Aeronaut Technote

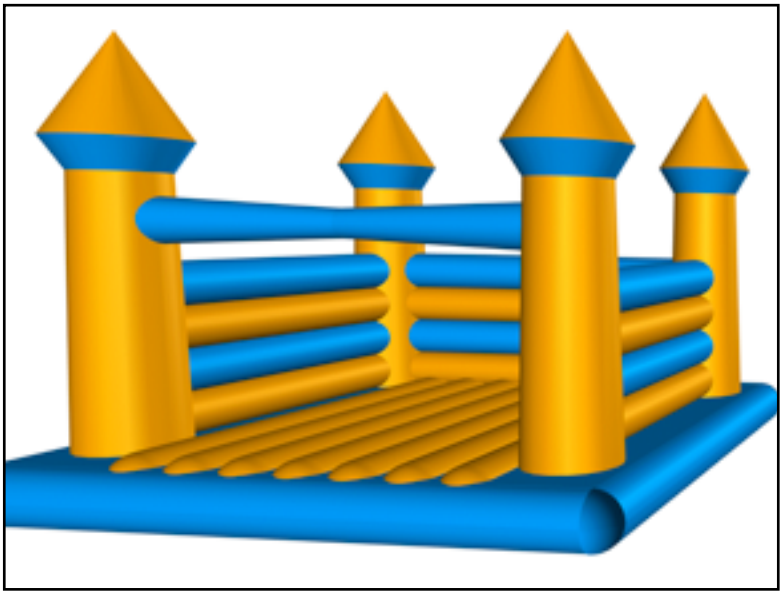
Subject: Inflatables in Vectorworks

Overview

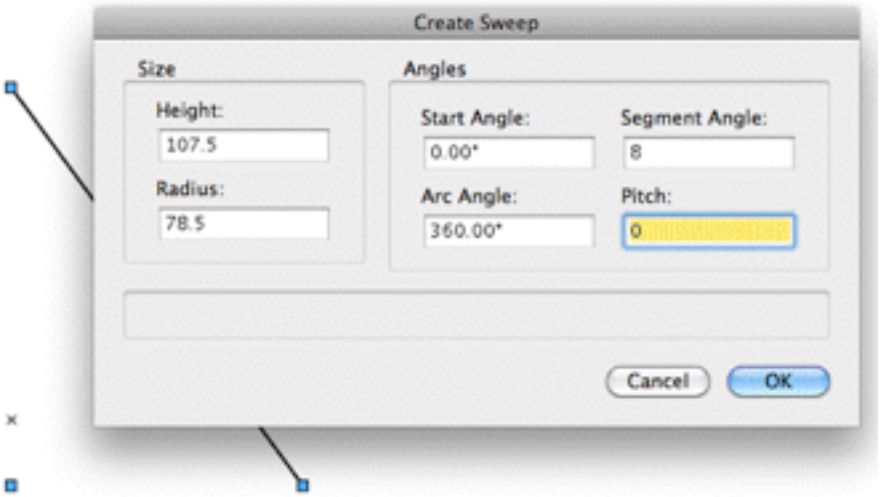
This technote shows how some Vectorworks features can be used to design inflatable objects. First a disclaimer! There are a heap of ways to go about designing inflatable objects and Vectorworks is just one choice. If you are comfortable and fast working in VW, it might be the most productive program to work in if you are designing an inflatable object.

A key point is that you need a plug-in from Vectorworks which does not come in the basic Fundamentals version of the program. You need the Mechanicals or other version of Vectorworks to get the Unfold Surfaces feature.

This technote is not a complete tutorial! Just a few ideas. You will no doubt understand that may of the shapes involved will look quite different when they are inflated and other parts of the structure such as the base as shown on the model are a kludge and would be done different in a real structure.

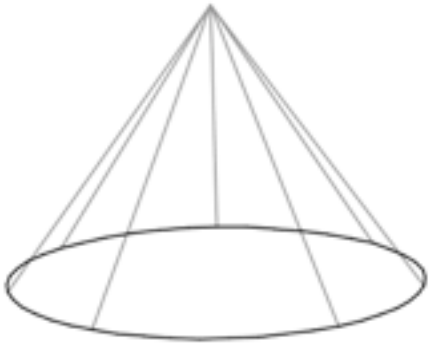


Most of the shapes used in this model are extrusions or sweeps. The towers are very simply made from a few sweeps. A sweep, sometimes also called "lathe" is used to make a surface by rotation. In VW, the centre of rotation is located with a locus. Before you perform anything in 3D, switch to the view you need for your model, in this case it's the Front view.

