Swivel 3D™

Three-Dimensional Drawing/Modeling for the Macintosh®

User's Guide

PARACOMP

Dear Customer:

Congratulations on your Swivel 3D purchase and welcome to the Paracomp family of products. You now own one of the finest graphics programs ever developed specifically for use on the Macintosh series of computers. Paracomp is dedicated to serving the Macintosh community with a wide variety of scientific and engineering oriented applications. Swivel 3D is a unique and powerful three dimensional (3D) drawing and modeling program. We have designed this program to give you both hours of fulfilling productivity plus hours of pure enjoyment.

Swivel 3D was created with the user in mind. The interface came into being after months of testing and suggestions from designers of all types. It was important to us that a very powerful 3D graphics package have an extremely intuitive environment for creating and moving objects. It was also important to us that the package had an assortment of unique and powerful features to take the creation and design process to the third dimension without the hassle normally associated with it.

Swivel 3D is the first of a new genre of graphic based drawing and modeling packages which for the first time bring mainframe capabilities to the Macintosh computers of today. Just 4 years ago I remember sitting in front of my 128k Macintosh using what was then to me the most amazing computer of the day. We have really come a long way. Today we have the Macintosh II with the power to let our imagination run wild. Paracomp is leading the way with a series of dynamic applications which can help all of us better understand, evaluate, and create in the world that we live in.

In addition to Swivel 3D, Paracomp is coming out with a number of new products. Look for Milo, Modelshop, and MacVLSI to name a few. Milo is a WYSIWYG (What-You-See-Is-What-You-Get) equation processor, which we feel is the mathematical processor of the future. Modelshop, a rapid prototyping environment for building architecturally oriented objects. The designer using Modelshop is given complete control over the conceptualization and design process. MacVLSI is a manual layout IC CAD (Integrated Circuit Computer Aided Design) package which we feel is the first serious application for use on the Mac II as a computer workstation. If you're interested in MacVLSI, call us, you will truly be amazed.

At Paracomp we listen to our customers. Upgrades to current products and future releases hinge on the feedback we receive. Your comments and suggestions are very important as we constantly upgrade our products. Of course our support and technical team is ready to help and answer all of your questions so don't be afraid to pick up the phone.

In closing, many people have lead to the success of Swivel 3D. I would like to especially thank Young Harvill for his brilliant work and determination to see it through. I would also like to thank Ann Harvill, Sean McKenna, Bill Rollinson, Laura Bauer and the complete Paracomp team for their hard work.

Thank you for your support and have fun with Swivel 3D!!

Bill Woodward
President
Paracomp Inc.
June 1988

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User's Guide Credits:

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Designed by Rollinson Design.

And special thanks to Bill Woodward and Jaron Lanier.

For Assistance with the software:

For help in solving problems or assistance with technical questions, please call Paracomp Tech Support, 415/543-3848, between 9:00 A.M. and 5:00 P.M., Pacific Coast Time.

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Table of Contents

System Requirements

The System

Swivel 3D is compatible with Macintosh Hierarchical File System (HFS) version 4.0 or later. See the section on *Color Handling on the Mac II* for special information on system requirements for color.

The Machine

Swivel 3D runs on the Macintosh Plus, the Macintosh SE, and the Macintosh II.

Archiving the Disks

Copy the Swivel 3D disks immediately and put the master disks away in a safe place. If you are not sure how to copy disks, consult the user guide that came with your Macintosh.

Choosing the Application Size

Two applications are included on the programs disk. One is for Macintosh Plus, Macintosh SE and Macintosh II systems with at least one megabyte of memory; the second is for those systems with two or more megabytes of memory. The difference between the two is the size of the working screen. Remember to back up both applications for archiving purposes. After completing this step, be sure to copy only that application appropriate for your specific system onto a working disk.

RAM Cache

On machines with less than 2 megabytes of memory, make sure that the RAM Cache setting is turned *off* —as set in the Control Panel under the Apple menu.

Installing Swivel 3D on a Hard Disk

To install Swivel 3D on a hard disk, boot the hard disk as usual and insert the Swivel 3D disk in any available drive. Open the disk, and copy the Swivel 3D application to the hard disk. You may elect to keep the demo files on floppy disks or to copy them to the hard disk as well.

Booting Swivel 3D

Open Swivel 3D from the desk top by double-clicking the arrow cursor on the application icon or by double clicking on one of the demo files.

Mac II Options

Monitors: To select color or black and white, open the Control Panel under the Apple menu and select Monitors. Select the color resolution you wish.

On a Mac II, Swivel 3D displays black and white images in the 2, 4, or 16 color modes. In the 256 color mode, Swivel 3D produces either a tonal shaded image in color, or a gray scale—if the black and white option is selected in the Control Panel.

Color Handling on the Mac II Requirements: Mac II with System 4.2 or later, Finder 6.0 or later, and Video Card with upgrade. Color is handled by the standard Macintosh interface.

- Minimum memory requirements: 1 megabyte.
- Suggested memory size: 2 megabytes or greater.

About This User's Guide

Macintosh Interface

In this *User's Guide*, it is assumed that you are already familiar with the standard Macintosh interface and that you already know how to use the mouse—to point, click, double-click and drag objects. If you have questions about these operations, consult the *User's Guide* that came with your Macintosh computer.

Learning About Swivel 3D™

There are probably as many ways to use (or ignore) a *User's Guide* as there are people using software.

If you are anxious to start, and don't want to read through the *Guide* in a systematic progression, we suggest going to the Tutorial. It takes you step by step through the basic Swivel features: creating, redesigning, linking and moving objects. The Tutorial chapter can be a companion guide to refer to as you are working.

Demo files

To get an idea of what Swivel can do, open some of the demo (demonstration) files and try moving objects on the screen. Double click on some of the objects to see how they are constructed. They can give you ideas about how to construct your own objects. Up to four Swivel documents can be open at one time. You can keep demo files open to refer to while you are working.

Swivel 3D Model Kits

(Appendix A) Model kits serve as more detailed tutorials, showing step by step how to create specific three-dimensional models.

The *Auto Horn Model Kit* takes you through all of Swivel 3D's basic features: creating objects, moving, redesigning and simple linking. It is an excellent place to start out with Swivel. The *Robot Arm Model Kit* shows you how to build models with constrained links and moving parts. *"Mr. Swivel Head"* is an advanced kit which shows you how to build and modify complex objects.

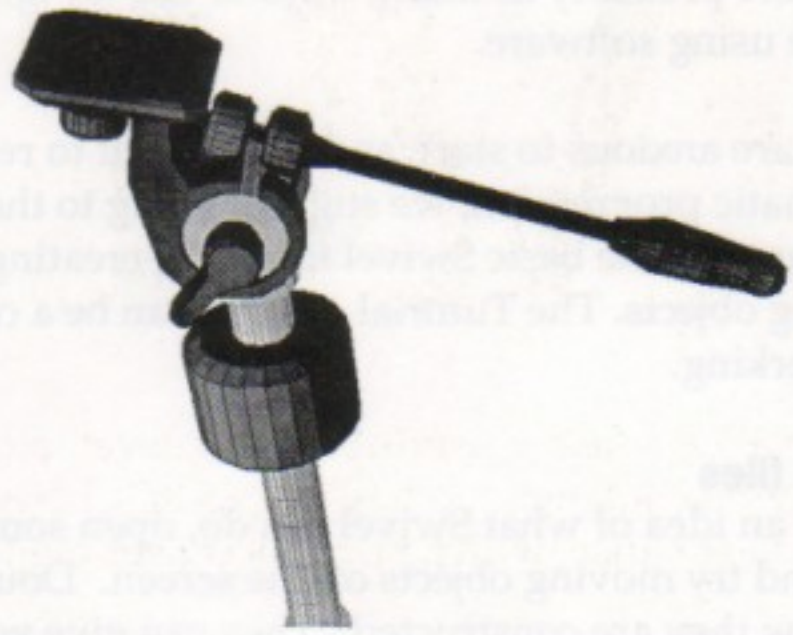
Don't Forget to Have Fun!

Take some time to just play. Start with small projects at first and progressively build up to a large project that you may have in mind.

Starting Out: A System Overview

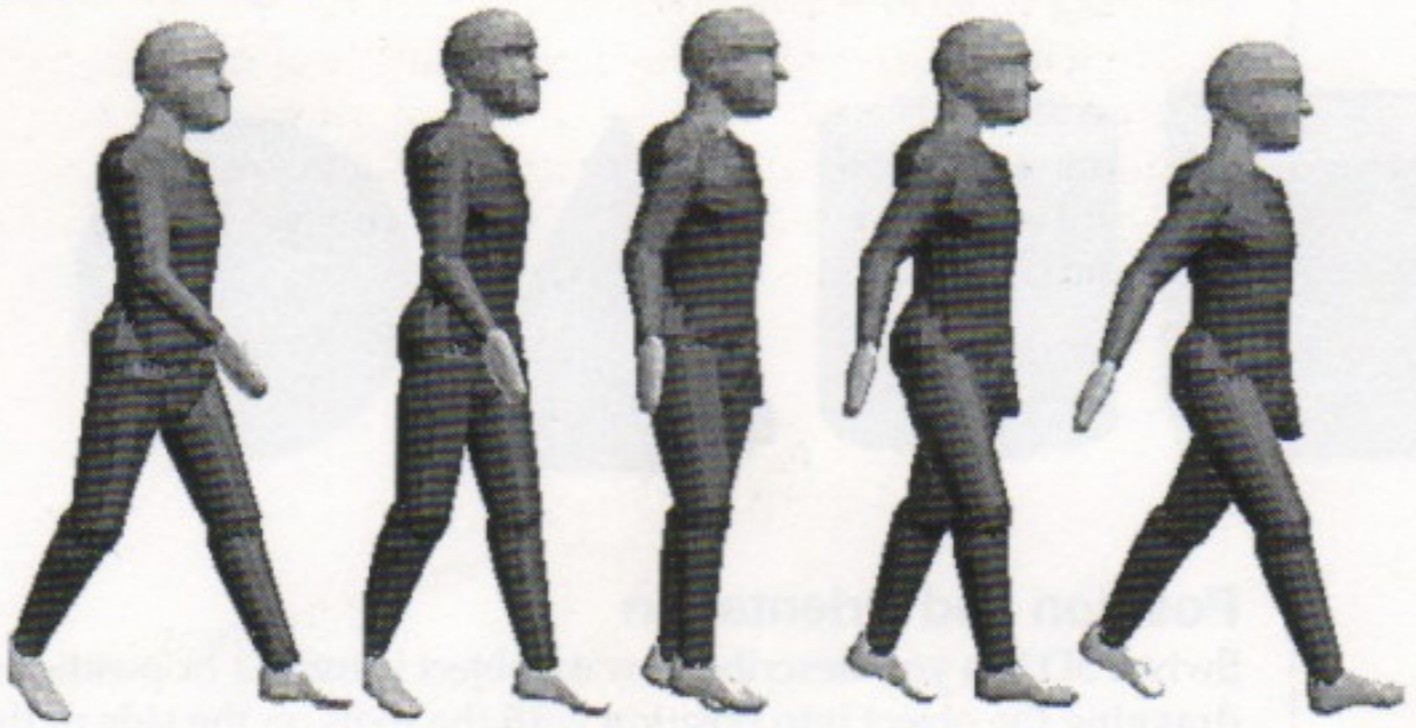
Getting to know the Swivel 3D World

Building models in Swivel is an opportunity to create your own small universe, because Swivel is a lot more than a three dimensional drawing/modeling program. It has 3-dimensional space and can move in "time" (if you consider its powerful animation capabilities.) Swivel's unique linking builds models with dynamically constrained moving parts.



As a natural, visual-thinking tool, Swivel 3D takes design concepts from ideation to presentation. A prototype can be assembled in Swivel, the interaction of its parts studied, its development documented. When it is ready for presentation, a wide range of special effects are available, including animation, special lighting or rendering options, shadowing and projected images.

Swivel 3D is compatible with almost all the great graphics programs: Take your models into VideoWorks™, Hypercard™, Pixel Paint™, Illustrator 88™, MacDraw™ and many others. The capabilities of Swivel 3D animation make graphics come alive.



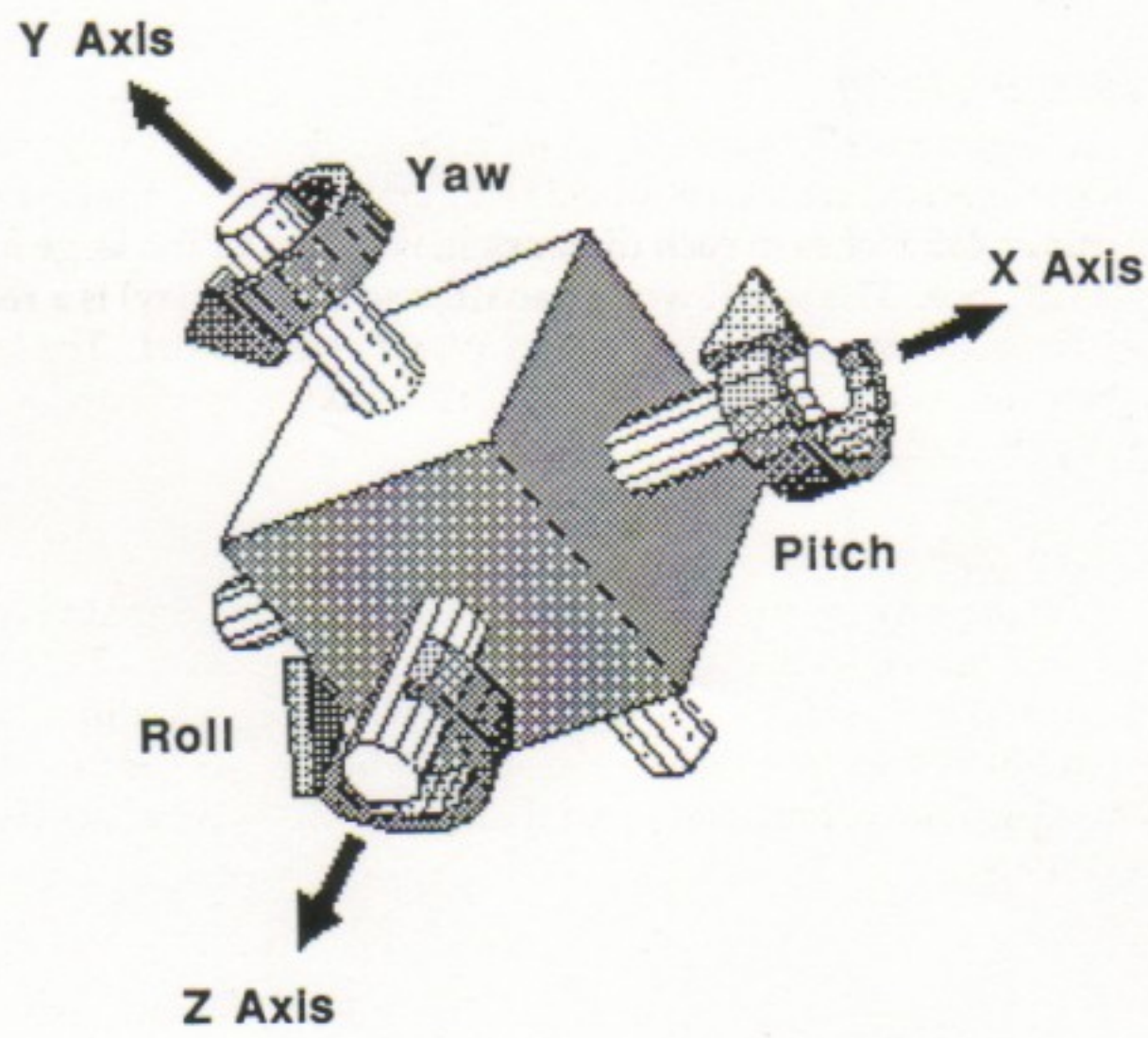
Swivel 3D is a fast, powerful tool for developing virtual environments and computer simulation models. Swivel 3D also makes it possible to build virtual instrument panels with accurately constrained range of motion.

Objects

The models that you build in Swivel 3D might consist of a single object, or they can be built from many objects linked together. Swivel constructs an object from the three cross-sections that you draw in the Design Object View.

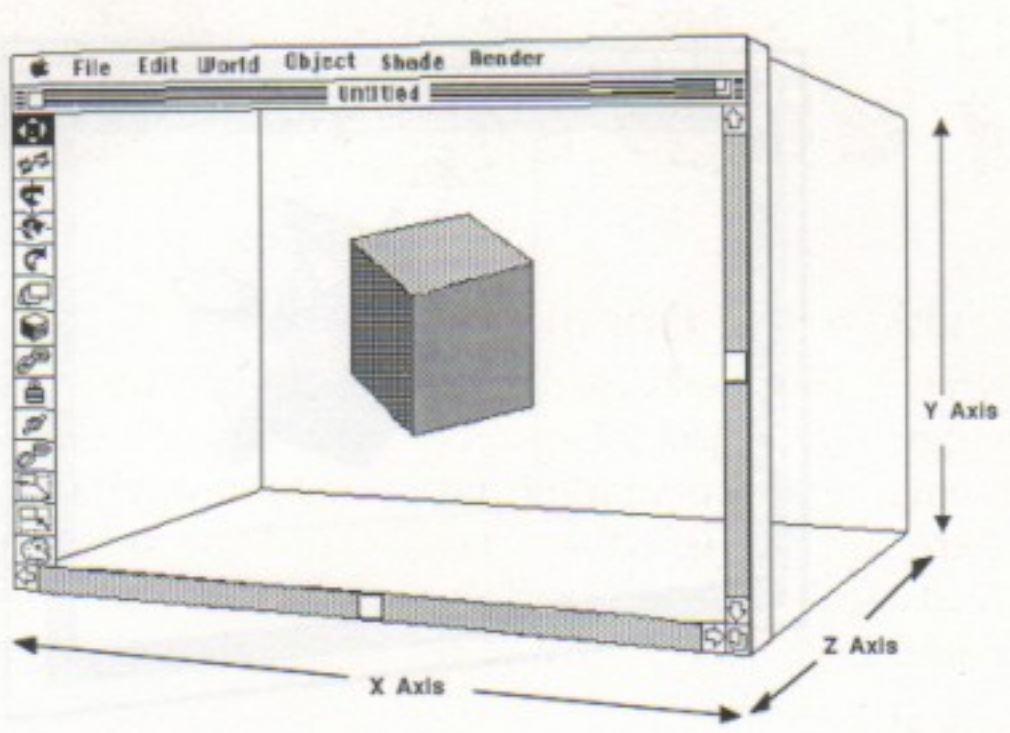
Position and Orientation

Swivel 3D lets you describe how an object is turned or positioned in two ways: (1) dragging the object into position with the tools on the side of the World View, and (2) entering its orientation and position numerically. To completely describe where an object is located in space, and how it is turned, Swivel uses six values called *degrees of freedom:* *X*, *Y*, and *Z* being the coordinates that define the *position* of the object. *Yaw*, *Pitch* and *Roll* define the object's orientation, or *attitude*.



Position is the spot in Swivel space where an object is located. An object's position can be moved in three dimensions: along the X axis (horizontal on the screen), along the Y axis (vertical on the screen), and along the Z axis, which represents depth into the screen, or out toward the viewer.

Attitude is the word used in Swivel to indicate the direction the object is facing: its orientation in space, measured in degrees. *Roll* is rotation about the Z axis; *Pitch* is rotation about the X axis; and *Yaw*, rotation about the Y axis.



The Swivel World

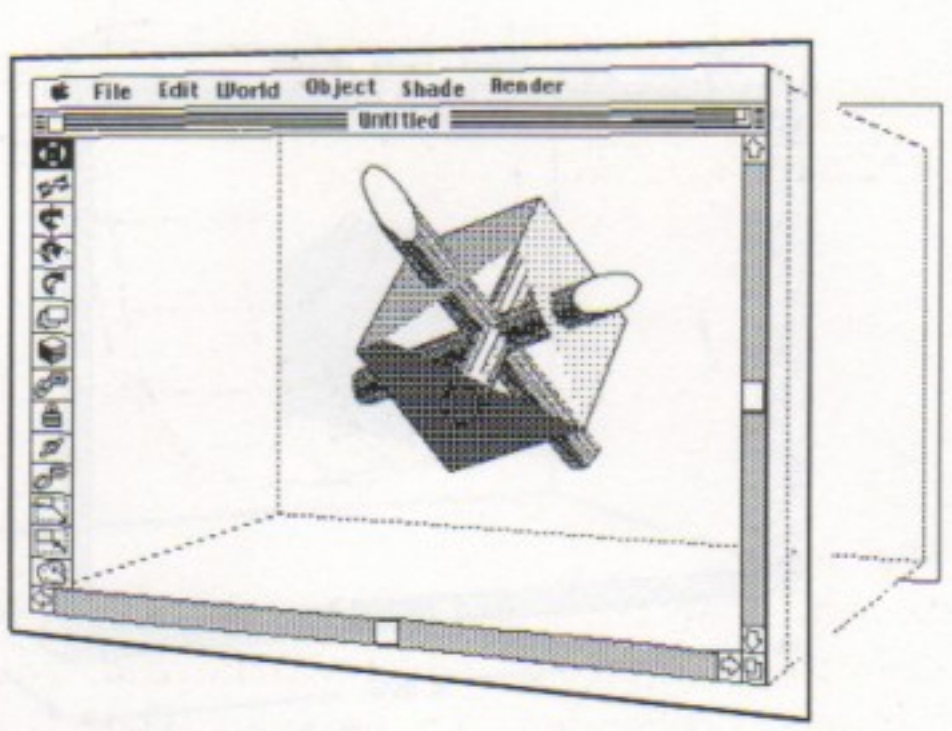
Unlike the regular world, which goes on more or less forever, Swivel 3D deals with a finite space. The Swivel world is a Cartesian three-dimensional space—plus or minus 455 inches in each dimension, which is far too large for a computer to display at once. The actual workspace (the screen display) is a rectangular box in which the active portion of the Swivel World is displayed. The front of the box is the window onto the Swivel 3D World, and the height and width are defined by the window you are using.

A World Tour

There are many ways to look at the World without changing anything in it. The World can be turned so that different sides face the window. The scroll bars at the bottom and right sides of the window allow you to pull different parts of the World into the Workspace area, without changing the size of the model. The Zoom and Unzoom commands expand or shrink the scale of the World visible in the Workspace.

Clipping Planes

Objects may go through the front or back of the Workspace and no longer be visible, though indeed *they still exist*. The front of the box is called the *Hither Clipping Plane*, as any object intersecting it will "lose" the part projecting beyond the workspace—it's "clipped" off and is not displayed. The back of the box is called The Yon Clipping Plane. When an object is pulled part way through the Hither Clipping Plane, its internal structure may be revealed as if by an X-Ray as the forward portion is clipped off—as shown in the accompanying art.



Objects disappear as they pass through the Hither Clipping Plane at the front of the Workspace, or the Yon Clipping Plane at the rear.

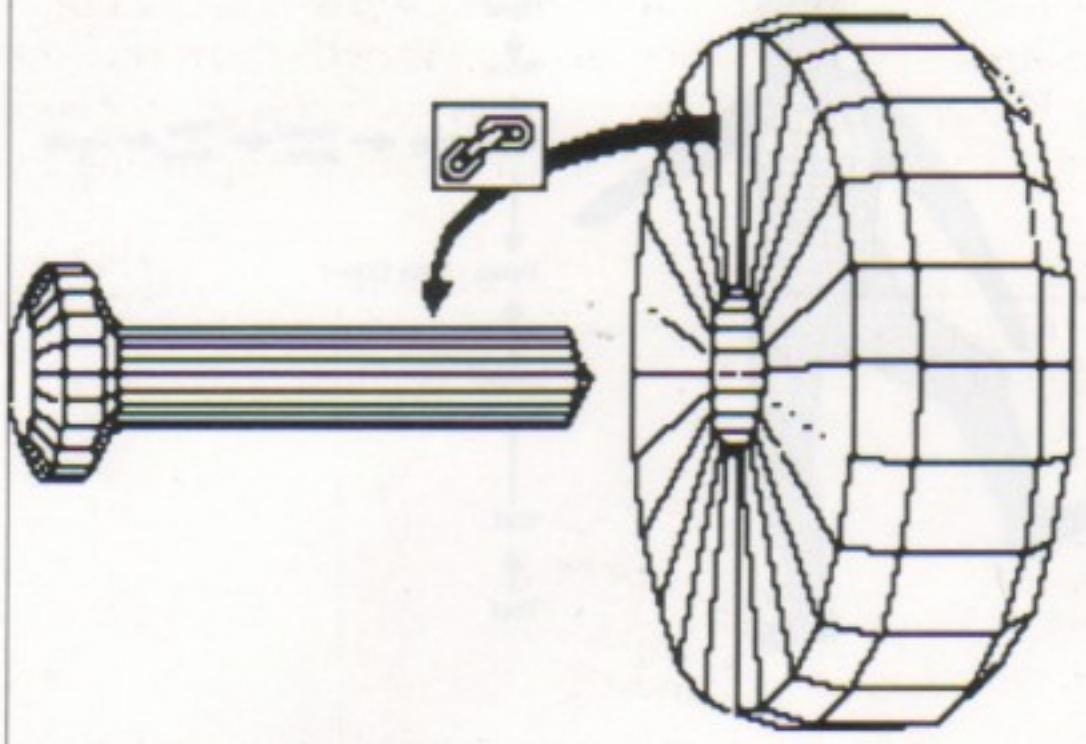
Linking Objects

One of Swivel's most powerful features is the capacity to attach objects together to form complex systems with moving parts and to build solid composite objects out of several smaller ones. Attachments in Swivel are called *Links*. A link between two objects in Swivel can affect how one object moves in relation to another. Linking also helps in aligning and adjusting the relationship between objects.

Trees

When two or more objects have been linked together, they form a tree. This is not because they look like trees (although they may), but because a tree serves as a metaphor for a certain way of connecting objects. Linked objects in Swivel, like branches on a tree, are attached to only one object for support, but may have many other objects attached to them.

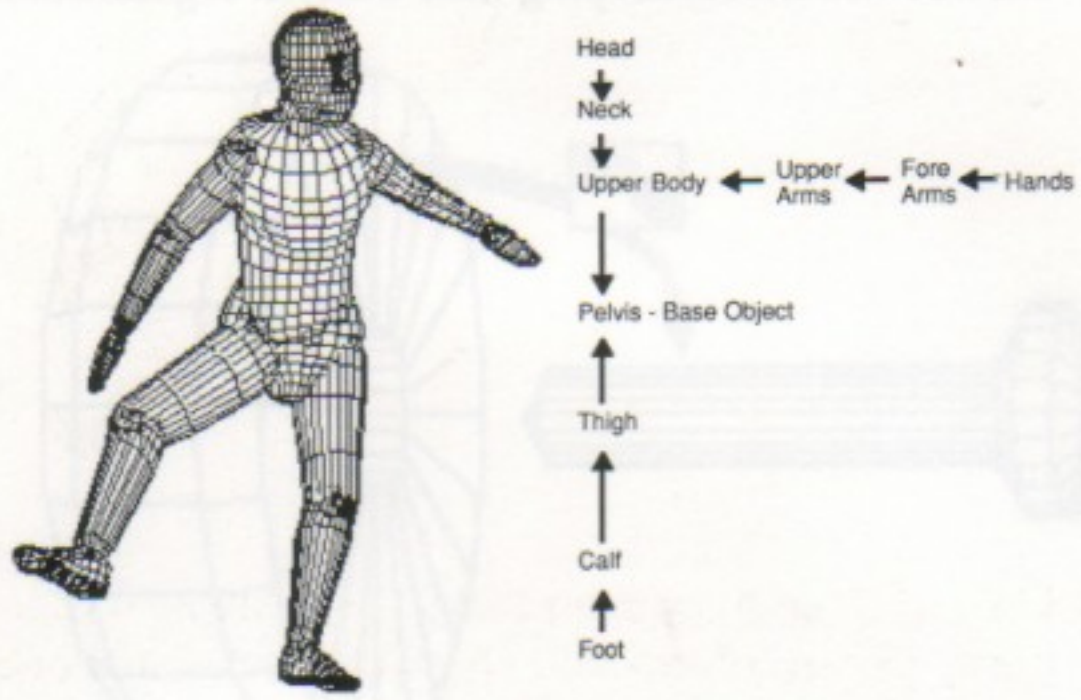
All objects start by being linked to the Swivel World. When one object is linked to another, it moves and turns whenever the other object moves and turns. If you move a base object with a series of links depending on it, all the objects in the tree will move, keeping their internal organization.



Object Hierarchy

Any time a link is created in Swivel 3D, a hierarchy is established. One of the objects is the *parent* object and the other is the *child*. The word *child* is used to denote the object's dependency on the object to which it is linked. Which role the object assumes is determined by the direction in which the link is made. To link an object in Swivel, drag the link from the child object to its new parent. A set of objects linked in a tree has a hierarchical order, similar to the way a family tree is organized. The highest level in the hierarchy is the World. The way you choose to organize linkings of swivel objects to make a given model is often suggested by the form of the model.

If you are creating a *dynamic* model, (one that will have moving parts,) the base of the object, or the part carrying the greatest mass is usually the parent for the other objects.



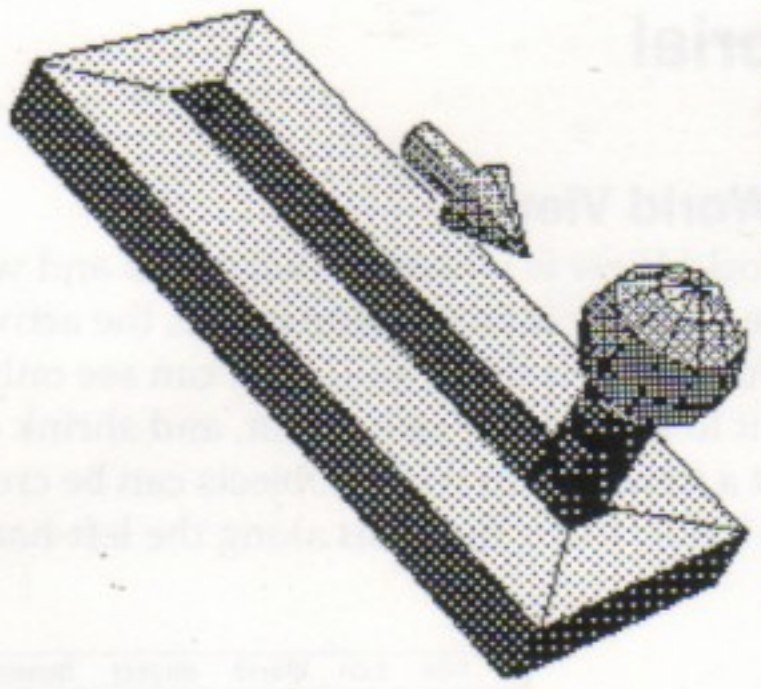
In the case of a human figure, it makes sense to begin the tree at the torso or pelvis. To create a leg, first attach the thigh to the pelvis, then the shin to the thigh, and, finally, the foot to the shin.

Up-Tree and Down-Tree

In complex linking arrangements, it is often easier to refer to relationships of many objects linked together as the *direction* they take in the system of a tree. Like a genealogical family tree, a Swivel tree grows downward. All objects in Swivel are *down-tree* from the world. When you move an object in Swivel, all objects down-tree from it are also moved. When you link an object in Swivel you drag the link from the child to the parent: that is, you drag the link up-tree. Parents are *up-tree* and children are *down-tree*.

Siblings: When objects are linked to the same parent they are called *siblings*. Siblings operate independently of one another. Unlinked, single objects are siblings in the sense that they are all linked to the World and their position, attitude, and scale are all relative to the same point.

Constraints: Links can be limited to allow different degrees of motion between two objects. Those limits are called *constraints*. You can create human forms linked to bend naturally, or *virtual* control panels with knobs that turn, switches that toggle, wheels that roll, and realistic joysticks. An object can be constrained to move a desired distance in certain directions and to be immobile in other directions.



The slider has been constrained so that it can move only to the ends of the slot. It has been locked in all other degrees of freedom.

Linking as an Alignment Strategy: Linking is sometimes used as a tool for lining up parts of a model. Once linked, the child object can be moved to a precise distance or rotated an exact number of degrees from its parent. Motion can be locked in one or more directions to allow one adjustment to be made at a time.

Opening Multiple Swivel Documents

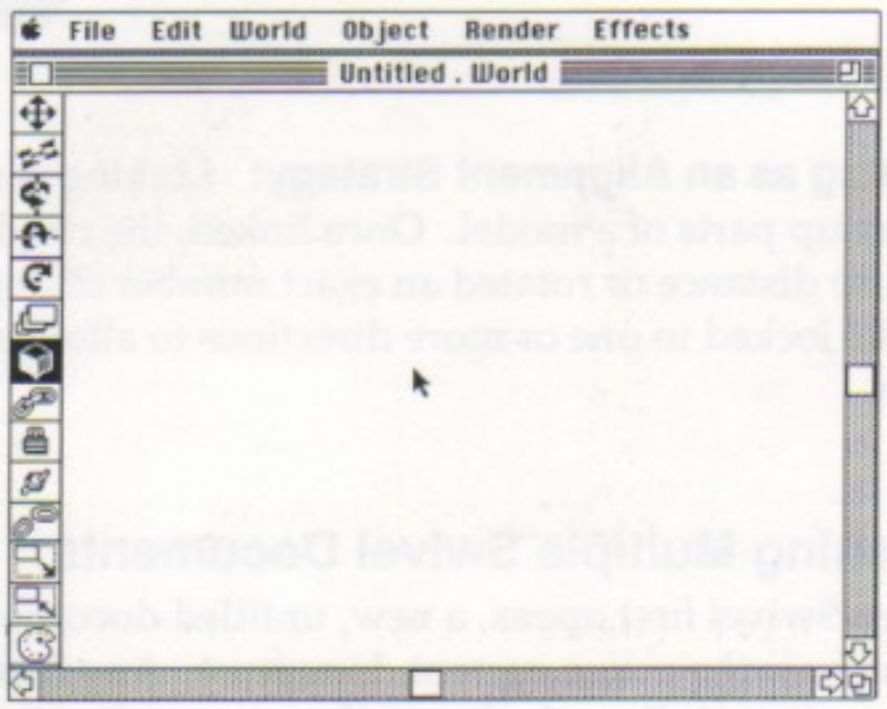
When Swivel first opens, a new, untitled document is created. The frontmost window is the active current document. Any menu choice, such as saving, closing, or printing, applies to the current document. Up to four Swivel documents can be open at one time. Objects cut or copied from one file can be pasted in another. It's a good idea to save your file regularly while you are working, and especially before printing.

A Swivel document has two views: the *World View*, which shows all the objects from the current world orientation, and the *Design Object View*, which shows the form of an individual object. Each view has a set of tools used to edit and change objects.

Tutorial

The World View

The World View is where Swivel opens and where most of the action takes place. It is the window into the Workspace, the active area of the total Swivel World. The Workspace is like a box. You can see only one side at a time, but you can rotate it to look at any viewpoint, and shrink or expand it to see as much or as little at a time as you wish. Objects can be created, moved and linked in the World View, using the tools along the left-hand side of the window.



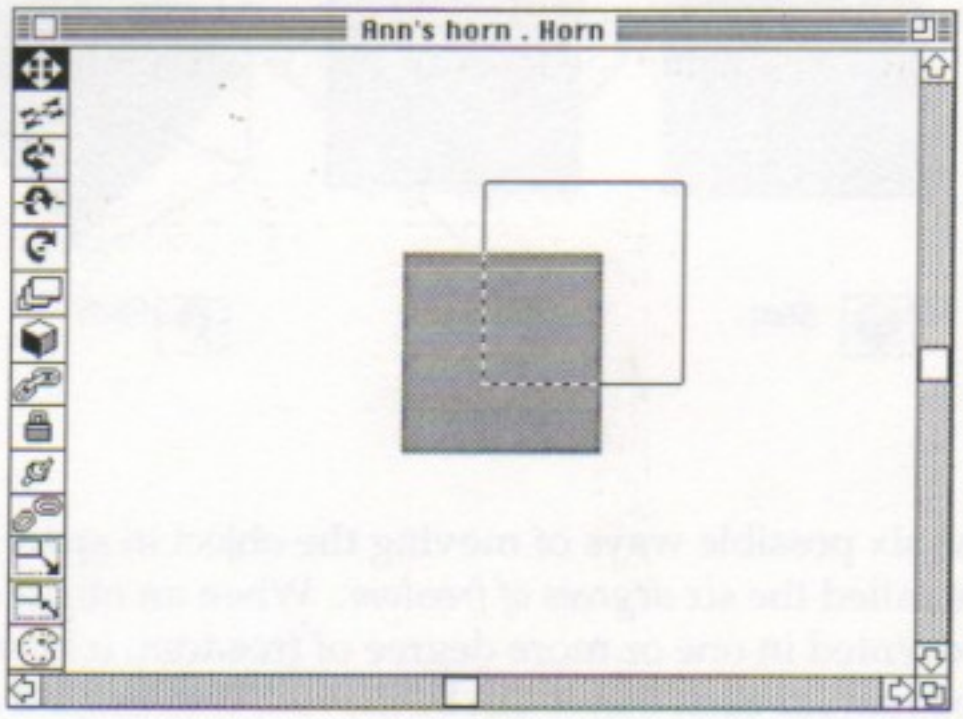
Getting a New Object

Click on the New Object Tool (see left) and then click in the spot where you want to place it. The new object will appear as a cube, with its left side facing you. Drag the new object to a new position anywhere in the plane of the screen with the *XY tool*. (see left). The XY tool is one of five Swivel 3D tools that change an object's position and attitude. After you use any tool, the current tool becomes the XY tool unless the Caps Lock key is on. When the Caps Lock key is depressed, the tool remains active until another one is selected.

Moving and Turning

Position and attitude are the two terms used to describe moving and turning operations.

The position of an object is the spot where it's located. An object's position can be moved in three dimensions: along the X axis, (horizontal), along the Y axis (vertical), and along the Z axis, which represents depth into the screen, or out toward the viewer.

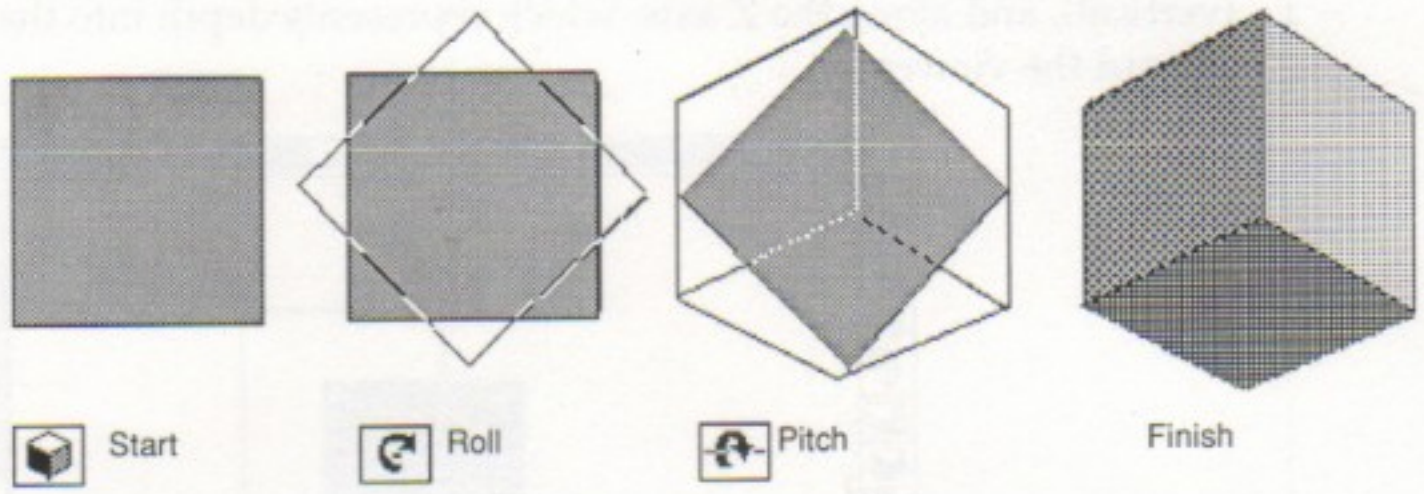


The XY tool can move the object anywhere in the XY plane. Try dragging the new object you have created, using the XY Tool. Select the *XZ tool* (see left) and push and pull the object back and forth in space by dragging with the mouse. The XZ tool moves objects horizontally as well as in and out. The icons for these tools describe the movements the object will make in response to your use of the particular tool.

Attitude is the word used in Swivel for the direction the object is facing (its orientation in space.) You can turn your object to any attitude by a series of rotations about the three axes:

- Roll—rotation about the Z axis
- Pitch—rotation about the X axis
- Yaw—rotation about the Y axis.

Try rotating your object several times in succession with the three rotation tools. The arrows on the tool icons will give you an idea of which way the object will turn with each tool.



The six possible ways of moving the object in space: *X*, *Y*, *Z*, *Yaw*, *Pitch*, and *Roll* are called the *six degrees of freedom*. When an object's motion is limited or prevented in one or more degree of freedom, it is *constrained*. Each degree of freedom for each object can be moved, constrained and manipulated separately. See the descriptions of the *Position* and *Attitude* dialogs for more advanced ways to move, rotate and constrain objects.

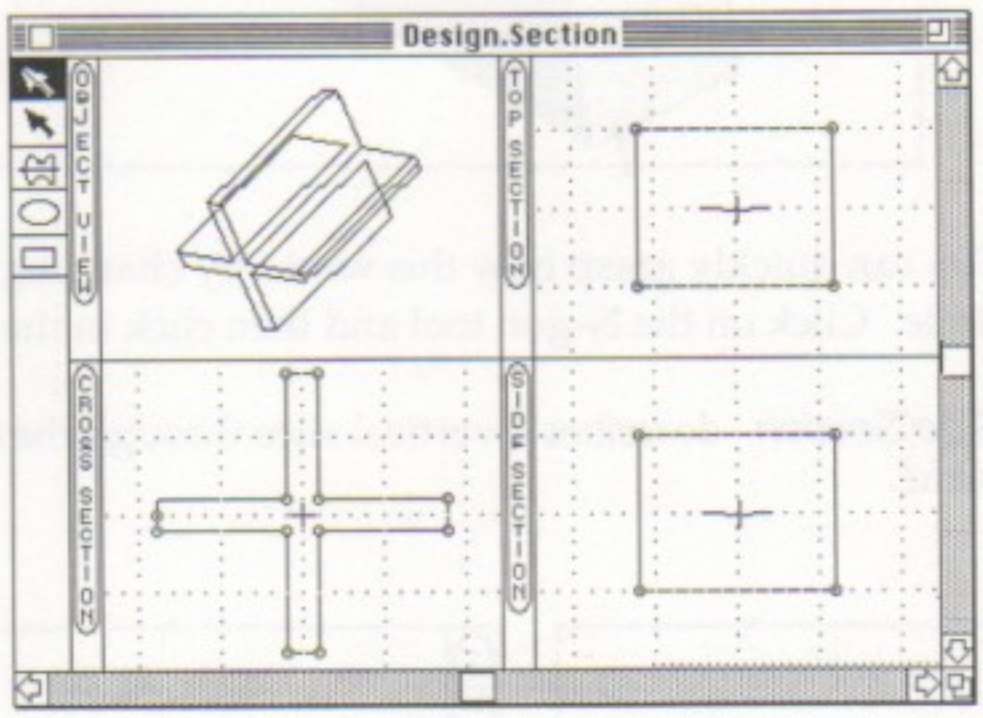
A further note about the words *Absolute* and *Relative*. Any movement in space has to be *relative* to something. Since you are creating the Swivel World, operations relative to *your* point of view are called *Absolute*. The tools for yaw, pitch and roll always turn objects as the icon arrows show, that is, their motion is relative to the screen rather than to the World.

Designing The Object

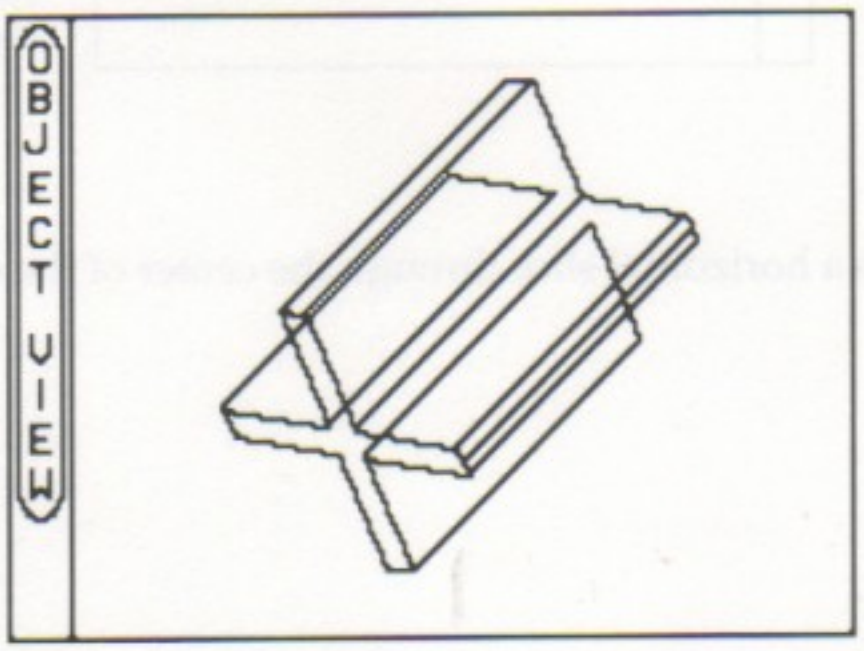
The *Design Object View* allows you to view and edit the structure of an object. This is the place where the shape of an object can be designed and changed.

The Design Object View

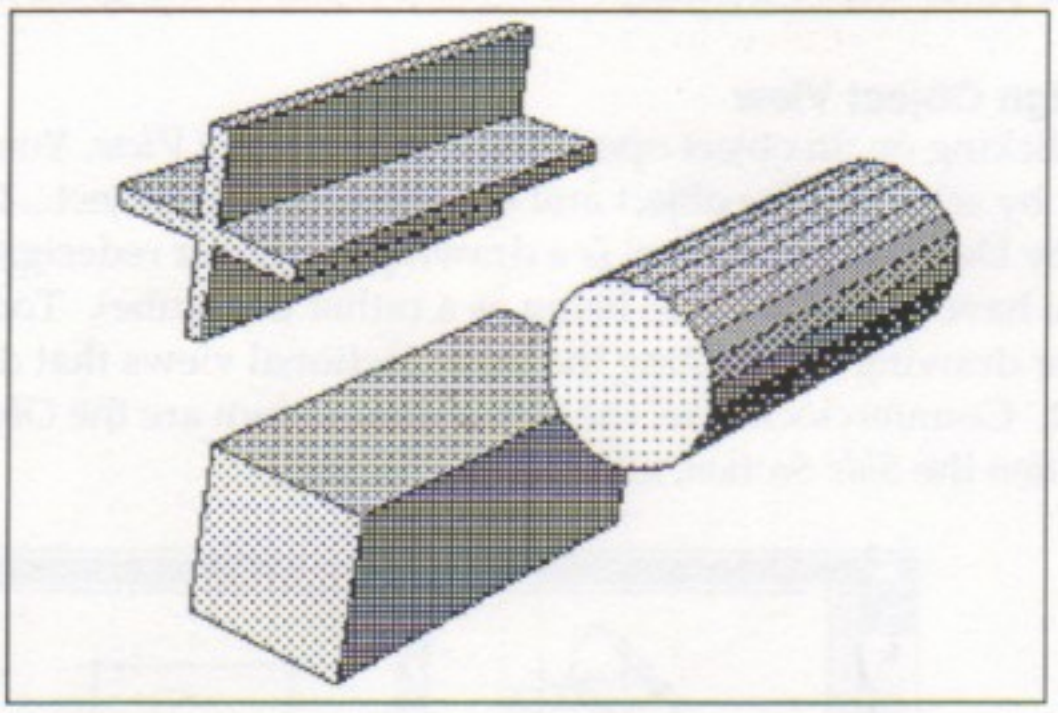
Double clicking on an object opens its Design Object *View*. You can also open this view by selecting the object and choosing Design Object... from the Object Menu. The Design Object View is a drawing board for redesigning the object (after you have brought it into being as a rather dull cube). Tools are stacked on the left for drawing and editing the three sectional views that define the shape of the object. Counterclockwise, the four views shown are the *Object View*, the *Cross-Section* the *Side Section*, and the *Top Section*.



Object View is an uneditable wireframe rendering of the object. As each change is made, the Object View redraws from the edited side's viewpoint so that you can check the effect. If the Object View itself is clicked on, it will show the object as it is in the World. The vertical button on the left of the Object View returns you to the WorldView.



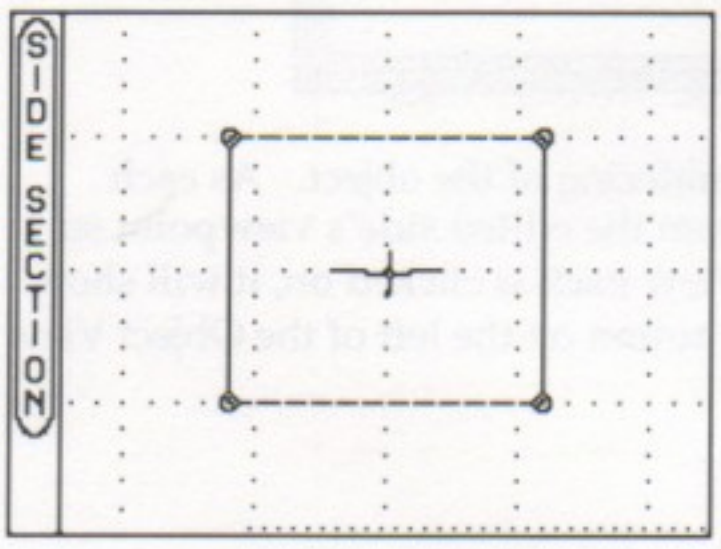
Cross Section defines the object's shape in a slice or section in the XY plane. The Cross Section stretches to fit the form created by the other two views.



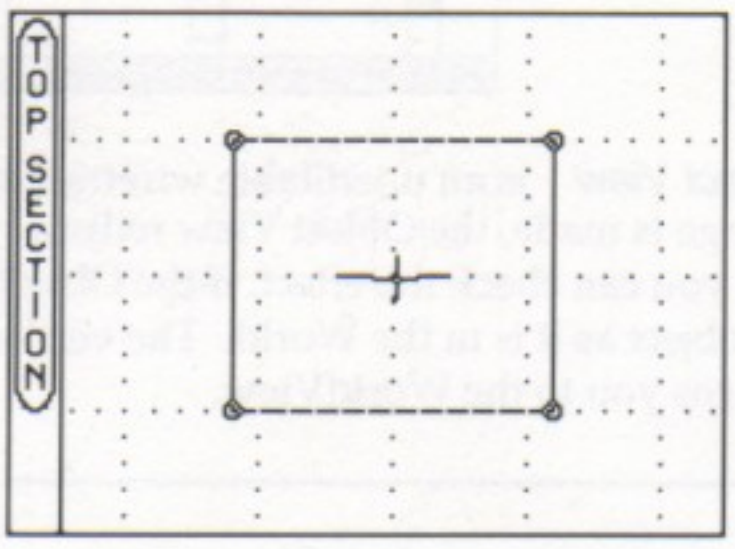
The three objects in this illustration are identical, except for their cross-sections.

You can quickly grasp how this works by changing the square Cross-Section, to a circle. Click on the N-gon tool and then click in the Cross Section View.

Side Section describes a vertical slice through the center of the object in the YZ plane.



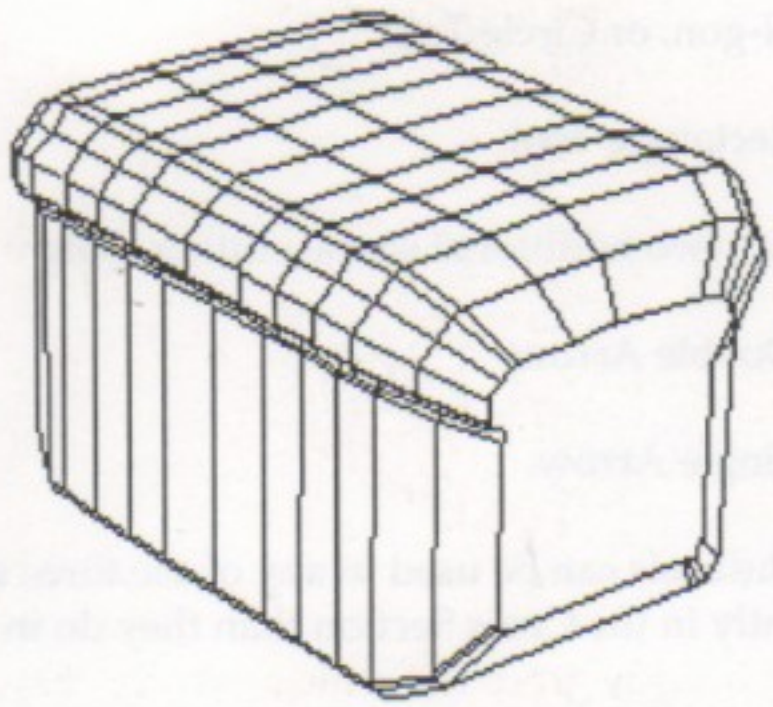
Left:
The Side Section View



Right:
The Top Section View

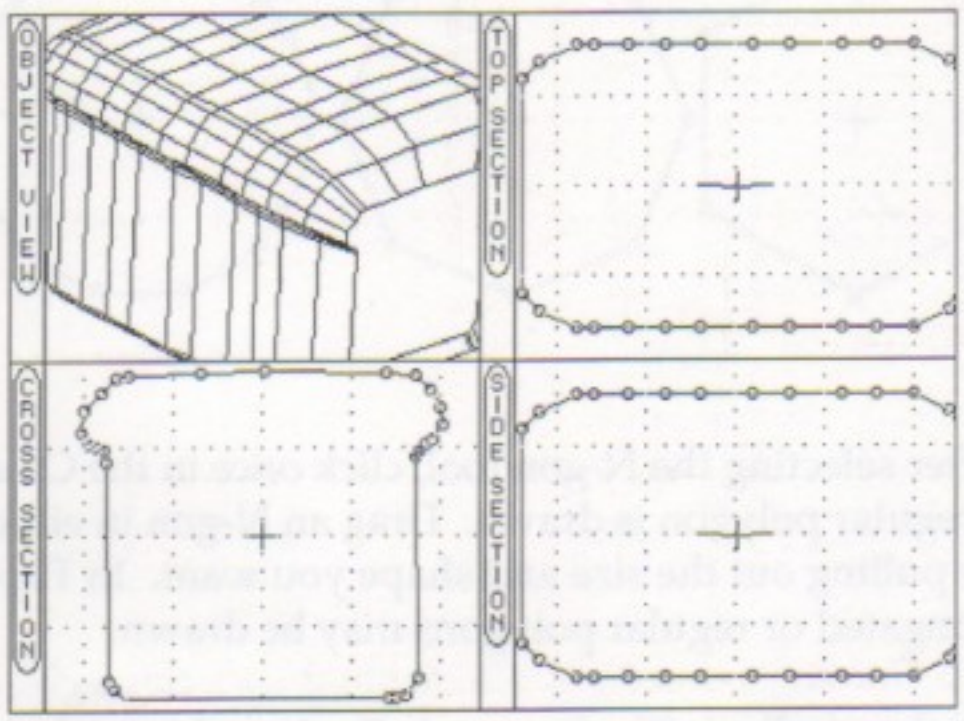
Top Section describes a horizontal slice through the center of the object in the XZ plane.

Any of the section views may be opened to the full window size by clicking on the vertical button with its name. It is useful to open a section to full size if you are describing a large shape, or if you are doing a lot of editing and do not want to wait for the Object view to update.



More About How Objects are Made

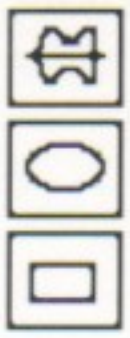
Swivel creates the object's form by stretching the Cross Section over the skeleton or framework formed by the top and side sections. If you use the standard square or circle cross sections, the *scale*, or size, of the object is determined by the side and top sections only. The Cross Section will be scaled to fit these sections.



To model a loaf of bread, first draw the cross section in the shape of a slice of bread from the loaf. The cross section determines the contour and shape of each slice of bread, but the side section determines the loaf's height (Y), and the top section sets the width (X) at a given slice along the loaf's length (Z).

Design Tools

There are three tools for creating new shapes in the Design Object View:



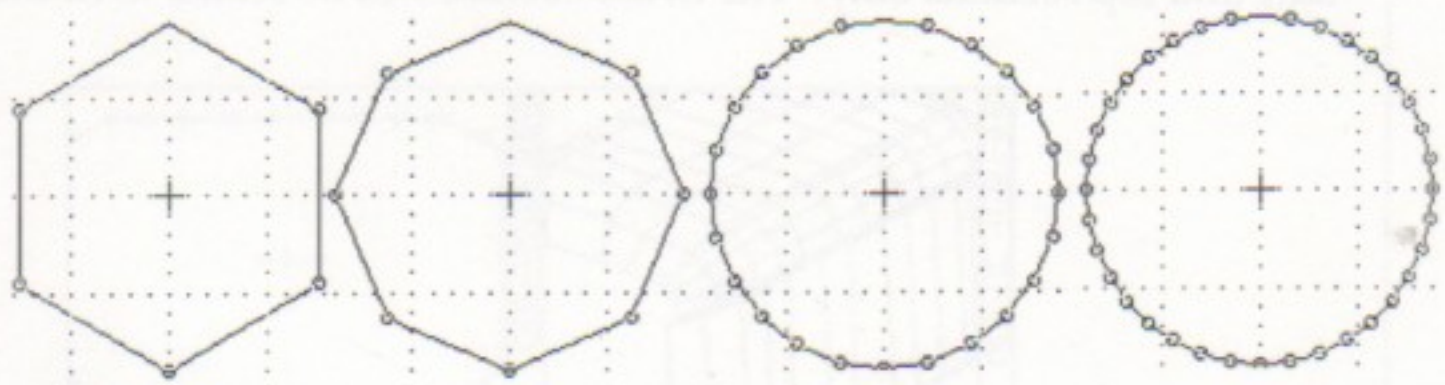
- Free Poly
- N-gon, or Circle Tool
- Rectangle tool.

