A Complete Guide to Building Your Own Deck

BY RICK ARNOLD

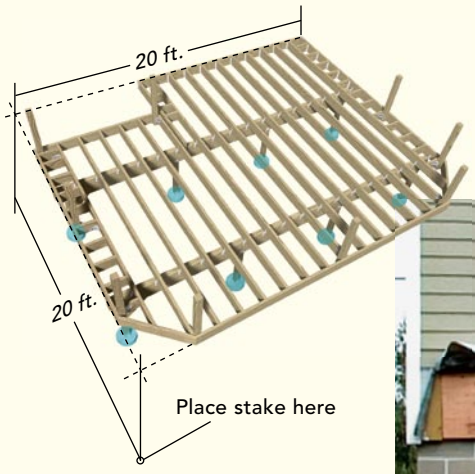
FROM FOOTINGS TO FINISH

1. Pier locations
2. Ledgers
3. Main beam and posts
4. Joists and newels
5. Decking
6. Stairs
7. Trim and rails

To me, deck building has always been one of the most rewarding jobs. Within just a few days, you've added a significant amount of finished square footage to a home. But deck building has dramatically changed since I started 25 years ago. Not only are there many more material choices, but there have been critical code changes that reflect the importance of proper design and construction. So while deck building remains one of the easier and more rewarding outdoor projects, it's crucial to adhere to codes and manufacturers' recommendations to ensure a safe and long-lasting deck.

The deck I'll describe here is medium-sized, with two sets of stairs to easily access both sides of the yard. It is framed with pressure-treated lumber, and the decking, railing, and trim are synthetic products. A double border accents the deck's perimeter. A ledger attaches the deck to the house on two sides; its weight is supported from below by two beams resting on eight 4x4 posts centered on concrete piers.

Rick Arnold is a contributing editor. Photos by John Ross, except where noted.



MARK THE PERIMETER,

THINK SAFETY

In most areas of the country, you need a building permit for a deck to ensure that it sits on an adequate foundation, is built properly with rot-resistant materials, and is attached securely to the house. Throughout this article, this symbol

Check✓Code

will alert you to where you should make sure your deck conforms to local building codes. For your own protection, wear safety glasses when cutting or nailing, wear hearing protection as necessary, and be careful when working from ladders or the framing of an unfinished deck with no railing.

To start, I measure and mark the edges of the deck's 20-ft. length on the house. Then I plumb down to the foundation, measure out the width of the deck (in this case also 20 ft.) from each point, and drive in a stake at each corner (drawing above). Next, I adjust the stakes so that they are exactly 20 ft. apart. To make sure the deck perimeter is square, I take diagonal measurements in both directions. If one diagonal is longer than the other, I adjust the corner locations until the diagonals are equal, making sure to maintain the 20-ft. distance between the two. I use string to outline the perimeter of the deck from the house, around the stakes, and back to the house.

Drawings: Toby Welles/WowHouse

DIG THE PIERS

Next, I string up a reference line to help me position the piers directly below where the beams will be. For this deck, I measured back exactly 3 ft. 6 in. from the perimeter to the center of the beam. To establish the center of the second beam, I measured 5 ft. from the house. To make adjustments easier, I use a batterboard, which allows me to fine-tune the string placement without moving the stakes. You can purchase metal batterboards (above) or make them with scrap wood on site (right).

I mark the locations of the piers, which are 6 ft. 9 in. apart, with surveyor's paint. I mark the center first, then roughly locate the perimeter of the hole. Now the strings can be removed and the holes dug.

POSITION AND POUR THE PIERS

Planning the piers

Concrete piers transfer the weight of the deck to solid ground. To do so effectively, they must extend below the frost line and any backfill that has been used for grading. The typical pier consists of a cardboard form, concrete, and an anchor bolt.

Three things affect the number and the size of the piers you use: how you frame the deck, the weight the deck is designed for, and the load-bearing capacity of the soil. The deck we built here called for eight piers measuring 10 in. dia. to support the two doubled 2x10 beams supporting the deck. When calculating the size and number of piers I need, I use the International Residential Code's (IRS) design load for decks, which is 50 lb. per sq. ft., or psf (40 psf live load—the weight of people, furniture, etc.—and 10 psf dead load, or the weight of the deck components). Different soils have different bearing capacities, measured in psf; if you're unsure of your soil, contact your local building department for the bearing capacity of soils in your area.

How much concrete do I need?

To pour the piers for an average-size deck, I use 80-lb. bags of concrete and an electric mixer, which rents for about $45 a day or sells for $250 or so. For major pours, I have a concrete truck deliver a 2500-lb. mix. Either way, the basic formulas below will help you to estimate the number of bags or cubic yards of concrete required based on pier size and depth.

Example Size of tubes: 10 in.
Number of tubes: 8
Average depth per tube: 4 ft.
0.8 (8 x 4) = 26 bags

Tube size	Number of 80-lb. bags per ft.	Cubic yards per ft.
8 in.	0.53 bag	0.013 cu. yd.
10 in.	0.8 bag	0.02 cu. yd.
12 in.	1.2 bags	0.03 cu. yd.
14 in.	1.6 bags	0.04 cu. yd.

Builder's tubes, or pier forms, come in diameters from 8 in. to 24 in. or more. The cardboard forms can be cut with a circular saw or a handsaw. Once the holes are dug, the tubes can be set in place and filled with concrete.

