Building a Slate-Tile Deck

Strong framing and proper substrate details reduce the chances of cracking

by Cameron Habel

Last year I got a call from a client who wanted to create more outdoor living space by building a deck along the back of her house over a part of the yard that was too steep to use. She said she wanted to use Trex, so I was picturing a conventional deck and guardrail. But when I stopped by her house — which was located in the hills above Oakland, Calif. — to look at the job, it became apparent that a conventional design was not going to work.

For one thing, the house had spectacular views of the bay and of San Francisco — views that a wood-picket guardrail would block. Therefore, I suggested using a glass or cable rail system.

Also, one end of the deck would lap onto an existing salt-finish concrete patio; in passing, the owner mentioned that she didn't like the surface of the patio and wondered if it would be possible to cover it with the same composite material we used on the deck. I suggested covering the patio with stone tile instead, and when she said she liked that idea I proposed putting the same material on the deck, too; that way, the two surfaces would match.

By the end of our meeting, the client had agreed to have my company cover the existing patio with slate tile and build a slate-covered wood-framed deck with a glass guardrail system. The deck would be accessed from the patio, the existing kitchen door, and new French doors in the dining room wall.

Figure 1. The joists run between a 4x10 ledger beam and a 4x12 outer beam carried by posts on concrete piers (above). One end of the deck laps about 5 feet onto an existing concrete patio (left and opposite).

Deck Structure

I would have preferred to build a free-standing deck and avoid having to deal with a ledger, but there was fill along the foundation so we couldn't have installed piers there without digging deep holes. Normally we only have to excavate to undisturbed soil, because in this area the temperature almost never drops below freezing.

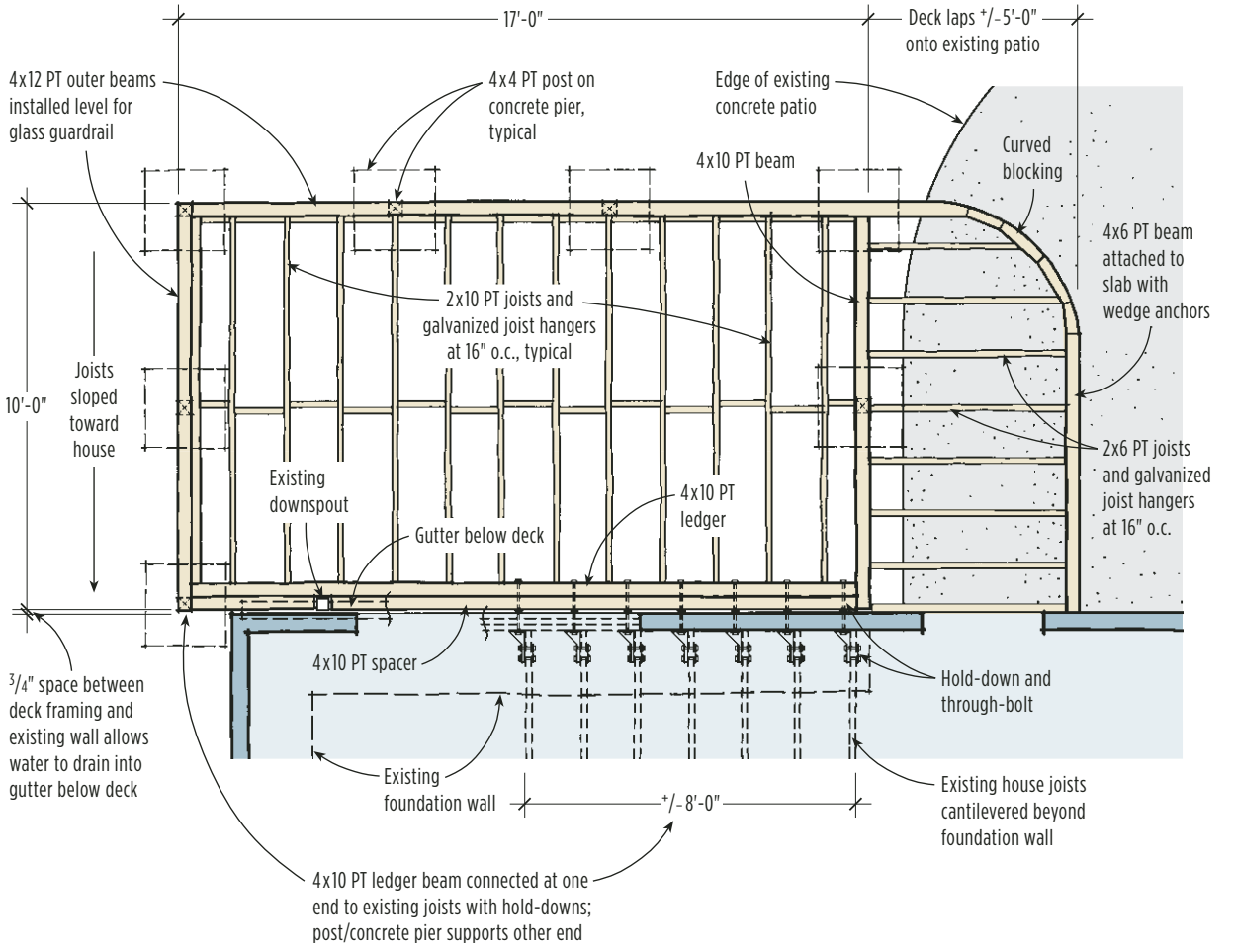
Our plan was to use a 4-by beam for the ledger, connect a portion of it to the house, and pick up the other end with a post on a concrete pier just beyond the end of the building. The framing at the other edges would land on posts, concrete piers, or the existing concrete patio (see Figure 1).