There are two additional shape-editing tools:

- Double Arrow
- Single Arrow.

All of the tools can be used in any of the three section views, though they work differently in the Cross Section than they do in the Top and Side Sections.

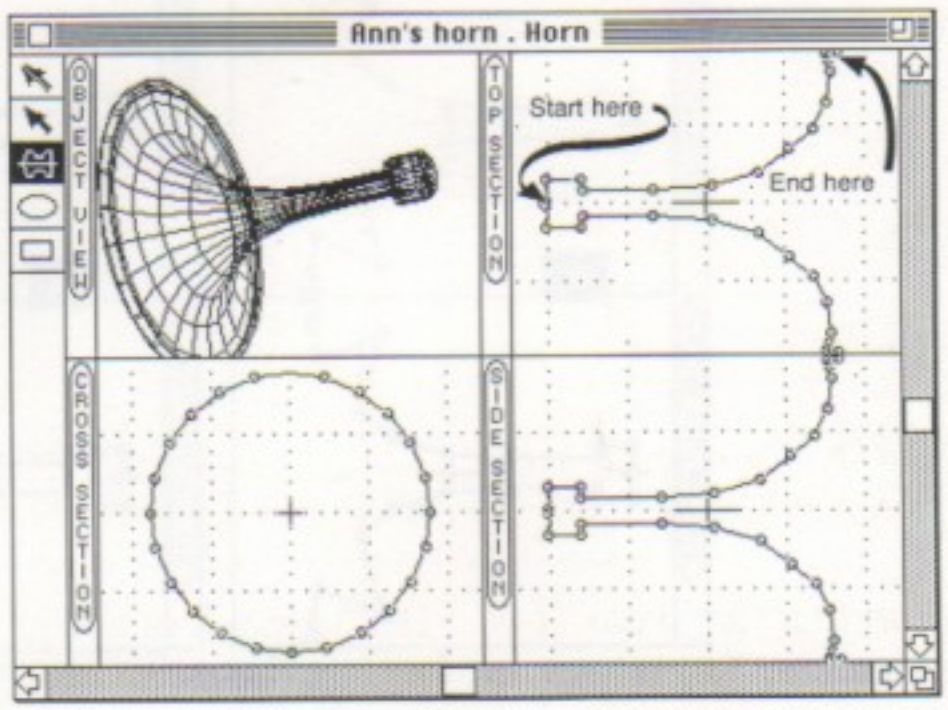
N-gon tool (or Circle Tool) The N-gon tool got its name because it draws polygons with various numbers of sides. To select a different number, double click on the N-gon icon. Illustrated are a representative samples.



After selecting the N-gon tool, click once in the Cross-Section View. In this section a regular polygon is drawn. Drag an N-gon in either Top or Side Section Views, by pulling out the size and shape you want. In Top and Side Sections, either elongated or regular polygons may be drawn.

Rectangle Tool The Rectangle Tool works much the same as the circle. In the Cross Section View, a single click will draw a regular (square) rectangle. In Top or Side Views you can drag a rectangle of any height and width.

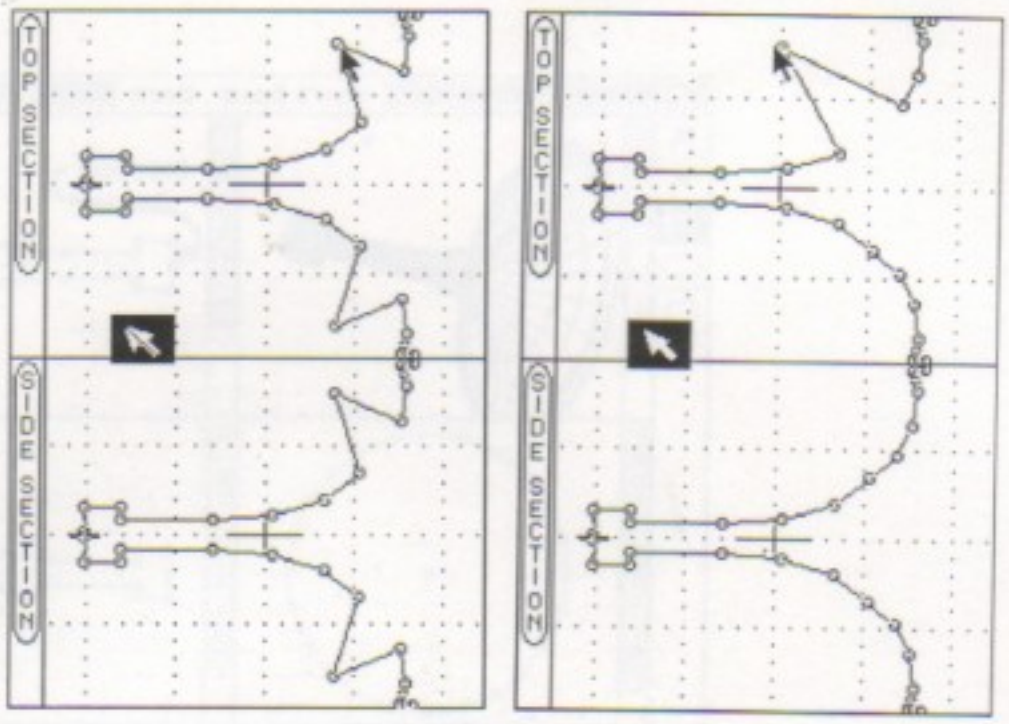
Free Poly Tool lets you draw any contour with as many or few sides as you want. Each click of the mouse will draw a single vertex, and the sides will be drawn between each point and the next. In the Cross-Section View, the Free Poly Tool draws one point at a time. The Free Poly Tool draws a symmetrical shape in both the Top and Side Views at the same time. Upon each click, a symmetrical point is drawn above and below the horizontal center line.



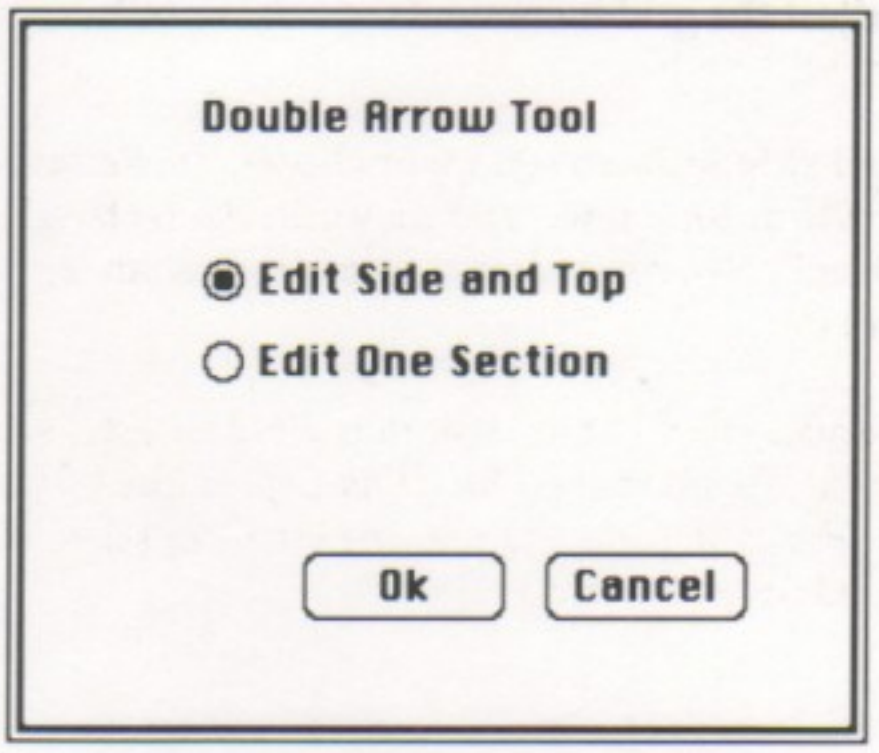
Draw Grid controls the distances between the points. If you need to make small curvatures, turn off the Draw Grid (under the Object Menu), or see the section on Grids to learn how to adjust the grid increments.

Editing the Section Views

Use the single and double arrow tools to edit and reshape the contours of each view separately. To keep the sections symmetrical, use the double arrow tool in editing the shape. Use the single arrow tool to edit one side at a time for assymetrical shapes. Pull out individual points to reshape the contour.



Double Click with the Double Arrow to decide whether to edit Top and Side Sections simultaneously or to edit one side only.



Object Types

Depending on how you use Swivel's Design Object View, you can create extruded forms, lathe forms, modified lathe forms, and complex combinations of these.

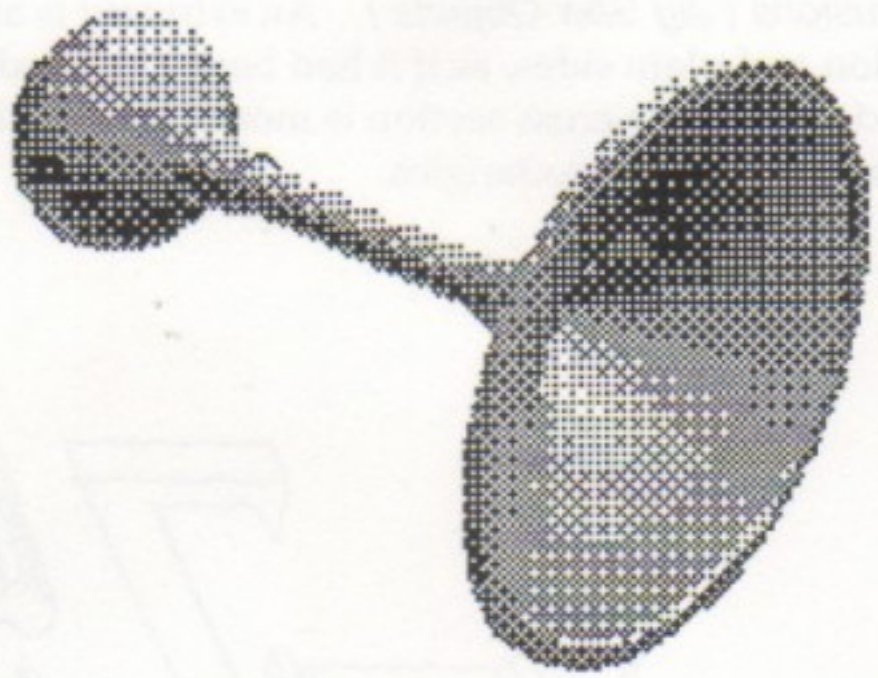
Extrusions (Jig Saw Objects) An *extrusion* is an object with a complex cross section and plain sides, as if it had been extruded through a die or cut-out with a cookie cutter. Its cross section is more complex than its side and top views, which usually are simple rectangles.

To make an extruded form, choose the *Free Poly Tool* and draw the shape to be extruded in the Cross Section View.

You can leave the top and side sections square or choose the *Rectangle Tool* and draw a rectangle in the side or top view. You may edit the rectangle to fit the final size of your extruded object. Swivel recognizes an object as an extrusion if the front and back planes are flat.

You can tell Swivel to handle an object as though it were an extrusion, even though the ends are not flat, by choosing *Draw End Caps* in the Object Form dialog under the Object Menu. For more information, see the discussion of Object Form in the section on advanced Swivel features.

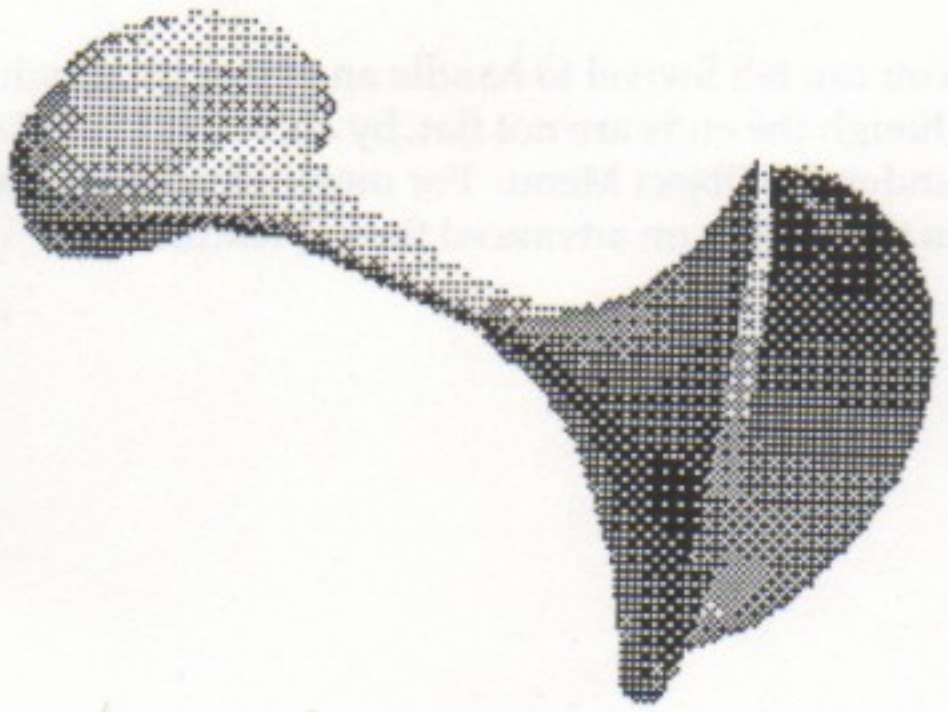
Lathe-Type Objects (Objects of Rotation) Lathe-Type objects have symmetrical side and top views with complex contours. The cross section of a lathe object is usually a circle (N-gon) or square or other simple form.



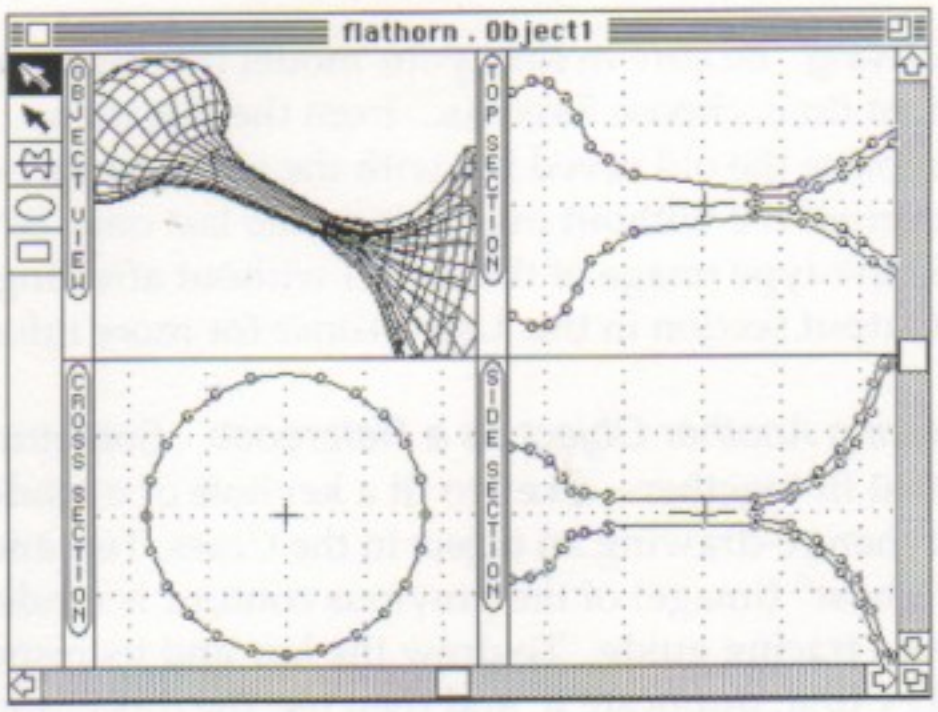
To make a lathe form, choose the Free Poly Tool and draw the symmetrical lathe form in the Side or Top Section. Start on the horizontal line at one end and follow the objects outline to the other end, clicking to set each point.

Now choose the Rectangle Tool or the Ngon Tool and click once in the Cross Section View to define the cross section. You can change the number of sides the circle or N-gon tool has by double-clicking on the tool before using it.

Click in the Object View to see how the new form looks in the World.

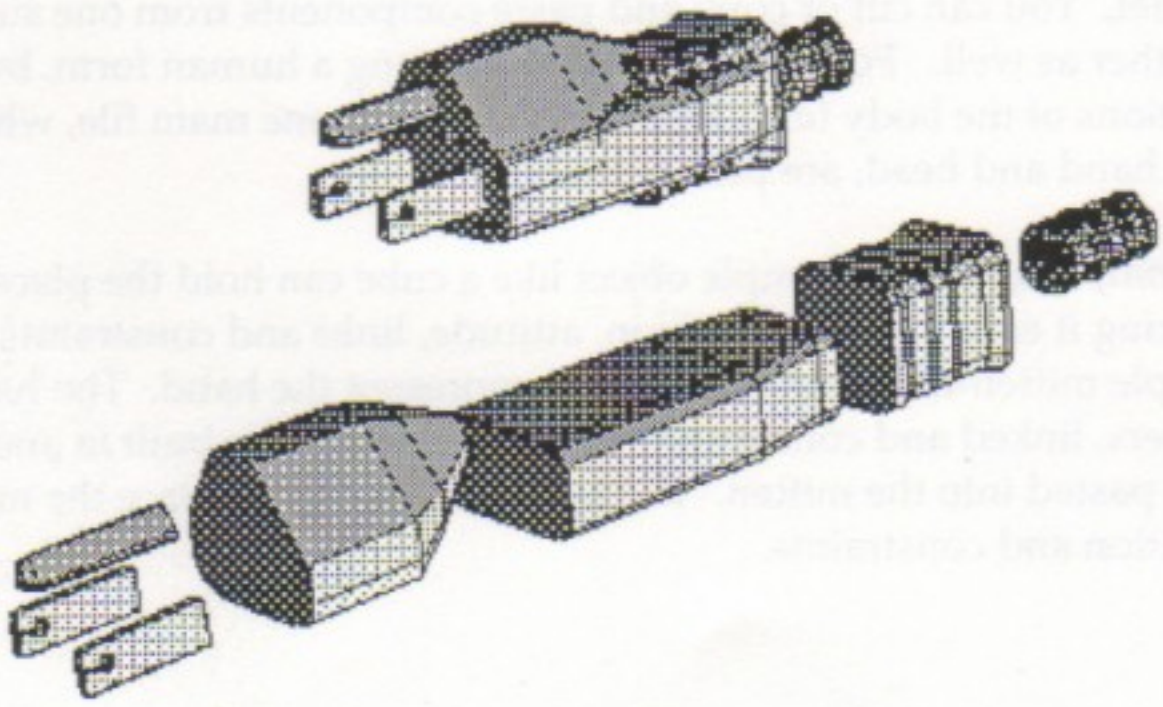


Modified Lathe-Type Objects After creating a lathe object you can modify the lathe form by using the Single or Double Arrow tools. This is a useful technique to describe parts of human forms such as torsos, arms and legs. Swivel still stretches the cross section to fit the path described by the Side and Top Sections, but now this path is asymmetrical.



Making Complex Forms and Models

Before launching into a complex model, get to know Swivel and how it works. Choose a simple part of your task and model it first. A complex form may be built from many Swivel objects. By dividing your model into subassemblies and then thinking about what Swivel objects are needed to make that part, you will clarify your task. A sketch or a list of parts for complex models is a good idea.



Designing Individual Objects To design an individual object, take a complex object you wish to make, and break its shape down into simple forms. Examine the simple form and see if it really contains only one cross section, if it is still too complex, reduce it further. The three-pronged plug seems like a single form, but it is actually a complex form that can be rendered in Swivel as the combination of many simple forms.

Saving Be sure to save your model frequently as you work. To save a file for the first time, choose Save As... from the File menu. After that, you can simply Save to replace the old saved file with the current one—or use Save As... again to save the current file without overwriting the last one. Save Picture saves a Paint-type or Draw-type image of the model without affecting the Swivel 3D document. See the Output section in this *User's Guide* for more information on saving picture files.

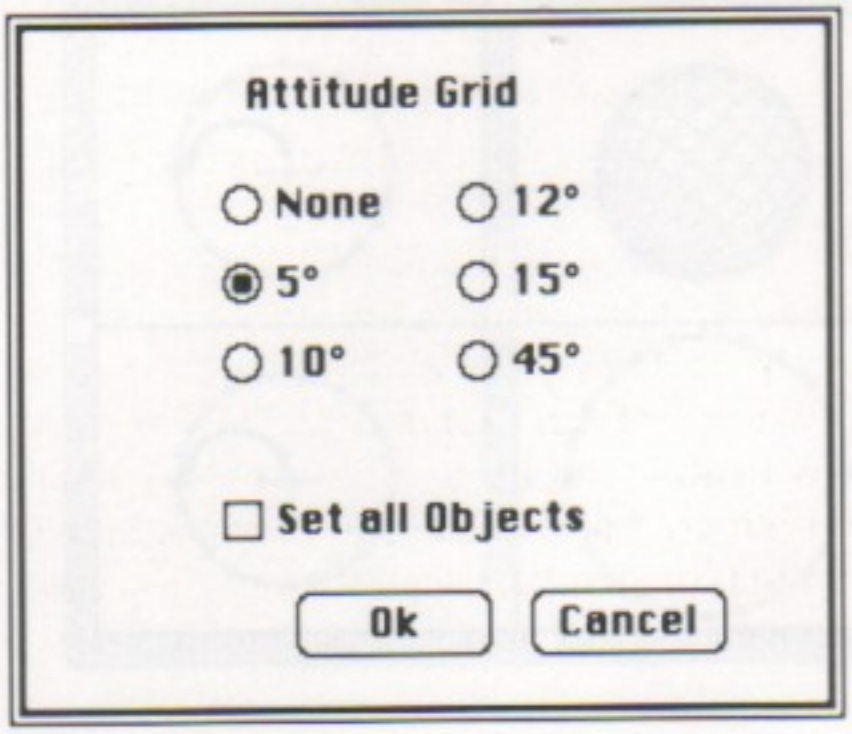
Using Another Object as a Reference Sometimes it is necessary to create objects that fit together—a key to fit a keyhole or a fender to match part of a chassis. When re-drawing an object in the Cross, Top and Side Sections a gray-scale "ghost" (image) of the previous contour is rendered. This impression can be used as a tracing guide. To draw the key and its respective hole, for example, create the key first, duplicate it, and then use the duplicate as your guide in drawing the square hole. In the case of the plug, try starting with the base object (such as the middle part of the plug, above) and duplicating it several times to construct each attached piece.

Pasting in Parts and Subassemblies When working on models with many objects, you will notice that Swivel begins to slow down. When the model gets complex enough to slow down the drawing time, you can build subassemblies in separate documents (up to four can be open at once) and paste them into the final model. You can cut or copy and paste components from one subassembly to another as well. For example, when building a human form, build the main portions of the body (e.g., legs, torso, arms) in one main file, while subassemblies, like hand and head, are built separately.

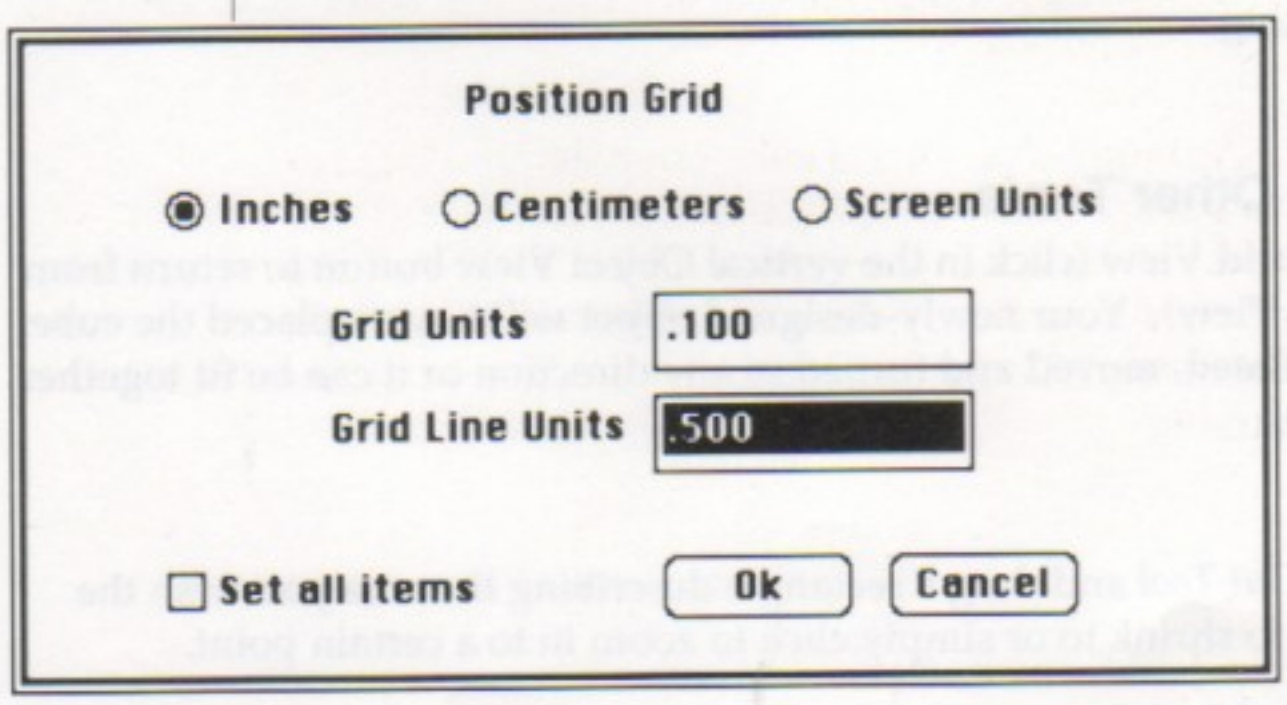
Dummy Objects A simple object like a cube can hold the place of a subassembly, making it easy to adjust position, attitude, links and constraints. You might use a simple mitten-like form or a cube to represent the hand. The hand with all the fingers, linked and constrained in motion, would be built in another file, copied and pasted into the mitten. The hand would then replace the mitten inheriting its position and constraints.

The Grids There are two grids in Swivel 3D: a position grid which regulates the movement of objects in space, and an attitude grid, in degrees, which regulates their rotation.

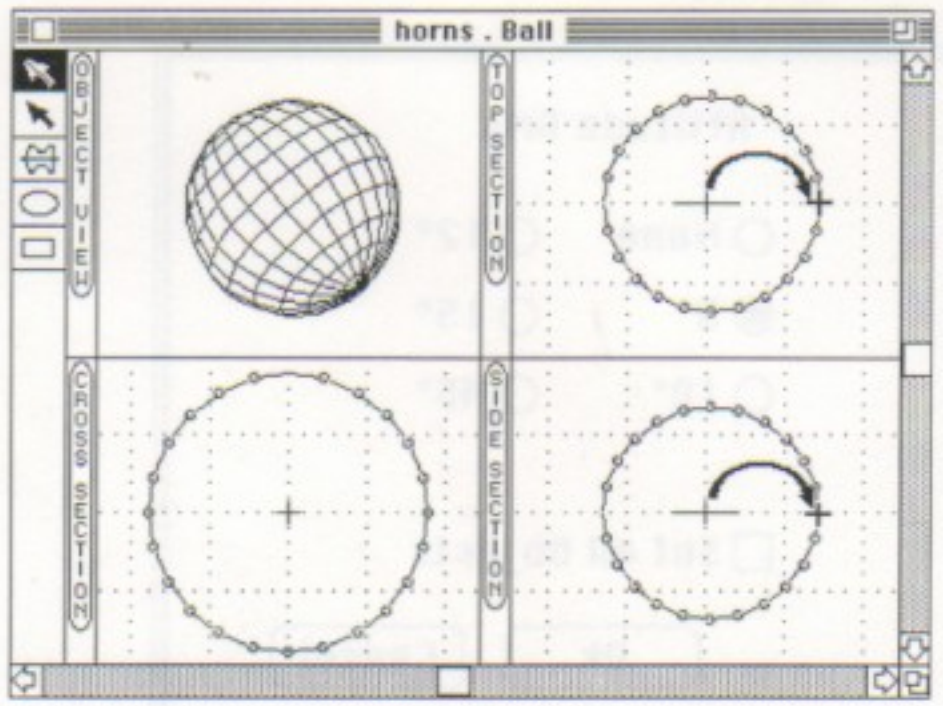
The Attitude Grid —The Attitude Grid, (located under the Object Menu), allows objects to be rotated in set increments, making angles easier to match. Selecting *Set all objects* snaps everything in the World to the nearest increment. The Attitude Grid also controls the Polar Grid increment in the Design Object View.



The Position Grid —This grid sets the units and grid increment for linear motion in both the World Grid and the Draw Grid in the Design Object View. The grid is a matrix that an object will "snap to" when it is moved in X, Y or Z. Each object in the World may have its own Position Grid. Selecting Set all Objects sets all objects in the world to have the size grid and system of measure you have selected.



Using the Grid for Alignment The grids can be a great help in getting assemblies lined up correctly. Check under the Object menu to see that the grid is on. If you find you are being forced to move things in larger increments than you want, the grid is too coarse. If the grid isn't providing positive enough guidance for placing things, it is too fine. In either case, you can select a better setting in the dialogs under the Object menu. Usually, all objects in the World are set to the same grid, but remember that you *can* set a different grid for each object when parts have different kinds of alignment needs.



Setting the Pivot Point The distances displayed in the Object Position dialog are distances measured from the object's center, or *pivot point*, to that of its up-tree object (the World for an unlinked object). Moving that center to the desired link location can make adjusting the position much easier, not to mention making moving parts rotate correctly. Get *Design Object* from the Object Menu, or double-click on the object and drag the "cross"–which marks the center–to the new link point in either the top or side view. Make the adjustment to the pivot point before linking.

Trying Some Other Tools

Return to the World View (click in the vertical Object View button to return from the Draw Object View). Your newly-designed object will have replaced the cube. It can be manipulated, moved and turned in any direction or it can be fit together with other objects.

Zoom Out

Select the *Zoom Out Tool* and drag a rectangle describing the area you wish the current window to shrink to or simply click to zoom in to a certain point.

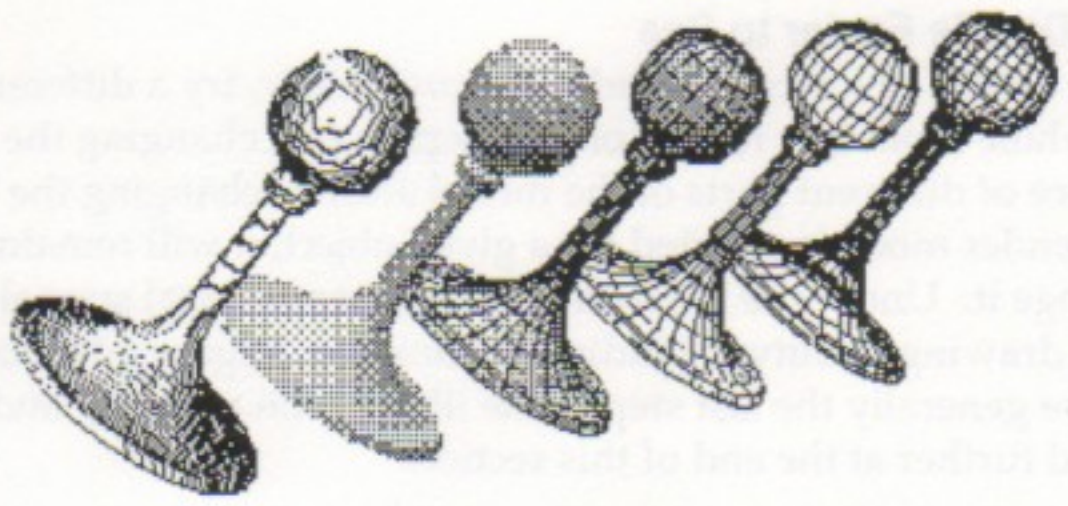
Zoom In

Select the *Zoom In Tool* and drag a rectangle enclosing the part of the image you want to enlarge, or simply click to zoom out to a certain point.

Duplicate

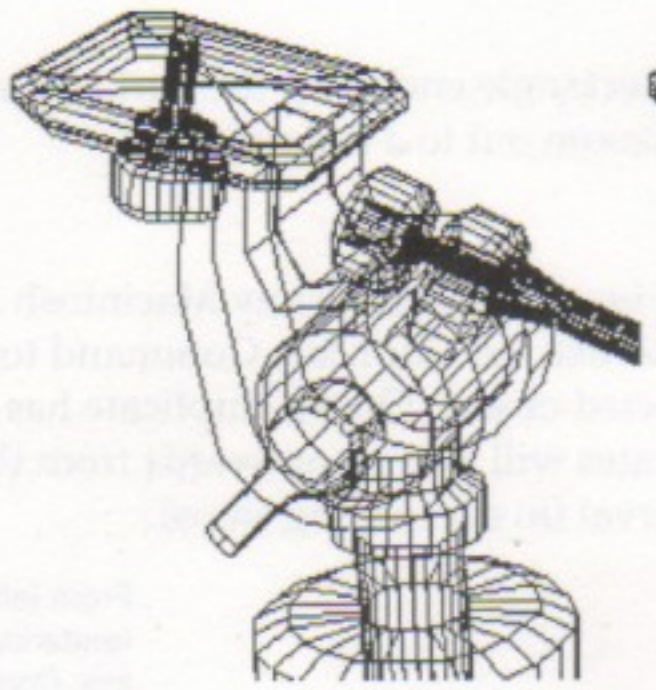
Type *Command/D* on the keyboard (as you would in any Macintosh application,) or pull down the the Edit Menu and use the Duplicate Command to create an object identical to the first constructed object. Once a duplicate has been made and positioned, subsequent duplicates will line up outwards from the first duplicate at the same distance interval (in succeeding steps).

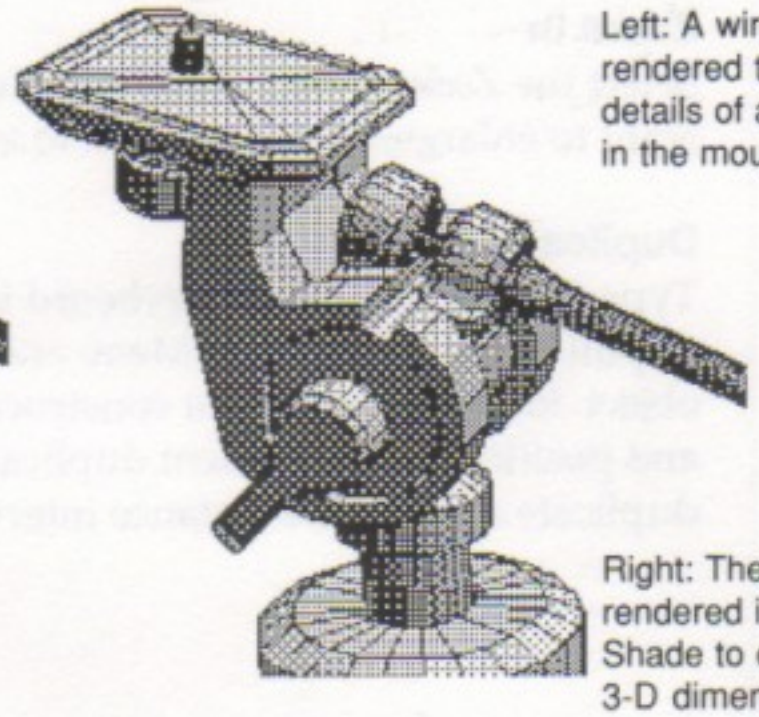
From left to right the rendering modes shown are: Contour, Shade, Outline Shade, Hidden Line, and Wireframe.



Render

Open the Render menu and try different drawing modes: wireframe, hidden line, etc. Sometimes the details of a particular object show up better in one style than in another. If you choose *Render Separately,* you can use a different style for each object. For example, you might use wire frame for one object, to allow an intersecting shaded object to be visible inside it.





Left: A wireframe-rendered tripod, showing details of a fastening bolt in the mounting plate

Right: The same tripod, rendered in Outline Shade to enhance the 3-D dimensionality.

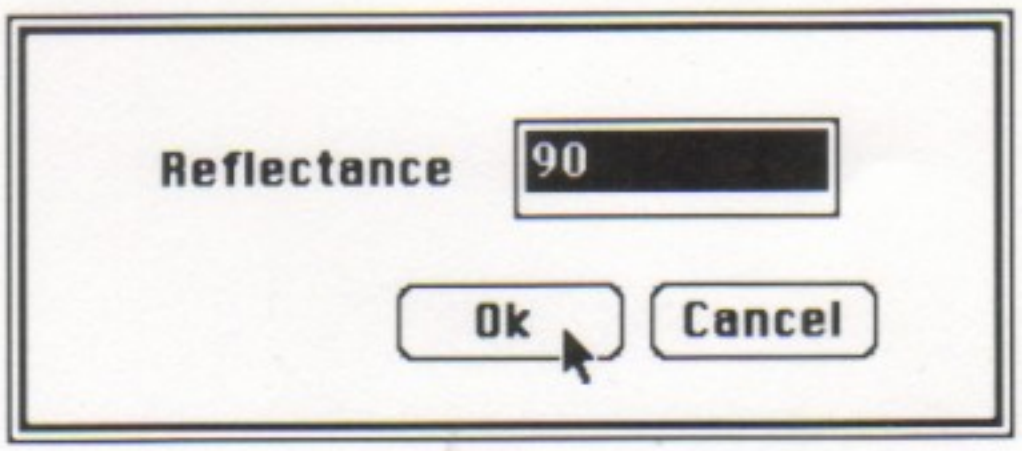
Making Details Easier to See

To make details of a model stand out more clearly, try a different rendering style for the whole model, or render objects separately, changing the color or reflectance of different parts of the model and/or changing the lighting direction. Once a render mode is selected for a given object, it will remain selected until you change it. Under the *Effects* menu, there are several special effects to enhance drawing quality, including shadowing, edge rendering and others. The effects are generally the last step in the illustration process, and they are discussed further at the end of this section.

Changing Color

Select the *Palette tool* and click on the object. On a Mac II, the Macintosh color wheel will open. If you're not sure how to use the Mac color interface, consult the user guide that came with your Mac II color monitor.

On an SE or Mac Plus, the Palette tool lets you choose the reflectance of the object, as shown in the illustrated dialog box. Try setting the reflectance very high (say 200) or low (50), then move the light around (get the lighting control under the Shade menu) and see how the appearance of your object changes.



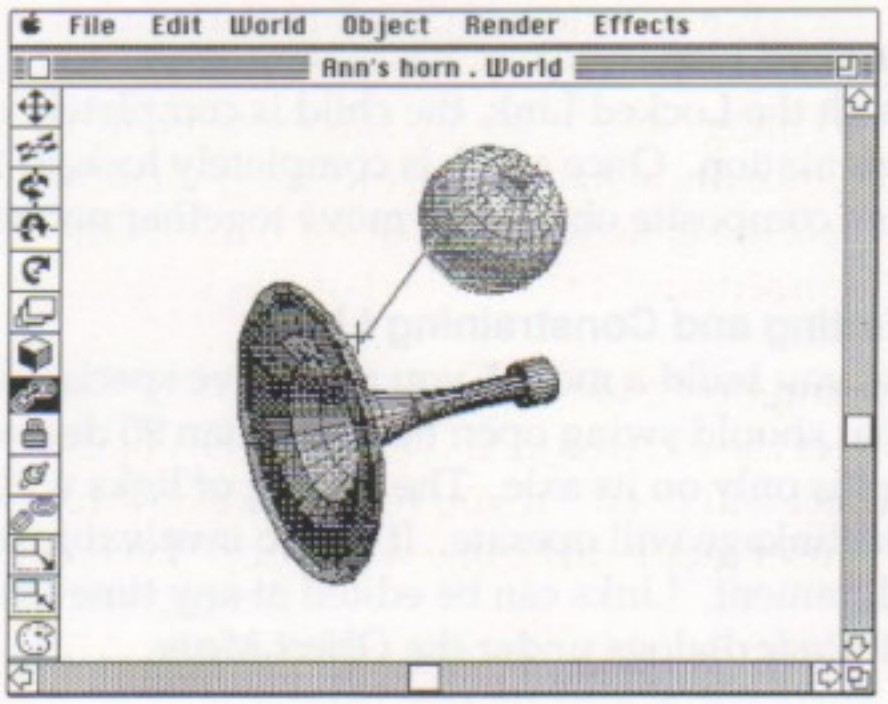
Linking Tools

There are three linking tools in Swivel's World View which create links with basic sets of constraints. These constraints can be further manipulated if you desire.

To use any of the linking tools, select a tool and use it to drag a line *from* the child object *to* the parent. Note: It is important that the link start with the object that will be the child. While you will be able to move the child object without the parent (depending on the type of link), you will not be able to move the parent without moving the child at the same time. The section on *Tree* structures in the *Starting Out* section describes parent and child objects.

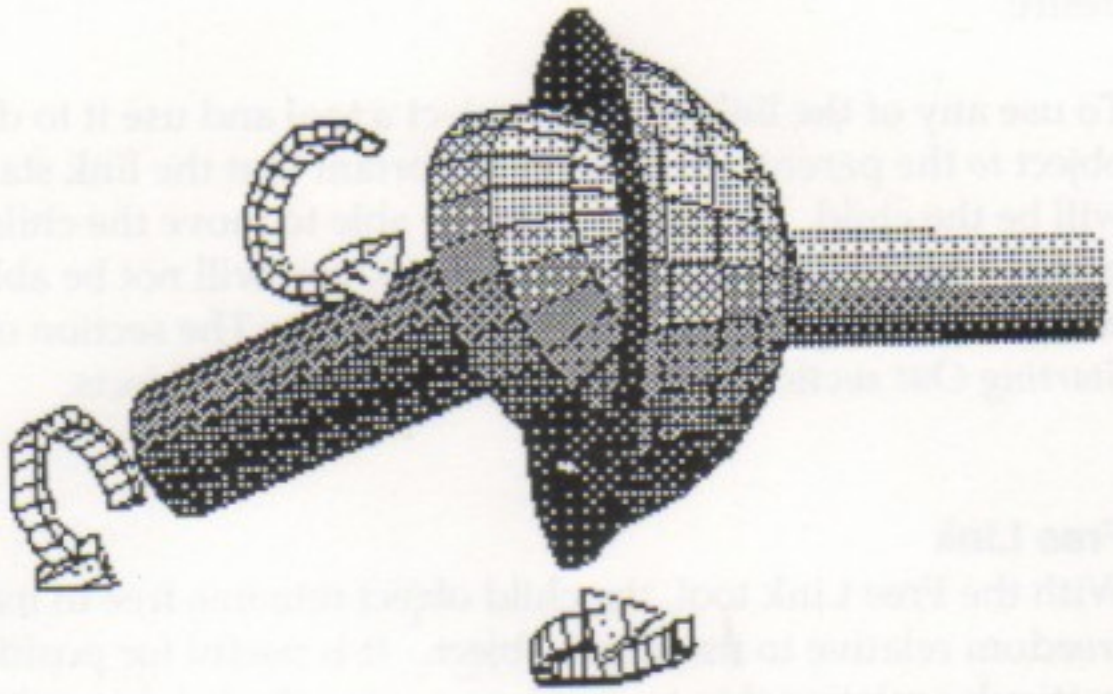
Free Link

With the Free Link tool, the child object remains free to move in all *six* degrees of freedom relative to its parent object. It is useful for positioning one object in a particular relationship to another: centered, at right angles, etc.



Ball-Joint Link

With the Ball-Joint Link, the child object is constrained to stay in position in X, Y and Z, but can swivel freely in all three degrees of orientation.

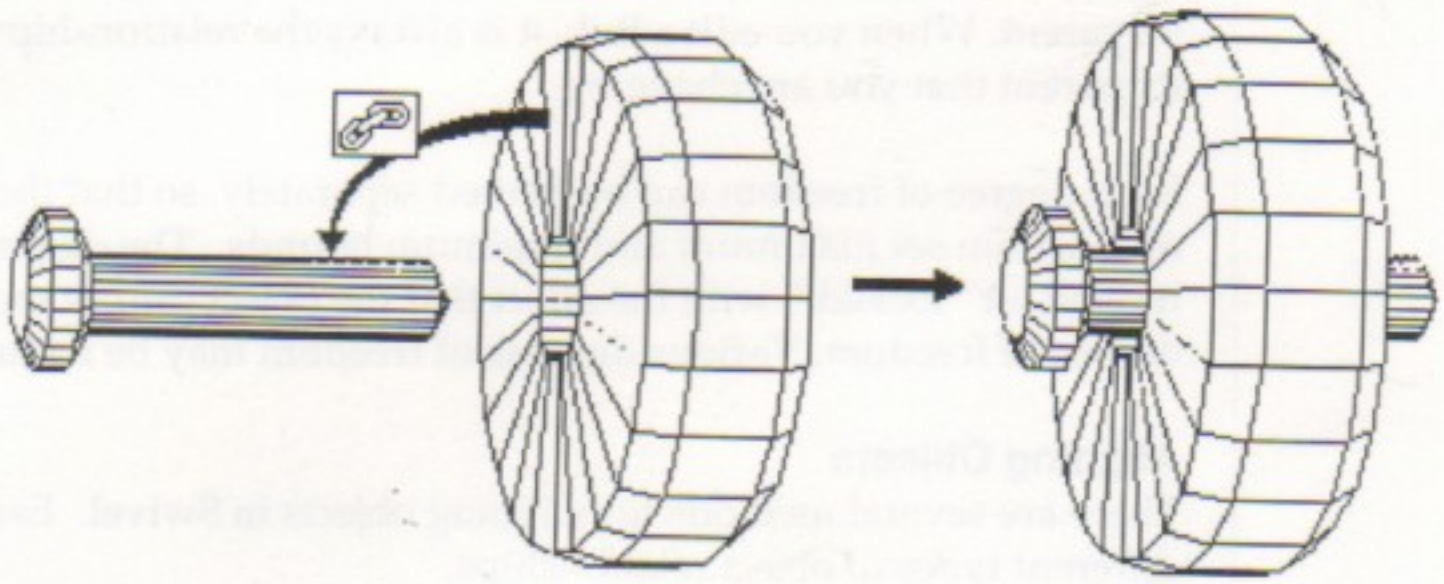


Locked Link

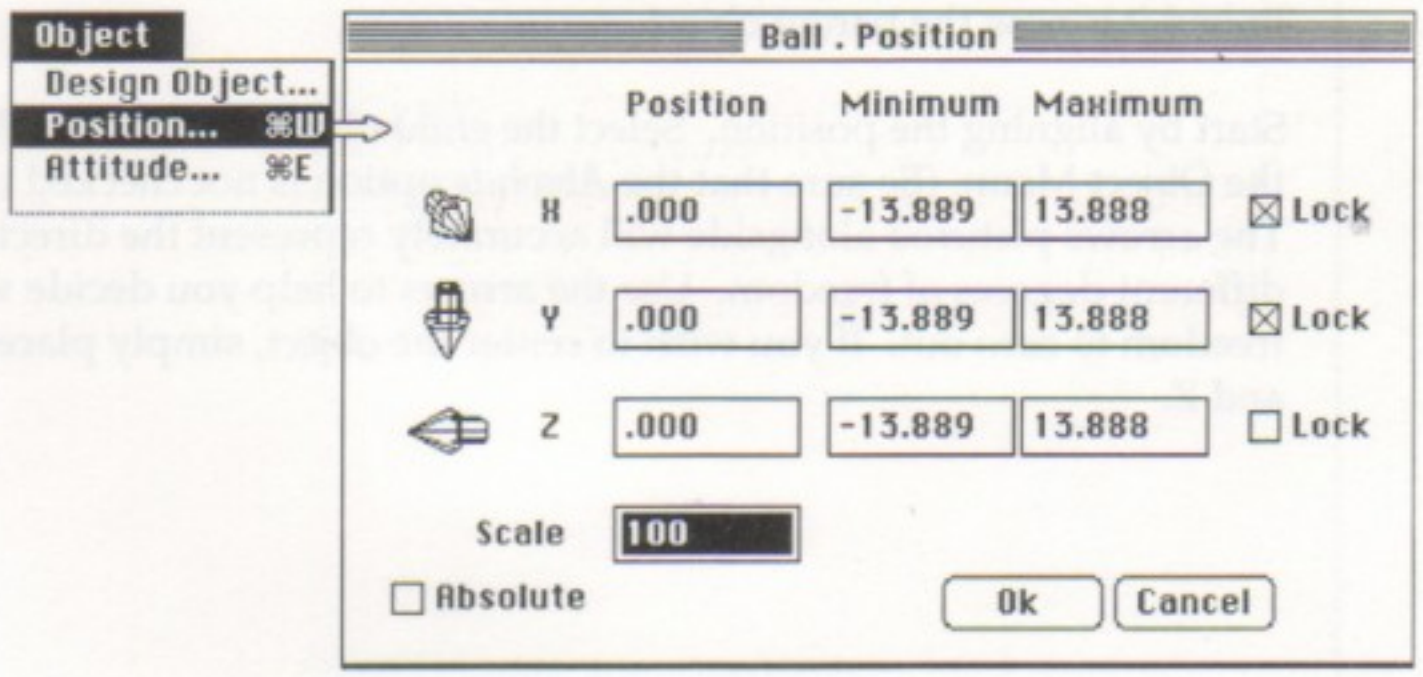
With the Locked Link, the child is completely constrained in position and orientation. Once a link is completely locked, the two objects become essentially one composite object and move together no matter which object is selected.

Editing and Constraining Links

As you build a model, you may have special limits in mind for a part: a car door that should swing open no more than 90 degrees, for instance, or a wheel that spins only on its axle. The editing of links will allow you to specify exactly how the linkage will operate. It is also invaluable in bringing two objects into alignment. Links can be edited at any time using the *Edit Position* and *Edit Attitude* dialogs under the *Object Menu*.



Open some of the demo files at this point, if you haven't already, and try moving different parts using the Swivel tools. These are linked objects. If you select one of the linked objects and get *Attitude* or *Position* from the Object Menu, a dialog will open and you can see how that particular link has been constrained: Is it locked in a particular degree of freedom? Or has a specific maximum and minimum travel been set for it? You can use these dialogs to edit links by typing in new values. Often it is easier to edit an object's position or attitude precisely by using numbers than by visual judgment.



Important: The child object must be selected to edit or constrain the link it has with its parent. When you edit a link, it is always the relationship of the child object to its parent that you are changing.

Each degree of freedom can be limited separately, so that the object can move, but only within set maximum and minimum bounds. The degree of freedom can be limited, or "locked," with the effect that the object cannot move at all in a high degree of freedom. Various degrees of freedom may be left unconstrained as well.

Aligning Objects

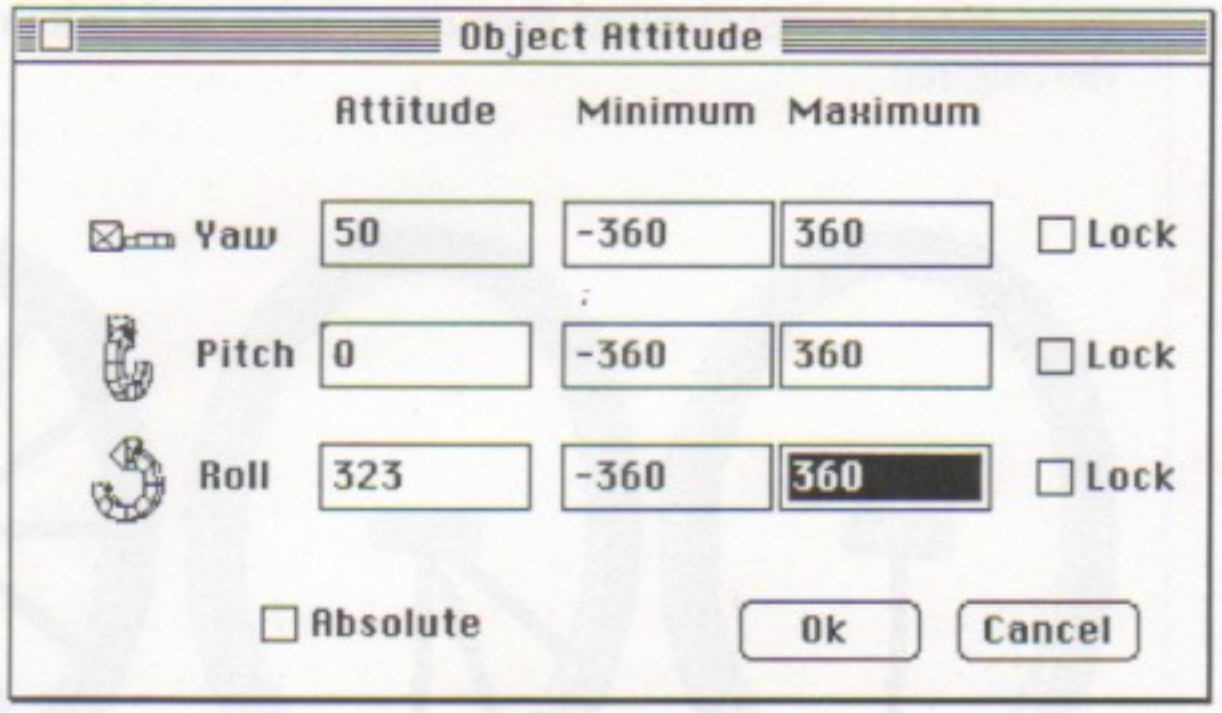
There are several methods for aligning objects in Swivel. Each is suited to different types of object relationships.

Alignment With World Grid Select the *World Grid* item in the Object Menu. This will turn on the grid in the World View. Objects will "snap" into position on the grid boundaries. If the grid is preventing you from positioning objects close together, you can change the size of the grid to match the specific objects you are aligning by using the *Position Grid* or *Attitude Grid* items in the Object Menu. Notice that Position and Attitude grids can be set independently for each object. If you wish to use a common grid, choose the *Set All* option in these dialogs.

Alignment Using Links You can use links to align objects. Link the object to be aligned to its target object using the Free Link Tool. Remember that the object you chose first with the link tool is the child object, and the object to which you linked it is now the parent object.

Start by aligning the position. Select the child object and choose *Position...* from the Object Menu. (Be sure that the *Absolute* option is not checked in this dialog.) The arrows pictured alongside will accurately represent the direction of the different degrees of freedom. Use the arrows to help you decide which degrees of freedom to zero out. If you wish to center the object, simply place zeros in X, Y and Z.

Next, adjust the Attitude. Open the *Attitude...* dialog from the Object Menu and enter zeros in one or all of the Yaw, Pitch and Roll settings to align the object's rotation as the arrows suggest.



Alignment Using Constraints Links and constraints can help you align objects interactively. Link the objects you wish to align as described earlier. Using the *Position...* dialog, zero the X, Y and/or Z values of the child, and lock the two degrees of freedom that are closest to being correct. That way, at the point you move it into position, you have to contend only with one degree of freedom at a time. You can repeat the process, locking one and unlocking another degree of freedom, as often as necessary to nudge the object into just the right spot.

Use the *Object Attitude...* dialog to match angles of objects in a similar manner. Get a rough approximation by eye, then use the dialog to edit and lock individual degrees of freedom.

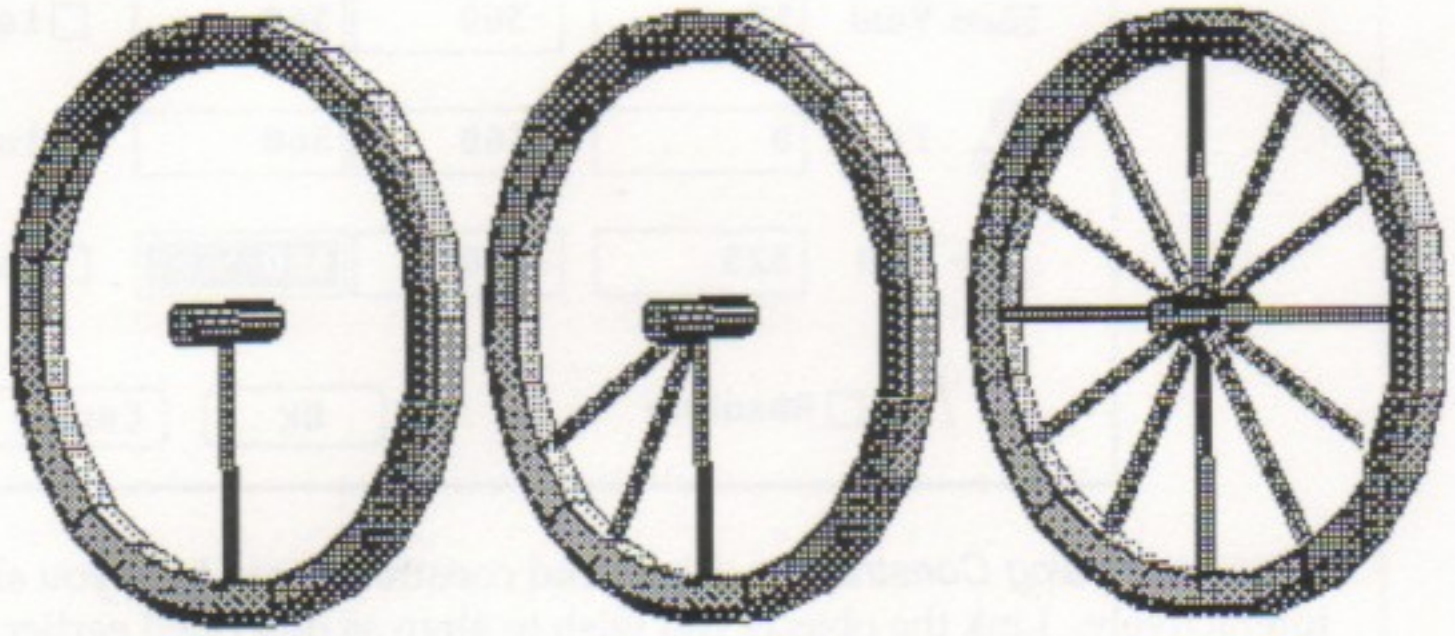
☒ Lock

Lock It Up

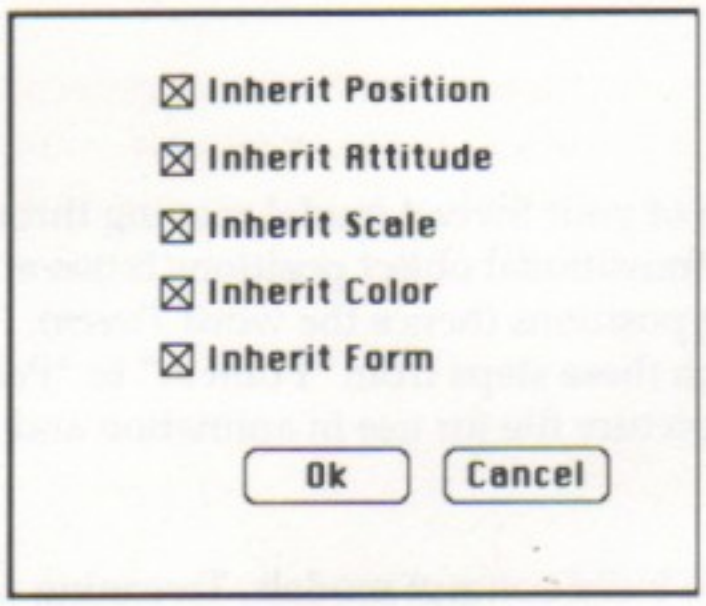
Once objects have been properly aligned, it is helpful to lock or constrain both the Position and Attitude so that parts don't get knocked out of line accidently.

