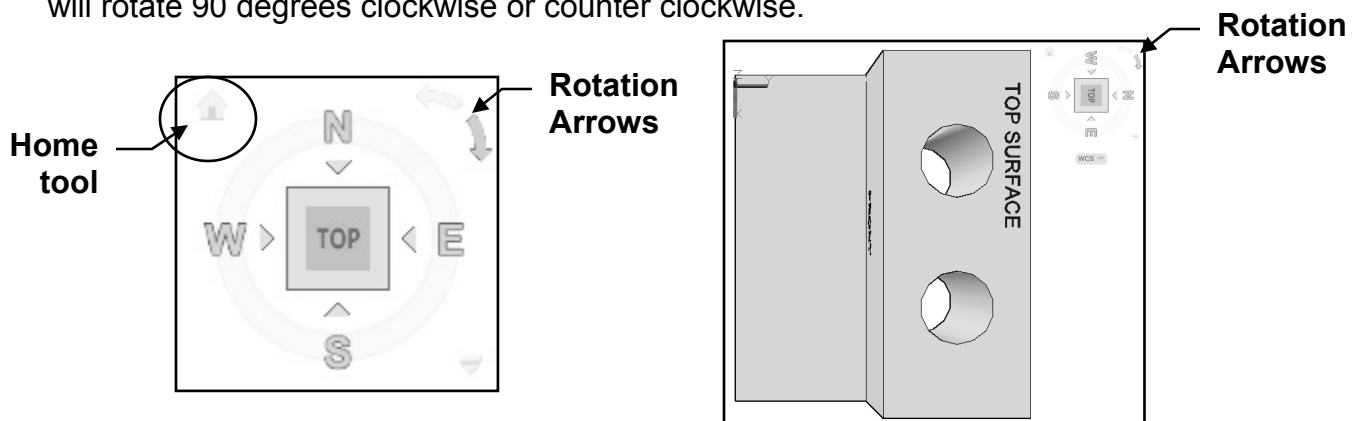
Selecting a View

The ViewCube allows you to manipulate the model in order to see and work on all sides. I have added text to the model so you can see how clicking on the ViewCube, such as Top, automatically shows you the view of the top.




Rotating a View

After you have selected a view, such as Top, place the cursor on the ViewCube. Rotation arrows should appear. If you click on either of the rotation arrows the view will rotate 90 degrees clockwise or counter clockwise.



Returning to Original View

You may always return to the original **Home** view by selecting the little Home tool.  Note: The **Home** tool only appears when you place the cursor near the ViewCube.

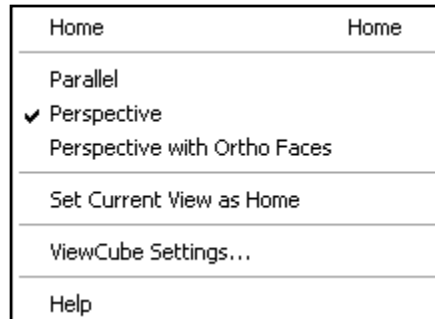
You may also select a new view to become the **Home** view.

1. Orient the model to the preferred **view**.
2. Right click on the ViewCube and select **Set current view as Home**.

ViewCube....continued

ViewCube Menu

If you right-click on the ViewCube the ViewCube menu will appear.

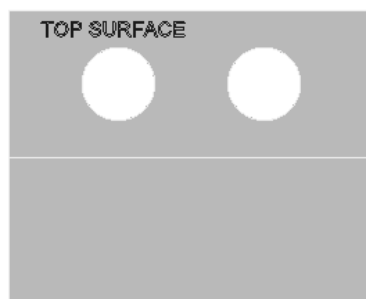


Home

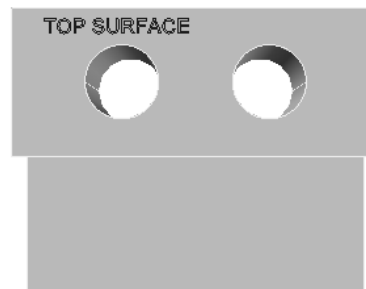
This will return you to the original view that you specified as the Home View. This is the same as selecting the Home tool.

Parallel and Perspective

Displays the View as Parallel or Perspective.



Parallel



Perspective

Perspective with Ortho Faces

If the current view is a face view it will appear as parallel.

