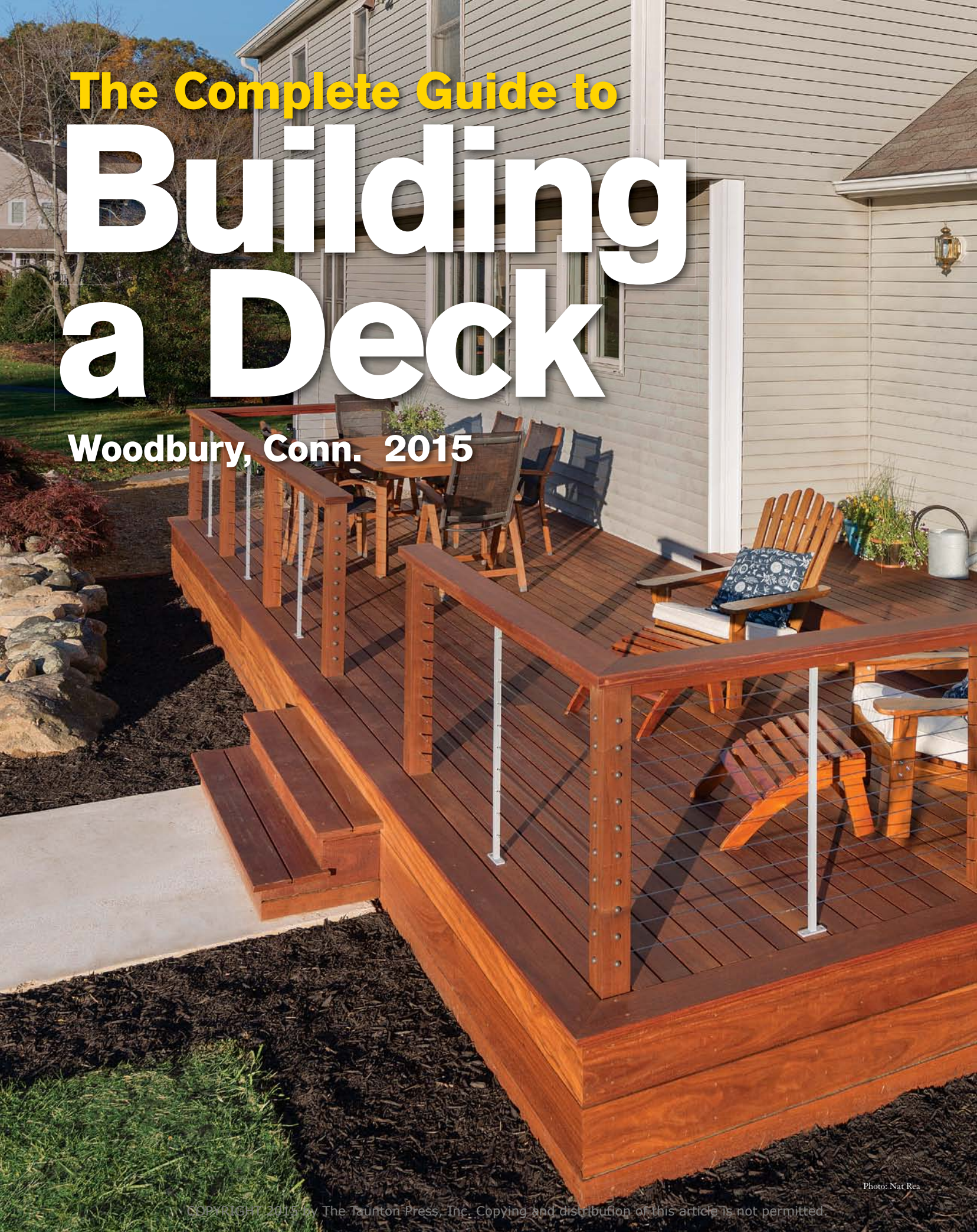


The Complete Guide to Building a Deck

Woodbury, Conn. 2015

Photo: Nat Rea

Build a modern living space with hardwood decking and cable railings

BY CHARLES BICKFORD

THINK SAFETY In most areas of the country, you need a building permit for a deck to ensure that it sits on adequate footings, is built properly with rot-resistant materials, and is attached securely to the house. Throughout the article, this symbol will alert you to deck-construction details that must conform to local building codes. (This deck was built in accordance with the American Wood Council's alternative deck code, the DCA 6-12, which many jurisdictions accept in lieu of the IRC.) 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.

Check✓Code

To see a video series on building this deck, visit FineHomebuilding.com/projecthouse.

ELEMENTS OF A

Sited at the top of a rise, Gloria and Walt's house has a great view of a pond that's surrounded by woods. The best place to take in the scenery had been the grade-level deck in back, but it was 30 years old and had seen better days. It was also too small to host a comfortable gathering. James Moffat of Hutker Architects in Vineyard Haven, Mass., designed a new deck with a similar low stance but increased the length by several feet and refined its appointments. Moffat envisioned the space as two distinct areas: one for sitting and the other for dining. The sitting area would be large enough to include future built-in seating. The dining area would fit eight easily and could expand for larger groups.

To accommodate the door that leads out to the deck, Moffat included a platform that serves as both a transitional landing and a great potential location for a grill.

In addition to the more common aspects of code-compliant deck building such as concrete footings and pressure-treated framing, this deck offers a few solutions to problems associated with low decks. Builder Chris Ahrens demonstrates attaching a ledger to a concrete foundation, pouring footings accurately, dressing up a deck with mitered skirtboards, and achieving a taut, clean-looking railing system. In keeping with the Project House tradition, *Fine Homebuilding*'s own Justin Fink stepped up to assist in the build.

Charles Bickford is a senior editor. Photos by the author and Andy Engel, except where noted.

2x10 ledger bolts to the foundation.

Railing posts are attached to frame with bolts and lateral-load connectors.