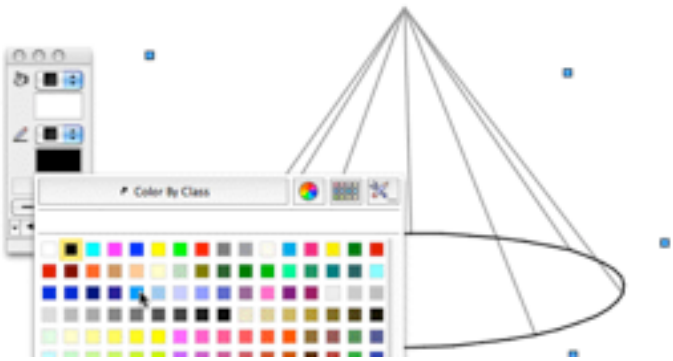


The resulting sweep is a cone. You can edit the parameters of this shape any stage by double clicking it and entering different values in the Object Info palette. For example, to get a quarter conical shape, you would enter 90° for the sweep angle instead of 360°.

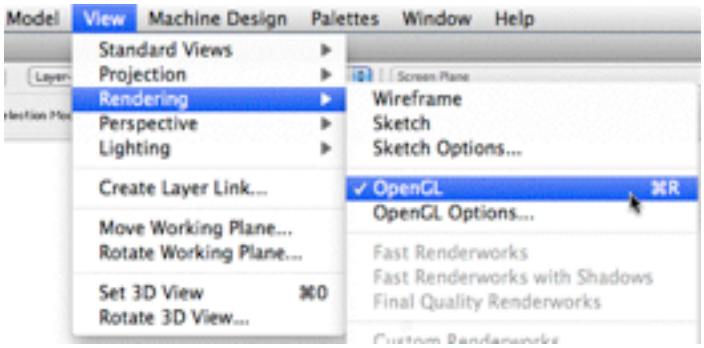
If you select the Rotate View tool from the 3D palette and rotate the cone, you can see it's really a 3D object now.

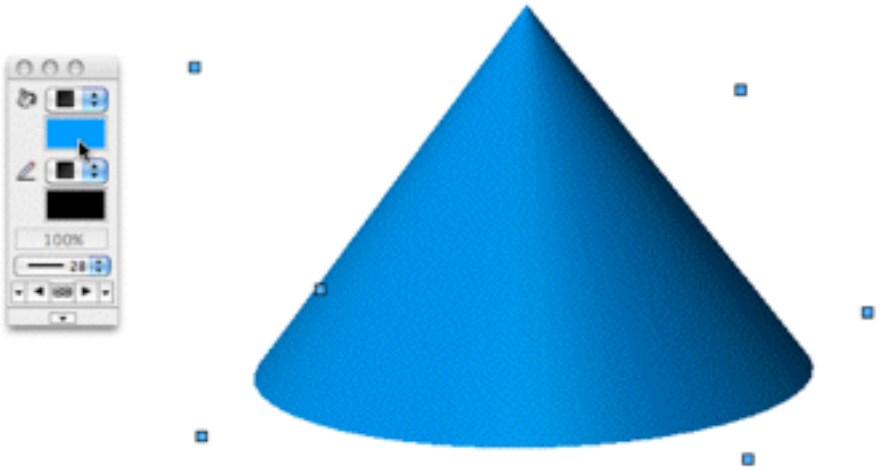


Select the object and give it a solid fill colour from the attributes palette.



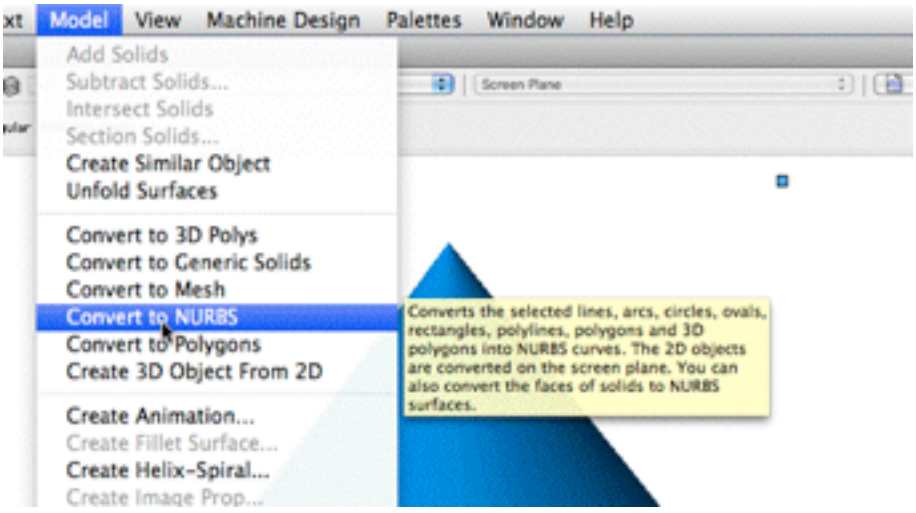
Now select OpenGL Render from the View Menu...





