

Acoustic Guitar – Bracing and Voicing – October 16, 2021

Source: Courses by Robbie Obrien (Kent Everett)

Guitar: Taylor Grand Auditorium (adjustable to most acoustics)

Assumption: you have built guitars and know the process

Guitar Back:

- Thickness:
 - Note – final thickness is not firm, depends on the wood
 - Drumsand - start at 3.0mm, thin gradually, checking sound (
 - Final - .095" / 2.35-2.50 mm (Indian Rosewood)
 - Looking for the best “gong” sound and flex...at the thickest point. Do not make too thin.
 - Note – thickness
 - Sanding - drum sand – 80/120 grit, orbital sand to 220 grit
- Bracing:
 - Quarter sawn, spruce or mahogany
 - Use 15 ft radius dish
 - 4 cross braces - 7mm x 18mm high. Quarter saw braces, cut to length based on blueprint/width of guitar. Use drumsander to get same thickness. Number each brace (1,2,3,4). Bottom - scribe on dish, trim with band saw. Sand the bottom using the radius dish...in the order of each brace (1,2,3,4). Space them out according to blueprint location. Top – draw line, from middle (18mm) sloping down gradually to 3" from end, 2.0mm thick. Rough cut on band saw, smooth sand on drumsander/orbital sander. Finish sand each brace rounding the tops.
- Glue on braces: Use radius dish with pad and gobar. Braces are numbered and arrowed in correct direction. Braces should protrude about ½ inch beyond guitar template line. Let dry....use a light to make sure the brace is glued 100% all along the back. Re-glue if this happens. Clean away all glue....he says this affects the sound.
- Center reinforcement strip. Cut into sections, this is glued on the center glue joint of the back to keep it from separating. About 1 inch wide, quarter sawn, 3mm thick, rounded corners. Glue on with gobars...centered on the back, using protective wood cover strips to prevent gobar dents. No need to use radius dish for gluing. Note – the last 2 sections of the center strip are glued on AFTER the back is glued into the guitar box.
- Voicing:
 - Thickness of back is not set...you sand down, voicing based on the wood and sound
 - Braces...remove brace wood using drill press sander/orbital sander/hand plane
 - Hold at the node, use tapping, try to get 4 different tones...one at each brace. Can also use flex as wood is removed to arrive at final
 - After back is glued to box, the back should “boom” with tapping
 - Sound port – oval is the best shape, in the middle of the side in the upper bout
 - Larger, wider guitars require higher, stiffer braces due to the size

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Guitar Top:

- Overview. Kent Everett emphasizes that the top bracing/voicing is much more critical than the back. Factors such as choice of wood, grain tightness, thickness, bracing, and most important, the quality of construction are key.
- Thickness/woods:
 - Final after sanding – 2.7 – 3.0mm, depending on the wood
 - Sitka spruce – strongest grain, can be thinnest....105-.125 / 2.6 – 3.17 ...flops after going thru drum sander....120 grit, prefers .110-.120 or 2.8 - 2.9 mm
 - Adirondack (red) spruce – softer than sitka, make a little thicker
 - Cedar – should be thicker than sitka, keep braces higher than sitka when voicing
 - Redwood – softer, not very strong, make this the thickest and braces high
 - Remember – top is still gonna get thinner during final sanding
 - Grains – used to be 25-30 grains per inch. Now, wider grains are acceptable (18-22). Wider gives more flop...but keep thicker....2.8, 2.9 mm. If you have wider grains, keep thicker. Red spruce can be wider grains, therefore, thicker.
 - Grades of wood. AAA is preferred, has tighter grains in the middle, wider on outside
 - Drumsand...even when down to, say 2.8mm, don't lower the drum, keep sending it through.
 - Minimum dimensions – cannot go lower than these – you REALLY want higher.....
 - Sitka - 105 thick, he prefers .120
 - Bridge plate – 2.0" wide x .125 thick, bridge pins down the middle
 - Shipping braces – 2, ½" wide by 1.0" long x .60 high (sand very thin)
 - X-brace – outer nodes ½" high, low spots 3/16" high, ½" high at the X
 - Tone bar braces – outer nodes 3/8" high, inner nodes ½" high, low spots 1/8" high
 - Sanding – 220 final
 - Engelmann, cedar, redwood: softer woods... add 1/16" to all heights
 - Note – if wood is soft, make it thicker. If too thin, sound/sustain degrades much quicker. Thicker wood sounds better over time and is stronger.
 - Flop test – continue til you get good "sheet metal" sound. Do not continue to remove wood.
- Install rosette. Drumsand to 3.1-3.0mm, install rosette, glue in the rosette using the gobars. Sand away dried rosette glue with 180/220. You can CAREFULLY drumsand the rosette to the top surface. If you need to continue to thin the top, drumsand the opposite side of the rosette down to the final thickness.
 - Thickness – use dremel and 1/16" bit, cut depth to thickness of rosette. Rosette is 1.65mm thick, test against cutter. Reverse directions, go slow, cut the middle circle 1st. Use a template/pattern to practice on. Make many passes, widening each time. When cutting final hole, make many passes to cut out the hole.
- Soundhole size. Everett says no larger than 4.0" (I use 3 7/8")
- Bracing.
 - Quartersawn spruce, use 30 ft radius dish
 - Profile – leave them square/flat top, no need to point the top
 - X-brace – he moved the x from 1 5/8 to 1 3/8 from the sound hole. Make sure the bridge plate does not move up.
 - Height = 5/8" at the X...leave more "meat" on after the X, do not shave that down yet
 - Width – 5/16"
 - Center is 5/8" high, node is 5/8" high and 3" from outside edge
 - Add extra "meat" 3" from the X heading to the 1st node

