Andersen Designs

CURVING WITH CALCULUS

by David P Andersen

Calculus, the method for defining curved lines as a sequence of increasingly shorter straight lines, was invented hundreds of years before algebra. In those early days, calculus was performed only with drawings and numbers and words, without equations. If scale modelers existed in those times, calculus would have allowed them to carve wingtips, canopies and other parts more accurately. We can too.

Here's the steps …

1. Obtain 3-views of the part

2. Draw horizontal lines on two of the views and measure the length and width of each layer.

3. Scan the third view, import it into DesignCAD and use the Dimension command to display the length and width of the image.

4. For each layer, drag & drop the length and width of the image to the measured length and width. Print the results.

5. Attach the prints to balsa sheets or other material, and cut them out.

6. Glue the layers together over one of the views.

7. Hold the part to its place in the airplane and trace the edge. Trim the stepped edges.

The following examples are from the windscreen and wingtips of a Scale Miles Messenger.

**Example 1:** 1/3rd scale Miles Messenger windscreen plug for vacuum forming.

F7

7.958
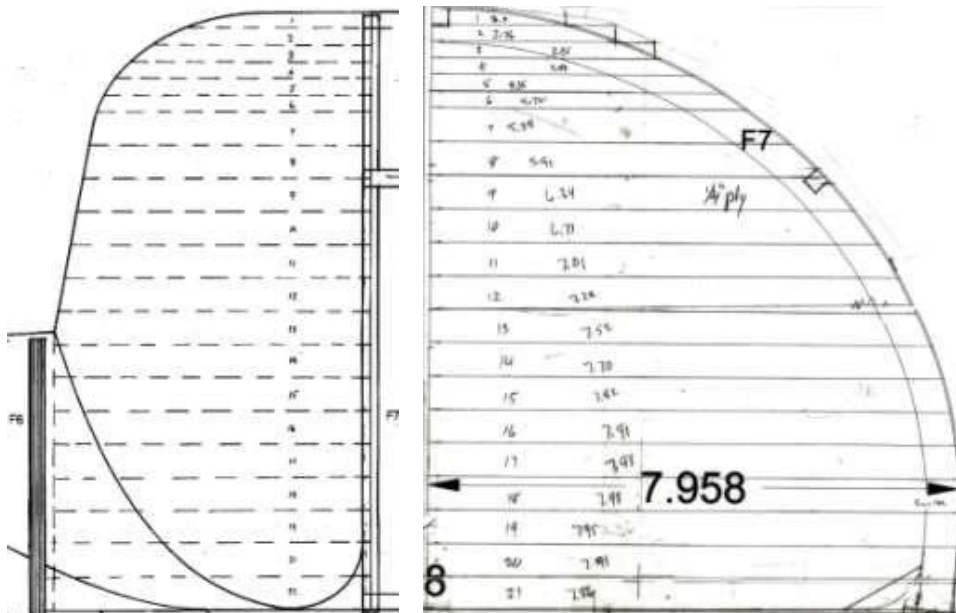
On the side and front views of the windscreen, draw layers 1" and ½" thick, thinner layers where the curve is sharp. Measure and record the length and width of each layer. Because a windscreen is symmetric, you need only measure one side of the top view.

Scan the top view into DesignCAD to digitize its shape. Use the Dimension command to display length and width. Drag & drop the length and width to the measured length and width of each layer and use the Parallel line command to thin the interiors. The example to the right shows layer 7.

7

Middle

5.379

4.245
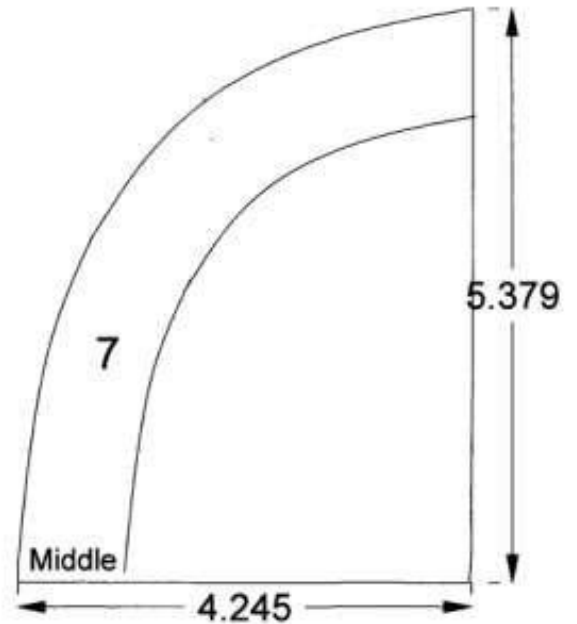
Print the results. Attach the patterns to balsa or other material.
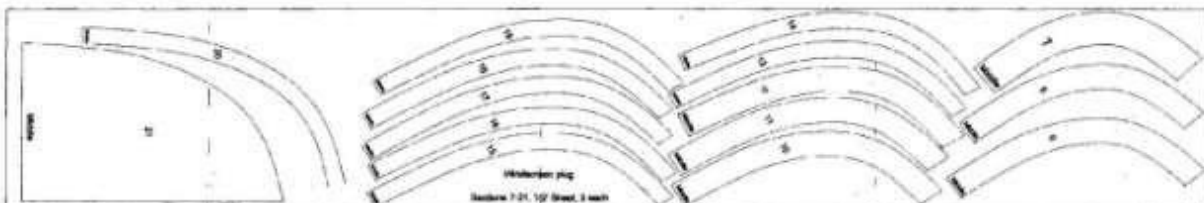
Cut out the results. Glue the left & right halves together.

