Structural Epoxy Repairs

by John Leeke

I recently mentioned "structural epoxy repairs" as a way to repair decayed sills and posts (1/89, p. 49). Now, I'll show you how this repair technique can be used to solve problems with damaged framing.

Wood timbers lose their strength when damaged by fungus, decay, and insects. This is common when a girt is set into a masonry wall. Masonry traps moisture against the wood timber. Fungus and wood ants feed on and weaken the damp wood (see Figure 1). Sometimes a plumber who cuts into a timber joist to run a pipe can damage it as well. In either case, the timber is too weak for structural support.

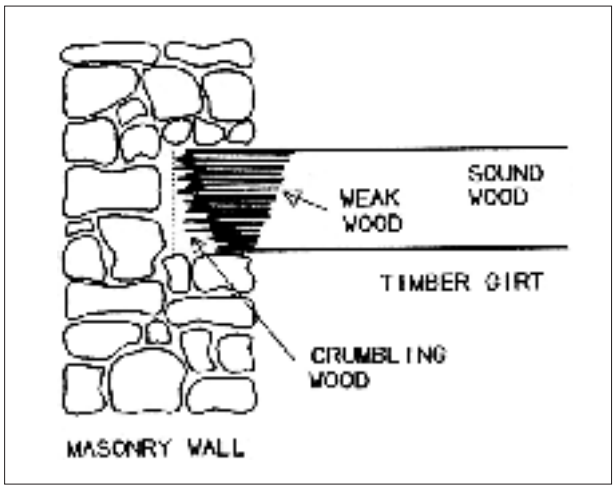

Figure 1. *When a girt is set in a masonry wall, trapped moisture lets in fungus, decay, and insects.*

Traditionally, a carpenter would scarf in a new section of solid-wood timber or replace the whole girt. A contractor might build up the girt with pressure-treated 2x lumber, or "sister" a couple of 2x planks onto the joist. You could also strengthen the weak timber with reinforcements embedded within the timber.

Structural Epoxy Repairs

Yet another way to fix weak and crumbling timbers involves structural epoxy repairs. With this technique, reinforcement bars, metal plates, or fiberglass rods are inserted into the timber. Then liquid-epoxy mastic is poured around the reinforcement, with the timber itself acting as a mold. When the epoxy hardens, it bonds the reinforcement to the timber (see Figure 2).

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This is all done with the timber in place, and only a limited amount of material surrounding the damaged part of the timber needs to be removed. Everything else that is attached to the timber stays in place. Since there are no sistered planks or heavy-metal brackets sticking out beyond the original surfaces of the timber, the repair looks better. Reinstallation of the exterior sheathing or interior finish is easier too.

The Problem

Let's say you have a timber where the decay has already weakened a section of the wood, and some wood is crumbling away or already gone.

To reinforce it, use high strength materials such as steel rebar or aluminum plates. They are fit within the timber, and they significantly strengthen it. Fiberglass rods and plates can also be used (see Figure 3). As in concrete work, the reinforcement must carry compression, tension, and shear loads. Fiberglass rods more closely match the flexibility of wood timbers.

The mastic for this process is made up of epoxy resin. You may want to make an "extended" resin by adding an aggregate of sand or other filler. Epoxy resins function in two ways. First, they replace decayed and missing wood and add strength. Epoxy resins formulated for structural work are two or three times stronger than sound wood. Second, epoxy resins bond the reinforcing components (fiberglass rods or metal plates, etc.) to the timber. Since epoxy adheres well to wood and reinforcement materials, the different materials act together as a single component. Structural epoxy is more rigid and less likely to creep under load than adhesive epoxies.

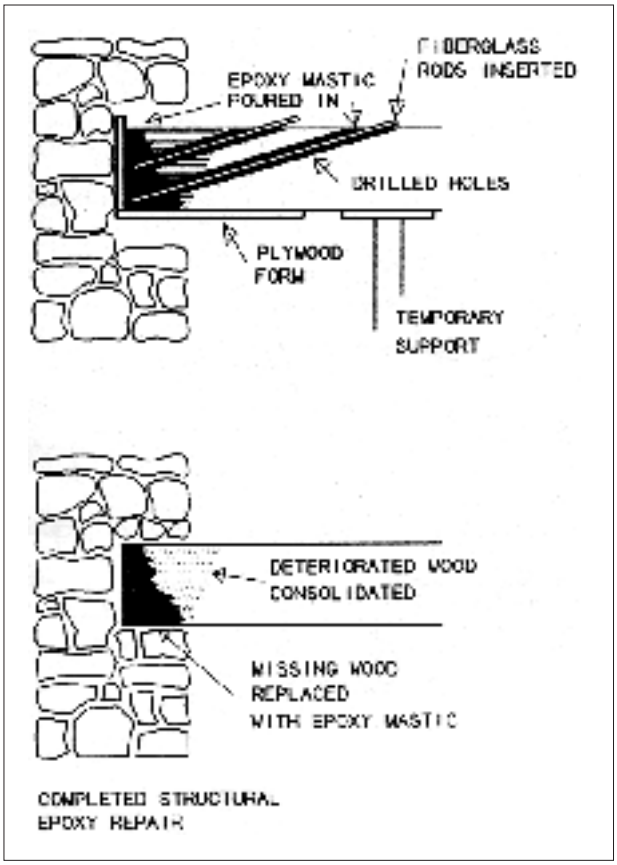

Figure 2. *With epoxy repair systems, reinforcement bars, metal plates, or fiberglass rods can be inserted into the timber. Liquid epoxy mastic is poured around the reinforcement.*

