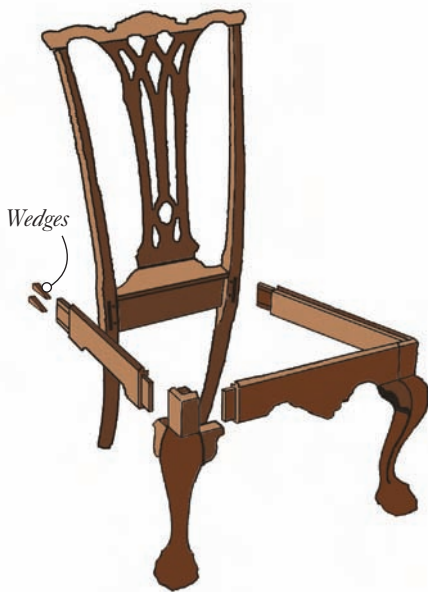


BY ADAM CHERUBINI

Sticking Together

Anatomy of an 18th-century chair glue-up.

Eighteenth-century Philadelphia's iconic Chippendale-style chairs featured unique joinery. Unlike earlier Philadelphia chairs or New England chairs of the same period, Philadelphia Chippendale-style chairs didn't have lower stretchers (joining the legs together beneath the seat support rails) to help support the back. This design choice put a great deal of stress on the seat-rail-to-rear-leg-joint. Typically, furniture forms with structurally inferior joints (such as William & Mary high chests with their spindly turned legs) don't last long. The pieces themselves don't survive and the forms are abandoned by furniture makers and go extinct.



Unique joints. Philadelphia chairmakers working in the third quarter of the 18th century built chairs without lower stretchers. The highly stressed joints between the seat and the back were unique. Rear tenons extended all the way through the back legs. Tiny wedges, hammered in from the back, ensured a tight fit.



Traditional fix. I've had trouble with these joints throughout this series. They have either been the albatross around my neck or my scarlet letter of shame, whichever is worse. Despite my troubles with these loose-fitting tenons, the wedges I'm tapping in are typical of Philadelphia Chippendale-style chairs.

Despite their inefficiencies of joinery, Philadelphia Chippendale chairs have, in large part, beaten the odds and remained in good condition. The reason for the success of this seemingly marginal furniture form is probably the mixture of careful joint preparation, joints designed to be repaired, and the use of hide glue.

In this article, we'll look in detail at how these chairs were put together. I'm hoping that even if you never intend to build a Chippendale-style chair, this article will get you thinking about what you can do to improve the lifespan of your projects and the quality of your joinery.

Wedged Tenons

Philadelphia Chippendale-style chairs are characterized by their use of through-tenons in the back legs. The increased length of a through-tenon reduces stresses inside the joint, making the joint stronger. But the extra length only helps if the joint is tight. I found cutting these joints a none-too-easy feat of woodworking. A close inspection of period chairs revealed I'm not completely out of my league. Period chairmakers seemed to have wedged their through tenons from the back.

We have reason to believe the wedges were original and intentional (that is, they're not a standard shop repair when tenons weren't prepared as required). The wedges are small; usually $\frac{3}{16}$ " thick (and as wide as the mortise) but only half the length of the tenon. Typically, the tenons are sawn down to their shoulders $\frac{1}{4}$ " from the top and bottom to allow for the wedges. Some chairs' tenons were not sawn, rather the wedges were placed above and below the tenons. The difference could be due to whether the side seat rails were pegged or not.

Pegging Judiciously

The rear seat rail tenons were typically pegged. I saw some chairs on which the rear side seat rail tenons (the wedged ones) were also pegged. I saw no chairs with pegs in the front legs. I think the pegs complicate repair. My experience is that they can be difficult to remove. Drilling them out isn't always so easy, especially without modern drills. Where pegs were used, the wedges were placed above and below the tenons to allow for maximum separation of the pegs. I don't know about you, but I get the sense



Wedge prep. Repairs and X-rays done at the Philadelphia Museum of Art indicate 18th-century Philadelphia chairmakers sawed their tenons in preparation for wedges.

these guys were really thinking about how their choices affected structural integrity, future repairs, etc.

