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STEM Guitar Project's BBT Acoustic Kit

Acoustic Stringed Instruments

Summer 7-22-2022

BBT Acoustic Alternative Top Bracing CADD Data Set- NoRev-2022Jun28

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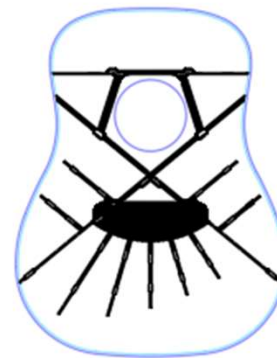
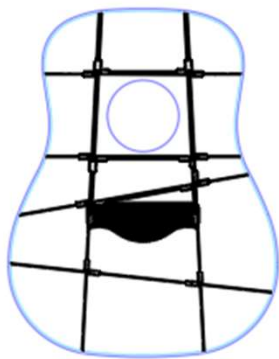
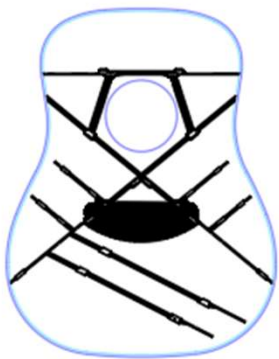
Overview of ETSU's Alternative BBT Top Bracing CADD Data Sets for the STEM Guitar Project's BBT Acoustic Guitar Kit

College of Business & Technology
Department of Engineering, Engineering Technology, & Surveying

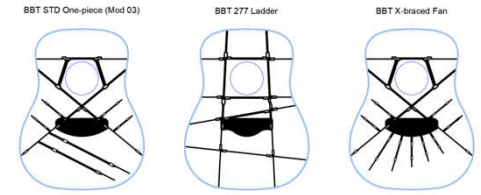
Mr. Bill Hemphill, Associate Professor
Engineering Technology



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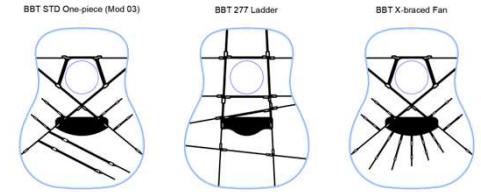


ETSU Guitar Building Project



- For use with the STEM Guitar Project's “BBT” Acoustic Guitar Kit
- Data set provided “as is”
 - No warranty; Use at your own risk
- Licensing Information: [CC BY-SA 4.0](https://creativecommons.org/licenses/by-sa/4.0/)
 - Preferred Attribution:
BBT Side Mold Assy & Spreaders, CNC Toolpaths, Drill Template, & Layout for CNC designed by Bill Hemphill, ETSU Guitar Building

ETSU Guitar Building Project



- For information regarding specifics of CADD layer naming and such, please refer to the following documentation:

[Design Standards & Best Practices for CADD/CAM/CNC](#)

Available URL:

https://faculty.etsu.edu/hemphill/pdf/ETSU_Standards-CADD_CAM_CNC-Latest_Rev.pdf

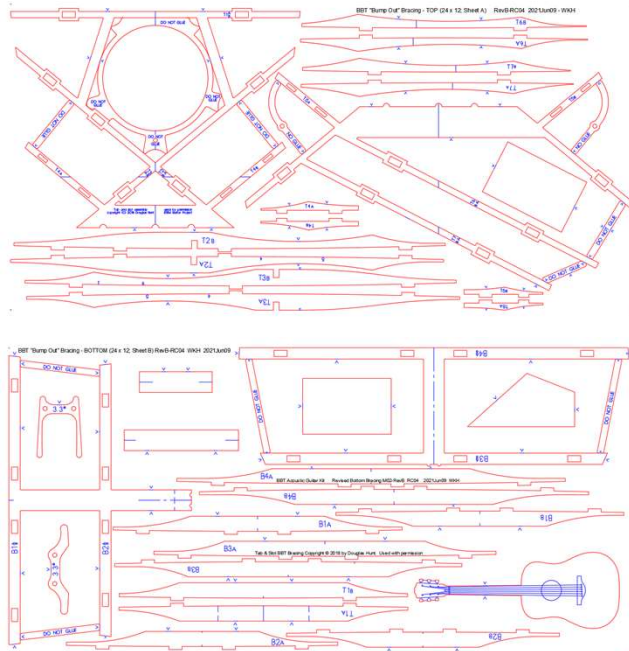
BBT Acoustic's Laser-cut Bracing



- Doug Hunt
 - Southern Wells School (Poneto, IN)
Design Technology Faculty
 - 2017 NSF Grant: The STEM Guitar Project
Co-Principal Investigator
 - Greatly simplify process for 1st time builders

- 2018 – 1st Prototype Bracing

- Laser-cut 3mm Baltic birch plywood
 - “Engineered wood product” & dimensionally stable
- Pre-radiused (25’R) & scalloped braces
 - “Tab & Slot” design ensures alignment
- “Martin-style” top & traditional bottom bracing
 - 2-piece bases (to fit 24” x 12” sheets)
 - Included in each BBT acoustic guitar kit



ETSU's Acoustic Guitar Building Program

- Partnership of Two Academic Programs:
 - Engineering Technology
 - Bluegrass, Old-Time, & Roots Music Studies
- Builders/Performers want opportunities for:
 - Customization & personalization (Visual)
 - Differentiation & transformation (Aural)
 - Tone & voicing
 - Alternative bracing options



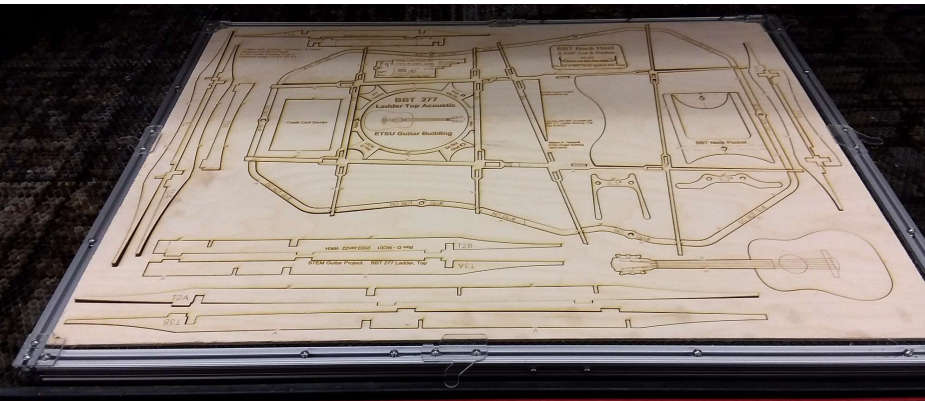
ETSU's Laser Cutting & Engraving Equipment