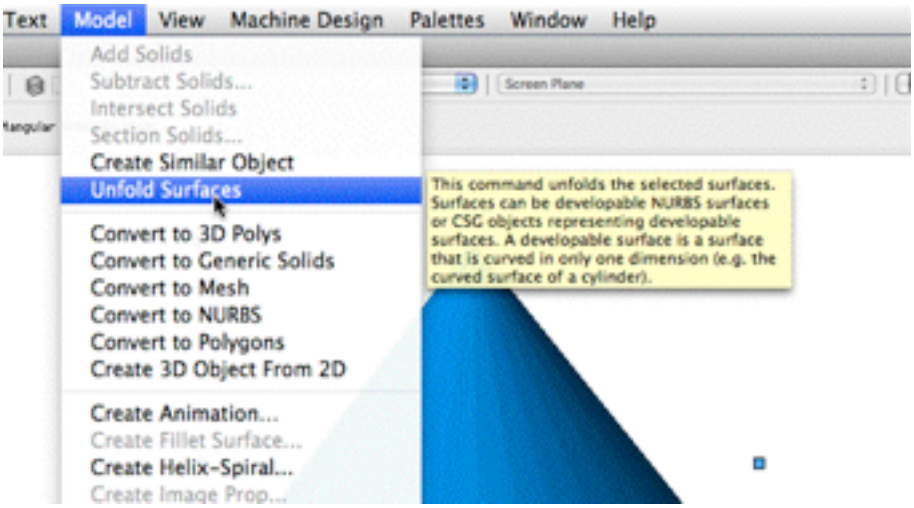
Colouring the object will serve two functions. 1, you can use the coloured shapes in your model. 2, more importantly, when you flatten patterns, you can see which parts belong where on the model.

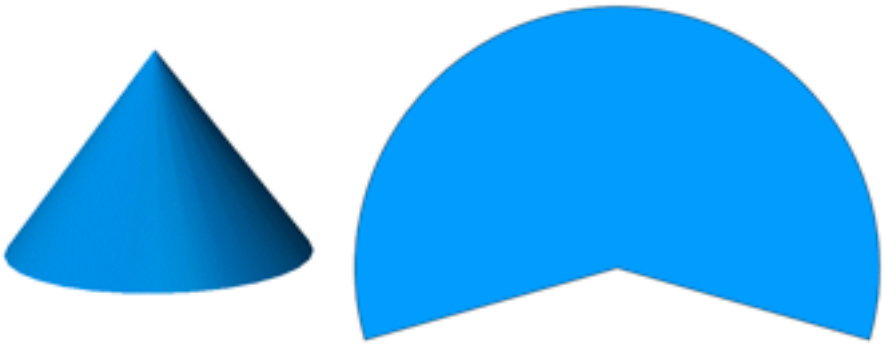
Now convert the shape into a Nurbs surface...



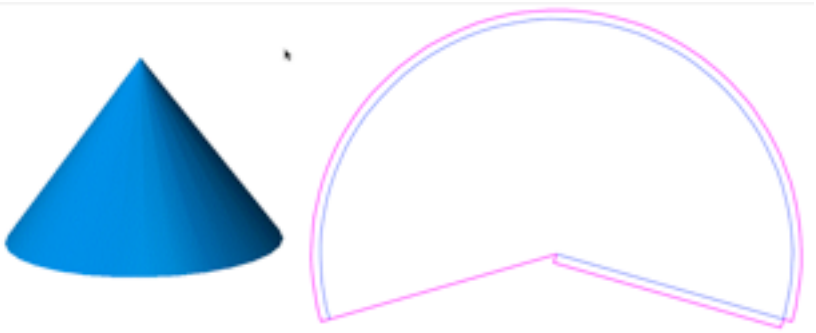
If the resulting model looks rough, you can select a higher resolution rendering. Go to the Render menu, select OpenGL options and change the resolution to something suitably high. Be careful... the higher the resolution, the longer the rendering will take.

Now, while the object is still selected, click on the Unfold surfaces menu...





