Ledgers on Challenging Walls

What to do when standard details don't work

by Andy Engel

Readers of this magazine likely know how to safely secure a deck ledger to most houses. But what about the oddball situations? Can you attach a ledger to a concrete wall? What about to masonry veneer, stucco, EIFS, logs, SIPs, I-joists, or cantilevered floor framing? The answer is often nuanced, but sometimes it's a flat-out "No."

And it's not just the mechanical attachment that makes for a safe, durable deck. "Flashing is as critical as the original design," notes Frank Woeste, P.E., Ph.D., professor emeritus at Virginia Tech. Poorly detailed flashing or flashing (such as aluminum) that corrodes in short order when in contact with ACQ preservatives lets in water that rots the house framing. It doesn't matter how many bolts you use to attach the ledger if the house framing it's attached to rots away.

DECKLOK BRACKET SYSTEMS

The advent of engineered floor systems also brought about some unanticipated (by carpenters, anyway) structural issues. As reported in the July/August 2007 issue of *Professional Deck Builder* (*Decking News,* "Siding Hides Warning Signs of Deck Collapse"), some early engineered floors used only 3/4-inch OSB as a rim board. Compound that with poor flashing, and you've got a recipe for collapse.

The details shown here are intended as guidelines; other solutions, good and bad, exist. And if you have any doubt at all, it's never a bad idea to pay for an engineer's expertise.

Masonry walls? It depends.

Direct attachment to solid masonry — poured concrete or grout-filled block — and concrete block is fairly simple. Details for doing so are widely available; the ones shown here (**Figure 1, page 2**) are from Virginia's code. For solid masonry, steel expansion anchors whose bolts are a minimum of 1/2 inch in diameter and penetrate the masonry by at least 2 1/2 inches can take the place of lag bolts. The anchor spacing would be as shown at right in the table "Ledger Fastener Spacing for Masonry Walls."

Note that I'm talking about structural masonry here, and not masonry veneer. Attachment to masonry veneer is a bad idea, and the reason that's so is discussed on page 6.

There is a potential problem with attaching a ledger to concrete, which Woeste says should trigger a building department to require an engineer's design: "Although the strength of some

Ledger Fastener Spacing for Masonry Walls		
Joist span	**1/2" bolts and expansion anchors**	**1/2" bolts and approved adhesive anchors**
0 to 6'-0"	36"	32"
6'-1" to 8'-0"	36"	32"
8'-1" to 10'-0"	34"	32"
10'-1" to 12'-0"	29"	24"
12'-1" to 14'-0"	24"	24"
14'-1" to 16'-0"	21"	16"
16'-1" to 18'-0"	19"	16"

expansion anchor bolts is rated, the strength of the concrete into which they're placed is probably not known in practice."

When attaching a ledger to hollow masonry block, use adhesive anchors, such as the Epcon A7 from ITW Red Head (800/348-3231, www.itw-redhead.com) or the Hilti HIT HY 20 system (866/445-8827, www.us.hilti.com). The threaded rod used with the anchors must be at least 1/2 inch in diameter and must penetrate the block by at least 3 1/2 inches.

The anchors used for this application are pouches made from plastic or stainless steel screen. They're filled with a special adhesive, inserted into a hole drilled (without using the impact feature of a hammer drill) in the block, and held in place with a tab. The threaded rod is inserted in the adhesive, which is allowed to set up according to the manufacturer's instructions before the ledger is installed. Be prepared for sticker shock — the adhesive anchors can cost upward of $40 per hole.

While there's no flashing called for when joining a ledger to masonry, it's recommended that the top of the ledger be caulked to the wall to keep out water. And don't be cheap here: Buy a high-quality caulk. It's all that's keeping water off the fasteners holding the deck up, and this is the only chance anyone will ever have to seal this joint.

Finally, when you're going to attach the joist hangers to a ledger installed on masonry, remember to order the 1 1/2-inch hanger nails.

