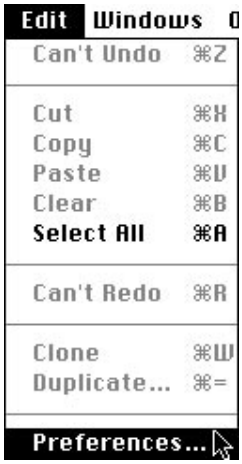
Transformations

When building a model, it is not always easy, nor always desirable, to build each and every component separately, and exactly in its final position, size, and orientation. This is where the Transformations—Translate, Rotate, Resize, Align, Move-To, Duplicate, Mirror—come into play; they can save you significant time and effort. This tutorial is intended to give you a look at how each of these transformations may be effectively used to create a basic object like a wheel. You may later use the same techniques to construct a more accurate wheel model, employing real-world size and proportion for a particular type of wheel.

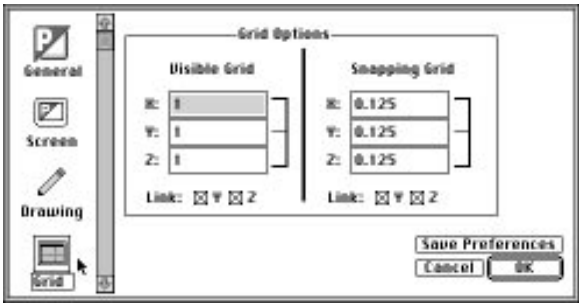


Edit Menu

Double-click on the ModelPro application icon to open a New, blank data base (or, if you are already "in" ModelPro, select New from the File Menu).

Setting the Preferences

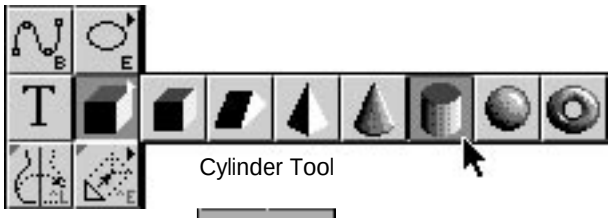
Select Preferences in the Edit menu. Select the Grid icon from the list on the right. The default is to link the x, y, z data fields. On the Snapping Grid side of the Grid Options, enter 0.125 in the x data field. Click on OK, or Save Preferences to save the new grid snapping configuration.



Grid Preferences

Creating a Spoke

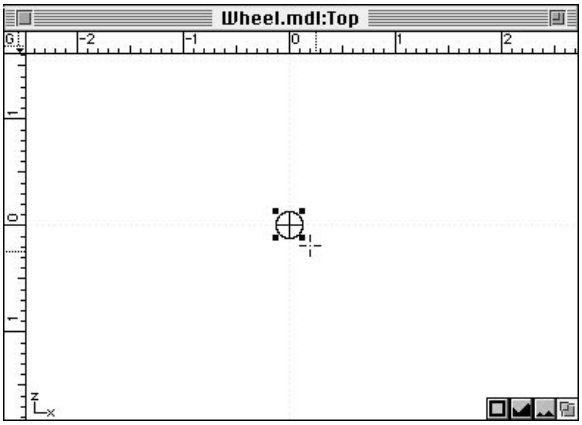
Select the Cylinder 3-D Primitive tool from the Tool palette. Select the Center-to-Corner drag mode in the Draw Options portion of the Tool palette (bottom). Click on the Grid snap button in the Snap palette (g key). In the Top view window, move the cursor to the center of the window, where the origin guides cross. Click-drag diagonally until the cursor snaps to x = 0.125 (combine what you see in the View window with the values you see in the Status Line palette, at the bottom of the screen, to accurately draw the cylinder shape).

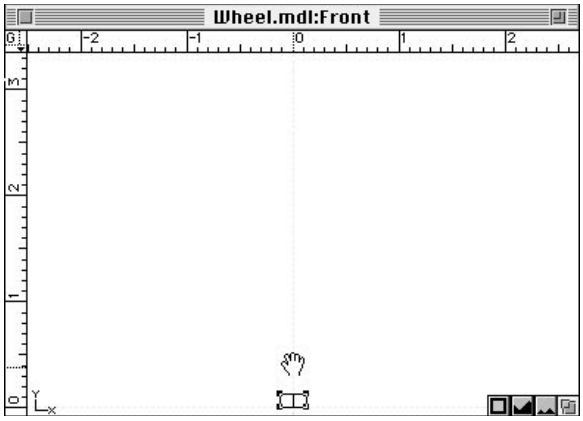

Cylinder Tool


Drag mode


Grid snap

Use the Hand tool to pan the view in the Front window down until the cylinder shape (rectangle in this view) is near the bottom of the window.





Draw the cylinder and pan Front view down

If the cylinder is not still selected, select it using the Standard Selector tool. In the Front View, drag the upper-right corner point of the cylinder straight up to y = 3.25. The Grid snap should still be engaged, and will help you once again to accurately reach the proper location.

