DEFLECTION TESTING OF ACOUSTIC GUITAR TOPS THEORY AND APPLICATION

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THEORY AND APPLICATION

By Brian Howard

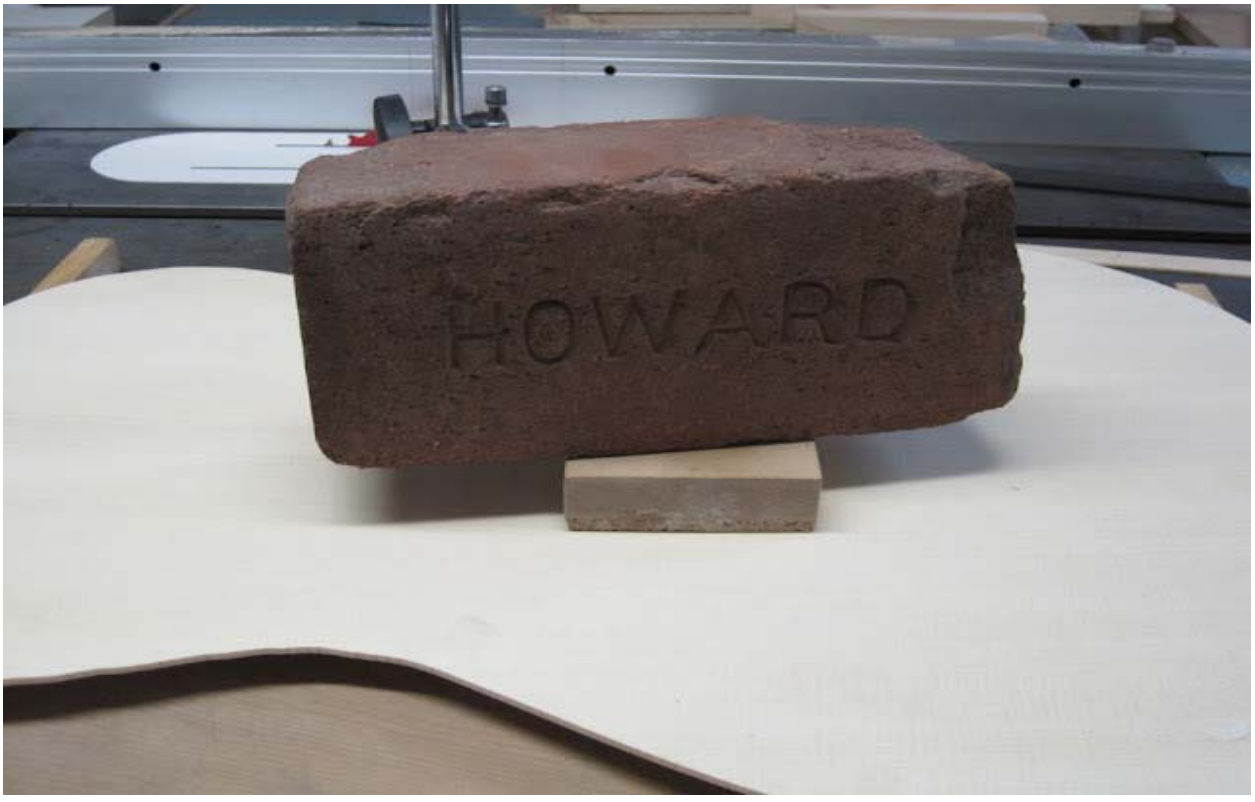
Deflection testing is a way to determine certain properties of the exact pieces of wood being used for construction and use this information to obtain very consistent sounding results from one instrument to the next. Much has been written on the flexibility of the top plate, cross grain versus long grain stiffness, modulus of elasticity, etc. While this is great knowledge it is sometimes very difficult to put into practice. Tables formulated for this always use averages for the variables which is fine but often there intended purpose is in construction of heavier things like houses. When dealing with tops for acoustic guitars our pieces are so small and thin and the load reactions must be in a tight window to get good results that this approach doesn't really work that well.

Factories use the average specifications for their wood to determine things like plate thickness and bracing shape and size. That is why if you play 10 guitars of the same brand , model and year of manufacture you will find there are 2 or so that sound great, 2-3 that sound pretty bad and the other 5 are just so so…….As a custom builder making single guitars or small batches we can do much better. We can take a little time and get the full potential from every guitar we make. Deflection testing is a quick simple and repeatable means to that end.

The principle here is very simple. By closely controlling the amount of flex in the top under a specified load we are in fact controlling how it reacts to changing loads imposed from a vibrating string. If we keep our tolerances tight and work carefully we can make guitars that respond to string vibration and load in almost identical manners. In theory this should only leave other differences in the wood itself that may influence tone very slightly like resin content and overall density. The problem is there are no standards for any of this and each of us must come up with our own practices for this procedure. I am going to share some of mine with you here. I will not share my reaction data but I will share my test specifications.

There are two different deflection tests that I run on each top. The first is to determine the thickness that a given top plate should be. Some will do this before they join the two halves of the top. And while that can certainly work I prefer to join my plate and cut it to rough shape first. To my mind this way has the advantage of only dealing with the wood that will actually be used on the guitar and involved in making sound. I really don't care about the wood in the scrap bin or how flexible it is and I don't want it altering what I am trying to do.