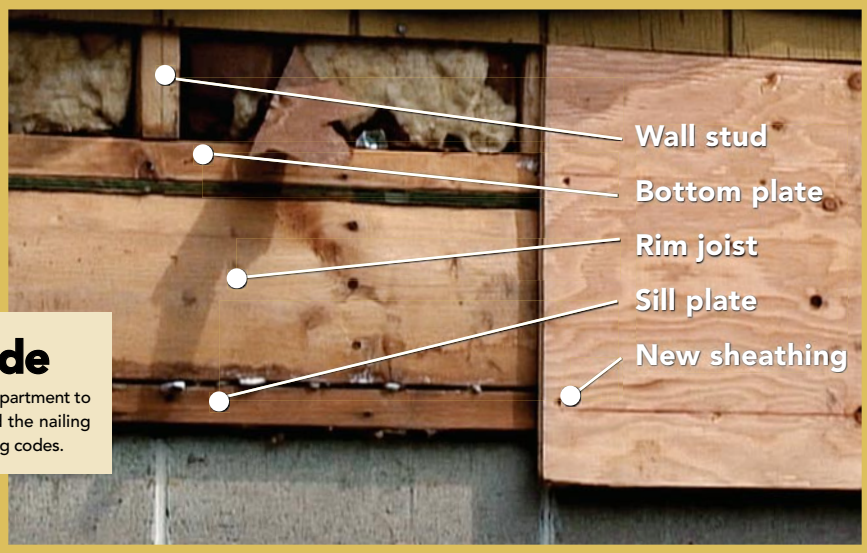
The top of the piers need to be only roughly the same height. After the concrete is poured, level and smooth it with a block of wood until the "cream" comes to the top and the aggregate settles. As the concrete sets, I backfill the holes and rake away any lumps.

Stop, inspect, and repair

If you're replacing an old deck, remove the existing ledger and inspect behind it for rot or decay. Nine times out of 10, you'll find some damage. In these situations, the most important thing is to identify the source of moisture infiltration and correct it before repairing the damage. If you find significant damage, address that before continuing to build your deck.

In this case, I removed the old deck to find that both the sheathing and the rim joist beneath it were damaged.

After repairing the rim joist, I used ½-in. construction-grade plywood to replace the rotten sheathing, butting it into the old sheathing and letting it hang down about 2 in. over the foundation. To prevent moisture migration in such places, I make sure the sheathing doesn't actually come in contact with the foundation.



Before nailing the new sheathing in place, I snap a chalkline to mark the sill and the bottom plate to make sure the nails hit the bottom plate and the sill without going into any wiring. It's also important to make sure the surface underneath the ledger lies flat and tight to the framing.

Check✓Code

Check with your local building department to see that replaced sheathing and the nailing schedule conform to local building codes.

FASTEN THE LEDGER

Before attaching the ledger board, I apply a self-adhesive flashing to protect the sheathing from any moisture that might migrate behind the ledger and cause rot. Several types are available; I use Grace roofing membrane, which comes in 12-in. and 18-in. widths. It readily sticks to the wall and is easy to work with. I like to use the roofing membrane because it's thicker and has a less aggressive adhesive than the decking membrane. As with any flashing, the top edge of the membrane should lap under any housewrap or flashing above it.

I use a laser transit to mark the height of the top of the ledger. I want the top of the ledger to be about 4 in. below the sliding door threshold to allow plenty of room for the decking as well as for ice and snow buildup. After marking the location on the house, I snap chalklines to indicate where to install the top of the ledger board.

I tack the ledger board in place with nails initially, but the ledger must be secured with code-approved hardware. On this deck, I used 3⅝-in. by ¼-in. LedgerLok fasteners (photo facing page) driven home with an impact driver.

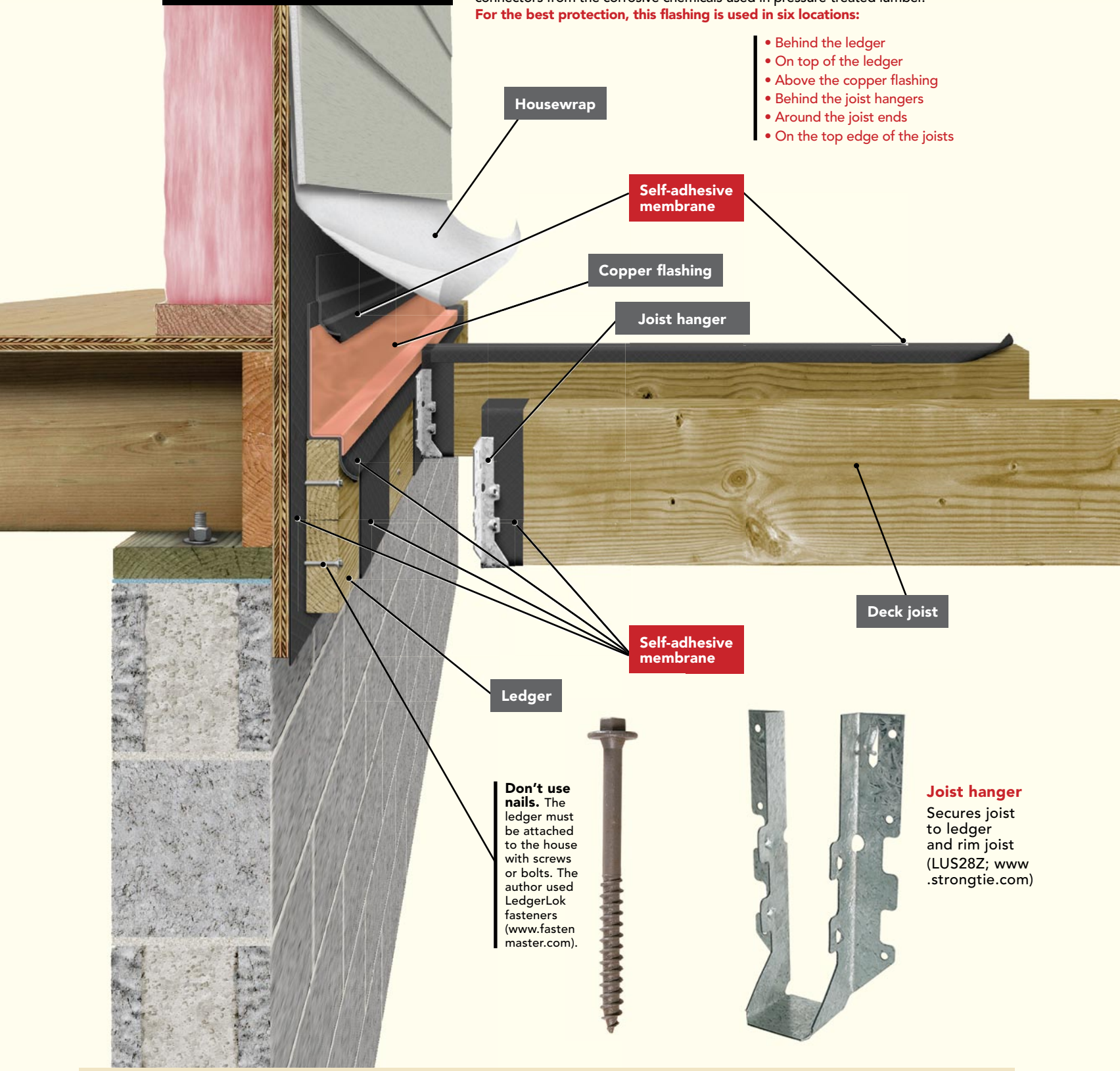
Over the top edge of the ledger, I apply another layer of self-adhesive membrane, and over that, a strip of copper flashing purchased from a local roofing contractor who bent it to match the ledger detail. To ensure moisture is directed away from the house, I tuck the top edge of the copper under another strip of adhesive flashing and the housewrap above it.