Cloning a Second Spoke

If the cylinder is not still selected, select it using the Standard Selector tool. Select Clone from the Edit menu (⌘-w) to make a duplicate of the cylinder located directly on top of the original.

Rotate Tool

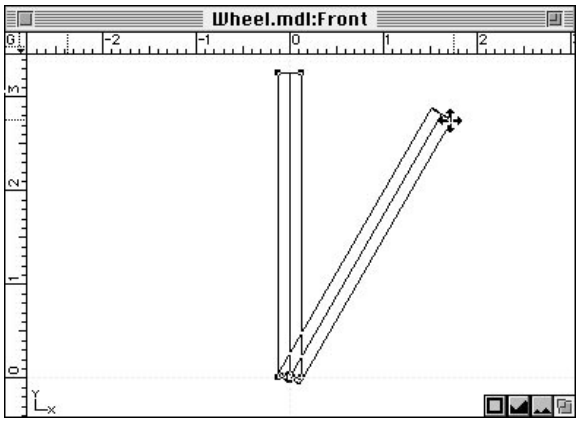
Repositioning the Second Spoke

If the cloned cylinder is not still selected, select it using the Standard Selector tool. Select the Rotate tool from the Tool palette. In the Rotate Tool Info palette at the top of the screen, click on the Increment check box to engage it, and enter 30 in the data field to make the rotation snap to a 30° angle about the Anchor. Select Galactic Core from the Anchor pull-down menu to set the Anchor point. The Anchor point automatically shows as a hollow, thick circle in the View windows.

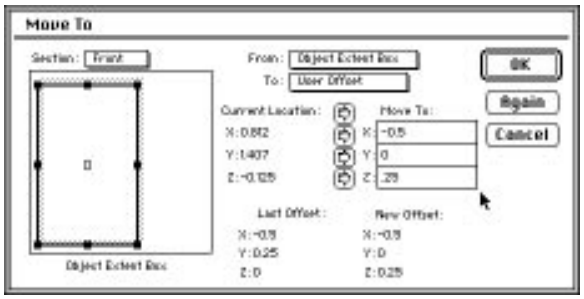
Move the cursor to the Front window and click-drag diagonally on the upper-right corner point of the selected cylinder. The cylinder will snap out to a 30° rotation. If you continue to drag the cylinder will snap to 60°, then to 90°, and so on. We want the 30° rotation.

Rotate Tool Info palette

If the cloned, rotated cylinder is not still selected, select it using the Standard Selector tool. Select Move To in the Operations menu (or ⌘-m). The Move To dialog box will appear. In the To pull-down menu, select User Offset. This will allow you to enter a specific distance to move the selected object. Enter x = -0.5 and z = 0.25 in their respective data fields. Click on OK to perform the move.

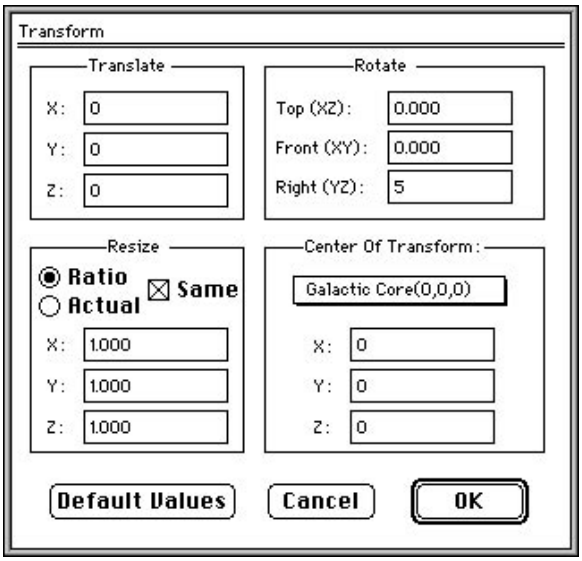


Using the Rotate tool



Move To dialog

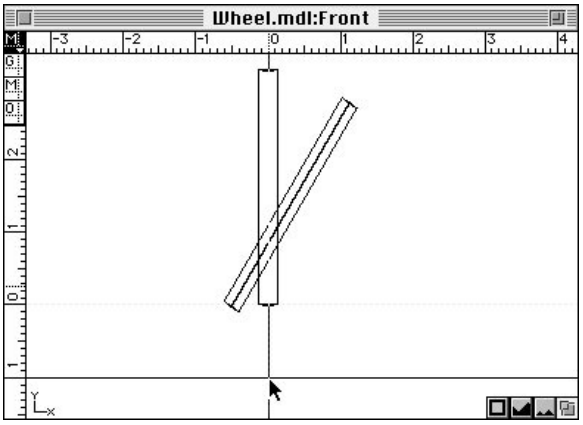
Using the Selector tool, select both cylinders. Hold the Shift key to select multiple items. Select Transform from the Operations menu (or ⌘-t). The Transform dialog box will appear. The default is for all of the transform values to be zero (no affect). In the Rotate section of the dialog box, enter 5 in Right (y-z) data field, to give the cylinder a 5° rotation on the x-axis. In the Center of Transform pull-down menu, select Galactic Core. Click on OK to perform the rotation. Save your model.

