A Deck Built to Fail

by James Eggert

Flashing, fastening, framing — you name it, it needed to be fixed

I'm a building inspector in New Haven, Conn. Recently, a city housing inspector asked me to check out a deck that he had seen on a three-family tenement. He said, in what turned out to be an understatement, "Something doesn't look right."

Before visiting the property, I looked up the information available on the address. Because it was a three-family dwelling, the International Building Code (IBC) would apply rather than the International Residential Code, which is limited to one- and two-family dwellings. The only building permit on file was an old one for an electrical upgrade.

Once on site, I found a 16-foot-by-8-foot three-story deck and stair assembly built in what I call "early paddock style." The owner had hired a contractor to remove the old porches and build this new structure to serve as secondary egress (a required element in multifamily housing). Next, he intended to have the existing interior secondary egress stairs demolished in order to gain floor space for another small bedroom on each floor.

Unfortunately, the new deck didn't meet code; in fact, it looked like someone had been trying to build a deck that violated every typical code requirement, starting at the foundation and continuing up from there.

On Shaky Ground

The foundation appeared to be constructed of six 12-inch-diameter piers arranged in two rows of three. The inner run of piers was located about 2 feet inside the rim. Posts rising from these piers — but not attached to them — supported a 2x8 nailed flat to the bottom of the joists to act as a beam (**Figure 1**).

But because a 2x8 on the flat isn't much of a beam, the inner piers weren't really supporting anything. That meant the outer three piers and the ledger were holding up three stories of deck loads. Some quick math gives us the load on the piers: 16 feet x 4 feet (half the deck's depth) x 50 pounds per square foot (psf) combined live and dead loads = 3,200 pounds per floor. That multiplied by three floors is a total load of 9,600 pounds, which divided by three piers is a load of 3,200 pounds per pier. A 12-inch-diameter pier provides bearing area of 113 square inches, and in average, 2,500-psf-bearing soils, one can carry 1,950 pounds — far short of 3,200 pounds. This deck was in trouble.

If you replaced the flat 2x8 "beam" at the interior run of piers with a real beam to handle half the load from the first floor, the outboard piers would still have to handle half of the load imposed by the second and third levels, or 6,400 pounds — a lot less than 9,600 pounds, but still more than the piers' capacity of 5,850 pounds (1,950 x three piers). Plus, I prefer to see a higher design live load — 60 psf or more — on a deck, because of party loading (for illustration, the live load requirement for restaurant decks is 100 psf), and by that standard these piers were even more inadequate.

Fix: With the addition of a beam, the three inboard piers will be able to handle the first floor, but to support the second and third floors, piers must be added or the existing piers replaced with larger ones; post anchors must also be added (IBC Section 1805).

Framing Nightmares

The framing wasn't any better than the foundation.

Ledger installation. The ledgers were nailed directly to the exposed studs of the house wall: There were no bolts, flashing, or sheathing, and I could look into the wall cavity and see the lath and plaster of the inside wall (**Figure 2**). (The contractor told me, "The siding repair is the owner's responsibility." It doesn't matter to me who does it — it has to be done.)

Fix: Remove each ledger, add sheathing and flashing, then reinstall the ledgers with proper bolting.

Inadequate joist attachment. Many of the joist hangers that attached the deck's 2x8 joists to the 2x10 rim joists were the wrong size. The single 2x10 rim joists actually do calculate out to be adequate support, but I couldn't find one nail in any of the joist hangers (**Figure 3**). The contractor had instead used drywall screws, which lack any meaningful shear strength and aren't resistant to corrosion. Another

Figure 1. Even with concrete footings below, a 2x8 on the flat does not qualify as a beam.

Figure 2. Required flashing and sheathing behind the deck ledger are missing, and the bolting schedule appears to be inadequate.

Figure 3. Drywall screws lack both the shear strength and the corrosion resistance to be used as structural deck fasteners.

Figure 4. Every hole of a piece of framing hardware must be filled with the proper nail or structural screw.

Figure 5. Non-corrosion-resistant nails are inadequate for this connection, no matter how many are used.

Figure 6. Stair rises cannot vary more than $\frac{3}{8}$ inch throughout a flight.

problem was that many of the holes in the joist hangers were unfilled; some hangers — like those on the stringers, holding up the stair run — were installed with only one or two screws (**Figure 4**).