Duplicating Links

In addition to limiting the range of motion and aiding in alignment and positioning of objects, linking is a good way to create regular arrangements of objects. If you wish to make a set of elements that have an identical spacing, start by making the first element, then duplicate it, and link the duplicate element to the original.

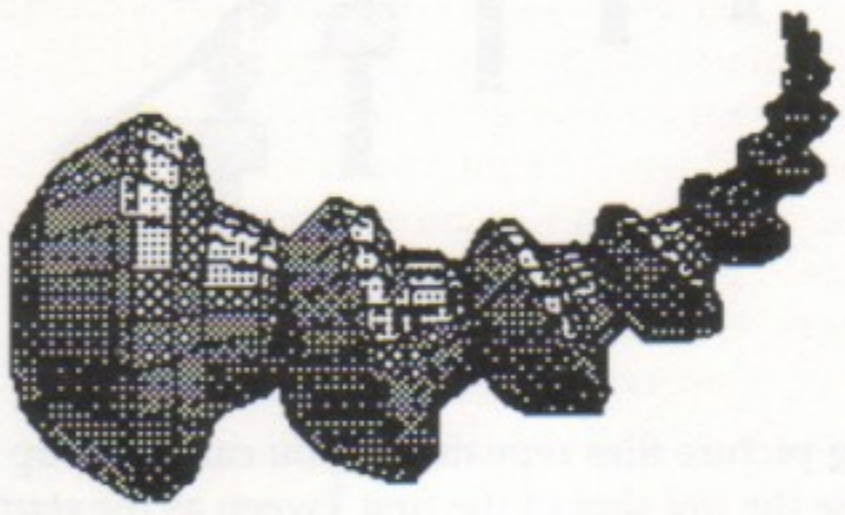


Align the duplicate element to the original element and establish the spacing you wish the elements to have. Once you have established the spacing and orientation, it is a good idea to lock the duplicate element's yaw, pitch, roll, X, Y, and Z in the Attitude and Position dialogs. Select the duplicate object and choose Duplicate Link from the Edit Menu. Duplicate Link duplicates the object you have selected and its relationship with its parent object. If the child object in the orginal link set was scaled up or down, the duplicated link will carry on that scaling, so that subsequent elements will get smaller and smaller (or larger and larger as the case may be). Distance in X, Y and Z, and rotations will also be faithfully carried on, creating spirals or other patterns.



Inherit Options

In using Inhert Options, you choose which (if any) of a parent object's characteristics are passed along to succeeding generations down the tree: for example, attitude, position, scale, form, contour or color. Select *Inherit* from the Edit menu, and check those qualities you want to pass along. Since each child object's attitude and position is relative to its parent object, any offset or twist will be mimicked. If scale is inherited also, (and there is a scale factor at the top), you can create a fine logarithmic natural form.



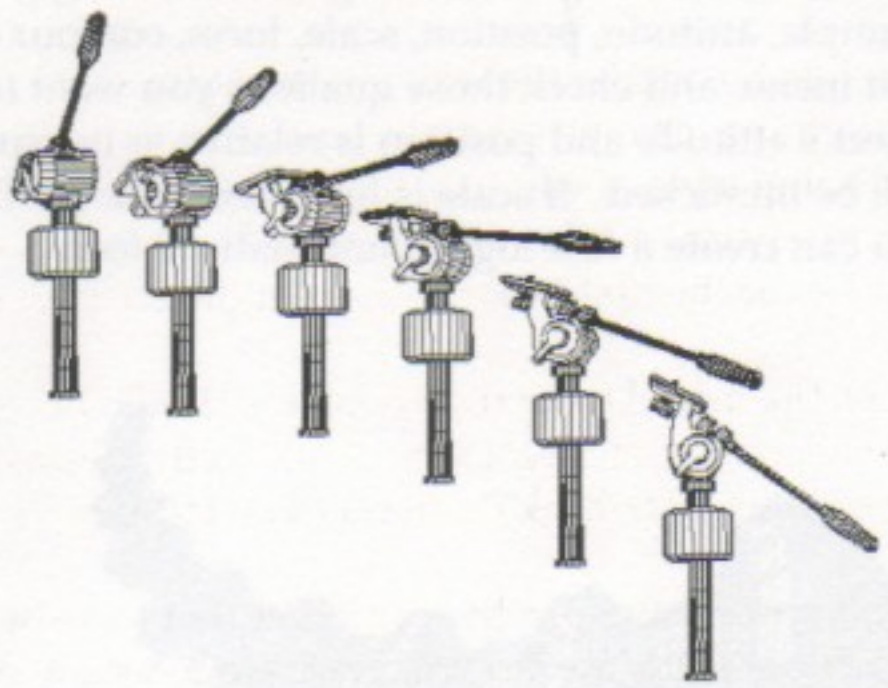
Duplicate, Duplicate Link, and Inherit give you three different ways to "mass produce" many similar or identical parts.

Special Effects

Tweening

Tweening is a simple animation of your Swivel model moving through space. Swivel will generate a series of transitional object positions *between* two that you set as the beginning and ending positions (hence the word *Tween*). You can watch your model move through these steps from "Point A" to "Point B," and/or save each "frame" as a picture file for use in animation and graphics programs.

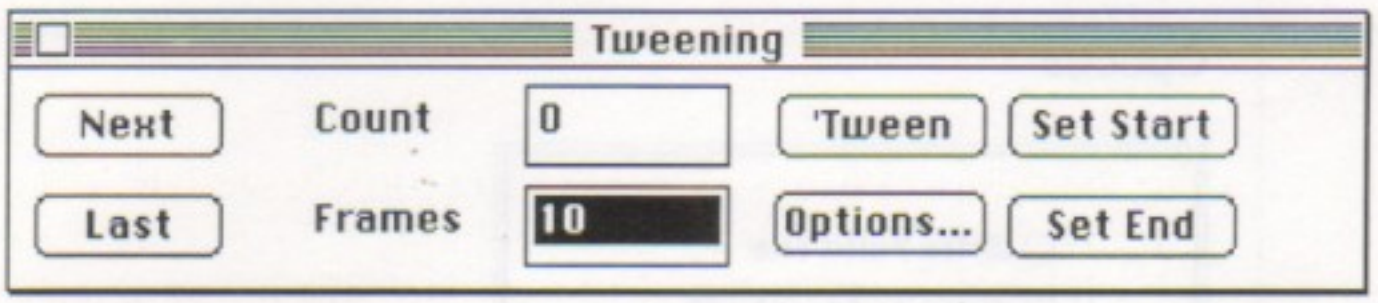
For the Designer using Swivel to build concept models, Tweening can be an effective presentation tool, demonstrating how moving parts behave, or showing different views of the form. Swivel's Tween is also an easy way to generate animations for use in Hypercard stacks or inVideoWorks animation sequences.



By tweening and saving picture files repeatedly, you can build up a more complex animation. Use the *end* shot of the first Tween as the *start* shot of your next. Swivel will continue to save and number the pictures until the disk space runs out.

To Use Tween

Select the *Open Tween* Panel from the Effects Menu. When the panel opens, it can be moved to a convenient place on the screen where it doesn't eclipse your model by dragging on the striped window ledge.



Arrange the model the way you want it to look, to begin the animation. Move the lighting, change the reflectance or color of the objects, and select a different rendering style, if you like, to get the image quality you want. You can also choose special rendering effects under Options. When you have the scene as you want it for the first "shot", click on the *Set Start* button.

Move the model to its final position. Linked objects can be moved about within the constraints of their links. Unlinked objects can be arranged separately. When all is final, click on the *Set End* button.

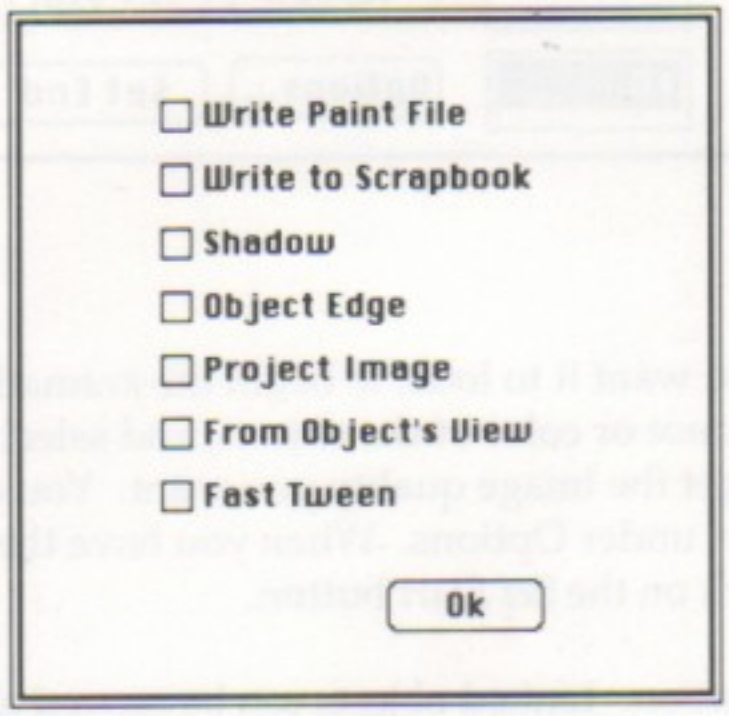
Count reflects the number of frames that have been displayed. *Frames* is the total number of shots Swivel will generate between the Start and End frames. The default number of screens is 10, but you can enter a number.either higher or lower

To Replay

To see the entire animation, click on the *Tween* button. Very complex models may take a while to draw between each frame. Use the Wireframe Rendering mode to speed up the process. You can also step through the animation one frame at a time, using *Next* or *Last* (to step sequentially backward).

Tweening More Complex Sequences Swivel will chart the simplest course between the two positions (not necessarily the same series of moves and rotations that you used to arrange the model). For rotations of 180° or greater, it's better to divide the animation into two or more Tween sequences.
Hint to create another Tween sequence continuing the same direction of motion, set Start, then tween again *without* setting End.

Options



Write Paint File If you select *Write Paint File* in the Tween Options dialog, Swivel will create a picture file representing each frame automatically—numbering them sequentially .

Write to the Scrapbook If *Write to the Scrapbook* is selected, a picture file is saved to the Scrapbook for each frame. The Output Style will be Paint-type or Draw-type, depending on which mode is currently selected in the Output Style dialog under the Edit Menu. The Write Paint and Write to the Scrapbook options will *not* save files if *Fast Tween* is selected.

Note: If (and when) Swivel runs out of disk space, in the process of saving picture files, the computer will beep and a dialog box will alert you to the shortage of memory or disk space. Normally, files will automatically be saved everytime you tween as long as Write Paint is selected.

From Object's (Point of)View This option holds the selected object motionless while the World moves around it.

Fast Tween If you want to know which path the object will follow, this option will save considerable processing time. *Fast Tween* draws a simple box (like the one displayed as an object is being moved) rather than rendering the actual object in detail.
Note: Paint files will *not* be saved during Fast Tween.

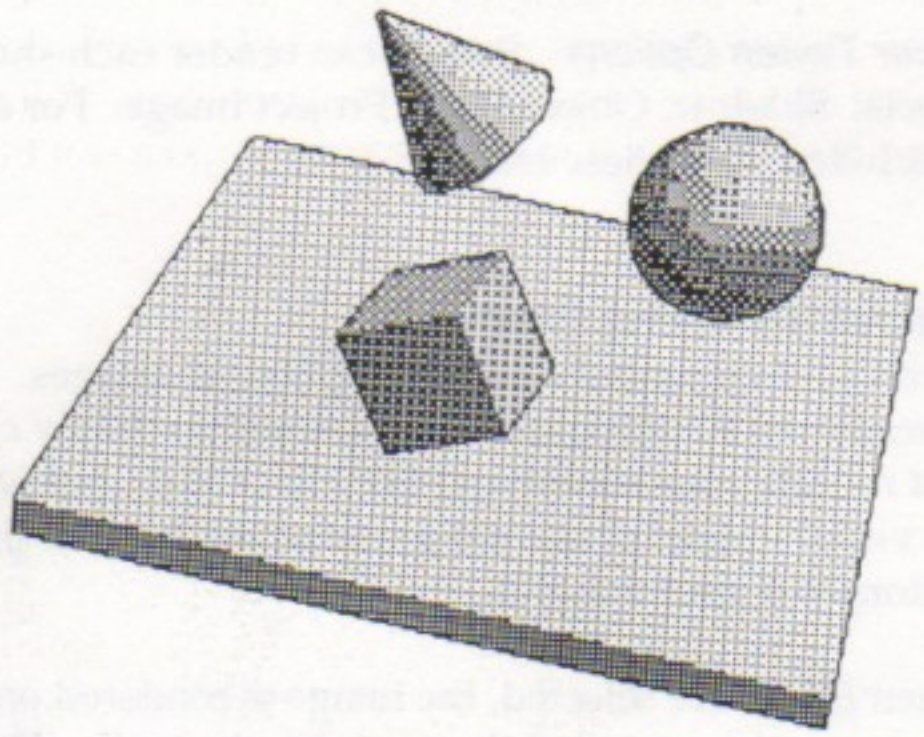
Other Tween Options Swivel can render each shot with the following special effects: Shadow, Object Edge, Project Image. For details, read the next section which describes these effects.

Special Rendering Effects

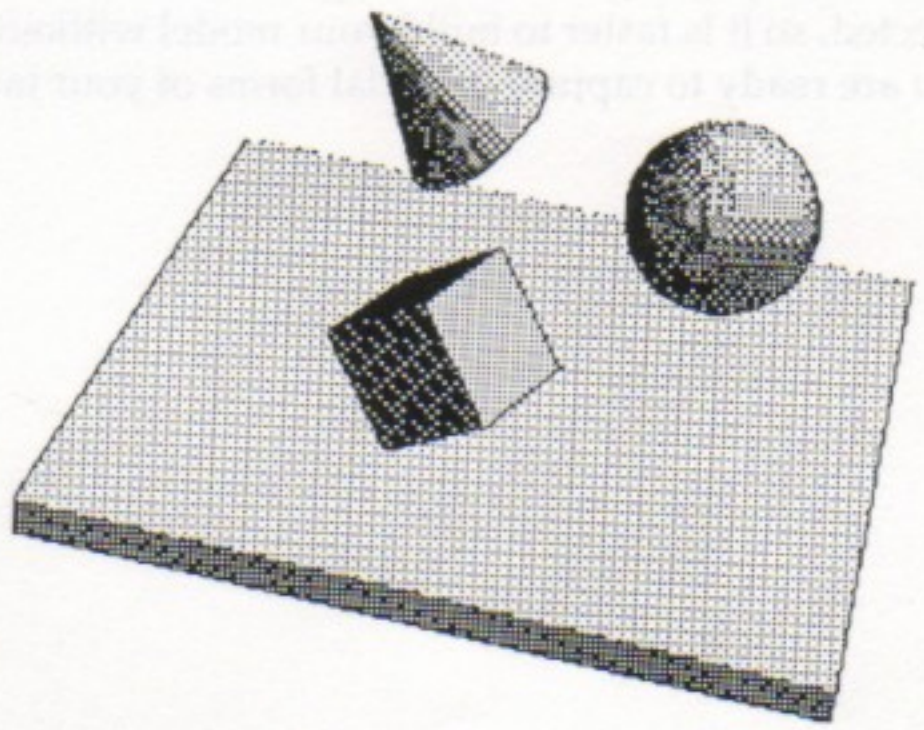
Effects contain tools for enhancing Swivel images. If you are using Swivel primarily as a conceptual tool, you will probably choose the rendering style that best reveals your model and leave it at that. But when you are concerned with the visual impact of the image for artwork or for presentation graphics, these options will prove useful.

When *Effects* are selected, the image is rendered once and then the effects disappear the next time the model is changed. This is true, with the exception of *Lighting*, *Lighting* is grouped with Effects because it controls the direction from which shadows are cast and images projected, but the light source is set until it is intentionally changed. Rendering will be somewhat slower when Effects is selected, so it is faster to build your model without them, then add them when you are ready to capture pictorial forms of your images.

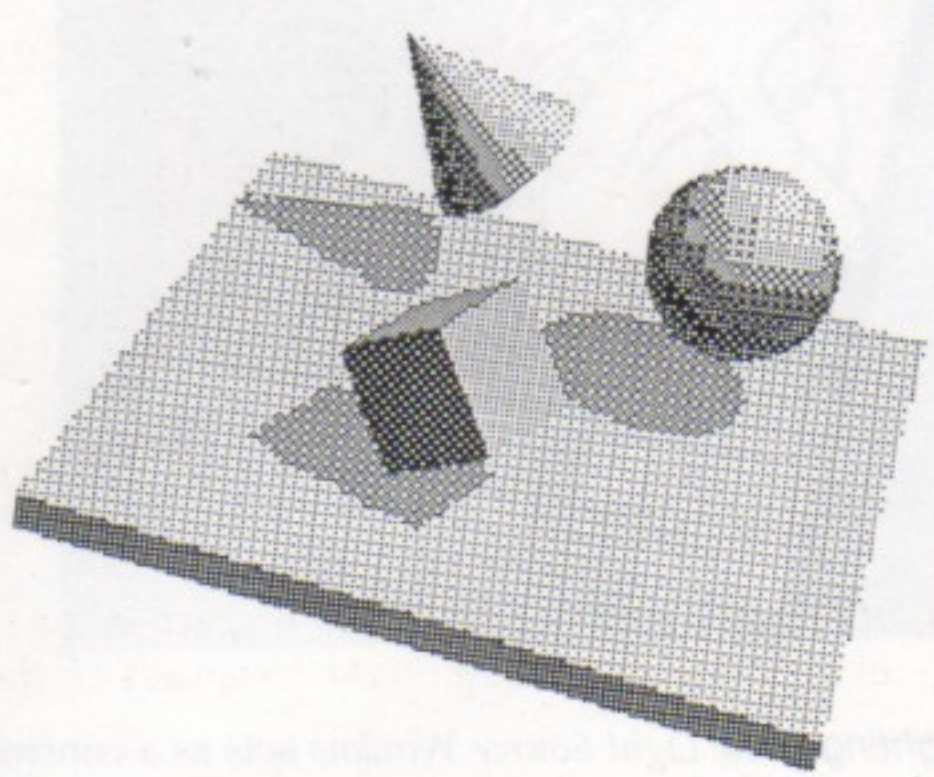
Object Edge This option helps clarify the boundary between different objects by drawing an outline around each object's perimeter. If the boundary between two intersecting objects has been lost, the *Object Edge* effect will bring it out. Changing the angle of view slightly (in the World Attitude dialog) can also help to reveal the structure.



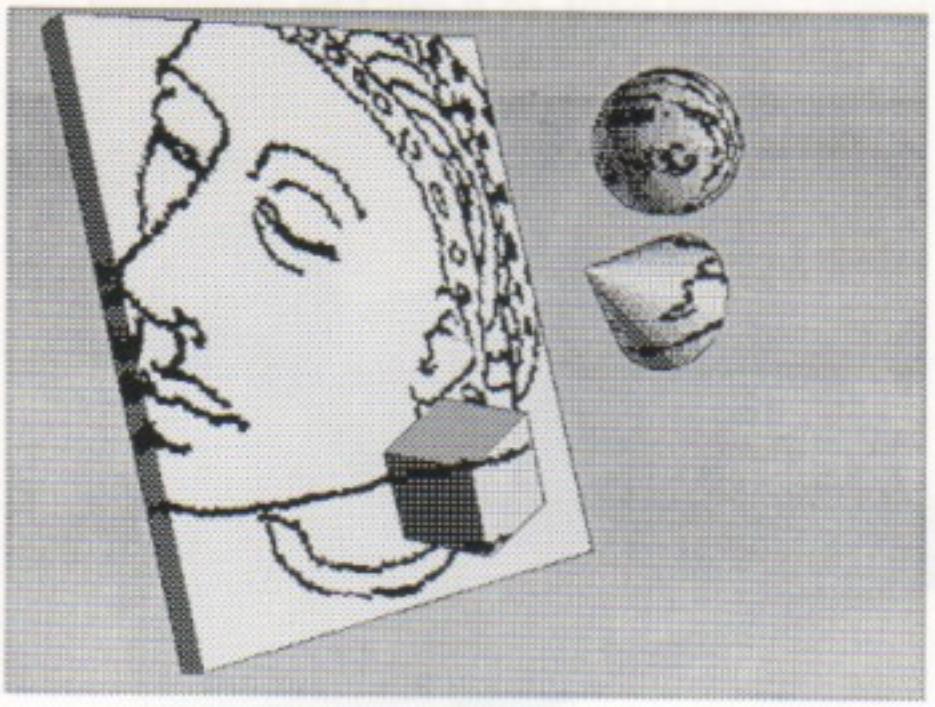
Depth Edge Intensifies the sense of space in the model by drawing heavier or lighter outlines, depending on the steepness of the edge's depth.



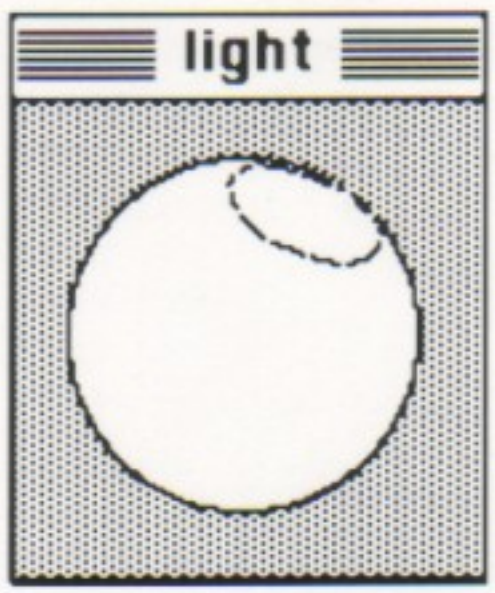
Shadow This option draws the shadows that would be cast by the model. The angle from which the shadows are cast is determined by the *Light Source*. Objects can cast shadows on themselves and across other objects, depending on how they are oriented to the light.source. Sometimes few (or no) parts of the model are lined up to cast shadows (the "High Noon" phenomenon). Choose the *Lighting* option and assign a new angle. It can also be helpful to create a large flat "Screen" Object (a square with a long [narrow] rectangular side and top section), enlarge it, and the set it behind the model to catch the shadows. The World itself is empty space and doesn't reflect light, so it can't be shadowed.



Project Image This option allows the program to project an image onto the model with the Light Source as the projector. Cut or copy any image from the Scrapbook. Choose Lighting and shine it on the face of the model to be projected on, then select P*roject Image.* Projected images can add detail to an object, by giving it surface texture or alphanumeric labels. Projection can also be used to decorate an object such as wallpaper in an architectural model. The image will wrap around the form if it is not flat.



Lighting The *Light Source Window* acts as a control for directing the lighting of the Swivel World—which has a single light source. Click-and-hold on the *Lens Circle* and move it around the sphere in order to change the direction of the light. The model will be lit from this direction until you change it again. The Lens Circle is the light source that casts shadows and acts as the "projector" for Project Image.

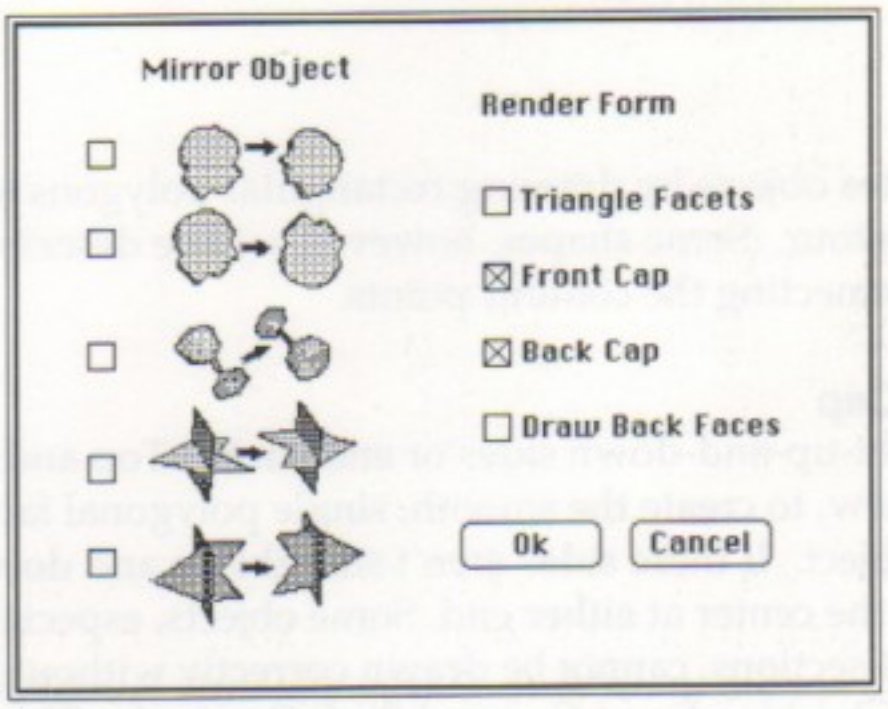


Further Swivel - More About Swivel 3D

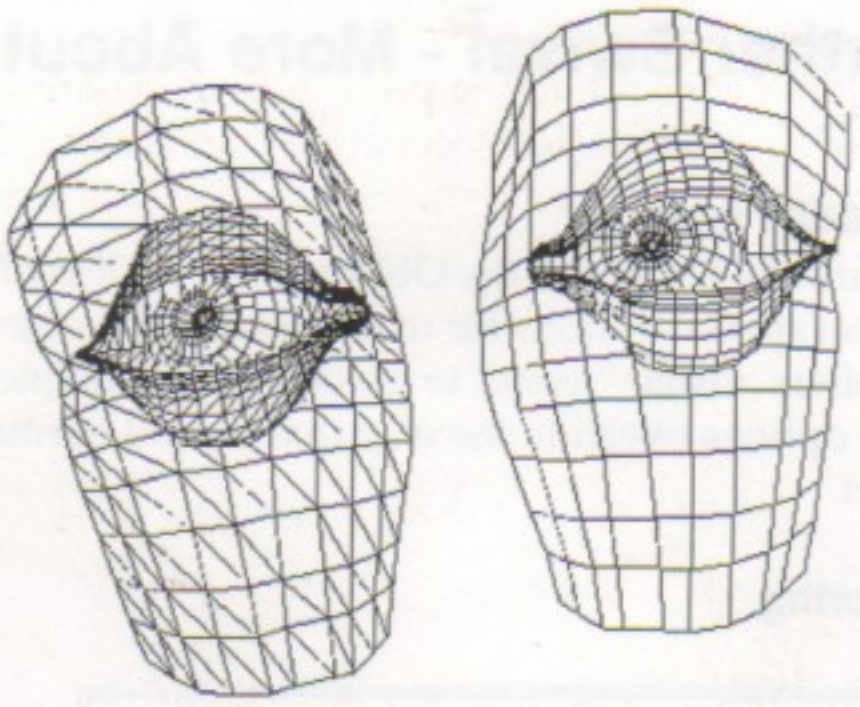
Object Form

Toward the bottom of the Object Menu is *Object Form....* This dialog offers several special options for manipulating the object's form. *Mirror Object*, on the left offers visual "icons" to guide your preferences. On the right side, *Render Form* options override the way that Swivel normally interprets and renders the object.

Mirroring



Matching sets of objects can be created by mirroring objects across one or more of five planes. First, duplicate the original object. Then choose *Object Form* under the Object Menu, and select a plane on which to base the mirror. If it has been a while since you designed the object, reviewing the Design Object View will clarify the identification of separate planes. You can choose as many as you wish. The simplest method (and often the most useful) is to make a right part from a left one by mirroring a single plane.

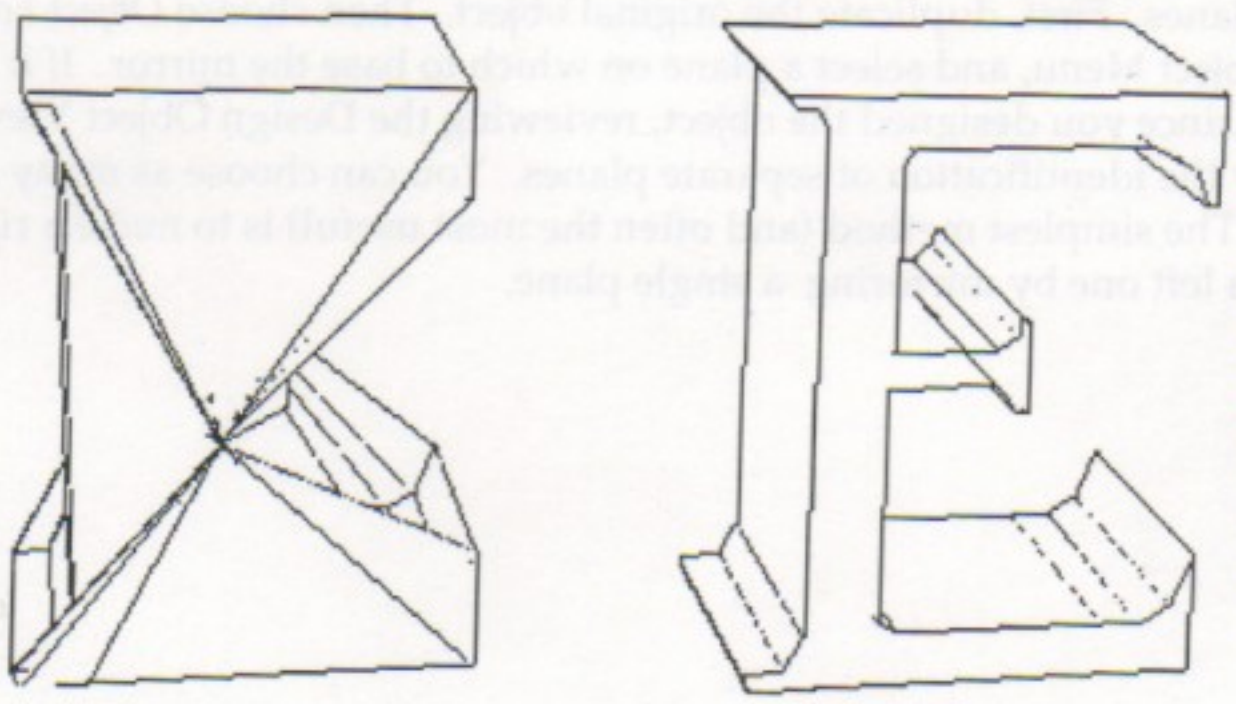


Triangle Facets

Normally, Swivel creates objects by drawing rectangular polygons to connect the points on the object contour. Some shapes, however, will be described better by triangular polygons connecting the contour points.

Front Cap and Back Cap

Swivel looks for straight-up-and-down sides or ends in the Top and Side contours in the Design Object view, to create the smooth, single polygonal face that is the mark of an extruded object. If these sides aren't straight up and down, converging lines will radiate from the center at either end. Some objects, especially those with complex polygon cross-sections, cannot be drawn correctly without these flat "caps" on either end. Checking Front Cap and Back Cap in the Object Form dialog tells Swivel to go ahead and draw flat polygon caps on the ends.

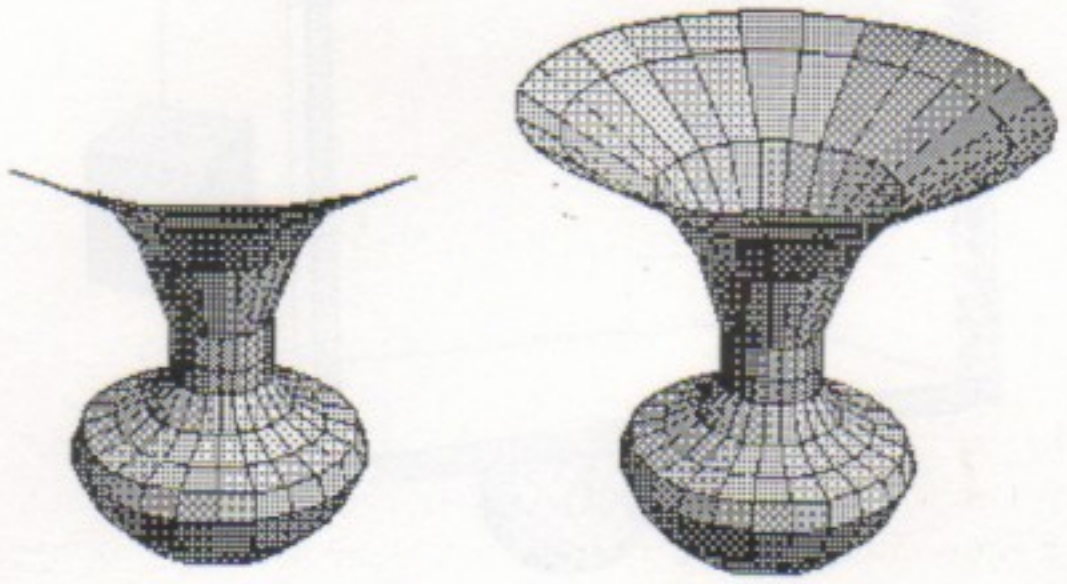


Left: Without the Front and Back Caps drawn, the inside curves of the object at the left have been drawn over.

Right: Swivel automatically selects Draw Front and Back Caps for objects with flat front and back faces in the Top and Side Sections of the Design Object View.

Draw Back Faces

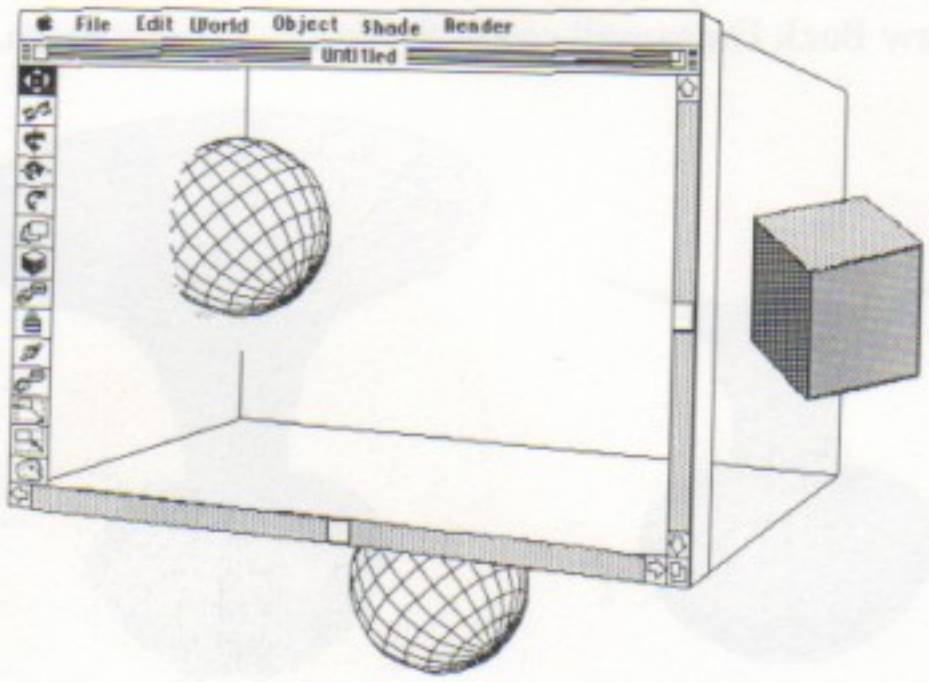
To speed up the rendering process, Swivel normally does not draw the back faces of an object if the object is solid and they will not show. Swivel looks for an opening in the object's form, or a single-sided object, and sets *Draw Back Faces* when necessary. In other cases when back faces should be displayed, choosing Draw Back Faces will cause Swivel to render them.



Swivel checks to see whether the back faces are required, and draws accordingly. Only the front faces of the object at the left are displayed when Draw Back Faces has been unselected.

Finding Objects

Objects can "disappear" into the Workspace for a number of reasons, but they're easily found and are unharmed when this happens.

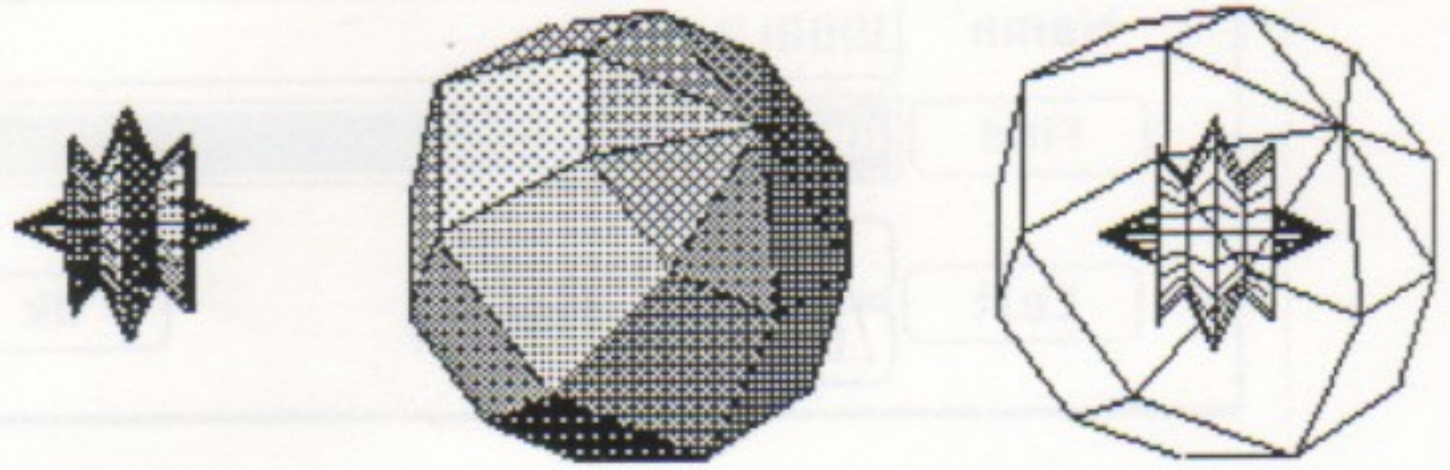


Lost in Space

Unlike the space we generally inhabit, Swivel space is finite. Sometimes an object vanishes because a zoom or move operation has removed it beyond the limits of that space. Select *Size to Fit* from the World menu, and the drawing will be reduced to show even the most remote object. Changing the World to another view can also help shift an object back to the known universe.

Engulfed by Another Object

If you zero the position of a small object, it may be completely engulfed by its parent. Select the parent, then use the cursor keys on the keyboard to travel "down-tree" to the lost object. (You can check to see that you have the right one by getting Draw Object from the Object menu). Edit the Position of the lost object to a point outside the parent.



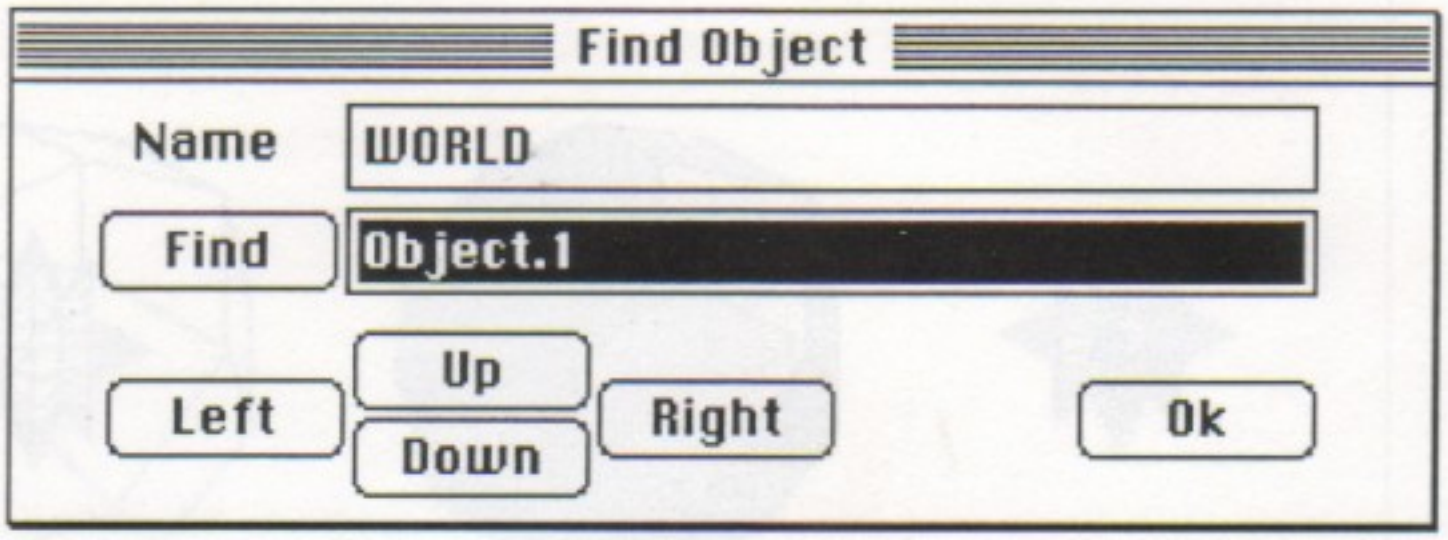
Another technique you may use is to select the larger object that has eaten your object and then use the *Render Separately* command in the Render menu. Be sure to select the object that has engulfed your object and choose the *Wireframe* command in the Render menu. This will allow you to view and select your lost object.

Out of Sight

If an object has become too large or too small to see, zooming the whole World with the Object View Zoom tools should solve the problem.

Finding Objects by Name

As each new object is created, Swivel gives it a name (Object#1, Object#2, etc). You can change the name to more adequately represent the subject at any time by getting the *Find* dialog from the Edit menu while the object is selected, and typing in the new name. To find an object by name, just type in the name of the object you're looking for.

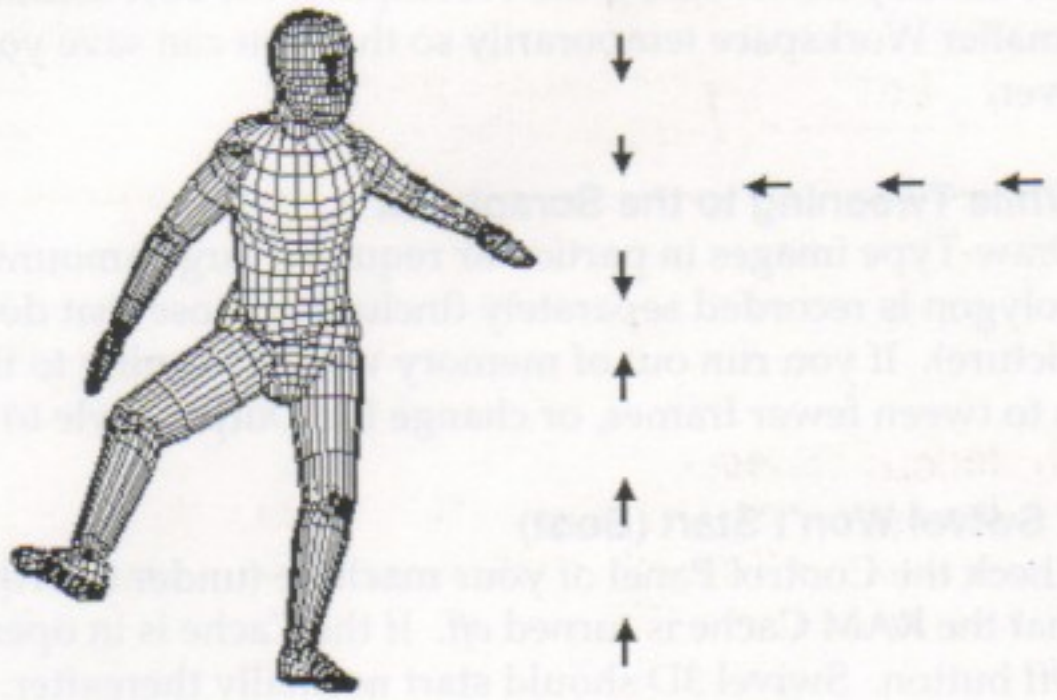


Mysterious Objects

If cubes appear as if by magic, check to see if the Caps Lock key is down, locking the New Object Tool into continuous action—creating new objects with every click of the mouse.

Climbing Trees

Any time two or more objects are linked, they form a *tree*. After a tree has been created, you can select and find objects by "climbing" from branch to branch. One way to traverse the links is by using the cursor arrow keys on the keyboard: the up arrow to move up-tree, the left arrow to select a left sibling, the right arrow for right, and the down arrow to go to the down-tree object. This kind of tree climbing can help when you have forgotten which object is the parent, or when an object is stuck or lost in such a way as would make it difficult to select . This frequently happens when you zero the position of a small object, leaving it engulfed entirely inside its parent. The *Find* command is another way of climbing from branch to branch on the tree.



Memory Limits

With a very complex model

If Swivel runs out of memory, or begins to slow down while building a very complex model, you can resize the Workspace, or break the model down into subassemblies which can be worked on in different files. You can have up to four Swivel files open at a time.

After using a Desk Accessory,

After you use a Desk Accessory (or DA), Swivel may tell you it is out of memory and ask if you want to resize the Workspace. This problem occurs because the DA closed improperly, which is unfortunately irremediable. Unless you enjoy continually down-sizing the Workspace, the best solution is to choose the smaller Workspace temporarily so that you can save your file, quit, and start over.

While Tweening to the Scrapbook

Draw-Type images in particular require a large amount of memory because each polygon is recorded separately (including those that don't show in the final picture). If you run out of memory while tweening to the Scrapbook, the option is to tween fewer frames, or change the Output Style to Paint-type.

If Swivel Won't Start (Boot)

Check the Control Panel of your machine (under the Apple Menu) to make sure that the RAM Cache is turned *off*. If the Cache is in operation, just click on the Off button. Swivel 3D should start normally thereafter.

If you are having problems starting Swivel by opening a file, try clicking directly on the Swivel Icon, and then opening the file from within the application.

Scratch Files

For each open Swivel file, a Scratch File is created to hold all the current changes. When the file is saved and closed, the scratch file is deleted. However, in case of a system error or crash, the scratch file may be left on the desktop. Rename the scratch file while it is on the desktop *immediately*, so that the program doesn't confuse it with future scratch files—as they are created. If you lose a file in a crash, you may be able to recover it by re-naming and then opening the renamed scratch file.

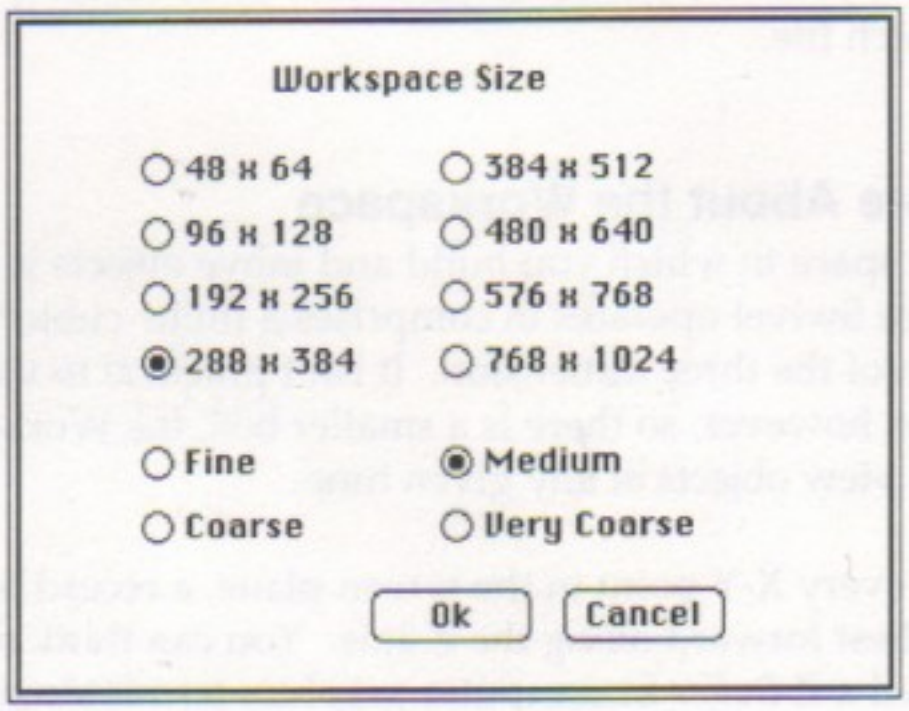
More About the Workspace

The space in which you build and move objects is called the Workspace. The total space Swivel operates in comprises a finite cubic "box", measuring 910 inches in each of the three dimension. It isn't practical to view that amount of space at one time, however, so there is a smaller box, the Workspace, in which you can work and view objects at any given time.

For every X-Y point in the screen plane, a record is maintained of the point farthest forward along the Z axis. You can think of this collection of records—called a *Z Buffer* in computer graphics terminology—as a relief map of the current scene. In addition to the Z Buffer there is a background screen (a bitmap of the current image), which Swivel draws *to* and prints *from*. Both of those measurement references together comprise the Workspace records.

Hither and Yon

The back plane of the Workspace is called the Yon Clipping Plane, and the front plane is called the Hither Clipping Plane. Objects which pass through these planes leave the Workspace and disappear from view. The Hither Clipping Plane can function as an X-Ray, revealing the internal structure of an object as it is pulled through the plane and as the forward portion is clipped off.

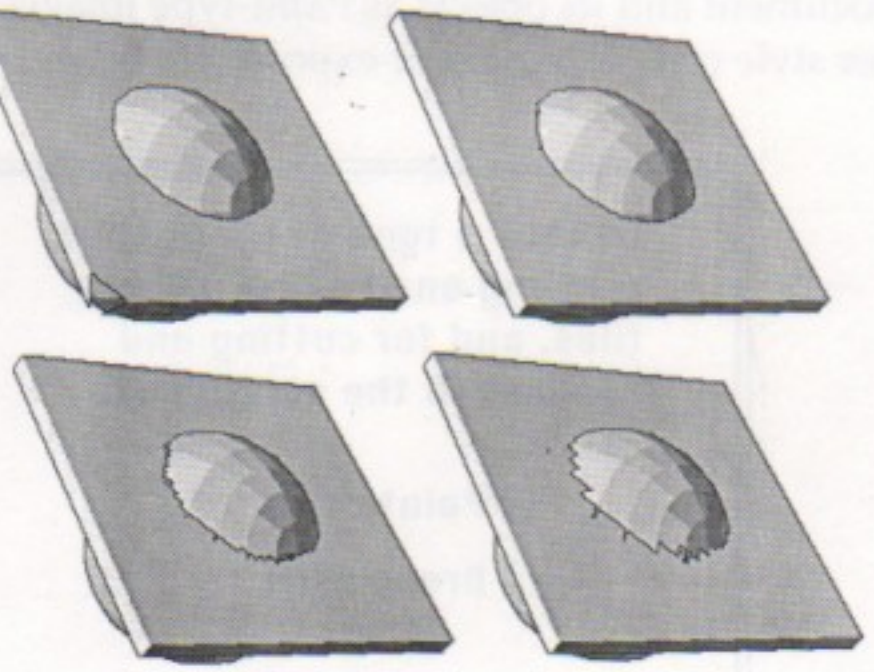


Workspace Size

The size of the Workspace you can effectively use depends on the computer and the amount of memory available. When Swivel is opened, it will look at your system and choose a Workspace size that appears to be the best fit: for example, a Workspace measuring 288 x 384 Screen Units (4.72 inches high by 7.1 inches wide) will just fit the window size of an SE or a Mac Plus. The 384 x 512 Workspace, one size larger, is a good start for the Mac II. If you have a very complex model that requires a great deal of memory, you may be asked to resize the Workspace. The viewing box has a front-to-back depth of 7.1 inches at medium coarseness.

Workspace Resolution

There are a finite number of screen units in the Workspace's Z dimension. Thus, resolution of the Workspace does not affect memory, but will change the appearance quality of the rendering and the depth of the Workspace in the Z dimension. The default resolution is *Medium*. Choosing a coarser setting makes the Workspace deeper by spreading the units further apart. A finer Workspace resolution will have less depth but show greater resolution of an object's intersections.



The quality of the intersections between objects is affected by the resolution of the Workspace. The top left set of objects shows an intersection in FINE resolution, the top right, MEDIUM, the bottom left COARSE and the bottom right VERY COARSE.

The dialog for resizing the Workspace is measured in screen units, but it may be more convenient to think about dimensions in inches or centimeters. Position Grid increments likewise can be measured in screen units, inches or centimeters.

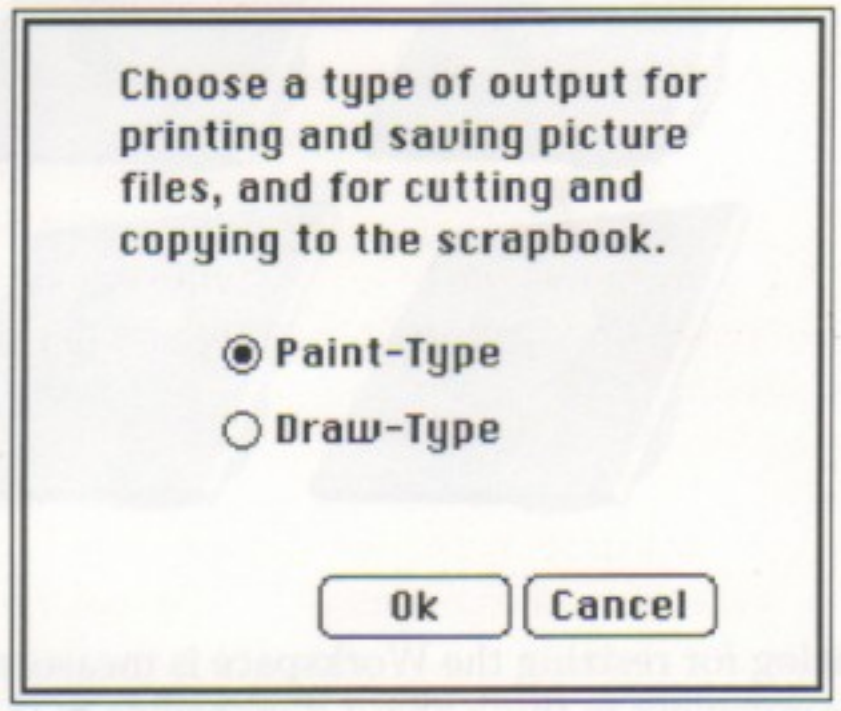
A Drawing Tip

Use the Caps Lock Key to retain the same tool for repeated operations if, for example, you are going to be linking a number of objects. As long as the Caps Lock Key is down, the tool will change only when you select a new one. With the Caps Lock Key up, the tool will revert to the XY tool after each operation. If you notice that the tools are not behaving as you expect, check to see if the Caps Lock Key is depressed.

Output

Style of Output

Swivel images, or, pictures of what is displayed on the screen, can be printed, or saved for use in other programs several ways. You can set the mode by which Swivel prints and writes image files to best match your intended use. This can be done by setting the *Output Style* in the Edit Menu. Swivel can output pictures of the current document and its objects as Paint-type images or as Draw-type images. Either style can be printed or exported to other programs.



Paint-Type

This is the standard (default) output mode. The image created by Swivel will be a bitmapped image of the current Swivel Document—just as it appears on the screen. Use *Paint-type* output for shaded, or shadowed images, and images with projected images, or complex intersections. Paint-type images require less memory, and can be re-drawn by the computer more quickly than Draw-type images.

Draw-Type

For higher-quality line drawing, use the *Draw-type* output mode. This will save the image as a set of procedures used to draw the image (a listing of lines, polygons and patterns), rather than as a bit map. Draw-Type is appropriate for use with drafting programs, plotters, and color printers. Wireframe or hidden-line objects work particularly well. Complex intersecting objects, or models with shadows and projected images don't print as well using Draw-Type. Every polygon in Swivel 3D models is drawn separately in Draw-type mode (including those back-facing polygons that do not show in the final image). For this reason, Draw-type images are slower to re-draw and often require more memory.

Printing a Swivel Image to the Imagewriter

For Best Results

In printing simple wireframe or hidden-line images, choose the Draw-Type mode. For shaded, edged or shadowed images, use the Paint-Type mode.

