Bill Wells

I am relatively new to woodturning but have worked with wood most of my life. That’s why I started turning segmented pieces right away—I had a shop full of lumber and no turning blanks. But rather than using a typical segmented design comprising small segments glued into rings, I started making staved designs, which are similar but with fewer pieces. I began with vertical beveled-edge staves, which are useful but limit your blank to having only vertical sides. Soon I moved on to bowl-shaped designs, which require tapered staves that form a conical blank (Figure 1).

In this article, I’ll describe how to design and build a tapered-stave bowl. The example project is based upon the bowl shown in the opening photo, but I have included everything you need to make a project of your own design.

Benefits
• Economical—very little wasted material
• Staves cut smoothly along the grain
• Requires only a dozen or so pieces, compared to hundreds
• Finished piece displays only facegrain

Design and plan
All segmented designs begin with a drawing, and stave designs are no exception. I use a software program, but all you need is ¼” (6mm) graph paper, a ruler, and a protractor. Make your drawings full size so you can use them later to easily determine stave dimensions.

See Figure 2 for terminology used in this article and Figure 3, the design drawing for the example project, showing all dimensions and angles. First, choose the number of staves for your bowl. I used twelve staves, which is enough to produce a decent turning blank; using fewer will reduce the wall thickness you will have when turning. Start your drawing with a V-shaped cone angle like the left image in Figure 2; I used 60°. If you want a flatter design, use a larger angle; a narrower design, a smaller angle. Next, draw the top line, which will establish the top diameter, and the bottom line for the base diameter.

Now you need to find dimensions and angles for the staves, as follows:

Stave width
If you have drawn a full-sized top view, you can measure the stave width directly from your drawing; otherwise, it can be estimated by dividing the circumference of the top (3.14 × diameter) by the number of staves. Since the top diameter of our example project is 8¾” (22cm), the circumference is 27½” (70cm). With twelve staves, the width would be 2.3” (5.8cm), which is very close to the measurement I took from my drawing, 2¼” (5.7cm).

Stave length
Stave length can be measured directly from your full-sized drawing; add ½” (13mm) for trimming. Figure 3 indicates a 5” (13cm) stave length, so I used 5½” (14cm). Neither stave length nor width needs to be exact, as long as all staves are cut to the same dimensions.

Miter and bevel angles
Calculation of miter and bevel angles for a tapered-stave design requires some number crunching, which I have done and presented in Figure 4, a table of pre-calculated miter and bevel angles for various cone angles and numbers of staves.

Grain orientation
For this project, the wood grain runs around the bowl, and, depending on the species, this can create a dramatic effect. I used bubinga for the example project, but any kiln-dried, defect-free hardwood can make beautiful bowls. To achieve this grain orientation, each stave will have the grain running across its width, not along its length. So you will be crosscutting your board to achieve the stave width and ripping to achieve the stave length. This is opposite from most woodworking applications, where you crosscut a board to length and rip it to width.

Your board should be at least ¾” (19mm) thick; the thickness determines how much material you will have to work with when turning. I used a 36”- (91cm-) long board, 5½” wide, which was plenty for the twelve staves plus two extras.

Two stave designs
Figure 1. Basic-stave design, left, is straight-sided; tapered-stave design, right, is cone-shaped.
**Table saw sled**

Much has been written about the need for absolute precision when cutting segments, and staves are a kind of segment. The most critical thing is to make every stave identical—same miter, bevel, width, and length for each. But you don’t have to use a micrometer to measure stave width and length; rounding up to the nearest fraction is OK, as long as you use the same dimension for each stave. You do need to set angles for miter and bevel precisely, and below I discuss ways to do this. But don’t worry; there is a fix if your angles are off slightly.

To cut the tapered segments, I made a simple sled from ¾" plywood, with a hardwood runner underneath that slides in the table saw’s miter slot (Photo 1). The key is to start by making the sled oversized, so that the left edge extends past the blade by an inch (25mm) or so. When you have completed the rest of the sled, raise the blade and push the sled through to trim off the overhang. This will make the left edge of the sled exactly parallel with the saw blade; now the left edge can serve as a reference for laying out angles.

Use a 4"- (10cm-) wide piece of plywood for the fence; be sure the top edge is smooth and straight. I used a digital protractor to set the angle of the fence to the miter angle, in this case, 7.6°. Since the digital protractor is aligned with the left edge of the sled, its angle is set to the complement of the miter angle: 90° - 7.6° = 82.4°.

The saw is set up for cutting staves. An adjustable stop block, at left, ensures each stave is cut at identical width. The saw blade is tilted to the required bevel angle, in this case, 13°.
fence till you get the angle you want, and then drive the other screws.

