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## Introduction

The basic building blocks that you can create in Visual Model are referred to as "objects". These objects are the building blocks of your model. Once an object has been created, it can be edited using a variety of commands to customize its appearance. Objects can also be combined together to create more complex shapes. In addition, certain objects act as "solids": these objects have "volume" and can be used to create complex geometric shapes through the addition, subtraction or intersection of solids.

Objects are drawn by selecting a drawing entity, such as a polygon, line or curve, then setting points in the viewport to determine the position and shape of the drawing entity.

The most important commands relating to object creation are displayed as buttons on a Toolbar that runs across the top of the software interface. Briefly, you select the kind of object you wish to draw from the Draw Toolbar, then a Points Toolbar appears to aid you in setting the points of the object that you are currently drawing. Finally, when you have finished drawing an object, that object is automatically selected as the current object and a Modify Toolbar is displayed to allow you to modify the object that you just created.

The viewport can be controlled to facilitate the object creation process. In addition, alternate viewports can be opened up to display orthographic views from above and to the side of the main viewport display to make it easier to understand an object's orientation in 3D space.

## **The Visual Model Interface**

The Visual Model interface consists of a Menu Bar containing pop-down menus, a Toolbar from which objects are created and edited, a Status Bar which displays information concerning the object you are manipulating, and a Viewport in which objects are drawn and manipulated.

## The Menu Bar


The **Menu Bar**, located directly below the Windows Title Bar, contains pop-down menus for the execution of all of the commands and features in Visual Model. However, most of these commands can be executed visually by selecting commands on the Toolbar and working in the viewport.

## The Toolbar

The **Toolbar**, located directly below the Menu Bar, contains buttons that allow you to create and edit objects in the viewport.

There are three different command sets that may appear on the Toolbar, depending on what you are currently doing. The Toolbar that is displayed at any given time depends on what you are doing. If no objects are selected in the viewport, Visual Model displays the Draw Toolbar to allow you to build a new object. However, if one or more objects are selected in the viewport, Visual Model assumes that you wish to edit these existing objects, and therefore displays the Modify Toolbar. Whenever you select a command from one of these Toolbars, a Points Toolbar appears to facilitate the definition of points in the viewport.

## The Draw Toolbar


The commands on the **Draw Toolbar** allow you to create the basic geometry that makes up your object. The Draw Toolbar appears by default if no objects have been created. However, if any objects exist in the viewport, then the Toolbar that is displayed depends on whether or not any of these existing objects are selected. When an object is selected in the viewport it is surrounded by a red rectangle and the Modify Toolbar is displayed. To return to the Draw Toolbar, simply move the pointer into the viewport and select anywhere away from the existing objects: this will deselect those objects and return you to the Draw Toolbar. Or, select the  button on the Modify Toolbar to return to the Draw Toolbar.


The specific commands in the Draw Toolbar are described in full in the [Drawing Objects](#) section.




## The Points Toolbar


The **Points Toolbar** appears while you are drawing or editing an object. In any situation where you are prompted to set points in the viewport, this Toolbar appears to help you define points in 3D space.

You can define a point simply by positioning the pointer in the viewport and clicking the left mouse button. However, in many cases you need to position points more accurately. For example, while drawing a single complex shape you may wish to use the  and

 commands in the Draw Toolbar to draw a polygon and an arc such that they are joined together. If this is the case, you would want to make sure that the arc begins at the same point where the polygons ends: the Points commands are used to achieve this kind of accuracy.

For most of the Points commands, you must pick a point in the viewport and then select one of the Points commands to fine-tune the position of that point. However, when setting points by entering absolute, relative or polar coordinates (using the ,

 or

 Points commands), you should not set that point in the viewport first.

The specific commands in the Points Toolbar are described in full in the [Setting Points](#) section.

## The Modify Toolbar

The **Modify Toolbar** is used to modify objects that currently exist in the viewport. Whenever one or more objects is selected in the viewport, this Toolbar appears so that these objects can be manipulated.

The commands on the Modify Toolbar allow you to create complex 3D shapes out of simple 2D objects. In addition, commands appear here for the grouping, scaling, rotating, cutting and pasting of objects.

Some of the commands in this Toolbar require that you define points in the viewport that determine how the command is executed. If this is the case the Points Toolbar will be displayed as soon as you select one of these commands.

The commands of the Modify Toolbar are described in detail in the Modifying Objects section.

## The Status Bar

Located directly below the Toolbar, the **Status Bar** displays important information concerning the work that you are currently performing in the main viewport.

The top line of the Status Bar contains three boxes which display, from left to right, the name of the Draw or Modify command that is being executed, a description of the next step that Visual Model expects in the current command, and the total number of points that have been set in the current command.

The second line of the Status Bar displays the current XYZ coordinate location of the pointer in the viewport, as well as the current layer number and name, and the kind of object that is currently selected in the viewport.

The XYZ coordinate display usually indicates the current position of the pointer in the viewport in relation to the coordinate system's origin. However, if you select the View, Show Delta command on the Menu Bar, the X, Y, and Z coordinate readouts will change to DX, DY, and DZ whenever a point is set in the viewport, and the distance displayed will represent the distance from the last set point to the current pointer position.

## **The Viewport**

The viewport is the area in which all geometry is created and displayed. It is a window into a virtual 3D universe that exists in all directions around it, and it defines a drawing plane on which object creation takes place.

The use and control of the viewport is detailed in the [Controlling the Viewport](#) section.

## Drawing Objects


To draw an object, first select the kind of object that you wish to draw, then set one or more control points that determine the object's shape, location and orientation in 3D space. Objects can be selected from the Draw Toolbar, or from the Draw pop-down menu on the Menu Bar. Note that the Draw Toolbar is only displayed if no objects are currently selected in the viewport.


After you select one of these commands, you are required to set one or more points in the viewport to define the object's position and orientation in 3D space. Points are set using the Points Toolbar.

The Status Bar below the Toolbar indicates the command that was chosen, as well as instructions for setting the next point in the viewport to create that object, the total number of points that have been set for the current object, and the layer on which the object is being created. When you position the pointer in the viewport, this Status Bar also displays the position of the pointer in 3D space.

## Setting Points in 3D Space

Whenever you create an object, you are required to set points. In these cases, a Points Toolbar is displayed to assist you. These are the same commands as those that appear in the Points pop-down on the Menu Bar.


Depending on the object that you are creating, the Status Bar will display messages explaining the significance of the point that you are currently setting. When you are done setting points, press the  button or press the right mouse button to complete the command. If you are not happy with the location at which you have set a point, press the


 button to undo your work: each time you press

, the next most recently set point is undone.

The challenge is to set points in 3D space, given that your monitor is a flat 2D display. The viewport is oriented by default such that X is horizontal, Y is vertical and Z is depth, and for simplicity's sake the discussion below assumes that this hasn't been changed. Obviously you can change the working plane of the main viewport so that it is no longer parallel to the XY plane, and the depth dimension would change accordingly.

Visual Model allows for several different ways to set a point in 3D space from the main viewport:

- \* You can set points in 3D space from the main viewport by using the Absolute, Relative , and Polar

 commands on the Points Toolbar, and defining "Z" values other than 0.

- \* While you are setting points you can rotate the view using the scroll bars beside and below the viewport. After rotating the main viewport the working plane is no longer parallel to the XY plane, you can set points in Z space.

Often it is easier (and a lot less confusing) to leave the main viewport in its default XY plane, and define points in Z space from the Top and Side alternate viewports. These viewports are opened using the View, Change Viewport Settings command on the Menu Bar. A red line in each of these alternate viewports represents the plane of the main viewport. Using the slider bars associated with these viewports, you can change the working plane of the main viewport by repositioning these red lines.

There are two ways to set a point in 3D space using these alternative viewports:

- \* You can change the working plane of the main viewport to a different Z depth, then set the point in the new XY plane. To do so, first move the pointer to one of the alternate viewports and drag the slider bar associated with it to change the working plane of the main viewport to the desired Z depth. Then, set the point at the desired position on the XY plane.
- \* You can set a point's position in one viewport, then change its "depth" in that viewport. To do so, first set the point in one of the viewports. Then, with the pointer located in the viewport in which you set the point, press the **Alt** key on the keyboard and hold down the left mouse button. Now release the **Alt** key, and with the left mouse button still depressed, drag the pointer to change the "depth" at which the point is placed in the current viewport. Look at the other viewports while dragging the pointer to see the point moving.

The most accurate way to set points is by using the commands on the Points Toolbar. These commands allow you to work more precisely. With some of these commands the point is set by typing in information in a dialog box; for others, you set a point in 3D space then select a Points command to fine-tune the position of that point.



## Modifying Objects

Once an object has been drawn in the viewport, it can be modified in many different ways. The points that make up the object can be repositioned; the lines that make up the object can be trimmed, joined or converted to and from polygon; and entire objects can be extruded, swept around a line, copied along a path or linked to create additional surfaces. Those commands that modify the object as a whole are discussed in the Modifying Objects section. Those commands that edit the points or lines that make up an object are discussed in the Editing Points and Lines section.

Before editing an object, you must select that object in the viewport. When an object is selected it is surrounded by a yellow rectangle. You may select more than one object simultaneously, and editing commands will be executed for all of these selected objects. The way in which objects are selected is discussed in the Selecting Objects section.

The commands that are used to modify objects are found on the Modify Toolbar, and under the Edit, Lines and Surfaces commands on the Menu Bar. Not all of the available commands are displayed on the Modify Toolbar; there are many important editing commands that are only found under the Edit and Lines commands on the Menu Bar.



## **Controlling the Viewport**

Visual Model allows you to create objects anywhere in 3D space. The viewport can be thought of as a window that only displays a portion of this 3D space at any given time. This window can be panned and rotated to view other areas as desired.

The default location and orientation of the viewport is such that the XY coordinate address of 0,0 is located in the center of the viewport, and the Z coordinate address of 0 is located right on the plane of the viewport. There are several ways to change the location and orientation of the viewport in 3D space: you can pan and rotate the viewport to the desired position, or you can set a new working plane.

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## The Coordinate System


Every point in 3D space has a coordinate address that defines its position in the X, Y and Z axes. The coordinate address of XYZ 0,0,0 is referred to as the "origin": it is located at the center of the main viewport by default, but if you pan the viewport display this may no longer be the case. The X axis runs from left to right in the viewport's default orientation and increases in a positive direction as you move to the right of the origin. The Y axis runs up and down in the viewport's default orientation and increases in a positive direction as you move above the origin. The Z axis runs perpendicular to the plane of the viewport's default orientation in a positive direction as you move deeper into the screen.

The numeric units of the coordinate system can be modified to facilitate the construction of objects in their proper scale. To change unit scale or assign that scale based on an existing object, use the View, Set Units command on the Menu Bar.

## Setting Drawing Units

Visual Model allows you to change the units of measurement that make up the coordinate system. This is useful when you wish to create objects to scale, and base that scale on a standard unit of measure. To set the desired drawing units, simply define two points in the viewport and indicate the distance in units that should separate these two points. You can set drawing units before creating any objects, or you can create an object and set the drawing units according to that object's scale in the viewport.

To set drawing units, select the **View, Set Units** command on the Menu Bar, then set the two points in the viewport that you wish to use to determine your drawing units.

After setting these points press  or the right mouse button, and you are prompted to enter the distance between these two points in units: whether this distance represents meters or miles is arbitrary, and depends on your needs.

## The Main View vs The Alternate Views

Visual Model allows you to display up to 3 views at once: the main viewport is attached to the interface, and this view can be panned and rotated to any position and orientation in 3D space. In addition, you can activate two "alternate" views, the Top and Side views, by selecting the **View, Change view settings** command on the Menu bar and activating the desired alternate view.

The **Top** view displays a view from directly above the main viewport. A red line running horizontally across this viewport represents the plane of the main viewport, as you look down on it.

The **Side** view displays a view from the right side of the main viewport. A red line running vertically across this viewport represents the plane of the main viewport, as you look at it from the side.


