NEMETSCHEK Vectorworks

Getting Started Guide

# Vectorworks Fundamentals

2014

# Vectorworks Fundamentals Getting Started Guide

Created using: Vectorworks Fundamentals 2014



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# Getting Started with Vectorworks Fundamentals

## Initial Setup

To ensure consistency when doing these exercises, please take a moment to set up your workspace and Vectorworks Preferences. This way, we can all start with the same base line.

First, open a new blank document by going to **File > New**. Choose Create Blank Document and click **OK**.

1. Go to **Tools > Workspaces > Fundamentals**.

2. Go to **Tools > Options > Vectorworks Preferences** and click the **Reset** button. Accept the "Are you sure…?" dialogue box, and select General in the Category list on the left.

3. Next, return to the Vectorworks Preferences (**Tools > Options > Vectorworks Preferences**), and choose the Display tab. Then check the option Center on objects after view change.

4. Click **OK** to close the Vectorworks Preferences.

5. Now we'll adjust the constraints categories. Go to **Tools > SmartCursor Settings**.

6. Dismiss the "Did you know…?" dialogue box, and click the **Reset** button. Accept the "Are you sure…?" dialogue box, and select General in the Category list on the left.

7. Uncheck Snap to Combined Page Area.

8. Click **OK** to close the SmartCursor setting dialogue box.

9. Last, go to **File > Page Setup**, uncheck the option Show Page Boundary, and click **OK** to close the Page Setup dialogue box.

10. Next, set the document units. Go to File **> Document Settings > Units…**

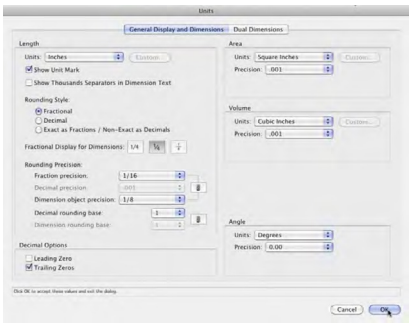
11. Set the Units dropdown menu to Inches, and also check the Show Unit Mark option.

12. Then tick Fractional for the Rounding Style.

13. Let's also set the Fractional Display for Dimensions to the second style by ticking the second button.

14. Choose 1/16 from the Fraction Precision dropdown menu.

15. Then set the Units dropdown menu under the Area section to Square Inches.



16. Last, from the Volume section; set the Unit dropdown menu to Cubic Inches and click **OK** to close the Units dialogue box.

17. Go to **File > Save** and save this file to your desktop (or wherever you would like) with the name "Preferences-file-setup."

## CPU Case

Now that the file is set up properly, we'll create the bottom portion of the clamshell. From this point forward, we'll refer to it as the CPU case.

1. In the Basic palette, double-click the **Rounded Rectangle** tool. This will open the Create Object dialogue box.

2. Input 15 1/12 for the **Width** and 10 1/12 for the **Height**.

3. Be sure Position At Next Click is checked, and choose Symmetrical from the Corner dropdown menu.

4. Also set the **Diam X** and **Diam Y** fields to 1" and then click **OK**.

5. Since Position at Next Click was checked, you will need to click somewhere near the origin (0,0) to create the rounded rectangle.

6. This rounded rectangle is the overall size of the CPU case. Now lets add some depth.

7. Next, go to the Standard Views menu in the View bar and choose Right Isometric.

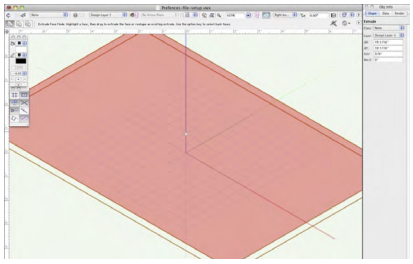
8. From the 3D Modeling tool set, select the **Push/Pull** tool. Be sure the first mode, Extrude Face, is enabled in the Tool bar.

9. Then move the pointer toward the center of the rounded rectangle.

10. Once the rounded rectangle is highlighted, click to begin extruding the rounded rectangle face. You should notice the pointer has changed to a double-headed arrow.

11. Now press the Tab key to enter the **Distance** field in the Floating Data bar and input 3/8. Press Enter to lock in the value.

12. Then click anywhere in the drawing area to create the Extrude.



## Trackpad

With the overall shape of the CPU case completed, we can now add the overall shapes for the trackpad, keyboard, and speakers.

To do this, we first need to create a working plane on the top face of the CPU face.

1. From the 3D Modeling tool set, select the **Set Working Plane** tool. Be sure the second mode, Planar Face mode, is enabled in the Tool bar.

2. Then move the pointer to the center of the CPU case. Once the cursor cue “Center” is displayed, click once to set the working plane. Use the blue highlighting as a visual reference so as to not set the working plane to the bottom face of the Extrude.

3. To create the trackpad, double-click the **Rounded Rectangle** tool in the Basic palette.

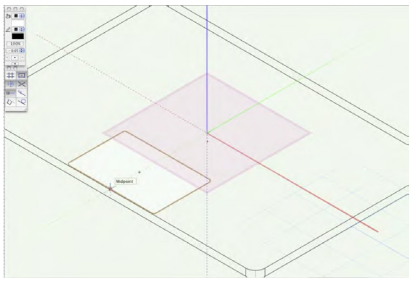
4. In the Create Object dialogue box, set the **Width** field to 4.5” and the **Height** field to 3”.

5. Next, notice the box position control is rotated to reflect the current view (Right Isometric). Choose the bottom center point from the box position controls, which is the center point closest to the W.

6. Then, choose Symmetrical from the Corner dropdown menu. Set the **Diam X** field to .25”, and the **Diam Y** value will update to match it since the corners are set to be symmetrical.

7. Check Position At Next Click—if not already selected—and click **OK**.

8. To place the rounded rectangle, move your cursor along the bottom left edge on the top surface of the CPU case until you see the “Midpoint” cursor cue.



9. Click to set the rounded rectangle. This is the overall shape for the trackpad. (Requires Screenshot to clear up any confusion about the correct edge)

10. At the moment, the trackpad and the CPU have a common edge. Realistically, however, the trackpad bottom edge would be offset from the CPU case’s edge. So let’s move the trackpad away from the edge some.

11. Switch to the **Selection** tool in the Basic tool palette, and select the trackpad if it is not already selected.

12. Now move the pointer along the common edge of the CPU case and trackpad until the pointer changes to a cross and the cursor cue “Midpoint” is displayed.

13. Then press and hold your mouse button to pick up and move the trackpad based on the selected point.

14. We are going to move the trackpad one inch away from the CPU case edge. To do this (with the mouse button still depressed), press the Tab key until your enter the ΔY field. Then enter 1" and hit Enter to lock in the value.

15. Move the pointer along the green dashed axis (Y Axis) until the cursor cue "Object / Y / Align Y" is displayed. Then release the mouse button to move the trackpad.

## Keyboard

The keyboard can be created based on the geometry of the trackpad.

1. Move your pointer along the trackpad edge located closest to the working plane origin (where the red, blue, and green axes meet) until the cursor changes to a cross and the cursor cue "Midpoint" is displayed.

2. Then press and hold the mouse button to pick up the rectangle by the selected point.

3. Next, press and hold the Option key (Macintosh) or Alt key (Windows), and drag the rectangle along the Y Axis (green line). Be sure your cursor stays on the top surface of the CPU case.

Notice there is a small plus (+) beside the cursor when you hold the Option or Alt key. This indicates that you will be creating a duplicate.

4. When you reach the top edge of the CPU case, the cursor cue "Midpoint" will be displayed.

5. Release the mouse button to create the duplicate. Then release the Option key.

6. In the Object Info palette, choose the top center point from the box position controls, which is the center point opposite its current point.

7. Now change the **Width** field to 11 3/8" and the **Height** field to 4 3/4". Then press Enter.

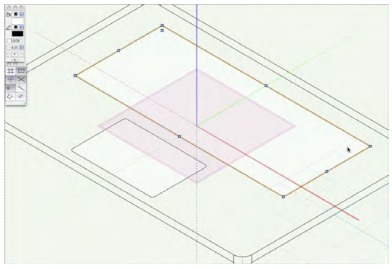
It is important to choose the position point from the box position controls before entering the new width and height, as the set point will be constrained during the resizing of an object. In this case, it keeps the rounded rectangle centered.