Attaching to Concrete or Solid Masonry

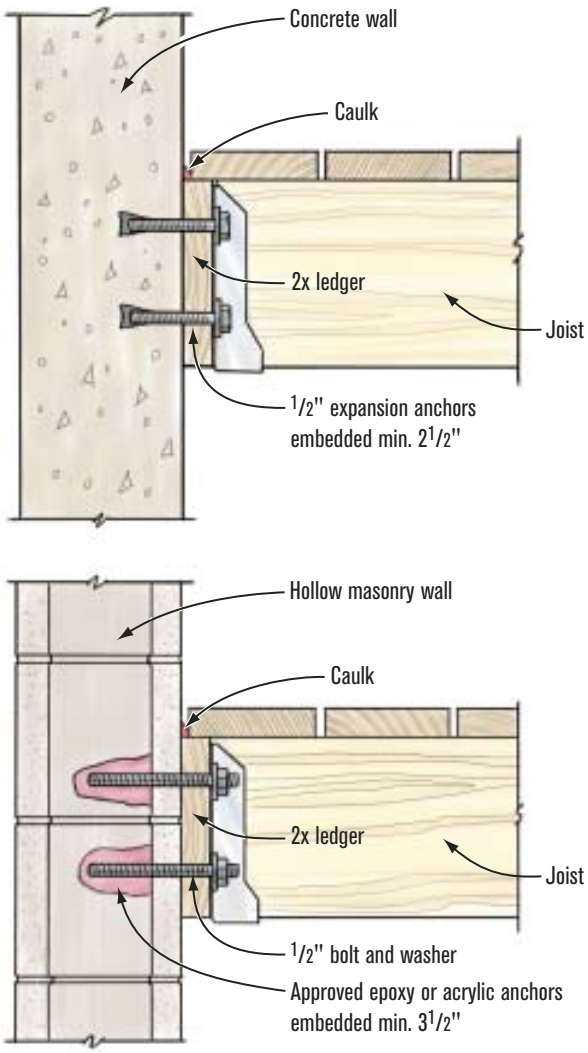

Figure 1. In most cases, deck ledgers can be bolted directly to poured concrete or concrete block walls. Expansion anchors — never lead shields — are used in solid masonry or filled block, and approved epoxy or acrylic anchors and bolts are used in hollow masonry.

Insulating concrete forms? Probably.

Forethought pays off when dealing with ICFs. To attach a ledger to an ICF wall, the IRC calls for direct concrete-to-wood contact, which is usually accomplished with "anchor tunnels." These plastic inserts thread into 6-inch-diameter holes drilled in the foam forms (**Figure 2**). Each tunnel holds an anchor bolt in its center, keeping it square to the wall as the concrete fills the tunnel during the pouring of the wall. Anchor tunnels are installed at a code-prescribed spacing, which varies with the floor loading and span, and they're staggered above and below the centerline of the ledger so as not to create a line that's likely to split the ledger.

But what do you do when the deck is an afterthought? Jim Eggert, a design-build contractor in Branford, Conn., specializes in ICF construction. He's supported ledgers on $^5/_8$-inch or $^3/_4$-inch stainless steel threaded rod that's epoxied into holes drilled in the ICFs. Eggert claims that these thicker rods can offer a bending moment that's sufficient to bridge the thickness of the foam in an ICF wall. Most jurisdictions would require an engineer's stamp of approval on such an assembly, however.

Figure 2. Plan ahead to attach to ICFs. A plastic anchor tunnel screws into a hole drilled in the ICF. The tunnel holds an anchor bolt square to the wall, and the concrete is poured around it. Tunnels are installed in a staggered line to minimize forces that might split the ledger.

Traditional stucco? Sure, but flashing can be tough.

In theory, attaching a ledger to a traditional stucco wall is pretty straightforward. But while it might be tempting to simply bolt the ledger through the stucco, such an attachment won't meet the requirements in the 2007 IRC Supplement (see *Professional Deck Builder,* "New Ledger Attachment Requirements Adopted," Jul/Aug 07). The ledger must be bolted to the framing because the stucco isn't structural and you'd be imposing shear loads on the bolts that aren't accounted for in the code tables.

To attach the ledger, you have to cut the stucco back to the framing with a masonry saw, which should be set deep enough to sever any wire lath underlying the stucco. This is easy enough to do if the stucco guys achieved a uniform thickness. The next trick is to slip a piece of flashing (galvanized steel would be the best choice, to be compatible with the steel wire lath) about 3 inches up under the building paper that should underlie the stucco. If you're very lucky, there won't be any nails holding the lath in place for those 3 inches.