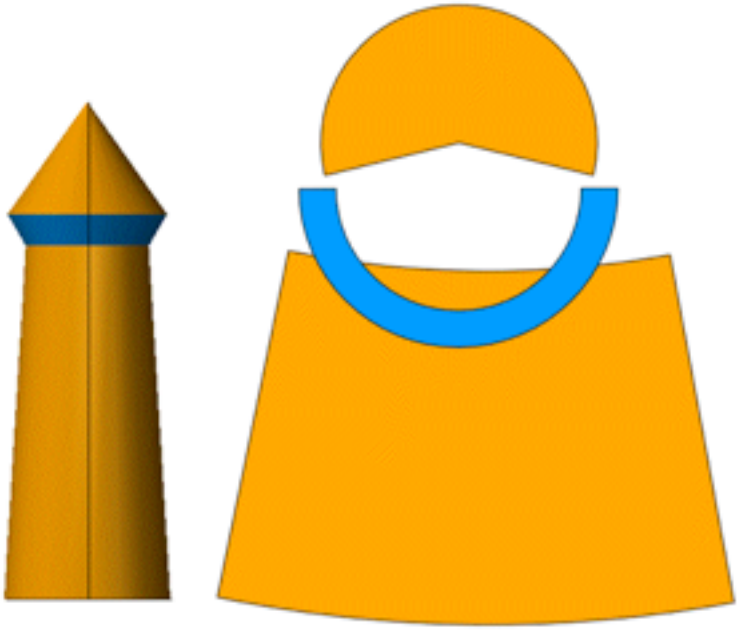
The result is that VW creates a flattened version of the NURBS surface. To use this in the real (fabric) world, you'd need to use something like Aeronaut's Add Seams plug-in to add the right seam allowances. Since this process removes the pattern colour, it's probably best left until last.



A complete tower is done in three sections... the top, the middle and the base. Start by making a vertical which is equal to the height of the final tower. Make a line for the base and then draw the sweep profile with three lines and three locii for the centre of rotation.

Select a line and a locus and sweep each to the same dimensions. Colour the sweeps to suit and render...

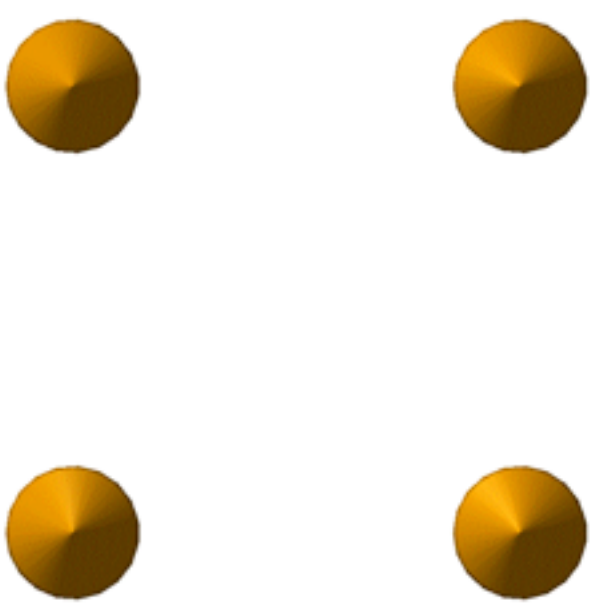
Now convert to a NURBS and flatten using Unfold Surface...



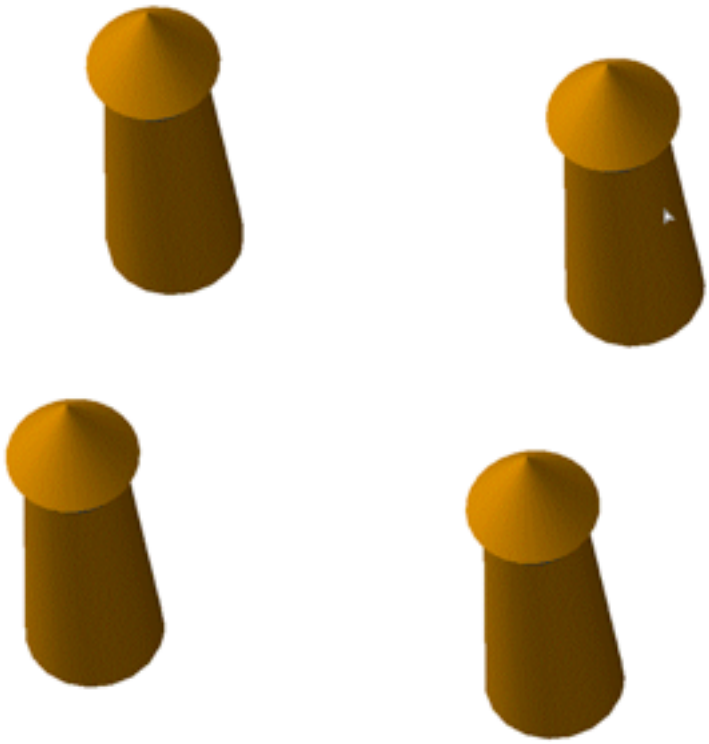
One colourful tower, ready for occupation!