8. Also choose Symmetrical from the Corner dropdown menu and set the **Diam X** field to ¼" and press Enter. Remember, the **Diam Y** will update automatically because all corners are set to be symmetrical. This rectangle is the overall shape for the keyboard.

9. Just as with the trackpad, realistically the keyboard should be offset slightly from the top edge of the CPU case. Let's do this now.

10. With the keyboard selected, go to **Modify > Move > Move 3D**. Since we are currently using a working plane, tick the Working Plane option.

11. Input a value of -1 ¼" in the **Y Offset** field, and then press **OK**. The keyboard will be moved from the CPU edge along the same green axis as the trackpad.



## Speakers

We can now create the speakers.

1. Select the **Zoom** tool from the Basic tool palette.

2. First, click near the center of the keyboard. Then move your cursor downward and to the right until the right side of the keyboard and part of the CPU are inside the marquee.

3. Click once to zoom in on the area inside the marquee.

4. Next, select the **Rectangle** tool from the Basic palette. Be sure the first mode, Rectangle mode, is enabled.

5. Now move the cursor upward along the right edge of the keyboard until the cursor cue "Arc" is displayed. If you still have not zoomed in close enough, press the Z key to evoke the Snap Loupe and find the Arc point.

The Snap Loupe feature zooms in temporarily on an area around the current mouse position in order to make snapping more precise. Regardless of the tool used, once the mouse button is depressed, the Snap Loupe will be revoked.

6. Click to set the first point of the rectangle.

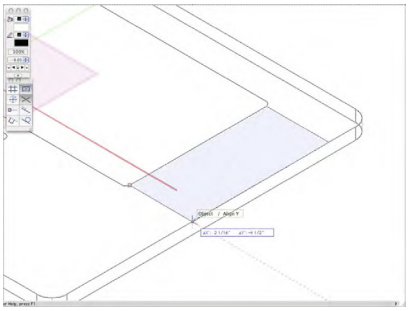
7. Once again, move the mouse cursor along the right edge of the keyboard, but this time move downward until you receive the “Arc” cursor cue near the bottom right corner. Again, use the Snap Loupe if necessary.

8. Do not click on this point, but hold your cursor over the point until the smart point is acquired. (Once a small red box appears around the point the smart point is acquired. You can also manually acquire the smart point by pressing the T key.)

9. Now, move your cursor horizontally away from the smart point toward the right edge of the CPU case. You should notice a red dashed line extending from the smart point. This is called the extension line.

10. Continue to move along the extension line until you reach the CPU edge. Once the cursor cue “Object / Align Y / Align Start Z” is displayed, click to set the rectangle.

Next, we need to decrease the size of the speaker slightly and also offset it from the CPU edge.



1. Switch to the **Offset** tool in the Basic tool palette. Be sure the first mode, Offset by Distance, and the fourth mode, Offset Original Object mode, is enabled in the Tool bar.

2. Also input a value of ¼” in the **Distance** field located in the Tool bar.

3. Then click once inside the selected rectangle to create the offset. This is the overall shape of the right speaker.

The left speaker can be created quickly by using the **Mirror** tool.

4. First tap the X key twice to deselect the right speaker and switch to the **Selection** tool.

5. Next, go to **View > Zoom > Fit to Objects** or click the Fit to Objects shortcut in the View bar. (Or use the Cmd + 6 [Macintosh] or Ctrl + 6 [Windows] keyboard shortcut.) You should now see all of the CPU case in the drawing area.

6. Now reselect the right speaker and then choose the **Mirror** tool from the Basic tool palette. Be sure the second mode, Mirror and

7. Move the cursor to the top edge of the CPU case to the point where it intersects with the working plane Y Axis (Green Axis line).

8. When the cursor cue “Midpoint” is displayed, click to set the first point of the mirror axis line.

9. Now hold the Shift key and move the cursor along the Y Axis.

10. Once the cursor cue “Y” is the displayed, click to set the mirror axis. The speaker is then mirrored to the left side. Now we have our overall shape for the left speaker.

## CPU Detailing

The shapes we’ve created to represent the trackpad, keyboard, and speakers would not set flush against the CPU top surface. On most laptops these objects are indented in the CPU case. So we’ll do this now and also create a cutout for the display hinge.

1. First, select the **Push/Pull** tool from the 3D Modeling tool set. Be sure the first mode, Extrude Face mode, is enabled.

2. Click the left speaker to start extruding the object.

3. Press Tab to enter the **Distance** field in the Floating Data bar.

4. Input -1/16” and press Enter to lock in the value.

5. Click to create the Extrude.

6. Repeat these steps for the right speaker, trackpad, and keyboard.

Now we are going to subtract these extrudes from the CPU case.

7. Tap the X key once to switch to the **Selection** tool.

8. Go to **Edit > Select All**. Now all of the objects are selected.

9. Next, right-click on the CPU case and choose Subtract Solids.

10. In the Select Object dialogue box, use the arrows to highlight the CPU case. Then click **OK**.

The other extrudes will be subtracted from the highlighted object. After clicking **OK**, notice the CPU case, which was an extrude, is now a solid subtraction.

OK, Let's cut out a space for the display hinge.

1. Select the **Rectangle** tool from the Basic palette. Then select the third mode, Side Center and Opposite Corner Rectangle mode.

2. Now choose Automatic from the Layer Plane dropdown menu in the View bar.

3. Move your cursor to the midpoint of the top edge of the CPU case.

4. Once the top face of the case is highlighted blue and the cursor cue "Midpoint" is displayed, click to start drawing the rectangle.

We need the width of the hinge to match the keyboard width, which is 11 3/8". With the current mode we are using to draw the rectangle, we need to input half of this width.

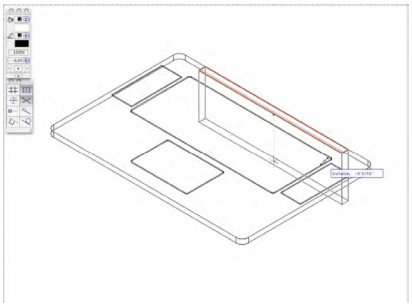
5. Press the Tab key to enter the Δ **X** field and input (11 3/8)/2.

6. Press the Tab key once more to enter the Δ **Y** field, and input -1/2 and then press the Enter key.

7. Now click in the drawing to set the rectangle.

8. Next, move your cursor inside the newly created rectangle and, once the rectangle is highlighted red, click to start your Extrude.

9. We need to subtract this rectangle from the CPU case: Hold the Option key (Macintosh) or the Alt key (Windows) and move the cursor downward.



10. Be sure the solid is extruded past the bottom surface of the CPU case, and while still holding the Option key (Macintosh) or Alt key (Windows), click to subtract this solid from the CPU case.

## CPU Case: Fillets

The CPU case is starting to come together nicely. Let's add a few fillets to the corners to give it a sleeker appearance.

1. Change the view to the Lower Right Isometric by choosing this option from the Standard Views dropdown menu in the View bar.

2. Choose the **Extract** tool from the 3D Modeling tool set. Be sure the Extract Surface mode is enabled in the Tool bar.

3. Then click the **Extract Preferences** button in the Tool bar.

4. Check the option Select Faces and click **OK** to close the dialogue box.

5. Now select the bottom face of the CPU case. Use the red highlighting as a visual reference to verify that you are selecting the bottom face and not the top face.

6. Once the correct face is selected, click the green checkmark in the Tool bar to complete the action. There should now be a NURBS surface on the bottom of the CPU case.

7. Next, select the **Push/Pull** tool from the 3D Modeling tool set. Make sure the first mode, Extrude Face mode, is enabled.

8. Then move your cursor to the NURBS Curve at the bottom of the CPU case and click once it is highlighted to start the Extrude.

9. Press the Tab to enter the **Distance** field and input a value of 3/16" and then press the Enter key to lock in the value.

10. Now click anywhere in the drawing to complete the Extrude. This is the part of the CPU case we are going to fillet.

11. Use the **Zoom** tool in the Basic tool palette to zoom in on one of the corners of the CPU case.

12. From the 3D Modeling tool set, choose the **Fillet Edge** tool and click the **Fillet Edge Preferences** button in the Tool bar.