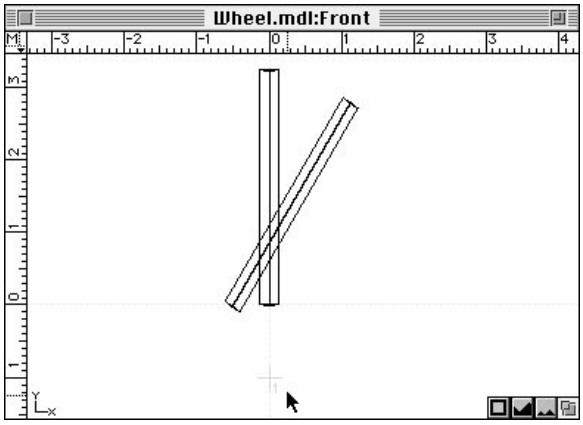


Transform dialog

Making More Spokes

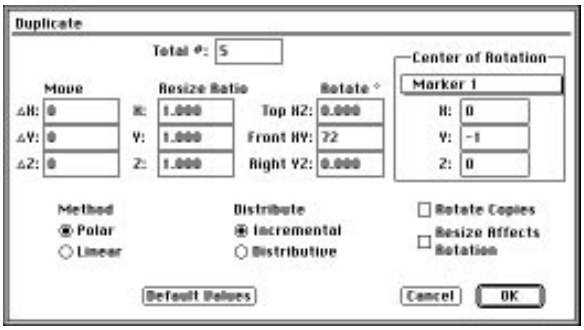
First, set a Marker at what will be the center of the wheel. In the Front window, drag a Marker from the upper-left corner of the Tool palette out into the window to x = 0, y = -1. The Grid snap should still be on to help you accurately place the marker.





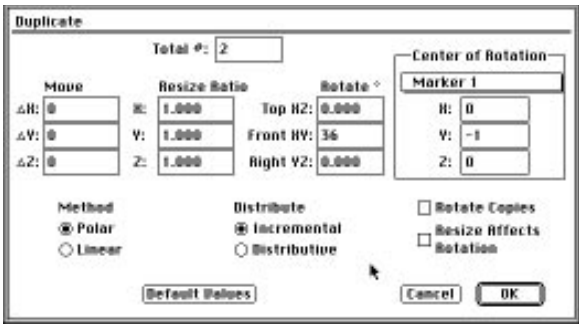
Setting a Marker

Next, use the Shift key with the Standard Selector to select both of the cylinders. Select Duplicate from the Edit menu (or ⌘-=). The Duplicate dialog box will appear. Enter 5 in the Total # data field. Select Polar (radio button) as the Method, and Incremental (radio button) as the Distribute. Enter 72 in the Front XY data field. Select Marker 1 from the Center of Rotation pull-down menu. The entries and selections you just made will cause 4 copies of the selected cylinders. Each copy will be rotated 72° from one another, about the Marker point. Since we wanted to make a complete circle (360°) with 5 sets of cylinders evenly spaced, we did a little math to determine how much to rotate each copy (360÷5=72). Click on OK to execute the duplication.

