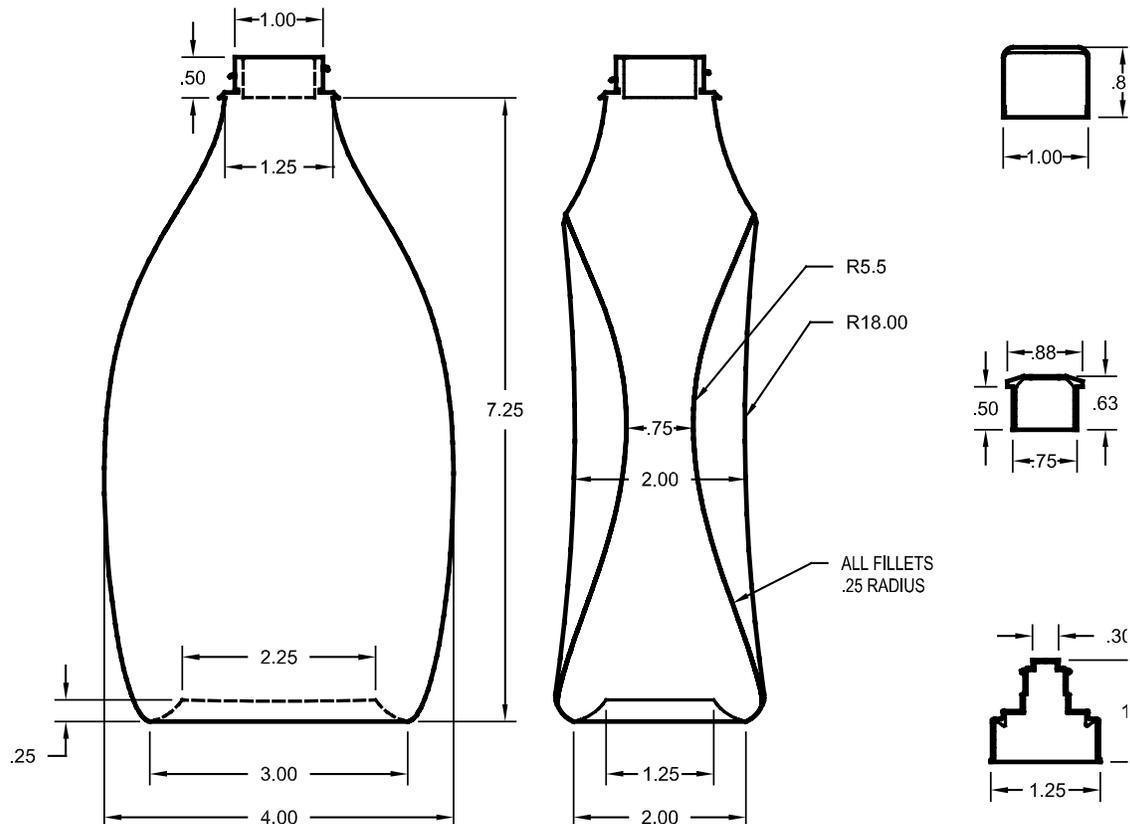# Modeling a Squeeze Bottle

Some models require more attention to detail. This is an example of a model that requires precise modeling techniques. This exercise also requires a number of different surface creation techniques.

The technical drawing is included to help you create a very precise model.

Creating a squeeze bottle:

To start the model:

1   Start a new model. Save as **Bottle**.

2   Make the following layers: **Construction, Curve, Bottle, BottleTop, Threads, Cap1, Cap2,** and **CapTop.**

3   Change to the **Construction** layer.

Create the Bottle Shape

To create the bottle shape, you will draw curves that define the bottom and top edge, then draw a curve that represents the side shape. You will then create a surface from these defining curves.

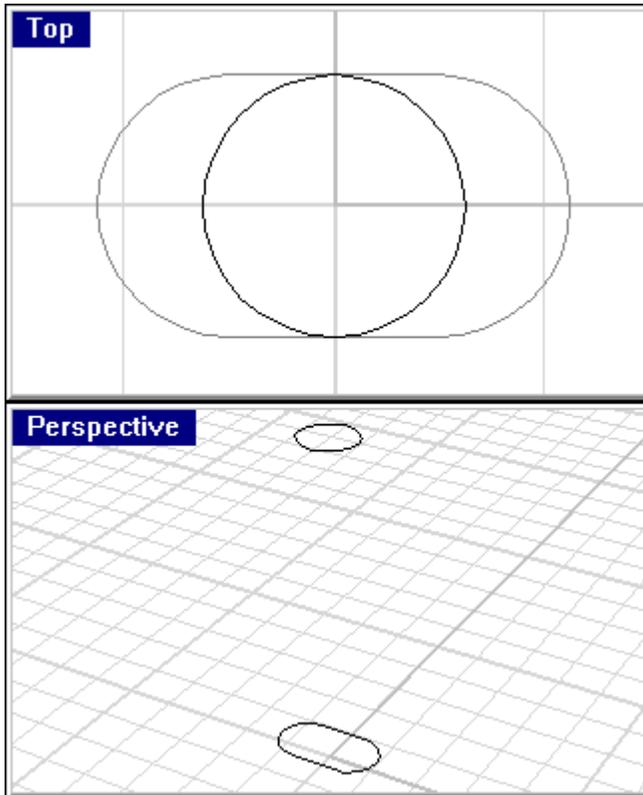**To draw a curve that defines the bottom of the bottle:**

