Epoxy Consolidation:
An Alternative Method for Restoring Piano Pin Blocks

„An interesting German harpsichord was rebuilt and somewhat modernized in 1950 by John Challis. Somehow, the original, very badly split pin block was considered just worthy enough at the time to be sent on to the next owner of the harpsichord. At a 1970s estate sale, the harpsichord sold to a new owner. Harpsichord maker and restorer Thomas Wolf was at the auction, but failed to win the harpsichord. However, when the auctioneer held up an old box of odd parts and miss-read the old label as „wristbands," Wolf purchased the box on the off-chance the pieces might be related to the harpsichord. Indeed they turned out to be not wristbands, but wrestplanks, including the harpsichord's original pin block, and the first of two replacement pin blocks which still carried the original veneer of decoratively painted soundboard wood. Wolf kept the pin blocks for the next several decades with no idea what became of the harpsichord. In the 1990s, the harpsichord was finally donated to Colonial Williamsburg Foundation. I suggested to the owner the name of an appraiser. Thomas Wolf Tom was very excited to hear about the harpsichord's re-emergence in Williamsburg, and eagerly donated the pin block fragments to Colonial Williamsburg. Since then, we have made detailed CAD drawings of the original pin block, and merged them with drawings of the harpsichord, thereby re-constructing essential details of scale and layout that had been lost since the 1950 rebuilding. German harpsichords are relatively rare to start with, in spite of the importance of JS. Bach and other composers writing for it in that part of Europe. This one, dated 1726, is thought to be the only known example from the Rhine valley." -
John Watson, Colonial Williamsburg

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Cracked pin blocks are a common problem with historic pianos and harpsichords. The out right removal and replacement of the pin block used to be the only possible solution, but the invasive nature of this procedure has caused many restorers to turn to other techniques. Keeping all the original components of an antique instrument is of paramount importance, and as the above story illustrates,we never know how future historians will view the objects we are dealing with today. Clearly, removing veneer and sawing-out pinblocks will not be viewed very kindly. This article is intended to offer an alternative.

Consolidation

Consolidation is a technique that is widely used by conservators as a means of imparting structural strength to a deteriorated object. The idea is to get a liquid consolidant to penetrate into the object, and then through evaporation or chemical reaction, the consolidant turns into a solid, providing structure from within the object itself. Piano technicians do this when we apply "juice" to hammer felt. The consolidant is nitrocellulose lacquer or acrylic key tops dissolved in acetone. When the solvent flashes off, the polymers reconnect into long chains and cross-link inside the felt, providing the structure. Consolidation treatments are not perfect. Once they are applied, the original object is usually permanently altered. Another problem is getting the consolidant to penetrate deeply into the surface of the object, which depends on the viscosity of the consolidant and the porosity of the object. The use of undiluted lacquer on hammer felt would be a good example of the importance of low viscosity. Without thinning the lacquer, it will not penetrate the felt and the resulting tone will be undesirable, to say the least. Consolidating the wood in a cracked pin block requires the use of specialized epoxies due to the required low viscosity. Penetration of the cracks in the wood and the wood cells themselves requires a liquid with a viscosity nearing that of water. (Viscosity is measured in units expressed as centipoises or cps. The viscosity of water at 20°C is 1cP. Do not use an epoxy that is above 200cps for this purpose.)We rely on the force of gravity and the effects of capillary action to move the epoxy into the cracks and damaged areas. Additionally,the epoxy must be 100% solids so that it will not shrink when it cures. Many epoxies are thinned with solvents to lower their viscosity,but when the solvent flashes off, they occupy less space, leaving voids within the wood.

The Epoxy
Epo-tek 301 is made by Epoxy Technology Inc. It has two distinct advantages for this procedure. First, it has a very low viscosity (100cps), which allows the epoxy to easily enter the hollow cavity of the wood cells. Second, the epoxy contains no solvents, so there is no shrinkage when the liquid epoxy becomes a solid acrylic within the cells. There are other products by other manufacturers that have these same properties, but commonly available epoxies, such as West System Epoxies, have a mixed viscosity of 975cps, which is way to high for our purposes.