Photo, LedgerLok fastener, facing page: Krysta S. Doerfler. All other product photos, except where noted: courtesy of Simpson Strong-Tie.

Ledger

Correct flashing is critical to prevent moisture damage to the house framing. Copper flashing, housewrap, and siding are the traditional choices for flashing the ledger. Self-adhesive membrane is also used to protect metal connectors from the corrosive chemicals used in pressure-treated lumber. **For the best protection, this flashing is used in six locations:**

- Behind the ledger
- On top of the ledger
- Above the copper flashing
- Behind the joist hangers
- Around the joist ends
- On the top edge of the joists



Don't use nails. The ledger must be attached to the house with screws or bolts. The author used LedgerLok fasteners (www.fastenmaster.com).

Joist hanger
Secures joist to ledger and rim joist (LUS28Z; www.strongtie.com)

Check Code Recent changes to the International Residential Code require the installation of additional hardware to increase the strength of the deck-ledger connection. Please consult your local code official to determine how the code applies in your area. Visit **FineHomebuilding.com** for additional information on code issues.

ASSEMBLE BEAMS

The beams for this deck were too long for a single piece of lumber to span the entire length, so I assembled them from a series of 2x10s fastened together with 3½-in. stainless-steel framing nails. By assembling the beams directly on top of the piers (I already stripped the cardboard off the tops), I could ensure that the joints were positioned directly over the posts. When nailing beam sections together, I drive the nails at an angle so that they don't protrude out the other side; driving a few in the opposite direction locks the lumber together. Clipping the outside corner dresses it up a little and prevents crew members from giving themselves a headache.

I snap a line over the piers to locate the center and position the screw that holds down the post base; then I use a hammer drill to make the hole. In this project, I used Titen HD screws, which can be placed after the piers have hardened, unlike anchor bolts, which must be set when the concrete is wet.

With the posts plumb and in place but not yet attached, I use a laser level to mark them to length relative to the bottom of the ledger plus the double 2x10 beam underneath. For this project, I used a rotary laser from Stabila (www.stabila.com). A low-tech alternative would be a long 2x4 and a bubble level. Hold the 2x4 to the bottom of the ledger, level it, then mark the post. Measure down the depth of the beam for the cutline. Once the posts are marked, you can take them down to cut them more easily.

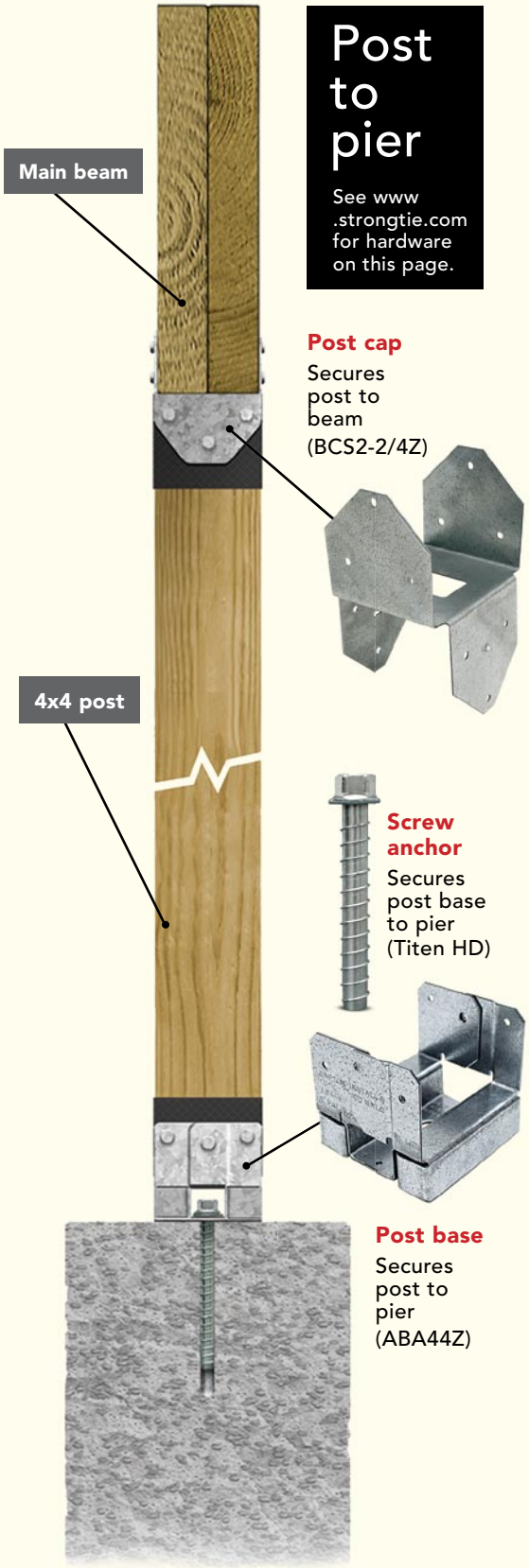
Next, I plumb the trimmed posts and nail them to the post bracket. Do not use a standard nailer; use one with a tip specifically designed to locate nail holes in connecting hardware. I then set the caps on top of the posts.

AND SET POSTS

With the posts firmly anchored to the piers, the first beam is lifted into place and the post caps are nailed secure.

As the support framing goes up, I check it for plumb, level, and square, and I attach temporary braces to keep it from moving. Later, I'll install permanent knee braces to increase the stability of the finished deck.