Remember, you probably only need to make one tower pattern. You can create the rest by duplication of the first pattern.

Switch to Top view and using Duplicate and Move, make three copies of the towers and arrange them into a square at the right distance apart.



Above, the four towers in top view. Below, isometric view.



The Walls

No doubt there are many techniques for making shapes like walls... and this is only one of them, done by an amateur!

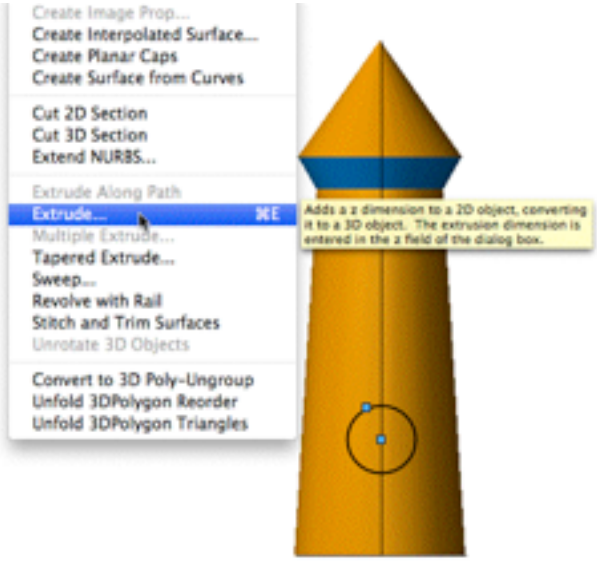
Remember always, that you should look for methods where you only make one pattern. If the four towers are identical, then only make one of them. The tubes forming the walls are symmetrical, so you only need to make one side and duplicate these patterns to form the entire tub . A lot less work.

This thinking applies to the following section.

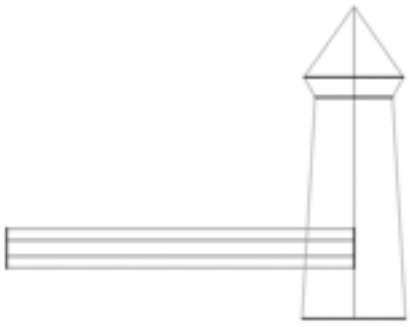
First the technique. We are going to extrude shapes to form the walls of the castle and then use the towers to clip the ends of the wall-tubes to get the right end profile. Because we have made life complicated for ourselves by tapering the towers, it's necessary to do this for each tube individually.

To be clear on the technique, here's the simple version first. Switch to Front view. Duplicate the tower (clipping deletes the object doing the clipping..)

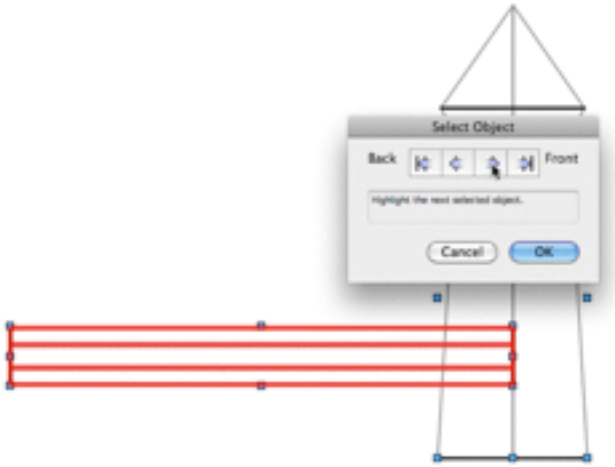
Draw a circle of 600 diameter centred on a tower. Select the tower and circle and Group them together. Select Extrude from the Model menu. Give the extrude a fill colour so you can see it when rendered or flattened.



Extrude to something like 5000. Switch to Top/Plan view. This will turn off the rendering and switch to a wireframe view. Check to make sure that the extruded circle is overlapping the tower shape.



Switch to the front and right views to ensure the overlap is there. Now select both the tower and the extrude and select the Subtract Surface from the Model menu...



Click on the arrows until the extruded circle is highlighted. Then click on OK. The tower will be subtracted or clipped off the end of the extrude. The tower will probably disappear... that's why we duplicated it to begin with.

The extrude will now be converted to a solid subtraction. While this is selected, click on Convert to NURBS from the Model menu. You will see from the Object Info palette that the shape is now a group. Ungroup it (organise menu), select the clipped right hand section and delete it.