13. In the Fillet Edge Preferences, check the options Select Tangent Entities and Select Faces.

14. Also change the **Radius** field to 3/16". Then click **OK** to close the dialogue box.

15. Now select the bottom face of the latest extrude we created.

16. Once the surface is highlighted, click the green checkmark in the Tool bar to complete the operation. The Object Info palette should now display Fillet.

17. Tap the X key twice to deselect the Fillet.

18. Then click Fit to Objects in the View bar (or use the Cmd + 6 [Macintosh] or Ctrl + 6 [Windows] keyboard shortcut) to view the whole CPU case in the drawing area.

19. Go back to the View bar and select Right Isometric from the Standard Views dropdown menu.

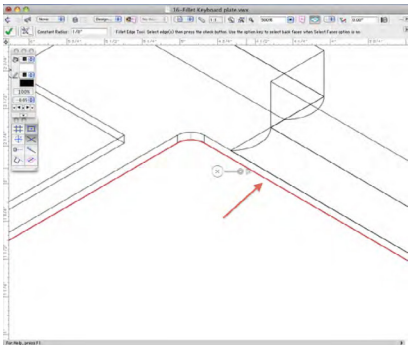
20. Again use the **Zoom** tool in the Basic tool palette to zoom in on any corner of the keyboard.

21. Next, select the **Fillet Edge** tool from the 3D Modeling tool set and click the **Fillet Edge Preferences** button in the Tool bar.

22. This time, make sure that Select Faces is unchecked but that Selected Tangent Entities is checked.

23. Set the **Radius** field to 1/8" and then click **OK** to close the Preferences.

24. Select the bottom edge of the keyboard.



25. Now click the green checkmark in the Tool bar to complete the operation.

## Display Case 2D Geometry

The CPU case is nearly complete, with the exception of the keys, which we'll come back to later. Let's move on to creating the general shapes for the display case.

To keep things organized, we're going to create the display on a separate design layer.

1. Go to **Tools > Organization** and choose the Design Layers tab or select the **Layers** button from the View bar.

2. To help with organization, let's name the active layer. Select Design Layer-1, and click the **Edit** button.

3. In the Edit Design Layers dialogue box, type "CPU laptop" in the **Name** field and click **OK**.

4. Now let's create a new design layer. To do so, click the **New** button in the Organization dialogue box.

5. Name this layer "Screen laptop," and click **OK** once to return to the Organization dialog box.

6. Change the visibility of the CPU laptop layer by clicking the middle visibility column to the left of the design layer name. The icon will change to an X to indicate the layer is invisible.

7. Click **OK** to close the Organization dialog box.

8. Now go to **View > Standard Views > Top/Plan**.

9. Select the **Rectangle** tool and create a rectangle of any size anywhere in the current drawing area.

10. Then go to the Object Info palette and input a value of 15 ½" in the **Width** field and 10 ½" in the **Height** field.

11. Click the **Fit to Objects** button in the View bar.

12. Next, select the **Fillet** tool in the Basic tool palette and select the third mode, Trim and Fillet mode.

13. Set the Fillet Radius to ½" in the Tool bar.

14. Since all of the corners are to have the same fillet radius, we can simply double-click the rectangle to fillet all four corners at once.

Normally you would need to select the intersecting lines to indicate which corner to fillet. Notice in the Object Info palette the Rectangle

1. Now switch to the **Offset** tool in the Basic tool palette. Be sure the first mode, Offset by Distance mode, and the third mode, Duplicate and Offset mode, are selected.

2. Additionally, set the **Distance** field to 1/16".

3. We need to create two offsets, so move your cursor toward the center of the polyline and click twice. You should now see three polylines.

4. If the smallest offset polyline is not already selected, press the X key to switch to the **Selection** tool and select it now.

5. In the Object Info palette, select top center point in the box position controls.

6. Then change the ∆**Y** field to 10" and press Enter.

7. Now switch to the **Zoom** tool and draw a marquee around the top left corners of the three polylines.

8. With the smallest offset polyline still selected, choose the **Offset** tool from the Basic tool palette.

9. Set the **Distance** field to ½" in the Tool bar, and click the area inside the selected polyline.

10. With the next offset selected, return to the **Distance** field in the Tool bar and input 1/16".

11. Click anywhere inside the current offset polyline to create one last polyline.

## Display Case 3D Geometry

It's time now to convert the 2D geometry for the display case into 3D geometry. Before we begin, to make things easier to see, we'll apply some colors to the current 2D geometry.

1. Press the X key to activate the **Selection** tool and the select the smallest polyline, if it is not already highlighted.

2. Next, click the solid fill color box and select any shade of green to apply to the polyline.

3. Now select the next closest polyline and apply a shade of blue.

4. Continue in sequential order with the polylines and apply any shade of following colors in order: red, dark gray, and then light gray.

If this display were to remain in 2D, the visual representation seen here would be fine; however in 3D we will need to apply a different thickness for each colored polyline. For this reason, we cannot have the polylines overlapping each other. So, next we'll clip the polylines to remove any unneeded or hidden geometry.

5. Hold the Shift key and select the two largest polylines (light gray and dark gray polylines). Then go to **Modify > Clip Surface.**

The Clip Surface command trims the bottom object in a selection so that any areas overlapped by the top object are cut out of it.

To see how the dark gray polyline was clipped from the light gray polyline, click and drag the light gray polyline to the left. Then press Command + Z (Macintosh) or Control + Z (Windows) to undo.

6. Now hold the Shift key and select the dark gray polyline and the red polyline.

7. Then go to **Modify > Clip Surface**.

8. Next, hold Shift and select the red polyline and the blue polyline.

9. Then, instead of using the menu command, right-click on the red polyline and choose Clip Surface.

10. One last time, hold Shift and select the blue polyline and the green polyline.

11. Right-click on the blue polyline and choose Clip Surface. Now each polyline has its own defined space without any overlapping.

Now we can begin creating the 3D geometry.

1. Select the light gray polyline and go to **Model > Extrude.**

2. In the Create Extrude dialog box, set the **Extrusion** field to 1/8", and then click **OK**.

3. Next, select the green polyline and go to **Model > Extrude**.

4. This time, set the **Extrusion** field to 1 mm and then click **OK**.

5. Select the blue polyline and use the keyboard shortcut Command +E (Macintosh) or Control + E (Windows) to extrude the polyline.

6. Input 1.5 mm in the **Extrusion** field and click **OK**.

7. Now extrude to two remaining polylines. Extrude the red polyline 2 mm and extrude the dark gray polyline 2.5 mm.

Now let's see the display in a rendered 3D view.

1. Tap the X key twice to deselect all objects. Then press the **Fit to Objects** button in the View bar (or use the Cmd + 6 [Macintosh] or Ctrl + 6 [Windows] keyboard shortcut) to fit the view to the whole screen.

2. Also go to the Standard Views dropdown menu and choose Left Isometric.

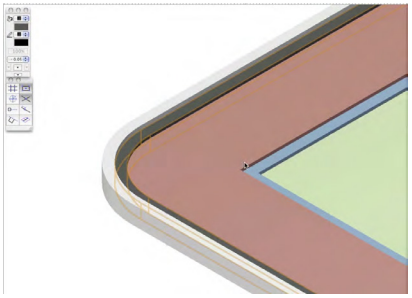
3. Use the **Zoom** tool and draw a marquee around one of the display corners.

4. To render this view, go to **View > Rendering > Open GL**.

5. You can also improve the quality of the rendering by going to **View > Rendering > Open GL Options**.

6. Change the Detail dropdown menu to High and the check the option Use Anti-Aliasing.

7. Click **OK**. You should notice the rounded edges appear much smoother.



## Positioning the Display Case

Since we've got the majority of the display case completed, we can line up the display case with the CPU case.

1. First, return to a Wireframe rendering by going to **View > Rendering > Wireframe.**

2. Then go to **Tools > Organization** and select the far-left visibility column for design layer CPU laptop to make this layer visible again. Click **OK** to close the dialogue box.