I follow with the second beam, again checking it for plumb, level, and square, and using temporary braces to hold it in place.



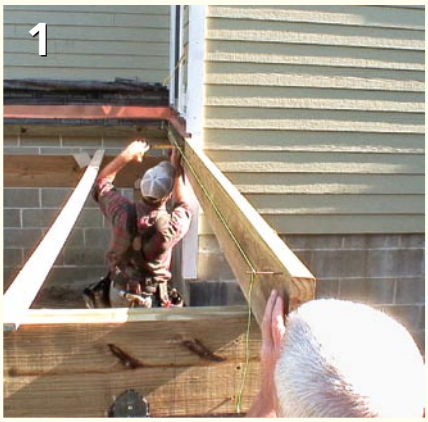
INSTALL THE JOISTS, RIM

1. On this deck, the ledger against one side of the house doubles as the first joist. To be sure it's straight, I string a line 2 in. off the joist and measure back to it along the string. Where the board veers off, I hammer it into alignment. Once it's straight, I tack it in place by toenailing it to the beam.

2. The deck plans I'm using call for 2x8 joists that are spaced 16 in. on center. Before I install them, I need to mark the joist layout on the ledger and on the beams. I mark the center of the deck on the ledger and on the outside beam, then snap a line between them. I use that line as a reference to mark all the joist locations along both beams.

3. After wrapping the joist ends, I attach hangers to the joists with a pneumatic nailer. There's more room to maneuver the nailer working off the stack than when the joists are in place against the ledger. Fastening a hanger to a joist first also makes it easier to align the joist flush with the top of the ledger.

4. With the hangers attached, the joists can be positioned according to the layout markings and nailed to the ledger. For now, I let the far ends run long.



5. The beams must be straight before I attach the joists. I run a string line, with ¾-in. blocks to hold the string off the beam at each end. Sliding a third ¾-in. block between the beam and the string reveals bends in the beam. A few whacks with a hammer usually set it straight. I then can secure the joists to the beam with right-angle brackets.

6. To cut the joists to length, I snap a chalkline, then square that line along the side of the joists with a Speed Square. I cut the joists with a circular saw.

7. I'm dressing up this deck with clipped corners, so I've cut both the rim and the side rim pieces to fall short of the corners by the same distance. I position the rim (the ends do not necessarily line up flush with a joist); then I nail it to the joists.

8. To create the angled corner, I string a chalkline across the inside points and snap it on the inside joist, draw the line down, and cut on the back side of it with the saw set at 45°. I finish the corner with a section of rim joist with 45° bevel cuts in both ends. The cuts abut the square-cut rim joists.

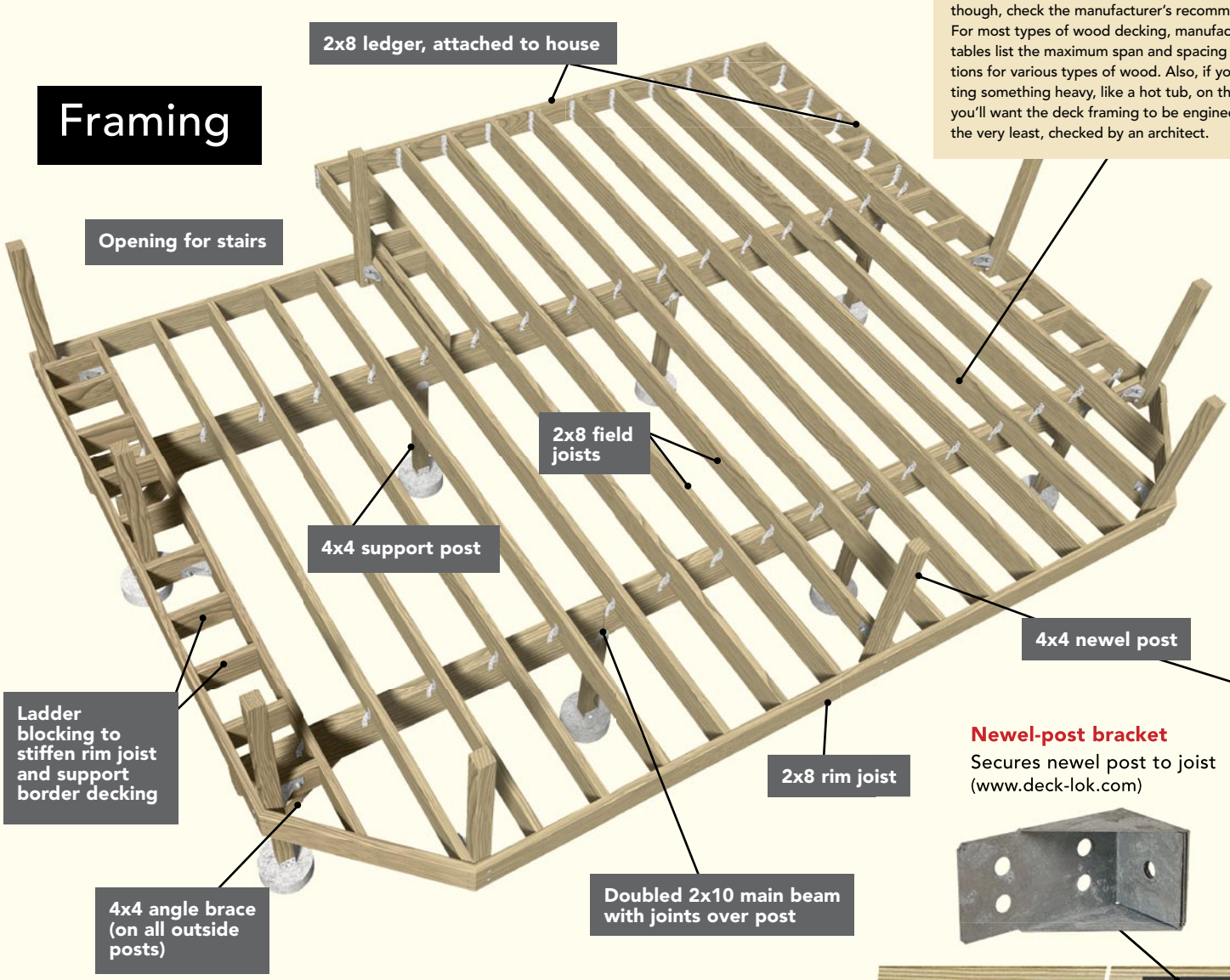
Photo, newel-post bracket, facing page: Krysta S. Doerfler