- ULS (75-Watt CO₂) Laser System
- Laser-specific CADD data formatting:
 - **Raster Etch:** Black; 'Default' lineweight
 - *Arial* is preferred typeface/font for laser work
AutoCAD: Use "Style" command
 - **Vector Etch:** Blue; 0.0mm lineweight
 - **Vector Cut:** Red; 0.0mm lineweight
- Reformat layer properties as required for your system

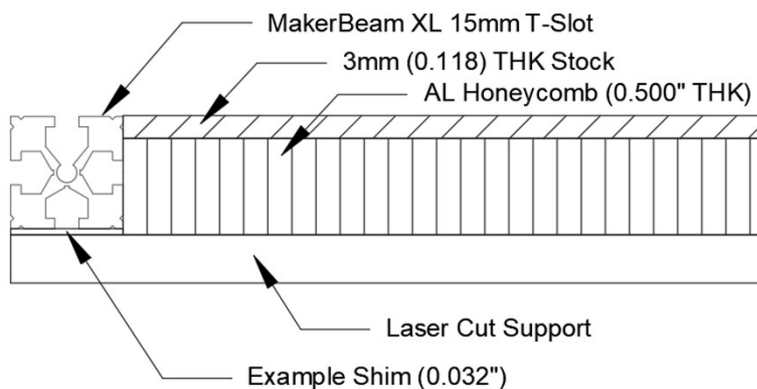


Low Profile, “Hold Flat” Sheet Stock Carrier

– Sheets held ‘flat’ with a custom frame assy.



- OpenBeam 15 x 15 mm T-slot AL frame (4 pieces)
- 24” x 18” x 1/2” AL honeycomb insert
- M3 hardware
- Laser-cut PETG ‘swing catches’ in corners & middle each side
 - Low profile design allows for raster etch “fly overs”
- AL foil-covered, laser cut support base



Each Bracing Design Set Contains:

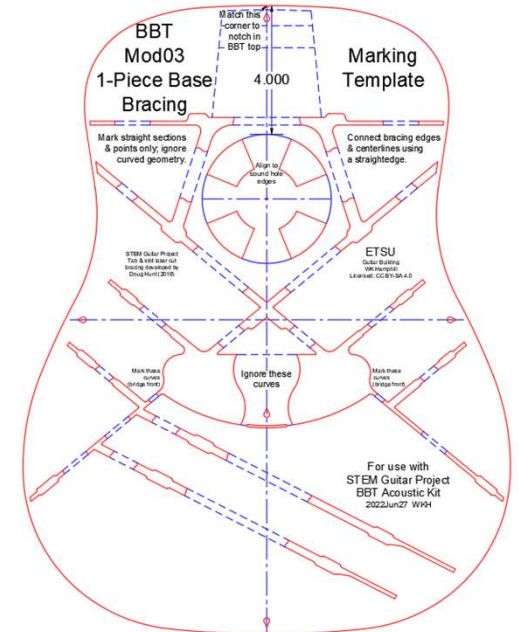
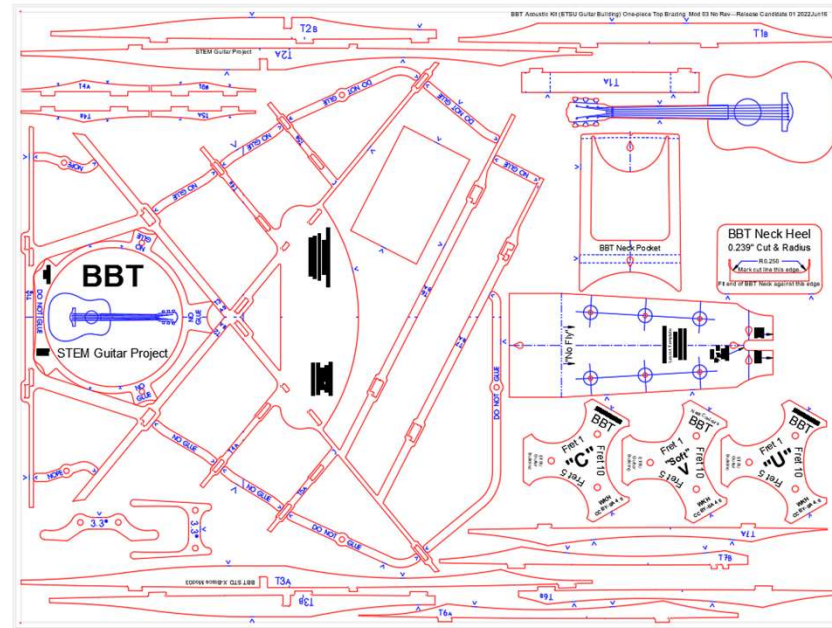
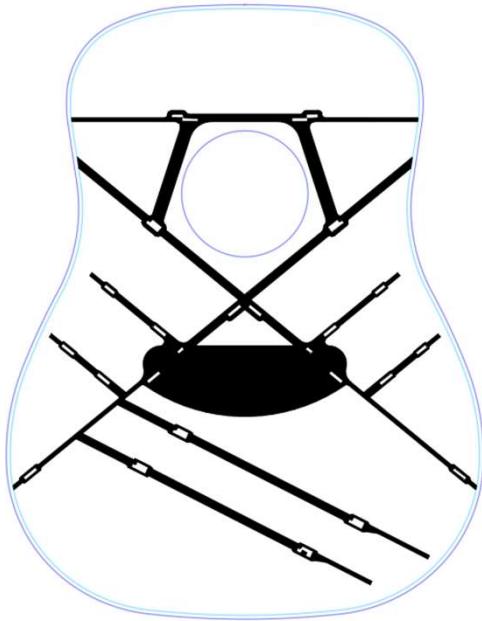
- Laser: 24” x 18” CADD Layout
 - Single piece base, pre-radiused & scalloped vertical bracing pieces, & an assortment of templates &/or gages
 - DWG (2007) and DXF R12 formats
- Laser: ‘Marking Template’—CADD
 - DWG (2007) and DXF R12 formats



DXF R12 Formatting & Typefaces/Font

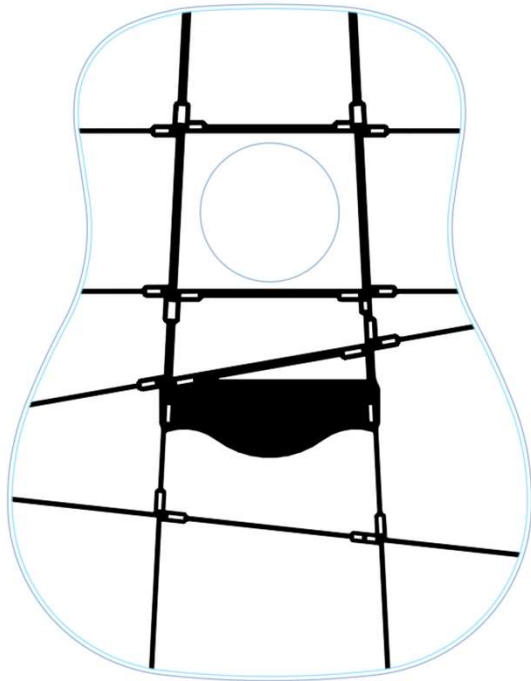
- Autodesk, Inc. is not a fan of the .DXF R12 ‘universal CADD exchange’ format
- Prior to laser operations, you will need to ***reset the system font to “Arial”*** (use ‘Style’ command)
 - Default `txt.shx` typeface is too thin