Using Hide Glue

Hide glue was used traditionally but it's also the best glue for this job. Mixed and used correctly, hide glue offers as much strength as any modern glue. But it has two unique advantages: Hide glue can be reversed with the application of heat and water. This allows furniture to be repaired more easily.

Second, hot hide glue has a very high stiffness, which allows it to bridge small gaps. Because of this, hide glue (or epoxy) will always be your best bet for sloppy joints. Unlike PVA (yellow and white) glues, hot hide glue doesn't need strong clamp pressure to achieve bond strength. My experience is that it actually prefers the opposite. If a joint



I meant to do that. The story of this joint stretches back nearly a year to the beginning of this series. The first thing I did was undercut this leg. A hasty repair was a recognition that I was in over my head with this project. As bad as this joint looks, the wedges are actually not repairs.

is too tight, the hide glue can get pushed out, which starves the joint and consequently reduces its strength.

There are two types of hide glue on the market: hot hide glue, available in dry form that you mix with water then heat, and liquid hide glue. Liquid hide glue is essentially hot hide with some form of salt added. The salt reduces the strength and the stiffness of the glue somewhat, but makes the glue more convenient to use. Make no mistake about it, the liquid stuff such as Patrick Edwards' Old Brown Glue (wpatrickedwards.com) is a gateway glue. Try it and you quickly become addicted to the hot stuff.

Using hide glue is like everything else we period woodworkers do. There's a technique you have to learn. There are no foolproof ways to use it.

What is often missing from discussions



Hot and sticky. I cover the bottom of my glue pot with dry glue. Then I pour in cold water to cover it. The dry glue quickly absorbs the water and becomes a gelatinous mush. Ten minutes later, I look in the pot, and maybe add a bit more water. In an hour it looks like this. The glue has absorbed all the water it cares to. A little excess water is present. Were there a cup of excess water, I would try to pour it off. The glue is gloppy, not runny at this point. Or you could forget about it and cook the water off.

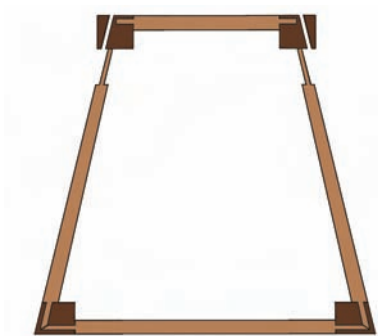
about glue is the fun factor. I find hide glue really fun to work with. When effecting rub joints, you essentially just stick pieces of your projects together like Lego bricks. Woodworking doesn't get more fun than that.

For those of you worried about hot hide glue stinking up your shop, stop worrying. Modern hide glues are very clean. It's essentially a refined form of Jell-O. It's not like having a rotting piece of meat in your shop – though that may have been what it was like 250 years ago. Glue lasts about a week in my shop, then it molds and I throw it in the garden.

Assembling the Chair

Several woodworkers I've spoken with expressed concern about fitting together a chair with angled tenons. The issue is a real one. On paper, there's no way to glue up the front seat rail and legs and get the rear tenons to fit.

The solution is to leave the front seat rail loose (at least). The problem with this approach is dealing with the very short working time of hot hide glue. Mix up a batch of thin glue. Test it between your thumb and forefinger to get an idea of how long it takes to gel. Once it starts gelling, you may have trouble pulling your joints up. You may have a few minutes of working time with fresh hot hide glue. A careful dry fit is always a good idea. Joints that require clamps to come together probably won't work with hide glue. They need to slide together nicely when dry. The warm, wet hide glue is less slippery than yellow glue and it probably swells the wood a little.



Angled challenge. In this illustration, we're looking down at the seat. Obviously the angled mortises in the back legs present a problem fitting the chair together. There may be enough flexibility in the side seat rails to get the tenons started, but I wouldn't recommend it.