On a Mac II, be sure that the monitor mode is set at 2 *Bits*. (Look in the control panel under the Apple Menu). On the SE or the Plus, no change will be necessary.

Choosing Your Imagewriter

Be sure that your Imagewriter is the chosen printer. Select Chooser from the Apple Menu and select Imagewriter as the current printer. Select the port that your Imagewriter is attached to.

Page Set-up

To change or check how the imagewriter will print your Swivel Image, select *Page Set-up...* from the File Menu. It will present you with a dialog in which you may set the size of paper you are using, the page orientation and the scale of the printed image.

Print

Now that your printer is chosen and the page is set, you may print. You don't have to choose the printer or establish the page set-up again, unless you wish to change the settings. Select *Print..* to choose the print quality you wish, (*Draft* does not function with Swivel 3D) and click on Ok.

Laserwriter

For Best Results

On a Mac II, be sure that the Monitor mode is set at 2 Bits. For simple wireframe or hidden-line images, select Draw-type Output Style. For complex shaded, edged or shadowed images, use Paint-type. Images printed in reduced size will have higher resolution.

Checking the Printer Settings

As with the Imagewriter, it is good to check the Chooser and Page Set-up dialogs before you start a printing session on a LaserWriter.

Print

Select *Print..* and click on OK .

Saving Before Printing

As with all software, it is *always* a good idea to save your file before sending it down all those cables. In fact, it's a good idea to save regularly throughout your Swivel session. **NOTE:** Saving the Picture file is *not* the same thing as saving the entire Swivel file. This operation only saves a picture of the Swivel file as it currently looks.

Using Swivel 3D Images With Other Graphic Programs

There are three major ways to export images made by Swivel to other graphics applications. Depending on whether you are exporting one object, exporting the entire world or building an animation, you may use *Save Picture* from the File Menu or *Write Paint* in the Tween Panel, or you can paste objects directly from Swivel to the Scrapbook.

Saving Picture Files

Choosing *Save Picture* from the File Menu will create and save an image of the whole Swivel document to a file. The file will automatically be named and numbered starting with "Link.Paint 0000". Link.Paint files must be opened from a graphics application. They cannot be opened from the desk top.

The type of picture file Swivel saves depends on the color environment and the Output Style chosen. Paint-type images saved on the Mac Plus, SE, or on the Mac II in 2-bit mode, are saved as PTNG files (MacPaint Files). Color images are saved as PICT files. All Draw-type images are saved as PICT files.

Because Swivel renders much faster than most drawing programs, objects and models with a large number of polygons, subsequently saved as Draw-type, may take a very long time to redraw in another application. This normally won't matter, if, for instance, you are taking a hidden-line image into a drafting program to add text, and you don't intend to work directly on the object. If the drawing delay becomes a problem, you may want to save the subassemblies of the model with fewer polygons separately, or save as a Paint-type picture.

Saving While Tweening

To generate a large number of picture files for an animation program or for a presentation of a sequence of images, use the Save Paint Option in the Tween Panel. See the section on *Tweening* for a discussion of setting up and generating a smooth sequence of images. Another Tweening option allows you to write a picture file directly to the Scrapbook for each frame.

Using the Scrapbook

The Scrapbook is a good way to transfer numerous small objects to other applications. Click on the object you wish to save to the Scrapbook. It will now be flashing. Choose *Copy* from the Edit Menu. The object is now on the clipboard. Open the Scrapbook from the Apple Menu and paste the object in the Scrapbook. To copy a tree, select and copy the base/parent object.

Tips for Using Swivel with other Applications

MacPaint, Full Paint, SuperPaint and other Paint Programs

Set Output Style to Paint-type. Choose *Save Picture* from the File Menu, or cut and/or copy the image and then paste it to the Scrapbook. The file will become a Paint-type file. Swivel objects from the Scrapbook will be rendered as bitmaps in any of the compatible Paint programs. On a Mac II, set the monitor mode to 2-color (black and white). The Paint-type programs do not render colored images.

MacDraw or MacDraft

Set Output Style to *Draw-Type*. Choose *Save Picture* from the File Menu, or cut and/or copy the image and then paste it to the Scrapbook. The file will become a PICT file.

Pixel Paint

Set the Monitor mode to 256 color on a Mac II. Set the Output Style to Paint-Type. Cut or copy the object to the Scrapbook, or choose *Save Picture* from the File Menu. The file will become a PICT file. Once in Pixel Paint,select the PICT icon before opening the Link.Paint file.

Image Studio

This program will accept Swivel images only from the Scrapbook or Clipboard. In either case, set the Output Style to *Paint-type*. Copy and paste the object to the Scrapbook, or use *Write to the Scrapbook* in the Tween Panel.

Adobe Illustrator '88

This program will accept PICT files. Save the image as a Draw-type file. Adobe Illustrator 88 handles color images, and will generate an Encapsulated Postscript (EPSF) File.

Encapsulated Postscript File (EPSF)
At this time, Swivel does not produce Encapsulated Postscript files. To convert a Swivel document for output as an Encapsulated Postscript File, try one of the following:

- Paint-type conversion: Transfer a Swivel file to Image Studio or Pixel Paint as described above, make any modifications and save from those applications as Encapsulated Postscript File.
- Draw-type file conversion: take the image into Adobe Illustrator 88. Use the Draw-type *Style Output*, and *Save Picture*.

Using Swivel 3D for Animation

To move tweened sequences of images to VideoWorks, use the *Write to Scrapbook* Option in the *Tween* panel. VideoWorks will accept color or black and white images.

Using Swivel 3D With Hypercard

Either Paint or Draw-type picture files can be opened in Hypercard from the Scrapbook or opened as *Link.Paint* files.

Making slides and Photographs from Swivel 3D Models

Photographing Swivel Models from the Monitor Sometimes it is useful, if not imperative, to be able to take slides directly off the monitor. These instructions are intended *only* as a rough guide because monitors differ widely. *Always* leave yourself time in the schedule to reshoot if necessary.
Use a tripod to steady your camera. A telephoto lens also helps, if one is available. Darken the room to avoid reflections on the screen. Line up the camera square to the monitor, and keep it level.

Use Ektachrome Professional, ASA 200 film. The shutter speed has to be quite long to minimize and even-out the scan lines from the monitor. Start with a half second. Bracket the aperture as widely as possible at least from f3.5 to f5.6. Keep a record of your shots, including the film type, ASA, shutter speed, f-stop, and the brightness setting on the monitor so that if the first batch isn't successful,you'll have exact information with which you can adjust your shots the next time (or, if they come out perfectly, you can repeat the process another time).

Photographing Printed Copy Another option for producing slides and other presentation materials is to print the file and photograph it as hard (paper) copy, preferably on a copy stand.

Cutting, Copying and Pasting Swivel Objects

Swivel objects can be cut or copied and then pasted to other Swivel documents or to the Scrapbook by selecting the object and choosing Cut or Copy from the Edit Menu. Paste the object using the Paste command. Once it has been pasted, the object is still a Swivel object, with all the Swivel information. The clipped image can be pasted into word processors and graphics programs. Complex Swivel objects may not print, or even be displayed, when pasted directly into large word processor files on Macs with limited memory. In those cases, it is better to save the image as a picture file.

User Interface Description

Swivel 3D Documents

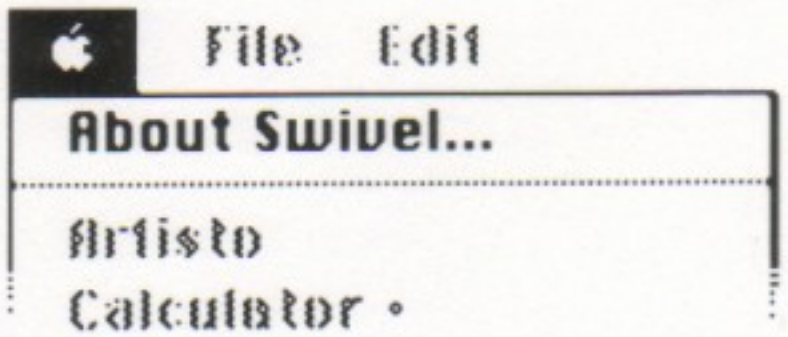
When Swivel first opens, a new, untitled document is created. The frontmost window is the active current document. Any menu choice, such as those that involve saving, closing, or printing, applies to the current document. Up to four Swivel documents can be open at one time. Objects cut or copied from one file can be pasted in another. It's a good idea to save your file regularly while you are working, and especially before printing.

A Swivel document has two views: the World View, which shows all the objects from the current World orientation, and the Design Object View, which shows the form of an individual object. Each view has a set of tools used to edit and change objects.

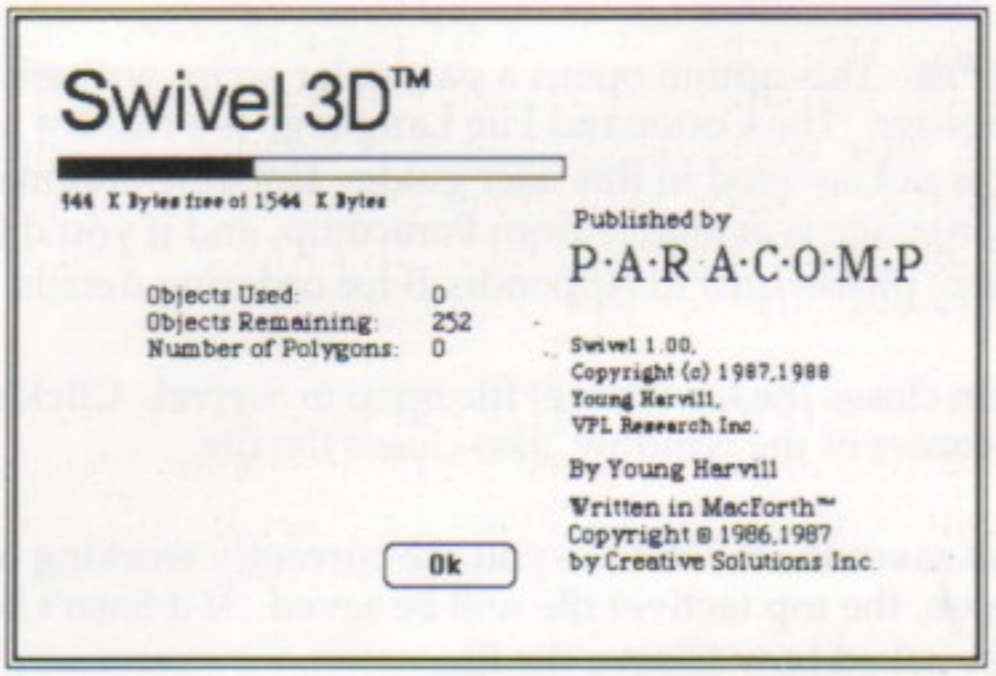
Using Menus and the View Tools you can create, move, spin, shape, and edit objects. They are the main building blocks of the User Interface.

The Menus

Apple Menu

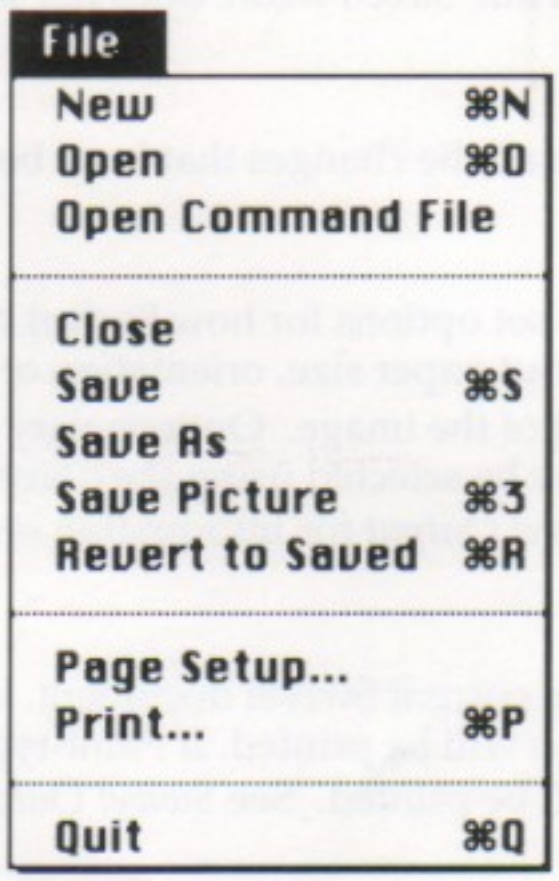


About Swivel 3D This menu option provides you with information about memory usage, number of objects in the current document and software version information.



Desk Accessories (DA's) DA's such as the Scrapbook, may be opened and used with Swivel. Swivel will automatically detect changes in the color or display settings made by DAs (such as the Control Panel) and reflexively update the documents.

The File Menu



New This option creates a new Swivel file, opening up an "untitled" screen display.

Open This option opens an existing Swivel file.

Open Command File This option opens a particular script written in the Swivel *Command File Language.* The Command File Language is a feature for advanced Swivel users and is not covered in this user guide. Documentation on the Command File Language is available from Paracomp, and if you'd like to receive further information, please turn to Appendix B for ordering details.

Close This option closes the *top* (active) file open in Swivel. Clicking the Exit box, in the upper left corner of the window, also closes the file.

Save This option saves the Swivel file you are currently working on. If several documents are open, the top (active) file will be saved. If it hasn't been saved before, you will be asked how to save the file.

Save As This option saves a copy of the Swivel file you are working on, under a new name. The old version is left unchanged.

Save Picture This option saves a picture of the scene as a Paint- or Draw-type file for editing or printing in a draw or paint program. The new document is automatically titled and numbered sequentially, which allows rapid saving for building animation sequences. Files will be named Link.Paint 000, Link.Paint 001, etc. Save Picture will save either a Paint-type or Draw-type file depending on the Output Style selected under the Edit menu. Save Picture does not save the Swivel Document itself.

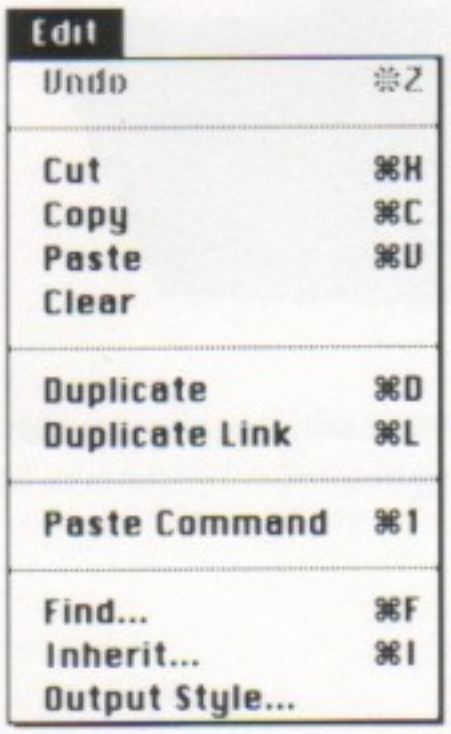
Revert to Saved This option will undo all the changes that have been made since the file was saved.

Page Setup This option allows you to set options for how Swivel documents will be printed. Options include choices about paper size, orientation of the image on the page, and reduction or enlargement of the image. Options vary depending on the printer that is selected. (Printers may be selected using the *Chooser* Desk Accessory in the Apple Menu.) See *Swivel Output* for information on using specific printers

Print This command serves to print the current Swivel document. If Draw-type Output style is selected, sorted polygons will be printed. If Paint-type is selected, the bitmap of the current document will be printed. See *Swivel Output* for information on using specific printers

Quit This command allows you to quit the application and return to the desktop. If there are open files that have not been saved, Swivel will ask you about saving each document before exiting to the desktop.

The Edit Menu



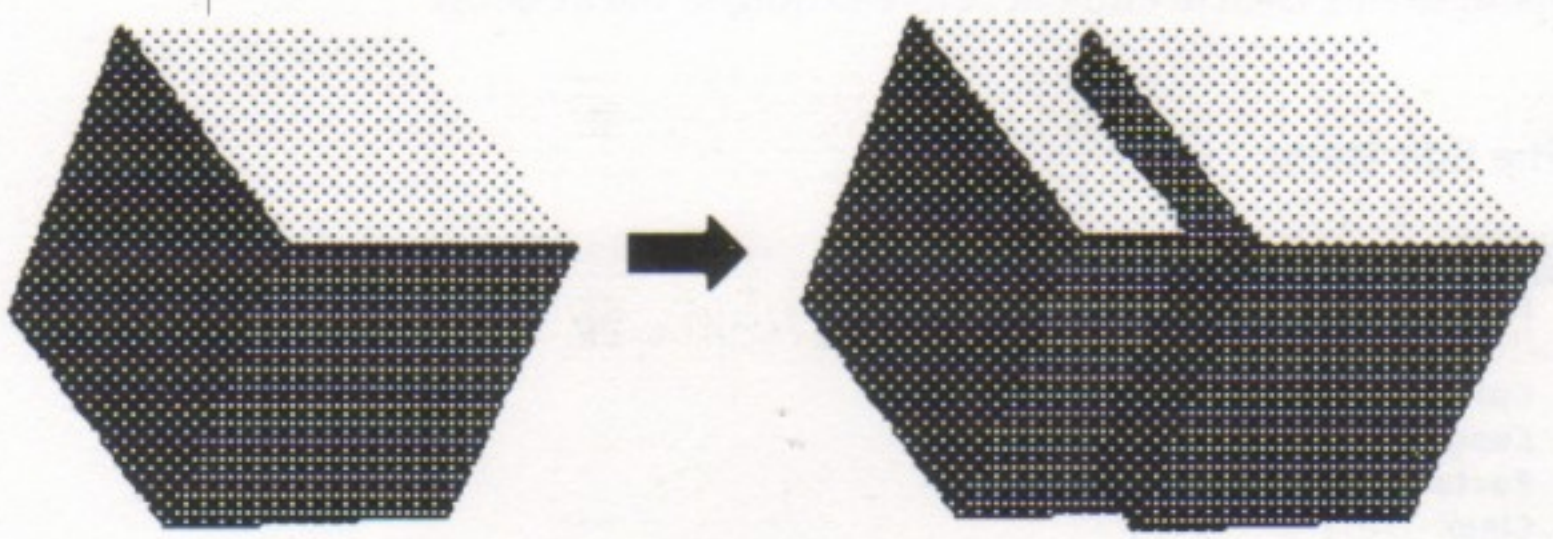
Undo This command cancels the last action. Selecting Undo a second time repeats the action, but returns you to the "pre-Undo" state.

Cut This command cuts an object and its links from a Swivel document and places it on the Clipboard.

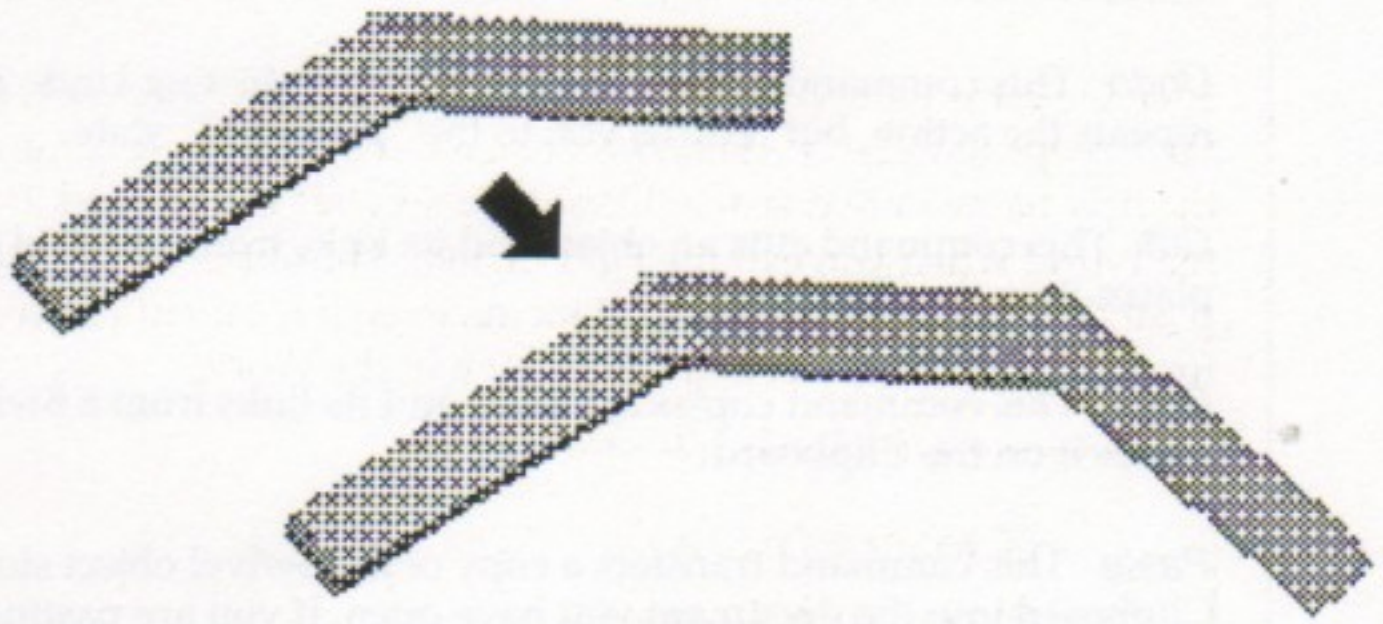
Copy This command copies an object and its links from a Swivel document, and places it on the Clipboard.

Paste This command transfers a copy of the Swivel object stored on the Clipboard into the document you have open. If you are pasting the Clipboard information into a selected object the pasted object *replaces* it and takes the selected object's attributes: it's position, orientation, and scale.

Clear This command deletes the selected object. (Undo will reverse the effects, if the *Clear* command was applied inadvertently.)

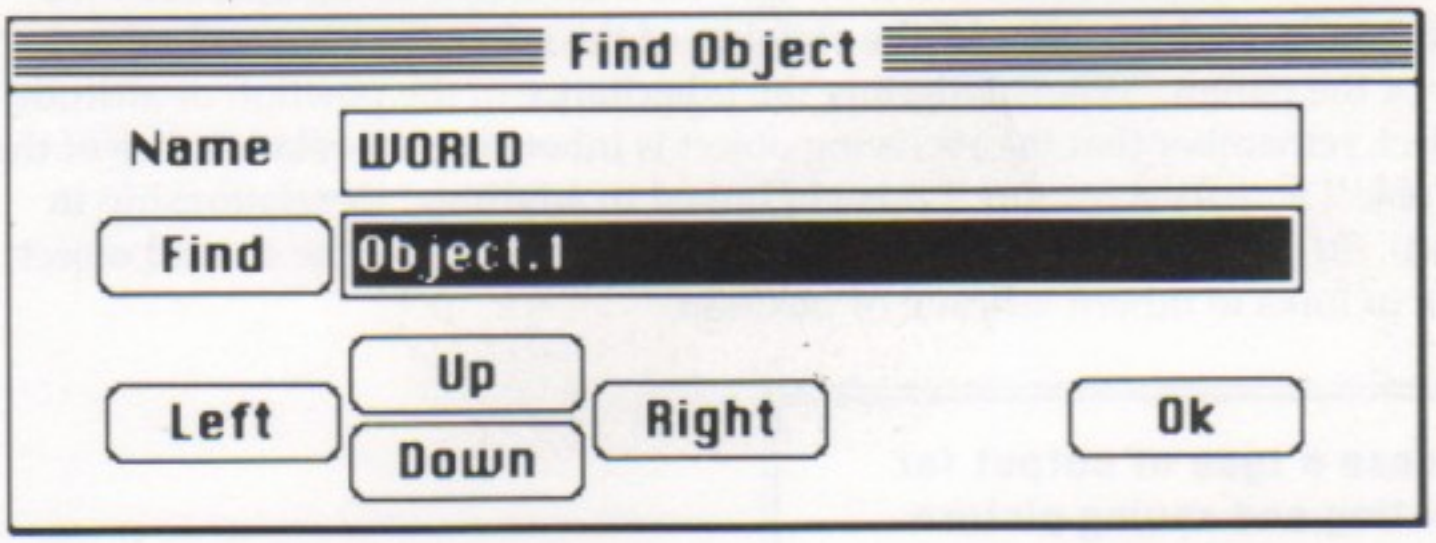


Duplicate This command duplicates the current object, along with any links (down-tree objects). If a spacing pattern of duplicated objects has been established, Swivel will follow that pattern.



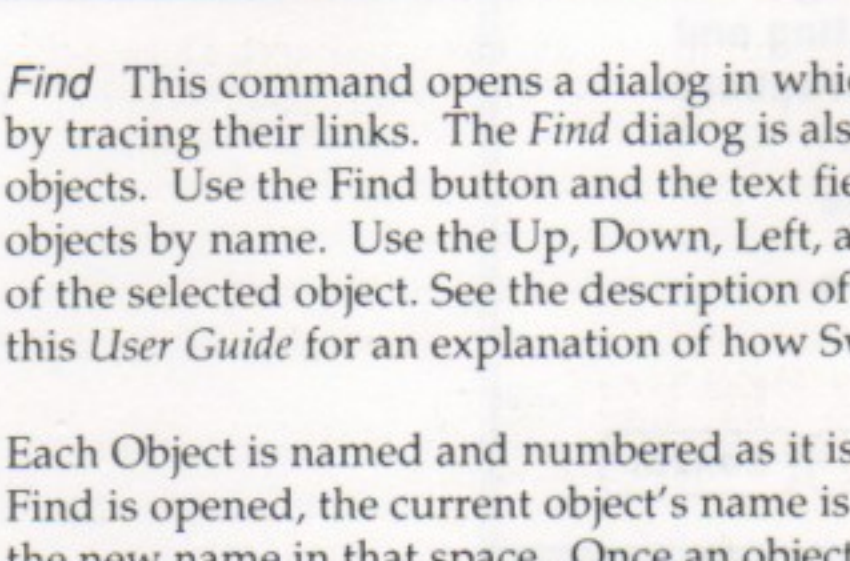
Duplicate Link This command duplicates the object and all of its linking constraints, position, attitude, scale and form to a new object. *Duplicate Link* is useful for natural forms such as shells, trees and tentacles, or for geometrically-repeating forms, such as spiral staircases.

Paste Command This command pastes a command from the Swivel Command File Language. See Appendix B for information on obtaining Command File Language documentation.

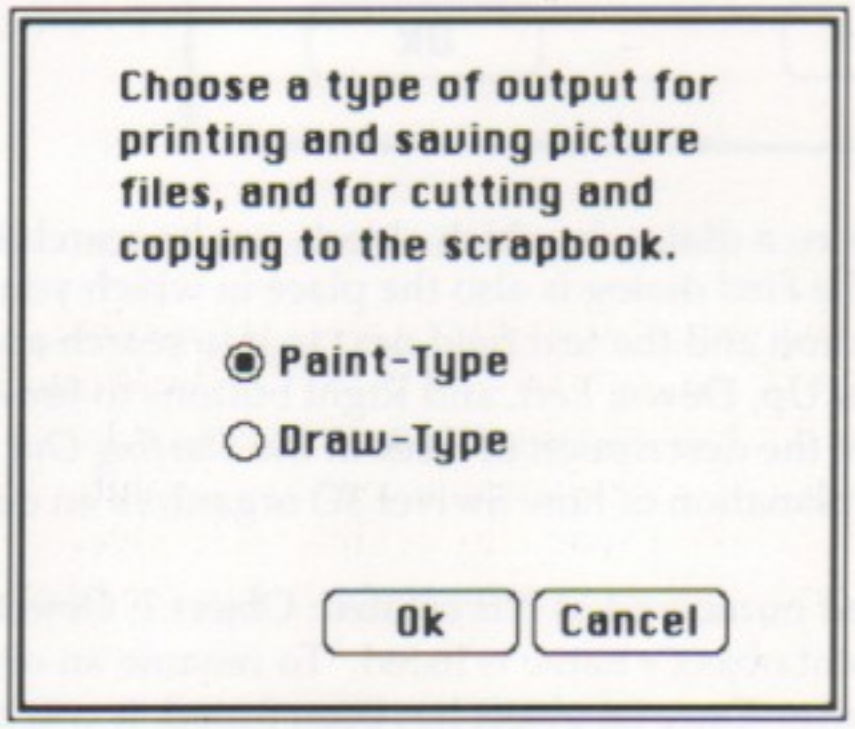


Find This command opens a dialog in which objects can be searched by name or by tracing their links. The *Find* dialog is also the place in which you can name objects. Use the Find button and the text field next to it to search and select objects by name. Use the Up, Down, Left, and Right buttons to browse the links of the selected object. See the description of trees in the *Starting Out* section of this *User Guide* for an explanation of how Swivel 3D organizes an object's links.

Each Object is named and numbered as it is created: Object.1, Object.2, etc. When Find is opened, the current object's name is listed. To rename an object, type in the new name in that space. Once an object has been found, it will be selected in the World when you exit the Find dialog. The object can then be edited by position or attitude in the object menu, even if it cannot be seen. This is useful for finding a lost object and centering it in the World.

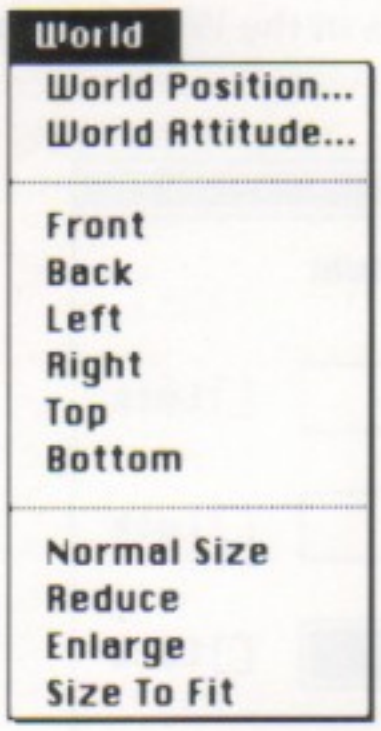


Inherit This command opens a dialog offering six *Inherit* options. Use the *Inherit* dialog to endow all the down-tree objects with one or more of a parent object's qualities. For example, if you wish to make all the objects in a given tree the same color as the parent object, first choose Inherit, then set Color as the only selected item, and finally, click on OK. All the children of the selected object will inherit the color of the parent. When assigning the inheritance of the position or attitude of an object, remember that the receiving object is inheriting the relationship of the selected object *with its parent* (or if it is not linked to anything, its relationship in the World). In practical terms this means that you must choose the second object in a chain of links to inherit attitude or position.

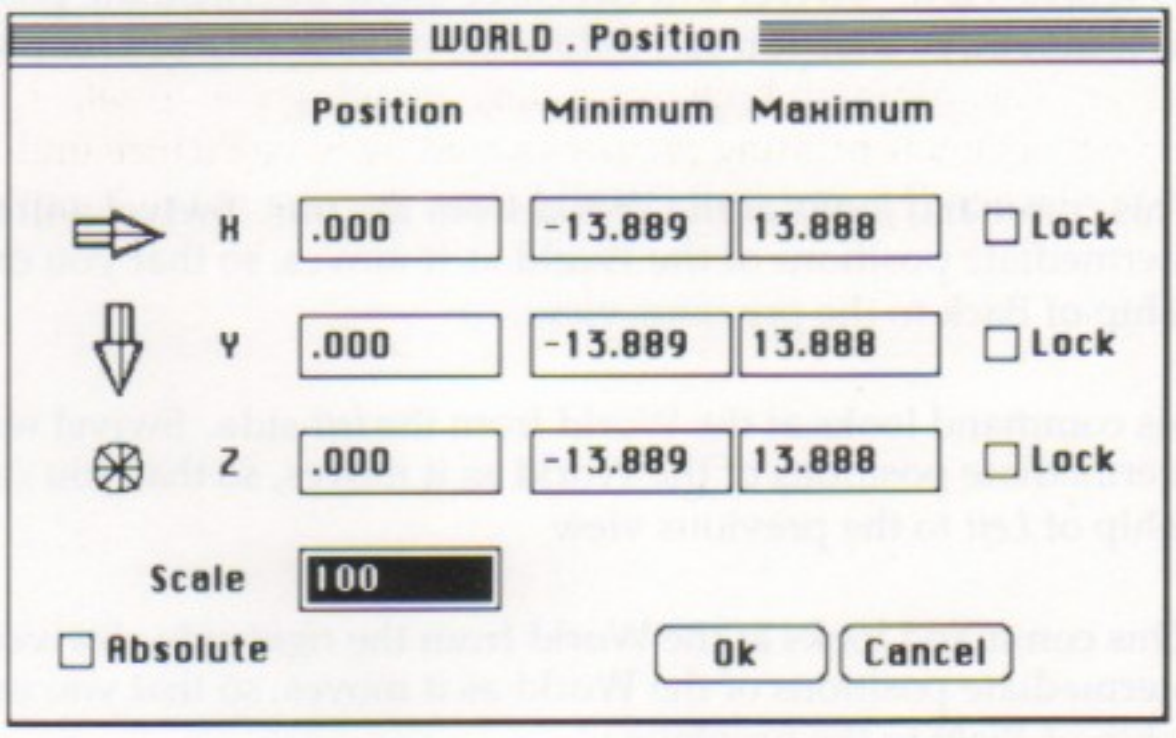


Output Style This command opens a dialog allowing you to select how objects are drawn for exporting or printing pictures saved by Save Picture under the File menu, in the Tween Options, or by cutting and pasting to the Scrapbook.

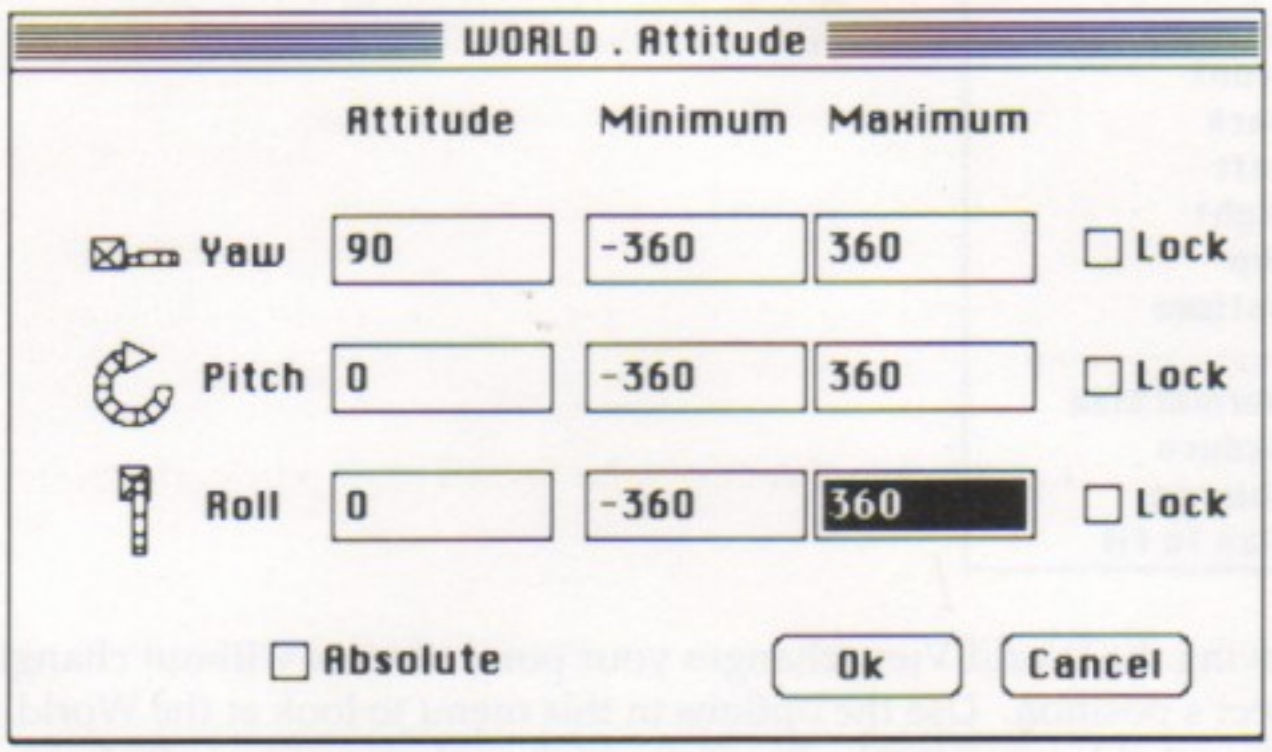
The World Menu



Moving the World View changes your point of view without changing the object's position. Use the options in this menu to look at the World from different sides, to get "the Big Picture" (by selecting *Size to Fit,*) or to examine details (by selecting *Enlarge.*) The World's positions are absolute: Top is still top—no matter how many rotations you may command. Swivel will tween the move to the World view you have selected so that you can see how you got there.



World Position This command opens a dialog in which you can edit the position of the World in X Y and Z, as well as its scale. The World moves relative to the user's view of it. All relationships *between* objects in the World are unchanged. The scale of the World can also be edited.



World Attitude This command opens a dialog for editing the attitude of the World in any combination of Yaw, Pitch, Roll.

Front This command rotates the World in order to offer a view of the model from the *Front* World View. Swivel will tween, or show intermediate positions of the World as it moves, so that you can follow the relationship of Front to the previous view.

Back This command looks at the World from the *rear*. Swivel will tween, or show intermediate positions of the World as it moves, so that you can follow the relationship of Back to the previous view.

Left This command looks at the World from the *left* side. Swivel will tween, or show intermediate positions of the World as it moves, so that you can follow the relationship of *Left* to the previous view

Right This command looks at the World from the *right* side. Swivel will tween, or show intermediate positions of the World as it moves, so that you can follow the relationship of *Right* to the previous view

Top This command looks at the World from the *top* side. Swivel will tween, or show intermediate positions of the World as it moves, so that you can follow the relationship of *Top* to the previous view

Bottom This command looks at the World from underneath. Swivel will tween, or show intermediate positions of the World as it moves, so that you can follow the relationship of *Bottom* to the previous view

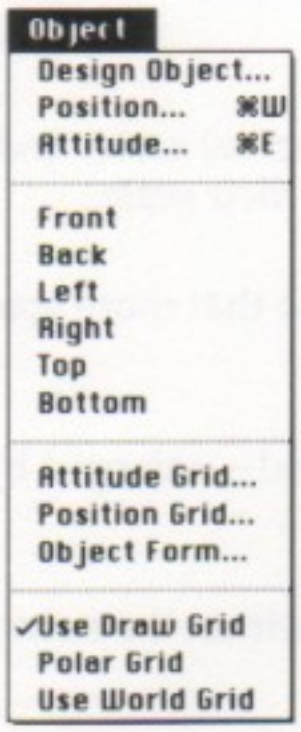
Normal Size This command redraws the World at actual scale. Individual objects that have been scaled up or down will retain their scale.

Reduce This command shrinks the World by 25% so that more space is visible. The actual size of objects is unchanged.

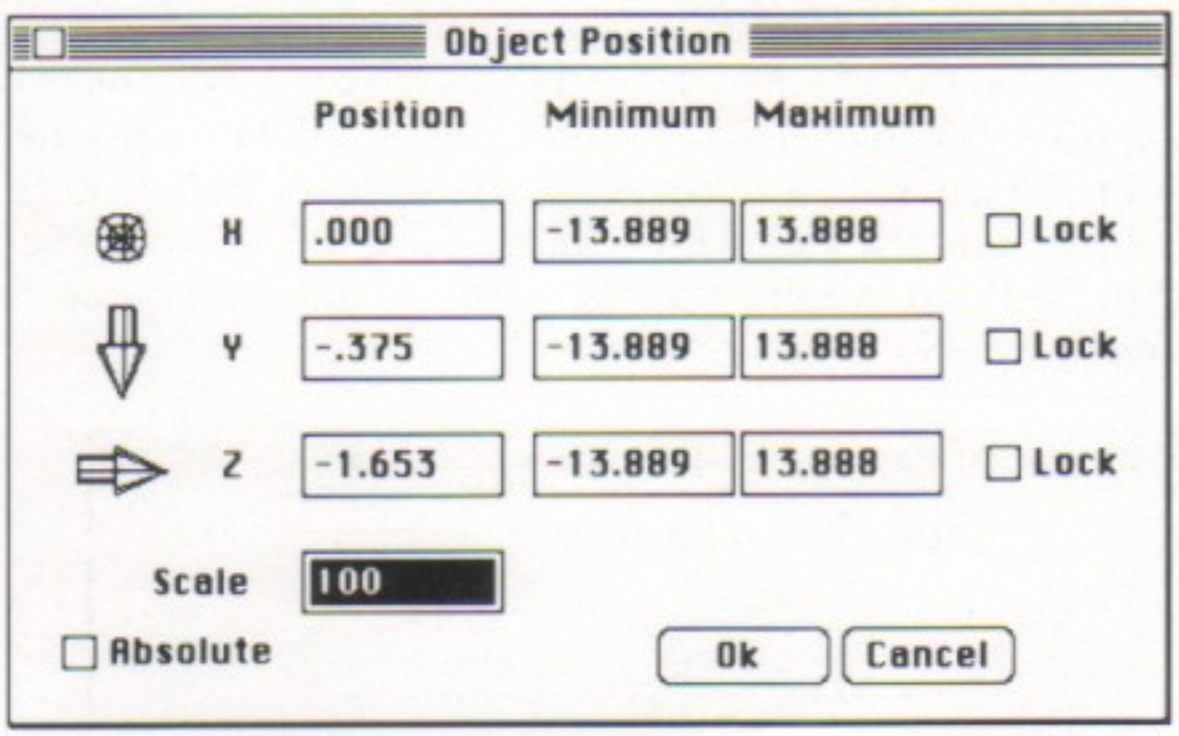
Enlarge This command offers a close-up of the World—enlarged by 25%. The actual size of objects is unchanged.

Size to Fit This command reduces the World to fit within the current window size.

Object Menu



Design Object This command opens the selected object in *Design Object View*—as does the action of double-clicking on the object. This option can be helpful when an object is difficult to click on because of the way it is incorporated into accompanying objects. *Find* can locate the object for designing. If no object is selected, nothing will happen.



Position This command opens a dialog for editing the current position of the object and its allowable range of motion. Values for positioning can be set separately for each X, Y and Z axis. The arrows by each axis indicate the direction the object will shift. Assigning *negative* numbers will move the object in the reverse of the direction shown by the arrows.

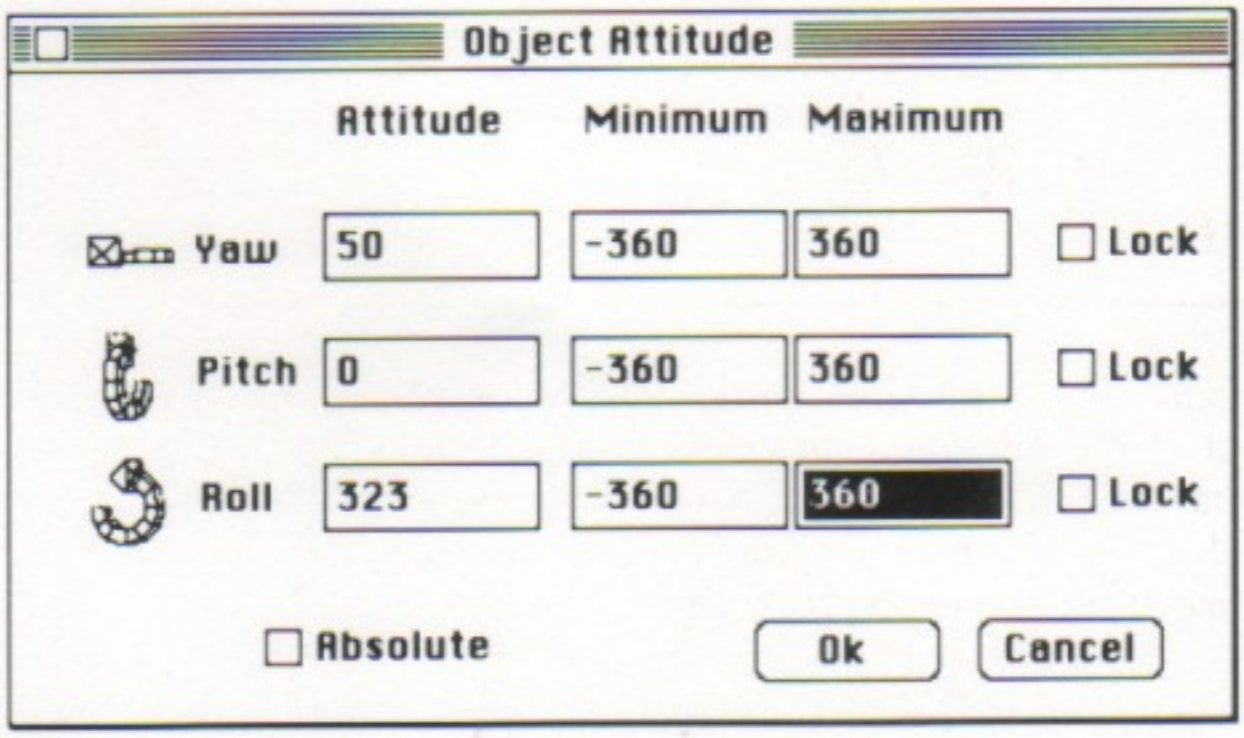
The object's position is measured relative to its parent object—if it has one. In this case, be sure that *Absolute* is checked. The object's position is measured from center to center. In the example, the center of the object is lined up with the center of its parent object in X. It is located -.375 from the center of its parent object in Y, and -1.653 from the parent object center in Z. If an object has no parent object, then its position is measured relative to the center of the World.

Checking the Lock box will prevent *any* motion of the object in that axis. This can be very important in aligning objects, as well as in building models whose moving parts are constrained within certain limits.

Absolute means that distance is measured from the center of the World to the center of the object. The units shown are inches, centimeters, or screen units, depending on which is selected in the *Position Grid*. The default unit is inches.

The *Maximum* and *Minimum* numbers are the range the object is allowed to move in each dimension. You might limit an elevator to travel up and down only the length of its shaft, or a chair to roll only to the end of its floor space. One easy way to set limits is to move the object to the desired stopping point by eye, then open the Position editing dialog. The current object position will show in the first column. Type the number into the maximum or minimum box for the axis to be limited.

Scale is the size of the object. All objects are created at full size, or 100(%). You can change the scale in the *Position* editing dialog by typing in a new number. For example, 50 will reduce the object in size by half; 200 will magnify it to two times its size. Scale changes made with the Scale tool in the World View will show up in the Position editing dialog. Use it to fine-tune a scale change you've already made by eye.



Attitude This command opens a dialog for editing the orientation of the object in space. In this panel, the current angle of the object and its allowable range of motion can be set separately in Yaw, Pitch and Roll. The arrows show how the object will rotate. Checking the *Lock* box will prevent any motion of the object in that degree of freedom. Editing can be *absolute* (relative to the World) or relative to the parent object. Angles are measured in degrees.

As with the *Object Position* editing dialog, use of the *Attitude* editing dialog is especially helpful when you move back and forth between adjusting angles numerically, and adjusting them by eye in the View Object Window.

Front This command swings the drawing around so that the front side of the selected object is facing the viewer. This doesn't alter any of the objects, or their positions, although things may look very different from what you expected. It is very useful when you are aligning objects.

Back This command swings the World around so that the Back side of the selected object is facing the viewer.

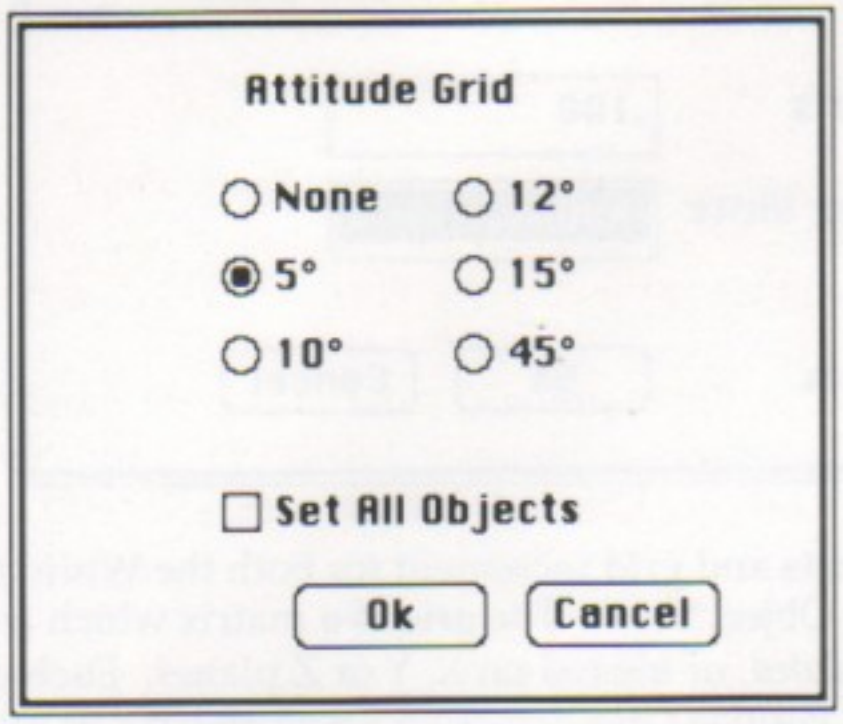
Left This command swings the World around so that the Left side of the selected object is facing the viewer.

Right This command swings the World around so that the Right side of the selected object is facing the viewer.

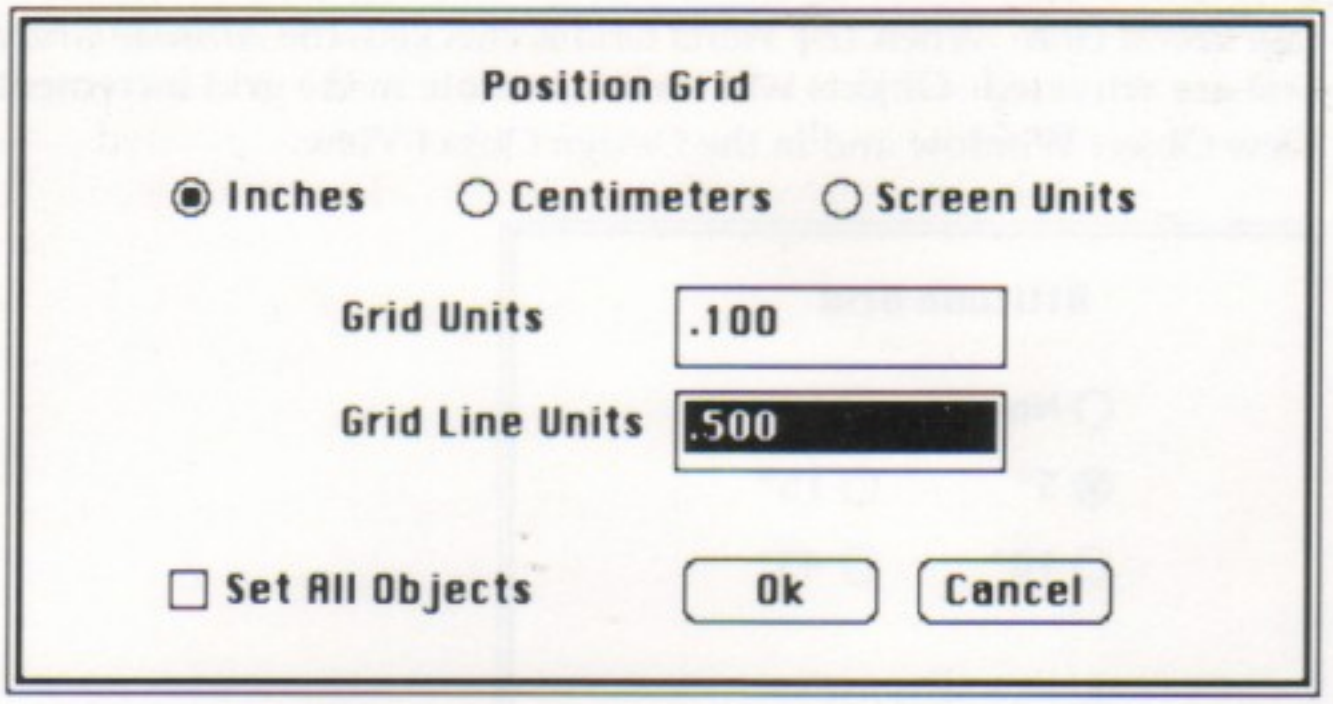
Top This command swings the World around so that the Top side of the selected object is facing the viewer.

Bottom This command swings the World around so that the Bottom side of the selected object is facing the viewer.

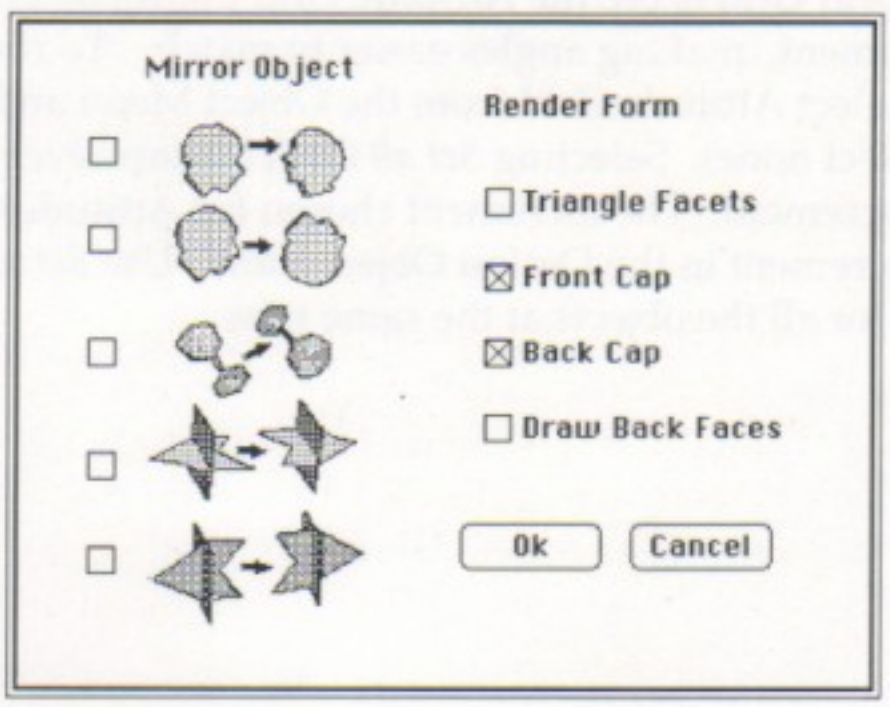
Use World Grid When *Use World Grid* is checked, the *Attitude Grid* and *Position Grid* are activated. Objects will travel or rotate in the grid increments both in the View Object Window and in the Design Object View.



Attitude Grid Use this dialog to set the Attitude grid for the selected object. When the World Grid is on, the Attitude Grid allows objects to be rotated to the selected increment, making angles easier to match. To rotate in finer increments, select Attitude Grid from the Object Menu and choose a smaller degree (or select none). Selecting *Set all Objects* snaps everything in the World to the nearest increment. The increment chosen for Attitude Grid also controls the Polar Grid increment in the Design Object View. Use *Set all Objects* to set the attitude grid for all the objects at the same time.



Position Grid Sets the units and grid increment for both the World Grid and the Draw Grid in the Design Object View. The grid is a matrix which an object will "snap to" when it is *translated*, or moved on X, Y or Z planes. Each object in the World may have its own *Position Grid*. Selecting *Set all objects* sets all the objects in the World to have the same grid and system of measure you have selected.



Key to "Mirror Object" options: (from top down)

- Horizontal Cross Section
- Vertical Cross Section
- Horizontal Top and Side Sections
- Vertical Top Section
- Vertical Side Section

Object Form This command opens a dialog for editing an object's form by "mirroring" it , thus controlling the way that Swivel alters the object's form. The following operations are effected by use of this command.

Mirror Object —This option clips an object's shape across various horizontal or vertical planes. This is useful when you need matching pairs of asymmetrical objects. If, for example, you have constructed a right forearm, you can make a left forearm by duplicating the right, selecting it, and choosing Horizontal Top and Side in the Mirror Object column. When you click on OK and return to the World View, the duplicate object will be a mirror image of the right forearm. It will be mirrored across the object's XY mid-plane.

Render Form—The check-boxes in this column let you override the way Swivel is rendering the form of your object.

Triangle Facets—Swivel normally renders objects with *rectangular* facets, but if you have a very asymmetrical form, you may wish to have an object rendered with *triangular* facets instead.

Front Cap and Back Cap—If you open the *Object Form* dialog, and find that *Front Cap* and *Back Cap* are checked, Swivel will identify this item as a extruded-type object. Additionally, when an object is created, Swivel checks to see if the ends are flat to identify an extruded-type object. If the ends are flat, Swivel will automatically cap the front and back planes of the object with a single polygon rather than constructing a faceted surface that meets at the center. You can override this decision by setting these check-boxes to render the object as you wish. Note, though, that Swivel will reset them if you change the shape of the object in the Design Object View.

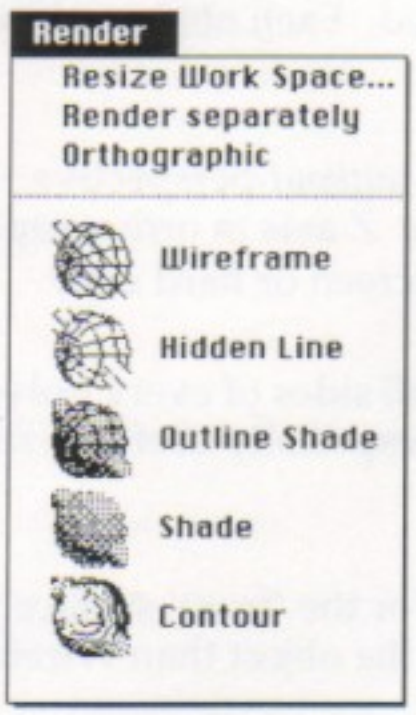
Draw Back Faces—Swivel will automatically decide whether or not to draw the rear-facing sides of objects. It does this by checking to see if the envelope of the object is closed. If it is, Swivel will not draw the back planes. In some cases, such as pulling objects through the hither clipping plane, you may wish the back sides of objects to be rendered. If so, check by this option. Note that Swivel will reset this option also, if the object's form is changed in the Design Object View.