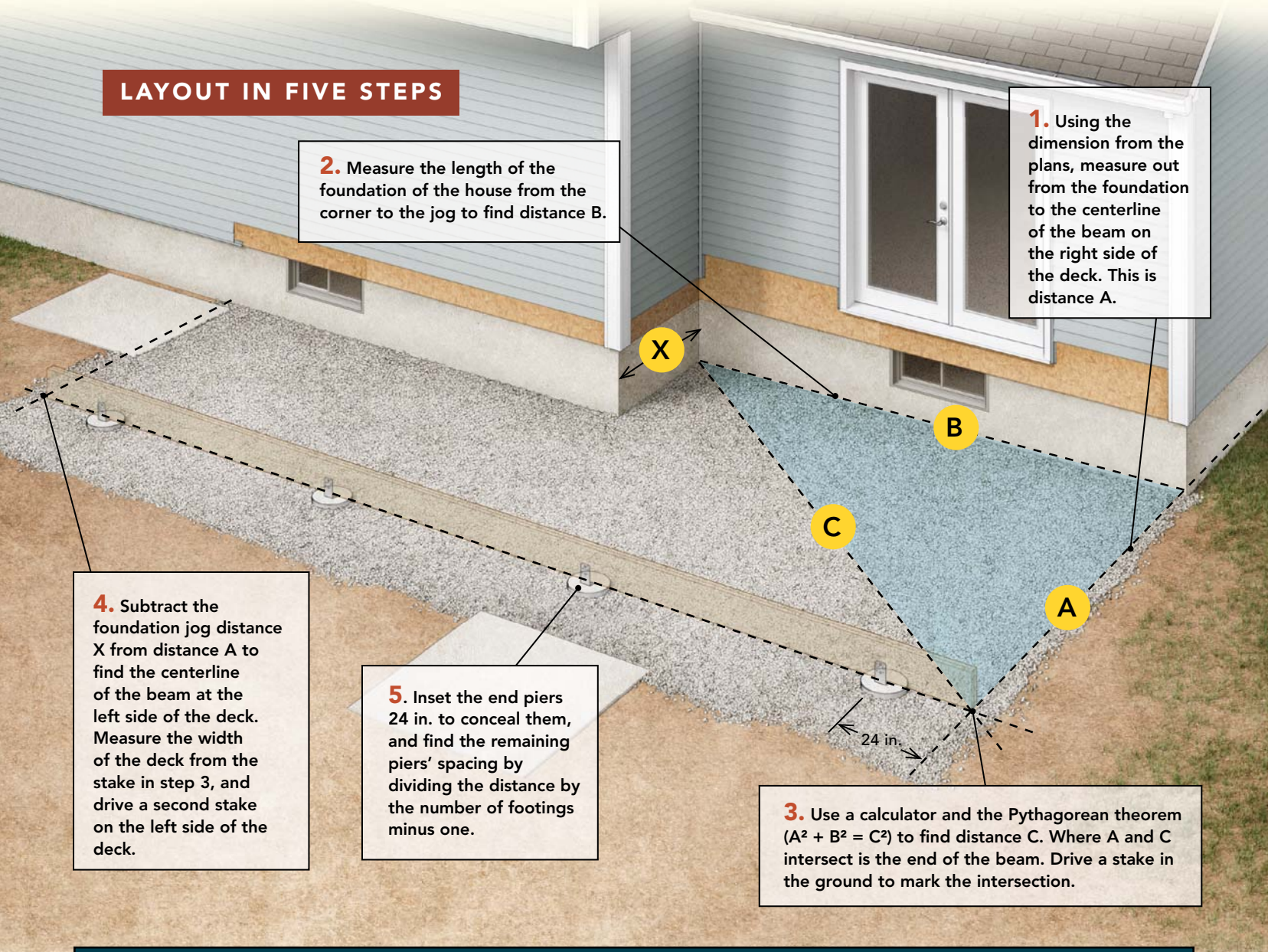
2x10 joists' length is fine-tuned to ensure that all deck boards are full width.

STRONG DECK FRAME

LAY OUT AND FORM THE CONCRETE PIERS

The first step was to locate and dig holes for the four piers that support the beam, then to lay out and attach the ledger to the foundation. The finished height of the piers was determined by the height of the ledger.

The location of the four piers was determined by subtracting the amount of joist cantilever (about 18 in.) from the overall width of the deck. When the pier locations were marked, Chris and Justin began to dig.



WHICH CAME FIRST, THE PIERS OR THE BEAM?

Deciding how many piers a deck needs, and how far apart they'll be, depends on the maximum total load on the deck, which is determined by multiplying the code-assumed per-sq.-ft. load of 50 lb. (at a minimum) by the size of the deck. Half of that load is supported by the ledger, and half by the beam and piers. The maximum span of the beam is determined by both the depth of the members—2x10s can span a greater distance than 2x8s—and the number of plies in the beam.

In this case, a double 2x10 was used. The maximum span of that beam meant that four piers were needed. Each pier carries a portion of the load based on the area of the deck it supports. The size of the pier is based on that load divided by the bearing capacity of the soil (the default value in the code is 1500 lb. per sq. ft.). In short, there are a lot of calculations you can do. Or you can simply go to table 4 in the DCA 6-12, where most of the work has been done for you.

Drawings: Christopher Mills

High-definition layout. *After marking the deck's outer corners with stakes and connecting them with a stringline, locate the pier centers and mark them with bright spray paint.*

Check the depth. *Pier holes must be dug to a depth determined by the regional code. Be sure to make the holes big enough to adjust the position of the piers.*

Big-base hybrid. *Tape larger plastic bases onto cardboard tube forms to increase the size and carrying capacity of the piers.*

Check the work. *After placing the forms, make sure they are plumb, and confirm their locations with a stringline before backfilling around them.*

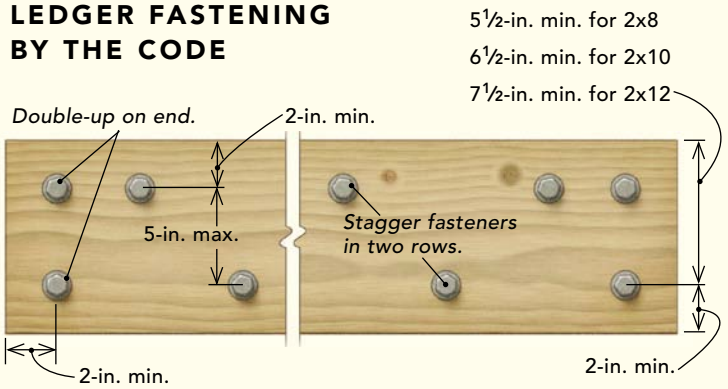
Under-deck prep. *With the piers backfilled, install a layer of landscape cloth followed by a layer of gravel to prevent weed growth and to control moisture beneath the deck.*

Check Code

The number, size, and depth of deck piers depend on the deck design, local climate, soil type, and whether the deck is supported by the house or is self-supporting. Check your local building code for guidance.