1   From the **Curve** menu, click **Rectangle**, then click **Center, Corner.**

2   At **Center of rectangle (Rounded)** prompt, type **R**, and press ENTER.

3   At the **Center of rectangle** prompt, move your cursor into the Top viewport then type **0,0,.25** and press ENTER.

4   At the **Corner or length** prompt, type **2.25** and press ENTER.

5   At the **Width** prompt, type **1.25** and press ENTER.

6   At the **Point for rounded corner to pass through (Corner=Arc)** prompt, type **.625** and press ENTER.
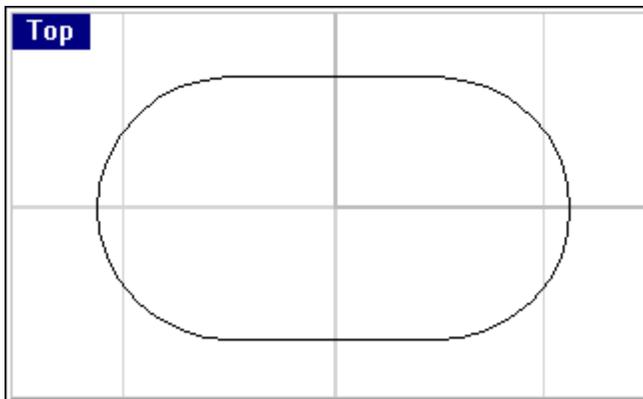
To draw a circle for the top of the bottle:

1   From the **Curve** menu, click **Circle**, then click **Center, Radius.**

2   To start the circle 7.25" above the construction plane, at the **Center of circle (Vertical OnCurve)** prompt, move your cursor into the Top viewport, then type **0,0,7.25**, and press ENTER.

3 At the **Radius** prompt, type **.625** and press ENTER.

To draw a rectangle that approximates the overall dimension of the bottle:

1 From the **Curve** menu, click **Rectangle**, then click **Corner, Corner.**

2 In the **Front** view, at the **First corner of rectangle (Rounded)** prompt, type **–2,0** and press ENTER.

3 At the **Other corner or length** prompt, type **4** and press ENTER.

4 At **Width** prompt, type **7.25** and press ENTER.
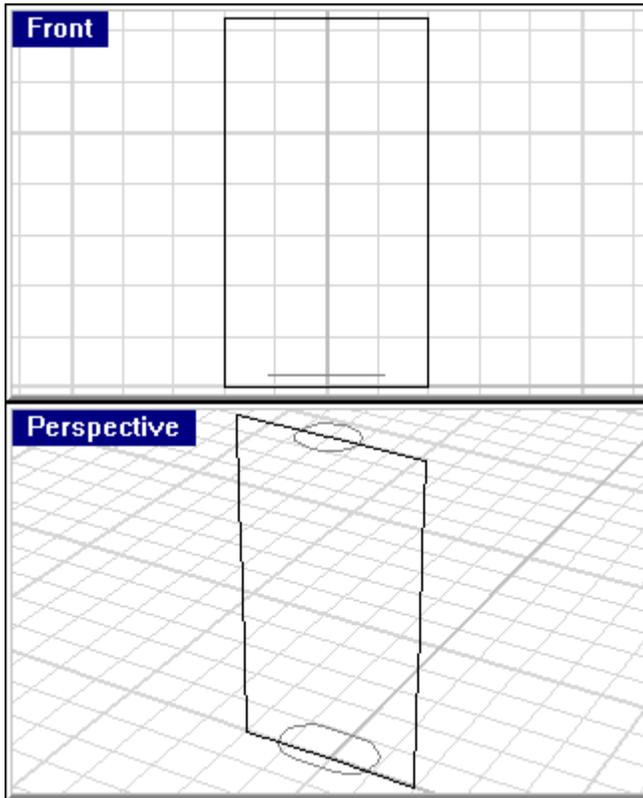
To draw the edge curve:

1 Change to the **Curve** layer.

2 From the **Curve** menu, click **Freeform**, then click **Control Points.**

Use the rectangle and object snaps to help you establish the correct size.