BBT Mod03 Top Bracing: Standard (Martin-style)

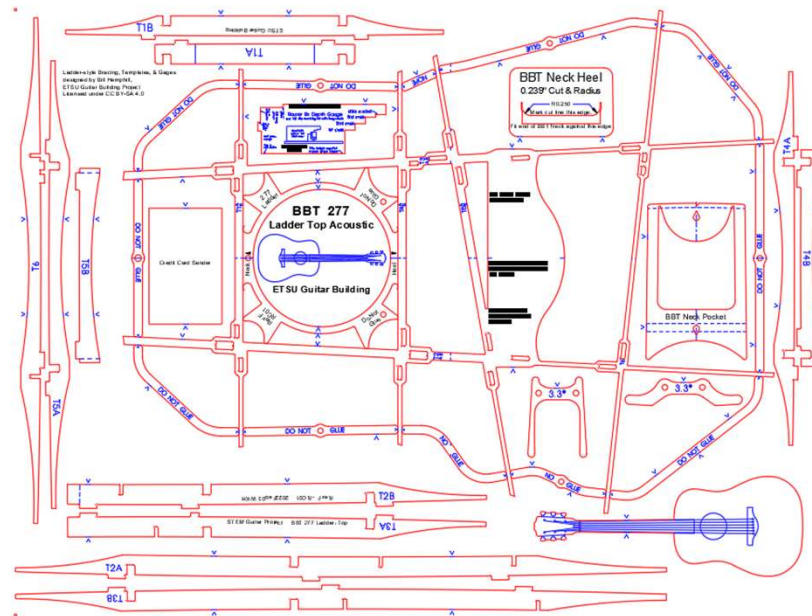


- 1-piece base w/ updated bridge & ‘thin ends’
 - Single (3mm) outboard braces; lighter & more responsive
- Sleeker ‘tab & slot’ footprint; bracing tabs are ‘keyed’
- 24” x 18” layout includes assorted templates & gages

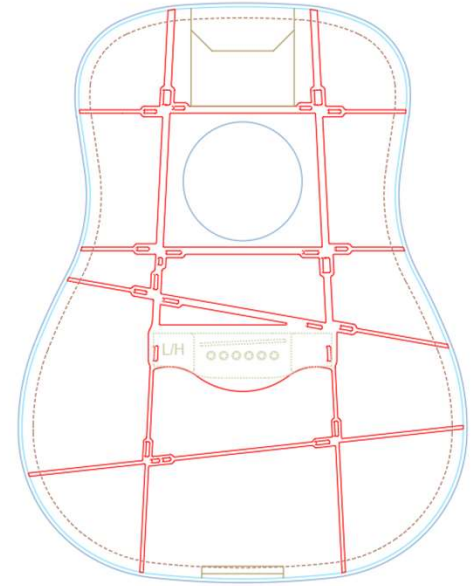
BBT 277 Ladder ('Vintage sound,' Pre-1970s)



Standard BBT 277 (R/H)