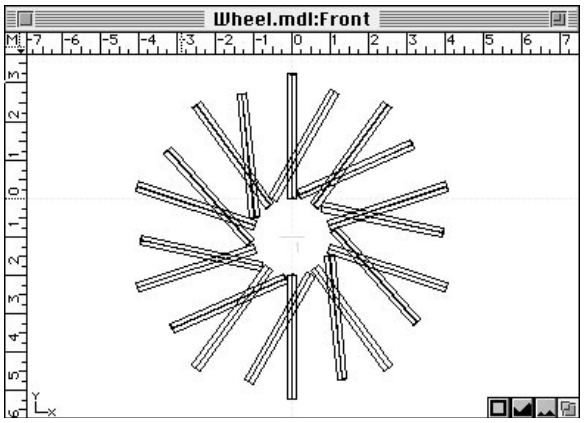


Duplicate dialog box

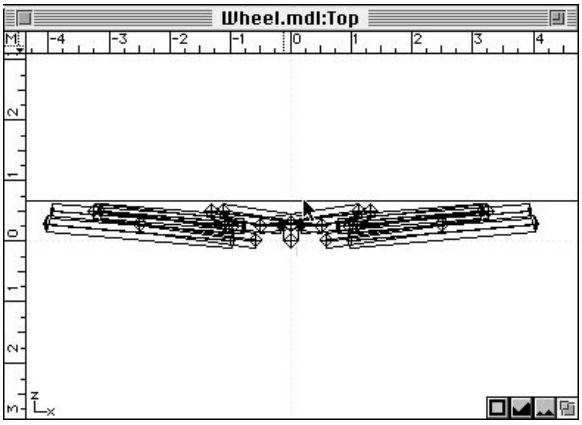
Select all of the spokes by choosing Select All from the Edit menu (or ⌘-A). Select Group from the Groups menu (⌘-g). Name the group “Spokes.” If the grouped spokes are not already selected, select the group with the Standard Selector. Choose Duplicate from the Edit menu. Enter 2 in the Total # data field. Enter 36 in the Front XY data field. This will make one copy of the grouped spokes and rotate that copy 36° to fill in the larger spaces between the 2-spoke sets. Click on OK to execute the duplication.



Duplicate dialog box



After Duplications

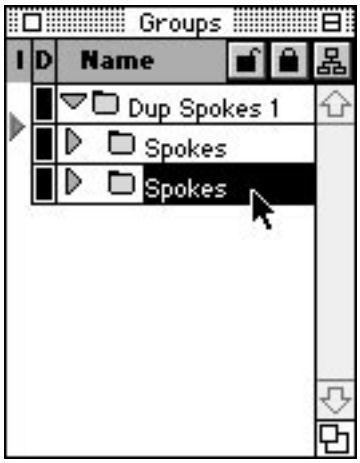


Set the Guide

Repositioning Half of the Spokes

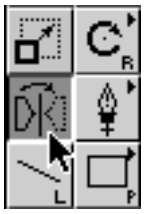
First, set a guide line in the Top view window to indicate the plane across which we want to mirror half of the spokes. Drag a Guide from the ruler at the top of the window down to a position just a hair above the spokes. Click on the Free snap button to release the Grid snap.

In the Groups palette, click on the folder arrow to expose the two spokes-group folders (Spokes 1 and Spokes 2). In the Groups palette, select one of the spokes-group folders by clicking on its name in the list (the selected item name will be highlighted).

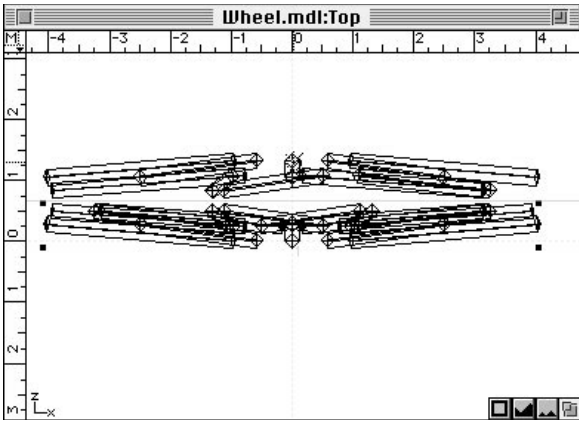


Select Spokes group

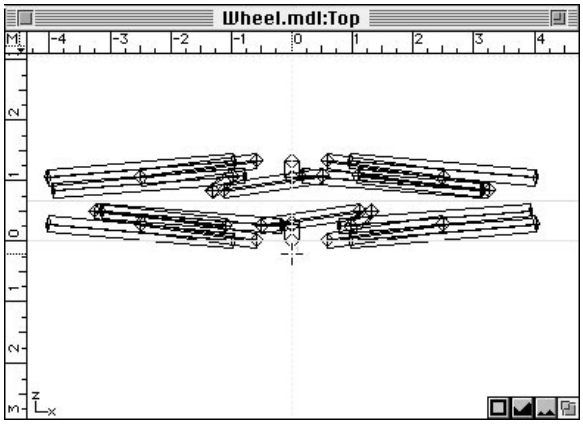
Select the Mirror tool from the Tool palette. In the Mirror Tool Info palette at the top of the screen, choose User Defined from the Anchor point pull-down menu. In the Top window, position the cursor at the place where the Guide you placed and x = 0 cross. Click-hold to set the Anchor point and reflect the selected group across the Guide. Then drag diagonally and about the Anchor point to rotate the reflected group about 180° (in the Tool Info palette, look at the Incremental Degrees data field to monitor the progress of rotation). Now, still holding the mouse key down, press the Shift key to snap the rotation to exactly 180°. Save your model.



