Mounting Deck Stairs

Dedicated footings and the right hardware make a secure stringer attachment

BY MIKE GUERTIN

Product photos: Dan Thornton

On the decks I built in the past, I never gave much thought to how secure the connection was between the stairs and the deck frame. I cobbled together an attachment using whatever was at hand: screws, nails, blocks of wood, and occasionally, angle brackets or field-modified metal hardware. Judging from what I've seen of others' work, I wasn't alone.

I started taking this connection seriously after seeing that a ½-in. gap had developed between the stringers and the frame on an older deck I was examining. Years of use, seasonal expansion and contraction of the wood, and frost heave at the bottom of the stairs had worked the nails out of the stringers' end grain. Now I look at the stringer attachment on every deck I inspect. Rarely are the stairs mounted securely, and many connections are downright scary. Not only is the stringer attachment suspect, but so is the capacity of the deck frame where the stringers mount. Most deck frames are designed for uniform loads, such as people and furniture. Impose a concentrated point load such as a stair without additional support, and you are likely overloading the frame.

Granted, the load is minimal when, for example, there are just two steps from grade to deck, and the risk of injury is pretty low should such a stair fail. But as the distance between the ground and the deck increases, so do the load and the risk. How tall must a set of stairs be before you take the connection seriously? I avoid that question altogether. To ensure that stairs of any size are supported properly, I frame a dedicated support system for the stairs and secure them with hardware specifically designed for stringer attachment. It doesn't take much more time or material to make a solid, durable stair connection than it does to cobble together a risky one, and no one ever complains when you don't cut a corner.

The case for independent stair support

Design loads for stairs parallel those for decks: generally, a combined live and dead load of 50 lb. per sq. ft. Let's take the example of a set of stairs that's 3 ft. wide, with eight treads that are 10 in. deep and a rise from grade to deck surface of 5 ft. That's 20 sq. ft. and a total load of 1000 lb. Half of this load is borne by the footing at the bottom, which leaves a 500-lb. load at the top. Adding that

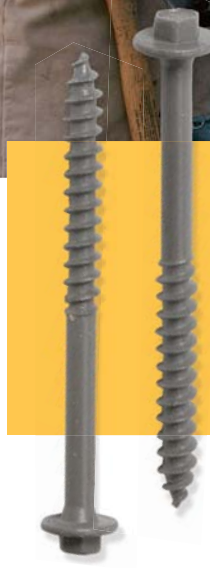
1 CONNECT THE POST

To support the stair as well as the eventual railing, run a 4x4 post from a footing through the frame to the railing height. With posts mounted inside the framing, use through bolts to resist thrust from the stairs. Posts mounted outside the deck frame can be fastened with structural screws since the thrust on the header will push the post against the frame.

Slick and quick through bolt. *FastenMaster's ThruLok requires no wrenches. Drive it most of the way with a drill, thread the special nut on the back side, and finish tightening.*

2 FASTEN THE HEADER

A single 2x8 (or larger) that's 7 in. wider than the outside of the stairs serves as a header. Secure it to the posts with structural screws.



Faster than lags. *Structural screws such as FastenMaster's LedgerLoks offer strength similar to ½-in. lags, but they install with a drill or impact driver and require no washers.*

3 HAMMER IN A JACK

To fully support the header, run 2x4 jacks between it and the footings. Join the jacks to the posts with structural screws.

load from the stairs to an end joist sized for the deck load only will overload that joist. You might double the joist to handle the load, but what about the ledger, the beam, and the footing? Standard ledger-fastening details don't allow for concentrated loads such as a double joist. Also, the beam and the footing may not be able to handle the additional load imposed by the double joist supporting the stairs unless specifically designed to do so.

Mounting the stairs to a deck's rim joist invites similar questions: How is the rim joist mounted to the joists, and can that connection handle the concentrated load? Were the beam and the footings sized to account for the stair load? You can certainly beef up the ledger-to-house connection, the joists, the beam, and the footings to handle stair loads, but since the code doesn't provide a prescriptive solution, that might require an engineer. The alternative is to support the stairs independently with their own posts and footings.

Footings and posts support stairs

There are usually 4x4 posts for railings at the top of stairs anyway, and I just extend these

4 BOLT A 2x4 TO THE LANDING

Wedge anchors drilled into the concrete secure a 2x4 cleat that will connect to the bottoms of the stringers.