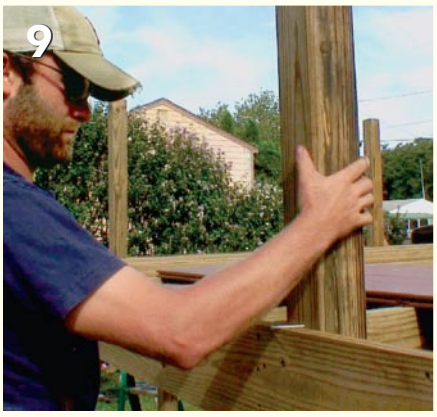
JOISTS, AND POSTS

Framing

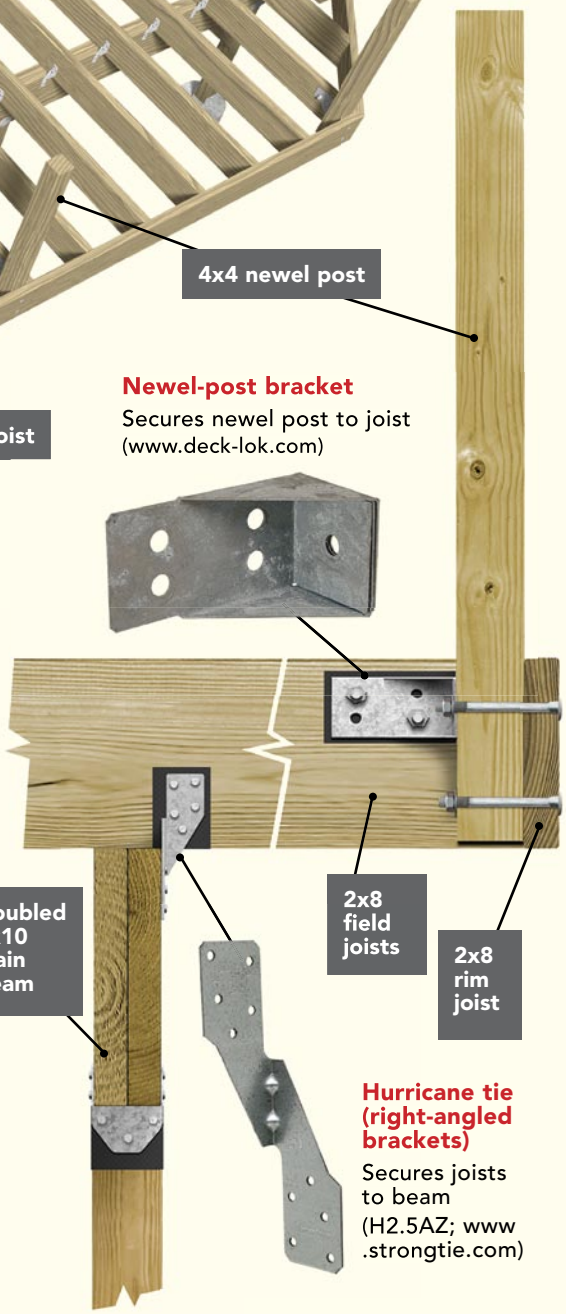
Check✓Code

At 16 in. on center, the joist spacing on this deck is typical. If you're using a composite decking material, though, check the manufacturer's recommendations. For most types of wood decking, manufacturer span tables list the maximum span and spacing combinations for various types of wood. Also, if you're putting something heavy, like a hot tub, on the deck, you'll want the deck framing to be engineered or, at the very least, checked by an architect.





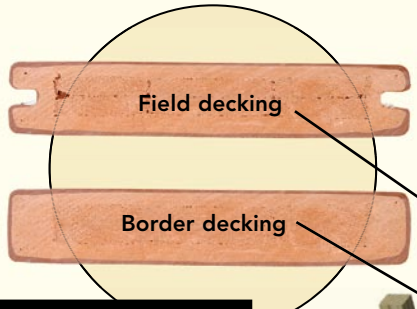
9, 10. The outside posts are nailed in place using a level to plumb them in both directions. Then I string a dry line from one to the other along the top. The inner posts are aligned with the string and then nailed. Posts are permanently secured with through-bolts and an angle bracket (drawing right).