Set Current View as Home

Selects the current view as the Home view. When you select Home this view will be displayed.

ViewCube Setting...

Displays the ViewCube Settings dialog box shown on the next page.

Help

Takes you directly to the ViewCube content in the Help Menu

ViewCube....continued

ViewCube Settings

To change the ViewCube settings, and you will want to, right click on the ViewCube and select **ViewCube Settings...** from the list.

Most of these settings are personal preference. But I suggest that you uncheck the two boxes that I have shown. I think it will make the manipulation of the views smoother and less confusing. But again, it is your personal preference.

On-screen position:

Controls which corner the ViewCube is displayed.

ViewCube size:

Controls the size of the ViewCube display.

Inactive opacity:

Controls how visible the ViewCube is when inactive only. It will display dark automatically when you pass the cursor over it.

Show UCS menu:

Controls the display of the UCS drop-down menu below the ViewCube.

Snap to closest view:

When using Click and Drag to rotate the View you have a choice of it automatically snapping to the closest View or smoothly rotating to the desired View. ***This is one that I prefer to uncheck in order to have a smooth rotation.***

Zoom to extents after view change:

Each time you select a new View it also will Zoom to Extents if you select this option. ***I prefer to control when Zoom is activated.***

Use View transitions when switching views:

Controls how smooth the transition appears when rotating.

Orient ViewCube to current UCS: (Important)

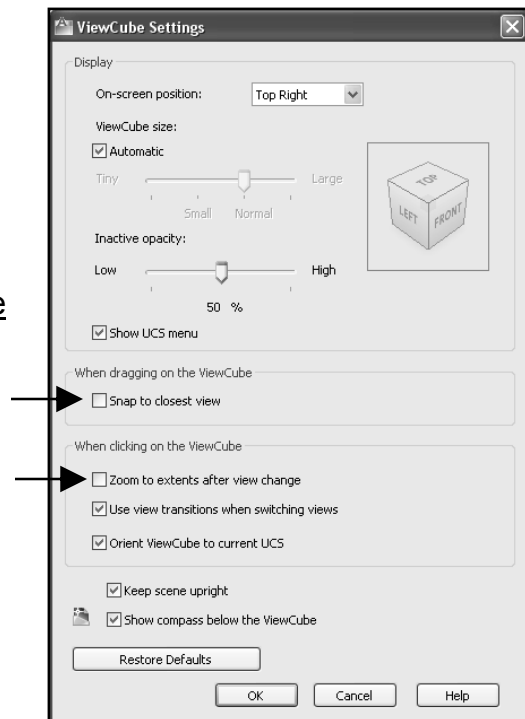
You definitely want this one ON. Everytime you move the Origin the Cube orients itself to match the new UCS. You will understand this one better in later lessons.

Keep scene upright:

Controls whether or not the view can be turned upside down. This reduces confusion.

Show compass below the ViewCube:

Controls the display of the compass, N, S, E, W.



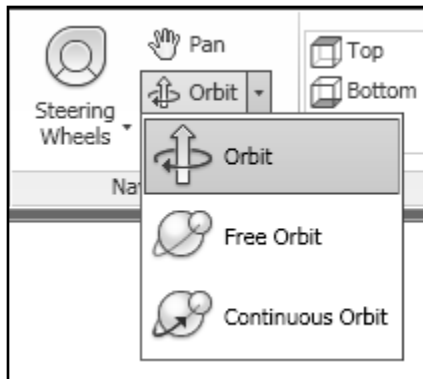
Note: The settings stay with the computer not the drawing file.

Orbit

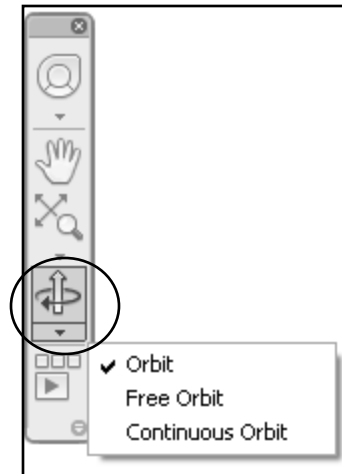
The **Orbit** tool allows you to rotate around the model using the click-drag method. This used to be the only way to freely rotate until ViewCube was added.