3 At the **Start of curve** prompt, snap to the right end of the ellipse in the **Front** viewport.

4 At the **Next point (Undo)** prompt, pick a point along the rectangle.

5 At the **Next point. Press Enter when done (Undo)** prompt, pick another point along the rectangle.

6 At the **Next point. Press Enter when done (Close Undo)** prompt, continue pick points along the rectangle ending at the quadrant of the circle.
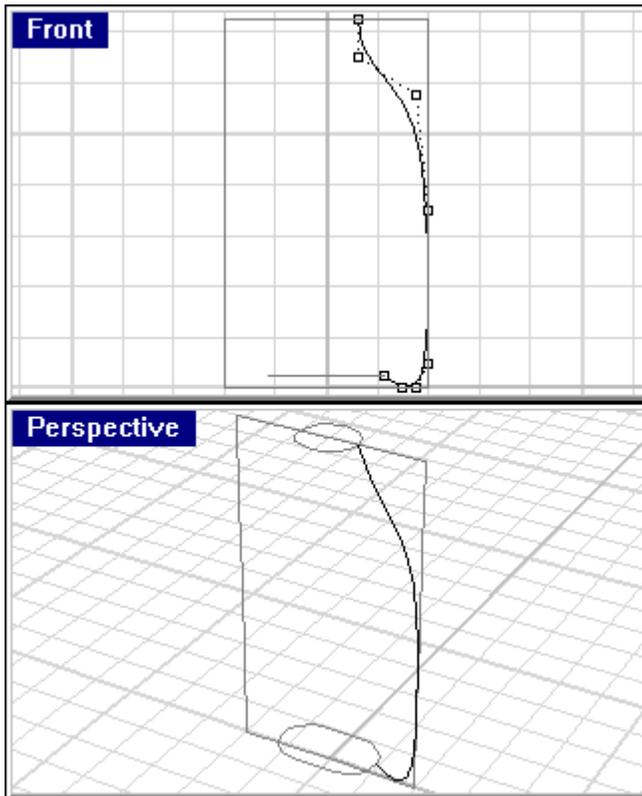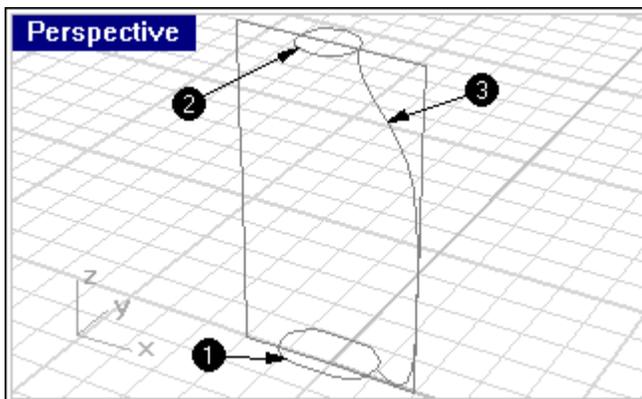

7 The curve will be used to create the surface of the bottle.

To create the surface for the bottle:

1 Change to the **Bottle** layer.

2 From the **Surface** menu, click **Sweep 2 Rails.**

The curve you created will be the shape curve (3). The rounded rectangle (1) and the circle (2) will be the rails.

3 At the **Select 2 rail curves** prompt, select the rounded rectangle.

4 At the **Select 2 rail curves** prompt, select the circle.

5 At the **Select cross-section curves (Point)** prompt, select the curve.

6   At the **Select cross-section curves (Point)** prompt, press ENTER.

7   In the **Sweep 2 Rails Options** dialog, click **OK**.
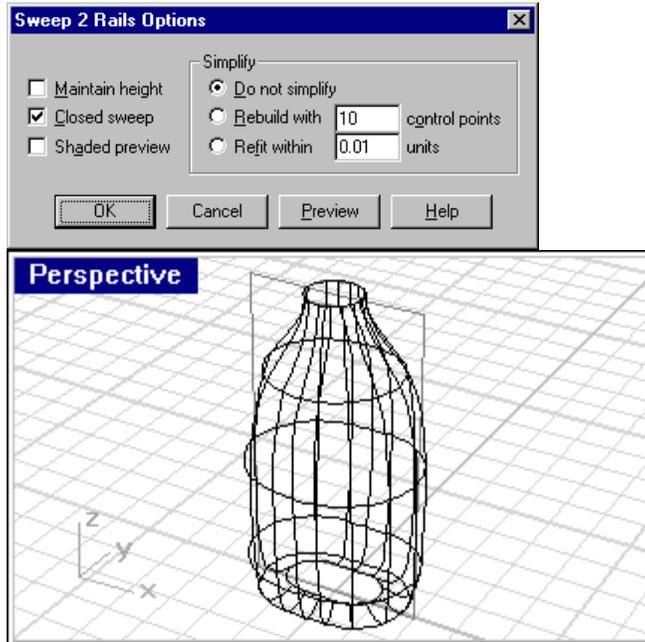
Cap the Top and Bottom

If you close the bottle, thereby creating a solid, Rhino can calculate the bottle's volume. If you were creating this bottle in real life, knowing the volume would be important. Normally, a bottle would have to be designed to hold a certain amount of stuff.

If the edges of the remaining open surfaces are planar curves, you can use the Cap command to close them. The open edges on the bottle are the top circle and the bottom rounded rectangle, and they are planar.

To cap the top and bottom:

1   From the **Solid** menu, click **Cap Planar Holes.**

2   At the **Select surfaces or polysurfaces to cap** prompt, choose the bottle.

3   At the **Select surfaces or polysurfaces to cap** prompt, press ENTER.

Flatten the Sides

You will notice that the bottle bulges too much in the **Right** view. We will create a custom surface to trim the bulge away.

