

BY CLAYTON DEKORNE



Blue stain (1) is caused by a fungus that lives in the sapwood of trees. It discolors the wood but is not rot and does not have any effect on the strength of the wood. In North America, the two most common types of true rot are “cubic brown rot” (2), which attacks the cellulose component of wood, and “white rot” (3), which feeds on the lignin that binds wood cells together.

A Builder's Guide to Wood Rot

Wood rot is caused by several kinds of fungi, but not all fungus that lives on wood causes rot. Mold, for example, is one type of fungus that can live on the surface of wood—and should be dealt with when present (see “Mold on Lumber,” page 32)—but has no effect on the strength of the wood.

Similarly, blue stain is caused by microscopic fungi that commonly infect the sapwood of living trees; the fungi remain in the wood when the tree is milled into lumber, but cause no loss in strength. Decay fungi, on the other hand, break down the cellular structure of wood, which does cause a loss of strength.

THE MECHANICS OF ROT

There are a number of different types of decay fungi, all of which rot wood by secreting enzymes or producing chemical reactions that break down the wood's cell walls. Decay becomes apparent

when the wood changes color, becoming either darker or lighter than surrounding wood. As decay advances, the wood develops checks and cracks in the discolored area and becomes obviously softer or more brittle than solid wood.

Rot fungi are living organisms that need four things to survive: food (wood); favorable temperatures (above 32°F to around 100°F), water, and oxygen. If wood is rotting, you can stop the rot process by eliminating one of these four things.

Generally, the most effective approach to combating rot is to keep the wood dry. New wood needs to be at around 28% moisture content before decay fungus can grab hold and start growing. That's very wet, close to saturation in most woods, but it doesn't mean the whole board needs to be completely soaked. A board that remains wet on one side and is continuously exposed to a high moisture content can begin to rot. As the rot advances and breaks down the wet



Both white and brown rot can grow in the same piece of wood—in this case (4), the sheathing around a poorly flashed cupola. Rotten wood is often found in a dry condition (5) and so is called “dry rot.” But the wood had to have once been wet for the decay to occur. In this case—an old wood gutter—the wood had ample opportunity to get wet.

MOLD ON LUMBER

Mold growth on lumber has no structural effect on the wood. Unlike rot fungi, mold fungi grow only on the surface of lumber and do not have roots that grow deep into the lumber. When you find mold on lumber in the lumberyard or after storing lumber on site (black is most common, but it can also be green, pink, or orange, among other colors), it should be avoided or cleaned off.

Typically, mold on lumber is an indication of high moisture levels in the wood, and the lumber needs to be dried to a moisture content below 22% before using it to frame a wall. (Dry below 19% before closing it in; some folks will even say below 12% before hanging drywall if they are concerned about interior wood joints staying tight.) The mold stain may remain on the surface of lumber after the wood is dry, and once encased in the wall is unlikely to be a problem ... except that it can be. There is limited research that “hidden” mold can increase the number of mold spores in the indoor air, but mold is one of those hair-trigger issues that is best to avoid if you can. If owners are walking the site and see mold on lumber, it will raise concerns, and concern easily escalates into fear and litigation. To avoid all that, it's best to not select it at the lumberyard to begin with. If it's delivered and can't be returned, or is discovered after it's on site, it's best to clean off the mold before building with it.

To clean mold from the surface of lumber, scrub with water and detergent, then rinse and wet vacuum the surface. The individuals doing this work should wear gloves, eye protection, and NIOSH-approved respirators. Do not use bleach. Bleach may remove the mold stain, but it won't remove mold spores and is a lung and skin irritant. Using bleach only unnecessarily exposes workers to a hazard. Detergent will do as well to remove the stain, and what will really get rid of mold spores is vigorous scrubbing, rinsing, and vacuuming. If the mold is caused by a flood contaminated with black water, use an EPA-registered disinfectant. These tend to have fewer adverse effects on workers than bleach, but you still need to follow safety guidelines for protecting workers. —C.D.K.



Photos: 4, Isaias Antonio Santos; 5, Kyle Diamond



Leaving rotted wood in place is often a judgment call. If the leaks above this fascia were solved and the moisture problem eradicated, would you leave these old rafter ends in place? It's a tough decision, but if new outriggers to support the fascia and soffit are put in place, the rotted beam ends could remain without the complete demolition and rebuilding of the eaves.

side of the board, more of the board will be exposed to that high moisture content, and eventually it will rot through.