LAY DOWN THE DECKING

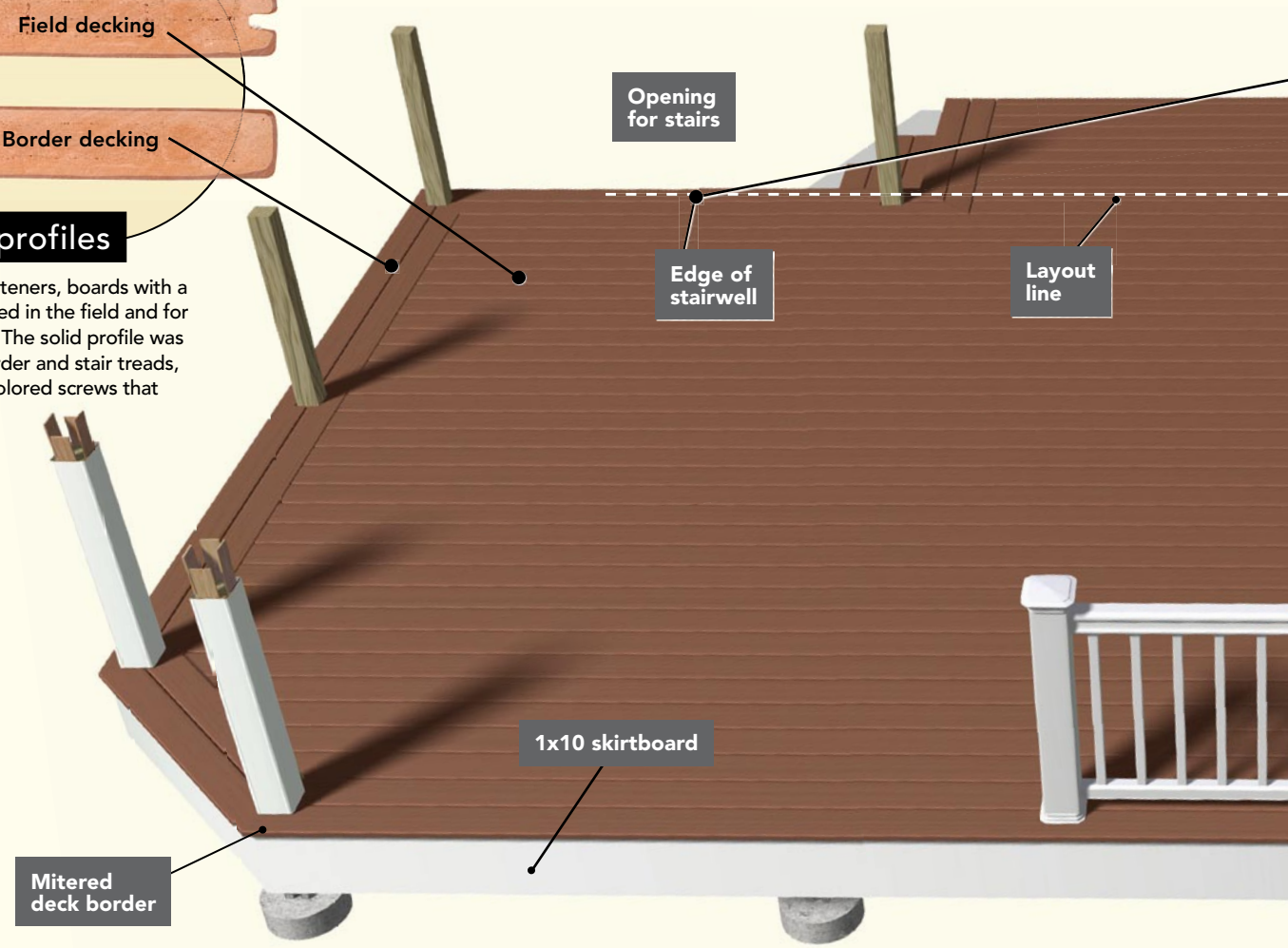
I start the decking with the border under the sliding glass door so that I can notch the first board to the wall of the house. This allows me to create the 1½-in. overhang that I want around the entire rim. A second board parallel to this one creates a doubled-up border that runs all around the deck like a picture frame. The frame pieces are scribed around the deck posts (a decorative sleeve and collar hide up to a ½-in. gap here) and mitered at 22.5° at each corner.

I base the field decking layout on the stair opening, where I want a full board with a proper overhang on the highly visible edge. This means I must rip 1 in. off the board closest to the house and make another adjustment at the rim joist (see facing page).



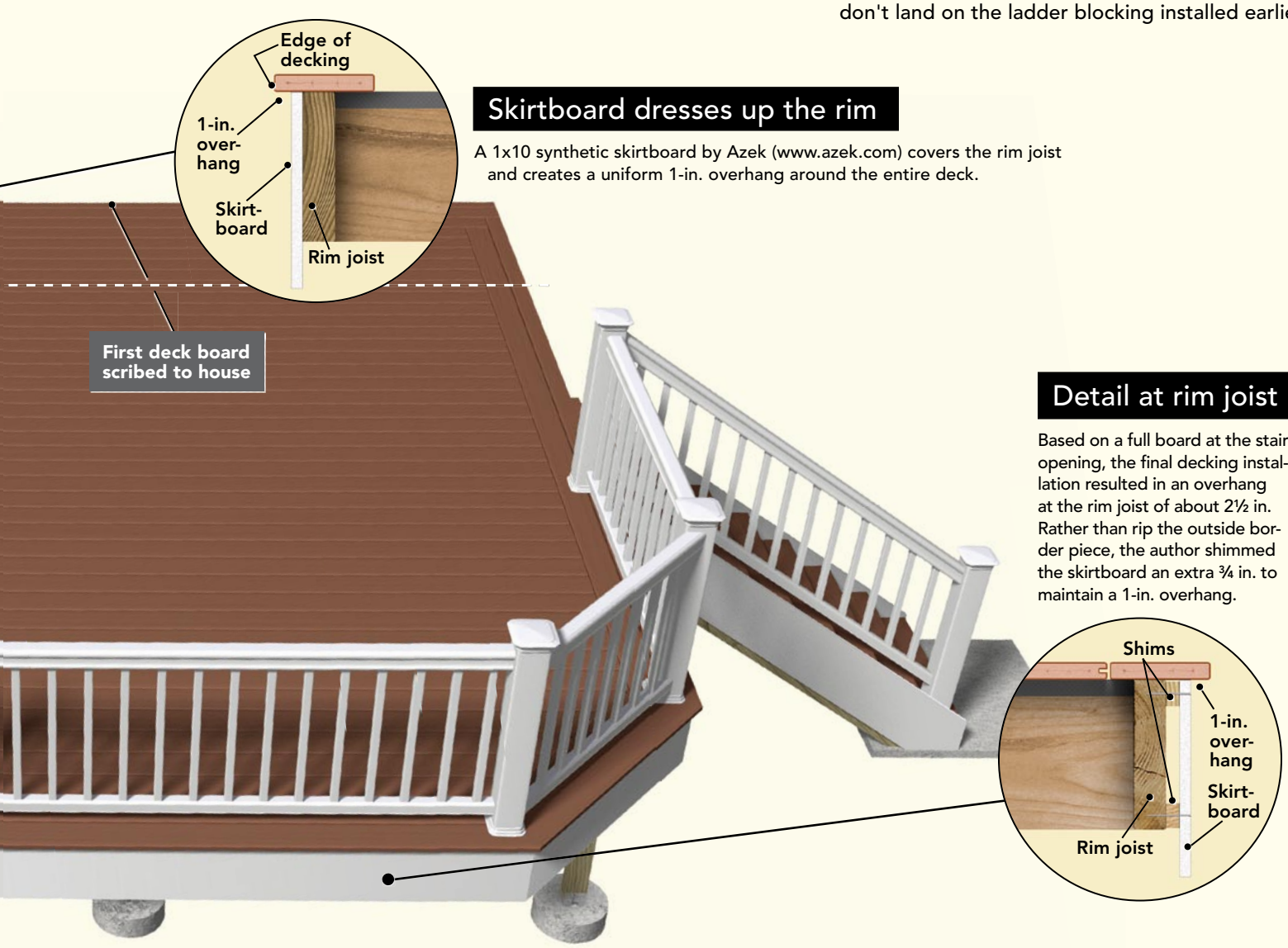
Two decking profiles

Installed with hidden fasteners, boards with a grooved profile were used in the field and for the inside border piece. The solid profile was used for the outside border and stair treads, and was installed with colored screws that match the decking.