ATTACH THE LEDGER

The height of this deck and its ledger was determined by the upper platform landing, which is one step below the doorsill. This meant that Chris would have to attach the ledger to the concrete foundation rather than to the house's rim joist. For this, he used ½-in. expansion bolts and spaced them according to a schedule in the DCA 6-12. To avoid having a bolt location too close to a joist, Chris and Justin laid out the joist locations on the ledger before attaching it to the foundation.



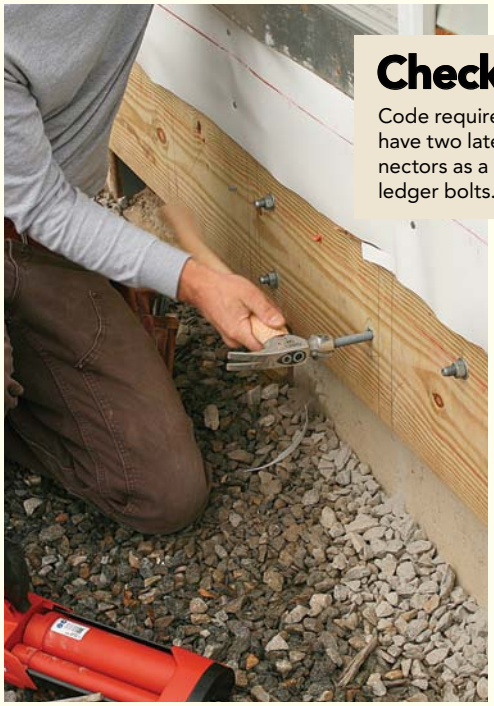
Lay out and drill. *Measure and cut 2x10s to length for each ledger, then use a framing square to lay out joist positions and the locations of the ½-in. expansion bolts.*

Set the height. *After measuring down from the doorsill, use a laser to establish a level line that indicates the top of the upper platform, then snap a chalkline.*

Locate the ledger. *Tack up blocking so that 7¼ in. extends below the line to represent the 2x8 platform framing. With the ledger resting up against the blocks, it's easily tacked in place with a couple of powder-actuated nails (far right).*

Drill the concrete. *Use a rotary hammer or hammer drill with a ½-in. masonry bit to drill into the concrete at each hole. Spin the nut onto the bolt before setting it with a hammer. This eliminates the problem of screwing nuts onto damaged threads.*

Glued to the foundation. *Attach code-mandated lateral-load hardware (Simpson DTT2Z or similar) with construction-grade epoxy and ½-in. galvanized threaded rod.*



Push, don't strike. *The threaded rod used to attach the hardware needs to be held firmly in place for 30 to 60 seconds until the epoxy firms up.*

Check✓Code

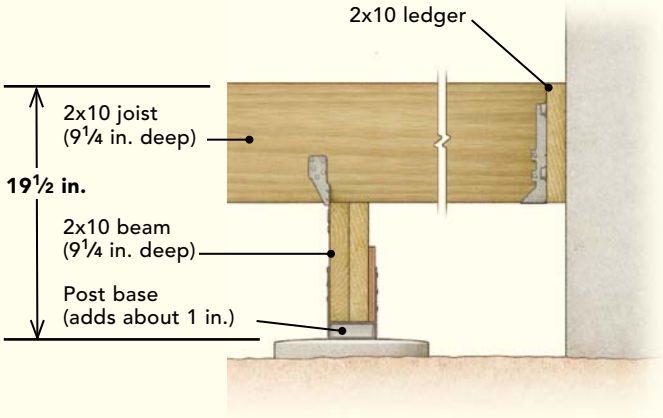
Code requires each deck to have two lateral-load connectors as a backup to the ledger bolts.

Hanging around. *Once the epoxy has set, it's a good idea to loosely attach the lateral-load hardware to the rod so that it's not forgotten.*

SET THE HEIGHT AND POUR THE PIERS

Because the beam was to be set directly onto the piers, there was very little wiggle room with regard to their height. The finished heights of all four piers had to be within ¼ in. of each other. A laser set to the height of the ledger was used to mark the tubes precisely.

Chris and Justin used a portable mixer to mix bagged concrete for the piers. They filled the tubes to the marks, then cut off the excess cardboard the next day when the concrete had set. Instead of using J-bolts, Chris drilled holes and epoxied bolts into the tops of the piers. This gave him greater accuracy than locating the bolts in the wet concrete.



The height of concrete piers isn't crucial on a raised deck, because leveling the beam is a matter of adjusting the length of each post. But for a low-level deck, where the beam sits right on post bases anchored to the top of the concrete piers, there is far less room for error.

Ledger determines pier height. *With a laser registered to the top of the ledger, use a 2x4 story pole that represents the height of the ledger, beam, and base hardware to mark the height of the pier.*

Mark the inside. *Nails pushed through the tube at the marks create an easy, accurate way to gauge the level of the pour.*

Find the center. *Once the concrete sets, measure out from the foundation, and mark the centerline of the beam on the outermost piers.*

Line up the piers. *Strike a chalkline across the pier tops to locate the centers of the bolts that will secure the beam hardware.*

Set the bolts. *When the bolt locations have been determined, drill a hole in each pier, and epoxy a bolt into the hole. The post bases can be attached when the epoxy has set.*

STRAIGHT TRUMPS PARALLEL

It's not crucial for the beam to be exactly parallel to the ledger and the deck rim; it just has to be straight and to land fully on the piers. With the ideal beam centerline (red) marked on the two end piers, stretch a chalkline across the row of footings to visualize the centerline of the other post bases. Before snapping the chalkline, adjust the two ends of the line either in or out to be sure that each post base will bear fully on its pier.