Use Draw Grid When checked, this option makes the draw grid active in both the World and the Design Object View.

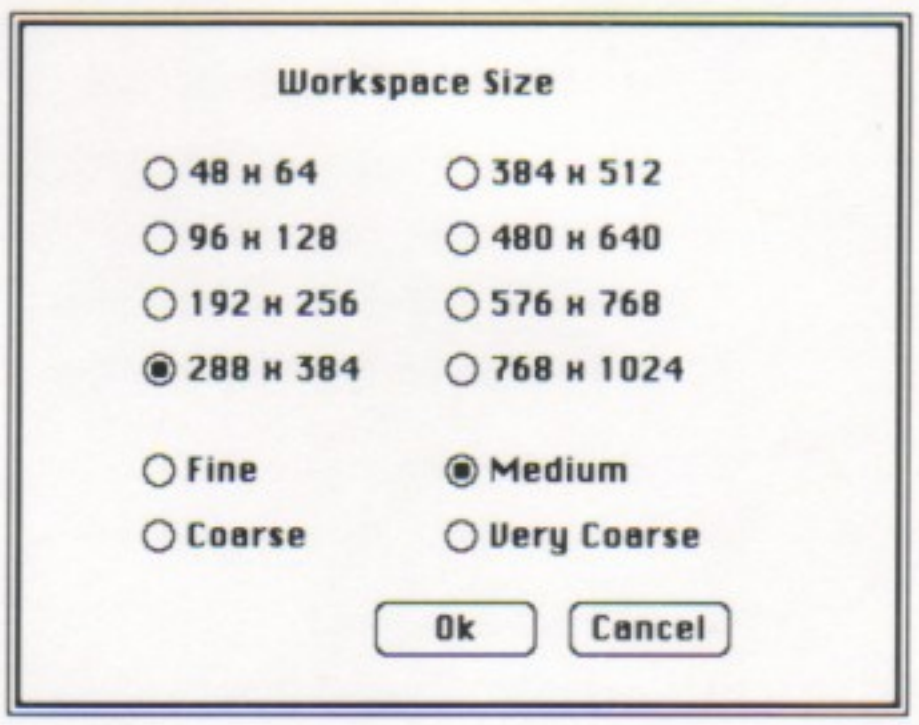
Use Polar Grid This is an alternative to the graph-paper style grid that you find when you first open the *Design Object* View. It allows you to shape round forms more naturally. The polar grid uses the angle increment defined in *Attitude Grid* as its angle increment, and different grid units can be selected there.

Use World Grid When *Use World Grid* is checked, the Attitude Grid and Position Grid are used to define a grid in the World View. Objects will "snap to" their new position and attitude by the grid increments.

Render Menu



Resize Workspace This command opens a dialog that offers choices between eight different sizes and four separate resolutions of the Workspace (the finite area in which Swivel operates). Units shown are in Screen Units. As soon as you have opened the dialog, Swivel determines the maximum size of Workspace that the available amount of memory can handle. A smaller Workspace requires less memory. If Swivel runs out of memory, you will be queried about resizing the Workspace. Resolution of the Workspace does not affect memory, but does change the appearance quality of the rendering, and the depth of the Workspace in the Z dimension. The default resolution is Medium. Choosing a coarser setting makes the Workspace deeper by spreading the units further apart. A finer Workspace resolution will have less depth, but afford you greater resolution of object intersections.



Render Separately This command renders each object separately according to the rendering style that has been selected. Swivel stores the rendering style of each object even when *Render Separately* is not selected. Each object can be rendered in a different mode.

Orthographic This command draws the world *without* perspective. Because objects do not diminish as they recede along the Z axis in orthographic mode, accurate measurements can be taken from the screen or hard copy.

Wireframe This command draws outlines for *all* sides of every polygon that comprises the object. Wireframe drawings are especially useful in that they reveal the internal structure of your object.

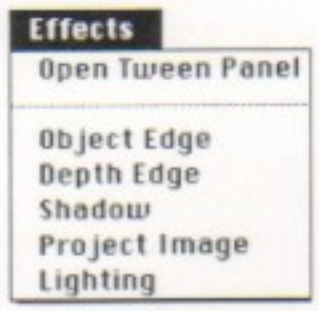
Hidden Line This command draws lines only for the 'front' surface polygons. Hidden Line provides a less confusing view of the object than Wireframe, which is especially helpful in viewing complex objects.

Outline Shade This command adds the poly-edge lines from Hidden Line to the tonal shade mode. The addition of edge lines clearly delineates the individual facets of the form.

Shade This command draws a tone-pattern on each face of the object, depending on the direction of the light.

Contour This command describes the surface of the object as a contour mapping. The effect is much like that of cross-hatched pen and ink illustration.

Effects Menu



The *Effects* menu offers display options that in most cases last only until the next time the model is moved or edited. The one exception is the *Lighting* command, (detailed in this portion) which remains set in a default position until it is intentionally redirected. These effects are usually the last to be applied in the preparation of an image for exporting or printing.

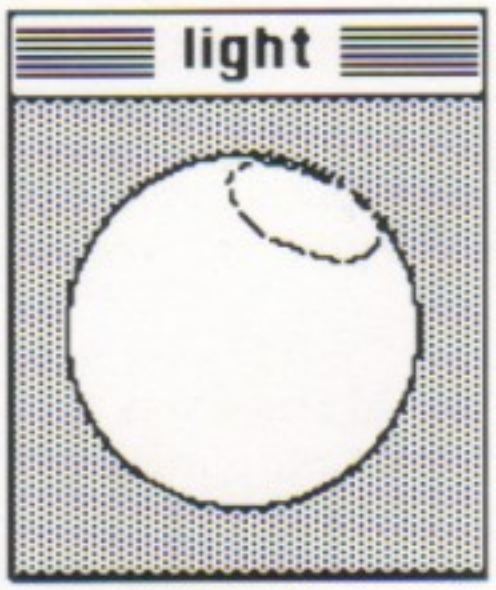
Open Tween Panel This command initiates the setting-up for Swivel 3D animation.

Object Edge This command redraws the scene once, with the outside edges of the objects reinforced. Defines separate objects clearly.

Depth Edge This command redraws the scene once with the steepest edges of the objects reinforced. Heightens the sense of depth in the scene.

Shadow This command redraws the scene once with the shadow cast by the objects in the path of the light source.

Project Image This command redraws the scene once, with the addition of an image (cut or copied from the Scrapbook) projected onto the object selected.



Lighting This command brings up the *Light* (Source) Window. Click and drag the Lens Circle (the smaller circle atop the larger circle) to change the direction of the light. The model will be lit from this direction until you change it again. The Lens Circle is also the light source for the "projector" used in *Project Image*.

The World View Tools Array

The World View is the "center stage" of Swivel. In using the World View tools, detailed in this section, you can create, link, manipulate, scale or color new images or objects. These are the objects that you will be printing, tweening, or saving as Paint or Pict files.

A Swivel programmatic visual "short-cut" should be noted here. During an operation that requires the position and rotation tools, a wireframe rectangular solid will be displayed, which represents the object. Any down-tree objects linked to it will appear as lines. Their positions relative to the object will stay the same.

XY Arrow This tool moves objects across the plane of the screen. Click on an object and drag it to a new XY position. Note that its down-tree objects will relocate accordingly.

XZ Arrow This tool moves objects in and out of space along the Z axis. Click on an object and drag it upward to push it back, or drag it downward to pull it forward. Left and right moves the object in X (horizontally).

Yaw Arrow This is the first of the rotational tools. It pivots the object around the Y axis. Click and drag the object to a new attitude. Holding the option or Command Key and dragging from side to side will also activate this tool.

Pitch Arrow This tool pivots the object around its X axis. Click and drag the object to a new attitude. Holding the Command Key and dragging from top to bottom will also activate this tool.

Roll Arrow This tool pivots the object around its Y axis. Click and drag the object to a new attitude. Holding the Command Key and dragging from top to bottom will also activate this tool.

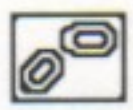
Scale Tool This tool makes the object larger or smaller. Drag the object downward to enlarge, upward to make it smaller.

New Object This tool creates a new object. Select this tool and click where you want to put a new object. The object will always be a default cube. Edit the object's shape by double-clicking it or by choosing *Design Object* from the Object menu

Free Link This tool attaches one object to another. Select the tool, click on the object you wish to link, and drag the link to the object to which you wish to attach it. Use the Edit Position or Edit Attitude items in the object menu to edit the constraints of the link. The linking line is stretched from the child object to the parent object. The child object is free to be manipulated independently. However, when a parent object is moved, its links, or children, move with it. See the section on linking in *Starting Out* for more information on linking hierarchies.

Lock Link This tool is similar to the *Free Link* tool, except that the link is entirely constrained. The child object (down-tree) cannot move at all, relative to its parent. Moving the child object will also move the parent in a locked link relationship.

Ball Joint Link This tool is similar to the *Free Link* tool, except that the link is constrained in X, Y or Z but is free to rotate as any ball joint should.

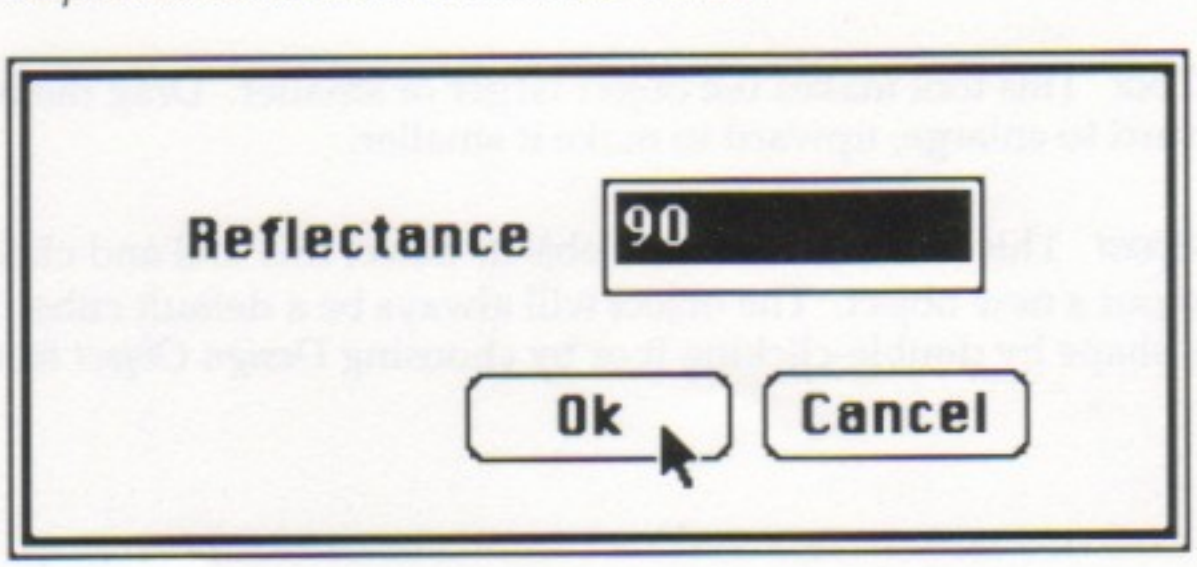


UnLink Tool This tool will undo a link with a single click on the child object.

Zoom In Tool This tool zooms in to the selected rectangle. Drag a rectangle around the portion of the World you want to view more closely. The World is unchanged; you are just seeing the object in a close-up view.

Zoom Out Tool This tool zooms out to the selected rectangle. Drag a rectangle showing the area you want to shrink the current view into. The World is unchanged; you can now see more of it.

Palette Tool Depending on whether you are working in color or black and white, the *Palette* tool opens the Macintosh Color Edit dialog, or a dialog for changing the reflectance (brightness) of the object. You can edit the reflectance or color of a selected object or of the background. For more information on color handling in Swivel 3D, see the section on *Color Handling on the Mac II* in the *System Requirements* section of this *User Guide*.



Design Object View

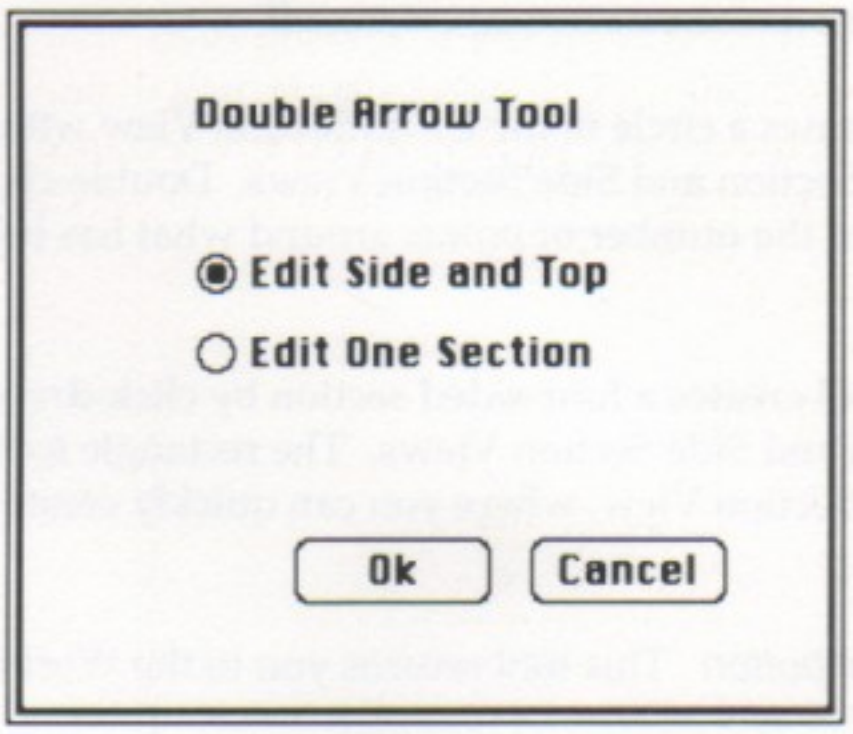
When an object is double clicked, or when *Design Object* is selected from the Object Menu, the *Design Object View* opens. The object will be displayed in four views: *Object View, Cross Section, Top Section* and *Side Section*. Drawing tools are arranged in a palette located on the left side.

The Wireframe view is updated after each edit to show the transformed object from the viewpoint of the side most-recently edited. Clicking on the vertical buttons on the left edge of each view (labeled *Top, Side,* or *Cross Section*) will expand the selected view to fill the entire window.

The center-point marked by cross hairs in the Top Section and Side Section views will be the pivot about which the object will yaw, pitch and roll. To reposition the center point, drag it to the new location.

Tools in the Design Object View

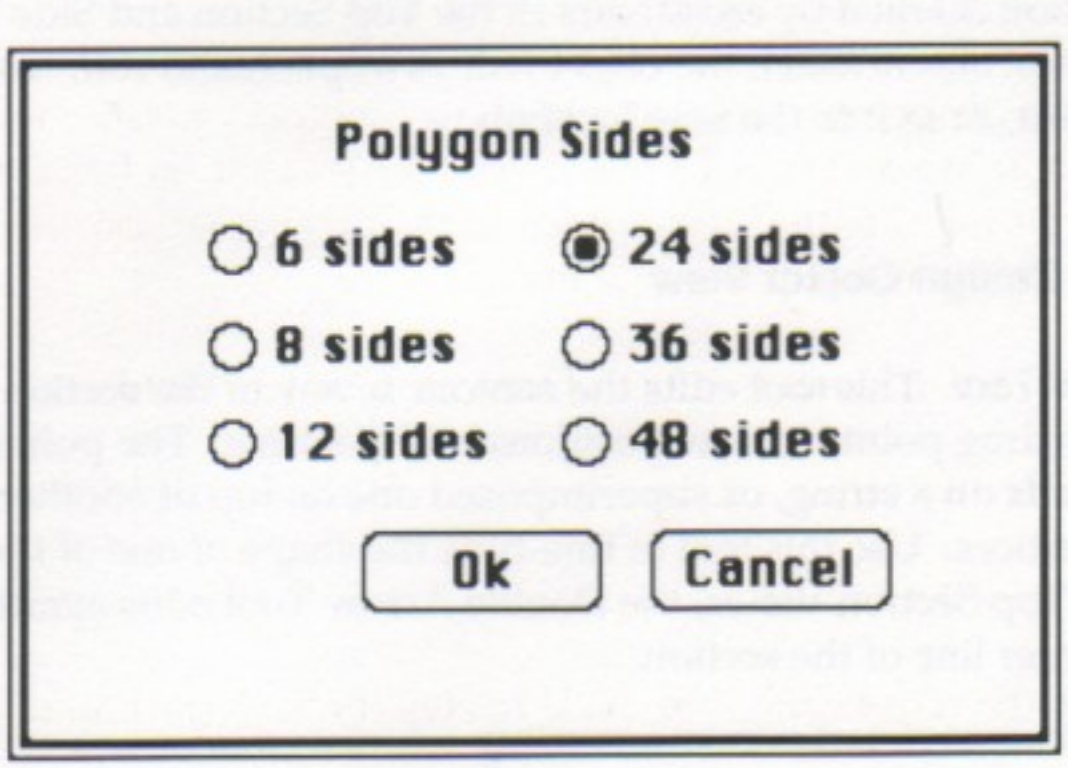
Double Arrow Tool This tool edits the contour in any of the section views. It allows you to drag points to new positions one at a time. The points can be slid along like beads on a string, or superimposed one on top of another to alter the number of vertices. Use this tool to fine-tune the shape of one of the views. In the Side and Top Section Views, the Double Arrow Tool edits symmetrically across the center line of the section.



Double-clicking on the Double Arrow Tool summons a dialog box in which you may establish whether the tool edits both the side and top sections at once, or edits them separately.

Single Arrow Tool This tool lets you drag single points in any view. It always edits the Side and Top Sections individually. It allows asymmetrical positioning of points. Use this tool to modify the shapes asymmetrically.

Free Poly Tool This tool draws a new object shape with a series of clicks, each of which will be a point along the object contour. In Top Section and Side Section views, the Free Poly Tool creates an object (symmetrically placed about the horizontal plane) with identical top and side Sections. In the Cross Section View, the Free Poly Tool makes only a single point with each click, and complex polygons can be drawn. In this view, the Free Poly Tool behaves the same as poly tools in other paint and draw programs.

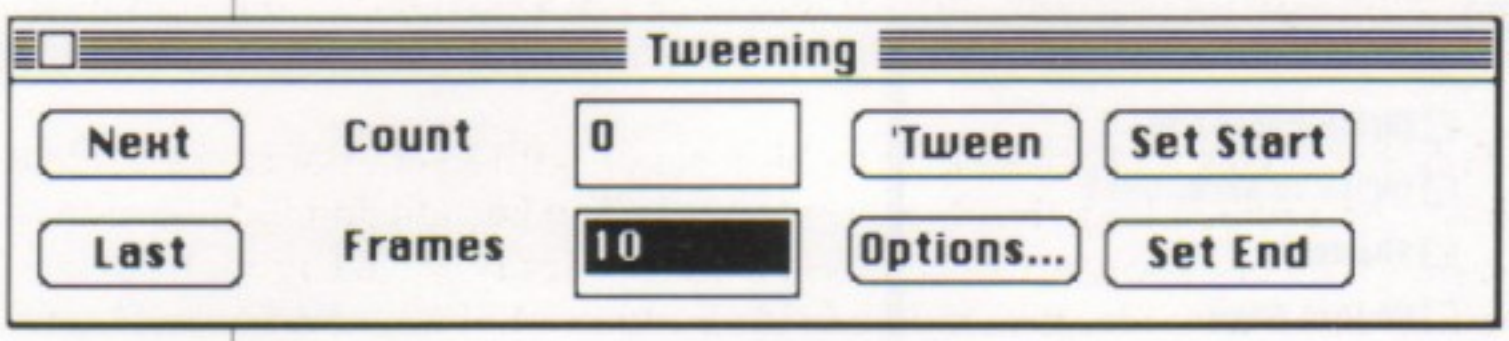


N-gon Tool This tool draws a circle in the Cross Section View with a single click, or drags a circle in Top Section and Side Section Views. Double-clicking on the N-gon tool gives a choice of the number of points around what has become a *circular* polygon

Rectangle Tool This tool creates a four-sided section by click-dragging out a rectangle in Top Section and Side Section Views. The rectangle tool works differently in the Cross Section View, where you can quickly create a square with a single click.

The Object View vertical button This tool returns you to the World View.

Tween Panel



Tweening describes the particular process of animating that creates a motion sequence by rendering of all objects between two positions. You can create an object and put it in one location in the World, then create another (different) object across the World from the first object. Then, with the Tweening dialog, you can set various parameters that will allow Swivel to automatically draw in the objects that move and transform between the starting and ending objects. Note that the simplest path is computed. In the dialog, you can establish values and command sequences for the animation.

Frames These are the total number of frames to be animated

Count The current frame.

Tween Performs the animation.

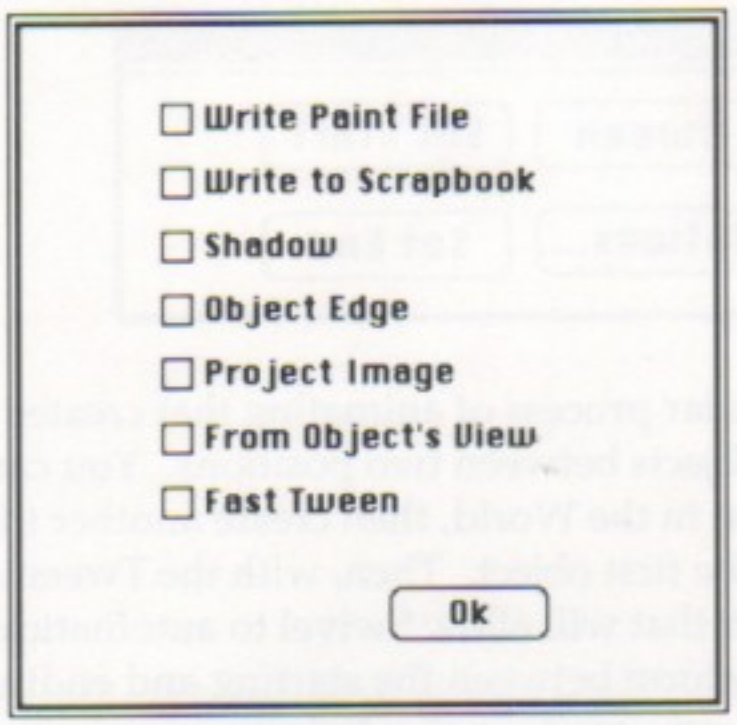
Next Display the next frame. Use Next to step through the animation frame by frame.

Last Display the frame before. Use Last to step through the animation in reverse sequence.

Set Start The current Swivel image will be the beginning frame in the Tweening sequence.

Set End The current Swivel image will be the ending frame in the Tweening sequence.

Options



Write Paint File Saves each frame in the Tweening sequence as a picture file. The Output Style is set to Paint-type or Draw-type under the Edit menu. The computer will beep and flash a dialog box if disk space runs out and the Save operation must be altered.

Write to Scrapbook Saves each frame in the Tweening sequence to the Scrapbook one-by-one as picture files. Write to Scrapbook is especially useful for taking images into VideoWorks or other graphic applications that accept Swivel images only from the Scrapbook.

Shadow Draws cast shadows on each of the frames in the Tweening sequence.

Object Edge Draws object edge lines on each frame in the Tweening sequence.

Project Image Projects an image cut or copied from the scrapbook onto each of the frames in the Tweening sequence.

From Object's Point of View Holds the selected object motionless while the world moves around it.

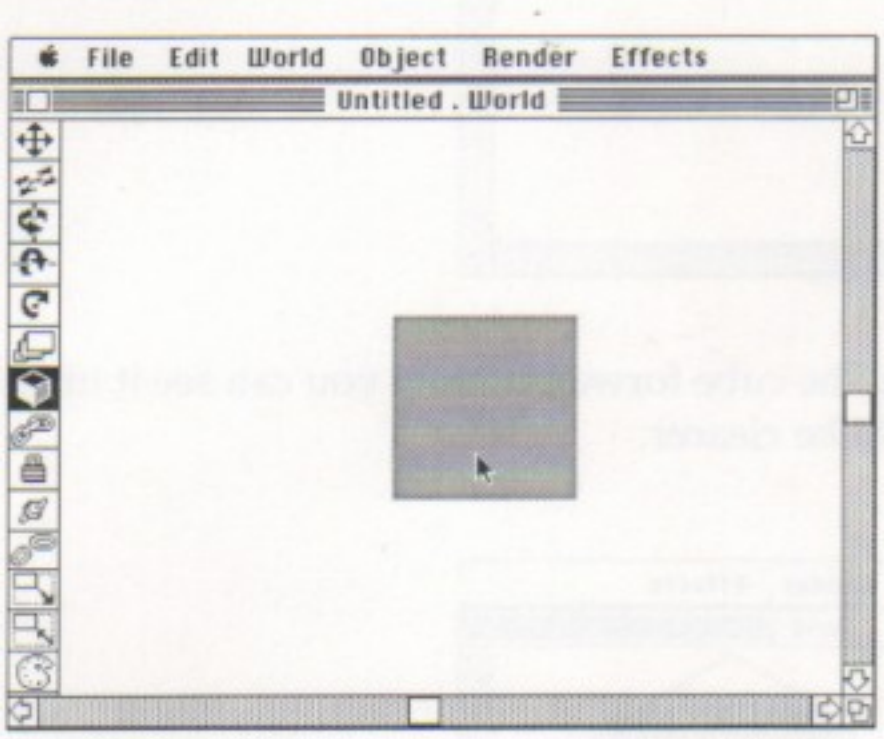
Fast Tween Tweens a simple box (like the one displayed while an object is being moved) rather than drawing the actual object. Speeds up the Tweening process, especially for complex objects. **Note:** Picture files will not be saved during Fast Tween.

Model Kit - Auto Horn

This tutorial takes you through all of the most essential Swivel operations, and demonstrates the step-by-step creation of a 3-D model of an automobile horn.

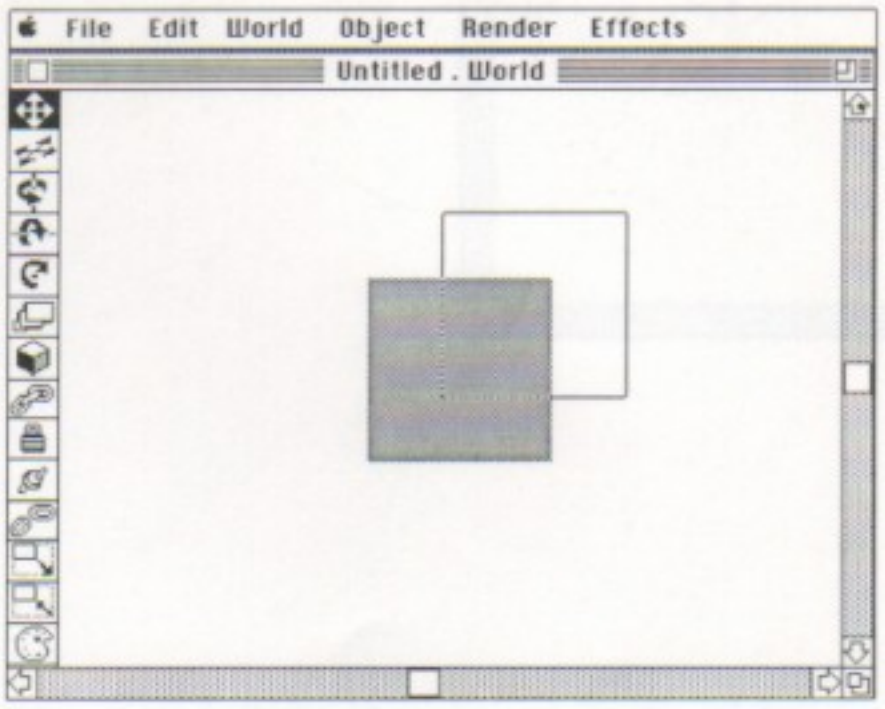
1

Open a new Swivel 3D file, and select the *New Object* tool. Click somewhere near the center of the window to create a new object. You'll find a grey rectangle appearing in that location.



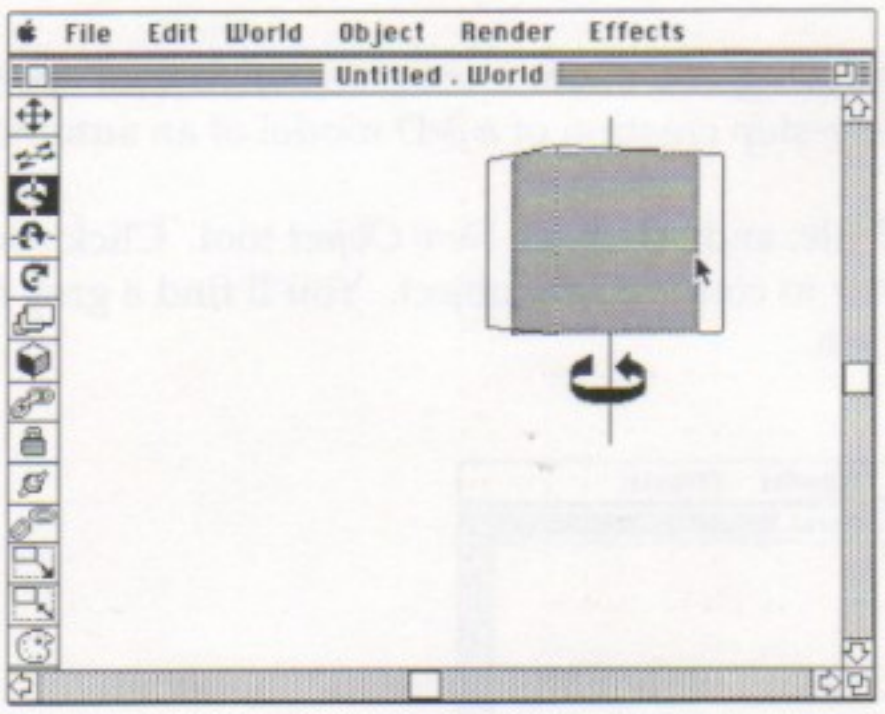
2

Use the XY tool to drag the cube to any position in the plane.

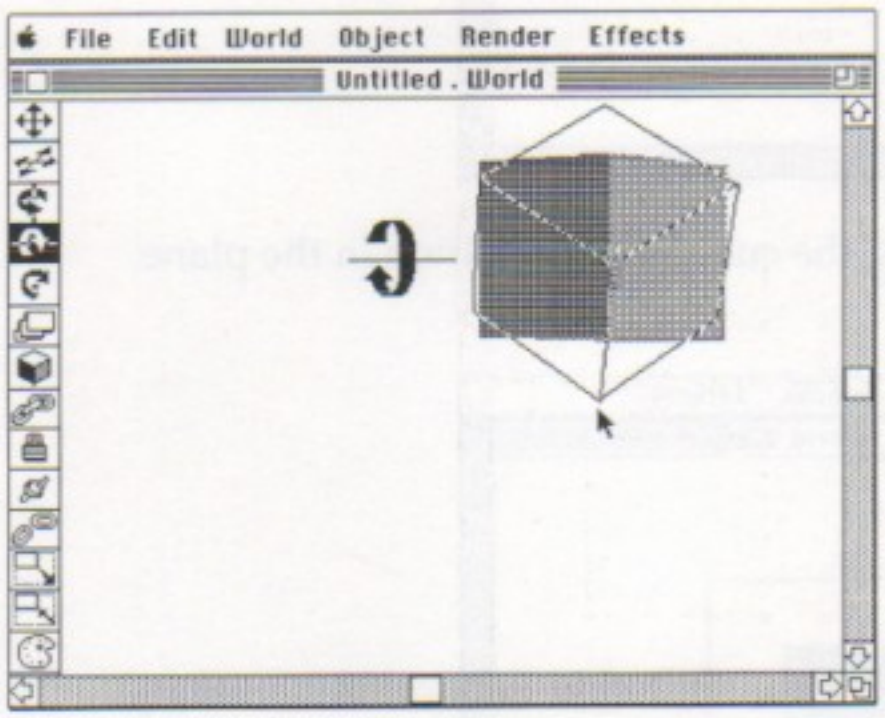


3

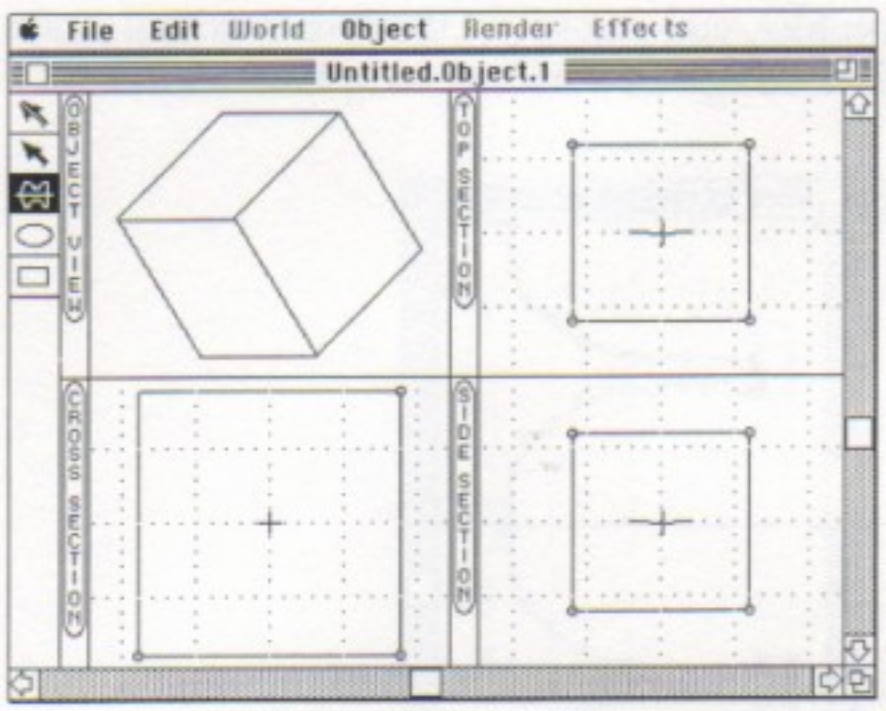
Select the Yaw tool , and drag the cube to rotate it around the Y axis.



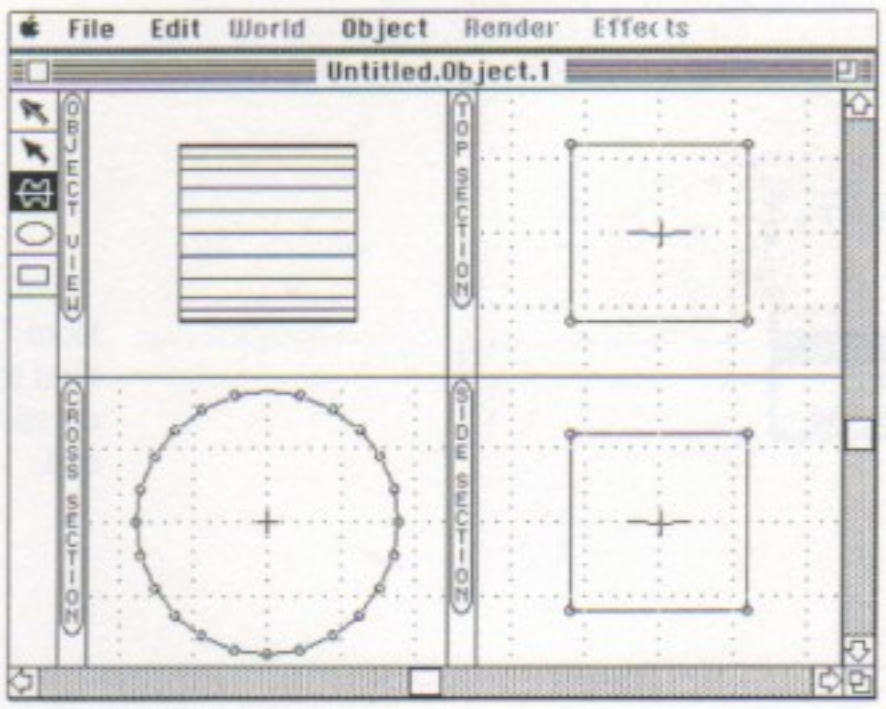
Use the *Pitch* tool to tip the cube forward. Now you can see it in perspective, and changes in the form will be clearer.



4 Double-click on the cube to open your work in the *Design Object View.*

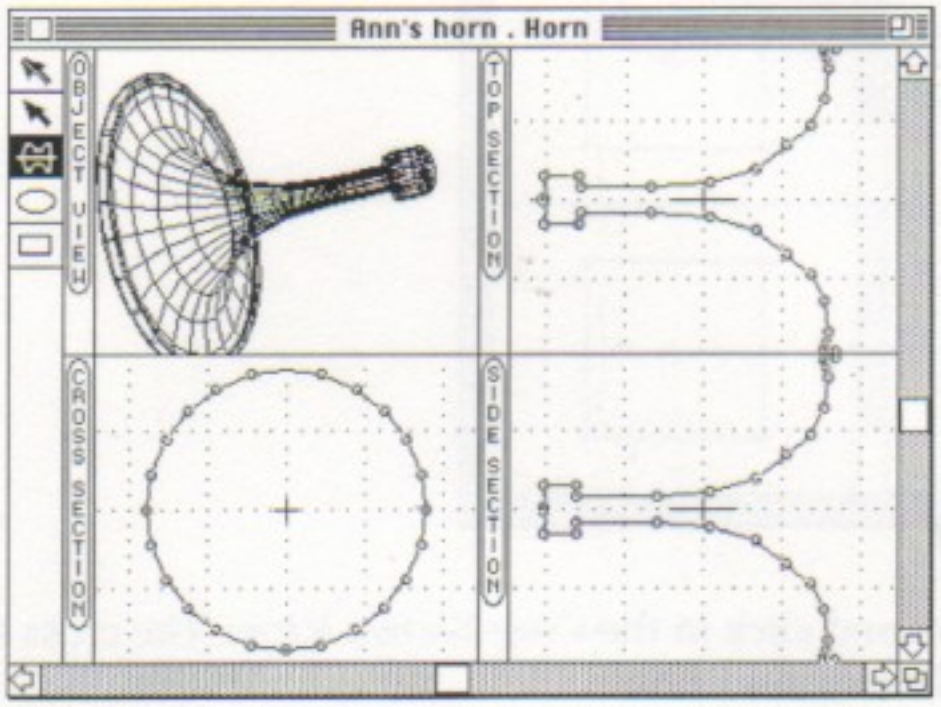


5 Select the *N-gon* Tool and click in the *Cross Section View.* The cross section, an open rectangle, will become a circle.



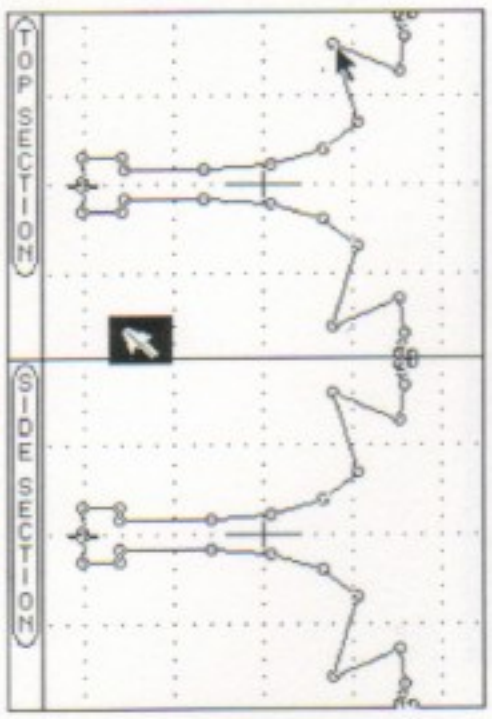
6

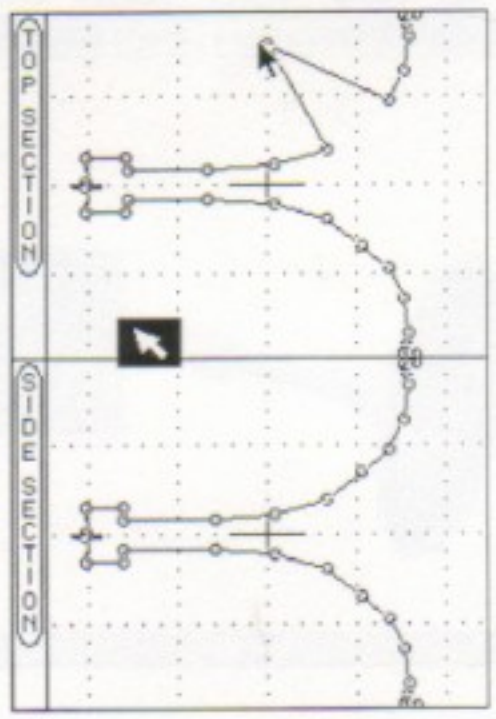
Select the *Free Poly* tool. Begin at the horizontal center line of the Top View, and draw the upper contour of the horn with a series of clicks. Double click when you reach the left end. If you like, you can select the *Free Poly* tool again and redraw the object, using your first design as a tracing template.



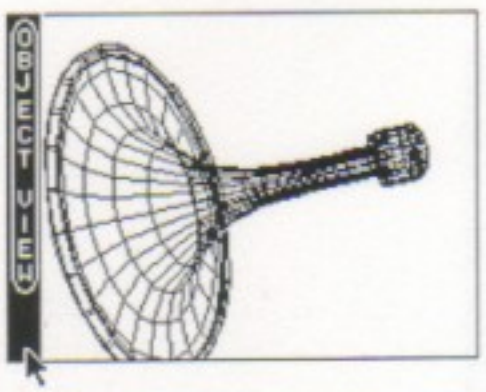
Note: Turn off the Draw Grid to make a finer curve for the trumpet bell.

7 Adjust any of the points need it with the *Double Arrow* tool. The *Double Arrow* tool changes the entire object symmetrically. The *Single Arrow* tool works on only one side of the object at a time.

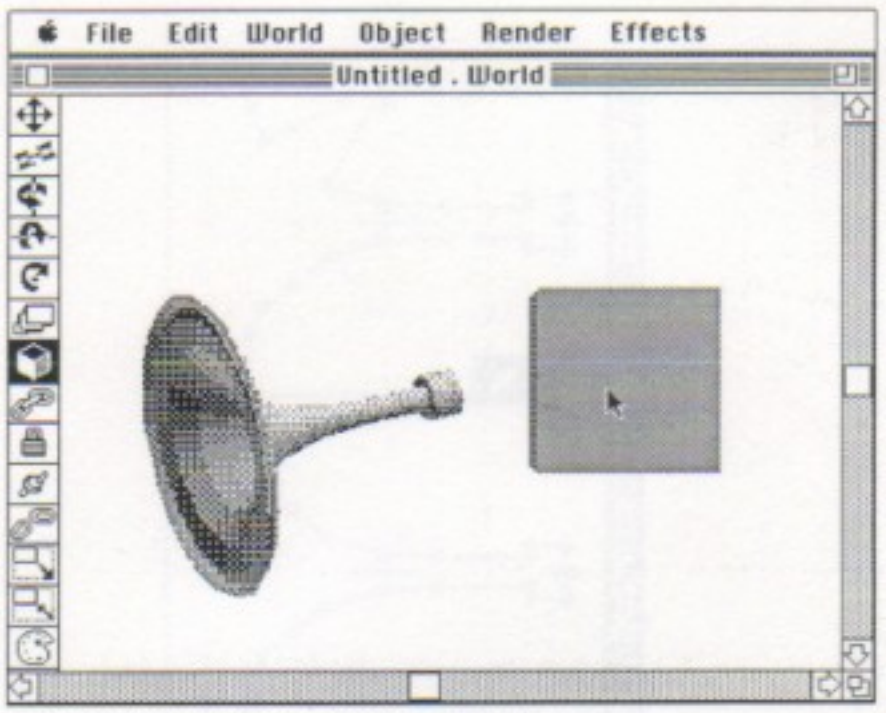




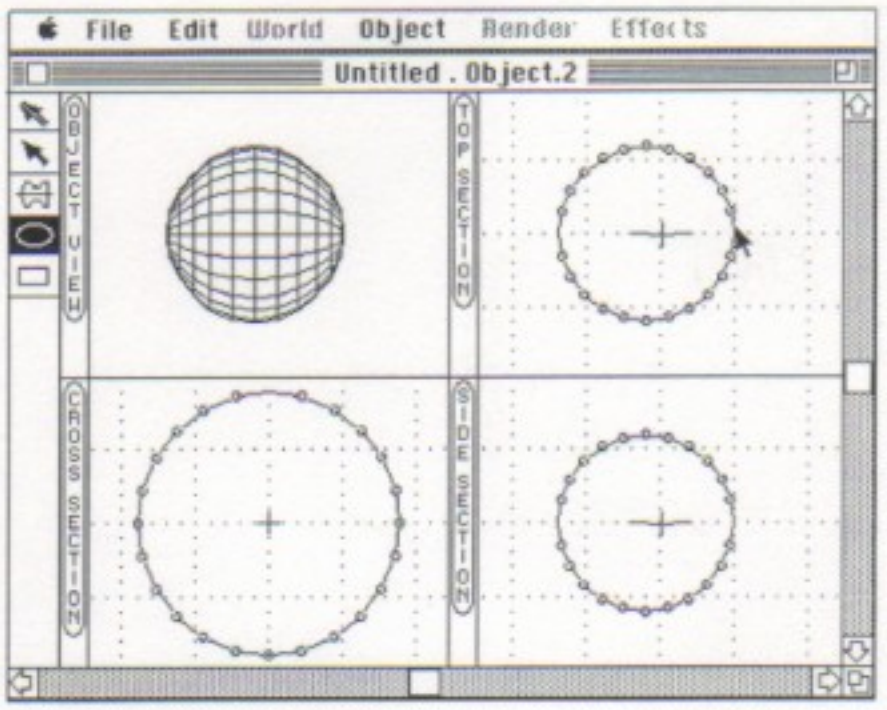
8 Click in the vertical *Object View* button to return to the World View.



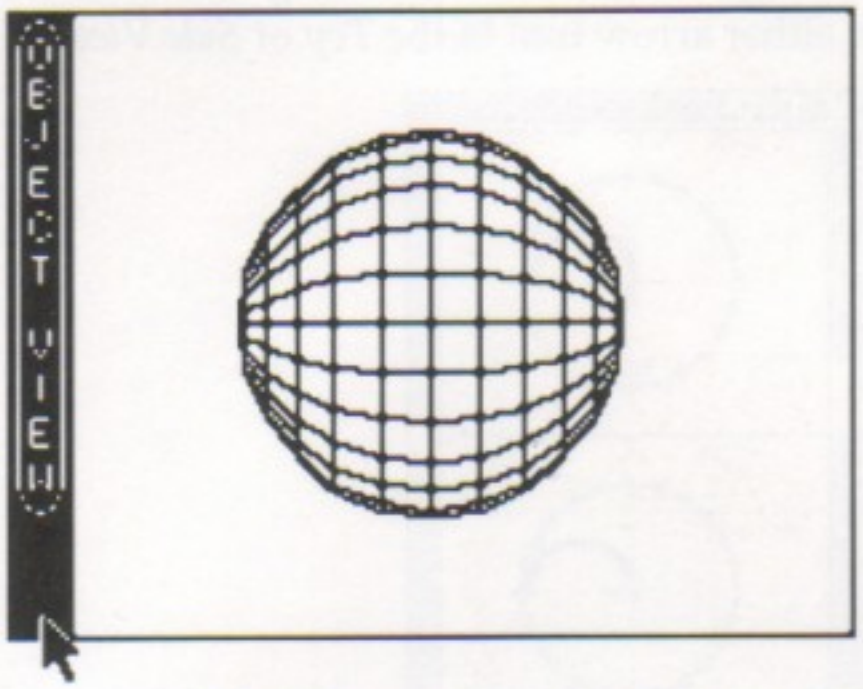
9 Use the *New Object* tool to create another object , which will become the bulb of the horn.



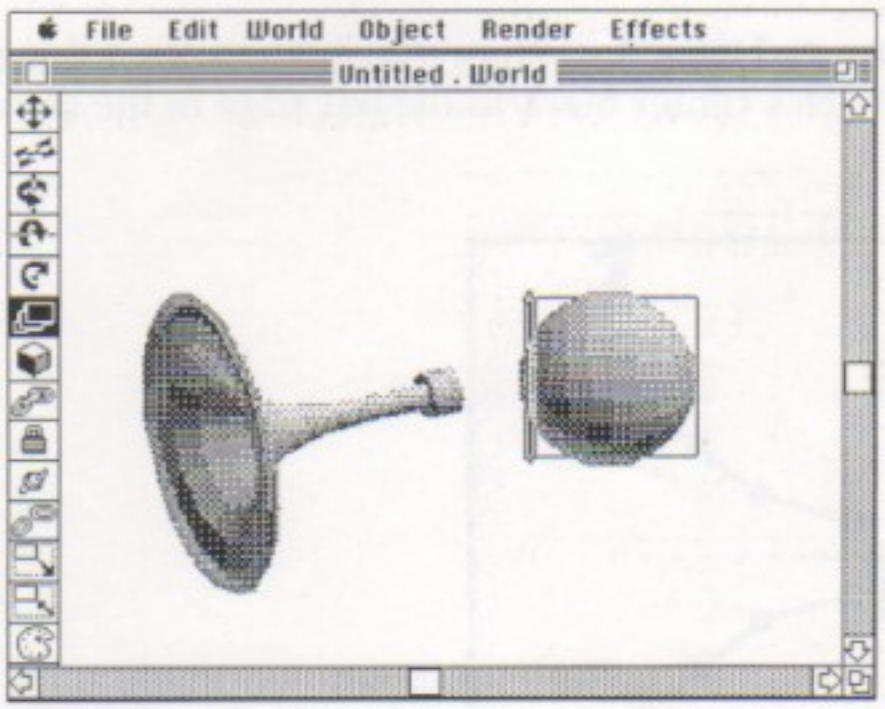
10 Double click the new object to open it in the *Design Object View*. Select the *N-gon* tool and click in the *Cross Section View*. Then re-select the *N-gon* and S-T-R-E-T-C-H a circle in the *Top* or *Side View* to create the sphere.



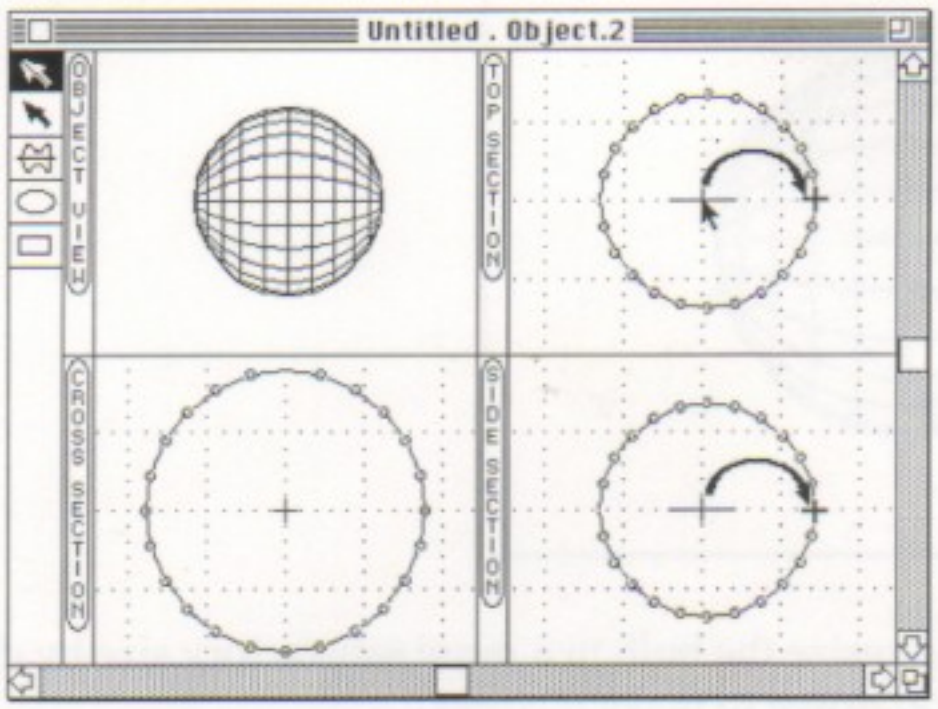
11 Click on the vertical *Object View* button to return to the *World View*.



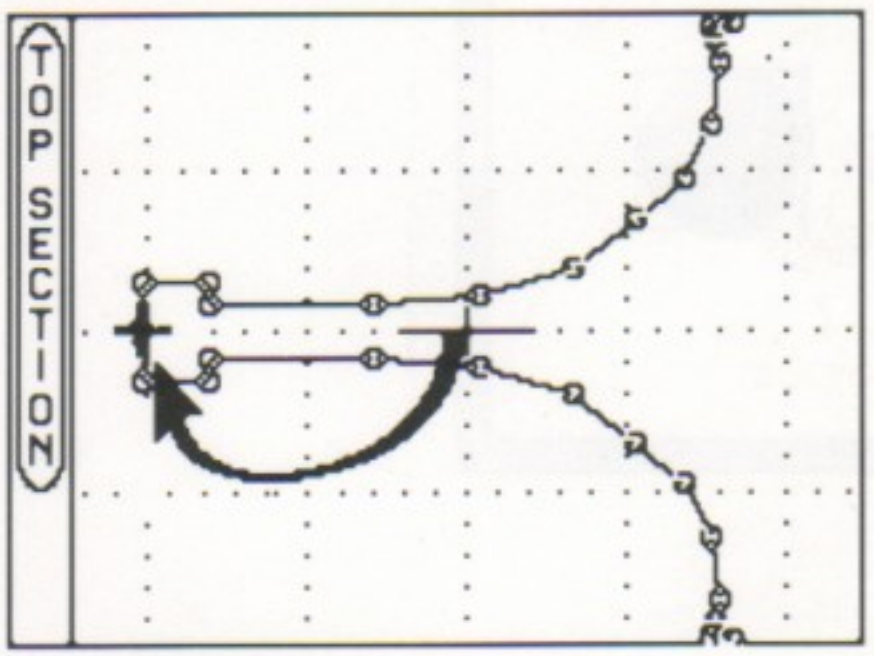
12 Get the *Scale* tool and resize the bulb to a more satisfactory size by dragging up to make it smaller and down to make it larger.



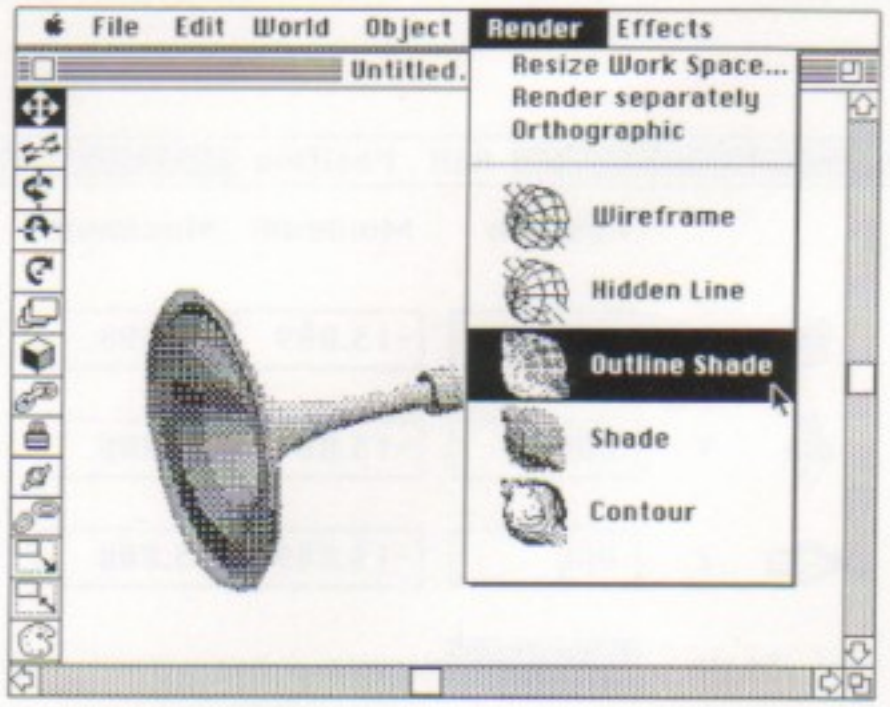
13 Open the bulb in the *Design Object View* again by double-clicking on it. Drag the center mark to the far left edge. To facilitate grabbing the center mark, approach it from underneath with either arrow tool in the *Top* or *Side View*.



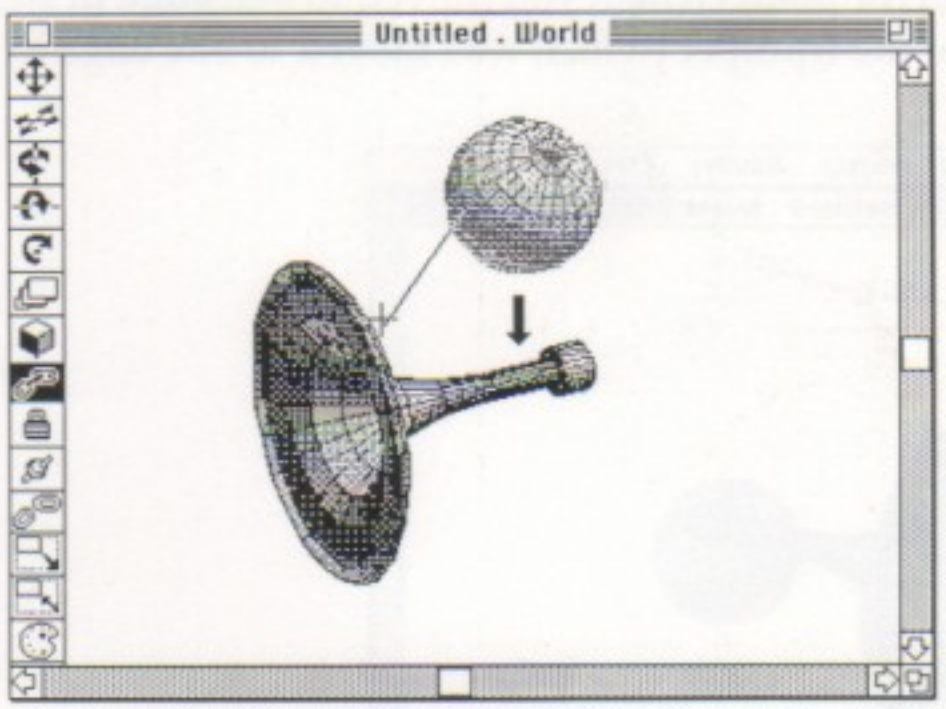
14 Return to the *World View* and double-click on the horn to open it in the *Design Object View*. Drag the horn's center mark to the left edge in the same manner as noted earlier.