The Top and Side alternate views are slaves to the main viewport: if you change the position or orientation of the main viewport, the position and orientation of the Top and Side viewports changes accordingly.


## Panning and Rotating the Viewport

There are two ways to pan or rotate the main viewport. You can do so numerically by selecting the **View, Change view settings** command, or by using the scroll bars that appear around the main viewport.

When you select the View, Change view settings command, you can type in new position and rotation coordinates for the main viewport in the **Trans** and **Rot** type-in wells. Or, you can select on the buttons associated with these type-ins and select your input from the resulting pop-down menu. If you select on a Tran button, you can choose 0.0 to return the pan setting to its default position, or you can choose Center to center the viewport on whatever geometry currently exists in space. If you select on a Rot button, you can choose 0.0 to return to the default rotation, or you can rotate the view in 90 degree increments.

Usually you will find it easier to pan and rotate the main viewport visually using the scroll bars that surround the viewport.


To rotate the viewport, first make sure that the Pan/Rotate button is not pressed (it should display the  icon, indicating that pressing this button will change it to the Pan mode). Or select the **View, Rotate** button on the Menu Bar to change to this mode. Now when you move the scroll bars that exist below and to the sides of the viewport you will be rotating the viewport display. The scroll bar to the right of the viewport rotates the view around a horizontal axis; the scroll bar below the viewport rotates the view around a vertical axis; and the scroll bar to the left of the viewport rolls the view.

To pan the viewport, first make sure that the Pan/Rotate button is pressed (it should display the  icon, indicating that pressing this button will change it to the Rotate mode). Or, select the **View, Pan/Zoom** button on the Menu Bar to change to this mode. Now when you move the scroll bars that exist below and to the sides of the viewport you will be panning and zooming the viewport display. The scroll bar to the right of the viewport pans the view up and down; the scroll bar below the viewport pans the view left and right; and the scroll bar to the left of the viewport zooms the view in and out.

As you pan or rotate the viewport, objects are redrawn according to the new viewport orientation. If there is a lot of geometry in the viewport, the time required to redraw the polygons may affect the speed at which the viewport can be panned or rotated. If this is the case, select **File, Options** from the Menu Bar and use the **Bounding** or **Skip Polys** buttons to limit the redrawing of polygons while the viewport is panned or rotated. These buttons are discussed in the Setting Defaults section.

## Defining a Working Plane

Another way to change the viewport display is to define a new working plane. When you define a new working plane the viewport's orientation is updated such that it is now located on this working plane.

To define a new working plane, select the **View, Set working plane** command on the Menu Bar. When you select this command you are prompted to enter 3 points in the viewport to define a plane. These points must be set on an existing object. Next, you can set a point which indicates which side of the working plane you wish to view your model from. After selecting the desired points, press the  button on the Points Toolbar or the right mouse button to complete the command.

After setting a working plane, you can return to the working plane at which you were most recently located by selecting the **View, Reset working plane** command on the Menu Bar.

## Defining and Using a Snap Grid

Visual Model allows you to define a "snap grid" in the viewport such that the pointer will always "snap" between the intersection points. When a snap grid is enabled the pointer doesn't move smoothly through the viewport; it jumps from one point in the snap grid to the next point. A snap grid is very useful when creating or orienting objects in a desired alignment, or to insure that objects are created in accurate increments.

Use the **View, Snap Grid** command to enable and disable the snap grid. When the grid is enabled, points appear in the viewport indicating the interval of the points in the grid. If you have not previously indicated the grid size, you will be asked to do so when you execute this command.

To change the grid size, select the **View, Grid Size** command. When you select this command you are asked to enter the desired distance in units between each of the points in the grid (units, in turn are determined using the View, Set Units command).


## Selecting Objects

Before editing an object, you must select that object in the viewport. When an object is selected it is surrounded by a yellow rectangle. You may select more than one object simultaneously, and editing commands will be executed for all of these selected objects.


If you have just created an object, that object is selected by default. To select an object that was created previously, you must first complete any object drawing and editing commands that you may have started, such that the Points Toolbar is not displayed, then:

- \* Create a bounding box around the desired object. To do so, move the pointer into the viewport, click and hold the left mouse button at a point that represents a corner of the desired bounding box, then drag the pointer to expand the bounding box until the desired object is completely surrounded and release the mouse button.
- \* Click the left mouse button on the desired object or objects. Point to the desired object in the viewport and click the left mouse button to select that object. This is a less accurate method of selecting objects, and if objects overlap it may be hard to select the desired object using this method.
- \* If many objects overlap, you can select one of the objects using the "click" method discussed above, then hold down the **Alt** key on your keyboard and click the left mouse button again: each time you click the left mouse button with the **Alt** key depressed, you are highlighting the next in the series of overlapping objects.
- \* If you want to add another object to a series of objects that are already selected, hold down the Shift key on your keyboard and use either of the two object selection methods described above: objects that are already selected will remain selected as you select new object.
- \* To select all of the objects in the viewport, use the **Edit, Select All** command on the Menu Bar. To deselect all selected objects, use the **Edit, Deselect All** command.

### The Add/Remove Toggle

The Add/Remove toggle, located at the far right side of the Draw and Edit Toolbars, determines whether you are currently selecting objects or deselecting them. In its default state, the toggle is not pressed, and therefore the button displays the  icon, indicating that when you press the button you will toggle it to deselect objects.

When this button is in its default state, objects are selected as described in the section above. If this button is pressed, previously selected objects will be deselected when you create a bounding box around the object or select on the object with the left mouse button.

In addition, when this button is pressed, it now displays the  icon, indicating that when you press the button you will toggle it to select objects.





## Grouping and Ungrouping Objects

Selected objects can be grouped together in any combination to facilitate their manipulation. This is especially useful in situations when you wish to move a group of objects, or when a specific group of objects are always edited in unison: once you define those objects as a group, they are selected and deselected as a group: you don't have to select each one individually.

Grouping objects is also extremely useful if you plan to load the model into Renderize Live for rendering. You can import SHP files (the Visual Model file format) into Renderize Live such that independent objects are created for each group in the SHP file.

You are not required to group objects together for manipulation (unless you wish to move a series of objects in unison): object editing commands are always executed for all of the objects that are selected in the viewport. However, grouping becomes convenient if a series of objects are always going to be manipulated in unison: creating a group out of these objects makes it easier to select and work with them together.

The  command on the Modify Toolbar is used to group objects: as soon as this button is pressed, all selected objects are linked together as a group. This is the same as selecting the **Edit, Group** command on the Menu Bar. In addition to creating groupings out of individual objects, you can also create groupings out of groups: the command retains the hierarchy of subgroupings should you decide to ungroup them later.

The  command allows you to break a group up into its constituent objects. This is the same as selecting **Edit, Ungroup** on the Menu Bar. When you use this command, any selected groups are broken up into its components, whether those components are constituent objects or smaller subgroupings.

Note that grouping does not effect the "individuality" of different objects: each separate entity remains separate.

## Organizing Your Work in Layers

Because complex models are often made up of many different objects, Visual Model allows you to place objects onto different layers in order to better organize your work. By organizing your work according to layer, you gain several advantages:

Because layers can be turned on and off individually, you can reduce confusion and improve performance by turning on, or enabling, only those layers that contain the objects that you are currently manipulating.

If you are planning to import your model into Renderize Live, organizing your work by layers according to the different material types you expect to use significantly facilitates the rendering process, because Renderize Live allows you to import models by layer such that individual materials and/or object are created for each layer.

When you create an object, it is assigned to the current layer. The current layer is chosen using the View, Change layer settings command on the Menu Bar, and the current layer number and name (if a name has been assigned) is displayed in the Status Bar above the main viewport.

In addition, you can also assign names and colors to a layer, or enable or disable layers using the View, Change layer settings command.

### Changing the Current Layer


When you enter Visual Model, the current layer is "0". You can create up to 256 layers.


To create an object on a particular layer, you must first make that layer the current layer. To do so, select the **View, Change layer settings** command. Then type the desired layer number in the Set Current type-in well or highlight the desired layer number by pointing to it and selecting, and press OK to complete the command. That layer number now appears on the Status Bar, indicating that it is the current layer, and any new objects that you create are assigned to this layer.

Note that you cannot make a disabled layer current. Enabling and disabling layers is discussed below.

Note that this does not alter the layer assignments for objects that already exist. To change the layer assignment of an existing object, see the following section.

### Changing an Object's Layer Assignment

If after creating an object you wish to assign it to a different layer, you can do so using the  button on the Modify Toolbar, or by selecting the **View, Set layer** command on the Menu Bar.

To change the layer assignment of an object, first make the layer on which you wish to assign the object the current layer (as described in the section above). Then select the object or objects that you wish to assign to this current layer. Finally, press the  button on the Modify Toolbar (or select the View, Set layer command) and these objects will be reassigned to the current layer.

### Assigning a Color to a Layer

You can assign a color to a layer such that when you render your viewport using the View, Quick render command each layer appears in its assigned color. This helps you to visualize your drawing's organization.

To assign a color to a layer, first select the View, Change layer settings command. Next, select the layer that you wish to assign a color to by highlighting it in the layer list. Finally, select a color by clicking on one of the color choices that appear on the window. When you select a color, that color is displayed in the current color well.

### Assigning a Name to a Layer

You can assign a name to a layer in order to give that layer a descriptive label: if the layer contains objects that make up a floor, you can call that layer "floor". Although layer names can be very long, we recommend that you limit your layer names to 8 characters in length if you plan on importing the model into Renderize Live later on: Renderize Live assigns object filenames based on layer name, and the DOS filename convention forces Renderize Live to truncate those layer names that are longer than 8 characters.

To assign a name to a layer, first select the View, Set layer command. Next, choose the layer that you wish to assign a name to by highlighting that layer in the layer list. Then type in the desired name in the Change Name type-in, and press the Enter key on your keyboard to execute the change.

When a named layer is made current, the layer name, as well as the layer number, is displayed on the Status Bar.

### **Enabling and Disabling Layers**

The ability to enable and disable layers is essential to facilitate the design process. When you disable a layer, that layer still exists: its display in the viewport is simply suppressed temporarily so that you can more easily see what you are doing.

To enable or disable layers, select the View, Change layer settings command. Highlight the layers in the layer list that you wish to enable or disable, then select the Enable or Disable buttons to enable or disable the selected layers. When a layer is disabled, the word "Off" appears beside the layer in the layer list. When a layer is enabled, the word "On" appears beside the layer.

In addition, the Disable All and Enable All buttons do just that: they disable or enable all of the layers globally. Sometimes, it's easier to globally disable all layers, the selectively enable only those layers that you wish to work on in the viewport.

Note that a disabled layer cannot be made current. Also note that disabled layers are not rendered, and they do not translate well to Renderize Live. Be sure to enable all layers that you wish to include in a rendering.

## **Moving Objects**

Objects can be moved in 3D space simply by positioning the pointer over a selected object in the viewport, holding down the left mouse button, and dragging the pointer to move the object.

Note that only selected objects are moved, and that all of the objects that are selected are moved in unison. Therefore, before moving any objects, be sure that only those objects that you wish to move are selected.

## Rendering Objects

Visual Model allows you to render objects in a variety of ways: you can render to perform a hidden-line wireframe display, or you can render to fill in the polygons as shaded surfaces.

To render an image in Visual Model, select the **View, Quick-render** command on the Menu Bar. When you select this command Render window appears.

You are offered two rendering choices: **Shade** or **Wire**. If you select Shade, then all of the objects in the main viewport will be rendered, or shaded. That is, the areas defined by each of the polygons in an object will be "filled in" with color, so that the object now appears solid (remember that only polygons define surfaces, so only polygons appear when you execute a rendering). The colors that are used are determined by the colors assigned to the layers on which each object is located. In addition, objects are shaded according to their position in relation to a light source that is placed at the camera position. That is, areas of an object that face the light will be shaded brighter than areas of the object that aren't facing the light.

