ATTACHING Deck Ledgers

Preventing rot at the band joist is as important as using strong enough fasteners

Beginning in 2001, members of the staff at Virginia Tech's Engineering and Wood Science Departments launched a project to develop and publish an inspection manual for residential decks and balconies. To our surprise, we found that problems with deck attachment are quite common and that the issues are more complex than we had thought. In this article, we'll focus on the forces at work between the deck ledger and the band joist, and offer connection details that will safely carry the typical loads.

In addition to using the right fasteners in sufficient numbers, an important factor in designing ledger attachments is preventing moisture damage — rot — from weakening the ledger and band joist. Field observations of existing decks by Roger Robertson of the Chesterfield County, Va., Building Department revealed decay in untreated band joists where deck ledgers were attached. In some cases, the decay had spread into the interior floor joists.

Flashing between the ledger and the band joist is important for keeping water out of the interior framing. In his field studies, Robertson observed that

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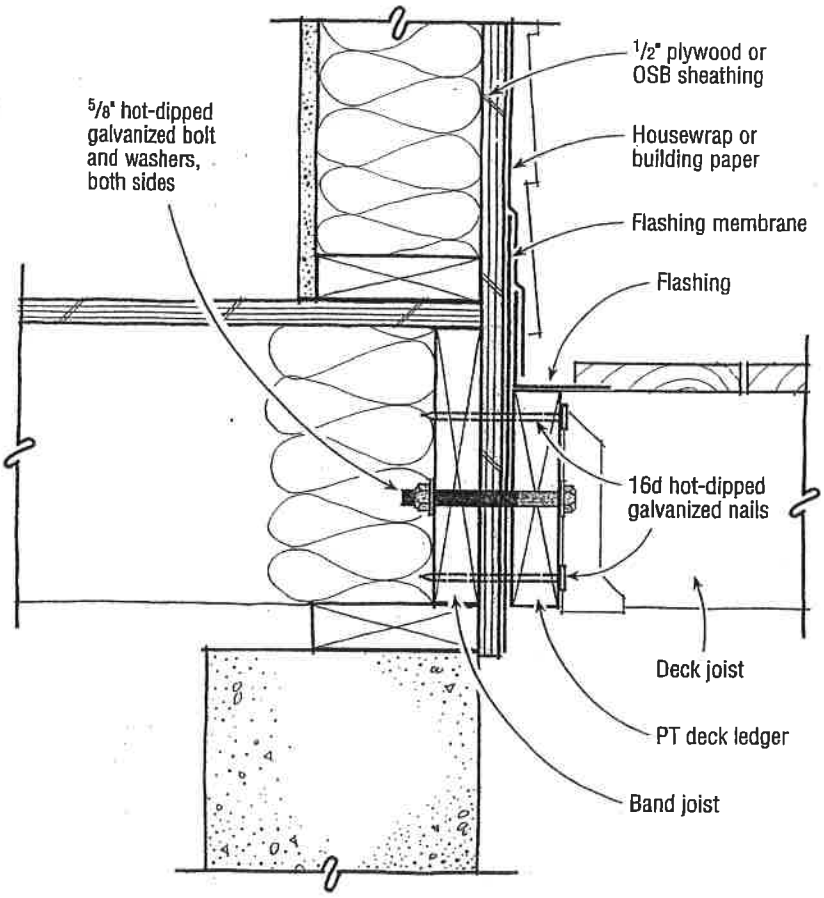
Detail 2: Attaching Ledger to Band Joist Over Structural Sheathing



Detail 2 Fastener Schedule*

Fasteners	8-foot Max Joist Span	16-foot Max Joist Span
5/8-in. hot-dipped galvanized bolts and washers and 16d common hot-dipped galvanized nails	1 bolt @ 3'-6" o.c. and 2 nails @ 8" o.c.	1 bolt @ 1'8" o.c. and 3 nails @ 6" o.c.

Minimum edge distance for bolts is 2 1/2 inches. Nails must penetrate the supporting structure band a minimum of 1 1/2 inches.

*Reprinted by permission from the *North Carolina Residential Code*. The nail size in the table has been increased from 12d to 16d common (3 1/2 inches) to accommodate 1/2-inch structural sheathing, as shown in the drawing. Note that you must use 5/8-inch bolts as well as nails to make the connection.