INSTALL THE HARDWARE AND BEAM

The main beam is a doubled 2x10 that is anchored to the piers with post-base hardware. The most important aspect of the installation is to create a straight and level beam. Chris and Justin assembled the beam in place, letting the ends run long so they could be trimmed flush with the deck joists. The joints in the beam occur at the piers, with at least one ply running continuously over each. When they had nailed the 2x10s together, they shimmed the beam level and attached it to the post bases.

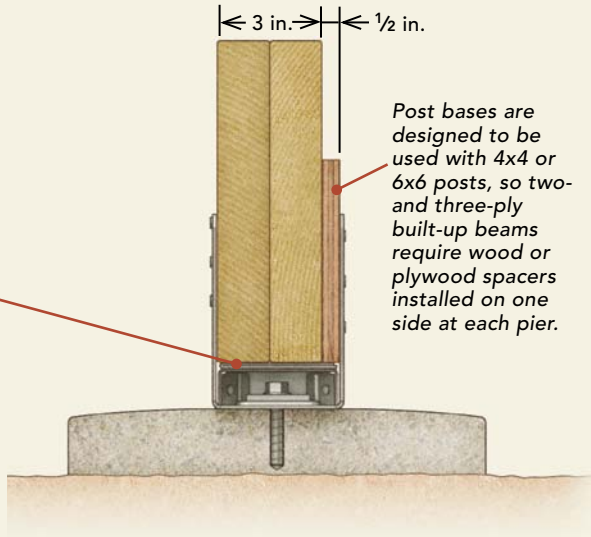
Build the beam in place. *This two-ply beam is made up of four 2x10s. The two butt joints are located directly on separate post bases.*

Check Code

Check local building codes to find the required size of a support beam. Code also specifies acceptable beam designs, splice locations, and nailing schedules.

DON'T FORGET THE SPACERS

In addition to padding out post bases with plywood spacers (right), make the beam level by shimming beneath it with galvanized nail plates that can be folded in half for extra thickness.



Post bases are designed to be used with 4x4 or 6x6 posts, so two- and three-ply built-up beams require wood or plywood spacers installed on one side at each pier.

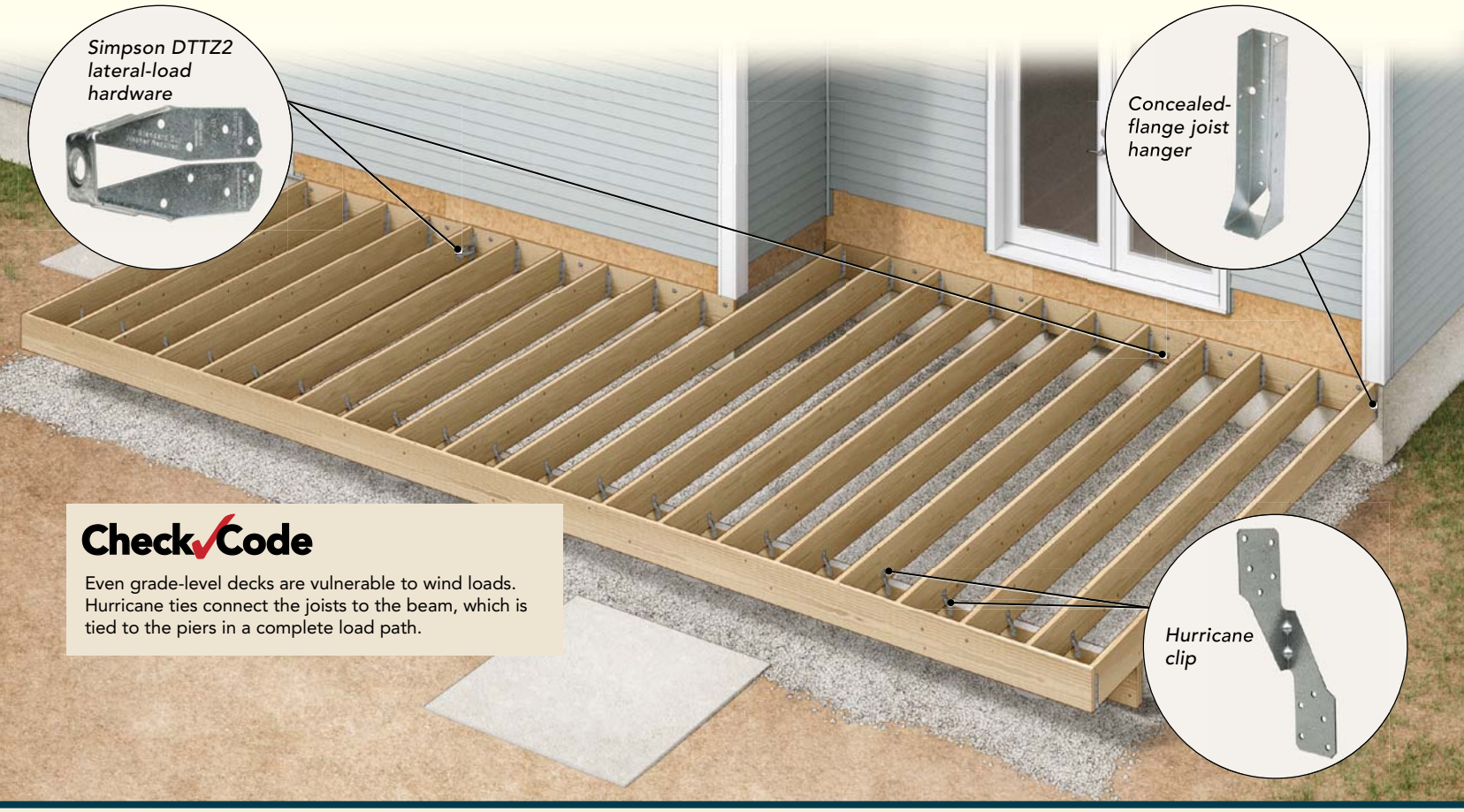
Protect the beam. *Water can get trapped between two mating surfaces and eventually compromise even pressure-treated wood. A strip of self-adhering flashing membrane keeps the water out.*

Don't skimp on the nails. *Keeping the plies flush, assemble the beam by nailing rows of four 10d galvanized threaded nails on 16-in. centers.*

FRAME THE DECK

With the ledger and beam in place, the next step was to install the end, center, and rim joists. Chris and Justin nailed concealed-flange hangers to both ends of the ledger and dropped in a 2x10 joist on each side. They squared each end joist to the ledger, then toenailed it to the beam. At the same time, they installed one joist in the middle to support the joint between the two halves of the rim joist.

