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Planning isn’t everything, but it certainly plays a huge role in successful segmented turning. Here, you’ll learn the steps to transforming your drawings into the accurate information you’ll need for each piece. Sharpen your pencil, grab a pad of graph paper, and let’s begin the journey.

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Planning is a good thing
In segmented turning, planning takes on a bigger role than in many other turning adventures:
• You must have a plan to create your design—shape, colors, and woods.
• You must have a plan to create the data necessary to build a cut list from which you’ll cut individual ring segments. Proper cut planning will ensure that all your parts fit together with sufficient allowances for reshaping the vessel at the lathe and to accommodate construction errors.

This article will show you two ways to generate the data needed to build any segmented vessel. First are the manual steps, which will help you understand the process. The second method—segmented software—is easy to navigate with rudimentary computer skills.

Steps in planning a vessel
Here are the basic steps necessary for planning the construction of a segmented vessel:
• Create a detailed drawing on graph paper
• Add the vessel inner wall to the drawing, factoring in extra thickness
• Draw in stock thicknesses, thus defining the rings or layers
• Determine wood species for color, contrast, and textures
• Measure maximum outside diameter (OD) and minimum inside diameter (ID) for each ring
• Plan the number of segments for each ring
• Calculate segment/ring cutting data, using one of several methods to be discussed
• Build a cut list
• Prep lumber
• Cut segments

By following these steps, you can build a glorious vessel.

Note: This is the second article in a three-part “Segmented Turning School.” The first article, “Cut Accurate Segments,” appeared in the Winter 2006 issue. That article and supporting features included information on building and calibrating a cutting sled.
Execute a plan on paper

Even if you jump right into segmented software, it’s important that you understand and appreciate the key steps. This section describes the steps necessary in designing and planning a simple segmented vessel such as the “Quick-Start Project” shown opposite and in the Winter 2005 issue.

1. On graph paper, draw a full-scale drawing of your vessel. The full-scale size will make it easier to capture critical measurements.

2. Complete the drawing by adding the interior wall, thus establishing the wall thickness. I suggest an initial wall thickness of ½” to ¾” to allow latitude in aligning the rings during construction, for glue-line overlap, and to accommodate changes in the exterior shape during turning. You can always reduce the thickness later.

3. Next, determine the thickness of each layer of segmented rings; this will be the thickness of the stock you use to build the rings. The rings shown are all ¾” thick. If you vary the ring thicknesses, you will alter the appearance. Add horizontal lines marking out those stock thicknesses.

4. For each ring, mark the maximum outside diameter (OD) required for construction and the minimum internal diameter (ID). Mark both left and right sides. This step is necessary to accommodate the curvature of the wall. The more the shape curves, the farther apart your OD and ID lines will be. Marking both vessel sides will allow you to easily measure the actual diameters in the following steps.

5. Number each ring for easier identification.

6. Determine the measurements for the individual segments for each ring. This requires transferring the measurements with a compass to another piece of graph paper and adding additional lines as shown. This example begins with Ring 2 of the “Quick Start Project” referenced in the Winter 2005 journal and posted on the AAW website (woodturner.org). (Ring 1 is solid stock.) Measure the ID and OD of Ring 2.

7. On a separate sheet of graph paper, draw a circle equal to the OD of Ring 2. From the same centerpoint, draw the ID circle of the same ring. Divide the aligned circles of Ring 2 into the desired number of segments and extend two of those dividing lines beyond...
the circles. In this example ring, use six segments.

8. Draw a line tangent with the OD circle and intersecting two adjacent extended segment lines. Measure the length of this line; this is your segment edge length. Construct another line parallel to this line but totally inside the ID circle. The distance between the two lines is your segment width.

9. Transfer the measured data for each ring to a data table; just keep repeating these steps for each ring. Remember to record:
   - Ring number
   - Wood species for each ring
   - Ring thickness (planed thickness of initial stock for that ring)
   - Segment width (ripped width of stock before cutting segments)
   - Segment edge length (crosscut outside width of ring segment)
   - Estimated stock length required

For planning, use ring circumference plus \( \frac{1}{8} \)" for each crosscut. (For a 12-segment ring, 24 saw cuts or 3" of additional stock.)

Whether you use pencil and paper, tables and charts, or software, this is how segment widths and lengths are determined. Worried about spending too much figurin’ time at the kitchen table and not enough time in the shop? Here are faster ways to proceed.

