CONCEPTS FOR A *WOODTURNER'S* GUITAR

Bernie Hrytzak

Turned Guitar, 2015,
Cedar, maple, rosewood,
ebony, purchased guitar
hardware, 40" × 14" × 5"
(102cm × 36cm × 13cm)

My interest in turning a round musical instrument began with the *Turned for Use II* exhibition, which opened during the AAW Symposium in Richmond in 2008. After making a mandolin for that exhibit, I decided to create a round-bodied guitar.

My process involved turning two shallow bowl shapes with relatively straight sides and gluing them together to form the guitar's hollow body. Then I turned a neck and glued extra wood at its end so I could form a peghead. The trick to turning a guitar neck is in the gluing up of the blank, as you are making a split turning, with two neck pieces separated by a spacer. I contoured the end of the turned neck to fit on top of the guitar body, then glued the fingerboard and peghead veneer to the neck.

I used a store-bought fingerboard blank and guitar hardware, such as frets, tuning machines, nut, strings, adjustable bridge/saddle, and tailpiece. A good source for these items is Stewart-MacDonald (stewmac.com), where you can also find helpful design criteria such as scale lengths and fret-spacing calculations. Guitar making is a complex pursuit, and my intent here is not to provide complete, detailed plans, but rather to convey the general idea.

Planning

My first step was to establish the size of the guitar by cutting out mock-ups of cardboard and holding them in my lap to determine fit. Then I built a rough full-scale prototype assembled only with hot-melt glue. This provided a good visual aid in planning the angle of neck to body.

Once I had a plan in mind, I made a cross-sectional sketch to scale, showing the profile of the soundboard (top) and backboard (bottom), along with the correct placement and angle of the neck (*Figure 1*). Working from this sketch, I made outside profile gauges from stiff cardboard that would later help me achieve the shape I wanted at the lathe.

The design

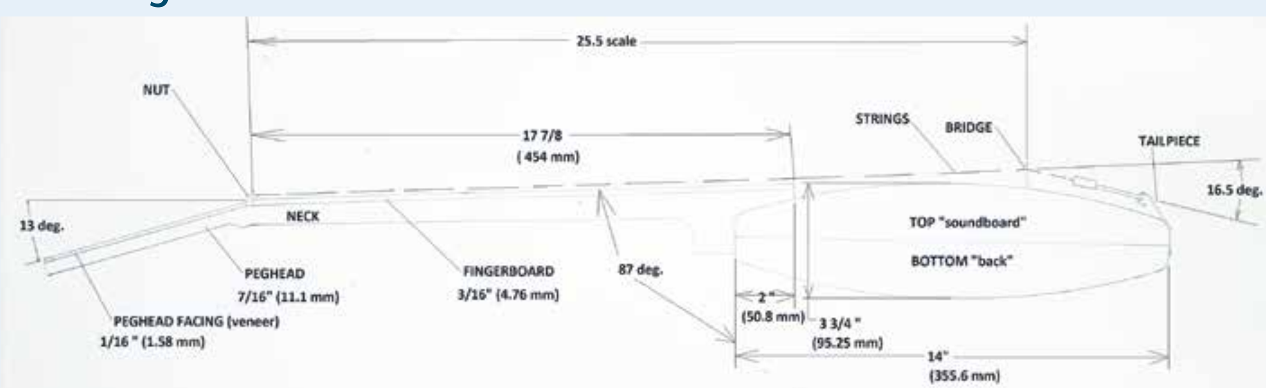


Figure 1. A cross sectional sketch is invaluable in visualizing the concept.

Soundboard, or top

The preferred wood for soundboards is Sitka spruce, for its favorable tonal quality, but cedar is an acceptable second choice, and that is what I used. I selected the wood by carefully checking the growth rings to make sure there were at least ten rings per inch and that there were no irregular rings. I planned on a final diameter of about 14" (36cm) and therefore jointed the edges on two pieces roughly 15" (38cm) inches long and 7½" (19cm) wide and glued them so the growth rings formed an "A," as shown in *Photo 1*. This is an important consideration for strength, as the soundboard has to resist the force of the string tension. I marked the glued-up top blank and cut it round on the bandsaw, then drilled a hole at the center on the inside surface for mounting it on a screw chuck for turning. I turned the top contour, using a profile gauge as a guide (*Photo 2*).

