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AUGI Training Program (ATP)

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-The ATP Staff

ATP007A — "WCS, Manipulating the UCS"
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(1.1) Intro -

When you begin a new drawing in AutoCAD you are automatically set to the "World Coordinate System" or WCS, with the Cartesian coordinate system in it's normal state, the X axis is horizontal, the Y axis is vertical and the Z axis is perpendicular to the XY plane. This is the default Coordinate system for AutoCAD, and we can all ways return to it by typing "UCS" *(enter)* then "W" *(enter)* for World, on the command line)
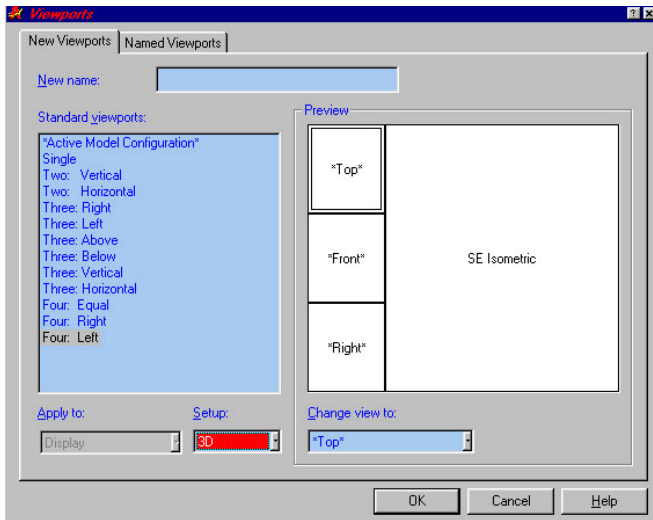
A user defines a User Coordinate System, or UCS, to change the location of the Origin point (0,0,0) and the orientation of the XY plane and the Z axis. Coordinate input and display are relative to the origin of the current UCS, so when you are doing absolute input (entering coordinates as X,Y,Z values on the command line) you will want to know where your origin is, and be able to move it where you need it at times. Snap, Grid and Ortho modes are also relative to the current UCS. Remember in 2D you were entering values as just X,Y but now you will be adding the Z value (X,Y,Z).

(1.2) Viewing the UCS —

You can not manipulate the WCS, but only the "User Coordinate System" (UCS).

To better understand the UCS lets look at the UCS as our piece of paper. By default, AutoCAD aligns the UCS with the WCS, and give us a view looking down at our paper ("TOP" view) (unless you have made changes to the acad.dwt template).
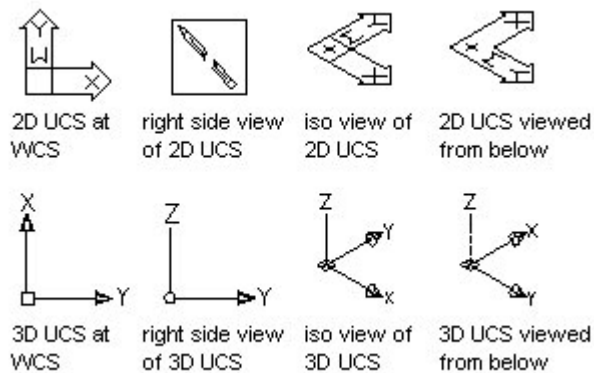
Lets change our view, the easy way, to show 4 (four) different views, Top, Front, Right, and SE Isometric. Click the "View" pulldown menu than click "Viewports", under this flyout click "Named Viewports". In this dialog box (fig01) click "Four: Left" in the "Standard viewports" section, and in the "Setup" section change that to "3D" than click "OK" to close and change to your new viewports.

viewports.jpg (fig01)

(1.2) Viewing the UCS – (continued)

You will want to become familiar with the following UCS icons (fig02).
AutoCAD will place the UCS icon at the origin if it can display the whole
icon in the viewport or it will place it at the lower left corner of the
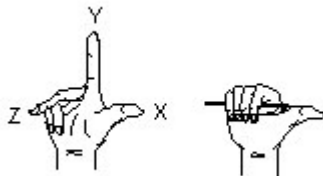viewport.

ucsicon.jpg (fig02)

(you can switch between the 2D and the 3D icon with the "UCSICON" command)

(1.3) Moving your UCS –

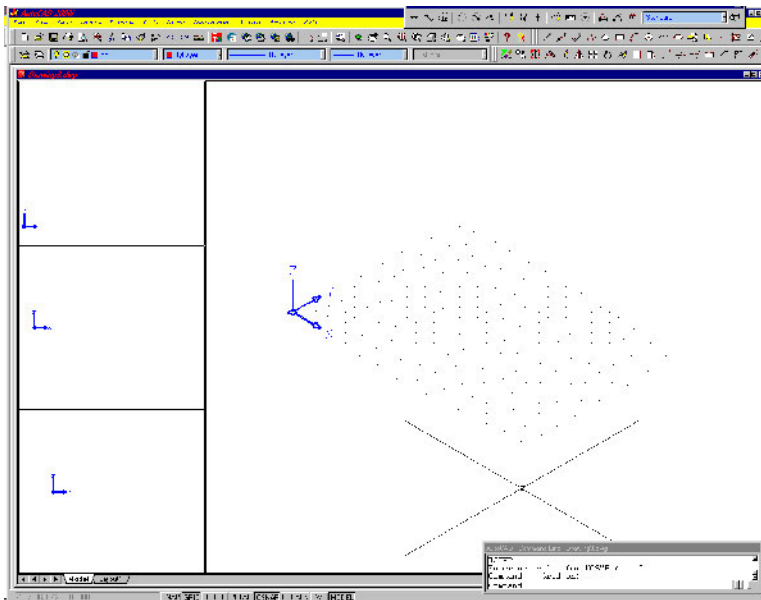For review, lets look at the "Right Hand Rule" (fig03)

right_hand_rule.jpg (fig03)