To create the trimming surface:

1   Change to the **Curve** layer.

2   In the **Right** view, draw to curves to approximate the shape at the edge of the bottle and the middle of the bottle.

3   The technical drawing gives dimensions for these curves, but for this exercise you can just approximate these. If you would like to go further, try to figure out on your own how to draw the curves to the exact specifications.
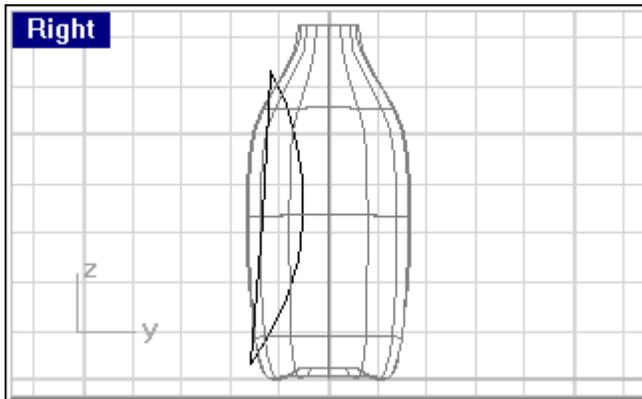

4   In the **Front** viewport move the curve with the smaller radius just outside the edge of the bottle by picking curve and dragging it to the right.
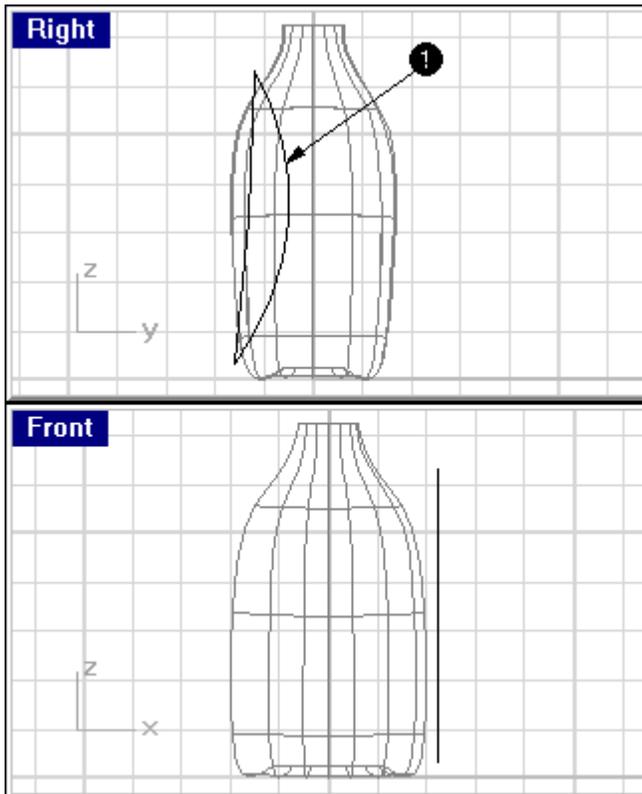

5   Select the curve you moved.

6   From the **Transform** menu, click **Mirror.**

7   At the **Start of mirror plane** prompt, move your cursor to the Front viewport, type 0,0, and press enter.

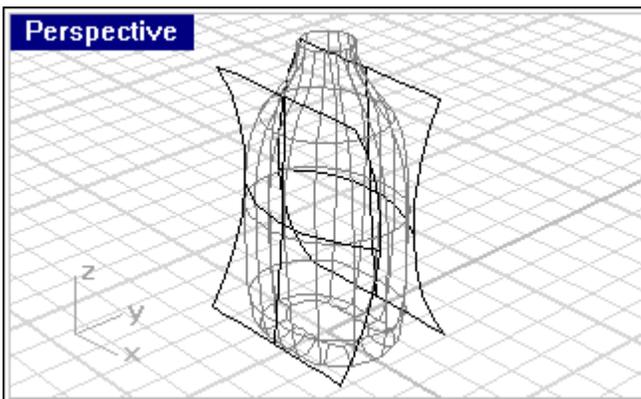8   At the **End of mirror plane** prompt, toggle Ortho on and pick a point directly above the previous point.
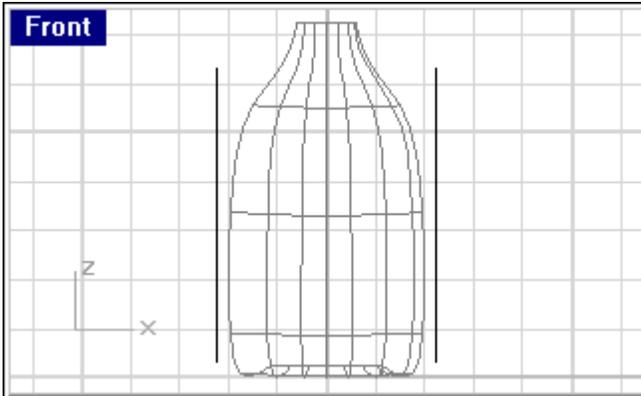
9   Select the three curves you just created.