I wouldn't be so lucky and would expect to spend some time cutting nails with a hacksaw blade or with a long metal cutting blade in a recip saw. I would double-flash such a ledger, as well as extend the bottom cut in the stucco an additional 3 inches to allow for flashing to extend beyond the edge of the ledger (**Figure 3**).

Flashing With Traditional Stucco

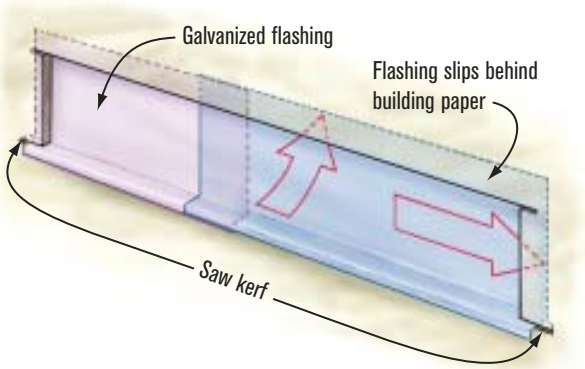

Figure 3. A masonry saw cuts out the stucco and lath. The bottom cut extends about 3 inches to the sides so that flashing can be extended beyond the ledger.

Engineered floors? Maybe.

By engineered floors, I'm talking about I-joists and open-web joists. The considerations are different for the two.

Whether or not a deck can be attached to an I-joist floor depends on the material used for the rim board. If it's an I-joist or plywood, forget it — unless you can convince an engineer to sign off on the detail. But if the rim is $1^1/_8$-inch LSL or $1^1/_4$-inch LVL, and the manufacturer lists that as appropriate for attaching a deck, then go right ahead (**Figure 4, page 4**). On an existing house, it's important to field-verify the rim-board material before bidding the job.

Watch out, too, when you turn the corner. It's pretty common for the rim board running perpendicular to the joists to be LVL or LSL, while the end joist that parallels the other joists is just another I-joist. If that's the case, your engineer would need to detail the ledger attachment

Ledger on Engineered Floors

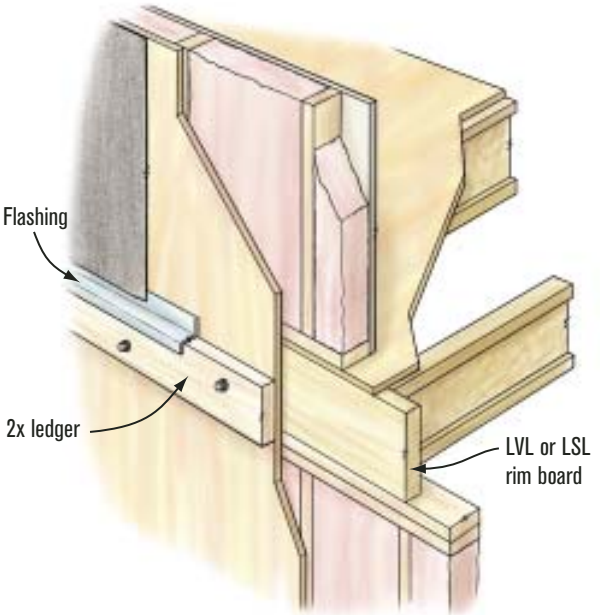

Figure 4. Ledger attachment to an I-joist floor depends on the rim-board material. If it's 1 1/4-inch LVL or 1 1/8-inch LSL — and the manufacturer approves — ledger attachment proceeds typically. Watch out for thin plywood or I-joists used as rim board.

