

Restoring Wood With Epoxy

Instead of tearing out and replacing rotten wood, you can fix damage and make wood look as good and last as long as new

by Tom O'Brien



Fascia



Windowsill



Column base



"Give me liberty or give me death!"

On March 20, 1775, Patrick Henry spoke those immortal words in a small church here in Richmond, Virginia, galvanizing the second revolutionary convention to fight for independence from England. As a carpenter living and working in Richmond's historic Church Hill district, named for the church where Patrick Henry delivered those famous words, I am constantly bombarded by history.

As a lover of history, I am both fascinated and humbled to know that many of the structures I work on have borne witness to profound events. So when I'm asked to rip out and replace a piece of weather-damaged woodwork where Robert E. Lee may have leaned a war-weary shoulder, I try to find an alternative. High-strength epoxies offer that alternative whether the wood you're fixing is 20 years old or 200 years old. With apologies to Mr. Henry, I have to say, "Give me epoxy."

Epoxy isn't for all repairs—Epoxy for wood repair has been around for decades and is routinely specified on major historical-restoration projects nationwide. One manufacturer, Abatron (sources of epoxy, p. 65), has been making epoxy wood-repair systems since 1959.

In the simplest terms, an epoxy repair goes something like this. After loose, crumbly wood is removed and sound wood is dried, a liquid consolidant is applied to impregnate and strengthen rot-damaged wood. Then a puttylike compound fills the gaps, replacing the missing wood.

The most common complaint I hear from people who've attempted an epoxy repair is that "the damn stuff all fell out." But after using epoxy wood-repair systems for many years, I've found that if procedures are followed carefully, epoxy is almost as wonderful as the advertisements claim. But when instructions aren't carried out carefully and dutifully, indeed, the damn stuff may all fall out.

Epoxy does have its drawbacks. First, it's expensive, at least 50¢ per fluid ounce, and that's for large quantities. Also, in many cases the repair procedure is more complex and time-consuming than a simple cut-and-replace job. In my opinion, some rotten-wood situations, such as framing lumber, square porch posts and stock railing parts, are usually easier to replace than to repair with epoxy, unless removal of the damaged wood is difficult, the damage is minimal or George Washington's initials are carved into the damaged wood.

Epoxies can also be used for major structural repairs such as rebuilding the tenons on large beams in historic timber frames. In these repairs a special epoxy that cures harder than conventional epoxy is combined with gravel, fiberglass-



Getting down to sound wood. The first step is removing loose, crumbly wood. A five-in-one painter's tool and an awl are best for digging out any wood that is not still firmly attached.



Consolidant is injected into the repair. Liquid epoxy, or consolidant, is squeezed into holes drilled around the repair. The consolidant saturates the soft wood, making it rock hard.

Brushed-on epoxy consolidates exposed wood. In addition to being injected, consolidant is brushed onto exposed wood until it no longer soaks into soft wood.





Two-part fillers are mixed on a board. After measuring the right amount of resin and hardener paste, the two are kneaded together on a scrap of plywood.

Keep the paste thin to prolong pot life. Epoxy cures more quickly if left in a large mass. To lengthen working time, the mixed epoxy is spread out in a thin layer before the filling begins.



Wood blocks save on epoxy. To keep from using large quantities of expensive epoxy, blocks of wood are encapsulated in the epoxy to act as aggregate.



reinforcement rods or metal plates to effect the repair. Structural repairs with epoxy require special skills and should be done by epoxy experts with the approval of a structural engineer.

On the other hand, nonstructural repairs such as window parts, turnings, door-jamb bottoms and decorative cornice work as well as minor structural repairs such as column bases are almost always worth restoring with epoxy (photos p. 60) and require only basic skills and common tools. I try to approach each new situation with an open mind, considering both replacement and epoxy as repair options. I don't make a decision until I have seriously evaluated the damage and considered the work involved.

Address the cause of the problem first—A while back, I repaired a fascia board with a small rotten area that was caused by a leaky box gutter. Despite my pleas, the homeowner never repaired the leak, and as you can imagine, the damn stuff all fell out. Regardless of whether you decide to replace or repair rotten wood, you must eliminate the reason that the wood rotted in the first place.