Attaching Ledger on Top of Structural Sheathing

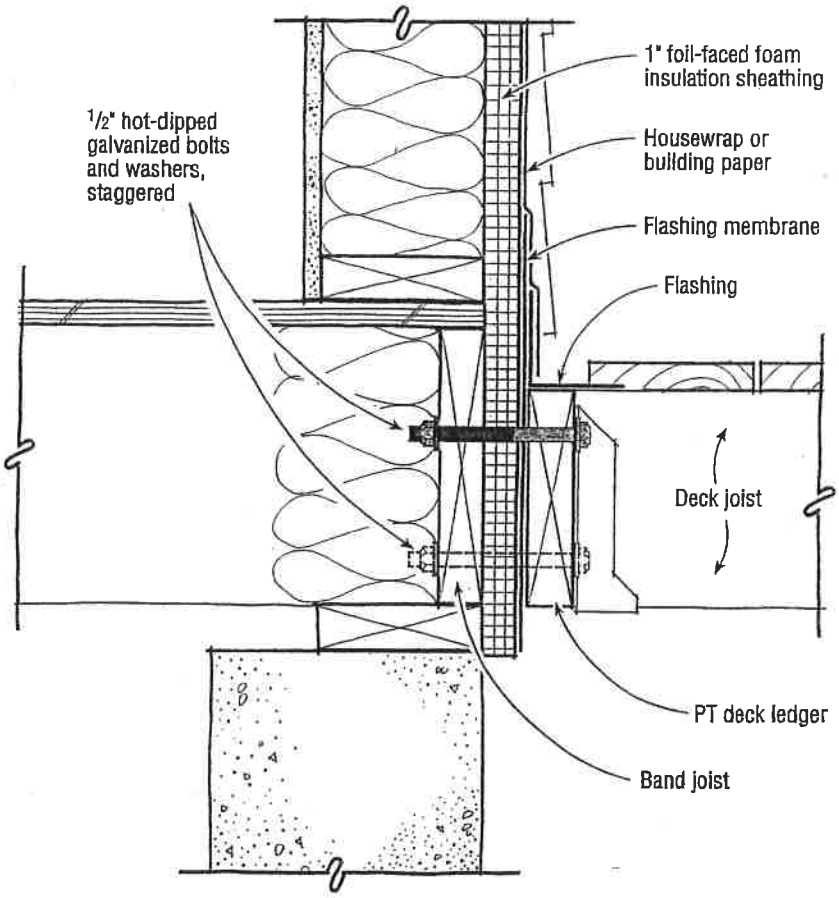
Because deck ledgers are often installed after the sheathing is nailed off (Detail 2), it's useful to have a fastener schedule that takes the 1/2-inch plywood or OSB into consideration. The *NDS* has no such design method, so we turned to the *North Carolina Residential Code*. Appendix M of that code includes a fastener schedule for deck ledgers that relies on 5/8-inch bolts and 16-penny common nails working together. The code specifies that no siding is permitted in the connection, but structural sheathing is okay where required if it's properly flashed. Note that the *NDS* requires bolt holes to be a minimum of 1/32 inch to a maximum of 1/16 inch larger than the bolt diameter. The purpose of this rule is to prevent the lumber from splitting if it shrinks in service.

Although the *International Residential Code* (*IRC*) specifies loads, maximum deck railing openings, and the need for lateral restraint, the *N.C. Code* is the only code we're aware of that gives design information for the ledger–band joist connection.

Attaching Ledger With Drainage Spacers

Sometimes spacers are installed between the deck ledger and the band joist to allow for drainage. While that can help prevent rot at the band joist, the spacers weaken the connection. *JLC* asked us to provide a bolting schedule for that condition, but unfortunately