I install the field decking first by butting the ends to the border, leaving a gap in accordance with the manufacturer's recommendations, and letting the far end run long. When the field is down, I cut it to length in place to install the border on that side.

For the final border, I snap a line the appropriate distance back from the edge and cut along it with a circular saw (adjust the blade depth so it doesn't cut into the framing). Additional blocking is added as needed to support board ends that don't land on the ladder blocking installed earlier.



Skirtboard dresses up the rim

A 1x10 synthetic skirtboard by Azek (www.azek.com) covers the rim joist and creates a uniform 1-in. overhang around the entire deck.

Detail at rim joist

Based on a full board at the stair opening, the final decking installation resulted in an overhang at the rim joist of about 2½ in. Rather than rip the outside border piece, the author shimmed the skirtboard an extra ¾ in. to maintain a 1-in. overhang.

BUILD STURDY STAIRS



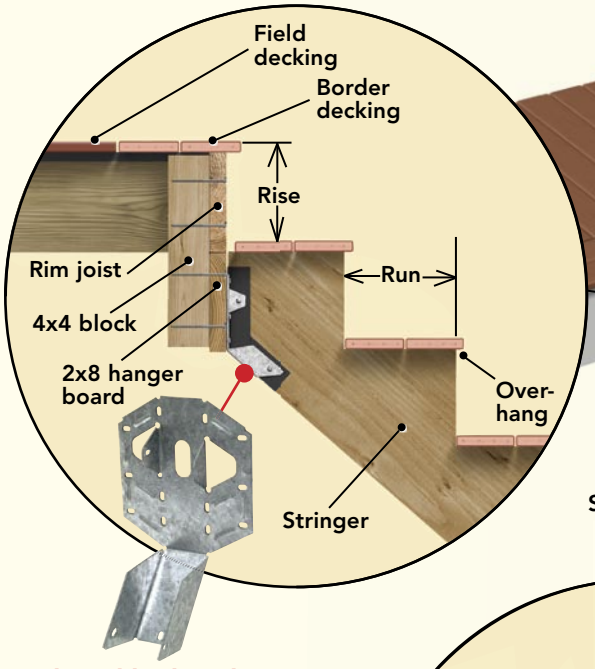

I start by placing concrete blocks as a temporary pad where I think the stairs will land. With a long level, I measure from the top of the deck down to the blocks. This is the total rise, and it enables me to calculate the number of steps and the riser height of the stairs (see below right). I use two clamps and a piece of wood to transfer these measurements to a framing square; this simple jig lets me mark the stringer board. Before cutting the stringers, I remove 1 in. (the depth of a tread) off the bottom so the rise there matches the rise of the other treads. Then I cut the stringer with a circular saw, finishing the corners with a reciprocating saw to avoid overcuts. I trace the pattern on the other stringers, and cut them the same way.

Stair connection

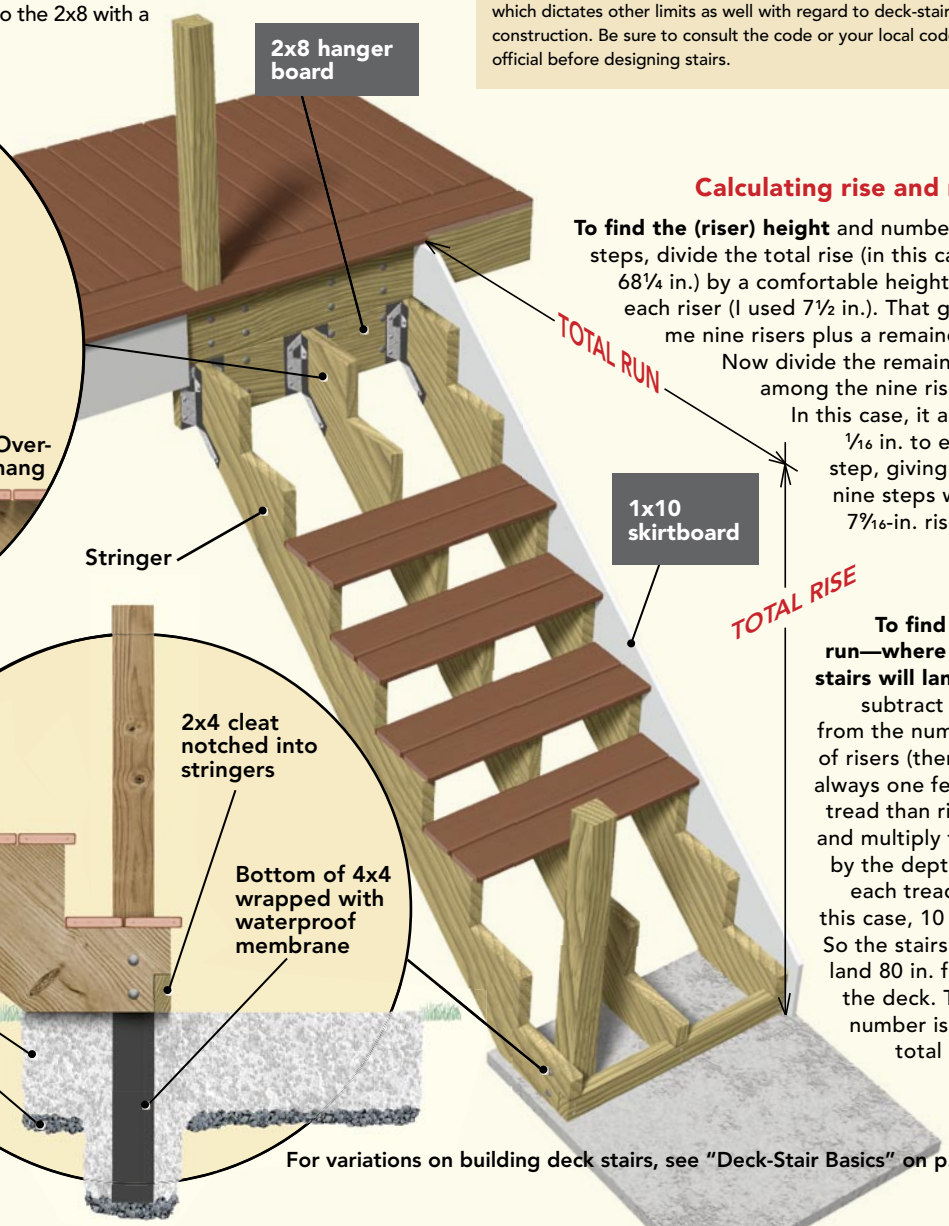
The tops of the stair stringers bear against a 2x8 hanger board that is attached below the rim joist with three short pieces of 4x4 and some LedgerLok screws. Each stringer is tied to the 2x8 with a metal connector (see below).