10 To create a surface defined by the curves you created, from the **Surface** menu, click **Loft.**

11 In the **Loft Options** dialog, click **OK**.
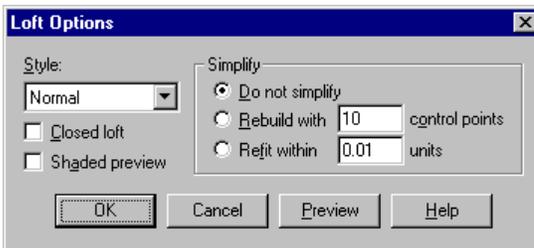
A lofted surface intersects the bottle.
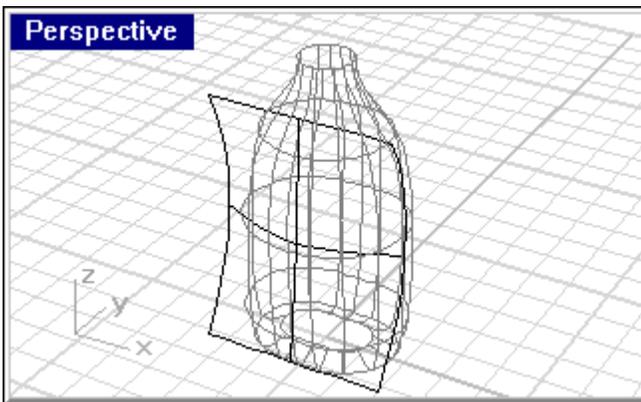
12 **Mirror** the surface to the other side of the bottle.

13 Save your model.

To remove the surface from the bottle:

1   Change to the **Bottle** layer.

2   From the **Solid** menu, click **Difference.**

3   At the **Select surface or polysurface** prompt, select the bottle.

4   At the **Select surface or polysurface to subtract** prompt, select the lofted surface.

Note: If difference doesn't work, try Union, if Union doesn't work try Intersection. If one boolean operation doesn't give you the right answer, you can generally try another one until you get the right answer.

5   Repeat this process for the other side of the bottle.


6   From the **Render** menu, click **Shade.**

Round the Edges of the Shapes

The bottle is now a closed solid. We now want to round off the sharp edges by adding a smooth radius between the edges.

To fillet the edges:

1   From the **Solid** menu, click **Fillet Edge.**

2   At the **Select edges to fillet (Radius=1.0)** prompt, select an edge that was trimmed.

3 At the **Select edges to fillet (Radius=1.0)** prompt, select the other edge that was trimmed.

4 At the **Select edges to fillet (Radius=1.0)** prompt, type **.25** and press ENTER.

5 At the **Select edges to fillet (Radius=0.25)** prompt, press ENTER.
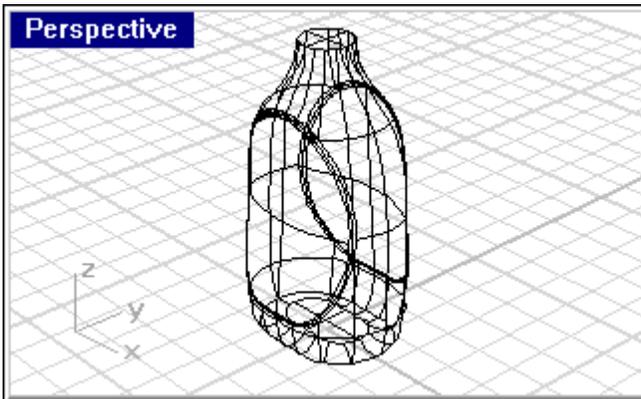
6 **Shade** the bottle to see the results.
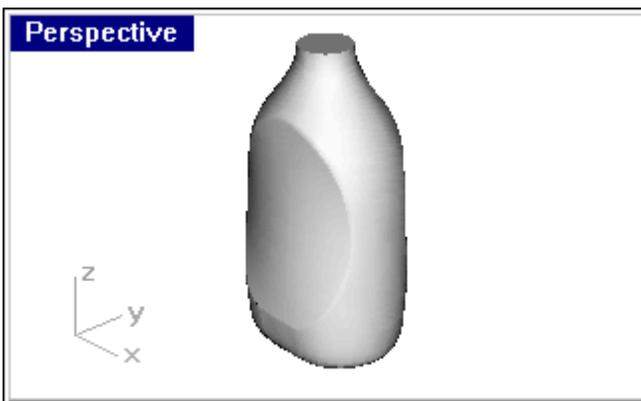
Create the Bottle's Top

To create the bottle throat, you are going to **Revolve** a profile curve to create surface, and then add threads.
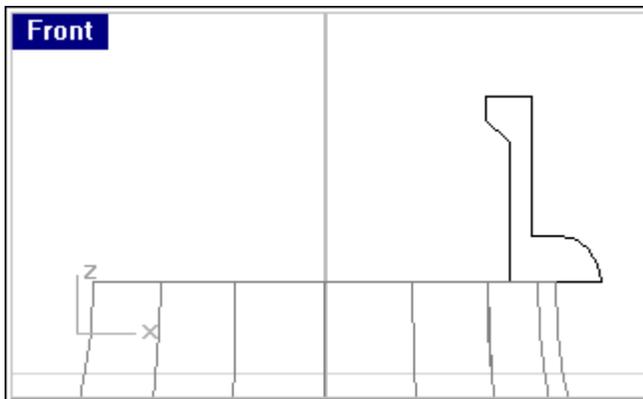
To create the profile curve:

1 Change to the **Curve** layer.

2 In the **Front** view, use the **Line Segments** command and an **Arc** to create a profile curve for the outside and the inside of the top.