15 Return to the *World View.* Pull down the *Render* Menu and select *Outline Shade.* This rendering mode will more clearly display the object's orientation in space by outlining the facets.

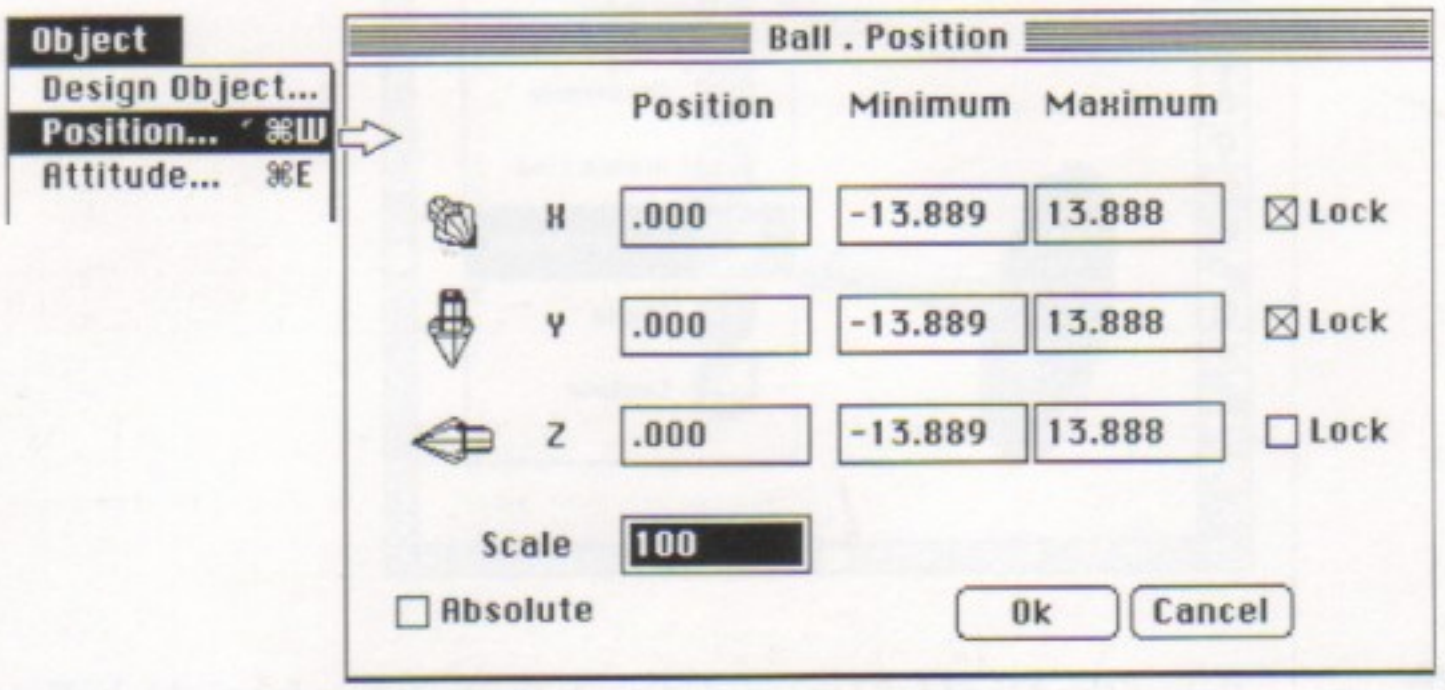


16 Select the *Free Link* tool and stretch the link line from the bulb to the horn: Depress the mouse button over the bulb, click-drag a line from the bulb to the horn, and release the button over the horn. The two parts are now linked.

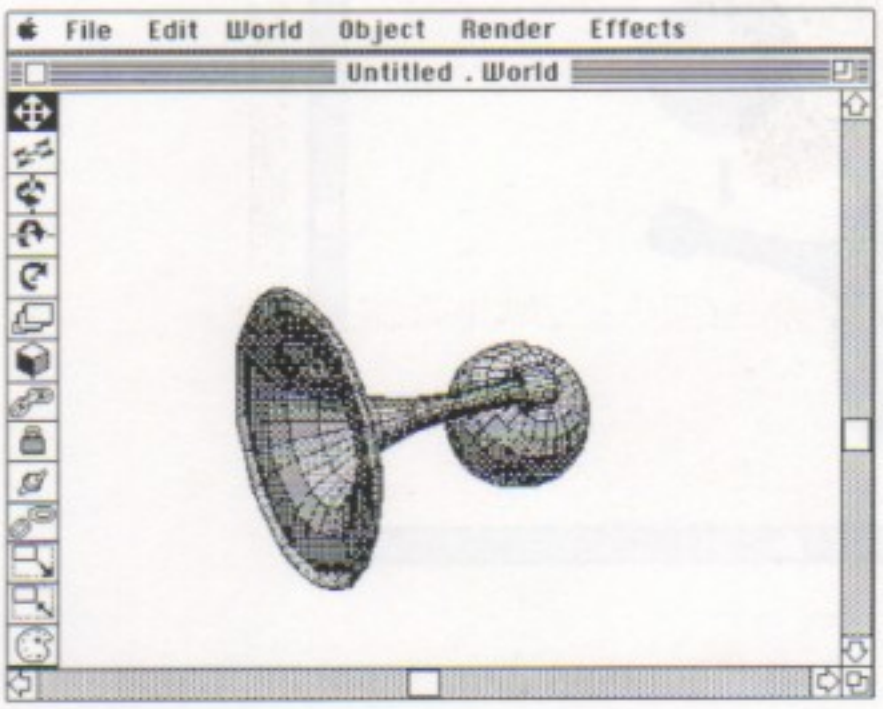


17

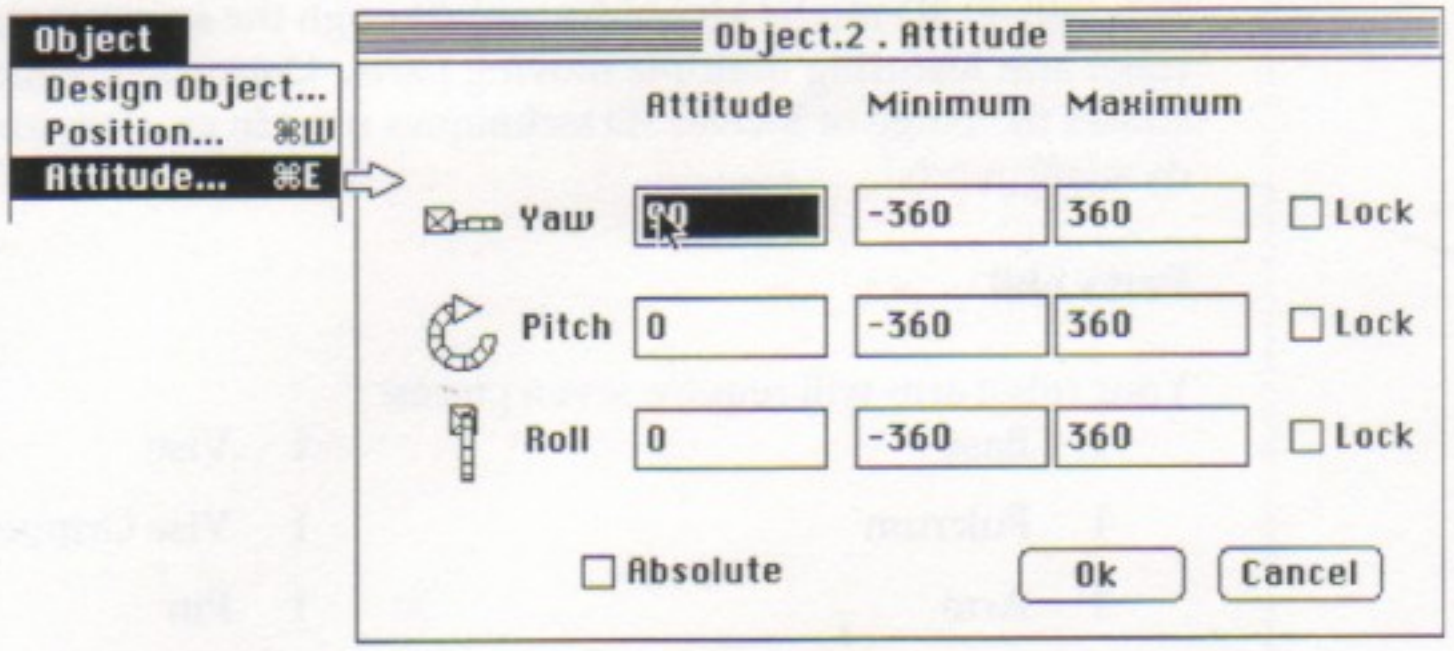
The bulb will still be flashing after it is linked, identifying it as the selected object. Drag down on the *Object* Menu and open the *Object Position* dialog. The first column of numbers will express the bulb's position in relation to its parent object, the trumpet of the horn. The distance is measured in screen units from center to center.



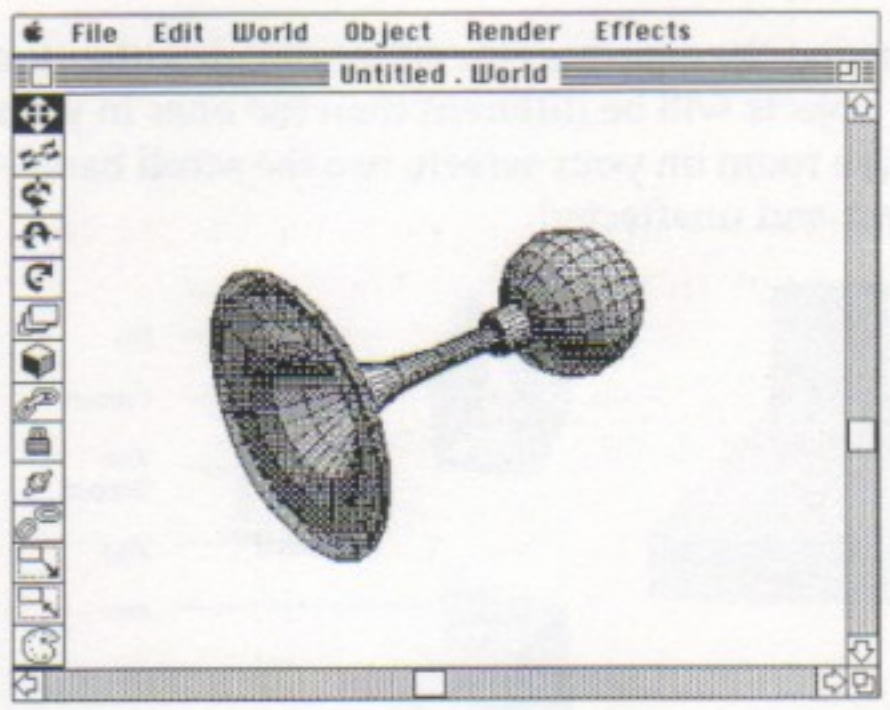
Enter zeros into the three text fields for X, Y and Z position. This edits the bulb's position so that its pivot point (which you moved to one edge in step 13) is right on the pivot point of the trumpet (which was moved to one edge in step 14).



18 Get *Object Attitude* from the *Object* menu and assign zero to the Yaw, Pitch and Roll.



19



Model Kit - Robot Arm

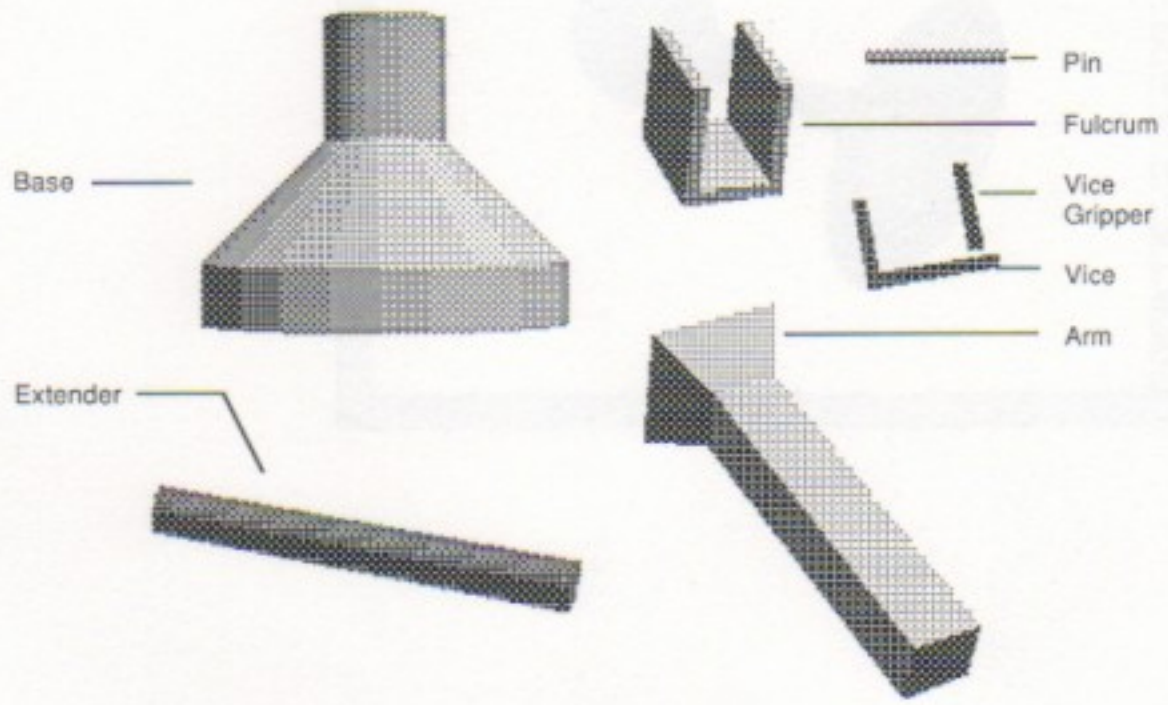
This Swivel 3D model kit guides you through the separate steps of "building" a robot arm featuring multiple moving parts. Constructing the robot arm demonstrates the range of Swivel 3D techniques used in creating and "animating" a dynamic model.

Parts List

Your robot arm will require seven pieces:

1	Base	1	Vise
1	Fulcrum	1	Vise Gripper
1	Arm	1	Pin
1	Extender		

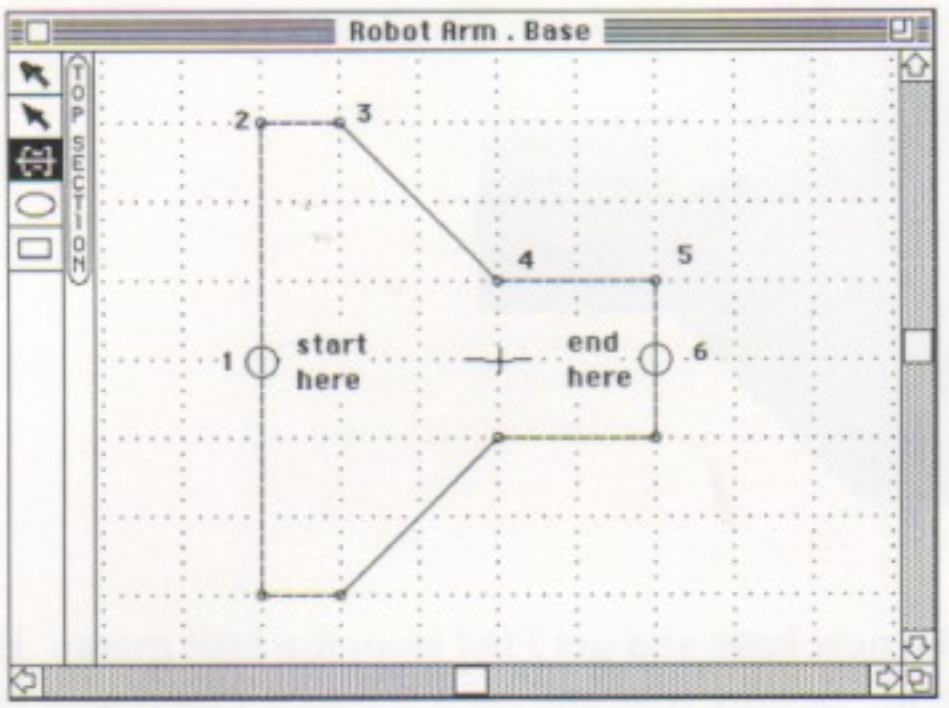
If at any time during the exercise you either rescale either the *World* or an object, the size of your objects will be different than the ones in your original work. If you do need more room on your screen, use the scroll bars—which will leave your model intact and unaffected.



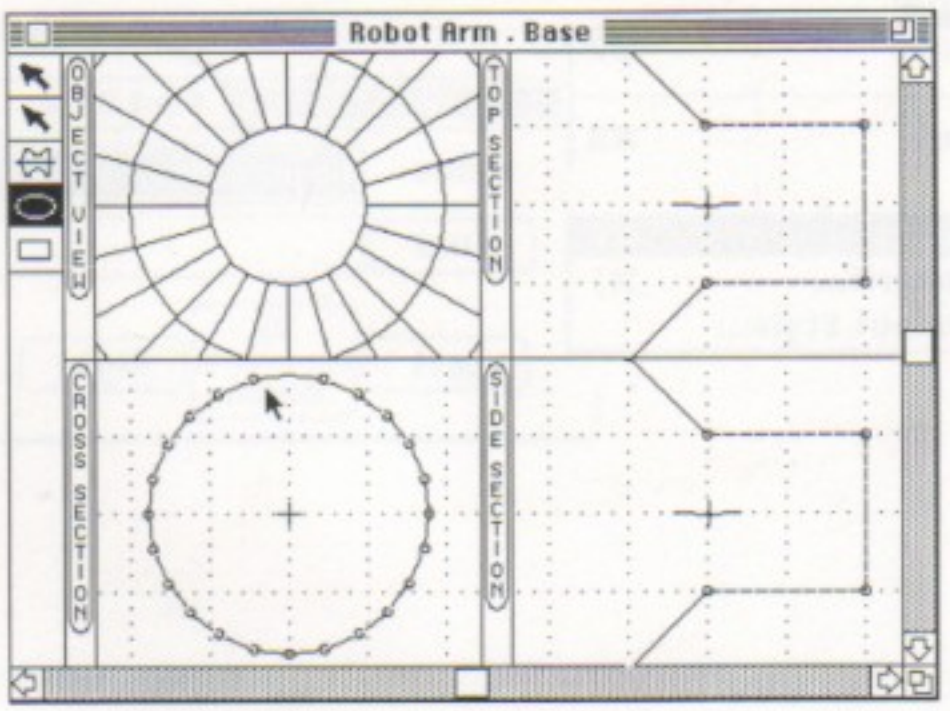
1 Step One -The Base

We will follow customary practice and begin with the base of a model. Select the *New Object* tool and click in the center of the screen. Double-click on the newly-drawn cube to open the *Design Object* screen.

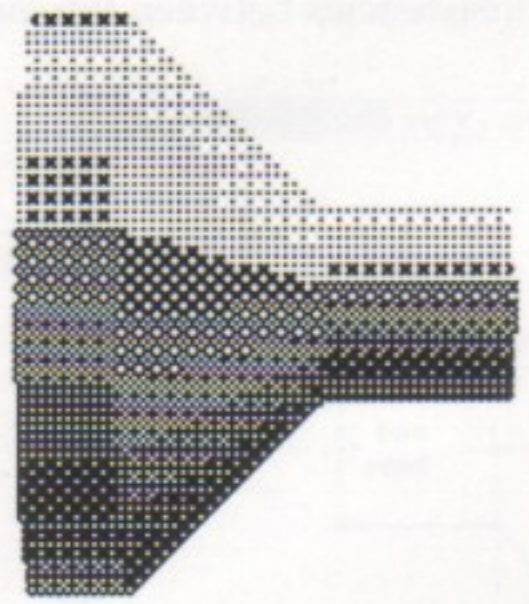
Select the *Free Polygon* tool and click the *Top Section* button. This will open the top section to encompass the entire screen—facilitating the drawing of larger parts. Draw the object's "points" in this order: 1, 2, 3, etc by a click at each suggested location. Follow the same grid spacing used in the example. This will help eliminate the possibility of inconsistencies between the models.



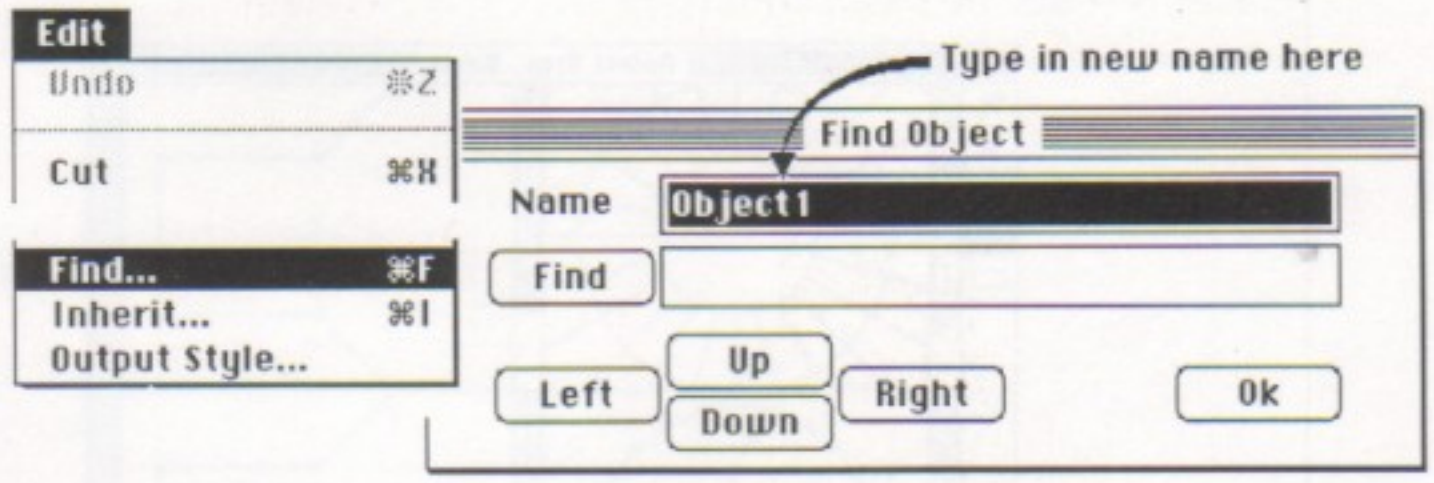
Click the Top Section button to return to the main Design Object View. Select the *N-gon Tool* and click on the Cross Section button. In this screen you will give the base a round cross section.



Click in the *Object View* Vertical Button to return to the Workspace and your Base should resemble the one illustrated below.

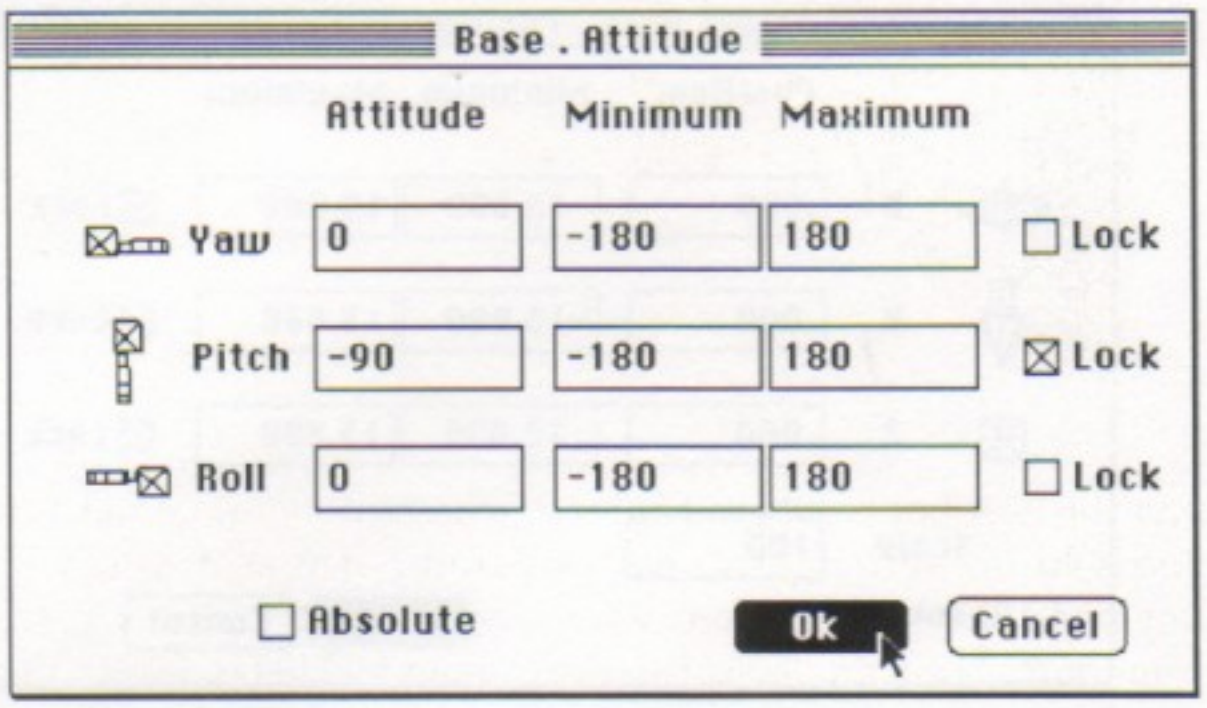


Select the new base and get *Find* from the Edit menu. Enter *Base* in the Object's name field. Be sure to name each separate object as it is created. In a model with many parts, naming each one when created can prevent you from editing the wrong part. Once an object is named, then its *Design Object View, Position* and *Attitude* dialogs will be labeled with its name.

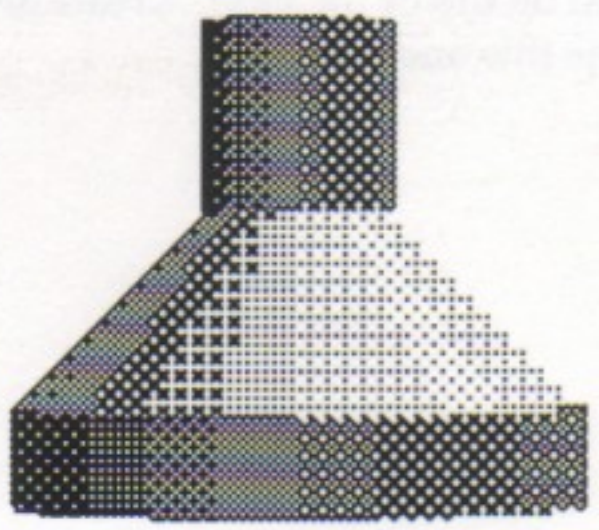


2 Step Two- Aligning the Base

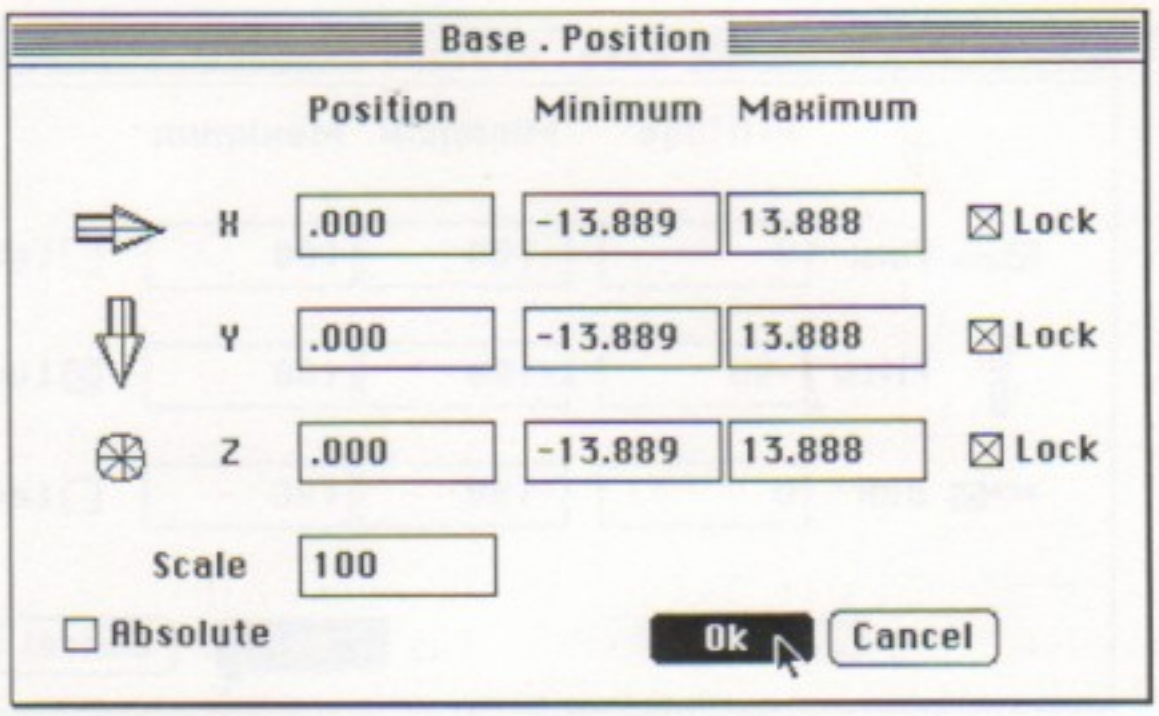
The Base will initially be "placed" on its side. Using the *Attitude* dialog in the Object menu, *Pitch* the base by a -90 degrees (-90 = 270). Notice that in the Attitude window that the yaw is already at 90 degrees. Swivel does this to give you a better perspective of an object in the Design Object View. Set the Base attitude so that Yaw, Pitch and Roll read 0, -90 and 0, respectively. Click OK. Notice that the base is now in an upright position.



This is what the base should look like in the Workspace

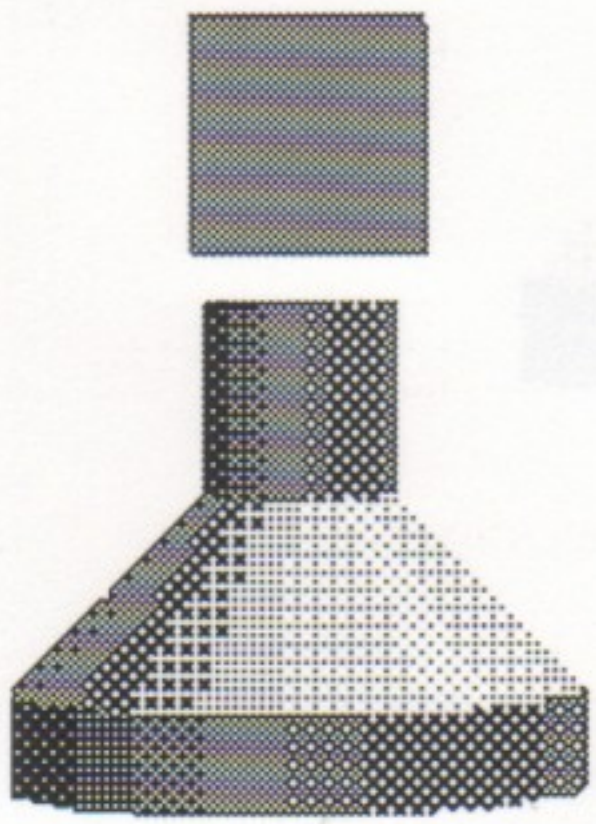


Moving the base to the center of the Workspace can be very useful when you need to align and link objects to it. Make sure the Base is selected and choose Position in the *Object* menu. Enter zeros (0) in the X, Y and Z positions (if not already noted) and *lock* all three positions. Since the Base is not linked to another object, all position dimensions refer to a specific location in the World. In actuality, it is now at the *center* of the World.

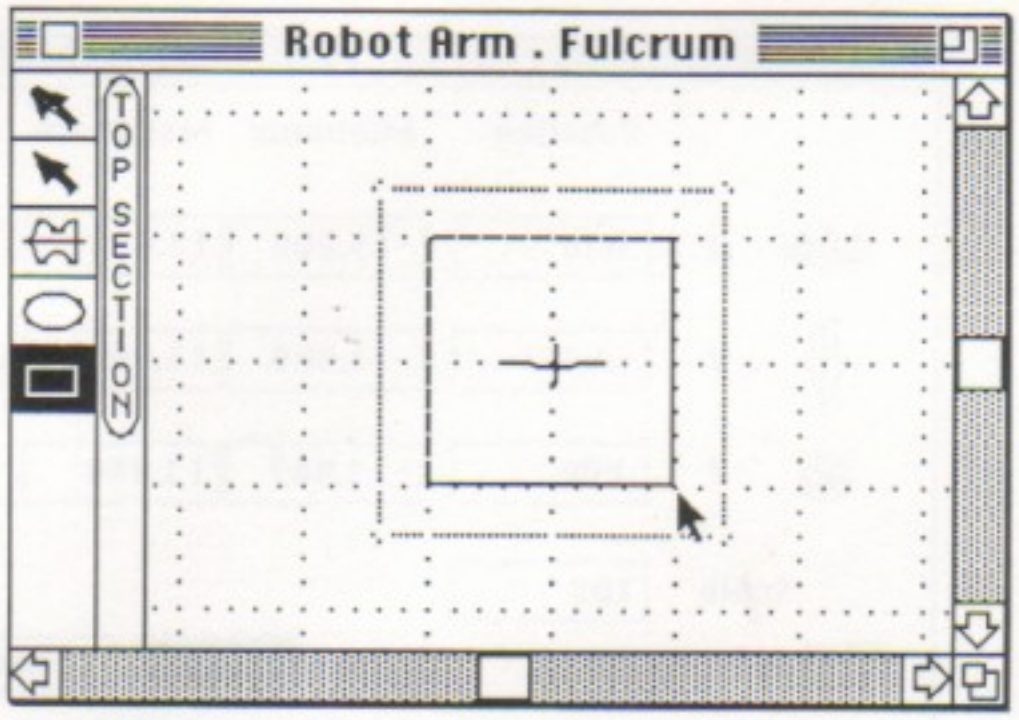


3 Step Three - The Fulcrum

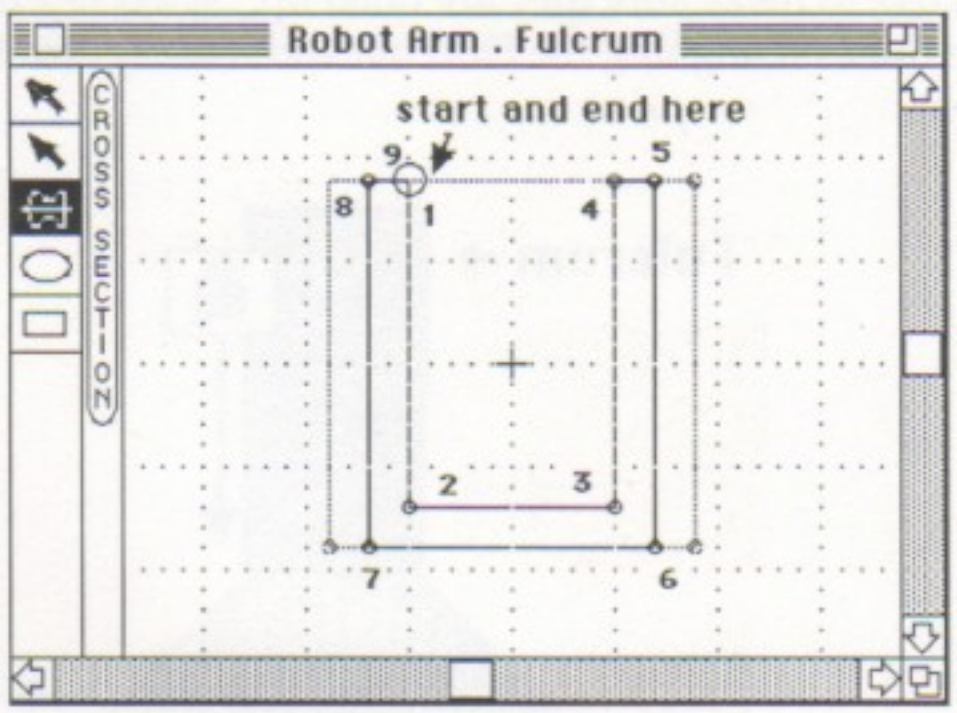
The Fulcrum you'll create will rest on top of the base. Create another new object and place it above the base. Name this one *Fulcrum*.



Double-click on the new object to enter the Design Object mode and drag a square in the Top Section using the grid and on-screen ghost-image as a reference point.



Select the *Free Polygon* Tool and draw a square in the *Cross Section* using the ghost-image onscreen for reference. The reason for not using the Rectangle tool is that in the Cross Section it will draw only a single sized square.

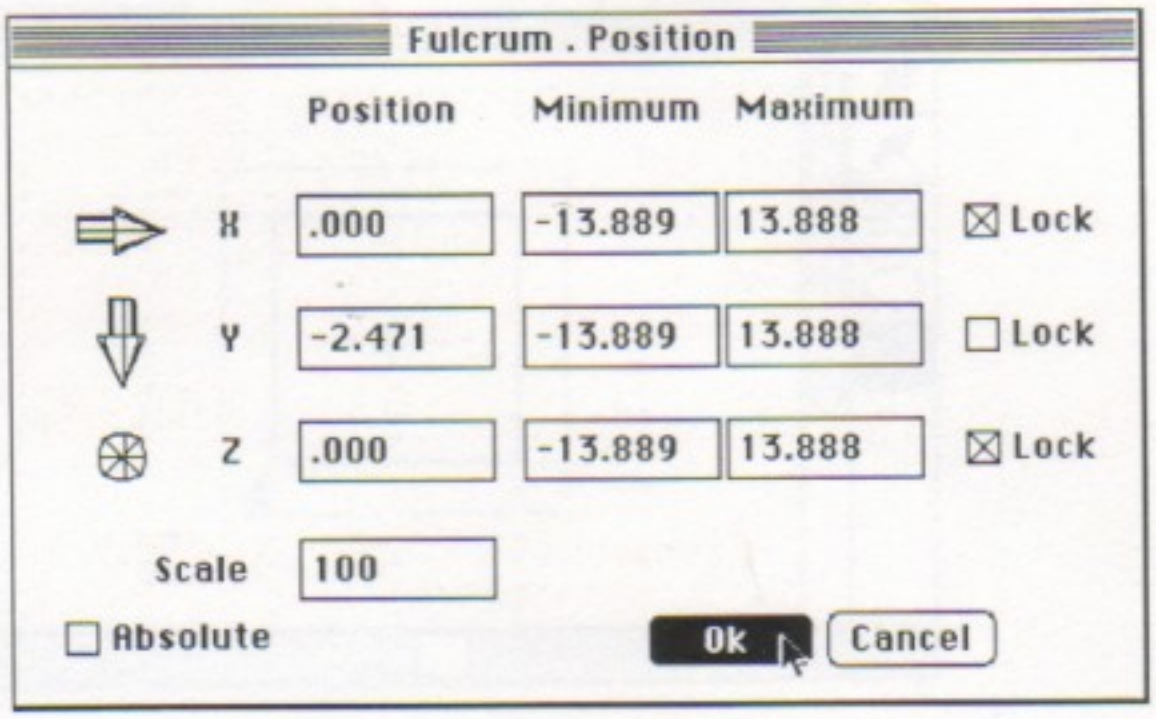


Use the Ver*tical Object View* button to return to the World View.

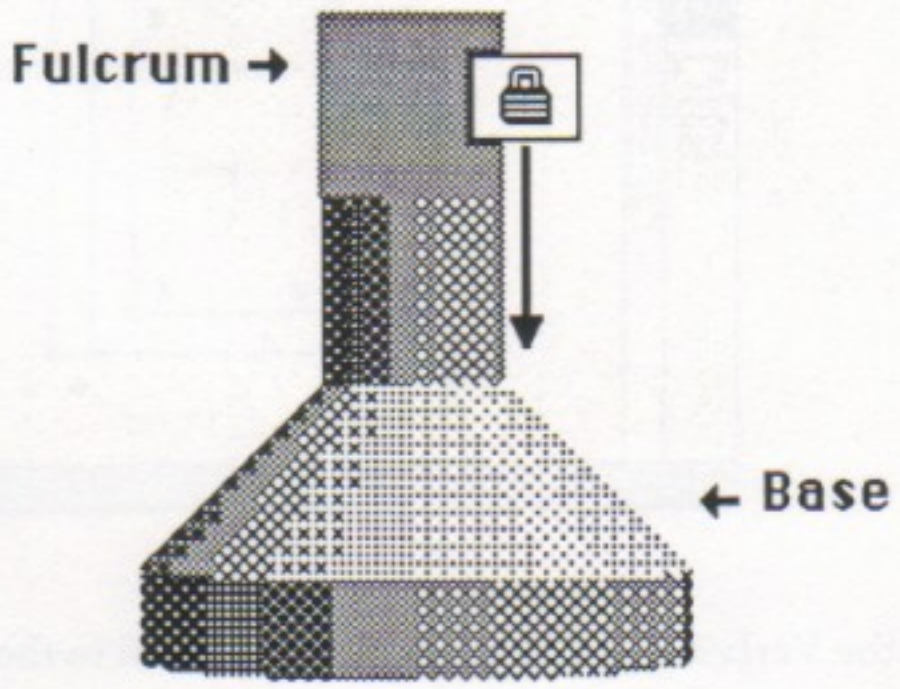
4

Step Four - Align the Fulcrum

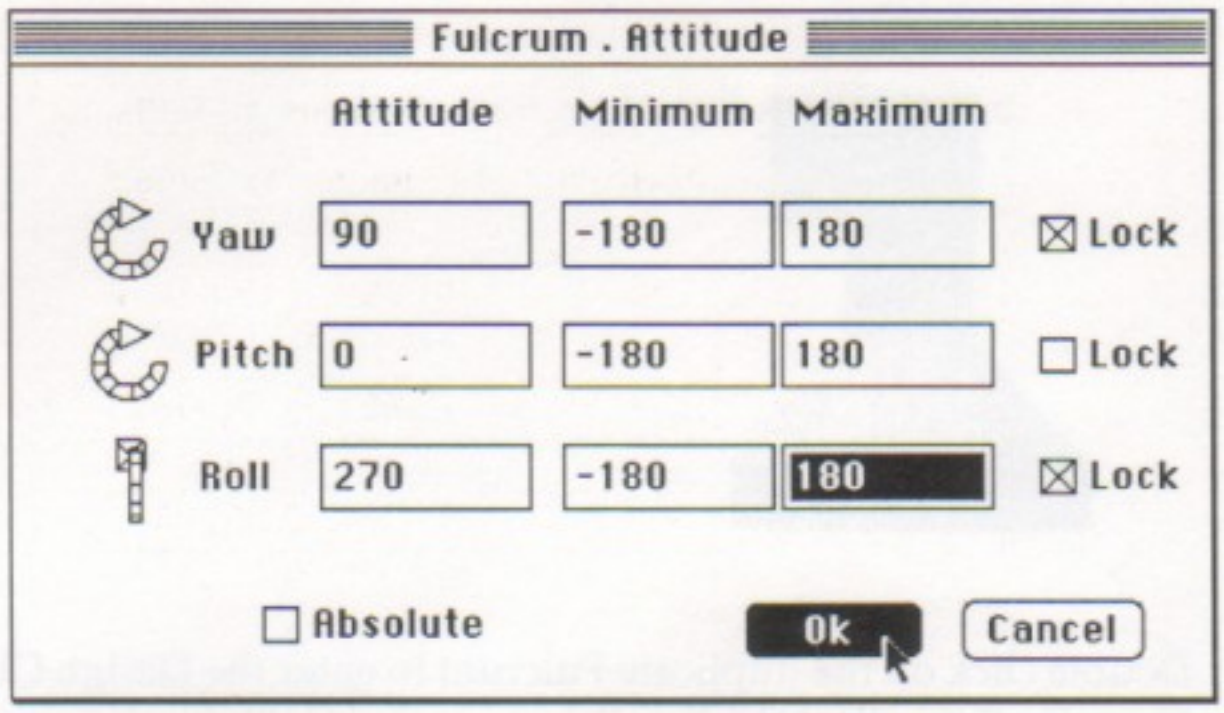
To put the Fulcrum on top of the Base, open the Fulcrum's *Position* dialog. Zero the X and Z positions. Lock it in the X and Z Position leaving the Y Position unlocked. Don't worry if the Y Position in this exercise doesn't match yours.



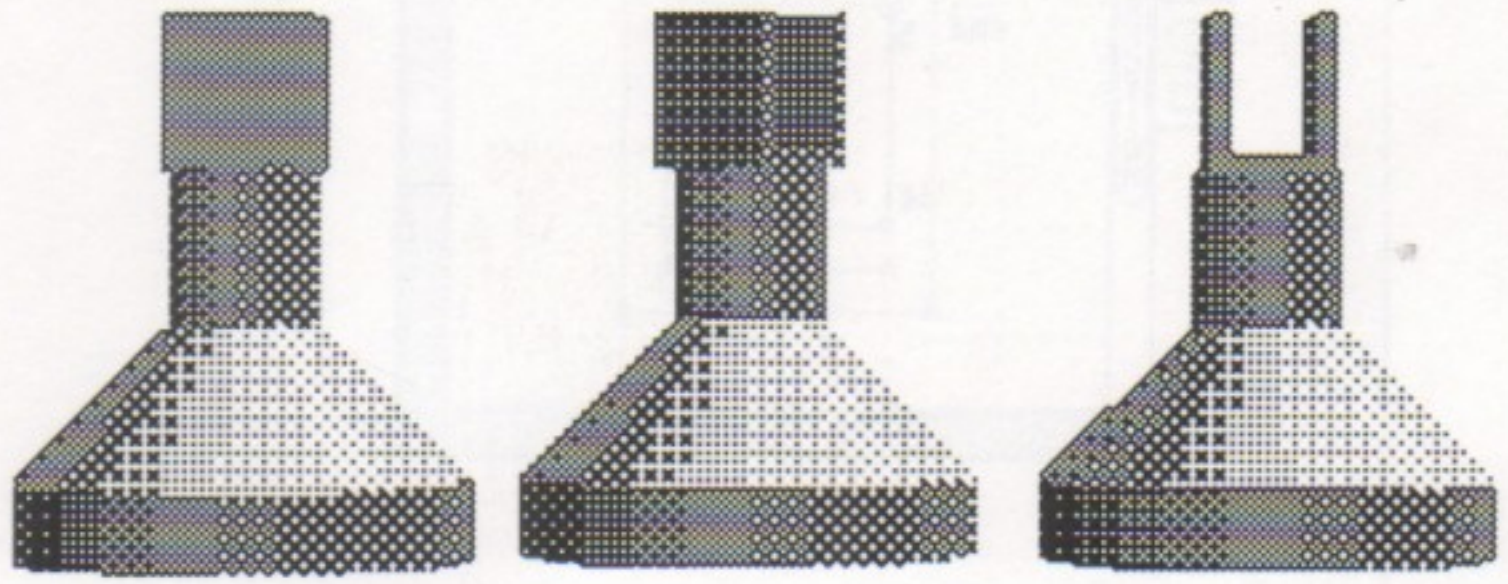
Move the Fulcrum to the top of the Base. Notice that you can only move the Fulcrum along the Y axis. You may want to look at the model from a different perspective to make sure they are lined up. Select *Left* in the World menu. When you are finished aligning the Fulcrum and Base, return the view of the World to the Front.



Using the *Lock* tool, lock the Fulcrum to the Base. Next, unlock the Fulcrum's *Pitch* in the *Attitude* dialog. Notice that Yaw and Pitch are the same. This happens occasionally, and won't effect the final outcome of your model.



Hold down the option or command key while click-dragging on the Fulcrum to swivel it around. It will have one degree of freedom: yaw or rotation around the vertical axis. Return the Fulcrum to its original position; Yaw 90, Pitch 0 and Roll 270 so that you will be able to follow the next set of directions.

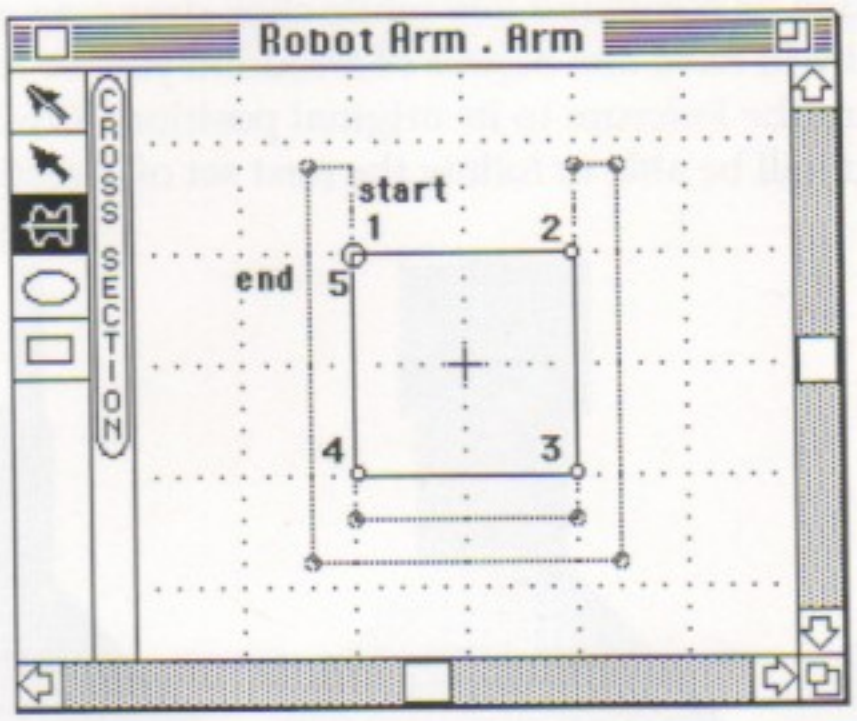


5

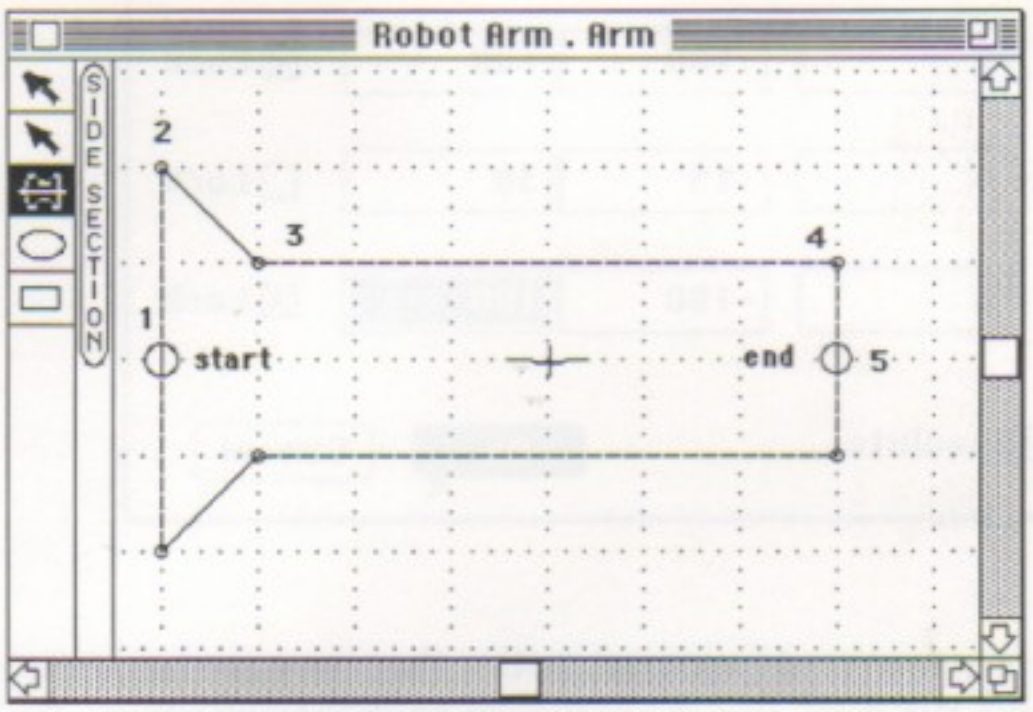
Step Five - The Arm

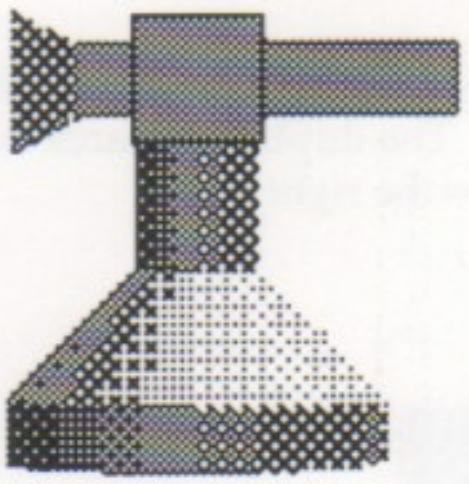
Duplicate the Fulcrum. The duplicate will be renamed the *Arm* and used as a template for drawing the Arm.

Double click on the duplicate Fulcrum to enter the Design Object View. In the Cross Section, select the *Free Polygon* tool and draw a square just inside the ghost-image of the previous cross section.



In the Side Section screen, draw the Arm in the order shown.



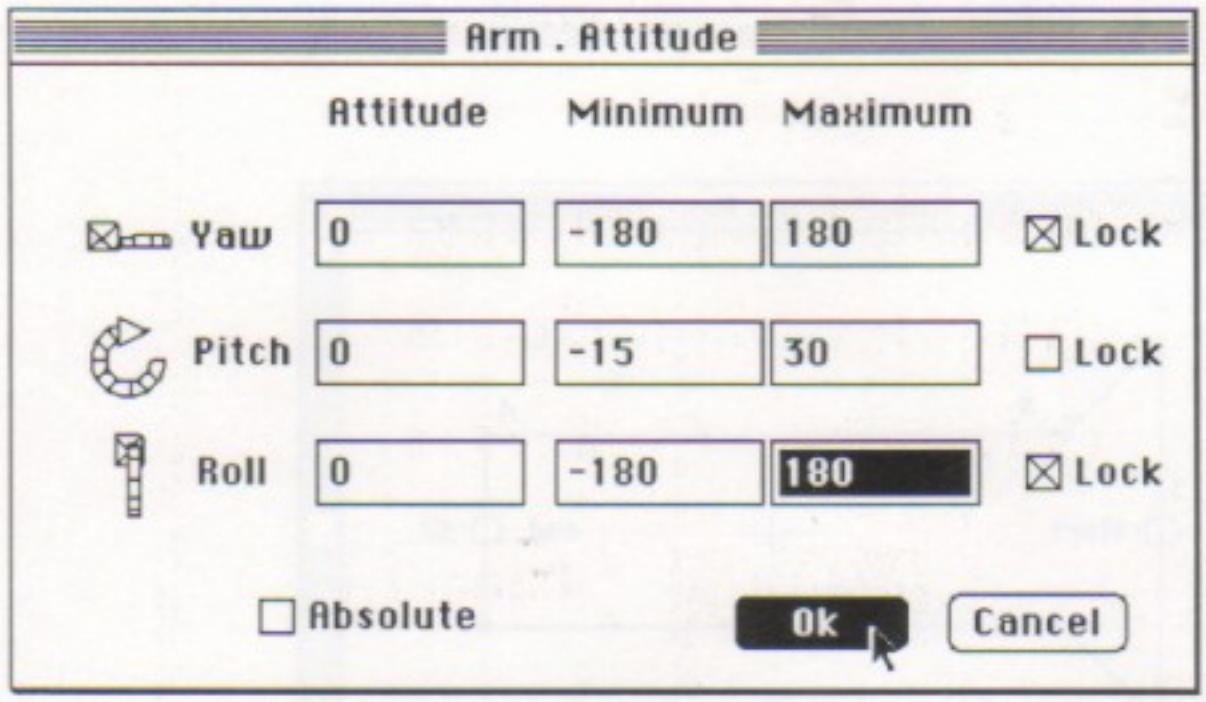


Workspace view

Step Six - Constraining the Arm

Move the center of the Arm to the middle of the Fulcrum. Select the Arm and *Lock* it to the Fulcrum. Using the Position dialog, set the values to zero and then lock X, Y and Z Positions.

To determine the *range of motion* of the Arm, unlock the pitch of the Arm. We will set the arm to *Pitch* forward by 30 degrees and backward by 15 degrees. Set the Minimum Pitch to -15 and the Maximum to 30. Click OK. Hold down both the Command/Option and Command/Apple keys and click-drag on the object in order to swivel both the Arm and the Fulcrum around.