3. Next, go to **View > Standard Views > Top/Plan** to change the view of the active design layer, Screen laptop.

4. Go to **View > Align Layer Views** to change the CPU laptop layer to match the Screen laptop layer.

5. So that we can see the entire CPU case and Display case, click the **Fit to Objects** button in the View bar.

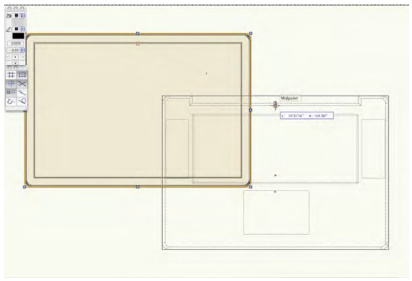
6. You should see that the Display case and CPU case and are not lined up properly. To fix this, go to **Edit > Select All** to select all parts of the Display case.

7. Then go to **Modify > Group**. As a group, all of the parts of the display case can be moved much more easily.

8. Switch to the **Selection** tool in the Basic palette.

9. Move the pointer to the top center of the smallest offset. (See video if this is unclear.) When the cursor cue "Midpoint" is displayed, click and hold your mouse button to pick up the group by this point. You may need to use the Snap Loupe (Z key) to acquire this point.

10. Then drag the group along the top edge of the CPU case that is closest to the keyboard.



11. When the cursor cue "Midpoint" is displayed, release the mouse button to complete the move.

12. Now we need to line up the CPU case and the Display case properly in the Z direction.

13. Choose Right Isometric from the Standard Views dropdown menu in the View bar.

14. Then go to **View > Align Layer Views** to align the CPU case layer to the same view.

15. Again, press Fit to Objects in the View bar.

16. Now use the **Zoom** tool to zoom in on the laptop corner closest to you.

The CPU case and display case are overlapping. In reality, only the top surface of the CPU case and the bottom surface of the display case should be touching.

1. To fix this, with the group still selected, go to **Modify > Move > Move 3D.**

2. In the Move dialogue box, set the **X** and **Y** fields to 0 and the **Z** field to 3/8". Remember 3/8" is the thickness the CPU case was originally extruded.

3. Click **OK** to complete the move.

## Display Case Fillet

We're almost done with the display case, but just as we did with the CPU case, let's fillet some of the edges for a sleeker appearance.

1. Click the **Fit to Objects** button in the View bar so that the entire laptop is in the drawing area.

2. Then switch to the **Zoom** tool and draw a marquee around the top right corner of the laptop to zoom in on this area.

3. We'll need to use the existing geometry of the Display case to create the fillets. So, press the X key to switch to the **Selection** tool and double-click the display to enter the Edit mode for this group.

So that we can see the different display case parts more easily, we will now render this view in Open GL.

4. Select Open GL from the Render modes dropdown menu in the View bar (or use the keyboard shortcut Command + Shift + G [Macintosh] or Control + Shift + G [Windows].

5. Now choose the **Extract** tool from the 3D Modeling tool set.

6. Enable the second mode, Extract Curve mode, in the Tool bar and then click the **Extract Preferences** button.

7. Check the options Select Tangent Entities and Create Planar Objects.

8. Also uncheck Select Faces if it is checked, and then click **OK** to close the dialog box.

9. Select the top outermost edge of the dark gray Extrude.

10. Then click the green checkmark in the Tool bar to complete the operation.

The resulting object should be a group. Since Create Planar Objects was checked in the Extract Preferences, this group consists of objects like lines and arcs to create this one shape. We'll need to compose objects into one polyline.

11. Next go to **Modify > Ungroup**. Notice the Object Info palette shows eight objects are selected.

12. To compose these objects into one polyline, go to **Modify > Compose.**

13. Now switch to the **Push/Pull** tool in the 3D Modeling tool set. Be sure the first mode, Extrude Face mode, is enabled.

14. Then move your cursor over the newly created polyline. Once the surface is highlighted, click to start extruding.

15. Press the Tab key to enter the **Distance** field, and enter a value of 1/16". Then press the Enter key to lock in the value.

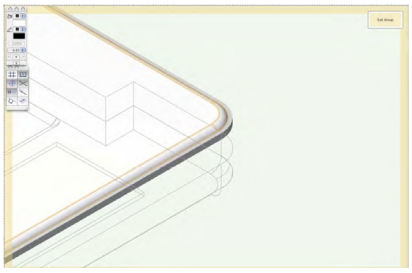
16. Click anywhere in the drawing to create the Extrude. This will be the top of the display case.

17. To fillet this extrude, from the 3D Modeling tool set select the **Fillet Edge** tool and set the **Radius** field in the Tool bar to 1/8".

18. Click the **Fillet Preferences** button in the Tool bar. Make sure Select Tangent Entities is checked. Click **OK**.

19. Select the top edge of the highlighted extrude.

20. Then click the green checkmark in the Tool bar to complete the operation.



21. To return to the design layer, click the **Exit Group** button.

## Rotating the Display Case

The display case is completed, so it's time to rotate it to an open position.

1. So that the entire laptop is visible in the drawing area, click the **Fit to Objects** button the View bar.

2. Next, choose Right from the Standard Views dropdown menu in the View bar.

3. Go to **View > Align Layer Views** to align the CPU laptop layer to the same view.

4. Select the **Zoom** tool and draw a marquee around the right corner of the laptop.

5. Now switch to the **Selection** tool and select the Display case if it is not already highlighted.

6. Then select the **Rotate** tool from the Basic tool palette. Be sure the first mode, Rotate mode, is enabled in the Tool bar.

7. Move your cursor to the bottom right corner of the display case, and click when the cursor cue "Endpoint" is displayed to set the point for the rotation axis.

8. Hold the Shift key and move your cursor upward. Once the cursor cue "Y" is displayed, click again to set the rotation axis.

9. To rotate the display to an open position, hold the Shift key and move the cursor to the right until you see the cursor cue "X."

10. Then click once to complete rotating the display case to an open position.

The laptop is opened to the correct angle but is sitting above the hinge location. The bottom edge of the display needs to be move down to match the bottom edge of the hinge.

11. With the display case still selected, go to **Modify > Move > Move…**

12. In the Move Selection dialogue box, set the X Offset to 0 and the Y Offset to -3/8" and click **OK** to move the display case.

## Creating the Hinge

The Display case is rotated in reference to the hinge, so we need to return to the CPU case to create the hinge quickly.

1. In the View bar click the **Layers** button to open the Organization dialog box.

2. Click in the blank area just to the left of the CPU laptop design layer to make the CPU laptop layer the active layer.

3. Also click in the middle visibility column for the Screen laptop layer, so that it is invisible. Then click **OK** to return to the drawing area.

4. Now choose Rear Right Isometric from the Standard Views dropdown menu on the View bar, and click the **Fit to Objects** button in the View bar as well.

5. We need to be a little closer to the hinge area, so manually input 100% in the **Zoom** field in the View bar. This will give us the best angle of the CPU case to create the hinge.

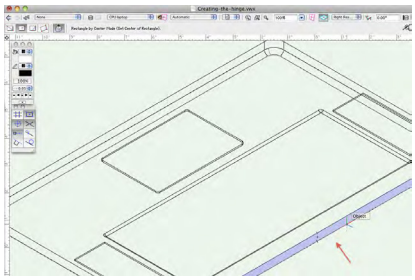
6. Choose the **Rectangle** tool from the Basic palette. Be sure the second mode, Center and Corner Rectangle mode, is enabled in the Tool bar.

7. Next, set the Active Plane dropdown menu to Automatic if it is not already set.

8. Click **OK** to the "Did You Know?" dialog box.

9. Then move your cursor toward the center of the open face for the hinge cutout.

10. Click once the face is highlighted blue and the "Center" cursor cue is displayed to start the rectangle.



11. Now, move the cursor to the right along the bottom edge of the highlighted face until the "Endpoint" cursor cue is displayed.

12. Click once to set the rectangle.

13. Move the cursor toward the center of the newly created rectangle and once the face is highlighted, click to begin the extrusion.

14. Press the Tab key to enter the **Distance** field for the Floating Data bar and input a value of ½" and then press the Enter key to lock in the value.

15. Click once to complete the extrusion.

16. With the hinge still selected, click the Fill Style color box in the Attributes palette and apply a medium gray color to the hinge.

17. To see how the hinge looks, choose Open GL from the click mode dropdown menu.

## Keys 2D Geometry

The laptop is almost completed but we need to add a keyboard and speakers to the CPU case.