Like any well-executed project, a successful epoxy repair begins with careful prep work. I start by digging out the loose, crumbling, spongy decay until I reach sound wood, which is wood that is still firmly attached to the original stock (top photo, p. 61). The sound wood may be wet, brown and ugly, but as long as the wood doesn't crumble or break off, I can dry it out, consolidate it and make it part of my repair.

My favorite tools for rot removal are a painter's five-in-one tool and a wire brush. A screwdriver, pocketknife or scratch awl is also handy for digging into deep, hard-to-get-at areas. After I've gotten rid of the nasty stuff, I remove any paint around the edges of the repair site with a scraper and a heat gun. Then I blow out all the loose debris and dust with compressed air. A shop vacuum and dust brush also work well. A clean surface is one of the keys to a permanent repair.

Drying out the damage—Excess moisture in wood keeps it from absorbing liquid consolidant, and unconsolidated wood may continue to rot over time. So the next step after removing rot is letting the remaining wood dry sufficiently.

For minor repairs such as a small rotten area in a fascia board, a day or two in dry air may be enough once the moisture source has been eliminated. Drying out larger repairs, however, such as a severely damaged column base where a great deal of moisture is trapped in the sound wood, may take more-intensive measures. If the wood is really saturated, I drill a number of 1/4-in. weep holes up from the bottom and the sides to let water run out. Then I make a tent out of 6-mil black plastic and duct tape to keep bad

weather away from the repair while allowing moisture to escape. I use black plastic instead of clear because it heats up more and speeds the drying process. With the plastic tent in place, all but the wettest areas should dry within a week.

If it's convenient, you can raise the plastic tent on days when no rain is predicted to allow more air circulation. If dampness remains after a week or if I have to start the repair sooner, I accelerate the drying by fanning the wood with a heat gun set on low.

When is the wood dry enough? Most manufacturers specify that the moisture content should be less than 20%. A moisture meter is the best way to measure wetness accurately, especially when it may be trapped beneath the surface; however, this device can cost a couple hundred dollars. Most of the manufacturer representatives that I talked to told me that a moisture meter is not absolutely necessary. Basically, they said to follow the Tom O'Brien moisture test: If the wood feels wet, then it's too wet.

Consolidation makes rotten wood as hard as stone—Simple repairs can be consolidated by merely brushing the liquid-epoxy consolidant on the surface. If the rot is extensive or cannot be easily reached with a brush or if I suspect that rot may be hidden beneath what appears to be sound wood, I drill a series of $\frac{3}{16}$ -in. or $\frac{1}{4}$ -in. holes in a random pattern about an inch apart, taking care to stop the drill bit just short of the bottom of the wood. I use these holes to inject consolidant deep into the damaged area so that the consolidant can soak into the soft but sound wood.

After a final cleanup to remove the sawdust from the drilling of the injection holes, it's almost time to mix the consolidant. However, before mixing any epoxy, I always sit down with a big cup of coffee and a couple of chocolate doughnuts and thoroughly reread the manufacturer's instructions. I have a three-ring binder in which I keep the manufacturer's instructions to all the epoxy products I use, along with my own detailed notes and any other literature that I've found informative. Making certain that I haven't overlooked anything in the preparation and reacquainting myself with the whole process is well worth any razzing I may receive about having to read the directions.

Epoxies have a limited working time, or pot life, so before I begin mixing, I make sure that I have all necessary tools on hand. The list includes duct tape and 6-mil plastic to protect surrounding areas from drips and runoff, 8-oz. hair-dye bottles (the kind with the nozzle top and graduations on the side) for mixing and injecting consolidant, tongue depressors or cedar shims for stirring, tin cans or plastic margarine tubs for brushing reservoirs, a variety of dispos-



The rest of the hole is filled by hand. Epoxy paste is packed into the repair by hand until the entire gap is filled.



All dressed up. The same poly tent that is used to keep moisture away from the repair while it dries also protects the epoxy from weather while it cures.

A homemade tool for re-creating odd shapes. Irregular profiles such as the fluted bottoms on these columns can be molded using a plastic putty knife with the shape cut into the blade.





Woodworking tools also handle epoxy. Cured epoxy can be worked like wood. A chisel and a Surform plane rough out the shape, and sandpaper does the smoothing.

A skim coat touches up small voids. Epoxy filler adheres well to itself, so any small areas left from the initial fill can be skim-coated and blended into the repair.