Donít Trap Water Against Logs

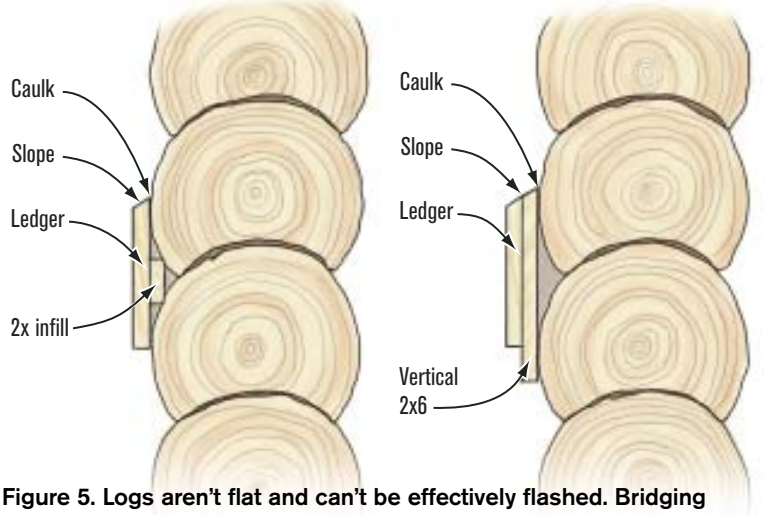

Figure 5. Logs aren't flat and can't be effectively flashed. Bridging the space between the logs with either a horizontal 2-by member or vertical 2x6 standoffs makes a flat surface. Engineering might be required, as these attachments aren't described in the code.

to that side of the house — or that portion of the deck would have to be freestanding.

Open-web floor trusses are another question. Codes in some areas outright forbid attaching a ledger to open-web floor trusses. Such floor systems are inherently engineered, and adding a load outside of the design's parameters can have unexpected consequences. However, Ron Strohbeck, a truss designer in Carlinville, Ill., notes, "Most truss manufacturers allow ledgers to be bolted to floor truss systems." But he advises, "Check with them first and check with the building department." This is definitely not a liability I'd take on without heeding Strohbeck's advice.

Log walls? Yes, with consideration.

If you've ever worked on a log home, you know that it brings some interesting challenges to the table. The walls aren't flat, for one, and to really grab your attention, you can count on them shrinking in height by as much as a foot, if green logs were used. Even so, veteran contributor Kim Katwijk, a deck builder in Olympia, Wash., says, "Logs are pretty easy."

Katwijk explains that how you attach a ledger depends on the size and design of the logs: "West Coast logs tend to be big, say 18 inches in diameter, and there's a large trough between them." When the ledger needs to go in this space, Katwijk bridges the gap to create a reasonably flat surface with a horizontal 2x6 (**Figure 5**) or by custom-tapering a 4x6 for very long logs, which can vary in width. The ledger is then attached to the face of this horizontal shim.

It's pretty much impossible to flash a ledger to a log home. You could cut a reglet (a slot meant to receive flashing) into the log above the ledger, but Katwijk believes capillary action is as likely to draw water in as the flashing is to keep it out. Instead, he tapers the top of the ledger, so water will drain away from the logs, and carefully installs the ledger so that no debris- and water-trapping pockets are created. He caulks the top of the ledger to the logs using a tripolymer caulk, inserting backer rod where needed.

Another challenge is that logs settle as they shrink. New homes built from standing dead timber shrink the least, according to Katwijk, but they can still shrink several inches. The worst situation is a second-floor deck on a new home made from green logs. You can expect the

Post Bases for Decks on Log Homes

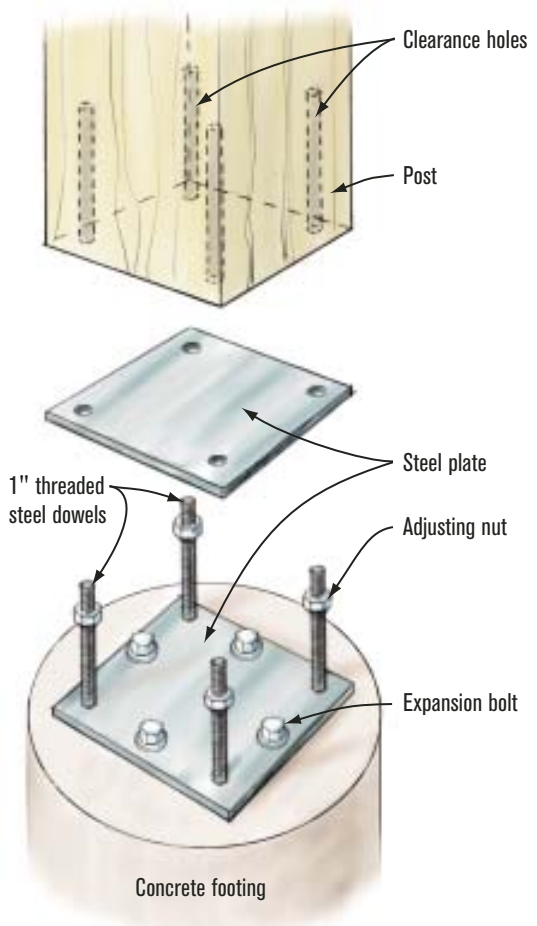

Figure 6. Logs shrink; vertical posts don't. Decks attached to new log homes have to accommodate the expected shrinkage in the logs. Fabricated engineered post bases that allow adjustment as the logs settle solve the problem.

