Cross-grain Solutions

BY ALAN TURNER

Methods to prevent cross-grain splits in traditional solid wood case construction.

Stack them up. *Hot hide glue makes quick work of gluing up a sandwich of corner blocking segments. This tactic prevents the bracket foot from splitting over time.*

What is obvious to the seasoned furniture maker often escapes the attention of the newer, aspiring maker. This is especially true when it comes to recognizing and avoiding cross-grain wood movement problems. Wood moves seasonally due to the ability of warm summer air to hold a far greater amount of moisture than cold winter air.

In Philadelphia, we are 60 miles from the ocean and we see the equilibrium moisture content (EMC) of wood at about 6 percent in February and approximately 12 percent in early September. This change from winter to summer causes wood to swell across the grain, and this can easily cause splitting in solid wood parts.

Several trips to the Philadelphia Museum of Art to examine pieces in storage, and in its furniture conservation lab, revealed a number that had experienced some level of failure due to cross-grain construction methods, inelegant cross-grain solutions, or had fallen victim to modern systems of climate control.

Museum conservator Christopher Storb argues that the 18th-century furniture we examined was built well for its time, but that the advent of dry, centrally heated buildings, coupled with poorly conceived repairs, are at least as much at fault as original design flaws.

"It is a mistake to think you can solve any major problems just with potatoes."

— Douglas Adams (1952 - 2001)
British humorist author

Solid Cases with Drawers

Many early pieces were built using solid wood – a slab-sided dovetailed carcase. Having the sides, top and bottom with the grain running in the same direction, works well with itself. But when you introduce drawers to the mix, issues arise. Drawers typically run on rails and need to be supported for their entire length.

Many 18th-century case pieces use a solid wood dust panel immediately behind the primary wood drawer blade. In American pieces, poplar was often used. To avoid the problem of running a drawer rail from front to back (and thus cross grain to the case side), the makers introduced a failure-prone element, a solid wood dust panel sitting at 90° to the direction of the drawer movement. With the drawer sliding across the grain, quick wearing of the poplar was

PHOTOS BY MARIO RODRIGUEZ

View from the back. *Here is a the rear of a drawer web frame with the rear tenon's shoulder cut short and left unglued to accommodate movement of the solid wood case side.*

Old nails. *The return moulding is nailed to the case side. There is no splitting so it appears that the old nails were still in use and had not been replaced with modern ones.*

often the result. A different solution was to use a hard maple drawer web frame mounted in a stopped dado.

When building a carcase, your solid wood choices are a single plank (or glued up panel of solid wood), or frame-and-panel construction. With solid wood, the side panels can expand and contract about 1/4", depending upon species and grain orientation. With this slab-sided construction, drawers run on drawer rails, and the rails are cross-grain to the solid wood sides.

On period pieces, the drawer rails were sometimes simply nailed to the case sides with the thought that the nails would give enough to prevent splitting. That usually worked, although the notion of nailing a structural part into a fine piece of furniture is not an attractive option for me.

Also, as Storb noted, nails of the 18th century were forged and quite soft, whereas modern nails, even the reproductions from Tremont, are much harder and thus less easily bent. Seen when effecting repairs, often an old nail will be bent much like the letter "Z" due to cross-grain wood movement. Modern nails do not bend easily and can cause splitting.

A better method is to let a stopped dado carry the weight of the drawer on the rails, and connect the rails in a frame held together with mortise-and-tenon joinery. The trick is to glue in the front and rear drawer blades, glue the front mortise-and-tenon joints that connect the drawer blade to the front of the drawer rails, but not glue the rear mortise-and-tenon joints or the rail into the stopped dado.

Instead, on the rear of the drawer rails, cut the tenon's shoulder about 3/8" short so that, when assembled, there is a gap at the shoulder. Wax the unglued tenon to ensure it does not stick. Then, when the seasons change, the carcase sides will not split.

Applied Mouldings on a Solid Case

Many pieces of furniture are adorned with mouldings, both simple and complex. When these are applied to the front of a piece, glue is all that is needed. The moulding will cause no problems because the grain is running the same direction. But when you turn the corner and apply moulding to the side of a solid-wood case, the moulding and the case side are cross-grain to each other.

The historic way that furniture makers installed the return mouldings was to glue the front several inches at the miter, then nail it to the case the rest of the way back. This works, but it is not a very elegant solution.

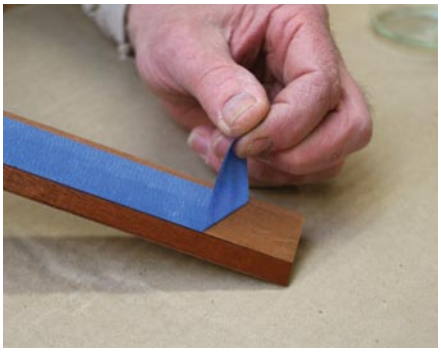
A second way was to cut a dovetail socket on the backside of the moulding, then install a key on the side of the case.