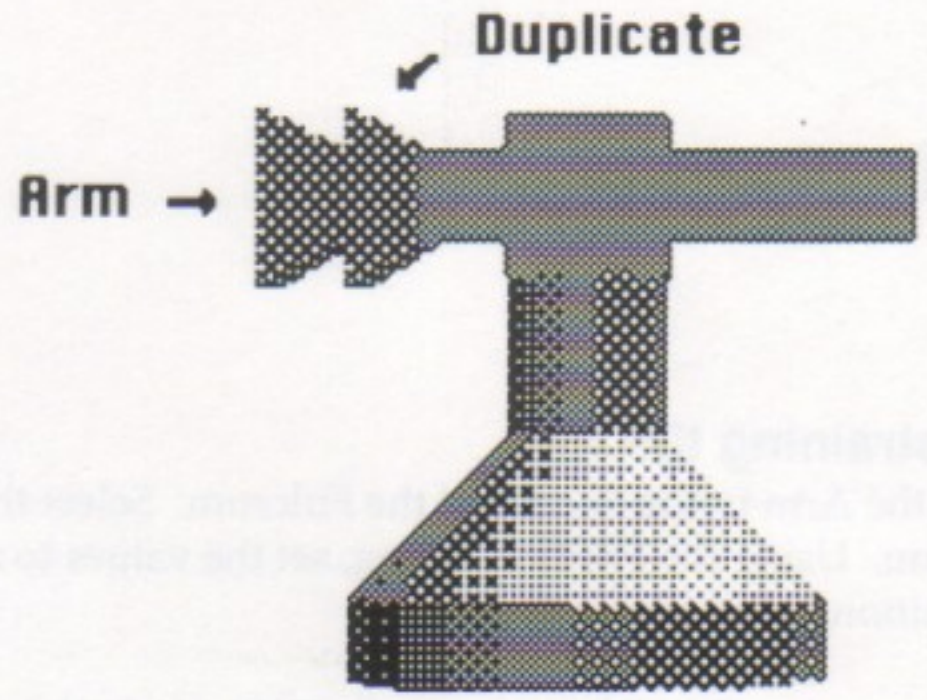


As you swivel the Arm and Fulcrum, notice that they are beginning to behave like a robot. To move the Arm and the Fulcrum back into position, make sure the Pitch value for both of them is 0.

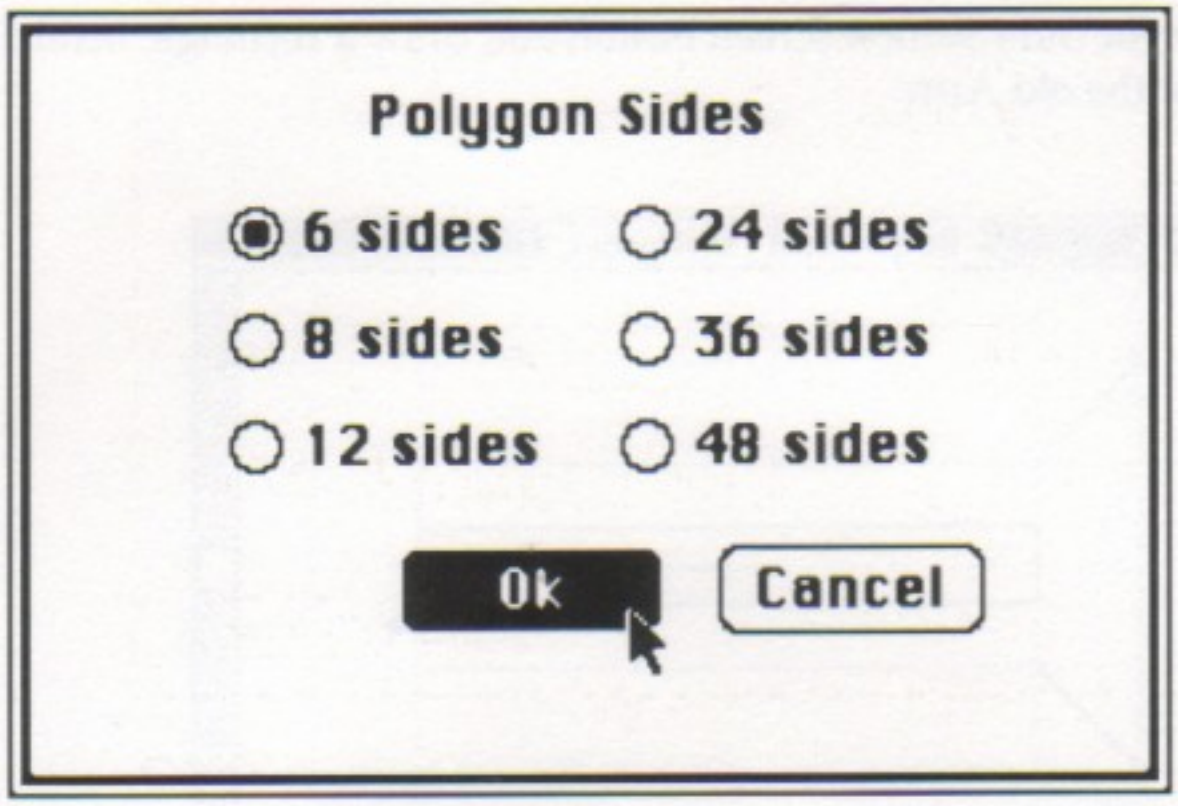
7

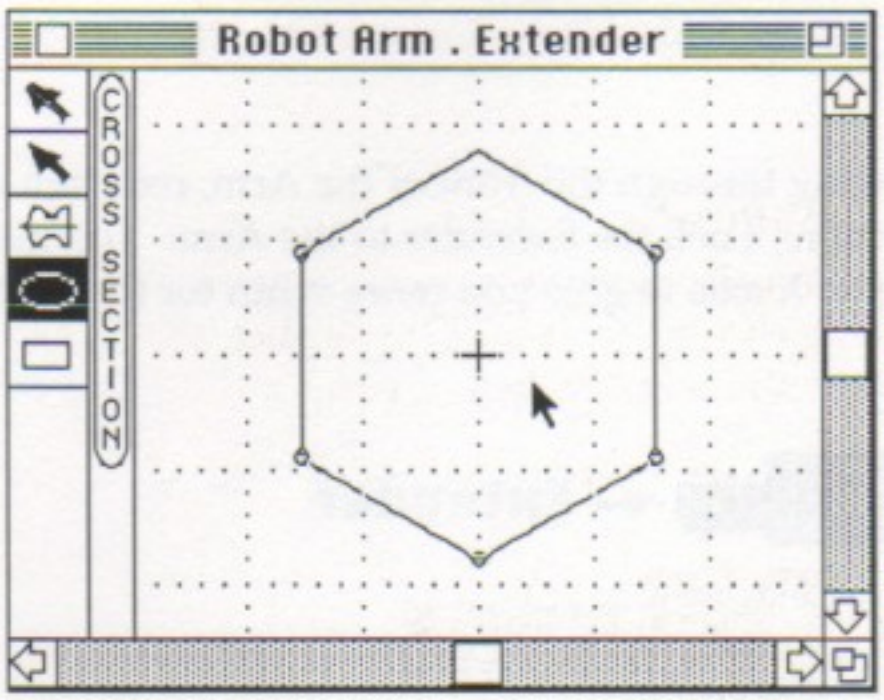
Step Seven - The Extender

Next build the Arm's linear extension piece, the Extender. The Extender will be located inside the arm. Duplicate the Arm. The duplicate shares the same Y and Z axis as the original Arm, shifted slightly to the right.

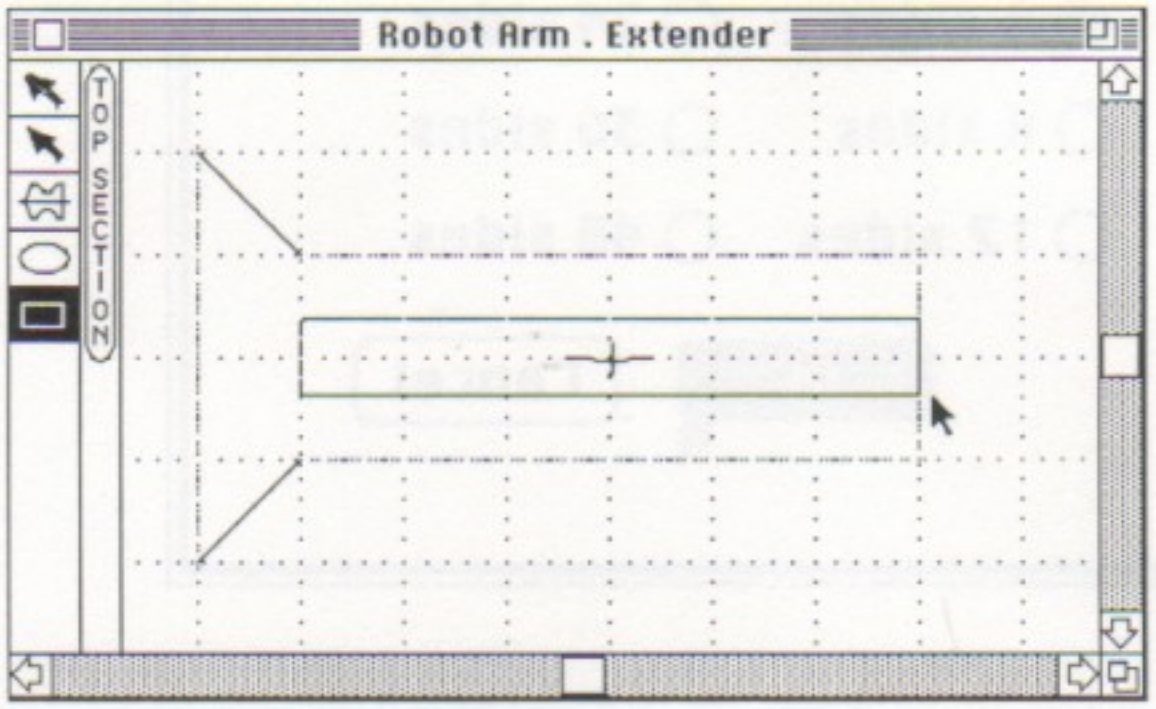


Use the duplicate to build the Extender. Enter the Design Object mode for the Duplicate and double-click the N-gon tool. Select the 6 sides button. Click OK. With the N-gon tool still highlighted, click on the Cross Section screen. There is now a six-sided polygon in your Cross Section screen.

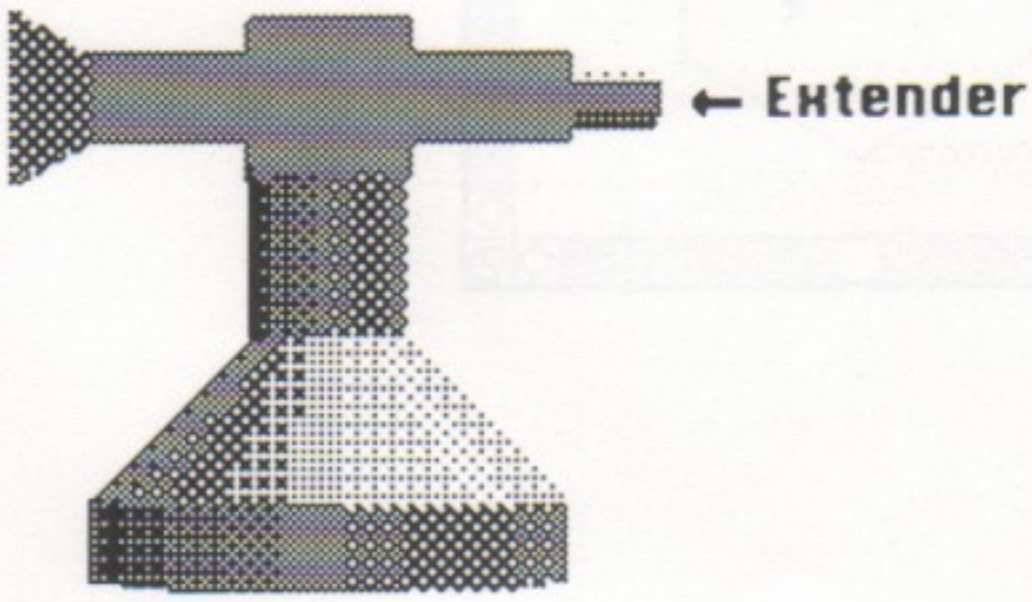

Polygon Sides
6 sides
24 sides
8 sides
36 sides
12 sides
48 sides
Ok
Cancel


Robot Arm . Extender
CROSS SECTION

Click on the Side Section screen button and draw a rectangle inside the ghost-image of the old Arm.

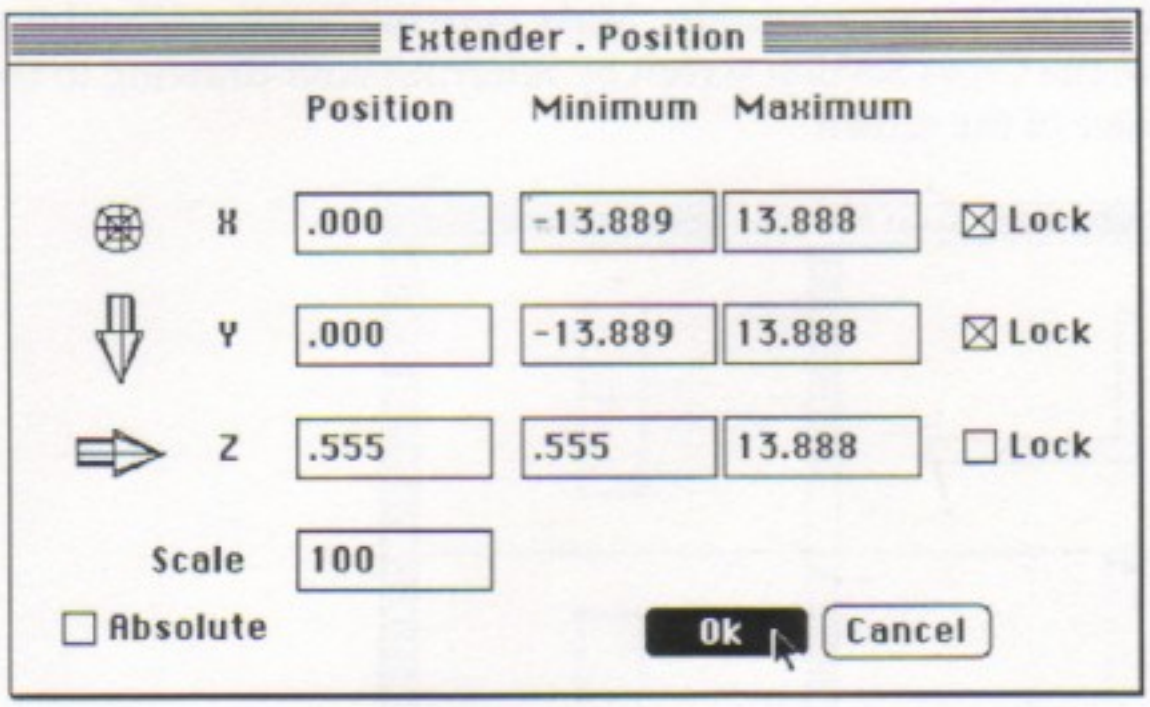


If the Extender is showing through the front of the Arm, redesign it to be slightly smaller in the Top Section. Lock the Extender to the Arm. You may need to unlock the Base along its X axis to give you more room for the next step.

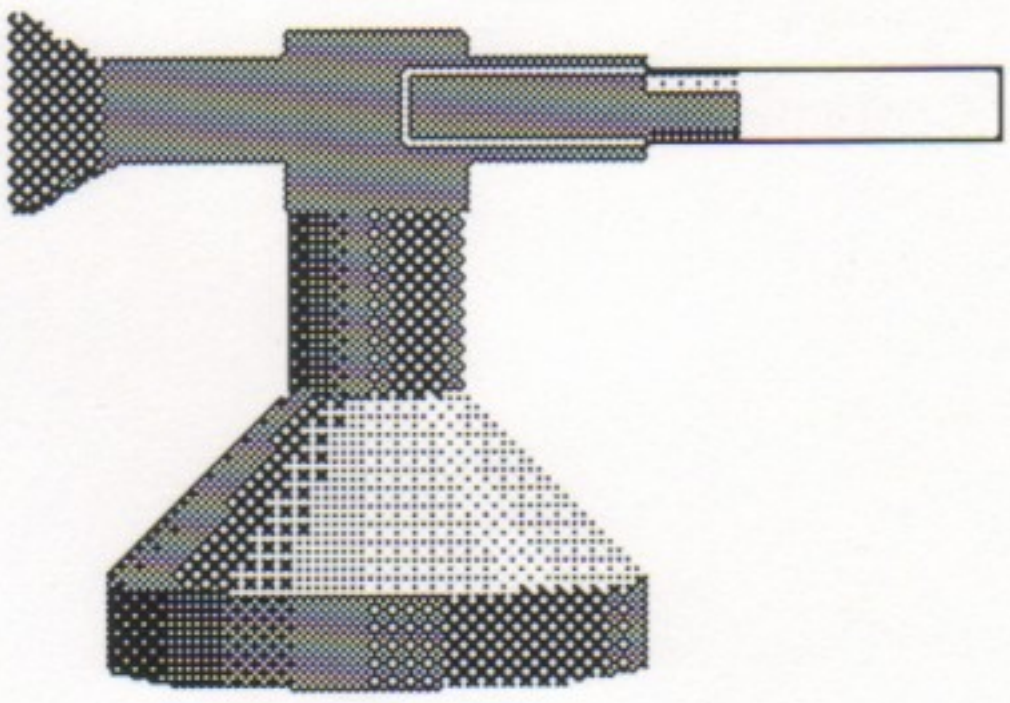


8 Step Eight - Constraining the Extender

Select the Extender and open the Position dialog. Unlock the Z axis and set its Z axis Minimum to match its current Position. This becomes one of its mechanical "Stops" preventing further motion in that direction.



Drag the Extender to the right so that it is a little more than half way out of the Arm. Open the Extender's Position dialog, and enter the Z axis position as the Maximum. (Maximum should be around 2.00)



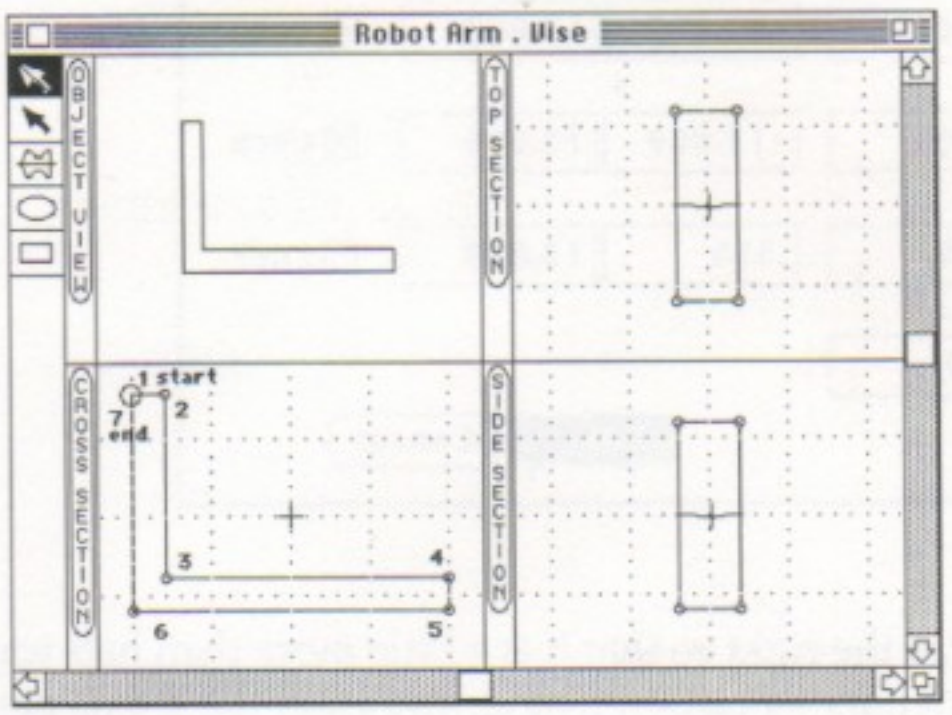
Try to move the Extender. Its range of motion is now constrained. Move the Extender to its minimum position before moving on.

9

Step Nine- The Vise

Create a new cube that will be used to constructed the Vise. At this point you might want to zoom in on the Vise.

Choose the Vise's Design Object view and click the Cross Section screen. Draw the Vise using the grid as a guide. In the Side Section screen, drag a rectangle using the ghost-image as a guide. Make sure the length of the drawing is equally divided in the Cross Section screen by referring your drawing to the cross-hair (+) in the center of the screen.

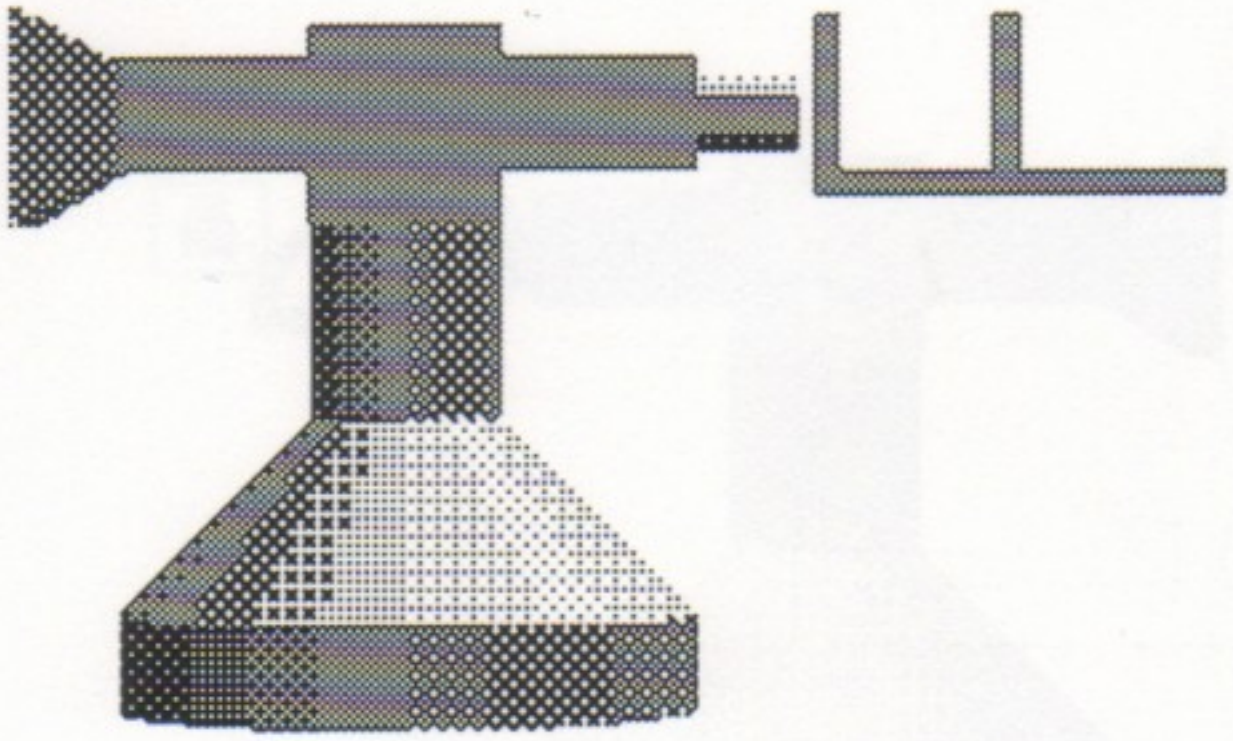


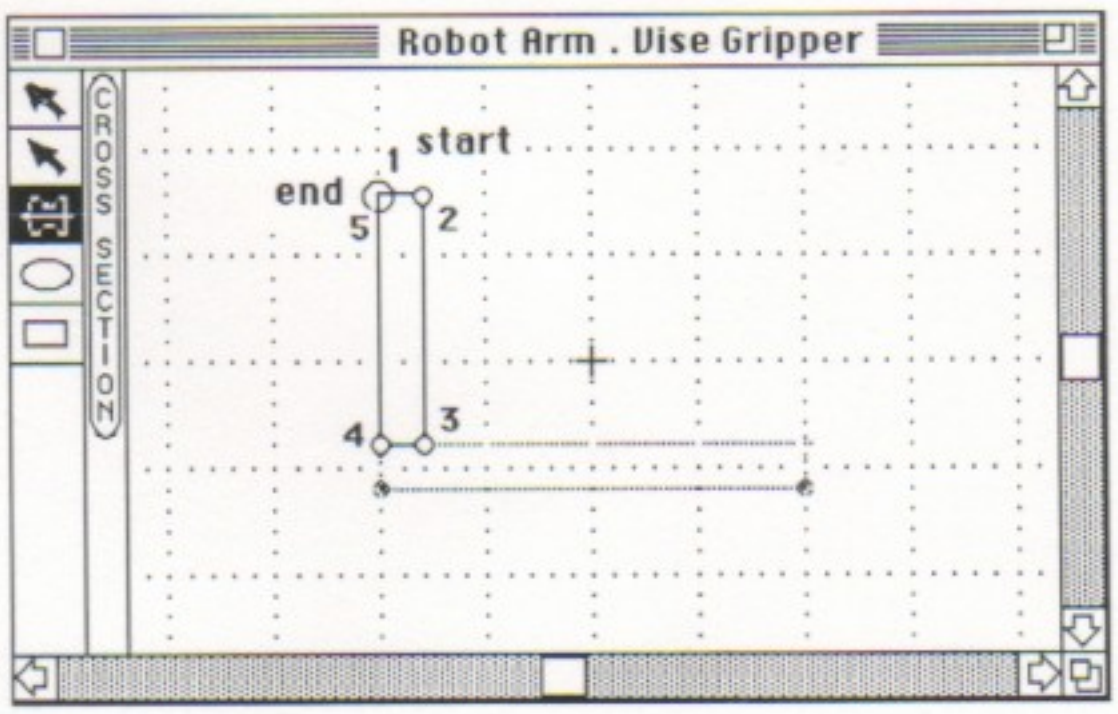
10

Step Ten - The Vise Gripper

Using the Attitude dialog, set the values to zero for the Vise's attitude in order to get a look at the object from the *Front*.

Duplicate the Vise and name the duplicate object the *Vise Gripper*. Open the Design Object view for the gripper and expand the Cross Section screen view by clicking on its button. This part will move in contrast to its twin. Using the Cross Section screen, redraw this part, using the Free Polygon tool—referring to the ghost-image as a guide.

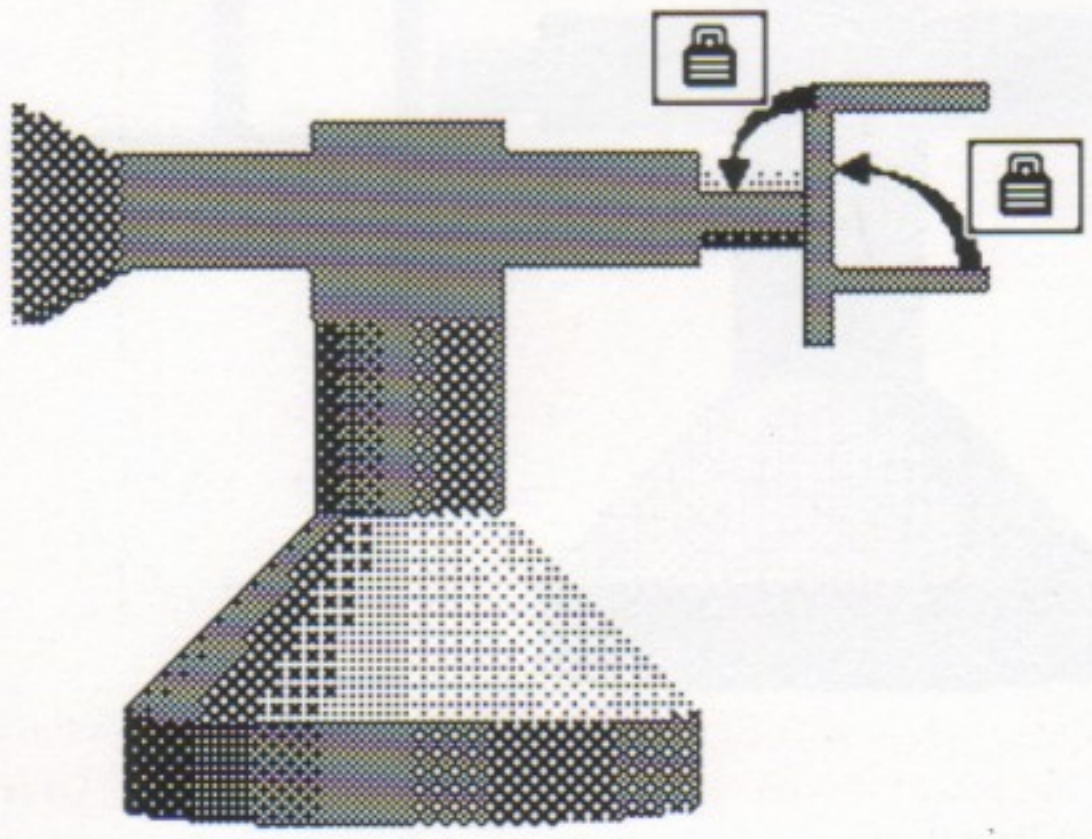




11 Step Eleven - Assembling the Vise

Link the Gripper to the Vise with the Lock Tool, and open its Position dialog. Unlock the X axis and set its Minimum and Maximum along the X axis of the Vise as you did in Step Eight, constraining the extender.

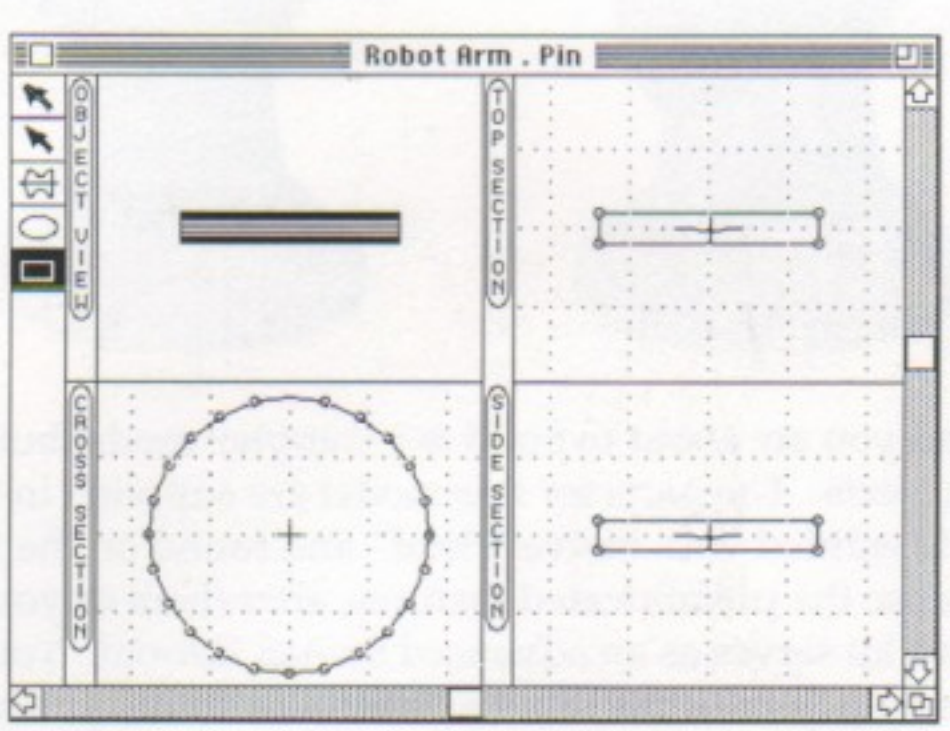
To attach the Vise to the Extender, Roll the Vise by +90 degrees. Move the Vise so that its middle is tangent to the end of the Extender. Select *Top* in the World menu to see if the Vise and the Extender are lined up. Return to the Front view of the world and Lock the Vise to the Extender. Next, unlock the Vise's Pitch in the Attitude menu.



12

Step Twelve - The Pin

Bring another cube into the Workspace which will be used to create the Pin. Follow the example in the Cross Section screen and Top Section screen on how to create it. Next, set the values for Yaw, Pitch and Roll to zero in the Pin's Attitude dialog. Lock the pin to the Arm and open the Pin's Position dialog. These values should also be zero for the X, Y and Z positions. This is a quick way to move an object to the center of another. Because the Pin is in the center of the Arm, the Arm now appears to use the Pin as a point of rotation.

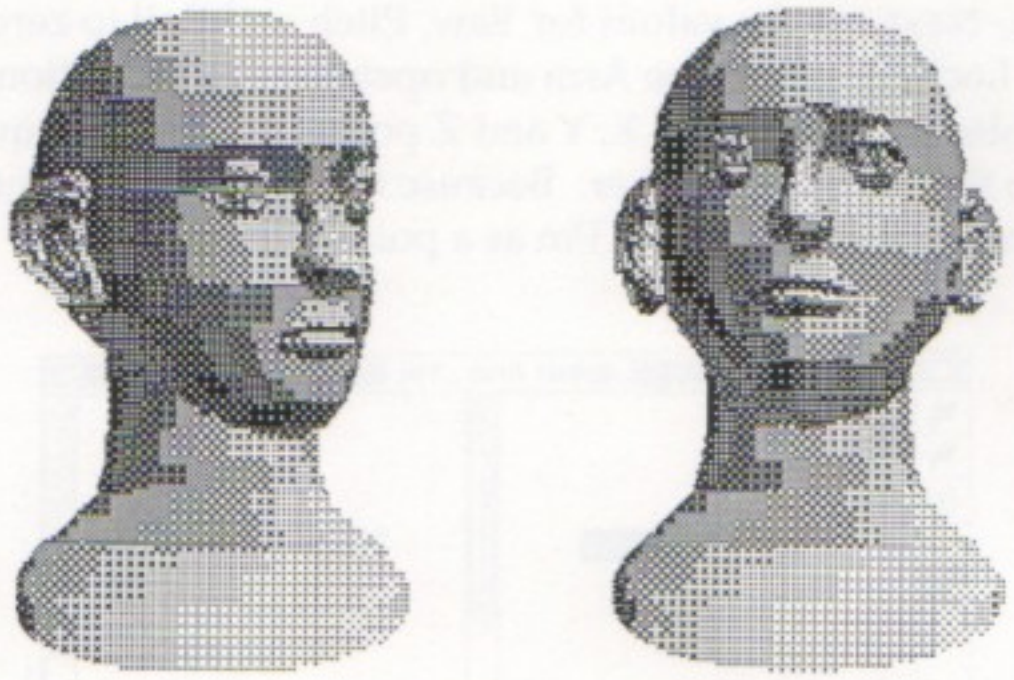


And with that step, we offer you our congratulations—you have successfully built a Robot Arm model. Now you can experiment with swivelling it around and extending it.

Final Step: Options

Highlight the different pieces by *coloring* them separately or by using Swivel's different *Rendering* commands. Choose *Render Separately* in order that each part might be assigned a different gray scale.

Model Kit - Mr. Swivel Head



The Head you are about to build is a complex model built of *ten* individual Swivel objects. The parts for this model are supplied in the Model Head Kit demo file entitled "Mr. Swivel Head" and found on the *Swivel 3D Demo* disk. You can use the prefabricated features, alter them or you can design your own. The Head kit serves as an advanced Swivel tutorial. You should have already built the auto horn or the robot arm models before you attempt to construct the head. You'll benefit from applying the processes and techniques spelled out in detail in those kits—which are referred to in this Kit in limited terms.

Building the Head Model

Whether you design your own features, modify existing ones, or simply use the demo file parts, be sure to build or clone the parts by working from a *second* opened file—separate from the *final* file you are constructing. Working with both files open, copy and paste parts as needed into the final model. After building one head kit, you can duplicate it and use edited parts to create a complete cast of characters, for example, as animation models.

Hint: Pay attention to the *Scale* of the objects as shown.

Parts List

1.	One Neck	Base Object locked in place at center of World
2.	One Head	Constrained Ball Joint link to Neck
3.	One Nose	Locked link to Head
4.	One Mouth	Locked link to Head
5.	Two Eye-Balls	Constrained Ball Joint link to Eye-lid Left is identical to Right
6.	Two Eye-Lids	Locked link to Head Left is Mirrored version of Right
7.	Two Ears	Locked link to Head Left is Mirrored version of Right.

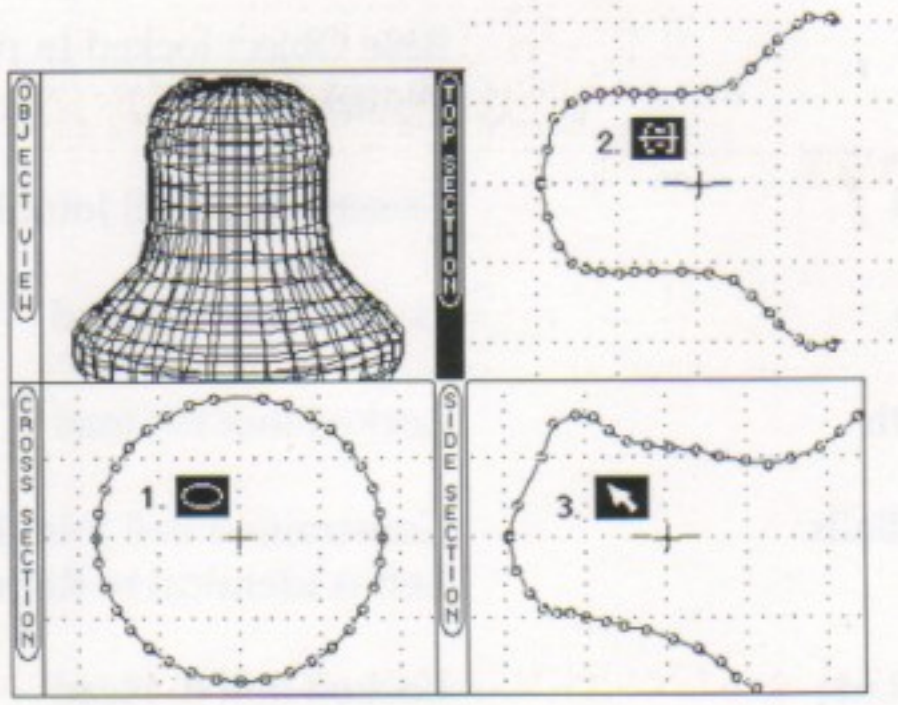
1

Step One - the Neck

Create (or copy the existing Neck) and paste it into a new file. Save the new file under your own choice of name.

In designing the Neck

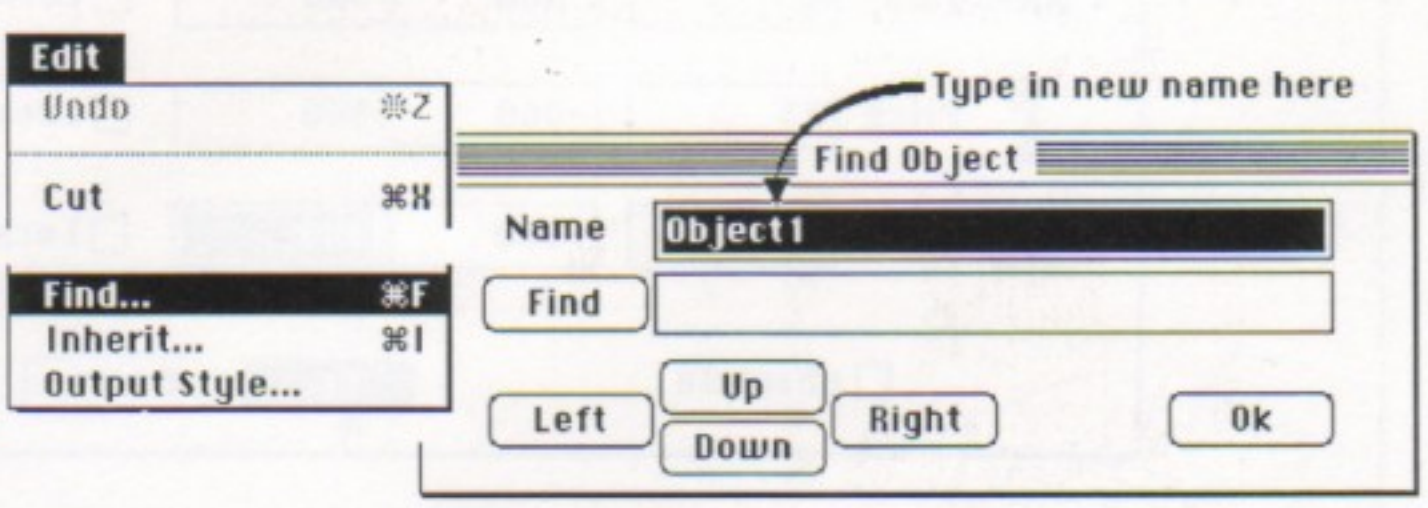
1. Use the *N-gon* tool to make the circular Cross Section.
2. Expand the Top Section and use the *Free Poly* tool. Though called the top, this will actually be the *front* view of the Neck.
3. Expand the Side Section and use the Single Arrow tool to edit the view. This view serves as the *Side* view of the Neck.



2

Step Two

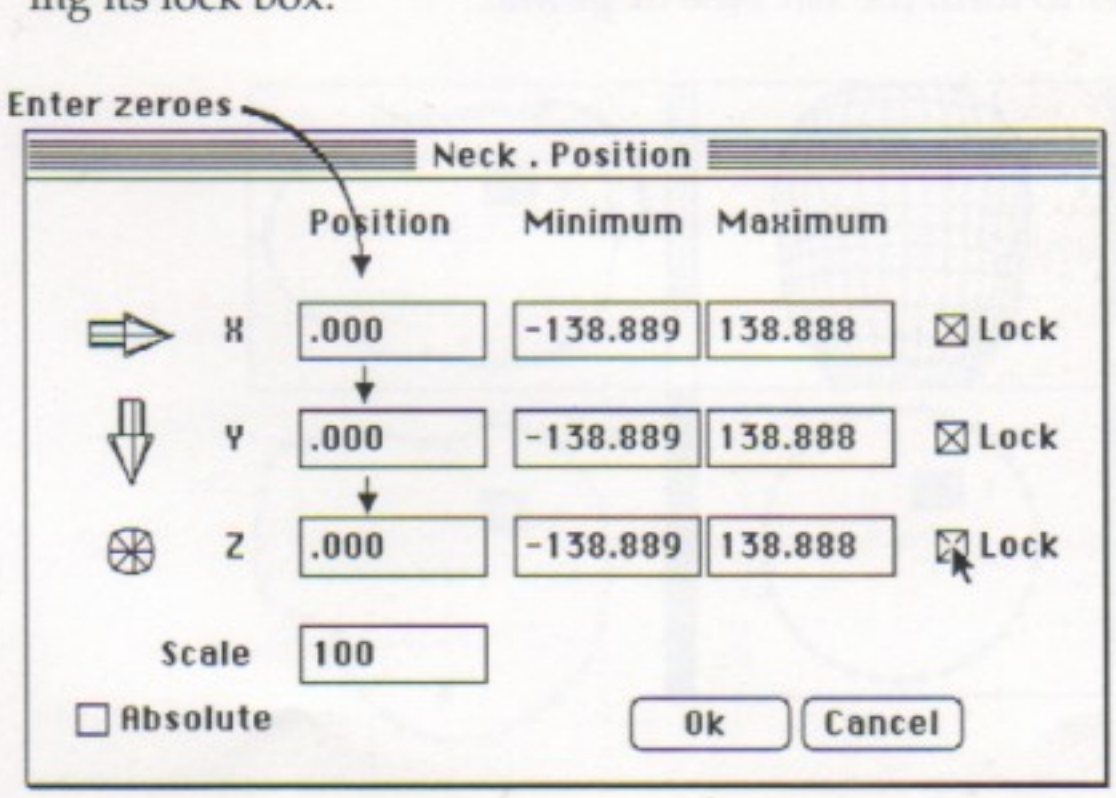
Open the *Find* dialog under the *Edit* menu. Name the object "Neck" by typing into the Text Field reading *Object1*. In a model with many parts, naming each one—as it is created—can help prevent editing of the wrong part. Once an object is named, its Design Object View, Position and Attitude dialogs will be automatically labeled with that name.



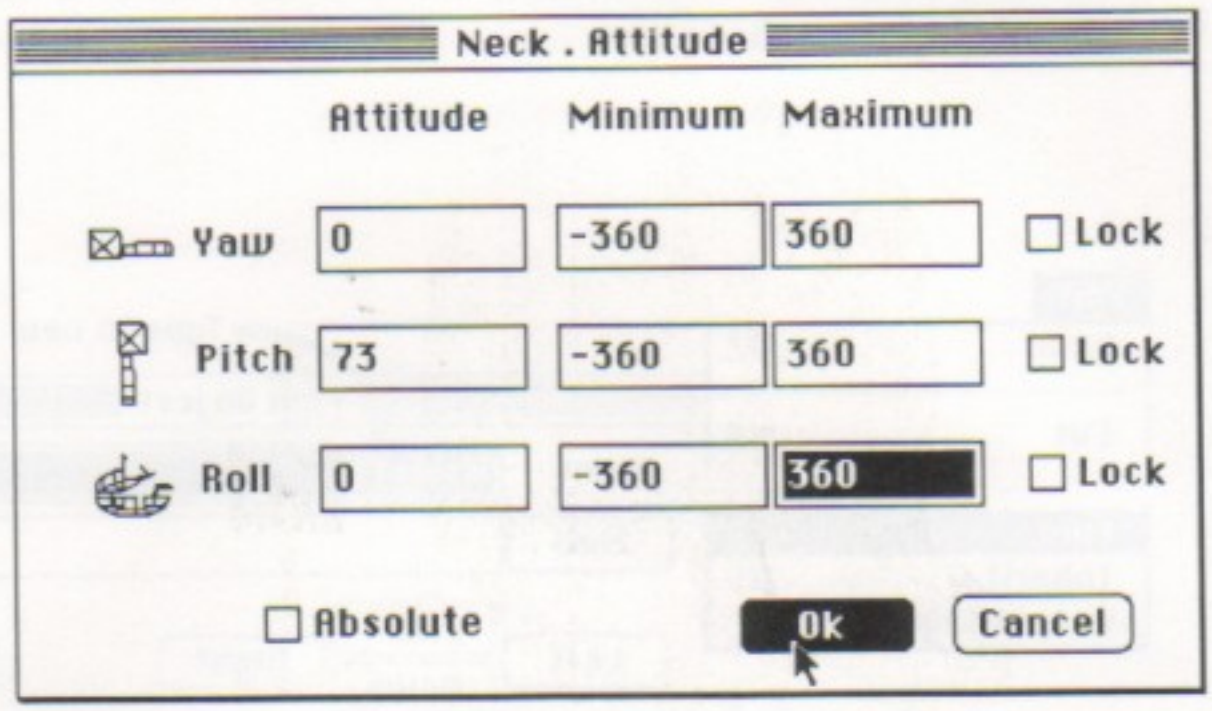
3

Step Three

Open the *Position* dialog in the Object menu, and enter zeros for the neck's X, Y, and Z positions (if necessary). As the neck will be the *base* object of the Head *tree*, its position is relative to the World. Setting the values at zero places the neck in the center of the Workspace. You can then lock each degree of freedom by checking its lock box.



Set the value for the Neck's Yaw and Roll to zero using the *Attitude* dialog, but set the pitch value somewhere between 70° and 90°. This rightens the neck from the "lying down" position in which it was designed. There is latitude in the "correct" angle because human bodies are flexible.

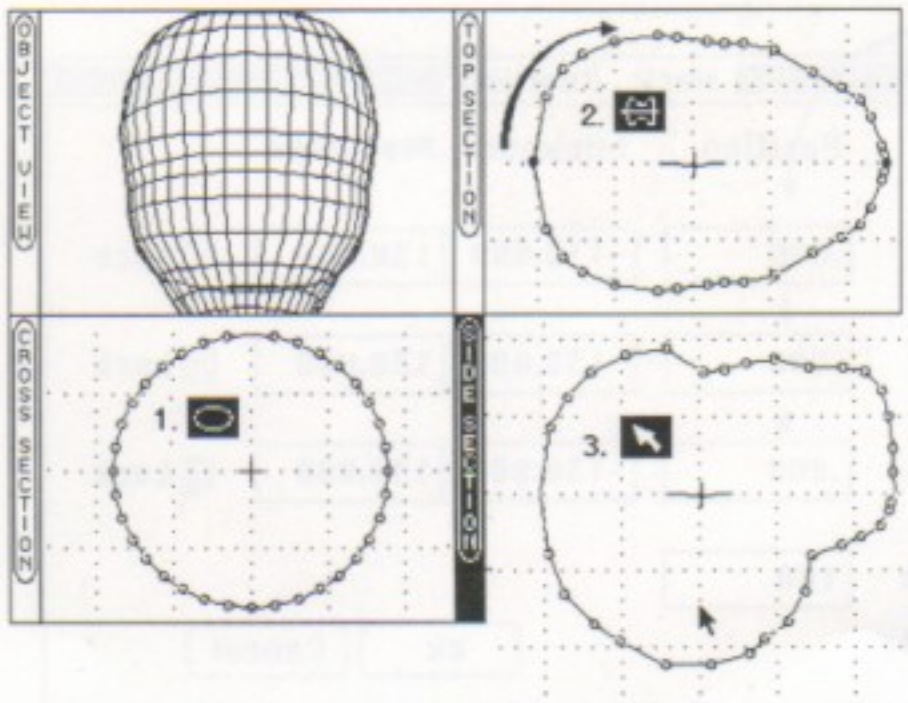


4 Step Four - Adding the Head

The Head

Create a new object and follow the design instructions for the head, or copy and paste in the head from the demo. Don't forget to name the object "Head".

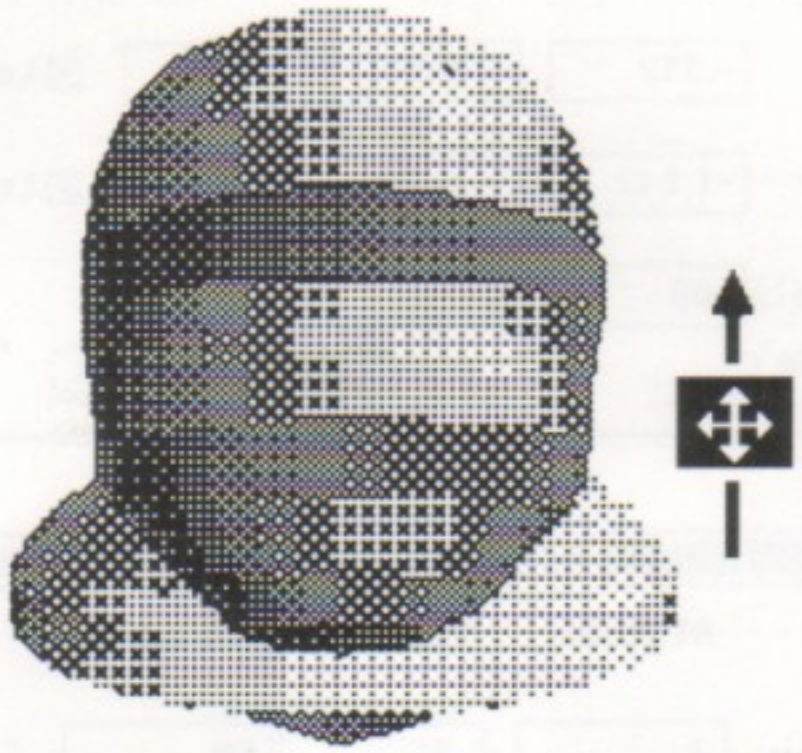
1. Click a circle in the Cross Section view with the N-gon tool.
2. Draw the *Front* face in the Top Section with the Free Poly tool.
3. Expand the Side View and use the Single Arrow to edit the side view in order to form the *side view* or profile.



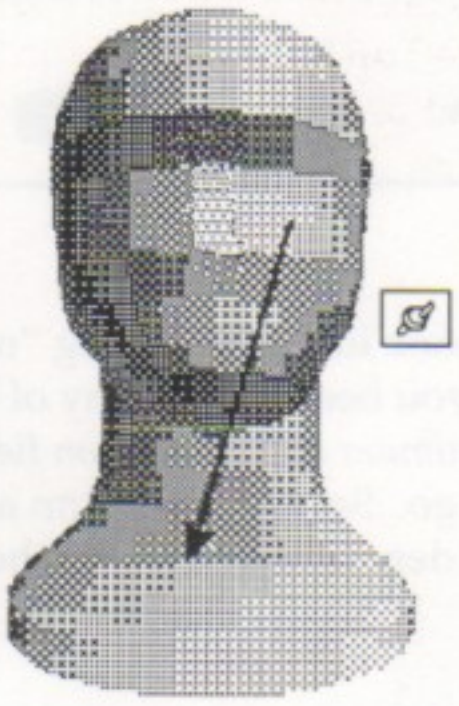
5

Step Five - Aligning the Head

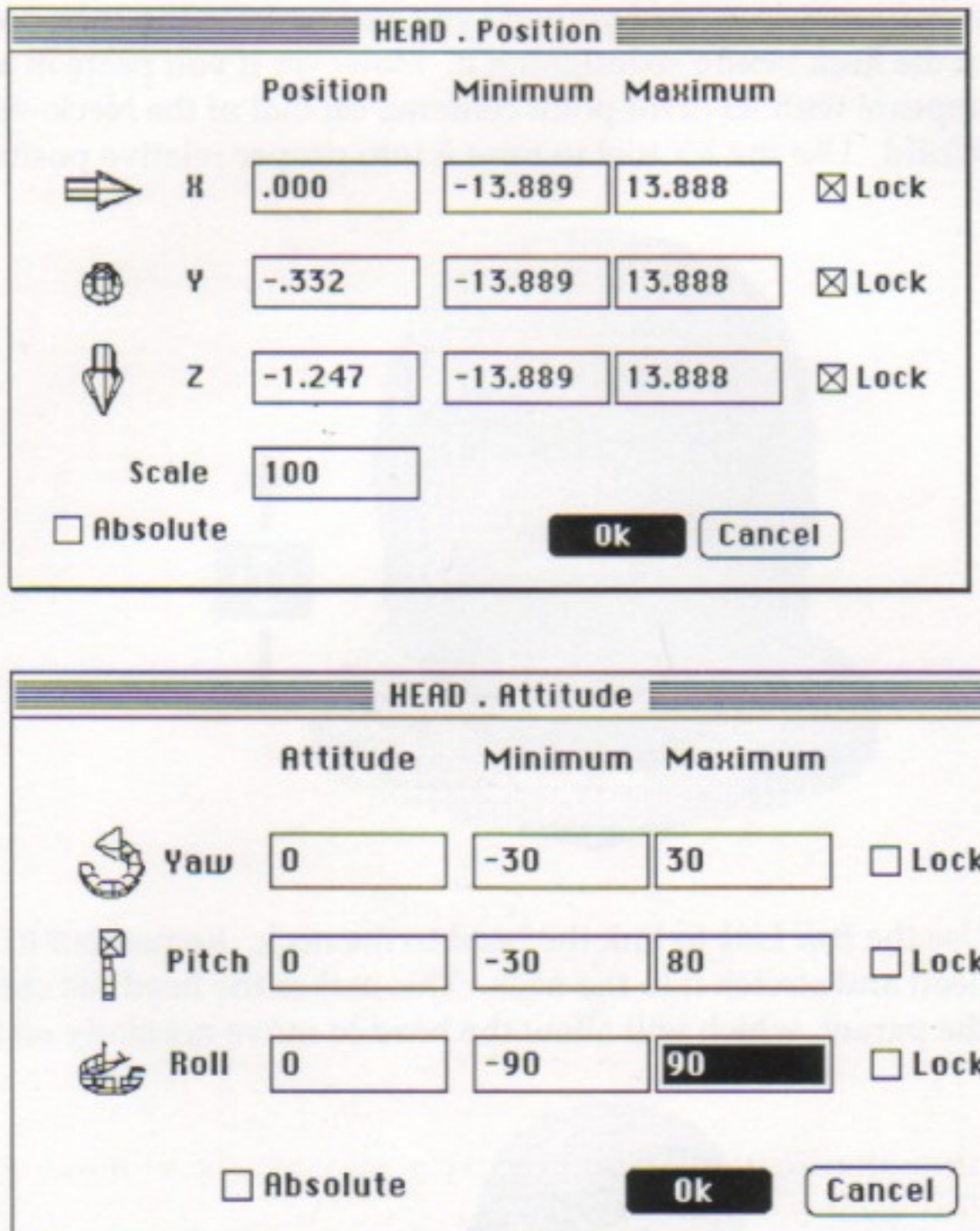
If you create the head yourself you can position the cube more or less at the top of the neck before redesigning it. However if you paste in a Head, you'll find it appears with its pivot point centered on that of the Neck—the center of the World. Use the XY tool to raise it into proper relative position.



Use the *Ball Link* to link the head to the neck. Remember to start the link with the head and stretch it to the neck. This makes the head the child object and the neck the parent, which will allow the head to move normally on the stationary neck.



Final Position and *Attitude* dialogs of the Head should look something like this.