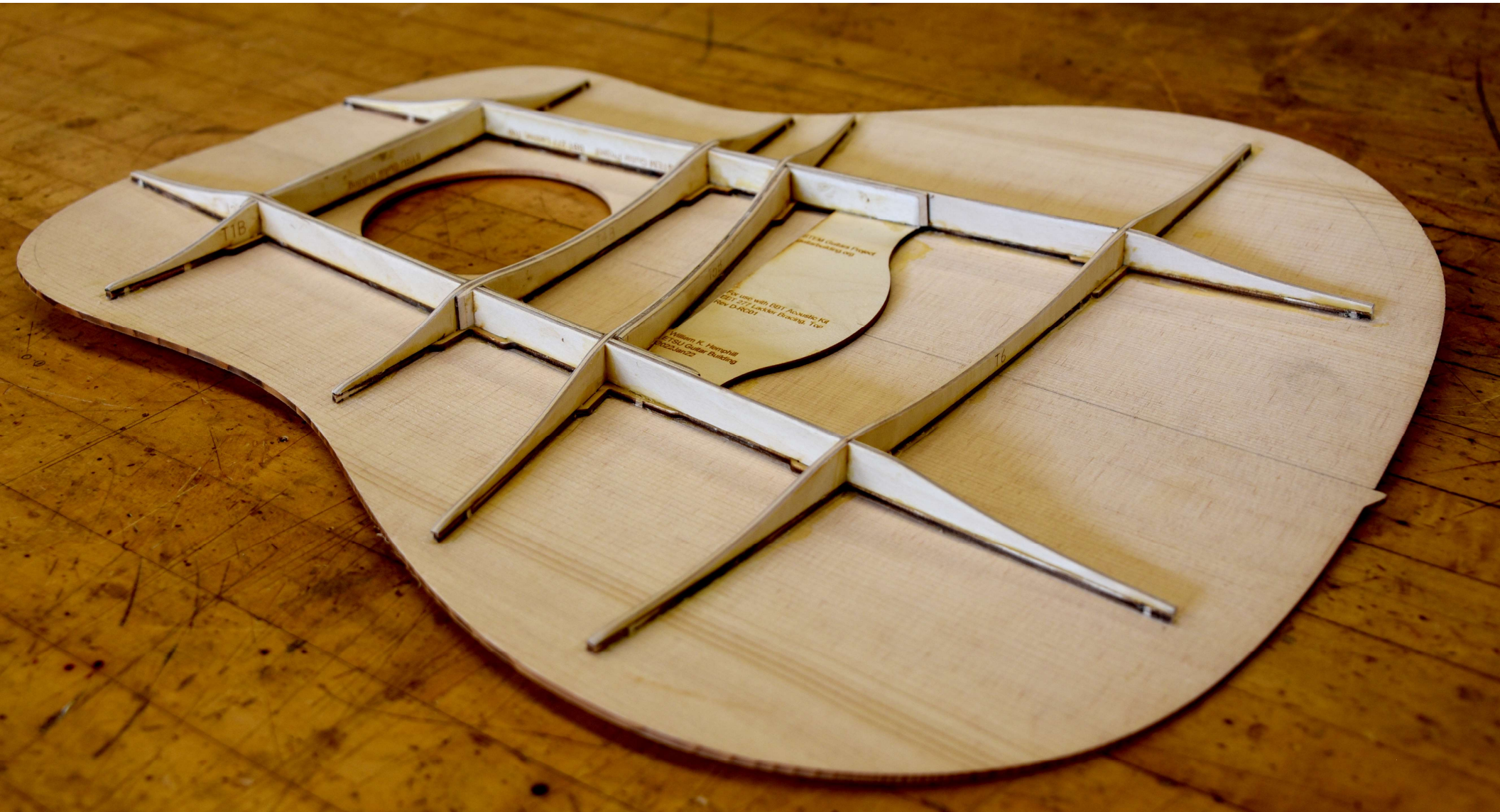


BBT 277L Rev F
Ladder-style top bracing
Lefthand (L/H) Prototype

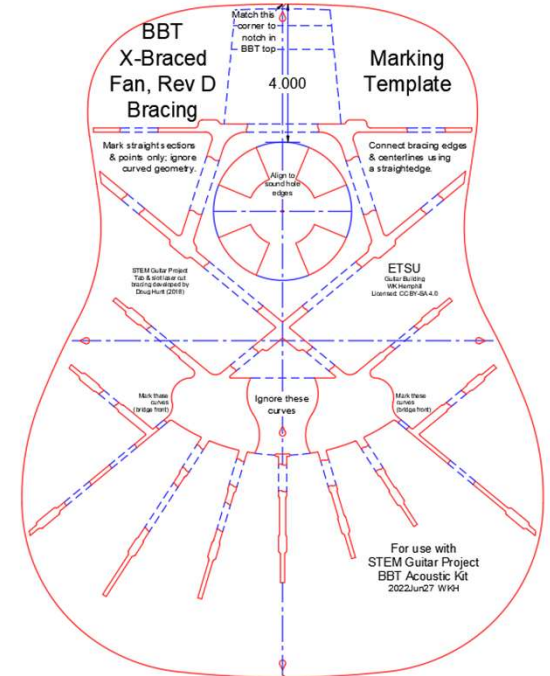
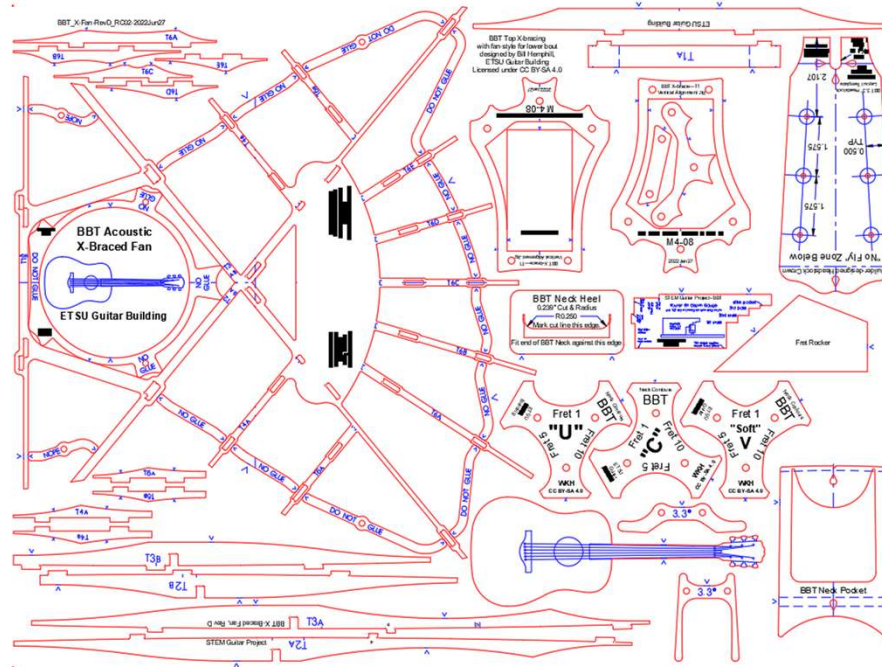
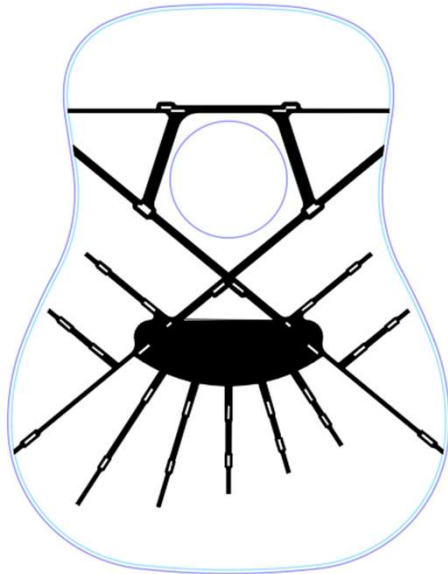


- Traditional bracing design; affordable mass market entry level;
- Sleeker 'tab & slot' footprint on 24" x 18" sheet
 - Single (3mm) "outboard" braces; lighter & responsive
- Prototype left-handed acoustic guitar in development

BBT '277 Ladder' Braced Top

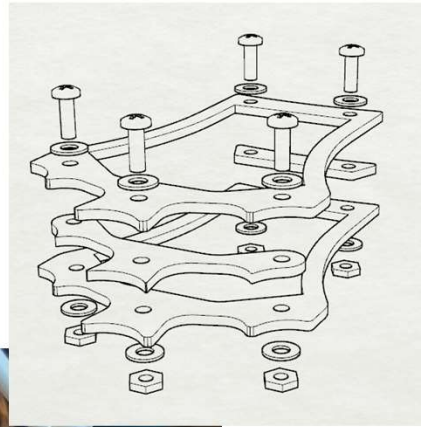
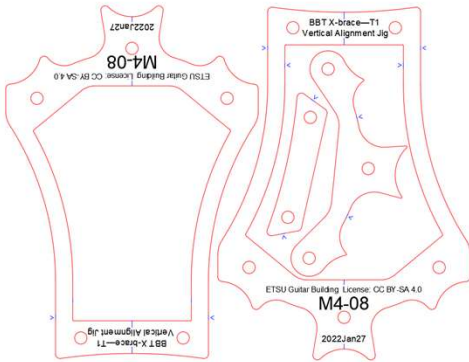


BBT “X-Braced Fan” (Steel String ‘Classical’)