If you select the Wire button, the main viewport is rendered in a wireframe mode using a hidden line methodology. This means that all of the lines that would not appear if the object were solid are not displayed, better conveying a 3D sense of the wireframe objects. The colors in which the wireframes are rendered are determined by the colors assigned to the layers on which each object is located.


In addition, you can load Visual Model models into Renderize Live software to generate high quality, full color photorealistic renderings. This capability is discussed at the end of this chapter.

## Setting Defaults

Visual Model allows you to set several system default values. These values determine the way objects are redrawn as the viewport is panned or rotated, the number of levels of "undo" to support, and the detail with which curves are drawn. **Select File, Options** from the Menu Bar to display the Defaults dialog box.


If you have a lot of geometry in the viewport, the time required to redraw every line in the model will inhibit the ability to pan or rotate the viewport. Select **Bounding**, and objects will be temporarily represented as bounding boxes while you reorient the viewport. Select **Skip Poly** to limit the number of lines that are redrawn while the viewport is being reoriented. Skip Poly is enabled by default, but 0 polygons are being skipped. Increase the value in the No. of Polys to skip type-in to increase the number of polygons to skip during this redraw process. The higher the value you enter here, the faster the viewport will react when you pan or rotate. As soon as you release the mouse button after panning or rotating the viewport, the objects are redrawn in their entirety.

The **No. of Undo levels** type-in allows you to indicate how many past operations to "remember" and retain in case you need to undo them. However, undo levels come at a cost: they increase your memory requirements. The amount of memory used by the undo levels depends on the operations being retained.

The **No. of Segments per arc** type-in allows you to determine the number of line segments to use to define an arc. The higher the value you enter here, the smoother your curve will be, but the more control points it will contain. If you use an arc in the creation of a 3D object, increasing this number increases the density of the polygon mesh, and therefore can increase the size of your model dramatically. This value is used to determine the detail of curves created using the ,



and

 commands on the Draw Toolbar, as well as the **Lines, Convert Line to curve** command on the Menu Bar.

## Loading and Saving Models

Models are loaded and saved using the selections on the File command on the Menu Bar. Visual Model can load files in the SHP, GED, OBJ and DXF file formats. Visual Model can save files in the SHP, GED and OBJ file formats.

**SHP** is the Visual Model file format. Save geometry in this format when you need to load it back into the Visual Model software, because it saves control points, units and other options related to the model and its creation process.

**GED** is the Renderize Live model file format. Save your work into this file format for importation into the Renderize Live Software. When imported into Renderize Live, a different material is created for each layer that was defined in Visual Model.

**OBJ** is the Wavefront model file format. Models saved to this format can also be imported into Renderize Live.

**DXF** is the data exchange format. Visual Model can load DXF files, but it cannot save them. When a DXF file is loaded, layer information from the DXF file is assigned as layers in Visual Model; block information from the DXF file is assigned as groups.

Loading Models

Combining Models

Saving Models

## Loading Models

Select **File, Load** to load existing geometry from disk file. As soon as you select this command a Windows File Browser appears to allow you to set the desired drive, directory, filename and file type of the model that you wish to load.

When you execute this command, any work that existed in the viewport is deleted, and the new model is loaded. If you load an SHP file, this model continues to contain the control point information for all of the objects in the file, as well as the units and other options that may have been in effect at the time the model was saved. However, the display of the model in the viewport may not be the same as when it was saved: viewport rotation is set back to the default values, and the viewport zoom is set to "extants": the entire model should be visible in the viewport.



## Combining Models

Models existing in independent files can be combined using the **File, Merge** command. This command works in the same manner as the File, Load command, except that the model that you loaded is added to the work that currently exists in the viewport.

## Saving Models

You can save your work at any time using the **File, Save** and **File, Save As** commands on the Menu Bar. When you save a model, all of the geometry that exists at the current time is saved to disk. In addition, layer and group information and drawing units are saved as well.

If you have previously saved your current work session, select File, Save to save it again under its current name.

If you have not saved your current work session, selecting File, Save or File, Save As will execute the same action. A Windows File Browser is displayed, and you can use this Browser to select the desired directory, file type and filename for the current model.

The file format in which you save a file depends on what you plan to do with that file later on. If you plan to continue manipulating the model in Visual Model, be sure to save the model in the SHP file format, as this format retains all of the control information for the objects you have created, as well as the default parameters under which the model was created. This makes it far easier to load and edit the model at a later time. SHP files also import well into Renderize Live, as objects and materials can be created in Renderize Live according to the layer or group definitions in the SHP file.

## Loading and Using Background Images

Visual Model includes the ability to load images and use them as a background in the viewport for digitizing purposes. You can load an image and "trace" the desired information to generate a model.

Select the **File, Background** command to load an image. When you select this command a Windows File Browser appears to allow you to set the desired drive, directory, filename and file type of the image that you wish to load.

Visual Model supports the loading of TGA, TIF, GIF, RAS, RAW and BMP image files.

After a background image has been loaded, you can enable or disable its display by selecting the **View, Toggle background** command on the Menu Bar.

## Using the File Browser

The File Browser appears whenever a command is issued which requires loading or saving a file. To choose a file, point to the desired filename on the list of filenames to highlight it, then select the OK button to load that file. Or, double-click on the desired filename on the list. Finally, you can also click in the Filename type-in, type in the desired filename and press the OK button.

To change directories, select on the desired directory name in the list of directories for the current drive. To change drives, click on the Drives pop-down menu and select from the list of valid disk drives.

### **The Files List**

The Files List displays a list of all files in the current directory matching the pattern (filename extension) that is displayed in the List files of type type-in.

### **The List Files of Type Pop-down Menu**

Select this pop-down menu to display a list of valid file types.

Models can be loaded and saved to and from the SHP, GED or OBJ file formats. You can also load models in the DXF file format.

Background images can be loaded from the TGA, TIF, GIF, RAS, RAW and BMP file formats.

### **The Directories List**

This list displays the directories on the selected disk drive. To change directories, either select the desired directory on the list to highlight it and press the OK button, or simply double-click on the desired directory.

### **The Filename Type-in**

The Filename type-in permits direct entry of the filename to be loaded or saved. If you select a filename by highlighting it in the File List, that filename appears here.

Otherwise, you can enter the desired filename directly using this type-in. When typing in a filename, be sure to include the filename extension.

### **The Cancel Button**

Closes the File Browser window and returns to the previous command level without loading or saving any file.

## Loading Visual Model Geometry into Renderize Live Software

Models created in Visual Model can be imported into Renderize Live software through one of the compatible file formats, or directly through the Windows Clipboard.

### Loading Visual Model Geometry from File

Visual Model saves 3 different model file formats that can be read by Renderize Live: SHP, GED, and OBJ.


SHP, the native Visual Model geometry file format, gives you the most flexibility when importing models into Renderize Live, because this file format saves layer and object grouping information in a way that Renderize Live can use. When you load an SHP file into Renderize Live, you are given the option of loading the model such that materials and objects are assigned according to the layer or group information in the SHP file (the strategic use of layers and groups is discussed below).

GED is the native Renderize Live geometry file format, and it offers the advantage of a fast loading time in Renderize Live. GED files retain layer information such that when a GED model is loaded into Renderize Live one object is created consisting of all the geometry, and a separate material is created for each object. This is fine if you do not plan on using texture mapping definitions, smoothing algorithms or other "object-specific" Renderize Live features. However, for maximum flexibility, you would want to use the SHP file format.

OBJ is a Wavefront geometry file format. When a model from this file format is loaded into Renderize Live, only one object is created, and only one material is assigned to this object.

### Loading Visual Model Geometry through the Windows Clipboard

Models created in Visual Model can be loaded into Renderize Live directly through the Windows Clipboard. This provides a speedy method to transfer models between the two applications.

To transfer a model through the Windows Clipboard, first select the desired geometry in Visual Model. Then select the  command on the Modify Toolbar to copy that geometry to the Windows Clipboard. Now, from Renderize Live, select the Edit, Load Visual Model command from the Menu Bar to load the geometry as an object.

Transferring models through the Windows Clipboard is the most efficient way of sharing data among applications. However, it is strongly recommended that you save your work before using this command option, because inter-application work can fragment or use up Windows resources.

## **Creating Models for Rendering**

To facilitate the interaction between Visual Model and Renderize Live, bear in mind the following while creating your models.

Pay Attention to Polygon Directions

Use Polygons, not Polylines

Don't Create 3D Polygons

Organize Your Work with Material Definition in Mind


Foreground Objects Should Have More Detail than Background Objects


## Pay Attention to Polygon Directions


Polygons only exist in one direction, and can only be rendered in that direction. The direction in which a polygon exists depends on the direction of the "normal" that is associated with that polygon. A normal can be thought of a line that protrudes from a polygon at a perpendicular: the direction of the normal determines the direction in which a polygon exists.

If a polygon is facing in the opposite direction from that which you expect or desire, that polygon is said to be "backfacing". Backfacing polygons are not rendered by default in Renderize Live, and although you can render backfacing polygons, it is better to create your models with polygons that face in the correct direction in the first place.


When creating geometry, remember the "right-hand rule". Hold your right hand in front of your face, thumb facing you. Now curl your fingers: they curl in a counter-clockwise direction. When you create polygons in a counter-clockwise direction, the normal will face toward you.

When you create polygons in Visual Model, try to create them in a counter-clockwise direction. If you are defining a series of lines or polylines to define an area, try to define the first line segment in a counter-clockwise direction. This being said, Visual Model will usually make sure a polygon's normal faces the viewport, especially when you are creating simple 2D polygons. Matters become more complicated when you create 3D polygons or polylines from which a Surface Patch  is later created (see the Don't Create 3D Polygons topic).

When performing a Sweep  command, the axis of rotation should be defined in the same direction as the object that is being swept, so that the polygons created as a result of this command will face out.

When performing an Extrude  command, the direction in which an extrusion is performed depends in part on the direction (clockwise or counter-clockwise) in which the extruded polygon or polyline is created.

## Use Polygons, Not Polylines

Remember that only polygons define surfaces, and therefore only polygons will render. Polygons are created using the ,



and



commands on the Draw Toolbar. Solid objects, such as boxes, cones, spheres, hemispheres and cylinders are also comprised of polygons. Finally, any geometry created when you extrude, sweep, path, spiral, patch or link objects is made up of polygons.

Polylines, created using the ,



and



commands on the Draw Toolbar, do not define an enclosed area, even if you have closed the line. However, you can use the Lines, Convert Line to Polygon command to change a polyline into a polygon and therefore make it a renderable entity.

Polylines are useful when you are Modifying Objects with the ,




or Spiral commands. Otherwise, use polygons to define enclosed areas such that renderable surfaces are defined.



## Don't Create 3D Polygons

A 3D model should be made up of any number of 2D polygons: a polygon should define a 2D surface. It is possible to define 3D polygons in Visual Model, but these will not render.

Instead of defining a 3D polygon to define an object, draw lines to define the desired 3D area, then execute the Surface Patch  command to fill that area with a polygon mesh. If you have already defined the 3D polygon, you can use the Lines, Convert Polygon to Line command on the Menu Bar to convert the polygon to lines, then break and join the lines until there are exactly four polylines, at which time you can create a surface patch. After generating a Surface Patch, be sure to delete the lines that were used to define the patch. Otherwise they may cause problems when you wish to render this object.

## **Organize Your Work with Material Definition in Mind**

When Renderize Live imports a model, materials and objects are defined according to layer or group information in the model file. By strategically organizing your work in Visual Model, you can greatly facilitate your work in Renderize Live.

For example, if you import your work into Renderize Live by layer, then you should assign objects to layers in Visual Model such that objects with different material assignments are organized on different layers. If you are planning to use texture maps in Renderize Live, keep in mind that the way textures are assigned to objects (scale, orientation and mapping type) are attributes of objects: therefore, even though two objects may be mapped with the same material, you may wish to organize them on different layers in Visual Model so that when they are imported into Renderize Live the texture mapping characteristics can be controlled independently for each of these objects.