Wood that has begun to rot but is still solid can be salvaged, however. Wood that has started to rot will stabilize once it has dried. The fungus goes dormant below a moisture content of about 22%, and as long as the moisture content is maintained below this level, the wood will not continue to rot. But the decay fungus can reactivate and begin growing when the moisture content again rises above 22%.

TYPES OF ROT

In general terms, the two most common types of wood-eating fungus in North America are “white rot” and “cubic brown rot.” White rot eats the lignin, leaving the cellulose and covering the wood surface with a white mat of fungal fibers. Cubic brown rot eats the cellulose component of wood, leaving the darker brown lignin component, which shrinks into characteristic blocky formations.

Rot is known by a lot of names, not all of which necessarily correspond to a specific fungus species. These are some of the common terms:

Dry rot is a term loosely applied to any dry, crumbly rot, and

especially when, in an advanced stage, the rot can be crushed easily to a dry powder. The term is a misnomer for any decay, though, since all fungi require considerable moisture for growth.

Heart rot is any rot confined to the heartwood. This type of rot, specific to certain species of fungi, generally originates in the living tree and rarely makes its way to the jobsite. However, it's not uncommon to discover boards in the lumberyard that slipped through the grading process with rotten hearts.

Soft rot is a special type of decay developing under very wet conditions in the outer wood layers. It is caused by cellulose-destroying microfungi that attack the secondary cell walls and not the intercellular layer. This sort of rot is found in old commercial cooling towers and in boat timbers at the water line—where, despite the nearly submerged conditions, the fungi still have access to oxygen, a necessary ingredient. Soft rot is not possible, however, in trees that have been submerged completely in rivers or swamps and then are brought up, dried, and milled into usable lumber. Under such fully submerged conditions, fungi spores in the wood are not able to develop without oxygen, and the wood, though soaked, is preserved. Sometimes, anaerobic bacteria help the preservation by breaking down some of the gummier parts of the tree, creating a



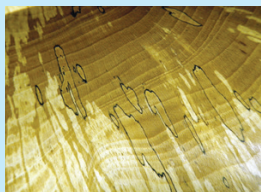
In cases of advanced decay (7), there is little question that the rotted structure needs to be completely replaced with new framing. But not all wood destruction is caused by rot. Water seeping through brick got things started here (8), and you can see where white rot lingers on the surface of this rim joist. But the ultimate destruction of this framing came from termites.

wood that is actually stronger than it might have been if the tree had been harvested on dry land in the first place.

Not all deteriorated wood is rot, though. Termite damage often looks exactly like “dry rot.” And in many cases, the scent of rot may be what drew the termites. But termites usually are a lot quicker than fungi at destroying the structural integrity of wood.

SPALTED WOOD

Spalting is caused by certain types of white-rot fungi growing in wood (primarily hardwoods such as maple, birch, and beech). The fungi create “zone lines” in the wood where territories of competing fungi meet. Though usually used for decorative woodwork and furniture (live-edge tables and shelves are currently in vogue), spalped wood is occasionally used for interior trim, as well. According to the Forest Products Laboratory, once the wood is harvested, the fungi die and remain in stasis without further growth or compromise to the wood. (It is also possible to induce spalting in harvested wood; see the Forest Products Laboratory’s technical bulletin “Producing Spalped Wood.”) —C.D.K.



INCIPIENT VS. ADVANCED DECAY

Early-stage decay that has not advanced far enough to soften or otherwise perceptibly impair the hardness of wood is known as “incipient decay.” It is usually accompanied by a slight discoloration of the wood, and the big question that carpenters often face when working on existing structures is whether it is OK to build onto slightly decayed framing. As long as the wood is solid and is kept dry, wood that is slightly discolored by decay fungus is OK to leave in place. Before sistering new framing to the old wood, treat the existing lumber with liberal doses of a copper-based wood preservative, such as QNap, or spray with a borate-based preservative, such as Bora-Care.

Wood in an advanced stage of decay, in which the attack has caused the wood fibers to become friable or has split the wood into sections, is essentially worthless. As much of this destroyed wood as possible should be replaced.

Inevitably, it may make sense to leave some damaged wood in place. For example, floor joists that have rotted at the ends near the sills may be inaccessible to remove. If reinforced with sistered joists and a new rim joist or blocking, the rotted ends can remain. The ends of the rafters shown in photo (6) are another case in point. As long as no structure depends on the deteriorated wood for support, and the wood is kept dry, they should be OK.

Clay DeKorne is chief editor of JLC.

Photos: 7, Isaias Antonio Santos; 8, Robert Mignogna; sidebar, Bernhard Hoffmann