The equipment needed is quite simple. A dial indicator, a magnetic base, a test weight and some small wood blocking. The process is very simple but care must be taken in setting up the equipment to get repeatable results. I use the top of my table saw as a bed for testing. It is flat and the magnetic base will stick to it. I lay two wood cauls across my table. 3/4" X 3/4" X 18" pieces are sufficient. I place them parallel with exactly 18" b4etween them. On my roughed out top I find the center of my X brace and mark it. Measure up and down from this point 9" and make marks at the edge of the plate. The top is placed with these marks aligned on the cauls. The dial indicator is placed with its pointer on the X brace center. It is set up so it is in the middle of its travel range. Be careful that the edge of the plate is not against the magnetic base or it will throw off all your readings. I use one of my cork lined sanding blocks as a cushion for the test weight so it is place right behind the indicator on the lower bout. The reading on the dial is then zeroed out. I place my test weight (a brick I use only for this….which weighs about 2.5 kilos) on the sanding block as close to but touching the indicator as I can and read the dial.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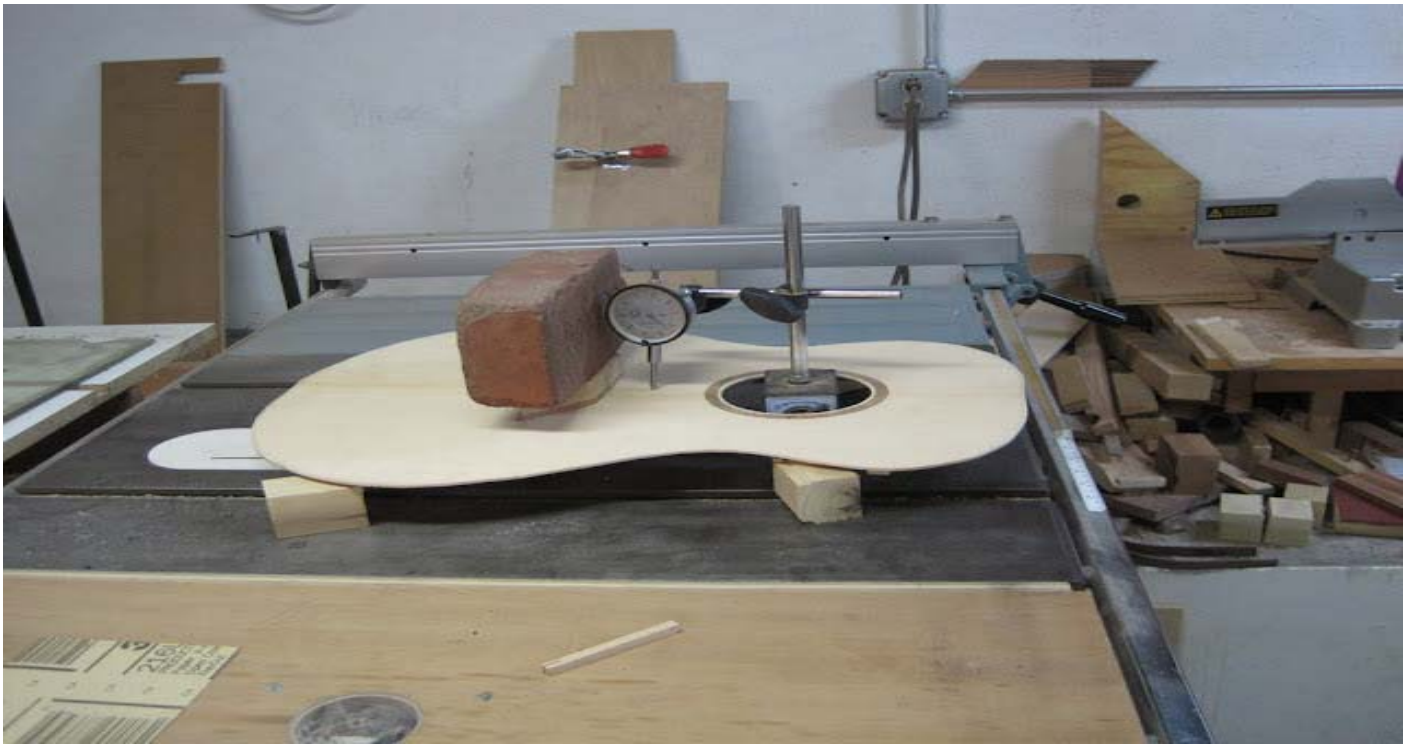
I will then carefully start to thin the plate stopping often to check it for deflection. At first I use a Bailey plane and switch to a scraper when I get close to my desired deflection reading. I am constantly checking around the plate to be sure I am staying at an even thickness. You may want to use a thickness sander if you have one and that is fine. Just remember in the end we are dealing with a small window of deflection we are looking for and material must be removed a few thousandths at a time. Something thickness sanders don't typically do very well. Once I have my desired deflection the top is ready for use.

I know that the sound hole and the rosette will change all this. I don't get concerned with that here. I am simply looking to obtain proper compliance from the top wood. The braces are the load bearing structure and I will account for the hole and rosette when I deflection test the braces. My goal thus far has been to simply create a plate that will behave much like a speaker cone and do so with repeatable results.

Once all my bracing and bridge plate are installed I final shape and sand all the finger braces and sound hole braces. The Main X brace and tone bars are rough shaped and new round of deflection testing begins. The set up is similar as before only the two wood cauls are replaced with 4 small blocks of the same height. These are positioned so that the ends of the X brace rest on them. Readings are again taken at the X brace center. This time the load is positioned directly over the bridge plate and instead of a sanding block under my weight I use

a special caul the same shape as the bridge plate. This time readings are taken in both directions and I will gradually shave specific parts of my X bracing to obtain the desired movement in the desired direction. I work the upper section of the X toward the sound hole to adjust inward movement and the lower section of the X to adjust outward movement.



After I get this to behave the way I want it to I have one last thing to do. I tune the tone bars by ear, tapping, listening and shaving. This is the only subjective part of the whole process and all I am looking to do is achieve a balanced and fairly dead sound from the lower portion of the soundboard. While tapping at the bridge area on the top. Then I am ready to build the box.