Concrete piers. There were seven piers in all, each 2 feet square and about 15 inches thick, and each reinforced with four pieces of #4 rebar. Before placing the concrete, we positioned Simpson CB44HDG (hot-dip galvanized) column bases in the piers to hold the 4x4 posts. Since we were framing the deck with pressure-treated Douglas fir (ACQ) and the new chemicals are so corrosive, we made sure all the metal connectors were hot-dip galvanized or approved for use with ACQ.

Slope. Most decks slope away from the house so that water will drain off the outboard edge. But in this case the continuous glass rail presented a barrier, so we sloped the deck toward the house and allowed it to drain through a 3/4-inch space between the deck and wall. We installed a gutter below the deck to catch this water and direct it away from the foundation (Figure 2, page 4).

The slope presented a challenge because the structural glass-rail system needed to be in continuous contact with

Deck Framing Plan



the perimeter beams. Sloping the end beam would have meant sloping the rail (which would look bad) or complicating the installation by requiring the glazing contractor to taper some of the glass panels. To avoid those scenarios, we installed the end beam level and allowed the joists to drop down from it at the end closest to the house. This created a small step at the bottom of one of the rails, which we later trimmed with strips of slate.

Framing Details

Since we wanted to retain an existing downspout from the roof, we blocked the 4x10 ledger beam an extra 3½ inches off the wall to allow the downspout to pass through. We used LedgerLok screws (FastenMaster, 800/518-3569, www.fastenmaster.com) to attach two lengths of 4x10 to the back of the ledger, leaving a gap for the downspout.

Wall connection detail. The usual way to fasten a deck ledger is to bolt it to the rim joist of the house. But on this house the joists cantilevered a short distance beyond the foundation wall so that we

Figure 2. Since a continuous glass handrail will prevent water from draining off the outer edge of the deck, the author sloped the joists toward the house (above left) and used stacks of 3-inch-square washers to space the ledger beam off the wall (above right). Water drains through this space and is collected by a gutter below the deck (left).

couldn't fasten to the rim, which was supported only by nails. Instead, we used Simpson HD2A hold-down hardware to attach the ledger to the floor joists beyond the rim — a connection detail similar to one an engineer had specified on an addition I'd built.

To gain access to the joists, we cut an opening through the stucco on the bottom side of the overhang; later we covered this opening with an access panel so that the connection could be inspected and maintained.

We staggered the bolts high and low through the beam and connected it at seven locations. Each hold-down was through-bolted to a joist and tied to the beam with 5⁄8-inch galvanized threaded rod (Figure 3, page 5).

To prevent leaks, we filled the holes through the stucco and the rim with Sikaflex-1a sealant (Sika Corp., 800/933-7452, www.sikaconstruction.com) before installing the rod. And to provide drainage we spaced the deck about 3⁄4 inch off the building by placing stacks of square 3-inch galvanized washers over the rods between the stucco and the ledger assembly.

Outboard edges. The left end of the deck lapped onto and was supported by the patio. We framed the two outboard edges of the deck with 4x12 beams, partly to support the load but also to make sure we had something solid to bolt the rail to.