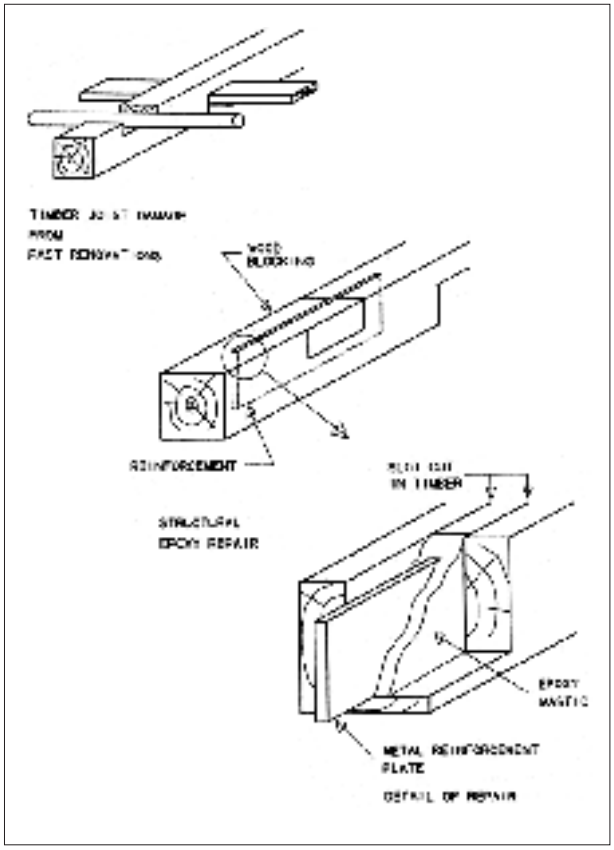

Figure 3. *When repairing timbers damaged from previous renovation, fiberglass rods or metal plates can be used as reinforcement.*

Engineering

You need to plan out the design for each structural epoxy repair. Use standard formulas that calculate expected loads and material strengths. It may seem unnecessary to design each and every repair, but a "seat-of-the-pants" approach produces variable results at best, and disaster at worst. With proper design, the existing timber, reinforcement, and mastic work together to improve the strength of the timber.

Historical Restoration

Structural epoxy repairs are often recommended for structural members with historic or artistic importance, such as a summer beam with molded chamfers on a timber with carvings or painted finishes. At times this method is more economical than traditional ones. This is especially true when damage is limited to a small area of timber that is part of the complex framing system.

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Two Available Systems

Two systems of structural epoxy repair have been developed. The first is the W.E.R. System. W.E.R. stands for "Wood Epoxy Repair." This system was developed in Canada through extensive laboratory and field testing. The system includes design and engineering methods as well as techniques for handling epoxy materials. Several examples of different kinds of repairs are detailed in the System Manual. (The W.E.R. System Manual is available from APT Publications, Box 8178, Fredericksburg, VA 22404.)

The second system is the Beta System. This was developed in the Netherlands by the Bureau Beta, and the technique is patented by them. Use of the system is licensed to trained applicators. Contractors and carpenters can take a short training course for $500 or $600. You must have taken the course to buy the system, though some Beta materials are available without a license. (The Beta System is available from Dell Corporation, 301/279-2612. Attn: Brian Blundell, 1045 Taft St., Box 1462, Rockville, MD 20850).

Epoxy Repair Advantages

- Using epoxy repair does little damage to the timber and causes little disruption to the surrounding parts of the building.
- The technique makes full use of the remaining strength of the old timber. In fact, the ep can even add to the natural strength of the timber, upgrading it for modern use.
- The system is simple, and these basic application techniques can be applied to wide variety of situations, including new work.
- The epoxy is as flexible as the wood around it. This is an improvement over improperly designed heavy-metal fasteners. When lag-bolted to wood timbers, rigid metal fasteners can rip the timbers apart as the wood moves over a period of years.
- For conservationists, epoxy repairs save as much of the original fabric of the timber as possible.

Disadvantages of Epoxy Repair

- The process is not reversible. You can't take a joint apart once it's locked together with epoxy. This is why it is important to do effective work the first time.
- The start-up costs are high, and they include the cost of training, supplies, and, in some cases, license fees.
- The materials are hazardous. You need gloves, goggles, and respirators for skin, eye, and lung protection. Improperly selected or poorly mixed epoxy materials can overheat and burst into flame.

Knowledge of Structures Still Necessary

I don't think structural epoxy repairs are a substitute for traditional skills and knowledge. A keen knowledge of how early structures were built and meant to work is still necessary. Using a calculator and engineering formulas or applying modern chemicals takes as much skill as using a carpenter's slick or smoothing adze. They are all "tools" that can be used effectively to solve structural problems on early buildings.

Sources for Epoxy Repair Supplies

ConServ Epoxies offers a full line of epoxy resins formulated for specific uses and related supplies; Conservation Services, Lakeside Trail, Kinnelon, NJ 07405; 201/838-(64128).

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Sika is recommended in the W.E.R. System. Sika Chemical Corporation, Box 297, Lundhurst, NJ 07071; 201/933-8800.

Arcon offers a full tine of epoxy resins and other supplies. Allied Resin Corporation, Weymouth Industrial Park, East Weymouth, MA 02189; 617/337-6070. ■

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