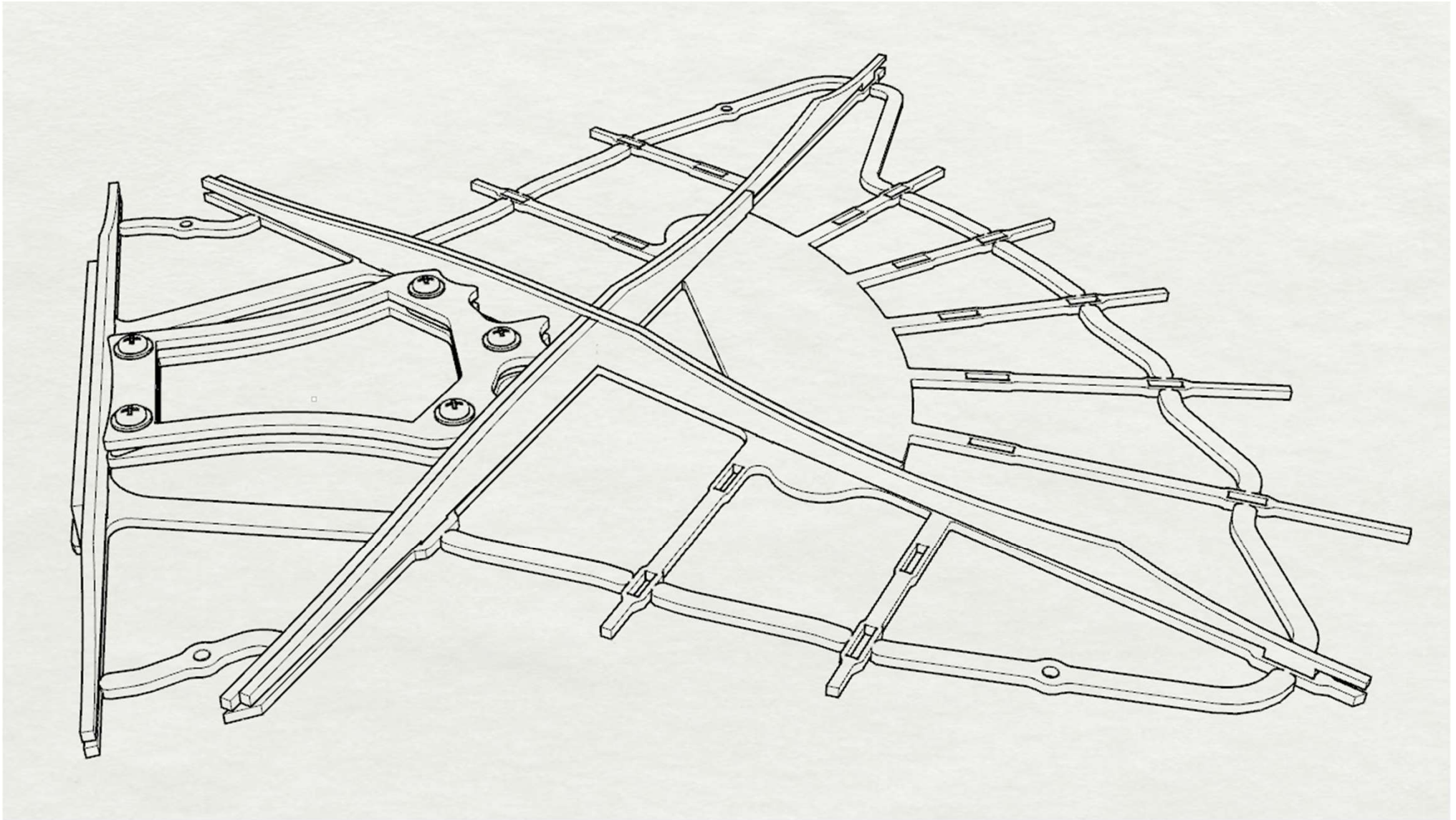
- Sleeker ‘tab & slot’ footprint on 24” x 18” sheet
- Single (3mm) “outboard” braces; lighter/responsive
- Layout includes an assortment of templates & gages