1. From the View bar choose Top/Plan from the Standard Views list.

2. Press the X key twice to deselect all objects. Click the **Fit to Objects** button in the View bar as well.

3. Then click the **Layers** button in the View bar to access the Organization dialog box.

4. We will be putting the keys on a separate design layer, so click the **New** button.

5. In the New Design Layer dialog box, name the new layer "Keys" and click the **OK** button twice to return on the drawing area.

6. Now select the **Zoom** tool and draw a marquee around the cutout for the keyboard on the CPU case.

7. Select the **Rectangle** tool and be sure the first mode, Rectangle mode, is enabled in the Tool bar.

8. Next, move your cursor to the top left corner of the keyboard cutout.

9. Press the Z key to evoke the Snap Loupe. Just inside of the actual corner of the keyboard cutout should be find an Arc Center snapping point.

10. Click once you have located this point to start the rectangle. Notice the Snap Loupe is revoked as soon as the mouse button is depressed.

11. Now move your cursor to the bottom right corner of the keyboard cutout and repeat the last two steps to find the Arc Center point. Once you click on the Arc Center point, the rectangle is created.

12. Choose the Fill Style color box in the Attributes palette and apply any shade of purple to this rectangle.

13. The majority of the keys on a keyboard have the same measurements, so we can use the Even Divide command to give us a good starting point.

14. Press the X key and select the purple rectangle if it is not already selected.

15. Then go to **Modify > Drafting Aides > Even Divide**.

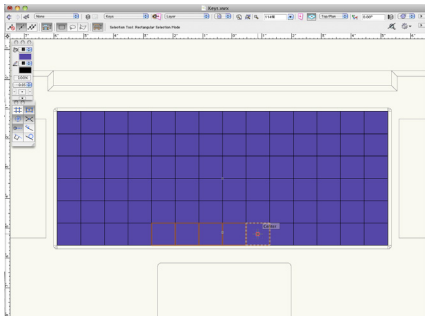
16. Set the Number of Divisions in the **Width** field to 14 and the Number of Divisions in **Height** field to 6. Click **OK**. Notice the Object Info palette now displays 84 rectangles.

Now we can start to combine some of these rectangles to create the large keys on the keyboard.

17. Tap the X key twice to switch to the **Selection** tool and deselect all the rectangles.

18. On the bottom row of rectangles select the fifth rectangle from the left.

19. Next, hold the Shift key and select the next four rectangles to the right of the rectangle you just selected.



20. Now go to **Modify > Add Surface**. This is the Space bar.

21. In the row that is second from the bottom, hold the Shift key and select the first two rectangles on the left side.

22. Go to **Modify > Add Surface.**

23. Repeat the last two steps for first two rectangles on the right side of the same row. These are the Shift keys.

24. Once more, repeat these steps for the first two rectangles on the right side in the row above the Shift keys. This is the Enter key.

The basic shape of the keys is now defined but we need to add some spacing between these keys to make them look more realistic.

1. Use the keyboard shortcut Command + A (Macintosh) or Control + A (Windows) to select all objects on the active layer.

2. Now hold the Shift key and click the Space bar, Shift key and Enter key to deselect these objects. The Object Info palette should display 73 rectangles. We are now going to add spaces around all 73 rectangles at once.

3. In the Object Info palette, be sure the Center point is the select point in the box position controls.

4. Next, input a value of 11/16" in the **Width** field and value of 5/8" in the **Height** field. Then press the Enter key.

The measurements for the Space bar, Shift keys, and Enter keys must be set individually.

5. First select all four of the keys mentioned above, and verify the Center point is selected in the box position controls.

6. Then select each key individually and input the following values in the Object Info palette: Shift keys and Enter key: ΔX = 1 1/2", ΔY = 5/8", Space bar: ΔX = 3 13/16", ΔY = 5/8"

## Keys 3D Geometry

The 2D geometry for the keys is now completed, so we need to create the 3D geometry and position them correctly on the CPU case.

1. Press Command + A (Macintosh) or Control + A (Windows) to select all of the keys.

2. Now go to **Model > Tapered Extrude**.

3. In the Create Tapered Extrude dialog box, set the **Height** field to 1/16" and the **Taper Angle** field to 45 degrees and click **OK** to create the tapered extrude object.

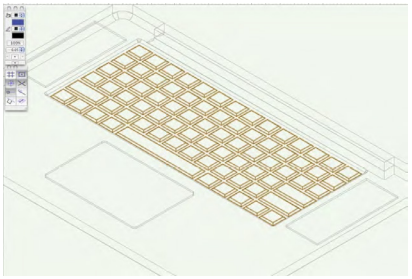
Notice that all of the keys are now one object. This is because all of the keys were selected at the time of the operation. That quickly we created the 3D geometry for the keys! Now we just need to move the keys to the correct Z height.

4. From the Standard Views dropdown menu in the View bar, select Right Isometric.

5. Then go to **View > Align Layer Views** so the CPU laptop layer is aligned with the Keys layer.

6. With the keys still selected, go to **Modify > Move > Move 3D**.

7. Input 0" in the **X'** and **Y' Offset** fields and ¼" in the **Z' Offset** field. Then click **OK** to move the keys into their proper position.



## Speaker Detailing

The last thing we need to do to complete this laptop 3D model is create the speakers.

1. First switch to a Top/Plan view by going to **View > Standard Views > Top/Plan.**

2. Now, go to **View > Align Layer Views** so that the CPU case is now in Top/Plan view as well.

3. Press the X key twice to deselect all objects, and then click the **Fit to Objects** button on the View bar.

As we have done throughout this exercise, we will place the speakers on their own layer to help with organization.

4. Click the **Layer** button in the View bar, and then click the **New** button.

5. Name this new design layer, "Speakers." Then click **OK** twice to return to the drawing area.

6. Next, use the **Zoom** tool and draw a marquee around the left speaker cutout to zoom to this area.

7. Switch to the **Rectangle** tool in the Basic tool palette. Be sure the first mode, Rectangle mode, is enabled.

8. Click the top left corner of the speaker cutout when the "Endpoint" cursor cue appears to start the rectangle.

9. Then click the bottom right corner of the speaker cutout when the "Endpoint" cursor appears to complete the rectangle.

10. Now select the **Circle** tool from the Basic palette, and be sure the first mode, Circle by Radius mode, is enabled.

11. Click anywhere inside the newly created rectangle to start drawing the circle.

12. Press the Tab key to enter the **Length** field and input 1/16". Then press the Enter key to lock in the value.

13. Now click anywhere in the drawing to place the circle.

14. With the circle still selected, go to **Edit > Duplicate Array.**

15. In the Duplicate Array dialog box, set the Shape dropdown menu to Rectangular Array.

16. Set the **Number of Columns** field to 6 and **Number of Rows** field to 15.

17. Then input ¼" for the **Distance Between Columns** field and -1/4" for the **Distance Between Rows** field.

18. Make sure Retain and Leave Selected are both checked on the bottom right.

19. Then click **OK** to create the Array.

20. So that these circles are easier to move as a unit, go to **Modify > Group**.

At the moment your group most likely does not sit inside the rectangle we drew earlier. It will only take a few steps to align these objects exactly.

1. Your group of circles should already be highlighted, so press the X key to switch to the **Selection** tool. Then hold down the Shift key and click the rectangle behind the group.

2. Next, go to **Modify > Align > Align/ Distribute**.

3. To the right of the Preview box, check the Align option and tick the option Center.

4. Below the Preview box, you also will want to check the Align option and tick the Center option.

5. Then click **OK** to align the two objects.

6. Now, hold the Shift key and click the rectangle to deselect this object.

7. With just the group selected, go to **Modify > Ungroup.**

8. Then hold the Shift key and re-select the rectangle.

9. Next, right-click on the any of the highlighted objects and choose Clip Surface from the context menu.

10. Press the Delete key to remove the unneeded circles. Now we have just one polyline. Select this polyline.

11. Go to **Model > Extrude** and set the **Extrusion** field to 1/16" to add depth to the speaker.

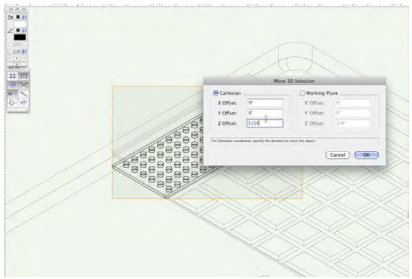
Now we need to properly position the speakers on the CPU case, then mirrored to the other side of the CPU case.