3 Begin the first point at **.5,7.25** so it aligns with the profile on the edge of the bottle.

4 Use the technical drawing below to draw the correct dimensions.

Tip: When drawing line segments, you can use *object snaps*, the *distance constraint* and *ortho* to draw precisely. For example, for the first line type **.5,7.25** for the starting point, then simply type **.25** to constrain the line to .25 units. Turn ortho on and drag the line to the right. The line will stop at .25 units from the beginning of the line. For the vertical line on the left, use the End object snap to pick the end of the first line, type .375 to constrain the distance, and drag the line up.
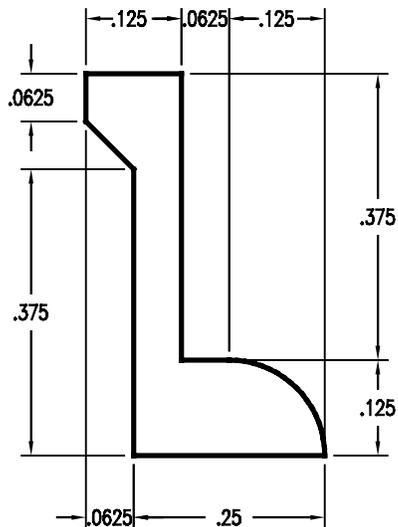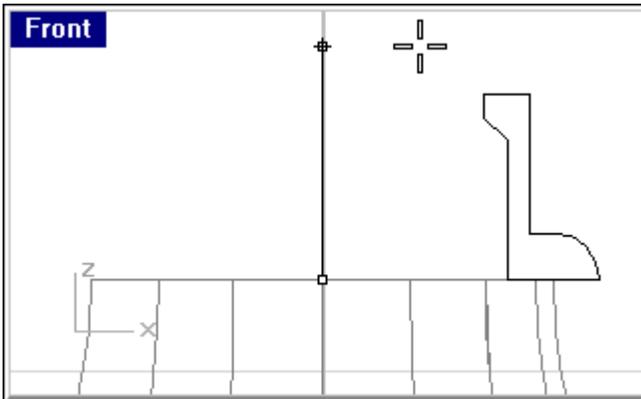

5 **Join** the segments together.


6 Change to the **Bottle Top** layer.

To create the top surface:

1 From the **Surface** menu, click **Revolve.**

2 At the **Select curve to revolve** prompt, select the profile curve.

3 At the **Start of revolve axis** prompt, snap to the center of the circle at the top of the bottle.
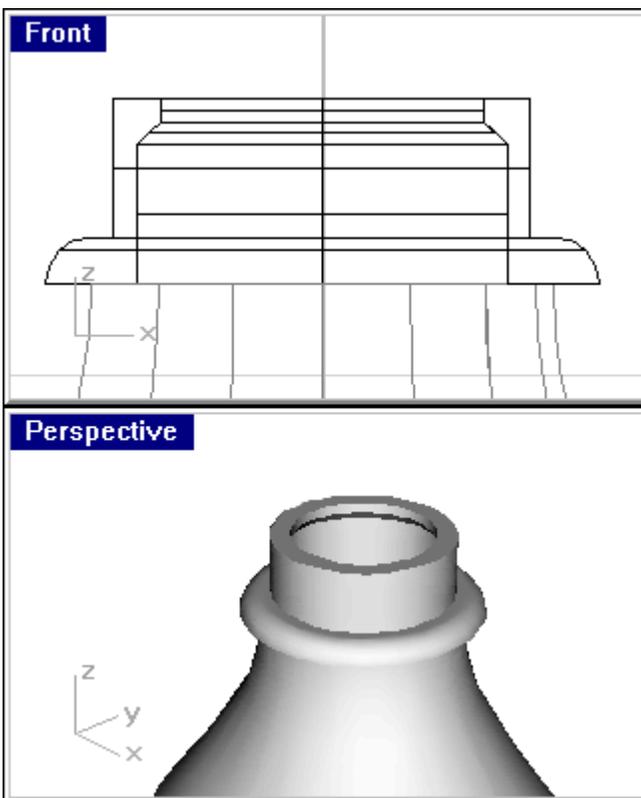
4   At the **End of revolve axis** prompt, pick a point directly above the previous point.