I also made an adjustable stop to ensure cutting accurate stave width. Your stop does not need to be adjustable, but it is essential to have some kind of rigid stop for consistency.

To set the blade bevel (some call this blade tilt) to 130° I use a magnetic digital angle gauge. Photo 2 shows the saw set up for cutting staves. The blade is tilted at the bevel angle, the fence is set at the miter angle, and the point of the board is against the stop to set the width. The stave length is predetermined by the width of the board, which has been ripped to 5½”.

To start, trim away the square end of your board to establish a mitered and beveled end, then turn the board over and cut your first stave. After each stave is cut, the board is turned over and the next stave cut. Each time you turn the board and cut, the stave will have the correct miter and bevel.

**Bevel the stave ends**

After all staves have been cut, the ends have to be beveled so that, when assembled, the staves will sit flat yet the staves will splay outward and the top rim will be horizontal, as shown in Photo 3. You can use the same sled as in the previous step, but re-set the saw blade’s bevel to one-half the cone angle. For the example project, I set the bevel to 60° ÷ 2, or 30°.

Now set the stave, wider side up, against the fence. Trim away until the top edge is beveled, as in Photo 4, and make a mark on the sled at the small end of the stave to indicate where to place the remaining staves when you cut them. Now do the same to the bottom edge of the stave, but trim with the narrower side up.

**Get ready to glue**

It is awkward to glue and then clamp together a dozen angled pieces. It helps greatly to have a set of custom-made cauls to keep the staves in a conical shape. I made twelve cauls, one for each stave (Photo 5). It helps to do a dry fit-up prior to gluing. Lay all your staves out in a fan pattern, wider side up and tape the staves together with blue painter’s tape (Photo 6). Then move the taped-up staves into a cone shape, set it on a work surface, and add the cauls and rubber bands (Photo 7). Notches in the cauls provide a place for rubber bands to grip, and the compressive force of the bands is directed inward.

Make these, or something similar, before gluing. You will be glad you did.

Next, separate the staves into two equal groups. You are going to glue up these two groups separately but at the same time. Keep each group securely taped and put a narrow strip of double-sided tape on the two edges that won’t be glued. This way, you will end up with two separate halves of your bowl blank.

Apply plenty of wood glue in the valleys between the staves (Photo 8). Now gather everything together and set the cone big end down on your
work surface, with the cauls in place, and stretch rubber bands to keep the assembly together. Now is the time to make sure the glue joints are aligned. Add several more and tighter, heavy rubber bands. Photo 9 shows the staves glued and clamped. Let dry overnight.

**Unbundle and check fit**
You now have two similar halves. Butt them together and, alas, the edges will not fit perfectly flat. This is normal; after all, you made several compound-miter cuts, so any slight variation in accuracy would be magnified across all the staves. To get the mating edges to fit flat together, sand both halves face down on a smooth sanding board (Photo 10). I use 120-grit abrasive glued to MDF.

Now glue the two halves together, using the same procedure as in the previous step.

**Make and glue the base**
For the example project, I made the base from a piece of ¾"-thick walnut, 5" square. I cut the base round on my bandsaw, then sanded it smooth and flat. I used a disc sander to sand the mating face of the stave assembly (Photo 11). Make sure the two pieces mate without gaps, then glue and clamp the two pieces together. I use a shopmade press for clamping (Photo 12), but other clamping methods, or even using weights, will work.

As you see in Photo 12, I also glued a waste block to the base for mounting on a faceplate. Let the glue dry overnight before proceeding to the next step.

**Finally, ready to turn!**
Mount the blank onto your lathe and rotate it by hand. It will be somewhat out of round, as would be a solid-wood blank. I use a ½" bowl gouge to rough-turn the outside, starting at a slow speed, and use the same tool for the interior. Except for the base, you will be cutting entirely along the grain, which will likely be smooth going.

After truing the bowl round, I had a little over ½" of uniform wall thickness to work with. Changing to a ⅜" (10mm) bowl gouge, I turned the piece to its final shape, with slight contours at the base and top (Photo 13). If you start with thicker material, you will have more flexibility with regard to your bowl’s final shape.

**Sanding and finishing**
I typically start sanding with 120-grit abrasive and progress to 800 grit. A staved piece sands nicely because you are sanding along the grain on each segment. To finish this project, I applied three coats of shellac, rubbing with 0000 steel wool between coats.

After parting the bowl off, I wrapped foam tape around the remaining base and waste block and held the bowl in place with the live center in the tailstock for completing the base (Photos 14, 15).

Bill Wells is a retired engineer living in Olympia, Washington. He has worked with wood in one way or another most of his life and is now a member of Woodturners of Olympia, an AAW chapter. Bill welcomes comments at bill98502@msn.com.