If you don't organize your work exactly right before exporting to Renderize Live, don't worry, Renderize Live gives you a good deal of flexibility in reorganizing your work. However, it is easier if this is done during the modeling phase.

## **Foreground Objects Should Have More Detail than Background Objects**

If you know approximately where your camera position will be in the rendered scene, you can create your objects with this position in mind. Objects that appear closer to the camera will appear larger in Renderize Live, and therefore they may require more detail. For example, if you are creating a sphere in Visual Model that will be in the foreground of a rendering, you may need to increase the number of polygonal surfaces that make up the sphere so that these flat surfaces don't show up in the rendering.



# Visual Model Overview

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## Drawing Objects: Overview

The Draw Toolbar appears by default if no objects have been created. However, if any objects exist in the viewport, then the Toolbar that is displayed depends on whether or not any of these existing objects are selected. When an object is selected in the viewport it is surrounded by a yellow rectangle and the Modify Toolbar is displayed. To return to the Draw Toolbar, simply move the pointer into the viewport and select anywhere away from the existing objects: this will deselect those objects and return you to the Draw Toolbar. Or, select the  button on the Modify Toolbar to toggle back to the Draw Toolbar.

Whenever you are drawing an object, a Points Toolbar is displayed to aid in the positioning of the points that make up the object. In addition, a Status Bar below the Toolbar indicates the command that was chosen, as well as instructions for setting the next point in the viewport and the total number of points that have been set for the current drawing command. When you position the pointer in the viewport, this Status Bar also displays the position of the pointer in 3D space.

## Using the Draw Commands



To draw an object, first select the kind of object that you wish to create by selecting one of the buttons in the Draw Toolbar (or select the desired object from the Draw pop-down command on the Menu Bar). After selecting a Draw command you are prompted to enter one or more points in the viewport to define that object's shape, position and orientation. The number of points that you need to set and the meaning of these points depends on the Draw command you are using. After defining the desired points, press the  button or the right mouse button to complete the command.

Points can be set freehand in the viewport or in conjunction with the Points \ commands that appear while you are setting points. In many cases, the points that make up the object can be repositioned even after the object has been created, using the Edit, Move Points or Edit, Join Points commands on the Menu Bar.



## Draw a Line

Draw a line or a series of line segments. A simple line is defined by 2 points: a startpoint and an endpoint. However, you can also define polylines, in which you the endpoint of one line segment acts as the startpoint of the next line segment. You can define up to 100 points each time you use this command.

This command differs significantly from the Polygon command, used to define polygons, in that the Line  command defines only the line segments themselves, while the  command creates a surface enclosed by the polygonal segments. Therefore, lines and polylines themselves are not renderable entities. However, you can change polylines to polygons using the Lines, Convert Line to Polygon command on the Menu Bar. In addition, if you execute a Modify command on the line or polyline to create a 3D object, the faces defined by the extrusion are a renderable entity.

Note that a polyline, created by selecting multiple points during the execution of this command, differs from a series of independent lines, in that the line segments of a polyline are joined. You may or may not wish to join these line segments, depending on the kind of operation you plan to perform: the Lines, Break Lines and Lines, Combine Lines commands allow you create or break up polylines from the line segments.

## **Draw a Polygon**

Draw a series of line segments that define an enclosed surface. You must define at least 3 points, and you can define a maximum of 100 points. Because a polygon always defines an enclosed surface, Visual Model will close the polygon automatically by drawing a line between the first point and the last point, if needed.

For rendering purposes, polygons must be planar: all of the points should be set on the same plane. In addition, you should not define a self-intersecting polygon (one in which the lines defined in one polygon command cross one-another as a result of the position at which the points were set), as it may not render as you would expect.

A polygon can be changed into a series of line segments, if necessary, by choosing the Line, Convert Polygon to Line command.

## **Draw a Rectangle**

Draw a rectangle by setting two points which represent the opposite corners of the rectangle. This command essentially creates a rectangular polygon, defining a surface within the area enclosed by the rectangle.



## **Draw a Box**

Draw a 3D box by setting three points. The first two points define a rectangle, and the third point, usually set on a different plane from the rectangle, determines the depth of the box.

Once you create a box, it exists as a solid object and can be used with Solids commands on the Menu Bar.



## Draw an Arc

An arc is a segment of a circle, and defined by setting three points. The first point represents the center point around which the arc is drawn; the second point represents the start point of the arc, or the radius of the circle from which the arc is created; and the third point defines the direction of the arc. The direction of the arc is very important, as it can determine whether the arc is front-facing or backfacing. Create the arc in a counter-clockwise direction to make it front-facing.

After setting three points, press the  button or the right mouse button and a dialog box appears prompting you to define the arc in terms of degrees.

The default **Number of Degrees** value that appears is the number of degrees at which you drew the arc: you can enter in a new value here to modify the length of the arc as desired or accept the current value.

The **No. of Segments** type-in in this dialog box allows you to regulate the detail in which an arc is drawn. The higher the number you enter here, the smoother the arc becomes, but the more points it contains. You may need to increase this value when drawing very large arcs. The default value that appears here can be set using the File, Options command on the Menu Bar.

Note that **As Is** and **Inverse** toggles also appears in the dialog box. The As Is button is enabled by default; when the Inverse button is enabled, the arc will be created around the entire circumference of the circle except at the area you defined. For example, if you define an arc and set the angle to 90 degrees, the press the Inverse button, an arc of 270 degrees will be created.

Once an arc is drawn, it actually exists as a polyline with a lot of small segments. If you wish to make this a renderable entity, you must use the Lines, Convert Line to Polygon command on the Menu Bar.

## **Draw a Curve**

Draw a curve by setting a series of control points through which the curve is created. The path at which a curve passes through any given point depends on the position of the previous point and following points on the curve. When the curve is drawn, it is "rubberbanded" between the control points: the more control points you define, the finer control you have over the curve.

Once a curve is drawn, it actually exists as a polyline with a lot of small segments. If you wish to make this a renderable entity, you must use the Lines, Convert Line to Polygon command on the Menu Bar.

## **Draw a Circle by Radius**

Draw a circle around a center by setting a radius distance. The number of line segments that make up the curve can be controlled using the **No. of Segments per Arc** setting on the [File, Options](#) command.

The first point you set is the center point around which the circle is drawn. The second point sets the radius and defines the origin point of the circle. The third point, which is optional, allows you to set the plane on which the circle is drawn. The position of the third point also determines in which direction the polygon will face: set the third point in a counterclockwise direction from the second point if you want the polygon to face toward you.

A circle is a polygonal entity: the area defined by the circle is rendered.

## **Draw a Circle by Diameter**

Draw a circle through a line that represents a diameter. The number of line segments that make up the curve can be controlled using the **No. of Segments per Arc** setting on the [File, Options](#) command.

The first two points you set draw a line which represents the diameter of the circle; the first point defines the circle's origin. The third point, which is optional, allows you to set the plane on which the circle is drawn. The position of the third point also determines in which direction the polygon will face: set the third point in a counterclockwise direction from the first point if you want the polygon to face toward you.

A circle is a polygonal entity: the area defined by the circle is rendered.





## Draw an Ellipse

Draw an ellipse by setting three points. The number of line segments that make up the curve can be controlled using the **No. of Segments per Arc** setting on the [File, Options](#) command.

The first point represents the center of the ellipse; the second point determines the width of the ellipse and defines the ellipse's origin point. The third point determines the height of the ellipse and the plane on which the ellipse is drawn. The position of the third point also determines in which direction the polygon will face: set the third point in a counterclockwise direction from the second point if you want the polygon to face toward you.

An ellipse is a polygonal entity: the area defined by the ellipse is rendered.



## Draw a Cone

Draw a cone by setting three points. The first two points define the diameter of the circle that is the base of the cone; the third point indicates the height of the cone and the direction in which it is drawn.

When this command is executed a cone is created using a series of polygons that are grouped together. If desired, these polygons can be broken up into their constituent parts.


The density of the polygon mesh that makes up this object is determined by the **No. of segments per arc** value in the File, Options menu.

Once you create a cone, it exists as a solid object and can be used with Solids commands on the Menu Bar.



## Draw a Sphere

Draw a sphere by setting two or three points. The first point defines the center of the sphere; the second point defines the radius of the sphere's equator; the third point determines the direction of the sphere's poles, where a line drawn between these poles will always intersect perpendicular to the line drawn with the first two points.


After you define the points of the sphere and press  or the right mouse button, a window appears on which you are prompted to enter **Longitudinal** and **Altitudinal density**. These values determine the density of the polygon mesh that makes up the sphere.

When this command is executed a sphere is created using a series of polygons that are grouped together. If desired, these polygons can be broken up into their constituent parts. Once you create a sphere, it exists as a solid object and can be used with Solids commands on the Menu Bar.



## Draw a Hemisphere

Draw a hemisphere by setting two or three points. The first point defines the center of the circle that is the base of the hemisphere; the second point defines the radius of this circle; the third point determines the direction of the hemisphere's pole.

After you define the points of the hemisphere and press  or the right mouse button, a window appears on which you are prompted to enter **Longitudinal** and **Altitudinal density**. These values determine the density of the polygon mesh that makes up the hemisphere.

When this command is executed a hemisphere is created using a series of polygons that are grouped together. If desired, these polygons can be broken up into their constituent parts. Once you create a hemisphere, it exists as a solid object and can be used with Solids commands on the Menu Bar.



## Draw a Cylinder

Define a cylinder by setting three points. The first two points define the diameter of the circle that is the base of the cylinder; the third point indicates the height of the cylinder and the direction in which it is drawn.

When this command is executed a cylinder is created using a series of polygons that are grouped together. If desired, these polygons can be broken up into their constituent parts.

The density of the polygon mesh that makes up this object is determined by the **No. of segments per arc** value in the File, Options menu.

Once you create a cylinder, it exists as a solid object and can be used with Solids commands on the Menu Bar.



## Paste an Object

Paste a previously cut or copied object into the viewport at a specified location, direction, scale and orientation. This is the same as selecting the **Edit, Paste** command on the Menu Bar.

When you select this command you are prompted to set anywhere from zero to three points: each of these points will only be taken into account in the pasting of the object if those points were set when the object was cut or copied.

The first point you are prompted to set is the origin point: the object will be pasted such that the same relationship exists between this point and the object as existed between the original object and the origin point that was set when the object was cut or copied. If no origin point was defined when the object was cut or copied, then the object will be pasted according to the location of the origin point that was defined when the object was created (this is usually the first point you set when drawing object; however, if the object is defined around a center point, then the origin point is the second point that you set when drawing the object).


The second point you are prompted to set is the scaling point: the object will be oriented and scaled when pasted such that the same relationship exists between this scaling point and the object as existed between the original object and the scaling point that was set when the object was cut or copied. If no scaling point was defined when the object was cut or copied, the object will be pasted at the same orientation and scale as it existed when cut or copied, regardless of the scaling point that you enter here.

The third point you are prompted to set is the plane point: the object will be rotated when pasted such that the same relationship exists between this plane point and the object as existed between the original object and the plane point that was set when the object was cut or copied. If no plane point was defined when the object was cut or copied, the object will be pasted on a plane parallel to the original object, regardless of the plane point that you set here.



## Undo an Operation



Undo one or more previously executed operations. This is the same as selecting the **Edit, Undo** command on the Menu Bar.

Visual Model actually supports multiple levels of undo. The first time you press this button, the most recent action you executed is undone. Press  again and the next most recently executed action is undone, and so on, through each of the levels of the undo process.

You can set the desired number of undo levels using the File, Options command. The default number is 10.

## **Redo an Operation**


Redo an operation that was previously undone. This is the same as selecting the **Edit, Redo** command on the Menu Bar.

This button undoes the  command that you just executed. Each time you press  the next most recently executed undo operation is redone.