Mirror Tool



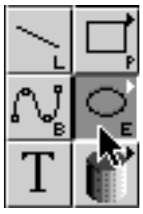
Mirror the spokes



Setting depth

Making the Hub

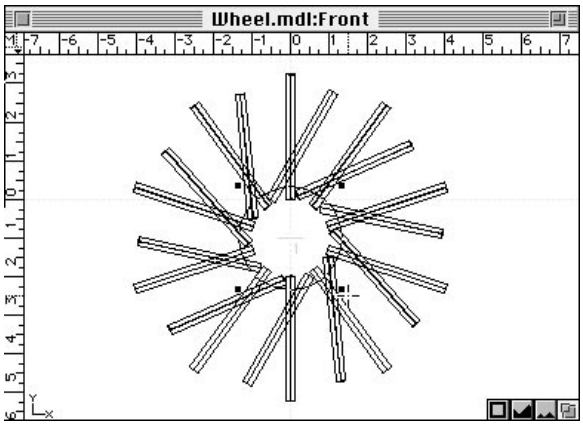
We want the hub to be positioned at the center of all of the spokes (Front window), and just a bit wider than the spokes as viewed in the Top window. Additionally, we want the hub shape to slightly overlap the spokes to hide the bare ends of the spokes inside of the hub.



Ellipse Tool

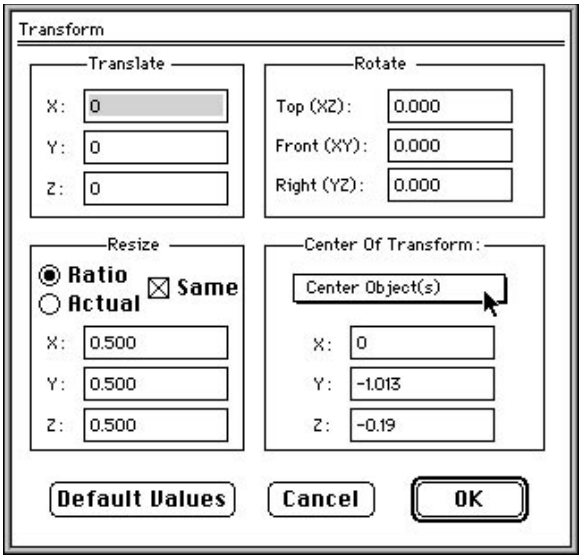
In the Top view, set the Depth Lock at (x = 0) and at a point just below the spokes. Now, when we draw a 2-D contour in the Front window, the contour's position in the Top window will be at the new Depth Lock location rather than the default (Galactic Core).

Select the Ellipse tool from the Tool palette. In the Front view window, position the cursor at the Marker which was set earlier. Click-drag while holding the Shift key (constrains the ellipse to be circular).



Draw the hub-circle

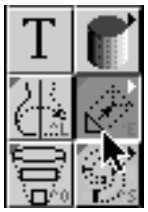
Clone the circle by choosing Clone in the Edit menu (⌘-w). Select Transformations from the Operations menu (⌘-t). Click on the Default Values button to reset the transformations to zero. In the Resize section of the dialog box, select Ratio (radio button) and Same (check box). Enter 0.5 in the x data field. Select Center Object(s) in the Center of Transform pull-down menu. This will reduce the cloned circle by 50% proportionally in all directions. Click OK to perform the transformation.



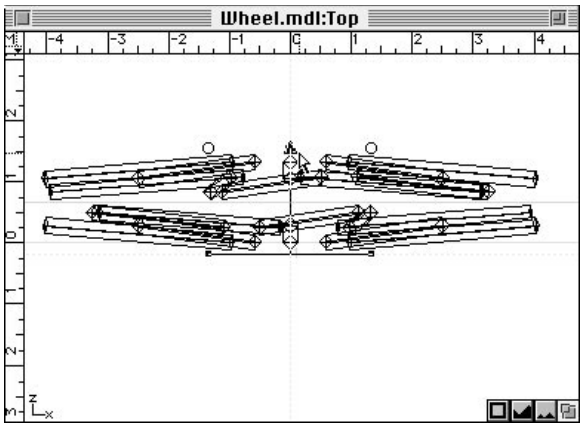
Transform dialog box

Select both of the circles and choose Join Elements from the Operations menu (or ⌘-j). This brings the two elements together in preparation to become the hub with its hole in the center. In the Groups palette, the new 2-circle item is named Joined Splines.

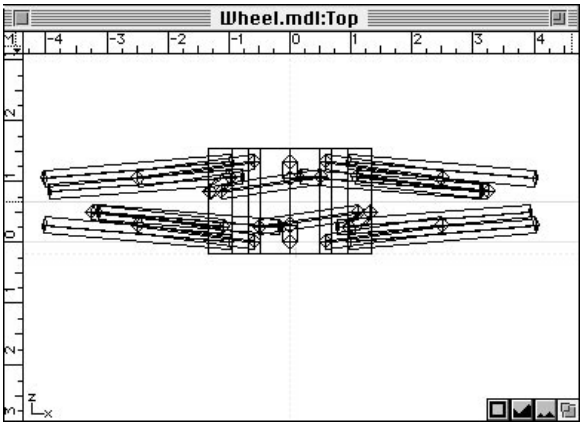
Select the Joined Splines (either with the Standard Selector or from the Groups menu). Select the Extrude tool from the Tool palette. In the View windows, the intuitive interface for the Extrude tool is visible. In the Top view, pull the triangle control point, at the top-center of the intuitive tool interface, straight down to a position just above the spokes (hold the Shift key, so as not to angle the extrude). This positions the opposite face of the hub. Click on the Extrude button in the Extrude Tool Info palette to execute the extrude operation. Save your model.