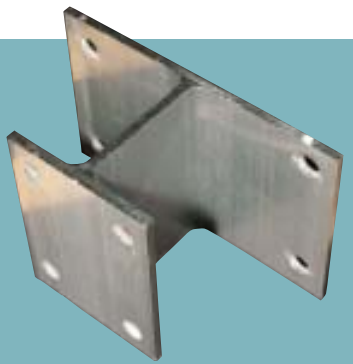

Figure 7. The Maine Deck Bracket is an option that works well on log homes.

supporting wall to shrink as much as a foot. In both these cases, the posts holding up the outside of a deck attached to a log home have to be made adjustable. Special hardware (**Figure 6**) takes care of such shrinkage, and you'll need to have it engineered. The log home supplier should be able to provide an estimate of the amount of shrinkage to allow for.

One relatively simple approach to hanging a ledger on a log house is to use a metal standoff (**Figure 7**). For example, the Maine Deck Bracket (207/212-0888, www.deckbracket.com) is an aluminum standoff that's bolted to the house at intervals determined by the joist span. A double 2-by bolts to the brackets, and acts as a flush beam to support the joists at the house. This leaves a generous drainage space between the house and the deck, reducing the likelihood of rot.

Cantilevered floors? No (but sometimes they can be framed around).

Attaching a ledger to cantilevered floor framing is generally forbidden by code — for good reason. Often, a cantilevered floor is pushed to its maximum load-bearing capacity just by supporting the existing loads. You can't know this without an engineer's evaluation. And even if the joists have some unused bearing capacity, it's likely that the band joist on the cantilever, to which the deck ledger would be attached, is just nailed into the end grain of the joists. That connection isn't adequate to support a deck (**see photo, page 1**). The band joist to which you typically attach a deck is supported directly by the house foundation.

It's possible, but a lot of work, to pull the band joist off the cantilever, and slide the deck joists under the cantilevered floor to where they can bear on the house's top wall plate or mudsill. The span design of these joists must take into account not only the typical loads from the deck, but also the load now imposed by the house floor, wall, and roof. And it's practically impossible to prevent water from following the deck joists into the house and rotting it out.

In fact, the first deck job I ever did was replacing such a deck, as well as a good portion of the house's walls and interior flooring. There were literally bushels of carpenter ants at work on that house because of the moisture damage caused by the deck. I'd avoid this approach like the plague.

If it's just a small cantilevered bay, then framing around it isn't very hard. Doubled or tripled joists on either side of the bay can carry a header, which in turn carries the framing beyond the cantilever (**Figure 8, page 6**).

Don't even think about it.

Clearly, there are more ways of attaching a deck ledger to a wall than are addressed even in the new ledger attachment section of the 2007 IRC Supplement. Nonetheless, there are

Getting Around a Chimney or a Cantilevered Bay

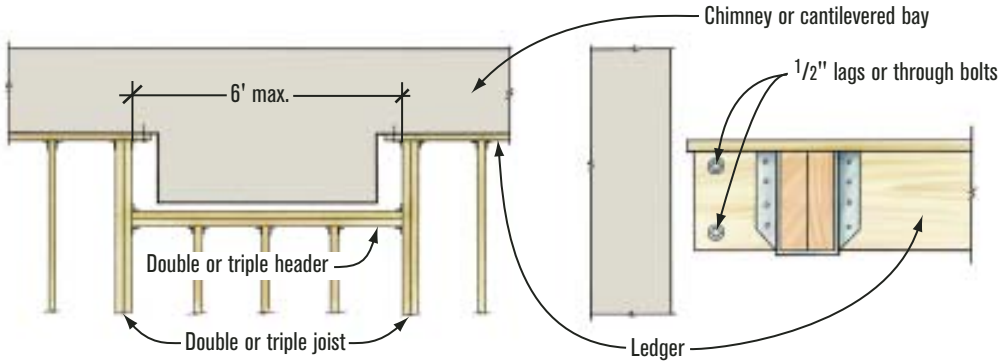

Figure 8. It's a code violation to attach a ledger to either a chimney or a cantilever. Box framing around it is the solution, up to about 6 feet. A larger box-out may be permissible with engineering.

situations where attaching a ledger just isn't appropriate.