Fix: Add blocking where the hangers are "attached" to air; remove improper screws; and install 10d nails or structural screws, available from Simpson or USP, in every hole (IBC S2304).

Nail troubles. While the joist hangers lacked nails, the rim board corners, the ends of horizontal railings, and the single headers were nailed with too many nails (**Figure 5**). For example, I counted 28 nails at one rim-to-corner-post connection. Though the codes specify only a minimum number of nails for certain connections, common sense should tell a carpenter that using too many nails will crack the lumber and reduce its structural capacity. Anyway, a nailed connection wasn't adequate in these places, and even if it were, none of the nails used were galvanized or stainless steel; I could see the corrosion stains on the wood.

Fix: Add corrosion-resistant through-bolts (IBC S2304).

Figure 7. Overcuts weaken stringers and reduce the uncut portion to less than the code-required 5 inches.

Figure 8. Safety glazing must be used near stairs.

Scary Stairs

All five runs of stairs had rise and tread discrepancies and undersized landings, and two of the runs had headroom issues. The rises, whose heights are supposed to be within $\frac{3}{8}$ inch of each other in each flight, were all over the place (**Figure 6**). On one flight, the rises ranged from 6 inches to as much as $7\frac{1}{2}$ inches. The risers were open, with more than a 4-inch space, and some of the treads were only 8 inches wide where R2 occupancies require 11 inches of width.

The stairs had other code violations. There were no graspable handrails and the stringers were overcut (**Figure 7**). Plus, window glazing was located only inches from the ends of the stair treads (**Figure 8**); because of the lack of safety glazing, the window could be broken

Figure 9. On notched stairs, the space between the bottom guard and the rear of the treads must be no larger than 6 inches.

Figure 10. Lapped joints in structural posts must be through-bolted.

by a snow shovel, or someone could fall down the inconsistent stairs and be cut.

Fix: Rebuild stairs and landings to code, adjust header placement to create adequate headroom, close the open risers, add handrails, and add safety glazing to the windows (IBC Chapter 10 and S2406).

Guards. The guards were nailed to the corner posts with nongalvanized fasteners. Adding some galvanized screws would help, but there were more problems. The horizontal rails were spaced more than 4 inches apart, and the space between the stair guards and the back of the stair treads exceeded the 6 inches allowed by code (**Figure 9**). The contractor did get the height of the guard right: 42 inches because of the R2 occupancy.

Fix: Correct the guard spacing and replace all fasteners with noncorrosive ones (IBC S1012.)

Corner posts. The corner posts were substantial — 6x6s — but the half-lap joints between the members looked like they were cut with a dull chain saw, and they were simply nailed together (**Figure 10**). To hide the visual problem and cover the choppy post-to-post laps, the contractor had installed regular wood putty at each corner.

Fix: Grind the putty away and add through-bolts (IBC Chapter 23).

Red Tag

This deck was a study in what not to do, and I had no qualms about being the bad guy and red-tagging it to stop any continued use. The owner has been cited for building without a permit and is required to correct all violations before the deck can be used. Had the original plan been carried out — removing the secondary interior stairs after the completion of the deck — I would have been compelled to tag the structure "Unsafe" and relocate the third-floor tenants to temporary housing at the owner's expense until the egress stairs were restored. Fortunately that phase had not begun.

Because he had a signed contract with a licensed contractor, the owner applied for reimbursement from the state contractor's fund, which provides up to $15,000 to remedy unfinished jobs or poor workmanship. The money comes from a "home improvement licensing fee" attached to every building permit issued in Connecticut. The state will aggressively seek repayment from the contractor who did the work.

Although the owner now has a building permit to install a properly built multi-story deck, no remediation work has been performed to date. My last conversation with the owner stipulated that prompt corrective action is needed and that he can't wait for reimbursement from the state. His immediate choices are fixing the deck or removing it; otherwise, the city will initiate court action that would include a fine, deck removal by a city-hired contractor, and a lien on the property. ❖

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Note: The IBC 2003 Code is used as a reference due to the multi-family occupancy of this building. Two-family and single-family residences are subject to the IRC and may have some different conditions.