1. The Orbit tool can be selected using one of the following:

Ribbon = View tab / Navigate panel
or
Navigation Bar / Orbit tool
or
Keyboard = 3do



Ribbon Tool



Navigation Bar Tool

2. Click and drag the cursor to rotate the model.
3. To stop press the **Esc** or **Enter** key
4. Select the **Home** tool to return to the original view orientation. (See page 14-6)

Orbit

Constrains 3D Orbit along the **XY** plane or the **Z** axis

Free Orbit

Orbits in any direction without reference to the planes.

The point of view is not constrained along the **XY** plane of the **Z** axis.

Continuous Orbit

Orbits continuously. Click and drag in the direction you want the continuous orbit to move, and then release the mouse button. The orbit continues to move in that direction.

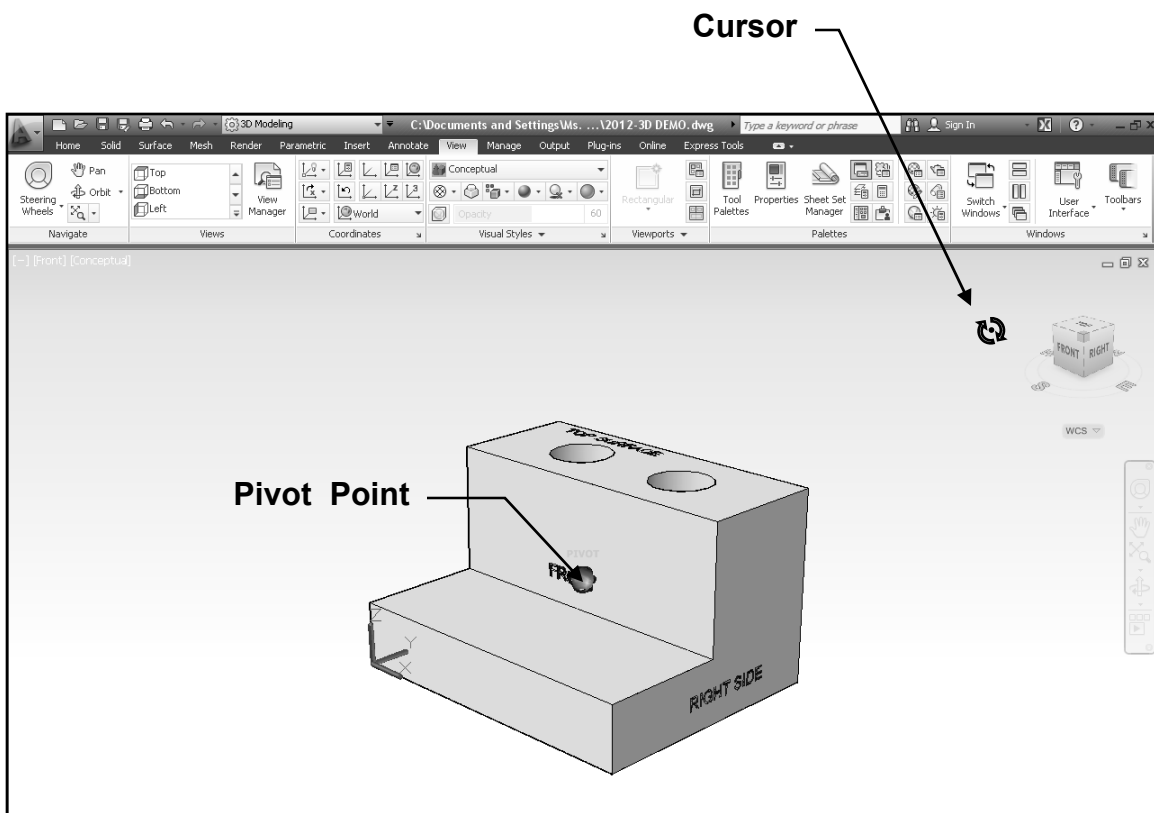
Rotate the Model quickly

You may also quickly rotate the model around a pivot point.

1. Place the cursor on the ViewCube
2. Press and hold down the left mouse button and drag the cursor.

The cursor will change to 2 circular arrows.

When the model is positioned as you wish, just release the left mouse button.