5   In the **Revolution Options** dialog box, click **Delete curve to revolve**, and click **OK**
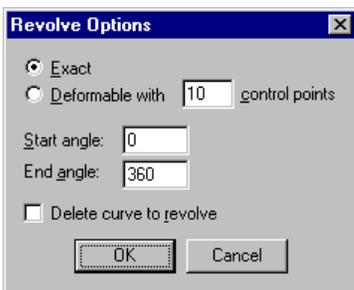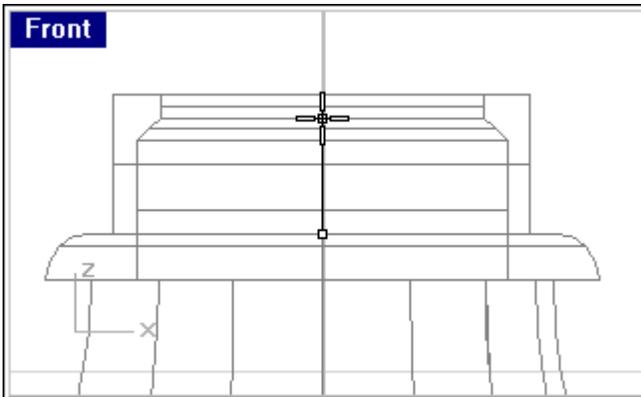


The top is created.

Adding the threads

To add the threads, you will **Sweep** a profile shape along a path drawn with the **Helix** command.

To create the path curve helix:

1   Change to the **Curve** layer.

2   From the **Curve** menu, click **Helix.**

3   At the **Start of axis (Vertical AroundCurve)** prompt, snap to the center point at the bottom of the area to be threaded.

4   At the **End of axis** prompt, snap to the center at the top of the area to be threaded..

5   To set the radius, at the **Radius** prompt, pick a point near the edge that is slightly smaller than the outside edge of the area to be threaded.
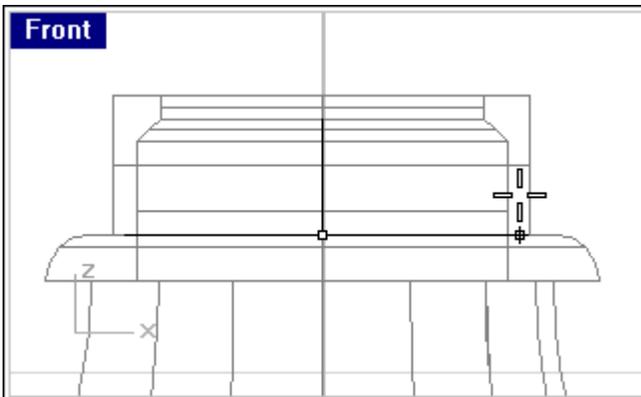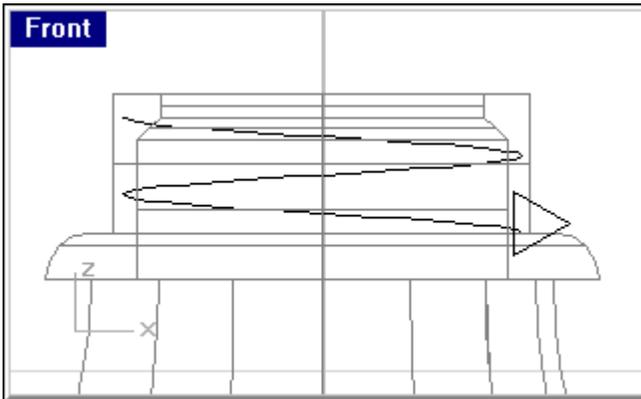

6   In the **Helix / Spiral** dialog, change the turns to **1.5**, check **Reverse twist**, then click **OK**.
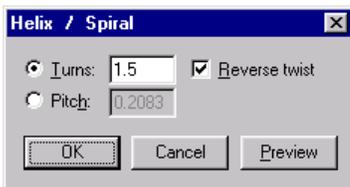
To draw the thread profile:

1   Draw a triangle using the **Polygon** command for the thread as shown below.

2   Select the triangle you created.

3   From the **Transform** menu, click **Array**, then click **Along Curve.**

4   At the **Select path curve** prompt, select the helix near the bottom.

5   In the **Array along curve options** dialog box, in the **Number of items** box, type **5**, under **Style**, click **Roadlike**, and then click **OK.**
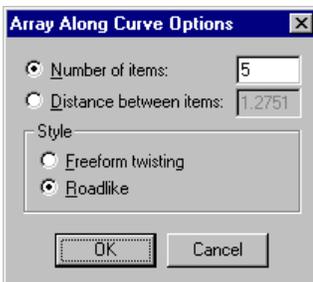

6   At the **Click in a viewport to choose a Cplane**, click in the **Top** viewport.

7   It might be a good idea at this point to change your perspective view so you can see the profile curves easier.

8   Delete the first and last profile curve.
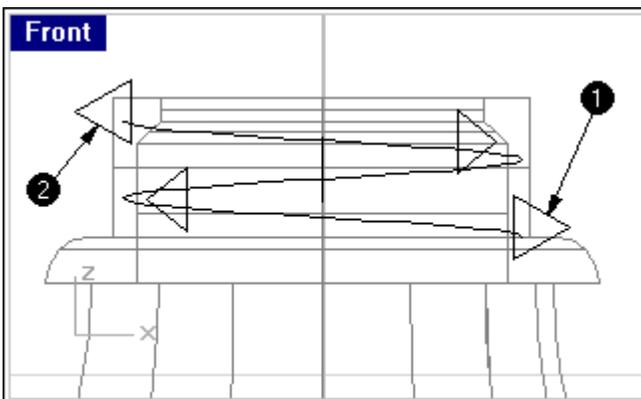
9   The remaining profile curves will be used to create a surface.