The thickness of the soundboard varies across its diameter to help it vibrate (and resonate sound) when the strings are plucked or strummed. This variation is achieved by turning the inside to different thicknesses, as indicated in *Figure 2*. In order to achieve these thicknesses precisely, I used a drill press to drill depth holes at 1" (25mm) increments from the center. The drill press table was useful for holding the soundboard so that the holes were drilled perpendicular to the tangent. Note that the thicknesses indicated in *Figure 2* are the minimum values required to avoid compromising strength.

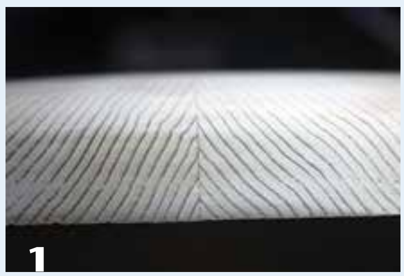
With the soundboard reverse-mounted on a vacuum chuck, I hollowed the soundboard to a depth of about ½" (13mm) to make room for working on the interlocking joint. Since I left more wood at the center, vibration was reduced while I worked on the joint, which is at the outside edge. In order to secure the soundboard to the backboard, the joint details must be accurate in depth and diameter to provide proper engagement and sufficient glue-joint strength. The shape of this joint can be seen in *Figure 2*.

I then proceeded to turn the top thickness to the required profile by using the depth holes as a guide. I left the holes barely visible and removed them in the final sanding process (*Photo 3*).

Backboard, or bottom

I prefer a hardwood such as maple for its strength for the backboard, which I shaped on the lathe in a similar manner ▸

Glue and turn the body



The alignment of the growth rings is critical for the strength of the soundboard.

I used profile gauges made of cardboard to get the soundboard and backboard profiles correct during turning.

Varying wall thickness

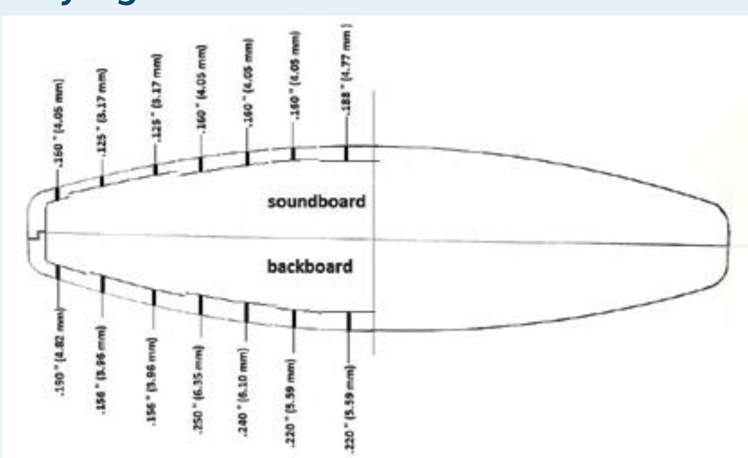


Figure 2. Intentional variations in the thickness of the soundboard and backboard improve the wood's ability to resonate sound.

Predrilled depth holes aid in achieving thickness variations.

Backboard

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Reinforcing blocks are glued in position in the backboard to provide strength to the neck and tailpiece areas.

Soundboard

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Cardboard f-hole templates provide a quick and accurate way of positioning the holes on the soundboard.

6

Inside the soundboard, with f-shaped sound holes, reinforcing blocks, and tuning bars that also act as bracing.

as the soundboard. While forming the interlocking joint that would mate with the soundboard, I tested the fit numerous times to ensure a good fit with no gaps. Once the correct profile was established and before removing the backboard from the lathe, I mated the soundboard with light tailstock support (using foam to prevent marking) and sanded the outside profile at the junction to ensure a flush joint.