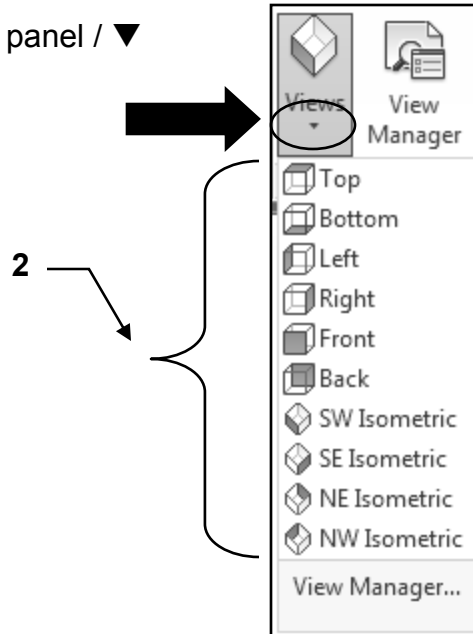
3D Views

You may prefer to rotate your model using fixed views such as Top or South West Isometric.

1. Select **3D Views** as follows:

Ribbon = View tab / Views panel / ▼

2. Select a View from the list.



The list of view options are the same as the ViewCube.

Selecting from this list or using ViewCube is the users personal preference

Visual Styles

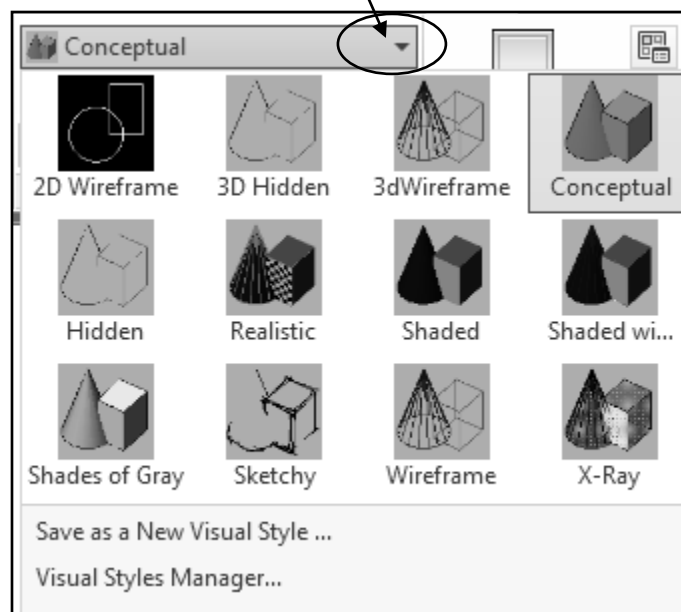
Description of Visual Styles

There are 12 visual styles supplied with the AutoCAD.

A visual style is a collection of customizable settings that control the display of the 3D model in the current viewport.

1. Select the **Visual Styles tools** as follows:

Ribbon = View tab / Visual Styles panel / ▼



2. Click on any box to select it.
3. Place the cursor on each of the styles and watch the model change to give you a preview before actually selecting the style.

Visual Styles descriptions:

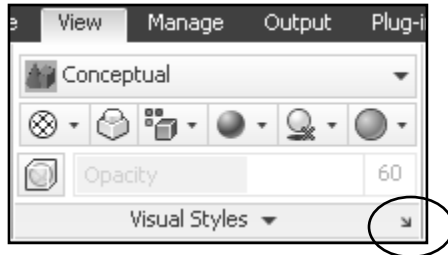
2D Wireframe:	All lines and curves shown in Parallel
Conceptual:	Shades the object with cool and warm using Gooch face style.
Hidden:	Wireframe representation and hides lines
Realistic:	Shades the object with dark to light.
Shaded:	Smooth shading
Shaded w/ Edges:	Smooth shading and visible edges
Shades of Gray:	Smooth shading and monochromatic shades of gray
Sketchy:	Hand-sketched effect .
Wireframe:	Lines and curves to represent the boundaries
X-Ray:	Partial transparency

Visual Styles Manager

The **Visual Styles Manager** palette allows you to modify the existing visual styles or create new.

1. Select the **Visual Styles Manager** as follows:

Ribbon = View tab / Visual Styles panel / ↘



The **Visual Styles Manager** Palette will appear on the left side of the drawing area.