Apply glue to the key in several places and carefully cut the dovetail key into pieces perhaps 2"-3" long, then remove every other one. Slide on the moulding, gluing it only at the front. This can work well, especially for larger mouldings, but on smaller mouldings there may be scant material in the moulding profile to permit the cutting of the socket. And if the piece is inadvertently lifted by the seemingly solid moulding, breakage is likely.

A third method of dealing with the return mouldings on the side of a piece was to make the return moulding of end-grain material, thus avoiding any cross-

End grain return. *In this solid wood dining room piece, the end-grain method for creating the return mouldings was used. This piece was subject to flood damage, so the delicate end-grain mouldings deteriorated.*

Elegant solution. *A plinth built like a drawer web frame with an unglued, short-shouldered tenon at the rear accommodates the side movement.*



Stick here, not there. *Shellac the portion of the moulding that will overhang the solid wood case so you don't accidentally glue the moulding to the solid wood case side.*

grain situation. This is a not-uncommon method seen in New York pieces. While it does avoid the cross-grain conundrum, the end cuts lack strength and are subject to breakage and deterioration, lacking, as they do, any long-grain structure.

Far less common, a fourth way to attach mouldings is similar to the drawer web-frame method. Build a mortise-and-tenon plinth base or top, thinner than the height of the moulding, and attach that to the case in a manner similar to the drawer frame.

Cut the front mortise and tenon in the traditional manner, but make the shoulder about 3/8" short on the rear of the side rails. Glue on the front rail of the plinth, glue the front mortise-and-tenon joints, and glue the rear of the plinth to the case – but do not glue the rear mortise-and-tenon joints and do not glue the side rails to the case.

Glue the moulding to the front of the case, and for the mitered returns, glue them to the side of the front plinth and to the side rail, but not to the end grain of the rear rail. Glue the moulding to the plinth only, and not to the case.

To protect against accidental glue creep onto the case, mark out the thickness of the plinth on the back of the moulding then carefully apply a coat of shellac to the portion of the moulding that will not be glued. Work carefully to prevent glue squeeze-out onto the case.

Glue Blocks & Bracket Feet

Bracket feet are attractive but generally not structural. Often the weight of a carcase is carried on hidden corner blocks, not on the feet themselves. This is because the bracket feet sit largely beyond the plane of the carcase due to their shape and the typical presence of a base moulding applied to the case.

The usual corner block is a 1" x 1" piece of solid wood about 1/8" longer than the total height of the foot, glued in long grain to the inside corner of each foot. One sometimes sees a split bracket foot because of this cross-grain construction.

To avoid this potential problem, make up a piece of plywood, so to speak. Make a group of 3/4" thick, 1" x 1" squares, and glue them into the inside corner of the feet, one at a time, alternating the grain direction for each layer, as shown in the opening photo.

The long grain will glue well to the inside of the feet, and the corner block will swell and shrink with the bracket feet as the seasons change. No strength will be sacrificed. Use rubbed, hot hide glue for this procedure and you will not need to mess with a million small clamps. As the glue dries it will tighten up the corner-block stack and you will have a strong and worry-free set of structural feet.

Classic problem. *Here is a classically split flat-bracket foot below a customary base moulding. Its inner corner is reinforced with a cross-grain glue block.*

Immovable object*. This solid mahogany sideboard top is badly split. The top itself is only about 1/4" thick, but it is set on an inflexible substrate: a rail-and-stile structure. The top moved but the substrate did not, so it split.*

Flexible connection. *This mock-up shows how a metal fastener can be installed with an oversized hole to avoid cross-grain splits.*

Attach the Top

If you build a slab-sided carcase and add a solid wood top, there are no cross-grain issues. You can simply glue or screw the top to the sub-top of the case. But for attaching a solid wood top to a plywood or frame-and-panel case, the top will move winter to summer, but the case sides will not.

The usual method is to drill for tight-fitting screws in the front to set the overhang, then to cut slots for the rear screws, with the notion that as the top moves seasonally, the slotted holes in the rear will accommodate the movement without splitting the top. This works well, but cutting the slots is fussy work.

An easier method is to drill the rear holes to a proper but generous size for the shank of the screw, then to counterbore from the backside (the top of the sub-top) to provide relief to permit wood movement. Note that at a 20" width, plain-sawn mahogany moves only 3/16" with a 6 percent EMC change, and with cherry and walnut, movement is about 5/16", so not a lot of room is needed for this simple method to be successful.

Chronic back problem. *Common in the period, a rather thin, solid wood back was simply nailed on. Splitting is also common.*

Solid Wood Backs

Certainly it is "period correct" to simply nail on a solid wood back of wide, thin planks and be done with your work. But splitting is pretty common when this method is used. Instead, use narrower boards and shiplap them, attaching each board only in the middle to force the wood movement equally on both edges. Or, if more formality is needed (or more strength), use frame-and-panel construction; that will add rigidity to your work.

With some thought and careful planning, even with the extreme moisture content issues caused by modern heating and cooling systems, one can design solutions to avoid improper cross-grain constructions. **PWM**

Shipshape solution. *Shiplapped boards, attached only in the middle of each, will avoid the splitting issues inherent in the use of wide planks.*

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