Check Code

The maximum recommended height for deck-stair risers is 7¾ in., according to the International Residential Code (IRC), which dictates other limits as well with regard to deck-stair construction. Be sure to consult the code or your local code official before designing stairs.



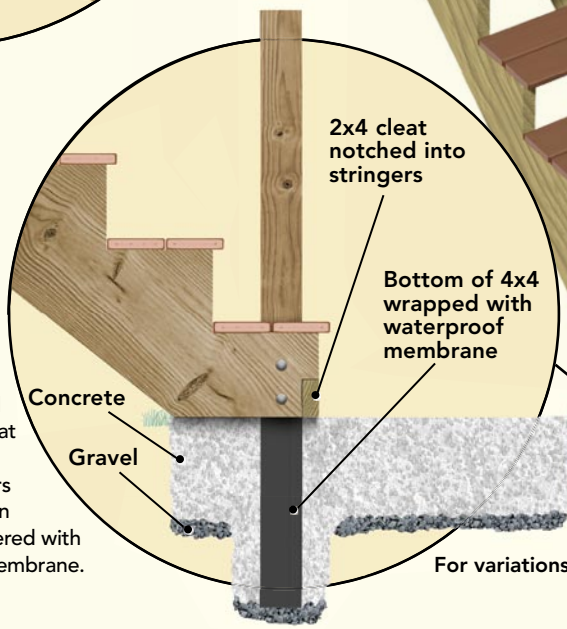
Adjustable-slope hanger
Secures stair stringer to hanger board (LSU26; www.strongtie.com)



Calculating rise and run

To find the (riser) height and number of steps, divide the total rise (in this case, 68¼ in.) by a comfortable height for each riser (I used 7½ in.). That gave me nine risers plus a remainder. Now divide the remainder among the nine risers. In this case, it adds 1/16 in. to each step, giving me nine steps with 7 9/16-in. risers.

To find the run—where the stairs will land—subtract one from the number of risers (there is always one fewer tread than riser) and multiply that by the depth of each tread (in this case, 10 in.). So the stairs will land 80 in. from the deck. That number is the total run.

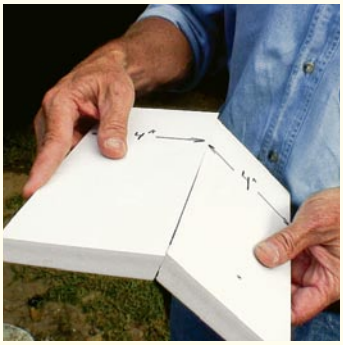


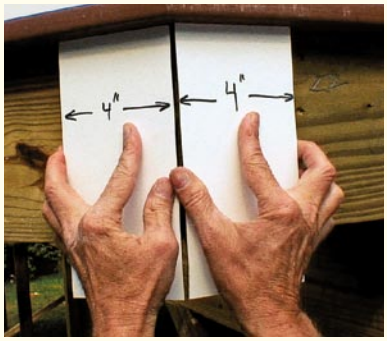
Landing and newel post

The temporary blocks are replaced with a 12-in.-deep concrete slab that provides a secure landing for the stringers. The concrete also anchors the newel post, which extends even deeper into the ground and is covered with a protective layer of waterproof membrane.

For variations on building deck stairs, see "Deck-Stair Basics" on p. 84.

FINISH WITH RAILS AND TRIM





Like the decking, the trim elements of this deck are made of synthetic materials. I start with a 1x10 trim board to cover the rim joists. Getting the corner bevels tight can be difficult, so here's one trick to do this precisely: First, cut two short pieces of trim—I made these 4 in.—and bevel one edge on each at 22.5°. Fit them together precisely at the corner, and draw a line on both sides to mark their position. Then measure from the end of the last piece of trim (or in this case, the edge of the stair) to that line, and add the lengths together. That gives me the total length from the end of the last piece to the tip of the bevel at the corner. I tack up the skirtboards with a nail gun and permanently affix them with stainless-steel screws. I apply bonding glue at the miter joints to help hold the PVC corners together.

Check✓Code

In addition to baluster spacing, the IRC also dictates that guardrails 36 in. or higher be installed on all decks that are 30 in. or more off the ground.

Baluster assemblies fit over bottom rails I've installed. At the top, they attach with a bracket that fastens to the post sleeve. At the corners, the ends of the baluster assemblies are cut so that they fit centered on the post sleeves. As a final step, I fit decorative post caps on top.

Composite sleeves fit over the pressure-treated posts I installed earlier. I shim them plumb, then slip a decorative collar over the sleeve to dress up the base and cover the gap at the bottom.

To install the railing, I attach brackets that accept a bottom rail that the baluster assembly clips over. Because they are prepainted, it's a good idea to take time to mark, cut, and fit the pieces carefully to make sure the finish isn't damaged.

The manufactured railing system on this deck, like most, has balusters spaced 4 in. apart as dictated by code. The pieces simply screw in place into pre-drilled holes. I start from the middle and work my way out, adjusting at the ends so that the balusters are close to 4 in. apart.