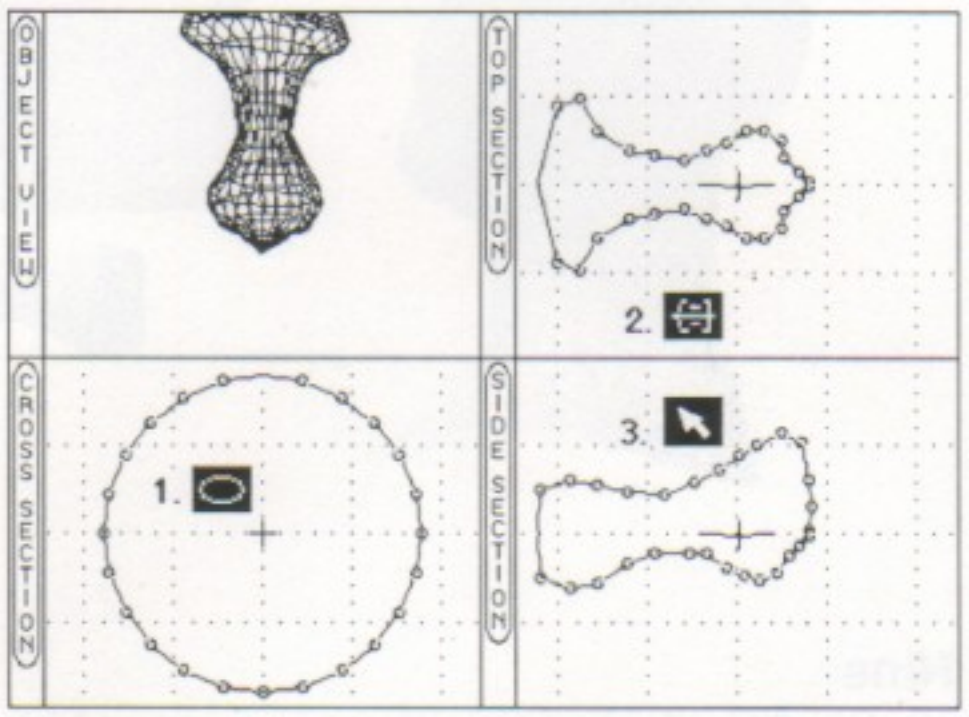
Since the head will be able to rotate in Yaw (shaking "no"), Pitch (nodding "yes") and Roll (shrugging "maybe") you needn't lock any of the degrees of freedom. The numbers entered in the *Minimum* and *Maximum* fields for each degree of rotation constrain how far they go. Set the maximum and minimums as shown or actually rotate the head in each degree separately to the point you consider to be a limit, and enter that number.

8

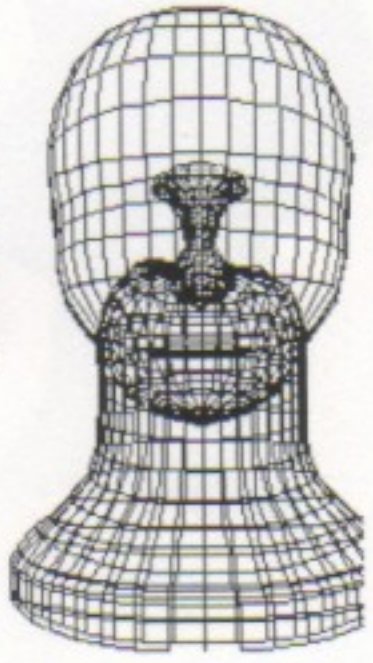
Step Eight

The Nose

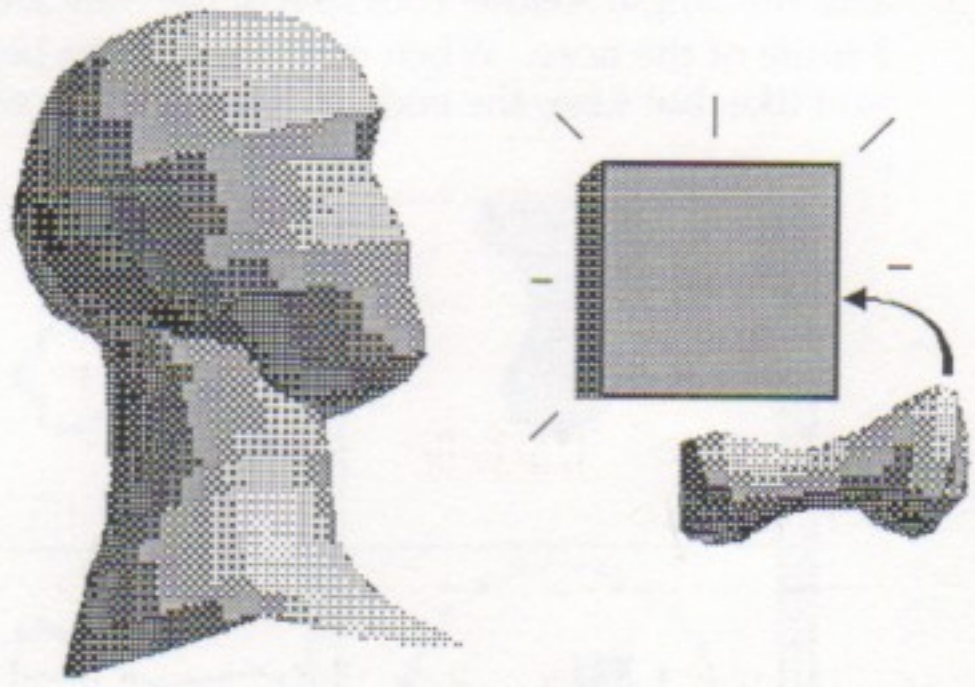
1. Use the N-gon Tool to make the circular Cross Section
2. Use the Free-Poly tool in the Top Section to draw both Top and Side Sections.
3. Use the Single Arrow Tool to edit the Side section only. This will be the Profile of the nose. When editing, pull the beak of the nose out as far as you like, but keep the ends in place so they will match the Top Section.



Create (or paste in) a nose and name it. If you paste it in, the nose may be invisible: it is engulfed inside the head and neck, since the paste operation automatically locates it at the center of the World: Select the Wireframe rendering mode from the Render Menu to reveal it, and use the XY tool to pull into position—leaving it selected.

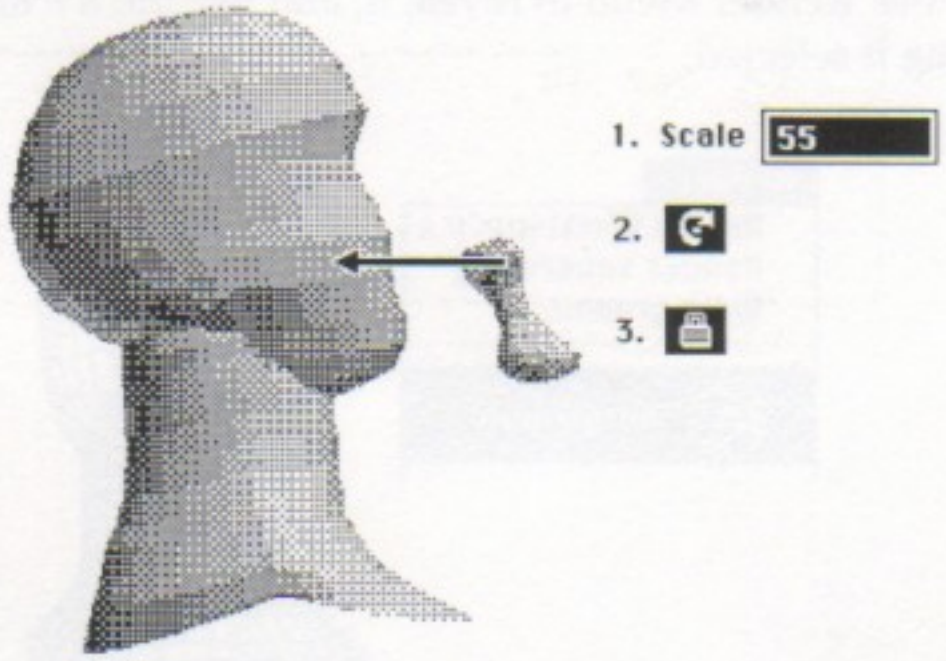


An alternative way to paste in objects is to create a new object cube to "hold the place" of the one to be pasted. When you paste with the cube selected, the pasted object replaces the cube, taking on its position, attitude and scale.



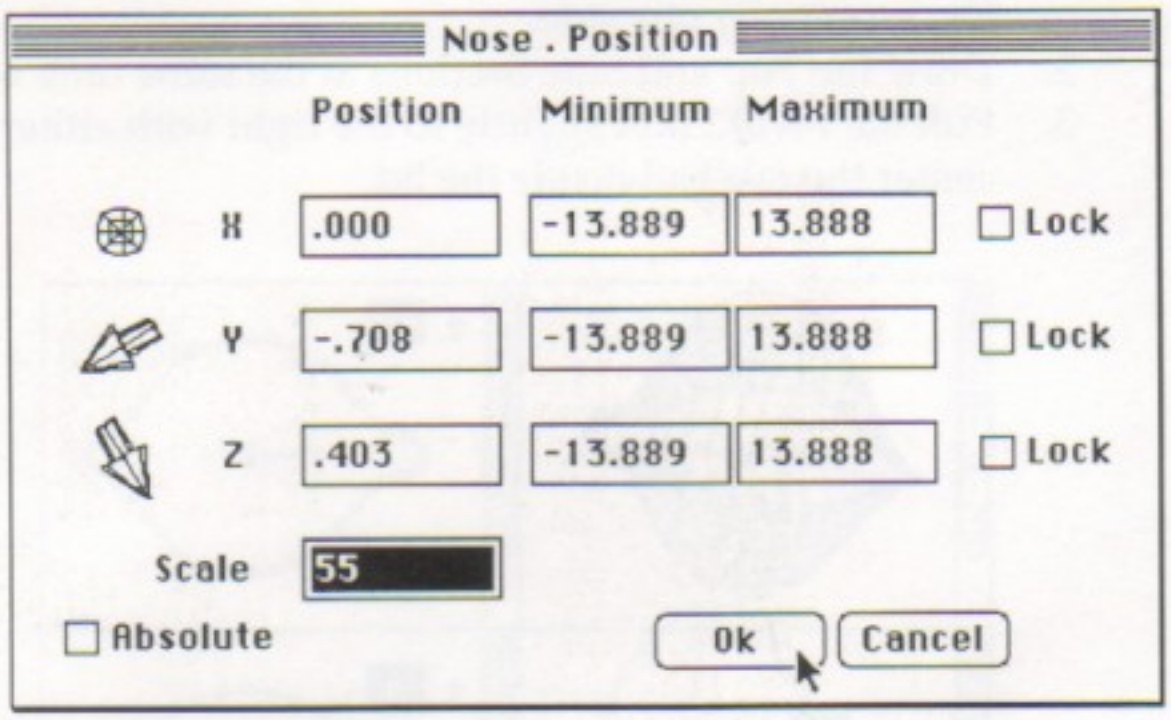
9 Step Nine

Rotate the World to the Left View (under the World Menu) to view the head in profile. It's a lot easier to position the nose from the side. Reselect the Shade type rendering mode. Link the nose to the head with the *Lock* tool.

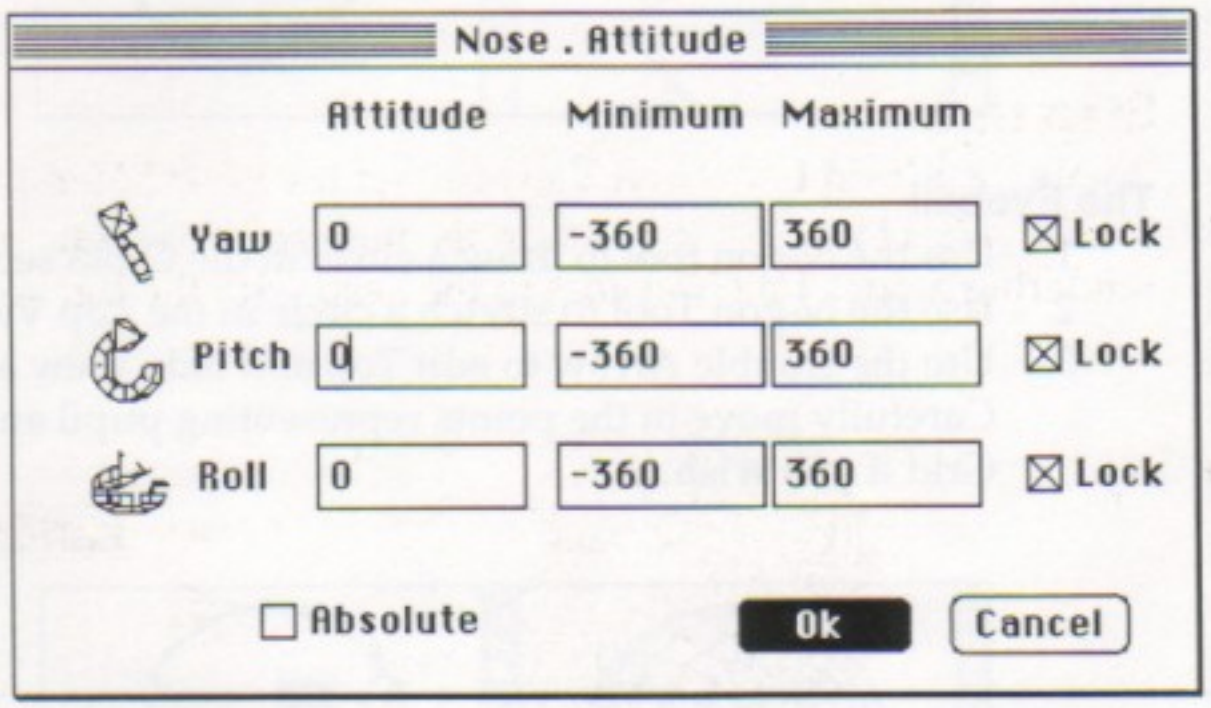


10 Step Ten

Fine tune the nose's alignment using its position and orientation dialogs.



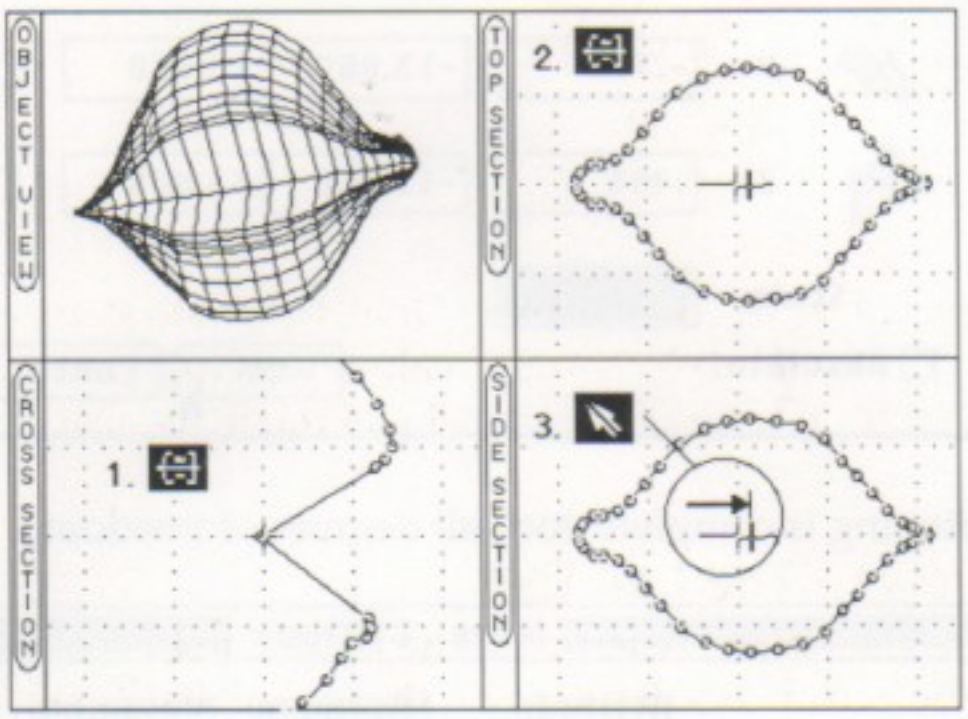
After positoning is complete, lock all degrees of freedom.



11 Step Eleven - The Right Eye

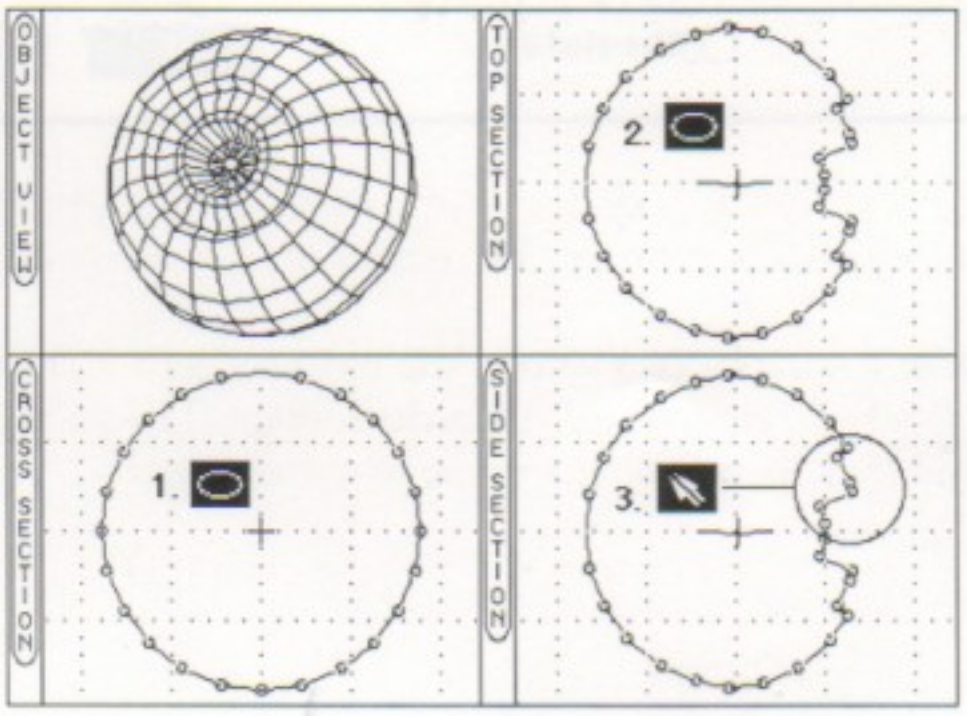
The Eyelid

1. Draw the Cross Section with the Free Poly tool. Like the lips, the eyelid has essentially one side.
2. Draw the Top and Side Sections at the same time with the Free Poly tool.
3. Pull the Pivot Point slightly to the right with either Arrow tool to help center the eye ball inside the lid.

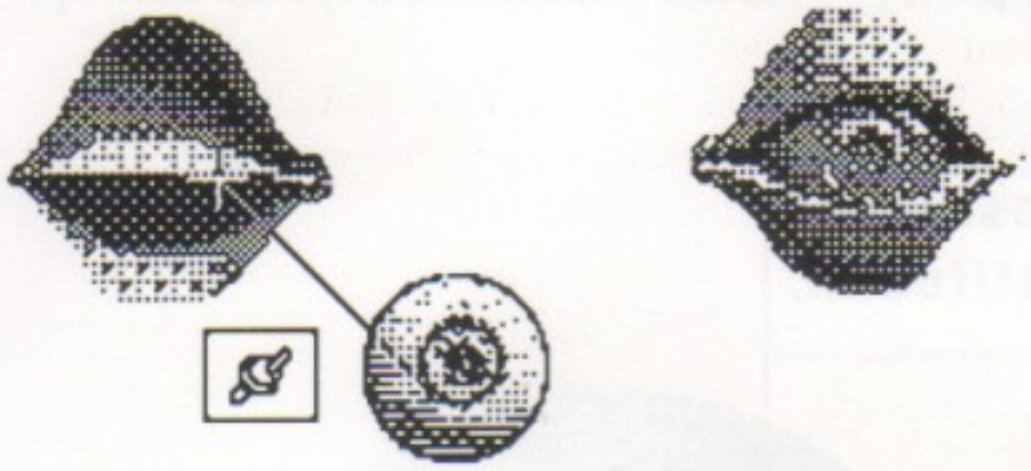


The Eyeball

1. Use the N-gon tool to draw a circle in the Cross section View.
2. Use the N-gon Tool to stretch a circle in the Top View, making a sphere.
3. Use the Double Arrow to edit Top and Side View at the same time. Carefully move in the points representing pupil and iris. Use the Polar Grid if you wish.



Create both the eyelid and the eyeball. You need only one of each, as you'll be able to duplicate them in order to make the other eye.



Link the eyeball to the right eyelid. Open the position panel for the eyeball, set its scale to 70 and set its X, Y and Z values to zero. The scale is relative to the lid, so when you scale the lid, the eyeball will retain its relative size.

12 Step Twelve - The Left Eye

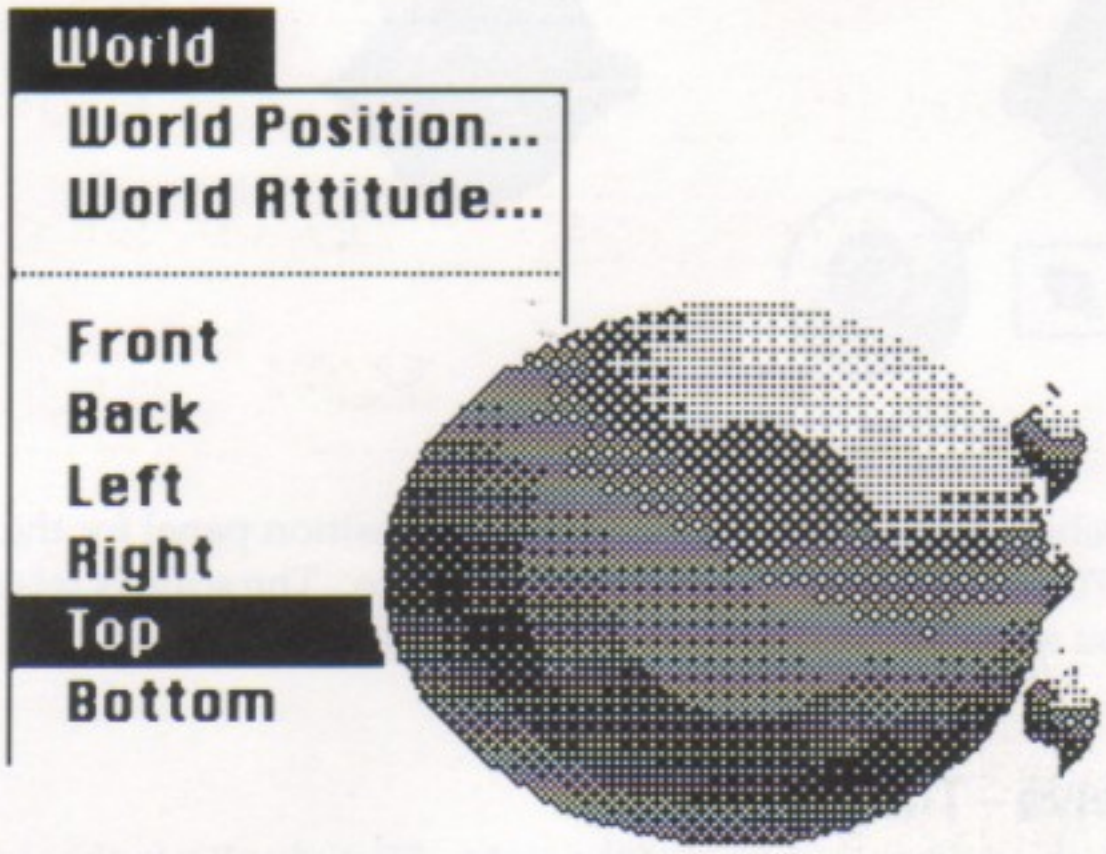
The left eye should be the *mirror* of the right. First, duplicate the right eye. By selecting the eyelid—its down link—the eyeball itself will be duplicated as well. With the lid selected, open the *Object Form* dialog and select the third Mirror option in the list in order to reverse the lid.

Mirror Object works only on the object selected: not on it's down-tree links. Luckily, the eyeball is symmetrical and needs no mirroring.

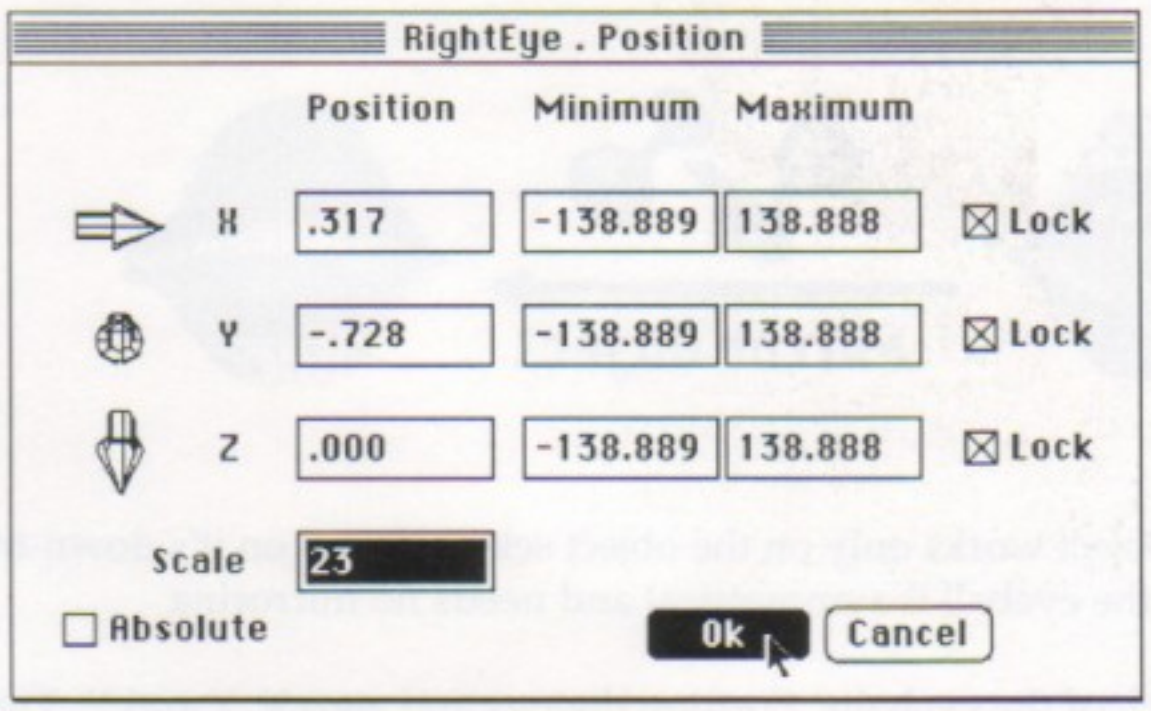
Open each of the eyeballs' Position dialogs and zero X, Y and Z. These should already be locked. Open their Attitude dialogs. Limit the Yaw and Pitch of the eyeballs and lock their Roll at a value of zero.

13 Step Thirteen- Positioning the Eyes

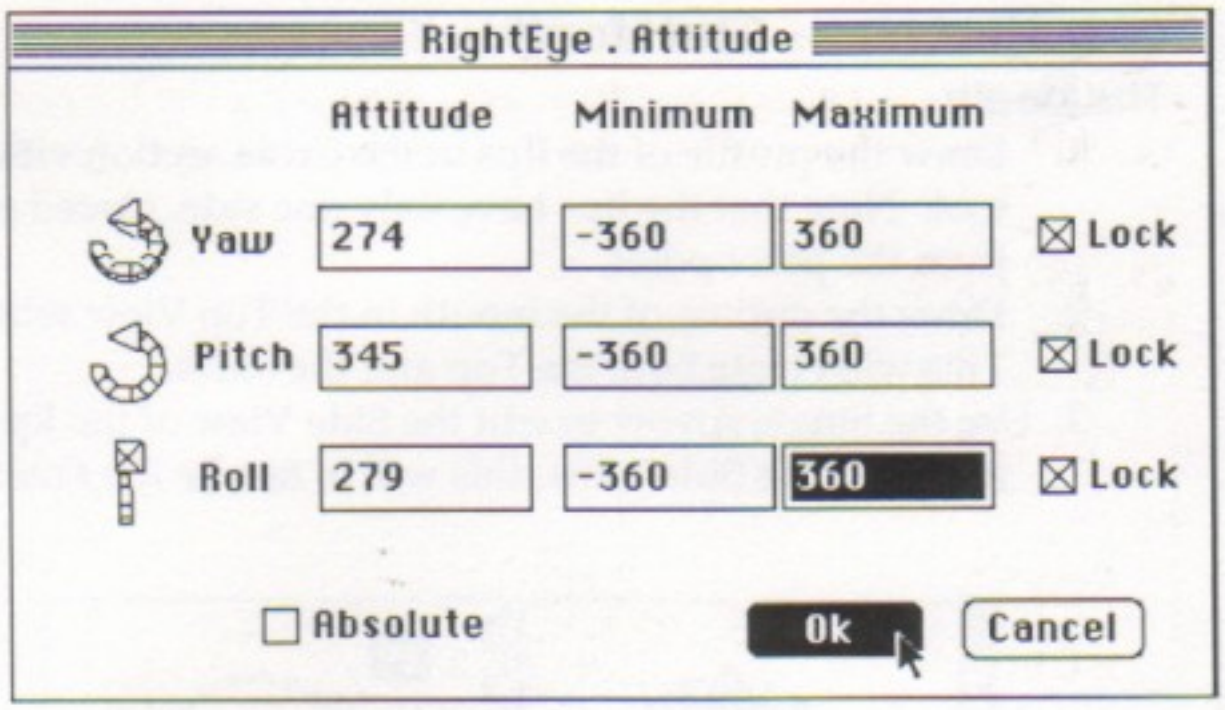
Position the eyes as accurately as possible, using the XY and XZ tools. Change the World View frequently as needed to see how the eye are lined up.

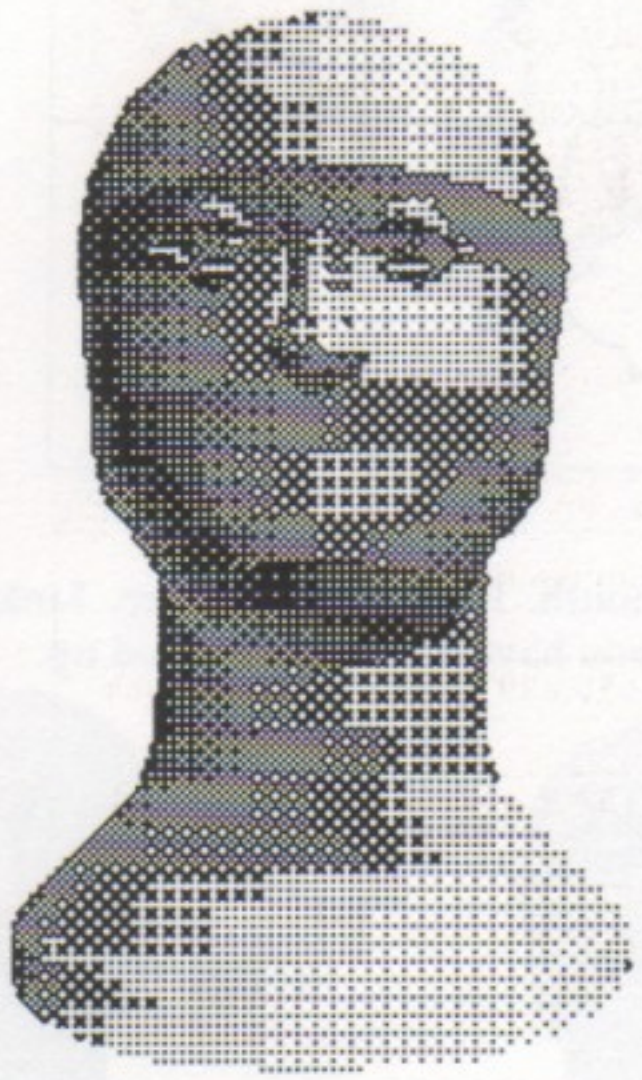


Finalize the eyes alignment using the Attitude and Position dialogs.



Note that the two eye's position will vary only in X. Since the head is centered in the World, the Left eye's X value will be negative and the Right Eye's X value will be the same—only positive.

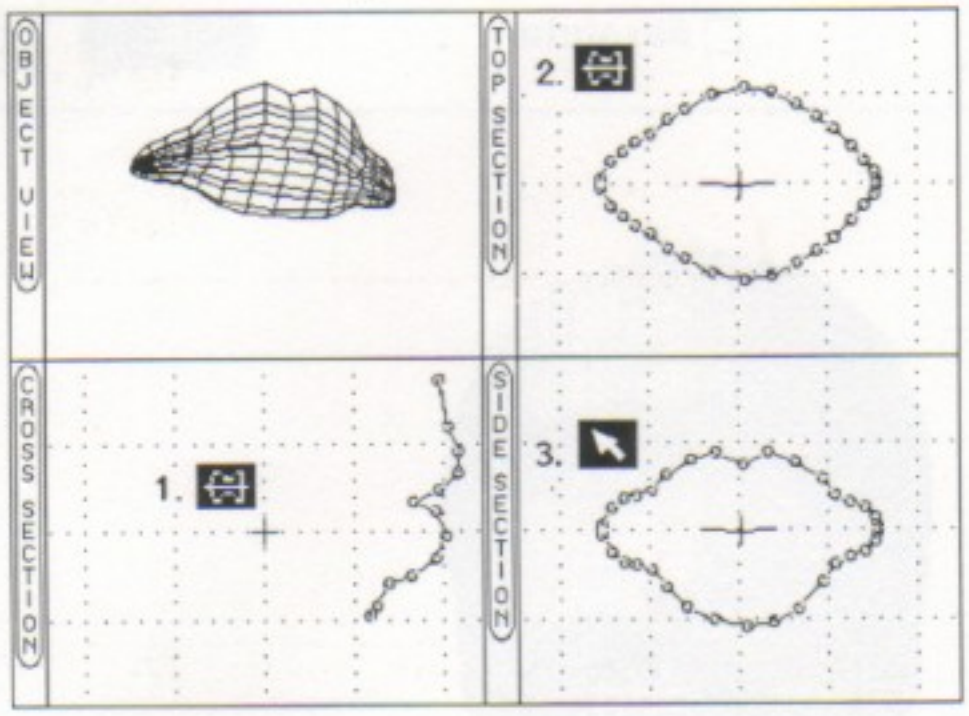

RightEye . Attitude
Attitude
Minimum
Maximum
Yaw
274
-360
360
Lock
Pitch
345
-360
360
Lock
Roll
279
-360
360
Lock
Absolute
Ok
Cancel



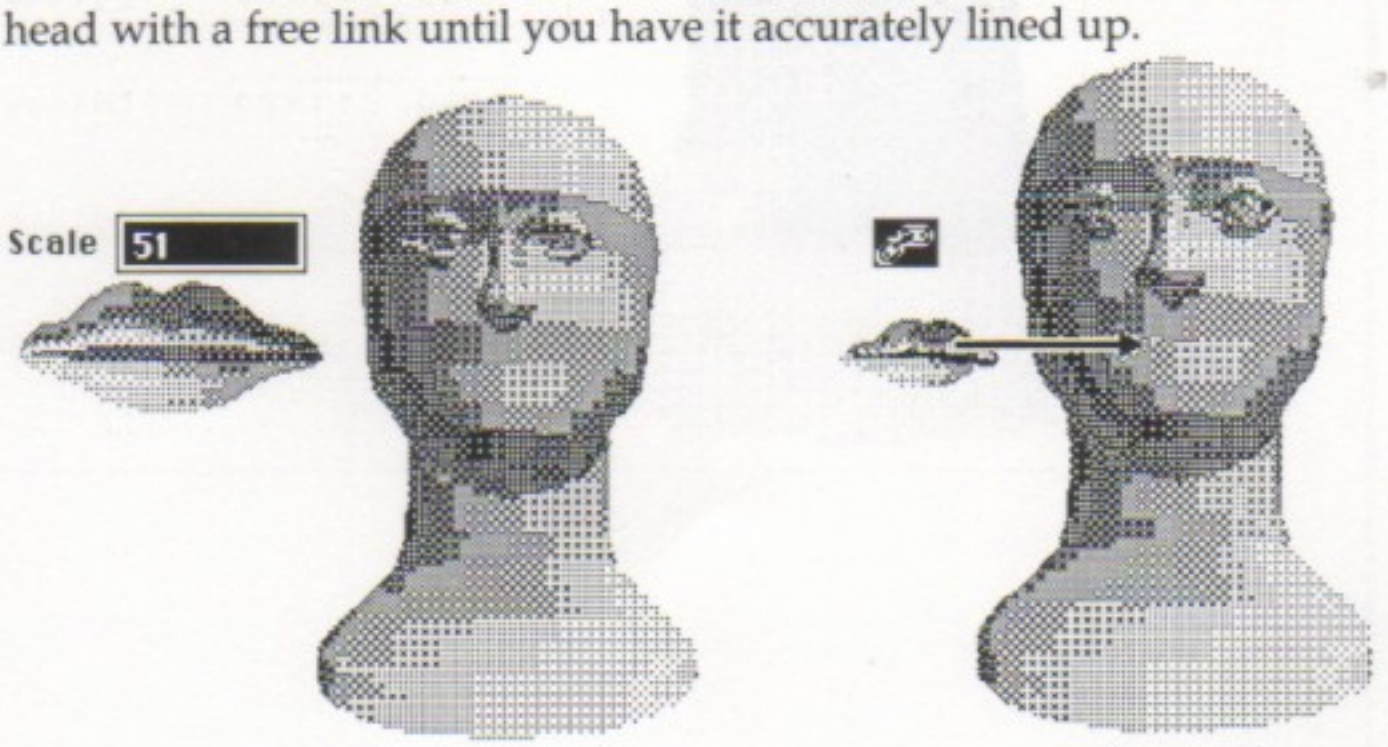
14 Step Fourteen - The Mouth

The Mouth

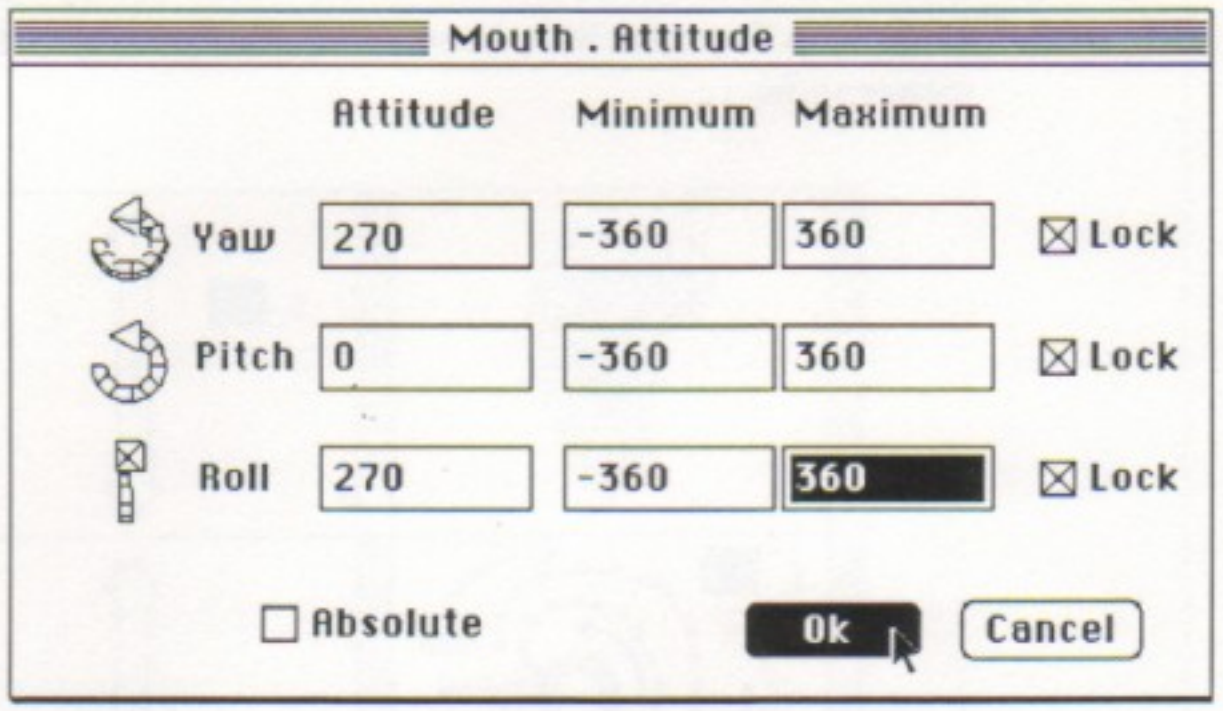
1. Draw the profile of the lips in the Cross section view using the Free Poly tool. Note that the lips have only one side, placed some distance out from the pivot point.
2. Draw the outline of the mouth in the Top View with the Free Poly Tool. This will create both the Top and the Sides.
3. Use the Single Arrow to edit the Side View of the lips only. Though drawn in the Side View, this will in fact be the *Front* view.

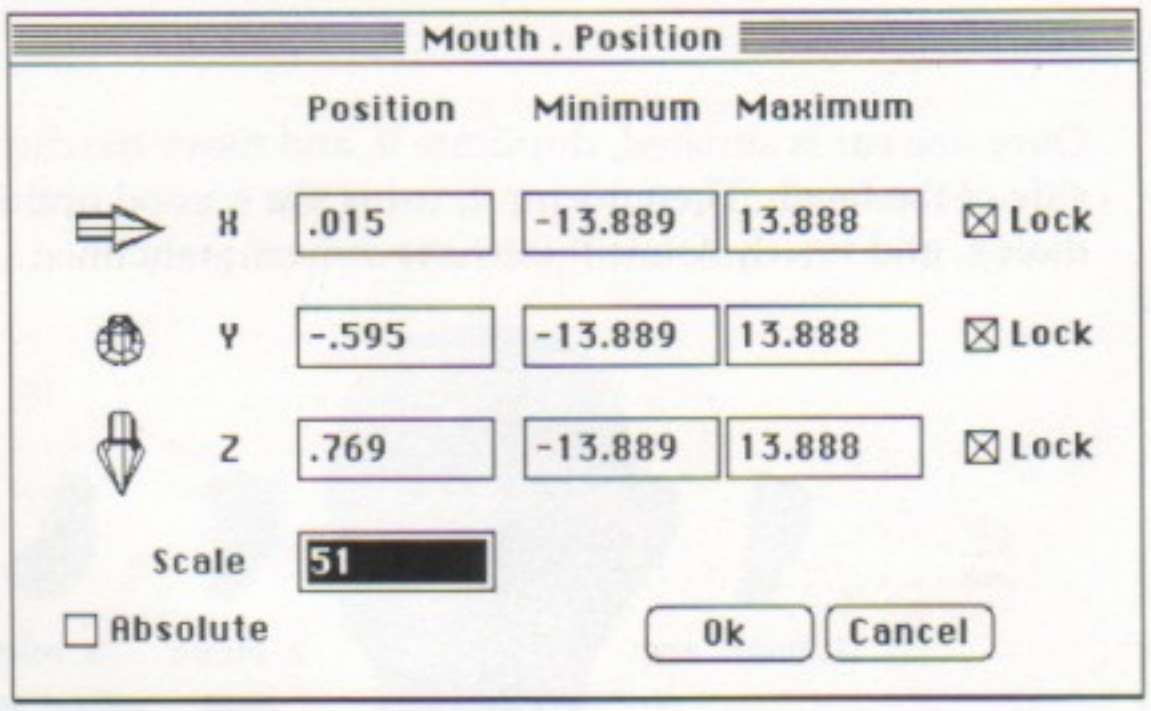


Paste in (or create) a new mouth. Position it as before. Link the mouth to the head with a free link until you have it accurately lined up.



Name the mouth, then lock and scale it to the Head. Do the final adjustments of attitude and position in the dialogs.

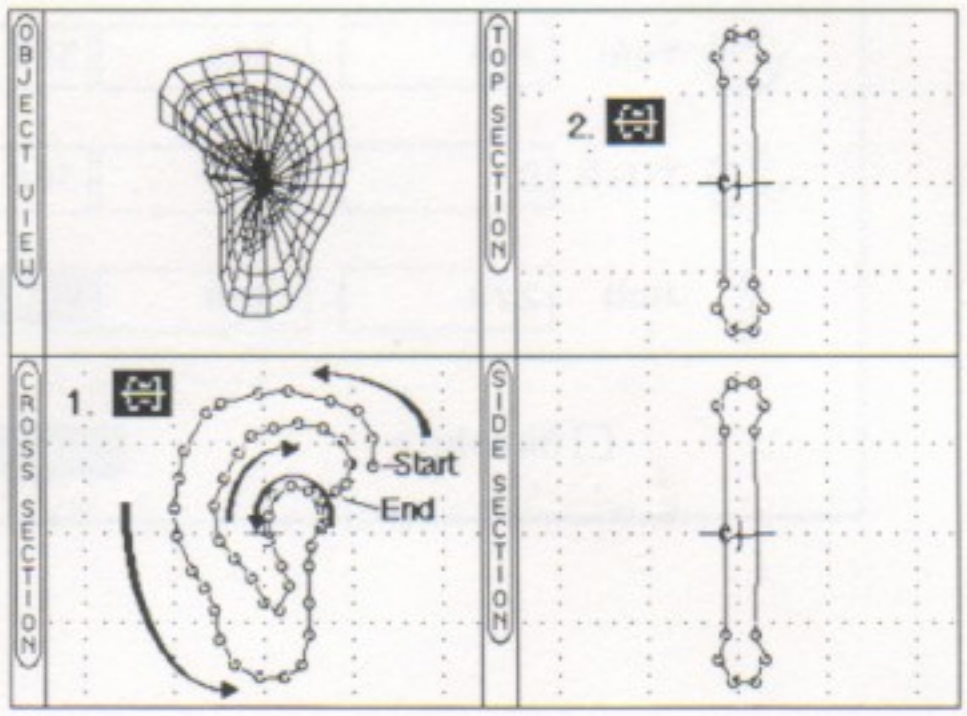




15 Step Fifteen - The Ears

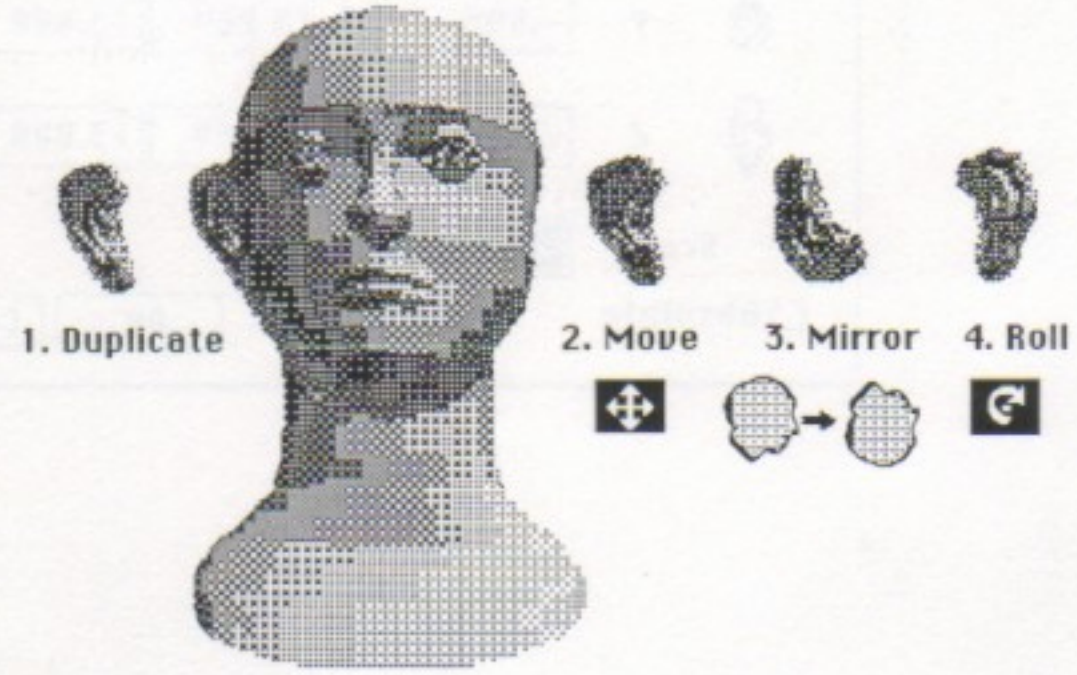
The Ear

1. Draw the contour of the ear in the Cross Section using the Free Poly tool.
2. Draw the Top and Side Views simultaneously with the Free Poly tool in either view

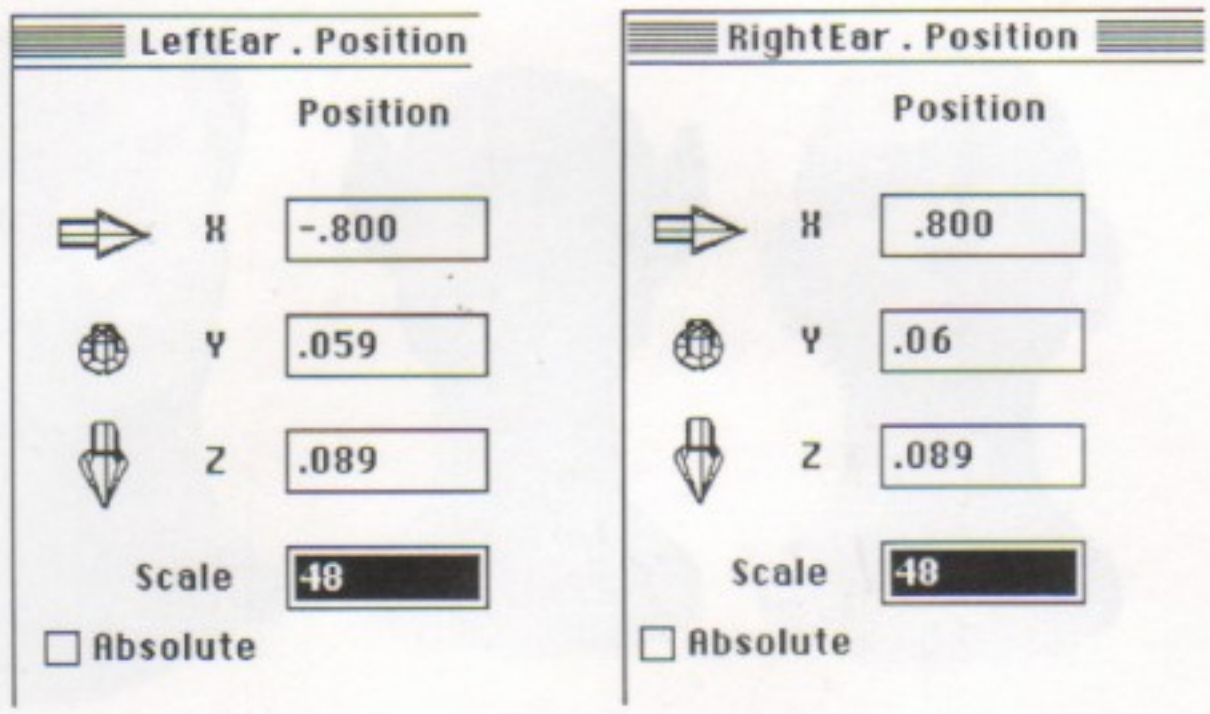


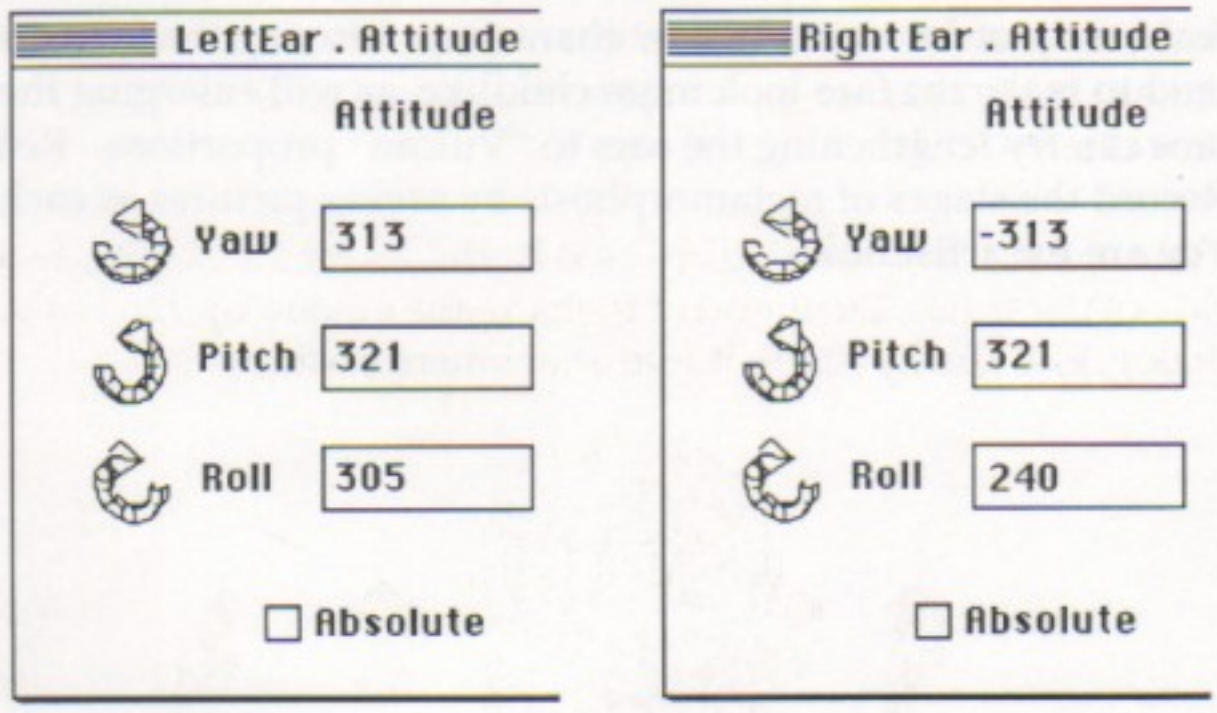
Scale the ear to 48% and move it to the approximate attachment point at the side of the head. You can adjust the position and attitude as closely as possible with the World view tools.

Once one ear is situated, duplicate it, and move the duplicate object to the other side of the head. Then mirror it, using the second option in the Object Form dialog, and finally rotate it into attachment position.

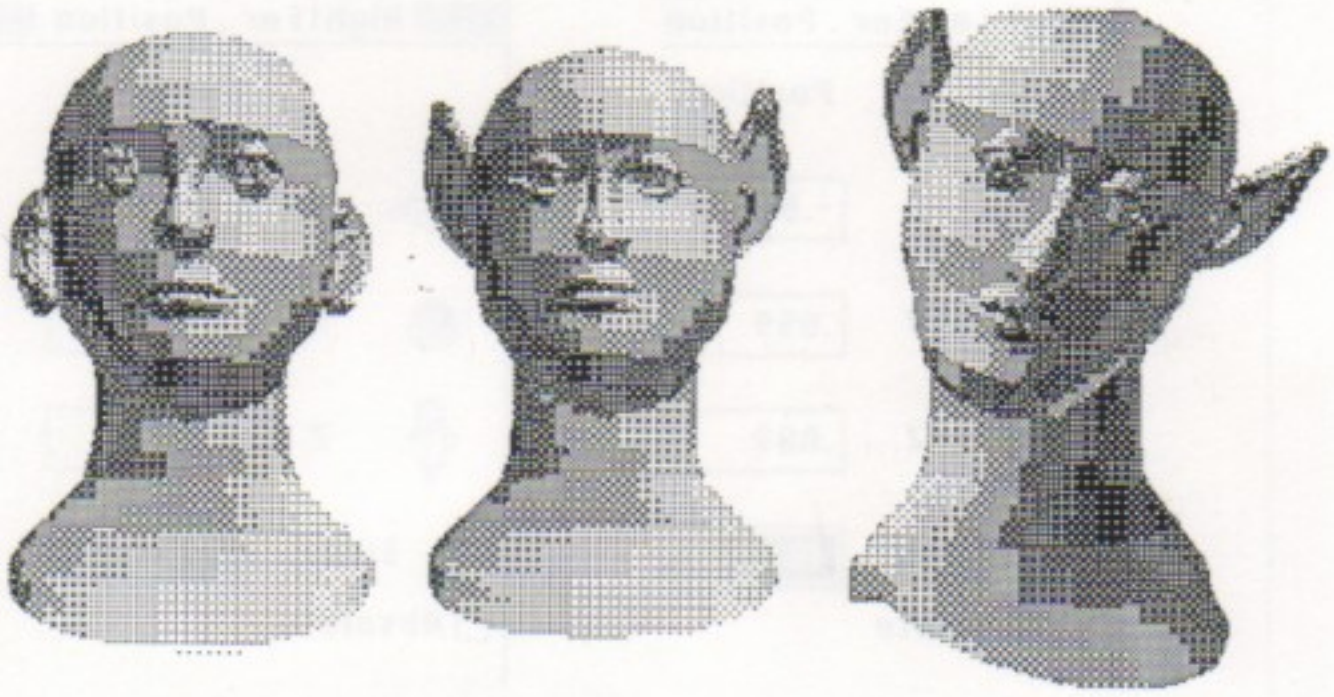


Finalize the position and orientation of both ears in the Position and Attitude dialogs. Note one difference in the orientation of the ears: Once an object is mirrored, the object's *frame of reference* for rotation is altered. Notice that the attitude for the left ear is quite different from that of the right.





The model is now complete. You can render, light and define it with various effects. You can make animations of the eyes rolling and the head swivelling by employing the *Tween* option found under the Effects menu.



You can also re-name your file (after saving the old file) and begin to edit the features in order to create new characters. Moving the eyes down and apart will tend to make the face look more childlike, as will enlarging the eyes. Star Trek fans can try lengthening the ears to "Vulcan" proportions. Redesign the nose. Record the stages of metamorphosis by saving pictures as each change is made. *You* are the artist now.

Appendix B: About the Command File Language

The Command File Language

The Command File Language allows the advanced Swivel user to design scripts that create objects and which move and tween models.

For further information and documentation contact
P A R A C O M P Inc.
123 Townsend Suite 310
San Francisco, CA 94107

INDEX

Note: QRG* means Quick Reference Guide - a card designed to fold out of the back of the manual.

D

G

H

I

K

L

M

N

O

P

Q

R

S

T

X

Y

Z

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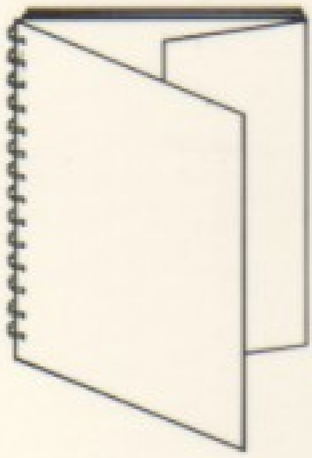

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