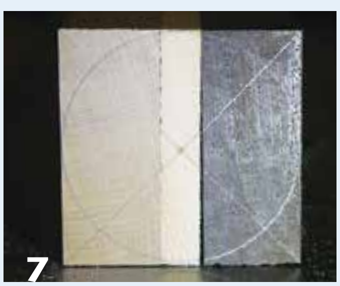
To achieve a strong assembly with the neck and tailpiece mounting points, I added reinforcing blocks inside the soundboard and backboard. These were made of maple and were contoured to fit the inside shapes of the corresponding parts. They were sized in thickness so that when the soundboard and backboard were glued together, the blocks would have a surface that would be glued as well, adding to the strength (*Photo 4*).

Sound holes and tuning

I decided to use f-shaped sound holes, and the design required them to be sufficiently away from the bridge so strength would not be compromised. The size of the holes must be sufficient to allow the sound to get out but not so large that the acoustic effect of the chamber is lost.

Once I determined the size of the sound holes, I created cardboard patterns and traced them on top of the soundboard. Then I drilled small holes to transfer the location to the inside of the soundboard. I reinforced the immediate area of the sound holes on the inside with wood glue and bandage gauze. Holes were then

Turn the neck



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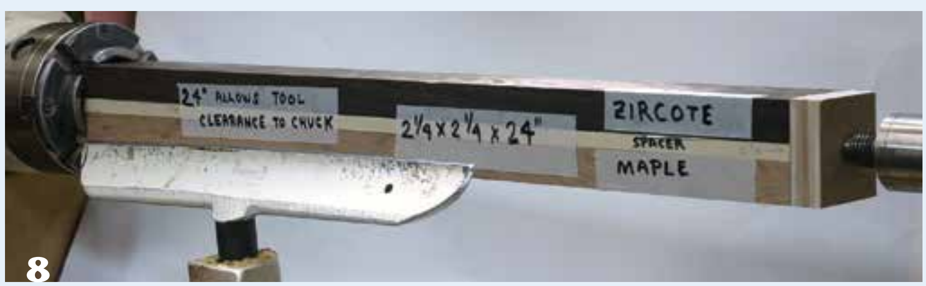

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The neck blank is a split turning that comprises stock for two necks plus a spacer between them, resulting in necks shallower than a half circle. A plywood waste block at the tailstock end prevents the live center from splitting the assemblage, glued only near the ends.

drilled to the inside at the extreme ends of the f-holes using a Forstner bit. Using the position of these holes, I used the templates to transfer the entire pattern to the inside. The remaining parts of the f-holes were opened up using a scroll saw with a very fine blade (*Photos 5, 6*).

An acoustic instrument sounds better if the soundboard is "tuned." To do this, I borrowed a concept used in the making of mandolins and glued wooden tuning bars inside the soundboard. These bars, which also help to strengthen the top, were profiled to fit the inside contour and glued in a splayed shape, being narrower at the tailpiece, as shown in *Photo 6*.

The method for tuning is to tap the soundboard gently with a wooden hammer, listen to the note produced, and remove tuning-bar material until the correct note is attained. I had to remove quite a bit of material at first but eventually had to fine tune carefully, as small changes make big differences in notes when you get close to the target. Both sides of the soundboard were tuned, the left side (as viewed from the peghead) to B-flat (treble) and the right side, to A-flat (bass). Tuning the soundboard in this way creates more pronounced sound characteristics.

Body assembly

I sanded the inside edges of the f-holes after the tuning was complete, then dry-fitted the soundboard and backboard to confirm a good glue joint. The insides of the soundboard and backboard were then sealed with shellac, followed by several coats of wipe-on polyurethane. I then sealed the outside edges near the glue joint with shellac so any glue squeeze-out would not interfere with the subsequent finish. I applied glue to the mating surfaces, aligned them, and applied light pressure using clamps with foam padding to protect the wood surfaces.

Add peghead material

10

Gluing material to the sides and bottom of the peghead achieves the required length and width.

Turning the neck

The next step was to construct and turn the neck. For this guitar, I decided on a scale of 25½" (64.8cm). This scale represents the distance from saddle to nut and predetermines the fret spacing and length of the fingerboard—in this case, 17⅞" (45cm). Adding length for the peghead and an extra 1¾" (4cm) for clearance near the chuck, I started with a neck blank that was 24" (61cm) long.