Stack the sections while gluing them together.

Place the result against the cabin former where the windscreen will be attached and trace the formers outline onto the plug. This will assure an exact fit of the molded plastic windscreen to the former.

Trim away the stepped edges, sand to final shape, add fiberglass cloth and primer and wet-sand to a super-smooth finish with 1500 grit sandpaper, ready for vacuum forming a clear plastic windscreen.

Example 2: Giant-Scale Wingtips.

The wingtip of a 1/3rd scale Miles Messenger is 17 inches by 5 inches, too big to carve from a single piece of balsa. More importantly, the left and right wingtips must be exactly symmetric for desirable stall characteristics. We need precision. So…
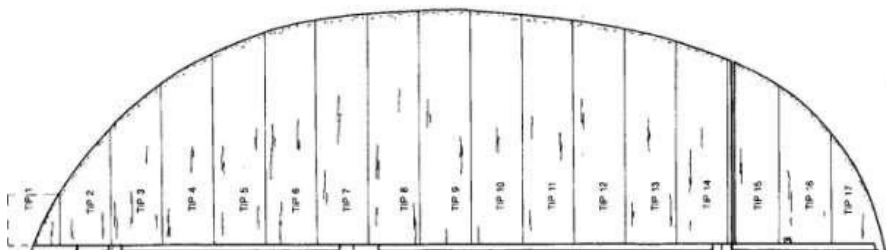
Divide the top view of the wingtip into 1" increments. Measure the wingtip span at each increment. From a drawing of the outermost wing rib, measure the thickness of the wingtip at each increment.

Draw the shape of the wingtip as seen from the front view.

Scan the front-view shape of the wingtip into your computer. Import this image into Design-CAD and use the AutoTrace command to create a CAD file of its shape. Then add dimensions to the drawing using the Dimension command. For each section, drag & drop the length and width to the thickness and chord previously measured. Then use the Parallel Line command to thin the shape by drawing an inside line.

Print the results and attach them to a sheet of balsa, ready to cut with a scroll saw.
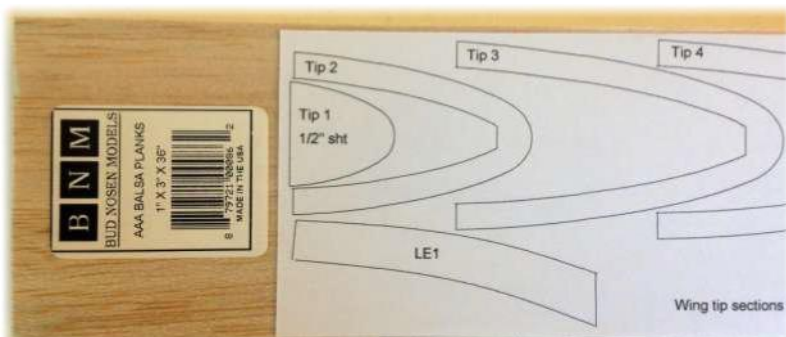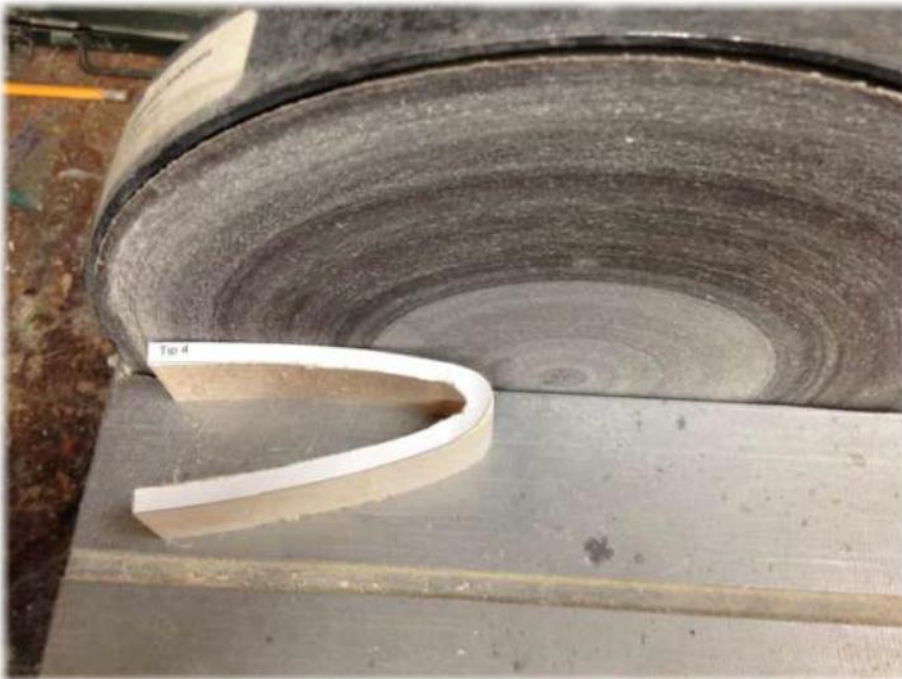
Cut each section slightly outside the line and trim to the line with a disk sander.

Print a copy of the end rib and mark each section on it. Then glue the sections together as they rest upon the end rib pattern.

Perform the calculus "limit to infinity" function by planning and sanding away the stepped edge into a smooth shape. Final sanding is accomplished after attaching the tip to the wing.

Archimedes would be pleased.

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