To create the thread surface:

1   Change to the **Bottle** layer.

2   You can see the helix and profile curves easier if you **Hide** the bottle top at this point.

Use the sweep along path command to create a surface that starts a point at one end of the helix, goes through each profile and ends at a point at the other end of the helix.

3   From the **Surface** menu, click **Sweep 1 Rail.**

4   At the **Select rail curve** prompt, select the helix.
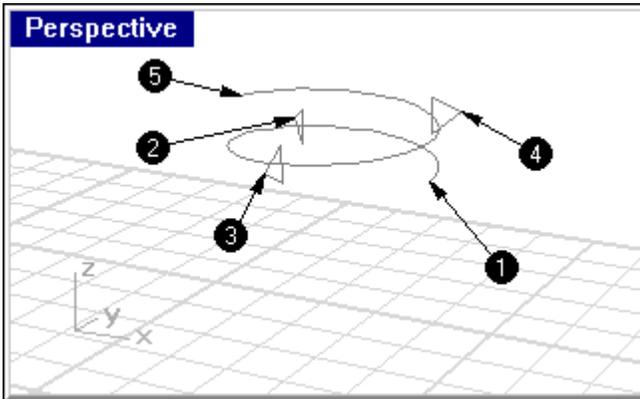
5   To start the surface at a point, at the **Select cross-section curves (Point)** prompt, type **p**, and press ENTER.

6   At the **Start of 1-rail sweep** prompt, use the **End** object snap to pick one end of the helix (1).

7   At the **Select cross-section curves (Point)** prompt, select the first profile curve (2) along the helix.

8   At the **Select cross-section curves (Point)** prompt, select the next profile curve (3) along the helix.

9   At the **Select cross-section curves (Point)** prompt, select the next profile curve (4) along the helix.

10   To end the surface at a point, at the **Select cross-section curves (Point)** prompt, type **p**, and press ENTER.

11   At the **End of 1-rail sweep** prompt, use the **End** object snap to pick the other end of the helix (5).

12   At the **Matching seams and directions...Select seam point to adjust. Press Enter when done (FlipDirection Automatic Natural)**prompt, press ENTER.
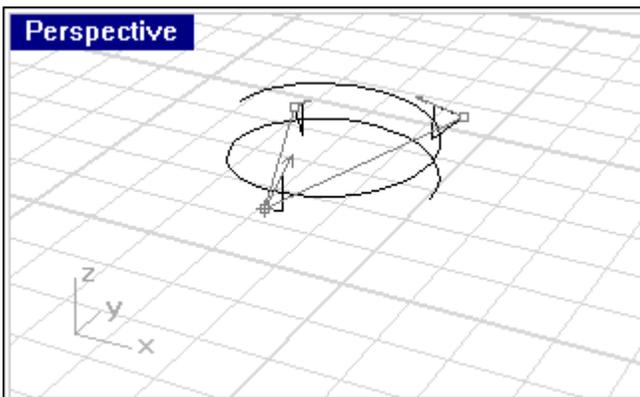
13 In the **Sweep 1Rail Options** dialog, change the **Style** to **Roadlike - Top**, then click **OK**.
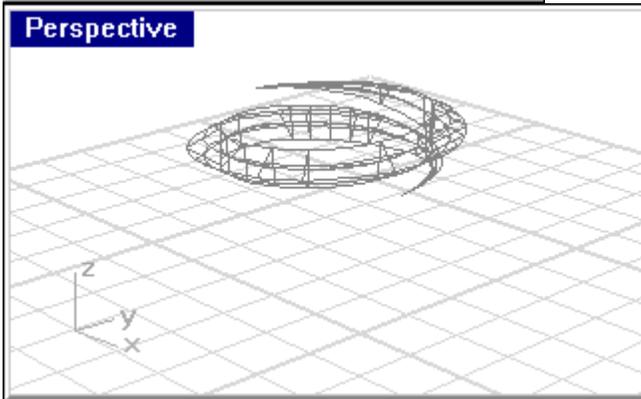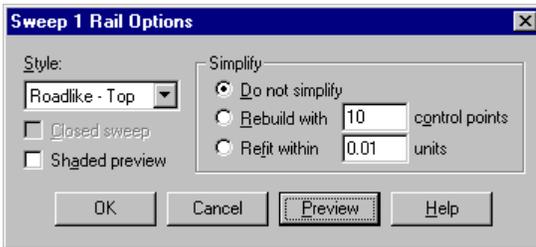
14 **Shade** the model.

15 **Render** the model.