Preventing Early Deck Framing Failures

by Frank Woeste

Collapsing decks—sometimes involving serious and even fatal injuries—continue to grab the headlines. NADRA (the North American Deck and Railing Association; nadra.org) estimates that nearly half of the more than 60 million residential and commercial decks in the U.S. are past their useful life.

Sometimes, the structural connections—think bolts, lag screws, engineered structural screws, ordinary decking screws, concrete anchors, joist hangers, and other structural connector hardware—are deficient due to a design defect or corrosion (rust), which alone can cause a deck element to fail without warning. But decayed framing system components, such as joists, beams, posts, footings, stairways, guard systems and handrails, decking, and treads, can alone cause or contribute to a collapse event. Of course, decayed wood coupled with a deficient connection can jointly cause a collapse event.

I believe that contractors can do more to extend the life of the framing on a new deck, avoiding costly repairs or deck replacement costs and—more importantly—preventing an unexpected early framing decay collapse event. My recommendation is to flash the tops of all joists, beams, and stair stringers to provide preservative-treated wood additional protection, and make sure that the framing can dry out.

Life Expectancy of Deck Framing

Prior to 2004, residential deck framing in my region was constructed with southern pine (SP) lumber and preservative-pressure-treated (PPT) with chromated-copper-arsenate (CCA) at the AWPA (American Wood Protection Association) Use Category UC4A level, known as "Ground Contact."

Because of its cellular structure, southern pine is a preferred species for the PPT process, and CCA was a proven effective preservative treatment for solid-sawn wood products. The expected life span of an elevated deck built with 2x8 or 2x10 SP joists and nail-laminated beams CCA-treated to AWPA UC4A requirements was typically two to three decades.

When manufacturers voluntarily discontinued producing chromated arsenicals for residential use in December 2003 and started treating lumber with alternative preservatives, they also reduced retention levels for lumber widely available to contractors and homeowners from "Ground Contact, UC4A" to "Above Ground," labeled AWPA UC3B. As a result, UC4A treated lumber largely disappeared from the marketplace, except as a special-order item (see "Treated Wood Industry Looks to Toughen Standards," *JLC* Feb/15). Unfortunately, by the end of the next decade, deck builders and others began to report unexpected deck framing decay, sometimes after only about 10 years of service.

Preservative treatment lumber tag on one end gives the size of the 2x12, along with the AWPA UC4A level that indicates it is suitable for "Ground Contact."

By 2016, the AWPA responded to the early decay issue by adding a footnote to the AWPA Standard U1, Table 2-1 Service Conditions for Use Category Designations: "Joists and beams shall be treated to requirements for UC4A when they are difficult to maintain, repair or replace and are critical to the performance and safety of the entire system/construction."

Joists and beams used to construct a residential deck are indeed "difficult to maintain, repair or replace" and, when elevated, are "critical to the performance and safety of the entire system/construction." The AWPA recommendation led to UC4A treated lumber becoming more commonly available, particularly in the wider dimensions typically used for framing decks. Being that AWPA U1 is a referenced standard in the IRC, contractors are well-advised to make sure they are indeed using PT lumber rated for ground contact (UC4A) for elevated deck joists and beams. In addition, deck contractors should save all treatment end-tags and give them to the homeowner for demonstrating that AWPA UC4A treated lumber was used and to save in case of a warranty claim.

The Need for Flashing

Even with UC4A treated lumber, the service-life of deck framing may be less than desired due to numerous factors, such as species of lumber, effectiveness of the preservative, climate, and treatment variables that can affect the quality of the treated materials. For example, the preservatives used during the treatment process are waterborne, so if the wood cells are already full or partially full of water because the lumber to be treated

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hasn't been well-dried, the cells will absorb very little treatment solution. In addition, the heartwood at the center of a log is difficult to treat, even if well dried.

While preservative treating plants generally subscribe to a third-party quality control (QC) inspection service that visits plants on a schedule, only a sample of lumber is tested per AWPA testing standards. As such, it is unlikely that the individual pieces of preservative-treated lumber delivered to your jobsite for a specific deck project would have been tested for chemical penetration and retention. In addition to the efficacy of the chemical treatment used, both penetration and retention of the chemical in each piece of lumber are critical to the in-service performance of the lumber. Due to the natural variability of moisture content (at the time of the pressure-treating process) and other treatment variables for each piece of lumber, it's likely that some pieces and batches of treated lumber may not perform in-service as expected.