X-brace-T1 Vertical Alignment Jig

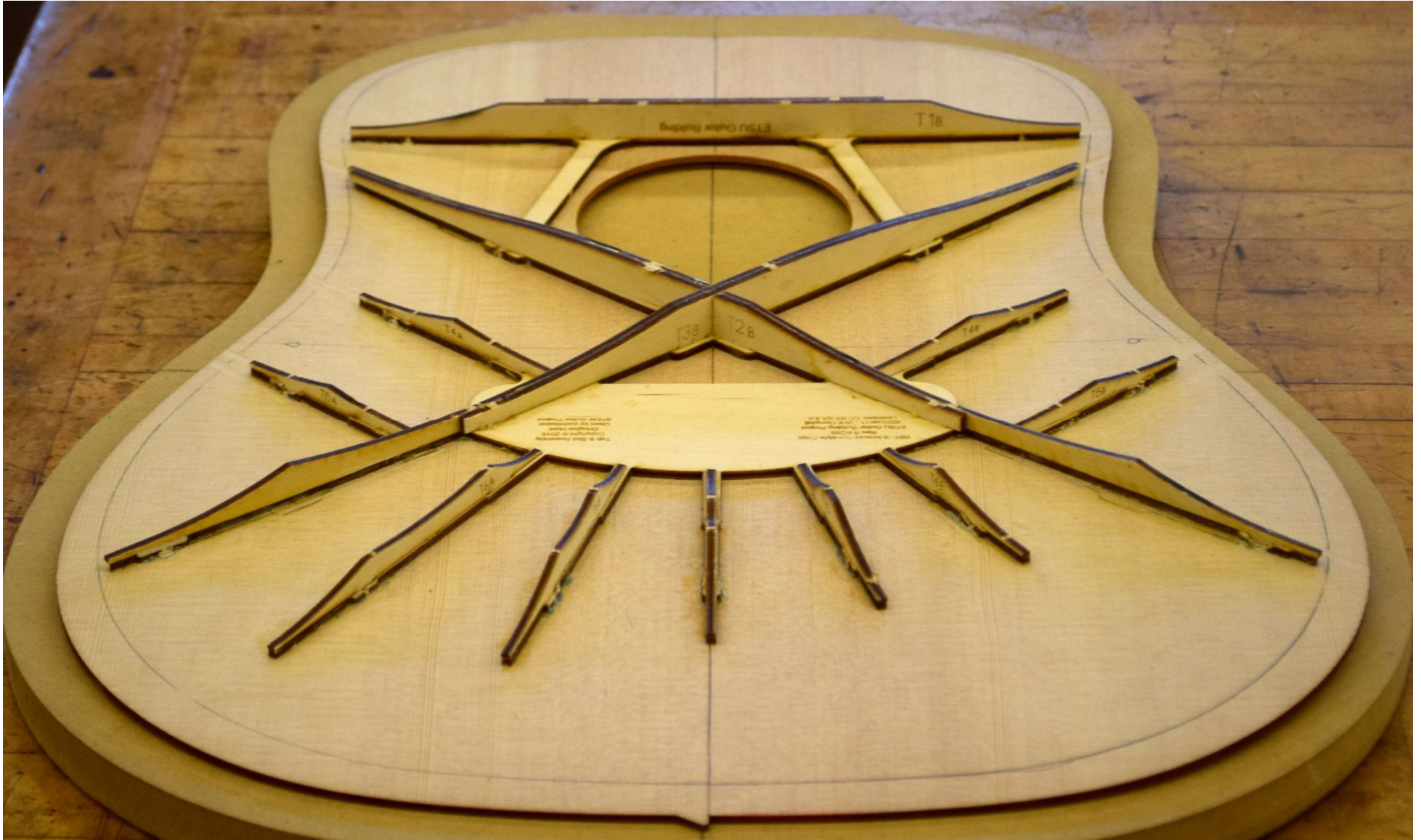


- “The Cupcake” ensures that the T1AB upper bout bracing remains vertical despite direction of go-bar rod loading
 - Ideally, T1A mates with neck block when gluing braced top to the side assembly
- 4-piece ‘Cupcake’ included within the X-braced Fan layout
 - Assemble w/ #8-32 x 1/2” hardware
- Applicable for use with all BBT X-braced top bracing configurations
 - Secure w/ 4 medium-sized clamps
- Alternate materials
 - UHMW (non-stick)
 - PETG

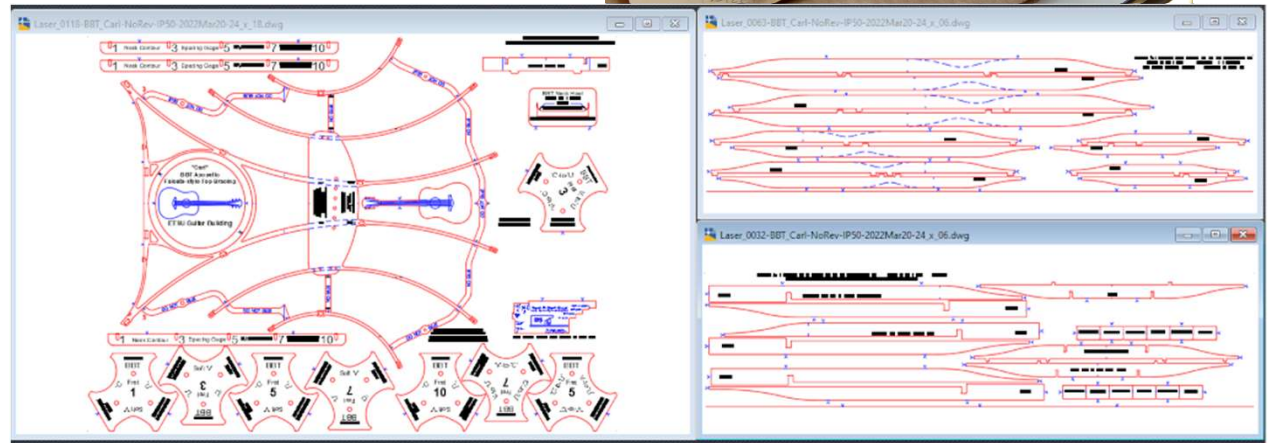
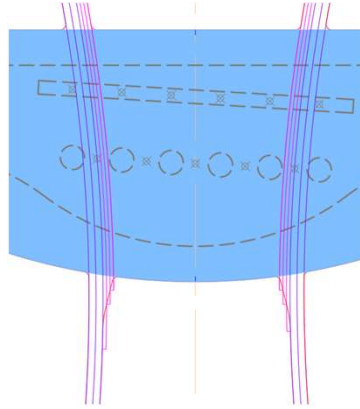
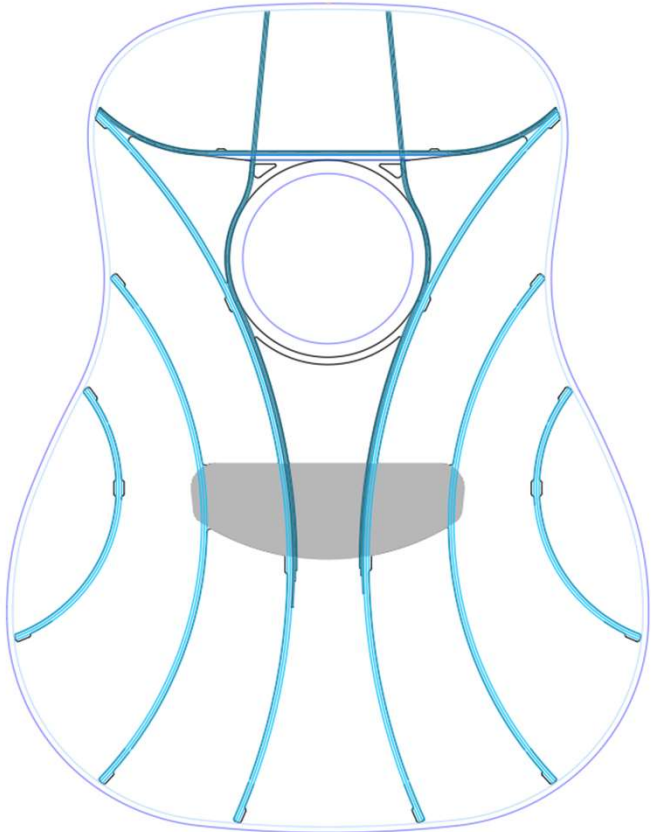
BBT X-braced Fan with T1 Vert. Align Jig in Place



BBT X-braced Fan Top Bracing

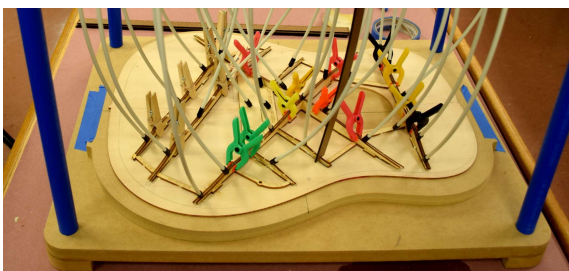


BBT “Carl” Falcate-style Bracing (In Development)