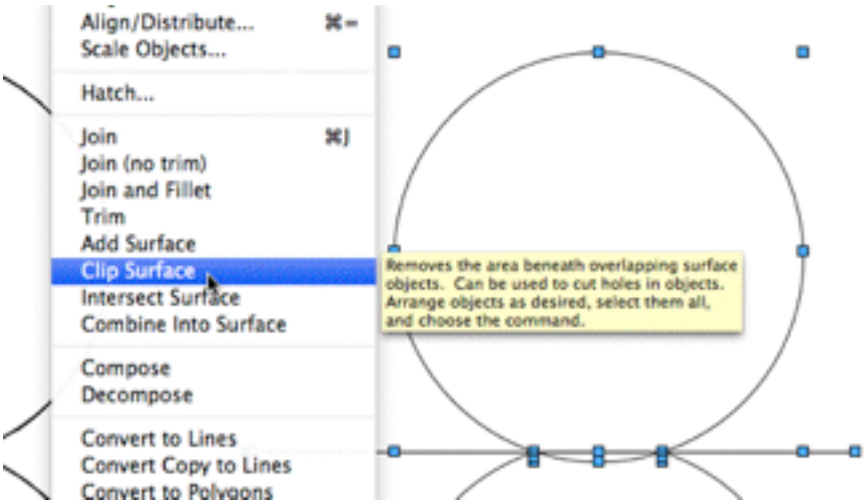
Now select Unfold Surfaces from the Model menu...

Notice the left end of the flattened extrude... it's exactly the shape you would expect to get when a coned object intersects a cylinder.

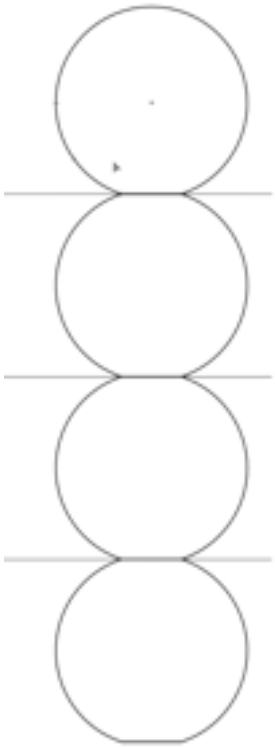
That's a basic extrude and subtract or clip technique that you can use to form walls and other elements of the castle model.

On our model, the side walls are formed from tubes, nominally 600mm diameter at 475 spacing. A line is drawn across the intersecting circles to form a gusset. The gussets are to retain the shape once inflated.

To form these shapes, select a line and circle and use clip surface until the circles are clipped. Delete the clipped parts of the circles...



The result should look this: The lines can be deleted and the tubes extruded clipped and flattened as shown earlier.

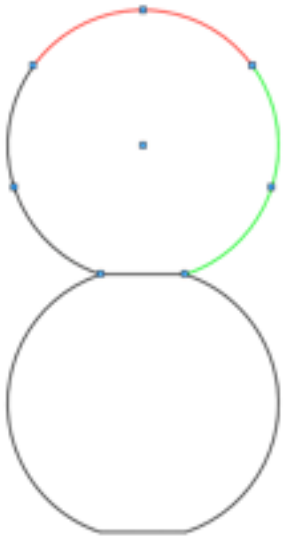


If you use the above technique without modification, you will end up with acceptable results, but when the tubes are unfolded, you will end up with several segments from each tube. When VW performs the flattening operation, you get one segment from the curved section of the tube and another segment from the gusset or flattened part of the tube.

You can easily add these segment back together to form the whole panel but here's another way of working. It takes a little longer in the first stage, but should result in easier to use patterns. Remember, the sides of the walls are symmetrical so only one side needs flattening.

For a start, draw only the top and second circle down. Draw lines and clip the circles as shown above. Now, select the circles and select Decompose from the Tool menu.

When you click on the circles, you will now find that they have been converted into something like quarter arcs. They're coloured here to make this easier to see.



Delete the red and green segments. Click on the end of the remaining segment and drag the end around so it meets the flattened base line. Repeat the decompose on the lower shape so each side is one arc.