Detail 3b: Attaching Ledger Over Foam Sheathing

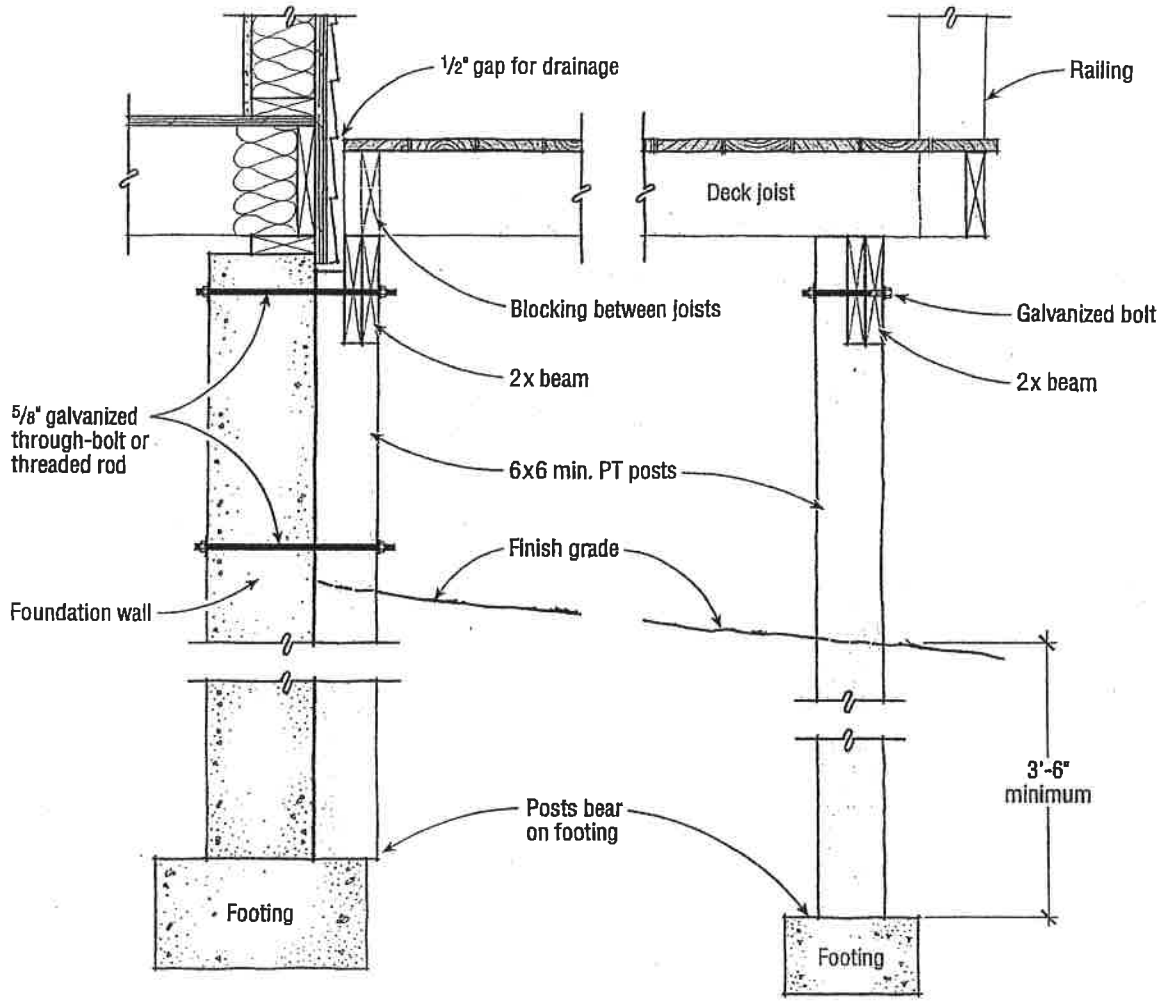


The authors used available *NDS* methods to create a fastener schedule that accounts for a drainage space behind a ledger attached over 1/2-inch sheathing (above left). Unfortunately, the sheathing provides no structural support to the bolt, resulting, from a design standpoint, in a 1-inch-wide gap between the ledger and the band. Thus, the same bolting schedule would apply to a ledger installed over 1-inch non-structural insulating sheathing (above).

- It relies on more efficient structural connections because the ledger rests directly on the end grain of the wood post. Connections that use lag screws, bolts, or nails loaded in shear require far more attention, in both design and construction, than a simple beam-to-post connection.
- It has structural redundancy, meaning that the possible failure of one element will not automatically produce or permit collapse of the entire structure. In this detail, the through-bolt prevents sideways movement of the deck, which might occur if the outside posts were not deeply embedded in the ground. In the unlikely event that the through-bolts should fail from corrosion or any other reason, the embedded 6x6 posts at the foundation wall would still prevent a lateral collapse of the entire deck.
- From an inspection point of view, it's easier to verify that a self-supporting deck is sound, because all the elements (except the footers) are exposed.

While the 6x6 posts we've seen in retail building supply centers are treated to the 0.40 lb/ft^3 retention, we recommend using posts treated to 0.60 for longer life. The ends of the posts placed in the ground should not be cut, as that exposes untreated heartwood. Southern pine heartwood, as well as the heartwood of other softwood species, does not accept the penetration of the CCA chemical treatment; thus, only the end surface contains the chemical. Another post option is PT parallam PSL, which, according to the TrusJoist website (www.tjm.com/), is treated at least to 0.60 lb/ft^3 retention. (The specific type of treatment should be considered by the deck designer in view of the fact that CCA is scheduled to be phased out for some residential applications

Detail 4: Deck Fully Supported With Posts



The authors strongly recommend avoiding mechanical shear connections altogether and, instead, supporting residential decks with PT posts, as shown here. Use .60-retention pressure-treated lumber for greatest durability.

beginning in December 2003.)

The posts are located next to the house and notched to receive the ledger. The deck joists are then supported on the built-up beams, which further minimizes reliance on mechanical connections (joist hangers). The through-rods address lateral support, which, while not quantitatively addressed by the building codes, is extremely important.