Extrude Tool



Reposition Extrude tool control point



After the extrude

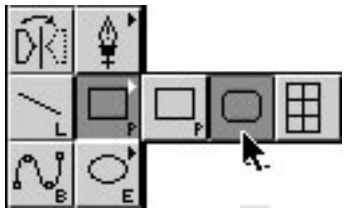
Making the Rim

We want the spokes and hub to be centered on the rim as viewed in the Front window. We want the rim to be slightly wider than the spokes at their furthest point from the center of the wheel, and to slightly overlap the spokes so as to hide the bare ends of the spokes.

First, in the Front view pull a Guide down from the ruler at the top of the window to a point just below the outer-most point of the spokes. Remember, the second spoke we made is angled, and its (and its duplicates) outer-most point is closer to the center than the outer-most point of the straight spokes.

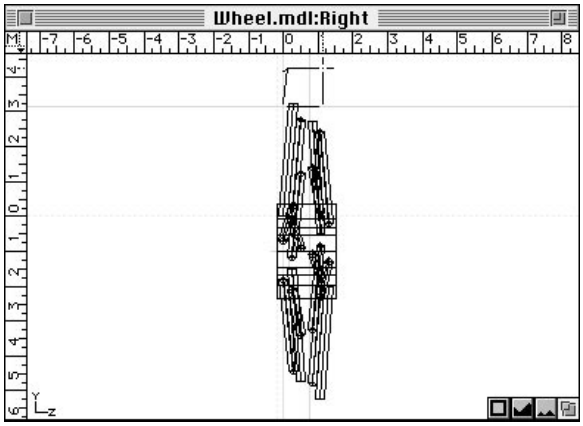
Select the Rounded-Rectangle tool from the Tool palette. In the Tool Info palette, enter 0.1 in the Radius data field. This sets the corner radius for the Rounded-Rectangle. Select the Corner-to-Corner drag mode from the Drawing Option section of the Tool palette. Select the Grid snap in the Snap palette. Move the cursor onto the Right view window, and position it at the point where the Guide you just set and the y origin line (z = 0) cross. Click-drag to z = 1.25, holding the Shift key to constrain the rectangle to be a square.

Set the Guide



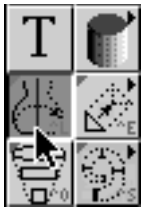
Rounded-Rectangle Tool

Select both the square and the hub. Select Align from the Operations menu. The Align dialog box will appear. Enable the Z check box, and the Align radio button under Z. Select the Centers radio button under Z. This will align our rim-square to be centered on the hub, and subsequently the hub and spokes will be centered on the rim. Click OK to perform the align operation.



Draw the Rectangle

Select the rim-square. Select the Lathe tool from the Tool Info palette. In the Lathe Tool Info palette, enter 0 in the x data field, -1 in the y data field, and 90 in the Bank data field. This sets the center of the lathe operation at the point where our Marker was set earlier in the tutorial, and changes the lathe plane to the Front view. Click Lathe in the Tool Info palette to perform the lathe operation. In the Groups palette the new lathed shape in named Lathe Mesh 1.