For example, attaching a deck ledger to masonry veneer — when the brick or stone is applied over a framed wall — is a code violation nearly everywhere. Masonry veneer is not designed to transfer the loads imposed by a deck; the deck pulling away from the house could also pull the masonry veneer away.

Structural insulated panels (SIPs) also present problems for deck-ledger attachment. SIPs are a sandwich of OSB and rigid foam. Typically, there will be a 2x6 member at each edge, and there may or may not be more 2x6 studs running up the center. Although SIPs can be used for stand-alone structures, they are also often used to sheathe and insulate timber-framed homes.

While the 2x6s in the SIPS might seem to provide a good anchor for lag bolts, the foam and OSB don't. Without engineering, the IRC has no provision for attaching to SIPs. If the SIP wall rests on a conventional floor system, however, you can attach to that floor as you normally would.

EIFS, or synthetic stucco systems, make me nervous. Although the new drainable systems are a dramatic improvement over the older systems — which engendered a flurry of class-action lawsuits in the 1990s — flashing and sealing EIFS is a job for a specialist.

Unless the deck ledger is in place when the stucco is applied, it's best to avoid attaching a ledger to a building clad in synthetic stucco. Penetrations to the stucco cladding are notorious for allowing leaks, which the synthetic stucco doesn't allow to dry out. The result will be rot and mold.

Freestanding Deck

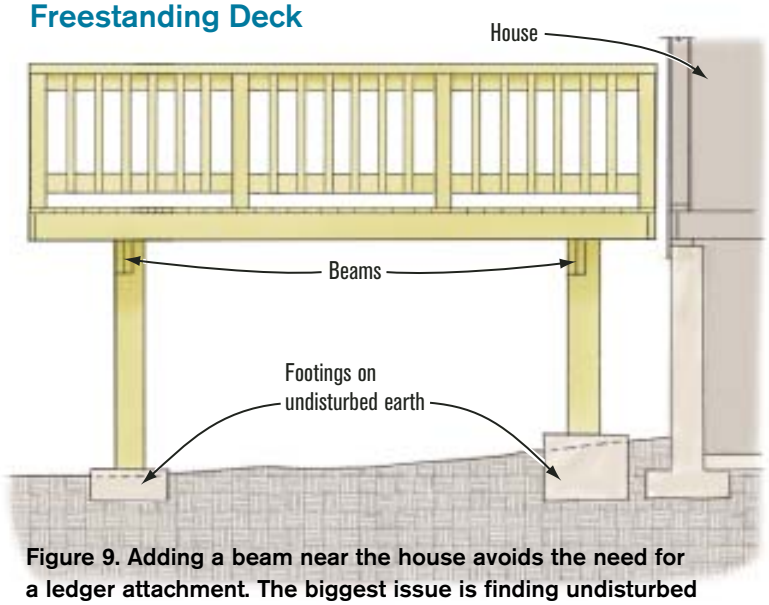

Figure 9. Adding a beam near the house avoids the need for a ledger attachment. The biggest issue is finding undisturbed earth to support the footings close to the house.

So, what's a deck builder to do?

Few of us want to turn down a job. Luckily, it's rarely necessary to do so. On most houses where attaching a ledger is a problem, there's probably a solution. "Almost all jurisdictions accept the sealed design of a registered professional engineer in situations that aren't described in the IRC," says Woeste. "An engineered solution is a professional approach for the contractor, and most important, it protects the client