According to Jim Mailey, a former training specialist (now retired) with Simpson Strong-Tie and author of NADRA's "Decks Done Right" education programs, "There are numerous stories from deck builders that the framing is lasting 7 to 10 years before significant decay has shown up that can be seen without doing the pick test (which can detect early decay before it becomes visually evident)." Based on a concern for occupant safety as well as deck replacement costs, I believe that measures to enhance the protection of framing lumber without increasing the potential for fastener and connector corrosion caused by higher preservative retention levels are warranted.

Extending the Deck Service-Life

Flashing all joists, built-up beams, and stair stringers while providing free or unobstructed ventilation below is a simple way to address this uncertainty and extend the service-life of deck framing to as much as 25 years. A self-adhering, self-sealing flashing (not all peel-and-stick membranes are self-sealing) or a self-sealing coating that has been tested to meet the standards of AAMA 711 should be used over the tops of joists to prevent the entry of water around the decking screws or other fasteners used to install the decking. The expected service-life of the flashing is also important as the tops of all joists between deck boards will have some UV exposure, and the outside top edge of band joists and beams may have maximum UV exposure most of the day.

Central Virginia deck after 10 years in service. The bulk of decay damage is where the top edges of joists are in contact with the decking. Such water-trapping joints accumulate water by gravity and capillary action and are slow to dry after a rainstorm since the top edge of the joist is not exposed to natural ventilation.

Constructed in coastal New Jersey, a deck joist in-service about 10 years was preservative treated to the "Above Ground" AWPA U1 Use Category.

Advanced decay of joists and beam treated to "Above Ground" based on an available treatment tag. The tag did not indicate an AWPA Use Category System.

Built-up beams are especially vulnerable to water collecting in the gaps between members, which can be avoided by flashing the top of the beams. At least one manufacturer, PWT, which offers a preservative-treated LVL, has a requirement to flash all framing. Flashing for 2-by joists should be a minimum of 2 1/2 inches wide to ensure good coverage. Built-up nail-laminated beams (two, three, and four plies) should be flashed with a single width that is adequately sized to cover the entire assembly.

Deck ledger. Of course, the single most important structural element to flash on a deck frame is the deck-ledger-to-house-band connection. While an in-depth discussion of this critical detail is beyond the scope of this article, guidance

The PWT preservative-treated LVL framing has been flashed for additional protection.

This UC4A-treated 6x6 southern pine post has been repaired using UC4B-treated 2x6 cleats and ¼-inch-by-3-inch structural fasteners. Note that the cleats (as well as the concrete, not shown) have been sloped to shed water.

Cutting a stringer creates "end grain" at each stair tread and riser. End grain absorbs water up to 100 times faster than the sides of the lumber do. As such, cut edges of the 2x12 preservative-treated southern pine stringers are flashed.

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on how to flash a deck ledger properly can be found in Figure 14 in the American Wood Council's DCA6 *Prescriptive Residential Wood Deck Construction Guide*, as well as in Mike Guertin's three-part series "Installing a Deck Ledger" (*PDB* Jul/19).

Posts. When deck structural support posts are embedded in the ground, AWPA recommends UC4B material, commonly known as "Ground Contact Heavy Duty." About four decades ago, leading post-frame building companies switched to UC4B after experiencing early decay failures.

For UC4A or UC4B structural deck posts attached to a concrete slab or pier, a post-base connector that separates the post end-grain at least one inch from the concrete or standing water should be used. UC4B may not be available in retail outlets and require a special order. Note that with UC4B lumber, stainless steel hardware is recommended to avoid premature corrosion.

These recommendations are in addition to IRC requirements, which call for field-cut ends, notches, and drilled holes in preservative-treated wood to be treated in the field in accordance with AWPA M4. According to the Forest Products Laboratory *Handbook*, sealing all end-grain surfaces to prevent liquid water from entering the wood "is probably the single most valuable improvement that can be made in standard construction practice to improve the performance of wood exposed to water. The end grain is so important because liquid water can enter wood through the end grain so quickly—100 times faster than from the sides is not unusual."

Flash *and* ventilate. Even when the tops of all joists and beam framing lumber are flashed, the installation of an under-decking water-management system that prevents the open, "natural ventilation" of the framing up to the flashed top edges will likely be counter-productive to preventing the decay potential of the framing lumber. For homeowners who seek a protected space under a deck, "above the joist systems" are available that prevent the framing system from being exposed to rain and snow water while not obstructing the natural ventilation of the joist framing below flashing. Wood structures that are protected by cover from the weather and well-ventilated are known to maintain a moisture content (MC) well below what's required for fungal decay. ❖

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