Primer protects the epoxy. As a final step before painting, a coat of primer is applied to seal the repair against moisture as well as against UV-radiation, which can damage some epoxies.



able paintbrushes and acid brushes for applying the consolidant and, most important, a lot of disposable latex gloves to protect my hands. For the filling stage I'll also need some small (1 sq. ft. to 2 sq. ft.) plywood scraps that I mix the filler paste on and bunches of plastic putty knives of various widths (1 in., 1½ in., 3 in. and 6 in.) for mixing and applying the epoxy filler.

After masking off my work area, I slip on three or four pairs of latex gloves. (When one pair gets messy, I simply peel them off and have a fresh pair to work with.) I mix the consolidant by pouring the specified amounts of resin and hardener into a hair-dye bottle. Then I stir the mixture thoroughly for five full minutes.

When I'm finished stirring, I pour about half of the liquid into an empty container for brushing and screw the nozzle top on my mixing bottle. Using the spout of the hair-dye bottle, I squeeze consolidant into the holes I drilled until the consolidant oozes out of the holes (center photo, p. 61). I also brush the liquid over the exposed wood (bottom photo, p. 61). Dry, damaged wood soaks up the liquid consolidant. So I continue to inject the liquid until the holes stay full, and I brush it on until the surface of the damaged wood is saturated and glossy.

Filling the gaps—The consolidant should have a few hours to dry, but it does not have to be fully cured before filling can begin. In fact, the best bond between the consolidated wood and the filler is achieved when the consolidant is still a little tacky. If the consolidant has fully hardened before I can fill the damaged area, I lightly sand the area or brush it with a light coat of consolidant to help the filler bond to the wood.

The mixing procedure for epoxy filler depends on the brand used. Some epoxies, such as Con-Serv and West System, start as liquids. With this type of epoxy, the resin and the hardener are combined in a small paint bucket or similar container. Once the liquid has been thoroughly stirred, powdered thickening agents are added to create the filler paste.

Other types of epoxy, such as Abatron, start out as two-part pastes, which are ready to mix with no other additives (top photo, p. 62). For this type of epoxy, I combine the two parts on a mixing board and knead the mixture thoroughly for at least five minutes with a 1½-in. plastic putty knife, scraping the surface of the board often to ensure a homogeneous mixture.

After the paste is mixed, I spread the filler out on a board in a thin layer (center photo, p. 62). Epoxy creates heat as it cures, and heat hastens the curing process. I've been told that a large mass of curing epoxy can actually generate enough heat to catch fire. Keeping the mixture in a thin layer minimizes heat buildup and lengthens the pot life of the mixture.

For a small repair, I usually fill the entire hole in one shot. However, large repairs have to be treated a little differently. Because of the heat-buildup problem with a large mass of curing epoxy, manufacturers recommend applying the epoxy in layers no more than 1 in. thick at any one time to avoid the risk of fire.

Large quantities of epoxy can also get pretty expensive. So to keep down the cost and to do most of the filling without risking fire or compromising structural integrity, I use small blocks of clean, dry wood as aggregate in the epoxy (bottom photo, p. 62). First I cut the blocks roughly to size and dry-fit them, making sure there is at least ¼ in. of space on all sides of the block for the epoxy. Next I coat the insides of the holes with plenty of epoxy paste. After buttering the blocks on all sides with the paste, I press them into the holes. The epoxy should ooze out on all sides of the blocks to ensure that no air pockets are left behind the blocks. I fill any remaining spaces with epoxy (top photo, p. 63) and let the repair cure overnight under the poly tent (center photo, p. 63).

Cured epoxy can be worked like wood—If the area I'm repairing has an irregular shape, such as the fluted base of a round column, I tool

the final layers of paste with a plastic putty knife cut to fit the contour of the irregular shape (bottom photo, p. 63). Once the epoxy has cured, it is delightfully easy to work (top photo, facing page). I use a Stanley Surform pocket plane (Stanley Tool Works, 600 Myrtle St., New Britain, Conn. 06050; 800-648-7654) and a wide, sharp wood chisel to do the rough-shaping. Then I sand the repair smooth with 100-grit paper, using a random-orbit sander wherever possible.