## **The Pan/Rotate Toggle**

This toggle determines the functionality of the slider bars around the main viewport. In its default state, this button is not pressed: moving the slider bars associated with the main viewport will rotate the viewport display around the viewport origin point. The button displays a  icon, indicating that when the button is pressed, the slider bars are used to pan around the viewport display.

The use of the Pan/Rotate toggle is discussed in the [Controlling the Viewport](#) section.




## **The Add/Remove Toggle**

The position of this toggle determines whether you are selecting or deselecting objects in the viewport. In its default state, this button is not pressed, meaning that you can select objects in the viewport: the button displays a  icon, indicating that when it is pressed you will be deselecting objects in the viewport. The use of this toggle is discussed in full in the [Selecting Objects](#) section.

## Return to the Modify Toolbar

Press this button to change from the Draw Toolbar to the Modify Toolbox. This button is only active if one or more objects is currently selected in the viewport.

Visual Model automatically changes to display the Modify Toolbar whenever an object is selected in the viewport. However, if you press the  button from the Modify Toolbar to display the Draw Toolbar, you will be in a situation where the Draw Toolbar is displayed and an object is selected in the viewport, at which time this button can be used to redisplay the Modify Toolbar.



## Modifying Objects: Overview


Once an object has been drawn in the viewport, there are many ways to modify it. This chapter discusses those commands which modify an object as a whole. This includes all of the commands on the Modify Toolbar, as well as a few object modifying commands not displayed on the Modify Toolbar.

Before modifying an object, you must select that object in the viewport. When an object is selected it is surrounded by a highlighted rectangle. You may select more than one object simultaneously, and editing commands will be executed for all of these selected objects. The way in which objects are selected is discussed in the [Selecting Objects](#) section.

Remember that only selected objects will be affected by these commands: unselected objects will be ignored.

## Deleting an Object

The **Edit, Delete** command on the Menu Bar is used to delete any objects that are currently selected in the viewport. As soon as you execute this command, all selected objects are deleted.

This command differs from the Edit, Cut command (or the  command on the Modify Toolbar) in that the deleted object cannot be pasted afterwards. However, if you delete an object and then change your mind, you can always use the Edit, Undo command (or


the  command on the Modify Toolar) to get it back.


## Slicing an Object

The **Edit, Slice** command on the Menu Bar is used to cut an object into two pieces, and if desired delete one of the sliced pieces. This command prompts you to define a cutting plane that acts as a knife that cuts through the object.

If you slice a polygon, which defines a surface, the polygon is automatically closed along the slicing plane to retain the surface definition.

When you select this command, you are prompted to enter two or three points to define a slicing plane, and an optional fourth point on the side of the slicing plane that you wish to delete. If you enter two points in the viewport, the slicing plane will run perpendicular to the viewport (in and out from the screen).

After defining the slicing plane, press  or the right mouse button to complete the command. The object that you sliced is now two separate objects, and both of these objects are selected.

If you slice more than one object at a time, or slice an object such that one slice of that object now contains non-contiguous lines or polygons, all of the new objects on one side of the slicing plane are automatically grouped together. You can use the Edit, Ungroup command (or the  command on the Modify Toolbar) to break the sliced group into its constituent subgroups or objects.



## Extrude an Object


This command takes 2D objects and gives them depth along a specified path. The path that defines the extrusion direction can be defined with up to 100 depth points, and a separate scale can be set for the object at each of these points.

When you execute this command, copies of the object are scaled and positioned along the extrusion path, and a polygon mesh is created between each of these copies. Therefore the surfaces created using this command can be rendered. If the 2D object being extruded is a polygon, then this command will create a solid object, which can be manipulated using the Solids commands.

First you are prompted to specify an **origin point**. This is the first point on the imaginary path along which the object will be extruded, and around which the object will be scaled as it is extruded.

After setting an origin point, you are prompted to enter one or more **extrusion depth** points: these points, along with the origin point define the path of the extrusion. When the command is executed, a copy of the object is placed at each of these depth points, at a predetermined scale.


Note that the direction in which an extrusion is performed depends on the extrusion depth value and the direction in which the extruded object was created. For example, if you create a polygon in a counter-clockwise direction in the default XY plane and you extrude it in a positive Z direction, the extrusion direction will go back, away from the viewport. However, if the polygon was created in a clockwise direction, the extrusion will go in the opposite direction, toward the viewport. Use the Edit, Reverse command on the Menu Bar to reverse the direction of lines and polygons if desired, before extruding them.

When you are finished setting depth points, press  or the right mouse button. Now a dialog box appears and asks you to set the **Scale Factor** for the copies that are placed at each of the depth points. A scale of "1" creates a copy at the same size as the original object: values below and above 1 will reduce or increase the scale of the object as it is copied and placed at each depth point. The object will be scaled during extrusion around the origin point that you set when you began the extrusion command.

When you are finished entering the scale factors for each of the copies the extrusion is generated and the resulting geometry is displayed on the screen.




## Sweep an Object

This command, also known as a "surface of revolution" takes a 2D object and revolves it around an axis in order to create complex geometric shapes. For example, you can use the  command to create a polyline outline of one half of a bottle, then revolve this half outline around an axis of rotation that touches the open side of the outline to create a 3D bottle. Or you can define a circle and revolve it around an axis of rotation located a distance away from the edge of the circle to create a donut. If this command creates an object that defines a completely enclosed area, then that object can be manipulated using the Solids commands.

When you execute this command your object is copied in a circular path around the axis of rotation, and a polygon mesh is created between each of these copies. Therefore the surfaces created using this command can be rendered. If you want the polygons that are created as a result of this command to face outward, be sure to define the axis of rotation in the same direction as the object that you wish to sweep.

First you are prompted to set two points that are to define an **axis of rotation**. The orientation of this line in relation to the object, and the proximity of the line to the object, will affect how the completed object appears (the farther the axis of rotation is set from a circle, the larger the hole in the resulting donut). The length of the line you define is not important, but the direction in which you define the line is: to insure that the polygons created using this command face away from the center be sure to define the axis of rotation line in the same direction as you defined the entity that you are sweeping.


After setting the two points that define the axis of rotation, press  or the right mouse button. Now a dialog box appears prompting you to indicate the **Number of copies** of the object to make around the axis of revolution, and the **Total # of degrees** in which to execute the command.

The **Number of copies** that you enter determines the amount of detail in the resulting object, a consideration that becomes important during rendering. If you wish a revolved surface to appear as a smooth curve during rendering, you need to increase the number of copies. However, the higher this value, the more polygons are created, and therefore the larger your model becomes. The value you enter here should be based on the object's projected prominence in the final scene.

The **Total # of degrees** that you enter determines how far around the axis of rotation you wish to execute the command. If you wish to sweep the object in a full circle around the axis of rotation, enter 360.

When you are finished entering information in this dialog box, press the OK button to complete the command: the sweep is generated and the resulting geometry is displayed on the screen.

## Spiral an Object

This command is similar to the Sweep  command, except that it lets you specify the distance to offset the object along the axis of rotation while sweeping it around the axis of rotation. When you execute a Sweep command on a circle, the result is a donut; when you execute a Spiral command on a circle, the result is a spring. If this command creates an object that defines a completely enclosed area, then that object can be manipulated using the Solids commands.

The Spiral command is not listed on the Modify Toolbar. Instead, it is accessed by selecting **Surfaces, Spiral** from the Menu Bar.

When you execute this command your object is copied in a spiral path around the axis of rotation, and a polygon mesh is created between each of these copies. Therefore the surfaces created using this command can be rendered. If you want the polygons that are created as a result of this command to face outward, be sure to define the axis of rotation in the same direction as the object that you wish to spiral.

First you are prompted to set two points that are to define an **axis of rotation**. The orientation of this line in relation to the object, and the proximity of the line to the object, will affect how the completed object appears. The length of the line you define is not important, but the direction in which you define the line is: to insure that the polygons created using this command face away from the center be sure to define the axis of rotation line in the same direction as you defined the entity that you are spiraling.

After setting the two points that define the axis of rotation, press  or the right mouse button. Now a dialog box appears prompting you to indicate the **Number of copies** of the object to make around the axis of revolution, the **Total # of degrees** in which to execute the command, the **Total offset**, which determines how far along the axis of rotation the object is offset as it is spiraled, and the **Total scale factor**, which determines how much the scale of the object changes as it is spiraled.

The **Number of copies** that you enter determines the amount of detail in the resulting object, a consideration that becomes important during rendering. If you wish a spiraled surface to appear as a smooth curve during rendering, you need to increase the number of copies. However, the higher this value, the more polygons are created, and therefore the larger your model becomes. The value you enter here should be based on the object's projected prominence in the final scene.

The **Total # of degrees** that you enter determines how far around the axis of rotation you wish to execute the command. If you wish to spiral the object in a full circle around the axis of rotation, enter 360. If you wish to spiral it in two full circles, enter 720.

The **Total offset** determines how far away along the axis of rotation the spiraled object will travel. The value that you enter here represents the distance from the original object to the last copy of the object in the spiral. For a tighter coil, enter a lower number; for a looser coil, enter a higher number.

The **Total scale factor** determines the rate at which the object will be scaled as it is spiraled. If you enter a value of 1, no scaling will occur and each copy of the object along the spiral will be the same size. If you enter a value of 2, the final object in the spiral will be twice the size of the original object, and the copies in-between these two objects will be scaled incrementally.

When you are finished entering information in this dialog box, press the OK button to complete the command: the spiral is generated and the resulting geometry is displayed on the screen.



## Link Objects with a Polygon Mesh


The command creates sophisticated 3D objects by drawing a polygon mesh between polygons or polylines that are used as cross sections. For example, you can define a rectangle on one plane and a circle on a second plane, then create a polygon mesh that links these two objects together.


You can select as many polygon or polyline objects as you wish to include in the execution of this command, and Visual Model will generate a mesh along the path defined by the positions of these objects relative to one-another. The shape of the resulting 3D object is determined by the shape of each of these "control objects".

Objects are linked by creating a polygon mesh from the first object to the second object, then from the second object to the third, and so on. The ordering of objects has nothing to do with their proximity to one-another. Instead, the object order is determined by two factors. If all objects in a mesh command are selected together, the mesh is created according to the order in which the objects were originally created. However, if you select the objects one at a time for the execution of this command, the objects are ordered according to the order in which they were selected. This is very important to insure that the mesh is drawn between the selected objects in the direction and order that you want.

When creating objects to be linked with a polygon mesh, pay close attention to where you place the origin points for those objects, as the way in which the polygon mesh is drawn depends on the relative positions of these origin points. The origin point is generally the first point that you set for an object. However, for radius circles, ovals and arcs, the origin point is the first point you set after defining the center point.

The "first" line drawn in a mesh between two or more objects is drawn from the origin point of the first object to the origin point of the next object. Imagine that you are linking two rectangles: if the origin point of rectangle "A" is located at the upper-left corner and the origin point of rectangle "B" is located at the lower-right corner, the resulting polygon mesh will be twisted between the two rectangles, because the mesh is drawn beginning from origin point to origin point.

All subsequent lines in a mesh are drawn from the next control point in the first object to the next control point in the second object, moving around each object in the direction that object was created. Usually this means that the mesh is created in a counter-clockwise direction on each object. However, "counter-clockwise" is a relative term: the side from which you view an object determines which direction is counter-clockwise. If after you execute this command the resulting mesh doesn't make sense, press Undo  to undo the operation, then select one of the two objects and use the Lines, Reverse command on the Menu Bar to reverse the direction in which that object exists, so that when you re-execute the Link command the resulting polygon mesh is correct.

When you select  from the Modify Toolbar, a dialog box appears in which you can select to **Delete Cross Sections** and **Cap Ends**.


When the **Delete Cross Sections** button is enabled, the objects from which the mesh is defined are deleted when the mesh is created.


When the **Cap Ends** button is enabled, polygons are created at either end of the mesh to close off the resulting 3D object at both ends.





## Create a Polygon Mesh between Lines

This command generates a polygon mesh between any four connected lines or polylines. These lines define boundary of the area in which the mesh is created, and they can be oriented anywhere in 3D space: they are not required to define a planer area.