12. Switch to a Right Isometric view by selecting Right Isometric from the Standard Views dropdown menu.

13. Then go to **View > Align Layer Views** so that the other visible layers are changed to a Right Isometric view as well.

14. Press the X key to switch to the **Selection** tool and select the speaker if it is not already highlighted.

15. Then go **Modify > Move > Move 3D** and set the **X'** and **Y' Offset** fields to 0. Set the **Z' Offset** field to 5/16" and click **OK** to move the speaker to its correct position.



All we have left to do is mirror the speaker, and our laptop model is complete.

1. Choose Top/Plan from the Standard View dropdown menu.

2. Then go to **View > Align Layer Views** to change the other

visible layers as well.

3. Press X twice to deselect the speaker. Additionally, click the **Fit to Objects** button on the View bar.

4. With the speaker once again selected, choose the **Mirror** tool from the Basic tool palette. Be sure the second mode, Mirror and Duplicate mode, is enabled in the Tool bar.

5. Now, move your cursor toward the center of the top edge of the CPU case.

Click once the cursor cue "Midpoint" is displayed.

Then hold the Shift key and move your cursor downward and click again when the cursor cue "Vertical" is shown to place the duplicate speaker on the right side of the CPU case.

## Viewports

That's it! Our laptop model is complete. Now let's change the colors to something more appropriate for a laptop and create one Open GL viewport and one Hidden Line rendering viewport.

1. Click the **Layer** button in the View bar.

2. In the Organization dialog box, make the Screen laptop layer visible by clicking the far left visibility column for that design layer.

3. Next, click the **New** button and name this model "Laptop complete."

4. Then click **OK** twice to return to the drawing layer.

5. Now go to **View > Layer Options** and choose Show/Snap/Modify Others.

6. Go to **Edit > Select All**.

7. In the Object Info palette, choose "Laptop complete" from the layer dropdown menu.

8. Now switch to a Right Isometric view from the Standard Views dropdown menu in the View bar.

Let's see what our laptop looks like rendered and apply some appropriate colors.

1. Click Fit to Objects in the View bar.

2. Select Open GL from the Render modes dropdown menu in the View bar.

As you can see, the display still has several colors to it. You can choose can keep these colors, or you may change the color of any part of the laptop by using the Attributes palette. Remember, some of these objects are in groups, so you will need to double-click the group first to enter the editing mode and then apply different colors to different objects within the group once you have your colors set. We can create two quick viewports.

3. Go to **View > Create Viewport**. Select New Sheet Layer from the Create On Layer list and name it Sheet Layer 1.

4. Click **OK** twice to close the dialog boxes.

5. You should have one large viewport on a Sheet layer. This viewport is too large for the page boundary. So with the viewport selected, change the scale in the dropdown menu in the Object Info palette to 1:4.

6. Then position the viewport so that it sits within the page boundary in the top half of the page.

7. Now let's duplicate this viewport. Hold the Option key (Macintosh) or Alt key (Windows) and click and drag the current viewport downward, making sure it's still within the page boundary.

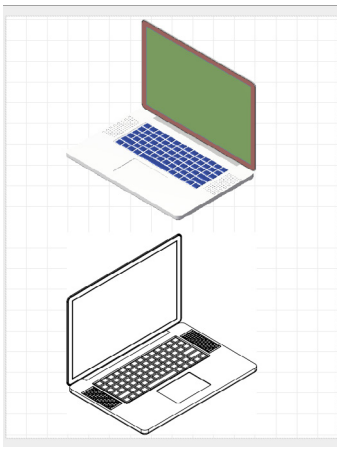
8. When you are happy with the placement, release the mouse button.

9. Next, in the Object Info for the duplicate viewport, change the View dropdown menu to Left Isometric and the Background Render dropdown menu to Hidden Line.

10. Finally, hold the Shift key and select both viewports.

11. Then in the Object Info palette click the **Update** button.

Here's the final product:



# Creating a Twist Table

In this addendum, we are going to create a twist table using more solid modeling operations. This time, instead of going through each document setting we'll just used the attached exercise file (Gsg-2014-f-twisttable-start).

1. Download or copy this file to your desktop. In Vectorworks, go to **File > Open**. Then select the exercise file from your desktop and click the **Open** button.

You should notice the page boundary orientation is now set to landscape and the units are millimeters.

2. Now that we have the same starting point, double click the **Rectangle** tool in the Basic palette. This will open the Create Object dialog box.

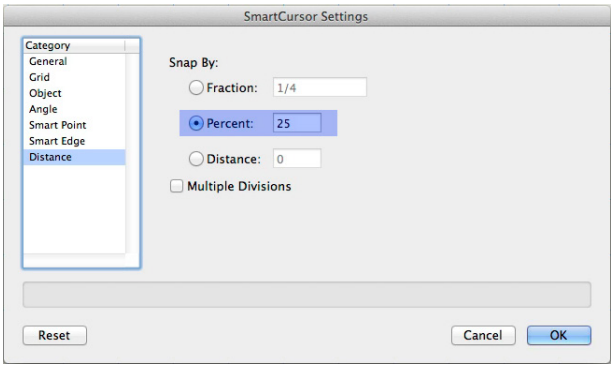
3. In the **Width** field input a value of 1000mm and do the same for the **Height** field.

4. Also choose the center mark on the box position matrix.

5. We want this rectangle to be placed at the center of the drawing area, so uncheck the option **Position At Next Click**.

6. Now we can input 0 in the X and Y fields to center rectangle. To create the rectangle click **OK**.

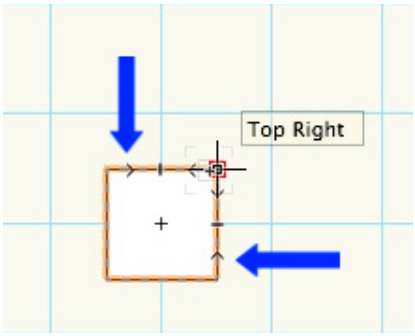
7. Next, in the Snapping palette double click the category **Snap to Distance** and verify that the Snap By option is set to 25%.




This means that we will receive snap points at 25% of the total length of an object on a straight or curved line, polygon edges, wall edges, and other linear objects.

8. Also select the **Grid** category and verify the options **Show Grid** and **Show 3d Z Axis** are checked. then click **OK**.

If you move your cursor to the top right corner of the rectangle you will be able to see the distance snap points here. OK.




We're going to use this rectangle along with the distance snapping to create the legs for the twist table.

9. To begin, click the **Fit to Object** button in the view bar so that you have a good view of the rectangle.

10. Then, select the **3D Locus** tool in the **3D Modeling** tool set.

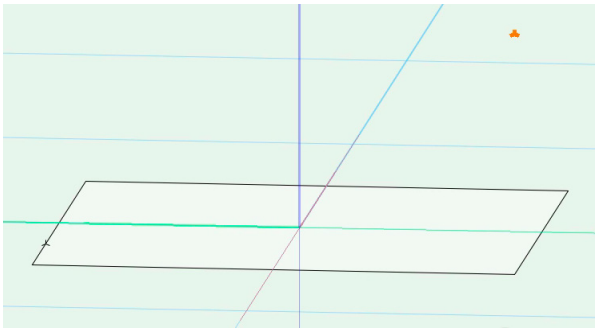
11. Now hover your cursor over the top left corner of the rectangle. You should see that there is a distance snapping point just to the right of this corner.

12. When you move your cursor to this point, the cursor cue, Along Line, should be displayed. Click this, snap point to place the 3D locus point.

13. Also click the bottom left corner of the rectangle to place another 3d locus point.

14. Additionally, with the last created 3D locus point still selected, set the **Z** field in the Object Info palette to **500** and press **Enter** to lock in the value.

15. Next, use the **Flyover** tool to get a side view of these 2 locus points. Notice the lasted created locus point sits 500mm above the layer plane.