We provided lateral strength by cross-bracing the end of the deck with 4x6 timbers. We installed them in line with the posts and beam because that method is stronger and looks better

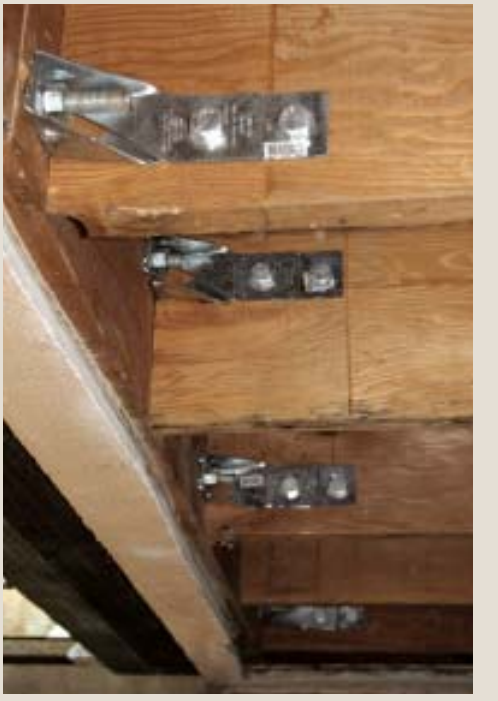
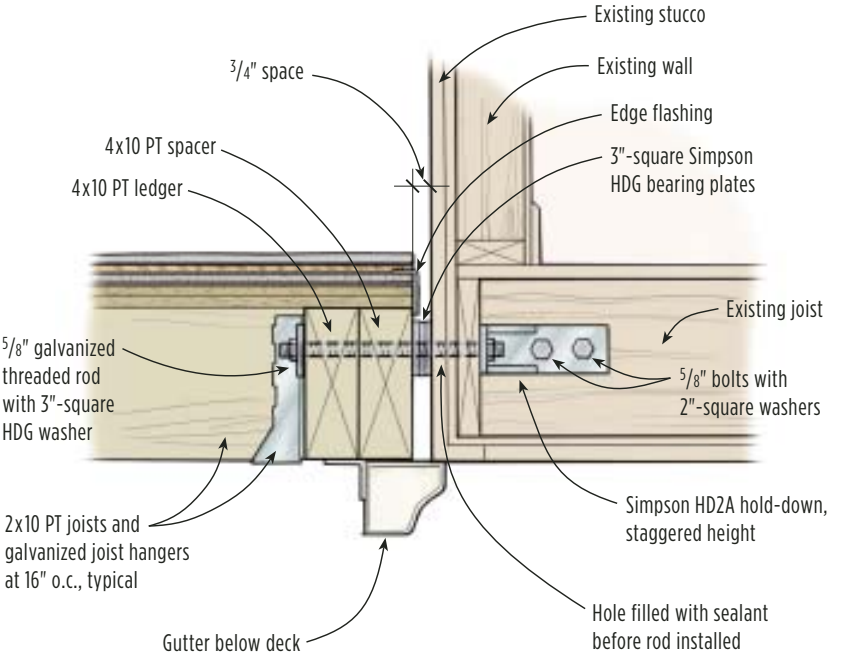


Figure 3. The left end of the ledger beam (above) is bolted to the house with 5/8-inch all-thread that runs between nuts and washers outside and Simpson HD2A hold-downs inside (above right). This ties the ledger to the joists instead of to the rim — which, because the joists are cantilevered, is not supported by a sill.

Ledger Connection Detail



than lapping the pieces (Figure 4).

Joists and sheathing. Once the perimeter framing was in place, we installed 2x10 pressure-treated Douglas fir joists 16 inches on-center, blocked midspan and supported by Simpson ZMAX joist hangers. We then sheathed the deck with a double layer of ¾-inch T&G pressure-treated plywood glued and nailed to the framing. The added layer provides the stiffness necessary to prevent natural stone tile from cracking. Had we been using ceramic tile, a single layer over our 16-inch joist spacing would have sufficed.

Crack-Isolation Membrane

An important aspect of this project was choosing a method to apply the stone that would reduce the likelihood of cracking caused by deflection or movement of the deck or slab. The proper way to do this is to install the stone (or tile) over a crack-isolation membrane. Also referred to as antifracture or uncoupling membranes, these materials are designed to reduce the amount of stress that can be transferred from the substrate to the finish. (For a list of available crack-isolation membranes, visit the Tile Council of North America Web site at www.tileusa.com.)