This command will only work on a completely enclosed area: therefore, be sure to create each of the lines or polylines that define the boundary such that the endpoint of one line matches the start point of the next line. You can use the Snap to Closest Point  command in the Points Toolbar to insure proper positioning while creating the line, or use the Edit, Join Points command on the Menu Bar to close gaps that may have been discovered after the lines were created.

Also note that the area in which a surface patch is created must be defined by exactly four lines or polylines (remember that a polyline includes geometry created with the Curve  and Arc

 commands, and addition to the Line

 command). If you have defined an area using more or less than four lines or polylines, use the Lines, Break Lines and Lines, Combine Lines commands on the Menu Bar to separate and combine line segments until exactly four lines or polylines exist.

If you have defined a polygon and you wish to generate a surface patch within the area that it encloses, you must first use the Lines, Convert polygon to line command to change the polygon into a polyline, then separate and combine the resulting line segments until exactly four polylines exist. If your polygon defines a planer surface you don't need to change it into a surface patch; however, if your polygon defines a 3D surface, you must change it into a surface patch (which defines the area in a mesh of 2D surfaces) in order to make that surface a renderable entity.

Before you execute this command you must select exactly four adjoining lines or polylines in the viewport that define a closed area. Then, when you select the  button, you are prompted to specify the **Polygon Density** for the mesh, as well as the **Tolerance** for points that are not joined.

The **Polygon Density** value you enter here determines the density of the polygon mesh that makes up the surface patch. The higher the number you enter, the more smoothly flowing the surface will appear during rendering; however, the higher this value, the more polygons are created, and therefore the larger your model becomes. The value you enter here should be based on the object's projected prominence in the final scene.

The **Tolerance value** determines how "forgiving" the command is to points that are not joined together. Normally, you can only generate a mesh within an area that is completely enclosed: any "holes" in the boundary will prevent the command from working. However, the Tolerance value allows you to work with lines that may not be exactly connected: the higher the value you enter here, the larger the gap that can exist between two lines. Obviously, as you increase the Tolerance, you risk getting unexpected results.

Select the **Delete Control Lines** button to delete the lines that defined the mesh area, after the mesh is created. It is important to delete the control lines if you plan on rendering the polygon mesh.

After setting the desired values in this window, press OK to complete the command, and a surface patch is generated between the four selected lines or polylines.

If Visual Model is unable to generate the surface patch, it is due to one of the following:

The area defined by the lines and polylines is not completely closed (gaps exist between one or more of the entities). Increase the Tolerance value in the Mesh dialog box or use the Edit, Join Points command to compensate.

The area is defined by more than or less than exactly four lines or polylines. Use the Lines, Break Lines and Lines, Combine Lines commands to regroup line segments such that only four polylines exist.

The area is defined by a polygon. Use the Lines, Convert Polygons to Lines command, then break and combine the resulting polyline until four polylines exist.




## Copy an Object Along a User-Defined Path

Generate a series of copies of an object and arrange them in a path that is defined by another object. This command requires that you select two objects in the viewport: a "copy" object and a "path" object. Any polyline, polygon or 3D object can be used as the "copy" object, and any polyline or polygon can be used as the "path" object.

The "path" object describes the direction and interval at which each copy of the "copy" object will be placed. The copies are placed at the control points in the "path" object. For example, if the path object is a polyline or polygon, copies are placed at each point that defines a line segment. If the path is a curve, however, a copy is placed at each line segment on the curve, which usually results in many copies placed very close together.


The "copy" object is duplicated and its copies positioned according to the control points on the "path" object. By default, copies are placed such that the midpoint of the "copy" object intersects the path. These copies are oriented on the path so that the path runs through the Z axis perpendicular to the XY plane on each copy. However, because the path usually changes direction at a control point, the direction of the path before and after the control point is averaged and the "copy" object is oriented accordingly.

It is extremely important to pay attention to the plane and direction in which a "copy" object is created. If the "copy" object is a 2D object to be used as a cross section, be sure to create this object flat on the XY plane, which is the default plane of the main viewport. If you have changed the rotation in the main viewport, you can reset it to the XY plane using the View, Change View Settings command and setting the X Rot and Y Rot values to 0. If the "copy" object is a 3D object, be sure that it is oriented in space such that the Z axis runs through the object in the direction that you want that object to be placed along the path.

When you select this command you are prompted to set a point on the object that you wish to use as the path over which the other object will be repeated. This allows Visual Model to distinguish the path object from the object to be copied. Use the Snap to Closest Point  button on the Points Toolbar to define a point that exists on the path object.

After setting a point on the path object, press  or the right mouse button, and a dialog box appears.

When the **Normalize Cross Section** button is selected, the size of each "copy" object is adjusted according to the angle at each control point in the path so that if a line were drawn from a position on one copy to the same position on the next copy, that line would be parallel to the path. This option is important if you are using the Link Cross Sections option to create a polygon mesh out of the resulting set of copies.

When the **Link Cross Sections** option is enabled, this command creates a polygon mesh, using the copies as cross sections,. This option will only work when the "copy" object is a 2D polygon or polyline. Enabling this option is the same as executing a Link  command over the copied objects along the path.

The **Scale** type-ins allow you to determine the scale of the last copy in the path in relation to the first copy, which is the same scale as the original "copy" object. If this value is 1 then all the copies are the same size as the original. If this value is 2, the last copy in the line will be twice as large as the original, and the scale of each of the copies in-between will increase progressively from the original object to the final copy in the path.


The **Offset** type-ins allow you to determine the position at which the "copy" object is placed onto the path. As mentioned earlier, the "copy" object is centered on the path by default. Change the offset values to modify the position of the copy on the path.



## Copy an Object Along a Straight Line

Generate a series of copies of an object and arrange them in a line. This command is useful when you need to position copies of a polyline, polygon or 3D object at even intervals. For example, you can use this command to place a series of columns in a line for a building.

When you select this command you are prompted to set two points in the viewport. These two points represent the path along which the copied objects will be placed, as well as the points around which the objects will be scaled, if a scale factor is specified. In addition, the distance between these two lines represents the incremental distance between objects: the length of the line defines the distance between each copy of the object.

After setting the two points that represent the path along which the copied objects are placed, press  or the right mouse button. A dialog box now appears prompting you to specify the desired **Number of copies** and the **Total scale factor**.

The **Number of copies** type-in indicates the total number of times the object will be copied. Each copy will be placed along the line that you drew in the viewport at a distance determined by the length of that line.

The **Total scale factor** determines the scale of the last copy in the line in relation to the original object. If this value is 1 then all the copies are the same size as the original. If this value is 2, the last copy in the line will be twice as large as the original, and each of the copies in-between will increase progressively from the original object to the final copy.

Note that position of the copy line relative to the original object determines how the copies are positioned. This is especially important if the objects are scaled as they are copied, as they are scaled around this line.

When you are finished entering information in this dialog box, press the OK button to complete the command: the object is copied and those copies are placed according to your specifications.

## Copy an Object Around a Circle

Generate a series of copies of an object and arrange them around a specified axis of rotation. This command is useful when you need to position copies of a polyline, polygon or 3D object at even intervals around a common point, as is the case when creating spokes on a wheel. In addition, you can define an offset along the axis of rotation so that the objects are copied and arranged in a spiral pattern.

This command is not listed on the Modify Toolbar. Instead, it is accessed by selecting **Surfaces, Circular Repeat** from the Menu Bar.

When you select this command, you are prompted to set two points which define the axis of rotation: this is the line around which the copied objects will be placed. The length of this line is not important, but the direction is. The direction of the line in relation to the direction of the object being copied determines the direction in which object is copied.

After setting the two points that define the axis of rotation, press  or the right mouse button. Now a dialog box appears prompting you to indicate the **Number of copies** of the object to make around the axis of revolution, the **Total # of degrees** in which to execute the command, the **Total offset**, which determines how far along the axis of rotation the object is offset as it is copied, and the **Total scale factor**, which determines how much the scale of the object changes as it is copied.

The **Number of copies** type-in indicates the total number of instances will be created, including the original object. Each copy will be placed at even intervals along the axis of rotation.

The **Total # of degrees** that you enter determines how far around the axis of rotation you wish to execute the command. If you wish to copy the object in a full circle around the axis of rotation, enter 360. If you wish to copy it in two full circles, enter 720 (you would only want to enter a number greater than 360 if you define an offset such that the copied objects are arranged in a spiral).

The **Total offset** determines how far away along the axis of rotation each copied object will be placed. The value that you enter here represents the distance from the original object to the last copy of the object. For a tighter spiral, enter a lower number; for a looser spiral, enter a higher number.

The **Total scale factor** determines the rate at which the object will be scaled as it is copied. If you enter a value of 1, no scaling will occur and each copy of the object will be the same size. If you enter a value of 2, the final copy of the object will be twice the size of the original object, and the copies in-between these two objects will be scaled incrementally.

When you are finished entering information in this dialog box, press the OK button to complete the command: the object is copied and those copies are placed according to your specifications.





## **Assign an Object to a Layer**

Assign any currently selected objects to the current layer. The current layer number and name is displayed in the Status Bar: as soon as you select this button any objects that are selected in the viewport are assigned to this layer. This is the same as selecting the **View, Set layer** command on the Menu Bar. To change the current layer, use the [View, Change layer settings](#) command on the Menu Bar.


An object can only exist on one layer; therefore, assigning an object to a layer removes it from the layer on which it was previously assigned.

The use of layers is very important in organizing your work, and therefore facilitating the design process. It is also extremely important if you plan to render your models, because Renderize Live allows you to define objects and materials based on this layer information.

The use of layers is discussed in the [Organizing Your Work in Layers](#) section.



## **Group and Ungroup Objects**

The  command creates a grouping out of all of the objects that are selected at the time the button is pressed. The

 command breaks up a previously defined grouping into its constituent parts.

You are not required to group objects together for modification or movement: all selected objects are manipulated in unison, regardless of whether they are grouped together.

However, grouping becomes convenient if a series of objects are always going to be manipulated in unison: creating a group out of these objects makes it easier to select and work with them together.

In addition, you can organize your work in groups to facilitate the rendering process, because Renderize Live allows you to define objects and materials based on this group information.


The use of groups is discussed in the [Grouping and Ungrouping Objects](#) section.



## Scale an Object

Scale an object around a specified point. This is the same as the **Edit, Scale** command on the Menu Bar. You can scale the object individually in the X, Y and Z axes, or you can scale it in all 3 dimensions simultaneously. Objects can be scaled by entering values that represent scale factors, or you can scale an object dynamically in the viewport.

When you select this command you are prompted to set an origin point around which the object is scaled. When the object is scaled it will be scaled toward or away from this point, depending on whether you are decreasing the size of the object or increasing it. If you do not set a point, the object will be scaled around its center.

After setting the desired origin point, press  or the right mouse button. Now a dialog box appears from which you can select along which axis the object is resized when scaled dynamically in the viewport, and in which you can enter specific scale factors for each dimension.

The **X**, **Y**, **Z** and **XYZ** buttons determine how an object is scaled dynamically in the viewport. For example, if you select the X button, then move the pointer into the viewport and drag it with the left mouse button depressed, the object is scaled along the X axis; if the XYZ button is pressed, the object is scaled in all dimensions at once as the pointer is dragged in the viewport: this allows you to retain the original shape and aspect ratio of the object as it is scaled.

In addition to dragging the pointer in the viewport to scale an object, you can use the **X**, **Y** and **Z Scale** type-ins in the dialog box to set a new scale, where values above one increase the scale of the object in that dimension, and values below one decrease the scale of the object.

After you have set the scale of the object to your liking, press OK to complete the command.



## Rotate an Object


Rotate an object around a point or a specified axis of rotation. This is the same as the **Edit, Rotate** command on the Menu Bar. The object can be rotated dynamically in the viewport, or by entering numeric values.

When you select this command, you are prompted to set zero, one or two points.