The Procedure

Removal of Strings and Tuning Pins
Ideally, the original strings and tuning pins should be removed and kept in order for re-installation. This is only possible when the tuning pins are already so loose that they can be extracted with upward twisting force from a pair of pliers. (Pad those jaws with leather, please.) It's easy to keep the strings and tuningpins in order by using a simple jig made from a block of Styrofoam and plywood. Glue the foam to one end of the plywood to serve as a pin block, and drive nails to serve as hitch pins. When there are agraffes involved, it is sometimes necessary to lift the coils off the tuning pins and leaving the strings in place. If the tuning pins are too tight to pull straight out, plan on replacing strings using appropriate wire. Since bass strings are often distinctive, try to leave them in place by lifting the coil off of the tuning pin. Careful cleaning of the pin block area and tuning pin holes is important. If debris or a bit of broken wire are left in the holes, this will cause a lot of trouble when the epoxy is being drilled out.

Sealing the Bottom
The biggest problem with this treatment is keeping the epoxy from draining out of the pin block before it sets. Seal any visible cracks in the bottom of the block using Scotch Magic Tape. (Surprisingly, it works pretty well) If the tuning pin holes are drilled right through the bottom, a seal can be created using a flat plank of wood clamped to the bottom of the block, with a 1/2" thick layer of foam carpet padding in between. An additional layer of waxed paper between the padding and the block keeps the whole thing from being glued in place. Two pin block jacks and lots of bar clamps will be required. Protect the key bed with a layer of waxed paper so that any leaks will be contained.

Set the Drill Angle
Use a 3/8" hand drill to re-drill the tuning pin holes. In order to duplicate the angle of the original holes, attach a "bull's eye" spirit level to the drill and zero it before filling the holes with epoxy. This can be done by gluing a small square of wood to the top of the drill, and install three small flat-head screws. Make a second square of wood with three holes drilled directly over the screw heads of the first piece, allowing those screws to be turned through those holes. With the level glued to the second square of wood and attach it to the first square with two screws so that it is sitting on the screw heads protruding from the first piece. By reaching through the adjustment holes, zero the level.

Mix and Apply
Wearing splash goggles and plastic gloves, mix the epoxy. For Epo-Tek 301, use a proportion of 3 parts resin to 1 part hardener, by weight. (By the way, this is not the manufacturers recommend mix proportions, but it seems to work well for this application.) Use a gram scale and mix directly into an 8 ounce plastic hair coloring bottle (Sally's Beauty Supply). Part A and Part B tend to stratify in the bottle and a great deal of stirring is required. Failure to get the two parts thoroughly mixed means that the epoxy will not cure. Also, heat buildup from the chemical reaction can be a problem. Keep the bottle away from bright lights or other heat sources once it is mixed. If the reaction really starts running away, the bottle will start heating up in your hand. It may actually melt the plastic bottle. Application is accomplished by filling the holes from the bottom up with a hypodermic syringe, or by pouring the epoxy directly into the tuning pin holes until they are full. It usually takes two 8-ounce kits to treat a full size pin block. Continue to top off the holes until they level off, just below the top. Any holes that are immediately drained are likely to have unsealed cracks. If these holes are repeatedly filled and then drained, that epoxy is going to start coming out somewhere, usually dripping epoxy onto the key bed. In this case, it is useless to

continue. The last few drops of epoxy generally seal the leak and fresh epoxy can be successfully applied the next day.

Drilling
Find the right size drill by experimenting. Start with a size that is about .006” smaller than the tuning pin and then test the results by slowly driving a pin into this hole, stopping often to test the torque. It is quite easy to break-off a tuning pin that has been driven into a hole that is too small, so take great care until the right size drill has been determined. When reusing the original pins, be aware that they may not all be the same size. Set up a vacuum cleaner hose to draw off the flashings and to cool the bit. The little crater (meniscus) that is formed by the liquid epoxy helps to center the drill. A sharp drill will produce white paper-like flashings, and when it gets dull, the flashings will be powdery. Have a new drill handy.