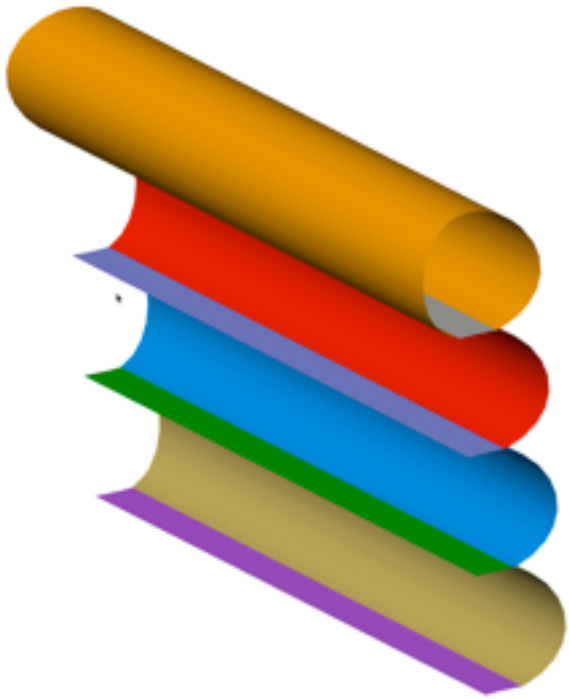
You will now have two horizontal lines across in the middle of the shape... one hidden behind the other. Delete one of them.

Select the lowest line and the arc either side (3 shapes), duplicate and move these down 475mm to recreate the original shape of the walls.

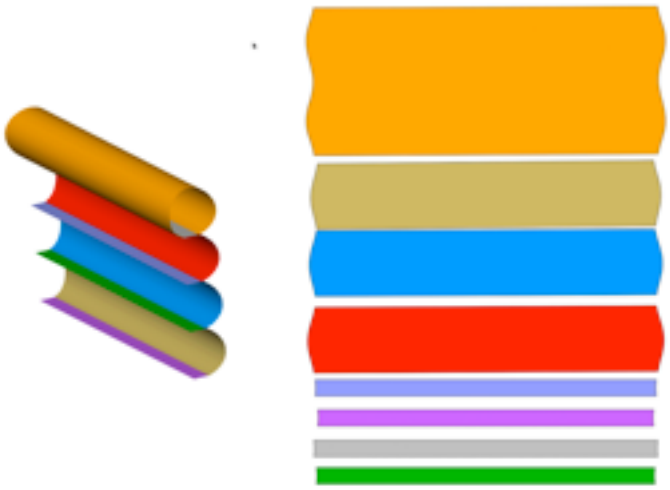
Select all these shapes and extrude them to something like 5000.

Use the tower to clip the ends of these extrudes the same way as last time. You will need to perform this operation more times because there are more segments, but you only need to do one side of the lower three tubes because they're symmetrical left-to-right.

Pick a colour for each segment so you can tell which is which when they are flattened later.



Unfold all the segments...



Add seam allowances to suit. Once the pieces have been correlated with the original colours on the extrude, they can be numbered, strike-up marks added if desired, and then they can be converted back to their proper colours for exporting and nesting.

The base of the model shown here is a kludge for illustration purposes. In reality, the methods used to create shapes such as the base use fairly simple rectangular shapes and hold them into the right form using internal gussets.

A Bottle

Shapes such as this bottle are moderately easy to design in Vectorworks.

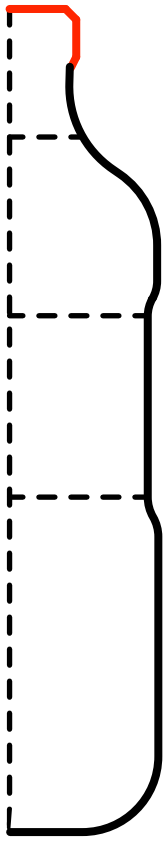
On the face of it, the shape can be made from a simple sweep of a polyline. This proves difficult to unfold, so a workaround is required on some parts of the shape.

Nevertheless, it's still only a 5 minute job.

The first stage is to draw the profile of the bottle to scale. Items such as the top can be done with lines.

The lower part of the bottle has curves and these have to be done with arcs or beziers. Use lines where you can since this will make less work later on.

This is the ideal profile using curves. The top is drawn with lines.



The label and top areas are marked so they can be made from different fabrics.

Bear in mind that when the bottle is inflated, that the air will bulge the shape and some of the curves can be approximations made with lines. For the best shape, you may also have to add some hollow to seams here and there.