If you do not set any points, an origin point is set at the center of the object and you can rotate the object around the X, Y or Z axes on which that point is located, or simultaneously around the XY axis defined by the point;

If you set one point, you can rotate the object around the X, Y or Z axes on which that point is located, or simultaneously around the XY axis defined by the point;

If you set two points, you are defining an axis of rotation around which the object can be rotated.


After setting the desired points, press  or the right mouse button, and a dialog box is displayed: the contents of this dialog box depend on whether you are rotating the object around a point or around an axis of rotation.

If you are rotating the object around a point, the dialog box displays **X**, **Y**, **Z** and **XY** buttons: the button that you enable here determines around which axis you will rotate the object dynamically in the viewport. After selecting the desired button, move the pointer into the viewport and drag it with the left mouse button depressed to rotate the object. In addition, you can determine the rotation along each axis in terms of degrees using the **X**, **Y** and **Z Rotate** type-ins.


If you are rotating the object around an axis of rotation, the dialog box displays a **Number of degrees** type-in. You can drag the pointer in the viewport with the left mouse button depressed to rotate the object around the axis of rotation, or you can enter the amount of rotation in degrees in this type-in.


Note: if you wish to view your object from a different angle, but you don't wish to change its orientation in 3D space, rotate the viewport display instead of rotating the object. Rotating the viewport display is described in the [Controlling the Viewport](#) section of the Visual Model Overview chapter.

## **Cut an Object**

Cut an object out of the viewport and retain it in the Windows Clipboard such that it can be pasted later using the Paste  command. This is the same as selecting the **Edit, Cut** command on the Menu Bar.


When you select this command you are prompted to set anywhere from zero to three points: the points you set here may be used when you paste the object later on.

The first point that you are prompted to set determines the object's origin; this determines where the object is placed in relation to the origin point that you set if you execute the  command later. If you do not set an origin point, then the

 command will place the object based on the origin point that was defined when the object was drawn.

The second point that you are prompted to set is a scaling point: when you paste the object you will be prompted to set a scaling point as well, and the object will be oriented and scaled according to the relative position of these scaling points. If you do not set a scaling point, the pasted object will appear in the same relative orientation and scale as the cut object.


The third point you are prompted to set defines a plane; when you paste the object you will be prompted to set a plane point as well, and the object will be placed in this plane in the same relative position as was set here. If you don't set a point to define a plane, the pasted object will be placed in a parallel plane as the cut object.

After defining the desired number of points, press  or the right mouse button to complete the command: the object will be cut from the viewport.

Note: if you wish to delete an object, and you are sure you will not want to paste it again later on, use the Edit, Delete command on the Menu Bar.

The third point you are prompted to set is the plane point: the object will be rotated when pasted such that the same relationship exists between this plane point and the object as existed between the original object and the plane point that was set when the object was cut or copied. If no plane point was defined when the object was cut or copied, the object will be pasted on a plane parallel to the original object, regardless of the plane point that you set here.

## **Copy an Object**

Copy an object in the viewport and retain it in the Windows Clipboard such that it can be pasted later using the Paste  command. This is the same as selecting the **Edit, Copy** command on the Menu Bar.

This command is the same as the Cut  command, except that the original object continues to exist in the viewport. For a description of the points that you are prompted to set with this command, refer to the Cut an Object section above.



## **The Draw Button**

Press this button to return to the Draw Toolbar so that you can draw a new object. Because the Modify Toolbar only appears when objects are selected in the viewport, you can also return to the Draw Toolbar by pointing to a position in the viewport where no objects exist and clicking the mouse button to deselect any selected objects.






## Overview


Whenever you create an object in Visual Model, you are required to set one or more points in order to define that object's shape, position and orientation in 3D space. In addition, other commands, such as setting a new viewport working plane, may require that you set points. Whenever you are required to set points the **Points Toolbar** appears to help you define points with more accuracy.


Each point has a location in 3D space, described by its X, Y and Z coordinates. The scale of the coordinate system can be specified using the View, Set Units command on the Menu Bar.


Depending on the object that you are creating, the Status Bar will display messages explaining the significance of the point that you are currently setting. When you are done setting points, press the  button or the right mouse button to complete the command. If you are not happy with the location at which you have set a point, press the

 button to undo your work: each time you press

, the next most recently set point is undone.




There are two types of commands on the Points Toolbar. The Absolute, Relative and Polar Point commands, ,

, and

, allow you to set points in terms of a specific coordinate address, or in relation to the previous point that was drawn. In these cases, you should not set the point in the viewport first: when you execute the command the point is automatically set in the viewport at the specified location.

However, all of the other commands in the Points Toolbar are used to modify the position of the point that you just set in the viewport. For these commands, you set the point first in the viewport, then execute one of these Points commands to fine-tune that point's location.


## Unsetting a Point

If you set a point and then decide to change that point's location, you can do so by pressing the  button on the Points Toolbar. When you press this button, the most recently set point is unset, and you are prompted to set it again. Each time you press  another point is unset until there are no set points, at which time pressing  will cancel the entire operation.

## **Moving a Point**

If after creating an object you need to change the position of one or more points in the object, you can do so using the Edit, Move Points and Edit, Join Points commands on the Menu Bar. These commands allow you to move the control points of an object after that object has been created.

## **Set an Absolute Point**

Set a point at a specific XYZ location in space. When you press the  button a dialog box appears and you are prompted to enter the numeric X, Y and Z coordinates for the point.


After you have entered an XYZ coordinate address, press OK to complete the command and a point is placed in the viewport at this location.

Note that this command is used to set a new point in the viewport: do not set the point in the viewport and then select this command to fine-tune its location.



## Set a Relative Point

Set a point by defining its location relative the last point you set. Basically, you are setting the point at a specific XYZ distance from the last point.


When you select the  button a dialog box appears. This box displays the XYZ location of the last point that you set, and prompts you to enter the X, Y and Z distances from that point at which you wish the new point to be set. Remember that you can enter negative or positive values here; this determines the direction from the existing point at which you wish to set the new point. After entering the desired values, press OK to complete the command.

Note that this command is used to set a new point in the viewport: do not set the point in the viewport and then select this command to fine-tune its location.



## Set a Polar Point

Set a point by defining its location relative to the last point you set. However, instead of specifying an XYZ location relative to the last point's coordinate address, you specify the plane on which you wish to set the new point relative to the existing point, as well as the distance between the two points and the angle at which to travel from the first point to set the second point.

When you select the  button a dialog box appears. First select the button indicating the plane on which this point is to be set in relation to the last point. If you select the XY button, the new point will be set on the same XY plane as the existing point. Next, indicate the Distance from last point, the distance between the two points. Finally indicate the Number of degrees, or the angle at which to travel from the last point to set the new point.


For example, if you are working in the main viewport at its default orientation where the XY plane is parallel to the plane of the viewport, and you have selected the XY button to set the new point on the same XY plane as the last point, entering an angle of 0 will set the new point directly to the right of the last point; entering an angle of 90 will set the new point directly above the last point.

Note that this command is used to set a new point in the viewport: do not set the point in the viewport and then select this command to fine-tune its location.

## Snap to the Closest Point

Move the last point you set to the same location as its nearest neighboring point. Use this command when you want a point to coincide precisely with another point in the drawing.

This command is very important to insure continuity among lines that were created with different Draw commands. It is almost impossible to set a point visually such that it exists at the same location as another point: the smallest gaps between points results in an open shape, and renderable faces can only be created from closed shapes.

To set a new point such that it coincides with an existing point, first set that point visually in the viewport as close as possible to the existing point (remember that you are working in 3D, so you may need to work in the **Top** or **Side** alternate viewports to set the new point's depth to match the existing point). After setting the point, select  to move it to the exact location as the existing point.

If after creating objects you discover gaps between points that you wish to be joined, you can use the Edit, Join Points or Edit, Weld commands on the Menu Bar to join them.

## **Snap to the Closest Line**


Move the last point you set to the closest point on the nearest line. As soon as you select this command, the last point you set is moved such that it exists on the nearest line at the position closest to its original location. In other words, the point is moved in a direction perpendicular to the line until it is on that line.


This command insures a degree of accuracy in point placement that isn't possible when setting points visually.



## **Snap to the Closest Surface**

Move the last point you set to the closest point on the nearest planer surface. As soon as you select this command, the last point you set is moved such that it exists on the nearest surface at the position closest to its original location. In other words, the point is moved in a direction perpendicular to the surface until it is on that surface.


Remember that only polygons define surfaces. If you create an enclosed area out of polylines using the Line  or Arc


 commands, these lines do not define a surface in the area that they enclose, and therefore this command won't recognize this area. To change these polyline entities into polygons so that they define a surface, use the Lines, Convert Line to Polygon command on the Menu Bar.

This command insures a degree of accuracy in point placement that isn't possible when setting points visually.

## **Snap to Center of the Closest Surface**

Move the last point you set to the center of the nearest plane. As soon as you select this command, the last point you set is moved such that it exists on the nearest plane, at the center of that plane.

Remember that only polygons define surfaces. If you create an enclosed area out of polylines using the Line  or Arc

 commands, these lines do not define a surface in the area that they enclose, and therefore this command won't recognize this area. To change these polyline entities into polygons so that they define a surface, use the Lines, Convert Line to Polygon command on the Menu Bar.

This command insures a degree of accuracy in point placement that isn't possible when setting points visually.



## **Snap to Midpoint of the Closest Line**

Move the last point you set to the midpoint on the nearest line.

This command insures a degree of accuracy in point placement that isn't possible when setting points visually.



## Welding Points

The **Edit, Weld** command on the Menu Bar is used to join points together by drawing lines between any unjoined points on adjoining objects. This command offers a simple method for closing gaps in your modeling, and it differs from the Edit, Join Points command in that Edit, Join Points repositions all of the points in a selected area of space so that they occupy the same location.


First select the objects that you wish to weld together, then select this command from the Menu Bar and a dialog box appears on which you can set the **Tolerance** of the command.

The higher the **Tolerance** value, the farther apart two objects can be and still get welded together. If you execute this command and nothing happens, try executing the command again with a higher Tolerance value until you achieve the desired result.

## Joining Points

The **Edit, Join Points** command in the Menu Bar is used to join two or more points. Usually, you want use this command to close an unintentional gap by joining two points that are in close proximity to one-another, but not actually touching (remember, even though two points may look like they're touching, they may in fact occupy slightly different coordinates in 3D space).


When you select this command you are prompted to define a rectangle: all of the control points within this rectangle will be moved to a common point. After defining the rectangle, you are prompted to set a destination point: this point determines where all of the control points within the rectangle will be move to. The destination point can exist anywhere in space, but most often you will set a point between the points that you wish to join, or even at the location of one of these points.

This command is very useful to join points of different objects together so that you get the desired results when you execute other editing commands over these objects. It is especially useful in closing gaps in an otherwise enclosed area so that you can create a polygon mesh using the  command (Surfaces, Patch on the Menu bar).


## Moving Points

The **Edit, Move Points** command in the Menu Bar is used to move one or more points in unison. This command differs from the Edit, Join Points command in that moved points retain their position relative to one-another: they are not moved to a common point.

When you select this command you are prompted to set two or three points:


If you set two points, the first point you set should be located at the point on the selected object that you wish to move (use the Snap to Closest Point  button to make sure you selecting exactly on a point on the object). The second point indicates the destination at which you wish to place the selected point.

If you set three points, the first two points define a rectangle (although you will not see a rectangular bounding box). All of the points of the selected object that fall within this box will be moved. The third point that you set will be the destination to which the upper-left point in the bounding box will be moved: all other points will be moved such that they retain the same position relative to this first point.


After setting the desired number of points, press  or the right mouse button to complete the command.

## Rounding Corners

The **Lines, Round Corner** command on the Menu Bar allows you to trim a hard corner such that it is now rounded. This corner can be defined by any two combined lines. Polyline and polygon segments are defined as combined lines; if you need to combine two separate lines, use the Lines, Combine Lines command before executing this command.