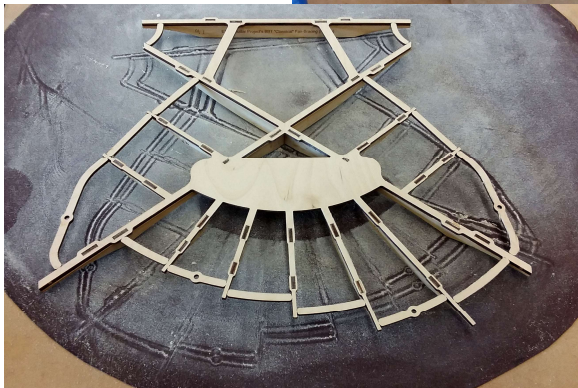
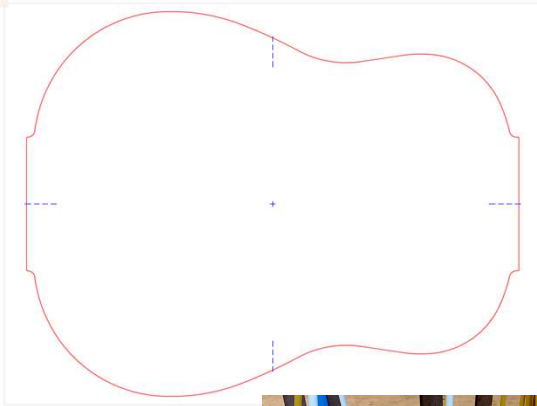
- Variant of Trevor Gore’s ‘falcate’ curved bracing
- Laminated 1/32” & 1/16” “bendy” Baltic birch plywood pieces
- Pre-stressed, laminated bracing; min. weight-> max. response

Best Practices: Bracing Removal (Part I)



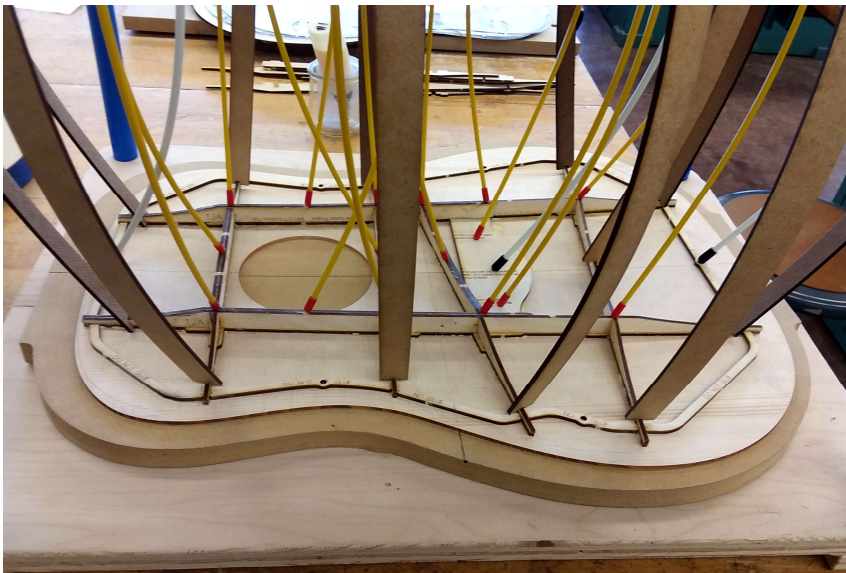
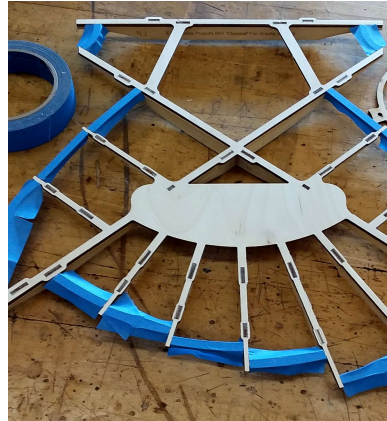
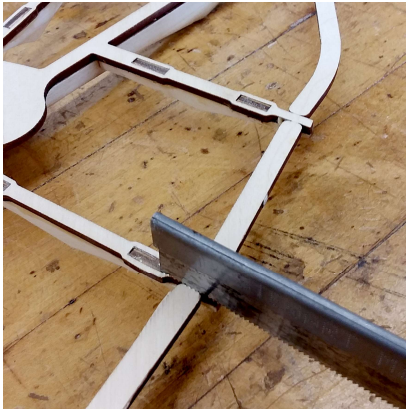
1. Score backside 'tabs' of laser cut bracing pieces
 - Scoring through veneer prevents tear out and splintering
2. From top side, use corner of a single edge razor (paint scrapper) to break through tabs carefully
 - ***Leave all "Do Not Glue," "No Glue," &/or "Nope" connectors attached***
3. Dry fit ALL pieces on radiused workboard
 - Sand/file/chisel internal corners of all tabs
 - Sand slots of intersecting vertical braces (e.g., X-braces T2AB and T3AB following direction of intersecting base)

Best Practices: Gluing the Bracing & Radius Sanding (Part II)



4. Use a pliable ‘non-stick’ or sacrificial medium over radiused work board & glue bracing assy separately (i.e., off the top)
 - Laser-cut waxed bakers’ sheet (24 x 18 x 1/8” THK)
 - Newspaper on cardboard
5. Pre-radiused braces do not require ‘strong’ go-bar rod loading
 - Yellow: 3/32” DIA wire fishing fiberglass rods
 - Laser cut tempered hardboard sticks
6. Radius sand bottom of glued assy to expose “clean” wood to top

Best Practices: Gluing Bracing Assy to Top (Part III)

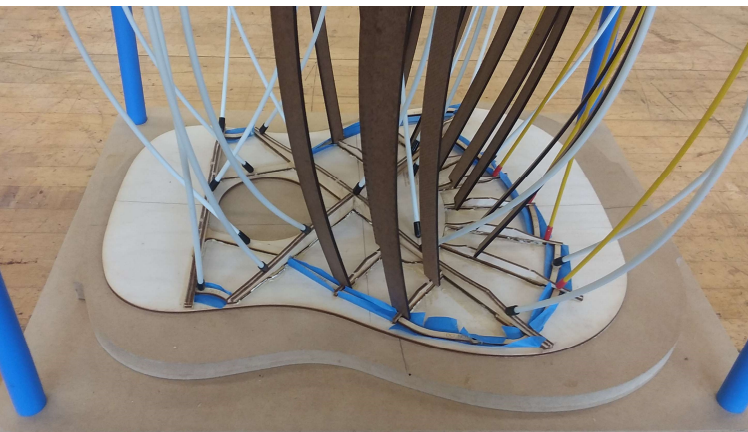


7. Score bottom of all “Do Not Glue” connectors; apply painters’ tape.
8. Use template or bracing base to mark outline of bracing for glue
 - Mark the **INSIDE** surface of the top
 - Carefully mark the body centerline
9. Dry clamp bracing assy onto top within radiused workboard
 - Have all necessary go-bar rods, sticks, &/or clamps staged and ready to apply immediately after gluing
 - The (pre-separated) Sound Hole Position & Orientation Jig is helpful
This Jig Will Not Be Glued!

