Technical Resource
X-brace vs longitudinal braces
re: *Ultimate Bluegrass Mandolin Construction Manual - 4th Edition*
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In **Chapter 5: The soundboard** in *The Ultimate Bluegrass Mandolin Construction Manual, 4th Edition* I did not include information about the use of X-bracing for the F5 mandolin as I feel it is something that violates the initial design of the instrument's soundboard and does not optimize the tune-ability of two longitudinal tone bars.

X-bracing was first commercially utilized by C.F. Martin (1796-1873) in guitar construction as a means of strengthening the soundboard and preventing it from buckling under the load of the strings' tension that pulls at and twists the soundboard at the bridge.

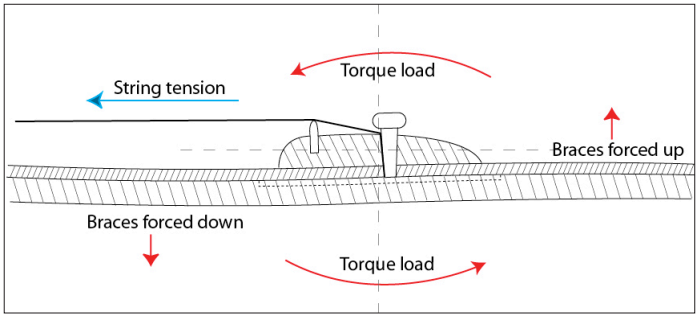

Fig. 1) On fixed bridge instruments, the tension of the strings pulls at the bridge and causes the bridge and soundboard to twist forward.

Archtop mandolins, guitars, and violins feature movable bridges whose load is directed downward to the soundboard. On these instruments there is no twisting or torque load at the bridge; as on fixed-bridge systems, just a downward force.

To achieve strength in archtop instruments, the arched shape inherently provides some strength, but to improve the rigidity of the soundboard - and to make the soundboard more supple as it nears the rim (ribs) - the soundboard (and backboard) is graduated; they are thicker in the center and get continuously thinner as they near the rim.

There are several things to consider here:
1) Adding X-braces to an already graduated soundboard defeats the purpose of the graduations. In a sense, adding X-bracing to a graduated soundboard is like overly graduating an already graduated soundboard.

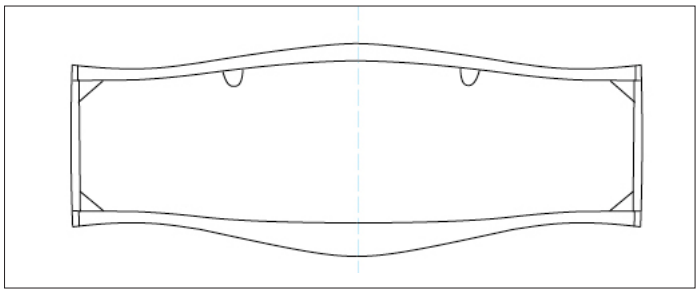
Fig. 2) This cross section drawing of an F5 mandolin (taken just behind the headblock) shows the graduation of the soundboard and backboard. Note the ends of the two tone bars that are attached to the soundboard.

2) An X-braced soundboard does not take advantage of the bridge feet resting on, or over a tone bar or brace.

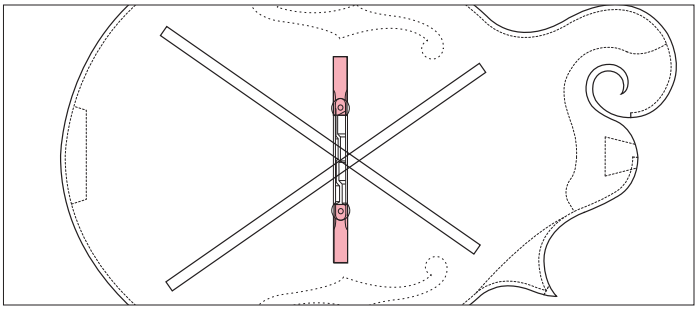
Fig. 3) When an X-brace pattern is used on an arch top instrument, the bridge feet (red) do not rest over or on the braces.

3) Longitudinal tone bars, like the singular bass bar of the violin, enable a bridge foot to rest over each tone bar.

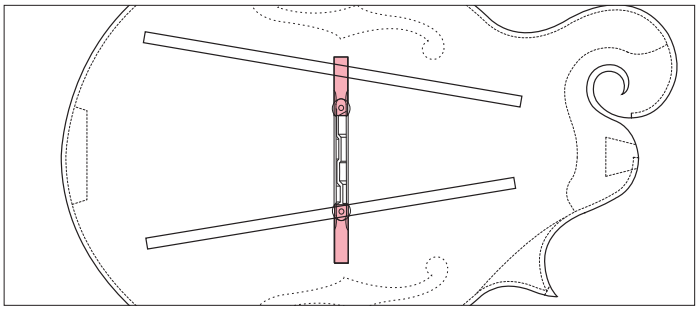
Fig. 4) Longitudinal tone bars enable the bridge feet to sit directly over the tone bars.

4) Unlike the X-braces that globally raise the pitch of a soundboard, separate tone bars have an inherent tuning quality based on their location: *As tone bars are positioned closer to the crown of the soundboard, the pitch of the soundboard increases. As tone bars are positioned closer to the edge the soundboard the pitch of the soundboard decreases.*

5) If you are tap tuning, X-bracing does not lend itself well to tap tuning the individual legs of the X-brace system, whereas the two separate longitudinal tone bars are easily tap tuned.

6) With all this in mind, X-bracing certainly will work, it is just not as efficient as longitudinal tone bars on graduated soundboards.

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