Chris measured out from the house, then marked and trimmed the end joists. That length is based on the combined width of all the deck boards and the spaces created by the hidden fasteners, minus the thickness of the rim joist, blocking, skirt, and ledger. When they had nailed on the rim, they cut the remaining joists to length and tacked them in place. Finally, they installed the joist-hangers and hurricane clips. The joists were spaced 16 in. on center, except in a few places where the joists would have interfered with keeping even spacing between the rail posts. Moving these joist locations took forethought and meant that the decking spanned a greater distance than 16 in. in places, but that wasn't a problem. The 5/4 cumaru decking that was used can easily span 24 in., and maintaining consistent spacing between the posts was crucial to the sleek look of the design.

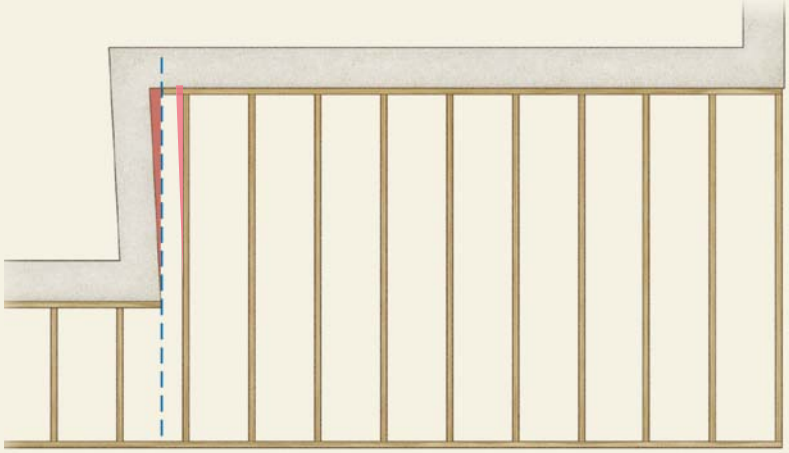


Check✓Code

Even grade-level decks are vulnerable to wind loads. Hurricane ties connect the joists to the beam, which is tied to the piers in a complete load path.

Dealing with a dropped deck

Attaching a deck ledger to concrete rather than the house's framing can mean dealing with some new challenges. According to Chris Ahrens, the most common ones are foundations with out-of-square corners, wavy walls, and basement windows that are in the ledger's path.



Out-of-square corners

If the deck is to wrap around corners or jogs in the foundation, check the foundation corners for square before setting the ledger. If you simply follow the jogs of the foundation, you could end up with an out-of-square frame.

Product photos: Dan Thornton

Square up the box. *Once the end joists are attached to the ledger, use the Pythagorean theorem to check that they are square to the house.*

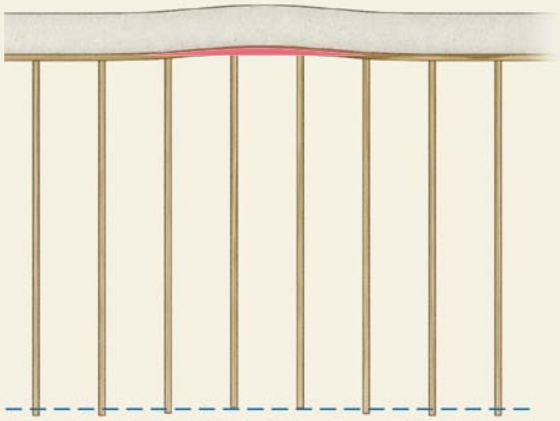
Parallel sides. *After checking for square, make sure that the end joists and center joist are parallel.*

Trim for the rim. *Taking the foundation's jog into account, cut the end and center joists to length.*

Attach the rim. *Nail each half of the rim joist into the joist ends with 16d galvanized common nails. Because the ledger was straight, the joists were gang-cut to length.*

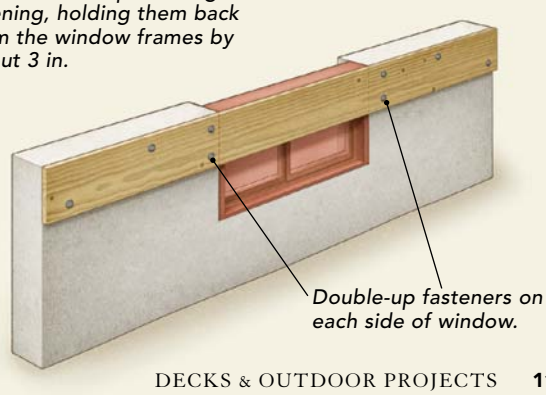
Wavy walls

Always knock off excess concrete left by the form ties to help ensure that the ledger lies flat against the wall. Even then, the ledger might not be perfectly flat. If you try to set joists cut to size, the opposite ends won't line up. In that case, let the joists run long over the beam. Before attaching the rim, snap a straight cutline, and trim the joists evenly.