The next page will describe the **Face Settings and Lighting**. The remainder of the selections will not be discussed but may be reviewed in the Help menu.

Select Conceptual

Face Settings	
Face style	Gooch
Lighting quality	Smooth
Color	Normal
Monochrome color	<input type="checkbox"/> 255,255,255
Opacity	-60
Material display	Off

Lighting	
Highlight intensity	-30
Shadow display	Off

Environment Settings	
Backgrounds	On

Edge Settings	
Show	Facet Edges
Color	<input checked="" type="checkbox"/> White
Occluded Edges	
Show	No

Visual Style tools:
Select the style box before making changes

Face settings and Lighting:
Refer to the next page.

This area not discussed in this workbook. Refer to the Help menu.

Continued on the next page...

Visual Styles Manager...continued

Face Settings

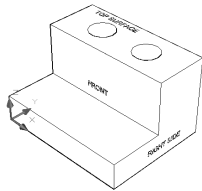
Controls the appearance of faces.

The Following is merely a sample of the controls that AutoCAD offers.

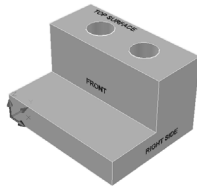
Face style	Gooch
Lighting quality	Smooth
Color	Normal
Monochrome color	<input type="checkbox"/> 255,255,255
Opacity	-60
Material display	Off

Face Style

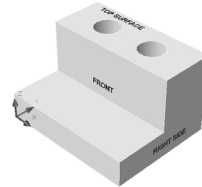
There are 3 Face Styles.



None



Realistic



Gooch

Lighting quality

There are 3 Lighting Qualities.

Faceted: faceted appearance.

Smooth: regular quality smooth appearance. (This is the default level)

Smoothest: High quality smooth appearance.



faceted



smooth



smoothest

Opacity

The opacity property controls the transparency of an object.



Opacity: off



Opacity: 20

Lighting

Highlight intensity	-30
Shadow display	Off

Highlight Intensity

The size of the highlights on an object affects the perception of shininess. A smaller, more intense highlight makes objects look shinier



Highlight Intensity: off



size: 10



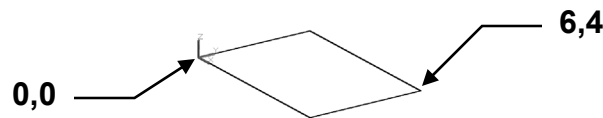
size: 30

Wire Frame Model

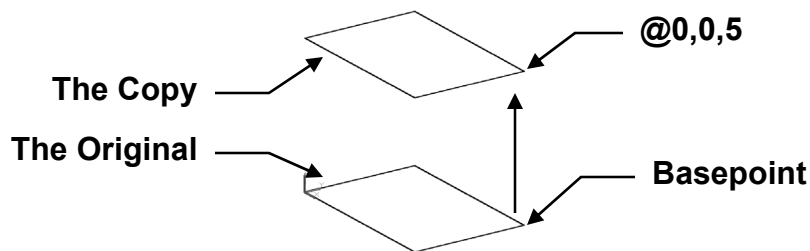
A wireframe model of a box is basically 12 pieces of wire (lines). Each wire represents an **edge** of the object. You can see through the object because there are no surfaces to obscure your view. This type of model does not aid in the visualization of the 3D object. Wireframe models have no volume or mass.

How to draw a Wireframe Box

1. Start a **NEW** file using **acad3D.dwt**
2. Draw a **Rectangle**, just like you would in 2D. (Select from Home tab / Draw panel)
First corner: 0,0 Second corner: 6,4
3. Zoom in closer if the rectangle seems too small.

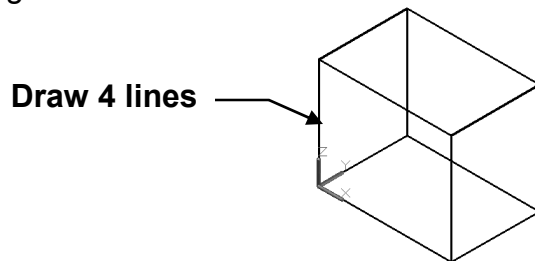


4. Copy the Rectangle 5" **above** the original rectangle as follows:
 - a. Select the **Copy** command from the Modify panel.
 - b. Select the Rectangle then <enter>.
 - c. Select the **basepoint** as shown below.
 - d. Type the **X, Y, Z** coordinates for the new location: **@ 0, 0, 5 <enter> <enter>**



*Now think about the coordinates entered. The coordinates @0, 0, 5 mean that you **do not** want the new rectangle location to move in the **X** or **Y** axis. But you **do** want the new rectangle location to move 5" in the **positive "Z"** axis.*

5. Now using **Line** command, draw lines from the corners of the lower rectangle to the upper rectangle.



Note: This wireframe is displayed as Parallel, SE Isometric.