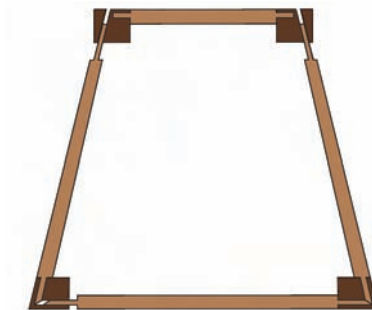


Gentle, even heat. The traditional cast iron glue pot is essentially a double boiler. It's important to heat the glue gently. Even heating is also helpful. Fill the outer pot such that the water comes above the level of the glue inside the inner pot.

Glue Blocks

Mortise-and-tenon joints are very capable when the motion is in the plane of the wide face of the tenon. Now that the chair is glued up I'd have no hesitation about sitting in it and leaning back. The tenons will take that. What tenons aren't great for is side-to-side motion. For this, period chairmakers reinforced their joints with carefully installed glue blocks.

Just to place this in perspective, glue blocks on period casework are often installed in a haphazard fashion. Some builders used neatly segmented blocks. Others seemed



No-glue solution. The solution is probably obvious to you. As long as you don't glue up the front seat rail, you can assemble the chair. The trick is how you do this with hot hide glue.



Continuous stream. Cook the glue until you get a single, uninterrupted stream flowing off your glue brush. If your glue is gloppy, it could be too cold or too dry. Use a thermometer until you can tell by eye what it needs. Heat the glue to 120° to 140° Fahrenheit. I keep an old wine bottle of water nearby. I check the glue periodically, adding water as it evaporates.

to use anything they could find from the shop floor. Glue blocks were often beveled, some carefully. Some were brought to shape with a hatchet. Chair makers in Philadelphia seemed to all use the exact same design for their glue blocks. They started with filler pieces. Two 4/4 pieces of pine made up the shape of the corner blocks. The fillers ran parallel to the pieces they had the most contact with. The corner blocks' grain always ran parallel to the legs. Once installed, each corner's block was rounded with a chisel.

Conclusion

The wedges in these chairs' tenons seem to indicate (once again) that period woodworkers really knew what they were doing. As individuals and as a group, they made good decisions. There doesn't seem to be a group of earlier chairs with through-tenons, and no wedges, indicating the wedges were a "lesson learned." The wedges appear to be an integral part of a pervasive design.

What I'm seeing here are smart woodworkers who understood their materials, their methods and their physics, solving problems caused by fairly sophisticated designs. The customers were looking for works of art in their homes. The style makers



Add fillers as needed. Filler blocks were used to flush the rear seat rail to their adjacent legs. Some fillers stretched across the entire rear rail. Some chairs didn't need fillers.



Simple blocks. The corner blocks were made up of two laminations of 4/4 pine. I didn't see any thought as to grain orientation beyond that they ran parallel to legs. The pieces didn't seem to be quartered or riven.

of the day (Thomas Chippendale was only one of many) were showcasing furniture with flowing curvilinear elements, naturalistic carvings, pierce work and more. In this case, the choice to skip the lower stretcher was probably an aesthetic one. Though it had the potential to reduce the strength and lifespan of the chair, the lack of the stretcher

allowed for an uninterrupted cabriole leg. It also eliminated turned components (the stretchers were usually turned), which may have been a problem for chairmakers in larger cities with more powerful Turners' Guilds.

While you may not enjoy the style, I hope you join me in my awe of these early

woodworkers. We often think about them as having no choices, working essentially as "survival" woodworkers. And while that may have indeed been the reality of their day-to-day existence, in this simple joint we see some fairly sophisticated decision making. They chose a through-joint to account for the lack of a stretcher, wedged it to ensure its structural integrity, and added glue blocks to reinforce it. Their glue allowed them to repair their products. They used pegs where they were most needed.

The uniformity of their products indicates to me that this community was closer knit than we might have previously thought. They certainly shared stylistic elements, but here we see them sharing structural elements as well. Their carefully made choices kept their furniture, and their community, together. Even if you never make a Philadelphia Chippendale-style chair, I hope you apply the same thoughtfulness in the connections you make with wood, be they structural or social. **PW**

Visit Adam's blog at artsandmysteries.com for more discussion of traditional woodworking techniques.

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