Driving Pins
Antique or new, tuning pins are not always the same diameter, so care has to be taken when driving them into the pin block. I drive them in part of the way and stop to test the torque with my tuning hammer. If the pin is too tight, it’s best to take it out so that the hole can be reamed to a larger size. It is easy to break an antique pin, even if it’s just a little too tight.

When problems arise
Broken tuning pins. Tuning pins often break where the hole is drilled for the becket, making it difficult for a broken tuning pin extraction tool. In this case, I usually clamp an expendable pair of vise-grip pliers onto the pin, and heat the pliers from the side with a plumber’s butane torch. The heat will travel down the tuning pin and soften the epoxy (a plastic). Removal becomes possible using the extraction tool or another pair of vise-grip pliers. Once the tuning pin is removed, fill the hole with fresh epoxy and make a replacement tuning pin. (See related skills.)If the epoxy fails to harden, it is usually because of a failed mixing process or inadequate stirring. The gelled epoxy must be removed from the holes by drilling with a smaller diameter drill, or by punching it out using a hollow cylinder made for this purpose. Once the epoxy is mostly removed, it can be retreated with new epoxy. A chemical bond will form with the gelled epoxy, causing it to harden.

Related Skills

Making an antique tuning pin
Start with cutting the correct length of drill rod. The diameter should be slightly larger,or exactly the desired diameter. Put the tuning pin blank into the drill press and use a file to fashion the bullet shaped on one end. Once the shape is established, use the file to reduce the diameter so that it is the same as one of the original pins. If the pin is tapered,copy that taper. Before removing the pin, add light threads by holding the file at a diagonal and taking a few final passes along the lower part of the pin. Forming the head is done by hammering the pin on an anvil, and finishing off the shape with a file. To keep hold of the pin during this part of the work, use a dowel with a hole drilled in the end as a pin vise. Once the pin is complete, heat it with a butane torch until its color turns blue, and quench it in water. This will harden the pin and “heat bluing” will prevent rust from forming.

Making a T-Hammer for Antique Pins
Following the procedure above, make the top part of a dummy tuning pin that has the same dimensions as the head of the original pins. Next, cut an 8” length of drill rod, (the diameter depends on the size of the tuning pin). and chuck this into the drill press. Choose a drill that is slightly larger than the, diameter of the tuning pin head, and clamp it vertically in a drill press vise. By lowering the turning rod onto the point of the stationary drill, centrifugal force will force the drill into the correct position to drill a hole into the exact center. Use cutting oil as a lubricant and drill to the desired dept. Now, for the fun part. Holding the drill rod with pliers, heat the end the end of the rod with a butane torch until it is cherry red. Quickly, put the head of the dummy pin into the hole and using a big hammer, smash the rod until the round hole has deformed into the shape of the tuning pin. Remove the dummy pin, reheat to cherry red and quench in water. Test the fit on the original pins, and clean up the outside shape with a file so that it will

fit between the pins. To make the handle, cut the rod to the desired length and file 4 flat spots on the end to make it square. The wooden handle can be turned out of some exotic wood, or can be as simple as a hardwood dowel. Drill a hole in the middle of the handle that is somewhat smaller that the squared off end of the rod, and simply drive the “square peg into a round hole”. Add a pin that runs through if necessary.

Conclusion

From a conservation point of view, Epoxy consolidation of piano pin blocks is far more desirable than replacing the original parts with new wood. There are details about the construction of a piano that are embedded in its parts. Paraphrasing John Watson, it’s like tearing pages out of an encyclopedia. In addition, the total process is less time consuming and can be quite profitable. Time required to completely treat a pin block, including restringing, is often only 5 days. Upright pianos that are not normally viable candidates for replacement pinblocks, can be restored for a reasonable price. Some pin blocks, like the Chickering grands with double flanges, are more easily consolidated than re-fabricated. Other pin blocks that are still functioning at the time of rebuilding, can be consolidated as insurance against future failures. Tuning a piano after this treatment has been done is not bad. The tuning pins typically turn smoothly after an initial “pop”: The feel in not unlike pins turning in a multilaminate pin blocks, (also a combination of wood saturated with polymers).Pianos treated with this procedure have been in service for 30 years without any failures. The first done by this author, an 1860’s Chickering grand, has been at the Smithsonian Institution since the 1978.

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