Some of these membranes come in liquid form and are troweled or painted on; others are sheet membranes that are applied to the substrate with thinset mortar. After the membrane is installed, the finish material is applied over it with thinset mortar. Membranes are available

Figure 4. The author cross-braced the end of the deck with 4x6 diagonals (above), which he fastened to the corner posts with the same bolts that hold the posts in the column bases (above right). The diagonals butt to a post at midspan and are bolted to it through the same Simpson CC44 column cap that connects the post to the beam above (right).

Edge Detail

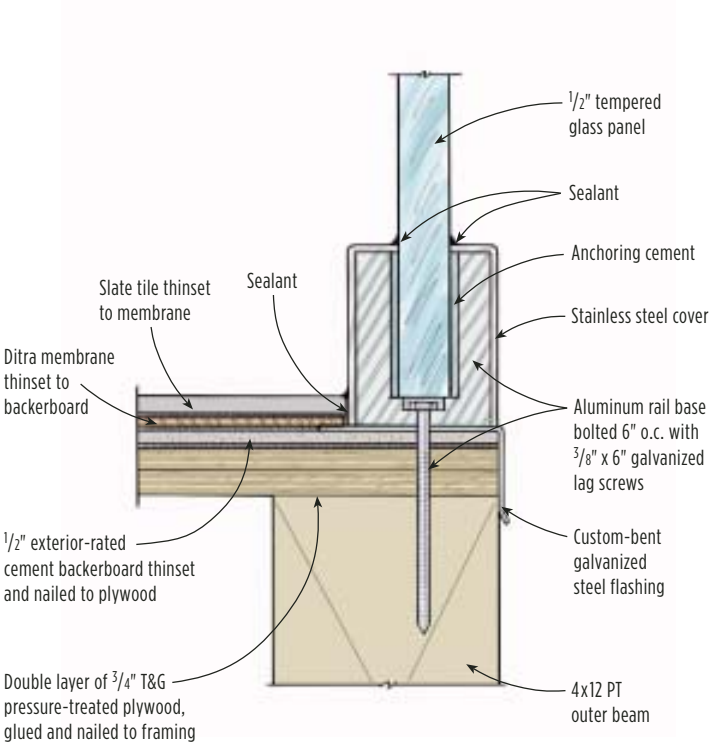


Figure 5. After the cement board was installed, the glazing contractor bolted the aluminum base shoe (above left) over a galvanized flashing at the edge of the deck (left). Later, when the tile had been set, he cemented 1/2-inch tempered-glass panels into the channel, then clad the channel with a stainless steel cover (above).

Figure 6. To accommodate possible movement in the slab, the tile contractor installed an isolation membrane, applying unmodified thinset to the substrate (left) and then pressing the membrane into place with a float (above).

for interior or exterior use over a variety of substrates, including plywood, cement board, and concrete. Many can be used to create waterproof installations suitable for use over living areas.

We used Ditra (Schluter Systems, 888/472-4588, www.schluter.com), a polyethylene sheet membrane with a distinctive gridlike surface. The indentations on the upper surface are undercut (like a dovetail joint) so that mortar will key into them. The underside of the membrane is faced with synthetic fleece, which sticks well to mortar while preventing it from clogging the interconnected channels on the membrane's grid.

If moisture or vapor gets below the membrane it can escape horizontally through these channels. According to the manufacturer, the vertical parts of the grid further isolate the finish material from the substrate below.

Ditra is 1/8 inch thick and comes in rolls 39 inches wide by 45 or 98 feet long. Full rolls cost about $1.55 per square foot, but our supplier will sell partial rolls for an added charge.

Installation guidelines. The installation handbook for Ditra provides detailed guidelines for many different types of installations. The specs for our installation — natural stone tile over wood framing not over living space — required a substrate of two layers of plywood sheathing, a layer of 1/2-inch exterior-rated cement backerboard, and Ditra that's been sealed at the edges and seams.

We installed backerboard over the sheathing with modified thinset mortar and galvanized roofing nails.

Once this was done, we installed edge flashings, and the glaziers installed the aluminum base channel for the glass-railing system.

Edge Flashings

There would be a slate-tile riser where the deck landed on the patio, but elsewhere we needed to install flashing to cover the edges of the cement board and sheathing; otherwise they'd remain exposed.