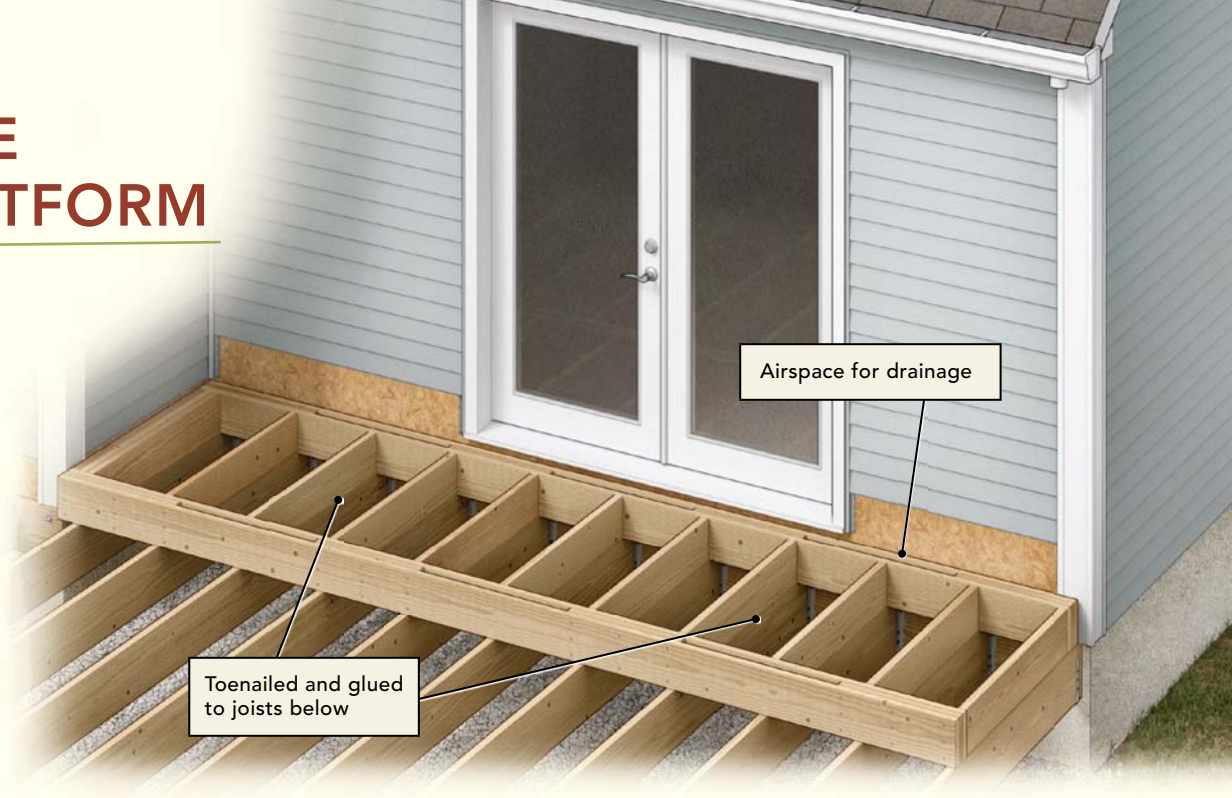
Basement windows

As long as the building official approves your plan, you can span the ledger right over small basement windows. In these cases, double-up the ledger fasteners on each side of the opening, holding them back from the window frames by about 3 in.



FRAME THE UPPER PLATFORM

With the main frame complete, the next step was to frame the upper platform. Chris wanted the 2x8 platform joists to bear directly on the joists below, so after cutting the rims to length, he laid them on the frame below and transferred the layout. The platform is spaced away from the house to promote drainage and airflow.



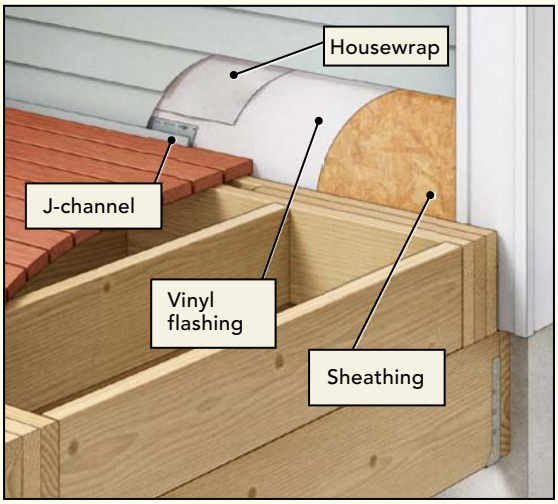
Framing the platform on the deck ensures accuracy. *Align the platform joists with those on the deck during assembly.*

Extra padding. *As on the main deck, the platform's decking perimeter of wider 5/4x6 boards requires blocking along the front and back.*

Not a drag. *After applying a liberal bead of construction adhesive on the deck-joist tops to prevent future squeaks, slide the platform into position, and toenail it to the frame below.*

FLASHING THE PLATFORM

Although the platform is held away from the house, the sheathing still needs to be protected. A housewrap layer keeps the sheathing dry, and a 12-in.-wide length of vinyl flashing diverts any water away from the house.



INSTALL THE RAILING POSTS

Although this deck is less than 30 in. high and therefore is not required by code to have a railing, James Moffat's design included a sleek stainless-steel cable railing from Feeney, making a great visual contrast to the wood decking and posts. Chris set up a drill press and, using one of the kit's intermediate aluminum pickets as a template, drilled the holes for the cable railing (⅜ in. dia. on 3-in. centers). The manufacturer recommends a spacing of less than 72 in. between posts; these ended up spaced about 65 in. apart.

Prepare the posts. *The most accurate way to drill the posts for the cables is to use a ⅜-in. Forstner bit in a drill press. Drill slowly from both sides to preserve the bit's edge and avoid splintering.*

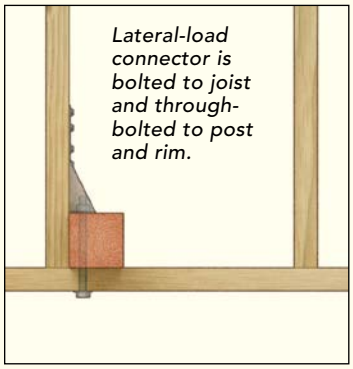
Work from outside. *When attaching the posts to the frame, it's faster and easier to drill and bolt from the outside rather than from between the deck joists.*

Check✓Code

According to the DCA 6-12, the posts must be able to resist an outward force of 200 lb. and must be reinforced with the same lateral-load connectors used at the ledger.