After you select this command you are prompted to set a point at the corner that you wish to round off. Be sure to use the Snap to Closest Point  button to set the point exactly on the desired corner.

Next you are prompted to set a second point at a distance from the first point: this represents the radius of the circle that defines the rounded corner. The larger the radius, the more rounded the corner will be (the farther away from the original corner point the rounding off will begin).


When you have set the desired corner and radius points, press  or the right mouse button to complete the command.



## Cutting Corners

Use the **Lines, Cut Corner** command to cut off the corner defined by any two combined lines. It is similar to the Line, Round Corner command except that it replaces the corner with a straight line instead of an arc.


Polyline and polygon segments are defined as combined lines; if you need to combine two separate lines, use the Lines, Combine Lines command before executing this command.

After you select this command you are prompted to set a point at the corner that you wish to cut off. Be sure to use the Snap to Closest Point  button to set the point exactly on the desired corner.

Next you are prompted to set a point that represents the point on the cutting line. The selected corner will be cut along a line that passes through this point, and this cutting line will always be oriented such that it intersects each of the combined lines at an equal distance from their common corner point.

## Breaking Lines

The **Lines, Break Lines** command is used to separate polylines or polygons into individual line segments. This command does not change the position or orientation of any points on the lines: it simply breaks them down into their constituent parts.


It may be desirable to use this command in conjunction with the Lines, Combine Lines command to regroup line segments together to facilitate their manipulation. A common use of this command is to break and combine lines such that exactly four polyline segments exist to define a closed 3D surface, at which time the Surface Patch  command can be used to generate a polygon mesh in the enclosed area.

As soon as you select this command, the lines that make up all of the highlighted objects are broken into separate entities. The bounding box that surrounds an object to indicate that object is selected will be replaced by a series of smaller bounding boxes, each one surrounding an individual line segment. Objects that are broken apart using this command can be recombined into their original state using the Lines, Combine Lines command. When you use this command to break a polygon into its constituent line segments, the polygon is converted into a series of lines, and therefore no longer defines a renderable surface. However, you can use the Lines, Combine Lines command to combine these lines back together, then use the Lines, Convert Line to Polygon command to make it a polygon again such that it defines a surface.

When you use this command to break a curve into many separate line segments, the control points that defined the curve originally are replaced by new control points that define each line segment.

## Combining Lines

The **Lines, Combine Lines** command is used to join individual line segments into a single polyline segment. This command does not change the position or orientation of any points on the lines: it simply joins together all lines that share common endpoints.


It may be desirable to use this command in conjunction with the Lines, Break Lines command to regroup line segments together to facilitate their manipulation. A common use of this command is to break and combine lines such that exactly four polyline segments exist to define a closed 3D surface, at which time the Surface Patch  command can be used to generate a polygon mesh in the enclosed area.

This command is also useful to join together a series of lines that define an enclosed area such that the resulting polyline can be converted into a polygon to make the enclosed area a renderable surface.


As soon as you select this command all adjoining selected lines are combined together to form a single polyline segment.


## Converting Polygons into Lines

The **Lines, Convert polygon to line** command converts a polygon into a polyline. The main difference between these two entities is that a polygon defines a renderable surface, whereas a polyline does not.

You may wish to execute this command on a polygon before executing an ,

 or

 command, to make sure that the resulting 3D object doesn't have a cap.

You can also use this command to change a 3D polygon (remember that 3D polygons cannot be rendered) into a polyline that defines an enclosed 3D area. Then you can use the Lines, Break lines and Lines, Combine lines commands to group your line entities such that exactly four polylines exist, at which point you can use the Surface Patch  command to create a renderable polygon mesh that defines the enclosed 3D area.

As soon as you execute this command any selected polygons are changed into polylines.


## Converting Lines into Polygons

The **Lines, Convert Line to polygon** command converts a group of combined lines into a polygon. The main difference between these two entities is that a polygon defines a renderable surface, whereas a polyline does not.

You may need to use the Lines, Combine lines command to combine individual line segments into a polyline before you execute this command.

As soon as you execute this command any selected combined lines are changed into a polygon. If these lines do not define an enclosed area, this command will draw a straight line between the first and last points to close the area.

## Reversing Lines

The **Lines, Reverse** command reverses the direction of the lines for any selected polylines, polygons or objects. Remember that the direction of a line is important in determining the direction in which any resulting polygons may face. In addition, the direction in which a line exists affects the way polygon meshes are created when that line is used as a cross section in the execution of a Link  command.

When you select this command, the lines that define all of the objects that are selected in the viewport are reversed. Everything will appear unchanged, but the lines run in the opposite direction. For rectangles, polylines, curves and arcs, this means that the origin point (the first point that was set when the object was created) now exists on the opposite endpoint. For polygons, circles and ellipses, this means that they now exist in the opposite direction from which they were created.


## Changing Lines to Curves

The **Lines, Line to Curve** command changes a polyline into a curve. Actually, because a curve is made up of many small line segments, this command simply chops the polyline into smaller segments that curve around the path defined by the original polyline. The number of segments that a polyline is broken into depends on the **No. of Segments per Arc** setting under the File, Options menu.

This command can be executed on polylines, polygons and rectangles, to create smoother curves around control points. When executing this command on polygons and rectangles, however, the polygon is changed into a polyline, and the curve is only created from the first control point to the last control point. The last line segment, drawn between the last control point and the first one to close the shape, is not converted to a curve, and therefore ceases to exist.

## Changing Curves to Lines

The **Lines, Curve to Line** command changes a curve to a polyline.


If you are converting a curve that was created using the Curve  command on the Draw Toolbar, this command draws straight lines between each of the control points that were used to create the original curve.





## Manipulating Solids: Overview

Visual Model allows you to perform Boolean operations on solid objects. You can create sophisticated geometric shapes by defining two simple objects and adding, subtracting or intersecting them.


A solid is an object that defines an enclosed volume. A volume is a 3D area enclosed on all sides by polygons. In other words, for an object to qualify as a solid, it must consist of an unbroken surface made up of polygons: all of the polygons must be surrounded on all sides by adjoining polygons. Solids are created automatically when you create boxes, cones, spheres, hemispheres or cylinders using the ,



or



commands on the Draw Toolbar.

In addition, solids can be created out of simple shapes using the ,



or



commands on the Modify Toolbar to extrude, sweep, link or path an object. However, the use of these commands does not insure the creation of a solid. For example, if you extrude a closed shape that is defined by polylines, the resulting object is not a solid: the polylines do not define a surface, so the extruded object is open at both ends.

Solids are manipulated using the **Solids** commands on the Menu Bar. These commands take into account not only the polygons, but the volume of space enclosed in these polygons, as part of a solid object. Before you can execute one of these commands, you must select two solid objects in the viewport. In order for a command to take effect, at least part of these two objects must overlap.

## Adding Solids


The **Solids, Add** command on the Menu Bar combines two solids by deleting the geometry of one object that exists inside the volume of the other object. The resulting object consists of the two original objects minus the geometry that existed where these two objects intersected.

When this command is executed, all of the parts of one object that exist within the volume of the other object are deleted, and a single object is created that continues to define the same total volume.

When rendered, two intersecting objects will look the same whether or not you execute this command. However, by removing those polygons that won't be seen because they exist inside another object, you are keeping your model size down.

## Subtracting Solids

The **Solids, Subtract** command on the Menu Bar subtracts one solid from another. The resulting object consists of one of the original objects minus the volume where that object intersected the second object.

When this command is executed you are prompted to select the object that you wish to subtract: use the Snap to Closest Point  command to select a point that exists uniquely on the object that you wish to subtract. The object that you select to subtract is deleted in its entirety: in addition, the volume where this object intersects the other object will be deleted as well, changing the shape of the remaining object.

## Intersecting Solids

The **Solids, Intersect** command on the Menu Bar deletes all parts of the two objects that do not intersect. The resulting object encloses the volume that the two original objects shared. In a sense, this command is the opposite of the Solids, Add command.

When this command is executed, the two objects are deleted except where they intersect. The resulting object at the area of intersection is a solid that encloses the entire area where the two objects originally intersected.



## Menu Bar Command Summary

This section lists each Menu Bar command and indicates the chapter or section in which you will find the command description.

### The File Menu

**New** Delete current work and begin a new model.

Open

Save

Save as

Merge

Load Background

Options

**Exit:** Exit the software.

### The Edit Menu

Undo

Redo

Cut

Copy

Paste

Delete

Group

Ungroup

Join points

Move points

Slice

Scale

Rotate

Select All

Deselect All

### The Lines Menu

All of the commands in this menu are described in the [Editing Points and Lines](#) section.

### The Draw Menu

All of the commands in this menu are described in the [Drawing Objects](#) section.

### The Surfaces Menu

All of the commands in this menu are described in the [Modifying Objects](#) section.

### The Solids Menu

All of the commands in this menu are described in the [Modifying Solids](#) section.

## **The Points Menu**

All of the commands in this menu are described in the [Setting Points](#) section.

## **The View Menu**

[Change view settings](#)

[Set working plane](#)

[Reset working plane](#)

[Pan/Zoom](#)

[Rotate](#)

[Set layer](#)

[Change layer settings](#)

[Snap grid](#)

[Grid size](#)

[Toggle background](#)

[Show units](#)

[Show delta](#)

[Quick render](#)

## **The Help Menu**

These common Windows options are self-explanatory.





# Drawing Objects

[Drawing Objects: Overview](#)

[Using the Draw Commands](#)



[Draw a Line](#)



[Draw a Polygon](#)



[Draw a Rectangle](#)



[Draw a Box](#)



[Draw an Arc](#)



[Draw a Curve](#)



[Draw a Circle by Radius](#)



[Draw a Circle by Diameter](#)



[Draw an Ellipse](#)



[Draw a Cone](#)



[Draw a Sphere](#)



[Draw a Hemisphere](#)



[Draw a Cylinder](#)



[Paste an Object](#)



[Undo an Operation](#)



[Redo an Operation](#)



[The Pan/Rotate Toggle](#)



[The Add/Remove Toggle](#)



[Return to the Modify Toolbar](#)




# Modifying Objects

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[Deleting an Object](#)

[Slicing an Object](#)


 [Extrude an Object](#)

 [Sweep an Object](#)

[Spiral an Object](#)


 [Link Objects with a Polygon Mesh](#)

 [Create a Polygon Mesh between Lines](#)

 [Copy an Object Along a User-Defined Path](#)


 [Copy an Object Along a Straight Line](#)


[Copy an Object Around a Circle](#)

 [Assign an Object to a Layer](#)





[Group and Ungroup Objects](#)

 [Scale an Object](#)

 [Rotate an Object](#)

 [Cut an Object](#)

 [Paste an Object](#)

 [Copy an Object](#)

 [Undo an Operation](#)

 [Redo an Operation](#)



[The Pan/Rotate Toggle](#)



[The Add/Remove Toggle](#)



[The Draw Button](#)




# Setting Points

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[Setting a Point in 3D Space](#)

[Unsetting a Point](#)


[Moving a Point](#)

 [Set an Absolute Point](#)


 [Set a Relative Point](#)

 [Set a Polar Point](#)


 [Snap to the Closest Point](#)

 [Snap to the Closest Line](#)

 [Snap to the Closest Surface](#)

 [Snap to Center of the Closest Surface](#)

 [Snap to Midpoint of the Closest Line](#)

 [The Pan/Rotate Toggle](#)



## **Editing Points and Lines**

Welding Points

Joining Points

Moving Points

Rounding Corners

Cutting Corners

Breaking Lines

Combining Lines

Converting Polygons into Lines

Converting Lines into Polygons

Reversing Lines

Changing Lines to Curves

Changing Curves to Lines





# Manipulating Solids

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[Adding Solids](#)

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## **Menu Bar Command Summary**

The File Menu

The Edit Menu

The Lines Menu

The Draw Menu

The Surfaces Menu

The Solids Menu

The Points Menu

The View Menu

The Help Menu