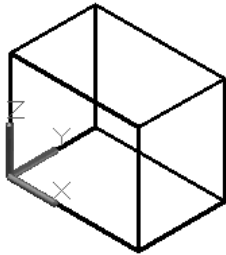
That is all there is to it. You have now completed a Wireframe Box. This Wireframe can now be used as the structure for a Surface Model described on the next page.

Surface Model

A **Surface Model** is like an empty cardboard box. All surfaces and edges are defined but there is nothing inside. The model appears to be solid but it is actually an empty shell. The hidden line removal command can be used because the front surfaces obscure the back surfaces from view. A surface model makes a good visual representation of a 3D object.

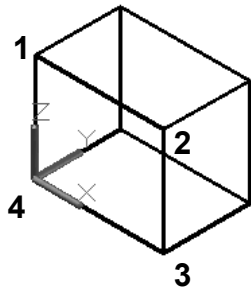
How to add a 3D Surface to a Wireframe structure

1. Create a Wireframe Model as shown on the previous page.

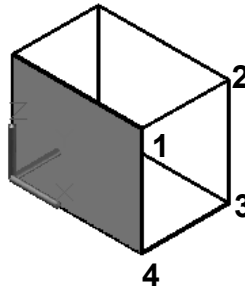


2. Type: **3dface** <enter>

3. Draw a 3D Surface by snapping to the 4 corners as shown below and **<enter>**.
(The Shape will **Close** automatically.)
Note: Each surface must be created as a separate object.

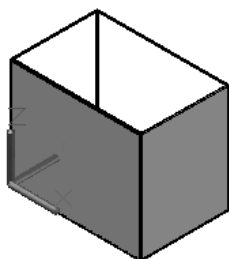


First Surface



Second Surface

Your 3D Wireframe model now has 2 surfaces attached.
Now you may even use a “Visual Style”.

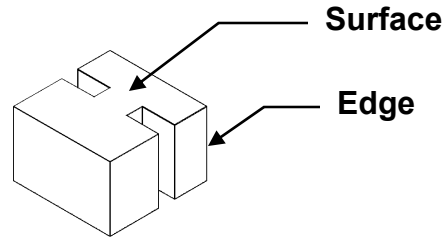


Solid Models

(Refer to Lesson 15 for more detailed instructions)

It is important that you understand both **Wireframe** and **Surface** Modeling **but** you will not be using either very often. **Solid Modeling** is the most useful and the most fun.

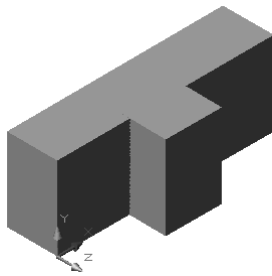
Solid models have **edges**, **surfaces** and **mass**.



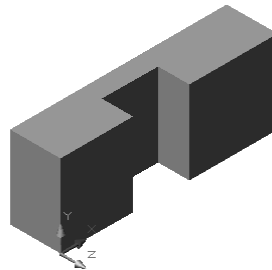
Solid Models can be modified using many **Solid Editing** features such as the ones described below.

Use Boolean operations:

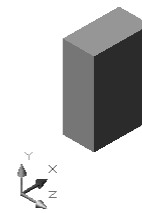
such as **Union**, **Subtract** and **Intersect** to create a solid form.