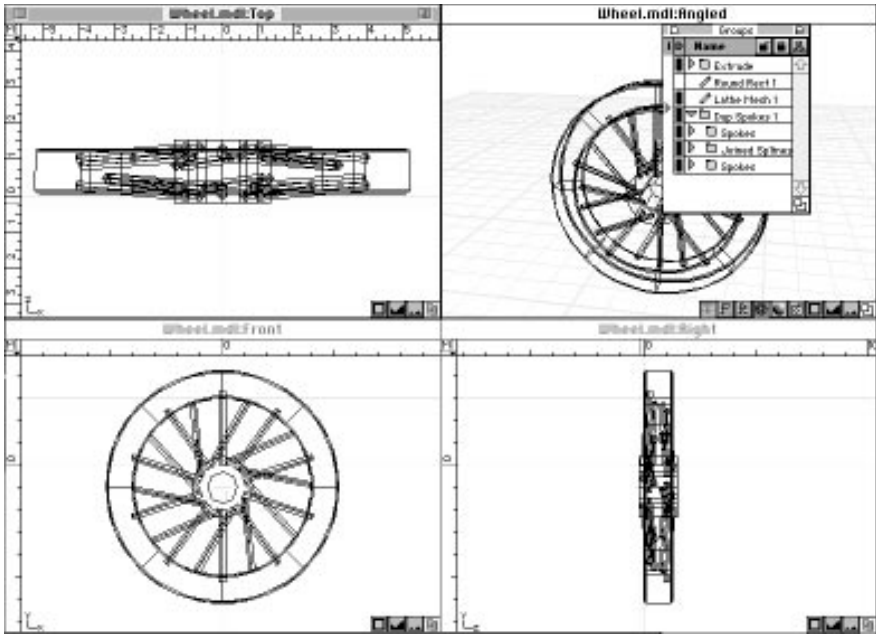


Lathe Tool

Lathe Tool Info palette

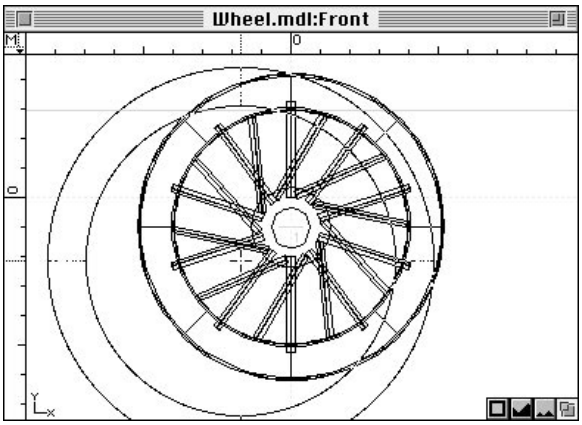
Making the Tire

First, we want to find the center of the assembly so that we can properly position the tire. Select the item named "Extrude" in the Groups palette (this is the hub). Select Information from the Groups menu (or ⌘-i). The Object/Group Information dialog box for the selected item will appear. In this case, the center we are looking for happens to be the Rotation Point of the hub. Note the information in the x, y, and z Rotation Point data fields.



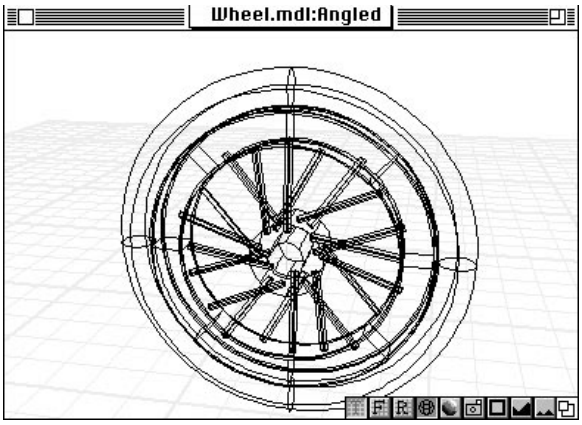
After Lathe operation

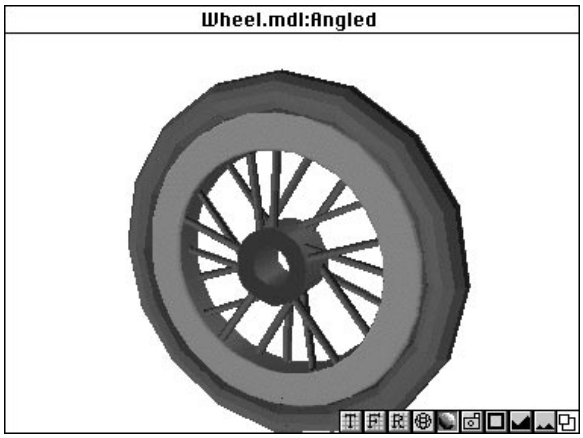
Select the Torus 3-D Primitive tool from the Tool palette. In the Torus Tool Info palette, enter 5.9 in the main radius data field, and 0.65 in the minor data field. Enable the check boxes next to the data fields to constrain the torus to these dimensions. Consult the Reference Manual for more information about controlling the size of a Torus. Select the Center-to-Corner drag mode in the Draw Options portion of the Tool palette. In the Front window, move the cursor near the location of the Marker we set earlier in this tutorial. Click-drag diagonally a short distance to display the torus preview; continue dragging until the cursor is located on the Marker. Release the mouse to set the torus in position.



Drawing the Torus

With the Standard Selector Tool, double-click on the torus. The Object/Group Information dialog box will appear. Enter the x, y, and z Rotation Point data that you noted above in the Center data fields. The Wheel is now complete. Save your model.

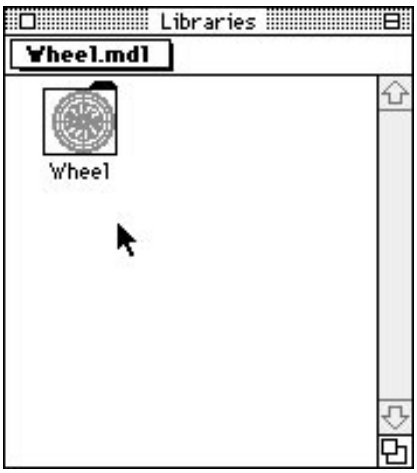




Completed Wheel model

Making the Wheel a Library Item

To keep our data base from growing too large, we can create duplicate items by making the parent item a Library. Library items do not take data space; they “point” back to the parent.