Keep trash, vegetation, and construction debris out of the backfill around the post, as it would compromise the lateral resistance of the embedded post section. We also suggest that the post be backfilled around its base with an 80-pound bag of concrete mix, followed by 8 inches of well-compacted native soil or a sand and gravel mixture. The concrete above the footing pad will stabilize the bottom of the post in the unlikely event that the footing pad should rotate in service. The size of the post footing pad and the depth of the post embedment for a design should be determined by the deck designer and depends on local frost depth and soil strength, as well as local building codes.

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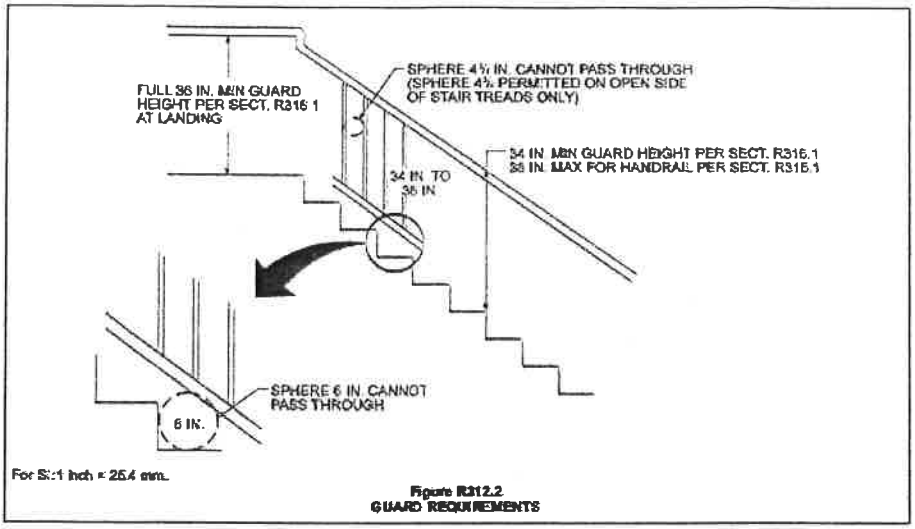
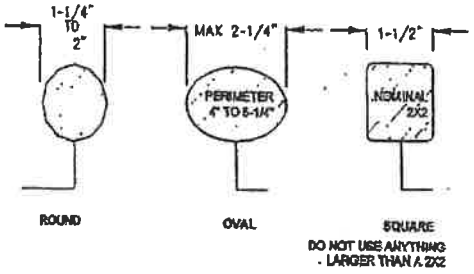
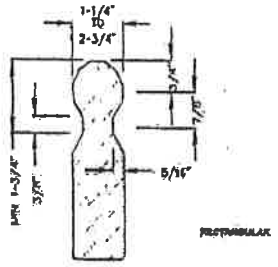


Figure R312.2
GUARD REQUIREMENTS



TYPE 1 HANDRAIL PROFILE
HANDRAILS WITH A CIRCULAR CROSS-SECTION SHALL HAVE AN OUTSIDE DIAMETER OF AT LEAST 1-1/4" AND NOT GREATER THAN 2". IF THE HANDRAIL IS NOT CIRCULAR, IT SHALL HAVE A PERIMETER OF AT LEAST 4" AND NOT GREATER THAN 6-1/4" WITH A MAXIMUM CROSS SECTION OF 2-1/4"



TYPE 2 HANDRAIL PROFILE
HANDRAILS WITH A PERIMETER GREATER THAN 6-1/4" SHALL PROVIDE A GRASPABLE FINGER RECESS ON BOTH SIDES OF THE PROFILE. THE FINGER RECESS SHALL:
1. BEGIN WITHIN A DISTANCE OF 3/4" MEASURED VERTICALLY FROM THE TALLEST PORTION OF THE PROFILE AND
2. ACHIEVE A DEPTH OF AT LEAST 5/16" WITHIN 7/8" BELOW THE WIDEST PORTION OF THE PROFILE. THE REQUIRED DEPTH SHALL CONTINUE FOR AT LEAST 3/8" TO A LEVEL THAT IS NOT LESS THAN 1-3/4" BELOW THE TALLEST PORTION OF THE PROFILE. THE MINIMUM WIDTH OF THE HANDRAIL ABOVE THE RECESS SHALL BE 1-1/4" TO A MAXIMUM OF 2-3/4". EDGES SHALL HAVE A MINIMUM RADIUS OF .01"

(8) **Stairs**

Stairs must be 36" wide, steps are to have a maximum rise of 8 ¼" and a minimum run of 9". Stairs should not have any opening in the rises greater than 4". Stairs must be equal in rise and tread depth to within 3/16" between adjacent stairs and no more than 3/8" difference between all stairs.

Stair requirements