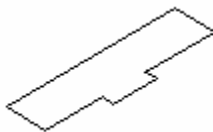
Union



Subtract



Intersect

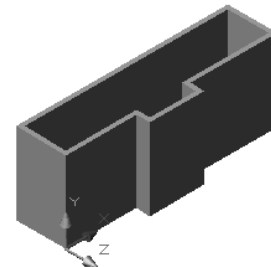


A simple shape can be:

Revolved



Extruded & Shelled



EXERCISE 14A

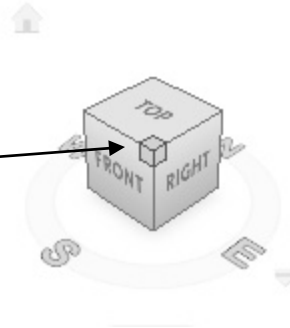
INSTRUCTIONS:

1. Start a **NEW** file using **acad3D.dwt** .
2. Create the **Wireframe** Model shown below. (Refer to page 14-14)
3. Display the Model as follows:

SE Isometric (Refer to page 14-10)

Or

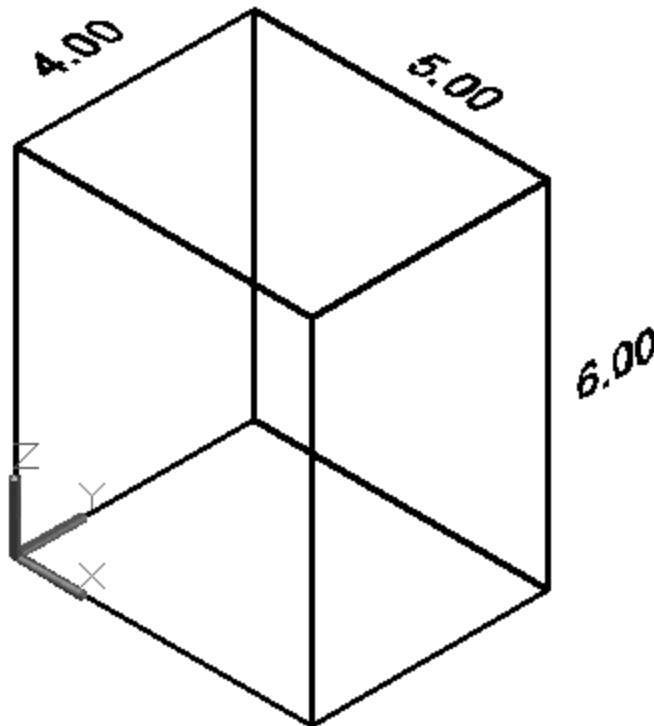
click on the corner of the ViewCube



Note:

The rectangle may appear small. Zoom in. Also, change the color if the default color is too light. Use “Properties”.

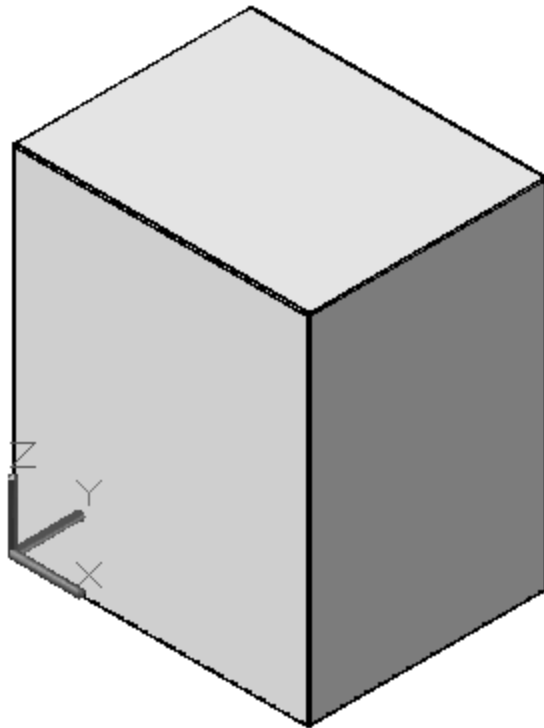
4. Display the Model as **Parallel** not perspective. (Refer to page 14-7)
5. Do not dimension.
6. **Save** the drawing as: **EX14A**



EXERCISE 14B

INSTRUCTIONS:

1. Open **EX14A** (If not already open)
2. Add surfaces to all 6 sides. (Refer to page 14-15)
(Use ViewCube or Orbit to rotate the model to access each side.)
3. Display as
 - a. **SE Isometric**
 - b. Visual Style = Conceptual (Refer to page 14-11)
 - c. **Parallel** (Refer to page 14-7)
4. **Save** the drawing as: **EX14B**



Notes: