Innovation in Violin Making
Cello Neck Reinforcement

JIM HAM

1755 Taylor St., Victoria, BC, V8R 3E8 Canada
jamespeterham@shaw.ca

Thursday, November 6, 2008, 2 pm

Fan Tao, Moderator: Our next presenter is Jim Ham. Jim is well known for his very innovative basses that have adjustable necks and other things. He's also been doing a lot of work these days with other instruments, especially cellos. This afternoon Jim will tell what he has developed for reinforcing cello necks.

Jim Ham: A problem that almost every modern cello has is that ever since we moved to high overstands somewhere in the 19th century, the part of the neck that extends above the top is subject to bending and moving with the changing humidity. Most cello players know that it's hard to keep that stable, so there have been a number of solutions to this issue. One example is David Burgess' method involving three wooden dowels, which was described in the *The Strad* magazine recently (Aug. 2008). Another is Gregg Alf's method that inserts a piece of DragonPlate™ (Allred & Assoc., Inc.), a type of carbon-fiber laminate, into a slot in the heel of the neck.

I've had the privilege of having a friendship with a brilliant guitar maker and innovator, Ken Parker. In talking this over with Ken, he said you've got to have a custom design with continuous fibers that follow the stress, and so I decided to do that.

That is the cutter that I decided to use so that I could make something that could be installed by anyone who is willing to tool up (Fig. 1). There's something special about this cutter, which Ken recommended. He said if you want to cut a channel, you need to use a router cutter that has an odd number of flutes. That's a big deal because that means it will only be cutting on one side at a time as it moves along. If anybody needs to get the link to where to buy that, contact me by email.

I decided to make a mold as shown in Fig. 2.

Figure 1. Three-flute ball-end cutter.

Figure 2. Mold.

I used that cutter with the routing setup to make a mold with the exact shape of the piece that will ultimately go into the cello neck.

To fit it into the cello neck is very tricky. If you're making a new cello, it's going to be a lot easier than doing it in a repair like this. This is a cello by a good, modern American maker. It's a professional cello owned by a professional player, and since it was made in 2002, the neck projection has gone down several millimeters. What I'm doing here is gluing a sacrificial piece of wood to the fingerboard surface after I've removed the neck from the cello. This will allow me to accurately rout the opening for the neck reinforcement (Fig. 3).

In the foreground of this photo (Fig. 4) is the reinforcement that was made using that mold. The reinforcement was made for me by J. B. Allred at Allred & Associates in New York. J. B. is a fantastic guy who makes the Gemini carving machines some of you use. He also owns a company that does high-tech defense-related work involving carbon fiber. He's a very skilled person in carbon fiber. I don't recommend that you try to make your own because there are a lot of ways that you can go wrong using carbon fiber. I've collaborated with J. B. on the design of this carbon-fiber reinforcement, which has a foam core that's milled with a CNC machine in a shape, then formed using my mold. In the background is the routing jig that I used to rout this thing.

A cello neck usually has both taper and slant to it because the fingerboard needs to slant. You know all about that if you make cellos or have seen Hans Weisshaar's book. So the sacrificial piece of wood that I glued to the surface allows me to then go to the jointer, where it is right now (Fig. 5), and rout a counterpart that makes it possible for the router to be exactly square to the surface that I'm going to rout, and also follow the taper of the neck.

This is my routing setup (Fig. 6). I've left the little crank in there. I have a special routing fixture that allows me to use a crank to very accurately adjust the height of the router. A footswitch on the floor controls the router so that both of my hands can control the work piece and not worry about turning the router on and off.

Figure 7 is another picture of the setup. It's not real clear, but the crank is still in there. It won't be when I actually rout it, but I wanted to show that you can use that. So the router is sticking up through the table. I've drawn a fence on the side where the cello neck is, and you can see where the reinforcement will be in the neck.

The router makes the two straight sections, but it doesn't make the curved section. You have to use hand tools. So there's a gouge (Fig. 8), which I use to shape the rounder part.

That's a drill bit (Fig. 9), which is exactly the same size as the router bit, so I drill there and gouge and shape that curve as it goes around the neck. I can fit it pretty well that way.

You can see where the router has made two passes. I've connected the two passes by using a drill and a gouge (Fig. 10).

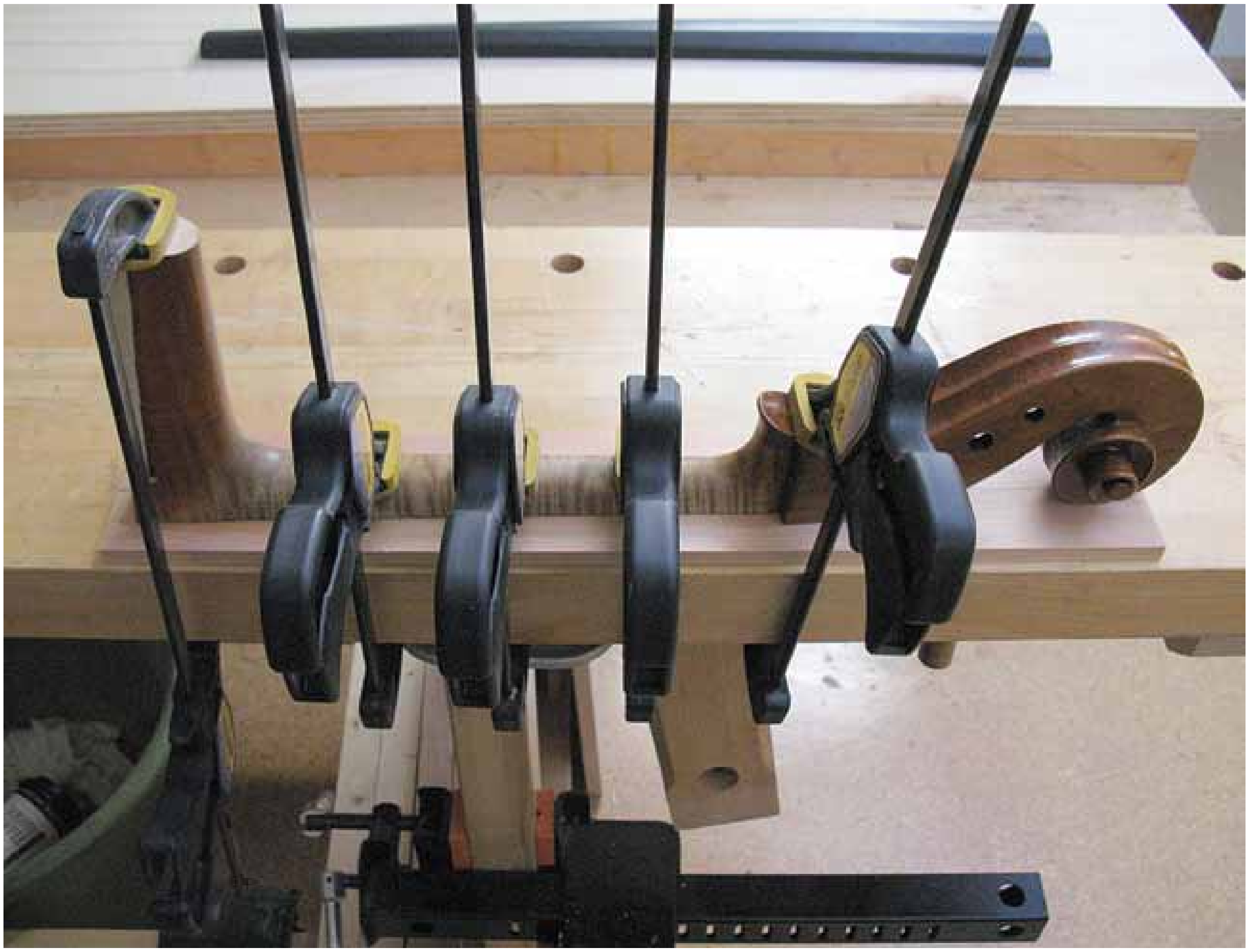

Figure 3. Gluing on sacrificial wood for routing.

Figure 4. Carbon fiber reinforcement and routing jig.

Figure 5. Jointing sacrificial surface, square to the neck heel.

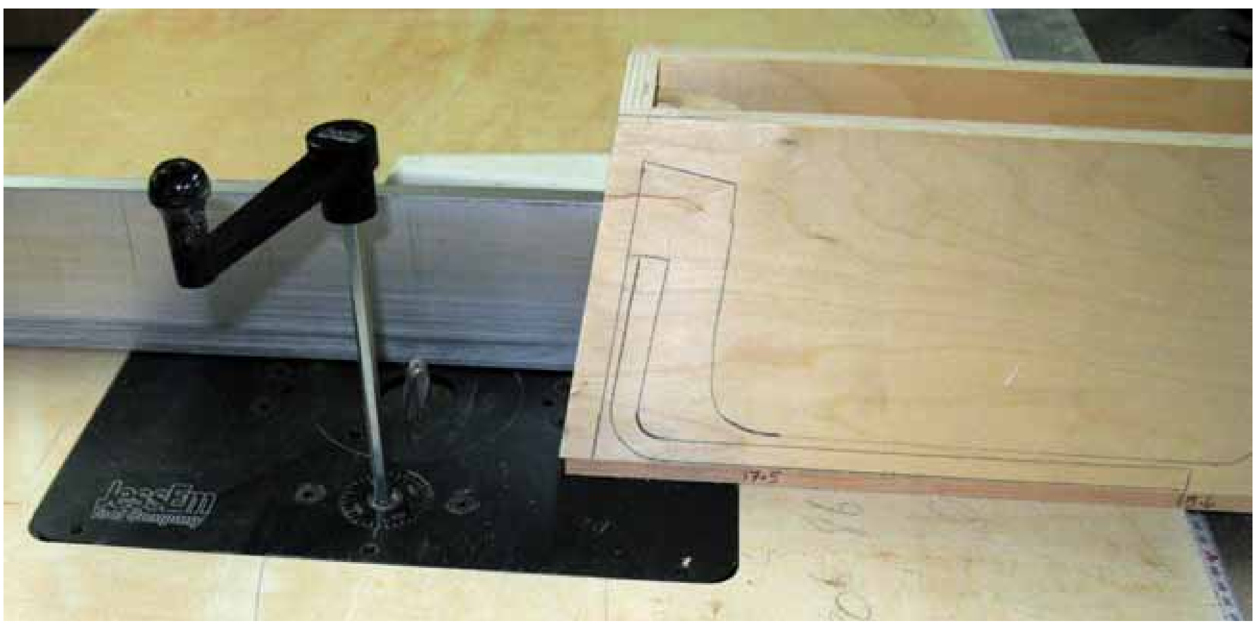

Figure 6. Side view of routing setup.

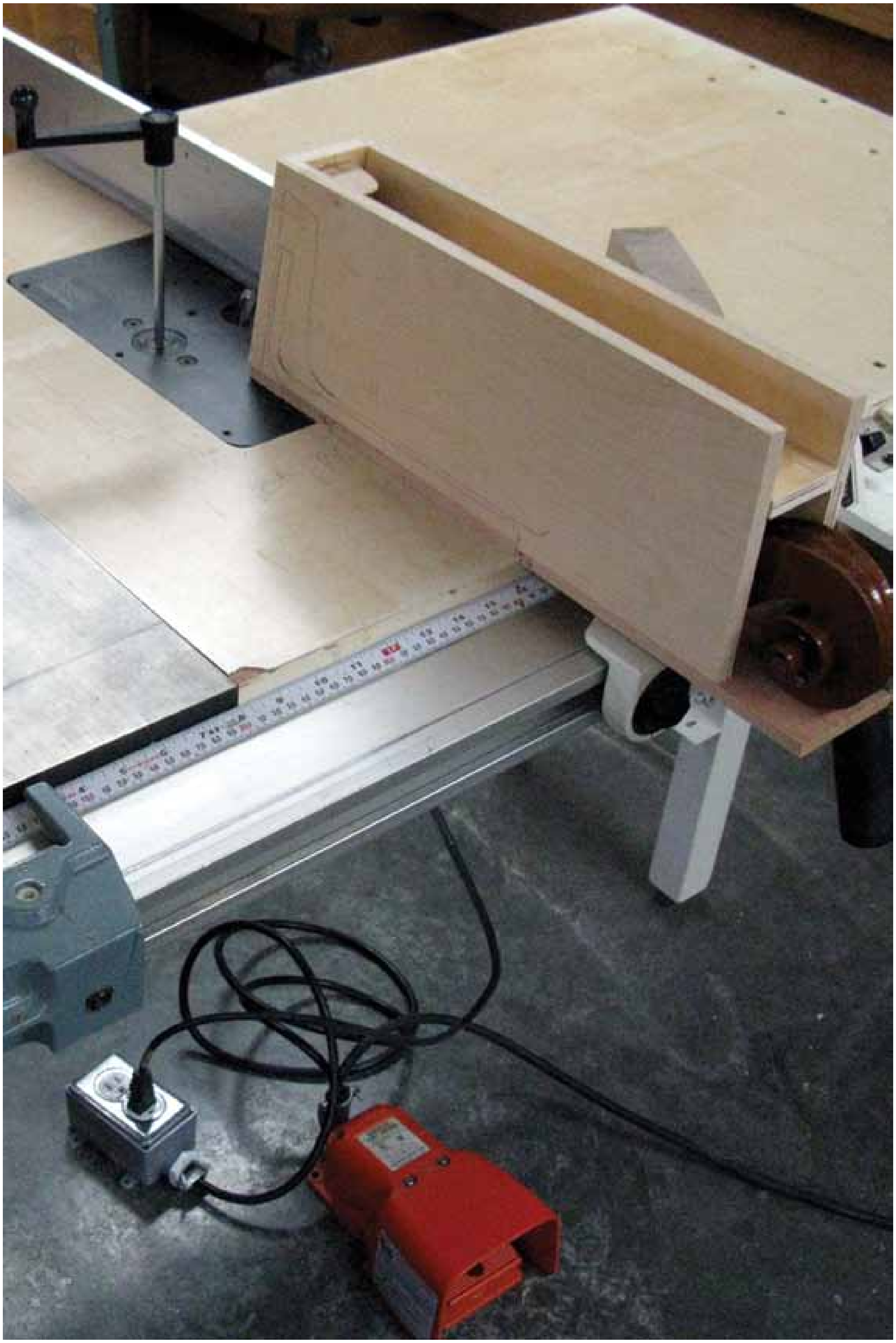

Figure 7. Routing setup perspective.

Figure 8. Gouge for the curved section.

Figure 9. Drill for the curved section.

Figure 10. Neck slots connected.

Now, I've got the reinforcement fitted into the neck (Fig. 11). It's flush to the underside of the fingerboard surface, or a little bit below that, and it's also below the surface in the heel of the neck just enough so I can fit a piece of wood over there. I will glue it in with epoxy, and that will securely attach it and stabilize the neck. Because this reinforcement is made with continuous fibers that follow the shape, it is extremely stiff. The one that I have here today is a prototype. J. B. assures me that the next one will be much stiffer because, after making the prototype, he has figured out how to lay it up even better. I'll show you the piece after this talk. I think you'll agree it's pretty impressive.

That's the reinforcement out of the neck (Fig. 12), and that's the reinforcement on its own with the foam core (Fig. 13). I think that shows the whole idea. My goal is to have J. B. manufacture them and we would make them available to everyone. If you want to set up for inserting them yourself, that's fine. I imagine somebody that does a lot of cello work is going to want to tool up to do that. Somebody that only does it occasionally might send a neck out and have a reinforcement put in.

As a final note, I think that, in addition to making the neck much stiffer and more resistant to warping, there may be a significant acoustic advantage to this. I intend to make a carbon-fiber fingerboard, where the neck and fingerboard system will become lighter and stiffer. That means its vibration frequency will be very much higher. My speculation is that its frequency of vibration will no longer be close to the lower pitch body modes. If so, it should draw less energy away from those important modes.

Daryl Griffith: When the final reinforcement is glued in, do you cover it at all? Do you make it invisible?

Mr. Ham: The only way you'll be able to see it is if you look under the fingerboard, you'll see the little filler piece.

Harry Fleishman: I've been using carbon fiber in guitar necks for about 25 years, and your speculation is absolutely on the money. I started working with a cello maker in the early 1980s putting car-

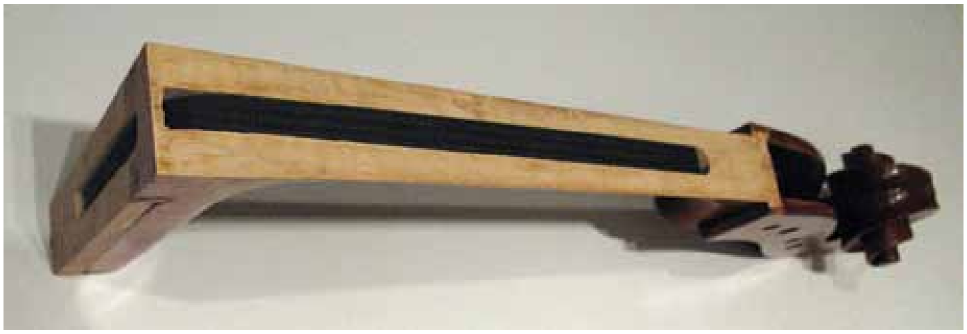

Figure 11. Carbon fiber brace fitted into the neck.

Figure 12. Brace out of the neck.

Figure 13. The carbon fiber brace.

bon fiber in the necks. Not for stiffness, but to raise the resonance, like you're saying. And it solved all those wolf tone problems.

Mr. Ham: Well, that's promising!

Mr. Fleishman: Yes. It was unbelievable. Initially, the cello maker was resistant, but it did work.

Mr. Tao: Thank you very much.