**Estimation method**

Sometimes only a close estimation will suffice because extra segment width has been added that will be turned away later on the lathe. For example, this method also works if only one ring is desired to trim a bowl rim.

To estimate the segment edge length, you will still require a drawing, as in Figure 6. Here are simpler steps:

1. Calculate the circumference of a ring by multiplying the OD times pi (pi or \( \pi = 3.14 \)).
2. Determine the number of segments required. (Circumference ÷ number of segments = estimated segment edge length.)

As long as you use a larger number of segments in a ring, the error in this method is not large. (The error decreases as the number of segments increases.) With six segments in a ring, the error is approximately 10 percent; with 12 segments, approximately 2 percent.

Using this method with every ring in a vessel will give you the desired shape only somewhat smaller in diameter. However, the proportions may be off.

**Accurate calculation**

Accurate calculation is not difficult and only requires knowing the tangent or the cut angle. Use the table below.

The formula is:

\[
\text{Segment edge length} = \frac{\text{Diameter of the ring} \times \text{tangent of cut angle}}{\text{Number of segments}}
\]

Diameter of the ring x tangent of cut angle = segment edge length.

Here is an example:

Vessel of 12 segments per ring; therefore, the cut angle is 15°. The ring is 10 inches in diameter TAN 15°=0.268. 10 x 0.268 = 2.68 inches segment edge length.

To eliminate all calculations, you can download a table from the AAW website (woodturner.org) that includes segment edge lengths for rings from 1 to 20 inches and for vessels with 6 to 24 sides.

**SEGMENTED TURNING GOOF**

Do you plan carefully, cut segments accurately, align rings properly, glue solidly, and still get gaps, voids, misalignments, and other errors? Well, you’re not alone. In the Summer 2006 issue, find out the common causes of why joints don’t look as good as you think they should. If you have problems you’d like addressed, send Jim an e-mail (Jim@JLRodgers.com). We’ll publish answers in the next issue. Join us.
**Segmented software**

If you follow the path of many segmented woodturners, you’ll progress from manual calculation to software. Today, I own or have access to all the programs shown at left. To stay ahead of my student inquiries, I have tested and used most of the different programs currently on the market in different situations. I have analyzed the calculations of each program and can assure that each is accurate.

Inexpensive software provides the basic calculations from which you will build your own table and cut list. More advanced software provides a formatted cut list, material descriptions, ring, and segment templates. Some programs even include three-dimensional drawings. Some suppliers allow you to download trial copies and purchase later.

Here is a list of what is currently available. Specifications and capabilities change with new releases; check with the providers for the latest information and specifications. For an easy comparison, the screen shots shown are for the same “Quick-Start Project.”

Regardless of whether you draw your vessel out or use software to execute the calculation, you should start with a full-scale drawing.

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<th>Software Name</th>
<th>Contact Information</th>
<th>Price</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>PWJ’s miter-angle calculator</td>
<td><a href="mailto:pjduckins@satx.rr.com">pjduckins@satx.rr.com</a></td>
<td>Free</td>
<td>Provides data for one ring.</td>
</tr>
<tr>
<td>Table Saw Miter Angles</td>
<td>turnedwood.com</td>
<td>$19.95</td>
<td>Allows data entry in fraction or decimal format, gives data for one ring only, and provides length and width of needed stock.</td>
</tr>
<tr>
<td>Seg-Calc 1.2</td>
<td>William <a href="mailto:Biddle@attbi.com">Biddle@attbi.com</a></td>
<td>$20.00</td>
<td>Data for full vessel of one stock thickness on one screen.</td>
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<tr>
<td>Seg-Calc</td>
<td></td>
<td></td>
<td>Provides data for one ring only, and provides length and width of needed stock.</td>
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<tr>
<td>Segmented Project Planner</td>
<td>Verifiedsoftware.com/goodturns</td>
<td>$36.95</td>
<td>Complete project data, bowl sketching, and cost analysis.</td>
</tr>
<tr>
<td>Woodturner Pro</td>
<td>Woodturnerpro.com</td>
<td>$40.00</td>
<td>Arrow keys give you a quick way to modify a drawing.</td>
</tr>
<tr>
<td>Woodturners Studio</td>
<td>Woodturnerscatalog.com</td>
<td>$69.99</td>
<td>Can execute drawings with Besier curves manipulation. Allows open segment design.</td>
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