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- Nodes – 3” from the kerf
 - Tops are rounded, not pointed
 - Must be tight....use a small wedge to fill in any gap...no sloppy joints
 - Tone – wider=more base, narrower=more treble
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- Bridge Location – for top strength, bridge MUST extend over the X-brace. Make sure X is not too wide.
 - Bridge plate - .125 inch thick (1/8”), 2.0” wide, string holes should be in the middle, no gap with x-brace
 - Tone bars – 2 nodes – 3” in from edge, 3” from X-brace, both are 5/8” high, run them to 1/8” from kerf
 - Shape - start low, 5/8” high at the X-brace, rise up to 5/8 at 1st node, drop to 5/16, then rise to 2nd node, 5/8” (make template)
 - Sound hole braces - flat braces around sound hole – 1.0” and a little thicker than normal
 - Finger braces – 5/16 wide x 5/16 high...run them to 1/8” of the kerf
 - Transverse brace – glue flat, no radius dish
 - Tongue depressor brace – butt up against the upper transverse brace, glue flat, no radius dish
 - Depth jig - 6 places where braces go into guitar side.....notch a piece of wood to check the depth (3/32) so all are the same
 - Center shipping braces – 2 of these, small, thin. Sand these to very thin while voicing

Everett Voicing: 2 methods to determine how to proceed –

- **Deflection** - set completed top on guitar sides in a guitar mold...push down with 5lb effort...should drop 1/32” (0.031 inch) as you push down. IF IT DOES NOT – you will need to tackle all braces a bit to get the deflection. Do not just remove from the x-brace center.
- **Flex** – you can flex the top and bend slightly to feel the flex. Be careful not to break the thin top.
- Mark node (dead spot) on tongue depressor brace....hold there
- Use tap method...on bridge plate - listen for 1st and 2nd gongs and vibration....it starts giving
 - Drill press sanding – set on low speed. Use sanding disc, 80 grit, sand each brace to smooth the tops
 - For voicing, switch to 120grit and continue to remove wood and tap and flex (on X-brace ends...equal?)
 - Keep checking DEFLECTION and TAPPING bridge plate, removing wood as needed
 - Switch to 150 grit
 - Mark places where you can take off some wood....small amounts only
 - Once you get the gongs you want – STOP – do not keep removing wood...this will only weaken the guitar
 - Key places – nodes and low places
 - Sand down the finger braces.....
 - Tone bar low spots – do not make them too thin...this weakens a key support area
 - Symmetrical – each side of X-brace should be same height
 - Responsiveness – this is what you are trying to affect...want to maximize this
 - Final sanding/chiseling – by hand...where braces join the x-brace....this is not for voicing, just to make it look good
 - Hand sand all braces to make them look good, 220 grit final
- Last ditch effort - after top is glued on and sanded to 220, test bottom and top of finished guitar with tap tone. Should get good “gong” sounds. If not, need to sand off some of the wood.
 - Top – sand around the edges, not the center. Test deflection with 5lb pressure, using a straight edge across bridge location to outer edges. Should depress down 1/32”. If not, sand down 2-4” around the guitar edges... do not sand the bridge location.
 - Bottom – same thing, sand around the edges, repeat until get good “gong”.
- Bracing dimensions and installation:
 - Top braces: Only the X-brace and Upper Transverse Brace get kerf-notched.

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Make template.