The width of the blank had to be large enough so I could turn the neck down to 1⅝" (41mm) at the nut end and 2⅛" (54mm) at the soundboard end. This meant starting with a blank 2¼" (6cm) square.

To prepare the neck blank, I glued two pieces of hardwood with a ⅜" (10mm) softwood spacer between them so that, when turned, the neck's profile is not quite half a circle (*Photo 7*). This process yields two guitar necks. Using a ⅜" spacer meant each of the two neck pieces would have to be 15⁄16" (24mm) thick. These pieces were glued at the ends only, with a plywood square added at the tailstock end to prevent the live center point from splitting the blanks apart (*Photo 8*). The waste areas could be cut off after turning to separate the parts.

I turned the necks to the required taper, noting the necessary widths at each end (*Photo 9*). I sanded the round portion while the workpiece was still on the lathe, and the flat surface off the lathe, after separating the assemblage.

Shaping the peghead

My plan called for the peghead to be angled 13 degrees from the neck, as shown in *Figure 1*. To ensure there would be sufficient material to achieve this shape, I had to glue extra wood, staggered, to the underside of the end of the turned neck. *Photo 10* shows this glue-up, along with side pieces positioned at the 13-degree back angle. These side strips acted as a cutting guide, as shown in *Photos 11 and 12*, but were also needed to make the peghead wide enough.

After verifying the peghead thickness required to accommodate the tuning machines I had bought and allowing for 1⁄16" (2mm) rosewood facing, I cut the peghead on the bandsaw to a thickness of 7⁄16" (11mm). I wanted a peghead with flowing lines, so I laid out the tuning-machine footprint on paper and designed a shape that would work within the constraints of tuning-knob accessibility (*Photo 13*). After cutting the peghead to shape and sanding the edges, I applied thin strips of ebony to the peghead's sides, using clamp blocks that matched the curves to ensure proper gluing pressure. When the glue had set, I sanded the edges flush with the top and bottom of the peghead.

I cut rosewood veneer to match the top shape of the peghead, allowing excess for sanding flush. I also cut an access hole so I'd be able to tension the truss rod (*see sidebar*). I created a decorative cover to hide the adjustment nut and then glued and clamped the peghead veneer in the correct position and, later, sanded the edges even with the peghead. ▸

Holes for the tuning machines were located by transferring the layout from the peghead template I had made earlier. I first drilled small holes all the way through; then I used the final-sized Forstner bit to start the hole from one side and then run all the way through from the other side to minimize tearout (*Photo 14*).

Fingerboard

I bought a rosewood fingerboard blank and ran it through the thickness planer to ensure parallelism and smooth surfaces. I also purchased acoustic-guitar fret stock and determined the fret spacing using a calculator made for that purpose (such as the one found at stewmac.com). Cutting the fret slots with a fret saw blade will ensure proper insertion and retention. Note that you can also purchase fingerboards pre-slotted according to your chosen scale.

If you are cutting your own fret slots, measure each fret location from the nut rather than from each other, to

Cut peghead

The side strips, glued at 13° from the neck line, act as a cutting guide.

Peghead layout and veneer

A template for locating holes for the tuning machines helps in determining the final shape of the peghead, whose rosewood veneer matches the fingerboard.

Optional Truss Rod

I decided to use a truss rod in the neck, an option sometimes not used in guitars with nylon strings. The tension of steel strings is more apt to bend a neck, and a truss rod can help straighten it. The truss rod is a slightly curved threaded rod embedded in a groove in the neck. If the neck warps or bends, applying tension to the rod will straighten the neck. You can purchase a truss rod and form the neck groove to accommodate it. I made my own out of ¼" (6mm) mild steel, put a bend in it, and threaded the end.

I cut a groove along the neck on the table saw with a dado blade. The truss rod hooks into a hole at the guitar-body end of the neck (*Photo a*) and lies in the groove. The threaded portion protrudes into the peghead, where clearance has to be provided for a nut and socket to tighten the rod if needed. A wood filler strip matching the curvature of the rod glued into the groove of the neck provides a solid backing for the rod to push against when tightened (*Photo b*).

A neck-embedded truss rod, here ready to be set in its groove, allows for straightening of a bent neck. The rod lies in a dado in the neck under the fingerboard. Plastic wrap prevents the rod from becoming glued in place.