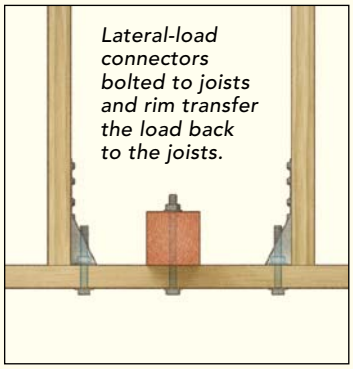
FOUR POST ATTACHMENTS

1 ON THE RIM, NEXT TO A JOIST



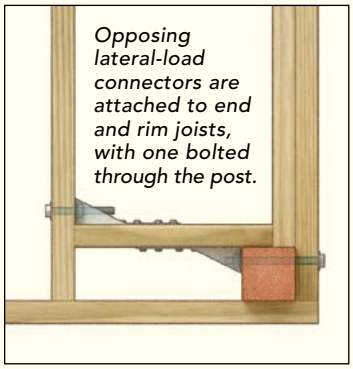
Lateral-load connector is bolted to joist and through-bolted to post and rim.

2 ON THE RIM, BETWEEN JOISTS



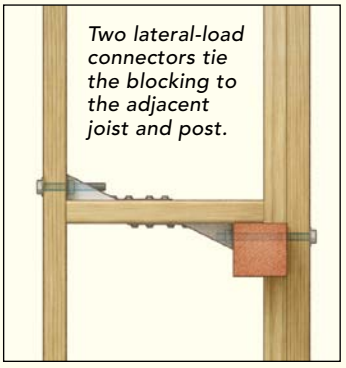
Lateral-load connectors bolted to joists and rim transfer the load back to the joists.

3 ON THE CORNER



Opposing lateral-load connectors are attached to end and rim joists, with one bolted through the post.

4 ON THE END JOIST



Two lateral-load connectors tie the blocking to the adjacent joist and post.

POUR PADS, FRAME STAIRS, AND WRAP THE SKIRT

The next step called for digging and pouring the two concrete stair pads, framing the stairs, and wrapping the deck with horizontal cumaru boards that would transition into risers at the stairs.

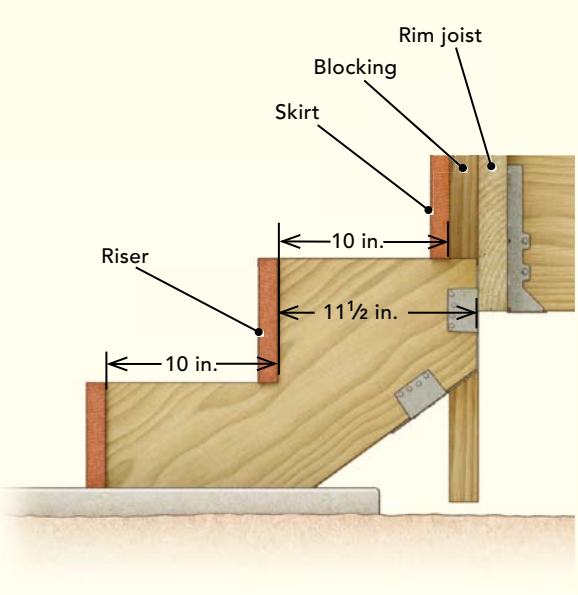
Check✓Code

Check local building codes to find the acceptable tread widths and riser heights. Stair pads must be at least the width of the stair and project at least 3 ft. from the bottom tread nosing.

Level form, level pour. *After digging a 4-in.-deep, flat-bottomed hole, drive stakes into each corner. When the 2x4 form is level, fasten it to the stakes so that it can be used as a guide to screed the surface of the concrete pad.*

Fine-tune the overhang. *The deck was planned for full-width boards with a 1-in. overhang at the edge. However, slight variations in board width add up. Before installing the skirtboard blocking, several deck boards with fastener spacers were laid out to verify dimensions.*

Skirt blocking. *Nail pressure-treated 2x4s vertically on 2-ft. centers to provide nailing for the hardwood skirting. Coat both ends of each block with a copper-based wood preservative such as Wolman CopperCoat to prevent rot.*



Cut the stringer long. *Extend the top of the stringer past the 2x4 blocking so that it meets the rim joist. That means having to add 1½ in. to the run dimension of the top tread cut.*

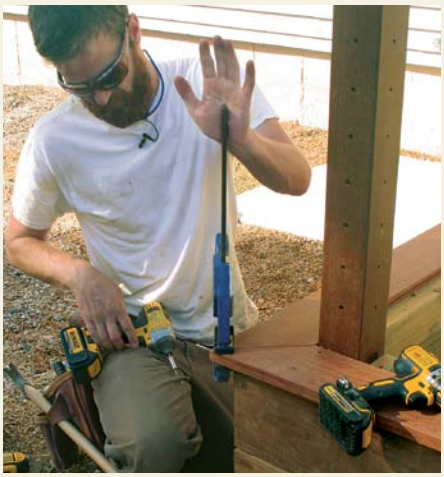
Hang the stringers next. *After cutting the two-riser stringers from 2x12 pressure-treated stock, fasten them to the rim with a galvanized connector (Simpson LSC or similar).*

Apply the skirt. *After treating the mitered ends with a wax-based sealant such as Anchorseal, install the skirtboards with stainless-steel, color-matched, trim-head screws.*

DECKING WITH HIDDEN FASTENERS

The design of the decking called for a mitered 5/4x6 perimeter to enclose a field of 5/4x4 boards. All of the cumaru decking was attached with Ipe Clip hidden fasteners, except for the perimeter, which was face-screwed to the frame and plugged. When the decking was complete, Chris and Justin sanded it using a random-orbit floor sander, then applied two coats of Ipe Oil.