Trace the braces on the top.....show each intersection (especially X-brace) and where they hit the outer line.

Need to see plan to get length and how many

Make a cut list of braces. Always cuts these bigger, you can trim down later.

Label each. Cut each $\frac{1}{2}$ inch over final length.

Radius each on 30 foot before you scallop them. Braces below sound hole get radiused, those above DO NOT get radiused.

All quarter sawn cuts (grain straight up and down). X-brace most important, use best QS wood for it. Off QS can go in top of guitar.

Sand all brace tops – use 180 to 220 for final. Can use sander for this....carefully.

- 2 X braces: 9 mm wide x 13.5 mm high. Cut one 22mm wide x 15mm for now, split in half later. Cut to length, about 20 inches, measure on guitar and use blueprint...leave $\frac{1}{4}$ - $\frac{1}{2}$ inch extra on ends. His x-braces protrudes over 1 inch.
- Scallop the brace. Use template, 2 humps...#1=3 inches in, $\frac{1}{2}$ high hump (final sanded = 9 mm high) and #2 closest to the X, $\frac{1}{2}$ inch high hump....2.5 mm at the ends where it protrudes through the side. At lowest part of scallop, 7.5 mm high, final sanded...do not go thinner here...this is a strength area. Now, go split this on the table saw so you have 2 identical braces. Final width = 9 mm. Make an X-brace template....radius and scallop it. Lap joint. Lay x-brace on top over the lines, mark where lap joint will be. Label L and R brace. Joint must be tight and at the correct angle. If this joint is loose, make a shim and put in the gap. Make sure flush on top and bottom. Radius the x-brace with 30 foot dish, then glue up with gobar...use a pad to protect the brace. Glue each brace separately. Gobar starting at the X, then the ends, then in between. Clean glue squeeze-out. Final height at the X = 13.5 mm or so...sanded.
- 2 tone bars: make template. 8 mm wide x 13 high. Length – leave 1 inch from outer line. Radius both together now, then scallop. Trace template against brace. See picture. Scallop: #1 hump 10mm high, 3 inches from outer end, #2 hump, 13mm high, 2.5 inches from x-brace, sloping down as it gets close to x-brace. Final height at x-brace is 2.5 mm, at an angle (look at the picture...get angle RIGHT, tight against x-brace). Final heights sanded...#1 hump=6.5mm, lowest = 4mm, #2 hump = 9mm. Glue in with gobar. Notice the angle from the picture.
- 4 finger braces: make template. 8mm wide x 1 inch from outside...measure each. See picture. Radius these now, then scallop. He cuts a “wedge shape” for these....2 pair, each pair same length. Make one long brace, then cut to short pieces. Go to “0” thickness at the ends. Final height = 6.5 mm, going down to nothing.
- Upper transverse brace. 13mm wide by x 15mm high, final sanded. Drill 5/16th hole for truss rod access. Centered, near top of brace, close to the top. Trim ends on band saw. Round the top shape of this one. Glue upper transverse brace and tongue depressor braces on FLAT SURFACE in gobar.
- Tongue depressor brace. 3mm thick (2.5 final) x 8 inches long and 1 inch wide..round corners by neck. Carve out groove for the truss rod wrench.
- 3 Soundhole braces...2.5mm thick final sanded. Use a clamp caul on top of the tongue depressor brace so that it doesn't spit from gobar pressure.
- Bridge patch. Make a template. Rosewood, 2.5mm thick x about 2.5" wide. Must fit exactly where the bridge is going to go. Use the plan to get bridge location. Do not let this touch the tone bars. Glue in the gobar with a caul to prevent dents.
- Shipping braces....2 small slivers, very thin, over center joint...about 1 inch long.
- X-brace small brace. Over the X joint....this gets shaved down to about 1mm thick. Can cover with gun patch.
 - Deflection process and results. (Based on Brian Howard method, see handout)
 - Results (See Below)

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Note: Thickness is measured in mm, Deflection is measured in thousandths of an inch

Guitar top – no braces	Thickness/Deflection		Thickness/Deflection		Thickness/Deflection	
Top - before trim to guitar shape	3.4	130				
Trimmed, no rosette	3.3	155	3.1	175		
Trimmed, rosette installed	2.9	232				
Guitar Top with braces	Deflection Test 1		Deflection Test 2		Deflection Test 3	
Braces – Top – no brace trim	2.9	18				
Braces – Under – no brace trim	2.9	15				
Braces – Top – braces trimmed 3X	2.9	38	2.9	39	2.9	45
Braces – Under – braces trimmed 3X	2.9	28	2.9	35	2.9	45