The Right Hand Rule determines the positive axis direction of the Z axis when you know the direction of the X and Y axis in a 3D coordinate system, it also determines the positive rotation direction about an axis in 3D space. (Point your right thumb in the positive direction of an axis, your fingers indicate the positive rotation direction around that axis).

Now depending on your system variable "UCSVP", your current UCS will depend on your active (current) viewport. By default this is set to "1" or ON but for learning purposes we are going to set this to "0" or OFF for all our viewports. (You may want to turn this back on after this section). Click in the "TOP" viewport to make it current then type "UCSVP" *(enter)* on the command line and then type "0" *(enter)*, now click in the "FRONT" viewport to make it current and do the same, continue in the other viewports. Turn on your Grid in the "SE Isometric" viewport (the big one) so you can watch your UCS (paper) change orientation. Click in the "TOP" viewport to make it current.

(1.3) Moving your UCS — (continued)

We will now change your UCS orientation by setting it to your views (fig04). Click in the "FRONT" viewport to make it current and type "UCS" *(enter)* at the command line, then type "V" *(enter)* to set it to your current View (front). Notice the Grid in your SE Isometric view changes to show your new UCS (paper) orientation. Try setting it to your "RIGHT" viewport and then back to the "TOP" viewport where we started.
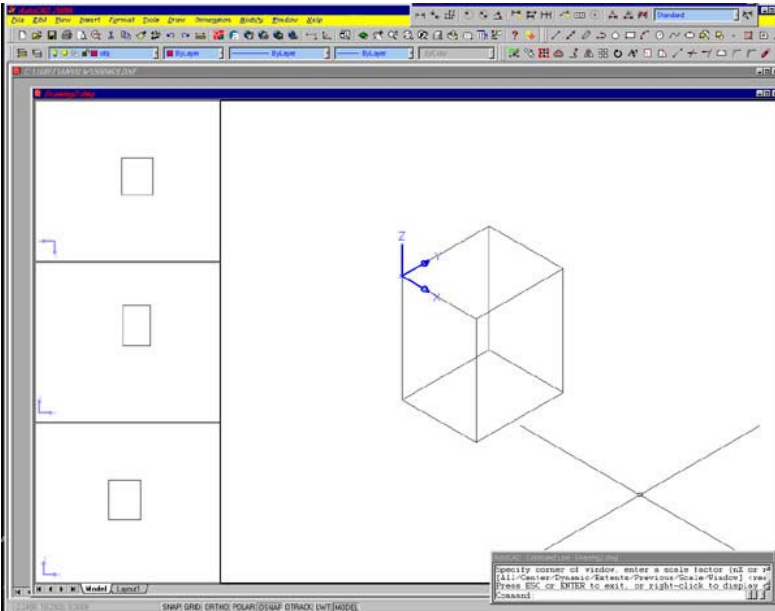

ucs_view.jpj (fig04)

To move the origin or change the Z depth of the XY plane, type "UCS" *(enter)* on the command line then type "M" *(enter)* for Move. Now pick or enter a new location for your origin, or type "Z" *(enter)* to specify a new distance to move the XY plane along the Z axis.

(1.4) Advanced UCS options –

Now to map your UCS to an object, or place it on a plane (Face), or just rotate it about an axis at an angle, we will need an object. Make your "TOP" viewport current and set your UCS to that view. Now type "BOX" *(enter)* on the command line, pick two points for corners and give it a height of about the same length as a side, you should now have a 3D wireframe box on your screen. (fig05)

ucs_object.jpg (fig05)

(1.4) Advanced UCS options – (continued)

Now we can place our UCS on this object, type "UCS" *(enter)* on the command line, then "N" *(enter)* for New, at the "Specify origin of New UCS or" prompt type "OB" *(enter)* for Object, and select your object. Try selecting the object in different places (select different lines) to see the different effects. Notice that AutoCAD will try to align the X axis with the line you select.

Try using the "Face" option of the UCS command. Type "UCS" *(enter)* on the command line, then type "N" *(enter)* for New and then type "F" *(enter)* for Face. Select a face (or side) of your box and notice the command line changes and gives you more options, if you do not like the orientation of the UCS try the "N", "X" and "Y" options and then hit enter to accept. Also try the "3points" option, pick your origin and a positive direction on the X and Y axis. You will also want to rotate your UCS at times, lets do this around the Z axis. Type "UCS" *(enter)* at the command line then "N" *(enter)* and now a "Z" *(enter)* for the Z axis. Use the default of 90 degrees or type in a new value. Try this on the other axis and remember to look at the "Right Hand Rule" (fig03) for rotation direction help.

In conclusion -

I personally think understanding how to manipulate your UCS (paper) is one of the most important things to learn while starting to use 3D in AutoCAD, and this is why I cover it first.