A wood filler strip, here ready to be glued in, covers the truss rod and provides backing support during tensioning. A threaded portion of rod protrudes into the peghead for adjustment. A socket wrench confirms access to the rod's tensioning nut.

avoid a compounding of errors. Once all fret locations are marked and depth requirements established, I cut the slots on the table saw using a sled. Then I trimmed the fingerboard to fit the taper of the neck, allowing for a trim piece in a contrasting wood at the outer edges.

Abalone dots are often used to denote positions on a fingerboard. I placed one dot on the fifth, seventh, tenth, and fifteenth intervals and two dots on the twelfth interval. I used a Forstner bit to drill holes to a depth that would ensure the dots would be flush to the surface when installed.

Using a fret-cutting tool, I cut the frets to the width of the fingerboard plus the width of the trim pieces. Since the decorative strips were not slotted like the fingerboard, I had to notch the ends of the frets before installing them. I used a drill press jig to push each fret home. A light tapping with wood and a hammer was necessary for a few stubborn frets. After the frets were in position, I sanded their ends smooth for comfortable playing. It is critical that all the frets be at the same height to compose tones properly, so I used a height gauge to find high points and filed them down where necessary. I then glued the decorative strips to the exposed edges of the fingerboard.

With the truss rod installed, I glued the fingerboard assembly to the neck, ensuring proper position, using padded clamps. Light sanding of joints was required to ensure smooth playing.

Join neck to body

A shaped support block provides a strong neck-to-body union. To improve joint strength, the grain of the block is oriented at an angle and dowels extend to the guitar body's internal reinforcing blocks.

I glued the nut in place at the same time to ensure it was properly positioned.

Neck-to-body assembly

To anchor the neck to the body of the guitar at the correct angle, I formed a support block whose top surface was angled 3 degrees relative to the guitar's horizontal plane (*Photo 15*). I shaped the block for a close fit to the neck and body and glued it to the neck. The outside profile was contoured after it was mated with the neck. The next step was to glue the assembly to the body; I used dowels to add strength to the union.

Finishing

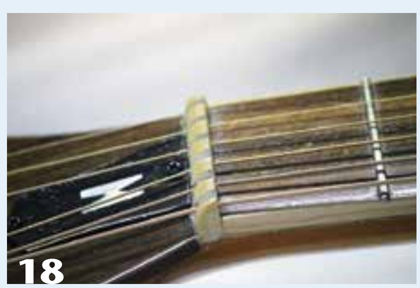
Once the assembly was completed, I drilled the mounting holes for the tailpiece and fitted the hardware. I adjusted the tailpiece height to achieve a 16.5-degree angle of the strings from the saddle to the tailpiece (called break angle). Too much break angle will add stress to the bridge and soundboard. Since the turned soundboard has a convex shape, I contoured the mating pads of the bridge for proper seating. Upon confirming a good fit, I removed the tailpiece and bridge and applied a finish to the guitar—several coats of tung oil on the fingerboard and a seal coat plus about thirty coats of lacquer on the body. After the lacquer cured for several months, I buffed the finish to its final sheen.

I then installed the hardware (*Photos 16–18*). I used a floating bridge/saddle, whose placement was determined by the scale I chose. For my guitar, the 25½" scale meant the saddle had to be 25½" from the nut. Accuracy with saddle placement and fret spacing is critical to playability and proper intonation.

There are many important factors in guitar construction; this article is not meant to cover them all in depth, but rather to offer the possibility of a legitimate guitar with lathe-turned parts. The sound characteristics of my guitar are different from typical acoustic guitars—the bass portion is less pronounced—but it does create a pleasant sound and is easy to play. ■

A retired automotive engineer, Bernie Hrytzak, from Chatham, Ontario, has been actively turning since 2005, when he joined the Thames Valley Woodturning Guild in London, Ontario, and the AAW. His turned work has been displayed in juried shows, art galleries, and museums.

Guitar hardware



Guitar hardware is added after finishing. From left: tailpiece, floating bridge/saddle, peghead with tuning machines, and bone nut, which was marked for string location, cut, and filed.