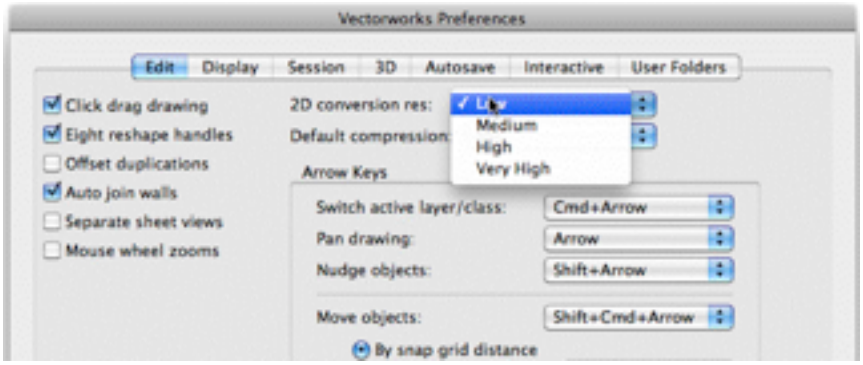
Since the top is made from simple lines, it can be easily converted into a Nurbs surface and flattened. The rest of the bottle has to be treated differently.

The next stage is done the way shown below because VW doesn't seem to want to turn a complex sweep into a flattened shape. We can still get the end result we want, but there's a bit of a workaround.

Duplicate the curved profile of the lower part of the bottle and move it to a new layer so you don't get confused. Working with multiple layers is a good idea on this sort of project so you can always go back a stage and try something different.

Select the profile and from the Tool menu select the convert to lines item. This will turn the arcs or beziers in the profile into simple line segments.

You do not want too many lines. If you have too many, go to Vectorworks prefs and set the 2D conversion res to Low...

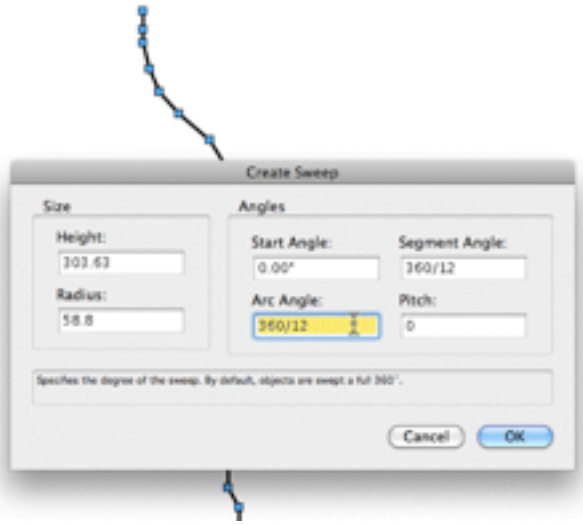


The profile should now be a reasonable approximation of the original shape.

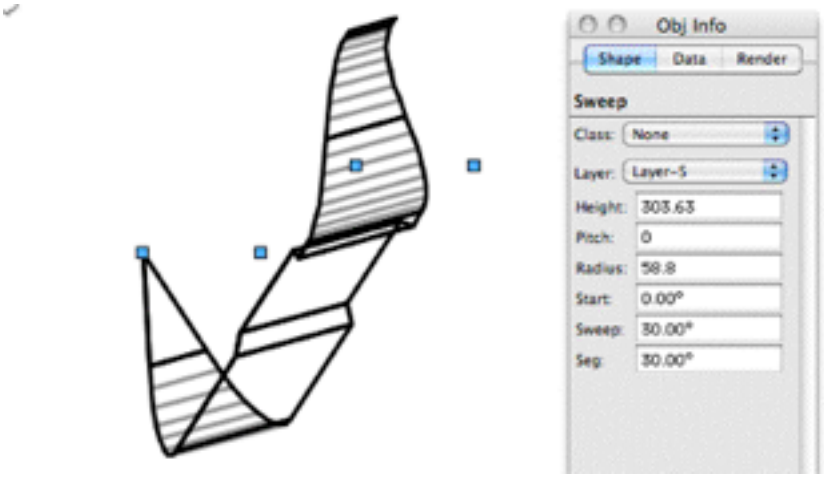
The bottle body is made from segments joined vertically like the slices of an orange. Select the profile and select Sweep from the Model menu.

Set the sweep angle to a value which will give you the required segment size. Probably somewhere between 8 and 12 segments is OK to form the bottle. You can enter this equation directly into the segments dialog if your maths is not too good!

Make the segment size the same as the sweep angle... 30°.



If you rotate the shape, you'll see that the profile is flat in one plane. That's been done by setting the segment to the same angle as the sweep.



Ungroup the sweep.

Select All and then select Convert to Mesh from the Model menu.

Ungroup and select Convert to Nurbs from the Model menu.

Ungroup and now select the Nurbs surfaces one by one and select Unfold Surfaces from the model menu to flatten the pieces. Align them as you go to form the pattern. Select all the unfolded pieces and select Add Surface from the tool menu. This will join all the bits together to form the pattern.

Add seam allowances and the job should be ready to cut.