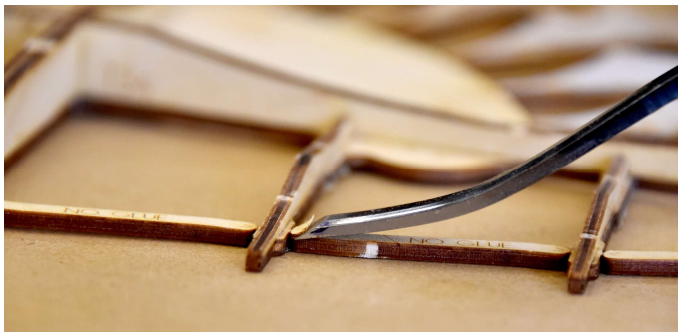
Best Practices: Gluing Bracing Assy to Top (Part IV)



10. Brush glue onto mating surfaces
 - Best working in 2-person teams:
 - a. Lead—bottom of bracing assy and remove tape from connectors
 - b. Helper—within outline of base
11. Carefully position and orient bracing assy onto the top
 - Use the Sound Hole Jig (Don't glue!) or carefully align bracing assy to the two accurately drawn centerlines
12. Secure bracing assy to top
 - Continually check & adjust bracing assy alignment and positioning while applying go-bar rods, sticks, & clamps

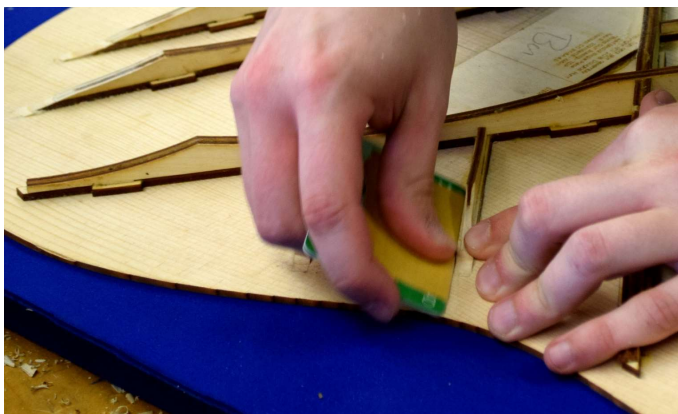


Best Practices: Post-Gluing Activities (Part V)



13. Carefully remove the “Do Not Glue” connectors

- Use a sharp chisel to make multiple shallow cuts diagonally down & towards the base
- Clean up glue squeeze out with chisel &/or sanding (Use “Credit Card Sander”)

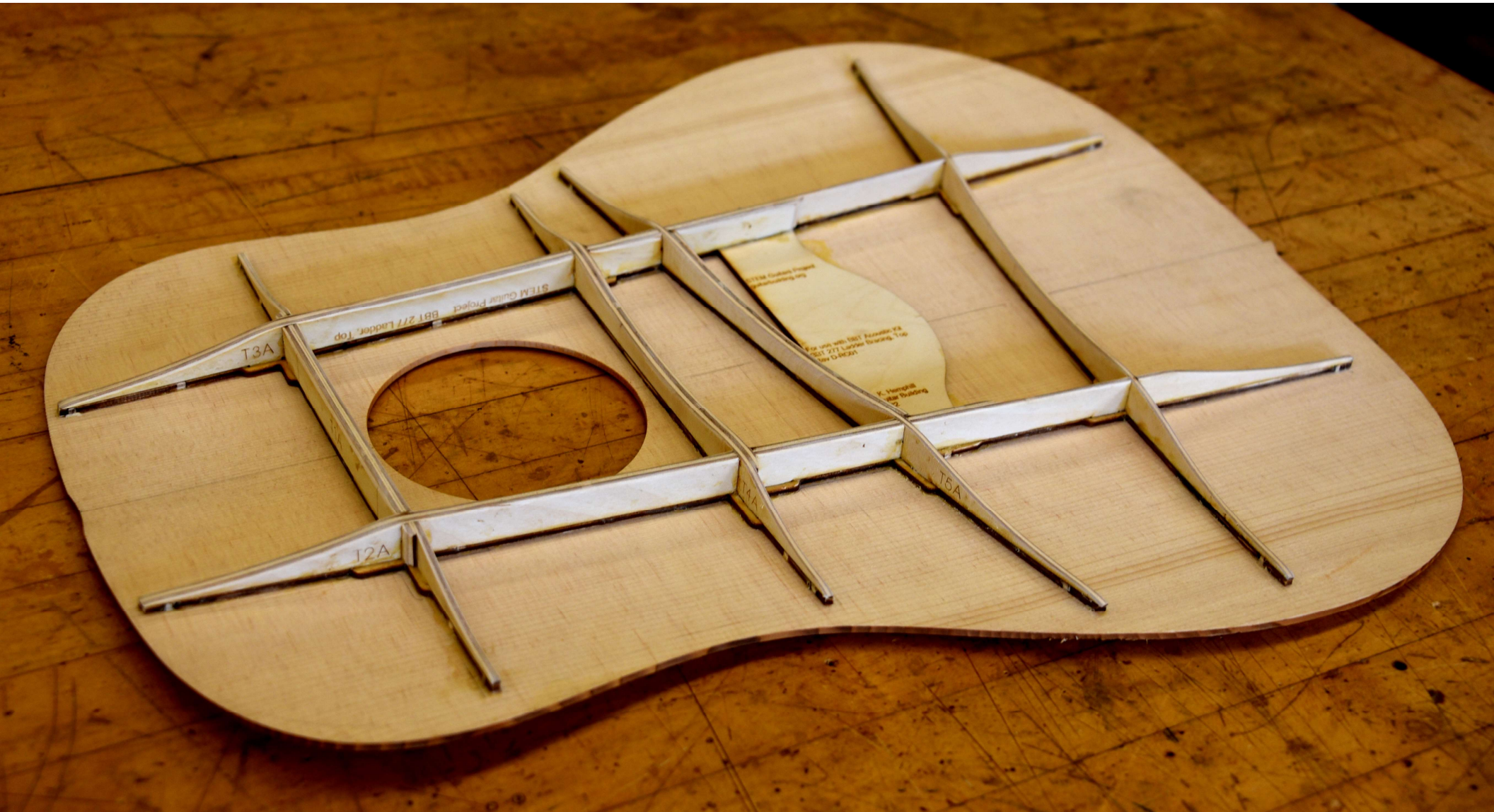


14. Sand &/or sculpt bracing as required to achieve desired tonality & weight and to fit within the kerfed body sides

- Protect inside surface of the top from errant chisel slippage &/or overly aggressive sanding
- Sculpt sides preserving scalloped heights
- Although unnecessary, some builders remove the slots’ “bump outs” from the base



Best Wishes in All of Your Guitar Building Endeavors...



For more information:

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