Libraries Palette

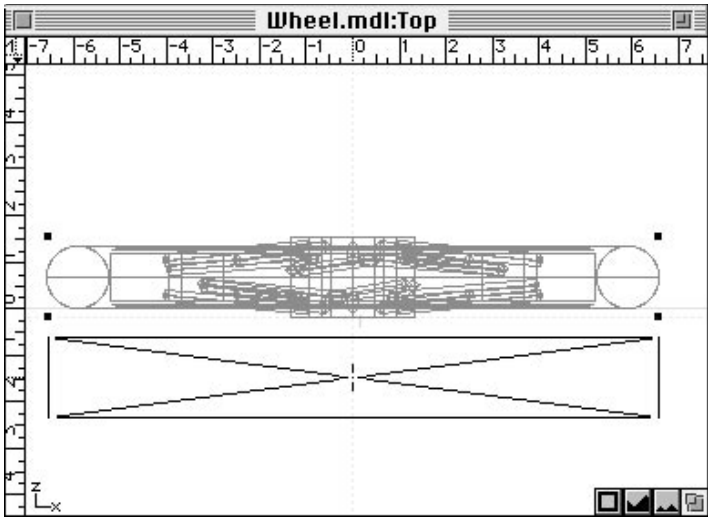
In the Groups palette, close all of the folders. Select everything by choosing Select All in the Edit menu (or ⌘-a). Select Group from the Group menu and name the new group “Wheel.” This creates a single folder containing all the parts of our wheel assembly.

Select Libraries from the Palettes sub-menu in the Windows menu. This will expose the Libraries palette. Drag the Wheel folder from the Groups palette to the Libraries palette. This makes Wheel a Library item and its icon changes from a folder to a Library icon in the Groups palette. In the Libraries palette the item appears as a folder with an on-the-fly icon of the wheel on it.

Placing the Library Wheel in the Data Base

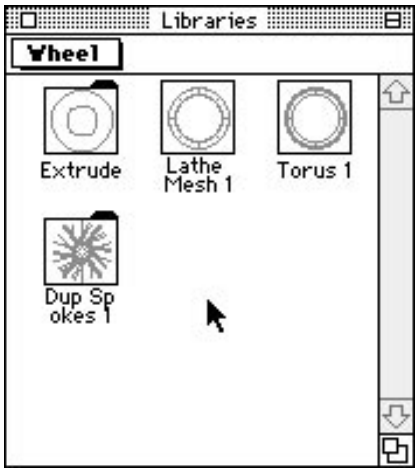
Library Tool

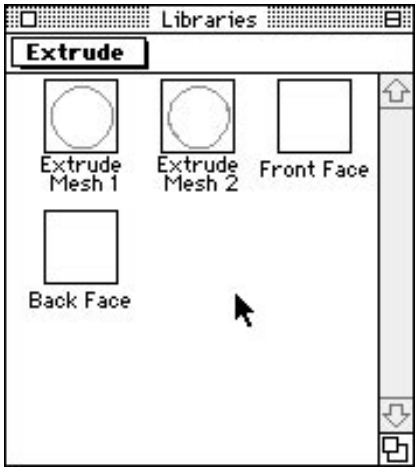
From the Libraries palette, drag the Wheel folder onto any one of the view windows. A bounding box preview of the item appears in all of the windows, and the Lasso tool icon temporarily changes to a Library tool icon in the Tool palette. “Drop” the bounding box preview at a location such that it does not overlap the parent wheel. In the Groups palette the newly placed Library item appears, with its name italicized. You may continue to place the wheel as many times as you wish. When you are done, click in an open space in the Libraries palette to disable the Library tool.



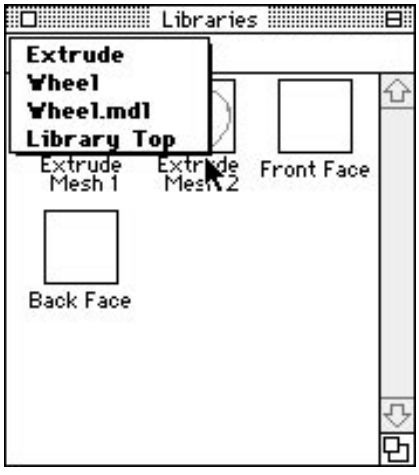
Placing the Library item

In the Libraries palette, double-click on the Wheel folder to expose the next lower level in its hierarchy. If you wish, you may place these items (and others lower in the hierarchy) in the same fashion as outlined above. Return to higher levels in the hierarchy by selecting the appropriate item in the pull-down menu in the Libraries palette. Save your model.





Lower levels in the hierarchy



Libraries palette pull-down menu

Now you are ready to animate, apply surface attributes, and render your model. Select Render/Animation in the File menu to transfer to Presenter 3.0.

Notes