Lateral Bracing for Freestanding Decks

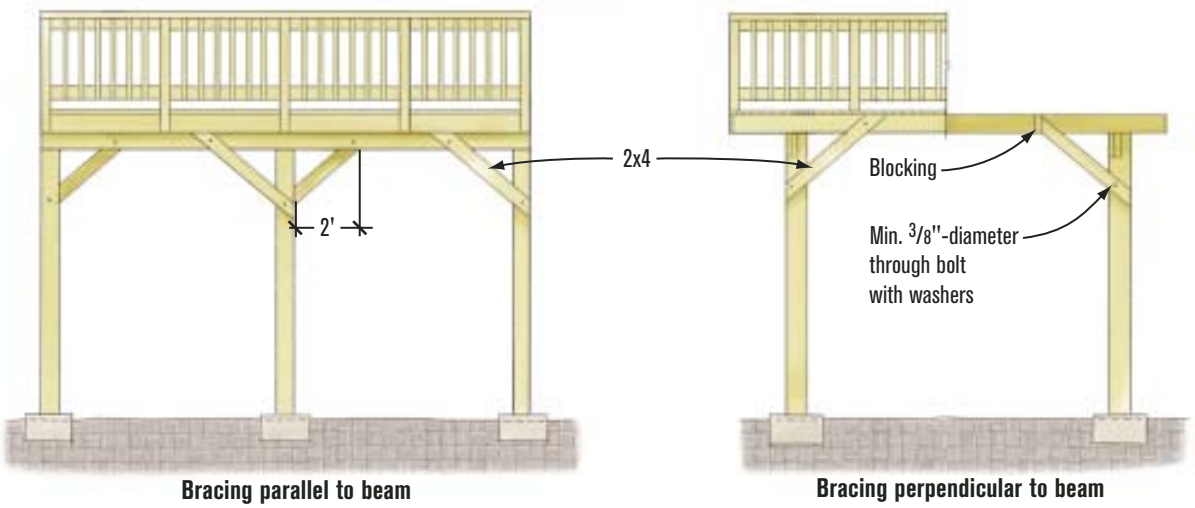

Figure 10. Freestanding decks require lateral bracing. Decks attached to the house with a ledger gain much of their lateral stability from that attachment. Diagonal bracing must make up for that lack on a freestanding deck.

from an accident." Additionally, from a contractor's point of view, an engineered design is a little like buying an insurance policy. While you're still liable for the construction of the deck, the engineer becomes responsible for problems with the overall design.

And, of course, there's a simple solution to problematic ledger-attachment situations: Don't use a ledger. Instead, build a freestanding deck (**Figure 9, page 6**), which uses a carrying beam, posts, and footings in place of the ledger. It's a good practice to set this beam 2 or 3 feet away from the house, and cantilever the deck the remaining distance.

Both Woeste and Katwijk advocate this approach, and Rhode Island contractor Mike Guertin points out: "One of the main advantages to building self-supporting decks is the little-used IRC provision that exempts them from frost-depth footings. Sounds crazy, doesn't it? Rhode Island's frost depth is 42 inches, and I absolutely love the look on building inspectors' faces when they come for a footing inspection and see I've dug down only 12 to 18 inches.

"I keep the code book handy: In the 2006 IRC, R403.1.4.1 exception 3 states, 'Decks not supported by a dwelling need not be provided with footings that extend below the frost line.' So the only provision for footings that applies to free-standing decks is in R403.1: 'Footings shall be supported on undisturbed natural soils or engineered fill.'"

Guertin goes on to say that finding undisturbed soil to support deck footings in the backfilled area close to a new house can be a dicey proposition. However, many building departments consider backfilled soil to be undisturbed after five years. And to add perspective, the worst thing likely to happen is that the deck might settle, an annoying but slowly occurring problem. Woeste notes, "To my knowledge, no one ever died from deck settlement." The same cannot be said of improperly fastened attached decks.

When properly constructed and attached, however, a ledger does help with lateral stability in addition to carrying part of the deck's load. When building a freestanding deck, that lack of stability must be taken into account. Katwijk will often tie a freestanding deck to the house for this purpose, but Woeste cautions against doing so in the case of masonry veneer, explaining, "Using masonry veneer to resist any load is a building code violation."

A less controversial option is to diagonally brace the support posts (**Figure 10**). Most deck builders brace the outer beam on taller decks anyway, so the method is familiar. The main differences are that you've got two beams to brace on a freestanding deck, and that bracing must be run both parallel and perpendicular to the beams. On a deck that attaches to the house with a ledger, the ledger provides the lateral stability perpendicular to the beam. ❖

Andy Engel is the editor of Professional Deck Builder.