With most repairs I usually have to touch up a few spots with a skim coat of epoxy (center photo, facing page). To achieve a smooth finish—and to reduce the amount of sanding—I mix a slightly more fluid batch of epoxy. Manufacturers have recommendations for adjusting the consistency in their instructions. Depending on the product, this is done by reducing the amount of thickeners, by adding a thinner or consolidant or by adding a specially designed liquid epoxy. When I'm in a rush, I fan the skim-coated areas with a heat gun set at low temperature, taking care not to cause the skim coat to blister. A heat gun can make the epoxy skim coat cure in 10 minutes to 15 minutes, and a quick pass with the sander blends it in with the rest of the repair. As a final step before the painter arrives, I give the repaired area a coat

of a high-quality exterior primer (bottom photo, facing page). Priming and painting not only protect the repair from the weather but also fend off the ultraviolet radiation that some epoxies are vulnerable to.

Keep an eye on the repaired areas—Although I consider a careful epoxy repair to be permanent, that doesn't mean it can be forgotten. The fact that the wood failed in the first place means it may be susceptible to damage in the future. For this reason I always urge homeowners to monitor the repair as well as neighboring areas as part of their regular maintenance schedule, along with keeping their rain gutters cleaned out, painting and doing other chores that keep moisture from deteriorating wood.

Maintenance should be twofold. First, make sure that whatever water leakage caused the wood to rot in the first place does not recur. Second, you should check the repair once or twice a year for soft areas that may develop where the consolidant may not have reached or where rot may have gone undetected. If discovered early, repairs can be made easily. □

Tom O'Brien is a restoration carpenter in Richmond, Virginia. Photos by Roe A. Osborn.

Sources of epoxy

There are too many manufacturers to include in this limited space, but here is a list of the epoxy makers I've had experience with.

Wood-restoration epoxies

Abatron Inc.
5501 95th Ave., Dept. FH
Kenosha, Wis. 53144
(800) 445-1754
Abatron is the oldest and largest maker of epoxies for wood repair. Available only by mail order, their products are easy to mix and tool, and they come in convenient, easy-to-use packaging. Starter kits are available in a variety of quantities.

My only problems with Abatron are that their small-print instructions are not comprehensive enough for first-time users and that their technical support is inconsistent

ConServ Epoxies
Housecraft Associates
7 Goodale Road

Newton, N.J. 07860
(201) 579-1112

ConServ is a much smaller operation than Abatron, but their products come with good instructions (a 65-page application manual is available for \$10). Technical support is good, and the company's owner, Brace Whipple, will talk you through the procedure. ConServ takes longer to cure but after curing stays more flexible than most epoxies.

ConServ is available only by mail order but comes in less convenient packaging. The mixing procedures are also more involved.

Repair Care Systems USA
300 Oak Street #155
Pembroke, Mass. 02359
(617) 829-4555

Repair Care is new to this country, but it has been in use for many years in the Netherlands. Instead of using consolidation, Repair Care requires that all damaged wood be removed before rebuilding.

Marine epoxies

West System Epoxy
Gougeon Brothers Inc.
P. O. Box 908
Bay City, Mich. 48707
(517) 684-7286

West System is intended mainly for boat repair, but it's also marketed for repairing wood rot. It's available at marine-supply centers nationwide and comes with an excellent technical manual. I'm told that Gougeon Brothers are renowned for their terrific technical support.

West System also uses no consolidant, and the 5:1 mixing ratio can be complicated.

Smith and Co.
5100 Channel Ave.
Richmond, Calif. 94804
(510) 237-6842

Smith is another marine epoxy. I bought some but haven't had a chance to try it yet. It's also marketed for wood repair.

Other products

Thompson-Minwax Co. Inc.
10 Mountainview Road, Suite A
Upper Saddle River, N. J.
07458-1934
(800) 523-9299

The Minwax product is actually a polyester rather than an epoxy. It looks and acts much like auto-body Bondo and is available in hardware stores and home centers nationwide. However, their instructions are skimpy, and they offer no technical support.

For additional information on epoxy repair, contact preservation consultant John Leeke (26 Higgins St., Portland, Maine 04103; 207-773-2306; johnleeke@aol.com). John publishes a series of Practical Restoration Reports, including one called "Epoxy Repairs for Exterior Wood" (10 pp., \$9.95), which is filled with many helpful tips.—T. O'B.