16. Let's connect these 2 locus points, using the **NURBS Curve** tool in the **3D Modeling** tool set.

17. Once you have the tool activated, click one of the 3D locus points. Then double click the other to create the NURBS

18. Next, double click the **Circle** tool in the Basic palette.

19. When the **Create Object** dialog box appears, set the **Diameter** field to **12** and click **OK** to create the circle.

20. Now press the **X** key on your keyboard to switch to the **Selection** tool. Hold the **Shift** key and click the previously draw NURBS curve. You should now have both the NURBS curve and the circle selected.

21. Then, go to **Model > Extrude Along Path**. Make sure the NURBS curve is highlighted as the path object and click **OK** to create the Extrude Along Path. This will serve as one of the legs for our twist table.

22. Let's create the rest of legs by going to **Edit > Duplicate Array**.

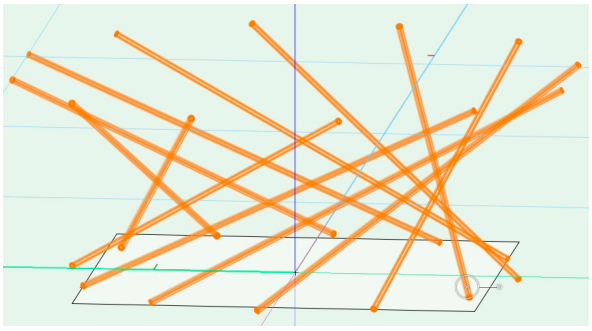
23. Choose **Circular Array** from the Shape drop down menu. Then set the **Number of Duplicates** field to **11**.

24. Since we want the to be created evenly in a circle set the **Angle Between Duplicates** field to **360/12**. This will create the appropriate angle for 12 objects evenly spaced in a complete circle.

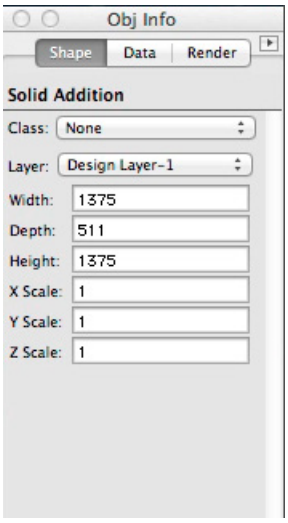
25. Also make sure the Circle Center Point **X** and **Y** fields are both set to **0**.

26. Additionally, choose **Use Duplication Angle** from the Rotate Duplicates section.

27. Last check the options **Retain** and **Leave Selected** in the Original Object section. Now click **OK** to create the duplicate extrude along path objects. The Object Info Palette should show 12 Extrude Along Path objects are selected.



28. So that we can treat all of these objects as one, go to **Model > Add Solids** to create one large solid addition from the 12 extrude along path objects. Notice the Object Info palette now shows Solid Addition.




At the moment, we have created all of the legs for the table, however all of the legs are still straight.

29. To create a slight curve to these legs, first select the **3D Locus** tool from the **3D Modeling** tool set again.

30. Then click at the center of the layer plane, where the 3 axis lines meet.

31. After placing the locus point, go to the Object Info palette and change the **Z** height for this locus to **500mm**. Press **Enter** on your keyboard to lock in the value.

32. Now we'll use the **Twist** tool in the **3D Modeling** tool set to add the curve to the table legs. Activate the **Twist tool**. Make sure the first mode **Solid** mode in selected in the **Tool** bar.

33. Next, you must select the solid object to be twisted, which in this case is the solid addition. Click the solid addition once.

34. Now we must choose a fixed point to twist the object around, which is the 3d locus point we just created. So click the locus point once as well.

35. Now we need to set the reference line. To do this, move your cursor to the right until you snap to the green Y-axis.

36. When you see the cursor cue Y and the **Working Plane Angle** field in the floating data bar reads -90°, click to set the reference line.

We now can begin twisting the object. If you move your cursor you should see a preview for the resulting twist. Since these are

table legs, we do not want too drastic of a curve in the legs.

37. So press the **Tab** key to enter the **Twist Angle** field in the floating data bar.

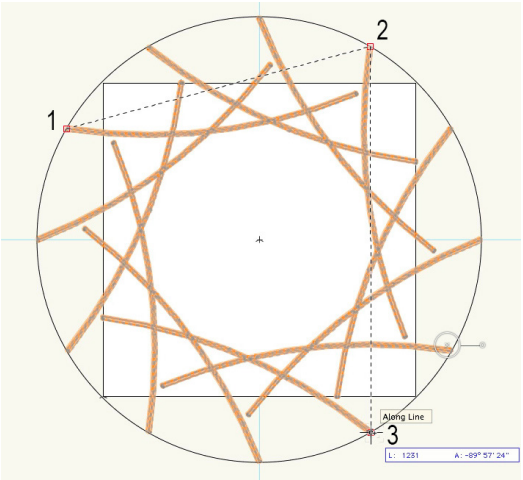
38. Input a value of **-15°** and press **Enter** to lock in the value. Now click once more to complete the twist.

39. There. Now take a moment with the **Flyover** tool to see how the solid addition as been twisted. Once you are done, return to a Top/Plan view.

The legs of the table are complete. Next, we need to create the tabletop.

40. To do this, select the **Circle** tool from the Basic palette. Also select the 3rd mode in the **Tool** bar, **Circle by Three Points** mode.

41. To create the circle, click these 3 endpoints.




Don't forget you can use the Snap Loupe by pressing the **Z** key to get closer a look as necessary.

42. We also need to create a smaller circle. So double click the **Circle** tool to access the Create Object dialog box.

43. Change the **Diameter** field to **25mm**. Then click **Ok** to create the circle, which should be placed at the center of the drawing.

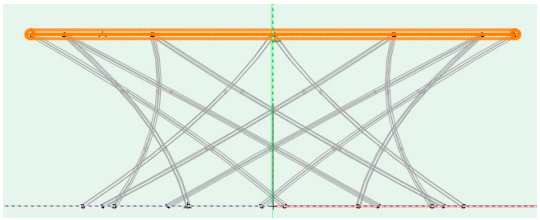
44. Now, switch to the **Selection** tool. Hold the **Shift** key and select the large circle. You should now have both circles selected.

45. Next, go to **Model > Extrude Along Path**. Make sure the larger circle is highlighted as the path and click **OK** to create the extrude along path object.

46. Currently, this object is sitting at 0 on the layer but it needs to be elevated 500mm to the top of the table legs. So, in the Object Info palette, set the **Z** field to **500** and press **Enter**.

47. Ok. Now let's switch to Front view.

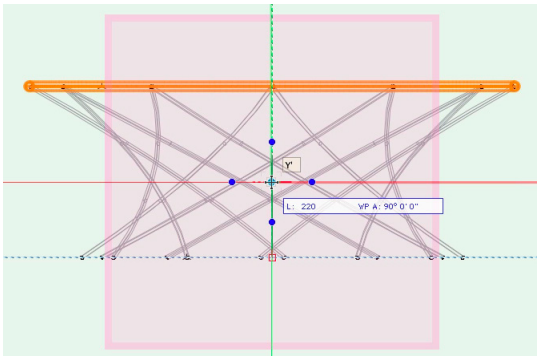
You can see the extrude along path we've just created meets the legs of the table legs and will serve as the railing for the glass tabletop. Let's also create the railing around the middle of the table legs.



48. First, using the **Selection** tool, click the green Y-axis line.

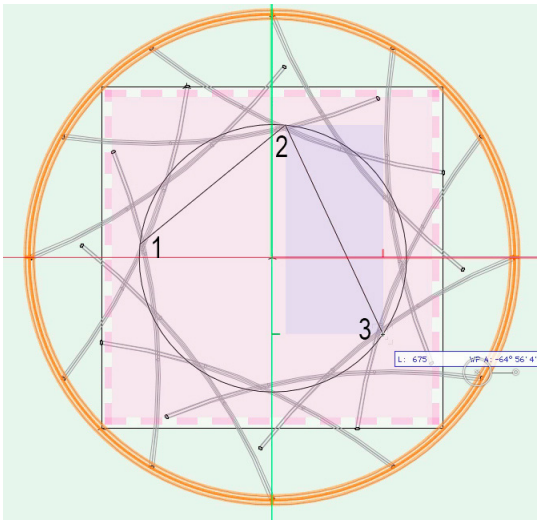
You should notice there are now additional selection handles available on the working plane. This will allow us to move and rotate the working plane.