I had a sheet-metal fabricator custom-bend galvanized steel flashings for the outboard edges of the deck. For added protection we coated the flashings with Clearco's high-performance zinc spray (800/533-5823, www.clearcoproducts.com), a cold galvanizing spray that produces a film that's 90 percent zinc.

We nailed the top edge of the flashing over the cement board so that the leg hung down and lapped onto the perimeter beam below. The drip edge provided a clean visual transition between the framing and the base of the rail, and kept water off the edge of the sheathing material.


Figure 7. A seaming tape bedded in thinset prevents leaks at joints in the membrane.

Glass Railing System

After the flashings were installed, it was time for the glazing sub to install the base shoe for the glass-railing system. There are many glass-railing systems on the market; we chose one made by C.R. Laurence (800/421-6144, www.crlaurence.com) because it eliminated the need for posts, which would block the view.

The rail consists of a heavy aluminum base shoe, 1/2-inch tempered-glass panels that fit into the shoe, and a stainless steel cap railing that fits over the top edge of the panels (Figure 5, page 7).

Installing the base shoe. Since this rail system was designed to be installed over a steel or concrete floor assembly, we had an engineer tell us how to attach it to a wood beam. His recommendation was to bolt the base 6 inches on-center with 3/8-inch-by-6-inch galvanized lag screws. The base shoe came drilled 12 inches on-center, so we had the glaziers drill more holes. The glaziers shimmed the base level over the metal drip edge, bolted it down, and then left while we did the tile work on the deck.

Completing the rail. After the tile on the deck was complete, the glaziers came back to install the glass and railing cap.

To enhance the view through the panels we purchased glass that had been treated with TekonUS Alpha (888/749-8638, www.tekonus.com), a chemical treatment process that reduces water spotting.

The glass panels were placed in the channel, wedged plumb with plastic wedges, and permanently secured with anchoring cement poured into the gap between glass and channel.

We purchased optional stainless steel cover pieces to hide the aluminum shoe. The stainless steel veneer is attached to the shoe with double-sided tape and sealed with silicone glazing sealant. The stainless steel cap rail has a built-in gasket that allows it to be friction-fit onto the edge of the glass.

Installing the Membrane

The tile-setter cut the membrane to length with scissors, applied it fleece-side-down on unmodified thinset mortar, and then pressed it firmly in place with a float (Figure 6, page 8). Unlike most sheet membranes, which lap at the seams, pieces of Ditra butt edge-to-edge. On the deck, the Ditra lapped onto edge flashings, but since there were no flashings on the slab, the membrane simply stopped at the edge.

Unmodified thinset. Schluter recommends using unmodified thinset under and over Ditra because latex-modified thinset must air-dry for the polymers in

Figure 8. The tile was set in unmodified thinset (far left), then grouted (left). The completed job adds an outdoor room to the house (below).

it to coalesce and harden.

Modified thinset takes much longer to cure when it's sandwiched between impermeable polyethylene and some other nearly impermeable material such as tile; although it will cure eventually, it could take 14 to 60 days, according to the Tile Council. And in the meantime, grouting the installation or allowing it to get rained on would be risky.

With unmodified thinset, the extended drying time is actually a plus, because the retained moisture helps it hydrate and form a stronger bond.

Waterproofing. Though the deck was built with pressure-treated lumber and was not over living space, we still wanted to prevent water from getting below the membrane; if the framing wasn't constantly going through wet/dry cycles, there would be less likelihood of the tile cracking. (Leaks would be an even greater concern in cold climates where water that gets below the membrane could freeze and break the mortar bond.)

To prevent leaks, Schluter recommends sealing the edges and seams of Ditra with unmodified thinset and a layer of its Kerdi-Band seaming tape (Figure 7, page 9), which is made from the same synthetic material as the Kerdi membrane used to waterproof pans and walls in showers. The Ditra handbook contains details that allow you to create fully waterproof installations, up to and including ones suitable for use over occupied space. We didn't go that far on this job; we simply sealed the seams.

Installing the Slate

We did this job during our rainy season. To avoid having to vacuum water out of the indentations before he could set tile, the tile-setter installed the membrane and slate a section at a time, tarped his work at night, and grouted it before moving on to another section.

He set the tile with unmodified thinset and used sanded grout in the joints (Figure 8), leaving a movement joint of matching silicone sealant every 10 to 12 feet.

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