No crowns. *To give the decking a flat surface, check the joist tops for humps, then snap a chalkline across the length of high joists and remove the excess with a power planer.*

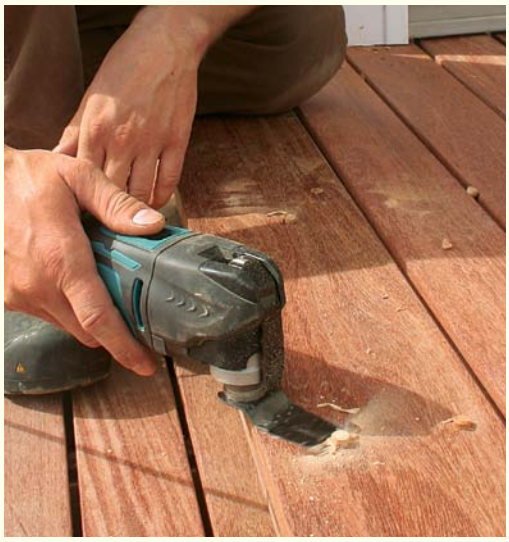


Get miters tight. *The 5/4x6 perimeter boards run outside the posts. To keep the miters flat, use a clamp on one side to lever the board into plane, then pin the joint with a stainless-steel trim-head screw.*

Fasteners keep the decking in line. *These Ipe Clip hidden fasteners are designed so that each stainless-steel screw is driven at a 45° angle into the previous board, pushing it back tight.*

Protect the house. *To prevent any migration of moisture from the deck to the house, apply peel-and-stick flashing membrane to the sheathing above the ledger.*

The last board—almost. *To make sure its width is correct, wait until both levels of decking are installed before ripping and fastening the platform riser.*



Finish work. *Once the glue on the plugs covering the countersunk screws that secure the perimeter boards has dried, use a multitool to trim the excess.*

Wrap the stringers, put down the treads. *The deck skirting turns onto the stringers and meets the risers in miter joints. Screw each two-board tread into place, and plug the holes. The smaller screw holes on the vertical skirt and risers don't require plugs.*

THE CABLE-RAIL SYSTEM

The final component to be installed on this deck was the cable railing from Feeney. With the railing posts already drilled and in place, Justin began by cutting and fastening the lock rails and cap rails that connect the posts. Chris followed closely behind, cutting to length the aluminum intermediate pickets that support the cables between the posts. The final step was threading the cables themselves through the posts and locking them into tension. The defining feature of this system is its clean look, so hidden fasteners and tight joinery are important.

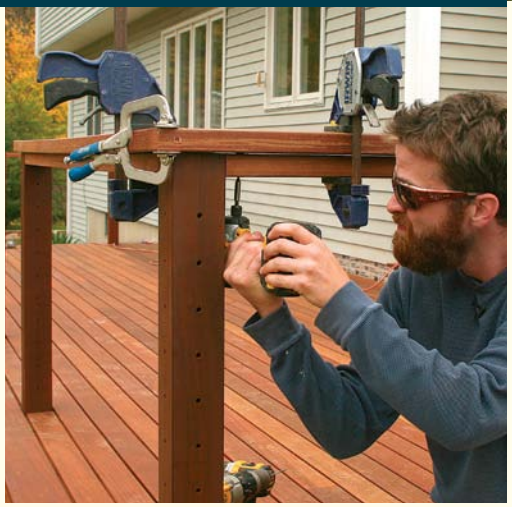
Check✓Code

Even under pressure, the space between railing cable must remain less than 4 in. That's why they're spaced at 3 in. and stretched tight.

LOCK RAIL AND CAP RAIL

Last chance for finish. *It's easier to apply finish (in this case, Ipe Oil) before the cable is installed.*

Lock rails resist the cable tension. *Measure and cut to length the 2x4 lock rails, then paint the end grain with a wax-based preservative. Attach the lock rails to the posts with pocket screws, using a strap clamp to draw the posts together.*



Keeping it clean. *After fitting and securing the cap-rail miter, attach the lock rail to the cap rail with deck screws from underneath.*

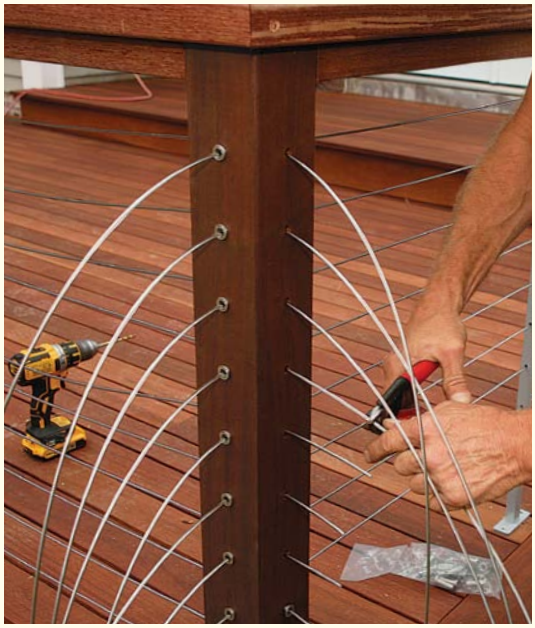
Top photo: Nat Rea

INSTALLING CABLE RAILS

Run the cable. *Each cable has a threaded end that is secured with a nut and washer. The other end is drawn through the pickets and the posts.*

Set the pickets as you go. *Cut the pickets to length so their holes align with those on the posts. Center and plumb each between a pair of posts, then fasten them in place.*

Relaxed meeting at the corner. *Each course of cable passes through the slightly oversize holes that intersect at the center of the corner post. To ease the passage, it's a good idea to keep the cables loose until both runs of cable are in.*



Use the clipping tool. *A dedicated cable cutter makes quick and clean work of trimming the stainless-steel cable.*

One-way connection. *Threaded down the cable into the post hole, the lock fitting allows the terminal end of the cable to be pulled taut without slipping. Trim excess cable to the fitting face with an angle grinder.*

A tight finish. *Working from the threaded end, tighten the cable by cranking down on the nut and washer. Finish both cable ends with a decorative cap.*