49. Click the center point on the working plane and move it upward, while holding the **Shift** key. When the **Length** field in the Floating Data bar is around 220mm click again to complete the move.




50. Next, switch to a Top view. Then activate the **Circle** tool and

click these 3 points. Again, don't forget you can use the Snap Loupe as necessary here.



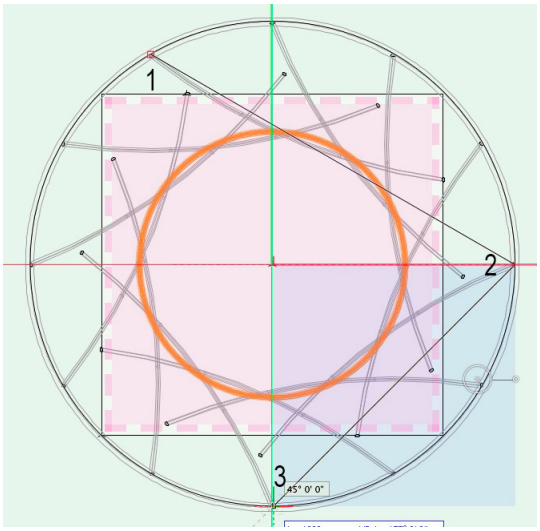

51. After completing the circle, double click the **Circle** tool in the Basic palette. Change the **Diameter** field to **12** and click **OK**.

52. Now switch to the **Selection** tool. Hold the **Shift** key and select the larger circle so that both circles are now highlighted.

53. Then, go to **Model > Extrude Along Path**. Again, be sure that the larger circle is highlighted as the path and click **OK** to create the extrude along path object.

The railings are done. Now we just need to create the glass surface for the top of the table.

54. Once again, select the **Circle** tool and click these 3 points to create the circle.

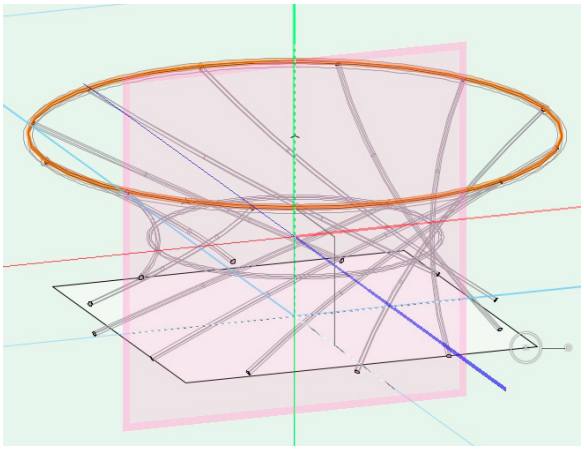



Just as we did previously press the **Z** key to use the Snap Loupe to get a closer look at the points.

55. Then, go to **Model > Extrude**. In the Create Extrude dialog box, set the **Extrusion** field to **6** and click OK to create the extrude.

56. The glass surface needs to sit at the top of the table, so set the **Bot Z** field in the Object Info palette to **500** and press **Enter**.

57. Now use the **Flyover** tool to take a look at this table in 3D.



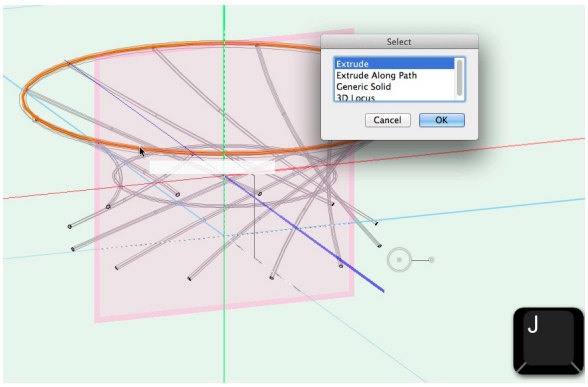
58. The extrude should still be selected, but if it is not select it and go to the Render tab in the Object Info palette.

59. Then select **Glass Clear** from the Texture drop down menu.

60. Now switch to the **Selection** tool.

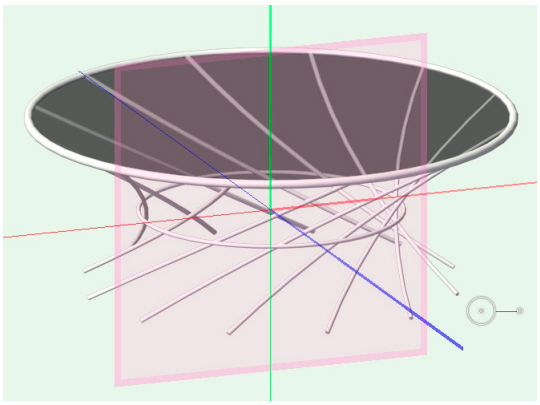
61. Go through and delete any extraneous objects like the rectangle on the ground plane and the 2 locus points.

Remember if you are unable to select an object because it shares an edge with another object, hover your cursor over the object, hold the **J** key and click. Then select your desired object from the list




62. The table is complete, so let's render in OpenGL or Final

Quality Renderworks to see the final results.



Last, lets create a few viewports to present this twist table.

63. Go to the View menu and select **Create Viewport**. In the Create Viewport dialog box, set the **Layer Scale** to **1:20**.

64. Also, select **New Sheet Layer** from the Create on Layer drop down menu.

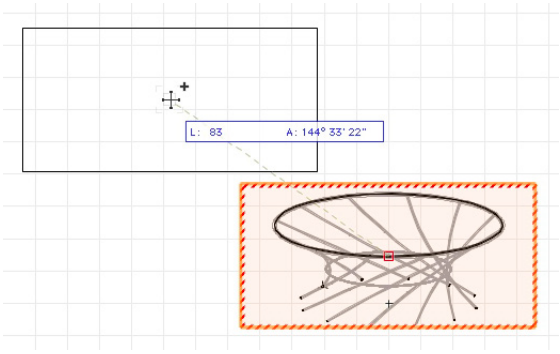
65. In the next dialog box, leave all settings at their default and click **OK** twice to create the viewport.

66. In the Object Info palette switch back to the Shape tab.

Notice the View drop down menu is set to **Custom**. This is because the viewport was created using the last view from the design layer, which was created using the **Flyover** tool.

Next, we'll create 2 more viewports display different views of the table.

67. With the **Selection** tool hold the **Option** key on Macintosh or the **Alt** key on Windows and click the drag the current viewport towards the top left of the corner of the drawing area.



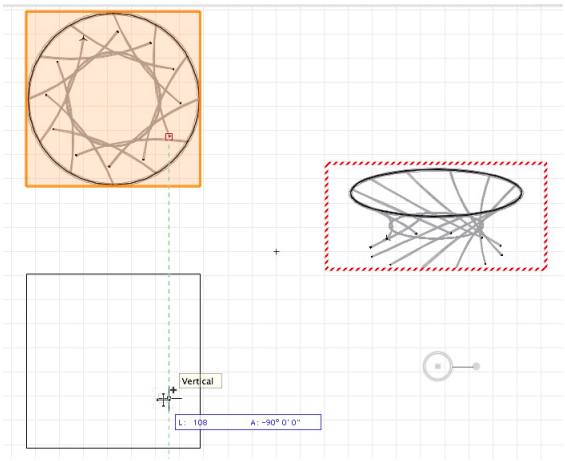

Notice the small plus sign beside the cursor, which indicates a duplicate, will be created.

68. Release the mouse click to create the duplicate. Also in the Object info palette change the View drop down menu to Top/Plan.

69. Additionally, reposition the viewport in the center of the page toward the right of the page.

OK we have one more viewport to create.

70. Again hold the **Option** key on Macintosh or the **Alt** key on Windows and click and drag from the last create viewport downward.




71. Release your mouse click when you satisfied with the viewports placement to create the duplicate.

72. This time in the Object Info palette change the View drop down menu to **Front** and choose **Hidden Line** from the Background Render drop down menu.

73. Select the 2 viewports with the red striped borders, which indicates they need to be updated.

74. Then click the **Update** button in the Object Info palette and your twist table project is completed.