Easy concrete anchors. *Wedge anchors rely on a cone-shaped bolt head that pulls up as the nut is tightened on the bolt. The bolt head pushes on the inside of a steel sleeve, expanding it inside a hole drilled in the concrete.*

5 USE DEDICATED HANGERS

Stringer hangers provide a reliable connection to the header. For aesthetics, set the end hangers so their flanges are to the inside of the stringers.

Connector screws don't pull out. *Connector screws offer much higher withdrawal strengths than nails. Unlike many other kinds of screws, they also offer shear strength similar to nails, which often makes them a superior choice for attaching structural connectors.*

Stringer hangers are simply better. *Made by both Simpson Strong-Tie and USP Structural Connectors, stringer hangers provide a simple and reliable connection. Fasten them with structural-connector screws by the same manufacturers.*

posts down to a pair of independent footings to support the stair load. It doesn't matter if the posts are mounted inside or outside the deck frame. I secure the posts to the footings with metal post bases and anchor bolts.

For most stairs, the footings only need to be 6 in. to 8 in. dia. The maximum code-allowed span for unnotched southern-pine stringers accommodates about 16 10-in.-deep treads. In this scenario, half of the treads are supported by these posts, and half are supported by the landing at the bottom. That's about 40 sq. ft. for a 3-ft.-wide set of stairs, which, multiplied by the 50-lb.-per-sq.-ft. design load, equals a total design load of 2000 lb., half of which needs to be carried at the top of the stair. The load on each footing is 500 lb., and 8-in.-dia. footings can handle about 575 lb. based on the code's default soil-bearing capacity of 1500 lb. per sq. ft. These footings need to be as deep as the other footings for that deck.

Two through-bolts secure each post to the end joist or rim joist. To make an attachment point for the stringers, I bolt a 2x8 or larger board to these posts as a header, then support it further with 2x4 jacks that run to the

6 JOIN THE POSTS AND STRINGERS

Blocking behind the posts reinforces them and the stringers. A threaded rod between the posts pulls them together, sandwiching blocking along the front.

Tension rod squeezes out a solid connection. *A long, ½-in. bolt joins with a 3-ft. piece of threaded rod and a connector nut to create a tension rod that pulls the rail posts tight against continuous blocking.*

footings. (The jacks should be treated and rated for ground contact.) In order to comply with hardware manufacturers' required minimum of 3½ in. between the edge of the stringer and the end of the single-ply header, I make the header at least 7 in. wider than the outside of the stairs.

I attach the stringers to the header with Simpson Strong-Tie's LSC adjustable stair-stringer connectors or USP Structural Connectors' CSH concealed stair hangers. I fasten the angle-shaped hardware to the header with structural-connector screws so that the point where the plumb cut meets the bottom of the stringer will align with the bend point on the hardware. The side tabs on the hardware go on the inner face of the outside stringers so they aren't visible. The stringer is fastened to the hardware with screws through the side-tab holes and with a single screw through the bottom of the hardware.

I use structural-connector screws because the 2012 IRC says that stairs can't be fastened using nails subject to withdrawal (R311.5.1). The stringer is attached using a metal connector, but the connector is commonly fastened with nails driven straight into the header. These nails are subject to withdrawal and may come loose over time. Mounting the connector with screws reduces the risk of withdrawal. Both Simpson and USP have structural screws for their hardware.

Securing the bottom of the stairs

There are no metal connectors made specifically to secure stringers directly to a stair landing or footing. I dig and form a concrete slab to serve as a footing for the stringers, as well as for a landing. The footing portion is directly beneath the bottom cut of the stringers and is 12 in. to 16 in. thick, 16 in. deep, and a few inches wider than the stairs. The landing portion is 6 in. to 8 in. thick and extends at least 3 ft. from the finish nosing of the bottom step.

Using wedge anchors, I attach a 2x4 cleat to the slab so it fits between the outer stringers, flush with their fronts. Screws through the outside stringers attach them to the cleat. I notch the middle stringers to fit around the 2x4. A hot-dipped galvanized ½-in.-dia. threaded rod (jamestowndistributors.com) and blocking tie the posts to the stair. □

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